# APPENDIX H

*Water Supply Assessment and Utilities Information*

# APPENDIX H-1

*Water Supply Assessment*

# Water Supply Assessment
# for the
# Montclair Place
# District Specific Plan

*Prepared for*

**The City of Montclair**

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**APRIL 2019**

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AF | Acre Feet |
| AFY | Acre Feet per Year |
| ASR | Aquifer Storage and Recovery |
| BMP | Best Management Practices |
| CA | California |
| CALSIM | California Water Allocation and Reservoir Operations Model |
| CBWCD | Chino Basin Water Conservation District |
| CCWRF | Carbon Canyon Water Reclamation Facility |
| CDA | Chino Basin Desalter Authority |
| CEQA | California Environmental Quality Act |
| CRA | Colorado River Aqueduct |
| CUWCC | California Urban Water Conservation Council |
| CVP | Central Valley Project |
| DHS | Department of Health Services |
| DWR | Department of Water Resources |
| DYY | Dry Year Yield |
| EIR | Environmental Impact Report |
| EPA | Environmental Protection Agency |
| gpd | Gallons Per Day |
| IAWP | Interim Agricultural Water Program |
| IEUA | Inland Empire Utilities Agency |
| IRP | Integrated Resources Plan |
| IRWM | Integrated Regional Water Management |
| LRP | Local Resources Program |
| MAF | Million Acre Feet |
| Max | Maximum |
| MCL | Maximum Contaminant Level |
| MGD | Million Gallons per Day |
| mg/L | Milligrams Per Liter |
| Min | Minimum |
| MOU | Memorandum of Understanding |
| MPDSP | Montclair Place District Specific Plan |
| MVWD | Monte Vista Water District |
| MWD | Metropolitan Water District of Southern California |
| MZ | Management Zone |

| | |
|---|---|
| NIDIS | National Integrated Drought Information System |
| NMSP | North Montclair Specific Plan |
| OBMP | Optimum Basin Management Program |
| QSA | Quantification Settlement Agreement |
| RP | Regional Plant |
| RWQCB | Regional Water Quality Control Board |
| SAWCo | San Antonio Water Company |
| SARWQCB | Santa Ana Regional Water Quality Control Board |
| SAWPA | Santa Ana Watershed Project Authority |
| SB | Senate Bill |
| SBCFCD | San Bernardino County Flood Control District |
| SCIWP | Southern California Integrated Watershed Program |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| TDS | Total Dissolved Solids |
| TIN | Total Inorganic Nitrogen |
| TVMWD | Three Valleys Municipal Water District |
| UNL | University of Nebraska - Lincoln |
| USBR | U.S. Bureau of Reclamation |
| UWMP | Urban Water Management Plan |
| VOC | Volatile Organic Compounds |
| WFA | Water Facilities Authority |
| WSA | Water Supply Assessment |
| WSDM | Water Surplus and Drought Management |

# EXECUTIVE SUMMARY

## ES.1 Purpose of Document

Senate Bill (SB) 610 became effective on January 1, 2002, amending the California Water Code (CWC) by requiring detailed analysis of water supply availability for certain types of development projects. The primary purpose of SB 610 is to improve the linkage between water and land use planning by ensuring greater communication between water providers and local planning agencies and ensuring that land use decisions for certain large development projects are fully informed as to whether sufficient water supplies are available to meet project demands. SB 610 requires the preparation of a water supply assessment (WSA) for any project that is subject to the California Environmental Quality Act (CEQA) and meets certain requirements. A WSA that is associated with a project must include a discussion of the availability of an identified water supply under normal-year, single-dry-year, and multiple-dry-year conditions over a 20-year projection, accounting for the projected water demand of the project in addition to other existing and planned future uses of the identified water supply.

The City of Montclair (City) is responsible for the preparation of the Montclair Place (Project) District Specific Plan (MPDSP). The Plan includes an assessment of utilities, including water supply. Senate Bill 610, requires that a water supply assessment (WSA), based on specific criteria, be prepared to document the sufficiency of available water supply for the City and the Project. The WSA identifies water supply and reliability to the City, now and into the future, including a sufficient water supply for the Project.

The WSA does not, nor it is intended to, identify infrastructure needs related to the provision of water for the proposed Montclair Place District. Additionally, per Water Code section 10914, the WSA is not intended to create a right or entitlement to water service or to any specific level of water service. This document is an analysis of current water supplies and calculated water demands based on given Project specifications, both projected for a 20-year planning period. The following analyses and conclusions are subject to change based on environmental, regulatory, legal, and project conditions.

The WSA includes a discussion of the relevant legislation requiring the WSA, an overview of the proposed Project, analysis of water demands for MVWD's existing service area and the Project area over a 20-year or more planning period, analysis of reliability of MVWD's water supplies, including each agency that impacts water supply and water quality to the region, and concludes with a sufficiency analysis of water supply during normal, single-dry, and multiple dry years over a 20-year planning period.

# City of Montclair
# Water Supply Assessment
# Montclair Place District Specific Plan

## Montclair Place

The Montclair Place District Specific Plan (MPDSP; Proposed Project) would assign and create appropriate Specific Plan (Plan) land use zones for parcels within the Plan area and provide development standards and architectural guidelines to guide development in the MPDSP area through 2040. The Proposed Project encompasses an area of approximately 104.35-acres (Plan area), the majority of which is currently occupied by the existing Montclair Place Mall (approximately 75 acres) properties. Additional project parcels include lands that are currently developed with commercial buildings and uses including restaurants and various retail entities as well as gym and a church that also serves as a Montessori School.

A key feature of the Plan would provide for the demolition of all or a portion of the existing Montclair Place Mall, some or all appurtenant free-standing outbuildings, and portions of the surface parking lots, to construct a pedestrian-oriented, mixed-use downtown district, with structured parking facilities through a series of planned phases. Specifically, the maximum number of dwelling units envisioned by the MPDSP is approximately 5 million square feet of residential uses (or 6,321 dwelling units) and the total additional commercial square footage envisioned by the Plan is approximately 2 million square feet. Additionally, the Proposed Project involves the construction of a hotel with approximately 100-200 rooms. The Proposed Project would replace the existing C-3 zoning with new mixed-use zones. As such, the MPDSP would enable the future development of commercial, office, multi-family residential, hotel, and mixed-use projects within walking and biking distance of the Montclair Transcenter.

The Project is located north of Interstate 10, west of Central Avenue, south of Moreno Street, and east of Monte Vista Avenue in the southwestern corner of San Bernardino County (Figure 1). The Project parcels are currently zoned C-3 (General Commercial) per the North Montclair Specific Plan (NMSP). The new MPDSP will supersede the NMSP, proposing three mixed-use zoning designations with additional open space in the Project area.

## Water Supply

The public water system that supplies water to the City of Montclair, and specifically to the proposed project area, is the Monte Vista Water District (MVWD). The MVWD is a county water district formed in 1927 that provides retail and wholesale water supply services to a population of over 130,000 within a 30-square mile area, including the communities of Montclair, Chino Hills, portions of Chino and the unincorporated area lying between the cities of Pomona, Chino Hills, Chino and Ontario. MVWD relies on four sources for its long-term water supply: local Chino Basin groundwater, imported water, entitlement water deliveries, and recycled water.

- Groundwater is produced from the Chino Groundwater Basin (Basin). The Basin was adjudicated in 1978, which allocated water production rights to water producers. The Judgment that was entered in 1978 has been amended several times. In 2012, the Court ordered that the Restated Judgment shall serve as the official and legally operative copy of the Judgment in the case. The Chino Basin Watermaster is responsible for carrying out the Judgment, and the Court retains continuing jurisdiction over the Basin. MVWD's current groundwater production right as a share of the safe yield of the Basin is 4,824 acre-feet per year (AFY). MVWD also received annual water rights from reallocations of unpumped agricultural rights, annual transfers from other parties, and recharged recycled water credits. In total, MVWD extracted 8,406 AFY from the Basin in 2015 (MVWD, 2015). Management of the Basin is accomplished by the Chino Basin Watermaster through the following three documents: 1) the 2012 Chino Basin Judgment (Superior Court, 2012); 2) the Peace Agreements (Watermaster, 2000, 2008); and 3) the Optimum Basin Management Program (OBMP; Watermaster, 1999).
- Imported State Water Project (SWP) water is received from the Metropolitan Water District of Southern California (MWD) through the Inland Empire Utilities Agency (IEUA) and the Water Facilities Authority (WFA). MVWD's imported water deliveries are treated by the WFA at its Agua de Lejos Treatment Plant located in Upland, California. MVWD is entitled to 24% of the treatment plant capacity; MVWD entitlement in 2015 equaled 21,776 AFY (MVWD 2016).
- Entitlement water deliveries are received from the San Antonio Water Company (SAWCo), including groundwater produced from local adjudicated groundwater basins and surface water produced from the San Antonio Creek Watershed. SAWCo delivers domestic and irrigation water to shareholders, of which MVWD owns 329.75 shares or 5.16% of the total available water supply. MVWD's allocation in 2015 was 611 AFY (MVWD, 2015).
- Recycled water is supplied to MVWD by IEUA through the Regional Recycled Water Distribution System, which is redistributed by MVWD through its retail distribution system to 18 sites for non-potable landscape irrigation. In 2015, MVWD provided approximately 308 AF of recycled water for landscape irrigation and purchased 483 AF of the City of Montclair's share of regional recycled water groundwater recharge. In 2011, MVWD developed a Recycled Water Master Plan which projected near-term expansion of its recycled water distribution system to serve up to 430 AFY.

**Water Demand**

MVWD's 2015 total demand was approximately 16,834 AFY (MVWD 2016). The build-out of Montclair Place will increase water demand by approximately 767 AFY. This, in conjunction with significant demand for potable water by 2020, will result in a total projected MVWD demand of 37,131 AFY by 2040, as shown in **Table 4-2**.

**Demand and Supply Projections**

Montclair Place is expected to be built within a 30-year period with an initial water demand in 2020. This development phasing plan allows for water demands to be met from sources that are currently being planned, developed and implemented. Supplies of imported water and groundwater are expected to remain relatively stable throughout the forecast period. Enhanced water conservation, increased local well production, and increased use of recycled water in the greater MVWD service area should provide for the balance of needed supplies.

Analysis of water demand and supply projections for MVWD, including the Montclair Place District (Section 4.0, Monte Vista Water District Water Demand and Supplies), demonstrates that projected supplies exceed demand through the year 2040 (See Section 4.1, Demand and Supply Comparison). MVWD might increase its supply to meet demand through the following measures: 1) production of groundwater based on safe yield allocation and utilization of water in storage; 2) increasing imported water purchases, if there is available WFA capacity; and 3) purchasing additional recycled water, if available. Collectively, these additional options will enable water supply to exceed water demand for the MVWD service area now and through the planning period.

Additionally, analysis of normal, single-dry, and multiple-dry year scenarios demonstrate the MVWD's ability to meet or exceed demand during the 20-year planning period in all hydrologic conditions.

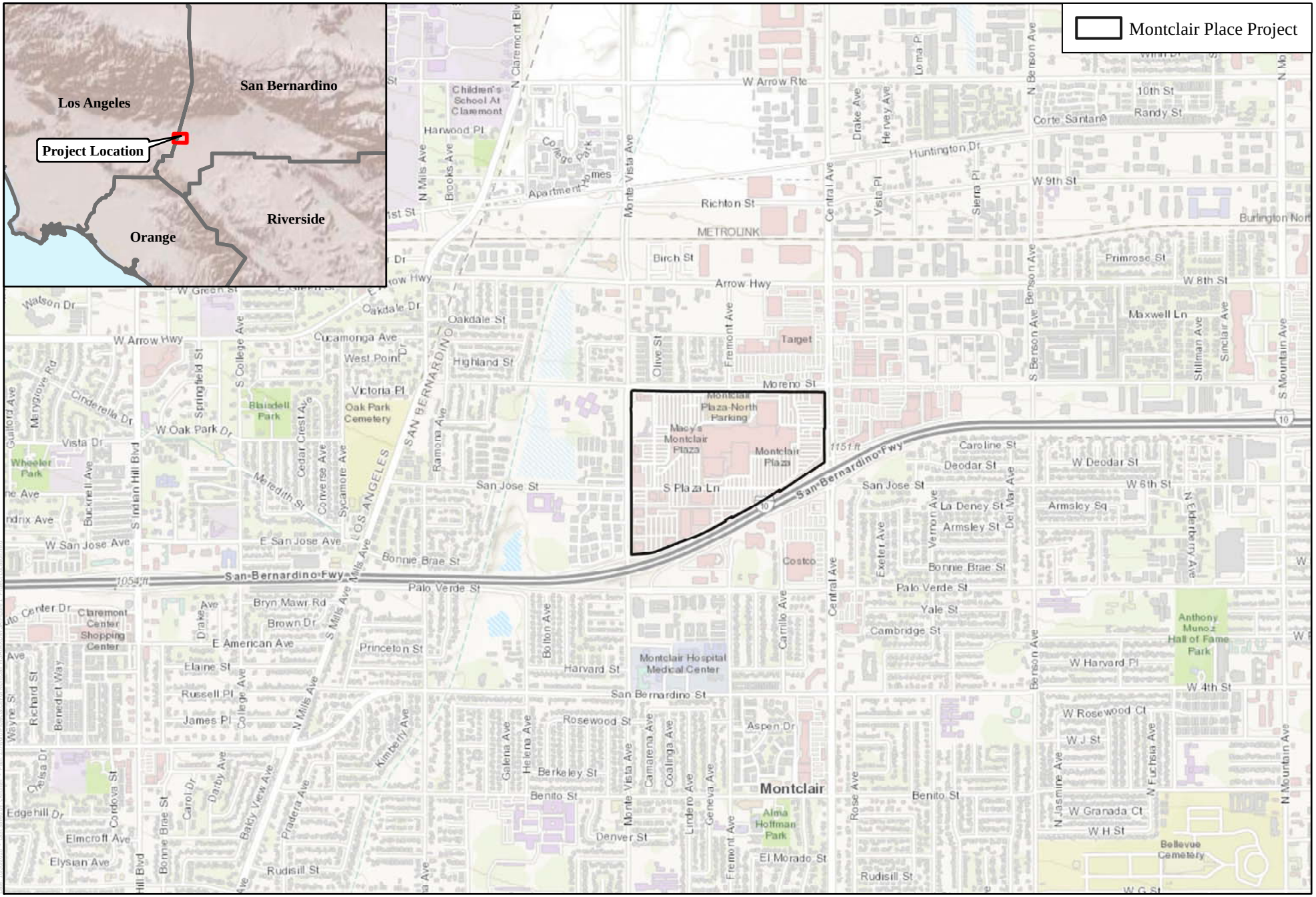
**Reliability**

Reliability of future water supplies to the region will be ensured through continued implementation of the OBMP, implementation of local agency programs, and combined efforts and programs among agencies, including all water retailers, and the Chino Basin Watermaster, IEUA, MWD, WFA, CDA, Santa Ana Regional Water Quality Control Board (RWQCB), Santa Ana Watershed Project Authority (SAWPA), the San Antonio Water Company (SAWCo) and the Chino Basin Water Conservation District.

Prevailing drought conditions throughout California and the Colorado River Basin, coupled with environmental issues affecting deliveries of SWP water through the Sacramento – San Joaquin Delta, have resulted in diminished imported surface water to Southern California. MWD, the major importer of surface water to Southern California, has developed plans and programs to address drought conditions and its continuing ability to meet the water demands of its service area. MWD continually re-evaluates these plans and programs for effectiveness in consideration of changing conditions. The plans describe a progressive series of actions, including tapping into stored water reserves and, if necessary, reductions in deliveries. This WSA demonstrates that possible reductions in imported water deliveries due to drought conditions do not prevent MVWD from satisfying its anticipated demands.

**Conclusion**

The information included in this WSA identifies a sufficient water supply and water reliability for the MVWD service area, now and through the planning period, including a sufficient water supply for the Montclair Place District Specific Plan.


Montclair Place Project
Los Angeles
San Bernardino
Project Location
Riverside
Orange
Montclair
Montclair Plaza-North Parking
Macy's Montclair Plaza
Montclair Plaza
S Plaza Ln
Target
Costco
Montclair Hospital Medical Center
Alma Hoffman Park
Anthony Munoz Hall of Fame Park
Claremont Center Shopping Center
Children's School At Claremont
College Park Apartment Homes
Blaisdell Park
Oak Park Cemetery
Bellevue Cemetery
Armsley Sq
San Bernardino Fwy
1054 ft
1151 ft
Arrow Hwy
W Arrow Rte
Huntington Dr
Central Ave
Monte Vista Ave
Benson Ave
Moreno St
San Jose St
Palo Verde St
Bonnie Brae St
Harvard St
Rosewood St
Berkeley St
Benito St
Denver St
El Morado St
Rudisill St
Richton St
Birch St
Primrose St
W 8th St
W 9th St
10th St
Maxwell Ln
Deodar St
W Deodar St
W 6th St
La Deney St
Caroline St
Yale St
Cambridge St
W Harvard Pl
W 4th St
W Rosewood Ct
W J St
W Granada Ct
W H St
W G St
Oakdale St
Cucamonga Ave
West Point Dr
Highland St
Victoria Pl
W Oak Park Dr
W San Jose Ave
E San Jose Ave
E American Ave
Princeton St
Bryn Mawr Rd
Brown Dr
Elaine St
Russell Pl
James Pl
Aspen Dr
Camarena Ave
Galena Ave
Helena Ave
Coalinga Ave
Geneva Ave
Lindero Ave
Rose Ave
Fremont Ave
Olive St
Vista Pl
Sierra Pl
Loma Pl
Drake Ave
Hervey Ave
Corte Santana
Randy St
Burlington North
Stillman Ave
Sinclair Ave
S Mountain Ave
N Fuchsia Ave
N Jasmine Ave
N Mountain Ave
Vernon Ave
Del Mar Ave
Exeter Ave
Carrillo Ave
Bolton Ave
Kimberly Ave
Baldy View Ave
Pradera Ave
Edgehill Dr
Elmcroft Ave
Elysian Ave
Cordova St
Chelsa Dr
Carol Dr
Darby Ave
Richard St
Benedict Way
Wayne St
Claremont Blvd
Mills Ave
Brooks Ave
Ramona Ave
Los Angeles
San Bernardino
Meredith St
Cedar Crest Ave
Converse Ave
Sycamore Ave
Springfield St
S College Ave
Cinderella Dr
Merrydale Rd
Guilford Ave
Vista Dr
Wheeler Park
Buckwell Ave
S Indian Hill Blvd
Oakdale Dr
Watson Dr
Drake Ave
Center Dr
Hill Blvd
Bonnie Brae St
Ramona Ave
Harwood Pl
N Claremont Blvd
N Mills Ave
Brooks Ave
Monte Vista Ave
Central Ave
Vista Pl
Sierra Pl
Loma Pl
Drake Ave
Hervey Ave
N Benson Ave
Corte Santana
Randy St
Huntington Dr
W 9th St
Richton St
METROLINK
Birch St
Arrow Hwy
Primrose St
W 8th St
Maxwell Ln
Target
Fremont Ave
Olive St
Moreno St
S Benson Ave
Stillman Ave
Sinclair Ave
S Mountain Ave
Montclair Plaza-North Parking
Macy's Montclair Plaza
Montclair Plaza
S Plaza Ln
1151 ft
San Bernardino Fwy
Caroline St
Deodar St
W Deodar St
San Jose St
W 6th St
La Deney St
Armsley Sq
Armsley St
Del Mar Ave
N Euclid Ave
Vernon Ave
Exeter Ave
Costco
Bonnie Brae St
Palo Verde St
Yale St
Cambridge St
Anthony Munoz Hall of Fame Park
W Harvard Pl
W 4th St
Carrillo Ave
Central Ave
Bolton Ave
Harvard St
Montclair Hospital Medical Center
San Bernardino St
W Rosewood Ct
W J St
W Granada Ct
W H St
Bellevue Cemetery
W G St
Rosewood St
Aspen Dr
Camarena Ave
Galena Ave
Helena Ave
Coalinga Ave
Geneva Ave
Lindero Ave
Rose Ave
Berkeley St
Benito St
Montclair
Alma Hoffman Park
Denver St
El Morado St
Rudisill St
Fremont Ave
N Fuchsia Ave
N Jasmine Ave
N Mountain Ave
Benito St
Rudisill St
Oakdale St
Cucamonga Ave
West Point Dr
Highland St
Victoria Pl
W Oak Park Dr
W San Jose Ave
E San Jose Ave
E American Ave
Princeton St
Bryn Mawr Rd
Brown Dr
Elaine St
Russell Pl
James Pl

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# 1 INTRODUCTION

The City of Montclair (City) is responsible for the preparation of the Montclair Place District Specific Plan Environmental Impact Report (EIR). The EIR includes an assessment of utilities, including water supply. Senate Bill 610, as it amends the California Water Code §§ 10910 *et seq.* requires that a water supply assessment (WSA), based on specific criteria, be prepared to document the sufficiency of available water supply for the City and the Montclair Place District Specific Plan (Project). The WSA identifies water supply and reliability to the City, now and through the planning period, including a sufficient water supply for the Project. The WSA does not, nor is it intended to, identify infrastructure needs related to the provision of water for the proposed Montclair Place**.**

The proposed 104.35-acre Project is a pedestrian-oriented, multi-modal, mixed-use, downtown district within walking and biking distance of the Montclair Transcenter and the anticipated extension of the Foothill Gold Line. The Project is being proposed by the City of Montclair and is located north of Interstate 10, west of Central Avenue, south of Moreno Street, and east of Monte Vista Avenue in the southwestern corner of San Bernardino County (see **Figure 1)**. The Project parcels are currently zoned C-3 (General Commercial) per the current North Montclair Specific Plan (NMSP) and are presently used as the Montclair Place regional mall, adjacent commercial buildings such as retail and restaurants, a gym, and a church that also serves as a Montessori School.

A key feature of the Plan would provide for the demolition of all or a portion of the existing Montclair Place Mall, some or all appurtenant free-standing outbuildings, and portions of the surface parking lots, to construct a pedestrian-oriented, mixed-use downtown district, with structured parking facilities through a series of planned phases. Specifically, the maximum number of dwelling units envisioned by the MPDSP is approximately 5 million square feet of residential uses (or 6,321 dwelling units) and the total additional commercial square footage envisioned by the Plan is approximately 2 million square feet. Additionally, the Proposed Project involves the construction of a hotel with approximately 100-200 rooms. The Proposed Project would replace the existing C-3 zoning with new mixed-use zones.

The WSA includes a discussion of the relevant legislation requiring the WSA, an overview of the proposed Project, analysis of water demands for MVWD's existing service area and the Project over a 20-year or more planning period, analysis of reliability of the MVWD's water supplies, including each agency that impacts water supply and water quality to the region, and concludes with a sufficiency analysis of water supply during normal, single-dry, and multiple dry years over a 20-year or more planning period.

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# 2 LEGISLATION

Due to the Project's potential impact on current and future water supplies, the State of California, through SB 610, requires that a WSA be completed for the proposed development. The Project proposes 6,321 residential units, exceeding the threshold of 500 units, triggering the requirement for the preparation of a WSA to determine the sufficiency of water supply to the project and MVWD's water customers now and for a 20-year planning period. The following information outlines the requirements of SB 610 as it amends the California Water Code §§ 10910 *et seq.*

## 2.1 SB 610 – Costa – Water Supply Planning

SB 610 became effective on January 1, 2002, amending the California Water Code by requiring detailed analysis of water supply availability for certain types of development projects. The primary purpose of SB 610 is to improve the linkage between water and land use planning by ensuring greater communication between water providers and local planning agencies and ensuring that land use decisions for certain large development projects are fully informed as to whether sufficient water supplies are available to meet project demands. SB 610 requires the preparation of a WSA for any project that is subject to the California Environmental Quality Act (CEQA) and meets certain requirements. SB 610 requires a city or county that determines a particular project is subject to CEQA to identify any public water system that may supply water for the project and to request those public water systems to prepare a specified WSA. The assessment is to include the following if applicable to the supply conditions:

1. Discussion with regard to whether the public water system's total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing.
2. Identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts.
3. Description of the quantities of water received in prior years by the public water system under the existing water supply entitlements, water rights or water service contracts.
4. Water supply entitlements, water rights or water service contracts shall be demonstrated by supporting documentation such as the following:
    a. Written contracts or other proof of entitlement to an identified water supply.

b. Copies of capital outlay program for financing the delivery of a water supply that has been adopted by the public water system.

c. Federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply.

d. Any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply.

5. Identification of other public water systems or water service contract holders that receive a water supply or have existing water supply entitlements, water rights, or water service contracts, to the same source of water as the public water system.

6. If groundwater is included for the supply for a proposed project, the following additional information is required:

   a. Review of any information contained in the Urban Water Management Plan (UWMP) relevant to the identified water supply for the proposed project.

   b. Description of any groundwater basin(s) from which the proposed project will be supplied. Adjudicated basins must have a copy of the court order or decree adopted and a description of the amount of groundwater the public water system has the legal right to pump. For non-adjudicated basins, information on whether the DWR has identified the basin as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current bulletin of DWR that characterizes the condition of the basin, and a detailed description of the efforts being undertaken in the basin to eliminate the long-term overdraft condition.

   c. Description and analysis of the amount and location of groundwater pumped by the public water system for the past 5 years from any groundwater basin which the proposed project will be supplied. Analysis should be based on information that is reasonably available, including, but not limited to, historic use records.

   d. Description and analysis of the amount and location of groundwater projected to be pumped by the public water system from any groundwater basin which the proposed project will be supplied. Analysis should be based on information that is reasonably available, including, but not limited to, historic use records.

   e. Analysis of sufficiency of the groundwater from the basin(s) from which the proposed project will be supplied.

7. The water supply assessment shall be included in any environmental document prepared for the project.

8. The assessment may include an evaluation of any information included in that environmental document. A determination shall be made whether the projected water supplies will be sufficient to satisfy the demands of the project, in addition to existing and planned future uses.

Additionally, SB 610 requires new information to be included as part of an UWMP if groundwater is identified as a source of water available to the supplier. The MVWD 2015 UWMP includes a comprehensive discussion of groundwater.

## 2.2 Water Conservation Legislation

The Water Conservation Act of 2009 (SBx7-7) requires all California urban water agencies to set and meet certain demand reduction targets in order to assist the State in reducing urban water use by 20% by 2020 (20x2020). The Act also requires each agency to monitor its progress toward its targets. This was implemented for the purpose of meeting the mandate to reduce per capita urban water consumption by 20% statewide. SBx7-7 describes the overall process by which MVWD is to comply with the requirements. It specifically identifies methods for establishing urban water use targets. These requirements and MVWD's specific Compliance Plan are outlined in the 2015 UWMP.

The Governor issued a State of Emergency and Continued State of Emergency in 2014 in response to the persistent state-wide drought. Most recently, Executive Order B-29-15 was issued by the Governor in April 2015 which essentially increases the potable urban water use reduction goal to 25% as compared to 2013 usage throughout the State. The Executive Order outlines specific water use reduction orders designed to heighten the urgency to reduce water consumption and facilitate the ability of local agencies to implement and enforce water conservation requirements. It addresses facilitating funding for projects designed to increase local water supplies and improve water supply reliability.

On April 7, 2017, the Governor lifted the Drought State of Emergency via Executive Order B-40-17, which rescinded via Executive Order B-29-15 following state-wide potable water reductions of more than 22% through conservation efforts.

On May 31, 2018, AB 1668 and SB 606 further amended the Water Code in relation to water management planning. Specifically, these bills placed a provisional end-use efficiency standard for residential water use of 55 gallons per capita per day, which shall be used until January 1, 2025, after which the standard shall be adjusted to 52.5 gallons per capita per day until 2030, and to 50 gallons per day beyond that date (CWC § 10609.4(a).)

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# 3 MONTCLAIR PLACE DISTRICT

## 3.1 Project Description

The proposed 104.35-acre Montclair Place District Specific Plan (Project) is pedestrian-oriented, multi-modal, mixed-use downtown district within walking and biking distance of the Montclair Transcenter and the anticipated extension of the Foothill Gold Line. The Project is being proposed by the City of Montclair and is located north of Interstate 10, west of Central Avenue, south of Moreno Street, and east of Monte Vista Avenue in the southwestern corner of San Bernardino County (see Figure 1). The Project parcels are currently zoned C-3 (General Commercial) per the current North Montclair Specific Plan (NMSP) and are presently used as the Montclair Place regional mall, adjacent commercial buildings such as retail and restaurants, a gym, and a church that also serves as a Montessori School.

The Project is comprised of three new land use categories including 60.07 acres of three mixed-use categories containing a total of 6,321 residential dwelling units and 2 million square feet of commercial use at build-out. Additionally, the Project involves the construction of a hotel with approximately 100-200 rooms, 15.96 acres of open space land use, and 28.32 acres of streets. The total area of the Project consists of 104.35 acres.

A water demand analysis was prepared by Dudek for the Project, *Montclair Place District Specific Plan Water Demand Analysis, October 16, 2018,* and is included as a technical memorandum in Appendix A.

The City has estimated a build-out period of up to 30 years, with water services beginning to come online in 2020. Table 3-1 identifies the number of residential units and acreage of commercial and open space uses anticipated to begin requiring water in the year 2020. Being that no detailed phased plan for build-out yet exists, Montclair Place development will be treated as fully built-out in the year 2020, providing a conservative over-estimate of Project water demands.

**Table 3-1**
**Project Projected Land Use Development**

| Land Use | Area (acres) | Percent Land Use | Average DU/acre | Total Units |
|---|---|---|---|---|
| Core | 15.91 | 15% | - | - |
| Residential | 10.96 | 11% | 218 | 2,387 |
| Commercial | 4.95 | 4% | - | - |
| Main Street District | 32.28 | 31% | - | - |
| Residential | 23.66 | 23% | 142 | 3,371* |
| Commercial | 8.62 | 8% | - | - |
| Town Center | 11.88 | 11% | - | - |
| Residential | 8.18 | 8% | 87 | 713 |
| Commercial | 3.70 | 3% | - | |
| *Residential Sub Total* | *42.80* | *41%* | *148* | *6,471* |
| *Commercial Sub Total* | *17.27* | *17%* | - | - |
| *Open Space Sub Total* | 15.96 | 15% | - | - |
| *Streets Sub Total* | 28.32 | 27% | - | - |
| **Grand Total** | **104.35** | **100%** | **-** | **6,471** |

* This number is composed of 3,221 residential units and 150 hotel units.

## 3.2 Montclair Place (Project) Water Demands

The MVWD 2015 UWMP does not project future water service for the property. In order to determine water demand requirements for the Project development, a water demand analysis was performed and is presented in a technical memorandum. The Project Technical Memorandum (Attachment A) includes important assumptions regarding the water demand the Project will impose on MVWD's water system. These assumptions provide the rationale for the volume of estimated Project water demand.

The water demand analysis includes all 104.35 gross acres of the Project by land use designation. For the water demand analysis, the Project is shown complete by 2020, although build-out is projected to last for up to 30 years. Section 4 of this WSA compares water demand with supply for MVWD's existing customers and the Project for the entire 20-year planning period required by SB610.

The Project will generate at build-out a water demand of approximately 767 AFY, which is 531 AFY greater than projected water demand under current development conditions.

**Table 3-2**
**Project Total Water Demand Projections by Land Use in Acre-Feet per Year**

| Land Use | Year | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 |
| Core Residential | 236.7 | 238.1 | 239.5 | 240.9 | 242.3 |
| Main Street Residential | 319.4 | 321.3 | 323.2 | 325.1 | 327.0 |
| Town Center Residential | 70.7 | 71.1 | 71.5 | 72.0 | 72.4 |
| Commercial | 39.5 | 39.8 | 40.0 | 40.2 | 40.4 |
| Open Space | 81.4 | 82.3 | 83.3 | 84.2 | 85.1 |
| **Total Water Demand (AFY)** | **747.7** | **752.6** | **757.5** | **762.4** | **767.2** |
| Current Conditions Demand | 229.7 | 231.2 | 232.7 | 234.2 | 235.8 |
| **Increased Water Demand (AFY)** | **518.0** | **521.4** | **524.8** | **528.2** | **531.4** |

The estimated water demand at Project build-out is approximately 767 AFY. Approximately 83.6% (641 AFY) of water demand for the Project is proposed for residential land use categories, whereas 5.3% (40.4 AFY) of the water demand is proposed for commercial land use, and 11.1% (85.1 AFY) is proposed for open space land use (outdoor irrigation).

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# 4 MONTE VISTA WATER DISTRICT WATER DEMAND AND SUPPLIES

MVWD currently serves water to an area of approximately 9.56 square miles, including the City of Montclair, portions of the City of Chino and unincorporated areas of San Bernardino County. MVWD's water service area and adjacent water districts are shown in Figure 2.

## 4.1 Overview of Supply and Demand

In fiscal year 2018, MVWD received approximately 45.3% of its water supply from groundwater, 42.4%% from imported water, 2.3% from entitlement water deliveries, and 10% from recycled water. Current and planned improvements will increase the reliability of each water source. Each of the sources of water for MVWD is more fully described beginning in Section 4.2.

MVWD currently obtains water from the following primary water sources: (1) groundwater from the Chino Groundwater Basin managed by the Chino Basin Watermaster; (2) imported State Water Project (SWP) water from the MWD through the Inland Empire Utilities Agency (IEUA); (3) entitlement water deliveries from the San Antonio Water Company (SAWCo) including groundwater produced from local adjudicated groundwater basins and surface water from the San Antonio Creek watershed; and (4) recycled water supplied by IEUA. MVWD owns six reservoirs with a combined storage capacity of 12 million gallons, 12 groundwater wells, two imported water connections to the Water Facilities Authority (WFA) Agua de Lejos Water Treatment Plant, seven booster pump stations, two CDA water connections, 198 miles of water distribution mains, and recycled water pipelines. Additionally, MVWD currently maintains two emergency interconnections with neighboring water agencies, although only one of these has ever been activated in the past 20 years.

**Growth Rate**

The MVWD's adopted 2015 UWMP included an analysis of its anticipated growth rate. The total retail population was calculated to be 55,581 in 2015 with an additional wholesale population of 77,596 for a total of 133,177. The retail population is expected to increase to over 65,649 by 2040. Table 4-1 shows the projected population for MVWD's service area. As shown in Table 4-1, the portion of the City of Chino within MVWD's service area is projected to reach full build-out by 2020. Population projections for the Project are also shown in Table 4-1. A conservative estimate assuming full Project build-out beginning at year 2020 is used for population and demand projections, with an average of 1.6 persons residing in each dwelling unit, although full Project build-out may occur for up to 30 years.

**Table 4-1**
**City of Chino and Project Population – Current and Projected**

| Area | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| City of Montclair | 38,332 | 39,700 | 41,100 | 42,500 | 43,900 | 45,346 |
| City of Chino | 4,235 | 4,955 | 4,955 | 4,955 | 4,955 | 4,955 |
| Unincorporated | 13,014 | 14,352 | 14,605 | 14,854 | 15,099 | 15,347 |
| **Total Retail** | **55,581** | **59,007** | **60,660** | **62,309** | **63,954** | **65,649** |
| City of Chino Hills | 77,596 | 89,314 | 91,137 | 92,991 | 94,895 | 96,831* |
| **Total Retail/Wholesale** | **133,177** | **148,321** | **151,797** | **155,306** | **158,849** | **162,480** |
| Montclair Place District | -- | 10,114 | 10,114 | 10,114 | 10,114 | 10,114 |
| **Proposed Retail/Wholesale** | **133,177** | **158,435** | **161,911** | **165,414** | **168,963** | **172,594** |

**Source:** MVWD 2015.
* City of Chino Hills 2040 Population Estimate not provided by the City to MVWD. Population estimated at growth rate used for City of Chino Hills projections, 2.04%.

## Water Demand

In 2015, MVWD's total water demand was approximately 16,834 acre-feet. The Montclair Place District will increase this demand, generating an additional build-out requirement of approximately 2,670 AFY or 2,594,309 gallons per day (gpd). This demand is comprised entirely of potable sources, as no recycled water has been directed to this Project.

## Demand and Supply Comparison

**Table 4-**2 shows the current and projected water demand and supply for MVWD, including additional demand the Project will require through 2040 to meet the SB 610 required 20-year planning period. This also aligns with the furthest projected demand in the MVWD 2015 UWMP. Demand and supply projections consider land use, in addition to water development programs and projects.

**Table 4-2**
**Current and Projected Water Supply and Demand Comparison**
**Monte Vista Water District and Montclair Place**

| Water Sources | Actual (AF) | Projected (AF) | | | | |
|---|---|---|---|---|---|---|
| | *2015* | *2020* | *2025* | *2030* | *2035* | *2040* |
| *Demand* | | | | | | |
| Potable MVWD | 8,984 | 11,519 | 11,756 | 12,060 | 12,361 | 12,645 |
| Wholesale | 6,933 | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Current Montclair Place Parcels | 126 | -- | -- | -- | -- | -- |
| Montclair Place | -- | 747.7 | 752.6 | 757.5 | 762.4 | 767.2 |
| **Total Potable Demand** | **16,043** | **34,917** | **35,159** | **35,468** | **35,773** | **36,062** |
| Recycled MVWD | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| Montclair Place | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total Water Demand** | **16,834** | **35,948** | **36,149** | **36,487** | **36,842** | **37,131** |
| *Supply* | | | | | | |
| Chino Groundwater Basin | 8,406 | 14,217 | 14,217 | 14,217 | 14,217 | 14,217 |
| Water Facilities Authority | 7,025 | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 611 | 596 | 596 | 596 | 596 | 596 |
| **Total Potable Supply** | **16,042** | **36,589** | **36,589** | **36,589** | **36,589** | **36,589** |
| IEUA Recycled Water | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Potable Supply Surplus/Shortage** | **0** | **1,672** | **1,430** | **1,122** | **816** | **527** |

**Source:** MVWD 2015 UMWP.

**Demand Assumptions:**

1. **MVWD Potable Demand:** Year 2015 is actual demand; projections in five-year increments to 2040 from the MVWD 2015 UWMP, pg. ES-2.
2. **Wholesale Potable Demand:** Year 2015 is actual demand; potential future demands by Chino Hills on the MVWD water system are estimated as the full contractual obligation volume, MVWD 2015 UWMP. Historical wholesale demand has ranged from 7,500 to 14,000 AFY.
3. **Montclair Place Potable Demand:** Demand projections for the Project are determined in the Montclair Place District Specific Plan Water Demand Analysis Technical Memorandum, October 16, 2018, included in Appendix A and summarized in Section 3.2 of this WSA. Residential water uses employ an end-use efficiency daily rate of 55 gallon

per capita per AB 1668 andSB 606. For these calculations, build-out is achieved in 2020, although project estimates account for up to a 30-year build-out period.

4. **MVWD Recycled Demand:** Year 2015 is actual demand; projections in five-year increments to 2040 from the MVWD 2015 UWMP, pg. ES-2.
5. **Montclair Place Recycled Demand:** Recycled water will not be utilized to meet demand needs of the Project.

**Supply Assumptions:**

1. **Chino Groundwater Basin:** Year 2015 is actual groundwater production; projections in five-year increments to 2040 are from the MVWD 2015 UWMP, pg. ES-3. The total MVWD entitlement of 14,217 AFY includes MVWD rights, Monte Vista Irrigation Company rights, recycled water recharge credits, transfers from SAWCo and transfers from the Agricultural and Non-agricultural pools. MVWD, however, may withdraw up to its full well production capacity of 28,183 AFY (full well capacity minus 15% to account for potential well shutdowns for maintenance or testing) as long as it purchases additional replenishment water for the amount above the entitlement volume, limited to the safe yield of the basin; groundwater replenishment expands the opportunity to overproduce.
2. **Water Facilities Authority:** MVWD may use up to its full share (24%) of WFA treatment plant capacity (81 MGD).
3. **San Antonio Water Company:** Annual non-shortage entitlement through MVWD ownership of outstanding SAWCo shares. MVWD holds 329.75 shares or 5.2%, totaling 596 AFY. Pre-drought entitlement was previously 855 AFY.
4. **IEUA Recycled Water:** Year 2015 is actual use; projections in five-year increments to 2040 are from the MVWD 2015 UWMP, pg. 4-1. Although the Montclair Place Project will not use recycled water as a source to meet demands, recycled water may be used in other portions of MVWD to meet competing demands.

Under existing contractual obligations, MVWD is required to supply up to 20.22 MGD (22,650 AFY) of potable water to the City of Chino Hills. Chino Hills, however, has historically required no more than 14,000 AFY of the contracted maximum. Given that the City of Chino Hills has reduced its per capita daily water demand by 24% under the SBX7-7, and population estimates project growth of the City of Chino Hills by approximately 24% between 2015 and 2040, it is unlikely that the entire wholesale contracted amount will be required during the planning period. Therefore, it is expected that MVWD will possess these additional resources to meet future development demands.

MVWD has the opportunity to further increase its supply to meet future demands through the following measures: 1) production of groundwater based on safe yield allocation and utilization of water in storage; 2) increasing imported water purchases, if available and if there is available WFA capacity; and 3) purchasing additional recycled water when available. Collectively, these additional options will enable water supply to exceed water demand for MVWD now and though the planning period.

However, even without these supply augmentation measures, it is calculated that MVWD supplies are sufficient to exceed the demand of all existing rights, entitlements, and contractual obligations while also meeting Project demands.

Reliability of future water supplies to the region will be ensured through continued implementation of the Optimum Basin Management Program (discussed in Section 4.2), implementation of local agency programs, and combined efforts and programs among member and cooperative agencies, including all water retailers, and the Chino Basin Watermaster, IEUA, MWD, Santa Ana Regional Water Quality Control Board, Santa Ana Watershed Project Authority, and the Chino Basin Water Conservation District. The Water Utility manages agreements and contracts with these agencies and continually monitors activities, projects and programs to optimize the City's water supply.

The following sections discuss each of the water sources for MVWD. Reliability of each of these sources is discussed in Section 5.

## 4.2 Groundwater

**Chino Groundwater Basin**

MVWD receives groundwater from the Chino Subbasin of the Upper Santa Ana Valley Groundwater Basin (DWR Basin 8-2.01) one of the largest basins in southern California, which is managed by Chino Basin Watermaster (Figure 3; Figure 4). The Chino Watermaster is guided by the provisions of the Chino Basin adjudication and subsequent agreements between the parties to the Judgment (Superior Court 2012). These agreements provide for groundwater production rights that are not fully utilized by the Basin's agricultural interests to be transferred to municipal water purveyors via two methods; agricultural land use conversion and early transfer as described below in the Groundwater Management Subsection.

The Chino Basin Watermaster prepares an Assessment Package each year to determine the assessments for each groundwater producer based on production from the prior fiscal year. As

shown in Table 4-3, during fiscal year 2017, MVWD received their assigned Early Transfer1 share of 2,885 AF and a Land Use Conversion2 amount of 67.6 AF; these amounts, however, are subject to reconciliation between the amount required and amount available. The reconciliation assigned a debit of 249 AF resulting in a Net Ag Pool Reallocation of 2,703 AF. Further, the City received 4,824 AF in Carry-Over from fiscal year 2016, and water transfers of 639 AF. Together with assigned water rights (4,824 AF), MVWD had a Total Annual Production Right of 12,990 AF for FYE 2017. The Total Annual Production Right for Monte Vista Irrigation Company, which is owned by the MVWD, is also listed in the Table 4-3. The combined MVWD and Monte Vista Irrigation Company groundwater extraction rights as assessed by the Chino Basin Watermaster as listed in Table 4-4 by fiscal year.

**Table 4-3**
**MVWD FYE 2017 Total Annual Groundwater Production Right (AF)**

| | Monte Vista Water District | Monte Vista Irrigation Company |
|---|---|---|
| Early Transfer | 2,885 | 405 |
| Land Use Conversion | 67.6 | 0 |
| Reallocation Adjustment | <249> | <34> |
| **Agricultural Pool Safe Yield Reallocation** | **2,703** | **371** |
| Assigned Water Rights | 4,824 | 677 |
| Carry Over from 2017 Underproduction | 4,824 | 677 |
| Transfers | 639 | 0 |
| **Total FYE 2017 Production Right** | **12,990** | **1,724** |
| **Total Assessable FYE 2017 Production** | **6,865** | **0** |
| **Net Underproduction** | **6,124** | **1,724** |

**Source:** Chino Basin Watermaster, Fiscal Year 2017-2018, Assessment Package, November 16, 2017
**Note:** All amounts are subject to change annually.

[1] Early Transfer is the reallocation of safe yield not produced by the Agricultural Pool to the Appropriative Pool on an annual basis rather than according to the five-year increment described in the Judgment (Superior Court 2012).

[2] Land Use Conversion is the amount of water rights converted from agricultural land to urban use (Superior Court 2012).

**Table 4-4**
**MVWD and Monte Vista Irrigation Company**
**Watermaster Assessed Groundwater Rights by Fiscal Year (AF)**

| 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|---|
| 14,506.3 | 14,103.8 | 15,438.1 | 15,136.8 | 15,086.2 | 14,713.7 |

## Groundwater Management

The Chino Basin Watermaster was established in 1978 by a judgment entered by the Superior Court of California, as amended in 2012. The Judgment required that the Watermaster develop a management plan for the Chino Groundwater Basin that meets water quality and water quantity objectives for the region.

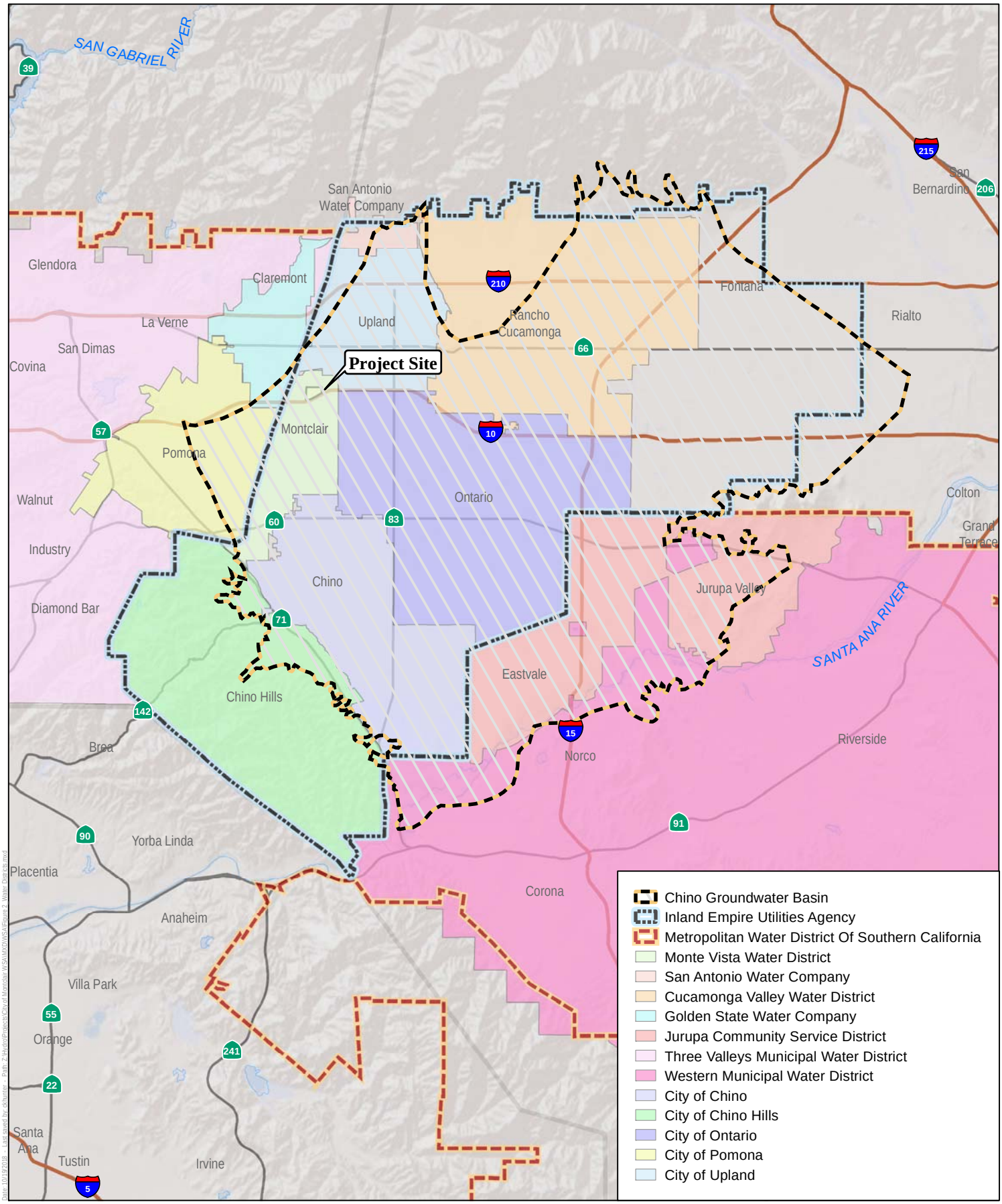
As mentioned earlier, the Watermaster is guided by the provisions of the Chino Basin Judgment and subsequent agreements between the parties to the Judgment. These agreements provide for groundwater production rights that are not fully utilized by the Basin's agricultural interests to be transferred to municipal water purveyors via two methods; agricultural land use conversion and early transfer. Three primary documents govern the adjudication and management of the Chino Basin: 1) the 2012 Chino Basin Judgment (Superior Court, 2012); 2) the Peace Agreement (Watermaster, 2000a); and 3) the OBMP (Watermaster, 1999). The following discusses each of these documents as they pertain to basin management and the MVWD water supply from groundwater.

MVWD's current assigned water production right, based on a share of safe yield, is 4,824 AFY from the Chino Groundwater Basin. Additional production allocations are received from annual entitlements of Early Transfers and Land Use Conversions, although they are subject to availability. Additional groundwater may also be available via a conjunctive use program for the Chino Basin in partnership with the Chino Basin Watermaster, IEUA, and MWD. The program is anticipated to reduce summertime peaking, deliver SWP supplies, control MWD surface water deliveries during future droughts/emergencies, and allow MWD to export stored water for other member agencies.

## Adjudication – 2012 Judgment

In 1978, the Superior Court of the State of California entered a judgment (restated in 2012) that adjudicated the water rights of the Chino Basin, and imposed a physical solution, which is the heart of the Judgment.

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SOURCE: USGS, DWR

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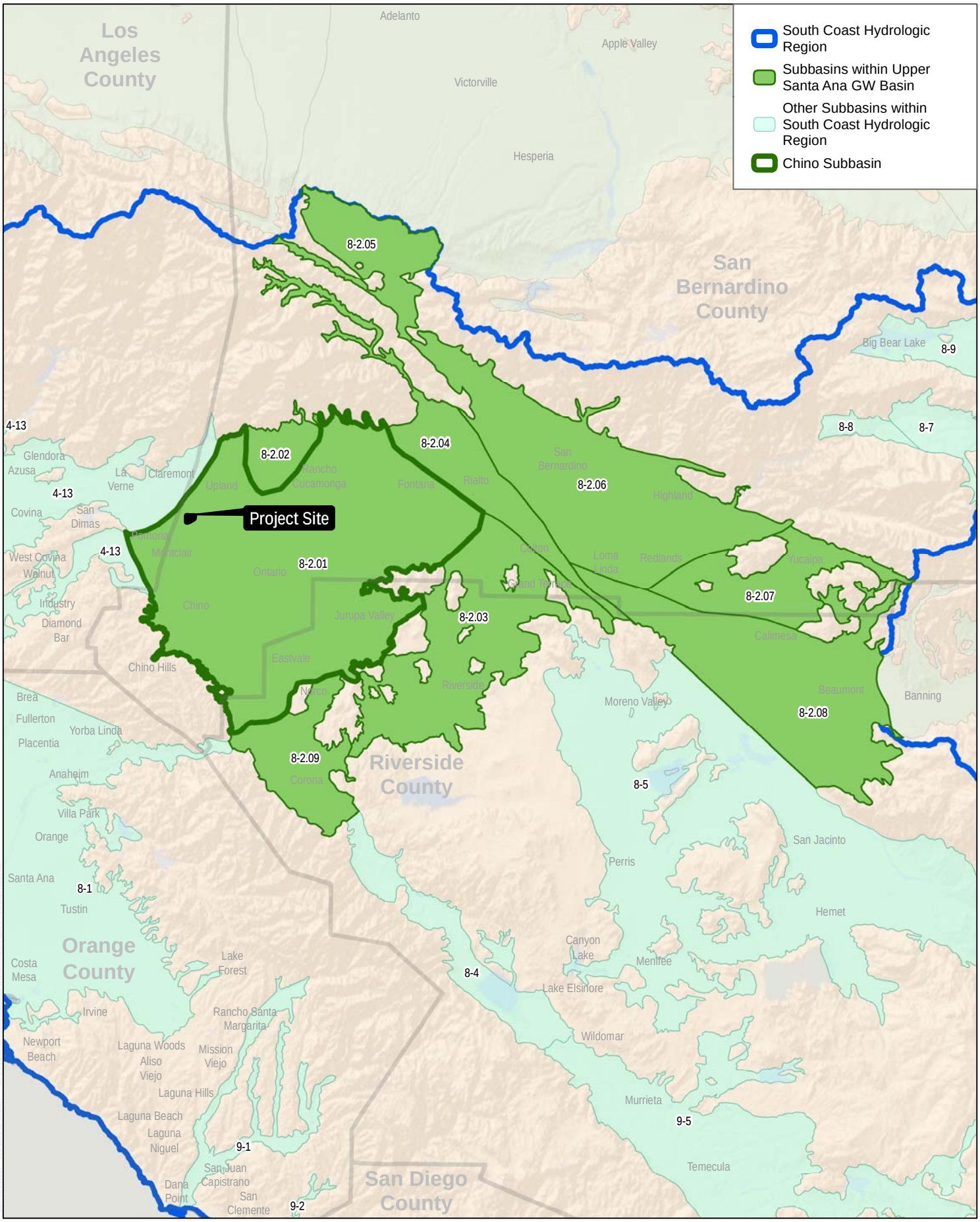
0 2.5 5 Miles

**FIGURE 2**

Water Districts

Montclair Place District Specific Plan Water Supply Assessment

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SOURCE: USGS

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**FIGURE 3**

Hydrologic Areas

Montclair Place District Specific Plan Water Supply Assessment

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- Montclair Place Project
- Chino Groundwater Basin

**Structures and Folds**

- anticline, certain
- anticline concealed
- syncline concealed

**Geologic and Fault Contacts**

- contact, certain
- fault, approx. located
- fault, certain
- fault, concealed
- scratch boundary
- dextral fault, certain
- fault, concealed, ball and bar

**Geologic Units**

- E; E-Ep = Eocene-Paleocene marine sedimentary rocks
- Ep = Paleocene marine sedimentary rocks
- J; J? = Jurassic marine sedimentary and metasedimentary rocks
- Ku; Ku? = Upper Cretaceous marine sedimentary and metasedimentary rocks
- M+KJfs; M; M? = Tertiary-Cretaceous marine sedimentary and metasedimentary rocks Miocene marine sedimentary rocks
- Mzv = Mesozoic metavolcanic rocks
- Oc; Oc? = Oligocene nonmarine (continental) sedimentary rocks
- P = Pliocene marine sedimentary rocks
- Q = Pleistocene-Holocene marine and nonmarine (continental) sedimentary rocks
- QPc = Pliocene-Pleistocene nonmarine (continental) sedimentary rocks
- Qoa = Pleistocene marine and nonmarine (continental) sedimentary rocks
- Tv = Tertiary volcanic rocks
- gb = Mesozoic plutonic rocks
- gr-m = Mesozoic to pre-Cambrian mixed rocks
- grMz; grMz? = Mesozoic plutonic rocks
- grPz
- m = pre-Cenozoic mixed rocks
- pC = pre-Cambrian marine sedimentary and metasedimentary rocks
- pCc
- sch

Project Site

SOURCE: California Geologic Survey 2010

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0 1.5 3 Miles

FIGURE 4

Geologic Map

Montclair Place District Specific Plan Water Supply Assessment

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According to the Judgment, there are significant imported water supplies available to supplement the native safe yield of the Basin. Therefore, the purpose of the physical solution was to establish a legal and practical means for making the maximum reasonable beneficial use of the waters of the Chino Basin by providing the optimum economic, long-term, conjunctive utilization of surface waters, ground waters and supplemental water, to meet the requirements of water users having rights in or dependence on the Chino Basin. A fundamental premise of the physical solution was that all water users dependent on the Chino Basin would be allowed to pump sufficient waters to meet their needs. To the extent that a water producer's pumping exceeds its share of the safe yield, the water producer has the obligation to provide for replenishment of the Basin for the amount of production exceeding its rights.

The Watermaster, as an extension of the court, manages the Basin in accordance with the provisions of the Judgment. An Assessment Package is produced by the Watermaster on an annual basis, which describes the rights and abilities to which appropriators are entitled according to the provisions of the Judgment.

Being that the Chino Groundwater Basin has been previously adjudicated, it is not subject to the majority of the requirements of the Sustainable Groundwater Act (SGMA) of 2016. The Watermaster is required to report annually to DWR on groundwater elevation data, aggregated extraction data, surface water supply, total water use and change in groundwater storage

**Water Rights – 2012 Judgment**

Three operating pools were established by the 1978 Judgment for Watermaster administration, restated in 2012: the Overlying Agricultural Pool, the Overlying Non-Agricultural Pool, and the Appropriative Pool. Rights to the safe yield of the Chino Basin were allocated to each operating pool. According to the Judgment, the safe yield of the Chino Basin was 140,000 AFY. In October 2015, Watermaster submitted the 2015 Safe Yield Reset Agreement, which was partially approved by the Court in 2017, and the Court reset safe yield from 140,000 AFY to 135,000 AFY. Safe Yield is defined as the long-term average annual quantity of groundwater (excluding replenishment water or stored water but including return flow to the Basin from the use of replenishment or storage water), which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result. Although the Court's ruling on the Safe Yield Reset Agreement is currently being appealed, the appellants and respondents are presently negotiating a settlement to resolve the appeal, and the appeal is unlikely to affect MVWD's ability to meet demand.

Overlying right is defined as the appurtenant right of an owner of lands overlying the Chino Basin to produce water from the Basin for overlying beneficial use on such lands. Appropriative

right is defined as the annual production right of a producer from the Chino Basin other than pursuant to an overlying right.

Aggregate preserved overlying rights in the safe yield for agricultural pool use, including the rights of the State of California, total 82,800 AFY, or 414,000 AF in any five consecutive years. Overlying rights for non-agricultural pool use total 7,366 AFY. In accordance with the provisions of the Chino Basin Watermaster process, when land converts from agricultural use to non-agricultural use, the purveyor that will supply water to the converted land may apply for additional groundwater production credit; i.e., Agricultural Land Use Conversion.

Appropriative rights allocated by the Judgment include rights by prescription and are entitled under the physical solution to share in the remaining safe yield, after satisfaction of overlying rights. Operating safe yield is defined as the amount of groundwater that the Watermaster shall determine can be produced from the Chino Basin by the Appropriative Pool parties free of replenishment obligation under the physical solution. Any subsequent change in the safe yield would debit or credit the Appropriative Pool. The MVWD' current share of the operating safe yield is 4,824 AFY. Additionally, MVWD owns the Monte Vista Irrigation Company, which has 677 AFY of base rights and receives its share of unpumped agricultural rights according to the Reallocation of Water Rights described as follows.

**Reallocation of Water Rights**

According to the Judgment, in any five years that any portion of the share of safe yield allocated to the Overlying Agricultural Pool is not produced, that water is available for reallocation to the Appropriative Pool. Priority of that water is first to supplement water available from operating safe yield to compensate for any reduction in the safe yield after the tenth year of operation (1988), conversion claims, and then for supplement to the operating safe yield without regard to reductions in safe yield.

Appropriative rights and corresponding shares of operating safe yield may be assigned or may be leased or licensed to another appropriator, as approved by the Watermaster.

**Overdraft - 2012 Judgment**

In adopting the operating safe yield for any year, the Watermaster is limited to 200,000 acre-feet of accumulated overdraft, and in no event shall the operating safe yield for all pools in any year be less than the Appropriative Pool's share of safe yield or exceed the Appropriative Pool's share of safe yield by more than 10,000 AF (Superior Court 2012).

**Groundwater Replenishment – 2012 Judgment**

Overdraft is defined as a condition wherein the total annual production from the Basin exceeds the safe yield. The 2012 Judgment restated that the Chino Basin, since at least 1953, was in a condition of overdraft. To prevent the reduction in safe yield, in 1998 the Watermaster began to institute certain conservation measures though the Optimum Basin Management Program (OBMP). The Watermaster levies an annual Replenishment Assessment in an amount sufficient to purchase replenishment water to replace production during the preceding year, which exceeds the safe yield.

Supplemental water may be used to recharge the Basin either directly by spreading and percolating or injecting the water into the Basin, or indirectly by delivering the water for use in lieu of production and use of safe yield or operating safe yield. Supplemental water may be obtained from any available source including recycled water, SWP, local import, and Colorado River supplies.

Much of the available natural surface water runoff in the Santa Ana River Watershed is captured and recharged to the groundwater aquifers. A system of flood control channels and percolation basins have been developed to increase the recharge capacity of the Basin. The groundwater recharge program is planned to be expanded in the future.

**Groundwater Replenishment – Recycled Water**

IEUA has primary responsibility for production and delivery of recycled water to Chino Basin facilities for recharge. Direct use of recycled water has priority over recharge deliveries.

The Chino Basin Recycled Water Groundwater Project, developed by the Chino Basin Water Conservation District (CBWCD), IEUA, San Bernardino County Flood Control District (SBCFCD), and the Chino Basin Watermaster, includes redevelopment and modification of the existing Chino Basin groundwater recharge facilities. Historically, these basins have been used primarily for flood control. However, as part of the OBMP, the recharge basins will help "drought-proof" the Chino Basin as they will be enhanced to capture storm water and provide for the greater ability to store imported water in the Chino Basin.

Recycled recharge water is credited to parties to the Regional Sewer Service Contract, based on relative contributions of wastewater flow delivered to the Regional Reclamation Plants by the respective agencies. This translates into additional groundwater pumping rights calculated annually as stored water credits. In fiscal year 2017, MVWD received 638 AF of additional production capability through supplemental water credits as a result of recycled water recharge activity (MVWD 2016).

**Carryover – 2012 Judgment**

Any Appropriator who produces less than its assigned share of operating safe yield may carry such unexercised right forward for use in subsequent years. The first water used in any such subsequent year is to be an exercise of that carryover right. If the aggregate carryover of any appropriator exceeds its share of operating safe yield, a storage agreement is executed with the Watermaster as a condition of preserving the surplus carryover. For example, MVWD's carryover to FYE 2018 was 6,124 AF (Watermaster 2017b). This amount was determined based on the amount of carryover from FYE 2016, plus the assigned share of safe yield, plus a one-time prior year adjustment, plus water transaction activity, plus Ag Pool safe yield reallocation for a total FYE 2017 production right, less FYE 2017 actual production and exchanges. This amount equaled 6,124 AF, of which 4,824 AF was carried over to FYE 2018 production and the excess carryover of 1,300 AF was placed in the MVWD's excess carryover local storage account.

**Groundwater Storage Capacity – 2012 Judgment**

The Judgment states that a substantial amount of available groundwater storage capacity exists in Chino Basin, which is not utilized for storage or regulation of Basin waters. The Basin stores approximately 5 MAF of groundwater and has the capability of storing an additional 1 MAF. Chino Basin reservoir capacity can appropriately be utilized for storage and conjunctive use of supplemental water with Basin waters. Any person or public entity may make reasonable beneficial use of the available groundwater storage capacity for storage of supplemental water, with allocation preference of storage capacity to the needs and requirements of the lands overlying the Basin and the owners of water rights in the Basin.

**Peace Agreement**

Adopted in July 2000 and amended in 2004, the "Peace Agreement" amended the 1978 Chino Basin Judgment for a term of 30 years. The Peace Agreement facilitates the implementation of the Optimum Basin Management Program (OBMP).

The Peace Agreement amended the judgment in three areas:

1) Members of the Overlying Non-Agricultural Pool have the right to transfer or lease their quantified production rights within the same pool or to the Watermaster in conformance with specified procedures.
2) Any appropriator who provides water service to overlying agricultural lands may exercise overlying rights to the extent necessary to provide water service to overlying lands.

3) For the term of the Peace Agreement, in any year in which sufficient unallocated safe yield from Overlying Agricultural Pool is available for conversion claims, the Watermaster can allocate each appropriator with a conversion claim, 2.0 AF of unallocated safe yield water for each converted acre approved.

The "Peace II" Agreement, signed in 2008, provided improved flexibility in managing the basin's water supply, better utilization of the desalters, and reduced water losses to the Santa Ana River. The Peace II Agreement determined the financial and institutional arrangements needed to implement basin reoperation and hydraulic control, including the following:

1) Ensures the beneficial use of groundwater in the southern end of the basin by enabling the construction of desalters to produce and treat above 40,000 AFY of groundwater degraded by past agricultural practices;
2) Maximizes the reuse of recycled water
3) Fulfills Watermaster's and IEUA's maximum benefit commitments;
4) Provides up to 400,000 AF of replenishment water for the desalters;
5) Creates 400,000 AF of new storage space available for groundwater storage programs; and
6) Extends the MZ1 recharge obligation to be a minimum of 6,500 AFY.

**Overdraft – Peace Agreements**

Individual producers do not currently have a limit on how much they can over-produce; however, they are assessed an amount to replenish the Basin for all overproduction. Producers generally develop annual demand projections that assist in making arrangements with other appropriators for pre-purchase of replenishment water through transfers and other agreements. This allows the Watermaster to optimize planning within the OBMP.

The Watermaster is responsible to conduct recharge and replenishment of the Basin. As party of its ongoing efforts to manage the basin so that ground water producers may pump groundwater in sufficient quantities to meet their needs, the Watermaster committed per the Peace Agreement to conduct physical recharge of supplemental water of at least 6,500 AFY in one or more of the areas known as Montclair, Brooks, and Upland spreading facilities (Management Zone 1 – MZ1). If the cumulative total of 32,500 AF of recharge has not been accomplished at the end of the five years, then recharge will continue at the same annual rate until 32,500 AF has been reached.

Cost and allocation of supplemental water is apportioned pro-rata among members of the Appropriative Pool according to the producer's share of the initial safe yield (135,000 AFY).

**In-Lieu of Groundwater Production**

Recharging the Basin may be accomplished either directly by spreading and percolating or injecting the water into the Basin, or indirectly by delivering the water for use in lieu of groundwater production and use of safe yield or operating safe yield.

In-lieu areas are designated by the Watermaster. The Watermaster has designated the entire Chino Basin as an in-lieu area. Any member of the Appropriative Pool, who is willing to abstain for any reason from producing any portion of its share of operating safe yield in any year, may offer the unproduced water to the Watermaster. The Watermaster then may purchase the unproduced groundwater in place of spreading replenishment water. The price is the lesser of the cost of replenishment water plus the cost of spreading, or the cost of supplemental surface supplies less the appropriator's average cost of groundwater production and the applicable production assessment.

**Storage and Recovery – Peace Agreements Local Storage**

Local storage is protected and each party has the right to store its un-produced carry-over water in the Basin. Local storage agreements are approved so long as the total quantity of supplemental water under local storage agreements does not exceed the cumulative total of 500,000 AF. Water held in storage is transferable, but storage capacity is not. As of June 30, 2015, MVWD estimated that it held a total of 26,484 AF in its excess carryover and local supplemental storage accounts (MVWD 2016).

Parties may continue to produce the actual quantity of carry-over water and supplemental water held in its storage account, subject only to the loss provisions. Rate of loss from local storage was zero percent until 2005, at which time it was recalculated to 2% based on the best available scientific information. The 2015 Safe Yield Reset Agreement lowered this rate to 0.07% Carryover Storage Loss deducted annually from each storage account. For fiscal year 2017, MVWD's Carryover Storage Loss was 5.93 AF (Watermaster, 2017b).

The Watermaster has the general discretion to place reasonable limits on the further accrual of carry-over and supplemental water in local storage. This is necessary to provide priority for the use of storage capacity for Storage and Recovery Programs that provide broad mutual benefits to all parties.

**Storage and Recovery Program**

The target for the Safe Storage Capacity in the Basin was set in the Peace II Agreement at 500,000 AF, but has since been raised to 600,000 AF. Safe Storage Capacity is defined as the maximum volume that may be extracted from the basin without incurring any significant long-term impacts.

Appropriative and Non-Agricultural Pool members are entitled to the compensation paid for a Storage and Recovery Program paid in any form, including money, revenues, credits, proceeds, programs, facilities, or other contributions. Compensation may also be used to offset the cost of operations, to reduce assessments on the members, and to defray the costs of capital projects at the request of the members.

The Watermaster is responsible to conduct best efforts to do the following: 1) complete the short-term conjunctive use project conducted by IEUA, Three Valleys Municipal Water District (TVMWD) and MWD; 2) develop a seasonal peaking program for in-Basin use and dry year yield to reduce the Basin's demand on MWD water; 3) develop a dry year export program; and 4) develop a seasonal peaking export program.

The short-term conjunctive use project includes construction of facilities to store water and later withdraw it for conjunctive use. The program goals are to reduce summertime peaking on MWD, deliver SWP supplies to Chino Basin, minimize MWD surface water deliveries during future droughts/emergencies, and to allow MWD to export storage water for other member agencies.

The program will create improved reliability by establishing an initial 100,000 AF storage account for MWD and providing a financial incentive for shifting demand on MWD surface deliveries to the winter months. This program is just one example of storage programs that are necessary to optimize Basin storage and supplies, reduce demand on imported water supplies, and make water available that may not have been otherwise.

**Transfers – Peace Agreements**

Transfers must have the approval of the Watermaster. Transfers include the assignment, lease, or sale of a right to produce water to another producer within the Chino Basin or to another person or entity for use outside the Basin whether the transfer is temporary or permanent. Lease of water rights are also permissible to allow producers to make up for the lessee's over-production.

According to the Watermaster Fiscal Year 2017-18 Assessment Package, MVWD did not complete any transfers. Transfers are recorded annually as arrangements are made. For Fiscal Year 2016-17, MVWD received 100 AF from the City of Pomona's Storage Account.

Overlying Non-Agricultural Pool members have the right to transfer or lease within the pool, and the right to transfer to the Watermaster for the purpose of replenishment for a desalter or for a storage and recovery program.

**Early Transfer**

An "early transfer" means the reallocation of safe yield not produced by the Overlying Agricultural Pool to the Appropriative Pool on an annual basis rather than according to the five-year increment described in the Judgment. The Early Transfer of not less than 32,800 AFY was the expected approximate amount of water not produced by the Agricultural Pool. Prior to 2017, Early Transfer was expected to be the greater of 32,800 AF or 32,800 AF plus the actual quantity of water not produced in a given year after all the land use conversions are satisfied. Early transfer water is allocated among members of the Appropriative Pool in accordance with their pro-rata share of the initial safe yield. MVWD's share of the initial safe yield is 8.797 percent, yielding an Early Transfer of 2,885.416 AFY for MVWD and 404.752 AF (1.234% of safe yield) for the Monte Vista Irrigation Company for fiscal year 2017-18.

**Land Use Conversion of Water Rights**

With the effective date of the Peace Agreement (June 2000), the amount of water rights converted from agricultural land to urban use was changed from 2.6 AF per acre with allocation between initial shares of safe yield and service provider to 2.0 AF per acre, all of which is allocated upon conversion of the land to the Appropriative Pool member service provider. Upon conversion of water rights, the purveyor pledges the amount of water needed for the urban land use, and up to 2.0 AFY per acre of land will be made available.

An Agricultural Pool member has the right to a voluntary agreement with an appropriator, which has a service area contiguous to or inclusive of the agricultural land, to provide the required water to the overlying land on behalf of the Ag Pool member. The appropriator is then entitled to a credit to off-set production to the extent it is serving the overlying land up to the amount of the historical maximum annual quantity previously used on that property. The credit is debited to the Ag Pool's collective production right. Total required reallocations from Early Transfers and Land Use Conversions are subject to availability.

**Optimum Basin Management Program for the Chino Basin**

In 1998, the Chino Basin Watermaster developed an integrated set of water management goals and actions for the Basin. Known as the Optimum Basin Management Program (OBMP), this document describes nine program elements to meet the water quality and local production objectives in the Basin. The OBMP encourages the increased use of local supplies to help "drought proof" the Basin (Watermaster, 1999).

The OBMP is intended to formulate and implement a groundwater management program that will preserve and enhance the safe yield and the water quality of the Chino Basin. The Watermaster's goal is to make it possible for all groundwater users to produce water from the basin for beneficial uses at an affordable cost. The OBMP is intended to allow continued reliance on groundwater for beneficial use within the basin while minimizing demand for imported water, and to encourage beneficial use of the large available storage space in the aquifer system. OBMP actions are intended to benefit both local and regional water supply programs.

The effort to complete the OBMP for the Chino Basin was divided into two phases. The first phase culminated in the September 1999 submittal of the draft Phase 1 Report to the Court with continuing jurisdiction over the Basin groundwater resources (Watermaster, 1999). The second phase, including a programmatic EIR, was completed and adopted in July 2000, as the Implementation Plan (Watermaster 2000b).

Phase 1 of the OBMP defined the state of the Chino Groundwater Basin, established the goals and objectives concerning major issues identified by stakeholders, and affirmed a management plan for the achievement of the stated goals and objectives. Phase 2 of the OBMP is the Implementation Plan for the installation and operation of OBMP facilities. The major OBMP facilities include pipelines, groundwater treatment plants, recharge basins, pump stations, production wells, and monitoring devices.

The four primary OBMP management goals are to enhance basin water supplies, to protect and enhance water quality, to enhance management of the basin, and to equitably finance the OBMP.

The OBMP includes nine program elements that were developed during the Phase 1 OBMP Report that collectively will meet the goals of the OBMP. The scope of implementation of some of the programs have been combined since they overlap and have synergies between them. The program elements include developing and implementing each of the following:

- Element 1 – Comprehensive Monitoring Program
- Element 2 – Comprehensive Recharge Program

- Element 3 – Water Supply Plan for the Impaired Areas of the Basin
- Element 4 – Comprehensive Groundwater Management Plan for Management Zone 1
- Element 5 – Regional Supplemental Water Program
- Element 6 – Cooperative Programs With the Regional Water Quality Control Board, Santa Ana Region, and Other Agencies to Improve Basin Management
- Element 7 – Salt Management Program
- Element 8 – Groundwater Storage Management Program
- Element 9 – Storage and Recovery Programs

**Monte Vista Water District Wells**

MVWD currently maintains 12 groundwater wells. Table 4-5 presents MVWD's existing wells and associated capacities.

**Table 4-5**
**Monte Vista Water District Active Groundwater Wells – 2015**

| Well Number | Operating Well Capacity (mgd) |
|---|---|
| 4 | **0.6** |
| 5 | 2.0 |
| 10[2] | 1.5 |
| 19 | 2.6 |
| 26 | 2.8 |
| 27 | 2.9 |
| 28 | 2.7 |
| 30 | 2.9 |
| 31 | 2.9 |
| 32[2] | 2.9 |
| 33[1] | 1.5 |
| 34[2] | 2.9 |
| **Total** | **28.2** |

**Source**: MVWD 2015 UWMP

1 Full Well 33 capacity is 2.9 mgd. The City of Chino owns half of the well's capacity

2 Wells 10, 32 and 34 are currently inactive due to the presence of 1,2,3-Trichloropropane (TCP). These wells will be reactivated upon the implementation of TCP treatment facilities.

MVWD's Water Facilities Master Plan includes recommendations for well improvements to provide for system reliability and continued groundwater pumping. Improvements are discussed in Section 5.1 of this WSA.

**Tables 4-6** and **4-7** provide the amount and location of groundwater pumped for the last six years prior to 2018 and groundwater projections through the year 2040, respectively.

**Table 4-6**
**MVWD Historic Amount of Groundwater Pumped from the Chino Basin (AF)**

| Well Number | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| 4 | 69.59 | 195.34 | 132.69 | 360.94 | 178.55 | 262.21 |
| 5 | 1,208.07 | 1,170.61 | 1,321.05 | 726.80 | 168.84 | 1,196.51 |
| 10* | 36.76 | 97.40 | 98.41 | 44.82 | 1.10 | 0.17 |
| 19 | 1,759.16 | 2,154.89 | 1,221.83 | 1,900.26 | 1,261.01 | 2,460.35 |
| 26 | 1,075.92 | 2,400.21 | 2,191.06 | 2,314.32 | 1,024.70 | 1,575.17 |
| 27 | 268.93 | 368.15 | 711.85 | 82.94 | 612.70 | 357.47 |
| 28 | 2,554.98 | 2,637.42 | 866.27 | 1,353.13 | 1,109.48 | 1,634.48 |
| 30 | 187.50 | 7.96 | 713.54 | 0.04 | 21.50 | 18.33 |
| 31 | 1,217.26 | 0.04 | 589.07 | 954.99 | 977.74 | 1,039.70 |
| 32* | 138.93 | 2,081.96 | 122.19 | 7.73 | 0 | 0.26 |
| 33 | 621.86 | 381.81 | 233.71 | 345.07 | 1,201.66 | 512.15 |
| 34* | 622.28 | 878.59 | 29.09 | 10.23 | 1.88 | 0 |
| **Total** | **9,761** | **12,374** | **8,231** | **8,101** | **6,559** | **9,057** |

**Note:** Years are shown in calendar years.
* Wells currently inactive

**Table 4-7**
**MVWD Projected Amount of Groundwater Pumping from the Chino Basin (AF)**

| 25-Year Projections | | | | | |
|---|---|---|---|---|---|
| 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| 8,406 | 28,183 | 28,183 | 28,183 | 28,183 | 28,183 |

**Source:** MVWD, 2015 Urban Water Management Plan, Table 4-1, pg. 4-1

## 4.3 Imported Water (Surface Water) – Water Facilities Authority

MVWD receives its imported water through the Water Facilities Authority (WFA). The WFA Agua de Lejos Treatment Plant is located in Upland, and receives surface water from the SWP. This water is purchased from MWD through IEUA.

MWD's Rialto Branch of the Foothill Feeder delivers SWP water to the WFA Agua de Lejos Water Treatment Plant for treatment. The Agua de Lejos Water Treatment Plant is permitted to treat 81 MGD of SWP water. The actual quantity of treated water has ranged from 12 MGD in the winter months to as high as 71 MGD during the summer of which MVWD has received as

little as no supply in the winter and as much as 30.5 MGD in summer months. WFA water enters the MVWD's potable water distribution system through two turnouts: one located at Arrow Highway and Benson Ave., and the second located at Benson Ave. and 17th Street. As WFA water is of higher quality than the City's groundwater, the water is normally delivered to the MVWD's distribution system at Plant 4, where it is then blended with water from MVWD wells to maintain water quality levels within State and Federal standards.

Under conditions of full requests, MVWD is entitled to 24% of the WFA Agua de Lejos Plant capacity (21,776 AFY or 19.4 MGD). However, MVWD has historically taken up to 37.6% of the capacity. Table 4-8 lists historical imported water production from 2012 through 2017.

**Table 4-8**
**Monte Vista Water District Historic Annual Imported Water Production (AF)**

| WFA | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| Imported Water | 3,505 | 5,736 | 5,965 | 4,530 | 4,799 | 5,105 |

MVWD may take delivery of more than its entitlement when other WFA members are not taking delivery of their full entitlements. Historically, there has always been unused capacity and the MVWD has always had an opportunity to meet water quality standards and demands through additional WFA imported water. Many of the WFA members desire less dependence on imported water and greater reliability and control on local supplies. As a result, development of local water supply programs has increased and continued opportunity for purchase of unused capacity is possible. However, increasing costs related to groundwater production and treatment and OBMP implementation also factor into determinations regarding resource utilization and it is possible that increasing groundwater costs would encourage full utilization of WFA capacity. For this reason, this analysis assumes MVWD utilizes only its entitlement, as adjusted by MWD actions related to available imported water supply.

Discussions of the opportunity to maintain and increase the capacity of the WFA treatment plant have occurred; however, analysis would need to be done to determine feasibility and economic benefits considering the climate of imported water reliability. The plant production capacity could be increased to 88 MGD through re-rating of the existing plant. Further plant capacity increases would require a plant expansion.

## 4.4 Entitlement Water (San Antonio Water Company)

San Antonio Water Company (SAWCo) was incorporated in 1882 as a privately owned mutual water company who delivers domestic and irrigation water to its shareholders. These shareholders include MVWD as well as residents of San Antonio Heights, the cities of Upland and Ontario, local golf courses, rock quarries, and grove irrigators (**Figure 2**). Of the total 6,389 SAWCo shares, MVWD holds 329.75 or 5.2%.

SAWCo's sources of domestic water supply include groundwater from the San Antonio Tunnel, Chino Groundwater Basin, and Cucamonga Groundwater Basin, and a small amount of purchased water from the City of Upland. SAWCo's sources of irrigation water supply include both surface water from the San Antonio Canyon and groundwater from Chino Groundwater Basin, Cucamonga Groundwater Basin, and the Six Basins area. Surface water from the San Antonio Canyon is used for irrigation, spreading over the San Antonio Tunnel to enhance natural groundwater flows for domestic supply, and delivered to the City of Upland's Surface Water Treatment Plant for domestic supply.

Total annual SAWCo water supply over the past decade ranged from 20,213 AFY in 2005 to 9,074 AFY in 2015. SAWCo's production rights total approximately 30,000 AFY. Roughly 80% of total deliveries are to non-domestic irrigation customers, primarily municipalities. SAWCo has generally fully utilized its water rights in all sources except San Antonio Creek.

Currently, each share is entitled to 1.808 AFY of water deliveries, for a total annual supply of 11,552 AFY. This is a decline from a pre-drought entitlement of 2.594 AFY per share, or 16,574 AFY in total annual supply.

In September 2010, SAWCo and MVWD entered into a Water Service Agreement, pursuant to which SAWCo may transfer to MVWD the right to pump MVWD's share of the SAWCo entitlement from the Chino Groundwater Basin (596.2 AFY). Since then, SAWCo and MVWD have developed additional delivery options, including a wheeling agreement with the City of Upland, an interconnection with the WFA, and transfer of groundwater production rights from Six Basins to the Chino Basin through the City of Pomona. Due to the drought, SAWCo allowed MVWD's Water Service Agreement to lapse at the end of its five-year term (December 31, 2015). MVWD is currently coordinating with SAWCo and its other municipal shareholders to develop new service agreements consistent with existing conditions.

## 4.5 Recycled Water

Water recycling involves the treatment of wastewater to create a high quality, safe source of water for outdoor irrigation, industrial and groundwater recharge uses. Water recycling is a critical component of the water resources management strategy for the region. The City relies on the Regional Recycled Water Distribution System operated by IEUA for its recycled water supply. Development and expansion of the regional system is critical to meeting the City's anticipated demands for recycled water. Development of the local recycled water distribution lines within the City is a partnership between the City, IEUA, and developers.

IEUA service area. Recycled water will provide a dependable local supply of water as well as reduce the likelihood of water rationing during droughts. In addition, the use of recycled water for groundwater recharge is an integral part of the OBMP. Region-wide implementation of recycled water projects are vital to the protection and enhancement of the safe yield and water quality of the Chino Groundwater Basin.

**IEUA Regional Wastewater Treatment Plants**

IEUA operates four regional wastewater treatment plants: Regional Plant No.1 (RP-1), RP-4, RP-5, and the Carbon Canyon Water Reclamation Facility (CCWRF). Each treatment plant produces tertiary treated recycled water in compliance with California's Title 22 regulations and exceeds the public health standards. In 2017, the water quality from these plants was characterized by an average level of total dissolved solids (TDS) of 412 mg/L (TDS limit: 550 mg/L) and an average level of total nitrogen (TIN) of 4.5 mg/L (TIN limit: 8 mg/L) (IEUA 2018).

The IEUA Regional Sewerage Service Contract defines the manner for a Contracting Agency to claim its respective share of the recycled water from the treatment plants. Under the current contract, MVWD may take delivery of more than its entitlement when other contracting agencies are not taking delivery of their full entitlements.

According to the IEUA Regional Recycled Water System Program, local recycled water facilities are those that serve the customers of only one contracting agency. Each local agency is responsible for the planning, design, construction and operation of local laterals within their service area. IEUA staff is working closely with each agency, including the City, to coordinate their recycled water planning efforts.

**Recycled Water for Regional Direct Use and Groundwater Recharge**

Recycled water used for groundwater recharge will be blended with MWD's imported SWP supplies and local storm water, consistent with the water quality requirements of the Chino Basin Watermaster's OBMP, Santa Ana Regional Water Quality Control Board's Basin Plan and the Department of Health Services (DHS).

Aquifer retention time, the distance to the nearest well, and groundwater migration will be considered in the calculation of the blending ratio necessary to comply with the requirement of the DHS. Current estimates are that approximately 15,000 AFY of recycled water could be recharged at spreading grounds throughout the Chino Basin by 2035. Additional facilities, including the construction of new transmission lines for imported water from the MWD Rialto Pipeline, development of new groundwater recharge basins, and installation of additional pumping capacity, will be needed to achieve the long-term water recycling goals for the region.

As the region continues to develop, significant new development will be designed to make the maximum beneficial use of recycled water. In addition, future expansion of recycled water facilities through retrofits to additional existing developments will continue. By 2035 direct recycling is planned to supply 82,330 AFY in the IEUA service area (IEUA 2016a).

**Recycled Water Use in the Monte Vista Water District**

MVWD recognizes the potential uses of recycled water in its community, such as landscape irrigation, parks, industrial and other uses, and works with IEUA to develop the needed recycled water infrastructure to support use of recycled water.

In 2015, MVWD provided 308 AF of recycled water to its recycled water customers and purchased an additional 483 AF from the IEUA Regional Recycled Water System as the City of Montclair's share of regional recycled groundwater recharge, as shown in **Table 4-9**. This is 515 AF less than the amount projected in the MVWD 2010 UWMP, a difference mostly due to the delay in expanding the MVWD's recycled water distribution system and the regional recharge program. Recycled water sales are estimated to eventually reach 430 AFY with the connection of additional customers.

**Table 4-9**
**2015 Recycled Water Use vs. 2010 UWMP Projects (AFY) Monte Vista Water District**

| Water Use Sector | 2015 Actual Use | 2010 Projection for 2015 |
|---|---|---|
| Landscape Irrigation | 308 | 430 |
| Groundwater Recharge | 483 | 876 |
| **Total Recycled Water Use** | **791** | **1,306** |

**Source:** MVWD 2015 UWMP

Recycled water use for 2020 is projected to be 1,031 AF, increasing to 1,069 AFY by 2040 as shown in Table 4-10.

**Table 4-10**
**Current and Projected Recycled Water Use in MVWD (AF)**

| | 2015[1] | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Landscape Irrigation | 308 | 430 | 430 | 430 | 430 | 430 |
| Groundwater Recharge[2] | 483 | 601 | 560 | 589 | 639 | 639 |
| **Total Recycled Water Use** | **791** | **1,031** | **990** | **1,019** | **1,069** | **1,069** |

1 Actual values from MVWD records
2 2020-204: City of Montclair estimated portion (4.3%) of IEUA's projected recycled water recharge.
**Source:** MVWD 2015.

Recycled water availability for IEUA's service area, as discussed in IEUA's 2015 Regional UWMP, was 60,200 AF for 2015, and is projected to increase to 75,100 AF by 2030 and 82,900 by 2040. Regional recycled water demands, including groundwater recharge, are projected to increase from 33,419 AF in 2015 to 67,969 AF by 2040. This demonstrates that available recycled water supply is projected to meet and exceed demand for recycled water.

Although the Project is not planned to receive recycled water to meet demands, the use of recycled water to meet irrigation demands in the MVWD service area increases the availability of other supply sources to meet Project demands.

## 4.6 Desalted Water

Brackish water at the southern end of the Chino Groundwater Basin is the water source for the Chino Basin Desalter Authority (CDA). Constructed in 2000 through a joint participation agreement among SAWPA, Western Municipal Water District, Orange County Water District, MWD and IEUA, the Chino I Desalter currently produced 10,000 AFY. Of this, approximated 9,000 AFY is provided as

potable water supply to the cities of Chino and Chino Hills. The Chino II Desalter was constructed in 2008 and currently produces between 14,000 and 15,900 AFY of potable water.

Although MVWD does not currently use desalted water from the CDA, this and other desalination projects indirectly benefit MVWD by fulfilling water demands of neighboring districts using sources other than those of MVWD water supplies.

# 5 RELIABILITY OF WATER SUPPLIES

MVWD, as well as all southern California communities and water agencies, is facing increasing challenges in their role as stewards of water resources in the region. For example, increased environmental regulations and competition for water from outside the region have resulted in reduced supplies of imported water. Continued population and economic growth increase water demand within the region, putting an even larger burden on local supplies.

The Project proposes three mixed-use land categories including approximately 104 acres for 5 million square feet of residential uses (6,321 dwelling units), 2 million square feet of commercial space, and a hotel with approximately 100-200 rooms. Total water demand at build-out for the Project is estimated to be approximately 2,906 AFY.

MVWD works with the following agencies to ensure water supply reliability to the region: Inland Empire Utilities Agency, Metropolitan Water District of Southern California, Water Facilities Authority, Chino Basin Watermaster, Chino Basin Water Conservation District, Santa Ana Regional Water Quality Control Board, and Santa Ana Watershed Project Authority.

The following sections discuss these agencies, and others throughout the region, their roles in water supply reliability, and the near and long-term efforts to ensure future reliability of water supplies to the City, MVWD Service Area and the region as a whole.

## 5.1 Monte Vista Water District

MVWD's water system is projected to expand as a result of the facilities (e.g., pipelines, wells, storage tanks) that are necessary to supply recycled water to new clients. In addition, MVWD's potable water distribution system has recently undergone pipeline expansion to increase capacity and pressure for potable water.

As mentioned in Section 1.0, this WSA does not identify specific infrastructure needs related to the provision of water for the Project, nor does MVWD have a specific capital improvement or outlay program representing this project. The City of Montclair and MVWD will work to secure local, regional, and federal permits and regulatory approvals for the Project that may be required for infrastructure expansion to meet Project demand.

MVWD's current Facilities Master Plan (2008) identifies various capital improvement projects to be completed over a 30-year time period at a cost of approximately $100 million. These improvements include pipeline updates, seismic improvements, pump rehabilitation or replacement, reservoir updates, water quality improvements, well development, and water supply

enhancements. The effect of these efforts will be to increase operation efficiency, reduce long-term costs, improve water quality and reliability, and meet regulatory requirements.

## 5.2 Chino Basin Watermaster

As required by the Court, the Chino Basin Watermaster prepares semiannual reports that describe implementation of the OBMP. These semiannual reports provide information on each of the nine OBMP program elements and their implementation status. The following provides an overview of some of the major activities to ensure reliability of the Basin:

**Groundwater Level Monitoring**

Groundwater level monitoring is important to understand the impacts of pumping, availability of storage, changes in Basin hydrology, and the influence of recharge on groundwater levels. The Watermaster currently maintains a basin-wide groundwater-level monitoring program to support Watermaster functions such as the reassessment of safe yield, the monitoring and management of ground-level movement, the analysis of desalter pumping impacts on private wells, the analysis of the impact of Peace II Agreement implementation in the Prado Basin, the triennial computation of ambient water quality for the Santa Ana River Basin Plan, and the assessment of hydraulic control.

For the basin-wide program, Watermaster staff manually measure groundwater levels in approximately 200 wells either through monthly manual methods or by pressure transducers that log data every 15 minutes. In conjunction with the basin-wide program, well owners including municipal water agencies, the California Department of Toxic Substances Control (DTSC), the Counties, and various private consulting firms measure groundwater levels at least semi-annually in 900 additional wells. For the MZ-1 program, groundwater level data is collected by pressure transducer at 60 wells throughout MZ-1 (Watermaster 2017a).

The most recently completed expansion project between the Chino Basin Desalter Authority (CDA) and the Watermaster included the construction of five wells for the new Chino Creek Well Field (CCWF). These wells are necessary to meet the hydraulic control commitment associated with the maximum benefit program and to provide additional raw water to the Chino I Desalter. The current expansion plan will add 3 more wells in the southern portion of the Basin to provide additional raw water to the Chino II Desalter.

The Watermaster and IEUA are constructing a number of monitoring wells at recharge basins to monitor the influence of recharge on the groundwater levels in general, and to monitor water quality resulting from the blend of supplemental and storm waters. At least one monitoring well will be installed down gradient of each recharge facility that receives recycled water (Watermaster 2018).

### Dry Year Yield Program

Participants in the Dry Year Yield (DYY) Program, as described to a greater extent in Section 5.4 are required to reduce (shift) their imported water usage by a predetermined amount during dry years. Each participating agency has a specific shift obligation that, when added together, will provide MWD with 33,000 AF of dry year yield (Watermaster 2003). The eight participating agencies include the cities of Chino, Chino Hills, Ontario, Pomona and Upland, Cucamonga Valley Water District, Jurupa Community Services District, and MVWD (Watermaster 2004). The DYY Program is designed to supply local water in a prolonged drought.

By April 30, 2011 all DYY program construction projects had been completed, as well as a full "put" and "take" cycle which left the DYY storage account with a zero balance. A new DYY cycle began in June 2017 which resulted in a DYY recharge of 29,465 AF by the end of 2017 (Watermaster 2018).

### Voluntary Forbearance

Land subsidence is a current groundwater issue in the Chino Basin. Land subsidence can occur in areas where underlying fine-grained sediment layers (silt and/or clay) are dewatered over a long period of time allowing these layers to compress. The area underlying Management Zone 1 (MZ-1) which includes the MVWD service area experienced ground fissuring as early as 1973, and an accelerated occurrence of subsidence ensued after 1991. A cause of ground fissuring within alluvial basins is the removal of subsurface fluids resulting in compaction of poorly consolidated aquifer materials and land subsidence.

In November 2007, the Watermaster adopted a subsidence management plan known as the MZ-1 Plan to address the historical occurrence of land subsidence and ground fissuring in the Chino Basin. This Plan requires several monitoring and mitigation measures to minimize land subsidence and ground fissuring including monitoring of ground-level movement, monitoring of horizontal strain, developing alternative pumping plans for MZ-1 producers, and installing instrumentation to measure land deformation among other activities. The annual Ground-Level Monitoring Program (GLMP), conducted since 2007, has shown that very little permanent land subsidence has occurred in the MZ-1 Managed Area, indicating that subsidence is being successfully managed in this area. Continued subsidence in the Northwest MZ-1 area, located to the west of the Project, is currently being addressed through the 2015 *Chino Basin Subsidence Management Plan* which expands land-subsidence management and abatement activities into this area of the Chino Basin (Watermaster 2018).

## 5.3 Water Facilities Authority (WFA)

The WFA is permitted to treat 81 MGD of SWP water through a MWD imported water connection located in the City of Upland. MWD's Rialto Branch of the Foothill Feeder delivers SWP water to the Agua de Lejos Plant for treatment. The actual quantity of treated water has ranged from 12 MGD in the winter months to as high as 71 MGD during the summer.

As discussed in Section 4, WFA-treated water enters MVWD's potable water distribution system through two turnouts: one located at Arrow Highway and Benson Ave., and the second located at Benson Ave. and 17th Street. As WFA water is of higher quality than the City's groundwater, the water is normally delivered to MVWD's distribution system at Plant 4, where it is then blended with water from MVWD wells to maintain water quality levels within State and Federal standards.

MVWD is entitled to 24% of the WFA Agua de Lejos Plant capacity, but has utilized up to 37.6% of the capacity (Watermaster 2018) Historically, the Agua de Lejos Plant has had unused capacity, allowing MVWD to meet water quality standards and demands through additional WFA imported water. Many of the WFA members desire less dependence on expensive imported water and greater reliability and control of local supplies. As a result, the development of local water supply programs has received increased attention and the continued opportunity for utilization of unused WFA treatment capacity is reasonably anticipated. Increasing costs related to groundwater production and treatment and OBMP implementation, however, also factor into determinations regarding resource utilization. It is possible that increasing groundwater costs could encourage full utilization of WFA capacity. For this reason, this analysis assumes that MVWD utilizes only its entitlement, as adjusted by MWD actions related to available imported water supply.

Discussions on the opportunity to maintain and increase the capacity of the WFA treatment plant have occurred; however, analysis would need to be done to determine feasibility and economic benefits considering the climate of imported water reliability. The plant production could be increased to 88 MGD through re-rating of the existing plant. Further capacity increases would require plant expansion. Increasing groundwater expenses and MWD incentive programs for imported water, however, may reduce the opportunity to take additional WFA water.

## 5.4 Inland Empire Utilities Agency (IEUA)

MVWD is a sub agency of the IEUA. Other retail water service agencies located within the IEUA service area include the City of Chino Hills, Cucamonga County Water District, Fontana Water Company, City of Ontario, and the City of Upland.

**Imported Water**

As a water wholesaler, MWD supplies imported water to IEUA to meet the water needs of its service area. MWD's diverse resources and aggressive conservation program protect the reliability of the region's water supply, as discussed further in Section 5.5. MWD demonstrates that sufficient supplies can be reasonably relied on to meet projected demand. As a result, during a single dry year or multiple dry years, MWD will have the resources to supply IEUA with 100% of its imported water demands (MWD 2016). However, with the DYY Program in effect, several of IEUA's retail agencies will reduce their imported water demands by their respective DYY Program shift, thus reducing demands on MWD. During a dry year, imported water demands are expected to decrease to approximately 55% (MVWD 2016).

**Dry Year Yield Program**

In June 2003, IEUA, the Watermaster, and MWD executed the Conjunctive Use Program Agreement (Number 49960) for the development of the Chino Basin DYY Program to help reduce demands on imported water during dry years by pumping additional groundwater (IEUA 2016b). Three Valleys Municipal Water District is also a signatory to the Program. The DYY Program is an implementation element of the OBMP Element Nos. 8 and 9, which were intended to develop and implement a groundwater storage and recovery program.

The DYY Program is the first step in a phased plan to develop and implement a comprehensive conjunctive use program to allow maximum use of imported water available during wet years and stored groundwater in the Chino Basin during dry years. MWD will utilize the Chino Basin for dry year storage up to 100,000 AF of surplus imported water. Imported water deliveries to participants would increase during wet or normal (or "put") years, and purchase of imported water would decrease during dry (or "take") years.

Collectively, the eight DYY participants, six of which are local retail agencies of IEUA, including MVWD, would perform to predetermined levels in order to achieve a maximum 25,000 AFY "put" and a maximum 33,000 AFY "take". Each of the local retail agencies volunteered to produce excess groundwater during a dry year in-lieu of receiving normal imported water deliveries. In exchange, they received funding for new groundwater treatment and well facilities that would enable additional groundwater production during dry years. IEUA's overall imported water demands during dry years would decrease by 29,000 AFY, which equals the portion of the 33,000 AFY of the DYY shift obligation for IEUA's local retail agencies, as shown in Table 5-1.

**Table 5-1**
**Participating Agencies DYY Shift Obligations**

| Local Retail Agency | DYY Program Shift Obligation (AFY) |
|---|---|
| City of Chino | 1,159 |
| City of Chino Hills | 1,448 |
| Cucamonga Valley Water District | 11,353 |
| Jurupa Community Services District[(1)] | 2,000 |
| Monte Vista Water District | 3,963 |
| City of Ontario | 8,076 |
| City of Pomona[(1)] | 2,000 |
| City of Upland | 3,001 |
| **Total** | **33,000** |

(1) Agencies not within the IEUA service area.

### Recycled Water for Direct Use

Recycled water is becoming an increasingly important source of local water for the region. According to IEUA, it has been assumed that recycled water will be 100% reliable during a single dry year. During multiple dry years, reliability remains unaffected and use of recycled water continues to help reduce potable water demands as new water users make optimum use of the regional recycled water system. It is projected that during multiple dry years, increased utilization of recycled water will increase to 105% of normal in the 2nd dry year and 110% of normal in the 3rd dry year (MVWD 2016).

### Recycled Water Recharge Project

The Chino Basin Recycled Water Recharge Project is part of the comprehensive Water Supply Enhancement Program jointly sponsored by IEUA, Chino Basin Watermaster, Chino Basin Water Conservation District, and the San Bernardino County Flood Control District. The recharge program is regulated by the RWQCB and is consistent with and responds to various plans, agreements, legal decisions, studies, task force objectives, and approvals throughout the region and the state.

The purpose of the Recharge Project is to enhance water supply reliability and improve groundwater quality in local potable water supply wells through the Chino Basin by increasing the recharge of storm water, imported water, and recycled water. Recycled water recharge from the 3rd quarter of 2017 through the 2nd quarter of 2018 has been estimated to be approximately

11,457 AF with an additional 8,835 AF of imported water and 3,884 AF of local runoff and storm water being recharged through the project basins (Watermaster & IEUA 2018).

The benefits of the Recharge Project include the following: 1) Blends high quality storm water and recycled water which allows for more local and less expensive water supplies to recharge the basin and reduces the need for more expensive imported water; 2) provides reliable "drought-proof" water supplies to meet future growth; 3) enhances the capacity to recharge more imported water in wet years when this water is more plentiful and less expensive; and 4) helps to offset reductions in imported water supplies through conjunctive management of ground and surface water supplies.

Pursuant to the OBMP, the Watermaster and IEUA partnered with the San Bernardino County Flood Control District and the Chino Basin Water Conservation District to construct the Chino Basin Facilities Improvement Project (CBFIP). The 18 associated recharge sites result in an average annual recharge of approximately 10,000 AFY of storm water, 70,200 AFY of supplemental "wet" water and 17,700 to 49,900 AFY of in-lieu supplemental water. Additionally, MVWD maintains 5 Aquifer Storage and Recovery (ASR) wells with an injection capacity of 5,500 AFY (Watermaster 2018).

## 5.5 Metropolitan Water District of Southern California

MWD's primary goal is to provide reliable water supplies to meet the water needs of its service area at the lowest possible cost. Prevailing drought conditions throughout California and the Colorado River Basin, coupled with environmental issues affecting deliveries of SWP water through the Sacramento – San Joaquin Delta, have resulted in diminished imported surface water to Southern California. MWD, the major importer of surface water to Southern California, has developed plans and programs to address drought conditions and its continuing ability to meet the water demands of its service area. One such project is MWD's Diamond Valley Lake located in Hemet, California. Diamond Valley Lake is an 810,000 AF capacity reservoir for regional seasonal and emergency storage of SWP and Colorado River water. The reservoir began storing water in November 1999 and reached the sustained water level by early 2002 (MWD 2016). MWD continually re-evaluates its plans and programs for effectiveness in consideration of changing conditions. The plans describe a progressive series of actions, including tapping into stored water reserves and, if necessary, reductions in deliveries, although MWD predicts its ability to provide 100% of its agencies' water needs through the year 2040. This WSA, however, demonstrates that any potential reductions in imported water deliveries due to drought conditions would not prevent MVWD from satisfying its anticipated demands.

**Colorado River Aqueduct (CRA)**

Pursuant to the 1964 U.S. Supreme Court decree, MWD's dependable supply of Colorado River water was limited to 550,000 acre-feet per year assuming no surplus or unused Arizona and Nevada entitlement was available and California agricultural agencies use all of their contractual entitlement. Historically, MWD has also possessed a priority for an additional 662,000 acre-feet per year depending on availability of surplus water. In addition, MWD maintains agreements for storage, exchanges and transfers within the service area of Imperial Irrigation District that provide hundreds of thousands of acre-feet per year of water to MWD (MWD 2016).

Water supplies from the Colorado River have been and continue to be a topic of negotiation and intense debate. The 1964 Court Decree required California to limit its annual use to 4.4 million acre-feet (MAF) basic annual apportionment of Colorado River water plus any available surplus. To keep California at 4.4 MAF, MWD reduces its level of diversions in years when no surplus is available.

In 1999, the Colorado River Board developed "California's Colorado River Water Use Plan," also known as the "California Plan" and the "4.4 Plan," which was endorsed by all seven Colorado River Basin states and the U.S. Department of the Interior (MWD 2016). This plan developed the framework that specifies how California will transition and live within its basic apportionment of 4.4 MAF of Colorado River water. The U.S. Bureau of Reclamation (USBR) implemented Interim Surplus Guidelines to assist California's transition to the 4.4 Plan.

In October 2003, the Quantification Settlement Agreement (QSA), a critical component of the California's Colorado River Water Use Plan was authorized defining Colorado River water deliveries, and facilitating the transfer of water from agricultural agencies to urban uses. The QSA provides the numeric baseline needed to measure conservation and transfer programs, and it allows for implementation of agricultural conservation, land fallowing, and other programs identified in MWD's 1996 IRP. The QSA has helped California reduce its reliance on Colorado River water above its normal apportionment.

MWD's 2015 Urban Water Management Plan, recognizes that the QSA supports MWD's development plans for CRA deliveries, and demonstrates the reliability benefits as a result of the QSA and existing supply enhancement programs.

**State Water Project (SWP)**

The reliability of the SWP impacts MWD's member agencies' abilities to plan for future growth and supply. DWR's most recent Bulletin 132-2016, *Management of the California State Water Project,* updates certain reliability information including water supply planning, construction, financing,

management, and operation activities of the State Water Project. Bulletin 132-2016 continues the Bulletin 132 annual series initiated in 1963 (DWR 2017a). Bulletin 132-2016 discusses significant events and issues that affect SWP management and operations, as well as water supply and delivery, Delta resources and environmental issues, facilities, and financial analysis.

In 2002, the DWR Bay-Delta Office prepared an original report, and later biannual updates since 2005 with the most recent update produced in 2017, specifically addressing the reliability of the SWP (DWR 2018b). This report, *The State Water Project Delivery Reliability Report,* provides information on the reliability of the SWP to deliver water to its contractors assuming historical precipitation patterns. The following SWP reliability information is included in these reports.

On an annual basis, each of the 29 SWP contractors including MWD request an amount of SWP water based on their anticipated yearly demand. In most cases, MWD's requested supply is equivalent to its full "Table A Amount"; currently at 1,911,500 AFY. After receiving the requests, DWR assesses the amount of water supply available based on precipitation, snow pack in northern California watersheds, volume of water in storage, projected carry over storage, and Sacramento-San Joaquin Bay Delta regulatory requirements. For example, the SWP annual delivery of water to contractors ranged from 552,600 AF in 1991 to 3.7 million acre-feet (MAF) in 2006.

Due to the uncertainty in water supply, contractors are not typically guaranteed their full Table A Amount, but instead a percentage of that amount based on the available supply. Typically, around December of each year, DWR provides the contractors with an initial estimate of allocation for the following year. Due to the variability in water supply for any given year, it is important to understand the reliability of the SWP to supply a specific amount of water each year to the contractors. As hydrologic and water conditions develop throughout the year, DWR revises the allocations. For example, in December 2017 SWP supplies were projected to meet 15% of most SWP contractor's Table A Amounts. This allocation was increased to 20% on January 29, 2018, to 30% on April 21, 2005. The final adjustment increase occurred on May 21, 2018 and the DWR projected the SWP would meet 35 % of most contractor's Table A Amounts.

SWP contractor's Table A for 2018 totaled 4.17 MAF, of which 100% was requested. The allocation decision was made consistent with the long-term water supply contracts, public policy, conservative projection of hydrology, SWP operational constraints, and 2018 contractor demands, including carryover water from 2017. SWP supplies were projected to meet 15% of contractor's Table A Amounts in 2018 (DWR 2017b). DWR revisions of 2018 allocations have adjusted, however, as the hydrologic and water supply conditions have develops, bringing approved allocations to 1.48 MAF of 15% of requested supply.

DWR analyzed the SWP's reliability using the California Water Allocation and Reservoir Operations Model (CALSIM II) in their State Water Project Reliability Report 2017. The CALSIM II model was developed by DWR and USBR to simulate operations of the SWP and the Central Valley Project (CVP). The CALSIM II model is used to estimate water deliveries to both SWP and CVP users under various assumptions such as hydrologic conditions, land use, regulations, and facility configurations. Documentation for CALSIM II, including assumptions, can be found on the DWR Web site at http://modeling.water.ca.gov.

One of the key assumptions of the CALSIM II model is that past weather patterns will repeat themselves in the future. The model uses a monthly time step to calculate available water supply based on historical rainfall data from 82 years of records (1922 – 2003). The model scenarios used in the preparation of the Reliability Report also assumed that regulatory requirements and facilities would not change in the future. DWR considered this assumption conservative since additional facilities such as reservoirs may be implemented in the future to specifically increase the SWP's reliability.

The CALSIM II model was used to complete three benchmark studies (Studies 1, 2 and 3) to evaluate supply and demand under different conditions for the 2002 Reliability Report. Table 5-2 shows the results of these studies, which estimate that SWP deliveries, on average, can meet between 72% and 76% of the maximum Table A Amount.

The Reliability Report recommended using the results of update studies 4 and 5 since they contain the most current information for assumed demands. The results of studies 4 and 5 show average deliveries of 62% of full Table A under current conditions (at the time of the studies), and 20% under future conditions. These studies also show a minimum delivery of 8% and 4 % of full Table A amounts for 2017 (Study 4) and 2040 (Study 5), respectively. The update studies indicate a lower minimum SWP delivery for current and future conditions in comparison to earlier CALSIM II modeling studies (see Table 5-2).

**Table 5-2**
**SWP Table A Deliveries from the Delta Percent of Total Table A Amount of 4.133 maf**

| Study # | Study | Average (% of Max Table A) | Maximum Table A | Minimum (Single Dry Year) |
|---|---|---|---|---|
| *SWP Delivery Reliability Report (2003)* | | | | |
| 1 | 2001 Study | 2.962 (72%) | 3.845 (93%) | 0.804 (19%) |
| 2 | 2021 Study A[1] | 3.083 (75%) | 4.133 (100%) | 0.830 (20%) |
| 3 | 2021 Study B[2] | 3.130 (76%) | 4.133 (100%) | 0.830 (20%) |
| *Update Studies* | | | | |
| 4 | Revised-Demand Today[3] (2017 Study) | 2.571 (62%) | 4.098 (99%) | 0.336 (8%) |
| 5 | Revised-Demand Future[4] (2040 Study) | 0.837 (20%) | 1.695 (41%) | 0.154 (4%) |

**Sources:** Department of Water Resources, 2017 SWP Delivery Reliability Final Report, Section 5, Table 5-3, pg. 21.; Metropolitan Water District, 2015 Integrated Water Resources Plan, Table 3-7, pg. 3.25.
[1] Assumes demands depend on weather conditions.
[2] Assumes demands at maximum Table A amount.
[3] Revises demands to current (2017) conditions.
[4] Revises demands at levels of use projected to occur by 2040.

In 1994, DWR and certain SWP contractors agreed to a set of principles known as the Monterey Agreement. The purpose of the Monterey Agreement is to resolve water allocation disputes among certain SWP contractors by amending long-term water supply contracts and to establish a new water management strategy for the SWP.

The Monterey Agreement states that contractors will be allocated part of the total available project supply in proportion to their Table A Amount. The Monterey Agreement changed SWP water allocation rules by specifying that, during drought years, project supplies be allocated proportionately based on the maximum contractual Table A Amount. Water is allocated to urban and agricultural purposes on a proportional basis, deleting a previous initial supply reduction to agricultural contractors. The agreement further defines and permits permanent sales of SWP Table A Amounts and provides for transfer of up to 130,000 AF of annual Table A Amounts from agricultural use to municipal use. The Agreement also allows SWP contractors to store water in another agency's reservoir or groundwater basin, facilitates the implementation of water transfers and provides a mechanism for using SWP facilities to transport non-project water for SWP water contractors. The Agreement provides greater flexibility for SWP contractors to use their share of storage in SWP reservoirs.

**Report on MWD Water Supplies, A Blueprint for Water Reliability**

MWD released a *Report on Metropolitan's Water Supplies, A Blueprint for Water Reliability* on March 25, 2003, to provide updated information on MWD's projected supply and demand for incorporation into Water Verification and Water Supply Assessments for compliance with SB 221 and SB 610, respectively. The report addresses water supply reliability issues and states MWD's roles and responsibilities, which include the following: (1) implementing water management programs that support the development of cost-effective local resources; (2) securing additional imported supplies as necessary through programs that increase the availability of water delivered through the Colorado River Aqueduct and the SWP; (3) providing the infrastructure needed to integrate imported and local sources; (4) establishing a comprehensive management plan dealing with periodic surplus and shortage conditions; and (5) developing a rate structure that strengthens MWD's financial capabilities to implement water supply programs and make infrastructure improvements.

The report details that MWD's regional water demand projections are 6% to 16% *higher,* depending on the particular 5-year projection period, and 11% *higher* for Year 2025, than the aggregated projections of MWD's member agencies. As stated in the Report, "this difference indicated that MWD's supplies would provide a level of 'margin of safety' or flexibility to accommodate delays in local resources development or adjustments in development plans" (MWD 2003). Additionally, the report concludes that "current practices allow MWD to bring water supplies on-line at least ten years in advance of demand with a very high degree of reliability." More particularly, MWD documented sufficient currently available supplies to meet 100% of member agencies' supplemental water demands for 20 years under Average and Wet Year conditions, for 15 years under Multiple Dry Year conditions (with 8% to 26% reserve capacity), and for 15 years under Single Dry Year conditions (with 8 to 25% reserve capacity). With the addition of supplies under development, MWD will be able to meet 100% of its agencies' supplemental water needs under all supply and demand conditions through 2030 with 20% to 25% reserve capacity (MWD 2003).

The Report also identifies the ways MWD is managing changes in Southern California's water supplies, including reduced Colorado River deliveries and water quality constraints. In addition, opportunities for additional supplies are currently being implemented in the following ways:

1) Full Diamond Valley Lake: The Lake is now fully operational with an increased conveyance capacity for refill system storage.

2) Re-Operation of Storage and Transfer Programs: In 2003, MWD developed additional storage and transfer capabilities and completed filling local resources to achieve full storage accounts in operational reservoirs and banking/transfer programs.
3) Enhanced Conservation Programs: A new campaign is designed to encourage more efficient outdoor water use and promote innovative conservation measures.
4) Development of Additional Local Resources: There are promising opportunities identified to develop seawater desalination and expand the Local Resources Program.

In addition to the *Report on Metropolitan's Water Supplies, A Blueprint for Water Reliability,* MWD's 2015 Regional Urban Water Management Plan (RUWMP) demand and supply analysis projects surpluses (of regional supplies compared with regional demands) ranging from 0.1 % to 110% in all years and all drought scenarios through 2040 (MWD 2016).

As demand forecasts are refined, supply goals are also refined. MWD has consistently supplied over 50% of water supplies to the southern California region. To continue to accomplish this, MWD continues to approve new and innovative projects and programs to ensure reliability. MWD has taken actions to move forward initiatives to bolster future supplies by supporting seawater desalination projects, increased commercial conservation efforts, improve water quality by decreasing salinity in supplies from the SWP and the Colorado River, increased underground storage and retrieval facilities, adopted principles for establishing cooperative programs, and endorsed legislation that would further water reliability.

**Integrated Water Resources Plan (IRP)**

To address the SWP reliability challenges, MWD and its member agencies developed an Integrated Water Resources Plan (IRP) in 1996. The overall objective of the IRP process is the selection and implementation of a Preferred Resource Mix (or strategy) consisting of complementary investments in local water resources, imported supplies and demand-side management that meet the region's desired reliability goal in a cost-effective and environmentally sound manner. The 1996 IRP was reviewed as part of MWD's strategic plan and rate refinement to guide the development and implementation of revised MWD water management programs through the year 2005.

The most recent IRP 2015 Update was approved and released in January 2016, and includes various projects and programs that contribute to the reliability of MWD's imported water supplies. The 2015 IRP Update concluded that the resource targets from the 1996 IRP, factored in with changed conditions and conservation, will continue to provide for 100% reliability through 2040.

While the IRP 2015 Update and the IRP Implementation Reports include goals for a variety of resource targets, they identify the most significant programs as conservation and local supply development among the Preferred Resource Mix. The IRP details the Local Resources Program (LRP) and the Seawater Desalination Program as a means to increase reliability of local supplies.

MWD initiated the LRP in 1982 to promote the development of water recycling projects that reduced demand for imported water and improved regional water supply reliability. In 1991, the Groundwater Recovery Program was implemented to similarly promote the recovery of local degraded groundwater supplies. In 1995, both programs were combined into the LRP. In 2017, MWD provided $36 million for the production of 228,815 AF of recycled water and groundwater recovery. As of 2017, the LRP, including both recycling and groundwater recovery, has provided a total financial incentive amounting to over $607 million that has produced more than 3.53 MAF through partnership with its member agencies. In all, MWD has funding agreements for 107 member agency projects to produce 441,000 AFY once fully implemented (MWD 2017).

In addition to the LRP, MWD also provides financial and technical assistance for implementing water conservation Best Management Practices (BMPs), as well as a significant investment in regional and local water conservation programs.

When viewed altogether, MWD has developed programs and identified projects that will meet cumulative IRP targets through 2040. However, when viewed by individual category, some development components may be at higher risk, or previously identified options simply may not be available for implementation. Since existing water supplies and programs are susceptible to potential changed conditions, MWD continues to identify and pursue additional resource opportunities consistent with the implementation buffer or contingency resources adopted as part of the IRP Update. This strategy of building upon and refining additional resource opportunities includes a diversified portfolio of actions that calls for stabilizing and maintaining imported water supplies, meeting future growth through increased water conservation while sustaining and developing new local supplies, pursuing a comprehensive transfers and exchange strategy, building storage in wet and normal years to manage risks and drought, and preparing for uncertainty with future water supply actions. One particular project that is an example of the ongoing efforts to stabilize imported SWP supplies is the California Water Fix and Eco Restore project. This plan includes the construction of two large tunnels to carry fresh water from the Sacramento River to the intake stations for the SWP, with a total design capacity of 18,000 cubic feet per second. In September 2018, the Draft EIR/EIS for this project was released for public review and comment.

MWD's 2015 IRP demonstrates that while changes occur to all water resources, MWD is able to maintain supply reliability through its diversified water resources portfolio. The IRP is an adaptive

planning framework, and with the adopted annual implementation reporting and five-year updating cycle, MWD and its member agencies will continue to refine and revise the resource targets as new information and technologies become available.

## 5.6 Santa Ana Watershed Project Authority

SAWPA was formed in 1968 as a planning agency and reformed in 1972 as a joint powers agency for the purpose of coordinating regional planning within the Santa Ana River Watershed, including the Santa Ana and San Jacinto Rivers, to address water quality and supply improvements. SAWPA is comprised of five major water supply and wastewater management agencies within the Santa Ana Watershed: Inland Empire Utilities Agency, Eastern Municipal Water District, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District.

Since the early 1970's, SAWPA has held a key role in the development and update of the Regional Basin Plan for the RWQCB. SAWPA conducts water-related investigations and planning studies, and builds facilities needed for regional water supply, wastewater treatment or water quality remediation.

SAWPA adopted an IRP in February 2014, the *One Water One Watershed 2.0 Plan*, to facilitate improvements to the local water supply system. The IRP focuses on the following goals (SAWPA 2014):

- Maintain reliable and resilient water supplies and reduce dependency on imported water.
- Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities.
- Preserve and enhance the ecosystem services provided by open space and habitat within the watershed.
- Protect beneficial uses to ensure high quality water for human and natural communities.
- Accomplish effective, equitable and collaborative integrated watershed management.

SAWPA conducted a stakeholder process, which resulted in identifying potential IRP projects for water conservation and infrastructure with a total estimated cost of over $4 billion. Approved in March 2000, Proposition 13 provided $235 million to the Southern California Integrated Watershed Program (SCIWP). The SCIWP was developed by SAWPA as a series of projects that would be required to achieve SAWPA's goal of making the watershed drought-proof; i.e., no imported water during drought years. On July 17, 2000, the SWRCB entered into a

memorandum of understanding to set forth general procedures and criteria for selecting projects to rehabilitate and improve the Santa Ana River watershed to be funded by the SCIWP. On August 1, 2000, SAWPA approved an Initial Project Priority List of 44 projects with an estimated cost of $689 million, and adopted a policy to ensure that the Project Priority List is reviewed and updated periodically to ensure timely and cost-effective use of funds.

The Chino Basin received $87 million for the construction of water desalters, groundwater recharge facilities and new wells, of which $48 million was allocated by SAWPA and the SWRCB for the Chino I Desalter Expansion and construction of the Chino II Desalter. This is part of the $250 million of total Proposition 13 funds approved for the Santa Ana River Watershed, subject to administration by SAWPA.

The Integrated Regional Water Management Program, jointly managed by the SWRCB and DWR, provides funding for regional projects. In order to access up to $25 million in funding, SAWPA updated their Project Priority List through the update of its Integrated Regional Water Management (IRWM) Plan (previously known as the IRP). In June 2006, SAWPA developed and submitted an IRWM Implementation Grant Step 2 Application requesting a total of $25 million for various water-related projects. On March 20, 2007, the SWRCB approved funding $25 million for SAWPA IRWM projects.

By updating its IRWM in 2010 as the first *One Water One Watershed Plan* SAWPA was able to obtain Proposition 84 funding, which can provide up to $114 million to the region for projects related to safe drinking water, water quality and supply, and water conservation efforts, amongst others.

## 5.7 Chino Basin Water Conservation District (CBWCD)

Chino Basin Water Conservation District, incorporated on December 6, 1949, is an independent special district that operates under authority of Division 21 of the California Water Code. Located in the western area of San Bernardino County, California, CBWCD currently has a 112-square mile service area encompassing the entire City of Montclair and portions of the cities of Chino, Chino Hills, Upland, Ontario, Rancho Cucamonga and some of the unincorporated areas of San Bernardino County.

Since its establishment in 1949, CBWCD has actively protected and replenished the Chino Groundwater Basin with natural area rainfall and storm water discharge from the San Gabriel Mountains. Recognizing that even in years of normal rainfall its service area depends heavily on groundwater, CBWCD's network of basins and spreading grounds allow captured runoff to percolate into the groundwater basin. With the population projected to dramatically increase in

the near future, CBWCD believes that conservation will increasingly be necessary as an effective means of coping with the increased demand. The prospect of intermittent regional droughts occurring in the future compels increased use of water conservation as a vital means to protect limited water resources.

CBWCD has adopted the following strategic goals:

1. To continue to provide the highest educational and physical recharge services at the lowest possible cost;
2. To cooperate with others in the economical and cost effective development and operation of new and enhance existing groundwater recharge facilities;
3. To actively promote and expand, as-needed, CBWCD's water conservation educational programs while actively supporting the conservation programs and activities of other agencies; and
4. To assist others in the economical implementation and operation of recycled water recharge projects and those involving groundwater remediation.

CBWCD's commitment to water conservation is multifaceted and includes not only the use of percolation basins to replenish the groundwater but also a commitment to provide water conservation education to individuals, school districts, civic organizations, and municipalities within its service area.

CBWCD is one of the first agencies in California to take a pro-active role in region-wide water conservation. It operates and maintains several water conservation recharge basins, which, on an average annual basis, capture and recharge a volume of stormwater in excess of 5,980 AF. Typically, this amount is equivalent to approximately 20% or more of all the artificial stormwater recharge that presently occurs in the Chino Groundwater Basin.

CBWCD currently provides water conservation educational services to approximately 400,000 customers within its service area. CBWCD owns and maintains a Water Conservation Demonstration Garden, which is visited annually by thousands of elementary school students from surrounding school districts as part of their curriculum of earth sciences.

## 5.8 Santa Ana Regional Water Quality Control Board – Region 8

**Background**

The State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (Regional Boards) are responsible for the protection and, where possible, the enhancement of the quality of California's waters. The SWRCB sets statewide policy, and together with Regional Boards, implements state and federal laws and regulations. Each of the nine Regional Boards adopts a Water Quality Control Plan or Basin Plan, which recognizes and reflects regional differences in existing water quality, the beneficial uses of the region's ground and surface waters, and local water quality conditions and problems (SARWQCB 2016).

In 1975, the Santa Ana Regional Water Quality Control Board (RWQCB) adopted the original Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin. In 1995, the RWQCB updated the Basin Plan to address issues that had evolved over time due to increasing populations and changing water demands in the region. The scope of the document covers the Santa Ana River Basin, which includes the upper and lower Santa Ana River watersheds including northwestern Orange County. In 2015, the most recent triennial review of the Basin Plan was conducted. In July of that year, at a public hearing, the RWQCB adopted Resolution No. R8-2015-0085, approving the Triennial Review Priority List and Work Plan.

The Basin Plan is more than just a collection of water quality goals and policies, descriptions of conditions, and discussions of solutions. It is also the basis for the RWQCB's regulatory programs. The Basin Plan establishes water quality standards for all the ground and surface waters of the region. The RWQCB also regulates water discharges to minimize and control impacts on the quality of the region's ground and surface water.

Water quality problems in the region are listed in the Basin Plan. For water bodies with quality below the levels necessary to allow all the beneficial uses of the water to be met, plans for improving water quality are included. Legal basis and authority for the RWQCB reflects, incorporates, and implements applicable portions of a number of national and statewide water quality plans and policies, including the California Water Code (Porter-Cologne Water Quality Control Act) and the Clean Water Act (SARWQCB 2016).

**Key Regional Issues**

Water quality degradation due to high concentrations of nitrogen and TDS is a significant regional water quality problem in the Santa Ana River Watershed (Watershed).

A Task Force was formed in 1995 to provide oversight, supervision, and approval of a study to evaluate the impact of (total inorganic nitrogen) TIN and (total dissolved solids) TDS on water resources in the Watershed. The ongoing study is coordinated by SAWPA, and is investigating questions related to TIN and TDS management in the Watershed, including groundwater sub-basin water quality objectives, sub-basin boundaries, and regulatory approaches to wastewater reclamation and recharge (SARWQCB 2016).

**Water Resources and Water Quality Management**

Numerous water resource management studies and projects, focused on water quality and/or water supply, are in progress in the Region under the auspices of a variety of parties. As stated above, the RWQCB has been working with SAWPA concerning water supply and reliability issues. SAWPA has been studying TIN and TDS issues and is a valuable partner in water resource and water quality management. SAWPA, and its member agencies, conduct water related investigations and planning studies, and build physical facilities where needed for water supply, wastewater treatment or water quality remediation.

Some of these activities bear directly on the implementation of the Basin Plan, while others may lead to future Basin Plan amendments to incorporate appropriate changes, such as revised regulatory strategies for various dischargers. These investigations and the implementation of appropriate physical solutions are an essential and integral part of the effort to restore and maintain water quality in the Region.

## 5.9 San Antonio Water Company (SAWCo)

SAWCo is responsible for providing water service to its domestic and irrigation shareholders. Water is currently delivered to shareholders based on monthly entitlement and available water supply. If SAWCo is able to produce more water, entitlement increases; if less, entitlement decreases.

Recent years have provided an example of SAWCo actions in the face of reductions to its water supply. In February 2014 and then again in March 2015, due to severe drought conditions, SAWCo reduced its per-share entitlement deliveries by 18% and 15%, respectively.

However, as SAWCo improves its water supply facilities and increases its ability to produce water over the next 20 years, total water supply and water supply reliability to the shareholders is expected to return to former levels and even increase. The increased water supply would also be driven by the company's shareholders looking to the water company for maximum deliveries of their entitlements. Water deliveries to these shareholders are provided by SAWCo based on the entitled shares and available water supply during different periods of the year. Maximizing the

water company's deliveries to its shareholders requires making full use of the groundwater and surface water rights owned by SAWCo. MVWD will work with SAWCo to maximize its supply and potentially increase its per-share entitlement, thus increasing MVWD's total annual SAWCo entitlement.

## 5.10 Water Quality Effect on Water Management Strategies and Supply Reliability

**Monte Vista Water District**

MVWD works collaboratively with the Chino Basin Watermaster, WFA, IEUA, and CDA to achieve the highest quality of water and to ensure reliability of water supplies. The identified water quality issues facing MVWD include 1,2,3-trichloropropane (TCP), TDS, nitrate, VOCs (dibromochloropropane), and perchlorate. A variety of water management strategies are implemented or planned for implementation by MVWD as discussed below.

**Expanded Water Quality Monitoring**

To comply with State and Federal Maximum Contaminant Levels (MCLs), MVWD safeguards its water supply by exceeding the monitoring frequency required by the EPA and DHS. MVWD's distribution system is also monitored at various locations to ensure good quality water throughout the distribution system. MVWD samples 16 State Board-approved locations within the distribution system on a weekly basis, while conducting monthly sampling on each active well, monitoring 165 potential contaminants (MVWD 2016).

**Water Source Blending**

MVWD blends its various sources of water to ensure that the quality of drinking water is in compliance with standards. For example, groundwater from wells with higher levels of nitrate is blended with other well water or imported water to create a blended supply to comply with state and federal standards.

**Water Treatment**

To address the concerns of nitrate and perchlorate, one of MWVD's wells is equipped with an ion exchange treatment system. The treatment system removes nitrate and perchlorate from groundwater produced from this well, and provides enhanced water quality and reliability. To address TCP issues, MVWD is implementing granular activated carbon treatment systems in the affected wells.

### Joint Water Supply Enhancement Project

As part of the Dry Year Yield Project[3], MVWD entered into a joint water supply enhancement project with the City of Chino, which resulted in $3.1 million to construct a groundwater production well and an ASR well with wellhead treatment facilities to provide additional high-quality groundwater supplies. High-quality water that is injected is blended with lower quality groundwater to produce water that complies with drinking water standards. The well was completed in 2008.

### Diversified Water Resource Mix

MVWD is seeking to maximize the use of alternative supplies resulting in a diversified water resource mix. MVWD's Water System Master Plan identifies the maximum use of recycled water and desalted water, where appropriate and available, as part of the plan to ensure a reliable water supply for its service area.

Additionally, groundwater will continue to be a focus of water management for MVWD to optimize and ensure reliability of this valuable and significant local resource. Section 5.10.2 provides water quality program activities of the Watermaster that seek to ensure a reliable supply of groundwater.

### Interconnections

To increase system reliability, MVWD has established interconnections with neighboring water agencies that may be activated in the event of an isolated interruption of water supply, and would serve to facilitate mutual aid. Interconnections presently exist between MVWD's system and the systems operated by the cities of Chino Hills and Upland.

### Chino Basin Watermaster

The Chino Basin Watermaster continues to conduct water quality management activities in the Chino Groundwater Basin that help to safeguard the groundwater supply (Watermaster 2018).

[3] The Watermaster and IEUA entered into an agreement with Metropolitan in 2003 for a groundwater conjunctive use storage program, which would include development of facilities to deliver and store imported water supplies in the Chino Basin.

**Groundwater Quality Monitoring**

In response to the results of the RWQCB and the Watermaster's groundwater quality monitoring programs (OBMP Program Element 1), the Watermaster has refined its water quality monitoring to focus on the following key areas:

- Identify and characterize water quality anomalies, such as the VOC anomaly south of the Ontario International Airport and groundwater contamination originating from the Chino Airport. Status reports on each of the anomalies were developed.
- Continue regular sampling of private and Watermaster wells to support the demonstration of Hydraulic Control and to characterize the interaction between the Santa Ana River and groundwater.
- Assist the RWQCB with research, monitoring, and the crafting of investigative and cleanup and abatement orders for potential dischargers involved with the Ontario International Airport.

The Watermaster developed its streamlined, key-well water quality monitoring program in which approximately 120 "key wells" are sampled bi-annually in the southern portion of the Basin. Approximately 20 wells will be sampled on an annual basis including the following water quality analyses:

- All groundwater samples are analyzed for general mineral and general physical parameters.
- Wells within or near the VOC plumes south of Ontario and Chino Airports are being analyzed for VOCs, in addition to the general mineral and general physical parameters.
- All private wells in the key program are being analyzed for perchlorate because of its widespread occurrence from recent sampling, and the concerns expressed by appropriators faced with expensive treatment costs for perchlorate-contaminated wells.

The Watermaster's water quality program also includes the collection of water quality data from other sources, which is routinely checked and maintained in the Watermaster's database. Data sources include appropriators (groundwater pumpers), DHS, Department of Toxic Substance Control for Stringfellow Acid Pits, and the RWQCB for sites under Cleanup and Abatement Orders.

The Watermaster continues to update its understanding of contaminants of concern in various plumes, and the extent of their migration. Analysis of environmental records continues, including state and federal databases of known users and dischargers of potentially hazardous chemicals. The Watermaster is also analyzing the relationship of potential sources of perchlorate with

downgradient impacted production wells. An analysis was also performed on current and emergent technologies for specific contaminants of concern in the Chino Basin, including nitrates, perchlorate, arsenic, and specific VOCs.

**TDS and Nitrogen Objectives for the Chino Basin**

The Watermaster continues to work with the TDS/Nitrogen Task Force to revise the subbasin boundaries and the TDS and Nitrogen objectives for the Chino Basin to promote maximum beneficial use of water in the Basin. The maximum beneficial use approach[4] will increase water supplies and lower water management costs over time while meeting water quality requirements. In December 2003, the Watermaster proposed specific water-quality management zone boundaries, and the recommendations were incorporated into the TDS/N Basin Plan Amendment in November 2003. The Basin Plan Amendment was approved by the SWRCB in 2004, including both "antidegradation" and "maximum benefit" objectives for TDS and Nitrate-N.

Watermaster developed surface water and groundwater monitoring programs that measure the progress of the Watermaster and IEUA in achieving the "maximum benefit" goal in the Basin. One such program is the development of the salt budget tool to estimate the current and future salt loads to the Basin. The tool was used to establish a TDS objective for the northern part of the Basin based on maximum beneficial use of water available to the region. The salt load projections were based on the water supply plan in the OBMP Implementation Plan and include alternative recycled water and SWP water recharge scenarios.

The Watermaster conducts a surface water monitoring program to characterize the water quality of water in the recharge basins and the water levels in some of these basins. The purpose of this program is to estimate the volume and quality of recharge. This information is used for multiple management programs including estimating the safe yield of the Basin. Currently, the Watermaster monitors the water quality in 20 basins. Generally, the water quality samples are taken after storm events; however, monitoring of nuisance flows also occurs. Each basin has been sampled three to five times each year, with increased sampling frequency for basins that are scheduled to receive recycled water.

[4] The quality of water required for each beneficial use often differs. Drinking water is the beneficial use that usually requires the highest quality water to protect human health. The quality of groundwater is a function of natural influences and human activities. Several beneficial uses exist for the use of groundwater. Groundwater quality standards for the Chino Basin protect water supplies for the beneficial use that requires the highest quality – drinking water. The standards also ensure the propagation and protection of wildlife and flora.

**VOC Plume at Ontario International Airport**

As discussed above, Groundwater Monitoring Programs include the identification and characterization of water quality anomalies, including the VOC anomaly south of the Ontario International Airport. Activities include assisting the RWQCB with research, monitoring and crafting of investigative and cleanup and abatement orders (CAO) for potential dischargers. A CAO adopted in November 2016 approved the preferred plume remediation and domestic water supply alternatives identified in the Remedial Action Plan. Construction of the decarbonator planned for groundwater remediation is scheduled to be completed by February 2020.

The Watermaster's water level and water quality monitoring program over the last several years has resulted in a robust database that provides key information used by the Watermaster and other stakeholders in the Basin to continue VOC plume abatement and cleanup activities.

**Water Facilities Authority**

MVWD receives imported water through IEUA from MWD, which receives raw water from northern California through the SWP. The SWP water is delivered to the WFA Agua de Lejos Water Treatment Plant through the MWD Rialto Reach of the Foothill Feeder. The WFA receives and treats SWP raw water. The quality of water from the WFA is generally and consistently quite good, although it can vary depending on hydrologic conditions in both northern and southern California.

The key water quality issues on the SWP are disinfection byproduct precursors, in particular total organic carbon and bromide. MWD is working to protect the water quality of this source, but it has needed to upgrade its water treatment plants to deal adequately with disinfection byproducts. Disinfection byproducts result from total organic carbon and bromide in the source water reacting with disinfectants at the water treatment plant, and they may place some near term restrictions on MWD's ability to use SWP water. MWD expects these treatment restrictions to be overcome through the addition of ozone disinfection at its treatment plants. Arsenic is also of concern in some groundwater storage programs.

Groundwater inflows into the California Aqueduct are managed to comply with regulations and protect downstream water quality while meeting supply targets. Additionally, nutrient levels are significantly higher in the SWP system than within the Colorado River, leading to the potential for algal related concerns that can affect water management strategies. MWD is engaged in efforts to protect the quality of SWP water from potential increases in nutrient loading from

wastewater treatment plants. Also, as in the Colorado River watershed, MWD is active in studies on the occurrence, sources, and fate and transport of constituents of emerging concern.

**San Antonio Water Company**

Surface water from local sources that originate in the San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several other smaller surface streams is generally of high quality, as these creeks are fed by snowmelt and other precipitation in the San Gabriel Mountains. Nevertheless, surface water sources are treated prior to introduction to the potable water supply in order to insure bacteriological quality and compliance with state and federal drinking water quality standards.

**Recycled Water Quality**

The State Water Resources Control Board has established regulations and guidelines for the use of recycled water under the California Code of Regulations, Title 22. In addition, IEUA sets requirements on recycled water retailers, including MVWD, that are incorporated in its agreements with retailers and in IEUA Ordinance No. 69, which regulates the availability and use of recycled water.

All of IEUA water recycling treatment plants produce recycled water suitable for full body contact recreation and generally meet the more stringent aquatic habitat criteria. Due to salinity management and the exclusive use of the SWP supply for imported water, TDS concentrations in recycled water remain relatively low (typically 500 mg/L). Since recycled water is regulated and monitored carefully, water quality is expected to remain high.

## 5.11 Water Shortage Plans

**MVWD's Water Shortage Contingency Plan**

MVWD's Water Shortage Contingency Plan, adopted in May 2010, is incorporated into District Ordinance 33 (Appendix O), which establishes year-round water use efficiency best practices and staged water supply shortage measures. This plan addresses emergency shortages, including catastrophic interruptions, and contains mandatory prohibitions, penalties, and consumption reduction methods. MVWD's stages of action present the measures by which customers are required to implement mandatory water conservation practices during a declared water shortage. MVWD may declare a shortage due to imported water supply cutbacks by MWD, as well as extended drought, equipment failure, act of terrorism, and/or natural disaster.

During periods of water supply shortages, state-mandated water use restrictions, or emergency conditions, MVWD may require its customers to reduce demands below levels projected by the current rate structure. This circumstance may result in insufficient revenues to meet necessary expenses. In order to protect MVWD financially in such circumstances, MVWD recently adopted "demand reduction rates" as part of its normal rate adoption process in order to ensure financial stability and high quality water service.

As a sub-agency of IEUA, MVWD will also respond to MWD's Water Surplus and Drought Management (WSDM) Plan. IEUA will also follow the guidance of MWD's WSDM Plan, while considering the needs and water shortage actions of each sub-agency. MVWD will focus on implementing/enforcing the elements of its own contingency plan in association with IEUA's response to a declared regional water shortage.

**MWD's Water Surplus and Drought Management (WSDM) Plan**

In 1999, MWD in conjunction with its member agencies developed the WSDM Plan. This plan addresses both surplus and shortage contingencies. IEUA, and MVWD as a member agency of IEUA, have adopted and follow the MWD WSDM Plan.

The WSDM Plan will guide management of regional water supplies to achieve the reliability goals of Southern California's IRP. The IRP sought to meet long-term supply and reliability goals for future water supply planning. The WSDM Plan guiding principle is to minimize adverse impacts of water shortage and ensure regional reliability. From this guiding principle come the following supporting principles:

- Encourage efficient water use and economical local resource programs.
- Coordinate operations with member agencies to make as much surplus water as possible available for use in dry years.
- Pursue innovative transfers and banking programs to secure more imported water for use in dry years.
- Increase public awareness about water supply issues.

The WSDM Plan guides the operations of water resources (local resources, Colorado River, State Water Project, and regional storage) to ensure regional reliability. It identifies the expected sequence of resource management actions MWD will take during surpluses and shortages of water to minimize the probability of severe shortages that require curtailment of full-service demands. Mandatory

allocations are avoided to the extent practicable; however, in the event of an extreme shortage an allocation plan will be adopted in accordance with the principles of the WSDM Plan.

The WSDM Plan describes MWD's ability to meet demand during a Surplus, Shortage, Severe Shortage, and Extreme Shortage. The WSDM Plan also defines seven shortage management stages to guide resource management activities. Each year, MWD will consider the level of supplies available and the existing levels of water in storage to determine the appropriate management stage for that year. Each stage is associated with specific resource management actions designed to: 1) avoid an Extreme Shortage to the maximum extent possible; and 2) minimize adverse impacts to retail customers should an Extreme Shortage occur. The following describes water management actions to be taken under each of the seven shortage stages, with the first shortage stage being the least severe and requiring the least consumption reduction and the seventh stage being the most severe and requiring the most stringent consumption restrictions.

**Shortage Stage 1:** MWD may make withdrawals from Diamond Valley Lake.

**Shortage Stage 2:** MWD will continue Shortage Stage 1 actions and may draw from out-of-region groundwater storage.

**Shortage Stage 3**: MWD will continue Shortage Stage 2 actions and may curtail or temporarily suspend deliveries to Long Term Seasonal and Replenishment Programs in accordance with their discounted rates.

**Shortage Stage 4:** MWD will continue Shortage Stage 3 actions and may draw from conjunctive use groundwater storage (such as the North Las Posas program) and the SWP terminal reservoirs.

**Shortage Stage 5:** MWD will continue Shortage Stage 4 actions. MWD's Board of Directors may call for extraordinary conservation through a coordinated outreach effort and may curtail IAWP deliveries in accordance with their discounted rates. In the event of a call for extraordinary conservation, MWD's Drought Program Officer will coordinate public information activities with member agencies and monitor the effectiveness of ongoing conservation programs. The Drought Program Officer will implement monthly reporting on conservation program activities and progress and will provide quarterly estimates of conservation water savings.

**Shortage Stage 6:** MWD will continue Shortage Stage 5 actions and may exercise any and all water supply option contracts and/or buy water on the open market either for consumptive use or for delivery to regional storage facilities for use during the shortage.

**Shortage Stage 7:** MWD will discontinue deliveries to regional storage facilities, except on a regulatory or seasonal basis, continue extraordinary conservation efforts, and develop a plan to allocate available supply fairly and efficiently to full-service customers. The allocation plan will be based on the Board-adopted principles for allocation listed previously. MWD intends to enforce these allocations using rate surcharges. Any deliveries exceeding 102% of the allotment will be assessed a surcharge equal to three times MWD's full-service rate.

The overriding goal of the WSDM Plan is to never reach Shortage Stage 7, an Extreme Shortage. Given present resources, MWD fully expects to achieve this goal over the next ten years and beyond.

**Reliability Modeling of the WSDM Plan**

Using a technique known as "sequentially indexed Monte Carlo simulation," MWD undertook an extensive analysis of system reservoirs, forecasted demands, and probable hydrologic conditions to estimate the likelihood of reaching each Shortage Stage through 2010. The results of this analysis demonstrated the benefits of coordinated management of regional supply and storage resources. Expected occurrence of a Severe Shortage is four percent or less in most years and never exceeds six percent; equating to an expected shortage occurring once every 17 to 25 years. An Extreme Shortage was avoided in every simulation run.

MWD also tested the WSDM Plan by analyzing its ability to meet forecasted demands given a repeat of the two most severe California droughts in recent history. Hydrologic conditions for the years 1923–34 and 1980–91 were used in combination with demographic projections to generate two hypothetical supply and demand forecasts for the period 1999–2010. MWD then simulated operation to determine the extent of regional shortage, if any. The results again indicate 100% reliability for full-service demands through the forecast period.

**MWD Catastrophic Loss Planning Measures**

To safeguard the region from a catastrophic loss of water supply, MWD and its member agencies have made and are continuing to make substantial investments in emergency storage, distribution system reliability upgrades, and interconnections with adjacent water purveyors. MWD's emergency plan assumes that demands are reduced 25% from the 2020 baseline demand forecast through extraordinary conservation, while the local supplies are largely undisrupted. With few exceptions, MWD asserts it can deliver emergency supply from its Diamond Valley Lake Reservoir throughout its service area via gravity, thereby eliminating dependence on power

sources that could also be disrupted by a major earthquake. MWD's WSDM Plan will guide management of available supplies and resources during an emergency.

IEUA maintains an emergency response plan for its service area. IEUA expects to meet emergency demands within the region through extraordinary conservation and groundwater pumping measures. Multiple sources of power exist within the service area making any electrical shortages a temporary disruption. In addition, IEUA is pursuing additional mutual aid agreements between local retail agencies.

**Catastrophic Supply Interruption Plans**

A water shortage emergency could be the result of a catastrophic event such as the failure of water distribution facilities, a regional power outage, earthquake, flood, supply contamination from a chemical spill, or other adverse conditions. The MVWD Board shall be responsible for authorizing and directing implementation of the water conservation stages described in the Water Shortage Contingency Plan, as appropriate, to address emergencies.

In the event of a water shortage emergency, MVWD will employ its Emergency Response Plan to minimize the impact of supply interruption. The major objectives to be accomplished include the following:

- Provide essential water services
- Manage repair crews
- Meet city, county, and state established priorities
- Coordinate service from outside water departments
- Provide and maintain an inventory of potable water resources
- Develop priorities

These objectives will be met through careful implementation of response activities, which include the following:

- Preserve water in storage
- Isolate areas for which restoration of service will require the longest period of time to accomplish and arrange for emergency water distribution
- Identify areas that can be served with minimal repairs
- Set priorities for repair work

## 5.12 Water Conservation as a Reliable Water Source

MVWD recognizes water use efficiency as an integral component of current and future water strategy for its service area. MVWD has made implementation of Best Management Practices (BMPs) the cornerstone of its conservation programs. As a sub-agency of IEUA, MVWD has supported regional water conservation, as a water resource management strategy, throughout the region. The major elements of the regional water conservation strategy are:

- Integrate conservation with other water management programs to maximize the overall water supply, water quality, flood control and environmental benefits to the region.
- Encourage all new developments to be more water (and energy) efficient.
- Encourage responsible irrigation and landscaping techniques, including use of recycled water, system audits, and weather-integrated automatically controlled system designs.
- Continue residential appliance/fixture retrofit programs that target the most wasteful in-door water consuming applications.
- Expand public education program and place an emphasis on development of partnerships with school districts to promote wise water use and how this behavior contributes to the quality of life and increased economic sustainability of the region.

MVWD and IEUA are signatories to the Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California with the California Urban Water Conservation Council (CUWCC). MVWD coordinates with IEUA to implement many of the CUWCC established BMPs, which include the following:

1. Water survey programs for single-family residential and multifamily residential customers
2. Residential plumbing retrofit
3. System water audits, leak detection, and repair
4. Metering with commodity rates for all new connections and retrofit of existing connections
5. Large landscape conservation programs and incentives
6. High-efficiency washing machine rebate programs
7. Public information programs
8. School education programs
9. Conservation programs for commercial, industrial, and institutional accounts

10. Wholesale agency programs
11. Conservation pricing
12. Water conservation coordinator
13. Water waste prohibition
14. Residential ultra-low-flush toilet replacement programs

MVWD is committed to conservation as a means to provide a sustainable supply of water to its service area, and plans to expand its conservation program in conjunction with IEUA into the future.

IEUA establishes conservation goals on a regional level and MVWD implements measures to help meet the regional goals. In its 2010 UWMP, IEUA established the regional goal for conservation of a 10% reduction in per-capita daily demand by 2015, reaching 20% reduction by 2020 (the 20x2020 Water Conservation Plan). Conservation activities during the last few years have been successful in reducing per-capita daily demand to less than the 2020 goal levels as of the completion of the IEUA 2015 UWMP. Water conservation has become an increasingly important element of water management for the region, and as a result, many of the conservation programs established in 2000 have been expanded to meet the region's conservation goal.

As the water wholesaler for the region, IEUA also introduced a variety of new and innovative incentive programs to help achieve the conservation goal. The programs directly benefit its sub-agencies, including MVWD. These programs will reduce MVWD's overall demand on imported water sources and ensure drought-proof resources.

## 5.13 Dry Year Reliability Analysis

The period between late 2011 and 2014 was the driest in California recorded history, with drought conditions continuing until 2017. Despite record setting rainfall in Northern California during the winter of 2016-2017, all of Southern California and 47.9% of the entire state remain in a state of moderate to extreme drought as of October 2018 (NIDIS 2018). In Northern and Central California, forecasts of unimpaired runoff from Sierra Nevada watersheds are well below average (DWR 2018a). The Colorado River Basin, an important source of water supply for Southern California, continues to experience the driest 19-year period in recorded history, with 95% of the Basin currently experiencing moderate to exceptional drought (UNL 2018).

Defining when a drought begins is a function of the impacts of dry conditions on water users. One dry year does not constitute a drought for most California water users as rainfall patterns may create multi-year cycles of dry conditions off-set by an extremely wet year. Past experience

with California droughts tells us that impacts of a single dry year are felt primarily by those most dependent on/affected by annual rainfall.

In February 2008, MWD approved its Water Supply Allocation Plan (WSAP). The WSAP serves as the current policy for allocating water supplied to MWD's member agencies in times of declared water shortages with the goal of reducing the quantity of water used within MWD's service area to conserve supply. The WSAP includes specific formulas for calculating MWD supply allocations to each member agency and also includes implementation elements needed for administering water supply allocations. The WSAP allocates supplies based on the needs of the water agencies throughout the service area.

*MVWD Dry Year Reliability Analysis*

MVWD's current water demand is approximately 17,000 AFY. By the year 2040, MVWD's water demand is projected to be 39,270 AFY, which includes an estimated 2,906 AFY of water associated with the Montclair Place District.

MVWD's Urban Water Management Plan (UWMP) Update 2015 updated water demands to reflect the developments that occurred between 2010 and 2015, developments that were anticipated for 2015, and projected water demands through the year 2040. MVWD's 2015 UWMP is generally consistent with the current IEUA 2015 Regional UWMP.

Table 5-3 presents the dry year demand and supply factors, based on the historical ranges listed in Table 5-4, utilized for the dry year analysis presented in Tables 5-5 through 5-7. These tables compare current and projected water supplies and demands in normal, single dry year and multiple dry year scenarios for the MVWD service area and the Project. The basis of the data in these tables is from Section 5.4 of MVWD's 2015 UWMP and Table 4-2 of this WSA. Supply and demand assumptions for the Project are interpolated on a straight-line basis beginning in 2020 (based on estimated year of first water consumption) through project completion in 2040, although build-out might not occur until 2050. Groundwater supplies during multiple dry years 1, 2, and 3 are estimated based on the factors in Table 5-3.5 In those instances where the estimated supply exceeds MVWD's anticipated annual entitlements (i.e., rights, currently 14,217 AFY) MVWD would incur a replenishment obligation. Such obligation may be satisfied by securing additional entitlements and/or tapping stored water reserves. MVWD wells currently have a capacity of approximately 33,156 AFY. MVWD's 2008 Water Master Plan, functioning

[5] MVWD's current groundwater ability as a share of the Basin operating safe yield (assigned water rights), plus additional groundwater supply ability from reallocations of Early Transfers and Land Use Conversions.

as its Capital Improvement Program, has developed a schedule of groundwater well replacement and rehabilitation to maintain, if not enhance, this production capacity through 2038 (MVWD 2016). For the purposes of reliability planning, MVWD suggests that full groundwater production capacity will be available at a 90% rate, allowing for equipment breakdown and other contingencies (29,841 AFY) (MVWD 2016).

Based on the results presented in Tables 5-5 through 5-7, MVWD should not experience any deficiency in meeting its demands in normal, single dry and multiple dry year scenarios for MVWD's existing and future developments, including the Project.

**Table 5-3**
**Supply Reliability as Percentage of Normal Water Year Supply**

| Supply Source | Normal Year | Single Dry Year | Multiple Dry Years | | |
|---|---|---|---|---|---|
| | | | *Year 1* | *Year 2* | *Year 3* |
| Chino Groundwater Basin | 100% | 100% | 100% | 100% | 100% |
| Water Facilities Authority | 100% | 100% | 100% | 100% | 100% |
| San Antonio Water Company[1] | 100% | 82% | 82% | 70% | 70% |
| Recycled Water | 100% | 100% | 100% | 100% | 100% |

1 Based on aggregated per-share allocation percentage reductions.

**Table 5-4**
**Basis of Water Year Data**

| Supply Source | Normal Year | Single Dry Year | Multiple Dry Years |
|---|---|---|---|
| Chino Groundwater Basin[1] | 1893-2015 | 2013 | 2013-2015 |
| Water Facilities Authority[2] | 1922-2012 | 1977 | 1990-1992 |
| San Antonio Water Company[1] | 1893-2015 | 2013 | 2013-2015 |

1 Western Regional Climate Center, Pomona Fairplex (047050), Monthly Sum of Precipitation, Period of Record: 11/1/1893 to 12/31/2015
2 MWD 2015 UWMP.

**Table 5-5**
**20-Year Water Supply and Demand Comparison**
**Normal Year Including the Project (AFY)**

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |

| | | | | | |
|---|---|---|---|---|---|
| San Antonio Water Company | 800 | 800 | 800 | 800 | 800 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply** | **53,448** | **53,407** | **53,436** | **53,486** | **53,486** |
| **Total Demand** | **38,037** | **38,250** | **38,600** | **38,969** | **39,270** |
| **Difference** | **15,411** | **15,157** | **14,836** | **14,517** | **14,216** |

**Table 5-6**
**20-Year Water Supply and Demand Comparison**
**Single Dry Year Including the Project (AFY)**

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 656 | 656 | 656 | 656 | 656 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply** | **53,304** | **53,263** | **53,292** | **53,342** | **53,342** |
| **Total Demand** | **38,037** | **38,250** | **38,600** | **38,969** | **39,270** |
| **Difference** | **15,267** | **15,013** | **14,692** | **14,373** | **14,072** |

**Table 5-7**
**20-Year Water Supply and Demand Comparison**
**Multiple Dry Years Including the Project (AFY)**

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| *Year 1* | | | | | |
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 656 | 656 | 656 | 656 | 656 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply** | **53,304** | **53,263** | **53,292** | **53,342** | **53,342** |
| **Total Demand** | **38,037** | **38,250** | **38,600** | **38,969** | **39,270** |
| **Difference** | **15,267** | **15,013** | **14,692** | **14,373** | **14,072** |
| *Year 2* | | | | | |
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 560 | 560 | 560 | 560 | 560 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply** | **53,208** | **53,167** | **53,196** | **53,246** | **53,246** |

| | | | | | |
|---|---|---|---|---|---|
| **Total Demand** | **38,037** | **38,250** | **38,600** | **38,969** | **39,270** |
| **Difference** | **15,171** | **14,917** | **14,596** | **14,277** | **13,976** |
| *Year 3* | | | | | |
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 560 | 560 | 560 | 560 | 560 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply** | **53,208** | **53,167** | **53,196** | **53,246** | **53,246** |
| **Total Demand** | **38,037** | **38,250** | **38,600** | **38,969** | **39,270** |
| **Difference** | **15,171** | **14,917** | **14,596** | **14,277** | **13,976** |

# 6 CONCLUSION

MVWD optimizes its water resource supply through an integrated resource approach, utilizing available water programs and projects. MVWD receives its water supplies from groundwater, imported water, entitlement water and recycled water. Complexities and continuing refinement in groundwater management and rights, evolving development of the regional recycled water system and supplies, desalter expansion and optimization projects, and challenges of imported water reliability require ongoing analysis of water demand and supply.

The City of Montclair is preparing an EIR for the Montclair Place District Specific Plan (Project), which includes an assessment of utility services, including water supply. Legislation through SB 610 requires that a water supply assessment be prepared to document the sufficiency of an available water supply for the MVWD service area which encompasses the City and the proposed Project.

This WSA includes a discussion of the relevant legislation requiring the WSA, an overview of the proposed Project, analysis of water demands for MVWD's existing supply sources and the Project over a 20-year or more planning period, a discussion of reliability of MVWD's water supplies including each agency that impacts water supply and water quality to the region, and concludes with a sufficiency analysis of water supply during normal, single-dry, and multiple dry years over a 20-year planning period. The WSA does not evaluate the adequacy of MVWD's infrastructure to handle the available water supplies or make any recommendations with respect to capital improvements that may be necessary in order to provide an adequate level of service to the Project.

This WSA identifies a sufficient water supply for the Project over a 20-year planning period. The City of Montclair has estimated a build-out for Project land uses over a 30-year period, with water services beginning to come online in 2020. It is anticipated that the phasing will allow for water demands to be met increasingly from sources that are currently being planned, developed and implemented, including conservation programs.

**Source of Water**

MVWD obtains water from the following primary water sources: groundwater produced via MVWD wells, imported water, entitlement water, and recycled water. MVWD currently receives approximately 50% of its water supply from groundwater, 42% from imported water, 3.5% from entitlement water, and 4.5% from recycled water. The Project, however, will not utilize recycled water.

**Water Demand and Supply Projections**

The build-out of the Project will increase MVWD's water demand by the year 2040 by approximately 767 AFY of water yielding a total projected service area demand of 37,131 AFY by 2040, as shown in Table 4-2.

Analysis of water demand and supply projections for MVWD, including the Montclair Place District (Section 4.0, Monte Vista Water District Water Demand and Supplies), demonstrate that projected supplies exceed demand through the year 2040. These projections consider land use, water development programs and projects, and water conservation.

MVWD has the opportunity to increase supply to meet future demands through the following measures: 1) production of groundwater based on safe yield allocation and utilization of water in storage; 2) increasing imported water purchases, if available and if there is available WFA capacity; and 3) purchasing additional recycled water, if available. Collectively, these additional options will enable water supply to exceed water demand for MVWD now and into the future.

Analyses of normal, single-dry, and multiple-dry year scenarios also demonstrate MVWD's ability to satisfy demand during the 20-year planning period in all hydrologic conditions.

Collectively, the information included in this Water Supply Assessment identifies a sufficient and reliable water supply for the MVWD service area, now and into the future, including a sufficient water supply for the Montclair Place District Specific Plan.

# 7 REFERENCES

The following documents were used, in conjunction with discussions with the City of Montclair and MVWD in preparing this water supply assessment:

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University of Nebraska – Lincoln, *United States Drought Monitor*, Accessed October 16, 2018. Available at https://droughtmonitor.unl.edu/.

# ATTACHMENT A

*Montclair Place District Specific Plan*
*Water Demand Analysis*

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# ATTACHMENT A
# Montclair Place District Specific Plan
# Water Demand Analysis

## TECHNICAL MEMORANDUM

**To:** Derek Reed, P.E. and Ruta Thomas
**From:** Christian Hunter
**Subject:** Montclair Place District Specific Plan Water Demand Analysis
**Date:** November 2, 2018

## INTRODUCTION

In support of our overall Water Supply Assessment effort, Dudek has developed water demand projections for the proposed Montclair Place District Specific Plan (Project) within the City of Montclair (City). Water demand projections were determined in five-year increments through build-out. The proposed Project is a pedestrian-oriented, multi-modal, mixed-use downtown district within walking and biking distance of the Montclair Transcenter and the anticipated extension of the Foothill Gold Line. Boundaries of the proposed Project are Moreno Street to the north, Central Avenue to the east, I-10 to the south and Monte Vista Avenue to the west. This Water Supply Assessment is prepared for Monte Vista Water District (MVWD) on behalf of the City to be included in the Environmental Impact Report (EIR) for the Project. The purpose of this technical memorandum is to develop the additional water demands that need to be served by MVWD as a result of creation of the proposed mixed-use district, also known as Montclair Place.

This technical memorandum will address the following:

- Unit water demand factors.
- Existing land use and water demand projection.
- Proposed land use and phasing.
- Proposed potable and recycled water demand projections.

## BACKGROUND

MVWD is the water supplier for the Project area while the City is the lead agency for development of the EIR. MVWD currently serves approximately 16,800 acre-ft per year (afy) or 15 million gallons per day (MGD) of retail and wholesale water annually to an area of

approximately 30 square miles and over 137,000 customers. MVWD's current service area population is anticipated to increase from 133,177 in 2015 to 158,849 by 2035. Contributing to this increase is the Montclair Place District, where construction is anticipated to being in 2020 with built-out anticipated to take up to 30 years.

MVWD currently obtains water from the following primary water sources: 1) groundwater from the Chino Groundwater Basin, 2) imported State Water Project (SWP) water, 3) entitlement water from the San Antonio Water Company (SAWCo), and most recently 4) recycled water. MVWD currently receives approximately 50% of its water supply from groundwater, 42% from imported water, 3.5% from SAWCo, and 4.5% from recycled water. MVWD receives its imported water from the Metropolitan Water District of Southern California (MWD) through the Inland Empire Utility Agency (IEUA), who wholesales the water to MVWD through the Water Facilities Authority (WFA). The WFA, a joint powers authority, built and manages the Agua de Lejos Water Treatment Plant to treat and distribute water to it members, including MVWD. IEUA also produces recycled water at its water reclamation facilities and wholesales to MVWD.

As per the information provided by Michael Diaz, City Planning Manager for the City of Montclair, the proposed Project is comprised of three mixed-use land use categories encompassing 104.35 acres composed of approximately 5 million square feet of residential uses (6,321 units) and 2 million square feet of commercial usage. Additionally, the Project involves the construction of a hotel with approximately 100-200 rooms.

## UNIT WATER DEMAND FACTORS

In order to determine potential water demand from a future designated land use or potential building square footage, an assumption of the unit water demand by area use must be prepared. The term "*unit water demand factor*" refers to the average water demand per unit area or dwelling units for a particular land use category.

In 2016, the Inland Empire Utilities Agency (IEUA) developed a land use-based demand model to provide a uniform tool for member agencies to calculate future water demands[1]. The IEUA model utilizes 13 categories of land use and historic consumption levels (2010-2014) to provide normalized unit water demand factors. Table 1 summarizes these unit water demand factors for all the land use categories used in this study. Additionally, the IEUA model adjusts demand projections for unbilled water, climate change, land use intensification and water conservation effort through extrapolated adjustment factors. The unit water demand factors, land use categories, and adjustment factors were used to generate the existing and proposed demand projections.

[1] IEUA, Land Use Based Demand Model Development, May 24, 2016.

**Table 1**
**Unit Water Demand and Adjustment Factors**

| Land Use Category | Unit Water Demand Factor (AFY/acre) | Total Adjustment Factor (% unit water demand) | | | | | |
|---|---|---|---|---|---|---|---|
| | | *2015* | *2020* | *2025* | *2030* | *2035* | *2040* |
| Very Low Residential (1-2 du/ac) | 1.27 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |
| Low Residential (3-7 du/ac) | 2.11 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |
| Medium Residential (8-14 du/ac) | 4.67 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |
| High Residential (15-24 du/ac) | 9.86 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |
| Very High Residential (25+ du/ac) | 87.2* | 6.81 | 7.45 | 8.09 | 8.73 | 9.37 | 10.01 |
| Commercial | 2.13 | 6.81 | 7.45 | 8.09 | 8.73 | 9.37 | 10.01 |
| Industrial | 0.65 | 6.81 | 7.45 | 8.09 | 8.73 | 9.37 | 10.01 |
| Public/ Institutional | 2.39 | 6.81 | 7.45 | 8.09 | 8.73 | 9.37 | 10.01 |
| Parks, Schools, Irrigation | 4.72 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |
| Agriculture | 0.34 | 6.81 | 8.05 | 9.29 | 10.53 | 11.77 | 13.01 |

**Source:** IEUA, Land Use Based Demand Model Development, May 24, 2016.

* The IEUA model uses a unit demand per dwelling unit factor of 0.40 AFY/du for multi-family residential buildings. The value here listed is for the 218 dwelling units per/acre density of the Montclair Place Core Zone. Unit water demand factors for the Main Street District and Town Center are 54.4 and 34.8 respectively.

## EXISTING LAND USE AND WATER DEMAND PROJECTION

The existing land is currently zoned as C3 – General Commercial in the City of Montclair General Plan and is presently occupied by the existing Montclair Place Mall (approximately 75 acres) properties. Additional project parcels include lands that are currently developed with commercial buildings and uses including restaurants and various retail entities as well as a gym and a church that also serves as a Montessori School (Figure A.1).

According to the IEUA Land, these parcels are principally designated Commercial (99.69 acres) while the Unitarian Universalist Church and two adjacent parcels are designated as Residential High (2.44 acres). Additionally, two thin parcels along the I-10 are designated as Non-Irrigated in the IEUA model (0.68 acres), and four undeveloped parcels are listed as Vacant (1.54 acres).

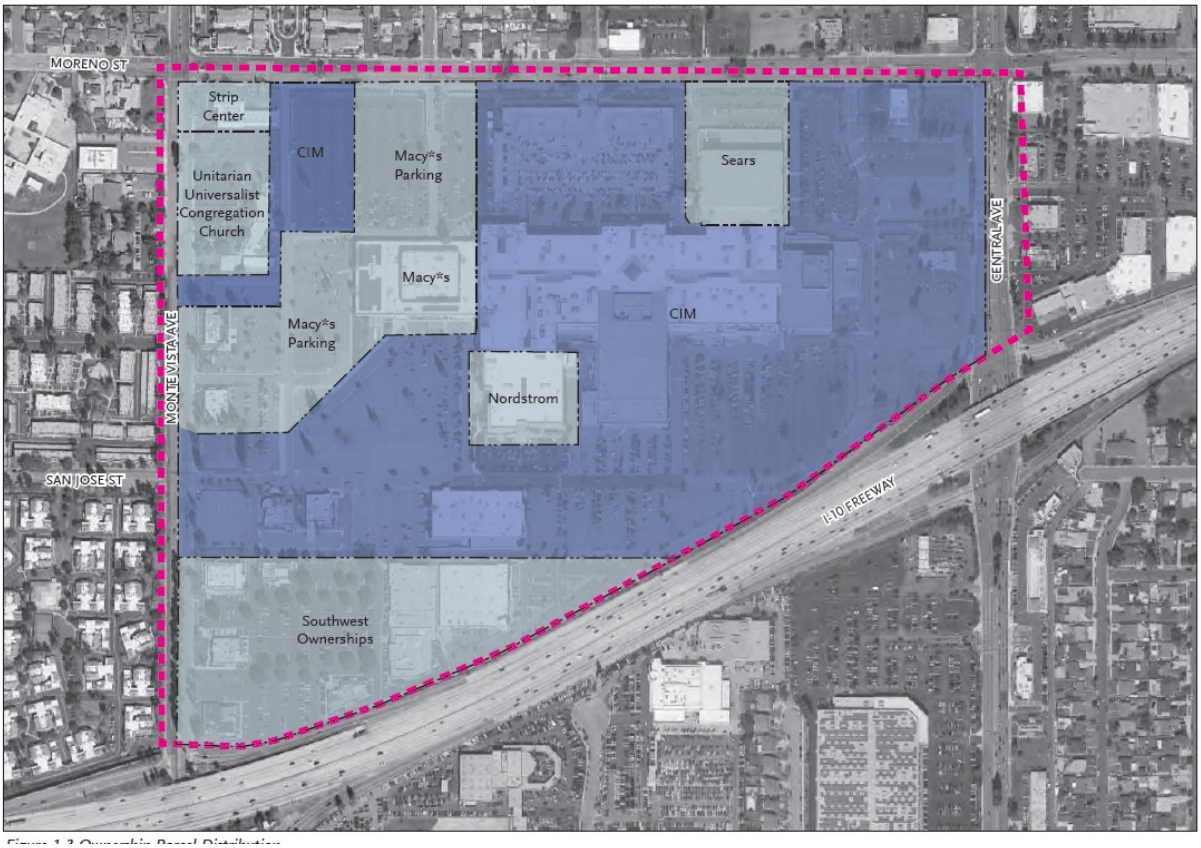
Water service to the property is currently provided by Monte Vista Water District whose Director of Engineering, Operations and Maintenance, Van Jew, provided a consumption report for the project parcels. Between July 2015 and June 2018, the Project area utilized an average of 254,400 cubic feet for potable uses, 52.8 cubic feet for detector checks (fire service/fire hydrant) and 217,300 cubic feet for irrigation each month (V. Jew, personal communication, September 12, 2018).

In urban water management planning for future water demands, the future increase in water demand may be estimated relative to projected population growth within the service area. Given the projected population growth of 18% for the MVWD service area between 2015 and 2040, it

would be reasonable to project that potable water uses in the Montclair Place area would increase by a similar factor, while irrigation and detector checks would remain relatively constant. Thus it is estimated using metered data from the previous year that average annual potable water use in the Project area would increase from 71.9 AFY (July 2017-June 2018) to 85.5 AFY by 2040, and the total water use would increase from 136.8 AFY to 150.4 AFY. Incorporating the unbilled water factor of 6.81% from the IEUA model, water demand for 2018 is estimated at 146.1 AFY.

These measured water demand rates for the Project parcels were compared to the demand estimates from the IEUA model. Linear interpolations for the unit water demand factors were calculated using the 2015 and 2020 model values from Table 1 as 2.28 AFY/acre for Commercial, 10.60 AFY/acre for High Residential, and 0 AFY/acre for Vacant and Non-irrigated lands. The IEUA model estimated 2018 water demand for the Project parcels as 229.11 AF, more than 50% greater than the measured value when also considering unbilled water. This overestimation of water demand might be the result of the general nature of the Commercial category, incorporating restaurants of higher water use with shopping centers of lower water use. Additionally, the IEUA model estimates land use factors by considering all properties of a given land use category, regardless of their age and level of conservation or end-use efficiency. Calibrating the model by adjusting the Commercial unit demand factor so that 2018 demand measurements match measured water demand, we propose a more appropriate factor of 1.35 AFY/acre. Utilizing this new factor to estimate 2040 Parcel demand under current conditions, the adjusted model demand (150.6 AFY) is similar to that projected above using population growth rates (150.4 AFY). Although future demands will be estimated using the original IEUA model unit demand factor for Commercial uses, these values might lead to a conservative overestimation of future water demands.

**Figure A.1 – Existing Project Land Uses**




**Source:** City of Montclair

## PROPOSED LAND USE AND PHASING

The relative growth and development of the Project was provided by the City of Montclair, per the *Montclair Place Specific Plan: Charrette Catalog of Drawings May 16, 2018.* A detailed ultimate land use evaluation was provided itemizing the development potential of the Project, broken down into residential, commercial or open space land use categories across the three new mixed-use zoning designations: Core, Main Street District and Town Center. The data contained future build-out land use information including the area and the dwelling units.

The majority of residential land uses projected in the study area consists of very high density residential, with an average density factor of 148 dwelling units per acre (DU/acre) and a total of 6,321 units. A proposed hotel in the Project area would add an additional 100-200 rooms which will be treated as 150 dwelling units based on an average occupancy of 75%[2]. Other land use

[2] CBRE Hotels Consulting, *2018 Southern California Lodging Forecast*, October 20, 2017.

designations include 17.27 acres of commercial use, 15.96 acres of parks/open space, and 28.32 acres of non-irrigated streets, curbs and sidewalks (Figure A.2).

Table 2 and Figure A.2 present the ultimate build-out acreage and dwelling units per acre of each land use category in the Project. As there is currently not an itemized schedule for build-out, however, water demands calculated in this analysis shall serve as conservative estimates by assuming complete build-out in 2020.

**Table 2**
**Project Projected Land Use Development**

| Land Use | Area (acres) | Percent Land Use | Average DU/acre | Total Units |
|---|---|---|---|---|
| Core | 15.91 | 15% | - | - |
| Residential | 10.96 | 11% | 218 | 2,387 |
| Commercial | 4.95 | 4% | - | - |
| Main Street District | 32.28 | 31% | - | - |
| Residential | 23.66 | 23% | 142 | 3,371* |
| Commercial | 8.62 | 8% | - | - |
| Town Center | 11.88 | 11% | - | - |
| Residential | 8.18 | 8% | 87 | 713 |
| Commercial | 3.70 | 3% | - | |
| *Residential Sub Total* | *42.80* | *41%* | *148* | *6,471* |
| *Commercial Sub Total* | *17.27* | *17%* | - | - |
| *Open Space Sub Total* | 15.96 | 15% | - | - |
| *Streets Sub Total* | 28.32 | 27% | - | - |
| **Grand Total** | **104.35** | **100%** | **-** | **6,471** |

* This number is composed of 3,221 residential units and 150 hotel units.

**Figure A.2 – Proposed Montclair Place District Zoning**




**Source:** Moule & Polyzoides, Montclair Place Specific Plan, Charrette Catalog of Drawings, 16 May 2018.

## PROPOSED WATER DEMAND PROJECTION

Projected water demands for each of the future land use categories were determined by multiplying the unit water demand factors by the corresponding area and adjusted for intensification, climate change, unbilled water rate and passive conservation per the IEUA Land Use-Based Water Demand Model.

Dudek utilized the conservative assumption of complete build-out in 2020 to determine the potable water demands for the Project. **Table 3** summarizes the total water demand by all land use categories. As construction and absorption is estimated to be continue for up to 30 years (2050), actual water demand in the Montclair Place District will most likely be much less than these estimated values.

**Table 3**
**Total Water Demand Projection (AFY) IEUA Land Use-Based Demand Model**

| Land Use | Year | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 |
| Core Residential | 1,026.7 | 1,032.8 | 1,038.9 | 1,045.0 | 1,051.1 |
| Main Street Residential | 1,383.2 | 1,391.4 | 1,399.7 | 1,407.9 | 1,416.2 |
| Town Center Residential | 305.9 | 307.8 | 309.6 | 311.4 | 313.2 |
| Commercial | 39.5 | 39.8 | 40.0 | 40.2 | 40.4 |
| Open Space | 81.4 | 82.3 | 83.3 | 84.2 | 85.1 |
| **Total Water Demand (AFY)** | **2,836.7** | **2,854.1** | **2,871.5** | **2,888.7** | **2,906.0** |
| Current Conditions Demand | 229.7 | 231.2 | 232.7 | 234.2 | 235.8 |
| **Increased Water Demand (AFY)** | **2,607.0** | **2,622.9** | **2,638.8** | **2,654.4** | **2,670.2** |

Although IEUA member agencies are required to use the Land Use-Based Demand Model for calculations of future water demands, this model uses historic water use rates for existing construction to estimate demands for newer, more efficient construction projects. Additionally, the IEUA model was published in May 2016, prior to the release of Assembly Bill No. 1668, Friedman – Water Management Planning and Senate Bill No. 606, Hertzberg – Water Management Planning. AB 1668 and SB 606, approved concurrently in May 2018, amend Water Code Sections 10608.20 and 10609.4, establishing an end-use efficiency standard of 55 gallons per capita daily residential water use until January 1, 2025 after which the standard will be adjusted to the greater of 52.5 gallons per capita or that established by a Department of Water Resources study. This is much less than the 0.25 AFY/capita (223 gallons/capita per day) utilized by the IEUA model.

Using the end-use efficiency levels mandated by AB 1668 and SB 606 and an average occupancy of 1.6 persons per dwelling unit, still allowing for adjustments due to land use intensification, climate change, unbilled water and passive conservation, Project water demands decrease significantly as seen below in **Table 4**. Commercial land use conservation efforts and Open Space land use efficiency measures such as drought resistant landscaping are not here considered, but would serve to decrease anticipated demand.

**Table 4**
**Total Water Demand Projection (AFY)**
**AB 1668 and SB 606 End-Use Efficiency Mandated Levels**

| Land Use | Year | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 |
| Core Residential | 236.7 | 238.1 | 239.5 | 240.9 | 242.3 |
| Main Street Residential | 319.4 | 321.3 | 323.2 | 325.1 | 327.0 |
| Town Center Residential | 70.7 | 71.1 | 71.5 | 72.0 | 72.4 |
| Commercial | 39.5 | 39.8 | 40.0 | 40.2 | 40.4 |
| Open Space | 81.4 | 82.3 | 83.3 | 84.2 | 85.1 |
| **Total Water Demand (AFY)** | **747.7** | **752.6** | **757.5** | **762.4** | **767.2** |
| Current Conditions Demand | 229.7 | 231.2 | 232.7 | 234.2 | 235.8 |
| **Increased Water Demand (AFY)** | **518.0** | **521.4** | **524.8** | **528.2** | **531.4** |

## CONCLUSION

Based on the projected development and growth of the Montclair Place District Specific Plan, and end-use efficiency standards for residential water mandated by AB 1668 and SB 606 approximately 83.6% of ultimate water demands within the study area will come from the residential land use categories. Commercial demand will amount to 5.3% while irrigation of open space land is estimated to account for 11.1% of the ultimate water demands. Overall, an average ultimate annual water demand of 757.5 AFY or 676,252 gpd is estimated by 2030 and 767.2 AFY or 684,911 gpd by 2040. This will require an overall increase in water demand from 2030 and 2040 estimates under current land use conditions of 524.8 AFY and 531.4 AFY respectively.

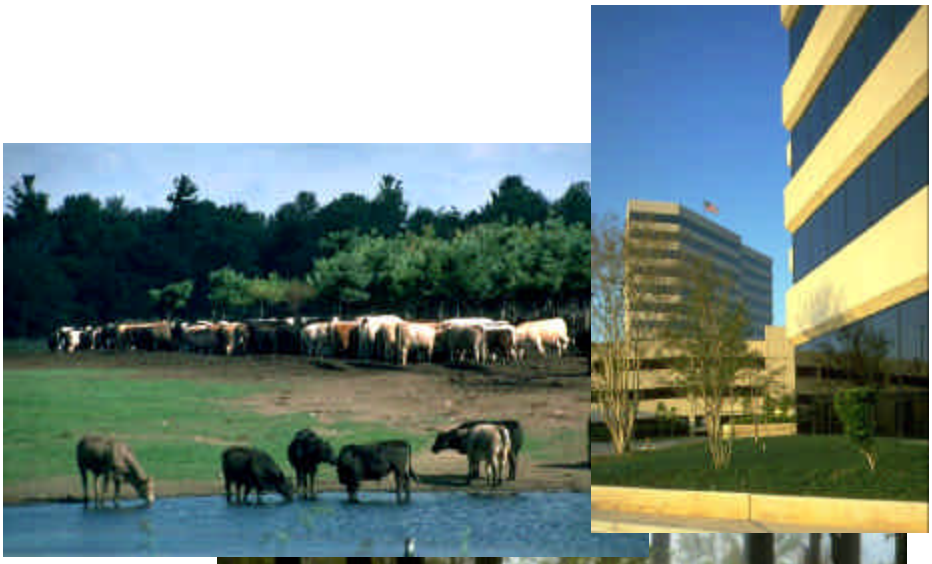
# ATTACHMENT A
# Montclair Place District Specific Plan
# Water Demand Analysis

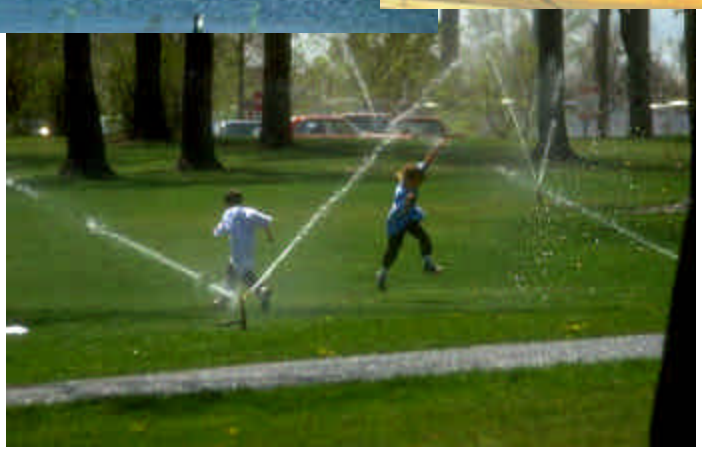
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# ATTACHMENT B

***Referenced Documents***

# Optimum Basin Management Program





## Draft Phase I Report

*Prepared for*

**Chino Basin Watermaster**

**August 19, 1999**

Wildermuth Environmental, Inc.

# Optimum Basin Management Program

## Phase I Report

*Prepared for the*
Chino Basin Watermaster

August 19, 1999

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415 North El Camino Real, Suite A
San Clemente, CA 92672
949.498.9294
www.wild-environment.com

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# SECTION 1
# INTRODUCTION

An Optimum Basin Management Program (OBMP) for the Chino Basin (Figure 1-1) is being developed pursuant to a Judgment entered in the Superior Court of the State of California for the County of San Bernardino and a February 19, 1998 ruling as described below. Pursuant to the Judgment, the Chino Basin Watermaster (Watermaster) files an annual report of Watermaster activities with the Court each year. The information presented below regarding the Judgment, Watermaster, and the events leading up to the February 19, 1998 ruling was obtained from these annual reports.

## THE CHINO BASIN JUDGMENT AND WATERMASTER

The Chino Basin Watermaster was established under a Judgment entered in the Superior Court of the State of California for the County of San Bernardino, entitled "Chino Basin Municipal Water District v. City of Chino *et al*," (originally Case No. SCV 164327, file transferred August 1989, by order of the Court and assigned new Case No. RCV 51010). The Honorable Judge Howard B. Wiener signed the Judgment on January 27, 1978. The effective date of this Judgment for accounting and operations was July 1, 1977.

The Judgment resulted from studies and discussions that began in the early 1970's and continued for several years. The initial action to formalize the producers' intentions was the passage in 1974 of a "Memorandum of Agreement on the Chino Basin Plan." In January 1975, Senator Ruben S. Ayala introduced Senate Bill 222 (S.B. 222) in the California Legislature. This bill authorized a production assessment levy of $2.00 per acre-foot per year for a period of three years. The funds were utilized to finance the essential studies and negotiations to implement a water management program for the Chino Groundwater Basin.

S.B. 222 was subsequently renumbered as a part of the Municipal Water District Law at Section 74120 of the Water Code. It was approved by Governor Ronald Reagan and filed with the Secretary of State on June 28, 1975. Three major groups that represented the majority of the producer's interests became active in the early negotiations under S.B. 222. The groups formalized into committees and eventually became known as the: Overlying (Agricultural) Pool, including the State of California and minimal producers; Overlying (Non-Agricultural) Pool representing industries; and Appropriative Pool, representing cities, water districts and water companies. Engineering, legal and other working sub-committees were formed to analyze and define specific problem areas. Representatives of the three pools, when acting together, were called the "Watermaster Advisory Committee." The Watermaster Advisory Committee forwarded recommendations for formal action to the Chino Basin Municipal Water District (CBMWD), which was assigned the responsibility of administering S.B. 222. Socio-economic, safe yield and other studies were conducted to provide the information necessary to reach an agreement regarding the allocation of rights between and within the pool committees.

The Watermaster Advisory Committee was established as the policy setting body and charged with oversight of Watermaster's discretionary activities. Members of each of the three pool committees met regularly to transact the business concerns of its respective producers. Decisions affecting more than one pool committee were forwarded to the Watermaster Advisory Committee. The Judgment provided a method to determine the voting power of the producers on the committees, through a formula based on assessments paid in the prior year and allocated safe yield.

The Judgment declares that the safe yield of the Chino Basin is 140,000 acre-ft/yr, which is allocated among the three pools as follows:

| | |
|---|---|
| Overlying agricultural pool | 82,800 acre-ft/yr |
| Overlying non-agricultural pool | 7,366 acre-ft/yr |
| Appropriative pool | 49,834 acre-ft/yr |

A fundamental premise of the Judgment (aka the physical solution) is that all Chino Basin water users will be allowed to pump sufficient water from the Basin to meet their requirements. To the extent that pumping exceeds the share of the safe yield, assessments are levied by the Watermaster to replace the overproduction. The Judgment recognizes that there exists a substantial amount of available groundwater storage capacity in the Chino Basin that can be utilized for storage and conjunctive use of supplemental water and basin waters; makes utilization of this storage subject to Watermaster control and regulation; and provides that any person or public entity, whether or not a party to the Judgment, may make reasonable beneficial use of the available storage, provided that no such use shall be made except pursuant to a written storage agreement with the Watermaster.

### EVENTS LEADING UP TO THE FEBRUARY 19, 1998 RULING

During fiscal year 1995-96, it was determined that the reappointment of the CBMWD board as Watermaster had not been submitted to the Court for approval in 1993. In January 1996, a motion was made and supported by a majority of the Advisory Committee to appoint the Advisory Committee to serve as Watermaster. Initially, this motion was supported by 71.64% of the Advisory Committee and as provided in Paragraph 16 of the Judgment, Watermaster Counsel was directed by the Advisory Committee to file the motion with the Court. A Watermaster Ad Hoc Transition Committee of pool members and interested parties was formed to work out the logistics involved with changing the Watermaster. Shortly after the motion was filed, the case was assigned to the Honorable Judge J. Michael Gunn. Fifteen committee members attended the first Ad Hoc Transition Committee meeting on January 31, 1996, and agreed unanimously to propose that an arbitrator or an arbitration process be put in place to address initial concerns raised by some parties to the Judgment regarding the Advisory Committee serving as Watermaster.

By early March, the Overlying (Agricultural) Pool and a few appropriators had reconsidered their positions and were opposed to the motion to appoint the Advisory Committee as Watermaster, even with an arbitration process. As a result, the motion was taken off calendar and additional Ad Hoc Transition Committee meetings were held. These meetings resulted in the development of a proposal for a nine-member board, which was approved by the Advisory Committee in April 1996. Watermaster Counsel was directed to file a motion to appoint the nine-member board, which was set for hearing on June 18, 1996.

On June 3, 1996, CBMWD filed an ex-parte motion to shorten the time on a motion to appoint itself as Interim Watermaster, to appoint itself "*nunc pro tunc*" Watermaster and to disqualify Watermaster Counsel based on the allegation that Counsel had a conflict of interest in serving both Watermaster and the Advisory Committee. The motion to shorten time was granted and the hearing was set for June 18, 1996. At the June 18, 1996 hearing, the Honorable Judge J. Michael Gunn granted the motions to appoint CBMWD nunc pro tunc and Interim Watermaster, and denied the motion to disqualify Watermaster Counsel. The Judge also ordered the parties to meet and confer regarding the nine-member board

proposal, which continued the matter to a *meet and confer* among all the interested parties, held July 29, 1996.

July 29, 1996, was the first of two *meet and confers*, held at the City of Chino Council Chambers. Although there was much discussion on that date, the only substantive decision made was to hold an additional *meet and confer* on August 28, 1996.

As a result of the second *meet and confer*, a three-member Watermaster Board proposal was submitted to the Court for hearing on September 18, 1996. As of the Court hearing date, only two of the three municipal water districts invited to participate on the proposed three-member Watermaster Board had responded affirmatively. CBMWD was expected to agree to participate after consideration at their October board meeting and the Court continued the motion until November 20, 1996. CBMWD did not take action to participate on the three-member Watermaster Board as anticipated and the motion was taken off calendar in November of 1996. Four additional workshops were held during late 1996 and into the early months of 1997. As a result, the original nine-member Watermaster Board proposal was modified and approved by the Watermaster Advisory Committee on January 30, 1997, by a majority vote of 67.99 percent.

On March 11, 1997, a new motion to appoint a nine-member Watermaster Board was heard by the Honorable Judge J. Michael Gunn. On April 29, 1997, Judge Gunn issued a ruling which:

- Appointed Anne J. Schneider, Esq. as Special Referee to make a recommendation to the Court regarding the issues raised by the motions.
- Ordered CBMWD, the Advisory Committee, and the DWR (Department of Water Resources) to negotiate terms for the DWR to serve as Interim Watermaster.
- Granted a motion submitted on March 6, 1997, by the law firm of Cihigoyenetche, Grossberg & Clouse, general counsel for CBMWD, to disqualify Watermaster Counsel.

Negotiations began regarding the DWR serving as interim Watermaster through Special Counsel to the Watermaster Advisory Committee, James L. Markman, CBMWD Counsel, Jean Cihigoyenetche, and the attorneys for the DWR.

Anne Schneider accepted the Court's appointment to become a Special Referee and began the process necessary to make a recommendation to the Court. No substantial decisions were reached by fiscal year end and the matter continued into fiscal year 1997-98.

The Special Referee held a special hearing on October 21, 1997, at the Watermaster offices. By mid December 1997, the Special Referee filed her written *Report and Recommendation* with the Court. Based on the *Report and Recommendation*, the Honorable J. Michael Gunn entered a ruling on February 19, 1998 which:

- Appointed the Nine-Member Board as Interim Watermaster.
- Directed that an Optimum Basin Management Program be developed.
- Directed negotiation with DWR be resumed.
- Set hearing dates regarding:
  - The Optimum Basin Management Program (October 28, 1999).
  - Continuance of the Nine-Member Board (October 28, 1999).

- Status of negotiations with DWR to serve as Watermaster and to carry out Watermaster operations (September 30, 1999).

This report documents the development of the OBMP for the Chino Basin pursuant to the Honorable J. Michael Gunn's February 19,1998 ruling.

## PROCESS TO DEVELOP THE OBMP

Since the ruling, the Watermaster, the producers, and other interested parties have met twice a month and held special workshops to develop the scope of work to prepare an OBMP and to cooperatively develop the OBMP. The Court officially accepted the scope of work to develop the OBMP on November 5, 1998.

Development of the OBMP required three parallel processes: institutional, engineering, and financial. The institutional process defined the management agenda, directed the engineering and financial processes, and built an institutional support for OBMP implementation. The engineering process developed planning data and management elements, and evaluated the technical and economic performance of the management elements. The financial process was supposed to develop alternative financing plans for the OBMP through its evolution. However because of institutional complexity involved in developing regional water supply facilities and their related financing, most of the financial process will occur in the latter half of 1999 and into the year 2000 – after this document is submitted to the Court in October 1999.

### Institutional Process

The institutional process consisted of the following tasks:

Task 1 Identify needs and interests of interested parties.

Task 2 Establish a meeting schedule necessary to complete the OBMP within the time frame allocated.

Task 3 Develop and refine the scope of work based on identified needs.

Task 4 Identify early implementation actions and develop a list of potential program (management) elements of the OBMP to balance needs and interests.

Task 5 Evaluate program elements and develop recommended management and implementation plan.

The first three tasks were completed with the submission of the recommended scope of work to the Special Referee and the Court. Task 4 work was begun in June 1998 with several early implementation action items having already been approved and with initial management concepts submitted to begin the list of potential program elements of the OBMP. The management concepts that were submitted represented concepts or implementation plans that described the party's vision of the OBMP. Submission of management concepts continued into July and August of 1998 and reflected the needs and interests that were previously identified for the OBMP. All proposals submitted were discussed and listed.

As part of Task 5, those proposals that appeared the most promising were forwarded to the engineering and financial consultants for reconnaissance-level, technical, economic and financial analyses. The results of the engineering and financial analyses were submitted to the producers and Watermaster for

review. Working together, the producers and the Watermaster Board have developed an Optimum Basin Management Program for the Chino Basin.

**Engineering Process**

The engineering process consisted of the following tasks:

Task 1 Develop Optimum Basin Management Program Criteria

Task 2 Assess Current State of the Basin

Task 3 Prepare Sections 1, 2, and 3 of the Optimum Basin Management Program document

Task 4 Develop the Components of the Optimum Basin Management Program

Task 5 Develop Implementation Plan

Task 6 Finalize Optimum Basin Management Program document

Tasks 1 and 2 define the basin problems, planning environment, and the needs and interests of the basin producers. Tasks 1, 2, and 3 were completed in December 1998 and draft Sections 1, 2, and 3 of the OBMP were provided to all interested parties for review. A matrix was developed that contains the goals, impediments to the goal, action items to achieve the goals and the implications of the action items. This matrix was used to define the program elements of the OBMP. Tasks 4 and 5 were engineering efforts to develop these elements and to describe the implementation process.

Over time, the institutional process Tasks 4 and 5, and engineering process Tasks 4 and 5 merged and became one seamless process. Completion of engineering process Task 6 will be completed when the financial process is completed sometime in the year 2000.

## ORGANIZATION OF THE OPTIMUM BASIN MANAGEMENT PROGRAM REPORT

The OBMP report is being presented in two phases. This document is the Phase I report and contains a description of the OBMP and the following additional sections:

*Section 2 – Current Physical State of the Basin* – This section describes the state of the Basin in terms of historical groundwater levels, storage, production, water quality, and safe yield. Current and projected water demands and water supply plans are described. Problems in these areas are identified and potential solutions or solution processes are described.

*Section 3 – Goals of the Optimum Basin Management Program* – This section describes the major issues defined by stakeholders in the OBMP process, the mission statement for the OBMP process and the goals for the OBMP process.

*Section 4 – Management Plan* – This section describes program elements to achieve the goals of the OBMP, a management plan, and a process to periodically review and update the OBMP.

*Appendix A – Public Comments*. This appendix contains written correspondence and a transcript of public comments on the OBMP from a Watermaster hearing held on September 15, 1999 (bound separately).

The technical memoranda produced to support the program elements and implementation process described in Section 4 are on file at the Watermaster offices. Copies are available upon request.

The Phase II report consists of more detailed descriptions of capital-intensive and institutionally complex features of the OBMP. The Phase 2 report will be bound separately.

# SECTION 2
# STATE OF THE BASIN

This section has been prepared for the OBMP stakeholders so that they will have a common starting point or frame of reference from which to develop the OBMP. The stakeholders developed the outline of this section with input from the Special Referee.

This section of the OBMP report describes the Basin, its physical state, future water demands in the Chino Basin area, and concludes with a summary of problems within the Basin. The physical state of the Basin includes a description of groundwater levels, groundwater storage, production patterns, groundwater quality, and safe yield. These characteristics of the Basin are intimately related, as are the solutions to the problems associated with these characteristics. Water demands in the Chino Basin area include an estimate of current water usage and future water demand projections for groundwater and other sources, an assessment of water quality conditions, and future projections of wastewater generation – including the relationship of source water quality and wastewater quality.

## DESCRIPTION OF THE BASIN

The Chino Basin consists of about 235 square miles of the upper Santa Ana River watershed. Figure 1-1 illustrates the boundary of the Chino Basin as it is legally defined in the stipulated Judgment in the case of Chino Basin Municipal Water District vs. the City of Chino *et al.* Figure 1-1 also shows the hydrologic boundary of the Basin, which is slightly different from the adjudicated boundary. Chino Basin is an alluvial valley that is relatively flat from east to west and slopes from the north to the south at a one to two percent grade. Valley elevation ranges from about 2,000 feet in the foothills to about 500 feet near Prado Dam. Chino Basin is bounded:

- on the north by the San Gabriel Mountains and the Cucamonga Basin;
- on the east by the Rialto-Colton Basin, Jurupa Hills, and the Pedley Hills;
- on the south by the La Sierra area and the Temescal basin; and
- on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins.

The Chino Basin is one of the largest groundwater basins in southern California with about 5,000,000 acre-ft of water in the Basin and an unused storage capacity of about 1,000,000 acre-ft. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies; and about 300 to 400 agricultural users produce groundwater from the Basin. The Chino Basin is an integral part of the regional and statewide water supply system. Prior to 1978, the Basin was in overdraft. After 1978, the Basin has been operated as described in the 1978 Judgment in Chino Basin Municipal Water District vs. City of Chino *et al*. (Chino Judgment or Judgment).

## SURFACE WATER RESOURCES

The principal drainage course of the Chino Basin is the Santa Ana River. It flows 69 miles across the Santa Ana Watershed from its origin in the San Bernardino Mountains to the Pacific Ocean. The Santa Ana River enters the Basin at the Riverside Narrows and flows along the southern boundary to the Prado Flood Control Reservoir where it is eventually discharged through the outlet at Prado Dam. Chino Basin is traversed by a series of ephemeral and perennial streams that include: Chino Creek, San Antonio Creek, Cucamonga Creek, Deer Creek, Day Creek, Etiwanda Creek and San Sevaine Creek. Figure 2-1

illustrates the stream system in the Chino Basin. San Antonio Creek joins Chino Creek and along with Cucamonga Creek, discharges directly into the Prado Reservoir. Cucamonga Creek changes its name to Mill Creek just north of the Prado Reservoir. Deer Creek was realigned and now discharges into Cucamonga Creek. Currently, Etiwanda Creek discharges into Day Creek at Wineville Basin. In the near future, Etiwanda Creek will be joined with San Sevaine Creek. Day Creek and San Sevaine Creek flow south and enter the Santa Ana River upstream of the Prado Reservoir.

These creeks carry significant flows only during, and for a short time after, intermittent storms that typically occur from November through March. Year-round flow occurs along the entire reach of the Santa Ana River due to year round surface inflows at Riverside Narrows, discharges from municipal water recycling plants that discharge in the River between the narrows and Prado Dam, and rising groundwater. Rising groundwater occurs in Chino Creek, in the Santa Ana River at Prado Dam, and potentially other locations on the Santa Ana River depending on climate and season. The rising groundwater in Chino Creek and the Santa Ana River contains high concentrations of total dissolved solids (TDS). Year-round discharges are sustained:

- in Chino Creek from the Inland Empire Utilities Agency (IEUA) Regional Plant No. 2 (RP2) to the Prado Reservoir, the source of which is from recycled water discharges from RP2; and
- in Cucamonga Creek from IEUA Regional Plant No. 1 (RP1) to the Prado Reservoir, the source of which is from recycled water discharges from RP1.

Significant nuisance flows have developed in Cucamonga Creek above RP1, the source of which is excess landscape irrigation and other outside urban uses. Some of the storm water runoff from the San Gabriel Mountains and urban areas is diverted for recharge in flood retention and spreading basins. These basins are shown in Figure 2-1.

**Geology**

Chino Basin was formed when eroded sediments from the San Gabriel Mountains, the Chino Hills, Puente Hills, and the San Bernardino Mountains filled a structural depression. The formation of the Basin is described in detail in the *Final* Task 2.2 and 2.3 Report, Describe Watershed Hydrology and Identify Current TDS and TIN Inflows in the Watershed (Wildermuth, 1997). The bottom of the Basin – the effective base of the freshwater aquifer – consists of impermeable sedimentary and igneous rocks. The base of the aquifer is overlain by older alluvium of the Pleistocene period followed by younger alluvium of the Holocene period.

The younger alluvium varies in thickness from over 100 feet near the mountains to a just few feet, south of Interstate 10 and generally covers most of the north half of the Basin in undisturbed areas. The younger alluvium is not saturated and thus does not yield water directly to wells. Water percolates readily in the younger alluvium and most of the large spreading basins are located in the younger alluvium.

The older alluvium varies in thickness from about 200 feet thick near the southwestern end of the Basin to over 1,100 feet thick southwest of Fontana, and averages about 500 feet throughout the Basin. Well capacities range between 500 and 1,500 gallons per minute (gpm). Well capacities exceeding 1,000 gpm are common, with some modern production wells test-pumped at over 4,000 gpm (e.g., Ontario Wells 30 and 31 in southeastern Ontario). In the southern part of the Basin where sediments tend to be more clayey, wells generally yield 100 to 1,000 gpm. Three main water-bearing (hydrostratigraphic) units were identified by Montgomery Watson (1992) during the development of a three-dimensional groundwater model of the Basin. Figure 2-2 shows the locations of two (of seven) generalized cross-sections through

the Chino Basin. These generalized cross-sections illustrate these main aquifer units and are shown in Figures 2-3 and 2-4.

Faults are one of the principal agents in the development of the landscape and restriction of groundwater flow in the Chino Basin. The basin is bounded by major fault systems along which the mountains and hills have been uplifted. The location of fault and groundwater barriers, and displacements in the effective base of the aquifer at faults are shown in Figure 2-2. The faults and groundwater barriers are significant in that they define the external boundaries of the Basin and influence the magnitude and direction of groundwater flow near the boundaries.

### MAJOR FLOW SYSTEMS

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct basins. Figure 2-5 is a groundwater elevation contour map for fall of 1997. Figure 2-5 also shows the location of five groundwater flow systems developed during the *TDS and Nitrogen Study* (Wildermuth, 1999) of which the Watermaster, the Chino Basin Water Conservation District (CBWCD), and the IEUA are study participants. Each flow system has a unique hydrology, and water resource management activities that occur in each flow system have little or no impact on the other systems. Each flow system can be considered a management zone. These management zones can be subdivided further if necessary to define and manage flow systems at a finer scale. These management zones are used to characterize the groundwater level, storage, production, and water quality conditions. Figure 2-6 shows these management zones relative to the subbasins used in the 1995 Regional Water Quality Control Plan (Basin Plan) for the Santa Ana Watershed. The Regional Water Quality Control Board, Santa Ana Region (Regional Board) has established water quality objectives for these subbasins and writes waste discharge requirements for waste dischargers based in part on these objectives. Presently, the Basin Plan subbasin boundaries and objectives are being rigorously reviewed. New boundaries similar to the management zone boundaries have been proposed. Revised boundaries and water quality objectives should be adopted sometime in the year 2000.

**Management Zone 1.** Management Zone 1 is bounded:

- on the southwest by the Chino and Puente Hills,
- on the northwest by the San Jose fault that separates Chino Basin from the Pomona and Claremont Heights Basins,
- on the north by an unnamed non-echelon fault system associated with the Cucamonga and Red Hill faults and separates the Chino Basin from the Cucamonga Basin,
- and on the east by a line that stretches from the southern most edge of the Red Hill fault to Prado Dam.

Groundwater in Management Zone 1 flows generally south with some localized flows to the west in response to groundwater production. Sources of water to Management Zone 1 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins, and subsurface inflow from the Pomona, Claremont Heights, and Cucamonga Basins. Discharge is through groundwater production and as rising groundwater in Chino Creek and the Santa Ana River.

**Management Zone 2.** Management Zone 2 is bounded:

- on the west by Management Zone 1,
- on the north by the Red Hill fault that separates the Chino Basin from the Cucamonga Basin,
- on the northeast by a segment of the Rialto-Colton fault,
- and on the east by a segment of Barrier J and a line extending from Barrier J in a southwesterly direction to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 2 flows generally in a southwesterly direction in the northern half of the management zone and then due south in the southern half of the zone. Sources of water to Management Zone 2 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins and subsurface inflow from the part of the Rialto Basin northwest of Barrier J and the Cucamonga Basin. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

**Management Zone 3.** Management Zone 3 is bounded:

- on the west by Management Zone 2,
- on the northeast by the Rialto-Colton fault that separates the Chino Basin from the Rialto Basin,
- on the southeast by the Bloomington divide, Jurupa Hills and line projecting from the most western extension of the Jurupa Hills to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 3 flows generally in a southwesterly direction. Sources of water to Management Zone 3 include direct percolation of precipitation, returns from irrigation, and subsurface inflow from the part of the Rialto Basin southeast of Barrier J. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

**Management Zone 4.** Management Zone 4 is bounded

- on the west by Management Zone 3,
- on the north by the Jurupa Hills,
- on the southeast by the Pedley Hills, and
- on the south by Management Zone 5.

Groundwater in Management Zone 4 flows west. Sources of water to Management Zone 4 include direct percolation of precipitation, and returns from irrigation. Discharge is through groundwater production.

**Management Zone 5**. Management Zone 5 is bounded:

- on the north and west by the Management Zones 3 and 4, Prado Dam,
- on the east by the Riverside Narrows, and
- on the south by the La Sierra area and Temescal Basin.

Sources of water to Management Zone 5 include streambed percolation in the Santa Ana River, direct percolation of precipitation, returns from irrigation and subsurface inflow from the Temescal Basin. Discharge is through groundwater production, consumptive use by phreatophytes, and rising groundwater

in the Prado Reservoir area, and potentially other locations on the Santa Ana depending on climate and season.

## GROUNDWATER LEVELS AND STORAGE

### Historical Groundwater Level Monitoring

Various entities have collected groundwater-level data in the past. Municipal and agricultural water supply entities have historically collected groundwater-level data in programs that range from irregular, study-oriented measurements to long-term periodic measurements. Groundwater-level measurements were made for specific investigations such as various California Department of Water Resources (DWR) studies, the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), and the Chino Basin Judgment (Chino Basin Municipal Water District vs. City of Chino *et al.*). The spatial extent and temporal history of groundwater-level measurements south of State Route 60 have always been less than north of State Route 60. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater-level measurements in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, the water level monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR.

Watermaster conducted its first mass groundwater-level monitoring program for the Chino Basin in the spring of 1986. In 1989, Watermaster initiated a more regular monitoring program for the Basin with groundwater-level measurements obtained in 1990, and periodically thereafter through 1997. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater-level measurements on a cooperative basis. Watermaster staff supplements these data with groundwater-level measurements collected by staff, primarily south of State Route 60. In addition to Watermaster staff efforts, private contractors conducting well efficiency tests collect groundwater-level measurements and submit these measurements to Watermaster. Watermaster has digitized all of these recent measurements. Watermaster has combined digitized groundwater-level measurements from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster began a process to develop a comprehensive groundwater-level monitoring program in the spring of 1998. The process consists of collecting groundwater-level data at all wells in the Basin from which groundwater-level measurements can be obtained for fall 1999, spring 2000, fall 2000, and spring 2001. These data will be mapped and reviewed. Based on this review and Watermaster management needs, a long-term water-level monitoring program will be developed and implemented in the fall of 2001.

### Historical Groundwater Levels

This section describes the groundwater-level time histories in the Chino Basin by management zone and characterizes the differences between management zones. Figure 2-7 illustrates the location of wells whose groundwater-level time histories are discussed herein and the management zone boundaries described in Section 1. The wells were selected based on length of record, completeness of record, and geographical distribution. Wells discussed herein are identified by their state well number. The behavior of groundwater-levels at specific wells is compared to climate, to pre- and post-Judgment periods, and to other factors as appropriate.

**Management Zone 1.** Wells 01S07W08N01 (Figure 2-8) and 01S08W11R01 and 01S08W14A03 (Figure 2-9) illustrate typical groundwater-level time histories in the northern end of Management Zone 1. The accumulated departure from mean precipitation (ADFM) curve is plotted on Figures 2-8 and 2-9 to illustrate climatic conditions. Positive sloping lines on the ADFM curve imply wet years or wet periods. Negatively sloping lines imply dry years or dry periods. For example, the period between 1937 to 1944 and 1978 to 1983 are extremely wet periods, and are represented as positively sloping lines. The period 1945 through 1977 is a drought period and is represented as a negatively sloping line, punctuated with a few wet years (positively sloped in 1952, 1958 and 1969). Short-term groundwater-level fluctuations shown in these figures are caused by including static and dynamic observations in the groundwater-level time histories. These time histories follow the climatic trends very closely with the 01S08W11R01 and 0S08W14A03 (westernmost wells) being slightly more sensitive to high rainfall years than 01S7W08N01 (eastern well). The groundwater-level response in well 01S7W08N01 lags the 1937 to 1944 and the 1978 to 1983 wet periods by about three to four years. By comparison, wells 01S08W11R01 and 0S08W14A03 responded to the 1978 to 1983 wet period within a year. The difference in response time is due to proximity of recharge to the area near the wells. Wells 01S08W11R01 and 0S08W14A03 are relatively close the Upland and Montclair Basins. Well 01S7W08N01 is two miles east of wells 01S08W11R01 and 0S08W14A03 with no significant recharge facilities nearby. In addition, the Metropolitan Water District of Southern California (MWDSC) recharged large quantities of State Water Project (SWP) water in the Montclair Basins during the period 1978 to 1983. The depth to water in the vicinity of these wells ranged from about 460 feet in the late 1920s to about 600 feet in 1996.

Wells 01S08W28E01 (Figure 2-10) and 01S08W31J01 and 01S08W33D01 (Figure 2-11) are about three miles south of wells 01S08W11R01 and 01S08W14A03 (Figure 2-9). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958, and 1969. The post-1977 groundwater-level increase is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The groundwater-level response in these wells responded to the 1978 to 1983 wet period within a year. The depth to water in the vicinity of these wells ranged from about 130 to 160 feet in the late 1920s to about 150 to 280 feet in 1996 with well 01S08W28E01 showing the greatest depth to water. Well 01S08W28E01 is a municipal production well owned by the City of Pomona and is located in an area of regionally depressed groundwater levels.

Wells 02S08W04P01 and 02S08W12F01 (Figure 2-12) are located about two to three miles south of well 01S08W28E01 (Figure 2-10) and wells 01S08W31J01 and 01S08W33D01 (Figure 2-11). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958 and 1969. The groundwater-level responses in these wells lag the 1937 to 1944 and the 1978 to 1983 wet periods by about two to three years. The response to the 1937 to 1944 wet period is surprisingly subtle compared to most other wells with contemporaneous time histories in Management Zone 1. This suggests that recharge in the area is low and that production is high. The post-1977 groundwater level increase for 02S08W04P01 is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The depth to water in the vicinity of these wells ranged from about 20 to 40 feet in the late 1920s to about 200 feet in 1982.

From north to the south, the following observations can be made regarding time histories of groundwater levels in Management Zone 1:

- groundwater levels are down from observed period of record highs in the late 1920s;
- the lowest groundwater levels were observed around 1977;

- groundwater levels have recovered slightly since 1977 due in part to the wet period of 1978 to 1983, reduction in overdraft after 1977, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water;
- a condition of long-term overdraft has occurred in this management zone with groundwater levels dropping by about 100 to 140 feet between the late 1920s to the present with most of the decline prior to 1977 and the Chino Basin Judgment (1978).

**Management Zone 2.** Figure 2-13 contains groundwater-level time histories for 01S07W14G01, 01S07W27D01, and 02S07W09M01. These wells are aligned north to south, approximately along a flow line. The groundwater-level time histories in Figure 2-13 show a general decline since before the 1937 to 1944 wet period, with little or no response to wet years until 1978. The post-1977 increase is probably due to the combination of 1978 to 1983 wet period, reduction in overdraft following the implementation of the Chino Basin Judgment, the start of artificial replenishment with imported water in the San Sevaine and Etiwanda flood control basins, and the increased use of imported surface water. The depth to water for 01S07W27D01 ranged from about 200 feet in the late 1920s to about 380 feet in 1974, a decline in groundwater levels of about 180 feet.

**Management Zone 3.** Figure 2-14 contains time histories for wells 01S06W11B01 and 01S05W16C01 that are located in the most upgradient part of Management Zone 3. The groundwater-level observations in these wells follow the general climatic trend. The groundwater-level time history for well 01S06W16C01 shows a general decline since the 1920s and a general non-responsiveness to significant wet years or periods. For example, there is a slight response to the 1937 to 1944 and 1978 to 1983 wet periods and no response to wet years in 1952, 1958, and 1969. Well 01S06W11B01 behaves in a similar manner with slightly less responsiveness. The lack of responsiveness is due to the lack of significant sources of recharge. There are no major streams or recharge basins in the upper part of Management Zone 3. The peak groundwater levels for both of these wells are lagged about three years behind the peaks in the ADFM curve for the 1937 to 1944 and 1978 to 1983 wet periods. The depth to water ranges from about 360 to 430 feet in the late 1920s to about 430 to 540 in 1978 for wells 01S05W16C01 and 01S06W11B01, respectively. The groundwater decline from the 1920s to the early 1990s is about 20 feet and 60 feet for wells 01S05W16C01 and 01S06W11B01, respectively. Figure 2-15 is a similar plot for wells 01S05W30L01 and 01S06W23D01. These wells have similar response characteristics as 01S06W11B01 and 01S05W16C01 with about 60 to 70 feet of groundwater decline over the period from the late 1920s to the early 1990s.

The relative amount of decline from 1920s to 1977 is less in Management Zone 3 than in Management Zone 1. This is due to greater production in Management Zone 1 than in Management Zone 3 and because of the specific yield (fraction of usable groundwater per unit volume), which is greater in the eastern portion of Chino Basin than in the western portion. The alluvium in the eastern part of the Chino Basin is derived from granitic rocks of the San Gabriel Mountains. The alluvium on the west side of Chino Basin is derived in part from the San Gabriel Mountains and marine sedimentary rocks of the Chino and Puente Hills. The latter produce finer-grained alluvium with more clay and poorer storage properties.

Figure 2-16 contains time histories for wells 02S06W05B01 and 02S07W34H01. These wells are aligned northeast to southwest, approximately along a flow line. The groundwater-level time histories end in the late 1970s or early 1980s, as is typical for agricultural wells in the southern half of the Basin. These time histories follow the general climatic trend, however, there is trend among the wells of a decreasing climatic influence from northeast to southwest. The depth to water for 02S06W05B01 ranged from 130 feet in the late 1920s, to about 200 feet in 1978, a decline in groundwater levels of about 70 feet.

**Management Zone 4.** Management Zone 4 is bounded on the north by the Jurupa Hills, on the east by the Pedley Hills, on the south by Management Zone 5 and on the west by Management Zone 3. The only outflow from Management Zone 4 is by production. Figure 2-17 contains groundwater-level time histories for wells 02S06W16B02 and 02S06W14C02. These wells generally follow the climatic trend. The depth to water for 02S06W14C02 ranged from about 7 feet in 1945 to about 17 feet in 1993, corresponding to an overall decline in groundwater levels of about 10 feet for this period.

**Management Zone 5**. Management Zone 5 is bounded on the north and west by the Management Zones 3 and 4, on the east by the Riverside Narrows and on the south by various unnamed hills. Figure 2-18 contains time histories for wells 02S07W36H02, 02S06W26D02, and 03S07W03N01. Groundwater levels in these wells follow the general climatic trend. However, wells 2S07W36H02 and 03S07W03N01 are much less responsive than well 02S07W26D02 due to the stabilizing effects of being adjacent to the Santa Ana River. The depth to water for 02S07W26D02 ranged from about 24 feet in 1939 to about 28 feet in 1992, corresponding to an overall decline in groundwater levels of about 4 feet for this period.

For the most part, the response of groundwater levels in the Chino Basin to significant storms and wet climatic periods is small. There are two reasons for this. First, the mountain drainage areas tributary to the Chino Basin are relatively small compared to the size of Chino Basin (235 square miles) and the amount of water in storage (~5,000,000 acre-ft). The mountain drainage areas tributary to the Chino Basin areas are:

| | | |
|---|---|---|
| San Antonio Creek | 17.7 | sq mi |
| Cucamonga Creek | 13.6 | |
| Deer Creek | 6.4 | |
| Day Creek | 7.7 | |
| Etiwanda Creek | 6.7 | |
| San Sevaine Creek | 9.7 | |
| Total | 61.7 | sq mi |

San Antonio Creek is mostly diverted for direct use and recharge in the Claremont Heights and Cucamonga Basins. Cucamonga, Deer, and Day Creeks are diverted for direct use and recharge in the Cucamonga Basin. Large storm flows from these creeks can make it into the Chino Basin, however these channels are concrete-lined and consequently large amounts of storm flow are not recharged. In contrast, San Bernardino area groundwater basins (Bunker Hill and Lytle Basins) – located just to the east of the Chino Basin – consist of about 120 square miles of aquifer and with about 466 square miles of tributary areas in the San Gabriel and San Bernardino mountains. The groundwater level response in the Chino Basin due to wet years is small, on the order of a few feet to tens of feet. In contrast, the San Bernardino area groundwater-level response to significant wet years and climatic periods could range from 100 to 300 feet.

### Regional Groundwater Level Changes

Figures 2-19 and 2-20 are groundwater elevation contour maps for the Chino Basin for 1997 and 1933, respectively. The 1997 map is based on data collected in Watermaster's ongoing monitoring programs and is representative of current conditions. The 1933 map is based on groundwater-level data compiled and mapped by the DWR. Figure 2-21 shows the change in groundwater level from 1933 to 1997 based on the groundwater elevation maps for 1933 and 1997. The regional groundwater decline by management zone is:

| Management Zone | Range |
|---|---|
| 1 | 50 to 150 feet |
| 2 | 50 to 100 feet |
| 3 | 50 to 100 feet |
| 4 | less than 50 feet |
| 5 | less than 50 feet |

Figure 2-22 is a map similar to Figure 2-21 with the water service area boundaries shown in place of management zone boundaries. The areas of greatest regional groundwater decline underlie the city of Pomona, the Monte Vista Water District, the City of Chino, and the western half of the City of Ontario.

Figure 2-23 shows the depth to water for fall 1997. Mendenhall surveyed the Basin in 1902 and found parts of the Chino Basin to be artesian as evidenced by springs and marshy areas (Mendenhall, 1904). This artesian area is also shown on Figure 2-23. In the artesian areas, the historical groundwater level or piezometric surface was at or exceeded the ground surface. Figure 2-23 suggests that the regional groundwater decline in the western Chino Basin is up to 200 feet since 1902. Groundwater levels appear to have stabilized since the Chino Basin Judgment was implemented and groundwater production has been managed within the Basin's safe yield. However, there may still be areas experiencing localized overdraft including the area overlain by the Cities of Chino, Chino Hills, Pomona, the western portion of the City of Ontario, and the Monte Vista Water District. Todd defines the *safe yield* of a groundwater basin as the amount of water that can be withdrawn annually without producing an undesirable result. Withdrawal or production is excess of safe yield is an *overdraft*. Domenico (1972) defines undesirable results to include not only the depletion of groundwater in storage but also intrusion of water of undesirable quality, contravention of existing water rights, and the deterioration of the economic advantages of pumping. Cherry (1979) includes subsidence in the list of undesirable results.

The significant issues related to large-scale regional groundwater declines in the Chino Basin include: decline in storage, higher pumping costs, loss of production capacity, water quality degradation, and subsidence.

In the mid-1970s, ground fissuring was identified in the southwestern portion of Chino Basin. Ground fissuring in this area has continued to the present, and subsidence has been documented and identified as the cause of ground fissuring (Kleinfelder, 1993; 1996). Kleinfelder documented regional subsidence through an analysis of topographic benchmarks from 1987 to 1993, 1993 to 1995, and from 1995 to 1999. The resulting contour maps of equal differences in elevation revealed a north-south trending, elongated area of subsidence underlying the City of Chino and California Institute of Men (CIM) (see Figures 2-23 and 2-24). Maximum subsidence over the period 1987-1995 was reported to be about 2 feet located along Central Avenue between Schaefer and Eucalyptus Avenues. However, about one foot (or 50 percent) of this subsidence occurred over the period from 1993-1995 – indicating that the rate of subsidence has increased. This was confirmed independently by scientists at the Jet Propulsion Laboratories using remote sensing (see www-radar.jpl.nasa.gov/sect323/InSar4crust/LosAngeles.html). Kleinfelder (1993; 1996) concluded that regional subsidence was caused by localized groundwater overdraft and declining groundwater levels. The reasoning to support this conclusion is four-fold:

- As shown in Figure 2-23, the area of regional subsidence and ground fissuring geographically coincides with the late 1800s artesian area mapped by Mendenhall (1904, 1908) – an area that has experienced extreme declines in groundwater levels.

- Subsidence is well documented in areas where underlying soils have experienced extensive fluid withdrawal. In saturated soils, buoyant conditions exist, where stresses between soil particles are low. But as the water level drops, the stresses between soil particles increase and overburden pressure causes soil consolidation.
- The initiation of ground fissuring temporally coincides with new groundwater production by the city of Chino Hills in the area of maximum subsidence. By 1975, groundwater levels had declined by a maximum of 200 feet in the former artesian area.
- Regional subsidence and ground fissuring is not attributable to other potential causes of subsidence. The area does not coincide with known faults or groundwater barriers and the area has not experienced significant petroleum extractions.

**Methodology for Estimating Groundwater Storage**

Estimating groundwater storage within the Chino Basin is a critical exercise because of the direct influence of storage upon the safe yield and reliability of the aquifer. The safe yield of a groundwater basin approximates the average annual recharge in a basin if the storage in the basin is large. The larger the storage, the more reliable the basin will be in dry period. The amount of water in storage in the Chino Basin is directly proportional to groundwater level.

The methodology for computing the volume of groundwater in storage consists of the following steps:

1. develop groundwater elevation maps for the basin;
2. obtain and map aquifer storage properties;
3. obtain and map the effective base of the freshwater aquifer;
4. divide the basin into a regular grid – with each grid cell assigned a:
   - groundwater elevation,
   - tops and bottom elevations of each aquifer
   - elevation of the effective base of the bottommost aquifer (*e.g.*, bedrock elevation), and
   - storage properties;
5. compute the volume of groundwater in storage for each grid cell, and sum the storage values of all grid cells.

In most parts of the Chino Basin, unconfined aquifers overlie confined aquifers. Thus, the storage in some grid cells consists of the sum of water in storage in confined and unconfined aquifers. The volume of groundwater in storage in each grid cell is estimated from the following equations:

volume in an unconfined aquifer in a grid cell is given by:

$$V_{i,l} = (GWE_{i,l} - B_{i,l}) * A_i * P_{i,l} \qquad \text{(Equation 1)}$$

volume in a confined aquifer in a grid cell is given by:

$$V_{i,l} = [(GWE_{i,l} - T_{i,l}) * SC_{i,l} + (T_{i,l} - B_{i,l}) * P_{i,l}] * A_I \qquad \text{(Equation 2)}$$

where:

$GWE_{i,l}$ is the groundwater/piezometric elevation for grid cell *i* and aquifer *l*
$T_{i,l}$ is the effective top elevation of a grid cell *i* and aquifer *l*
$B_{i,l}$ is the effective bottom elevation of grid cell *i* and aquifer *l*
$A_i$ is the surface area of grid cell *i*
$P_{i,l}$ is the effective porosity of grid cell *i* and aquifer *l*
$SC_{i,l}$ is the storage coefficient of a grid cell *i* and aquifer *l*

Not all the water in storage is available for production. A minimum volume of groundwater must be maintained in storage to ensure that groundwater can flow to wells. This minimum storage is included in the volume computations described above.

A maximum storage could also be defined, although it is more difficult to do so. The difficulties associated with maximum storage relate to defining which high groundwater-level impacts are acceptable and to whom. An across-the-basin increase of 50 feet would probably impact only those lands near the Santa Ana River with unknown water quality impacts everywhere.

**Time History of Groundwater Storage for the Basin**

Groundwater-level maps were prepared using all available data for 1933, 1965, 1969, 1974, 1977, 1983, 1991, and 1997. Aquifer geometry and storage properties were developed from the Chino Basin Water Resources Management Study (CBWRMS) (Montgomery Watson, 1995). Equations 1 and 2 were used to estimate the groundwater in storage for these years. Figures 2-19 and 2-20 illustrate the spatial distribution of groundwater elevations within the Chino Basin for the fall 1997 and 1933, respectively. The estimated volume of groundwater in storage in the Chino Basin using this methodology and information was:

| Year | Volume (acre-ft) |
|---|---|
| 1933 | 6,300,000 |
| 1997 | 5,300,000 |

Groundwater storage decreased by about 1,000,000 acre-ft during the 64-year period of 1933 to 1997. Table 2-1 lists the estimated storage in each of the management zones shown in Figure 2-5 and aggregations of the management zones into the Lower Chino Basin (south of State Route 60), the Upper Chino Basin (north of State Route 60) and the Total Chino Basin. The storage estimates in Table 2-1 are shown graphically in Figures 2-25 and 2-26. The lowest level of groundwater storage during the period 1960 to the present occurred in 1977 at the end of a 33-year drought. Prior to 1977, groundwater storage was falling at a rate of about 25,500 acre-ft/yr. The decline in storage was due to drought and groundwater production in excess of sustainable yield. The period of 1978 though 1983 was an extremely wet period. The physical solution with the Chino Basin Judgment was implemented in 1978. The end of the drought and the elimination of basin-wide overdraft caused an increase in storage. Table 2-1 shows the change in storage relative to 1977 (the lowest level of storage) for the period 1965 to 1997. The losses in storage that occurred during the period 1965 to 1977 have been partially offset by gains in storage that occurred after 1977.

Figure 2-27 shows the time history of storage in the upper and lower parts of the Chino Basin. There was a decline in storage prior to 1977. After 1977, storage in the upper basin increases, however the rate of increase declines over time. This continued increase in storage after 1983 probably is due to:

- accumulation of unproduced safe yield rights in local storage accounts;
- lagged inflows from the deep unsaturated zone in the northern half of the Basin; and
- lagged subsurface inflows from the Lytle Basin north of Barrier J and the Riverside Basin through the Bloomington divide.

After 1977, storage in the lower part of the Basin appears to have stabilized and follows the general climatic pattern.

Table 2-2 and Figure 2-28 show a comparison of the time history of total Chino Basin storage to groundwater production, volume of water stored in cyclic and local storage accounts, and climate. As of fall 1997, the combined volume of water in cyclic and local storage accounts was about 274,000 acre-ft and is greater than the increase in total storage that occurred between 1977 (pre-Judgment) and the present. The increase in storage since 1977 is about 174,000 acre-ft. This is counter intuitive, that is, the change in total storage since 1977 should be greater than the volume of water in cyclic and local storage accounts – especially given that the Basin has experienced a wetter than average period since 1977. The discrepancy may be due in part to under reporting of production in the agricultural pool, storage losses to the Santa Ana River, and inaccuracies in the methods used to compute storage herein.

**Losses From Storage**

The surface water discharge in the Santa Ana River consists of storm flow and baseflow. Baseflow is divided into two components: wastewater discharged from publicly-owned treatment plants (POTWs) and rising groundwater. The rising groundwater component in the Santa Ana River can be divided into two components: short-term storage water from seasonal recharge along the river, and persistent rising water caused by the regional groundwater gradient towards the river. The short-term storage component of rising water will decrease when total groundwater storage is increased either naturally (wet years) or artificially. If total groundwater storage is maintained at higher levels, recharge of surface water from the Santa Ana River will decrease.

Because of the spatial distribution of storage, the rising groundwater response to increases in groundwater storage is often lagged and variable in time. For example, the baseflow at Riverside Narrows (the location where the Santa Ana River enters the Chino Basin) peaks about five to seven years after heavy recharge years in the upstream groundwater basins. Chino Basin groundwater discharge to the river also exhibits a slight lag time. The time history of baseflow at Prado consists of a complicated mix of rising water responses from the Bunker Hill, Riverside, Chino and Temescal Basins. Analysis of the increase in rising water in the Chino Basin caused by an increase in groundwater storage requires the filtering out of these other sources of surface discharge from historical records and modeling results.

The accumulation of groundwater in storage will cause an increase in groundwater discharge in the Santa Ana River and its tributaries Chino Creek and Mill Creek – losses from storage that are not recoverable. The physics of the groundwater storage-baseflow relationship can be represented by linear reservoir theory where outflow is directly proportional to storage:

$$O = K * S \qquad \text{(Equation 3)}$$

where:

O is the outflow from storage ($L^3/T$)

S is volume of water in storage ($L^3$)
K is the linear reservoir coefficient ($T^{-1}$)
L denotes units of length and
T denotes unites of time.

This formula can be calibrated to a specific range of storage and groundwater management conditions. The flow in the Santa Ana River in the Chino Basin was decomposed into rising water from the Chino Basin and other components. The rising water component was subdivided into short-term storage water from seasonal recharge along the river in Management Zone 5, and persistent rising water caused by the regional groundwater gradient towards the River from all management zones. This decomposition was done using simulation model results from the **C**hino Basin **I**ntegrated **G**roundwater and **S**urface Water **M**odel (CIGSM) developed for the Chino Basin Water Resources Management Task Force (Montgomery Watson, 1995, and unpublished modeling results for calibration and planning simulations).

**Historical Storage Losses to the Santa Ana River.** Rising groundwater estimates were made for the period of model calibration 1960 to 1989, and the forecasting period of 1990 to 2040. Certain historical periods were studied to isolate the spatial effects of groundwater production patterns and hydrology on rising groundwater. For example, the period 1960 to 1977 represents the pre-Judgment period that has higher groundwater production than the period after 1978 that represents the period when the Basin was managed by Watermaster without basin-wide overdraft. Linear reservoir theory was used to develop a simple relationship of change in groundwater discharge to the Santa Ana River to incremental change in groundwater storage.

Hydrograph decomposition for the historical period was done using water balance tables from CIGSM for reaches of the Santa Ana River and its tributaries. Analysis of the hydrology of the period suggest that two periods could be used to develop a linear reservoir relationship:

- 1970 to 1977 representing a pre-Judgment period; and
- 1984 to 1989 representing a post-Judgment period.

The period 1970 to 1977 was a dry period following significant recharge along the river from the 1969 storms. The 1984 to 1989 period was also a dry period following the wet period from 1978 to 1983. Both of these periods exhibit recession flows typical of streams fed by groundwater systems. CIGSM model-estimated rising water was plotted against the model-estimated storage in the Chino Basin. The annual rising water estimates and respective storage estimates are shown graphically in Figures 2-34 and 2-35. Simple linear regressions were done for the 1974 to 1977 period and 1987 to 1989 period to estimate the linear reservoir coefficient (K) for the linear reservoir equation (Equation 3). The linear reservoir coefficient is the slope of the best-fit lines in Figures 2-34 and 2-35. The resulting linear reservoir coefficients are 0.0254 for the 1970 to 1977 period, and 0.0203 for the 1987 to 1989 period. Physically, the linear reservoir coefficient represents the fraction of the storage that annually becomes rising water. Thus, an increase in storage of 100,000 acre-ft in the 1987 will cause about 2,000 acre-ft of new rising water in the first year. Groundwater storage after the first year would be reduced to 98,000 acre-ft. In the second year, the storage would be reduced another 2.03 percent, or 1,970 acre-ft, and so on. The 0.0051 difference in linear reservoir coefficients for the pre- and post-Judgment periods is due in part to changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

**Future Storage Losses to the Santa Ana River.** An estimate of the linear reservoir coefficient for the period 1990 through 2040 was estimated by comparing the total Santa Ana River flow at Prado Dam and groundwater storage for Alternatives 3 and 4 of the CBWRMS. Alternative 3 represents a specific groundwater management strategy that could be implemented. Alternative 4 is identical to Alternative 3 with the addition of a conjunctive use program and an increase in limits for local storage accounts. The

conjunctive use program has three cycles of build up in storage to approximately 300,000 acre-ft and subsequent pump-out periods. The increase in storage in local storage accounts is gradual and incremental throughout the period. The rising water losses from the conjunctive use storage and the increase in local storage accounts are simply the difference in Santa Ana River flow between these alternatives. Table 2-3 lists the differences in groundwater storage and Santa Ana River flow. The linear reservoir coefficient for future conditions is estimated to be about 0.0408, or 4.1 percent of storage – about double that of the 1984 to 1989 period. The increase in the linear reservoir coefficient was caused by changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

**Computation of Storage Losses to Santa Ana River.** The linear reservoir equation can be used to estimate losses from groundwater storage accounts to the Santa Ana River:

$$q_t = K * (S_t + 0.5 * T *(I_t - Q_t)) \qquad \text{(Equation 4)}$$

where:

- $q_t$ is the annual loss from a storage account in period *t* to *t+1* (acre-ft/yr)
- K is the linear reservoir coefficient
- $S_t$ is water in a storage account at the end of period *t* (acre-ft)
- $I_t$ is the water put into a storage account in period *t* to *t+1* (acre-ft/yr)
- $Q_t$ is the water taken from the storage account for use in period *t* to *t+1* (acre-ft/yr)
- T duration of time between *t* to *t+1*, assumed to be one year

The volume of water in storage accounts at the end of a period is equal to:

$$S_{t+1} = S_t + T * (I_t - Q_t - q_t) \qquad \text{(Equation 5)}$$

Using a linear reservoir coefficient of 0.0201 and Equation 4, the total water lost from local storage accounts and cyclic storage since the Judgment became active in 1978 is estimated to be about 50,000 acre-ft or about 18 percent of the volume that Watermaster currently assumed was in storage. The time history of accumulating storage accounts and estimated losses to baseflow are listed in Table 2-4. Watermaster does not currently compute losses from storage accounts. This means that when water in storage accounts is produced, additional overdraft of the Basin will occur. Losses from conjunctive use projects could be very large. In the example in Table 2-3, three filling and withdrawal cycles were done over a 40-year period with each reaching a fill capacity of 300,000 acre-ft. The model estimated losses of over 300,000 acre-ft over three fill and extraction cycles – a loss of over one-third of the water stored. If these losses were not accounted for, the Basin would be overdrafted by 300,000 acre-ft over the 40-year period.

The losses described above were developed from modeling studies. Monitoring to verify these losses has not been done in the past nor is it practical in the future. The measuring errors associated with such a program would be larger than the probable losses from storage. The only practical ways to estimate such losses are to:

- Use a linear reservoir model as described above, or
- Calibrate a groundwater flow model over the period that water is held in cyclic, local, and conjunctive use storage and compare it to a simulation run with the same hydrology that did not have water in these storage accounts. The difference in groundwater discharge to the river would be the losses due to cyclic, local, and conjunctive use storage. Adjustments to storage accounts could be made retroactively or a new loss factor established for the next period.

## GROUNDWATER PRODUCTION

### Historical Groundwater Production Monitoring

Prior to 1975, groundwater production monitoring was not formally done by a single entity for the benefit of the Basin. Municipal and some industrial producers kept production records with some submitting annual production reports to the State Water Resources Control Board (SWRCB). Very few agricultural wells had meters and fewer kept records of production. During the period 1975 to 1978, production monitoring at agricultural wells improved slightly. Most of the agricultural production volumes for the period preceding 1978 are comprised of estimates provided by producers and are not based on direct measurements from in-line flow meters.

Since 1978, Watermaster has collected information to develop production estimates. Production estimates in the appropriative pool and overlying non-agricultural pool are based on totalizing in-line flow meter data provided to Watermaster on a quarterly basis by these producers. Watermaster aggregates these quarterly values to obtain annual production for these pools. Production estimates for the agricultural pool are based in part on totalizing in-line flow meter data, water duty methods, and hour-meter data combined with well efficiency tests. As with the other pools, reporting is done by the producers. However, not all agricultural pool producers provide Watermaster with estimates of their production. About one third of agricultural pool producers either did not file production reports or filed incomplete reports in fiscal year 1997/98 (telephone discussion with Jim Theirl, 1998).

### Historical Groundwater Production

Table 2-4 contains estimates of annual groundwater production in the Chino Basin from three different sources: summaries of SWRCB filings and interviews with some producers; Watermaster estimates, and production estimates developed for calibration of CIGSM developed for the CBWRMS. The second column in Table 2-5 contains annual production estimates that were used to develop the safe yield in the Judgment. The third column contains Watermaster estimates of annual production that are based on production reports submitted to Watermaster by the producers. The fourth column contains annual production estimates that are based on SWRCB filings, production reports from producers, and water duty methods. In the latter case, water duty methods were used as a check on reported production and supplemented reported production data when production data was missing or under-reported at wells.

The safe yield of the Chino Basin was based on the hydrology of the period 1965 to 1974. The average annual groundwater production for that period from SWRCB filings and interviews was estimated at 152,100 acre-ft/yr. The engineer working on the historical production data knew there was *unaccounted for* production and assumed that actual production was 20 percent more than the estimate from SWRCB filings and interviews, or about 180,000 acre-ft/yr (Carroll, 1977). This estimate is close to the 189,400 acre-ft/yr average for the same period from the CBWRMS.

In Table 2-5, the period of Watermaster groundwater production estimates overlaps the period of CBWRMS production estimates. For their common period of record (1975 through 1989), the CBWRMS estimates are consistently higher. This occurs in part because some of the agricultural producers fail to report production or fail to provide production information to Watermaster. For the CBWRMS, water demands based on land use were compared to reported production. If the water demand for the land uses in a given area was greater than reported production, then reported production was increased to meet the demands based on land use. This method was validated in the CIGSM model calibration process (Montgomery Watson, 1993). In the latter years, the CBWRMS production estimates increasingly diverge from Watermaster estimates. For their common period of record, the average annual groundwater production was estimated at 147,900 acre-ft/yr by Watermaster and 174,000 acre-ft/yr by the CBWRMS – a difference of about 26,000 acre-ft/yr. Actual production is probably somewhere in between Watermaster and CBWRMS estimates.

**Spatial and Temporal Changes in Groundwater Production**

Table 2-6 lists Watermaster's estimates of Chino Basin production by pool for the period of fiscal year 1974/75 to 1997/98, and the relative amount of production by pool. Over this period, groundwater production has ranged from a high of 181,000 acre-ft/yr (1975/76) to a low of about 122,600 acre-ft/yr (1982/83), and has averaged about 147,100 acre-ft/yr. The distribution of production by pool has shifted since 1975 with the agricultural pool production dropping from about 55 percent in 1974/75 to 28 percent in 1996/97. During the same period, appropriative pool production increased from about 40 percent in 1974/75 to 68 percent in 1996/97. The increases in appropriative pool production have kept pace with decline in agricultural production. Production in the overlying non-agricultural pool declined from about 5 percent in 1974/74 to about 2 percent in the mid-1980s, rose to about 4 percent by 1990/91 and has remained at about 4 percent of total production thereafter.

Figure 2-29 is a plot that compares the change in total groundwater production in the Chino Basin to the change in urban and agricultural/other non-urban land uses. Prior to 1980, the decline in groundwater production appears proportional to the decline in agricultural and other non-urban land uses. After 1980, groundwater production appears to be relatively stable even though the decline in agricultural and other non-urban land uses is accelerating.

Figures 2-30 and 2-31 are similar to Figure 2-29 except they represent the Basin north of State Route 60 and south of State Route 60, respectively. North of State Route 60, the pattern of land use change is similar to the entire basin, but the groundwater production that was declining from 1960 to 1980 rose sharply after 1980. South of State Route 60, groundwater production was generally declining throughout the period of 1960 to 1990. The rate of decline in production in the southern half of the Basin after 1980 matches the rate of increase in production north of State Route 60, such that the total annual production in the Basin after 1980 is relatively constant (see Figure 2-29).

Figures 2-32 through 2-36 illustrate the location and magnitude of groundwater production at wells in the Chino Basin for years 1960, 1970, 1980, 1989 and 1997. These maps are based on production estimates developed in the *Chino Basin Water Resources Management Study* (Montgomery Watson, 1995) and by Watermaster. Two trends are evident in the period 1960 through 1998:

- In the southern half of the Basin there is an increase in the number of active wells and a decrease in the per well production. This is due to the land use transition from predominately irrigated agriculture uses to predominately dairy uses and due to a recent well inspection program, resulting in more wells of record.

- In the northern half of the Basin there is an increase in the number of wells producing over 2,000 acre-ft/yr. This is consistent with the land use transition from agricultural uses to urban uses and with the trend for increasing imported water costs.

### Groundwater Production and Safe Yield

Recent and past studies have provided some insight into the influence of groundwater production in the southern end of the Chino Basin on the safe yield of the Basin. Three studies were done that quantified the impacts of proposed desalters in the lower Chino Basin on groundwater discharge to the Santa Ana River. The proposed desalters were first described in *Nitrogen and TDS Studies, Upper Santa Ana Watershed* (James M. Montgomery, Consulting Engineers, Inc., 1991). This study matched desalter production to meet future potable demands in the lower Chino Basin through the year 2015. The well fields were sited to maximize the interception of rising water and to induce streambed percolation in the Santa Ana River. The decrease in rising water and the increase in streambed percolation were projected to range from 45 to 65 percent of total desalter production.

Well field design studies for the SAWPA desalter provided estimates of the volume of rising water intercepted by the currently proposed desalter – scheduled for completion in March 2000 (Wildermuth, 1993). These studies used a very detailed model of the lower Chino Basin (rectangular 400-foot by 400-foot grid covering the lower Chino Basin) to evaluate the hydraulic impacts on rising water and groundwater levels at nearby wells. These studies showed the relationship of interception of rising water to well field location and well field capacity. The fraction of the desalter production composed of decreased rising water and the increased stream bed percolation water was estimated to range from 40 to 50 percent.

No formal studies and estimates of desalter well field interception of rising water were made during the *Chino Basin Water Resources Management Study* (Montgomery Watson, 1995). An informal estimate of the interception of rising water was made by Wildermuth (letter to Neil Cline, dated August 9, 1993). Wildermuth used the groundwater model developed in *Chino Basin Water Resources Management Study* for a well field similar to the SAWPA desalter well field and used the model calibration period of 1960 to 1989. This study estimated the interception of rising groundwater at about 80 percent of desalter production capacity.

These three studies suggest that the yield of the Basin could be increased by simply increasing the production near the river, and that for every two acre-ft of new, near-river production the safe yield could be increased by one acre-ft, that is the marginal change in safe yield with increased near-river production is about 0.5 acre-ft/yr per acre-ft/yr of production. The opposite is also true. That is, if production were to decrease in the southern half of the Basin, the safe yield will also decrease. Agricultural production is projected to decrease about 40,000 acre-ft/yr when current agricultural land use transitions to urban use. If the magnitude and spatial distribution of current agricultural production is not replaced with new production then the yield of the Chino basin will decrease by a comparable amount.

## HISTORICAL AND CURRENT GROUNDWATER QUALITY

### Historical Groundwater Quality Monitoring

Various entities have collected groundwater quality data in the past. Municipal and agricultural water supply entities have collected groundwater quality data to comply with Department of Health Services requirements under Title 22 or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the DWR, by

participants in the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), by dischargers under order from the Regional Board, and by the County of San Bernardino. The DWR and the SBCFCD were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and Norco, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (Metropolitan) conducted the first comprehensive survey of groundwater quality covering all constituents regulated in California Code of Regulations Title 22.

In 1989, Watermaster initiated a regular monitoring program for the Basin with groundwater quality data obtained in 1990 and periodically thereafter to the present. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster staff supplements this data with data obtained through a Watermaster sampling and analysis program in the area south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under orders of the Regional Board. Watermaster has combined previously digitized groundwater quality data from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster plans to begin the development of a new, more comprehensive water quality monitoring program to support the OBMP starting in July 1999. The program consists of two phases. The initial phase consists of collecting and analyzing groundwater quality samples at all producing wells in the over a three year period starting in July 1999. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed The second phase consists of implementing the long term monitoring program and will start in July 2002.

**Water Quality Conditions**

Sources of water quality degradation can be classified into point and non-point sources. Point sources are confined to point discharges to the soil, groundwater, or stream systems. Examples include conventional wastewater and industrial discharges to streams or ponds, and leaky underground storage tanks. Non-point sources are areal discharges to soil, groundwater and surface waters, such as land application of waste and fertilizers and atmospheric deposition of contaminants to the soil and water bodies. The discussion below describes the water quality state of the Basin as it exists today for specific constituents of concern. The constituents described below are regulated for drinking water purposes in *California Code of Regulations, Title 22* or are regulated in the *1995 Water Quality Control Plan for the Santa Ana River Basin* (Basin Plan).

Figures 2-37a-h illustrate land uses in the Chino Basin in 1933, 1949, 1957, 1963, 1975, 1984, 1990 and 1993. These land use maps were developed from DWR land use surveys for 1933 through 1984, and from Southern California Association of Governments surveys for 1990 and 1993. The maps show a steady, dramatic change over time from agricultural to urban land uses. An exception to this occurs in the southern Chino Basin where dairies have moved in to replace irrigated and non-irrigated agriculture. These maps are useful in characterizing water quality degradation associated with non-point source loading from agriculture. The land uses shown in these maps are quantified in Table 2-7.

**Total Dissolved Solids (TDS).** TDS is regulated as a secondary contaminant in Title 22. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L, however the upper limit is 1,000 mg/L. For irrigation uses, TDS should generally be less than 700 mg/L. The Regional Board has established TDS limitations for all municipal wastewater plants that discharge

recycled water to the Santa Ana River. A problem arises in that TDS concentrations increase through municipal use -- typically by about 150 to 250 mg/L. The TDS limitations for water recycling plants that discharge to the Santa Ana River in the Chino Basin are listed below:

| Plant | TDS Limit (mg/L) |
|---|---|
| IEUA RP1 | 540 |
| IEUA RP2 | 610 |
| IEUA Carbon Canyon | 555 |
| IEUA RP4 | 505 |
| Western Riverside Regional | 625 |
| City of Riverside | 650 |
| Jurupa Indian Hills | 650 |

The TDS in source (drinking) water generally must be kept well below 500 mg/L (preferably less than 300 mg/L) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets Regional Board limitations. The treatment cost to remove TDS from water is very expensive – about $500 to $700 per ton.

Table 2-9 provides the average TDS concentrations by well for five-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 2-38, 2-39, and 2-40 show average TDS concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Historically, TDS has not been measured at wells on an annual basis. The choice of one year, say 1963 for example, might have only one-third as many TDS measurements at wells compared to a five-year period. Thus, averaging TDS over a five-year period was necessary to get adequate spatial coverage of measurements.

TDS concentrations in the northeast part of the Basin range from about 170 to about 300 mg/L for the period 1960 through 1990, with typical concentrations in the mid- to low-200s. TDS concentrations in excess of 200 mg/L indicate degradation from overlying land use. With few exceptions, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation, such as the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near IEUA Regional Plant No. 1 (RP1) in South Ontario. The TDS anomaly from Kaiser is not shown on Figures 2-38, 2-39 and 2-40. A TDS anomaly from former municipal wastewater ponds can be seen in the east central part of Management Zone 2.

The impacts of agriculture on TDS in groundwater primarily are caused by fertilizer use on crops, consumptive use, and dairy waste disposal. The TDS impacts from the dairies located in the southern half of the Basin is reflected at least partially in Figures 2-39 and 2-40. The intensity of the TDS loading from dairy waste to the Basin is illustrated in Table 2-8 (Table 2-1 from *Final Task 6 Memorandum, Development of a Three-Dimensional Groundwater Model*, Montgomery Watson, 1994). This table shows the steady buildup of the dairy cattle population in the southern Chino Basin between 1949 and 1989. The total amount of TDS from manure discharged to the southern half of the Basin that will reach groundwater is estimated to be about 1,200,000 tons through 1989 and averages about 29,000 tons per year. The dairy loading numbers in Table 2-8 assume that half of the manure was hauled out of the Basin after 1973, which was a requirement of the Santa Ana watershed Water Quality Control Plan enacted in

1973. The amount of manure exported out of the Basin was never verified until the late 1990's. The TDS loading to groundwater from dairy waste disposal activities could be far greater than estimated in Table 2-8.

As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L, and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/L, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/L, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

TDS concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of Management Zones 1, 2, and 3. TDS concentrations are significantly higher in the southern parts of Management Zones 1, 2, and 3, and all of Management Zone 5 where they typically exceed the 500 mg/L recommended MCL and frequently exceed the upper limit of 1,000 mg/L.

**Nitrate.** Nitrate is regulated in drinking water in Title 22 with an MCL of 10 mg/L (as nitrogen). Table 2-10 provides the average nitrate concentrations by well for 5-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 2-41, 2-42, and 2-43 show the average nitrate concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Nitrate measurements in the surface water flows in the San Gabriel Mountains and in groundwater near the foot of these mountains are generally less than 0.5 mg/L (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/L indicate degradation from overlying land use. Similar to TDS, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of Management Zones 1, 2 and 3; and
- Dairy areas in the southern parts of Management Zones 1, 2 and 3 and all of Management Zone 5.

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in northern parts of Management Zones 1, 2 and 3 over the period 1960 to the present. These are areas formerly occupied by citrus and vineyard land uses (see Figures 2-37a-d), and nitrate concentrations underlying these areas rarely exceed 20 mg/L (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of Management Zones 1, 2 and 3, and all of Management Zone 5. These are areas where land use has progressively converted from irrigated/non-irrigated agriculture to dairy uses (see Figures 2-37e-h), and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L by 1991-1995.

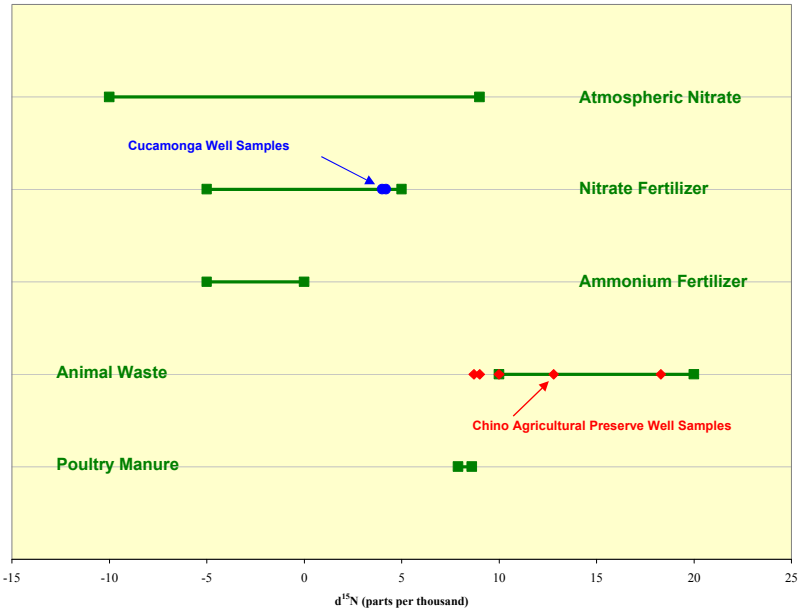
There are two stable isotopes of nitrogen: $^{14}N$ and $^{15}N$. Within the nitrogen cycle, thermodynamic and kinetic processes occur which fractionate these isotopes in various nitrogen-bearing compounds. Most biologically-mediated reactions (*e.g.*, assimilation, nitrification, and denitrification) result in $^{15}N$ enrichment of the substrate and depletion of the product. Nitrogen isotope chemistry is a technique to help distinguish potential sources of nitrogen in the environment (Clark and Fritz, 1997). The enrichment of $^{15}N$ relative to atmospheric nitrogen is expressed as $\delta^{15}N$ and has units of parts per thousand (permil). The following table shows the ranges of nitrogen isotopes of potential sources of nitrate (Battaglin *et al.*, 1997):

| Source of Nitrate | $d^{15}N$ of Nitrate (permil) |
|---|---|
| Atmospheric Nitrate | -10 to 9 |
| Nitrate Fertilizer | -5 to 5 |
| Ammonium Fertilizer | -5 to 0 |
| Animal Waste | 10 to 20 |
| Poultry Manure | 7.9 to 8.6 |

As part of the 1997 groundwater-monitoring program, samples were collected from six wells for nitrogen isotope analysis:

| State Well Number | Region | Nitrate-N (mg/L) | $d^{15}N$ (permil) |
|---|---|---|---|
| 01S07W14D01 | Cucamonga – Former Citrus | 3.2 | 4.0 |
| 01S07W14D02 | Cucamonga – Former Citrus | 4.0 | 4.2 |
| 02S07W34D | Chino Agricultural Preserve | 106.0 | 12.8 |
| 03S07W05G | Chino Agricultural Preserve | 77.3 | 18.3 |
| 02S07W20A | Chino Agricultural Preserve | 64.5 | 10.0 |
| 02S07W16D | Chino Agricultural Preserve | 63.6 | 8.7 |
| 02S07W16D - Duplicate | | 63.6 | 9.0 |

The samples from the wells in areas where the antecedent land use was predominantly citrus had nitrate values that were significantly below the maximum contaminant level (MCL) of 10 mg/L. Nitrate values in samples from the Chino Agricultural Preserve all exceeded the MCL by at least a factor of six. In addition, the $\delta^{15}N$ values for the Cucamonga wells were about 4 permil, while the $\delta^{15}N$ values for the Chino Agricultural Preserve wells ranged from 8.7 to 18.3 permil. The nitrogen isotope results are compared graphically with ranges from known sources in the figure below.



The high nitrate concentrations shown in Figure 2-43 probably depict the nitrate impacts from the agricultural waste disposal areas located in the southern half of the Basin.

**Other Constituents of Potential Concern.** Tables 2-11a through 2-11c summarize inorganic and organic constituents that have been analyzed for and detected in groundwater samples from wells in the Chino Basin through July 1998. Table 2-12 summarizes the information in Tables 2-11a through 2-11c for the constituents detected at or above their MCLs. This is a synoptic analysis and includes all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. The data do represent the most comprehensive information available to date.

A large subset of this data was extracted from the California Department of Health Services (DHS) database (current through July 1998). For each constituent, the tables lists:

- the number of measurements at or above one-half the applicable MCL;
- the number of wells with measurements at or above one-half the applicable MCL;
- the number of measurements at or above the applicable MCL;
- the number of wells with measurements at or above the applicable MCL; and
- the applicable MCL.

The tables are organized as follows:

- Table 11a: Inorganic constituents, total trihalomethanes (THMs) and radioactivity with primary MCLs;
- Table 11b: Organic chemicals with primary MCLs;
- Table 11c: Inorganic constituents and organic chemicals with secondary MCLs, lead and copper rule, and California DHS Action Levels.

Table 12 summarizes the constituents that were detected at concentrations greater than one-half their MCL, and are grouped by chemical type. These values represent a mixture of data from monitoring and production well samples. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

*Inorganic Constituents*. Five inorganic constituents were detected at or above their MCL in more than 20 wells:

- TDS;
- nitrate;
- fluoride;
- iron; and
- manganese.

TDS and nitrate have been discussed in previous subsections. Fluoride, iron, and manganese naturally exist in groundwater. Their concentrations depend on mineral solubility, ion exchange reactions, surface

complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature. Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). Based on the available data, none of these constituents shows a spatial pattern throughout Chino Basin (see Figures 2-44, 2-45 and 2-46). However, site-specific monitoring wells may reveal point sources (*e.g.*, wells near landfills have shown relatively high concentrations of manganese).

In addition, perchlorate has recently been detected in several wells in the Chino Basin (Figure 2-47), in other basins in California and other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate ($ClO_4^-$) originates as a contaminant in the environment from the solid salts of ammonium perchlorate ($NH_4ClO_4$), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion ($ClO_4^-$) is exceedingly mobile in soil and groundwater environments. It can persist for many decades under typical groundwater and surface water conditions, because of its resistance to react with other available constituents. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

At very high levels, perchlorate interferes with the function of the thyroid gland and the production of hormones necessary for normal human development. In the extreme cases, it can cause brain damage in fetuses and a potentially fatal form of anemia in adults. However, effects of chronic exposures to lower levels currently detected in groundwater are not known.

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and likely other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel

Perchlorate is of concern because of the existing uncertainties in:

- the toxicological database documenting its health effects at low levels in drinking water;
- the actual extent of the occurrence of perchlorate in ground and surface waters, which is compounded by some uncertainty in the validation of the analytical detection method;
- the efficacy of different treatment technologies for various water uses such as drinking water or agricultural application; and
- the extent and nature of ecological impact or transport and transformation phenomena in various environmental media.

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The US Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 (µg/L). In 1997, the DHS and California EPA's Office of Environmental Health Hazard Assessment reviewed the EPA risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced but has not been brought to a vote (CA Senate Bill 1033).

*Volatile Organic Chemicals*. Six volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- 1,1-dichloroethene;
- 1,2-dichloroethane;
- benzene;
- tetrachloroethene (PCE);
- trichloroethene (TCE); and
- vinyl chloride.

TCE and PCE were/are widely used industrial solvents. TCE was commonly used for metal degreasing and was also used as a food extractant. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners used PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). The areal distributions of PCE and TCE are shown in Figures 2-48 and 2-49. 1,1-Dichloroethane, 1,1-Dichloroethene, *cis*-1, 2-dichloroethene, 1,2-dichloroethane, and vinyl chloride are degradation by-products of PCE and TCE and their areal distributions are shown in Figures 2-50 though 2-54.

The spatial distributions of TCE and PCE appear to be correlatable to identified point sources in the Chino Basin (see the following subsection and Figure 2-58.) The areal distributions of 1,2-dichloroethane and vinyl chloride appear to be more extensive. 1,2-Dichloroethane is used as a lead-scavenging agent in gasoline (Oak Ridge National Laboratories, 1989) and the greater areal distribution of 1,2-dichloroethane and vinyl chloride may reflect numerous minor releases from gasoline stations, automobile service stations, *et cetera*. This hypothesis appears to be corroborated, in part, by the distribution of benzene, which is a minor contaminant in gasoline (see Figure 2-55). Gasoline used in the United States contains between 0.8 and 2 percent benzene (Oak Ridge National Laboratories, 1989).

*Pesticides/herbicides*. Two were detected at or above their MCL in more than 10 wells:

- dibromochloropropane (DBCP); and
- lindane.

DBCP was used as a fumigant for citrus, other orchards and some field crops prior to being banned in 1987. The areal distribution of DBCP appears to be related to historical citrus crop production in Chino Basin (see Figures 2-37a-d and 2-56). Lindane is used as an insecticide on foliar plants and fruit and vegetable crops; its areal distribution is shown in Figure 2-57.

**Point Sources of Concern**

The previous water quality discussion described water quality conditions broadly across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 2-58 shows the location of various point sources and areas of water quality degradation associated with these sources.

**Chino Airport.** The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (Regional Board, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL is TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L. Figure 2-58 shows the approximate areal extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 1990. The plume is elongate in shape, about 2,200 feet wide and extends approximately 8,000 feet from the airport's northern boundary in a south to southwestern direction.

**California Institute for Men.** The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicate that the most common VOCs detected in groundwater underlying CIM are PCE and TCE. Other VOCs detected include carbon tetrachloride, chloroform, 1,2-dichloroethene, bromodichloromethane, 1,1,1-trichloroethane, and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geomatrix Consultants, 1996). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of May 1996. The plume is approximately 1,000 feet wide and extends about 3,600 feet southwest.

**General Electric Flatiron Facility.** The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations consisted primarily of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The Regional Board issued an investigative order to General Electric in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 µg/L. Other VOCs periodically detected, but commonly below MCLs, include PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997). Figure 2-58 shows the approximate areal extent of TCE in groundwater at concentrations exceeding MCLs, as of November 1997. The plume is approximately 3,000 feet wide and

extends about 8,400 feet south-southwest (hydraulically downgradient) from the southern border of the site.

**General Electric Test Cell Facility.** The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avion, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicate that the most common and abundant VOC detected in groundwater is TCE. Other VOCs detected include PCE, *cis*-1,2-dichloroethene, 1,2-dicholoropropane, 1,1-dichloroethene, 1,1-dichloroethane, benzene, toluene and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) is 1,240 µg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) is 190 µg/L (BDM International, 1997). Figure 2-58 shows the areal extent of VOC contamination exceeding federal MCLs as of March 1997. The plume is elongate in shape, about 1,000 to 1,200 feet wide and extends approximately 8,000 feet from the Test Cell Facility in a southwesterly direction.

**Kaiser Steel Fontana Steel Site**. Between 1943 and 1983, Kaiser Steel Corporation (Kaiser), operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the Regional Board issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigation and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. Figure 2-58 shows the approximate areal extent of the TDS/TOC groundwater plume as of November 1991. The plume is approximately 3,000 feet wide and extends about 17,000 feet southwest. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

**Milliken Sanitary Landfill.** The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the release. The most common VOCs detected are TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs include vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well is 159.6 µg/L (GeoLogic Associates, 1998). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations

exceeding MCLs as of April 1998. The plume is approximately 1,900 feet wide and extends about 2,000 feet south of the MSL's southern border (GeoLogic Associates, 1998).

**Municipal Wastewater Disposal Ponds.** Treated municipal wastewater has been disposed into ponds located near the current IEUA Regional Plant 1 (RP1) located in south Ontario and the former Regional Plant 3 (RP3) located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. The locations of these ponds are shown in Figure 2-58. Contaminant plumes emanating from these ponds have never been fully characterized.

**Upland Sanitary Landfill.** The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells (an upgradient well, a cross-gradient well, and a downgradient well) (City of Upland, 1998). The results of groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, *cis*-1,2 dichloroethene, 1,1-dichloroethane, and benzene. The 1990-95 average total VOC concentration in the downgradient monitoring well is 125 µg/L (GeoLogic Associates, 1997). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of April 1998. However, the plume is defined only by the three on-site monitoring wells. The plume extent may be greater than is depicted on Figure 2-58.

**National Priorities List Sites.** Three facilities in, or directly tributary to, the Chino Basin are on the current National Priorities List (NPL) of Superfund sites:

- Stringfellow;
- Dodson Brothers; and
- Pacific Polishing (Figure 2-58).

Elevated levels of TCE and its degradation by-products have been detected in groundwater in the vicinity of the Dodson Brothers Superfund site (*cf.* Tables 2-44 and 2-53).

**TCE/PCE Anomaly – South of the Ontario Airport.** A plume containing TCE and PCE exists south of the Ontario Airport. The plume extends from approximately State Route 60 on the north, Turner Avenue on the east to Schaeffer Avenue on the south and Vineyard Avenue on the west. Figure 2-58 shows the approximate areal extent of the plume. The plume appears to be approximately 6,000 feet wide and 9,000 feet long. The maximum reported TCE and PCE concentrations are 142 µg/L and 2 µg/L, respectively.

**Role of the Vadose Zone in Future Water Quality**

The vadose zone is the unsaturated part of the aquifer that lies between the water table surface and the land surface. The vadose zone has become larger and thicker over time as the groundwater levels in the Basin have declined due to overdraft. Some of the contaminants discharged to the land surface or into ponds remain in the vadose zone. The mechanisms for retention of contaminants within the vadose zone are complex, but are generally caused by sorption and precipitation. Some contaminants move down towards the saturated zone at much lower rates (a few feet per year) than they can move once they get to the saturated zone (a few feet per day). MWDSC completed a study of the TDS and nitrate impacts in the Chino Basin from a proposed 700,000 acre-ft storage program California (MWDSC, 1988). The outcome of this study suggested that the raising of groundwater levels associated with the increase in storage would mobilize TDS and nitrates in the vadose zone and cause serious water quality problems throughout the Basin. The proposed storage program did not add contaminants – it flushed contaminants already in the vadose zone into the saturated zone. This potential effect could not be verified with more advanced modeling in the CBWRMS due to problems with the model. Real-world experiments to verify the TDS and nitrate contamination are not practical for a basin as large as the Chino Basin.

As the agricultural land uses in the Chino Basin convert, the loading of contaminants to the vadose zone will be significantly reduced, as will percolation at the land surface that drives the contaminants down towards the saturated zone. This will have the effect of reducing the rate of vadose zone loading to the saturated zone.

## SAFE YIELD

The safe yield of the Chino Basin was established in the 1978 Judgment to be 140,000 acre-ft/yr. The basis for this estimate is described by William J. Carroll in his testimony on December 19 and 20, 1977, during the adjudication process. Table 2-13 lists the hydrologic components developed by Carroll to estimate the safe yield of the Chino Basin. These components were developed for the period 1965 to 1974, a period that Carroll referred to as the *base period*. The hydrologic components listed in Table 2-13 are described below.

**Deep Percolation of Precipitation and Surface Inflow** – consists of the deep percolation of precipitation and streamflow. Carroll developed the estimate of 47,500 acre-ft/yr based on an extrapolation of the early Chino Basin modeling results from the DWR.

**Deep Percolation of Artificial Recharge** – consists of the percolation of local runoff in spreading basins. Carroll estimated that the local runoff recharged in SBCFCD-controlled facilities to be about 2,800 acre-ft/yr during the base period. The Etiwanda Water Company also recharged about 1,000 acre-ft/yr of Deer and Day Creek water in the Chino Basin during the base period.

**Deep Percolation of Chino Basin Groundwater Used for Irrigation (domestic and agricultural)** – defined as the fraction of water applied for irrigation that percolates through the soil and recharges underlying groundwater. Carroll estimated that about 15 percent of the water used for domestic irrigation would percolate to groundwater; and that 45 percent of the water used for agricultural irrigation would percolate to groundwater. The volume of percolation of Chino Basin groundwater used for irrigation over the base period was estimated by Carroll to be about 61,700 acre-ft/yr.

**Deep Percolation of Imported Water Used for Irrigation (domestic and agricultural)** – same as deep percolation of Chino Basin groundwater except that the water used for irrigation is imported to and used

over the Chino Basin. The volume of percolation of imported water used for irrigation over the base period was estimated by Carroll to be about 7,000 acre-ft/yr.

**Recharge of Sewage** – defined to be the percolation in ponds of wastewater discharged by municipal wastewater treatment plants. This component almost completely ceased during the base period and was known to be eliminated as a recharge source when the safe yield was estimated. The volume of sewage recharge over the base period was about 18,200 acre-ft/yr. The inclusion of recharge of sewage as a component of safe yield in the stipulated Judgment was therefore not hydrologically consistent with how the Basin was to be operated post-Judgment.

**Subsurface Inflow** – defined to be the groundwater inflow to the Chino Basin from adjacent groundwater basins and mountain fronts including:

| | |
|---|---|
| Bloomington Divide (Riverside Basin) | 3,500 acre-ft/yr |
| San Gabriel Mountain front | 2,500 acre-ft/yr |
| Colton Rialto Basin | 500 acre-ft/yr |
| Cucamonga Basin | 100 acre-ft/yr |
| Claremont and Pomona Basins | 100 acre-ft/yr |
| Jurupa Hills | 500 acre-ft/yr |
| **Total** | **7,200 acre-ft/yr**<br>**say 7,000** |

**Subsurface Outflow** – defined as groundwater that rises to the ground surface in Prado Basin to become Santa Ana River flow. Estimates of subsurface outflow were based on studies by DWR, United States Geological Survey (USGS), and Carroll. Carroll estimated the subsurface outflow to average about 6,800 acre-ft/yr over the base period.

**Extractions** – consists of groundwater extractions from the Chino Basin. Carroll estimated the groundwater extractions to average about 180,000 acre-ft/yr during the base period.

In addition to these components, Carroll estimated the change in storage over the base period to be about 40,000 acre-ft/yr; that is, the groundwater in storage declined by about 400,000 acre-ft between 1965 and 1974. Carroll estimated the safe yield to be the equal to the average extraction over the base period minus the average annual overdraft during the base period:

safe yield = extraction - overdraft
= 180,000 - 40,000
= 140,000 acre-ft/yr

A more recent estimate the safe yield can be abstracted from the groundwater modeling work done for the *Chino Basin Water Resources Management Study -- Task 6 Memorandum Develop Three Dimensional Groundwater Model* (Montgomery Watson, 1994). The hydrologic components derived from the modeling results for a 30-year period -- October 1960 to September 1989 (water years 1961 to 1989) - are listed in Table 2-14. The safe yield based on the CBWRMS results (1961 to 1989) computed in a manner similar to Carroll is:

safe yield = extraction - overdraft
= 183,000 - 17,000

= 166,000 acre-ft/yr

The safe yield based on CBWRMS modeling results for the base period (1965 to 1974) used by Carroll would be:

safe yield = extraction - overdraft
= 189,000 - 20,000
= 169,000 acre-ft/yr

A more conceptually correct estimate of the safe yield would include a reduction for artificial recharge of imported water and other waters that are currently not part of the yield, such as recharge of reclaimed water. The adjusted estimates would then be:

| | |
|---|---|
| Carroll's estimate 1965 to 1974 | 118,000 acre-ft/yr |
| CBWRMS estimate 1961 to 1989 | 151,000 acre-ft/yr |
| CBWRMS estimate 1965 to 1974 | 156,000 acre-ft/yr |

Watermaster may decide to change the safe yield of the Basin based on new information such as that developed from the CBWRMS and subsequent studies. Safe yield is used to determine the need for replenishment obligation for individual parties to the judgment. New water from the capture and recharge of storm water, from induced recharge caused by increased southern basin production (or, conversely, the reduction of yield from reduced production in the southern Chino Basin), or from other sources will enhance the yield of the Basin and thereby reduce the cost of purchasing imported water for replenishment.

At the time the Chino Judgment was implemented (1978), about 41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined and is projected to be almost completely gone by 2020. This will result in a decline in irrigation returns to groundwater and a potential decrease in the safe yield. In addition, San Bernardino County, Riverside County, and the US Army Corps of Engineers (USACE) have constructed flood control projects that capture and convey runoff to the Santa Ana River - effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains in the Chino Basin. This also may have resulted in a decrease in the safe yield of the Chino Basin.

Water harvesting opportunities exist that can be used to offset the yield lost to urbanization and flood control improvements. Water harvesting consists of capturing and recharging runoff caused by urbanization. Most of the precipitation falling on undeveloped land or land in agricultural uses is lost to evapotranspiration. Runoff increases dramatically with urbanization due to drainage improvements, increased impervious land cover, and decreased evapotranspiration of rainfall. The potential yield from this additional runoff is numerically equal to the increase in runoff that occurs when the land is converted to urban uses. The actual yield is equal to the additional runoff that is captured and put to beneficial use. In the Chino Basin, the best and least expensive way to put this yield to beneficial use is groundwater recharge.

Urbanization also creates reclaimed water. Presently, most of this water is discharged to the Santa Ana River. IEUA currently plans to use some of their reclaimed water for direct uses, including non-potable industrial uses, irrigation, and groundwater recharge. Increasing the yield of the Chino Basin by increased capture of local runoff will improve the dilution of reclaimed water used for groundwater recharge and reduce the cost of mitigation requirements for such reclamation.

## WATER DEMANDS AND WATER SUPPLY PLANS

### Current and Future Water Demands

The purpose of this subsection is to describe the current and projected water demands and supplies for agencies that produce groundwater from the Chino Basin. This information will serve as the basis for identifying future water resources issues in the Chino Basin area. Updated forecasts of water demands and supplies were requested from each Chino Basin water agency and industrial producer. Requested data included demands, water supply plans by individual well or source, well construction and operating data, and water production and treatment costs. Many agencies provided updated information. Where responses were incomplete, previous information developed as part of the 1995 Chino Basin Water Resources Management Study (CBWRMS) was used. The planning period for this evaluation is 2000 to 2020.

**Growth Projections.** There are several indicators of potential growth within the Chino Basin study area. These include population, housing, employment, and land use. The Southern California Association of Governments (SCAG) periodically develops population, housing, and employment projections. SCAG prepares growth projections as part of its regional transportation planning for Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties. The most recent SCAG projection is SCAG-98, which was adopted in April 1998.

The SCAG-98 projection indicates the six-county region will grow from 15.6 million people in 1994 to 22.4 million in 2015. This represents an increase 6.7 million people between 1994 and 2015 and a growth rate of 43 percent. San Bernardino and Riverside counties are projected to grow at a rate that is more than double the regional average. San Bernardino County is projected to grow from 1,558,000 people in 1994 to 2,830,000 in 2020. Riverside County is projected to increase from 1,377,000 people in 1994 to 2,816,000 in 2020.

*Population*. Table 2-15 summarizes the population projections for the Chino Basin area by water purveyor. The SCAG projections were desegregated by city and census tract and combined by water purveyor service area. These projections indicate population will increase from 971,000 in 1994 to 1,631,000 in 2020. This is a growth rate of 68 percent or 2.6 percent per year. The population in some water service areas in the San Bernardino County portion of the Basin are projected to increase by as much as 125 percent.

*Housing*. Total housing is projected to increase from 284,000 units in 1994 to 496,000 in 2020, a growth rate of 75 percent. By comparing population and housing, the average occupancy is projected to decrease slightly from 3.4 to 3.3 persons per dwelling unit.

*Employment*. Employment is projected to increase from 316,000 jobs in 1994 to 702,000 jobs in 2020, a growth rate of 122 percent.

*Water Demand Projections*. Current water demands and supply projections form the basis for evaluating future water management programs in the Chino Basin area. Water demands are developed based on the water service areas shown in Table 2-16.

Water demand projections can be developed by several different methods. These include per capita, water duty and units of use approaches. The most frequently used methods are the per capita consumption method and the water duty method.

For this assessment, all water demands are based on information provided by the water agencies. In the absence of agency data, the assumptions in the CBWRMS have been used. These projections have been compared with the current SCAG projections. However, no adjustments to he demands have been made.

Projected water demands for the Chino Basin are presented in Table 2-16. This table indicates that Chino Basin area water demands will reach 348,000 acre-ft/yr in 2000 to 418,000 acre-ft/yr in 2020. Significant municipal water demand growth is expected to occur in the agricultural preserve area. This will result in increased demands for the Cities of Chino, Chino Hills and Ontario, and Jurupa Community Services District. Agricultural water demands are expected to decrease during the planning period as land is converted to urban uses.

**Water Supply Plans**

The principal water supplies in the Chino Basin area are groundwater pumped from the Chino Basin, other local groundwater and surface water, imported water purchased from Metropolitan and recycled water. The amounts of water utilized from each source are based on data provided by each water purveyor. If data was not provided, the supplies area based on projections developed for the Chino Basin Water Resources Management Study (1995). Each of these sources is discussed below. Table 2-17 presents projected water supply plans for appropriators in the Chino Basin area. Table 2-18 summarizes the water demands by major source categories. The growth in demand and general source plan is shown is shown graphically in Figure 2-60. Review of Table 2-18 and Figure 2-60 shows that there will be about 40,000 to 50,000 acre-ft/yr of Chino Basin production that will incur a replenishment obligation. The replenishment obligation can be met by the recharge of imported and reclaimed water, in-lieu replenishment involving imported water, and from water in local storage accounts. In the long run, the replenishment obligation of about 40,000 to 50,000 acre-ft/yr will need to be met with imported and recycled water. Thus the imported and recycled water components in Table 2-18 and Figure 2-60 should sum to a total of 40,000 to 50,000 acre-ft/yr higher.

**Chino Basin Groundwater.** The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. Water is reallocated from the Overlying Agricultural Pool to the Appropriative Pool when it is not put to use by the agricultural users. As agricultural production declines, the reallocations to the Appropriative Pool will increase. Total production from the Chino Basin is projected to range between 180,000 to 190,000 acre-ft/yr over the planning period. Production in excess of safe yield must be replaced through the purchase of replenishment water, which is imported into the Chino Basin, by the Watermaster.

**Other Local Supplies.** Other local water sources provide a portion of the water supplies for Chino Basin water agencies. These supplies include surface water and groundwater.

*Surface Water*. A number of water supply agencies, which produce groundwater from the Chino Basin, obtain a portion of their water supplies from local surface water sources. These agencies include the: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. The principal surface water sources include San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several smaller surface sources. For the most part, these surface water sources are fully developed and no significant additional supplies are anticipated to be developed in the future. Usage is expected to remain at 16,000-17,000 acre-ft/yr.

*Other Groundwater*. Other local groundwater supplies represent a significant supplemental source of water for Chino Basin water agencies. Other groundwater supplies in the study area include the Claremont Heights, Live Oak, Pomona and Spadra Basins in Los Angeles County, the Riverside South

and Temescal Basins in Riverside County, and the Colton-Rialto, Cucamonga, Lytle Creek Bunker Hill, and Riverside North Basins in San Bernardino County. Agencies using other local groundwater include: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, Southern California Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. These supplies may increase slightly in the future as additional wells are constructed. However, most of these sources are essentially fully developed. Descriptions of these groundwater basins were presented in the CBWRMS Final Report (1995). The aggregate supply from these basins is currently 63,000 acre-ft/yr and is projected to be 76,000 acre-ft/yr in 2020.

**Imported Water.** Two regional agencies are responsible for imported water deliveries within the study area: Metropolitan Water District of Southern California (Metropolitan) and San Bernardino Valley Municipal Water District (SBVMWD). Metropolitan is a wholesale water agency serving supplemental imported water to 27 members (city and water agencies) in portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties. This service area has a current population of more than 16 million people. Approximately one-half of the total water used throughout the entire Metropolitan service area is imported water purchased from Metropolitan to supplement the local water supplies in its service area. Metropolitan obtains imported supplies from the Colorado River and the State Water Project (SWP). The demand for direct delivery of imported water for the Chino Basin purchased from Metropolitan is projected to increase from about 68,000 acre-ft/yr in 1997 to 129,000 acre-ft/yr by 2020, an increase of about 90% percent. The demand for replenishment water in the Chino Basin could reach 40,000 acre-ft/yr by 2020 if reclaimed water is not used for replenishment or direct uses and water in local storage accounts is not available for use as replenishment.

SBVMWD is a wholesale water purveyor in the easternmost portion of the study area and adjacent portions of San Bernardino County. SBVMWD is a SWP Contractor having an entitlement of 102,600 acre-ft/yr. In addition, SBVMWD is responsible for basin management in the Bunker Hill basin. The City of Rialto and West San Bernardino County Water District obtain water from SBVMWD through its Baseline Feeder that supplies Bunker Hill groundwater (included in *other groundwater* above).

**Recycled Water**. There are several existing sources of recycled water in use within the Chino Basin study area. These are the Pomona Water Reclamation Plant (operated by the Los Angeles County Sanitation Districts), Regional Plants 1, 2 and 4, and Carbon Canyon Water Reclamation Plant operated by IEUA, Upland Hills Water Reclamation Plant operated by the City of Upland, CIM Water Reclamation Plant operated by the California Institution for Men at Chino, and Indian Hills Water Reclamation Plant operated by Jurupa Community Services District. For this section, only existing and planned recycled water uses that will be implemented in the next two years are included in the water supply plans. This is about 11,500 acre-ft/yr.

**Summary.** The plans summarized in this section represent the current non-OBMP water supply plans of each individual water agency, as qualified previously. Future evaluation of these plans may indicate problems relative to their long-term feasibility. Availability of imported water supplies will have a significant effect on plan feasibility.

### WASTEWATER FLOWS, TREATMENT AND DISPOSAL

This section summarizes existing and proposed municipal wastewater treatment and disposal plans for the Chino Basin study area for the planning period of 2000 through 2020. Existing municipal wastewater treatment facilities are described briefly along with a review of present and projected wastewater flows. Future treatment and disposal plans for the study area are also discussed.

**Wastewater Flow Projections**

Wastewater flow projections are made using a combination of methods similar to water demand projections. Depending on the planning data available, wastewater flow projections are made using per capita-based, EDU-based, area-based, and water consumption-based methods. The per capita method uses projected populations and average unit wastewater flows per person (90-110 gallons per day per person). EDU-based projections use unit flows per equivalent dwelling unit (EDU), where an EDU is the average amount of sewage generated by a single-family residential household (about 270 gallons per day). EDUs are estimated for commercial and industrial land uses using fixture unit counts or estimated wastewater flows. Flow projections are computed by projecting future EDUs and multiplying by the unit flow per EDU. Area-based methods typically use unit flow factors for each land use type. Flows are computed by multiplying the unit factor for each land use type by the corresponding acreage and totaling the individual flows for each land use type. Water consumption-based methods compute wastewater flows based on the difference between water demand and water consumption. Water consumption is the amount of water that does not return to the sewer system and is a function of the particular land use type and water use group. Currently, most wastewater flow projections in the study area are based on either per capita or EDU methods. Figure 2-61 illustrates the projected wastewater flows for each service area described below.

**LACSD Service Area.** The Los Angeles County Sanitation Districts (LACSD) furnishes wastewater services for Pomona and Claremont. Using the SCAG-98 growth projections and a wastewater generation factor of 110 gpcd, the wastewater flows for this area are estimated to increase from 22,000 acre-ft/yr to 30,000 acre-ft/yr in 2020.

**IEUA Service Area.** IEUA develops ten-year wastewater forecasts for its service area in conjunction with its annual capital improvement plan (CIP). As part of its current CIP, IEUA also prepared a fifty-year projection of wastewater flows. These projections indicate wastewater flows will increase from 57,000 acre-ft/yr in 1997 to 112,000 acre-ft/yr in 2020. This represents an increase of 96 percent.

**Riverside County Service Area.** Wastewater collection for the portion of the study area in Riverside County is provided by several agencies including Jurupa Community Services District and Norco. Other portions are unsewered. Wastewater flows for the Riverside County area are estimated to increase from 10,000 acre-ft/yr in 1997 to 15,000 acre-ft/yr by 2020 based on projected population increases. This includes wastewater generated by unsewered areas. Additional wastewater from outside the study area is expected to be treated at the Western Riverside Regional Water Reclamation Plant. However, no estimates of these additional flows were received.

**Treatment and Disposal**

Seven agencies are responsible for wastewater treatment and disposal for their respective areas. In Los Angeles County, LACSD is the treatment and disposal agency. In western San Bernardino County, IEUA and the City of Upland perform this role. In the easterly portion of the study area, the City of Rialto provides this service. In Riverside County, several agencies are responsible for wastewater treatment, including the Cities of Riverside and Corona, and JCSD.

There are three basic wastewater service areas within the study area. These areas include:

- LACSD System (Los Angeles County)
- IEUA System (Western San Bernardino County)
- Riverside County

**LACSD System.** The LACSD provides regional wastewater collection and treatment for most of Los Angeles County. LACSD is divided into districts that handle wastewater management within their service areas. LACSD No. 21 provides this service for the Claremont, La Verne, and Pomona service areas. Urban and industrial wastewater flows from the Los Angeles County portion of the study area are collected by the cities of Claremont, La Verne, and Pomona. This wastewater is routed to LACSD No. 21 for treatment at LACSD's Pomona WRP and San Jose Creek WRP. With the exception of recycled water used by the City of Pomona from the Pomona WRP, all wastewater reaching the sewer system is exported out of the study area. The Pomona WRP has capacity of 15 MGD and is expected to operate at that level during the planning period.

**IEUA System.** IEUA has constructed a Regional Sewerage System within its service area to collect, treat and dispose of wastewater delivered by contracting local agencies. The contracting cities and water districts are responsible for wastewater collection within their individual service areas. A system of regional trunk and interceptor sewers that convey sewage to regional wastewater treatment plants is owned and operated by IEUA. IEUA's wastewater collection system is divided into two major service areas: the Northern Service Area and the Southern Service Area.

IEUA currently operates four wastewater treatment plants: Regional Plant No. 1 (RP1), Regional Plant No. 2 (RP2) Regional Plant No. 4 (RP4), and Carbon Canyon Water Reclamation Plant (CCWRP). A fifth regional plant, known as Regional Plant No. 3 (RP3), is no longer in service. One new treatment plant, Regional Plant No. 5 (RP5), is in the planning stages. All of these plants are or will be capable of producing effluent that meets Title 22 requirements for water reclamation. Figure 2-62 illustrates the projected flows and capacity staging of these plants. Each of these plants are described below

*Regional Plant No. 1*. Although RP1 is designed to treat 44 mgd, the capacity was downrated to 32 mgd in 1992 due to more stringent permit requirements. The plant is being operated at an interim capacity of 41 mgd while plant upgrades are completed. A 1996 Regional Board cease and desist order requires the plant to be restored to its design capacity by 1999. RP1 is expected to operate at near its design capacity and treat wastewater flows from its service area and excess flows from RP4 until 2014. A plant expansion to about 56 mgd is planned to be on-line by 2014 to meet increased flows from its service area.

*Regional Plant No. 2*. RP2 serves the City of Chino and surrounding areas. A 1994 cease and desist order by the Regional Board requires the plant to be flood protected or relocated. Consequently, the plant will be potentially abandoned and its capacity replaced by a new RP5 by 2001. Solids handling facilities will continue to operate at this site.

*Regional Plant No. 4*. RP4 is a 7-mgd wastewater treatment facility that recently began operation. The plant will be expanded to 14 mgd by 2008 and 21 mgd by 2021. Population growth and corresponding wastewater production in the northeastern region of the District, including portions of City of Fontana and Cucamonga County Water District will determine the rate of expansion.

*Carbon Canyon Water Reclamation Plant*. Carbon Canyon Water Reclamation Plant (CCWRP) became operational in May 1992. CCWRP is designed to produce recycled water that can be used for non-potable purposes including industrial and irrigation uses in the western region of the Chino Basin. The initial design capacity of 10.2 mgd is planned for increase to 15.3 mgd in the year 2014. Sludge generated at the CCWRP is treated at the RP2 sludge processing facilities and will be for the foreseeable future.

*Regional Plant No. 5*. Growth in the southern portion of the IEUA service area will require additional treatment capacity. IEUA plans to construct a new RP5 by 2001. The initial phase of this plant will be 12 mgd of which 5 mgd will replace capacity at RP2. The new RP5 is expected to serve the San

Bernardino Agricultural Preserve area as well as treating 3.6 mgd from southern Ontario. A second phase expansion to 18 mgd is projected to be completed by 2008 with a third phase expansion by 2021.

**Western Riverside County Regional Wastewater Treatment System**. The Western Riverside County Regional Wastewater Authority, a Joint Powers Authority, has constructed a regional wastewater treatment facility to serve portions of Jurupa CSD, Norco, Home Gardens Sanitary District and Western MWD. This facility is located in Western Riverside County near the intersection of McCarty Road and Hellman Avenue. This facility has an initial treatment capacity of 8.5 mgd. The treatment plant will be expanded to an ultimate capacity of 13.3 mgd. The facility provides tertiary filtration and nitrogen removal to meet projected discharge requirements. Effluent from this plant will be discharged to the Santa Ana River. Projections of flows to this plant are not available as of the date of this report.

## SUMMARY OF GROUNDWATER LEVEL, STORAGE, PRODUCTION AND WATER QUALITY PROBLEMS

### Groundwater Level Problems

Overall, groundwater levels have declined between 50 to 200 feet in the Chino Basin since the turn of the century. The western side of the Basin, notably Management Zones 1a and 1b, has experienced the greatest decline in groundwater levels. The City of Chino and CIM have recently experienced ground-surface fissures that are thought to be related to increased groundwater production in the vicinity of the City of Chino. Groundwater producers that affect groundwater levels in this area include the cities of Chino, Chino Hills, Ontario, Pomona, the Monte Vista Water District, CIM, and agricultural producers. The City of Chino Hills has reported loss of production at one well due to recently declining groundwater levels. The management steps to eliminate groundwater-level problems in this area are described below.

**Ground Level Survey.** Conduct a ground-level survey of the area in Management Zone 1. This would include a review of past surveys and new surveys. The survey results would be compared to historical surveys to determine the location, rate, and magnitude of subsidence in the Basin. Periodic surveys should be conducted afterwards to monitor for further subsidence.

**Monitoring.** Develop and implement a groundwater-level and quality monitoring program that can be used to observed groundwater trends. This program should be developed and implemented before a groundwater recharge/production management plan is developed for Management Zone 1 in order to define local groundwater flow systems for better management of recharge and production.

**Balance Groundwater Production and Recharge.** Balance groundwater production with recharge in Management Zone 1, or, if necessary, balance production and recharge more locally within Management Zone 1. This may require temporarily reducing production below the level at which balance occurs to bring groundwater levels up to a safe level. A *safe* level needs to be determined. Recharge of local or native and imported water should be increased as much as practical. Given that recharge in the area is maximized, production may still have to be reduced in Management Zone 1 and replaced with either production from Management Zone 2 or some other source of water.

### Groundwater Storage

The Chino Basin has immense storage capacity. Since the Judgment was implemented, total groundwater storage appears to have stabilized. However, as noted earlier, the storage in the Basin has declined by about 1,000,000 acre-ft since 1933. Therefore, there is at least 1,000,000 acre-ft of unused storage capacity available in the Basin. Increasing storage has some costs. There will be losses to the Santa Ana River due to rising groundwater. The analysis previously presented suggests that the losses from local

and cyclic storage accounts due to rising groundwater during the period 1978 to 1997 could be as high as 50,000 acre-ft (or 18 percent of the volume that Watermaster assumes is in storage). Ignoring these losses will result in overdraft of the Chino Basin. A significant increase in groundwater storage, say on the order of 100,000s of acre-ft, may induce large groundwater losses to the Santa Ana River. In addition, a storage increase of this magnitude may have groundwater quality impacts due to flushing of contaminants within the vadose zone. The volume of safe storage from a water quality perspective is unknown. The management steps to mitigate the significant issues with groundwater storage are described below:

**Develop Storage Accounting System that Includes Losses.** Presently, Watermaster keeps track of transfers to and from local and cyclic storage accounts without accounting for groundwater losses. Watermaster should adopt a loss-estimating procedure and adjust the volume in storage accounts each year.

**Water Quality Impacts from Conjunctive Use Programs.** Mitigation measures need to be developed to protect producers in the event that large conjunctive-use programs cause unacceptable water quality impacts.

### Groundwater Production

The primary issues for groundwater production are localized overdraft in Management Zone 1, and the potential changes in safe yield that can occur with changes in the location and magnitude of pumping. The location and amount of groundwater production generally appears to be balanced in the Basin except for Management Zone 1. Groundwater levels need to be increased in Management Zone 1 to minimize future subsidence and ground fissures, maintain production at a sustainable level, and improve groundwater quality. The management steps for this issue are identical to those for *Groundwater Levels.*

Groundwater production in the southern half of the Basin will need to be managed to ensure that safe yield is not reduced as agricultural areas convert to urban uses. Losses in safe yield due to decreases in agricultural production in the southern part of the Basin are distributed among the appropriators based on their initial share of safe yield. Thus, the loss in yield is translated throughout the Basin. Increasing production near the Santa Ana River could enhance exiting safe yield. The management steps for addressing this issue are listed below.

**Optimization Studies.** Conduct studies to optimize groundwater production patterns in southern Chino Basin. These studies will involve geologic investigations and modeling of southern Chino Basin.

**Southern Basin Water Supply Plan.** Develop a groundwater production and treatment plan that matches the emerging water demands of development in the southern Chino Basin with facilities necessary to provide water of appropriate quality.

### Water Quality

The TDS and nitrate problems in the Basin are the most costly ones to deal with and are primarily non-point source related. By contrast, point-source dischargers of organic solvents and other contaminants are dealing with most of their related groundwater plumes. The cost of TDS and nitrate removal is estimated to be about $700 per acre-ft. The cost to remove solvents is generally under $100 per acre-ft. Figure 2-59 shows the locations of known point sources and areas with impaired water quality in the Chino Basin.

The source of the TDS and nitrate contamination in the northern part of the Basin has mostly disappeared. The primary sources of TDS and nitrate contamination in the southern part of the Basin are dairies and they will probably remain active for the next 20 years. TDS and nitrate degradation should continue in

the southern basin for the foreseeable future and the cost to treat contaminated groundwater will escalate over current costs due to past and continued animal waste disposal practices. The steps to manage groundwater quality problems in the Basin are described below.

**Point-Source Management.** Watermaster should work with the Regional Board, Department of Toxic Substances Control and other regulatory agencies to identify point-source discharge related problems, facilitate their solution, and where necessary, use its institutional influence to obtain prompt and satisfactory mitigation. In some cases, the solution to a point-source problem and a non-point source problem can be addressed through one coordinated capture and treat project with reduced cost to all parties.

**Non-point Source Management.** The groundwater contaminated from non-point sources in the northern and southern parts of the Basin will need to be treated through dilution, demineralization or some other process, so that the water can be put to beneficial use. This is absolutely necessary in the southern Chino Basin to maintain safe yield. The *Optimization Studies* and *Southern Basin Water Supply Plan* steps listed under *Groundwater Production* apply here as well. The export of dairy waste from the Basin should be maximized.

**Safe Yield**

All the problems listed above need to be addressed to maintain safe yield. In addition to those steps, maximizing the capture and recharge of storm water and reclaimed water could increase safe yield. The SBCFCD, Riverside County Flood Control and Water Conservation District (RCFCWCD), and the USACE have developed and continue to develop new flood control projects that efficiently convey flood waters out of the Chino Basin and reduce recharge. This has a negative impact on safe yield. Watermaster needs to participate in these flood control projects to maximize recharge. Watermaster and the Chino Basin Water Conservation District initiated a multiphase recharge master plan study and completed Phase 1 in May 1998. Phases 2 and 3 need to be completed.

# SECTION 3
# GOALS OF THE OBMP

This section presents the mission statement for the OBMP, the issues, needs and interests that were articulated by the stakeholders, and the goals of the OBMP. Each of these items was developed as part of the institutional process. These items were discussed in numerous public meetings and their final form is based on the consensus of those stakeholders that participated in the process.

## MISSION STATEMENT

The stakeholders have met twice per month since the February 19, 1998 ruling by Judge Gunn, to develop the OBMP. As part of this process, the stakeholders defined a new paradigm from which they view their stewardship responsibilities, current and anticipated problems in the Basin, and the solution approaches to those problems. This new paradigm is described in the following mission statement and core values developed by the stakeholders:

> *The purpose of the Optimum Basin Management Program is to develop a groundwater management program that enhances the safe yield and the water quality of the Basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*

The stakeholders have adopted the following core values associated with the mission statement.

**Water Quality**. All producers desire to produce water of a quality that is safe and suitable for the intended beneficial use.

**Long View**. All producers desire a long term, stable planning environment to develop local water resources management projects. The producers, independently and through Watermaster, will strive to take the long view in their planning assumptions and decisions to ensure a stable and robust management program.

**Increased Local Supplies.** All producers will, for an undetermined time into the future, be dependent on high quality imported water for direct uses and for groundwater replenishment. Because high quality imported supplies may not be available, the producers will strive to minimize their dependency on imported water and to increase their dependency on local supplies when economically justified.

**Groundwater Storage**. Unused groundwater storage capacity in the Chino Basin is a precious natural resource. The producers will manage the unused storage capacity to maximize the water quality and reliability and minimize the cost of water supply for all producers. The program will encourage the development of regional conjunctive use programs.

**Storm Water Recharge**. The producers will strive to increase storm water recharge and thereby maintain and enhance the safe yield and water quality.

**Reclaimed Water Recharge**. The safe yield of the Chino Basin will be enhanced through the recharge of reclaimed water. The producers will strive to maximize the recharge of reclaimed water to enhance the safe yield and water quality.

**Cost of Groundwater Supplies**. The producers are committed to finding ways to subsidize the cost of using poor quality groundwater in a cost-effective and efficient manner.

## MANAGEMENT ISSUES, NEEDS, AND INTERESTS

As part of the OBMP scoping process, issues, needs and interest were solicited from the stakeholders in the Basin. These issues, needs and interests have been summarized in a tabular form in Tables 3-1 through 3-7, where each table refers to a class of issues, needs and interests that include:

- safe yield
- native and imported water recharge
- quality and quantity
- reclaimed water
- conjunctive-use storage
- costs
- human resources and administration

Attribution for the source of each issue, need, and interest is listed in these tables. In some cases, a specific issue, need and interest may show up in more than one class. These needs and interests were discussed at several scoping meetings and were used to focus problem identification, OBMP goals, and the resulting OBMP scope of work.

## MANAGEMENT GOALS OF THE OBMP

In June 1998, the stakeholders began the process of developing management goals for the OBMP that address the issues, needs, and interests of the producers. The process involved the proposal of an initial set of goals followed by discussion and group editing at the bi-monthly meetings. The initial set of goals of the OBMP is listed below.

**Goal No. 1 – Enhance Basin Water Supplies**. This goal applies not only to local groundwater, but also to all sources of water available for the enhancement of the Chino Groundwater Basin. The following activities enhance basin water supplies:

- *Enhance recharge of storm water runoff*. Increasing the recharge of storm water in the Basin will increase the water supplies in the Chino Basin. The relatively low TDS and nitrate concentrations of storm flow will improve groundwater quality.
- *Increase the recharge of recycled water*. The recharge of recycled water above that required for replenishment obligations can be used for safe yield augmentation and/or conjunctive use.
- *Develop new sources of supplemental water*. New sources of supplemental water, including surface and groundwater from other basins, can be used to meet Chino Basin area demands, reduce dependency on Metropolitan supplies, and improve drought reliability.
- *Promote the direct use of recycled water*. Promoting the direct use of recycled water for non-potable uses will make more native groundwater available for higher-priority beneficial uses.
- *Promote the treatment and use of contaminated groundwater*. Groundwater in some parts of the Basin is not produced because of groundwater contamination problems and thus the yield of the Basin may be reduced. The yield of the Basin can be maintained and enhanced by the production and treatment of these contaminated waters.

- *Reduce groundwater outflow*. Increasing groundwater production near the Santa Ana River will increase the streambed percolation of the Santa Ana River into the groundwater basin, and reduce groundwater outflow from the Basin and thereby increase the supply of groundwater in the Basin.
- *Re-determine safe yield.* Recent studies suggest that the safe yield may be greater than the 140,000 acre-ft as stated in the Judgment. The activities listed above will cause the yield to increase further. Continuing to operate the Basin at 140,000 acre-ft/yr will cause groundwater in the Basin to be lost to the Santa Ana River. The safe yield will be re-determined on an as needed basis to maximize the current yield and to cause future increases in yield

**Goal No. 2 – Protect and Enhance Water Quality**. This goal will be accomplished by implementing activities that capture and dispose of contaminated groundwater, treat contaminated groundwater for direct high-priority beneficial uses, and encourage better management of waste discharges that impact groundwater. The following activities will protect and enhance water quality:

- *Treat contaminated groundwater to meet beneficial uses*. Groundwater in some parts of the basins is not produced because of groundwater contamination problems. Groundwater quality can be protected by intercepting contaminants before they spread. Intercepted groundwater could be treated and used directly for high priority beneficial uses or injected back to the aquifer.
- *Monitor and manage the Basin to reduce contaminants and to improve water quality*. Actively assisting and coordinating with the Regional Board, the EPA, and other regulatory agencies in water quality management activities would help improve water quality in the Basin.
- *Manage salt accumulation through dilution or blending, and the export of salt*.
- *Address problems posed by specific contaminants.*

**Goal No. 3 – Enhance Management of the Basin**. This goal will be accomplished by implementing activities that will lead to optimal management of the Chino Basin. The following activities will protect and enhance management of the Basin:

- *Develop policies and procedures that will encourage stable, creative and fair water resources management in the Basin*.
- *Optimize the use of local groundwater storage.* Policies and procedures for local storage, cyclic storage and other types of storage accounts will be created to maximize drought protection and improve water quality, and to create an efficient system to transfer water from producers with surplus water to producers that need water.
- *Develop and/or encourage production patterns, well fields, treatment and water transmission facilities and alternative water supply sources to ensure maximum and equitable availability of groundwater and to minimize land subsidence*.
- *Develop conjunctive-use programs with others to optimize the use of the Chino Basin for in-basin producers and the people of California*.

**Goal No. 4 – Equitably Finance the OBMP**. This goal is based on the following principles:

- *The primary source of revenue to finance the implementation will be the consumers of the Chino Basin groundwater.*

- *The consumers in the Chino Basin must be treated equitably by passing the cost of the OBMP on a per acre-foot basis or by other methods, based on formulas to be determined.*
- *Financial incentives and disincentives will be established to assure that existing groundwater is pumped out of the Basin and a higher quality of water is used to replenish the Basin.*
- *Opportunities for creativity will be provided to the producers so that they are motivated to use their assets and abilities in the implementation of the OBMP.*
- *Recover value from utilization of storage of supplemental water and from rising water outflow.*

The Special Referee and her engineer reviewed these goals and provided direction to the stakeholders. In particular, the Special Referee suggested that the goals and action items were too vague. The goals and action items were refined and produced in a tabular format. The goals setting process concluded on November 26, 1998. The final set of goals is listed in Table 3-8. Table 3-8 lists each goal, the impediments to each goal, action items to surmount each impediment and achieve the goal, and the implication of the individual action items. The stakeholders were asked to review the final set of goals and action items listed in Table 3-8 to make sure that their individual issues, needs, and interests were addressed by the management goals. The stakeholders concluded that the set of goals listed in Table 3-8 addressed their needs and interests.

# SECTION 4
# MANAGEMENT PLAN

## INTRODUCTION

The Optimum Basin Management Program (OBMP) goals, impediments to the goals, action items to remove the impediments, and implications of the action items are summarized in Table 3-8. This section of the OBMP report describes the actions that, when implemented, will achieve the goals of the OBMP. Table 3-8 includes a column that cross-references the action items listed for each goal with OBMP program elements. The program elements described herein include:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program
- Program Element 9 – Develop and Implement Conjunctive-Use Programs

The scope of the program elements was developed by the Chino Basin stakeholders. Each program element contains a series of comprehensive actions and plans to implement those actions. It is anticipated that a specific implementation program will be the result of Phase II of the OBMP development process. It will include the specific details of how the plan will be implemented and funded, and by whom. Implementation of all program elements is necessary to achieve the goals of the OBMP. Because of overlap and synergies, some of the program elements were combined as they were developed. The following program elements were combined: 3/5, 6/7, and 8/9. The program elements are summarized in this section. Task Memorandums were prepared for each program element during development of the OBMP Phase I Report and are available from the Watermaster offices. They describe each program element in detail and generally include:

- need and function
- description of program element actions
- cost
- implementation entities
- implementation schedule for the short-term (first three years), mid-term ($4^{th}$ through $10^{th}$ years) and-long term ($11^{th}$ through $50^{th}$ years)

The emphasis in this section is on a description of OBMP actions, schedule and cost. The program element descriptions provide Watermaster and the Court with a means of comparing actions taken in OBMP implementation with progress in achieving the goals of the OBMP.

## PROGRAM ELEMENT 1 – DEVELOP AND IMPLEMENT COMPREHENSIVE MONITORING PROGRAM

### Need and Function

*Program Element 1 – Develop and Implement a Comprehensive Monitoring Program* contains monitoring activities that are action items explicitly listed in Table 3-8 and provides information required by other program elements of the OBMP.

The first impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … due to groundwater outflow from the southern part of the Basin." This impediment speaks to the reduction in groundwater production in the southern part of the Basin as agricultural land is converted to urban uses, and to increase outflow as groundwater storage is increased due to other management activities. The amount of safe yield lost due to these activities needs to be computed and used in the administration of the Judgment – otherwise the Basin will be overdrafted. The re-determination of safe yield and estimation of losses from groundwater storage programs require comprehensive water level mapping across the Basin, analysis of water level time histories at wells, and accurate estimations of groundwater production. The current groundwater level monitoring is not adequate. The primary problems with the current groundwater level monitoring program include poor areal distribution of wells in the monitoring program, short time histories, questionable data quality, and insufficient resources to develop and conduct a comprehensive program. Groundwater production estimates from the agricultural pool rely on water duty methods for most of the producers and some producers do not provide the Chino Basin Watermaster (Watermaster) with information upon which production estimates can be made. Rigorous groundwater level and production monitoring programs are described below.

The first impediment to *Goal 2 – Protect and Enhance Water Quality* can be stated as: "Watermaster lacks comprehensive, long-term information on groundwater quality." The primary uses of water quality information include, but are not limited to:

- locate and characterize water quality challenges in the Basin and formulate corrective management plans;
- provide an understanding of how the Basin works;
- determine whether water quality produced by a well is suitable for the desired use (*e.g.*, potable quality for potable use); and
- design treatment systems to improve water quality to a level to meet a desired use.

Currently, Watermaster obtains water quality data from all the appropriators for their active wells and from the Regional Board for wells monitored under their supervision (*e.g.*, landfill monitoring and other special water quality investigations). Watermaster has a limited groundwater quality monitoring program in the southern part of the Basin measuring general minerals and physical properties at about 60 wells. There is little historical or current water quality information for most of the 600 agricultural wells in the southern half of the Basin, for wells in the overlying non-agricultural pool, and for inactive appropriative pool wells. The water quality being produced at a majority of the wells in the Basin is unknown.

A salt budget approach has been proposed as a management tool for the Basin. The salt management steps included in *Program Element 7 Develop and Implement Salt Management Program* will be used by

the Watermaster and other stakeholders to reduce the rate of salt accumulation in the Basin. Groundwater quality monitoring will be used to help assess the state of salt in the Basin in the future after the salt management plans are implemented. The direction and cost of future water management activities in the Basin depends on the water quality. A comprehensive groundwater quality monitoring program is fundamental to management of the Basin. A rigorous groundwater quality monitoring program is described below.

The fifth impediment to *Goal 2 – Protect and Enhance Water Quality* can be stated as: "The Basin is not using as much high quality storm water as it could for recharge." The first step in determining how much storm water recharge is occurring is to monitor the volume of inflow and outflow that is occurring at existing facilities, the amount of storm water that is available for recharge in the absence of recharge facilities, and to estimate the associated water quality. Characterizing the water quality of local and imported waters used for recharge in the Basin is necessary to protect water quality for beneficial uses, assess salt balance, design treatment processes to produce water of a quality suitable for intended uses, and to minimize the cost of recycled water recharge. Engineering investigations can utilize these data to design new facilities, and modify/operate existing facilities.

Storage of water in the Basin for local or regional conjunctive use may cause outflow to the Santa Ana River and some of its tributaries in the Chino Basin to increase. The water quality of this outflow may cause water quality deterioration in the Santa Ana River and require mitigation. Watermaster needs to develop a long-term database to assess losses from storage, and surface water impacts in the Santa Ana River and its Chino Basin tributaries from groundwater management activities.

The second impediment to *Goal 3 – Enhance Management of the Basin* can be stated as: "Existing production patterns are not balanced, cause losses, can contribute to local subsidence, and water quality problems." The impediment speaks to a lack of local balance between groundwater recharge and production. The lack of information on how groundwater moves in the Basin can lead to production and replenishment patterns that cause loss of yield and other problems as stated in the impediment. Groundwater level, groundwater quality, and accurate production estimates are necessary to define the groundwater flow systems and to implement equitable and cost-effective management plans.

**Monitoring Programs to Support Water Resources Management in the Chino Basin**

**Groundwater Level Monitoring Program**. Watermaster began a process to develop a comprehensive groundwater level monitoring program in the spring of 1998. The process consists of two parts – an initial survey followed by long-term monitoring at a set of key wells. The initial survey was to consist of collecting groundwater level data at all wells in the Basin from which groundwater level measurements can be obtained for spring 1998, fall 1998, spring 1999, and fall 1999. Due to resource limitations at the Watermaster, the initial survey is partially complete and will not be completed until after fall 2001. The data from the initial survey will be mapped and reviewed. Based on this review and Watermaster management needs, a long-term monitoring program will be developed and implemented in the fall of 2001. Watermaster staff will conduct this program with minimal outside assistance. Watermaster staff expects that they will measure groundwater levels in the initial survey at about 400 wells in overlying agricultural pool and about 100 other wells from the other pools and unassigned monitoring wells. The long-term monitoring program will use about half of the wells used in the initial survey plus all wells in the other pools and unassigned wells monitored under the direction of the Regional Board and others. Keys well located in agricultural areas will be replaced as necessary if the original well must be destroyed when the agricultural land surrounding the well is converted to other use.

**Groundwater Quality Monitoring Program**. Watermaster will begin the development of a comprehensive water quality monitoring program in July 1999. As with the groundwater level monitoring program, the water quality monitoring program will consist of an initial survey and a long-term monitoring effort. The initial survey will consist of:

- collection of all water quality data from appropriators' wells that are tested by appropriators;
- collection of all water quality data from Regional Board for water quality monitoring efforts that are conducted under their supervision; and
- collection and analysis of at least one water quality sample at all (or a representative set of) other production wells in the Basin. Assumed maximum number of wells sampled by Watermaster staff in the initial survey is 600.

Re-sampling and analysis will be done at wells sampled by Watermaster if volatile organic compounds (VOCs) are detected. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed and implemented in the fall of 2002. The long-term monitoring program will contain a minimum set of key wells that can be periodically monitored to assess water quality conditions in the Basin over time. Table 4-1 lists the analytes and the analytical costs for sampling 200 wells per year for three years (plus an estimated 10 more wells for verification re-sampling). The average annual analytical cost is about $185,000 per year and totals about $555,000 if all wells were sampled. Watermaster staff will be trained to obtain samples at these wells and will require a total of about 140 person-days per year. Outside services will cost about $60,000 per year. Water quality data for all operable wells in the other pools will be provided by the well owners in those pools.

**Production Monitoring Program.** All wells that produce more than 10 acre-ft/yr will have in-line totalizing flow meters. To accomplish this, about 600 agricultural wells will be equipped with in-line totalizing flow meters. Production records from wells owned by appropriators and overlying non-agricultural pool members will report quarterly as has been done in the past. Watermaster staff will read the meters of wells owned by agricultural pool members at least once a year during the period of mid-May through June. Watermaster staff will digitize all production records in Watermaster's database and use this information in the administration of the Judgment. The cost of the installing in-line flow meters in the overlying agricultural pool is summarized in Table 4-2 and totals about $810,000. It has been recommended by the overlying agricultural pool that Watermaster fund up to 50 percent of the cost, with the remaining funds coming from the individual producers.

In addition to the above, all producers will provide Watermaster on an annual basis a *water use and disposal survey* form that describes the sources of water used by each producer and how that water is disposed after use. The purpose of the form is to provide information to Watermaster that will enable accurate salt budget estimates as described in *Program Element 6 – Develop and Implement Cooperative Programs with the Regional Board and Other Agencies to Improve Basin Management*, and for other water resources management investigations that may be undertaken by Watermaster in the future as part of the OBMP.

**Surface Water Discharge and Quality Monitoring.** The current program of measuring water quality at recharge basins should be expanded to all recharge and retention basins that contribute significant recharge to the Basin. Water level sensors will be installed in all recharge and retention basins that contribute significant recharge to the Chino Basin. These facilities were listed in Table 3 of the *Program Element 2 – Develop and Implement a Comprehensive Recharge Program* draft memorandum and are reproduced here in Table 4-3. A total of 16 new water-level sensors will be required at a total cost of

$192,000. Water level data acquisition and water quality sampling will be done by Watermaster staff. The annual cost of laboratory analysis and interpretation of water level and water quality data is about $45,000.

Watermaster needs to assess the existing surface water discharge and associated water quality monitoring programs for the Santa Ana River and its Chino Basin tributaries to determine the adequacy of the existing monitoring programs for characterizing historical ambient conditions and their utility in detecting water quality impacts from future Chino Basin management activities. If necessary, Watermaster could contract with the agencies conducting these programs to modify their programs to accommodate Watermaster. Ideally, a cooperative program involving all the interested agencies could be developed at a reduced cost for all. The cost of the initial assessment of surface water data for the Santa Ana River is about $15,000.

**Ground Level Monitoring Program.** Ground level surveys are proposed herein as an offshoot of the subsidence issues in Management Zone 1. The stakeholders are interested in determining if and how much subsidence has occurred in the Basin. Watermaster will conduct an analysis of historical ground level survey and remote sensing data to make this determination. The analysis consists of the following tasks:

- Historical survey data collected and/or on file by federal, state, and local agencies will be compiled, mapped, and reviewed to estimate total subsidence for as long a period as possible. Estimated cost to complete this review is about $15,000.
- Synthetic aperture radar (SAR) imagery will be used to assess the time history of subsidence in the Basin for the period 1993 though 1999. Estimated cost to develop this time history is about $20,000. It should be noted that the City of Chino has already conducted a similar investigation for most of the Basin and that the effort described herein is to expand on the work already done by the City.
- Based on the above information, a network of ground elevation stations in subsidence-prone areas will be developed and periodic surveys of these stations will be done. The frequency of periodic surveys will be established for the Basin as a whole with more frequent surveys done for some areas of the Basin. The estimated cost of this effort is not certain. It should be noted that the City of Chino has already conducted a similar survey within the City of Chino and that the effort described herein is to expand on the surveys done by the City to the entire Basin.

These tasks can be accomplished in the first year.

**Well Construction, Abandonment and Destruction Monitoring.** Watermaster maintains a database on wells in the Basin and Watermaster staff makes frequent well inspections. Watermaster sometimes finds a new well during routine well inspections. The near-term frequency of inspection is expected to increase due to the groundwater level, quality and production monitoring programs. Watermaster needs to know when new wells are constructed as part of its administration of the Judgment. Valuable information for use in managing the Chino Basin is usually developed when wells are constructed including: well design, lithologic and geophysical logs, groundwater level and quality data, and aquifer stress test data. Producers generally notify Watermaster when they construct a new well but seldom, if ever, provide the information listed above. Watermaster has not generally asked for these data. Well owners must obtain permits from the appropriate county and state agencies to drill a well and to put the well in use. Watermaster will develop cooperative agreements with the counties of Los Angeles, Orange, Riverside, and San Bernardino, and the California Department of Health Services (DHS) to ensure that the

appropriate entities know that a new well has been constructed. Watermaster staff will obtain well design, lithologic and geophysical logs, groundwater level and quality data, and aquifer stress test data.

The presence of abandoned wells is a threat to groundwater supply and a physical hazard. Watermaster staff will review its database, make appropriate inspections, consult with well owners, and compile a list of abandoned wells in the Chino Basin. The owners of the abandoned wells will be requested to properly destroy their wells following the ordinances developed by the county in which the abandoned well is located. Watermaster staff will update its list of abandoned wells annually and provide this list to the counties for follow-up and enforcement.

**Cooperative Efforts with Appropriate Agencies to Implement Program**

**Groundwater Level Monitoring.** Watermaster will develop a groundwater level measurement protocol for use by all cooperating entities. Groundwater levels will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster staff
- Overlying Non-agricultural Pool – pool member or Watermaster staff
- Appropriative Pool – pool member or Watermaster staff
- Other wells – Watermaster staff will obtain data from Regional Board or owners.

**Groundwater Quality Monitoring.** Watermaster will develop groundwater sampling and analysis protocols for use by all cooperating entities. Groundwater quality analyses will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster staff
- Overlying Non-agricultural Pool – pool member
- Appropriative Pool – pool member
- Other wells – Watermaster staff will obtain data from Regional Board or owners.

**Proposed Production Monitoring Program.** Watermaster will develop and implement an in-line meter installation program for the overlying agricultural pool. The installation program will take place over a three-year period starting in Watermaster fiscal year 1999/00. Groundwater production estimates and water use and disposal survey forms will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster will read meters and producers will prepare and submit water use and disposal survey forms
- Overlying Non-agricultural Pool – pool member will read the meters and prepare and submit the water use and disposal survey forms
- Appropriative Pool – pool member will read the meters and will prepare and submit the water use and disposal survey forms.

**Surface Water Discharge and Water Quality Program.** Watermaster will take the lead in completing the following activities:

- Chino Basin Water Conservation District (Conservation District) and Watermaster will jointly install water level sensors in all existing recharge and retention facilities that have potential for storm water recharge.
- Watermaster staff will obtain grab samples approximately every two weeks for all basins during the rainy season and have these samples analyzed.

- Watermaster will review the surface water discharge and associated water quality monitoring programs for the Santa Ana River and the lower Chino Basin tributaries, and compare what is available from these programs to what is needed for Watermaster investigations under the OBMP.

**Ground Level Survey.** Watermaster will conduct the analysis to estimate historical subsidence and to monitor future subsidence in the Chino Basin.

**Monitoring of Well Construction, Abandonment and Destruction.** Watermaster will take the lead in completing the following activities:

- Develop agreements with county and state agencies to notify each other regarding construction of new wells and to obtain construction related information.
- Watermaster staff will prepare a list of abandoned wells and request the owners of abandoned wells to properly destroy their wells.

The counties will follow-up to ensure that abandoned wells within their jurisdiction are properly destroyed.

**Implementation Actions and Schedule**

**First Three Years (1999/00 to 2001/02).** The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Complete initial survey for the groundwater level program.
- Complete initial survey for groundwater quality program.
- Complete meter installation program for overlying agricultural pool.
- Complete ground level survey.
- Complete installation of water level sensors in recharge and retention facilities.
- Complete Santa Ana River surface water monitoring adequacy analysis.
- Start and continue surface water discharge and quality monitoring at recharge and retention facilities.
- Develop agreements with county and state agencies regarding notification of new well drilling.
- Well construction and related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

**Years Four to Ten (2002/03 to 2010/11).** The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

- Start and continue long-term groundwater level monitoring program, cause key wells to be relocated as necessary.
- Start and continue long-term groundwater quality monitoring program, cause key wells to be relocated as necessary.
- Continue production monitoring.

- Conduct remote sensing analysis using synthetic aperture radar or other techniques at least every ten years (2010/11) or sooner, if necessary.
- Participate, as necessary, in the Santa Ana River surface water monitoring.
- Continue surface water discharge and quality monitoring at recharge and retention facilities.
- Well construction and related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

**Years Eleven to Fifty (2011/12 to 2050/51).** The following actions will be completed in years eleven to fifty, commencing fiscal year 2011/12:

- Continue long-term groundwater level monitoring program, cause key wells to be relocated as necessary.
- Continue long-term groundwater quality monitoring program, cause key wells to be relocated as necessary.
- Continue production monitoring.
- Conduct remote sensing analysis using synthetic aperture radar or other technique at least every ten years (2020/21, 2030/31, 2040/41, 2050/51) or sooner, if necessary.
- Participate as necessary in the Santa Ana River surface water monitoring.
- Continue surface water discharge and quality monitoring at recharge and retention facilities.
- Well construction related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

## PROGRAM ELEMENT 2 -- DEVELOP AND IMPLEMENT COMPREHENSIVE RECHARGE PROGRAM

### Need and Function of the Program Element

The need for a comprehensive recharge program was described in the introduction to the Final Report for Phase 1 of the Chino Basin Recharge Master Plan (Wildermuth, 1998). Program Element 2 -- Develop and Implement Comprehensive Recharge Program contains action items explicitly listed in Table 3-8.

The first impediment to Goal 1 – Enhance Basin Water Supplies can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … due to groundwater outflow from the southern part of the Basin" speaks to poorly planned recharge where recharge of storm water and recycled water could be placed too low in the Basin to be recovered. Some recycled water projects that are currently being planned will increase recharge when groundwater production downgradient of these proposed recharge projects is decreasing. The result will be increased outflow to the Santa Ana River and no yield improvement. A comprehensive program must ensure that the locations of recharge and production are such that yield is maximized.

The second impediment to *Goal 1 – Enhance Basin Water Supplies* and the fifth impediment to *Goal 2 – Protect and Enhance Groundwater Quality* can be stated as: "The Basin is not using as much high quality storm water as it could for recharge." At the time the Chino Judgment was adopted (1978), about

41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined and is projected to be almost completely converted to urban uses by 2020. This will result in a decline of irrigation returns to groundwater and a potential decrease in the safe yield. San Bernardino County, Riverside County, and the US Army Corps of Engineers (USACE) have constructed flood control projects that efficiently capture and convey storm flow to the Santa Ana River, effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains in the Chino Basin. In most cases, no provisions were made to mitigate the loss of recharge from flood control projects. Also, there have been no mitigation efforts to preserve recharge when land use is converted from native and agricultural uses to urban uses. Thus, the safe yield may have decreased in the Chino Basin due to land use changes and flood control improvements. Water harvesting opportunities exist that can be used to offset the yield lost to urbanization and flood control improvements. Water harvesting consists of capturing and recharging new storm flow caused by urbanization. Most of the precipitation falling on undeveloped land or land in agricultural uses is lost to evapotranspiration. Storm flow increases dramatically with urbanization due to an increase in impervious land cover, decrease in evapotranspiration of rainfall, and construction of drainage improvements. The potential yield from this additional storm flow is numerically equal to the increase in storm flow that occurs when the land is converted to urban uses. The actual yield is equal to the additional rainfall-storm flow that is captured and put to beneficial use. In the Chino Basin, the best and least expensive way to put this new water to beneficial use is groundwater recharge.

Increasing the yield of the Chino Basin by increased capture of storm flow will improve ambient water quality and increase the assimilative capacity of the Chino Basin. Increasing the capture of storm flow will reduce the cost of mitigation requirements for recharge of recycled water. The Basin Plan assumes that a certain average annual quantity of storm flow will be recharged each year. The volume of recycled water that can be used in the Basin, without total dissolved solids (TDS) mitigation, is numerically-tied to the average annual quantity of storm flow that recharges the Basin. A decrease in the recharge of storm flow will result in a decrease in the volume of recycled water that will be permitted in the Basin without TDS mitigation. Likewise, an increase in the recharge of storm flow will result in an increase in the volume of recycled water that will be permitted in the Basin without TDS mitigation. Therefore, the volume of storm flow recharge from storm flow has a dramatic impact on the future and cost of recycled water recharge.

The annual replenishment obligation will grow from about 30,000 to 55,000 acre-feet per year (acre-ft/yr) over the next 20 to 30 years. Watermaster has access to spreading facilities with a current capacity of about 29,000 acre-ft/yr when imported water from Metropolitan is available. Assuming replenishment water is available seven out of ten years, the average annual recharge capacity of recharge facilities available to Watermaster is about 20,000 acre-ft year. The in-lieu recharge potential for the Chino Basin is about 57,000 acre-ft/yr and will remain constant over the next 20 to 30 years based on the water supply plan included in this OBMP. Assuming in-lieu replenishment water is available seven out of ten years, the average annual in-lieu recharge capacity available to Watermaster is about 40,000 acre-ft year. The replenishment obligation, available recharge capacity over the next 20 years is (acre-ft/yr):

| Year | Replenishment Obligation | Recharge Capacity | | | Surplus Recharge Capacity |
|---|---|---|---|---|---|
| | | Physical | In-Lieu | Total | |
| 2000 | 31,000 | 20,000 | 40,000 | 60,000 | 29,000 |
| 2020 | 55,000 | 20,000 | 40,000 | 60,000 | 5,000 |

The surplus recharge capacity could be used up quickly by future replenishment needs and implementation of conjunctive-use programs. A modest conjunctive use program consisting of an annually occurring seasonal shift of imported demands and a dry year yield component that would use up 150,000 acre-ft of storage will require about 46,000 acre-ft of recharge capacity. New recharge capacity is needed immediately for even a modest conjunctive-use program. The availability of in-lieu recharge capacity listed above is not a certainty. In the present mode of basin management, in-lieu recharge capacity is available on an ad hoc basis and requires the cooperation of water supply agencies that have access to supplemental water. Watermaster needs to obtain enough recharge capacity to meet its replenishment obligations for ultimate demands on the Chino Basin. The safest and most conservative way to ensure that recharge capacity will be available is for Watermaster to develop new recharge capacity that will meet ultimate replenishment obligations. For an average annual recharge capacity of 55,000 acre-ft/yr, Watermaster will need an annual recharge capacity of about 80,000 acre-ft/yr (80,000~55,000/0.7). The new recharge capacity by management zone for the year 2020 is estimated to be about:

| | |
|---|---|
| Management Zone 1 | 18,000 acre-ft/yr |
| Management Zone 2 and 3 | 34,000 acre-ft/yr |
| Total | 52,000 acre-ft/yr |

The allocation of recharge capacity to management zones is based on balancing recharge and production in each management zone with the year 2020 production pattern described in Program Elements 3 and 5. Figure 4-1 shows the existing spreading and storm water retention basins in the Chino Basin. Figure 4-1 also shows the preferred area, based on current knowledge, for new recharge basins in Management Zone 2 and 3. The preferred recharge area is rapidly developing. It is unlikely that Watermaster will be able to purchase lands already in urban use and construct new basins. Therefore, Watermaster needs to obtain new recharge sites in the preferred area immediately. Recharge capacity in Management Zone 1 can be obtained by expanding recharge capacity at the Montclair Basins, improving the Upland and Brooks Basins, and through groundwater injection. During Phase II of the OBMP, Watermaster will develop an implementation plan to secure a total physical recharge capacity of about 80,000 acre-ft/yr with recharge facilities sized and located that will balance the production and recharge.

**Past Efforts by Watermaster and the Conservation District**

The Conservation District and the Watermaster completed phase 1 of a three-phase work plan to improve recharge and establish a long-range recharge master plan for the Chino Basin. The three phases consist of:

> *Phase 1 - Initial Screening and Assessment*. Conduct an assessment of how much storm flow is currently recharged and how much additional recharge could occur at new and existing spreading basin sites. From this assessment a list of promising spreading basins will be developed. Research questions will be developed for the promising sites and a detailed scope of work will be developed for Phase 2. Phase 1 was completed in January 1998 and is summarized below.
>
> *Phase 2 - Engineering Assessments of Promising Sites*. Site-specific investigations, percolation rate monitoring and the preparation of cost estimates for developing and managing these basins will be developed in this phase. The institutional issues regarding ownership of facilities, management of non-Conservation District-owned facilities, disposition of water recharged, and Basin Plan modifications will be identified.

Principles of agreement will be developed that describe the institutional issues and means to resolve these issues through agreements. A list of recharge projects will be identified and prioritized based on need and cost effectiveness. A detailed scope of work will be developed for Phase 3.

*Phase 3 - Develop an Implementation Plan*. A plan to develop and manage spreading basins will be prepared. The plan will include existing and new basins and a schedule for spreading basin improvements based on developing recharge capacity to match need for increased groundwater yield at minimum cost.

The Phase 1 effort was completed in January 1998. The objective of the Phase 1 analysis of the Recharge Master Plan was to determine the potential for artificial recharge given the resources in the Chino Basin. This was accomplished through data collection, research, and a massive computational and engineering assessment. Existing storm water recharge in the Chino Basin was estimated to be about 12,000 acre-ft/yr. This 12,000 acre-ft is part of the existing safe yield. The potential storm water recharge was estimated to range from about 25,000 to 30,000 acre-ft/yr given proper routine maintenance at existing and then-current planned facilities. Subsequent investigations by the Conservation District suggest that the potential recharge is lower. Incorporating the Conservation District's recent work, the potential range is probably around 12,000 to 22,000 acre-ft/yr. Table 4-4 lists the existing flood control/spreading basins and annual average recharge estimates based on updated Phase 1 modeling results. Most basins are not maintained to optimize recharge and there is little quantitative information on basin conditions or current recharge performance. Recharge of storm flows at existing basins could reach about 28,000 acre-ft/yr under ultimate land use conditions. The investigation also showed that it was economical to construct recharge facilities in areas with low percolation rates (<0.25 ft/day) if the facilities were part of a flood retention project. The potential recharge capacity and cost for recharge of imported and recycled water were developed. Operational plans that specify the amount and scheduling of imported water and recycled water recharge were developed. About 17,000 acre-ft/yr of recycled water recharge capacity was developed. The potential for imported water recharge ranges from about 100,000 acre-ft/yr to 135,000 acre-ft/yr at existing basins and one new large facility. Based on the work done for Program Elements 3 and 5 of the OBMP, the imported water recharge capacity needs to be expanded from its current capacity of 29,000 acre-ft/yr to about 80,000 acre-ft/yr to accommodate Watermaster replenishment activities.

**Phase 2 Scope of Work for Hydrogeologic and Engineering Investigations**

The Phase 2 work, as recommended in the Phase 1 report, was not formally started. Phase 2 consists of eight tasks.

Task 1 Conduct Reconnaissance Analysis to Identify Existing Recharge Basins and Potential New Recharge Sites. The purpose of this task is to develop a list of existing basins that can be used to recharge storm water, recycled water and imported water; and to identify areas for new recharge facilities. Based on the results of this task, some existing basins and new sites with potential for recharge by spreading and injection will be studied in detail in subsequent tasks and others with little potential recharge will either be studied later or not considered as recharge sites. This task consists of the following subtasks:

1.1 Meeting(s) with San Bernardino County Flood Control District (SBCFCD), Riverside County Flood Control and Water Conservation District (RCFCWCD), Los Angeles County Public Works Department (LACPWD) (collectively, the flood control agencies), the USACE, the Conservation District and the Watermaster. The purpose of these meetings is to discuss the use of existing flood control/recharge basins, recharge potential of these basins, past

investigations, future flood control plans that could in include recharge, and institutional impediments to storm water recharge.

1.2 Meetings with planning agencies and the flood control agencies to inform these agencies of the need to set aside open space for recharge and to locate suitable areas for future recharge sites; to seek their cooperation in obtaining such lands, and to develop incentive programs to set aside land for recharge. A permanent basin-wide water conservation planning committee chaired by the Watermaster will be formed to facilitate the process of building and maintaining recharge facilities.

1.3 Develop a financing concept to provide capital for the improvement of existing facilities, construction of new facilities, operations and maintenance, and to mitigate adverse impacts of new spreading basins.

1.4 Review new hydrogeologic and facilities information that became available after completion of the Phase 1 analysis.

1.5 Evaluate Phase 1 computer simulation results to determine the location and magnitude of storm flow that is not being captured at existing facilities and that could be captured and recharged in either new facilities or from improved operations at existing facilities.

1.6 Develop a list of existing and proposed recharge facilities that merit detailed investigation. The priority list should be based on management issues (*e.g.*, subsidence and water quality), cost effectiveness, and for existing facilities, the availability of the facilities for recharge.

1.7 Conduct reconnaissance level feasibility investigation of using injection wells for recharge in Management Zone 1. The purpose of this recharge will be to increase the piezometric levels, reduce future subsidence, and improve water quality.

Task 2 Preliminary Assessment of the Capture of New Recharge. The objective of this task is to estimate the fate of artificial recharge. That is, to estimate the recharge benefits, areas of potential high groundwater, and losses to the Santa Ana River. The scenarios to be tested include recharge scenarios developed in the Phase 1 analysis (modified based on the results of Conservation District investigations and the results of Task 1). The *Rapid Assessment Model (RAM) Tool,* currently under development by the Watermaster, or *Chino Integrated Groundwater Surface Water Model (CIGSM)* are two models that could be used to make this assessment. It is not likely that the CIGSM would be used due to the time and expense to make it ready for use (see Program Elements 6 and 7 later in this section).

Task 3 Conduct Field Program. The purpose of this task is to develop fundamental information that can be used to assess the recharge potential of some existing and proposed basins, and to develop design information for new basins. The field program recommended for Phase 2 includes:

- obtaining and interpreting continuous cores for the upper 50 feet of sediment in existing facilities and the upper 100 feet of sediments from areas adjacent to existing and proposed basins;
- trenching to observe and interpret the near surface soil profiles;
- gradation tests of materials obtained from the trenches; and

- the installation of water level sensors identical to what Conservation District has installed in some of their basins.

Water level data will be collected at basins that are equipped with water level sensors. These data will be interpreted to produce percolation rates at each basin. The percolation rates will be correlated to soil properties and subsurface conditions to determine what is controlling recharge at a specific facility and to develop general design guidelines for the Chino Basin area. The field program is summarized in Table 4-5 covers 16 existing basins and up to three new surface water recharge facilities. Table 4-5 includes a cost estimate for this field program. Field programs for injection tests in Management Zone 1 will be developed in the work done in Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1.

Task 4 Develop Principles of Agreement. This task involves developing principles of agreement between SBCFCD, RCFCWCD, USACE, the Conservation District, and the Watermaster regarding the operation of existing and proposed storm flow management facilities. The goals of the principles are to maintain flood protection and maximize recharge. This work will involve the preparation of draft principles and many meetings. New technical information will need to be developed on an *ad hoc* basis in response to technical issues that will be involved in the principles. A set of principles will be developed with the Regional Board regarding TDS and nitrogen offset credits for recharge of recycled water.

Task 5 Develop Preliminary Operating Plans and Designs. Preliminary operating plans and facility improvements will be developed for all (new and proposed) recharge basins in the Chino Basin based on the results of Tasks 1 through 4. Preliminary capital and operating cost estimates will be developed.

Task 6 Estimate the Average Annual Recharge for Each Basin. Given the results of Tasks 1 through 5, the input data for the computer simulation models used in Phase 1 will be updated. The simulation models will be used to estimate the average annual recharge in each recharge basin. Estimates of imported water and recycled water recharge capacity will be updated. The priority list developed in Task 1 will be updated based on the results of this task.

Task 7 Develop Early Action Plan and Scope of Work for Phase 3. Given the results of Tasks 1 through 6, an early action plan and scope of work for Phase 3 will be developed. The early action plan, will include a list of high priority recharge projects that can be implemented with minimal additional analyses, and a list of lower priority projects that will require longer lead times to implement. These projects may include operating existing facilities to increase recharge, other non-controversial modifications to existing facilities, and construction of new recharge facilities. The scope of work will contain engineering design, environmental assessment and processing, and financing tasks. The scope of work will contain parallel tracks for the early action plan and the lower priority projects.

Task 8 Prepare Report. Technical memoranda will be prepared for Tasks 1 through 7. A final summary report will be prepared incorporating the task memoranda and a scope of work for Phase 3.

**Cooperative Efforts with Appropriate Agencies to Implement Program**

There are two fundamental levels of implementation appropriate for the comprehensive recharge program: one to develop the program, and one to construct, manage and operate the program. For development of the program, the implementing agencies include:

- the Watermaster, representing the producers who will benefit from the recharge and who will pay the cost of the plan development and implementation;

- the Conservation District, the flood control agencies, and the USACE who own the existing facilities and who (for the flood control agencies) will benefit from reduced flood control costs and improved storm water quality in the Santa Ana River and its tributaries;
- the planning agencies whose cooperation will be necessary to site new recharge facilities within their service areas; Inland Empire Utilities Agency (IEUA), Three Valleys Municipal Water District (TVMWD), and Western Municipal Water District (WMWD) as the provider of imported and recycled water for recharge; and producers that will utilize their own facilities for groundwater injection.

Watermaster will develop the recharge program for the Basin in the first four years of OBMP implementation. Watermaster will enter in to agreements with cooperative entities to implement the recharge program. Potential cooperative entities include Conservation District, the flood control agencies, USACE, Metropolitan Water District of Southern California (MWDSC), IEUA, TVMWD, and WMWD. These contracts will include specific performance goals and schedule. Watermaster will monitor these contracts very closely. If the cooperative entities fail to perform according to the terms of their contract, then Watermaster will terminate the agreements and either enter into an agreement with another cooperative entity or implement the program itself.

**Implementation Actions and Schedule**

**First Three Years (1999/00 to 2001/02).** The following actions will be completed in the first three years commencing fiscal year 1999/00:

- The Phase 2 scope of work should be completed within the first three years.
- Based on the results of the Phase 2 work, a list of high priority and low priority recharge projects will be identified. An action plan will be developed to implement the high priority projects as soon as possible and to implement the low priority projects as resources will allow.
- Task 1.1 and 1.2 should begin immediately, prior to the OBMP being submitted to the Court for approval.
- Watermaster advisory committee should form an *ad hoc* committee to start the coordination process and formalize the permanent basin-wide water conservation planning committee. Task 1.5 should also begin immediately.
- In year three, all high priority projects that involve re-operation of existing recharge/flood control facilities should be implemented, and Phase 3 should be started.
- Watermaster should begin the process of acquiring new recharge sites and easements identified in the Phase 2 and 3.

**Years Four to Ten (2002/03 to 2010/11).** The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

**Years four and five**

- Complete Phase 3.
- Implement all high priority projects that involve construction and re-operation at existing facilities.

- Watermaster should continue the process of acquiring new recharge sites and easements identified in the Phase 2 and 3. By year five, recharge sites should have acquired to recharge at least 55,000 acre-ft/yr.
- Update the comprehensive recharge program in year 5.

**Years five to ten**

- Implement all high priority projects that involve the construction of new recharge facilities.
- Update the comprehensive recharge program in year 10.

**Years Eleven to Fifty (2011/12 to 2050/51)**. The following actions will be completed in years eleven to fifty, commencing fiscal year 2011/12:

- Implement all other recharge projects based on need and available resources.
- Update the comprehensive recharge program every five years.

### PROGRAM ELEMENT 3 – DEVELOP AND IMPLEMENT WATER SUPPLY PLAN FOR THE IMPAIRED AREAS OF THE BASIN

### PROGRAM ELEMENT 5 – DEVELOP AND IMPLEMENT REGIONAL SUPPLEMENTAL WATER PROGRAM

#### Need and Function of the Program Elements

These program elements serve the OBMP goals listed in Table 3-8. The specific goals, impediments and action items are described below.

The first impediment in *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced due to outflow from the southern part of the Basin." The fourth impediment in *Goal 2 – Protect and Enhance Water Quality* can be stated as: "Poor ambient groundwater quality limits direct use of groundwater and can lead to loss of Basin yield." Most of the agricultural land use in the southern part of the Basin will convert to urban uses over the next 20 to 30 years. Groundwater from the southern part of the Basin will have to be treated prior to use for these new land uses. Groundwater outflow to the Santa Ana River will occur if the decrease in agricultural groundwater production in the southern part of the Basin is not matched by an increase in municipal groundwater production in the same area. The increase in outflow will result in a decrease in safe yield that will reduce the initial rights of the producers in appropriative pool by about 74 percent. The increase in groundwater outflow to the Santa Ana River will cause an increase in river discharge and a degradation of water quality in the river. Currently, agricultural production in the southern part of the Basin is estimated using primarily water duty methods to be about 40,000 acre-ft/yr. Annual estimates of agricultural production are expected to be larger after in-line meters are in place. If the current level of groundwater production in the southern part of the Basin were to cease, the rising water discharge to the Santa Ana River could increase by approximately the numerical equivalent of the current production – about 40,000 acre-ft/yr. This new discharge would have an associated TDS concentration of about 1,300 milligrams per liter (mg/L) (almost twice the basin plan objective of 740 mg/L and 2.5 times the secondary drinking water MCL of 500 mg/L) and a nitrogen concentration of 30 mg/L-N (three times the basin plan objective of 10 mg/L-N and primary drinking water MCL of 10 mg/L-N). The Santa Ana River downstream of the Chino Basin is the primary drinking water supply for most of Orange County. Therefore, Santa Ana River water quality impacts caused by not producing Chino Basin groundwater will adversely affect the municipal water supplies in Orange County. The Regional Board has indicated that

any adverse impacts to the Santa Ana River water quality associated with increased outflows from Chino Basin groundwater will have to be completely mitigated – presumably by desalting recycled water discharges to the Santa Ana River.

The third impediment in Goal 1 – Enhance Basin Water Supplies can be stated as: "Because there is a lack of assimilative capacity for total dissolved solids and nitrogen in the Chino Basin, there are economic limitations on the recharge of recycled water." Most of the recycled water produced in the Basin is exported out of the Basin because of either lack of demand for direct use or economic limitations caused by the lack of assimilative capacity in the Chino Basin. The TDS and nitrogen objectives in the Santa Ana Watershed are under rigorous review and new water quality objectives and water recycling guidelines should be implemented in the next few years. Recharge of recycled water could be used to replenish over-production, supplement the yield of the Basin, and lower the demand for imported water from the Sacramento Delta. There are three treatment options that that can be used to enable the recharge of recycled water: desalting recycled water prior to recharge, desalting groundwater to offset the salt load in the recycled water, and blending recycled water with low TDS imported and/or storm waters.

The fourth impediment in *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Because future demands are increasing and there are limitations on basin and traditional supplies, new sources of supplemental water need to be developed." Alternatives to the use of imported water from MWDSC need to be developed to meet future demands, improve reliability and minimize cost of supplies. The new supplies include recycled water, groundwater from adjacent basins, Santa Ana River water and other waters as can be identified and conveyed to the Chino Basin.

The third impediment in *Goal 2 – Protect and Enhance Water Quality* can be stated as: "There is ongoing legacy contamination in the vadose zone with TDS and nitrogen from agriculture." The vadose zone that underlies areas that were or are currently in agricultural use is likely to be degraded with TDS and nitrogen. The vadose zone will contribute to future TDS and nitrogen degradation of the saturated zone. The primary areas of concern are the areas that were formerly in citrus in the northern part of the Basin and the entire southern half of the Basin. There are two significant implications of legacy contamination in vadose zone: groundwater degradation from TDS and nitrogen will continue into the future long after the agriculture has left – even if extraordinary efforts are used to clean up degraded groundwater; and, groundwater treatment ranging from blending to desalting will be necessary far into the future to put the degraded groundwater to beneficial use.

There are other goals and impediments to goals that are listed for these program elements, but they are somewhat redundant with those listed above and are not described herein. Fundamentally, the goal of Program Elements 3 and 5 is to develop a regional, long range, cost-effective, equitable, water supply plan for producers in the Chino Basin that incorporates sound basin management. The water supply plan developed during Phase II of the OBMP process will include:

- a cost-effective plan to maximize the beneficial use of Chino Basin groundwater and the safe yield.
- a program to reliably meet the long-term water supply needs of area purveyors.
- an implementation program.

**Water Demand Planning Assumptions**

The planning assumptions and basic data used to develop and evaluate water supply plans are described below.

**Available Water Supply from the Impaired Area.** As urbanization of the agricultural areas of San Bernardino and Riverside counties in the southern half of the Basin occurs, the agricultural water demands will decrease and urban water demands will increase significantly. Future development in these areas is expected to be a combination of urban uses (residential, commercial, and industrial). The cities of Chino, Chino Hills, and Ontario, and the Jurupa Community Services District (JCSD) are expected to experience significant new demand as these purveyors begin serving urban customers in the former agricultural area. For planning purposes, the agricultural area is assumed to be fully developed by the year 2020.

Based on current estimates of overlying agricultural pool production, it is expected that at least 40,000 acre-ft/yr of groundwater will need to produced in the southern part of the Basin to maintain the safe yield. Actual replacement groundwater production required could be far greater than 40,000 acre-ft/yr if current agricultural production is greater than reported to Watermaster. Recall in the Section 2 discussion on Chino Basin production, that there was a difference in the agricultural production reported to Watermaster (based on water duty methods) and the production estimates developed in the CBWRMS based on water duty methods and water budget modeling, with Watermaster's estimates being about 26,000 acre-ft/yr lower for the period 1978 to 1989. Watermaster will install in-line meters on all wells over the next three years after which accurate estimates of agricultural production will be available. If these estimates show that agricultural production is higher than previously reported, then the groundwater production rates from the southern part of the Basin will have be increased to maintain yield.

**Water Supply Plans.** Water demands, supply projections for agencies that produce groundwater from the Chino Basin, and estimates of the safe operating yield of the Basin are the basis for evaluating the water supply plans presented in this analysis. Initial water supply plans were developed by Montgomery Watson in 1998 and modified by WE, Inc., based on information supplied by the municipal and industrial producers. The initial plans are shown in Table 2-17.

Based on the data presented in Section 2, the municipal and industrial demands are projected to increase 30 percent between 2000 and 2020. Several agencies will experience increases in demand exceeding 30 percent over the next 20 years, including the cities of Chino, Chino Hills, Norco, Ontario, Cucamonga County Water District (CCWD), Fontana Water Company (FWC), JCSD, and the West San Bernardino County Water District (WSBCWD). Forecasts from municipal and industrial entities indicate that water supply sources for the Chino Basin in 2020 will consist predominantly of Chino Basin wells through direct use or treatment and use, groundwater and treated surface water from other basins, and MWDSC supplies.

The demand data in Section 2 and individual water supply plans were used to quantify the future demand for each purveyor that will need to be satisfied from new water supply sources. Future sources for each purveyor were evaluated and classified into two categories: secure sources and non-secure sources. Secure sources are those with a high probability of being available throughout the planning period. These include existing and available supplies from Chino Basin wells, existing water and desalter plants (*i.e.*, WFA/JPA, CCWD, and TVMWD water treatment plants and Santa Ana Watershed Project Authority [SAWPA] Desalter), imported treated MWDSC water from the Weymouth treatment plant, and imported surface water from other basins. Non-secure sources are not currently available and must be developed to serve the Basin purveyors. These depend on a future event, such as the construction of a treatment plant or acquisition of a new water source.

Table 4-7 lists the 2020 demand projections, projected secure water supply sources including Chino Basin groundwater, production rights, over/under production, the water needed in the future, and the

replenishment obligations. The quantity of water that will be required by each water purveyor was found by subtracting the secure water supply for each purveyor from the purveyor's 2020 demand.

As shown in Table 4-6 of the 404,000 acre-ft/yr of total demand predicted in 2020, approximately 364,000 acre-ft/yr will be met from secure water sources with the remaining 40,000 acre-feet of demand being met from projects described in this program element. The breakdown of the 40,000 acre-ft/yr by purveyor from largest to smallest user is as follows:

| | |
|---|---|
| Jurupa CSD | 10,720 acre-ft/yr |
| City of Chino | 9,540 acre-ft/yr |
| City of Ontario | 8,400 acre-ft/yr |
| City of Chino Hills | 5,600 acre-ft/yr |
| City of Norco | 3,260 acre-ft/yr |
| Santa Ana River WC | 2,170 acre-ft/yr |
| Swan Lake | 350 acre-ft/yr |
| Total in 2020 | 40,040 acre-ft/yr |

The demand in years 2005, 2010, and 2015 was predicted assuming a uniform increase in annual demand for each of the above purveyors. Table 4-7 lists the demands for these intermediate planning years.

For the purpose of this analysis, it was assumed that there is approximately 48,000 acre-ft/yr of agricultural production in the southern part of the Chino Basin in the year 2000, and that this production will reduce to about 8,000 acre-ft/yr in the year 2020. This decline in agricultural production must be matched by new production in the southern part of the Basin or the safe yield in the Basin will be reduced. The remaining 8,000 acre-ft/yr of production in the southern part of the Basin will be used by the State of California.

**Potential Supplemental Water Supply Sources.** An evaluation of potential future supplemental water supply sources is given in Table 4-8. Of these sources, the most viable is supplied through existing basin conventional water treatment plants that treat imported State Water Project (SWP) water from MWDSC. For the purposes of this analysis, it is assumed that future supplemental water supplies will come from expansion of the CCWD Lloyd Michael water treatment plant (WTP) and the WFA/JPA Agua de Lejos WTP.

**Alternative Water Supply Plan Descriptions**

Four initial water supply plan alternatives and ten subalternatives were developed. The initial alternatives consisted of various combinations of wells, desalters, water treatment plants, water and brine pipelines, and pumping stations. Purveyors that will require new water supplies include the cities of Chino, Chino Hills, Ontario, Norco, JCSD, Santa Ana River Water Company (SARWC), and Swan Lake. A fifth alternative was also developed that included three subalternatives for various levels of recycled water use. The water supply plans are described in detail in the Task Memorandum on file with the Watermaster for this Program Element. The initial alternatives that were evaluated included:

Alternative 1: Supplemental Water Deliveries Only

- Subalternative 1A: Supplemental Water Delivery – Agricultural Converts to Urban Uses
- Subalternative 1B: Supplemental Water Delivery – Agricultural Use Stays

Alternative 2: Groundwater Pump, Treat, and Serve Only

- Subalternative 2A-1: Regional Groundwater Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 2A-2: Ad Hoc Groundwater Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 2B-1: Regional Groundwater Pump, Treat, and Serve – Agricultural Use Stays
- Subalternative 2B-2: Ad Hoc Groundwater Pump, Treat, and Serve – Agricultural Use Stays

Alternative 3 – Conjunctive Use

- Subalternative 3A: Conjunctive – Agricultural Converts to Urban Uses
- Subalternative 3B: Conjunctive – Agricultural Use Stays

Alternative 4: Supplemental Water Delivery and Regional Groundwater Pump, Treat, and Serve

- Subalternative 4A: Supplemental Water Delivery and Regional Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 4B: Supplemental Water Delivery and Regional Pump, Treat, and Serve – Agricultural Use Stays

Alternative 5: Reclaimed Water Delivery

- Subalternative 5A: Direct Non-Potable Reuse Only
- Subalternative 5B: Reclaimed Water Delivery for Spreading Only
- Subalternative 5C: Direct Non-Potable Reuse and Recharge of Reclaimed Water

**Recommended Water Supply Plan for the OBMP**

Considerable discussion of the alternative water supply plans occurred at the OBMP workshops in February through May of 1999. The discussions focused, in part, on the assumption and details of each alternative and cost. Based on technical, environmental, and cost considerations, the stakeholders selected Alternative 4A for detailed review and refinement. Alternative 6A was developed based on Alternative 4A and 5C, includes an accelerated desalting schedule and has no future supplemental water deliveries to the southern part of the Basin. The Alternative 6A water supply plan consists of the following key elements.

**Groundwater Production Pattern.** Groundwater production for municipal use will be increased in the southern part of the Basin to: meet the emerging demand for municipal supplies in the Chino Basin, maintain safe yield, and to protect water quality in the Santa Ana River. All new southern Basin production will require desalting prior to use. The cities of Chino, Chino Hills, Ontario and Norco, and the JCSD will maximize their use of groundwater from the southern part of the Basin prior to using other supplies. The SAWPA desalter, currently under construction will have to be expanded from 8 million

gallons per day (mgd) to 10 mgd by 2003. Two new desalters will be constructed – the *east* and *west* desalters. The east desalter will need to be on-line by late 2003 at a capacity of 14 mgd. The west desalter will need to be on-line by 2010 with a capacity of 7.5 mgd. Both these new desalters will be expanded in the future. The cost of the southern Basin desalting system will be shared by all Basin producers such that the agencies making direct use of this water above are not unfairly burdened with the cost of treating this water. It was demonstrated during discussions on this program element that equitable cost sharing could be achieved. It was also demonstrated that the groundwater production pattern in the Alternative 6A water supply plan was the least cost plan when lost safe yield and Santa Ana River water quality mitigation costs are avoided. The stakeholders came to an agreement on May 27, 1999 that the Alternative 6A water supply plan should be included in the OBMP.

The total replenishment obligation associated with this groundwater production pattern is 31,000 acre-ft/yr in the year 2000 and will increase to about 55,000 acre-ft/yr by the year 2020. The replenishment obligation can be satisfied using water in local storage, direct recharge of imported and recycled water, and by in-lieu exchange.

**Imported Water.** Imported water use will increase to meet emerging demands for municipal and industrial supplies in the Chino Basin area, Watermaster replenishment, and conjunctive use. Expanded use of imported water in the northern part of the Basin will have a lower priority than maintaining groundwater production in the southern part of the Basin.

**Recycled Water.** Recycled water use (direct use and recharge) will increase to meet emerging demands for non-potable water and artificial recharge. Under the current Basin Plan, all new recycled water use will require mitigation for TDS and nitrogen impacts. Recycled water use will be expanded as soon as practical. The two new desalters described above and the increase in storm water recharge will provide mitigation for the expanded use of recycled water.

Under Alternative 6A , two new desalters will be constructed and the SAWPA desalter currently under construction will be expanded immediately. The general location of these desalters, their respective well fields, product water pipelines, and delivery points are shown in Figure 4-2. Table 4-9 shows the timetable for the new desalters along with the salt removal capacity of these desalters. Table 4-10 contains the capital and annual costs for these facilities. An initial financing and cost sharing plan for this part of the OBMP will be developed during the Phase II OBMP process.

**Implementation Requirements and Issues**

Technical evaluation requirements and issues relating to facilities siting, facilities description and operations, and technical feasibility include:

- Basin exploration to assess ambient water quality and potential well field locations.
- Geotechnical and hydrogeological investigations.
- Siting investigations for desalters, wells, pipelines, and other facilities.
- Pump tests to determine viability of aquifer production.
- Modeling for safe yield impacts for alternatives identified in the OBMP.
- Preliminary engineering (reverse osmosis [RO] process design, facility layouts, pipeline alignments).
- Aquifer and groundwater quality monitoring.
- Santa Ana Regional Interceptor (SARI) capacity/availability.

- Analyses of the availability/capacity of existing infrastructure.
- Project phasing schedule.
- Construction delivery method (design-bid-build versus design-build).

Financial evaluation requirements and issues include:

- Economic feasibility analysis.
- Project financing plan.
- Interagency agreements/approvals/contracts.
- Potential impact on replenishment obligations.
- Cost/benefit analyses to evaluate incentives.
- Method of operation (agency operation versus contract operation).
- Future availability of MWDSC incentives.
- Sale of rising groundwater to Orange County.

California Environmental Quality Act (CEQA) and permitting requirements and issues include:

- Selection of implementing/lead agency.
- Preparation of necessary documents for CEQA/ National Environmental Policy Act (NEPA) compliance.
- Compliance with Basin Plan.
- Regulatory requirements/approvals from DHS and Regional Board Requirements.
- Interagency agreements/approvals/contracts.

**Implementing Agencies**

There are a number of specific responsibilities that must be defined when implementing any of the previously discussed alternatives. These responsibilities are listed in Table 4-11. One agency could assume all the responsibilities listed in Table 4-11; however, reality dictates that no single agency can typically meet all of these responsibilities. The following section provides a description of the agencies that could become the lead implementing agency for the construction, operation, and technical and financial support of the chosen water supply alternative.

**Chino Basin Watermaster**. Watermaster was created on January 27, 1978 by the San Bernardino County Superior Court after extensive negotiations between the municipal, industrial, and agricultural producers. The Chino Basin Watermaster is the entity charged with administering adjudicated water rights and managing groundwater resources within the Chino Basin. The Watermaster's primary responsibilities include: manage and control the replenishment of water supplies in the Basin, acquire and spread replenishment water as needed, approve and facilitate the storage of supplemental water in the Basin, and develop and implement an optimum basin management program to manage the Basin.

**Inland Empire Utilities Agency.** IEUA, formerly the Chino Basin Municipal Water District, serves 570,000 people and covers 242-square miles in the areas of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, Upland and the Chino Agricultural Preserve. The Agency's major responsibilities are: wastewater treatment and disposal; supplemental water supply; industrial waste or non-reclaimable waste disposal; and water recycling. Under the *Regional Sewage Service Program*, the Agency operates three domestic wastewater treatment plants. The program enables local communities to take advantage of shared facilities and to further reduce costs by combining staffs and operations. Two

additional water recycling facilities will be on-line in the next 10 years to accommodate the growth of the area's industrial and residential communities, as well as to meet increasingly stringent environmental regulations.

**Three Valleys Municipal Water District.** In recognition of the need for additional sources of water for the growing region, the Pomona Area Water Committee was organized in 1945 for securing annexation to the MWDSC. Through the efforts of the committee, the District was formed on January 26, 1950 by public election. The District is a local government agency with a board of directors elected by the registered voters residing within the District's boundaries. The District's boundary includes approximately 133 square miles with a current population of 475,000. Approximately 126,600 retail customers are served by the local agencies to whom the District provides supplemental water.

**Western Municipal Water District.** Western Municipal Water District of Riverside County was formed in 1954 to bring supplemental water to growing western Riverside County. Western's district consists of a 510-square mile area of western Riverside County, with a population of nearly one-half million people. Western is in the heart of the Santa Ana Basin and within its district lies the communities of Jurupa, Mira Loma, Rubidoux, Riverside, Norco, Corona, Elsinore Valley, and Rancho California. A member agency of the Metropolitan Water District of Southern California, Western serves imported water directly to more than 10,000 retail customers who are located in the unincorporated and non-water bearing areas around Lake Mathews and portions of the city of Riverside. The District also serves ten wholesale customers with Colorado River and SWP water. In addition to its retail water service, the District has committed to retail sewer service to 2600 customers in the Lake Hill/Home Gardens area.

**Santa Ana Watershed Project Authority.** SAWPA is a joint powers agency that was originally formed to develop water and wastewater management plans for the Santa Ana River watershed. The agency is now responsible for regional water quality planning and implements projects at the request of its member agencies. Members of SAWPA include: IEUA, Eastern Municipal Water District (Riverside County), San Bernardino Valley Municipal Water District (SBVMWD), WMWD (Riverside County), and the Orange County Water District (OCWD). SAWPA owns and operates the Santa Ana Regional Interceptor (SARI) sewer brine disposal system that offers a means of exporting non-reclaimable wastewater from the southern portion of the Chino Basin (CBMWD Reclaimed Water Master Plan, 1993). In addition to the SARI, SAWPA, in cooperation with a number of other agencies who provided support and financial resources, constructed the Arlington Desalter to begin reversing the Arlington Basin's salinity. The Arlington Desalter produces approximately 6 mgd of drinking quality water. SAWPA also owns and operates the SAWPA Chino Desalter that, upon construction by the year 2000, will supply approximately 8 mgd of potable drinking water to JCSD, Chino, Chino Hills, and Norco.

### Cooperative Efforts with Appropriate Agencies to Implement Program

Watermaster will assume the leadership role for developing and implementing the OBMP regional water supply plan (Alternative 6 described above) including the development of new desalting plants and the expansion of the new SAWPA desalter. Watermaster will enter into agreements with cooperative entities to implement the OBMP regional water supply plan. Potential cooperative entities include CCWD, IEUA, TVMWD, WMWD, SAWPA, WFA/JPA, and private entities. These contracts will include specific performance goals and schedule. If a cooperative entity fails to perform according to the terms of their agreement, then Watermaster will terminate the agreements and either enter into an agreement with another cooperative entity or implement the program itself.

The new desalting projects could be designed, built, operated and owned by IEUA, WMWD, SAWPA, or by private entity under long-term contract to supply water from the desalters. A private entity may be the preferred way to construct the east desalter because of rapid implementation requirements of that desalter.

CCWD, IEUA, TVMWD, and WFA/JPA will be responsible for providing imported supplies.

IEUA and WMWD will be responsible for expanding the recycled water use in the Basin.

**Implementation Actions and Schedule**

**First Three Years (1999/00 to 2001/02).** The following actions will be completed in the first three years commencing fiscal year 1999/00:

Preliminary Engineering – Year 1

- Basin exploration to assess current water quality and identify well field locations.
- Geotechnical and hydrogeological investigations.
- Siting investigations for desalters, wells, pipelines, and other facilities.
- Re-evaluation of potential purveyor water supplies/demands.
- Analysis of availability & capacity of existing infrastructure.
- Analysis of SARI capacity & availability.
- Concept design for new treatment facilities.
- Preparation of necessary documents for CEQA/NEPA compliance.
- Regulatory requirements/approvals from DHS and Regional Board Requirements.
- Conditional use and other permits from local agencies.
- Economic feasibility analysis.
- Project financing plan.
- Selection of implementing/lead agency.
- Interagency agreements/approvals/contracts.
- Method of operation (agency operation versus contract operation).

Design and Construction of East Desalter and
Design and Construction of Expansion of SAWPA Desalter – Years 2 and 3

- Purchase land for ultimate facilities.
- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of purveyor water supplies/demands.
- Preliminary engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction.

- Start-up by 2003.

**Years Four to Ten (2002/03 to 2010/11).** The following actions will be completed in years four through ten, commencing fiscal year 2002/03

Design and Construction of Western Desalter

- Purchase land for ultimate facilities.
- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of potential purveyor water supplies/demands.
- Geotechnical and hydrogeological investigations.
- Preliminary engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction
- Start-up by 2010

East, West, and SAWPA desalters:

- Operate facilities through period.
- Upgrade facilities as necessary to maintain state-of-the-art and to meet regulatory requirements.

**Years Eleven to Twenty (2010/11 to 2019/20).** The following actions will be completed in years eleven to twenty, commencing fiscal year 2010/11

Expansion of Eastern Desalter, and
Expansion of Western Desalter

- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of potential water supplies/demands.
- Geotechnical and hydrogeological investigations.
- Preliminary Engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction.
- Start-up by 2015.

East, West, and SAWPA desalters:

- Operate facilities through period.

- Upgrade facilities as necessary to maintain state-of-the-art and to meet regulatory requirements.

**PROGRAM ELEMENT 4 – DEVELOP AND IMPLEMENT COMPREHENSIVE GROUNDWATER MANAGEMENT PLAN FOR MANAGEMENT ZONE 1 (MZ1)**

**Need and Function**

*Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1* contains action items explicitly listed in Table 3-8.

The second impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, piezometric levels in the deep aquifers of Management Zone 1 will continue to decline adding to the potential for additional subsidence and fissures, lost production capability and water quality problems. This impediment speaks to a localized subsidence and fissuring problem within the City of Chino and to a potentially larger and similar problem in the southern end of Management Zone 1 in the former artesian area. This part of the Basin contains a higher fraction of fine-grained materials that originated from sedimentary deposits in the Chino and Puente Hills. This area also consists of a multiple aquifer system. The upper aquifer(s) are moderately high in TDS and are often very high in nitrate. The City of Chino Hills has drilled a series of wells into the deeper aquifer(s) to obtain better quality water. The storage and hydraulic properties of the deeper aquifers are quite limited relative to the upper aquifer. The correlation of the recent groundwater production in the deep aquifers and the timing of the subsidence and fissuring, and a review of the hydrogeologic data from the area very strongly suggest that deep aquifer production is the likely cause of the subsidence. Figure 4-2 illustrates the location and magnitude of subsidence and fissuring in the City of Chino and Figure 4-3 shows the location of the this subsidence anomaly relative to Management Zone 1 and the former artesian area. The *Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1* task memorandum is on file and available from the Watermaster offices. It describes the subsidence problem in the Management Zone 1 area as it is currently understood in more detail.

**MZ 1 Management Plan**

The continued occurrence of subsidence and fissuring in Management Zone 1 is not acceptable and must be reduced to tolerable levels or completely abated. However, there is some uncertainty as to the causes of subsidence and fissuring and more information is necessary to distinguish among potential causes. An interim management plan must be developed and implemented to:

- minimize subsidence and fissuring in the short-term;
- collect the information necessary to understand the extent and causes of subsidence and fissuring; and
- formulate an effective long-term management plan.

**MZ 1 Interim Management Plan**. The interim management plan would consist of the following activities:

- Voluntarily modify groundwater production patterns in Management Zone 1 for a five-year period. For example, there is some indication that deep aquifer production beneath the City of Chino contributed to recent subsidence and fissuring in the area. Reduction or elimination of deep aquifer production beneath the area of subsidence and fissuring is a logical short-term mitigation strategy.

- Balance recharge and production in Management Zone 1. Based on preliminary engineering investigations with RAM tool, it appears that current levels of pumping and recharge are balanced. However, increases in pumping should be balanced with increases in recharge.
- Determine gaps in existing knowledge. Primarily, there is a lack of understanding of Management Zone 1 hydrogeology, of the nature and extent of subsidence and fissuring, and of the exact causes of subsidence and fissuring.
- Implement a process to fill the gaps in existing knowledge. This would include hydrogeologic, geophysical, and remote sensing investigations of Management Zone 1, as well as certain monitoring programs, such as piezometric, production, water quality, ground level, and subsidence monitoring.
- Formulate a long-term management plan. The long-term management plan will include goals, activities to achieve those goals, and a means to evaluate the success of the plan.

**MZ 1 Long-Term Management Plan**. The long-term management plan will be formulated during the interim management plan based on investigations, monitoring programs and data assessment. It will likely include modifications to groundwater pumping rates and the locations of pumping, recharge, and monitoring. The long-term management plan will be adaptive in nature – meaning monitoring and periodic data assessment will be used to evaluate the success of the management plan and to modify the plan, if necessary.

**Cooperative Efforts with Appropriate Agencies to Implement Plan**

The subsidence and fissuring problem appears to be currently focused in the City of Chino and the California Institution for Men (CIM). However, it is reasonable given the current knowledge, to expand the minimum area of concern to the entire former artesian area shown in Figure 4-3 and slightly beyond that area. Changes in pumping and recharge patterns in Management Zone 1, and more generally the area of concern, will most likely be part of the management plan. The producers in the area include the cities of Chino, Chino Hills, Ontario, Pomona and Upland, the Monte Vista Water District (MVWD), San Antonio Water Company (SAWC), Southern California Water Company (SCWC), the State of California (CIM, California Institution for Women [CIW]), and SAWPA. Watermaster may need to have entities that increase their production to provide for the recharge of an equivalent amount of water to maintain the balance of pumping and recharge. Watermaster will take the leadership role in the development and implementation of the Management Zone 1 management plan.

**Implementation Actions and Schedule for the First Five Years**

Year 1

- Establish a Management Zone 1 committee and develop interim management plan.

Years 2 to 5

- Implement the interim management plan, including appropriate monitoring.

Years 3 to 5

- Annual assessment of data from monitoring programs, and modification of monitoring programs if necessary.

Year 5

- Develop long-term management plan.

**Implementation Actions and Schedule for Years Six to Ten.**

Year 6

- Implement the long-term management plan.

Years 6 to 10

- Annual assessment of data from monitoring programs, and modification of management plan if necessary.

**Implementation Actions and Schedule for Years Eleven to Fifty.**

Assessment of data from monitoring programs every three years and modification of management plan if necessary.

## PROGRAM ELEMENT 6 – DEVELOP AND IMPLEMENT COOPERATIVE PROGRAMS WITH THE REGIONAL BOARD AND OTHER AGENCIES TO IMPROVE BASIN MANAGEMENT

## PROGRAM ELEMENT 7 – DEVELOP AND IMPLEMENT SALT MANAGEMENT PROGRAM

### Need and Function

These program elements are needed to address some of the water quality management problems that have occurred in the Basin. These water quality problems are described in Section 2 *Current Physical State of the Basin* and Table 3-8 in Section 3 *Goals of the OBMP*. The specific water quality issues addressed by these program elements are listed below:

- The Special Referee has indicated that Watermaster needs to routinely demonstrate that implementation of the OBMP will lead to groundwater quality improvements. Watermaster should develop and use a method to determine water quality trends and to verify whether the OBMP is improving water quality.
- There is legacy contamination in the vadose zone from past agricultural activities (TDS and nitrogen) that will continue to degrade groundwater long into the future.
- Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed.
- There is ongoing salt and nitrogen loading from agriculture.

### Demonstration of Water Quality Improvement

The TDS and nitrogen challenges in the Chino Basin are caused by agriculture and safe yield management. The TDS and nitrogen impacts from agriculture were described in Section 2. Table 4-12 shows in summary format how the TDS concentration in source supplies and fertilizer affect the TDS concentration in irrigation return flows to groundwater. The TDS concentration in the irrigation return flow is about four times higher than the TDS concentration in the irrigation supply. The majority of the increase in TDS concentration is caused by consumptive use and a negligible contribution from the fertilizer. The table also shows the affect of the use of dairy manure for fertilizer and soil improvement. The TDS contribution from manure is much larger than from commercial fertilizer, however the concentration increase from consumptive use is more significant particularly for source water TDS concentrations typical in the southern part of the Basin (>500 mg/L). Similar TDS concentration increases in irrigation return flows occur for other crop types such as citrus and grapes, both of which were significant in the past. Table 4-12 shows TDS concentrations for urban irrigation return flows for a

representative range in municipal source water TDS concentration. The range of TDS concentrations in urban irrigation returns is from about 1,200 to 1,800 mg/L with less than ten percent coming from fertilizers and the overwhelming majority of the TDS increase coming from consumptive use.

Figure 4-4 is a map that shows the general groundwater flow directions in the Chino Basin. The map contains velocity vectors that show direction and relative velocity of groundwater flow. One of the more interesting interpretations of this map is that groundwater generally flows away from the Santa Ana River. Small amounts of rising groundwater occur seasonally in Chino and Mill Creeks and are typically less than 11,000 acre-ft/yr. The only way significant amounts of groundwater can leave the Basin are through consumptive use, the discharge of recycled water to the Santa Ana River near Prado, and the discharge of brine to either the Santa Ana Regional Interceptor (SARI) or the Non-Reclaimable Waste Line (NRWL). The groundwater flow pattern shown in Figure 4-5 is largely influenced by production. If there were a significant reduction in groundwater production in the southern part of the Basin, then groundwater outflow to the Santa Ana River would increase and the safe yield would be reduced. The safe yield of the Basin depends on recharge of Santa Ana River water and minimal outflow of groundwater to the river. Without the recycled water discharges to the Santa Ana River near Prado dam and brine discharges to the SARI and the NRWL, the Chino Basin would almost be a completely closed system.

The vadose zone is the part of the aquifer that lies between the soil and the water table. The vadose zone is partially saturated and buffers the mineral salt loads entering from the soil. The buffering effect reduces the magnitude of the peak loads to the saturated zone and spreads out the loading of the saturated zone over a period of time that is longer than the soil loading. Salts in the vadose zone are being released to the saturated zone now and will continue to be released to the saturated zone for some time after the agricultural lands are converted to urban uses. The quantity of salt reaching groundwater should reduce in the future for two reasons:

- salt loading to the soil from agricultural will reduce over time
- less water will percolate through the vadose zone as the agricultural area becomes paved through urbanization (60 to 80 percent impervious).

If current rates of agricultural loading were to continue indefinitely, TDS and nitrate concentrations in groundwater could continue to rise. TDS projections for the Chino Basin that were made during the *Chino Basin Water Resources Management Study* (CBWRMS) suggested that the TDS concentrations would continue to rise in groundwater throughout most of the 50-year planning horizon of 1990 through 2040. These graphs are included in the Program Element 6 Task Memorandum on file and available from the Watermaster offices. In the CBWRMS, agricultural activities were assumed to decline to minimum levels by the year 2020. If and when the land use in the area is converted to urban uses, the source water TDS served to the new urban areas will be always less than 400 mg/L and the mineral salts from the source water will be mostly discharged in recycled water discharges to the Santa Ana River, brine line discharges (from new desalters) and increased rising groundwater flows to the Santa Ana River. The TDS concentration in groundwater will, after some period of time, decline slowly but should still remain significantly higher than be served as a municipal supply.

The Court will require Watermaster t develop and use a method to demonstrate that actions taken in the OBMP will improve groundwater quality. The question arises: how *do we assess progress towards improving groundwater quality if groundwater monitoring alone will continue to show degradation even after significant steps are taken to improve water quality?*

The alternatives available to the Watermaster range from groundwater quality monitoring alone to the application of numerical models in conjunction with monitoring. As mentioned above, if groundwater monitoring were the only metric for measuring improvement, then it will appear for many years that

construction of desalters and the export of dairy waste will have no benefit. The use of numerical models to assess progress in improving water quality is extremely expensive if their only use were to assess such progress.

A method that combines monitoring and a salt budget is more practical and cost-effective than large-scale modeling. The salt budget approach consists of a salt mass accounting in each management zone and the Basin as a whole. The magnitude of each inflow and outflow component would be estimated. The TDS and nitrogen concentration of each inflow and outflow component would be estimated. Water quality will improve if the flow-weighted concentration in the inflow is less than the flow-weighted concentration in the outflow.

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] < 0 \quad \text{water quality is improving}$$

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] > 0 \quad \text{water quality is degrading}$$

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] = 0 \quad \text{water quality is not changing}$$

where: $I_k$ is volumetric recharge component *k*
$C_k$ is the TDS or nitrogen concentration associated with recharge component *k*
$O_j$ is volumetric discharge component *j*
$C_j$ is the TDS or nitrogen concentration associated with discharge component *j*

The inflow components include: precipitation, artificial recharge of storm flows, artificial recharge of recycled water, and applied water. The outflow components include: evapotranspiration, surface water outflow, recycled water export, groundwater export and brine export. The TDS and nitrogen mass increments added to water as it is applied to irrigated lands or to disposal land needs to be estimated. The inflow and outflow components used in this approach will produce average recharge and discharge from the Basin, that is, there will be no change in groundwater storage.

The salt budget will be computed for existing conditions to assess the current balance, hereafter referred to as the baseline case. An assessment of future water quality improvements that will occur from the OBMP will be made by changing the water and waste management assumptions in the baseline case to reflect OBMP implementation. The changes in the inflow and outflow components and their associated TDS and nitrogen concentration will be made and the salt budget equations would be re-solved. The relative improvement of water quality will be assessed by comparing the salt budget of the OBMP to the baseline plan. Later, during periodic OBMP updates, the salt budget will be computed based on the then current water quality (from monitoring programs) and the then current water and waste management plans. These periodic assessments will allow Watermaster to determine if the OBMP is improving water quality.

There are some limitations to the salt budget method and the use of such a method should be considered in light of all anticipated water quality assessment needs in the Basin. Table 4-13 presents a tabular comparison of future water quality information requirements with alternative methods and approximate costs to use those methods over the next 20 years. The CBWRMS developed a comprehensive set of models for the Chino Basin that is capable of assessing the impact of past and future water resources management activities on groundwater level, streamflow, and water quality. The *Chino Integrated Groundwater and Surface Water Model* (CIGSM) is extremely complex and expensive to maintain and use.

The salt budget method will cost about $80,000 to $100,000 to develop and use the first time. Subsequent uses, in either OBMP updates or *ad hoc* investigations, will involve developing new water quality input

data based on new monitoring data and revised water and waste management scenarios. Total cost over the next 20 years should range between $300,000 to $400,000. CIGSM is composed of series of models. In contrast to the salt budget method, CIGSM is very complex and difficult to use. The cost to re-calibrate CIGSM, to update the planning data, and to use the model to evaluate the initial OBMP is about $700,000 based on recent detailed estimates developed for the TIN/TDS Study (Wildermuth Environmental, 1999). The cost to use CIGSM over the next 20 years will run between $3,000,000 to $4,000,000.

**Cooperative Efforts with the Regional Water Quality Control Board**

Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed. Watermaster's past monitoring efforts have been largely confined to mineral constituents in the southern half of the Basin and to available monitoring data supplied by municipal and industrial producers. The Regional Water Quality Control Board (Regional Board) has limited resources to detect, monitor and cause the clean up of point and non-point water quality problems in the Chino Basin. The Regional Board commits its resources to enforce remedial actions when it has identified a potential responsible party. The Regional Board does not take action when the sources are not easily identified or when the sources are diffuse, such as non-point sources. Notable examples include the mercury problem in the east Ontario area and some solvent plumes in the lower Chino Basin. It is not a question of Regional Board willingness to in this area; it is the allocation of limited RWQCB resources. Watermaster can improve water quality management in the Basin by committing resources to:

- identify water quality anomalies through monitoring;
- assist the Regional Board in determining sources of the water quality anomalies;
- establish priorities for clean-up jointly with RWQCB; and
- remove organic contaminants through its regional groundwater treatment projects in the southern half of the Basin.

The last bulleted item requires some explanation. The well field for SAWPA desalter will eventually intercept a solvent plume of unknown origin that is emanating from the Chino airport area. There is a second solvent plume northeast of the Chino airport area that could be intercepted by the current desalter or another future desalter. This will require additional treatment for the water produced by the desalter. The desalter project can be used to clean up these plumes at some additional cost. The cost of cleaning up the solvent plumes at the desalters will be less than the cost of a dedicated solvent removal system. The additional cost should be paid for by the entity responsible for the solvent discharge. A similar process was used by the Regional Board and Kaiser Steel Corporation to mitigate a TDS plume in the north half of the Chino Basin.

**TDS and Nitrogen (Salt) Management in the Chino Basin**

TDS and nitrogen management will require minimizing TDS and nitrogen additions by fertilizers and dairy wastes, desalting of groundwater in the southern part of the Basin (for water supply purposes), and maximizing the artificial recharge of storm water. The latter two management components are included in Program Elements 3 and 2, respectively

The agricultural area in the southern part of the Chino Basin will gradually convert to urban uses over the next 20 to 30 years and, thus, in the long term, the TDS and nitrogen challenges from irrigated agriculture and dairy waste management will go away. The Regional Board will adopt new dairy waste discharge requirements in the summer of 1999. The requirements will include the following:

- Each dairy will develop and implement an engineered waste management plan that will contain dairy process water and on-dairy precipitation runoff for up to a 25-year, 24-hour storm
- Manure scraped from corrals must be exported from the dairy within 180 days
- All manure stockpiled in the Chino Basin as of December 1, 1999, will be exported from the Basin by December 1, 2001.
- No manure may be disposed of in the Chino Basin
- Some manure can be applied to land at agronomic rates if and only if in the opinion of the Executive Officer there is reasonable progress toward the construction of a new desalter in the Chino Basin.

The Santa Ana River Watershed Group (SARWG) is a stakeholder group made up of municipal, county, regional and federal agencies, and private individuals that are working through complex land use and environmental issues in the Santa Ana Watershed. One of their work products is a draft manure management strategy (MMS) for the Chino Basin. The primary component of MMS is the export of manure either as a raw or an improved material. The MMS describes the economics of manure management and the means to finance manure export.

The new dairy waste discharge requirements may have the unintended result of actually causing Santa Ana River quality to degrade. Some or all of the dairy farmers could move out of the Basin if they cannot afford to continue dairy operations as a result of the new waste discharge requirements. A rapid departure of the dairies will result in a rapid decline in groundwater production in the southern part of the Basin and a subsequent increase in poor quality rising water. The rising groundwater will degrade the river. As part of the OBMP, Watermaster will annually review the economics of dairy waste management in the Chino Basin and may contribute funds to subsidize the removal of manure from the Basin. In the first year of the OBMP implementation, Watermaster will contribute $150,000. Watermaster will closely monitor the activities of the Regional Board, SARWG and others whose actions will influence the amount of TDS and nitrogen entering the Basin.

The urban land use that will replace agriculture will require low TDS municipal supplies that in turn will produce lower TDS irrigation returns to groundwater than those generated by agriculture. The construction of desalters in the southern part of the Basin (as described in Program Elements 3 and 5) will extract and export huge quantities of salt from the Basin. Table 4-9 lists the salt removal capacity of desalters described in Program Elements 3 and 5. By 2020, the salt removal capacity of the desalters will reach over 80,000 tons per year. The dairy salt contribution is currently about 30,000 tons per year. It is premature to set salt reduction goals until the salt budget method described above is developed and the salt budget is assessed for the Basin. However, it seems reasonable to expect that the salt budget will be impacted favorably by the desalters and future land use conversions, and that Watermaster should expect a reduction in salt loading of about 80,000 to 100,000 tons of salt per year in the next 20 to 30 years.

**Implementation Actions and Schedule**

**First Three Years (1999/00 to 2001/02).** The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Watermaster will form an ad hoc committee, hereafter *water quality committee*. The purposes of the *water quality committee* are to review water quality conditions in the Basin and to develop (with the Regional Board) cooperative strategies and plans to improve water quality in the Basin. The committee would meet regularly with

Regional Board staff to share information and to recommend cooperative efforts for monitoring groundwater quality and detecting water quality anomalies. The schedule and frequency of meetings will be developed with the Regional Board during the first year of the OBMP implementation.

- Watermaster will refine its monitoring efforts to support the detection and quantification of water quality anomalies. This may require additional budgeting for analytical work and staff/support.
- If necessary, Watermaster will conduct investigations to assist the Regional Board in accomplishing mutually beneficial objectives.
- Watermaster will seek funding from outside sources to accelerate detection and clean up efforts.
- Develop salt budget goals, develop the salt budget method described above and review all the OBMP actions.
- Watermaster will annually review the economics of dairy waste management in the Chino Basin and may contribute funds to subsidize the removal of manure from the Basin. In the first year of the OBMP implementation, Watermaster will contribute $150,000.

At the conclusion of the third year, the *water quality committee* will have met several times, developed and implemented a cooperative monitoring plan with the Regional Board, and developed a priority list and schedule for cleaning up all known water quality anomalies.

**Years Four through Fifty (2002/03 to 2050/51).** The following actions will be completed in years four through fifty, commencing fiscal year 2002/03:

- Continue monitoring and coordination efforts with the Regional Board.
- Annually update priority list and schedule for cleaning up all known water quality anomalies.
- Continue to seek funding from outside sources to accelerate clean up efforts.
- Implement projects of mutual interest.
- As part of periodic updates of the OBMP, re-compute the salt budget using the salt budget method. The salt budget method would be used to reassess future OBMP actions to ensure that salt management goals are attained.
- Annually review the economics of dairy waste management in the Chino Basin and consider contributing funds to subsidize the removal of manure from the Basin.

### PROGRAM ELEMENT 8 – DEVELOP AND IMPLEMENT GROUNDWATER STORAGE MANAGEMENT PROGRAM

### PROGRAM ELEMENT 9 – DEVELOP AND IMPLEMENT CONJUNCTIVE USE PROGRAMS

#### Need and Function

The first impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … (because) the current manner in which Watermaster manages cyclic and local storage accounts will cause overdraft." Watermaster is concerned about the magnitude of water lost from the Chino Basin from rising groundwater when groundwater is stored in the

local storage, cyclic, conjunctive use and other storage accounts. Watermaster is interested in determining how much water can be stored without significant loss from local accounts and in developing a procedure to equitably distribute these losses among entities that have storage accounts. Watermaster may consider setting limits for individual storage accounts for members of the overlying non-agricultural and appropriative pools that ensure reasonable and beneficial use of Chino Basin water.

The third impediment to *Goal 3 – Enhance Management of the Basin* can be stated as: "About 500,000 acre-ft of storage in the Chino Basin cannot be used due to water quality and institutional issues." The impediment speaks to two issues. The first issue is a concern by the producers of adverse water quality impacts if groundwater storage is significantly (see Section 2) increased. The second issue is the past inability of Watermaster, producers, and MWDSC to be able to agree on a conjunctive use program for the Chino Basin.

Parties to the Judgment can store un-pumped groundwater rights for various reasons that include:

**Future use during shortage of other less expensive water supplies.** Some parties to the Judgment have access to other sources of water that are less expensive than producing Chino Basin groundwater. The alternative water supplies available to these parties include imported water, local streamflow, and other groundwater basins. By not pumping their Chino Basin rights, they can then store water in the Chino Basin for later use when their other less expensive sources are scarce. This is conjunctive use.

**Exchange or sell to other producers.** Some parties to the Judgment produce less than their rights resulting from decreased demand, groundwater quality problems, or because they have access to other less expensive supplies. The un-pumped water pursuant to the Judgment can be exchanged or sold to other parties to the Judgment.

**Temporary shortfall in production capacity.** Some parties may not be able to use all their rights due to temporary shortfalls in production capacity caused by water quality or mechanical problems. The un-pumped water goes into local storage accounts until production capacity is recovered or increased.

As a means of efficiently managing their available water supply, each appropriative and overlying non-agricultural producer tries to minimize the cost of water from the sources of supply available to that producer. Some producers have multiple sources of supply and some have limited supplies. Some agencies are in a position, because of the sources of supply available to them, to accumulate water in local storage accounts in most years. Conversely, some agencies produce groundwater from the Chino Basin in excess of their rights and cannot make use of local storage accounts except through the purchase or lease of other water. There are two fundamental reasons why storage limits should be considered.

**Ensure reasonable beneficial use.** The accumulation of water in local storage accounts in quantities that cannot be put to a reasonable beneficial use is in conflict with Section 2 of Article X of the California Constitution. Therefore, if a local storage account maximum storage limit needs to be set, the limit should be based on the producer's ability to put the stored water to reasonable beneficial use.

**Reduce groundwater losses to the Santa Ana River.** The cumulative losses of water from local storage accounts can grow to be large and, thus, the ability to use the stored water to Chino Basin producers is lost. These losses could be minimized by storing water for shorter periods of time prior to use and by limiting the water put into storage accounts to an amount that can be put to reasonable beneficial use.

**Estimate of the Water Lost from Storage**

The accumulation of groundwater in storage without an increase in groundwater production will cause the baseflow to increase in the Santa Ana River and some of its tributaries (Chino Creek and Mill Creek). Investigations conducted by Watermaster in 1995 concluded that losses from water in local storage accounts and cyclic storage are about two percent per year of the water in storage. These losses could reach over four percent in the future if groundwater production patterns are not managed in the southern part of the Basin. Exhibit A in the Program Element 8 Task Memorandum (on file and available from the Watermaster offices) shows the estimated losses from each local storage account, the cyclic storage account, and the Basin as a whole for the 20-year post-Judgment period of 1978 to 1997. The total water lost from local storage accounts and cyclic storage for the 20-year period of 1978 through 1997 is about 50,500 acre-ft. If the water in these storage accounts is produced without accounting for the losses then the Basin will be overdrafted by an amount equal to the water lost from storage.

**Storage Limit Concepts**

Currently there is no existing aggregate limit for local storage accounts. Watermaster's Uniform Groundwater Rules and Regulations (UGRR) contains an aggregate threshold storage value of 100,000 acre-ft above which losses to rising water are to be computed and allocated to the storage parties on a pro rata basis. The UGRR does not specify whether the loss is to be computed for the increment of storage above 100,000 acre-ft or total storage. The 100,000 acre-ft threshold value is an arbitrary number. Some loss will occur when water is placed into local storage. Using 100,000 acre-ft as a threshold value ensures that up to 2,000 acre-ft/yr of unaccounted-for-losses from storage will occur every year. This water will not be in the Basin when the storage parties attempt to recover the stored water. If losses are not accounted for, then the Basin is not being operated in the safe yield mode as required by the Judgment. Therefore, regardless of how storage limits are set, Watermaster should deduct the rising water losses from planned storage for all local storage accounts and for the storage accounts of non-Judgment parties. There are several different ways to develop upper limits on the individual local storage accounts. Some of these are described below.

**Limit based on the ability to use.** In this concept, an upper limit is based on the storage party's ability to store and recover all the water in its account over a fixed period, say five years. The storage party would have to demonstrate that it has enough production capacity to recover all the water in storage over a five-year period. The fixed period would be the same for all storage parties. In this concept, each storage party would have to demonstrate to Watermaster that they have the ability to put a specific volume of water into storage and be able to recover that water, adjusted for losses, over a fixed period of time. Thus, the storage party will have the facilities in place for groundwater production. This type of limit ensures that the water is put to a reasonable beneficial use. For example, suppose an agency has Chino Basin production capacity of 25,000 acre-ft/year, an operating yield of 15,000 acre-ft/yr and the fixed period has been set at five years. Then they would be allowed to put 50,000 acre-ft into its local storage account. If an agency were to increase its Chino Basin production capacity then its local storage account limit could be increased by an amount equal to five times the increase in production capacity. The five-year period used above is arbitrary – Watermaster would need to determine the length of the fixed period.

**Arbitrary limits.** In discussions regarding storage limits in prior years, Watermaster considered setting storage limits based on a multiple of safe yield for overlying non-agricultural pool and a multiple of operating safe yield for the appropriative pool. Parties that have historically over-produced and that will continue to over-produce may not ever be able to use such a local storage account. Parties that under-produce will fill their accounts and may hold water in these accounts for long periods of time and incur

large storage losses. This has been the trend with the past operation of the local storage accounts. Upper limits based on this concept are arbitrary and may not provide for reasonable beneficial use of Chino Basin water. Storage limits based on a multiple of prior years production, an arbitrary volume equal for all parties, or any other arbitrary volume suffer from the same limitations.

**Limit based on time water is in storage.** In this concept, no volume limit would be set. Water could not be kept in storage for more than some fixed period of time, say ten years, regardless of the amount of water in storage. Water transferred from the local storage account for use by the storage party would be taken from the earliest water put into the local storage account. The storage party would be required to recover a volume of groundwater from its local storage account, sell or transfer a similar volume to another party, or sell a similar volume to Watermaster in order to reduce the quantity in its storage account by an amount equal to the water stored prior to the fixed period less losses to rising water. Simply stated, unused water from the first year would either be used or sold to Watermaster or other producer in the eleventh year, unused water from the second year would either be used or sold in the twelfth year, and so on if a ten year time limit is used.

**Upper limit based on total storage and time water is in storage.** This is a composite of the *ability to use* and *time in storage* concepts. In this case a volumetric upper limit would be set for each storage party based on the storage party's ability to store and recover water over a fixed period of time. A time constraint would be added such that water would not be kept in storage more than some fixed period of time.

In all the above storage limit concepts, the storage parties would sell their current year under-production to Watermaster or other parties to the Judgment each year that their local storage accounts are full. Watermaster, or parties to the Judgment, would then use this water to meet current replenishment obligations.

**Implementation of Local Storage Account Limits**

Watermaster's UGRR presently require an *initial determination of local storage requirements to be made*. Watermaster then allocates this storage to members of the appropriative and overlying non-agricultural pools when specific parties make an application for a local storage agreement. Watermaster must periodically review the status of the local storage accounts and adjust the local storage requirement as described in the UGRR. While not explicitly described in the Judgment or UGRR, local storage account limits based on the *ability to us*e, *time in storage,* or a composite of the two, are consistent with the Judgment and could be implemented with some changes in the UGRR.

Local storage account limits based on the *ability to use* require that each agency make a determination of their Chino Basin groundwater production capacity and submit that finding to Watermaster. Watermaster would determine the duration over which the volume in local storage accounts would be used. Storage account limits for each storage party would be computed as:

Storage Limit = duration of storage period * (Chino Basin production capacity – average operating yield)

The average operating yield would equal the average of previous years operating yield entitlements (*e.g.*, five year average). Watermaster could periodically, or upon petition by a storage party, review and adjust the storage limits.

Local storage account limits based on the *time in storage* require that Watermaster determine the time-in-storage limit. Watermaster could then go through production and local storage account records to determine if water must be either used or sold to Watermaster. Local storage account limits based on the composite of the *ability to use* and *time in storage* require the implementation steps described for both concepts.

Some storage parties may currently have more water in their local storage accounts than would be allowed in the storage limit concepts listed above. In this case, the storage party would not be allowed to put water into their local storage accounts and under-production would be purchased by Watermaster.

If, as a result of these storage limits, Watermaster is required to purchase more water than is required for replenishment, then either the storage party will be allowed to temporarily store additional water in its local storage account or Watermaster payments for that water may have to be temporarily deferred.

Water in local storage accounts is used for replenishment of overdraft either by the producer's that hold a local storage account, or is sold to other producers with replenishment obligations. It is possible that Watermaster could fulfill all replenishment obligations exclusively from local storage accounts for several years. Watermaster should fulfill the need for replenishment from increased production with imported water for those areas that have a critical need for imported water and use the water stored in local storage accounts for the rest of the replenishment obligation.

**Storage Management Program**

Since 1995, the producers have developed numerous storage management proposals. This storage management program described here was developed in April and May of 1999 and differs from the previous proposals that sought to assign all the readily-useful storage in the Basin up among producers. If successfully implemented, storage limits on individual storage accounts may not need to be considered by Watermaster. The proposal described herein will allow:

- Watermaster to develop conjunctive use programs that will benefit <u>all</u> the producers in the Basin;
- ensure that Basin water and storage are put to maximum beneficial use; and
- maintain the integrity of the Judgment.

**Definitions**. *Operational Storage Requirement* – The operational storage requirement is the storage or volume in the Chino Basin that is necessary to maintain safe yield. In the context of this storage management program, the operational storage is estimated to be about 5,300,000 acre-ft. An engineering analysis will be done to assess the operational storage requirement of the Basin as part of the implementation of this program.

*Safe Storage* – Safe storage is an estimate of the maximum storage in the Basin that will not cause significant water quality and high groundwater-related problems. In the context of this storage management program, the safe storage is estimated to be about 5,800,000 acre-ft. An engineering analysis will be done to assess the safe storage requirement of the Basin as part of the implementation this plan.

*Safe Storage Capacity* – The safe storage capacity is the difference between safe storage and operational storage requirement and is the storage that could be safely used by producers and Watermaster for storage programs. Based on the above, the safe storage capacity is about 500,000 acre-ft. The allocation and use of storage in excess of safe storage will preemptively require mitigation, that is, mitigation must be defined and resources committed to mitigation prior to allocation and use.

**Key Elements**

- No maximum storage limit will be placed on local storage accounts for a period of five years ending on June 30, 2004, and water that becomes eligible for storage can be stored.
- The need for storage limits will be re-evaluated in five years based on the ability of the storing party to use the water in storage (ability to use concept) and on Watermaster's need for storage programs that provide regional benefits.
- Storage is not assignable.
- All water in local storage and other storage accounts will incur losses at a rate of 2 percent of water in storage each year starting in fiscal year 2002/03.
- The storage loss rate and safe yield will be estimated in the year 2012/13 and every ten years thereafter.
- Watermaster will develop regional conjunctive-use programs to store supplemental water for MWDSC and other entities that can cause supplemental water to be stored in the Basin.
- The regional conjunctive-use programs will provide benefits to all producers in the Basin, the people of California and the nation. Watermaster's conjunctive-use programs will take priority over conjunctive-use programs developed by others.
- Storage committed to conjunctive-use programs may consist of two parts, storage within the safe storage capacity and storage in excess of safe storage. Storage in excess of safe storage capacity will preemptively require mitigation.
- The initial target storage for Watermaster's conjunctive-use program will be 150,000 to 300,000 acre-ft within the safe storage capacity.
- Cyclic storage will be folded into conjunctive-use storage.
- Watermaster's conjunctive-use program tentatively consists of the following elements:
  - complete the existing short term conjunctive-use project;
  - seasonal peaking program for in Basin use and dry year program to reduce the demand on Metropolitan to 10 percent of normal summer demand (requiring 150,000 acre-ft of storage);
  - dry-year export program; and
  - seasonal peaking export program.

**Re-determination of Safe Yield and Storage Loss Rates.** The safe yield and storage loss rate will be assessed every ten years starting in the year 2012/13. The ten-year period of 2002/03 to 2011/12 will be used to compute the safe yield and to estimate the storage loss rate.

Safe yield and storage loss rate determinations require accurate groundwater level and production data. Watermaster does not have accurate production data from agricultural producers. Watermaster estimates most of the production in the agricultural pool using a water duty method that does not meet the requirements of the Judgment. Program Element 1 of the OBMP includes a program to install meters and obtain production measurements from all wells in the Basin. It will take three years to fully meter all agricultural wells. Watermaster will have accurate production monitoring at all wells starting in year

2002/03. Watermaster is in the process of developing a groundwater level monitoring program for the Basin. This plan should be implemented in the year 1999/00.

The safe yield in the Judgment was developed over the period 1965 to 1974 using the procedure described in Section 2 of the OBMP report. The safe yield will be re-determined in year 2012/13 using the ten-year period 2002/03 to 2011/12 because it will contain accurate production data and groundwater level data. A ten-year period is proposed to be consistent with the method used in the engineering work for the Judgment and is the minimum necessary to estimate a safe yield.

Re-determination of the storage loss rate will require the use of a numerical flow model. The *RAM Tool* developed by Watermaster will be modified and used for this purpose. The model would be used as follows:

- Calibrate the RAM tool for the safe yield period. In the calibration process, the hydrology for the period 2002/03 to 2011/12 will be developed including deep percolation of applied water and precipitation, unmeasured storm water recharge, subsurface inflow from adjacent basins, and uncontrolled discharges from the Basin (rising water).
- Once calibrated, the water supply plans of the producers and other storage entities will be modified to assume that no water would be put into storage accounts. The model will be rerun with this assumption and the results would be compared to the calibration run to determine losses from storage and the storage loss rate.
- The storage loss rate would be set based on the relationship of water in storage and associated losses.

Watermaster's new groundwater level and production monitoring are crucial to this effort.

**Implementation Actions and Schedule**

**First Three Years (1999/00 to 2001/02).** The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Receive Court approval of OBMP.
- Evaluate need to modify Watermaster UGRR to reflect the storage management plan.
- Determine the operational storage requirement and safe storage.
- Begin formal implementation of comprehensive monitoring programs described in Program Element 1 (including groundwater level, groundwater quality, production, and surface water monitoring in the Santa Ana River).
- Complete the existing short-term conjunctive-use pilot project with MWDSC.
- Conduct engineering and environmental analyses, other feasibility efforts, and negotiate agreements to:
- implement a conjunctive-use program that includes seasonal peaking for in Basin use and dry year program to reduce the demand on MWDSC to 10 percent of normal summer in-Basin demand (requiring 150,000 acre-ft of storage);
- implement a conjunctive-use program for dry-year export; and
- implement a seasonal peaking program for export.

**Years Four through Ten (2002/03 to 2008/09).** The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

- Continue monitoring as described in Program Element 1.
- Begin construction of facilities to implement the conjunctive-use projects listed in *years one through three*, in year 2003/04.
- Commence conjunctive-use operations.
- Start assessing losses in year 2002/03.

**Years Eleven through Fifty (2009/10 to 2048/49)**. The following actions will be completed in years eleven through fifty, commencing fiscal year 2009/10:

- Continue monitoring as described in Program Element 1.
- Continue conjunctive-use operations.
- In year 2012/13, compute safe yield and storage loss rate for period 2002/03 through 2011/12, and reset safe yield and storage loss rates for the next the next ten-year period 2012/13 to 2021/22. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2022/23, compute safe yield and storage loss rate for period 2012/13 through 2021/22, and reset safe yield and storage loss rates for the next the next ten-year period 2022/23 to 2031/32. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2032/33, compute safe yield and storage loss rate for period 2022/23 through 2031/32, and reset safe yield and storage loss rates for the next the next ten-year period 2042/43 to 2041/42. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2042/43, compute safe yield and storage loss rate for period 2032/33 through 2041/42, and reset safe yield and storage loss rates for the next the next ten-year period 2052/53 to 2051/52. Reassess storage management plan and modify Watermaster UGRR, if needed.

## PROGRAM COST AND EARLY IMPLEMENTATION PLAN

Table 4-14 contains a 20-year cost projection for implementation of the OBMP. The 20-year cost of OBMP implementation is about $400,000,000. The following program elements will be implemented entirely by Watermaster:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program

Watermaster has committed to fund these program elements in their entirety through Watermaster assessments and through grants obtained directly by Watermaster. The Watermaster budget for fiscal 1999-2000 provides funding necessary to begin the efforts described in these program elements. The cost of the first three years is about $2,900,000 and average annual cost for the next 20 years is about $480,000.

The following program elements will be started by Watermaster in fiscal 1999-2000 and will be completed by others by agreement with Watermaster:

- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 5 – Develop and Implement Regional Supplemental Water Program

The Watermaster budget for fiscal 1999-2000 provides funding necessary to begin the planning processes for these program elements. For Program Element 2, Watermaster's projected budget includes funds for completion of Phases 2 and 3 of the recharge master plan of $430,000 to be spent in the first three years of OBMP implementation. For Program Elements 3 and 5, the Watermaster budget contains funds to start the planning process and to define the scope of the facilities at enough detail so that agreements can be done for others to build and operate the facilities required in these program elements. Watermaster has budgeted about $650,000 for this process over the first three years of OBMP implementation. These agreements will be described in Part 2 of the OBMP report documents.

The Watermaster budget includes funds to begin the planning process for Program Element 9 – Develop and Implement Conjunctive-Use Programs. Watermaster has budgeted about $430,000 for this process over the first three years of OBMP implementation. The stakeholders envision that the cost of conjunctive use will be borne by outside interests that will store water in the Chino Basin.

### OBMP PROGRESS REPORTS AND PROGRAM UPDATES

Watermaster will report progress on the OBMP in its annual report to the Court. Watermaster will formally review and update the OBMP at a frequency of five years or less.

### LEGAL QUESTIONS AND ISSUES

The Judgment prescribes the process by which the Watermaster Board receives recommendations from the producers and is empowered to make decisions. To address the unresolved legal questions and issues identified below, the items will be brought to the individual pool committees for discussion and consideration. The pools in turn will develop their positions and recommendations for discussion and consideration by the Advisory Committee. The Advisory Committee will meet to discuss and consider the questions. The Advisory Committee's recommendations will be forwarded to the Watermaster Board for its consideration and implementation. Should the Watermaster Board disagree with the Advisory Committee recommendation, it has several options based on the Judgment and past practice. These options are:

If the Advisory Committee vote is equal to or greater than 80 percent:

1. Ask the Advisory Committee to reconsider the question based on a Board recommendation.

2. If the Advisory Committee does not wish to reconsider the matter, the Watermaster Board may ask the Court to consider the matter.

If the Advisory Committee vote is less than 80 percent:

1. Hold a hearing on the matter and develop written findings and conclusions.

During implementation of the OBMP, all unresolved legal questions and issues listed below will be addressed through the process described above. A schedule to address these items will be developed, and Watermaster will prepare written findings and conclusions to be submitted to the Court as part of the implementation process. This will be done regardless of the Advisory Committee vote or Watermaster findings and conclusions in an effort to more effectively keep the Court apprised of the OBMP implementation progress.

Watermaster recommends this manner of addressing legal questions and issues pursuant to the Judgment and in keeping with the Plaintiff's Post Trial Memorandum filed with the Court on July 12, 1978. At 4:13-20 in Paragraph B. 2. Watermaster Organization and Powers, of the Post Trial Memorandum it states:

> "At the same time, the Watermaster Advisory Committee was created and given broad powers to review, advise and consent to the actions of the Watermaster, subject to more detailed actions by the pool committees formed to advise, consent and administer the affairs of the several pools established under the Physical Solution. In these many provisions, there is a balance created to assure the protection of the private rights of the parties and the general public interest in the preservation of the resource. (emphasis added)."

The process described above will be used to address the legal questions and issues listed below.

- Transfers of water within and from the overlying non-agricultural pool
- Clarification and/or expansion of definitions of types of water in Judgment
- Evaluation of Judgment provisions and rules and regulations affected by the OBMP

These questions and issues will be resolved in the first three years of the OBMP implementation.

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# *PEACE AGREEMENT*

# *CHINO BASIN*

*JUNE 29, 2000*

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# PEACE AGREEMENT
# CHINO BASIN

THIS AGREEMENT (Agreement) is dated the 29th day of June, 2000 regarding the Chino Groundwater Basin.

## RECITALS

**WHEREAS,** disputes have arisen from time to time among and between water users within the Santa Ana River Watershed resulting in a judgment entered in Orange County Superior Court Case No. 117628, Orange County Water District v. City of Chino in 1969; and

**WHEREAS,** a complaint was filed on January 2, 1975, seeking an adjudication of water rights, injunctive relief and the imposition of a physical solution for the Chino Groundwater Basin (hereinafter Chino Basin); and

**WHEREAS,** a Judgment was entered in San Bernardino County Superior Court Case No. 164327 in Chino Basin Municipal Water District v. City of Chino, et al. in 1978, now designated No. RCV 51010 that adjudicated rights to the groundwater and storage capacity within the Chino Basin and established a physical solution; and

**WHEREAS,** the Parties intend that each Producer should be able to Produce both the quantity and quality of water to meet its water supply needs to the greatest extent possible from the water that underlies the Producer's area of benefit; and

**WHEREAS,** the Judgment provides the State of California is the largest owner of land overlying the Chino Basin, and provides that all future Production by the State, or its departments or agencies for overlying use on State-owned lands shall be considered as use by the Agricultural Pool; and

**WHEREAS,** Paragraph 16 of the Judgment authorized the appointment of a Watermaster for a term or terms of five (5) years; and

**WHEREAS,** Watermaster has the express powers and duties as provided in the Judgment or as "hereafter ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction" subject to the limitations stated elsewhere in the Judgment; and

**WHEREAS,** Paragraph 41 of the Judgment provides that "Watermaster, with the advice of the Advisory and Pool Committees" has "discretionary powers in order to develop an optimum basin management program (OBMP) for Chino Basin"; and

**WHEREAS,** on February 19, 1998, in San Bernardino County Superior Court Case Number RCV 51010, the Court appointed a "Nine-member Board as Interim Watermaster for a twenty-six month period commencing March 1, 1998 and ending June 30, 2000" and "directed the Interim Watermaster to develop and submit the OBMP"; and

**WHEREAS,** a draft Programmatic Environmental Impact Report (PEIR) for the OBMP has been completed and distributed to the Parties as well as the State Clearinghouse and other interested Parties and the Inland Empire Utilities Agency (IEUA) is serving as "Lead Agency" for purposes of preparing and completing the PEIR as previously directed by the Court on November 18, 1999; and

**WHEREAS,** this Agreement facilitates the implementation of the OBMP which is subject to environmental review under the California Environmental Quality Act (CEQA) as previously directed by the Court; and

**WHEREAS,** disputes have arisen in regard to a number of matters pertaining to the power and authority of the Court and Watermaster under the Judgment, including but not limited to Watermaster power and author-

ity regarding recharge, owning property, holding water rights, water Transfers, storage, yield management, land use conversions, assessments, benefits, procedures and the adoption and implementation of the OBMP; and

**WHEREAS**, OCWD has filed a petition with the State Water Resources Control Board requesting a change of the Santa Ana River's "Fully Appropriated" status, and filed an application to appropriate up to five hundred seven thousand (507,000) acre-feet of such newly declared surplus water; and

**WHEREAS**, the Parties to this Agreement desire to resolve issues by consent under the express terms and conditions stated herein; and

**WHEREAS**, the Parties wish to preserve and maintain Watermaster's role under the Judgment without compromising the Parties' collective and individual "benefits of the bargain" under this Agreement; and

**WHEREAS**, the Parties intend that this Agreement shall enable the adoption and implementation of an OBMP consistent herewith, which will benefit the Basin and all Parties hereto;

**NOW, THEREFORE**, in consideration of the mutual promises specified herein and by conditioning their performance under this Agreement upon conditions precedent set forth in Article III, the Watermaster approval and Court Order of its terms, and for other good and valuable consideration, the Parties agree as follows:

## I
## DEFINITIONS AND RULES OF CONSTRUCTION

1.1 Definitions. As used in this Agreement, these terms, including any grammatical variations thereof shall have the following meanings:

(a) "Agricultural Pool" shall have the meaning of Overlying (Agricultural) Pool as used in the Judgment and shall include all its members;

(b) "Appropriative Pool" shall have the meaning as used in the Judgment and shall include all its members;

(c) "Basin Water" means groundwater within Chino Basin which is part of the Safe Yield, Operating Safe Yield, or Replenishment Water in the Basin as a result of operations under the physical solution decreed in the Judgment. Basin Water does not include "Stored Water;"

(d) "Best Efforts" means reasonable diligence and reasonable efforts under the totality of the circumstances. Indifference and inaction do not constitute Best Efforts. Futile action(s) are not required.

(e) "CBWCD" means the Chino Basin Water Conservation District;

(f) "CEQA" means the California Environmental Quality Act, Public Resources Code Sections 21000 et seq; 14 California Code of Regulations 15000 et seq.;

(g) "Chino Basin" or "Basin" means the groundwater basin underlying the area shown on Exhibit "B" to the Judgment and within the boundaries described on Exhibit "K" to the Judgment;

(h) "Chino Basin Watershed" means the surface drainage area tributary to and overlying Chino Basin;

(i) "Chino I Desalter" also known as the SAWPA Desalter means the Desalter owned and operated by PC14 with a present capacity of eight (8) million gallons per day (mgd) and in existence on the Effective Date;

(j) "Chino I Desalter Expansion" means the planned expansion of the Chino I Desalter from its present capacity of eight (8) mgd to a capacity of up to fourteen (14) mgd, to be owned and operated by IEUA and WMWD acting through PC14;

(k) "Chino II Desalter" means a new Desalter not in existence on the Effective Date with a design capacity of ten (10) mgd, to be owned, constructed, and operated by IEUA and WMWD acting independently or in their complete discretion, acting through the PC14, constructed and operated consistent with the OBMP and to be located on the eastside of the Chino Basin;

(l) "Court" means the court exercising continuing jurisdiction under the Judgment;

(m) "Date of Execution" means the first day following the approval and execution of the Agreement by the last Party to do so;

(n) "Desalter" and "Desalters" means the Chino I Desalter, Chino I Desalter Expansion, the Chino II Desalter and Future Desalters, consisting of all the capital facilities and processes that remove salt from Basin Water, including extraction wells, transmission facilities for delivery of groundwater to the Desalter, Desalter treatment and delivery facilities for the desalted water including pumping and storage facilities, and treatment and disposal capacity in the SARI System;

(o) "Early Transfer" means the reallocation of Safe Yield not Produced by the Agricultural Pool to the Appropriative Pool on an annual basis rather than according to the five year increment described in Paragraph 10 of Exhibit "H" of the Judgment;

(p) "Effective Date" means October 1, 2000, provided that all conditions precedent have been waived or satisfied;

(q) "Future Desalters" means enlargement of the Chino I Desalter to a capacity greater than the Chino I Expansion or enlargement of the Chino II Desalter and any other new Desalter facilities that may be needed to carry out the purposes of the OBMP over the term of this Agreement;

(r) "General law" means all applicable state and federal law;

(s) "Groundwater" means water beneath the surface of the ground and within the zone of saturation, i.e., below the existing water table;

(t) "IEUA" means the Inland Empire Utilities Agency, referred to in the Judgment as Chino Basin Municipal Water District;

(u) "In-lieu recharge" means taking supplies of Supplemental Water in lieu of pumping groundwater otherwise subject to Production as an allocated share of Operating Safe Yield, as provided in Exhibit "H" Paragraph 11 of the Judgment;

(v) "Judgment" means the Judgment dated January 27, 1978, in San Bernardino County Case No. 164327 (redesignated as San Bernardino County Case No. RCV 51010) as amended by Order Approving Amendments to Judgment Dated December 1, 1995, and Order for Amendments to the Judgment Regard-

ing Changes in Pooling Plans and Appropriative Pool Representation on the Advisory Committee, dated September 18, 1996 and other such amendments;

(w) "Jurupa Community Services District" (JCSD) means the Jurupa Community Services District and the Santa Ana River Water Company individually. Subject to the provisions of this Agreement, the design and delivery obligations for the Chino II Desalter set forth in Section 7.3 regarding Jurupa Community Services District include both the Jurupa Community Services District and the Santa Ana River Water Company. Santa Ana River Water Company may exercise its discretion to receive its portion of the desalted water through an interconnection or at its own expense through an independent pipeline to connect to the Chino II Desalter or in any other method as the Jurupa Community Services District and the Santa Ana River Water Company may jointly agree. Nothing in this definition shall be construed as expanding the initial mgd capacity of the Chino II Desalter as provided in the facilities plan which is attachment "1" to the OBMP Implementation Plan (Exhibit "B" hereto). If it is necessary to meet Santa Ana River Water Company's demands and there is insufficient initial capacity in the Chino II Desalter to satisfy the demands of Santa Ana River Water Company for desalted water in the quantities as provided in the Revised Draft Water Supply Plan Phase I Desalting Project Facilities Report, Jurupa's and Ontario's entitlement to desalted water made available from the initial capacity of the Chino II Desalter shall abate pro-rata to accommodate the demand of Santa Ana River Water Company up to a maximum quantity of 1,300 acre feet per year.

(x) "Local Storage" means water held in a storage account pursuant to a Local Storage agreement between a party to the

Judgment and Watermaster and consisting of: (i) a Producer's unproduced carry-over water or (ii) a party to the Judgment's Supplemental Water, up to a cumulative maximum of fifty thousand (50,000) acre-feet for all parties to the Judgment.

(y) "Material Physical Injury" means material injury that is attributable to the Recharge, Transfer, storage and recovery, management, movement or Production of water, or implementation of the OBMP, including, but not limited to, degradation of water quality, liquefaction, land subsidence, increases in pump lift (lower water levels) and adverse impacts associated with rising groundwater. Material Physical Injury does not include "economic injury" that results from other than physical causes. Once fully mitigated, physical injury shall no longer be considered to be material;

(z) "Metropolitan Water District" means the Metropolitan Water District of Southern California;

(aa) "New Yield" means proven increases in yield in quantities greater than historical amounts from sources of supply including, but not limited to, capture of rising water, capture of available storm flow, operation of the Desalters (including the Chino I Desalter), induced Recharge and other management activities implemented and operational after June 1, 2000;

(bb) "Non-Agricultural Pool" shall have the meaning as used in the Judgment for the Overlying (Non-Agricultural Pool) and shall include all its members;

(cc) "OBMP Assessments" means assessments, other than the assessments levied as provided in Section 5.1(g), levied by Watermaster for the purpose of implementing the Optimum

Basin Management Program (OBMP),, which shall be deemed Administrative Assessments under Paragraph 54 of the Judgment.

(dd) "OCWD" means the Orange County Water District;

(ee) "Operating Safe Yield" means the annual amount of groundwater which Watermaster shall determine, pursuant to criteria specified in Exhibit "I" to the Judgment, can be Produced from Chino Basin by the Appropriative Pool parties free of Replenishment obligation under the Physical Solution. Watermaster shall include any New Yield in determining Operating Safe Yield;

(ff) "Overdraft" means a condition wherein the total annual Production from the Basin exceeds the Safe Yield thereof, as provided in the Judgment;

(gg) "Party or Parties" means a Party to this Agreement;

(hh) "Party or parties to the Judgment" means a party to the Judgment;

(ii) "Produce or Produced" means to pump or extract groundwater from the Chino Basin;

(jj) "Producer" means any person who Produces groundwater from the Chino Basin;

(kk) "Production" means the annual quantity, stated in acre feet, of water Produced from the Chino Basin;

(ll) "PC14" means Project Committee No. 14, members of SAWPA, composed of IEUA, WMWD, and OCWD, pursuant

to Section 18 of the SAWPA Joint Exercise of Powers Agreement which now constitutes the executive Authority through which SAWPA acts with respect to the Chino I Desalter;

(mm) "Public Hearing" means a hearing of Watermaster after notice pursuant to Paragraphs 58 and 59 or other Paragraphs of the Judgment that may be applicable, to all parties to the Judgment and to any other person entitled to notice under the Judgment, this Agreement or general law;

(nn) "Recharge and Recharge Water" means introduction of water into the Basin, directly or indirectly, through injection, percolation, delivering water for use in-lieu of Production or other method. Recharge references the physical act of introducing water into the Basin. Recharge includes Replenishment Water but not all Recharge is Replenishment Water. This definition shall not be construed to limit or abrogate the authority of CBWCD under general law;

(oo) "Replenishment Water" means Supplemental Water used to Recharge the Basin pursuant to the physical solution, either directly by percolating or injecting the water into the Basin or indirectly by delivering the water for use in lieu of Production and use of Safe Yield or Operating Safe Yield;

(pp) "Recycled Wastewater" means water which, as a result of treatment of wastewater, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource, referred to as "reclaimed water" in the Judgment.

(qq) "Safe Yield" means the long-term average annual quantity of groundwater (excluding Replenishment Water or Stored Water but including return flow to the Basin from use of

Replenishment or Stored Water) which can be Produced from the Basin under cultural conditions of a particular year without causing an undesirable result;

(rr) "Salt Credits" means an assignable credit that may be granted by the Regional Water Quality Control Board and computed by Watermaster from activities that result from removal of salt from the Basin, or that result in a decrease in the amount of salt entering the Basin;

(ss) "SAWPA" means the Santa Ana Watershed Project Authority;

(tt) "Sphere of Influence" has the same meaning as set forth in Government Code Section 56076;

(uu) "Storage and Recovery Program" means the use of the available storage capacity of the Basin by any person under the direction and control of Watermaster pursuant to a storage and recovery agreement but excluding "Local Storage", including the right to export water for use outside the Chino Basin and typically of broad and mutual benefit to the parties to the Judgment;

(vv) "Stored Water" means Supplemental Water held in storage, as a result of direct spreading, injection or in-lieu delivery, for subsequent withdrawal and use pursuant to agreement with Watermaster;

(ww) "Supplemental Water" means water imported to Chino Basin from outside the Chino Basin Watershed and recycled water;

(xx) "Transfer" means the assignment, lease, or sale of a right to Produce water to another Producer within the Chino Basin or to another person or entity for use outside the Basin in con-

formance with the Judgment, whether the Transfer is of a temporary or permanent nature;

(yy) "TVMWD" means Three Valleys Municipal Water District (referred to in the Judgment as Pomona Valley Municipal Water District);

(zz) "Watermaster" means Watermaster as the term is used in the Judgment;

(aaa) "Watermaster Resolution 88-3" means the resolution by the Chino Basin Watermaster establishing the procedure for transferring unallocated Safe Yield water from the Agricultural Pool to the Appropriative Pool, adopted on April 6, 1988 and rescinding Resolution 84-2 in its entirety;

(bbb) "WMWD" means Western Municipal Water District;

1.2 Rules of Construction.

(a) Unless the context clearly requires otherwise:

(i) The plural and singular forms include the other;

(ii) "Shall," "will," "must," and "agrees" are each mandatory;

(iii) "may" is permissive;

(iv) "or" is not exclusive;

(v) "includes" and "including" are not limiting; and

(vi) "between" includes the ends of the identified range.

(b) Headings at the beginning of Articles, paragraphs and sub-paragraphs of this Agreement are solely for the convenience of the Parties, are not a part of this Agreement and shall not be used in construing it.

(c) The masculine gender shall include the feminine and neuter genders and vice versa.

(d) The word "person" shall include individual, partnership, corporation, limited liability company, business trust, joint stock company, trust, unincorporated association, joint venture, governmental authority, water district and other entity of whatever nature.

(e) Reference to any agreement (including this Agreement), document, or instrument means such agreement, document, instrument as amended or modified and in effect from time to time in accordance with the terms thereof and, if applicable, the terms hereof.

(f) Except as specifically provided herein, reference to any law, statute, ordinance, regulation or the like means such law as amended, modified, codified or reenacted, in whole or in part and in effect from time to time, including any rules and regulations promulgated thereunder.

## II
## COMPLIANCE WITH CEQA

2.1 Commitments Shall be Consistent With CEQA Compliance. In executing this Agreement, the Parties agree that no commitment will be made to carry out any "project" under the OBMP and within the meaning of CEQA unless and until the environmental review and assessments required by CEQA for that defined "project" have been

completed. Any future implementing actions in furtherance of Program Elements 2 through 9 that meet the definition of "project" under CEQA, shall be subject to further environmental documentation in the form of an exemption, a negative declaration, mitigated negative declaration, environmental impact report, supplemental EIR or subsequent EIR. Any challenge claiming a breach of this article shall be brought within the same period of time applicable to claims under Public Resources Code section 21000, et seq.

2.2 Reservation of Discretion. Execution of this Agreement is not intended to commit any Party to undertake a project without compliance with CEQA or to commit the Parties to a course of action, which would result in the present approval of a future project.

2.3 No Prejudice by Comment or Failure to Comment. Nothing in the PEIR, or a Party's failure to object or comment thereon, shall limit any Party's right to allege that "Material Physical Injury" will result or has resulted from the implementation of the OBMP, the storage, recovery, management, movement or Production of water as provided in Article V herein.

2.4 Acknowledgment that IEUA is the Lead Agency. IEUA has been properly designated as the "Lead Agency" for the purposes of preparing the PEIR as ordered by court on November 18, 1999.

## III
## CONDITIONS PRECEDENT

3.1 Performance Under Articles V, VI, and VII is Subject to Satisfaction of Conditions Precedent. Each Party's obligations under this Agreement are subject to the satisfaction of the following conditions on or before the dates specified below, unless satisfaction of a specified condition or conditions is waived in writing by all other Parties:

(a) The Parties' covenants and commitments set forth in Article V are expressly conditioned upon Watermaster's contemporaneous approval of this Agreement and the OBMP Implementation Plan by June 29, 2000 and upon an Order of the Court directing Watermaster to proceed in accordance with this, Agreement and only this Agreement, on or before July 13, 2000. Watermaster's approval of this Agreement and the OBMP Implementation Plan shall be in the form of a resolution substantially similar to Exhibit "A" attached hereto and it shall contain a commitment to adopt the requisite policies and procedures to implement the provisions set forth in Article V on or before December 31, 2000, unless an earlier date for performance is otherwise expressly provided herein.

(b) Appropriation by the California Legislature of at least $121,000,000 from the proceeds made available by the passage of Proposition 13 for the benefit of the SAWPA by October 1, 2000.

## IV
## MUTUAL COVENANTS

4.1 Joint Defense. The Parties shall proceed with reasonable diligence and use Best Efforts to jointly defend any lawsuit or administrative proceeding challenging the legality, validity, or enforceability of any term of this Agreement. However, nothing herein shall require the State of California to incur legal or administrative costs in support of such an effort.

4.2 No Opposition to the OBMP. No Party to this Agreement shall oppose Watermaster's adoption and implementation of the OBMP as provided in Exhibit B attached hereto in a manner consistent with this Agreement, or the execution of Memoranda of Agreement that incorporate the provisions which are substantially similar to those

contained in Exhibit "C" attached hereto. Nothing herein shall be construed as limiting any Party's right of participation in all the functions of Watermaster as are provided in the Judgment or to preclude a party to the Judgment from seeking judicial review of Watermaster determinations pursuant to the Judgment or as otherwise provided in this Agreement.

4.3 Indemnification of the Agricultural Pool. The Parties shall indemnify and defend the State of California and the members of the Agricultural Pool against any lawsuit or administrative proceedings, without limitation, arising from Watermaster's adoption, approval, management, or implementation of a Storage and Recovery Program.

4.4 Consent to Specified Changes to the Judgment. Each Party consents to the following modifications to the Judgment.

(a) The Judgment shall be amended so that the last sentence of Paragraph 8 of the Judgment reads:

> All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom for the term of the Peace Agreement except that the members of the Overlying (Non-Agricultural) Pool shall have the right to Transfer or lease their quantified Production rights within the Overlying (Non-Agricultural) Pool or to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000.

(b) Paragraph 6 of Exhibit "G" to the Judgment regarding the Overlying Non-Agricultural Pool shall be amended to read:

> Assignment. Rights herein decreed are appurtenant to that land and are only assignable with the land for over-

lying use thereon; provided, however, (a) that any appropriator who may, directly or indirectly, undertake to provide water service to such overlying lands may, by an appropriate agency agreement on a form approved by Watermaster, exercise said overlying right to the extent, but only to the extent necessary to provide water service to said overlying lands, and (b) the members of the pool shall have the right to Transfer or lease their quantified Production rights within the pool or to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000 for the term of the Peace Agreement.

(c) The 1995 Amendment to the Judgment shall be amended as follows: Section 10(b)(3)(i) shall now read:

"For the term of the Peace Agreement, in any year in which sufficient unallocated Safe Yield from the Overlying (Agricultural) Pool is available for such conversion claims, Watermaster shall allocate to each appropriator with a conversion claim, 2.0 acre-feet of unallocated Safe Yield water for each converted acre for which conversion has been approved and recorded by the Watermaster."

Appendix 1 to the Judgment shall be construed to be consistent with this amendment. All other parts of the 1995 Amendment shall remain the same.

4.5 Construction of "Operating Yield" Under the Judgment. Exhibit I to the Judgment shall be construed to authorize Watermaster to include New Yield as a component of Operating Safe Yield.

4.6 Best Efforts to Obtain Funding for OBMP. Each Party shall use Best Efforts to obtain and support funding that is consistent with the

OBMP and this Agreement. The Parties shall coordinate their individual efforts and report their progress to Watermaster no less than each quarter beginning on the Effective Date.

4.7 CBWCD. Watermaster shall provide for, arrange or approve the necessary revenue to fund Recharge activities listed in the OBMP and CBWCD shall not assume any legal duty or responsibility to conduct Recharge other than as is expressly set forth herein, as it may agree or as may be provided under general law or the Judgment.

## V
## WATERMASTER PERFORMANCE

5.1 Recharge and Replenishment. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Recharge and Replenishment:

(a) All Recharge of the Chino Basin with Supplemental Water shall be subject to Watermaster approval.

(b) Watermaster will ensure that any person may make application to Watermaster to Recharge the Chino Basin with Supplemental Water, including the exercise of the right to offer to sell in-lieu Recharge water to Watermaster as provided in the Judgment and the Agreement in a manner that is consistent with the OBMP and the law. Watermaster shall not approve an application by any party to the Judgment if it is inconsistent with the terms of the Agreement, or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any Party or the Basin caused by the Recharge of Supplemental Water shall be fully and reasonably mitigated as a condition of approval. In the event the Material Physical Injury cannot be fully and

reasonably mitigated, the request for Recharge of Supplemental Water must be denied.

(c) Watermaster shall administer, direct and conduct the Recharge of all water n a manner that is consistent with this Agreement, the OBMP and causes no Material Physical Injury to any party to the Judgment or the Chino Basin. Nothing herein shall be construed as committing a Party to provide Supplemental Water upon terms and conditions that are not deemed acceptable to that Party.

(d) Notwithstanding Section 5.1(c), CBWCD shall reserve its complete discretion to Recharge the Basin with water other than Supplemental Water as may be authorized by general law so long as the Recharge is in accordance with the limitations in the Judgment, if any and is in accordance with the provisions of Section 5.1(d)(i)-(v).

(i) Upon request by Watermaster CBWCD shall exercise Best Efforts to consult, coordinate and cooperate with Watermaster when recharging water into the Basin;

(ii) CBWCD shall provide Watermaster with reasonable notice in advance of any material change in its historic Recharge operations;

(iii) CBWCD shall not be required to provide funding for Recharge projects merely by virtue of its execution of this Agreement;

(iv) CBWCD shall Recharge the Basin in a manner that does not cause Material Physical Injury to any party to the Judgment or the Basin. Upon Watermaster's receipt of a written allegation that an existing or proposed

CBWCD Recharge activity has or will cause Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing within a reasonable time. Watermaster shall provide notice and opportunity to be heard to interested parties to the Judgment including CBWCD. After hearing, Watermaster may approve, deny or condition the CBWCD's Recharge. Watermaster's decision shall be based upon the record and it shall be subject to the court's review;

(v) CBWCD's Recharge of the Basin coupled with an intent to store and recover water shall require a storage and recovery agreement.

(e) Watermaster shall exercise its Best Efforts to:

(i) protect and enhance the Safe Yield of the Chino Basin through Replenishment and Recharge;

(ii) ensure there is sufficient Recharge capacity for Recharge Water to meet the goals of the OBMP and the future water supply needs within the Chino Basin;

(iii) direct Recharge relative to Production in each area and sub-area of the Basin to achieve long term balance and to promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin;

(iv) evaluate the potential or threat for any Material Physical Injury to any party to the Judgment or the Chino Basin, including, but not limited to, any Material Physical Injury that may result from any Transfer of water in storage or water rights which is proposed in place of

physical Recharge of water to Chino Basin in accordance with the provisions of Section 5.3;

(v) establish and periodically update criteria for the use of water from different sources for Replenishment purposes;

(vi) ensure a proper accounting of all sources of Recharge to the Chino Basin;

(vii) Recharge the Chino Basin with water in any area where groundwater levels have declined to such an extent that there is an imminent threat of Material Physical Injury to any party to the Judgment or the Basin;

(viii) maintain long-term hydrologic balance between total Recharge and discharge within all areas and sub-areas;

(ix) coordinate, facilitate and arrange for the construction of the works and facilities necessary to implement the quantities of Recharge identified in the OBMP Implementation Plan.

(f) Watermaster shall undertake Recharge, using water of the lowest cost and the highest quality, giving preference as far as possible to the augmentation and the Recharge of native storm water.

(g) In furtherance of its obligations under this Section, for a period of five years, commencing with Fiscal Year 2000-2001, and within each such Fiscal Year Watermaster shall arrange for the physical Recharge of Supplemental Water in the amount of an annual average of 6,500 acre-feet per year in one or more of

the areas commonly known as the Montclair, Brooks and Upland spreading facilities.

(i) If for any reason at the end of the five year period, a cumulative total of 32,500 acre-feet of physical Recharge has not been accomplished under this sub-division, then Recharge shall continue at the above referenced locations at the average annual rate of 6,500 acre-feet until the full 32,500 acre-feet of physical Recharge has been accomplished;

(ii) The Recharged Supplemental Water shall increase the Operating Safe Yield under the Judgment. The cost and allocation of this Supplemental Water under this Section 5.1g shall be apportioned pro rata among the members of the Appropriative Pool under the Judgment according to the Producer's share of the initial Safe Yield;

(iii) The need to continue physical Recharge under this paragraph shall be evaluated by Watermaster after the conclusion of Fiscal Year 2004-2005. In evaluating further physical Recharge pursuant to this paragraph, Watermaster shall take into account the provisions of this Article, the Judgment and the OBMP among all other relevant factors. Except as to Watermaster's determination of Material Physical Injury, the rights of each party to the Judgment to purchase or lease water to meet its over-Production obligation shall be unaffected by this provision;

(h) Watermaster shall not own Recharge projects, including but not limited to spreading grounds, injection wells, or diversion works. It shall never own real property. However, Watermaster may own water rights in trust for the benefit of the

parties to the Judgment. Moreover, Watermaster shall arrange, facilitate and provide for Recharge by entering into contracts with appropriate persons, which may provide facilities and operations for physical Recharge of water as required by the Judgment and this Agreement, or pursuant to the OBMP. Any such contracts shall include appropriate terms and conditions, including terms for the location and payment of costs necessary for the operation and maintenance of facilities, if any.

(i) CBWCD's rights and obligations to obtain Replenishment Water are unaffected by the execution of this Agreement. Its obligation, rights and duties regarding Recharge may be set by arms length negotiation through separate agreement or as they otherwise exist under general law and the Judgment.

(j) Watermaster shall provide an annual accounting of the amount of Recharge and the location of the specific types of Recharge.

5.2 Storage and Recovery. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding the storage and recovery of water:

(a) In General.

(i) All storage capacity shall be subject to regulation and control by Watermaster;

(ii) No person shall store water in and recover water from the Chino Basin without an agreement with Watermaster;

(iii) Watermaster will ensure that any person, including but not limited to the State of California and the Department

of Water Resources may make application to Watermaster to store and recover water from the Chino Basin as provided herein in a manner that is consistent with the OBMP and the law. Watermaster shall not approve an application to store and recover water if it is inconsistent with the terms of this Agreement or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any Party or the Basin caused by the storage and recovery of water shall be reasonably and fully mitigated as a condition of approval. In the event the Material Physical Injury cannot be mitigated, the request for storage and recovery must be denied.

(iv) This Agreement shall not be construed to limit the State or its department or agencies from using available storage capacity in the Basin in accordance with the provisions of this Section under a storage and recovery agreement with Watermaster.

(b) Local Storage.

(i) For a period of five years from the Effective Date, Watermaster shall ensure that: (a) the quantity of water actually held in Local Storage under a storage agreement with Watermaster is confirmed and protected and (b) each party to the Judgment shall have the right to store its un-Produced carry-over water. Thereafter, a party to the Judgment may continue to Produce the actual quantity of carry-over water and Supplemental Water held in its storage account, subject only to the loss provisions set forth in this Section 5.2. This means a party to the Judgment may increase the total volume of carry-over water it holds in Local Storage up to five years after the

Effective Date and as Watermaster may approve pursuant to a Local Storage agreement for Supplemental Water.

(ii) For a period of five years from the Effective Date, any party to the Judgment may make application to Watermaster for a Local Storage agreement, whereby it may store Supplemental Water in the Chino Basin.

(iii) Watermaster shall provide reasonable advance written notice to all interested parties of the proposed Local Storage agreement, prior to approving the agreement. The notice shall include the persons engaged in the Local Storage, the location of the Recharge and Production facilities and the potential for any Material Physical Injury, if any.

(iv) Watermaster shall approve the Local Storage agreement so long as: (1) the total quantity of Supplemental Water authorized to be held in Local Storage under all then existing Local Storage agreements for all parties to the Judgment does not exceed the cumulative total of 50,000 acre-feet; (2) the party to the Judgment making the request provides their own Recharge facilities for the purpose of placing the Supplemental Water into Local Storage; (3) the agreement will not result in any Material Physical Injury to any party to the Judgment or the Basin. Watermaster may approve a proposed agreement with conditions that mitigate any threatened or potential Material Physical Injury.

(v) There shall be a rebuttable presumption that the Local Storage agreement for Supplemental Water does not

result in Material Physical Injury to a party to the Judgment or the Basin.

(vi) In the event any party to the Judgment, or Watermaster, objects to a proposed Local Storage agreement for Supplemental Water and submits evidence that there may be a Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing and allow the objecting party to the Judgment a reasonable opportunity to be heard.

(vii) In the event more than one party to the Judgment submits a request for an agreement to store Supplemental Water pursuant to a Local Storage agreement, Watermaster shall give priority to the first party to file a bona fide written request which shall include the name of the party to the Judgment, the source, quantity and quality of the Supplemental Water, an identification of the party to the Judgment's access to or ownership of the Recharge facilities, the duration of the Local Storage and any other information Watermaster shall reasonably request. Watermaster shall not grant any person the right to store more than the then existing amount of available Local Storage. The amount of Local Storage available for the storage of Supplemental Water shall be determined by subtracting the previously approved and allocated quantity of storage capacity for Supplemental Water from the cumulative maximum of 50,000 acre-feet.

(viii) Watermaster shall base any decision to approve or disapprove any proposed agreement upon the record.

(ix) Any party to the Judgment may seek judicial review of Watermaster's decision.

(x) Five years after the Effective Date, Watermaster shall have discretion to place reasonable limits on the further accrual of carry-over and Supplemental Water in Local Storage. However, Watermaster shall not limit the accrual of carry-over Local Storage for Fontana Union Mutual Water Company and Cucamonga County Water District when accruing carry-over storage pursuant to *Lease of Corporate Shares Coupled with Irrevocable Proxy, dated July 1, 1993 between Cucamonga County Water District and Fontana Water Resources Inc. and the Settlement Agreement Among Fontana Union Water Company, Kaiser Steel Reserves Inc., San Gabriel Valley Water Company and Cucamonga County Water Districts dated February 7, 1992*, to a quantity less than 25,000 acre-feet for the term of this Agreement.

(xi) Watermaster shall evaluate the need for limits on water held in Local Storage to determine whether the accrual of additional Local Storage by the parties to the Judgment should be conditioned, curtailed or prohibited if it is necessary to provide priority for the use of storage capacity for those Storage and Recovery Programs that provide broad mutual benefits to the parties to the Judgment as provided in this paragraph and Section 5.2(c) below;

(xii) Watermaster shall set the annual rate of loss from Local Storage for parties to the Judgment at zero until 2005. Thereafter the rate of loss from Local Storage for parties to the Judgment will be 2% until recalculated based upon the best available scientific information. Losses

shall be deducted annually from each party to the Judgment's storage account;

(xiii) Watermaster shall allow water held in storage to be transferred pursuant to the provisions of Section 5.3 below. Storage capacity is not transferable by any party to the Judgment or any Party hereto.

(c) Storage and Recovery Program.

(i) Watermaster will ensure that no person shall store water in and recover water from the Basin, other than pursuant to a Local Storage agreement, without a storage and recovery agreement with Watermaster;

(ii) Watermaster shall prepare a list of basic information that a proposed applicant for a Storage and Recovery Program must submit to Watermaster prior to the execution of a storage and recovery agreement;

(iii) As a precondition of any project, program or contract regarding the use of Basin storage capacity pursuant to a Storage and Recovery Program, Watermaster shall first request proposals from qualified persons.

(iv) Watermaster shall be guided by the following criteria in evaluating any request to store and recover water from the Basin by a party to the Judgment or any person under a Storage and Recovery Program.

(a) The initial target for the cumulative quantity of water held in storage is 500,000 acre-feet in addition to the existing storage accounts;

(b) Watermaster shall prioritize its efforts to regulate and condition the storage and recovery of water developed in a Storage and Recovery Program for the mutual benefit of the parties to the Judgment and give first priority to Storage and Recovery Programs that provide broad mutual benefits;

(v) For the term of this Agreement, members of the Appropriative Pool and the Non-Agricultural Pool shall be exclusively entitled to the compensation paid for a Storage and Recovery Program irrespective of whether it be in the form of money, revenues, credits, proceeds, programs, facilities, or other contributions (collectively "compensation") as directed by the Non-Agricultural and the Appropriative Pools;

(vi) The compensation received from the use of available storage capacity under a Storage and Recovery Program, may be used to off-set the Watermaster's cost of operation, to reduce assessments on the parties to the Judgment within the Appropriative and Non-Agricultural Pools, and to defray the costs of capital projects as may be requested by the members of the Non-Agricultural Pools and the Appropriative Pool;

(xiii) Any potential or threatened Material Physical Injury to any party to the Judgment or the Basin caused by storage and recovery of water, whether Local Storage and recovery or pursuant to a Storage and Recovery Program, shall be reasonably and fully mitigated as a condition of approval;

(ix) Watermaster reserves discretion to negotiate appropriate terms and conditions or to refuse to enter into a Storage

and Recovery or to deny any request. However, with respect to persons not parties to the Judgment, Watermaster reserves complete discretion. Watermaster shall base any decision to approve or disapprove any proposed Storage and Recovery Program upon the record. However, it may not approve a proposed Storage and Recovery Program unless it has first imposed conditions to reasonably and fully mitigate any threatened or potential Material Physical Injury;

(x) Any party to the Judgment may seek review of the Watermaster's decision regarding a Storage and Recovery Program.

(d) The specific terms and conditions for the use of the facilities of CBWCD in connection with Local Storage or Storage and Recovery Programs shall be covered under separate agreements reached by arms length bargaining between Watermaster and CBWCD. Watermaster and any other Party shall not be entitled to the income received by CBWCD for use of its facilities in connection with Local Storage or Storage and Recovery Programs without the consent of CBWCD. Nothing in this Agreement shall be construed as preventing CBWCD from entering into an agreement with others for use of its facilities in a manner consistent with Section 5.1(d) i-v of this Agreement.

(e) Nothing herein shall be construed as prohibiting the export of Supplemental Water stored under a Storage and Recovery Program and pursuant to a storage and recovery agreement.

(f) Watermaster shall exercise Best Efforts to undertake the following measures:

(i) Complete the Short-term conjunctive use project, authorized by Watermaster and conducted by IEUA, TVMWD and MWD;

(ii) Evaluate and develop a seasonal peaking program for in-Basin use and dry year yield to reduce the Basin's demand on the Metropolitan Water District for imported water;

(iii) Evaluate and develop a dry year export program;

(iv) Evaluate and develop a seasonal peaking export program;

5.3 Transfers. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding the Transfer of water:

(a) Watermaster will ensure that any party to the Judgment may Transfer water in a manner that is consistent with this Agreement, the OBMP and the law. Watermaster shall not approve a Transfer if it is inconsistent with the terms of the Agreement, or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any party to the Judgment or the Basin caused by the Transfer of water shall be fully and reasonably mitigated as a condition of approval. In the event the Material Physical Injury cannot be fully and reasonably mitigated, the request for Transfer must be denied.

(b) A party to the Judgment may make application to Watermaster to Transfer water as provided in the Judgment.

(i) Watermaster shall provide reasonable advance written notice to all the parties to the Judgment of a proposed Transfer, prior to approving the Transfer. The notice shall include the persons engaged in the Transfer, the location of the Production and Watermaster's analysis of the potential for Material Physical Injury, if any;

(ii) Watermaster shall approve the Transfer of water as provided in the Judgment so long as the individual Transfer does not result in any Material Physical Injury to any party to the Judgment or the Basin. Watermaster may approve a proposed Transfer with conditions that fully and reasonably mitigate any threatened or potential Material Physical Injury;

(iii) There shall be a rebuttable presumption that the Transfer and the Production by the transferee does not result in Material Physical Injury to a party to the Judgment or the Basin;

(iv) In the event any party to the Judgment, or Watermaster, objects to a proposed Transfer and submits evidence that there may be Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing and allow the objecting party to the Judgment a reasonable opportunity to be heard;

(v) Watermaster shall base any decision to approve or disapprove any proposed Transfer upon the record after considering potential impacts associated with the individual Transfer alone and without regard to impacts attributable to any other Transfers;

(vi) Any party to the Judgment may seek judicial review of the Watermaster's decision.

(c) Watermaster shall allow Producers to lease water rights to make up for the lessee's over-Production.

(d) Except as provided in Section 5.2, Producers shall not be required to file a storage and recovery or recapture plan except when Producing water transferred from a storage account.

(e) Watermaster shall approve the Transfer or lease of the quantified Production rights of Non-Agricultural Producers within the Non-Agricultural Pool subject to the provisions of paragraph (b) above. The right to Transfer within the pool includes the right to lease water to other members of the Non-Agricultural Overlying Pool. In addition, the parties to the Judgment with rights within the Non-Agricultural Pool shall have the additional right to Transfer their rights to Watermaster for the purposes of Replenishment for a Desalter or for a Storage and Recovery Program.

(f) Consistent with the provisions of 88-3, Watermaster shall approve the Transfer of unallocated Safe Yield under-Produced by the Agricultural Pool in Fiscal Year 1998-99, for Transfer to the Appropriative Pool in Fiscal Year 1999-2000, 35,262.452 acre-feet consistent with Watermaster Resolution 88-3. This Transfer shall be in addition to the Early Transfer of the 32,800 acre-feet per year from the Agricultural Pool to the Appropriative Pool referenced below in 5.3(g).

(g) Watermaster shall approve an "Early Transfer" of water to the Appropriative Pool in an amount not less than 32,800 acre-feet per year that is the expected approximate quantity of water not Produced by the Agricultural Pool. The quantity of water sub-

ject to Early Transfer under this paragraph shall be the greater of (i) 32,800 acre-feet or (ii) 32,800 acre-feet plus the actual quantity of water not Produced by the Agricultural Pool for that Fiscal Year that is remaining after all the land use conversions are satisfied pursuant to 5.3(i) below.

(i) The Early Transfer water shall be annually allocated among the members of the Appropriative Pool in accordance with their pro-rata share of the initial Safe Yield.

(ii) The Transfer shall not limit the Production right of the Agricultural Pool under the Judgment to Produce up to 82,800 acre-feet of water in any year or 414,000 acre-feet in any five years as provided in the Judgment.

(iii) The combined Production of all parties to the Judgment shall not cause a Replenishment assessment on the members of the Agricultural Pool. The Agricultural Pool shall be responsible for any Replenishment obligation created by the Agricultural Pool Producing more than 414,000 acre-feet in any five-year period.

(iv) The parties to the Judgment and Watermaster shall Produce water in accordance with the Operating Safe Yield and shall procure sufficient quantities of Replenishment Water to satisfy over-Production requirements, whatever they may be, and avoid Material Physical Injury to any party to the Judgment or the Basin;

(v) Nothing herein shall be construed as modifying the procedures or voting rights within or by the members of the Agricultural Pool.

(h) The amount of water rights converted for agricultural land to urban use is presently 2.6 acre-feet per acre, with 1.3 acre-feet per acre being allocated collectively to all members of the Appropriative Pool with an initial share of Safe Yield and 1.3 acre-feet per acre being allocated to that appropriator providing service for that urban use. The rate of 2.6 acre-feet per acre shall be changed to a total of 2.0 acre-feet per acre, all of which shall be allocated upon the conversion of the land to that party to the Judgment which is an a member of the Appropriative Pool, on the Effective Date of this Agreement, and whose Sphere of Influence or authorized service area contains the land (purveyor). Upon such conversion of water rights, the purveyor will pledge that amount of water needed for such urban land use, when such urban land use is established, up to 2 acre-feet of water per acre of land per year will be made available for service for such converted land by purveyor under its then-existing standard laws, regulations, rules and policies, or for service arranged by such purveyor, subject only to prohibition of such service by a federal, state agency or court with jurisdiction to enforce such prohibition. The owner of such converted land shall have the right to enforce such pledge by specific performance or writ of mandate under the terms of this Agreement. No monetary damages shall be awarded.

(i) The members of the Agricultural Pool, including the State of California, shall have the right to engage in a voluntary agreement with an appropriator which has a service area contiguous to or inclusive of the agricultural land, to provide the required water to the overlying land on behalf of the member of the Agricultural Pool unless otherwise prohibited by general law. The appropriator providing service shall be entitled to a credit to off-set Production to the extent it is serving the overlying land up to the amount of the historical maximum annual quantity of water previously used on the property.

5.4 Assessments, Credits, and Reimbursements. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Assessments.

(a) During the term of this Agreement, all assessments and expenses of the Agricultural Pool including those of the Agricultural Pool Committee shall be paid by the Appropriative Pool. This includes but is not limited to OBMP Assessments, assessments pursuant to Paragraphs 20, 21, 22, 30, 42, 51, 53, 54 both General Administrative Expenses and Special Project Expenses, 55, and Exhibit F (Overlying Agricultural Pool Pooling Plan) of the Judgment except however in the event the total Agricultural Pool Production exceeds 414,000 acre-feet in any five consecutive year period as defined in the Judgment, the Agricultural Pool shall be responsible for its Replenishment obligation pursuant to Paragraph 45 of the Judgment.

(b) The City of Pomona (Pomona) shall be allowed a credit of up to $2 (two) million against OBMP Assessments for its installation and operation and maintenance of its existing anion exchange project, which is hereby determined to further the purposes of the OBMP. Pomona's construction and operation of its anion exchange project was not legally compelled and Pomona had no legal duty to construct the project. For the 30 (thirty) year initial Term of this Agreement, Pomona's OBMP Assessment shall be credited $66,667 per year, not to exceed Pomona's total BMP Assessment attributable to the project's Production for that year. Extension of the Term of this Agreement shall not extend the period of credit.

(c) Kaiser Ventures (Kaiser) in recognition of its contribution of 25,000 acre-feet to offset Replenishment obligations for the

Desalters shall be allowed a credit of up to $900,000 (nine hundred thousand dollars) against OBMP Assessments for the Desalters and related facilities. For the 30 (thirty) year initial Term of this Agreement, Kaiser's OBMP Assessment shall be credited up to $30,000 (thirty thousand dollars) per year, not to exceed Kaiser's OBMP Assessment attributable to Desalters and related facilities. Extension of the Term of this Agreement shall not extend the period of credit. In the event Kaiser Transfers its water rights appurtenant to its overlying land which it owns on the date of execution, the purchaser (Kaiser's successor in interest) shall be entitled one-half (½) of the annual credit.

(d) Watermaster shall adopt reasonable procedures to evaluate requests for OBMP credits against future OBMP Assessments or for reimbursement. Any Producer or party to the Judgment, including but not limited to the State of California, may make application to Watermaster for reimbursement or credit against future OBMP Assessments for any capital or operations and maintenance expenses incurred in the implementation of any project or program, including the cost of relocating groundwater Production facilities, that carries out the purposes of the OBMP including but not limited to those facilities relating to the prevention of subsidence in the Basin, in advance of construction or that is prospectively dedicated to service of the stated goals of the OBMP. Watermaster shall exercise reasonable discretion in making its determination, considering the importance of the project or program to the successful completion of the OBMP, the available alternative funding sources, and the professional engineering and design standards as may be applicable under the circumstances. However, Watermaster shall not approve such a request for reimbursement or credit against future BMP Assessments under this section where the

Producer or party to the Judgment was otherwise legally compelled to make the improvement.

(e) Any Producer that Watermaster compels to move a groundwater Production facility that is in existence on the Date of Execution shall have the right to receive a credit against future Watermaster assessments or reimbursement up to the reasonable cost of the replacement groundwater Production facility.

(f) The procurement of Replenishment Water and the levy of assessments shall be consistent with the provisions of Section 5.4(a) above.

5.5 Salt Credits. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Salt Credits. Watermaster shall assign to the members of the Appropriative Pool, salt credits under the OBMP other than those that were previously allocated for the existing Chino I Desalter, or are attributable to a project or program undertaken by the State of California for the benefit of its overlying land and that carry out the purposes of the OBMP.

5.6 Metering. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding metering:

(a) With respect to the obligation to install meters, which is set forth in the Judgment Paragraph 21, any Assessment levied by Watermaster on the members of the Agricultural Pool, regarding metering shall be paid by the Appropriative Pool. Members of the Agricultural Pool, shall have no obligation to install meters hereafter. The obligation to install meters on wells

owned or operated by members of the Agricultural Pool, shall become that of the Watermaster.

(b) Agricultural Pool meters shall be installed within thirty-six months of the Date of Execution. Watermaster shall be responsible for providing the meter, as well as the cost of any installation, maintenance, inspection, testing and repairing. The members of the Agricultural Pool, shall provide reasonable access during business hours to a location reasonably appropriate for installation, inspection, and repairing of a meter.

(c) The State of California reserves its right to continue to install, operate, maintain, inspect, test and repair its own meters on wells owned or operated by the State, unless it consents to installation by Watermaster in which case Watermaster assumes the cost.

## VI
## COVENANTS BY THE MEMBERS OF THE AGRICULTURAL POOL

6.1 Best Efforts to Support Storage and Recovery. The members and representatives of the Agricultural Pool shall exercise Best Efforts to support the development of any Storage and Recovery Project, once it has been approved by Watermaster, so long as there is no Material Physical Injury to a member of the Agricultural Pool or the Basin.

6.2 Covenant of Good Faith and Fair Dealing. The members and representatives of the Agricultural Pool, including the State of California in its capacity as a member and owner of overlying land within the Agricultural Pool, shall be bound by the covenant of good faith and fair dealing, and not oppose or undermine the efforts of Watermaster to secure the development of a Storage and Recovery Program, so

long as there is no potential or threatened Material Physical Injury to a member of the Agricultural Pool or the Basin.

6.3 Waiver of Compensation. For the term of this Agreement, the members and representatives of the Agricultural Pool shall waive any claims or rights they might raise or possess, and shall not be entitled, to any compensation from a Storage and Recovery Program irrespective of whether it be in the form of money, revenues, credits, proceeds, programs, facilities, or other contributions (compensation). Further, the members of the Appropriative Pool and the Non-Agricultural Overlying Pool shall have the exclusive rights to any such compensation. This Section shall not apply to the charges adopted by CBWCD for storage and recovery purposes. This paragraph shall not be construed as a limitation on the ability of the State of California to make application to the Watermaster for a Storage and Recovery Program pursuant to Section 5.2.

## VII
## DESALTERS

7.1 Need for Desalters. The OBMP requires construction and operation of Desalters. The Desalters shall be owned, operated and maintained by IEUA and WMWD acting independently or in their complete discretion, acting through PC14 consistent with the terms of this Agreement.

7.2 Ownership and Operation.

(a) Chino I Desalter.

(i) The existing "Chino I Desalter," also known as the "SAWPA Desalter," consisting of extraction wells, transmission facilities for delivery of groundwater to the Chino I Desalter, Desalter treatment and delivery facil-

ities for product water, including pumping and storage facilities, and treatment and disposal capacity in the SARI System, is owned and operated by SAWPA, which has created "The Project Committee No. 14 (PC14)" comprised of SAWPA members, IEUA, WMWD, and OCWD, pursuant to "Project Agreement No. 14" dated April 2, 1991, to exercise all the powers and responsibilities of Section 18 of the SAWPA Joint Exercise of Powers Agreement, which now constitutes the executive authority through which SAWPA acts with respect to the Chino I Desalter and to fund repayment for any loans for construction and operation and maintenance of such Desalter and a "Financing Agreement" dated April 1, 2000.

(ii) The Chino I Desalter is operated pursuant to (a) "take or pay" agreements with the purchasers of water made available from such Desalter; (b) an agreement with the Metropolitan Water District (MWD) subsidizing that Desalter to reduce the cost of the water made available by that Desalter compared to the alternative cost of uninterruptible treated imported water available from MWD; and (c) an agreement with the Watermaster, all Pools of Producers from the Chino Basin, Kaiser Ventures, Inc., formerly known as Kaiser Resources, Inc. (Kaiser) and the California Regional Water Quality Control Board, Santa Ana Region (RWQB), regarding provision of certain water with which to satisfy the Replenishment obligation for operating the Desalter.

(b) Chino II Desalter and Chino I Expansion.

IEUA and WMWD acting independently or in their complete discretion through PC14 must own and operate the Chino II

Desalter and the Chino I Expansion in the same manner as the Chino I Desalter, except as otherwise provided in this Agreement.

(c) Future Desalters.

IEUA and WMWD acting independently or in their complete discretion through PC14 must own and operate Future Desalters, if and only if, they can secure funding from state, federal or sources other than the Parties to pay the capital costs required to construct Future Desalters.

7.3 Design and Construction of Chino II Desalter, Chino I Expansion and Future Desalters.

(a) IEUA and WMWD acting independently or in their complete discretion, acting through PC14 shall design and construct the Chino II Desalter on the eastside of the Chino Basin and expand the capacity of the Chino I Desalter already in existence on the Date of Execution, from 8 mgd up to 14 million gallons per day.

(b) The Chino II Desalter shall have an initial capacity of 10 mgd and shall be designed to deliver water to Jurupa Community Services District, the City of Ontario, and if requested, others subject to the limitations of available funding. The existing capacity of the Chino I Desalter shall be expanded by a minimum of 2 mgd and up to 6 mgd, depending on the rate of development and availability of funding and shall be designed to deliver water to the Cities of Chino, Chino Hills and the State of California as provided in this Section.

(c) There is no minimum initial capacity established for Future Desalters as the size and timing of Future Desalters are dependent upon variables not presently subject to reliable estimates.

(i) It is contemplated by the Parties that Future Desalters, and a further expansion of the Chino I Desalter to a capacity greater than the Chino I Expansion or the Chino II Desalter to a capacity greater than 10 mgd may occur;

(ii) IEUA and WMWD shall design and construct Future Desalters, whether acting independently, or in their complete discretion, through PC14, provided that their obligation shall be conditioned upon their ability to secure funding from the state or federal sources other than the Parties to pay the capital costs of construction. Absent such funding, the IEUA and WMWD, acting independently or, in their complete discretion, acting through PC14, shall have no obligation to construct Future Desalters;

(d) The specific location of wells to supply the Chino II Desalter and Future Desalters shall be determined with Watermaster approval and shall be in a location, which is consistent with and shall carry out the purpose of the OBMP. The design and construction of the Chino II Desalter, Chino I Expansion, and Future Desalters shall be in accordance with the OBMP and subject to Watermaster approval. Watermaster approval shall not be unreasonably withheld and shall insure that the operation of the Desalters will implement the OBMP and not result in Material Physical Injury to any party to the Judgment or the Basin.

(e) Wells operated in connection with the Desalters shall be designed and constructed to Produce water with high total

dissolved solids (TDS) and be located in areas consistent with the purposes of the OBMP.

7.4 Funding.

(a) The capital costs of the Chino I Desalter are not affected by this Agreement.

(b) The capital costs of designing and constructing the Chino II Desalter and the Chino I Desalter Expansion shall be partially derived from Proposition 13 funds. The Parties shall exercise their Best Efforts to secure said funds from the appropriate state agencies. However, all unmet capital, operation and maintenance costs relative to the Chino II Desalter shall be paid from the following sources and in the following order of priority:

(i) The net amount of funding received by SAWPA from its existing preliminary gross allocation of $87,000,000 from the $235,000,000 Proposition 13 bond funding provided for the Santa Ana River Watershed sub-account, which currently includes $20,000,000-30,000,000 earmarked for the Chino II Desalter and $5,000,000 for the Chino I Desalter Expansion;

(ii) All other eligible Proposition 13 bond funding;

(iii) All other available federal, state or SAWPA funding;

(iv) MWD subsidies or other funding without committing the storage space of the Chino Basin under any storage and recovery or conjunctive use agreement, such as that secured pursuant to Agreement Number 7658, between MWD, SAWPA, IEUA, WMWD and OCWD dated

December 7, 1995, and entitled "Chino Basin Desalinization Program, Phase I, Joint Participation Agreement for Recovery and Utilization of Contaminated Groundwater;"

(v) Revenue derived from the sale of water made available from the Desalters; and

(vi) Any additional revenue arranged by IEUA and WMWD acting independently or in their complete discretion, acting through PC14, pursuant to an agreement substantially similar to or an amendment of the SAWPA PC14 Agreement entered into on or about April 2, 1991.

(c) IEUA's and WMWD's obligation to construct Future Desalters whether acting independently, or in their complete discretion, through PC14, shall be conditioned upon their ability to secure state or federal funding to pay for the capital costs related to such construction. Absent such state and/or federal funding, the IEUA and WMWD, acting independently or, in their complete discretion, acting through PC14, shall have no obligation to construct Future Desalters.

(i) If, after the earlier of ten years, or the conversion of 20,000 acres of agricultural land, Watermaster, in its discretion, determines that Future Desalters are necessary to implement the OBMP, IEUA or WMWD, acting independently or in their complete discretion acting through PC14, shall have a period up to thirty-six (36) months to secure sufficient funding from State or Federal sources to pay for all the capital costs required to construct "Future Desalters;"

(ii) If IEUA and WMWD acting independently or, in their complete discretion, acting through PC14 cannot secure the necessary funding, the Parties, other than the Agricultural Pool, will exercise their Best Efforts to negotiate new terms and conditions so as to accomplish the implementation of this portion of the OBMP;

(iii) If, however, the Parties, other than the Agricultural Pool, are unable to negotiate new terms to this Agreement within twenty-four (24) months from the initiation of negotiations, the Parties may appoint a mutually agreed upon mediator. Failing an agreement, the Parties reserve all legal rights and remedies, provided that the Agricultural Pool shall not be liable for the costs of the Future Desalters. The remainder of this Agreement shall remain in full force and effect.

7.5 Replenishment Water. Replenishment for the Desalters shall be provided from the following sources in the following order of priority.

(a) Watermaster Desalter Replenishment account composed of 25,000 acre-feet of water abandoned by Kaiser pursuant to the "Salt Offset Agreement" dated October 21, 1993, between Kaiser and the RWQB, and other water previously dedicated by the Appropriative Pool.

(b) New Yield of the Basin, unless the water Produced and treated by the Desalters is dedicated by a purchaser of the desalted water to offset the price of desalted water to the extent of the dedication;

(c) Safe Yield of the Basin, unless the water Produced and treated by the Desalters is dedicated by a purchaser of the desalted

water to offset the price of desalted water to the extent of the dedication;

(d) Additional Replenishment Water purchased by Watermaster, the costs of which shall be levied as an Assessment by Watermaster.

7.6 Sale of Water.

(a) The terms and conditions for the purchase and sale of water from the Chino I Desalter shall be as provided by separate agreement.

(b) The terms and conditions for the purchase and sale of desalted water from the Chino II Desalter and Chino I Expansion are as follows.

(i) Members of the Appropriative Pool and the State of California shall have the first priority right to purchase desalted water developed by Chino II and Chino I Expansion on an equal basis, pursuant to a water supply contract, which is not a "take or pay" contract but contains a minimum annual quantity of water available to be purchased and is consistent with the provisions of this Agreement.

(ii) OCWD shall have the second priority right to purchase desalted water from the Chino II Desalter and the Chino I Expansion provided that IEUA and WMWD have elected to act through PC14.

(iii) If the members of the Appropriative pool, the State of California and the OCWD do not contract for the delivery of all desalted water made available by Chino

II Desalter and the Chino I Expansion, other persons may purchase the water.

(c) The terms and conditions for the purchase and sale of desalted water from Future Desalters are contingent upon IEUA and WMWD acting independently or, in their complete discretion, acting through PC14, securing sufficient funding to pay the capital costs of transporting the desalted water from the Chino II Desalter and Chino I Expansion to other parties to the Judgment that are members of the Appropriative Pool and that desire to purchase desalted water. If sufficient funding is acquired, then other parties to the Judgment that are members of the Appropriative Pool shall have the right to purchase desalted water under the terms and conditions provided in this Article.

(d) The price of desalted water to the parties to the Judgment that are members of the Appropriative Pool, the State of California and OCWD when purchasing water pursuant to Section 7.6(b)2 above, shall be the actual cost of providing the water but shall not exceed $375.00 per acre foot, as adjusted by the purchase and sale agreement between IEUA, WMWD, PC14 and the purchasing party, but in no event shall such adjustment exceed the annual consumer's price index for the LA/Anaheim/ Riverside Area or the percent increase in the MWD treated water rates, or its equivalent, whichever is less as measured from the Effective Date.

(i) If a party to the Judgment elects to Produce water for the Chino II Desalter, the Chino I Expansion or Future Desalters they shall be entitled to a credit against the purchase price in an amount equivalent to the cost of alternative Replenishment Water then available from MWD as interruptible, untreated water or the then pre-

vailing value of the avoided Replenishment obligation, whichever is less;

(ii) If the purchaser is a person other than a party to the Judgment, the price shall be no less than the cost of the alternative water supplies with comparable reliability and quality or if no purchasers are identified then at the highest price that may be attained under the circumstances;

(iii) Fifty percent of any annual revenues received by the Project 14 Committee in excess of the actual ongoing operation, maintenance and Replenishment expenses which revenues are derived from sales of water to any person not a Producer under the Judgment, or the OCWD, shall be provided to Watermaster for use as an off-set against any future assessments against the Parties by Watermaster.

(e) The term of such Water Supply Contract shall be not less than 30 years if requested by a Party to this Agreement.

## VIII
## TERM

8.1 Commencement. This Agreement shall become effective on the Effective Date and shall expire on the Termination Date.

8.2 Expiration. Unless extended pursuant to paragraph 8.3, this Agreement shall expire and thereupon terminate on December 31 of the thirtieth (30th) calendar year starting on January 1, of the first calendar year following the Effective Date.

8.3 Meet and Confer. The Parties agree to meet and confer during the 25th year of this Agreement to discuss any new or modified terms which may be requested or required by each Party in order to continue the term of this Agreement. However, no Party shall be required to modify or amend a term of this Agreement as a precondition to exercising their right to one thirty (30) year extension as provided in 8.4 below.

8.4 Independent Right to Extend. The term of this Agreement may be extended for a period of an additional thirty (30) years, upon the unilateral election of either the Appropriative or Agricultural Pool, (as a Pool only and not the individual members of either Pool) acting in accordance with Watermaster procedures under the Judgment, prior to the end of the twenty-fifth ($25^{th}$) year. The election shall be made in writing with a copy to be sent to the Watermaster and all Parties to this Agreement. In the event an election is made to continue this Agreement, the Agreement shall continue for the extended term on the same terms and conditions as existed during the first thirty (30) years of the Agreement.

8.5 Force Majeure.

(a) If the performance, in whole or in part, of the obligations of the respective Parties is prevented by act or failure to act of any agency other than a Party to this Agreement, court or any other person, by natural disaster or catastrophic event (such as earthquake, fire, drought or flood), contamination, war, strikes, lockouts, acts of God, or acts of civil or military authority, by the operation of applicable law, or by any other cause beyond the control of the affected Party or Parties, whether similar to the causes specified herein or not, the obligation of the affected Party or Parties to perform an act or actions under this Agreement shall be suspended from the time and to the extent that the performance thereof is prevented, but reasonable diligence

shall be observed by the affected Party or Parties, so far as it lies in their power, in performing such respective obligations in whole or in part under this Agreement.

(b) In the event performance is prevented as described above, the Parties agree actively to cooperate and use their Best Efforts to resume performance.

8.6 Only One Mandatory Extension. In no event shall a Party be required to extend performance under this Agreement beyond the first two terms of this Agreement, irrespective of the existence of force majeure. Any further extensions under this Agreement shall be consensual among the Parties to such an agreement.

8.7 Effect of Termination. Upon termination of this Agreement further performance by the Parties under the Agreement shall be excused. Performance under the Agreement shall not be the cause of any action or claim other than as expressly provided herein. Other than as provided in paragraph 8.8, upon termination of this Agreement, the legal rights, remedies, responsibilities and authorities of all Parties regarding the Judgment, interpretation of the Judgment and the powers and authority of Watermaster or the Court, in existence on the Date of Execution, whatever they may be, are expressly reserved and shall be as they existed on the Date of Execution, provided that such rights and remedies shall not be a basis to challenge a Party's performance under this Agreement.

8.8 Rescission of Resolutions 84-2 and 88-3. Upon termination of this Agreement, the members of the Appropriative Pool shall have no obligation to pay the Watermaster Assessments for the members of the Agricultural Pool. The provisions of Resolution 84-2 and 88-3 shall be rescinded and except as provided for in Section V above,

pertaining to "Early Transfers" of Safe Yield during the term of this Agreement, the members of the Appropriative Pool shall not be entitled to further Early Transfers of water from the Agricultural Pool. Upon the termination of this Agreement, the Parties agree that no further Early Transfers of unallocated Safe Yield shall occur. The determination of the Safe Yield as provided for in the Judgment at Paragraph 44 shall be construed to mean that the Appropriative Pool shall receive no Transfers of unallocated Safe Yield from the Agricultural Pool for a period of five (5) consecutive years after the termination of this Agreement, at which time the Appropriative Pool shall receive the difference between 414,000 acre-feet allocated to the Agricultural Pool and the actual water used by the Agricultural Pool for the first five consecutive calendar years immediately following the termination of this Agreement.

8.9 Mediation Upon Failure to Secure Capital Funding for Future Desalters. If IEUA or WMWD have not acquired the funding within thirty-six (36) months of the date of the Watermaster determination regarding the need for the Future Desalters as provided in Article VII, then the members of the Appropriative Pool, Non-Agricultural Pool and IEUA and WMWD will exercise Best Efforts to negotiate new terms and conditions for the capital costs for any such Future Desalters.

8.10 Parties Rights Unaffected Upon Termination. Each Party's rights shall be unaffected by their having approved, executed or implemented this Agreement pursuant to their mutual consent other than as provided is Section 8.8.

# IX
# CONFLICTS

9.1 Events Constituting a Default by a Party. Each of the following constitutes a "default" by a Party under this Agreement.

(a) A Party fails to perform or observe any term, covenant, or undertaking in this Agreement that it is to perform or observe and such failure continues for ninety (90) days from a Notice of Default being sent in the manner prescribed in Section 10.13.

9.2 Remedies Upon Default. In the event of a default, each Party shall have the following rights and remedies:

(a) Specific Performance. Each Party agrees and recognizes that the rights and obligations set forth in this Agreement are unique and of such a nature as to be inherently difficult or impossible to value with money. If one Party does not perform in accordance with the specific wording of any of the provisions in this Agreement applicable to that Party, defaults, or otherwise breaches this Agreement, an action at law for damages or other remedies at law would be wholly inadequate to protect the unique rights and interests of the other Party to the Agreement. Accordingly, in any court controversy concerning this Agreement, the Agreement's provisions will be enforceable in a court of equity by specific performance. This specific performance remedy is not exclusive and is in addition to any other remedy available to the Parties to enforce the terms of this Agreement.

(b) Injunction. Each Party agrees and recognizes that the rights and obligations set forth in this Agreement are material to another Party and of such a nature that there will be substantial

reliance upon the terms of this Agreement. If one Party does not perform in accordance with specific wording of any of the provisions of this Agreement applicable to that Party, defaults, or otherwise breaches this Agreement, an action at law for damages or other remedies at law would be wholly inadequate to prevent substantial and irreparable harm to another Party to the Agreement. Accordingly, in any court controversy concerning this Agreement, the Agreement's provisions will be enforceable in a court of equity by mandatory and prohibitory injunction. This mandatory and prohibitory injunction remedy is not exclusive and is in addition to any other remedy available to the Parties to enforce the terms of this Agreement.

(c) Cumulative Rights and Remedies. The Parties do not intend that any right or remedy given to a Party on the breach of any provision under this Agreement be exclusive; each such right or remedy is cumulative and in addition to any other remedy provided in this Agreement or otherwise available at law or in equity. If the non-breaching Party fails to exercise or delays in exercising any right or remedy, the non-breaching Party does not thereby waive that right or remedy. Furthermore, no single or partial exercise of any right, power, or privilege precludes any further exercise of a right, power, or privilege granted by this Agreement or otherwise.

(d) Attorneys' Fees. In any adversarial proceedings between the Parties other than the dispute resolution procedure set forth below and under the Judgment, the prevailing Party shall be entitled to recover their costs, including reasonable attorneys' fees. If there is no clear prevailing Party, the Court shall determine the prevailing Party and provide for the award of costs and reasonable attorneys' fees. In considering the reasonableness of either Party's request for attorneys' fees as a prevailing Party, the Court shall consider the quality, efficiency, and

value of the legal services and similar/prevailing rate for comparable legal services in the local community.

9.3 Dispute Resolution.

(a) Scope of Dispute Resolution. Disputes (Disputes) between the Parties other than those constituting a "Default", or "Exclusion" (defined below), shall be resolved pursuant to the provisions of this Section.

(b) Exclusions:

(i) Emergency. An emergency event which, if not promptly resolved may result in imminent danger to the public health, safety or welfare shall not be subject to dispute resolution.

(ii) Complete Discretion. Those matters reserved to the complete discretion of a Party under this Agreement shall not be subject to dispute resolution.

(iii) Review Under the Judgment Unaffected. The rights and remedies of the parties to the Judgment to seek review of Watermaster actions shall not be subject to dispute resolution.

(c) Disputes.

(i) Each Party to this Agreement may submit any Dispute related to or arising under this Agreement to non-binding mediation by delivering a Notice of Dispute to the other Party;

(ii) The written Notice of Dispute prepared by the Party shall be delivered to the other Party in accordance with Section 10.13. The Notice of Dispute shall clearly describe the basis of the dispute and the Sections of the Agreement under which the Dispute arises;

(iii) The non-binding mediation shall be conducted by Judicial Arbitration Mediation Services (JAMS) or an equivalent mediation service agreed to by the Parties;

(iv) Unless otherwise agreed, a mediator shall be appointed within forty-five (45) days of the date the Notice of Dispute is delivered to hear the dispute and provide a written determination. The mediator shall be chosen jointly by the Parties. If the Parties cannot agree, the Court shall appoint the mediator. Employees or agents of Watermaster or any Party are ineligible to serve as the mediator;

(v) The mediation shall be held within ninety (90) days of the date the Notice of Dispute is delivered;

(vi) Any statute of limitations applicable to any claims, rights, causes of action, suits, or liabilities of whatever kind or nature, in law, equity or otherwise, whether known or unknown, shall be tolled during the mediation process. For purposes of this Section, the mediation process shall commence upon the service of a Notice of Dispute to the other Party pursuant to Section 9.3c(i) above. For purposes of this Section, the mediation process shall be deemed complete ten (10) days after service of the mediator's written notice of the conclusion of the mediation;

# X
# GENERAL PROVISIONS

10.1 Supersedence. Upon execution of this Agreement, any and all existing agreements or contracts between the Parties concerning the precise subject matter of this Agreement are hereby rescinded to the extent that they conflict with express terms herein.

10.2 Applicability to Others.

(a) After the Date of Execution, each Party agrees that any other agreement or contract relating to the subject matter of this Agreement, or the Judgment, to which it is a party, shall be consistent with the provisions of this Agreement, unless all other Parties consent to the inconsistent agreement or contract.

(b) After the Date of Execution, each Party reserves complete discretion to enter into other agreements or contracts on subject matter not covered by the terms of this Agreement.

10.3 Admissions by Parties. Nothing in this Agreement constitutes an admission of liability by any Party hereto for any prior or past acts that preceded the Date of Execution. This Agreement and any documents prepared in connection herewith may not be used as evidence in any litigation, except as necessary to interpret or enforce the terms of this Agreement.

10.4 Construction of Agreement. Each Party, with the assistance of competent legal counsel, has participated in the drafting of this Agreement and any ambiguity should not be construed for or against any Party on account of such drafting.

10.5 Each Party Bears Own Costs. Each Party is to bear its own costs, expenses, and attorneys' fees arising out of or in connection with the subject matter of this Agreement and the negotiation, drafting, and execution of this Agreement. Each of the Parties understands that this Agreement includes all claims for loss, expense and attorneys' fees, taxable or otherwise, incurred by it or arising out of any matters leading up to the execution of this Agreement.

10.6 Waiver of Breach. No waiver or indulgence of any breach or series of breaches of this Agreement shall be deemed or construed as a waiver of any other breach of the same or any other provision hereof or affect the enforceability of any part or all of this Agreement. No waiver shall be valid unless executed in writing by the waiving Party.

10.7 Awareness of Contents/Legal Effect. The Parties expressly declare and represent that they have read the Agreement and that they have consulted with their respective counsel regarding the meaning of the terms and conditions contained herein. The Parties further expressly declare and represent that they fully understand the content and effect of this Agreement and they approve and accept the terms and conditions contained herein, and that this Agreement is executed freely and voluntarily.

10.8 Agreement Binding On All. This Agreement shall be binding upon and shall inure to the benefit of each of the Parties, and each of their respective agents, employees, directors, officers, attorneys, representatives, principals, shareholders, sureties, parents, subsidiaries, affiliates, successors, predecessors, assigns, trustees or receivers appointed to administer their assets, and attorneys of any and all such individuals and entities. All the covenants contained in this Agreement are for the express benefit of each and all such persons described in this Section. This Agreement is not intended to benefit any third parties.

10.9 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute one Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

10.10 Captions. The captions contained herein are included solely for convenience and shall not be construed as part of this Agreement or as full or accurate descriptions of the terms hereof.

10.11 Choice of Law. This Agreement shall be construed and enforced pursuant to the laws of the State of California.

10.12 Authority to Enter into This Agreement. Each Party represents and warrants that its respective obligations herein are legal and binding obligations of such Party; that each Party is fully authorized to enter into this Agreement, and that the person signing this Agreement hereinafter for each Party has been duly authorized to sign this Agreement on behalf of said Party.

10.13 Notice.

(a) Any notice required under this Agreement shall be written and shall be served either by personal delivery, mail or fax.

(b) In the case of service by personal delivery or fax, no additional time, in days, shall be added to the time in which a right may be exercised or an act may be done.

(c) In the case of service by mail, notice must be deposited in a post office, mailbox, sub post-office, substation, or mail chute, or other like facility regularly maintained by the United States Postal Service, in a sealed envelope, with postage paid, addressed to the representative(s) of the Party

on whom it is to be served, at their place of business. The service is complete at the time of deposit. Any period of notice and any right or duty to do any act or make any response within any period or on a date certain after service of notice by mail shall be extended five days. Any period of notice and any right or duty to do any act or make any response within any period or on a date certain after service of notice by Express mail or other method of delivery providing for overnight delivery shall be extended by two court days.

10.14 Amendments and/or Changes to Agreement.

(a) Any amendments and/or changes to this Agreement must be in writing, signed by a duly authorized representative of the Parties hereto, and must expressly state the mutual intent of the Parties to amend this Agreement as set forth herein. The Parties to this Agreement recognize that the terms and conditions of this Agreement, which are set forth herein in the Sections preceding this Section have been arrived at through the collective negotiations by the Parties.

(b) The Parties hereby agree that no amendments and/or changes may be made to this Agreement without the express written approval of each Party to this Agreement, provided that upon request, no such approval shall be unreasonably withheld.

## XI
## ACKNOWLEDGMENTS: CONFIRMATION OF RIGHTS

11.1 Each Party's rights to water it presently holds in storage with Watermaster are confirmed and protected.

11.2 The Parties confirm that in addition to the benefits received by the State under this Agreement, including an exemption from the payment of Watermaster Assessments as a member of the Agricultural Pool, the rights of the State of California under the Judgment to Produce water are not modified or altered by this Agreement. For all purposes of the Judgment all future Production by the State or its departments or agencies, including but not limited to the Department of Corrections, Department of Fish and Game, Youth Authority, Department of Parks and Recreation, Department of Toxic Substances Control, and Department of Transportation as set forth in Paragraph 10 of the Judgment, for overlying use on State-owned lands, shall be considered use by the Agricultural Pool. This Agreement is not intended to limit the State or its departments or agencies including but not limited to, the Department of Corrections, Department of Fish and Game, Youth Authority, Department of Parks and Recreation, Department of Toxic Substances Control, and Department of Transportation from exercising the State's rights of future Production for overlying use on State-owned lands as set forth in Paragraph 10 of the Judgment. The Parties agree that they will not oppose the State's exercise of its rights pursuant to the Judgment. The State of California is not executing this Agreement on behalf of the State Water Resources Control Board, the Department of Water Resources, Department of Toxic Substances Control, or the California Regional Water Quality Control Board or the Department of Fish and Game except as stated above. Nothing in this Agreement shall be construed in any way as modifying, altering or limiting the regulatory and trustee obligations, legal rights or duties of any State Agencies, including the Department of Fish and Game, the State Water Resources Control, the California Regional Water Quality Control Boards, the Department of Toxic Substances Control and Department of Water Resources. This Agreement does not limit in any way, and expressly recognizes the rights and ability of the Department of Water Resources to make application to

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED: 7/31/00

**CITY OF ONTARIO**

By _____

DATED:

**CITY OF POMONA**

By _____

DATED:

**CITY OF UPLAND**

By _____

[Signatures continued on following pages]

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED:

**CITY OF ONTARIO**

By_____

DATED:

7-31-2000

**CITY OF POMONA**

By_____

DATED:

**CITY OF UPLAND**

By_____

[Signatures continued on following pages]

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED: **CITY OF ONTARIO**

By_____

DATED: **CITY OF POMONA**

By_____

DATED: 7/24/00 **CITY OF UPLAND**

By Robert R. Nelson

[Signatures continued on following pages]

DATED: 8/1/00

**STATE OF CALIFORNIA**

By Marilyn H. Levin

DATED:

**CITY OF CHINO**

By_____

DATED:
07/31/00

**CUCAMONGA COUNTY WATER DISTRICT**

By Jeanne M. Wilson

DATED:

**MONTE VISTA WATER DISTRICT**

By_____

DATED: 7-27-2000

**FONTANA UNION WATER COMPANY**

By Ronald J. Black

[Signatures continued on following pages]

DATED:

**STATE OF CALIFORNIA**

By_____

DATED:

**CITY OF CHINO**

By Edwin M. De Lira

DATED:

**CUCAMONGA COUNTY WATER DISTRICT**

By_____

DATED:

**MONTE VISTA WATER DISTRICT**

By_____

DATED:

**FONTANA UNION WATER COMPANY**

By_____

[Signatures continued on following pages]

DATED:

**STATE OF CALIFORNIA**

By_____

DATED:

**CITY OF CHINO**

By_____

DATED:

**CUCAMONGA COUNTY WATER DISTRICT**

By_____

DATED: 7/31/00

**MONTE VISTA WATER DISTRICT**

By Mark Z. Kenny

DATED:

**FONTANA UNION WATER COMPANY**

By_____

[Signatures continued on following pages]

DATED:

**CITY OF CHINO HILLS**

By_____

DATED:

**JURUPA COMMUNITY SERVICES DISTRICT**

By_____

DATED:

**AGRICULTURAL POOL**

By_____

DATED:

**APPROPRIATIVE POOL**

By_____

DATED: 7/27/00

**NON-AGRICULTURAL POOL**

By_____

[Signatures continued on following pages]

DATED: 7/31/00

**CITY OF CHINO HILLS**

By _____

DATED:

**JURUPA COMMUNITY SERVICES DISTRICT**

By _____

DATED:

**AGRICULTURAL POOL**

By _____

DATED:

**APPROPRIATIVE POOL**

By _____

DATED:

**NON-AGRICULTURAL POOL**

By _____

[Signatures continued on following pages]

DATED: July 31, 2000

**INLAND EMPIRE UTILITY AGENCY**

By John L. Anderson

DATED:

**THREE VALLEYS MUNICIPAL WATER DISTRICT**

By_____

DATED:

**KAISER VENTURES, INC.**

By_____

DATED:

**WESTERN MUNICIPAL WATER DISTRICT**

By_____

[Signatures continued on following pages]

DATED:

**INLAND EMPIRE UTILITY AGENCY**

By_____

DATED:

**THREE VALLEYS MUNICIPAL WATER DISTRICT**

By_____

DATED: 7/31-00

**KAISER VENTURES, INC.**

By_____

DATED:

**WESTERN MUNICIPAL WATER DISTRICT**

By_____

[Signatures continued on following pages]

DATED:

**INLAND EMPIRE UTILITY AGENCY**

By_____

DATED:

**THREE VALLEYS MUNICIPAL WATER DISTRICT**

By_____

DATED:

**KAISER VENTURES, INC.**

By_____

DATED:

**WESTERN MUNICIPAL WATER DISTRICT**

By_____

[Signatures continued on following pages]

DATED: 7/31/00

**SAN ANTONIO WATER COMPANY**

By Tom Thomas

DATED:

**CHINO BASIN WATER CONSERVATION DISTRICT**

By_____

DATED:

[Signatures continued on following pages]

DATED:

**SAN ANTONIO WATER COMPANY**

By_____

DATED: 7/28/2000

**CHINO BASIN WATER CONSERVATION DISTRICT**

By_____

DATED:

[Signatures continued on following pages]

# EXHIBIT A

WATERMASTER RESOLUTION
NO. 2000-__

**RESOLUTION OF THE CHINO BASIN WATERMASTER TO ADOPT THE GOALS AND PLANS OF THE PHASE I REPORT AS IMPLEMENTED BY THE OBMP IMPLEMENTATION PLAN, CONSISTENT WITH THE PEACE AGREEMENT AS ITS OBMP ("OBMP"), TO ADOPT THE REQUISITE POLICIES AND PROCEDURES TO IMPLEMENT THE PROVISIONS SET FORTH IN ARTICLE V OF THE PEACE AGREEMENT ON OR BEFORE DECEMBER 31, 2000, AND TO APPROVE THE "PEACE AGREEMENT."**

WHEREAS, the Judgment in the Chino Basin Adjudication, *Chino Basin Municipal Water District v. City of Chino, et al.*, San Bernardino Superior Court No. 164327, created the Watermaster and directed it to perform the duties as provided in the Judgment or ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction; and

WHEREAS, the Judgment directs Watermaster to develop an OBMP subject to the limitations contained in the Judgment; and

WHEREAS, Watermaster and prepared and submitted a Phase I Report regarding the OBMP to the Court; and

WHEREAS, the Court ordered the Inland Empire Utilities Agency (IEUA) to act as "lead agency" for the purposes of preparing any applicable environmental review for the OBMP in the form of a Programmatic Environmental Impact Report (PEIR) and the Court is exercising continuing jurisdiction over this matter; and

WHEREAS, the parties developed a Memorandum of Principles which articulated a framework of an agreement which the Watermaster Board

articulated a framework of an agreement which the Watermaster Board unanimously approved on May 26, 2000; and

WHEREAS, the parties have reduced the principles into a more definitive agreement and an OBMP Implementation Plan.

WHEREAS, the goals and plans in the Phase I Report implemented consistent with the OBMP Implementation Plan and the Peace Agreement constitute the OBMP; and

WHEREAS, the IEUA has prepared and circulated a draft PEIR and held a public meeting to take public comment on the OBMP on June 28, 2000; and

WHEREAS, the parties to the Peace Agreement and the parties to the Judgment have requested Watermaster to approve the Peace Agreement and the OBMP Implementation Plan and to implement the goals and plans contained in the OBMP Phase I Report in a manner consistent with the Peace Agreement and the OBMP Implementation Plan.

NOW, THEREFORE, IT IS HEREBY RESOLVED AND DETERMINED THAT:

1. The goals and plans in the Phase I Report and their implementation as provided in and consistent with the Implementation Plan and the Peace Agreement are in furtherance of the physical solution set forth in the Judgment and Article X, Section 2 of the California Constitution.

2. Although not a signatory, the Chino Basin Watermaster Board supports and approves the Peace Agreement negotiated by the parties thereto.

3. Subject to the satisfaction of all conditions precedent set forth in the Peace Agreement and the unanimous approval of the Peace Agreement by the Parties thereto no later than August 1, 2000:

   a. Watermaster adopts the goals and plans of the Phase I Report consistent with the Implementation Plan and the Peace Agreement.

   b. The Watermaster will proceed in accordance with the OBMP Implementation Plan and the Peace Agreement.

   c. Watermaster will comply with the conditions described in Article V of the Peace Agreement labeled, "Watermaster Performance" and Watermaster shall adopt all necessary policies and procedures in order to implement the provisions set forth in Article V on or before December 31, 2000, unless an earlier date is specified in the Peace Agreement or the OBMP Implementation Plan.

4. The Watermaster Board will transmit a request to the Court to issue an Order authorizing and directing Watermaster to proceed in accordance with this Resolution.

5. In approving this Agreement, Watermaster is not committing to carry-out any project within the meaning of CEQA unless and until environmental review and assessments required by CEQA

for that defined "project" have been completed. Any future actions that meet the definition of a "project" under CEQA shall be subject to environmental documentation.

October 25, 2007

**PEACE II AGREEMENT:**
**PARTY SUPPORT FOR WATERMASTER'S OBMP IMPLEMENTATION PLAN, – SETTLEMENT AND RELEASE OF CLAIMS REGARDING FUTURE DESALTERS**

**WHEREAS,** paragraph 41 of the Judgment entered in *Chino Basin Municipal Water District v. City of Chino* (San Bernardino Superior Court Case No. 51010) grants Watermaster, with the advice of the Advisory and Pool Committees, "discretionary powers in order to implement an Optimum Basin Management Program ("OBMP") for the Chino Basin";

**WHEREAS,** the Parties to the Judgment executed an agreement resolving their differences and pledging their support for Watermaster actions in accordance with specific terms in June of 2000 ("Peace Agreement");

**WHEREAS,** Watermaster approved Resolution 00-05, and thereby adopted the goals and objectives of the OBMP, the OBMP Implementation Plan and committed to act in accordance with the terms of the Peace Agreement;

**WHEREAS,** pursuant to Article IV, paragraph 4.2, each of the parties to the Peace Agreement agreed not to oppose Watermaster's adoption and implementation of the OBMP Implementation Plan attached as Exhibit "B" to the Peace Agreement;

**WHEREAS,** the Peace Agreement, the OBMP Implementation Plan and the Chino Basin Watermaster Rules and Regulations contemplate further actions by Watermaster in furtherance of its responsibilities under paragraph 41 of the Judgment and in accordance with the Peace Agreement and the OBMP Implementation Plan;

**WHEREAS,** the Parties to the Peace Agreement made certain commitments regarding the funding, design, construction and operation of Future Desalters;

**WHEREAS,** after receiving input from its stakeholders in the form of the Stakeholder's Non-Binding Term Sheet, Watermaster has proposed to adopt Resolution 07-05 attached as Exhibit "1" hereto to further implement the OBMP through a suite of measures commonly referred to and herein defined as "Peace II Measures", including but not limited to the 2007 Supplement to the OBMP, the Second Amendment to the Peace Agreement, amendments to Watermater's Rules and Regulations, the purchase and sale of water within the Overlying (Non-Agricultural) Pool and certain Judgment amendments; and

**NOW, THEREFORE,** in consideration of the mutual promises specified herein and by conditioning their performance under this Agreement upon the conditions precedent set forth in Article III herein, the Watermaster Approval, and Court Order, and for other good and valuable consideration, the Parties agree as follows:

## ARTICLE I
## DEFINITIONS AND RULES OF CONSTRUCTION

1.1 Definitions.

(a) "Desalters" means Desalters and Future Desalters collectively, as defined in the Peace Agreement.

(b) "Hydraulic Control" means the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. The Chino North Management Zone is defined in the 2004 Basin Plan amendment (RWQCB resolution R8-2004-001) attached hereto as Exhibit "B."

(c) "Leave Behind" means a contribution to the Basin from water held in storage within the Basin under a Storage and Recovery Agreement that may be established by Watermaster from time to time that may reflect any or all of the following: (i) actual losses; (ii) equitable considerations associated with Watermaster's management of storage agreements; and (iii) protection of the long-term health of the Basin against the cumulative impacts of simultaneous recovery of groundwater under all storage agreements.

(d) Re-Operation" means the controlled overdraft of the Basin by the managed withdrawal of groundwater Production for the Desalters and the potential increase in the cumulative un-replenished Production from 200,000 authorized by paragraph 3 of the Engineering Appendix Exhibit I to the Judgment, to 600,000 acre feet for the express purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution.

(e) Unless otherwise expressly provided herein, all definitions set forth in the Peace Agreement and the Judgment are applicable to the terms as they are used herein.

1.2 Rules of Construction.

(a) Unless the context clearly requires otherwise:

(i) The plural and singular forms include the other;

(ii) "Shall," "will," "must," and "agrees" are each mandatory;

(iii) "May" is permissive;

(iv) "Or" is not exclusive;

(v) "Includes" and "including" are not limiting; and

(vi) "Between" includes the ends of the identified range.

(b) Headings at the beginning of Articles, paragraphs and subparagraphs of this Agreement are solely for the convenience of the Parties, are not a part of this Agreement and shall not be used in construing it.

(c) The masculine gender shall include the feminine and neuter genders and vice versa.

(d) The word "person" shall include individual, partnership, corporation, limited liability company, business trust, joint stock company, trust, unincorporated association, joint venture, governmental authority, water district and other entity of whatever nature.

(e) Reference to any agreement (including this Agreement), document, or instrument means such agreement, document, instrument as amended or modified and in effect from time to time in accordance with the terms thereof and, if applicable, the terms thereof.

(f) Except as specifically provided herein, reference to any law, statute or ordinance, regulation or the like means such law as amended, modified, codified or reenacted, in whole or in part and in effect from time to time, including any rules and regulations promulgated thereunder.

## ARTICLE II
## COMPLIANCE WITH CEQA

2.1 Project Description. The proposed project description regarding the design, permitting, construction and operation of Future Desalter, securing Hydraulic Control through Basin Re-Operation is set forth in Attachment "A" to Watermaster Resolution 07-05 attached hereto as Exhibit "1."

2.2 Acknowledgment of IEUA as the Lead Agency for CEQA Review. IEUA has been properly designated as the "Lead Agency" for the purposes of completing environmental assessment and review of the proposed project.

2.3 Commitments are Consistent with CEQA. The Parties agree and acknowledge that no commitment will be made to carry out any "project" under the amendments to the OBMP and within the meaning of CEQA unless and until the environmental review and assessment that may be required by CEQA for that defined "project" have been completed.

2.4 Reservation of Discretion. Execution of this Agreement is not intended to commit any Party to undertake a project without compliance with CEQA or to commit the Parties individually or collectively to any specific course of action, which would result in the present approval of a future project.

2.5 No Prejudice by Comment or Failure to Comment. Nothing contained in environmental review of the Project, or a Party's failure to object or comment thereon, shall limit any

Party's right to allege that "Material Physical Injury" will result or has resulted from the implementation of the OBMP or its amendment.

## ARTICLE III
## CONDITIONS PRECEDENT

3.1 Performance Under Articles IV-XII is Subject to Satisfaction of the Conditions Precedent. Each Party's obligations under this Agreement are subject to the satisfaction of the following conditions precedent on or before the dates specified below, unless satisfaction or a specified condition or conditions is waived in writing by all other Parties:

(a) Watermaster approval of Resolution 07-05 in a form attached hereto as Exhibit "1," including the following Attachments thereto

(i) the amendments to the Chino Basin Watermaster Rules and Regulations set forth in Attachment "F" thereto.

(ii) the 2007 Supplement to the OBMP Implementation Plan set forth in Attachment "D" thereto.

(iii) the amendments to the Judgment set forth in Attachments "H, I, and J" thereto.

(iv) the Second Amendment to the Peace Agreement set forth in Attachment "L" thereto.

(v) the Purchase and Sale Agreement for the Purchase of Water by Watermaster From the Overlying (Non-Agricultural) Pool as set forth in Attachment G thereto.

(b) The execution of the proposed Second Amendment to the Peace Agreement by all Parties to the Peace Agreement .

(c) Court approval of the proposed Judgment Amendments and a further order of the Court directing Watermaster to proceed in accordance with the terms of the Peace II Measures as embodied in Resolution 07-05.

## ARTICLE IV
## MUTUAL ACKNOWLEDGEMENT AND COVENANTS

4.1 Acknowledgment of Peace II Measures. The collective actions of Watermaster set forth in Watermaster Resolution 07-05 and the Attachments thereto (Peace II Measures) constitute further actions by Watermaster in implementing the OBMP in accordance with the grant and limitations on its discretionary authority set forth under paragraph 41 of the Judgment

4.2 Non-Opposition. No Party to this Agreement shall oppose Watermaster's adoption of Resolution 07-05 and implementation of the Peace II measures as embodied therein

including the Judgment Amendments, Amendments to the Peace Agreement, the 2007 Supplement to the OBMP Implementation Plan and Amendments to the Chino Basin Watermaster's Rules and Regulations or to Watermaster's execution of memoranda of agreement that are not materially inconsistent with the terms contained therein. Notwithstanding this covenant, no party shall be limited in their right of participation in all functions of Watermaster as they are provided in the Judgment or to preclude a Party to the Judgment from seeking judicial review of Watermaster determinations pursuant to the Judgment or as otherwise provided in this Agreement.

4.3 Consent to Amendments. Each Party expressly consents to the Judgment amendments and modifications set forth in Watermaster's Resolution 07-05.

4.4 Non-Agricultural Pool Intervention. The Parties acknowledge and agree that any Party to the Judgment shall have the right to purchase Non-Agricultural overlying property within the Basin and appurtenant water rights and to intervene in the Non-Agricultural Pool.

## ARTICLE V
## FUTURE DESALTERS

5.1 Purpose. Watermaster plans to coordinate and the Parties to the Judgment plan to arrange for the physical capacity and potable water use of water from the Desalters. Desalters in existence on the effective date of this Agreement will be supplemented to provide the required capacity to cumulatively produce approximately 40,000 acre-feet per year of groundwater from the Desalters by 2012.

5.2 2007 Supplement to the OBMP Implementation Plan. The OBMP Implementation Plan will be supplemented as set forth in the 2007 Supplement to the OBMP Implementation Plan to reflect that Western Municipal Water District ("WMWD"), acting independently or in its complete discretion with the City of Ontario ("Ontario") or the Jurupa Community Services District ("Jurupa") or both, will exercise good faith and reasonable best efforts to arrange for the design, planning, and construction of Future Desalters in accordance with the 2007 Supplement to the OBMP Implementation Plan, to obtain Hydraulic Control, further Re-Operation and support the Future Desalters.

5.3 Implementation. WMWD, acting independently or in its complete discretion with Ontario, Jurupa, or both, will exercise good faith and reasonable best efforts to arrange for the design, planning, and construction of Future Desalters in accordance with the 2007 Supplement to the OBMP Implementation Plan, to account for Hydraulic Control, Re-Operation and Future Desalters.

(a) WMWD, acting independently or in its complete discretion with Ontario or Jurupa or both, will exercise good faith and reasonable best efforts to proceed in accordance with the timeline for the completion of design, permitting, finance and construction as attached hereto as Exhibit "2"

(b) WMWD, acting independently or in its complete discretion with the City of Ontario or the Jurupa Community Services District or both, will provide quarterly progress reports to Watermaster and the Court.

5.4 Project Description. The Future Desalters will add up to 9 mgd to existing Desalters. This will include production capacity from new groundwater wells that will be located in the Southerly end of the Basin, as depicted in Exhibit "3" attached hereto and incorporated herein by this reference. The final design and construction of Future Desalters *may* depend on the terms and conditions that may be freely arrived at by fair bargaining among WMWD and the Chino Basin Desalter Authority ("CDA") or whether it is required to build stand-alone facilities or both. There are material yield benefits to the Parties to the Judgment that are achieved by obtaining Hydraulic Control through Basin Re-Operation. The extent of these benefits is somewhat dependent upon the final location of new production facilities within the southerly end of the Basin. Accordingly, Watermaster will ensure that the location of Future Desalter groundwater production facilities will achieve both Hydraulic Control and maximize yield enhancement by their location emphasizing groundwater production from the Southerly end of the Basin.

5.5 Implementing Agreements. Within twenty-four (24) months of the effective date, WMWD, acting independently or in its complete discretion with the City of Ontario or the Jurupa Community Services District or both, will exercise good faith and reasonable best efforts to complete final binding agreement(s) regarding Future Desalters that includes the following key terms:

(a) Arrangements for WMWD's purchase of product water from CDA;

(b) Arrangements with CDA, Jurupa and other Chino Basin parties for the common use of existing facilities, if any;

(c) Arrangement with the owners of the SARI line;

(d) Arrangements with the Appropriative Pool regarding the apportionment of any groundwater produced as controlled overdraft in accordance with the Physical Solution between Desalters I, Desalters II on the one hand and the Future Desalters on the other hand;

(e) WMWD's payment to Watermaster to reimburse Parties to the Judgment for their historical contributions towards the OBMP, if any;

(f) The schedule for approvals and project completion.

5.6 Reservation of Discretion. Nothing herein shall be construed as committing WMWD, or any members of CDA to take any specific action(s) to accommodate the needs or requests of the other, Watermaster, or any Party to the Judgment, whatever the request may be.

5.7 Condition Subsequent. WMWD's obligation to execute a binding purchase agreement with CDA or to independently develop the Future Desalters is subject to the express condition subsequent that the total price per acre-foot of water delivered must not be projected to exceed the sum of the following: (i) the full MWD Tier II Rate; (ii) the MWD Treatment Surcharge calculated in terms of an annual average acre-foot charge; and (iii) $150 (in 2006 dollars) per acre-foot of water delivered to account for water supply reliability.

(a) The full acre-foot cost to Western for Capital and O&M (assuming the priority allocation of controlled overdraft), includes:

(i) the delivery of the desalted water to its Mockingbird Reservoir or directly to the City of Norco,

(ii) any applicable ongoing Watermaster assessments, payments to CDA and JCSD and for SARI utilization.

(b) Provided that if third-party funding, grants and a MWD subsidy under the Local Resources Program or otherwise should reduce Western's costs to an amount which is $75 (in 2006 dollars) below the cap described in paragraph 5.5, Western will transmit an amount equal to fifty (50) percent of the amount less than the computed price cap less $75 (in 2006 dollars) to Watermaster.

(c) Western may elect to exercise its right of withdrawal under this paragraph 5.7 within 120 days following the later of: (1) completion of preliminary design; or (2) the certification of whatever CEQA document is prepared for the project, but not later than sixty (60) days thereafter and in no event after a binding water purchase agreement has been executed.

5.8 Limitations. The operation of the Future Desalters will be subject to the following limitations:

(a) Well Location. New groundwater production facilities for the Future Desalters will be located in the southern end of the Basin to achieve the dual purpose of obtaining Hydraulic Control and increasing Basin yield.

(i) New wells will be constructed in the shallow aquifer system among Desalter I wells No. 1 through 4 and west of Desalter I.

(ii) So long as these wells produce at least one-half of the Future Desalter groundwater, the Future Desalters shall be entitled to first priority for the allocation of the 400,000 acre-feet of controlled overdraft authorized by the Judgment Amendments to Exhibit I.

(b) Export. The export of groundwater from the Basin must be minimized. WMWD will present a plan for export minimization to the Watermaster for review and approval prior to operation of the Future Desalters.

(i) Watermaster will account for water imported and exported by WMWD.

(ii) Watermaster will prepare an initial reconciliation of WMWD's imports and exports at the end of the first ten (10) years of operation and every year thereafter to determine whether a "net export" occurred.

(iii) WMWD will pay an assessment, if any, on all "net exports" in accordance with Judgment Exhibit "H," paragraph 7(b) after the initial reconciliation is completed at the end of the first ten (10) years of operation.

## ARTICLE VI
## GROUNDWATER PRODUCTION BY AND REPLENISHMENT FOR DESALTERS

6.1 Acknowledgment. The Parties acknowledge that the hierarchy for providing Replenishment Water for the Desalters is set forth in Article VII, paragraph 7.5 of the Peace Agreement, and that this section controls the sources of water that will be offered to offset Desalter Production.

6.2 Peace II Desalter Production Offsets. To facilitate Hydraulic Control through Basin Re-Operation, in accordance with the 2007 Supplement to the OBMP Implementation Plan and the amended Exhibits G and I to the Judgment, additional sources of water will be made available for purposes of Desalter Production and thereby some or all of a Replenishment obligation. With these available sources, the Replenishment obligation attributable to Desalter production in any year will be determined by Watermaster as follows:

(a) Watermaster will calculate the total Desalter Production for the preceding year and then apply a credit against the total quantity from:

(i) the Kaiser account (Peace Agreement Section 7.5(a).);

(ii) dedication of water from the Overlying (Non-Agricultural) Pool Storage Account or from any contribution arising from an annual authorized Physical Solution Transfer in accordance with amended Exhibit G to the Judgment;

(iii) New Yield (other than Stormwater (Peace Agreement Section 7.5(b));

(iv) any declared losses from storage in excess of actual losses enforced as a "Leave Behind";

(v) Safe Yield that may be contributed by the parties (Peace Agreement Section 7.5(c));

(vi) any Production of groundwater attributable to the controlled overdraft authorized pursuant to amended Exhibit I to the Judgment.

(b) To the extent available credits are insufficient to fully offset the quantity of groundwater production attributable to the Desalters, Watermaster will use water or revenue obtained by levying the following assessments among the members of the Overlying (Non-Agricultural) Pool and the Appropriative Pool to meet any remaining replenishment obligation as follows.

(i) A Special OBMP Assessment against the Overlying (Non-Agricultural) Pool as more specifically authorized and described in amendment to Exhibit "G" paragraph 8(c) to the Judgment will be dedicated by Watermaster to further off-set replenishment of the Desalters. However, to the extent there is no remaining replenishment obligation attributable to the Desalters in any year after applying the off-sets set forth in 6.2(a), the OBMP Special Assessment levied by Watermaster will be distributed as provided in Section 9.2 below. The Special OBMP Assessment will be assessed pro-rata on each member's share of Safe Yield, followed by

(ii) A Replenishment Assessment against the Appropriative Pool, pro-rata based on each Producer's combined total share of Operating Safe Yield and the previous year's actual production. Desalter Production is excluded from this calculation. However, if there is a material reduction in the net cost of Desalter product water to the purchasers of product water, Watermaster may re-evaluate whether to continue the exclusion of Desalter Production but only after giving due regard to the contractual commitment of the parties.

(iii) The quantification of any Party's share of Operating Safe Yield does not include the result of any land use conversions.

(c) The rights and obligations of the parties, whatever they may be, regarding Replenishment Assessments attributable to all Desalters and Future Desalters in any renewal term of the Peace Agreement are expressly reserved and not altered by this Agreement.

## ARTICLE VII
## YIELD ACCOUNTING

7.1 New Yield Attributable to Desalters. Watermaster will make an annual finding as to the quantity of New Yield that is made available by Basin Re-Operation including that portion that is specifically attributable to the Existing and Future Desalters. Any subsequent recalculation of New Yield as Safe Yield by Watermaster will not change the priorities set forth above for offsetting Desalter production as set forth in Article VII, Section 7.5 of the Peace Agreement. For the initial term of the Peace Agreement, neither Watermaster nor the Parties will request that Safe Yield be recalculated in a manner that incorporates New Yield *attributable to the Desalters* into the determination of Safe Yield so that this source of supply will be available for Desalter Production rather than for use by individual parties to the Judgment.

7.2 Apportionment of Controlled Overdraft. Within twelve (12) months of the court approval and no later than December 1, 2008, with facilitation by Watermaster, WMWD and the Appropriative Pool will establish by mutual agreement the portion of the 400,000 acre-feet of the controlled overdraft authorized by the amendment to Exhibit "I" to the Judgment that will be allocated among the Desalters and pursuant to a proposed schedule.

(a) To the extent the groundwater wells for the Future Desalters pump at least fifty (50) percent groundwater from the southern end of the Basin as set forth in Exhibit "3" the *Future Desalters* will be entitled to first priority to the controlled overdraft authorized by the amendment to Exhibit "I" to the Judgment.

(b) WMWD and the Appropriative Pool will exercise good faith and reasonable best efforts to arrive at a fair apportionment. Relevant considerations in establishing the apportionment include, but are not limited to: (i) the nexus between the proposed expansion and achieving Hydraulic Control;(ii) the nexus between the project and obtaining increased yield; (iii) the identified capital costs; (iv) operating and maintenance expenses; and (iv) the availability of third-party funding.

(c) The parties will present any proposed agreement regarding apportionment to Watermaster. Watermaster will provide due regard to any agreement between WMWD and the Appropriative Pool and approve it so long as the proposal phases the Re-Operation over a reasonable period of time to secure the physical condition of Hydraulic Control and will achieve the identified yield benefits while at the same time avoiding Material Physical Injury or an inefficient use of basin resources.

(d) If WMWD and the Appropriative Pool do not reach agreement on apportionment of controlled overdraft to Future Desalters, then no later than August 31, 2009, the members of the Appropriative Pool will submit a plan to Watermaster that achieves the identified goals of increasing the physical capacity of the Desalters and potable water use of approximately 40,000 acre-feet of groundwater production from the Desalters from the Basin no later than 2012. The Appropriative Pool proposal must demonstrate how it has provided first priority to the Future Desalters if the conditions of paragraph 7.2(a) are met.

(e) Watermaster will have discretion to apportion the controlled overdraft under a schedule that reflects the needs of the parties and the need for economic certainty and the factors set forth in Paragraph 7.2(a) above. Watermaster may exercise its discretion to establish a schedule for Basin Re-Operation that best meets the needs of the Parties to the Judgment and the physical conditions of the Basin, including but not limited to such methods as "ramping up," "ramping down," or "straight-lining."

(i) An initial schedule will be approved by Watermaster and submitted to the Court concurrent with Watermaster Resolution 07-05.

(ii) Watermaster may approve and request Court approval of revisions to the initial schedule if Watermaster's approval and request are supported by a technical report demonstrating the continued need for access to controlled overdraft, subject to the limitations set forth in amended Exhibit "I" to the Judgment and the justification for the amendment.

7.3 Suspension. An evaluation of Watermaster's achievement of Basin outflow conditions, achievement of Hydraulic Control and compliance with Regional Board orders will be completed annually by Watermaster. Re-Operation and Watermaster's apportionment of controlled overdraft will not be suspended in the event that Hydraulic Control is secured in any year *before* the full 400,000 acre-feet has been produced so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures to avoid Material Physical Injury and that equitably distributes the cost of any mitigation attributable to the identified contingencies, and (ii) Watermaster is in substantial compliance with a Court approved Recharge Master Plan as set forth in Paragraph 8.1 below.

7.4 Storage: Uniform Losses. The Parties acknowledge that Watermaster has assessed a two (2)-percent loss on all groundwater presently held in storage to reflect the current hydrologic condition. As provided in the Peace Agreement, Watermaster will continue to maintain a minimum 2 (two) percent loss until substantial evidence exists to warrant the imposition of another loss factor. However, the Parties further acknowledge and agree that losses have been substantially reduced through the OBMP Implementation Plan and the operation of Desalters I and II and that once Hydraulic Control is achieved outflow and losses from the Basin will have been limited to de minimis quantities. Therefore, Watermaster may establish uniform losses for all water held in storage based on whether the Party has substantially contributed to Watermaster reducing losses and ultimately securing and maintaining Hydraulic Control.

(a) Pre-Implementation of the Peace Agreement. The uniform annual loss (leave behind) of six (6) percent will be applied to all storage accounts to address actual losses, management and equitable considerations arising from the implementation of the Peace Agreement, the OBMP Implementation Plan, the 2007 Supplement to the OBMP Implementation Plan, including but not limited to the Desalters and Hydraulic Control unless the Party holding the storage account: (i) has previously contributed to the implementation of the OBMP as a Party to the Judgment, is in compliance with their continuing covenants under the Peace Agreement or in lieu thereof they have paid or delivered to Watermaster "financial equivalent" consideration to offset the cost of past performance prior to the implementation of the OBMP and (ii) promised continued future compliance with Watermaster Rules and Regulations. In the event that a Party satisfies 7.4(a)(i) and7.4(a)(ii) they will be assessed a minimum loss of two (2) percent against all water held in storage to reflect actual estimated losses. Watermaster's evaluation of the sufficiency of any consideration or financial equivalency may take into account the fact that one or more Parties to the Judgment are not similarly situated.

(b) Post-Hydraulic Control. Following Watermaster's determination that it has achieved Hydraulic Control and for so long as Watermaster continues to sustain losses from the Basin to the Santa Ana River at a de minimis level (less than one (1) percent), any Party to the Judgment (agency, entity or person) may qualify for the Post-Hydraulic Control uniform loss percentage of less than 1 percent if they meet the criteria of 7.4(a)(i) and 7.4(a)(ii) above.

7.5 Allocation of Losses. Any losses from storage assessed as a Leave Behind in excess of actual losses ("dedication quantity") will be dedicated by Watermaster towards groundwater Production by the Desalters to thereby avoid a Desalter replenishment obligation that may then exist *in the year* of recovery. Any dedication quantity which is not required to offset Desalter Production in the year in which the loss is assessed, will be made available to the members of the Appropriative Pool. The dedication quantity will be pro-rated among the members of the Appropriative Pool in accordance with each Producer's combined total share of Operating Safe Yield and the previous year's actual production. However, before any member of the Appropriative Pool may receive a distribution of any dedication quantity, they must be in full compliance with the 2007 Supplement to the OBMP Implementation Plan and current in all applicable Watermaster assessments.

## ARTICLE VIII
## RECHARGE

8.1 Update to the Recharge Master Plan. Watermaster will update and obtain Court approval of its update to the Recharge Master Plan to address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and subsequently operated at a new equilibrium at the conclusion of the period of Re-Operation. The Recharge Master Plan will be jointly approved by IEUA and Watermaster and shall contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections. Specifically, the Plan will reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that following the full beneficial use of the groundwater withdrawn in accordance with the Basin Re-Operation and authorized controlled overdraft, that sufficient Replenishment capability exists to meet the reasonable projections of Desalter Replenishment obligations. With the concurrence of IEUA and Watermaster, the Recharge Master Plan will be updated and amended as frequently as necessary with Court approval and not less than every five (5) years. Costs incurred in the design, permitting, operation and maintenance of recharge improvements will be apportioned in accordance with the following principles.

a. Operations and Maintenance. All future operations and maintenance costs attributable to all recharge facilities utilized for recharge of recycled water in whole or in part unfunded from third party sources, will be paid by the Inland Empire Utilities Agency ("IEUA") and Watermaster. The contribution by IEUA will be determined annually on the basis of the relative proportion of recycled water recharged bears to the total recharge from all sources in the prior year. For example, if 35 percent of total recharge in a single year is from recycled water, then IEUA will bear 35 percent of the operations and maintenance costs. All remaining unfunded costs attributable to the facilities used by Watermaster will be paid by Watermaster.

i. IEUA reserves discretion as to how it assesses its share of costs.

ii. Watermaster will apportion its costs among the members of the stakeholders in accordance with Production, excluding Desalter Production.

iii. The operations and maintenance costs of water recharged by aquifer storage and recovery will not be considered in the calculation other than by express agreement.

b. Capital. Mutually approved capital improvements for recharge basins that do or can receive recycled water constructed pursuant to the Court approved Recharge Master Plan, if any, will be financed through the use of third party grants and contributions if available, with any unfunded balance being apportioned 50 percent each to IEUA and Watermaster. The Watermaster contribution shall be allocated according to shares of Operating Safe Yield. All remaining unfunded costs attributable to the facilities used by Watermaster will be paid by Watermaster.

8.2 Coordination. The members of the Appropriative Pool will coordinate the development of their respective Urban Water Management Plans and Water Supply Master Plans with Watermaster as follows.

(a) Each Appropriator that prepares an Urban Water Management Plan and Water Supply Plans will provide Watermaster with copies of their existing and proposed plans.

(b) Watermaster will use the Plans in evaluating the adequacy of the Recharge Master Plan and other OBMP Implementation Plan program elements.

(c) Each Appropriator will provide Watermaster with a draft in advance of adopting any proposed changes to their Urban Water Management Plans and in advance of adopting any material changes to their Water Supply Master Plans respectively in accordance with the customary notification routinely provided to other third parties to offer Watermaster a reasonable opportunity to provide informal input and informal comment on the proposed changes.

(d) Any party that experiences the loss or the imminent threatened loss of a material water supply source will provide reasonable notice to Watermaster of the condition and the expected impact, if any, on the projected groundwater use.

8.3 Continuing Covenant. To ameliorate any long-term risks attributable to reliance upon un-replenished groundwater production by the Desalters, the annual availability of any portion of the 400,000 acre-feet set aside as controlled overdraft as a component of the Physical Solution, is expressly subject to Watermaster making an annual finding about whether it is in substantial compliance with the revised Watermaster Recharge Master Plan pursuant to Paragraphs 7.3 and 8.1 above.

8.4 Acknowledgment re 6,500 Acre-Foot Supplemental Recharge. The Parties make the following acknowledgments regarding the 6,500 Acre-Foot Supplemental Recharge:

(a) A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin, Watermaster has committed to use its best efforts to direct recharge relative to production in each area and sub-area of the Basin and to achieve long-term balance between total recharge and discharge. The Parties acknowledge that to assist Watermaster in providing for recharge, the Peace Agreement sets forth a requirement for Appropriative Pool purchase of 6,500 acre-feet per year of Supplemental Water for recharge in Management Zone 1 (MZ1). The purchases have been credited as an addition to Appropriative Pool storage accounts. The water recharged under this program has not been accounted for as Replenishment water.

(b) Watermaster was required to evaluate the continuance of this requirement in 2005 by taking into account provisions of the Judgment, Peace Agreement and OBMP, among all other relevant factors. It has been determined that other obligations in the Judgment and Peace Agreement, including the requirement of hydrologic balance and projected replenishment obligations, will provide for sufficient wet-water recharge to make the separate commitment of Appropriative Pool purchase of 6,500 acre-feet unnecessary. Therefore, because the recharge target as described in the Peace Agreement has been achieved, further purchases under the program will cease and Watermaster will proceed with operations in accordance with the provisions of paragraphs (c), (d) and (e) below.

(c) The parties acknowledge that, regardless of Replenishment obligations, Watermaster will independently determine whether to require wet-water recharge within MZ1 to maintain hydrologic balance and to provide equal access to groundwater in accordance with the provisions of this Section 8.4 and in a manner consistent with the Peace Agreement, OBMP and the Long Term Plan for Subsidence.". Watermaster will conduct its recharge in a manner to provide hydrologic balance within, and will emphasize recharge in MZ1. Accordingly, the Parties acknowledge and agree that each year Watermaster shall continue to be guided in the exercise of its discretion concerning recharge by the principles of hydrologic balance.

(d) Consistent with its overall obligations to manage the Chino Basin to ensure hydrologic balance within each management zone, for the duration of the Peace Agreement (until June of 2030), Watermaster will ensure that a minimum of 6,500 acre-feet of wet water recharge occurs within MZ1 on an annual basis. However, to the extent that water is unavailable for recharge or there is no replenishment obligation in any year, the obligation to recharge 6,500 acre-feet will accrue and be satisfied in subsequent years.

(1) Watermaster will implement this measure in a coordinated manner so as to

facilitate compliance with other agreements among the parties, including but not limited to the Dry-Year Yield Agreements.

(2) In preparation of the Recharge Master Plan, Watermaster will consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to further enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master Plan.

(e) Five years from the effective date of the Peace II Measures, Watermaster will cause an evaluation of the minimum recharge quantity for MZ1. After consideration of the information developed in accordance with the studies conducted pursuant to paragraph 3 below, the observed experiences in complying with the Dry Year Yield Agreements as well as any other pertinent information, Watermaster may increase the minimum requirement for MZ1 to quantities greater than 6,500 acre-feet per year. In no circumstance will the commitment to recharge 6,500 acre-feet be reduced for the duration of the Peace Agreement.

## ARTICLE IX

9.1 Basin Management Assistance. Three Valleys Municipal Water District ("TVMWD") shall assist in the management of the Basin through a financial contribution of $300,000 to study the feasibility of developing a water supply program within Management Zone 1 of the Basin or in connection with the evaluation of Future Desalters. The study will emphasize assisting Watermaster in meeting its OBMP Implementation Plan objectives of concurrently securing Hydraulic Control through Re-Operation while attaining Management Zone 1 subsidence management goals. Further, TVMWD has expressed an interest in participating in future projects in the Basin that benefit TVMWD. If TVMWD wishes to construct or participate in such future projects, TVMWD shall negotiate with Watermaster in good faith concerning a possible "buy-in" payment.

9.2 Allocation of Non-Agricultural Pool OBMP Special Assessment

a. For a period of ten years from the effective date of the Peace II Measures, any water (or financial equivalent) that may be contributed from the Overlying (Non-Agricultural) Pool in accordance with paragraph 8(c) of Exhibit G to the Judgment (as amended) will be apportioned among the members of the Appropriative Pool in each year as follows:

| | | |
|---|---|---|
| (i) | City of Ontario. | 80 af |
| (ii) | City of Upland | 161 af |
| (iii) | Monte Vista Water District | 213 af |
| (iv) | City of Pomona | 220 af |
| (v) | Marygold Mutual Water Co | 16 af |
| (vi) | West Valley Water District | 15 af |

(vii) Santa Ana River Water Co. 31 af

b. In the eleventh year from the effective date of the Peace II Measures and in each year thereafter in which water may be available from the Overlying (Non-Agricultural) Pool in excess of identified Desalter replenishment obligations as determined in accordance with Section 6.2 above, any excess water (or financial equivalent) will be distributed pro rata among the members of the Appropriative Pool based upon each Producer's combined total share of Operating Safe Yield and the previous year's actual production.

## ARTICLE X
## SETTLEMENT AND RELEASE

10.1 Settlement. By its execution of this Agreement, the Parties mutually and irrevocably, fully settle their respective claims, rights and obligations, whatever they may be, regarding the design, funding, construction and operation of Future Desalters as set forth in and arising from Article VII of the Peace Agreement.

10.2 Satisfaction of Peace Agreement Obligation Regarding Future Desalters. The Parties' individual and collective responsibilities arising from the Part VII of the Peace Agreement and the OBMP Implementation Plan regarding the planning, design, permitting, construction and operation of Future Desalters, whatever they may be, are unaffected by this Agreement. However, upon the completion of a 10,000 AFY (9 mgd) expansion of groundwater production and desalting from Desalter II as provided for herein, the Parties will be deemed to have satisfied all individual and collective pre-existing obligations arising from the Peace Agreement and the OBMP Implementation Plan, whatever they may be, with regard to Future Desalters as described in Part VII of the Peace Agreement and the OBMP Implementation Plan.

10.3 Satisfaction of Pomona Credit. In recognition of the ongoing benefits received by TVMWD through the City of Pomona's anion exchange project, as its sole and exclusive responsibility, TVMWD will make an annual payment to Watermaster in an amount equal to the credit due the City of Pomona under Peace Agreement Paragraph 5.4(b) ("the Pomona Credit").

(a) Within ninety (90) days of each five-year period following the Effective Date of this Agreement, in its sole discretion TVMWD shall make an election whether to continue or terminate its responsibilities under this paragraph. TVMWD shall provide written notice of such election to Watermaster.

(b) Watermaster will provide an annual invoice to TVMWD for the amount of the Pomona Credit.

(c) Further, in any renewal term of the Peace Agreement, TVMWD will continue to make an equivalent financial contribution which TVMWD consents to

Watermaster's use for the benefit of MZ1, subject to the same conditions set forth above with respect to TVMWD's payment of the "Pomona Credit".

(d) In the event TVMWD elects to terminate is obligation under this Paragraph, the Peace Agreement and the responsibility for satisfying the Pomona Credit will remain unchanged and unaffected, other than as it will be deemed satisfied for each five-year period that TVMWD has actually made the specified payment.

10.4 Release. Upon WMWD's completion of a 10,000 AFY (9 mgd) expansion of groundwater production and desalting in a manner consistent with the parameters set forth in this Agreement, each Party, for itself, its successors, assigns, and any and all persons taking by or through it, hereby releases WMWD and IEUA from any and all obligations arising from WMWD's and IEUA's responsibility for securing funding, designing, and constructing Future Desalters as set forth in or arising exclusively from Article VII of the Peace Agreement and the Program Elements 3, 6, and 7, OBMP Implementation Plan only, and each Party knowingly and voluntarily waives all rights and benefits which are provided by the terms and provisions of section 1542 of the Civil Code of the State of California, or any comparable statute or law which may exist under the laws of the State of California, in or arising from WMWD's and IEUA's responsibility for securing funding, designing, and constructing Future Desalters as set forth in or arising exclusively from Article VII of the Peace Agreement and the OBMP Implementation Plan only. The Parties hereby acknowledge that this waiver is an essential and material term of this release. The Parties, and each of them, acknowledge that Civil Code section 1542 provides as follows:

**A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS OR HER FAVOR AT THE TIME OF EXECUTING THE RELEASE, WHICH IF KNOWN BY HIM OR HER MUST HAVE MATERIALLY AFFECTED HIS OR HER SETTLEMENT WITH THE DEBTOR.**

Each Party understands and acknowledges that the significance and consequence of this waiver of Civil Code section 1542 is the waiver of any presently unknown claims as described above, and that if any Party should eventually suffer additional damages arising out of the respective claim that Party will not be able to make any claim for those additional damages. Further, all Parties to this Agreement acknowledge that they consciously intend these consequences even as to claims for such damages that may exist as of the date of this Agreement but which are not known to exist and which, if known, would materially affect the Parties' respective decision to execute this Agreement, regardless of whether the lack of knowledge is the result of ignorance, oversight, error, negligence, or any other cause.

10.5 Assessments. In view of the substantial investments previously made and contemplated by Watermaster and the parties over the term of the Peace Agreement and in particular to implement the OBMP, the parties desire substantial certainty regarding Watermaster's principles of cost allocation. The principles set forth in the Peace Agreement and the

Peace II Measures including those stated herein, constitute a fair and reasonable allocation of responsibility among the stakeholders. Accordingly, other than in the event of an emergency condition requiring prompt action by Watermaster or to correct a manifest injustice arising from conditions not presently prevailing in the Basin and unknown to Watermaster and the parties and then only to the extent Watermaster retains discretion, Watermaster will maintain the principles of cost allocation for apportioning costs and assessments as provided in the Judgment and now implemented through the Peace Agreement and the Peace II Measures for the balance of the initial Term of the Peace Agreement. For the balance of the initial Term of the Peace Agreement, the parties to the Peace II Agreement will waive any objections to the Watermaster's principles of cost allocation other than as to issues regarding whether Watermaster has: (i) properly followed appropriate procedures; (ii) correctly computed assessments and charges; and (iii) properly reported .

10.6 Reservation of Rights. Nothing herein shall be construed as precluding any party to the Judgment from seeking judicial review of any Watermaster action on the grounds that Watermaster has failed to act in accordance with the Peace Agreement as amended, this Agreement, the Amended Judgment, the OBMP Implementation Plan as amended and applicable law.

## ARTICLE XI
## TERM

11.1 Commencement. This Agreement will become effective upon the satisfaction of all conditions precedent and shall expire on the Termination Date.

11.2 Termination. This Agreement is coterminous with the initial term of the Peace Agreement and will expire of its own terms and terminate on the date of the Initial Term of the Peace Agreement.

## ARTICLE XIII
## GENERAL PROVISIONS

12.1 Construction of this Agreement. Each Party, with the assistance of competent legal counsel, has participated in the drafting of this Agreement and any ambiguity should not be construed for or against any Party on account of such drafting.

12.2 Awareness of Contents/Legal Effect. The Parties expressly declare and represent that they have read the Agreement and that they have consulted with their respective counsel regarding the meaning of the terms and conditions contained herein. The parties further expressly declare and represent that they fully understand the content and effect of this Agreement and they approve and accept the terms and conditions contained herein, and that this Agreement is executed freely and voluntarily.

12.3 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute on Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: Party: _____

By _____

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: April 24, 2008

Party: Non-Agricultural Pool

By _____

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: 12/11/07

Party: CITY OF UPLAND

By _____
ROBB QUINCEY
CITY MANAGER

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated:

Party: TVMWD

By

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated:

Party: San Antonio Water Company

By Tom Thomas
Tom Thomas
President

Ken Willis
Secretary

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated:

Party: Cucamonga Valley Water District

By _____

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## TERM

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12.2 Awareness of Contents/Legal Effect. The Parties expressly declare and represent that they have read the Agreement and that they have consulted with their respective counsel regarding the meaning of the terms and conditions contained herein. The parties further expressly declare and represent that they fully understand the content and effect of this Agreement and they approve and accept the terms and conditions contained herein, and that this Agreement is executed freely and voluntarily.

12.3 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute on Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated:

Party: WESTERN MWD

By _____

## ARTICLE XI
## TERM

11.1 Commencement. This Agreement will become effective upon the satisfaction of all conditions precedent and shall expire on the Termination Date.

11.2 Termination. This Agreement is coterminous with the initial term of the Peace Agreement and will expire of its own terms and terminate on the date of the Initial Term of the Peace Agreement.

## ARTICLE XIII
## GENERAL PROVISIONS

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: December 7, 2007

Party: FONTANA UNION WATER COMPANY

By _____
Robert A DeLoach, President

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## TERM

11.1 Commencement. This Agreement will become effective upon the satisfaction of all conditions precedent and shall expire on the Termination Date.

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: 12/12/07

Party: West End Consolidated Water Co

By Tom R. Thomas
Tom R. Thomas

## ARTICLE XI
## TERM

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11.2 Termination. This Agreement is coterminous with the initial term of the Peace Agreement and will expire of its own terms and terminate on the date of the Initial Term of the Peace Agreement.

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IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: Dec. 19, 2007

Party: Ag Pool - Watermaster

By: Richard Gleason

October 25, 2007

## ARTICLE XI
## TERM

11.1 Commencement. This Agreement will become effective upon the satisfaction of all conditions precedent and shall expire on the Termination Date.

11.2 Termination. This Agreement is coterminous with the initial term of the Peace Agreement and will expire of its own terms and terminate on the date of the Initial Term of the Peace Agreement.

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12.3 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute on Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated:

Party: CITY OF CHINO

By

ATEST:

DATED: 2-21-08

Lenna J. Tanner, City Clerk

# Exhibit 1

September 21, 2007

**WATERMASTER RESOLUTION**
**NO. 07-05**

**RESOLUTION OF THE CHINO BASIN WATERMASTER REGARDING THE PEACE II AGREEMENT AND THE OBMP IMPLEMENTATION PLAN**

**WHEREAS,** the Judgment in the Chino Basin Adjudication, *Chino Municipal Water District v. City of Chino, et al.,* San Bernardino Superior Court No. 51010, created the Watermaster and directed it to perform the duties as provided in the Judgment or ordered or authorized by the court in the exercise of the Court's continuing jurisdiction;

**WHEREAS,** Watermaster has the express powers and duties as provided in the Judgment or as "hereafter" ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction" subject to the limitations stated elsewhere in the Judgment;

**WHEREAS,** Watermaster, with the advice of the Advisory and Pool Committees has discretionary powers to develop an OBMP for Chino Basin, pursuant to Paragraph 41 of the Judgment;

**WHEREAS,** in June of 2000, the Parties to the Judgment executed the Peace Agreement providing for the implementation of the OBMP and Watermaster adopted Resolution 00-05 whereby it agreed to act in accordance with the Peace Agreement;

**WHEREAS,** the Court ordered Watermaster to proceed in accordance with the Peace Agreement and the OBMP Implementation, Exhibit "B" thereto;

**WHEREAS,** Watermaster adopted and the Court approved Chino Basin Watermaster Rules and Regulations in June of 2001;

**WHEREAS,** the Peace Agreement, the OBMP Implementation Plan and the Chino Basin Watermaster Rules and Regulations reserved Watermaster's discretionary powers in accordance with Paragraph 41 of the Judgment, with the advice from the Advisory and Pool Committees, and contemplated further implementing actions by Watermaster;

**WHEREAS,** the Judgment requires that Watermaster in implementing the Physical Solution, and the OBMP have flexibility to consider and where appropriate make adjustments after taking into consideration technological, economic, social and institutional factors in maximizing the efficient use of the waters of the Basin.

**WHEREAS,** the Parties to the Judgment provided input into the creation of a "Stakeholder Non-Binding Term Sheet" that articulated methods to maximize beneficial use of the Basin ("Peace II measures") was distributed to and considered by each of the Pools, the Advisory Committee and the Watermaster Board and subsequently transmitted to the Court;

**WHEREAS,** Watermaster will continue to require that to the extent any of the Peace II Implementing Measures constitute "projects" within the meaning of the California Environmental Quality Act ("CEQA"), compliance with CEQA will be required as a pre-condition of Watermaster's issuance of any final, binding approvals; and

**WHEREAS,** the actions articulated in the "Stakeholder Non-Binding Term Sheet" and contemplated herein to maximize the beneficial use of the groundwater and the Basin benefit the Basin and the Parties to the Judgment.

**NOW, THEREFORE, IT IS HEREBY RESOLVED AND DETERMINED THAT:**

1. Watermaster caused the completion of a preliminary engineering, hydrogeologic, and technical evaluation of the physical impacts to the Basin and to the Parties to the Judgment that may result from implementation of the Peace II measures. The preliminary evaluation was conducted by Mark Wildermuth of Wildermuth Environmental.

2. The Assistant to the Special Referee, Joe Scalmanini of Luhdorff & Scalmanini Consulting Engineers, transmitted his technical review in March of 2007 ("Report"). In relevant part, the Report states:

> "For planning level analysis, the existing model is a useful and applicable tool to simulate approximate basin response to management actions that involve the quantities and distribution of pumping and recharge in the basin. For example, for the most notable of its applications to date, which has been to conduct a planning level analysis of intended future hydraulic control, the model can be confidently utilized to examine whether groundwater conditions (levels) will form in such a way that hydraulic control will be achieved as result of basin re-operation and, if not, what other changes in basin operation are logically needed to achieve it." (Report at p. 37)

3. Watermaster caused the preparation of a specific project description set forth in Attachment "A" hereto for the purpose of conducting a more refined engineering, hydrogeologic and technical evaluation of the physical impacts to the Basin and to the Parties to the Judgment that may result from implementation of the Peace II measures.

4. Watermaster caused the completion of a macro socioeconomic analysis by Dr. David Sunding, a PhD in economics and professor at the University of California Berkeley set forth in Attachment "B" hereto. The macro analysis provided an evaluation of the macro costs and benefits to the parties as a whole that may be attributable to the Peace II measures.

5. Watermaster caused an update of the previously completed socioeconomic analysis conducted pursuant to the Judgment. The analysis was completed by Dr. Sunding, and it considered the positive and negative impacts of implementing the OBMP, the Peace Agreement, and the Peace II measures, including Watermaster assessments. The analysis also addressed the potential distribution of costs and benefits among the parties that were initiated

with the approval of the Peace Agreement. The study was completed in final draft form on September 13, 2007 and is set forth in Attachment "C" hereto. Each of the Parties to the Judgment has had the opportunity to comment on earlier drafts of the report and on the final draft of the report and to consider the analyses contained therein prior to Watermaster's approval of this Resolution 07-05.

9. Watermaster has caused the preparation of the 2007 Supplement to the Optimum Basin Management Program ("OBMP") addressing Watermaster's efforts to, among other things; pursue Hydraulic Control through Basin Re-Operation as set forth in Attachment "D" hereto.

10. Watermaster has prepared a summary of the cumulative total of groundwater production and desalting from all authorized Desalters and other activities authorized by the 2007 Supplement to the OBMP Implementation Plan as amended as provided in the Peace Agreement in a schedule that: (i) identifies the total quantity of groundwater that will be produced through the proposed Basin Re-Operation to obtain Hydraulic Control, and (ii) characterizes and accounts for all water that is projected to be produced by the Desalters for the initial Term of the Peace Agreement (by 2030) as dedicated water, New Yield, controlled overdraft pursuant to the Physical Solution or subject to Replenishment . This schedule is set forth in Attachment "E" hereto. Watermaster will modify its projections from time to time, as may be prudent under the circumstances.

11. More than fifteen months have passed since the Non-Binding Term Sheet was initially published by Watermaster in its current form and transmitted to the Court for its consideration and more than six months have passed following Watermaster's declaration that any party interested in participating in the development and construction of Future Desalters should identify their interest in making a proposal and no party has stepped forward and made a responsive proposal in lieu of the Western Municipal Water District proposal.

12. The Peace II measures collectively consist of:

(a) Watermaster's election to exercise its reserved discretion as provided in the Judgment, the Peace Agreement and the OBMP Implementation Plan, to amend the Watermaster Rules and Regulations as more fully set forth in Attachment "F" attached hereto and incorporated herein by this reference;

(b) Watermaster's execution and Court approval of the proposed Purchase and Sale Agreement with the Non-Agricultural (Overlying) Pool as more fully set forth in Attachment "G" attached hereto and incorporated herein by this reference;

(c) Watermaster's and the Court's approval of the proposed amendments to the Judgment as more fully set forth in Attachment "H", Attachment "I" and Attachment "J" attached hereto and incorporated herein by this reference;

(d) Watermaster's approval of and further agreement to act in accordance with the Peace II Agreement, including the provisions related to Future Desalters, as more fully set forth in Attachment "K" attached hereto, upon a further order of the

Court directing Watermaster to proceed in accordance with its terms;

(e) Watermaster's and the Court's approval of the 2007 Supplement to the OBMP Implementation Plan as they are more fully set forth in Attachment "D" attached hereto and incorporated herein by this reference; and

(f) Execution of the proposed Second Amendment to the Peace Agreement as more fully set forth in Attachment "L" attached hereto and incorporated herein by this reference, approval by Watermaster and a further order of the Court directing Watermaster to proceed in accordance with its terms.

13. The Overlying (Non-Agricultural), the Overlying (Agricultural) Pool, and the Appropriative Pool have approved the Peace II measures and recommended Watermaster's adoption of this Resolution 07-05

14. The Advisory Committee has approved the Peace II measures and recommended Watermaster's adoption of this Resolution 07-05.

15. In adopting this Resolution and by its agreement to implement the Peace II measures, Watermaster is not committing to carry out any project within the meaning of CEQA unless and until CEQA compliance has been demonstrated for any such project.

16. The Watermaster Board will transmit this Resolution 07-05, and the Peace II implementing measures, and the referenced Attachments to the Court along with other supporting materials and request the Court to approve the proposed Judgment Amendments and to further order that Watermaster proceed to further implement the 2007 Supplement to the OBMP as provided in the Peace II measures.

Date: 10-25-07

for CHINO BASIN WATERMASTER

# Attachment A

September 21, 2007

**Attachment "A"**
**Project Description**
**for the**
**2007 Amendment to the Chino Basin**
**Optimum Basin Management Program**

## Introduction

This document contains the project description for the Chino Basin desalting and re-operation programs that has been distilled from various planning investigations and was described in the Stakeholder Non-Binding Term Sheet. This document was prepared for use in: (a) Chino Basin Watermaster's evaluation of the potential actions to cause Material Physical Injury to the Basin or the Parties to the Judgment; (b) in connection with Watermaster's request for Court review and approval of proposed actions in further implementation of the Optimum Basin Management Program ("OBMP"); and (c) an environmental impact report to be prepared as part of the expansion of the desalters.

## Requirements of the 2004 Amendment to the Water Quality Control Plan for the Santa Ana Watershed

Water quality objectives are established by the Regional Water Quality Control Board, Santa Ana Region ("Regional Board") to preserve the beneficial uses of the Chino Basin and the Orange County Basin located downstream of the Chino Basin. Prior to the 2004 Amendment, the Regional Water Quality Control Plan (Basin Plan) contained restrictions on the use of recycled water within the Chino Basin for irrigation and groundwater recharge. The pre-2004 Basin Plan contained TDS "anti-degradation" objectives that ranged from 220 to 330 mg/L over most of the Chino Basin. Ambient TDS concentrations slightly exceeded these objectives. There was no assimilative capacity for TDS; thus, the use of the Inland Empire Utilities Agency's ("IEUA") recycled water for irrigation and groundwater recharge would have required mitigation even though the impact of this reuse would not have materially impacted future TDS concentrations or impaired the beneficial uses of Chino Basin groundwater.

In 1995, the Regional Board initiated a collaborative study with 22 water supply and wastewater agencies, including Watermaster and the IEUA, to devise a new TDS and nitrogen (total inorganic nitrogen or TIN) control strategy for the Santa Ana Watershed. This study culminated in the Regional Board's adoption of the 2004 Basin Plan Amendment in January 2004 (Santa Ana Regional Water Quality Control Board, 2004). The 2004 Basin Plan Amendment included two sets of TDS objectives – antidegradation objectives that ranged between 280, 250 and 260 mg/L for Management Zones 1, 2, and 3, respectively; and a "maximum benefit"-based TDS objective of 420 mg/L for the Chino North Management Zone, which consists of almost all of Management Zones 1, 2, and 3. The relationship of the Management Zones that were developed for the OBMP and the "maximum benefit" based management zones is shown in Figure 1. Under the "maximum benefit"-based objective, the new TDS concentration limit for recycled water

that is to be used for recharge and other direct uses is 550 mg/L as a 12-month average. This discharge requirement has been incorporated into the IEUA's National Pollutant Discharge Elimination System (NPDES) permits for its wastewater treatment facilities.

In order for the IEUA and Watermaster to gain access to the assimilative capacity afforded by the "maximum benefit"-based objectives, the IEUA and Watermaster have to demonstrate that the maximum beneficial use of the waters of the State is being achieved. The 2004 Basin Plan Amendment contains a series of commitments that must be met in order to demonstrate that the maximum benefit is being achieved. These commitments include:

1. The implementation of a surface water monitoring program;
2. The implementation of groundwater monitoring programs;
3. The expansion of Desalter I to 10 million gallons per day (mgd) and the construction of a 10-mgd Desalter II
4. The commitment to future desalters pursuant to the OBMP and the Peace Agreement;
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program;
6. The management of recycled water quality;
7. The management of the volume-weighted TDS and nitrogen in artificial recharge to less than or equal to the maximum benefit objectives;
8. The achievement and maintenance of hydraulic control of subsurface outflows from the Chino Basin to protect the Santa Ana River water quality; and
9. The determination of the ambient TDS and nitrogen concentrations in the Chino Basin every three years.

The IEUA and Watermaster have previously demonstrated compliance with all of these requirements with the sole exception of hydraulic control. Hydraulic control is defined as the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. Hydraulic control ensures that the water management activities in the Chino North Management Zone do not result in material adverse impacts on the beneficial uses of the Santa Ana River downstream of Prado Dam. Achieving hydraulic control also maximizes the safe yield of the Chino Basin as required by Paragraph 30 and 41 of the Judgment. Two reports by Wildermuth Environmental, Inc. ("WEI"), prepared in 2006 at the direction of Watermaster, demonstrate that hydraulic control has not yet been achieved in the area between the Chino Hills and Chino Desalter I, well number 5 (WEI, 2006a and b).

Without hydraulic control, the IEUA and Watermaster will have to cease the use of recycled water in the Chino Basin and will have to mitigate the effects of using recycled water back to the adoption of the 2004 Basin Plan Amendment, which is December 2004. The demand for recycled water in the Chino Basin is projected to reach from about 12,500 acre-ft/yr in 2005 to 58,000 acre-ft/yr in 2010, 68,000 acre-ft/yr in 2015, 79,000 acre-ft/yr in 2020 and 89,000 acre-ft/yr in 2025. Recycled water reduces the demand of

State Water Project ("SWP") water by an equal amount, thereby reducing the demand on the Sacramento Delta and reducing energy consumption. Recycled water is a critical element of the OBMP and water supply reliability in the Chino Basin area.

Failure to achieve hydraulic control could lead to restrictions from the Regional Board on the use of imported SWP water for replenishment when the TDS concentration in SWP water exceeds the antidegradation objectives. The Regional Board produced a draft order that would treat the recharge of SWP water as a waste discharge. There would be no assimilative capacity if the Chino Basin antidegradation objectives were in force. Figure 2 shows the percent of time that the TDS concentration at Devil Canyon is less than or equal to a specific value based on observed TDS concentrations at the Devil Canyon Afterbay. This restriction will occur about 35, 52, and 50 percent of the time for Management Zones 1, 2, and 3, respectively. This will affect other basins in the Santa Ana Watershed, and the Regional Board is encouraging all basin managers to propose "maximum benefit"-based objectives similar to those in Chino Basin. With the "maximum benefit"-based TDS objective in the Chino Basin, there is assimilative capacity, and there would be no such restriction on the recharge of imported water.

The Regional Board is using its discretion in granting "maximum benefit" objectives even though hydraulic control has not been demonstrated. The Regional Board will continue to use "maximum benefit"-based objectives in the Chino Basin as long as the IEUA and Watermaster continue to develop and implement, in a timely manner, the OBMP desalter program as described in the project description below.

**The Stakeholder Non-Binding Term Sheet: Peace II Implementing Measures**

Under Watermaster oversight, the Chino Basin OBMP stakeholders have been engaged in, among other things, complying with the Peace Agreement provision regarding the planning and financing of the expansion of the OBMP desalting program to its full planned capacity generally referred to as Future Desalters (See Peace Agreement Article VII.). The stakeholders have been evaluating various alternatives since early 2004 and produced the Stakeholders' Non-Binding Term Sheet that was transmitted to the Court along with a request by Watermaster for further technical review by the Assistant to the Special Referee in May of 2006. The Assistant's review was completed in March of 2007.

The Non-Binding Term Sheet includes several items that will collectively further implement the existing OBMP Implementation Plan (Peace II Measures). The two items of interest to this project description are: the expansion of the desalting program and "Basin Re-Operation," which are both physically described in Section II, Refined Basin Management Strategy, subsections A and B; and Section IV, Future Desalters.

The construction of a new desalter well field will be sized and located to achieve hydraulic control. The desalter will produce at least 9 mgd of product water. New groundwater production for the expanded desalter program will occur in the Southern end of the basin. Some of this new desalter supply will come from a new well field that will

be constructed in a location among Desalter I wells 1 through 4 and west of these wells. These wells will be constructed to pump groundwater from the shallow part of the aquifer system, which is defined herein to be the saturated zone that occurs within about 300 feet of the ground surface. The total groundwater pumping for all of the desalters authorized in the term sheet will be about 40,000 acre-ft/yr.

"Re-operation" means the increase in controlled overdraft, as defined in the Judgment, from 200,000 acre-ft over the period of 1978 through 2017 to 600,000 acre-ft through 2030 with the 400,000 acre-ft increase allocated specifically to the meet the replenishment obligation of the desalters. Re-operation is required to achieve hydraulic control. Re-Operation and Watermaster's apportionment of controlled overdraft will not be suspended in the event Hydraulic Control is secured in any year *before* the full 400,000 acre-feet has been produced so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures to avoid Material Physical Injury and that equitably addresses this contingency, and (ii) Watermaster continues to demonstrate credible material progress toward obtaining sufficient capacity to recharge sufficient quantities of water to cause the Basin to return to a new equilibrium at the conclusion of the Re-Operation period. In addition to contributing to the achievement of hydraulic control, Re-operation will contribute to the creation of new yield. Watermaster has the discretion to apportion the 400,000 acre-feet increase in controlled overdraft under a schedule for re-operation that best meets the needs of the Parties and the conditions of the basin over the Initial Term of the Peace Agreement (before June 30, 2030).

**The Project Description**

The proposed project has two main features: the expansion of the desalter program such that the groundwater pumping for the desalters will reach about 40,000 acre-ft and that the pumping will occur in amounts and at locations that contribute to the achievement of hydraulic control; and the strategic reduction in groundwater storage (re-operation) that, along with the expanded desalter program, significantly achieves hydraulic control.

**The Expanded Desalting Program.** A new well field, referred to as the Chino Creek Well Field (CCWF), will be constructed. The capacity of this well field could range from about 5,000 acre-ft/yr to 7,700 acre-ft/yr. The capacity of the CCWF will be determined during the design of the well field. Groundwater produced at the CCWF will be conveyed to Desalter I. The approximate location of the CCWF is shown in Figure 3. The capacity of Desalter I will not be increased; although, it is likely that the treatment systems at Desalter I will be modified to accommodate the chemistry of the raw water pumped from the CCWF. The product water capacity of Desalter I is about 14,200 acre-ft/yr which corresponds to a raw water pumping requirement of about 16,100 acre-ft/yr. The volume of groundwater pumping at existing Desalter I wells 13, 14, and 15 and conveyed to Desalter I will be reduced to accommodate new pumping at the CCWF.

The treatment capacity of Desalter II will be increased from 10,400 acre-ft/yr to about 21,000 acre-ft/yr, which corresponds to the raw water pumping requirement of 11,800

acre-ft/yr expanding to 23,900 acre-ft/yr. The increase in groundwater pumping for Desalter II will come in part from greater utilization of the existing Desalter II wells and the addition of new wells to the Desalter II well field from either the construction of new wells and/or connecting Desalter I wells 13, 14, and 15.

The new product water developed at Desalter II would be conveyed to the Jurupa Community Services District ("JCSD"), the City of Ontario, and/or Western Municipal Water District ("WMWD") through existing and new pipelines. The facilities required to convey this water include pipelines, pump stations, and reservoirs. The precise locations of these facilities are unknown at this time.

The most current working description of these facilities is contained a report that was prepared for the City of Ontario and WMWD, entitled Chino Desalter Phase 3 Alternatives Evaluation (Carollo, 2007). Currently (September 2007), the City of Ontario and the WMWD are working with the JCSD and others to refine the alternatives in the Carollo report. The assumed startup for the expanded desalters is January 2013.

Finally, 40,000 acre-ft/yr of groundwater is expected to be produced by all Existing and Future Desalters. The parties that are engaged in developing the desalter expansion are planning for a total of 40,000 acre-ft/yr of desalter groundwater pumping. Watermaster, on behalf of the Parties, will review the desalter pumping requirements to achieve hydraulic control during the project evaluation in the summer and fall of 2007.

**Re-Operation.** Through re-operation and pursuant to a Judgment Amendment, Watermaster will engage in controlled overdraft and use up to a maximum of 400,000 acre-ft to off-set Desalter replenishment through 2030. After the 400,000 acre-ft is exhausted and the period of Re-Operation is complete, Watermaster will recalculate the safe yield of the basin. The Re-Operation will have no impact on Operating Safe Yield or on the parties' respective rights thereto. For project evaluation purposes, the Re-Operation and controlled overdraft of 400,000 will be examined under two different schedules that bracket the range in expected schedules. The first schedule will be based on allocating the 400,000 acre-ft at a constant percentage of desalter pumping such that the 400,000 acre-ft is used up in a constant proportion of the desalter pumping through 2030. The second schedule will use the controlled overdraft to off-set desalter the applicable replenishment obligation completely each year until the 400,000 acre-ft is completely exhausted.

The New Yield as defined by the Peace Agreement, attributable to the authorized desalters and the reduction in storage from re-operation, will be assigned to the authorized desalters. The resulting replenishment obligation assigned to the authorized desalters will then be handled as any other replenishment obligation pursuant to the Judgment. The New Yield is expected to come from a reduction in groundwater discharge from the Chino Basin to the Santa Ana River within the reservoir created by Prado Dam and from new induced recharge of the Santa Ana River upstream of Prado Dam.

## Other Important Facility and Operational Plans that Will Occur Concurrently with the Proposed Project

**Expansion of Artificial Recharge Capacity.** Watermaster and the IEUA will need to expand artificial recharge capacity in the Chino Basin to meet future replenishment obligations. This will occur independently from the proposed project. Current supplemental water recharge capacity is about 91,000 acre-ft/yr. The required recharge capacity to meet future replenishment obligations is about 150,000 acre-ft, a capacity expansion of about 59,000 acre-ft/yr. This expansion will occur through construction of new spreading basins, improvements to existing spreading basins and stormwater retention facilities, aquifer storage and recovery wells. The proposed project will be analyzed without recharge expansion projects.

**Expansion of Storage and Recovery Programs.** Currently, there is only one groundwater storage program approved in the Chino Basin: the 100,000 acre-ft Dry Year Yield Program with the Metropolitan Water District of Southern California (Metropolitan). Metropolitan, the IEUA, and Watermaster are considering expanding this program an additional 50,000 acre-ft to 150,000 acre-ft over the next few years. Watermaster is also considering an additional 150,000 acre-ft in programs with non-party water agencies. The total volume of groundwater storage allocated to storage programs that could overlay the proposed project is about 300,000 acre-ft.

These storage programs, if not sensitive to the needs of hydraulic control, could cause groundwater discharge to the Santa Ana River and result in non-compliance with hydraulic control and a loss in safe yield. There have been no planning investigations that articulate how the expansion from the existing 100,000 acre-ft program to the future 300,000 acre-ft set of programs will occur and thus this expansion is not included herein

## References

Santa Ana Regional Water Quality Control Board, 2004, Resolution No R8-2004-0001, http://www.waterboards.ca.gov/santaana/pdf/04-01.pdf

Stakeholder Non-Binding Term Sheet, in the form transmitted to the Court, 2006

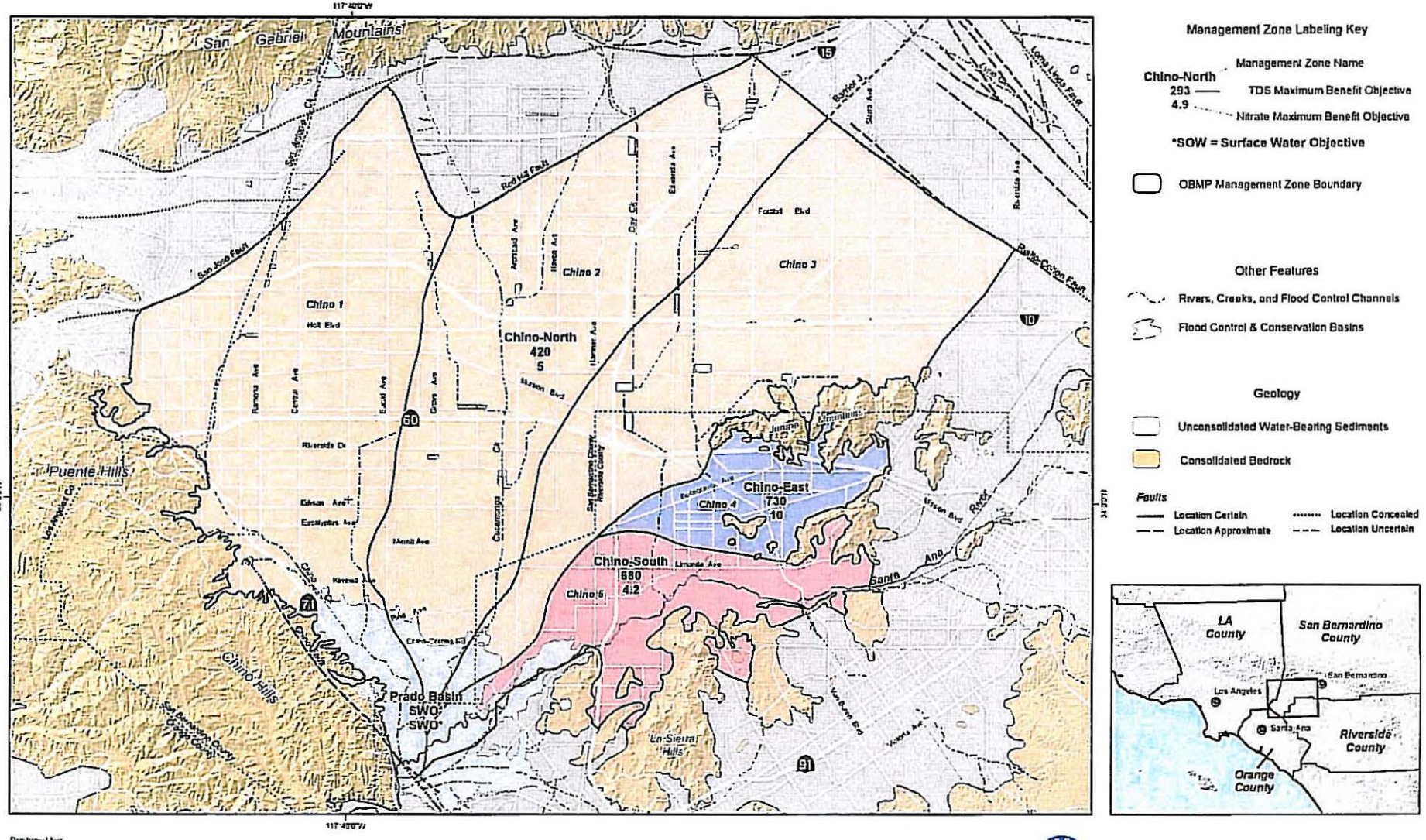
Wildermuth Environmental, Inc., 2006a. Draft Report, Analysis of Future Replenishment and Desalter Plans Pursuant to the Peace Agreement and Peace II Process, April 2006; prepared for the Chino Basin Watermaster.

Wildermuth Environmental, Inc., 2006b. Chino Basin Maximum Benefit Monitoring Program Annual Report, April 2006; prepared for the Chino Basin Watermaster and Inland Empire Utilities Agency.

Wildermuth Environmental, Inc., 2006c. Draft Report, Addendum to the Draft April 2006 Report, Analysis of Future Replenishment and Desalter Plans Pursuant to the Peace

Agreement and Peace II Process, December 2006; prepared for the Chino Basin Watermaster.

Carollo Engineers, 2007. Chino Desalter Phase 3 Alternatives Evaluation, May 2007; Prepared for the City of Ontario and the Western Municipal Water District.



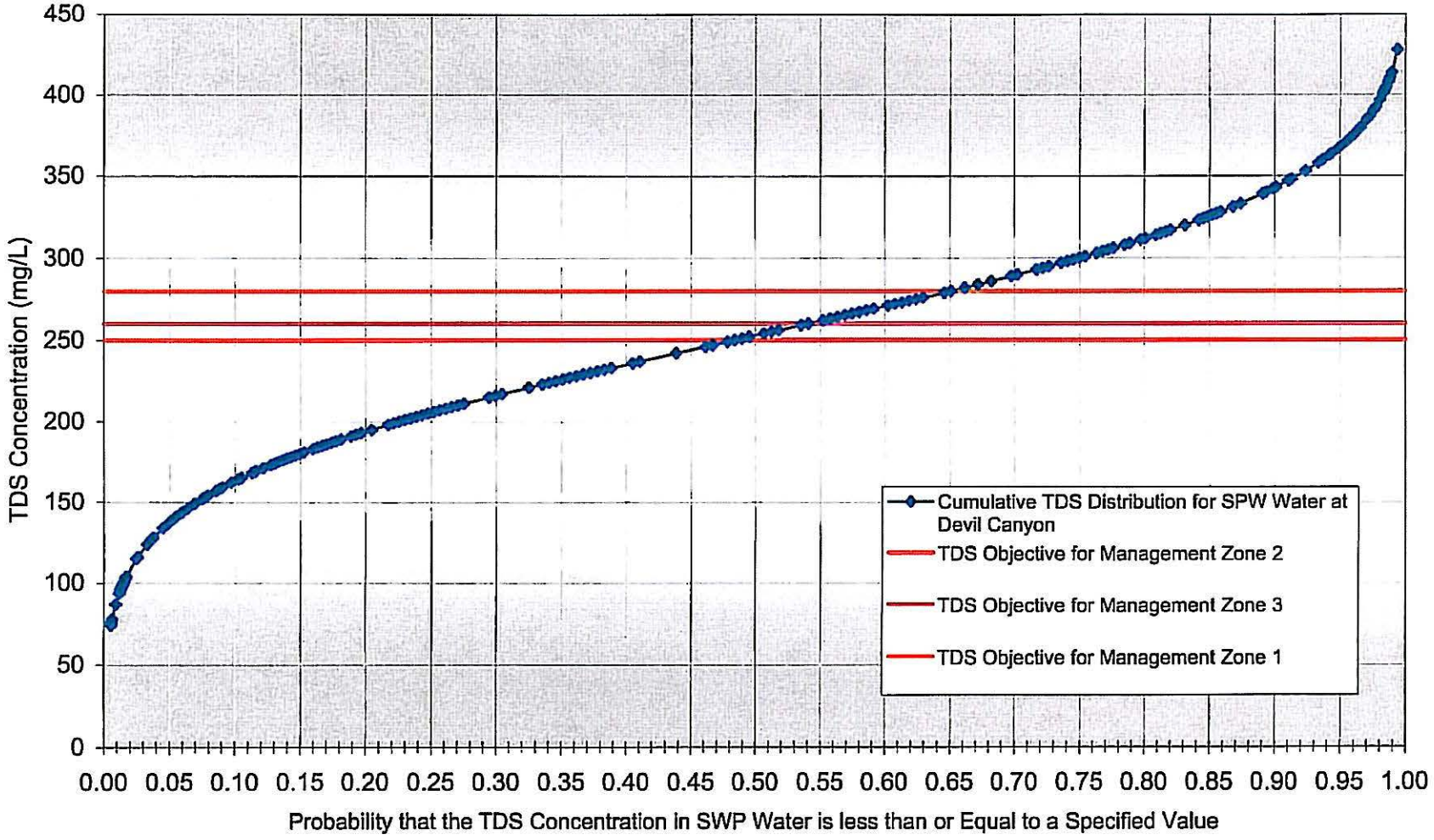

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Author: AEM
Date: 20070705
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Chino Basin Optimum Basin Management Program
*Peace II Amendment (2007)*

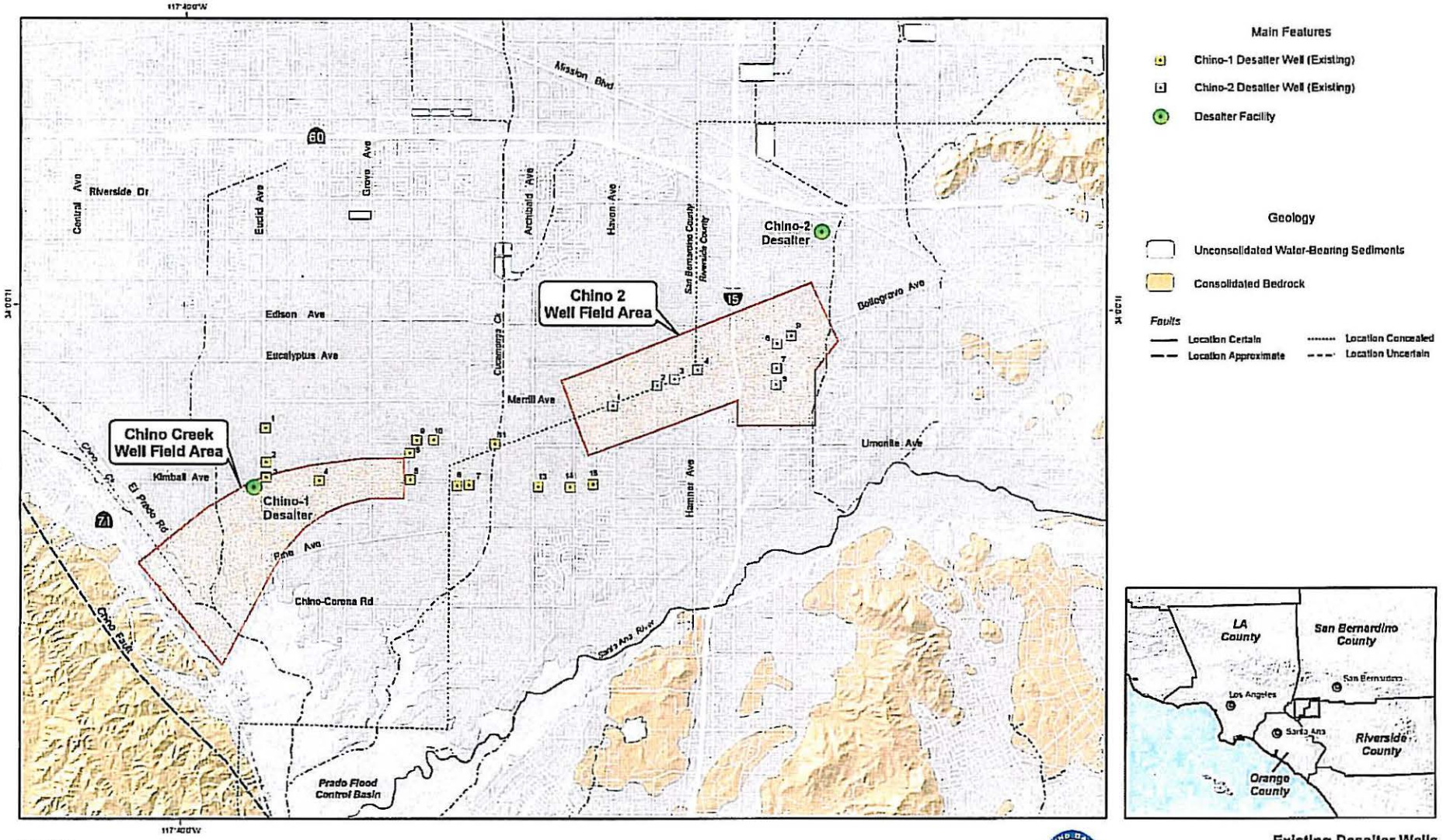
**Comparison of OBMP Management Zones and RWQCB Basin Plan Management Zones**

**Figure 1**

**Figure 2**
**Historical TDS Concentration in State Water Project Water at Devil Canyon**




20070701Figure 2 Devils_TDS.xls – Figure 2 Project Description




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Chino Basin Optimum Basin Management Program
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**Existing Desalter Wells, Proposed Chino Creek Well Field, and Chino 2 Expansion Well Field**

**Figure 3**

# Attachment B

# Analysis of Aggregate Costs and Benefits of Hydraulic Control, Basin Re-Operation and Desalter Elements of Non-Binding Term Sheet

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November 29, 2006

**Summary**

The report measures the economic costs and benefits of achieving hydraulic control through re-operation of the Chino Basin. Various scenarios are considered in the analysis, with scenarios chosen to reflect uncertainty regarding future values of water, the time path of annual overdrafts selected to dewater the basin, and the use of the resulting induced inflow from the Santa Ana River. As shown in Table 1, depending on the scenario chosen, the net benefits of achieving hydraulic control through basin re-operation range between $283.1 million and $438.8 million in 2006 dollars.

## 1. Introduction

Hydraulic control refers to the elimination or reduction to negligible quantities of discharge from the Chino North Management Zone to the Santa Ana River. Basin re-operation is defined as the increase in controlled overdraft as defined in the Judgment from 200,000 acre-feet over the period 1978 through 2017, to 600,000 acre-feet through 2030 with the 400,000 acre-feet allocated specifically to meet the replenishment obligation of the desalters.

## 2. Framework

The model of groundwater value used in this report is standard in the academic literature.[1] The net benefits in each period resulting from access to a groundwater resource are the gains from pumping (i.e., the demand for water) minus the costs of extraction in the current period and a "user cost" term that reflects the change in future consumption possibilities resulting from current choices. The stream of annual net benefits is then discounted back to current dollars using a discount factor predicated on the rate of interest.

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[1] Brozovic, N., D. Sunding and D. Zilberman, "Optimal Management of Groundwater Over Space and Time." *Frontiers in Water Resource Economics*. D. Berga and R. Goetz, eds. New York: Springer-Verlag, 2005; Gisser, M., and Sanchez, D.A. "Competition versus Optimal Control in Groundwater Pumping." *Water Resources Research* (1980): 638-642; Brown, G., Jr., and Deacon, R. "Economic Optimization of a Single-Cell Aquifer." *Water Resources Research* (1975): 557-564.

The interest rate used in the analysis is 5.5%. This rate corresponds to the current risk-free long-term rate of interest, a relevant rate for public agencies with good credit. The discount factor for a payment occurring in some future period $t$ is then $(1.055)^{-t} \approx e^{-0.055t}$.

Let $y_t$ denote groundwater produced during period $t$, and $x_t$ equal the stock of groundwater at beginning of period $t$. The value of the groundwater resource is then

$$Value = \sum_{t=0}^{\infty} (1+r)^{-t} \left[ B(y_t) - C(x_t, y_t) \right],$$

where $B(y_t)$ denotes the benefits from groundwater production in period t, and $C(x_t, y_t)$ is the cost of extraction and recharge. In an economic optimization model, the problem is to find the time path of production and stock that maximizes the present value of access to the aquifer, subject to physical constraints such as the equation of motion $x_{t+1} = x_t + g(x_t, y_t) - y_t$ (where $g(x_t, y_t)$ denotes natural and artificial recharge) and regulatory constraints such as water quality objectives and requirements to operate the basin in a steady-state condition.

Viewed this way, basin re-operation and its alternatives can be modeled as different evolutions of production, stock and recharge. The net benefit of a particular basin re-operation strategy versus a baseline that maintains the current stock of groundwater is the difference of present value resulting from a particular choice of these policy variables.

The study period extends indefinitely into the future, but the period between the present and 2030 is modeled in more detail. This feature results from the fact that the Peace Agreement lasts until 2030, and more detailed environmental and water use modeling is available to this date. As described below, terminal values are assigned to key parameters from 2031 on, and at this point the groundwater system in the Chino Basin is assumed to enter into a steady state, with no expected change in production, groundwater elevation or recharge amounts.

Table 2 displays the assumptions made about groundwater production from the Chino Basin. All figures in the table are common to all scenarios considered, and thus these assumptions are not the basis for differences in value between scenarios. The table shows groundwater production increasing steadily throughout the study period. Desalter production is also increasing throughout the study period. Operating yield is set at 145,000 acre-feet through 2017, at which point it declines to 140,000 acre-feet annually. Finally, new stormwater recharge is assumed to be 12,000 acre-feet annually.

It is necessary to describe a scenario without basin re-operation in order to calculate the net benefits, if any, from this type of strategy. Table 3 displays the physical consequences of such an alternative. If the basin is not de-watered, then hydraulic control will not be achieved, and there will be water quality costs as a result. One such consequence is that relatively high-quality water must be used for recharge. In particular, the Basin would lose the ability to use relatively inexpensive recycled water for replenishment purposes

and would be forced to use water purchased from MWD instead.[2] Thus, Table 3 shows that the entire replenishment obligation for both normal and desalter production is met through the purchase of replenishment water from MWD.

In the event that hydraulic control is achieved, there are two types of benefits to the Chino Basin as a whole. The first benefit relates to water quality. As discussed above, if hydraulic control is achieved, then recycled water can be used for 30% of the total Basin replenishment obligation, up to an assumed capacity of 30,000 acre-feet annually.[3] The second benefit is that lowering the groundwater elevation in the Basin induces an inflow of water from the Santa Ana River. Specifically, forgiving a reduction in the stock of groundwater in the Basin results in an average of 9,900 acre-feet annually until the 400,000 acre-feet of depletion credits are exhausted, and then 12,500 acre-feet annually thereafter. This natural recharge is new yield in the Basin; as discussed below, it can be used either for reducing the desalter replenishment obligation or as an asset in its own right.

## 3. Scenarios

The valuation model is implemented under a variety of assumptions about how re-operation will occur, how the Santa Ana River inflows are treated, and the level of future water prices. This section describes the construction of alternative scenarios.

*Implementation of Basin Re-Operation*

The basic principle of basin re-operation is that it is a means of achieving hydraulic control by increasing cumulative overdraft by 400,000 acre-feet through 2030. Overdraft is to be achieved by forgiving the replenishment obligation of the desalters by some annual amount over a defined period of time. This general principle is silent about *how* the total quantity of forgiveness of desalter replenishment is to be allocated over time.

This analysis considers two possible implementation scenarios. The first scenario, termed the straightline alternative, envisions an annual overdraft of 20,346 acre-feet occurring until 2030, at which time the annual overdraft would fall to zero and the system is assumed to enter into a new steady-state from 2031 onward. The second scenario, called the most rapid depletion path alternative, sets the annual overdraft to eliminate the desalter replenishment obligation for as long as possible.

Tables 4 and 7 display annual overdraft amounts under these two alternatives for implementing basin re-operation. As described, the straightline alternative entails constant annual overdraft quantities, resetting to zero from 2031 onwards. The most rapid

[2] Alternatively, recycled water would have to be desalted prior to recharge. Costs are not available at this time for this option.

[3] Assumptions provided by Watermaster staff. If hydraulic control is achieved, it may be possible to increase this limit. In this case, the benefits resulting from basin re-operation would increase.

depletion path reaches a maximum annual overdraft of 30,289 acre-feet before dropping to zero in 2020.

*Allocation of Induced Santa Ana River Inflow*

A second dimension along which the scenarios vary is with regard to the allocation of Santa Ana River inflows induced by the reduction of the groundwater stock. A total of 12,500 acre-feet of new yield is assumed to result from the dewatering, and the scenarios differ in terms of the use of this new yield. One scenario allocates all Santa Ana River inflows from re-operation to reducing the desalter replenishment obligation. An alternative scenario treats these inflows as a resource to be used for any purpose; consequently, desalter replenishment obligations are higher under this assumption.

Tables 5 and 6 relate to the straightline depletion case and show replenishment obligations and sources under the two Santa Ana River inflow allocation alternatives. In Table 5, new yield is allocated to desalter replenishment, and the desalter replenishment obligation is negligible in the near term and reaches a maximum of 9,943 acre-feet during the study period. In Table 6, by contrast, total replenishment obligations are higher since the new yield can be used for any chosen purpose.

Tables 8 and 9 show replenishment obligations under the most rapid depletion path scenario. Results are similar as in the straightline depletion scenario, with the exception that desalter replenishment is forestalled until 2025 if new yield is allocated to this purpose.

*Future Water Prices*

Given the important role of relative prices in the economic analysis, and given uncertainties regarding the evolution of water values in Southern California, the analysis considers two alternative scenarios regarding future water prices. These scenarios are taken from MWD and are commonly referred to as the high rate and low rate scenarios. MWD scenarios cover Tier 1 and Tier 2 water, as well as replenishment water. The high rate scenario has the Tier 2 rate growing at an annual rate of 3.11% for the next five years, and then by 4.50% from 2011 to 2030. The replenishment rate grows at 6.94% through 2011, and then at 4.50% to 2030. In the low rate scenario, the Tier 2 rate grows by 2.28% annually for the next five years, and then by 3.00% from 2011 to 2030. The replenishment rate is assumed to grow by 4.79% through 2011, and by 3.00% thereafter.

The current price of recycled water for replenishment is assumed to be $69 per acre-foot.[4] In the high rate scenario, this price was assumed to grow at the same rate of inflation as

[4] One public comment received after the July 26, 2006 presentation stated that the actual price paid for recycled water should be used in the analysis. While this price is not yet known, it is likely to exceed $69 per acre-foot. Note, however, that this study considers the aggregate costs and benefits of elements of the non-binding term sheet. Thus, changes in the price of recycled water have distributional as opposed to efficiency effects, that is, they change the relative level of benefits enjoyed by the parties in the Chino Basin rather than affecting the total level of benefits.

the Tier 2 and MWD replenishment prices: 4.50%. Similarly, the recycled water price grows by 3.00% annually in the low rate scenario.

**4. Other Effects of Basin Re-Operation**

An additional benefit of hydraulic control is a reduction in storage losses. Measuring the value of reduced storage losses is conditioned on several factors that are not fully known at present. Of course, the ex post performance of any groundwater storage program depends on the sequence of puts and takes, which depend in turn on the sequence of wet and dry years. Based on conversations with Watermaster staff, the groundwater storage program is assumed to be 400,000 acre-feet over the study period, but may range from 300,000 to 500,000 acre-feet.[5] Calculations provided by Wildermuth Environmental detail the relationship between average storage over the life of the MWD Dry Year Yield program and associated losses at 0.66 and 2 percent. Table 12 summarizes cumulative losses through 2028, together with present values calculated using the high and low rate scenarios for MWD replenishment rates as described above.

Assuming 2 percent loss and a 400,000 acre-foot storage program, the present value of reduced storage losses is $24.9 million in 2006 dollars in the high rate scenario and $20.4 million in the low rate scenario. These calculations are performed ex ante, and the actual magnitude of reduced storage losses will depend on factors including the size of the storage program, the percentage storage loss, the timing of puts and takes, and the actual replenishment rates charged by MWD. For the purpose of aggregating reduced storage loss benefits with other benefits and costs of basin re-operation, we will assume a 400,000 acre-foot storage program for both the high and low rate scenarios with storage losses equal to half of the amounts in Table 12 (recall that storage losses could range from 0 to 2 percent). The corresponding values of reduced storage losses are $12.4 million and $10.2 million for the high and low rate scenarios, respectively.

Achieving hydraulic control through basin re-operation will also result in higher pumping costs since forgiveness of the desalter replenishment operation is intended to lower the groundwater elevation in certain regions. The information needed to calculate the present value of increased pumping costs includes the quantity-weighted average change in lift in the Basin resulting from re-operation, the energy requirement per unit lift and energy costs per kilowatt-hour. Wildermuth Environmental provided the weighted average changes in groundwater elevation. The price of electricity is assumed to be $0.14/kwh, and the pumping efficiency is taken to be 75 percent. The California Energy Commission forecasts that commercial and agricultural electricity rates charged by investor-owner utilities operating in California will decline slightly in nominal terms until 2013, when

[5] The Peace Agreement provides that there is Target Storage of 500,000 acre-feet *in excess* of then existing storage, whereas this report only considers the Safe Harbor quantity of 500,000 acre-feet of storage in total. In some sense, there is a tradeoff between the decision to pursue max-benefit and the feasibility of obtaining the higher amount of storage. It should also be noted, however, that the basin is at the limit of shift capacity for export, and expansion of recharge to achieve greater storage is costly. Further, the PEIR only considered an additional 250,000 acre-feet of storage.

their forecast terminates.[6] This analysis assumes that nominal electricity prices are constant.

Combining this information, increased pump lift costs have a present value of $14.9 million in the straightline depletion scenario. In the rapid pulldown scenario, re-operation has a larger impact on the present value of energy costs since the groundwater elevation is reduced to the same level but at an earlier date. Increased energy costs have a present value of $19.4 million in this scenario. Both calculations include increased energy costs in the new basin steady state achieved after 2030.

## 5. Results

Table 1 summarizes the results of the economic analysis. The figures in the table are the net benefits resulting from access to the Chino Basin aquifer under the alternative management and price scenarios described in the previous section. In all cases, basin re-operation results in aggregate net benefits. However, there are significant differences in net benefits depending on the realization of future water prices and the use of Santa Ana River inflows induced by reducing the stock of groundwater. The rapidity with which basin re-operation is implemented matters less.

When Santa Ana River inflow is allocated to desalter replenishment and overdraft occurs in constant annual amounts to 2030, basin re-operation results in gains of between $283.1 and $391.4 million in present value terms, depending on the growth of water prices and how the replenishment credit is used over time. These gains result from the ability to use recycled water for a fraction of recharge if hydraulic control is achieved, the value of new yield, and the value of the forgiven desalter replenishment.[7]

Since new yield is reliable, in any case more reliable than a supply of replenishment water, allocating it to desalter replenishment would seem to be inefficient. The Tier 2 rate is well above the price of replenishment water, which is a weighted average of the MWD replenishment rate and the price of recycled water. When Santa Ana River inflows are decoupled from replenishment obligations, the gains from straightline basin re-operation are between $341.9 and $438.8 million.

There is a small increase in the net benefits of basin re-operation when the most rapid overdraft strategy is implemented. Several factors explain this result. First, in the most rapid depletion scenario, the 30,000 acre-foot constraint on annual recycling recharge binds more frequently. Accordingly, less recycled water is recharged over the study

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[6] http://www.energy.ca.gov/electricity/rates_iou_vs_muni_nominal/medium_commercial.html; http://www.energy.ca.gov/electricity/rates_iou_vs_muni_nominal/agricultural.html

[7] Another potential source of loss is the option value of the water taken from the groundwater stock. That is, water used to avoid desalter replenishment is water that is not available in the event of a major disruption in surface water supplies to the region. Given the difficulty of describing and quantifying these future states of nature, option values have not been calculated. However, conversations with Watermaster staff indicate that dewatering will not result in any meaningful loss of operational flexibility since the percentage depletion of the aquifer envisioned through re-operation is relatively small.

period under this scenario. Second, while the most rapid depletion strategy delays replenishment, it also hastens the date at which a large replenishment obligation occurs once the desalter replenishment forgiveness of 400,000 acre-feet is exhausted.[8] Given the relatively low real discount rate used in this study (i.e., the nominal discount rate minus the rate of growth of water prices), it is not surprising that dynamic factors such as this do not have a large effect on net benefits.

[8] This study has not considered the capital and operating costs of expanding recharge capacity. Allocating Santa Ana River inflows to desalter replenishment delays the date at which capacity is exceeded, as does the most rapid depletion strategy.

**Table 1: Net Benefits of Hydraulic Control, Basin Re-Operation and Desalter Production**

(Figures in millions of 2006 dollars)

*Gain Over Baseline: SAR Inflow Allocated to Desalter Replenishment*

| | *High Rate* | *Low Rate* |
|---|---|---|
| *Straightline* | 388.6 | 283.1 |
| *Most Rapid* | 391.4 | 288.4 |

*Gain Over Baseline: SAR Inflow Unallocated*

| | *High Rate* | *Low Rate* |
|---|---|---|
| *Straightline* | 436.2 | 341.9 |
| *Most Rapid* | 438.8 | 347.7 |

Source: Calculated.

**Table 2: Production, Operating Yield and Stormwater Recharge**

| *Year* | *Total Production* | *Chino Desalter Production* | *Operating Yield* | *New Stormwater Recharge* |
|---|---|---|---|---|
| 2006 | 223,505 | 30,019 | 145,000 | 12,000 |
| 2007 | 230,566 | 31,923 | 145,000 | 12,000 |
| 2008 | 237,634 | 33,827 | 145,000 | 12,000 |
| 2009 | 244,702 | 35,731 | 145,000 | 12,000 |
| 2010 | 251,874 | 37,748 | 145,000 | 12,000 |
| 2011 | 251,768 | 38,980 | 145,000 | 12,000 |
| 2012 | 251,661 | 40,212 | 145,000 | 12,000 |
| 2013 | 251,551 | 41,445 | 145,000 | 12,000 |
| 2014 | 251,557 | 42,789 | 145,000 | 12,000 |
| 2015 | 250,216 | 42,789 | 145,000 | 12,000 |
| 2016 | 250,427 | 42,789 | 145,000 | 12,000 |
| 2017 | 250,640 | 42,789 | 145,000 | 12,000 |
| 2018 | 250,851 | 42,789 | 140,000 | 12,000 |
| 2019 | 251,060 | 42,789 | 140,000 | 12,000 |
| 2020 | 251,270 | 42,789 | 140,000 | 12,000 |
| 2021 | 254,049 | 42,789 | 140,000 | 12,000 |
| 2022 | 256,827 | 42,789 | 140,000 | 12,000 |
| 2023 | 259,605 | 42,789 | 140,000 | 12,000 |
| 2024 | 262,384 | 42,789 | 140,000 | 12,000 |
| 2025 | 265,163 | 42,789 | 140,000 | 12,000 |
| 2026 | 266,133 | 42,789 | 140,000 | 12,000 |
| 2027 | 267,104 | 42,789 | 140,000 | 12,000 |
| 2028 | 268,074 | 42,789 | 140,000 | 12,000 |
| 2029 | 269,044 | 42,789 | 140,000 | 12,000 |
| 2030 | 270,014 | 42,789 | 140,000 | 12,000 |

Source: Wildermuth Environmental.

**Table 3: Replenishment Obligations and Sources – No Basin Re-Operation**

| *Year* | *Normal Production Replenishment Obligation* | *Chino Desalter Replenishment Obligation* | *MWD Replenishment* | *Recycling Replenishment* |
|---|---|---|---|---|
| 2006 | 36,487 | 30,019 | 66,505 | 0 |
| 2007 | 41,643 | 31,923 | 73,566 | 0 |
| 2008 | 46,806 | 33,827 | 80,634 | 0 |
| 2009 | 51,970 | 35,731 | 87,702 | 0 |
| 2010 | 57,126 | 37,748 | 94,874 | 0 |
| 2011 | 55,788 | 38,980 | 94,768 | 0 |
| 2012 | 54,448 | 40,212 | 94,661 | 0 |
| 2013 | 53,107 | 41,445 | 94,551 | 0 |
| 2014 | 51,768 | 42,789 | 94,557 | 0 |
| 2015 | 50,427 | 42,789 | 93,216 | 0 |
| 2016 | 50,638 | 42,789 | 93,427 | 0 |
| 2017 | 50,851 | 42,789 | 93,640 | 0 |
| 2018 | 56,062 | 42,789 | 98,851 | 0 |
| 2019 | 56,271 | 42,789 | 99,060 | 0 |
| 2020 | 56,482 | 42,789 | 99,270 | 0 |
| 2021 | 59,260 | 42,789 | 102,049 | 0 |
| 2022 | 62,038 | 42,789 | 104,827 | 0 |
| 2023 | 64,816 | 42,789 | 107,605 | 0 |
| 2024 | 67,595 | 42,789 | 110,384 | 0 |
| 2025 | 70,374 | 42,789 | 113,163 | 0 |
| 2026 | 71,344 | 42,789 | 114,133 | 0 |
| 2027 | 72,315 | 42,789 | 115,104 | 0 |
| 2028 | 73,285 | 42,789 | 116,074 | 0 |
| 2029 | 74,255 | 42,789 | 117,044 | 0 |
| 2030 | 75,225 | 42,789 | 118,014 | 0 |

Source: Calculated.

Normal Production Replenishment Obligation = Total Production – Desalter Production – Operating Yield – New Stormwater Recharge

Desalter Replenishment Obligation = Desalter Production

**Table 4: Overdraft and SAR Inflow – Straightline Depletion Scenario**

| *Year* | *Annual Overdraft* | *Cumulative Overdraft* | *SAR Inflow* |
|---|---|---|---|
| 2006 | 16,000 | 16,000 | 9,900 |
| 2007 | 16,000 | 32,000 | 9,900 |
| 2008 | 16,000 | 48,000 | 9,900 |
| 2009 | 16,000 | 64,000 | 9,900 |
| 2010 | 16,000 | 80,000 | 9,900 |
| 2011 | 16,000 | 96,000 | 9,900 |
| 2012 | 16,000 | 112,000 | 9,900 |
| 2013 | 16,000 | 128,000 | 9,900 |
| 2014 | 16,000 | 144,000 | 9,900 |
| 2015 | 16,000 | 160,000 | 9,900 |
| 2016 | 16,000 | 176,000 | 9,900 |
| 2017 | 16,000 | 192,000 | 9,900 |
| 2018 | 16,000 | 208,000 | 9,900 |
| 2019 | 16,000 | 224,000 | 9,900 |
| 2020 | 16,000 | 240,000 | 9,900 |
| 2021 | 16,000 | 256,000 | 9,900 |
| 2022 | 16,000 | 272,000 | 9,900 |
| 2023 | 16,000 | 288,000 | 9,900 |
| 2024 | 16,000 | 304,000 | 9,900 |
| 2025 | 16,000 | 320,000 | 9,900 |
| 2026 | 16,000 | 336,000 | 9,900 |
| 2027 | 16,000 | 352,000 | 9,900 |
| 2028 | 16,000 | 368,000 | 9,900 |
| 2029 | 16,000 | 384,000 | 9,900 |
| 2030 | 16,000 | 400,000 | 9,900 |

Sources: Annual and Cumulative Overdraft: Assumed; SAR Inflow, Wildermuth Environmental.

**Table 5: Replenishment Obligations and Sources – Straightline Depletion Scenario with SAR Inflow Allocated to Desalter Replenishment**

| *Year* | *Normal Production Replenishment Obligation* | *Chino Desalter Replenishment Obligation* | *MWD Replenishment* | *Recycling Replenishment* |
|---|---|---|---|---|
| 2006 | 36,487 | 4,119 | 28,424 | 12,182 |
| 2007 | 41,643 | 6,023 | 33,366 | 14,300 |
| 2008 | 46,806 | 7,927 | 38,314 | 16,420 |
| 2009 | 51,970 | 9,831 | 43,261 | 18,541 |
| 2010 | 57,126 | 11,848 | 48,282 | 20,692 |
| 2011 | 55,788 | 13,080 | 48,208 | 20,660 |
| 2012 | 54,448 | 14,312 | 48,133 | 20,628 |
| 2013 | 53,107 | 15,545 | 48,056 | 20,595 |
| 2014 | 51,768 | 16,889 | 48,060 | 20,597 |
| 2015 | 50,427 | 16,889 | 47,121 | 20,195 |
| 2016 | 50,638 | 16,889 | 47,269 | 20,258 |
| 2017 | 50,851 | 16,889 | 47,418 | 20,322 |
| 2018 | 56,062 | 16,889 | 51,065 | 21,885 |
| 2019 | 56,271 | 16,889 | 51,212 | 21,948 |
| 2020 | 56,482 | 16,889 | 51,359 | 22,011 |
| 2021 | 59,260 | 16,889 | 53,304 | 22,845 |
| 2022 | 62,038 | 16,889 | 55,249 | 23,678 |
| 2023 | 64,816 | 16,889 | 57,194 | 24,512 |
| 2024 | 67,595 | 16,889 | 59,139 | 25,345 |
| 2025 | 70,374 | 16,889 | 61,084 | 26,179 |
| 2026 | 71,344 | 16,889 | 61,763 | 26,470 |
| 2027 | 72,315 | 16,889 | 62,443 | 26,761 |
| 2028 | 73,285 | 16,889 | 63,121 | 27,052 |
| 2029 | 74,255 | 16,889 | 63,801 | 27,343 |
| 2030 | 75,225 | 16,889 | 64,480 | 27,634 |

Source: Calculated.

Normal Production Replenishment Obligation = Total Production – Desalter Production – Operating Yield – New Stormwater Recharge

Desalter Replenishment Obligation = Desalter Production – Annual Overdraft – SAR Inflow

Recycling Replenishment = min[0.3*(Normal Production Replenishment Obligation + Desalter Replenishment Obligation), 30,000]

MWD Replenishment = Normal Production Replenishment Obligation + Desalter Replenishment Obligation - Recycling Replenishment

**Table 6: Replenishment Obligations and Sources – Straightline Depletion Scenario with SAR Inflow Unllocated**

| *Year* | *Total Replenishment Obligation* | *MWD Replenishment* | *Recycling Replenishment* |
|---|---|---|---|
| 2006 | 50,505 | 35,354 | 15,152 |
| 2007 | 57,566 | 40,296 | 17,270 |
| 2008 | 64,634 | 45,244 | 19,390 |
| 2009 | 71,702 | 50,191 | 21,511 |
| 2010 | 78,874 | 55,212 | 23,662 |
| 2011 | 78,768 | 55,138 | 23,630 |
| 2012 | 78,661 | 55,063 | 23,598 |
| 2013 | 78,551 | 54,986 | 23,565 |
| 2014 | 78,557 | 54,990 | 23,567 |
| 2015 | 77,216 | 54,051 | 23,165 |
| 2016 | 77,427 | 54,199 | 23,228 |
| 2017 | 77,640 | 54,348 | 23,292 |
| 2018 | 82,851 | 57,995 | 24,855 |
| 2019 | 83,060 | 58,142 | 24,918 |
| 2020 | 83,270 | 58,289 | 24,981 |
| 2021 | 86,049 | 60,234 | 25,815 |
| 2022 | 88,827 | 62,179 | 26,648 |
| 2023 | 91,605 | 64,124 | 27,482 |
| 2024 | 94,384 | 66,069 | 28,315 |
| 2025 | 97,163 | 68,014 | 29,149 |
| 2026 | 98,133 | 68,693 | 29,440 |
| 2027 | 99,104 | 69,373 | 29,731 |
| 2028 | 100,074 | 70,074 | 30,000 |
| 2029 | 101,044 | 71,044 | 30,000 |
| 2030 | 102,014 | 72,014 | 30,000 |

Source: Calculated.

Total Replenishment Obligation = Total Production – Operating Yield – Annual Overdraft – New Stormwater Recharge

Recycling Replenishment = min[0.3*Total Replenishment Obligation, 30,000]

MWD Replenishment = Total Replenishment Obligation - Recycling Replenishment

**Table 7: Overdraft and SAR Inflow – Most Rapid Depletion Scenario**

| *Year* | *Annual Overdraft* | *Cumulative Overdraft* | *SAR Inflow* |
|---|---|---|---|
| 2006 | 20,119 | 20,119 | 9,900 |
| 2007 | 22,023 | 42,141 | 9,900 |
| 2008 | 23,927 | 66,069 | 9,900 |
| 2009 | 25,831 | 91,900 | 9,900 |
| 2010 | 27,848 | 119,748 | 9,900 |
| 2011 | 29,080 | 148,828 | 9,900 |
| 2012 | 30,312 | 179,141 | 9,900 |
| 2013 | 31,545 | 210,685 | 9,900 |
| 2014 | 32,889 | 243,574 | 9,900 |
| 2015 | 32,889 | 276,463 | 9,900 |
| 2016 | 32,889 | 309,352 | 9,900 |
| 2017 | 32,889 | 342,241 | 9,900 |
| 2018 | 32,889 | 375,130 | 9,900 |
| 2019 | 24,870 | 400,000 | 9,900 |
| 2020 | 0 | 400,000 | 12,500 |
| 2021 | 0 | 400,000 | 12,500 |
| 2022 | 0 | 400,000 | 12,500 |
| 2023 | 0 | 400,000 | 12,500 |
| 2024 | 0 | 400,000 | 12,500 |
| 2025 | 0 | 400,000 | 12,500 |
| 2026 | 0 | 400,000 | 12,500 |
| 2027 | 0 | 400,000 | 12,500 |
| 2028 | 0 | 400,000 | 12,500 |
| 2029 | 0 | 400,000 | 12,500 |
| 2030 | 0 | 400,000 | 12,500 |

Sources: Annual and Cumulative Overdraft: Assumed; SAR Inflow: Wildermuth Environmental.

**Table 8: Replenishment Obligations and Sources – Most Rapid Depletion Scenario with SAR Inflow Allocated to Desalter Replenishment**

| *Year* | *Normal Production Replenishment Obligation* | *Chino Desalter Replenishment Obligation* | *MWD Replenishment* | *Recycling Replenishment* |
|---|---|---|---|---|
| 2006 | 36,487 | 0 | 25,541 | 10,946 |
| 2007 | 41,643 | 0 | 29,150 | 12,493 |
| 2008 | 46,806 | 0 | 32,764 | 14,042 |
| 2009 | 51,970 | 0 | 36,379 | 15,591 |
| 2010 | 57,126 | 0 | 39,988 | 17,138 |
| 2011 | 55,788 | 0 | 39,051 | 16,736 |
| 2012 | 54,448 | 0 | 38,114 | 16,335 |
| 2013 | 53,107 | 0 | 37,175 | 15,932 |
| 2014 | 51,768 | 0 | 36,238 | 15,530 |
| 2015 | 50,427 | 0 | 35,299 | 15,128 |
| 2016 | 50,638 | 0 | 35,447 | 15,191 |
| 2017 | 50,851 | 0 | 35,596 | 15,255 |
| 2018 | 56,062 | 0 | 39,243 | 16,819 |
| 2019 | 56,271 | 8,019 | 45,003 | 19,287 |
| 2020 | 56,482 | 30,289 | 60,739 | 26,031 |
| 2021 | 59,260 | 30,289 | 62,684 | 26,865 |
| 2022 | 62,038 | 30,289 | 64,629 | 27,698 |
| 2023 | 64,816 | 30,289 | 66,574 | 28,532 |
| 2024 | 67,595 | 30,289 | 68,519 | 29,365 |
| 2025 | 70,374 | 30,289 | 70,663 | 30,000 |
| 2026 | 71,344 | 30,289 | 71,633 | 30,000 |
| 2027 | 72,315 | 30,289 | 72,604 | 30,000 |
| 2028 | 73,285 | 30,289 | 73,574 | 30,000 |
| 2029 | 74,255 | 30,289 | 74,544 | 30,000 |
| 2030 | 75,225 | 30,289 | 75,514 | 30,000 |

Source: Calculated.

Normal Production Replenishment Obligation = Total Production – Desalter Production – Operating Yield – New Stormwater Recharge

Desalter Replenishment Obligation = Desalter Production – Annual Overdraft – SAR Inflow

Recycling Replenishment = min[0.3*(Normal Production Replenishment Obligation + Desalter Replenishment Obligation), 30,000]

MWD Replenishment = Normal Production Replenishment Obligation + Desalter Replenishment Obligation - Recycling Replenishment

**Table 9: Replenishment Obligations and Sources – Most Rapid Depletion Scenario with SAR Inflow Unllocated**

| *Year* | *Total Replenishment Obligation* | *MWD Replenishment* | *Recycling Replenishment* |
|---|---|---|---|
| 2006 | 46,387 | 32,471 | 13,916 |
| 2007 | 51,543 | 36,080 | 15,463 |
| 2008 | 56,706 | 39,694 | 17,012 |
| 2009 | 61,870 | 43,309 | 18,561 |
| 2010 | 67,026 | 46,918 | 20,108 |
| 2011 | 65,688 | 45,981 | 19,706 |
| 2012 | 64,348 | 45,044 | 19,305 |
| 2013 | 63,007 | 44,105 | 18,902 |
| 2014 | 61,668 | 43,168 | 18,500 |
| 2015 | 60,327 | 42,229 | 18,098 |
| 2016 | 60,538 | 42,377 | 18,161 |
| 2017 | 60,751 | 42,526 | 18,225 |
| 2018 | 65,962 | 46,173 | 19,789 |
| 2019 | 74,190 | 51,933 | 22,257 |
| 2020 | 99,270 | 69,489 | 29,781 |
| 2021 | 102,049 | 72,049 | 30,000 |
| 2022 | 104,827 | 74,827 | 30,000 |
| 2023 | 107,605 | 77,605 | 30,000 |
| 2024 | 110,384 | 80,384 | 30,000 |
| 2025 | 113,163 | 83,163 | 30,000 |
| 2026 | 114,133 | 84,133 | 30,000 |
| 2027 | 115,104 | 85,104 | 30,000 |
| 2028 | 116,074 | 86,074 | 30,000 |
| 2029 | 117,044 | 87,044 | 30,000 |
| 2030 | 118,014 | 88,014 | 30,000 |

Source: Calculated.

Total Replenishment Obligation = Total Production – Operating Yield – Annual Overdraft – New Stormwater Recharge

Recycling Replenishment = min[0.3*Total Replenishment Obligation, 30,000]

MWD Replenishment = Total Replenishment Obligation - Recycling Replenishment

**Table 10: Prices – High Price Scenario**

| *Year* | *Tier 2 Price* | *Replenishment Price* | *Recycling Price* |
|---|---|---|---|
| 2006 | 427 | 238 | 69 |
| 2007 | 427 | 238 | 72 |
| 2008 | 459 | 275 | 75 |
| 2009 | 473 | 297 | 79 |
| 2010 | 486 | 314 | 82 |
| 2011 | 497 | 331 | 86 |
| 2012 | 519 | 346 | 90 |
| 2013 | 543 | 361 | 94 |
| 2014 | 567 | 378 | 98 |
| 2015 | 593 | 395 | 103 |
| 2016 | 619 | 412 | 107 |
| 2017 | 647 | 431 | 112 |
| 2018 | 676 | 450 | 117 |
| 2019 | 707 | 471 | 122 |
| 2020 | 739 | 492 | 128 |
| 2021 | 772 | 514 | 134 |
| 2022 | 807 | 537 | 140 |
| 2023 | 843 | 561 | 146 |
| 2024 | 881 | 587 | 152 |
| 2025 | 920 | 613 | 159 |
| 2026 | 962 | 641 | 166 |
| 2027 | 1,005 | 669 | 174 |
| 2028 | 1,050 | 700 | 182 |
| 2029 | 1,098 | 731 | 190 |
| 2030 | 1,147 | 764 | 198 |

Source: Metropolitan Water District of Southern California.

**Table 11: Prices – Low Price Scenario**

| *Year* | *Tier 2 Price* | *Replenishment Price* | *Recycling Price* |
|---|---|---|---|
| 2006 | 427 | 238 | 69 |
| 2007 | 427 | 238 | 71 |
| 2008 | 450 | 261 | 73 |
| 2009 | 457 | 268 | 75 |
| 2010 | 463 | 282 | 78 |
| 2011 | 477 | 300 | 80 |
| 2012 | 491 | 309 | 82 |
| 2013 | 506 | 318 | 85 |
| 2014 | 521 | 328 | 87 |
| 2015 | 537 | 338 | 90 |
| 2016 | 553 | 348 | 93 |
| 2017 | 570 | 358 | 96 |
| 2018 | 587 | 369 | 98 |
| 2019 | 604 | 380 | 101 |
| 2020 | 622 | 391 | 104 |
| 2021 | 641 | 403 | 107 |
| 2022 | 660 | 415 | 111 |
| 2023 | 680 | 428 | 114 |
| 2024 | 700 | 441 | 117 |
| 2025 | 722 | 454 | 121 |
| 2026 | 743 | 467 | 125 |
| 2027 | 765 | 481 | 128 |
| 2028 | 788 | 496 | 132 |
| 2029 | 812 | 511 | 136 |
| 2030 | 836 | 526 | 140 |

Source: Metropolitan Water District of Southern California.

**Table 12: Expected Value of Reduced Storage Losses**

| **Program Size** | *Losses* | *Present Value - High Rate* | *Present Value - Low Rate* |
|---|---|---|---|
| 300,000 | 80,175 | 18,647,350 | 15,290,827 |
| 400,000 | 106,900 | 24,863,133 | 20,387,769 |
| 500,000 | 133,626 | 31,079,149 | 25,484,903 |

Source: Wildermuth Environmental.

# Attachment C

**Report on the Distribution of Benefits to Basin Agencies from the Major Program Elements Encompassed by the Peace Agreement and Non-Binding Term Sheet**

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October 17, 2007

## 1. Introduction and Summary of Findings

This report measures the costs and benefits to various Chino Basin agencies of the program elements encompassed by the Peace I and Peace II Agreements. Both agreements are considered relative to a baseline state of the world existing after the Judgment but prior to the Peace Agreement. The analysis examines net returns to the ten largest agencies that hold groundwater rights in the Basin over the time period 2007 to 2030. Together, these agencies account for over 91 percent of Basin safe operating yield.

Overall, the study shows that the two agreements produce substantial net benefits to Chino Basin agencies – over $904 million in present value terms. The provisions of the Peace II Agreement are especially valuable, as they account for $723 million (80 percent) of the total net benefit to the Basin agencies studied. Through the attainment of hydraulic control, the program elements in Peace II Agreement include the introduction of large quantities of recycled water in the Basin, which lessens the need to procure other supplies to meet growing demand for water. With respect to the distribution of net benefits across agencies, shown in the summary tables below, the main outcome is that all agencies benefit from the agreements, although the magnitude of the net benefit varies considerably among agencies.

| | **Total Net Benefit (1000s of 2007$)** | | |
|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Peace I* | *Peace II vs. Baseline* |
| City of Chino | $20,294 | $75,671 | $95,966 |
| City of Chino Hills | $12,217 | $61,320 | $73,537 |
| City of Ontario | $42,547 | $189,724 | $232,271 |
| City of Upland | $9,442 | $34,644 | $44,086 |
| Cucamonga Valley Water District | $60,667 | $217,462 | $278,128 |
| Fontana Union Water Co. | $4,839 | $25,429 | $30,268 |
| Monte Vista Water District | $7,025 | $33,455 | $40,480 |
| San Antonio Water Company | $1,141 | $5,995 | $7,136 |
| Jurupa CSD | $15,772 | $19,482 | $35,254 |
| City of Pomona | $8,189 | $59,348 | $67,537 |
| **Total** | **$182,133** | **$722,530** | **$904,663** |

| | Net Benefit per Acre-Foot (2007$) | | |
|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Peace I* | *Peace II vs. Baseline* |
| City of Chino | $31.30 | $116.70 | $148.00 |
| City of Chino Hills | $20.60 | $103.38 | $123.98 |
| City of Ontario | $24.20 | $107.91 | $132.11 |
| City of Upland | $17.46 | $64.07 | $81.54 |
| Cucamonga Valley Water District | $32.92 | $118.01 | $150.93 |
| Monte Vista Water District | $20.13 | $95.88 | $116.01 |
| Jurupa CSD | $17.86 | $22.06 | $39.92 |
| City of Pomona | $11.10 | $80.47 | $91.58 |
| **Overall Average** | **$19.84** | **$78.69** | **$98.53** |

In terms of total net benefit, two agencies, City of Ontario and Cucamonga Valley Water District, receive over half of all the net benefits resulting from the agreements. An important reason these agencies receive a large share of the net benefit from the agreements is due to their relative size: the two agencies combined account for approximately half of the consumer demand for Basin water.[1] Controlling for agency size on the basis of demand for Basin water, the net benefit resulting from the combined program elements in the Peace I and Peace II Agreements shows considerably less variation. The table above indicates that 7 of the 8 agencies with positive demand for Basin water receiving benefits ranging from $82 to $151 per acre –foot.[2]

## 2. Conceptual Framework

The model of groundwater value used in this report is standard in the academic literature and builds on the methodology used in the earlier aggregate study of Basin net benefits. The net benefits resulting from access to a groundwater resource are the gains from pumping (the demand for water) less the cost of extraction and conveyance, and a user cost component, which reflects the lost option value entailed by removing a unit of water from storage. The stream of annual net benefits is discounted back to current dollars using a discount factor predicated on the rate of interest, which is taken to be the current risk-free long-term rate of interest and is set at 4.5 percent per year.

Allocation of aggregate costs and benefits to individual agencies in the Basin is accomplished by a complex set of legal rules (e.g., shares of operating yield), cost-sharing arrangements that fund programs for Basin improvements through collective institutions, and market forces. The goal of this study is to measure net benefits to individual agencies under three scenarios: (i) a baseline case defined by the Judgment; (ii) a set of rules to operate the Basin and fund programs through collections as defined by the Peace Agreement; and (iii) an alternative set of rules that are

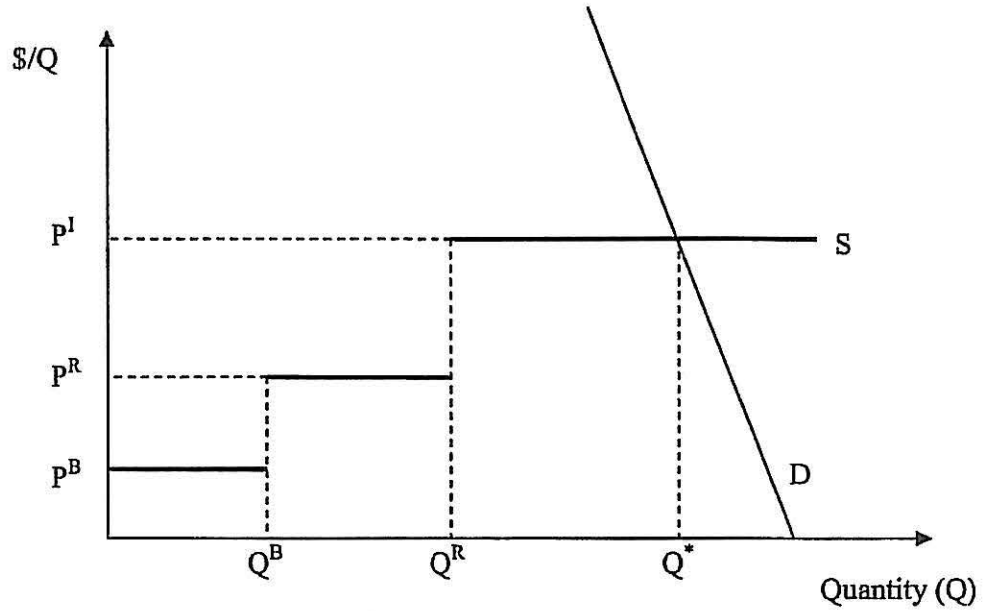
[1] Consumer demand for Basin water, which is met through some combination of Basin supply and water imports, is calculated for each agency as Urban Water Demand less available surface water and other groundwater supplies. Over the 2007-2030 period of study, the City of Ontario and Cucamonga Valley Water District are projected to meet consumer demand of 3.4 million acre-feet out of 6.9 million acre-feet (49 percent) of total consumer demand for Basin water.

[2] Fontana Union Water Company and San Antonio Water Company are not included in these calculations, because the available surface water and other groundwater supplies for these agencies exceed their Urban Water Demand.

designed to achieve hydraulic control and are defined in Peace II Agreement (as represented in the Non-Binding Term Sheet dated May 23, 2006).

To understand the allocation of benefits among individual agencies in the appropriative pool most clearly, consider for the moment the case in which the appropriative pool comprises 100 percent of the Basin water. Figure 1 depicts the aggregate supply (S) and demand (D) schedules for this Basin. Aggregate demand is total water demand in the Basin, and the supply curve is a step function, ordered from the least expensive uses of water to the most expensive uses of water.[3] Many of the effects modeled in this study amount to changes in agencies' cost of meeting water demand. An arrangement or cost-sharing rule that reduces an agency's cost of service provides a net benefit to that agency and its ratepayers.

**Figure 1. Conceptual Model: Aggregate Demand and Supply**




The first step of the supply curve, which represents the least expensive water source, is groundwater pumped directly from the Basin. The extent of groundwater pumping in the Basin is limited by the steady-state ("safe") yield, which is represented in the figure by quantity $Q^B$. The cost per unit of Basin water is denoted by the (implicit) price $P^B$, which includes lift costs, conveyance costs, and user cost. The second step of the supply curve represents replenishment water. After the safe yield of the Basin is exhausted, additional groundwater pumping can occur provided that replenishment water is purchased to recharge the Basin. The effective capacity of the Basin is the sum of Basin safe yield and Basin recharge capacity, denoted by the quantity $Q^R$ in the figure. (The recharge capacity of the Basin is given by the difference $Q^R$ - $Q^B$.)

[3] In practice, the water supply function has multiple steps, with each step representing the various pumping and conveyance costs of a sequence of wells, and, for this reason, aggregate supply conditions are often approximated by an upwards-sloping, continuous supply function; however, the essential points of the model can be made more clearly by grouping water costs into common categories represented by each of the three steps.

Replenishment water is supplied to the Basin through replenishment water imports at the MWD replenishment rate, which is denoted in the figure by $P^R$. The third step in the supply function, the most-expensive source of water, is imported water for direct (consumptive) use. Imported water for direct use is available to agencies in the Basin at a price denoted by $P^I$, which reflects the cost of procuring new water supplies from outside the Basin. The cost of developing reliable sources of water outside the Basin may differ across agencies in practice according to the options available to each agency in developing outside water sources. The outside option for each agency in the present study, unless stated otherwise, is taken to have a cost equal to the Tier 2 MWD rate for untreated water.

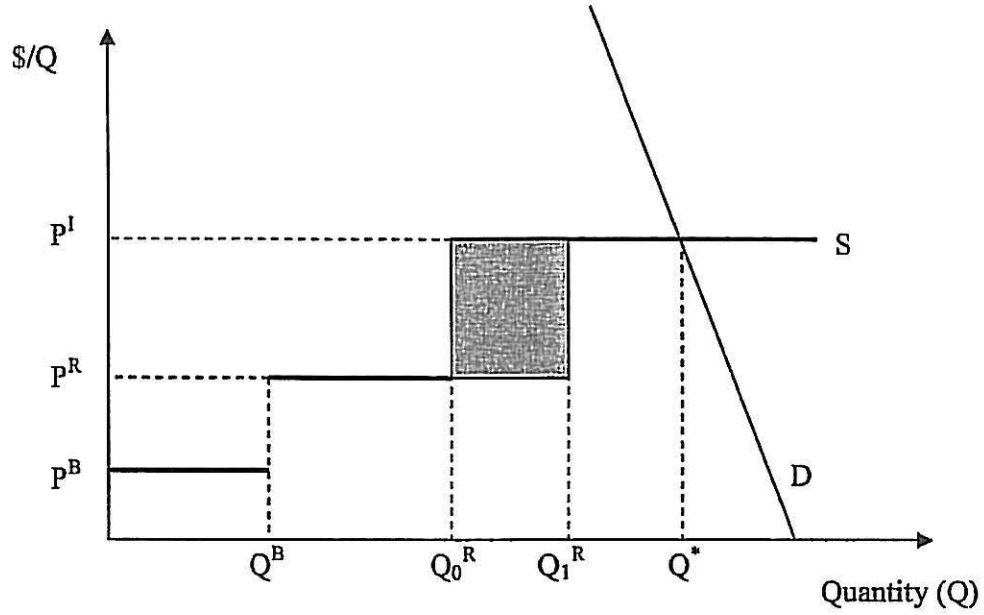
The equilibrium quantity of water consumed is given by the intersection of supply and demand, which occurs at the quantity $Q^*$ and the price $P^I$. The key to characterizing the distribution of benefits from policies that increase the effective yield from the Basin, either by expanding Basin safe yield or by augmenting Basin recharge capacity, is the understanding that economic values, as captured by prices, are realized on the margin of water use where supply intersects with demand (the third step in the figure). Gains from management of the Basin are created by replacing units of water at the third and most-expensive step of the supply function with less expensive sources of water. Because individual supplies are added together to get aggregate supply, the distribution of market benefits to individual agencies in response to Basin improvements depends on the composition of water use by each agency across each of the steps of supply, in effect where each agency is "located" on the supply schedule. In general, agencies who meet their meet urban water demand to a greater degree with marginal units of water (i.e., imported water for direct use) acquire a larger share of the benefits from Basin improvements than agencies that are less represented on this "extensive margin" of supply.[4]

Consider a policy that increases the recharge capacity of the Basin. In general, such an effort has two effects that, taken together, can alter the net benefits received by water agencies: (i) increasing the Basin recharge capacity involves a fixed cost component that must be allocated among agencies according to some cooperative, cost-sharing rule; and (ii) increasing the Basin recharge capacity allows for greater use of replenishment water that can displace expensive Tier 2 water on the margin. The distribution of net benefits in the Basin is altered in cases where the market allocation of benefits from the increased use of replenishment water differs from the allocation of cost among individual agencies.

Figure 2 shows the gain from an increase in recharge capacity in the Basin. The increase in recharge capacity increases the effective yield in the Basin, which is depicted in the figure by the movement from $Q_0^R$ to $Q_1^R$. The increased recharge capacity allows Basin agencies to incur additional replenishment obligations that displace $Q_1^R - Q_0^R$ units of imported water for direct use. The total producer benefit resulting from the increase in recharge capacity is represented by the shaded region in the figure, which sums the difference between the Tier 2 rate and replenishment rate for each additional unit of water that can be replenished.

[4] Generally, users disproportionately represented on the margin of supply represent agencies that incurred large increases in urban water demand subsequent to the assignment of safe operating yield and were forced to meet the increase in demand with relatively expensive sources of imported water.

**Figure 2. Benefit of an Increase in Basin Recharge Capacity**

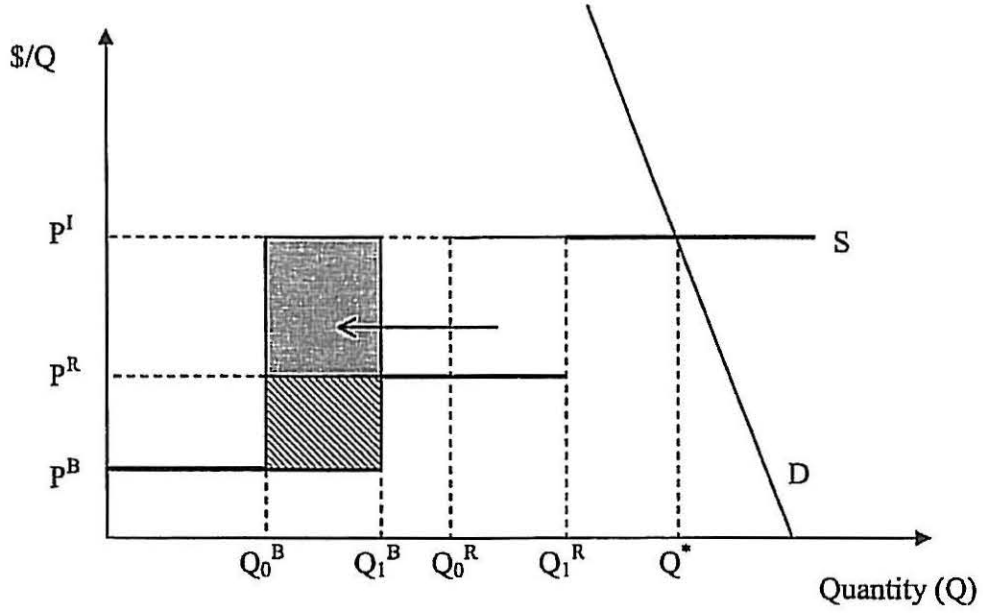



Among individual agencies in the Basin, the benefit of an increase in recharge capacity is distributed exclusively to agencies on the extensive margin of water supply. For this reason, the market return from an increase in recharge capacity can be distributed equally across agencies only in the case where the agencies have equal shares of the third step of water supply in the Basin. To illustrate this point, consider an agency that faces sufficiently small water demand relative to its share of Basin production rights that its urban water demand can be met each year entirely through the use of Basin safe yield. Such an agency would require the use of neither imported replenishment water nor imported water for direct use to meet its urban water demand, and would stand to receive no market benefit from participating in a cooperative policy designed to increase Basin recharge capacity. To the extent that cooperative assessments levied to recoup the cost of increasing Basin recharge capacity are based on relative share of operating yield, as opposed to being levied in proportion to the initial share of imported water deliveries for direct use across agencies, policies that increase Basin recharge capacity alter the distribution of net benefits.

Next, consider the benefit associated with an increase in Basin safe yield. Figure 3 shows the effect of an increase in Basin safe yield from $Q_0^B$ to $Q_1^B$ units. The increase in Basin safe yield extends the lowest step of the supply function and displaces $Q_1^B - Q_0^B$ units of replenishment water purchases. The value of the displaced replenishment water (net of the cost of Basin water) is shown by the cross-hatched region in the figure. The increase in Basin safe yield, in turn, increases the effective yield in the Basin (the sum of Basin yield and recharge capacity) from $Q_0^R$ to $Q_1^R$, which is represented in the figure by a rightward shift in the replenishment step of supply. The increase in Basin safe yield therefore also displaces $Q_1^R - Q_0^R = Q_1^B - Q_0^B$ units of imported water on the extensive margin of supply, which provides an additional gain represented by the shaded region of the figure. The total market benefit to all agencies is represented by the sum of these two regions. The value of an increase in Basin safe yield is the difference between

the price of imported water for direct use and the procurement cost of Basin groundwater for each unit of additional water made available to Basin agencies.

**Figure 3. Benefit of an Increase in Basin Safe Yield**




The economic value of an increase in safe yield conveys upward into market benefit across both steps of supply. For this reason, policies which lead an increase in Basin safe yield are not only more valuable to agencies in the Basin than an increase in recharge capacity, but the benefits are also distributed more equally. As in the case of an increase in replenishment capacity, the ultimate repository of market value for a one-unit increase in safe yield is a unit of displaced water on the extensive margin of supply; however, this displacement now occurs with Basin safe yield rather than through the use of imported replenishment water. To see how the market benefits of a policy that increases Basin safe yield are distributed to individual agencies, consider again an agency that meets its urban water demand each year entirely through the use of Basin safe yield without the need for replenishment water or imported water for direct use. Unlike the case of an increase in replenishment capacity, the increase in Basin safe yield provides each agency with physical water assets (e.g., according to its share of Basin safe yield) that can be sold to other agencies in the transfer market. The gain to this agency following the increase in Basin safe yield depends on the price it receives in the transfer market, for instance if the transfer price is equal to the replenishment rate ($P^R$) then the agency acquires a share of the benefits in the cross-hatched region of the figure in proportion to its share of Basin safe yield. The remaining benefit of each unit of water provided as the share of safe yield to this agency is acquired by the water purchaser in the transfer market.

In sum, agencies that initially meet their urban water demand with a relatively large share of imported water for direct use receive the largest share of the market benefit from a policy that increases Basin safe yield. These agencies receive the full market value ($P^I - P^B$) for each unit of water displaced through their allocated share of the increase in Basin safe yield. To the extent

that agencies with an initially large share of imported water purchases for direct use participate in the transfer market, these agencies also acquire the difference between the Tier 2 water price and the transfer price for each unit of water purchased from agencies that are under-represented on the extensive margin of supply. If the transfer price of water is taken to be equal to the replenishment rate ($P^R$), then the market benefit represented by the shaded region of Figure 3 is divided among agencies according to their relative share of production on the extensive margin of supply, while the market benefit represented by the cross-hatched region of Figure 3 is divided among agencies according to their relative share of Basin safe yield.[5] Policies that expand Basin safe yield lead to redistributive effects on the net benefits received by individual agencies whenever the allocation of costs in the cooperative arrangement differ from this distribution of benefits provided in the market.

The above framework for calculating the distribution of net benefits from various program elements is applied to the Chino Basin as follows. First, the water yield in the Basin is calibrated to the relevant quantity supplied by the appropriative pool by netting out production by the overlying rights-holders from the Basin safe yield. This is essentially the distinction made in practice between "safe yield" and "safe operating yield" in the Basin. As it pertains to the calculation of net benefits to agencies with appropriative rights, policies that increase the Basin yield (as in Figure 3) now refer both to policies that directly increase Basin safe yield as well as to policies that redistribute the existing safe yield from overlying right-holders to members of the appropriative pool, for instance through net agricultural transfer.

Second, as defined by the framework above, net benefits are calculated for individual agencies according to calculations on the avoided cost of Tier 2 water purchases provided by program elements in the Peace I and Peace II agreements, respectively, relative to the baseline scenario.[6] Considering the change in cost from the introduction of new program elements suppresses the need to explicitly calculate components of cost that are common to the baseline, Peace I, and Peace II scenarios.

Third, the analysis abstracts from seasonal and annual cycles in water availability by considering expected values where possible. Seasonal cycles are smoothed in all scenarios by using annual data on demand and supply conditions facing agencies. Annual cycles are smoothed in all scenarios by treating each year as an average weather occurrence represented by the expectation that each 10-year future horizon in the model is comprised of 7 "wet" years, in which replenishment water is available to agencies in the Basin, and 3 "dry" years, in which replenishment water is not available.[7] Each year in the model thus has the interpretation of representing production decisions that are 30 percent dry and 70 percent wet. By smoothing annual production outcomes into an expected value framework, this implies that a replenishment

[5] This argument does not rely on the water transfer price being equal to the replenishment rate and applies to any water transfer pricing rule that divides the gains from exchange (defined here by the value $P^I - P^B$).

[6] An alternative scenario is also considered that denominates the avoided cost of imported water for direct use at the Tier 1 rate, which provides a bracketing condition on the range of outside options available to individual agencies for procuring reliable new sources of water at rates between the Tier 1 and Tier 2 MWD prices.

[7] The expected sequence of wet and dry years is based on the assumption that underlies program element 2 of the OBMP that "replenishment water is available 7 out of 10 years." (Implementation Plan: Optimal Basin Management Plan for the Chino Basin, p13: http://www.cbwm.org/docs/legaldocs/Implementation_Plan.pdf.)

water step exists in the supply function in each year of the study, but that the length of the step is treated as 70 percent of the recharge capacity in the Basin.

Fourth, the net benefit of policies that increase the safe operating yield of the appropriative pool is distributed among individual agencies, in part, through water exchanges between agencies in the transfer market. Water transfers are specified to exchange units of water between agencies that are not adequately represented on the extensive margin of supply to agencies which are more highly represented on this margin. Specifically, the water price in the transfer market is fixed at the prevailing MWD replenishment rate in each period to divide these rents from exchange.

Finally, the net benefit returned to each agency under Peace I and Peace II rules relative to the baseline scenario is computed by coupling the market distribution of benefits, as outlined by the framework here, with the distribution of cost implied by the rules encompassed by each agreement. These rules are defined in the following description of scenarios.

## 3. Common Components

Several components common to all scenarios frame the overall analysis.

### *3.1. Agencies Considered*

Because of the detailed calculations required to divide the net benefit created by each scenario among individual agencies in the study, the study encompasses only the ten largest water-holding agencies in the Basin (the cities of Chino, Chino Hills, Ontario, Pomona, and Upland, Fontana Union Water Company, Monte Vista Water District, Cucamonga Valley Water District, Jurupa Community Services District, and San Antonio Water Company). These ten agencies account for 91.2 percent of the Basin-wide safe operating yield.

### *3.2. Smoothing Across Hydrologic Years*

Because production is smoothed across years, the patterns of local storage and local supplemental storage are also smoothed for each agency. This abstracts from the actual series of puts and takes that rely on temporal adjustments in water storage by accounting for the expected local storage need of individual agencies. (Recall that each year is a representative hydrologic year characterized by expected conditions that are 70 percent wet and 30 percent dry.) A single local storage account is constructed for each agency that combines local storage with local supplemental storage in all scenarios, and the local storage balance of each agency is adjusted each year to reflect the fact that replenishment water is available to meet replenishment obligations only 70 percent of the time.

For this reason, the annual amount held in storage for each agency is 3/7 ($3/7 = 10/7 - 1$) of the annual excess demand for water that cannot be met by the agency through the allocation of contemporaneous supply. The expected arrival time of a dry year in which replenishment water is not available is given by the mean of a Poisson process ($\mu = 10/3$), and the average holding time for a unit of water held in storage is half the expected arrival time of a dry year, which implies that the average annual amount of water held in local storage is 5/7 ($5/7 = 3/7*10/3*1/2$) of the annual excess demand for each agency that cannot be met through the allocation of contemporaneous water supply. In each year, the local storage account is reconciled with the storage balance in the previous year by adding the increment in local storage to the excess

demand for water for each agency. Local storage levels increase smoothly over time in the model for most agencies due to the projected increases in urban water demand.

### *3.3. Water Prices*

Annual water prices and the discount factor that converts annual values into present value are common across all scenarios. The market rates used in 2007 are the current water rates listed by MWD ($427/AF for Tier 2 water, $238/AF for replenishment water), and a $13 surcharge is added to the replenishment rate to reflect the $251/AF charge currently paid by each agency for replenishment water procured through Watermaster. The price of water transactions in the transfer market is taken in each period to be the price of replenishment water.[8] The MWD rate forecast through 2012 is taken as the mean of the high- and low-rate forecasts provided by MWD over this horizon. Recycled water rates through 2011 are taken from IEUA projections provided in the 2007 IEUA Long-Run Plan of Finance, with a 25 percent non-member surcharge included for recycled water deliveries outside the IEUA service area (Jurupa Community Services District and the City of Pomona). The price of desalter water for urban supply is taken to be the price cap specified in section 7.6d of the Peace Agreement, which is $375 in 2007. All water rates outside the range of published forecasts are assumed to increase at a rate of 4.5 percent per year. The discount factor is also taken to be 4.5 percent.

### *3.4. Demand*

Demand for Basin water for each agency is identical across all three scenarios. Agency-level demand for Basin water is calculated from data provided in the relevant 2005 Urban Water Management Plans (UWMP) by taking the projected demand (gross of conservation) compiled by each agency and converting this into a residual (Basin) demand component by netting out available supplies of surface water and other groundwater sources available to each agency.[9] In the case of Pomona, residual demand for Basin water is taken to be net of Puente and Spadra Basin recycled water, which implicitly assumes that this water would be available to Pomona irrespective of whether hydraulic control is attained in Chino Basin. Residual Basin water demand is linearized for each agency to recover values in the intervening years between the 5-year intervals reported in each UWMP. Residual demand for Fontana Union Water Co., which has rights but serves no subscribers, is zero in all scenarios, as is residual demand facing San Antonio Water Co., which has available surface water and other basin groundwater supply in excess of demand. The combined residual demand for the remaining agencies in the Basin is 215,996 AF in 2007 and increases over time with population growth projections to 337,246 AF in 2030. Among agencies with positive demand values, residual demand in 2007 ranges from a low of 12,753 AF for Monte Vista Water District to a high of 49,552 AF for the City of Ontario, and the residual water demand for the City of Ontario and Cucamonga Valley Water District over the entire horizon is about double the residual water demand of Pomona, 2-3 times greater than the City of Chino, City of Chino Hills, and Jurupa Community Services District, and 5-6

[8] The average water transaction price in the data provided in the Watermaster's 2006-2007 Assessment Packet is $177, which represents an approximate 30 percent discount below the current replenishment rate of $251. This observed price discount below the expected transfer price accords with the "wet year" transfer price that would arise in a representative hydrologic year that is 70 percent wet and 30 percent dry when the "dry year" transfer price is $422, a value bounded by the prevailing Tier 2 price of untreated water of $427.

[9] for IEUA members, these data are taken from the IEUA Urban Water Management Plan (2005), Table 2-7, and, for Jurupa Community Services District and the City of Pomona, these data are taken from the individual 2005 Urban Water Management Plans (2005) available on each agencies website.

times greater than the residual demand facing the City of Upland and Monte Vista Water District.

### *3.5. Desalter Production*

Desalter production is treated as equal across all scenarios. Implicitly, this views the level and location of desalter activity to be determined by the requirements outlined by the Judgment.[10] An alternative approach would be to construct a baseline scenario in which agencies provide their own salt removal infrastructure. One difference between this alternative approach and the present one is that, under baseline conditions with individual desalting O&M costs would be roughly the same, whereas the capital costs of building desalter facilities would be larger by the amount of funding that became available in the Basin through grants made possible by the Peace Agreement.

The projected desalter water for urban supply sets a schedule of delivery to three agencies considered in the study (City of Chino, City of Chino Hills, and Jurupa). The desalter water for urban supply rises from 15,230 AF to 38,088 AF over the period 2007-2030 among agencies in the study, with the remaining desalter supply being delivered to the City of Norco and the Santa Ana River Water Company. Each unit of desalter water supply, including deliveries to the City of Norco and the Santa Ana River Water Company, creates a replenishment obligation for producers in the Basin, and this obligation is divided among agencies according to the various rules encompassed by each of the three scenarios considered (as described below).

### *3.6. Watermaster Assessments*

Although the assessment fees levied by Watermaster differ across the scenarios according to the total cost of the program elements embodied in each scenario, the rules in which assessments are distributed across individual agencies are common to all scenarios. Specifically, appropriative pool assessments are based on each agency's calculated share of actual fiscal year production. Given that total production and the share of production by individual agencies encompasses only a subset of total Basin production (e.g., roughly 87 percent in 2007), this approach slightly over-estimates assessment costs in all scenarios by attributing 100 percent of the program cost to the ten agencies included in the study. Because the assessment costs used under the Peace I and Peace II scenarios include the baseline costs, as well as significant additional program costs, the over-allocation of assessment costs to individual agencies in the study provides a conservative estimate of the total benefit generated under Peace I and Peace II. The different components of the assessment costs were decomposed into program expenses from the 3-year assessment projections provided by Watermaster.[11] All cost components thereafter are assumed to increase at a rate of 4.5 percent.

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[10] Projected desalter production is taken from IEUA's UWMP (2005, Table 3-10 and Table 7-1), and includes the desalter production of Chino I, Chino I expansion, Chino II, and Desalter 3. The overall level of desalter activity, which grows to an ultimate production level of 43,000 AF by year 2025, an amount slightly below the 50,457 AF desalter production level anticipated by 2020 in the OBMP: (Implementation Plan: Optimal Basin Management Plan for the Chino Basin, Table 3, p59: http://www.cbwm.org/docs/legaldocs/Implementation_Plan.pdf.)

[11] Personal correspondence with Watermaster staff (August 7, 2007).

## 4. Baseline Scenario

### *4.1. Basin Supply*

In the baseline scenario, available Basin supply for each agency in each year is comprised of the agency's share of: (i) safe operating yield, (ii) projected desalter water for urban supply, and (iii) the net agricultural pool transfer. The safe operating yield is allocated to individual agencies based on the share of safe operating yield in the Basin defined by the Judgment.

The projected desalter water for urban supply is taken for the baseline case (as well as for the remaining scenarios) from projections available in the IEUA UWMP.[12] Desalter water for urban use is treated in the model both as a source of water supply in the Basin and as a replenishment obligation, where the replenishment obligation associated with each unit of desalter water supply is shared by agencies through the allocation of storage losses and replenishment assessments by Watermaster, which are calculated for the baseline case according to each agencies pro rata share of safe operating yield up to the available recharge capacity in the Basin and by in lieu recharge according to each agencies pro rata share of safe operating yield for any obligation above the available recharge capacity.

The net agricultural transfer to each agency in each year is calculated by taking a straight-line projection of land-use conversions between 2006 conditions reported in the 2006-2007 Watermaster Assessment Package, and assumed "full build-out conditions" in 2030 in which all acres in the agricultural pool eligible for conversion are converted.[13] For the baseline scenario, each converter is credited with 1.3 AF of Basin water for each acre converted, and the sum of water allocated to all land-use conversions and agricultural pool production in each year is deducted from the agricultural pool safe yield of 82,800 AF to get the net agricultural pool transfer to the appropriative pool in each year.[14] Among the ten largest members of the appropriative pool considered in the study, the net agricultural transfer increases from 46,265 AF to 71,377 AF over the 2007-2030 period, which accounts for approximately 92 percent of the total water transfer to the appropriative pool in each year.

Under baseline conditions, there is also an issue of timing of the agricultural pool transfer, with no early transfer of agricultural pool water being made to the appropriative pool prior to the Peace Agreement. Under the Judgment, the agricultural pool allocation was defined to be 414,000 AF in every 5 years. This implies a 4-year waiting period for the appropriative pool before any agricultural transfer takes place, followed by a large allocation of the cumulative agricultural pool under-production in year 5, and an annual stream of transfers thereafter based on a rolling horizon comprised of the previous 5 years agricultural pool under-production. In the

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[12] IEUA Urban Water Management Plan (2005), Tables 3-10 and 7-1.

[13] Watermaster, Fiscal Year 2006-2007 Final Assessment Package, Land Use Conversion Summary (p10): http://www.cbwm.org/docs/financdocs/Assessment%20Package%20FY%202006-2007%20Final.pdf. Values after the conversion of all agricultural land eligible for conversion are based on Watermaster calculations (personal communication with Watermaster staff, July 12, 2007).

[14] Under baseline conditions, 1.3 AF of water is allocated to the appropriative pool based on share of safe operating yield in the baseline scenario. This value is not parsed out from the net agricultural transfer that occurs each year, because all water transfers between the agricultural pool and the appropriative pool are based on shares of safe operating yield and an amount greater than 1.3 AF per acre is transferred from the agricultural pool to the appropriative pool in each year.

baseline scenario, the agricultural pool transfer is calculated on an annual basis and timing lags in the delivery of water are suppressed. Differences in the actual timing of the water have no implications for the baseline values in the study, because the rate of water price inflation is taken to be equal to the discount rate, so that delays in water delivery have no implications for the present value calculation.

The sum of these components in each year gives Basin supply for each agency. This represents the first step of the supply function depicted in Figure 1.[15] In total, Basin supply among the ten largest agencies considered in the study rises from 116,044 AF to 164,014 AF over the 2007-2030 period, with the increase in supply generated through land use conversions and increased desalter water for urban supply. (This latter source of water supply is matched by an associated increase in the desalter replenishment obligation, as discussed below.)

### *4.2. Import Demand*

Import demand for each agency in the Basin represents the amount of demand facing each agency that cannot be met with available Basin supplies (including supplies which can be purchased from other Basin agencies in the transfer market). Import demand for each agency, which must be met through some combination of replenishment water purchases and imported water purchases for direct use, is the sum of three components: (i) excess demand for water; (ii) storage account adjustments; and (iii) water transfers.

Excess demand for each agency in the Basin is calculated as residual demand less the available Basin supply. Excess demand for water is negative in each year for Fontana Union Water Co. and San Antonio Water Co., which implies that these agencies are water suppliers in the transfer market. In each year, approximately 70 percent of the excess demand for water in the Basin is derived from Cucamonga Valley Water District and the City of Ontario, which indicates a large water demand for Basin water among these agencies relative to their share of Basin supply.

In practice, the demand for water in dry years is met, in part, by smoothing the additional water supplies available in wet years across time through local storage. As discussed above, the model considers each year to be a representative year (30 percent dry and 70 percent wet), so that the annual amount of water held in local storage by each agency is 5/7 of the annual excess demand that cannot be met with contemporaneous supply. Local storage in the model, which represents the combined total held in local storage and local supplemental storage accounts in a representative year, increases over the period 2007-2030 from 83,706 AF to 141,565 AF among agencies in the study, where the growth in local storage over the period occurs in proportion to the 70 percent increase in excess demand for Basin water as population increases in the region.

Local storage accounts are not constructed for Fontana Union Water Co. and San Antonio Water Co., because these agencies have excess supply of water in each year above what is necessary to meet their urban water demands. In practice, these agencies may hold water in local storage to arbitrage expected differences in transfer prices between wet and dry years, but such arbitrage

[15] Because desalter water is not a unique source of supply, an accounting adjustment is made later to back out desalter water supplies from Basin supply by creating an off-setting replenishment obligation for each unit of desalter water used for urban supply.

opportunities are suppressed in the model, because variations in annual water availability are smoothed in the model to a basis of a representative hydrologic year.

In each year, a storage account adjustment is made for each agency by adding the incremental growth in local storage from the previous year's value to the excess demand for water. The amount of water held in local storage adjusts upward each year to meet the growth in excess demand, and this need for added storage to smooth increasing volumes of water between wet and dry years is deducted from contemporaneous water supply.

After storage account adjustments are made in each year, individual excess demand and individual excess supply conditions clear each year in the transfer market. Excess supply to be cleared in the transfer market in each year is comprised of sales by Fontana Union Water Co. and San Antonio Water Co., and, to a lesser extent, by Jurupa Community Services District beginning in 2021. Jurupa CSD becomes a net supplier of water in the transfer market due to the relatively large purchases of desalter water for urban supply in the data provided in IEUA's UWMP (2005). Water transfers are allocated from these suppliers to individual agencies with positive demand for transfer water in proportion to each agency's share of excess demand relative to total excess demand for water in the Basin. The total amount of water transacted in the Basin rises from 12,677 AF to 20,401 AF over the 2007-2030 period, and the largest buyers of transfer water in each period are Cucamonga Valley Water District and the City of Ontario.

### *4.3. Water Imports*

Water is imported into the Basin to meet the sum of import demand for direct use and desalter replenishment requirements. Imported water is taken as replenishment water in each period up to the limit on recharge capacity in the Basin (i.e., the second step of the water supply relationship in Figure 1), and the residual quantity of imported water that cannot be met with replenishment water is taken as Tier 2 water imports. Under baseline conditions, the recharge capacity of the Basin is taken to be 29,000 AF per year, which represents the available spreading facilities discussed as pre-existing facilities in program element 2 of the OBMP.[16] Given the smoothing of production into the basis of representative hydrologic years, this implies that baseline conditions in the Basin can accommodate 20,300 AF of recharge per year (0.7*29,000 AF). This recharge capacity defines the limit to which imported water in the Basin can be taken at the lower MWD replenishment rate.[17]

Imported replenishment water in the Basin must first be taken to meet the replenishment obligation of the desalters. The desalter replenishment obligation under baseline conditions is desalter production for urban supply less a 2 percent storage loss component deducted from individual local storage accounts.[18] Under baseline conditions, the desalter replenishment obligation (net of the storage loss allocation) begins at 13,556 AF in 2007 and grows to 40,169 AF per year in 2030. In the year 2010, the desalter replenishment obligation rises to 22,604 AF,

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[16] Implementation Plan: Optimal Basin Management Plan for the Chino Basin, p13: http://www.cbwm.org/docs/legaldocs/Implementation_Plan.pdf.

[17] The increase in Basin recharge capacity, as described in the Recharge Master Plan (WEI, Black and Veatch 2001: http://www.cbwm.org/docs/rechdocs/rechmastplanphase2rep/chapters/pdf/) is a major program element considered in the Peace Agreement, both in terms of benefit and cost.

[18] Personal correspondence with Watermaster staff.

an amount in excess of the 20,300 AF recharge capacity of the Basin in the baseline scenario, and the replenishment obligation remains above the recharge capacity for the remainder of the time horizon. Over the period 2007-2009, the amount of recharge capacity in excess of the desalter replenishment requirement (e.g., 20,300 – 13,556 = 6,744 AF in 2007) is allocated to individual agencies in proportion to each agency's share of imported water demand relative to total imported water demand in the Basin. Over the period 2010-2030, the desalter replenishment obligation exceeds the recharge capacity of the Basin, and the remaining desalter replenishment obligation above 20,300 AF is met through in lieu production by individual agencies in the Basin. In the baseline scenario, the desalter replenishment obligation, both the portion met with replenishment water purchases and the portion taken as in lieu production, is met by individual agencies according to each agency's pro rata share of safe operating yield.[19]

Aggregate supply and demand are cleared each year on the third step of supply by reconciling effective Basin water supply (Basin supply plus Basin recharge) with import demand through purchases of Tier 2 water from MWD. Tier 2 MWD water purchases are allocated to individual agencies based on the share of each agency's imported water demand relative to total imported water demand in the Basin. Under baseline conditions, the total purchases of Tier 2 water among agencies in the Basin rises from 97,766 AF in 2007 to 200,097 AF in 2030, with the combined purchase share of Cucamonga Valley Water District and the City of Ontario—the two largest purchasers of imported water—representing between 62 percent and 73 percent of total Tier 2 water purchases in each year.

### *4.4. Water Procurement Costs*

The total cost of water procurement to individual agencies is the sum of five components: (i) Tier 2 water purchases; (ii) transfer water purchases; (iii) desalter water purchases for urban supply; (iv) desalter replenishment costs; and (v) Watermaster general assessments on the appropriative pool. Water procurement costs associated with Basin production also exist, but these costs exist in all scenarios and consequently net out of the comparison of the various program net benefits.

For the purpose of allocating Watermaster assessments, Tier 2 water purchases are assumed to occur outside the framework of the cooperative organization. That is, the actual production level of each agency, as recorded by the Watermaster each fiscal year for the basis of assessments, does not include any production demands that an individual agency meets through Tier 2 purchases acquired from MWD. For this reason, a separate accounting calculation is made for actual production to recover the allocation of Watermaster assessment costs to individual agencies in each period. Actual production for each agency is residual demand for Basin water less Tier 2 water purchases less storage losses and adjustments to the storage account balance.

Watermaster replenishment assessments are levied to recover desalter replenishment costs (for units up to the 20,300 AF recharge capacity of the Basin) through replenishment water purchased from MWD each year. These costs are allocated to individual agencies according to each agencies pro rata share of safe operating yield.

Watermaster general assessments are levied under baseline conditions to cover the cost of administrative costs, exclusive of the OBMP costs and the special project costs that pertain to

[19] Personal correspondence with Watermaster staff (August 29, 2007).

Peace I and Peace II. In 2007, these costs account for $816 thousand of the projected $7.87 million costs to be levied for general assessments under prevailing Peace conditions. Under baseline conditions, moreover, only the appropriative pool share of general assessment costs is paid by the appropriative pool, which amounts to $624 thousand of the $816 thousand administrative costs in 2007, with the remaining share of costs paid by the overlying agricultural and non-agricultural pools. The costs attributed to the appropriative pool are allocated across to individual agencies according to each agency's share of actual production relative to total Basin production.

### *4.5. Summary of Baseline Outcomes*

Table 1 provides a breakdown of the projected outcome for the eight largest producers under baseline conditions in the year 2015. Total urban water demand for these producers is 293,214 AF in 2015. Total residual demand, which is the difference between urban water demand and the Basin supply available to each agency, is 273,430 AF. Available Basin water supply, the sum of the shares of safe operating yield, net agricultural transfer (inclusive of land-use conversions), and desalter water for urban supply, is 123,554 AF in the year 2015. The total water transfers of 13,089 AF reflect sales by Fontana Union Water Company and San Antonio Water Company to the remaining producers encompassed by the study. The net storage acquisition of 1,022 AF reflects the change in the local storage balance between the year 2014 (106,032 AF) and the year 2015 (107,054 AF). This increment in the water held in local storage, which must be met by in lieu production by agencies, adds to residual demand for water in the Basin, and the difference between this term and the sum of available Basin water supply and water purchases in the transfer market results in a combined import demand among producers of 137,809 AF.

Total desalter production in the year 2015 is 34,122 AF, which exceeds the available recharge capacity of the Basin, so that imported water demand is met entirely with Tier 2 water purchases.[20] Actual production among these eight agencies (123,250 AF) is the difference between residual demand for Basin water, Tier 2 purchases from MWD, in lieu recharge taken to meet the desalter replenishment obligation, storage losses (2% of local storage = 2,141 AF), and the net storage acquisition. Watermaster administrative assessments are in 2015 are $1.2 million, of which $957 thousand is paid by agencies in the appropriative pool.

[20] An additional 3,905 AF of desalter water production is projected for the Santa Ana River Water Company and City of Norco, who are not considered in this study.

**Table 1: Year 2015 Outcome Under the Baseline Scenario**

| | Appropriator | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Chino | Chino Hills | Ontario | Upland | Cucamonga | Monte Vista | Jurupa | Pomona | **Total** |
| Urban Water Demand | 26,200 | 24,700 | 66,600 | 22,500 | 72,500 | 14,100 | 36,350 | 30,264 | **293,214** |
| Available Surface Water | 0 | 0 | 0 | 5,200 | 3,000 | 0 | 500 | 0 | **8,700** |
| Available Other Groundwater | 0 | 0 | 0 | 3,800 | 5,400 | 0 | 0 | 1,884 | **11,084** |
| *Residual Demand* | *26,200* | *24,700* | *66,600* | *13,500* | *64,100* | *14,100* | *35,850* | *28,380* | **273,430** |
| Safe Operating Yield | 4,034 | 2,111 | 11,374 | 2,852 | 3,619 | 4,824 | 2,061 | 11,216 | **42,092** |
| Net Ag Transfer | 8,916 | 2,398 | 8,660 | 1,875 | 2,980 | 3,228 | 12,840 | 7,371 | **48,268** |
| Desalter Water Supply | 5,000 | 4,200 | 5,000 | 0 | 0 | 0 | 19,922 | 0 | **34,122** |
| *Available Supply* | *17,950* | *8,709* | *25,033* | *4,727* | *6,600* | *8,052* | *33,896* | *18,587* | **123,554** |
| Net Storage | 487 | 280 | 717 | -122 | 1,039 | 108 | -1,653 | 166 | **1,022** |
| Transfers | 758 | 1,411 | 3,668 | 750 | 5,078 | 534 | 26 | 864 | **13,089** |
| *Import Demand* | *7,979* | *14,860* | *38,616* | *7,901* | *53,461* | *5,622* | *275* | *9,095* | **137,809** |
| Local Storage | 5,893 | 11,422 | 29,690 | 6,266 | 41,072 | 4,320 | 1,396 | 6,995 | **107,054** |
| Tier 2 Purchases | 7,979 | 14,860 | 38,616 | 7,901 | 53,461 | 5,622 | 275 | 9,095 | **137,809** |
| Actual Production | 17,512 | 9,328 | 25,067 | 4,589 | 9,889 | 7,210 | 33,343 | 16,312 | **123,250** |
| Watermaster Assessments | $97 | $52 | $139 | $26 | $55 | $40 | $185 | $91 | **$685** |

Notes:

1. All figures in acre-feet except Watermaster assessments.
2. Watermaster assessments are expressed in real terms (1,000s of 2007$.)

## 5. Peace I Scenario

The Peace Agreement introduced various program elements in the Basin that were not present under baseline conditions. The main components of the Peace Agreement considered here that altered net benefits in the Basin are: (i) an increase in Basin recharge capacity from 29,000 AF to 134,000 AF; (ii) a change in the rules for land use conversion; (iii) transfer of agricultural pool assessments to the appropriative pool; (iv) the introduction of a storage and recovery program; (v) an increase in stormwater recovery from 5,000 AF per year to 12,000 AF per year; and (v) the Pomona credit. This section describes the changes that occurred through these program elements to alter net benefits received by individual agencies in relation to the earlier discussion of the baseline outcome detailed above.

### *5.1. Basin Supply*

Under the set of Basin programs encompassed by the Peace Agreement, three factors led to changes in available Basin supply: (i) increased stormwater capture; (ii) a change in the water allocation resulting from land use conversions (including "early transfer"); and (iii) the introduction of the Dry Year Yield program for storage and recovery through MWD. The increased stormwater capture is represented by an annual increase in Basin supply by 12,000 AF of "new yield" in exchange for tying up 12,000 AF of recharge capacity.

The net agricultural transfer to each agency under Peace conditions increased the return to each converter from 1.3 AF of Basin water for each acre converted to 2.0 AF of Basin water for each acre converted. An early transfer program of 32,800 AF per year to the appropriative pool was also introduced, which ultimately led to an over-allocation of agricultural pool water to the appropriative pool.[21] The net agricultural pool allocation to individual agencies replicates the Watermaster calculation in each year, given the projected pattern of land use conversion calculated through 2030. The agricultural pool transfer provides a credit of 2.0 AF per acre for all land-use conversions taking place after the signing of the Peace Agreement and credits earlier conversions at the 1.3 AF per acre rate and the early transfer to members of the appropriative pool is based on each agency's share of safe operating yield. Because the sum of these two components and the projected agricultural pool production level after land-use conversions have been made exceeds the 82,800 AF of available agricultural pool water in every year, each agency is charged a replenishment obligation for the amount of over-allocated agricultural pool water in proportion to each agency's share of safe operating yield. This is equivalent to deducting the over-allocation of agricultural pool water from the 32,800 AF early transfer after land use conversions take place and dividing this residual amount of water (e.g., 32,800 – 4,270 = 28,530 AF in Fiscal Year 2006-2007) pro rata among members of the appropriative pool.

In total, the net agricultural pool transfer to the appropriative pool is the same under baseline and Peace rules (49,831 AF in 2007 and 76,909 AF in 2030). Among appropriators considered in the

[21] Watermaster, Fiscal Year 2006-2007 Final Assessment Package, Land Use Conversion Summary (p10): http://www.cbwm.org/docs/financdocs/Assessment%20Package%20FY%202006-2007%20Final.pdf. In the Fiscal Year 2006-2007 Final Assessment Package provided by the Watermaster, the amount of over-allocation was 4,270 AF (3,893 AF of which is incurred as a replenishment obligation to agencies encompassed by the study), and the model projects this total to increase through the process of future land use conversions to 5,127 AF in 2030 (4,674 AF of which is incurred as a replenishment obligation to agencies encompassed by the study).

study, which encompass 91.2 percent of safe operating yield but 100 percent of land use conversions, the change in land-use conversion rules under the Peace Agreement provides a slightly larger net agricultural transfer among agencies considered than under baseline conditions (e.g., 71,673 AF after all conversions take place compared to 71,377 AF under baseline rules). The outcome for individual agencies under the Peace rules for net agricultural pool transfer relative to the baseline scenario is discussed later.

The DYY storage and recovery program alters the allocation of Basin water supply by allowing individual agencies to purchase water from MWD in wet years and store it for use in subsequent dry years. The effective rate paid to MWD for DYY water inputs, net of subsidies paid to the participating agencies, is approximately equal to the current replenishment rate,[22] and the annual MWD replenishment rate is used in each period to price DYY water inputs to individual producers. The present analysis considers the value of the currently-approved 150,000 AF storage and recovery program.[23] Although further expansion beyond this level has been discussed, the study does not consider the potential expansion of this program to 500,000 AF nor the possibility for sales of this water to take place outside the Basin. The increase in the DYY program from 100,000 AF to 150,000 AF is assumed to take place immediately in the year 2007. To adjust the implied pattern of puts and takes of a 150,000 AF storage and recovery program to the smooth production horizon of a representative hydrologic year, we assume that water production in the DYY program is limited to 50,000 AF in each dry year. Given a 0.3 probability of a dry year, this implies an average of 15,000 AF of water is made available in the Basin each year through the DYY program. The distribution of the DYY program storage across individual agencies is given by the table of DYY shift obligations provided by IEUA for the current DYY-100 program, and these values are scaled upwards proportionately to 150,000 AF.[24] It is assumed that there is no storage loss for units of water placed in storage.[25] In effect, this implies that participating agencies in the DYY program purchase 15,000 AF of water in a representative hydrologic year at MWD replenishment rates and covert this amount into 15,000 AF of reliable Basin supply through the use of existing recharge facilities.

Among the ten largest agencies considered in the study, Basin supply under Peace conditions rises from 137,416 AF in 2007 to 185,692 AF in 2030. This reflects an approximate increase of 26,000 AF per year relative to baseline conditions (under baseline conditions, Basin supply is 111,486 AF in 2007 and 159,496 AF in 2030), and the source of the additional Basin supply under the Peace Agreement amounts to the roughly 11,000 AF increased stormwater yield (the share of the 12,000 AF "new yield" acquired by the ten largest agencies) plus the 15,000 AF recovery of DYY storage water.

### *5.2. Import Demand*

Import demand for each agency in the Basin is calculated in the same manner as the baseline case. As noted above, this involves deducting Basin supply from the Basin water demand facing each agency to get excess demand, correcting excess demand to account for the dynamic adjustments that occur in local storage accounts, and then reconciling excess supply and excess

[22] Personal communication with IEUA staff.
[23] Personal communication with Watermaster staff.
[24] IEUA Urban Water Management Plan (2005), Table 6-5.
[25] Personal correspondence with Watermaster staff.

demand among individual agencies in the Basin through water transactions in the transfer market.

Two major changes occur under Peace in the resulting evaluation of import demand. First, import demand is now lower each year than under baseline conditions by the approximate 26,000 AF of additional Basin supply that is available each year. This ultimately defrays Tier 2 water purchases as the supply-side of the model is built upwards to the third step of supply. Second, the amount of water held in the local storage account of individual agencies decreases, for instance by 17,769 AF in 2007 (83,706 AF in the baseline versus 65,937 AF under Peace.) Much of this difference in local storage balances is the result of participation in the DYY program crowding-out storage activities that would otherwise take place in local storage accounts.

### *5.3. Water Imports*

As in the baseline case, annual water imports must flow into the Basin to meet the sum of import demand and replenishment requirements, where the Basin replenishment requirements now include 12,000 AF of stormwater recharge and 15,000 AF of replenishment water purchases for the DYY program in addition to the desalter replenishment obligation. Imported replenishment water represents the second step of the water supply relationship in Figure 2, and this step is elongated under Peace by the increase in Basin recharge capacity to 134,000 AF. Given the smoothing of production, this implies that Basin recharge capacity is 93,800 AF per year (0.7*134,000 AF) in a representative hydrologic year. Of this amount, 27,000 AF per year of recharge capacity is now used to accommodate the combined requirements of stormwater recharge and DYY program recharge, and a substantial share of the remaining recharge capacity is used to fulfill the replenishment obligation of the desalters. The desalter replenishment obligation in each year is defined in the same manner as in the baseline scenario to be desalter production less storage losses of 2 percent deducted from the local storage accounts of producers in the Basin.[26]

Under Peace conditions the need for imported Tier 2 water is smaller than under the baseline. Three main effects drive this change: (i) the recharge capacity of the Basin can now accommodate the entire desalter replenishment obligation each year without requiring agencies to engage in in-lieu recharge; (ii) the amount of annual Basin over-production that can be sustained in the Basin is larger by the amount of the increase in recharge capacity; and (iii) the reduction in local storage reduces the allocation of Basin storage losses to the desalter. The first two components produce direct value to agencies on the extensive margin of supply by defraying Tier 2 purchases (as depicted in Figure 2). The third component, the change in the designation of storage losses against the replenishment obligation of the desalters, creates no economic benefit to the Basin and is purely redistributional in its effects, because the change in the designation of storage losses does not alter the physical recharge capacity of the Basin. An individual agency that incurs a one-unit storage loss gives up a unit of water from local storage, and the value of this unit of water is distributed back to other agencies in the form of a credit against the desalter replenishment obligation.

[26] Peace Agreement, Article 5.2b(xii).

Under Peace conditions, the amount of replenishment water that is purchased from MWD in each representative hydrologic year is 81,800 AF (93,800 AF of recharge capacity less the 12,000 AF stormwater recharge). This 81,800 AF of replenishment water, which is purchased at MWD replenishment rates, is allocated first to meet the 15,000 AF per year replenishment water requirement for DYY participants and to meet the replenishment obligation of the desalter, with the remaining recharge capacity in each year allocated among individual agencies according to each agency's imported water demand relative to total imported water demand in the Basin.

As in the baseline scenario, imported water demand in excess of the recharge capacity of the Basin is cleared each year in the Peace I scenario on the third step of supply through purchases of Tier 2 water from MWD. Tier 2 MWD water purchases, as in the baseline case, are allocated to individual agencies based on the share of each agency's imported water demand relative to total imported water demand in the Basin.

Under peace conditions, the total purchases of Tier 2 water among agencies in the Basin rise from 25,692 AF in 2007 to 127,710 AF in 2030, a decline of approximately 72,000 AF per year relative to the baseline scenario. This decline in Tier 2 water purchases is approximately equal to the increase in recharge capacity under the Peace Agreement and represents a replacement of Tier 2 water purchases with replenishment water purchases at the lower MWD rate in each year. Cucamonga Valley Water District and the City of Ontario, the two largest buyers of imported water in both the baseline and Peace I, receive the largest share of the net benefit of this offset in Tier 2 water, because of their disproportionate representation on the extensive margin of supply.

### *5.4. Water Procurement Costs*

The total cost of water procurement to individual agencies is the sum of eight components: (i) Tier 2 water purchases; (ii) transfer water purchases; (iii) desalter water purchases for urban supply; (iv) replenishment water purchases; (v) desalter replenishment costs; (vi) Watermaster general assessments on the appropriative pool; (vii) Watermaster general assessments on the agricultural pool paid by the appropriative pool; and (viii) the Pomona credit. The first three components of water procurement cost are calculated in the same manner as in the baseline case, with the exception that the total quantities of Tier 2 purchases and transactions in the transfer market differ.[27]

Desalter replenishment costs are recovered through Watermaster replenishment assessments in an amount equal to the cost of replenishment water purchased from MWD to meet the replenishment obligation of the desalters each year. As in the baseline case, these costs are allocated to individual agencies according to each agencies pro rata share of safe operating yield.[28]

Replenishment water purchases allocated to individual agencies related to the DYY program are levied back on individual agencies in proportion to their storage claims in the program, as detailed above. Any remaining recharge capacity in excess of the amount needed to fulfill DYY

[27] Changes in the pattern of Tier 2 water purchases and water transfers that occur across scenarios and over time within each scenario can have equilibrium effects on market prices; however, price changes in these markets are not considered in the scope of the present study.

[28] Personal correspondence with Watermaster staff (August 29, 2007).

contributions and the replenishment obligation of the desalters and DYY is allocated in each year to individual agencies according to each agency's imported water demand relative to total imported water demand in the Basin.

The total costs recovered through Watermaster general assessments for the program elements in the Peace I scenario include OBMP assessments, special project assessments, and recharge debt payments. The additional OBMP and special project assessments in the Peace I scenario amount to a total $7.05 million out of the $7.87 million (90 percent) in total Watermaster expenses in 2007, and these additional costs of implementing the program elements in the Peace I scenario rise to $13.8 million in 2030. As in the baseline scenario, the allocation of all appropriative pool general assessments to individual agencies is made based on each agency's share of safe operating yield in the Basin.

The Peace Agreement negotiated the transfer of all general assessment fees from the agricultural pool to the appropriative pool. The total assessment fees paid by the agricultural pool, which are now assumed by members of the appropriative pool, amount to $1.1 million in 2007 and decline to $460 thousand in 2030 due to land use conversions that result in a decline in agricultural water use as a share of total Basin safe yield. In total, the general assessments paid by the appropriative pool inclusive of the transfer of agricultural pool assessments increase ten-fold from $624 thousand in the baseline scenario to $6.3 million under Peace conditions in 2007 and the assessment costs in the Peace I scenario remain at least 7 times as large as the costs attributable to baseline conditions in the Basin throughout the production horizon. The agricultural pool share of Watermaster assessment fees is paid by individual agencies in the appropriative pool according to the agency's share of the net agricultural transfer in each year.[29]

Finally, the Pomona credit of $66,667 per year is paid every year by each agency in proportion to the agency's share of safe operating yield.

### *5.5. Comparison of Baseline and Peace Agreement Outcomes*

Under the terms of the Peace Agreement, the present value of the net benefit of the program elements for the ten agencies encompassed by the study is $182 million. The main component associated with this increased net benefit is the displacement of Tier 2 water with new Basin yield and replenishment water. Under baseline conditions, the present value of total Tier 2 water purchases over the 2007-2030 period is $1.53 billion, whereas, under Peace conditions, the present value of Tier 2 water purchase over the period decreases to $931 million. This decrease in Tier 2 water under Peace conditions was replaced with replenishment water at the lower MWD rate, and the combined cost of imported water in the Peace I scenario decreased by $310 million in present value terms (from $2.06 billion under baseline conditions to $1.75 billion under Peace conditions). This benefit was acquired at the expense of an increase in the present value of assessment costs from $16.7 million to $146 million.

[29] For details on this calculation and the distribution of general appropriative pool assessments based on pro rata share of safe operating yield, see Watermaster, Fiscal Year 2006-2007 Final Assessment Package, Pool 3 Assessments Summary (p5): http://www.cbwm.org/docs/financdocs/Assessment%20Package%20FY%202006-2007%20Final.pdf.

Table 2 provides a breakdown of the projected outcomes under Peace conditions in the year 2015 for the eight largest producers in the study. A comparison of these outcomes with those that emerge under baseline conditions in Table 1 provides a useful profile of the essential differences in Basin performance under each scenario. Residual demand for Basin water is identical in each scenario. This quantity corresponds to the value Q* in Figure 1. The safe operating yield of the agencies considered is the same in both cases, as is desalter water for urban supply. The net agricultural pool allocation to the appropriative pool is slightly higher under Peace (48,848 AF relative to 48,268 AF under baseline rules). This is because the agencies considered in the study represent 91 percent of Basin production and nearly 100 percent of the land use conversions, which are credited with a larger water allocation under Peace. Available Basin supply in the Peace I scenario is accordingly higher by the sum of this component and the 15,000 AF of supply available to agencies through the DYY program, which leads to a commensurate reduction in imported water demand.

The level of local storage is lower under Peace by approximately the 15,000 AF of storage that is now accounted for in the DYY program. Replenishment purchases are now possible due to the increase in Basin recharge capacity, and the agencies combine to purchase 31,533 AF of replenishment water in the year 2015.

In total, Tier 2 water use falls from 137,809 AF under baseline conditions (inclusive of the purchases required by in lieu recharge) to 82,658 AF under Peace conditions. This decrease in Tier 2 water imports reflects the displacement of Tier 2 water purchases through a combination of new Basin yield and increased replenishment water purchases made possible by the expansion of Basin recharge capacity.

Actual production among these eight agencies is higher in the Peace I scenario by 36,953 AF in the year 2015 (160,203 AF vs. 123,250 AF in the baseline scenario). This increment in Basin production represents the effective increase in Basin recharge capacity available to these producers after accounting for the combined 27,000 AF of recharge capacity utilized by stormwater and DYY program recharge.

**Table 2: Year 2015 Outcome Under Peace I Scenario**

| | Appropriator | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Chino | Chino Hills | Ontario | Upland | Cucamonga | Monte Vista | Jurupa | Pomona | **Total** |
| Urban Water Demand | 26,200 | 24,700 | 66,600 | 22,500 | 72,500 | 14,100 | 36,350 | 30,264 | **293,214** |
| Available Surface Water | 0 | 0 | 0 | 5,200 | 3,000 | 0 | 500 | 0 | **8,700** |
| Available Other Groundwater | 0 | 0 | 0 | 3,800 | 5,400 | 0 | 0 | 1,884 | **11,084** |
| *Residual Demand* | *26,200* | *24,700* | *66,600* | *13,500* | *64,100* | *14,100* | *35,850* | *28,380* | **273,430** |
| Safe Operating Yield | 4,034 | 2,111 | 11,374 | 2,852 | 3,619 | 4,824 | 2,061 | 11,216 | **42,092** |
| New Yield | 883 | 462 | 2,489 | 624 | 792 | 2,455 | 451 | 2,489 | **10,645** |
| Net Ag Transfer | 10,558 | 2,173 | 7,210 | 1,467 | 2,460 | 2,553 | 16,658 | 5,769 | **48,848** |
| Desalter Water Supply | 5,000 | 4,200 | 5,000 | 0 | 0 | 0 | 19,922 | 0 | **34,122** |
| Storage & Recovery | 527 | 658 | 3,671 | 1,364 | 5,160 | 1,801 | 909 | 909 | **15,000** |
| *Available Supply* | *21,001* | *9,604* | *29,744* | *6,308* | *12,032* | *10,234* | *39,074* | *20,349* | **148,346** |
| Net Storage | 428 | 288 | 771 | -107 | 1,058 | 133 | 0 | 225 | **2,797** |
| Transfers | 726 | 1,985 | 4,854 | 914 | 6,854 | 516 | -3,224 | 1,065 | **13,690** |
| *Import Demand* | *4,901* | *13,399* | *32,773* | *6,171* | *46,272* | *3,483* | *0* | *7,192* | **114,191** |
| Local Storage | 3,713 | 10,783 | 26,326 | 5,137 | 37,191 | 2,761 | 0 | 5,737 | **91,649** |
| Replenishment Purchases | 1,353 | 3,700 | 9,050 | 1,704 | 12,778 | 962 | 0 | 1,986 | **31,533** |
| Tier 2 Purchases | 3,548 | 9,699 | 23,723 | 4,467 | 33,494 | 2,521 | 0 | 5,206 | **82,658** |
| Actual Production | 21,653 | 11,373 | 34,071 | 7,119 | 18,142 | 10,695 | 35,850 | 21,299 | **160,203** |
| Watermaster Assessments | $849 | $401 | $1,258 | $267 | $629 | $411 | $1,353 | $795 | **$5,963** |

Figure 1 compares the benefit received by each agency from reduced water procurement costs to the increase in assessment cost that result from the implementation of the program elements in the Peace I scenario. The assessment costs associated with implementing the program elements considered in the Peace I scenario are represented by an overall increase from $16.7 million to $146 million in present value terms. The program benefits in present value terms in the Peace II scenario are reflected in the decrease in water procurement costs from $2.1 billion under baseline conditions to $1.8 billion in the Peace I scenario.

In terms of the total benefit, two agencies, City of Ontario and Cucamonga Valley Water District, receive the largest share of the benefits resulting from the Peace I program elements, while the assessment costs are distributed more equally among producers. In total, the City of Ontario and Cucamonga Valley Water District together receive 46 percent of the benefit of decreased water procurement costs and incur 32 percent of the increase in assessment costs. An important reason these agencies receive a large share of the net benefit from the agreements is due to a scale effect in the annual level of residual demand for Basin water, for instance in 2015 these two agencies combined account for 48 percent of residual demand for Basin water (130,700 AF out of 273,430 AF).

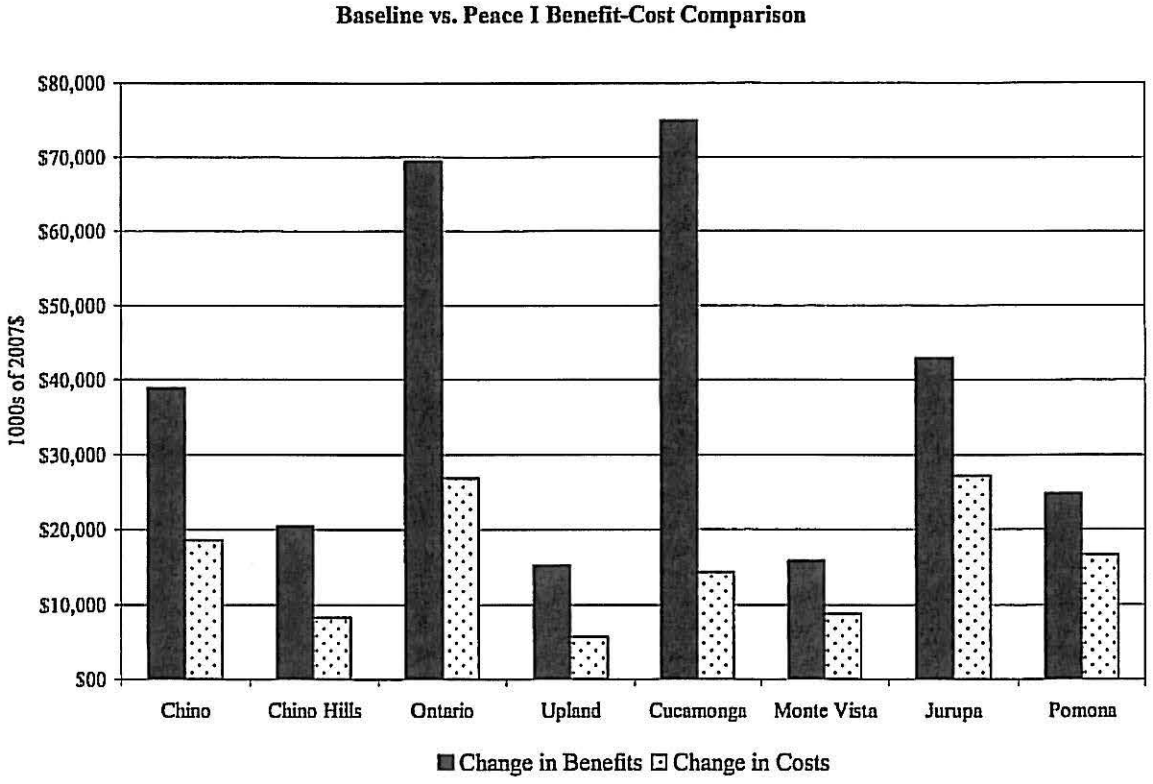



**Figure 1**

**Distribution of Net Benefit, Peace I vs. Baseline ($/per AF)**

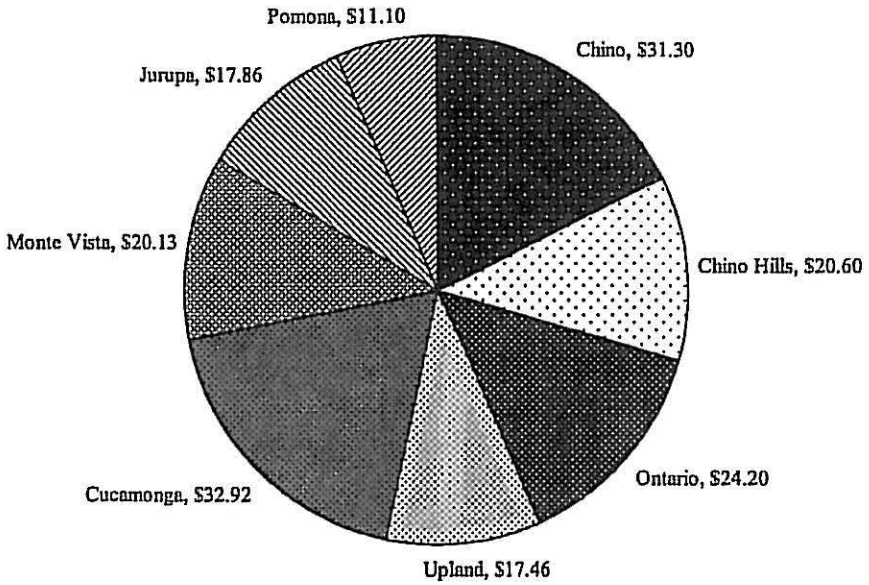



**Figure 2**

Figure 2 shows the distribution of net benefits per acre-foot of residual water demand across individual agencies in the Basin resulting from the program elements in the Peace I scenario. Fontana Union Water Company and San Antonio Water Company are not included in these calculations, because the available surface water and other groundwater supplies for these agencies exceed their total demand. Controlling for agency scale on the basis of residual demand for Basin water among the remaining producers, the net benefit resulting from the combined program elements in the Peace II Agreement is grouped between $11.10/AF for the City of Pomona to $32.92/AF for Cucamonga Valley Water District. Overall, the present value of the net benefit to all parties over the 24 year horizon resulting from a move from baseline conditions to Peace conditions is $182 million and the total residual demand for water over this period is 6.9 million AF, which implies an average return of $19.84 per acre-foot to the agencies encompassed by the study.

## 6. Peace II Scenario

The Peace II scenario introduces several major program elements in the Basin that build on the existing conditions under Peace. The main components of the Peace II scenario that alter market values in the Basin relative to the Peace I scenario are: (i) hydraulic control, which provides 400,000 AF of cumulative forgiveness and SAR inflow of 9,900 AF per year in the Basin; (ii)

the production of recycled water; (iii) a change in the allocation of the replenishment obligation associated with over-production in the agricultural pool transfer; (iv) a transfer of overlying non-agricultural pool water to the appropriative pool; and (v) a transfer of the Pomona credit from Basin agency to Three Valleys. This section describes the changes that occurred through these program elements to alter net benefits received by individual agencies in relation to the earlier discussion of the existing program elements in Peace Agreement.

### *6.1. Basin Supply*

Under the set of programs encompassed by the Peace II Agreement, five factors led to changes in available Basin supply relative to prevailing conditions under Peace: (i) a change in the water allocation resulting from land use conversions; (ii) the influx of recycled water (for direct use and groundwater recharge), (iii) the transfer of 49,178 AF of overlying non-agricultural water to the appropriative pool; (iv) 9,900 AF per year of inflow from the Santa Ana River (SAR), eventually rising to 12,500 AF per year; and (v) 400,000 AF of cumulative forgiveness for Basin over-production. Unlike the program elements implemented in the Peace I scenario, all elements of the Peace II scenario (with the exception of the transfer of the Pomona credit to Three Valleys) fundamentally alter supply conditions on the lowest step of the supply relationship by contributing new sources of Basin yield.

The net agricultural transfer to each agency in the Peace II scenario maintains the return to each converter of 2.0 AF of Basin water for each acre converted and the early transfer of 32,800 AF per year to the appropriative pool, but alters the allocation rule for the replenishment obligation for the amount of over-allocated agricultural pool water. Under Peace II rules, the replenishment obligation for over-allocated agricultural pool water is made on the basis of a weighted average of the share of safe operating yield and share of cumulative land-use conversions for each agency (the "proportion of water available for reallocation (PAR)") rather than in proportion to each agency's share of safe operating yield in the Peace I scenario. By placing greater weight on land use conversions, a greater share of the replenishment obligation for over-allocated agricultural pool water is placed on land-use converters. For instance, the combined share of safe operating yield of the two largest land-use converters in the Basin—City of Chino and Jurupa Community Services District—is approximately 10 percent, whereas the combined PAR share of these agencies in Fiscal Year 2006-2007 is 38 percent.[30]

The use of significant quantities of recycled water is made possible in the Basin by the attainment of hydraulic control.[31] Recycled water projections for direct use in the Basin increase from 11,924 AF in 2007 to 60,450 AF in 2030 and recycled water use for groundwater recharge rises over the period from 3,443 AF to 35,000 AF.[32, 33] The recycled water price charged by

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[30] Watermaster, Fiscal Year 2006-2007 Final Assessment Package, Land Use Conversion Summary (p10): http://www.cbwm.org/docs/financdocs/Assessment%20Package%20FY%202006-2007%20Final.pdf.

[31] Personal correspondence with IEUA staff.

[32] Projections on recycled water deliveries for direct use and on total recycled water for groundwater recharge is provided for IEUA members in IEUA Urban Water Management Plan (2005), Table 3-13. The projections on recycled water deliveries for direct use to non-IEUA members as well as the distribution of recycled water deliveries for groundwater recharge across individual agencies are based on personal communication with IEUA staff (July 11, 2007).

[33] In no case does the amount of recycled water used for recharge exceed the DHS-approved dilution rates.

IEUA for recycled water deliveries in each period is viewed as sufficient to recover the fully amortized capital and operating costs of their recycled water operations.[34]

The amount of transfer of overlying non-agricultural water to the appropriative pool is taken to be 49,178 AF, which is the ending total balance in the pool 2 local storage account in the Watermaster final assessment package for fiscal year 2006-2007.[35] This amount of water is allocated proportionally in four equal installments over the four-year period 2007-2010 to agencies in the appropriative pool according to their share of safe operating yield, and the price in each period is set at 92 percent of the prevailing MWD replenishment rate.[36]

Finally, in meeting the goal of hydraulic control in the Peace II scenario, two sources of water are created: (i) the Santa Ana River (SAR) inflow is calculated to generate 9,900 AF of new Basin yield each year, eventually rising to 12,500 AF per year; and (ii) 400,000 AF of cumulative overdraft is necessary in the Basin over the period 2007-2030.[37] Both the 9,900 AF per year of SAR inflow and the allocation of the 400,000 AF of cumulative forgiveness are allocated to meet the replenishment obligation of the desalters. The dynamic path of forgiveness for the desalter obligation follows the most-rapid depletion path defined by the aggregate study, which assumes that the Basin overdraft occurs to whatever extent is necessary to meet the replenishment obligation of the desalters (net of storage losses and SAR inflow). Under the most-rapid depletion path, hydraulic control is achieved on the cumulative overdraft of 400,000 AF from the Basin in the year 2024, which raises the SAR inflow from 9,900 AF to 12,500 AF over the remaining period 2025-2030.

### *6.2. Import Demand*

The demand for imported water for each agency in the Basin is calculated in the same manner as in the Peace scenario. In terms of the resulting values, the influx of new Basin water supply in response to recycled water use alter the resulting evaluation of import demand relative to the prevailing conditions under Peace in two significant ways. First, import demand is now lower each year relative to the outcome under Peace conditions by the amount of new Basin supply. This water ultimately defrays Tier 2 water purchases as the supply side of the model is built upwards and aggregated across each step towards the extensive margin of supply. As these supplies are developed, available supply in the Basin rises to 266,134 AF by the year 2030, an increase of 80,442 AF above the Peace I scenario and 106,678 AF above the baseline conditions.

Second, the amount of water held in local storage by individual agencies decreases to account for the effect of these new, reliable water sources in the Basin and the corresponding reduction in the need to smooth out the cyclical components of water supplies with puts and takes. As recycled water supplies are developed in the Basin, the need for local storage decreases; for instance, the total amount of water held in local storage in the Basin in 2030 decreases from 141,565 AF under baseline conditions, to 129,259 AF in the Peace I scenario, to 80,500 AF in the Peace II scenario.

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[34] IEUA, Operating and Capital Program Budget, Fiscal Year 2007/08, Volume 1 (July 2007), p231.

[35] Watermaster, Fiscal Year 2006-2007 Final Assessment Package, Pool 2 Water/Storage Transactions (p12): http://www.cbwm.org/docs/financdocs/Assessment%20Package%20FY%202006-2007%20Final.pdf.

[36] Non-Binding Term Sheet, item IX.C.

[37] Personal correspondence with staff at Wildermuth Environmental.

The quantity of water transactions in the water transfer market rises significantly as the number of agencies selling water increases with the influx of recycled water supplies. This changes the distribution of net benefits, both directly by the allocation of recycled water supplies based on proximity of users (rather than according to the share of safe operating yield) and indirectly by reducing the number of agencies that procure water on the extensive margin of supply.

### *6.3. Water Imports*

An important outcome in the Peace II scenario as a result of hydraulic control is the decrease in Tier 2 water purchases relative to both the baseline and Peace I scenarios. Unlike the case of the Peace I scenario, in which the decline in Tier 2 purchases was largely offset by an increase in assessment costs to support the increase in recharge capacity, the avoided Tier 2 water purchases in the Peace II scenario are associated either with negligible costs (SAR inflow and forgiveness for Basin over-draft) or with the relatively low cost associated with recycled water, which is valued at IEUA recycled water rates. These differences are characterized in the discussion below.

In addition, the level of water imports increases slightly in the Peace II scenario, because of a reduction in the storage loss component allocated to meet the desalter replenishment obligation. In the Peace II scenario, the desalter replenishment obligation is taken to be desalter production less storage losses of 1 percent from the local storage accounts of producers in the Basin.[38]

### *6.4. Water Procurement Costs*

All program costs that form the basis for Watermaster assessments in the Peace I scenario (as described above) are considered in the Peace II scenario, with the exception of the Pomona credit, which is no longer paid by appropriators in the Basin and is instead paid by Three Valleys Municipal Water District.[39] The removal of this fee from Watermaster assessments leads to an increase in net benefit to agencies in the Basin by $66,667, and this is returned to agencies in proportion to each agency's share of safe operating yield. The increase in net benefit is offset by a proportional increase in cost for Three Valleys Municipal Water District, and the present value of this stream of payments over the period 2007-2030 at the prevailing rate of discount (4.5 percent) is $1.0 million.

Recycled water costs are allocated to each agency using the recycled water prices provided by IEUA, as discussed above. The desalter replenishment obligation, which begins in the year 2024 after the 400,000 AF of over-draft credits are exhausted, is met in the Peace II scenario through Watermaster replenishment assessments as follows. Half of the desalter replenishment obligation is met by individual agencies according to pro rata shares of safe operating yield, as in the Peace I scenario, and the remaining half of the desalter replenishment obligation is met according to each agency's share of actual production relative to total production in the Basin.[40] This latter portion of the Watermaster replenishment assessments accords with the method of allocating Watermaster general assessments to the appropriative pool in all three scenarios considered. The

[38] Non-Binding Term Sheet, Item VI.B.1.
[39] Non-Binding Term Sheet, item VII.A.
[40] Personal correspondence with Watermaster staff (August 29, 2007).

method for calculating the remaining water procurement costs for each agency is identical to the method described above for the Peace I scenario.

### *6.5. Comparison of Baseline, Peace I, and Peace II Outcomes*

Relative to baseline conditions, the present value of total net benefit among the ten agencies encompassed by the study for the program elements contained in the Peace II scenario is $904.6 million, which represents an additional net benefits of $722.5 million relative to the outcome of the Peace I scenario.

The main factor associated with this increased net benefit is the displacement of Tier 2 water with recycled water, SAR in-flow, and, in the period 2007-2024, with forgiveness for 400,000 AF of Basin over-draft to attain hydraulic control. Under peace I conditions, the present value of total Tier 2 water purchases over the period 2007-2030 is $931 million, whereas, in the Peace II scenario, the present value of Tier 2 water purchases over the period is $271 million. This decrease in Tier 2 water costs in the Peace II scenario was replaced with a combination of 400,000 AF of forgiveness for Basin over-draft and recycled water at the lower IEUA recycled water rate.[41] The combined present value of cost of imported water and recycled water inputs in the Peace II scenario is $1.0 billion, which represents a substantial reduction in the present value of water procurement cost from $1.75 billion in the Peace I scenario.

Table 3 depicts the projected outcomes to individual agencies in the Peace II scenario for the year 2015. A comparison of these outcomes with those that emerge in the baseline scenario in Table 1 and the Peace I scenario in Table 2 provides a useful profile of the essential differences in Basin performance under Peace II conditions. Residual demand, which corresponds to the value Q* in Figure 1, is identical in all three scenarios, as is the safe operating yield of the agencies and desalter production. The net agricultural pool transfer to the appropriative pool (48,530 AF) is between the values that emerge in the Peace I scenario (48,848 AF) and the baseline scenario (48,268 AF). Relative to the outcome under Peace I conditions, the new rules for assessing replenishment obligations for the over-allocated agricultural pool water redistribute the net returns away from the major land-use converters in the Basin (in particular, the City of Chino and Jurupa Community Services District).

Available Basin supply in the Peace II scenario in the year 2015 (208,199 AF) is considerably higher than the available Basin supply in the baseline scenario (123,554 AF) and Peace I scenario (148,346 AF), which leads to a commensurate reduction in imported water demand. Virtually the entire difference in imported water demand between the Peace I scenario and the Peace II scenario is the result of the 60,171 AF addition of recycled water (direct use plus groundwater replenishment).

The level of local storage in the Peace II scenario in, 53,293 AF, is lower than local storage levels in the baseline (107,054 AF) and Peace I scenarios (91,649 AF) due to the large influx of

[41] The allocation of the 400,000 AF of forgiveness to meet the replenishment obligations of the desalters is implicitly valued at the Tier 2 rate, because each unit of forgiveness that is credited against the desalter replenishment obligation, which is valued directly in the model at the replenishment rate, "frees up" a unit of recharge capacity that allows a unit of Tier 2 water to be displaced on the extensive margin of supply.

reliable Basin water through the development of the recycling program and the acquisition of SAR inflow. This greater availability of Basin water supply also facilitates a richer pattern of water transfers in the Peace II scenario.

In total, Tier 2 water purchases in the year 2015 are 10,186 AF, which represents a substantial reduction from the 137,089 AF of Tier 2 water purchases that take place under baseline conditions (inclusive of the purchases required by in lieu recharge) and the 82,658 AF under Peace I conditions. Replenishment water purchases increase in the Peace II scenario from 31,533 AF in the Peace I scenario to 41,800 AF in the Peace II scenario. The increase in replenishment imports reflects the replacement of 35,267 AF of replenishment obligations in the Peace I scenario with SAR inflow and desalter forgiveness in the year 2015, less the 20,671 AF claim on recharge facilities associated with the groundwater recharge component of the recycled water program in the Peace II scenario. The decrease in Tier 2 water imports of 72,430 AF between the Peace I and Peace II scenario is the result of the displacement of Tier 2 water purchases with a combination of recycled water, SAR in-flow, and allowed over-draft.

Actual production among these eight agencies in the year 2015 (182,170 AF) is higher in the Peace II scenario than in the Peace I scenario (160,203 AF) and the baseline scenario (121,138 AF). This increment in Basin production relative to the Peace I scenario represents the increase in Basin supply resulting from the use of recycled water for groundwater recharge as well as small adjustments in storage loss and net storage requirements.[42]

Finally, notice in the comparison of Tier 2 purchases by individual agencies in Tables 1-3 that the distribution of Tier 2 water purchases across individual agencies in the Basin differs in all three scenarios relative to the distributions of safe operating yield and the distribution of actual production. These elements together comprise the basis for the allocation of collective Basin net benefits to individual agencies, with the division of market benefits from Basin improvement activities determined by each agency's share of Tier 2 water purchases, and the allocation of cost determined through Watermaster formulas that are based either on a individual agency's share of actual production to total Basin production or on a individual agency's share of safe operating yield. Differences in the distributions of these three key values across individual agencies in the Basin are responsible for inequalities in the distribution the net benefit from the various program elements that improve the management of Chino Basin water resources.

[42] Recycled water for direct use offsets urban water demand, but does not otherwise influence Basin production.

**Table 3: Year 2015 Outcome Under Peace II Scenario**

| | Appropriator | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Chino | Chino Hills | Ontario | Upland | Cucamonga | Monte Vista | Jurupa | Pomona | **Total** |
| Urban Water Demand | 26,200 | 24,700 | 66,600 | 22,500 | 72,500 | 14,100 | 36,350 | 30,264 | **293,214** |
| Available Surface Water | 0 | 0 | 0 | 5,200 | 3,000 | 0 | 500 | 0 | **8,700** |
| Available Other Groundwater | 0 | 0 | 0 | 3,800 | 5,400 | 0 | 0 | 1,884 | **11,084** |
| *Residual Demand* | *26,200* | *24,700* | *66,600* | *13,500* | *64,100* | *14,100* | *35,850* | *28,380* | **273,430** |
| Safe Operating Yield | 4,034 | 2,111 | 11,374 | 2,852 | 3,619 | 4,824 | 2,061 | 11,216 | **42,092** |
| New Yield | 883 | 462 | 2,489 | 624 | 792 | 2,455 | 451 | 2,489 | **10,645** |
| Net Ag Transfer | 10,103 | 2,176 | 7,559 | 1,581 | 2,560 | 2,739 | 15,599 | 6,215 | **48,530** |
| Desalter Water Supply | 5,000 | 4,200 | 5,000 | 0 | 0 | 0 | 19,922 | 0 | **34,122** |
| Storage & Recovery | 527 | 658 | 3,671 | 1,364 | 5,160 | 1,801 | 909 | 909 | **15,000** |
| Recycled Water, Direct Use | 6,300 | 4,000 | 8,800 | 0 | 15,900 | 500 | 2,500 | 1,500 | **39,500** |
| Recycled Water, Replenishment | 2,402 | 2,188 | 5,590 | 2,450 | 5,304 | 1,070 | 1,667 | 0 | **20,671** |
| *Available Supply* | *29,248* | *15,796* | *44,482* | *8,871* | *33,336* | *11,990* | *42,181* | *22,294* | **208,199** |
| Net Storage | 0 | 69 | 527 | -153 | 5 | 94 | 0 | 217 | **759** |
| Transfers | -3,048 | 2,784 | 7,026 | 1,389 | 9,546 | 684 | -6,331 | 1,955 | **14,004** |
| *Import Demand* | *0* | *6,190* | *15,619* | *3,087* | *21,223* | *1,520* | *0* | *4,347* | **51,986** |
| Local Storage | 0 | 6,360 | 15,798 | 3,306 | 21,974 | 1,507 | 0 | 4,347 | **53,293** |
| Replenishment Purchases | 0 | 4,977 | 12,559 | 2,482 | 17,064 | 1,222 | 0 | 3,495 | **41,800** |
| Tier 2 Purchases | 0 | 1,213 | 3,060 | 605 | 4,158 | 298 | 0 | 852 | **10,186** |
| Actual Production | 19,900 | 14,516 | 42,550 | 10,227 | 26,762 | 12,159 | 33,350 | 22,706 | **182,170** |
| Watermaster Assessments | $707 | $447 | $1,368 | $327 | $804 | $411 | $1,129 | $753 | **$5,946** |

Figure 3 compares the benefit received by each agency from reduced water procurement costs to the increase in assessment cost that result from the implementation of the program elements in the Peace II scenario. The program costs in the Peace II scenario do not differ substantively from program costs in the Peace I scenario, and represent an overall increase from $17 million to $143.2 million in present value terms. The program benefits in present value terms in the Peace II scenario are reflected in the decrease in water procurement costs from $2.1 billion under baseline conditions to $1.1 billion in the Peace II scenario.

City of Ontario and Cucamonga Valley Water District receive the largest share of the benefits resulting from the Peace II program elements, while the assessment costs resulting from the Peace II program elements are notably smaller and distributed more equally across the agencies. In total, the City of Ontario and Cucamonga Valley Water District together receive 56 percent of the benefit of decreased water procurement costs and incur 39 percent of the increase in assessment costs.

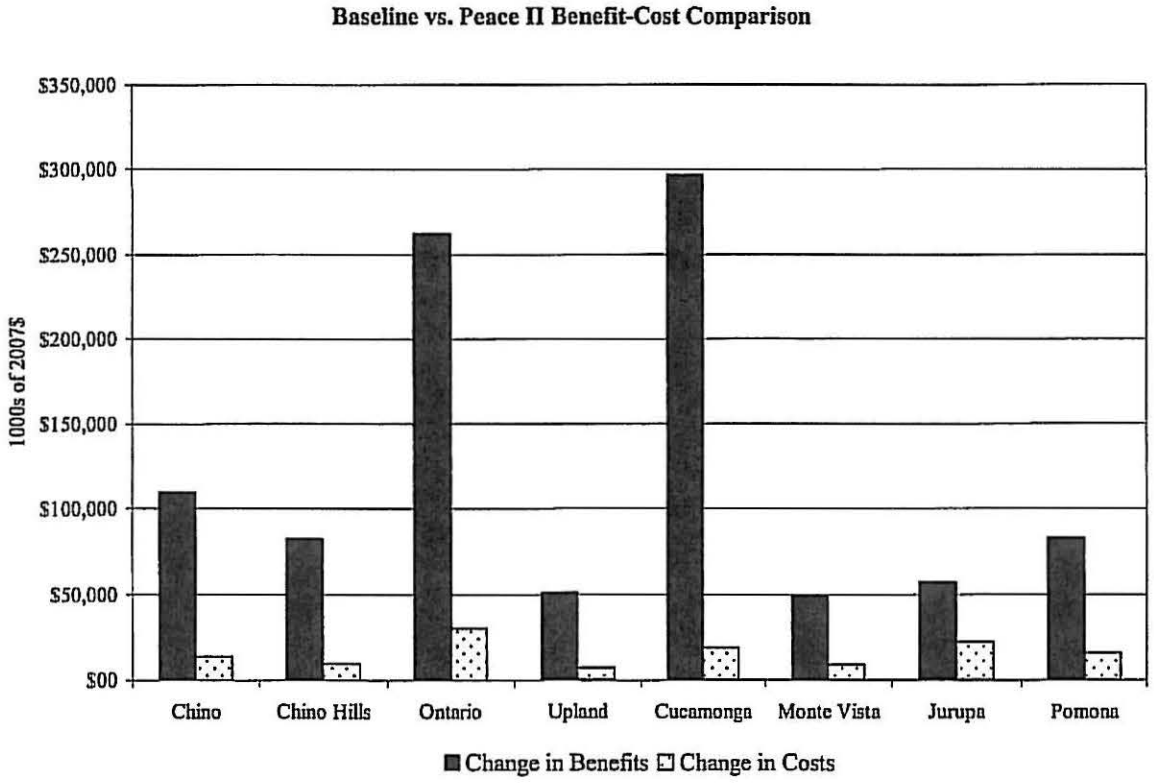



**Figure 3**

**Distribution of Net Benefit, Peace II vs. Baseline ($/per AF)**

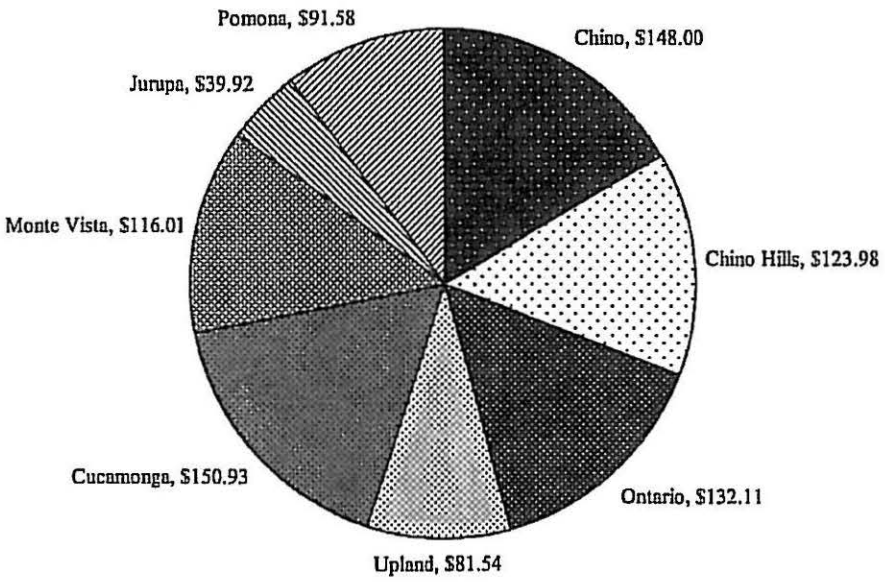



**Figure 4**

Figure 4 depicts the distribution of net benefits per acre-foot of residual water demand across individual agencies in the Basin resulting from the program elements in the Peace II scenario. Overall, the present value of the net benefit to all parties over the 24 year horizon resulting from a move from baseline conditions to Peace conditions is $905 million and the total projected water demand over this period is 9.1 million AF, which implies an average return of $98.53 per acre-foot to the agencies encompassed by the study.

Noting, as before, that Fontana Union Water Company and San Antonio Water Company have available surface water and other groundwater supplies in excess of their demand, and controlling for agency scale on the basis of residual demand for Basin water among the remaining producers, the net benefit resulting from the combined program elements in the Peace II Agreement lies between $39.92/AF for Jurupa CSD to $150.93 for Cucamonga Valley Water District.

The net benefit/AF received by Jurupa Community Services District is significantly smaller than the net benefit/AF received by other producers, because of systematic differences in the way this agency meets consumer water demand. Jurupa Community Services District is disadvantaged in the ability to capitalize on program elements that improve Basin performance by the large share of desalter water for urban water supply it receives, which cannot be defrayed by the development of new Basin supplies, and by a negligible reliance on imported water from MWD.

Among the remaining agencies, the Cities of Pomona and Upland receive a smaller share of the net benefit/AF, while Monte Vista Water District, the Cities of Chino, Ontario, Upland, and Chino Hills, and Cucamonga Valley Water District each receive a net benefit/AF above $116/AF.

## 7. Alternative Scenarios

This section examines the sensitivity of the results to variations in various assumptions underlying the model. In theory, each of the factors considered here has the potential to change the relative rankings among agencies with respect to benefits per acre-foot. For example, increasing the cost of capital will tend to elevate the ranking of agencies that receive benefits in early years. These sensitivity analyses are intended to bracket actual results and measure the sensitivity of outcomes to changes in assumptions.

Five parameters are varied and the model results are recalculated in each case. The alternative scenarios considered are: (i) variation in the share of the desalter replenishment obligation attributed to the appropriative pool in the baseline case; (ii) variation in the discount rate; (iii) variation in Urban Water Demands; (iv) variation in the availability of Tier 1 water to agencies in the Basin; and (v) increases in effective recycled water prices due to the long-run average cost of recycled water infrastructure improvements.

The model results are most sensitive to the scenario in which all Tier 2 water purchases in the model are replaced with Tier 1 water purchases at the lower MWD rate. The results of this scenario are shown in Table 4. This scenario provides a bracketing assumption on the value of the outside water options available to agencies and it is unlikely that each agency can meet annual increases in urban water demand every year with a continued expansion of Tier 1 purchases. To the extent that individual agencies differ in their access to Tier 1 water, moreover, market forces would lead to a displacement of Tier 2 water purchases on the extensive margin of supply before any displacement occurs of Tier 1 water purchases, so that a model that considered a relatively equal mix of Tier 1 and Tier 2 water supplies would not result in values near the mid-point between the Tier 1 scenario and the Tier 2 scenario. Nonetheless, the total net benefit in the Basin under Peace II scenario remains high—$611.7 million ($88.89/AF)—even when the entire increase in Basin supply is valued at the displacement cost of Tier 1 water.

The model results are fairly robust to variations in the remaining parameters. In total, the net benefit of the Peace II program elements varies across the scenarios in a range between $806.7 million - $864.4 million ($87.87/AF - $104.22/AF) in each scenario, relative to the $904.6 million ($98.53/AF) at baseline levels of the parameters.

**Table 4: Tier 2 Replaced By Tier 1**

| | Net Benefit (1000s of $) | | Net Benefit/AF | |
|---|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Baseline* | *Peace I vs. Baseline* | *Peace II vs. Baseline* |
| City of Chino | $8,549 | $77,828 | $13.18 | $120.03 |
| City of Chino Hills | $18 | $46,218 | $0.03 | $77.92 |
| City of Ontario | $1,451 | $148,970 | $0.83 | $84.73 |
| City of Upland | $328 | $27,599 | $0.61 | $51.04 |
| Cucamonga Valley Water District | $14,025 | $175,240 | $7.61 | $95.10 |
| Fontana Union Water Co. | $1,451 | $26,880 | | |
| Monte Vista Water District | ($2,090) | $27,005 | ($5.99) | $77.39 |
| San Antonio Water Company | $342 | $6,337 | | |
| Jurupa CSD | $10,611 | $29,242 | $12.01 | $33.11 |
| City of Pomona | ($5,720) | $46,453 | ($7.76) | $62.99 |
| **Total** | **$28,965** | **$611,773** | **$3.15** | **$66.63** |

**Table 5: 50% of Desalter Obligation Paid by Ag Pool**

| | Net Benefit (1000s of $) | | Net Benefit/AF | |
|---|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Baseline* | *Peace I vs. Baseline* | *Peace II vs. Baseline* |
| City of Chino | $15,450 | $91,122 | $23.83 | $140.53 |
| City of Chino Hills | $9,681 | $71,001 | $16.32 | $119.70 |
| City of Ontario | $28,888 | $218,613 | $16.43 | $124.34 |
| City of Upland | $6,017 | $40,661 | $11.13 | $75.20 |
| Cucamonga Valley Water District | $56,320 | $273,782 | $30.56 | $148.57 |
| Fontana Union Water Co. | ($2,836) | $22,592 | | |
| Monte Vista Water District | $1,232 | $34,687 | $3.53 | $99.41 |
| San Antonio Water Company | ($669) | $5,326 | | |
| Jurupa CSD | $13,297 | $32,779 | $15.06 | $37.11 |
| City of Pomona | ($5,280) | $54,068 | ($7.16) | $73.31 |
| **Total** | **$122,101** | **$844,632** | **$13.30** | **$91.99** |

**Table 6: 5.5% Discount Rate**

| | Net Benefit (1000s of $) | | Net Benefit/AF | |
|---|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Baseline* | *Peace I vs. Baseline* | *Peace II vs. Baseline* |
| City of Chino | $17,681 | $84,906 | $27.27 | $130.95 |
| City of Chino Hills | $11,108 | $65,916 | $18.73 | $111.13 |
| City of Ontario | $38,234 | $207,227 | $21.75 | $117.86 |
| City of Upland | $8,595 | $39,560 | $15.90 | $73.16 |
| Cucamonga Valley Water District | $54,862 | $247,990 | $29.77 | $134.57 |
| Fontana Union Water Co. | $4,231 | $26,907 | | |
| Monte Vista Water District | $6,265 | $36,087 | $17.95 | $103.42 |
| San Antonio Water Company | $997 | $6,343 | | |
| Jurupa CSD | $13,877 | $31,426 | $15.71 | $35.58 |
| City of Pomona | $7,315 | $60,400 | $9.92 | $81.90 |
| **Total** | **$163,165** | **$806,761** | **$17.77** | **$87.87** |

**Table 7: 10% Conservation**

| | Net Benefit (1000s of $) | | Net Benefit/AF | |
|---|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Baseline* | *Peace I vs. Baseline* | *Peace II vs. Baseline* |
| City of Chino | $18,131 | $88,819 | $31.07 | $152.20 |
| City of Chino Hills | $13,070 | $70,172 | $24.48 | $131.45 |
| City of Ontario | $44,196 | $223,937 | $27.93 | $141.52 |
| City of Upland | $8,602 | $39,805 | $17.68 | $81.80 |
| Cucamonga Valley Water District | $64,718 | $268,848 | $39.02 | $162.10 |
| Fontana Union Water Co. | $4,989 | $30,656 | | |
| Monte Vista Water District | $6,205 | $37,920 | $19.76 | $120.75 |
| San Antonio Water Company | $1,176 | $7,227 | | |
| Jurupa CSD | $15,189 | $33,707 | $19.11 | $42.40 |
| City of Pomona | $6,788 | $63,259 | $10.23 | $95.30 |
| **Total** | **$183,064** | **$864,350** | **$22.07** | **$104.22** |

**Table 8: 50% Increase in Recycled Water Price**

| | Net Benefit (1000s of $) | | Net Benefit/AF | |
|---|---|---|---|---|
| | *Peace I vs. Baseline* | *Peace II vs. Baseline* | *Peace I vs. Baseline* | *Peace II vs. Baseline* |
| City of Chino | $20,294 | $88,913 | $31.30 | $137.13 |
| City of Chino Hills | $12,217 | $69,270 | $20.60 | $116.78 |
| City of Ontario | $42,547 | $220,779 | $24.20 | $125.57 |
| City of Upland | $9,442 | $42,215 | $17.46 | $78.07 |
| Cucamonga Valley Water District | $60,667 | $262,234 | $32.92 | $142.30 |
| Fontana Union Water Co. | $4,839 | $30,268 | | |
| Monte Vista Water District | $7,025 | $39,277 | $20.13 | $112.56 |
| San Antonio Water Company | $1,141 | $7,136 | | |
| Jurupa CSD | $15,772 | $31,962 | $17.86 | $36.19 |
| City of Pomona | $8,189 | $66,517 | $11.10 | $90.19 |
| **Total** | **$182,133** | **$858,571** | **$19.84** | **$93.51** |

# Attachment D

October 25, 2007

Attachment "D"

# 2007 SUPPLEMENT TO THE IMPLEMENTATION PLAN OPTIMUM BASIN MANAGEMENT PROGRAM FOR THE CHINO BASIN

## INTRODUCTION

This document describes the supplement to the implementation plan for the Chino Basin Optimum Basin Management Program (OBMP), as determined through the 2007 "Peace II" process.

## PROGRAM ELEMENT 1 DEVELOP AND IMPLEMENT COMPREHENSIVE MONITORING PROGRAM

### A. Production Monitoring Program

All active wells (except for minimum user wells) are now metered. Watermaster reads the production data from the meters on a quarterly basis and enters these data into Watermaster's relational database.

### B. Surface Water Discharge and Quality Monitoring

Water Quality and Quantity in Recharge Basins. Watermaster measures the quantity and quality of storm and supplemental water entering the recharge basins. Pressure transducers or staff gauges are used to measure water levels during recharge operations. In addition to these quantity measurements, imported water quality values for State Water Project water are obtained from the Metropolitan Water District of Southern California (MWDSC) and recycled water quality values for the RP1 and RP4 treatment plant effluents are obtained from IEUA. Watermaster monitors the storm water quality in the eight major channels (San Antonio, West Cucamonga, Cucamonga, Deer Creek, Day Creek, San Sevaine, West Fontana, and DeClez) usually after each major storm event. Combining the measured flow data with the respective water qualities enables the

calculation of the blended water quality in each recharge basin, the "new yield" to the Chino Basin, and the adequate dilution of recycled water.

Surface Water Monitoring in Santa Ana River (SAR). Watermaster measures the discharge of the river and selected water quality parameters to determine those reaches of the SAR that are gaining flow from Chino Basin and/or, conversely, those reaches that are losing flow into the Chino Basin. These bi-weekly flow and water quality measurements are combined with discharge data from permanent USGS and Orange County Water District (OCWD) stream gauges and discharge data from publicly owned treatment works (POTWs). These data are used in groundwater modeling to assess the extent of hydraulic control.

**HCMP Annual Report**

In January 2004, the RWQCB amended the Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin to incorporate an updated total dissolved solids (TDS) and nitrogen (N) management plan. The Basin Plan Amendment includes both "antidegradation" and "maximum benefit" objectives for TDS and nitrate-nitrogen for the Chino and Cucamonga groundwater management zones. The application of the "maximum benefit" objectives relies on Watermaster and the IEUA's implementation of a specific program of projects and requirements, which are an integral part of the OBMP. On April 15, 2005, the RWQCB adopted resolution R8-2005-0064; thus approving the Surface Water Monitoring Program and Groundwater Monitoring Program in support of maximum benefit commitments in the Chino and Cucamonga Basins. Watermaster and the IEUA completed the 2006 Annual Report, which summarizes the results for those two programs, and submitted it to the RWQCB on April 16, 2007 in partial fulfillment of maximum benefit commitments.

**Chino Basin Recycled Water Groundwater Recharge Program**

The IEUA, Watermaster, Chino Basin Water Conservation District, and San Bernardino County Flood Control District jointly sponsor the Chino Basin Recycled Water Groundwater Recharge Program. This is a comprehensive water supply program to enhance water supply reliability and improve the groundwater quality in local drinking water wells throughout the Chino Groundwater Basin by increasing the recharge of stormwater, imported water, and recycled water. The recharge program is regulated under RWQCB Order No. R8-2005-0033 and Monitoring and Reporting Program No. R8-2005-0033.

Monitoring Activities. Watermaster and the IEUA collect weekly and bi-weekly water quality samples from basins that are actively recharging recycled water and from lysimeters installed within those basins. Monitoring wells located down gradient of the recharge basins are sampled every two weeks during the reporting period for a total of about 100 samples.

Construction Activities. Lysimeters and monitoring wells associated with the RP-3, DeClez, and Ely Basins were installed in fiscal year (FY) 2006/07.

## C. Ground Level Monitoring Program

Watermaster developed a multifaceted land surface monitoring program to develop data for a long-term management plan for land subsidence in Management Zone 1 (MZ-1). The monitoring program consisted of three main elements:

- An aquifer system monitoring facility consisting of multiple depth piezometers and a dual bore extensometer.
- The application of synthetic aperture radar interferometry (InSAR) to measure historical land surface deformation.
- Benchmark surveys to measure land surface deformation, "ground truth" the InSAR data, and evaluate effectiveness of the long term management plan.

Following two years of data collection and analysis, Watermaster submitted the MZ-1 Summary Report in October 2005, which contained Guidance Criteria to minimize subsidence and fissuring. The Guidance Criteria included a listing of Managed Wells and their owners subject to the criteria, a map of the so-called Managed Area, an initial threshold water level (Guidance Level) of 245 feet below the top of the PA-7 well casing, and a plan for ongoing monitoring and notification. Since October 2005, the MZ-1 Summary Report and the Guidance Criteria contained therein have been discussed extensively by the parties involved, and were adopted by the Watermaster Board at its May 2006 Meeting. The final MZ-1 Subsidence Management Plan was adopted by the Watermaster Board at its June 2007 Meeting, was subsequently revised, and was submitted to the Court for approval at a hearing on November 15, 2007.

The MZ-1 monitoring program continues unabated. Water level monitoring expanded to the central regions of MZ-1 with the installation of transducers/data loggers at selected wells owned by the City of Chino, the Monte Vista Water District, and the City of Pomona. This expansion of the water level monitoring program is the initial effort to better understand the mechanisms behind ongoing land subsidence in this region.

# PROGRAM ELEMENT 2 -- DEVELOP AND IMPLEMENT COMPREHENSIVE RECHARGE PROGRAM

## INTRODUCTION

Construction on the Chino Basin Facilities Improvement Project (CBFIP) Phase I was completed by December 31, 2005 at a cost of $38M; 50% from a SWRCB Proposition 13 Grant, and 25% each from Watermaster and the IEUA. A CBFIP Phase II list of projects was developed by Watermaster and the IEUA, including monitoring wells, lysimeters, recycled water connections, SCADA system expansions, three MWDSC turnouts, and berm heightening and hardening. At a cost of approximately $15M, these Phase II facilities will be financed through a 50% Grant from DWR and 25% each from Watermaster and the IEUA.

In FY 2005-2006, the CBFIP Phase I facilities were able to recharge 49,000 AF of storm and supplemental water. By the start of FY 2009-2010, most of the basins will be able to operate on a 12 months per year basis with combinations of storm, imported, and recycled water, with occasional downtime for silt and organic growth removal. Operations and basin planning are coordinated through the Groundwater Recharge Coordinating Committee (GRCC) which meets monthly.

Update to the Recharge Master Plan. The Recharge Master Plan will be updated as frequently as necessary and not less than every five (5) years, to reflect an appropriate schedule for planning, design, and physical improvements as may be required to offset the controlled mining at the end of the Peace Agreement and the end of forgiveness for Desalter replenishment.

Coordination. Watermaster will ensure that the members of the Appropriative Pool will coordinate the development of their respective Urban Water Management Plans and Water Supply Master Plans with Watermaster as follows.

(a) Watermaster will obtain from each Appropriator that prepares an Urban Water Management Plan and Water Supply Plan copies of their existing and proposed plans.

(b) Watermaster will use the Plans in evaluating the adequacy of the Recharge Master Plan and other OBMP Implementation Plan program elements.

(c) Each Appropriator will provide Watermaster with a draft in advance of adopting any proposed changes to their Urban Water Management Plans and in advance of adopting any material changes to their Water Supply Master Plans respectively in accordance with the customary notification routinely provided to other third parties to offer Watermaster a reasonable opportunity to provide informal input and informal comment on the proposed changes.

(d) Any party that experiences the loss or the imminent threatened loss of a material water supply source will provide reasonable notice to Watermaster of the condition and the expected impact, if any, on the projected groundwater use.

Suspension. To ameliorate any long-term risks attributable to reliance upon un-replenished groundwater production by the Desalters, the annual availability of any portion of the 400,000 acre-feet set aside for forgiveness, is expressly subject to Watermaster making an annual finding it is in substantial compliance with the revised Watermaster Recharge Master Plan pursuant to Paragraph 7.3 above.

Acknowledgment re 6,500 Acre-Foot Supplemental Recharge. The Parties have made the following acknowledgments regarding the 6,500 Acre-Foot Supplemental Recharge:

(a) A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin, Watermaster has committed to use its best efforts to direct recharge relative to production in each area and sub-area of the Basin and to achieve long-term balance between total recharge and discharge. The Parties acknowledge that to assist Watermaster in providing for recharge, the Peace Agreement sets forth a requirement for Appropriative Pool purchase of 6,500 acre-feet per year of Supplemental Water for recharge in Management Zone 1 (MZ1). The purchases have been credited as an addition to Appropriative Pool storage accounts. The water recharged under this program has not been accounted for as Replenishment water.

(b) Watermaster was required to evaluate the continuance of this requirement in 2005 by taking into account provisions of the Judgment, Peace Agreement and OBMP, among all other relevant factors. It has been determined that other obligations in the Judgment and Peace Agreement, including the requirement of hydrologic balance and projected replenishment obligations, will provide for sufficient wet-water recharge to make the separate commitment of Appropriative Pool purchase of 6,500 acre-feet unnecessary. Therefore, because the recharge target as described in the Peace Agreement has been achieved, further purchases under the program will cease and Watermaster will proceed with operations in accordance with the provisions of paragraphs (c), (d) and (e) below.

(c) The parties acknowledge that, regardless of Replenishment obligations, Watermaster will independently determine whether to require wet-water recharge within MZ1 to maintain hydrologic balance and to provide equal access to groundwater in accordance with the provisions of this Section 8.4 and in a manner consistent with the Peace Agreement, OBMP and the Long Term Plan for Subsidence. Watermaster will conduct its recharge in a manner to provide hydrologic balance within, and will emphasize recharge in MZ1. Accordingly, the Parties acknowledge and agree that each year Watermaster shall continue to be guided in the exercise of its discretion concerning recharge by the principles of hydrologic balance.

(d) Consistent with its overall obligations to manage the Chino Basin to ensure hydrologic balance within each management zone, for the duration of the Peace Agreement (until June of 2030), Watermaster will ensure that a minimum of 6,500 acre-feet of wet water recharge occurs within MZ1 on an annual basis. However, to the extent that water is unavailable for recharge or there is no replenishment obligation in any year, the obligation to recharge 6,500 acre-feet will accrue and be satisfied in subsequent years.

(1) Watermaster will implement this measure in a coordinated manner so as to facilitate compliance with other agreements among the parties, including but not limited to the Dry-Year Yield Agreements.

(2) In preparation of the Recharge Master Plan, Watermaster will consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to further enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master Plan.

(e) Five years from the effective date of the Peace II Measures, Watermaster will cause an evaluation of the minimum recharge quantity for MZ1. After consideration of the information developed in accordance with the studies conducted pursuant to paragraph 3 below, the observed experiences in complying with the Dry Year Yield Agreements as well as any other pertinent information, Watermaster may increase the minimum requirement for MZ1 to quantities greater than 6,500 acre-feet per year. In no circumstance will the commitment to recharge 6,500 acre-feet be reduced for the duration of the Peace Agreement.

**Hydraulic Control.** In accordance with the purpose and objective of the Physical Solution to "establish a legal and practical means for making the maximum reasonable beneficial use of the waters of the Chino Basin" (paragraph 39) and the identified Basin Management Parameters, Watermaster will manage the Basin to secure Hydraulic Control through controlled overdraft for a period of approximately 23 (twenty-three) years (Re-Operation). Hydraulic Control ensures that the water management activities in the Chino North Management Zone do not cause materially adverse impacts to the beneficial uses of the Santa Ana River downstream of Prado Dam. "Hydraulic Control" means the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. The Chino North Management Zone is more fully described and set forth in Exhibit 1 to this Appendix I.

**Re-Operation.** Independent of Watermaster determinations regarding Operating Safe Yield and without effect on or regard for the parties' respective rights thereto in any year, Re-Operation of the Basin through the managed withdrawal of groundwater from the Basin is required to achieve and maintain Hydraulic Control. Given the expected water quality, increased yield and economic benefits associated with Hydraulic Control, a Re-Operation through coordinated and controlled overdraft is a prudent and efficient use of the Basin resources *to the extent* groundwater is required to achieve and maintain Hydraulic Control. "Re-operation" means the potential increase in the accumulated overdraft from 200,000 acre-feet previously authorized under Exhibit I over the period 1978 through 2017 to 600,000 acre-feet through 2030, with the 400,000 acre-feet increase being expressly allocated to meet the replenishment obligation of the Desalters. Accordingly, a cumulative change in storage of up to 400,000 acre-feet greater than initially authorized by the original Judgment may result. However, the use of

water pumped pursuant to Re-operation is subject to the following limitations:

(a) Future Desalter Groundwater Production Facilities. Future Desalter groundwater production facilities will emphasize Production from the southern end of the Basin.

(b) The Material Physical Injury. Controlled overdraft must not cause material physical injury to any Party or the Basin.

(c) Proposed Schedule. An initial schedule for Re-Operation, including annual and cumulative quantities to be pumped through Re-Operation will be developed. Watermaster may modify the proposed schedule from time to time as it may be prudent under the circumstances, but only after first obtaining Court approval.

(d) Annual Accounting. Watermaster will prepare an annual summary accounting of the cumulative total of groundwater production and desalting from all authorized desalters and other activities authorized by the Optimum Basin Management Program in a schedule that: (i) identifies the total change in groundwater storage that will result from the Re-Operation; and (ii) characterizes and accounts for all water that is projected to be produced by all authorized desalters.

(e) Recharge and Replenishment Compliance. Watermaster must be in substantial compliance with its then existing recharge and replenishment plans and obligations, and will make an annual finding whether or not it is in compliance.

(f) Replenishment. Groundwater produced by Desalters in connection with Re-Operation to achieve Hydraulic Control will be replenished through, inter alia, the water made available through controlled overdraft.

(g) Suspension. Re-Operation and Watermaster's apportionment of controlled overdraft will not be suspended in the event that Hydraulic Control is secured in any year *before* the full 400,000 acre-feet has been produced so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures to avoid Material Physical Injury and that equitably addresses this contingency, and (ii) Watermaster continues to demonstrate a credible material progress toward obtaining sufficient capacity to recharge sufficient quantities of water to cause the Basin to return to a new equilibrium at the conclusion of the Re-Operation.

(h) Definition of Desalters. "Desalters" means the Chino I Desalter, the Chino I Expansion, the Chino II Desalter and Future Desalters, consisting of all the capital facilities' and processes that remove salt from the Basin water, including extraction wells, transmission facilities for delivery of groundwater to the Desalter. Desalter treatment and delivery facilities for the desalted water include pumping and storage facilities and treatment and

disposal capacity in the Santa Ana Regional Interceptor.

## PROGRAM ELEMENT 3 DEVELOP AND IMPLEMENT WATER SUPPLY PLAN FOR THE IMPAIRED AREAS OF THE BASIN, PROGRAM ELEMENT 5 DEVELOP AND IMPLEMENT REGIONAL SUPPLEMENTAL WATER PROGRAM

Construction on the Chino I Desalter Expansion and the Chino II Desalter facilities was completed in February 2006 and an application has been made for $1.6 M in Proposition 50 funds to add 8 MGD of ion exchange capacity to the Chino II Desalter. As currently configured, the Chino I Desalter provides 2.6 MGD of treated (air stripping for VOC removal) water from Wells Nos. 1-4, 4.9 MGD of treated (ion exchange for nitrate removal) water from Wells Nos. 5-15, and 6.7 MGD of treated (reverse osmosis for nitrate and TDS removal) water from Wells Nos. 5-15 for a total of 14.2 MGD (16,000 AFY). The Chino II Desalter provides 4.0 MGD of ion exchange treated water and 6.0 MGD of reverse osmosis treated water from 8 additional wells for a total of 10.0 MGD (11,000 AFY).

Consultants to the City of Ontario and Western Municipal Water District recently completed their evaluation of three alternative configurations for expansion of the Chino Desalters. Their results are presented in the report "Chino Desalter Phase 3 Alternatives Evaluation," dated May 2007. Essentially, they found that the preferred alternative would be to construct a 10.5 mgd (10,600 AFY) expansion to the existing Chino II Desalter, with raw water coming from the existing Wells Nos. 13, 14, and 15. A new Chino Creek Well Field, required for hydraulic control of the basin, would replace the raw water lost from the Wells Nos. 13, 14, and 15. Negotiations are currently underway between the City of Ontario, WMWD, and JCSD to determine capacity allocations and cost sharing for the new facilities.

## PROGRAM ELEMENT 4 DEVELOP AND IMPLEMENT COMPREHENSIVE GROUNDWATER MANAGEMENT PLAN FOR MANAGEMENT ZONE 1 (MZ1)

The occurrence of subsidence and fissuring in Management Zone 1 is not acceptable and should be reduced to tolerable levels or abated. The OBMP calls for a management plan to reduce or abate the subsidence and fissuring problems to the extent that it may be caused by production in MZ1.

In October 2005, Watermaster completed the MZ-1 Summary Report, including the Guidance Criteria. Since then the impacted parties have had numerous meetings to transform the Summary Report into a Long-term Management Plan. The Summary Report and the Guidance Criteria

were adopted by the Watermaster Board in May 2006, and the Long-term Management Plan was adopted in June 2007, was subsequently revised, and was submitted to the Court for approval at a hearing on November 15, 2007..

## PROGRAM ELEMENT 6 DEVELOP AND IMPLEMENT COOPERATIVE PROGRAMS WITH THE REGIONAL BOARD AND OTHER AGENCIES TO IMPROVE BASIN MANAGEMENT, and PROGRAM ELEMENT 7 SALT MANAGEMENT PROGRAM

On going discussions are being held with the RWQCB and the San Bernardino County Department of Airports in order to determine the engineering solution and costs for remediating the TCE plume at the Chino Airport. The consulting engineer for the SBCDA is currently characterizing the extent of off-site contamination and investigating remedial alternatives. For the Ontario Airport (OIA) plume, the Potentially Responsible Parties (PRPs) have been working with Watermaster to quantify the depth and extent of the TCE plume. At the Stringfellow site, the consultants to DHS have been investigating whether the perchlorate plume from the site adds to the existing perchlorate levels in the Santa Ana River, or whether the perchlorate plume is diverted towards the Chino II Desalter well field. Lastly, Watermaster continues to monitor the activities of General Electric's (GE) remediation at the Flat Iron facility and their efforts to develop a new location for recharge of their treated effluent.

**MZ-3 Monitoring Program.**
The former Kaiser plume has been incorporated into an overall monitoring program for the MZ-3 area. The MZ-3 monitoring program is also assessing the groundwater quality impairment from total dissolved solids (TDS), nitrate, and perchlorate. Quarterly samples will now be collected from all 4 wells to help recharacterize the Kaiser plume.

**Ontario International Airport (OIA) Volatile Organic Chemical Plume.**
Watermaster has provided water quality, water level, and well construction data from more than 400 private wells and 200 public wells to the RWQCB, which in turn forwarded the database to the PRPs pursuant to their request. Subsequently the PRPs submitted their sampling work plan and health and safety plan for the well installation and sampling.

**Chino Airport VOC Plume.**
Watermaster met with the RWQCB, the San Bernardino County Department of Airports, and their consultant Tetra Tech on April 18, May 25, and June 26, 2007 to discuss a joint remediation of the VOC plume from the airport. Such a joint remediation would help address other issues in the southwestern portion of Chino Basin such as maintenance of hydraulic control and the provision of high quality drinking water in an area of increasing demand. As a result of these meetings, Watermaster agreed to provide a database containing well construction information, water quality, water levels, and production for wells located southwest of the Chino airport. In

addition, Watermaster provided results from sampling all the wells in this location to provide up-to-date analytical data on all the possible contaminants in these wells. These data are being reviewed with Tetra Tech to begin the engineering of appropriate remedial actions.

**GE Flat Iron Remediation.**
Finally, with respect to the GE Flat Iron remediation, GE conducted a screening of options for the disposal of treated effluent from their operational pump and treat facilities. Currently, GE discharges their effluent into the Ely Basins, where it percolates back into the groundwater. However, this operation limits Watermaster's ability to recharge recycled water into the Ely Basins and, consequently, Watermaster has asked that GE develop alternative disposal means. As a result of their screening, GE has decided to investigate, in detail, the construction of groundwater injection wells that would be operated in conjunction with their own recharge basin. GE completed their planning in December 2006 and began detailed design based upon the RWQCB's approval of the concept.

**TDS and Nitrogen Monitoring Pursuant to the 2004 Basin Plan Amendment**
Pursuant to the 2004 Basin Plan Amendment and the Watermaster/IEUA permit to recharge recycled water, Watermaster and the IEUA have conducted and will continue to conduct groundwater and surface water monitoring programs. Quarterly HCMP reports that summarize data collection efforts will continue to be submitted to the RWQCB.

## PROGRAM ELEMENT 8 DEVELOP AND IMPLEMENT GROUNDWATER STORAGE MANAGEMENT PROGRAM, PROGRAM ELEMENT 9 DEVELOP AND IMPLEMENT STORAGE AND RECOVERY PROGRAMS

Currently, there is only one groundwater storage program approved in the Chino Basin: the 100,000 acre-ft Dry-Year Yield Program with the Metropolitan Water District of Southern California (MWD). The MWD, IEUA, and Watermaster are considering expanding this program by an additional 50,000 acre-ft to 150,000 acre-ft over the next few years. Watermaster is also considering an additional 150,000 acre-ft in programs with non-party water agencies.

# Attachment E

**Attachment "E"**

**Desalter Replenishment with Most Rapid Depletion of the Re-Operation Account**

(acre-ft/yr)

| Fiscal Year | Desalter Pumping | New Yield | Re-Operation | | | Residual Replenishment Obligation |
|---|---|---|---|---|---|---|
| | | | Replenishment Allocation for Desalter III | Replenishment Allocation to CDA | Balance | |
| | | | | | 400,000 | 0 |
| 2006 / 2007 | 28,700 | 8,610 | 0 | 20,090 | 379,910 | 0 |
| 2007 / 2008 | 28,700 | 8,610 | 0 | 20,090 | 359,820 | 0 |
| 2008 / 2009 | 28,700 | 8,610 | 0 | 20,090 | 339,730 | 0 |
| 2009 / 2010 | 28,700 | 8,610 | 0 | 20,090 | 319,640 | 0 |
| 2010 / 2011 | 28,700 | 8,610 | 0 | 20,090 | 299,550 | 0 |
| 2011 / 2012 | 28,700 | 8,610 | 0 | 20,090 | 279,460 | 0 |
| 2012 / 2013 | 34,050 | 10,215 | 5,000 | 18,835 | 255,625 | 0 |
| 2013 / 2014 | 39,400 | 11,820 | 10,000 | 17,580 | 228,045 | 0 |
| 2014 / 2015 | 39,400 | 11,820 | 10,000 | 17,580 | 200,465 | 0 |
| 2015 / 2016 | 39,400 | 11,820 | 10,000 | 17,580 | 172,885 | 0 |
| 2016 / 2017 | 39,400 | 11,820 | 10,000 | 17,580 | 145,305 | 0 |
| 2017 / 2018 | 39,400 | 11,820 | 10,000 | 15,305 | 120,000 | 2,275 |
| 2018 / 2019 | 39,400 | 11,820 | 10,000 | | 110,000 | 17,580 |
| 2019 / 2020 | 39,400 | 11,820 | 10,000 | | 100,000 | 17,580 |
| 2020 / 2021 | 39,400 | 11,820 | 10,000 | | 90,000 | 17,580 |
| 2021 / 2022 | 39,400 | 11,820 | 10,000 | | 80,000 | 17,580 |
| 2022 / 2023 | 39,400 | 11,820 | 10,000 | | 70,000 | 17,580 |
| 2023 / 2024 | 39,400 | 11,820 | 10,000 | | 60,000 | 17,580 |
| 2024 / 2025 | 39,400 | 11,820 | 10,000 | | 50,000 | 17,580 |
| 2025 / 2026 | 39,400 | 11,820 | 10,000 | | 40,000 | 17,580 |
| 2026 / 2027 | 39,400 | 11,820 | 10,000 | | 30,000 | 17,580 |
| 2027 / 2028 | 39,400 | 11,820 | 10,000 | | 20,000 | 17,580 |
| 2028 / 2029 | 39,400 | 11,820 | 10,000 | | 10,000 | 17,580 |
| 2029 / 2030 | 39,400 | 11,820 | 10,000 | | 0 | 17,580 |
| Totals | 876,050 | 262,815 | 175,000 | 225,000 | | 213,235 |

## Attachment "E"

## Desalter Replenishment with Proportional Depletion of the Re-Operation Account

(acre-ft/yr)

| Fiscal Year | Desalter Pumping | New Yield | Re-Operation | | | Residual Replenishment Obligation |
|---|---|---|---|---|---|---|
| | | | Replenishment Allocation for Desalter III | Replenishment Allocation to CDA | Balance | |
| | | | | | 400,000 | 0 |
| 2006 / 2007 | 28,700 | 8,610 | 0 | 7,371 | 392,629 | 12,719 |
| 2007 / 2008 | 28,700 | 8,610 | 0 | 7,371 | 385,258 | 12,719 |
| 2008 / 2009 | 28,700 | 8,610 | 0 | 7,371 | 377,886 | 12,719 |
| 2009 / 2010 | 28,700 | 8,610 | 0 | 7,371 | 370,515 | 12,719 |
| 2010 / 2011 | 28,700 | 8,610 | 0 | 7,371 | 363,144 | 12,719 |
| 2011 / 2012 | 28,700 | 8,610 | 0 | 7,371 | 355,773 | 12,719 |
| 2012 / 2013 | 34,050 | 10,215 | 5,000 | 8,745 | 342,028 | 10,090 |
| 2013 / 2014 | 39,400 | 11,820 | 10,000 | 10,119 | 321,908 | 7,461 |
| 2014 / 2015 | 39,400 | 11,820 | 10,000 | 10,119 | 301,789 | 7,461 |
| 2015 / 2016 | 39,400 | 11,820 | 10,000 | 10,119 | 281,670 | 7,461 |
| 2016 / 2017 | 39,400 | 11,820 | 10,000 | 10,119 | 261,551 | 7,461 |
| 2017 / 2018 | 39,400 | 11,820 | 10,000 | 10,119 | 241,431 | 7,461 |
| 2018 / 2019 | 39,400 | 11,820 | 10,000 | 10,119 | 221,312 | 7,461 |
| 2019 / 2020 | 39,400 | 11,820 | 10,000 | 10,119 | 201,193 | 7,461 |
| 2020 / 2021 | 39,400 | 11,820 | 10,000 | 10,119 | 181,073 | 7,461 |
| 2021 / 2022 | 39,400 | 11,820 | 10,000 | 10,119 | 160,954 | 7,461 |
| 2022 / 2023 | 39,400 | 11,820 | 10,000 | 10,119 | 140,835 | 7,461 |
| 2023 / 2024 | 39,400 | 11,820 | 10,000 | 10,119 | 120,715 | 7,461 |
| 2024 / 2025 | 39,400 | 11,820 | 10,000 | 10,119 | 100,596 | 7,461 |
| 2025 / 2026 | 39,400 | 11,820 | 10,000 | 10,119 | 80,477 | 7,461 |
| 2026 / 2027 | 39,400 | 11,820 | 10,000 | 10,119 | 60,357 | 7,461 |
| 2027 / 2028 | 39,400 | 11,820 | 10,000 | 10,119 | 40,238 | 7,461 |
| 2028 / 2029 | 39,400 | 11,820 | 10,000 | 10,119 | 20,119 | 7,461 |
| 2029 / 2030 | 39,400 | 11,820 | 10,000 | 10,119 | 0 | 7,461 |
| Totals | 876,050 | 262,815 | 175,000 | 225,000 | | 213,235 |

# Attachment F

September 21, 2007

**ATTACHMENT "F"**

**DISCRETIONARY ACTIONS**
**TO AMEND WATERMASTER RULES AND REGULATIONS**

Pursuant to the Judgment, the Peace Agreement and Watermaster Rules and Regulations, Watermaster will undertake the following actions:

## I. Agricultural Pool Reallocation

A. Section 6.3(c) of the Watermaster Rules and Regulations shall be amended to read:

"(c) In the event actual Production from the Agricultural Pool does not exceed 82,800 acre-feet in any one year or 414,000 acre-feet in any five years but total allocation from all the uses set forth in section 6.3(a) above exceeds 82,800 in any year, the amount of water made available to the members of the Appropriative Pool under section 6.3(a) shall be reduced pro rata in proportion to the benefits received by each member of the Appropriative Pool through such allocation. This reduction shall be accomplished according to the following procedure:

1. All of the amounts to be made available under 6.3(a) shall be added together. This amount shall be the "Potential Acre-Feet Available" for Reallocation.

2. Each Appropriative Pool member's requested share of the Potential Acre-Feet Available for Reallocation shall be determined. This share shall be expressed as a percentage share of the Potential Acre-Feet Available for Reallocation.

3. Each Appropriative Pool member's share of the Potential Acre-Feet Available for Reallocation shall be reduced pro rata according to the percentage determined in 2 above."

B. Section 6.3(d) of the Watermaster Rules and Regulations shall be added to read:

"(d) In the event actual Production from the Agricultural Pool does not exceed 82,800 acre-feet in any one year or 414,000 acre-feet in any five years and total Production from all the uses set forth in section 6.3(a) above does not exceed 82,800 acre-feet in any year, the amount of surplus water made available to the members of the Appropriative Pool shall be allocated according to the formula described in 6.3(c)."

C. Section 9.6 of the Watermaster Rules and Regulations will be amended to include an articulated rule of construction that: "This provision will be construed by as permitting Watermaster to accept new voluntary agreements only to the extent that such voluntary agreements occur within areas eligible for conversion as described in Attachment 1 to the Judgment, previously added to the Judgment as an amendment by Order of the Court dated November 17, 1995."

D. By Resolution, Watermaster will ratify all current Watermaster accounting practices with regard to Land Use Conversions, Assignments, voluntary agreements, Early Transfer, and reallocation of surplus Agricultural Pool water and continue to implement such provisions in a consistent manner.

## II. Storage

A. By Resolution, Watermaster has previously established a uniform loss percentage for all water held in storage at 2 percent, until it may be recalculated based upon the best available scientific information.

B. Watermaster will impose a uniform loss against all water in storage in an amount of 2 (two) percent where the Party holding the storage account: (i) has previously contributed to the implementation of the OBMP as a Party to the Judgment, is in compliance with their continuing covenants under the Peace Agreement or in lieu thereof they have paid or delivered to Watermaster "financial equivalent" consideration to offset the cost of past performance prior to the implementation of the OBMP and (ii) promised continued future compliance with Watermaster Rules and Regulations. Where a Party has not satisfied the requirement of B(i) and B(ii) Watermaster will assess a 6 (six) percent loss. Following a Watermaster determination that Hydraulic Control has been achieved, Watermaster will assess losses of less than one 1 percent where the Party satisfies B(i) and B(ii).

C. Section 8.1(f)(iii) a) and b) of Watermaster Rules and Regulations will be amended to substitute the date of July 1, 2010 for July 1, 2005.

D. Section 8.2(a), (b), (g), (h) of Watermaster Rules and Regulations will be amended to substitute the date of July 1, 2010 for July 1, 2005.

## III. Errors

A. A new Section 3.3. of Watermaster Rules and Regulations and shall read as follows:

"3.3 Error Corrections. All reports or other information submitted to Watermaster by the parties shall be subject to a four-year limitations period regarding the correction of errors contained in such submittals. In addition, all information generated by Watermaster shall be subject to the same four-year

limitations period. All corrections to errors shall apply retroactively for no more than four years."

**IV. Further Conforming Changes.**

A. After consultation with the stakeholders, Watermaster may make further conforming changes to its Rules and Regulations to eliminate any inconsistencies with the Peace II measures and to more effectively implement the measures from time to time.

**Date:** _____ _____

**For CHINO BASIN WATERMASTER**

# Attachment G

September 21, 2007

**Attachment "G"**

# PURCHASE AND SALE AGREEMENT FOR THE PURCHASE OF WATER BY WATERMASTER FROM OVERLYING (NON-AGRICULTURAL) POOL

THIS AGREEMENT (Agreement) is dated 27th day of September, 2007, regarding the Chino Groundwater Basin.

## RECITALS

**WHEREAS,** the Peace Agreement expressly authorized a transfer of water from the Overlying (Non-Agricultural) Pool to Watermaster for use as replenishment for the Desalters and for use in connection with a Storage and Recovery Program;

**WHEREAS,** Watermaster is evaluating its replenishment needs under the Judgment and several Storage and Recovery opportunities;

**WHEREAS,** Watermaster desires to purchase and the Overlying (Non-Agricultural) Pool desires to sell, all of the Non-Agricultural Pool water held in storage as of June 30, 2007;

**WHEREAS,** Watermaster is proposing an amendment to the Overlying (Non-Agricultural) Pool Pooling Plan set forth in Exhibit "G" to the Judgment whereby members of the Pool may offer water for purchase by Watermaster and thence the members of the Appropriative Pool under the process set forth therein;

**NOW THEREFORE,** in consideration of the mutual promises specified herein and by conditioning their performance under this Agreement upon the conditions precedent set forth herein, and for other good and valuable consideration, the Parties agree as follows:.

A. **Peace Agreement Transfer.** This purchase and sale agreement is in accordance with Section 5.3(e) of the Peace Agreement that provides that "parties to the Judgment with rights within the Non-Agricultural (Overlying) Pool shall have the additional rights to Transfer their rights to Watermaster for the purposes of Replenishment for a Desalter or for a Storage and Recovery Program."

B. **Quantity.** The quantity of water being made available to Watermaster by the Non-Agricultural (Overlying) Pool on a one-time basis ("Storage Transfer Quantity") is equivalent to the total quantity of water held in storage by the members of the Overlying (Non-Agricultural) Pool held in storage on June 30, 2007 ("Storage Quantity"), less a ten percent dedication for the purpose of Desalter Replenishment, less the quantity of water transferred pursuant to paragraph I below ("Special Transfer Quantity").

C. **Notice.** Within twenty-four months of the final Court approval of this Agreement ("Effective Date"), and only with the prior approval of the Appropriative Pool, Watermaster will provide written **Notice of Intent to Purchase** the Non-Agricultural (Overlying) Pool water pursuant to Section 5.3(a) of the Peace Agreement, which therein identifies whether such payment will be in connection with Desalter Replenishment or a Storage and Recovery Program.

D. **Payment.** Commencing thirty (30) calendar days from the Notice of Intent to Purchase ("Payment Date") Watermaster will pay to the Non-Agricultural Overlying Pool for each acre-foot of the Storage Transfer Quantity in accordance with the following schedule as the schedule is adjusted for inflation by the consumers price index ("cpi") for San Bernardino County from May 31, 2006 until the Payment Date.:

1. $215 times 1/4 of the Storage Transfer Quantity on the Payment Date.
2. $220 times 1/4 of the Storage Transfer Quantity on the first anniversary of the Payment Date.
3. $225 times 1/4 of the Storage Transfer Quantity on the second anniversary of the Payment Date
4. $230 time 1/4 of the Storage Transfer Quantity on the third anniversary of the Payment Date.

However, all payments provided for herein, including inflation adjustments, are subject to an express price cap and will not exceed ninety-two (92) percent of the then prevailing MWD replenishment rate in any year.

E. **Dedication to Desalter Replenishment.** Upon Watermaster's issuance of its written **Notice of Intent to Purchase**, and Watermaster's tender of its initial payment on the Payment Date, ten (10) percent of the Storage Quantity will be dedicated for replenishment of Desalter production without compensation. Watermaster will receive but will not pay for this dedication.

F. **Use and Distribution.** Watermaster will take possession of the water made available pursuant to this Agreement and make use of and distribute the water made available in a manner consistent with Section 5.3(e) of the Peace Agreement.

G. **Condition Precedent.** This Agreement and the Parties performance hereunder are expressly conditioned upon Court approval of this Agreement.

H. **Early Termination.** This Agreement will expire and be of no further force and effect if: Watermaster does not issue its **Notice of Intent to Purchase** in accordance with Paragraph D above within twenty-four (24) months of Court approval. Upon Watermaster's failure to satisfy the condition subsequent, the rights of the Non-Agricultural (Overlying) Pool will remain unaffected and without prejudice as result of their having executed this Agreement except that in the event of Early Termination, the Storage Transfer Quantity, will then be made available for purchase by Watermaster and thence the members of the Appropriative Pool in accordance with Paragraph 9.(iv) of Amended Exhibit G, the Overlying (Non-Agricultural) Pool,

Pooling Plan, including the requirement of a ten percent dedication towards Desalter replenishment.

I. **One Time Transfer in Furtherance of the Physical Solution and in Aid of Desalter Replenishment ("Special Transfer Quantity").** In consideration of the Overlying (Non-Agricultural) Pool members' irrevocable commitment made herein and it the Peace II Measures Watermaster will purchase and immediately make available the quantity of 8,530 acre-feet (less a ten percent dedication to Watermaster for Desalter Production) to the San Antonio Water Company (SAWCO) and Vulcan Materials, a member of the Overlying (Non-Agricultural) Pool under terms established as between those parties. This One Time Transfer is in addition to and without prejudice to the discretionary rights of the members of the Overlying (Non-Agricultural) Pool to make available and Watermaster and members of the Appropriative Pool to purchase water as Physical Solution transfers. No member of the Appropriative Pool, other than SAWCO assumes any responsibility for the purchase of this Special Transfer Quantity from Vulcan.

IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: NON-AGRICULTURAL OVERLYING POOL

By _____

# Attachment H

September 21, 2007

**Attachment "H"**

**JUDGMENT AMENDMENT**
**to Paragraph 8**

The Paragraph 8 of the Judgment shall be amended to read as follows:

"8. The parties listed in Exhibits "C" and "D" are the owners or in possession of lands which overlie Chino Basin. As such, said parties have exercised overlying water rights in Chino Basin. All overlying rights owned or exercised by parties listed in Exhibits "C" and "D" have, in the aggregate, been limited by prescription except to the extent such rights have been preserved by self-help by said parties. Aggregate preserved overlying rights in the Safe Yield for Agricultural Pool use, including the rights of the State of California, total 82,800 acre-feet per year. Overlying rights for non-agricultural pool use total 7,366 acre-feet per year and are individually decreed for each affected party in Exhibit "D." No portion of the Safe Yield of Chino Basin exists to satisfy unexercised overlying rights and such rights have all been lost by prescription. However, uses may be made of Basin water on overlying lands which have no preserved overlying rights pursuant to the Physical Solution herein. All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom for the term of the Peace Agreement except that the members of the Overlying (Non-Agricultural) Pool shall have the right to Transfer or lease their quantified Production rights: (i) within the Overlying (Non-Agricultural) Pool; (ii) to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000; or (iii) in accordance with the Overlying-(Non-Agricultural) Pool Pooling Plan set forth in Exhibit "G."

# Attachment I

October 25, 2007

**Attachment "I"**

**JUDGMENT AMENDMENT**
**TO EXHIBIT G**

Exhibit G, the Overlying (Non-Agricultural) Pool Pooling Plan will be amended to revise Paragraph 5 to read as follows:

"5. Assessments.

(a) Replenishment Assessments. Each member of this Pool shall pay an assessment equal to the cost of replenishment water times the number of acre feet of production by such producer during the preceding year in excess of (a) his decreed share of the Safe Yield, plus (b) any carry-over credit under Paragraph 7 hereof.

(b) Administrative Assessments. In addition, the cost of the allocated share of Watermaster administration expense shall be recovered on an equal assessment against each acre-foot of production in the pool during such preceding fiscal year or calendar quarter; and in the case of Pool members who take substitute groundwater as set forth in Paragraph 8 hereof, such producer shall be liable for its share of administration assessment, as if the water so taken were produced, up to the limit of its decreed share of Safe Yield.

(c) Special Project OBMP Assessment. Each year, every member of this Pool will dedicate ten (10) percent of their annual share of Operating Safe Yield to Watermaster or in lieu thereof Watermaster will levy a Special Project OBMP Assessment in an amount equal to ten percent of the Pool member's respective share of Safe Yield times the then-prevailing MWD Replenishment Rate.

And to renumber Paragraph 9 as Paragraph 10 and add Paragraph 9 to read as follows:

"9. Physical Solution Transfers. All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom except that for the term of the Peace Agreement the members of the Overlying (Non-Agricultural) Pool shall have the discretionary right to Transfer or lease their quantified Production rights and carry-over water held in storage accounts in quantities that each member may from time to time individually determine as Transfers in furtherance of the Physical Solution: (i) within the Overlying (Non-Agricultural) Pool; (ii) to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000; (iii) in conformance with the procedures described in Paragraph I of the Purchase and Sale Agreement for the Purchase of Water by Watermaster from Overlying (Non-Agricultural Pool dated June 30, 2007; or (iv) to Watermaster and thence to members of the Appropriative Pool in accordance with the following guidelines and those procedures Watermaster may further provide in Watermaster's Rules and Regulations:

(a) By December 31 of each year, the members of the Overlying (Non-Agricultural) Pool shall notify Watermaster of the amount of water each member shall make available in their individual discretion for purchase by the Appropriators. By January 31 of each year,

Watermaster shall provide a Notice of Availability of each Appropriator's pro-rata share of such water;

(b) Except as they may be limited by paragraph 9(e) below, each member of the Appropriative Pool will have, in their discretion, a right to purchase its pro-rata share of the supply made available from the Overlying (Non-Agricultural) Pool at the price established in 9(d) below. Each Appropriative Pool member's pro-rata share of the available supply will be based on each Producer's combined total share of Operating Safe Yield and the previous year's actual Production by each party;

(c) If any member of the Appropriative Pool fails to irrevocably commit to their allocated share by March 1 of each year, its share of the Overlying (Non-Agricultural) Pool water will be made available to all other members of the Appropriative Pool according to the same proportions as described in 9(b) above and at the price established in Paragraph 9(d) below. Each member of the Appropriative Pool shall complete its payment for its share of water made available by June 30 of each year.

(d) Commensurate with the cumulative commitments by members of the Appropriative Pool pursuant to (b) and (c) above, Watermaster will purchase the surplus water made available by the Overlying (Non-Agricultural) Pool water on behalf of the members of the Appropriative Pool on an annual basis at 92% of the then-prevailing "MWD Replenishment Rate" and each member of the Appropriative Pool shall complete its payment for its determined share of water made available by June 30 of each year.

(e) Any surplus water cumulatively made available by all members of the Overlying (Non-Agricultural) Pool that is not purchased by Watermaster after completion of the process set forth herein will be pro-rated among the members of the Pool in proportion to the total quantity offered for transfer in accordance with this provision and may be retained by the Overlying (Non-Agricultural) Pool member without prejudice to the rights of the members of the Pool to make further beneficial us or transfer of the available surplus.

(f) Each Appropriator shall only be eligible to purchase their pro-rata share under this procedure if the party is: (i) current on all their assessments; and (ii) in compliance with the OBMP.

(g) The right of any member of the Overlying (Non-Agricultural) Pool to transfer water in accordance with this Paragraph 9(a)-(c) in any year is dependent upon Watermaster making a finding that the member of the Overlying (Non-Agricultural) Pool is using recycled water where it is both physically available and appropriate for the designated end use in lieu of pumping groundwater.

(h) Nothing herein shall be construed to affect or limit the rights of any Party to offer or accept an assignment as authorized by the Judgment Exhibit "G" paragraph 6 above, or to affect the rights of any Party under a valid assignment."

# Attachment "I-1"

# Map Re-Operation

# Attachment J

September 21, 2007

**Attachment "J"**

**JUDGMENT AMENDMENT**
**to Exhibit I**

**Exhibit "I" "ENGINEERING APPENDIX" is amended to read as follows:**

1. **Basin Management Parameters.** In the process of implementing the physical solution, Watermaster shall consider the following parameters:

(a) Pumping Patterns. Chino Basin is a common supply for all persons and agencies utilizing its waters. It is an objective in management of the Basin's waters that no producer be deprived of access to said waters by reason of unreasonable pumping patterns, nor by regional or localized recharge of replenishment water, insofar as such result may be practically avoided.

(b) Water Quality. Maintenance and improvement of water quality is a prime consideration and function of management decisions by Watermaster.

(c) Economic Considerations. Financial feasibility, economic impact and the cost and optimum utilization of the Basin's resources and the physical facilities of the parties are objectives and concerns equal in importance to water quantity and quality parameters.

2. **Hydraulic Control and Re-Operation.** In accordance with the purpose and objective of the Physical Solution to "establish a legal and practical means for making the maximum reasonable beneficial use of the waters of the Chino Basin" (paragraph 39) including but not limited to the use and recapture of reclaimed water (paragraph 49(a) ) and the identified Basin Management Parameters set forth above, Watermaster will manage the Basin to secure and maintain Hydraulic Control through controlled overdraft.

(a) **Hydraulic Control.** "Hydraulic Control" means the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. The Chino North Management Zone is more fully described and set forth in Attachment I-1 to this Engineering Appendix. By obtaining Hydraulic Control, Watermaster will ensure that the water management activities in the Chino North Management Zone do not cause materially adverse impacts to the beneficial uses of the Santa Ana River downstream of Prado Dam.

(b) **Re-Operation.** "Re-Operation" means the controlled overdraft of the Basin by the managed withdrawal of groundwater for the Desalters and the potential increase in the cumulative un-replenished Production from 200,000 acre-feet authorized by paragraph 3 below, to 600,000 acre feet for the express purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution.

[1] The increase in the controlled overdraft herein is separate from and in addition to the 200,000 acre-feet of accumulated overdraft authorized in paragraph 3(a) and 3(b) below over the period of 1978 through 2017.

[2] "Desalters" means the Chino I Desalter, the Chino I Expansion, the Chino II Desalter and Future Desalters, consisting of all the capital facilities and processes that remove salt from Basin water, including extraction wells and transmission facilities for delivery of groundwater to the Desalter. Desalter treatment and delivery facilities for the desalted water include pumping and storage facilities and treatment and disposal capacity in the Santa Ana Regional Interceptor.

[3] The groundwater Produced through controlled overdraft pursuant to Re-Operation does not constitute New Yield or Operating Safe Yield and it is made available under the Physical Solution for the express purpose of satisfying some or all of the groundwater Production by the Desalters until December 31, 2030. ("Period of Re-Operation").

[4] The operation of the Desalters, the Production of groundwater for the Desalters and the use of water produced by the Desalters pursuant to Re-Operation are subject to the limitations that may be set forth in Watermaster Rules and Regulations for the Desalters.

(5) Watermaster will update its Recharge Master Plan and obtain Court approval of its update, to address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and operated at a new equilibrium at the conclusion of the period of Re-Operation. The Recharge Master Plan shall contain recharge projections and summaries of the projected water supply availability as well as the physical means to accomplish recharge projections. The Recharge Master Plan may be amended from time to time with Court approval.

(6) Re-Operation and Watermaster's apportionment of controlled overdraft in accordance with the Physical Solution will not be suspended in the event that Hydraulic Control is secured in any year *before* the full 400,000 acre-feet has been Produced without Replenishment, so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures that will avoid unreasonable and unmitigated material physical harm to a party or to the Basin and that equitably distributes the cost of any mitigation attributable to the identified contingencies; and (ii) Watermaster is in substantial compliance with a Court approved Recharge Master Plan.

3 **Operating Safe Yield.** Operating Safe Yield in any year shall consist of the Appropriative Pool's share of Safe Yield of the Basin, plus any accumulated overdraft of the Basin which Watermaster may authorize under 3(a) and 3(b) below. In adopting the Operating Safe Yield for any year, Watermaster shall be limited as follows:

(a) Accumulated Overdraft. During this Judgment and Physical Solution, the overdraft accumulated from and after the effective date of the Physical Solution and resulting from an excess of Operating Safe Yield over Safe Yield shall not exceed 200,000 acre feet.

(b) Quantitative Limits. In no event shall Operating Safe Yield in any year be less than the Appropriative Pool's share of Safe Yield, nor shall it exceed such share of Safe Yield by more than 10,000 acre-feet. The Initial Operating Safe Yield is hereby set at 54,834 acre-feet per year. Operating Safe Yield shall not be changed upon less than five (5) years' notice by Watermaster.

Nothing contained in this paragraph shall be deemed to authorize directly or indirectly, any modification of the allocation of shares in Safe Yield to the overlying pools, as set forth in Paragraph 44 of the Judgment.

4. **Groundwater Storage Agreements.** Any agreements authorized by Watermaster for Storage of supplemental water in the available groundwater storage capacity of Chino Basin shall include, but not be limited to:

(a) The quantities and term of the storage right.

(b) A statement of the priority or relations of said right, as against overlying or Safe Yield uses, and other storage rights.

(c) The procedure for establishing delivery rates, schedules and procedures which may include:

[1] spreading or injection, or

[2] in lieu deliveries of supplemental water for direct use.

(d) The procedures for calculation of losses and annual accounting for water in storage by Watermaster.

(e) The procedures for establishment and administration of withdrawal schedules, locations and methods.

# Attachment K

October 25, 2007

**PEACE II AGREEMENT:**
**PARTY SUPPORT FOR WATERMASTER'S OBMP IMPLEMENTATION PLAN, –**
**SETTLEMENT AND RELEASE OF CLAIMS**
**REGARDING FUTURE DESALTERS**

**WHEREAS,** paragraph 41 of the Judgment entered in *Chino Basin Municipal Water District v. City of Chino* (San Bernardino Superior Court Case No. 51010) grants Watermaster, with the advice of the Advisory and Pool Committees, "discretionary powers in order to implement an Optimum Basin Management Program ("OBMP") for the Chino Basin";

**WHEREAS,** the Parties to the Judgment executed an agreement resolving their differences and pledging their support for Watermaster actions in accordance with specific terms in June of 2000 ("Peace Agreement");

**WHEREAS,** Watermaster approved Resolution 00-05, and thereby adopted the goals and objectives of the OBMP, the OBMP Implementation Plan and committed to act in accordance with the terms of the Peace Agreement;

**WHEREAS,** pursuant to Article IV, paragraph 4.2, each of the parties to the Peace Agreement agreed not to oppose Watermaster's adoption and implementation of the OBMP Implementation Plan attached as Exhibit "B" to the Peace Agreement;

**WHEREAS,** the Peace Agreement, the OBMP Implementation Plan and the Chino Basin Watermaster Rules and Regulations contemplate further actions by Watermaster in furtherance of its responsibilities under paragraph 41 of the Judgment and in accordance with the Peace Agreement and the OBMP Implementation Plan;

**WHEREAS,** the Parties to the Peace Agreement made certain commitments regarding the funding, design, construction and operation of Future Desalters;

**WHEREAS,** after receiving input from its stakeholders in the form of the Stakeholder's Non-Binding Term Sheet, Watermaster has proposed to adopt Resolution 07-05 attached as Exhibit "1" hereto to further implement the OBMP through a suite of measures commonly referred to and herein defined as "Peace II Measures", including but not limited to the 2007 Supplement to the OBMP, the Second Amendment to the Peace Agreement, amendments to Watermater's Rules and Regulations, the purchase and sale of water within the Overlying (Non-Agricultural) Pool and certain Judgment amendments; and

**NOW, THEREFORE,** in consideration of the mutual promises specified herein and by conditioning their performance under this Agreement upon the conditions precedent set forth in Article III herein, the Watermaster Approval, and Court Order, and for other good and valuable consideration, the Parties agree as follows:

## ARTICLE I
## DEFINITIONS AND RULES OF CONSTRUCTION

1.1 Definitions.

(a) "Desalters" means Desalters and Future Desalters collectively, as defined in the Peace Agreement.

(b) "Hydraulic Control" means the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. The Chino North Management Zone is defined in the 2004 Basin Plan amendment (RWQCB resolution R8-2004-001) attached hereto as Exhibit "B."

(c) "Leave Behind" means a contribution to the Basin from water held in storage within the Basin under a Storage and Recovery Agreement that may be established by Watermaster from time to time that may reflect any or all of the following: (i) actual losses; (ii) equitable considerations associated with Watermaster's management of storage agreements; and (iii) protection of the long-term health of the Basin against the cumulative impacts of simultaneous recovery of groundwater under all storage agreements.

(d) Re-Operation" means the controlled overdraft of the Basin by the managed withdrawal of groundwater Production for the Desalters and the potential increase in the cumulative un-replenished Production from 200,000 authorized by paragraph 3 of the Engineering Appendix Exhibit I to the Judgment, to 600,000 acre feet for the express purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution.

(e) Unless otherwise expressly provided herein, all definitions set forth in the Peace Agreement and the Judgment are applicable to the terms as they are used herein.

1.2 Rules of Construction.

(a) Unless the context clearly requires otherwise:

(i) The plural and singular forms include the other;

(ii) "Shall," "will," "must," and "agrees" are each mandatory;

(iii) "May" is permissive;

(iv) "Or" is not exclusive;

(v) "Includes" and "including" are not limiting; and

(vi) "Between" includes the ends of the identified range.

(b) Headings at the beginning of Articles, paragraphs and subparagraphs of this Agreement are solely for the convenience of the Parties, are not a part of this Agreement and shall not be used in construing it.

(c) The masculine gender shall include the feminine and neuter genders and vice versa.

(d) The word "person" shall include individual, partnership, corporation, limited liability company, business trust, joint stock company, trust, unincorporated association, joint venture, governmental authority, water district and other entity of whatever nature.

(e) Reference to any agreement (including this Agreement), document, or instrument means such agreement, document, instrument as amended or modified and in effect from time to time in accordance with the terms thereof and, if applicable, the terms thereof.

(f) Except as specifically provided herein, reference to any law, statute or ordinance, regulation or the like means such law as amended, modified, codified or reenacted, in whole or in part and in effect from time to time, including any rules and regulations promulgated thereunder.

## ARTICLE II
## COMPLIANCE WITH CEQA

2.1 Project Description. The proposed project description regarding the design, permitting, construction and operation of Future Desalter, securing Hydraulic Control through Basin Re-Operation is set forth in Attachment "A" to Watermaster Resolution 07-05 attached hereto as Exhibit "1."

2.2 Acknowledgment of IEUA as the Lead Agency for CEQA Review. IEUA has been properly designated as the "Lead Agency" for the purposes of completing environmental assessment and review of the proposed project.

2.3 Commitments are Consistent with CEQA. The Parties agree and acknowledge that no commitment will be made to carry out any "project" under the amendments to the OBMP and within the meaning of CEQA unless and until the environmental review and assessment that may be required by CEQA for that defined "project" have been completed.

2.4 Reservation of Discretion. Execution of this Agreement is not intended to commit any Party to undertake a project without compliance with CEQA or to commit the Parties individually or collectively to any specific course of action, which would result in the present approval of a future project.

2.5 No Prejudice by Comment or Failure to Comment. Nothing contained in environmental review of the Project, or a Party's failure to object or comment thereon, shall limit any

Party's right to allege that "Material Physical Injury" will result or has resulted from the implementation of the OBMP or its amendment.

## ARTICLE III
## CONDITIONS PRECEDENT

3.1 Performance Under Articles IV-XII is Subject to Satisfaction of the Conditions Precedent. Each Party's obligations under this Agreement are subject to the satisfaction of the following conditions precedent on or before the dates specified below, unless satisfaction or a specified condition or conditions is waived in writing by all other Parties:

(a) Watermaster approval of Resolution 07-05 in a form attached hereto as Exhibit "1," including the following Attachments thereto

(i) the amendments to the Chino Basin Watermaster Rules and Regulations set forth in Attachment "F" thereto.

(ii) the 2007 Supplement to the OBMP Implementation Plan set forth in Attachment "D" thereto.

(iii) the amendments to the Judgment set forth in Attachments "H, I, and J" thereto.

(iv) the Second Amendment to the Peace Agreement set forth in Attachment "L" thereto.

(v) the Purchase and Sale Agreement for the Purchase of Water by Watermaster From the Overlying (Non-Agricultural) Pool as set forth in Attachment G thereto.

(b) The execution of the proposed Second Amendment to the Peace Agreement by all Parties to the Peace Agreement .

(c) Court approval of the proposed Judgment Amendments and a further order of the Court directing Watermaster to proceed in accordance with the terms of the Peace II Measures as embodied in Resolution 07-05.

## ARTICLE IV
## MUTUAL ACKNOWLEDGEMENT AND COVENANTS

4.1 Acknowledgment of Peace II Measures. The collective actions of Watermaster set forth in Watermaster Resolution 07-05 and the Attachments thereto (Peace II Measures) constitute further actions by Watermaster in implementing the OBMP in accordance with the grant and limitations on its discretionary authority set forth under paragraph 41 of the Judgment

4.2 Non-Opposition. No Party to this Agreement shall oppose Watermaster's adoption of Resolution 07-05 and implementation of the Peace II measures as embodied therein

including the Judgment Amendments, Amendments to the Peace Agreement, the 2007 Supplement to the OBMP Implementation Plan and Amendments to the Chino Basin Watermaster's Rules and Regulations or to Watermaster's execution of memoranda of agreement that are not materially inconsistent with the terms contained therein. Notwithstanding this covenant, no party shall be limited in their right of participation in all functions of Watermaster as they are provided in the Judgment or to preclude a Party to the Judgment from seeking judicial review of Watermaster determinations pursuant to the Judgment or as otherwise provided in this Agreement.

4.3 Consent to Amendments. Each Party expressly consents to the Judgment amendments and modifications set forth in Watermaster's Resolution 07-05.

4.4 Non-Agricultural Pool Intervention. The Parties acknowledge and agree that any Party to the Judgment shall have the right to purchase Non-Agricultural overlying property within the Basin and appurtenant water rights and to intervene in the Non-Agricultural Pool.

## ARTICLE V
## FUTURE DESALTERS

5.1 Purpose. Watermaster plans to coordinate and the Parties to the Judgment plan to arrange for the physical capacity and potable water use of water from the Desalters. Desalters in existence on the effective date of this Agreement will be supplemented to provide the required capacity to cumulatively produce approximately 40,000 acre-feet per year of groundwater from the Desalters by 2012.

5.2 2007 Supplement to the OBMP Implementation Plan. The OBMP Implementation Plan will be supplemented as set forth in the 2007 Supplement to the OBMP Implementation Plan to reflect that Western Municipal Water District ("WMWD"), acting independently or in its complete discretion with the City of Ontario ("Ontario") or the Jurupa Community Services District ("Jurupa") or both, will exercise good faith and reasonable best efforts to arrange for the design, planning, and construction of Future Desalters in accordance with the 2007 Supplement to the OBMP Implementation Plan, to obtain Hydraulic Control, further Re-Operation and support the Future Desalters.

5.3 Implementation. WMWD, acting independently or in its complete discretion with Ontario, Jurupa, or both, will exercise good faith and reasonable best efforts to arrange for the design, planning, and construction of Future Desalters in accordance with the 2007 Supplement to the OBMP Implementation Plan, to account for Hydraulic Control, Re-Operation and Future Desalters.

(a) WMWD, acting independently or in its complete discretion with Ontario or Jurupa or both, will exercise good faith and reasonable best efforts to proceed in accordance with the timeline for the completion of design, permitting, finance and construction as attached hereto as Exhibit "2"

(b) WMWD, acting independently or in its complete discretion with the City of Ontario or the Jurupa Community Services District or both, will provide quarterly progress reports to Watermaster and the Court.

5.4 Project Description. The Future Desalters will add up to 9 mgd to existing Desalters. This will include production capacity from new groundwater wells that will be located in the Southerly end of the Basin, as depicted in Exhibit "3" attached hereto and incorporated herein by this reference. The final design and construction of Future Desalters *may* depend on the terms and conditions that may be freely arrived at by fair bargaining among WMWD and the Chino Basin Desalter Authority ("CDA") or whether it is required to build stand-alone facilities or both. There are material yield benefits to the Parties to the Judgment that are achieved by obtaining Hydraulic Control through Basin Re-Operation. The extent of these benefits is somewhat dependent upon the final location of new production facilities within the southerly end of the Basin. Accordingly, Watermaster will ensure that the location of Future Desalter groundwater production facilities will achieve both Hydraulic Control and maximize yield enhancement by their location emphasizing groundwater production from the Southerly end of the Basin.

5.5 Implementing Agreements. Within twenty-four (24) months of the effective date, WMWD, acting independently or in its complete discretion with the City of Ontario or the Jurupa Community Services District or both, will exercise good faith and reasonable best efforts to complete final binding agreement(s) regarding Future Desalters that includes the following key terms:

(a) Arrangements for WMWD's purchase of product water from CDA;

(b) Arrangements with CDA, Jurupa and other Chino Basin parties for the common use of existing facilities, if any;

(c) Arrangement with the owners of the SARI line;

(d) Arrangements with the Appropriative Pool regarding the apportionment of any groundwater produced as controlled overdraft in accordance with the Physical Solution between Desalters I, Desalters II on the one hand and the Future Desalters on the other hand;

(e) WMWD's payment to Watermaster to reimburse Parties to the Judgment for their historical contributions towards the OBMP, if any;

(f) The schedule for approvals and project completion.

5.6 Reservation of Discretion. Nothing herein shall be construed as committing WMWD, or any members of CDA to take any specific action(s) to accommodate the needs or requests of the other, Watermaster, or any Party to the Judgment, whatever the request may be.

5.7 Condition Subsequent. WMWD's obligation to execute a binding purchase agreement with CDA or to independently develop the Future Desalters is subject to the express condition subsequent that the total price per acre-foot of water delivered must not be projected to exceed the sum of the following: (i) the full MWD Tier II Rate; (ii) the MWD Treatment Surcharge calculated in terms of an annual average acre-foot charge; and (iii) $150 (in 2006 dollars) per acre-foot of water delivered to account for water supply reliability.

(a) The full acre-foot cost to Western for Capital and O&M (assuming the priority allocation of controlled overdraft), includes:

(i) the delivery of the desalted water to its Mockingbird Reservoir or directly to the City of Norco,

(ii) any applicable ongoing Watermaster assessments, payments to CDA and JCSD and for SARI utilization.

(b) Provided that if third-party funding, grants and a MWD subsidy under the Local Resources Program or otherwise should reduce Western's costs to an amount which is $75 (in 2006 dollars) below the cap described in paragraph 5.5, Western will transmit an amount equal to fifty (50) percent of the amount less than the computed price cap less $75 (in 2006 dollars) to Watermaster.

(c) Western may elect to exercise its right of withdrawal under this paragraph 5.7 within 120 days following the later of: (1) completion of preliminary design; or (2) the certification of whatever CEQA document is prepared for the project, but not later than sixty (60) days thereafter and in no event after a binding water purchase agreement has been executed.

5.8 Limitations. The operation of the Future Desalters will be subject to the following limitations:

(a) Well Location. New groundwater production facilities for the Future Desalters will be located in the southern end of the Basin to achieve the dual purpose of obtaining Hydraulic Control and increasing Basin yield.

(i) New wells will be constructed in the shallow aquifer system among Desalter I wells No. 1 through 4 and west of Desalter I.

(ii) So long as these wells produce at least one-half of the Future Desalter groundwater, the Future Desalters shall be entitled to first priority for the allocation of the 400,000 acre-feet of controlled overdraft authorized by the Judgment Amendments to Exhibit I.

(b) Export. The export of groundwater from the Basin must be minimized. WMWD will present a plan for export minimization to the Watermaster for review and approval prior to operation of the Future Desalters.

(i) Watermaster will account for water imported and exported by WMWD.

(ii) Watermaster will prepare an initial reconciliation of WMWD's imports and exports at the end of the first ten (10) years of operation and every year thereafter to determine whether a "net export" occurred.

(iii) WMWD will pay an assessment, if any, on all "net exports" in accordance with Judgment Exhibit "H," paragraph 7(b) after the initial reconciliation is completed at the end of the first ten (10) years of operation.

## ARTICLE VI
## GROUNDWATER PRODUCTION BY AND REPLENISHMENT FOR DESALTERS

6.1 Acknowledgment. The Parties acknowledge that the hierarchy for providing Replenishment Water for the Desalters is set forth in Article VII, paragraph 7.5 of the Peace Agreement, and that this section controls the sources of water that will be offered to offset Desalter Production.

6.2 Peace II Desalter Production Offsets. To facilitate Hydraulic Control through Basin Re-Operation, in accordance with the 2007 Supplement to the OBMP Implementation Plan and the amended Exhibits G and I to the Judgment, additional sources of water will be made available for purposes of Desalter Production and thereby some or all of a Replenishment obligation. With these available sources, the Replenishment obligation attributable to Desalter production in any year will be determined by Watermaster as follows:

(a) Watermaster will calculate the total Desalter Production for the preceding year and then apply a credit against the total quantity from:

(i) the Kaiser account (Peace Agreement Section 7.5(a).);

(ii) dedication of water from the Overlying (Non-Agricultural) Pool Storage Account or from any contribution arising from an annual authorized Physical Solution Transfer in accordance with amended Exhibit G to the Judgment;

(iii) New Yield (other than Stormwater (Peace Agreement Section 7.5(b));

(iv) any declared losses from storage in excess of actual losses enforced as a "Leave Behind";

(v) Safe Yield that may be contributed by the parties (Peace Agreement Section 7.5(c));

(vi) any Production of groundwater attributable to the controlled overdraft authorized pursuant to amended Exhibit I to the Judgment.

(b) To the extent available credits are insufficient to fully offset the quantity of groundwater production attributable to the Desalters, Watermaster will use water or revenue obtained by levying the following assessments among the members of the Overlying (Non-Agricultural) Pool and the Appropriative Pool to meet any remaining replenishment obligation as follows.

(i) A Special OBMP Assessment against the Overlying (Non-Agricultural) Pool as more specifically authorized and described in amendment to Exhibit "G" paragraph 8(c) to the Judgment will be dedicated by Watermaster to further off-set replenishment of the Desalters. However, to the extent there is no remaining replenishment obligation attributable to the Desalters in any year after applying the off-sets set forth in 6.2(a), the OBMP Special Assessment levied by Watermaster will be distributed as provided in Section 9.2 below. The Special OBMP Assessment will be assessed pro-rata on each member's share of Safe Yield, followed by

(ii) A Replenishment Assessment against the Appropriative Pool, pro-rata based on each Producer's combined total share of Operating Safe Yield and the previous year's actual production. Desalter Production is excluded from this calculation. However, if there is a material reduction in the net cost of Desalter product water to the purchasers of product water, Watermaster may re-evaluate whether to continue the exclusion of Desalter Production but only after giving due regard to the contractual commitment of the parties.

(iii) The quantification of any Party's share of Operating Safe Yield does not include the result of any land use conversions.

(c) The rights and obligations of the parties, whatever they may be, regarding Replenishment Assessments attributable to all Desalters and Future Desalters in any renewal term of the Peace Agreement are expressly reserved and not altered by this Agreement.

## ARTICLE VII
## YIELD ACCOUNTING

7.1 New Yield Attributable to Desalters. Watermaster will make an annual finding as to the quantity of New Yield that is made available by Basin Re-Operation including that portion that is specifically attributable to the Existing and Future Desalters. Any subsequent recalculation of New Yield as Safe Yield by Watermaster will not change the priorities set forth above for offsetting Desalter production as set forth in Article VII, Section 7.5 of the Peace Agreement. For the initial term of the Peace Agreement, neither Watermaster nor the Parties will request that Safe Yield be recalculated in a manner that incorporates New Yield *attributable to the Desalters* into the determination of Safe Yield so that this source of supply will be available for Desalter Production rather than for use by individual parties to the Judgment.

7.2 Apportionment of Controlled Overdraft. Within twelve (12) months of the court approval and no later than December 1, 2008, with facilitation by Watermaster, WMWD and the Appropriative Pool will establish by mutual agreement the portion of the 400,000 acre-feet of the controlled overdraft authorized by the amendment to Exhibit "I" to the Judgment that will be allocated among the Desalters and pursuant to a proposed schedule.

(a) To the extent the groundwater wells for the Future Desalters pump at least fifty (50) percent groundwater from the southern end of the Basin as set forth in Exhibit "3" the *Future Desalters* will be entitled to first priority to the controlled overdraft authorized by the amendment to Exhibit "I" to the Judgment.

(b) WMWD and the Appropriative Pool will exercise good faith and reasonable best efforts to arrive at a fair apportionment. Relevant considerations in establishing the apportionment include, but are not limited to: (i) the nexus between the proposed expansion and achieving Hydraulic Control;(ii) the nexus between the project and obtaining increased yield; (iii) the identified capital costs; (iv) operating and maintenance expenses; and (iv) the availability of third-party funding.

(c) The parties will present any proposed agreement regarding apportionment to Watermaster. Watermaster will provide due regard to any agreement between WMWD and the Appropriative Pool and approve it so long as the proposal phases the Re-Operation over a reasonable period of time to secure the physical condition of Hydraulic Control and will achieve the identified yield benefits while at the same time avoiding Material Physical Injury or an inefficient use of basin resources.

(d) If WMWD and the Appropriative Pool do not reach agreement on apportionment of controlled overdraft to Future Desalters, then no later than August 31, 2009, the members of the Appropriative Pool will submit a plan to Watermaster that achieves the identified goals of increasing the physical capacity of the Desalters and potable water use of approximately 40,000 acre-feet of groundwater production from the Desalters from the Basin no later than 2012. The Appropriative Pool proposal must demonstrate how it has provided first priority to the Future Desalters if the conditions of paragraph 7.2(a) are met.

(e) Watermaster will have discretion to apportion the controlled overdraft under a schedule that reflects the needs of the parties and the need for economic certainty and the factors set forth in Paragraph 7.2(a) above. Watermaster may exercise its discretion to establish a schedule for Basin Re-Operation that best meets the needs of the Parties to the Judgment and the physical conditions of the Basin, including but not limited to such methods as "ramping up," "ramping down," or "straight-lining."

(i) An initial schedule will be approved by Watermaster and submitted to the Court concurrent with Watermaster Resolution 07-05.

(ii) Watermaster may approve and request Court approval of revisions to the initial schedule if Watermaster's approval and request are supported by a technical report demonstrating the continued need for access to controlled overdraft, subject to the limitations set forth in amended Exhibit "I" to the Judgment and the justification for the amendment.

7.3 Suspension. An evaluation of Watermaster's achievement of Basin outflow conditions, achievement of Hydraulic Control and compliance with Regional Board orders will be completed annually by Watermaster. Re-Operation and Watermaster's apportionment of controlled overdraft will not be suspended in the event that Hydraulic Control is secured in any year *before* the full 400,000 acre-feet has been produced so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures to avoid Material Physical Injury and that equitably distributes the cost of any mitigation attributable to the identified contingencies, and (ii) Watermaster is in substantial compliance with a Court approved Recharge Master Plan as set forth in Paragraph 8.1 below.

7.4 Storage: Uniform Losses. The Parties acknowledge that Watermaster has assessed a two (2)-percent loss on all groundwater presently held in storage to reflect the current hydrologic condition. As provided in the Peace Agreement, Watermaster will continue to maintain a minimum 2 (two) percent loss until substantial evidence exists to warrant the imposition of another loss factor. However, the Parties further acknowledge and agree that losses have been substantially reduced through the OBMP Implementation Plan and the operation of Desalters I and II and that once Hydraulic Control is achieved outflow and losses from the Basin will have been limited to de minimis quantities. Therefore, Watermaster may establish uniform losses for all water held in storage based on whether the Party has substantially contributed to Watermaster reducing losses and ultimately securing and maintaining Hydraulic Control.

(a) Pre-Implementation of the Peace Agreement. The uniform annual loss (leave behind) of six (6) percent will be applied to all storage accounts to address actual losses, management and equitable considerations arising from the implementation of the Peace Agreement, the OBMP Implementation Plan, the 2007 Supplement to the OBMP Implementation Plan, including but not limited to the Desalters and Hydraulic Control unless the Party holding the storage account: (i) has previously contributed to the implementation of the OBMP as a Party to the Judgment, is in compliance with their continuing covenants under the Peace Agreement or in lieu thereof they have paid or delivered to Watermaster "financial equivalent" consideration to offset the cost of past performance prior to the implementation of the OBMP and (ii) promised continued future compliance with Watermaster Rules and Regulations. In the event that a Party satisfies 7.4(a)(i) and7.4(a)(ii) they will be assessed a minimum loss of two (2) percent against all water held in storage to reflect actual estimated losses. Watermaster's evaluation of the sufficiency of any consideration or financial equivalency may take into account the fact that one or more Parties to the Judgment are not similarly situated.

(b) Post-Hydraulic Control. Following Watermaster's determination that it has achieved Hydraulic Control and for so long as Watermaster continues to sustain losses from the Basin to the Santa Ana River at a de minimis level (less than one (1) percent), any Party to the Judgment (agency, entity or person) may qualify for the Post-Hydraulic Control uniform loss percentage of less than 1 percent if they meet the criteria of 7.4(a)(i) and 7.4(a)(ii) above.

7.5 Allocation of Losses. Any losses from storage assessed as a Leave Behind in excess of actual losses ("dedication quantity") will be dedicated by Watermaster towards groundwater Production by the Desalters to thereby avoid a Desalter replenishment obligation that may then exist *in the year* of recovery. Any dedication quantity which is not required to offset Desalter Production in the year in which the loss is assessed, will be made available to the members of the Appropriative Pool. The dedication quantity will be pro-rated among the members of the Appropriative Pool in accordance with each Producer's combined total share of Operating Safe Yield and the previous year's actual production. However, before any member of the Appropriative Pool may receive a distribution of any dedication quantity, they must be in full compliance with the 2007 Supplement to the OBMP Implementation Plan and current in all applicable Watermaster assessments.

## ARTICLE VIII
## RECHARGE

8.1 Update to the Recharge Master Plan. Watermaster will update and obtain Court approval of its update to the Recharge Master Plan to address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and subsequently operated at a new equilibrium at the conclusion of the period of Re-Operation. The Recharge Master Plan will be jointly approved by IEUA and Watermaster and shall contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections. Specifically, the Plan will reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that following the full beneficial use of the groundwater withdrawn in accordance with the Basin Re-Operation and authorized controlled overdraft, that sufficient Replenishment capability exists to meet the reasonable projections of Desalter Replenishment obligations. With the concurrence of IEUA and Watermaster, the Recharge Master Plan will be updated and amended as frequently as necessary with Court approval and not less than every five (5) years. Costs incurred in the design, permitting, operation and maintenance of recharge improvements will be apportioned in accordance with the following principles.

a. Operations and Maintenance. All future operations and maintenance costs attributable to all recharge facilities utilized for recharge of recycled water in whole or in part unfunded from third party sources, will be paid by the Inland Empire Utilities Agency ("IEUA") and Watermaster. The contribution by IEUA will be determined annually on the basis of the relative proportion of recycled water recharged bears to the total recharge from all sources in the prior year. For example, if 35 percent of total recharge in a single year is from recycled water, then IEUA will bear 35 percent of the operations and maintenance costs. All remaining unfunded costs attributable to the facilities used by Watermaster will be paid by Watermaster.

i. IEUA reserves discretion as to how it assesses its share of costs.

ii. Watermaster will apportion its costs among the members of the stakeholders in accordance with Production, excluding Desalter Production.

iii. The operations and maintenance costs of water recharged by aquifer storage and recovery will not be considered in the calculation other than by express agreement.

b. Capital. Mutually approved capital improvements for recharge basins that do or can receive recycled water constructed pursuant to the Court approved Recharge Master Plan, if any, will be financed through the use of third party grants and contributions if available, with any unfunded balance being apportioned 50 percent each to IEUA and Watermaster. The Watermaster contribution shall be allocated according to shares of Operating Safe Yield. All remaining unfunded costs attributable to the facilities used by Watermaster will be paid by Watermaster.

8.2 Coordination. The members of the Appropriative Pool will coordinate the development of their respective Urban Water Management Plans and Water Supply Master Plans with Watermaster as follows.

(a) Each Appropriator that prepares an Urban Water Management Plan and Water Supply Plans will provide Watermaster with copies of their existing and proposed plans.

(b) Watermaster will use the Plans in evaluating the adequacy of the Recharge Master Plan and other OBMP Implementation Plan program elements.

(c) Each Appropriator will provide Watermaster with a draft in advance of adopting any proposed changes to their Urban Water Management Plans and in advance of adopting any material changes to their Water Supply Master Plans respectively in accordance with the customary notification routinely provided to other third parties to offer Watermaster a reasonable opportunity to provide informal input and informal comment on the proposed changes.

(d) Any party that experiences the loss or the imminent threatened loss of a material water supply source will provide reasonable notice to Watermaster of the condition and the expected impact, if any, on the projected groundwater use.

8.3 Continuing Covenant. To ameliorate any long-term risks attributable to reliance upon un-replenished groundwater production by the Desalters, the annual availability of any portion of the 400,000 acre-feet set aside as controlled overdraft as a component of the Physical Solution, is expressly subject to Watermaster making an annual finding about whether it is in substantial compliance with the revised Watermaster Recharge Master Plan pursuant to Paragraphs 7.3 and 8.1 above.

8.4 Acknowledgment re 6,500 Acre-Foot Supplemental Recharge. The Parties make the following acknowledgments regarding the 6,500 Acre-Foot Supplemental Recharge:

(a) A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin, Watermaster has committed to use its best efforts to direct recharge relative to production in each area and sub-area of the Basin and to achieve long-term balance between total recharge and discharge. The Parties acknowledge that to assist Watermaster in providing for recharge, the Peace Agreement sets forth a requirement for Appropriative Pool purchase of 6,500 acre-feet per year of Supplemental Water for recharge in Management Zone 1 (MZ1). The purchases have been credited as an addition to Appropriative Pool storage accounts. The water recharged under this program has not been accounted for as Replenishment water.

(b) Watermaster was required to evaluate the continuance of this requirement in 2005 by taking into account provisions of the Judgment, Peace Agreement and OBMP, among all other relevant factors. It has been determined that other obligations in the Judgment and Peace Agreement, including the requirement of hydrologic balance and projected replenishment obligations, will provide for sufficient wet-water recharge to make the separate commitment of Appropriative Pool purchase of 6,500 acre-feet unnecessary. Therefore, because the recharge target as described in the Peace Agreement has been achieved, further purchases under the program will cease and Watermaster will proceed with operations in accordance with the provisions of paragraphs (c), (d) and (e) below.

(c) The parties acknowledge that, regardless of Replenishment obligations, Watermaster will independently determine whether to require wet-water recharge within MZ1 to maintain hydrologic balance and to provide equal access to groundwater in accordance with the provisions of this Section 8.4 and in a manner consistent with the Peace Agreement, OBMP and the Long Term Plan for Subsidence.". Watermaster will conduct its recharge in a manner to provide hydrologic balance within, and will emphasize recharge in MZ1. Accordingly, the Parties acknowledge and agree that each year Watermaster shall continue to be guided in the exercise of its discretion concerning recharge by the principles of hydrologic balance.

(d) Consistent with its overall obligations to manage the Chino Basin to ensure hydrologic balance within each management zone, for the duration of the Peace Agreement (until June of 2030), Watermaster will ensure that a minimum of 6,500 acre-feet of wet water recharge occurs within MZ1 on an annual basis. However, to the extent that water is unavailable for recharge or there is no replenishment obligation in any year, the obligation to recharge 6,500 acre-feet will accrue and be satisfied in subsequent years.

(1) Watermaster will implement this measure in a coordinated manner so as to

facilitate compliance with other agreements among the parties, including but not limited to the Dry-Year Yield Agreements.

(2) In preparation of the Recharge Master Plan, Watermaster will consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to further enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master Plan.

(e) Five years from the effective date of the Peace II Measures, Watermaster will cause an evaluation of the minimum recharge quantity for MZ1. After consideration of the information developed in accordance with the studies conducted pursuant to paragraph 3 below, the observed experiences in complying with the Dry Year Yield Agreements as well as any other pertinent information, Watermaster may increase the minimum requirement for MZ1 to quantities greater than 6,500 acre-feet per year. In no circumstance will the commitment to recharge 6,500 acre-feet be reduced for the duration of the Peace Agreement.

## ARTICLE IX

9.1 Basin Management Assistance. Three Valleys Municipal Water District ("TVMWD") shall assist in the management of the Basin through a financial contribution of $300,000 to study the feasibility of developing a water supply program within Management Zone 1 of the Basin or in connection with the evaluation of Future Desalters. The study will emphasize assisting Watermaster in meeting its OBMP Implementation Plan objectives of concurrently securing Hydraulic Control through Re-Operation while attaining Management Zone 1 subsidence management goals. Further, TVMWD has expressed an interest in participating in future projects in the Basin that benefit TVMWD. If TVMWD wishes to construct or participate in such future projects, TVMWD shall negotiate with Watermaster in good faith concerning a possible "buy-in" payment.

9.2 Allocation of Non-Agricultural Pool OBMP Special Assessment

a. For a period of ten years from the effective date of the Peace II Measures, any water (or financial equivalent) that may be contributed from the Overlying (Non-Agricultural) Pool in accordance with paragraph 8(c) of Exhibit G to the Judgment (as amended) will be apportioned among the members of the Appropriative Pool in each year as follows:

| | | |
|---|---|---|
| (i) | City of Ontario. | 80 af |
| (ii) | City of Upland | 161 af |
| (iii) | Monte Vista Water District | 213 af |
| (iv) | City of Pomona | 220 af |
| (v) | Marygold Mutual Water Co | 16 af |
| (vi) | West Valley Water District | 15 af |

(vii) Santa Ana River Water Co. 31 af

b. In the eleventh year from the effective date of the Peace II Measures and in each year thereafter in which water may be available from the Overlying (Non-Agricultural) Pool in excess of identified Desalter replenishment obligations as determined in accordance with Section 6.2 above, any excess water (or financial equivalent) will be distributed pro rata among the members of the Appropriative Pool based upon each Producer's combined total share of Operating Safe Yield and the previous year's actual production.

## ARTICLE X
## SETTLEMENT AND RELEASE

10.1 Settlement. By its execution of this Agreement, the Parties mutually and irrevocably, fully settle their respective claims, rights and obligations, whatever they may be, regarding the design, funding, construction and operation of Future Desalters as set forth in and arising from Article VII of the Peace Agreement.

10.2 Satisfaction of Peace Agreement Obligation Regarding Future Desalters. The Parties' individual and collective responsibilities arising from the Part VII of the Peace Agreement and the OBMP Implementation Plan regarding the planning, design, permitting, construction and operation of Future Desalters, whatever they may be, are unaffected by this Agreement. However, upon the completion of a 10,000 AFY (9 mgd) expansion of groundwater production and desalting from Desalter II as provided for herein, the Parties will be deemed to have satisfied all individual and collective pre-existing obligations arising from the Peace Agreement and the OBMP Implementation Plan, whatever they may be, with regard to Future Desalters as described in Part VII of the Peace Agreement and the OBMP Implementation Plan.

10.3 Satisfaction of Pomona Credit. In recognition of the ongoing benefits received by TVMWD through the City of Pomona's anion exchange project, as its sole and exclusive responsibility, TVMWD will make an annual payment to Watermaster in an amount equal to the credit due the City of Pomona under Peace Agreement Paragraph 5.4(b) ("the Pomona Credit").

(a) Within ninety (90) days of each five-year period following the Effective Date of this Agreement, in its sole discretion TVMWD shall make an election whether to continue or terminate its responsibilities under this paragraph. TVMWD shall provide written notice of such election to Watermaster.

(b) Watermaster will provide an annual invoice to TVMWD for the amount of the Pomona Credit.

(c) Further, in any renewal term of the Peace Agreement, TVMWD will continue to make an equivalent financial contribution which TVMWD consents to

Watermaster's use for the benefit of MZ1, subject to the same conditions set forth above with respect to TVMWD's payment of the "Pomona Credit".

(d) In the event TVMWD elects to terminate is obligation under this Paragraph, the Peace Agreement and the responsibility for satisfying the Pomona Credit will remain unchanged and unaffected, other than as it will be deemed satisfied for each five-year period that TVMWD has actually made the specified payment.

10.4 Release. Upon WMWD's completion of a 10,000 AFY (9 mgd) expansion of groundwater production and desalting in a manner consistent with the parameters set forth in this Agreement, each Party, for itself, its successors, assigns, and any and all persons taking by or through it, hereby releases WMWD and IEUA from any and all obligations arising from WMWD's and IEUA's responsibility for securing funding, designing, and constructing Future Desalters as set forth in or arising exclusively from Article VII of the Peace Agreement and the Program Elements 3, 6, and 7, OBMP Implementation Plan only, and each Party knowingly and voluntarily waives all rights and benefits which are provided by the terms and provisions of section 1542 of the Civil Code of the State of California, or any comparable statute or law which may exist under the laws of the State of California, in or arising from WMWD's and IEUA's responsibility for securing funding, designing, and constructing Future Desalters as set forth in or arising exclusively from Article VII of the Peace Agreement and the OBMP Implementation Plan only. The Parties hereby acknowledge that this waiver is an essential and material term of this release. The Parties, and each of them, acknowledge that Civil Code section 1542 provides as follows:

**A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS OR HER FAVOR AT THE TIME OF EXECUTING THE RELEASE, WHICH IF KNOWN BY HIM OR HER MUST HAVE MATERIALLY AFFECTED HIS OR HER SETTLEMENT WITH THE DEBTOR.**

Each Party understands and acknowledges that the significance and consequence of this waiver of Civil Code section 1542 is the waiver of any presently unknown claims as described above, and that if any Party should eventually suffer additional damages arising out of the respective claim that Party will not be able to make any claim for those additional damages. Further, all Parties to this Agreement acknowledge that they consciously intend these consequences even as to claims for such damages that may exist as of the date of this Agreement but which are not known to exist and which, if known, would materially affect the Parties' respective decision to execute this Agreement, regardless of whether the lack of knowledge is the result of ignorance, oversight, error, negligence, or any other cause.

10.5 Assessments. In view of the substantial investments previously made and contemplated by Watermaster and the parties over the term of the Peace Agreement and in particular to implement the OBMP, the parties desire substantial certainty regarding Watermaster's principles of cost allocation. The principles set forth in the Peace Agreement and the

Peace II Measures including those stated herein, constitute a fair and reasonable allocation of responsibility among the stakeholders. Accordingly, other than in the event of an emergency condition requiring prompt action by Watermaster or to correct a manifest injustice arising from conditions not presently prevailing in the Basin and unknown to Watermaster and the parties and then only to the extent Watermaster retains discretion, Watermaster will maintain the principles of cost allocation for apportioning costs and assessments as provided in the Judgment and now implemented through the Peace Agreement and the Peace II Measures for the balance of the initial Term of the Peace Agreement. For the balance of the initial Term of the Peace Agreement, the parties to the Peace II Agreement will waive any objections to the Watermaster's principles of cost allocation other than as to issues regarding whether Watermaster has: (i) properly followed appropriate procedures; (ii) correctly computed assessments and charges; and (iii) properly reported .

10.6 Reservation of Rights. Nothing herein shall be construed as precluding any party to the Judgment from seeking judicial review of any Watermaster action on the grounds that Watermaster has failed to act in accordance with the Peace Agreement as amended, this Agreement, the Amended Judgment, the OBMP Implementation Plan as amended and applicable law.

## ARTICLE XI
## TERM

11.1 Commencement. This Agreement will become effective upon the satisfaction of all conditions precedent and shall expire on the Termination Date.

11.2 Termination. This Agreement is coterminous with the initial term of the Peace Agreement and will expire of its own terms and terminate on the date of the Initial Term of the Peace Agreement.

## ARTICLE XIII
## GENERAL PROVISIONS

12.1 Construction of this Agreement. Each Party, with the assistance of competent legal counsel, has participated in the drafting of this Agreement and any ambiguity should not be construed for or against any Party on account of such drafting.

12.2 Awareness of Contents/Legal Effect. The Parties expressly declare and represent that they have read the Agreement and that they have consulted with their respective counsel regarding the meaning of the terms and conditions contained herein. The parties further expressly declare and represent that they fully understand the content and effect of this Agreement and they approve and accept the terms and conditions contained herein, and that this Agreement is executed freely and voluntarily.

12.3 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute on Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

IN WITNESS THEREOF, the Parties hereto have set forth their signatures as of the date written below:

Dated: Party: _____

By _____

# Attachment L

September 21, 2007

**ATTACHMENT "L"**

**SECOND AMENDMENT**
**TO PEACE AGREEMENT**

THIS SECOND AMENDMENT TO PEACE AGREEMENT ("AGREEMENT") is dated the ____ of September 2007 regarding the Chino Groundwater Basin.

**RECITALS**

A. The Parties entered into that certain "Peace Agreement" dated June 29, 2000. The Peace Agreement was approved by the Court in San Bernardino Superior Court Case No. RCV 51010.

B. The Parties entered into a First Amendment to the Peace Agreement on September 2nd of 2004 regarding the deletion of Salt Credits and the Stormwater Component of New Yield.

NOW THEREFORE, in consideration of the covenants and conditions herein contained, and for other good and valuable consideration the receipt of which is hereby acknowledged, the Parties agree as follows:

**AGREEMENT**

**Section 1.** **OBMP Credits Modified.** The Peace Agreement § 5.4(d) will be amended to read:

(d) Watermaster shall adopt reasonable procedures to evaluate requests for OBMP credits against future OBMP Assessments or for reimbursement. Any Producer or party to the Judgment, including but not limited to the State of California, may make application to Watermaster for reimbursement or credit against future OBMP Assessments for any capital or operations and maintenance expenses incurred in the implementation of any project or program, including the cost of relocating groundwater Production facilities, that carries out the purposes of the OBMP and specifically relates to the prevention of subsidence in the Basin, in advance of construction or that is prospectively dedicated to service of the stated goals of the OBMP. Watermaster shall exercise reasonable discretion in making its determination, considering the importance of the project or program to the successful completion of the OBMP, the available alternative funding sources, and the professional engineering and design standards as may be applicable under the circumstances. However, Watermaster shall not approve such a request for reimbursement or credit against future OBMP Assessments under this section where the Producer or party to the Judgment was otherwise legally compelled to make the improvement.

**Section 2.** **Increase the Limit on Storage of Local Supplemental Water** The current cap of 50,000 acre-feet of Storage of Supplemental Water described in paragraph 5.2(b)(iv) and 5.2(b)(vii) of the Peace Agreement shall be increased from 50,000 to 100,000 acre-feet. Any Party to the Judgment may make Application to Watermaster to store Supplemental Water pursuant to the terms of section 5.2(b) of the Peace Agreement except that the rebuttable presumption applicable to Local Storage Agreements described in Peace Agreement paragraph 5.2(b)(v) shall no longer be in effect with regard to such applications.

**Section 3.** **Effect of Amendment.** Except as amended hereby, the Peace Agreement remains in full force and effect.

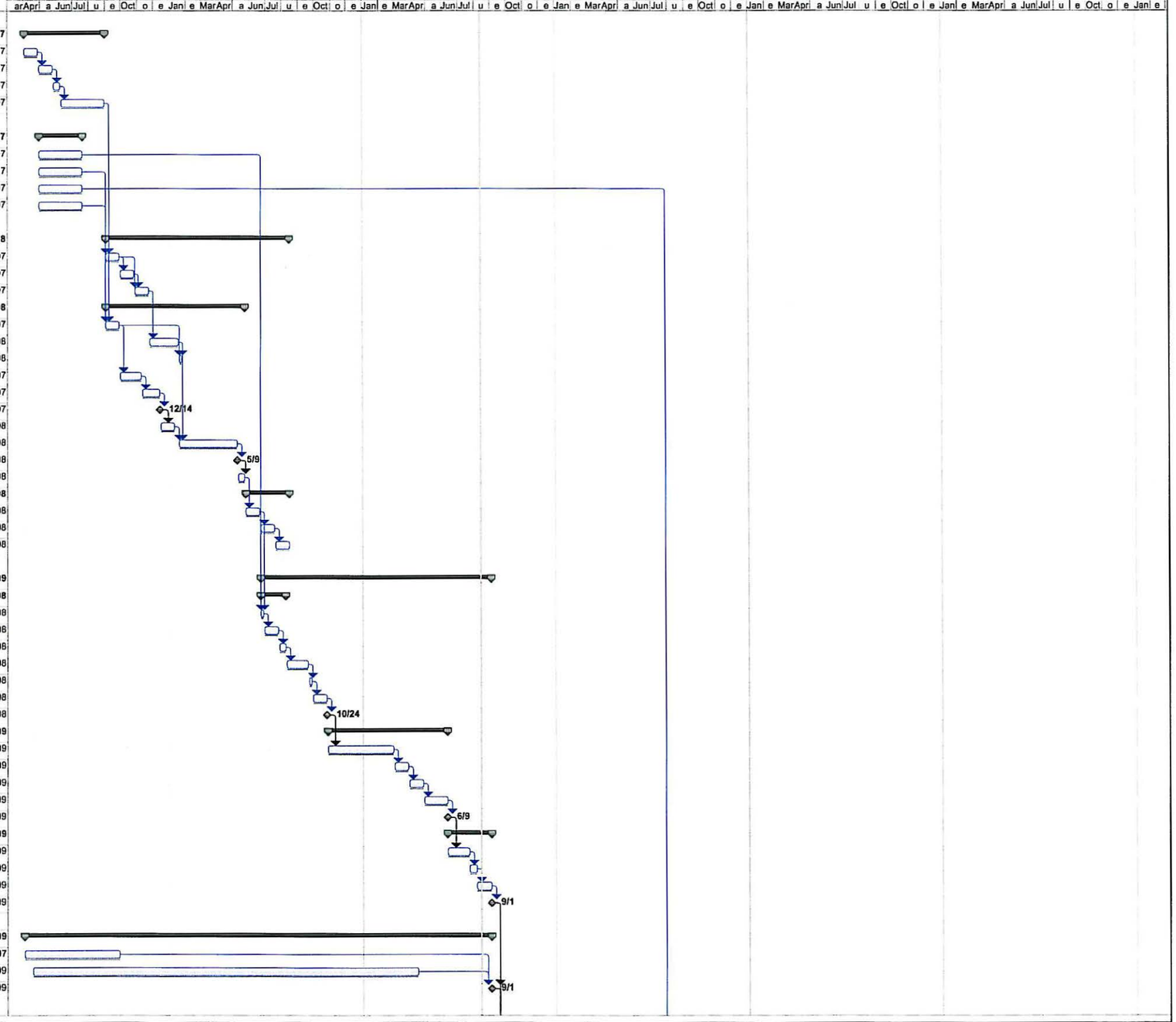
IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

**The materials included as Exhibit 1 to the Peace II Agreement are included as attachments to Resolution 07-05 and the Resolution itself**

# Exhibit 2

# Schedule A -- Pragmatic Schedule for the Planning, Design and Construction of the Chino Creek Well Field

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | | | | |
| 2 | **Prepare Project Description** | **110 days** | **Mon 4/2/07** | **Fri 8/31/07** |
| 3 | Prepare Draft Project Description | 20 days | Mon 4/2/07 | Fri 4/27/07 |
| 4 | Circulate and Revise Draft Project Description | 20 days | Mon 4/30/07 | Fri 5/25/07 |
| 5 | Finalize Draft Project Description | 10 days | Mon 5/28/07 | Fri 6/8/07 |
| 6 | Prepare Screening-level Initial Study | 60 days | Mon 6/11/07 | Fri 8/31/07 |
| 7 | | | | |
| 8 | **Select Consultants** | **60 days** | **Mon 4/30/07** | **Fri 7/20/07** |
| 9 | Select CEQA Consultant | 60 days | Mon 4/30/07 | Fri 7/20/07 |
| 10 | Select Well Design Consultant | 60 days | Mon 4/30/07 | Fri 7/20/07 |
| 11 | Select Facilities Design Consultant | 60 days | Mon 4/30/07 | Fri 7/20/07 |
| 12 | Select Program Manager | 60 days | Mon 4/30/07 | Fri 7/20/07 |
| 13 | | | | |
| 14 | **Select Well Sites** | **250 days** | **Mon 9/3/07** | **Fri 8/15/08** |
| 15 | Develop Three Well Field Alternatives | 20 days | Mon 9/3/07 | Fri 9/28/07 |
| 16 | Determine Property Ownership in Each Well Field Alternative | 20 days | Mon 10/1/07 | Fri 10/26/07 |
| 17 | Select Alternative Well Sites | 20 days | Mon 10/29/07 | Fri 11/23/07 |
| 18 | **Implement Well Site Investigation Program** | **190 days** | **Mon 9/3/07** | **Fri 5/23/08** |
| 19 | Develop Investigation Plan | 20 days | Mon 9/3/07 | Fri 9/28/07 |
| 20 | Negotiate Access to Test Sites | 40 days | Mon 11/26/07 | Fri 1/18/08 |
| 21 | Obtain Permits | 5 days | Mon 1/21/08 | Fri 1/25/08 |
| 22 | Prepare Bid Package | 30 days | Mon 10/1/07 | Fri 11/9/07 |
| 23 | Advertise | 25 days | Mon 11/12/07 | Fri 12/14/07 |
| 24 | Select Contractor | 0 days | Fri 12/14/07 | Fri 12/14/07 |
| 25 | Negotiate Contract | 20 days | Mon 12/17/07 | Fri 1/11/08 |
| 26 | Construct Test Wells, Run Stress Test and WQ Tests | 80 days | Mon 1/21/08 | Fri 5/9/08 |
| 27 | Characterize Production Requirements and Water Quality | 0 days | Fri 5/9/08 | Fri 5/9/08 |
| 28 | Revise Well Field Design | 10 days | Mon 5/12/08 | Fri 5/23/08 |
| 29 | **Prepare Well Field Predesign Report** | **60 days** | **Mon 5/26/08** | **Fri 8/15/08** |
| 30 | Prepare Draft Report | 20 days | Mon 5/26/08 | Fri 6/20/08 |
| 31 | Circulate and Revise Predesign Report | 20 days | Mon 6/23/08 | Fri 7/18/08 |
| 32 | Finalize Predesign Report | 20 days | Mon 7/21/08 | Fri 8/15/08 |
| 33 | | | | |
| 34 | **CEQA Process for Chino Creek Well Field** | **312 days** | **Mon 6/23/08** | **Tue 9/1/09** |
| 35 | **Prepare Final Project Description** | **35 days** | **Mon 6/23/08** | **Fri 8/8/08** |
| 36 | Prepare Final Project Description | 5 days | Mon 6/23/08 | Fri 6/27/08 |
| 37 | Circulate and Revise Final Project Description | 20 days | Mon 6/30/08 | Fri 7/25/08 |
| 38 | Finalize Project Description | 10 days | Mon 7/28/08 | Fri 8/8/08 |
| 39 | Prepare Initial Study | 30 days | Mon 8/11/08 | Fri 9/19/08 |
| 40 | Prepare Notice of Preparation (NOP) | 5 days | Mon 9/22/08 | Fri 9/26/08 |
| 41 | Circulate NOP | 20 days | Mon 9/29/08 | Fri 10/24/08 |
| 42 | Conduct Public Meeting Regarding NOP | 0 days | Fri 10/24/08 | Fri 10/24/08 |
| 43 | **Prepare Draft EIR** | **162 days** | **Mon 10/27/08** | **Tue 6/9/09** |
| 44 | Prepare Administrative Draft EIR | 90 days | Mon 10/27/08 | Fri 2/27/09 |
| 45 | Circulate and Review Administrative Draft | 20 days | Mon 3/2/09 | Fri 3/27/09 |
| 46 | Prepare Draft EIR | 20 days | Mon 3/30/09 | Fri 4/24/09 |
| 47 | Review Period for Draft EIR | 32 days | Mon 4/27/09 | Tue 6/9/09 |
| 48 | Public Review Meeting | 0 days | Tue 6/9/09 | Tue 6/9/09 |
| 49 | **Finalize EIR** | **60 days** | **Wed 6/10/09** | **Tue 9/1/09** |
| 50 | Prepare Response to Comments | 30 days | Wed 6/10/09 | Tue 7/21/09 |
| 51 | Circulate and Review Responses to Comments | 10 days | Wed 7/22/09 | Tue 8/4/09 |
| 52 | Prepare Final EIR | 20 days | Wed 8/5/09 | Tue 9/1/09 |
| 53 | Certify Final EIR | 0 days | Tue 9/1/09 | Tue 9/1/09 |
| 54 | | | | |
| 55 | **Select Well Field Alternative** | **632 days** | **Mon 4/2/07** | **Tue 9/1/09** |
| 56 | Negotiate Chino Airport/County Contribution | 130 days | Mon 4/2/07 | Fri 9/28/07 |
| 57 | Negotiate OIA PRPs Contribution | 520 days | Wed 4/18/07 | Tue 4/14/09 |
| 58 | Select Well Field | 0 days | Tue 9/1/09 | Tue 9/1/09 |
| 59 | | | | |

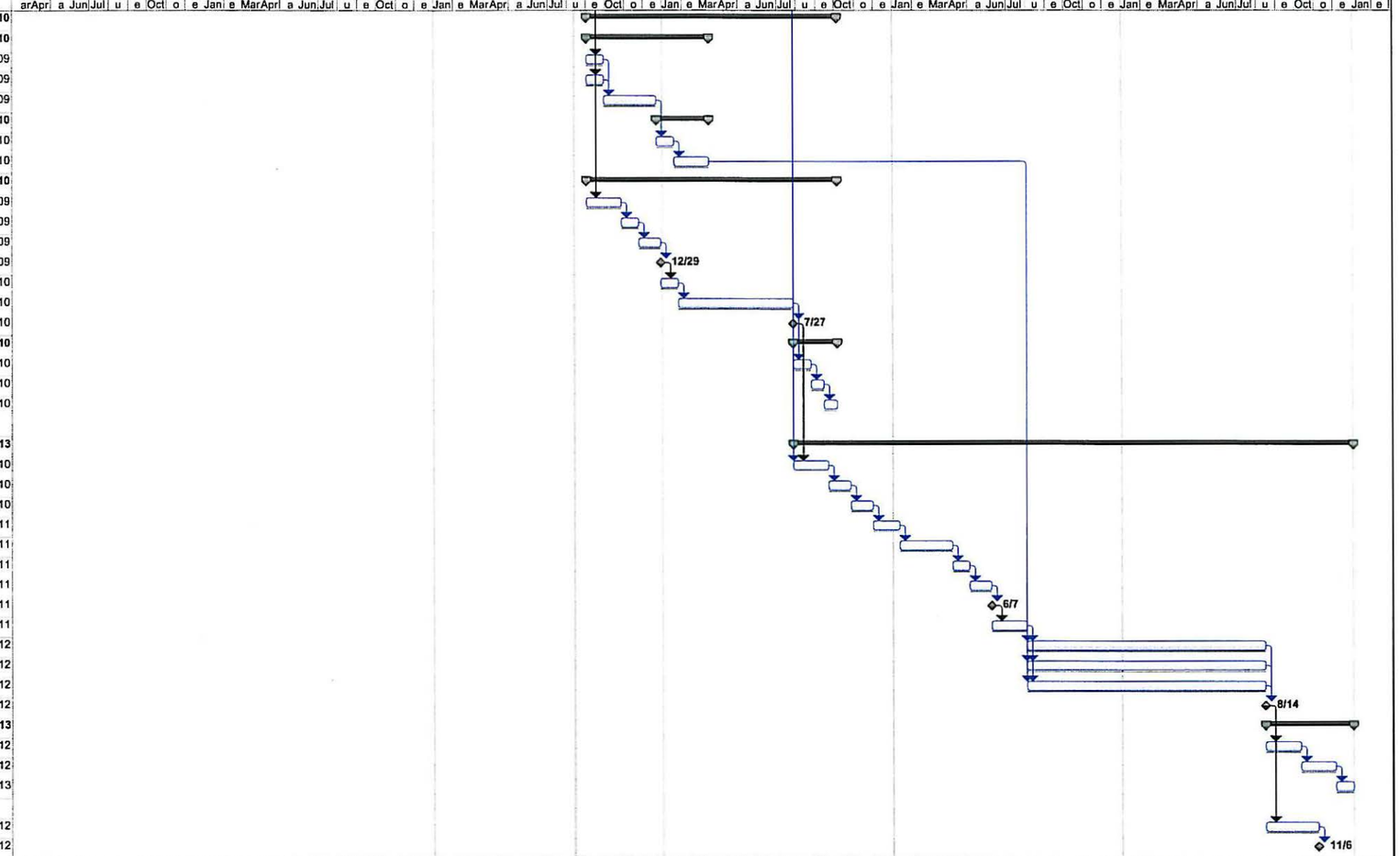



Project: 20070329 Schedule A Chino C
Date: Wed 8/12/09

Task — Progress — Summary — External Tasks — Split
Split — Milestone — Project Summary — External MileTask

## Schedule A -- Pragmatic Schedule for the Planning, Design and Construction of the Chino Creek Well Field

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 60 | **Final Design of Well Field** | **285 days** | **Wed 9/2/09** | **Tue 10/5/10** |
| 61 | **Obtain Wells Sites** | **140 days** | **Wed 9/2/09** | **Tue 3/16/10** |
| 62 | Prepare Legal Descriptions | 20 days | Wed 9/2/09 | Tue 9/29/09 |
| 63 | Establish Value | 20 days | Wed 9/2/09 | Tue 9/29/09 |
| 64 | Negotiate Site Acquisition | 60 days | Wed 9/30/09 | Tue 12/22/09 |
| 65 | **Obtain Raw Water Pipeline Easements** | **60 days** | **Wed 12/23/09** | **Tue 3/16/10** |
| 66 | Prepare Legal Description | 20 days | Wed 12/23/09 | Tue 1/19/10 |
| 67 | Negotiate Easements | 40 days | Wed 1/20/10 | Tue 3/16/10 |
| 68 | **Prepare Final Well Field Design** | **285 days** | **Wed 9/2/09** | **Tue 10/5/10** |
| 69 | Prepare Plans and Specifications for Wells | 40 days | Wed 9/2/09 | Tue 10/27/09 |
| 70 | Prepare Bid Package | 20 days | Wed 10/28/09 | Tue 11/24/09 |
| 71 | Advertise | 25 days | Wed 11/25/09 | Tue 12/29/09 |
| 72 | Select Contractor | 0 days | Tue 12/29/09 | Tue 12/29/09 |
| 73 | Negotiate Contract | 20 days | Wed 12/30/09 | Tue 1/26/10 |
| 74 | Construct Six New Wells | 130 days | Wed 1/27/10 | Tue 7/27/10 |
| 75 | Finalize Well Production and WQ Characteristic | 0 days | Tue 7/27/10 | Tue 7/27/10 |
| 76 | **Prepare Well Construction Report** | **50 days** | **Wed 7/28/10** | **Tue 10/5/10** |
| 77 | Prepare Draft Well Construction Report | 20 days | Wed 7/28/10 | Tue 8/24/10 |
| 78 | Circulate and Review Draft | 15 days | Wed 8/25/10 | Tue 9/14/10 |
| 79 | Finalize Well Construction Report | 15 days | Wed 9/15/10 | Tue 10/5/10 |
| 80 | | | | |
| 81 | **Design and Construct Pipeline, Wellhead, and Treatment Plant Improvements** | **635 days** | **Wed 7/28/10** | **Tue 1/1/13** |
| 82 | Prepare 30 Percent Design Report | 40 days | Wed 7/28/10 | Tue 9/21/10 |
| 83 | Prepare 50 Percent Design Report | 25 days | Wed 9/22/10 | Tue 10/26/10 |
| 84 | Prepare 70 Percent Design Report | 25 days | Wed 10/27/10 | Tue 11/30/10 |
| 85 | Prepare Final Design Report | 30 days | Wed 12/1/10 | Tue 1/11/11 |
| 86 | Prepare Plans and Specifications | 60 days | Wed 1/12/11 | Tue 4/5/11 |
| 87 | Prepare Bid Package | 20 days | Wed 4/6/11 | Tue 5/3/11 |
| 88 | Advertise | 25 days | Wed 5/4/11 | Tue 6/7/11 |
| 89 | Select Contractor | 0 days | Tue 6/7/11 | Tue 6/7/11 |
| 90 | Negotiate Contracts | 40 days | Wed 6/8/11 | Tue 8/2/11 |
| 91 | Construct Raw Water Pipeline | 270 days | Wed 8/3/11 | Tue 8/14/12 |
| 92 | Construct Wellhead Improvements | 270 days | Wed 8/3/11 | Tue 8/14/12 |
| 93 | Construct Desalter I Improvements | 270 days | Wed 8/3/11 | Tue 8/14/12 |
| 94 | Construction Complete | 0 days | Tue 8/14/12 | Tue 8/14/12 |
| 95 | **Prepare Construction Report** | **100 days** | **Wed 8/15/12** | **Tue 1/1/13** |
| 96 | Prepare Draft Construction Report | 40 days | Wed 8/15/12 | Tue 10/9/12 |
| 97 | Circulate and Review Draft | 40 days | Wed 10/10/12 | Tue 12/4/12 |
| 98 | Finalize Construction Report | 20 days | Wed 12/5/12 | Tue 1/1/13 |
| 99 | | | | |
| 100 | Start Up Testing of Improvements | 60 days | Wed 8/15/12 | Tue 11/6/12 |
| 101 | Start of Regular Operations | 0 days | Tue 11/6/12 | Tue 11/6/12 |

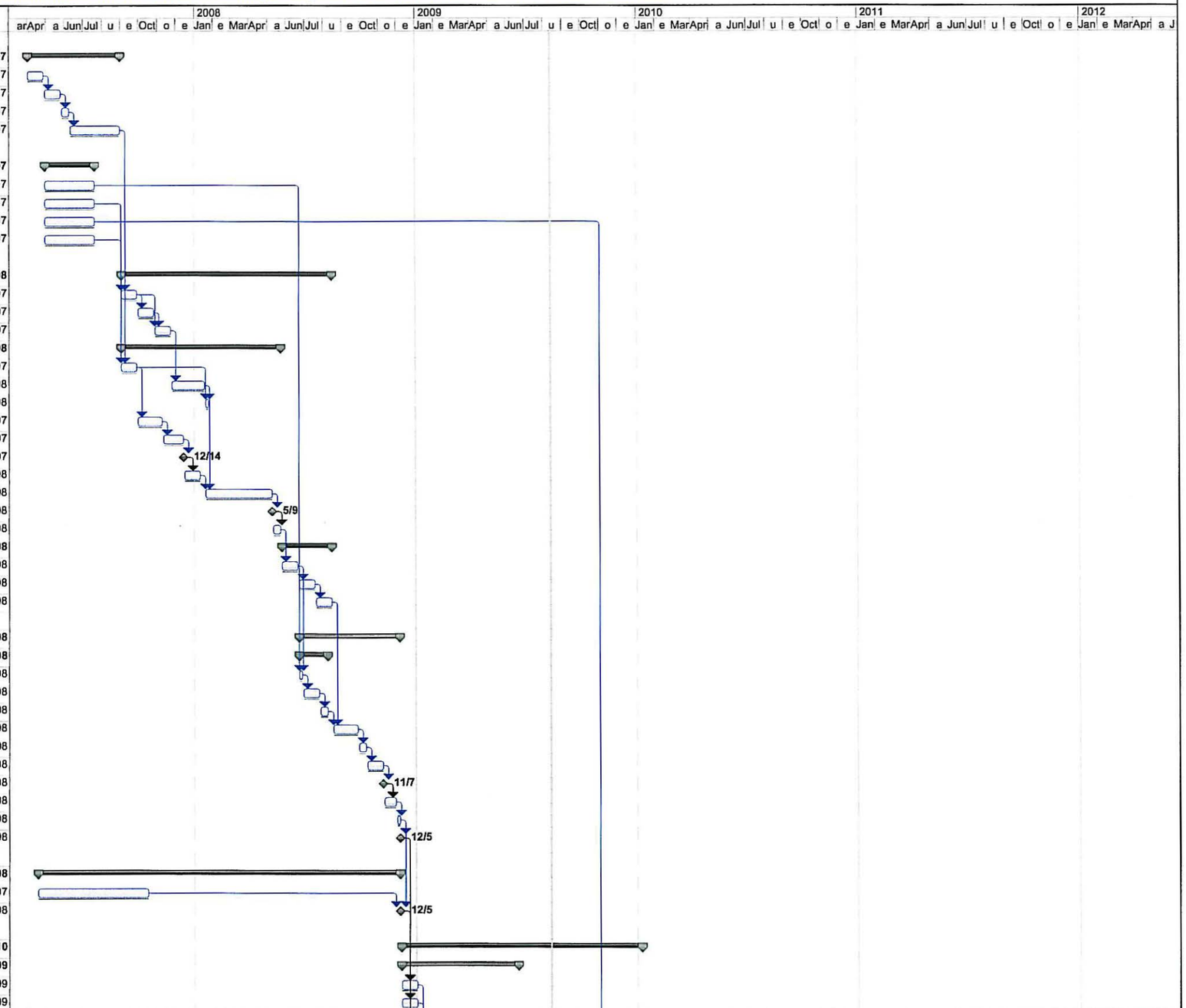



Project: 20070329 Schedule A Chino C
Date: Wed 8/12/09

Task — Progress — Summary — External Tasks — Split
Split — Milestone — Project Summary — External MileTask

# Schedule B -- Accelerated Schedule for the Planning, Design and Construction of the Chino Creek Well Field

| ID | Task Name | Start | Finish |
|---|---|---|---|
| 1 | | | |
| 2 | **Prepare Project Description** | **Mon 4/2/07** | **Fri 8/31/07** |
| 3 | Prepare Draft Project Description | Mon 4/2/07 | Fri 4/27/07 |
| 4 | Circulate and Revise Draft Project Description | Mon 4/30/07 | Fri 5/25/07 |
| 5 | Finalize Draft Project Description | Mon 5/28/07 | Fri 6/8/07 |
| 6 | Prepare Screening-Level Initial Study | Mon 6/11/07 | Fri 8/31/07 |
| 7 | | | |
| 8 | **Select Consultants** | **Mon 4/30/07** | **Fri 7/20/07** |
| 9 | Select CEQA Consultant | Mon 4/30/07 | Fri 7/20/07 |
| 10 | Select Well Design Consultant | Mon 4/30/07 | Fri 7/20/07 |
| 11 | Select Facilities Design Consultant | Mon 4/30/07 | Fri 7/20/07 |
| 12 | Select Program Manager | Mon 4/30/07 | Fri 7/20/07 |
| 13 | | | |
| 14 | **Select Well Sites** | **Mon 9/3/07** | **Fri 8/15/08** |
| 15 | Develop Three Well Field Alternatives | Mon 9/3/07 | Fri 9/28/07 |
| 16 | Determine Property Ownership in Each Well Field Alternative | Mon 10/1/07 | Fri 10/26/07 |
| 17 | Select Alternative Well Sites | Mon 10/29/07 | Fri 11/23/07 |
| 18 | **Implement Well Site Investigation Program** | **Mon 9/3/07** | **Fri 5/23/08** |
| 19 | Develop Investigation Plan | Mon 9/3/07 | Fri 9/28/07 |
| 20 | Negotiate Access to Test Sites | Mon 11/26/07 | Fri 1/18/08 |
| 21 | Obtain Permits | Mon 1/21/08 | Fri 1/25/08 |
| 22 | Prepare Bid Package | Mon 10/1/07 | Fri 11/9/07 |
| 23 | Advertise | Mon 11/12/07 | Fri 12/14/07 |
| 24 | Select Contractor | Fri 12/14/07 | Fri 12/14/07 |
| 25 | Negotiate Contract | Mon 12/17/07 | Fri 1/11/08 |
| 26 | Construct Test Wells, Run Stress Test and WQ Tests | Mon 1/21/08 | Fri 5/9/08 |
| 27 | Characterize Production Requirements and Water Quality | Fri 5/9/08 | Fri 5/9/08 |
| 28 | Revise Well Field Design | Mon 5/12/08 | Fri 5/23/08 |
| 29 | **Prepare Well Field Predesign Report** | **Mon 5/26/08** | **Fri 8/15/08** |
| 30 | Prepare Draft Report | Mon 5/26/08 | Fri 6/20/08 |
| 31 | Circulate and Revise Predesign Report | Mon 6/23/08 | Fri 7/18/08 |
| 32 | Finalize Predesign Report | Mon 7/21/08 | Fri 8/15/08 |
| 33 | | | |
| 34 | **CEQA Process for Chino Creek Well Field** | **Mon 6/23/08** | **Fri 12/5/08** |
| 35 | **Prepare Final Project Description** | **Mon 6/23/08** | **Fri 8/8/08** |
| 36 | Prepare Final Project Description | Mon 6/23/08 | Fri 6/27/08 |
| 37 | Circulate and Revise Final Project Description | Mon 6/30/08 | Fri 7/25/08 |
| 38 | Finalize Project Description | Mon 7/28/08 | Fri 8/8/08 |
| 39 | Prepare Initial Study | Mon 8/18/08 | Fri 9/26/08 |
| 40 | Prepare Mitigated Negative Declaration | Mon 9/29/08 | Fri 10/10/08 |
| 41 | Circulate Mitigated Negative Declaration | Mon 10/13/08 | Fri 11/7/08 |
| 42 | Conduct Public Meeting Regarding Mitigated Negative Declaration | Fri 11/7/08 | Fri 11/7/08 |
| 43 | Prepare Response to Comments | Mon 11/10/08 | Fri 11/28/08 |
| 44 | Prepare Final Mitigated Negative Declaration | Mon 12/1/08 | Fri 12/5/08 |
| 45 | IEUA Adopts Mitigated Negative Declaration | Fri 12/5/08 | Fri 12/5/08 |
| 46 | | | |
| 47 | **Select Well Field Alternative** | **Wed 4/18/07** | **Fri 12/5/08** |
| 48 | Negotiate Chino Airport/County Contribution | Wed 4/18/07 | Tue 10/16/07 |
| 49 | Select Well Field | Fri 12/5/08 | Fri 12/5/08 |
| 50 | | | |
| 51 | **Final Design of Well Field** | **Mon 12/8/08** | **Fri 1/8/10** |
| 52 | **Obtain Wells Sites** | **Mon 12/8/08** | **Fri 6/19/09** |
| 53 | Prepare Legal Descriptions | Mon 12/8/08 | Fri 1/2/09 |
| 54 | Establish Value | Mon 12/8/08 | Fri 1/2/09 |

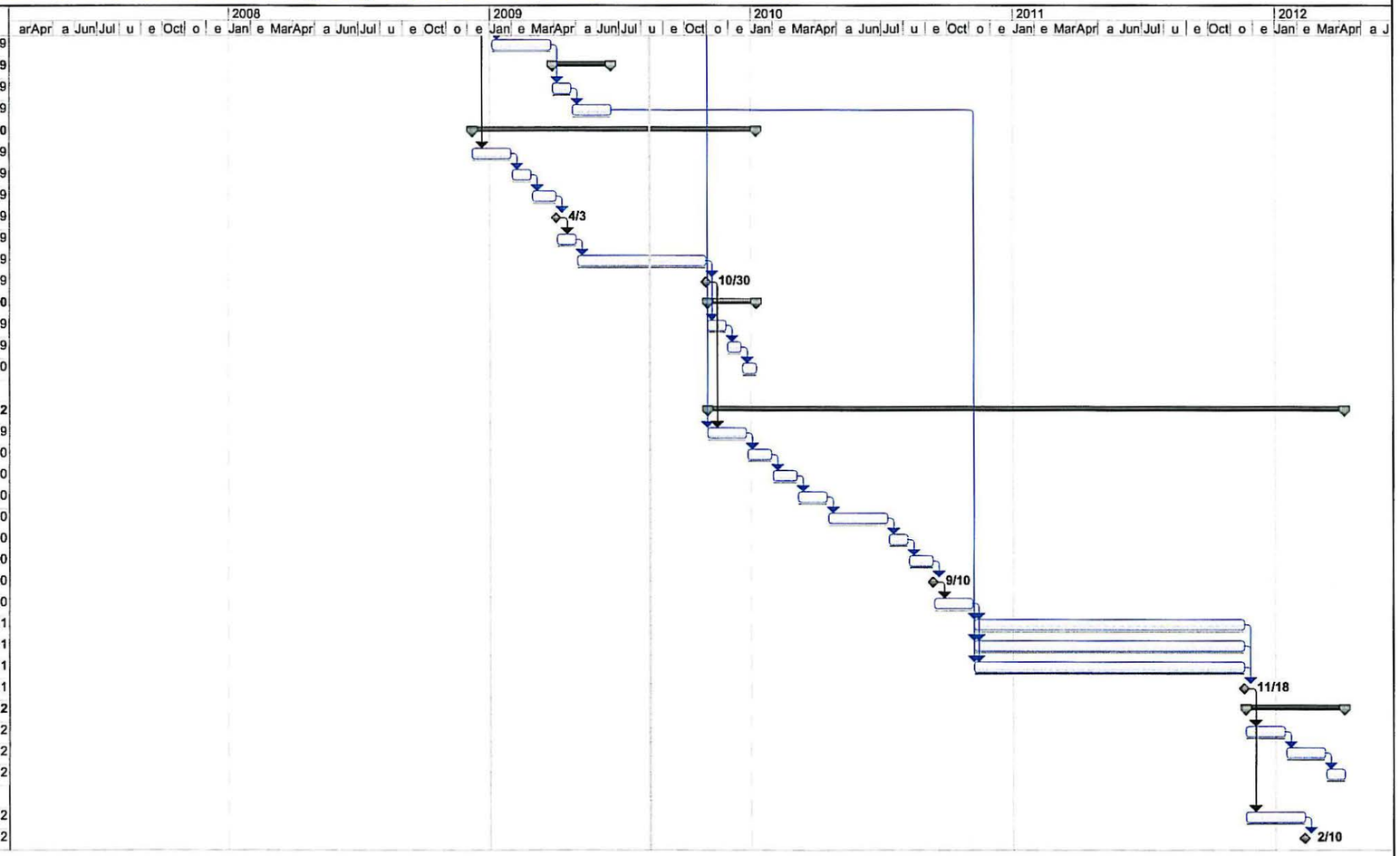



Project: 20070329 Schedule B Chino C
Date: Wed 9/12/07

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External MileTask | Split

# Schedule B -- Accelerated Schedule for the Planning, Design and Construction of the Chino Creek Well Field

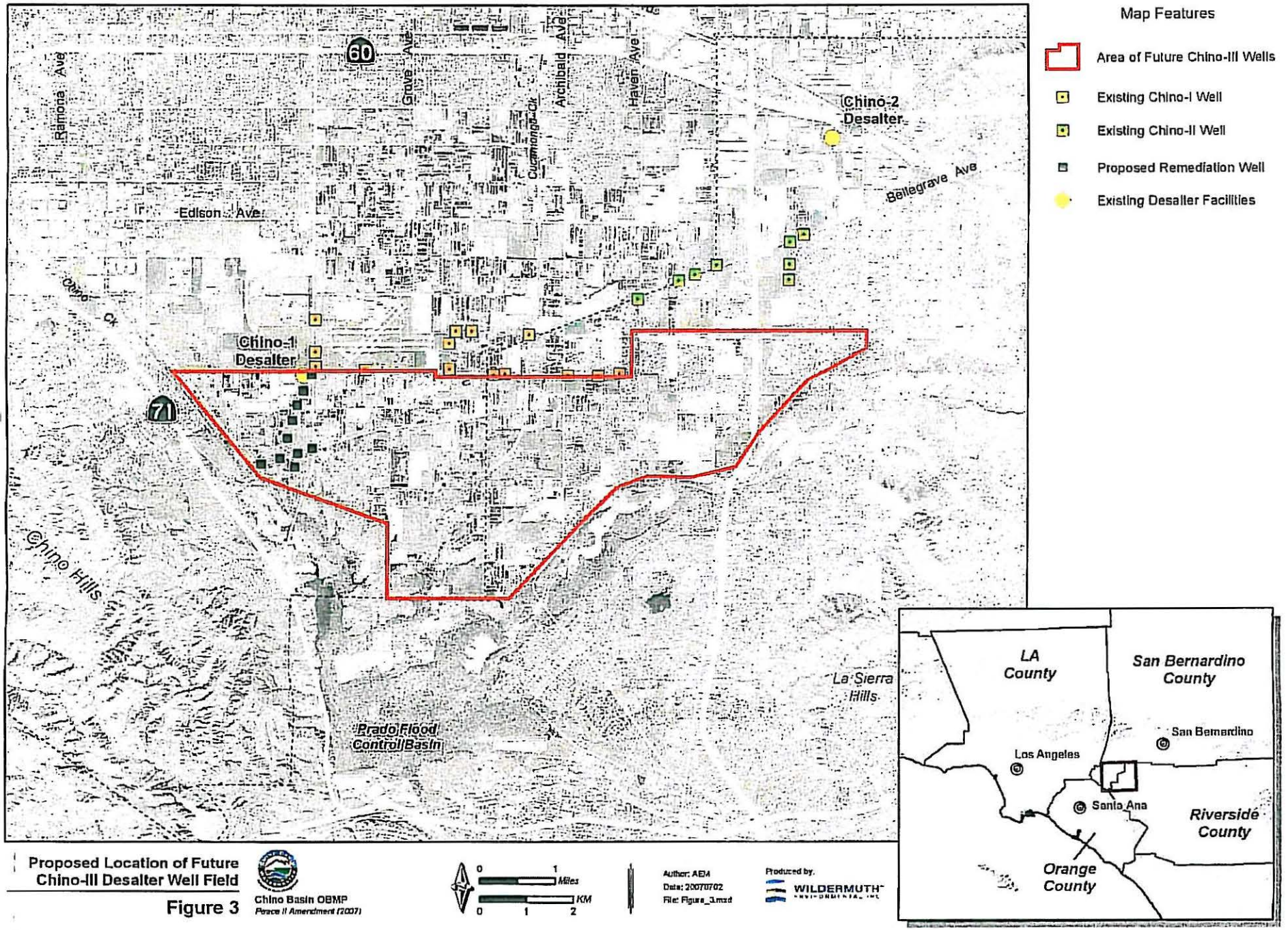
| ID | Task Name | Start | Finish |
|---|---|---|---|
| 55 | Negotiate Site Acquisition | Mon 1/5/09 | Fri 3/27/09 |
| 56 | **Obtain Raw Water Pipeline Easements** | **Mon 3/30/09** | **Fri 6/19/09** |
| 57 | Prepare Legal Description | Mon 3/30/09 | Fri 4/24/09 |
| 58 | Negotiate Easements | Mon 4/27/09 | Fri 6/19/09 |
| 59 | **Prepare Final Well Field Design** | **Mon 12/8/08** | **Fri 1/8/10** |
| 60 | Prepare Plans and Specifications for Wells | Mon 12/8/08 | Fri 1/30/09 |
| 61 | Prepare Bid Package | Mon 2/2/09 | Fri 2/27/09 |
| 62 | Advertise | Mon 3/2/09 | Fri 4/3/09 |
| 63 | Select Contractor | Fri 4/3/09 | Fri 4/3/09 |
| 64 | Negotiate Contract | Mon 4/6/09 | Fri 5/1/09 |
| 65 | Construct Six New Wells | Mon 5/4/09 | Fri 10/30/09 |
| 66 | Finalize Well Production and WQ Characteristics | Fri 10/30/09 | Fri 10/30/09 |
| 67 | **Prepare Well Construction Report** | **Mon 11/2/09** | **Fri 1/8/10** |
| 68 | Prepare Draft Well Construction Report | Mon 11/2/09 | Fri 11/27/09 |
| 69 | Circulate and Review Draft | Mon 11/30/09 | Fri 12/18/09 |
| 70 | Finalize Well Construction Report | Mon 12/21/09 | Fri 1/8/10 |
| 71 | | | |
| 72 | **Design and Construct Pipeline, Wellhead, and Treatment Plant Improvemer** | **Mon 11/2/09** | **Fri 4/6/12** |
| 73 | Prepare 30 Percent Design Report | Mon 11/2/09 | Fri 12/25/09 |
| 74 | Prepare 50 Percent Design Report | Mon 12/28/09 | Fri 1/29/10 |
| 75 | Prepare 70 Percent Design Report | Mon 2/1/10 | Fri 3/5/10 |
| 76 | Prepare Final Design Report | Mon 3/8/10 | Fri 4/16/10 |
| 77 | Prepare Plans and Specifications | Mon 4/19/10 | Fri 7/9/10 |
| 78 | Prepare Bid Package | Mon 7/12/10 | Fri 8/6/10 |
| 79 | Advertise | Mon 8/9/10 | Fri 9/10/10 |
| 80 | Select Contractor | Fri 9/10/10 | Fri 9/10/10 |
| 81 | Negotiate Contracts | Mon 9/13/10 | Fri 11/5/10 |
| 82 | Construct Raw Water Pipeline | Mon 11/8/10 | Fri 11/18/11 |
| 83 | Construct Wellhead Improvements | Mon 11/8/10 | Fri 11/18/11 |
| 84 | Construct Desalter I Improvements | Mon 11/8/10 | Fri 11/18/11 |
| 85 | Construction Complete | Fri 11/18/11 | Fri 11/18/11 |
| 86 | **Prepare Construction Report** | **Mon 11/21/11** | **Fri 4/6/12** |
| 87 | Prepare Draft Construction Report | Mon 11/21/11 | Fri 1/13/12 |
| 88 | Circulate and Review Draft | Mon 1/16/12 | Fri 3/9/12 |
| 89 | Finalize Construction Report | Mon 3/12/12 | Fri 4/6/12 |
| 90 | | | |
| 91 | Start Up Testing of Improvements | Mon 11/21/11 | Fri 2/10/12 |
| 92 | Start of Regular Operations | Fri 2/10/12 | Fri 2/10/12 |




Project: 20070329 Schedule B Chino C
Date: Wed 9/12/07

Task — Progress — Summary — External Tasks — Split
Split — Milestone — Project Summary — External MileTask

# Exhibit 3




**Proposed Location of Future Chino-III Desalter Well Field**

**Figure 3**

Chino Basin OBMP
*Peace II Amendment (2007)*

# FINAL
# PROGRAM ENVIRONMENTAL IMPACT REPORT

# FOR THE

# OPTIMUM BASIN MANAGEMENT PROGRAM

# VOLUME I

Prepared for:

**Inland Empire Utilities Agency**
9400 Cherry Avenue, Bldg. A
Fontana, California 92335

Prepared by:

**Tom Dodson & Associates**
2150 North Arrowhead Avenue
San Bernardino, California 92405

July 2000

**TOM DODSON & ASSOCIATES**
2150 N. ARROWHEAD AVENUE
SAN BERNARDINO, CA 92405
TEL (909) 882-3612 • FAX (909) 882-7015
E-Mail tda@tstonramp.com



# MEMORANDUM

**TO:** Richard Atwater

**FROM:** Tami Fincher

**DATE:** July 26, 2000

**SUBJECT:** Submittal of Final Program Environmental Impact Report for the Optimum Basin Management Program

---

On behalf of everyone at Tom Dodson and Associates (TDA), I am pleased to submit to you the final draft of the OBMP PEIR. This document is being submitted to you as a single sided reproducible copy for you use and distribution purposes. This document completes the final task outlined in our contract, and fulfills all of TDA's obligations to Inland Empire Utilities Agency for this project.

It has been a true pleasure to work with you and all of your staff on this project. In particular, I would like to extend a special thank you to Garth Morgan, Neil Clifton, Harlan Delzer, Kathy Beckley, Ben Pak, Barbara Kruells, Patti Bonavitz, and April Woodruff for their skillful and professional efforts in helping to complete the requirements of the CEQA review process in such a timely and efficient manner. You have an incredibly capable staff, and their assistance has been invaluable to us over the course of the past year. Thank you.

We deeply appreciate the opportunity that IEUA has afforded TDA in working on this OBMP project. All of us here at TDA look forward to working with you and your staff in the future, as you continue to implement projects under the program document adopted for the OBMP. I believe that this PEIR establishes a clear and effective framework for the development of future water supply facilities to meet demands in the Chino Basin. Congratulations to everyone at IEUA on the successful adoption of the OBMP, the certification of the Peace Agreement, and the approval of the OBMP Implementation Plan. Best wishes for the smooth implementation of projects under this program, and I commend you on your commitment to a promising future legacy for the water supply in the Chino Basin.

Very Respectfully Yours,

Tami Fincher

Tami Fincher

/tcf

Attachments: Volume I and Volume II of Final Program EIR for the OBMP

# INLAND EMPIRE UTILITIES AGENCY
## NOTICE OF DETERMINATION

To: Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814
and
San Bernardino County
Clerk of the Board
385 North Arrowhead Avenue
San Bernardino, CA 92415

From: Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, California 92335

**Subject:**
**Filing of Notice of Determination in compliance with Section 21108 or 21152 of the Public Resources Code.**

**Project Title**

Chino Basin Optimum Basin Management Program

| SCH#2000041047 | Mr. Richard Atwater | (909) 357-0241 |
|---|---|---|
| **State Clearinghouse Number** | **Lead Agency Contact Person** | **Telephone Number** |

**Project Location**

The OBMP will be implemented within the Chino Basin which is bounded on the north by the San Gabriel Mountains and the Cucamonga Basin; on the east by the Rialto-Colton Basin, Jurupa Hills and the Pedley Hills; on the south by the La Sierra area, the Santa Ana River and the Temescal Basin; and on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins. The Chino Basin is one of the principle subbasins contributing flow to the Santa Ana River which flows approximately 69 miles from the San Bernardino Mountains to the Pacific Ocean.

**Project Description**

The Optimum Basin Management Program (OBMP) implements a groundwater management program for the Chino Basin that is designed to enhance the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the basin in a cost-effective manner. To carry out this purpose, the OBMP consists of four primary management goals. Goal number one is to enhance basin water supplies. Goal number two is to protect and enhance water quality. Goal number three is to enhance management of the basin. Goal number four is to equitably finance the OBMP. The OBMP will be implemented as a program with future specific projects over the next 20-30 years.

This is to advise that the Inland Empire Utilities Agency approved the above described project on July 12, 2000 and has made the following determinations regarding the above described project:

1. The project [☑ will ☐ will not] have a significant effect on the environment.
2. A Program Environmental Impact Report (PEIR) was prepared for this project, and the Agency determined that the project has a potential to cause significant adverse environmental effects with implementation of proposed mitigation measures. The PEIR was certified by the Agency Board.
3. Mitigation measures identified in the PEIR were made a condition of the approval of the project.

This is to certify that the PEIR and record of project approval are available to the general public at the Inland Empire Utilities Agency office in Fontana.

Signature Date Title

Date received for filing:

STATE OF CALIFORNIA-THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

9208_

# ENVIRONMENTAL FILING FEE CASH RECEIPT

DFG 753.5a (6-91)

Lead Agency: Inland Empire Utilities Agency Date: 7/12/00

County/State Agency of Filing: County of San Bernardino Document No.:

Project Title: Chino Basin Optimum Basin Management Program.

Project Applicant Name: Inland Empire Utilities Agency Phone Number: 909-357-0241

Project Applicant Address: 9400 Cherry Ave.,Bldg.A,Fontana, CA 92335

Project Applicant *(check appropriate box):* Local Public Agency [X] School District [ ] Other Special District [ ]
State Agency [ ] Private Entity [ ]

Check #055193

| CHECK APPLICABLE FEES: | | | |
|---|---|---|---|
| (X) | Environmental Impact Report | $850.00 | $ 850.00 |
| ( ) | Negative Declaration | $1,250.00 | $ |
| ( ) | Application Fee Water Diversion *(State Water Resources Control Board Only)* | $850.00 | $ |
| ( ) | Projects Subject to Certified Regulatory Programs | $850.00 | $ |
| (X) | County Administrative Fee | ~~$25.00~~ XXXX | $ 35.00 |
| ( ) | Project that is exempt from fees | | |
| | TOTAL RECEIVED | | $ 885.00 |

*Signature and title of person receiving payment:* John Rangula Deputy Clerk

FIRST COPY-PROJECT APPLICANT SECOND COPY-DFG/FASB THIRD COPY-LEAD AGENCY FOURTH COPY-COUNTY/STATE AGENCY OF FILING

# RESOLUTION NO. 2000-7-1

## A RESOLUTION OF THE BOARD OF THE INLAND EMPIRE UTILITIES AGENCY* CERTIFYING THE FINAL PROGRAM ENVIRONMENTAL IMPACT REPORT FOR THE OPTIMUM BASIN MANAGEMENT PLAN AND ADOPTION OF FINDINGS AND STATEMENT OF OVERRIDING CONSIDERATIONS

Whereas, the California Environmental Quality Act (CEQA) of 1970, as amended, requires that prior to approval of any project, the Lead Agency shall consider the potential impacts and effects of said project, consider alternatives to the project, and identify mitigation measures necessary to reduce or eliminate the impact of the project on the environment; and

Whereas, the Inland Empire Utilities Agency* (IEUA) is the Lead Agency for the Optimum Basin Management Plan (OBMP) and has caused to be prepared a Program Environmental Impact Report (PEIR) for the OBMP in accordance with CEQA and its implementing guidelines; and

Whereas, the IEUA prepared and circulated a Notice of Preparation (NOP) to the public, responsible agencies and other interested parties for their review and comment, pursuant to CEQA Guidelines Section 15083; and

Whereas, pursuant to comments received on the scope and content of the PEIR in response to the NOP document, IEUA prepared and circulated a draft PEIR assessing the project's environmental impact for public review; and

Whereas, IEUA issued the Notice of Completion for the draft PEIR on May 5, 2000 and the draft PEIR was available for public review and comment from May 5, 2000 through June 23, 2000; and

Whereas, IEUA received 18 letters with comments and concerns regarding the content of the draft PEIR for the OBMP; and

Whereas, the Draft EIR determined that the majority of potential adverse environmental impacts are either non-significant without mitigation or can be reduced to a level of insignificance with mitigation, including the following: land use, population and housing, geologic resources/constraints, water resources/water quality, air quality construction impacts, transportation and circulation, biological resources, energy, hazards and risk of upset, noise, public services, utilities, cultural resources, and aesthetics and visual resources; and

Whereas, the draft PEIR for the OBMP identified a single significant adverse environmental impact relating to air quality from emissions due to electricity consumption in support of OBMP projects; and

Whereas, IEUA provided a copy of the Responses to Comments to all Responsible Agencies on June 30, 2000, in accordance with CEQA; and

Whereas, the Final OBMP PEIR will be available for use as the base environmental document by any Responsible Agency proceeding to implement future site-specific projects under the OBMP in accordance with programmatic procedures outlined in the State CEQA Guidelines Sections 15162 and 15168; and

Whereas, the IEUA Board has received and has reviewed the Final OBMP PEIR, consisting of the draft PEIR, all Responses to Comments, the Mitigation Monitoring and Reporting Program, Findings of Fact and Statement of Overriding Considerations, and all other material in the administrative record; and

Whereas, pursuant to duly given public notice, the IEUA Board has held a full and fair public hearing on June 28, 2000 concerning the OBMP and the PEIR and has considered all written and oral comments and testimony relating thereto and is fully advised thereon.

NOW, THEREFORE, BE IT RESOLVED, DETERMINED AND ORDERED BY THE INLAND EMPIRE UTILITIES AGENCY* AS FOLLOWS:

Section 1. A full and fair public hearing having been held on the PEIR prepared in connection with the OBMP, as stated in the recitals herein, the IEUA hereby approves and certifies the PEIR for the Optimum Basin Management Plan as before the IEUA Board at this time which incorporates the written comments incorporated herein by reference, and all as more fully described in the Final OBMP PEIR, and adopts the Mitigation Monitoring and Reporting Program and Facts, Findings and Statement of Overriding Considerations.

The IEUA further finds that changes or alterations have been required in connection with the adoption of the OBMP and have been incorporated in conjunction with the OBMP which avoid or substantially lessen the significant environmental effects identified in the PEIR.

Pursuant to Public Resources Code Section 21081 (b), the IEUA further finds that where the responsibility for implementation of mitigation measures has been assigned to participating agencies, such mitigation measures are within the responsibility and jurisdiction of such other agencies and such changes can and should be adopted by such agencies when they carry out future site-specific projects under the OBMP.

Section 2. The IEUA hereby authorizes and directs the filing and posting of a Notice of Determination as required by Section 21152 of the Public Resources Code, and that filing required by pursuant to Section 21089 (b) of the Public Resources Code by the General Manager with the Clerk of the Board of Supervisors of San Bernardino County and the State Clearinghouse, Governor's Office of Planning and Research, as soon as possible after the adoption of this Resolution.

Section 3. The IEUA hereby adopts the mitigation measures recommended as conditions of project approval in Sections 1 and 4 of the Final OBMP PEIR, and the Mitigation Monitoring and Reporting Program prepared for the purpose of monitoring the changes which have been adopted or made a condition of project approval as described in Section 1 of this Resolution and all as more fully described in the Mitigation Monitoring and Reporting Program.

Section 4. This Resolution shall take effect upon adoption

ADOPTED, this 12th day of July, 2000.

John L. Anderson
President of the Inland Empire Utilities Agency* and of the Board of Directors thereof.

ATTEST:

Secretary of the Inland Empire Utilities Agency* and of the Board of Directors thereof.

(SEAL)

* A Municipal Water District

STATE OF CALIFORNIA )
)SS
COUNTY OF )
SAN BERNARDINO )

I, Anne Dunihue, Secretary of the Inland Empire Utilities Agency*, DO HEREBY CERTIFY that the foregoing Resolution being No. 2000-7-1, was adopted at an adjourned regular Board Meeting on July 12, 2000, of said Agency by the following vote:

| | |
|---|---|
| AYES: | Dunihue, Troxel, Catlin, Koopman, Anderson |
| NOES: | None |
| ABSTAIN: | None |
| ABSENT: | None. |

Anne Dunihue
Secretary

*A Municipal Water District

RESOLUTION NO. 2000-7-2

**RESOLUTION OF THE BOARD OF DIRECTORS OF INLAND EMPIRE UTILITIES AGENCY*, SAN BERNARDINO COUNTY, CALIFORNIA, TO ADOPT THE GOALS AND PLANS OF THE PHASE I REPORT, THE OPTIMUM BASIN MANAGEMENT PLAN (OBMP), AND THE OBMP IMPLEMENTATION PLAN, AND TO APPROVE THE PEACE AGREEMENT – CHINO BASIN ("PEACE AGREEMENT")**

WHEREAS, the Judgment in the Chino Basin Adjudication, Chino Basin Municipal Water District v. City of Chino, et al., San Bernardino Superior Court No. 16437, created the Watermaster and directed it to perform the duties as provided in the Judgment or ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction; and

WHEREAS, the Judgment directs Watermaster to develop an OBMP subject to the limitations contained in the Judgment; and

WHEREAS, Watermaster has prepared and submitted a Phase I Report regarding the OBMP to the Court; and

WHEREAS, the Court has ordered the Inland Empire Utilities Agency (IEUA) to act as "lead agency" for the purposes of preparing any applicable environmental review for the OBMP in the form of a Program Environmental Impact Report (PEIR), and the Court is exercising continuing jurisdiction over this matter; and

WHEREAS, the parties to the Judgment have developed a Memorandum of Principles which articulated a framework of an agreement which the Watermaster Board of Directors approved unanimously on May 26, 2000; and

WHEREAS, the parties to the Judgment have rendered the Memorandum of Principles into a more definitive agreement known as the Peace Agreement and into an OBMP Implementation Plan; and

WHEREAS, the goals and plans in the Phase I Report, implemented consistent with the OBMP Implementation Plan and the Peace Agreement, constitute the OBMP; and

WHEREAS, the IEUA has prepared and circulated a draft OBMP PEIR and held a public hearing to receive public comment regarding the OBMP on June 28, 2000; and

WHEREAS, the parties to the Peace Agreement and the parties to the Judgment have requested that IEUA approve the Peace Agreement, adopt the OBMP and OBMP Implementation Plan, and implement the goals and plans presented in the OBMP Phase I Report as they apply to IEUA, in a manner consistent with the Peace Agreement and the OBMP Implementation Plan.

NOW THEREFORE, the Board of Directors of the Inland Empire Utilities Agency* does hereby RESOLVE, DETERMINE, AND ORDER as follows:

Section 1: The goals and plans in the Phase I Report and their implementation as provided in, and consistent with, the Implementation Plan and the Peace Agreement are in furtherance of the physical solution set forth in the Judgment and Article X, Section 2 of the California Constitution.

Section 2: Subject to the satisfaction of all conditions precedent set forth in the Peace Agreement by the Parties thereto, the IEUA Board supports and approves the Peace Agreement negotiated by the parties thereto, including, but not limited to, Article VII thereof.

Section 3:

a. IEUA hereby adopts the OBMP and OBMP Implementation Plan.

b. IEUA approves the goals and plans of the Phase I Report, consistent with the OBMP Implementation Plan and the Peace Agreement.

c. IEUA supports Watermaster's proceeding in accordance with the OBMP Implementation Plan and the Peace Agreement.

d. IEUA supports Watermaster's compliance with the conditions described in Article V of the Peace Agreement labeled, "Watermaster Performance" in order to implement the provisions set forth in Article V as specified in the OBMP Implementation Plan and the Peace Agreement.

Section 4: The IEUA Board authorizes the President to execute the Peace Agreement on behalf of the Inland Empire Utilities Agency.

Section 5: In approving this Resolution, IEUA is not committing to carry-out any project, within the meaning of CEQA, unless and until environmental review and assessments, as required by CEQA for that defined "project", have been completed. Any future actions that meet the definition of a project under CEQA shall be subject to environmental review as required under the California Environmental Quality Act, utilizing the OBMP PEIR as appropriate.

ADOPTED, this 12th day of July 2000.

John L. Anderson
President of the Inland Empire Utilities Agency* and of the Board of Directors thereof

ATTEST:

Anne Dunihue
Secretary of the Inland Empire Utilities Agency* and of the Board of Directors thereof

(SEAL)

* A MUNICIPAL WATER DISTRICT

STATE OF CALIFORNIA )
)SS
COUNTY OF )
SAN BERNARDINO )

I, Anne W. Dunihue, Secretary of the Inland Empire Utilities Agency*, DO HEREBY CERTIFY that the foregoing Resolution being No. 2000-7-2, was adopted at an adjourned regular Board Meeting on July 12, 2000, of said Agency by the following vote:

| | |
|---|---|
| AYES: | Dunihue, Troxel, Catlin, Koopman, Anderson |
| NOYES: | None |
| ABSTAIN: | None |
| ABSENT: | None. |

Anne Dunihue
Secretary

(SEAL)

* A MUNICIPAL WATER DISTRICT

# INLAND EMPIRE UTILITIES AGENCY
# MAIN OFFICE - BOARD ROOM

# FOR THE

# REVIEW AND CERTIFICATION OF FINAL PROGRAM EIR OF THE OBMP

# AT THE ADJOURNED REGULAR MEETING OF THE IEUA BOARD OF DIRECTORS

# JULY 12, 2000 - 9:00 AM

*John Anderson* **CALL FOR ITEM #4**

Item #4 is the certification of the Final Program EIR of the OBMP. Rich Atwater will lead the discussion.

*Rich Atwater* **OVERVIEW OF THE Program EIR**

OBMP support issues
Groundwater storage and conjunctive use
Recycling and Recycled Recharge Projects
Water Quality and the Future Economic Development

INTRODUCTION OF TOM DODSON

*Tom Dodson* **Lead discussion of action items**

Briefly review the Program EIR process and benefit
Facts, Findings, and Statement of Overriding Considerations
Mitigation Monitoring and Reporting Program

BACK TO RICH ATWATER - closing comments, thank you(s) for Mr. Tom Dodson, Ms. Tami Fincher, and the rest of the TDA staff

*John Anderson* **Comments from the PUBLIC** (if needed)

*John Anderson* **Comments from the Board Members** (if needed)

*John Anderson* **Call for motions**

Approve the Facts, Findings, and Statement of Overriding Considerations
Approve the Mitigation Monitoring and Reporting Program

CERTIFICATION of the Program EIR of the OBMP

AGENDA

# BOARD OF DIRECTORS ADJOURNED REGULAR MEETING
# INLAND EMPIRE UTILITIES AGENCY*
# AGENCY HEADQUARTERS, FONTANA, CALIFORNIA
# WEDNESDAY, JULY 12, 2000
# 9:00 A.M.

## CALL TO ORDER

## FLAG SALUTE

## PUBLIC COMMENT

Members of the public may address the Board on any item that is within the jurisdiction of the Board; however, no action may be taken on any item not appearing on the agenda unless the action is otherwise authorized by Subdivision (b) of Section 54954.2 of the Government Code. Those persons wishing to address the Board on any matter, whether or not it appears on the agenda, are requested to complete and submit to the Board Secretary a "Request to Speak" form which are available on the table in the Board Room. Comments will be limited to five minutes per speaker. Thank you.

## ADDITIONS TO THE AGENDA

In accordance with Section 54954.2 of the Government Code (Brown Act), additions to the agenda require two-thirds vote of the legislative body, or, if less than two-thirds of the members are present, a unanimous vote of those members present, that there is a need to take immediate action and that the need for action came to the attention of the local agency subsequent to the agenda being posted.

## 1. CONSENT CALENDAR

NOTICE: All matters listed under the Consent Calendar are considered to be routine and non-controversial and will be acted upon by the Board by one motion in the form listed below. There will be no separate discussion on these items prior to the time the Board votes unless any Board members, staff or the public requests specific items be discussed and/or removed from the Consent Calendar for separate action.

### A. TREASURER'S REPORT

1. Vouchers List
2. Investments

### B. RP-1 CHEMICAL FEED IMPROVEMENTS CONTRACT, PROJECT NO. EN98013, PROJECT ACCEPTANCE

It is recommended that the Board accept the work performed by Coons Construction as complete under the construction contract for the RP-1 Chemical Feed Improvements Contract, Project No. 98013; and Authorize the Chief Executive Officer/General Manager to execute the Notice of Completion.

C. KIMBALL INTERCEPTOR AND CHINO INTERCEPTOR DIVERSION LINE CONTRACT, PROJECT NO. EN97004, PROJECT ACCEPTANCE (PHASE I, KIMBALL INTERCEPTOR, SEGMENT II)

It is recommended that the Board accept the work performed by Murray Company as complete under the construction contract for the Kimball Interceptor and Chino Interceptor Diversion Line, Phase I, Segment II, Project No. EN97004; and authorize the Chief Executive Officer/General Manager to execute the Notice of Completion.

D. RP-1 AUTOMATED OUTALL DIVERSION TO STORAGE POND IMPROVEMENTS CONTRACT, PROJECT NO. EN99014, PROJECT ACCEPTANCE

It is recommended that the Board accept the work performed by DenBoer Engineering and Construction, as complete under the construction contract for the RP-1 Automated Outfall Diversion to Storage Pond Improvements, Project No. EN99014; and authorize the Chief Executive Officer/General Manager to execute the Notice of Completion.

E. CONSTRUCTION CONTRACT AWARD, CARBON CANYON WASTEWATER RECLAMATION FACILITY CHLORINE CONTRACT TANK SLIDE GATES REPLACEMENT, PHASE II, PROJECT NO. EN98006

It is recommended that the Board award a construction contract for the CCWRF Chlorine Contact Tank Slide Gates Replacement, Phase II, Project No. EN98006, to Coons Construction, for their low bid of $42,900; and authorize the Chief Executive Officer/General Manager to execute the contract.

2. MONTHLY REPORT OF FINANCIAL AFFAIRS

Staff will present the Monthly Report of Financial Affairs for the month ending May 31, 2000.

C. KIMBALL INTERCEPTOR AND CHINO INTERCEPTOR DIVERSION LINE CONTRACT, PROJECT NO. EN97004, PROJECT ACCEPTANCE (PHASE I, KIMBALL INTERCEPTOR, SEGMENT II)

It is recommended that the Board accept the work performed by Murray Company as complete under the construction contract for the Kimball Interceptor and Chino Interceptor Diversion Line, Phase I, Segment II, Project No. EN97004; and authorize the Chief Executive Officer/General Manager to execute the Notice of Completion.

D. RP-1 AUTOMATED OUTALL DIVERSION TO STORAGE POND IMPROVEMENTS CONTRACT, PROJECT NO. EN99014, PROJECT ACCEPTANCE

It is recommended that the Board accept the work performed by DenBoer Engineering and Construction, as complete under the construction contract for the RP-1 Automated Outfall Diversion to Storage Pond Improvements, Project No. EN99014; and authorize the Chief Executive Officer/General Manager to execute the Notice of Completion.

E. CONSTRUCTION CONTRACT AWARD, CARBON CANYON WASTEWATER RECLAMATION FACILITY CHLORINE CONTRACT TANK SLIDE GATES REPLACEMENT, PHASE II, PROJECT NO. EN98006

It is recommended that the Board award a construction contract for the CCWRF Chlorine Contact Tank Slide Gates Replacement, Phase II, Project No. EN98006, to Coons Construction, for their low bid of $42,900; and authorize the Chief Executive Officer/General Manager to execute the contract.

2. MONTHLY REPORT OF FINANCIAL AFFAIRS

Staff will present the Monthly Report of Financial Affairs for the month ending May 31, 2000.

3. EXECUTION AND DELIVERY OF A TAX AND REVENUE ANTICIPATION NOTE

It is recommended that the Board of Directors adopt Resolution 2000-7-1, authorizing the execution and delivery of a Tax and Revenue Anticipation Note (TRAN) to support the Commercial Paper Program.

4. CERTIFICATION OF THE FINAL PROGRAM ENVIRONMENTAL IMPACT REPORT (PEIR) OF THE OPTIMUM BASIN MANAGEMENT PLAN (OBMP)

It is recommended that the Board of Directors adopt the Facts, Findings, and Statement of Overriding Considerations for the Optimum Basin Management Plan Program Environmental Impact Report; adopt the Mitigation Monitoring and Reporting Program established in the Final Program Environmental Impact Report; and certify the Final Program Environmental Impact Report as complete.

5. ADOPTION OF PEACE AGREEMENT - CHINO BASIN

It is recommended that the Board of Directors adopt the Peace Agreement - Chino Basin dated the 29th day of June, 2000; and authorize the Board President to execute the Agreement.

6. LEGISLATION UPDATE

A. Status Report on Congressional Activities
B. Status Report on California Legislative Bills
C. Public Information Officer Activities Status

7. CHIEF EXECUTIVE OFFICER/GENERAL MANAGER'S REPORT

A. Miscellaneous Agency Matters

## 8. DIRECTORS' COMMENTS

This is the time and place for the Members of the Board to report on prescheduled Committee/District Representative Assignment meetings, which were held since the last regular Board meeting, and/or any other items of interest.

## 9. CLOSED SESSION

A. PURSUANT TO GOVERNMENT CODE SECTION 54956.9 (a), CONFERENCE WITH LEGAL COUNSEL - EXISTING LITIGATION
CBMWD vs. City of Chino et al., Case No. RCV 51010
Orange County Water District vs. City of Chino, et al., Case No. 117628
Superior Court, County of Orange

## ADJOURN

*A Municipal Water District

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this meeting, please contact the Board Secretary (909/357-0241 x201), 48 hours prior to the scheduled meeting so that the Agency can make reasonable arrangements.

**Declaration of Posting**

I, Patti Bonawitz, Board Secretary of the Inland Empire Utilities Agency*, A Municipal Water District, hereby certify that a copy of this agenda has been posted by 5:30 p.m. in the foyer at the Agency's main office, 9400 Cherry Avenue, Building A, Fontana on Thursday, July 6. 2000.

Patti Bonawitz

# CANDIDATE FACTS, FINDINGS, AND STATEMENT OF OVERRIDING CONSIDERATIONS REGARDING THE ENVIRONMENTAL EFFECTS FROM IMPLEMENTING THE OPTIMUM BASIN MANAGEMENT PROGRAM

## A. INTRODUCTION

The Inland Empire Utilities Agency (IEUA or Agency), in approving Optimum Basin Management Plan (OBMP), makes the findings described below, based on the facts summarized in this document, and adopts the statement of overriding considerations presented at the end of the findings. Hereafter, the following document (Final Program Environmental Impact Report for the Optimum Basin Management Plan, SCH #2000041047) will be referred to as he "PEIR" for the term Program Environmental Impact Report. The total action that may be implemented by approval of the OBMP by IEUA consists of all of the actions outlined in the OBMP to achieve hydrologic control of the Chino Basin to achieve the goal of meeting future water demands within the Basin while protecting safe yield and water quality.

Adoption and implementation of the OBMP constitutes the "proposed project" that will be evaluated in this Program Environmental Impact Report (PEIR). To carry out this proposal, the Chino Basin Water Master, including IEUA and other participating jurisdictions, compiled the OBMP to achieve the goals outlined above. It is the total program outlined in the OBMP, including the Peace Agreement Chino Basin and OBMP Implementation Plan, that constitutes the proposed project evaluated in the PEIR.

## B. PROJECT SUMMARY

### B.1 PROJECT LOCATION

The OBMP will be implemented within the Chino Basin which is bounded on the north by the San Gabriel Mountains and the Cucamonga Basin; on the east by the Rialto-Colton Basin, Jurupa Hills and the Pedley Hills; on the south by the La Sierra area, the Santa Ana River and the Temescal Basin; and on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins. The Chino Basin is one of the principle subbasins contributing flow to the Santa Ana River which flows approximately 69 miles from the San Bernardino Mountains to the Pacific Ocean.

### B.2 PROJECT CHARACTERISTICS

The Optimum Basin Management Program (OBMP) occurs in the Chino Groundwater Basin and is intended to develop a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the basin in a cost-effective manner. To carry out this purpose, the OBMP consists of four primary management goals. Goal number one is to enhance basin water supplies. Goal number two is to protect and enhance water quality. Goal number three is to enhance management of the basin. Goal number four is to equitably finance the OBMP.

In order to administer water-usage for the long-term beneficial use of all component members of Watermaster, an OBMP consisting of two phases has been developed. Phase I of the OBMP consists of defining the state of the Chino Groundwater Basin, establishing goals concerning major issues identified by stakeholders, and affirming a management plan for the achievement of said goals. Phase 2 of the OBMP is intended to be the physical implementation plan for the installation and operation of OBMP facilities. The major OBMP facilities consist of monitoring wells, extensiometers, pipelines, desalters, possibly an ion exchange facility, recharge basins (both existing and new), pump stations, production wells and production monitoring devices.

The aforementioned facilities are examples of the necessary types of physical structures that will be implemented to achieve the project objectives that are outlined in the form of nine Program Elements. The detailed list of proposed facilities that may be implemented under the umbrella of the OBMP is provided in Table 4.2-3 of the PEIR. This list of Program Elements comprises the ultimate focus of Watermaster's future actions, agendas, and policies. The elements contained in the OBMP are as follows:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program
- Program Element 9 – Develop and Implement Conjunctive-Use Programs

It is the implementation of the listed program elements where the potential occurs for the OBMP to cause physical changes in the environment and to produce potential adverse impacts to the environment.

## C. ENVIRONMENTAL REVIEW

The entire administrative record, including the OBMP, the PEIR, public comments and responses, IEUA Staff reports, and these facts, findings and statement of overriding considerations, serve as the basis for the IEUA Board's environmental determination. The Board's environmental determination is that the PEIR addresses all of the potential impacts from implementing the OBMP as outlined above. The detailed environmental impacts and proposed mitigation measures for the future development projects are presented in Chapter 4 of the PEIR and in the responses to comments (under separate cover) which are part of the PEIR. Alternatives to the proposed project are discussed in Chapter 5 of the PEIR. Evaluations of growth inducement, cumulative impacts, and irreversible commitment of resources are provided in Chapter 6, Topical Issues, of the PEIR. The following findings contain a summary of the facts used in making determinations for each environmental issues addressed in the PEIR.

1. Consideration of the EIR: The Final Environmental Impact Report, PEIR, dated July 12, 2000 has been presented to the Board of Directors of the Inland Empire Utilities Agency. The Board makes the following certifications pursuant to the California Environmental Quality Act Guidelines section 15090. The Board finds and certifies that the PEIR has been completed in compliance with CEQA. The Board certifies that all voting members have reviewed and considered the PEIR prior to approving this proposal. In addition, all voting Board members have reviewed and considered the additional information presented at or prior to the public hearing on June 28, 2000. The Board further finds and certifies that the PEIR reflects the independent judgement and analysis of the Board and is adequate for this proposed project.

2. Full Disclosure: The Board finds and certifies that the PEIR constitutes a complete, accurate, adequate and good faith effort at full disclosure under CEQA.

3. Location of Record Proceedings: The documents and other materials which constitute the record of proceedings upon which this decision is based are in the custody of the IEUA located at 9400 Cherry Avenue, Bldg. A, Fontana, California. This information is provided in compliance with Public Resources Code §21081.6(a)(2).

4. Inland Empire Utilities Agency as Lead Agency Under CEQA: The Inland Empire Utilities Agency has been designated as the "lead agency" as defined by CEQA Guidelines section 15050 by order of the Hon. Judge Michael Gunn of the San Bernardino Superior Court. In compliance with this judicial order, IEUA has prepared the draft and Final PEIR for the OBMP, prepared these findings in accordance with the CEQA Guidelines and the Public Resources Code, and will carry out all other duties and responsibilities required of a lead agency under the Public Resources Code and the CEQA Guidelines.

## D. FINDINGS

Presented below are the environmental findings made by the IEUA after its review of the documents referenced above; and consideration of written and oral comments on the proposed project at a public hearing, including all other information provided during the decision-making process. These findings provide a summary of the information contained in the PEIR, related technical documents, and the public hearing record that have been referenced by the IEUA Board in making its decision to approve the OBMP as the first step in achieving hydrologic control of the Chino Basin.

The PEIR prepared for the OBMP addresses the consequences of implementing nine program elements and a large number of potential site specific projects in the future. This PEIR evaluated 14 major environmental issue categories for potential significant adverse impacts. These major environmental issue categories, in the order presented in the PEIR, are: land use, population and housing, geologic resources/constraints, water resources/water quality, air quality, transportation and circulation, biological resources, energy, hazards/risk of upset, noise, public services, utilities, cultural resources, and aesthetics and visual resources. When all impact categories are included, the PEIR reached a total of 28 findings on environmental issues. Short- and long-term impacts and project-specific and cumulative impacts were evaluated for implementation of the proposed project. Some of the issue categories contained several subissues which are summarized below. Of these 14 major

environmental categories, the Board concurs with the findings in the PEIR that the issues and subissues discussed below can be mitigated below a significant impact threshold; or for those issues which cannot be mitigated below a level of significance, that overriding considerations exist which make those impacts acceptable.

Those environmental issue categories identified in the PEIR as having no potential for significant adverse impact, with or without mitigation, are described below in Section E. The discussion in Section E summarizes the findings contained in the PEIR for the nonsignificant issues, including those for which mitigation has been identified to reduce impacts below a significant level. Unavoidable (unmitigable) significant adverse impacts of the project are described in Section F of this document. An analysis and comparison of the alternatives to the proposed project are described in Section G of this document. Project benefits are described in Section H. The balancing of benefits and impacts and the statement of overriding considerations are described and evaluated in Section I of this document.

Several additional mitigation measures were identified for modification and implementation in the Responses to Comments on the PEIR and these changes have been incorporated into the Final PEIR. All of these changes in mitigation measures remain within the scope of the performance standards outlined in the Draft PEIR. Mitigation measures referenced in this document are also contained in the mitigation monitoring and reporting program which is attached to the PEIR. The agent responsible for implementation and monitoring is identified in the monitoring program. The mitigation measures were carried forward into the Mitigation Monitoring and Reporting Program prepared by the IEUA for implementation. Based on the analysis in this document, many of the identified mitigation measures are the responsibility of IEUA; however, individual participating agencies (Responsible Agency) will be responsible for projects that they initiate under the OBMP's auspices. The monitoring program ensures that the measures identified in the PEIR are implemented in accordance with discussions in the PEIR.

## E. NONSIGNIFICANT IMPACTS IDENTIFIED IN THE PEIR

The following issues were identified in the PEIR as having no potential to cause significant impact or were capable of having impacts reduced below a significant level by implementing the identified mitigation measures. In the following presentation, each resource issue is identified; it is followed by a summary description of the potential significant adverse environmental effect and a short discussion of the findings and facts in the administrative record, as defined above.

The Board hereby finds that all mitigation measures identified in the Final PEIR that will be implemented to mitigate the impacts of this project will be incorporated into, or will be required of, the project to avoid or substantially lessen potentially significant environmental impacts to a level of insignificance. Public Resources Code Section 21081 states that no public agency shall approve or carry out a project for which an environmental impact report has been completed which identifies one or more significant effects unless the public agency makes one, or more, of the following findings:

a. Changes or alterations have been required in, or incorporated into the project which mitigate or avoid the significant environmental effects thereof as identified in the completed environmental impact report;

b. Such changes or alterations are within the responsibility and jurisdiction of another public agency and such changes have been adopted by such agency or can and should be adopted by such other agency; and/or

c. Specific economic, social or other considerations make infeasible the mitigation measures or project alternatives identified in the environmental impact report.

The Board hereby finds, pursuant to Public Resources Section 21081, that the following issues are nonsignificant because they have no potential to cause a significant impact or because mitigation measures will be implemented as outlined below. The Board further finds that no additional mitigation measures or project changes are required to reduce the potential impacts discussed below to a level of nonsignificance. These issues and the measures adopted to mitigate them to a level of insignificance are as follows:

**1. Land Use:**

*a. Conflicts with current zoning:* Development of the project has the potential to cause conflicts with adjacent land uses. Mitigation measures, including but not limited to the selection of alternative sites for construction of future desalters where desalter operations can create significant incompatibilities with adjacent uses and/or the preparation of technical reports that identify specific measures that reduce potential incompatible activities or effects below thresholds established in the general plan for the jurisdiction where the facility will be located, have been found to mitigate this impact to an insignificant level.

*b. Agricultural resources:* The Chino Basin contains very significant agricultural resources, primarily dairy ranches that are located in the southern portion of the basin. At the project-specific level, the OBMP has the potential to adversely affect agricultural resources and/or operations. Mitigation measures, including but not limited to the selection of alternative sites where future project facilities are proposed for locations that support active agricultural operations on important farmlands, have been found to mitigate this impact to an insignificant level.

*c. Disruption of established communities:* At the project-specific level, the OBMP has the potential to disrupt the continuity of established communities through the installation of pipelines and recharge facilities. Mitigation measures, including but not limited to the selection of alternative sites and/or the preparation of technical reports that identify specific measures that will be utilized to reduce potential incompatible activities or effects below thresholds established in the general plan for the jurisdiction where the facility will be located, have been found to mitigate this impact to an insignificant level.

*d. Loss of development acreage:* Construction of the project facilities has the slight chance to impact the developable acreage in the Chino Basin. The facilities that may potentially effect development include pipelines and recharge basins. The proposed desalters, production and monitoring wells and other project facilities are considered to have a non-significant adverse impact in this regard. Mitigation measures, including but not limited to the selection of alternative sites and/or the preparation of technical reports identifying specific measures to reduce potential

incompatible activities or effects below thresholds established in the general plan for the jurisdiction where the facility will be located, have been found to mitigate this impact to an insignificant level.

**2. Population and Housing:**

It is remotely possible that the development of specific facilities, such as desalters, production wells or recharge basins, could adversely impact existing homes. Mitigation measures, including but not limited to ensuring that short- and long-term housing of comparable quality and value are made available to homeowners prior to initiating construction of the project facility, have been found to mitigate this impact to an insignificant level.

**3. Geologic Resources/Constraints:**

*a. Fault rupture:* No known faults occur within the project area; therefore, the potential for fault rupture is considered to be low. Mitigation measures, including, but not limited to, requiring adherence to seismic engineering construction, land use, and development standards, have been found to mitigate this impact to an insignificant level.

*b. Seismic ground-shaking:* The project site may be subject to significant ground-shaking caused by earthquakes along portions of the fault systems within the vicinity of the project over the life of the proposed project. Mitigation measures, including but not limited to the application of current and appropriate seismic design and construction criteria to all structures subject to significant seismic shaking, have been found to mitigate this impact to an insignificant level.

*c. Liquefaction:* Liquefaction results when water-saturated, sandy, unstable soils are subject to intense shaking, such as that caused by an earthquake. A portion of the project area may be prone to liquefaction. Mitigation measures, including but not limited to the requirement that each site within identified Liquefaction Hazard Zones be evaluated by a licensed engineer prior to design and/or land disturbance/construction have been found to mitigate this impact to an insignificant level.

*d. Erosion and grading:* The project may result in erosion and/or unstable soil conditions due to grading activities. With the exception of the recharge basins, all ground disturbing activities will affect small areas that can be designed to minimize the amount of ground disturbance. Mitigation measures, including but not limited to use of protective coverings, limiting the amount of area disturbed and the length of time slopes and barren ground are left exposed, construction of diversion dikes and interceptor ditches, and planting of windbreaks, have been found to mitigate erosion and grading impacts to an insignificant level.

*e. Subsidence hazards:* A portion of the project area has been identified as experiencing land subsidence impacts within a former artesian area of the valley. A variety of mitigation measures have been adopted to address this impact. The proposed goals of the project include further study of this phenomena as part of a regional monitoring program. Whatever future pumping patterns are implemented in support of the project, desalters will not be allowed to increase subsidence in any way within pre-existing subsidence zones. To ensure that pumping impacts in the vicinity of the desalter well field do not have an adverse impact on water levels and subsidence issues, the following

performance standards shall be used to evaluate the desalters. First, the water level declines in areas surrounding the desalter pumping locations will not be allowed to decline to the extent that pumping capabilities for surrounding wells are impacted. If surrounding wells and producers are impacted by declines in water levels, alternative access to equivalent quantity and quality of water will be provided to the affected surrounding parties. Second, if desalter well fields are demonstrated to cause or exacerbate impacts to subsidence areas measurable by a decline of over six (6) inches in ground level at a quarter (1/4) mile radius, or at the radius of the nearest non-project participating structure, then pumping patterns for the desalters shall be modified to reduce impacts to cause no more than six (6) inches of decline in ground level at the smallest of the two radii. Mitigation measures, including but not limited to those mentioned above, have been found to mitigate this impact to an insignificant level.

**4. Water Resources/ Water Quality:**

*a. Changes in absorption rates, drainage patterns and surface runoff*: Implementation of the project may impact absorption rates, drainage patterns and surface run-off. Actions under the project affecting these areas include, but are not limited to, the installation of three desalters, construction of new recharge basins and modifying ground water production. Mitigation measures for this impact will include but not be limited to (i) installation of equipment within or along existing disturbed easements or rights-of-way or otherwise disturbed areas, (ii) the covering of all areas not covered by structures with hardscape, native vegetation and/or human-made landscape areas, and (iii) collection and retention of surface runoff at desalter facilities. Mitigation measures, including but not limited to those listed above, have been found to mitigate this impact to an insignificant level.

*b. Water-related hazards, flooding:* The utilization of flood control basins for purposes for recharge has the potential to cause increased risks to people and property for flood-related hazards. Mitigation measures have been adopted to address this impact. By establishing an order of priorities for the basin, along with the specific management plans to be created for each basin prior to initiation of recharge operations, potential conflicts between flood control operations and recharge operations will be minimized. The Watermaster or other agencies will define the amount of water that can be set aside as a conservation pool within existing flood control basins and specific operational parameters. This will ensure that recharge activities do not conflict with flood control operations at any flood control basin. Variable pooling and recharge schedules will ensure that flood-related hazards remain less than significant. Project participants will also assist with the control and restoration of any environmental damage that may occur due to an accidental release from the SARI line. Mitigation measures, including but not limited to those set forth above, have been found to mitigate this impact to an insignificant level.

*c. Discharge of pollutants and alteration of surface water quality:* The installation of monitoring wells will create ground disturbances and entail drilling activities that could result in release of pollutants, including eroded sediment. In addition, the potential for accidental releases of petroleum products does exist during well construction activities. Abandonment of wells can also result in the discharge of pollutants. Mitigation measures to address this impact include but are not limited to the following:

(i) inclusion of the estimated amount of water lost from the Basin due to rising water at the low end of the Basin in the compilation of local and *in lieu* groundwater storage balances;

(ii) sampling of well sites prior to refurbishment or capping to ensure that the discharge does not contain any contaminants exceeding regulatory thresholds;

(iii) generally prohibiting the discharge of recycled water into streams that are transporting storm flows, unless modeling verifies that the volume of recycled water and total dissolved solids (TDS) will not cause the TDS of the storm flow to exceed the project objective for TDS at the location where the recycled water is discharged into the storm flow; and

(iv) preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for all project construction sites and the posting of a performance bond.

Mitigation measures, including but not limited to those listed above, have been found to mitigate this impact to an insignificant level.

*d. Rate of groundwater flow:* The installation and operation of the wells to support desalters will result in a substantial quantity of water being pulled out of the lower portions of the Basin. While the quantity of water produced may be unchanged, the pumping will be occurring in a concentrated location, and thus has the potential to impact groundwater flow patterns in this area. Mitigation measures, including but not limited to the adoption of mandatory performance standards which compensate for possible water level decline and potential subsidence impacts, have been found to mitigate this impact to an insignificant level.

*e. Groundwater quality:* The installation of monitoring wells will create ground disturbances and entail drilling activities which can result in release of pollutants. Additional activities under the project may also impact ground water quality. Mitigation measures to mitigate this impact include but are not limited to the following:

(i) the identification of Best Management Practices that will minimize the potential for accidental releases of any chemicals or materials that could degrade water quality;

(ii) identification of all chemicals that will be used at the drilling site prior to authorization of drilling contracts under the project;

(iii) submittal of a SWPPP prior to the commencement of drilling;

(iv) monitoring of recharge wells to identify the volume and rate of recharge that can be conducted without causing the project's water quality objective for TDS and TIN to be exceeded;

(v) providing specific data to the Department of Health Services when recharge of recycled water is proposed; and

(vi) establishment of a management plan that is satisfactory to the SBCFCD for any recharge project.

Mitigation measures, including but not limited to those set forth above, have been found to mitigate this impact to a level of insignificance.

**5. Air Quality:**

The project is located within the Chino Basin, which, in turn, is located within the South Coast Air Basin (SCAB). The South Coast Air Quality Management District has jurisdiction over air quality issues within the SCAB. Impacts to air quality under the project can be divided into two categories: construction impacts and operational impacts.

*a. Construction Impacts:* Construction of the project may cause temporary adverse effects to the air quality of the project area, particularly with respect to dust and airborne particulate. Mitigation measures, including but not limited to the application of non-toxic soil stabilizers, replacement of ground cover or pavement immediately after construction is complete, watering grading sites, and suspending grading activities when wind exceeds 25 miles per hour, have been determined to mitigate the impact of construction activities on air quality to an insignificant level.

*b. Operational Impacts:* The Final EIR for the OBMP has found the operational impacts of the project to be potentially significant, despite the imposition of all feasible mitigation measures. Operational impacts to air quality are discussed in Section F and are the subject of a Statement of Overriding Considerations in Section I, as required by CEQA Guidelines Sections 15091 and 15093.

**6. Transportation and Circulation:**

During the construction of the project, there may be short-term detours, disruptions of traffic flow, and the potential creation of traffic hazards as a result of construction within the road rights-of-way. For long-term operational facilities, the potential exists that a facility, such as a desalter, may create localized traffic hazards. Mitigation measures, including but not limited to the preparation of traffic studies for any project which increases traffic generation, requirements that each construction contractor provide adequate traffic management during construction and that no open trenches or traffic safety hazards be left in the roadways when construction personnel are not present, repair of roads to their pre-construction status, and a requirement that roadway improvements for project facilities be provided that will eliminate traffic hazards associated with access to the facility in accordance with standard agency requirements or prudent circulation system planning requirements, have been found to mitigate this impact to an insignificant level.

**7. Biological Resources:**

Implementation of the project has the potential to impact biological resources depending on the site(s) selected for project facilities and the amount of site disturbance required to install the project facilities. It is possible, depending on the location of the project facilities and improvements, that the project may impact candidate, sensitive, or special status species and other sensitive natural communities. Since several endangered species occur in the Chino Basin, including the Arroyo Toad, Least Bell's Vireo, Southwestern Willow Flycatcher, Quino Checkerspot Butterfly, San Bernardino Kangaroo Rat, and the Coastal California Gnatcatcher, the possibility that these species will be impacted must be considered. Some individuals of the species may be displaced or succumb due to direct construction impacts or otherwise be impacted due to competition for limited adjacent holding capacities. Several unique plant communities occur within the project area, including chaparral, coastal sage scrub, deciduous woodlands, grasslands and wetlands. In addition, the project area contains the California Sycamore Series, the Arroyo Willow Series and Delhi Sands. Depending upon the siting of project facilities and improvements, these plant communities could be impacted by the project.

*a. Special status species:* Due to the numerous endangered, threatened and special status species found throughout the project area, the mitigation measures set forth below have been adopted. Prior to facility construction or installation, project specific biological resource surveys will be conducted on site when any previously undeveloped area may be disturbed by project implementation. If any sensitive species have the potential to occur on the site where project facilities are proposed, or if previous environmental studies have not been conducted, surveys will be conducted in accordance with all established state, federal and generally accepted biological survey protocols for each potential species that may be located onsite. Further, all mitigation measures recommended by jurisdictional agencies will be implemented. Project facilities will be designed to protect habitat values and to preserve significant, viable habitat areas. Within designated habitat areas of rare, threatened or endangered species, disturbance of protected biotic resources will be prohibited. Impacts and disturbances to individuals and species considered sensitive by jurisdictional agencies will be avoided, whenever feasible. With respect to the continued preservation of the Least Bell's Vireo, an endangered species, the amount of water taken from or added to the Santa Ana River will ensure that the water level is maintained between the 505' and 498' elevation mark. Mitigation measures, including but not limited to those listed above, have been found to mitigate the project's impact on special status species to an insignificant level.

*b. Vegetation communities:* Due to the numerous vegetation communities present throughout the project area and the potential impact the project may have on these communities, the mitigation measures set forth below have been adopted. Conservation or open space easements, granting of development rights, or other similar protections for biological habitats which are to be preserved in their natural state will be required. To maximize habitat protection, primary emphasis will be placed on the preservation of large, unbroken blocks of natural open space and wildlife habitat area as well as protecting the integrity of habitat linkages. Preservation of sensitive habitat areas will be emphasized. Landscaping adjacent to areas containing important biological resources will be designed to avoid invasive species which could negatively impact the value of the preserved resources. The preservation of individual oak, sycamore and walnut trees within proposed

development sites will be maximized. Buffer zones will be required adjacent to areas of preserved biological resources. Mitigation measures, including but not limited to those discussed above, have been found to mitigate the impact on vegetation communities to an insignificant level.

**8. Hazards and Risk of Upset:**

The project may pose certain hazards and risks, ranging from construction activities to operation of facilities such as wells, desalters and other facilities. The project may also require the transportation and handling of hazardous materials. Mitigation measures for this impact include but are not limited to the following:

(i) incorporation of Best Management Practices for all project facilities that handle hazardous materials to reduce the potential for the accidental release of hazardous chemicals;

(ii) for project facilities handling hazardous materials, preparation of a business plan which assesses potential accidental release scenarios and identifies equipment and response capabilities required to provide immediate containment, control and collection of any released material;

(iii) preparation of reports modeling pathways of release and secondary containment for the storage of any acutely hazardous material at a project facility;

(iv) delivery of all contaminated material to a licensed treatment, disposal or recycling facility that has the appropriate systems to manage the contaminated material without significant impact on the environment;

(v) specific contaminant thresholds will be established, and sufficient sampling to ensure attainment of these thresholds will be conducted before determining that an area contaminated by an accidental release is fully remediated,;

(vi) preparation and implementation of a road operation management plan during construction activities within existing road rights-of-way or other easements where continuous access is required;

(vii) to the extent feasible, construction activities in support of the project will not be located in major evacuation or emergency response routes;

(viii) where available, selection of alternative treatment systems that reduce potential health risks at project facilities;

(ix) preparation of reports defining potable water production requirements and aquifer areas to be removed from water production prior to approving specific recycled water recharge facility locations and volumes;

(x) preparation of hydrogeologic studies for each recharge site defining the recharge impacts on existing known contaminated plumes;

(xi) termination or modification of recycled recharge operations if impacts that were not forecast to occur demonstrate that the recharge operations are causing significant adverse impacts on the groundwater aquifer.

Mitigation measures, including but not limited to those discussed above, have been found to mitigate this impact to an insignificant level.

**9. Energy:**

Substantial energy resources will be required to support OBMP projects in the future, particularly desalter facilities and pumps to move poor quality water, recycled water and storm water throughout the Basin. Adequate energy resources were determined to be available, and no mitigation measures were included under this issue discussion. Specific mitigation measures are recommended to further insure that impacts of the project on electrical and natural gas utilities remain insignificant. These measures are summarized below in the utility discussion on each of these energy resource providers.

**10. Noise:**

The project has the potential to generate short- and long-term changes in the noise environment of the project area. The project may also contribute to the cumulative increase in noise that accompanies urban growth and development.

*a. **Short-term noise:*** Construction noise would be generated by any of the project facilities and would include trucks, construction equipment, portable generators and concrete mixers. Since construction noise is of a temporary nature, most jurisdictions do not require such noise to be mitigated to specific threshold levels. Mitigation measures, including but not limited to restricting construction hours to the hours of 7 a.m. to 7 p.m. on Monday through Friday and 9 a.m. to 6 p.m. on Saturday, equipping all construction vehicles with properly operating and maintained mufflers, providing adequate hearing protection for construction employees, and installing portable noise barriers where appropriate, have been found to mitigate the short-term noise impact to an insignificant level.

*b. **Long-term noise:*** Operation of several facilities contemplated under the project could result in noise levels greater than the 60-65 dBA CNEL values that are considered acceptable for noise sensitive uses. Noise generation from the project facilities will come not only from the facilities themselves, but also from traffic to and from the facilities and from equipment used at the facility. Mitigation measures for this impact include:

(i) requiring all production wells and booster pump noise levels attenuated to 50 dBA CNEL at 50 feet from the wellhead;

(ii) including adequate measures in the project design of all facilities so that interior noise levels are consistent with Title 25 (California Noise Insulation Standards);

(iii) requiring all parking for desalter uses adjacent to residential areas be enclosed within a structure or separated by a solid wall with quality landscaping as a visual buffer; and

(iv) requiring that desalters are constructed and operated so that noise levels from operations do not exceed 50 dBA during night hours and 65 dBA averaged over the twelve hours of daytime when located adjacent to existing or future sensitive land uses.

Mitigation measures, including but not limited to those listed above, have been found to mitigate this impact to an insignificant level.

**11. Public Services:**

The implementation of the project could increase the demand for police protection services, specifically with respect to potential trespass upon project facilities. Mitigation measures, including but not limited to the installation of fences or some other form of controlled access to project facilities, have been found to mitigate this impact to an insignificant level.

**12. Utilities:**

The utility issues of concern are increased demand for utility capacity without existing capacity or comparable increases in capacity from implementing the project. The project, as proposed, will not significantly impact utilities in the project area. However, the following mitigation measures are recommended to further insure the insignificance of the project related impacts upon utilities:

*a. Electricity:* The following mitigation measures are recommended to further insure that impacts of the project on electrical utilities are insignificant. Developers in the proposed project area should coordinate with Southern California Edison and other power companies regarding the location and phasing of required on-site electrical facilities. Proposed building construction should comply with Title 24 of the California Administrative Code. On-site electrical lines should be installed underground. Project planners and architects should consult with Southern California Edison regarding current energy conservation techniques. Architectural planning and design, to the extent feasible, should take full advantage of such concepts as natural heating and/or cooling through sun and wind exposure and solar energy collection systems.

*b. Natural Gas:* The following mitigation measures are recommended to further insure that impacts of the project on natural gas utilities are insignificant. The thermal insulation installed in walls and ceilings should meet the standards established by the State of California. Windowless walls for western exposures and sill orientation of buildings to use solar heating systems and efficient heating-cooling systems should be installed whenever feasible. Landscaping should be used to

moderate building heat gain. Use of energy conservation methods that can be readily incorporated into project design.

*c. Wastewater:* The following mitigation measures are recommended to further insure that impacts of the project on wastewater capacity within the project area are insignificant. Wastewater treatment facilities/distribution system improvements and expansion projects should precede or be concurrent with growth generating projects as required to maintain adequate system capacity levels. Future developers should be assessed a sewer capacity and connection fee by the appropriate serving agency. All industrial and commercial users should take on-site measures to reduce the load strength of their sewage.

*d. Solid Waste:* The following mitigation measures are recommended to further insure that impacts of the project on solid waste capacity within the project area are insignificant. All proposed development/redevelopment projects within the proposed project area that will generate solid waste should be reviewed on a project-by-project basis by the permitting jurisdictional agencies in coordination with County landfill officials to determine the degree of impact upon remaining landfill capacity. Projects should be approved only after it is determined that the additional solid waste generated can be disposed of within existing landfill facilities.

*e. Water Supplies:* The following mitigation measures are recommended to further insure that impacts of the project on water supply within the project area are insignificant. All project related development/redevelopment that includes exterior landscape elements should employ xeriscape plant design and water conservation concepts. The xeriscape requirements should include use of drought tolerant species, drip irrigation, soil moisture sensors and automatic irrigation systems. Mulch should be used extensively in all landscaped areas to reduce erosion and evaporation. Lawns should be kept to a minimum and warm-season grasses used.

**13. Cultural Resources.** A large portion of the project area contains sensitive cultural sites. Activities requiring the excavation or movement of soil material at any location within the project area have the potential to adversely effect cultural resources. Cultural resources within the project area include prehistoric food processing sites and campsites, village sites, historic privy pits, barns, foundations and dams. While a large portion of the project area has been surveyed for cultural resources, many potential project area sites have not. Mitigation measures for this impact include but are not limited to the following:

(i) preparation of a basic archeological inventory of any proposed project site and an assessment of the cultural resources present;

(ii) monitoring by an archeological monitor and a Native American observer/consultant in situations where cultural resources are potentially subject to direct or indirect impact and testing or where data recovery is not proposed;

(iii) data recovery when an archeological resource is found to be significant and no other preservation option is available; and

(iv) the siting of future projects outside the highly sensitive cultural resource areas depicted in the Final EIR when feasible.

Mitigation measures, including but not limited to those discussed above, have been found to mitigate the impact on archeological resources to an insignificant level.

In addition to the above-mentioned mitigation measures, the following mitigation measures should be considered by agencies proposing to construct project facilities: conducting a comprehensive historic building survey, adopting a preservation ordinance, ensuring that other planning programs, plans and ordinances are compatible with historic preservation goals, developing a public appreciation of cultural resources program, and redesigning project facilities as appropriate to comply with these measures. While these measures are not necessary to mitigate the project impacts to a level of insignificance, these measures will enhance the protection and preservation of cultural resources throughout the project area.

**14. Aesthetics and Visual Resources:**

Visual resources include natural and human-made features that give a particular environment its aesthetic qualities. These resources include remote and pristine environments, landscapes with unique land forms or vegetation patterns, and water bodies or rock formations with unusual or outstanding qualities. All of the cities within the project area provide protection for aesthetic and visual resources within their respective general plans. The project area includes several important visual and aesthetic resources including, but not limited to, views of the San Gabriel Mountains, numerous scenic routes and highways, and scenic vistas. The construction and implementation of project facilities may adversely impact these resources. Potential impacts include lights and glare from new facilities and vehicles traveling to and from these facilities and blockage of views of and from existing neighborhoods. Mitigation measures for this impact include but are not limited to the following:

(i) revegetation of all surface areas disturbed by project construction;

(ii) conformance with design requirements of jurisdictional agencies when project facilities are proposed adjacent to scenic highways, corridors or other scenic features identified by planning agencies;

(iii) where facilities will disrupt views from occupied areas with significant scenic vistas, performance of a visual simulation analysis. If the analysis identifies a significant aesthetic or visual impact, the proposed facility will be relocated, redesigned to reduce the impact to an insignificant level, or a subsequent environmental evaluation will be prepared;

(iv) adherence to local agency design guidelines for above-ground facilities; and

(v) placement of all utilities underground, unless not technically feasible.

Mitigation measures, including but not limited to those mentioned above, have been determined to mitigate these impacts to an insignificant level.

**This concludes the summary of environmental impacts that are considered nonsignificant or that can be mitigated below a significant level.**

## F. SIGNIFICANT UNAVOIDABLE EFFECTS OF THE PROJECT

The IEUA Board finds that despite the incorporation of extensive changes and alterations into the proposed project, approving and implementing the OBMP will allow one impact to remain unavoidably significant because this impact cannot be mitigated to a nonsignificant level. This unavoidable significant adverse environmental impact is air quality, where emissions associated with electrical consumption will exceed the South Coast Air Quality Management District's thresholds of significant for nitrogen oxides. This impact and the measures identified to minimize it to the extent feasible are summarized below. Thus, the potential for significant effects to occur for this issue would continue to exist regardless of whether or not participating agencies implement the project changes and mitigation measures contained in the PEIR.

The potential impact to the above listed resource and existing background conditions were concluded to be significant based on the whole record which demonstrated that this impact could not be reduced below thresholds of significance by the proposed project changes to the OBMP (alternatives, mitigation measures, or design changes). To the extent that future site specific projects implemented under the OBMP generates the emissions forecast from electricity consumption, approval of the OBMP contributes to the significant impact summarized and described below. Thus, despite the incorporation of changes to the proposed project outlined in the PEIR, and summarized below, the following impact caused by the proposed project cannot be fully mitigated to a level of insignificance and a statement of overriding consideration is thereby included herein.

### 1. Air Quality:

The PEIR for the OBMP discusses air quality impacts at pages 4-270 through 4-295 of the Draft PEIR. Air pollution emissions, specifically nitrogen dioxide emissions, are considered to be adverse, unavoidable, and unable to be fully mitigated to insignificance. Changes or alterations have been incorporated into the project which substantially lessen the significant environmental air quality impact, as set forth below, although these changes and alterations have not reduced the impact to a level of insignificance. To the extent these impacts remain significant and unavoidable, such impacts are acceptable when weighed against the overriding social, economic, legal, technical, and other benefits provided by the project, as stated in the Statement of Overriding Considerations presented below.

The OBMP Final EIR describes air quality impacts associated with operation of project facilities as an unavoidable significant impact. The construction and operation of new wells, desalters and booster pumps required to move poor quality water, recycled water and storm water will exceed the South Coast Air Quality Management District's (SCAQMD) threshold of significance for NOx. Mitigation measures including but not limited to compliance with SCAQMD rules, regulations and

permit conditions have been identified in the OBMP Final PEIR. No other feasible mitigation measures are identified by the OBMP Final PEIR, nor are other feasible mitigation measures known, which could avoid or further lessen this impact.

**This concludes the discussion of all potential significant unavoidable adverse impacts attributable to the implementation of the proposed project.**

## G. ALTERNATIVES TO THE PROPOSED ACTION

The California Environmental Quality Act (CEQA) requires discussion of reasonable project alternatives that could feasibly attain the project's objectives (14 CCR §15126(d)). CEQA requires that an EIR evaluate a reasonable range of alternatives to the project, or to the location of the project that: (1) offers substantial environmental advantages over the proposed project, and (2) may be feasibly accomplished in a successful manner and within a reasonable period of time considering the economic, environmental, legal, social, and technological factors involved.

The basic objectives of the OBMP is to implement a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the basin in a cost-effective manner. To carry out this purpose, the OBMP consists of four primary management goals. Goal number one is to enhance basin water supplies. Goal number two is to protect and enhance water quality. Goal number three is to enhance management of the basin. Goal number four is to equitably finance the OBMP.

The PEIR considered a total of three alternatives to the proposed action. These alternatives were defined based on mandatory requirements and alternatives designed to reduce the identified significant impacts of the project as previously identified. The three alternatives that were subject to evaluation in the PEIR with the proposed action are:

a. No Project/No Implementation of the OBMP
b. Conjunctive Use Alternative
c. SAWPA Alternative

The purpose in analyzing alternatives to a proposed project is to determine if an alternative is capable of eliminating or reducing potential significant adverse environmental effects, "even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly" (State CEQA Guidelines, Section 15126(d)(3)). The following discussion summarizes the PEIR evaluation of each of these alternatives in determining whether they are feasible alternatives to the proposed action (State CEQA Guidelines, Section 15126(d)) and whether an alternative can eliminate or substantially lessen significant impacts described in this document for the proposed action. Each of these alternatives specified below is infeasible or less desirable than the proposed project, and therefore is rejected, for the reasons set forth below.

*a. No Project Alternative:* Under this alternative, the management of the Chino Basin would revert to the water serving agencies. This alternative would result in a violation of the Chino Basin Judgement Ruling of February 19, 1998, which directed the development and implementation of the

Optimum Basin Management Program. In addition, this alternative cannot be considered the environmentally superior alternative to the proposed project from a total environmental standpoint because the environmental damage from implementing the water supply on a case-by-case basis is forecast to be substantially more significant than that arising from implementing the OBMP. In addition, the project goals of safe yield and water quality improvement cannot be insured under the no-project alternative. Therefore, this alternative would not provide an overall environmental benefit, would achieve none of the project objectives, and would forego all project benefits. For these reasons, the no project alternative is infeasible and, therefore, is rejected.

*b. Conjunctive Use Alternative.* This alternative would create a conjunctive use plan for the Chino Basin. Under such a plan, Watermaster would develop a regional conjunctive-use program to store supplemental water. The ability to attain the project goals and objectives would be maintained under this alternative. However, this alternative cannot be considered the environmentally superior alternative. The potential environmental risks of a conjunctive use alternative are much higher than those associated with the proposed project. The Conjunctive Use Alternative would pose an increased threat to local water quality through the mobilization of water quality anomalies, the increased number of recharge sites required, and the likelihood that overall salt balance would be disturbed. Most importantly, the conjunctive use alternative may cause additional water in the aquifer to rise to a sufficient elevation which would encroach into the vadose zone where existing contaminants could further pollute the basin. For these reasons, the conjunctive use alternative is deemed infeasible and less desirable than the proposed project and, therefore, is rejected.

*c. Santa Ana Watershed Project Authority (SAWPA) Alternative.* As with the proposed project, this alternative is watershed based, proposing a regional program to assure a sustainable water supply for the future, while at the same time seeking to enhance the environment. However, this alternative would have comparable impacts to the proposed project and is therefore not a superior environmental alternative. In addition, the SAWPA Alternative includes numerous projects outside the project area, which could slow the implementation of the SAWPA Alternative, whereas the proposed project is focused solely on the Chino Basin area. The SAWPA Alternative also produces a lower level of new groundwater storage than does the proposed project, thereby failing to achieve an important project goal. For these reasons, the SAWPA Alternative is considered infeasible and less desirable than the proposed project and, therefore, is rejected. In comments on the PEIR, SAWPA indicated that its program should not be considered an alternative, but a program to be implemented in conjunction with the OBMP. This was concluded to be a valid comment, but the additional programs in the SAWPA alternative were considered to be an alternative means of achieving goals and objectives similar to the OBMP. They can still be implemented in conjunction with the OBMP, but will not accomplish the full scope of hydrologic control that could be achieved with the OBMP, or the OBMP in conjunction with the SAWPA projects.

Based on the analysis contained in the OBMP PEIR, the OBMP was identified as the environmentally superior alternative, along with the SAWPA alternative which would have comparable environmental impacts.

**This concludes the discussion of alternatives to the proposed project and the Board findings regarding each of the alternatives evaluated for the project in the EIR.**

## H. PROJECT BENEFITS

The benefits from approving the proposed project are related to the enhanced water supply and water quality that will result from the implementation of the OBMP. The project benefits outlined below were considered by the IEUA Board in performing the balancing test with those unavoidable significant adverse impacts presented earlier in this document.

### *1. Benefits of Implementing the Proposed Project*

The four primary (general) benefits that will accrue to the future residents of the Chino Basin from implementation of the OBMP include:

1 - Enhance Basin Water Supplies
2 - Protect and Enhance Water Quality
3 - Enhance Management of the Basin
4 - Equitably Finance the OBMP

Specific benefits that can be achieved under the first general benefit (enhanced water supply) include:

a) Maintenance or increase of groundwater production in the southern portion of the Basin with treatment and service of contaminated groundwater in the southern third of the Basin.
b) Location of new recharge facilities in the upper half of the Basin.
c) Location of new recharge facilities in the lower half of the Basin when recovery of recharged water can be ensured.
d) Development and implementation of a comprehensive basin-wide ground level, groundwater level, quality, and production monitoring program.
e) Development and implementation of a comprehensive plan of stormwater recharge.
f) Development of a comprehensive stormwater flow and quality monitoring program in partnership with other agencies charged with flow and quality monitoring.
g) Development of new stormwater recharge projects at existing and future flood control facilities.
h) Maximization of recharge capacity at existing recharge facilities through improved maintenance.
i) Development of methods to account for losses from storage accounts; and the setting of limits on storage if necessary.
j) Development of a comprehensive ground level, groundwater level, and quality monitoring program in Management Zone 1.
k) Development of an immediate groundwater management program for Management Zone 1, followed by management programs for Management Zones 2, 3, 4, & 5.
l) Creation of new assimilative capacity through the development of offset programs and through other mitigation programs.
m) Maximization of the direct use of recycled water.
n) Development of new sources of supplemental water from the Bunker Hill Basin, the Santa Ana River and other outside Basin sources.

Specific benefits that can be achieved under the second general benefit (enhanced water quality) include:

a) Development and implementation of a comprehensive groundwater quality monitoring program.
b) Coordination with regulatory agencies to share monitoring and other information to detect and define water quality problems.

c) Participation in projects of mutual interest including the RWQCB watershed management efforts within the Chino Basin.
d) Development and implementation of programs to address problems posed by specific contaminants.
e) Exportation of manure, enhanced manure management, or facilitation or support of salt removal efforts.
f) Treatment of dairy sewage and the elimination of discharge to groundwater, or exportation of dairy sewage.
g) Development of programs to pump and treat degraded groundwater and to put the treated water to direct beneficial uses.
h) Development and implementation of a comprehensive stormwater recharge plan.
i) Development of a comprehensive stormwater flow and quality monitoring program in partnership with other agencies charged with flow and quality monitoring.
j) Development of new stormwater recharge projects at existing and future flood control facilities.
k) Maximization of recharge capacity at existing recharge facilities through improved maintenance or operational and/or structural improvements.
l) Periodic assessment of the salt balance of the Basin.
m) Development of new TDS export facilities and/or finding means of using the Non-Reclaimable Wastewater System and the Santa Ana Regional Interceptor with less cost.
n) Establishment of financial incentives to ensure that when existing groundwater is pumped, it is replaced with high quality water to replenish the Basin over time.
o) Increasing the groundwater recharge volume in excess of production to cause an increase in the storage volume without an increase in rising water (discharge from the Basin.
p) Promote public education.

Specific benefits that can be achieved under the third general benefit (enhanced basin management) include:

a) Development of methods to account for losses from storage accounts; setting of limits on storage if necessary.
b) Development and implementation of a comprehensive Basin-wide ground level, groundwater level, water quality, and production monitoring program (Same as with Goal No. 1).
c) Development of new production patterns that optimize yield and beneficial use; and the development of incentive programs and policies that encourage (or rules that enforce) new production patterns.
d) Development of programs to pump and treat degraded groundwater and to put the treated water to direct beneficial uses (Same as with Goal No. 2).
e) Development of conjunctive-use policies and programs that take into account water quantity and quality.

Specific benefits that can be achieved under the fourth general benefit (equitable financing) include:

a) Identification of an equitable approach to spread the cost of OBMP implementation either on a per acre-foot basis or by some other equitable means.
b) Identification of ways to recover value from utilizing Basin assets including storage and rising water leaving the Basin.
c) Evaluation of the project and management components and a ranking of the components with equal consideration given to water quantity, water quality and cost and based on their ability to meet the goals of the OBMP.

## I. OVERRIDING CONSIDERATIONS

This section of the findings addresses the requirements in Section 15093 of the California Environmental Quality Act Guidelines. Section 15093 requires the Lead Agency to balance the benefits of a proposed project against its unavoidable significant adverse impacts, and to determine whether the project related significant impacts can be acceptably overridden by the project benefits

when the two are compared and balanced. As outlined in Section F above, the proposed project is forecast to contribute to cumulative, unavoidable significant adverse environmental impacts in one environmental category: air quality.

The IEUA Board finds that the previously stated benefits of the proposed project, contained in the proposed action and as will be implemented by IEUA and the participating agencies through implementation of the OBMP outweigh the cumulative, unavoidable significant adverse environmental effect to air quality that has been outlined above. In a region where water resources are limited and poor water quality makes access to good quality water more difficult, the Board concludes that these benefits outweigh the indirect cumulative effects to the region's air quality.

The Board's findings set forth in the preceding sections have identified all of the adverse environmental impacts and the feasible mitigation measures which can reduce impacts to insignificant levels where feasible, or to the lowest achievable levels where significant unavoidable impacts remain. The findings have also analyzed three alternatives to determine whether they are reasonable or feasible alternatives to the proposed action or whether these alternatives might reduce or eliminate the two significant impacts of the proposed action.

The Final OBMP PEIR presents evidence that implementing the proposed project will contribute to significant adverse impact which cannot be substantially mitigated to insignificant levels. This significant impact has been outlined above and the Board finds that all feasible alternatives and mitigation measures have been adopted or identified for implementation by IEUA and other agencies (specifically the participating agencies of the Chino Basin Watermaster). The IEUA does have responsibility for implementing many of the mitigation measures contained in the PEIR or discussed in this document when it directly carries out specific future projects under the OBMP. Other participating agencies will serve as CEQA Responsible Agencies for their own projects and will be required to implement mitigation measures outlined in the Final OBMP PEIR, as is appropriate for the specific project being considered by the agency under the OBMP umbrella (program).

The Board finds that the project's benefits are substantial as outlined in Section H of this document and summarized above and that these benefits justify overriding the unavoidable significant adverse impacts associated with the proposed project. This finding is supported by the fact that many of the benefits listed above result in the project fulfilling an important role for IEUA and the Watermaster participating agencies by allowing these agencies to implement their urban water master plans and meet essential water supply requirements of their customers. The Board further finds that the benefits outlined above, when balanced against the unavoidable significant adverse environmental impacts, outweigh the impacts because of the environmental, social and economic values which accrue to IEUA, the Chino Basin Watermaster and the participating agencies as outlined in Section H of this document.

As the CEQA Lead Agency for the proposed action, the Board has independently reviewed the applicable sections of this document and the OBMP PEIR, and fully understands the scope of proposed project. Further, the Board finds that all potential adverse environmental impacts and all feasible mitigation measures to reduce these impacts have been identified in the PEIR, public comment, and public testimony. These impacts and mitigation measures are discussed in Sections

E.1 and F and the Board concurs with the facts and findings contained in those sections. The Board also finds that a reasonable range of alternatives was considered in the PEIR, as summarized in Section G of this document and that no feasible alternatives which substantially lessen project impacts are available for adoption.

The Board concurs with the extensive environmental, economic and social benefits identified above which will accrue to the IEUA, Chino Basin Watermaster, participating agencies and the customers that are served essential water resources from implementing the proposed project. The Board has balanced these substantial social and economic benefits against the unavoidable significant adverse effect of the proposed project. Given the substantial social and economic benefits that will accrue to the Chino Basin from implementing the proposed project, the IEUA Board hereby finds that these benefits identified herein, collectively and individually, outweigh the unavoidable significant adverse air quality impact, and hereby override this unavoidable environmental effects to obtain the social and economic benefits listed in Section H.

# *FINAL*
# PROGRAM ENVIRONMENTAL IMPACT REPORT

# FOR THE

# OPTIMUM BASIN MANAGEMENT PROGRAM

# VOLUME I

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July 2000

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AAQS | Ambient Air Quality Standards |
| acre-ft/yr | acre-feet per year |
| afy | acre-feet per year |
| ADT | Average Daily Traffic |
| APCD | Air Pollutation Control District |
| AQAP | Air Quality Attainment Plan |
| AQMD | Air Quality Management District |
| ARB | Air Resource Board |
| BACT | Best Available Control Technology |
| BLM | U.S. Bureau of Land Management |
| BMP | Best Management Practice |
| BNSF | Burlington Northern Santa Fe Railway |
| CAA | Clean Air Act |
| CAAQS | California Ambient Air Quality Standards |
| CAL-EPA | California Environmental Protection Agency |
| Caltrans | California Department of Transportation |
| CARB | California Air Resource Board |
| CCAA | California Clean Air Act |
| CCR | California Code of Regulations |
| CCWD | Cucamonga County Water District |
| CDFG | California Department of Fish and Game |
| CESA | California Endangered Species Act |
| CEQA | California Environmental Quality Act |
| cfs | cubic feet per second |
| CHP | California Highway Patrol |
| CIM | California Institute for Men |
| CIP | Capital Improvement Program |
| CMP | Congestion Management Plan |
| CNEL | Community Noise Equivalent Level |
| CNPS | California Native Plant Society |
| COE | U.S. Army Corps of Engineers |
| CTP | Comprehensive Transportation Plan |

# ABBREVIATIONS AND ACRONYMS (continued)

| | |
|---|---|
| dB | decibels |
| dBA | A-weighted decibels |
| DHS | California Department of Health Services |
| DOF | Department of Finance |
| DOT | Department of Transportation |
| DTSC | Department of Toxics and Substance Control |
| DWR | Department of Water Resources |
| EDU | equivalent dwelling unit |
| EIR | environmental impact report |
| EMP | Evaluation Monitoring Program |
| EPA | U.S. Environmental Protection Agency |
| g | gravity |
| gpd | gallons per day |
| gpm | gallons per minute |
| HAP | hazardous air pollutants |
| HOV | high occupancy vehicle |
| IEUA | Inland Empire Utilities Agency |
| JCSD | Jurupa Community Services District |
| JPA | Joint Powers Authority |
| kWh | killowatt hour |
| LACSD | Los Angeles County Sanitation District |
| Leq | Equivalent Noise Levels |
| LF | lineal feet |
| Ldn | Day-Night Noise Levels |
| LOS | Level of Service |
| MAF | million acre-feet |
| MG | million gallons |
| MGD | million gallons per day |
| mg/L | milligrams per liter |
| mph | miles per hour |
| MSDS | Material Safety Data Sheets |
| MSL | Milliken Sanitary Landfill |

# ABBREVIATIONS AND ACRONYMS (continued)

| | |
|---|---|
| NAAQS | National Ambient Air Quality Standards |
| NDDB | Natural Diversity Data Base |
| NESHAPs | National Emission Standards for Hazardous Air Pollutants |
| NIH | National Institute of Health |
| NOP | Notice of Preparation |
| NPDES | National Pollution Discharge Elimination System |
| NPS | National Priorities Lis |
| NRC | Nuclear Regulatory Commission |
| OBMP | Optimum Basin Management Program |
| OCWD | Orange County Water District |
| OSHA | Occupational Safety and Health Act |
| PEIR | Program Environmental Impact Report |
| RCPG | Regional Comprehensive Plan and Guide |
| RFD | reference dose |
| RMP | Regional Mobility Plan |
| ROC | Reactive Organic Compound |
| ROG | Reactive Organic Gas |
| RO | reverse osmosis |
| RO/IX | reverse osmosis/ion exchange |
| RTP | Regional Transportation Plan |
| RWMP | Regional Water Master Plan |
| RWQCB | Regional Water Quality Control Board, Santa Ana Region |
| SANBAG | San Bernardino Associated Governments |
| SBCFCD | San Bernardino County Flood Control District |
| SCAB | South Coast Air Basin |
| SCAG | Southern California Associated Government |
| SCAQMD | South Coast Air Quality Management District |
| SCE | Southern California Edison |
| SCGC | Southern California Gas Company |
| SCS | Soil Conservation Services |
| SIP | State Implementation Plan |
| SMARA | Surface Mining and Reclamation Act |

# ABBREVIATIONS AND ACRONYMS (continued)

| | |
|---|---|
| SR | State Route |
| SWP | State Water Project |
| TAC | toxic air contaminants |
| T-BACT | Best Available Control Technology for Toxics |
| TCE | trichloroethylene |
| TDA | Tom Dodson & Associates |
| TDS | Total Dissolved Solids |
| TIN | Total Inorganic Nitrogen |
| tpy | tons of pollutants per year |
| UBC | Uniform Building Code |
| UFC | Uniform Fire Code |
| UP | Union Pacific Railroad |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USL | Upland Sanitary Landfill |
| VMT | vehicle miles traveled |
| VOC | Volatile Organic Compound |
| WRCOG | Western Riverside Council of Governments |
| WRP | Water Reclamation Plant |
| WSA | water serving agencies |

# CHAPTER 1
# EXECUTIVE SUMMARY

## 1.1 INTRODUCTION

The Optimum Basin Management Program (OBMP) encompasses the Chino Groundwater Basin (the Basin), located in southern California. The Basin is located primarily in San Bernardino County, with a lesser proportion of the project area overlying Riverside County and a very small section located in eastern Los Angeles County. The project area consists of an alluvial valley that is relatively flat from east to west and slopes from north to south at a one to two percent grade. Valley elevation ranges from about 2,000 feet in the foothills below the San Gabriel Mountains to about 500 feet near Prado Dam. The principal drainage course for the Basin is the Santa Ana River. While still considered to be a single basin, the Chino Groundwater Basin has been divided into five management zones, based upon similar hydrologic conditions, and into three subbasins, as defined in the 1995 Water Quality Control Plan for the Santa Ana Watershed (Region 8).

The Basin is one of the largest groundwater basins in southern California, containing about 5,000,000 acre-feet of water in storage, with an additional, unused storage capacity of about 1,000,000 acre-feet. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies from the Basin. The average safe-yield of the Basin is approximately 140,000 acre-feet. An additional 300 to 400 agricultural users also produce groundwater from the Basin.

To manage the Basin for the long-term benefit of all producers in the area, an Optimum Basin Management Program has been developed pursuant to a Judgement entered in the Superior Court of the State of California on February 19, 1998. The overseeing body for guidance in the development and implementation of the OBMP is the Chino Basin Watermaster (Watermaster). This body was effectively established on July 1, 1977. The Inland Empire Utilities Agency (IEUA or the Agency) has agreed to serve as the California Environmental Quality Act (CEQA) Lead Agency for the preparation and administration of the Program Environmental Impact Report (PEIR).

In order to administer water-usage for the long-term beneficial use of all component members of Watermaster, an OBMP consisting of two phases has been developed. Phase I of the OBMP consists of defining the state of the Chino Groundwater Basin, establishing goals concerning major issues identified by stakeholders, and affirming a management plan for the achievement of said goals. Phase 2 of the OBMP is intended to be the physical implementation plan for the installation and operation of OBMP facilities. The major OBMP facilities consist of monitoring wells, extensometers, pipelines, desalters, possibly an ion exchange facility, recharge basins (both existing and new), pump stations, production wells and production monitoring devices.

The aforementioned facilities are examples of the necessary types of physical structures that will be implemented to achieve the project objectives that are outlined in the form of nine Program Elements. This list of Program Elements comprises the ultimate focus of Watermaster's future actions, agendas, and policies. The elements are as follows:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program
- Program Element 9 – Develop and Implement Conjunctive-Use Programs

It is the implementation of the listed program elements where the potential occurs for the OBMP to cause physical changes in the environment and to produce potential adverse impacts to the environment. The purpose of this PEIR is to evaluate potentially significant adverse environmental impacts from implementing all of the OBMP facilities required to support the program, and to provide means for the minimization of adverse impacts to both the natural and manmade environment.

## 1.2 SUMMARY OF ENVIRONMENTAL ANALYSIS

Because the proposed project encompasses variety of potentially similar facility types for implementation, a decision was made to prepare a PEIR. The procedures for program EIRs are outlined in Section 15168 of the State CEQA Guidelines. In accordance with these procedures, IEUA chose to prepare and circulate a Notice of Preparation which determined that all standard issues contained in the CEQA Environmental Checklist Form would be examined in the PEIR prepared for the OBMP.

A copy of the Notice of Preparation for the proposed project is provided in this document as Appendix 8.1 of Chapter 8 of this PEIR. The following issues were evaluated in the PEIR and a determination was made that less than significant impacts would occur to the natural resources and man-made systems if the project is implemented as described in the Chapter 3, Project Description of this PEIR, and if adverse environmental impacts are mitigated to a less than significant level as provided in Table 1.2-1. The only environmental issue with impacts identified to be potentially significant and unavoidable was air quality. The issues where less than significant impact are forecast to occur after mitigation include:

| | | |
|---|---|---|
| Land Use/Planning | Transportation and Circulation | Public Services |
| Population and Housing | Biological Resources | Utilities |
| Geologic Resources/Constraints | Energy | Cultural Resources |
| Water Resources/Water Quality | Hazards and Risk of Upset | Aesthetics and Visual Resources |
| Air Quality | Noise | |

Please refer to discussions in Chapter 4 of this PEIR for a detailed discussion of these issues and the substantive basis for concluding that implementation of the proposed project will or will not cause any significant adverse impacts that cannot be mitigated to a less than significant level.

A summary of the environmental findings and mitigation measures in this Environmental Impact Report is contained in Table 1.2-1 which begins on the following page. The summary shows that the proposed project cause few significant unavoidable adverse environmental impacts if implemented as described in the this document. Most environmental impacts caused by the project are non-significant without any mitigation. A few of the impacts described in the following table and the analysis in Chapter 4 are required to be mitigated to less than significant levels with implementation of recommended mitigation measures.

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
|---|---|---|---|
| Land Use | Cause significant conflict with the General Plan or zone designations;<br>a significant conflicts with applicable environmental plans or policies adopted by agencies with jurisdiction over the project; and/or incompatibilities with existing land use in the vicinity.<br><br>Affect agricultural resources or operations (e.g. impacts to soils or farmlands, or impacts from incompatible land uses).<br><br>Disrupt or divide the physical arrangement of an established community (including a low-income or minority community).<br><br>Cause significant displacement or loss of acreage that could be used for development; and/or cause or contribute to significant growth inducement.<br><br>Cumulative Impacts | Following selection of alternative sites for construction of future desalters, each site shall be evaluated for potential incompatibility with adjacent existing or proposed land uses. Where desalter operations can create significant incompatibilities (lighting, noise, use of hazardous materials, traffic, etc.) with adjacent uses, an alternative site shall be selected, or a technical report shall be prepared that identifies the specific measures that will be utilized to reduce potential incompatible activities or effects to below thresholds established in the general plan for the jurisdiction where the facility will be located.<br><br>Where future OBMP facilities are proposed on locations that support agricultural operations on important farmlands, alternative sites shall be selected that do not occupy such acreage (unless agricultural operations have already been terminated).<br><br>Prior to implementing each proposed water facility, the land use compatibility of the proposed facility with both existing and future potential adjacent uses will be evaluated for consistency relative to general plan goals. This evaluation will examine the specific activities associated with the proposed facilities and determine whether specific incompatibilities, such as noise, fugitive dust, hazards or risk, or aesthetics would conflict with adjacent uses. Measures identified in the Subchapter of the OBMP PEIR will be used to mitigate potential incompatibilities where they are identified, or alternative locations will be selected.<br><br>See above mitigations. | Less than significant impact<br><br>Less than significant impact |
| Population and Housing | Substantially increase the Chino Basin population above that identified in regional population forecasts and planned for in the local jurisdiction general plans; increase the demand for housing above the regional population forecasts. | If future facilities must be located on parcels occupied by existing housing, the proponent of the facility will ensure that short- and long-term housing of comparable quality and value are made available to the home owner(s) prior to initiating construction of the facility. | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | Displace a substantial amount of housing, especially affordable housing.<br><br>Have a potential to induce substantial growth in an area either directly or indirectly (e.g. through projects in an undeveloped area or extension of major infrastructure). | | |
| Geologic Resources / Constraints | Subject to fault rupture<br><br>Subject to seismic groundshaking.<br><br>Subject to seismic ground failure, including liquefaction.<br><br>Subject to seiche, tsunami, or volcanic hazards.<br><br>Subject to landslide or mudflow hazards.<br><br>Subject to erosion or unstable soil conditions from grading activities, or cause significant changes in topography<br><br>Subject to subsidence hazards.<br><br>Subject to expansive soil hazards.<br><br>Contain any unique geologic or physical features. | <u>Soils</u><br><br>Add protective covering of mulch, straw or synthetic material (erosion control blankets, tacking will be required).<br><br>Limit the amount of area disturbed and the length of time slopes and barren ground are left exposed. After pipeline installation, soil will be compacted to a level similar to pre-construction conditions.<br><br>Construct diversion dikes and interceptor ditches to divert water away from construction areas.<br><br>Install slope drains (conduits) and/or water-velocity-control devices to reduce concentrated high-velocity streams from developing.<br><br>Construction of facilities and structures areas with high liquefaction potential will be limited without further geologic and hazard-related studies conducted by a qualified geologist or geotechnical firm. Such studies will provide guidelines to minimize the risks to humans and to capital-intensive facilities.<br><br>If a conjunctive use program might be implemented that would bring water levels up to a level that significantly increases the risk of liquefaction, a more detailed monitoring and geologic study focused on this issue will be conducted to determine whether or not liquefaction poses a hazard to surface structures and to human safety. If such a study finds the impacts to be significant, the volume of water permitted to be stored in the basin will be decreased sufficiently until a water level is achieved that does not pose any significant hazard to surface structures or people. | Less than significant impact |
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| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| Geologic Resources / Constraints (continued) | | Geology<br><br>Mitigate the risks from geological hazards through a combination of engineering construction, land use and development standards.<br><br>Require each site within identified Liquefaction Hazard Zones to be evaluated by a licensed engineer prior to design or land disturbance/construction.<br><br>Apply appropriate design and construction criteria to all structures subject to significant seismic shaking.<br><br>Prohibit critical, essential, and high risk land uses near earthquake special studies areas shown on the Hazard Overlay Maps developed by the County of San Bernardino and Riverside.<br><br>Require stability analysis for Landslide Hazard areas designated "Generally Susceptible" and "Mostly Susceptible" on the Hazards Overlay Maps.<br><br>Institute restrictions on construction in high landslide potential and steep-slope areas to ensure safe development.<br><br>Continue to identify and study subsidence hazards and susceptible areas, and propose mitigation technology that is appropriate to the findings of the monitoring study. The implementation of OBMP facilities will *not* in any way contribute to subsidence conditions in *pre-existing subsidence zones* (as shown in Figure 4.4-16). The OBMP will not cause or contribute to any new, significant subsidence impacts greater than a total of six inches in magnitude over the planning period. Impacts less than 6 inches in new areas are considered to be less than significant. | Less than significant impact |
| Geologic Resources / Constraints (continued) | | If modeling and/or additional studies conducted for the expanded OBMP SAWPA desalter wellfield demonstrates that such pumping will contribute to subsidence in the existing subsidence area, then a potentially significant impact can occur, and a subsequent environmental document will be prepared. No OBMP activities allowed under this document will be permitted to cause or contribute to the subsidence within the pre-existing subsidence area defined in the OBMP Phase I | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | Report and Figure 4.4-16.*<br><br>To ensure that pumping impacts in the vicinity of the desalter well field do not have an adverse impact on water levels and subsidence issues, the follow performance standards will be used to evaluate the desalters:<br><br>a. Water level declines in areas surrounding the desalter pumping locations will not be allowed to decline to the extent that pumping capabilities for surrounding wells are impacted. If surrounding wells and producers are impacted by declines in water levels, alternative access to equivalent quantity and quality of water will be provided to affected surrounding parties. This water may be provided through distribution of funding to affected parties for the deepening of existing wells, or may be provided through the delivery (paid for by the implementing agency) of comparable or improved quality and quantity of water from other sources.<br><br>b. If desalter well fields are demonstrated to cause or exacerbate impacts to subsidence areas measurable by a decline of over six inches in ground level at a 1/4 mile radius, or at the radius of the nearest non-OBMP-participating structure, then pumping patterns for the desalters will be modified to reduce impacts to cause no more than six inches of decline in ground level at the smallest of the two radii. | |
| Geologic Resources / Constraints (continued) | | c. If an engineering study is prepared prior to installing a well or well field by a qualified geologist and hydrologist and demonstrates that subsidence greater than six inches can be permitted without causing significant subsidence hazards, then the investigation will define the new threshold for the specific location and it will be observed as the alternative threshold of significant subsidence.<br><br>Require site-specific geotechnical investigations of proposed development to include an assessment of potential impacts and mitigation measures related to expansive and reactive soils and liquefaction. Under the OBMP, Watermaster will continue to monitor the areas with potential liquefaction hazards and will work with local jurisdictions to ensure that any future structures are constructed with | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | the appropriate foundations to address increased liquefaction potentials apropos to the specific area. This mitigation measure will reduce impacts to a less than significant level.<br><br>Apply provisions of hillside erosion and sediment control that reduce volume and velocity of flows and content of sediment to levels that do not cause significant rill or gully erosion in susceptible areas. In addition, provide for restoration of areas that do become eroded.<br><br>Prevent unnatural erosion in erosion-susceptible areas by tailoring grading, land clearance, and grazing, and by prohibiting use of off-road vehicles.<br><br><u>Seismicity</u><br><br>When determined necessary by the affected jurisdictions, geotechnical and soils engineering reports will be prepared in conjunction with the preparation of preliminary design layouts and grading plans for all new development projects implemented within the proposed Project Area. These studies will verify the presence or absence of hazardous soil conditions. If necessary, these reports will provide specific mitigation measures for the treatment of *potential* geologic and soils hazards. | |
| Geologic Resources / Constraints (continued) | | Comprehensive geotechnical investigation will be required prior to engineering and design development or structural and/or substantial rehabilitation of structures identified under Risk Class I & II, e.g., public facilities, as identified below:<br><br>*Risk Class I & II, Structures Critically Needed after Disaster:* Structures which are critically needed after a disaster include important utility centers, fire stations, police stations, emergency communication facilities, hospitals, and critical transportation elements such as bridges and overpasses and smaller dams.<br><br>Acceptable Damage: Minor non-structural; facility should remain operational and safe, or be suitable for quick restoration of service.<br><br>*Risk Class III:* High occupancy structures; uses are required after disasters, i.e., places of assembly such as schools and churches. | Less than significant impact |

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| | | Acceptable Damage: Some impairment of function acceptable; structure needs to remain operational.<br><br>*Risk Class IV, Ordinary Risk Tolerance:* The vast majority of structures in urban areas; most commercial and industrial buildings, small hotels and apartment buildings, and single family residences.<br><br>Acceptable Damage: An "ordinary" degree of risk should be acceptable. The criteria envisioned by the Structural Engineers Association of California provide the best definition of the "ordinary" level of acceptable risk. These criteria require that buildings be able to:<br><br>a. Resist minor earthquakes without damage;<br><br>b. Resist moderate earthquakes without structural damage, but with some non-structural damage; or | |
| Geologic Resources / Constraints (continued) | | c. Resist major earthquakes, of the intensity or severity of the strongest experienced in California, without collapse, but with some structural, as well as non-structural damage.<br><br>*Risk Class V, Moderate to High Risk Tolerance:* Open space uses, such as farms, ranches and parks without high occupancy structures; warehouses with low intensity employment; and the storing of non-hazardous materials.<br><br>Acceptable Damage: Not applicable.<br><br>All structures previously identified in categories III through V will be designed in accordance with the applicable multiplier factor seismic design provisions of the Seismic Safety Report to promote safety in the event of an earthquake.<br><br>The direct impacts of faults upon proposed projects will be considered during preliminary planning processes, and the engineering design phases.<br><br>All rehabilitation and new development projects implemented as a | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | result of the proposed Project will be built in accordance with current and applicable Uniform Building Code (UBC) standards and all other applicable City, County, State and Federal laws, regulations and guidelines, which may limit construction and site preparation activities such as grading, and will make provisions for appropriate land use restrictions, as deemed necessary, to protect residents and others from potential environmental safety hazards, either seismically induced or those resulting from other conditions such as inadequate soil conditions, which may exist in the proposed Project Area.<br><br>Local grading and building codes should reflect measures to minimize possible seismic damage. | |
| Geologic Resources / Constraints (continued) | | <u>Optional</u><br><br>Utilize geologic and seismic data in land planning so that identified risk areas, if any, are avoided, or structures and landforms treated and designed to reflect local site conditions.<br><br>Inspect older facilities and improve earthquake design features when possible.<br><br>Maintain a disaster preparedness plan. | Less than significant impact |
| Water Resources / Water Quality | Cause changes in absorption rates, drainage patterns or the rate and amount of surface runoff.<br><br>Cause the exposure of people or property to water-related hazards, such as flooding.<br><br>Discharge pollutants into surface waters or cause alterations to surface water quality. | To minimize potential ground disturbances associated with installation and maintenance of proposed monitoring equipment on existing wells, the equipment will be installed within or along existing disturbed easements or right-of-way or otherwise disturbed areas, including access roads and pipeline or existing utility easements.<br><br>The Watermaster or other agencies implementing recharge programs will confer with the San Bernardino County Department of Transportation and Flood Control and for each flood control basin that is proposed to be utilized for recharging water to the Chino Basin, to define the amount of water that can be set aside as a conservation pool within existing flood control basins and specific operational parameters (such as time and volume of water that can be diverted into each basin). This will ensure that recharge activities do not conflict with flood control operations at any flood control basins. Variable pooling and | Less than significant impact |

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| | | recharge schedules that are coordinated with storm forecasting to halt deliveries during storm events will ensure that flood-related hazards remain less than significant. | |
| Water Resources / Water Quality (continued) | Change the amount of surface water in any water body.<br><br>Cause change in currents, or the course or direction of surface water movements.<br><br>Cause the change in the quantity of groundwater, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations, or through substantial loss of groundwater recharge capability.<br><br>Alter the direction or rate of flow of groundwater.<br><br>Have an impact on groundwater quality. | Within each desalter site, surface runoff will be collected and retained (for use onsite) or detained, and treated when released by passing the runoff through a "first-flush" treatment system, which may include onsite riparian area, detention basin with filtration system at the outlet, or other system that removes the majority of urban storm runoff pollutants, such as petroleum products and sediment. The purpose of this measure is to remove the onsite contribution to cumulative urban storm runoff and ensure the discharge from the desalter sites is treated to reduce contributions of urban pollutants to downstream flows.<br><br>In compiling local and *in lieu* groundwater storage balances, the Watermaster will include the estimated amount of water lost from the Basin due to rising water at the low end of the Basin and adjust storage salt balance accounts accordingly.<br><br>For each OBMP construction site, regardless of size, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented. Each plan will identify the best management practices (BMPs) that will be used for that site to minimize the potential for accidental releases of any chemicals or materials on the site that could degrade water quality, including solid waste and require that any spills be clean-up, contaminated material properly disposed of and the site returned to pre-discharge condition, or in full compliance with regulatory limits for the discharged material. The portion of the SWPPP that addresses erosion and related sediment discharge will specify the percentage of pollutant removal, as illustrated in the attached Figure 4.5-56 which was abstracted from Supplement A to the "Riverside County Drainage Area Management Plans, Attachment" publication. At a minimum BMPs will achieve 60 percent removal of sediment and other pollutants from disturbed sites. | Less than significant impact |
| Water Resources / Water Quality (continued) | | For long-term mitigation of site disturbances at OBMP facility locations, all areas not covered by structures will be covered with hardscape (concrete, asphalt, gravel, etc.), native vegetation and/or man-made landscape areas (for example, grass). Revegetated or | Less than significant impact |

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| | | landscaped areas will provide sufficient cover to ensure that, after a two year period, erosion will not occur from concentrated flows (rills, gully, etc.) and sediment transport will be minimal as part of sheet flows. These measures and requirements will be applied to closure of abandoned well site disturbed areas.<br><br>Prior to cleaning out, refurbishing or capping a well, samples will be obtained and chemically analyzed to ensure that the discharge does not contain any contaminants exceeding regulatory thresholds. If contaminants are discovered, then they will be removed or lowered below the regulatory threshold prior to discharge to the environment. Discharge of non-stormwater into storm drains will require a NPDES permit.<br><br>Recycled water will not be discharged to streams that are transporting storm flows for subsequent groundwater recharge (except as authorized by existing discharge permits issued by the Regional Board), unless mitigation as identified in mitigation measure 4.5-12 is provided. If the storm water component of the combined flow is a part of the total sub-basin assimilative capacity, which is fully allocated, then mitigation pursuant to mitigation measure 4.5-12 for recharge of the recycled water will be the same as if the recycled water had been directly recharged. However, if the assimilative capacity of the storm water has not been allocated, then mitigation will be based on the quality of the of the commingled storm flow and recycled wastewater.*<br><br>OBMP participants do not have responsibility and control over the SARI line, but they do interact with the agencies that would respond to an accidental release from the SARI line (or the Los Angeles County Nonreclaimable Wastewater Line). OBMP participants will provide support, as required or appropriate, and assist with control of and restoration of the environment damaged by an accidental release from the line. | |
| Water Resources / Water Quality (continued) | | Prior to authorizing contracts for drilling monitoring or production wells under OBMP auspices, the entity funding the well drilling effort will require the well driller to identify all chemicals that will be used at the drilling site and require the submittal of a SWPPP for review and approval before allowing the drilling to commence. A performance bond will be provided by the driller to ensure that any residual contamination from well drilling can be corrected. Further, the | Less than significant impact |

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| | | implementing agency will construct wells in a manner that will reduce the risk of movement of groundwater between zones of different quality , as required under California well standards.*<br><br>When closing abandoned wells in the Chino Basin the entity closing the well will, where technically feasible determine whether the groundwater in the well is contaminated. This will be accomplished by sampling and analyzing the well water. If contamination is identified, the entity will report the discovery to the appropriate parties, including the owner (if known) and the regulatory agencies. The Watermaster will monitor the status of the well until residual contamination is remediated.<br><br>When recharge of State Project Water (SPW) or recycled water with TDS greater than the background groundwater TDS or the Basin Plan water quality objective is utilized at a recharge site, the entity conducting the recharge will conduct additional analysis including modeling to identify the volume and rate of recharge that can be conducted without causing the Basin Plan water quality objective for TDS to be exceeded. In addition, the amount of additional salt added to the Basin above the background groundwater quality condition will be calculated and the greater of the two amounts will be offset, either by blending with lower TDS water (storm water) provided that the assimilative capacity of the sotrm water has not already been allocated as more thoroughly described in mitigation measure 4.5-8. The program could utilize SWP water for recharge when such water is available and when such water is better in quality than recycled water (i.e. lowest TDS). Under no circumstance will discharge of SPW or recycled water cause or contribute to a | |
| Water Resources / Water Quality (continued) | | cumulative violation of Basin Plan water quality objectives or interfere with a designated beneficial use for a water or groundwater body.*<br><br>When recharge of recycled water is proposed for a specific location, the entity proposing such recycling will provide the following data to DHS: the area encompassed by the minimum six months detention period before use and the area encompassed by the long-term equilibrium concentration of 20 percent recycled water within the aquifer. Based on these area estimates, the entity will determine whether any existing WSA production wells or water supply aquifers will be impacted by these pumping constrained areas. If impacts will affect existing wells | Less than significant impact |

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| | | or water supply aquifers, the entity proposing to discharge recycled water will fund the provision of a comparable quality and quantity of potable water to the WSA [this can be done through installing new wells, direct water deliveries (for example from desalters), etc.].*<br><br>When recharge of recycled water with TIN greater than the background groundwater TIN or the Basin Plan objective at a recharge site is utilized, the entity conducting the recharge will conduct modeling and/or additional studies to identify the volume and rate of recharge that can be conducted without causing the Basin Plan water quality objective for TIN to be exceeded. Under no circumstance will discharge of SPW or recycled water cause or contribute to a cumulative violation of Basin Plan water quality objectives or interfere with a designated beneficial use for a water or groundwater body.*<br><br>When recharge of water is proposed within the vicinity of an existing or known groundwater quality anomaly (contaminated groundwater plume), modeling and/or additional studies will be conducted to determine whether recharge of the recycled water will increase the local hydraulic gradient and cause more rapid spread of the existing plume. If existing domestic water production wells will be impacted by the plume a minimum of one year earlier than under pre-existing conditions, or if significant quantities of additional groundwater (more than 5,000 acre-feet) will become contaminated within a five year period due | |
| Water Resources / Water Quality (continued) | | to the recharge of water, an alternative location for recharge will be selected to avoid not only the loss of the recharged water due to contamination, but also additional high quality groundwater due to more rapid expansion of the contaminated plume.<br><br>Whenever possible and feasible, OBMP projects that are highly capital intensive, or that employ workers who are onsite for more than just maintenance activities, will consider Figure 4.5-47 when siting specific project locations for OBMP facilities. Areas defined on this map that potentially may be affected by flood-hazards will be avoided, unless conjunctive use and flood-control operations demand that facilities must be located within these areas. If facilities are constructed in a flood zone, the facility will be brought to a level above flood hazards, or hardened against flood related impacts. Additionally, if facilities | Less than significant impact |

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| | | must be located within flood plains or hazard areas, a flood management program to minimize impacts to people and surrounding property will be created and implemented for each facility that may occur within these hazard areas.<br><br>Prior to implementation of any recharge projects as either existing or new basins, a management plan will be established to the satisfaction of SBCFCD. This plan will be created specifically for each individual basin to ensure the safety of surrounding property and people from undue risks associated with water-related hazards (i.e. flooding). The management plan will firmly establish a priority of flood-control functions over and above recharge-related operations. Weather forecasts of upcoming storm events will be carefully monitored and in the event of a significant forecasted storm-event, recharge deliveries the basins will be ceased until further notice is received from SBCFCD that it is safe for deliveries to resume. Additionally, no more than three days' percolative capacity of water will be allowed to sit in a basin at a time if such basin is also used for flood control activities. Additionally, each SBCFCD basin will have a specific management plan developed, so as to coordinate flood control with recharge. This mitigation measure will ensure | |
| Water Resources / Water Quality (continued) | | that people and property are not subject to additional risk associated with water-related hazards in the Basin, and will allow SBCFCD to make full utilization of the basin's flood control capacity in the event of a storm.<br><br>In order to offset salt additions above the objective for the appropriate Subbasin defined in the Basin Plan, desalters will be constructed. Recharge of water with TDS concentrations above the Basin Plan objectives will not occur until it can be adequately demonstrated that the users of pumped groundwater which are adversely affected by such recharge will be appropriately compensated or will receive sufficient amounts of high quality water to offset the adverse effects of the high TDS pumped groundwater at an overall cost no greater than that which would have been incurred by the adversely affected producers in the absence of the recharge. Desalters may be the source of higher quality water needed for mitigation. If water with TDS in excess of water quality objectives is recharged in such close proximity to the desalter extraction wells that other producers are unaffected, then mitigation | Less than significant impact |

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| | | will be accomplished when it is demonstrated that the salt leaving the basin, as a result of the OBMP desalter capacity that has been allocated to mitigate the TDS impacts of recycled water recharge is equal to or greater than the increment of additional salt above established Basin Plan water quality objectives. Desalters will be designed to capture any increase in rising water.*<br><br>Among the alternatives available to reduce or control adverse effects caused by recharge is the use of injection of water of higher quality to resident poor quality groundwater to serve as a barrier against the migration of the poor quality gorundwater. | |
| Air Quality | Construction Impacts | Water active grading sites at least twice daily and when dust is observed migrating from the site. The project will comply with SCAQMD Rule 403 requirements where applicable. Rule 403 prohibits visible dust emissions beyond the property boundaries.<br><br>Suspend all grading and excavation operations when wind speeds exceed 25 mph.<br><br>Apply non-toxic chemical soil stabilizers according to manufacturers specifications to inactive construction areas (previously graded areas inactive for 10 days or more).<br><br>Replace ground cover or pave disturbed areas immediately after construction is completed in the affected area.<br><br>Sweep streets once a day and when soil material is observed on traveled roadways. | Less than significant impact |
| | Operation Impacts | See discussion in Subchapter 4.6, Section 4.6.5. | Potentially significant |
| Transportation and Circulation | Cause an increase in vehicle trips or traffic congestion.<br><br>Cause hazards to safety from design features, such as sharp curves, or dangerous intersections. | For each development project that will increase traffic generation relative to current traffic generation, the IEUA will prepare a traffic study that identifies the net number of trips, the effect on levels of service to maintain a LOS "E".<br><br>The IEUA will require the construction contractor to provide adequate traffic management resources during construction (signing protective | Less than significant |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | Cause inadequate emergency access or inadequate access to nearby uses. | devices. flag persons. etc.) to maintain safe traffic flow, particularly emergency access, on local streets at all times. | |
| Transportation and Circulation (continued) | Cause insufficient parking capacity onsite or offsite.<br><br>Cause hazards for pedestrians or bicyclists.<br><br>Cause conflicts with adopted policies supporting alternative transportation, such as bus turnouts and bicycle racks.<br><br>Cause adverse impacts to rail, waterborne or air traffic. | During construction the IEUA will require traffic hazards for vehicles, bicycles, and pedestrians be adequately identified and such traffic controlled to minimize hazards.<br><br>The IEUA will require the contractor to ensure no open trenches or traffic safety hazards be left in roadways during periods of time when construction personnel are not present (nighttime. weekends. etc.).<br><br>The IEUA will require all roads be repaired adequately after pipeline installation to ensure that traffic can move in the same manner as before construction without damage to vehicles.<br><br>Emphasize transportation demand management or non-motorized transportation alternatives for OBMP project related employees, where feasible, to reduce demand for roadway capacity.<br><br>Future OBMP facility ingress/egress will be reviewed with the agency having jurisdiction or the roadway providing access, and roadway improvements required to eliminate any traffic hazards associated with access to a facility in accordance with standard agency requirements or prudent circulation system planning requirements. | Less than significant impact |
| Biological Resources | Have a substantial adverse direct or indirect effect on any species identified as a candidate, sensitive, or special status species.<br><br>Have a substantial adverse effect on riparian habitat or other sensitive natural community.<br><br>Have a substantial adverse effect on federally protected wetlands. | Place primary emphasis on the preservation of large, unbroken blocks of natural open space and wildlife habitat area, and protect the integrity of habitat linkages. As part of this emphasis, incorporate programs for purchase of lands, clustering of development to increase the amount of preserved open space, and assurances that the construction of pipelines and other facilities or infrastructure improvements meet standards identical to the environmental protection policies applicable to the specific project. | Less than significant impact |
| Biological Resources | Substantially interfere with the movement of native fish or wildlife species, migratory wildlife corridors, or impede the use of | When determining which portion of a facility sit should be retained in open space, give emphasis to the preservation of habitat areas and linkages, avoiding destruction of viable, sensitive habitat areas and | Less than significant impact |

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| | native wildlife nursery sites.<br><br>Conflict with local policies or ordinances protecting biological resources.<br><br>Conflict with provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved habitat conservation plan.<br><br>Substantially impact candidate, sensitive or special status species of riparian or other sensitive natural communities. | linkages as a trade-off for preserving open space for purely aesthetic purposes. Further, whenever feasible, avoid impacts and disturbances to individuals and species considered sensitive by jurisdictional agencies.<br><br>Require facility designs to be planned to protect habitat values and to preserve significant, viable habitat areas and habitat connection in their natural conditions.<br><br>a. Within designated habitat areas of rare, threatened or endangered species, prohibit disturbance of protected biotic resources.<br><br>b. Within riparian areas and wetlands subject to state or federal regulations (e.g. blue line streams); riparian woodlands, oak and walnut woodland, and habitat linkages, require that the vegetative resources which contribute to habitat carrying capacity (vegetative diversity, faunal resting sites, foraging areas, and food sources) are preserved in place or replaced so as no to result in an measurable reduction in the reproductive capacity of sensitive biotic resources.<br><br>c. Within habitats of plants listed by the CNDDB or CNPS as "special" or "of concern," require that new facilities not result in a reduction in the number of these plants, if they are present.<br><br>Maximize the preservation of individual oak, sycamore and walnut trees within proposed development sites.<br><br>Prohibit the use of motorized vehicles within sensitive habitat areas and linkages except for crucial maintenance and/or construction activities. | |
| Biological Resources (continued) | | Require the establishment of buffer zones adjacent to areas of preserved biological resources. Such buffer zones will be of adequate width to protect biological resources from grading and construction activities, as well as from the long-term use of adjacent lands. Permitted land modification activities with preservation and buffer areas are to be limited to those that are consistent with the maintenance of the reproductive capacity of the identifies resources. The land uses and | Less than significant impact |

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| | | design of project facilities adjacent to a vegetative preservation area, as well as activities within the designated buffer area are not to be permitted to disturb natural drainage patterns to the point that vegetative resources receive too much or too little water to permit their ongoing health. In addition, landscape adjacent to areas of preserved biological resources will be designed so as to avoid invasive species which could negatively impact the value of the preserved resource.<br><br>Require conservation or open space easements, granting of development rights, or other similar protections over biological habitats, and habitat linages being preserved in their natural state.<br><br>Prior to facility construction or installation, project specific biological resource surveys will be conducted onsite when any previously undeveloped areas may be disturbed by project implementation. If any sensitive species have the potential to occur on the site where OBMP facilities are proposed, or if previous environmental studies have not been conducted, IEUA will conduct all surveys in accordance with all established state, federal and generally accepted biological survey protocols for each potential species that may be located onsite. Further, IEUA will implement all mitigation measures recommended by jurisdictional agencies.<br><br>Mitigation measures should be determined on a project by project basis. Potential mitigation measures may include avoidance or minimization of impacts. One means of minimizing impacts to sensitive plants, for example, has included transplanting individuals out of harm's way. | |
| Biological Resources (continued) | | The amount of water taken from or added to the Santa Ana River will be coordinated where possible to maintain the water level below the 505' elevation mark but above the 498' mark. If weather and hydrologic forecasts and reservoir conditions indicate that the pool elevation may exceed 505' because of a projected disparity between inflow and outflow, the water control manager at the Reservoir Operation Center shall take all steps necessary (including immediate release of water at the maximum possible rate to prevent the pool elevation from exceeding 505', or to reduce the amount of time the pool is above 505' (if, in fact, the maximum possible release rate does not succeed in keeping the pool elevation below 505'). This mitigation measure will help to ensure the preservation of critical habitat for the least Bell's | Less than significant impact |

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| | | vireo, and preservation of associated riparian resources.*<br><br>Mitigation must be designed so that development of a given project will effectively benefit the species. The 2081 and 10(a) permits should be complimentary of one another to avoid conflicts between state and federal mitigation requirements. These permits will likely require land purchase, endowment funds, fencing funds, and mitigation measures. Section 7 consultations also usually include a land acquisition component.* | |
| Energy | Construction and operation impacts. | No mitigation is proposed. | Less than significant impact |
| Hazards and Risk of Upset | Create a risk of accidental explosion or release of hazardous substances, including, but not limited to oil, pesticides, chemicals or radiation.<br><br>Have a possibility to interfere with an emergency response plan or emergency evacuation plan. | For OBMP facilities that handle hazardous materials or generate hazardous waste the Business Plan prepared and submitted to the county or local city will incorporate best management practices designed to minimize the potential for accidental release of such chemicals. The facility managers will implement these measures to reduce the potential for accidental releases of hazardous materials or wastes. | Less than significant impact |
| Hazards and Risk of Upset (continued) | Create any health hazards or potential health hazards.<br><br>Cause exposure of people to existing sources of potential health hazards.<br><br>Increase fire hazards in wildland areas or in the Project Area. | The business plan will assess the potential accidental release scenarios and identify the equipment and response capabilities required to provide immediate containment, control and collection of any released material. Adequate funding will be provided to acquire the necessary equipment, train personnel in responses and to obtain sufficient resources to control and prevent the spread of any accidentally released hazardous or toxic materials.<br><br>For the storage of any acutely hazardous material at an OBMP facility, such as chlorine gas, modeling of pathways of release and potential exposure of the public to any released material will be completed and specific measures, such as secondary containment, will be implemented to ensure that sensitive receptors will not be exposed to significant health threats based on the toxic substance involved.<br><br>All contaminated material will be delivered to a licensed treatment, disposal or recycling facility that has the appropriate systems to | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | manage the contaminated material without significant impact on the environment.<br><br>Before determining that an area contaminated as a result of an accidental release is fully remediated, specific thresholds of acceptable clean-up will be established and sufficient samples will be taken within the contaminated area to verify that these clean-up thresholds have been met.<br><br>During construction activities within existing road rights-of-way or other easements where continuous access is required, a road operation management plan will be prepared and implemented. At a minimum this plan will define how to minimize the amount of time spent on construction activities; how to minimize disruption of vehicle and alternative modes of traffic at all times, but particularly during periods of high traffic volumes; adequate signage and other controls, including flagpersons, to ensure that traffic can flow adequately during construction; the identification of alternative routes that can meet the traffic flow requirements of a specific area, | |
| Hazards and Risk of Upset (continued) | | including communication (signs, webpages, etc.) with drivers and neighborhoods where construction activities will occur; and at the end of each construction day roadways will be prepared for continued utilization without any significant roadway hazards remaining.<br><br>To the extent feasible, installation of pipelines or other construction activities in support of the OBMP will not be located on major evacuation or emergency response routes within any communities in the Chino Basin. Where construction on such routes is necessary, local emergency response providers will be contacted and emergency access and evacuation requirements will be maintained at a level sufficient to meet their needs.<br><br>Where alternative treatment systems are available to reduce potential health risks at OBMP facilities, such alternatives will be selected if they meet defined technical, logistical and economic requirements for operation of such facilities.<br><br>Prior to approving specific recycled water recharge facility locations and volumes, the extent of the aquifer area that would be removed from | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | water production to meet potable water production requirements (6-month detention and 20% concentration in groundwater) will be defined. If it conflicts with significant water production wells (existing or proposed), an alternative recharge location will be selected, or wells will be closed and a new supply developed.<br><br>Hydrogeologic studies, including modeling, will be doen for each recharge site to define the recharge impacts on existing known contaminated plumes. If modeling demonstrates that the rate of contaminated plume expansion or secondary effects associated with such expansion will adversely impact groundwater or water production capabilities, the recharge facility will be moved to an alternative location where such impacts will not occur or impacted production facilities will be replaced. | |
| Hazards and Risk of Upset (continued) | | All recycled water recharge operations will be monitored, and if impacts that were not forecast to occur demonstrate that the recharge operations are causing a significant adverse impact on the groundwater aquifer, the recycled recharge operations will be terminated or modified to eliminate the adverse impact. | Less than significant impact |
| Noise | Increase noise exposure for sensitive receptors from new noise sources.<br><br>Expose people to severe noise levels. | Construction will be limited to the hours of 7 a.m. to 7 p.m. on Monday through Friday, and between 9 a.m. to 6 p.m. on Saturday, and will be prohibited on Sundays and federal holidays.<br><br>All construction vehicles and fixed or mobile equipment will be equipped with properly operating and maintained mufflers.<br><br>All employees that will be exposed to noise levels greater than 75 dB over an 8-hour period will be provided with adequate hearing protection devices to ensure no hearing damage will result from construction activities.<br><br>If equipment is being used that can cause hearing damage at adjacent noise receptor locations (distance attenuation will be taken into account), portable noise barriers will be installed that are demonstrated to be adequate to reduce noise levels at receptor locations below hearing damage thresholds. | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | All production wells or booster pumps will have their noise levels attenuated to 50 dBA CNEL at 50 feet from the well head.<br><br>Project design will include measures which assure adequate interior noise levels as required by Title 25 (California Noise Insulation Standards). | |
| Noise (continued) | | Require that all parking for desalter uses adjacent to residential areas be enclosed within a structure or separated by a solid wall with quality landscaping as a visual buffer.<br><br>Desalters will be constructed and operated so that noise levels from operations do not exceed 50 dB during night hours and 65 dB averaged over the 12 hours of day time when located adjacent to existing or future sensitive land uses. This can be achieved by siting desalters a sufficient distance from sensitive noise receptors; by incorporating attenuation features in the facility or designing attenuation features at the boundary of the property. | Less than significant impact |
| Public Services | Cause a significant demand for police protection services; a significant demand for fire protection services; a significant demand for school room capacity; and a significant demand for library capacity. | OBMP facilities will be fenced or otherwise have access controlled to prevent illegal trespass to attractive nuisances, such as construction sites or recharge sites. | Less than significant impact |
| Utilities | Cause a significant demand for electricity and natural gas services.<br><br>Cause a significant demand for communication system services.<br><br>Cause a significant demand for wastewater collection or treatment system capacity.<br><br>Cause a significant demand for solid waste disposal capacity.<br><br>Cause a significant demand for water supply | <u>Electricity</u><br><br>Developers in the proposed Project Area should coordinate with SCE regarding the location and phasing of required on-site electrical facilities.<br><br>Proposed building construction should comply with Title 24 of the California Administrative Code.<br><br>Onsite electrical lines should be installed underground.<br><br>Project planners and architects should consult with SCE regarding current energy conservation techniques. | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | capacity. | Project planners and architects should also consider the use of energy-efficient architecture and landscape design concepts which will work to reduce the long-term demands for fossil fuels. Such measures should include the following: | |
| Utilities (continued) | | · Architectural planning and design, to the extent feasible, should take full advantage of such concepts as natural heating and/or cooling through sun and wind exposure and solar energy collection system opportunities when practical; and<br><br>· Landscape design should be tailored, where feasible, to the use requirements of individual structures, with the intent to minimize heat gain in summer, maximize heat gain in winter, and promote air circulation for heating and cooling purposes.<br><br><u>Natural Gas</u><br><br>Natural gas service to the proposed Study Area should be in accordance with the appropriate purveyors policies and extension rules as required. These are on file with the California Public Utilities Commission. In addition, the following general measures are recommended:<br><br>· The thermal insulation installed in walls and ceilings should meet the standards established by the State of California.<br><br>· All buildings should be constructed in conformance with Title 24, Part 6, Division T-20, Chapter 2 of the California Administrative Code.<br><br>· Windowless walls for western exposures and sill orientation of buildings to use solar heating systems and efficient heating-cooling systems should be installed whenever feasible.<br><br>· The use of landscaping to moderate building heat gain, such as the use of deciduous trees in parking areas and on the southern and western exposures of buildings to provide shade during the summer, yet allow maximum light and heat | Less than significant impact |

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| | | during the winter, should be encouraged. | |
| Utilities (continued) | | · Energy conservation methods that could be readily incorporated into a development should be conceived during the design phase of Plan related development projects. Consultation with the appropriate purveyors during the design phase will facilitate the process of adapting the project's architectural design to maximize efficient energy use.<br><br>Wastewater<br><br>Wastewater treatment facilities/distribution system improvement/expansion projects will precede or be concurrent with all growth generating projects as required to maintain adequate system capacity levels.<br><br>Measure 4.13-8 was determined to not apply to the OBMP, the measure has been deleted. The deletion of the measure will not have any significant effect on the implementation of the OBMP since it only applied to developer capacity fees that are in no way related to the OBMP.<br><br>All industrial and commercial users should take on-site measures to reduce the load strength of their sewage.<br><br>Solid Waste<br><br>All proposed development/redevelopment projects within the proposed Study Area that will generate solid waste, will be reviewed on a project-by-project basis by the permitting jurisdiction in coordination with County landfill officials to determine the degree of impact upon remaining landfill capacity. Projects should be approved only after it is determined that the additional solid waste generated can be disposed of within existing landfill facilities.<br><br>Water Supplies<br><br>All Plan-related development/redevelopment projects including exterior landscape elements will employ xeriscape plant design and | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | water conservation concepts. At a minimum xeriscape requirements will include the following: | |
| Utilities (continued) | | a. The use of drought-tolerant species, drip irrigation systems, soil moisture sensors, and automatic irrigation systems, when appropriate.<br><br>b. Extensive use of mulch in all landscaped areas. Use of mulch will improve water holding capacities of the soil by reducing evaporation and erosion.<br><br>c. A minimal use of lawn, except to accommodate-lawn dependent uses such as playing fields. Warm-season grasses will be used.<br><br>d. The use of gray water separation storage and transmission systems when feasible for irrigation purposes.<br><br>The conservation of water should be of significant concern to all citizens in Southern California, and some conservation proceedings are presently mandated by state legislation. As such, the following measures should be implemented for all Plan related construction projects when appropriate to comply with state legislation:<br><br>· Plumbing fixtures that reduce water usage should be utilized (i.e., low-volume toilet tanks, flow-control devices for faucets and shower heads) in accordance with Title 24 of the California Administrative Code.<br><br>· The use of drought-tolerant plant species and drip irrigation systems should be considered in order to reduce water usage.<br><br>· Installation of ultra-low flush toilets in all new construction should occur.<br><br>· Installation of low-flow showers and faucets in accordance with California Administrative Code, Title 24, Part 6, Article 1, T20-1406F should occur.* | Less than significant impact |
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| Utilities (continued) | | Recommendations to be implemented where applicable:<br><br><u>Interior</u><br><br>· Supply line pressure: recommend water pressure greater than 50 psi be reduced to 50 psi or less by means of pressure-reducing valve.<br><br>· Flush valve operated water closets: recommend three gallons per flush.<br><br>· Drinking fountains: recommend installation of self-closing valves.<br><br>· Pipe insulation: recommend all hot water lines in dwelling units be insulated to provide hot water quickly with less water and to prevent hot pipes from heating cold pipes.<br><br><u>Exterior</u><br><br>· Preserve and protect existing trees and shrubs. Established plants are often adapted to low water conditions and their use saves water needed to establish replacement vegetation.<br><br>· Group plants of similar water use to reduce over-irrigation of low-water-using plants.<br><br>· Provide information to occupants regarding benefits of low-water-using landscaping and sources of additional assistance.<br><br>· Use pervious paving material whenever feasible to reduce surface water runoff and to aid in ground water recharge.<br><br>· Grade slopes so that runoff of surface water is minimized. | Less than significant impact |
| Cultural Resources | Disturb, damage, or destroy cultural resources. | <u>Archaeology</u><br><br>Inventory: A required basic archaeological inventory should encompass the following guidelines: | Less than significant impact |

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| | | a. Literature and Records Search - Existing maps, site reports, site records, and previous EIRs in the region of the subject area should be researched to identify known archaeological sites and works completed in the region. All maps, EIRs, historical maps and documents, and site records should be cited in text and references. Local historical societies should also be contacted and referenced. State Information Centers will provide the bulk of this information. The San Bernardino County Archives or the Eastern Information Center at UC Riverside should be contacted.<br><br>b. Field Reconnaissance - Conduct a surface survey to obtain comprehensive examination of current status of the area and gather general understanding of the kinds of cultural and related phenomena present. At a minimum, all ground surfaces chosen for survey should be walked over in such a way that every foot of ground can be visually scanned. All previously recorded cultural resources should be revisited to determine their current status, and all newly discovered sites should be recorded on either State Form 422 or 523 and supplements, as appropriate. Trinomial designations will be obtained from the Information Center. For the inventory process, a compilation of all historical resources, including archaeological and historic resources older than 50 years, using appropriate State record forms, following guidelines in the California Office of Historic Preservation's handbook should be completed for all new discoveries. | |
| Cultural Resources (continued) | | Two copies should be submitted to the San Bernardino County Archeological Information Center for the assignment of trinomials if discovered within San Bernardino County. Otherwise, the appropriate comparable agency in Riverside County will be the recipient of these reports.<br><br>c. Report - A technical report should be prepared which fully describes both the methods and results of all efforts. Research sources should be listed, and the information summarized. The field work should be presented in detail, with all appropriate maps and graphics. Any areas not inspected with full intensity should be specified, preferably | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | using clear, easily understood maps, and the reasons for the deficiency presented. Site records should be prepared for all new discoveries, and amendments prepared to update old records where necessary; since locational data are shielded from public access, the actual forms should be provided in the separable appendix, but the sites should be described in the main text. Each resource description should include a professional opinion of significance, with reference to the qualities or research potential which make it worthy of further consideration. Archaeological sites which need test excavation to confirm significance, integrity, and boundaries should be identified, and a sampling program recommended.<br><br>For each potentially significant cultural resource, possible impacts should be listed and mitigating measures developed. All standards for compliance with the CEQA requirements and those of the lead agencies should be addressed. | |
| Cultural Resources (continued) | | Assessment: Properties will be evaluated using a well-understood cultural context that describes the cultural development of an area and identifies the significant patterns that properties represent. This same historic context is used to organize all identification, registration, and preservation decisions within the planning framework. To be useful in subsequent stages of the planning process, evaluation decisions must make clear the significance of the property with the historic context. Potential preservation treatments should not influence the evaluation of significance.<br><br>The nature and type of assessment will depend on the particular resource(s) and level of information for a particular region. Consequently, it is not possible to prescribe specific methods to be utilized. However, there are certain basic elements that should be included and are as follows:<br><br>a. Preparation of a Research Design - Archaeological documentation can be carried out only after defining explicit goals and a methodology for reaching them. The goals of the documentation effort directly reflect the goals of the preservation plan and the specific needs identified for the relevant historic contexts. | Less than significant impact |

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| | | b. Field Studies - The implementation of the research design in the field must be flexible enough to accommodate the discovery of new or unexpected data classes or properties, or changing field conditions. An important consideration in choosing methods to be used in the field studies should be assuring full, clear, and accurate description of all field operations and observations, including excavation and recording techniques and stratigraphic or inter-site relationships. | |
| Cultural Resources (continued) | | c. Report - The assessment report should evaluate the significance and integrity of all historical resources within the project area, using criteria established in Appendix K of the CEQA Guidelines for important archaeological resources and/or CFR 60.4 for eligibility for listing on the National Register of Historic Places. The report should contain the following information and should be submitted to the San Bernardino county Archaeological Information Center or to the Eastern Information Center at UC Riverside for permanent archiving:<br><br>(1) Description of the study area;<br>(2) Relevant historical documentation/background research;<br>(3) The research design;<br>(4) The field studies as actually implemented, including any deviation from the research design and the reason for the changes;<br>(5) All field observations;<br>(6) Analysis and results, illustrated as appropriate with tables, maps, and graphs;<br>(7) Evaluation of the study in terms of the goals and objectives of the investigation, including discussion of how well the needs dictated by the planning process were served;<br>(8) Information on where recovered materials are curated and the satisfactory condition of those facilities to protect and to preserve the artifacts and supporting data. The County of San Bernardino requests that | Less than significant impact |

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| | | historical resource data and artifacts collected within this project area be permanently curated at a repository within the County. | |
| Cultural Resources (continued) | | d. In the event that a prehistoric or historic artifact over 50 years in age is encountered within the project area, especially during construction activities, all land modification activities in the immediate area of the finds should be halted and an onsite inspection should be performed immediately by a qualified archaeologist. This professional will be able to assess the find, determine its significance, and make recommendations for appropriate mitigation measures. Further, if human remains of any kind are encountered on the property, the San Bernardino or Riverside County Coroner's Office must be contacted within 24 hours of the find, and all work should be halted until a clearance is given by that office and any other involved agencies.<br><br>Monitoring: In situations where resources are potentially subject to direct or indirect impact and testing or data recovery is not proposed, an archaeological monitor and Native American observer/consultant should be present during subsurface work. One circumstance under which this might occur would be if a known resource was close to a area of impact and the site boundaries were ambiguous. Monitors help insure that exposed data or materials are collected and that if potentially significant cultural materials or features are encountered, they will be preserved either by realignment of the proposed facilities or by prompt evaluation and recommendations for any necessary mitigative measures.<br><br>Data Recovery: If an archaeological resource is found to be significant and no other preservation option is possible, mitigation of adverse effects by scientific data recovery, including analysis and reporting is the method of last resort. Such a mitigation program is usually only developed after an assessment test has been completed to identify physical parameters and cultural complexity, and formulate a research design. Each specific program would have to be developed in response to the site and potential impact, with the concurrence of the appropriate agencies and in consultation with Native American representatives. | Less than significant impact |
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| Cultural Resources (continued) | | Future Project Siting: Future project will be located, whenever possible or feasible, outside of the highly sensitive cultural resource areas depicted in Figures 4.14-1. Before any projects are located, and before any construction activities begin, any proposed project that will result in ground disturbance to any area that does not have a complete cultural resource survey on record with either the AIC or the EIC offices will conduct a site specific cultural resource evaluation and report prior to any ground breaking activity. Further, if cultural resources have been identified on the site, a qualified archeologist or paleontologist will be retained to devise an excavation and/or curation plan for the resources, and a qualified cultural resource monitor will be present onsite during all construction-related activities that could potentially uncover previously undiscovered resources. This monitor will examine excavated soils and have the authority to cease construction activities if resources are un-earthed.<br><br><u>Architectural Resources</u><br><br>Based solely upon this level of investigation and at this stage of project planning, it would be premature to propose specific mitigation measures. However, certain options can be presented presupposing a general level of knowledge regarding impacts. These options can be utilized to avoid impacts upon the cultural resources - the preferred result - or to lessen adverse effects. It should be emphasized that these options are not the only ones that may be applied. As such, these measures are not recommended as conditions of Project approval but are included for the Authority's consideration and implementation as appropriate.<br><br>a. Conduct a comprehensive historic building survey which is integrated with economic development programs;<br><br>b. Adopt a preservation ordinance and create a preservation board; | Less than significant impact |
| Cultural Resources (continued) | | c. Ensure other planning programs, plans, and ordinances are compatible to the historic preservation goals and policies;<br><br>d. Direct existing funding sources and loan programs to historic neighborhoods in need of revitalization; | Less than significant impact |

| Environmental Category/Issue | Impact Description | Mitigation Measures | Impact After Mitigation |
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| | | e. Provide incentives and direction encouraging preservation and revitalization; and<br><br>f. Develop ongoing programs for enhancing public appreciation of historic resources.<br><br>g. Project Redesign<br><br>A proposed project may be redesigned in either of two ways:<br><br>(1) Outside of site boundaries, thus avoiding impact to the site; or<br>(2) Restricting impacts to those areas of a site where previous impacts have already destroyed the integrity and research potential.<br><br>Other options may also apply and may include capping of the site, relocation of structures, and integration of extant buildings into project design. | |
| Aesthetics and Visual Resources | Have a significant affect on a scenic vista or scenic highway.<br><br>Have a demonstrable negative aesthetic effect.<br><br>Create light or glare. | All surface areas disturbed by OBMP construction activities, except those area used structures or hardscapes) will be revegetated, either with native vegetation in natural landscapes or in accordance with a landscape plan in man-made landscape areas (note that native vegetation is also eminently suited to man-made landscapes and requires less maintenance). Once construction is completed, revegetation will begin immediately and, where a formal landscape plan is being implemented, it will be coordinated with the local agency and the local design guidelines for consistency. | Less than significant impact |
| Aesthetics and Visual Resources (continued) | | Where facilities are proposed to be located adjacent to scenic highways, corridors or other scenic features identified in local agency planning documents, OBMP facility implementation will conform with design requirements established in these planning documents.<br><br>Where facilities will disrupt views from occupied areas with significant scenic vistas, a visual simulation analysis will be performed of the facility's impact on the important view. If the analysis identifies a | Less than significant impact |

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| | | significant impact on a scenic vista, the facility will be relocated, redesigned to reduce the impact to a non-significant level, or a subsequent environmental evaluation will be prepared.<br><br>When OBMP above ground facilities are constructed in the future, the local agency design guidelines for the project site will be followed to the extent that they do not conflict with the engineering and budget constraints established for the facility.<br><br>All utilities for OBMP facilities will be placed underground unless such undergrounding is not technically feasible.<br><br>Future project review and implementation will implement the following:<br><br>· Use of low pressure sodium lights where security needs require such lighting to minimize impacts of glare.<br><br>· Height of lighting fixtures will be lowered to the lowest level consistent with the purpose of the lighting to reduce unwanted illumination.<br><br>· Directing light and shielding will be used to minimize off-site illumination.<br><br>· No light will be allowed to intrude into sensitive light receptor areas. | |

# CHAPTER 2
# INTRODUCTION

## 2.1 BACKGROUND

By way of history, the Chino Basin Watermaster was established by a Judgment entered by the Superior Court of California in 1978. The Judgment provides for Watermaster to develop a management program for the Chino Groundwater Basin that includes both water quality and water quantity related considerations. The Watermaster was also recently directed by the court to develop an Optimum Basin Management Program (OBMP) for the Chino Basin. The OBMP Phase I Report, written in accordance with the Court's ruling, includes tasking towards a comprehensive groundwater monitoring program and management plan, both of which are identified as mandated requirements in the Chino Basin Judgment. Management goals for the OBMP consist of maintaining groundwater quality, water supply and production at an acceptable level for long-term beneficial and conjunctive uses.

Specifically, Watermaster was created on January 27, 1978 by the San Bernardino County Superior Court after extensive negotiations. The negotiations occurred primarily among three different interest groups or pools: the Appropriative Pool (municipal), the Overlying (non-agricultural) Pool (industrial) and the Overlying (agricultural) Pool (agricultural). These groups agreed to a stipulated settlement or physical solution, commonly called "the Judgment", which was entered to provide for administration of the Basin's adjudicated water rights and to provide a Basin-wide governing body for management of groundwater resources. The Judgment also established an "Advisory Committee", which has representatives from all three pools as members. Items of interest or commonality to all pools are considered by the Advisory Committee and by the Watermaster Board in addition to being considered at the Pool level. The Judgment (including the Rules and Regulations for the Watermaster and the Committees) is the document that formally establishes the Pools, the Advisory Committee, the Watermaster and the procedural framework to implement and enforce the physical solution among the several hundred parties who rely on the Chino Groundwater Basin as a water source.

Since the Judgment was entered, it has been amended several times. The most substantive of these amendments is the land use conversion amendment, which was done in November of 1995. This amendment simplifies the method used to calculate the amount of water an appropriator will receive when land which was previously used for agricultural purposes is converted to urban purposes.

For the first 20 years under the adjudication, the Chino Basin Municipal Water District Board of Directors served as "the Watermaster Board". In 1996, at the request of the producers, a motion to appoint a new nine-member Watermaster Board that is more representative of the Basin was filed with the Court. On February 19, 1998, the Court ruled to establish the new nine-member Water-

master Board, effective March 1, 1998. Pursuant to the Judgment, the new Watermaster is charged with development of an OBMP.

For joint power authorities or agencies comprised of a number of participating entities, such as the Watermaster, any member of the authority can serve as the lead agency on a project under the California Environmental Quality Act (CEQA). By mutual agreement, Inland Empire Utilities Agency (IEUA or the Agency) has agreed to serve as the lead agency for the CEQA environmental review process for the adoption and implementation of the OBMP.

In this instance, the process by which the OBMP will be adopted is similar in nature to the workings of a joint powers authority (JPA). Watermaster has designated IEUA as the lead agency for this OBMP project. As the CEQA Lead Agency, IEUA must conduct the environment, review process in accordance with CEQA guidelines and requirements. This process requires the IEUA to evaluate and minimize potentially negative impacts to the environmental prior to project approval and implementation. The course of action that was determined to be most appropriate by the IEUA for compliance with CEQA was the preparation of a Program Environmental Impact Report (PEIR). Prior to starting work on the PEIR, a Notice of Preparation (NOP) was distributed to 192 potentially impacted parties and agencies. Comments were solicited via written responses to the NOP and oral comments were received at a scoping meeting that occurred on December 9, 1999. All comments received prior to December 30, 1999 have been incorporated into the scoping process for this document, and a summary of comments is provided in Appendix 8.1 of Chapter 8 to this PEIR.

Prior to initiation of the PEIR process, a series of debates occurred over whether or not the OBMP falls within the jurisdiction of CEQA, or if the OBMP can be considered exempt under the provisions regarding "Feasibility and Planning Studies" in CEQA Guidelines Section 15262 or "Information Collection," in CEQA Guidelines Section 15306. It appears, however, that the OBMP qualifies as a "project" under CEQA (Public Resources Code Section 21065, and by the State CEQA Guidelines in 14 California Code of Regulations, Sections 15357,15377, and 15378), and it can not be clearly demonstrated that the OBMP falls entirely within the definition of the aforementioned existing CEQA exemptions. Thus, the Watermaster and its constituent agencies have decided to prepare a PEIR for the OBMP, since the OBMP cannot be definitively excluded as a project and may not qualify for a categorical exemption.

A PEIR has been selected for the OBMP based on the definition of a program document contained in Section 15168 of the State CEQA Guidelines which states:

> "A program EIR is an EIR which may be prepared on a series of actions that can be characterized as one large project and are related either: (1) Geographically, (2) As a logical part in the chain of contemplated actions,..."

If IEUA chooses to certify this PEIR, and to approve the OBMP, then other constituent Watermaster parties also have the option to adopt the OBMP. As CEQA responsible agencies listed in this

document, each constituent agency, following their own review and approval of the OBMP Final EIR document, can implement specific projects under the OBMP in the future. A responsible agency, as defined by CEQA is, "a public agency which proposes to carry out or approve a project, for which a Lead Agency is preparing or has prepared an EIR." A responsible agency is not obligated to implement or fulfill the project elements set forth in an EIR. A responsible agency is simply a party that may have follow-on actions which relate to the proposed project and fall within the scope of the certified EIR. Thus, the requirements and responsibilities for lead and responsible agencies differ in nature. Watermaster constituent agencies, therefore, qualify as responsible agencies; however, they are not legally obligated to, but may choose to independently approve or adopt the OBMP and certify the PEIR to implement projects within the scope of the OBMP.

A future project implemented under the umbrella of the OBMP PEIR may not need any additional documentation, depending upon the project being within the scope of the certified OBMP PEIR in accordance with State CEQA Guideline Sections 15162 (Subsequent EIRs and Negative Declarations) and 15168 (Program EIR). IEUA envisions the following procedure for future site specific projects that it may implement on a case-by-case basis. The first step will be to prepare an Initial Study to determine if the specific project falls "within the scope of the program approved earlier" and the "program EIR adequately describes the activity for the purposes of CEQA" (Section 15168 (e) (1) and (2) of the State CEQA Guidelines). In preparing the Initial Study, a determination would be made regarding which, if any, of the identified mitigation measures should be brought forward from the OBMP PEIR to mitigate impacts for the specific project. If the specific project is adequately addressed in the OBMP EIR, then the process permits the implementing agency to publish a notice of this finding, adopt the finding at the hearing where the project is funded by the agency, and a Notice of Determination can be filed.

Because of concerns expressed by other agencies commenting on the OBMP PEIR, IEUA intends to afford other agencies that may have an interest in a project an opportunity to review the documentation (such as engineering reports or investigations and the Initial Study) with adequate time to effectively participate in the IEUA decision on the project. However, each agency that adopts the OBMP and certifies the OBMP PEIR retains the right to comply with CEQA in any fashion that meets the requirements of the statute and the State CEQA Guidelines. This would include the use of exemptions where appropriate, adoption of Negative Declarations for projects, and preparation and certification of an Addendum to an EIR, or of a Supplemental or Subsequent EIR. The procedures for making these decision are outlined in detail in Articles 18 and 19 and Sections 15180 through 15168 of the State CEQA Guidelines. Each agency must select the appropriate review process for future specific projects, but the availability of the OBMP PEIR provides an additional processing mechanism, and identifies general mitigation measures that can be used by the agency where such mitigation is required.

A flow chart outlining the proposed IEUA CEQA review process and a sample initial study evaluation form are included at the end of this Final OBMP PEIR for information.

If the potential environmental impacts fall outside of the impact forecasts contained in the OBMP PEIR, after implementing the mitigation measures outlined in this document, then a new impact will occur, or an identified impact will be worsened, i.e. made more significant. Under such circumstances a new environmental document (Negative Declaration, Supplemental or Subsequent EIR) must be prepared and circulated in the same manner as the OBMP PEIR. IEUA believes that the CEQA process is fully protective of the environment as a result of these requirements, including the groundwater resources upon which many appropriators and producers rely to meet water supply demands.

The CEQA process is not the only forum that will be available for review of future specific projects being implemented under the OBMP umbrella. The Watermaster is finalizing a draft "Peace Agreement Chino Basin" which outlines a process for implementing OBMP projects that is designed to ensure participation by all of the participating agencies. It is anticipated that all projects that may affect hydrologic control in the Chino Basin, or where water credits and financing alternatives will be at issue, will undergo peer review under the framework established in the "Peace Agreement".

Further, in recognition of concerns expressed during the DEIR comment period regarding adequate opportunity to participate in an open review process, IEUA makes a commitment to provide all parties interested in a future specific project with a minimum of 30 days to review the engineering investigation documents and the Initial Study prepared for a project that has been found to be within the scope of the OBMP PEIR. Of course, for projects undergoing additional review for a Negative Declaration or a Supplemental or Subsequent EIR, public review periods are dictated by CEQA and these requirements will be followed. With the Watermaster review process combined with IEUA's commitment to provide adequate time for interested parties to review future specific project proposals in detail, IEUA concludes that adequate review procedures are in place to ensure effective participation by interested parties in the CEQA process. Since many future projects (for example groundwater monitoring wells, pipelines, small recharge projects, etc.) are expected to fully comply with CEQA by relying on the OBMP PEIR, IEUA does not believe it is necessary to restrict the available processing options for complying with CEQA. Please note that as each future specific project is considered and then approved by the IEUA Board, a new Notice of Determination will be filed which provides a backstop provision for any interested party if it does not believe that full compliance with CEQA has been achieved.

As stated before, CEQA requires that the Lead Agency consider the environmental information in the project record, including this PEIR, prior to making a decision on the proposed project. The decision that will ultimately be considered by the governing board of the IEUA is whether or not to certify the Final PEIR (FEIR) as adequate to address the environmental effects of implementation of the OBMP. The Final PEIR was certified and approved by the IEUA Board of Directors on July 12, 2000, following all appropriate public review and comment requirements established in the CEQA Guidelines.

This PEIR has been prepared by Tom Dodson & Associates (TDA) under contract to the Inland Empire Utilities Agency in accordance with Section 21151 of CEQA. The Agency retained TDA, with the consent and approval of the Chino Basin Watermaster Board, to assist in performing the independent review of the project required by CEQA prior to releasing the PEIR as a draft for public review. IEUA has reviewed the content of the Draft PEIR and concurs with the evaluations, conclusions and findings contained herein. The Board certified the Final PEIR on July 12, 2000.

## 2.2 SCOPE AND CONTENT OF THIS PEIR

As the Lead Agency, IEUA initially concluded that the proposed project could result in one or more potentially significant adverse impacts to the environment and, therefore, a PEIR should be prepared. In accordance with Sections 15063 and 15082 of the State CEQA Guidelines, the IEUA prepared a Notice of Preparation of a PEIR to solicit comments identifying the environmental resources and manmade systems that could experience significant environmental impact if the proposed project is implemented. Additionally, a public scoping meeting was held for the same purpose.

Comments on the scope of the PEIR received during the NOP process and public meeting process are summarized in Appendix 8.1 and have been considered and evaluated in this document.

In addition to evaluating the specific environmental issues, this PEIR contains all of the sections mandated by the State CEQA Guidelines. Table 2.3-1 provides a listing of the contents required in an EIR along with a reference to the chapter and page number where these issues can be reviewed in the document. This PEIR is contained in two volumes.

## 2.3 PEIR FORMAT AND ORGANIZATION

This PEIR contains eight chapters which, when considered as a whole, provide the reviewer with an evaluation of the potential significant adverse impacts from implementing the proposed project, the construction and operation of the project proposed by IEUA and associated applications. The following paragraphs provide a summary of the content of each chapter of this PEIR.

Chapter 1 contains the executive summary for the PEIR. This includes an overview of the proposed project and a tabular summary of the potential adverse impacts and mitigation measures.

Chapter 2 provides the reviewer with an introduction to the document. This chapter of the document describes the background of the proposed project, its purpose, and its organization. The CEQA process to date is summarized and the scope of the PEIR is identified. Technical evaluations prepared for the PEIR are discussed and the format and availability of the PEIR are described.

Chapter 3 contains the project description used to forecast environmental impacts. This chapter describes for the reviewer how the existing environment will be altered by the proposed project.

This chapter sets the stage for conducting the environmental impact forecasts contained in the next several chapters.

Chapter 4 presents the environmental impact forecasts for the issues considered in this PEIR. For the environmental issue identified in Chapter 1, the following impact evaluation is provided for the reviewer: the project's existing environmental setting; the potential impacts forecast to occur if the project is implemented; proposed mitigation measures; unavoidable adverse impacts; and cumulative impacts.

Chapter 5 contains the evaluation of alternatives to the proposed project. Included in this chapter is an analysis of the no project alternative and other project alternatives.

Chapter 6 presents the topical issues that are required in a PEIR. These include: any significant irreversible environmental changes, and growth inducing effects of the project. As of January 1, 1995, the assessment of short-term benefits relative to long-term impacts is no longer required because it is considered redundant to other sections in a PEIR. This change was adopted as part of SB 749 (Thompson) which became law in January 1995.

Chapter 7 describes the resources used in preparing the PEIR. This includes persons and organizations contacted; list of preparers; and bibliography.

Chapter 8 contains those materials referenced as appendices to the PEIR, such as the Notice of Preparation, comment letters, distribution list, and other materials referred to in the PEIR.

Volume II contains Comments to Draft PEIR, Responses to Comments, Attachments, Peace Agreement and Implementation Plan

**Table 2.3-1**
**REQUIRED EIR CONTENTS**

| Required Section (CEQA) | Section in EIR | Page Number |
|---|---|---|
| Table of Contents (Section 15122) | same | ii |
| Summary (Section 15123) | Chapter 1 | 1-1 |
| Introduction | Chapter 2 | 2-1 |
| Project Description (Section 15124) | Chapter 3 | 3-1 |
| Significant Environmental Effects of Proposed Project (Section 15126a); Environmental Impacts | Chapter 4 | 4-1 |
| Unavoidable Significant Environmental Effects (Section 15126b) | Chapter 4 | 4-1 |
| Mitigation Measures (Section 15126e) | Chapter 4 | 4-1 |

| Required Section (CEQA) | Section in EIR | Page Number |
|---|---|---|
| Cumulative Impacts (Section 15130) | Chapter 4 | 4-1 |
| Alternatives to the Proposed Project (Section 15126f) | Chapter 5 | 5-1 |
| Growth-Inducing Impacts (Section 15126d) | Chapter 6 | 6-1 |
| Irreversible Environmental Changes (Section 15126c) | Chapter 6 | 6-1 |
| Effects Found Not to be Significant (Section 15128) | Chapter 4 | 4-1 |
| Organizations and Persons Consulted (Section 15129) | Chapter 7 | 7-1 |
| Initial Study, Notice of Preparation, and Comment Letters | Chapter 8 | 8-1 |
| Volume II - Comments to OBMP Draft PEIR, Responses to Comments, Attachments, Peace Agreement, and Implementation Plan | Volume II | -- |

## 2.4 AVAILABILITY OF THE OBMP PEIR

The Draft PEIR for the OBMP has been distributed directly to all public agencies and interested persons identified on the NOP mailing list (see Appendix 8.1 of Chapter 8), as well as the State Clearinghouse, and any other requesting agencies or individuals. All reviewers will be provided 30-days to review the Draft PEIR and submit comments to the IEUA for consideration and response. The Draft PEIR is also available for public review at the following locations during the 30-day review period:

Chino Branch Library
13180 Central Avenue
Chino, CA 91710

Chino Hills Branch Library
2003 Grand Avenue
Chino Hills, CA 91709

Fontana Branch Library
8334 Emerald Street
Fontana, CA 92335

Ontario City Library
215 East "C" Street
Ontario, CA 91764-4198

Rancho Cucamonga Public Library
7368 Archibald Avenue
Rancho Cucamonga, CA 91730

## 2.5 INCORPORATION BY REFERENCE

The following documents are cited throughout this Draft PEIR and are hereby incorporated by reference as permitted by State CEQA Guideline Section 15150, and are available at Inland Empire Utilities Agency at the following address:

Inland Empire Utilities Agency
9400 Cherry Avenue, Building A

Fontana, CA 92335

1. *Chino General Plan*, City of Chino, 1993
2. *Chino Hills General Plan*, City of Chino Hills, 1994
3. *Fontana General Plan*, City of Fontana, 1989
4. *Montclair General Plan*, City of Montclair, 1983
5. *Norco General Plan*, City of Norco, 1985
6. *Ontario General Plan*, City of Ontario, 1992 and *New Model Colony Amendment*
7. *Pomona General Plan*, City of Pomona, 1977
8. *Rancho Cucamonga General Plan*, City of Rancho Cucamonga, 1994
9. *Rialto General Plan*, City of Rialto, 1985
10. *Upland General Plan*, City of Upland, 1992.

Please note, all future references to the City of Ontario's Sphere of Influence area should be treated as references to the New Model Colony General Plan Amendment adopted on November 30, 1999.

All EIR documents related to the aforementioned General Plans are hereby included as reference and supporting informational materials for this PEIR.

- *Chino Basin Municipal Water District Final Report on Reclaimed Water Master Plan,* Montgomery Watson, April 1993.
- *Chino Basin Watermaster Optimum Basin Management Program Phase 1 Report*, Wildermuth Environmental, October 1999.
- *Chino Basin Water Resources Management Study Final Summary Report,* Montgomery Watson *et al.,* September 1995.
- *Chino Basin Water Resources Management Study Model Calibration Results*, Montgomery Watson Americas, Inc., August 26, 1993.
- *Chino Basin Water Resources Management Task Force Final Task 1 Memorandum: Water and Wastewater Planning Environment,* James M. Montgomery, Consulting Engineers, Inc. *et al.*, March 1993.

· *Chino Basin Water Resources Management Task Force Final Task 2 Memorandum: Develop Management Planning Elements,* James M. Montgomery, Consulting Engineers, Inc. *et al.*, June 1992.

· *Chino Basin Water Resources Management Task Force Final Task 3 Memorandum: Description of Economic Procedures to be Used for Evaluating Planning Alternatives,* CH2M Hill, July 5, 1995.

· *Chino Basin Water Resources Management Task Force Final Task 4 Memorandum: New Planning Model Implementation Plan,* James M. Montgomery, Consulting Engineers, Inc. *et al.*, May 1992.

· *Chino Basin Water Resources Management Task Force Final Task 5 Memorandum: Chino Basin Conceptual Model,* James M. Montgomery, Consulting Engineers, Inc. *et al.* September 1992.

· *Chino Basin Water Resources Management Task Force Final Task 6 Memorandum: Development of Three Dimensional Groundwater Model,* Montgomery Watson *et al.* March 1994.

· *Chino Basin Water Resources Management Task Force Final Task 7 Memorandum: Water Resource Planning Module User's Manual,* Diba Consulting Software Engineers (under contract to Montgomery Watson *et al.*) December 1995.

· *Chino Basin Water Resources Management Study Final Task 9 Memorandum: Evaluate Legal, Institutional and Regulatory constraints,* Camp Dresser & McKee, Inc., March 1996.

· *Chino Basin Water Urban Water Management Plan,* Metropolitan Water District of Southern California, 1995.

· *Draft Water Supply Plan Facilities Report Alternative 6A – Phase 1*, Black and Veatch Corporation, November 9, 1999.

· *Integrated Water Resources Plan,* Metropolitan Water District of Southern California, 1996.

· *Phase 1 Final Report Chino Basin Recharge Master Plan*, Wildermuth *et al.,* January 1998.

- *Regional Urban Water Management Plan,* Metropolitan Water District of Southern California, 1995.
- *Santa Ana Watershed Project Authority Water Resources Plan*, June 1998, prepared by SAWPA Planning Depatment.

## 2.6 REVIEW PROCESS

In summary, after receiving comments on the Draft PEIR, the IEUA will prepare a Final PEIR for review by the IEUA Board of Directors prior to their making a decision about the project. The IEUA Board of Directors will review the Final PEIR for adequacy and when determined adequate, the PEIR can be used as the informational document for compliance with the CEQA. As described previously in Section 2.1, other responsible agencies may also choose to review and approve the PEIR document and to adopt the OBMP. Information concerning the PEIR public review schedule for this project can be obtained by contacting:

Mr. Neil Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana, CA 92335
(909) 357-0241

The aforementioned process was completed and the Final PEIR for the OBMP was certified and approved by the IEUA Board of Directors on July 12, 2000. At this hearing the *Peace Agreement Chino Basin* and the *OBMP Implementation Plan* were also adopted by the Board of Directors.

# CHAPTER 3
# PROJECT DESCRIPTION

Note: All Chapter 3 figures are located at the end of this chapter, not immediately following their reference in the text.

## 3.1 INTRODUCTION

The Optimum Basin Management Program (OBMP) focuses on the Chino Groundwater Basin (Chino Basin or the Basin) as shown on the vicinity map in Figure 3.1-1. Figure 3.1-2 illustrates the boundary of the Chino Groundwater Basin as it is legally defined in the stipulated Judgment in the case of Chino Basin Municipal Water District *vs.* the City of Chino *et al.* Figure 3.1-2 also shows the hydrologic boundary of the Chino Groundwater Basin, which is slightly different from the adjudicated boundary. The Chino Basin consists of an alluvial valley that is relatively flat from east to west, sloping from north to south at a one to two percent grade. Basin elevation ranges from about 2,000 feet in the foothills to about 500 feet near Prado Dam.

## 3.2 LOCATION

Figure 3.2-1 depicts the Chino Basin adjudicated boundaries relative to USGS 7.5 Minute Series Quadrangles. Chino Basin is bounded:

- on the north by the San Gabriel mountains and the Cucamonga Basin;
- on the east by the Rialto-Colton Basin, Jurupa Hills and the Pedley Hills;
- on the south by the La Sierra area, the Santa Ana River and the Temescal Basin; and
- on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins.

The principal drainage course for the Basin is the Santa Ana River. It flows sixty-nine miles across the Santa Ana Watershed from its origin in the San Bernardino Mountains to the Pacific Ocean. The Santa Ana River enters the Basin at the Riverside Narrows and flows along the southern boundary to the Prado Flood Control Reservoir where it is eventually discharged through the outlet at Prado Dam. The Basin is traversed by a series of ephemeral and perennial streams that include: Chino Creek, San Antonio Creek, Cucamonga Creek, Deer Creek, Day Creek, Etiwanda Creek and San Sevaine Creek. These creeks, flowing primarily north to south, carry significant flows only during, and for a short time after, intermittent storms that typically occur from October through April. Year-round flow occurs along the entire reach of the Santa Ana River due to year round surface inflows at Riverside Narrows, discharges from municipal water recycling plants that intercept the SAR between the narrows and Prado Dam, and rising groundwater. Rising groundwater occurs in Chino Creek, in the Santa Ana River at Prado Dam, and potentially at other location on the Santa Ana River, depending on climate and season.

While still considered to be a single basin, the Chino Groundwater Basin has been divided into five management zones based upon Basingeo-physical characteristics (shown in Figure 3.2-2), and into three different subbasins (shown in Figure 3.2-3) based on the Santa Ana Regional Water Quality Control Plan (Basin Plan). Presently, the Basin Plan subbasin boundaries and objectives are under review by the Santa Ana Regional Water Quality Control Board (RWQCB). New boundaries similar to the management zones shown in the OBMP are being considered for adoption by the RWQCB.

The five management zones described in the OBMP, shown previously in Figure 3.2-2, are based on the observation of five distinct groundwater flow systems that are characterized by similar hydrologic characteristics, which allow the potential for each region to be individually managed (OBMP Phase I Report, Section 2-3). The water resource management activities that occur in each flow system have little to no impact on the other systems. These management zones are used to characterize the groundwater level, storage, production, and water quality conditions within the Chino Basin. These management zones, in addition to the hydrologic boundary of the Basin itself, are not intended to represent absolute barriers or isolation mechanisms, rather these divisions have been made based on observed flow characteristics and general patterns that can be elucidated from existing groundwater flow data. The groundwater flow model, shown in Figure 3.2-4, is the basis from which observations were made to establish the management zone boundaries.

Water in Management Zone 1 flows generally south with some localized flows to the west in response to groundwater production. Sources of water to Management Zone 1 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins, and subsurface inflow from the Pomona, Claremont Heights and Cucamonga Basins. Discharge is through groundwater production, and as rising groundwater in Chino Creek and the Santa Ana River.

Water in Management Zone 2 flows generally in a southwesterly direction in the northern half of the zone, and then due south in the southern half of the zone. Sources of water to Management Zone 2 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in the spreading basins, and subsurface inflow from the part of the Rialto Basin northwest of Barrier J and the Cucamonga Basin. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

Water in Management Zone 3 flows primarily in a southwesterly direction. Sources of water include direct percolation of precipitation, returns from irrigation, and subsurface inflow from the part of the Rialto Basin southeast of Barrier J. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado reservoir area.

Water in Management Zone 4 flows in a westerly direction. Sources of water to Management Zone 4 include direct percolation of precipitation, and returns from irrigation. Discharge is through groundwater production.

Water in Management Zone 5 has sources of water including streambed percolation of the Santa Ana River, direct percolation of precipitation, returns from irrigation and subsurface inflow from the Temescal Basin. Discharge is through groundwater production, consumptive use by phreatophytes and rising groundwater in the Prado Reservoir area, and potentially in other locations along the Santa Ana River, depending on climate and season.

The Basin is one of the largest groundwater basins in southern California, containing a capacity of about 5,000,000 acre-feet (acre-ft) for water storage, with an additional, unused storage capacity of about 1,000,000 acre-ft (Department of Water Resources Bulletin 118, "California Groundwater Basins"). Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies from the Chino Basin. An additional 300 to 400 agricultural users also produce groundwater from the Basin.

## 3.3 PROJECT CHARACTERISTICS

In order to ensure a continuing water supply for the long-term beneficial use of all Watermaster parties, an OBMP consisting of two phases is being developed for implementation. Phase I of the OBMP consists of defining the state of the Chino Groundwater Basin, establishing goals concerning major issues identified by stakeholders, and affirming a management plan for the achievement of said goals. Phase I also provides a process that facilitates periodic reviews, public comments, and necessary updates.

Section 2 of the OBMP Phase I Report includes the identification of the physical state of the Chino Groundwater Basin, the predicted future water demands, and the determination of problematic issues associated with the management of the Chino Groundwater Basin.

Section 3 of the OBMP Phase I Report establishes the goals of the OBMP. A mission statement combined with a listing of values, issues, needs and interests deemed important by parties is also contained within this section of the OBMP. The mission statement for the OBMP is as follows:

> *The purpose of the Optimum Basin Management Program is to develop a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*

Section 4 of the OBMP Phase I Report describes the Management Program and Program Elements for implementation under the OBMP.

Phase II of the OBMP is the development of the specific implementation plans that will effectively allow for the physical construction, operation, management and monitoring of OBMP facilities. This Phase will consist of a series of Memoranda of Agreements, Technical Memoranda, Facility Reports, Policy Documents, and development of Water Supply Plans, Recharge Master Plans, Joint Powers

Authority Agreements, Safe Yield and other related documents will be completed during implementation of the OBMP over the 20-year planning period. When complete, these documents will provide detailed plans for the implementation of Program Elements and the achievement of OBMP Goals listed below. Collectively these documents will facilitate successful implementation of Phase II of the OBMP. It is intended that the OBMP be flexible enough that changes in future demands, and situations can thus be dealt with accordingly.

As a result of the finalization of the Peace Agreement and Implementation Plan during the review process of the DEIR, and in response to comments received on the DEIR, the following statement has been included to reference these documents in the Final PEIR approved July 12, 2000.

The Goals, Management Program, and Program Elements are to be implemented as set forth in the OBMP Implementation Plan, consistent with the Peace Agreement, and supplemented by the rEvised Draft Water Supply Plan Phase 1 Desalting Project Facilities Report attached to this document as an Appendix and incorporated herein by this reference.

### 3.3.1 Goals

Four primary management goals for the OBMP were developed during a series of meetings to address the issues, needs and interests of the producers. The set of goals are listed below:

Goal No. 1 - Enhance Basin Water Supplies
Goal No. 2 - Protect and Enhance Water Quality
Goal No. 3 - Enhance Management of the Basin
Goal No. 4 - Equitably Finance the OBMP

The first goal applies not only to local groundwater, but also to all sources of water available for the enhancement of the Chino Groundwater Basin. Fourteen actions were identified in Section 3 of the OBMP Phase I Report that will assist in the satisfaction of Goal No. 1. The activities are as follows:

1) Maintenance or increase of groundwater production in the southern portion of the Basin with treatment and service of contaminated groundwater in the southern third of the Basin.
2) Location of new recharge facilities in the upper half of the Basin.
3) Location of new recharge facilities in the lower half of the Basin when recovery of recharged water can be ensured.
4) Development and implementation of a comprehensive basin-wide ground level, groundwater level, quality, and production monitoring program.
5) Development and implementation of a comprehensive plan of stormwater recharge.
6) Development of a comprehensive stormwater flow and quality monitoring program in partnership with other agencies charged with flow and quality monitoring.
7) Development of new stormwater recharge projects at existing and future flood control facilities.

8) Maximization of recharge capacity at existing recharge facilities through improved maintenance.
9) Development of methods to account for losses from storage accounts; and the setting of limits on storage if necessary.
10) Development of a comprehensive ground level, groundwater level, and quality monitoring program in Management Zone 1.
11) Development of an immediate groundwater management program for Management Zone 1, followed by management programs for Management Zones 2, 3, 4, & 5.
12) Creation of new assimilative capacity through the development of offset programs and through other mitigation programs.
13) Maximization of the direct use of recycled water.
14) Development of new sources of supplemental water from the Bunker Hill Basin, the Santa Ana River and other outside Basinsources.

Goal No. 2, to protect and enhance water quality, will be accomplished by implementing activities that capture and dispose of contaminated groundwater, treat contaminated groundwater for direct high-priority beneficial uses, and encourage better management of waste discharges that impact groundwater. The following seventeen activities are envisioned to protect and enhance water quality (OBMP Phase I Report, Section 3). Cross Referencing with Program Elements described starting in Section 3.3.2 is provided in parentheses following each activity description.

1) Development and implementation of a comprehensive groundwater quality monitoring program. (PE1)
2) Coordination with regulatory agencies to share monitoring and other information to detect and define water quality problems. (PE6, PE7, PE9)
3) Coordination of action regarding the Watermaster priorities of mutual interest. (PE8, PE9)
4) Participation in projects of mutual interest including the RWQCB watershed management efforts within the Chino Basin. (PE6, PE3)
5) Development and implementation of programs to address problems posed by specific contaminants. (PE4, PE5, PE6, PE7)
6) Exportation of manure, enhanced manure management, or facilitation or support of salt removal efforts. (PE7)
7) Treatment of dairy sewage and the elimination of discharge to groundwater, or exportation of dairy sewage. (PE7)
8) Development of programs to pump and treat degraded groundwater and to put the treated water to direct beneficial uses. (PE3, PE5)
9) Development and implementation of a comprehensive stormwater recharge plan. (PE2, PE8, PE9)
10) Development of a comprehensive stormwater flow and quality monitoring program in partnership with other agencies charged with flow and quality monitoring. (PE6, PE9)
11) Development of new stormwater recharge projects at existing and future flood control facilities. (PE2, PE6, PE9)

12) Maximization of recharge capacity at existing recharge facilities through improved maintenance or operational and/or structural improvements. (PE2, PE9)
13) Periodic assessment of the salt balance of the Basin. (PE7)
14) Development of new TDS export facilities and/or finding means of using the Non-Reclaimable Wastewater System and the Santa Ana Regional Interceptor with less cost. (PE3, PE5)
15) Establishment of financial incentives to ensure that when existing groundwater is pumped, it is replaced with high quality water to replenish the Basin over time. (PE2, PE3, PE5, PE8, PE9)
16) Increasing the groundwater recharge volume in excess of production to cause an increase in the storage volume without an increase in rising water (discharge from the Basin). (PE2, PE3, PE5, PE7, PE8, PE9)
17) Promote public education. (All Program Elements)

The third goal, to enhance management of the Basin, will be achieved by implementing activities that will lead to optimal management of the Chino Basin. Five activities have been identified to assist in accomplishing this goal (OBMP Phase I Report, Section 3).

1) Development of methods to account for losses from storage accounts; setting of limits on storage if necessary. (PE8, PE9)
2) Development and implementation of a comprehensive Basin-wide ground level, groundwater level, water quality, and production monitoring program (Same as with Goal No. 1). (PE1, PE3, PE4, PE5, PE7)
3) Development of new production patterns that optimize yield and beneficial use; and the development of incentive programs and policies that encourage (or rules that enforce) new production patterns. (PE1, PE3, PE5, PE8)
4) Development of programs to pump and treat degraded groundwater and to put the treated water to direct beneficial uses (Same as with Goal No. 2). (PE3, PE5)
5) Development of conjunctive-use policies and programs that take into account water quantity and quality. (PE2, PE3, PE5, PE9)

The last goal is to equitable finance the OBMP. Three actions items have been identified to accomplish this goal (OBMP Phase I Report, Section 3). They are the following:

1) Identification of an equitable approach to spread the cost of OBMP implementation either on a per acre-foot basis or by some other equitable means. (PE3, PE9)
2) Identification of ways to recover value from utilizing Basin assets including storage and rising water leaving the Basin. (PE8)
3) Evaluation of the project and management components and a ranking of the components with equal consideration given to water quantity, water quality and cost and based on their ability to meet the goals of the OBMP. (All Program Elements)

### 3.3.2 Program Element 1 Develop and Implement Comprehensive Monitoring Program

There have been six types of monitoring identified within the OBMP to support water resources management in the Chino Basin. The first program that is currently being evaluated and implemented is the Groundwater Level Monitoring Program. In the spring of 1998, the Watermaster began a two-part process of developing a comprehensive groundwater level monitoring program. The initial step consists of a survey to collect groundwater level data at all wells in the Basin from which groundwater level measurements can be obtained from the spring of 1999 through fall 2002. The data from this initial survey will be mapped and reviewed.

Based on the review and the Watermaster management needs, a long-term monitoring program will be developed and implemented beginning in the fall of 2002. Watermaster staff expects that they will measure groundwater levels in the initial survey at about 400 wells overlying agricultural pool and about 100 other wells from the other pools and unassigned monitoring wells. The long-term monitoring program will use about half of the wells used in the initial survey plus all wells in the other pools and unassigned wells monitored under the direction of the RWQCB and others. Key wells located in agricultural areas will be replaced as necessary if the original well must be destroyed when the agricultural land surrounding the well is converted to other use.

The next type of monitoring activities are those currently being undertaken as part of the Groundwater Quality Monitoring Program. In July 1999, Watermaster began a similar process to the one identified for the groundwater level monitoring program, consisting of an initial survey and a long-term monitoring effort. The initial survey efforts will involve the collection of all water quality data from appropriators' wells that are tested by appropriators, the collection of all water quality data from the RWQCB for water quality monitoring efforts that are conducted under their supervision, and collection and analysis of at least one water quality sample at all (or a representative set of) other production wells in the Basin.

The assumed maximum number of wells to be sampled by Watermaster staff in the initial survey is 600. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed and implemented in the fall of 2003. The long-term monitoring program will contain a minimum set of key wells that can be periodically monitored to assess water quality conditions in the Basin over time. Water quality data for all operable wells in the other pools will be provided by the well owners in those pools.

The third type of monitoring will be an enhanced Production Monitoring Program. At least 50 percent of wells that produce more than 10 acre-feet per year (acre-ft/year) will have in-line totalizing flow meters. To accomplish this, about 300 agricultural wells will be equipped with in-line totalizing flow meters. Production records from wells owned by appropriators and overlying non-agricultural pool members will report quarterly as has been done in the past.

If necessary, Watermaster staff will read the meters of wells owned by agricultural pool members at least once a year during the period of mid-May through June. Watermaster staff will ender all production records in Watermaster's database and use this information in the administration of the Judgment. In addition, Watermaster will ascertain the sources of water used by each producer and how that water is disposed of after use. This information is to enable accurate salt budget estimates

as described in Program Element 6 to be developed and for other water resources management investigations that may be undertaken by Watermaster in the future as part of the OBMP.

The fourth type of monitoring, Surface Water Discharge and Quality Monitoring, is currently in operation to measure water quality at all existing recharge basins. Water level sensors will be installed in all recharge and retention basins that contribute significant recharge to the Chino Basin. A total of 16 new water level sensors will be required. Additionally, the Watermaster needs to assess the existing surface water discharge and associated water quality monitoring programs for the Santa Ana River and its Chino Basin tributaries to determine the adequacy of the existing monitoring programs for characterizing historical ambient conditions and their utility in detecting water quality impacts from future Chino Basin management activities. It is anticipated this will be complete in early fiscal year 2000-2001.

The fifth type of monitoring involves a Ground Level Monitoring Program in which ground level surveys are proposed as an offshoot of the subsidence issues in Management Zone 1. The stake-holders are interested in determining if and how much subsidence has occurred in the Basin. Watermaster will continue to conduct an analysis of historical ground level survey and remote sensing data to make this determination. The analysis consists of the three tasks:

- Historical survey data collected and/or on file by federal, state, and local agencies will be compiled, mapped, and reviewed to estimate total subsidence for as long a period as possible. This activity will be completed in early fiscal year 2000-2001.

- Synthetic aperture radar (SAR) imagery will be used to assess the time history of subsidence in the Basin for the period 1993 though 1999. This was completed in FY 1999-2000.

- Based on the above information, a network of ground elevation stations in subsidence-prone areas will be developed and periodic surveys of these stations will be done. The frequency of periodic surveys will be established for the Basin as a whole with more frequent surveys done for some areas of the Basin. This activity will be completed in early fiscal year 2000-2001.

The sixth and last type of monitoring activity is that of Well Construction, Abandonment and Destruction Monitoring. Watermaster maintains a database on wells in the Basin and Watermaster staff makes annual well inspections. Watermaster sometimes finds a new well during routine well inspections. The near-term frequency of inspection is expected to increase due to the groundwater level, quality and production monitoring programs. Watermaster needs to know when new wells are constructed as part of its administration of the Judgment. Watermaster will develop cooperative agreements with the counties of Los Angeles, Orange, Riverside, and San Bernardino to be informed as to when a new well has been constructed. The presence of abandoned wells is a threat to groundwater supply and a physical hazard. Watermaster staff will review its database, make

appropriate inspections, consult with well owners, and compile a list of abandoned wells in the Chino Basin. The owners of the abandoned wells will be requested to properly destroy their wells following the ordinances developed by the county in which the abandoned well is located. Watermaster staff will update its list of abandoned wells annually and provide this list to the counties for follow-up and enforcement.

### 3.3.3 Program Element 2 Develop and Implement Comprehensive Recharge Program

The safe yield of the Chino Basin was established in the 1978 Judgment to be 140,000 acre-ft/year. The basis for this estimate is described by William J. Carroll in his testimony on December 19 and 20, 1977, during the adjudication process. Table 3.3-1 lists the hydrologic components developed by Mr. Carroll to estimate the safe yield of the Chino Basin. These recharge and discharge components were developed for the period 1965 to 1974, a period that Carroll referred to as the base period. The safe yield was determined using the average production and change in storage during the period 1965 to 1974. Therefore, any recharge source that contributed recharge to the Chino Basin during this period is part of the safe yield. Since 1975, some of the recharge components may have changed. For example, the recharge of recycled water at RP-1 was discontinued in 1974 and the returns from use by irrigated agriculture may have declined as irrigated agriculture was replaced by dairies. Storm flow recharge has also declined as additional channels have become concrete lined. It is difficult to compute a reliable safe yield and to numerically estimate the impacts from the changes in land use and water use on safe yield until Watermaster can develop good estimates of production and storage through the monitoring program described in Program Element 1.

**Table 3.3-1**
**COMPONENTS OF SAFE YIELD**
**ADOPTED IN THE CHINO BASIN JUDGMENT**

| Hydrologic Component | Annual Average | |
|---|---|---|
| | Acre-ft/year | Percentage |
| ***Inflows to Chino Basin*** | | |
| Deep Percolation | | |
| Precipitation and Surface Inflow | 47,500 | 33% |
| Imported Water | 7,000 | 5% |
| Irrigation | | |
| Domestic | 9,800 | 7% |
| Agriculture | 51,900 | 36% |
| Artificial Recharge | 3,900 | 3% |
| Recharge of Recycled Water | 18,200 | 13% |
| Subsurface Inflow | 7,000 | 5% |
| TOTAL Inflow | 145,300 | 100% |
| ***Outflows from Chino Basin*** | | |

| | | |
|---|---|---|
| Subsurface Outflow | 7,200 | 4% |
| Extractions | 180,000 | 96% |
| TOTAL Outflow | 187,200 | 100% |
| ***Hydrologic Balance*** | | |
| Estimated Annual Average Change in Storage 1965-1974 | -40,000 | |
| Safe Yield (equal to average annual extraction plus annual average change in storage) | 140,000 | |

Watermaster is currently gathering information to compute a new safe-yield, however, it will take approximately 13 years to obtain enough data of sufficient quality to develop this new estimate. In the meantime, there is still debate as to how to treat new storm water recharge developed as part of the OBMP. One option being considered proposes that appropriators share in the new recharge, based on initial shares of safe yield, and pay the Watermaster through the assessment of actual costs for the resulting new yield. Assessment may also be used to pay for facilities to improve storm water recharge over the next 10 years.

It has also been proposed that after 2013, and every 10 years thereafter, Watermaster will recompute the safe yield and the appropriators' volumetric shares will be adjusted to account for the loss in historical recharge and the gains in new recharge.

The Draft Recharge Policy and Memorandum of Agreement is only one element of a comprehensive recharge program. As water demand in the Chino Basin area continues to grow, and as the reliability of Metropolitan Water District of Southern California (MWDSC)as a supplier of imported water becomes uncertain, new recharge of storm flow could offer substantial benefits to Basin producers by offsetting some of the new imported water costs. Recharge of stormwater can be implemented by means of spreading and percolation at both existing and new facilities throughout the Basin, or by means of direct injection into the aquifer. The OBMP Phase I Report estimated that Watermaster's average annual replenishment obligations for ultimate demands on the Chino Basin will be approximately 55,000 afy by the year 2020. Since the present mode of in-lieu replenishment operates primarily on an ad hoc basis, the safest and most conservative way to ensure that recharge capacity will be available is for Watermaster to develop new recharge capacity that will meet ultimate requirements. Watermaster estimates that it will need an estimated 88,000 afy recharge capacity by the year 2020 to safely meet its requirements. For this reason, the development of a comprehensive recharge master plan is essential for the continuance of Basin production patterns. In the OBMP Phase I Report, the estimated capacity for recharge was listed as 80,000 afy. Recent information from Wildermuth Environmental, Inc. has reevaluated this quantity to reflect updated estimates that yield the 88,000 afy capacity being evaluated in this document.

The most current thinking is to make available up to 88,000 acre-feet per year (afy) of recharge capacity for future utilization. Table 4.2-3 identifies an existing total recharge capacity in eleven basins of approximately 69,500 afy. These basins could be modified to accept delivery of water for recharge from a variety of sources, including recycled water, imported water, and stormwater. To achieve sufficient recharge capacity, new recharge basin(s) will be required to handle an additional 10,500 acre-feet of water per year. Assuming a each acre has the ability to percolate one acre-foot of water per day for 210 days of water deliveries, an additional 50 acres of recharge basins will have to be constructed. For forecasting purposes, it is assumed that up to 30,000 acre-feet of stormwater can be recharged into the Basin aquifer (currently up to 12,000 acre-feet are recharged) with a TDS value of 120 mg/l; up to 62,500 acre-feet of SPW can be recharged with TDS values ranging between 250 and 400 mg/l; and up to 40,000 acre-feet of recycled water can be recharged with an average TDS value of 420 mg/l. The actual mix will vary annually depending upon water availability and infrastructure in place to deliver water to recharge basins.

The inclusion of the three additional basins (Wineville, Jurupa, and the RP-3 site) for recycled water recharge will also be analyzed in this document, as 40,000 afy of recycled water is being proposed for recharge under the OBMP. The fact that the locations where this recharge may occur has been expanded to include these three additional basins does not change the impact conclusions in a programmatic document such as this one; especially since site specific impacts from recharging recycled water must be evaluated in the future when specific recharge proposals are proposed with sufficient information to support site specific evaluations.

For clarification purposes in response to comments received in comment letter 10, it should be noted that there is enough capacity in existing basins to allow for the replenishment obligation to be met, but this does not necessarily preclude the construction of new recharge basins for purposes of better managing the Chino Basin. Thus the terms "new," "proposed" and/or "future" are adjectives used throughout the document to clarify the context in which recharge basin types are being discussed.

Additional information regarding the proposed recharge basins has been included as an attachment in the form of Table 1 in the comments and responses to comments section of this document.

At one time, 41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined, and is expected to be almost completely converted to urban uses by 2020, except possibly for the land utilized by the State of California. Also, as more and more flood control projects are constructed that efficiently capture and convey storm flows to the Santa Ana River, groundwater recharge that took place in the stream channels and floodplains of the Chino Basin has been eliminated to a great extent without proposed mitigation for impacts to the Basin's safe yield.

In addition to quantity-related recharge considerations and maintenance of groundwater levels, the location of both existing and proposed future recharge/injection facilities could have an affect on the numeric water-quality values in an area. If high quality stormwater is delivered and recharged into

impaired areas, it may be possible to improve water quality through dilution with stormwater having lower Total Dissolved Solids (TDS) and nitrate concentrations than existing groundwater supplies.

Groundwater recharge using both recycled and stormwater flow can also be used to help offset loss of production, surface ruptures and subsidence in areas that have been subjected to long-term overdraft prior to the Judgment. Areas such as the City of Chino, City of Chino Hills and the California Institute for Men located in Chino may have all been affected, among other things, by the pre-Judgment overdraft in the Basin. Additional recharge in the west side of the Basin by ground-water injection or by shifting replenishment from east-side basins to west-side basins is one way of potentially improving production capability in Management Zone 1, and specifically in the deeper aquifers. The zone currently appears to be in balance.

A three-phase Recharge Plan has been described in a June 6, 1999 Program Element 2 Memorandum by Wildermuth Environmental, Incorporated (see all Task Memoranda in the technical appendices). Of this three part plan, Phase 1 for this program element involves the initial screening and assessment of various potential recharge sites, and it has been completed. Phase 2 involves the engineering assessments of promising sites (percolation rate monitoring, etc.), along with the assessment of institutional issues such as cost, ownership, management, and, if necessary, Basin Plan amendments. Phase 2 is scheduled to be completed by 2002. Phase 3 of the Recharge Plan involves the development of a specific implementation plan to develop, construct, and manage spreading basins during the years 2002-2011. A list of prospective basins, along with lists of potentially required modifications for use, has been prepared by Wildermuth Environmental as part of an "Initial Draft Memorandum of Agreement for the Maximization of Recharge in the Chino Basin Phase 2 -- Optimum Basin Management Program." The table and initial draft MOA are included in this document's technical appendices.

Ultimately, the comprehensive recharge plan will coordinate recycled water recharge with percolation of surface runoff from the mountains, urban stormwater runoff, and State Water Project sources and other imported sources, so as to minimize future dependency on uncertain imported water supplies during future droughts (MWDSC Integrated Water Resources Plan, 1996). This comprehensive recharge plan is consistent with MWDSC's April, 1999 adopted Water Surplus and Drought Management Plan (WSDM). The plan will also seek to locate new recharge facilities in the upper half of the Basin to ensure recovery of this water for subsequent beneficial use, and to increase Basin yield. The proposed plan will only locate new recharge facilities in the lower half of the Basin when recovery of recharged water can be assured, and when water quality in the lower portion of the Basin will not be adversely affected. Some locations that may potentially be used as recharge facilities are shown in Figure 3.3-1.

### 3.3.4 Program Elements 3 and 5

Program Element 3 consists of the development and implementation of a water supply plan for the impaired areas of the Basin. The areas that typically have the highest concentrations of TDS and

nitrates are located in the southern portion of the Basin. A water supply plan for the Basin must seek to provide impaired areas with high quality water. Thus, the plan will focus on the development of regional and local groundwater treatment systems/programs to treat degraded groundwater for subsequent direct beneficial use, the development of programs to improve groundwater quality (by decreasing TDS and nitrate concentrations), and the means by which safe yield can be maintained or increased into the future. The combination of these elements will help to minimize Basin outflow, stop the spreading of degraded quality water, and improve Santa Ana River water quality.

Program Element 5 consists of developing and implementing a regional supplemental water program. This element closely relates to Program Element 3 since the extraction and treatment of impaired water must be carefully balanced with use and recharge of supplemental water sources. Also, in some cases delivery and beneficial use of supplemental water sources could be used in place of continued production in an impaired area, or in place of costly pumping and treating options. Although supplemental water sources typically are considered less expensive, they do not solve the water quality problem itself for areas high in nitrates and TDS. In this light, the water supply plan and supplemental water program are best viewed together in a comprehensive manner that will allow for a balanced use of all available options to ensure that adequate supplies of high quality water will be available to meet future demands and that impaired groundwater supplies will be able to be beneficially used in the future. For this reason, desalination facilities are also included as elements of the water supply plan.

Municipal and industrial demands are projected to increase as much as 30 percent between 2000 and 2020. Several agencies will experience increases in demand exceeding 30 percent over the next 20 years, including the cities of Chino, Chino Hills, Norco, and Ontario, and Cucamonga County Water District, Fontana Water Company, Jurupa Community Services District, and the West San Bernardino County Water District. Forecasts from municipal and industrial entities indicate that water supply sources for the Basin in 2020 will consist predominantly of Chino Basin wells through direct use or treatment and use, imported groundwater, and treated surface water from other Basins and MWDSC supplies. The demand in 2020 is projected to be approximately 404,000 afy, of which approximately 364,000 afy is from secure water sources. The remaining 40,040 afy will then be met through the implementation of the water supply plan to follow, most likely through desalters. This volume of water production in the southern end of the Basin must be maintained for the appropriators to ensure the Basin maintains the existing safe-yield, especially when agricultural pumping eventually diminishes in the future.

The means by which the water supply plan and supplemental water program can be implemented include a variety of options. After considering 6 water supply alternatives and 15 sub-alternatives, the consensus of the OBMP stakeholders was to further evaluate Subalternative 6A as the preferred water supply plan (Draft Water Supply Plan Facilities Report -- Alternative 6A, Black and Veatch, November 9, 1999). Subalternative 6A is comprised of two options for the implementation of a Regional Desalting Program and the expansion of the SAWPA Desalter. Although only Alternative 6A options are described herein, due to the fact that the general consensus at the time of document

preparation leaned towards these options, this does not preclude modification to the proposed alternatives or further consideration of other alternatives described in the OBMP Phase I Report and in the Water Supply Facilities Plan prepared by Black and Veatch.

Key Elements for the Reverse Osmosis (RO) and RO/Ion Exchange (IX) options under Alternative 6A are shown in Figures 3.3-2 and 3.3-3. The plans involve the construction of east and west regional desalters, possibly an ion exchange facility, expansion of the SAWPA Desalter, and construction of water transmission pipelines, brine disposal pipelines, and pump stations. In addition, wells could be constructed in two distinctive well fields, east and west, which could supply the desalters with raw water via a common source water conveyance system. Since one of the goals of the OBMP is to preserve the yield of the Basin by reducing the loss of groundwater to the Santa Ana River, the well fields could be located north of the Santa Ana River along the southern portion of the Basin. The controlling criteria for determining the locations of the groundwater treatment facilities include the following: close proximity to the proposed well fields and purveyor delivery points, and near access to the Santa Ana Regional Interceptor (SARI pipeline) for brine disposal, ability to capture rising water that is poor quality, and maintenance of safe yield.

Figures 3.3-4 and 3.3-5 illustrate the approximate locations for Phase 1 groundwater treatment facilities assuming reverse osmosis (RO) only and reverse osmosis/ion exchange (RO/IX), respectively. The East Desalter could be located at the northwest corner of the intersection of Hamner Avenue and Cloverdale Road. This location provides a central location along the proposed eastern well field. The IX facility could be located near Jurupa Community Service District Well No. 8 on Van Buren Boulevard between Etiwanda Avenue and Bain Street. The expansion of the SAWPA Desalter will take place at the existing SAWPA site, which is west of the intersection of Kimball and Euclid Avenues. Facility capacities for both RO and RO/IX are based on the assumption that approximately 40,000 afy of poor quality groundwater will need to be pumped and treated in the southern portion of the Basin in order to maintain the current safe yield value and to prevent approximately 40,000 afy of poor quality groundwater from overflowing or surfacing from groundwater and discharging into the Santa Ana River, when agricultural production decreases, resulting in a decrease in the safe yield of the appropriators. The location of the desalter well field is the most important facility component for the desalter from an environmental impact standpoint. The well field is shown on figures 3.3-4 and 3.3-5 for the two location options being considered.

As agricultural areas convert to urban land uses, groundwater production in the southern part of the Basin must be maintained in order to maintain the safe yield of the Basin, to protect the water quality of the Santa Ana River, and to meet the emerging water demands of the area for urban uses. Currently the groundwater in the southern portion of the Basin has high levels of total dissolved solids (TDS) and nitrate. Both of these contaminants make much of the existing groundwater non-potable without advanced treatment. The suspected source of these contaminants are irrigation return flows from agriculture, dairy waste, municipal waste and industrial discharge, and groundwater pumping patterns.

The Santa Ana River, downstream of the Chino Basin, is the primary drinking water supply, through groundwater replenishment, for most of Orange County. Therefore, adverse impacts to the municipal water supplies of Orange County could be caused if groundwater is not pumped and treated in the southern portion of the Chino Basin. The water that would overflow into Orange County, if not pumped in the Chino Basin, could have an average TDS concentration of about 1,300 mg/L (more than twice the Basin Plan objective at Prado Dam) and nitrate as nitrogen concentration of 30 mg/L (three times the Basin Plan objective).

The groundwater quality in the southern part of the Basin should begin to improve in the future as agricultural land uses transition to urbanization and the groundwater treatment facilities become operational. As the groundwater is withdrawn, treated, and used within the southern part of the Basin, that portion of the water which will return to the groundwater table will be of higher quality than that which was previously produced.

In considering the following treatment options, there is a distinction between the reverse osmosis and ion exchange treatment processes. RO facilities treat the water for both total dissolved solids and for nitrates, while the ion exchange facility would treat only for nitrates and does not reduce the overall salts in the water. The input water quality for a reverse osmosis facility is assumed to have about 1,300 mg/L of TDS and 130 mg/L of nitrate as nitrate. Purveyors of drinking water typically strive to provide customers with water that has a TDS concentration less than 500 mg/L ( a secondary drinking water standard, U.S. Environmental Protection Agency) and the Department of Heath Services requires that drinking water have a nitrate concentration less than 10 mg/L as nitrogen.

The treatment process for reverse osmosis removes both total dissolved solids and nitrates from the water. The ion exchange treatment process effectively eliminates only nitrates from the water supply.

The Phase 1 design capacity is presented in Table 3.3-2, followed by expected purveyor demands and future phasing capacities in Table 3.3-3 for the alternative involving RO only. In addition to the facilities listed below, this alternative will require approximately 32,000 feet of pipeline ranging in size from 12 to 24 inches in diameter. The East Desalter will also require an approximately 450 HP pump station, and the SAWPA desalter expansion will require the installation of an approximately 250 HP pump station.

The expected capacities and phasing for the combination RO and IX facilities are shown in Tables 3.3-4 and 3.3-5. In addition to the facilities listed below, approximately 32,000 feet of pipeline ranging in size from 12 to 20 inches in diameter will need to be installed as part of project implementation. Additionally, the East desalter will require an approximately 200 HP pump station to be constructed. The expansion of the SAWPA desalter facility will require the construction of a an approximately 250 HP pump station.

Estimated pipeline diameters and horsepower values for the two alternatives may differ as the facility components for each treatment process may differ. Please refer to the *Revised Draft Water Supply Plan Phase 1 Desalting Project Facilities Report* (June, 2000) for the most current project description available regarding the desalination facilities.

With the selection of one of the aforementioned alternatives, the water supply plan and the subsequent distribution of supplemental water sources can then be better defined for project implementation. The cost allocation can also be broken down in more detail once one of the alternatives is agreed upon as the focus of future studies.

## Table 3.3-2
## RO ALTERNATIVE DESIGN CAPACITY

| Treatment Facility | Design Capacity | Average Production / Nominal Capacity[1] |
|---|---|---|
| East OBMP Desalter | | |
| Finished Water Flow Rate, acre-ft/year | | 29,110 |
| MGD | 28.9 | 26.0 |
| cfs | 44.8 | 40.3 |
| Brine Flow Rate, acre-ft/year | | 5,140 |
| MGD | 5.1 | 4.6 |
| cfs | 7.9 | 7.1 |
| SAWPA Desalter Expansion | | |
| Finished Water Flow Rate, acre-ft/year | | 1,700 |
| MGD | 1.7 | 1.5 |
| cfs | 2.6 | 2.3 |
| Brine Flow Rate, acre-ft/year | | 300 |
| MGD | 0.4 | 0.3 |
| cfs | 0.6 | 0.5 |
| West OBMP Desalter (or further SAWPA Expansion) | | |
| Finished Water Flow Rate, acre-ft/year | | 3,190 |
| MGD | 3.2 | 2.9 |
| cfs | 5.0 | 4.5 |
| Brine Flow Rate, acre-ft/year | | 560 |
| MGD | 0.6 | 0.5 |
| cfs | 0.9 | 0.8 |
| Total Finished Water Flow Rate, acre-ft/year | | 34,000 |
| MGD | 33.8 | 30.4 |
| cfs | 52.4 | 47.1 |
| Total Brine Flow Rate, acre-ft/year | | 1,500 |
| MGD | 6.1 | 5.4 |
| cfs | 9.4 | 8.4 |

[1] Includes 90 percent plant availability factor.

## Table 3.3-3
## PHASING AND EXPECTED PURVEYOR DEMANDS FOR THE RO ALTERNATIVE

| Facility | Estimated Purveyor Demands, acre-ft/year | | | |
|---|---|---|---|---|
| | 2005 | 2010 | 2015 | 2020 |
| East OBMP Desalter | | | | |
| JCSD | 3,740 | 5,790 | 7,810 | 9,850 |
| Swan Lake | 350 | 350 | 350 | 350 |
| SARWC | 1,180 | 1,460 | 1,650 | 1,850 |
| City of Norco | 1,530 | 2,140 | 3,330 | 4,350 |
| Ontario | 3,200 | 4,500 | 8,530 | 12,710 |
| East Desalter Subtotal: | 10,000 | 14,240 | 21,670 | 29,110 |
| SAWPA Desalter Expansion | | | | |
| City of Chino Hills | 1,700 | 2,400 | 2,800 | 3,000 |
| West OBMP Desalter | | | | |
| City of Chino | 0 | 1,060 | 2,130 | 3,190 |
| Total OBMP Deliveries | 11,500 | 17,000 | 25,500 | 34,000 |
| Total Chino Basin Well Production[1] | 10,000 | 20,000 | 30,000 | 40,000 |

[1] Assumes 85 percent desalter recovery.

## Table 3.3-4
## PHASING AND EXPECTED PURVEYOR DEMANDS FOR THE RO/IX ALTERNATIVE

| Facility | Estimated Purveyor Demands, acre-ft/year | | | |
|---|---|---|---|---|
| | 2005 | 2010 | 2015 | 2020 |
| East OBMP Desalter | | | | |
| SARWC | 1,280 | 1,540 | 1,730 | 1,920 |
| City of Norco | 1,660 | 2,2,50 | 3,490 | 4,500 |
| Ontario | 0 | 4,690 | 8,870 | 13,150 |
| JCSD | 0 | 0 | 0 | 1,480 |
| East Desalter Subtotal: | 2,940 | 8,480 | 14,090 | 21,050 |
| SAWPA Desalter Expansion | | | | |
| City of Chino Hills | 1,700 | 2,400 | 2,800 | 3,000 |
| OBMP Ion Exchange Plant | | | | |
| JCSD | 4,050 | 6,150 | 8,180 | 8,720 |
| Swan Lake | 350 | 350 | 350 | 350 |
| Ion Exchange Subtotal: | 4,400 | 6,500 | 8,530 | 9,070 |
| West OBMP Desalter | | | | |
| City of Chino | 0 | 1,120 | 2,230 | 3,300 |
| Total OBMP Deliveries | 9,040 | 17,800 | 26,550 | 35,120 |
| Total Chino Basin Well Production[1] | 10,000 | 20,000 | 30,000 | 40,000 |

[1] Assumes 85 percent desalter recovery.

## Table 3.3-5
## RO/IX FACILITY DESIGN CAPACITY

| Treatment Facility | Design Capacity | Average Production / Nominal Capacity[1] |
|---|---|---|
| East OBMP Desalter | | |
| Finished Water Flow Rate, acre-ft/year | | 21,050 |
| MGD | 20.9 | 18.8 |
| cfs | 32.4 | 29.1 |
| Brine Flow Rate, acre-ft/year | | 3,750 |
| MGD | 3.8 | 3.4 |
| cfs | 5.9 | 5.3 |
| OBMP Ion Exchange Plant | | |
| Finished Water Flow Rate, acre-ft/year | | 9,070 |
| MGD | 9.0 | 8.1 |
| cfs | 14.0 | 12.6 |
| Brine Flow Rate, acre-ft/year | | 280 |
| MGD | 0.4 | 0.3 |
| cfs | 0.6 | 0.5 |
| SAWPA Desalter Expansion | | |
| Finished Water Flow Rate, acre-ft/year | | 1,700 |
| MGD | 1.7 | 1.5 |
| cfs | 2.6 | 2.3 |
| Brine Flow Rate, acre-ft/year | | 300 |
| MGD | 0.4 | 0.3 |
| cfs | 0.6 | 0.5 |
| West OBMP Desalter (or further expansion of SAWPA Desalter) | | |
| Finished Water Flow Rate, acre-ft/year | | 3,300 |
| MGD | 3.2 | 3.0 |
| cfs | 5.1 | 4.7 |
| Brine Flow Rate, acre-ft/year | | 550 |
| MGD | 0.6 | 0.5 |
| cfs | 0.9 | 0.8 |
| Total Finished Water Flow Rate, acre-ft/year | | 35,120 |
| MGD | 34.9 | 31.4 |
| cfs | 54.1 | 48.7 |
| | 5.2 | |
| | 8.0 | |
| Total Brine Flow Rate, acre-ft/year | | 4,880 |
| MGD | 5.2 | 4.5 |
| cfs | 8.0 | 7.1 |

[1] Includes 90 percent plant availability factor.

### 3.3.5 Program Element 4 Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1

In recent years, the piezometric groundwater levels of the deep aquifers of Management Zone 1 have continued to decline, adding to the potential for additional subsidence and fissuring, lost production capability and water quality problems in the area. There is a history of localized subsidence and fissuring within the City of Chino, and a potentially larger and similar problem in the southern end of Management Zone 1 in the former artesian area. In some areas producers have reported stable and/or increased water levels. Further studies to be conducted during implementation of the OBMP will analyze this issue in-depth, and will determine the extent to which this is still a problem since the inception of the Judgment. This study will also provide insight into mitigation options contemplated to address any continued problems in the area. The study mitigation options are anticipated to include recharge, injection, and/or changes in production patterns.

This part of the Basin contains a higher fraction of fine grained materials that originated from sedimentary deposits in the Chino and Puente Hills. This area also consists of a multiple aquifer system. The upper aquifer(s) are moderately high is TDS and are often very high in nitrates. The City of Chino Hills has drilled a series of wells into the deeper aquifer to obtain better quality water, however the storage and hydraulic properties of the deeper aquifers are quite limited relative to the upper aquifer. According to Wildermuth Environmental Inc., the correlation of recent groundwater production in deep aquifers with the timing of the subsidence and fissuring, and a review of the hydrogeologic data from the area very strongly suggests that there is a correlation between the deep aquifer production and the subsidence problem. The Management Zone 1 (MZ1) Management Plan currently consists of an interim plan with several components including development of a long-term plan which will arise from data to be obtained in the near future. The goals of the Interim Plan are as follows: (a) minimize subsidence and fissuring in the short-term; (b) collect the information necessary to understand the extent and causes of subsidence; and (c) formulate an effective long-term management plan.

The Interim Plan consists of a series of activities. The first element of the Interim Plan is a voluntary modification of deep aquifer groundwater production by some agencies in MZ1 for a 5-year period to see if there is a reduction or elimination of subsidence and fissuring in the area. Another element is that any increase in pumping should be matched by increased recharge in the same general area. Additionally, gaps in existing knowledge must be filled. Primarily, there is a lack of understanding of MZ1 hydrogeology, of the nature and extent of subsidence and fissuring, and of the exact causes of subsidence and fissuring. A process must be implemented to fill the gaps in this knowledge base, including investigations of hydrogeologic, geophysical and remote sensing investigations, as well as monitoring programs. Finally, once this information has been obtained, it can be used to formulate an effective long-term management plan.

Water producers in the area with subsidence and fissuring (including California Institution for Men (CIM) and California Institute for Women and the City of Chino) may voluntarily evaluate pumping

and recharge patterns and cooperate with all agencies to implement such a management plan. Additionally, producers such as Chino Hills, Ontario, Pomona, Upland, Monte Vista Water District, San Antonio Water Company, and Southern California Water Company must also be part of the management plan since the problems mentioned previously could potentially be of concern to a greater general area. As for recharge entities in the area, Watermaster will serve as a coordination agency for members, however other agencies in the area that may implement the recharge projects for the OBMP include the Chino Basin Water Conservation District and the San Bernardino County Flood Control District. The implementation schedule and a discussion of the subsidence and hydro-geologic characteristics in this area are included with the other task memoranda in the technical appendices to this document *(Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1).*

### 3.3.6 Program Element 6 Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management

Program Element No. 6 deals with working cooperatively with the Santa Ana RWQCB towards their Watershed Management Efforts in addition to working with other agencies to improve Basin Management. The goal is to establish a working relationship with regulatory agencies, to share monitoring responsibilities and to facilitate information distribution and sharing so that coordinated action may be taken to define and address water quality issues, and to allow for improved timeliness in clean-up efforts. Currently, the Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed. Watermaster's past monitoring efforts have been largely confined to mineral constituents in the southern half of the Basin and to available monitoring data supplied by municipal and industrial producers. According to Section 4 of the OBMP Phase I Report, the RWQCB has limited resources to detect, monitor and implement the clean up of point and non-point water quality problems in the Chino Basin. The Regional Board commits its resources to enforce remedial actions when it has identified a potential responsible party. The RWQCB does not take action when the sources are not easily identified or when the sources are diffuse, such as non-point sources. Notable examples include the mercury problem in the east Ontario area and some solvent plumes in the lower Chino Basin. It is not a question of Regional Board willingness in this area; it is the availability of limited RWQCB resources for allocation. Watermaster can improve water quality management in the Basin by committing resources to:

- Identify water quality anomalies through monitoring;
- Assist the RWQCB in determining sources of the water quality anomalies;
- Establish priorities for clean-up jointly with RWQCB; and
- Remove organic contaminants through its regional groundwater treatment projects in the southern half of the Basin.

Additionally, coordination of efforts to blend recycled water, imported water and natural stormwater, facilitating better management of TDS and nitrate in flushing/cleaning-up the groundwater Basin is being studied by the Watermaster. The RWQCB is interested in establishing legal contracts with Watermaster and/or contributing agencies to include discussions and conditions for salt offsets from R/O for water reclamation programs, and to allow percolation of state project water without offsets if hydraulic isolations is achieved by the desalters.

Program Element 6 is closely related to Program Element 7 and thus for consideration in the OBMP and for analysis purposes theses two elements will be jointly addressed in the water resources discussion (Chapter 4, Subchapter 4.5 of this document).

### 3.3.7 Program Element 7 Develop and Implement Salt Management Program

Salinity management is a significant problem throughout southern California. The MWDSC and U.S. Bureau of Reclamation sponsored a study (*Salinity Management Study*, June 1999) to identify possible strategies and actions to manage salinity in all the watersheds within coastal plan of southern California.

There is a legacy of contamination in the vadose zone from past agricultural activities (TDS and nitrogen loading), possibly compounded by other activities, that is forecast to continue degrading groundwater long into the future. As of yet, Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed. A TDS and nitrate study currently being conducted through SAWPA by Wildermuth Environmental is to be used to provide the baseline data for the development of new Basin Plan objectives.

Program Element 7 also happens to be relevant to conjunctive use issues. One of the main goals of a conjunctive use program is to put inexpensive sources of water to maximum beneficial use. Potential benefits to a conjunctive use program include the following:

- Potential seasonal storage long term replenishment deliveries to appropriators;
- Higher water levels (reduced pumping costs);
- Expanded recharge facilities to capture stormwater (translating into improved water quality and increased yield);
- Increased water quality monitoring;
- Improved modeling of the basin;
- Increased emergency back-up capability; and
- Basin safe yield maintenance.

The primary goal of a conjunctive use program includes optimum use of surface water and ground-water storage capabilities. Other objectives of the conjunctive use program are to increase the amount of water available for delivery to appropriators so that additional water may be provided to

minimize shortages and to delay the implementation of drought management procedures. To achieve the goals of the conjunctive use program, water entities must seek to store water that would not be stored under other currently available programs (i.e. water that would otherwise be lost out of the Basin). An initial volume of approximately 150,000 acre-ft of storage may be established by Watermaster to implement the conjunctive use program subject to potential review and storage increase at a later date. Further, a financial incentive may be provided to help shift demand for surface deliveries to the winter months. The water present in the storage capacity could then be pumped in lieu of surface deliveries by supplemental water supply sources. A fundamental precept of this conjunctive use program is that recharge and other activities geared towards using storage in the Basin must not exceed the Basin Plan salinity objectives that will be finalized by the RWQCB in the near future. A storage program such as this has the potential to cause increases in rising groundwater volumes, if hydraulic isolation using the desalters is not appropriately phased with the storage program. The desalter's pumping requirements will exceed estimated storage losses, or else the Watermaster could potentially be required to pay mitigation fees to downstream agencies to treat water in the Santa Ana River. The framework for this mitigation program is already in place under the Judgment and will effectively provide for the coordination of recharge and pumping systems in the Basin.

Some of the TDS and nitrogen challenges in the Chino Basin are caused by agriculture and safe yield management practices in the past, and in the present. The TDS and nitrogen impacts from agriculture are fully described in Section 2 of the OBMP Phase I Report. The major considerations are summarized as follows:

- As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/l, and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/l, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/l, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

- There was a steady buildup of the dairy cattle population in the southern Chino Basin between 1949 and 1989. In one study, the total amount of TDS from manure discharged to the southern half of the Basin that will reach groundwater is estimated to be about 1,200,000 tons through 1989 and averages about 29,000 tons per year. Other studies indicate that these salt loading numbers could be even higher. These numbers assume that half of the manure was hauled out of the Basin after 1973, which was a requirement of the Santa Ana Watershed Water Quality Control Plan enacted in 1973. The amount of manure exported out of the Basin was never verified until the late 1990's, so the TDS loading to the groundwater could be greater than estimated, especially if initial estimates

of stockpiled manure are significantly different. Similarly, existing nitrate concentrations in the Basin are not quite as high as those forecasted in some studies, so salt loading impacts could also be slightly lower than forecasted, however, the impacts are still significant and nitrate concentration levels downgradient of previous agricultural regions are still above potable drinking water standards for use.

- TDS concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of Management Zones 1, 2, and 3. TDS concentrations are significantly higher in the southern parts of Zones 1, 2, and 3, and all of Management Zone 5 where they typically exceed the recommended 500 mg/l drinking water standard, and frequently exceed the secondary upper limit of 1,000 mg/l.

- Nitrate is regulated in drinking water according to Title 22 standards defined in the California Code of Regulations by the Department of Health Services. The maximum concentration allowed in drinking water for consumptive use is 10 mg/L as nitrogen. Nitrate measured in the surface water flows that come in from the San Gabriel Mountains, and in groundwater near the foot of these mountains are generally less than 0.5 mg/l (OBMP Phase 1 Report, Section 2). Nitrate concentrations in excess of 0.5 mg/l indicate degradation from overlying land use. Similar to TDS, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by citrus in the norther parts of Management Zones 1, 2, and 3, and dairy areas in the southern parts of the same zones plus Management Zone 5. Nitrate concentrations within these areas have increased significantly over the period from 1960 to the present.

If current rates of agricultural loading were to continue indefinitely, TDS and nitrate concentrations in groundwater could continue to rise. TDS projections for the Chino Basin that were made during the Chino Basin Water Resources Management Study (CBWRMS) suggested that the TDS concentrations would continue to rise in groundwater throughout most of the 15-year planning horizon of 1990 through 2004. In actuality, the observed rate at which the TDS has increased is much less than the study projected. Findings show that the average TDS values are significantly lower than those that were projected for 2000, however, the existing concentrations are still above potable water standards in these areas. In the future, as the land use in the area transitions to urban uses, the source water TDS levels served to the new urban areas will be less than 400 mg/l, and the mineral salts from the source water will be mostly discharged in recycled water discharges to the Santa Ana River and brine line discharges (potentially from a new desalter). The TDS concentration in groundwater will, after some period of time, decline slowly, but should still remain significantly higher that can be utilized as a municipal supply.

Several alternatives are available to Watermaster for assessing progress towards improving groundwater quality. It is apparent that with the salt loading that has occurred and the likelihood that

water quality will remain relatively the same for a number of years despite construction of desalters and export of wastes, a simple monitoring program may not successfully reflect a significant improvement in water quality in the near future. Instead a method that combines monitoring and establishment and management of a salt budget appears to be a more practical approach. The salt budget approach consists of a salt mass balance accounting of the Basin as a whole by inflows and outflows. The magnitude of each inflow and outflow can be estimated and the TDS and nitrogen concentration of each inflow and outflow component can be estimated. Watermaster has committed to reduce the salt loading currently occurring by increasing the quantity of salt currently leaving the Basin and/or by improving the quality of improved or recharged water.

The salt budget will be computed for existing conditions to assess the current balance as the baseline case. Then, future water quality improvements measurements will be made by changing the water and waste management assumptions in the baseline case to reflect OBMP implementation. Later, during OBMP updates, the salt budget may be re-computed based on the then current water quality (from monitoring programs) and the then current water and waste management plans, if at the time, water quality becomes substantially worse than predicted. A different, but more costly, alternative is to refine and utilize a comprehensive set of complex tools for the Chino Basin that is capable of assessing the impact of past and future water resource management activities on groundwater levels, streamflow and water quality.

Additional cooperative efforts with the RWQCB will be necessary to better mange the Basin and to:

- Identify water quality anomalies through monitoring;
- Assist the Regional Board in determining sources of water quality anomalies;
- Establish priorities for clean-up jointly with RWQCB; and
- Remove organic contaminants through regional groundwater treatment projects in the southern half of the Basin(such as the one related to the solvent plume from the Chino Airport area).

TDS and nitrate management in the Basin will require minimizing TDS and nitrogen additions by fertilizers and wastes, treatment of groundwater in the southern part of the Basin, and maximizing the artificial recharge of stormwater.

New dairy waste discharge requirements already adopted by the Regional Board include the following:

- Each dairy will develop and implement an engineered waste management plan that will contain dairy process water and on-dairy precipitation runoff for up to a 25 year-24 hour storm.
- Manure must be scraped from corrals and exported from the dairy within 180 days.
- All manure stockpiled in the Chino Basin as of December 1, 1999 must be exported from the Basin by December 1, 2001.

- No manure may be disposed of in the Chino Basin.
- Some manure can be applied to land at agronomic rates if and only if in the opinion of the Executive Officer of the RWQCB there is reasonable progress toward the construction of a new desalter in the Chino Basin.

The urban land use that will replace agriculture will require low TDS municipal supplies that in turn will produce lower TDS irrigation returns to groundwater than those generated by agriculture. The construction of desalters in the southern part of the Basin will extract and export huge quantities of salt from the basin. By 2020 the salt removal capacity of the desalters may reach over 56,000 tons per year. The dairy contribution of salt is currently about 30,000 tons per year. It is premature to set salt reduction goals until the salt budget method described earlier is developed and the salt budget is assessed. However, it seems reasonable to expect that the salt budget will be impacted favorably by desalters and future land use conversions.

Of the two alternatives mentioned under Program Elements 3 and 5 for water treatment facilities, the alternative involving only reverse osmosis will ultimately (by 2020) result in the removal of 56,000 tons of salt per year. The reverse osmosis coupled with ion exchange will only remove 43,000 tons of salt per year.

The implementation schedule to complete the proposed salt budget evaluation can be seen in Section 4 of the OBMP Phase I Report.

Program Element 6 is closely related to Program Element 7 and thus for consideration in the OBMP and for analysis purposes theses two elements will be jointly addressed in the water resources discussion (Chapter 4, Section 5 of this document).

### 3.3.8 Program Element 8 Develop and Implement Groundwater Storage Management Program

The Watermaster is concerned about the magnitude of water lost from the Chino Basin from rising groundwater when groundwater is stored in the local storage, cyclic, conjunctive use and other storage accounts. Program Element 8 deals with the development of methods to account for losses storage accounts and setting limits on storage if necessary. The accumulation of groundwater in storage without an increase in groundwater production is assumed to cause the baseflow to increase in the Santa Ana River and some of its tributaries (Chino Creek and Mill Creek). Investigations conducted by Watermaster in 1995 concluded that losses from water in storage accounts are about two percent per year of the water in storage. These losses could reach over four percent in the future if groundwater production patterns are not managed in the southern part of the Basin. Based on this analysis, or a large scale conjunctive use program, the total water lost from local storage and cyclic storage accounts for the 20-year period of 1978 through 1997 could be as much as 50,500 acre-ft. If the water in these storage accounts is produced without accounting for the losses then the Basin will

be overdrafted by an amount equal to the water lost from storage if the safe yield is 140,000 afy or less.
There is currently no existing aggregate limit for local storage accounts. Watermaster's Uniform Groundwater Rules and Regulations (UGRR) contains an aggregate threshold storage value of 100,000 acre-ft above which losses to rising water are to be computed and allocated to the storage parties on a pro rata basis if the losses are increased. The UGRR does not specify whether the loss is to be computed for the increment of storage above 100,000 acre-ft or total storage. The 100,000 acre-ft threshold value is an arbitrary number. Some loss will occur when water is placed into local storage. Using 100,000 acre-ft as a threshold value ensures that up to 2,000 afy of unaccounted-for-losses from storage will occur every year. This water will not be in the Basin when the storage parties attempt to recover the stored water.

The Watermaster has had a number of workshops to discuss losses from and setting limits on storage accounts. An aggregate "safe storage" volume of 500,000 acre-ft was tentatively agreed upon. Losses would still apply to all water in storage, but little if any significant water quality impacts are anticipated if the aggregate amount of water in storage is less than 500,000 acre-ft. Watermaster discussed four possible alternative methods to establish storage limits, if necessary. It is anticipated, however, that setting storage limits will not be necessary once losses begin to be applied to the accounts. A brief discussion of several of the potential methods to set storage limits, if necessary, follows.

The Watermaster may choose to deduct the rising water losses from planned storage for all local storage accounts and for the storage accounts of non-Judgment parties. There are several different ways to develop upper limits on the individual local storage accounts. The OBMP Phase I Report lists four different possibilities. The first being a limit based on the ability to use. In this concept, an upper limit is based on the storage party's ability to store and recover all the water in its account over a fixed period such as five years. The storage party would have to demonstrate that it has enough production capacity to recover all the water in storage over a five-year period. The fixed period would be the same for all storage parties. In this concept each storage party would have to demonstrate to Watermaster that they have the ability to put a specific volume of water into storage and be able to recover that water, adjusted for losses, over a fixed period of time. Thus, the storage party will have the facilities in place for groundwater production. This type of limit ensures that the water can be put to a reasonable beneficial use. The five-year period used is arbitrary as the Watermaster would need to determine the length of the fixed period as part of its ongoing management effort.

The second method is establishment of arbitrary limits. In discussions regarding storage limits in prior years, Watermaster considered setting storage limits based on a multiple of safe yield for Overlying Non-Agricultural pool and a multiple of operating safe yield for the Appropriative Pool. Parties that have historically over-produced and that will continue to over-produce may not ever be able to use such a local storage account. Parties that under-produce will fill their accounts and may hold water in these accounts for long periods of time and incur large storage losses. This has been

the trend with the past operation of the local storage accounts. Upper limits based on this concept are arbitrary and may not provide for reasonable beneficial use of Chino Basin water. Storage limits based on a multiple of prior years production, an arbitrary volume equal for all parties, or any other arbitrary volume suffer from the same limitations. Setting arbitrary upper limits without providing a means to utilize the water would cause economic hardship for both under and over producers.

The next storage limit method discussed in the OBMP Phase I Report is a limit based on the time that water is in storage. In this concept, no volume limit would be set. Water could not be kept in storage for more than some fixed period of time, say ten years, regardless of the amount of water in storage. Water transferred from the local storage account for use by the storage party would be taken from the earliest water put into the local storage account. The storage party would be required to recover a volume of groundwater from its local storage account, sell or transfer a similar volume to another party, or sell a similar volume to Watermaster in order to reduce the quantity in its storage account by an amount equal to the water stored prior to the fixed period, less losses to rising water. Unused water from the first year would either be used or sold to Watermaster or a producer in the eleventh year, unused water from the second year would either be used or sold in the twelfth year, and so on if a ten year time limit is used.

The fourth method is the upper limit based on total storage and time water is in storage. This is a composite of the "ability to use" and "time in storage" concepts. In this case a volumetric upper limit would be set for each storage party based on the storage party's ability to store and recover water over a fixed period of time. A time constraint would be added such that water would not be kept in storage more than some fixed period of time.

In all the above storage limit concepts, the storage parties would sell their current year under-production to Watermaster or other parties to the Judgment each year if their local storage accounts are full. Watermaster, or parties to the Judgment, would then use this water to meet current replenishment obligations.

Program Element 8 is closely related to Program Element 9. Thus for consideration in the OBMP and for analysis purposes theses two elements will be jointly addressed in the water resources discussion (Chapter 4, Section 5 of this document).

### 3.3.9 Program Element 9 Develop and Implement Conjunctive-Use Programs

The ninth Program Element focuses on the development of conjunctive use programs that account for water quantity and quality and will assist in balancing production and recharge in the Basin. The Watermaster will develop regional conjunctive-use programs to store supplemental water for MWDSC, and other entities that can cause supplemental water to be stored in the Basin. The regional conjunctive-use programs will provide benefits to all producers in the Basin, the people of California and the nation. Watermaster's conjunctive-use programs will take priority over conjunctive-use programs developed by others. Storage committed to conjunctive-use programs may

consist of two parts, storage within a safe storage capacity and storage in excess of safe storage. Storage in excess of safe storage capacity will automatically require mitigation. The initial target storage for Watermaster's conjunctive-use program will be 150,000 to 300,000 acre-ft within the safe storage capacity. Cyclic storage will be folded into conjunctive-use storage. The Watermaster's conjunctive-use program tentatively consists of the following elements:

- Complete the existing short-term conjunctive-use project;
- Seasonal peaking program for in Basin use and dry year yield program to reduce the demand on various water supply entities to 10 percent of normal summer demand (requiring 150,000 acre-ft of storage);
- Dry-year export program; and
- Seasonal peaking export program.

This chapter summarizes the various components of this project that have the potential to result in physical changes to the environment.

The Program Element 9 conjunctive use discussion is a conservative program that could be implemented under the existing environmental conditions without significant facility augmentation, however, a more substantial conjunctive use program than the one previously described above is outlined as an Alternative to the OBMP program proposal. Both the "Conjunctive Use Alternative" and a second, more regional, conjunctive use program labeled as the "SAWPA Alternative" are described and analyzed in the Alternatives section of this document, in addition to the No Project Alternative that is required for consideration under State CEQA guidelines. These alternatives, how they differ from the aforementioned program, and the forecasted environmental impacts resulting from each alternative are all fully addressed in Chapter 5 of this PEIR.

Program Element 8 is closely related to Program Element 9. Thus for consideration in the OBMP and for analysis purposes theses two elements will be jointly addressed in the water resources discussion (Chapter 4, Section 5 of this document).

## 3.4 USES OF THIS ENVIRONMENTAL IMPACT REPORT

As previously stated, the Inland Empire Utilities Agency Board of Directors must approve and certify the PEIR before any of the proposed development will be allowed to proceed and cause the corresponding changes to the physical environment. This PEIR will be used as the information source and CEQA compliance document for the following discretionary actions or approvals by the Inland Empire Utilities Agency, and subsequently by Watermaster and any constituent agencies should they also decide to adopt the OBMP. Responsible agencies for this PEIR may include:

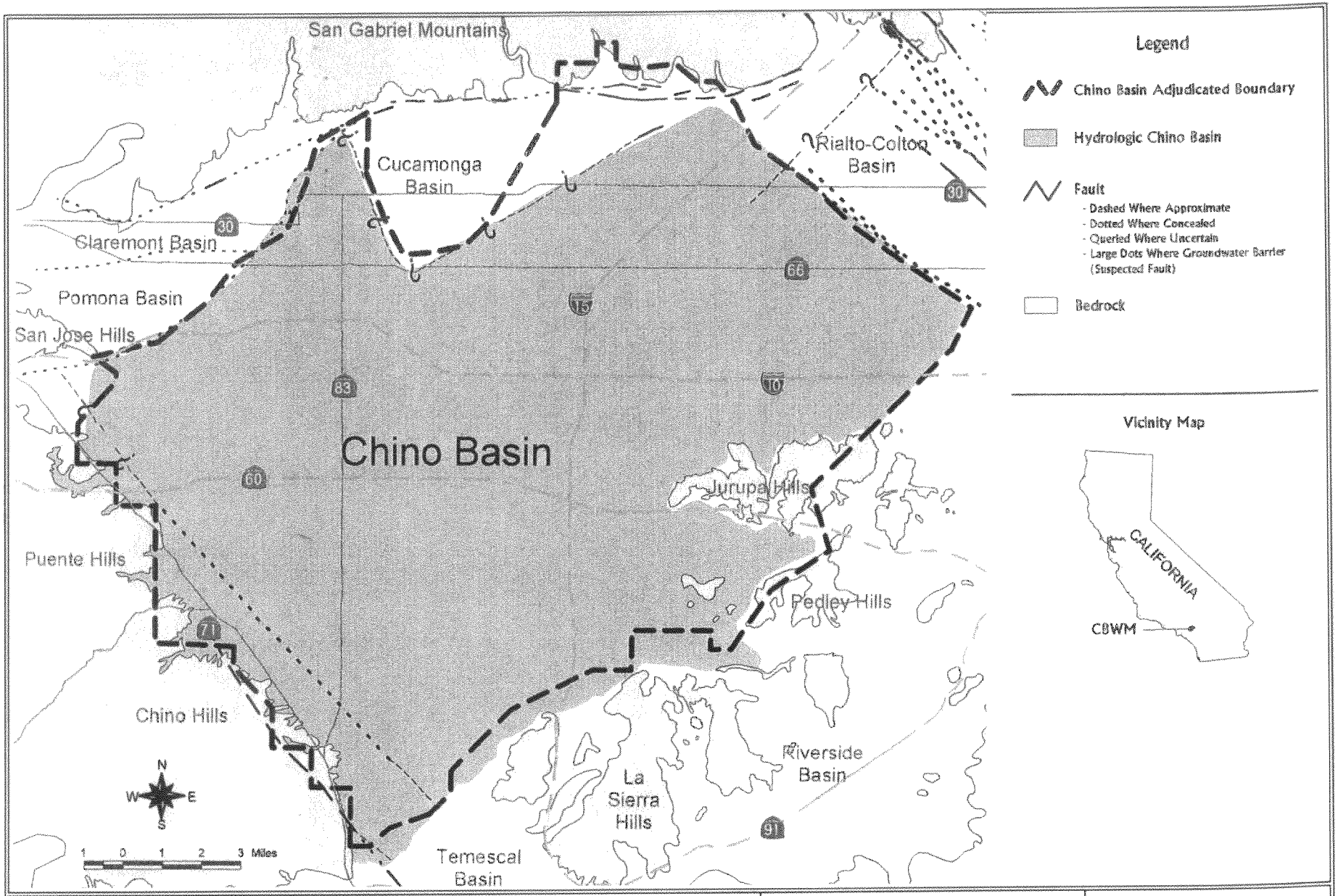
- Chino Basin Watermaster
- Metropolitan Water District of Southern California
- Three Valleys Municipal Water District of Southern California

- Western Municipal Water District
- Various agencies of the State of California, including Department of Justice, Department of Fish and Game, Department of Toxic Substances Control, and Department of Transportation
- County of San Bernardino (including San Bernardino County Flood Control District)
- Regional Water Quality Control Board
- Department of Health Services
- Other various cities and water supply agencies

Other public agencies not listed here may also choose to utilize this PEIR to evaluate discretionary actions for compliance with CEQA guidelines and regulations.




| VICINITY MAP SHOWING CHINO BASIN | TOM DODSON & ASSOCIATES<br>Environmental Consultants | FIGURE 3.1-1 |
|---|---|---|
| Source: Wildermuth Environmental, Inc. | | |

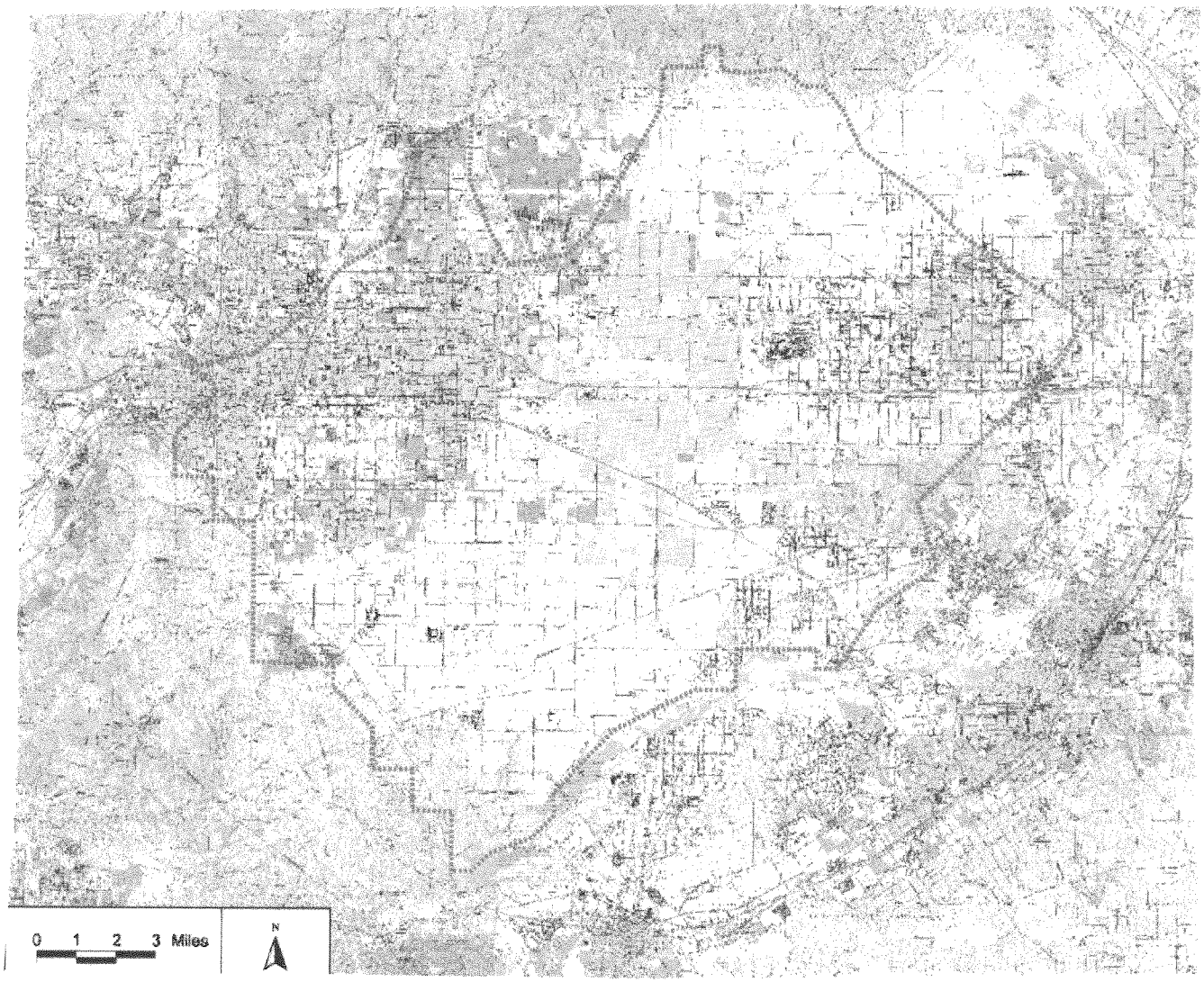



**CHINO GROUNDWATER BASIN LEGAL AND HYDROLOGIC BOUNDARIES**

Source: OBMP Phase I Report, Figure 1-1

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 3.1-2**

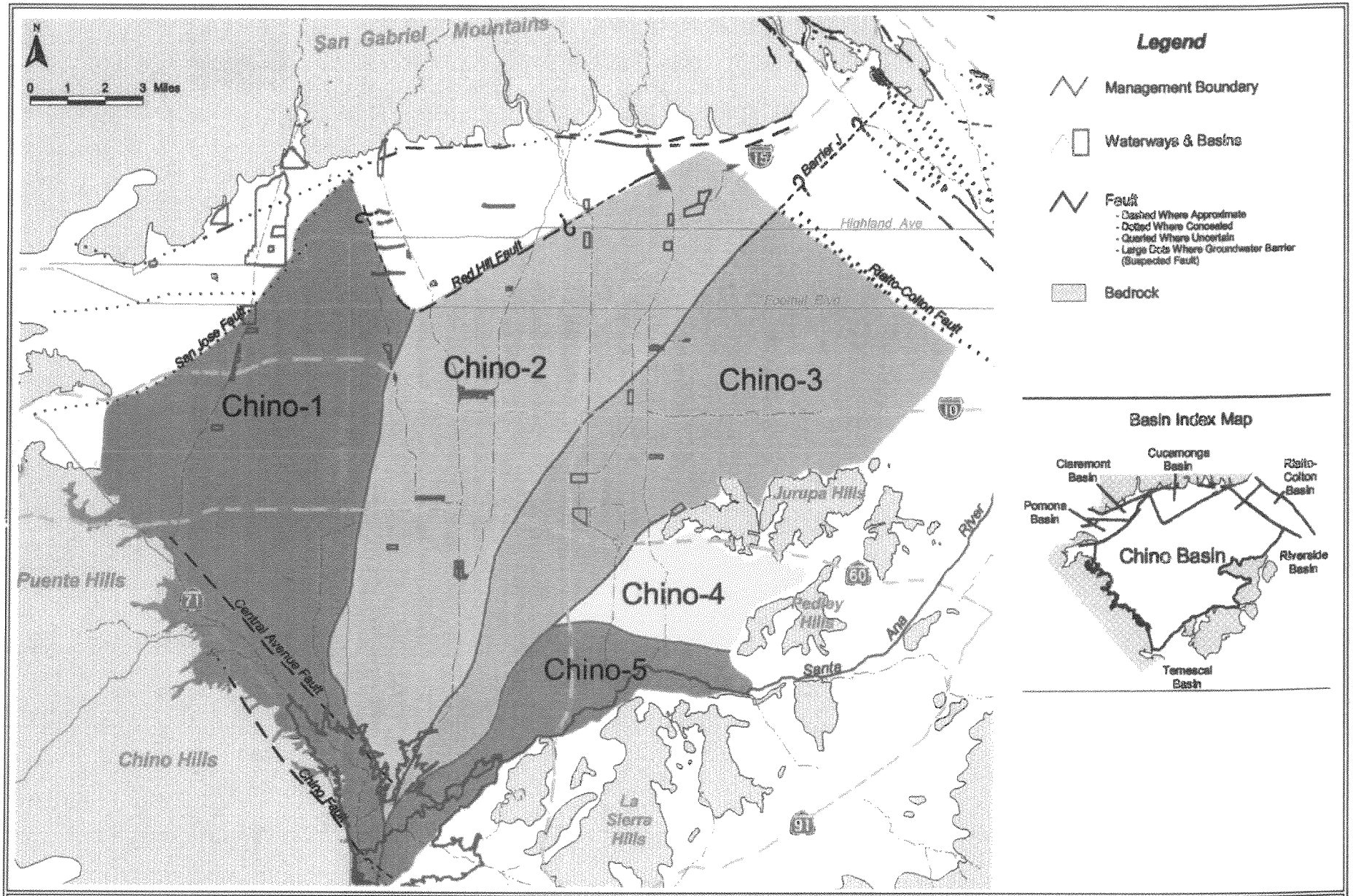



**CHINO BASIN LEGAL BOUNDARIES RELATIVE TO USGS 7.5 MINUTE SERIES QUADRANGLES**

Source: Wildermuth Environmental, Inc.

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Environmental Consultants

**FIGURE 3.2-1**

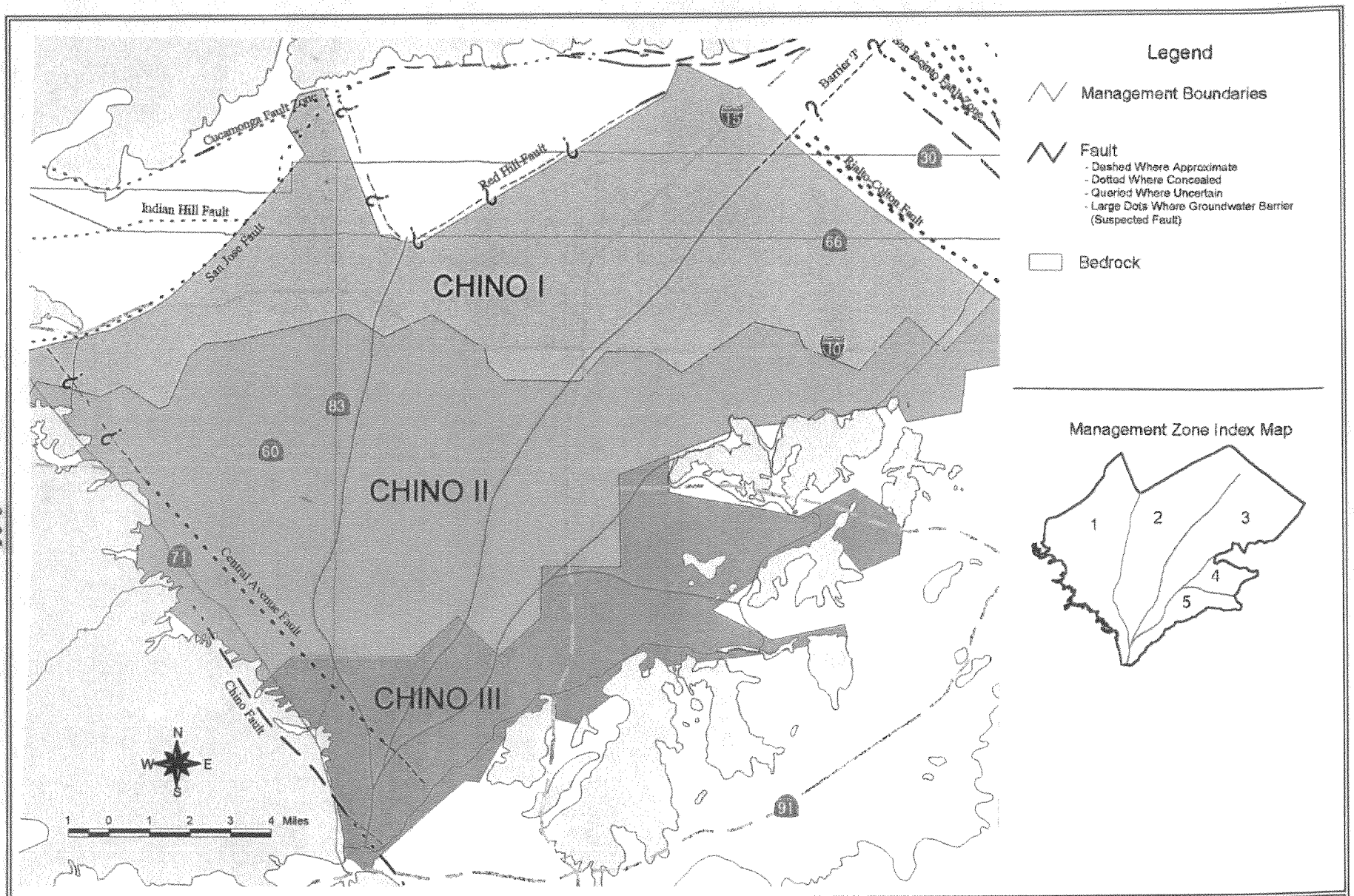



**CHINO BASIN MANAGEMENT ZONES**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 3.2-2**

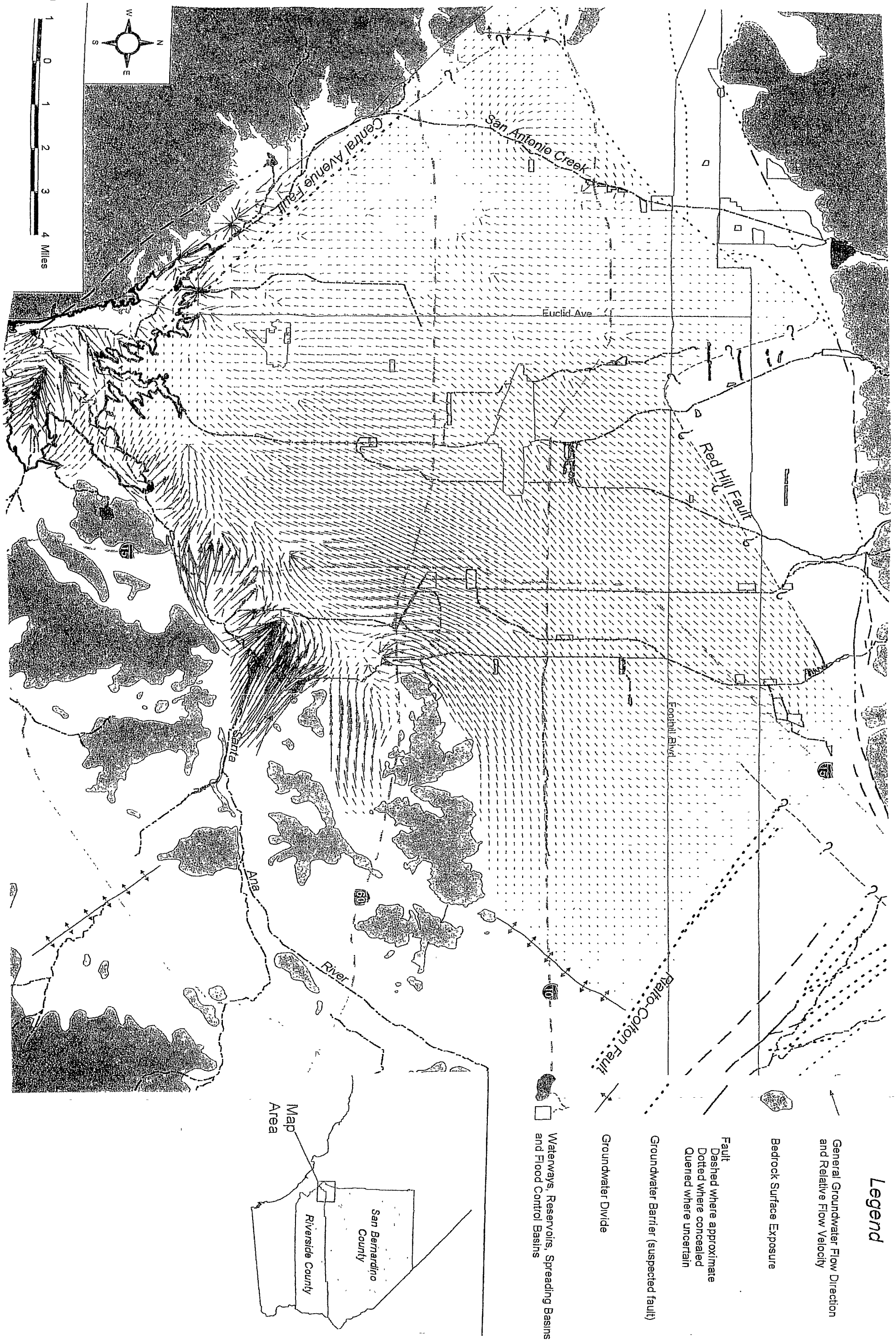



**CHINO SUBBASINS DEFINED IN THE 1995 BASIN PLAN**

Source: OBMP Phase I Report, Figure 2-6

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Environmental Consultants

**FIGURE 3.2-3**

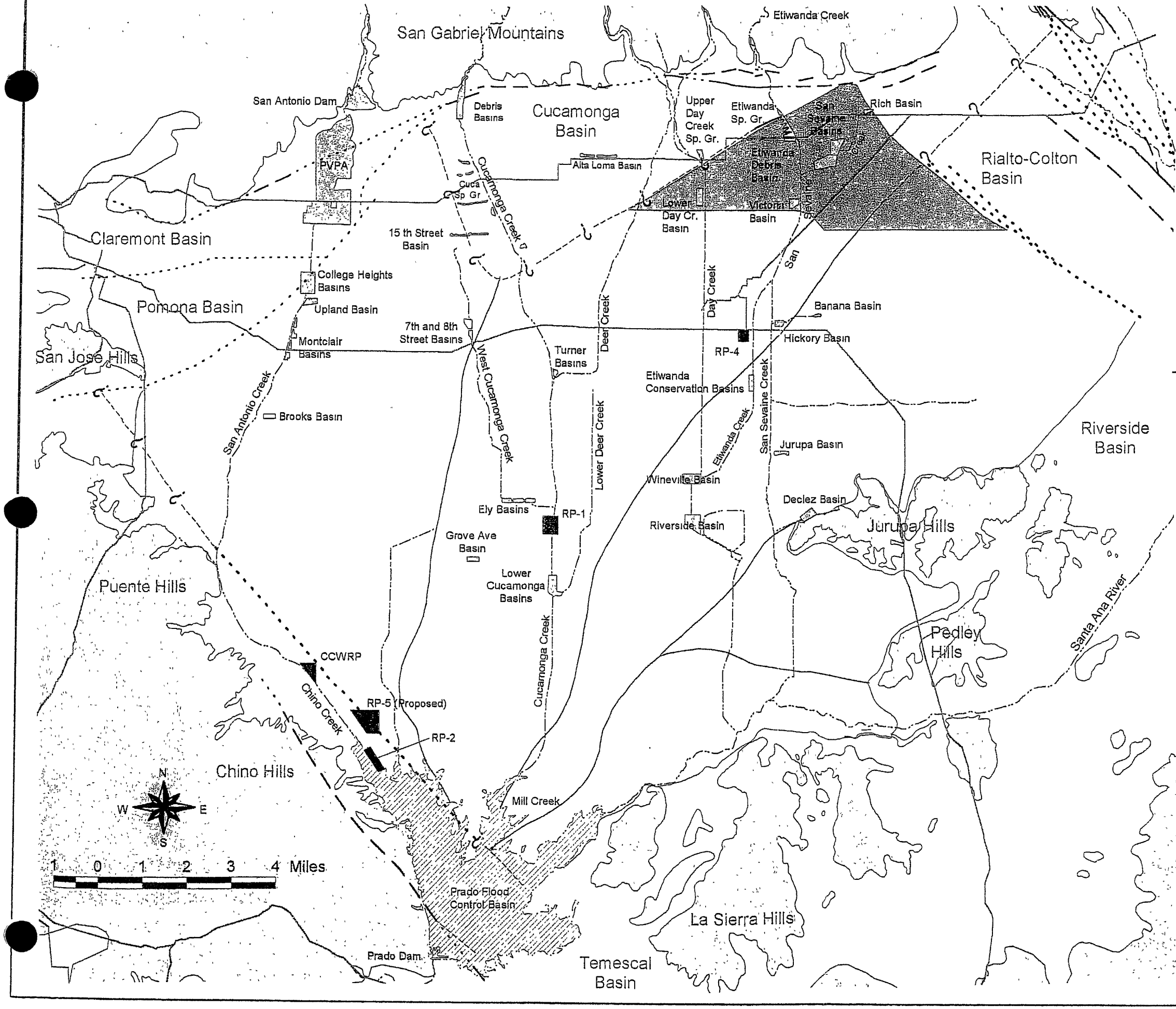



**CHINO BASIN GROUNDWATER FLOW MODEL**

Source OBMP Phase I Report, Figure 4-4

**TOM DODSON & ASSOCIATES**
Environmental Consultants

**FIGURE 3.2-4**




## Legend

- Preferred Recharge Area for New Basins
- Flood Control / Conservation Basins
- IEUA POTW's
- Prado Flood Control Basin
- Hydrologic Chino Basin
- Bedrock
- MWD Pipeline
- Stream System
- Management Boundaries
- Fault
  - Dashed Where Approximate
  - Dotted Where Concealed
  - Queried Where Uncertain
  - Large Dots Where Groundwater Barrier (Suspected Fault)

### Management Zone Index Map

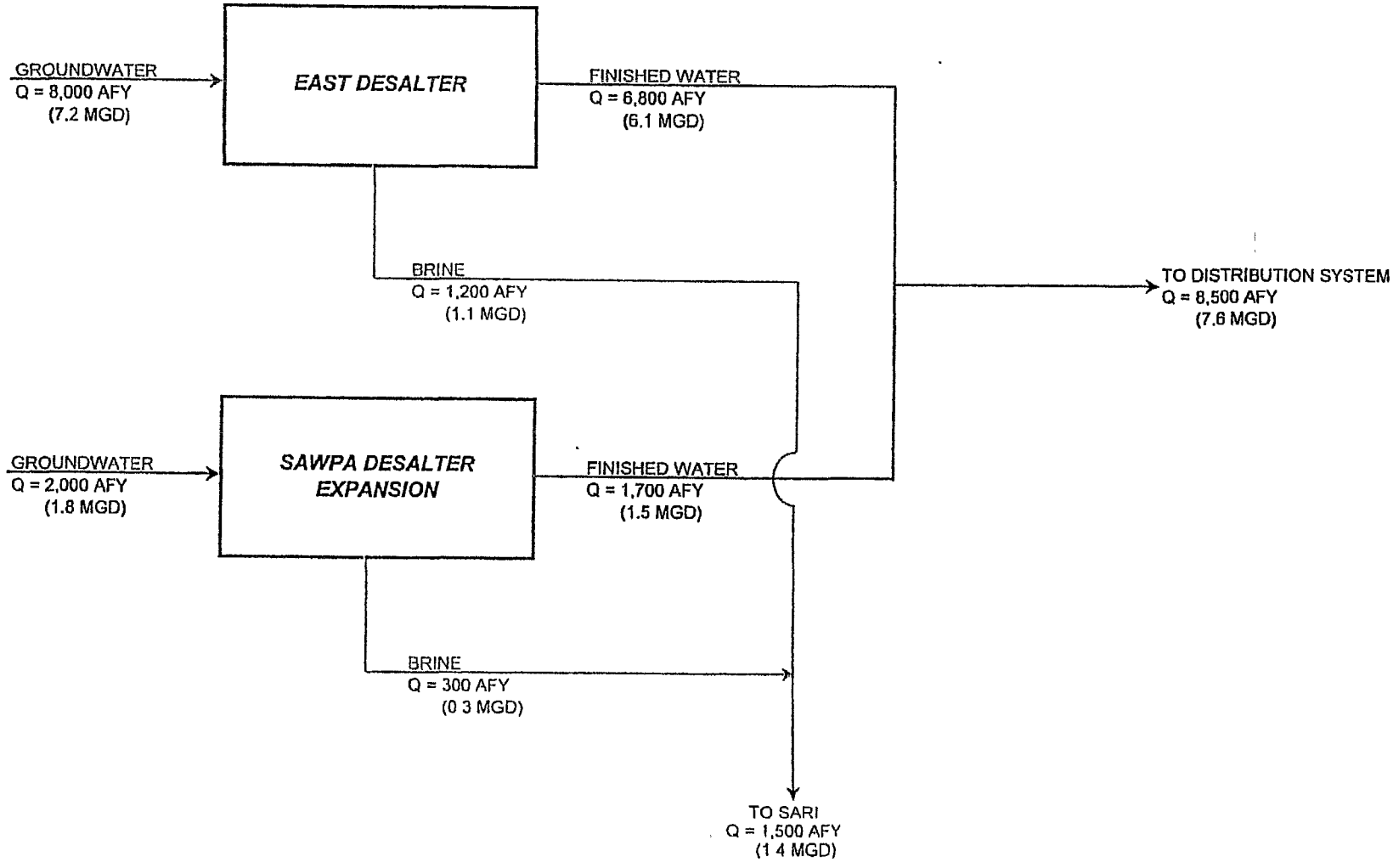



**FIGURE 3.3-1**

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Environmental Consultants

**OBMP PROPOSED EXISTING RECHARGE BASINS**

Source: OBMP Phase I Report, Figure 4-1

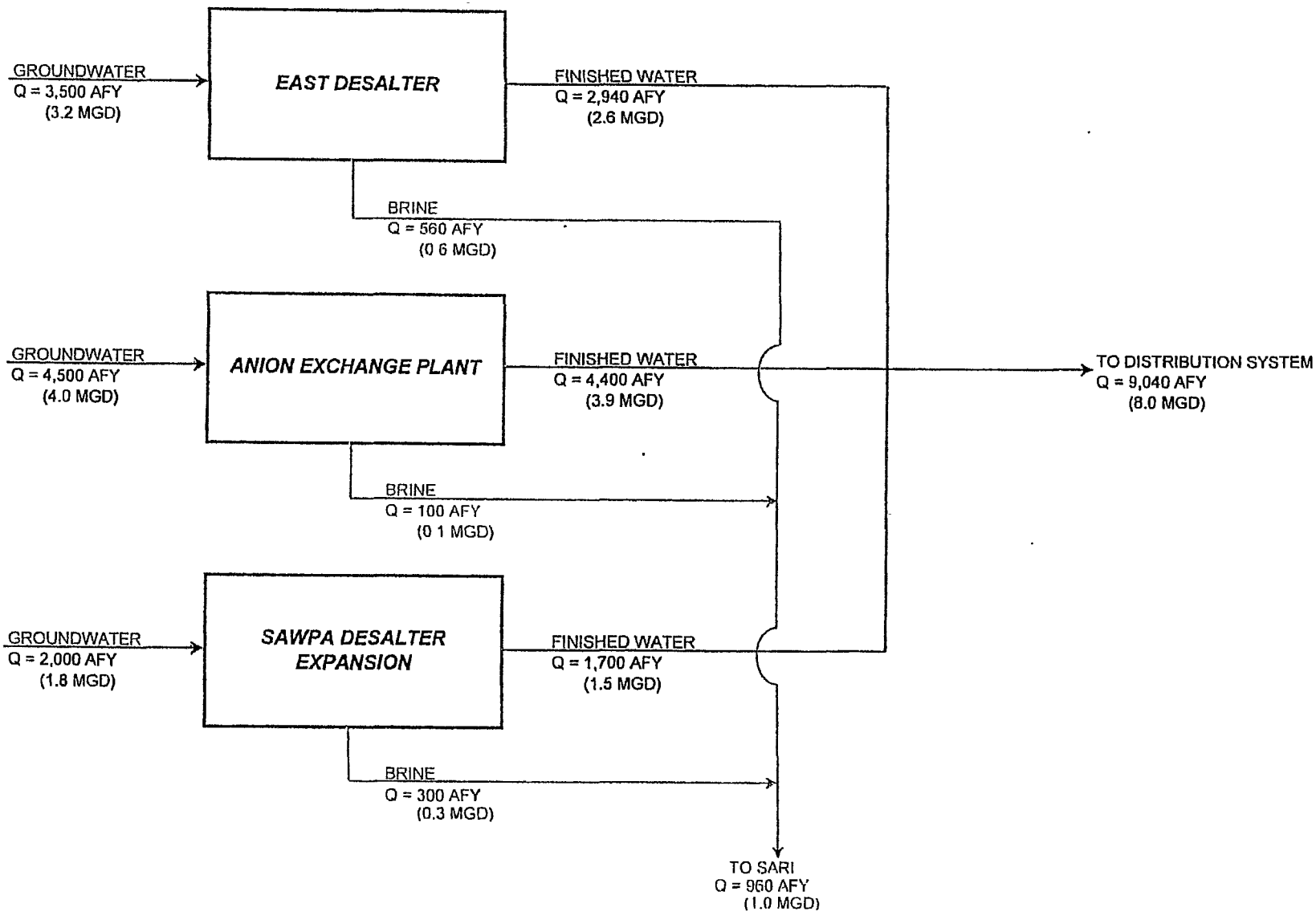



**RO ALTERNATIVE: KEY ELEMENT PROCESSES**

Source Black & Veatch, Water Supply Facilities Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 3.3-2**




**RO/IX ALTERNATIVE: KEY ELEMENT PROCESSES**

Source. Black & Veatch, Water Supply Facilities Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 3.3-3**

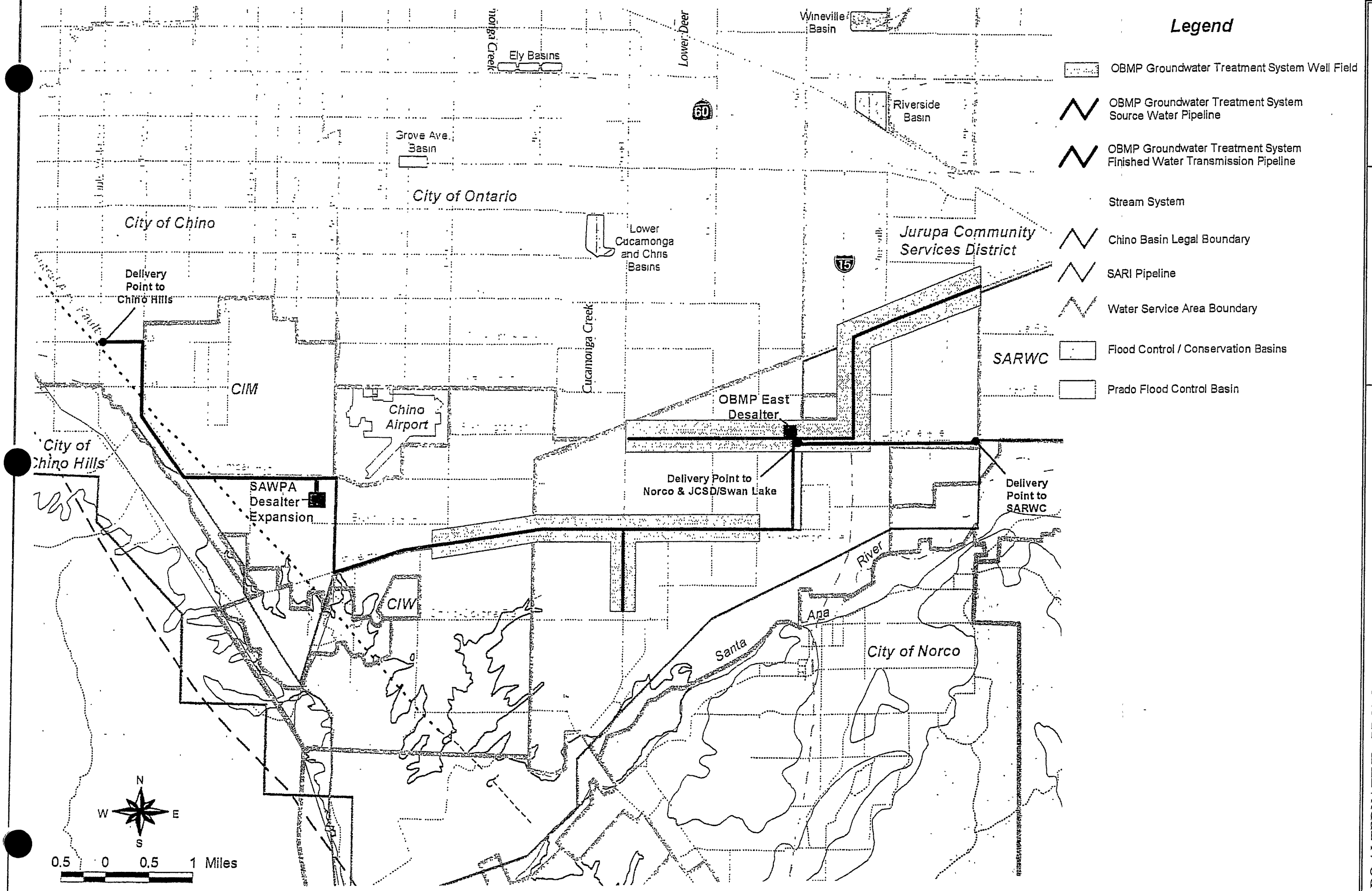
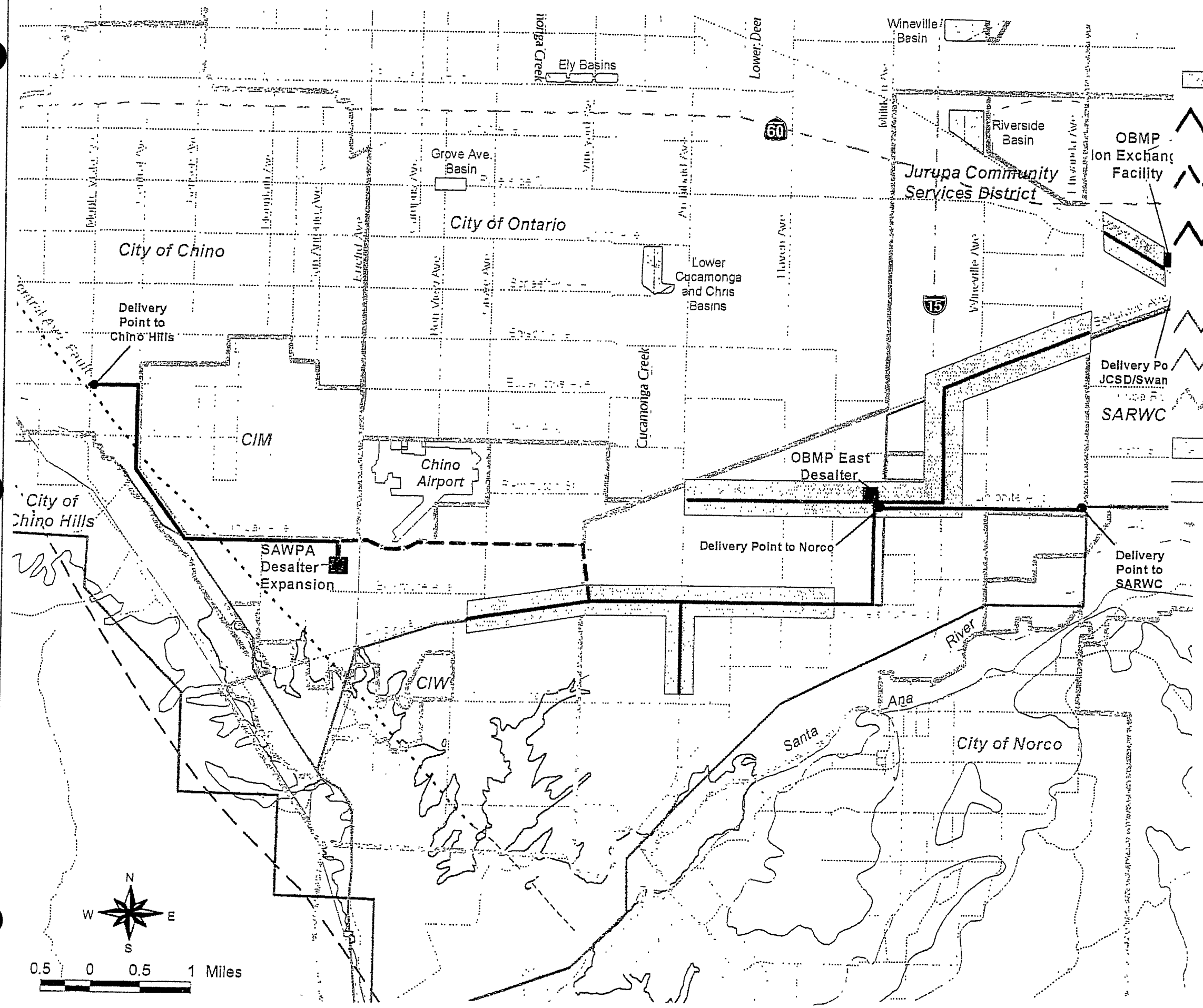



**FIGURE 3.3-4**

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**RO ALTERNATIVE: PROPOSED FACILITIES LOCATIONS**

Source: Black and Veatch, Water Supply Facilities Plan




## Legend

- OBMP Groundwater Treatment System Well Field
- OBMP Groundwater Treatment System Source Water Pipeline
- Existing JCSD Finished Water Transmission Pipeline from SAWPA Desalter (To be used as OBMP Groundwater Treatment System Source Water Pipeline)
- OBMP Groundwater Treatment System Finished Water Transmission Pipeline
- Stream System
- Chino Basin Legal Boundary
- SARI Pipeline
- Water Service Area Boundary
- Flood Control / Conservation Basins
- Prado Flood Control Basin

**FIGURE 3.3-5**

TOM DODSON & ASSOCIATES
Environmental Consultants

**RO/IX ALTERNATIVE: PROPOSED FACILITIES LOCATIONS**

Source: Black and Veatch, Water Supply Facilities Plan

# CHAPTER 4
# ENVIRONMENTAL IMPACT EVALUATION

Note: All Chapter 4 figures are located at the end of their subchapter, not immediately following their reference in the text.

## 4.1 INTRODUCTION

This chapter of the Program Environmental Impact Report (PEIR) provides the detailed information used to forecast the type and significance of potential adverse environmental impacts that implementation of the Optimum Basin Management Program (OBMP) and subsequent specific project approvals can cause if the Program is implemented as proposed. In the following subchapters each of the environmental topics identified in the Notice of Preparation (NOP) and scoping meeting as having a potential to cause significant impact is evaluated. The environmental impact analysis section for each environmental topic is arranged in the following manner:

a. An introduction that summarizes the specific issues identified in the NOP and the scoping process as issues of concern for the specific environmental topic;

b. A summary of the current or existing environmental setting for each physical resource or human infrastructure system is presented as the physical baseline for the environment from which impacts will be forecast;

c. Based on stated assumptions, the potential impacts without applying any mitigation are forecast and the significance of impacts is assessed using identified criteria or thresholds of significance;

d. Recommended measures that can be implemented to substantially lessen potential adverse environmental impacts are identified, and their effectiveness in reducing impacts to non-significant levels is evaluated;

e. Potential cumulative adverse environmental impacts are assessed under each environmental topic, where applicable; and

f. Unavoidable adverse environmental impacts, including significant unavoidable impacts, are identified, and any adverse impacts that may be caused by implementing mitigation measures are addressed.

In order to provide the reviewer with a criterion or set of criteria with which to evaluate the significance of potential adverse impact, this document provides issue specific criteria, i.e., thresholds of significance, for each topic considered in this PEIR. These criteria are either standard thresholds

established by law or policy (such as ambient air quality standards) or project-specific evaluation thresholds that are developed and used specifically for this project. After comparing the forecasted physical changes in the environment that may be caused by the proposed project with the significance threshold criterion or criteria, a conclusion is reached on whether the proposed project has the potential to cause a significant adverse environmental impact for the issue being evaluated.

Measures to reduce adverse environmental impacts are identified and described in this chapter of the PEIR. Over that past several years, mitigation has evolved in scope and complexity. As society responds to environmental issues that affect whole communities, last year's mitigation measures are integrated into rules and regulations, such as the Uniform Building Code or Water Quality Control Plans. Measures incorporated into rules and regulations become mandatory requirements (not discretionary) and they no longer need to be identified as project specific mitigation measures. Land use jurisdictions, such as the cities or county within the project area, similarly incorporate former mitigation measures into the agency's "standard conditions of approval" for projects under their purview.

Finally, as developers and planners become more sophisticated, they integrate sound environmental mitigation into their project design. As a result, the boundary between regulatory requirements, standard conditions, proponent design guidelines and mitigation measures identified in environmental documents, all designed to reduce significant environmental impacts, gets blurred. The discussion of mitigation measures under each environmental topic summarizes all of the various measures anticipated to be incorporated into the OBMP to reduce potential significant adverse environmental effects, either to the extent feasible or to a level of non-significance. After determining the degree of mitigation that can be achieved by the proposed measures and after identifying any adverse impacts that the mitigation measures can cause, a conclusion is provided regarding the significant and/or unavoidable adverse impact for each environmental topic.

This document utilizes conservative (worst case) assumptions in making impact forecasts based on the assumption that the impact forecasts should over predict (if they cannot be absolutely quantified) consequences, rather than under predict them. The information used and analyses performed to make impact forecasts are provided in depth in this document to allow reviewers to follow a chain of logic for each impact conclusion and to allow the reader to reach independent conclusions regarding the significance of the potential impacts described in the following subchapters. Reviewers are encouraged to comment on the analyses, conclusions and the thresholds of significance used to make the forecasts of adverse environmental impacts in this PEIR.

# 4.2 LAND USE

## 4.2.1 Introduction

Land use issues were included as a topic for evaluation in this PEIR because implementation of the OBMP will result in the installation of water management facilities throughout the project area. These facilities will be constructed to minimize incompatibilities with existing and prospective future uses on adjacent land. Although water supply facilities are not required to comply with land use designations of general plans, whenever feasible, efforts will be made to ensure that the proposed water supply facilities are generally supportive of overall goals and policies presented in the General Plan for the area in which facilities are proposed. The NOP and scoping processes identified several land use issues that are evaluated in this subchapter of the PEIR. The following land use issues have been identified as having a potential to experience significant impact:

- Land use conflicts (construction and operation impacts),
- Growth inducement,
- Inconsistencies between proposed project and applicable general plans and regional plans,
- OBMP proposals for dealing with transition of agricultural operations to urban uses in the southern end of the Basin,
- General plans and master facility plan consistency with OBMP, and
- Effect of implementing OBMP projects on acreage that could be used for development, i.e., displacement or loss of development potential.

This subchapter of the PEIR addresses the above issues and has been compiled by relying primarily upon data contained in a previous planning document prepared in support of the Chino Basin Water Resources Management Study and the general plans and other pertinent planning documents for the project area. These planning documents include the "Final Task 1 Memorandum, Water and Wastewater Planning Environment" (1993) and the general plans for the following agencies: cities of Chino Hills, Chino, Fontana, Ontario, Montclair, Norco, Pomona, Rancho Cucamonga, and Rialto; the counties of Riverside and San Bernardino; and the Southern California Association of Government publications: Regional Comprehensive Plan and Guide (RCPG) and Regional Mobility Plan (RMP). One issue examined in this subchapter is growth inducement. It is a key issue of concern related to implementation of the OBMP and by examining it in this first chapter of the PEIR, the stage is set to include the implications for growth in all subsequent sections of this document.

## 4.2.2 Environmental Setting

### 4.2.2.1 Existing Land Use Designations

In order to forecast potential land use impacts, data on existing land uses is required at two different scales. The first level of analysis is to provide land use data (existing land uses and general plan land use designations) at the broadest scale within the project area. To accomplish this it was necessary to compile information regarding the total area (acreage) that may be impacted by implementing the OBMP and the general land use patterns within the area of potential impact. The second level of analysis is to assess the land uses (existing and designated) within the immediate vicinity of proposed OBMP or related facility/infrastructure improvements. This brings the land use focus down to the project specific level where individual facility land use compatibility issues can be addressed.

The boundary of the Chino Basin, as illustrated in Figures 3.1-2, encompasses all or a portion of each of the jurisdictions identified above. A decision has been made in this document to address the land use impacts for each city within the Basin. This decision is based on two factors. First, water from within the Basin can be used to support development throughout a city's boundaries, which means that existing and future land uses in areas adjoining the Basin may be dependent upon water resources in the Chino Basin. Second, the physical boundaries of the Chino Basin do not coincide with the arbitrary boundaries of cities. As a result of these poorly defined overlapping boundaries, it is almost impossible to segregate the land uses within a city between those in and those out of the Basin. Therefore, the evaluation of land use issues which follows addresses the total land within each city that in some manner overlies the Chino Basin.

The "Final Task 1 Memorandum" (Memorandum) was prepared in 1993 by a team led by James M. Montgomery, Consulting Engineers (now Montgomery Watson). This document establishes a baseline for land uses within a "Study" area that will be used in this PEIR. Table 4.2-1 lists the planning areas and agencies included within the Study area. Figure 4.2-1 illustrates the boundaries of the areas included within the Study area. Using land use data from the 1990 Southern California Association of Governments (SCAG) Land Use Survey and reviews of the pertinent city and county general plans, the planning and land use data for the Study area were compiled in the document. Although 1990 data were used in this document, it remains representative for the general evel of land use evaluation conducted- in this PEIR. This is because the land use patterns were essentially established, either existing or planned, by 1990 and with the exceptions noted below. No major changes in land use have occurred during the 1990s. Where major changes in land use have occurred, such as the annexation of unincorporated agricultural lands to the Cities of Ontario and Chino, these changes are discussed separately in the following text.

The Study area defined in the Memorandum encompasses an estimated 225,937 acres, extending from Pomona on the west to portions of City of Rialto and Jurupa Community Services District (JCSD) on the east and Rancho Cucamonga on the north and Corona on the south (see Figure 4.2-1). The western portion of the study area is fully urbanized, with very little remaining areas to be

developed within the cities of Pomona, Claremont, Upland and Montclair. For example, according to the Montclair General Plan (1981) about 12 percent of that city remained undeveloped in 1981 (467 acres out of 3,894 acres). Within these developed communities redevelopment of existing urbanized land is more common than conversion of open space or agricultural land to urban uses.

**Table 4.2-1**
**STUDY AREA DEFINITION AND PLANNING AGENCIES**

| Planning Area | Planning Agency |
|---|---|
| Bloomington / Fontana | San Bernardino County |
| California Institute for Men, Chino | State of California |
| California Institute for Women, Frontera | State of California |
| Chino | City of Chino |
| Chino Airport | San Bernardino County |
| Chino Hills | City of Chino Hills |
| Chino Hills State Park | State of California |
| Claremont | City of Claremont |
| Corona[1] | City of Corona |
| El Prado Park and Golf Course | San Bernardino County |
| Fontana | City of Fontana |
| Jurupa | Riverside County |
| La Verne | City of La Verne |
| Montclair | City of Montclair |
| Norco | City of Norco |
| Ontario | City of Ontario |
| Pomona | City of Pomona |
| Rancho Cucamonga | City of Rancho Cucamonga |
| Rialto[1] | City of Rialto |
| Riverside Agricultural Preserve[2] | Riverside County |
| San Antonio Heights (included with Upland) | San Bernardino County |
| San Bernardino Agricultural Preserve | San Bernardino County |
| Upland | City of Upland |

[1] Portion of area included in study area.
[2] Included in Jurupa Community Services District Plan.

In contrast the City of Fontana General Plan (1989) indicated that out of 33,623 acres within its City and Sphere of Influence boundaries, 19,756 acres or 58.7 percent of the area within the City remained undeveloped in 1989. Thus, the western half of the Basin is more intensely urbanized than the eastern half of the Basin, but the whole Study area is rapidly becoming a fully urbanized region of southern California. New development is rapidly converting historic agricultural and open space areas in the eastern and southern portion of the Study area, while the existing urbanized areas in the western portion of the Study area have their land uses established and the future consists of redevelopment, not new development, in a manner consistent with the established land use pattern. Overall, the structure has been established for the conversion of agricultural uses to urbanized uses in the future, yet to date, the actual uses have not changed significantly.

Within the Study area the existing land uses in 1990 were dominated by residential development (~29%) and vacant areas and agricultural land (~43%). Table 4.2-2 summarizes the current and future land use within the Study area. The pattern of land uses in 1990 is depicted on Figure 4.2-2. The vacant land within the Study area occurs primarily in the southern, northern and central portion of the Study area. Open space areas in the southern portion of the Study area are dominated by Chino Hills State Park (recreational open space), Prado Basin (Santa Ana River flood control and riparian woodland/wildlife habitat) and agricultural lands. Open areas to the northeast consist of privately owned land that has substantially transitioned or is in transition to residential land uses. The Jurupa Hills form an open space island in the central eastern portion of the Study area.

**Table 4.2-2**
**SUMMARY OF CURRENT AND FUTURE LAND USE**

| Code | Land Use Type | Current (acres) | 2020 (acres) |
|---|---|---|---|
| 1100 | Residential | 65,078 | 99,389 |
| 1200 | Commercial and Services | 13,250 | 19,404 |
| 1300 | Industrial | 15,836 | 39,224 |
| 1400 | Transportation, Communications, and Utilities | 11,794 | 15,046 |
| 1500 | Mixed Commercial and Industrial | 213 | 872 |
| 1600 | Mixed Urban (residential, commercial and industrial) | 18 | 20,241 |
| 1700 | Under Construction | 4,020 | 0 |
| 1800 | Open Space and Recreation | 3,864 | 24,791 |
| 1900 | Urban Vacant | 9,478 | 0 |
| 2100 | Cropland and Improved Pasture Land | 19,211 | 2,387 |
| 2200 | Orchards and Vineyards | 3,963 | 0 |
| 2300 | Nurseries | 708 | 0 |
| 2400 | Dairy and Intensive Livestock | 8,335 | 55 |
| 2500 | Poultry Operations | 222 | 0 |
| 2600 | Other Agriculture | 1,539 | 237 |
| 2700 | Horse Ranches | 962 | 0 |
| 3100 | Vacant Undifferentiated | 61,725 | 49 |
| 3200 | Abandoned Orchards and Vineyards | 2,107 | 0 |
| 3300 | Vacant With Limited Improvements | 225 | 0 |
| 4100 | Water, Undifferentiated | 888 | 0 |
| 4400 | Water Within a Military Installation | 37 | 0 |
| 4500 | Area of Inundation (flood control and reservoirs) | 0 | 4,242 |
| 9000 | Undefined | 2,466 | 0 |
| | TOTAL | 225,937 | 225,937 |

Note: Current land use is based on 1990 SCAG Land Use Survey. Future land use is based on city and county general plans.

The acreage allocated to water infrastructure and facilities within the Study area is not summarized because it is too difficult to abstract from the broad land use categories. Land Use Code 1400 (see

Table 4.2-2) identifies that amount of acreage allocated to transportation, communication and utility infrastructure. The majority of the acreage under this category consists of roads and electricity transmission corridors, often underlain by water and wastewater pipelines. Water facilities, consisting of reservoirs, treatment plants, and recharge basins are part of the 11,794 acres assigned to this land use code within the Study area. This represents about 5.2 percent of the total land area within the Study area. This percentage utilization for utility infrastructure is consistent with an allocation of approximately 5 percent of total land areas to such uses. Much of the water infrastructure consists of subsurface pipelines which do not conflict with overlying uses, such as roads, residential, commercial or other uses.

Figure 4.2-3 illustrates the future pattern of land uses within the Study area. In 1990, the 2020 land uses within the Study area were envisioned to effectively eliminate agriculture, from about 10 percent current to about one percent ultimate. Residential uses account for 44 percent of the ultimate land use and industrial uses expand by about 250 percent to about 17.3 percent of ultimate land development. The greatest change in land use forecast at ultimate development is the effective elimination of the "Vacant Undifferentiated" land use category in the future land use forecast. The land use pattern expected to evolve in the future is essentially an extension or duplication of the level of urban development, which currently exists in the western portion of the Study area, throughout the Study area, with some exceptions. The exceptions include the large open space associated with Prado Basin flood control activities and agricultural land that will be maintained in the southernmost portion of the Study area.

The ultimate land use shown in Figure 4.2-3 did envision the gradual transition of the San Bernardino County Agricultural Preserve to urban uses. In 1994, the San Bernardino County Local Agency Formation Commission allocated the total preserve area (about 15,400 acres) to the cities of Chino and Ontario. That portion of the preserve north of Merrill Avenue was assigned to Ontario's Sphere of Influence (8,200 acres) and the portion south of Merrill Avenue to the San Bernardino County Line was assigned to Chino's Sphere of Influence (7,200 acres). The Ontario Sphere of Influence is formally designated by the City as the "New Model Colony" area and was annexed on November 30, 1999. These Sphere areas are shown in Figure 4.2-4. Since allocation of the Spheres to the cities, the City of Ontario has annexed the whole 8,200 acre area (1999). Proposed uses are consistent with those portrayed in Figure 4.2-3 and include 5,200 acres of residential uses, 504 acres of commercial uses, 338 acres of industrial and business park uses, 500 acres of educational uses, 888 acres of parks and trails and 776 acres of other public and infrastructure uses. A few hundred acres of agricultural uses are expected to remain.

The City of Chino has annexed 1,810 acres of its expanded Sphere known as Subarea 1 (see Figure 4.2-5). Within Subarea 1 the land use designations include: 605 acres of industrial; 320 acres of agriculture; and 885 acres of greenspace (area within the Prado Flood Control Basin subject to inundation. Additional annexations within the assigned Sphere are under consideration, but no other annexation have yet been completed. Due to a substantial amount of acreage in Chino's Sphere

being located within Prado Basin, a substantial portion of greenspace will be retained, comparable to the open space shown in the southern portion of Figure 4.2-3.

Other annexations have occurred since the Montgomery report was published, but these annexations have been consistent with the land use designations contained in each city's general plans and as generally shown in Figure 4.2-3.

#### 4.2.2.2 Discussion of Regulations Controlling Water Facility Infrastructure Development

California Government Code Section 53091 specifies that water supply facilities, such as those associated with the OBMP, are exempt from zoning restrictions. Specifically, the text of the Section 53091 states: *Zoning ordinances of a county or city shall not apply to the location or construction of facilities for the production, generation, storage or transmission of water....* The purpose of this section is to ensure that water system infrastructure can be installed to meet the demand by all water consuming land uses and it recognizes the universal role that water supply plays within our society.

The majority of general plans within the Study area contain Infrastructure Elements or otherwise discuss water supply in only the most general terms. For example, the Ontario General Plan states: *Infrastructure means underpinnings - the basic urban systems and services that keep a community functioning. Although historically citizens have not paid much attention to infrastructure systems unless they weren't working properly, as freeways become more congested and landfills are closed, infrastructure capacities will command more public attention in the future.* This statement is followed by two goals: *Goal 1.0: Ensure an adequate supply of safe water for Ontario residents and businesses* and *Goal 2.0: Ensure that the use and consumption of water is properly managed.* These two themes, adequacy of supply with sufficient delivery infrastructure and managing consumption and use of water, are key issues of discussion within all of the general plans affecting the Study area, regardless of whether the water purveyor within the City is operated independently or by the City. Based on the above referenced California Government Code section and the general support for water system infrastructure contained in the general plans, there are very few land use regulation constraints that will limit the future development of adequate water system infrastructure to support the OBMP. It should be noted that most agencies carefully coordinate the implementation of water system infrastructure, particularly storage reservoirs which have a substantial visual presence, to ensure that individual facilities meet the overall goals and objectives of the general plans, not just the water supply and management goals and objectives, whenever possible.

### 4.2.3 Project Impacts

Implementation of the OBMP will result in direct physical change to existing land uses within the Study area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study area. Thus, the potential environmental impacts from implementing the OBMP can be divided into those specific projects that the Watermaster and individual water serving agencies (WSA) will construct and

operate and any indirect responsibility for future growth that may be assigned to OBMP implementation within the Study area. Table 4.2-3 contains a list of potential projects and the estimated acreage that will be required to support their development in the future as they are funded by the Watermaster or individual WSA. Figure 4.2-6 shows the water service area and lists the WSA that deliver municipal water within the Study area. The information contained in this table and figure will be used to discuss environmental impacts throughout much of this subchapter and the remainder of the document.

**Table 4.2-3**
**PROPOSED FACILITIES RELATED TO THE OBMP**

| Recharge Facility Description (MOA List of Facilities) | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Upland Basin | 5,000 afy | 14.6 | Yes | Northern portion | |
| Pipeline | | 0.6 | No | Northern portion | Assumes a 500' connection pipeline and a 50' easement |
| College Heights SW Basin | 4,500 afy | 12.9 | Yes | Northern portion | |
| Pipeline | | 9.1 | No | Northern portion | Assumes 7,920' connection pipeline and a 50' easement |
| College Heights SE Basin | 6,500 afy | 18.0 | Yes | Northern portion | |
| Pipeline | | 0.6 | No | Northern portion | Assumes a 500' connection pipeline and a 50' easement |
| Brooks Street Basin | 4,000 afy | 15.0 | Yes | Middle portion | |
| Pipeline | | 0.8 | No | Middle portion | Assumes a 660' connection pipeline and a 50' easement |
| Eighth / Seventh Street Basins | 2,500 afy | 27.0 | Yes | Northern portion | |
| Pipeline | | 2.3 | No | Northern portion | Assumes a 1,980' connection pipeline and a 50' easement |
| Etiwanda Conservation Area | 22,000 afy | 40.0 | Yes | Middle portion | |
| Pipeline | | 1.1 | No | Middle portion | Assumes a 1,000' connection pipeline and a 50' easement |
| Lower Day Basin | 8,000 afy | 17.7 | Yes | Northern portion | |

## Table 4.2-3
## PROPOSED FACILITIES RELATED TO THE OBMP

| Recharge Facility Description (MOA List of Facilities) | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Pipeline | | 3.8 | No | Northern portion | Assumes a 3,300' connection pipeline and a 50' easement |
| Victoria Basin | 4,000 afy | 15.0 | Yes | Northern portion | |
| Pipeline | | 0.6 | No | Northern portion | Assumes a 500' connection pipeline and a 50' easement |
| San Sevaine Basins 1-5 | 6,000 afy | 86.0 | Yes | Northern portion | |
| Pipeline | | 4.6 | No | Northern portion | Assumes 4,000' connection pipeline and a 50' easement |
| Turner Basin | 1,500 afy | 19.0 | Yes | Middle portion | |
| Pipeline | | 7.6 | No | Middle portion | Assumes 6,600' connection pipeline and a 50' easement |
| Hickory Basin | 1,500 afy | 11.0 | Yes | Northern portion | |
| Pipeline | | 0.6 | No | Northern portion | Assumes a 500' connection pipeline and a 50' easement |
| Etiwanda Percolation Ponds | 4,000 afy | 10.0 | Yes | Middle portion | |
| Pipeline | | 9.1 | No | Middle portion | Assumes a 7,920' connection pipeline and a 50' easement |
| Jurupa Basin | 3,600 afy | 60.0 | Yes | Northern portion | |
| Pipeline | | 3.0 | No | Northern portion | Assumes 2,700' connection pipeline and a 50' easement |
| RP-3 Plant Facility | 3,000 afy | 50.0 | No | Middle portion | |
| Pipeline | | 12.0 | No | Middle portion | Assumes a 10,000' connection pipeline and a 50' easement |
| Wineville Basin | 4,500 | 75.0 | Yes | Middle portion | |
| Pipeline | | 12.0 | No | Middle portion | Assumes a 10,000'connection pipeline and a 50' easement |

## Table 4.2-3
## PROPOSED FACILITIES RELATED TO THE OBMP

| Recharge Facility Description (MOA List of Facilities) | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Total (New Pipelines and New Basins) | | 117.8 | | | |
| Total | 80,600 afy | 539.0 | | | |

| OBMP Desalter Alternative 6A (Reverse Osmosis Only) | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Transmission pipelines | 32,000 ft | 36.7 | No | Southern portion | This estimate of 32,000 is sized for ultimate capacity |
| East Desalter | 34.0 | 17.0 | No | Southern portion | |
| Pump Station for East Desalter | 1.0 | 1.0 | No | Southern portion | |
| New Wells for East Desalter | 24.0 | 12.0 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| SAWPA Desalter Expansion | 2.0 MGD | 1.0 | No | Southern portion | |
| Pump Station for SAWPA Desalter Expansion | 1.0 | 1.0 | No | Southern portion | |
| New Wells for SAWPA Desalter | 2.0 | 1.0 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| West Desalter | 3.8 MGD | 1.9 | No | Southern portion | |
| Pump Station for West Desalter | 1.0 | 1.0 | No | Southern portion | |
| New Wells for West Desalter | 3.0 | 1.5 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| TOTAL | | 74.1 | | | |

## Table 4.2-3
## PROPOSED FACILITIES RELATED TO THE OBMP

| OBMP Desalter Alternative 6A (Reverse Osmosis with Loan Exchange) | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Transmission pipelines | 32,000 LF | 36.7 | No | Southern portion | This estimate of 32,000 is sized for ultimate capacity |
| East Desalter | 24.6 MGD | 12.3 | No | Southern portion | |
| Pump Station for East Desalter | 1.0 | 1.0 | No | Southern portion | |
| New Wells for East Desalter | 18.0 | 9.0 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| SAWPA Desalter Expansion | 2.0 MGD | 1.0 | No | Southern portion | May be combined with East Desalter expansion |
| Pump Station for SAWPA Desalter Expansion | 1.0 | 1.0 | No | Southern portion | |
| New Wells for SAWPA Desalter | 2.0 | 1.0 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| West Desalter | 3.9 MGD | 2.0 | No | Southern portion | |
| Pump Station for West Desalter | 1.0 | 1.0 | No | Southern portion | |
| New Wells for West Desalter | 3.0 | 1.5 | No | Southern portion | Possibly more wells will be needed if actual production is less than expected |
| Ion Exchange Plant | 9.3 MGD | 4.7 | No | Southern portion | This plant will use JCSD wells, no new wells would be constructed |
| TOTAL | | 66.5 | | | |

## Table 4.2-3
## PROPOSED FACILITIES RELATED TO THE OBMP

| OBMP Monitoring Plan Wells, and Other Projects | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| Ultimate Number of New Monitoring Wells | 50.0 | 11.5 | No | Throughout Basin | Assumes 100' x 100' construction easement. The actual number of wells necessary may be considerably less, but this is a worst-case scenario. |
| San Antonio Water Company Future Production Wells | 2.0 | 1.0 | No | Northern portion | Assumes 0.5 acre/well |
| Baseline Feeder Western Extension | | | No | | |
| Expansion of Lloyd Michael Water Treatment Plant | 45 MGD expansion | 22.5 | No | Northern portion | Assumes 0.5 acre/MGD |
| CCWD transmission / distribution pipelines | | | No | | |
| CCWD storage facilities | | | No | | |
| CCWD spreading facilities | | | No | | |
| CCWD Blending Stations and Treatment Facilities | | | No | | |
| CCWD Booster stations | | | No | | |
| CCWD Production Wells and Manifold System | | | No | | |
| CCWD Connection to MWDSC Facilities | | | No | | |
| State of California Production Wells | 2.0 | 1.0 | No | Southern portion | Assumes 0.5 acre/well |
| State of California Exchange Treatment Plant | | | Yes | Southern portion | |
| City of Chino New Production Well | 1.0 | 0.5 | No | Middle portion | More wells may be constructed in the future but exact details are not yet known |
| City of Chino Nitrate Removal Facility | 11,000 AF | | | | |
| | | | | | |

**Table 4.2-3**
**PROPOSED FACILITIES RELATED TO THE OBMP**

| OBMP Monitoring Plan Wells, and Other Projects | Quantity | Facility Area (in acres) | Is Facility Pre-Existing? | Location (of Chino Basin) | Comments |
|---|---|---|---|---|---|
| City of Chino Construction of Recycled Water Distribution System | | > 30 acres | No | South portion | |
| Baseline Feeder Extension | | | | | |
| Pipeline | 40,000 LF | 45.9 | No | Middle portion | 50 feet easement |
| Appurtenances | 1,000 ft | 0.02 | No | | 10 appurtenance x 100 sq ft each |
| Reservoir | 1 | 1.0 | No | | |
| New Pump Station | 1 | 1.0 | No | | |
| Modifications to Existing Pump | 1 | 1.0 | Yes | | |
| TOTAL | | 115.5 | | | |

### 4.2.3.1 Threshold of Significance

There are no formal standards or thresholds for evaluating the significance of land use impacts. Even when evaluating a potential for land use conflicts, a number of factors must be considered (such as noise, different activity patterns of land uses, odors, etc.) in determining the significance of potential conflicts. Since there are no formal thresholds that define significant land use impacts, the following thresholds will be utilized in evaluating the significance of potential land use impacts from implementing the OBMP:

- The project causes an unavoidable conflict with a general plan land use designation or zoning classification;
- The project conflicts with, or is inconsistent with, applicable environmental plans or policies adopted by agencies with jurisdiction over the project to the extent that the conflict is unavoidable and unresolvable;
- The project is incompatible with existing land use in the vicinity;
- The project results in an unavoidable disruption or division in the physical arrangement of an established community (including a low-income or minority community; and
- The project induces significant growth within the project area or in the region.

Each of these significance thresholds will be applied to the potential land use impacts forecast to occur from implementing the OBMP, and a conclusion regarding the significance of potential land use impacts will be clearly presented in the following analysis.

### a. Can implementation of the OBMP cause significant conflict with the General Plan or zone designations?

The four main treatment of facilities that will be implemented in support of the OBMP include recharge basins, desalting facilities, monitoring wells and pipelines. Specific locations for these facilities (other than rehabilitation and use of existing recharge basins) have not been selected at this point in time. Therefore, the location of these facilities will be determined on a case-by-case basis in the future. Each of these facilities is designed to enhance the safe yield of the Basin and improve water quality, which is consistent with the statement in California Government Code Section 53091 that such facilities are not subject to zoning ordinances. Each of these facilities is also consistent with the general goals, objectives and policies of general plans within the Study area that an "adequate supply of safe water" be provided for residents and that use and consumption of water is properly managed. With the possible exception of direct conflicts with adjacent land uses, discussed below, implementation of the OBMP is not forecast to cause any significant conflicts with general plans or zoning designations in for those jurisdictions within the Study area. This conclusion is based on the findings outlined above and the recognition in the general plans for communities in the Study area that adequate water system infrastructure is an essential component of future growth, just as are adequate roads, utilities, wastewater and other infrastructure systems.

With regard to potential conflicts with regional plans, the regional population forecasts contained in the SCAG publications, particularly the RCPG, are all based on the adopted general plans of the jurisdictions located within the Study area. The OBMP does not contain any policies or propose any activities that would modify or affect any general plan; it simply provides a program to manage the Chino Basin's safe yield and enhance future water quality for the Study area's water purveyors as they provide water to meet the future water demands envisioned in these general plans. The activities that will be supported by the OBMP are one level removed from the actual design, construction and operation of the water systems required to meet the demand from future growth within the Study area communities. As such, the implementation of the OBMP is consistent with the RCPG population forecast and has no potential to modify this forecast in any manner.

In SCAG's March 1996 RCPG, the Metropolitan Water District of Southern California (MWDSC) prepared an evaluation of water resource issues as they affect most of the southern California region and all of the Study area. The planning horizon utilized in this evaluation was the year 2010. The following conclusion regarding the balance between water supply and water demand is included in this document:

*The projected yield from existing and potential supplies is estimated to total 5.02 MAF, which will meet consumptive demands of 4.54 MAF and have water stored in surface reservoirs and ground-*

*water basins for use in drier years. The supply augmentations and water management programs (such as development of reclaimed water, development of storage strategies including conjunctive use of imported surface and local groundwater supplies, and water conservation) are consistent with mitigation measures for water supplies proposed in SCAG's 1989 Growth Management Plan Environmental Impact Report.*

*In the year 2010, regional consumptive demand with BMP implementation is expected to increase from 4.54 MAF to 4.85 MAF under drought condition due to the hotter and drier weather. At the same time, water supplies are expected to decrease. Under a record drought such as 1991, existing water supplies could dwindle to 2.40 MAF as shown in Table 10-9. Recognizing that it is too expensive to plan for no shortages under extreme drought conditions, MWDSC's reliability goal for its service area allows for a 10 percent reduction in water demand beyond BMPs at a frequency of one in 50 years. Hence, the water supply augmentation and water management programs being pursued are expected to yield 4.35 MAF to meet 90 percent of the region's consumptive demands (see Figure 10-5).* (MAF = million acre feet and BMPs = Best Management Practices)

The OBMP is a water management program specifically designed to provide supply augmentation by implementing use of recycled water, implementation of storage strategies (such as stormwater runoff conservation), conjunctive use of the local groundwater supply in the Chino Basin, and treatment of poor quality water. Therefore, its implementation will serve as one program designed to meet the goals outlined in the discussion of water resources within the RCPG. The OBMP is, therefore, considered to be fully consistent with the regional plan addressing this issue for southern California, including the Study area.

**b. Will the project create a significant conflict with applicable environmental plans or policies adopted by agencies with jurisdiction over the project?**

The agency with jurisdiction over adoption and implementation of the OBMP is the Chino Basin Watermaster and the individual WSA that serve water customers or manage wastewater within the Study area. The applicable environmental policies that affect the Study area are contained in the local jurisdiction general plans and the agencies with oversight regarding the proposed activities contained in the OBMP. These agencies include the California Department of Health Services (DHS) that regulates the reuse of recycled water and the Santa Ana Regional Water Quality Control Board and the Water Quality Control Plan Santa Ana River Basin (1995 Basin Plan), which establishes beneficial uses and water quality objectives for water resources in the Chino Basin.

Regarding the environmental plans and policies contained in general plans of local land use agencies within the Study area, implementation of the OBMP has a potential for significant conflicts with certain policies or general plan elements. However, each of these environmental plan/policy issues are discussed separately in this PEIR and the following summarizes the conclusions reached in these evaluations regarding potential for significant conflicts with such plans:

1. Geology/Seismic Hazards: Because the OBMP management activities may raise or lower the water table in certain locations, potential geologic or seismic constraints may be increased within the Study area which would conflict with goals, objectives and policies in general plans. The evaluation of these issues in the PEIR indicates that such a potential does exist from implementing the OBMP, but it can be managed on a site-by-site basis in the future to prevent the significant expansion of liquefaction zones or subsidence zones within the Study area.

2. Flood Hazards: The OBMP envisions the use of flood control basins and the use storm flows for recharge which could alter the potential for downstream flood hazards. Evaluations in the hydrology discussion of this document indicate that the potential for significant conflicts with flood management goals outlined in general plans can be managed on a case-by-case basis to ensure that adequate capacity is maintained in flood control basins and that diversions from storm runoff do not create adverse flood hazards downstream of such facilities.

3. Fugitive Dust Hazards: Some of the general plans and the South Coast Air Quality Management District (SCAQMD) Air Quality Management Plan (AQMP) address high wind conditions and fugitive dust control policies. Some OBMP projects will result in disturbing areas with exposure to high wind conditions (Santa Ana winds) or that will generate fugitive dust. Specific fugitive dust/wind erosion control measures are outlined in the AQMP and these measures will be implemented for OBMP projects to ensure that fugitive dust generating activities do not conflict with control plans.

4. Environmental Risks: Many of the general plans identify policies for addressing the potential risks associated with utilizing hazardous materials or transporting fluids by pipeline that could degrade the environment through accidental releases. These activities are also addressed as part of the San Bernardino County Hazardous Waste Management Plan. These issues are discussed in the hazards section of the PEIR and with implementation of mitigation measures to minimize risks from accidental releases and to restore any areas contaminated by such releases, implementation of the OBMP will not create a significant conflict with policies addressing hazardous materials use and management of potential contamination.

5. Noise: OBMP projects will result in creating short-term noise effects on the environment and facilities, such as wells and desalters, have a potential to cause noise during operation (long-term) because of pumps and other related facilities. Noise thresholds are established in local general plans. Implementation of the OBMP will be carried out in conformance with these noise thresholds or standards and as a result, the OBMP's Program's implementation is not forecasted to have significant conflicts with the goals and policies of the local jurisdiction general plans with regards to noise.

6. Mineral Resources: Because many of the best locations for percolating or recharging water to the Basin are located in areas that overlay aggregate mineral resources (coarse, young alluvial deposits), a potential exists for new recharge basins or recharge wells to conflict with policies

for retaining access to such mineral resources. This issue is addressed in the PEIR and based on the limited area of new recharge basins and the fact that they do not inherently conflict with mining operations, no significant conflict was identified between OBMP implementation and mineral resource policies in Study area general plans.

7. Cultural Resources: Cultural resources (Native American, prehistoric and historic) occur throughout most of the Study area and a potential exists for OBMP facilities to impact such facilities in conflict with plans and policies contained in Study area general plans. Specific mitigation measures have been identified to ensure that cultural resources are given adequate protection as individual facilities are developed in the future. With implementation of such mitigation measures, no significant conflicts with cultural resource goals and policies in Study area general plans is forecast to occur.

8. Aesthetic Resources and Values: Each general plan for Study area jurisdictions defines significant views and aesthetic resources within a community. Goals and policies are established in these general plans to minimize conflicts with views, to protect scenic vistas and to meet aesthetic or design guidelines for new facilities. A potential exists for OBMP facilities to conflict with plans and policies contained in the Study area general plans. Specific mitigation measures have been identified to ensure that aesthetic resources are given adequate consideration and protection as individual facilities are developed in the future. With implementation of such mitigation measures, no significant conflicts with aesthetic or visual goals and policies in Study area general plans is forecast to occur.

9. Recreational and Open Space Resources: Each general plan for the Study area also identifies the type and extent of recreational facilities and open space resources that will be protected or established within a community. Goals and policies are established in these general plans to protect and minimize conflicts with recreational and open space resources. A potential exists for OBMP facilities to conflict with plans and policies contained in the Study area general plans. Specific mitigation measures have been identified to ensure that recreational and open space resources are given adequate consideration and protection as individual facilities are developed in the future. With implementation of such mitigation measures, no significant conflicts with recreational and open space goals and policies in Study area general plans is forecasted to occur.

With regard to DHS regulations related to use of recycled water and the Basin Plan beneficial use designations and water quality objectives for specific subbasins of the Chino Basin, a detailed analysis of water quality issues is provided in this document in the Water Resources/Water Quality subchapter. Fundamentally, the OBMP is designed to enhance water quality within the Chino Basin, but some specific activities, such as recharging recycled water, have a potential to conflict with the DHS regulations and the water quality objectives defined in the Basin Plan. Through a combination of managing future water production well locations, managing future recharge activities through blending and other measures, and extracting salt with desalters to increase salt removal or benefit for

the Chino Basin, the DHS and Basin Plan objectives and policies can be fulfilled without implementation of the OBMP causing a significant conflict.

As with any project being implemented as part of a program extending over many years, a potential exists for plans and policies to change or for a specific project to result in a potentially significant conflict with existing plans and policies. Based on the type of projects envisioned for implementation under the OBMP and the measures available to control or avoid such conflicts, the analyses in this PEIR indicate that such potential conflicts, as outlined above, can be managed, or reduced, to below a significant level of conflict. However, the California Environmental Quality Act (CEQA) process does provide a fail-safe mechanism for future projects by ensuring that each proposed specific project will be reviewed in the context of the findings and mitigation measures outlined in this document. Under the programmatic concept, OBMP implementation will be carried out by ensuring that all future specific facility projects, or future OBMP modifications, are evaluated under Sections 15162 and 15168 of the State CEQA Guidelines (copy attached for information in Appendix 8.2 of Chapter 8). Under this review process, if a specific project is identified as causing a significant impact in one of the issue categories addressed in this document or as causing a significant conflict with the plans and policies discussed above, that define significance thresholds, then a subsequent EIR will be prepared. Thus, the combination of the measures identified in this document and the mandatory CEQA procedures discussed above will ensure that no specific OBMP project or future OBMP amendment or modification will result in significant conflicts with plans or policies, without this information be made available to the decision-makers prior to a decision being made on such specific projects or amendments. Mitigation measures for specific issues outlined above are identified in the subchapter where the issue is evaluated in this PEIR.

### c. Will implementation of the proposed project cause incompatibilities with existing land use in the vicinity?

In the context of the two-tiered evaluation being conducted in this PEIR (general plan and specific project levels), the implementation of the OBMP will not cause any changes in existing land uses or existing land use designations as defined in the general plans of the local jurisdictions in the Study area. Fundamentally, each general plan assigns each parcel of land a specific land use and, in those limited instances where potentially incompatible land uses are located adjacent to one another, the general plans define those measures that must be implemented to ensure compatibility between such uses. Thus, where commercial uses and residential uses abut one another, specific lighting and noise incompatibilities posed by such juxtaposition are controlled by implementing controls on the intensity and direction of lighting and by implementing noise buffers that attenuate noise from commercial activities. Since the OBMP will not alter any existing general plans or land use designations, its implementation has no potential to cause any incompatibilities at the general plan level.

At the project specific level, future projects do have a potential to cause significant incompatibilities. However, specific incompatibilities cannot be defined until specific project locations are identified

for individual projects implemented under the OBMP. As was outlined above in the discussion of potential conflicts with environmental plans and policies, mitigation measures have been identified for specific land use conflicts that may potentially cause incompatibilities. These measures are discussed at a general level for the type of projects and activities that will be implemented under the OBMP.

Thus, where an OBMP project will be located adjacent to a potentially conflicting use (such as a production well adjacent to residential uses), the location of the facility may be moved, thus totally avoiding the incompatibility, or specific measures may be implemented to attenuate an impact. For the example given, the well pump could cause an incompatibility between a production well and residential uses due to noise impacts. Instead of relocating the well, the pump motor could be placed in a structure that would provide sufficient noise attenuation to ensure that the pump noise would not conflict with the adjacent residential use. As discussed in the previous section of this subchapter, for each of the major environmental issues specific measures have been identified that can reduce the impacts from implementing future OBMP projects to a non-significant level of impact, using the thresholds of significance identified for that issue (i.e,. noise attenuation for residential uses to below 50 decibel (dB) Community Noise Equivalent Level (CNEL) during evening hours).

Potential production well incompatibilities have already been discussed for residential uses. But the same incompatibility may occur if a production well must be placed near a biologically sensitive site. Where significant biological resources occur, avoidance of siting a facility may be the best way to avoid creating an incompatibility between land uses, but again, mitigation by attenuating sound levels to at or near background conditions may be a viable alternative for a particularly important production well site. Regardless, mitigation is available to ensure that the potential incompatibilities are either avoided, prevented or controlled to less than significant levels of impact.

The construction of OBMP facilities will generate noise and fugitive dust during construction. Specific measures to control fugitive dust and noise have been identified in these respective issue subchapters so that a nuisance (incompatibility) will not be caused while construction is in progress. During operation, the activity of delivering and recharging water does not pose any known direct conflicts, even when recharge facilities are located adjacent to sensitive land uses. However, recharge basins do pose an inherent safety hazard for trespass once in operation, so access controls (fences, etc.)may be installed to ensure that trespass is controlled, particularly by children, to the maximum extent feasible, unless a recharge basin takes the form of a small lake, pond or golf cousre landscape water formation..

Pipelines are generally placed underground and do not pose any potential incompatibility with surface uses overlying their location or with adjacent uses. Installing pipelines can create the same potential incompatibilities with adjacent uses as identified above for reconstructing existing recharge basins or constructing new recharge basins. An additional incompatibility from constructing pipelines, which are commonly placed in road or other utility rights-of-way, is the short-term disruption of traffic flow and creation of traffic hazards. Again, mitigation measures are identified to

ensure that pipeline construction activities do not create significant adverse impacts related to these conflicts in activities.

The desalters proposed for implementation are in essence, water treatment facilities that generate a modest amount of noise; that use hazardous materials; that serve to increase local traffic due to employment; and that are constructed in a manner to resemble a light industrial facility. Although desalter facilities and operations do not encompass activities typical of those associated with heavy industry or large commercial operations, the activities associated with a desalter would be considered incompatible where adjacent uses include residential uses or sensitive biological resource habitat. When desalters are considered for implementation in the future, part of the siting criteria will include avoidance of sensitive land uses that would result in placing incompatible land uses adjacent to one another, or to identifying the specific mitigation measures outlined in this document that will be implemented to reduce potential incompatibility to a non-significant level.

Mitigation is identified below for implementation with the OBMP when placing incompatible land uses adjacent to one another is considered. The implementation of a formal siting process for OBMP projects will either result in avoiding juxtaposition of incompatible land uses, or in the identification and implementation of sufficient mitigation to ensure that even when such uses are adjacent, no significant incompatibility will remain.

### d. Will implementation of the proposed project affect agricultural resources or operations (e.g. impacts to soils or farmlands, or impacts from incompatible land uses)?

The Chino Basin contains very significant agricultural resources, primarily dairy ranches that are located in the southern portion of the Basin. As described in the environmental setting discussion to this subchapter, actions have been taken (beginning in 1994) which have resulted in a large portion of the dairy ranches in San Bernardino County being annexed or available for annexation to the cities of Chino and Ontario. Agricultural uses are forecast to gradually shift to urban uses within the Study area, but there is no specific schedule for this transition to urban uses. The time period required for transition will depend upon future demand for urban development in the area, and the overall costs of operating, maintaining and closing the dairy ranches.

The first step in the transition to urban uses has been taken by most jurisdictions with agricultural areas (excluding some county areas) because new land use designations have been or are in the process of being assigned to the dairy ranch areas. As previously discussed, of the 8,200 acres recently annexed to the City of Ontario, 5,200 acres have been assigned residential designations, 504 acres commercial designations, 338 acres industrial, 500 acres for educational uses, and 776 acres are allocated to public and infrastructure uses. Thus, 89 percent of the recently annexed area are allocated to urban uses.

At the general plan level, the OBMP will not cause or contribute to the transition of agricultural land to urban uses. Increasing the safe yield of the Chino Basin and enhancing water quality through

treatment of water in the lower portions of the Basin with high Total Dissolved Solids (TDS) concentrations will has no identifiable potential to cause or contribute to this transition in uses. Thus, at the Study area planning level, OBMP implementation is not forecast to have any adverse effect on the agricultural to urban land use transition.

At the project specific level, the OBMP may have a very small impact on agricultural operations. First, the recharge basins must be located in the upper to middle portion of the Chino Basin in order to make the percolated water available for utilization within the Basin. Any recharge in the lower portion of the Basin would be difficult to capture and due to poor water quality, recharged water in the lower portion of the Basin could only be made available through treatment (desalting). Therefore, the installation and operation of such facilities has little or no potential to have a direct adverse impact on agricultural operations.

Since most pipelines will be placed within existing rights-of-way (implying that these alignments are already disturbed) and if placed under agricultural land would allow most agricultural operations to continue, the installation and operation of pipelines is not forecast to cause any measurable loss of agricultural land.

Production wells, monitoring wells and desalters have a reasonable possibility of removing some agricultural land from operation. The total acreage of removal for desalter and wells footprints is forecast to be less than 100 acres (see Table 4.2-3). Given the approximate 11,000 acres of agricultural land scheduled for conversion to urban uses in San Bernardino County alone, the potential conversion of less than 100 acres in support of OBMP projects is not forecast to be a significant impact to agricultural lands or operations. The project's contribution to cumulative removal of agricultural operations could be considered significant as discussed in more detail below, but mitigation is provided that will allow OBMP implementation to avoid contributing to a cumulative significant loss of land currently dedicated to agricultural operations and to cumulative conversion of important farmlands and prime agricultural soils located in the southern portion of the Basin.

**e. Will implementation of the proposed project disrupt or divide the physical arrangement of an established community (including a low-income or minority community)?**

At the general plan level the OBMP will not affect any existing land use designations and, therefore, its implementation has no potential to contribute to area divisions of the physical arrangements of existing communities in the Study area.

At the project specific level, the only proposed OBMP facilities large enough to create any physical divisions in the physical arrangement of communities would be pipelines and recharge facilities. Pipelines will be placed underground and therefore have no potential to cause any long-term physical divisions in communities. Recharge basins will be located within areas of high percolation, usually adjacent to existing stream channels or in areas where aggregate mining of coarse alluvium has occurred and/or is underway. The limited acreage of recharge basins within or adjacent to stream channels or mining areas is not forecast to increase the physical division of communities beyond that

which currently exists where such features are located. However, to ensure that no future recharge basins disrupt or divide the physical arrangements of established communities, project specific mitigation is identified below for implementation during the siting of such basins. Implementation of the recommended measure will ensure that established communities are not disrupted or divided by OBMP implementation.

### f. Will implementation of OBMP projects cause significant displacement or loss of acreage that could be used for development?

The estimate for total acreage that could be utilized by OBMP facilities (see Table 4.2-3) is about 728 acres. This can be compared to the 225,937 acres included in the Study area, of which more than 75,000 acres were vacant in 1990 (see Table 4.2-2). Of the facilities proposed, the pipelines and recharge basins are unlikely to permanently remove developable land from uses designated on the Study area general plans. This is because pipelines will be placed underground and should not conflict with surface uses and most of the recharge basins will be located adjacent to or within managed floodplains. These facilities comprise approximately more than 500 acres of the total forecast OBMP ground disturbance, leaving about 200 acres that may be developed on land that could be developed for direct urban purposes.

The proposed desalters, production and monitoring wells, and other facilities constitute the remaining ~200 acres of OBMP related facilities. These facilities will mostly be located in the southern portion of the Basin where desalting is required. This acreage is so small relative to the amount of vacant or agricultural acreage in this portion of the Basin (~25,000 acres in San Bernardino-Riverside counties), that the loss of this small amount of acreage is considered to be a non-significant adverse impact. Note that Table 4.2-2 identifies an additional 3,252 acres of land that is forecast to be converted to public and infrastructure uses. The estimated 728 acres of OBMP related ground disturbance is approximately 15.6 percent of this 3,252 acres which is consistent with the finding of non-significant impact made above. No mitigation is required other than the siting procedure already described below.

### g. Will implementation of the proposed project cause or contribute to significant growth inducement?

To understand the potential effect of the OBMP on future growth and growth inducement within the Study area, it is necessary to understand the role that the OBMP will play if it is implemented. The purpose of the OBMP is to provide an overall management strategy, tied to specific facilities and management actions, that will provide the Chino Basin with "*a groundwater management program that enhances the safe yield and the water quality of the Basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*" (Page 3-1, OBMP Phase I Report). The OBMP is not intended to be directly involved in supplying municipal water supplies to customers. Thus, the Program and its implementation are one step removed from actual development and provisions of adequate water supplies in support of building-out each jurisdictions' general plan. Perhaps most the Basin's WSA have already planned to serve the build-out populations within their

service areas. As a program, the OBMP may reduce costs and achieve a more reasonable mix of water supplies for these WSA's, but the program does not supplant the already existing requirement and planning efforts of the WSA's to provide the water supplies for the Study areas ultimate build-out population.

In this analysis of future growth and potential growth inducement, it is this document's contention that growth decisions have already been made by local agencies governing land use decisions, and further, that the OBMP does not remove any existing constraint on future development because existing WSA's have alternative means (perhaps not as cost or environmentally effective as the OBMP) to meet future water demands. This concept is embodied in policy principles adopted by the MWDSC's Board of Directors and restated as part of the RCPG's Water Resources evaluation for southern California. These policy principles state:

1. *Water supply is not a reason in and of itself to limit or control growth in California. There are sufficient water resources to accommodate continued population and economic growth through better management, including conservation, voluntary transfers and additional storage and conveyance facilities. Water supply for urban, agricultural and environmental uses will be adequate and reliable.*

2. *Growth management and the allocation and direction of development should be the responsibility of general purpose government. Utilities, including water purveyors, should provide adequate facilities to serve the project growth at the state, regional and local levels.*

3. *For planning and infrastructure purposes, water supply should be treated as a utility not required to be a general purpose government plan element. However, water purveyors at the state, regional and local levels should be members of any proposed infrastructure planning structure to ensure optimum coordination and infrastructure resources investment...*

The net effect of these principles is to define water infrastructure as following, not leading or causing development. The question still remains as to whether the implementation of the OBMP causes or accommodates growth and the related environmental impacts caused by the increased population that can occupy the Study area in the future. The answer to this question can be found in the land use planning process which now determines the future vision of the region at build-out as defined by general plans for the Study area and the regional planning documentation which already indicates that adequate water supplies are available to meet this future demand. As noted above, the OBMP does not provide an overall increase in availability of water, it provides a management plan that will more efficiently utilize the existing water resources found within the Chino Basin.

The ultimate vision of future growth and development within the project area was established in the governing Study area general plans, and it is assumed in these general plans that the WSA's have identified the infrastructure required to support the population which will be in place as growth occurs in the future. The net effect of these general plans is to create a set of expectations regarding future land use and growth that may or may not occur depending upon the actual carrying capacity of

the various utility and service resources required to meet future growth. It also seems clear that the established planning process and the overall growth pressures in southern California are the primary causes of future growth, i.e. they induce the actual growth that occurs, and the various utilities, such as the WSA's, are effectively forced to create urban water management plans that can accommodate such growth, at least within the limits of current or future resources that may be available. As the RCPG analysis of water resources indicates, there are sufficient water resources to meet future demand for the foreseeable future.

As noted above, the position taken in this document is that the utility planning process is more appropriately playing a passive (accommodating) role, not an active (inducing) role, in future growth that is dictated by local land use plans and the continuing growth of population throughout southern California. If communities within the project area chose to restrict growth and maintain a certain vision of the future as a static or slowly growing entity, the land use planning agencies (cities and counties) had the opportunity during the general planning process to establish such plans. Under such circumstances, the utility providers, including the WSA's would have designed their future service plans to accommodate a level of future growth consistent with available resources

In reality, however, the WSA's, acting as responsible water planning agencies, must plan for a level of future growth that appears to match available water resources with forecast growth through the 2010 planning horizon. At present the WSA water supply plans rely to a large extent on water importation. The OBMP provides an alternative management program for the Chino Basin that will reduce reliance on imported water and still allow the WSA to accommodate growth as envisioned in the Study area general plans. Based on this analysis, implementation of the OBMP is not considered to be a significant growth inducing action.

### 4.2.4 Mitigation Measures

The analysis above indicates that implementing the OBMP has only limited potential to cause significant adverse land use impacts. The following mitigation measures are recommended as actions that need to be implemented for individual projects proposed as part of the OBMP:

**4.2-1 Following selection of alternative sites for construction of future desalters, each site shall be evaluated for potential incompatibility with adjacent existing or proposed land uses. Where desalter operations can create significant incompatibilities (lighting, noise, use of hazardous materials, traffic, etc.) with adjacent uses, an alternative site shall be selected, or a technical report shall be prepared that identifies the specific measures that will be utilized to reduce potential incompatible activities or effects to below thresholds established in the general plan for the jurisdiction where the facility will be located.**

**4.2-2 Where future OBMP facilities are proposed on locations that support agricultural operations on important farmlands, alternative sites shall be selected that do not occupy such acreage (unless agricultural operations have already been terminated).**

**4.2-3 Prior to implementing each proposed water facility, the land use compatibility of the proposed facility with both existing and future potential adjacent uses will be evaluated for consistency relative to general plan goals. This evaluation will examine the specific activities associated with**

**the proposed facilities and determine whether specific incompatibilities, such as noise, fugitive dust, hazards or risk, or aesthetics would conflict with adjacent uses. Measures identified in the Subchapter of the OBMP PEIR will be used to mitigate potential incompatibilities where they are identified, or alternative locations will be selected.**

With implementation of these three measures, the only potentially significant land use issues related to OBMP implementation (incompatibility between a proposed specific facility or activity and sensitive land uses and cumulative contributions to removal of important farmlands) will be reduced below the significance thresholds outlined at the beginning of section 4.2.3.1. Originally the NOP scoping process identified six potentially significant impacts for further analysis. The analysis conducted for this PEIR, contained in Section 4.2, supports the conclusion that only two of these six issue are potentially significant and that with implementation of the mitigation measures listed above, impacts will be reduced to a less than significant level.

### 4.2.5 Unavoidable Adverse Impact

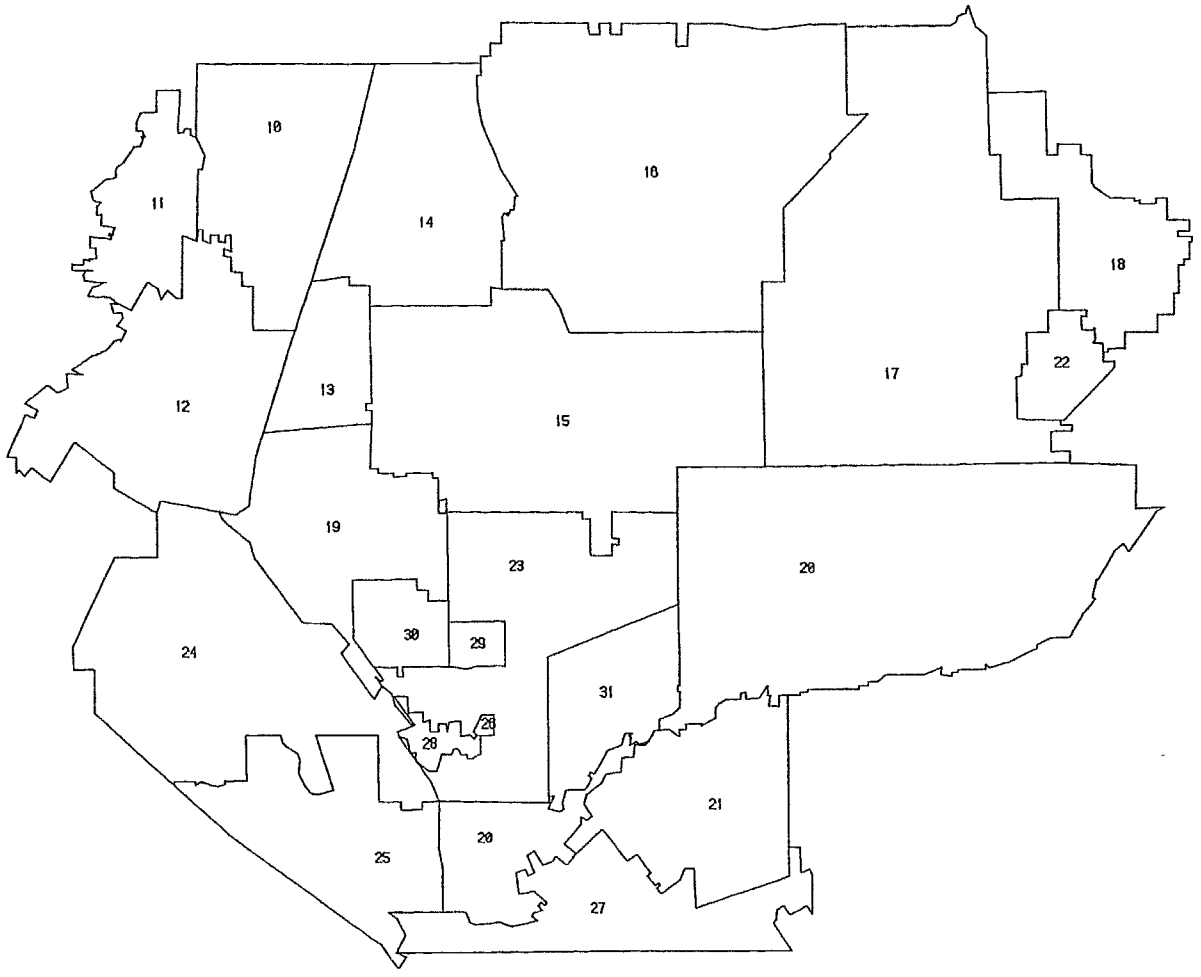
The land use impact evaluation presented above indicates that implementation of the proposed project will be consistent with the Study area general plan land use designations and environmental policies. Implementing the proposed project is not forecast to cause any direct or indirect significant adverse land use impacts after implementation of the two mitigation measures outlined above. Therefore, no significant unavoidable adverse land use impacts are forecast to occur if the OBMP is approved and implemented for the Chino Basin.

### 4.2.6 Cumulative Impact

The OBMP activities are specifically designed to provide a more efficient and effective program for managing all of the water resources that occur within the Chino Basin. The proposed project has been evaluated as being fully consistent with the Study area's general plans and the OBMP activities are not forecast to contribute to any land use incompatibilities with existing or future uses within the Study area based on implementing identified mitigation measures. The loss of agricultural land within the southern portion of the Chino Basin has been identified as an unavoidable cumulative impact from transition of the existing agricultural operations to urban uses. The OBMP could contribute to this loss of agricultural activity in a small, but cumulatively significant manner by converting up to 100 acres of agricultural acreage to OBMP program water resource uses. The project's potential contribution to this cumulative impact can be avoided by implementing the proposed mitigation outlined above.

Finally, the OBMP has been determined not to contribute to future growth as envisioned in the Study area general plans. This conclusion is based on two lines of reasoning: first, the OBMP replaces existing sources of water and water resources management that would have been used by individual WSA to meet future growth that is envisioned in the general plans and therefore, implementing the OBMP does not remove any constraint on growth; and second, the provision of water to meet future demand is determined to be growth accommodating, not growth inducing. The OBMP can be

implemented without causing or contributing to future significant cumulative growth or development within the Chino Basin.




Legend

| Area No | Planning Area Name |
|---|---|
| 10 | Claremont |
| 11 | La Verne |
| 12 | Pomona |
| 13 | Montclair |
| 14 | Upland (inlcuding San Antonio Heights) |
| 15 | Ontario |
| 16 | Rancho Cucamonga |
| 17 | Fontana |
| 18 | Rialto |
| 19 | Chino |
| 20 | Jurupa |
| 21 | Norco |
| 22 | Bloomington/Fontana |
| 23 | San Bernardino Agricultural Preserve |
| 24 | Chino Hills |
| 25 | Chino Hills State Park |
| 26 | California Institution for Women, Frontera |
| 27 | Corona |
| 28 | El Prado Park and Golf Course |
| 29 | Chino Airport |
| 30 | California Institution for Men, Chino |
| 31 | Riverside Agricultural Preserve |

Scale: 1 inch = 15,000 feet

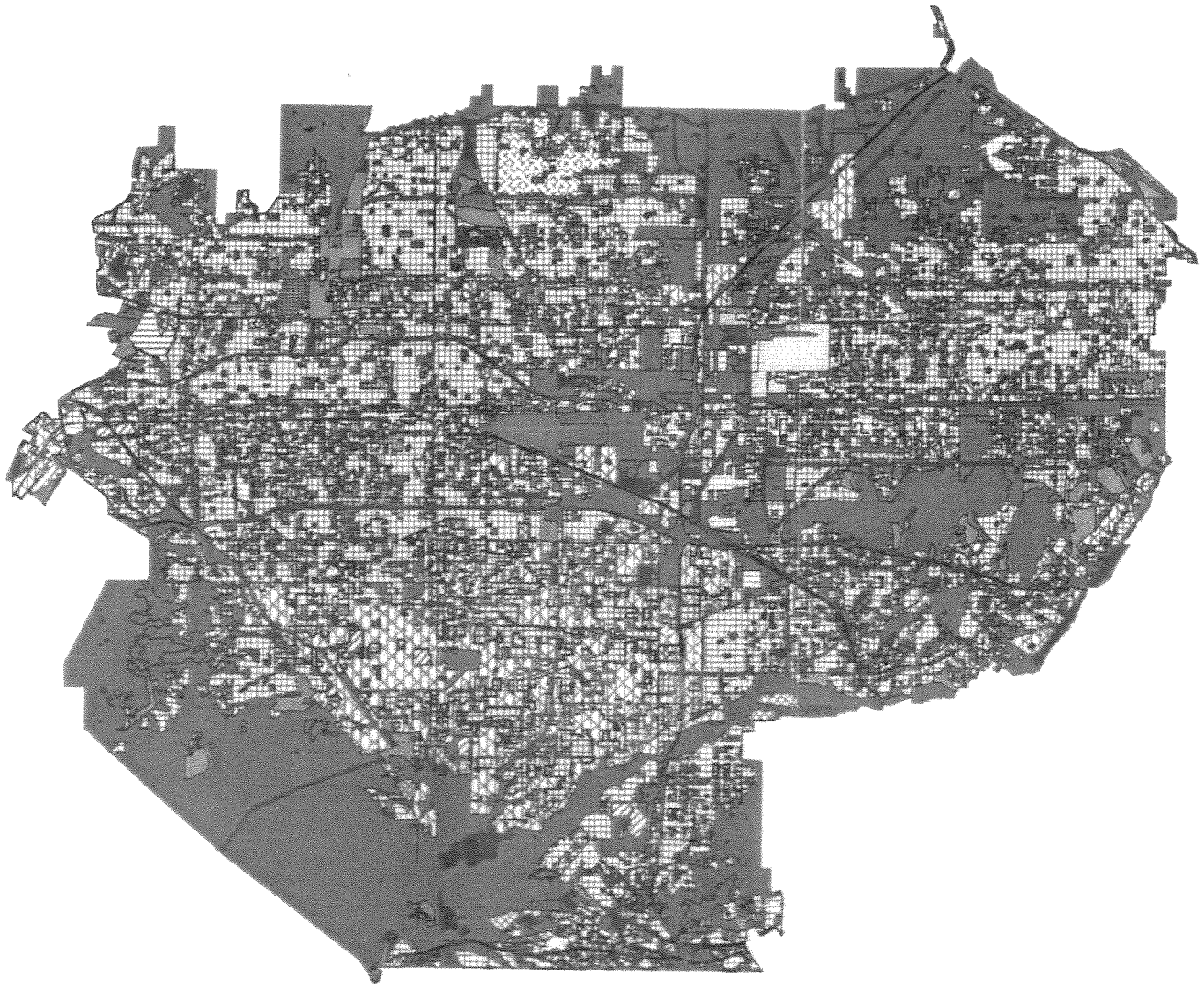
* Portions of Planning Area 23 have been annexed by the City of Ontario and are now part of Planning Area 15

**PLANNING AREAS**

Source. Chino Basin Water Resources Management Task Force, Final Task 1 Memorandum, Water and Wastewater Planning Environment, March 1993

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.2-1**



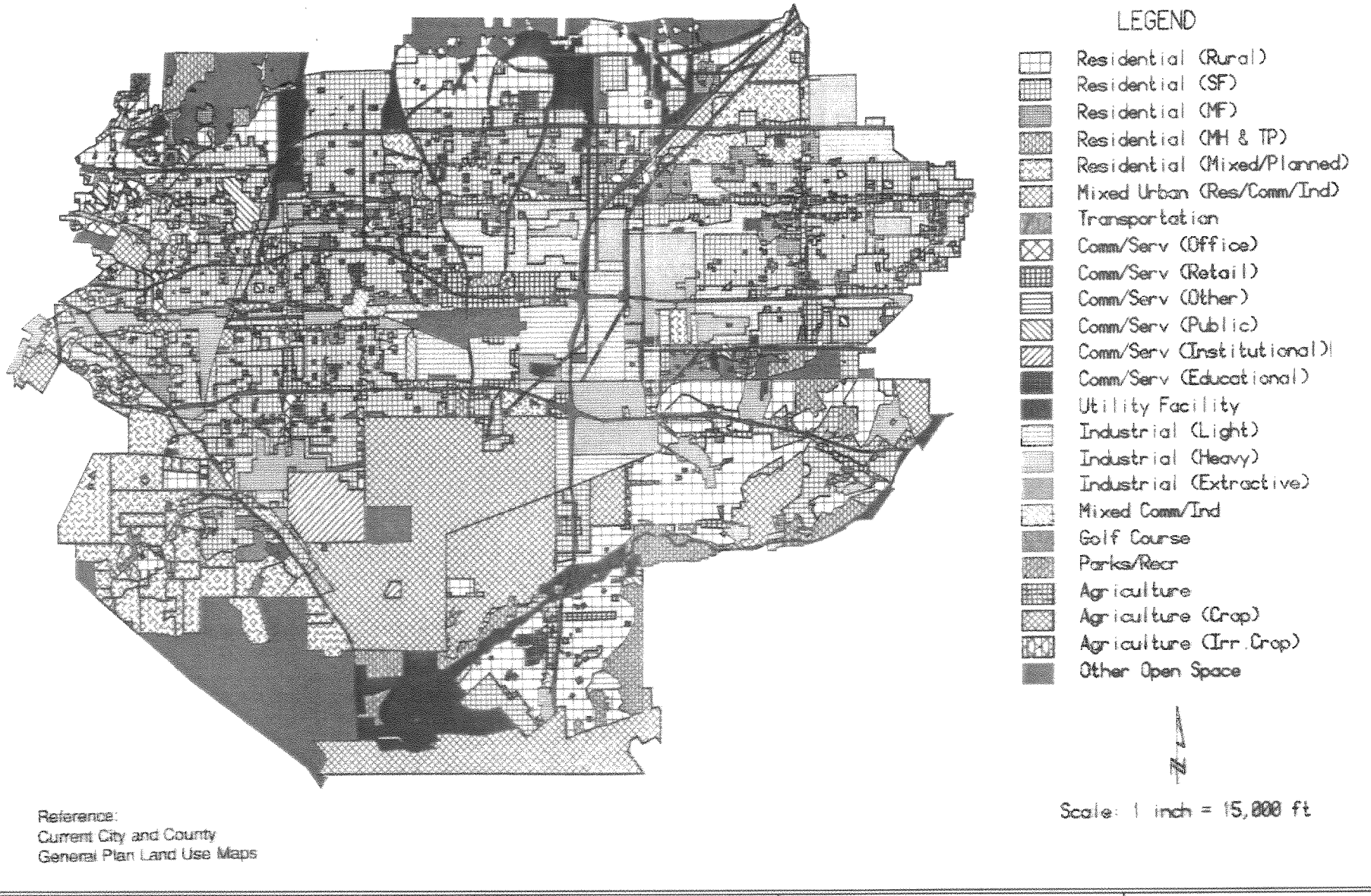

Reference:
SCAG Land Use Survey, 1990

**1990 LAND USE**

Source: Chino Basin Water Resources Management Task Force, Final Task 1 Memorandum, Water and Wastewater Planning Environment, March 1993

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**FIGURE 4.2-2**



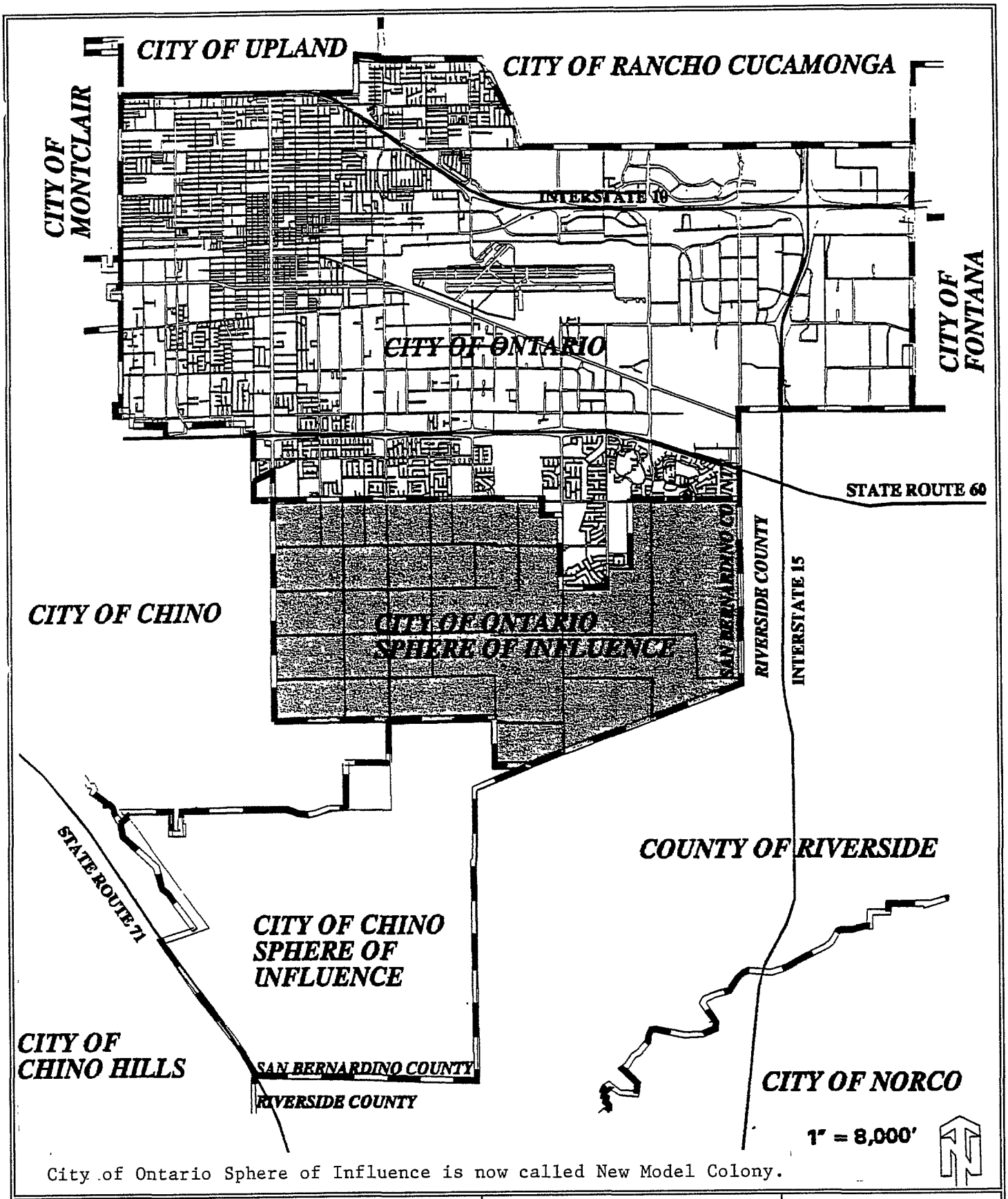

Reference:
Current City and County
General Plan Land Use Maps

**ULTIMATE LAND USE**

Source: Chino Basin Water Resources Management Task Force, Final Task 1 Memorandum, Water and Wastewater Planning Environment, March 1993

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**FIGURE 4.2-3**



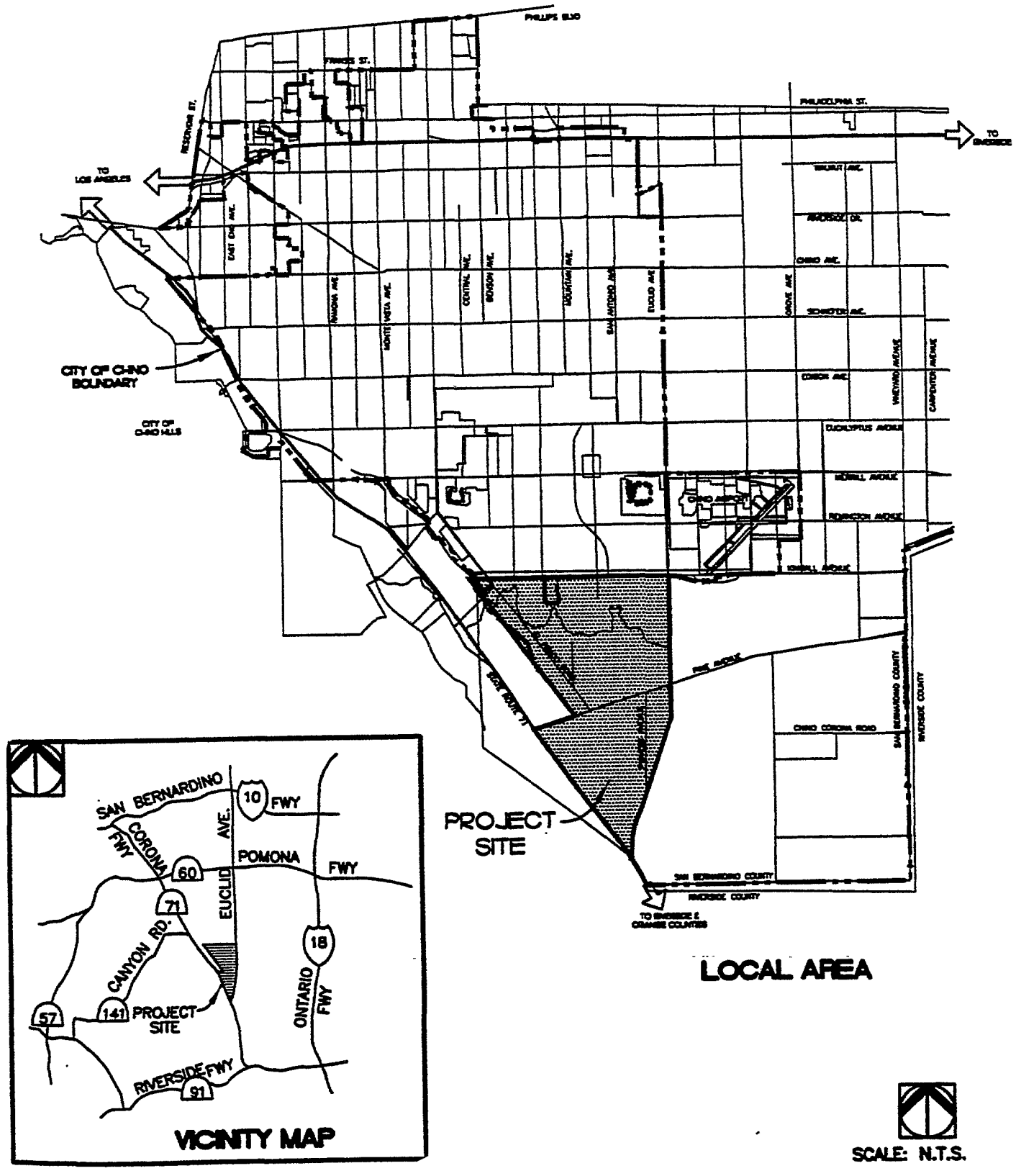

City of Ontario Sphere of Influence is now called New Model Colony.

**CITIES OF CHINO AND ONTARIO SPHERE EXPANSION AREAS**

Source: Ontario Sphere of Influence Final EIR, October 1997

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.2-4**




| | | |
|---|---|---|
| **LOCATION MAP**<br>**CITY OF CHINO - SUBAREA 1**<br>Source Chino Valley Dairy Preserve Final PEIR, August 1998 | **TOM DODSON & ASSOCIATES**<br>Environmental Consultants | **FIGURE 4.2-5** |

# 4.3 POPULATION AND HOUSING

## 4.3.1 Introduction

The intent of Subchapter 4.3 is to present environmental impact forecasts associated with population and housing that may result from the implementation of the proposed OBMP project. This section will provide an analysis of the existing population for the affected cities and unincorporated areas of the counties of Riverside and San Bernardino that lie within the boundaries of the Chino Basin; compare the current population to the population forecasted for the Chino Basin; and assess the potential for the OBMP to effect or change this future population forecast. In addition to analyzing impacts to population, impacts to growth from implementing the OBMP that were analyzed in Subchapter 4.2 will be summarized from an inducement to growth and from a restriction to growth standpoint. Potential effects on housing resources will be addressed and the potential to displace housing, especially potential displacement of affordable housing within the Chino Basin.

Comment letters received on the NOP identified concerns regarding consistency with the affected cities and counties general plans. This issue is discussed in some detail in Subchapter 4.2. The analysis within this section will include a discussion on the population and housing projected by the jurisdictions in relationship to the ability to provide water service based on the anticipated growth within the Chino Basin.

To evaluate impacts to population and housing needs, reports compiled by the following agencies have been utilized:

- Cities of Chino, Chino Hills, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, and Upland;
- Counties of Riverside and San Bernardino;
- Southern California Association of Governments; and,
- California Department of Finance (DOF), Population and Demographics Research Unit.

Data has been abstracted from the city and county general plans and general plan environmental impact reports (EIRs) and discussions have been conducted with city, county and SCAG personnel in order to characterize the existing environmental setting and to make the impact forecast.

## 4.3.2 Environmental Setting

The Chino Basin consists of approximately 235 square miles of the upper Santa Ana watershed encompassing portions of Los Angeles, Riverside and San Bernardino Counties. There are ten cities and unincorporated areas of both Riverside and San Bernardino Counties either wholly or partially lying within the adjudicated boundary of the Chino Basin. Please refer to Figure 4.2-1. Jurisdictions with partial coverage within the Chino Basin boundaries, such as the City of Rialto, for

analysis purposes, have been treated as if their entire corporate limits were contained within the Basin. Therefore, the existing population, forecasts and build out projects are based on the entire corporate boundaries rather than an extraction of the data based on a smaller subset. This assumption is considered reasonable since the water supplied to all of a city's water consumers could be extracted from within the Chino Basin and there is no known way to determine what portion of a city's population is being served by water extracted from within the Basin.

#### 4.3.2.1 Population

The SCAG has estimated the population of the Chino Basin service area. These estimates are enumerated in Table 4.3-1 for the affected cities and portions of the Counties of Riverside and San Bernardino beginning with the base year 1994 and forecasting the current year and future years at 5-year intervals through year 2020. The current population estimate for the Chino Basin portion of the area shown in Figure 4.2-1 is approximately 1,070,481. The persons within the project area will increase by more than 11 percent over the next 5 years and will approach an estimated population of 1,666,498 people in the year 2020.

#### 4.3.3.2 Housing

The Housing data contained within Tables 4.3-2 and 4.3-3 was derived from the following sources:

a. City of Chino General Plan, 1993 (Housing, 1989) – Population pg. IV-5 and Buildout pg. IV-7;
b. City of Chino Hills General Plan, 1994 – Population pg. 2-7 (Housing) and Buildout pg. 1-21 (Land Use);
c. Fontana General Plan, 1989 – Population pg. 4-8 (Housing) and Buildout pg. 2-5 (Land Use);
d. Montclair General Plan, 1983 (Amendments 1984-85; Housing Element Amended, 1991) – Population and Buildout pg. 9;
e. Norco General Plan, 1995 Housing Element - Housing Characteristics pg. 22;
f. Ontario General Plan, 1992 – Population pg. 9-5 and Buildout pg. 7-34
g. Pomona General Plan, 1973 (Volume One-Profiles) - People pg. 9 and Appendix VI pg. 33;
h. General Plan for the City of Rancho Cucamonga, 1981 (Amended 1984 and 1989) – Population and Buildout pg. III-37;
i. City of Rialto General Plan, 1992 – Population pg. IV-8 and Buildout pg. II-19;
j. City of Upland General Plan, 1982 (Updates compiled 1992) – Population pg. V-2 and Buildout pg. IV-11; and
k. Southern California Association of Governments.

**Table 4.3-1**
**SCAG POPULATION FORECAST**

| Cities/Counties | 1994 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| Chino | 62,800 | 66,100 | 69,400 | 72,900 | 76,700 | 80,400 |
| Chino Hills | 40,947 | 52,646 | 61,513 | 69,396 | 82,693 | 93,351 |
| Fontana | 103,100 | 119,900 | 136,800 | 154,400 | 173,500 | 192,600 |
| Montclair | 30,200 | 32,200 | 34,200 | 36,300 | 38,600 | 40,900 |
| Norco | 24,705 | 26,735 | 28,764 | 30,794 | 32,584 | 34,456 |
| Ontario | 144,000 | 149,500 | 155,100 | 161,000 | 167,300 | 173,700 |
| Pomona | 138,749 | 155,962 | 167,688 | 177,687 | 188,859 | 204,455 |
| Rancho Cucamonga | 115,000 | 128,300 | 141,800 | 155,900 | 171,000 | 186,300 |
| Rialto | 80,000 | 91,200 | 102,600 | 114,400 | 127,200 | 140,100 |
| Upland | 67,500 | 70,800 | 74,200 | 77,800 | 81,600 | 85,400 |
| Unincorporated Riverside County | 84,866 | 92,552 | 99,480 | 106,481 | 113,173 | 119,205 |
| Unincorporated San Bernardino County | 94,762 | 137,232 | 179,067 | 223,294 | 269,730 | 315,631 |
| TOTALS | 986,629 | 1,123,127 | 1,250,612 | 1,380,352 | 1,522,939 | 1,666,498 |

Source: SCAG, 1998 RTP Adopted Forecast, April 1998. Information for unincorporated San Bernardino County is based on RSA 28.

Along with the projected population increases, there will be a corresponding increase in the estimated number of dwelling units within the project area. Based upon information contained within the affected agency general plans, the estimated number of residential dwelling units at buildout is anticipated to be approximately 371,183 dwelling units, comprised of a combination of single family, multi-family and seniors units. Table 4.3-2 summarizes the expected dwelling units for the affected agencies based upon general plan data. Table 4.3-3 compares population to households within the Chino Basin area (year 1997).

**Table 4.3-2**
**ESTIMATED DWELLING UNITS AT**
**GENERAL PLAN BUILDOUT**

| Cities/County | Dwelling Units at General Plan Build Out |
|---|---|
| Chino | 21,397 |
| Chino Hills | 26,815 |
| Fontana | 44,164 |
| Montclair | 12,259 |
| Norco | 5,900 |
| Ontario | 48,756 |
| Pomona | 46,299 |
| Rancho Cucamonga | 58,974 |
| Rialto | 32,619 |
| Upland | 74,000 |
| TOTAL | 371,183 |

### 4.3.3 Project Impacts

As described in detail in Subchapter 4.2, the population growth forecasts presented above and associated occupancy of dwelling units required to support this population represent assumed growth with or without implementation of the OBMP. Regional growth in southern California is driven by a combination of in-migration and recruitment (births over deaths) from the existing population. The analysis of growth in Subchapter 4.2 concluded that there are adequate water supplies available within the Basin and through imports to meet the future urban population growth within the Chino Basin. Therefore, water does not serve as a constraint to growth and by planning and expanding water system infrastructure to meet this future demand, WSA's are accommodating, not inducing growth.

Further, the implementation of the OBMP does not represent a new supply of water to meet future demands within the Chino Basin. If approved, the OBMP will provide a program to more efficiently and effectively manage all available water resources (high quality surface water and groundwater, poorer quality water in the southern portion of the Basin, imported water, imported groundwater, recycled water and storm water flows) to meet future water demands. The discussion on growth inducement in Subchapter 4.2 concluded that growth will occur and individual water purveyors will

## Table 4.3-3
## CITY AND COUNTY POPULATION ESTIMATES

| City/County | Population[1] | Household[1] | Persons/HH[1] | Population/ 1990 Census[2] | Population/ City's GP[3] | Pop. Estimate @ Buildout[3] | Pop. Estimate/ City (4-98)[4] | Pop. Estimate/DoF DRU (1-1-98)[5] |
|---|---|---|---|---|---|---|---|---|
| Chino | 62,671 | 54,911 | 3.331 | 59,682 | 56,136 | 70,551 | 62,671 | 64,536 |
| Chino Hills | 51,418 | 51,270 | 3.220 | N/A | 48,041 | 72,400 - 79,800 | 51,471 | 54,667 |
| Fontana | 104,201 | 103,715 | 3.458 | 77,971 | 69,657 | 193,018 | 104,201 | 107,590 |
| Montclair | 29,735 | 29,392 | 3.349 | 28,434 | 30,783 | 41,500 | 29,735 | 30,134 |
| Norco | 25,482 | 20,159 | 3.416 | 23,302 | 0 | 0 | 25,482 | 0 |
| Ontario | 141,082 | 139,949 | 3.353 | 124,260 | 124,260 | 134,038 * | 142,497 | 143,799 |
| Pomona | 142,902 | 140,178 | 3.766 | 131,723 | 119,144 | 140,000 | 142,902 | 0 |
| Rancho Cucamonga | 116,045 | 113,563 | 3.066 | 101,408 | 115,010 | 158,071 | 116,043 | 118,432 |
| Rialto | 80,249 | 80,175 | 3.352 | 72,388 | 70,335 | 87,748 - 98,557 | 80,249 | 81,476 |
| Upland | 65,733 | 65,202 | 2.778 | 63,948 | 47,647 | 74,000 | 65,733 | 67,012 |
| Unincorporated Riverside County | data not available | | | | | | | |
| Unincorporated San Bernardino Co. | data not available | | | | | | | |
| TOTAL | 819,518 | 798,514 | | | | | | |

Note: [1] City and County Population and Housing Estimates – January 1, 1997. Prepared by the California Department of Finance, Demographic Research Unit.
[2] 1990 Census (need to verify #)
[3] Population per City's General Plan
[4] Population estimates provided from City's Planning or Community Development Departments, April 1998
[5] Population estimates provided from the Department of Finance, Population and Demographic Research Unit, 1-1-98
* Additional population of 103,000 per the Ontario AG Preserve Sphere Area
** Information for unincorporated San Bernardino County based on RSA 28 data.

meet this growth through a less coordinated and less environmentally sound mix of available water resources. The population and housing discussion presented below is based on these assumptions.

#### 4.3.3.1 Threshold of Significance

The following criteria will be used as the thresholds of significance in this evaluation of population and housing for the OBMP

- Substantially increase the Chino Basin population above that identified in regional population forecasts and planned for in the local jurisdiction general plans;
- Substantially increase the demand for housing above the regional population forecasts; and
- Displace a substantial amount of housing, especially affordable housing.

#### 4.3.3.2 Population and Housing Impacts

**a. Will the project cause official regional or local population projections to be exceeded?**

As discussed in the introduction to this section, the implementation of the OBMP project has no potential to cause a substantial increase in population and, in and of itself, is not forecast to cause a cumulative exceedance of the official regional or local population projections. This is because the OBMP does not propose the construction of any human occupancy structures or generate the need for a large number of permanent employees to move to the area to implement the OBMP Program Elements. An estimated 100 people may be required to operate all of the proposed facilities and implement that OBMP Program Elements. Large numbers of people will only be present on-site for short periods of time during construction and maintenance activities. Otherwise the implementation of the OBMP is not forecast to add more than about 300 people to the Chino Basin population from its implementation.

SCAG forecasts steady growth in residential housing within the Chino Basin project area. The total occupied housing stock is expected to exceed 371,183 units within the next 20 years. Household occupancy size is correspondingly expected to increase from a current average of 3.3 persons per dwelling. The SCAG growth forecasts have been used in the preparation of the affected cities and counties General Plans and Housing Element updates and the affected water agencies Urban Water Management Plan projections. By providing an alternative method of meeting future water demand within the Chino Basin, the OBMP is consistent with, growth accommodating not growth inducing, in the context of these growth projections. The OBMP will also not alter the existing land use mix within the local agency general plans, except to convert up to 728 acres within the Chino Basin to water system infrastructure instead of alternative uses. This amount of area being dedicated to water system infrastructure is consistent with overall infrastructure acreage requirements set forth in the

1993 Montgomery Task 1 Land Use Memorandum for SAWPA and in local agency general plans. Therefore, if the OBMP is approved and implemented, it has no potential to increase the future Chino Basin population above that identified in SCAG's regional population forecasts and local jurisdiction general plans. No adverse impact to future population is forecast to occur and no mitigation is required.

**b. Does the proposed project have a potential to induce substantial growth in an area either directly or indirectly (e.g. through projects in an undeveloped area or extension of major infrastructure)?**

As previously discussed, the inducement of growth is in part based on the ability to meet water demands of the Chino Basin. Current water demands are estimated to be 348,000 acre-feet. Future water demand is anticipated to reach 418,000 acre-feet per year in 2020. Municipal water demand growth is expected as a result of the conversion of agricultural lands within the Cities of Chino, Chino Hills, Ontario and Norco and the remaining county jurisdiction in Riverside and San Bernardino counties to urban land uses and this growth has been committed and analyzed under separate review. The cities within the Chino Basin have evaluated water services requirements within their respective general plans based upon ultimate development (buildout) conditions. In addition, the water agencies within the Chino Basin have prepared Urban Water Management Plans, or otherwise prepared water supply plans, to assess the short-term and long-term water demands of their service areas. The WSA's cite the continued use of groundwater supplies, the provision for surface deliveries, the option of utilizing recycled water supplies and the importation of water through the Lloyd Michael Water Treatment Plant from MWDSC as primary sources for an adequate water supply to meet future water demand, as summarized in Subchapter 4.2. For future supplies, the WSA's are looking to continued development of water conservation programs and best management practices in addition to an expansion of water reclamation, increased ability for water exchanges and transfers, enhancement of groundwater quality, treatment of non-potable groundwater to potable standards and recycling standards. Each agency projects a continued reliance on imported water supplies to meet future supply needs.

Thus, regardless of whether the OBMP is implemented, individual WSA's have identified individual actions that they can implement to meet future water demands within the Chino Basin. The OBMP provides an alternative water supply plan that provides for more efficient and effective enhancement of safe yield and water quality that will fully comply with the Judgment that established the physical solution for the Chino Basin. In essence, the OBMP follows a similar path in forecasting future water supply needs and includes many of the practices and programs cited within the individual agencies Urban Water Management Plans. It is complimentary to numerous goals within the individual Plans. The OBMP, as an example seeks to promote utilizing recycled water supplies, developing water conservation programs and expanding recycling opportunities for the Basin.

The OBMP takes a more global approach to water demand and supply issues compared to the evaluations at a general plan or Urban Water Management Plan level and looks toward providing

more effective and efficient ways to protect the viability of the entire Basin. Furthermore, emphasis is placed upon programs such as recycling of water, improving water quality and the extraction of salts. The OBMP functions as one path of fulfilling the water supply demands outlined in local jurisdiction general plans and Urban Water Management Plans. As such it is growth accommodating as outlined above and in Subchapter 4.2, but it does not in and of itself create opportunities for additional people to move to the region nor to construct additional facilities beyond those previously under consideration to accommodate the population that will locate in the area in accordance with adopted general plan visions of ultimate development within each community located in the Chino Basin. Based on this analysis, no potential exists for implementation of the OBMP to cause or contribute to significant adverse growth inducement within the Chino Basin.

**c. Will the project displace existing housing or increase demand, especially affordable housing?**

No housing is proposed to be displaced or eliminated by the proposed project. The goal of the project and the effect of the physical changes is to install certain water system infrastructure to enhance safe yield and water quality within the Chino Basin. It is remotely possible that development of specific facilities, such as desalters, production wells or even recharge basins could adversely impact existing housing. A mitigation measure is outlined below to ensure that such an impact is fully mitigated. With implementation of such mitigation, the proposed project is not forecast to cause a significant displacement of existing housing, increase demand for housing or to cause a loss of affordable housing.

### 4.3.4 Mitigation Measures

The only potential significant population/housing impact from implementing the OBMP might be the displacement of existing housing in support of specific OBMP facilities in the future. The following mitigation measure is recommended as an action that may need to be implemented for individual projects proposed as part of the OBMP:

**4.3-1 If future facilities must be located on parcels occupied by existing housing, the proponent of the facility will ensure that short- and long-term housing of comparable quality and value are made available to the home owner(s) prior to initiating construction of the facility.**

With implementation of this measure, the only potentially significant population/housing impact identified in this evaluation will be reduced below the significance threshold outlined at the beginning of section 4.3.3.

### 4.3.5 Unavoidable Adverse Impact

The population and housing evaluation presented above indicates that the proposed project has a potential to cause only one potentially significant adverse impact, i.e. impact to existing housing from constructing future facilities. Mitigation has been provided to eliminate or reduce this impact

to a non-significant level. Since alternative housing is and can be made available in the future if required, the proposed project is not forecast to cause any adverse impacts, unavoidable or otherwise.

### 4.3.6 Cumulative Impacts

Based on the evaluation in this Subchapter, the OBMP can be implemented without causing or contributing to any cumulative significant adverse impacts on population and housing resources, as the exist or are forecast to occur within the Chino Basin. This includes potential growth inducing impacts for which the conclusion was reached that the OBMP will not cause any significant inducement to growth within the Basin.

# 4.4 GEOLOGIC RESOURCES / CONSTRAINTS

## 4.4.1 Introduction

This subsection of Chapter 4 will identify and evaluate various geologic, seismic and soil impacts and constraints related to the implementation of the OBMP, the proposed project. CEQA Guidelines (Section 15126.2, subd. (a)) require an analysis of potential safety problems that might be encountered as a result of implementing a proposed project. This analysis section contains an appraisal of geologic resource and constraint related impacts. Also, where appropriate, mitigation measures will be provided to minimize the exposure of people and property to geology-related hazards such as susceptibility to surface ruptures from faulting, groundshaking, ground failures (including subsidence and liquefaction), or effects of seismically induced water hazards (i.e., tsunamis and seiches).

To evaluate potential geologic constraints or impacts associated with this project, data from the following sources were utilized:

- City of Fontana, General Plan and General Plan EIR
- City of Rancho Cucamonga, General Plan and General Plan EIR
- County of San Bernardino, General Plan and General Plan EIR
- County of Riverside, General Plan and General Plan EIR
- Wildermuth Environmental Optimum Basin Management Program Phase I Report (OBMP)
- City of Ontario, General Plan and General Plan EIR
- City of Rialto, General Plan and General Plan EIR
- City of Chino, General Plan and General Plan EIR
- City of Chino Hills, General Plan and General Plan EIR
- City of Pomona, General Plan
- City of Upland, General Plan
- City of Norco, General Plan
- Final Task 5 Memorandum; Chino Basin Conceptual Model (WEI, JMM, CDM, CH2M Hill, September 1992)
- Industrial Minerals in California (USGS Survey, 1958, reprinted 1989)

Data are abstracted from these documents in order to characterize the existing environmental setting and to make the impact forecast.

## 4.4.2 Environmental Setting

The OBMP Phase I Report (2-2 to 2-5) and the TIN/TDS Study Phase 2A (3-25 to 3-32) Reports prepared by Wildermuth Environmental describe the underlying geology and hydrology of each management zone within the Chino Basin in detail. The following description of the existing geologic environment is intended to be a summary of the information presented in these documents, combined with data from the General Plans of cities located within the legal boundaries of the Chino Basin. The discussion provided below is intended to communicate with the non-technical reader/reviewer; thus, it is formatted as a simplified explanation/summary of the geology and

seismicity of the area. Readers interested in the technical details of the data and reports are referred to the two aforementioned reports, along with the safety or geologic hazards sections of the general plans mentioned in the list of resources found in Section 4.4.1 of this chapter.

Chino Basin is primarily located within the southwestern portion of San Bernardino County, with a smaller portion of the Basin being located within the northwestern portion of Riverside County. The San Bernardino County General Plan Final EIR describes the geologic setting as follows:

> *San Bernardino County is located in a tectonically active region near the boundary of two major crustal plates. This boundary (between the Pacific and American Plates) is generally marked by the San Andreas Fault Zone, which extends through the southwestern portion of the County. The San Andreas system exhibits predominantly right strike-slip movement (i.e, horizontal displacement to the right when viewed across the fault), whereby the Pacific Plate moves relatively northwest with respect to the continent. This active tectonic environment has strongly influenced the geologic and physiographic history of the County...The extreme southwestern portion of the Valley is within the Peninsular Ranges Physiographic Province. This area is characterized by northwest-southeast trending longitudinal mountain ranges and valley with intervening faults. The San Andreas, San Jacinto, and Elsinore Fault zones constitute the primary structural features of the Peninsular Ranges Province, and extend through southwestern San Bernardino County in a generally northwest-southeast direction. These (and related) structures delineate a series of crustal blocks aligned in a stepped topography across the province. Elevations become progressively higher in these blocks away from the coast, culminating in the San Jacinto Peninsular Ranges Province in the Valley region includes the Chino and Puente hills (the northernmost extensions of the Santa Ana Mountains) and adjacent valleys. These areas incorporate rugged low lying highlands and alluviated basins at elevations of approximately 500 to 1,500 feet MSL. (VIII-3 to VIII-4)*

Also, the drainage pattern for the area is tributary to the Santa Ana River, and is primarily composed of intermittent drainage courses (San Bernardino County General Plan FEIR, VIII-5). Figure 4.4-1 shows the existing drainage pattern for the Chino Basin. The portion of the Chino Basin within the boundaries of Riverside County has the same general geologic characteristics as those described in the San Bernardino County General Plan.

Quaternary alluvial deposits and recent soils comprise the majority of the stratigraphy of San Bernardino County and northern Riverside County portions of the Chino Basin. Other strata may include Tertiary marine and non-marine sedimentary and volcanic units; Mesozoic marine sedimentary, metasedimentary, metavolcanic and plutonic rocks, Paleozonic sedimentary and metasedimentary units; and Precambrian igneous and metamorphic rocks (San Bernardino County General Plan FEIR, VIII-5).

The soils within the Valley areas of San Bernardino County and northern Riverside County (including Chino Basin), include generally deep well-drained sands, sandy loams, and silty loams on level alluvial basins and fans, and shallow to deep, well to excessively drained sandy loams on foothills and upland areas (San Bernardino County General Plan FEIR, VIII-5).

Specific geologic and hydrologic characteristics of the Chino Basin are described in the OBMP Phase I report as follows:

*Chino Basin was formed when eroded sediments from the San Gabriel Mountains, the Chino Hills, Puente Hills, and the San Bernardino Mountains filled a structural depression...The bottom of the Basin - the effective base of the freshwater aquifer - consists of impermeable sedimentary and igneous rocks, the base of the aquifer is overlain by older alluvium of the Pleistocene period followed by younger alluvium of the Holocene period.*

*The younger alluvium varies in thickness from over 100 feet near the mountains to just a few feet, south of Interstate 10 and generally covers most of the northern half of the Basin in undisturbed areas. The younger alluvium is not saturated and thus does not yield water directly to wells. Water percolates readily in the younger alluvium and most of the large spreading basins are located in the younger alluvium.*

*The older alluvium varies in thickness from about 200 feet thick near the southwestern end of the Basin to over 1,100 feet thick southwest of Fontana, and averages about 500 feet thick throughout the Basin. Well capacities range between 500 and 1,500 gallons per minute (gpm). Well capacities exceeding 1,000 gpm are common, with some modern production wells test-pumped at over 4,000 gpm ...In the southern part of the Basin where sediments tend to be more clayey, wells generally yield 100 to 1,000 gpm. Three main water-bearing (hydrostratigraphic) units were identified by Montgomery Watson (1992) during the development of a three-dimensional groundwater model of the Basin. Figure [4.4-2] shows the locations of two (of seven generalized cross-sections through the Chino Basin. These generalized cross-sections illustrate these main aquifer units and are shown in figures [4.4-3] and [4.4-4].*

*Faults are one of the principal agents in the development of the landscape and restriction of groundwater flow in the Chino Basin. The Basin is bounded by major fault systems along which the mountains and hills have been uplifted. The location of fault and groundwater barriers, and displacements in the effective base of the aquifer at faults are shown in Figure [4.4-1]. The faults and groundwater barriers are significant in that they define the external boundaries of the Basin and influence the magnitude and direction of groundwater flow near the boundaries. (OBMP Phase I Report, 2-2 to 2-3).*

Both active and inactive earthquake faults occur in the Chino Basin. As listed in Section 3-8 of the Rancho Cucamonga General Plan, the faults considered to have the greatest potential to generate seismic shaking in the Basin are:

- Cucamonga Fault
- Red Hill Fault
- San Jose Fault
- San Antonio Fault
- San Jacinto Fault
- San Andreas Fault
- Elsinore Fault.

Significant groundshaking could be caused by a major earthquake on one of the regional faults. Ground accelerations from a maximum credible earthquake on the San Andreas Fault could range as high as 1.0 g based on a magnitude 8.2 earthquake on this fault (Rancho Cucamonga General Plan, Section 3-8).

The general topography for the Chino Basin consists of slopes less than 10 percent for all areas except small regions of the Basin such as the Jurupa and Pedley hills. The OBMP does not propose to build structures within any areas having a slope greater than 10 percent.

### 4.4.2.1 Soils

Soils within the Chino Basin include generally deep well-drained sands, sandy loams, silty loams on level alluvial basins and fans; and shallow to deep well to excessively drained sandy loams on foothills and upland areas (San Bernardino County General Plan EIR, VIII-5). These types of soils are suitable to agricultural use.

The Chino Basin contains a number of soils which meet the criteria for Valuable agricultural soil based on capability classes and the three Important soil groups (County of San Bernardino, 1979). The greatest concentrations of these soils are in the vicinity of the cities of Chino and Ontario, and in the eastern Valley areas. Portions of nine separate soil associations are located within the Valley region (including Chino Basin). Six of these nine soil associations (making up approximately 80 percent of the Valley area) possess physical and chemical characteristics suitable for agricultural production (Soil Conservation Surveys, 1980). Table 4.4-1 lists the various soil classification units, along with a description of suitability for agricultural purposes. It should be noted that much of this area currently supports urban development, or is zoned for future urban development. Consequently, these areas are not currently available for agricultural use. Projected continuation of urban growth, as depicted in local agency general plans encompassing the Chino Basin, foster the continued conversion of agricultural land to urban uses. (San Bernardino County General Plan EIR, VIII-191 and Subchapter 4.2 of this PEIR)

The following soil analysis will utilize the San Bernardino and Riverside County soil surveys and data contained in a "Final Task 5 Memorandum: Chino Basin Conceptual Model" (WEI, JMM, CDM, CH2M-Hill, 1992).

General soil associations in the Chino Basin Project area are shown on Figure 4.4-2 (adapted from Task 5 Memorandum Plate 5). The study area is overlain by 78 alluvial soil types described for their top 60 inches of thickness. The soils tend to be sand, silt and clay loams with occasionally gravelly or cobbly sandy loams. Fifteen of the 78 soil types are prime agricultural soils and 20 are rated "suitable" for cultivation. The thirteen general soil association within the study area have been grouped into three major soil groups. These soil groups are described below.

> *Group 1 Soils are on recent (younger) alluvial fans and plains, and consist of deep, permeable soils with no development in the profile. The soils of Group 1 were formed by the transport of unconsolidated materials. These soils represent about 75 percent of the study area. Presented in decreasing order of frequency, the general soil associations contained in Group 1 soils are:*
>
> - *Tujunga-Delhi (3)*
> - *Tujunga-Soboba (4)*
> - *Hanford-Greenfield (2)*
> - *Foster-Grangeville (1)*

## Table 4.4-1
## SOIL CAPACITY GROUPING

| Capability Class | Designation | Capability Subclass | Designation | Capability Unit | Designation |
|---|---|---|---|---|---|
| I | Few limitations to restrict agricultural use. | e | Erosion as the primary risk or limitation. | 0. | Poor root penetration due to sand and gravel substratum. |
| II | Moderate limitations that reduce plant choice and/or require conservation measures. | w | High water content as the primary risk or limitation. | 1. | Erosion hazard. |
| III | Severe limitations that reduce plant choice and/or require conservation measures. | s | Shallow, droughty or stony soil conditions as the primary risk or limitation. | 2. | Poor drainage or flooding. |
| IV | Very severe limitations that reduce plant choice and/or require special management. | c | Excessively cold or dry climate as the primary risk or limitation. | 3. | Slow permeability of the subsoil or substratum. |
| V | Soils with limitations which limit their use largely to posture, range, woodland, or wildlife habitat. | | | 4. | Coarse texture or excessive gravel. |
| VI | Soils with severe limitations that are generally unsuitable for cultivation. | | | 5. | Fine or very fine surface texture. |
| VII | Soils with very severe limitations which are largely unsuitable for cultivation. | | | 6. | Excessive salt or alkali. |
| VIII | Soils and land forms unsuitable for commercial plants. | | | 7. | Excessive cobbles, stones or rocks. |
| | | | | 8. | Impervious bedrock or hardpan within rooting depth. |
| | | | | 9. | Low fertility or toxicity. |

Source: Soil Conservation Service, 1980

*The number in parenthesis () corresponds to the soils location legend on Figure 4.4-2. Generally, the soils in Group 1 are found on slopes that range from zero to nine percent and consist of coarse textured soils developed in granitic alluvium, gravelly or cobbly alluvium, or weakly consolidated sandstone and shale. Runoff from these soils is usually low and infiltration is moderate to high (greater than 1 inch per hour). Soil depths are greater than 60 inches.*

*Group 2 soils occur on older alluvial fans and terraces and have a more developed profile than the soils of Group 1. Group 2 represents about 5 to 10 percent of the study area. Presented in decreasing order of frequency, the general soil associations contained in the group 2 soils are*

- *Merrill-Chino (5)*
- *Placentia (6)*
- *Ramona-Arlington (7)*
- *Rincon-Zamora (8)*

*These soils are developed on granitic or sedimentary alluvium and are moderately fine textured soils of silty loam or sandy loam in the surface layer with clay loam in the subsoils and substratum. These soils have a moderate to low infiltration rate (less than 1 to 2 inches per hour). The subsoils are more finely textured than the surface soils. A portion of these soils are found on zero to 2 percent slopes; these soils are moderately developed with clays in the subsoils and claypan in the lower horizon. Group 2 soils located on slopes ranging from 2 to 5 percent contain some hardpan 48 to 72 inches below the surface. Group 2 soils found on 5 to 9 percent slopes include the steep side slopes of alluvial fans and terraces.*

*Group 3 soils overlie crystalline, sedimentary or granitic bedrock. These soils are found in the Chino Hills, Puente Hills, the base of the San Gabriel and Jurupa mountains and in small areas near the San Bernardino-Riverside county line. Group 3 represents about 15 to 20 percent of the study area. Presented in decreasing order of frequency, the general soil associations contained in soil group 3 are:*

- *San Benito-Soper (12)*
- *Altamont-Diablo (9)*
- *San Andreas-San Benito (11)*
- *Friant-Escondido (10)*
- *Vista Cienable (13)*

*These soils are found on steep slopes ranging from 15 to 20 percent. The soils are predominantly pale brown loams, fine sandy loams, or clays. The substrate of parent materials of these soil associations are shales, schist, gneisses, coarse-grained sandstones, granodiorites and moderately high infiltration rates (1 to 2 inches per hour). The depth of these soils ranges from 20 to 40 inches.*

The soils that comprise the Chino Basin have accumulated from the alluvium washed down from the San Gabriel and Santa Ana blocks during the latter part of the Quaternary epoch. The alluvium can be classified based on apparent age. Figure 4.4-3 shows the generalized location of stratigraphic column cross sections for water-bearing sequence in the Chino Basin area. Figures 4.4-4 and 4.4-5 show the actual cross-sections, themselves. In Figures 4.4-4 and 4.4-5 the Chino Basin has been divided into water-bearing and nonwater-bearing formations. "The latter are further differentiated as (a) consolidated stratified rocks, and (b) metamorphic and igneous rocks of the basement complex. Water bearing formations overlie nonwater-bearing formations. The alluvial formations of the Chino Basin are typically younger alluvium, older alluvium, terrace deposits and residuum" (Task 5 Memorandum, 2-1 to 2-2).

*Younger alluvium consists of relatively unweathered sand, gravel, and silt deposits up to 150 feet thick, and occupies streambeds, washes, and other areas of younger or recent sedimentation. Oxidized particles tend to be flushed out of the sediments during transport. Recent alluvium is commonly light yellow, brown, or gray...The primary source for the origin and generation of younger alluvium within the chino Basin is the San Gabriel Mountains.*

*During transport, the largest of the fragments travel the least distance. The northern part of the Chino study area, close to the base of the San Gabriel Mountains, therefore, exhibits younger alluvium composed primarily of coarser material mixed with some clay and sand. Farther from the mountain front the slope of the land is gentler and the particles are of smaller size. The alluvium here is in layers of gravel, sand and silt. The finest particles are able to travel the greatest distances and settle out farthest from the mountains, near Prado Dam.*

*In most places the highly permeable younger alluvium is above the water table. Water percolated readily through the younger alluvium*

*Sand dunes in the east-central part of the valley floor were formed as a result of the "Santa Ana" wind storms, carrying sand winnowed from alluvial deposits lying tot he northeast of the dune area. The spread of irrigated agriculture and the planting of windbreaks in the valley, however, have probably acted to stabilize the dunes. The dune sand has been grouped with the younger alluvium because of its similar water bearing characteristics...*

*A thick section of stabilized, moderately to deeply weathered alluvium of Pleistocene Age unconformably underlies the younger alluvium. Older alluvium is typically distinguishable by its red-brown or brick-red color. Beneath the older alluvium are formations that range in age from Pleistocene to Precambrian, in an unconformable sequence. Around the edge of the Chino study area the base of the alluvial layers can be readily distinguished but in many places in the central part of the valley, the base of the older alluvium cannot be defined...the average thickness is estimated to be not more than 500 feet.*

*Older alluvium is made up of boulders gravel, sand silt and clay derived largely from basement rocks in the San Gabriel Mountains. The accumulation of the older alluvium began, probably in middle Pleistocene time, when the present valley first began to form south of the rising San Gabriel block.*

*The combined effects of sorting and weathering give the older alluvium in the central part of the area the lowest clay content and the highest well yields and transmissivity of the alluvium of this area...*

*The terrace deposits consist of dark red and red-brown alluvial material resting on planed-off bedrock surfaces above stream level...Because terrace deposits consist of alluvium resting on bedrock above stream level, they are mainly above the water table and do not store significant amounts of water.*

*In areas of low relief where there is little erosion, in-place, deep weathering of basement and consolidated sediments has resulted in extensive residual formations that locally store and yield water. Structures of the disintegrated and decomposed parent rock are preserved in the residuum and grade into those of the underlying bedrock. The residual materials are marked by oxidation colors of red and brown. Because of their relatively high clay content and generally thin and disconnected occurrence, they are inferior to transported and reworked alluvium as a source of water to wells. These soils are generally found in the Norco area and adjacent to the Santa Ana River near Pedley Hills.*

*The nonwater-bearing formations include continental deposits of late Pliocene to middle Pleistocene age, marine sedimentary and volcanic strata of late cretaceous to later Tertiary age, and crystalline igneous*

*and metamorphic rocks of the basement complex...San Timoteo beds in the easternmost part of the study area belong to the lover levels of ta thick sequence of deposits in which fossils of middle to late Pliocene age have been found. These beds resemble the older alluvium of the Chino study area, but are cut by numerous faults and are sharply folded as a result of mid-Pleistocene mountain building.*

*In the western part of the Chino study area, consolidated sedimentary and volcanic rocks, ranging in age from late cretaceous to Pliocene consist of well stratified marine sandstones, shales and conglomerates and interlayered lava flows...*

*The basement complex consists of deformed and re-crystallized metamorphic rocks that have been invaded and displaced in places by huge masses of granitic and related igneous rocks. The intrusive granitic rocks, which make up most of the basement complex, were emplaced about 110 million years ago in the late Middle Cetaceous (Larsen, 1958). These were subsequently uncovered by erosion, especially in the San Gabriel Mountains and in the uplands of the Perris block. They have been the major source of detritus to the younger sedimentary formations, in particular, to the water bearing deposits of the Chino study area.* (Task 5 Memorandum, 2-2 to 2-5)

A representation of the geologic time scale is included for reference purposes as Figure 4.4-6.

### 4.4.2.2 Mineral Resource

The San Bernardino County General Plan EIR (SBC GP EIR) describes the existing mineral resources and mining activities within the southwestern portion of the County, an area known as the Valley region.

Existing mineral production in the Valley region is limited to oil and gas and industrial minerals. Oil and gas production occurs from two small oilfields in the Chino Hills area (less than 200,000 bbl total reserves)" (SBC GP EIR, VIII-201). In 1989, eleven non-fuel mineral operations were conducted in the Valley region.

*These production operations included extraction of industrial materials such as specialty sand, construction aggregate, limestone, concrete aggregate, clay, slag and portland cement. The majority of these materials come from alluvial fans and bedrock deposits exposed along the southern San Gabriel and San Bernardino mountains, and the northern San Jacinto and Jurupa mountains...All active industrial mineral sites within the Valley (as well as a number of additional nearby areas) are all designated for Resource Conservation (RCN) land uses, which include mining as an allowable activity ...The Valley also includes a number of MRZ-2 classifications, most of which are associated with existing mineral operations (and similar nearby deposits) along the southern flank of the San Gabriel and San Bernardino Mountains. . . The Valley region contains considerable deposits of a number of industrial minerals (e.g. sand, gravel, limestone) at least some of which will likely come into production over the next several years. This assumption is based on the projections for growth within the Valley, the necessity of large quantities of industrial minerals (e.g. aggregate) in urban construction, and the limited transportation capability of such low unit value minerals...the production of low unit value minerals is generally limited by transportation costs.* (SBC GP EIR, VIII-201 to 202)

A graphical representation of the mineral resources described for San Bernardino and surrounding counties is included for reference as Figure 4.4-7. This map shows the distribution of non-metallic mineral resource locations within southern California. The only significant mineral resources that

occur within or near the project area are limestone, sand and gravel, crushed rock and rip rap. The location of these resources is primarily in the Jurupa and Pedley Hills, and also near the Santa Ana River.

The Riverside County General Plan contains a map of mineral resource locations within the northern portion of the county. This map of mineral resource distribution is included as Figure 4.4-8. Other than industrial minerals (i.e. sand, gravel, etc.), few mineral resources occur within the project area.

A map of generalized production aggregate resource locations and classifications is shown for southern California (Figure 4.4-9). The Chino Basin is primarily classified as PRZ-3, with localized areas designated PRZ-2, MRZ-1, and MRZ-3. PRZ-3 areas area areas containing construction aggregate deposits, the significance of which cannot be evaluated from preliminary data. PRZ-2 areas are those where preliminary data indicates that significant construction aggregate resources could be present. These PRZ-2 areas are located in the City of Fontana North of the Interstate 10 Freeway, and in areas surrounding the San Antonio Creek as it flows through the Chino Basin. Finally, the MRZ-3 classification indicates areas containing construction aggregate deposits, the significance of which cannot be evaluated from exiting data. The MRZ-3 area located within the Chino Basin is in the City of Chino west of Highway 71. A small portion of an area designated MRZ-1 is also located within the eastern extremes of the City of Chino. The MRZ-1 category can be described as an area where sufficient data exists to adequately determine no significant mineral resources are present.

The Fontana General Plan specifically identifies the location of mineral resource deposits and production operations within that City's planning area, as shown in Figure 4.4-10. The aggregate resources are generally located in the Lytle Creek area. This area has been identified under the Surface Mining and Reclamation Act of 1975 (SMARA), as a "Regionally Significant Construction Aggregate Resource Area." These areas are shown because of their "potential to provided needed mineral resources for future regional use" (Fontana General Plan, CE-2). Already, use of some of these resource areas is precluded by both urban and agricultural uses (Fontana General Plan, CE-1).

The PRZ-2 resource area surrounding the San Antonia Wash area is described in more detail in the Montclair General Plan. This area is

> *"located on an alluvial fan created by deposits brought down by water movement from the mountain ranges to the north. The material composition of the alluvium is generally gravelly cobbled, or stony, coarse granite and makes excellent sand and gravel resources. Several areas adjacent to the San Antonio Wash have, in the past, been utilized for surface mining operations restricted to sand and gravel excavation. All operations have subsequently become inactive...due to the poor economic return realized from current conditions. As extraction operations cut deeper into the earth, the quality of the material declines, thus requiring more costly processing. Mining operations have attained these depths, and have resulted in a negative cost/benefit relationship to the mining operation."*

The MRZ-3 area located in the City of Chino is depicted in Figure 4.4-11. The City of Chino General Plan discusses the resources in this area as follows:

> *Although sand and gravel deposits do exist, there is a lack of specificity to delineate mineral material suitable for construction use. As new information is learned about the quality of minerals n this zone, its usefulness for construction may increase. According to the DMG [Division of Mine and Geology], approximately 245 million tons of aggregate will be needed to satisfy demand in the Claremont-Upland P-C Region through the year 2031. However, current reserves...total approximately 55 million tons," and surrounding alluvial fan areas including the Deer, Day and San Dimas Washes do not contain sufficient reserves permitted for use to meet the forecasted demand. Thus, the City of Chino is "conscientious towards conserving aggregate use, whenever possible."* (Conservation/Open Space, V-31)

The MRZ-1 area located in the City of Chino is comprised primarily by shale, siltstone, carbonates and chlorite schist. These materials are considered unsuitable for use as aggregate. "Fine grained sedimentary deposits also exist in this zone which are also unsuitable for use as aggregate." (City of Chino General Plan, V-31)

None of the portion of Chino Basin overlying Riverside County is located within a MRZ-2 zone. This Riverside County area is classified as MRZ-3 and PRZ-3. A map showing the generalized aggregate resource classifications was previously included as Figure 4.4-10. A map with locations of existing resource extraction areas is also included for Western Riverside County as Figure 4.4-9. The only resources present are construction aggregate resources such as rock products, limestone, and clay.

### 4.4.2.3 Seismic Activity

The City of Rancho Cucamonga General Plan EIR contains a detailed analysis of potential seismic activity for all significant faults within the vicinity of the Chino Basin Planning Area (Rancho Cucamonga GP EIR, III-8 to III-13).

> *Southern California is a very active seismic region and is part of a larger, seismically active area known as the "Ring of Fire" which encompasses both sides of the Pacific Ocean. Numerous earthquakes have occurred in this region over the past 200 years. Significant seismic activity, greater than Magnitude (M) 5 on the Richter Scale, is clearly associated with known active faults.*

A map showing the location of major faults in the vicinity of Chino Basin is included as Figure 4.4-12.

> *In order to assess the potential risk they pose to the City, it is important to estimate the size of earthquakes associated with the faults in the area. Those faults most likely affecting the [project area] are described below with their estimated earthquake potential.*
>
> *<u>San Andreas Fault</u> Probably the most well known in California, this fault is the boundary between two huge crustal plates (Pacific and North American) which are moving relative to each other at the rate of a few inches per year. This fault is widely recognized as the longest and most active fault in the state. It has been mapped from Cape Mendicino in northern California to an area near the Mexican border. The fault is known to be active from historic earthquakes, some of which have caused surface rupture, and from abundant evidence of displacement of recent sediments. A reasonable estimate of a maximum credible earthquake along the San Andreas fault is M 8.25.*

*San Jacinto Fault Like the San Andreas fault, the San Jacinto fault has been active for millions of years. Several historic earthquakes in Southern California have been associated with this fault. A maximum credible earthquake for the San Jacinto of M 7.5 has been assigned.*

*Elsinore Fault The Whittier-Elsinore fault lies 20 miles to the southwest of the City. Displacements associated with this potentially active fault have been vertical, unlike the horizontal movements associated with the San Andreas and the San Jacinto. The Elsinore fault branches into the Whittier fault and the Chino fault. The latter is buried along most of its length and is the closest part of the Elsinore system to the City of Rancho Cucamonga. The Elsinore-Whittier alignment is estimated to produce a maximum credible earthquake of M 7.5, although this magnitude is probably high for the Chino branch.*

*Cucamonga Fault This fault is considered potentially active, primarily because of scarps that indicate offset in recent alluvial deposits along the northern edge of the City. Although the length of the fault is not known for certain, it has been mapped from near Lytle Creek, 2.5 miles northeast of the City, to the north of San Antonio Canyon. Mapped traces of the fault vary from a single line near Cucamonga Creek to a zone a half mile wide south of East Etiwanda Canyon. A significant offset in the mapped traces occurs across the alluvial deposits of Deer Creek. A reasonable estimate of maximum credible earthquake for the Cucamonga fault is M 7.0.*

*San Jose Fault Capable of producing a M 6.5 earthquake, this... [fault runs] southwest from a point near the San Antonio Canyon, the San Jose fault has displaced earth in the San Jose Hills.*

*San Antonio Canyon Faults Potentially active and identified from several mapped traces in the canyon, the San Antonio Canyon fault is about 15 miles long. This fault may be capable of a M 6.5 earthquake.*

*Red Hill Fault This fault is well known as the geologic divider between the Cucamonga and Chino groundwater basins. The northeast trend of this barrier corresponds closely with a prominent scarp in the alluvial fan south of Day Canyon and with the southern edge of Red Hill. Microseismic monitoring has shown that a large number of small earthquakes (M I to M 3) occur beneath the [City of Rancho Cucamonga] and that a few epicenters were located on or near the trace of the Red Hill Fault. A maximum credible magnitude of M 6.5 has been assigned to the fault.*

*The northeastern end of the Red Hill fault has apparently displaced recent alluvial deposits and has also been included in an Alquist-Priolo Special Studies Zone. The remainder of its trace, however, did not meet state criteria, despite substantial evidence for its continuation to the southwest. In view of this, the City of Rancho Cucamonga has established its own special study zone along the most probable trace which is shown in the General Plan as an inferred fault.*

*Red Hill Trace The geological study for a recent development (Rancho Cucamonga Tract 10035) discovered a possible 'finger" of the Red Hill Fault to the west of the main trace near Red Hill. Additional study indicated that although it was likely not a branch, it is possible that additional extensions of the fault may exist in this area.*

*Other Faults Additional faults are known in the region, some of which exist within the City. However, these would not be expected to cause seismic shaking greater than those listed in Table 4.4-2. Possible local fault traces paralleling the Red Hill however, might be associated with future ground rupture or may have caused unusual distribution of near-surface sedimentary soils in the past.*

Table 4.4-2 (Rancho Cucamonga General Plan) summarizes the maximum credible earthquakes associated with each of the above described faults. There is little doubt that Rancho Cucamonga and the Chino Basin will experience strong seismic shaking in the future. Several of the nearby faults

have the potential to generate large earthquakes that would be felt in the Basin. The Rancho Cucamonga General Plan describes the potential groundshaking, which would apply generally to the whole Chino Basin in the following manner:

> *The level of shaking that might occur can be estimated by first assuming that the maximum credible earthquake for a fault could occur at its nearest approach to the City. The ground response, developed from measurements of past earthquakes, can then be used to estimate expected bedrock accelerations. Fife and others (1976) mapped isoacceleration lines for southwest San Bernardino County, which might be expected from earthquakes on the San Andreas, San Jacinto, Cucamonga, and Whittier-Elsinore faults, based on attenuation relationships derived by Schnabel and Seed (1972). The ranges of these accelerations shown for the City are listed in Table 4.4-2. Also included are the Red Hill, San Jose, and San Antonio faults and calculated maximum expected acceleration for all seven faults, based on near-field attenuation relationships developed by Idriss and Power (1978).*

**Table 4.4-2**
**MAXIMUM GROUND ACCELERATIONS ESTIMATED FOR SEISMIC EVENTS NEAR OR WITHIN THE CHINO BASIN AREA**

| Fault | Estimated Maximum Credible Earthquake[1] | Estimated Maximum Accelerations[2] |
|---|---|---|
| Cucamonga | 7.0 | .60 - .95 |
| Red Hill | 6.5 | .70 - .80 |
| San Jose | 6.5 | .50 - .75 |
| San Antonio | 6.5 | .50 - .75 |
| San Jacinto | 7.5 | .40 - .85 |
| San Andreas | 8.25 | .35 - .70 |
| Elsinore-Chino | 7.5 | .30 - .55 |

[1] Richter Magnitude: Estimated based on Slemmons (1977) and Greenfelder (1974)
[2] Accelerations are for bedrock as calculated by Idriss and Pong (1987)

Source: Summarized from Rancho Cucamonga General Plan EIR (1981)

*The highest accelerations expected beneath the Project Area according to Fife and others (1976) would be about 75 percent of gravity (0.75g) adjacent to Cucamonga fault as a result of a maximum credible 6.5 earthquake. Based on more recent rupture length-magnitude and attenuation relationships (Slemmons, 1977; Idriss and Power, 1978), bedrock acceleration may be as high as 0.95g. This assumes that a Magnitude 7.0 event could occur on a plane dipping 45 degrees to the north and the center of energy release would be 5 km deep. Accelerations north of the surface trace, which would be the upthrown block, might be even higher.*

*The Red Hill fault, if the maximum credible earthquake occurs, could generate bedrock accelerations as high as 0.8g. Bedrock beneath the eastern edge of the City of Rancho Cucamonga might be expected to experience up to 0.85g from a large earthquake on the San Jacinto fault.*

*Values shown in Table 4.4-2 are for accelerations in bedrock. Seismologists consider bedrock to be material with a shear wave velocity faster than 2,000 feet per second. Seismic velocities beneath the City are not specifically known, but in general, these velocities are typically attained at a depth of about 500 feet in the valley alluvium (Fife and others, 1976). Areas with deep cohesionless soils, such as those underlain by recent fan deposits, might be expected to experience accelerations at the ground surface that are as low as 60 percent of those calculated for bedrock (after Seed and others, 1975). Areas with stiffer soils, such as older, clayey alluvium, would be expected to experience higher percentages of the calculated values. Predominant periods of shaking are expected to be shorter in bedrock than in areas covered by thick alluvial deposits.*

*Other faults near the Chino Basin include the Rialto-Colton Fault, the Indian Hill Fault, and the Lytle Creek Fault. According to the Geologic Map, these faults are not known to be active in the last 700,000 years. Additionally, the Chino Avenue Fault is located westerly of the City of Chino, however none of these faults are predicted to generate maximum accelerations greater than those contained in Table 4.4-2.*

According to the Riverside County General Plan, the portion of the Chino Basin that is located in Riverside County does not overlie any Alquist-Priolo special studies zones, shown in Figure 4.4-13. A portion of the map of Alquist-Priolo special studies zones for San Bernardino County is included as Figure 4.4-14. A small portion of the special study area for the Cucamonga fault appears to be within the boundaries of the Chino Basin. The State of California requires additional geologic investigations prior to construction of facilities within this study area. This special studies zone occupies part of the area marked as high-priority for construction of groundwater recharge facilities, and more geologic investigations are necessary for facilities sited near this area.

### 4.4.2.4 Ground Rupture

Fracturing and displacement of the ground surface can occur as a direct result of movement along a geologically young fault (primary ground rupture), or as a result of sympathetic movement from intense groundshaking on weakened, older fault traces (secondary ground rupture). Primary ground rupture commonly results in greater surface displacements, while secondary ground rupture is commonly more widespread. Either type of ground rupture is destructive to surface improvements, and in 1972 the State of California legislated the Alquist-Priolo Special Studies Zone Act (now known as Alquist-Priolo Earthquake Fault Zones Act) to define and restrict areas of potential fault-related ground rupture. As of 1972, the faults listed for specialized study areas included the San

Andreas, San Jacinto and part of the Cucamonga fault zones. In 1974, however, a preliminary draft of the Proposed Seismic and Public Safety Element of the Environmental Improvement Agency (San Bernardino Planning Department) recommended that the County consider additional faults for special studies, including (in order of priority as listed):

- The branch of the eastern portion of the Cucamonga fault;
- The Red Hill fault (a branch of the Cucamonga fault);
- The Chino-Elsinore fault (northwesterly extension of the Elsinore fault).

The fundamental purpose of requiring further study in Alquist-Priolo zones is to prevent high-occupancy structures and important or potentially hazardous facilities from being constructed across an active earthquake fault, if avoidable.

The San Bernardino County General Plan EIR states that, "Known historic ground rupture in the Valley region is limited to minor fault creep along the San Jacinto Fault Zone near the city of Colton. ...Regionally, the potential hazards associated with ground rupture in the Valley are considered relatively low, due to the local nature of rupture related damage (i.e., along the fault traces themselves) and the provisions of the Alquist-Priolo Act" (SBC GP EIR, VIII-16). The only nearby special studies zone occurs adjacent to the northeastern portion of the Chino Groundwater Basin Boundary along a branch of the Cucamonga Fault.

Portions of the City of Norco and unincorporated Riverside County lie within specially designated County Hazard areas, however these are not part of the Alquist-Priolo Special Study Zones established by the State of California. A map showing Riverside County Fault Hazard Zones was previously included as Figure 4.4-13. This map also indicates areas with high potential for liquefaction hazards, discussed below.

### 4.4.2.5 Liquefaction Hazards

Liquefaction is a process that occurs during the shaking action of an earthquake. When loose granular materials (such as silt, sand or gravel) become saturated with water and are subjected to high levels of groundshaking, extreme damages to structures due to settling, tilting or floating of the foundation may result. Under such circumstances, when the soil and water mix, an unstable quicksand-like media forms. "Liquefaction of unconsolidated materials can be caused by strong vibratory motion resulting from seismic activity. Loose granular soils are most susceptible to these effects, while the stability of silty clay and clay materials is generally not as affected. Among granular materials, finer textured varieties are more susceptible to liquefaction than coarse graded materials. Additionally, liquefaction is generally restricted to saturated or near-saturated materials at depth of less than 50 feet" (SBC GP EIR, VIII-18).

One area of relatively high liquefaction potential occurs within the Valley region. This is an approximately 20 square-mile area located in the southwestern portion of the City of Chino and adjacent

areas, such as the Prado Basin area. This area has relatively shallow groundwater table, and generally sandy alluvial soils. Figure 4.4-15 shows the approximate location of this area. The areas that are most susceptible to liquefaction correspond to former artesian areas of the Basin, and other areas with high groundwater levels, which existed before extensive groundwater pumping lowered the groundwater levels.

#### 4.4.2.6 Settlement/Subsidence

Settlement is the localized lowering of the ground surface due to a decrease in the volume of the underlying soil or sediment. Various phenomena can cause settlement or subsidence, including consolidation, hydro-consolidation, and seismically induced settlement. The most common reason for subsidence in valley areas is the lowering of the groundwater table.

A common cause of ground fissuring within alluvial basins is the removal of subsurface fluids resulting in compaction of poorly consolidated aquifer materials and land subsidence (Fife et al., 1976; Galloway et al., 1998). A number of studies have attributed this process to the ground fissuring and apparent subsidence that has occurred in MZ-1 (Fife et al, 1976, Kleinfelder, 1993, 1996, 1999; Geomatrix, 1994). This section reviews the basic principles of aquifer system compaction; describes the general hydrogeology of the Chino Basin; [and] lists the evidence for groundwater withdrawal as the cause of land subsidence and fissuring in MZ 1" (Wildermuth Environmental, Task Memorandum: Program Element 4, 1999).

> *The Chino Basin Integrated Groundwater and Surface Water Model (CIGSM) model depicts the hydrogeologic geometry of the Chino Basin as a "layer-cake" of unconsolidated sediments within a basin of impermeable bedrock. The "layer-cake" consists of laterally extensive, sediment packages that alternate between high permeability aquifers and low permeability aquicludes. Aquifers that are located beneath an aquiclude (and are completely saturated) are considered to exist under confined conditions, where piezometric levels are higher than the bottom of the overlying aquiclude. The upper aquifer, where saturated, is considered to exist under unconfined conditions. The layer-cake model is a simplified description of the Chino Basin, and represents the essence of the hydrogeology. In reality, the stratigraphy is extremely complex, which is a reflection of a complex depositional history. The sediments accumulated in numerous terrestrial environments, including river channels, levees, floodplains, lakes and marshes. Terrestrial environments are notoriously unstable over geologic time – river channels migrate and cannibalize floodplain deposits, lakes fill up with sediments, etc. In addition, climate, sediment sources, and rates of tectonic subsidence/uplift vary over time, which further complicates the depositional/erosional history within the basin. While the aquifers in the Chino Basin are predominantly course-grained and commonly yield significant volumes of water to wells, they are not laterally extensive, homogeneous units of gravel and sand. They are heterogeneous in texture (both laterally and vertically) and sometimes consists of a high percentage of fine-grained sediments. For instance, a thick gravel bed penetrated by a well hole may pinch-out laterally and be encased within fine-grained sediments. This gravel bed may yield water initially, but lose capacity over time due to low seepage rates from the surrounding fine-grained sediments. The same heterogeneity concept applies to the aquicludes. Lateral discontinuity of sediment layers and textural heterogeneity are more the rule than the exception. The southern part of MZ 1 is an example of heterogeneity within the upper aquifer. While the CIGSM model designates the upper 200-300 feet of sediments as the upper aquifer, it is known that the upper 100 feet of sediments in this area is predominantly fine-grained (discussed below).*

*A number of lines of evidence strongly suggest that ground fissuring within MZ 1 is related to regional land subsidence due to groundwater overdraft:*

***Ground fissures.** The most obvious evidence of land subsidence in MZ 1 is the appearance and propagation of land surface fissures in the area of California Institution for Men (CIM) and the City of Chino....A general north-south trend of fissuring located directly east of the main trough of subsidence that has been mapped by ground level surveying (discussed below). [See Figure 4.4-16]*

*As stated previously, ground fissuring was first observed east of Central Avenue and crossing Edison Avenue in 1973 by a United State Geologic Survey geologist (Fife, et al., 1976). Beginning in 1991, a number of additional fissures appeared within the northwestern portion of CIM property. During following years, fissuring occurred to the north of and parallel to the CIM fissuring in the City of Chino and southward into the CIM Minimum compound where several structures have been damaged...*

*Geomatrix (1994) studied the ground fissures on CIM property and also reviewed case histories of fissuring throughout the southwestern United States. Their study noted similarities between the physical structure of the CIM fissures and the fissures described in the literature that were associated with areas of subsidence due to groundwater overdraft and aquifer system compaction. They also noted that this type of fissuring typically occurs along the edges of a subsidence trough. Geomatrix hypothesized that the CIM fissuring is a manifestation of east-west directed extensional stress associated with regional subsidence to the west.*

***Ground** level surveys: The City of Chino and CIM have conducted a number of ground level surveys in the southern part of MZ 1 as part of their ground fissuring investigations. Conclusions drawn from these ground level surveys state that:*

- *Land subsidence has occurred in this area since 1987 or earlier.*
- *The zone of subsidence is generally aligned north-south with the axis of maximum subsidence located about 1,500 feet west of the north-south trending zone of ground fissuring.*
- *Subsidence is likely due to groundwater overdraft and declining piezometric levels.*

*The maximum observed subsidence is approximately 2.2 feet, and occurs along Central Avenue between Eucalyptus and Schaefer Avenues. The subsidence trough approximately extends from Pipeline Avenue on the west to Benson avenue on the east, and from Merrill Avenue on the south to the edge of the survey area on the north (Riverside Drive). The contours suggest that the subsidence trough extends further north of Riverside Drive, but the ground level surveys did not include benchmarks north of Riverside Drive.*

*Three significant findings of the latest Kleinfelder survey (1999) are:*

- *Subsidence has apparently slowed during the 1995-1999 period.*
- *The axis of maximum subsidence is coincident with wells operated by the City of Chino Hills that are perforated through the deeper aquifers*
- *A potential error exists in the ground level surveys. The reference benchmark may be within the subsiding area and, hence, may have affected the magnitude of the calculated subsidence values. However, Kleinfelder believe this error is small (~0.1 feet).*

*Geomatrix (1994) also conducted a ground level survey for CIM by comparing manhole cover elevations at the CIM Minimum and Central compounds from 1988 to 1994. The survey indicated that subsidence had occurred during the period with elevations lower by about 2.1 foot along Vernon Avenue. The survey also suggested that subsidence diminished to the east with elevations lower by about 0.25 to 0.5 feet*

*within the CIM Minimum compound. These findings are generally consistent with the Kleinfelder ground level surveys with respect to the magnitude and spatial distribution of subsidence.*

*Geomatrix (1994) also noted that by comparing 1993 ground level survey data collected for the City of Chino with 1967 USGS topographic benchmark data, the area west and north of CIM experienced subsidence up 3 to 4 feet during this 26-year period. (Wildermuth Environmental, Task Memorandum: Program Element 4, 1999).*

In 1999, synthetic aperture radar studies were conducted by Jet Propulsion Laboratory (JPL) under contract to City of Chino. A summary of this study follows:

*This technique provides a measure of the distance between the radar antenna and the land surface, and by comparing images acquired at different time, changes in land surface elevation can be observed. From the three studies conducted from October 1993 to December 1995, and from January 1996 to October 1997, and from October 1997 to early 1999, a number of observations can be made, some of which are:*

- *Land subsidence has occurred within MZ1 during the entire period from October 1993 through 1998.*
- *Both ground level surveys and SAR imagery both indicate a north-south aligned trough with the axis of maximum subsidence located along Central Avenue.*
- *Interferograms show a zone of diminishing subsidence extending north of Riverside Drive - possibly as far north as Interstate 10.*
- *The interferograms degrade south of Edison Avenue, prohibiting comparison with ground level survey south of Edison Avenue.*
- *Where SAR imagery and ground level surveys overlap, the magnitude of subsidence correlates favorably.*

*These observations indicate that subsidence is occurring in MZ 1 and that such subsidence may be occurring further north than previously thought. (Wildermuth Environmental, Task Memorandum: Program Element 4, 1999) The existence of fine-grained aquicludes underlying MZ 1, coupled with historical decline in piezometric levels, are a typical combination leading to aquifer system compaction and land subsidence (Wildermuth Environmental, Task Memorandum: Program Element 4, 1999).*

*Several pieces of evidence suggest that MZ1 may be underlain by a fine-grained aquiclude. This evidence includes the fact that the southern part of MZ 1 is located on the outer margins of the alluvial fan at the base of the San Gabriel Mountains. These types of deposits are typically fine-grained. Further, the nearby Chino Hills are composed of fine-grained sedimentary rocks, and geophysical logs of wells and soil borings show predominantly fine-grained materials at depths less than 100 feet. At depths around 250 feet, a thick fine-grained unit exists beneath the area of subsidence (as defined by the ground level surveys described above). "Also, analysis of water levels and drawdown-recovery characteristics at wells perforated below this thick unit show that the fine grained unit acts as a confining layer, or aquiclude. During the 1900's much of the southern part of MZ 1 was an area of flowing artesian groundwater conditions (Mendenhall, 1908) - indicating the existence of fine-grained confining layers...This artesian condition also indicates that piezometric levels were above land surface. At locations where groundwater could seep upward through the confining layers, a marshy conditions would occur...meaning the sedimentary column in this area was completely saturated at this time.(Wildermuth Environmental, Task Memorandum: Program Element 4, 1999) This marshy area is also the area described under liquefaction issues as being potentially at risk for liquefaction to occur.*

Groundwater levels eventually declined in these marshy areas to approximately 150 feet below ground surface from the mid-1940's to 1978.

> *This decline in groundwater levels coincided with (1) and extended period of below normal precipitation and (2) groundwater overdraft associated with accelerated human activities in the basin...Since 1978, groundwater levels have recovered by about 40 feet in the southern part of MZ 1. This recovery coincided with (1) wetter than normal periods form 1978 to 1983 and... (2) the adjudication of the Chino Basin in 1978 that resulted in management of groundwater production and the initiation of artificial recharge in forebay areas to the north.*
>
> *As previously stated, the upper 100 feet of sediments in this shallow zone are predominantly fine-grained. Dewatering of these fine-grained sediments since the 1940's likely increased effective stresses within the sediments (to levels greater than maximum past effective stress) and resulted in aquifer system compaction.*
>
> *Geomatrix (1994) agreed with this scenario and speculated that these long-term water level declined since the 1940s, and especially from 1960 to 1978, were responsible for the ground fissuring first observed in 1973 by the USGS.*
>
> *While water levels in the shallow aquifer zone have recovered somewhat since 1978, piezometric levels in the deep aquifers (below the thick fine-grained unit) have had a separate and distinct history. In the southern part of MZ1, little water level data exists prior to 1980 for the deep aquifers. However, in the late 1980's a number of wells were drilled in this area for municipal use - some perforated below the thick fine-grained unit. These wells are owned by the City of Chino Hills*
>
> *Geomatrix (1994) and Kleinfelder (1999) have speculated that pumping of the deep aquifer is the cause of recent subsidence and ground fissuring in the area. Their reasoning is as follows:*
>
> - *An accelerated occurrence of fissuring commenced in 1991, two to three years after the completion and initial operation of the deep aquifer wells.*
> - *The axis of maximum subsidence, as delineated by ground level surveys (1987-1994), is aligned with the locations of these deep aquifer wells.*
>
> (Wildermuth Environmental, Task Memorandum: Program Element 4, 9-11, 1999)
>
> *...As groundwater is extracted from the deep aquifer, piezometric head (i.e. pore fluid pressure) decreased within the aquifer, and attempts to equilibrate by drawing water from the pore spaces in the surrounding sediments. In the classical situation, the deep aquifer is in hydraulic continuity with the upgradient forebay area where water is recharged to the basin. If for some reason, the continuity between the forebay and deep aquifers is interrupted, then the pumped aquifer will attempt to equilibrate by drawing water from the surrounding fine grained sediments (e.g. the aquiclude). time.* (Wildermuth Environmental, Task Memorandum: Program Element 4, 9-11, 1999)

This situation may result in subsidence, and two potential causes relative to the observed areas of subsidence are as follows: (1) discontinuity in the geometry of the gravel/sand strata within the aquifers, and/or (2) groundwater production from areas upgradient and tributary to subsidence zones. (Wildermuth Environmental, Task Memorandum: Program Element 4, 11, 1999)

If local groundwater production is conclusively demonstrated to be the cause of subsidence in MZ1, a distinction must still be made between long-term Basin-wide overdraft prior to 1978 and recent

local overdraft of deep aquifers. The OBMP Monitoring Plan is currently guiding the study of subsidence. The OBMP proposes to continue periodic studies of the subsidence issue throughout the 50-year planning period.

#### 4.4.2.7 Seiche

Seiche is the oscillation of the surface of a landlocked water body that varies from a few minutes to several hours. Seiche can be seismically induced or be the result of material (rocks, landslide, etc.) falling into the water body. No major surface water body occurs in or near the proposed project sites. Lake Arrowhead is the nearest water body that could potentially be affected by seiche conditions, but it is not located in the Santa Ana River Basin. Big Bear Lake, which is in the Santa Ana River Basin, is not proximate enough to the OBMP project area to pose any seiche constraints or impacts.

### 4.4.3 Project Impacts: Geology and Soils

This project proposes a variety of new facilities in support of the OBMP, including the construction of structures that will be occupied during working hours. The other proposed new structures or facilities associated with this project are pipelines, wells, booster pumps, channel improvements, and retention/detention/percolation basins. For the latter facilities people typically will be present onsite for only short periods of time during construction and maintenance activities for the facilities. Only at the desalter facilities will people regularly be present for long durations, beyond the normal window of time required by routine maintenance activities.

The implementation of the OBMP within the project area would include installing new infrastructure systems, pipelines, wells, storage and treatment facilities consistent with OBMP policies and mitigation measures outlined in this document designed to reduce or eliminate potentially significant incompatibilities. Theoretically the facility components could be built in any type of land use jurisdiction, given that sufficient need can be demonstrated for a facility in support of the OBMP, and given that no other alternatives locations or type of facilities can accomplish the same objectives. The geology and soil issues of focus in this evaluation are examined at the level of constraints imposed on future activities proposed in support of the OBMP. These constraint issues are evaluated in the following text.

#### 4.4.3.1 Significance Criteria

The following criteria will be used for determining potential significant impacts related to geology and soil issues:

- Expose people or structures to substantial geologic hazards, including the risk of injury or death to humans and the loss of structures due to ground rupture, strong seismic groundshaking or seismic related ground failures, including liquefaction and landslides

- Exposure of humans, structures or infrastructure to soil constraints, including soil characteristics that create a high risk of injury or death to humans and the premature loss of structures or infrastructure.

- Significant alterations in the site topography that can create a high potential for downstream erosion (such as loss of topsoil) and sedimentation

- The project could result in the loss or major alteration/damage to a unique geologic resource

### 4.4.3.2 Potential Impacts

#### a. Is the Project Area subject to fault rupture?

Based on all geologic studies and maps for the region discussed in subsection 4.4.2 above, no active faults are known to occur within the project area and no Alquist-Priolo Special Studies Zones have been designated within the Chino Basin. The Cucamonga Fault, which is considered active, is located just northeast of the Chino Basin proper. Therefore, the potential for fault rupture within the project area is considered to be low, and potential impacts can be mitigated to reduce impacts by implementing the mitigation measures listed in the following subsection. These measures will ensure that the proposed OBMP facilities are not subjected to fault rupture hazards in the event of future seismic activity. The mitigation measures are designed to deal with future projects on a case-by-case basis and will reduce impacts to levels that are less than significant.

#### b. Is the Project Area subject to significant seismic groundshaking?

Table 4.4-2 indicates that the project site may be subject to significant seismic ground-shaking over the life of the proposed project, caused by earthquakes along portions of the fault systems within vicinity of the project. As part of the OBMP proposed new infrastructure system, both existing and proposed additions and facilities will be constructed to ensure that they can meet current building code and safety requirements, including seismic standards. Any replacement or modification of existing structures with new facilities will include incorporation of current seismic design standards. Because of the identified potential for significant seismic shaking hazards within the Chino Basin, mitigation will be implemented to ensure that construction of new facilities meets safety requirements.

At the project specific level, future projects do have a potential to experience significant constraints, especially if constructed proximate to a fault zone, whether active or not. Aside from identifying known fault locations at this time (see Figure 4.4-12, geotechnical constraints associated with faults cannot be defined until specific project locations are identified for individual projects implemented under the OBMP. These impacts can still be managed on site-by-site basis by implementation of a number of mitigation measures which are outlined below. Such measures could include avoidance

through relocation of a facility or conducting a geotechnical survey to define site specific design mitigation measures. If such design measures are not sufficient to reduce potential groundshaking impacts to a non-significant impact, selection of an alternative location may be the only measure available to reduce impacts to a non-significant level of impact.

With the implementation of the seismic groundshaking hazard mitigation measures in a project specific manner in the future, the potential impacts related to area seismic constraints will be reduced and can be classified as less than significant.

### c. Is the Project Area subject to significant seismic ground failure, including liquefaction?

Liquefaction results when water-saturated, sandy, unstable soils are subject to intense shaking, such as that caused by an earthquake. These soils lose cohesiveness, causing structures to fail. Studies indicate the current location of liquefaction-prone soils in the proposed Project Area are the former artesian areas located in and around the Cities of Chino, Chino Hills (see Figure 4.4-15) The potential for liquefaction is either less than significant or nonexistent in all other areas within the Chino Basin. Liquefaction is typically only an issue when the water table is within 50 feet of the ground surface. Figure 4.4-15, in addition to depicting current areas of potential liquefaction, also shows potential liquefaction areas that are forecasted in the year 2020 for both OBMP and no OBMP conditions. The OBMP model forecasts that the areas where groundwater is within 50 feet of the ground surface will increase in size. This increase is substantially less with the implementation of the OBMP compared to the Baseline (i.e. No-OBMP) condition. However, if a conjunctive use program is implemented that would cause water levels to rise significantly within the liquefaction zone shown in Figure 4.4-15, potential for liquefaction to occur may increase. Thus, a mitigation measure is proposed to eliminate or minimize the potential for any future OBMP activities to create a new potential for liquefaction, should any OBMP activities be implemented which might substantially raise existing piezometeric levels.

### d. Is the Project Area subject to significant seiche, tsunami, or volcanic hazards?

Based on all geologic studies and maps for the region, no surface water bodies are in the project area that could create seiche or tsunami and no volcanic hazards occur in the Project Area. Without the presence of any of these hazards in the area, no hazard exists that can adversely impact future OBMP activities or be impacted by these activities. No mitigation is required.

### e. Is the Project Area subject to significant landslide or mudflow hazards?

The Project Area is not subject to significant landslide or mudflow hazards. Development on steep slopes can increase rates of erosion and exacerbate landslide hazards which may threaten structures. For the most part, no substantial amount of development is proposed for areas with steep slopes. To prevent increased risk of mudflows and landslides, development in areas where slopes exceed

15 percent will be restricted for OBMP projects; therefore, land-use impacts on hillsides are not anticipated to be significant. This measure is identified as mitigation in the discussion below.

Within the remainder of the Project Area, no slope areas exist that could result in significant landslides or mudslides, both due to the type of soils, degree of slope (less than 9% throughout most parts of the valley), and existing development covering much of the Chino Basin. Without the presence of any landslide or mudslide hazards within the project area, no such hazard exists that can adversely impact future redevelopment activities or be impacted by these activities. No mitigation is required.

**f. Is the project area subject to significant erosion or unstable soil conditions from grading activities, or will the proposed project cause significant changes in topography?**

The project area is not subject to significant erosion or unstable soil conditions from grading activities, nor will any of the activities proposed by the OBMP cause significant changes in topography. In general, the majority of project area is topographically compatible with all of the proposed project facilities outlined in the Project Description. With the exception of the recharge basins, all ground disturbing activities (pipelines, wells, pumps, etc.) will affect small areas that can be designed to minimize the amount of ground disturbance. For recharge basins, the amount of area disturbed may be substantial, but the basins are designed to contain surface runoff, including all runoff diverted into a basin, for percolation. Local effects on soils and geology would result primarily from the construction activities associated with the proposed action, such as grading, excavating, and recontouring the soils. These activities could alter soil profiles and the local topography and create a potential for significant erosion. To ensure that significant erosion and unstable soil conditions are not created during construction and operation of future specific projects, mitigation measures are identified to control such water related erosion. These measures will ensure that discharges of surface runoff will not exceed the erosive velocity for affected areas and that no unstable slopes are installed as part of future projects.

During construction, removal of vegetative cover and disturbance of existing topography by the exposure of cut slopes and grading activities could increase the potential for erosion by wind and water. Appropriate watering for fugitive dust controls and water erosion control measures to address non-point source water pollution will be necessary during construction of specific OBMP facilities in previously undeveloped areas.

Regional effects on geology and soils within the remaining portion of the Project Area could be significant. There are approximately 225,000 acres of land within the proposed project area. A substantial portion of that could, over the life of the OBMP, be developed into residential, commercial, and industrial uses. Alteration of natural surface and soil conditions will occur as a result of grading, trenching, and vehicular traffic across undeveloped land surfaces. These activities will cause degradation of naturally occurring geologic and topographic features, resulting in short-term exposure of underlying soils, all of which will create adverse conditions related to soil erosion by wind and water.

Mitigation measures are available to minimize erosion problems associated with wind and water, especially during the construction phase of projects. The measures below should be applied to all construction projects, to reduce erosion damage and eliminate creation of unstable slopes. However, the measures outlined below can only be applied to future specific OBMP projects. After the construction phase, long-term erosion control can be accomplished by keeping soils under vegetative cover and planting wind breaks. After construction, soils underlying facilities and pavements will not be subject to erosion. With implementation of all measures, erosion and unstable slope impacts attributable to future OBMP projects will be reduced to a less than significant level.

### g. Is the Project Area subject to significant subsidence hazards?

Within the project area, a portion of the City of Chino and CIM has been identified as experiencing land subsidence impacts within a former artesian area of the valley (see Figure 4.4-16). These subsidence effects are described above and are assumed to be related to deep aquifer extractions within the area itself and within areas upgradient of the subsidence zone.

The proposed OBMP goals include further studies of this phenomenon as part of a regional monitoring program. Additionally, one of the OBMP goals listed in Chapter 3 is to attempt to minimize and abate future subsidence-related impacts through balanced Basin management practices that aspire to prevent localized overdraft by means of proposing prudent water supply and recharge options to help producers meet existing and future obligations in a way that does not cause a negative impact to the environment.

Further hydrogeologic investigations will be required for the expansion of the SAWPA desalters as the well field is partially located within the subsidence zone. Whatever future pumping pattern is implemented in support of the OBMP desalters will not be allowed to increase subsidence in any way within existing subsidence areas as shown in Figure 4.4-16. Mitigation is included that that sets the performance standard for no net contribution to subsidence in existing subsidence areas due to the implementation of OBMP activities. The recharge efforts are designed to provide additional water supplies and to assist in offsetting localized overdraft within the subsidence area. The only groundwater pumping proposed as part of the OBMP is that associated with future desalter construction and operation. This pumping will occur in the shallow aquifer, not the deep aquifer that is more intimately connected to the subsidence issue. The desalters being considered would be located to the east and south of the subsidence area in the City of Chino. Hydrogeologic studies including modeling will be conducted prior to initiating well extractions for the desalters proposed in the OBMP. In addition to ongoing monitoring to ensure that water extractions do not contribute to subsidence, the OBMP can provide mitigation through localized recharge (using either basins or infiltration wells) or change well pumping patterns. Based on the management goals and available management tools, the OBMP is forecast to have a beneficial impact to the existing area of subsidence. As discussed above, the siting of future OBMP facilities will take into consideration the subsidence potential in southwestern Chino, and in other areas within the subsidence zone described

in the OBMP Phase I Report, and will not exacerbate the problem by increasing pumping in areas that are closely related (in a hydrological or geological sense) to the former artesian area (i.e. the existing subsidence trough). A hydrogeological study will be performed for the expansion of the SAWPA desalter. In areas where no subsidence currently exists, but where heavy future production as part of the OBMP (especially desalter well fields) may occur, the performance standard is established in the mitigation measures that determines impacts will be kept to a less than significant level. If modelling studies indicate that impacts may be greater than the thresholds set forth in the mitigation measures, subsequent environmental documentation will be required. If projects adhere to the mitigation measures set forth in this document, impacts related to this issue can be considered less than significant.

### h. Is the Project Area subject to significant expansive soil hazards?

The soil associations present within the project area do not have any significant expansive soil characteristics. The relative shrink-swell potential for the soils in the project area are very low, and thus, does not pose a significant hazard or major constraint related to future OBMP projects. Potential impacts associated with expansive soils are not forecast to pose any significant constraint in developing future facilities and no mitigation is required.

### i. Does the Project Area contain any unique geologic or physical features?

The project site is underlain by old and young alluvium, and river wash deposits. These are common geologic substrates within the San Bernardino Valley Area. Areas with steep slopes will have limited (if any) development associated with the OBMP; the integrity of the bedrock areas within the Project Area is not forecast to be disturbed by implementing the OBMP. Without the presence of any existing unique geologic or physical features within the Project Area, the proposed project cannot significantly impact such features. No mitigation is required.

## 4.4.4 Mitigation Measures

The following mitigation measures will be implemented for individual projects implemented under the OBMP. Implementation of this measures can reduce all potential impacts to a level that is considered to be less than significant with respect to the proposed thresholds.

### 4.4.4.1 Soils

Mitigation measures are available to minimize erosion problems associated with wind and water, especially during the construction phase when trenches and cut slopes are exposed. During construction, the length of time vegetation and other cover is absent should be minimized. When cut slopes are exposed, any of the following measures may be useful in limiting erosion.

**4.4-1 Add protective covering of mulch, straw or synthetic material (erosion control blankets, tacking will be required).**

**4.4-2 Limit the amount of area disturbed and the length of time slopes and barren ground are left exposed. After pipeline installation, soil shall be compacted to a level similar to pre-construction conditions.**

**4.4-3 Construct diversion dikes and interceptor ditches to divert water away from construction areas.**

**4.4-4 Install slope drains (conduits) and/or water-velocity-control devices to reduce concentrated high-velocity streams from developing.**

**4.4-5 Construction of facilities and structures areas with high liquefaction potential shall be limited without further geologic and hazard-related studies conducted by a qualified geologist or geotechnical firm. Such studies will provide guidelines to minimize the risks to humans and to capital-intensive facilities.**

**4.4-6 If a conjunctive use program might be implemented that would bring water levels up to a level that significantly increases the risk of liquefaction, a more detailed monitoring and geologic study focused on this issue will be conducted to determine whether or not liquefaction poses a hazard to surface structures and to human safety. If such a study finds the impacts to be significant, the volume of water permitted to be stored in the Basin will be decreased sufficiently until a water level is achieved that does not pose any significant hazard to surface structures or people.**

After the construction phase, long-term erosion control can be accomplished by keeping soils under vegetative cover, hardscape (pavement, gravel, or other hard cover) and planting wind breaks. The type of vegetation used as wind breaks must comply with SCAQMD's standards. After construction, soils underlying facilities and pavements will not be subject to erosion.

Mitigation measures identified above shall be employed within the proposed project area. In addition, mitigation measures dealing with seismic and geologic hazards as addressed in the General Plans/EIRs of the Participating Jurisdictions shall be implemented. Examples of measures which are designed to minimize the potential for damage, injury and loss of life resulting from geologic hazards include the following:

### 4.4.4.2 Geology

**4.4-7 Mitigate the risks from geological hazards through a combination of engineering construction, land use and development standards.**

**4.4-8 Require each site within identified Liquefaction Hazard Zones to be evaluated by a licensed engineer prior to design or land disturbance/construction.**

**4.4-9 Apply appropriate design and construction criteria to all structures subject to significant seismic shaking.**

**4.4-10 Prohibit critical, essential, and high risk land uses near earthquake special studies areas shown on the Hazard Overlay Maps developed by the County of San Bernardino and Riverside.**

**4.4-11 Require stability analysis for Landslide Hazard areas designated "Generally Susceptible" and "Mostly Susceptible" on the Hazards Overlay Maps.**

4.4-12 Institute restrictions on construction in high landslide potential and steep-slope areas to ensure safe development.

4.4-13 Continue to identify and study subsidence hazards and susceptible areas, and propose mitigation technology that is appropriate to the findings of the monitoring study. The implementation of OBMP facilities shall *not* in any way contribute to subsidence conditions in ***pre-existing subsidence zones*** (as shown in Figure 4.4-16). The OBMP will not cause or contribute to any new, significant subsidence impacts greater than a total of six inches in magnitude over the planning period. Impacts less than 6 inches in new areas are considered to be less than significant.

4.4-14 If modeling and/or additional studies conducted for the expanded OBMP SAWPA desalter wellfield demonstrates that such pumping will contribute to subsidence in the existing subsidence area, then a potentially significant impact can occur, and a subsequent environmental document will be prepared. No OBMP activities allowed under this document will be permitted to cause or contribute to the subsidence within the pre-existing subsidence area defined in the OBMP Phase I Report and Figure 4.4-16.*

4.4-15 To ensure that pumping impacts in the vicinity of the desalter well field do not have an adverse impact on water levels and subsidence issues, the follow performance standards shall be used to evaluate the desalters:

a. Water level declines in areas surrounding the desalter pumping locations will not be allowed to decline to the extent that pumping capabilities for surrounding wells are impacted. If surrounding wells and producers are impacted by declines in water levels, alternative access to equivalent quantity and quality of water will be provided to affected surrounding parties. This water may be provided through distribution of funding to affected parties for the deepening of existing wells, or may be provided through the delivery (paid for by the implementing agency) of comparable or improved quality and quantity of water from other sources.

b. If desalter well fields are demonstrated to cause or exacerbate impacts to subsidence areas measurable by a decline of over six inches in ground level at a 1/4 mile radius, or at the radius of the nearest non-OBMP-participating structure, then pumping patterns for the desalters shall be modified to reduce impacts to cause no more than six inches of decline in ground level at the smallest of the two radii.

c. If an engineering study is prepared prior to installing a well or well field by a qualified geologist and hydrologist and demonstrates that subsidence greater than six inches can be permitted without causing significant subsidence hazards, then the investigation will define the new threshold for the specific location and it will be observed as the alternative threshold of significant subsidence.

4.4-16 Require site-specific geotechnical investigations of proposed development to include an assessment of potential impacts and mitigation measures related to expansive and reactive soils and liquefaction. Under the OBMP, Watermaster will continue to monitor the areas with potential liquefaction hazards and will work with local jurisdictions to ensure that any future structures are constructed with the appropriate foundations to address increased liquefaction potentials apropos to the specific area. This mitigation measure will reduce impacts to a less than significant level.

4.4-17 Apply provisions of hillside erosion and sediment control that reduce volume and velocity of flows and content of sediment to levels that do not cause significant rill or gully erosion in susceptible areas. In addition, provide for restoration of areas that do become eroded.

**4.4-18 Prevent unnatural erosion in erosion-susceptible areas by tailoring grading, land clearance, and grazing, and by prohibiting use of off-road vehicles.**

The foregoing are general examples of appropriate mitigation measures. As development is proposed during Plan implementation, more detailed project-specific measures may be employed.

### 4.4.4.3 Seismicity

The following measures shall apply to OBMP projects proposed within the Chino Basin:

**4.4-19 When determined necessary by the affected jurisdictions, geotechnical and soils engineering reports shall be prepared in conjunction with the preparation of preliminary design layouts and grading plans for all new development projects implemented within the proposed Project Area. These studies will verify the presence or absence of hazardous soil conditions. If necessary, these reports will provide specific mitigation measures for the treatment of *potential* geologic and soils hazards.**

**4.4-20 Comprehensive geotechnical investigation shall be required prior to engineering and design development or structural and/or substantial rehabilitation of structures identified under Risk Class I & II, e.g., public facilities, as identified below:**

***Risk Class I & II, Structures Critically Needed after Disaster:*** **Structures which are critically needed after a disaster include important utility centers, fire stations, police stations, emergency communication facilities, hospitals, and critical transportation elements such as bridges and overpasses and smaller dams.**

**Acceptable Damage: Minor non-structural; facility should remain operational and safe, or be suitable for quick restoration of service.**

***Risk Class III:*** **High occupancy structures; uses are required after disasters, i.e., places of assembly such as schools and churches.**

**Acceptable Damage: Some impairment of function acceptable; structure needs to remain operational.**

***Risk Class IV, Ordinary Risk Tolerance:*** **The vast majority of structures in urban areas; most commercial and industrial buildings, small hotels and apartment buildings, and single family residences.**

**Acceptable Damage: An "ordinary" degree of risk should be acceptable. The criteria envisioned by the Structural Engineers Association of California provide the best definition of the "ordinary" level of acceptable risk. These criteria require that buildings be able to:**

**a. Resist minor earthquakes without damage;**

**b. Resist moderate earthquakes without structural damage, but with some non-structural damage; or**

**c. Resist major earthquakes, of the intensity or severity of the strongest experienced in California, without collapse, but with some structural, as well as non-structural damage.**

***Risk Class V, Moderate to High Risk Tolerance:*** **Open space uses, such as farms, ranches and parks without high occupancy structures; warehouses with low intensity employment; and the storing of non-hazardous materials.**

**Acceptable Damage: Not applicable.**

**4.4-21 All structures previously identified in categories III through V shall be designed in accordance with the applicable multiplier factor seismic design provisions of the Seismic Safety Report to promote safety in the event of an earthquake.**

**4.4-22 The direct impacts of faults upon proposed projects shall be considered during preliminary planning processes, and the engineering design phases.**

**4.4-23 All rehabilitation and new development projects implemented as a result of the proposed Project shall be built in accordance with current and applicable Uniform Building Code (UBC) standards and all other applicable City, County, State and Federal laws, regulations and guidelines, which may limit construction and site preparation activities such as grading, and shall make provisions for appropriate land use restrictions, as deemed necessary, to protect residents and others from potential environmental safety hazards, either seismically induced or those resulting from other conditions such as inadequate soil conditions, which may exist in the proposed Project Area.**

**4.4-24 Local grading and building codes should reflect measures to minimize possible seismic damage.**

Implementation of the above mitigation measures will lower the Project's impact to seismic safety to that of below significance. Impacts, however, must be considered significant and not mitigated until such time these measures are implemented through a final Mitigation Monitoring and Reporting Program.

The following measures are ***not*** recommended as conditions of project approval, but are provided for the consideration of decision-making bodies as a means to further reduce safety risks by fortifying existing seismic safety policies.

There are three related initial actions which the Participating Jurisdictions should follow to ensure mitigation of seismic-related hazards:

**4.4-25 Utilize geologic and seismic data in land planning so that identified risk areas, if any, are avoided, or structures and landforms treated and designed to reflect local site conditions.**

**4.4-26 Inspect older facilities and improve earthquake design features when possible.**

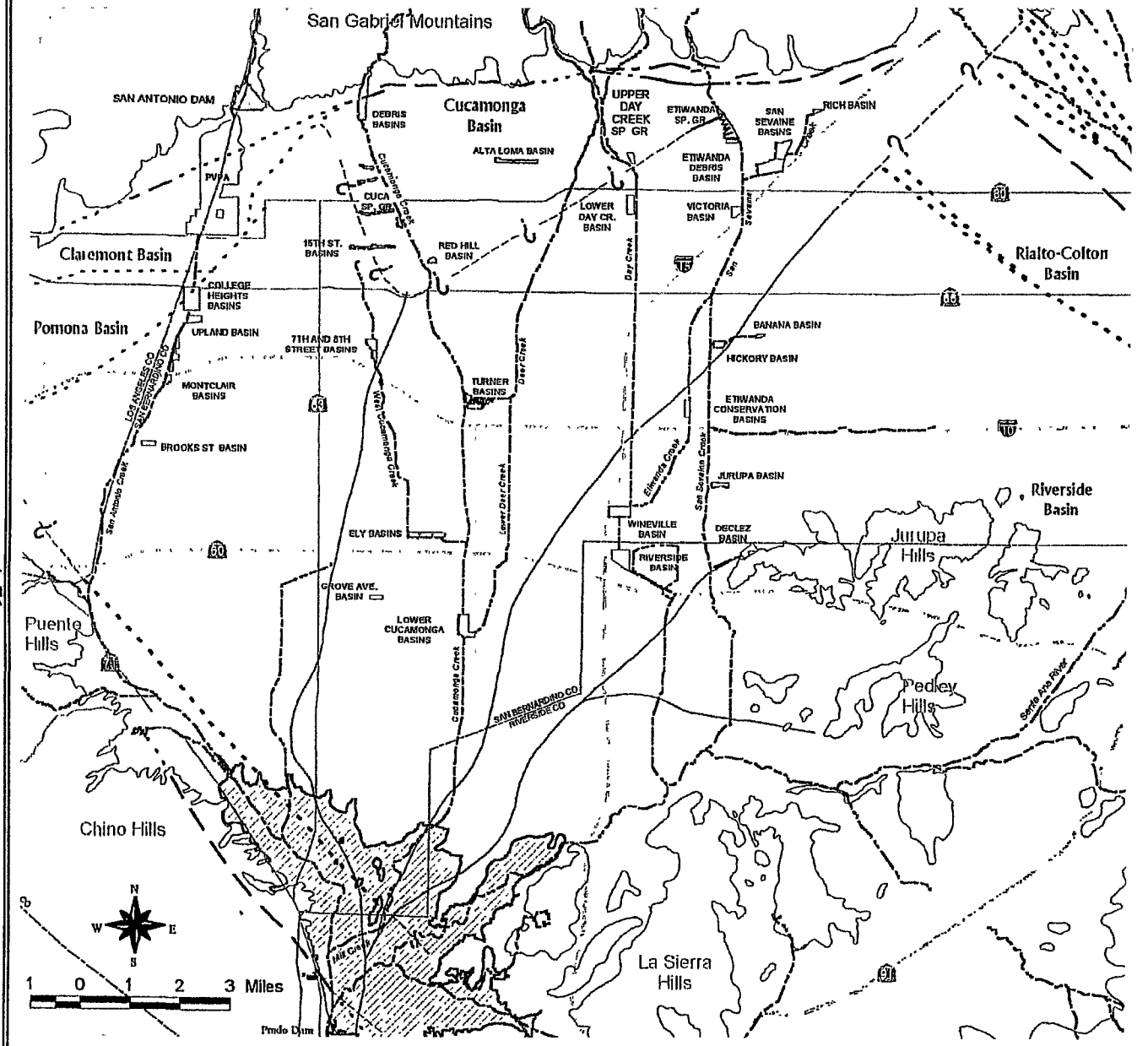
**4.4-27 Maintain a disaster preparedness plan.**

### 4.4.5 Unavoidable Adverse Impact

The geologic and soil resource impact evaluation presented above indicates that the proposed project, implementing the OBMP, has a potential to cause or be exposed to significant geotechnical impacts or constraints, but with proposed mitigation, implementing the OBMP will not cause any significant unavoidable adverse geologic and soil resource impacts or be exposed to significant geotechnical constrains. Therefore, no significant unavoidable adverse geologic or soil impacts are forecast to occur if the proposed project is implemented.

### 4.4.6 Cumulative Impact

Future development in accordance with the OBMP will not cause any significant adverse geologic or soil impacts. With implementation of the mitigation measures outlined above, the proposed project will not contribute to cumulative exposure of humans in occupied structures to seismic, liquefaction or subsidence hazards. Therefore, no additional mitigation measures are required to ensure that cumulative geologic and soil impacts remain below a significant impact threshold.

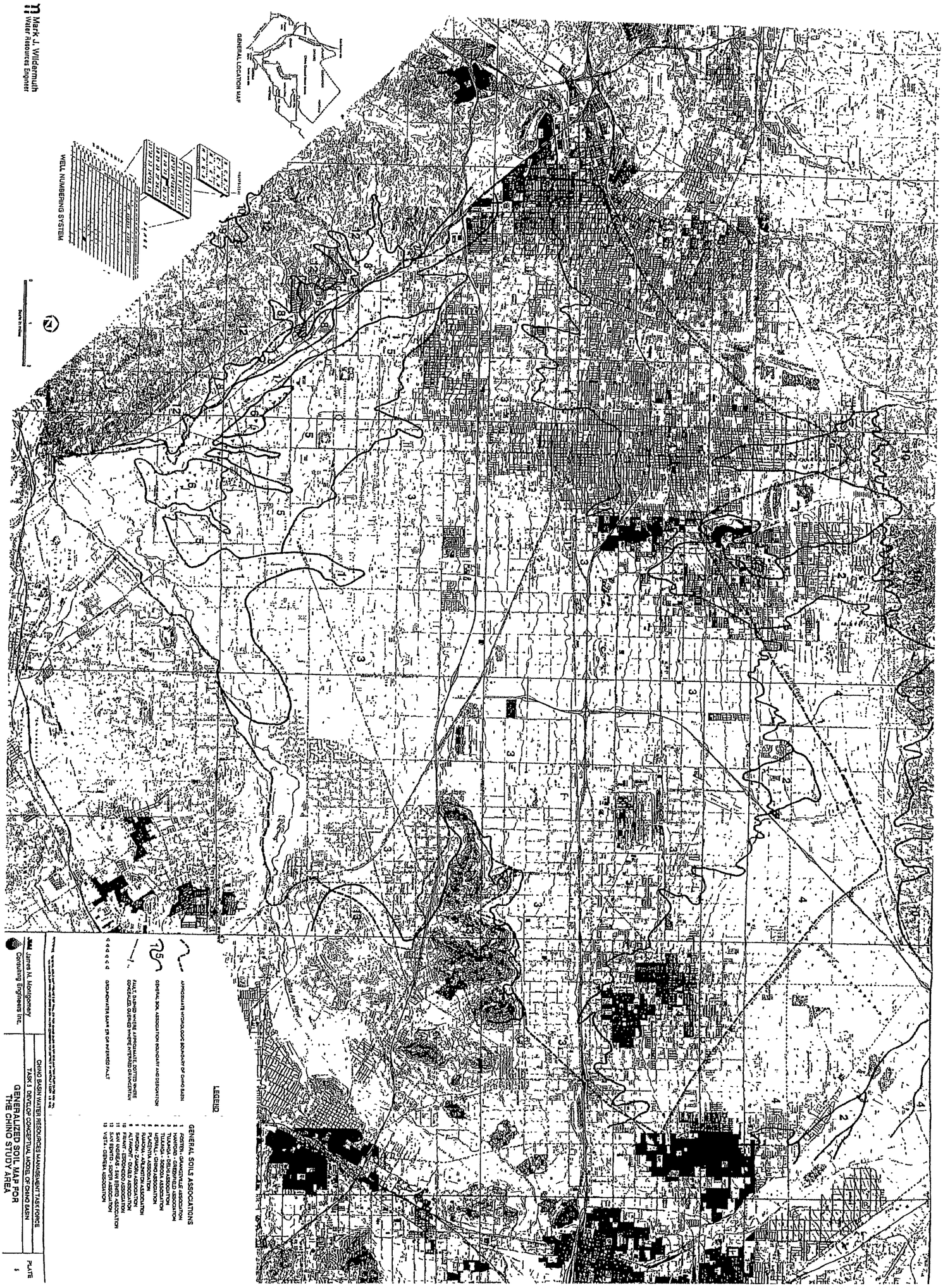



**EXISTING DRAINAGE PATTERN FOR THE CHINO BASIN**

Source. OBMP Phase I Report, Figure 2-1

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-1**

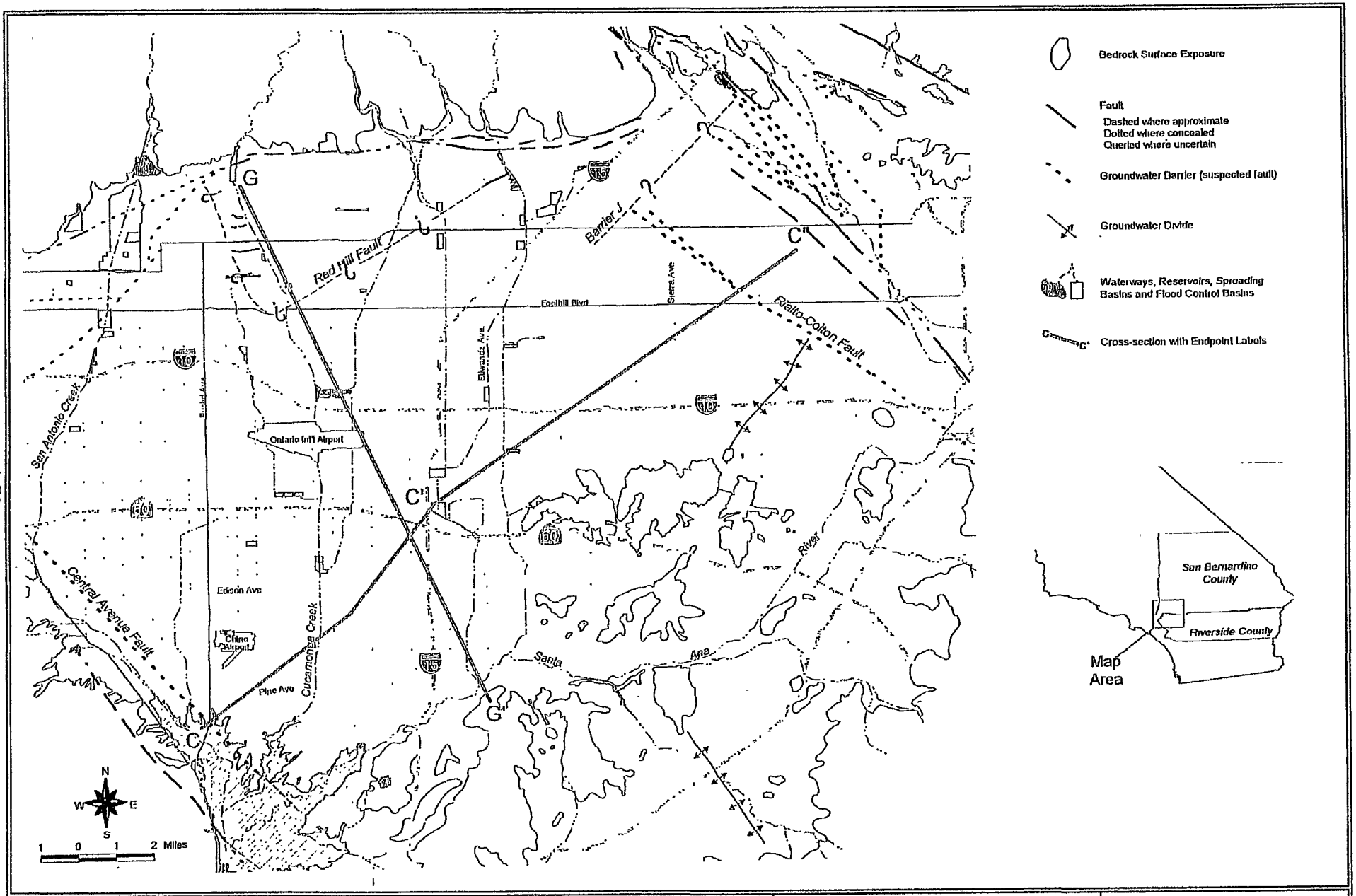



**GENERAL SOIL ASSOCIATIONS IN THE CHINO AREA**

Source: Task 5 Memorandum Plate 5

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-2**

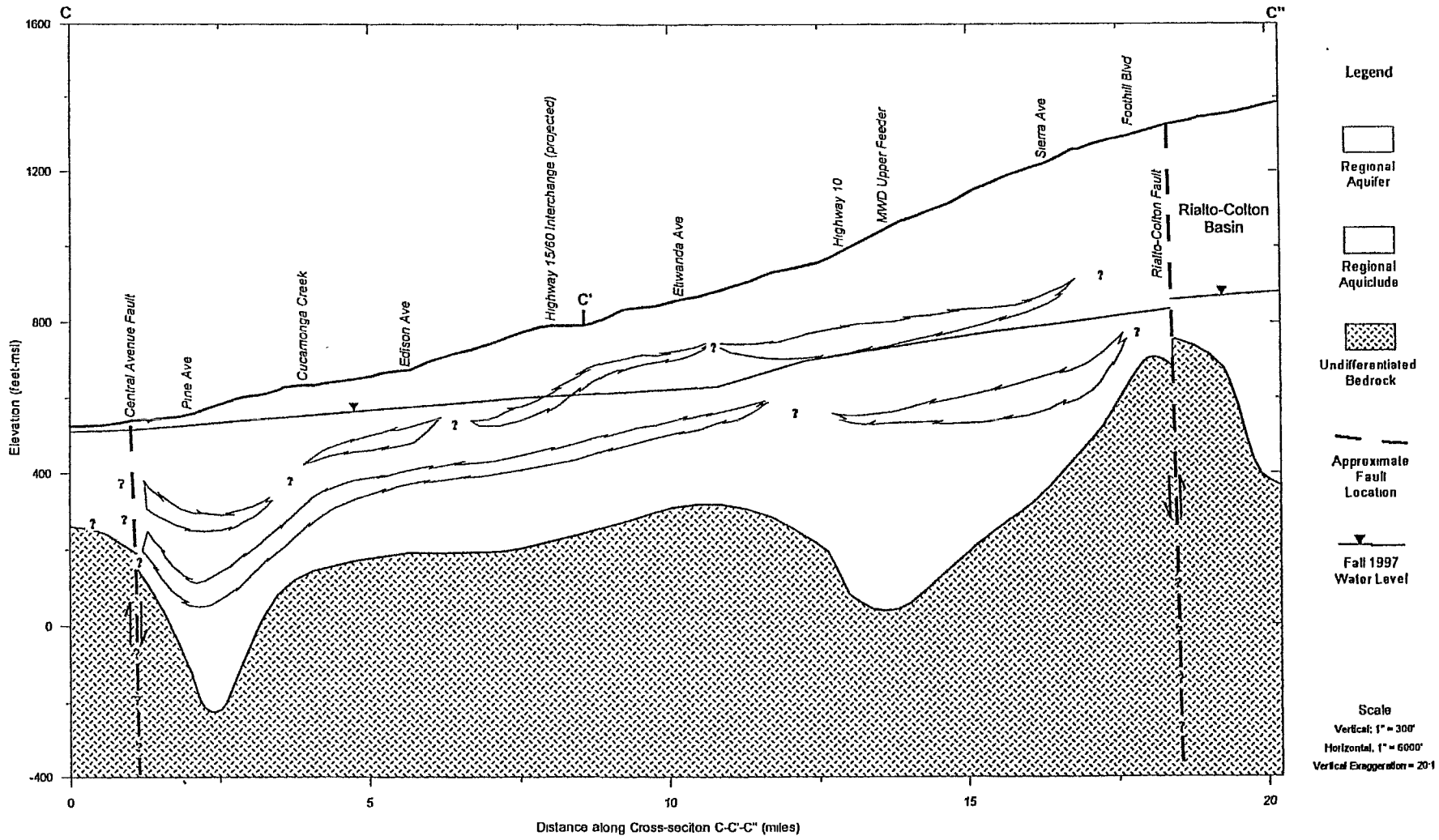



**LOCATION OF TWO GENERALIZED CROSS-SECTIONS FOR THE CHINO BASIN**

Source: OBMP Phase I Report, Figure 2-2

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-3**

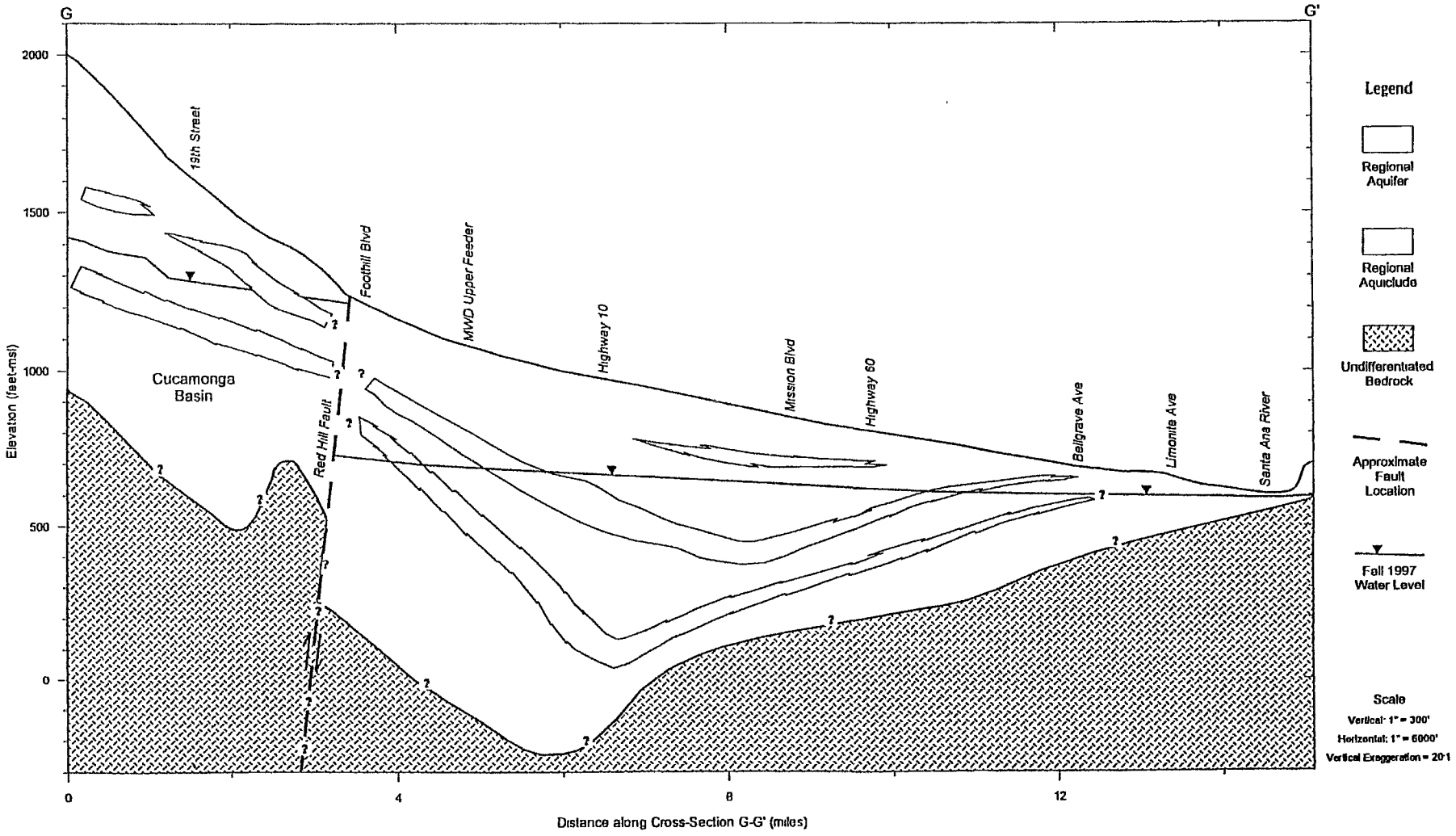



**GENERALIZED CROSS-SECTION C-C'-C"**

Source: OBMP Phase I Report, Figure 2-3

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Environmental Consultants

**FIGURE 4.4-4**

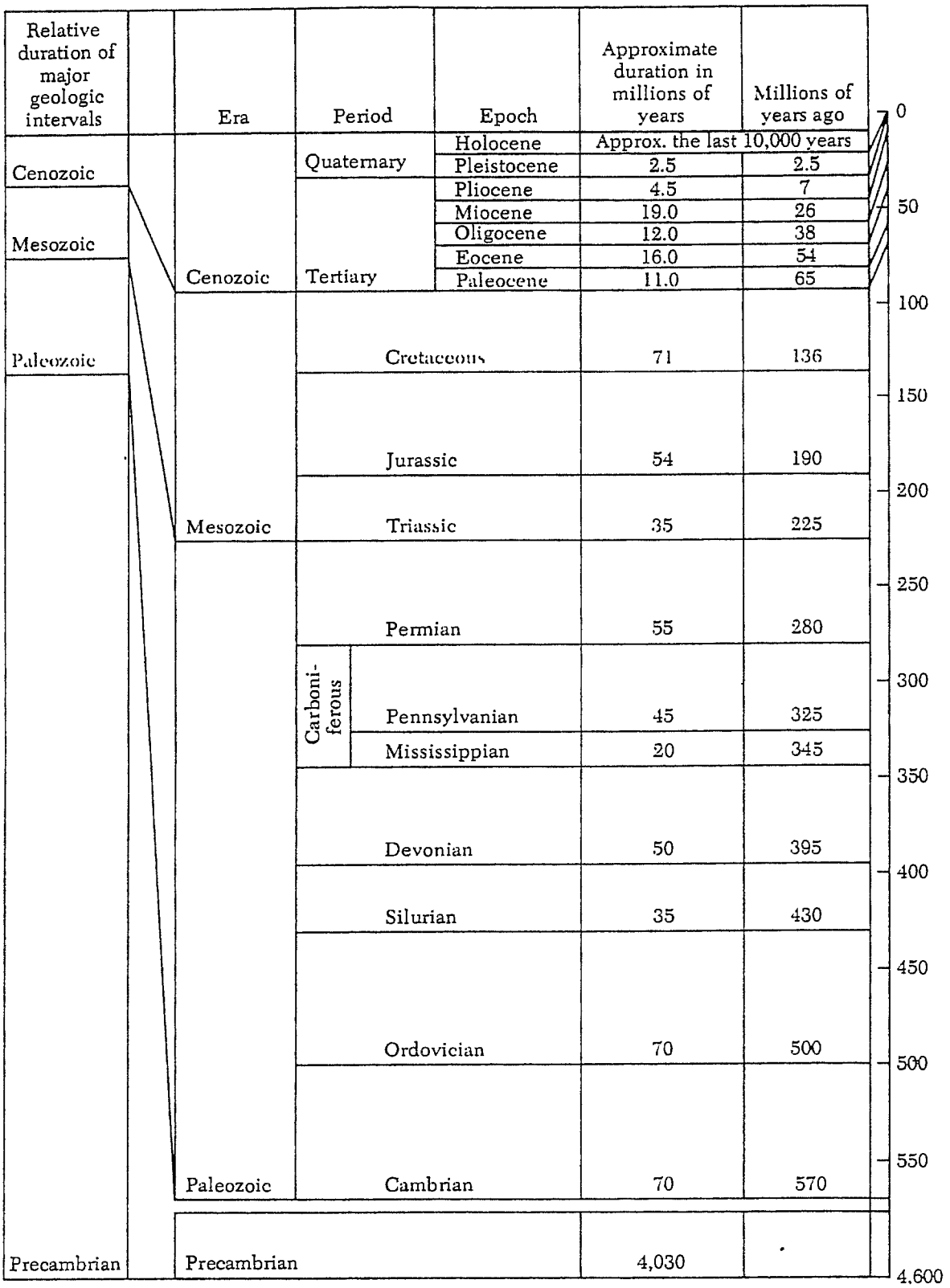



**GENERALIZED CROSS-SECTION G-G'**

Source: OBMP Phase I Report, Figure 2-4

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**FIGURE 4.4-5**

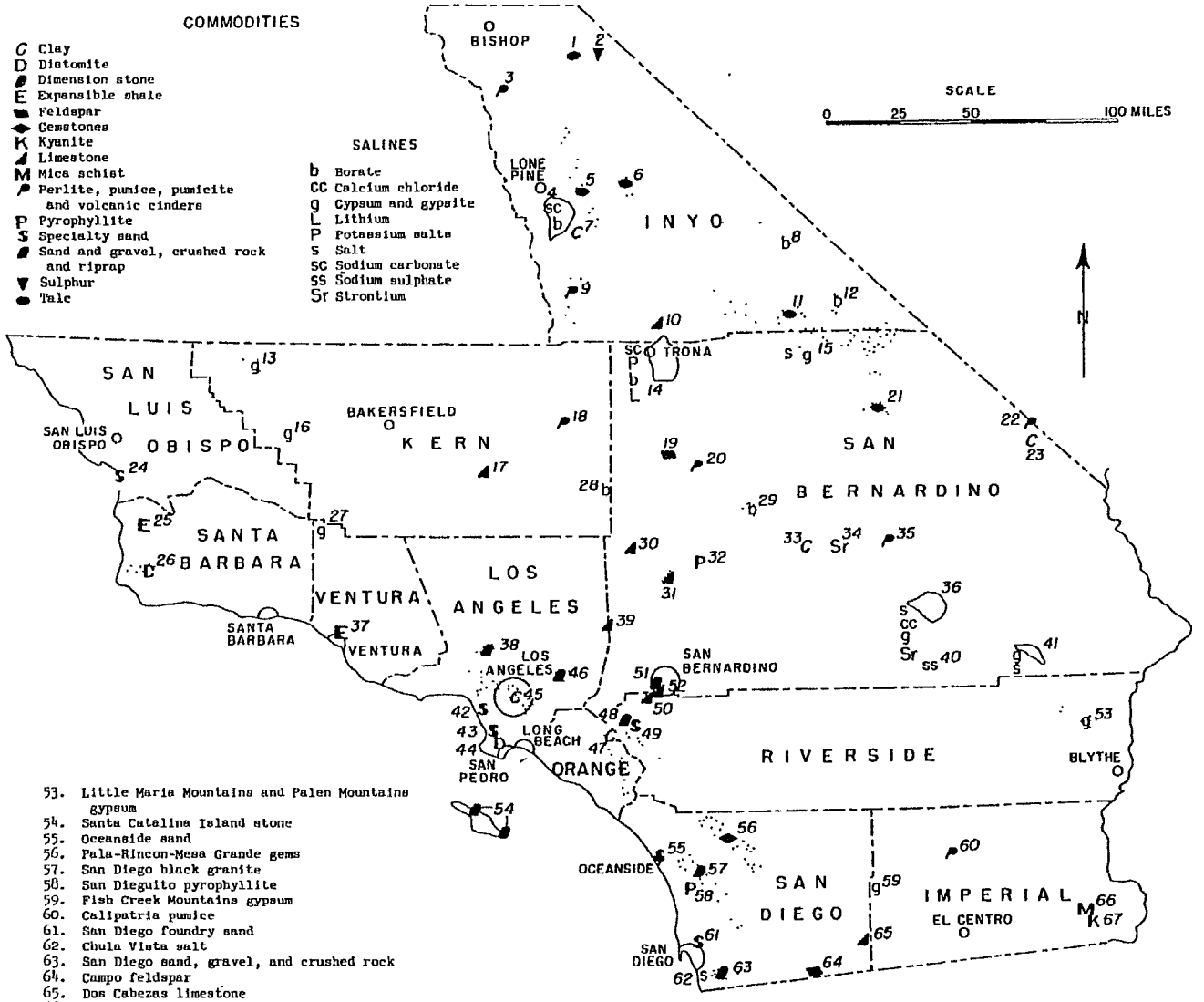



**GEOLOGIC TIME SCALE**

Source: Bolt, Bruce A., *Earthquakes: A Primer*, W.H. Freeman and Co., 1978

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**FIGURE 4.4-6**




# NON-METALLIC MINERAL RESOURCES IN THE CHINO BASIN VICINITY

Source: California Minerals, USGS Survey, 1958

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-7**

# FIGURE 4.4-8

TOM DODSON & ASSOCIATES
Environmental Consultants

## RIVERSIDE COUNTY MINERAL RESOURCES IN THE CHINO BASIN

Source: County of Riverside General Plan

•LEGEND•

- ANTIMONY
- ASBESTOS
- BERYLLIUM
- CLAY
- COAL
- COPPER
- FELDSPAR & SILICA
- FLUORSPAR
- GEMS
- GOLD
- GYPSUM
- IRON
- LEAD-SILVER-ZINC
- LIMESTONE
- MAGNESIUM
- MANGANESE
- MICA
- MINERAL PAINT
- MOLYBDENUM
- PEAT
- PERLITE
- RARE EARTHS
- ROCK PRODUCTS
- SAND & GRAVEL
- SPECIALTY SANDS
- TALC
- TIN
- TUNGSTEN
- URANIUM
- MRZ-2 ZONES

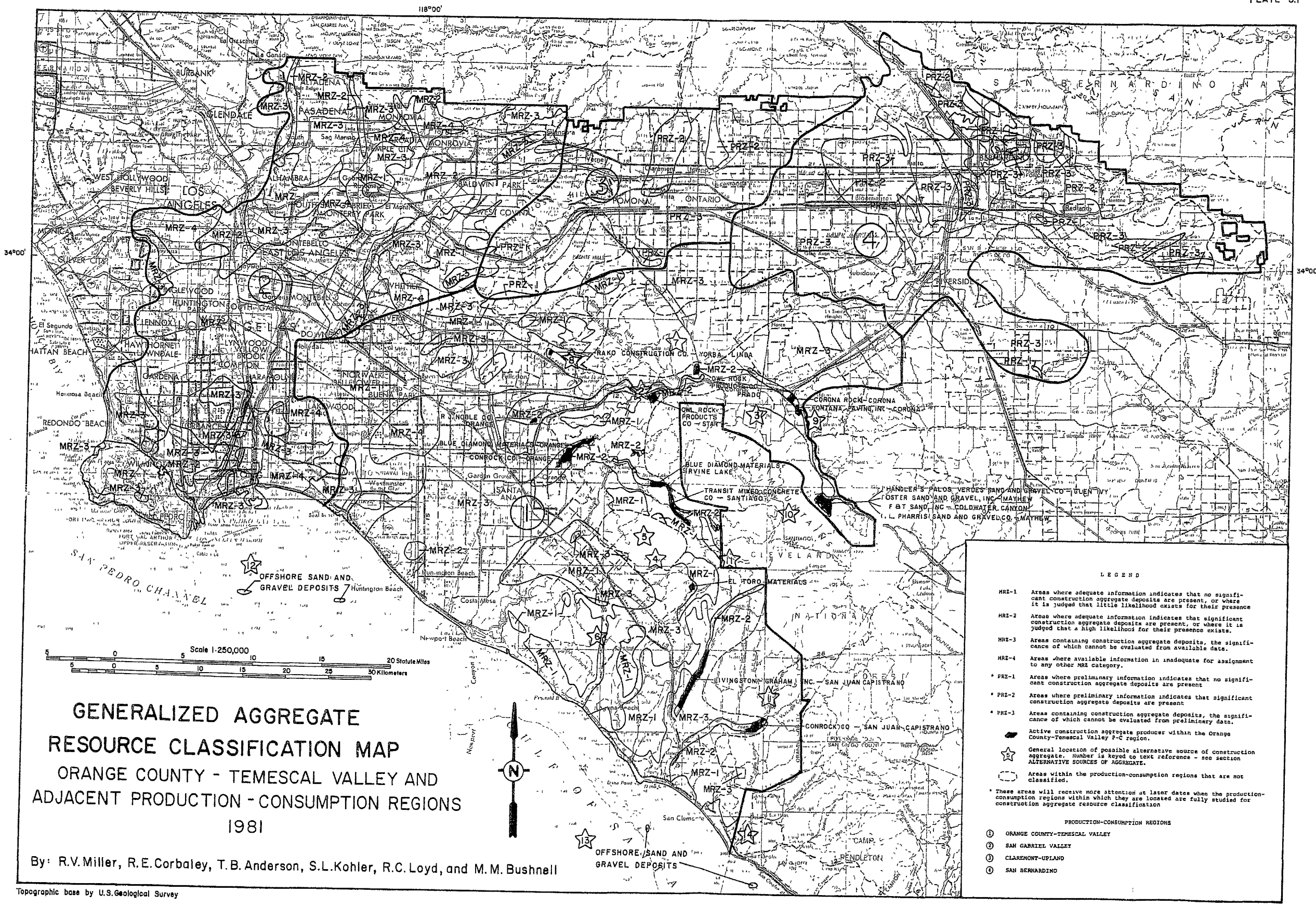
MAP COMPILED BY THE RIVERSIDE COUNTY PLANNING DEPARTMENT APRIL 1983.

APPROXIMATE SCALE ONE INCH= 4.75 MILES.

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

SPECIAL REPORT 143
PLATE 3.1




# GENERALIZED AGGREGATE RESOURCE CLASSIFICATION MAP

## ORANGE COUNTY - TEMESCAL VALLEY AND ADJACENT PRODUCTION - CONSUMPTION REGIONS 1981

By: R.V. Miller, R.E. Corbaley, T.B. Anderson, S.L. Kohler, R.C. Loyd, and M.M. Bushnell

Topographic base by U.S. Geological Survey

LEGEND

| | |
|---|---|
| MRZ-1 | Areas where adequate information indicates that no significant construction aggregate deposits are present, or where it is judged that little likelihood exists for their presence |
| MRZ-2 | Areas where adequate information indicates that significant construction aggregate deposits are present, or where it is judged that a high likelihood for their presence exists. |
| MRZ-3 | Areas containing construction aggregate deposits, the significance of which cannot be evaluated from available data. |
| MRZ-4 | Areas where available information is inadequate for assignment to any other MRZ category. |
| * PRZ-1 | Areas where preliminary information indicates that no significant construction aggregate deposits are present |
| * PRZ-2 | Areas where preliminary information indicates that significant construction aggregate deposits are present |
| * PRZ-3 | Areas containing construction aggregate deposits, the significance of which cannot be evaluated from preliminary data. |
| | Active construction aggregate producer within the Orange County-Temescal Valley P-C region. |
| (1) | General location of possible alternative source of construction aggregate. Number is keyed to text reference - see section ALTERNATIVE SOURCES OF AGGREGATE. |
| | Areas within the production-consumption regions that are not classified. |

* These areas will receive more attention at later dates when the production-consumption regions within which they are located are fully studied for construction aggregate resource classification

PRODUCTION-CONSUMPTION REGIONS

1. ORANGE COUNTY-TEMESCAL VALLEY
2. SAN GABRIEL VALLEY
3. CLAREMONT-UPLAND
4. SAN BERNARDINO

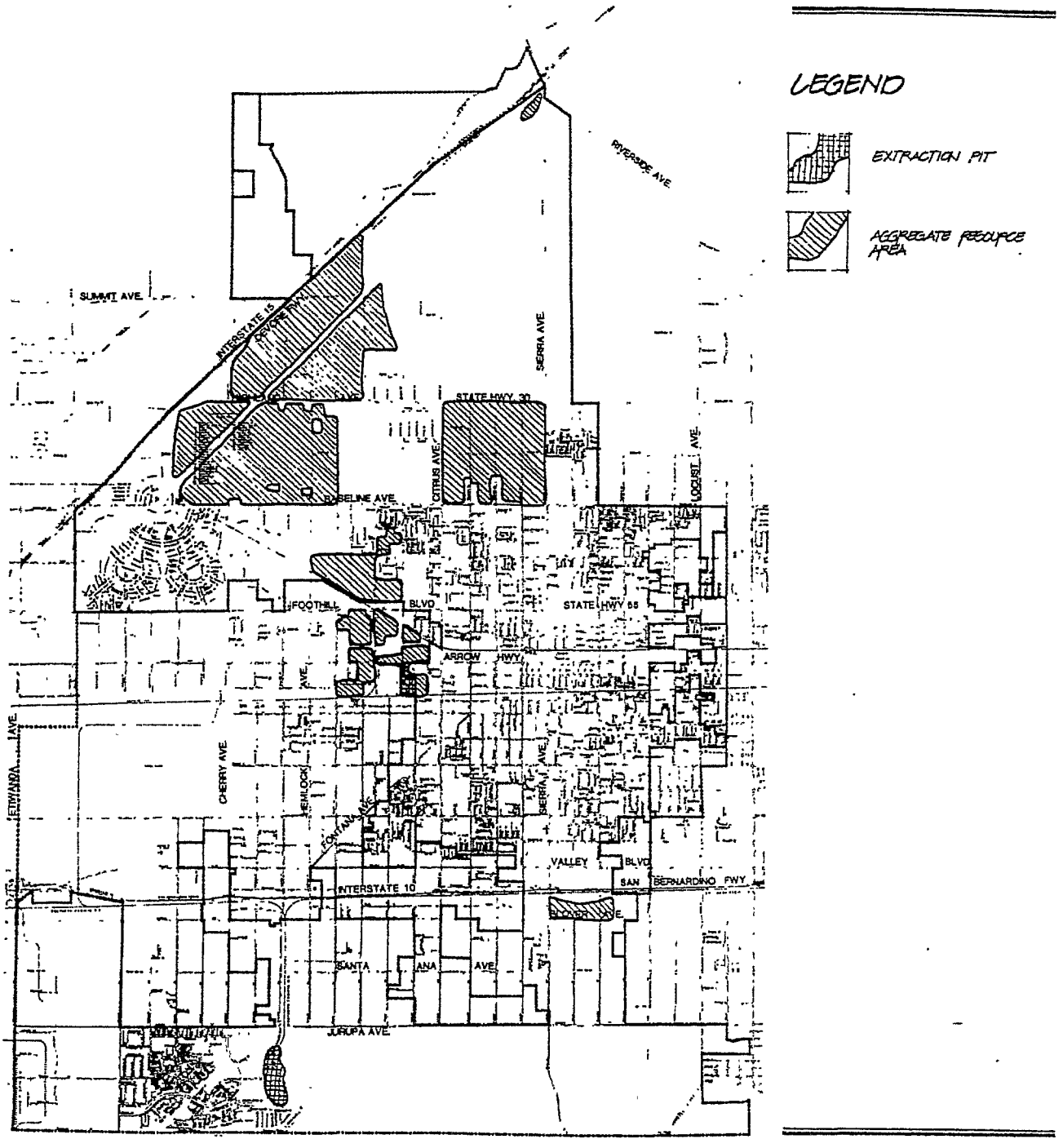
TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-9**

**GENERALIZED PRODUCTION AGGREGATE RESOURCES IN THE CHINO BASIN VICINITY**

Source: USGS Department of Conservation

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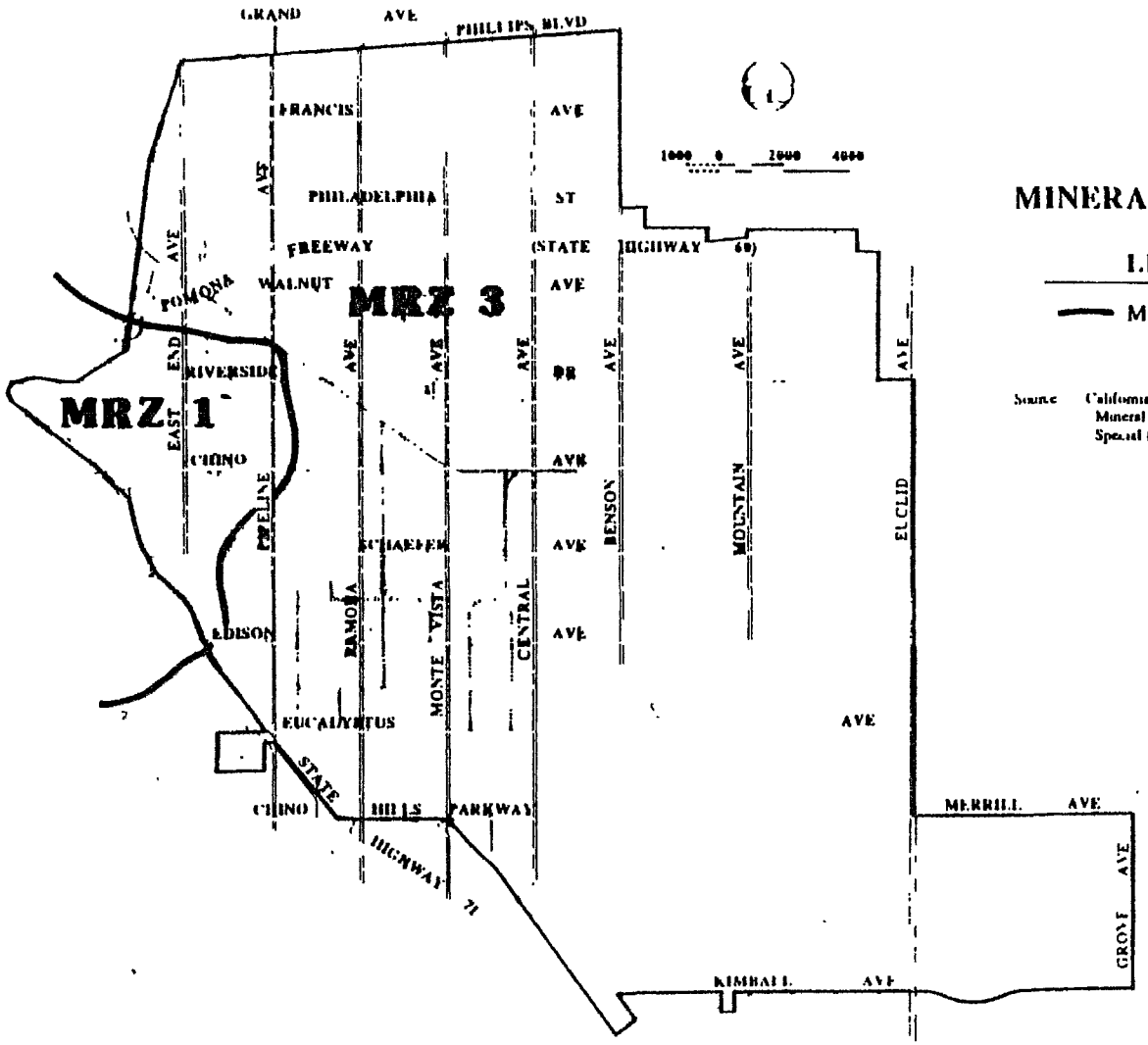



**CITY OF FONTANA**
**MINERAL RESOURCE AREAS**

Source: City of Fontana General Plan

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Environmental Consultants

**FIGURE 4.4-10**




## MINERAL RESOURCE ZONES

**LEGEND**

Mineral Resource Zone Boundary

Source: California Division of Mines and Geology
Mineral Land Classification of the Greater Los Angeles Area
Special Report No 143 (October 1987)

## CITY OF CHINO
**Conservation/Open Space**
**General Plan Element**

**CITY OF CHINO MINERAL RESOURCE ZONES**

Source: City of Chino General Plan

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**FIGURE 4.4-11**

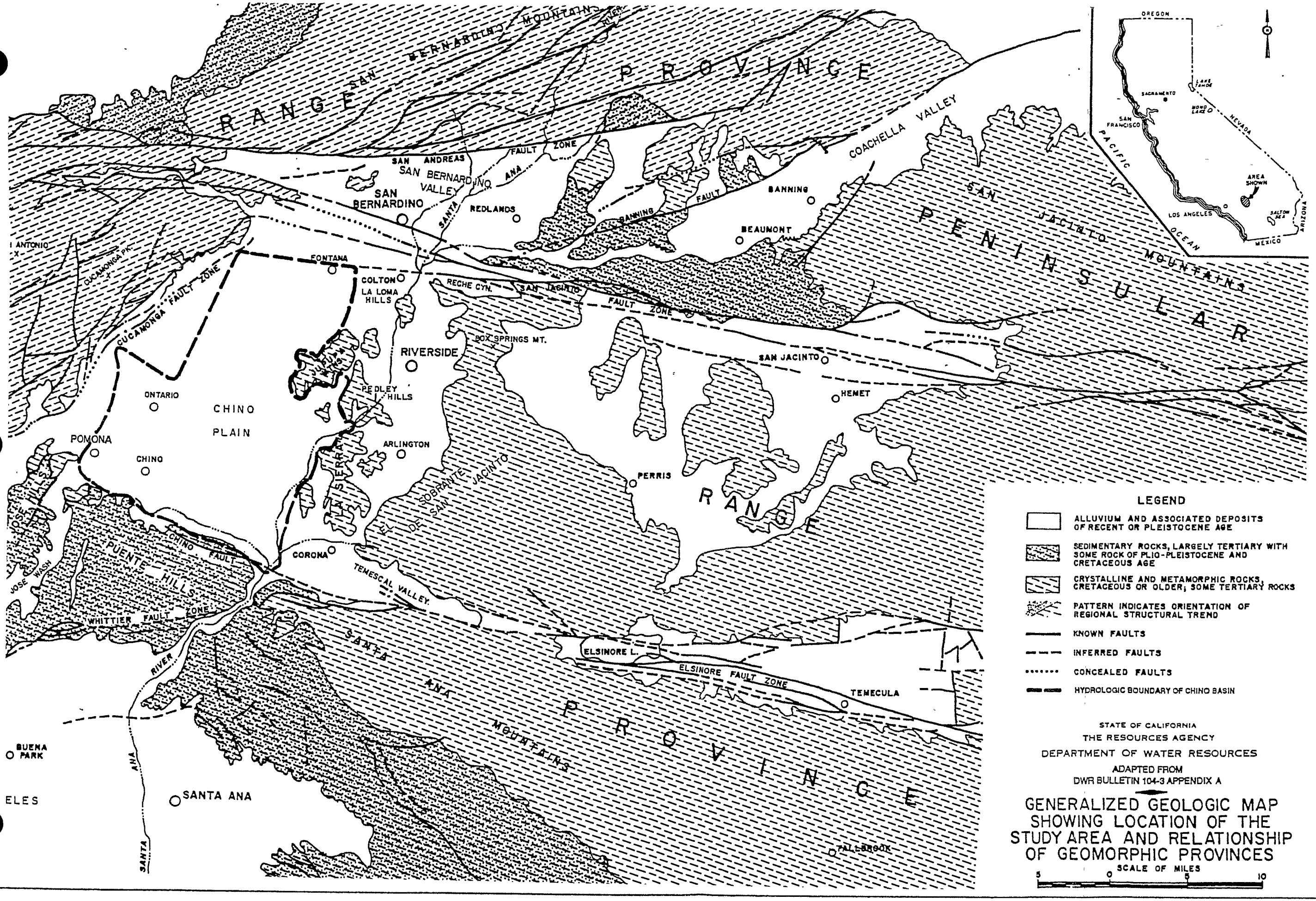
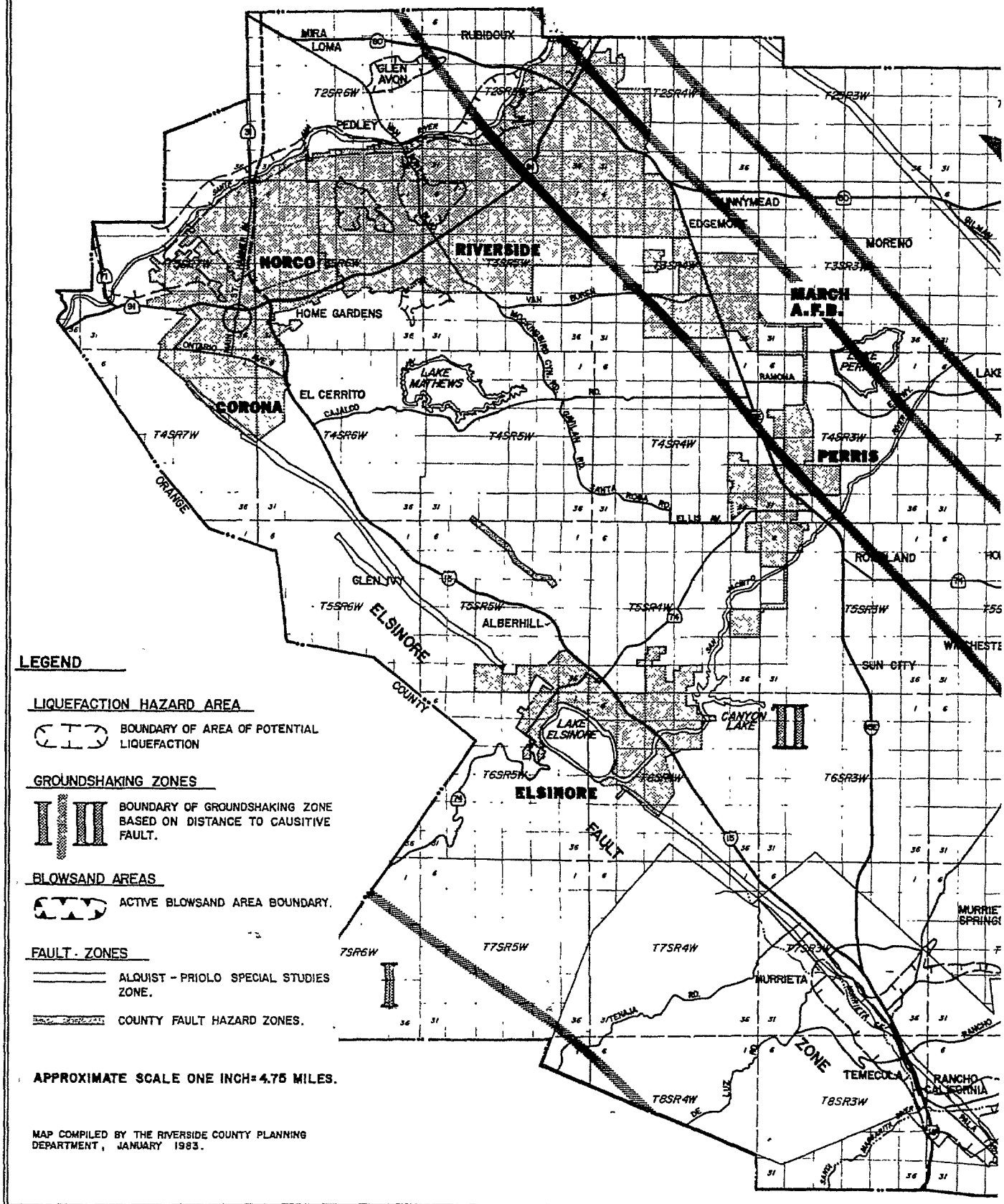



**FIGURE 4.4-12**

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**MAJOR FAULTS IN THE CHINO BASIN AND SURROUNDING AREAS**

Source: Task 5 Memorandum Plate 1

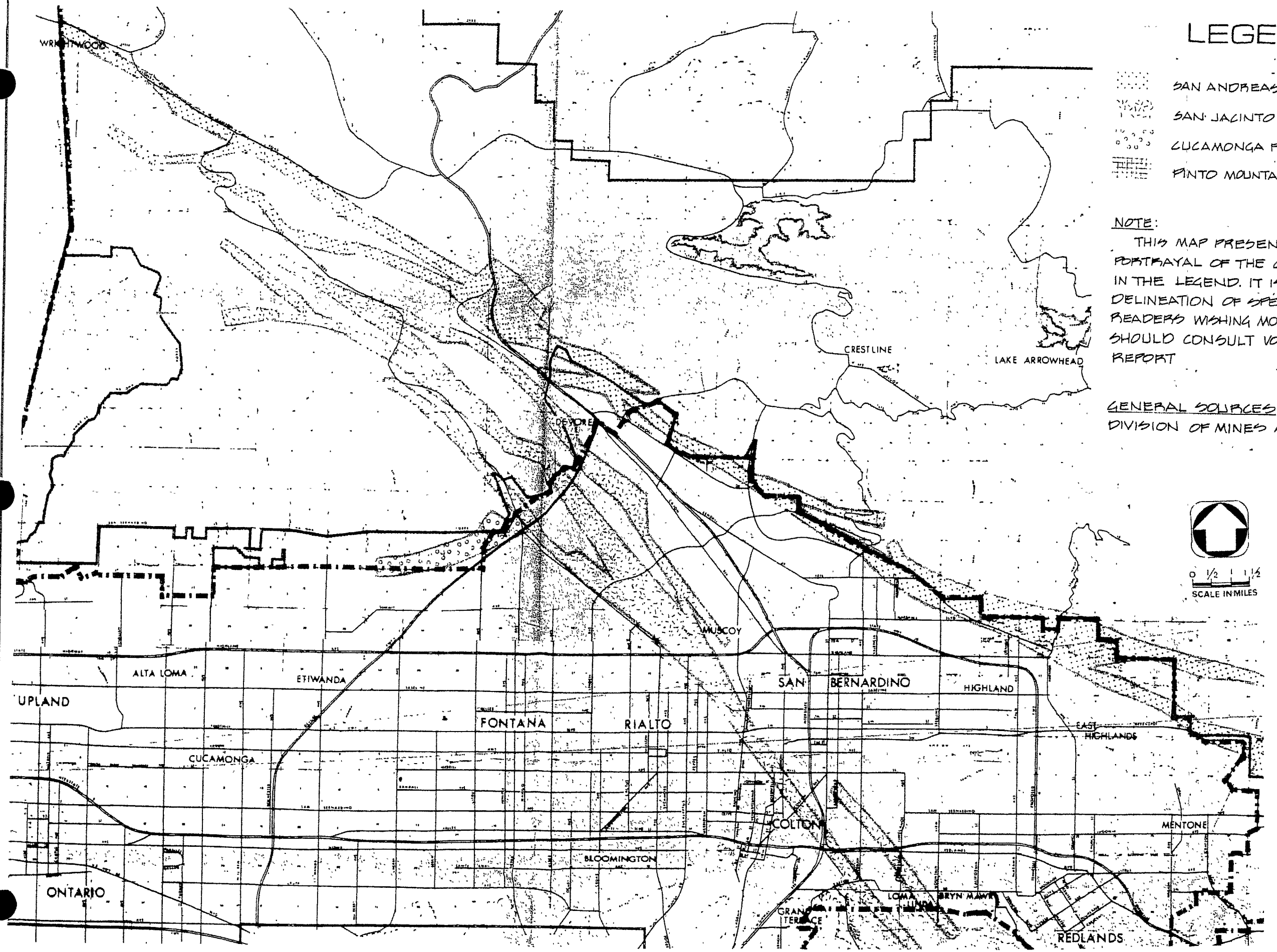



**RIVERSIDE COUNTY SEISMIC HAZARDS SHOWING NO ALQUIST-PRIOLO SPECIAL STUDIES AREAS IN CHINO BASIN**

Source: Compiled by Riverside County Planning Department

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Environmental Consultants

**FIGURE 4.4-13**




# LEGEND

- SAN ANDREAS FAULT ZONE
- SAN JACINTO FAULT ZONE
- CUCAMONGA FAULT ZONE
- PINTO MOUNTAIN FAULT ZONE

NOTE:

THIS MAP PRESENTS A GRAPHIC PORTRAYAL OF THE CONDITIONS CITED IN THE LEGEND. IT IS NOT A PRECISE DELINEATION OF SPECIFIC FEATURES, READERS WISHING MORE EXACT INFORMATION SHOULD CONSULT VOLUME II OF THIS REPORT

GENERAL SOURCES: CALIFORNIA DIVISION OF MINES AND GEOLOGY

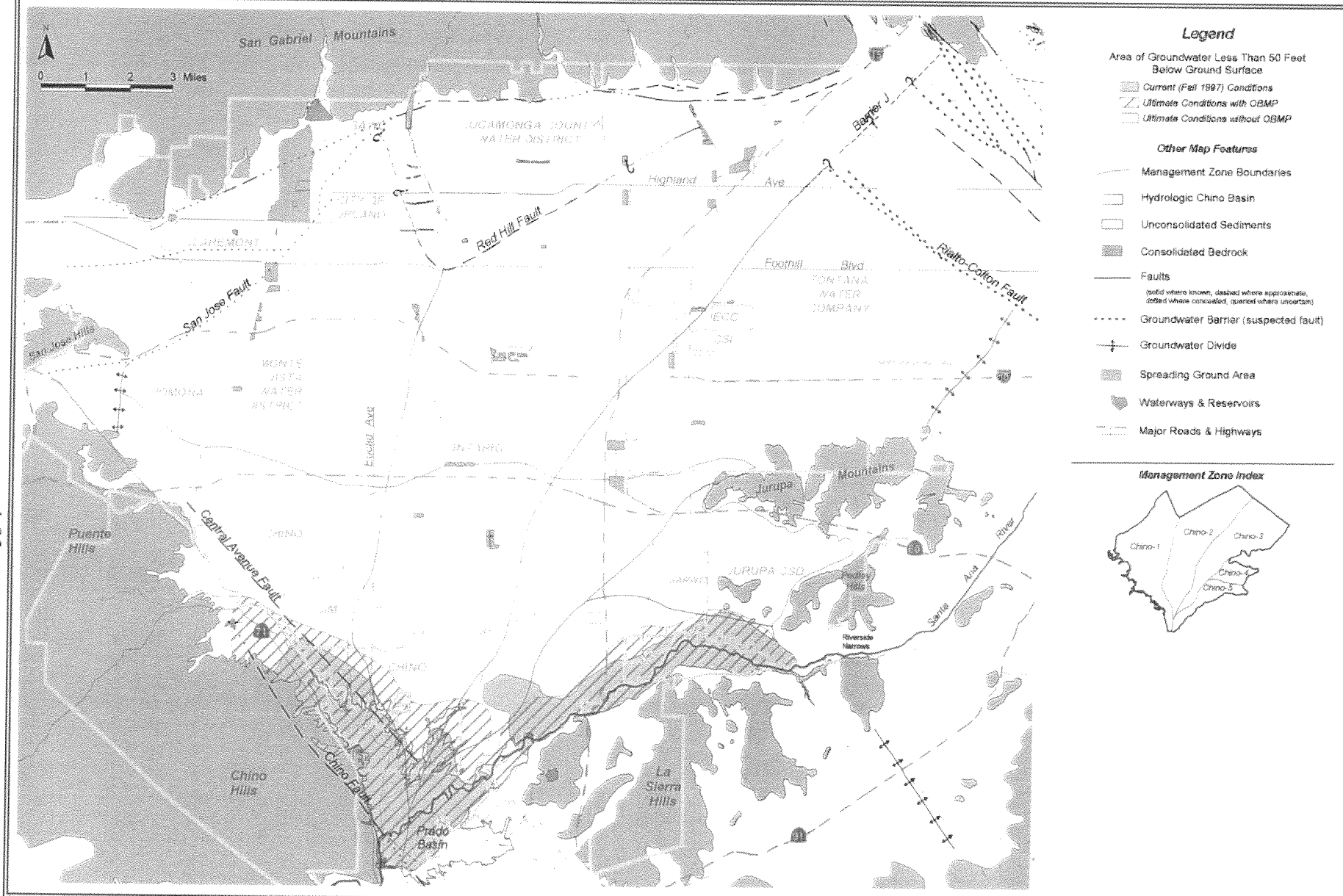
**FIGURE 4.4-14**

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**ALQUIST-PRIOLO SPECIAL STUDIES AREA IN SAN BERNARDINO COUNTY**

Source: County General Plan Maps

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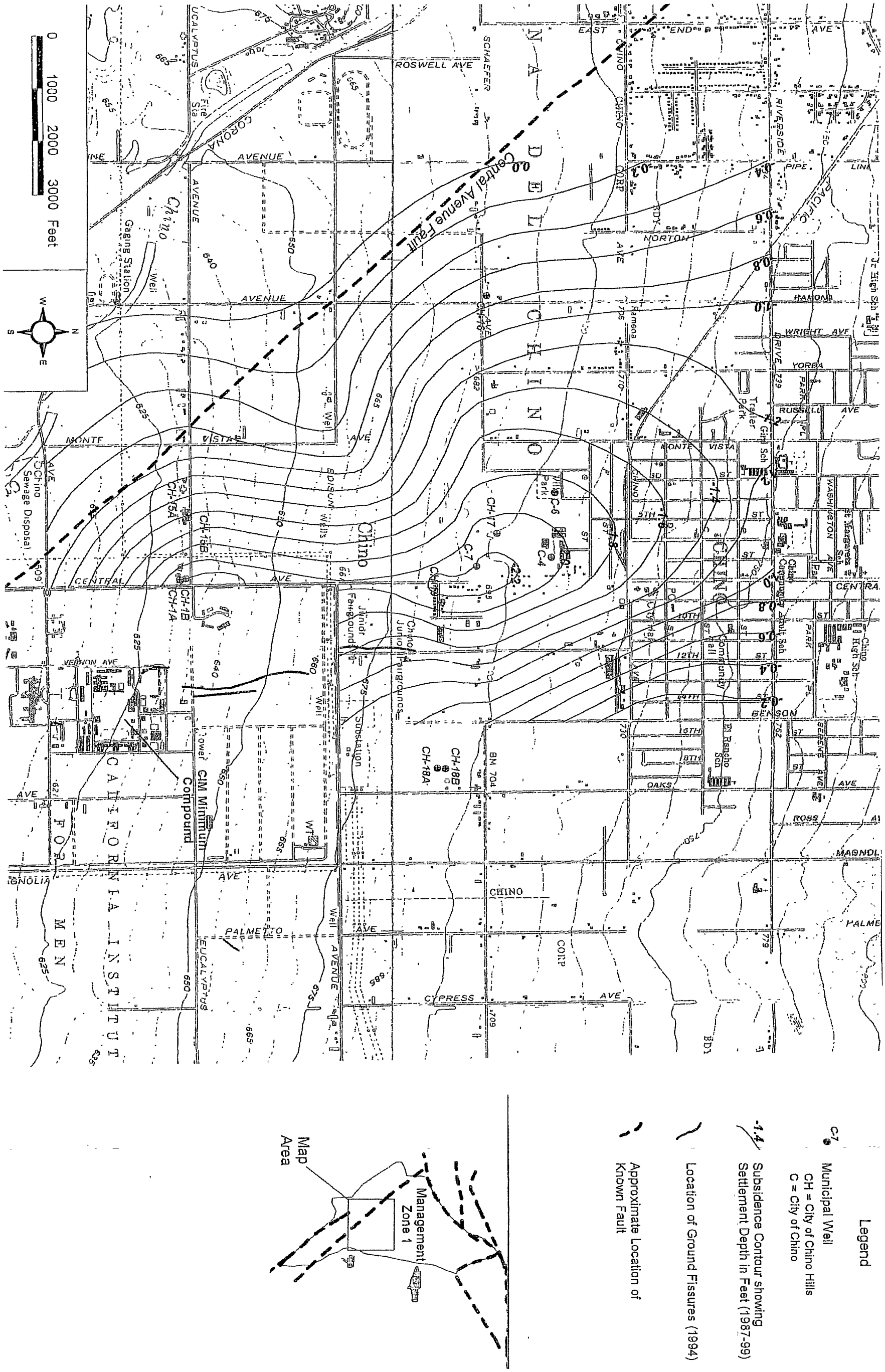



**AREA IN SOUTHWEST CHINO BASIN (SAN BERNARDINO COUNTY) WITH HIGH LIQUEFACTION POTENTIAL**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-15**




**SUBSIDENCE CONTOURS AND GROUND FISSURES IN THE CHINO AREA**

Source OBMP Phase I Report, Figure 2-24

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.4-16**

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# 4.5 WATER RESOURCES/WATER QUALITY

## 4.5.1 Introduction

*The purpose of the Optimum Basin Management Program is to develop a groundwater management program that enhances the safe yield and the water quality of the Basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*

As the above mission statement for the Optimum Basin Management Program (OBMP) states, the intent of the OBMP is to implement those physical modifications to the Chino Basin that will lead to enhanced safe yield and better water quality, while being more cost effective than would occur if the individual water serving agencies (WSAs) implemented their own individual programs. Assuming this goal can be fulfilled and considering the OBMP in its broadest sense as a program, implementation of the OBMP would inherently result in a beneficial effect on the Chino Basin, i.e., enhanced safe yield and better water quality. However, even though our understanding of the science of hydrology is relatively sophisticated, the ability to physically modify a complex hydrologic system, such as the Chino Basin, and manage it to achieve such goals is not perfect, and individual actions taken to achieve an overall beneficial effect on the Basin may result in unintended consequences to the Basin's hydrology or in indirect adverse environmental effects (physical changes) to other environmental or man-made resources or systems within the Chino Basin.

The California Environmental Quality Act (CEQA) was adopted to ensure that decision-makers examine these potential unintended environmental consequences and indirect effects of implementing a program, such as the OBMP. CEQA's objective is to ensure that decision-makers are provided with sufficient information about all the potential environmental impacts of a proposed project so that they are fully informed of potential environmental consequences before proceeding to approve and implement a program, even when it will have otherwise beneficial consequences.

Water resource and water quality issues are included as a topic for evaluation in this Program Environmental Impact Report (PEIR) because implementation of the OBMP will result in the installation of water management facilities and activities throughout the project area. Implementation of the OBMP will intentionally modify many of the hydrologic characteristics of the Chino Basin and the focus of analysis in this subchapter of the PEIR is to assess the potential environmental consequences of these proposed physical changes to the Basin. Since the level of detail contained in the OBMP does not yet lend itself to site specific evaluations, a program environmental evaluation is carried out in this environmental document.

Under the programmatic concept, the focus is on the type of facilities and activities that will be implemented under the OBMP, and an examination of the general impacts that may result from implementing facilities and activities, instead of site specific impacts. However, when we know enough about the background environmental resources and systems, it is possible to forecast fairly accurately the type of impacts that may occur, and more importantly, to identify those mitigation measures that can ensure potential impacts from constructing and operating facilities and related activities will not reach a level of significant impact. If in the future, a specific OBMP project

cannot be implemented within the threshold limits or performance standards established in this PEIR, the proponent for that facility or activity has the responsibility to prepare a subsequent environmental document (negative declaration or EIR) in conformance with Sections 15162 and 15168 of the State CEQA Guidelines. In any case, every future specific project proposed for implementation under the OBMP must undergo at least a preliminary analysis (Initial Study or its equivalent) to determine whether the analysis in this PEIR adequately characterizes the potential environmental impacts or whether subsequent environmental document is required.

The OBMP envisions a variety of facilities and activities that, when implemented as a whole, are intended to enhance the safe yield and water quality of the Chino Basin. These activities include: (1) additional recharge to the Basin groundwater aquifer, including use of stormwater, State Project Water (SPW), and recycled water (reclaimed treated wastewater effluent); (2) importation of potable water from the Bunker Hill Basin for direct use (Baseline Feeder); (3) installation of production and monitoring wells; (4) construction of desalters, possibly including deionizing equipment, to treat groundwater with high total dissolved solids (TDS) and nitrates for municipal and industrial uses; and (5) installation of pipelines to transfer water around the Basin as needed to meet OBMP objectives.

As described in Section 1 of the OBMP, the process that culminated in the preparation of the OBMP has been both complicated and controversial. Essentially, the various WSAs and other interested parties could not agree on the details of how the Judgment, entered in Superior Court in 1978 (Case No. RCV 51010), should be implemented. Much of that controversy still lingers and is characterized in the comments received from agencies when the Notice of Preparation (NOP) for preparing the OBMP PEIR was issued in November 1999. The NOP and scoping process (a scoping meeting was held for this project on December 9, 1999) generated an extensive list of concerns, most of which are evaluated in this PEIR. However, some of the issues raised in the comments are either not ripe for evaluation at this point in time (i.e., they can only be substantively addressed when a specific location(s) for a facility or activity is identified or when additional data regarding the Chino Basin become available) or they are not appropriate subjects for consideration in an EIR. The following text discusses the water resource and water quality issues raised during the comment period and describes how they are addressed, or not addressed as the case may be, and the rationale for the treatment of an issue in this PEIR.

The NOP comment letters and the scoping meeting issues are provided in subchapter 8, Appendix 8.1. A table summarizing the issues or comments raised in the comment letters and scoping meeting is also contained in Appendix 8.1. The following is a further summarization of the environmental concerns and issues from implementing the OBMP that will be evaluated in this subchapter of the PEIR.

- Consider beneficial projects that are being implemented to clean up existing groundwater contamination (commented by General Electric)

- Consider how extraction and recharge patterns may affect groundwater flow patterns and existing groundwater contamination (General Electric, Regional Board, Monte Vista Water District, and Western Municipal Water District)

- Address adverse effects of the OBMP on water quality and quantity (Fontana Water Company, Regional Board, and City of Pomona)
- Address adverse effects on water resource availability for domestic or other beneficial use purposes (Fontana Water Company, and Regional Board)
- Address the need for abatement of sources of groundwater contamination (Fontana Water Company)
- Address construction activity water quality effects (Regional Board)
- Address the regulatory requirements for OBMP operations, such as NPDES permits, DHS, California Department of Fish and Game (CDFG), dairy discharge requirements and manure removal standards, etc. (Regional Board and Cucamonga County Water District)
- Provide more detail on how the OBMP can mitigate existing yield and water quality problems (Monte Vista Water District)
- Define existing yield of each management zone and native recharge, compare to circumstances forecast to occur in 2020 and identify mitigation measures for imbalances and shortfalls (Monte Vista Water District)
- Define existing water quality of each management zone and native recharge, compare to circumstances forecast to occur in 2020 and identify mitigation measures for imbalances and degradation (Monte Vista Water District)
- Address the effects of financial assessment for mitigation measures (Monte Vista Water District)
- Address the impacts of in-lieu recharge vs. wet-water recharge (Monte Vista Water District)
- Address the financial effects of the OBMP phasing plan (Monte Vista Water District)
- Consider an alternative to subsidizing manure removal by shifting subsidy to water supply to benefit salt balance and dairy/agricultural operations (Monte Vista Water District)
- Address cumulative effects of various programs and projects that may degrade surface and ground water resources and cause non-compliance with the Basin Plan (Western Municipal Water District and Jurupa Community Services District)
- Address the effects from recharging recycled water lower in the Basin instead of SPW recharge higher in the Basin (Western Municipal Water District and Cucamonga County Water District)
- Address potential effects on State of California agency water facilities (existing wells and ability to drill new wells) in the Chino Basin (State of California Department of Justice)
- Address water storage impacts on degradation of water quality in the lower portions of Chino Basin (State of California Department of Justice)
- Address effects of recharging recycled water using local and regional methodologies (Jurupa Community Services District)
- Address impacts for individual agency wells using historical and current salt/nitrogen concentration levels (Jurupa Community Services District)

- Address the need for current groundwater quality mitigation instead of linking it to future TDS loading (Jurupa Community Services District)
- Address the balance between OBMP project benefits and negative impacts to exist water supplies (Jurupa Community Services District)
- Address potential indirect physical impacts of financing the OBMP to the extent that it may affect future OBMP project implementation (Cucamonga County Water District)
- Address financial effects of inequitable financing of OBMP costs on growth and land use if certain water users are unfairly saddled with higher costs (Cucamonga County Water District)
- Address the effect of over-extraction in the north end of the Basin and its effects on prevent high-quality recharge water from flowing south and flushing the basin (Cucamonga County Water District)
- Address the physical impacts of increased recharge or decreased pumping on subsidence and non-subsidence zones within Management Zone 1 (Cucamonga County Water District)
- Address the effects on water levels at Prado Dam due to increased capture and recharge in the upper portion of the Basin (Cucamonga County Water District)
- Address any increased in-stream flow appropriations and effects on natural riparian systems (California Department of Fish and Game)

This subchapter of the PEIR addresses as many of the above issues as is feasible at this stage of the review for the OBMP. The subchapter has been compiled by relying primarily upon data contained in a previously published documents including: the various elements of the OBMP, the Chino Basin Groundwater Storage Program EIR, TDS and Nitrogen Study, and the Santa Ana Region Water Quality Control Plan (1995). The next section of this document, the Environmental Setting, is abstracted from the Section 2, State of the Basin, in the OBMP and is presented in much of its entirety with minor editing for consistency.

## 4.5.2 Environmental Setting

### 4.5.2.1 Description of the Basin

The Chino Basin consists of about 235 square miles of the upper Santa Ana River watershed. Figure 3.2-1 illustrates the boundary of the Chino Basin as it is legally defined in the stipulated Judgment in the case of Chino Basin Municipal Water District vs. the City of Chino et al. Figure 3.2-1 also shows the hydrologic boundary of the Basin, which is slightly different from the adjudicated boundary. Chino Basin is an alluvial valley that is relatively flat from east to west and slopes from the north to the south at a one to two percent grade. Valley elevation ranges from about 2,000 feet in the foothills to about 500 feet near Prado Dam. Chino Basin is bounded: on the north by the San Gabriel Mountains and the Cucamonga Basin; on the east by the Rialto-Colton Basin, Jurupa Hills, and the Pedley Hills; on the south by the La Sierra area and the Temescal basin; and on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins.

The Chino Basin is one of the largest groundwater basins in southern California with about 5,300,000 acre-ft of water in the Basin and an unused storage capacity of about 1,000,000 acre-ft. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies; and about 300 to 400 agricultural users produce groundwater from the Basin. The Chino Basin is an integral part of the regional and statewide water supply system. Prior to 1978, the Basin was in overdraft. After 1978, the Basin has been operated as described in the 1978 Judgment in Chino Basin Municipal Water District vs. City of Chino et al. (Chino Judgment or Judgment).

### 4.5.2.2 Surface Water Resources

The principal drainage course of the Chino Basin is the Santa Ana River. It flows 69 miles across the Santa Ana Watershed from its origin in the San Bernardino Mountains to the Pacific Ocean. The Santa Ana River enters the Basin at the Riverside Narrows and flows along the southern boundary to the Prado Flood Control Reservoir where it is eventually discharged through the outlet at Prado Dam. Chino Basin is traversed by a series of ephemeral and perennial streams that include: Chino Creek, San Antonio Creek, Cucamonga Creek, Deer Creek, Day Creek, Etiwanda Creek and San Sevaine Creek. Figure 4.4-1 illustrates the stream system in the Chino Basin. San Antonio Creek joins Chino Creek and along with Cucamonga Creek, discharges directly into the Prado Reservoir. Cucamonga Creek has its name changed to Mill Creek just north of the Prado Reservoir. Deer Creek was realigned, and now discharges into Cucamonga Creek. Currently, Etiwanda Creek discharges into Day Creek at Wineville Basin. In the near future, Etiwanda Creek will be joined with San Sevaine Creek. Day Creek and San Sevaine Creek flow south and enter the Santa Ana River upstream of the Prado Reservoir.

These creeks carry significant flows only during, and for a short time after, passing frontal storms that typically enter southern California from November through March. Year-round flow occurs along the entire reach of the Santa Ana River due to year round surface inflows at Riverside Narrows, discharges from municipal water recycling plants that discharge in the River between the narrows and Prado Dam, and rising groundwater. Rising groundwater occurs in Chino Creek, in the Santa Ana River at Prado Dam, and potentially other locations on the Santa Ana River depending on climate and season. The rising groundwater in Chino Creek and the Santa Ana River contains high concentrations of total dissolved solids (TDS). Year-round discharges are sustained:

- in Chino Creek from the Inland Empire Utilities Agency (IEUA) Regional Plant No. 2 (RP2) to the Prado Reservoir, the source of which is from recycled water discharges from RP2; and

- in Cucamonga Creek from IEUA Regional Plant No. 1 (RP1) to the Prado Reservoir, the source of which is from recycled water discharges from RP1.

Significant nuisance flows have developed in Cucamonga Creek above RP1, the source of which is excess landscape irrigation and other outside urban uses. Some of the storm water runoff from the

San Gabriel Mountains and urban areas is diverted for recharge in flood retention and spreading basins. These basins are shown in Figure 4.4-1.
For a discussion of the geology of the Chino Basin, please refer to subchapter 4.4.2.

### 4.5.2.3 Major Flow Systems

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct basins. Figure 4.5-1 is a groundwater elevation contour map for fall of 1997. It also shows the location of the five groundwater flow systems (Management Zones) developed during the *TDS and Nitrogen Study* (Wildermuth, 1999) of which the Watermaster, the Chino Basin Water Conservation District (CBWCD), and the IEUA are study participants. Each flow system has a unique hydrology, and water resource management activities that occur in each flow system have little or no impact on the other systems.

Each flow system can be considered a management zone. These management zones can be subdivided further if necessary to define and manage flow systems at a finer scale. These management zones are used to characterize the groundwater level, storage, production, and water quality conditions. Additionally, in the 1995 Regional Water Quality Control Plan (Basin Plan) for the Santa Ana Watershed, the Chino Basin was divided into three subbasins for management purposes (shown on Figure 4.5-2). The Regional Water Quality Control Board, Santa Ana Region (Regional Board) has established water quality objectives for these subbasins and writes waste discharge requirements for waste dischargers based in part on these objectives. Presently, the Basin Plan subbasin boundaries and objectives are being rigorously reviewed. New boundaries similar to the management zone boundaries have been proposed. Revised boundaries and water quality objectives should be adopted sometime in the near future.

Management Zone 1. Management Zone 1 is bounded: on the southwest by the Chino and Puente Hills; on the northwest by the San Jose fault that separates Chino Basin from the Pomona and Claremont Heights Basins; on the north by an unnamed non-echelon fault system associated with the Cucamonga and Red Hill faults and separates the Chino Basin from the Cucamonga Basin; and on the east by a line that stretches from the southern most edge of the Red Hill fault to Prado Dam.

Groundwater in Management Zone 1 flows generally south with some localized flows to the west in response to groundwater production. Sources of water to Management Zone 1 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins, and subsurface inflow from the Pomona, Claremont Heights, and Cucamonga Basins. Discharge is through groundwater production and as rising groundwater in Chino Creek and the Santa Ana River.

Management Zone 2. Management Zone 2 is bounded: on the west by Management Zone 1; on the north by the Red Hill fault that separates the Chino Basin from the Cucamonga Basin; on the northeast by a segment of the Rialto-Colton fault; and on the east by a segment of Barrier J and a line

extending from Barrier J in a southwesterly direction to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 2 flows generally in a southwesterly direction in the northern half of the management zone and then due south in the southern half of the zone. Sources of water to Management Zone 2 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins and subsurface inflow from the part of the Rialto Basin northwest of Barrier J and the Cucamonga Basin. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

Management Zone 3. Management Zone 3 is bounded: on the west by Management Zone 2; on the northeast by the Rialto-Colton fault that separates the Chino Basin from the Rialto Basin; and on the southeast by the Bloomington divide, Jurupa Hills and a line projecting from the most western extension of the Jurupa Hills to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 3 flows generally in a southwesterly direction. Sources of water to Management Zone 3 include direct percolation of precipitation, returns from irrigation, and subsurface inflow from the part of the Rialto Basin southeast of Barrier J. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

Management Zone 4. Management Zone 4 is bounded: on the west by Management Zone 3; on the north by the Jurupa Hills; on the southeast by the Pedley Hills; and on the south by Management Zone 5.

Groundwater in Management Zone 4 flows west. Sources of water to Management Zone 4 include direct percolation of precipitation, and returns from irrigation. Discharge is through groundwater production.

Management Zone 5. Management Zone 5 is bounded: on the north and west by the Management Zones 3 and 4, and Prado Dam; on the east by the Riverside Narrows; and on the south by the La Sierra area and Temescal Basin.

Sources of water to Management Zone 5 include streambed percolation in the Santa Ana River, direct percolation of precipitation, returns from irrigation and subsurface inflow from the Temescal Basin. Discharge is through groundwater production, consumptive use by phreatophytes, and rising groundwater in the Prado Reservoir area, and potentially other locations on the Santa Ana depending on climate and season.

#### 4.5.2.4 Groundwater Levels and Storage

Historical Groundwater Level Monitoring

Various entities have collected groundwater-level data in the past. Municipal and agricultural water supply entities have historically collected groundwater-level data in programs that range from irregular, study-oriented measurements to long-term periodic measurements. Groundwater-level measurements were made for specific investigations such as various California Department of Water Resources (DWR) studies, the 1969 Judgment on the Santa Ana River (Orange County Water District vs. City of Chino et al.), and the Chino Basin Judgment (Chino Basin Municipal Water District vs. City of Chino et al.). The spatial extent and temporal history of groundwater-level measurements south of State Route 60 have always been less than north of State Route 60. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater-level measurements in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, the water level monitoring south of State Route 60 stopped almost completely except for the cities of Chino and Chino Hills, and the Jurupa Community Services District (JCSD).

Watermaster conducted its first mass groundwater-level monitoring program for the Chino Basin in the spring of 1986. In 1989, Watermaster initiated a more regular monitoring program for the Basin with groundwater-level measurements obtained in 1990, and periodically thereafter through 1997. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater-level measurements on a cooperative basis. Watermaster staff supplements these data with groundwater-level measurements collected by staff, primarily south of State Route 60. In addition to Watermaster staff efforts, private contractors conducting well efficiency tests collect groundwater-level measurements and submit these measurements to Watermaster. Watermaster has digitized all of these recent measurements. Watermaster has combined digitized groundwater-level measurements from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster began a process to develop a comprehensive groundwater-level monitoring program in the spring of 1998. The process consists of collecting groundwater-level data at all wells in the Basin from which groundwater-level measurements can be obtained for fall 1999, spring 2000, fall 2000, and spring 2001. These data will be mapped and reviewed. Based on this review and Watermaster management needs, a long-term water-level monitoring program will be developed and implemented in the fall of 2001.

Historical Groundwater Levels

This section describes the groundwater-level time histories in the Chino Basin by management zone and characterizes the differences between management zones. Figure 4.5-3 illustrates the location of wells whose groundwater-level time histories are discussed herein and the management zone boundaries described in Section 1. The wells were selected based on length of record, completeness of record, and geographical distribution. Wells discussed herein are identified by their state well number. The behavior of groundwater-levels at specific wells is compared to climate, to pre- and post-Judgment periods, and to other factors as appropriate.

*Management Zone 1.* Wells 01S07W08N01 (Figure 4.5-4) and 01S08W11R01 and 01S08W14A03 (Figure 4.5-5) illustrate typical groundwater-level time histories in the northern end of Management Zone 1. The accumulated departure from mean precipitation (ADFM) curve is plotted on Figures 4.5-4 and 4.5-5 to illustrate climatic conditions. Positive sloping lines on the ADFM curve imply wet years or wet periods. Negatively sloping lines imply dry years or dry periods. For example, the period between 1937 to 1944 and 1978 to 1983 are extremely wet periods, and are represented as positively sloping lines. The period 1945 through 1977 is a drought period and is represented as a negatively sloping line, punctuated with a few wet years (positively sloped in 1952, 1958 and 1969).

Short-term groundwater-level fluctuations shown in these figures are caused by including static and dynamic observations in the groundwater-level time histories. These time histories follow the climatic trends very closely with the 01S08W11R01 and 0S08W14A03 (westernmost wells) being slightly more sensitive to high rainfall years than 01S7W08N01 (eastern well). The groundwater-level response in well 01S7W08N01 lags the 1937 to 1944 and the 1978 to 1983 wet periods by about three to four years. By comparison, wells 01S08W11R01 and 0S08W14A03 responded to the 1978 to 1983 wet period within a year. The difference in response time is due to proximity of recharge to the area near the wells. Wells 01S08W11R01 and 0S08W14A03 are relatively close the Upland and Montclair Basins. Well 01S7W08N01 is two miles east of wells 01S08W11R01 and 0S08W14A03 with no significant recharge facilities nearby. In addition, the Metropolitan Water District of Southern California (MWDSC) recharged large quantities of State Water Project (SWP) water in the Montclair Basins during the period 1978 to 1983. The depth to water in the vicinity of these wells ranged from about 460 feet in the late 1920s to about 600 feet in 1996.

Wells 01S08W28E01 (Figure 4.5-6) and 01S08W31J01 and 01S08W33D01 (Figure 4.5-7) are about three miles south of wells 01S08W11R01 and 01S08W14A03 (Figure 4.5-5). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958, and 1969. The post-1977 groundwater-level increase is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The groundwater-level response in these wells responded to the 1978 to 1983 wet period within a year. The depth to water in the vicinity of these wells ranged from about 130 to 160 feet in the late 1920s to about 150 to 280 feet in 1996 with well 01S08W28E01 showing the greatest depth to water. Well 01S08W28E01 is a municipal production well owned by the City of Pomona and is located in an area of regionally depressed groundwater levels.

Wells 02S08W04P01 and 02S08W12F01 (Figure 4.5-8) are located about two to three miles south of well 01S08W28E01 (Figure 4.5-10) and wells 01S08W31J01 and 01S08W33D01 (Figure 4.5-7). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958 and 1969. The groundwater-level responses in these wells lag the 1937 to 1944 and the 1978 to 1983 wet periods by about two to three years. The response to the 1937 to 1944 wet period is surprisingly subtle compared to most other wells with contemporaneous time histories in Management Zone 1. This suggests that recharge in the area is low and that production is high. The post-1977 groundwater level increase for 02S08W04P01 is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of

groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The depth to water in the vicinity of these wells ranged from about 20 to 40 feet in the late 1920s to about 200 feet in 1982.

From north to the south, the following observations can be made regarding time histories of groundwater levels in Management Zone 1:

- groundwater levels are down from observed period of recorded highs in the late 1920s;
- the lowest groundwater levels were observed around 1977;
- groundwater levels have recovered slightly since 1977 due in part to the wet period of 1978 to 1983, reduction in overdraft after 1977, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water;
- a condition of long-term overdraft has occurred in this management zone with groundwater levels dropping by about 100 to 140 feet between the late-1920s to the present with most of the decline prior to 1977 and the Chino Basin Judgment (1978).

*Management Zone 2.* Figure 4.5-9 contains groundwater-level time histories for 01S07W14G01, 01S07W27D01, and 02S07W09M01. These wells are aligned north to south, approximately along a flow line. The groundwater-level time histories in Figure 4.5-9 show a general decline since before the 1937 to 1944 wet period, with little or no response to wet years until 1978. The post-1977 increase is probably due to the combination of 1978 to 1983 wet period, reduction in overdraft following the implementation of the Chino Basin Judgment, the start of artificial replenishment with imported water in the San Sevaine and Etiwanda flood control basins, and the increased use of imported surface water. The depth to water for 01S07W27D01 ranged from about 200 feet in the late-1920s to about 380 feet in 1974, a decline in groundwater levels of about 180 feet.

*Management Zone 3.* Figure 4.5-10 contains time histories for wells 01S06W11B01 and 01S05W-16C01 that are located in the most upgradient part of Management Zone 3. The groundwater-level observations in these wells follow the general climatic trend. The groundwater-level time history for well 01S06W16C01 shows a general decline since the 1920s and a general non-responsiveness to significant wet years or periods. For example, there is a slight response to the 1937 to 1944 and 1978 to 1983 wet periods and no response to wet years in 1952, 1958, and 1969. Well 01S06W11B01 behaves in a similar manner with slightly less responsiveness. The lack of responsiveness is attributable to the lack of significant sources of recharge.

There are no major streams or recharge basins in the upper part of Management Zone 3. There are three proposed recharge basins located centrally in this zone: Etiwanda recharge basins, plus Jurupa and Wineville basins. Regional Plant Site 3 is also being developed for groundwater recharge. The peak groundwater levels for both of these wells are lagged about three years behind the peaks in the ADFM curve for the 1937 to 1944 and 1978 to 1983 wet periods. The depth to water ranges from about 360 to 430 feet in the late 1920s to about 430 to 540 in 1978 for wells 01S05W16C01 and 01S06W11B01, respectively. The groundwater decline from the 1920s to the early-1990s is about 20 feet and 60 feet for wells 01S05W16C01 and 01S06W11B01, respectively.

Figure 4.5-11 is a similar plot for wells 01S05W30L01 and 01S06W23D01. These wells have similar response characteristics as 01S06W11B01 and 01S05W16C01 with about 60 to 70 feet of groundwater decline over the period from the late-1920s to the early-1990s.
The relative amount of decline from 1920s to 1977 is less in Management Zone 3 than in Management Zone 1. This is due to greater production in Management Zone 1 than in Management Zone 3 and because of the specific yield (fraction of usable groundwater per unit volume), which is greater in the eastern portion of Chino Basin than in the western portion. The alluvium in the eastern part of the Chino Basin is derived from granitic rocks of the San Gabriel Mountains. The alluvium on the west side of Chino Basin is derived in part from the San Gabriel Mountains and also from marine sedimentary rocks of the Chino and Puente Hills. The latter produce finer-grained alluvium with more clay and poorer storage properties.

Figure 4.5-12 contains time histories for wells 02S06W05B01 and 02S07W34H01. These wells are aligned northeast to southwest, approximately along a flow line. The groundwater-level time histories end in the late 1970s or early 1980s, as is typical for agricultural wells in the southern half of the Basin. These time histories follow the general climatic trend, however, there is trend among the wells of a decreasing climatic influence from northeast to southwest. The depth to water for 02S06W05B01 ranged from 130 feet in the late-1920s, to about 200 feet in 1978, a decline in groundwater levels of about 70 feet.

*Management Zone 4.* Management Zone 4 is bounded on the north by the Jurupa Hills, on the east by the Pedley Hills, on the south by Management Zone 5 and on the west by Management Zone 3. The only outflow from Management Zone 4 is by production. Figure 4.5-13 contains groundwater-level time histories for wells 02S06W16B02 and 02S06W14C02. These wells generally follow the climatic trend. The depth to water for 02S06W14C02 ranged from about 7 feet in 1945 to about 17 feet in 1993, corresponding to an overall decline in groundwater levels of about 10 feet for this period.

*Management Zone 5.* Management Zone 5 is bounded on the north and west by the Management Zones 3 and 4, on the east by the Riverside Narrows and on the south by various unnamed hills. Figure 4.5-14 contains time histories for wells 02S07W36H02, 02S06W26D02, and 03S07W03N01. Groundwater levels in these wells follow the general climatic trend. However, wells 2S07W36H02 and 03S07W03N01 are much less responsive than well 02S07W26D02 due to the stabilizing effects of being adjacent to the Santa Ana River. The depth to water for 02S07W26D02 ranged from about 24 feet in 1939 to about 28 feet in 1992, corresponding to an overall decline in groundwater levels of about 4 feet for this period.

For the most part, the response of groundwater levels in the Chino Basin to significant storms and wet climatic periods is small. There are two reasons for this. First, the mountain drainage areas tributary to the Chino Basin are relatively small compared to the size of Chino Basin (235 square miles) and the amount of water in storage (~5,000,000 acre-ft). The mountain drainage areas tributary to the Chino Basin areas are:

| | |
|---|---|
| San Antonio Creek | 17.7 sq mi |
| Cucamonga Creek | 13.6 |
| Deer Creek | 6.4 |
| Day Creek | 7.7 |
| Etiwanda Creek | 6.7 |
| San Sevaine Creek | 9.7 |
| TOTAL: | 61.7 sq mi |

San Antonio Creek is mostly diverted for direct use and recharge in the Claremont Heights and Cucamonga Basins. Cucamonga, Deer, and Day Creeks are diverted for direct use and recharge in the Cucamonga Basin. Large storm flows from these creeks can make it into the Chino Basin, however these channels are concrete-lined and consequently large amounts of storm flow are not recharged. In contrast, San Bernardino area groundwater basins (Bunker Hill and Lytle Basins) – located just to the east of the Chino Basin – consist of about 120 square miles of aquifer and with about 466 square miles of tributary areas in the San Gabriel and San Bernardino mountains. The groundwater level response in the Chino Basin due to wet years is small, on the order of a few feet to tens of feet. In contrast, the San Bernardino area groundwater-level response to significant wet years and climatic periods could range from 100 to 300 feet.

Regional Groundwater Level Changes

Figures 4.5-15 and 4.5-16 are groundwater elevation contour maps for the Chino Basin for 1997 and 1933, respectively. The 1997 map is based on data collected in Watermaster's ongoing monitoring programs and is representative of current conditions. The 1933 map is based on groundwater-level data compiled and mapped by the DWR. Figure 4.5-17 shows the change in groundwater level from 1933 to 1997 based on the groundwater elevation maps for 1933 and 1997. The regional groundwater decline over this time frame by management zone is:

| Management Zone | Range |
|---|---|
| 1 | 50 to 150 feet |
| 2 | 50 to 100 feet |
| 3 | 50 to 100 feet |
| 4 | less than 50 feet |
| 5 | less than 50 feet |

Figure 4.5-18 is a map similar to Figure 4.5-17 with the water service area boundaries shown in place of management zone boundaries. The areas of greatest regional groundwater decline underlie the City of Pomona, the Monte Vista Water District, the City of Chino, and the western half of the City of Ontario.

Figure 4.5-19 shows the depth to water for fall 1997. Mendenhall surveyed the Basin in 1902 and found parts of the Chino Basin to be artesian as evidenced by springs and marshy areas (Mendenhall, 1904). This artesian area is also shown on Figure 4.5-19. In the artesian areas, the historical groundwater level or piezometric surface was at or exceeded the ground surface. Figure 4.5-19 suggests that the regional groundwater decline in the western Chino Basin is up to 200 feet since

1902. Groundwater levels appear to have stabilized since the Chino Basin Judgment was implemented and groundwater production has been managed within the Basin's safe yield. However, there may still be areas experiencing localized overdraft including the area overlain by the Cities of Chino, Chino Hills, Pomona, the western portion of the City of Ontario, and the Monte Vista Water District. Todd defines the safe yield of a groundwater basin as the amount of water that can be withdrawn annually without producing an undesirable result. Withdrawal or production is excess of safe yield is an overdraft. Domenico (1972) defines undesirable results to include not only the depletion of groundwater in storage but also intrusion of water of undesirable quality, contravention of existing water rights, and the deterioration of the economic advantages of pumping. Cherry (1979) includes subsidence in the list of undesirable results.

The significant issues related to large-scale regional groundwater declines in the Chino Basin include: decline in storage, higher pumping costs, loss of production capacity, water quality degradation, and subsidence.

In the mid-1970s, ground fissuring was identified in the southwestern portion of Chino Basin. Ground fissuring in this area has continued to the present, and subsidence has been documented and identified as the cause of ground fissuring (Kleinfelder, 1993; 1996). Kleinfelder documented regional subsidence through an analysis of topographic benchmarks from 1987 to 1993, 1993 to 1995, and from 1995 to 1999. The resulting contour maps of equal differences in elevation revealed a north-south trending, elongated area of subsidence underlying the City of Chino and California Institute of Men (CIM) (see Figures 4.5-19 and 4.5-20). Maximum subsidence over the period 1987-1995 was reported to be about 2 feet located along Central Avenue between Schaefer and Eucalyptus Avenues. However, about one foot (or 50 percent) of this subsidence occurred over the period from 1993-1995 – indicating that the rate of subsidence has increased. This was confirmed independently by scientists at the Jet Propulsion Laboratories using remote sensing (see www-radar.jpl.nasa.gov/sect323/InSar4crust/LosAngeles.html). Kleinfelder (1993; 1996) concluded that regional subsidence was caused by localized groundwater overdraft and declining groundwater levels. The reasoning to support this conclusion is four-fold:

- As shown in Figure 4.5-19, the area of regional subsidence and ground fissuring geographically coincides with the late 1800s artesian area mapped by Mendenhall (1904, 1908) – an area that has experienced extreme declines in groundwater levels.
- Subsidence is well documented in areas where underlying soils have experienced extensive fluid withdrawal. In saturated soils, buoyant conditions exist, where stresses between soil particles are low. But as the water level drops, the stresses between soil particles increase and overburden pressure causes soil consolidation.
- The initiation of ground fissuring temporally coincides with new groundwater production by the city of Chino Hills in the area of maximum subsidence. By 1975, groundwater levels had declined by a maximum of 200 feet in the former artesian area.
- Regional subsidence and ground fissuring is not attributable to other potential causes of subsidence. The area does not coincide with known faults or groundwater barriers and the area has not experienced significant petroleum extractions.

The OBMP report contains a detailed discussion of the methodology for estimating groundwater storage in the Chino Basin. The methodology is not repeated here since it is not essential to an

understanding of the estimated groundwater in storage. Those persons interested in this methodology can obtain a copy from the IEUA or Watermaster office upon request.

The safe yield of a groundwater basin approximates the average annual recharge in a basin if the storage in the basin is large. The larger the storage, the more reliable the basin will be in dry period. The amount of water in storage in the Chino Basin is directly proportional to groundwater level. In most parts of the Chino Basin, unconfined aquifers overlie confined aquifers. Thus, the storage in some grid cells consists of the sum of water in storage in confined and unconfined aquifers. The volume of groundwater in storage in each grid cell was estimated in the OBMP. Not all the water in storage is available for production. A minimum volume of groundwater must be maintained in storage to ensure that groundwater can flow to wells. This minimum storage is included in the volume computations.

A maximum storage could also be defined, although it is more difficult to do so. The difficulties associated with maximum storage relate to defining which high groundwater-level impacts are acceptable and to whom. An across-the-basin increase of 50 feet would probably impact only those lands near the Santa Ana River with unknown water quality impacts everywhere.

Time History of Groundwater Storage for the Basin

Groundwater-level maps were prepared using all available data for 1933, 1965, 1969, 1974, 1977, 1983, 1991, and 1997. Aquifer geometry and storage properties were developed from the Chino Basin Water Resources Management Study (CBWRMS) (Montgomery Watson, 1995). Equations defined in the OBMP were used to estimate the groundwater in storage for these years. Figures 4.5-15 and 4.5-16 illustrate the spatial distribution of groundwater elevations within the Chino Basin for the fall 1997 and 1933, respectively. The estimated volume of groundwater in storage in the Chino Basin using this methodology and information was:

| Year | Volume (acre-feet) |
|---|---|
| 1933 | 6,300,000 |
| 1997 | 5,300,000 |

Groundwater storage decreased by about 1,000,000 acre-ft during the 64-year period of 1933 to 1997. Table 4.5-1 lists the estimated storage in each of the management zones shown in Figure 4.5-1 and aggregations of the management zones into the Lower Chino Basin (south of State Route 60), the Upper Chino Basin (north of State Route 60) and the Total Chino Basin. The storage estimates in Table 4.5-1 are shown graphically in Figures 4.5-21 and 4.5-22. The lowest level of groundwater storage during the period 1960 to the present occurred in 1977 at the end of a 33-year drought. Prior to 1977, groundwater storage was falling at a rate of about 25,500 acre-ft/yr. The decline in storage was due to drought and groundwater production in excess of sustainable yield. The period of 1978 though 1983 was an extremely wet period. The physical solution with the Chino Basin Judgment was implemented in 1978. The end of the drought and the elimination of basin-wide overdraft caused an increase in storage. Table 4.5-1 shows the change in storage relative to 1977 (the lowest

level of storage) for the period 1965 to 1997. The losses in storage that occurred during the period 1965 to 1977 have been partially offset by gains in storage that occurred after 1977.

Figure 4.5-23 shows the time history of storage in the upper and lower parts of the Chino Basin. There was a decline in storage prior to 1977. After 1977, storage in the upper basin increases, however the rate of increase declines over time. This continued increase in storage after 1983 probably is due to:

- accumulation of unproduced safe yield rights in local storage accounts;
- lagged inflows from the deep unsaturated zone in the northern half of the Basin; and
- lagged subsurface inflows from the Lytle Basin north of Barrier J and the Riverside Basin through the Bloomington divide.

After 1977, storage in the lower part of the Basin appears to have stabilized and follows the general climatic pattern.

Table 4.5-2 and Figure 4.5-24 show a comparison of the time history of total Chino Basin storage to groundwater production, volume of water stored in cyclic and local storage accounts, and climate. As of fall 1997, the combined volume of water in cyclic and local storage accounts was about 274,000 acre-ft and is greater than the increase in total storage that occurred between 1977 (pre-Judgment) and the present. The increase in storage since 1977 is about 174,000 acre-ft. This is counter intuitive, that is, the change in total storage since 1977 should be greater than the volume of water in cyclic and local storage accounts – especially given that the Basin has experienced a wetter than average period since 1977. The discrepancy may be due in part to under reporting of production in the agricultural pool, storage losses to the Santa Ana River, and inaccuracies in the methods used to compute storage herein.

Losses From Storage

The surface water discharge in the Santa Ana River consists of storm flow and baseflow. Baseflow is divided into two components: wastewater discharged from publicly-owned treatment plants (POTWs) and rising groundwater. The rising groundwater component in the Santa Ana River can be divided into two components: short-term storage water from seasonal recharge along the river, and persistent rising water caused by the regional groundwater gradient towards the river. The short-term storage component of rising water will decrease when total groundwater storage is increased either naturally (wet years) or artificially. If total groundwater storage is maintained at higher levels, recharge of surface water from the Santa Ana River will decrease.

Because of the spatial distribution of storage, the rising groundwater response to increases in groundwater storage is often lagged and variable in time. For example, the baseflow at Riverside Narrows (the location where the Santa Ana River enters the Chino Basin) peaks about five to seven years after heavy recharge years in the upstream groundwater basins. Chino Basin groundwater discharge to the river also exhibits a slight lag time. The time history of baseflow at Prado consists of a complicated mix of rising water responses from the Bunker Hill, Riverside, Chino and Temescal Basins.

Analysis of the increase in rising water in the Chino Basin caused by an increase in groundwater storage requires the filtering out of these other sources of surface discharge from historical records and modeling results.

The accumulation of groundwater in storage will cause an increase in groundwater discharge in the Santa Ana River and its tributaries Chino Creek and Mill Creek – losses from storage that are not recoverable. The physics of the groundwater storage-baseflow relationship can be represented by linear reservoir theory where outflow is directly proportional to storage:

$$O = K * S \quad \text{(Equation 1)}$$

where:

| | |
|---|---|
| O | is the outflow from storage (L3/T) |
| S | is volume of water in storage (L3) |
| K | is the linear reservoir coefficient (T -1) |
| L | denotes units of length and |
| T | denotes unites of time. |

This formula can be calibrated to a specific range of storage and groundwater management conditions. The flow in the Santa Ana River in the Chino Basin was decomposed into rising water from the Chino Basin and other components. The rising water component was subdivided into short-term storage water from seasonal recharge along the river in Management Zone 5, and persistent rising water caused by the regional groundwater gradient towards the River from all management zones. This decomposition was done using simulation model results from the Chino Basin Integrated Groundwater and Surface Water Model (CIGSM) developed for the Chino Basin Water Resources Management Task Force (Montgomery Watson, 1995, and unpublished modeling results for calibration and planning simulations).

*Historical Storage Losses to the Santa Ana River.* Rising groundwater estimates were made for the period of model calibration 1960 to 1989, and the forecasting period of 1990 to 2040. Certain historical periods were studied to isolate the spatial effects of groundwater production patterns and hydrology on rising groundwater. For example, the period 1960 to 1977 represents the pre-Judgment period that has higher groundwater production than the period after 1978 that represents the period when the Basin was managed by Watermaster without basin-wide overdraft. Linear reservoir theory was used to develop a simple relationship of change in groundwater discharge to the Santa Ana River to incremental change in groundwater storage.

Hydrograph decomposition for the historical period was done using water balance tables from CIGSM for reaches of the Santa Ana River and its tributaries. Analysis of the hydrology of the period suggest that two periods could be used to develop a linear reservoir relationship:

- 1970 to 1977 representing a pre-Judgment period; and
- 1984 to 1989 representing a post-Judgment period.

The period 1970 to 1977 was a dry period following significant recharge along the river from the 1969 storms. The 1984 to 1989 period was also a dry period following the wet period from 1978 to

1983. Both of these periods exhibit recession flows typical of streams fed by groundwater systems. CIGSM model-estimated rising water was plotted against the model-estimated storage in the Chino Basin. The annual rising water estimates and respective storage estimates are shown graphically in Figures 4.5-25 and 4.5-26. Simple linear regressions were done for the 1974 to 1977 period and 1987 to 1989 period to estimate the linear reservoir coefficient (K) for the linear reservoir equation (Equation 1). The linear reservoir coefficient is the slope of the best-fit lines in Figures 4.5-25 andO4.5-26. The resulting linear reservoir coefficients are 0.0254 for the 1970 to 1977 period, and 0.0203 for the 1987 to 1989 period. Physically, the linear reservoir coefficient represents the fraction of the storage that annually becomes rising water. Thus, an increase in storage of 100,000 acre-ft in the 1987 will cause about 2,000 acre-ft of new rising water in the first year. Groundwater storage after the first year would be reduced to 98,000 acre-ft. In the second year, the storage would be reduced another 2.03 percent, or 1,970 acre-ft, and so on. The 0.0051 difference in linear reservoir coefficients for the pre- and post-Judgment periods is due in part to changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

*Future Storage Losses to the Santa Ana River*. An estimate of the linear reservoir coefficient for the period 1990 through 2040 was estimated by comparing the total Santa Ana River flow at Prado Dam and groundwater storage for Alternatives 3 and 4 of the CBWRMS. Alternative 3 represents a specific groundwater management strategy that could be implemented. Alternative 4 is identical to Alternative 3 with the addition of a conjunctive use program and an increase in limits for local storage accounts. (Note the alternatives considered in the OBMP are similar to, but not precisely the same, as alternatives considered in the PEIR.) The conjunctive use program has three cycles of build up in storage to approximately 300,000 acre-ft and subsequent pump-out periods. The increase in storage in local storage accounts is gradual and incremental throughout the period. The rising water losses from the conjunctive use storage and the increase in local storage accounts are simply the difference in Santa Ana River flow between these alternatives. Table 4.5-3 lists the differences in groundwater storage and Santa Ana River flow. The linear reservoir coefficient for future conditions is estimated to be about 0.0408, or 4.1 percent of storage – about double that of the 1984 to 1989 period. The increase in the linear reservoir coefficient was caused by changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

*Computation of Storage Losses to Santa Ana River*. The linear reservoir equation can be used to estimate losses from groundwater storage accounts to the Santa Ana River:

$$qt = K * (St + 0.5 * T *(It - Qt)) \quad \text{(Equation 2)}$$

where:

| | |
|---|---|
| qt | is the annual loss from a storage account in period t to t+1 (acre-ft/yr) |
| K | is the linear reservoir coefficient |
| St | is water in a storage account at the end of period t (acre-ft) |
| It | is the water put into a storage account in period t to t+1 (acre-ft/yr) |
| Qt | is the water taken from the storage account for use in period t to t+1 (acre-ft/yr) |
| T | duration of time between t to t+1, assumed to be one year |

The volume of water in storage accounts at the end of a period is equal to:

$$St+1 = St + T * (It - Qt - qt) \quad \text{(Equation 3)}$$

Using a linear reservoir coefficient of 0.0201 and Equation 2, the total water lost from local storage accounts and cyclic storage since the Judgment became active in 1978 is estimated to be about 50,000 acre-ft or about 18 percent of the volume that Watermaster currently assumed was in storage. The time history of accumulating storage accounts and estimated losses to baseflow are listed in Table 4.5-4. Watermaster does not currently compute losses from storage accounts. This means that when water in storage accounts is produced, additional overdraft of the Basin will occur. Losses from conjunctive use projects could be very large. In the example in Table 4.5-3, three filling and withdrawal cycles were done over a 40-year period with each reaching a fill capacity of 300,000 acre-ft. The model estimated losses of over 300,000 acre-ft over three fill and extraction cycles – a loss of over one-third of the water stored. If these losses were not accounted for, the Basin would be overdrafted by 300,000 acre-ft over the 40-year period.

The losses described above were developed from modeling studies. Watermaster indicates that monitoring to verify these losses has not been done in the past nor is it practical in the future. The measuring errors associated with such a program would be larger than the probable losses from storage. IEUA staff believes that monitoring can accomplish identification of direction of flow by monitoring water quality in the wells; thus indicating interception of flows downgradient in the Basin for drawing water from the Santa Ana River. Watermaster concluded that the only practical ways to estimate such losses are to:

- Use a linear reservoir model as described above, or
- Calibrate a groundwater flow model over the period that water is held in cyclic, local, and conjunctive use storage and compare it to a simulation run with the same hydrology that did not have water in these storage accounts. The difference in groundwater discharge to the river would be the losses due to cyclic, local, and conjunctive use storage. Adjustments to storage accounts could be made retroactively or a new loss factor established for the next period.

### 4.5.2.5 Groundwater Production

Historical Groundwater Production Monitoring

Prior to 1975, groundwater production monitoring was not formally done by a single entity for the benefit of the Basin. Municipal and some industrial producers kept production records with some submitting annual production reports to the State Water Resources Control Board (SWRCB). Very few agricultural wells had meters and fewer kept records of production. During the period 1975 to 1978, production monitoring at agricultural wells improved slightly. Most of the agricultural production volumes for the period preceding 1978 are comprised of estimates provided by producers and are not based on direct measurements from in-line flow meters.

Since 1978, Watermaster has collected information to develop production estimates. Production estimates in the appropriative pool and overlying non-agricultural pool are based on totalizing in-line flow meter data provided to Watermaster on a quarterly basis by these producers. Watermaster aggregates these quarterly values to obtain annual production for these pools. Production estimates for the agricultural pool are based in part on totalizing in-line flow meter data, water duty methods, and hour-meter data combined with well efficiency tests. As with the other pools, reporting is done by the producers. However, not all agricultural pool producers provide Watermaster with estimates of their production. About one third of agricultural pool producers either did not file production reports or filed incomplete reports in fiscal year 1997/98 (telephone discussion with Jim Theirl, 1998).

Historical Groundwater Production

Table 4.5-4 contains estimates of annual groundwater production in the Chino Basin from three different sources: summaries of SWRCB filings and interviews with some producers; Watermaster estimates, and production estimates developed for calibration of CIGSM developed for the CBWRMS. The second column in Table 4.5-5 contains annual production estimates that were used to develop the safe yield in the Judgment. The third column contains Watermaster estimates of annual production that are based on production reports submitted to Watermaster by the producers. The fourth column contains annual production estimates that are based on SWRCB filings, production reports from producers, and water duty methods. In the latter case, water duty methods were used as a check on reported production and supplemented reported production data when production data was missing or under-reported at wells.

The safe yield of the Chino Basin was based on the hydrology of the period 1965 to 1974. The average annual groundwater production for that period from SWRCB filings and interviews was estimated at 152,100 acre-ft/yr. The engineer working on the historical production data knew there was unaccounted for production and assumed that actual production was 20 percent more than the estimate from SWRCB filings and interviews, or about 180,000 acre-ft/yr (Carroll, 1977). This estimate is close to the 189,400 acre-ft/yr average for the same period from the CBWRMS.

In Table 4.5-5, the period of Watermaster groundwater production estimates overlaps the period of CBWRMS production estimates. For their common period of record (1975 through 1989), the CBWRMS estimates are consistently higher. This occurs in part because some of the agricultural producers fail to report production or fail to provide production information to Watermaster. For the CBWRMS, water demands based on land use were compared to reported production. If the water demand for the land uses in a given area was greater than reported production, then reported production was increased to meet the demands based on land use. This method was validated in the CIGSM model calibration process (Montgomery Watson, 1993). In the latter years, the CBWRMS production estimates increasingly diverge from Watermaster estimates. For their common period of record, the average annual groundwater production was estimated at 147,900 acre-ft/yr by Water-master and 174,000 acre-ft/yr by the CBWRMS – a difference of about 26,000 acre-ft/yr. Actual production is probably somewhere in between Watermaster and CBWRMS estimates.

Spatial and Temporal Changes in Groundwater Production

Table 4.5-6 lists Watermaster's estimates of Chino Basin production by pool for the period of fiscal year 1974/75 to 1997/98, and the relative amount of production by pool. Over this period, groundwater production has ranged from a high of 181,000 acre-ft/yr (1975/76) to a low of about 122,600 acre-ft/yr (1982/83), and has averaged about 147,100 acre-ft/yr. The distribution of production by pool has shifted since 1975 with the agricultural pool production dropping from about 55 percent in 1974/75 to 28 percent in 1996/97. During the same period, appropriative pool production increased from about 40 percent in 1974/75 to 68 percent in 1996/97. The increases in appropriative pool production have kept pace with decline in agricultural production. Production in the overlying non-agricultural pool declined from about 5 percent in 1974/74 to about 2 percent in the mid-1980s, rose to about 4 percent by 1990/91 and has remained at about 4 percent of total production thereafter.

Figure 4.5-27 is a plot that compares the change in total groundwater production in the Chino Basin to the change in urban and agricultural/other non-urban land uses. Prior to 1980, the decline in groundwater production appears proportional to the decline in agricultural and other non-urban land uses. After 1980, groundwater production appears to be relatively stable even though the decline in agricultural and other non-urban land uses is accelerating.

Figures 4.5-28 and 4.5-29 are similar to Figure 4.5-27 except they represent the Basin north of State Route 60 and south of State Route 60, respectively. North of State Route 60, the pattern of land use change is similar to the entire basin, but the groundwater production that was declining from 1960 to 1980 rose sharply after 1980. South of State Route 60, groundwater production was generally declining throughout the period of 1960 to 1990. The rate of decline in production in the southern half of the Basin after 1980 matches the rate of increase in production north of State Route 60, such that the total annual production in the Basin after 1980 is relatively constant (see Figure 4.5-27).

Figures 4.5-30 through 4.5-34 illustrate the location and magnitude of groundwater production at wells in the Chino Basin for years 1960, 1970, 1980, 1989 and 1997. These maps are based on production estimates developed in the Chino Basin Water Resources Management Study (Montgomery Watson, 1995) and by Watermaster. Two trends are evident in the period 1960 through 1998:

- In the southern half of the Basin there is an increase in the number of active wells and a decrease in the per well production. This is due to the land use transition from predominately irrigated agriculture uses to predominately dairy uses and due to a recent well inspection program, resulting in more wells of record.

- In the northern half of the Basin there is an increase in the number of wells producing over 2,000 acre-ft/yr. This is consistent with the land use transition from agricultural uses to urban uses and with the trend for increasing imported water costs.

Groundwater Production and Safe Yield

Recent and past studies have provided some insight into the influence of groundwater production in the southern end of the Chino Basin on the safe yield of the Basin. Three studies were done that quantified the impacts of proposed desalters in the lower Chino Basin on groundwater discharge to the Santa Ana River. The proposed desalters were first described in Nitrogen and TDS Studies, Upper Santa Ana Watershed (James M. Montgomery, Consulting Engineers, Inc., 1991). This study matched desalter production to meet future potable demands in the lower Chino Basin through the year 2015. The well fields were sited to maximize the interception of rising water and to induce streambed percolation in the Santa Ana River. The decrease in rising water and the increase in streambed percolation were projected to range from 45 to 65 percent of total desalter production.

Well field design studies for the SAWPA desalter provided estimates of the volume of rising water intercepted by the currently proposed desalter – scheduled for completion in March 2000 (Wildermuth, 1993). These studies used a very detailed model of the lower Chino Basin (rectangular 400-foot by 400-foot grid covering the lower Chino Basin) to evaluate the hydraulic impacts on rising water and groundwater levels at nearby wells. These studies showed the relationship of interception of rising water to well field location and well field capacity. The fraction of the desalter production composed of decreased rising water and the increased stream bed percolation water was estimated to range from 40 to 50 percent.

No formal studies and estimates of desalter well field interception of rising water were made during the Chino Basin Water Resources Management Study (Montgomery Watson, 1995). An informal estimate of the interception of rising water was made by Wildermuth (letter to Neil Cline, dated August 9, 1993). Wildermuth used the groundwater model developed in Chino Basin Water Resources Management Study for a well field similar to the SAWPA desalter well field and used the model calibration period of 1960 to 1989. This study estimated the interception of rising groundwater at about 80 percent of desalter production capacity.

These three studies suggest that the yield of the Basin could be increased by simply increasing the production near the river, and that for every two acre-ft of new, near-river production the safe yield could be increased by one acre-ft, that is the marginal change in safe yield with increased near-river production is about 0.5 acre-ft/yr per acre-ft/yr of production. The opposite is also true. That is, if production were to decrease in the southern half of the Basin, the safe yield will also decrease. Agricultural production is projected to decrease about 40,000 acre-ft/yr when current agricultural land use transitions to urban use. If the magnitude and spatial distribution of current agricultural production is not replaced with new production then the yield of the Chino basin will decrease by a comparable amount.

### 4.5.2.6 Historical and Current Groundwater Quality

Historical Groundwater Quality Monitoring

Various entities have collected groundwater quality data in the past. Municipal and agricultural water supply entities have collected groundwater quality data to comply with Department of Health Services requirements under Title 22 or for programs that range from irregular study-oriented

measurements to long-term periodic measurements. Groundwater quality observations have been made by the DWR, by participants in the 1969 Judgment on the Santa Ana River (Orange County Water District vs. City of Chino et al.), by dischargers under order from the Regional Board, and by the County of San Bernardino. The DWR and the SBCFCD were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and Norco, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (Metropolitan) conducted the first comprehensive survey of groundwater quality covering all constituents regulated in California Code of Regulations Title 22.

In 1989, Watermaster initiated a regular monitoring program for the Basin with groundwater quality data obtained in 1990 and periodically thereafter to the present. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster staff supplements this data with data obtained through a Watermaster sampling and analysis program in the area south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under orders of the Regional Board. Watermaster has combined previously digitized groundwater quality data from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster plans to begin the development of a new, more comprehensive water quality monitoring program to support the OBMP starting in July 1999. The program consists of two phases. The initial phase consists of collecting and analyzing groundwater quality samples at all producing wells in the over a three year period starting in July 1999. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed The second phase consists of implementing the long term monitoring program and will start in July 2002.

Water Quality Conditions

Sources of water quality degradation can be classified into point and non-point sources. Point sources are confined to point discharges to the soil, groundwater, or stream systems. Examples include conventional wastewater and industrial discharges to streams or ponds, and leaky underground storage tanks. Non-point sources are areal discharges to soil, groundwater and surface waters, such as land application of waste and fertilizers and atmospheric deposition of contaminants to the soil and water bodies. The discussion below describes the water quality state of the Basin as it exists today for specific constituents of concern. The constituents described below are regulated for drinking water purposes in California Code of Regulations, Title 22 or are regulated in the 1995 Water Quality Control Plan for the Santa Ana River Basin (Basin Plan).

Figures 4.5-35 a-h illustrate land uses in the Chino Basin in 1933, 1949, 1957, 1963, 1975, 1984, 1990 and 1993. These land use maps were developed from DWR land use surveys for 1933 through 1984, and from Southern California Association of Governments surveys for 1990 and 1993. The

maps show a steady, dramatic change over time from agricultural to urban land uses. An exception to this occurs in the southern Chino Basin where dairies have moved in to replace irrigated and non-irrigated agriculture. These maps are useful in characterizing water quality degradation associated with non-point source loading from agriculture. The land uses shown in these maps are quantified in Table 4.5-7.

*Total Dissolved Solids (TDS).* TDS is regulated as a secondary contaminant in Title 22. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/l, however the upper limit is 1,000 mg/l. For irrigation uses, TDS should generally be less than 700 mg/l. The Regional Board has established TDS limitations for all municipal wastewater plants that discharge recycled water to the Santa Ana River. A problem arises in that TDS concentrations increase through municipal use – typically by about 150 to 250 mg/l. The TDS limitations for water recycling plants that discharge to the Santa Ana River in the Chino Basin are listed below:

| Plant | TDS Limit (mg/l) |
|---|---|
| IEUA RP1 | 540 |
| IEUA RP2 | 610 |
| IEUA Carbon Canyon | 555 |
| IEUA RP4 | 505 |
| Western Riverside Regional | 625 |
| City of Riverside | 650 |
| Jurupa Indian Hills | 650 |

The TDS in source (drinking) water generally must be kept well below 500 mg/l (preferably less than 300 mg/l) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets Regional Board limitations. The treatment cost to remove TDS from water is very expensive – about $500 to $700 per ton.

Table 4.5-9 provides the average TDS concentrations by well for five-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 4.5-36 through 4.5-38 show average TDS concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Historically, TDS has not been measured at wells on an annual basis. The choice of one year, say 1963 for example, might have only one-third as many TDS measurements at wells compared to a five-year period. Thus, averaging TDS over a five-year period was necessary to get adequate spatial coverage of measurements.

TDS concentrations in the northeast part of the Basin range from about 170 to about 300 mg/l for the period 1960 through 1990, with typical concentrations in the mid- to low-200s. TDS concentrations in excess of 200 mg/l indicate degradation from overlying land use. With few exceptions, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation, such as the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near IEUA Regional Plant No. 1 (RP1) in South Ontario. The TDS anomaly from Kaiser is not shown on Figures 4.5-36 through 4.5-38 A TDS anomaly from former municipal wastewater ponds can be seen in the east central part of Management Zone 2.

The impacts of agriculture on TDS in groundwater primarily are caused by fertilizer use on crops, consumptive use, and dairy waste disposal. The TDS impacts from the dairies located in the southern half of the Basin is reflected at least partially in Figures 4.5-37 and 4.5-38. The intensity of the TDS loading from dairy waste to the Basin is illustrated in Table 4.5-8 (Table 2-1 from Final Task 6 Memorandum, Development of a Three-Dimensional Groundwater Model, Montgomery Watson, 1994). This table shows the steady buildup of the dairy cattle population in the southern Chino Basin between 1949 and 1989. The total amount of TDS from manure discharged to the southern half of the Basin that will reach groundwater is estimated to be about 1,200,000 tons through 1989 and averages about 29,000 tons per year. The dairy loading numbers in Table 4.5-8 assume that half of the manure was hauled out of the Basin after 1973, which was a requirement of the Santa Ana watershed Water Quality Control Plan enacted in 1973. The amount of manure exported out of the Basin was never verified until the late 1990's. The TDS loading to groundwater from dairy waste disposal activities could be far greater than estimated in Table 4.5-8.

As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/l, and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/l, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/l, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

TDS concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of Management Zones 1, 2, and 3. TDS concentrations are significantly higher in the southern parts of Management Zones 1, 2, and 3, and all of Management Zone 5 where they typically exceed the 500 mg/l recommended MCL and frequently exceed the upper limit of 1,000 mg/l.

*Nitrate.* Nitrate is regulated in drinking water in Title 22 with an MCL of 10 mg/l (as nitrogen). Table 4.5-10 provides the average nitrate concentrations by well for 5-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 4.5-39, 4.5-40, and 4.5-41 show the average nitrate concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Nitrate measurements in the surface water flows in the San Gabriel Mountains and in groundwater near the foot of these mountains are generally less than 0.5 mg/l (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/l indicate degradation from overlying land use. Similar to TDS, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of Management Zones 1, 2 and 3; and
- Dairy areas in the southern parts of Management Zones 1, 2 and 3 and all of Management Zone 5.

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in northern parts of Management Zones 1, 2 and 3 over the period 1960 to the present. These are areas formerly occupied by citrus and vineyard land uses (see Figures 4.5-35 a-d), and nitrate concentrations underlying these areas rarely exceed 20 mg/l (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of Management Zones 1, 2 and 3, and all of Management Zone 5. These are areas where land use has progressively converted from irrigated/non-irrigated agriculture to dairy uses (see Figures 4.5-35 a-h), and nitrate concentrations typically exceed the 10 mg/l MCL and frequently exceed 20 mg/l by 1991-1995.

There are two stable isotopes of nitrogen: 14N and 15N. Within the nitrogen cycle, thermodynamic and kinetic processes occur which fractionate these isotopes in various nitrogen-bearing compounds. Most biologically-mediated reactions (e.g., assimilation, nitrification, and denitrification) result in 15N enrichment of the substrate and depletion of the product. Nitrogen isotope chemistry is a technique to help distinguish potential sources of nitrogen in the environment (Clark and Fritz, 1997). The enrichment of 15N relative to atmospheric nitrogen is expressed as δ15N and has units of parts per thousand (permil). The following table shows the ranges of nitrogen isotopes of potential sources of nitrate (Battaglin et al., 1997):

| Source of Nitrate | $\delta^{15}$N of Nitrate (permil) |
|---|---|
| Atmospheric Nitrate | -10 to 9 |
| Nitrate Fertilizer | -5 to 5 |
| Ammonium Fertilizer | -5 to 0 |
| Animal Waste | 10 to 20 |
| Poultry Manure | 7.9 to 8.6 |

As part of the 1997 groundwater-monitoring program, samples were collected from six wells for nitrogen isotope analysis:

| State Well Number | Region | Nitrate-N (mg/l) | $\delta^{15}$N of Nitrate (permil) |
|---|---|---|---|
| 01S07W14D01 | Cucamonga - Former Citrus | 3.2 | 4.0 |
| 01S07W14D02 | Cucamonga - Former Citrus | 4.0 | 4.2 |
| 02S07W34D | Chino Agricultural Preserve | 106.0 | 12.8 |
| 03S07W05G | Chino Agricultural Preserve | 77.3 | 18.3 |
| 02S07W20A | Chino Agricultural Preserve | 64.5 | 10.0 |
| 02S07W16D | Chino Agricultural Preserve | 63.6 | 8.7 |
| 02S07W16D | Duplicate | 63.6 | 9.0 |

The samples from the wells in areas where the antecedent land use was predominantly citrus had nitrate values that were significantly below the maximum contaminant level (MCL) of 10 mg/l. Nitrate values in samples from the Chino Agricultural Preserve all exceeded the MCL by at least a factor of six. In addition, the δ15N values for the Cucamonga wells were about 4 permil, while the δ15N values for the Chino Agricultural Preserve wells ranged from 8.7 to 18.3 permil. The nitrogen isotope results are compared graphically with ranges from known sources in the Figure 4.5-42.

The high nitrate concentrations shown in Figure 4.5-41 probably depict the nitrate impacts from the agricultural waste disposal areas located in the southern half of the Basin.

*Other Constituents of Potential Concern.* Tables 4.5-11a through 4.5-11c summarize inorganic and organic constituents that have been analyzed for and detected in groundwater samples from wells in the Chino Basin through July 1998. Table 4.5-12 summarizes the information in Tables 4.5-11a through 4.5-11c for the constituents detected at or above their MCLs. This is a synoptic analysis and includes all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. The data do represent the most comprehensive information available to date.

A large subset of this data was extracted from the California Department of Health Services (DHS) database (current through July 1998). For each constituent, the tables lists:

- the number of measurements at or above one-half the applicable MCL;
- the number of wells with measurements at or above one-half the applicable MCL;
- the number of measurements at or above the applicable MCL;
- the number of wells with measurements at or above the applicable MCL; and
- the applicable MCL.

The tables are organized as follows:

- Table 4.5-11a: Inorganic constituents, total trihalomethanes (THMs) and radioactivity with primary MCLs;
- Table 4.5-11b: Organic chemicals with primary MCLs;
- Table 4.5-11c: Inorganic constituents and organic chemicals with secondary MCLs, lead and copper rule, and California DHS Action Levels.

Table 4.5-12 summarizes the constituents that were detected at concentrations greater than one-half their MCL, and are grouped by chemical type. These values represent a mixture of data from monitoring and production well samples. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

*Inorganic Constituents.* Five inorganic constituents were detected at or above their MCL in more than 20 wells: TDS; nitrate; fluoride; iron; and manganese.

TDS and nitrate have been discussed in previous subsections. Fluoride, iron, and manganese naturally exist in groundwater. Their concentrations depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions,

in turn, depend on pH, oxidation-reduction potential, and temperature. Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/l to 10-20 mg/l (Freeze and Cherry, 1979). Based on the available data, none of these constituents shows a spatial pattern throughout Chino Basin (see Figures 4.5-43 through 4.5-45). However, site-specific monitoring wells may reveal point sources (e.g., wells near landfills have shown relatively high concentrations of manganese).

The OBMP also includes an extensive discussion of other man-made pollutants, typically considered hazardous or toxic in character. The materials are discussed in subchapter 4.10, Hazards and Risk of Upset. The reader should refer to the discussion of contaminants such as perchlorate, volatile organic compounds, and pesticides and herbicides in that subchapter. Also discussed in subchapter 4.10 are point sources of pollution, typically industrial areas where contaminant plumes have been identified. Overall contamination for the Chino Basin is shown in Figure 4.5-46.

Role of the Vadose Zone in Future Water Quality

The vadose zone is the unsaturated part of the aquifer that lies between the water table surface and the land surface. The vadose zone has become larger and thicker over time as the groundwater levels in the Basin have declined due to overdraft. Some of the contaminants discharged to the land surface or into ponds remain in the vadose zone. The mechanisms for retention of contaminants within the vadose zone are complex, but are generally caused by sorption and precipitation. Some contaminants move down towards the saturated zone at much lower rates (a few feet per year) than they can move once they get to the saturated zone (a few feet per day). MWDSC completed a study of the TDS and nitrate impacts in the Chino Basin from a proposed 700,000 acre-ft storage program California (MWDSC, 1988). The outcome of this study suggested that the raising of groundwater levels associated with the increase in storage would mobilize TDS and nitrates in the vadose zone and cause serious water quality problems throughout the Basin. The proposed storage program did not add contaminants – it flushed contaminants already in the vadose zone into the saturated zone.

The Chino Basin Water Resources Management Study model conducted for a 300,000 acre foot conjunctive use program shows virtually no adverse impacts for utilization of this quantity of additional storage capacity in the basin. The model at this level is fully adequate to evaluate impacts associate with this 300,000 acre-foot volume. This model was not designed to be run for a 700,000 acre-foot program, thus it would not be appropriate to draw conclusions regarding such an expanded conjunctive use program unless a model had been designed and run, in order to verify whether or not contamination may occur from such a program.

If an expanded conjunctive use program is considered in the future, it is required that additional investigations be conducted before implementation, and another model with appropriate parameters, or some other investigations, will be necessary to fully address whether or not there is the potential for contamination in the vadose zone associated with a 700,000 acre-foot program. If adverse impacts are forecast to occur after such investigations, further environmental documentation will need to be prepared. As additional information for consideration with regards to this issue, it should be noted that in the past, the CBWRMS model has been successfully run and observed by Wildermuth Environmental to not show any

significant increase in TDS concentrations by management zone, even when significant quantities of water with extremely high TDS values were utilized.

The proposed maximum quantity of water for conjunctive use considered in the Draft PEIR is approximately 300,000 acre-feet. Past historical practices were utilized to establish this threshold, namely the "mining" of the Basin that occurred prior to 1978, which was on the order of 500,000 acre-ft. Current safe-yield management of the Basin utilizes this capacity that was previously "mined" and has not demonstrated any further contamination of the saturated zone from such activity. To be even more conservative, a best engineering judgment was made to limit the conjunctive use capacity to 300,000 acre-ft, well within the previously demonstrated capacity of the Basin.

As the agricultural land uses in the Chino Basin convert, the loading of contaminants to the vadose zone will be significantly reduced, as will percolation at the land surface that drives the contaminants down towards the saturated zone. This will have the effect of reducing the rate of vadose zone loading to the saturated zone.

#### 4.5.2.7 Safe Yield

The safe yield of the Chino Basin was established in the 1978 Judgment to be 140,000 acre-ft/yr. The basis for this estimate is described by William J. Carroll in his testimony on December 19 and 20, 1977, during the adjudication process. Table 4.5-13 lists the hydrologic components developed by Carroll to estimate the safe yield of the Chino Basin. These components were developed for the period 1965 to 1974, a period that Carroll referred to as the base period. The hydrologic components listed in Table 4.5-13 are described below.

*Deep Percolation of Precipitation and Surface Inflow* – consists of the deep percolation of precipitation and streamflow. Carroll developed the estimate of 47,500 acre-ft/yr based on an extrapolation of the early Chino Basin modeling results from the DWR.

*Deep Percolation of Artificial Recharge* – consists of the percolation of local runoff in spreading basins. Carroll estimated that the local runoff recharged in SBCFCD-controlled facilities to be about 2,800 acre-ft/yr during the base period. The Etiwanda Water Company also recharged about 1,000 acre-ft/yr of Deer and Day Creek water in the Chino Basin during the base period.

*Deep Percolation of Chino Basin Groundwater Used for Irrigation (domestic and agricultural)* – defined as the fraction of water applied for irrigation that percolates through the soil and recharges underlying groundwater. Carroll estimated that about 15 percent of the water used for domestic irrigation would percolate to groundwater; and that 45 percent of the water used for agricultural irrigation would percolate to groundwater. The volume of percolation of Chino Basin groundwater used for irrigation over the base period was estimated by Carroll to be about 61,700 acre-ft/yr.

*Deep Percolation of Imported Water Used for Irrigation (domestic and agricultural)* – same as deep percolation of Chino Basin groundwater except that the water used for irrigation is imported to and

used over the Chino Basin. The volume of percolation of imported water used for irrigation over the base period was estimated by Carroll to be about 7,000 acre-ft/yr.

*Recharge of Sewage* – defined to be the percolation in ponds of wastewater discharged by municipal wastewater treatment plants. This component almost completely ceased during the base period and was known to be eliminated as a recharge source when the safe yield was estimated. The volume of sewage recharge over the base period was about 18,200 acre-ft/yr. The inclusion of recharge of sewage as a component of safe yield in the stipulated Judgment was therefore not hydrologically consistent with how the Basin was to be operated post-Judgment

*Subsurface Inflow* – defined to be the groundwater inflow to the Chino Basin from adjacent groundwater basins and mountain fronts including:

| | |
|---|---|
| Bloomington Divide (Riverside Basin) | 3,500 acre-feet/year (afy) |
| San Gabriel Mountain | 2,500 acre-feet/year |
| Colton Rialto Basin | 500 acre-feet/year |
| Cucamonga Basin | 100 acre-feet/year |
| Claremont and Pomona Basins | 100 acre-feet/year |
| Jurupa Hills | 500 acre-feet/year |
| TOTAL | 7,200 acre-feet/year (say 7,000) |

*Subsurface Outflow* – defined as groundwater that rises to the ground surface in Prado Basin to become Santa Ana River flow. Estimates of subsurface outflow were based on studies by DWR, United States Geological Survey (USGS), and Carroll. Carroll estimated the subsurface outflow to average about 6,800 acre-ft/yr over the base period.

*Extractions* – consists of groundwater extractions from the Chino Basin. Carroll estimated the groundwater extractions to average about 180,000 acre-ft/yr during the base period.

In addition to these components, Carroll estimated the change in storage over the base period to be about 40,000 acre-ft/yr; that is, the groundwater in storage declined by about 400,000 acre-ft between 1965 and 1974. Carroll estimated the safe yield to be the equal to the average extraction over the base period minus the average annual overdraft during the base period:

safe yield = extraction - overdraft
= 180,000 - 40,000
= 140,000 acre-ft/yr

A more recent estimate the safe yield can be abstracted from the groundwater modeling work done for the Chino Basin Water Resources Management Study -- Task 6 Memorandum Develop Three Dimensional Groundwater Model (Montgomery Watson, 1994). The hydrologic components derived from the modeling results for a 30-year period -- October 1960 to September 1989 (water years 1961 to 1989) - are listed in Table 4.5-14. The safe yield based on the CBWRMS results (1961 to 1989) computed in a manner similar to Carroll is:

safe yield = extraction - overdraft
= 183,000 - 17,000
= 166,000 acre-ft/yr

The safe yield based on CBWRMS modeling results for the base period (1965 to 1974) used by Carroll would be:

safe yield = extraction - overdraft
= 189,000 - 20,000
= 169,000 acre-ft/yr

A more conceptually correct estimate of the safe yield would include a reduction for artificial recharge of imported water and other waters that are currently not part of the yield, such as recharge of recycled water. The adjusted estimates would then be:

| | |
|---|---|
| Carroll's estimate 1965 to 1974 | 118,000 acre-ft/yr |
| CBWRMS estimate 1961 to 1989 | 151,000 acre-ft/yr |
| CBWRMS estimate 1965 to 1974 | 156,000 acre-ft/yr |

Watermaster may decide to change the safe yield of the Basin based on new information such as that developed from the CBWRMS and subsequent studies. Safe yield is used to determine the need for replenishment obligation for individual parties to the judgment. New water from the capture and recharge of storm water, from induced recharge caused by increased southern basin production (or, conversely, the reduction of yield from reduced production in the southern Chino Basin), or from other sources will enhance the yield of the Basin and thereby reduce the cost of purchasing imported water for replenishment.

At the time the Chino Judgment was implemented (1978), about 41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined and is projected to be almost completely gone by 2020. This will result in a decline in irrigation returns to groundwater and a potential decrease in the safe yield. In addition, San Bernardino County, Riverside County, and the U.S. Army Corps of Engineers (USACE) have constructed flood control projects that capture and convey runoff to the Santa Ana River - effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains in the Chino Basin. This also may have resulted in a decrease in the safe yield of the Chino Basin.

Water harvesting opportunities exist that can be used to offset the yield lost to urbanization and flood control improvements. Water harvesting consists of capturing and recharging runoff caused by urbanization. Most of the precipitation falling on undeveloped land or land in agricultural uses is lost to evapotranspiration. Runoff increases dramatically with urbanization due to drainage improvements, increased impervious land cover, and decreased evapotranspiration of rainfall. The potential yield from this additional runoff is numerically equal to the increase in runoff that occurs when the land is converted to urban uses. The actual yield is equal to the additional runoff that is captured and

put to beneficial use. In the Chino Basin, the best and least expensive way to put this yield to beneficial use is groundwater recharge.

Urbanization also creates reclaimed or recycled water from treated wastewater. Presently, most of this water is discharged to the Santa Ana River. IEUA currently plans to use some of their recycled water for direct uses, including non-potable industrial uses, irrigation, and groundwater recharge. Increasing the yield of the Chino Basin by increased capture of local runoff will improve the dilution of recycled water used for groundwater recharge and reduce the cost of mitigation requirements for such reclamation.

### 4.5.2.8 Water Demands and Water Supply Plans

Current and Future Water Demands

The purpose of this subsection is to describe the current and projected water demands and supplies for agencies that produce groundwater from the Chino Basin. This information provides some of the basic information required to make the impact forecast in the following section of this document. Updated forecasts of water demands and supplies were requested from each Chino Basin water agency and industrial producer. Requested data included demands, water supply plans by individual well or source, well construction and operating data, and water production and treatment costs. Many agencies provided updated information. Where responses were incomplete, previous information developed as part of the 1995 Chino Basin Water Resources Management Study (CBWRMS) was used. The planning period for this evaluation is 2000 to 2020.

*Growth Projections.* Subchapter 4.3 summarizes current growth forecasts based on the OBMP discussion, SCAG projections and ultimate buildout of local agency general plans in the Chino Basin. Substantial growth of population, housing, and employment are forecast to occur over the twenty year period from 2000 to 2020. Tables 4.3-1 and 4.3-3 provide a summary of population growth projections.

*Water Demand Projections.* Current water demands and supply projections form the basis for evaluating future water management programs in the Chino Basin area. Water demands are developed based on the water service areas shown in Table 4.5-15.

Water demand projections can be developed by several different methods. These include per capita, water duty and units of use approaches. The most frequently used methods are the per capita consumption method and the water duty method.

For this assessment, all water demands are based on information provided by the water agencies. In the absence of agency data, the assumptions in the CBWRMS have been used. These projections have been compared with the current SCAG projections. However, no adjustments to he demands have been made.

Projected water demands for the Chino Basin are presented in Table 4.5-16. This table indicates that Chino Basin area water demands will range from 348,000 acre-ft/yr in 2000 to 418,000 acre-ft/yr in 2020. Significant municipal water demand growth is expected to occur in the agricultural preserve area. This will result in increased demands for the Cities of Chino, Chino Hills and Ontario, and Jurupa Community Services District. Agricultural water demands are expected to decrease during the planning period as land is converted to urban uses.

Water Supply Plans

The principal water supplies in the Chino Basin area are groundwater pumped from the Chino Basin, other local groundwater and surface water, imported water purchased from Metropolitan and recycled water. The amounts of water utilized from each source are based on data provided by each water purveyor. If data was not provided, the supplies area based on projections developed for the Chino Basin Water Resources Management Study (1995). Each of these sources is discussed below. Table 4.5-16 summarizes the water demands by major source categories. Review of Table 4.5-17 shows that there will be about 40,000 to 70,000 acre-ft/yr of Chino Basin production that will incur a replenishment obligation. The replenishment obligation can be met by the recharge of imported and recycled water, in-lieu replenishment involving imported water, and from water in local storage accounts. In the long run, the replenishment obligation of about 40,000 to 50,000 acre-ft/yr will need to be met with imported and recycled water. Thus the imported and recycled water components in Table 4.5-18 should sum to a total of 40,000 to 50,000 acre-ft/yr higher.

*Chino Basin Groundwater*. The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. Water is reallocated from the Overlying Agricultural Pool to the Appropriative Pool when it is not put to use by the agricultural users. As agricultural production declines, the reallocations to the Appropriative Pool will increase. Total production from the Chino Basin is projected to range between 180,000 to 190,000 acre-ft/yr over the planning period. Production in excess of safe yield must be replaced through the purchase of replenishment water, which is imported into the Chino Basin through IEUA as a member agency of MWDSC, and approved by the Watermaster.

*Other Local Supplies*. Other local water sources provide a portion of the water supplies for Chino Basin water agencies. These supplies include surface water and groundwater.

Surface Water. A number of water supply agencies, which produce groundwater from the Chino Basin, obtain a portion of their water supplies from local surface water sources. These agencies include the: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. The principal surface water sources include San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several smaller surface sources. For the most part, these surface water sources are fully developed and no significant additional supplies are anticipated to be developed in the future. Usage is expected to remain at 16,000-17,000 acre-ft/yr.

Other Groundwater. Other local groundwater supplies represent a significant supplemental source of water for Chino Basin water agencies. Other groundwater supplies in the study area include the Claremont Heights, Live Oak, Pomona and Spadra Basins in Los Angeles County, the Riverside South and Temescal Basins in Riverside County, and the Colton-Rialto, Cucamonga, Lytle Creek Bunker Hill, and Riverside North Basins in San Bernardino County. Agencies using other local groundwater include: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, Southern California Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. These supplies may increase slightly in the future as additional wells are constructed. However, most of these sources are essentially fully developed. Descriptions of these groundwater basins were presented in the CBWRMS Final Report (1995). The aggregate supply from these basins is currently 63,000 acre-ft/yr and is projected to be 76,000 acre-ft/yr in 2020.

Imported Water. Two regional agencies are responsible for imported water deliveries within the study area: MWDSC and San Bernardino Valley Municipal Water District (SBVMWD). Metropolitan is a wholesale water agency serving supplemental imported water to 27 members (city and water agencies) in portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties. This service area has a current population of more than 16 million people. Approximately one-half of the total water used throughout the entire Metropolitan service area is imported water purchased from Metropolitan to supplement the local water supplies in its service area. Metropolitan obtains imported supplies from the Colorado River and the State Water Project (SWP). The demand for direct delivery of imported water for the Chino Basin purchased from Metropolitan is projected to increase from about 68,000 acre-ft/yr in 1997 to 129,000 acre-ft/yr by 2020, an increase of about 90 percent. The demand for replenishment water in the Chino Basin could reach 40,000 acre-ft/yr by 2020 if recycled water is not used for replenishment or direct uses and water in local storage accounts is not available for use as replenishment.

SBVMWD is a wholesale water purveyor in the easternmost portion of the study area and adjacent portions of San Bernardino County. SBVMWD is a SWP Contractor having an entitlement of 102,600 acre-ft/yr. In addition, SBVMWD is responsible for basin management in the Bunker Hill basin. The City of Rialto and West San Bernardino County Water District obtain water from SBVMWD through its Baseline Feeder that supplies Bunker Hill groundwater (included in other groundwater above).

Recycled Water. There are several existing sources of recycled water in use within the Chino Basin study area. These are the Pomona Water Reclamation Plant (operated by the Los Angeles County Sanitation Districts), Regional Plants 1, 2 and 4, and Carbon Canyon Water Reclamation Plant operated by IEUA, Upland Hills Water Reclamation Plant operated by the City of Upland, CIM Water Reclamation Plant operated by the California Institution for Men at Chino, and Indian Hills Water Reclamation Plant operated by Jurupa Community Services District. For this section, only existing and planned recycled water uses that will be implemented in the next two years are included in the water supply plans. This is about 11,500 acre-ft/yr.

Summary. The plans summarized in this section represent the current non-OBMP water supply plans of each individual water agency, as qualified previously. Future evaluation of these plans may indicate problems relative to their long-term feasibility. Availability of imported water supplies will have a significant effect on plan feasibility.

### 4.5.2.9 Wastewater Flows, Treatment and Disposal

Wastewater Flow Projections

Wastewater flow projections are made using a combination of methods similar to water demand projections. Depending on the planning data available, wastewater flow projections are made using per capita-based, equivalent dwelling units (EDU) based, area-based, and water consumption-based methods. The per capita method uses projected populations and average unit wastewater flows per person (90-110 gallons per day per person). EDU-based projections use unit flows per equivalent dwelling unit (EDU), where an EDU is the average amount of sewage generated by a single-family residential household (about 270 gallons per day). EDUs are estimated for commercial and industrial land uses using fixture unit counts or estimated wastewater flows. Flow projections are computed by projecting future EDUs and multiplying by the unit flow per EDU. Area-based methods typically use unit flow factors for each land use type. Flows are computed by multiplying the unit factor for each land use type by the corresponding acreage and totaling the individual flows for each land use type.

Water consumption-based methods compute wastewater flows based on the difference between water demand and water consumption. Water consumption is the amount of water that does not return to the sewer system and is a function of the particular land use type and water use group. Currently, most wastewater flow projections in the study area are based on either per capita or EDU methods.

*LACSD Service Area.* The Los Angeles County Sanitation Districts (LACSD) furnishes wastewater services for Pomona and Claremont. Using the SCAG-98 growth projections and a wastewater generation factor of 110 gpcd, the wastewater flows for this area are estimated to increase from 22,000 acre-ft/yr to 30,000 acre-ft/yr in 2020.

*IEUA Service Area.* IEUA develops ten-year wastewater forecasts for its service area in conjunction with its annual capital improvement plan (CIP). As part of its current CIP, IEUA also prepared a fifty-year projection of wastewater flows. These projections indicate wastewater flows will increase from 57,000 acre-ft/yr in 1997 to 112,000 acre-ft/yr in 2020. This represents an increase of 96 percent.

*Riverside County Service Area.* Wastewater collection for the portion of the study area in Riverside County is provided by several agencies including Jurupa Community Services District and Norco. Other portions are unsewered. Wastewater flows for the Riverside County area are estimated to increase from 10,000 acre-ft/yr in 1997 to 15,000 acre-ft/yr by 2020 based on projected population increases. This includes wastewater generated by unsewered areas. Additional wastewater from outside the study area is expected to be treated at the Western Riverside Regional Water Reclamation Plant. However, no estimates of these additional flows were received.

This completes the description of the existing environmental setting in which the OBMP is proposed to be implemented.

### 4.5.3 Project Impacts

As set forth at the beginning of this subchapter, the goal of the OBMP is to enhance safe yield and water quality from implementing a series of programs that include facilities and activities summarized in the OBMP. Most of these facilities and activities are generally defined at present, which of necessity has resulted in the preparation of a programmatic environmental document, rather than an evaluation of site specific facilities and activities. As the list of concerns and issues outlined in section 4.5.1 of this subchapter illustrates, the ability of the OBMP to fulfill its purpose remains controversial, and many of the water serving agencies within the Chino Basin have identified concerns regarding the effects of implementing the OBMP on water resources and water quality in the Chino Basin.

The key to forecasting the potential for adverse impact to water resource and water quality is to consider the activities associated with implementing the OBMP, which can perhaps be best described by considering each Program Element and first determining whether implementing the element has any physical consequences. A summary of the elements and an assessment of their potential for water resource/quality impacts is presented. For a summary of the acreage required for specific facilities please refer to Table 4.2-3.

*Program Element 1: Develop and Implement Comprehensive Monitoring Program*

This program has very little potential to adversely effect water resources or water quality. Groundwater levels and quality will be sampled; water production will be monitored; surface water discharge and quality will be monitored; ground level will be monitored (Management Zone 1). Some new wells will be installed (estimated to be 50 wells (see Table 4.2-3)) and some existing wells will be properly abandoned. All of these activities are not forecast to cause adverse impacts to water resources or monitoring. In fact, proper abandonment of wells should eliminate a potential source of pollution from illegal disposal activities. Installing wells, sensors and other such features can disturb previously undisturbed areas and create a potential for erosion and sedimentation that must be controlled to prevent water quality degradation.

*Program Element 2: Develop and Implement a Comprehensive Recharge Program*

The most current thinking is to make available up to 88,000 acre-feet per year (afy) of recharge capacity for future utilization. Table 4.2-3 identifies an existing total recharge capacity in eleven basins of approximately 69,500 afy. These basins could be modified to accept delivery of water for recharge from a variety of sources, including recycled water, imported water, and stormwater. To achieve sufficient recharge capacity, new recharge basin(s) will be required to handle an additional 10,500 acre-feet of water per year. Assuming a each acre has the ability to percolate one acre-foot of water per day for 210 days of water deliveries, an additional 50 acres of recharge basins will have to be constructed. For forecasting purposes, it is assumed that up to 30,000 acre-feet of stormwater can be recharged into the Basin aquifer (currently up to 12,000 acre-feet are recharged) with a TDS value of 120 mg/l; up to 62,500 acre-feet of SPW can be recharged with TDS values ranging between

250 and 400 mg/l; and up to 40,000 acre-feet of recycled water can be recharged with an average TDS value of 420 mg/l. The actual mix will vary annually depending upon water availability and infrastructure in place to deliver water to recharge basins.

*Program Element 3 - Develop and Implement Water Supply Plan for the Impaired Areas of the Basin*

*Program Element 5 - Develop and Implement Regional Supplemental Water Program*

These two elements are addressing the Basin safe yield issue. The objective is to increase the municipal and industrial groundwater production and operate desalters. It is estimated that the replenishment obligation will be 31,000 acre-feet in 2000 and 55,000 acre-feet in 2020. To meet this replenishment obligation the OBMP would use water in local storage, direct recharge of water, and in lieu exchange. It is assumed that the desalters would ultimately have a treatment capacity of 30 million gallons per day (MGD), of which approximately 20 percent would be need to discharged as concentrated TDS water to the Santa Ana Regional Interceptor (SARI) line.

*Program Element 4 - Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1 (MZ1)*

This element does not contain specific identified facilities at this time, but it envisions an interim plan that would voluntarily modify groundwater production in the area of subsidence within MZ-1. Under a proposed scenario this could include shifting production to the east and north into Management Zone 2 or 3 in a cooperative effort with adjacent water producers or the delivery of desalted water from the SAWPA desalter unit which is now in operation. The second goal in MZ-1 is to balance recharge and production within the zone as a whole. If required, additional recharge could be carried out at the Montclair basins or other recharge basins within MZ-1. The final component of this element is to establish monitoring to fill gaps in existing knowledge about the zone and utilize the data generated to prepare a long-term management plan.

*Program Element 6 - Develop and Implement Cooperative Programs with the Regional Board and other Agencies to Improve Basin Management*

*Program Element 7 - Develop and Implement Salt Management Program*

These elements focus more on planning and cooperative efforts than on activities that could change the physical environment. The first action is to create a working group (committee) to review water quality conditions and develop cooperative strategies and plans to improve Basin water quality. Additional monitoring and investigations will be established to detect and characterize water quality anomalies and other water quality problems in cooperation with the Regional Board. Funds will be sought to accelerate detection and cleanup effort for anomalies. An acceptable method of defining the salt budget and improvements in water quality will be developed. Once the salt budget methodology is established, it would be used to define future actions to ensure salt management

goals are attained. At this point in time, the Watermaster is not proposing to subsidize the removal of manure from the Basin.

*Program Element 8 - Development and Implement Groundwater Storage Management Program*

*Program Element 9 - Develop and Implement Conjunctive Use Programs*

These elements involve completing the OBMP, preparing a storage management plan by determining operation storage requirements and safe storage capacity. Implement monitoring programs and complete a short-term conjunctive use pilot program that is not yet defined. Conjunctive use programs (seasonal peaking and dry-year) will be defined during this period. This latter action will require sufficient definition of a conjunctive use program to a level of detail that will allow detailed evaluation which would be speculative at this time. A general conjunctive use program is evaluated as one of the alternatives in this document.

The potential impacts from implementing each of the program elements will be evaluated in the following analysis.

### 4.5.3.1 Significance Criteria

The IEUA has not established any specific CEQA significance thresholds for water resource and water quality impacts. However, using the Santa Ana Regional Board's Basin Plan and other documentation, the following thresholds are proposed for assessing and determining significant drainage or water quality impacts from implementing the proposed project.

- Substantially degrade water quality in the Chino Basin
- Reduce the safe yield of the Chino Basin
- Violate any water quality standards or waste discharge requirements established in the Santa Ana Basin Water Quality Control Plan (1995).
- Substantially alter the existing drainage pattern of the area in a manner which would result in substantial erosion or sedimentation within or downstream of the Amended Project Area.
- Substantially alter the existing drainage pattern of the area or substantially increase the rate or amount of surface runoff in a manner which would result in flooding within or downstream of OBMP facilities
- Create or contribute runoff which would exceed the capacity of existing or planned storm water drainage systems.
- Place structures within a 100-year flood hazard area which would expose people or structures to significant risk of loss, injury or death.

Each of the above thresholds will be applied to the potential water resource and water quality impacts forecast to occur from implementing the OBMP, and a decision regarding the significance of potential hydrology impacts will be clearly presented in the following analysis.

### a. Will the project cause changes in absorption rates, drainage patterns or the rate and amount of surface runoff?

Although the OBMP does not fit tidily into the standard format for evaluating water resource and water quality issues in an EIR, the following evaluation format does provide a structure for ensuring that each of the issues is fully considered. Implementing the OBMP is forecast to disturb approximately 728 acres if all of the facilities and activities being considered are implemented.

Implementing Program Element 1 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. The process of sampling groundwater levels and quality at existing and future wells is not forecast to alter absorption rates, alter drainage patterns or the rate and amount of any surface runoff. No adverse impacts to these water issues are forecast to occur from implementing groundwater level and quality monitoring, either directly or indirectly.

2. Installation and operation of water production monitoring systems on existing and future wells is not forecast to cause any direct or indirect measurable change in absorption rates, drainage patterns or the rate and amount of surface runoff. It is assumed that any electrical connections will be installed along existing access routes to wells or that remote sending devices will be utilized that do not require direct electrical connections. Therefore, the gathering of the water production data can be conducted without causing any potential for adverse impacts to these water issues.

3. Obtaining surface water discharge and quality data depends upon sampling within existing stream channels. According to SBCFCD, many sites for measuring flows within each major stream channel are already in place as part of the County Flood Control monitoring programs (personal communication with Randy Forbey, SBCFCD, May 4, 2000). When existing flow measuring stations do not exist, but are necessary to fulfill monitoring goals, they will be installed by Watermaster or by other contributing entities.

4. Ground level monitoring is conducted by both direct and indirect (including remote sensing) methods that do not require substantial changes in the physical environment which could cause changes in absorption rates, drainage patterns, or the rate and amount of any surface runoff. Only a small potential for increased impervious areas would be associated with these activities for extensometers and metering devices, but this acreage is so small relative to the project area that impacts are considered to be ***de minimus*** and less than significant.

5. Installing monitoring wells will create a minor (approximately 400 square feet based on a 20' x 20' well pad) increase in impervious surface (50 wells x 400 sq ft = ½ acre) within the Basin. This is a ***de minimus*** decrease in absorption rate within a Basin containing more than 225,000 acres. In addition, as wells are abandoned, any impervious areas surrounding the wells can be removed which will offset the loss due to new monitoring well construction.

Implementing Program Element 2 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. The process of modifying existing recharge basins to recharge water under the OBMP will entail enhancement of these basins for absorption of water to be recharged to the Chino Basin aquifer. Therefore, no adverse effect to absorption is forecast to occur from implementing this component of Program Element 2. For stormwater recharge, the drainage pattern may be altered to direct flows into recharge basins. For example, along San Sevaine Creek, diversion facilities already exist to direct flows into the Jurupa Basin. Also, the OBMP planners indicate that economics may justify collecting high quality stormwater flows in the lower portion of the basin and pumping them to the upper subbasins for recharge.

   Diversion facilities will not effectively change the fundamental drainage patterns in the Basin, but such facilities may alter the rate and amount of any surface runoff in stream channels during high flow conditions, to the extent that it does not interfere with flood control functions of certain basins, Regarding flood control functions, it will be necessary to establish a conservation pool for each flood control detention basin to ensure that use of such basins will not conflict with flood management objectives. This can be accomplished by defining conservation pool volumes for flood control basins, by not using flood control basins to recharge stormflows, or by ensuring that recharge of SPW or recycled water is conducted during periods when flood flows will not occur. Variable pooling and recharge schedules that are coordinated with storm forecasting to halt deliveries during storm events will ensure that flood-related hazards remain less than significant.

   Indirectly, the effect of reducing stormwater (flood) flows by diverting them into recharge basins is considered beneficial for downstream flood hazards. The volume of runoff being delivered to Orange County downstream from Prado Dam far exceeds mandated flows (approximately 250,000+ afy of average flow versus a requirement for 42,000 acre-feet). The increase in stormwater recharged to the Basin is forecast to be a maximum of 30,000 afy compared to an estimated 12,000 acre-feet of stormwater recharge at present. Under this assumption the potential exists for the project to affect the rate and amount of surface flows from implementing the OBMP by 18,000 acre-feet, but this effect is not forecast to be significant because the net change relative to obligations is so small.

2. The purpose for constructing new recharge basins is to increase absorption, so the effect of implementing the OBMP will be to increase absorption in those areas converted to recharge basins, which will be a beneficial effect. The effects of diverting stormwater to new recharge basins is the same for drainage patterns and rate and volume of flow as described for the remodification and use of existing basins as outlined above.

Implementing Program Elements 3 and 5 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. The installation of three desalters is forecast to disturb a total of approximately 75 acres. Of this acreage, about 10 acres is forecast to be converted to impervious surface with a comparable reduction in absorption rate. A ten-acre area of impervious surface is relatively small and likely to be *de minimus* within a basin of approximately 225,000 acres. However, the cumulative contribution to increases in absorption rate may be considered significant. Therefore, mitigation is provided below to contain all flows on desalter sites to be used to irrigate buffer landscaping on the desalter properties. With implementation of such a measure, the proposed project is not forecast to contribute to cumulatively significant increases in runoff due to increased impervious surface and decreased rate of absorption of precipitation.

2. Meeting the replenishment obligations, up to 55,000 afy, can be fulfilled with a mix of local water in storage, direct recharge of water or *in lieu* exchange. Adequate recharge capacity is available to meet this need as outlined in the previous discussion. Reliance on local water in storage or *in lieu* exchange water has an indirect effect on water resources that is not obvious at first glance. Specifically, reliance on water already stored in the Chino Basin has an adverse impact because a portion of the water in storage is lost to rising groundwater. Analysis presented in the section 4.5.2 indicates that about 18 percent of water stored is lost due to rising groundwater. This loss component must be taken into account if water in storage in the basin is to be used to meet replenishment obligations. A mitigation measure is included in this document to ensure that such estimated losses are taken into account as part of meeting replenishment obligations.

Implementing Program Element 4 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. Modifying groundwater production for Management Zone 1 has no potential to adversely impact absorption rates (even pipelines for transporting the water will be below ground), drainage patterns or the rate and amount of surface runoff. No adverse impact can affect these water issues from implementing this component of Program Element 4.

2. Meeting any additional recharge requirements in MZ 1 and MZ3 according to IEUA staff, can occur without any modifications to the physical environment. Little potential exists for recharge operations in MZ 1 to adversely impact the environment. If new recharge basins were constructed in this area, few impervious surfaces would be created, so there would be little alteration in the drainage, absorbtion rate or surface runoff. Impacts are forecast to be less than significant.

3. Collection of additional data to fill gaps in knowledge about the zone is not forecast to include any activities that will affect absorption rates, drainage patterns or the rate and amount of surface runoff.

Implementing Program Elements 6 and 7 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. The process of developing cooperative strategies and plans has no potential to change the physical environment; therefore, no potential effects to absorption rates, drainage patterns or rate and amount of surface runoff is forecast to result from implementing this component of Program Elements 6 and 7.

2. Seeking funds to speed up cleanup and restoration of contaminated sites does not, in itself, cause any adverse impacts to the environment. Prior to utilizing funds to conduct cleanup and restoration activities, these activities must completed additional environmental investigations to address issues, such as waste transport effects on local roads; potential public health risks from transporting the contaminated material; proper treatment, disposal or even recycling of the contaminated waste; etc.

Implementing Program Elements 8 and 9 is forecast to affect absorption rates, drainage patterns or the rate and amount of surface runoff in the following way:

1. The process of developing storage and conjunctive use programs and plans has no potential to change the physical environment; therefore, no potential effects to absorption rates, drainage patterns or rate and

amount of surface runoff is forecast to result from implementing this component of Program Elements 8 and 9.

2. Collection of additional data to fill gaps in knowledge about the water storage is not forecast to include any activities that will affect absorption rates, drainage patterns or the rate and amount of surface runoff.

3. Attempting to make impact forecasts for an undefined pilot conjunctive use program would be speculative and the State CEQA Guidelines (Section 15145) indicate that the public be informed of this conclusion and no further evaluation is necessary. Before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

### b. Will the project cause the exposure of people or property to water-related hazards, such as flooding?

Implementing Program Element 1 is forecast to affect water related hazards in the following manner:

1. The process of sampling groundwater levels and quality at existing and future wells and extensometers is not forecast to cause any change in water-related hazards, such as flooding. No adverse impacts are forecast to occur with relation to this issue, either through direct or indirect impacts.

2. Installation and operation of water production monitoring systems on existing and future wells in not forecast to cause any change in circumstances regarding water-related hazards. No adverse impacts are forecast to occur with relation to this issue.

3. Water quality sampling is a passive activity and will not cause any adverse impacts, either directly or indirectly to water-related hazards.

4. Ground level monitoring procedures have no foreseeable impact on water-related hazards. No adverse impacts, either direct or indirect are forecast.

5. Installing monitoring wells will create a minor increase in impervious surface (a small portion of the 728 acres that may potentially be impacted as part of OBMP implementation). In actuality, most of this 728 acres will not be made impervious, or it is already impervious, so the net change in stormwater runoff from monitoring wells and the OBMP as a whole is not forecast to be a substantial enough quantity to cause a concern for flooding related issue. This 728 acre area in relation to the Basin as a whole (approximately 225,000 acres) will cause a *de minimus* increase in potential stormwater runoff, which is related to flooding hazards. However, this increase stormwater flows is small enough to be considered a less than significant impact when viewed in light of the Chino Basin's existing and proposed future drainage system.

Implementation of Program Element 2 is forecast to affect water related hazards in the following manner:

1. The construction of new, and the utilization of existing, basins for recharge purposes would not create any significant impervious surfaces that would alter stormwater runoff volumes, and consequently impact flood control capacities. However, the utilization for recharge of basins used for flood control

purposes by the San Bernardino County Flood Control District has the potential to cause increased risks to people and property for flooding related hazards if not properly mitigated. A mitigation measure is proposed below that would reduce the potential water-related hazards impact to a less than significant level by establishing the priority of flood-control functions over recharge-related functions for all basins that are operated for flood-control purposes. By establishing this order of priorities for the basin, along with the need for a specific management plan to be created for each basin prior to initiation of recharge operations, potential conflicts between flood control operations and recharge operations will be minimized and any potential adverse impacts will be reduced to a level that is less than significant. In basins that are not already used for flood control purposes, the possibility exists of creating new diversion works and turnout structures from flood control channels into these storage basins. Creation of these structures and utilization of these basins would actually reduce flooding hazards Additionally, stormwater flows could potentially be captured and pumped to the top portion of the basin for recharge purposes, however this is not forecast to have any adverse impacts to water-related hazards.

Implementation of Program Elements 3 and 5 have the potential to affect water related hazards in the following manner:

1. Other than to potentially create additional impervious surfaces due to desalter, well and extensometer installation (as previously discussed under Program Element 1) the development and implementation of a water supply plan for the impaired area of the Basin, and the development and implementation of a regional supplemental water program for the Basin do not have any potential to adversely impact flooding and water-related hazards. The increase in impervious surface area is *de minimus* with regards to the Basin size, and is well within the capacity of existing and planned flood control facilities.

2. The construction and operation of desalting, and possibly ion exchange facilities is part of this program element. To reduce exposure of people and property associated with this facility, the desalter either shall be constructed outside of any potential flooding hazard area, brought to a level above potential flood hazards, or constructed in manner that otherwise reduces flood-related hazards to a level of non-significance. Additionally, any wells that are located within a hazard area will be hardened against flood-related impacts. Figure 4.5-47 is a map of flood hazard areas within San Bernardino County and portions of Riverside County. This map will be used in siting current and future OBMP facilities in order to minimize impacts related to potential flooding hazards. This mitigation will reduce impacts to a less than significant level.

Program Element 4 has the potential to impact water-related hazards in the following manner:

1. This particular program element deals with potential shifting production from Management Zone 1 to Zones 2 and/or 3 to meet future water supply demands, or will require additional planned recharge beyond the recharge plan discussed in Program Elements 3 and 5, or the use of desalter and/or supplemental water to meet obligations in this area. Only the potential additional recharge to support potential increases in pumping within this zone have any potential to impact water-related hazards, and then only if such recharge occurs in a basin that is conjunctively utilized for flood control purposes. The impacts related to recharging in such multi-purpose basins can be mitigated to a level that is less than significant as discussed above under Program Element 2.

Program Elements 6 and 7 have the potential to impact water-related hazards in the following manner:

1. These program elements are more ministerial than physical in nature, thus the impacts related to cooperative efforts with RWQCB and the development and implementation of a Salt Management Program do not have many physical environmental consequences that are related to hazards such as flooding. For this issue, no adverse environmental impacts to water-related hazards are forecast to occur.

Program Elements 8 and 9 have the potential to impact water-related hazards in the following manner:

1. The development of a storage management program has little potential in itself of causing any adverse environmental effects. These program elements, as with Program Elements 6 and 7, are mainly ministerial in nature. Storage loss rates will be assessed, and new storage account management practices may be established by Watermaster in the future, but these activities will not substantially affect water-related hazard impacts. Impacts related to this issue are forecast to be less than significant.

2. The implementation of a conjunctive use program as part of Program Element 9 is only generally defined at this point in time. In the future, Watermaster will better outline the details and exact physical actions necessary to implement a comprehensive recharge, storage and extraction plan for volumes of water up to 500,000 afy in a basin-wide, and potentially regional, conjunctive use program. At this time, forecasted impacts regarding such a conjunctive use program would only be speculative, thus before a conjunctive use program is implemented, further environmental evaluation will be necessary.

### c. Will the project discharge pollutants into surface waters or cause alterations to surface water quality?

Implementing Program Element 1 may result in the following discharges that could cause alterations to surface water quality:

1. The process of sampling groundwater levels and quality at existing and future wells is not forecast to generate any discharges of pollutants or cause any alterations to surface water quality. No adverse impacts to surface water quality is forecast to occur from implementing groundwater level and quality monitoring, either directly or indirectly.

2. Installation and operation of water production monitoring systems on existing and future wells is not forecast to cause the discharge of any pollutants that could degrade surface water quality. It is assumed that any electrical connections will be installed along existing access routes to wells or that remote sending devices will be utilized that do not require direct electrical connections. Therefore, the gathering of the water production data can be conducted without causing any potential for adverse impacts to surface water quality.

3. Obtaining surface water discharge and quality data depends upon sampling within existing stream channels. According to SBCFCD, many sites for measuring flows within each major stream channel are already in place as part of the County Flood Control monitoring programs (personal communication with Randy Forbey, SBCFCD, May 4, 2000). When existing flow measuring stations do not exist, but are necessary to fulfill monitoring goals, they will be installed by Watermaster or by other contributing

entities. In any case, stream runoff volume and water quality sampling is a passive activity that has no potential to cause discharges of pollutants that could degrade water quality.

4. Ground level monitoring is conducted by both direct and indirect (including remote sensing) methods that do not require many changes in the physical environment which could generate pollutant and cause degradation of surface water quality. No significant adverse impacts are forecasted for this issue.

5. Installing monitoring wells will create ground disturbances and entail drilling activities which can result in release of pollutants, including eroded sediment. Typically, well drilling involves setting up the drill rig and support equipment on an area between 1/4 and 1/2 acre. The site is cleared of vegetation (if not already clear), the rig moves onto the site, support equipment and material (pipes) are laid out on the site and drilling commences, which includes the preparation and utilization of drilling muds which lubricate the well. After the well is completed, the well bore is typically cleaned by pumping the well for a discrete period of time. This ensures that the water being sampled in monitoring wells will not be contaminated by drilling mud or other materials used to ready the well to serve for monitoring purposes over the long-term.

   Drilling and preparing a well to serve its monitoring role has a potential to cause the following discharges of pollutants and subsequent surface water quality degradation. As a result of clearing and preparing a site for well drilling, up to ½ acre of land may be exposed to erosion and generation of sediment which can reach surface water in the Chino Basin. With approximately 50 monitoring wells being considered for installation under the OBMP, cumulative disturbance for this activity may reach 25 acres. Although individual well sites may not disturb large areas, localized erosion and sediment discharges both during well installation could significantly impact a local water body. Therefore, in those instances where vegetation must be cleared from a site to drill a well (note that wells can be drilled on asphalt pads where clearing and/or grading is not required), mitigation will be implemented to prevent the discharge of eroded sediments from a site. The mitigation during site construction and drilling will include the implementation of best management practices designed to control erosion for each specific well location so that it will not cause significant discharge of sediment from OBMP well construction sites. Long-term mitigation will be accomplished by hardening wells sites or revegetating those portions of the site that will not be retained for future operations.

   The potential for accidental releases of petroleum products does exist during well construction activities. This issue is addressed under accidental releases which are evaluated in Subchapter 4.10. Mitigation is identified in Subchapter 4.10 that will ensure any accidental releases are controlled prior to the extent feasible through implementation of house keeping measures and, if an accidental release occurs, that the contaminant is collected, treated and disposed in a manner that does not adversely impact the environment. Further, any cleanup will reduce concentrations of any contaminants to at or below regulatory thresholds for the released contaminant. With implementation of the proposed mitigation measures, no potential exists for significant discharge of pollutants and subsequent significant degradation of surface water quality.

   Drilling muds/fluids will be retained in a lined pond or man-made container. Unless required for a specific purpose during drilling, no hazardous or toxic substances will be used in drilling fluids. At the end of drilling, the fluids will be removed from the site, by truck or other alternative transportation methods, for disposal at an appropriately licensed facility, or the fluid may be allowed to dry out and be graded into the site, if it is tested and verified not to contain any contaminants. If left on the property, it

will be integrated into the final well pad in a fashion that will not allow it to be eroded from the property.

Well clean-out, development/rehabilitation, or flushing can also cause the discharge of pollutants and subsequent degradation of surface water quality. The groundwater pumped to the surface to clean the well will first be sampled and the estimated volume of groundwater that will be pumped estimated. Prior to pumping the well for clean-out the well driller will verify that the groundwater extracted and discharged does not contain any contaminants that could exceed discharge thresholds established by the Basin Plan or a direct waste discharge requirement as issued by the Regional Board. If discharges contain contaminants of concern, then the discharge will be exported from the site by truck or other method of transportation and delivered to a detention basin or holding tank and treated prior to discharge or transported to a treatment facility for treatment and disposal.

6. In addition to well drilling activities, the process of abandoning wells can result in discharge of pollutants. After an abandoned well is closed, the remainder of the site should be returned to a condition consistent with the surrounding environmental condition. Specifically, if a site is within an urban area, it should be paved or covered with appropriate materials consistent with adjacent property. In natural settings, the disturbed area around a well should be revegetated consistent with the adjacent native vegetation to prevent future erosion and sedimentation. Implementing such measures can ensure that well abandonment does not cause erosion and contribute to surface water quality degradation.

Implementing Program Element 2 may result in the following discharges that could cause alterations to surface water quality:

1. The process of modifying existing recharge basins and constructing new recharge basins (including diversion facilities) to recharge water under the OBMP will entail construction activities that have a potential to cause the same type construction related sediment and petroleum material discharges as identified and discussed for well sites above, excluding drilling mud/fluids. Because of the larger amount of acreage involved in recharge basin construction activities, the measures to control erosion and sedimentation and minimize and control accidental releases of pollutants must be incorporated into a Storm Water Pollution Prevention Plan (SWPPP) and a Notice of Intent (NOI) for the construction activities must be submitted to the State Water Resources Control Board (SWRCB) as part of the National Pollutant Discharge Elimination System (NPDES) control efforts for non-point pollution sources. Although the recharge sites are larger, the same general mitigation measures, site specific BMPs, must be applied to ensure that sediment and other pollutants are not discharged from the site into surface water supplies. No additional mitigation is required to reduce potential construction activity impacts to surface water quality to a non-significant level.

2. The issue of recharging substantial additional volumes of water to the Chino Basin is a key component of the OBMP. Recharge to the Chino Basin aquifer is integral to maintaining the safe yield of the Basin (as discussed below), but it also has potential direct and indirect consequences on water quality that is a major concern, particularly in relation to meeting the Regional Board's Basin Plan beneficial uses and water quality objectives. The following is an extended discussion of the issues outlined under the Program Element 2 summary discussion in the introduction to Subchapter 4.5.3. This material is adapted from the OBMP and additional information provided by Mark Wildermuth of Wildermuth Environmental, Inc., the Chino Basin Watermaster's hydrological engineering consultant.

Planning Assumptions for OBMP

As part of the OBMP, two primary alternatives were defined for analysis - a baseline or no OBMP alternative and a with OBMP alternative. The baseline alternative is based on water supply plans provided by the producers and modified pursuant to the Judgment. The OBMP water supply plan is based on the facilities and operating plans in the Optimum Basin Management Program, Phase I Report prepared by Wildermuth Environmental, Inc., Draft Water Supply Plan Facilities Report, Alternative 6A - Phase I (November 1999) prepared by Black and Veatch, and the Draft Recharge Memorandum of Agreement (Recharge MOA) dated February 2000.

Based on evolving information regarding recharge issues, the need for supplemental recharge capacity has been revised to about 88,000 acre-ft/year, which is 8,000 acre-ft/yr higher than stated in the OBMP Phase I report and the draft Recharge MOA. This change is due to revised water supply plans submitted by producers and corrections in the procedure for estimating replenishment obligations in the out years. As an example, a hypothetical replenishment plan under the OBMP is presented in Table 4.5-17. The OBMP envisions new recharge of storm water and that this new recharge will be used to increase safe yield of the basin. Increases (or decreases) in safe yield are allocated to producers in the appropriative pool (appropriators) based on their initial share of safe yield. If the new recharge is allocated to the appropriators per the Judgment and the safe yield prior to the new recharge is assumed be 140,000 acre-ft/yr, then the need for supplemental recharge capacity is about 63,000 acre-ft/yr. Therefore the supplemental recharge capacity requirements for the OBMP can be described as a range of 63,000 to 88,000 acre-ft/yr. The OBMP alternative has two sub alternatives:

- OBMP Alternative A1- Local storm water recharge is increased from an existing level of about 13,000 acre-ft/year to 30,000 acre-ft year and that supplemental recharge capacity is increased from 29,000 acre-ft/yr to 63,000 acre-ft/yr.

- OBMP Alternative A2 - Local storm water recharge is increased from an existing level of about 13,000 acre-ft/year to 40,000 acre-ft year and that supplemental recharge capacity is increased from 29,000 acre-ft/yr to 53,000 acre-ft/yr.

- OBMP Alternative B - Local storm water recharge is not increased and supplemental recharge capacity is increased from 29,000 acre-ft/yr to 88,000 acre-ft/yr.

Associated with each alternative are water supply plans and related recharge and replenishment plans. The revised Chino Basin groundwater production plans associated with the baseline and OBMP alternatives in 2020 are shown in Tables 4.5-18a and 4.5-18b. Tables 4.5-19 and 4.5-20 contain the water supply plans for the OBMP and baseline alternatives, respectively. Tables 4.5-21 and 4.5-22 contain the storm water and supplemental water recharge plans for the OBMP Alternative A1 and the baseline alternative, respectively. The recharge estimates shown in Tables 4.5-21 and 4.5-22 are best estimates at this time and could vary plus or minus 50 percent after implementation. All plans are for the year 2020 conditions. Full build out of the agricultural areas is assumed to occur by the year 2020 and represents the foreseeable ultimate water demands for the Chino Basin area.

The water supply plan for the baseline alternative was developed with information supplied by the water supply agencies/companies in the Chino Basin area and was subsequently modified to reflect shortfalls in replenishment capacity and loss of safe yield associated with the baseline plan. For the baseline alternative, Chino Basin groundwater production was reduced due to an anticipated reduction in safe yield of about 40,000 acre-ft/yr. The safe yield will be reduced because the level of groundwater

production in the southern part of the basin, currently produced by agriculture, is assumed to not be maintained under the no OBMP alternative after the land converts to urban uses and groundwater outflow to the Santa Ana River will increase to a level equal to the reduction in agricultural production (i.e., approximately 40,000 acre-ft/yr).

The reduction in safe yield and increased demand for Chino Basin groundwater in the remaining parts of the Basin will create a replenishment obligation greater than the supplemental water replenishment capacity in the Basin. For the baseline alternative, the Chino Basin groundwater production was reduced to a sustainable level of about 116,000 acre-ft/yr under the above assumption. The production reduction was allocated to producers in the overlying non-agricultural and appropriative pools on a pro rata basis based on their production goals for the year 2020. The Chino Basin groundwater production for the OBMP water supply plan is listed in Table 4.5-18a was modified to levels shown in Table 4.5-18b, and it was assumed that the shortfall will be made up with treated imported water. It was not possible to determine if the existing facilities for treatment and distribution of imported supplies have enough capacity to meet a new demand created by the loss of Chino Basin yield and recharge limitations.

Surface Water Quality Impacts in the Santa Ana River

One of the consequences forecast to result from implementing the OBMP is a continued volume of rising water into the Santa Ana River comparable that which currently occurs. This impact forecast is based on the assumption that the whole of the OBMP is implemented, including recharge into the Basin and installation of desalters to continue removing ground water is the lower portion of the Basin that is equivalent to that currently being pumped by the agricultural pool (estimated to be ~40,000 afy). Thus, under the OBMP surface water quality in the Santa Ana River is forecast to remain approximately the same as a result of maintaining a similar or comparable volume of rising water over the long-term.

In comparison to current conditions, groundwater discharge to the Santa Ana River for the baseline (no OBMP) alternative could increase about 40,000 acre-ft/yr. The average TDS and nitrate of this discharge is estimated to be about 1,300 mg/l and 30 mg/l nitrate as nitrogen, respectively, for this rising water. The Regional Water Quality Control Board - Santa Ana Region (Regional Board), has indicated that if this discharge were to occur, that it will require that this groundwater discharge be completely mitigated. This is because the quality of water being discharged would degrade the quality of the Santa Ana River to a level that may exceed the 700 mg/l TDS water quality objective for water being discharged through Prado Dam. The most likely form of mitigation required by the Regional Board under such a circumstance will be the demineralization of recycled water discharged to the River such that TDS and nitrogen concentrations in the River would not be adversely impacted by the increased in rising groundwater discharge. An estimate of the amount of new demineralization capacity that would need to be constructed at recycled water treatment plants that discharge to the Santa Ana River has not yet been calculated.
On the other hand, with the OBMP the groundwater discharge to the Santa Ana River and its tributaries will be either be the same as the current level of about 9,000 acre-ft/yr or reduced from current levels to negligible levels, which could improve surface water quality in the River. This will be accomplished by replacing current agricultural groundwater production with desalter production in the same geographical area. With the OBMP the desalter well fields are proposed to be sited and operated in such a way as to control groundwater discharge to the Santa Ana River and its tributaries.

Figure 4.5-48 shows the location of the Chino Basin relative to the Santa Ana River and the Orange County groundwater basin. Changes in Santa Ana River surface water discharge caused by actions in the Chino Basin including the recharge of recycled water and storm flows will impact the volume of water available for diversion and recharge in the Orange County groundwater basin. The OBMP includes the recharge of up to 40,000 acre-ft/yr of recycled water and 30,000 acre-ft/yr of storm water. The purpose of this recharge is to augment the natural yield of the basin and to replace some of the state project water that has been used for groundwater replenishment pursuant to the Judgment. In the absence of the OBMP, the recycled and storm water proposed for recharge will be discharged to the Santa Ana River. Table 4.5-23 summarizes the projected discharge and TDS impacts for the Santa Ana River below Prado.

Impacts on Beneficial Uses of Surface Water in the Chino Basin

The quality of Santa Ana River (SAR) water is function of the quality and quantity of the various sources of water that contributes to the SAR (RWQCB, 1995). The Santa Ana River Watermaster (Watermaster) has divided the discharge in the SAR into three components consisting of storm flow, base flow and non-tributary flow. Storm flow is discharge caused by direct runoff of precipitation and usually occurs in December through April. With some exceptions, the TDS and TIN of storm flows are generally very low - the exceptions being runoff from agricultural lands.

Base flow consists of rising groundwater and the direct discharge of recycled water to the SAR and its tributaries. The TDS and TIN of rising water is not well characterized, but is significantly higher in concentration than storm water. The TDS and TIN of the recycled water discharges varies among the treatment plants.

Non-tributary flows primarily consist of the direct discharge of imported water to the SAR and its tributaries. The Watermaster also distinguishes other non-tributary flows, such as groundwater that is pumped in the San Bernardino area and discharged to the SAR upstream of Prado and treated groundwater from the Arlington Desalter that is discharged to the SAR upstream of Prado.

The RWQCB has established TDS and TIN objectives for Reaches 2 and 3 of the SAR (Figure 4.5-48). Reach 3 runs from Prado Dam to the Mission Boulevard bridge in Riverside. The TDS and TIN objectives for Reach 3 are 700 mg/l and 10 mg/l, respectively, for base flow measured in the SAR above Prado in August. Non-point surface inflows (storm water and urban nuisance flows) and agricultural surface returns to the SAR are managed by Best Management Practices where appropriate.

The quantity and quality of base flow are most consistent in August (RWQCB, 1995). The RWQCB believes that the dominant source of water during August is recycled water discharged to the SAR. The purpose of the August-only objective is to verify the wasteload allocation and to determine if assimilative capacity exists (RWQCB, 1995). The RWQCB reviews water quality data from OCWD and the USGS, and conducts its own sampling program in the SAR below Prado in August. The RWQCB uses water quality models to develop wasteload allocations for the recycled water dischargers to the SAR. These models do not include storm flows. The volume of storm flows have increased due to urbanization in the SAR watershed upstream of Prado Dam. Urban storm water runoff has been shown by the Chino Basin Watermaster (Wildermuth, 1998) to be very low in TDS and TIN - generally less than 100 mg/l and 1 mg/l, respectively.

Reach 2 runs from 17th Street in Santa Ana upstream to Prado Dam. Surface water discharge from Reach 3 flows into Reach 2. The TDS objective for Reach 2 is 650 mg/l measured in the SAR below Prado - the same location that compliance with the Reach 3 objective is determined. The value of 650 mg/l is also the TDS objective of the Orange County Forebay subbasin in the 1995 Basin Plan. In contrast to Reach 3, the RWQCB computes a five-year moving average of TDS for the SAR below Prado based on Watermaster's annual average estimate of TDS in the total flow (excludes non-tributary discharges and groundwater that is pumped and discharged to the SAR upstream of Prado Dam). The use of this moving average allows the effects of wet and dry years to be smoothed out over the five-year period (RWQCB, 1995). The Basin Plan does not have a TIN objective for Reach 2. The Basin Plan assumes that TIN compliance in Reach 3 is protective of Reach 2.

The TDS objectives for Reaches 2 and 3 are measured at the same physical location - the SAR below Prado dam. The Reach 3 objective uses a portion of the data used to measure compliance for Reach 2 for TDS. The watershed upstream of Prado Dam is rapidly urbanizing and the storm runoff and recycled water discharges to the SAR have increased significantly. The increased use of recycled water upstream of Prado could lead to higher TDS concentrations in the SAR below Prado Dam in the summer. This would occur because the upstream agencies will preferentially reuse their lower TDS recycled water and will continue to discharge their higher TDS recycled water to the SAR It would be speculative to attempt to forecast the effect of such an impact, because over the 20 year planning period (2000-2020), the amount of recycled water discharged is actually forecast to increase, by several thousands of acre-feet due to population growth, even after taking into consideration a full 40,000 acre-feet of recycled water being recharged or otherwise reused in the upper portions of the Basin. When placed in this context, the potential for degradation of surface water quality downstream of Prado Dam is not considered to significant and adverse.

With the no-OBMP alternative, the TDS concentrations below Prado Dam should remain about the same or decrease based on the following assumptions: the increase in and regulation of storm water discharges in the Santa Ana River watershed, discharge limitations at water recycling plants that discharge to the River, and the demineralization of recycled water discharged to the River by Chino Basin recycled water plants. The TIN concentrations below Prado Dam should remain either about the same or improve due to: nitrogen discharge limitations at water recycling plants that discharge to the River, increases in and regulation of storm water discharges in the Santa Ana River watershed, the demineralization of recycled water discharged to the River by Chino Basin recycled water plants, and the de-nitrification capabilities at the Orange County Water District constructed wetlands in the Prado reservoir.

For the OBMP alternative, the TDS concentrations below Prado Dam should remain about the same or decrease due to: the increase in and regulation of storm water discharges in the Santa Ana River watershed, and discharge limitations at water recycling plants that discharge to the River. The TIN concentrations below Prado dam should remain either about the same or improve due to: nitrogen discharge limitations at water recycling plants that discharge to the River, increases in and regulation of storm water discharges in the Santa Ana River watershed, and the de-nitrification capabilities at the Orange County Water District constructed wetlands in the Prado reservoir. While not anticipated, should the with OBMP alternative threaten or cause the TDS and TIN concentrations to increase in the River below Prado and exceed their respective water quality objectives, the TDS and TIN discharge limitations at Chino Basin water recycling plants would have to be lowered to a level that would protect downstream beneficial uses. Thus, under the OBMP alternative and assumptions outlined above, no

significant conflict with the Basin Plan surface water quality objectives is forecast to occur from implementing the proposed project.

A final issue of concern regarding surface water quality is the discharge of recycled water or SPW into stream channels as part of a recharge effort (for example to transport the recycled water from a point of discharge to a basin for recharge. The potential for this impact to occur is low because it would be unwise to discharge recycled water to a channel during storm flows. However, to prevent this potential degradation of storm flows from occurring, a mitigation measure has been incorporated in this PEIR that mandates no recycled water releases to channels that are carrying storm flows. The eliminates the potential for this surface water quality impact to occur.

Implementing Program Elements 3 and 5 is forecast to affect pollutant discharges and potential alterations to surface water quality in the following manner:

1. The installation of three desalters is forecast to disturb a total of approximately 75 acres. As outlined for disturbances associated with monitoring wells, recharge basins and pipelines, construction activities associated with desalter operations have a potential to cause the discharge of pollutants, particularly eroded sediment and accidental releases of petroleum products, and possible degradation of surface water quality. Previously identified mitigation measures for construction activities will also apply to construction of the desalters. With implementation of these measures, no significant surface water quality impacts are forecast to occur.

2. Meeting the replenishment obligations, up to 55,000 afy, can be fulfilled with a mix of local water in storage, direct recharge of water or *in lieu* exchange. Adequate recharge capacity is available to meet this need as outlined in the previous discussion. The potential environmental effects described under Program Element 2 for recharge basin effects on surface water also apply to the proposed replenishment program. No additional surface water quality impacts have been identified from meeting the replenishment obligations for the Chino Basin under the OBMP.

3. As part of the desalter operations, salt removed is concentrated and of 100 percent of the water taken into the desalter, there will be an approximate 15-16 percent rejection rate. Assuming an input of water with 750 mg/l TDS, the concentration in the rejected fluid is estimated to be approximately 5,000 mg/l. This fluid will be discharged to the Santa Ana Regional Interceptor (SARI) line. Assuming 40,000 afy of desalting capacity, an estimated 35,000,000 million gallons of water could be treated on a given day. With a 15 percent rejection rate, the amount of fluid discharged to the SARI line would be about 5.25 million gallons. With approximately 30 MGD disposal capacity, the SARI line is currently transporting approximately 9 MGD. Sufficient capacity exists in the SARI line to accept the volume of rejected fluid from the 40,000 acre-feet of desalinated water. The issue of concern is the accidental spill of this fluid which could adversely impact surface water quality.

   This issue was discussed with IEUA engineers, and information was provided that identifies the local discharge limits to the SARI line. There is no TDS limit, but since the 5,000 mg/l value is so far below sea water, no adverse effect to seawater is forecast to occur rom transporting this fluid to the ocean in an already permitted, and environmentally approved, wastewater disposal system. The discharge limits for the SARI line are shown on Table 4.5-23 (taken from Santa Ana Watershed Project Authority Ordinance No. 3) and these limits are placed on individual permits issued for discharge into the SARI line.

If an accidental release of the fluid in the SARI line occurred in the future, the potential damage would be similar to that when a major interceptor sewer line ruptures and releases wastewater. Ignoring the fact that a gravity flow line like the SARI line would probably pull in the soil around it and possibly plug itself, a major accidental release would require a standard series of steps to correct the problems and impacts: including stopping the discharge; containing the released fluid, providing an alternative by-pass line until the line is repaired; collection of the contaminated material (to the extent feasible); and restoration of areas contaminated by the release. The short-term damage from an accidental release might be significant (note that the SARI line carries discharges other than from the desalters), but the contribution from the desalters should not contain any significant contaminants since is will simply be concentrated salts from the local aquifer in the vicinity of the desalters. With the requirement to restore any areas contaminated by an accidental release from the SARI line (which would be required by the Regional Board), the potential significant surface water quality impacts to the environment, including surface water, would be mitigated to a non-significant level.

Implementing Program Element 4 is forecast to impact pollutant discharges and surface water quality in the following way.

1. Modifying groundwater production for Management Zone 1 (MZ 1) has no potential to adversely impact surface water quality. It may have a potentially beneficial effect. Data indicates that water from adjacent management zones or higher in MZ 1 is of better quality (except a localized nitrate plume) than that in the southern portion of MZ 1. Although the effect may be minor, the recycled water generated from the higher quality (less TDS and nitrate) water would be marginally better as a result of beginning which lower TDS water. Otherwise, no adverse impact can affect these water issues from implementing this component of Program Element 4.

2. Meeting any additional recharge requirements in MZ 1 can occur without any modifications to the physical environment. However, if construction impacts are incurred for construction of new recharge areas within MZ 1, the mitigation measures previously identified for construction activities will ensure that no adverse surface water quality impacts will result from implementing Program Element 4. No potential exists for recharge operations in MZ 1 to adversely impact the surface water environment.

3. Collection of additional data to fill gaps in knowledge about the zone is not forecast to include any activities that will cause discharge of pollutants or adversely affect surface water quality.

Implementing Program Elements 6 and 7 is forecast to affect pollutant discharges and surface water quality in the following way:

1. The process of developing cooperative strategies and plans has no potential to change the physical environment; therefore, no potential exists to cause the discharge of pollutants or to adversely impact surface water quality.

2. Seeking funds to speed up cleanup and restoration of contaminated sites does not, in itself, cause any adverse impacts to the environment. Prior to utilizing funds to conduct cleanup and restoration activities, these activities must complete additional environmental investigations to address issues, such as waste transport effects on local roads; potential public health risks from transporting the contaminated material; proper treatment, disposal or even recycling of the contaminated waste; etc. Since no specific

sites are referenced for speeding the remediation process, it would be speculative to assume that surface water quality impacts would occur from obtaining such grants.

Implementing Program Elements 8 and 9 is forecast to affect pollutant discharges and surface water quality in the following way.

1. The process of developing storage and conjunctive use programs and plans has no potential to change the physical environment; therefore, no potential exists to discharge pollutants or to adversely impact surface water from implementing this component of Program Elements 8 and 9.

2. Collection of additional data to fill gaps in knowledge about the water storage is not forecast to include any activities that will adversely affect discharge of pollutants or degradation of water quality.

3. Attempting to make impact forecasts for an undefined pilot conjunctive use program would be speculative, and the State CEQA Guidelines (Section 15145) indicate that the public be informed of this conclusion and no further evaluation is necessary. Note that a pilot conjunctive use program would be expected to use recharge basins to deliver the water for percolation into the Basin groundwater aquifer, and the surface water quality issues associated with such activities have already been addressed above. Before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

## d. Will the project change the amount of surface water in any water body?

Implementation of Program Element 1 is forecast to affect surface water quantities in the following manner:

1. The process of sampling groundwater and measuring piezometric levels is a relatively passive action that does not pose any substantial adverse impact to the quantity of water present in any water body.

2. Installation and operation of water production monitoring systems has no substantial direct impact to the amount of surface water present in any water body. No adverse impact is forecast to occur as a result of this monitoring activity.

3. Ground level monitoring activities are typically remote or do not have direct impacts on water quantities in surface water bodies. Activities associated with ground level monitoring are not forecast to have any significant effect on the amount of water contained in surface water bodies.
4. Installation of new monitoring wells may create a minor increase in impervious surfaces that could contribute to a very small increase in stormwater runoff to surface water bodies within the Chino Basin, however, this increase will be *de minimus* in nature since the actual impervious surface will only increase by approximately up to 50 acres in a 225,000 acre basin.

Implementation of Program Element 2 is forecast of change the amount of surface water present in any water body in the following manner:

1. The process of modifying or utilizing existing and possibly new recharge basins for recharge purposes has the potential to affect the quantity of surface water in the water body at Prado Reservoir. The

recharge basins will be utilized to recharge approximately 40,000 afy of recycled water that normally would be discharged and reach the Prado Basin area. Last year, approximately 12,000 afy of stormwater was recharged into the Chino Basin. The recharge program identified in the OBMP could potentially recharge up to 30,000 afy in the Chino Basin. This would result in the net diversion of 18,000 afy of recharge from flowing surface water flowing into the Prado Reservoir. The baseflow, based on a 5-year moving average from 1992, through Prado Dam was measured to be around 250,000 to 310,000 afy. The diversion of a maximum total recharge quantity (for recycled water and stormwater elements of the recharge plan) of 58,000 afy would be cause a reduction along the order of one-fifth of the amount of the total base flow. Currently, the flow through Prado Dam is very high, and has to potential to raise water levels to a point that could threaten surrounding riparian areas. In a comment letter included in the FEIR for Regional Plant 5 from the U.S. Fish and Wildlife Service, it was reported that flows exceeded the maximum conservation pool limit of 505' (established in an April 1995 Cooperative Agreement involving the Army Corps of Engineers (COE)) for 7 days in 1995. Historically, the conservation pool level has been rising over the years since 1991. The conservation pool elevation limit (with appropriate mitigation measures for riparian habitat impacts) was increased from 494' in 1988 to 498' in 1995. In a later MOA between the COE and OCWD, the permanent water conservation pool was mitigated and increased to elevation 505 feet. The relocation of discharge and stormwater would have a beneficial impact on the future attempt to maintain water at or below this elevation. No adverse impact is forecast to occur as a result of the recharge program proposed under the OBMP.

2. The construction of diversion and turnout structures themselves do not have any direct impact on the water quantity in any water body; however, their operation will result in the delivery of recharge and stormwater, discussed above, to various basins throughout the project area. This relocation of water would theoretically decrease the amount of water that reaches Prado Dam; however, the as recharge water supplies are diverted, wastewater flow volumes will also be increasing, so the change in water volume due to recharge projects in the Chino Basin is not forecast to cause any significant adverse impact. Further, as water levels near Prado Dam have been relatively high of late, and could potentially adversely impact riparian areas should they continue to rise, the proposed project may have a beneficial effect on the circumstances at Prado Basin.

The shift of 40,000 acre-ft/year of recycled water from discharge to recharge will be occurring gradually over the course of the OBMP timeframe. As this water is being diverted, wastewater flows will be increasing to the Prado Basin area. The following analysis provides data for both current and 2020 projected wastewater volumes. The Los Angeles County Sanitation district predicts an increase in wastewater discharge for the cities of Pomona and Upland from 22,000 to 30,000 acre-ft/year. The IEUA service area generation of wastewater flow will increase from 57,000 acre-ft/year to 112,000 acre-ft/year. Project areas within Riverside County are forecast to have increased wastewater generation by 5,000 acre-ft/year, an increase from 10,000 acre-ft/year to 15,000 acre-ft/year. In total, wastewater will increase, regardless of the proposed OBMP project, by approximately 68,000 acre-ft/year. Consequently, even with the diversion of 40,000 acre-ft/year of wastewater flows, there will still be a net increase in flows to Prado Dam, potentially on the order of 28,000 acre-ft/year (the relative amount will ultimately depend on the amount of direct beneficial use by industrial and irrigation users in the future). This ultimate increase of 28,000 is less than that which would otherwise occur by 40,000 acre-feet, however, the increase that will occur regardless of OBMP implementation can be partially offset and have a beneficial impact on riparian resources to help maintain water levels closer to existing water levels.

3. The construction of new basins for recharge purposes and the installation of diversion or turnout structures for water delivery to the basins will have the same types of effects as described under this program element in the previous two numbered analysis paragraphs.

4. The construction of pipelines and other related facilities may indirectly relate to surface water body quantities of water as pipelines facilitate transportation of water from one discharge location to another, however, the pipelines themselves are not the direct goal for water relocation. The true objective of the recharge program is outlined under the recharge basin impact evaluation discussed above, and pipelines are merely a component of this program. No significant adverse environmental effects are forecast to occur related to surface water bodies in conjunction with pipeline installation and operation.

5. The recharge of State Project Water (SPW) in the recharge basins will not affect the amount of water present in any local water bodies, and the environmental impacts of the source water supplies for the SPW have already been evaluated for CEQA compliance. OBMP use of SPW will not cause any additional adverse environmental impacts to the amount of surface water in any water body.

Program Elements 3 and 5 are forecast to affect surface water quantities in area water bodies in the following manner:

1. The implementation of desalters in the southern portion of the basin will effectively reduce or stop loss of safe yield capacity as rising groundwater to the Santa Ana River. According to an April 22, 2000 memorandum from Mark Wildermuth to Traci Stewart of Watermaster, "the groundwater discharge to the Santa Ana River and its tributaries will either be the same as the current level of about 9,000 afy or reduced from current levels to negligible levels. This will be accomplished by replacing current agricultural groundwater production with desalter production in the same geographical area. With the OBMP, the desalter well fields will be sited and operated in such a way as to control groundwater discharge to the Santa Ana River and its tributaries." Further, "In comparison to current conditions, groundwater discharge to the Santa Ana River for the baseline alternative will increase about 40,000 afy. The average TDS and nitrate of this discharge is estimated to be about 1300 mg/l and 30 mg/l nitrate nitrogen, respectively. The implementation of the OBMP will thus have the beneficial impact of potentially reducing poor-quality groundwater outflows from discharging into the Santa Ana River in the future.

2. The pipelines and desalter facilities themselves will not have any potential impacts related to surface water body volumes. The pumps that are installed for the desalters will result in the decrease in groundwater outflow as described in the previous paragraph, causing a beneficial impact to decrease poor-quality outflows from discharging into the Santa Ana River. This hydraulic control is a beneficial impact of implementing the OBMP versus the No Project Alternative.

Implementing Program Element 4 is forecast to impact surface water quantities in the following way.

1. Modifying groundwater production for Management Zone 1 (MZ 1) has no potential to alter the quantity of surface water in any water body. Therefore, no adverse impact can affect this water issue from implementing this component of Program Element 4.

2. Meeting any additional recharge requirements in MZ 1 can occur without any modifications to the physical environment. No potential exists for recharge operations in MZ 1 to adversely impact the surface water environment.

3. Collection of additional data to fill gaps in knowledge about the zone is not forecast to include any activities that will cause a change in the volume of water in any water body.

Implementation of Program Elements 6 and 7 have the potential to affect surface water body quantities of water in the following manner:

1. The implementation of Cooperative Programs with the Regional Board and other agencies to improve Basin Management is primarily an administrative activity focused on identification and remediation action planning for site-specific contamination plumes in the Basin. These clean-up activities and plans would only benefit the basin, and should not have any impacts on the quantity of water in any surface water body. No adverse effects are forecast to occur for this issue.

2. The development and implementation of a Salt Management Program involves the creation of a salt budget for the Basin. Under the OBMP alternative implementation, the groundwater outflow through the southern portion of the basin either would remain constant or decrease below the current loss of approximately 9,000 afy. This is considered to be a beneficial impact. If the OBMP was not implemented and the desalters (facilities for salt balance mitigation) were never constructed, up to 40,000 afy of poor quality water could be discharged into the Santa Ana River. Thus, beneficial, not adverse, impacts are forecast to occur from implementation of a salt management program that would utilize desalters.

Implementation of Program Elements 8 and 9 have the potential to affect surface water body quantities of water in the following manner:

1. Program Element 8 is primarily ministerial in nature. Thus, for this issue of analysis, no environment-altering activities are proposed under this element. No adverse environmental impacts are forecast to occur.

2. Program Element 9 involves a conjunctive use program for recharging, storing, pumping and transporting water throughout the Basin. This program element is not yet well enough defined that the environmental impacts can be reviewed at a non-speculative level. At this time, forecasting detailed impacts regarding such a conjunctive use program would only be speculative, thus before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

No mitigation is required for this issue since there are no significant environmental impacts resulting from substantial changes in the amount of surface water in any water body.

### e. Will the project cause change in currents, or the course or direction of surface water movements?

Implementing Program Element 1 has the potential to change currents or the course or direction of surface water movements in the following way:

1. The process of sampling groundwater levels and quality at existing and future wells and extensometers is not forecast to change surface water currents, or the course or direction of surface water movements. No adverse impacts to these water issues are forecast to occur from implementing groundwater level and quality monitoring, either directly or indirectly.

2. Installation and operation of water production monitoring systems on existing and future wells is not forecast to cause any change in circumstances regarding surface water movement. No adverse impacts are forecast to occur with relation to this issue.

3. The action of obtaining surface water discharge and quality data depends upon sampling within existing stream channels. According to SBCFCD, many sites for measuring flows within each major stream channel are already in place as part of the County Flood Control monitoring programs (personal communication with Randy Forbey, SBCFCD, May 4, 2000). When existing flow measuring stations do not exist, but are necessary to fulfill monitoring goals, they will be installed by Watermaster or by other contributing entities. Locations for measuring flows within each major stream channel are assumed to be in place as a result of County Flood Control monitoring programs. In any case, stream runoff volume and water quality sampling is a passive activity that has no potential to cause changes in surface water currents, or the course or direction of surface water movements, either directly or indirectly.

4. The impact of installing up to 12 extensometers on less than 6 acres of land will have a ***de minimus*** impact on impervious surface area within the Basin. No adverse impacts from surface runoff, either direct or indirect, are forecast.

5. The installation of monitoring wells will create ground disturbances and entail drilling activities which are not anticipated to affect surface water currents or the course or direction of surface water movements, either directly or indirectly.

Implementation of Program Element 2 is forecast to affect surface water movements in the following manner:

1. The process of modifying existing recharge basins for stormwater recharge under the OBMP will entail enhancement of these basins by creating new diversion works and turnout structures to allow for redirection of stormwater flows from flood control channels into the recharge basins. For example, along San Sevaine Creek, diversion facilities already exist to direct flows into the Jurupa Basin. The OBMP planners have indicated that economics may justify collecting high quality stormwater flows in the lower portion of the basin and pumping them to the upper subbasins for recharge. The diversion facilities will involve the use of pipelines to accomplish the redirection of flows. Direction of surfaces flows will thus be altered, but this will not have a significant adverse impact, since the relative amount of surface water reaching Prado Dam will not change significantly due to increases in wastewater flows. In each instance where storm flows are diverted to basins for recharge (up to 30,000 acre-feet), the current, in terms of volume and perhaps velocity, will be reduced. This reduction serves to augment flood control activities and downstream impacts from such diversion are considered beneficial for flood control purposes and by reducing the volume of water stored behind Prado Dam, the riparian habitat will also benefit.

Implementation of Program Elements 3 and 5 have the potential to affect currents or the course or direction of surface water movements in the following way:

1. Other than to potentially create additional impervious surfaces due to desalter, well and extensometer installation (as previously discussed under Program Element 1) the development and implementation of a water supply plan for the impaired area of the Basin, and the development and implementation of a regional supplemental water program for the Basin do not have any potential to adversely impact surface water movements.

2. To meet the replenishment obligations, up to 55,000 afy, a mix of local water in storage, direct recharge of water or ***in lieu*** exchange is forecasted to occur. Adequate recharge capacity is available to meet this need and includes the basin enhancement as outlined in the previous discussion. No adverse impacts, either direct or indirect are forecast.

Program Element 4 has the potential to impact surface water movements in the following manner:

1. This particular program element deals with potential shifting production from Management Zone 1 to Zones 2 and/or 3 to meet future water supply demands, or will require additional planned recharge beyond the recharge plan discussed in Program Elements 3 and 5, or the use of desalter and/or supplemental water to meet obligations in this area. There is no potential impacts to surface water movement by shifting production between Management Zones. Transfers will be conducted by way of underground pipelines and will not impact surface water currents or the direction of flows. No adverse impacts, either direct or indirect are forecast.

Program Elements 6 and 7 have the potential to impact currents, or the course or direction of surface water movement in the following manner:

1. The process of developing cooperative strategies and plans has no potential to change the physical environment; therefore, no potential effects to currents or the physical direction of surface water flows is forecast to result from implementing this component of Program Elements 6 and 7.

2. Meeting any additional recharge requirements in MZ 1 can occur without any modifications to the physical environment. No potential exists for recharge operations in MZ 1 to adversely impact the environment.

3. Seeking funds to speed up cleanup and restoration of contaminated sites does not, in itself, cause any adverse impacts to the environment. Prior to utilizing funds to conduct cleanup and restoration activities, these activities must completed additional environmental investigations to address issues, such as waste transport effects on local roads; potential public health risks from transporting the contaminated material; proper treatment, disposal or even recycling of the contaminated waste; etc.

Program Elements 8 and 9 have the potential to impact surface water movement in the following manner:

1. The development of programs for storage management and conjunctive use have little potential in themselves of causing any adverse environmental effects. These program elements, as with Program

Elements 6 and 7, are mainly ministerial in nature. Impacts related to this issue are forecast to be less than significant.

2. Collection of additional data to fill gaps in knowledge about the water storage is not forecast to include any activities that will affect changes in currents, or the course or direction of surface water movements.

3. The implementation of a conjunctive use program as part of Program Element 9 is only generally defined at this point in time. In the future, Watermaster will better outline the details and exact physical actions necessary to implement a comprehensive recharge, storage and extraction plan for volumes of water up to 500,000 afy in a basin-wide, and potentially regional, conjunctive use program. At this time, forecasting detailed impacts regarding such a conjunctive use program would only be speculative, thus before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

### f. Will the project cause the change in the quantity of groundwater, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations, or through substantial loss of groundwater recharge capability?

Implementation of Program Element 1 has the potential to affect groundwater quantities in the following manner:

1. The construction and use of monitoring wells (to measure groundwater levels) and extensometers will not adversely impact the quantity of groundwater available in the basin. Although these facilities will result in the interception of the groundwater aquifer, the well and extensometers themselves are passive monitoring devices that will cause no substantial impact to the volume of water in the aquifer. Impacts are forecast to be less than significant for this issue.

2. Again, the installation of production monitoring devices and the activity of monitoring ground surface levels are both passive activities that will not have any substantial affect on groundwater quantities within the Basin.

Implementation of Program Element 2 has the potential to impact groundwater quantities in the following manner:

1. The recharge program that is a component of the OBMP has the potential to increase the quantity of water available for production in the basin. The safe yield prior to new recharge for the Basin is assumed to be 140,000 afy. The recharge program being analyzed in this document proposes to recharge a range of 63,000 to 88,000 afy (Memorandum from Mark Wildermuth to Traci Stewart, April 22, 1999). It is anticipated that this quantity is necessary in order to meet replenishment obligations, given the ability to recharge SPW and stormwater every 7 out of 10 years. In a one year period, the quantity of groundwater recharged into the basin due to the OBMP may increase the quantity of water in the Basin by a maximum of 88,000 afy. This recharge plan assumes that most of the recharge will occur above the Interstate-10 Freeway and that this water will be recaptured (i.e. pumped) before it has the ability to flow out the southern portion of the basin as rising groundwater into the Santa Ana River. The desalters that are also part of the OBMP will act as a hydraulic control mechanism to prevent the outflows of this recharged water from the basin. The 88,000 afy is the ultimate goal of the OBMP for recharge, however, pumping will also have increased by the time this goal is reached, so there will be no

additional outflows from the basin resulting from the recharge program. The general effect that is forecast to occur will be a beneficial increase in the safe yield quantity from the additional recharge of up to 88,000 afy.

2. The recharge basins, turnouts and pipelines are all the means by which to accomplish the recharge program, however the construction of the recharge facilities themselves has no potential to change groundwater quantities since the aquifer will not be encountered directly through any cuts or excavations during construction/operation of the recharge facilities.

Program Elements 3 and 5 have the potential to affect groundwater quantities in the following manner:

1. The development and implementation of a water supply plan for the impaired area of the basin involves the potential construction and operation of up to three desalter facilities in the southern (impaired) portion of the basin. The desalters will be synchronized to come online as agricultural production in the southern portion of the basin declines due to increasing urbanization of these areas. Agricultural production is expected to decrease by approximately 40,000 afy by 2020, and the desalters are phased to coincide with a proportional increase in their production by 40,000 afy in the year 2020. As a result of this water supply plan, the safe yield will be maintained and there is no net impact to groundwater quantities associated with this element of the water supply plan.

2. Although recharge within the basin may initially appear to cause an increase in the groundwater quantity, in fact the quantity will actually remain virtually the same since production will be increasing commensurately with increased recharge. No adverse impacts to groundwater quantity are forecast to occur under implementation of the OBMP. In fact, impacts to the basin safe-yield under the OBMP are only beneficial. If the OBMP is not implemented, there could be a substantial adverse change in the safe-yield of the basin by approximately 58,000 afy (40,000 afy of agricultural production loss plus loss of an additional 18,000 afy of stormwater recharge).

Implementation of Program Element 4 had the potential to affect groundwater quantities in the following manner:

1. This program element proposes that a comprehensive groundwater management plan be developed and implemented under the OBMP. Pumping may be shifted from one management zone to another management zone, or SPW may be used instead of pumping, or additional recharge may occur in Management Zone 1. None of these options, however, will directly cause a change in the safe-yield value for the whole Basin. These are primarily just different water accounting practices with no substantial ability to impact the total groundwater quantity in the basin. Thus, no impact to groundwater quantities is forecast to occur due to implementation of this Program Element. Only voluntary reductions in pumping, combined with recharge in excess of required replenishment in the area would cause an increase in groundwater quantities for this area. The purpose of the OBMP is to basically maintain the status quo for groundwater quantities within the Chino Basin over an extended period of time. If no OBMP alternative is implemented, there could be significant adverse impacts associated with the safe-yield loss, however the OBMP is firmly committed to maintaining or increasing Basin safe-yield. No adverse environmental impacts are forecast to occur for groundwater quantity is Program Element 4 is implemented.

Implementation of Program Elements 6 and 7 has the potential to affect groundwater quantities in the following manner:

1. Program Element 6 is primarily administrative in function to facilitate cooperative efforts with other jurisdictional agencies in the area. Such projects are not yet defined but focus primarily on Basin clean up operations and on maintaining or improving groundwater quality and quantity. Most actions associated with this element are passive in nature and do not have any adverse environmental impacts that can be forecast at this time. Future activities that may be implemented under this element may require additional environmental evaluation if there are any potential physical changes in the environment that may result.

2. Program Element 7 deals primarily with the development of a detailed salt budget and management program. Monitoring programs associated with this element have no substantial potential to adversely impact groundwater quantities. Salt management activities may include operation of the desalters, and this would have a beneficial impact on the salt budget of the basin since salt would be exported from the Basin via brine discharge to the SARI line. The impacts associated with the desalter have already been discussed under the analysis of impacts for Program Elements 3 and 5 in this section.

Program Elements 8 and 9 have the potential to affect groundwater quantities in the following manner:

1. The groundwater storage management program has the potential to slightly increase (relative to historic practices) groundwater quantities over the long-term as it proposes to assess approximately a three percent loss to storage accounts that do not produce their stored quantities within a certain time frame. In the past, this increment was not included in Watermaster accounting practices, and some of the water was lost as it migrated south, and flowed out of the Basin. In the future, as this loss is accounted for in new storage practices, these losses will not continue, and the basin will not be overproduced by the amount equal to storage losses that leave the basin. This will not cause an overall increase in safe-yield, rather it will help to better maintain the existing safe-yield and prevent overdraft. There are no adverse groundwater quantity-related impacts associated with implementation of Program Element 8.

2. Evaluated at a very general level, Program Element 9 has a vast potential to impact groundwater quantities in the Basin. A large conjunctive use program would substantially increase water levels and total volumes of groundwater within the Basin. This program is only roughly defined at this point in time. The program which could possibly increase storage up to a total quantity of 500,000 afy (a net addition of 300,000 afy on top of approximately 200,000 afy which is currently in storage already). More detailed impact evaluation is necessary before such a conjunctive use plan is implemented. General impacts related to this issue may include an increase in groundwater quantities in the basin may cause adverse water quality and potentially liquefaction impacts if the vadose zone within the Basin is intercepted. In the future, Watermaster will better outline the details and exact physical actions necessary to implement a comprehensive recharge, storage, and extraction plan for volumes of water up to 500,000 afy in a basin-wide, and potentially regional, conjunctive use program. At this time, forecasting detailed impacts regarding such a conjunctive use program would only be speculative, thus before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

## g. Will the project alter the direction or rate of flow of groundwater?

Groundwater level changes caused by implementation of the OBMP were estimated with Watermaster's groundwater modeling tool that Watermaster has named *Rapid Assessment Model* (RAM). The RAM tool uses the *Modular Three-Dimensional Finite-Difference Flow Model* developed by the USGS. The current RAM tool implementation is a steady state model that was initially developed in 1998 with subsequent revisions to address specific questions by Watermaster. Figure 4.5-49 illustrates the estimated groundwater elevation in the Chino Basin for 1997 and represents current conditions. The current conditions map is based on observed groundwater levels. RAM modeling for water level impact forecasting was conducted as part of the analysis process for this PEIR by Wildermuth Environmental. Figures 4.5-50 through 4.5-51 are RAM tool projections of the groundwater elevations at ultimate equilibrium for the baseline, and in 2020 for the OBMP alternatives. Figures 4.5-52 through 4.5-53 show the differences in groundwater elevation between current and ultimate conditions for the baseline, and current and 2020 conditions for the OBMP alternatives, respectively. Figure 4.5-54 shows the projected difference in groundwater elevations in the year 2020 between the ultimate baseline and 2020 OBMP alternative conditions.

In comparison to current groundwater elevations, groundwater elevations at ultimate conditions for the baseline alternative are higher in the southern part of the basin due to the elimination of agricultural production in the agricultural areas of the southern Chino Basin and due to reduced groundwater production throughout the rest of the basin. In fact, groundwater levels approach the ground surface near the Santa Ana River (Figure 4.5-50).

In comparison to current groundwater elevations, groundwater elevations for the OBMP alternative in the southern part of the basin are similar to current conditions because production in the southern part of the basin is similar to current production levels and the basin is assumed to be operated in a safe yield mode with a safe yield equal to the current estimate of safe yield of 140,000 acre-ft/yr. For the OBMP alternative, groundwater levels are higher in the northern parts of the basin in the vicinity of recharge facilities due to the increased recharge that occurs in the OBMP alternative. The general groundwater gradient from the north to the south is slightly steeper than current conditions and baseline 2020 conditions. Groundwater velocities are slightly higher than the baseline alternative in the area between the recharge areas in the north and the OBMP desalter well fields in the southern Chino Basin.

Implementing Program Element 1 has the potential to alter the direction or rate of flow of ground water in the following way:

1. The process of sampling groundwater levels and groundwater quality at existing and future wells and extensometers is not forecast to change the direction or rate of flow of groundwater currents. No adverse impacts to these water issues are forecast to occur from implementing groundwater level and quality monitoring, either directly or indirectly.

2. Installation and operation of water production monitoring systems on existing and future wells in not forecast to cause any change in circumstances regarding groundwater rate flows or movement. No adverse impacts are forecast to occur with relation to this issue.

3. The action of obtaining surface water discharge and quality data depends upon sampling within existing stream channels. Locations for measuring flows within each major stream channel are assumed to be in place as a result of County Flood Control monitoring programs. In any case, stream runoff volume and water quality sampling is a passive activity that has no potential to cause changes in the direction or rate of flow of groundwater, either directly or indirectly.

4. Ground level monitoring is conducted by indirect (including remote sensing) methods that do not require any changes in the physical environment which could result in changes of groundwater directions or rates of flow. No adverse impacts, either direct or indirect are forecast.

5. The installation of monitoring wells will create no substantial impacts to groundwater flows.

Implementation of Program Element 2 is forecast to affect groundwater direction and/or the rate of flow in the following manner:

1. The recharge of up to 88,000 afy of water from various sources in the northern portion of the basin, combined with desalter-related pumping in the southern portion of the basin, will cause an increase in the hydraulic gradient in the basin. Consequently, groundwater velocities may increase slightly above what they are currently.

Implementation of Program Elements 3 and 5 have the potential to affect the direction and rate of flows of groundwater in the following way:

1. The development and implementation of a water supply plan for the impaired area of the Basin, and the development and implementation of a regional supplemental water program for the Basin do not have any potential to adversely impact groundwater rates or direction of flows. If any impact occurs, it is anticipated to be beneficial, due to supplemental water program beneficial effects on subsidence (achieved either through desalters, increased recharge (both spreading and injection), and possible decreases in localized production.

2. The installation and operation of the wells to support desalters will result in a substantial quantity of water being pulled out of the lower portion of the Basin. This pumping is intended to replace agricultural production that will transition to urban land use in the future. While the quantity of water produced may be unchanged, the pumping will be occurring in a concentrated location , and thus has the potential to impact groundwater flow patterns in this area. The changes in groundwater flow patterns are not considered significant unless contaminant plumes are mobilized which could reduce the area and amount of groundwater available for future production. This is shown no to be the case in Figure 4.5-55. There is no significant difference in mobilization of plumes between the OBMP and Baseline Alternatives. For other impacts related to desalter well fields, see discussions in Chapter 4, Subchapter 4.5 of this document. For those issues, mitigation measures were provided to reduce such impacts to a less than significant level. Further, localized impacts to groundwater levels and to subsidence areas in the vicinity of the desalter well fields will require further studies to ensure that impacts are reduced to a less than significant level. Mitigation measures in the form of performance standards to mitigate for

possible water level decline and potential subsidence impacts are provided below. These measures will reduce impacts to less than significant levels.

3. To meet the replenishment obligations, up to 55,000 afy, a mix of local water in storage, direct recharge of water or *in lieu* exchange is forecasted to occur. Adequate recharge capacity will be made available to meet this need under the OBMP, and includes the basin enhancements as outlined in the previous discussion. No adverse impacts, either direct or indirect are forecast.

Program Element 4 has the potential to alter the direction or rate of flow of groundwater in the following manner:

1. Modifying groundwater production for Management Zone 1 (MZ 1) has the potential to impact groundwater flow rates within this management zone, however this would have a beneficial impact on the area by allowing water to replenish localized areas that are possibly overdrafted, which in turn would have a beneficial impact on the subsidence zone in the City of Chino. Similarly, greater recharge in areas tributary to the subsidence zone could have a beneficial impact on the current circumstances in the Chino area.

2. Groundwater flow rates, due to a possible implementation of additional recharge in MZ 1 may slightly increase as a result of project implementation, but no significant adverse impacts are forecasted to occur, and mitigation and monitoring measures are provided below to ensure plume mobilization impacts remain less than significant.

3. Collection of additional data to fill gaps in knowledge about the zone is not forecast to include any activities that will affect the direction or the rates of flow of groundwater.

Program Elements 6 and 7 have the potential to impact the direction or the rate of flow of groundwater in the following manner:

1. The process of developing cooperative strategies and plans has no potential to change the physical environment; therefore, no potential effects to groundwater direction or rates of flow is forecast to result from implementing this component of Program Elements 6 and 7.

2. Meeting any additional recharge requirements in MZ 1 can occur without any modifications to the physical environment. No potential exists for recharge operations in MZ 1 to adversely impact the groundwater flow rates in this zone.

3. Seeking funds to speed up cleanup and restoration of contaminated sites does not, in itself, cause any adverse impacts to the environment. Prior to utilizing funds to conduct cleanup and restoration activities, these activities must complete additional environmental investigations to address issues, such as waste transport effects on local roads; potential public health risks from transporting the contaminated material; proper treatment, disposal or even recycling of the contaminated waste; etc. These activities are already under the jurisdiction of the RWQCB, and thus no additional mitigation is required since the OBMP will comply with the already established rules and regulations of the RWQCB regarding any cooperative clean-up efforts that may be under-taken as part of the OBMP.

Program Elements 8 and 9 have the potential to alter the direction or rate of flows of groundwater in the following manner:

1. The development of programs for storage management accounting practices has little potential of causing any adverse environmental effects. Impacts related to this issue are forecast to be less than significant.

2. Collection of additional data to fill gaps in knowledge about the water storage is not forecast to include any activities that will affect changes in groundwater direction and rates of flow.

3. The implementation of a conjunctive use program as part of Program Element 9 is only generally defined at this point in time. In the future, Watermaster will better outline the details and exact physical actions necessary to implement a comprehensive recharge, storage and extraction plan for volumes of water up to 500,000 afy in a basin-wide, and potentially regional, conjunctive use program. At this time, forecasting detailed impacts regarding such a conjunctive use program would only be speculative, thus before a conjunctive use program is implemented, further detailed environmental evaluation will be necessary. A comparative evaluation with a conjunctive use program is provided in the alternative section.

## h. Will the project have an impact on groundwater quality?

Implementing Program Element 1 may result in the following activities that could have an adverse impact on groundwater quality:

1. The process of sampling groundwater levels and quality at existing and future wells is not forecast to generate any discharges of pollutants or cause any alterations to groundwater quality. No adverse impacts to groundwater quality is forecast to occur from implementing groundwater level and quality monitoring, either directly or indirectly.
2. Installation and operation of water production monitoring systems on existing and future wells is not forecast to cause the discharge of any pollutants that could degrade groundwater quality. It is assumed that any electrical connections will be installed along existing access routes to wells or that remote sending devices will be utilized that do not require direct electrical connections. Therefore, the gathering of the water production data can be conducted without causing any potential for adverse impacts to groundwater quality.

3. Obtaining surface water discharge and quality data depends upon sampling within existing stream channels. According to SBCFCD, many sites for measuring flows within each major stream channel are already in place as part of the County Flood Control monitoring programs (personal communication with Randy Forbey, SBCFCD, May 4, 2000). When existing flow measuring stations do not exist, but are necessary to fulfill monitoring goals, they will be installed by Watermaster or by other contributing entities. In any case, stream runoff volume and water quality sampling is a passive activity that has no potential to cause discharges of pollutants that could degrade groundwater quality.

4. Ground level monitoring is conducted by both direct and indirect (including remote sensing) methods that do not require any changes in the physical environment which could generate pollutant and cause degradation of groundwater quality. Only during extensometer installation might there be temporary

construction impacts, however these impacts are considered to be less than significant if the project is implemented so as to conform with the mitigation measures set forth in this PEIR.

5. Installing monitoring wells will create ground disturbances and entail drilling activities which can result in release of pollutants. The measures identified to control potential surface water pollution (BMPs, minimizing accidental releases of pollutants, etc.) are also protective of groundwater quality because the prevent the transport and percolation of pollutants into the Chino Basin groundwater aquifers. Although chemicals that could pollute a well are not normally utilized in modern well drilling operations, a potential exists for the drilling fluids to contain potential pollutants that could degrade groundwater quality. To prevent degradation of groundwater from happening, mitigation measures will be implemented as outlined below. These measures will require approval of all chemicals used in drilling fluids by the agency installing the wells prior to initiation of drilling. Also, the driller will be required to provide a performance bond to ensure that any contamination of the aquifer at a well location can be returned to natural background concentrations of chemical constituents before a well is brought on line for either monitoring or production.

6. In addition to well drilling activities, the process of abandoning wells under Program Element 1 can result in the identification of residual contamination in the well bore or in the adjacent groundwater. The discovery of such contamination is a passive discovery on the part of those implementing well closures, but to ensure that greater impacts do not affect the Chino Basin aquifer, the Watermaster will fully characterize the extent of contamination and identify the severity of the contamination (termed a water quality anomaly in the OBMP). Based on this assessment, Watermaster will notify the appropriate authorities and/or entity responsible or the well and monitor the clean-up of contamination. The goal here is to ensure that groundwater quality is not allowed to further degrade once contamination is identified in the well abandonment process. Mitigation is identified below to ensure that this measure is implemented and groundwater quality is protected to the extent feasible.

Implementing Program Element 2 may result in the following discharges that could cause degradation of groundwater quality:

1. The process of modifying existing recharge basins and constructing new recharge basins (including diversion facilities) to recharge water under the OBMP will entail construction activities that have been previously addressed. No additional evaluation is required to address the effects of construction and ensure that groundwater quality will be protected by the mitigation measures to ensure that surface water quality is not significantly degraded.

2. The issue of recharging substantial additional volumes of water to the Chino Basin is a key component of the OBMP. Recharge to the Chino Basin aquifer is integral to maintaining the safe yield of the Basin (as discussed below), but it also has potential direct and indirect consequences on groundwater quality that is a major concern, particularly in relation to meeting the Regional Board's Basin Plan beneficial uses and water quality objectives and Department of Health Services (DHS). The following is an extended discussion of the issues outlined under the Program Element 2 summary discussion in the introduction to Subchapter 4.5.3. This material is adapted from the OBMP and additional information provided by Mark Wildermuth of Wildermuth Environmental, Inc., the Chino Basin Watermaster's hydrological engineering consultant. Planning assumptions were summarized under Subchapter 4.5.3.c

and these assumptions will be considered along with the proposed activities summarized above for Program Element 2.

The recharge of storm water into the Chino Basin is not forecast to cause any adverse effects within any subbasin in which it may occur. Storm flows have been measured as having a TDS of approximately 100 mg/l, and therefore recharge of up to 30,000 acre-feet (compared to the current 12,000 acre-feet) of storm water within any subbasin will have a beneficial groundwater quality impact. Note, however, that recharge of storm water in the lower subbasin could have the adverse impact of contaminating the storm flows sufficiently to lose its value as potable water; therefore, all stormwater recharge, including stormwater generated within the lower subbasin, will be carried out in the two upper subbasins.

The recharge of State Project Water (SPW) is slightly more problematic. SPW varies in quality, and has ranged between the lower 200 mg/l to about 420 mg/l. The Chino Basin already has a salt imbalance which is part of the rationale for preparing and implementing the OBMP. Even though SPW is considered throughout the State as a natural source of water for recharge and use as potable water (or direct reuse after treatment), SPW delivered with concentrations above 330 mg/l will add salt to the Chino Basin, particularly if recharged in the upper subbasin where groundwater quality (TDS) is better than 330 mg/l. The net effect of recharging SPW of greater than 330 mg/l will be to degrade groundwater quality in the two upper subbasins, and as noted above, recharging up to 62,500 acre-feet of SPW in the lower subbasin would be tantamount to losing the SPW as a source of domestic water supply.

Recharge with SPW is a complex problem because in many instances the water quality of SPW is sufficient to not cause degradation. In order to ensure that imported SPW does not cause significant groundwater quality degradation or substantially increase the salt balance, the Watermaster will ensure that recharge with SPW does not degrade groundwater beyond the Basin Plan TDS or nitrate water quality objective (note that SPW has very low nitrate concentrations and its recharge would generally improve nitrate groundwater quality, not degrade it). Mitigation is established to require this measure be implemented.

A portion of the 88,000 afy of recharge may be comprised by up to 40,000 afy of recycled water. Under the 1995 Santa Regional Water Quality Control Plan (Basin Plan), the Chino Subbasins are defined as having no additional assimilative capacity for salts. What this means is that without mitigation, no recharge of water with TDS and nitrate (as nitrogen) concentrations above the Basin Plan objectives can occur. The recharge of approximately 40,000 afy of recycled water with an estimated TDS concentration of approximately 420 mg/l of salt. This equates to a total input of 22,269 tons of salt per year. Note, however, that in a letter from the Regional Board dated November 27, 1996, the Board has indicated that water with TDS values up to 470 mg/l can be recharged in the upper subbasin recognizing some assimilative capacity. Also, in the lower subbasin, there appears to be some assimilative capacity as a result of discharging recycled water with TDS concentrations about 300 mg/l below the Basin Plan objective (420 mg/l vs. 740 mg/l). Please note that in comment 9-18 made on the DEIR by the RWQCB, based on their opinion, there does not appear to be assimilative capacity in Subbasin III at this time. Further it should be noted that waste discharge requirements must be obtained from the RWQCB, and that any discharge of recycled water into a stream or channel carrying storm or other flows will be required to obtain the appropriate permit(s) from the RWQCB.

If the 40,000 afy had the Basin Plan TDS objective concentration of 220 mg/l, there would be a net addition of 10,137 tons of salt per year. The input of recycled water into the basin would cause a net increase over the Basin Plan objective of 12,132 tons. This would be the only potential adverse impact associated with an increase in the groundwater quantity due to recycled water recharge. This impact can be mitigated to a less than significant level with desalters in the southern portion of the basin. The installation and operation of desalters in the lower portion of the basin would provide adequate mitigation to offset the additional salt input into the basin through recycled water recharge. By the year 2020 the three desalters will remove 56,297 tons of salt per year (Alternative 6A--RO only) or 43,698 (Alternative 6B–RO/IX), which is more than enough to mitigative capacity to compensate for the salt loading associated with either recycled water or state project water. See Table 3 attachment to comments and responses to comments. Further, it should be noted that in comment letter number 9 by the RWQCB (Section 9-18) a recently completed TIN/TDS report indicates that TDS concentrations of 249 mg/L in this region exceed the Basin Plan objective of 220 mg/L. Consequently, it should be noted that it is the opinion of the Regional Board that there is no longer any recognized assimilative capacity in Chino Subbasin I.

Regarding salt balance, extensive discussions have been carried out regarding the effect of not only recharge with SPW but overall salt balance in the Basin. The following impact forecast has been developed regarding the overall hydrologic and salt budget of the Basin.

Tables 4.5-24 and 4.5-25 compare the hydrologic and salt budget for the Chino Basin for the baseline and OBMP alternatives (see planning assumptions, Subchapter 4.5.3.c). Table 4.5-24 shows these budgets for OBMP Alternative A where supplemental water recharge is 100 percent imported water and Table 4.5-25 shows these budgets for OBMP Alternative A where supplemental water recharge is 50 percent imported water and 50 percent recycled water from IEUA. Tables 4.5-26 and 4.5-27 are similar tables for OBMP Alternative B. These tables list the various hydrologic components of the inflows and outflows of the basin. The estimated safe yield for the baseline alternative is about 105,000 acre-ft/yr and is about 55,000 acre-ft/yr less than the ~160,000 acre-ft/yr safe yield of OBMP alternative. The difference in yield between the alternatives is due to:

- OBMP alternative increases safe yield by about 17,000 acre-ft/yr through new storm water recharge, and

- Baseline alternative loses about 40,000 acre-ft of safe yield due to increased groundwater discharge (rising water outflow) to the Santa Ana River caused by reduced groundwater production in the southern part of the basin.

Review of the salt budget as described by total dissolved solids (TDS) in Tables 4.5-25 through to 4.5-28 indicate the following:

- For the baseline alternative, the flow-weighted average TDS in recharge to the basin is about 490 mg/l.

- With the OBMP, the flow-weighted average TDS in recharge to the basin ranges from a low of about 440 mg/l for Alternative A using only imported water for replenishment purposes; to a high of about 480 mg/l for Alternative B using a 50 percent recycled water and 50 percent recycled water for replenishment purposes.

- For the baseline alternative, the annual TDS discharge from the basin is about 40 percent from groundwater production and 60 percent from groundwater discharge to the Santa Ana River. With the OBMP, the annual TDS discharge from the basin is about 90 percent from groundwater production and 10 percent groundwater discharge to the Santa Ana River. See table below (in tons per year):

| Discharge Component | Baseline | OBMP | Difference |
|---|---|---|---|
| Production | 53,632 | 143,399 | 89,768 |
| Direct | 40,180 | 53,997 | 13,817 |
| OBMP Facilities | 0 | 70,748 | 70,748 |
| SAWPA | 8,295 | 10,867 | 2,571 |
| Other | 5,157 | 7,787 | 2,630 |
| Rising Water | 84,356 | 15,918 | -68,348 |
| Phreatophyte | 0 | 0 | 0 |
| Subtotal Outflows | 137,988 | 159,318 | 21,329 |

The groundwater discharge to the river in OBMP alternative is comparable in flow and TDS concentration to current conditions. The groundwater discharge to the river in the baseline alternative is about 40,000 acre-ft higher than the OBMP alternative and will contribute to elevated TDS concentrations in the Santa Ana River. As the data above indicates, aside from localized water quality degradation, the Basin-wide effect of using imported water will be to improve groundwater quality.

The highest potential for adverse impact to groundwater quality occurs when recycled water is utilized for recharge. Recent experience in measuring water quality impacts associated with recycled water recharge indicates that it can be recharged without significantly degrading water quality. There are four water quality factors that need to be considered with the recharge of recycled water before it can be utilized as a potable water supply. The first threshold is that the maximum recycled water contribution to a domestic well's supply is 20 percent. The implication of this policy is that until the recycled water is diluted to a 20 percent or less concentration in the groundwater beneath and downstream of a recharge site the recycled water is not usable. Depending on the volume of recycled water recharged at a specific location, this can remove substantial acreage (50-100 acres) from existing or future potable water production.

In addition to the 20 percent requirement imposed by DHS there is a minimum retention time of six months. Again, this restricts a substantial area from potable water production. Finally, DHS also requires a minimum horizontal separation between groundwater recharge and extraction. Fundamentally, these "groundwater" requirements are established by the DHS to protect the public health and as a result fairly substantial areas (possibly several thousand acres at 40,000 acre-feet of recycled water) may be removed from groundwater production, unless mitigation is implemented to ensure that the amount of area removed is reduced to the minimum feasible. Mitigation is provide below to accomplish this goal, and reduce potential impacts from recharging and using recycled water.

California Recharge Guidelines also include provisions for recharge of groundwater basins through injection wells. If recycled water is to be used in the injection process, it must meet these guidelines established by the DHS. The Total Organic Carbon content must be at or below 1 mg/l. Further, the

Total Inorganic Nitrogen concentration must be less than 5 mg/l, however, the DHS reviews and customizes these guidelines for each project that comes under its review.

To ensure that recharge of recycled water (whether it is surface recharge or inject) does not cause significant degradation of existing groundwater quality, modeling will be required to evaluate the change in groundwater quality where the recycled water recharge plume intercepts the groundwater table. If the modeling indicates that the change in TDS will exceed the Basin Plan TDS Water Quality Objective for the subbasin in which recharge occurs, an alternative location will be selected which protects and fulfills the objective. With such mitigation, and based on the data in Table 4.5-26, recycled water can be used without causing significant degradation of groundwater quality in the Chino Basin. It should also be noted that waste discharge requirements may be established by the RWQCB if water to be recharged exceeds basin plan objectives. Please refer to letter number 9 in the comments section that precedes the text of this document.

The mitigative capacity of the desalters to remove salt from the basin is presented in a supplemental table that has been included in this document in response to comments received on the DEIR. Table 3 is located in the attachments to the comments and responses to comments section that is located in Volume II of this document.

Another issue of concern raised in comments in response to the Notice of Preparation was a concern for changes in direction and/or rate of water quality anomalies (areas of contamination, most commonly as a result of human activities). Wildermuth examined this issue and concluded that implementation of the OBMP would not cause greater displacement of contaminated plumes. Figure 4.5-55 shows the estimated current locations of selected plumes of various contaminants that were identified in the OBMP Phase I Report. Figure 4.5-55 also shows the projected locations of these plumes in the year 2020 for the baseline and with OBMP alternative. The projections are based on groundwater seepage velocity projections made with the RAM tool for the year 2020 with the intervening years interpolated between current and the year 2020. The relative displacement of the plumes is similar for the baseline and with OBMP alternative. Thus, the impact over the next 20 years is forecast to be comparable under the proposed project and no project alternatives, i.e. no change in physical condition over the next 20 years. Based on this data, no potentially significant impact to groundwater quality will result from mobilizing plumes based on proposed recharge programs. However, to ensure that this conclusion remains valid for specific recharge locations, the OBMP implementation of recycled water recharge projects will include modeling to verify that no local plumes will be adversely impacted. This measure will be implemented through mitigation outlined below.

The beneficial uses of groundwater in the Chino Basin and the downstream Orange County groundwater basin are defined in the *Water Quality Control Plan, Santa Ana River Basin* (Basin Plan) prepared by the California Regional Water Quality Control Board (RWQCB) in 1995. These beneficial uses include municipal (MUN), agricultural (AGR), industrial (IND), and process (PROC) uses. The current Basin Plan divides the Chino Basin into three subbasins for water quality management -Chino I, Chino II and Chino III; and the Orange County Basin into the Santa Ana Forebay and the Santa Ana Pressure subbasins. The water quality objectives for these are described in the Basin Plan. The water quality objectives of significance for this effort are total inorganic nitrogen (TIN) and TDS. TIN as used herein is the sum of ammonia (NH3-N), nitrite (NO2-N) and nitrate (NO3-N). In groundwater TIN is almost completely composed of nitrate. Santa Ana River discharge may include all three forms of inorganic

nitrogen. Upon recharge the ammonia is rapidly converted to nitrite, which in turns converts to nitrate. The TDS and TIN objectives for the Chino and Orange County groundwater basins are listed below:

| Subbasin | Objectives (mg/l) | |
|---|---|---|
| | TDS | TIN |
| Chino I | 220 | 5 |
| Chino II | 330 | 6 |
| Chino III | 740 | 11 |
| Santa Ana Forebay | 600 | 3 |
| Santa Ana Pressure | 500 | 3 |

In the Basin Plan the RWQCB has asserted that there is no assimilative capacity for TDS and TIN in the Chino I and II Subbasins because either the ambient TDS and TIN concentrations exceed the TDS and TIN objectives or because it is expected that the ambient concentrations will exceed the objectives in the future. The Subbasin boundaries, respective TDS and TIN objectives and findings of assimilative capacity may change in the next year or two due to a recent study of the objectives and current ambient quality (Wildermuth Environmental, 1999). In general, the TDS and TIN objectives will be lower and assimilative capacity will be absent for all subbasins or not allocated. It was noted in comment letter number 9 from the RWQCB that staff will recommend that no assimilative capacity for TDS or TIN in Chino Subbasins I or II or III be recognized for the reasons discussed in Section 9-19 of the letter.

For OBMP Alternative A1 groundwater levels and storage will not change significantly compared to existing conditions. The expected maximum storage volume for the OBMP Alternative A1 is an increase of 500,000 acre-feet plus local recharge programs to ring the total storage volume up to 5,900,000 acre-ft, (about and 11 percent increase of the existing storage of about 5,300,000 acre-ft). Note that this storage volume is higher than would occur if a 300,000 acre-foot conjunctive use program were implemented. TDS and TIN concentrations in groundwater will be less with the OBMP because groundwater storage will not increase significantly as in the baseline alternative. Exceptions to this will occur if storage exceeds safe storage (as defined in the OBMP Phase I Report) under conjunctive use programs. Conjunctive use related TDS and TIN impacts due to increases in groundwater storage will probably be less than the baseline alternative and will be mitigated by the proponent of the conjunctive use programs prior to the initiation of a conjunctive use program. The desalters in the OBMP Alternative A1 will allow the beneficial use of poor quality non-potable groundwater through treatment and distribution to various water users in and outside of the Basin.

The inclusion of the three additional basins (Wineville, Jurupa, and the RP-3 site) for recycled water recharge has already been analyzed in this document in that 40,000 afy of recycled water is what is being proposed for recycled water recharged under the OBMP. The fact that the locations where this recharge may occur has been expanded to include these three additional basins does not change the impact conclusions in a programmatic document such as this one; especially since site specific impacts from recharging recycled water must be evaluated in the future when specific recharge proposals are proposed with sufficient information to support site specific evaluations.

Extensive data demonstrating that recycled water recharge can be implemented under the current regulatory framework has been demonstrated with the concurrence of the Department of Health Services (DHS), Drinking Water Field Operations Branch (Los Angeles) for implementation of the San Gabriel Valley Recycled Water Demonstration Project. DHS made "findings of non-impairment of the receiving

aquifers where water quality of the recycled water is not as high quality as that being generated by the IEUA wastewater reclamation facilities. A copy of this document is attached at Appendix 8.3. RP-1 and RP-4 effluent is of higher quality than water currently being recharged by Los Angeles County Sanitation District, and assuming that similar showings of non-impairment can be demonstrated, IEUA believes that it will be feasible to implement recycled water programs of comparable volume in the Chino Basin, as long as other water quality criteria can be fulfilled or protected (such as Basin Plan water quality objectives and beneficial uses.

Based on Wildermuth's evaluation, the data are equivocal regarding the ability to meet the future Basin Plan water quality objectives throughout the three subbasins of the Chino Basin. However, it is clear, based on the analyses performed to date, that the future water quality within the Basin will be better with the implementation of the OBMP, than under a no OBMP alternative. State another way, the future groundwater quality will degrade less, and perhaps not significantly, in the Basin with implementation of the OBMP. The analysis indicates that future groundwater quality will degrade if an overall management program is not implemented. Taken in this context, future Chino Basin groundwater quality will benefit, not be adversely impacted by implementing the OBMP.

Implementing Program Elements 3 and 5 is forecast to affect groundwater quality in the following manner:

1. The installation of three desalters is forecast to disturb a total of ~75 acres. As outlined for disturbances associated with monitoring wells, recharge basins and pipelines, construction activities associated with desalter operations have a potential to cause the discharge of pollutants, particularly eroded sediment and accidental releases of petroleum products, and possible degradation of surface water quality. Previously identified mitigation measures for construction activities will also apply to construction of the desalters. With implementation of these measures, no significant groundwater quality degradation is forecast to occur from constructing the desalters.

2. Meeting the replenishment obligations, up to 55,000 afy, can be fulfilled with a mix of local water in storage, direct recharge of water or *in lieu* exchange. Adequate recharge capacity is available to meet this need as outlined in the previous discussion. The potential environmental effects described under Program Element 2 for recharge basin effects on groundwater quality also apply to the proposed replenishment program. No additional groundwater quality impacts have been identified from meeting the replenishment obligations for the Chino Basin under the OBMP.

3. As part of the desalter operations, salt will be removed from the lower subbasin and over time as the water recharged into Chino I and II flows into Chino III, groundwater quality will improve. This improvement will require a substantial amount of time because of the legacy of salts that remain in the vadose zone, primarily in Chino III, but also in Chino I and II. Assuming 40,000 afy of desalting capacity, an estimated 35 million gallons of water could be treated on a given day. With a 15 percent rejection rate, the amount of fluid discharged to the SARI line would be about 5.25 million gallons. This equates to approximately 2 million pounds of salt being extracted and removed from the Basin per day at a concentration of 5,000 mg/l. This equates to about 100 tons per day of salt removed from the Chino Basin, or about 35,000 tons per year, assuming 350 days of operation per year when all of the proposed desalters are in operation. Also, refer to Table 3 which is included as an attachment to the comments and responses to comments section that is located in Volume II of this document.

The OBMP contains an extensive discussion of the complex issue of measuring and demonstrating improvement in groundwater quality (pages 4-27 through 4-31). The following general conclusions can be reached. With agriculture persisting in the lower subbasin TDS concentrations will continue to degrade, primarily du to irrigation return flows. With transition of the area to urban uses and implementation of the OBMP, TDS concentrations will decline, after a period of time, slowly, but are not forecast to be reduced to the point that the Chino III groundwater can be used for domestic water supply purposes without treatment. The difficulty for Basin managers and regulators is to agree upon some method of measuring the changes in improvements in water quality, particularly when no change is likely to be measurable for a discrete period of time. Implementation of expanded groundwater quality monitoring and numerical models is recommended as the best means to track the improvement in groundwater quality that is anticipated to occur, albeit gradually, over the planning horizon.

Overall, implementation of Program Elements 3 and 5 is forecast to make the major contribution in the OBMP to improving groundwater quality within the Chino Basin. It will carry out the direct removal of a significant quantity of salt from the Basin, through discharge of recycled water, SARI line discharges. Also, it is anticipate that losses to the basin in the form of rising groundwater will decrease due to OBMP implementation. This impact is considered beneficial overall, not adverse. Equally important, when compared to the alternative of no OBMP implementation, the benefits are substantial.

4. In addition to replacing agricultural production in the Basin, the desalters will remove a substantial tonnage of salt from the Basin. By 2020 the desalters will have the capacity to remove an annual tonnage of salt ranging from 43,698 to 56,297 tons. Since there is currently considered to be no assimilative capacity in the Chino Basin, the installation of the desalters would effectively provide mitigation for salt inputs and allow for substantial increases in recharge capacity for the basin. This is forecast to be a beneficial impact to the basin and it will provide effective mitigation for the recharge of SPW and recycled water which both tend to have TDS concentrations above the Basin Plan objectives.

5. The development and implementation of a regional supplemental water program to deliver SPW to purveyors and into the Chino Basin (potentially for recharge too) has the potential to affect groundwater quantities since this water could be used in place of pumping water from the Basin. Additionally, SPW could be used as a source of recharge water to meet basin replenishment obligations. As part of the recharge program IEUA has an entitlement to approximately 62,500 afy of SPW. The recharge program could still potentially use entirely SPW to meet the replenishment obligation. If this were the case, up to 88,000 afy of SPW could potentially be recharged into the Basin (though this is unlikely since recycled water and stormwater will likely be significant components of this recharge plan). The replenishment obligation for the Basin is 55,000 afy, however, recharge water sources may only be available every 7 out of 10 years, so an annual recharge capacity of 88,000 afy is necessary to ensure that the replenishment obligation can be met on average within a 10 year period). SPW is estimated to have a TDS concentration ranging between 250 and 400 mg/l for TDS. The salt addition to the basin for SPW water with a TDS concentration of 400 mg/l at a volume of 88,000 afy is 46,657 tons. For the same volume of water with a TDS concentration equal to the Basin Plan objective of 220 mg/l, the salt addition would be 25,662 tons per year. The difference between these two tonnages is well within the capacity of the desalters to mitigate adverse impacts due to salt loading. Impacts related to TDS concentrations in excess of the Basin Plan objective TDS concentrations can be mitigated to a less than significant level by operation of the desalting facilities proposed under the OBMP.

Implementing Program Element 4 is forecast to impact groundwater quality in the following way.

1. Modifying groundwater production for Management Zone 1 (MZ 1) has no substantial potential to adversely impact groundwater quality. It may have a potentially beneficial effect. Data indicates that groundwater from adjacent management zones or higher in MZ 1 is of better quality than that in the southern portion of MZ 1. Although the effect may be minor, the recycled water generated from the higher quality (less TDS and nitrate) water would be marginally better as a result of beginning with lower TDS water. Otherwise, no adverse groundwater quality impact is forecast to occur if the location of groundwater production is relocated in the Basin in conformance with implementing this component of Program Element 4.

2. Meeting any additional recharge requirements in MZ 1 can occur without any modifications to the physical environment. However, if construction impacts are incurred for construction of new recharge areas within MZ 1, the mitigation measures previously identified for construction activities will ensure that no adverse groundwater quality impacts will result surface water contamination. Regarding the effects of recharging water to the MZ 1 aquifer, the potential groundwater quality impacts will be the same as that outlined for Program Element 2 above. A potential does exist to degrade groundwater quality significantly, but this potential impact can be mitigated with the recharge of an appropriate blend of water sources for the specific location, based upon physical modeling and/or additional studies studies that must be conducted prior to implementing the recharge.
3. Collection of additional data to fill gaps in knowledge about the zone is not forecast to include any activities that will cause discharge of pollutants or adversely affect groundwater quality.

Implementing Program Elements 6 and 7 is forecast to affect groundwater quality in the following way:

1. The process of developing cooperative strategies and plans has no potential to substantially cause adverse impacts to the physical environment; therefore, no potential exists to cause the discharge of pollutants or to adversely impact groundwater quality. These cooperative efforts are intended to benefit the Basin through coordinated beneficial use oriented efforts and strategies.

2. Seeking funds to speed up cleanup and restoration of contaminated sites does not, in itself, cause any adverse impacts to the environment. Prior to utilizing funds to conduct cleanup and restoration activities, these activities must complete additional environmental investigations to address issues, such as waste transport effects on local roads; potential public health risks from transporting the contaminated material; proper treatment, disposal or even recycling of the contaminated waste; etc. Since no specific sites are referenced for speeding the remediation process, it would be speculative to assume that groundwater quality impacts would occur from obtaining such grants. In fact, the specific purpose of such grants would be to remove contamination from groundwater; therefore, the impact of Program Elements 6 and 7.

Implementing Program Elements 8 and 9 is forecast to affect groundwater quality in the following way.

1. The process of developing storage and conjunctive use programs and plans has no substantial potential to change the physical environment; therefore, no potential exists to discharge pollutants or to adversely impact groundwater quality from implementing this component of Program Elements 8 and 9.

2. Collection of additional data to fill gaps in knowledge about the water storage is not forecast to include any activities that will adversely affect discharge of pollutants or degradation of groundwater quality.

3. Attempting to make impact forecasts for an undefined pilot conjunctive use program would be speculative and the State CEQA Guidelines (Section 15145) indicate that the public be informed of this conclusion and no further evaluation is necessary. Note that a pilot conjunctive use program would be expected to use recharge basins to deliver the water for percolation into the Basin groundwater aquifer, and the groundwater quality issues associated with such activities have already been addressed above.

This completes the environmental analysis of potential impacts on water resources and water quality from implementing the OBMP. The responses to the specific environmental concerns raised in Subchapter 4.5.1 are addressed in Appendix 8.1 where the data in the above analysis that addresses a concern is specifically referenced. In addition, a minor amount of additional information is included in these specific responses to concerns. The reader is referenced to Appendix 8.1 for this information.

## 4.5.4 Mitigation Measures

4.5-1 To minimize potential ground disturbances associated with installation and maintenance of proposed monitoring equipment on existing wells, the equipment will be installed within or along existing disturbed easements or right-of-way or otherwise disturbed areas, including access roads and pipeline or existing utility easements.

4.5-2 The Watermaster or other agencies implementing recharge programs will confer with the San Bernardino County Department of Transportation and Flood Control and for each flood control basin that is proposed to be utilized for recharging water to the Chino Basin, to define the amount of water that can be set aside as a conservation pool within existing flood control basins and specific operational parameters (such as time and volume of water that can be diverted into each basin). This will ensure that recharge activities do not conflict with flood control operations at any flood control basins. Variable pooling and recharge schedules that are coordinated with storm forecasting to halt deliveries during storm events will ensure that flood-related hazards remain less than significant.

4.5-3 Within each desalter site, surface runoff will be collected and retained (for use onsite) or detained, and treated when released by passing the runoff through a "first-flush" treatment system, which may include onsite riparian area, detention basin with filtration system at the outlet, or other system that removes the majority of urban storm runoff pollutants, such as petroleum products and sediment. The purpose of this measure is to remove the onsite contribution to cumulative urban storm runoff and ensure the discharge from the desalter sites is treated to reduce contributions of urban pollutants to downstream flows.

4.5-4 In compiling local and *in lieu* groundwater storage balances, the Watermaster will include the estimated amount of water lost from the Basin due to rising water at the low end of the Basin and adjust storage salt balance accounts accordingly.

4.5-5 For each OBMP construction site, regardless of size, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented. Each plan will identify the best management practices (BMPs) that will be used for that site to minimize the potential for accidental releases of any chemicals or materials on the site that could degrade water quality, including solid waste and require that any spills be clean-up, contaminated material properly disposed of and the site returned to pre-discharge condition, or in full compliance with regulatory limits for the discharged material. The portion of the SWPPP that addresses erosion and related sediment discharge will specify the percentage of pollutant removal, as illustrated in the attached Figure 4.5-56 which was abstracted from Supplement A to the "Riverside County Drainage Area Management Plans, Attachment" publication. At a minimum BMPs will achieve 60 percent removal of sediment and other pollutants from disturbed sites.

4.5-6 For long-term mitigation of site disturbances at OBMP facility locations, all areas not covered by structures will be covered with hardscape (concrete, asphalt, gravel, etc.), native vegetation and/or man-made landscape areas (for example, grass). Revegetated or landscaped areas will provide sufficient cover to ensure that, after a two year period, erosion will not occur from concentrated flows (rills, gully, etc.) and sediment transport will be minimal as part of sheet flows. These measures and requirements will be applied to closure of abandoned well site disturbed areas.

4.5-7 Prior to cleaning out, refurbishing or capping a well, samples will be obtained and chemically analyzed to ensure that the discharge does not contain any contaminants exceeding regulatory thresholds. If contaminants are discovered, then they will be removed or lowered below the

regulatory threshold prior to discharge to the environment. Discharge of non-stormwater into storm drains will require a NPDES permit.

4.5-8 Recycled water will not be discharged to streams that are transporting storm flows for subsequent groundwater recharge (except as authorized by existing discharge permits issued by the Regional Board), unless mitigation as identified in mitigation measure 4.5-12 is provided. If the storm water component of the combined flow is a part of the total sub-basin assimilative capacity, which is fully allocated, then mitigation pursuant to mitigation measure 4.5-12 for recharge of the recycled water will be the same as if the recycled water had been directly recharged. However, if the assimilative capacity of the storm water has not been allocated, then mitigation will be based on the quality of the of the commingled storm flow and recycled wastewater.*

4.5-9 OBMP participants do not have responsibility and control over the SARI line, but they do interact with the agencies that would respond to an accidental release from the SARI line (or the Los Angeles County Nonreclaimable Wastewater Line). OBMP participants will provide support, as required or appropriate, and assist with control of and restoration of the environment damaged by an accidental release from the line.

4.5-10 Prior to authorizing contracts for drilling monitoring or production wells under OBMP auspices, the entity funding the well drilling effort will require the well driller to identify all chemicals that will be used at the drilling site and require the submittal of a SWPPP for review and approval before allowing the drilling to commence. A performance bond will be provided by the driller to ensure that any residual contamination from well drilling can be corrected. Further, the implementing agency will construct wells in a manner that will reduce the risk of movement of groundwater between zones of different quality , as required under California well standards.*

4.5-11 When closing abandoned wells in the Chino Basin the entity closing the well will, where technically feasible determine whether the groundwater in the well is contaminated. This will be accomplished by sampling and analyzing the well water. If contamination is identified, the entity will report the discovery to the appropriate parties, including the owner (if known) and the regulatory agencies. The Watermaster will monitor the status of the well until residual contamination is remediated.

4.5-12 When recharge of State Project Water (SPW) or recycled water with TDS greater than the background groundwater TDS or the Basin Plan water quality objective is utilized at a recharge site, the entity conducting the recharge will conduct additional analysis including modeling to identify the volume and rate of recharge that can be conducted without causing the Basin Plan water quality objective for TDS to be exceeded. In addition, the amount of additional salt added to the Basin above the background groundwater quality condition will be calculated and the greater of the two amounts will be offset, either by blending with lower TDS water (storm water) provided that the assimilative capacity of the sotrm water has not already been allocated as more thoroughly described in mitigation measure 4.5-8. The program could utilize SWP water for recharge when such water is available and when such water is better in quality than recycled water (i.e. lowest TDS). Under no circumstance will discharge of SPW or recycled water cause or contribute to a cumulative violation of Basin Plan water quality objectives or interfere with a designated beneficial use for a water or groundwater body.*

4.5-13 When recharge of recycled water is proposed for a specific location, the entity proposing such recycling will provide the following data to DHS: the area encompassed by the minimum six months detention period before use and the area encompassed by the long-term equilibrium concentration of 20 percent recycled water within the aquifer. Based on these area estimates,

the entity will determine whether any existing WSA production wells or water supply aquifers will be impacted by these pumping constrained areas. If impacts will affect existing wells or water supply aquifers, the entity proposing to discharge recycled water will fund the provision of a comparable quality and quantity of potable water to the WSA [this can be done through installing new wells, direct water deliveries (for example from desalters), etc.].*

4.5-14 When recharge of recycled water with TIN greater than the background groundwater TIN or the Basin Plan objective at a recharge site is utilized, the entity conducting the recharge will conduct modeling and/or additional studies to identify the volume and rate of recharge that can be conducted without causing the Basin Plan water quality objective for TIN to be exceeded. Under no circumstance will discharge of SPW or recycled water cause or contribute to a cumulative violation of Basin Plan water quality objectives or interfere with a designated beneficial use for a water or groundwater body.*

4.5-15 When recharge of water is proposed within the vicinity of an existing or known groundwater quality anomaly (contaminated groundwater plume), modeling and/or additional studies will be conducted to determine whether recharge of the recycled water will increase the local hydraulic gradient and cause more rapid spread of the existing plume. If existing domestic water production wells will be impacted by the plume a minimum of one year earlier than under pre-existing conditions, or if significant quantities of additional groundwater (more than 5,000 acre-feet) will become contaminated within a five year period due to the recharge of water, an alternative location for recharge will be selected to avoid not only the loss of the recharged water due to contamination, but also additional high quality groundwater due to more rapid expansion of the contaminated plume.

4.5-16 Whenever possible and feasible, OBMP projects that are highly capital intensive, or that employ workers who are onsite for more than just maintenance activities, will consider Figure 4.5-47 when siting specific project locations for OBMP facilities. Areas defined on this map that potentially may be affected by flood-hazards will be avoided, unless conjunctive use and flood-control operations demand that facilities must be located within these areas. If facilities are constructed in a flood zone, the facility will be brought to a level above flood hazards, or hardened against flood related impacts. Additionally, if facilities must be located within flood plains or hazard areas, a flood management program to minimize impacts to people and surrounding property will be created and implemented for each facility that may occur within these hazard areas.

4.5-17 Prior to implementation of any recharge projects as either existing or new basins, a management plan will be established to the satisfaction of SBCFCD. This plan will be created specifically for each individual basin to ensure the safety of surrounding property and people from undue risks associated with water-related hazards (i.e. flooding). The management plan will firmly establish a priority of flood-control functions over and above recharge-related operations. Weather forecasts of upcoming storm events will be carefully monitored and in the event of a significant forecasted storm-event, recharge deliveries the basins will be ceased until further notice is received from SBCFCD that it is safe for deliveries to resume. Additionally, no more than three days' percolative capacity of water will be allowed to sit in a basin at a time if such basin is also used for flood control activities. Additionally, each SBCFCD basin will have a specific management plan developed, so as to coordinate flood control with recharge. This mitigation measure will ensure that people and property are not subject to additional risk associated with water-related hazards in the Basin, and will allow SBCFCD to make full utilization of the basin's flood control capacity in the event of a storm.

4.5-18 In order to offset salt additions above the objective for the appropriate Subbasin defined in the Basin Plan, desalters will be constructed. Recharge of water with TDS concentrations above the

**Basin Plan objectives will not occur until it can be adequately demonstrated that the users of pumped groundwater which are adversely affected by such recharge will be appropriately compensated or will receive sufficient amounts of high quality water to offset the adverse effects of the high TDS pumped groundwater at an overall cost no greater than that which would have been incurred by the adversely affected producers in the absence of the recharge. Desalters may be the source of higher quality water needed for mitigation. If water with TDS in excess of water quality objectives is recharged in such close proximity to the desalter extraction wells that other producers are unaffected, then mitigation will be accomplished when it is demonstrated that the salt leaving the basin, as a result of the OBMP desalter capacity that has been allocated to mitigate the TDS impacts of recycled water recharge is equal to or greater than the increment of additional salt above established Basin Plan water quality objectives. Desalters will be designed to capture any increase in rising water.***

**4.5-19 Among the alternatives available to reduce or control adverse effects caused by recharge is the use of injection of water of higher quality to resident poor quality groundwater to serve as a barrier against the migration of the poor quality gorundwater.**

* Indicates that a modification to the mitigation measure has been made for clarification purposes in response to comments received on the DEIR.

## 4.5.5 Unavoidable Adverse Impacts

The whole objective of implementing the OBMP is to create an integrated program to manage water resources within the Chino Basin to protect and enhance the existing safe yield of the Basin and to preserve existing water quality while making progress in enhancing this critical water characteristics. As previously noted, on the whole the OBMP can accomplish these objectives. At this point in time, compared to the no project alternative, which is the implementing of individual water supply master plans by the Chino Basin WSAs, the OBMP provides the only holistic approach to managing the Basin and protecting the water resource and water quality values required to meet future water supply requirements in the Basin.

However, as with any program that must substantially manipulate large components of the environment to achieve its goals, the OBMP has a potential to cause adverse environmental effects, some of them potentially significant. For most of the OBMP Program Elements at this stage of review, there is no potential for unavoidable adverse impacts to water resources and water quality, let alone significant unavoidable adverse impacts. For those Program Elements that have evolved sufficiently to define specific facilities and activities, there will be some unavoidable water resource and water quality impacts, and without mitigation, other impacts could be unavoidably significant. These issues are summarized below using the Program Element summaries provided at the beginning of Subchapter 4.5.3.

### 4.5.5.1 Program Element 1

Development and implementation of a comprehensive monitoring program will not, for the most part, result in any unavoidable adverse impacts to water resources and water quality. All monitoring equipment and efforts can be terminated at any time and these facilities removed from the

environment. On the other hand the installation of monitoring wells and associated activities has a potential to cause or contribute to degradation of surface, and ultimately, groundwater quality. Mitigation measures are identified to reduce potential impacts from installation and operation of monitoring wells as proposed in Program Element 1 to a non-significant level.

#### 4.5.5.2 Program Element 2

Developing and implementing a comprehensive recharge program has a potential to cause direct and indirect significant unavoidable adverse water resource and water quality impacts. Extensive mitigation has been identified to prevent recharging water to the Chino Basin groundwater aquifer from causing or contributing to these potential impacts. Through a combination of blending water sources, recharging at the correct locations, avoiding contaminated plumes and ensuring that recharge basin operations do not conflict with flood control operations and do not contribute to significant water quality degradation (both short- and long-term), this program element can be implemented without causing significant unavoidable adverse water resource and water quality impacts.

#### 4.5.5.3 Program Elements 3 and 5

The implementation of desalters and replenishment programs (new water supplies from impaired areas and regional supplemental water programs) at the scale envisioned in the OBMP also has a potential to cause unavoidable significant adverse water resource and water quality impacts. Mitigation has been identified to control these unavoidable impacts to within a level of non-significance.

#### 4.5.5.4 Program Element 4

The actions associated with Program Element 4, implementing a comprehensive management plan of MZ 1, were identified as having no potential to cause significant unavoidable adverse water resource impacts after implementation of mitigation measures, particularly for recharge in MZ 1.

#### 4.5.5.5 Program Elements 6 and 7

The program actions under these two Elements, further development of cooperative and salt management programs, were concluded to pose no potential for significant unavoidable adverse impacts without mitigation.

#### 4.5.5.6 Program Elements 8 and 9

The program actions under these two Elements, further development of a groundwater storage management program and a conjunctive use program, were generally concluded to pose no potential for significant unavoidable adverse impacts without mitigation. It is assumed that a "pilot" conjunc-

tive use program will simply be an extension of recharge programs outlined above which will require mitigation to ensure that no unavoidable significant adverse water resource or water quality impacts occur from their implementation.

### 4.5.6 Cumulative Impacts

The OBMP consists of a program to manage the whole of the water resources and water quality issues within the Chino Basin. As such, the OBMP's ability to enhance and protect safe yield and water quality indicates that from the water resources and water quality standpoint, the cumulative effects of the program for the Basin as a whole will be beneficial, not adverse. The areas where OBMP programs have a potential to cause local cumulative impacts include: contributions to increased cumulative runoff and flood hazards (mitigated to a level of non-significance); violation of area-wide Basin Plan water quality objectives and beneficial uses (mitigated to a level of non-significance); contributions to subsidence (mitigated to a level of non-significance); preventing a loss of safe yield, on the order of 40,000 acre-feet (a beneficial impact); and maintaining water quality throughout the Basin at or better than current conditions (a beneficial impact). Based on the evaluation contained in this subchapter, implementation of the proposed OBMP is not forecast to cause any cumulative significant adverse environmental impacts with implementation of the recommended mitigation.

**Table 4.5-1**
**ESTIMATED VOLUME OF GROUNDWATER IN STORAGE IN THE CHINO BASIN FOR SELECTED AREAS AND YEARS (acre-feet)**

| Year | | Management Zone MZ 1 | MZ 2 | MZ 3 | MZ 4 | MZ 5 | Lower Chino | Upper Chino | Total Chino Basin |
|---|---|---|---|---|---|---|---|---|---|
| 1965 | Volume | 1,713,920 | 2,208,147 | 1,213,002 | 58,389 | 259,321 | 2,035,804 | 3,416,975 | 5,452,779 |
| | %Change[a] | 9% | 6% | 4% | 6% | (1%) | 6% | 6% | 6% |
| 1969 | Volume | 1,671,715 | 2,204,049 | 1,220,580 | 60,093 | 266,271 | 2,042,278 | 3,380,430 | 5,422,708 |
| | %Change[a] | 6% | 6% | 5% | 9% | 2% | 6% | 5% | 5% |
| 1974 | Volume | 1,625,359 | 2,116,609 | 1,188,221 | 55,671 | 260,549 | 1,971,641 | 3,274,768 | 5,246,410 |
| | %Change[a] | 3% | 1% | 2% | 1% | (0%) | 3% | 2% | 2% |
| 1977 | Volume | 1,578,063 | 2,086,177 | 1,165,445 | 55,264 | 261,721 | 1,921,216 | 3,225,454 | 5,146,671 |
| | %Change[a] | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| 1983 | Volume | 1,696,255 | 2,096,980 | 1,165,379 | 56,023 | 259,544 | 1,953,182 | 3,321,000 | 5,274,182 |
| | %Change[a] | 7% | 1% | (0%) | 1% | (1%) | 2% | 3% | 2% |
| 1991 | Volume | 1,653,396 | 2,120,942 | 1,176,420 | 56,657 | 251,797 | 1,921,934 | 3,337,277 | 5,259,211 |
| | %Change[a] | 5% | 2% | 1% | 3% | (4%) | 0% | 3% | 2% |
| 1997 | Volume | 1,676,486 | 2,126,330 | 1,202,870 | 57,558 | 257,469 | 1,985,198 | 3,335,514 | 5,320,712 |
| | %Change[a] | 6% | 2% | 3% | 4% | (2%) | 3% | 3% | 3% |

(a) Change relative to storage in 1977.

## Table 4.5-2
## ESTIMATED VOLUME OF GROUNDWATER IN STORAGE IN THE CHINO BASIN VERSUS CLIMATE CHANGES, PRODUCTION PATTERNS, VOLUME OF LOCAL AND CYCLIC STORAGE AND ARTIFICIAL RECHARGE

| Year | Storage (acre-feet)[a] Volume | % Change | Climate Index[b] Volume | % Change | Production (acre-feet)[c] Volume | % Change | Volume of Local + Cyclic Storage (acre-feet) Volume | % Change | Artificial Recharge of Imported Water (acre-feet)[d] Volume | % Change | Landuse (acres)[a,e] Urban | Ag | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | 5,452,779 | 0% | -2.12 | 0% | 199,904 | 0% | | | 3,002 | 0% | *22,975* | *56,680* | *37,201* |
| 1966 | *5,430,225* | (0%) | -2.13 | (0%) | 186,264 | (7%) | | | 0 | N/A | *23,426* | *55,891* | *37,538* |
| 1967 | *5,437,743* | (0%) | -1.73 | 19% | 192,597 | (4%) | | | 526 | (82%) | *23,878* | *55,102* | *37,876* |
| 1968 | *5,445,261* | (0%) | -1.88 | 12% | 190,489 | (5%) | | | 2,229 | (26%) | *24,329* | *54,313* | *38,214* |
| 1969 | 5,422,708 | (1%) | -0.83 | 61% | 192,103 | (4%) | | | 0 | N/A | *24,780* | *53,524* | *38,551* |
| 1970 | *5,281,669* | (3%) | -1.21 | 43% | 197,057 | (1%) | | | 0 | N/A | *25,231* | *52,735* | *38,889* |
| 1971 | *5,316,929* | (2%) | -1.51 | 29% | 197,428 | (1%) | | | 0 | N/A | *25,683* | *51,946* | *39,227* |
| 1972 | *5,352,188* | (2%) | -1.96 | 8% | 166,826 | (17%) | | | 0 | N/A | *26,134* | *51,157* | *39,565* |
| 1973 | *5,387,448* | (1%) | -1.85 | 13% | 180,997 | (9%) | | | 0 | N/A | *26,585* | *50,368* | *39,902* |
| 1974 | 5,246,410 | (4%) | -2.04 | 4% | 191,536 | (4%) | | | 840 | (72%) | *27,037* | *49,579* | *40,240* |
| 1975 | *5,179,917* | (5%) | -2.19 | (3%) | 189,637 | (5%) | | | 2,001 | (33%) | 27,488 | 48,790 | 40,578 |
| 1976 | *5,213,163* | (4%) | -2.48 | (17%) | 174,498 | (13%) | | | 939 | (69%) | *28,822* | *47,378* | *40,656* |
| 1977 | 5,146,671 | (6%) | -2.83 | (33%) | 163,705 | (18%) | | | 531 | (82%) | *30,156* | *45,966* | *40,733* |
| 1978 | *5,252,930* | (4%) | -1.87 | 12% | 167,410 | (16%) | | | 19,588 | 553% | *31,490* | *44,554* | *40,811* |
| 1979 | *5,231,678* | (4%) | -1.76 | 17% | 167,669 | (16%) | 15,911 | 0% | 829 | (72%) | *32,824* | *43,142* | *40,889* |
| 1980 | *5,210,426* | (4%) | -0.74 | 65% | 174,421 | (13%) | 24,715 | 55% | 7,582 | 153% | *34,158* | *41,730* | *40,967* |
| 1981 | *5,189,174* | (5%) | -1.22 | 43% | 162,814 | (19%) | 33,759 | 112% | 17,183 | 472% | *35,492* | *40,319* | *41,045* |
| 1982 | *5,167,922* | (5%) | -1.14 | 47% | 151,878 | (24%) | 36,599 | 130% | 16,079 | 436% | *36,826* | *38,907* | *41,123* |
| 1983 | 5,274,182 | (3%) | 0.01 | 100% | 172,420 | (14%) | 55,995 | 252% | 21,817 | 627% | *38,160* | *37,495* | *41,201* |
| 1984 | *5,261,082* | (4%) | -0.25 | 88% | 176,218 | (12%) | 73,822 | 364% | 0 | N/A | 39,494 | 36,083 | 41,279 |
| 1985 | *5,262,954* | (3%) | -0.43 | 80% | 167,119 | (16%) | 97,437 | 512% | 18,404 | 513% | *44,349* | *34,891* | *37,615* |
| 1986 | *5,264,825* | (3%) | -0.13 | 94% | 180,778 | (10%) | 113,362 | 612% | 11,616 | 287% | *49,205* | *33,699* | *33,951* |
| 1987 | *5,266,696* | (3%) | -0.69 | 68% | 180,115 | (10%) | 128,122 | 705% | 8,586 | 186% | *54,061* | *32,507* | *30,288* |
| 1988 | *5,268,568* | (3%) | -0.85 | 60% | 189,513 | (5%) | 165,990 | 943% | 3,449 | 15% | *58,916* | *31,315* | *26,624* |
| 1989 | *5,270,439* | (3%) | -1.09 | 49% | 164,752 | (18%) | 174,505 | 997% | 6,452 | 115% | *63,772* | *30,123* | *22,960* |
| 1990 | *5,272,310* | (3%) | -1.46 | 31% | | | 163,012 | 925% | 3,793 | 26% | 68,627 | 28,931 | 19,297 |
| 1991 | 5,259,211 | (4%) | -1.53 | 28% | | | 187,986 | 1,081% | 3,310 | 10% | *68,740* | *28,808* | *19,307* |
| 1992 | *5,310,462* | (3%) | -1.52 | 28% | | | 201,503 | 1,166% | 8,246 | 175% | *68,853* | *28,684* | *19,318* |
| 1993 | *5,300,212* | (3%) | -0.36 | 83% | | | 204,698 | 1,187% | 11,566 | 285% | 68,966 | 28,561 | 19,328 |
| 1994 | *5,289,962* | (3%) | -0.71 | 67% | | | 211,350 | 1,228% | 23,003 | 666% | *68,627* | *28,931* | *19,297* |
| 1995 | *5,279,711* | (3%) | -0.08 | 96% | | | 230,861 | 1,351% | 120 | (96%) | *68,740* | *28,808* | *19,307* |
| 1996 | *5,269,461* | (3%) | -0.09 | 96% | | | 229,840 | 1,345% | 82 | (97%) | *68,853* | *28,684* | *19,318* |
| 1997 | 5,320,712 | (2%) | 0.00 | 100% | | | 223,587 | 1,305% | 5,648 | 88% | *68,966* | *28,561* | *19,328* |

(a) Italics indicates interpolated values
(b) Based on precipitation in Fontana normalized to 26.6 inches
(c ) Production data is from the CIGSM Model of the Chino Basin
(d) As reported in the monthly MWD billings
(e) Adjusted land uses from JMM, SAWPA Basin Plan Upgrade Task Force, Appendices for Nitrogen and TDS Studies USAW, February 1991.

## Table 4.5-3
## COMPARISON OF GROUNDWATER STORAGE AND SANTA ANA RIVER FLOW FOR CBWRMS ALTERNATIVES 3 AND 4 (acre-feet)

| Simulation Year | Hydrologic Year | End of Year Storage | | Total Santa Ana River Flow at Prado | | Difference in Storage | Difference in Outflow (Losses to River from Storage) |
|---|---|---|---|---|---|---|---|
| | | Alt 3 | Alt 4 | Alt 3 | Alt 4 | | |
| 2000 | 1947 | 4,725,000 | 4,792,000 | 347,407 | 352,943 | 67,000 | 5,536 |
| 2001 | 1948 | 4,713,000 | 4,827,000 | 413,738 | 420,894 | 114,000 | 7,156 |
| 2002 | 1949 | 4,706,000 | 4,869,000 | 466,627 | 476,705 | 163,000 | 10,078 |
| 2003 | 1950 | 4,697,000 | 4,905,000 | 406,421 | 416,560 | 208,000 | 10,139 |
| 2004 | 1951 | 4,692,000 | 4,950,000 | 543,868 | 550,967 | 258,000 | 7,099 |
| 2005 | 1952 | 4,742,000 | 5,034,000 | 792,539 | 817,176 | 292,000 | 24,637 |
| 2006 | 1953 | 4,713,000 | 4,998,000 | 440,611 | 448,703 | 285,000 | 8,092 |
| 2007 | 1954 | 4,720,000 | 4,896,000 | 651,547 | 666,182 | 176,000 | 14,635 |
| 2008 | 1955 | 4,711,000 | 4,784,000 | 565,954 | 577,107 | 73,000 | 11,153 |
| 2009 | 1956 | 4,709,000 | 4,684,000 | 585,669 | 591,800 | -25,000 | 6,131 |
| 2010 | 1957 | 4,703,000 | 4,682,000 | 661,933 | 664,800 | -21,000 | 2,867 |
| 2011 | 1958 | 4,723,000 | 4,706,000 | 781,641 | 783,833 | -17,000 | 2,192 |
| 2012 | 1959 | 4,697,000 | 4,683,000 | 466,853 | 469,124 | -14,000 | 2,271 |
| 2013 | 1960 | 4,674,000 | 4,670,000 | 496,566 | 495,354 | -4,000 | -1,212 |
| 2014 | 1961 | 4,646,000 | 4,646,000 | 426,841 | 429,353 | 0 | 2,512 |
| 2015 | 1962 | 4,631,000 | 4,692,000 | 597,518 | 596,920 | 61,000 | -598 |
| 2016 | 1963 | 4,614,000 | 4,727,000 | 587,424 | 591,025 | 113,000 | 3,601 |
| 2017 | 1964 | 4,586,000 | 4,750,000 | 487,997 | 493,835 | 164,000 | 5,838 |
| 2018 | 1965 | 4,584,000 | 4,796,000 | 717,162 | 727,487 | 212,000 | 10,325 |
| 2019 | 1966 | 4,571,000 | 4,833,000 | 623,701 | 635,886 | 262,000 | 12,185 |
| 2020 | 1967 | 4,572,000 | 4,874,000 | 699,926 | 719,041 | 302,000 | 19,115 |
| 2021 | 1968 | 4,540,000 | 4,840,000 | 488,588 | 497,664 | 300,000 | 9,076 |
| 2022 | 1969 | 4,576,000 | 4,783,000 | 1,041,947 | 1,055,875 | 207,000 | 13,928 |
| 2023 | 1970 | 4,556,000 | 4,678,000 | 830,366 | 836,723 | 122,000 | 6,357 |
| 2024 | 1971 | 4,530,000 | 4,570,000 | 517,684 | 522,635 | 40,000 | 4,951 |
| 2025 | 1972 | 4,501,000 | 4,545,000 | 424,518 | 427,887 | 44,000 | 3,369 |
| 2026 | 1973 | 4,492,000 | 4,540,000 | 639,882 | 642,372 | 48,000 | 2,490 |
| 2027 | 1974 | 4,481,000 | 4,533,000 | 607,742 | 610,451 | 52,000 | 2,709 |
| 2028 | 1975 | 4,451,000 | 4,510,000 | 479,146 | 481,087 | 59,000 | 1,941 |
| 2029 | 1976 | 4,422,000 | 4,491,000 | 502,324 | 500,819 | 69,000 | -1,505 |
| 2030 | 1977 | 4,405,000 | 4,527,000 | 597,505 | 602,728 | 122,000 | 5,223 |
| 2031 | 1978 | 4,451,000 | 4,621,000 | 1,023,131 | 1,035,589 | 170,000 | 12,458 |
| 2032 | 1979 | 4,442,000 | 4,655,000 | 788,345 | 803,158 | 213,000 | 14,813 |
| 2033 | 1980 | 4,480,000 | 4,738,000 | 993,827 | 1,009,339 | 258,000 | 15,512 |
| 2034 | 1981 | 4,456,000 | 4,763,000 | 751,693 | 760,693 | 307,000 | 9,000 |
| 2035 | 1982 | 4,451,000 | 4,805,000 | 727,380 | 741,379 | 354,000 | 13,999 |
| 2036 | 1983 | 4,499,000 | 4,844,000 | 1,069,565 | 1,089,631 | 345,000 | 20,066 |
| 2037 | 1984 | 4,472,000 | 4,730,000 | 736,299 | 747,600 | 258,000 | 11,301 |
| 2038 | 1985 | 4,450,000 | 4,621,000 | 513,855 | 524,741 | 171,000 | 10,886 |
| 2039 | 1986 | 4,437,000 | 4,523,000 | 650,023 | 658,253 | 86,000 | 8,230 |
| 2040 | 1987 | 4,413,000 | 4,501,000 | 574,550 | 581,532 | 88,000 | 6,982 |
| Total Lost From Conjunctive Use Storage and Expanded Local Storage (2000 to 2040) | | | | | | | 335,538 |

## Table 4.5-4
## COMPARISON OF ESTIMATES OF WATER IN CYCLIC AND LOCAL STORAGE ACCOUNTS WITH AND WITHOUT LOSSES TO THE SANTA ANA RIVER (acre-feet)

| Year | Cyclic and Local Storage Accounts | | | | | |
|---|---|---|---|---|---|---|
| | | | | Accounting for Losses | | |
| | Put | Take | Watermaster Estimated End of Period Storage | Losses to Baseflow | Estimated End of Period Storage | Cumulative Losses |
| 1978 / 79 | 16,074 | 0 | 16,074 | 163 | 15,911 | -163 |
| 1979 / 80 | 19,898 | 10,678 | 25,295 | 417 | 24,715 | -580 |
| 1980 / 81 | 12,665 | 3,021 | 34,938 | 600 | 33,759 | -1,179 |
| 1981 / 82 | 6,015 | 2,454 | 38,500 | 721 | 36,599 | -1,901 |
| 1982 / 83 | 20,345 | 0 | 58,846 | 949 | 55,995 | -2,850 |
| 1983 / 84 | 19,158 | 0 | 78,004 | 1,331 | 73,822 | -4,181 |
| 1984 / 85 | 25,986 | 615 | 103,375 | 1,756 | 97,437 | -5,938 |
| 1985 / 86 | 18,192 | 106 | 121,461 | 2,162 | 113,362 | -8,099 |
| 1986 / 87 | 31,257 | 14,021 | 138,698 | 2,476 | 128,122 | -10,575 |
| 1987 / 88 | 58,037 | 17,153 | 179,582 | 3,016 | 165,990 | -13,591 |
| 1988 / 89 | 43,990 | 31,983 | 191,588 | 3,491 | 174,505 | -17,083 |
| 1989 / 90 | 26,742 | 34,774 | 183,555 | 3,461 | 163,012 | -20,544 |
| 1990 / 91 | 34,451 | 5,877 | 212,129 | 3,599 | 187,986 | -24,143 |
| 1991 / 92 | 83,614 | 66,103 | 229,640 | 3,994 | 201,503 | -28,137 |
| 1992 / 93 | 30,388 | 23,028 | 237,000 | 4,165 | 204,698 | -32,302 |
| 1993 / 94 | 32,807 | 21,889 | 247,918 | 4,266 | 211,350 | -36,568 |
| 1994 / 95 | 30,333 | 6,288 | 271,963 | 4,534 | 230,861 | -41,102 |
| 1995 / 96 | 38,488 | 34,785 | 275,666 | 4,724 | 229,840 | -45,826 |
| 1996 / 97 | 20,698 | 22,301 | 274,063 | 4,649 | 223,587 | -50,476 |

## Table 4.5-5
## CHINO BASIN GROUNDWATER PRODUCTION ESTIMATES (acre-feet)

| Year | Production Estimates | | |
|---|---|---|---|
| | SWRCB(1) | Watermaster(2) | CBWRMS(3) |
| 1947 | 108,079 | | |
| 1948 | 121,367 | | |
| 1949 | 127,427 | | |
| 1950 | 138,168 | | |
| 1951 | 152,784 | | |
| 1952 | 145,957 | | |
| 1953 | 164,175 | | |
| 1954 | 159,944 | | |
| 1955 | 174,205 | | |
| 1956 | 192,319 | | |
| 1957 | 172,818 | | |
| 1958 | 167,383 | | |
| 1959 | 179,794 | | |
| 1960 | 186,465 | | |
| 1961 | 194,763 | | 217,536 |
| 1962 | 185,230 | | 201,675 |
| 1963 | 172,008 | | 190,548 |
| 1964 | 184,336 | | 201,234 |
| 1965 | 158,389 | | 190,358 |
| 1966 | 147,552 | | 199,904 |
| 1967 | 156,900 | | 186,264 |
| 1968 | 160,250 | | 192,597 |
| 1969 | 153,975 | | 190,489 |
| 1970 | *154,000* | | 192,103 |
| 1971 | 149,150 | | 197,057 |
| 1972 | *157,000* | | 197,428 |
| 1973 | *134,000* | | 166,826 |
| 1974 | 149,680 | | 180,997 |
| 1975 | | 175,757 | 191,536 |
| 1976 | | 181,017 | 189,637 |
| 1977 | | 173,355 | 174,489 |
| 1978 | | 154,675 | 163,706 |
| 1979 | | 141,314 | 167,410 |
| 1980 | | 140,566 | 167,689 |
| 1981 | | 144,416 | 174,421 |
| 1982 | | 137,532 | 162,814 |
| 1983 | | 122,635 | 151,878 |
| 1984 | | 132,799 | 172,420 |
| 1985 | | 134,563 | 176,218 |
| 1986 | | 136,113 | 167,119 |
| 1987 | | 147,068 | 180,778 |
| 1988 | | 152,402 | 180,115 |
| 1989 | | 143,998 | 189,513 |
| 1990 | | 154,620 | |
| 1991 | | 140,151 | |
| 1992 | | 141,904 | |
| 1993 | | 135,923 | |
| 1994 | | 129,682 | |
| 1995 | | 152,678 | |
| 1996 | | 150,669 | |
| 1997 | | 159,012 | |
| 1998 | | 150,226 | |
| | *Averages* | | |
| 1947 to 1974 | 158,361 | na | na |
| 1947 to 1960 | 156,492 | na | na |
| 1961 to 1974 | 161,231 | na | 193,215 |
| 1965 to 1974 | 152,090 | na | 189,402 |
| 1978 to 1989 | na | 147,881 | 173,983 |
| 1978 to 1998 | na | 142,997 | na |

(1) - From JMM notes on Chino Basin Adjudication.
(2) - Appendix H, Twentieth Annual Report of the Chino Basin Watermaster.
(3) - Chino Basin Water Resources Management Study, Task 6 Report.
na - not applicable.

## Table 4.5-6
## CHINO BASIN PRODUCTION BY POOL

| Fiscal Year | Appropriative Pool | | | Overlying Agricultural Pool | Overlying Non-Agricultural Pool | Total | Distribution by Pool | | |
|---|---|---|---|---|---|---|---|---|---|
| | Production | Exchanged with Metropolitan | Total | | | | Appropriative Pool | Overlying Agricultural Pool | Overlying Non-Agricultural Pool |
| 1974 - 1975 | 70,312 | 0 | 70,312 | 96,567 | 8,878 | 175,757 | 40% | 55% | 5% |
| 1975 - 1976 | 79,312 | 0 | 79,312 | 95,349 | 6,356 | 181,017 | 44% | 53% | 4% |
| 1976 - 1977 | 72,707 | 0 | 72,707 | 91,450 | 9,198 | 173,355 | 42% | 53% | 5% |
| 1977 - 1978 | 60,659 | 0 | 60,659 | 83,934 | 10,082 | 154,675 | 39% | 54% | 7% |
| 1978 - 1979 | 60,597 | 0 | 60,597 | 73,688 | 7,127 | 141,412 | 43% | 52% | 5% |
| 1979 - 1980 | 63,834 | 0 | 63,834 | 69,369 | 7,363 | 140,566 | 45% | 49% | 5% |
| 1980 - 1981 | 70,726 | 0 | 70,726 | 68,040 | 5,650 | 144,416 | 49% | 47% | 4% |
| 1981 - 1982 | 66,731 | 0 | 66,731 | 65,117 | 5,684 | 137,532 | 49% | 47% | 4% |
| 1982 - 1983 | 63,481 | 0 | 63,481 | 56,759 | 2,395 | 122,635 | 52% | 46% | 2% |
| 1983 - 1984 | 70,558 | 0 | 70,558 | 59,033 | 3,208 | 132,799 | 53% | 44% | 2% |
| 1984 - 1985 | 76,912 | 0 | 76,912 | 55,236 | 2,415 | 134,563 | 57% | 41% | 2% |
| 1985 - 1986 | 80,859 | 0 | 80,859 | 52,061 | 3,193 | 136,113 | 59% | 38% | 2% |
| 1986 - 1987 | 84,662 | 0 | 84,662 | 59,847 | 2,559 | 147,068 | 58% | 41% | 2% |
| 1987 - 1988 | 91,579 | 7,634 | 99,213 | 57,865 | 2,958 | 152,402 | 60% | 38% | 2% |
| 1988 - 1989 | 93,617 | 6,424 | 100,041 | 46,762 | 3,619 | 143,998 | 65% | 32% | 3% |
| 1989 - 1990 | 101,344 | 16,377 | 117,721 | 48,420 | 4,856 | 154,620 | 66% | 31% | 3% |
| 1990 - 1991 | 86,658 | 14,929 | 101,587 | 48,085 | 5,407 | 140,150 | 62% | 34% | 4% |
| 1991 - 1992 | 91,982 | 12,202 | 104,184 | 44,682 | 5,240 | 141,904 | 65% | 31% | 4% |
| 1992 - 1993 | 86,367 | 13,657 | 100,024 | 44,092 | 5,464 | 135,923 | 64% | 32% | 4% |
| 1993 - 1994 | 80,798 | 20,195 | 100,993 | 44,298 | 4,586 | 129,682 | 62% | 34% | 4% |
| 1994 - 1995 | 93,419 | 4,222 | 97,641 | 55,022 | 4,327 | 152,768 | 61% | 36% | 3% |
| 1995 - 1996 | 101,606 | 6,167 | 107,773 | 43,639 | 5,424 | 150,669 | 67% | 29% | 4% |
| 1996 - 1997 | 107,984 | 0 | 107,984 | 44,809 | 6,219 | 159,012 | 68% | 28% | 4% |
| 1997 - 1998 | 101,710 | 4,275 | 105,985 | 43,344 | 5,171 | 150,225 | 68% | 29% | 3% |
| Totals | 1,958,414 | 106,082 | 2,064,496 | 1,447,468 | 127,379 | 3,533,261 | | | |
| Average | 81,601 | 4,420 | 86,021 | 60,311 | 5,307 | 147,219 | 56% | 41% | 4% |
| Max | 107,984 | 20,195 | 117,721 | 96,567 | 10,082 | 181,017 | 68% | 55% | 7% |
| Min | 60,597 | 0 | 60,597 | 43,344 | 2,395 | 122,635 | 39% | 28% | 2% |

## Table 4.5-7
## ESTIMATED HISTORICAL LAND USES IN CHINO BASIN

| Land Use Category | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1933 (acres) | 1949 (acres) | 1957 (acres) | 1963 (acres) | 1975 (acres) | 1984 (acres) | 1993 (acres) |
| Non-irrigated Field Crops and Pasture | 37,242 | 37,157 | 52,950 | 36,600 | 20,754 | 12,942 | 5,411 |
| Irrigated Field Crops and Pasture | 32,539 | 32,539 | 24,320 | 23,927 | 18,295 | 15,677 | 13,141 |
| Irrigated and Non-irrigated Citrus | 15,866 | 15,866 | 9,464 | 4,303 | 1,947 | 865 | 0 |
| Irrigated Vineyards | 1,332 | 1,332 | 7,268 | 18,057 | 9,353 | 8,195 | 2,975 |
| Non-irrigated Vineyards | 94 | 94 | 79 | 0 | 0 | 0 | 1,629 |
| Dairies and Feedlots | 259 | 259 | 3,963 | 4,140 | 6,280 | 6,517 | 7,611 |
| Urban Residential, Commercial, Industrial and Vacant | 7,135 | 7,157 | 17,695 | 25,598 | 41,405 | 53,260 | 65,115 |
| Special Impervious | 305 | 305 | 305 | 314 | 309 | 1,839 | 3,851 |
| Native Vegetation | 22,083 | 22,145 | 21,633 | 21,249 | 20,481 | 19,904 | 19,328 |
| *Total Urban* | *7,440* | *7,462* | *18,000* | *25,912* | *41,714* | *55,099* | *68,966* |
| *Total Non-urban* | *109,415* | *109,393* | *119,678* | *108,276* | *77,109* | *64,101* | *50,095* |
| *Potential Dairy Disposal Area* | *87,073* | *86,988* | *94,082* | *82,887* | *50,349* | *37,680* | *23,156* |

# Table 4.5-8
# ESTIMATED DAIRY WASTE GENERATION AND MINERAL LOADING IN THE CHINO BASIN

| Year | Total Acreage (acres) | Area in Feedlots (acres) | Number of Milking Cows | Number of Non-Milking Cows (Equ. Milking Cows) | Total Mass of Manure Disposed in Basin (tons) | Mass of TDS from Manure to Groundwater (tons) | Mass of Nitrate from Manure Entering Soil (tons) | Theoretical Manure Disposal Area (acres) | Theoretical Manure Application Rate (tons/acre) |
|---|---|---|---|---|---|---|---|---|---|
| *1949* | 55 | 47 | 1,079 | 324 | 4,217 | 329 | 53 | 86,988 | 0.05 |
| 1950 | 457 | 389 | 8,969 | 2,697 | 35,071 | 2,736 | 440 | 85,187 | 0.4 |
| 1951 | 860 | 731 | 16,860 | 5,071 | 65,925 | 5,142 | 828 | 83,386 | 1 |
| 1952 | 1,262 | 1,073 | 24,751 | 7,444 | 96,779 | 7,549 | 1,215 | 81,585 | 1 |
| 1953 | 1,665 | 1,415 | 32,642 | 9,817 | 127,632 | 9,955 | 1,603 | 79,784 | 2 |
| 1954 | 2,067 | 1,757 | 40,533 | 12,190 | 158,486 | 12,362 | 1,990 | 77,982 | 2 |
| 1955 | 2,469 | 2,099 | 48,424 | 14,563 | 189,340 | 14,769 | 2,377 | 76,181 | 2 |
| 1956 | 2,872 | 2,441 | 56,315 | 16,936 | 220,194 | 17,175 | 2,765 | 74,380 | 3 |
| *1957* | 3,274 | 2,783 | 64,205 | 19,309 | 251,048 | 19,582 | 3,152 | 72,579 | 3 |
| 1958 | 3,511 | 2,984 | 68,856 | 20,708 | 269,233 | 21,000 | 3,381 | 71,210 | 4 |
| 1959 | 3,748 | 3,186 | 73,507 | 22,107 | 287,419 | 22,419 | 3,609 | 69,840 | 4 |
| 1960 | 3,986 | 3,388 | 78,158 | 23,505 | 305,605 | 23,837 | 3,837 | 68,471 | 4 |
| 1961 | 4,223 | 3,589 | 82,809 | 24,904 | 323,790 | 25,256 | 4,066 | 67,102 | 5 |
| 1962 | 4,460 | 3,791 | 87,460 | 26,303 | 341,976 | 26,674 | 4,294 | 65,733 | 5 |
| *1963* | 4,697 | 3,992 | 92,111 | 27,702 | 360,162 | 28,093 | 4,522 | 64,364 | 6 |
| 1964 | 4,918 | 4,181 | 96,450 | 29,007 | 377,127 | 29,416 | 4,735 | 62,848 | 6 |
| 1965 | 5,140 | 4,369 | 100,789 | 30,311 | 394,092 | 30,739 | 4,948 | 61,331 | 6 |
| 1966 | 5,361 | 4,557 | 105,128 | 31,616 | 411,058 | 32,063 | 5,161 | 59,815 | 7 |
| 1967 | 5,582 | 4,745 | 109,467 | 32,921 | 428,023 | 33,386 | 5,374 | 58,299 | 7 |
| 1968 | 5,803 | 4,933 | 113,806 | 34,226 | 444,988 | 34,709 | 5,587 | 56,783 | 8 |
| 1969 | 6,025 | 5,121 | 118,145 | 35,531 | 461,953 | 36,032 | 5,800 | 55,267 | 8 |
| 1970 | 6,246 | 5,309 | 122,483 | 36,836 | 478,919 | 37,356 | 6,014 | 53,750 | 9 |
| 1971 | 6,467 | 5,497 | 126,822 | 38,141 | 495,884 | 38,679 | 6,227 | 52,234 | 9 |
| 1972 | 6,688 | 5,685 | 131,161 | 39,445 | 512,849 | 40,002 | 6,440 | 50,718 | 10 |
| 1973 | 6,910 | 5,873 | 135,500 | 40,750 | 529,815 | 41,326 | 6,653 | 49,202 | 11 |
| 1974 | 7,131 | 6,061 | 143,657 | 42,793 | 370,912 | 28,931 | 4,657 | 47,685 | 8 |
| *1975* | 7,352 | 6,249 | 152,052 | 44,859 | 391,155 | 30,510 | 4,912 | 46,169 | 8 |
| 1976 | 7,464 | 6,344 | 158,358 | 46,267 | 405,388 | 31,659 | 5,097 | 44,635 | 9 |
| 1977 | 7,575 | 6,439 | 164,784 | 47,673 | 420,808 | 32,823 | 5,284 | 43,100 | 10 |
| 1978 | 7,687 | 6,534 | 171,330 | 49,077 | 435,911 | 34,001 | 5,473 | 41,566 | 10 |
| 1979 | 7,799 | 6,629 | 177,995 | 50,478 | 451,194 | 35,193 | 5,665 | 40,031 | 11 |
| 1980 | 7,910 | 6,724 | 184,780 | 51,874 | 466,654 | 36,399 | 5,860 | 38,497 | 12 |
| 1981 | 8,022 | 6,819 | 191,684 | 53,264 | 482,287 | 37,618 | 6,056 | 36,962 | 13 |
| 1982 | 8,134 | 6,914 | 198,708 | 54,648 | 498,090 | 38,851 | 6,254 | 35,427 | 14 |
| 1983 | 8,245 | 7,009 | 205,852 | 56,024 | 514,059 | 40,097 | 6,455 | 33,893 | 15 |
| *1984* | 8,357 | 7,103 | 213,115 | 57,392 | 530,192 | 41,355 | 6,657 | 32,358 | 16 |
| *1985* | 8,469 | 7,198 | 220,498 | 58,750 | 546,484 | 42,626 | 6,862 | 31,091 | 18 |
| *1986* | 8,580 | 7,293 | 228,000 | 60,097 | 562,932 | 43,909 | 7,068 | 29,823 | 19 |
| *1987* | 8,692 | 7,388 | 200,070 | 54,019 | 498,200 | 38,860 | 6,256 | 28,556 | 17 |
| *1988* | 8,804 | 7,483 | 171,347 | 47,608 | 431,100 | 33,626 | 5,413 | 27,288 | 16 |
| *1989* | 8,915 | 7,578 | 173,520 | 48,212 | 436,568 | 34,052 | 5,482 | 26,020 | 17 |
| *1990* | 8,915 | 7,578 | 175,414 | 48,738 | 441,332 | 34,424 | 5,542 | 24,753 | 18 |
| *1991* | 8,915 | 7,578 | 177,308 | 49,264 | 446,097 | 34,796 | 5,601 | 23,485 | 19 |
| *1992* | 8,915 | 7,578 | 179,201 | 49,790 | 450,861 | 35,167 | 5,661 | 22,218 | 20 |
| *1993* | 8,915 | 7,578 | 181,095 | 50,316 | 455,626 | 35,539 | 5,721 | 20,950 | 22 |
| *1994* | 8,915 | 7,578 | 182,989 | 50,842 | 460,391 | 35,910 | 5,781 | 20,950 | 22 |
| *1995* | 8,915 | 7,578 | 184,883 | 51,369 | 465,155 | 36,282 | 5,841 | 20,950 | 22 |
| *1996* | 8,915 | 7,578 | 186,776 | 51,895 | 469,920 | 36,654 | 5,901 | 20,950 | 22 |
| 1997 | 8,915 | 7,578 | 188,670 | 52,421 | 474,684 | 37,025 | 5,960 | 20,950 | 23 |
| Totals | | | | | 18,678,084 | 1,456,391 | 234,530 | na | na |
| Average | 6,106 | 5,190 | 129,562 | 36,939 | 381,185 | 29,732 | 4,786 | 49,364 | 10 |

Sources: Final Task 6 Memorandum, Development of a Three-Dimensional Groundwater Model, Montgomery Watson, 1994; RWQCB
1997 Cow count:9 (personal conversation with Robert Holub of RWQCB, 1998)

## Table 4.5-9
## AVERAGE TDS VALUES FOR SELECTED WELLS WITHIN EACH MANAGEMENT AREA

| Well | Average TDS (mg/l) Per Period | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 |
| *Management Zone 1A* | | | | | | | |
| 01S08W15J01 | 276 | 247 | N/A | 208 | 294 | 301 | 304 |
| 01S08W25Q02 | N/A | 181 | 233 | 209 | 213 | 219 | 206 |
| 01S08W15R00 | N/A | N/A | N/A | 213 | 216 | 200 | 219 |
| 01S08W34A01 | N/A | N/A | 250 | 219 | 331 | 376 | N/A |
| 01S07W08N01 | 209 | 227 | 199 | 226 | 239 | 214 | 224 |
| 01S08W11R01 | N/A | 312 | 383 | 345 | 394 | 333 | 371 |
| 01S08W14A03 | 374 | 292 | 295 | 388 | 358 | N/A | N/A |
| 01S08W27H01 | N/A | N/A | 483 | 434 | 443 | 678 | 607 |
| 01S08W31J01 | N/A | N/A | N/A | N/A | N/A | 411 | 408 |
| *Management Zone 1B* | | | | | | | |
| 02S08W23C01 | 390 | N/A | N/A | 205 | N/A | 259 | 208 |
| 02S08W11L04 | N/A | 236 | 222 | 206 | 208 | N/A | 228 |
| 02S08W15C03 | N/A | N/A | 284 | 295 | 291 | 353 | 349 |
| 02S08W22J01 | N/A | 261 | N/A | 645 | N/A | N/A | 781 |
| *Management Zone 2A* | | | | | | | |
| 01S06W31D01 | 160 | 134 | N/A | 164 | N/A | 250 | 193 |
| 01S07W14G01 | N/A | N/A | 189 | 193 | 186 | 224 | 172 |
| 01S07W27D01 | N/A | 183 | 250 | 220 | 232 | 247 | N/A |
| 02S07W04B01 | 236 | 218 | 215 | N/A | N/A | N/A | N/A |
| 01S07W13R01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *Management Zone 2B* | | | | | | | |
| 02S07W22K01 | 617 | 215 | 250 | 315 | N/A | N/A | 223 |
| *Management Zone 3A* | | | | | | | |
| 01S06W11B01 | 210 | 204 | 206 | 220 | N/A | 244 | 218 |
| 01S06W23D01 | 230 | N/A | N/A | 241 | N/A | 264 | 275 |
| 02S06W05A01 | 196 | 184 | 198 | N/A | N/A | 227 | 248 |
| 01S05W21B01 | 268 | 256 | 291 | N/A | 344 | 354 | N/A |
| *Management Zone 3B* | | | | | | | |
| 02S07W34K02 | 1305 | 1778 | 1977 | 735 | N/A | N/A | N/A |
| 03S07W03N01 | 399 | 574 | 592 | N/A | N/A | N/A | N/A |
| *Management Zone 4* | | | | | | | |
| 02S06W16B04 | N/A | N/A | 316 | 310 | 735 | 696 | N/A |
| 02S06W16B03 | N/A | N/A | 348 | 370 | 765 | 658 | 788 |
| *Management Zone 5* | | | | | | | |
| 03S07W11L03 | 600 | 578 | 633 | 645 | 771 | 660 | 841 |
| 02S06W26D02 | 497 | 580 | 650 | 685 | N/A | 720 | N/A |
| 02S07W36H02 | N/A | 1065 | 1477 | 1257 | 1156 | 1100 | 1047 |

## Table 4.5-10
## AVERAGE NITRATE VALUES FOR SELECTED WELLS WITHIN EACH MANAGEMENT AREA

| Well | Average Nitrate-N (mg/l) Per Period | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1961-1965 | 1966-1970 | 1971-1975 | 1976-1980 | 1981-1985 | 1986-1990 | 1991-1995 |
| *Management Zone 1A* | | | | | | | |
| 01S07W08N01 | 2.7 | 4.9 | 3.3 | 4.2 | 4.4 | 4.6 | 5.4 |
| 01S08W11R01 | N/A | 22.4 | 21.0 | 19.4 | 21.8 | 17.9 | 18.8 |
| 01S08W14A03 | 21.2 | 12.9 | 22.6 | 15.4 | 17.0 | N/A | 18.4 |
| 01S08W15J01 | 8.3 | 7.0 | N/A | 7.4 | 6.5 | 5.1 | 6.7 |
| 01S08W15R00 | N/A | N/A | N/A | 3.2 | 2.4 | 4.8 | 3.1 |
| 01S08W25Q02 | N/A | 2.7 | 3.8 | 4.3 | 3.4 | 4.0 | 5.2 |
| 01S08W27H01 | N/A | N/A | 1.5 | 13.8 | 20.4 | 4.9 | 4.0 |
| 01S08W31J01 | N/A | N/A | N/A | N/A | N/A | 6.4 | 6.8 |
| 01S08W34A01 | N/A | N/A | 5.2 | 4.0 | 11.7 | 17.7 | N/A |
| *Management Zone 1B* | | | | | | | |
| 02S08W11L04 | N/A | 2.6 | 1.8 | 1.7 | 1.9 | N/A | 4.8 |
| 02S08W15C03 | N/A | N/A | 3.0 | 2.2 | 3.4 | 4.8 | 5.6 |
| 02S08W22J01 | N/A | 1.8 | N/A | 12.3 | N/A | 17.9 | 19.5 |
| 02S08W23C01 | 5.0 | N/A | N/A | 3.2 | N/A | 5.6 | 5.2 |
| *Management Zone 2A* | | | | | | | |
| 01S06W31D01 | 0.4 | 0.5 | N/A | 1.3 | 1.9 | 2.5 | 1.9 |
| 01S07W13R01 | 0.8 | N/A | N/A | N/A | N/A | N/A | N/A |
| 01S07W14G01 | N/A | N/A | 2.9 | 0.4 | 0.4 | 0.5 | 0.7 |
| 01S07W27D01 | 2.7 | 2.9 | 3.0 | 5.0 | 5.0 | 4.6 | 0.0 |
| 02S07W04B01 | 1.8 | 2.3 | 2.4 | N/A | N/A | N/A | N/A |
| *Management Zone 2B* | | | | | | | |
| 02S07W22K01 | 9.5 | 1.6 | 1.7 | 5.9 | N/A | N/A | 3.5 |
| *Management Zone 3A* | | | | | | | |
| 01S05W21B01 | 6.5 | 8.6 | 8.9 | N/A | 15.2 | 15.2 | N/A |
| 01S06W11B01 | 1.9 | 1.1 | 1.8 | 2.5 | 2.5 | 4.3 | 5.5 |
| 01S06W23D01 | 4.0 | N/A | N/A | 5.8 | 3.3 | 7.2 | 12.2 |
| 02S06W05A01 | 1.4 | 1.3 | 1.5 | N/A | N/A | 2.9 | 5.2 |
| *Management Zone 3B* | | | | | | | |
| 02S07W34K02 | 4.8 | 8.3 | 16.5 | 0.5 | N/A | N/A | N/A |
| 03S07W03N01 | 3.1 | 5.7 | 8.0 | N/A | N/A | N/A | N/A |
| *Management Zone 4* | | | | | | | |
| 02S06W16B03 | N/A | N/A | 4.4 | 7.8 | 19.4 | 22.6 | 23.3 |
| 02S06W16B04 | N/A | N/A | 6.5 | 7.5 | 19.9 | 24.3 | 22.6 |
| *Management Zone 5* | | | | | | | |
| 02S06W26D02 | 3.6 | 3.4 | 5.4 | 8.1 | N/A | 8.6 | N/A |
| 02S07W36H02 | N/A | 3.8 | 6.7 | 4.3 | 6.9 | 2.7 | 6.5 |
| 03S07W11L03 | 0.5 | 0.8 | 0.7 | 3.6 | 3.2 | 6.1 | 14.9 |

## Table 4.5-11a
## INORGANIC CONSTITUENTS, THMs, RADIOACTIVITY WITH PRIMARY MCLs

| Constituent | Observations At or Above 1/2*MCL | Wells w/ Observations At or Above 1/2*MCL | Observations At or Above MCL | Wells w/ Observations At or Above MCL | MCL |
|---|---|---|---|---|---|
| *Inorganic Chemicals* | | | | | |
| Aluminum | 2 | 2 | 0 | 0 | 1 mg/L |
| Antimony | 0 | 0 | 0 | 0 | 0.006 mg/L |
| Arsenic | 8 | 1 | 0 | 0 | 0.05 mg/L |
| Asbestos | 0 | 0 | 0 | 0 | 0.05 mg/L |
| Barium | 0 | 0 | 0 | 0 | 1 mg/L |
| Beryllium | 7 | 5 | 2 | 1 | 0.004 mg/L |
| Cadmium | 17 | 8 | 5 | 4 | 0.005 mg/L |
| Chromium | 16 | 10 | 7 | 5 | 0.05 mg/L |
| Cyanide | 0 | 0 | 0 | 0 | 0.2 mg/L |
| Fluoride | 302 | 51 | 160 | 30 | 2 mg/L |
| Mercury | 4 | 3 | 2 | 2 | 0.002 mg/L |
| Nickel | 2 | 2 | 0 | 0 | 0.1 mg/L |
| Nitrate (as N) | 4165 | 513 | 2053 | 322 | 10 mg/L |
| Selenium | 3 | 1 | 3 | 1 | 0.05 mg/L |
| Thallium | 0 | 0 | 0 | 0 | 0.002 mg/L |
| *Total Trihalomethanes* | | | | | |
| Total Trihalomethanes[a] | 0 | 0 | 0 | 0 | 0.1 mg/L |
| Bromodichloromethane (THM) | 0 | 0 | 0 | 0 | see THM |
| Bromoform (THM) | 0 | 0 | 0 | 0 | see THM |
| Chloroform (THM) | 0 | 0 | 0 | 0 | see THM |
| Dibromochloromethane (THM) | 0 | 0 | 0 | 0 | see THM |
| *Radioactivity* | | | | | |
| Gross Alpha Particle Activity | 39 | 16 | 11 | 7 | 15 pCi/L |
| Gross Beta Particle Activity | 0 | 0 | 0 | 0 | 50 pCi/L |
| Radium-226 and 228[b] | 0 | 0 | 0 | 0 | pCi/L |
| Strontium-90 | 0 | 0 | 0 | 0 | 8 pCi/L |
| Tritium | 0 | 0 | 0 | 0 | 20,000 pCi/L |
| Uranium | 5 | 3 | 0 | 0 | 20 pCi/L |

(a) Includes individual THM constituents analyzed separately
(b) Radium-226 MCL is 3 pCi/L; Radium-228 MCL is 2 pCi/L

## Table 4.5-11b
## ORGANIC CHEMICALS WITH PRIMARY MCLs

| Constituent | Observations At or Above 1/2*MCL | Wells w/ Observations At or Above 1/2*MCL | Observations At or Above MCL | Wells w/ Observations At or Above MCL | MCL |
|---|---|---|---|---|---|
| *Organic Chemicals* | | | | | |
| 1,1,1-Trichloroethane (1,1,2-TCA) | 0 | 0 | 0 | 0 | 0.2 mg/L |
| 1,1,2,2-Tetrachloroethane | 0 | 0 | 0 | 0 | 0.001 mg/L |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane | 0 | 0 | 0 | 0 | 1.2 mg/L |
| 1,1,2-Trichloroethane (1,1,2-TCA) | 0 | 0 | 0 | 0 | 0.005 mg/L |
| 1,1-Dichloroethane | 34 | 7 | 22 | 7 | 0.005 mg/L |
| 1,1-Dichloroethylene | 497 | 18 | 355 | 13 | 0.006 mg/L |
| 1,2,4-Trichlorobenzene | 0 | 0 | 0 | 0 | 0.07 mg/L |
| 1,2-Dichlorobenzene | 0 | 0 | 0 | 0 | 0.6 mg/L |
| 1,2-Dichloroethane | 134 | 77 | 122 | 76a | 0.0005 mg/L |
| 1,2-Dichloropropane | 1 | 1 | 0 | 0 | 0.005 mg/L |
| 1,3-Dichloropropane | 0 | 0 | 0 | 0 | 0.0005 mg/L |
| 1,4-Dichlorobenzene | 3 | 2 | 2 | 1 | 0.005 mg/L |
| 2,3,7,8-TCDD (Dioxin) | 0 | 0 | 0 | 0 | 0.00000003 mg/L |
| 2,4,5,-TP (Silvex) | 0 | 0 | 0 | 0 | 0.05 mg/L |
| 2,4-D | 0 | 0 | 0 | 0 | 0.07 mg/L |
| Alachlor | 0 | 0 | 0 | 0 | 0.002 mg/L |
| Atrazine | 0 | 0 | 0 | 0 | 0.003 mg/L |
| Bentazon | 0 | 0 | 0 | 0 | 0.018 mg/L |
| Benzene | 155 | 89 | 43 | 23 | 0.001 mg/L |
| Benzo(a)Pyrene | 0 | 0 | 0 | 0 | 0.0002 mg/L |
| Carbofuran | 0 | 0 | 0 | 0 | 0.018 mg/L |
| Carbon Tetrachloride | 1 | 1 | 1 | 1 | 0.0005 mg/L |
| Chlordane | 0 | 0 | 0 | 0 | 0.0001 mg/L |
| cis-1,2-Dichloroethylene | 9 | 3 | 4 | 1 | 0.006 mg/L |
| Di (2-ethylhexyl) Adipate | 0 | 0 | 0 | 0 | 0.4 mg/L |
| Di(2-Ethlhexyl)Phthalate | 25 | 10 | 25 | 10 | 0.004 mg/L |
| Dibromochloropropane (DBCP) | 1068 | 45 | 758 | 41 | 0.0002 mg/L |
| Dinosep | 0 | 0 | 0 | 0 | 0.007 mg/L |
| Diquat | 0 | 0 | 0 | 0 | 0.02 mg/L |
| Endothal | 0 | 0 | 0 | 0 | 0.1 mg/L |
| Endrin | 0 | 0 | 0 | 0 | 0.002 mg/L |
| Ethylbenzene | 0 | 0 | 0 | 0 | 0.7 mg/L |
| Ethylene Dibromide (EDB) | 3 | 3 | 1 | 1 | 0.00005 mg/L |
| Glyphosate | 0 | 0 | 0 | 0 | 0.7 mg/L |
| Heptachlor | 0 | 0 | 0 | 0 | 0.00001 mg/L |
| Heptachlor Epoxide | 0 | 0 | 0 | 0 | 0.00001 mg/L |
| Hexachlorobenzene | 0 | 0 | 0 | 0 | 0.001 mg/L |
| Hexachlorocyclopentadiene | 0 | 0 | 0 | 0 | 0.05 mg/L |
| Lindane (gamma-BHC) | 61 | 46 | 20 | 15 | 0.0002 mg/L |
| Methoxychlor | 0 | 0 | 0 | 0 | 0.04 mg/L |
| Molinate | 0 | 0 | 0 | 0 | 0.02 mg/L |
| Monochlorobenzene | 0 | 0 | 0 | 0 | 0.07 mg/L |
| Oxamyl | 0 | 0 | 0 | 0 | 0.2 mg/L |
| Pentachlorophenol | 0 | 0 | 0 | 0 | 0.001 mg/L |
| Picloram | 0 | 0 | 0 | 0 | 0.5 mg/L |
| Polychlorinated Biphenyls (PCB's) | 0 | 0 | 0 | 0 | 0.0005 mg/L |
| Simazine | 0 | 0 | 0 | 0 | 0.004 mg/L |
| Styrene | 0 | 0 | 0 | 0 | 0.1 mg/L |
| Tetrachloroethene (PCE) | 521 | 59 | 198 | 54 | 0.005 mg/L |
| Thiobencarb | 0 | 0 | 0 | 0 | 0.07 mg/L |
| Toluene | 0 | 0 | 0 | 0 | 0.15 mg/L |
| Toxaphene | 0 | 0 | 0 | 0 | 0.003 mg/L |
| trans-1,2-Dichloroethylene | 0 | 0 | 0 | 0 | 0.01 mg/L |
| Trichloroethene (TCE) | 1022 | 85 | 699 | 74 | 0.005 mg/L |
| Trichlorofluoromethane | 0 | 0 | 0 | 0 | 0.15 mg/L |
| Vinyl chloride | 154 | 81 | 136 | 79 | 0.0005 mg/L |
| Xylene | 0 | 0 | 0 | 0 | 1.75 mg/L |

(a) 67 wells at MCL only 2 wells have elevated results

## Table 4.5-11c
## INORGANIC CONSTITUENTS, ORGANIC CHEMICALS WITH SECONDARY MCLs; LEAD AND COPPER RULE; AND CONSTITUENTS WITH DHS ACTION LEVELS

| Constituent | Observations At or Above 1/2*MCL | Wells w/ Observations At or Above 1/2*MCL | Observations At or Above MCL | Wells w/ Observations At or Above MCL | MCL |
|---|---|---|---|---|---|
| *Secondary MCL* | | | | | |
| Foaming Agents (MBAS) | 41 | 22 | 37 | 19 | 0.5 mg/L |
| Iron | 104 | 48 | 54 | 28 | 0.3 mg/L |
| Manganese | 317 | 45 | 285 | 24 | 0.05 mg/L |
| Silver | 1 | 1 | 1 | 1 | 0.1 mg/L |
| Total Dissolved Solids (TDS)[b] | 2978 | 522 | 1077 | 219 | 500 mg/L |
| Total Dissolved Solids (TDS)[c] | 1077 | 219 | 119 | 44 | 1,000 mg/L |
| Zinc | 1 | 1 | 0 | 0 | 5 mg/L |
| *Lead and Copper Rule* | | | | | |
| Copper | 1 | 1 | 0 | 0 | 1 mg/L |
| Lead | 62 | 25 | 24 | 14 | 0.015 mg/L |
| *DHS Action Levels* | | | | | |
| **Inorganics** | | | | | |
| Boron | 122 | 47 | 48 | 19 | 1 mg/L |
| Perchlorate | 7 | 4 | 1 | 1 | 0.018 mg/L |
| **Organics** | | | | | |
| 1,3-Dichlorobenzene | 0 | 0 | 0 | 0 | 0.13 mg/L |
| 2,4-Dimethylphenol | 0 | 0 | 0 | 0 | 0.4 mg/L |
| 2-Chlorotoluene | 0 | 0 | 0 | 0 | 0.045 mg/L |
| 4-Chlorotoluene | 0 | 0 | 0 | 0 | 0.045 mg/L |
| a-Benzene Hexachloride | 0 | 0 | 0 | 0 | 0.0007 mg/L |
| Aldicarb | 0 | 0 | 0 | 0 | 0.01 mg/L |
| Aldrin | 0 | 0 | 0 | 0 | 0.00005 mg/L |
| Baygon | 0 | 0 | 0 | 0 | 0.09 mg/L |
| b-Benzene Hexachloride | 0 | 0 | 0 | 0 | 0.0003 mg/L |
| Captan | 0 | 0 | 0 | 0 | 0.35 mg/L |
| Carbaryl | 0 | 0 | 0 | 0 | 0.06 mg/L |
| Diazinon | 0 | 0 | 0 | 0 | 0.014 mg/L |
| Dichlorodifluoromethane | 0 | 0 | 0 | 0 | 1 mg/L |
| Dieldrin | 0 | 0 | 0 | 0 | 0.00005 mg/L |
| Dimethoate | 0 | 0 | 0 | 0 | 0.14 mg/L |
| Diphenamide | 0 | 0 | 0 | 0 | 0.04 mg/L |
| Ethion | 0 | 0 | 0 | 0 | 0.035 mg/L |
| Formaldehyde | 0 | 0 | 0 | 0 | 0.03 mg/L |
| Heptachlor | 0 | 0 | 0 | 0 | 0.05 mg/L |
| Isopropyl N Carbamate | 0 | 0 | 0 | 0 | 0.035 mg/L |
| Malathion | 0 | 0 | 0 | 0 | 0.16 mg/L |
| Methyl Isobutyl Ketone | 0 | 0 | 0 | 0 | 0.04 mg/L |
| Methyl Parathion | 0 | 0 | 0 | 0 | 0.03 mg/L |
| Methyl-Tert-Butyl Ether | 0 | 0 | 0 | 0 | 0.035 mg/L |
| n-Butylbenzene | 0 | 0 | 0 | 0 | 0.045 mg/L |
| Parathion | 0 | 0 | 0 | 0 | 0.03 mg/L |
| Pentachloronitrobenzene | 0 | 0 | 0 | 0 | 0.0009 mg/L |
| Phenol | 6 | 2 | 5 | 2 | 0.005 mg/L |
| Trithion | 0 | 0 | 0 | 0 | 0.007 mg/L |

(a) Not including constituents contained in Primary MCL standards
(b) Recommended Secondary MCL Range of 500 mg/l
(c) Upper Secondary MCL Range of 1,000 mg/l

## Table 4.5-12
## CONSTITUENTS DETECTED AT OR GREATER THAN THEIR MCLs

| Constituent | Observations At or Above 1/2*MCL | Wells w/ Observations At or Above 1/2*MCL | Observations At or Above MCL | Wells w/ Observations At or Above MCL | MCL |
|---|---|---|---|---|---|
| *Inorganic Constituents* | | | | | |
| Aluminum | 2 | 2 | 0 | 0 | 1 mg/L |
| Arsenic | 8 | 1 | 0 | 0 | 0.05 mg/L |
| Beryllium | 7 | 5 | 2 | 1 | 0.004 mg/L |
| Boron | 122 | 47 | 48 | 19 | 1 mg/L |
| Cadmium | 17 | 8 | 5 | 4 | 0.005 mg/L |
| Chromium | 16 | 10 | 7 | 5 | 0.05 mg/L |
| Copper | 1 | 1 | 0 | 0 | 1 mg/L |
| Fluoride | 302 | 51 | 160 | 30 | 2 mg/L |
| Iron | 104 | 48 | 54 | 28 | 0.3 mg/L |
| Lead | 62 | 25 | 24 | 14 | 0.015 mg/L |
| Manganese | 317 | 45 | 285 | 24 | 0.05 mg/L |
| Mercury | 4 | 3 | 2 | 2 | 0.002 mg/L |
| Nickel | 2 | 2 | 0 | 0 | 0.1 mg/L |
| Nitrate (as N) | 4165 | 513 | 2053 | 322 | 10 mg/L |
| Perchlorate | 7 | 4 | 1 | 1 | 0.018 mg/L |
| Selenium | 3 | 1 | 3 | 1 | 0.05 mg/L |
| Silver | 1 | 1 | 1 | 1 | 0.1 mg/L |
| Total Dissolved Solids (TDS)[a] | 2978 | 522 | 1077 | 219 | 500 mg/L |
| Total Dissolved Solids (TDS)[b] | 1077 | 219 | 119 | 44 | 1,000 mg/L |
| Zinc | 1 | 1 | 0 | 0 | 5 mg/L |
| *Radioactivity* | | | | | |
| Gross Alpha Particle Activity | 39 | 16 | 11 | 7 | 15 pCi/L |
| Uranium | 5 | 3 | 0 | 0 | 20 pCi/L |
| *Volatile Organic Chemicals* | | | | | |
| 1,1-Dichloroethane | 34 | 7 | 22 | 7 | 0.005 mg/L |
| 1,1-Dichloroethylene | 497 | 18 | 355 | 13 | 0.006 mg/L |
| 1,2-Dichloroethane | 134 | 77 | 122 | 76 | 0.0005 mg/L |
| 1,2-Dichloropropane | 1 | 1 | 0 | 0 | 0.005 mg/L |
| 1,4-Dichlorobenzene | 3 | 2 | 2 | 1 | 0.005 mg/L |
| Benzene | 155 | 89 | 43 | 23 | 0.001 mg/L |
| Carbon Tetrachloride | 1 | 1 | 1 | 1 | 0.0005 mg/L |
| cis-1,2-Dichloroethylene | 9 | 3 | 4 | 1 | 0.006 mg/L |
| Phenol | 6 | 2 | 5 | 2 | 0.005 mg/L |
| Tetrachloroethene (PCE) | 521 | 59 | 198 | 54 | 0.005 mg/L |
| Trichloroethene (TCE) | 1022 | 85 | 699 | 74 | 0.005 mg/L |
| Vinyl chloride | 154 | 81 | 136 | 79 | 0.0005 mg/L |
| *Semi-Volatile Organic Chemical* | | | | | |
| Di(2-Ethlhexyl)Phthalate | 25 | 10 | 25 | 10 | 0.004 mg/L |
| *Pesticides/Herbicides* | | | | | |
| Dibromochloropropane (DBCP) | 1068 | 45 | 758 | 41 | 0.0002 mg/L |
| Ethylene Dibromide (EDB) | 3 | 3 | 1 | 1 | 0.00005 mg/L |
| Lindane (gamma-BHC) | 61 | 46 | 20 | 15 | 0.0002 mg/L |
| *Aesthetic Standards* | | | | | |
| Foaming Agents (MBAS) | 41 | 22 | 37 | 19 | 0.5 mg/L |

(a) Recommended Secondary MCL Range of 500 mg/l
(b) Upper Secondary MCL Range of 1,000 mg/l

**Table 4.5-13**
**COMPONENTS OF SAFE YIELD**
**ADOPTED IN THE CHINO BASIN JUDGMENT**

| Hydrologic Component | Annual Average (acre-ft/yr) | (%) |
|---|---|---|
| *Inflows to Chino Basin* | | |
| Deep Percolation | | |
| Precipitation and Surface Inflow | 47,500 | 33% |
| Imported Water | 7,000 | 5% |
| Irrigation | | |
| Domestic | 9,800 | 7% |
| Agriculture | 51,900 | 36% |
| Artificial Recharge | 3,900 | 3% |
| Recharge of Sewage | 18,200 | 13% |
| Subsurface Inflow | 7,000 | 5% |
| Total Inflow | 145,300 | 100% |
| *Outflows from Chino Basin* | | |
| Subsurface Outflow | 7,200 | 4% |
| Extractions | 180,000 | 96% |
| Total Outflow | 187,200 | 100% |
| *Hydrologic Balance* | | |
| Estimated Annual Average Change in Storage 1965-1974 | -40,000 | |
| Safe Yield (equal to average annual extraction plus annual average change in storage) | 140,000 | |

## Table 4.5-14
## CIGSM ESTIMATE OF THE CHINO BASIN HYDROLOGIC BUDGET
## 1961 THROUGH 1989 (acre-feet)

| Year | Total Inflow Native Hydrology | Net Recharge from Stream Flow | Artificial Recharge(1) | Groundwater Pumpage | Change in Storage | End of Period Storage |
|---|---|---|---|---|---|---|
| 1961 | 125,306 | -7,071 | 11,561 | 217,536 | -87,740 | 5,202,000 |
| 1962 | 178,032 | -4,822 | 10,785 | 201,790 | -17,795 | 5,184,205 |
| 1963 | 133,270 | -8,167 | 12,466 | 190,303 | -52,734 | 5,131,471 |
| 1964 | 131,485 | -13,229 | 13,959 | 201,234 | -69,019 | 5,062,452 |
| 1965 | 128,015 | -9,024 | 13,902 | 190,358 | -57,465 | 5,004,987 |
| 1966 | 178,168 | -8,248 | 14,362 | 199,904 | -15,622 | 4,989,365 |
| 1967 | 195,119 | -2,428 | 15,336 | 186,264 | 21,763 | 5,011,128 |
| 1968 | 143,669 | -10,342 | 14,619 | 192,597 | -44,651 | 4,966,477 |
| 1969 | 251,892 | 4,321 | 16,927 | 190,489 | 82,651 | 5,049,128 |
| 1970 | 135,837 | -13,076 | 15,059 | 192,103 | -54,283 | 4,994,845 |
| 1971 | 140,908 | -10,250 | 16,179 | 197,057 | -50,220 | 4,944,625 |
| 1972 | 133,383 | -7,170 | 14,000 | 197,428 | -57,215 | 4,887,410 |
| 1973 | 174,962 | 431 | 3,028 | 166,826 | 11,595 | 4,899,005 |
| 1974 | 145,476 | -2,968 | 3,440 | 180,997 | -35,049 | 4,863,956 |
| 1975 | 127,546 | 1,914 | 4,601 | 191,536 | -57,475 | 4,806,481 |
| 1976 | 112,294 | 7,107 | 3,933 | 189,637 | -66,303 | 4,740,178 |
| 1977 | 116,683 | 3,955 | 3,620 | 174,498 | -50,240 | 4,689,938 |
| 1978 | 263,055 | 6,785 | 15,484 | 163,705 | 121,619 | 4,811,557 |
| 1979 | 189,299 | -7,278 | 34,122 | 167,410 | 48,733 | 4,860,290 |
| 1980 | 250,304 | -5,201 | 19,989 | 167,669 | 97,423 | 4,957,713 |
| 1981 | 129,165 | -8,810 | 27,727 | 174,421 | -26,339 | 4,931,375 |
| 1982 | 153,379 | -6,532 | 28,096 | 162,814 | 12,129 | 4,943,504 |
| 1983 | 252,507 | -5,897 | 32,589 | 151,878 | 127,321 | 5,070,825 |
| 1984 | 134,649 | -11,399 | 21,737 | 172,420 | -27,433 | 5,043,392 |
| 1985 | 139,320 | -8,934 | 20,897 | 176,218 | -24,935 | 5,018,457 |
| 1986 | 149,613 | -4,196 | 18,425 | 167,119 | -3,277 | 5,015,180 |
| 1987 | 104,914 | -9,595 | 23,530 | 180,778 | -61,929 | 4,953,251 |
| 1988 | 110,004 | -5,589 | 2,667 | 180,115 | -73,033 | 4,880,218 |
| 1989 | 107,188 | -3,905 | 7,407 | 189,513 | -78,823 | 4,801,395 |
| | | | *Statistics for Period 1961 to 1989* | | | |
| Average | 156,395 | -5,159 | 15,188 | 183,263 | -16,839 | 4,955,683 |
| Max | 263,055 | 7,107 | 34,122 | 217,536 | 127,321 | 5,202,000 |
| Min | 104,914 | -13,229 | 2,667 | 151,878 | -87,740 | 4,689,938 |
| | | | *Statistics for Period 1965 to 1974* | | | |
| Average | 162,743 | -5,875 | 12,685 | 189,402 | -19,850 | 4,961,093 |
| Max | 251,892 | 4,321 | 16,927 | 199,904 | 82,651 | 5,049,128 |
| Min | 128,015 | -13,076 | 3,028 | 166,826 | -57,465 | 4,863,956 |

Source: Revised and final calibration simulations for the CBWRMS; previously unpublished. The results listed above are slightly different than reported by Montgomery Watson (1993) and supersede previously reported values.

## Table 4.5-15
## SUMMARY OF PROJECTED WATER DEMANDS BY PURVEYOR (acre-feet)

| Purveyor | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Ameron | 9 | 9 | 9 | 9 | 9 |
| City of Chino | 15,800 | 17,050 | 18,300 | 19,550 | 20,800 |
| City of Chino Hills | 17,640 | 19,100 | 20,670 | 22,350 | 23,240 |
| City of Norco | 7,000 | 7,400 | 7,700 | 8,400 | 9,000 |
| City of Ontario(a) | 41,530 | 45,830 | 53,530 | 61,330 | 69,030 |
| City of Pomona(a) | 37,200 | 38,440 | 39,580 | 40,900 | 42,104 |
| City of Upland | 22,000 | 23,000 | 24,000 | 24,000 | 24,000 |
| Cucamonga County Water District | 49,910 | 54,440 | 58,960 | 63,480 | 68,000 |
| Fontana Water Company | 36,800 | 41,200 | 45,600 | 49,900 | 54,300 |
| Jurupa Community Services District | 14,200 | 17,000 | 19,600 | 22,200 | 24,800 |
| Kaiser Ventures | 670 | 670 | 670 | 670 | 670 |
| Marygold Mutual Water Company | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |
| Mira Loma Space Center | 25 | 25 | 25 | 25 | 25 |
| Monte Vista Irrigation Company | 0 | 0 | 0 | 0 | 0 |
| Monte Vista Water District | 14,160 | 14,160 | 14,160 | 14,160 | 14,160 |
| San Antonio Water Company - Domestic | 640 | 1,620 | 1,640 | 1,660 | 1,680 |
| San Bern. County Parks Dept. | 75 | 75 | 75 | 75 | 75 |
| San Bernardino Co Division of Airports - Domestic | 300 | 300 | 300 | 300 | 300 |
| Santa Ana River Water Company | 2,000 | 2,090 | 2,120 | 2,140 | 2,170 |
| Reliant Energy | 3,300 | 3,300 | 3,300 | 3,300 | 3,300 |
| Southern California Water Company | 14,200 | 14,950 | 15,680 | 15,680 | 15,680 |
| Sunkist | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| Swan Lake | 350 | 350 | 350 | 350 | 350 |
| West San Bernardino County WD | 6,130 | 7,835 | 10,900 | 10,900 | 10,900 |
| Total Purveyor Demand | 286,859 | 311,894 | 340,259 | 364,509 | 387,763 |
| · Agricultural Producers | 49,100 | 39,975 | 30,850 | 21,725 | 10,000 |
| Total Demand | 335,959 | 351,869 | 371,109 | 386,235 | 397,763 |

Notes:
1 - SB County ag, CIM,and CIW included in the agricultural producers demand
2 - Mira Loma Space Center to be served by Jurupa Community Services District.
3 - Data from Chino Basin Water Resources Management Study Final Report, 1995
4 - Total Ag production from CBWCD and Watermaster Phase 1 Recharge Master Plan by Mark J. Wildermuth, Water Resources Engineers

**Table 4.5-16**
**SUMMARY OF AVERAGE ANNUAL PROJECTED WATER DEMAND BY SOURCE (acre-feet/year)**

| Source | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Imported Water | 62,090 | 77,720 | 103,170 | 117,510 | 125,224 |
| Chino Basin Production Pools 2 and 3 | 148,630 | 157,891 | 156,511 | 168,502 | 180,191 |
| Chino Basin Production Pool 1 | 46,490 | 39,120 | 28,580 | 18,270 | 7,950 |
| Other Local Supplies | 77,711 | 80,895 | 86,890 | 88,010 | 88,590 |
| Recycled Water | 8,300 | 8,300 | 8,300 | 8,300 | 8,300 |
| Total | 343,221 | 363,926 | 383,451 | 400,592 | 410,255 |

## Table 4.5-17
## HYPOTHETICAL REPLENISHMENT PLAN WITH THE OBMP

| (1) Year | (2) Replenishment Obligation | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (11) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Replenishment Plan | | | | | | | | |
| | | Underproduction | | Storage | | | Supplemental Water | | | |
| | | Total | Used for Replenishment | Volume in Storage at Start of Year | Used for Replenishment | Losses | Cyclic Storage Program | | | Imported/ Recycled Replenishment |
| | | | | | | | Storage | Used for Replenishment | Losses | |
| 2001 | 40,000 | 19,437 | 19,437 | 182,705 | 20,000 | 0 | 36,796 | 563 | 0 | 0 |
| 2002 | 43,871 | 19,125 | 19,125 | 162,705 | 20,000 | 0 | 36,233 | 4,746 | 0 | 0 |
| 2003 | 47,742 | 18,814 | 18,814 | 142,705 | 20,000 | 2,654 | 31,487 | 8,928 | 540 | 0 |
| 2004 | 51,613 | 18,502 | 18,502 | 120,051 | 20,000 | 2,201 | 22,018 | 13,111 | 309 | 0 |
| 2005 | 55,485 | 18,191 | 18,191 | 97,850 | 20,000 | 1,757 | 8,598 | 8,598 | 0 | 8,696 |
| 2006 | 59,356 | 18,200 | 18,200 | 76,093 | 20,000 | 1,322 | 0 | 0 | 0 | 21,156 |
| 2007 | 63,227 | 18,208 | 18,208 | 54,771 | 20,000 | 895 | 0 | 0 | 0 | 25,018 |
| 2008 | 67,098 | 18,217 | 18,217 | 33,876 | 20,000 | 478 | 0 | 0 | 0 | 28,881 |
| 2009 | 70,969 | 18,226 | 18,226 | 13,398 | 13,398 | 134 | 0 | 0 | 0 | 39,345 |
| 2010 | 74,840 | 18,235 | 18,235 | 0 | 0 | 0 | 0 | 0 | 0 | 56,605 |
| 2011 | 76,319 | 18,945 | 18,945 | 0 | 0 | 0 | 0 | 0 | 0 | 57,374 |
| 2012 | 77,799 | 19,655 | 19,655 | 0 | 0 | 0 | 0 | 0 | 0 | 58,143 |
| 2013 | 79,278 | 20,366 | 20,366 | 0 | 0 | 0 | 0 | 0 | 0 | 58,912 |
| 2014 | 80,757 | 21,076 | 21,076 | 0 | 0 | 0 | 0 | 0 | 0 | 59,681 |
| 2015 | 82,236 | 21,786 | 21,786 | 0 | 0 | 0 | 0 | 0 | 0 | 60,450 |
| 2016 | 83,804 | 21,975 | 21,975 | 0 | 0 | 0 | 0 | 0 | 0 | 61,830 |
| 2017 | 85,373 | 22,163 | 22,163 | 0 | 0 | 0 | 0 | 0 | 0 | 63,209 |
| 2018 | 86,941 | 22,352 | 22,352 | 0 | 0 | 0 | 0 | 0 | 0 | 64,589 |
| 2019 | 88,509 | 22,540 | 22,540 | 0 | 0 | 0 | 0 | 0 | 0 | 65,969 |
| 2020 | 90,077 | 22,729 | 22,729 | 0 | 0 | 0 | 0 | 0 | 0 | 67,348 |
| Totals | 1,405,295 | 398,742 | 398,742 | 884,153 | 173,398 | 9,441 | 135,132 | 35,946 | 850 | 797,208 |
| Average | 70,265 | 19,937 | 19,937 | 44,208 | 8,670 | 472 | 6,757 | 1,797 | 42 | 39,860 |

## Table 4.5-18a
## PUMPING RIGHTS, PRODUCTION AND REPLENISHMENT OBLIGATIONS FOR YEAR 2020 (acre-feet/year)

| Producer | Initial Share | | With OBMP | | | |
|---|---|---|---|---|---|---|
| | | | Allocation from New Recharge | Operating Yield | Production | Replenishment Obligation |
| *Pool 2 -- Overlying Non Agricultural Pool* | | | | | | |
| Ameron Steel Products | 98 | 1.329% | | 98 | 9 | 0 |
| Angelica Rental Service | 0 | 0.000% | | 0 | 0 | 0 |
| Arrowhead Mountain Spring Water | 0 | 0.000% | | 0 | 0 | 0 |
| Blue Seal Linen | 19 | 0.255% | | 19 | 0 | 0 |
| California Steel Industries | 1,300 | 17.650% | | 1,300 | 1,800 | 500 |
| Calmat Company | 318 | 4.315% | | 318 | 0 | 0 |
| Kaiser Resources | 1,630 | 22.134% | | 1,630 | 670 | 0 |
| Mira Loma Space Center | 104 | 1.414% | | 104 | 25 | 0 |
| Praxair | 427 | 5.803% | | 427 | 0 | 0 |
| Quaker Chemical | 0 | 0.000% | | 0 | 0 | 0 |
| Red Star Fertilizer (to be reassigned) | 16 | 0.213% | | 16 | 0 | 0 |
| San Bernardino Co. Dept. of Airports | 134 | 1.818% | | 134 | 300 | 166 |
| Reliant Energy | 954 | 12.952% | | 954 | 0 | 0 |
| Southern California Edison | 28 | 0.380% | | 28 | 0 | 0 |
| Sunkist Growers | 1,873 | 25.435% | | 1,873 | 1,470 | 0 |
| Swan Lake | 464 | 6.303% | | 464 | 0 | 0 |
| General Electric | 0 | 0.000% | | 0 | 0 | 0 |
| Subtotal | 7,366 | 100.000% | | 7,366 | 4,274 | 666 |
| *Pool 3 -- Appropriative Pool* | | | | | | |
| OBMP Treatment Facilities | 0 | 0.000% | 0 | 0 | 40,000 | 40,000 |
| SAWPA Desalter (1) | 0 | 0.000% | 5,292 | 5,292 | 10,584 | 5,292 |
| Inland Empire Utilities Agency | 0 | 0.000% | 0 | 0 | 0 | 0 |
| City of Chino | 4,034 | 7.357% | 898 | 16,679 | 10,000 | 0 |
| City of Chino Hills | 2,111 | 3.850% | 470 | 4,953 | 3,610 | 0 |
| City of Norco | 202 | 0.368% | 45 | 337 | 0 | 0 |
| City of Ontario | 11,374 | 20.743% | 2,532 | 29,852 | 31,480 | 1,628 |
| City of Pomona | 11,216 | 20.454% | 2,497 | 18,719 | 19,529 | 810 |
| City of Upland | 2,852 | 5.201% | 635 | 4,760 | 3,050 | 0 |
| Cucamonga County Water District | 10,016 | 18.266% | 2,230 | 17,315 | 10,160 | 0 |
| Fontana Union Water Company | 0 | 0.000% | 0 | 0 | 0 | 0 |
| Fontana Water Company | 0 | 0.000% | 0 | 546 | 21,200 | 20,654 |
| Jurupa Community Services District | 1,593 | 2.905% | 355 | 22,159 | 14,450 | 0 |
| Marygold Mutual Water Company | 655 | 1.195% | 146 | 1,093 | 0 | 0 |
| Monte Vista Irrigation Company | 0 | 0.000% | 0 | 0 | 0 | 0 |
| Monte Vista Water District | 5,501 | 10.032% | 1,225 | 9,218 | 14,160 | 4,942 |
| Mutual Water Co. of Glen Avon Heights | 468 | 0.853% | 104 | 781 | 0 | 0 |
| San Antonio Water Company | 1,507 | 2.748% | 336 | 2,515 | 1,110 | 0 |
| San Bernardino County Prado Parks | 0 | 0.000% | 0 | 0 | 75 | 75 |
| Santa Ana River Water Company | 1,301 | 2.373% | 290 | 2,171 | 0 | 0 |
| Southern California Water Company | 412 | 0.751% | 92 | 688 | 2,160 | 1,472 |
| West End Consolidated Water Company | 948 | 1.729% | 211 | 1,582 | 1,500 | 0 |
| West San Bernardino County Water Dist | 644 | 1.174% | 143 | 1,075 | 0 | 0 |
| Subtotal | 54,834 | 100.000% | 17,500 | 139,734 | 183,068 | 74,874 |
| Total Replenishment Obligation | | | | | | 75,540 |
| Underproduction of Rights | | | | | | |
| Overlying Non-Agricultural Pool | | | | | | 3,758 |
| Appropriative Pool | | | | | | 31,540 |
| Total Under Production of Rights | | | | | | 35,297 |
| Deduct SAWPA Desalter Obligation | | | | | | 0 |
| Net "Wet" Replenishment Obligation | | | | | | 44,000 |
| "Wet" Recharge Capacity | | | | | | 80,000 |
| Shortfall in Replenishment | | | | | | 0 |

# Table 4.5-18b
# PUMPING RIGHTS, PRODUCTION AND REPLENISHMENT OBLIGATIONS AFTER ADJUSTMENT FOR LOSS IN YIELD BASELINE (NO OBMP) ALTERNATIVE (acre-feet/year)

| Producer | Initial Share | | Operating Yield | Initial Production Goal | Initial Replenishment Obligation | Year 2020 adjustments Initial Under Production | Reduction 100% on Production | Final Production | Final Under Production | Revised Replenishment Obligation |
|---|---|---|---|---|---|---|---|---|---|---|
| *Pool 2 – Overlying Non Agricultural Pool* | | | | | | | | | | |
| Ameron Steel Products | 98 | 1.524% | 98 | 9 | 0 | 89 | 3 | 6 | 92 | 0 |
| Angelica Rental Service | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arrowhead Mountain Spring Water | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue Seal Linen | 19 | 0.293% | 19 | 0 | 0 | 19 | 0 | 0 | 19 | 0 |
| California Steel Industries | 1,300 | 20.246% | 1,300 | 1,800 | 500 | 0 | 608 | 1,192 | 108 | 0 |
| Calmat Company | 318 | 4.950% | 318 | 0 | 0 | 318 | 0 | 0 | 318 | 0 |
| Kaiser Resources | 1,630 | 25.390% | 1,630 | 670 | 0 | 960 | 226 | 444 | 1,187 | 0 |
| Mira Loma Space Center | 104 | 1.622% | 104 | 25 | 0 | 79 | 8 | 17 | 88 | 0 |
| Praxair | 427 | 6.657% | 427 | 0 | 0 | 427 | 0 | 0 | 427 | 0 |
| Quaker Chemical | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red Star Fertilizer (to be reassigned) | 16 | 0.244% | 16 | 0 | 0 | 16 | 0 | 0 | 16 | 0 |
| San Bernardino Co. Dept. of Airports | 134 | 2.085% | 134 | 300 | 166 | 0 | 101 | 199 | 0 | 65 |
| Reliant Energy | 10 | 0.149% | 10 | 0 | 0 | 10 | 0 | 0 | 10 | 0 |
| Southern California Edison | 28 | 0.436% | 28 | 28 | 0 | 0 | 9 | 19 | 9 | 0 |
| Sunkist Growers | 1,873 | 29.176% | 1,873 | 1,470 | 0 | 403 | 497 | 973 | 900 | 0 |
| Swan Lake | 464 | 7.230% | 464 | 350 | 0 | 114 | 118 | 232 | 232 | 0 |
| General Electric | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 6,421 | 100.000% | 6,421 | 4,652 | 666 | 2,435 | 1,571 | 3,081 | 3,405 | 65 |
| *Pool 3 – Appropriative Pool* | | | | | | | | | | |
| OBMP Treatment Facilities | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter (1) | 0 | 0.000% | 0 | 12,195 | 12,195 | 0 | 4,119 | 8,076 | 0 | 8,076 |
| Inland Empire Utilities Agency | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| City of Chino | 4,034 | 7.357% | 12,838 | 10,950 | 0 | 1,888 | 3,699 | 7,251 | 5,587 | 0 |
| City of Chino Hills | 2,111 | 3.850% | 2,943 | 3,610 | 667 | 0 | 1,219 | 2,391 | 553 | 0 |
| City of Norco | 202 | 0.368% | 145 | 0 | 0 | 145 | 0 | 0 | 145 | 0 |
| City of Ontario | 11,374 | 20.743% | 19,023 | 37,880 | 18,857 | 0 | 12,795 | 25,085 | 0 | 6,062 |
| City of Pomona | 11,216 | 20.454% | 8,040 | 19,529 | 11,489 | 0 | 6,597 | 12,933 | 0 | 4,892 |
| City of Upland | 2,852 | 5.201% | 2,044 | 3,050 | 1,006 | 0 | 1,030 | 2,020 | 25 | 0 |
| Cucamonga County Water District | 10,016 | 18.266% | 7,778 | 10,160 | 2,382 | 0 | 3,432 | 6,728 | 1,050 | 0 |
| Fontana Union Water Company | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fontana Water Company | 0 | 0.000% | 546 | 21,200 | 20,654 | 0 | 7,161 | 14,039 | 0 | 13,493 |
| Jurupa Community Services District | 1,593 | 2.905% | 20,642 | 18,170 | 0 | 2,472 | 6,138 | 12,032 | 8,609 | 0 |
| Marygold Mutual Water Company | 655 | 1.195% | 470 | 0 | 0 | 470 | 0 | 0 | 470 | 0 |
| Monte Vista Irrigation Company | 0 | 0.000% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Monte Vista Water District | 5,501 | 10.032% | 3,980 | 14,160 | 10,180 | 0 | 4,783 | 9,377 | 0 | 5,397 |
| Mutual Water Co. of Glen Avon Heights | 468 | 0.853% | 335 | 0 | 0 | 335 | 0 | 0 | 335 | 0 |
| San Antonio Water Company | 1,507 | 2.748% | 1,080 | 1,110 | 30 | 0 | 375 | 735 | 345 | 0 |
| San Bernardino County Prado Parks | 0 | 0.000% | 0 | 75 | 75 | 0 | 25 | 50 | 0 | 50 |
| Santa Ana River Water Company | 1,301 | 2.373% | 933 | 0 | 0 | 933 | 0 | 0 | 933 | 0 |
| Southern California Water Company | 412 | 0.751% | 295 | 2,160 | 1,865 | 0 | 730 | 1,430 | 0 | 1,135 |
| West End Consolidated Water Company | 948 | 1.729% | 680 | 1,500 | 820 | 0 | 507 | 993 | 0 | 314 |
| West San Bernardino County Water Dist | 644 | 1.174% | 462 | 0 | 0 | 462 | 0 | 0 | 462 | 0 |
| Subtotal | 54,834 | 100.000% | 82,234 | 155,749 | 80,219 | 6,704 | 52,610 | 103,139 | 18,513 | 39,418 |
| Totals | 61,255 | | 88,655 | 160,401 | 80,885 | 9,139 | 54,181 | 106,220 | 21,918 | 39,483 |
| Underproduction of Rights | | | | | | | | | | |
| Overlying Non-Agricultural Pool | | | | | | 2,435 | | | | 3,405 |
| Appropriative Pool | | | | | | 6,704 | | | | 18,513 |
| Total Under Production of Rights | | | | | | 9,139 | | | | 21,918 |
| Deduct SAWPA Desalter Obligation | | | | | | | | | | |
| Net "Wet" Replenishment Obligation | | | | | 74,181 | | | | | 20,970 |
| "Wet" Recharge Capacity | | | | | 20,000 | | | | | 20,000 |
| Shortfall in Replenishment | | | | | 54,181 | | | | | 970 |

## Table 4.5-19
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *City of Chino* | | | | | |
| Chino Basin Wells | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| SAWPA Desalter (8 mgd Plant) | 1,680 | 3,360 | 3,360 | 3,360 | 3,360 |
| WFA Treatment Plant | 4,020 | 2,640 | 2,830 | 3,010 | 3,200 |
| Reclaimed Water | 100 | 1,050 | 1,050 | 1,050 | 1,050 |
| OBMP Supply WFA Transfer from Ontario | 0 | 0 | 0 | 0 | 0 |
| West CBWM OBMP Desalter | 0 | 0 | 1,060 | 2,130 | 3,190 |
| Total Supply | 15,800 | 17,050 | 18,300 | 19,550 | 20,800 |
| Total Demand | 15,800 | 17,050 | 18,300 | 19,550 | 20,800 |
| *City of Chino Hills* | | | | | |
| Chino Basin Wells | 3,610 | 3,610 | 3,610 | 3,610 | 3,610 |
| SAWPA Desalter (8 mgd Plant) | 1,120 | 5,840 | 5,840 | 5,840 | 5,840 |
| SAWPA Desalter (to 10 mgd Plant) | 0 | 1,700 | 1,700 | 1,700 | 1,700 |
| Reclaimed Water | 400 | 1,020 | 1,020 | 1,815 | 2,610 |
| WFA Treatment Plant | 0 | 6,930 | 8,500 | 9,385 | 9,480 |
| MVWD Supply Chino GW | 12,510 | 0 | 0 | 0 | 0 |
| Total Supply | 17,640 | 19,100 | 20,670 | 22,350 | 23,240 |
| Total Demand | 17,640 | 19,100 | 20,670 | 22,350 | 23,240 |
| *City of Norco* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter (8 mgd Plant) | 0 | 0 | 0 | 0 | 0 |
| City of Corona | 220 | 0 | 0 | 0 | 0 |
| Temescal Basin Groundwater | 5,880 | 5,870 | 5,560 | 5,070 | 4,650 |
| Supply from JCSD | 900 | 0 | 0 | 0 | 0 |
| OBMP Supply East CBWM OBMP Desalter | 0 | 1,530 | 2,140 | 3,330 | 4,350 |
| Total Supply | 7,000 | 7,400 | 7,700 | 8,400 | 9,000 |
| Total Demand | 7,000 | 7,400 | 7,700 | 8,400 | 9,000 |
| *City of Ontario* | | | | | |
| Chino Basin Wells | 34,720 | 32,950 | 32,950 | 32,950 | 32,950 |
| WFA Treatment Plant | 6,590 | 12,660 | 15,020 | 17,950 | 20,630 |
| Reclaimed Water | 840 | 840 | 1,680 | 2,520 | 3,360 |
| Supply from SAWC (Chino GW) | 850 | 850 | 850 | 850 | 850 |
| OBMP Supply East CBWM OBMP Desalter | 0 | 0 | 4,500 | 8,530 | 12,710 |
| Total Supply | 43,000 | 47,300 | 55,000 | 62,800 | 70,500 |
| Total Demand | 41,530 | 45,830 | 53,530 | 61,330 | 69,030 |
| Supply to Sunkist (Chino GW) | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |

## Table 4.5-19 (continued)
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *City of Pomona* | | | | | |
| Chino Basin Wells | 5,220 | 5,220 | 5,220 | 5,220 | 5,220 |
| Pomona Nitrate Treatment Plant (Chino GW) | 13,880 | 13,880 | 13,880 | 13,880 | 13,880 |
| Other Groundwater Basins | 5,160 | 5,160 | 5,160 | 5,160 | 5,160 |
| Reclaimed Water | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Pedley Treatment Plant | 3,800 | 3,800 | 3,800 | 3,800 | 3,800 |
| TVMWD Weymouth Treatment Plant | 2,140 | 3,380 | 4,520 | 5,840 | 7,044 |
| Total Supply | 37,200 | 38,440 | 39,580 | 40,900 | 42,104 |
| Total Demand | 37,200 | 38,440 | 39,580 | 40,900 | 42,104 |
| *City of Upland* | | | | | |
| Chino Basin Wells | 2,429 | 2,430 | 3,410 | 3,070 | 3,050 |
| Supply from SAWC (non-Chino GW) | 4,920 | 4,520 | 4,520 | 4,520 | 4,520 |
| Supply from SAWC (San Antonio Canyon TP) | 2,411 | 2,390 | 2,390 | 2,690 | 2,690 |
| Supply from WECWC (Chino GW) | 0 | 1,420 | 1,440 | 1,480 | 1,500 |
| Supply from WECWC (other GW basins) | 4,650 | 4,650 | 4,650 | 4,650 | 4,650 |
| WFA Treatment Plant | 7,590 | 7,590 | 7,590 | 7,590 | 7,590 |
| Total Supply | 22,000 | 23,000 | 24,000 | 24,000 | 24,000 |
| Total Demand | 22,000 | 23,000 | 24,000 | 24,000 | 24,000 |
| *Cucamonga County Water District* | | | | | |
| Chino Basin Wells | 8,000 | 10,160 | 10,160 | 10,160 | 10,160 |
| Other Groundwater Basins | 12,650 | 11,180 | 12,390 | 12,390 | 12,390 |
| Reclaimed Water | 0 | 0 | 0 | 2,402 | 4,804 |
| CCWD Bridge Water Treatment Plant — Surface | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| CCWD Lloyd Michael Treatment Plant ) MWD | 21,710 | 25,550 | 28,860 | 30,978 | 33,096 |
| CCWD Royer-Nesbit Treatment Plant ) MWD | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 |
| Deer Creek | 550 | 550 | 550 | 550 | 550 |
| Total Supply | 49,910 | 54,440 | 58,960 | 63,480 | 68,000 |
| Total Demand | 49,910 | 54,440 | 58,960 | 63,480 | 68,000 |
| *Fontana Water Company* | | | | | |
| Chino Basin Wells | 1,840 | 22,825 | 16,050 | 20,375 | 24,800 |
| Other Groundwater Basins | 12,700 | 12,700 | 12,700 | 12,700 | 12,700 |
| Reclaimed Water | 0 | 0 | 0 | 1,685 | 3,370 |
| Fontana Water Treatment Plant | 0 | 0 | 18,600 | 16,915 | 15,230 |
| Sandhill Treatment Plant | 7,400 | 7,400 | 0 | 0 | 0 |
| Total Supply | 21,940 | 42,925 | 47,350 | 51,675 | 56,100 |
| Total Demand | 36,800 | 41,200 | 45,600 | 49,900 | 54,300 |
| Supply to California Steel | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |

## Table 4.5-19 (continued)
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Jurupa Community Services District* | | | | | |
| Chino Basin Wells (Potable) | 14,425 | 12,535 | 12,885 | 13,265 | 13,625 |
| Chino Basin Wells (Non-potable) | 50 | 250 | 450 | 650 | 850 |
| Other Groundwater Basins | 500 | 500 | 500 | 500 | 500 |
| SAWPA Desalter (8 mgd Plant) | 1,800 | 0 | 0 | 0 | 0 |
| OBMP Supply East CBWM OBMP Desalter | 0 | 3,740 | 5,790 | 7,810 | 9,850 |
| Total Supply | 16,775 | 17,025 | 19,625 | 22,225 | 24,825 |
| Total Demand | 14,200 | 17,000 | 19,600 | 22,200 | 24,800 |
| Supply to Mira Loma SC | 25 | 25 | 25 | 25 | 25 |
| Supply to Norco | 900 | 0 | 0 | 0 | 0 |
| Supply to Swan Lake | 350 | 0 | 0 | 0 | 0 |
| Supply to SARWC | 1,300 | 0 | 0 | 0 | 0 |
| Subtotal | 2,575 | 25 | 25 | 25 | 25 |
| *Mira Loma SC* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from JCSD | 25 | 25 | 25 | 25 | 25 |
| Total Supply | 25 | 25 | 25 | 25 | 25 |
| Total Demand | 25 | 25 | 25 | 25 | 25 |
| *Santa Ana River Water Company* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Almost Chino Basin Wells (along SAR outside legal bndy) | 700 | 910 | 660 | 490 | 320 |
| Supply from JCSD | 1,300 | 0 | 0 | 0 | 0 |
| OBMP Supply East CBWM OBMP Desalter | 0 | 1,180 | 1,460 | 1,650 | 1,850 |
| Total Supply | 2,000 | 2,090 | 2,120 | 2,140 | 2,170 |
| Total Demand | 2,000 | 2,090 | 2,120 | 2,140 | 2,170 |
| *Swan Lake* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from JCSD | 350 | 0 | 0 | 0 | 0 |
| OBMP Supply East CBWM OBMP Desalter | 0 | 350 | 350 | 350 | 350 |
| Total Supply | 350 | 350 | 350 | 350 | 350 |
| Total Demand | 350 | 350 | 350 | 350 | 350 |
| *Marygold Mutual Water Company* | | | | | |
| Baseline Feeder | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |
| Total Supply | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |
| Total Demand | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |

## Table 4.5-19 (continued)
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Monte Vista Water District* | | | | | |
| Chino Basin Wells | 26,670 | 14,160 | 14,160 | 14,160 | 14,160 |
| WFA Treatment Plant | 0 | 0 | 0 | 0 | 0 |
| Total Supply | 26,670 | 14,160 | 14,160 | 14,160 | 14,160 |
| Total Demand | 14,160 | 14,160 | 14,160 | 14,160 | 14,160 |
| Supply to Chino Hills (Chino GW) | 12,510 | 0 | 0 | 0 | 0 |
| *San Antonio Water Company -- Domestic* | | | | | |
| Chino Basin Wells | 70 | 1,050 | 1,070 | 1,090 | 1,110 |
| Other Groundwater Basins | 400 | 400 | 400 | 400 | 400 |
| San Antonio Canyon | 0 | 0 | 0 | 0 | 0 |
| San Antonio Tunnel | 1,020 | 1,020 | 1,020 | 1,020 | 1,020 |
| Total Supply | 1,490 | 2,470 | 2,490 | 2,510 | 2,530 |
| Total Demand | 640 | 1,620 | 1,640 | 1,660 | 1,680 |
| Supply to Ontario (Chino GW) | 850 | 850 | 850 | 850 | 850 |
| *Southern California Water Company* | | | | | |
| Chino Basin Wells | 2,160 | 2,160 | 2,160 | 2,160 | 2,160 |
| Other Groundwater Basins | 4,950 | 4,490 | 4,850 | 4,850 | 4,850 |
| TVMWD -- Miramar Water Treatment Plant | 7,090 | 8,300 | 8,670 | 8,670 | 8,670 |
| Total Supply | 14,200 | 14,950 | 15,680 | 15,680 | 15,680 |
| Total Demand | 14,200 | 14,950 | 15,680 | 15,680 | 15,680 |
| West End Consolidated Water Company | | | | | |
| Chino Basin Wells | 0 | 1,420 | 1,440 | 1,480 | 1,500 |
| Other Groundwater Basins | 4,650 | 4,650 | 4,650 | 4,650 | 4,650 |
| Total Supply | 4,650 | 6,070 | 6,090 | 6,130 | 6,150 |
| Total Demand | 0 | 0 | 0 | 0 | 0 |
| Supply to Upland | 4,650 | 6,070 | 6,090 | 6,130 | 6,150 |
| *West San Bernardino County Water District* | | | | | |
| Other Groundwater Basins | 5,330 | 6,835 | 9,520 | 9,510 | 9,510 |
| SBVMWD Baseline Feeder | 800 | 1,000 | 1,380 | 1,390 | 1,390 |
| Total Supply | 6,130 | 7,835 | 10,900 | 10,900 | 10,900 |
| Total Demand | 6,130 | 7,835 | 10,900 | 10,900 | 10,900 |

## Table 4.5-19 (continued)
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor<br>Source | Year<br>2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Ameron* | | | | | |
| Chino Basin Wells | 9 | 9 | 9 | 9 | 9 |
| Total Supply | 9 | 9 | 9 | 9 | 9 |
| Total Demand | 9 | 9 | 9 | 9 | 9 |
| *San Bernardino County Division of Airports* | | | | | |
| Chino Basin Wells (Potable (Domestic)) | 300 | 300 | 300 | 300 | 300 |
| Total Supply | 300 | 300 | 300 | 300 | 300 |
| Total Demand | 300 | 300 | 300 | 300 | 300 |
| *Reliant Energy* | | | | | |
| Chino Basin Wells | 800 | 0 | 0 | 0 | 0 |
| Reclaimed Water | 0 | 3,300 | 3,300 | 3,300 | 3,300 |
| IEUA – MWD Water from CRA | 2,500 | 0 | 0 | 0 | 0 |
| Total Supply | 3,300 | 3,300 | 3,300 | 3,300 | 3,300 |
| Total Demand | 3,300 | 3,300 | 3,300 | 3,300 | 3,300 |
| *Sunkist* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from Ontario (Chino GW) | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| Total Supply | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| Total Demand | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| *Kaiser Ventures* | | | | | |
| Chino Basin Wells | 670 | 670 | 670 | 670 | 670 |
| Total Supply | 670 | 670 | 670 | 670 | 670 |
| Total Demand | 670 | 670 | 670 | 670 | 670 |
| *San Bernardino County Parks Department* | | | | | |
| Chino Basin Wells | 75 | 75 | 75 | 75 | 75 |
| Total Supply | 75 | 75 | 75 | 75 | 75 |
| Total Demand | 75 | 75 | 75 | 75 | 75 |
| *Monte Vista Irrigation Company* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Total Supply | 0 | 0 | 0 | 0 | 0 |
| Total Demand | 0 | 0 | 0 | 0 | 0 |
| *California Steel* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Fontana Water Company | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |
| Total Supply | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |
| Total Demand | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |

## Table 4.5-19 (continued)
## WATER SUPPLY PLANS FOR THE OBMP (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Totals By Source Type and Pool | | | | | |
| Pool 1 Overlying Agricultural Pool | 49,100 | 39,975 | 30,850 | 21,725 | 10,000 |
| Pool 2 Overlying Non-Agricultural Pool | | | | | |
| Chino Basin Groundwater | 3,624 | 2,474 | 2,474 | 2,474 | 2,474 |
| East CBWM OBMP Desalter | 0 | 350 | 350 | 350 | 350 |
| Other Local Supplies | 0 | 0 | 0 | 0 | 0 |
| Imported Water | 2,500 | 0 | 0 | 0 | 0 |
| Recycled Water | 0 | 3,300 | 3,300 | 3,300 | 3,300 |
| Total Pool 2 | 6,124 | 6,124 | 6,124 | 6,124 | 6,124 |
| Pool 3 Appropriative Pool | | | | | |
| Chino Basin Groundwater | 122,774 | 132,700 | 127,495 | 132,120 | 137,125 |
| East CBWM OBMP Desalter | 0 | 6,450 | 13,890 | 21,320 | 28,760 |
| West CBWM OBMP Desalter | 0 | 0 | 1,060 | 2,130 | 3,190 |
| SAWPA Desalter (8 mgd Plant) | 4,600 | 9,200 | 9,200 | 9,200 | 9,200 |
| SAWPA Desalter (10 mgd Plant) | 0 | 1,700 | 1,700 | 1,700 | 1,700 |
| Other Local Supplies | 84,141 | 83,605 | 80,320 | 80,000 | 79,450 |
| Imported Water | | | | | |
| WFA Treatment Plant | 18,200 | 29,820 | 33,940 | 37,935 | 40,900 |
| CCWD Lloyd Michael TP | 21,710 | 25,550 | 28,860 | 30,978 | 33,096 |
| CCWD Royer Nesbit | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Other | 11,730 | 11,680 | 31,790 | 31,425 | 30,944 |
| Subtotal | 49,940 | 68,050 | 95,970 | 101,728 | 106,330 |
| Recycled Water | 8,340 | 9,910 | 10,750 | 16,472 | 22,194 |
| Total Pool 3 | 269,795 | 311,615 | 340,385 | 364,670 | 387,949 |
| Total All Pools | 325,019 | 357,714 | 377,359 | 392,519 | 404,073 |
| Total Water Produced By Desalter Projects | | | | | |
| *OBMP Projects* | | | | | |
| East Desalter Production | 0 | 6,800 | 14,240 | 21,670 | 29,110 |
| East Desalter Raw Water Supply | 0 | 8,000 | 16,753 | 25,494 | 34,247 |
| West Desalter Production | 0 | 0 | 1,060 | 2,130 | 3,190 |
| West Desalter Raw Water Supply | 0 | 0 | 1,247 | 2,506 | 3,753 |
| SAWPA Desalter Expansion Production | 0 | 1,700 | 1,700 | 1,700 | 1,700 |
| SAWPA Desalter Expansion Raw Water Supply | 0 | 1,956 | 1,956 | 1,956 | 1,956 |
| *SAWPA Desalter* | | | | | |
| Production | 4,600 | 9,200 | 9,200 | 9,200 | 9,200 |
| Raw Water Supply | 5,292 | 10,584 | 10,584 | 10,584 | 10,584 |
| *Pomona Ion Exchange* | | | | | |
| Production | 13,880 | 13,880 | 13,880 | 13,880 | 13,880 |
| Raw Water Supply | 14,309 | 14,309 | 14,309 | 14,309 | 14,309 |
| Total Chino Basin Groundwater Production Summary | | | | | |
| Pool 1 | 49,100 | 39,975 | 30,850 | 21,725 | 10,000 |
| Pool 2 | 3,624 | 2,824 | 2,824 | 2,824 | 2,824 |
| Pool 3 | 128,495 | 153,319 | 158,114 | 172,739 | 187,744 |
| Total | 181,219 | 196,118 | 191,788 | 197,288 | 200,568 |

## Table 4.5-20
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *City of Chino* | | | | | |
| Chino Basin Wells | 10,000 | 10,000 | 10,000 | 10,000 | 10,950 |
| SAWPA Desalter (8 mgd Plant) | 1,680 | 3,360 | 3,360 | 3,360 | 3,360 |
| WFA Treatment Plant | 4,020 | 2,640 | 3,890 | 5,140 | 5,440 |
| Reclaimed Water | 100 | 1,050 | 1,050 | 1,050 | 1,050 |
| Total Supply | 15,800 | 17,050 | 18,300 | 19,550 | 20,800 |
| Total Demand | 15,800 | 17,050 | 18,300 | 19,550 | 20,800 |
| *City of Chino Hills* | | | | | |
| Chino Basin Wells | 3,610 | 3,610 | 3,610 | 3,610 | 3,610 |
| SAWPA Desalter (8 mgd Plant) | 1,120 | 2,240 | 2,240 | 2,240 | 2,240 |
| Reclaimed Water | 1,020 | 1,020 | 1,020 | 1,020 | 1,020 |
| WFA Treatment Plant | 0 | 0 | 0 | 0 | 0 |
| MVWD Supply Chino GW | 11,890 | 12,230 | 13,800 | 15,480 | 16,370 |
| Total Supply | 17,640 | 19,100 | 20,670 | 22,350 | 23,240 |
| Total Demand | 17,640 | 19,100 | 20,670 | 22,350 | 23,240 |
| *City of Norco* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter (8 mgd Plant) | 0 | 0 | 0 | 0 | 0 |
| City of Corona | 220 | 400 | 600 | 800 | 1,000 |
| Temescal Basin Groundwater | 5,880 | 5,600 | 5,700 | 6,200 | 6,600 |
| Supply from JCSD | 900 | 1400 | 1400 | 1400 | 1400 |
| Total Supply | 7,000 | 7,400 | 7,700 | 8,400 | 9,000 |
| Total Demand | 7,000 | 7,400 | 7,700 | 8,400 | 9,000 |
| *City of Ontario* | | | | | |
| Chino Basin Wells | 34,720 | 32,950 | 33,440 | 33,590 | 39,350 |
| WFA Treatment Plant | 7,340 | 12,660 | 19,030 | 25,840 | 26,940 |
| Reclaimed Water | 0 | 840 | 1,680 | 2,520 | 3,360 |
| Supply from SAWC (Chino GW) | 850 | 850 | 850 | 850 | 850 |
| Total Supply | 42,910 | 47,300 | 55,000 | 62,800 | 70,500 |
| Total Demand | 41,440 | 45,830 | 53,530 | 61,330 | 69,030 |
| Supply to Sunkist (Chino GW) | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |

## Table 4.5-20 (continued)
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *City of Pomona* | | | | | |
| Chino Basin Wells | 5,220 | 5,220 | 5,220 | 5,220 | 5,220 |
| Pomona Nitrate Treatment Plant (Chino GW) | 13,880 | 13,880 | 13,880 | 13,880 | 13,880 |
| Other Groundwater Basins | 5,160 | 5,160 | 5,160 | 5,160 | 5,160 |
| Reclaimed Water | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 |
| Pedley Treatment Plant | 3,800 | 3,800 | 3,800 | 3,800 | 3,800 |
| TVMWD Weymouth Treatment Plant | 2,140 | 3,380 | 4,520 | 5,840 | 7,044 |
| Total Supply | 37,200 | 38,440 | 39,580 | 40,900 | 42,104 |
| Total Demand | 37,200 | 38,440 | 39,580 | 40,900 | 42,104 |
| *City of Upland* | | | | | |
| Chino Basin Wells | 2,429 | 2,430 | 3,410 | 3,070 | 3,050 |
| Supply from SAWC (non-Chino GW) | 4,920 | 4,520 | 4,520 | 4,520 | 4,520 |
| Supply from SAWC (San Antonio Canyon TP) | 2,411 | 2,390 | 2,390 | 2,690 | 2,690 |
| Supply from WECWC (Chino GW) | 0 | 1,420 | 1,440 | 1,480 | 1,500 |
| Supply from WECWC (other GW basins) | 4,650 | 4,650 | 4,650 | 4,650 | 4,650 |
| WFA Treatment Plant | 7,590 | 7,590 | 7,590 | 7,590 | 7,590 |
| Total Supply | 22,000 | 23,000 | 24,000 | 24,000 | 24,000 |
| Total Demand | 22,000 | 23,000 | 24,000 | 24,000 | 24,000 |
| *Cucamonga County Water District* | | | | | |
| Chino Basin Wells | 8,000 | 10,160 | 10,160 | 10,160 | 10,160 |
| Other Groundwater Basins | 12,650 | 11,180 | 12,390 | 12,390 | 12,390 |
| Reclaimed Water | 0 | 0 | 0 | 2,402 | 4,804 |
| CCWD Bridge Water Treatment Plant | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| CCWD Lloyd Michael Treatment Plant | 21,710 | 25,550 | 28,860 | 30,978 | 33,096 |
| CCWD Royer-Nesbit Treatment Plant | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 |
| Deer Creek | 550 | 550 | 550 | 550 | 550 |
| Total Supply | 49,910 | 54,440 | 58,960 | 63,480 | 68,000 |
| Total Demand | 49,910 | 54,440 | 58,960 | 63,480 | 68,000 |
| *Fontana Water Company* | | | | | |
| Chino Basin Wells | 1,840 | 22,825 | 16,050 | 20,375 | 24,800 |
| Other Groundwater Basins | 12,700 | 12,700 | 12,700 | 12,700 | 12,700 |
| Reclaimed Water | 0 | 0 | 0 | 1,685 | 3,370 |
| Fontana Water Treatment Plant | 0 | 0 | 18,600 | 16,915 | 15,230 |
| Sandhill Treatment Plant | 7,400 | 7,400 | 0 | 0 | 0 |
| Total Supply | 21,940 | 42,925 | 47,350 | 51,675 | 56,100 |
| Total Demand | 36,800 | 41,200 | 45,600 | 49,900 | 54,300 |
| Supply to California Steel | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |

## Table 4.5-20 (continued)
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Jurupa Community Services District* | | | | | |
| Chino Basin Wells (Potable) | 14,425 | 11,815 | 12,845 | 15,265 | 17,695 |
| Chino Basin Wells (Non-potable) | 50 | 250 | 450 | 650 | 850 |
| Other Groundwater Basins | 500 | 3,600 | 4,500 | 4,500 | 4,500 |
| SAWPA Desalter (8 mgd Plant) | 1,800 | 4,500 | 5,000 | 5,000 | 5,000 |
| Total Supply | 16,775 | 20,165 | 22,795 | 25,415 | 28,045 |
| Total Demand | 14,200 | 17,000 | 19,600 | 22,200 | 24,800 |
| Supply to Mira Loma SC | 25 | 25 | 25 | 25 | 25 |
| Supply to Norco | 900 | 1,400 | 1,400 | 1,400 | 1,400 |
| Supply to Swan Lake | 350 | 350 | 350 | 350 | 350 |
| Supply to SARWC | 1,300 | 1,390 | 1,420 | 1,440 | 1,470 |
| Subtotal | 2,575 | 3,165 | 3,195 | 3,215 | 3,245 |
| *Mira Loma SC* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from JCSD | 25 | 25 | 25 | 25 | 25 |
| Total Supply | 25 | 25 | 25 | 25 | 25 |
| Total Demand | 25 | 25 | 25 | 25 | 25 |
| *Santa Ana River Water Company* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Almost Chino Basin Wells (along SAR outside legal bndy) | 700 | 700 | 700 | 700 | 700 |
| Supply from JCSD | 1,300 | 1,390 | 1,420 | 1,440 | 1,470 |
| Total Supply | 2,000 | 2,090 | 2,120 | 2,140 | 2,170 |
| Total Demand | 2,000 | 2,090 | 2,120 | 2,140 | 2,170 |
| *Swan Lake* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from JCSD | 350 | 350 | 350 | 350 | 350 |
| Total Supply | 350 | 350 | 350 | 350 | 350 |
| Total Demand | 350 | 350 | 350 | 350 | 350 |
| *Marygold Mutual Water Company* | | | | | |
| Baseline Feeder | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |
| Total Supply | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |
| Total Demand | 1,450 | 1,580 | 1,620 | 1,660 | 1,700 |

## Table 4.5-20 (continued)
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Monte Vista Water District* | | | | | |
| Chino Basin Wells | 26,050 | 26,390 | 27,960 | 29,640 | 30,530 |
| WFA Treatment Plant | 0 | 0 | 0 | 0 | 0 |
| Total Supply | 26,050 | 26,390 | 27,960 | 29,640 | 30,530 |
| Total Demand | 14,160 | 14,160 | 14,160 | 14,160 | 14,160 |
| Supply to Chino Hills (Chino GW) | 11,890 | 12,230 | 13,800 | 15,480 | 16,370 |
| *San Antonio Water Company -- Domestic* | | | | | |
| Chino Basin Wells | 70 | 1,050 | 1,070 | 1,090 | 1,110 |
| Other Groundwater Basins | 400 | 400 | 400 | 400 | 400 |
| San Antonio Canyon | 0 | 0 | 0 | 0 | 0 |
| San Antonio Tunnel | 1,020 | 1,020 | 1,020 | 1,020 | 1,020 |
| Total Supply | 1,490 | 2,470 | 2,490 | 2,510 | 2,530 |
| Total Demand | 640 | 1,620 | 1,640 | 1,660 | 1,680 |
| Supply to Ontario (Chino GW) | 850 | 850 | 850 | 850 | 850 |
| *Southern California Water Company* | | | | | |
| Chino Basin Wells | 2,160 | 2,160 | 2,160 | 2,160 | 2,160 |
| Other Groundwater Basins | 4,950 | 4,490 | 4,850 | 4,850 | 4,850 |
| TVMWD -- Miramar Water Treatment Plant | 7,090 | 8,300 | 8,670 | 8,670 | 8,670 |
| Total Supply | 14,200 | 14,950 | 15,680 | 15,680 | 15,680 |
| Total Demand | 14,200 | 14,950 | 15,680 | 15,680 | 15,680 |
| West End Consolidated Water Company | | | | | |
| Chino Basin Wells | 0 | 1,420 | 1,440 | 1,480 | 1,500 |
| Other Groundwater Basins | 4,650 | 4,650 | 4,650 | 4,650 | 4,650 |
| Total Supply | 4,650 | 6,070 | 6,090 | 6,130 | 6,150 |
| Total Demand | 0 | 0 | 0 | 0 | 0 |
| Supply to Upland | 4,650 | 6,070 | 6,090 | 6,130 | 6,150 |
| *West San Bernardino County Water District* | | | | | |
| Other Groundwater Basins | 5,330 | 6,835 | 9,520 | 9,510 | 9,510 |
| SBVMWD Baseline Feeder | 800 | 1,000 | 1,380 | 1,390 | 1,390 |
| Total Supply | 6,130 | 7,835 | 10,900 | 10,900 | 10,900 |
| Total Demand | 6,130 | 7,835 | 10,900 | 10,900 | 10,900 |

## Table 4.5-20 (continued)
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| *Ameron* | | | | | |
| Chino Basin Wells | 9 | 9 | 9 | 9 | 9 |
| Total Supply | 9 | 9 | 9 | 9 | 9 |
| Total Demand | 9 | 9 | 9 | 9 | 9 |
| *San Bernardino County Division of Airports* | | | | | |
| Chino Basin Wells (Potable (Domestic)) | 300 | 300 | 300 | 300 | 300 |
| Total Supply | 300 | 300 | 300 | 300 | 300 |
| Total Demand | 300 | 300 | 300 | 300 | 300 |
| *Reliant Energy* | | | | | |
| Chino Basin Wells | 800 | 0 | 0 | 0 | 0 |
| Reclaimed Water | 0 | 3,300 | 3,300 | 3,300 | 3,300 |
| IEUA -- MWD Water from CRA | 2,500 | 0 | 0 | 0 | 0 |
| Total Supply | 3,300 | 3,300 | 3,300 | 3,300 | 3,300 |
| Total Demand | 3,300 | 3,300 | 3,300 | 3,300 | 3,300 |
| *Sunkist* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Supply from Ontario (Chino GW) | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| Total Supply | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| Total Demand | 1,470 | 1,470 | 1,470 | 1,470 | 1,470 |
| *Kaiser Ventures* | | | | | |
| Chino Basin Wells | 670 | 670 | 670 | 670 | 670 |
| Total Supply | 670 | 670 | 670 | 670 | 670 |
| Total Demand | 670 | 670 | 670 | 670 | 670 |
| *San Bernardino County Parks Department* | | | | | |
| Chino Basin Wells | 75 | 75 | 75 | 75 | 75 |
| Total Supply | 75 | 75 | 75 | 75 | 75 |
| Total Demand | 75 | 75 | 75 | 75 | 75 |
| *Monte Vista Irrigation Company* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Total Supply | 0 | 0 | 0 | 0 | 0 |
| Total Demand | 0 | 0 | 0 | 0 | 0 |
| *California Steel* | | | | | |
| Chino Basin Wells | 0 | 0 | 0 | 0 | 0 |
| Fontana Water Company | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |
| Total Supply | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |
| Total Demand | 1,700 | 1,725 | 1,750 | 1,775 | 1,800 |

## Table 4.5-20 (continued)
## WATER SUPPLY PLANS FOR THE BASELINE (acre-feet/year)

| Purveyor / Source | Year 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Totals By Source Type and Pool | | | | | |
| Pool 1 Overlying Agricultural Pool | 49,100 | 39,975 | 30,850 | 21,725 | 10,000 |
| Pool 2 Overlying Non-Agricultural Pool | | | | | |
| Chino Basin Groundwater | 3,624 | 2,824 | 2,824 | 2,824 | 2,824 |
| East CBWM OBMP Desalter | 0 | 0 | 0 | 0 | 0 |
| Other Local Supplies | 0 | 0 | 0 | 0 | 0 |
| Imported Water | 2,500 | 0 | 0 | 0 | 0 |
| Recycled Water | 0 | 3,300 | 3,300 | 3,300 | 3,300 |
| Total Pool 2 | 6,124 | 6,124 | 6,124 | 6,124 | 6,124 |
| Pool 3 Appropriative Pool | | | | | |
| Chino Basin Groundwater | 122,154 | 143,860 | 141,395 | 149,890 | 164,565 |
| East CBWM OBMP Desalter | 0 | 0 | 0 | 0 | 0 |
| West CBWM OBMP Desalter | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter (8 mgd Plant) | 4,600 | 10,100 | 10,600 | 10,600 | 10,600 |
| SAWPA Desalter (10 mgd Plant) | 0 | 0 | 0 | 0 | 0 |
| Other Local Supplies | 84,141 | 86,625 | 85,100 | 86,140 | 86,780 |
| Imported Water | | | | | |
| WFA Treatment Plant | 18,950 | 22,890 | 30,510 | 38,570 | 39,970 |
| CCWD Lloyd Michael TP | 21,710 | 25,550 | 28,860 | 30,978 | 33,096 |
| CCWD Royer Nesbit | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Other | 11,730 | 11,680 | 31,790 | 31,425 | 30,944 |
| Subtotal | 50,690 | 61,120 | 92,540 | 102,363 | 105,400 |
| Recycled Water | 8,120 | 9,910 | 10,750 | 15,677 | 20,604 |
| Total Pool 3 | 269,705 | 311,615 | 340,385 | 364,670 | 387,949 |
| Total All Pools | 324,929 | 357,714 | 377,359 | 392,519 | 404,073 |
| Total Water Produced By Desalter Projects | | | | | |
| *OBMP Projects* | | | | | |
| East Desalter Production | 0 | 0 | 0 | 0 | 0 |
| East Desalter Raw Water Supply | 0 | 0 | 0 | 0 | 0 |
| West Desalter Production | 0 | 0 | 0 | 0 | 0 |
| West Desalter Raw Water Supply | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter Expansion Production | 0 | 0 | 0 | 0 | 0 |
| SAWPA Desalter Expansion Raw Water Supply | 0 | 0 | 0 | 0 | 0 |
| *SAWPA Desalter* | | | | | |
| Production | 4,600 | 10,100 | 10,600 | 10,600 | 10,600 |
| Raw Water Supply | 5,292 | 11,619 | 12,195 | 12,195 | 12,195 |
| *Pomona Ion Exchange* | | | | | |
| Production | 13,880 | 13,880 | 13,880 | 13,880 | 13,880 |
| Raw Water Supply | 14,309 | 14,309 | 14,309 | 14,309 | 14,309 |
| Total Chino Basin Groundwater Production Summary | | | | | |
| Pool 1 | 49,100 | 39,975 | 30,850 | 21,725 | 10,000 |
| Pool 2 | 3,624 | 2,824 | 2,824 | 2,824 | 2,824 |
| Pool 3 | 127,875 | 155,909 | 154,019 | 162,514 | 177,189 |
| Total | 180,599 | 198,708 | 187,693 | 187,063 | 190,013 |

# Table 4.5-21
# ARTIFICIAL RECHARGE PLAN FOR THE CHINO BASIN FOR 2020

| Spreading Basin | 2020 Conditions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Supplemental Water | | | | | | | | |
| | | | Recycled | | | | | | | | |
| | Storm Water (acre-ft/yr) | Imported (acre-ft/yr) | RP1 (acre-ft/yr) | RP2 (acre-ft/yr) | Carbon Cyn (acre-ft/yr) | RP4 (acre-ft/yr) | RP5 (acre-ft/yr) | Other (acre-ft/yr) | Subtotal (acre-ft/yr) | Subtotal (acre-ft/yr) | Total (acre-ft/yr) |
| 7th and 8th Street | 600 | 0 | | | | | | | 0 | 0 | 600 |
| 15th St | 0 | 0 | | | | | | | 0 | 0 | 0 |
| Bannana | 400 | 0 | | | | | | | 0 | 0 | 400 |
| Brooks | 1,200 | 2,000 | | | | | | | 0 | 2,000 | 3,200 |
| Declez | 600 | 0 | | | | | | | 0 | 0 | 600 |
| Ely | 2,800 | 0 | | | | | | | 0 | 0 | 2,800 |
| Etiwanda Spr. Grnds | 0 | 4,000 | | | | | | | 0 | 4,000 | 4,000 |
| Etiwanda Debris | 3,300 | 4,000 | | | | | | | 0 | 4,000 | 7,300 |
| Etiwanda Perc. Bas | 800 | 0 | | | | | | | 0 | 0 | 800 |
| Grove | 600 | 0 | | | | | | | 0 | 0 | 600 |
| Hickory | 800 | 0 | | | | | | | 0 | 0 | 800 |
| Jurupa | 3,000 | 0 | | | | | | | 0 | 0 | 3,000 |
| Montclair 1 | 1,600 | 5,000 | | | | | | | 0 | 5,000 | 6,600 |
| Montclair 2 | 600 | 6,000 | | | | | | | 0 | 6,000 | 6,600 |
| Montclair 3 | 500 | 5,000 | | | | | | | 0 | 5,000 | 5,500 |
| Montclair 4 | 700 | 0 | | | | | | | 0 | 0 | 700 |
| Riverside | 2,500 | 0 | | | | | | | 0 | 0 | 2,500 |
| San Sevaine 1 | 2,600 | 5,000 | | | | | | | 0 | 5,000 | 7,600 |
| San Sevaine 2 | 400 | 5,000 | | | | | | | 0 | 5,000 | 5,400 |
| San Sevaine 3 | 700 | 4,000 | | | | | | | 0 | 4,000 | 4,700 |
| San Sevaine 4/5 | 500 | 0 | | | | | | | 0 | 0 | 500 |
| Turner 1 | 500 | 0 | | | | | | | 0 | 0 | 500 |
| Rich | 1,200 | 0 | | | | | | | 0 | 0 | 1,200 |
| Upland | 1,100 | 2,000 | | | | | | | 0 | 2,000 | 3,100 |
| Victoria | 500 | 2,000 | | | | | | | 0 | 2,000 | 2,500 |
| Wineville | 2,500 | 0 | | | | | | | 0 | 0 | 2,500 |
| Total | 30,000 | 44,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44,000 | 74,000 |

# Table 4.5-22
# ARTIFICIAL RECHARGE PLAN FOR THE CHINO BASIN FOR 2000

| Spreading Basin | 2000 Conditions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Supplemental Water | | | | | | | | |
| | | | Recycled | | | | | | | | |
| | Storm Water (acre-ft/yr) | Imported (acre-ft/yr) | RP1 (acre-ft/yr) | RP2 (acre-ft/yr) | Carbon Cyn (acre-ft/yr) | RP4 (acre-ft/yr) | RP5 (acre-ft/yr) | Other (acre-ft/yr) | Subtotal (acre-ft/yr) | Subtotal (acre-ft/yr) | Total (acre-ft/yr) |
| 7th and 8th Street | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| 15th St | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Bannana | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Brooks | 807 | 0 | 0 | | | | | | 0 | 0 | 807 |
| Declez | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Ely | 2,749 | 0 | 500 | | | | | | 500 | 500 | 3,249 |
| Etiwanda Spr. Grnds | 575 | 0 | 0 | | | | | | 0 | 0 | 575 |
| Etiwanda Debris | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Etiwanda Perc. Bas | 575 | 0 | 0 | | | | | | 0 | 0 | 575 |
| Grove | 0 | 0 | 0 | | | | | | | | |
| Hickory | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Jurupa | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Montclair 1 | 807 | 650 | 0 | | | | | | 0 | 650 | 1,457 |
| Montclair 2 | 282 | 0 | 0 | | | | | | 0 | 0 | 282 |
| Montclair 3 | 359 | 0 | 0 | | | | | | 0 | 0 | 359 |
| Montclair 4 | 510 | 0 | 0 | | | | | | 0 | 0 | 510 |
| Riverside | 1,387 | 0 | 0 | | | | | | 0 | 0 | 1,387 |
| San Sevaine 1 | 2,476 | 0 | 0 | | | | | | 0 | 0 | 2,476 |
| San Sevaine 2 | 315 | 0 | 0 | | | | | | 0 | 0 | 315 |
| San Sevaine 3 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| San Sevaine 4/5 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Turner 1 | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Rich | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Upland | 893 | 0 | 0 | | | | | | 0 | 0 | 893 |
| Victoria | 0 | 0 | 0 | | | | | | 0 | 0 | 0 |
| Wineville | 1,778 | 0 | 0 | | | | | | 0 | 0 | 1,778 |
| Total | 13,513 | 650 | 500 | 0 | 0 | 0 | 0 | 0 | 500 | 1,150 | 14,663 |

## Table 4.5-23
## FLOW AND TDS IMPACTS OF THE OBMP FOR THE SANTA ANA RIVER BELOW PRADO FOR ULTIMATE CONDITIONS

| Month | Baseline | | OBMP Alt A1 | | | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Discharge At Below Prado | | Recycled Water Recharge | | Storm Water Recharge | | Total Discharge At Below Prado | | | |
| | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) |
| 10/80 | 28,213 | 546 | 2,842 | 390 | 0 | 0 | 25,372 | 564 | -2,842 | 17 |
| 11/80 | 31,283 | 575 | 2,842 | 390 | 0 | 0 | 28,442 | 593 | -2,842 | 18 |
| 12/80 | 37,679 | 609 | 2,842 | 390 | 0 | 0 | 34,838 | 627 | -2,842 | 18 |
| 1/81 | 41,828 | 612 | 2,842 | 390 | 5666 | 100 | 33,321 | 718 | -8,508 | 106 |
| 2/81 | 33,466 | 552 | 2,842 | 390 | 5666 | 100 | 24,959 | 673 | -8,508 | 121 |
| 3/81 | 39,751 | 561 | 2,842 | 390 | 5666 | 100 | 31,244 | 661 | -8,508 | 99 |
| 4/81 | 33,859 | 557 | 2,842 | 390 | 0 | 0 | 31,018 | 573 | -2,842 | 15 |
| 5/81 | 28,901 | 563 | 2,842 | 390 | 0 | 0 | 26,060 | 582 | -2,842 | 19 |
| 6/81 | 26,767 | 544 | 2,842 | 390 | 0 | 0 | 23,926 | 562 | -2,842 | 18 |
| 7/81 | 25,374 | 530 | 2,842 | 390 | 0 | 0 | 22,532 | 548 | -2,842 | 18 |
| 8/81 | 25,226 | 525 | 2,842 | 390 | 0 | 0 | 22,384 | 542 | -2,842 | 17 |
| 9/81 | 25,408 | 525 | 2,842 | 390 | 0 | 0 | 22,566 | 542 | -2,842 | 17 |
| 10/81 | 27,535 | 573 | 2,842 | 390 | 0 | 0 | 24,693 | 594 | -2,842 | 21 |
| 11/81 | 29,709 | 544 | 2,842 | 390 | 0 | 0 | 26,867 | 561 | -2,842 | 16 |
| 12/81 | 30,894 | 566 | 2,842 | 390 | 0 | 0 | 28,052 | 584 | -2,842 | 18 |
| 1/82 | 39,929 | 545 | 2,842 | 390 | 5666 | 100 | 31,421 | 640 | -8,508 | 94 |
| 2/82 | 34,803 | 517 | 2,842 | 390 | 5666 | 100 | 26,295 | 620 | -8,508 | 104 |
| 3/82 | 55,778 | 433 | 2,842 | 390 | 5666 | 100 | 47,270 | 476 | -8,508 | 43 |
| 4/82 | 42,463 | 431 | 2,842 | 390 | 0 | 0 | 39,621 | 434 | -2,842 | 3 |
| 5/82 | 29,860 | 487 | 2,842 | 390 | 0 | 0 | 27,018 | 498 | -2,842 | 10 |
| 6/82 | 27,369 | 519 | 2,842 | 390 | 0 | 0 | 24,527 | 534 | -2,842 | 15 |
| 7/82 | 27,238 | 541 | 2,842 | 390 | 0 | 0 | 24,396 | 558 | -2,842 | 18 |
| 8/82 | 25,872 | 526 | 2,842 | 390 | 0 | 0 | 23,030 | 543 | -2,842 | 17 |
| 9/82 | 26,796 | 539 | 2,842 | 390 | 0 | 0 | 23,954 | 557 | -2,842 | 18 |
| 10/82 | 26,530 | 536 | 2,842 | 390 | 0 | 0 | 23,688 | 554 | -2,842 | 18 |
| 11/82 | 39,794 | 567 | 2,842 | 390 | 0 | 0 | 36,952 | 580 | -2,842 | 14 |
| 12/82 | 42,807 | 462 | 2,842 | 390 | 0 | 0 | 39,965 | 468 | -2,842 | 5 |
| 1/83 | 57,677 | 510 | 2,842 | 390 | 5666 | 100 | 49,169 | 564 | -8,508 | 54 |
| 2/83 | 66,135 | 410 | 2,842 | 390 | 5666 | 100 | 57,627 | 441 | -8,508 | 31 |
| 3/83 | 145,709 | 329 | 2,842 | 390 | 5666 | 100 | 137,201 | 337 | -8,508 | 8 |
| 4/83 | 69,957 | 458 | 2,842 | 390 | 0 | 0 | 67,115 | 461 | -2,842 | 3 |
| 5/83 | 70,667 | 399 | 2,842 | 390 | 0 | 0 | 67,825 | 399 | -2,842 | 0 |
| 6/83 | 45,489 | 446 | 2,842 | 390 | 0 | 0 | 42,647 | 450 | -2,842 | 4 |
| 7/83 | 36,772 | 529 | 2,842 | 390 | 0 | 0 | 33,930 | 541 | -2,842 | 12 |
| 8/83 | 42,393 | 506 | 2,842 | 390 | 0 | 0 | 39,551 | 514 | -2,842 | 8 |
| 9/83 | 32,686 | 564 | 2,842 | 390 | 0 | 0 | 29,844 | 581 | -2,842 | 17 |
| 10/83 | 41,111 | 520 | 2,842 | 390 | 0 | 0 | 38,269 | 530 | -2,842 | 10 |
| 11/83 | 48,299 | 556 | 2,842 | 390 | 0 | 0 | 45,457 | 567 | -2,842 | 10 |
| 12/83 | 54,190 | 525 | 2,842 | 390 | 0 | 0 | 51,348 | 532 | -2,842 | 7 |
| 1/84 | 41,820 | 575 | 2,842 | 390 | 5666 | 100 | 33,312 | 672 | -8,508 | 97 |
| 2/84 | 34,519 | 573 | 2,842 | 390 | 5666 | 100 | 26,011 | 696 | -8,508 | 123 |
| 3/84 | 33,050 | 562 | 2,842 | 390 | 5666 | 100 | 24,542 | 689 | -8,508 | 127 |
| 4/84 | 31,126 | 546 | 2,842 | 390 | 0 | 0 | 28,284 | 562 | -2,842 | 16 |
| 5/84 | 29,775 | 547 | 2,842 | 390 | 0 | 0 | 26,933 | 564 | -2,842 | 17 |
| 6/84 | 28,901 | 540 | 2,842 | 390 | 0 | 0 | 26,059 | 556 | -2,842 | 16 |
| 7/84 | 28,381 | 538 | 2,842 | 390 | 0 | 0 | 25,539 | 555 | -2,842 | 16 |

## Table 4.5-23 (continued)
## FLOW AND TDS IMPACTS OF THE OBMP FOR THE SANTA ANA RIVER BELOW PRADO FOR ULTIMATE CONDITIONS

| Month | Baseline | | OBMP Alt A1 | | | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Discharge At Below Prado | | Recycled Water Recharge | | Storm Water Recharge | | Total Discharge At Below Prado | | | |
| | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) |
| 8/84 | 28,076 | 535 | 2,842 | 390 | 0 | 0 | 25,234 | 551 | -2,842 | 16 |
| 9/84 | 27,792 | 533 | 2,842 | 390 | 0 | 0 | 24,950 | 549 | -2,842 | 16 |
| 10/84 | 29,137 | 547 | 2,842 | 390 | 0 | 0 | 26,295 | 564 | -2,842 | 17 |
| 11/84 | 32,608 | 562 | 2,842 | 390 | 0 | 0 | 29,766 | 578 | -2,842 | 16 |
| 12/84 | 52,704 | 454 | 2,842 | 390 | 0 | 0 | 49,862 | 457 | -2,842 | 4 |
| 1/85 | 39,314 | 525 | 2,842 | 390 | 5666 | 100 | 30,806 | 616 | -8,508 | 91 |
| 2/85 | 40,109 | 542 | 2,842 | 390 | 5666 | 100 | 31,601 | 635 | -8,508 | 93 |
| 3/85 | 36,858 | 559 | 2,842 | 390 | 5666 | 100 | 28,350 | 668 | -8,508 | 109 |
| 4/85 | 32,315 | 550 | 2,842 | 390 | 0 | 0 | 29,473 | 566 | -2,842 | 15 |
| 5/85 | 32,393 | 556 | 2,842 | 390 | 0 | 0 | 29,551 | 571 | -2,842 | 16 |
| 6/85 | 30,273 | 549 | 2,842 | 390 | 0 | 0 | 27,431 | 565 | -2,842 | 16 |
| 7/85 | 28,474 | 547 | 2,842 | 390 | 0 | 0 | 25,632 | 564 | -2,842 | 17 |
| 8/85 | 28,117 | 543 | 2,842 | 390 | 0 | 0 | 25,275 | 560 | -2,842 | 17 |
| 9/85 | 28,496 | 539 | 2,842 | 390 | 0 | 0 | 25,654 | 556 | -2,842 | 17 |
| 10/85 | 30,786 | 555 | 2,842 | 390 | 0 | 0 | 27,944 | 572 | -2,842 | 17 |
| 11/85 | 41,152 | 547 | 2,842 | 390 | 0 | 0 | 38,310 | 558 | -2,842 | 12 |
| 12/85 | 34,993 | 525 | 2,842 | 390 | 0 | 0 | 32,151 | 537 | -2,842 | 12 |
| 1/86 | 36,475 | 562 | 2,842 | 390 | 5666 | 100 | 27,967 | 673 | -8,508 | 111 |
| 2/86 | 54,947 | 444 | 2,842 | 390 | 5666 | 100 | 46,439 | 489 | -8,508 | 45 |
| 3/86 | 56,061 | 460 | 2,842 | 390 | 5666 | 100 | 47,553 | 507 | -8,508 | 47 |
| 4/86 | 37,129 | 533 | 2,842 | 390 | 0 | 0 | 34,287 | 545 | -2,842 | 12 |
| 5/86 | 31,500 | 550 | 2,842 | 390 | 0 | 0 | 28,658 | 566 | -2,842 | 16 |
| 6/86 | 30,007 | 550 | 2,842 | 390 | 0 | 0 | 27,165 | 566 | -2,842 | 17 |
| 7/86 | 28,357 | 532 | 2,842 | 390 | 0 | 0 | 25,515 | 548 | -2,842 | 16 |
| 8/86 | 27,504 | 535 | 2,842 | 390 | 0 | 0 | 24,662 | 551 | -2,842 | 17 |
| 9/86 | 29,509 | 534 | 2,842 | 390 | 0 | 0 | 26,667 | 549 | -2,842 | 15 |
| 10/86 | 30,611 | 539 | 2,842 | 390 | 0 | 0 | 27,770 | 554 | -2,842 | 15 |
| 11/86 | 31,434 | 542 | 2,842 | 390 | 0 | 0 | 28,592 | 557 | -2,842 | 15 |
| 12/86 | 33,360 | 543 | 2,842 | 390 | 0 | 0 | 30,518 | 557 | -2,842 | 14 |
| 1/87 | 38,964 | 512 | 2,842 | 390 | 5666 | 100 | 30,457 | 600 | -8,508 | 88 |
| 2/87 | 34,466 | 548 | 2,842 | 390 | 5666 | 100 | 25,958 | 664 | -8,508 | 115 |
| 3/87 | 37,959 | 532 | 2,842 | 390 | 5666 | 100 | 29,451 | 629 | -8,508 | 97 |
| 4/87 | 32,009 | 534 | 2,842 | 390 | 0 | 0 | 29,167 | 548 | -2,842 | 14 |
| 5/87 | 30,196 | 539 | 2,842 | 390 | 0 | 0 | 27,354 | 555 | -2,842 | 16 |
| 6/87 | 27,857 | 533 | 2,842 | 390 | 0 | 0 | 25,016 | 549 | -2,842 | 16 |
| 7/87 | 27,766 | 531 | 2,842 | 390 | 0 | 0 | 24,924 | 548 | -2,842 | 16 |
| 8/87 | 27,195 | 529 | 2,842 | 390 | 0 | 0 | 24,353 | 546 | -2,842 | 16 |
| 9/87 | 27,478 | 531 | 2,842 | 390 | 0 | 0 | 24,637 | 547 | -2,842 | 16 |
| 10/87 | 33,463 | 541 | 2,842 | 390 | 0 | 0 | 30,621 | 555 | -2,842 | 14 |
| 11/87 | 35,662 | 502 | 2,842 | 390 | 0 | 0 | 32,820 | 512 | -2,842 | 10 |
| 12/87 | 39,577 | 531 | 2,842 | 390 | 0 | 0 | 36,735 | 541 | -2,842 | 11 |
| 1/88 | 41,240 | 505 | 2,842 | 390 | 5666 | 100 | 32,732 | 585 | -8,508 | 80 |
| 2/88 | 35,358 | 540 | 2,842 | 390 | 5666 | 100 | 26,850 | 649 | -8,508 | 109 |
| 3/88 | 35,519 | 535 | 2,842 | 390 | 5666 | 100 | 27,011 | 641 | -8,508 | 106 |
| 4/88 | 37,278 | 516 | 2,842 | 390 | 0 | 0 | 34,436 | 527 | -2,842 | 10 |
| 5/88 | 29,849 | 524 | 2,842 | 390 | 0 | 0 | 27,008 | 538 | -2,842 | 14 |

## Table 4.5-23 (continued)
## FLOW AND TDS IMPACTS OF THE OBMP FOR THE SANTA ANA RIVER BELOW PRADO FOR ULTIMATE CONDITIONS

| Month | Baseline | | OBMP Alt A1 | | | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Discharge At Below Prado | | Recycled Water Recharge | | Storm Water Recharge | | Total Discharge At Below Prado | | | |
| | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) |
| 6/88 | 28,499 | 531 | 2,842 | 390 | 0 | 0 | 25,657 | 547 | -2,842 | 16 |
| 7/88 | 28,973 | 518 | 2,842 | 390 | 0 | 0 | 26,131 | 532 | -2,842 | 14 |
| 8/88 | 27,790 | 528 | 2,842 | 390 | 0 | 0 | 24,948 | 544 | -2,842 | 16 |
| 9/88 | 28,021 | 529 | 2,842 | 390 | 0 | 0 | 25,179 | 544 | -2,842 | 16 |
| 10/88 | 29,370 | 536 | 2,842 | 390 | 0 | 0 | 26,528 | 551 | -2,842 | 16 |
| 11/88 | 31,749 | 546 | 2,842 | 390 | 0 | 0 | 28,907 | 562 | -2,842 | 15 |
| 12/88 | 43,344 | 486 | 2,842 | 390 | 0 | 0 | 40,503 | 493 | -2,842 | 7 |
| 1/89 | 32,953 | 521 | 2,842 | 390 | 5666 | 100 | 24,445 | 634 | -8,508 | 113 |
| 2/89 | 38,288 | 469 | 2,842 | 390 | 5666 | 100 | 29,781 | 547 | -8,508 | 78 |
| 3/89 | 33,514 | 532 | 2,842 | 390 | 5666 | 100 | 25,007 | 646 | -8,508 | 114 |
| 4/89 | 29,971 | 542 | 2,842 | 390 | 0 | 0 | 27,130 | 558 | -2,842 | 16 |
| 5/89 | 28,178 | 524 | 2,842 | 390 | 0 | 0 | 25,336 | 539 | -2,842 | 15 |
| 6/89 | 27,426 | 528 | 2,842 | 390 | 0 | 0 | 24,585 | 544 | -2,842 | 16 |
| 7/89 | 28,848 | 510 | 2,842 | 390 | 0 | 0 | 26,007 | 523 | -2,842 | 13 |
| 8/89 | 26,045 | 516 | 2,842 | 390 | 0 | 0 | 23,204 | 531 | -2,842 | 15 |
| 9/89 | 25,971 | 526 | 2,842 | 390 | 0 | 0 | 23,130 | 543 | -2,842 | 17 |
| 10/89 | 27,747 | 533 | 2,842 | 390 | 0 | 0 | 24,905 | 549 | -2,842 | 16 |
| 11/89 | 29,210 | 526 | 2,842 | 390 | 0 | 0 | 26,369 | 541 | -2,842 | 15 |
| 12/89 | 29,878 | 543 | 2,842 | 390 | 0 | 0 | 27,036 | 560 | -2,842 | 16 |
| 1/90 | 34,713 | 518 | 2,842 | 390 | 5666 | 100 | 26,206 | 622 | -8,508 | 104 |
| 2/90 | 43,831 | 470 | 2,842 | 390 | 5666 | 100 | 35,324 | 535 | -8,508 | 66 |
| 3/90 | 29,486 | 520 | 2,842 | 390 | 5666 | 100 | 20,978 | 651 | -8,508 | 131 |
| 4/90 | 28,618 | 535 | 2,842 | 390 | 0 | 0 | 25,776 | 551 | -2,842 | 16 |
| 5/90 | 28,553 | 530 | 2,842 | 390 | 0 | 0 | 25,711 | 546 | -2,842 | 15 |
| 6/90 | 26,182 | 525 | 2,842 | 390 | 0 | 0 | 23,341 | 542 | -2,842 | 16 |
| 7/90 | 24,285 | 528 | 2,842 | 390 | 0 | 0 | 21,443 | 546 | -2,842 | 18 |
| 8/90 | 25,191 | 519 | 2,842 | 390 | 0 | 0 | 22,349 | 535 | -2,842 | 16 |
| 9/90 | 24,647 | 522 | 2,842 | 390 | 0 | 0 | 21,806 | 539 | -2,842 | 17 |
| 10/90 | 25,901 | 535 | 2,842 | 390 | 0 | 0 | 23,059 | 553 | -2,842 | 18 |
| 11/90 | 28,131 | 532 | 2,842 | 390 | 0 | 0 | 25,289 | 548 | -2,842 | 16 |
| 12/90 | 28,296 | 545 | 2,842 | 390 | 0 | 0 | 25,455 | 562 | -2,842 | 17 |
| 1/91 | 34,453 | 529 | 2,842 | 390 | 5666 | 100 | 25,945 | 637 | -8,508 | 109 |
| 2/91 | 40,817 | 544 | 2,842 | 390 | 5666 | 100 | 32,310 | 635 | -8,508 | 91 |
| 3/91 | 85,634 | 365 | 2,842 | 390 | 5666 | 100 | 77,126 | 383 | -8,508 | 19 |
| 4/91 | 28,265 | 476 | 2,842 | 390 | 0 | 0 | 25,423 | 486 | -2,842 | 10 |
| 5/91 | 28,104 | 498 | 2,842 | 390 | 0 | 0 | 25,263 | 510 | -2,842 | 12 |
| 6/91 | 28,601 | 526 | 2,842 | 390 | 0 | 0 | 25,759 | 541 | -2,842 | 15 |
| 7/91 | 25,879 | 517 | 2,842 | 390 | 0 | 0 | 23,038 | 533 | -2,842 | 16 |
| 8/91 | 25,221 | 508 | 2,842 | 390 | 0 | 0 | 22,379 | 523 | -2,842 | 15 |
| 9/91 | 24,296 | 502 | 2,842 | 390 | 0 | 0 | 21,454 | 517 | -2,842 | 15 |
| 10/91 | 24,878 | 513 | 2,842 | 390 | 0 | 0 | 22,036 | 529 | -2,842 | 16 |
| 11/91 | 28,115 | 529 | 2,842 | 390 | 0 | 0 | 25,274 | 545 | -2,842 | 16 |
| 12/91 | 32,378 | 523 | 2,842 | 390 | 0 | 0 | 29,537 | 535 | -2,842 | 13 |
| 1/92 | 37,399 | 482 | 2,842 | 390 | 5666 | 100 | 28,891 | 566 | -8,508 | 84 |
| 2/92 | 65,972 | 370 | 2,842 | 390 | 5666 | 100 | 57,465 | 396 | -8,508 | 26 |
| 3/92 | 60,091 | 438 | 2,842 | 390 | 5666 | 100 | 51,584 | 478 | -8,508 | 40 |

## Table 4.5-23 (continued)
## FLOW AND TDS IMPACTS OF THE OBMP FOR THE SANTA ANA RIVER BELOW PRADO FOR ULTIMATE CONDITIONS

| Month | Baseline | | OBMP Alt A1 | | | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Discharge At Below Prado | | Recycled Water Recharge | | Storm Water Recharge | | Total Discharge At Below Prado | | | |
| | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) |
| 4/92 | 29,036 | 466 | 2,842 | 390 | 0 | 0 | 26,194 | 475 | -2,842 | 8 |
| 5/92 | 28,326 | 533 | 2,842 | 390 | 0 | 0 | 25,484 | 549 | -2,842 | 16 |
| 6/92 | 25,658 | 531 | 2,842 | 390 | 0 | 0 | 22,816 | 548 | -2,842 | 18 |
| 7/92 | 25,794 | 527 | 2,842 | 390 | 0 | 0 | 22,952 | 544 | -2,842 | 17 |
| 8/92 | 25,800 | 495 | 2,842 | 390 | 0 | 0 | 22,958 | 508 | -2,842 | 13 |
| 9/92 | 25,120 | 522 | 2,842 | 390 | 0 | 0 | 22,278 | 539 | -2,842 | 17 |
| 10/92 | 28,576 | 545 | 2,842 | 390 | 0 | 0 | 25,735 | 562 | -2,842 | 17 |
| 11/92 | 27,479 | 540 | 2,842 | 390 | 0 | 0 | 24,637 | 557 | -2,842 | 17 |
| 12/92 | 51,162 | 447 | 2,842 | 390 | 0 | 0 | 48,321 | 450 | -2,842 | 3 |
| 1/93 | 237,386 | 272 | 2,842 | 390 | 5666 | 100 | 228,878 | 275 | -8,508 | 3 |
| 2/93 | 164,133 | 346 | 2,842 | 390 | 5666 | 100 | 155,626 | 354 | -8,508 | 8 |
| 3/93 | 71,229 | 441 | 2,842 | 390 | 5666 | 100 | 62,721 | 474 | -8,508 | 33 |
| 4/93 | 48,767 | 471 | 2,842 | 390 | 0 | 0 | 45,926 | 476 | -2,842 | 5 |
| 5/93 | 37,874 | 503 | 2,842 | 390 | 0 | 0 | 35,033 | 512 | -2,842 | 9 |
| 6/93 | 32,374 | 540 | 2,842 | 390 | 0 | 0 | 29,533 | 555 | -2,842 | 14 |
| 7/93 | 26,603 | 546 | 2,842 | 390 | 0 | 0 | 23,761 | 565 | -2,842 | 19 |
| 8/93 | 25,309 | 539 | 2,842 | 390 | 0 | 0 | 22,467 | 558 | -2,842 | 19 |
| 9/93 | 23,588 | 537 | 2,842 | 390 | 0 | 0 | 20,746 | 557 | -2,842 | 20 |
| 10/93 | 25,178 | 547 | 2,842 | 390 | 0 | 0 | 22,336 | 567 | -2,842 | 20 |
| 11/93 | 31,551 | 555 | 2,842 | 390 | 0 | 0 | 28,710 | 571 | -2,842 | 16 |
| 12/93 | 30,568 | 510 | 2,842 | 390 | 0 | 0 | 27,726 | 523 | -2,842 | 12 |
| 1/94 | 30,887 | 547 | 2,842 | 390 | 5666 | 100 | 22,379 | 680 | -8,508 | 133 |
| 2/94 | 45,403 | 453 | 2,842 | 390 | 5666 | 100 | 36,895 | 512 | -8,508 | 59 |
| 3/94 | 40,957 | 589 | 2,842 | 390 | 5666 | 100 | 32,450 | 692 | -8,508 | 103 |
| 4/94 | 30,500 | 544 | 2,842 | 390 | 0 | 0 | 27,658 | 559 | -2,842 | 16 |
| 5/94 | 28,422 | 542 | 2,842 | 390 | 0 | 0 | 25,581 | 559 | -2,842 | 17 |
| 6/94 | 25,185 | 538 | 2,842 | 390 | 0 | 0 | 22,344 | 557 | -2,842 | 19 |
| 7/94 | 24,758 | 539 | 2,842 | 390 | 0 | 0 | 21,916 | 558 | -2,842 | 19 |
| 8/94 | 24,135 | 526 | 2,842 | 390 | 0 | 0 | 21,294 | 544 | -2,842 | 18 |
| 9/94 | 24,433 | 523 | 2,842 | 390 | 0 | 0 | 21,591 | 540 | -2,842 | 17 |
| 10/94 | 27,885 | 526 | 2,842 | 390 | 0 | 0 | 25,043 | 542 | -2,842 | 15 |
| 11/94 | 31,004 | 525 | 2,842 | 390 | 0 | 0 | 28,162 | 538 | -2,842 | 14 |
| 12/94 | 30,650 | 543 | 2,842 | 390 | 0 | 0 | 27,808 | 558 | -2,842 | 16 |
| 1/95 | 124,632 | 367 | 2,842 | 390 | 5666 | 100 | 116,124 | 379 | -8,508 | 12 |
| 2/95 | 51,348 | 477 | 2,842 | 390 | 5666 | 100 | 42,840 | 533 | -8,508 | 56 |
| 3/95 | 160,082 | 338 | 2,842 | 390 | 5666 | 100 | 151,575 | 346 | -8,508 | 8 |
| 4/95 | 54,543 | 494 | 2,842 | 390 | 0 | 0 | 51,701 | 500 | -2,842 | 6 |
| 5/95 | 42,040 | 522 | 2,842 | 390 | 0 | 0 | 39,199 | 532 | -2,842 | 10 |
| 6/95 | 37,544 | 511 | 2,842 | 390 | 0 | 0 | 34,702 | 521 | -2,842 | 10 |
| 7/95 | 24,568 | 512 | 2,842 | 390 | 0 | 0 | 21,726 | 528 | -2,842 | 16 |
| 8/95 | 25,559 | 541 | 2,842 | 390 | 0 | 0 | 22,718 | 559 | -2,842 | 19 |
| 9/95 | 25,336 | 535 | 2,842 | 390 | 0 | 0 | 22,494 | 553 | -2,842 | 18 |
| 10/95 | 26,351 | 533 | 2,842 | 390 | 0 | 0 | 23,509 | 551 | -2,842 | 17 |
| 11/95 | 28,274 | 541 | 2,842 | 390 | 0 | 0 | 25,432 | 558 | -2,842 | 17 |
| 12/95 | 29,879 | 520 | 2,842 | 390 | 0 | 0 | 27,038 | 534 | -2,842 | 14 |
| 1/96 | 34,208 | 546 | 2,842 | 390 | 5666 | 100 | 25,700 | 662 | -8,508 | 116 |

## Table 4.5-23 (continued)
## FLOW AND TDS IMPACTS OF THE OBMP FOR THE SANTA ANA RIVER BELOW PRADO FOR ULTIMATE CONDITIONS

| Month | Baseline | | OBMP Alt A1 | | | | | | Difference | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Discharge At Below Prado | | Recycled Water Recharge | | Storm Water Recharge | | Total Discharge At Below Prado | | | |
| | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) | Volume (af/m) | TDS (mg/L) |
| 2/96 | 68,561 | 365 | 2,842 | 390 | 5666 | 100 | 60,053 | 388 | -8,508 | 24 |
| 3/96 | 40,347 | 492 | 2,842 | 390 | 5666 | 100 | 31,839 | 571 | -8,508 | 79 |
| 4/96 | 34,497 | 532 | 2,842 | 390 | 0 | 0 | 31,656 | 545 | -2,842 | 13 |
| 5/96 | 35,438 | 511 | 2,842 | 390 | 0 | 0 | 32,597 | 521 | -2,842 | 11 |
| 6/96 | 33,170 | 501 | 2,842 | 390 | 0 | 0 | 30,328 | 511 | -2,842 | 10 |
| 7/96 | 29,959 | 497 | 2,842 | 390 | 0 | 0 | 27,117 | 509 | -2,842 | 11 |
| 8/96 | 25,172 | 537 | 2,842 | 390 | 0 | 0 | 22,331 | 555 | -2,842 | 19 |
| 9/96 | 24,971 | 530 | 2,842 | 390 | 0 | 0 | 22,129 | 548 | -2,842 | 18 |
| 10/96 | 29,041 | 536 | 2,842 | 390 | 0 | 0 | 26,199 | 551 | -2,842 | 16 |
| 11/96 | 37,026 | 487 | 2,842 | 390 | 0 | 0 | 34,184 | 495 | -2,842 | 8 |
| 12/96 | 39,517 | 486 | 2,842 | 390 | 0 | 0 | 36,676 | 493 | -2,842 | 7 |
| 1/97 | 69,209 | 385 | 2,842 | 390 | 5666 | 100 | 60,702 | 411 | -8,508 | 26 |
| 2/97 | 32,086 | 523 | 2,842 | 390 | 5666 | 100 | 23,579 | 640 | -8,508 | 118 |
| 3/97 | 30,967 | 539 | 2,842 | 390 | 5666 | 100 | 22,460 | 669 | -8,508 | 130 |
| 4/97 | 30,304 | 519 | 2,842 | 390 | 0 | 0 | 27,463 | 532 | -2,842 | 13 |
| 5/97 | 33,889 | 482 | 2,842 | 390 | 0 | 0 | 31,048 | 490 | -2,842 | 8 |
| 6/97 | 33,184 | 472 | 2,842 | 390 | 0 | 0 | 30,343 | 480 | -2,842 | 8 |
| 7/97 | 31,742 | 471 | 2,842 | 390 | 0 | 0 | 28,901 | 479 | -2,842 | 8 |
| 8/97 | 36,168 | 438 | 2,842 | 390 | 0 | 0 | 33,327 | 442 | -2,842 | 4 |
| 9/97 | 37,822 | 440 | 2,842 | 390 | 0 | 0 | 34,981 | 444 | -2,842 | 4 |
| 10/97 | 30,227 | 502 | 2,842 | 390 | 0 | 0 | 27,386 | 514 | -2,842 | 12 |
| 11/97 | 31,902 | 502 | 2,842 | 390 | 0 | 0 | 29,060 | 513 | -2,842 | 11 |
| 12/97 | 43,177 | 456 | 2,842 | 390 | 0 | 0 | 40,335 | 460 | -2,842 | 5 |
| 1/98 | 44,801 | 437 | 2,842 | 390 | 5666 | 100 | 36,294 | 493 | -8,508 | 56 |
| 2/98 | 195,307 | 287 | 2,842 | 390 | 5666 | 100 | 186,800 | 291 | -8,508 | 4 |
| 3/98 | 55,396 | 460 | 2,842 | 390 | 5666 | 100 | 46,888 | 508 | -8,508 | 48 |
| 4/98 | 47,537 | 470 | 2,842 | 390 | 0 | 0 | 44,696 | 475 | -2,842 | 5 |
| 5/98 | 74,371 | 380 | 2,842 | 390 | 0 | 0 | 71,529 | 380 | -2,842 | 0 |
| 6/98 | 37,519 | 463 | 2,842 | 390 | 0 | 0 | 34,677 | 469 | -2,842 | 6 |
| 7/98 | 27,550 | 520 | 2,842 | 390 | 0 | 0 | 24,709 | 534 | -2,842 | 15 |
| 8/98 | 28,023 | 522 | 2,842 | 390 | 0 | 0 | 25,182 | 536 | -2,842 | 15 |
| 9/98 | 27,729 | 523 | 2,842 | 390 | 0 | 0 | 24,887 | 538 | -2,842 | 15 |
| Average | 38,502 | 512 | 2,842 | 390 | 1,417 | 25 | 34,244 | 542 | -4,258 | 29 |
| Max | 237,386 | 612 | 2,842 | 390 | 5,666 | 100 | 228,878 | 718 | -2,842 | 133 |
| Min | 23,588 | 272 | 2,842 | 390 | 0 | 0 | 20,746 | 275 | -8,508 | 0 |
| StDev | 25,639 | 52 | 0 | 0 | 2,459 | 43 | 24,641 | 68 | 2,459 | 34 |
| Coef of Var | 67% | 10% | 0% | 0% | 174% | 174% | 72% | 13% | -58% | 114% |

# Table 4.5-24
# HYDROLOGIC AND SALT BUDGET SUMMARY FOR THE CHINO BASIN COMPARISON OF BASELINE TO OBMP ALTERNATIVE A AT YEAR 2020 REPLENISHMENT WITH IMPORTED WATER ONLY

| Inflow/Outflow Components | With OBMP | | | | No OBMP | | | | *With OBMP minus No OBMP* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | TDS Conc | TDS Mass | % of Inflow | Volume | TDS Conc | TDS Mass | % of Inflow | Volume | TDS Conc | TDS Mass | % of Inflow |
| | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | |
| *Inflows* | | | | | | | | | | | | |
| Deep Percolation of Precipitation | 69,691 | 100 | 9,482 | 7.1% | 69,691 | 100 | 9,482 | 7.6% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from Dairies and Agriculture | 3,378 | 2,572 | 11,818 | 8.9% | 3,378 | 2,572 | 11,818 | 9.5% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from All Other Sources | 42,734 | 1,256 | 73,013 | 54.7% | 42,734 | 1,267 | 73,685 | 59.4% | 0 | -12 | -672 | -5% |
| Non Santa Ana River Storm Flow Recharge | 30,000 | 100 | 4,082 | 3.1% | 13,513 | 100 | 1,839 | 1.5% | 16,487 | 0 | 2,243 | 2% |
| Santa Ana River Recharge | 19,100 | 567 | 14,734 | 11.0% | 19,100 | 567 | 14,734 | 11.9% | 0 | 0 | 0 | -1% |
| Imported Water Recharge | 44,000 | 250 | 14,966 | 11.2% | 20,000 | 250 | 6,803 | 5.5% | 24,000 | 0 | 8,163 | 6% |
| Recycled Water Recharge | 0 | 487 | 0 | 0.0% | 500 | 487 | 331 | 0.3% | -500 | 0 | -331 | 0% |
| Subsurface Inflow | 16,400 | 240 | 5,355 | 4.0% | 16,400 | 240 | 5,355 | 4.3% | 0 | 0 | 0 | 0% |
| Subtotal of Inflows | 225,303 | 435 | 133,449 | 100% | 185,316 | 492 | 124,046 | 100% | 39,987 | -57 | 9,403 | 0% |
| *Outflows* | | | | | | | | | | | | |
| Production | 197,742 | 533 | 143,399 | 90.0% | 116,620 | 339 | 53,632 | 39% | 81,122 | 194 | 89,768 | 51% |
| *Direct* | *132,849* | *399* | *53,997* | *33.9%* | *99,069* | *298* | *40,180* | *29%* | *33,780* | *1* | *13,817* | *5%* |
| *OBMP Facilities* | *40,000* | *1,300* | *70,748* | *44.4%* | *0* | *na* | *0* | *0%* | *40,000* | *1,300* | *70,748* | *44%* |
| *SAWPA Desalter* | *10,584* | *755* | *10,867* | *6.8%* | *8,076* | *755* | *8,295* | *6%* | *2,509* | *0* | *2,571* | *1%* |
| *Other* | *14,309* | *400* | *7,787* | *4.9%* | *9,476* | *400* | *5,157* | *4%* | *4,833* | *0* | *2,630* | *1%* |
| Rising Water | 9,000 | 1,300 | 15,918 | 10.0% | 47,694 | 1,300 | 84,356 | 61% | -38,694 | 0 | -68,438 | -51% |
| Phreatophyte | 12,300 | 0 | 0 | 0.0% | 12,300 | 0 | 0 | 0% | 0 | 0 | 0 | 0% |
| Subtotal Outflows | 219,042 | 535 | 159,318 | 100% | 176,614 | 574 | 137,988 | 100% | 42,429 | -40 | 21,329 | 0% |
| Inflow - Outflow | 6,261 | | -25,868 | | 8,703 | | -13,942 | | -2,442 | | -11,926 | |
| Safe Yield Estimate | | | | | | | | | | | | |
| "Native" Inflow | 181,303 | | | | 164,816 | | | | | | | |
| Less Uncontrolled Outflow | 21,300 | | | | 59,994 | | | | | | | |
| Equals ~ Safe Yield | 160,003 | | | | 104,822 | | | | | | | |

# Table 4.5-25
# HYDROLOGIC AND SALT BUDGET SUMMARY FOR THE CHINO BASIN COMPARISON OF BASELINE TO OBMP ALTERNATIVE A AT YEAR 2020 REPLENISHMENT WITH 50% IMPORTED WATER AND 50% RECYCLED WATER

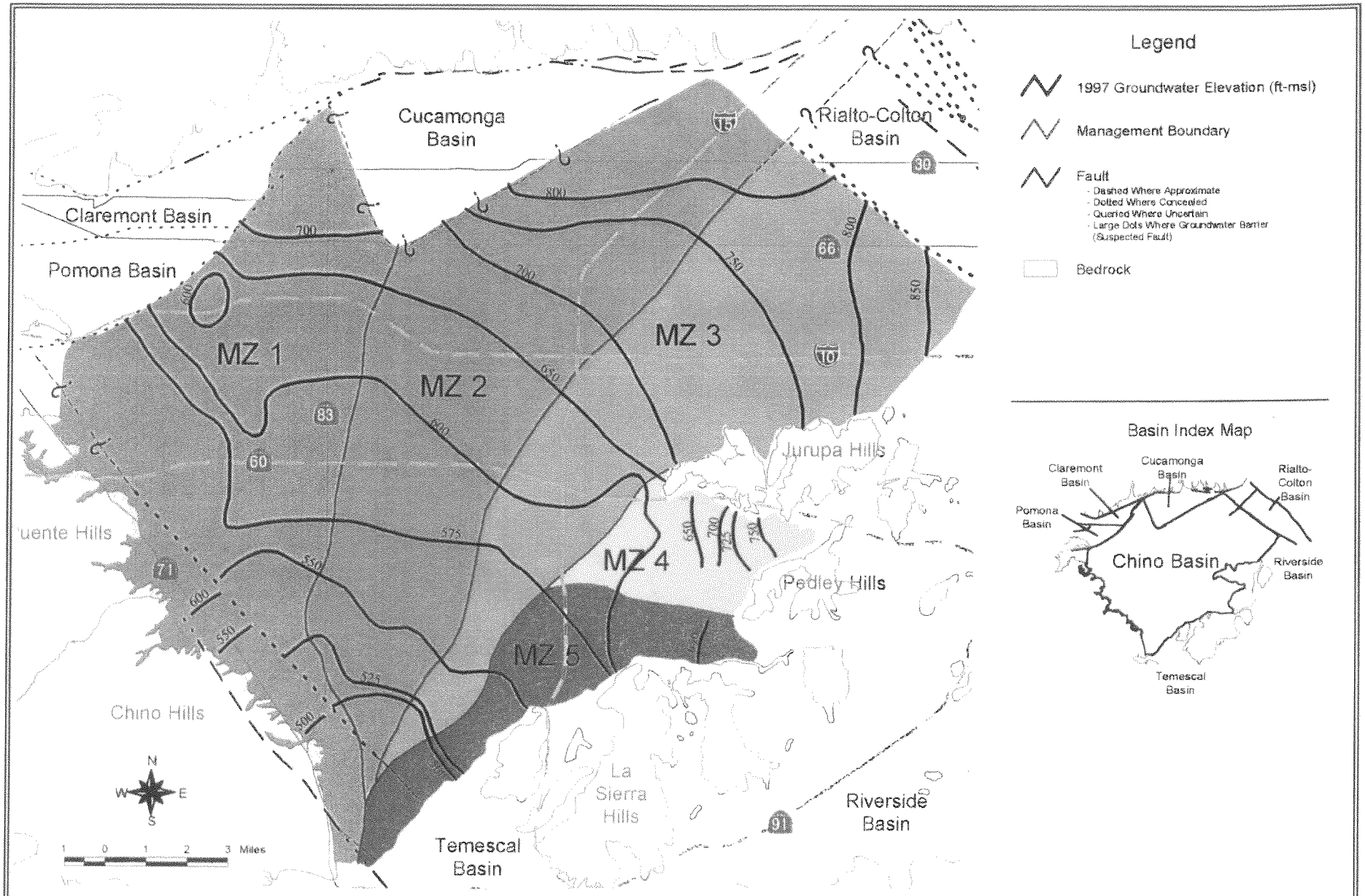
| Inflow/Outflow Components | With OBMP | | | | No OBMP | | | | *With OBMP* minus *No OBMP* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | TDS | | % of Inflow | Volume | TDS | | % of Inflow | Volume | TDS | | % of Inflow |
| | | Conc | Mass | | | Conc | Mass | | | Conc | Mass | |
| | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | |
| *Inflows* | | | | | | | | | | | | |
| Deep Percolation of Precipitation | 69,691 | 100 | 9,482 | 7% | 69,691 | 100 | 9,482 | 7.6% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from Dairies and Agriculture | 3,378 | 2,572 | 11,818 | 8% | 3,378 | 2,572 | 11,818 | 9.5% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from All Other Sources | 42,734 | 1,256 | 73,013 | 52% | 42,734 | 1,267 | 73,685 | 59.4% | 0 | -12 | -672 | -7% |
| Non Santa Ana River Storm Flow Recharge | 30,000 | 100 | 4,082 | 3% | 13,513 | 100 | 1,839 | 1.5% | 16,487 | 0 | 2,243 | 1% |
| Santa Ana River Recharge | 19,100 | 567 | 14,734 | 10% | 19,100 | 567 | 14,734 | 11.9% | 0 | 0 | 0 | -1% |
| Imported Water Replenishment | 22,000 | 250 | 7,483 | 5% | 20,000 | 250 | 6,803 | 5.5% | 2,000 | 0 | 680 | 0% |
| Recycled Water Replenishment | 22,000 | 487 | 14,577 | 10% | 500 | 487 | 331 | 0.3% | 21,500 | 0 | 14,246 | 10% |
| Subsurface Inflow | 16,400 | 240 | 5,355 | 4% | 16,400 | 240 | 5,355 | 4.3% | 0 | 0 | 0 | -1% |
| Subtotal of Inflows | 225,303 | 458 | 140,543 | 100% | 185,316 | 492 | 124,046 | 100% | 39,987 | -34 | 16,497 | 0% |
| *Outflows* | | | | | | | | | | | | |
| Production | 197,742 | 533 | 143,399 | 90% | 116,620 | 339 | 53,632 | 39% | 81,122 | 194 | 89,768 | 51% |
| *Direct* | *132,849* | *299* | *53,997* | *34%* | *99,069* | *298* | *48,180* | *29%* | *33,780* | *1* | *13,817* | *5%* |
| *OBMP Facilities* | *40,000* | *1,300* | *70,748* | *44%* | *0* | *na* | *0* | *0%* | *40,000* | *1,300* | *70,748* | *44%* |
| *SAWPA Desalter* | *10,584* | *755* | *10,867* | *7%* | *8,076* | *755* | *8,295* | *6%* | *2,509* | *0* | *2,571* | *1%* |
| *Other* | *14,309* | *400* | *7,787* | *5%* | *9,476* | *400* | *5,157* | *4%* | *4,833* | *0* | *2,630* | *1%* |
| Rising Water | 9,000 | 1,300 | 81,615<br>15,918 | 10% | 47,694 | 1,300 | 84,356 | 61% | -38,694 | 0 | -68,438 | -51% |
| Phreatophyte | 12,300 | 0 | 0 | 0% | 12,300 | 0 | 0 | 0% | 0 | 0 | 0 | 0% |
| Subtotal Outflows | 219,042 | 535 | 159,318 | 100% | 176,614 | 574 | 137,988 | 100% | 42,429 | -40 | 21,329 | 0% |
| Inflow - Outflow | 6,261 | | -18,775 | | 8,703 | | -13,942 | | -2,442 | | -4,833 | |
| Safe Yield Estimate | | | | | | | | | | | | |
| "Native" Inflow | 181,303 | | | | 164,816 | | | | | | | |
| Less Uncontrolled Outflow | 21,300 | | | | 59,994 | | | | | | | |
| Equals – Safe Yield | 160,003 | | | | 104,822 | | | | | | | |

## Table 4.5-26
## HYDROLOGIC AND SALT BUDGET SUMMARY FOR THE CHINO BASIN
## COMPARISON OF BASELINE TO OBMP ALTERNATIVE B AT YEAR 2020
## REPLENISHMENT WITH IMPORTED WATER ONLY

| Inflow/Outflow Components | With OBMP | | | | No OBMP | | | | *With OBMP* minus *No OBMP* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | TDS Conc | TDS Mass | % of Inflow | Volume | TDS Conc | TDS Mass | % of Inflow | Volume | TDS Conc | TDS Mass | % of Inflow |
| | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | |
| *Inflows* | | | | | | | | | | | | |
| Deep Percolation of Precipitation | 69,691 | 100 | 9,482 | 6.9% | 69,691 | 100 | 9,482 | 7.6% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from Dairies and Agriculture | 3,378 | 2,572 | 11,818 | 8.6% | 3,378 | 2,572 | 11,818 | 9.5% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from All Other Sources | 42,734 | 1,256 | 73,013 | 53.0% | 42,734 | 1,267 | 73,685 | 59.4% | 0 | -12 | -672 | -6% |
| Non Santa Ana River Storm Flow Recharge | 13,513 | 100 | 1,839 | 1.3% | 13,513 | 100 | 1,839 | 1.5% | 0 | 0 | 0 | 0% |
| Santa Ana River Recharge | 19,100 | 567 | 14,734 | 10.7% | 19,100 | 567 | 14,734 | 11.9% | 0 | 0 | 0 | -1% |
| Imported Water Recharge | 63,000 | 250 | 21,429 | 15.6% | 20,000 | 250 | 6,803 | 5.5% | 43,000 | 0 | 14,626 | 10% |
| Recycled Water Recharge | 0 | 487 | 0 | 0.0% | 500 | 487 | 331 | 0.3% | -500 | 0 | -331 | 0% |
| Subsurface Inflow | 16,400 | 240 | 5,355 | 3.9% | 16,400 | 240 | 5,355 | 4.3% | 0 | 0 | 0 | 0% |
| Subtotal of Inflows | 227,816 | 444 | 137,669 | 100% | 185,316 | 492 | 124,046 | 100% | 42,500 | -48 | 13,623 | 0% |
| *Outflows* | | | | | | | | | | | | |
| Production | 197,742 | 533 | 143,399 | 90.0% | 116,620 | 339 | 53,632 | 39% | 81,122 | 194 | 89,768 | 51% |
| *Direct* | *132,849* | *299* | *53,997* | *33.9%* | *99,069* | *298* | *40,180* | *29%* | *33,780* | *1* | *13,817* | *5%* |
| *OBMP Facilities* | *40,000* | *1,300* | *70,748* | *44.4%* | *0* | *na* | *0* | *0%* | *40,000* | *1,300* | *70,748* | *44%* |
| *SAWPA Desalter* | *10,584* | *755* | *10,867* | *6.8%* | *8,076* | *755* | *8,295* | *6%* | *2,509* | *0* | *2,571* | *1%* |
| *Other* | *14,309* | *400* | *7,787* | *4.9%* | *9,476* | *400* | *5,157* | *4%* | *4,833* | *0* | *2,630* | *1%* |
| Rising Water | 9,000 | 1,300 | 15,918 | 10.0% | 47,694 | 1,300 | 84,356 | 61% | -38,694 | 0 | -68,438 | -51% |
| Phreatophyte | 12,300 | 0 | 0 | 0.0% | 12,300 | 0 | 0 | 0% | 0 | 0 | 0 | 0% |
| Subtotal Outflows | 219,042 | 535 | 159,318 | 100% | 176,614 | 574 | 137,988 | 100% | 42,429 | -40 | 21,329 | 0% |
| Inflow - Outflow | 8,774 | | -21,649 | | 8,703 | | -13,942 | | 71 | | -7,707 | |
| Safe Yield Estimate | | | | | | | | | | | | |
| "Native" Inflow | 164,816 | | | | 164,816 | | | | | | | |
| Less Uncontrolled Outflow | 21,300 | | | | 59,994 | | | | | | | |
| Equals – Safe Yield | 143,516 | | | | 104,822 | | | | | | | |

# Table 4.5-27
# HYDROLOGIC AND SALT BUDGET SUMMARY FOR THE CHINO BASIN COMPARISON OF BASELINE TO OBMP ALTERNATIVE B AT YEAR 2020 REPLENISHMENT WITH 50% IMPORTED WATER AND 50% RECYCLED WATER

| Inflow/Outflow Components | With OBMP | | | | No OBMP | | | | *With OBMP* minus *No OBMP* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | TDS | | | Volume | TDS | | | Volume | TDS | | |
| | | Conc | Mass | % of Inflow | | Conc | Mass | % of Inflow | | Conc | Mass | % of Inflow |
| | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | | (acre-ft/yr) | (mg/L) | (tons) | |
| *Inflows* | | | | | | | | | | | | |
| Deep Percolation of Precipitation | 69,691 | 100 | 9,482 | 6.4% | 69,691 | 100 | 9,482 | 7.6% | 0 | 0 | 0 | -1% |
| Deep Percolation of Applied Water from Dairies and Agriculture | 3,378 | 2,572 | 11,818 | 8.0% | 3,378 | 2,572 | 11,818 | 9.5% | 0 | 0 | 0 | -2% |
| Deep Percolation of Applied Water from All Other Sources | 42,734 | 1,256 | 73,013 | 49.4% | 42,734 | 1,267 | 73,685 | 59.4% | 0 | -12 | -672 | -10% |
| Non Santa Ana River Storm Flow Recharge | 13,513 | 100 | 1,839 | 1.2% | 13,513 | 100 | 1,839 | 1.5% | 0 | 0 | 0 | 0% |
| Santa Ana River Recharge | 19,100 | 567 | 14,734 | 10.0% | 19,100 | 567 | 14,734 | 11.9% | 0 | 0 | 0 | -2% |
| Imported Water Replenishment | 31,500 | 250 | 10,714 | 7.2% | 20,000 | 250 | 6,803 | 5.5% | 11,500 | 0 | 3,912 | 2% |
| Recycled Water Replenishment | 31,500 | 487 | 20,871 | 14.1% | 500 | 487 | 331 | 0.3% | 31,000 | 0 | 20,540 | 14% |
| Subsurface Inflow | 16,400 | 240 | 5,355 | 3.6% | 16,400 | 240 | 5,355 | 4.3% | 0 | 0 | 0 | -1% |
| Subtotal of Inflows | 327,816 | 477 | 147,826 | 100% | 185,316 | 492 | 124,046 | 100% | 42,500 | -15 | 23,780 | 0% |
| *Outflows* | | | | | | | | | | | | |
| Production | 197,742 | 533 | 143,399 | 90.0% | 116,620 | 339 | 53,632 | 39% | 81,122 | 194 | 89,768 | 51% |
| *Direct* | *132,849* | *299* | *53,997* | *33.9%* | *99,069* | *298* | *40,180* | *29%* | *33,780* | *1* | *13,817* | *5%* |
| *OBMP Facilities* | *40,000* | *1,300* | *70,748* | *44.4%* | *0* | *na* | *0* | *0%* | *40,000* | *1,300* | *70,748* | *44%* |
| *SAWPA Desalter* | *10,584* | *755* | *10,867* | *6.8%* | *8,076* | *755* | *8,295* | *6%* | *2,509* | *0* | *2,571* | *1%* |
| *Other* | *14,309* | *400* | *7,787* | *4.9%* | *9,476* | *400* | *5,157* | *4%* | *4,833* | *0* | *2,630* | *1%* |
| Rising Water | 9,000 | 1,300 | 15,918 | 10.0% | 47,694 | 1,300 | 84,356 | 61% | -38,694 | 0 | -68,438 | -51% |
| Phreatophyte | 12,300 | 0 | 0 | 0.0% | 12,300 | 0 | 0 | 0% | 0 | 0 | 0 | 0% |
| Subtotal Outflows | 219,042 | 535 | 159,318 | 100% | 176,614 | 574 | 137,988 | 100% | 42,429 | -40 | 21,329 | 0% |
| Inflow - Outflow | 8,774 | | -11,492 | | 8,703 | | -13,942 | | 71 | | 2,450 | |
| Safe Yield Estimate | | | | | | | | | | | | |
| "Native" Inflow | 164,816 | | | | 164,816 | | | | | | | |
| Less Uncontrolled Outflow | 21,300 | | | | 59,994 | | | | | | | |
| Equals = Safe Yield | 143,516 | | | | 104,822 | | | | | | | |

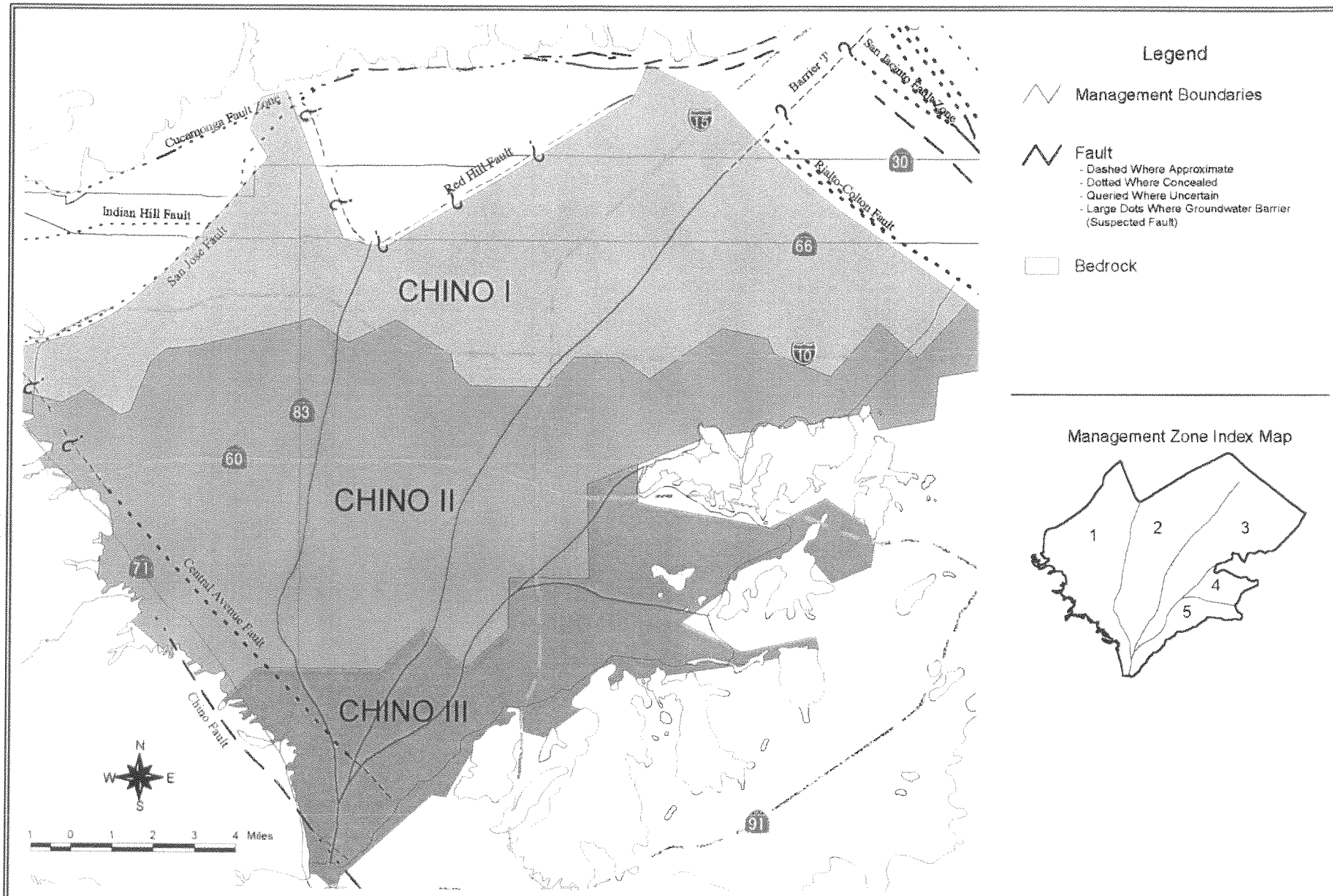



**MANAGEMENT ZONES AND FALL 1997 GROUNDWATER ELEVATION CONTOURS**

Source: OBMP Phase I Report, Figure 2-5

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-1**

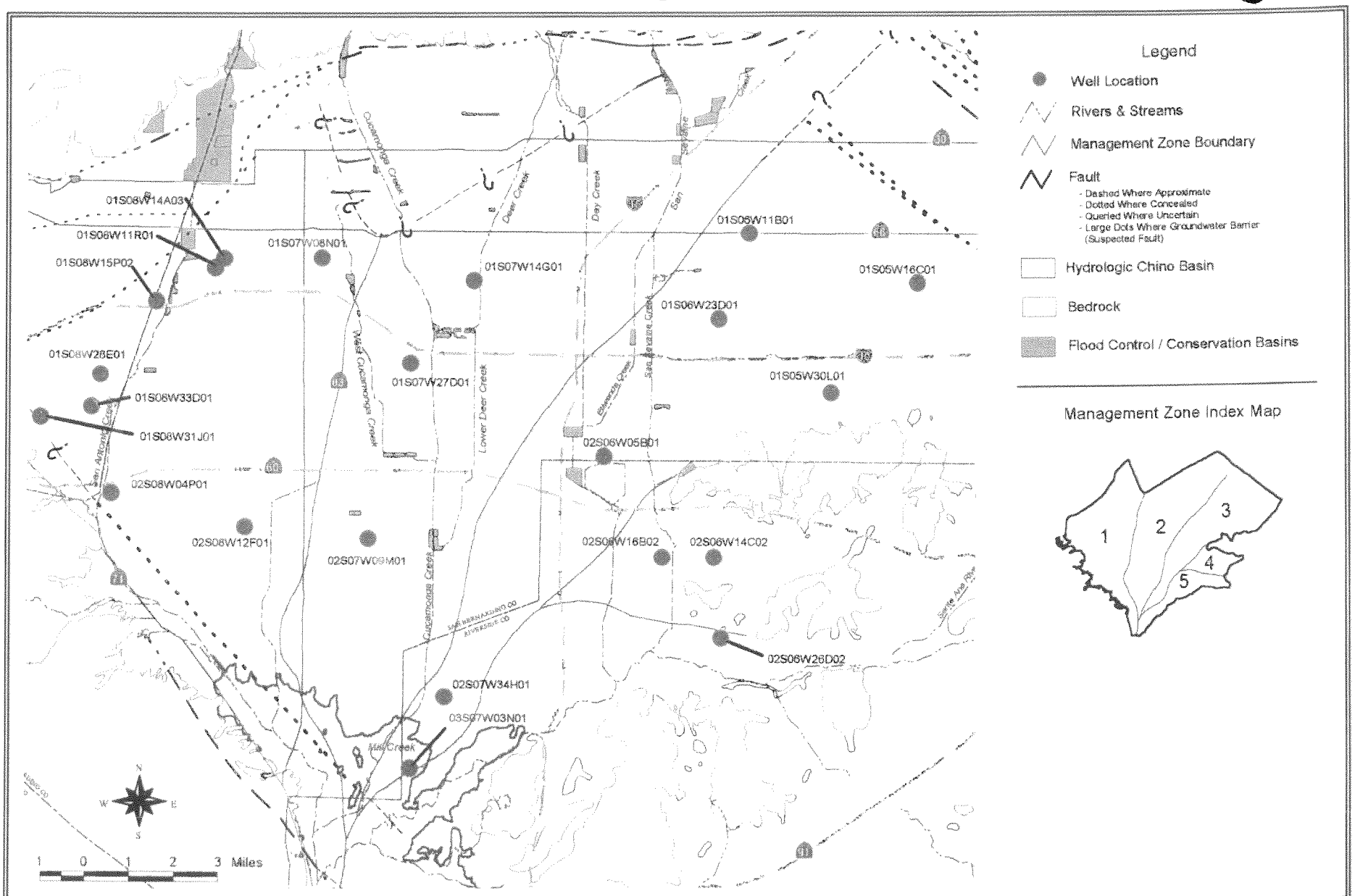



**CHINO SUBBASINS DEFINED IN THE 1995 (AND PRIOR) WATER QUALITY CONTROL PLANS**

Source: OBMP Phase I Report, Figure 2-6

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-2**

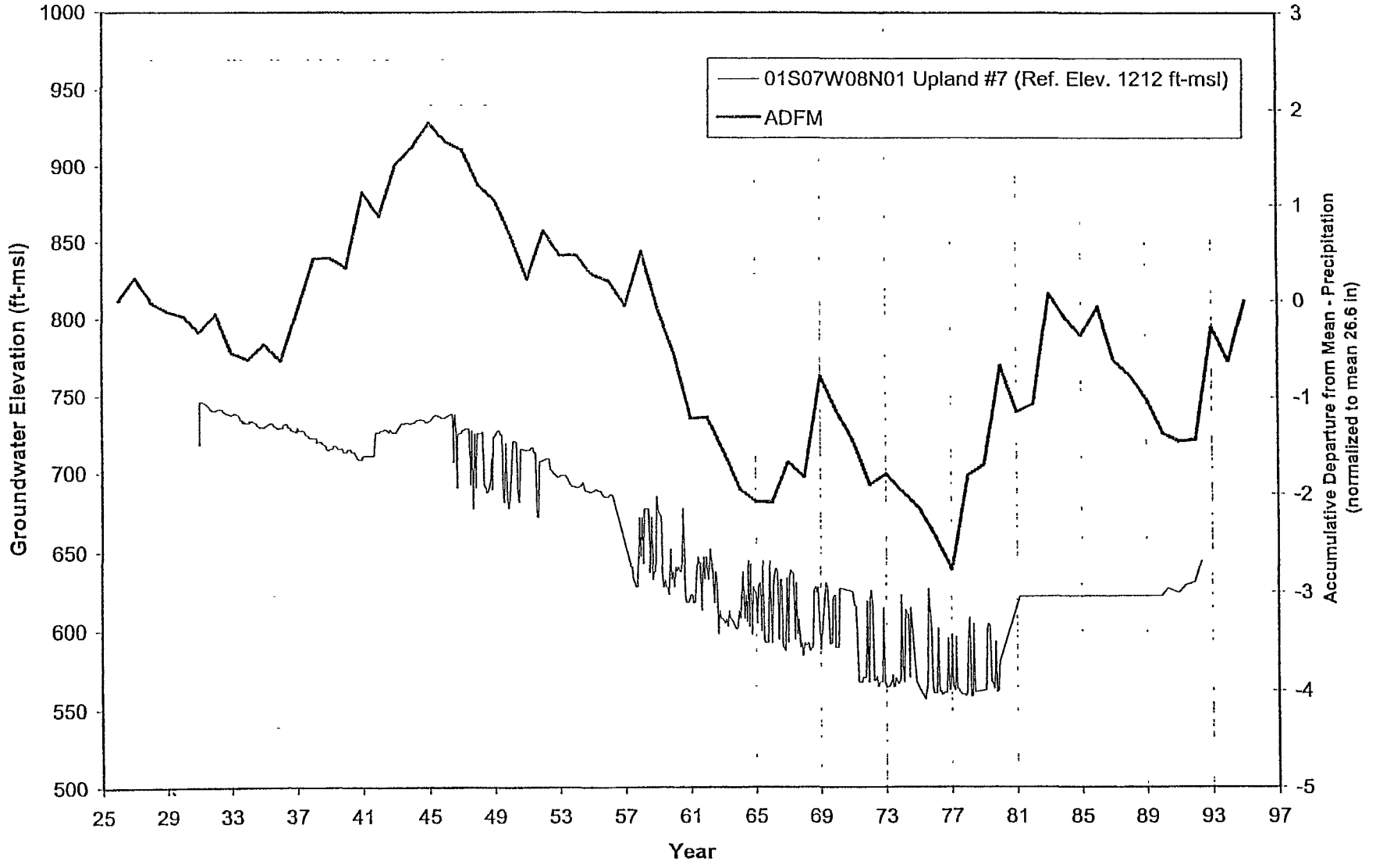



**WELL LOCATION MAP FOR WATER LEVEL TIME HISTORIES**

Source: OBMP Phase I Report, Figure 2-7

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-3**

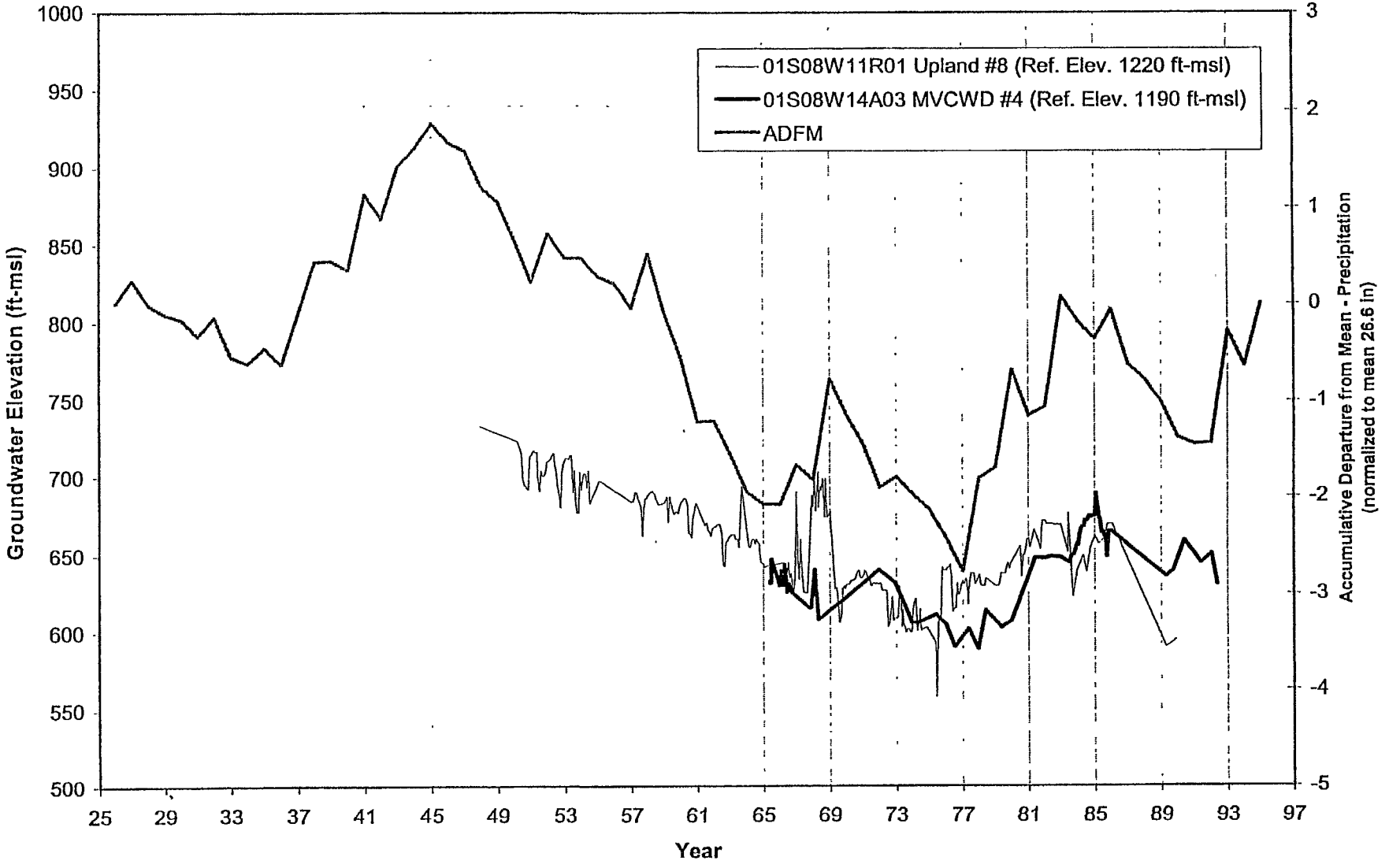



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 1)**

Source: OBMP Phase 1 Report, Figure 2-8

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-4**

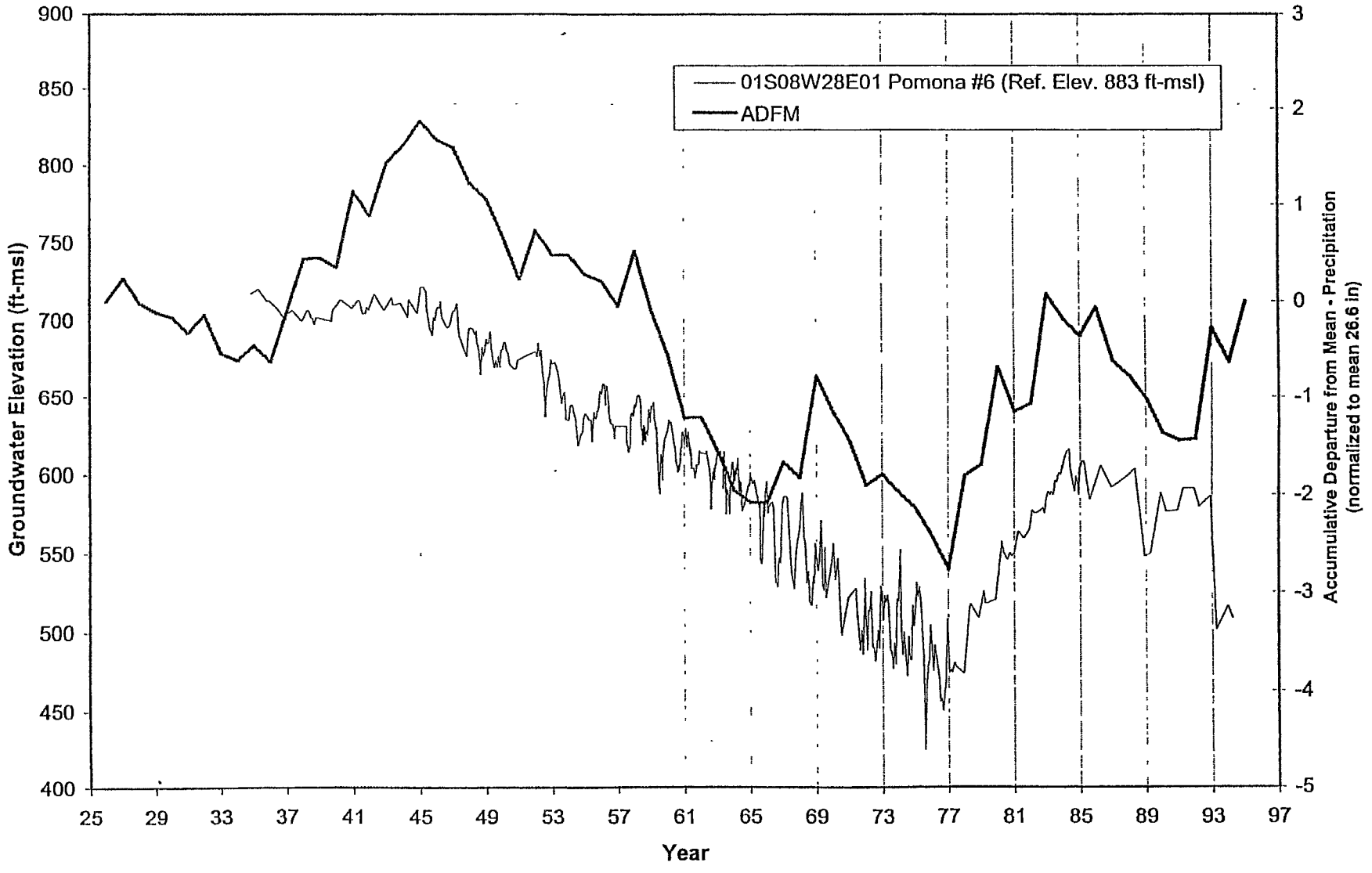



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 1)**

Source: OBMP Phase I Report, Figure 2-9

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-5**

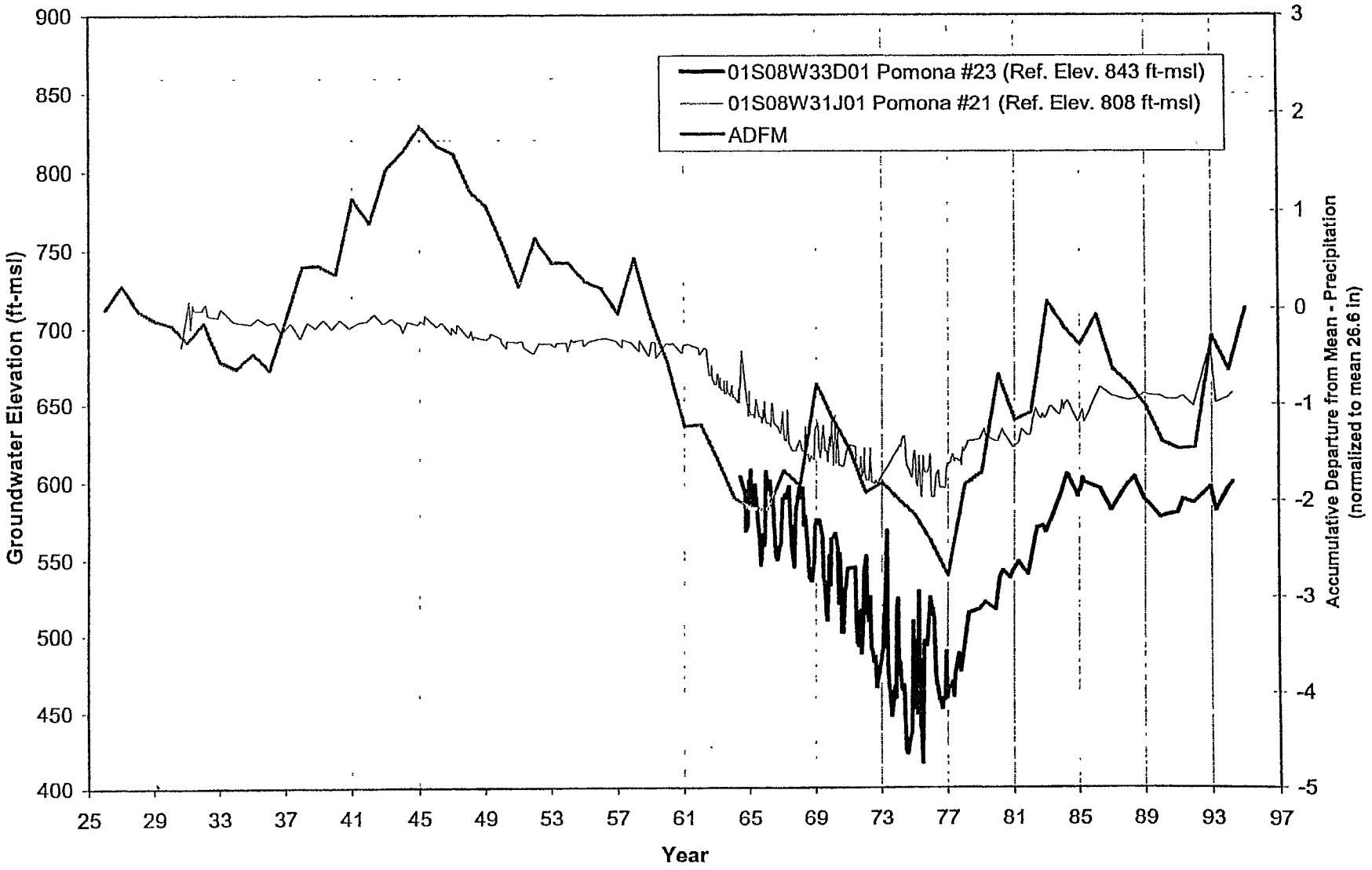



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 1)**

Source: OBMP Phase I Report, Figure 2-10

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-6**

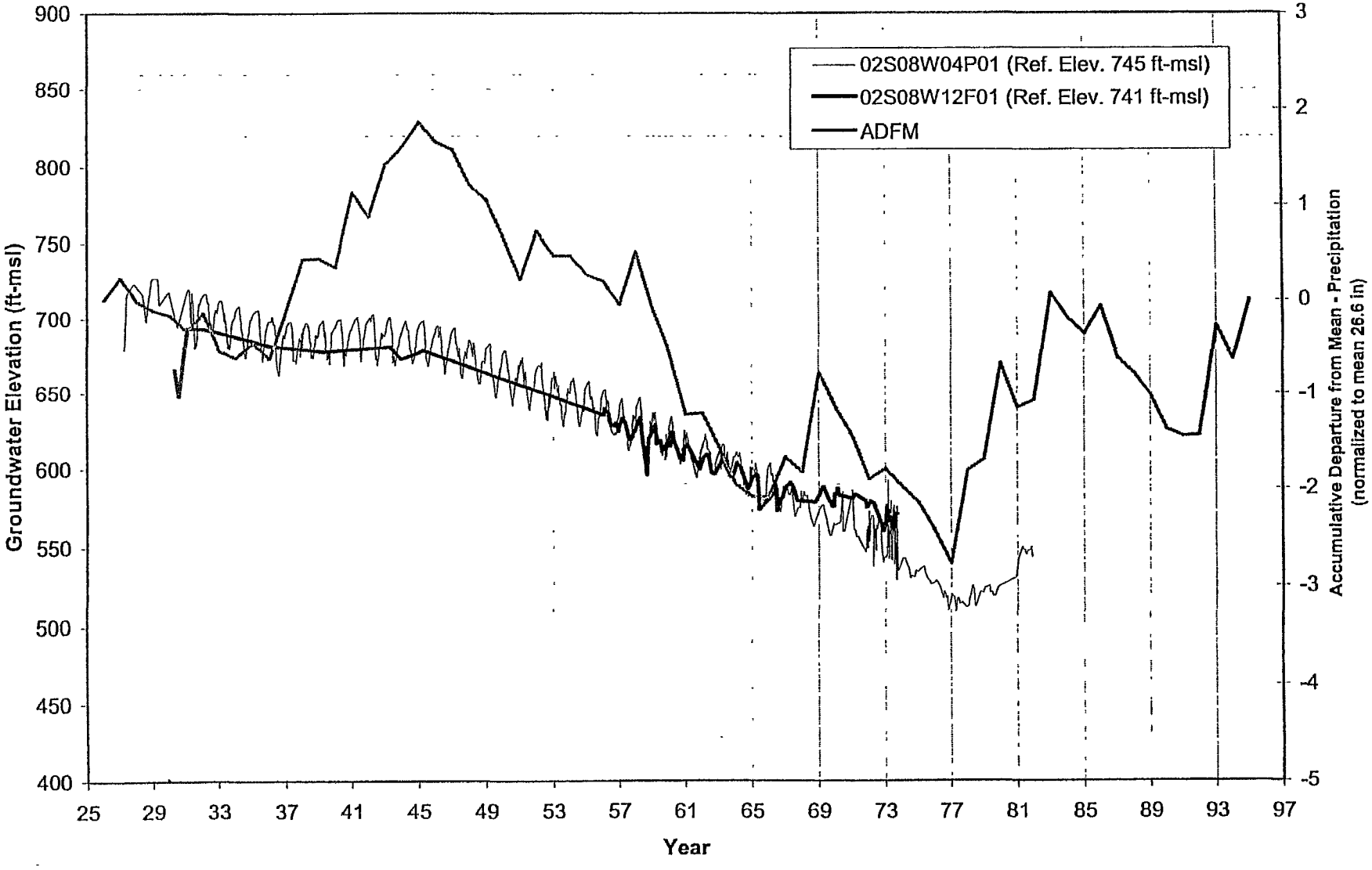



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 1)**

Source: OBMP Phase I Report, Figure 2-11

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-7**

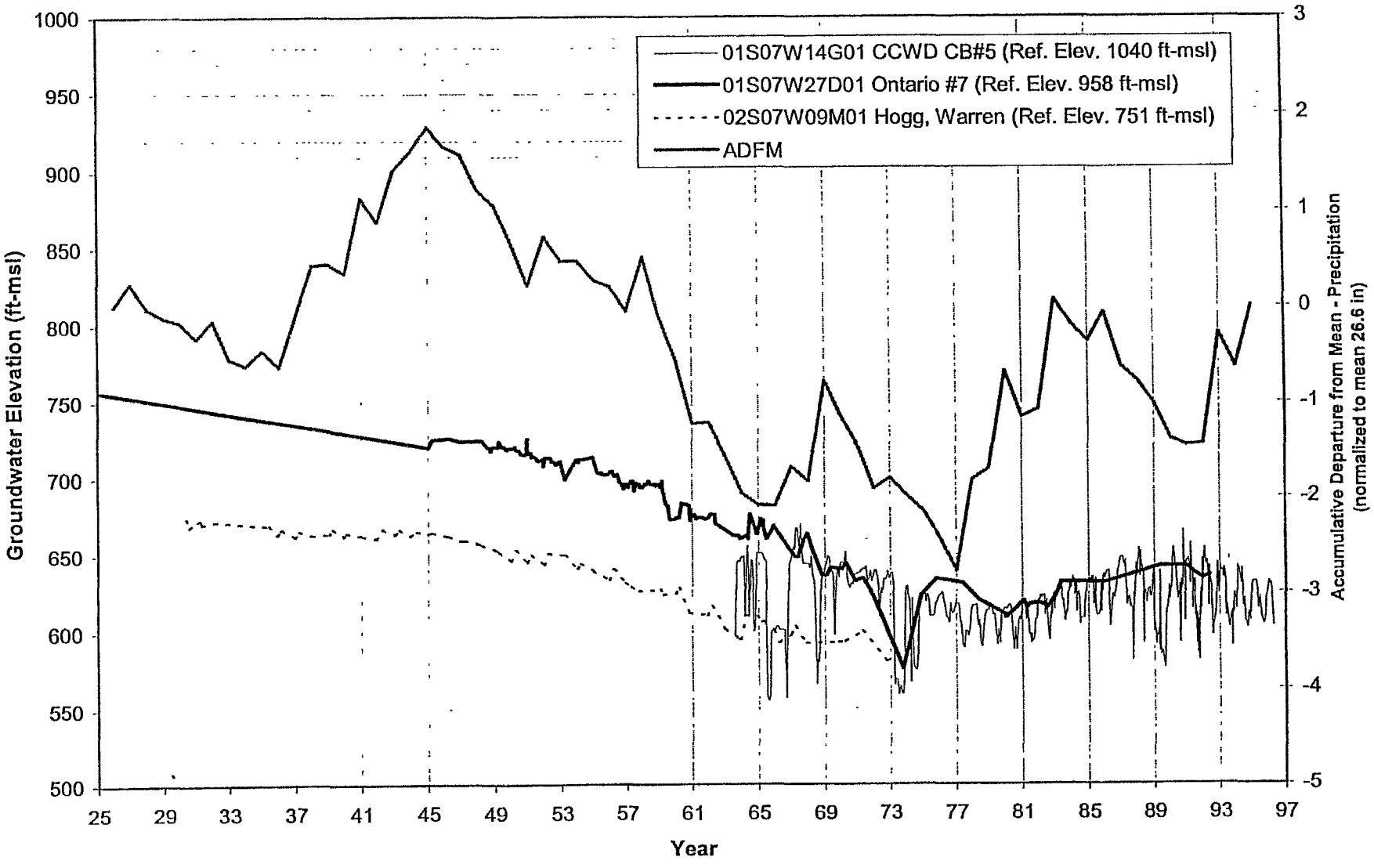



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 1)**

Source: OBMP Phase I Report, Figure 2-12

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-8**

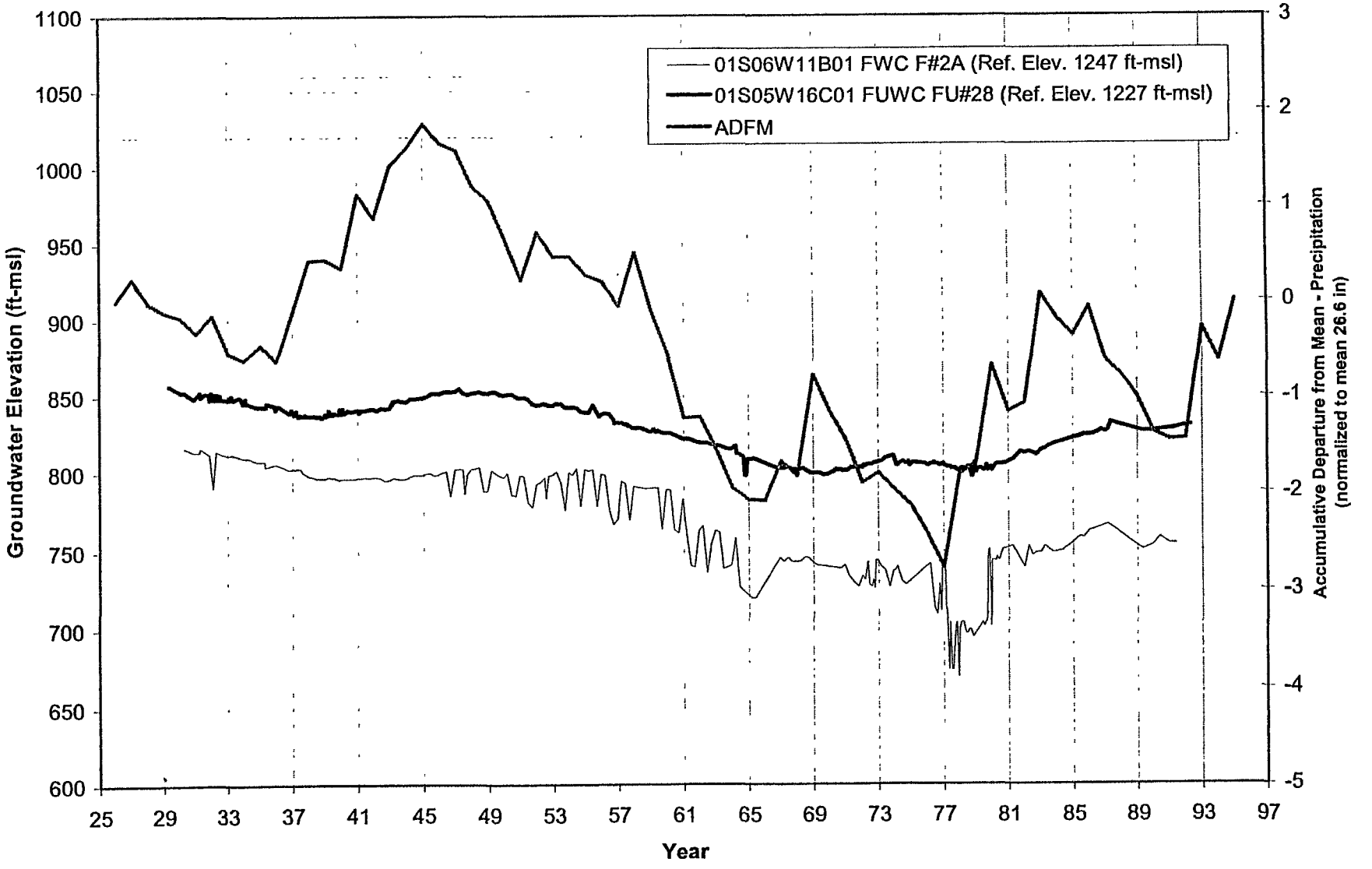



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 2)**

Source: OBMP Phase I Report, Figure 2-13

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-9**

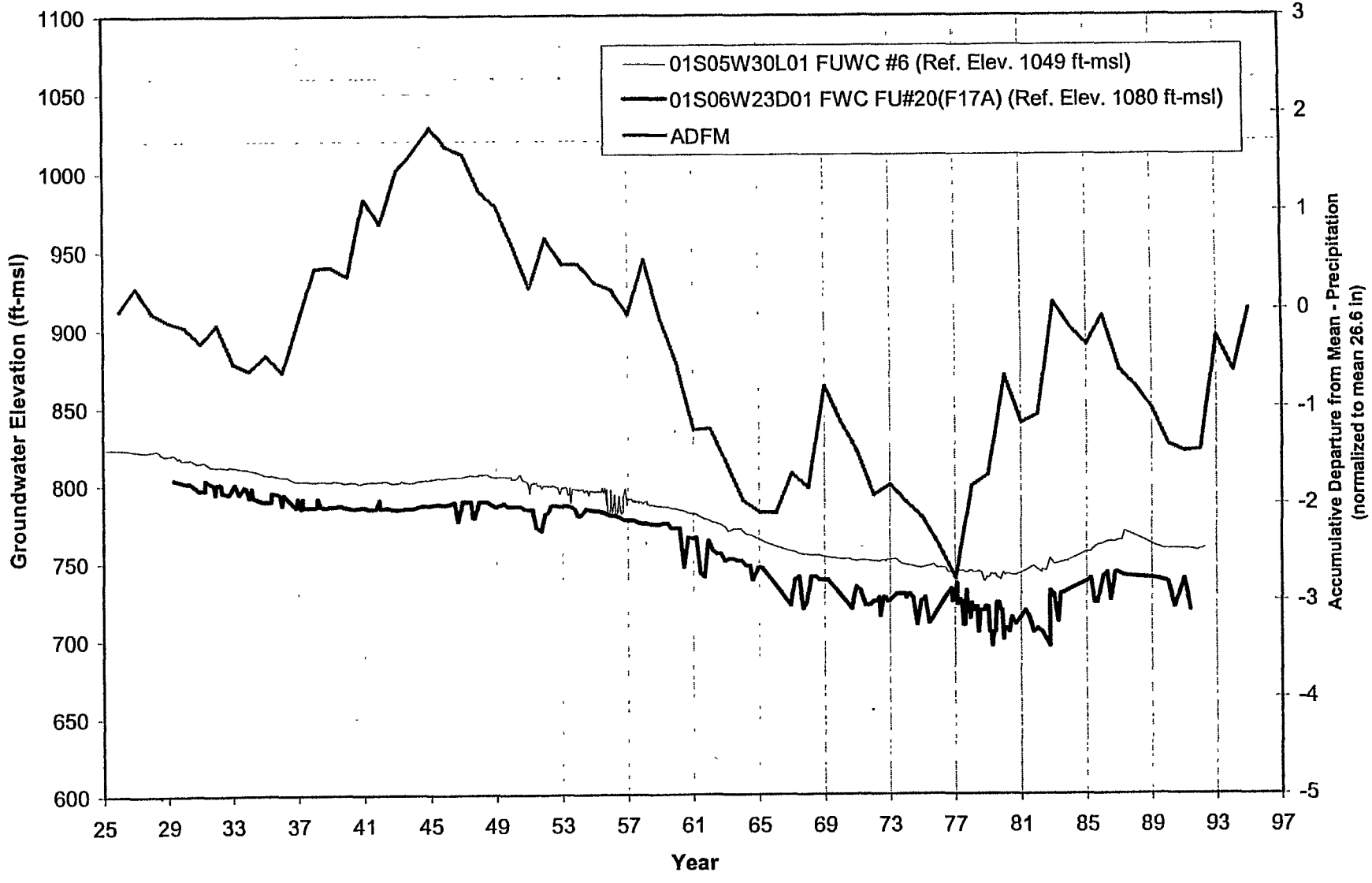



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 3)**

Source: OBMP Phase I Report, Figure 2-14

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-10**

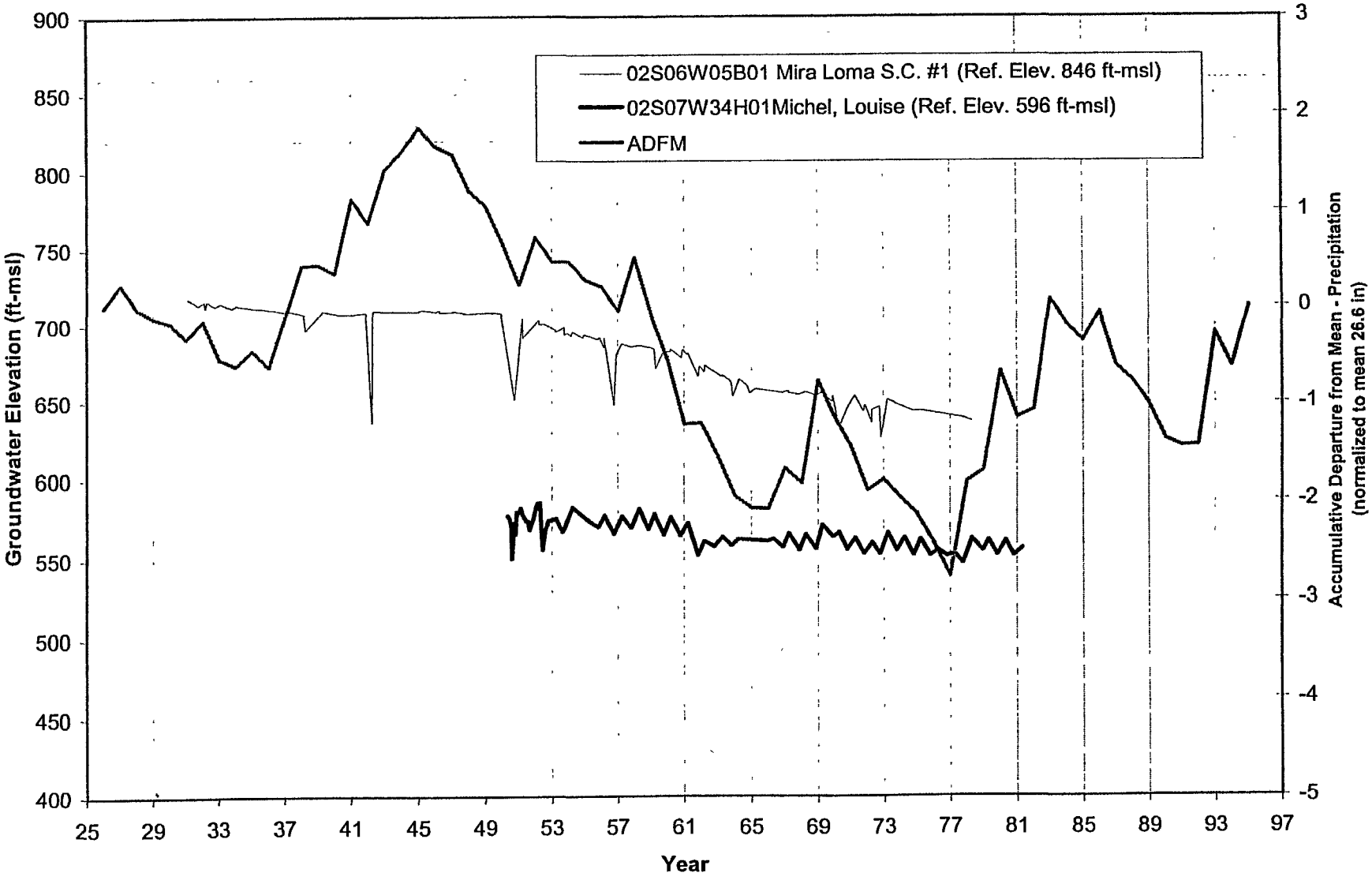



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 3)**

Source: OBMP Phase I Report, Figure 2-15

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-11**

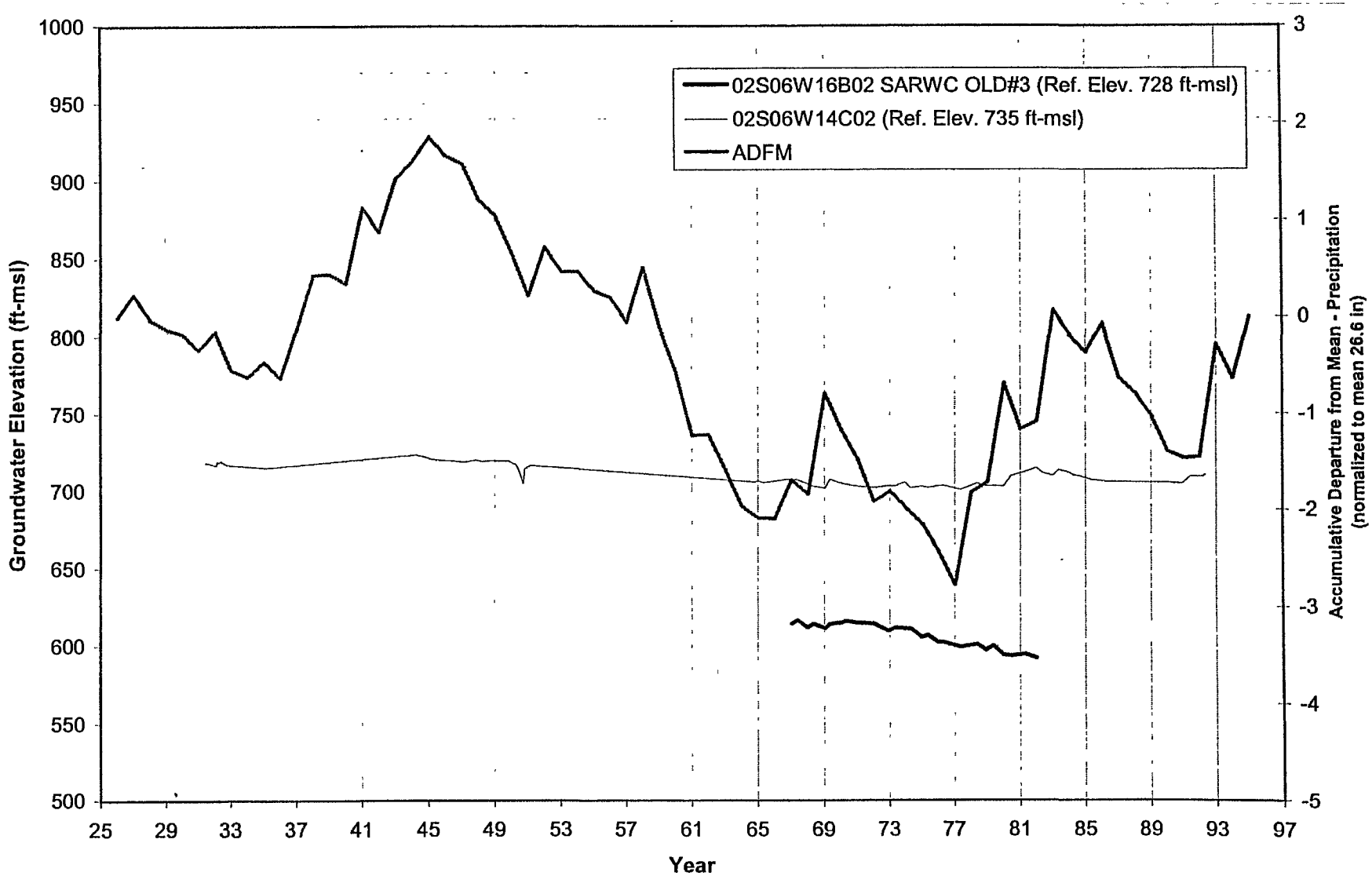



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 3)**

Source OBMP Phase I Report, Figure 2-16

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-12**

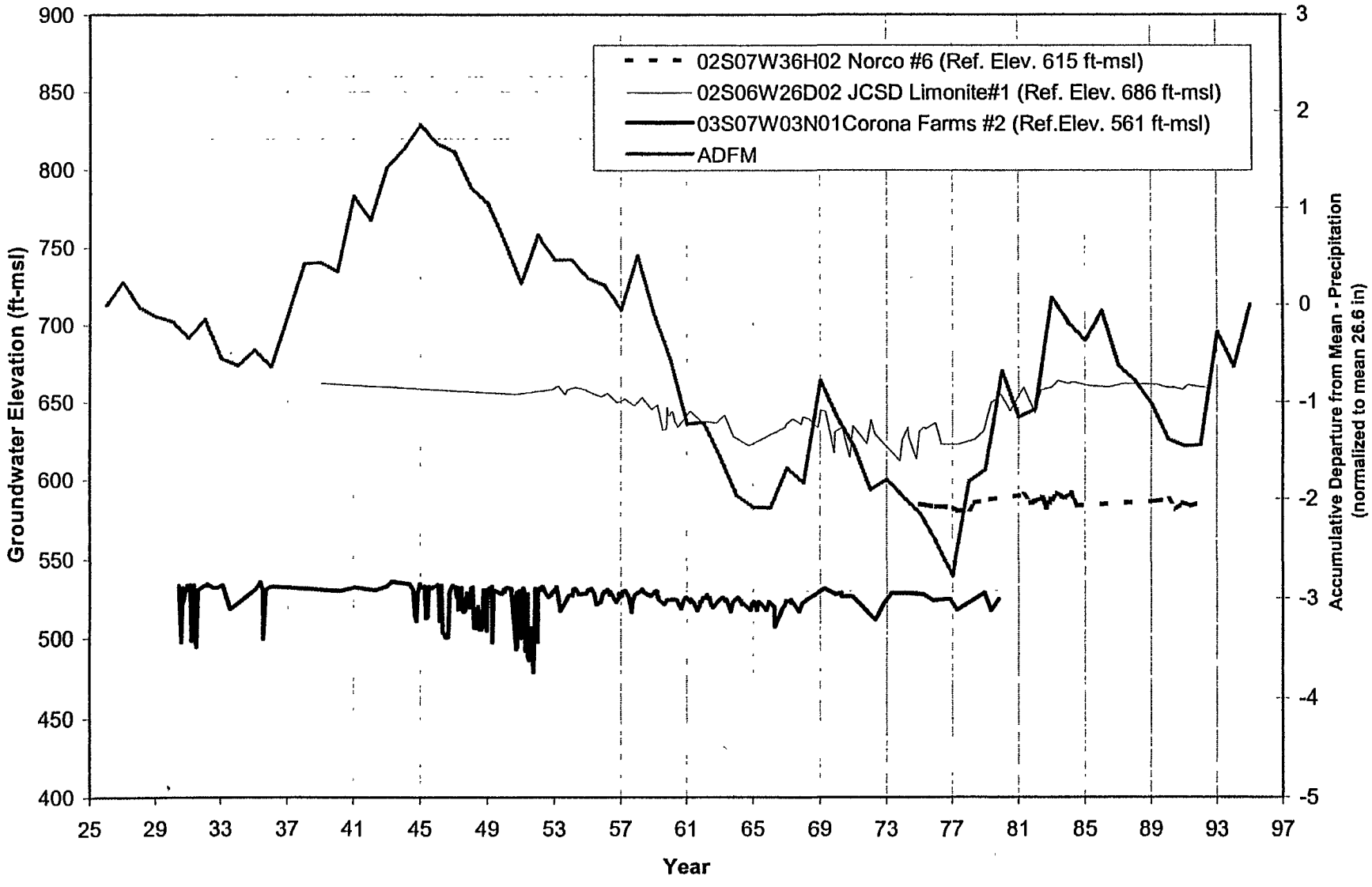



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 4)**

Source: OBMP Phase I Report, Figure 2-17

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-13**

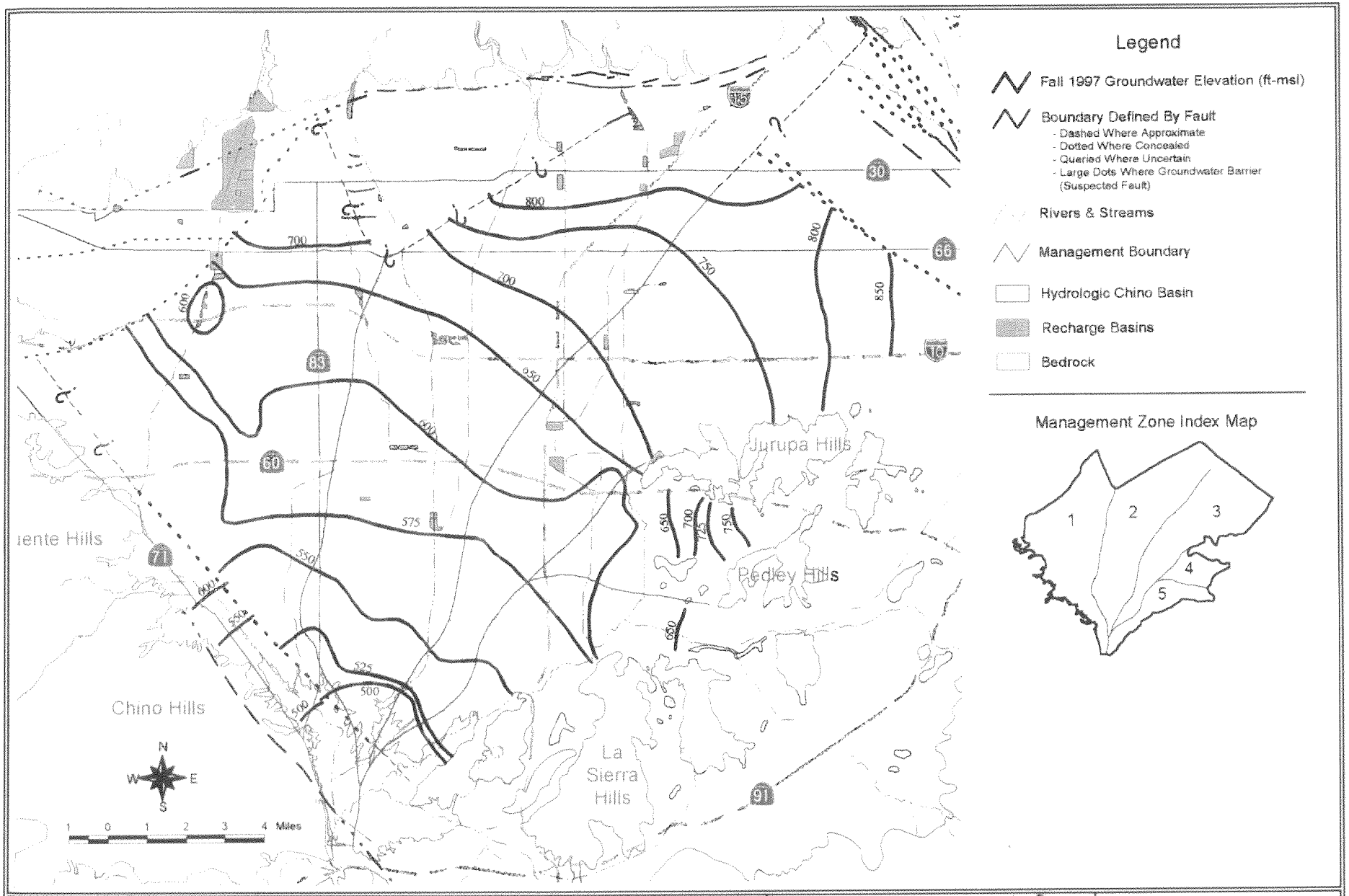



**HISTORICAL GROUNDWATER ELEVATION (MANAGEMENT ZONE 5)**

Source. OBMP Phase I Report, Figure 2-18

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-14**

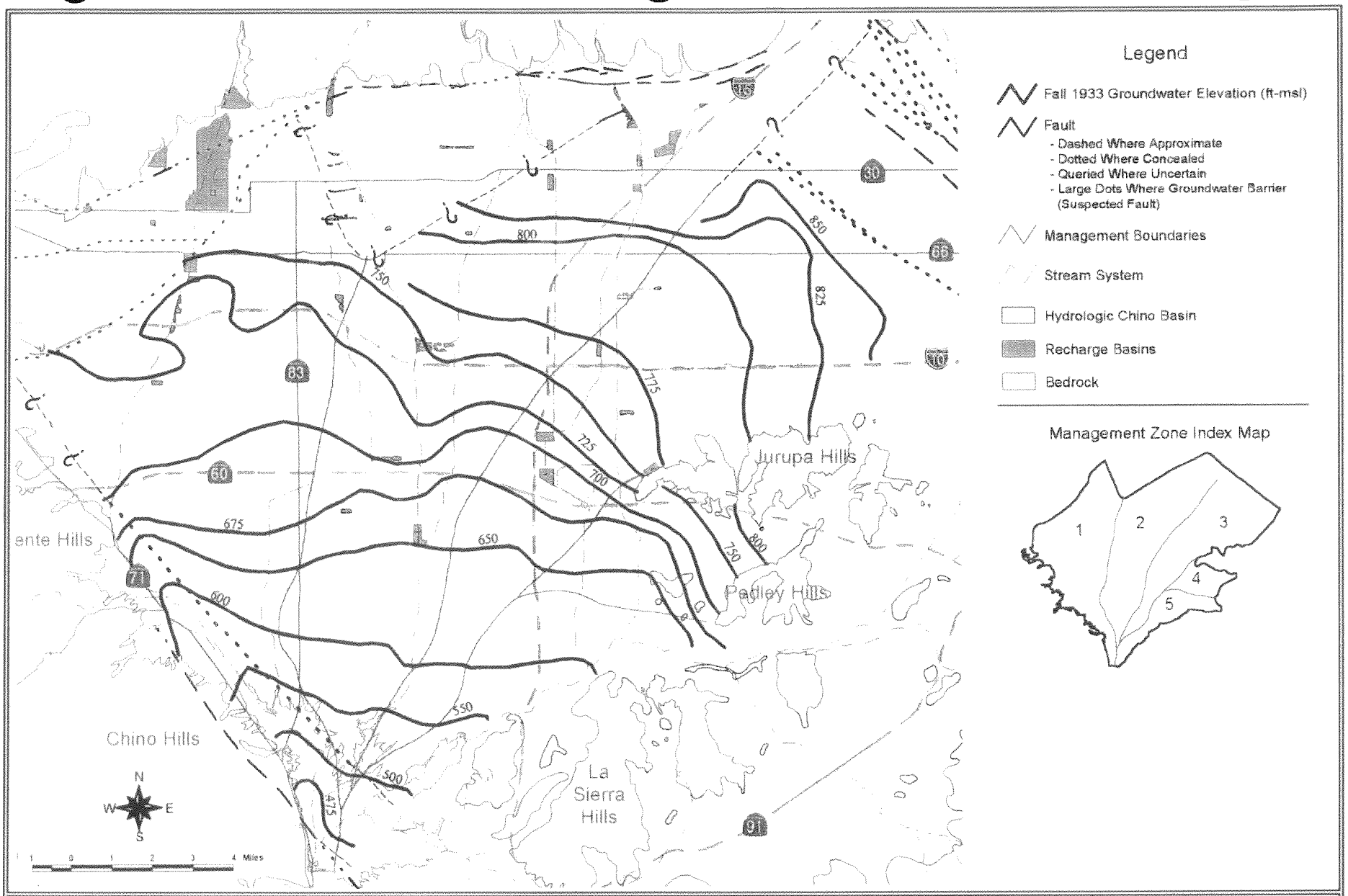



**FALL 1997 GROUNDWATER ELEVATION MAP**

Source: OBMP Phase I Report, Figure 2-19

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-15**

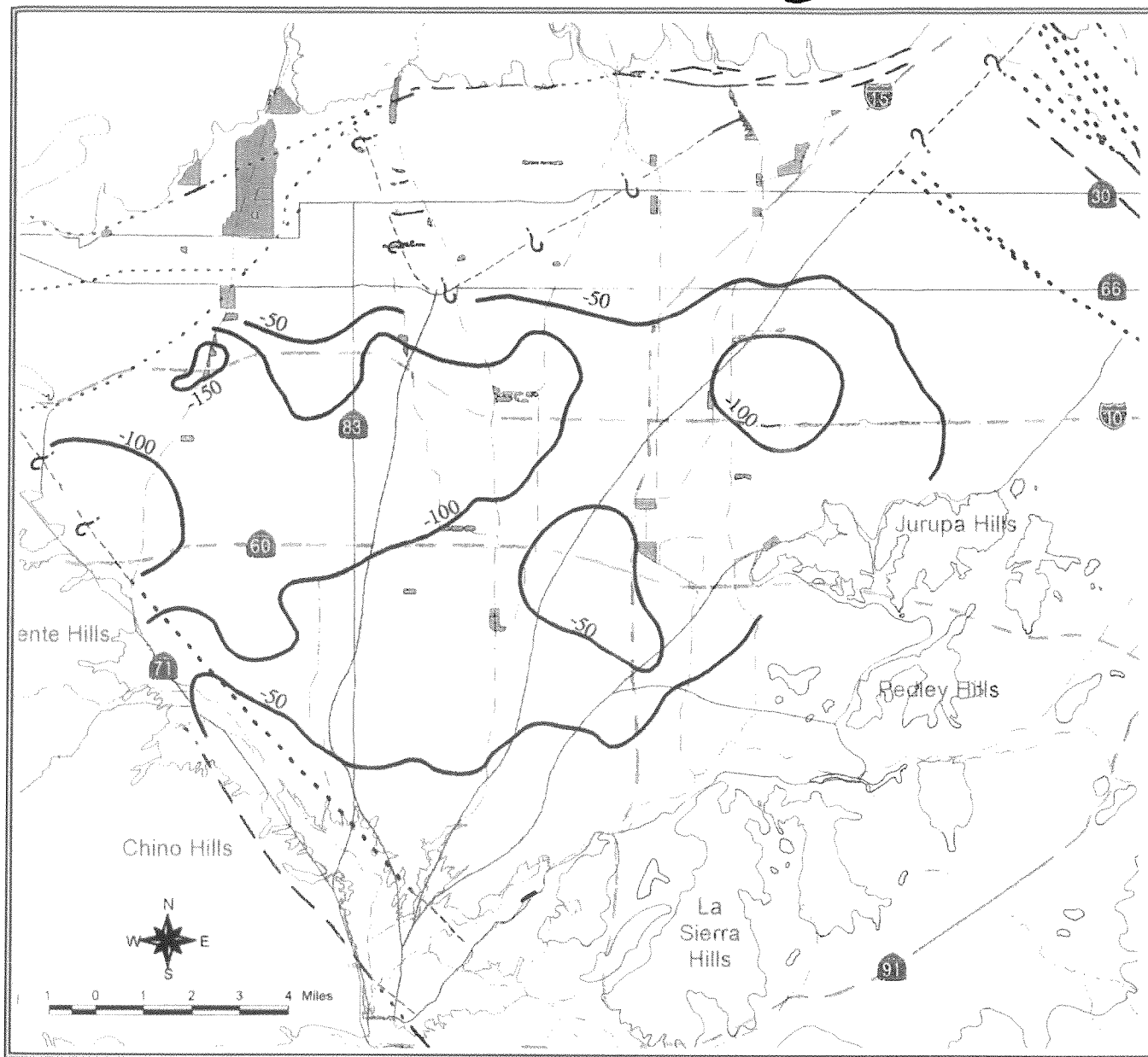



**FALL 1993 GROUNDWATER ELEVATION MAP**

Source: OBMP Phase I Report, Figure 2-20

TOM DODSON & ASSOCIATES
Environmental Consultants

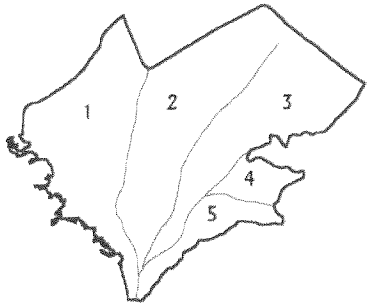
**FIGURE 4.5-16**




Legend

- Groundwater Elevation Difference (feet)
- Fault
  - Dashed Where Approximate
  - Dotted Where Concealed
  - Queried Where Uncertain
  - Large Dots Where Groundwater Barrier (Suspected Fault)
- Management Boundaries
- Stream System
- Hydrologic Chino Basin
- Recharge Basins
- Bedrock

Management Zone Index Map

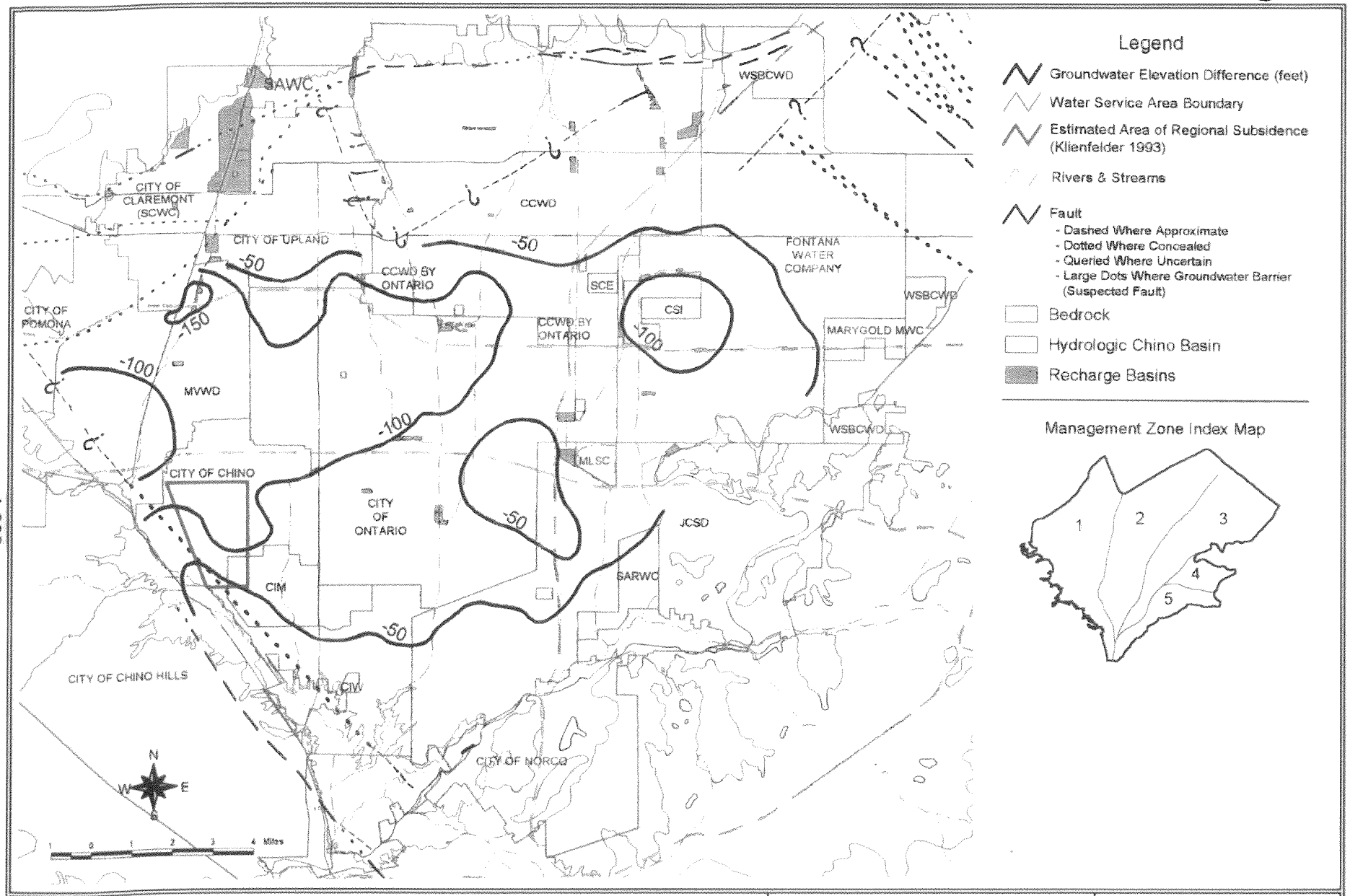



**GROUNDWATER LEVEL CHANGE BETWEEN FALL 1933 - FALL 1997 WITH MANAGEMENT ZONE BOUNDARIES**

Source: OBMP Phase I Report, Figure 2-21

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-17**

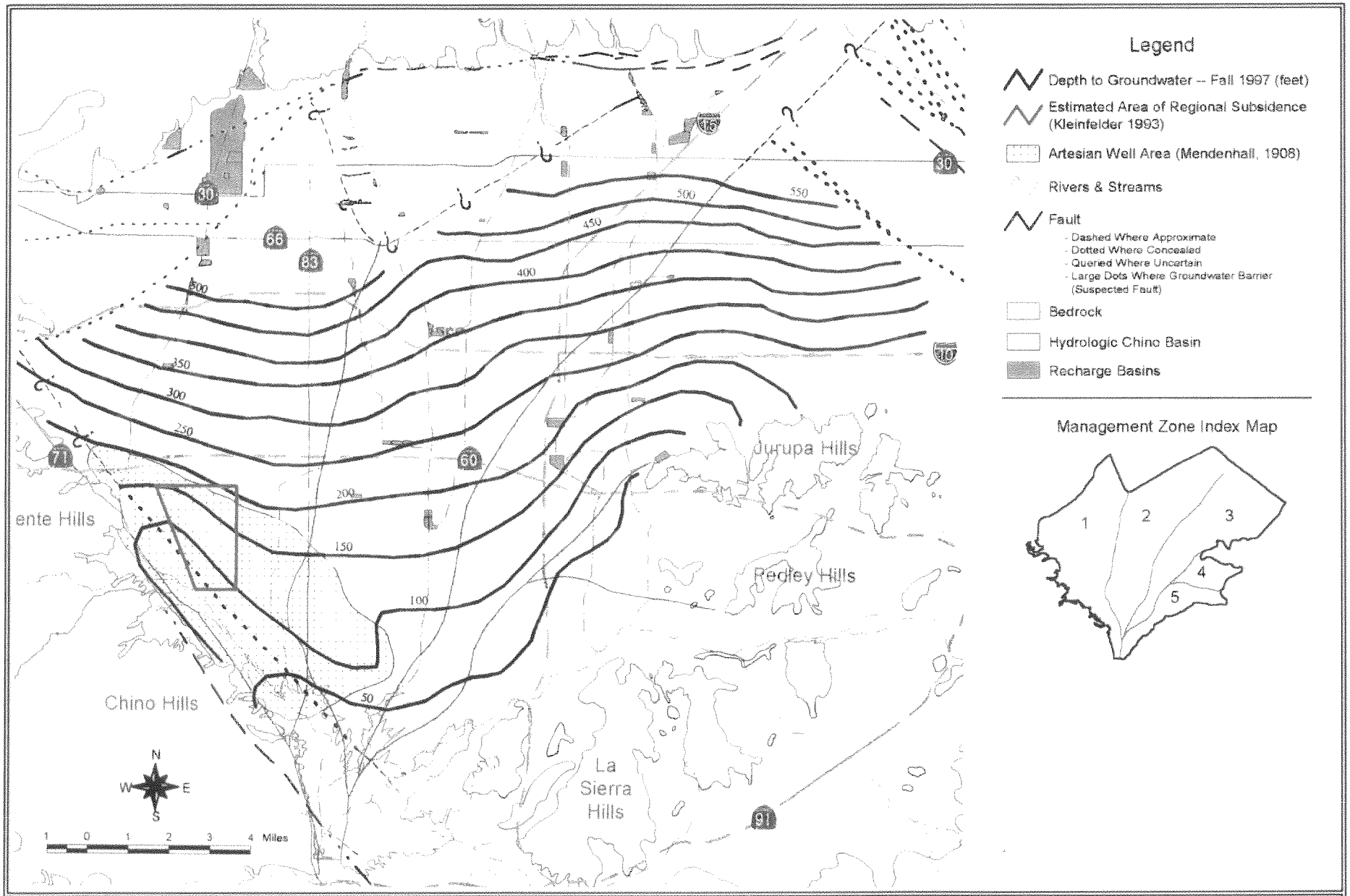



**GROUNDWATER LEVEL CHANGE BETWEEN FALL 1933 - FALL 1997 WITH WATER SERVICE AREAS**

Source: OBMP Phase I Report, Figure 2-22

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-18**

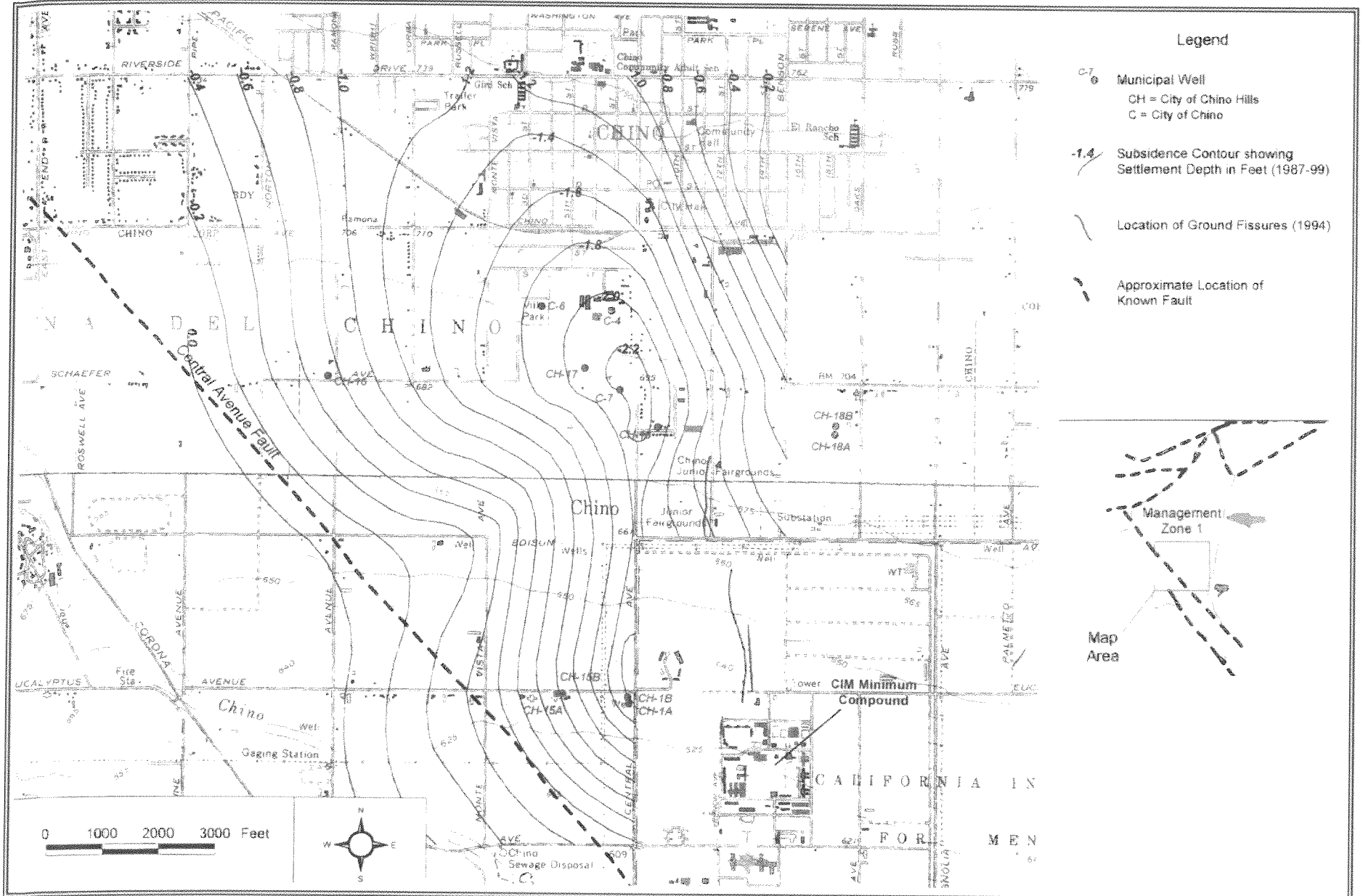



**DEPTH TO WATER FOR 1997 AND ARTESIAN AREA IN 1902**

Source: OBMP Phase I Report, Figure 2-23

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-19**

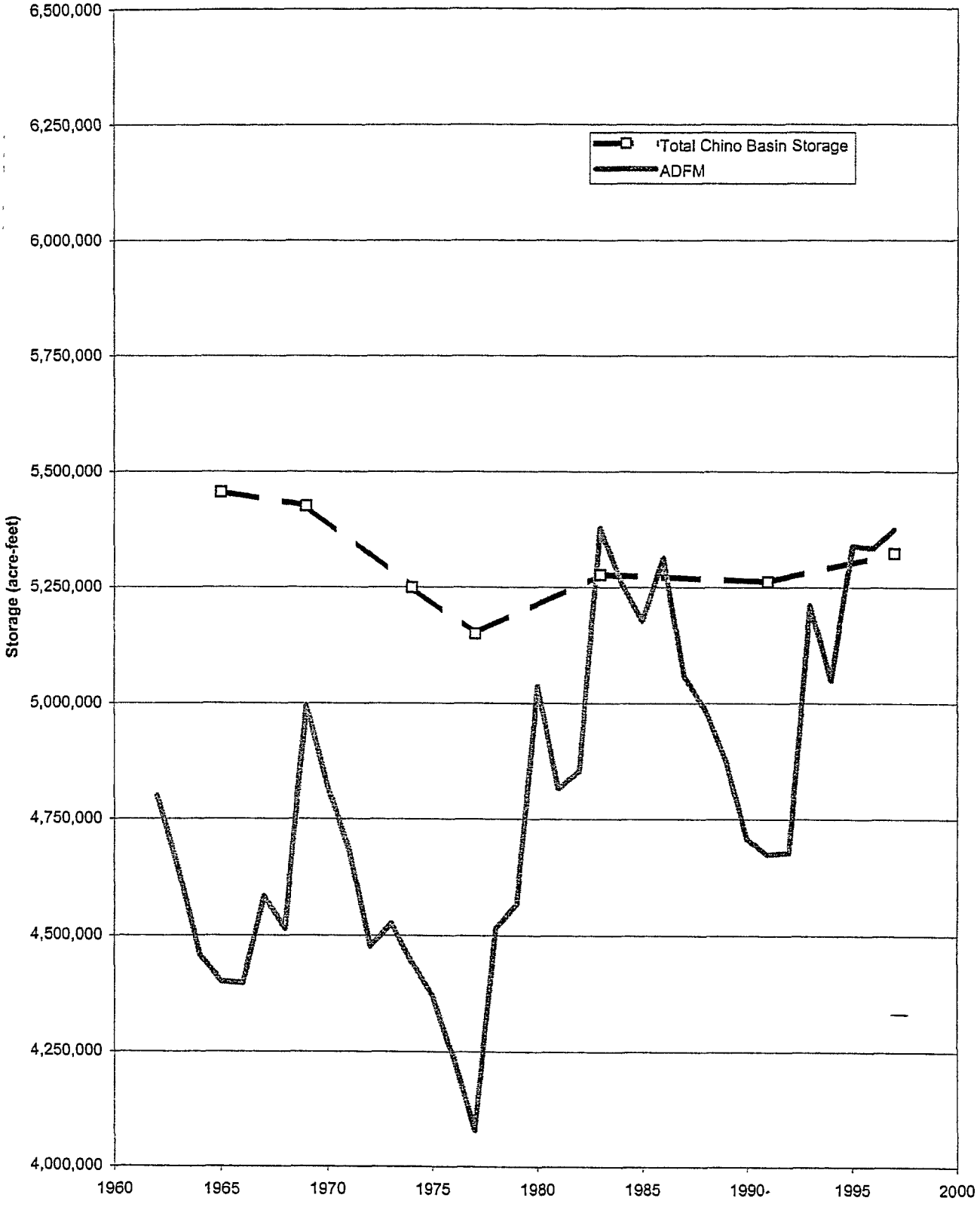



**SUBSIDENCE CONTOURS AND GROUND FISSURES IN THE CHINO AREA**

Source: OBMP Phase I Report, Figure 2-24

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-20**

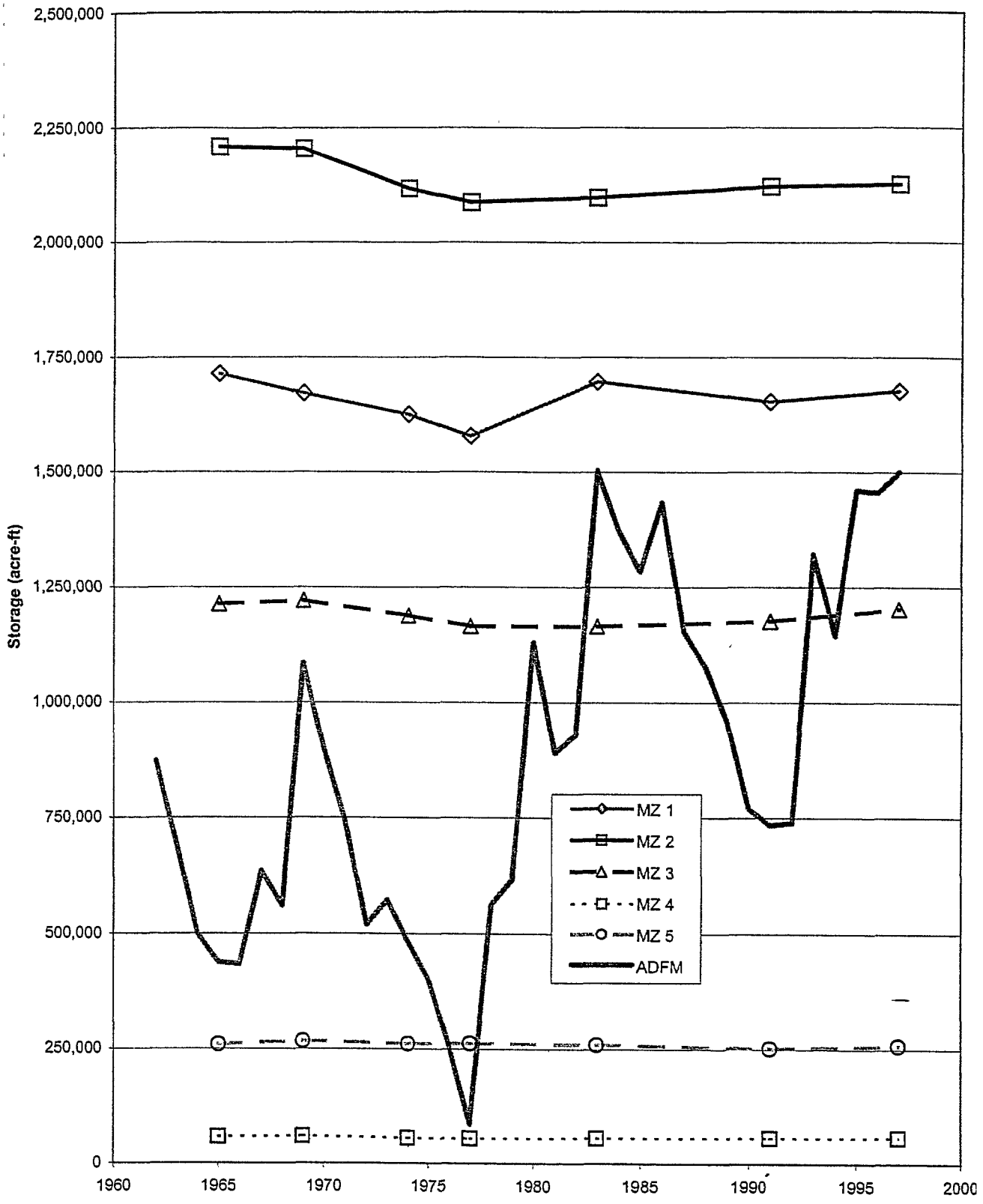



**ESTIMATED GROUNDWATER STORAGE IN THE CHINO BASIN FROM 1965-1997**

Source: OBMP Phase I Report, Figure 2-25

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-21**

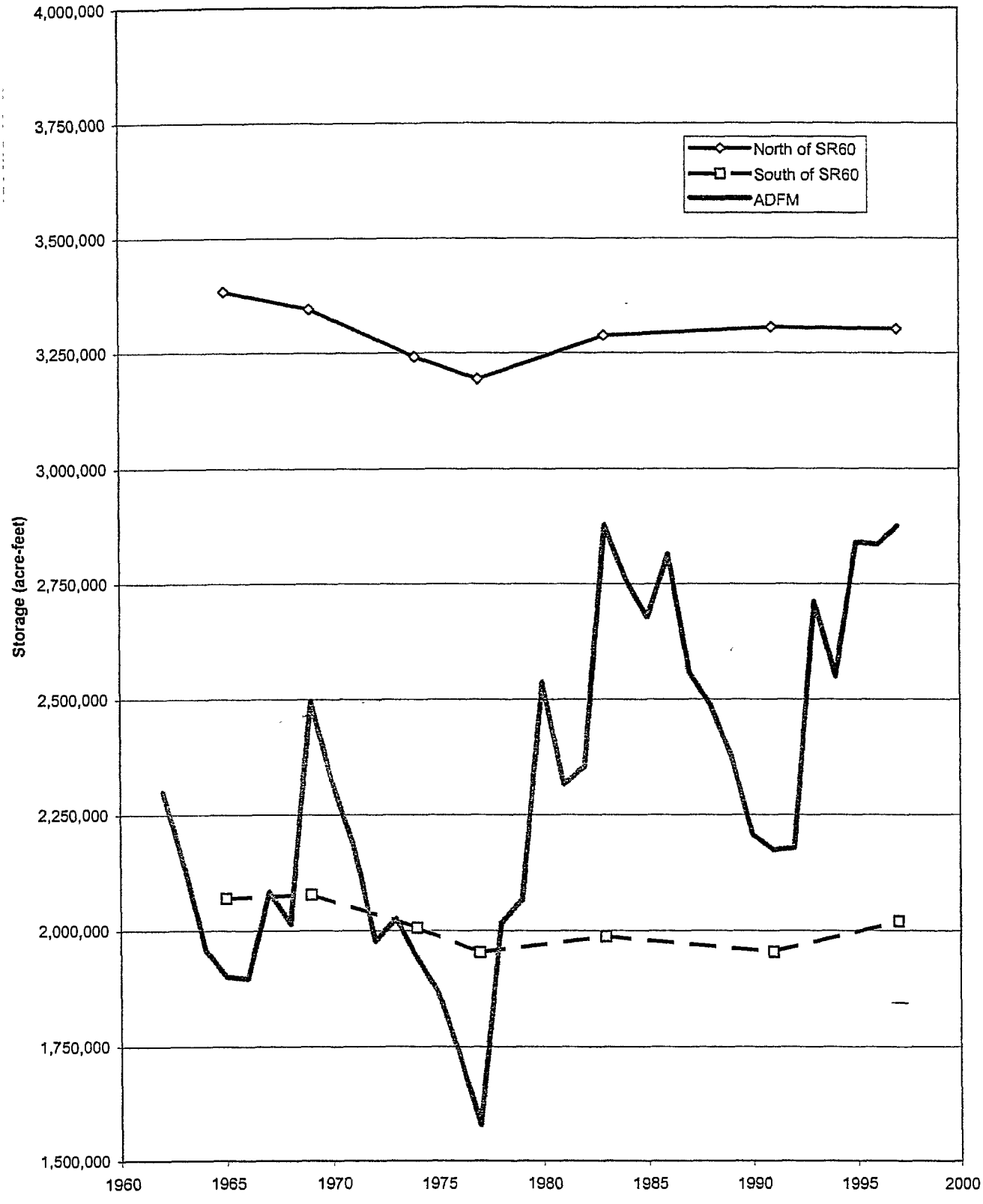



**Estimated Groundwater Storage In the Chino Basin Management Zones**

Source: OBMP Phase I Report, Figure 2-26

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-22**

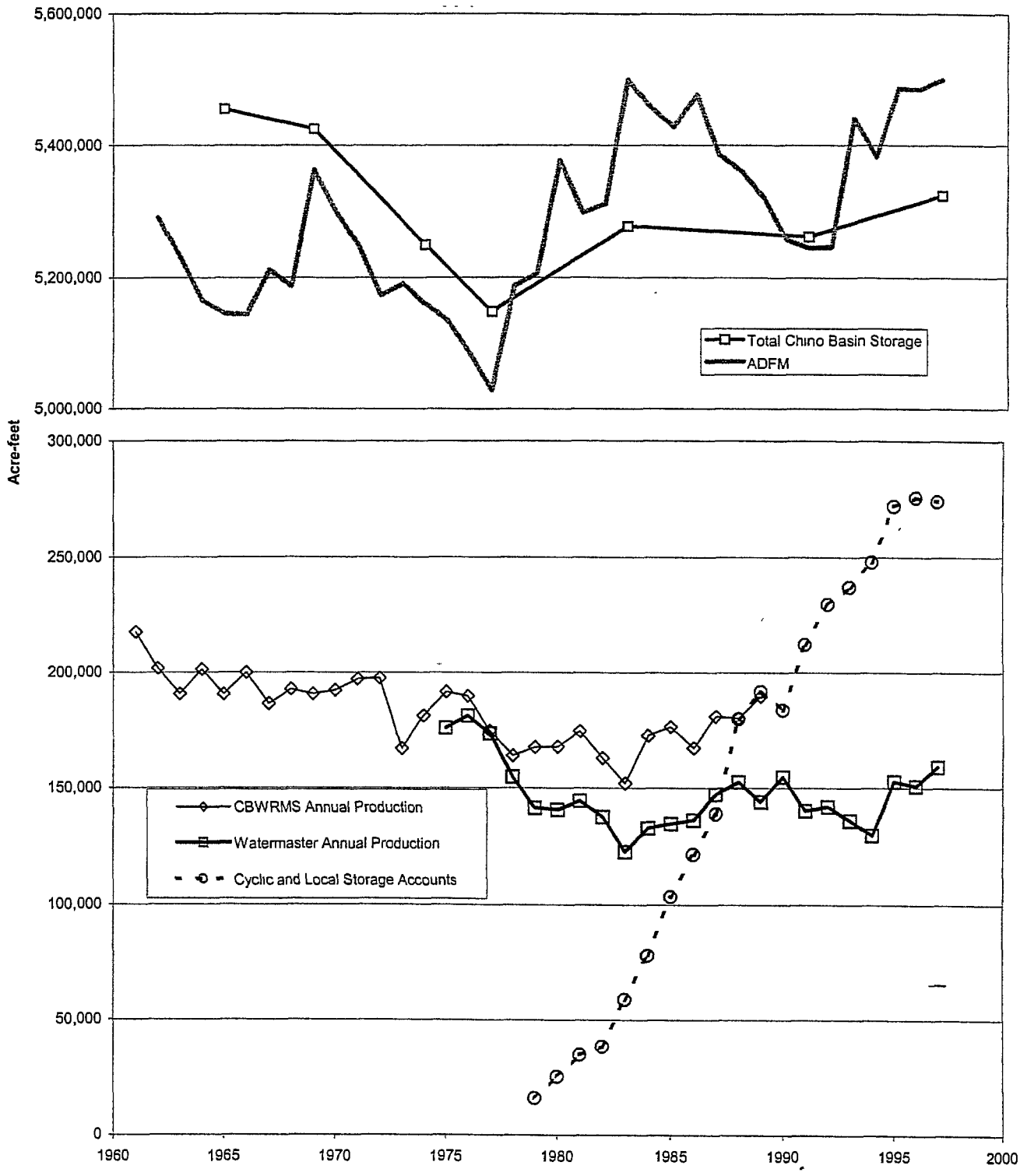



**Estimated Groundwater Storage In the Chino Basin North and South of State Route 60 from 1965-1997**

Source. OBMP Phase I Report, Figure 2-27

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-23**

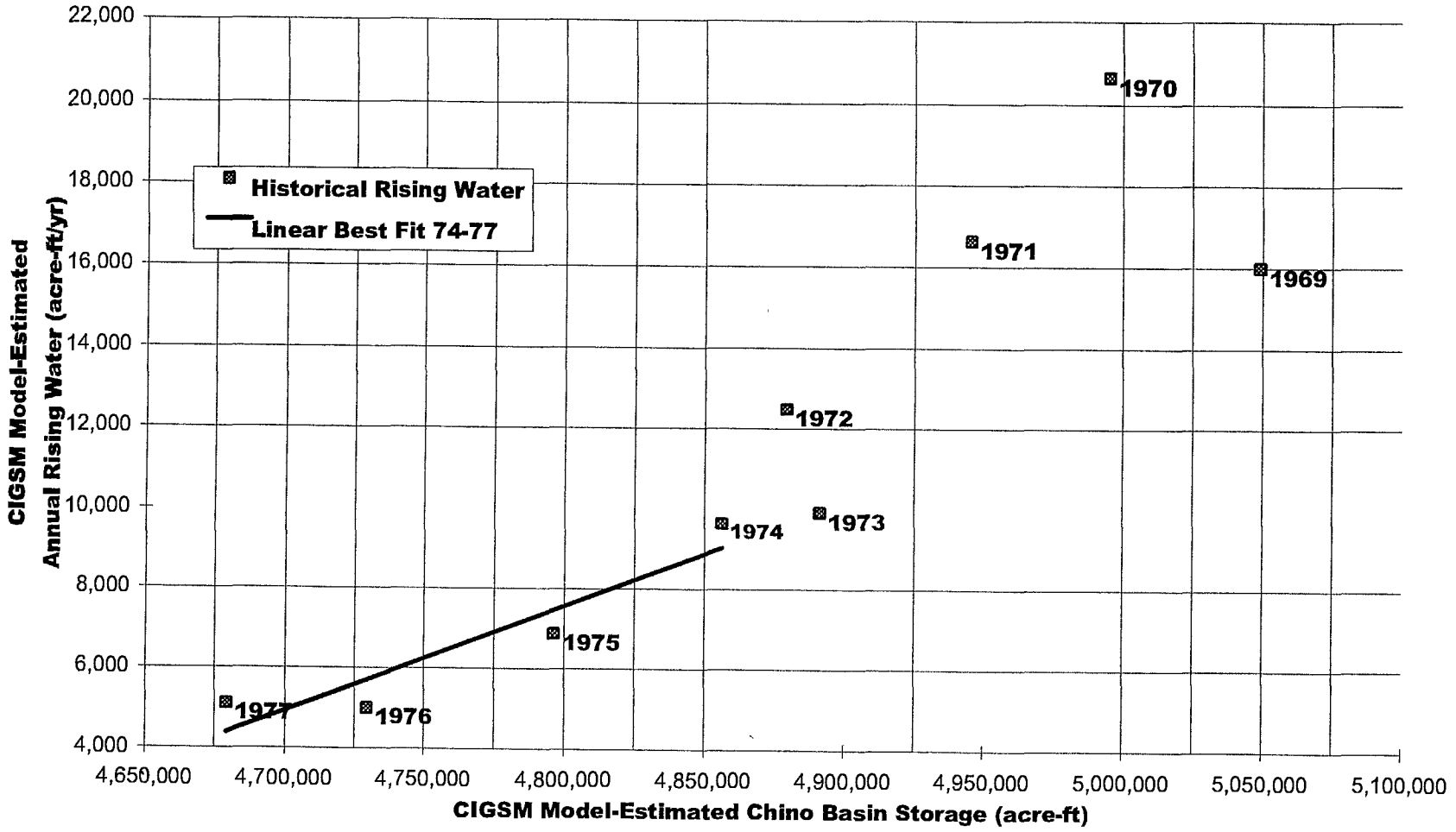



**Estimated Groundwater Storage Compared to Average Production and Storage Accounts in the Chino Basin 1965-1997**

Source: OBMP Phase I Report, Figure 2-28

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-24**

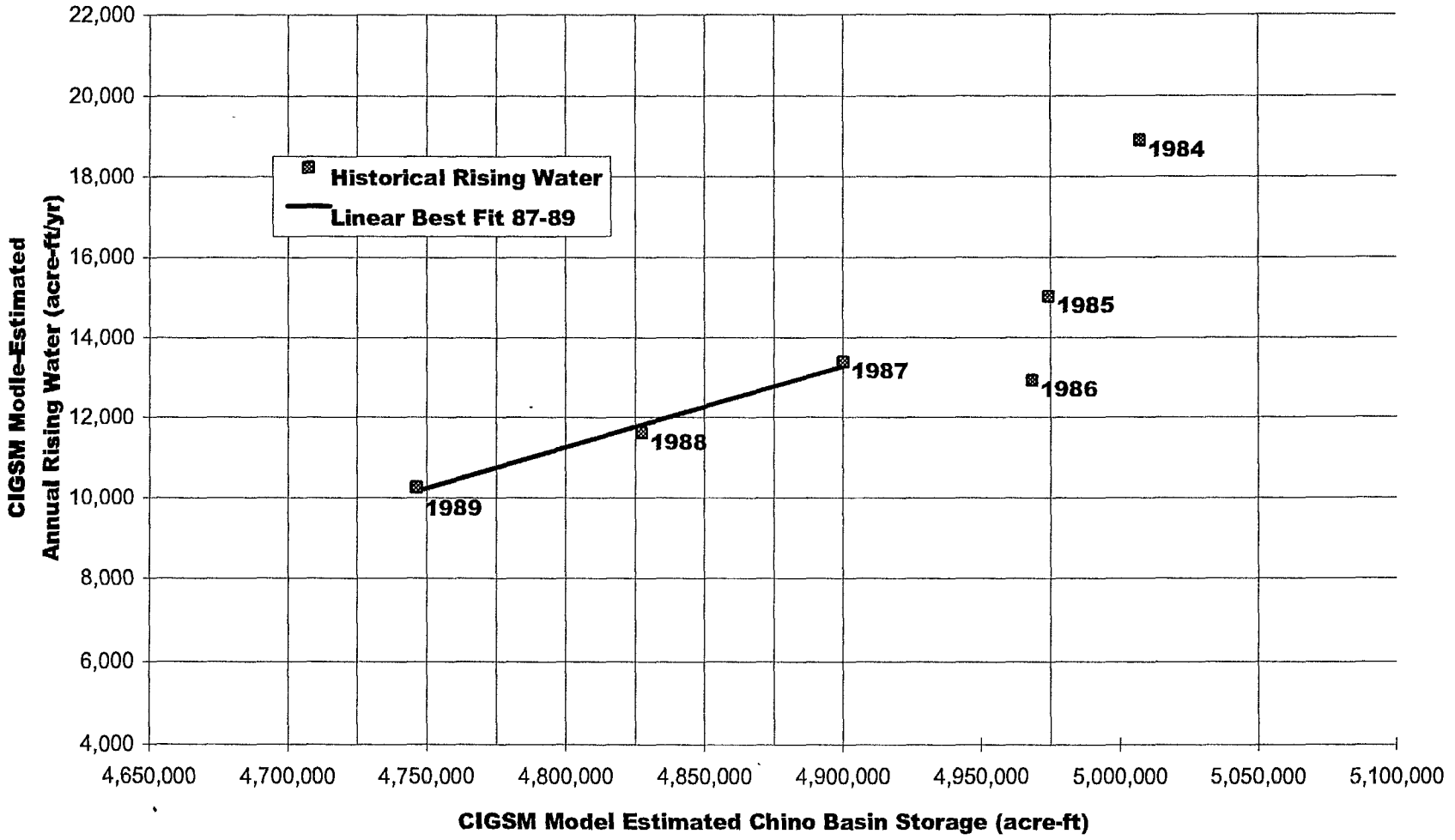



**HISTORICAL STORAGE - RISING WATER RELATIONSHIP**
**1969 THROUGH 1977**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-25**

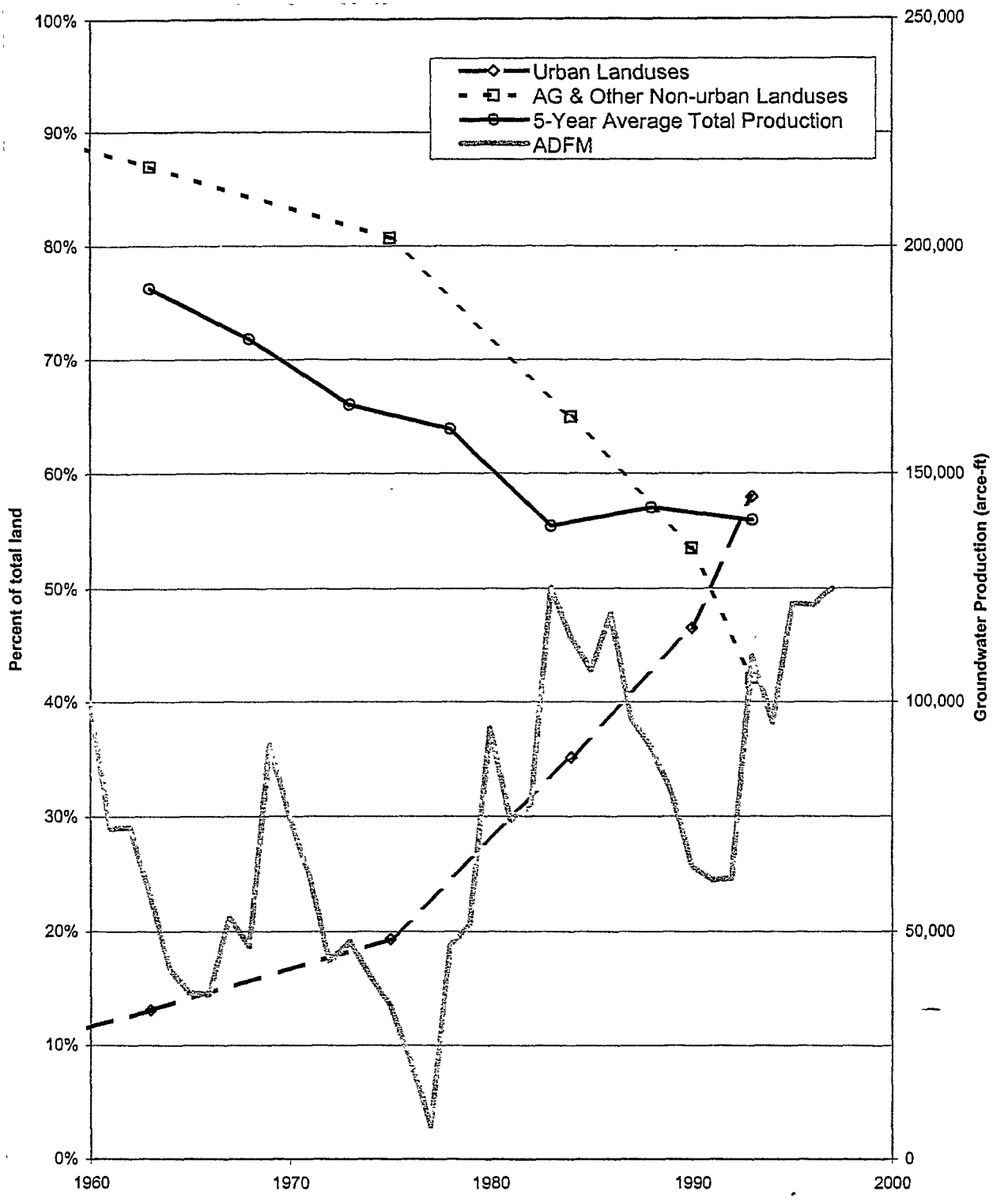



**HISTORICAL STORAGE - RISING WATER RELATIONSHIP**
**1984 THROUGH 1989**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-26**

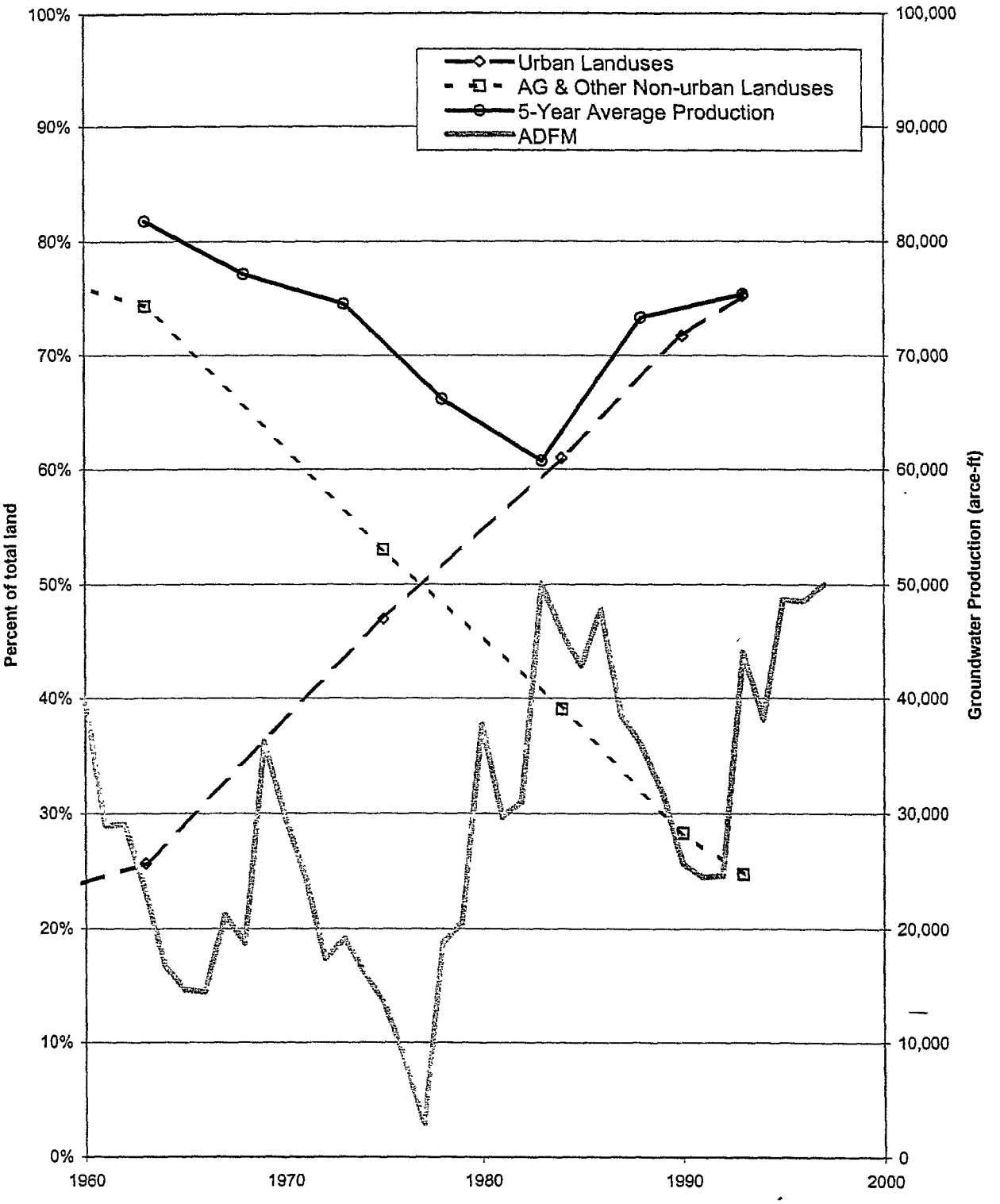



**Estimated Groundwater Production in the Chino Basin Compared to Climate and Land Use**

Source. OBMP Phase I Report, Figure 2-29

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-27**

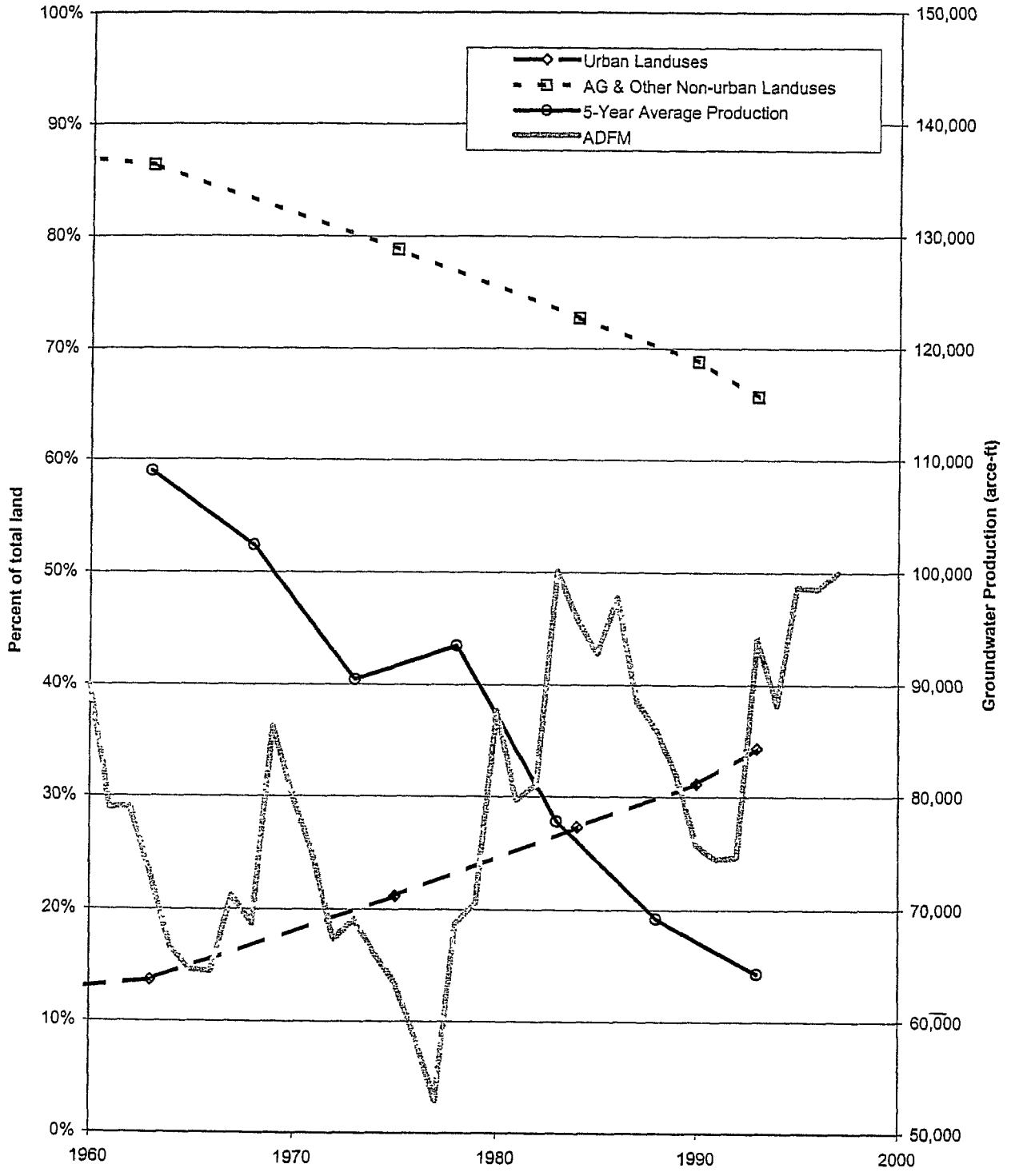



**Estimated Groundwater Production in the Chino Basin North of SR-60 Compared to Climate and Land Use**

Source: OBMP Phase I Report, Figure 2-30

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-28**

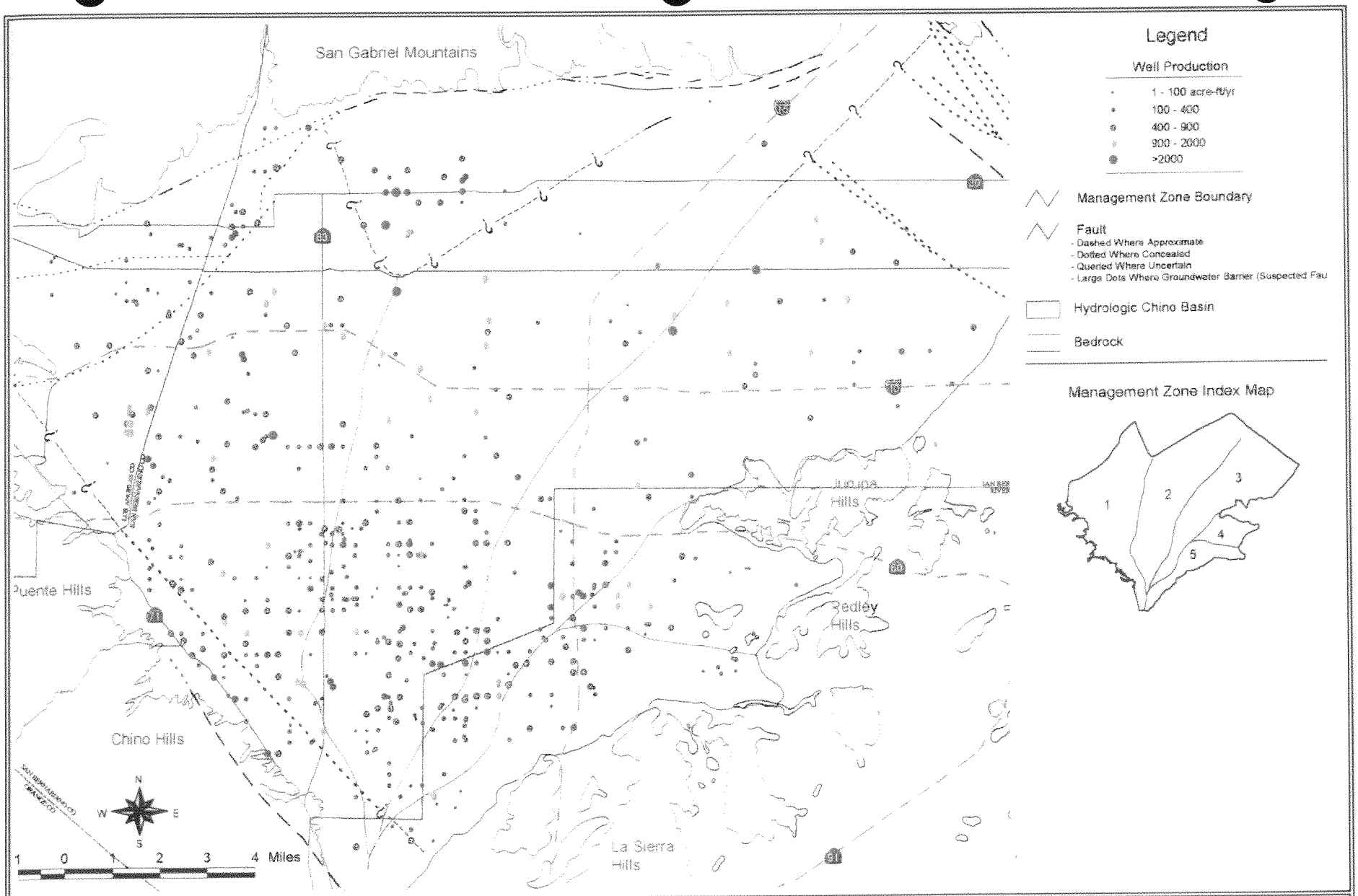



**Estimated Groundwater Production in the Chino Basin South of SR-60 Compared to Climate and Land Use**

Source. OBMP Phase I Report, Figure 2-31

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-29**

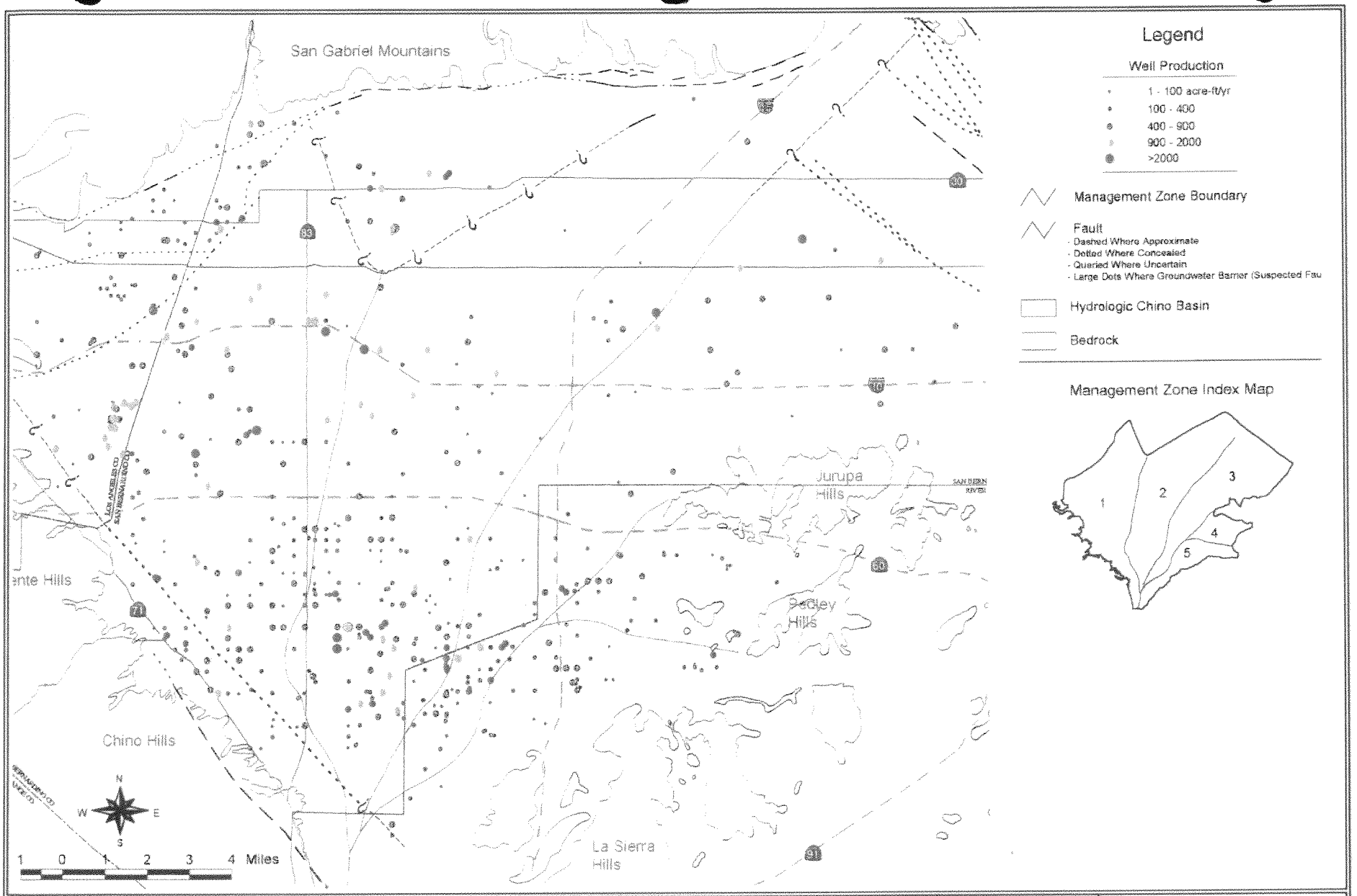



**1961 ANNUAL PRODUCTION ESTIMATES BY WELLS FROM CBWRMS**

Source: OBMP Phase I Report, Figure 2-32

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-30**

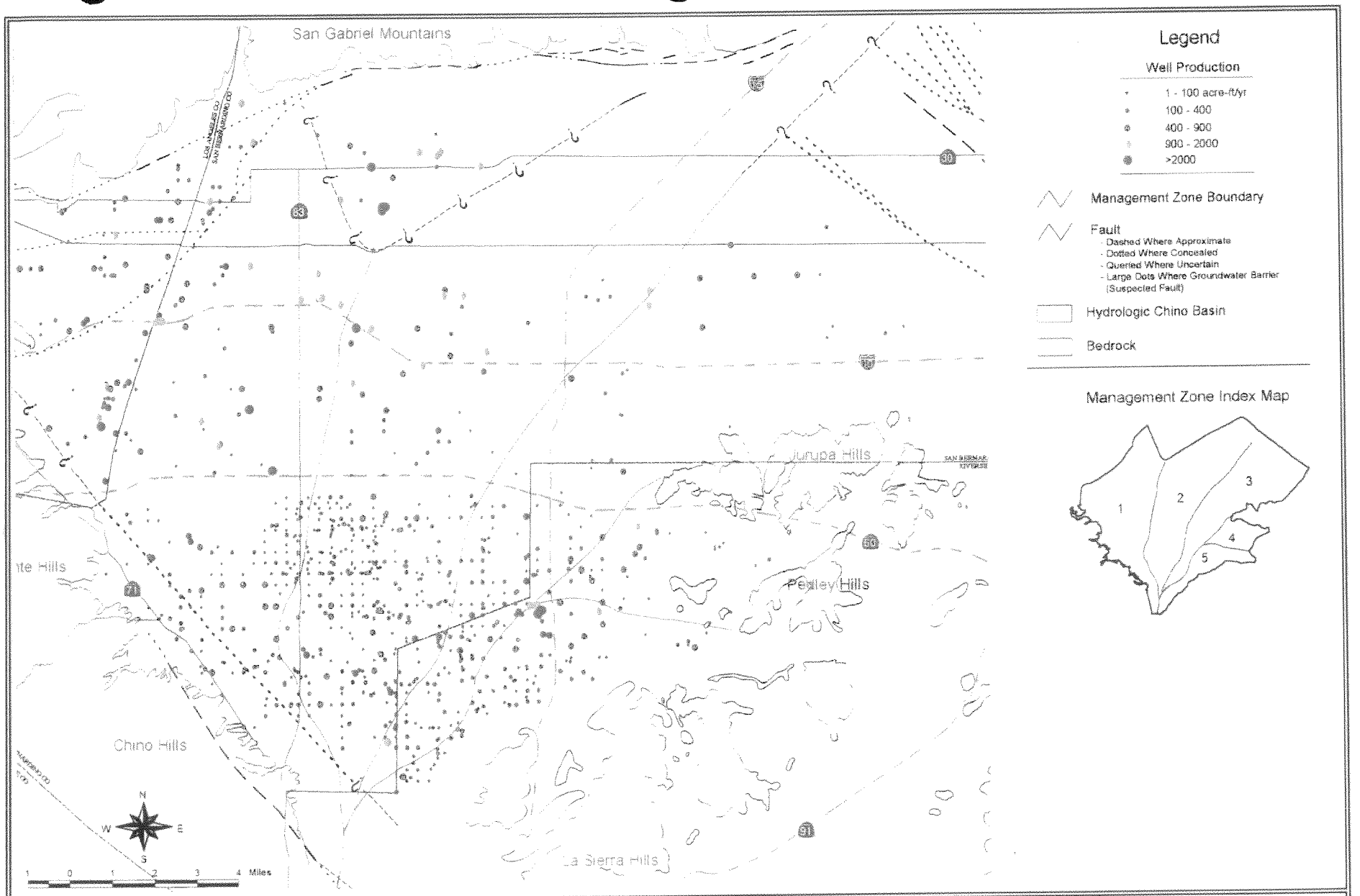



**1971 ANNUAL PRODUCTION ESTIMATES BY WELL FROM CBWRMS**

Source: OBMP Phase I Report, Figure 2-33

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-31**

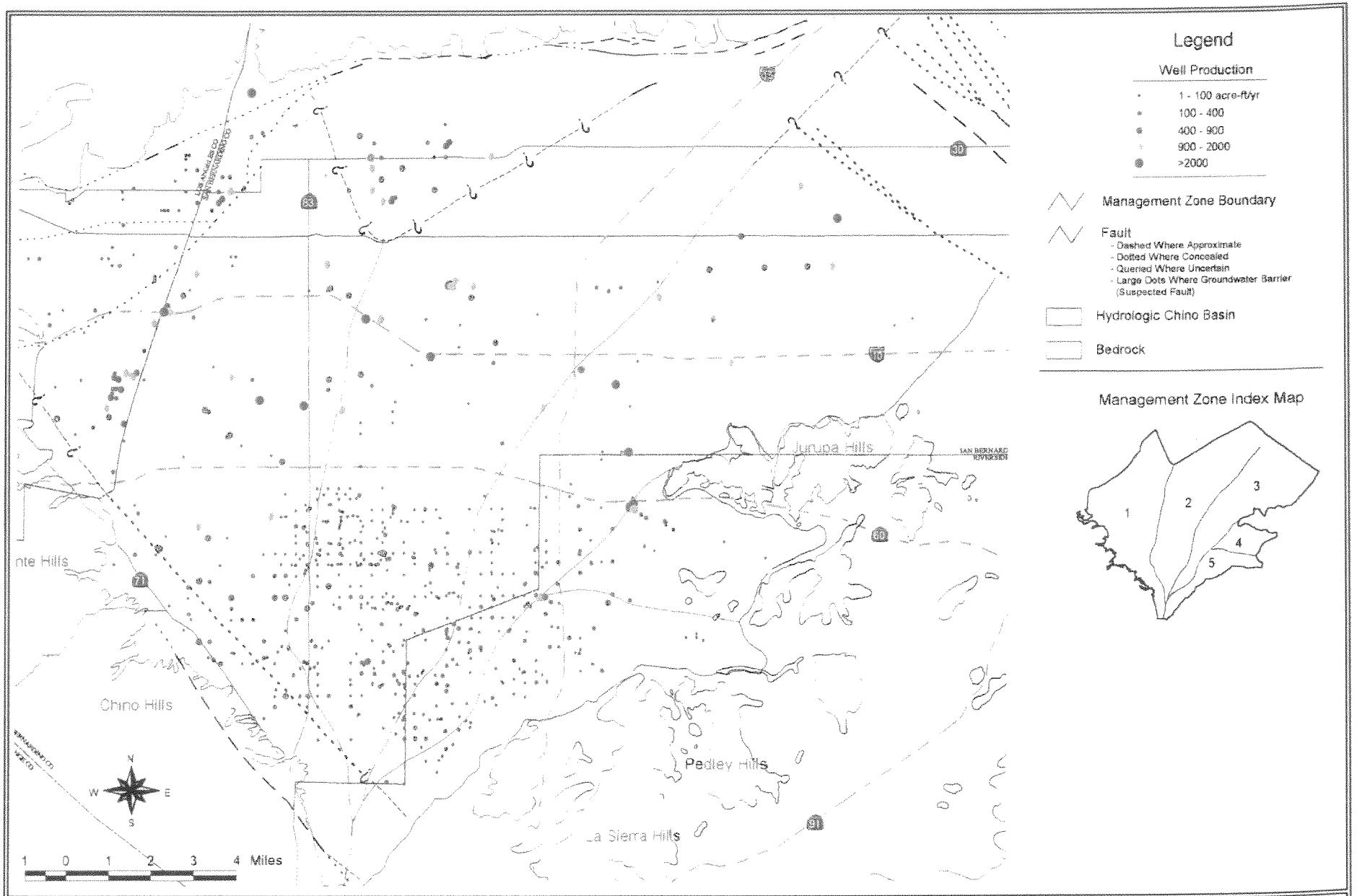



**1981 ANNUAL PRODUCTION ESTIMATES BY WELL FROM CBWRMS**

Source: OBMP Phase I Report, Figure 2-34

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-32**

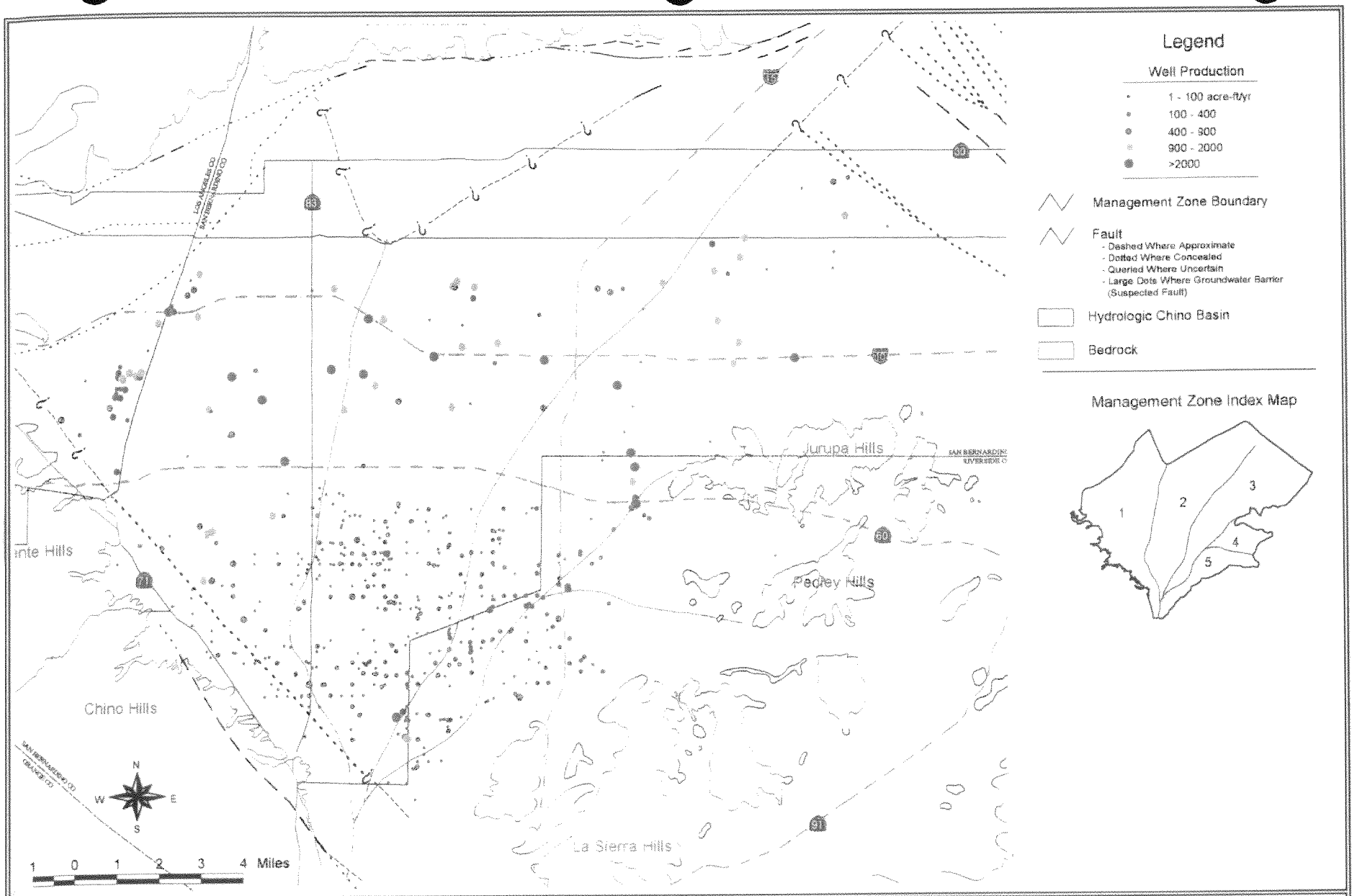



**1989 ANNUAL PRODUCTION ESTIMATES BY WELL FROM CBWRMS**

Source: OBMP Phase I Report, Figure 2-35

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-33**




**1998 ANNUAL PRODUCTION ESTIMATES BY WELL FROM WATERMASTER**

Source: OBMP Phase I Report, Figure 2-36

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-34**

**Figure 4.5-35a**
**1933 Land Use**

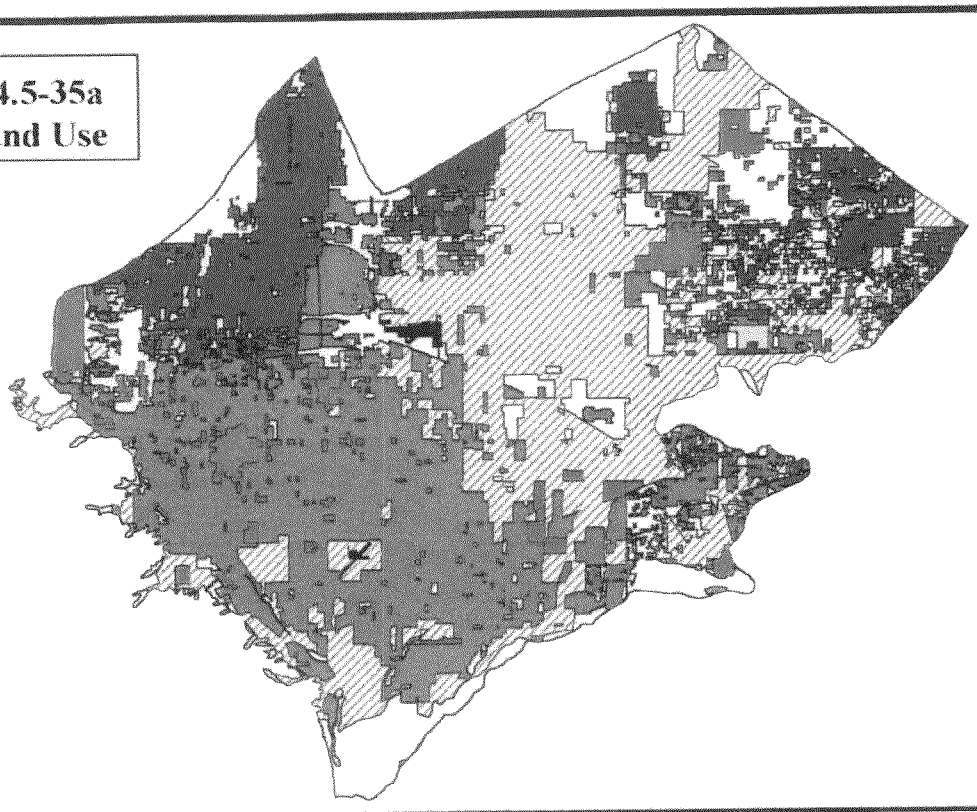
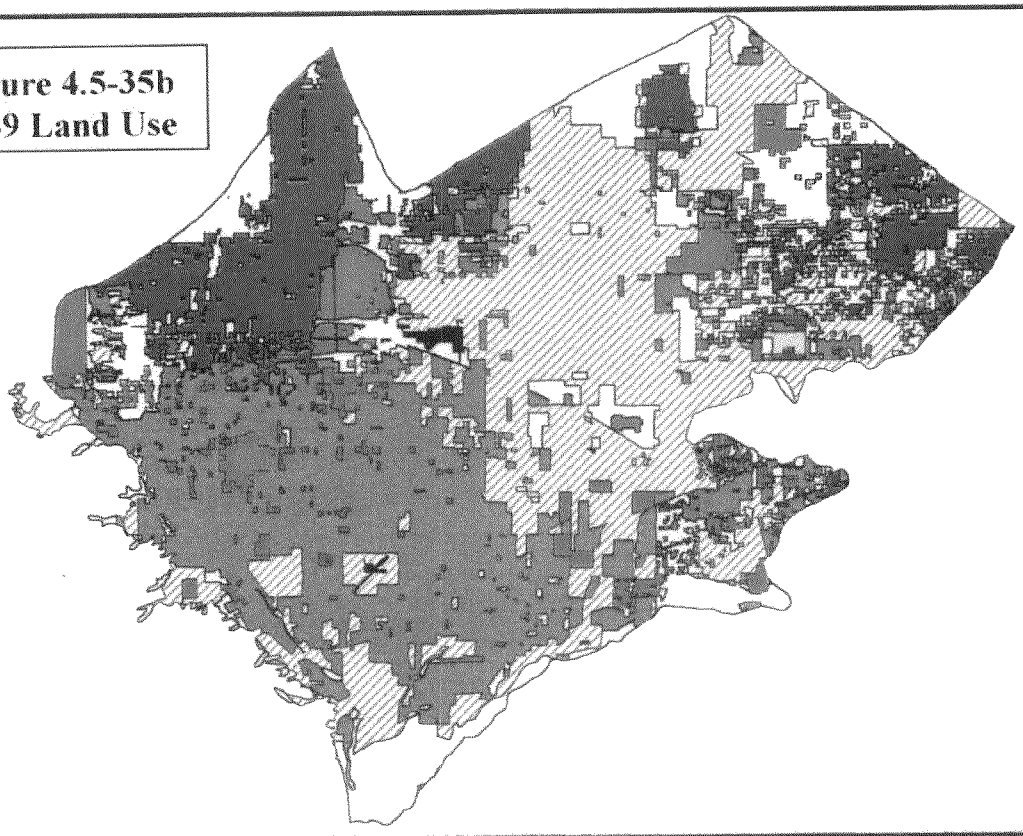


**Figure 4.5-35b**
**1949 Land Use**



- Non-Irrigated Fieldcrops, Pasture
- Irrigated Fieldcrops, Pasture
- Irrigated and Non-Irrigated Citrus
- Irrigated Vineyards
- Non-Irrigated Vineyards
- Dairies and Feedlots
- Urban, Residential, Commercial, Industrial, and Vacant
- Native Vegetation
- Special Impervious

TOM DODSON & ASSOCIATES
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Source: OBMP Phase I Report, Figure 2-37a-b

**Figure 4.5-35c**
**1957 Land Use**

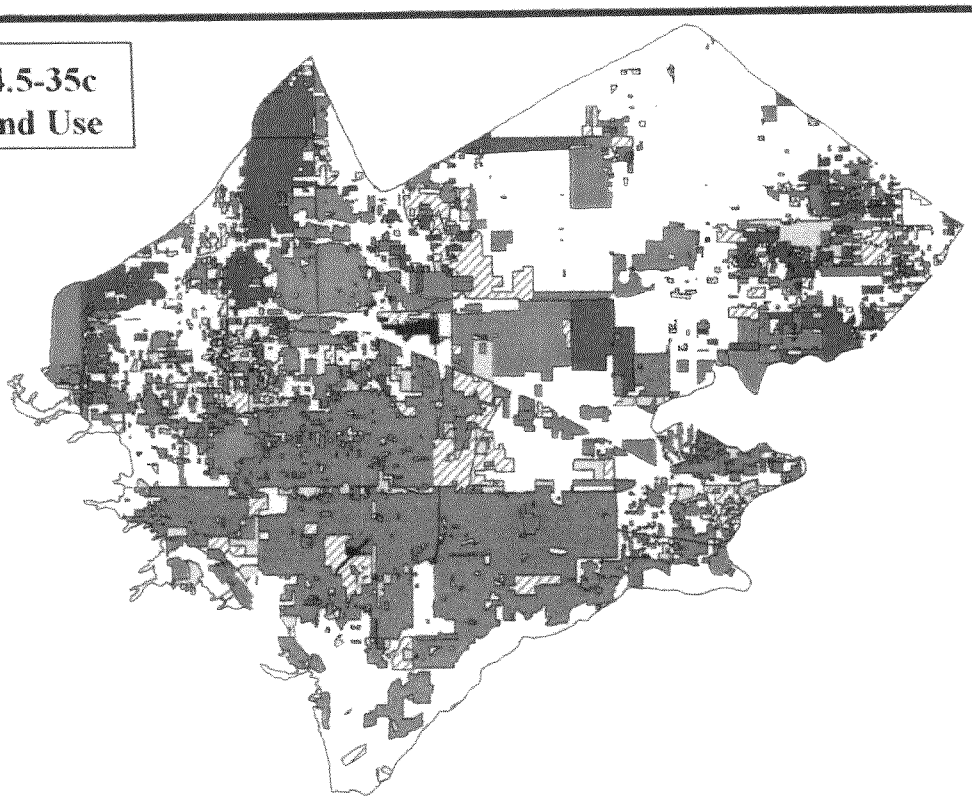
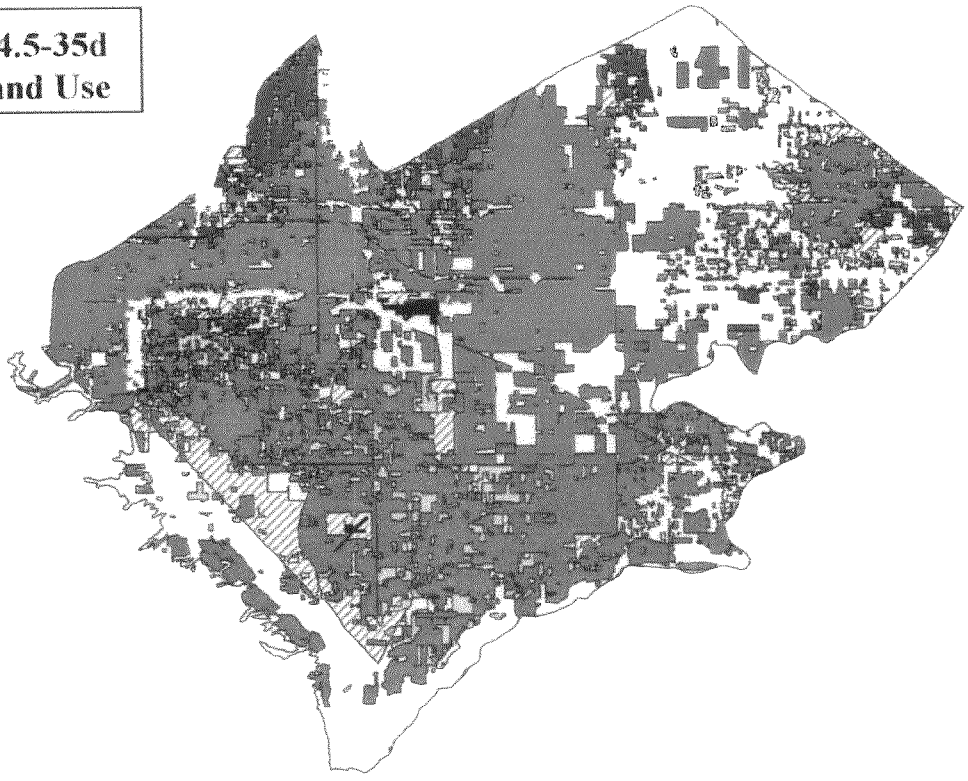


**Figure 4.5-35d**
**1963 Land Use**



- Non-Irrigated Fieldcrops, Pasture
- Irrigated Fieldcrops, Pasture
- Irrigated and Non-Irrigated Citrus
- Irrigated Vineyards
- Non-Irrigated Vineyards
- Dairies and Feedlots
- Urban, Residential, Commercial, Industrial, and Vacant
- Native Vegetation
- Special Impervious

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Source: OBMP Phase I Report, Figure 2-37c-d

**Figure 4.5-35e**
**1975 Land Use**

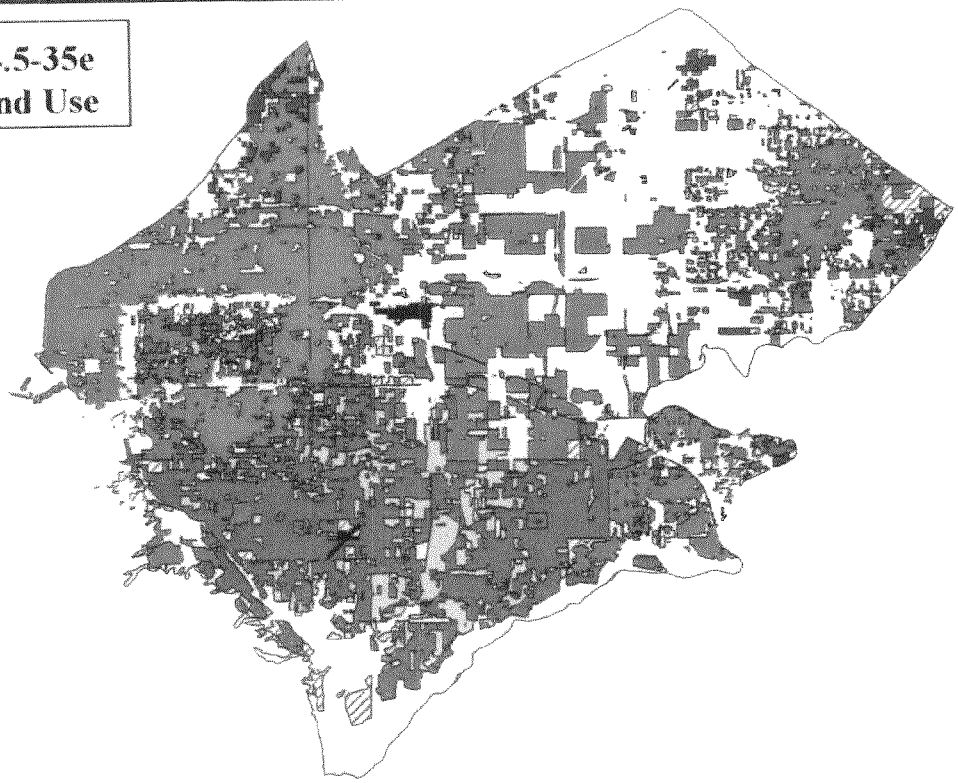
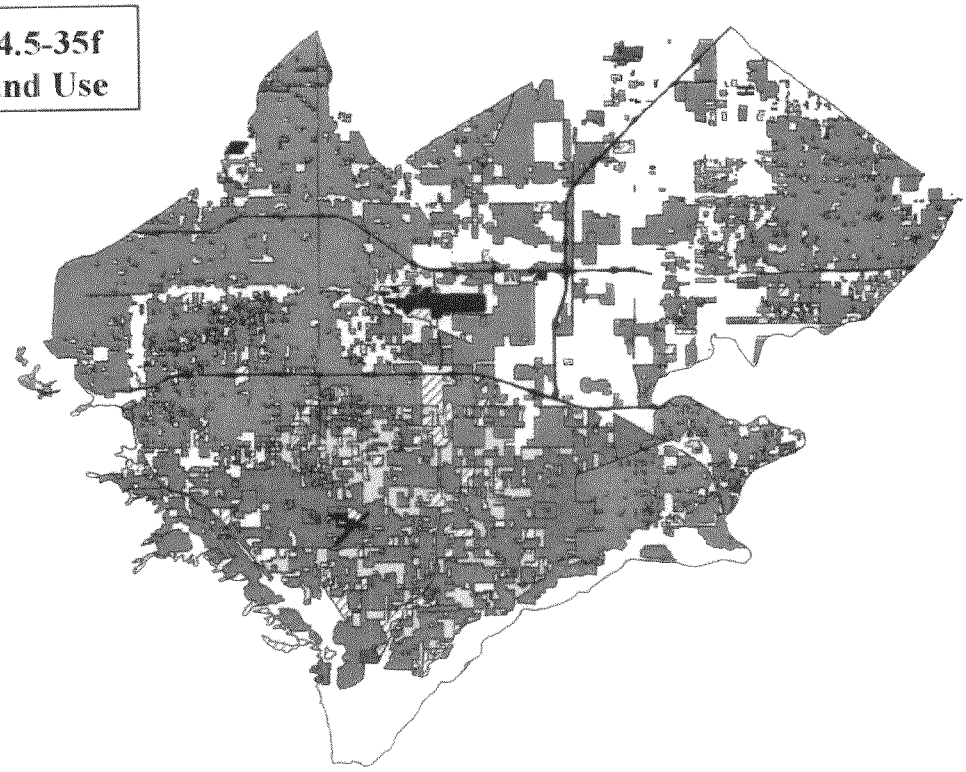


**Figure 4.5-35f**
**1984 Land Use**



- Non-Irrigated Fieldcrops, Pasture
- Irrigated Fieldcrops, Pasture
- Irrigated and Non-Irrigated Citrus
- Irrigated Vineyards
- Non-Irrigated Vineyards
- Dairies and Feedlots
- Urban, Residential, Commercial, Industrial, and Vacant
- Native Vegetation
- Special Impervious

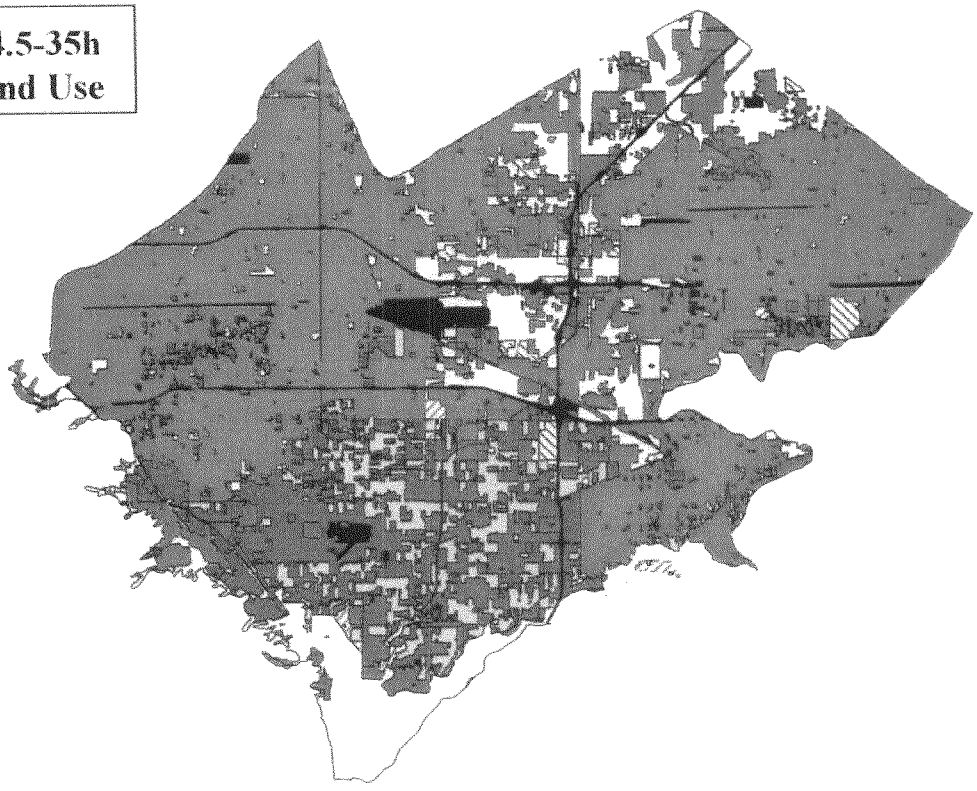
TOM DODSON & ASSOCIATES
Environmental Consultants

Source: OBMP Phase I Report, Figure 2-37e-f

**Figure 4.5-35g**
**1990 Land Use**



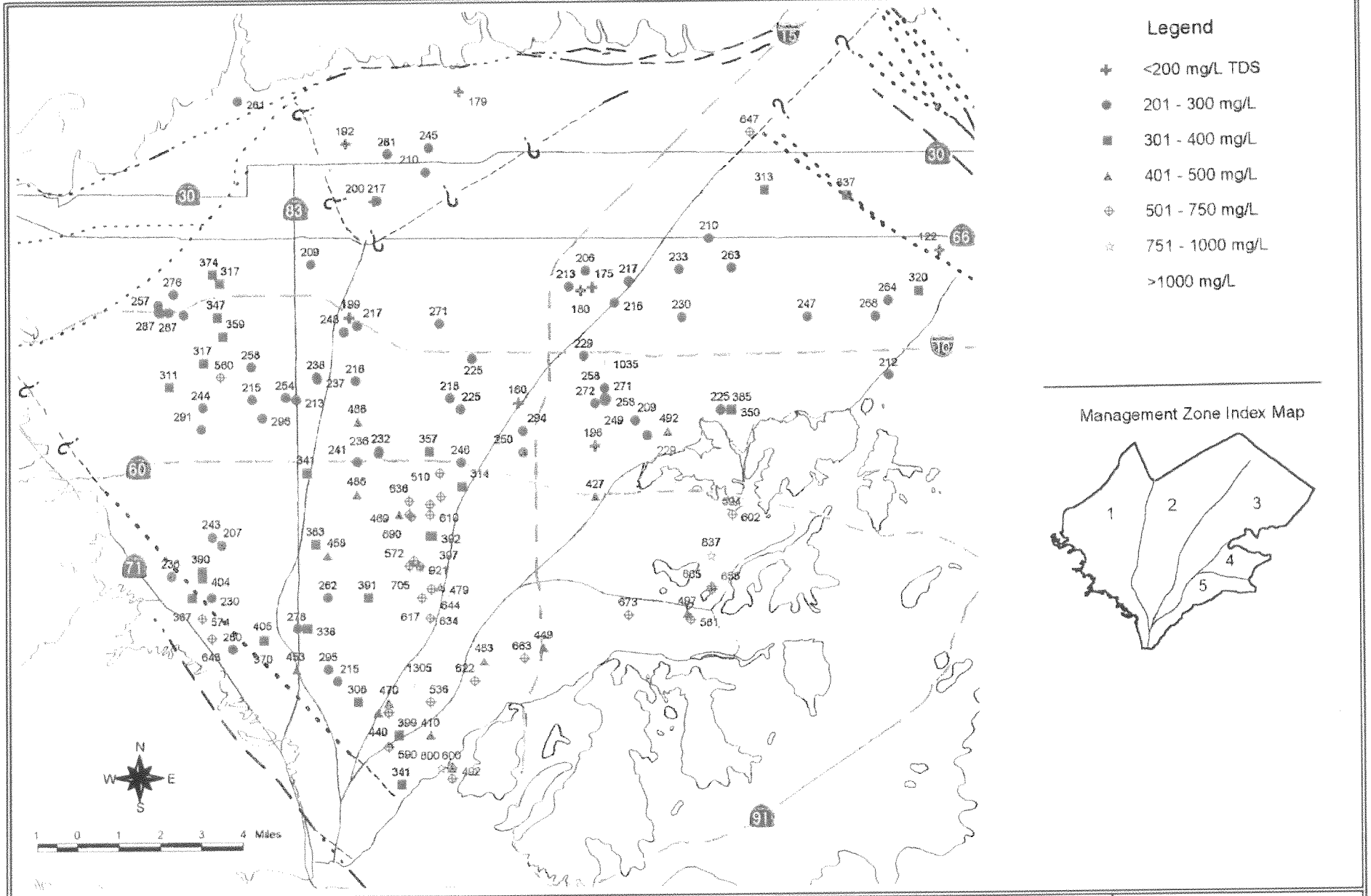
**Figure 4.5-35h**
**1993 Land Use**



- Non-Irrigated Fieldcrops, Pasture
- Irrigated Fieldcrops, Pasture
- Irrigated and Non-Irrigated Citrus
- Irrigated Vineyards
- Non-Irrigated Vineyards
- Dairies and Feedlots
- Urban, Residential, Commercial, Industrial, and Vacant
- Native Vegetation
- Special Impervious

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Source: OBMP Phase I Report, Figure 2-37g-h

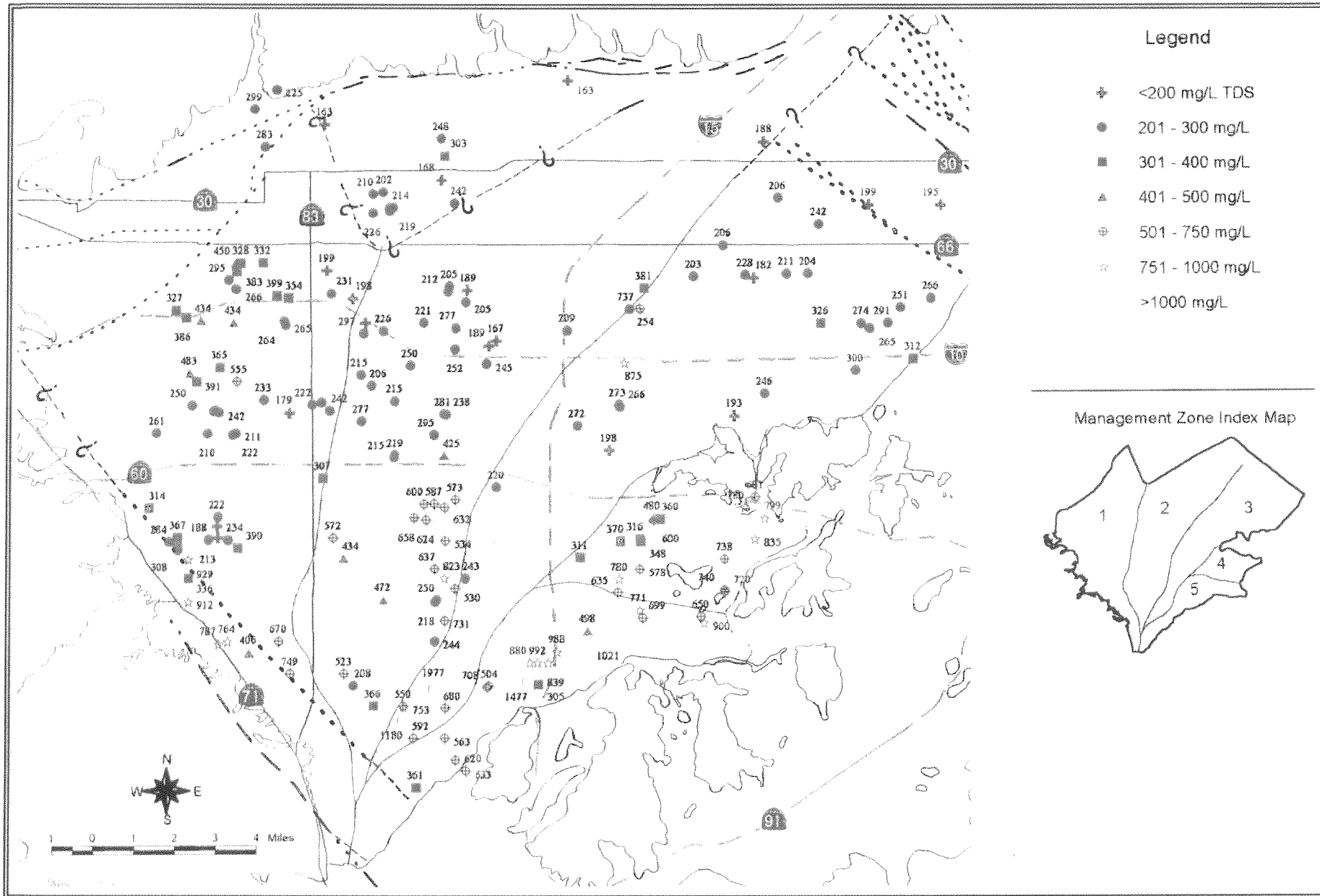



**AVERAGE TDS CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1961 TO 1965**

Source: OBMP Phase I Report, Figure 2-38

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-36**

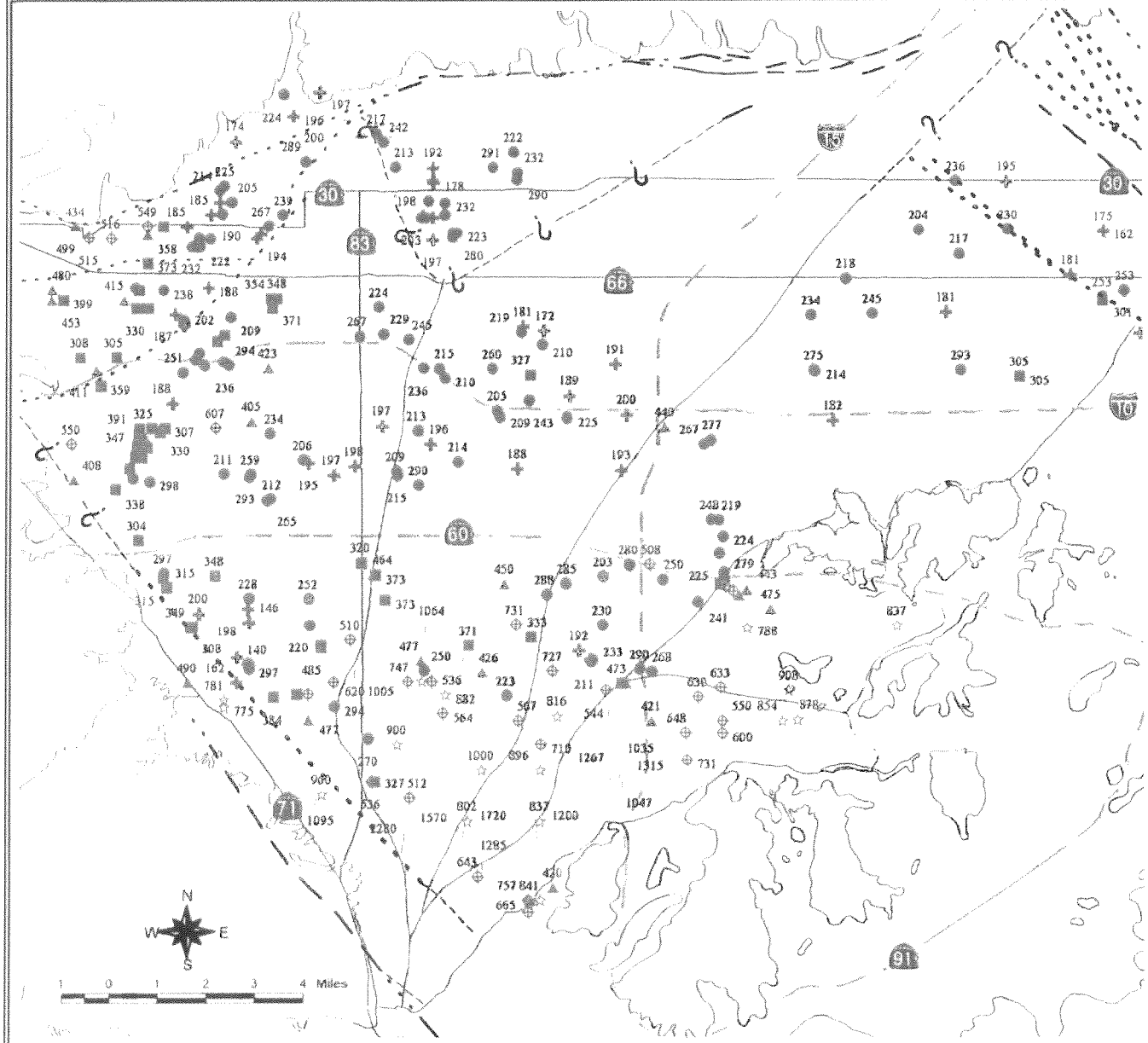



**AVERAGE TDS CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1971 TO 1975**

Source: OBMP Phase I Report, Figure 2-39

TOM DODSON & ASSOCIATES
Environmental Consultants

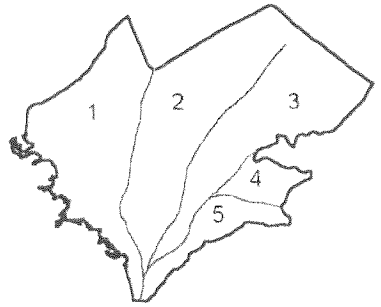
**FIGURE 4.5-37**




Legend

- <200 mg/L TDS
- 201 - 300 mg/L
- 301 - 400 mg/L
- 401 - 500 mg/L
- 501 - 750 mg/L
- 751 - 1000 mg/L
- >1000 mg/L

Management Zone Index Map

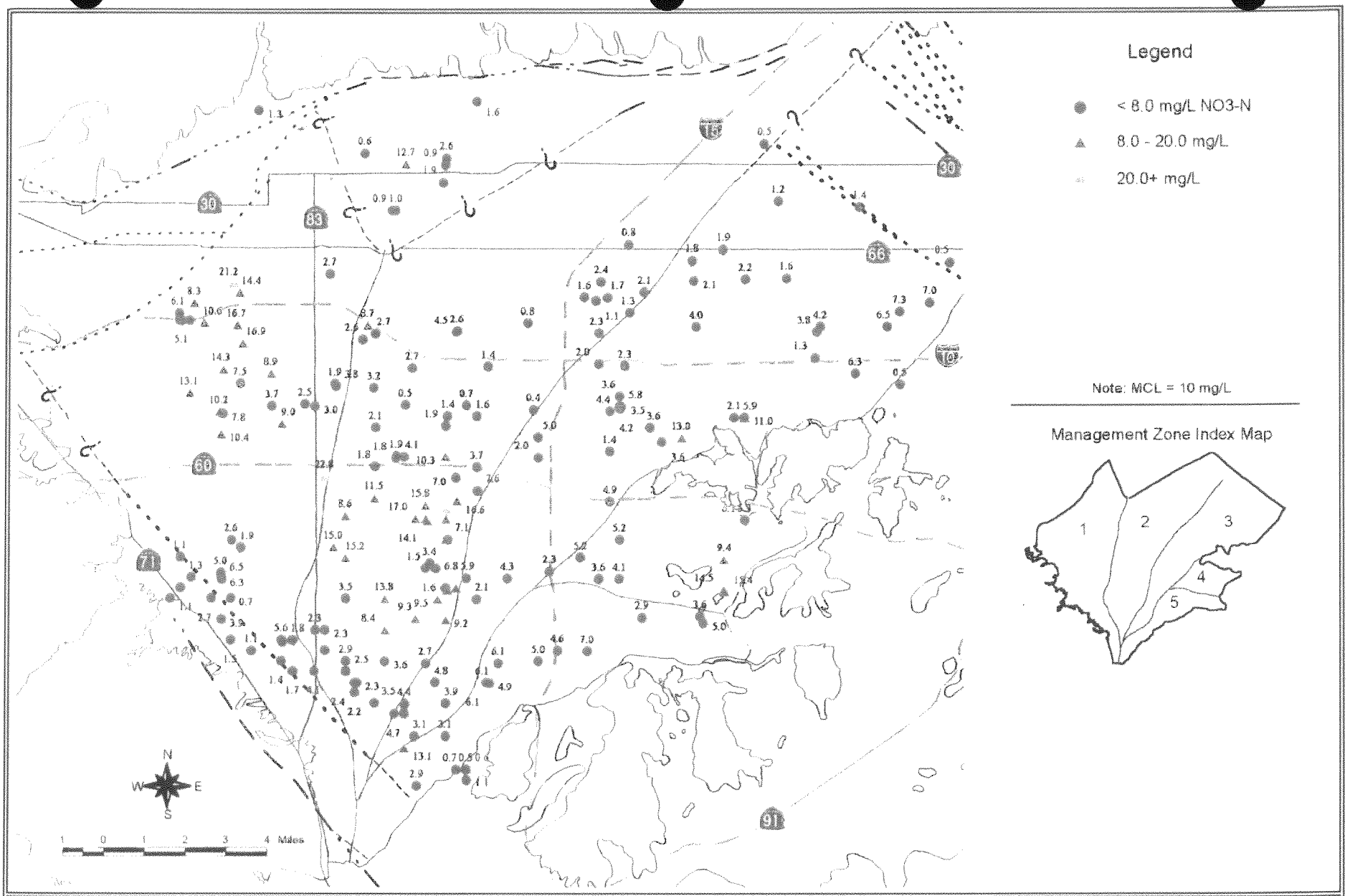



**AVERAGE TDS CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1991 TO 1995**

Source: OBMP Phase I Report, Figure 2-40

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-38**

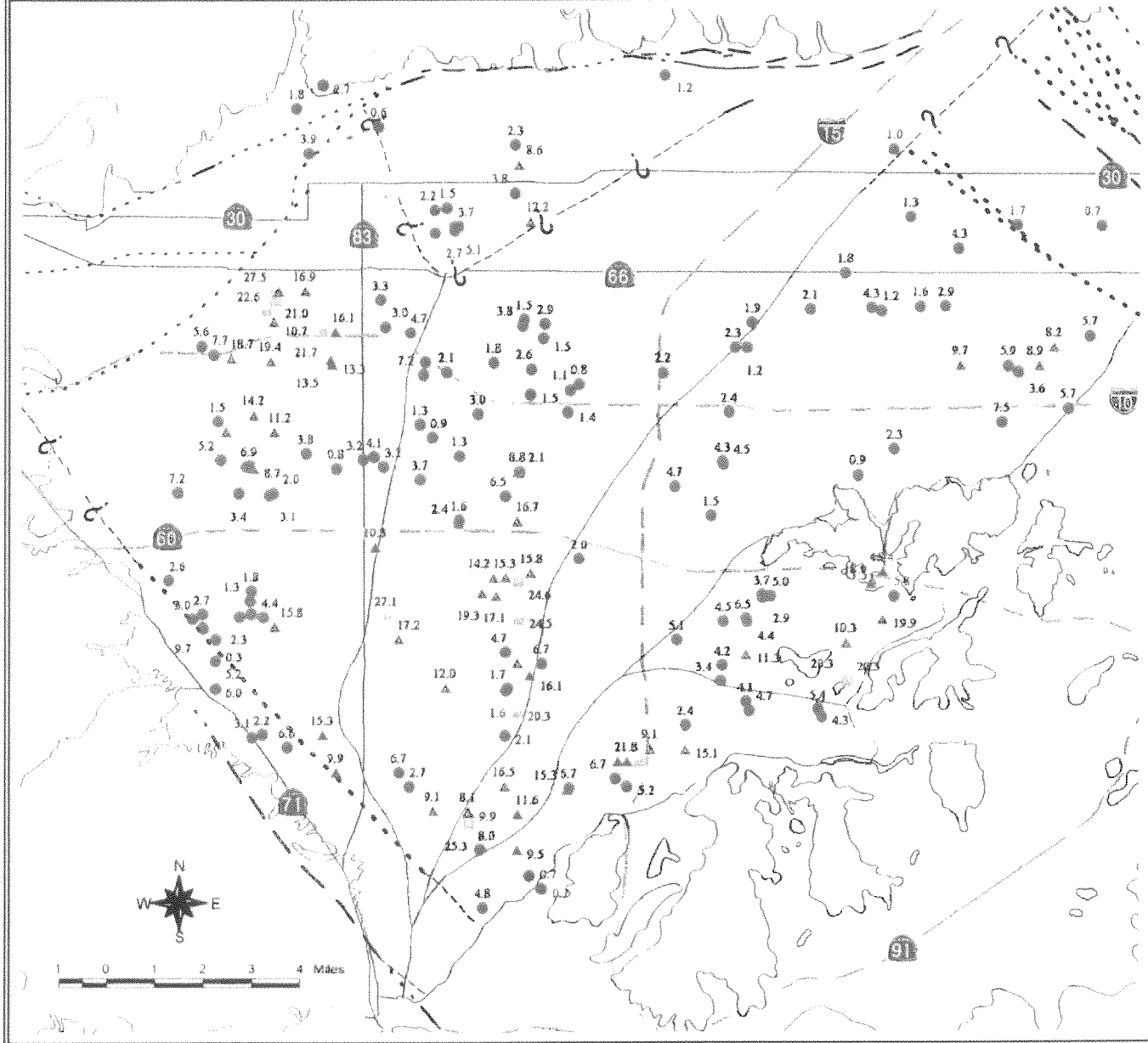



**AVERAGE NITRATE-N CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1961 TO 1965**

Source: OBMP Phase I Report, Figure 2-41

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-39**

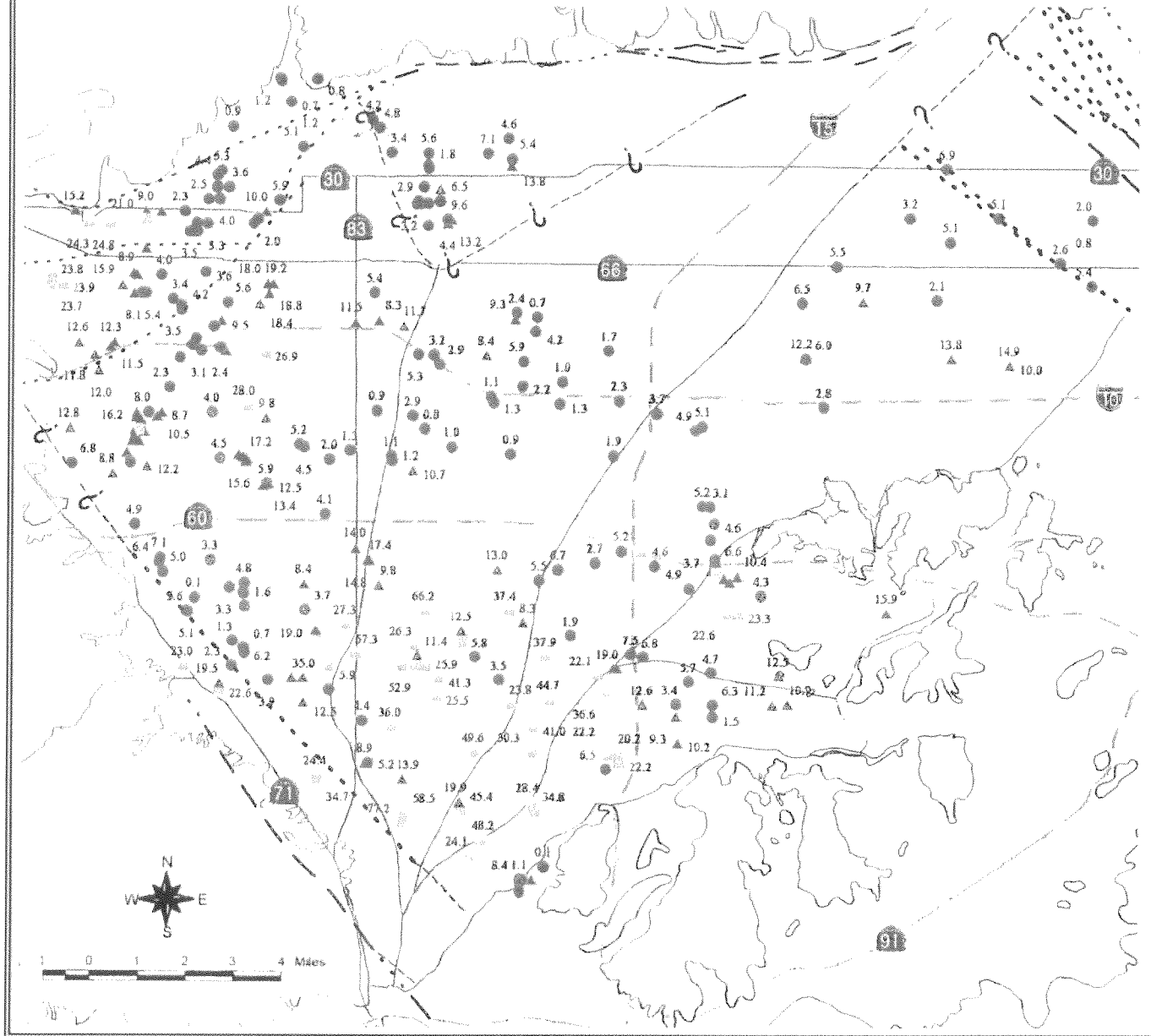



**AVERAGE NITRATE-N CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1971 TO 1975**

Source: OBMP Phase I Report, Figure 2-42

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-40**

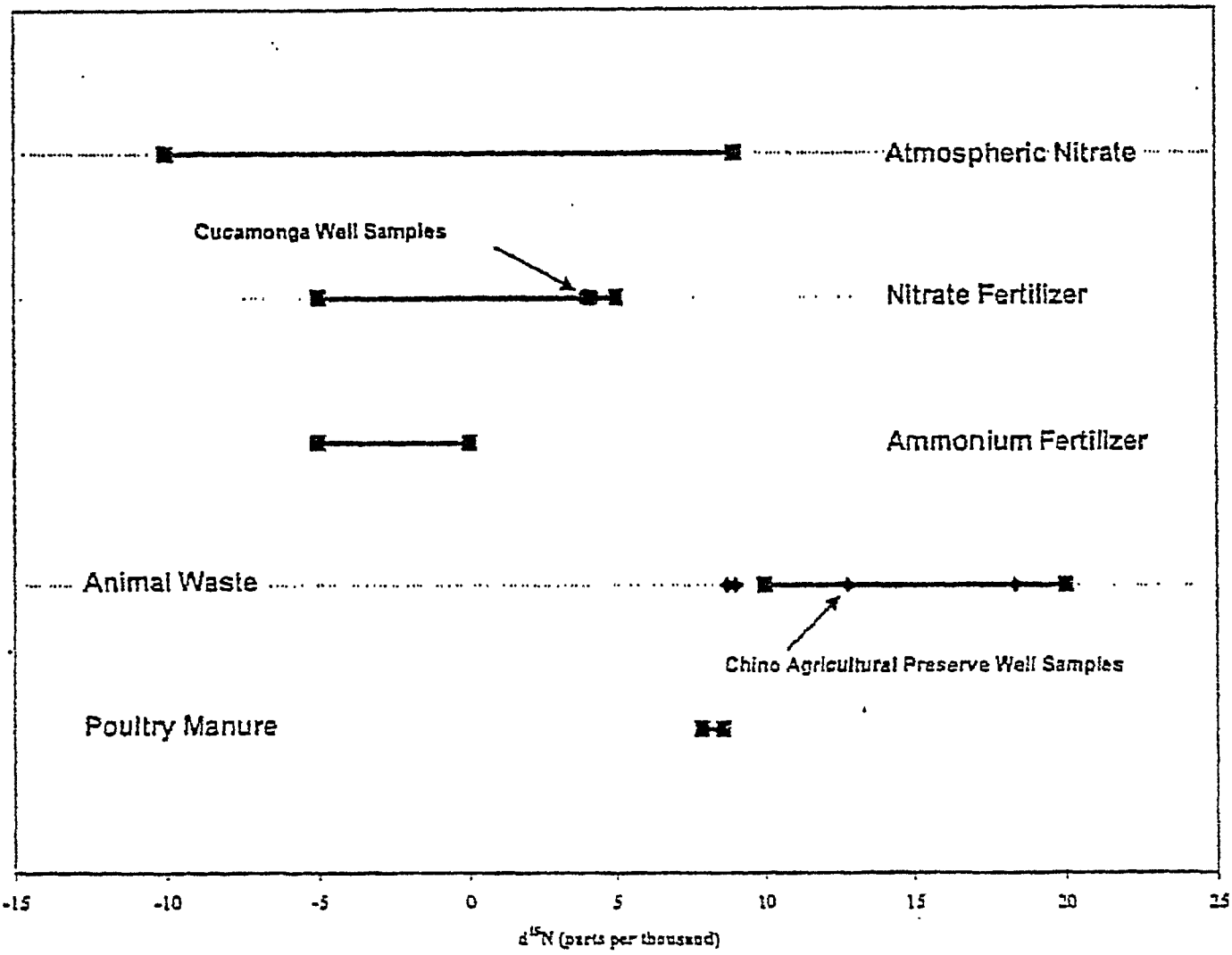



**AVERAGE NITRATE-N CONCENTRATIONS (mg/L) IN THE CHINO BASIN - 1991 TO 1995**

Source: OBMP Phase I Report, Figure 2-43

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-41**

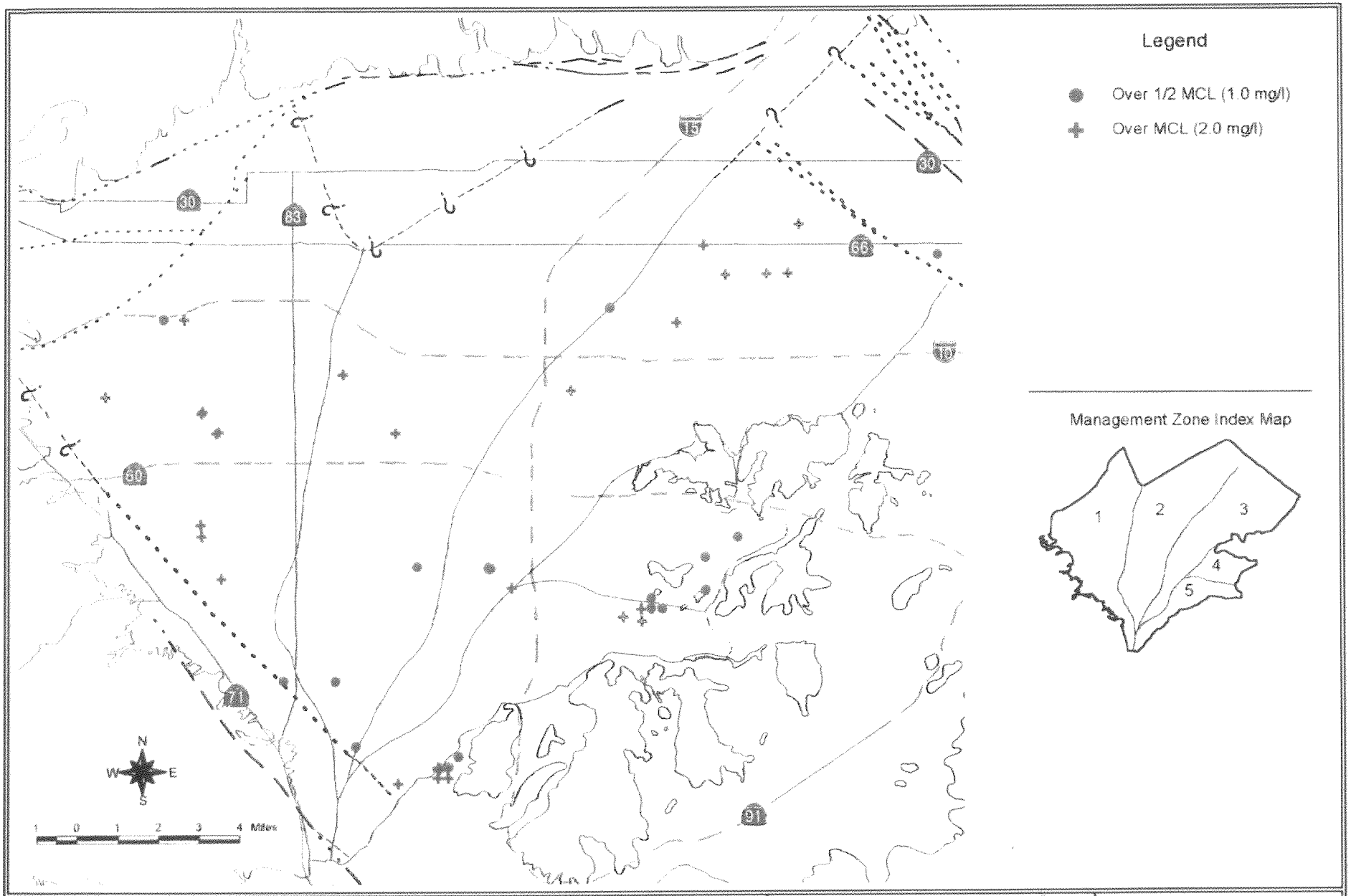



**COMPARISON OF NITRATE ISOTOPE RESULTS WITH RANGES FROM KNOWN SOURCES**

Source. OBMP Phase I Report

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-42**

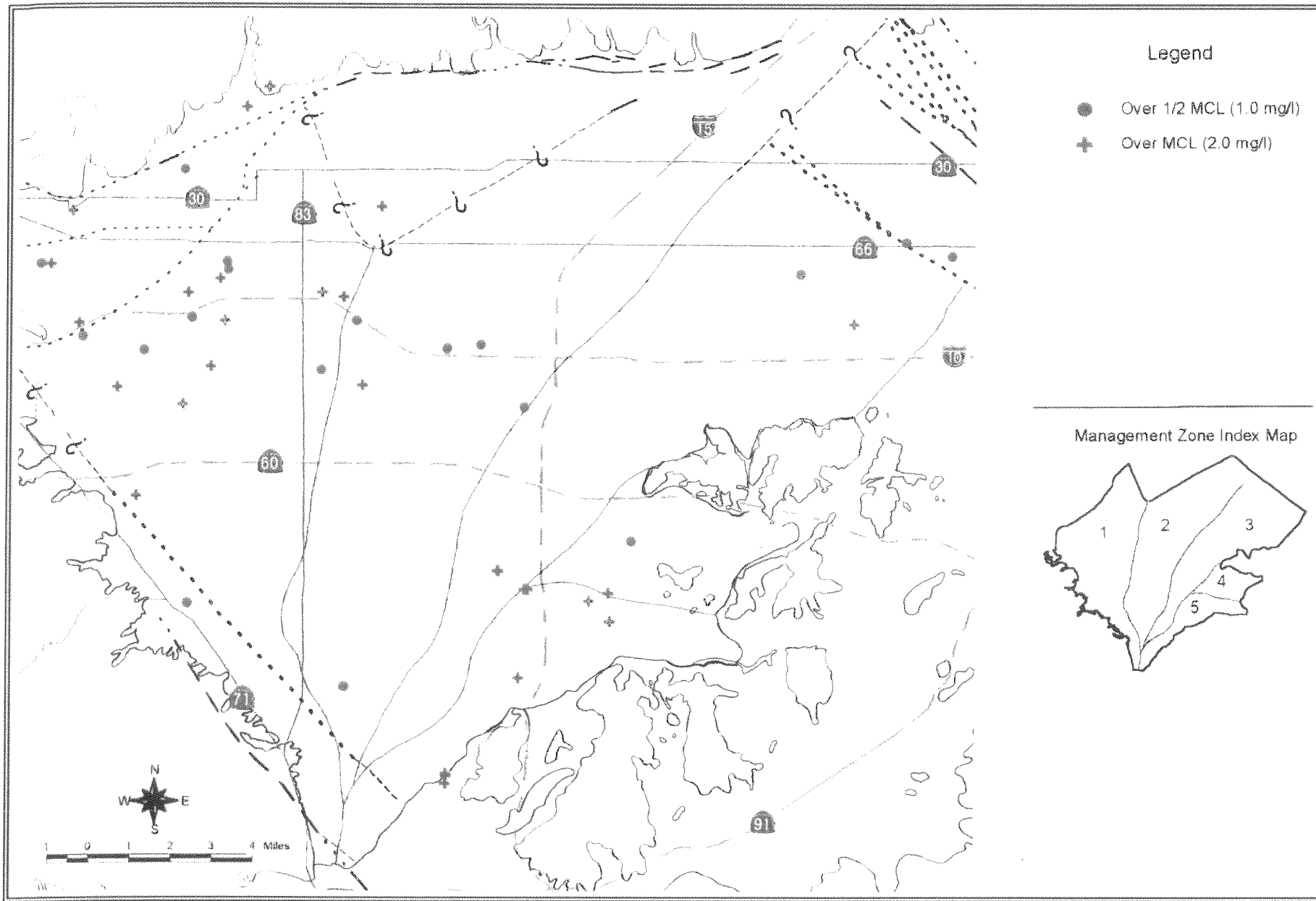



**WELLS WITH ONE OR MORE HISTORICAL FLUORIDE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-44

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-43**

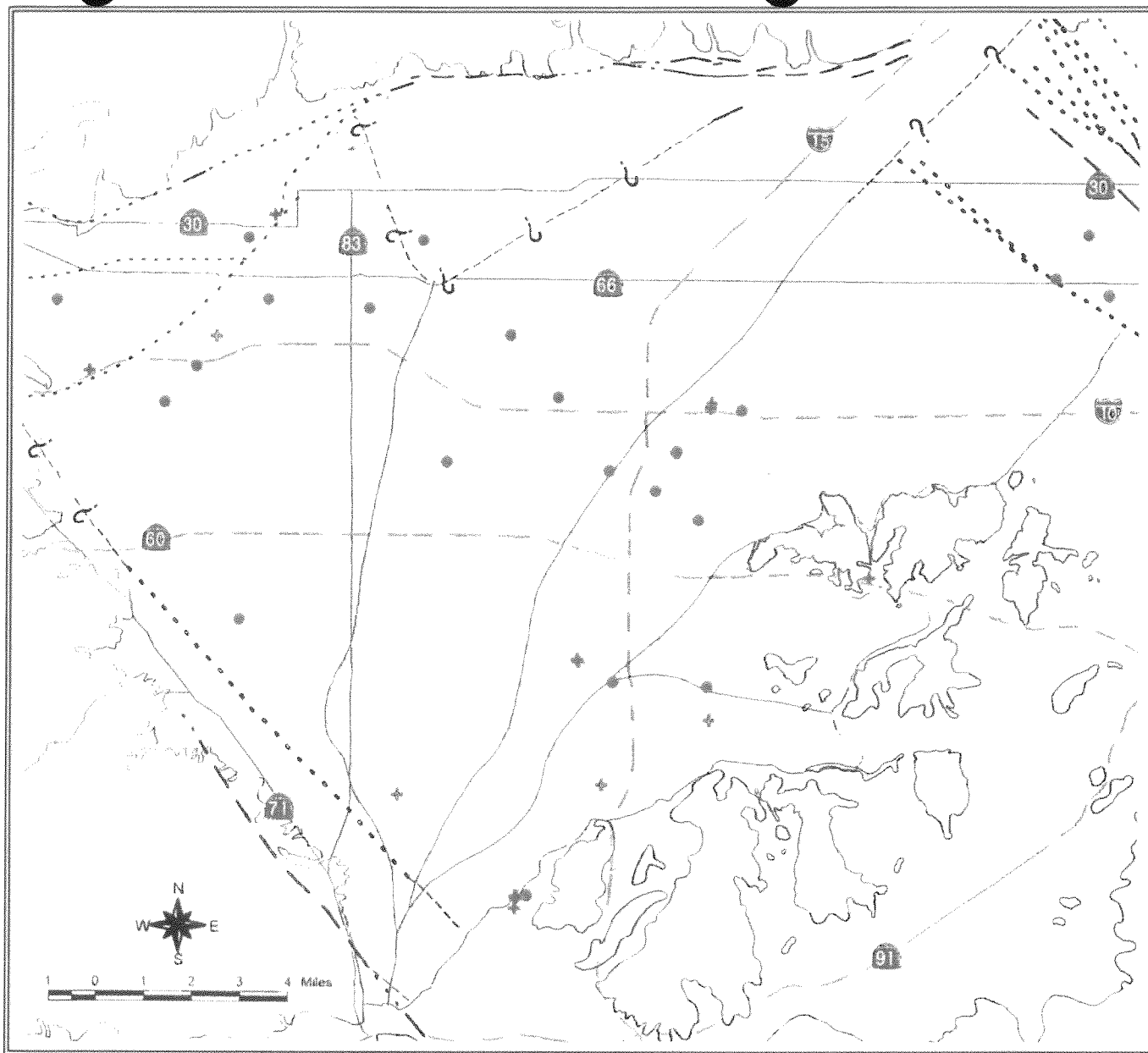



**WELLS WITH ONE OR MORE HISTORICAL IRON VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-45

TOM DODSON & ASSOCIATES
Environmental Consultants

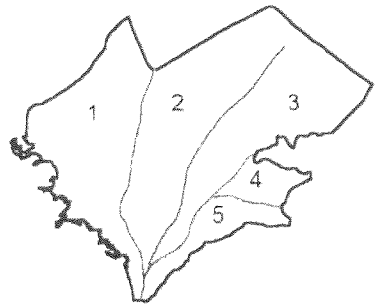
**FIGURE 4.5-44**




Legend

- Over 1/2 MCL (1.0 mg/l)
- Over MCL (2.0 mg/l)

Management Zone Index Map

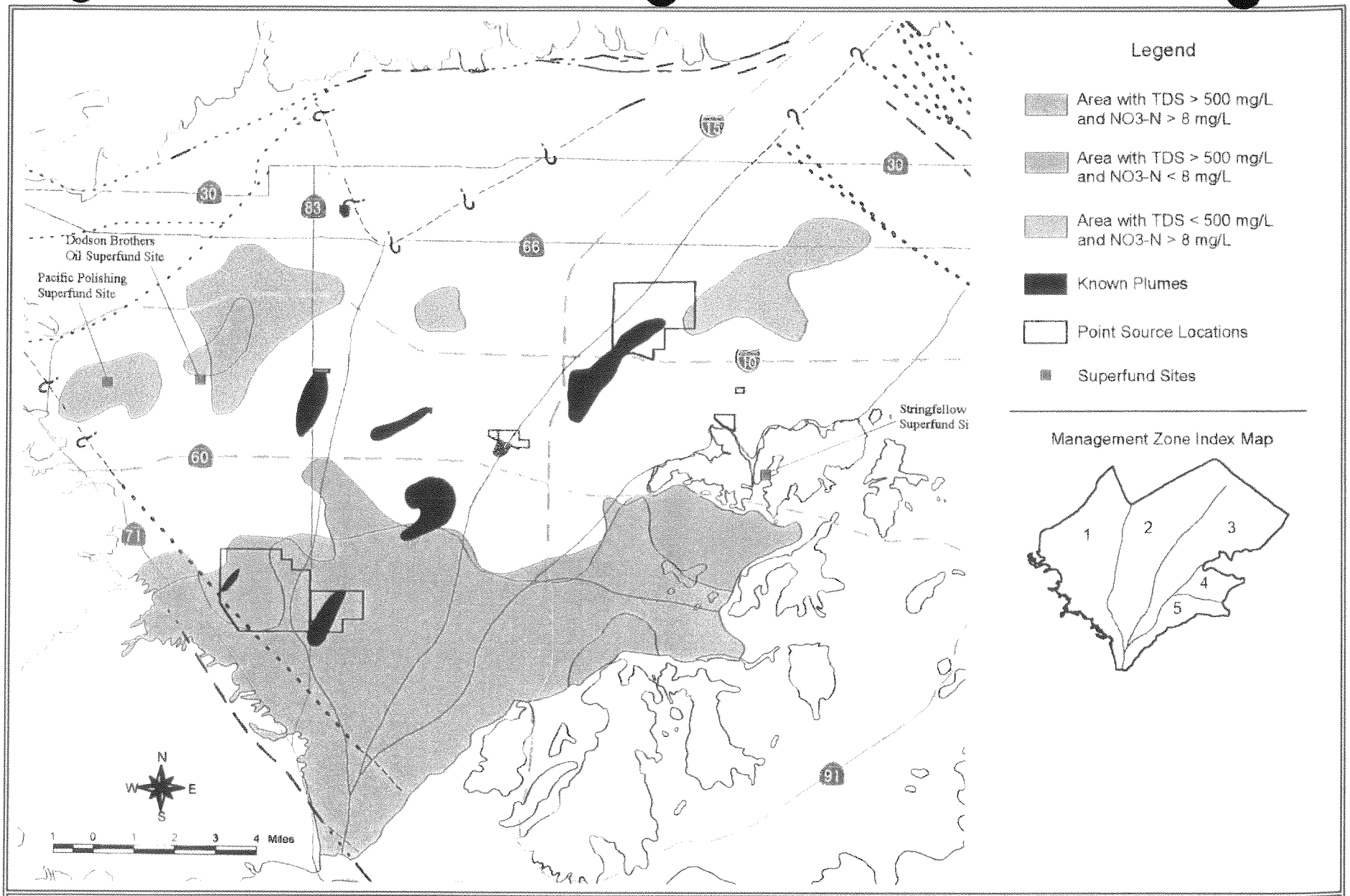



**WELLS WITH ONE OR MORE HISTORICAL MANGANESE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-46

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-45**

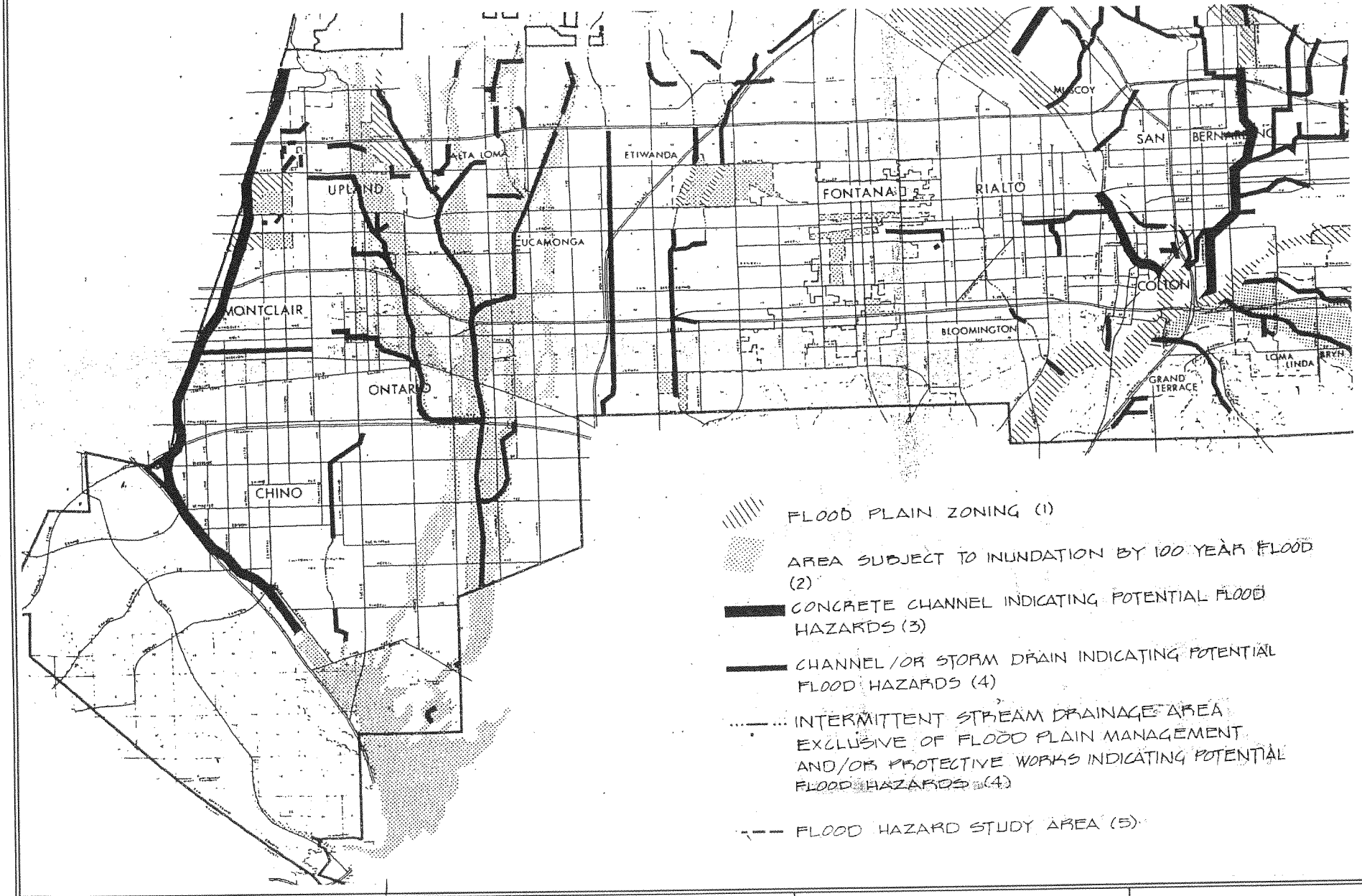



**LOCATIONS OF KNOWN POINT SOURCES AND AREAS WITH IMPAIRED WATER QUALITY IN THE CHINO BASIN**

Source: OBMP Phase I Report, Figure 2-59

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-46**

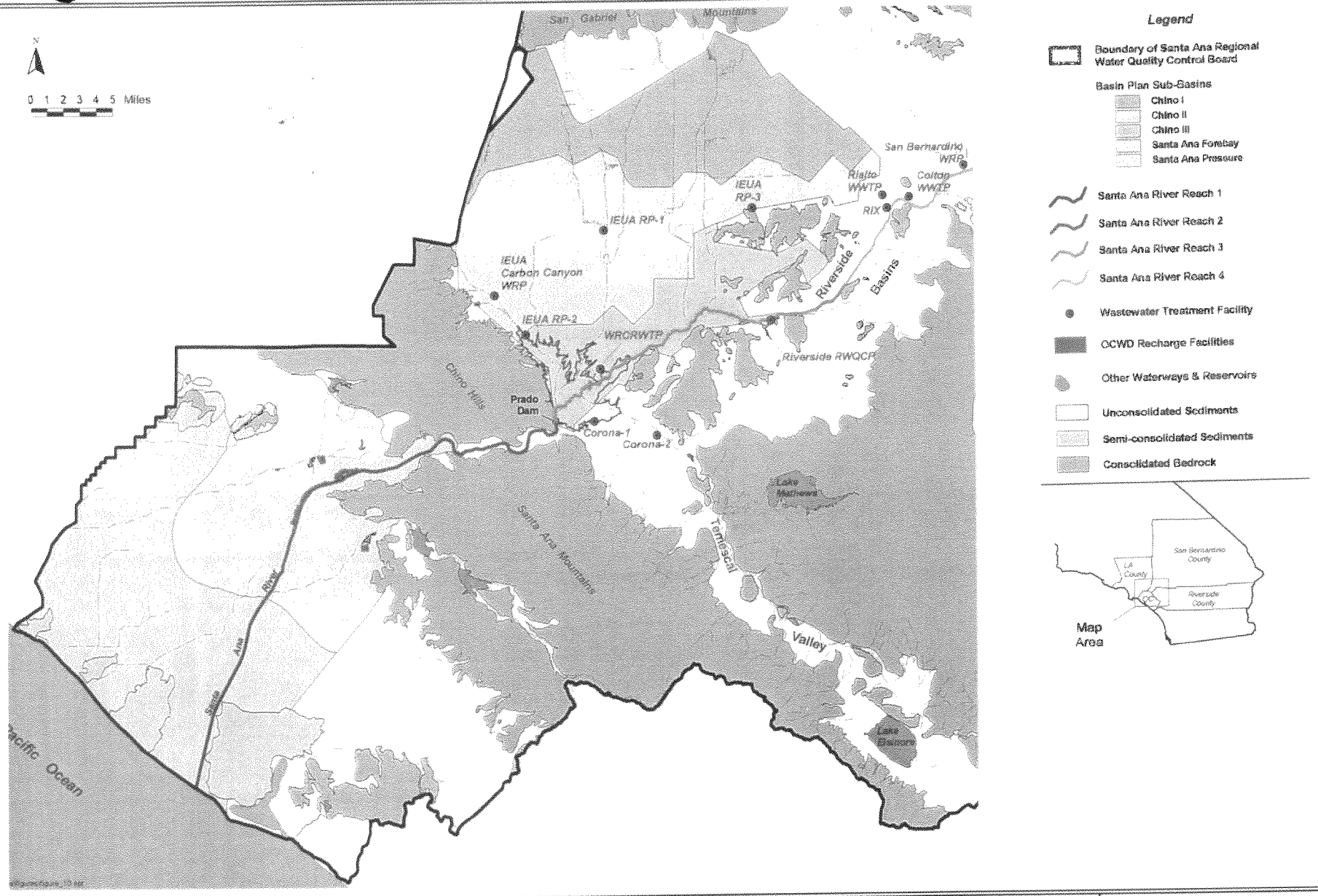



**FLOOD HAZARDS FOR SAN BERNARDINO COUNTY**

Source: San Bernardino County Hazards Maps

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-47**

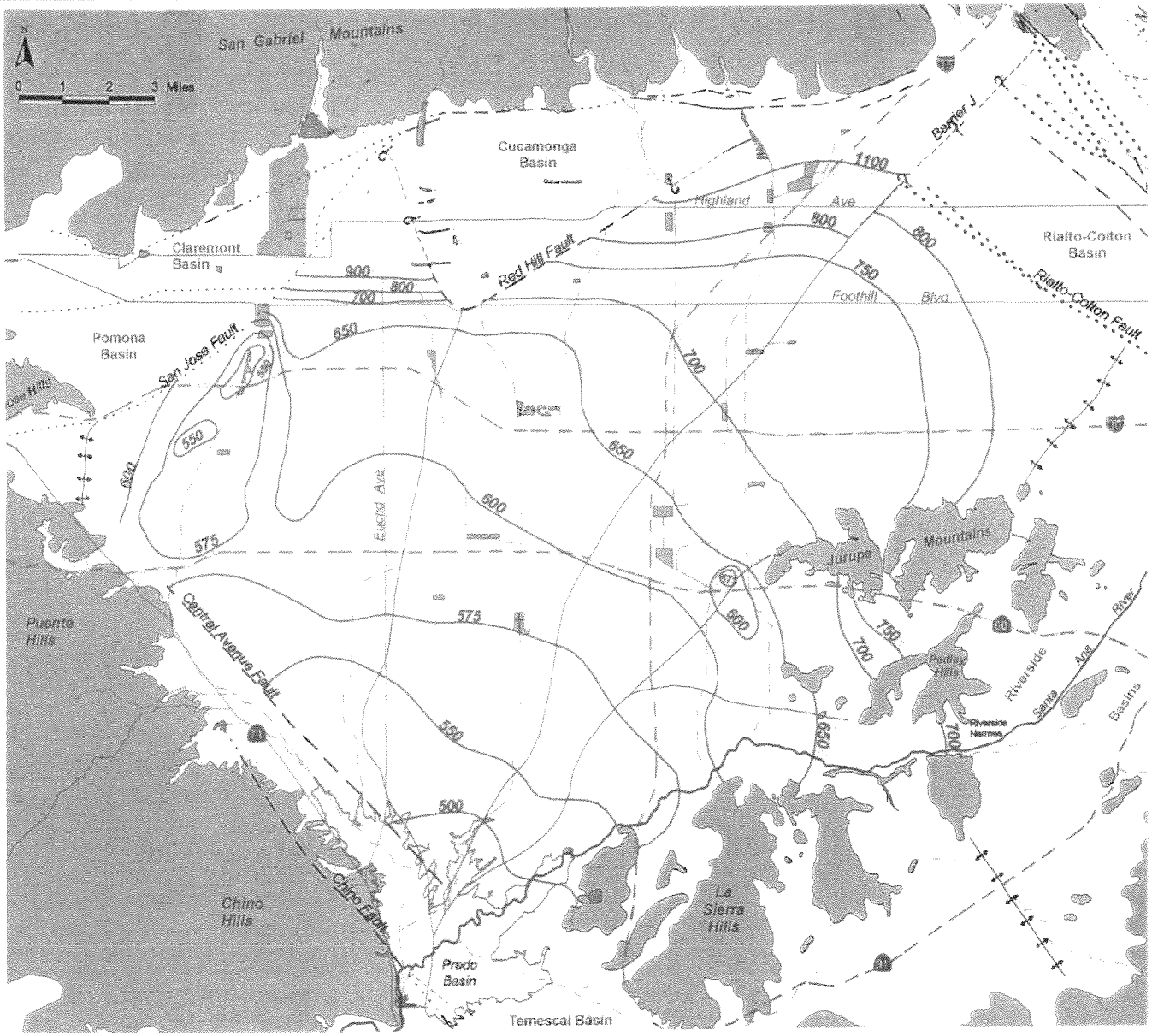



# LOCATION MAP OF CHINO BASIN, SANTA ANA RIVER, AND BASIN PLAN SUBBASINS

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-48**



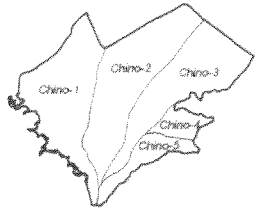

**Legend**

- 1200 — Groundwater Elevation Contour (feet above mean sea level)
- Management Zone Boundaries
- Hydrologic Chino Basin

*Other Map Features*

- Unconsolidated Sediments
- Consolidated Bedrock
- Faults (solid where known, dashed where approximate, dotted where concealed, queried where uncertain)
- Groundwater Barrier (suspected fault)
- Groundwater Divide
- Spreading Ground Area
- Waterways & Reservoirs
- Major Roads & Highways

*Management Zone Index*

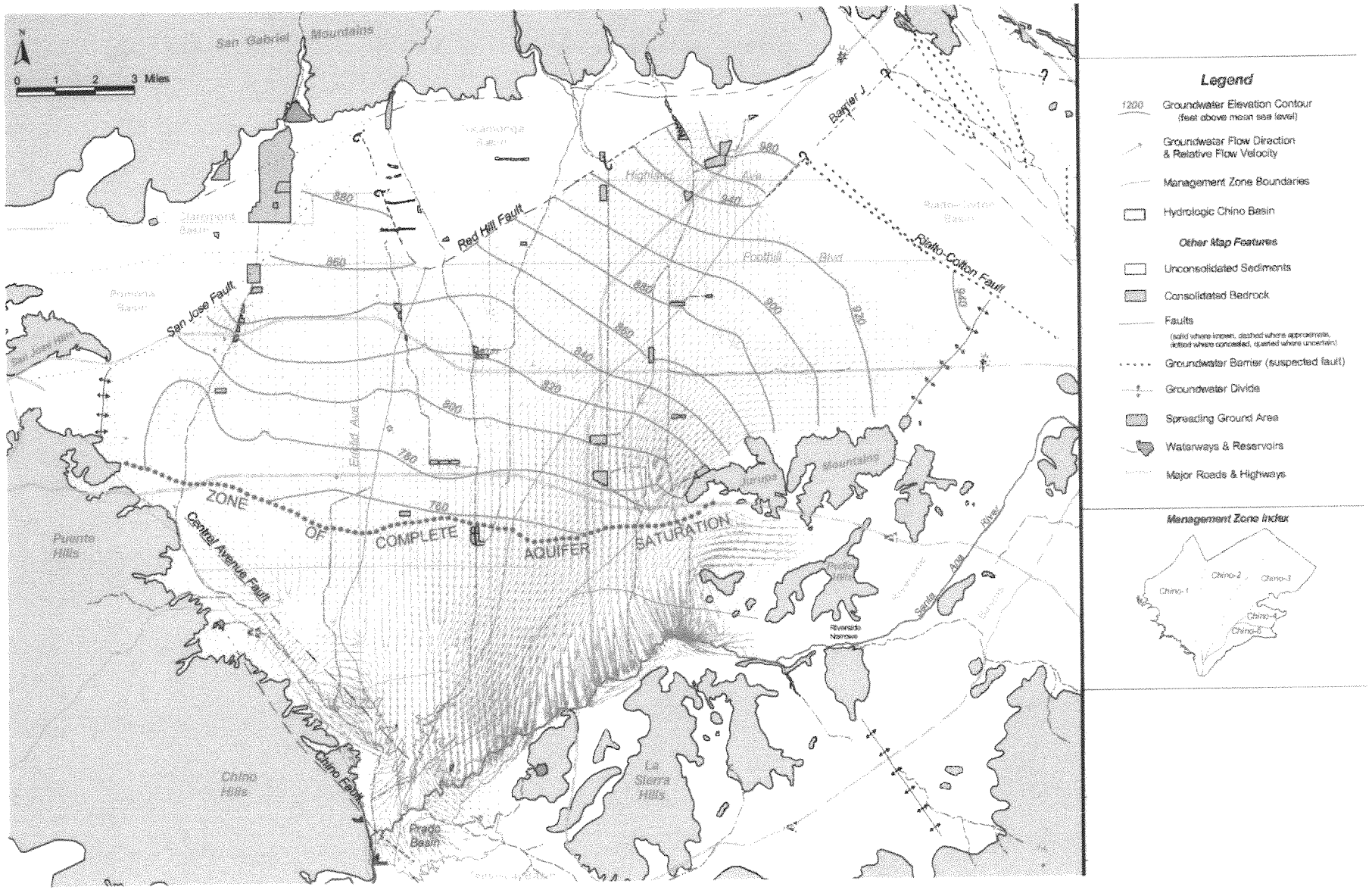



**ESTIMATED GROUNDWATER ELEVATION FOR CURRENT (1997) CONDITIONS**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-49**

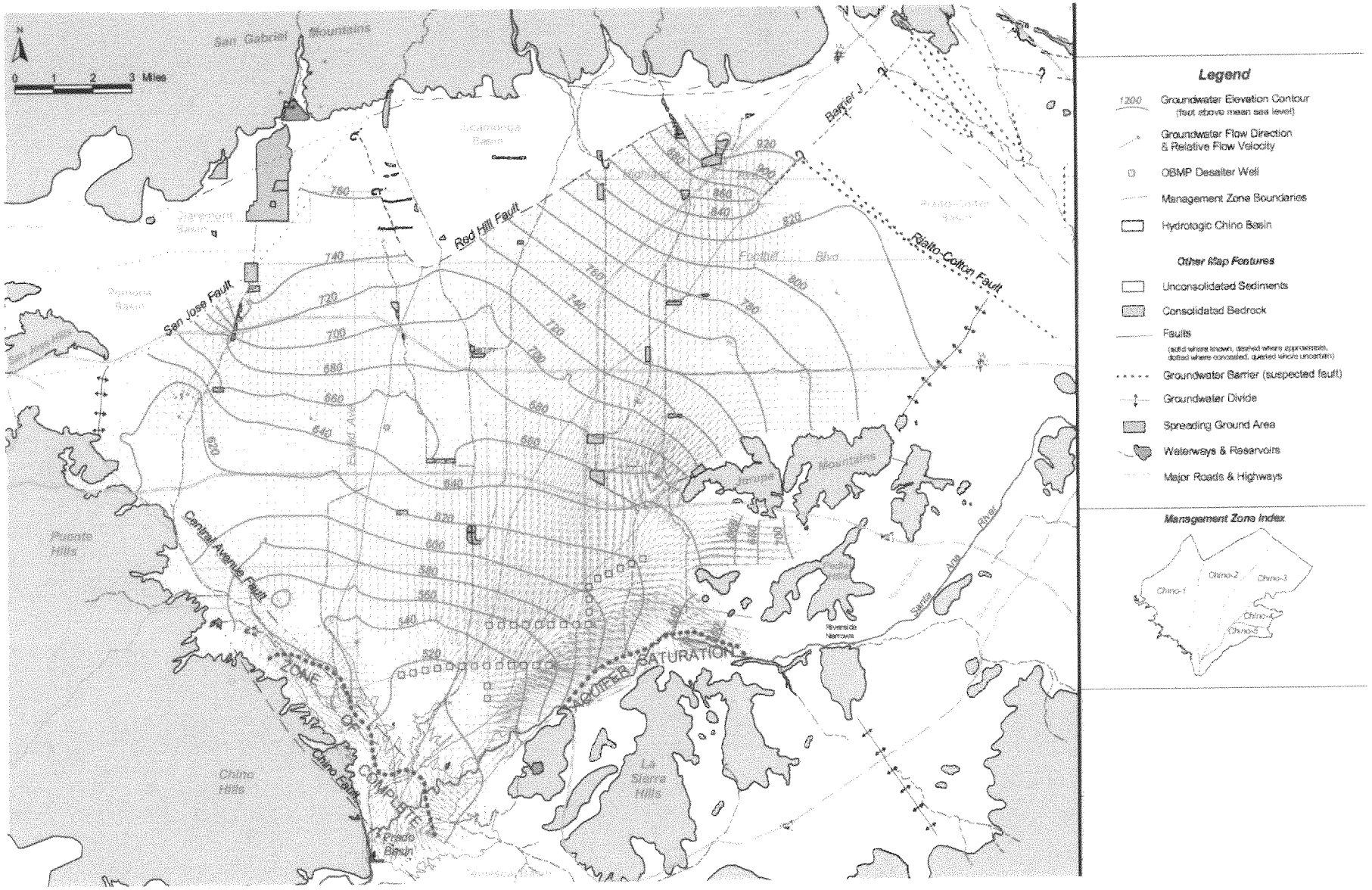



**ESTIMATED GROUNDWATER ELEVATION FOR ULTIMATE CONDITIONS WITHOUT OBMP**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-50**

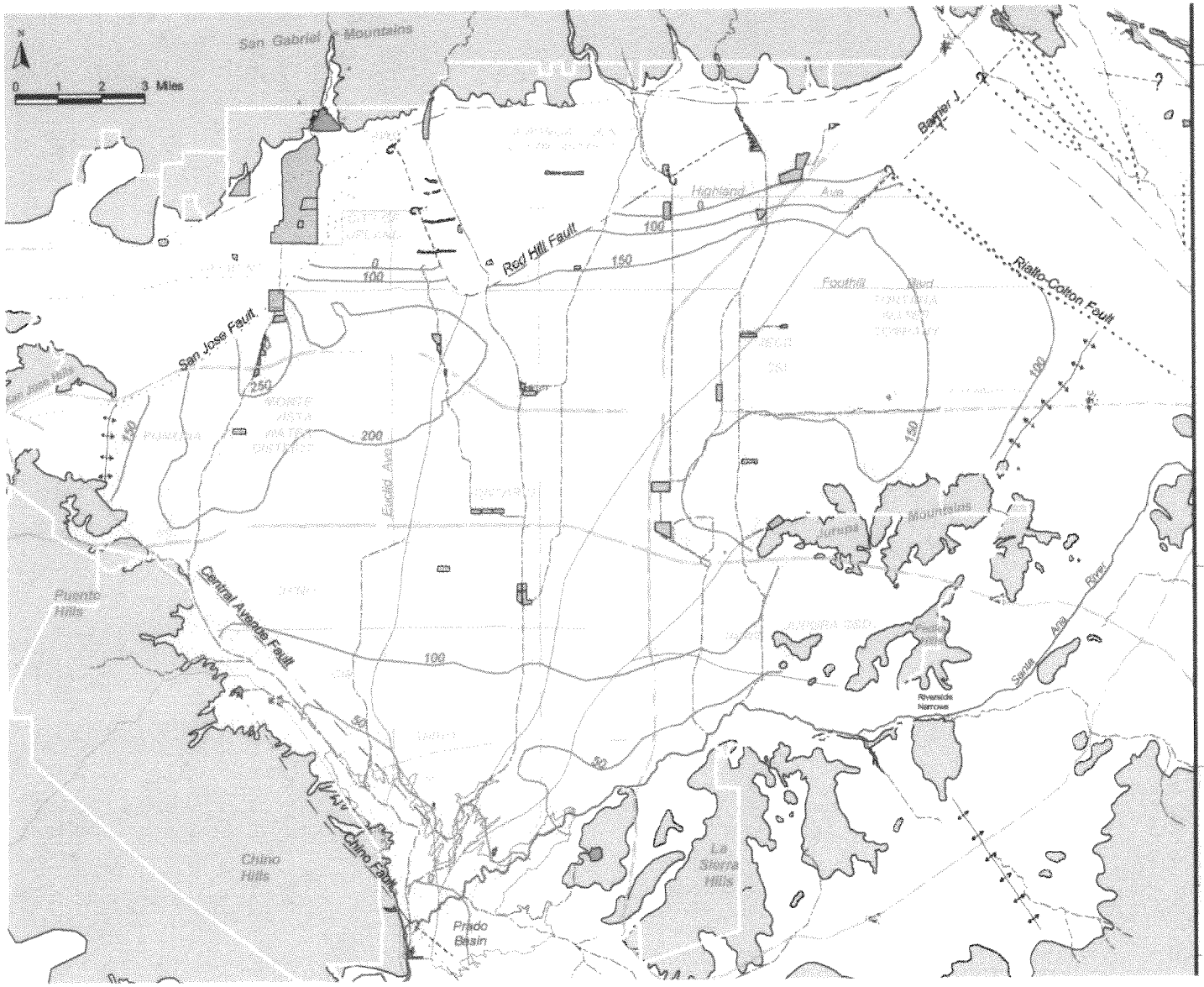



**ESTIMATED GROUNDWATER ELEVATION FOR ULTIMATE CONDITIONS WITH OBMP**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-51**

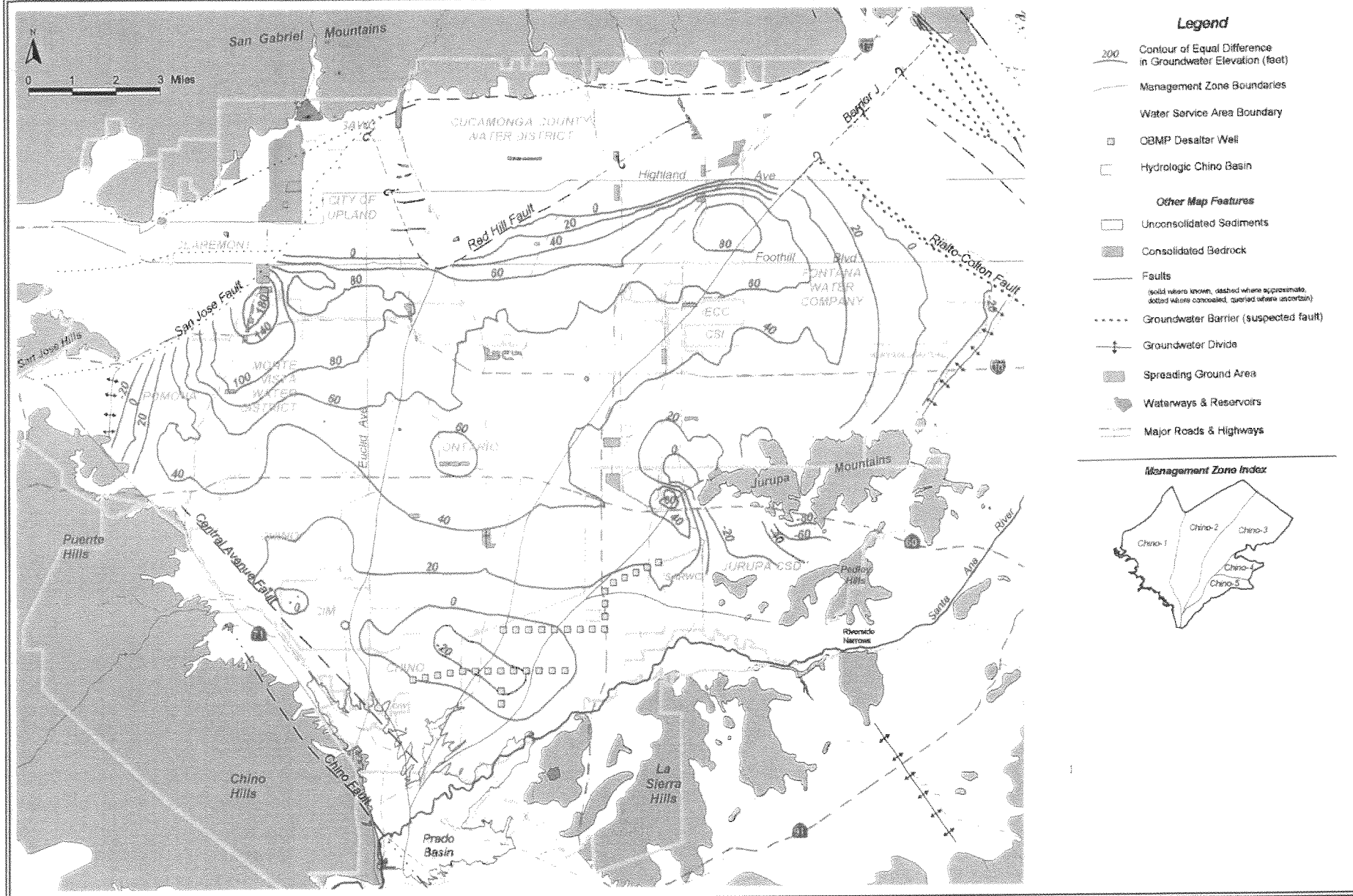



**CHANGE IN GROUNDWATER ELEVATIONS FROM 1997 TO ULTIMATE CONDITIONS WITHOUT OBMP**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-52**

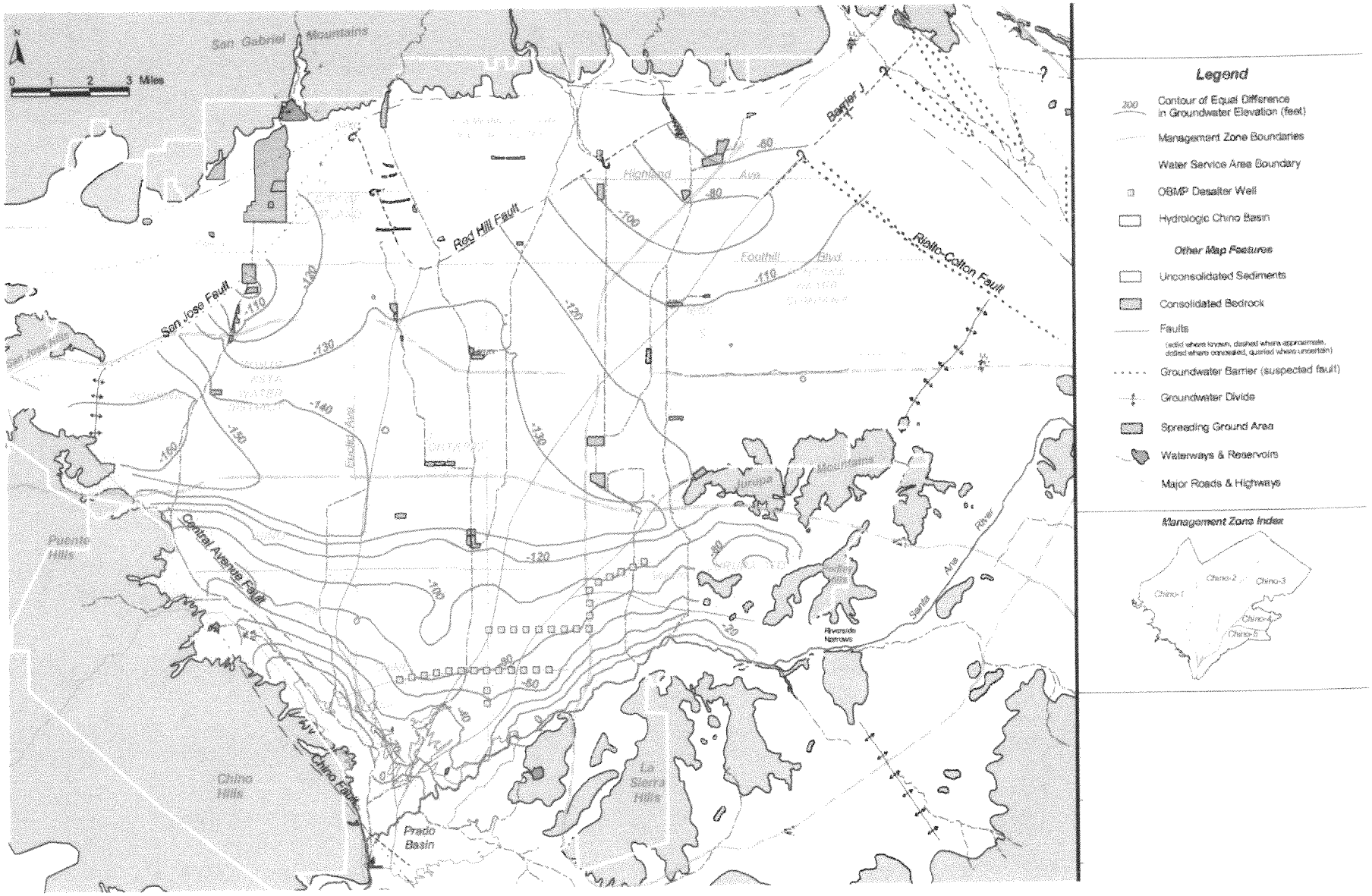



**CHANGE IN GROUNDWATER ELEVATIONS FROM 1997 TO ULTIMATE CONDITIONS WITH OBMP**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-53**

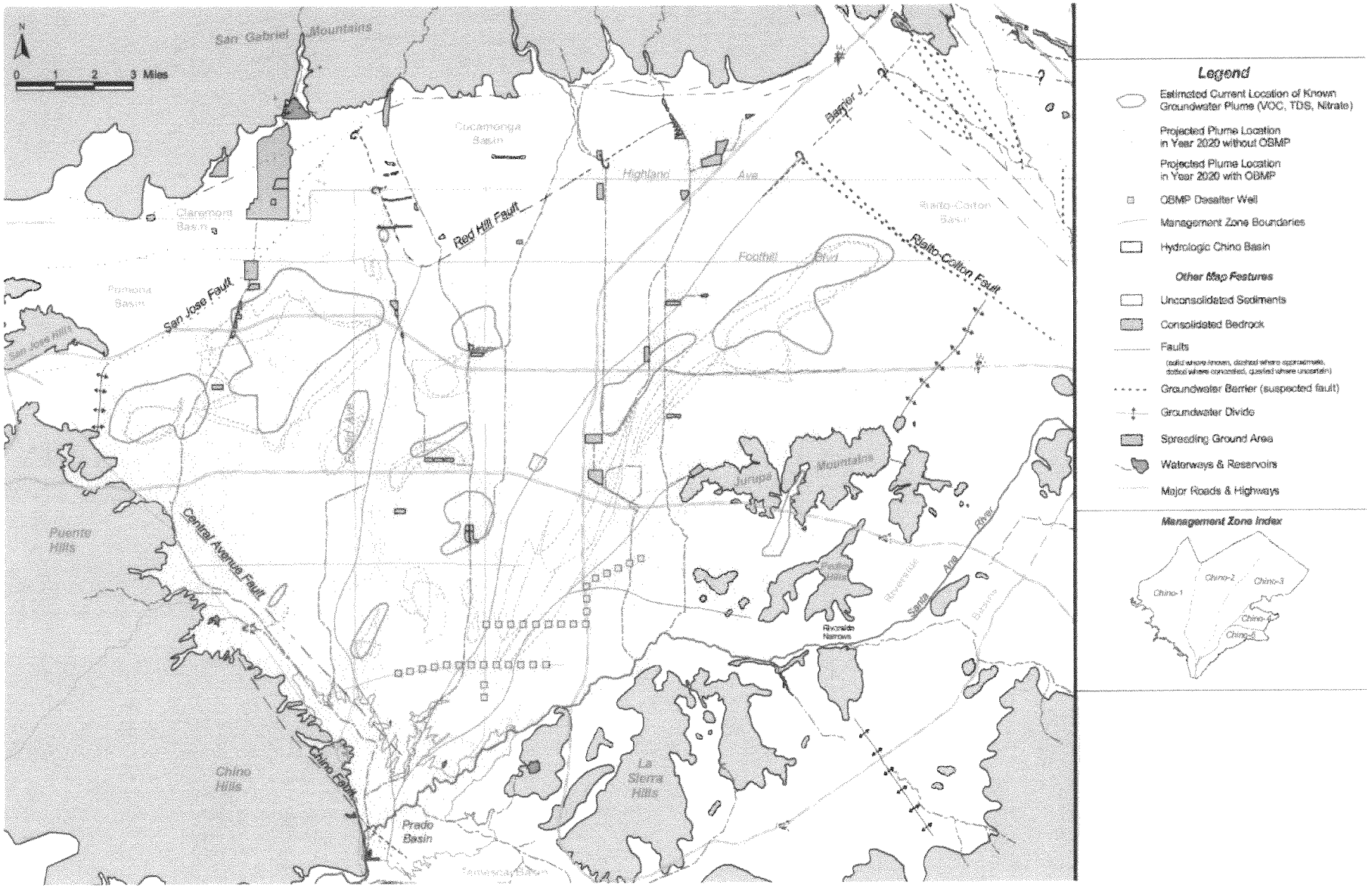



**DIFFERENCE IN GROUNDWATER ELEVATIONS FROM NON-OBMP TO OBMP CONDITIONS FOR ULTIMATE CONDITIONS**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-54**

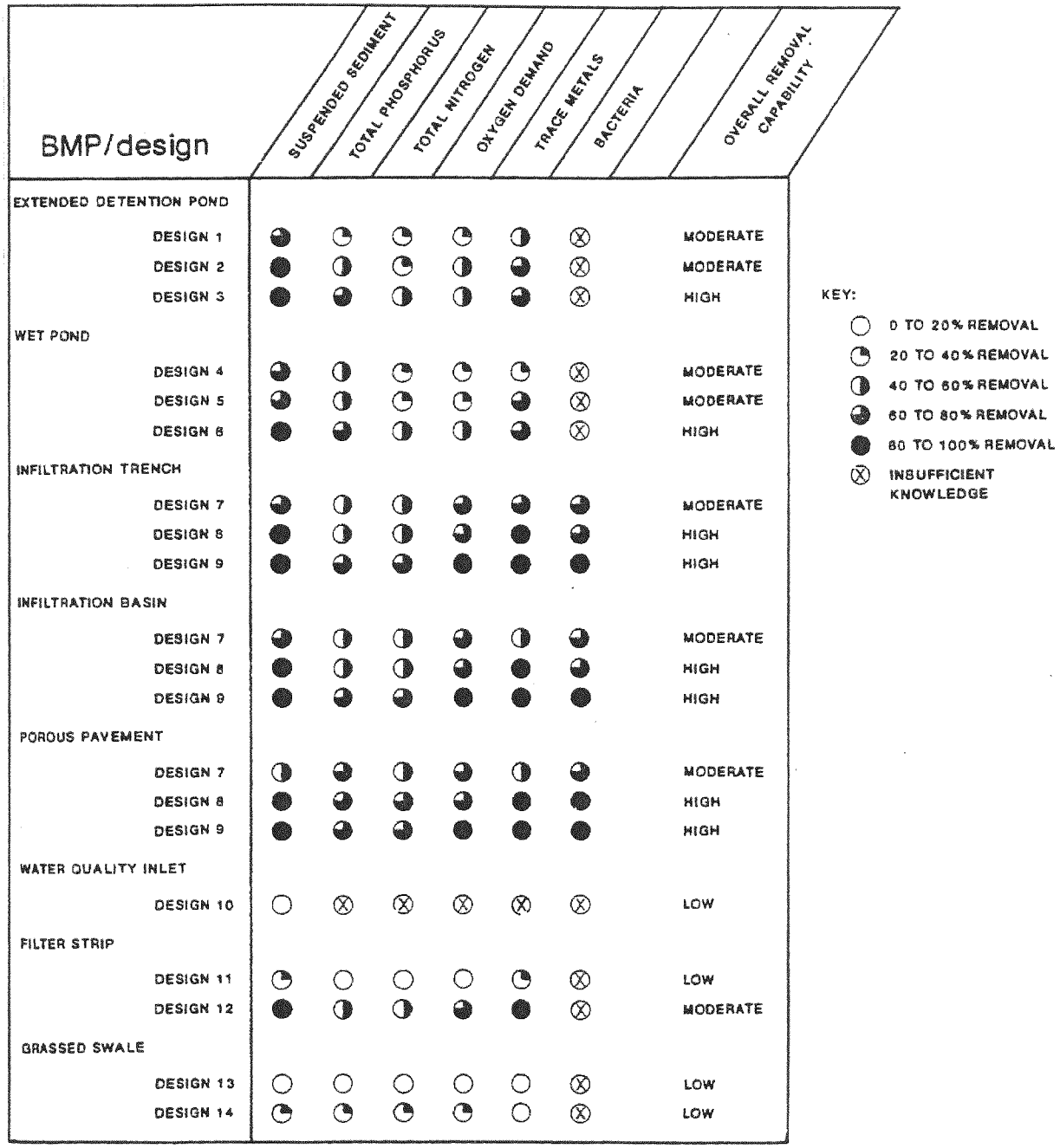



**LOCATION AND MOVEMENT OF KNOWN GROUNDWATER PLUMES WITH AND WITHOUT OBMP**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-55**




Design 1: First-flush runoff volume detained for 6-12 hours.
Design 2: Runoff volume produced by 1.0 inch, detained 24 hours.
Design 3: As in Design 2, but with shallow marsh in bottom stage.
Design 4: Permanent pool equal to 0.5 inch storage per impervious acre.
Design 5: Permanent pool equal to 2.5 (Vr); where Vr=mean storm runoff.
Design 6: Permanent pool equal to 4.0 (Vr); approx. 2 weeks retention.
Design 7: Facility exfiltrates first-flush; 0.5 inch runoff/imper. acre.
Design 8: Facility exfiltrates one inch runoff volume per imper. acre.
Design 9: Facility exfiltrates all runoff, up to the 2 year design storm.
Design 10: 400 cubic feet wet storage per impervious acre.
Design 11: 20 foot wide turf strip.
Design 12: 100 foot wide forested strip, with level spreader.
Design 13: High slope swales, with no check dams.
Design 14: Low gradient swales with check dams.

**COMPARATIVE POLLUTANT REMOVAL OF URBAN BMP DESIGNS**

Source: Wildermuth Environmental, Inc.

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.5-56**

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# 4.6 AIR QUALITY

## 4.6.1 Introduction

Air Quality was identified as a topic for evaluation in this PEIR because construction and operation of the proposed facilities have the potential to generate substantial air emissions. The emissions will be associated with operation of construction equipment, the disturbance of soil and energy consumed to power equipment. This section of the PEIR will attempt to quantify these emissions based on information contained in the OBMP. Air quality impacts will be forecast and evaluated in as much detail as allowed based on the level of detail contained in the OBMP.

## 4.6.2 Environmental Setting

The OBMP encompasses the Chino Basin. The Chino Basin is located within the South Coast Air Basin (SCAB). Jurisdiction over air quality issues within the SCAB are under the jurisdiction of the South Coast Air Quality Management District (SCAQMD).

The project area is comprised of highly urbanized areas, natural open space, and agricultural areas that are primarily associated with the dairy industry. The applicable general plans (cities and counties) envision additional urban development with a reduction in the agricultural uses.

While the SCAB has some of the most unhealthful air in the nation, air quality within the SCAB continues to show improvement. However at this time, the SCAB is classified non-attainment for four of the six criteria pollutants utilized to determine attainment of natural ambient air quality standards (NAAQS).

### 4.6.2.1 Climate/Meteorology[1]

Climate in the OBMP area is characterized by warm, dry summers, low precipitation, and mild winters. Average daily winter temperature is 51°F and average daily summer temperature is 75°F. During the year, temperatures range from a low near 20°F during the winter to a high of over 100°F during the summer. More than two-thirds of annual rainfall occurs from December through March with approximately 90 percent occurring between November and April. Little rain falls between May and November, due to the semipermanent Pacific high pressure system that prevents storms from entering the OBMP area. In the OBMP area, mean annual precipitation ranges from 13 inches near Prado Dam to 25 inches at the base of the San Gabriel Mountains. In these mountains, average annual rainfall has reached as high as 40 inches with extremes ranging between 40 and 200 percent

[1] Metropolitan Water District of Southern California, Chino Basin Groundwater Storage Program, Draft Environmental Impact Report.

of normal. In nearly all months out of the year, evaporation exceed precipitation. Relative humidity averages 45 percent year-round; 40 to 70 percent in winter, and 10 to 20 percent in summer. Topography is a major factor influencing wind direction over the project area. Prevailing winds are generally light, and westerly or southwesterly. Night and early morning winds are usually northeasterly. Some afternoon sea breezes blow into the Chino Basin from the Los Angeles area. Summer daytime wind speed averages 10 to 15 miles per hour (mph) whereas the winter daytime wind speed averages 5 to 8 mph. There is little seasonal variability in this pattern. Occasionally during autumn and winter, "Santa Ana" conditions develop from a high pressure zone to the east and bring dry, high velocity winds from the deserts to the east and northeast over Cajon Pass. These winds, gusting to over 80 mph, can reduce relative humidity to below 10 percent.

The Basin experiences a persistent temperature inversion (increasing temperature with increasing altitude) as a result of the Pacific high. This inversion limits the vertical dispersion of air contaminants, holding them relatively near the ground. As the sun warms the ground and the lower air layer, the temperature of the lower air layer approaches the temperature of the base of the inversion (upper) layer until the inversion layer finally breaks, allowing vertical mixing with the lower layer. This phenomenon is observed in mid-afternoon to late afternoon on hot summer days, when the smog appears to clear up suddenly. Winter inversions frequently bread by mid-morning.

The SCAQMD maintains monitoring stations throughout the SCAG to monitor concentrations of criteria pollutants in the air. The nearest SCAQMD monitoring stations to the Chino Basin that measure all criteria pollutants are the East San Gabriel Valley V1 station and the Central San Bernardino V2 station. Air quality monitoring data from these stations for the last 3 years available (1996-1998) are provided in Tables 4.6-1 and 4.6-2.

These stations are located generally upwind and downwind of the Chino Basin. The data on Tables 4.6-1 and 4.6-2 indicate that air quality is essentially the same for carbon monoxide and nitrogen dioxide both upwind while ozone and $PM_{10}$ levels are generally higher downwind or easterly of the OBMP area.

### 4.6.2.2 Air Quality Regulations

Federal Regulations/Standards

Pursuant to the federal Clean Air Act (CAA) of 1970, the U.S. Environmental Protection Agency (EPA) established NAAQS. The NAAQS were established for several major pollutants, termed "criteria" pollutants because the choices of NAAQS are supported by specific medical evidence. The NAAQS are two-tiered: primary, to protect public health; and secondary, to prevent degradation to the environment (e.g., impairment of visibility, damage to vegetation and property, etc.).

## Table 4.6-1
## AIR POLLUTANT DATA SUMMARY FROM CENTRAL SAN BERNARDINO V2 MONITORING STATION (1996-1998)

| Pollutant | SCAQMD Station Data | | |
|---|---|---|---|
| | 1996 | 1997 | 1998 |
| Ozone | | | |
| Highest 1 hour, ppm | 0.24 | 0.20 | 0.21 |
| Days > 0.12 ppm[1] | 63 | 32 | 39 |
| Days ≥ 0.09 ppm[2] | 113 | 102 | 65 |
| Carbon Monoxide | | | |
| Highest 1 hour, ppm | 6.0 | 8.0 | 6.3 |
| Days > 35.0 ppm[1] | 0 | 0 | 0 |
| Days > 20.0 ppm[2] | 0 | 0 | 0 |
| Highest 8 hour, ppm | 4.6 | 6.0 | 4.7 |
| Days > 9.0 ppm[1,2] | 0 | 0 | 0 |
| Nitrogen Dioxide | | | |
| Highest 1 hour, ppm | 0.15 | 0.14 | 0.11 |
| Days > 0.25 ppm[2] | 0 | 0 | 0 |
| Annual Average | 0.038 | 0.035 | 0.034 |
| Days ≥ 0.053 ppm[1] | No | No | No |
| Sulfur Dioxide | | | |
| Highest 24 hour, ppm | NM | NM | NM |
| Days > 0.05 ppm[2] | NM | NM | NM |
| Particulates ($PM_{10}$) | | | |
| Highest 24 hour | 136 | 108 | 114 |
| Days > 150 $\mu g/m^3$ [1] | 0 | 0 | 0 |
| Days > 50 $\mu g/m^3$ [2] | 35 | 28 | 22 |
| AAM[1] | 52.5 | 51.4 | 46.3 |
| Year > 50 $\mu g/m^3$ | Yes | Yes | No |
| AGM[2] | 45.9 | 45.6 | 39.3 |
| Year > 30 $\mu g/m^3$ | Yes | Yes | Yes |

ppm - parts per million; $\mu G/m^3$ - micrograms per cubic meter
NM - Not measured at this station
AAM - Annual Arithmetic Mean
AGM - Annual Geometric Mean

[1] Federal Standard
[2] State Standard

Source: SCAQMD Annual Monitoring Reports, 1996-1998

## Table 4.6-2
## AIR POLLUTANT DATA SUMMARY FROM EAST SAN GABRIEL VALLEY V1 MONITORING STATION (1996-1998)

| Pollutant | SCAQMD Station Data | | |
|---|---|---|---|
| | 1996 | 1997 | 1998 |
| Ozone | | | |
| Highest 1 hour, ppm | 0.20 | 0.16 | 0.15 |
| Days > 0.12 ppm[1] | 26 | 11 | 19 |
| Days ≥ 0.09 ppm[2] | 74 | 42 | 43 |
| Carbon Monoxide | | | |
| Highest 1 hour, ppm | 6.0 | 8.0 | 6.0 |
| Days > 35.0 ppm[1] | 0 | 0 | 0 |
| Days > 20.0 ppm[2] | 0 | 0 | 0 |
| Highest 8 hour, ppm | 4.0 | 4.3 | 3.9 |
| Days > 9.0 ppm[1,2] | 0 | 0 | 0 |
| Nitrogen Dioxide | | | |
| Highest 1 hour, ppm | 0.15 | 0.16 | 0.14 |
| Days > 0.25 ppm[2] | 0 | 0 | 0 |
| Annual Average | 0.0415 | 0.0338 | 0.364 |
| Days ≥ 0.053 ppm[1] | No | No | No |
| Sulfur Dioxide | | | |
| Highest 24 hour, ppm | NM | NM | NM |
| Days > 0.05 ppm[2] | NM | NM | NM |
| Particulates ($PM_{10}$) | | | |
| Highest 24 hour | 100 | 116 | 87 |
| Days > 150 $\mu g/m^3$ [1] | 0 | 0 | 0 |
| Days > 50 $\mu g/m^3$ [2] | 24 | 24 | 16 |
| AAM[1] | 45.2 | 45.9 | 40.6 |
| Year > 50 $\mu g/m^3$ | No | No | No |
| AGM[2] | 39.3 | 40.8 | 35.7 |
| Year > 30 $\mu g/m^3$ | Yes | Yes | Yes |

ppm - parts per million; $\mu G/m^3$ - micrograms per cubic meter
NM - Not measured at this station
AAM - Annual Arithmetic Mean
AGM - Annual Geometric Mean

[1] Federal Standard
[2] State Standard

Source: SCAQMD Annual Monitoring Reports, 1996-1998

The six criteria pollutants are ozone ($O_3$), carbon monoxide (CO), particulates less than ten microns ($PM_{10}$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), and lead (Pb). The primary standards for these pollutants are shown in Table 4.6-3; the health effects resultant from exposure to these pollutants are shown in Table 4.6-4. In July 1997, the EPA adopted a new NAAQS for particulates less than 2.5 microns (PM2.5).

Data collected at permanent monitoring stations are used by the EPA to classify regions as "attainment" if the primary NAAQS have been achieved, or "non-attainment" if not. The Basin is currently classified as a non-attainment area for four criteria pollutants. The Basin air quality status is listed as "extreme" for ozone, "serious" for CO, and "non-attainment" for $PM_{10}$. Concentrations of $SO_2$ and Pb are classified as "attainment." The Basin attainment status for PM2.5 has not been determined.

A 5-year deadline for NAAQS attainment was set by the CAA; however, the attainment date was subsequently revised by the CAA Amendments, which also required the states to identify non-attainment subareas within their borders and to develop an EPA approved State Implementation Plan (SIP), demonstrating attainment of all NAAQS by 1982. In a later EPA mandate, that attainment deadline was extended to 1987. The 1990 CAA Amendments specify new strategies for attaining NAAQS nationwide over the next 20 years, including mandatory 3 percent annual reductions of air pollutant emissions for both existing and new stationary sources, the scheduled introduction of low emitting cars and trucks into the nation's motor vehicle fleet, and the development of mass transit or higher occupancy vehicle alternatives to the single passenger automobile. The CAA Amendments designated the Basin as: "extreme" for ozone, requiring attainment with the federal ozone standard by 2010; "serious" for CO, requiring attainment of federal CO standards by 2000; and "serious" for $PM_{10}$ requiring attainment with federal standards by 2001.

The EPA has designated the SCAG as the Metropolitan Planning Organization responsible for ensuring compliance with the requirements of the CAA.

State Regulations/Standards

The State of California began to set California ambient air quality standards (CAAQS) in 1969 under the mandate of the Mulford-Carrell Act. The CAAQS are generally more stringent than the NAAQS. In addition to the six criteria pollutants covered by the NAAQS, there are CAAQS standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. These standards are listed in Table 4.6-3.

## Table 4.6-3
## AMBIENT AIR QUALITY STANDARDS

| Pollutant | Average Time | State Concentration | Federal Primary | Federal Secondary |
|---|---|---|---|---|
| Ozone | 1 Hour | 0.09 ppm (180 µg/m$^3$) | 0.12 ppm (235 µg/m$^3$) | Same as Primary Std. |
| Nitrogen Dioxide | Annual Average | – | 0.053 ppm (100 µg/m$^3$) | |
| | 1 Hour | 0.25 ppm (470 µg/m$^3$) | – | Same as Primary Std. |
| Carbon Monoxide | 8 Hour | 9 ppm (10 mg/m$^3$) | 9 ppm (10 mg/m$^3$) | |
| | 1 Hour | 20 ppm (23 mg/m$^3$) | 35 ppm (40 mg/m$^3$) | |
| PM10 | Annual Geometric Mean | 30 µg/m$^3$ | – | |
| | 24 Hour | 50 µg/m$^3$ | 150 µg/m$^3$ | Same as Primary Std. |
| | Annual Arithmetic Mean | – | 50 µg/m$^3$ | |
| Sulfur Dioxide | Annual Average | – | 80 µg/m$^3$ (0.03 ppm) | – |
| | 24 Hour | 0.04 ppm (105 µg/m$^3$) | 365 µg/m$^3$ (0.14 ppm) | – |
| | 3 Hour | – | – | 1300 µg/m$^3$ (0.5 ppm) |
| | 1 Hour | 0.25 ppm (655 µg/m$^3$) | – | – |
| Lead | 30-Day Average | 1.5 µg/m$^3$ | – | – |
| | Calendar Quarter | – | 1.5 µg/m$^3$ | Same as Primary Std. |
| Sulfates | 24 Hour | 24 µg/m$^3$ | – | – |
| Hydrogen Sulfide | 1 Hour | 0.03 ppm (42 µg/m$^3$) | – | – |
| Vinyl Chloride (chloroethene) | 24 Hour | 0.010 ppm (26 µg/m$^3$) | – | – |
| Visibility Reducing Particles | 8 Hour (10 am to 6 pm, PST) | ** | – | – |

** In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent. Measurement in accordance with ARB Method V.

## Table 4.6-4
## HEALTH EFFECTS SUMMARY FOR AIR POLLUTANTS

| Pollutants | Sources | Primary Effects |
|---|---|---|
| Ozone | Atmospheric reaction of organic gases with nitrogen oxides in sunlight. | Aggravation of respiratory and cardio-vascular diseases. Irrigation of eyes. Impairment of cardiopulmonary function. Plant leaf injury. |
| Nitrogen Dioxide | Motor vehicle exhaust. High temperature. Stationary combustion. Atmospheric reactions. | Aggravation of respiratory illness. Reduced visibility. Reduced plant growth. Formation of acid rain. |
| Carbon Monoxide | Incomplete combustion of fuels and other carbon-containing substances, such as motor vehicle exhaust. Natural events, such as decomposition of organic matter. | Reduced tolerance for exercise. Impair-ment of mental function. Impairment of fetal development. Death at high levels of exposure. Aggravation of some heart disease (angina). |
| PM10 | Stationary combustion of solid fuels. Construction activities. Industrial processes. Atmospheric chemical reactions. | Reduced lung function. Aggravation of the effects of gaseous pollutants. Aggra-vation of respiratory and cardiorespiratory diseases. Increased cough and chest dis-comfort. Soiling. Reduced visibility. |
| Sulfur Dioxide | Combustion of sulfur-containing fossil fuels. Smelting of sulfur-bearing metal ores. Industrial processes. | Aggravation of respiratory diseases (asthma, emphysema). Reduced lung function. Irritation of eyes. Reduced visibility. Plant injury.<br><br>Deterioration of metals, textiles, leather, finishes, coating, etc. |
| Lead | Contaminated soil. | Impairment of blood function and nerve construction. Behavioral and hearing problems in children. |

Source: SCAQMD 1993

Originally, there were no attainment deadlines for the CAAQS. However, the California Clean Air Act (CCAA) of 1988 provided a timeframe and a planning structure to promote their attainment. The CCAA required non-attainment areas in the State to prepare attainment plans, and proposed to classify each such areas on the basis of the submitted plan, as follows: moderate, if CAAQS attainment could not occur before December 31, 1994; serious, if CAAQS attainment could not occur before December 31, 1997; and severe, if CAAQS attainment could not be conclusively demonstrated at all. The attainment plans are required to achieve a minimum 5 percent annual reduction in the emissions of non-attainment pollutants, unless all feasible measures have been

implemented. The Basin is classified as a "severe" non-attainment area for ozone and carbon monoxide. Per SCAQMD's comments, the basin is now considered to be in attainment of both federal and state nitrogen dioxide standards.

Regional Air Quality Planning Framework

The California Air Resources Board (CARB) coordinates and oversees both State and federal air pollution control programs in California. The CARB has divided the State into 15 air basins. Significantly authority for air quality control within them has been given to local Air Pollution Control Districts (APCD) or Air Quality Management District (AQMD), which regulate stationary source emissions and develop local non-attainment plans. CARB has designated all of Los Angeles County south of the San Gabriel Mountains, Orange County, and the non-desert portions of Riverside and San Bernardino counties as the Basin under the jurisdiction of the SCAQMD. SCAQMD is responsible for regulatory stationary source emissions, and has been given the authority to regulate mobile emissions as an indirect source. The SCAQMD and SCAG jointly conduct air quality planning in the Basin. The CARB regulates motor vehicles and fuels.

Regional Air Quality Management Plan

Compliance with the provisions of the federal CAA and CCAA is the primary focus of the latest AQMP developed by SCAQMD and SCAG. The Plan is revised every 3 years, with the latest version adopted by the SCAQMD in November 1996 and title the 1997 AQMP. The latest AQMP was adopted by the CARB in February 1997, and was included in the SIP and send to the EPA for its review and approval.

According to the 1997 AQMP, attainment for all federal health standards is to occur no later than year 2000 for carbon monoxide, the year 2006 for $PM_{10}$ and the year 2010 for ozone. State standards would be attained no later than the year 2000 for carbon monoxide. State standards for ozone and $PM_{10}$ would not be achieved until after the year 2010. Both the federal and State standards for nitrogen dioxide have been met, and the SCAQMD has requested EPA redesignation of the Basin to "attainment" for this criteria pollutant.

The 1997 AQMP includes short-term, intermediate, and long-term control measures, and market based incentive strategies to meet targets for emission reduction. The short-term measures identified specific control measures under existing technology. The control measures consist mainly of stationary source controls that will be the subject of the SCAQMD rule making, CARB adopted motor vehicle emissions standards and fuel specifications, and federally adopted programs to reduce emissions from sources under federal jurisdiction. Intermediate term measures are composed primarily of the extension, or more stringent application, of short-term control measures. Long-term measures depend on substantial technological advancements and breakthroughs that are expected to occur throughout the next two decades.

Control measures focus on adoption of new regulations or enhancement of existing regulations for stationary sources, implementation/facilitation of advanced transportation technologies (i.e., telecommunication, zero emission and alternative fuel vehicles and infrastructure and both capital and non-capital based transportation improvements). Capital based improvements consist of high occupancy vehicle (HOV) lanes, transit improvements, traffic flow improvements, park and ride and intermodal facilities, and urban freeway, bicycle and pedestrian facilities. Non-capital based improvements consist of rideshare matching and Congestion Management Plan (CMP) based transportation demand management activities.

One type of transportation measure eliminated from the 1997 AQMP was indirect source controls, which would regulate local land use decisions, particularly medium to large-scale developments. These measures were found too expensive to implement without producing cost-effective emissions reductions. Rule 2202, the replacement for Regulation XV - Ridesharing, remains in effect to ensure that emissions reduction levels originally forecast with implementation of Regulation XV and other indirect source control strategies are achieved. This removal reflects a growing understanding that command and control measures tied to local land use decisions do not effectively alter travel behavior.

Air Toxics

Toxic air contaminants (TACs) are airborne substances that are capable of causing short-term or long-term adverse human health effects. TACs include both organic and inorganic chemical substances. TACs may be emitted from a variety of common sources, including gasoline stations, automobiles, dry cleaners, industrial operations, and painting operations. Research and teaching facilities where a variety of chemicals are used for various experiments may also be a source of TACs.

The 1990 federal CAA Amendments expanded the regulation of hazardous air pollutants (HAPs; the federal government terminology for TACs), establishing a list of 172 individual compounds and 17 compounds categories to be regulated as HAPs. The federal CAA required the EPA to establish a stringent, technology based emissions standard for stationary sources of emissions of these listed substances. The Act also required the EPA to list "major" and "area" source categories that the EPA finds sufficiently threatening to human health or the environment by November 1993, to establish emissions standards for at least 40 stationary source categories by November 1994, and to establish standards for all regulated sources by November 2002.

"Major sources" are defined as any stationary source that emits at least 10 tons per year (tpy) of any HAP or 25 tons per year of any combination of HAPs. "Area sources" are stationary sources encompassing small diverse facilities that routinely release small amounts of HAPs. By November 1997, the EPA must list sufficient categories and subcategories of area sources to ensure that 90 percent of the emissions of the 30 HAPs presenting the greatest threat to the public health in the largest number of urban areas are subject to regulation.

In the state of California, the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB2588) requires specified facilities to submit to the local air pollution control agency, in this case, the SCAQMD, a comprehensive plan to inventory air toxics emissions for all substances listed pursuant to the Act. After the inventory preparation plan is approved, the facility must implement the plan and submit the resulting air toxics emission inventory to the District. After the District receives the completed emission inventories subject to the Act, it is then required to identify high priority facilities for which health risk assessments must be prepared to estimate the potential health risk associated with TAC emissions.

Assembly Bill 1807 (Tanner Bill) set up a statewide process to determine the need for methods to set standards for toxic air contaminants. The process includes identification of toxic air contaminants, determination of emissions and ambient levels of the identified compounds, preparation of regulatory needs documents, and establishment of minimum statewide emission control standards by the Air Resources Board (ARB).

The ARB has identified several chemicals as TACs under the Tanner Bill, including asbestos, benzene, cadmium, carbon tetrachloride, chlorinated dioxins and dibensofurans (15 species), chromium (VI), ethylene dibromide, ethylene oxide and methylene chloride as toxic air contaminants. The ARB has not developed statewide ambient air quality standards for any of these toxic chemicals.

Table 10-2 of the CEQA Handbook identifies air toxics that are subject to regulations. The uses identified that utilize air toxics do not include water treatment or production facilities as potential sources of air toxics.

The SCAQMD regulates levels of air toxics through a permitting process that covers both construction and operation. Both new and existing industries routinely use materials classified as air toxics. For both new and modified sources, the SCAQMD has adopted Rule 1401, with which the project proponent must comply before the project can be constructed and put into operation. A permit, when issued, will allow the facility to operate and will specify the conditions, if any, that might limit its operation.

Rule 1401 pertains to new source review of carcinogenic air contaminates. Rule 1401 specifies limits for maximum individual cancer risks resulting from permit units which emit carcinogenic air contaminants. It imposes Best Available Control Technology for Toxics (T-BACT) requirements based on allowable risk. It should be noted that the cumulative analysis requirement in Rule 14-1 has been eliminated. Cumulative or facility wide inventory requirements are considered to be included in AQMD Rule 1402, per SCAQMD's comments on the DEIR.

The cumulative impacts from the new units plus all permitted units within a 100-meter radius operated by the applicant must be modeled. This cumulative risk must not result in:

- A maximum individual excess cancer risk greater than one in one million ($1x10^{-6}$), if the unit is constructed without T-BACT;
- A maximum individual excess cancer risk greater than ten in one million ($1x10^{-5}$), if the unit is constructed with T-BACT; or
- Greater than 0. 5 excess cancers in the population subject to a risk greater than one in one million.

In addition to the air toxics, the SCAQMD controls the emissions of reactive organic gases (ROGs), and odors through regulations and the permitting process.

***Regulation II***

Identifies the information required of applicants seeking a Permit to Construct for air pollution sources and requires submission of information before an application can be considered. Specific rules that maybe applicable to the OBMP include: (1) Rule 201 - Permit to Construct, (2) Rule 204 - Permit Conditions, (3) Rule 212 - Standard for Approving Permits, and (4) Rule 217 - Provisions for Sampling and Testing Facilities.

Regulation II also contains a "List of Criteria Identifying Information Required of Applicants Seeking a Permit to Construct." Include in this list are a concentration impact analysis, a health risk assessment, a Best Available Control Technology (BACT) evaluation, and source test data. The type of information and level of detail required will vary depending on the scope of the project, predicted emissions, and potential health effects.

***Regulation IV***

Operation of existing equipment is governed by Regulation IV. All visible emissions are regulated by rules in Regulation IV. Odors are regulated by Rule 402, "Public Nuisance."

***Regulation XI***

Addresses source-specific standards. Specific rules that maybe applicable to OBMP facilities under this regulations include: (1) Rule 1110.2 - Emissions from Stationary Internal Combustion Engines, and (2) Rule 1146.1 - Emission of Oxides of Nitrogen from Small Industrial, Institutional and Commercial Boilers, Steam Generators and Process Heaters.

***Regulation XIII***

Addresses new source review. This regulation sets forth preconstruction review requirements to ensure that operation of new or modified facilities does not interfere with progress toward attainment of the national ambient air quality standards, and that future economic growth within the SCAQMD is not unnecessarily restricted.

A key impact of Regulation XIII is the required application of BACT and use of emission offsets. BACT must be employed for any permit which results in a net emission increase of any non-

attainment air contaminant, any halogenated hydrocarbon or ammonia. Air contaminants of concern include carbon monoxide, sulfur dioxide, nitrogen oxides, particulate matter, lead compounds, and ROGs. BACT is determined by SCAQMD based either on published guidelines or on a case-by-case basis.

The SCAQMD which has jurisdiction over air quality issues in the SCAB has determined that compliance with the terms and conditions of its applicable permits and regulations is adequate mitigation for potential project-related impacts to air quality. No further mitigation is required.

The EPA rejected the ozone attainment portion of the 1997 SIP for the Basin in January 1999. The SCAQMD will incorporate the required changes in its 2000 AQMD for inclusion in the 2000 SIP.

#### 4.6.2.3 Air Quality Planning Conformity

The issue of air quality conformity or consistency with the regional air quality planning process is determined by comparing the proposed project with the regional growth forecasts contained in these documents. The SCAQMD AQMP has concluded that regional air quality for the SCAB can meet NAAQS by the year 2010 with reasonable growth if all of the measures identified in the AQMP to reduce pollutant emissions are implemented. Part of the overall air quality planning effort has been the compilation of a RCPG 1996 by the SCAG. For planning purposes, the AQMP assumes that if future growth in the region is consistent with the forecasts contained in the RCPG, the measures identified in the AQMP will be sufficient to reduce emissions in the SCAB to the point that ambient air pollutants concentrations will not exceed the federal NAAQS by the year 2010. The AQMP indicates that there still maybe violations of the California AAQS for ozone in the year 2010, but the region will be near compliance for these standards.

Given this assumption, the key to determining consistency with the AQMP and RCPG is to evaluate the project's contribution to growth projections by ascertaining whether the project is being implemented consistent with applicable General Plan and whether growth forecasts for the region are meeting or exceeding the forecast contained within the RCPG.

This project does not propose to alter existing land use designations or increase development densities allowed by applicable general plans.

### 4.6.3 Air Quality Impact Analysis

This section assesses potentially significant environmental impacts to air quality resulting from the proposed OBMP. Section 4.6.3.2 assesses project impacts to air quality from construction emission sources. Section 4.6.3.3 assesses project impacts to air quality from operational emission sources. These two sections include comparisons to significance criteria outlined in Section 4.6.3.1. This assessment is based on data for the proposed project outlined in the OBMP.

### 4.6.3.1 Criteria for Determining Significant Impact

Thresholds for Construction Emissions

Specific criteria for determining whether the potential air quality impacts of a project are significant are set forth in the SCAQMD's CEQA Air Quality Handbook. The criteria include emission thresholds, compliance with State and federal air quality standards, and conformity with the existing SIP or consistency with the current AQMP.

The following CEQA significance thresholds for construction emissions have been established by the SCAQMD:

- 24.75 tons per quarter or 550 pounds per day of CO
- 2.5 tons per quarter or 75 pounds per day of ROC
- 2.5 tons per quarter or 100 pounds per day of $NO_X$
- 6.75 tons per quarter or 150 pounds per day of $SO_X$
- 6.75 tons per quarter or 150 pounds per day of $PM_{10}$

Thresholds for Operational Emissions

The daily operational emissions "significance" thresholds are as follows:

*Regional Emissions Thresholds*

- 550 pounds per day of CO
- 55 pounds per day of ROC
- 55 pounds per day of $NO_X$
- 150 pounds per day of $SO_X$
- 150 pounds per day of $PM_{10}$

Projects in the SCAB with operation-related emissions that exceed any of the emission thresholds are considered significant by the SCAQMD.

*Location Emission Standards*

- California State 1-hour CO standard of 20.0 ppm
- California State 8-hour CO standard of 9.0 ppm

The significance of localized project impacts depends on whether ambient CO levels in the vicinity of the project are above or below State and federal CO standards. If ambient levels are below the standards, a project is considered to have significant impacts if project emissions result in an exceedance of one or more of these standards. If ambient levels already exceed a State or Federal

standard, project emissions are considered significant if they increase one hour CO concentrations by 1.0 ppm or more, or eight hour CO concentrations by 0.45 ppm or more.

Facilities with emissions of TACs are considered significant if a health risk assessment shows an increased risk of greater than ten in one million.

The potential air quality impacts of the proposed project were assessed using guidelines and data developed by the SCAQMD CEQA Air Quality Handbook.

### 4.6.3.2 Construction Emissions

Implementation of the OBMP will result in the installation of pipelines, new wells, pump station, desalter units, storage facilities, and water treatment facilities. The plan envisions utilizing existing water percolation basins that will be connected to the system by new pipelines. It is projected that all the new pipelines and desalter units, except the West Desalter, will be installed during the first 5 years of the project. This is an aggressive schedule, but also provides for a worse-case evaluation of air quality impacts. The SCAQMD construction thresholds are based on quarterly and daily emissions from a project. Because construction schedules are not available at this time, the annual emissions will be circulated and converted to quarterly emissions.

Pipelines Construction

Based on data provided in Table 4.2-3, it is projected this project will result in about 35,380 lineal feet (LF) of new pipeline being installed in the first 5 years. Assuming that pipe installation will occur evenly over the 5-year period, it is forecast that approximately 7,100 feet of pipeline will be installed annually. It is also projected that an additional 32,000 LF of pipeline will be installed as part of the East Desalter facility resulting in the potential for 39,100 LF in pipe to be installed in a given year. Generally the installation of underground pipelines in roadways is slower than installation in undeveloped areas due to the presence of existing underground utilities. Typically about 300 LF of pipe can be installed per day. Based on these projections, it is forecast that installation of the pipe will require the following pieces of equipment.

Developed Areas
Backhoe
Service Truck
Front Loader
Asphalt Roller
Water Truck

It is forecast that most of the pipe will be 12 and 16-inch diameter pipe. Trucks delivering the pipe and appurtenant equipment can carry an average of about 900 feet of 12 and 16-inch pipe per load and installation of approximately 39,100 LF of pipe will require about 43 truck deliveries per year. It is anticipated that the majority of the pipe and equipment will come from the Fontana, Ontario, Mira

Loma area by way of the freeways. Such deliveries will result in roundtrips that average about 40 miles at an average speed of about 40 mph.

It is also projected that installation of the pipelines will require about 10 workers at any given time. This will result in 10 passenger vehicle trips that average about 30 miles roundtrip at an average speed of 35 mph. It is also projected that all of the 39,100 LF of pipeline will be installed in existing paved roads. This will result in trucks delivering asphalt and base material to repair the pipe trenches. At the projected pipe installation rate of 300 feet per day, it is forecast that one truck per day for each base and asphalt will be needed. This equates to a total of 260 roundtrips per year (130 days x 2 trucks/day) to deliver these materials. It is forecast these trucks will travel about 30 miles roundtrip at an average speed of 30 mph.

Based on the above data, it is forecast that installation of the pipelines will result in the following emissions.

Pipe and Materials Delivery

The SCAQMD CEQA Handbook provides tables to calculate emissions from large diesel trucks on a per mile traveled basis. Utilizing CEQA Handbook data for the year 2001, it is forecast that the annual delivery of pipe and materials will result in 1,720 miles being traveled (43 trucks x 40 miles). The average speed of the trucks per trip is projected to be 40 mph. Using Table A9-5-K-6 of the CEQA Handbook, it is forecast that these delivery trips will result in the following emissions:

CO = 25 lbs/year
ROC = 3 lbs/year
NOx = 19 lbs/year
$PM_{10}$ = 2 lbs/year

These emissions are considered worse case because they are based on SCAQMD 2001 (first year of construction) emission projections for vehicles. As newer vehicles are produced, the CEQA Handbook projects that engine emissions will decline to meet clean air standards.

Based on data provided in Table A9-5-K-6, it is projected the asphalt and base delivery vehicles will produce the following emissions based on a projected 7,800 vehicle miles traveled. Once again, these pollutant vehicle rates are based on projected 2001 emission rates for large trucks.

CO = 148 lbs/year
ROC = 19 lbs/year
NOx = 83 lbs/year
$PM_{10}$ = 7 lbs/year

Total annual pipe and materials delivery emissions

2001
CO = 173 lbs/year
ROC = 22 lbs/year
NOx = 102 lbs/year
$PM_{10}$ = 9 lbs/year

Construction Workers Commute (Table A9-5-J-6)

2001
CO = 2 lbs/year
ROC = 0 lbs/year
NOx = 0 lbs/year
$PM_{10}$ = 0 lbs/year

Pipeline Construction Equipment

Based on an average pipe installation rate of 300 feet per day, it is forecast that the annual average pipe installation activities will require 130 eight-hour work days to complete. It should be noted the CEQA Handbook only provides one set of emissions data for large equipment. It does not project vehicle emissions for future years. These data in the CEQA Handbook is considered worse case because it is data generated in 1985 by the Federal EPA and vehicle emissions have and will continue to improve since that time.

Installation of the pipeline and appurtenant equipment will require the operation of a diesel powered diesel backhoe for 130 work days (8 hours) during any given year. Based on data contained in the CEQA Handbook it is calculated the backhoe will generate the following daily emissions:

CO = 5.4 lbs/day
ROC = 1.2 lbs/day
NOx = 13.6 lbs/day
SOx = 1.1 lbs/day
$PM_{10}$ = 1.1 lbs/day

Based on normal construction methods, it is projected that the other construction equipment (all diesel powered) will be utilized in the following manner.

Front Loader - 8 hours/day for 130 days
Roller - 5 hours/day for 130 days

Based on the above and data in the CEQA Handbook, the following annual emissions are projected:

| Front Loader | | | Roller | | |
|---|---|---|---|---|---|
| CO | = | 269 lbs/year | CO | = | 195 lbs/day |
| ROC | = | 94 lbs/year | ROC | = | 42 lbs/day |
| NOx | = | 923 lbs/year | NOx | = | 566 lbs/day |
| SOx | = | 90 lbs/year | SOx | = | 44 lbs/day |
| $PM_{10}$ | = | 77 lbs/year | $PM_{10}$ | = | 33 lbs/year |

The two trucks to be utilized in developed areas will travel about one mile per day for 130 days. These vehicles will generate the following 2001 emissions:

CO = 24 lbs/year
ROC = 4 lbs/year
NOx = 8 lbs/year
$PM_{10}$ = 1 lbs/year

Fugitive Emission During Pipeline Construction

Based on the above calculations, implementation of the pipe installation activities will result in the following pipeline construction vehicle emissions for the worst case year 2001.

CO = 1,690 lbs/year
ROC = 464 lbs/year
NOx = 4,418 lbs/year
SOx = 383 lbs/year
$PM_{10}$ = 368 lbs/year
Fugitive $PM_{10}$ = 643 lbs/year

Construction activities can generate significant volumes of particulate matter (dust) from the disturbance of soil material. Such dust is generally chemically inert and of a large enough diameter to be readily filtered by the human breathing system. Due to their large size and weight most of the dust particles settle out of the air soon after they are generated. Particulates with the respirable range of ten microns or less in diameter ($PM_{10}$) comprise 20 to 40 percent of dust near a construction site (CEQA Handbook). Implementation of the OBMP could result in the generation of $PM_{10}$ from pipe trench excavations, the storage of backfill material and the movement of equipment. Based on available information and data in the CEQA Handbook, the following annual fugitive emissions are forecast to be generated.

Trenching

Based on data provided in the CEQA Handbook, the excavation of 39,100 LF of pipe trench is forecast to generate the following.

Dirt Storage Piles

It is assumed that excavated soil will be stored adjacent to the trench in piles that are about 6 feet wide. The 39,100 feet of trench excavated within a maximum year will create storage piles that total about 5 acres in size. Based on data contained in the CEQA Handbook, the following $PM_{10}$ generation is forecast to occur.

Fugitive $PM_{10}$ = 123 lbs/year

Construction in developed areas will require the use of a service truck and a water truck. These vehicles will generally travel about one mile daily on paved surfaces for 130 days a year. This will result in the $PM_{10}$ generation:

Fugitive $PM_{10}$ = 52 lbs/year

Based on the above, it is forecast that installation of the pipelines will generate the following annual fugitive $PM_{10}$ emissions:

Fugitive $PM_{10}$ = 643 lbs/year

Well Development

Well Drilling Equipment Delivery

Based on data provided in the OBMP, is projected that about 30 new wells could be installed in the first 10 years. It is forecast that a maximum of 5 wells will be developed in any given year.

Development of five new wells during a given year will require the delivery and set up of the drilling rig. It is anticipated these wells will be drilled at different times and the drilling equipment transported to and from the sites on separate occasions.

For the purposes of this evaluation, it is forecast that delivery of the drilling equipment five times will result in five 50 miles roundtrips at an average speed of 30 mph. Using data contained in Table A9-5-K-6 of the CEQA Handbook, the following emissions are forecast to occur.

CO = 5 lbs/year
ROC = 1 lbs/year

NOx = 3 lbs/year
$PM_{10}$ = negligible

Well Drilling

It is forecast the drilling of five wells to an average depth of 850 feet each will require a total of 440 hours with drilling being ongoing 24 hours per day. Using CEQA Handbook data, it is forecast these activities will generate the following emissions:

CO = 290 lbs/year
ROC = 65 lbs/year
NOx = 748 lbs/year
SOx = 63 lbs/year
$PM_{10}$ = 63 lbs/year

Well Test Pumping

It is anticipated that test pumping each well will take about 8 hours/day for about 5 days each (total 25 days). These activities will result in the following emissions:

CO = 135 lbs/year
ROC = 30 lbs/year
NOx = 340 136 lbs/year
SOx = 28 lbs/year
$PM_{10}$ = 28 lbs/year

Equipment Delivery

Delivery of the well casings, pumps, motors, etc. is forecast to result in about 1,000 miles being traveled by trucks averaging about 45 mph. These delivery trips will result in the following emissions.

CO = 20 lbs/year
ROC = 3 lbs/year
NOx = 13 lbs/year
$PM_{10}$ = 2 lbs/day

Finish Well

Lining, packing and development of the five wells are forecast to generate the following emissions:

CO = 135 lbs/year

ROC = 30 lbs/year
NOx = 340 lbs/year
SOx = 28 lbs/year
$PM_{10}$ = 28 lbs/year

Fugitive emissions from well construction due to the small area of the well sites (less than one-half acre square feet) and the short period of site preparation, it is projected that site development will generate the following:

$PM_{10}$ = 62 lbs/year

Total Production Well Development Emissions

CO = 593 lbs/year
ROC = 128 lbs/year
NOx = 1444 lbs/year
SOx = 119 lbs/year
$PM_{10}$ = 121 lbs/year
Fugitive $PM_{10}$ = 62 lbs/year

Monitoring Wells

According to the OBMP, about 50 monitoring wells may be installed to monitor groundwater quality in the future. Typically these are drilled to shallower depths than water production wells do not require test pumping and thus require less development time and materials to construct. It is forecast that development of the monitoring wells could result in air emissions in a given year that are one half the emissions associated with production well development.

Total Emissions from Production and Monitoring Well Development:

CO = 687 lbs/year
ROC = 147 lbs/year
NOx = 1,651 lbs/year
SOx = 136 lbs/year
$PM_{10}$ = 327 lbs/year

Reservoir Construction

The OBMP envisions the potential need for reservoirs. Development of a reservoir site will require site preparation (clearing, grading, etc.) on about two acre of land. The sites will take about a total of 3 days to complete. It is anticipated the site preparation will require the use of a small dozer, a front loader and a water truck. It is projected that reservoir materials and equipment delivery will require

about thirty 50 mile roundtrips by truck at 40 mph. As with the pipe deliveries, it is anticipated the materials will be delivered using freeways and take about 4 days.

Construction of the reservoir will take about 10 workers for about 30 days each. It is anticipated these workers will come from the local work force and travel to the site in private vehicles. It is projected these commute trips will average about a 40 miles roundtrip primarily on local streets. Once constructed, the reservoir will be coated to prevent corrosion.

Vehicle Emissions from Site Preparation

CO = 0.8 lbs/day
ROC = negligible
NOx = negligible
$PM_{10}$ = negligible
Fugitive $PM_{10}$ = 49.3 lbs/day

Vehicle Emissions from Materials Delivery

CO = 5.5 lbs/day
ROC = 0.8 lbs/day
NOx = 0.8 lbs/day
$PM_{10}$ = negligible

Workers Commute

CO = 2.1 lbs/day
ROC = 0.1 lbs/day
NOx = 2.5 lbs/day
$PM_{10}$ = 0.8 lbs/day

Emissions From Coating Reservoirs 6 mils thick.

Typically, the exteriors of reservoirs are coated with a primer and enamel coats to prevent corrosion and for aesthetic purposes. Presently, low volatile reactive organic compound (VOC or ROC) coatings are available. Based on manufacturer emission data for such coatings it is forecast that a 5 million gallon tank coated to a 6 mil thickness will generate the following ROC emissions:

ROC = 317 lbs/year

Total Reservoir Construction Emissions

CO = 112 lbs/year
ROC = 331 lbs/year
NOx = 20 lbs/year
$PM_{10}$ = 10 lbs/year
Fugitive $PM_{10}$ = 221 lbs/year

Identified Construction-Related Emissions Without Mitigation:

Based on the activities identified above, it is projected that implementation of the OBMP will generate the following unmitigated annual emissions. These emissions are compared to the SCAQMD's threshold of significance for evaluating this projects potential impacts to air quality.

Annual Construction Emissions

CO = 2,489 lbs/year or 1.2 tpy
ROC = 882 lbs/year or 0.4 tpy
NOx = 6,067 lbs/year or 3.0 tpy
SOx = 219 lbs/year of 0.1 tpy
$PM_{10}$ = 1,569 lbs/year or 0.8 tpy

It is not possible to predict construction schedules at this time, but it should be anticipated that the construction activities identified will occur somewhat equally throughout a given year. This will result in the annual emissions being spreadout over all four quarter years and result in the following quarterly unmitigated emissions:

| Quarterly Construction Emissions | | | SCAQMD Thresholds |
|---|---|---|---|
| CO | = | 0.3 tons/quarter | 24.75 tons per quarter or 550 lbs/day |
| ROC | = | 0.1 tons/quarter | 2.5 tons per quarter or 75 lbs/day |
| NOx | = | 0.8 tons/quarter | 2.5 tons per quarter or 100 lbs/day |
| SOx | = | >0.1 tons/quarter | 6.75 tons per quarter or 150 lbs/day |
| $PM_{10}$ | = | 0.2 tons/quarter | 6.75 tons per quarter or 150 lbs/day |

As can be seen, the projected construction related annual impacts are forecast to be well below the SCAQMD's quarterly thresholds of significance for all criteria pollutants without mitigation. At this time, there is inadequate data to forecast potential daily emissions.

These emissions forecasts are based on an aggressive schedule of development. If development should occur at a lesser intensity, construction-related emissions would be reduced.

#### 4.6.3.3 Other Construction Emissions

The OBMP identifies the construction of such other facilities as desalter units, pump stations, expansion of water treatment plants, and a recycled water distribution system. Neither the size (other than numbers of acres) or timing of construction of these facilities are known. It is not anticipated, however, that more than one of the major facilities will be constructed in a given year. It is anticipated that no more than 50 acres of land will be under development. Table 6-3 of the CEQA Handbook provides screening data for projects to assist lead agencies in determining a project's potential to generate significant construction-related air quality impacts. Table 6-3 identifies projects that result in less than 177 acres in a quarter year as potentially having non-significant construction-related air quality impacts. Table 6-3 also identifies projects that contain less than 559,000 square feet of gross floor area as also having the potential to result in less than significant construction-related air quality impacts.

Based on data identified in Table 6-3, it is projected that construction of the other facilities may not result in significant construction-related impacts. As previously stated, however, the number and size of OBMP projects constructed within a given year will affect the potential for significant adverse construction-related impacts to result.

#### 4.6.3.4 Operations Emissions

The only potentially significant operations emissions associated with the project will be the consumption of electrical energy by motors at wells, desalters, pump stations, etc.

Wells

As previously stated, it is anticipated that up to 30 new wells could be constructed by implementation of the OBMP. While not presently sized, it is anticipated these wells will be equipped with 500 Bhp electrical motors and thus generate about 15,000 horsepower. Under a likely operations condition with one-half the wells operating 24 hours per day, these motors would consume 180,000 horsepower hours per day. One horsepower hour is equivalent to 0.7457 kilowatt. This converts to about 134 megawatt hours. The CEQA Handbook contains emission factors for criteria pollutants from electricity consumption (Table A9-11-B) and based on these factors, the following emissions would occur on a maximum water pumping day.

| | | |
|---|---|---|
| CO | = | 26.8 lbs/day |
| ROC | = | 1.4 lbs/day |
| NOx | = | 104.1 lbs/day |
| SOx | = | 16.1 lbs/day |
| $PM_{10}$ | = | 5.3 lbs/day |

All of these emissions are below the SCAQMD's threshold of significance for criteria pollutants except NOx which exceeds the threshold of 55 lbs/day.

Further review conducted in response to comments received by SCAG and verbal comments from Dave Argo and new information provided in the *Revised Draft Water Supply Plan Phase I Desalting Project Facilities Report* indicates that NOx emissions may, in fact, be less than that quantity identified above. The desalter pumps were originally sized at 500Bhp, however, personal communication between Dave Argo of Black and Veatch and Tami Fincher of Tom Dodson and Associates on June 29, 2000 indicates that no more than 150 horsepower per desalter well pump should be necessary. This would reduce NOx emissions to approximately 31.2 lbs/day. However, several additional factors should be considered. Two booster pump stations utilizing 142 and 347 Bhp motors will be necessary for the desalter water distribution system. The NOx emissions from these motors remains within the scope of what was previously analyzed for the well pumps sized at 500 Bhp minus the 31.2 lbs/day of NOx resulting from the thirty desalter well pumps resized at 150 Bhp each, so impacts remain within the range originally forecast. In the future, a conjunctive use program may utilize existing wells for extraction of stored water. The pumps for these wells will remain less than 500 Bhp in size and will not contribute to the cumulative exceedance of the 104.1 lbs/day NOx value that was analyzed in under the original project description, or else a new environmental document must be prepared. It should still be noted that when emissions are totaled for the sum of all pumping for desalters, conjunctive use and/or distribution are totaled, the total still exceeds 55 lbs/day. Therefore, impacts are considered to be significant.

It should be noted that these emissions are associated with buildout of the OBMP. Until about one-half or 15 wells are on line, operations impacts of the wells will be below significance thresholds.

Desalter Units

Data provided in the OBMP indication that operation of the East and West Desalters could ultimately consume about 30,057,967 kilowatt hours of electricity annual. This converts to about 82.3 megawatt hours. Based on data contained on Table A9-11-13, the following emissions are forecast to result.

| | | |
|---|---|---|
| CO | = | 16.5 lbs/day |
| ROC | = | 0.8 lbs/day |
| NOx | = | 94.6 lbs/day |
| SOx | = | 9.9 lbs/day |
| $PM_{10}$ | = | 3.3 lbs/day |

Other Operations Emissions

Implementation of the OBMP will result in the use of vehicles to inspect, maintain, and repair the facilities. While it is not possible to predict the number and length of such trips on a daily basis, it is forecast that emissions associated with these activities will be negligible.

| Total Operation Emissions | | | Operations Emissions Thresholds |
|---|---|---|---|
| CO | = | 43.3 lbs/day | 550 lbs/day |
| ROC | = | 2.2 lbs/day | 55 lbs/day |
| NOx | = | 198.6 lbs/day | 55 lbs/day |
| SOx | = | 26.0 lbs/day | 150 lbs/day |
| $PM_{10}$ | = | 8.6 lbs/day | 150 lbs/day |

Operations emissions are all below thresholds for criteria pollutants except NOx which exceeds the significance thresholds. These emissions are considered worst-case because they reflect operation at maximum capacity. This is a highly unlikely condition and actual emissions are expected to be substantially lower.

It should be noted that potentially significant operations emissions are associated with stationary equipment. Such equipment may be subject to permitting by the SCAQMD. Compliance with the terms of the permits is deemed adequate mitigation by the SCAQMD for potential air emission impacts.

Toxic Emissions

Table 10-2 of the CEQA Handbook identifies the type of facilities that are representative of users that could generate toxic contaminants. Water treatment and supply facilities are not listed. Water facilities do utilize chlorine which is identified as a contaminant of concern for acute exposure.

Water facilities do utilize chlorine to disinfect water. The use and storage of chlorine is regulated by state and local rules and regulations. Compliance with these rules and regulation are deemed by regulatory agencies to be adequate to mitigate the potential risk of exposure to acceptable levels.

## 4.6.4 Mitigation Measures

### 4.6.4.1 Construction Impacts

**4.6-1 Water active grading sites at least twice daily and when dust is observed migrating from the site. The project will comply with SCAQMD Rule 403 requirements where applicable. Rule 403 prohibits visible dust emissions beyond the property boundaries.**

**4.6-2 Suspend all grading and excavation operations when wind speeds exceed 25 mph.**

**4.6-3 Apply non-toxic chemical soil stabilizers according to manufacturers specifications to inactive construction areas (previously graded areas inactive for 10 days or more).**

**4.6-4 Replace ground cover or pave disturbed areas immediately after construction is completed in the affected area.**

**4.6-5 Sweep streets once a day and when soil material is observed on traveled roadways.**

### 4.6.4.2 Operation Impacts

Other than compliance with SCAQMD rules, regulations and permit conditions, no further mitigation can be identified.

## 4.6.5 Unavoidable Significant Impact

Operation of the facilities identified in the OBMP have the potential to result in significant adverse air quality impacts. This impact must be classified as a Class I impact, however it should be noted that in the future efforts will be made to minimize impacts, and it may be possible to reduce impacts to less than significant levels. Adverse impacts could result at or near buildout of the OBMP. This would result from operation of all the systems at or near full capacity at the same time. It is possible that staggering the operation of pumps and motors could result in a substantial reduction in energy consumed and emissions generated. These forecasts are also worst case because it is highly likely that all the electricity consumed will not be produced in the SCAB. Further, with the deregulation of utilities services, it may be possible to knowingly purchase electricity produced outside the SCAB. Current rules and regulations are now under review and may be revised to reflect the new utilities production and distribution situation. Since these revisions have not been formally adopted, however, impacts must still be forecast according to a "worst-case" scenario, and impacts must be classified as potentially significant.

## 4.6.6 Cumulative Impact

Implementation of the OBMP will contribute pollutants into the SCAB from construction and operation of the facilities. These facilities are designed to provide an adequate water supply for the land uses and intensities identified in applicable general plans. The AQMD assumes that if growth occurs that is consistent with applicable general plans then, ambient air quality standards can be met. Because this project does not propose amendments to existing general plan land uses, it is in conformity with the AQMD and will not result in significant adverse cumulative air quality impacts.

# 4.7 TRANSPORTATION AND CIRCULATION

## 4.7.1 Introduction

Potential impacts to the transportation and circulation system were included as a topic of evaluation in this PEIR based on the ultimate (buildout) development conditions anticipated by affected jurisdictions the within the OBMP's project area. The NOP and scoping processes did not identify specific concerns relating to potential impacts that might result from the installation of water management facilities throughout the Chino Basin.

This subchapter focuses on the transportation and circulation system in the Chino Basin and the potential impacts to this system of the environment from implementing the OBMP. Four types of circulation systems are evaluated: air transport, non-motorized transport, rail and roads. The evaluations are based upon information contained within general plans and other pertinent transportation planning resources for the project area. General Plans from the following entities were utilized: cities of Chino, Chino Hills, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, and Upland; and the counties of Riverside and San Bernardino. In addition, SCAG and Western Riverside Council of Governments (WRCOG) publications, such as the RCPG, RMP, the Regional Transportation Plan (RTP) and Non-motorized Transportation Plan were consulted. Traffic volume data was provided from the California Department of Transportation relating to California State Highways and San Bernardino Associated Governments (SANBAG) relating to projected traffic volumes.

## 4.7.2 Environmental Setting

### 4.7.2.1 Air Transport System

The Chino Basin Project Area is well served by a number of airport facilities providing service to the cities within the Inland Empire, communities in the High Desert region, Los Angeles County and Orange County. The air transport system is comprised of a commercial air carrier facility, general aviation airports and private airfields. The following is a description of the main airport facilities in the Chino Basin Project Area:

Ontario International Airport serves the growing international air transportation needs of the Inland Empire area. It functions as a major satellite airport to Los Angeles International Airport, providing both passenger and air cargo service.

The Chino Airport is located 4 miles southeast of downtown Chino, at the southeast corner of Euclid Avenue and Merrill Avenue. The facility provides general aviation services for approximately 950 aircraft based there.

Rialto Municipal Airport, located west of Cedar Avenue between Baseline Road and Highland Avenue (SR 30) is also a general aviation airport. It is also designated by the Federal Aviation Administration (FAA) as a reliever airport for Ontario International Airport, relieving the larger facility of some of the general aviation activities which would otherwise locate there.

Cable Airport, located in the northwest portion of the City of Upland, serves the general aviation needs of the Upland community and adjacent cities. It is a privately owned, public use airport, serving customers with light personal and business airplanes.

#### 4.7.2.2 Non-Motorized Transport System

Non-motorized transport encompasses bicycle, equestrian and pedestrian circulation. Within the various affected jurisdictions, bicycle trails are noted as an energy efficient alternative to the automobile to help link the commercial, residential and open space uses within a community. The Project area has various sites, areas and paths which the bicyclist may access. The City of Upland has designated State Routes 83 and 66 as routes for bicycles. The City of Chino has identified numerous trails within their General Plan including: Euclid and Chino Avenues, the Cypress Channel, the Southern California Edison (SCE) easement along Edison Avenue, adjacent to the San Antonio Channel. Other jurisdictions have identified potential trails long the Santa Ana River, Philadelphia, Walnut, Riverside and San Antonio Avenues in the western portion of the Basin Area. Regional connections to specific attractions are encouraged with the general plans. As an example, within the City of Chino, the Chino Fairgrounds and Ruben Ayala Community Park attract recreational cyclists.

According to information from WRCOG, the Northwest APD (cities of Corona, Norco and Riverside) has the most miles and extensive system of existing bicycle facilities in the subregion. There were 56 miles of existing bike paths/lanes in 1995 with an additional 210 miles planned with future developments This APD also contains the most population and greatest population density (2,458 persons/square mile), as well as the second youngest average median age group (29.6 years), in the subregion. The Northwest APD also contains the greatest number and concentration of major activity centers in the subregion, including Reg 15 employer sites (those employers with 100 or more employees). In addition, the Northwest APD is ranked third of the six APDs in the subregion in terms of the percentage of combined journey to work non-motorized mode split (walk+bike) trips; however, in terms of the number of trips, the Northwest APD has the largest number of commuters who bicycle to work. The Northwest APD also has the highest average jobs per household ratio in the subregion at 1.28, compared to 0.85 for the subregion as a whole. The Northwest APD also has the most households with no vehicle available, and the largest teen population in the subregion.

Equestrian and pedestrian circulation primarily consists of multi-purpose trails and sidewalks. The equestrian trails generally share rights-of-way with secondary arterials, utility lines, and flood control channels. The City of Upland's General Plan has identified pedestrian enhancements for a number of primary roadways and facilities including the Cucamonga Wash and the San Antonio Wash. The

City of Norco has provided an extensive system of equestrian paths and trails within their corporate limits. The City of Chino and Chino Hills provide a series of local trails that also provide access to a larger regional system of trails. Numerous local trails serve as equestrian attractions, such as the Chino Fairgrounds, Chino Hills State Park, the Prado Dam area, and the Santa Ana River.

#### 4.7.2.3 Rail System

Extensive rail service is provided within the Chino Basin area serving both passenger and freight services. The Burlington Northern Santa Fe (BNSF) and the Southern Pacific main lines run in an east-west direction north and south of Interstate 10, respectively. The BNSF line carries both freight and passenger traffic including Metrolink and Amtrak services. The Southern Pacific main line runs south of, and parallel to, the I-10 Freeway through the cities of Chino, Fontana, Ontario, Pomona, and Rialto. This line provides freight rail service. The two main line railroads maintain major facilities in the Chino Basin region including a major classification yard in West Colton and rail-truck transload and warehousing facilities in Fontana and Pomona. These railroads connect southern California with other U.S. regions, Mexico and Canada via their connections with other railroads.

#### 4.7.2.4 Road System

The Project Area is served by a number of regional roadways which provide access to Los Angeles, Orange, Riverside and San Bernardino County areas. The primary regional roadway network is comprised of two interstate freeways, the San Bernardino Freeway (I-10), which passes on an east-west alignment through the central portion of the Chino Basin area, and the Ontario Freeway (I-15) oriented north-south through the middle of the Chino Basin. In addition, there are five State Routes (SR) running through the Project Area. The Pomona Freeway (SR 60) passes through the southern portion of the Chino Basin also in an east-west direction and provides access to Riverside County via Los Angeles and San Bernardino Counties. The Corona Expressway (SR 71) connects Riverside County with Orange County through a reach of San Bernardino County and the cities of Chino Hills and Pomona. Highland Avenue (SR 30) and Foothill Boulevard (SR 66) provide circulation within the northern Chino Basin area in an east-west direction through the cities of Fontana, Rancho Cucamonga, Rialto and Upland. Euclid Avenue (SR 83) provides north-south access through the cities of Chino, Ontario and Upland. The State Route 30 freeway (Foothill Freeway) is currently under construction and will provide a new route at the north end of the Basin.

The following is a description of the main regional roadways in the Chino Basin Project Area:

San Bernardino Freeway (I-10) is an eight-lane interstate freeway which currently traverses the Project Area in an east-west direction. The projected year 2020 average daily traffic (ADT) volumes on I-10 range from 85,900 vehicles per day to 134,100 vehicles per day through the Project Area.

Ontario Freeway (I-15) is a six to eight lane interstate freeway bisecting the Project Area connecting Riverside County to San Bernardino County. The projected year 2020 ADT volumes on I-15 range from 89,600 vehicles per day to 122,400 vehicles per day through the Project Area.
Highland Avenue (SR 30) provides circulation within the northern Chino Basin area in an east-west direction through the cities of Fontana, Rancho Cucamonga, Rialto and Upland. It varies in configuration and ultimate right-of-way through the each of the affected cities. The City of Fontana identifies the roadway as a primary highway intended to accommodate four travel lanes with a median. The City of Rancho Cucamonga designates the roadway as a collector. The City of Rialto's General Plan defines SR 30 as a freeway and in its current condition is a two-lane road west of Riverside Avenue and a four-lane divided highway east of Riverside Avenue. The City of Upland categorizes the roadway as a collector and identifies it as Nineteenth Street form Mountain Avenue to east City limits. The projected ADT volume on Highland Avenue ranges from 68,200 vehicles per day near Alder Avenue in the City of Fontana to 80,200 vehicles per day west of Carnelian Street in the City of Rancho Cucamonga in the year 2020.

Pomona Freeway (SR 60) is a six-lane facility which traverses the Project Area in an east-west direction, providing access to Riverside County via Los Angeles and San Bernardino Counties. The projected year 2020 ADT volumes on SR 60 range from 63,700 vehicles per day (east of Pedley Road) to 133,000 vehicles per day (west of the SR 83).

Foothill Boulevard (SR 66) provides an additional circulation route within the northern Chino Basin area in an east-west direction through the cities of Fontana, Rancho Cucamonga, Rialto and Upland. It varies in configuration and ultimate right-of-way through the each of the affected cities. The City of Fontana identifies the roadway as a Major Highway that can accommodate six travel lanes and may have raised medians. Within the City of Rancho Cucamonga, SR 66 is categorized as a major divided arterial. Rialto designates SR 66 as a major arterial consisting of a four-lane facility. The City of Upland categorizes the roadway as a major arterial comprised of four traffic lanes and a frontage road. The projected ADT volume on Foothill Boulevard ranges from 7,300 vehicles per day near Citrus Avenue in the City of Fontana to 21,100 vehicles per day west of Central Avenue in the City of Upland in the year 2020.

Corona Expressway (SR 71) is a six-lane divided freeway located in the western portion of the Chino Basin. The project 2020 ADT volumes on SR 71 range from 13,400 vehicles per day near Pine Avenue in south Chino to 32,300 vehicles per day at the confluence of State Route 60.

Euclid Avenue (SR 83) is a roadway which traverses the Project Area in a north-south direction from the southern portion of the City of Chino through the City of Ontario and up into the northern portion of the City of Upland. Euclid Avenue varies in configuration and ultimate right-of-way through the each of the affected cities. In the City of Chino, Euclid Avenue is designated as an expressway with eight travel lanes under the proposed Master Plan of Arterials. The City of Ontario identifies the roadway as a divided arterial accommodating four to six lanes of traffic with a median. The City of Upland categorizes the roadway as a major arterial and includes a wide landscaped median with six

lanes south of Foothill Boulevard and four traffic lanes north of Foothill Boulevard. The projected ADT volume on Euclid Avenue ranges from 7,200 vehicles per day in then City of Chino to 34,300 vehicles per day north of I-10 in the City of Upland in the year 2020.
Based upon information provided by SANBAG through the Comprehensive Transportation Plan (CTP) funded 2020 Model (Hybrid Model) for the West Valley, the projected volumes for year 2020 are estimated to be 1,751,800 Annual ADT. This is an overall reduction of 22 percent from the 1998 Annual ADT which was 2,243,200 ADT which is attributable to a combination of construction of new roads, greater use of alternative means of transportation including rail and transit and establishing job centers closer to housing centers. Table 4.7-1, *Traffic Volumes on Key Roads* depicts the ADT for Interstates and State Routes within the Chino Basin area.

The forecasting of traffic volumes is necessary for presenting a global picture of traffic flow, evaluating traffic trends, and planning and designing highways. A more localized method to determining traffic flow is based on a Level of Service (LOS) approach. Traffic flow is measured by the number of vehicles that can pass over a given section of road in a given time period, particularly through constrictions, such as intersections with stop signs or traffic signals. The LOS on a roadway varies between LOS "A", unrestricted traffic flow to forced flow conditions with high approach delays. The definitions of LOS for uninterrupted flow (flow unrestrained by the existence of traffic control devices) are:

- LOS "A" representing free flow where individual users are virtually unaffected by the presence of others in the traffic stream.

- LOS "B", in the range of stable flow, but where the presence of other users in the traffic stream begins to be noticeable. Here the freedom to select desired speeds is relatively unaffected but there is a slight decline in the freedom to maneuver.

- LOS "C", in the range of stable flow, but where the operation of individual users becomes significantly affected by intersections with others in the traffic stream.

- LOS "D" representing high-density but stable flow where speed and freedom to maneuver are severely restricted and the driver experiences a generally poor level of comfort and convenience.

- LOS "E" representing operating conditions at or near the capacity level where all speeds are reduced to a low, but relatively uniform value. Small increases in flow will cause breakdowns in traffic movement.

- LOS "F" which defines forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations.

## Table 4.7-1
## TRAFFIC VOLUMES ON KEY ROADS

| Roadway | 1998 Annual ADT | 2020 Projected Annual ADT |
|---|---|---|
| Interstate 10 | | |
| I-10 at San Bernardino County Line | 231,000 | 129,700 |
| I-10 at State Route 83 | 230,000 | 131,000 |
| I-10 at Interstate 15 | 218,000 | 134,100 |
| Interstate 15 | | |
| I-15 at State Route 60 | 172,000 | 113,500 |
| I-15 at Interstate 10 | 175,000 | 114,400 |
| I-15 at State Route 66 | 132,000 | 122,400 |
| State Route 30 | | |
| SR-30 at Upland City Limit | 24,900 | 75,600 |
| SR 30 at State Route 83 | 18,000 | 74,000 |
| SR 30 at Interstate 15 | 12,800 | 74,000 |
| State Route 60 | | |
| SR 60 at San Bernardino County Line | 170,000 | 130,500 |
| SR 60 at State Route 83 | 201,000 | 133,000 |
| SR 60 at Interstate 15 | 186,000 | 126,400 |
| SR 60 at Pedley Road | 86,000 | 66,200 |
| State Route 66 | | |
| SR 66 at San Bernardino County Line | 36,500 | 21,100 |
| SR 66 at State Route 83 | 42,000 | 16,200 |
| SR 66 at Interstate 15 | 47,000 | 20,100 |
| State Route 71 | | |
| SR 71 at State Route 60 | 57,000 | 77,100 |
| SR 71 at Route 142 (Chino Hills Pkwy) | 40,000 | 63,300 |
| SR 71 at State Route 83 | 37,000 | 33,900 |
| State Route 83 | | |
| SR 83 at State Route 71 | 12,500 | 7,400 |
| SR 83 at State Route 60 | 32,000 | 21,900 |
| SR 83 at Interstate 10 | 33,500 | 34,300 |
| SR 83 at State Route 66 | 34,500 | 22,100 |
| SR 83 at State Route 30 | 14,500 | 9,600 |
| TOTAL ADT: | 2,243,200 | 1,751,800 |

Source: 1998 Traffic Volumes on California State Highways, Caltrans, 1998.
CTP Funded 2020 Model (Hybrid Model) West Valley, SCAG, 2000.

The definitions of LOS for interrupted traffic flow (flow restrained by the existence of traffic signals and other traffic control devices) differ slightly depending on the specific element of the roadway being considered, e.g., signalized intersections versus arterial segments. The LOS criteria for signalized intersections are:

- LOS "A" - describes operations with average intersection stopped delay (how long a driver must wait at a signal before the vehicle can begin moving again) of five seconds or less.
- LOS "B" - average stopped delay between 5.1 and 15.0 seconds per vehicle.
- LOS "C" - average stopped delay between 15.1 and 25.0 seconds per vehicle.
- LOS "D" - average stopped delay between 25.1 and 40.0 seconds per vehicle.
- LOS "E" - average stopped delay between 40.1 and 60.0 seconds per vehicle.
- LOS "F" - average stopped delay greater than 60.0 seconds per vehicle.

An intersection is also designated as operating at LOS "F" when the volume/capacity ratio of the critical movements at the intersection is equal to or greater than 1.0.

In 1992, the San Bernardino Associated Governments adopted a Congestion Management Program (CMP) for San Bernardino County. The requirements for the CMP were formulated by the legislature to address a number of transportation concerns relating to a lack of an integrated system and the increases in the number of vehicles causing traffic congestion. SANBAG was required to establish traffic levels of service standards for, at a minimum, all state highways and principal arterials. SANBAG determined that the LOS standard shall be "E" for all roadway links and intersections to the County of Riverside. Local jurisdictions in most cases are more restrictive in their LOS threshold, which for roadways and intersections is a LOS "D".

### 4.7.3 Project Impacts

Transportation impacts of a project are defined in the CEQA Guidelines as causing "an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system." An impact is also considered significant if it results in the violation of existing standards or policies, such as the goal of LOS "C" or "D" contained in the general plans throughout San Bernardino County. Implementation of the OBMP is not anticipated to substantially increase the traffic load or alter the carrying capacity of street systems within the Chino Basin area. The OBMP is a water management program specifically designed to provide a more efficient and effective water supply program through implementation of recycled water use, implementation of storage strategies and conjunctive use of the local groundwater supply in the Chino Basin. None of the physical changes in

the environment are forecast to directly or indirectly cause any permanent changes in any transportation or circulation systems.

Of the four main types of facilities that will be implemented in support of the OBMP, the installation and construction of pipelines and the proposed desalters will generate the potential for short-term, construction impacts to the existing circulation system. Pipelines will be placed underground (except possibly within OBMP facilities) and there will be short-term disruptions of traffic flows and the potential creation of traffic hazards as a result of the construction within road rights-of-way. Mitigation measures are identified to ensure that pipeline construction activities do not create significant adverse impacts related to these conflicts in activities.

The desalters will serve to modestly increase local traffic due to employment. An estimated 100 people may be required to operate all of the proposed facilities and implement the OBMP Program Elements. Large number of people will only be present in-site for short periods of time during construction and maintenance activities.

#### 4.7.3.1 Threshold of Significance

The following criteria will be used as the thresholds of significance in this evaluation of traffic and circulation for the OBMP.

- Substantially increase the traffic flow or reduce the capacity of the street system within the Chino Basin above that identified in regional traffic forecasts and planned for in the local jurisdiction general plans.
- Result in the violation of existing standards or policies.
- Cause a substantial change in the functioning of an existing or future alternative transportation system

#### a. Will the project cause an increase in vehicle trips or traffic congestion?

The OBMP project area is extensively developed with residential, commercial, and industrial uses that already utilize an established circulation pattern. In addition, the existing circulation system experiences certain levels of utilization based on the existing levels of development and the role that certain roads (I-10, I-15 and SR-60) play in regional and interstate travel and commerce. The four main types of facilities that will be implemented in support of the OBMP include recharge basins, desalting facilities, monitoring wells and pipelines. There are no specific development proposals under consideration that would indicate existing or future traffic generation and destination activities will be altered by implementation of the proposed project. Aside from the short-term construction related trips, the proposed project is not forecast to cause any adverse impacts on the project area circulation system as a result of implementing the Program Elements to enhance the safe yield of the

Basin and improve the water quality. An estimated 100 people may be required to operate all of the proposed facilities and implement the OBMP Program Elements. Assuming 10 trips per day per employee family per day in the context of millions of trip ends within the Chino Basin, the proposed project has no potential to cause or contribute to any project specific or cumulative significant traffic impacts.

The General Plans identify a circulation system designed to meet the buildout traffic generation of their respective jurisdictions. Future traffic volume estimates are enumerated in Table 4.7-1. Fundamentally, the ultimate road sections throughout the circulation system are designed to provide adequate capacity for the projected trip generation within the Chino Basin project area. The General Plan EIRs have concluded that their local circulation systems, with planned improvements will be adequate to meet the forecast traffic volumes at build-out without any significant adverse circulations system impacts. Road improvements are constantly being implemented by the cities and the counties under their capital improvement programs, and when an individual OBMP construction project occurs in the future, any existing deficiencies may have been corrected and a project may not be required to provide any mitigation. Future Initial Studies prepared in accordance with the PEIR requirements contained in Section 15168 of the State CEQA Guidelines can document these improvements, which may eliminate the need for mitigation or define the need for additional mitigation. With implementation of project specific road improvements in accordance with local agency general plan requirements, no significant circulation system impacts are forecast to occur in the future.

**b. Will the project cause hazards to safety from design features, such as sharp curves, or dangerous intersections?**

Off of project sites, OBMP pipelines will be placed underground and there will be short-term disruptions of traffic flows and the potential creation of traffic hazards as a result of the construction within road rights-of-way. Mitigation measures are identified to ensure that pipeline construction activities do not create significant adverse impacts related to construction activities. Further, individual projects in the future will undergo review for approval by the IEUA and these reviews will control potential for safety hazards from short-term construction activities.

For long-term operational facilities, a potential exists for a facility, such as a desalter, to create localized traffic hazards, such as ingress and egress from a facility onto a highway with high speed traffic. Mitigation can be implemented, such as acceleration and turn lanes, to ensure that future specific projects can be implemented without causing any significant traffic hazards. A mitigation measures is included below to ensure that no significant local traffic hazards are caused by implementing the OBMP.

**c. Will the project cause inadequate emergency access or inadequate access to nearby uses?**

The proposed project may create short-term detours related to construction activities of OBMP facilities and pipelines. To limit reductions in emergency access, all affected public safety providers shall be notified prior to the construction of OBMP facilities or the closure of a public street. See mitigation under Subchapter 4.10.

### d. Will the project cause insufficient parking capacity onsite or offsite?

Project specific future demand for parking capacity will be identified on a case-by-case basis. Each jurisdiction has established parking capacity requirements that will be implemented as individual projects are reviewed and approved. The OBMP facilities will be constructed in compliance with the municipal codes where the projects will be constructed. No mitigation is necessary because provision of adequate parking onsite will meet the needs of the facilities.

### e. Can the project cause hazards for pedestrians or bicyclists?

During short-term construction projects to install pipelines and construct facilities, the project has a potential to create traffic hazards for pedestrians or bicyclists. However, after completing the proposed pipeline installations, the project impacts to hazards should be positive because existing hazards can be eliminated. Mitigation is proposed below that can reduce potential hazards to a non-significant level of impact. Without implementing these measures, potentially significant hazards could result from project implementation.

### f. Will the project create conflicts with adopted policies supporting alternative transportation, such as bus turnouts and bicycle racks?

Implementation of the OBMP is not envisioned to create conflicts with adopted policies supporting alternative transportation. An estimated 100 people may be required to operate all of the proposed facilities and implement the OBMP Program Elements. These employees will be encouraged to utilize alternative transportation modes as are deemed appropriate for their work conditions. No mitigation is required.

### g. Will the project cause adverse impacts to rail, waterborne or air traffic?

The proposed project has no potential to adversely impact waterborne traffic since such a transportation system does not occur within the Chino Basin project area. The OBMP is not anticipated to conflict with rail or air service to the existing facilities within the project area. There may be short-term detours related to construction that may affect rail service. These detours will be coordinated with the railroad companies prior to construction activities. No other potential impacts to the rail transportation system have been identified from implementing the proposed project.

## 4.7.4 Mitigation Measures

Mitigation measures have been identified in the impact analysis to prevent future development projects from contributing to significant local traffic impacts and to prevent short- and long-term hazards to pedestrian or bicycle traffic. The following measures will be implemented to ensure that future traffic generation does not cause significant impacts to the circulation system and to ensure that traffic hazards are controlled and reduced to a non-significant level of impact.

**4.7-1 For each development project that will increase traffic generation relative to current traffic generation, the IEUA shall prepare a traffic study that identifies the net number of trips, the effect on levels of service to maintain a LOS "E".**

**4.7-2 The IEUA shall require the construction contractor to provide adequate traffic management resources during construction (signing protective devices. flag persons. etc.) to maintain safe traffic flow, particularly emergency access, on local streets at all times.**

**4.7-3 During construction the IEUA shall require traffic hazards for vehicles, bicycles, and pedestrians be adequately identified and such traffic controlled to minimize hazards.**

**4.7-4 The IEUA shall require the contractor to ensure no open trenches or traffic safety hazards be left in roadways during periods of time when construction personnel are not present (nighttime. weekends. etc.).**

**4.7-5 The IEUA shall require all roads be repaired adequately after pipeline installation to ensure that traffic can move in the same manner as before construction without damage to vehicles.**

**4.7-6 Emphasize transportation demand management or non-motorized transportation alternatives for OBMP project related employees, where feasible, to reduce demand for roadway capacity.**

**4.7-7 Future OBMP facility ingress/egress shall be reviewed with the agency having jurisdiction or the roadway providing access, and roadway improvements required to eliminate any traffic hazards associated with access to a facility in accordance with standard agency requirements or prudent circulation system planning requirements.**

These measures ensure that implementation of the OBMP will not cause significant impacts to the circulation system or to street users by creating uncontrolled safety hazards. Based on the proposed project's anticipated activities, the potential circulations system impacts associated with OBMP facilities can be reduced to a non-significant level by implementing the above recommended mitigation measures.

### 4.7.5 Unavoidable Adverse Impact

The traffic and circulation impact discussion presented above indicates that implementation of the OBMP for the Chino Basin area will not cause any significant adverse circulation system impacts. The program will support more efficient and effective water supplies and is, therefore, not forecast to cause any change in the buildout circulation system for the local agency general plans. Therefore, no significant adverse and unavoidable traffic impacts are forecast to occur if the proposed project is implemented.

### 4.7.6 Cumulative Impact

The Chino Basin project area circulation systems have been evaluated as generating trips from existing residences and businesses, as well as serving as a destination for commercial and industrial traffic. The OBMP will not cause traffic generation that will be different from that which is forecast to occur within the general plans for the affected jurisdictions. The addition of up to 100 permanent jobs in support of OBMP activities result in a *de minimus* contribution to an area that is forecast to generate approximately two million trips per day at present and into the future. By facilitating implementation of the general plans through the development activities identified in the Project Description (Chapter 3), implementation of the OBMP will accommodate, but not cause, cumulative traffic growth as is forecast to occur as the affected jurisdictions are buildout.

Therefore, under the current conditions, the proposed project is not forecast to contribute to cumulative significant traffic impacts within the Chino Basin area. As individual development projects are considered in the future, OBMP projects will be required to identify any circulation system effects and provide mitigation, if required. The proposed project does not have the potential to contribute to the generation of substantial volumes of traffic that could contribute to cumulatively significant effects on existing or future roadway capacities.

# 4.8 BIOLOGICAL RESOURCES

## 4.8.1 Introduction

This section is intended to serve as a broad overview of biological resources in the West San Bernardino Valley that are included within, or occur adjacent to the project area. This section will include a general inventory and description of the communities, sensitive habitats, and species of special concern that may occur in the vicinity of Chino Basin. The majority of the project area has already been developed. Within the valley area itself, there are very few undisturbed areas with significant biological resources. Most of the land has been previously disturbed as part of construction and grading operations. Near the foothills of the San Gabriel Mountains there is a greater potential for encountering significant biological resources than in the valley area. Additionally, the Santa Ana River Corridor and the Prado Basin Reservoir contain many sensitive plant and animal species. Riparian/wetland resources can also be found in the southern portion of the project area, and along some of the existing drainage courses throughout the Basin.

Data provided in this section of the PEIR was obtained from the following biological resources:

- Kirtland Biological Services – Trapping Studies for the San Bernardino Kangaroo Rat, Etiwanda Basin Expansion Project, December 13, 1999 (KBS Report).
- Tierra Madre Consultants, Inc. – Southern California Edison Properties Focused Surveys for the Delhi Sand Flower-loving Fly, December 29, 1999 (TMC Report).
- Tom Dodson & Associates – Biological Assessment for the Inland Empire Utilities Agency Recycled Water Groundwater Recharge Project, January 1999 (TDA Report).
- Kendall H. Osborne – Focused Survey for Delhi Sands Giant Flower-loving Fly on a 40-acre Site in Etiwanda, October 1999 (Osborne Report).
- LSA Associates, Inc.,Ventura Freeway Corridor Areawide Plan DEIR, March 1999.
- San Bernardino County General Plan EIR Biological Background Report, March 1989.
- Riverside County General Plan, 1984.
- California Natural Diversity Database, California Department of Fish and Game, 2000.
- Hickman, James ed., *The Jepson Manual: Higher Plants of California*, 1993.
- Munz, Philip, *A Flora of Southern California,* 1974.
- Ventura Freeway Corridor Areawide Plan EIR, 1999.
- Chino Basin Groundwater Storage Program DEIR, MWDSC, 1988.

Data contained in these reports, where applicable, are summarized herein with editing to conform to the EIR format.

The principal environmental actions that may need to be implemented as a part of this project are:

1. Compliance with NEPA and CEQA guidelines regarding sensitive biological resources
2. U.S. Army Corps of Engineers (COE) Clean Water Act Section 404 Permit and U.S. Environmental Protection Agency (EPA) 404 (b)1 Alternatives Analysis
3. Section 7 and/or 10 of U.S. Endangered Species Act of 1973, as amended
4. U.S. Migratory Bird Treaty Act
5. U.S. Bald Eagle Act
6. California Endangered Species Act
7. California Department of Fish and Game (CDFG) Streambed Alteration Agreement (Section 1600 of the Fish and Game Code)
8. State of California Native Plant Protection Act
9. Plant Protection and Management Ordinances (County Code Title 8, Div. 11)

Both the California and Federal endangered species acts provide legislation to protect the habitats of listed species as well as the species itself. If a state or federally listed endangered species was determined to be present, the proposed project may be constrained to avoid or minimize effects to the species. Species specific mitigation measures would thus need to be agreed upon and implemented to the satisfaction of all jurisdictional agencies. These jurisdictional agencies may be some or all of the following: U.S. Fish and Wildlife Service (USFWS), CDFG, and/or COE.

### 4.8.2 Environmental Setting

The project area is comprised of a primarily urban setting, as indicated on Figure 4.8-1. The vast majority of the approximately 225,000 acres that comprises the Chino Basin has been previously developed or disturbed by human activity. Relatively speaking, very few pristine areas of undisturbed natural habitat remain. The following is a discussion of areas with in the Chino Basin that have the largest areas of extant habitat communities or have the most significant biological resources:

The Prado Reservoir area comprises 9,741 acres northwest of Corona and south of Chino. Approximately 4,000 acres of this area can be classified as riparian woodland vegetation, of which 2,000 to 2,500 acres is dense riparian habitat dominated by large stands of willow woodland. This is one of the largest remaining riparian woodland in southern California. This areas supports a wide array of sensitive species, both floral and faunal. According to the Biological Resources section for the Chino Basin Groundwater storage Program Draft Environmental Impact Report for MWDSC, a total of 311 species of vascular plants, belonging to 65 families, were identified in the Basin area. Three major vegetational communities occur in this area. First is riparian habitat which occurs in low lying sections of the Basin and along the Santa Ana River and streams running into the Basin.

The riparian habitat is dominated by extensive stands of black willow, and smaller stands of arroyo willow. Several stands of tall cottonwoods and a single stand of sycamore have been identified. The second habitat type is upland habitat characteristic of coastal sage scrub, plus grasses and exotic weeds. This upland area has been heavily impacted by agriculture and grazing activities. The third major vegetational type is the aquatic and semi-aquatic communities occurring in permanent streams and artificial duck ponds, and intermittently filled reservoirs and streams within the Basin. The wildlife in the riparian area includes a variety of amphibians, mammals, and birds. For an additional discussion of the biological resources identified in the area, please refer to MWDSC Chino Basin Groundwater Storage EIR's biological resource section which is included as Appendix 8.4 of Chapter 8 to this document.

The Santa Ana River and its tributaries within the Chino Basin are also significant areas for biological resources as they provide refugia and breeding grounds for neotropical migrant species as well as provide habitat linkages and movement corridors connecting various large blocks of relatively undisturbed habitat areas. The MWDSC Chino Basin EIR also reports that many of these tributary streams will be fully lined as part of flood control activities in the future.

Another significant area for biological resources that lies adjacent to the Chino Basin is Chino Hills State Park has approximately 13,000 acres of wild land situated in the hills north of Santa Ana Canyon. Although Chino Hill State Park containing large blocks of non-native grasslands, it is also contains riparian habitat comprised of coast live oak and sycamore woodlands. Additionally, this park contains one of the largest remaining stands of Southern California black walnut. This park functions as an important area for connectivity to and movement between the park the boundary of the project area.

### 4.8.2.1 Plant Communities

The inventory of generalized plant communities that follows was obtained from San Bernardino County's Vegetation Map by Holland Classification. This Map is included for reference purposes as Figure 4.8-1.

- Mule Fat Scrub
- Southern Cottonwood-Willow Riparian Forest
- Coastal Sage Scrub
- Hoaryleaf Ceanothus Chaparral
- Non-Native Grassland

Additionally, a review of San Bernardino and Riverside County general plan documents listed the plant communities shown below as being present in the project area. The general characteristics of these communities are described in the following discussion extracted from San Bernardino County's Biological Resources Report.

***Chaparral***

*Several different chaparral subtypes occur in San Bernardino County. The most common subtypes in the valley region are southern mixed chaparral, chamise chaparral and scrub oak chaparral. These associations are located predominantly along the lower slopes of the mountains and in the interface zone between valley and mountain regions.*

*Southern mixed chaparral is composed of broad-leaved sclerophyllous shrubs that grow to about 8-12 feet tall and form dense, often nearly impenetrable stands. The plants of this association are typically deep-rooted. There is usually little or not understory, except in openings; however, considerable leaf litter accumulates. This habitat occurs on dry, rocky often steep north-facing slopes with little soil. It may grade into Riversidean coastal sage scrub at lower elevations, but generally grown on moister and rockier sites. Characteristic shrub species include chamise, toyon and lemonadeberry.*

*Chamise chaparral is dominated by chamise, almost to the exclusion of all other plants. This habitat occurs on shallower, drier soils or at somewhat lover elevations than mixed chaparral. Chamise has adapted tot he characteristic fire cycles of this habitat by stump sprouting. In mature stands, the shrubs are densely interwoven and there is very little herbaceous understory or leaf litter.*

*Scrub oak chaparral is a dense evergreen association that grown to twenty feet tall and is dominated by scrub oak. This habitat occurs on wetter sites than other chaparral associations, often at slightly higher elevations. These more favorable sites recover from fire more quickly than other chaparral subtypes and substantial leaf litter accumulates. Additional shrub species found in scrub oak chaparral include eastwood manzanita, toyon and mountain mahogany, poison oak and narrow leaf bedstraw. Other*

*chaparral associations may occur in the Valley region but are more predominant at higher elevations. Such associations include buck brush chaparral, bigpod ceanothus chaparral and interior live oak chaparral.*

*Chaparral habitats are suitable for burrows and soil nests of many mammal species. Another important feature of this habitat are rock outcrops, which are important for reptiles and as raptor perch sites. No sensitive species of San Bernardino county are directly dependent upon chaparral habitat. However, sensitive faunal species from adjacent coastal sage scrub habitat may utilize chaparral as a corridor or for foraging. These species may include Stephens' kangaroo rat, Los Angeles pocket mouse, and San Diego horned lizard.*

According to the California Native Plant Society (CNPS) database, subseries of this habitat type that may occur within the project area are the scalebroom series and the Hoaryleaf ceanothus series. These series are described below as they appear in the CNPS database.

The scalebroom series occurs on upland that are rarely flooded, low gradient deposits along streams. Species composition differs greatly among stands. Some stands in this habitat may have sufficient emergent trees to be placed in tree-dominated series. The federal and state listed Slender-horned spineflower (CNPS list 1B plant) and santa Ana river woollystar (CNPS list 1B plant) grow in some stands of this series. This series may occur in western Riverside County.

The hoaryleaf ceanothus series occurs on upland slopes that are south-facing at high elevations. Soils are deep or shallow and usually coarse textured. Hoaryleaf ceanothus occurs as scattered shrubs or as the sole or dominant shrub in chaparral. Stands where hoaryleaf ceanothus and chamise are equally important are members of the chamise-hoaryleaf series. Series height is less than 3.5 meters, and occurs from 100 to 1,350 meters in elevation.

***Coastal sage scrub***

*Coastal sage scrub in the valley region is classified as Riversidean sage scrub, the most xeric expression of coastal sage scrub south of Point Concepcion (Holland 1986). This habitat grows on steep slopes with severely drained soil and dominant species are relatively shallow-rooted shrubs, seldom over four feet tall.*

*Riversidean Alluvial Sage Scrub is a variation of Riversidean sage scrub which also exists in the valley region. This vegetation type is the dominant habitat of the Upper Santa Ana River floodplain and also occurs in the Cajon and Lytle washes (CNDDB, 2000)...*

*Coastal sage scrub habitat in Southern California is decreasing rapidly as a result of urbanization. Evidence of its decline is the growing number of declining plants often associated with it. In the valley region of San Bernardino county, three state and/or federally listed endangered species are known to occur in association with the coastal sage scrub: slender-horned spineflower (Centrostegia lepoceras), Santa Ana River woolly star (Eriastrum densifolium spp. sanctorum), and Nevin's barberry (Berberis nevinii). Additionally, Pringles monardella is federally listed as a Category I species, while Payson's jewelflower and California bedstraw are category 2 species.*

*San Bernardino kangaroo rat a federally listed endangered species; and Stephens' kangaroo rat, a state-listed threatened species and federally listed endangered species are also known to have its habitat associate with this community type in the Valley area. Los Angeles pocket mouse is federally listed as a category 2 species and a species of special concern by the state. The Los Angeles pocket mouse has been found in San Bernardino county near the Cajon Wash, north of Etiwanda and San Bernardino and in Reche Canyon...The Valley region of San Bernardino county represents the northern limit of the range of the whiptail and coastal California gnatcatcher, a federally listed threatened species. Currently the U.S. Fish and Wildlife Service has proposed critical habitat for this species. This area is discussed and depicted in the Project Impacts subsection to follow.*

***Deciduous woodlands***

*California walnut woodland is a rather specialized woodland habitat restricted to the Chino Hills and Etiwanda area within the Valley region. This woodland, which occurs among rocky outcrops integrating with scrub habitat or on more mesic sites integrating with canyon live oak woodland, is dominated by California walnut; associated species include canyon live oak, Engelman oak, sugar bush, and squaw bush. California walnut woodland is considered a sensitive habitat due to its small acreage and limited distribution in the county; no sensitive floral species are solely dependent on this woodland habitat for their life cycle, however. No federal or state sensitivity listing exists for the live oak walnut or for any other species associated with California walnut woodland. Animals associates with California walnut woodland are similar to the species that would utilize oak woodland. These include Anna's hummingbird, acorn woodpecker, Nuttall's woodpecker, deer mouse, California ground squirrel, striped skunk, and coyote. No sensitive animals as listed by the USFWS or CDFG are*

*dependent on California walnut woodland within the valley region on San Bernardino county.*

***Grasslands***

*The disturbed grasslands of the valley region of San Bernardino county are a heterogeneous complex that may be associated with shrubs or trees on land that has been disturbed or altered by development or fire. Non-native weedy vegetation is common in this habitat and includes slender wild oats, foxtail fescue, ripgutgrass, short-pod mustard, red-stem filaree, and pin-clover. On sensitive plant species may occur in the grassland areas of the northern Valley area of San Bernardino County, Orcutt's brodiaea. This species, which is seriously threatened by development, may be found in valley/foothill grasslands, cismontane woodlands and vernal pool habitats. Birds or prey utilize grassland areas for foraging. Locally breeding raptor species include black-shouldered kite, red-tailed hawk, red-shouldered hawk, great horned owl, and barn owl, Other faunal associates include house mouse, southern grasshopper mouse, and gopher snake. No sensitive animal species are expected to utilize the grassland areas of the valley region of San Bernardino County.*

***Wetland***

*Wetland communities are areas of land which are either permanently or seasonally wet and support vegetation that is specifically adapted for saturated soil conditions. These areas include riparian areas and marshes, where moisture is at or near the surface, and often include intermittent drainages. In southern California, wetland habitats are declining and are considered sensitive. Wetlands are further subject to state and federal regulations that include the federal Clean water Act (Section 404) and the CDFG Streambed Alteration Agreement (Section 1600 of the Fish and Game Code). A number of stream channels flow through the valley region of San Bernardino County including Cucamonga Creek, Cajon and Lytle creek washes, and Santa Ana River. Where water is present near the surface in stream channels, a riparian woodland community can be maintained. In stream channels with intermittent surface or groundwater availability, a riparian scrub community may also develop. Both of these communities exist in the valley region. Dominant woodland tree species include Fremont cottonwood, arroyo willow and black willow with western sycamore on the upper terraces. Common shrubs include mulefat, California mugwort, poison oak and the coyote bush. A well developed stand of riparian woodland occurs in the Prado Basin of San Bernardino County and extends into Riverside county. Remnant riparian woodlands also occur in less frequently flooded areas such as the Santa Ana Wash area.*

*A freshwater marsh is located north of Etiwanda in the Day Canyon wash area. Freshwater marsh also occurs in the Prado Basin and may occur in the other drainages*

*of the valley region, wherever moisture is at or near the surface for a long duration during the growing season. This habitat is usually dominated by perennial emergent species 4 to 7 feet tall. Stands of bulrushes or cattails often characterize this habitat. Also, large stands of the non-native pest plant giant reed grass (Arundo) occur along much of the basin's riparian areas. This giant reed grass not only takes over native riparian communities, but it also uses a tremendous amount of water.*

*These Riparian resources serve as important habitat, as water sources, and as movement corridors for wildlife. This habitat type also supports numerous sensitive animal species including least Bell's vireo, a state and federally listed endangered species; southwestern willow flycatcher, a state and federally listed endangered species; bald eagle, a state and federally endangered species; western yellow-billed cuckoo, a state listed threatened species; long eared own, a species of special concern and the California black rail, a state listed threatened species. The cuckoo and vireo occur in the dense riparian habitat of the Prado Basin in Riverside county but apparently have been extirpated from the valley region of San Bernardino County. The black rail, dependent on marshes, was recorded long ago at Chino but is not known to occur currently in San Bernardino County. (San Bernardino County Plan Biological Background Report, 1987)*

Other riparian and wetlands vegetation series that may occur within the project area are the Arroyo willow series, the California sycamore series, types of riparian woodland forests. The California Native Plant Society database describes these series as follows:

### *California Sycamore Series*

This vegetation series occurs on upper terraces and canyon slopes that are commonly rocky. This series occurs along the Santa Ana River, and possibly in other areas of San Bernardino County. Series height is less than 35 meters.

### *Arroyo Willow Series*

These riparian willow stands may or may not be dominated by a single species. If no dominant willow is present at low elevations, then the stand can be characterized as a mixed willow series. Montane and subalpine willow stands are placed in separate classes since different willow species are restricted to those elevations. Stands of the Arroyo willow series have environmental conditions similar to alder, cottonwood and other willow series. Tree density and cover occurs along the Santa Ana River, and a possible candidate site occurs in San Bernardino County. Series height is typically less than 10 meters.

San Bernardino County's has prepared a Sensitive Biological Areas Map for the Western Valley Planning Area which outlines several habitat types that have been particularly sensitive for certain sensitive species. This map is part of the multi species habitat conservation plan that is currently

under development by the county. The four habitat or area types that are identified on this map are described below.

### *Coastal Sage Scrub*

Please refer to the habitat description previously provided in this subchapter for information regarding this community type. The coastal scrub series is better though of as a collection of several vegetative series. One such series is the California buckwheat series. This series occurs on upland slopes that are rarely flooded low-gradient deposits along streams. Soils are shallow and rocky. This series is comparable to coast bluff scrub but differs in plant height and cover from coastal sage, but contrasts little in species composition. Three varieties of *Eriogonum fasciculatum* grow in the range of coastal scrub. There is some geographic separation between them. Stands dominated by *E. gigateum* are included in this series, stands of this series differ from the California sagebrush-California buckwheat series in the California buckwheat dominates here. This series occurs in Cajon creek, Cucamonga Canyon, Lytle Creek, San Sevaine Canyon and the Upper Santa Ana River.

### *Delhi Sands*

While this is not a definitive community type, *per se*, it is typified as a blow sand community species, which is associated with a suite of blow sand endemic invertebrates. These blow sand areas, including the delhi soil series, are highly important habitat requirements for the federally listed endangered Delhi Sands Flower-loving Fly. Soil surveys for southwestern San Bernardino County (USDA Soil Conservation Service 1980) and western Riverside County (USDA Soils Conservation Service 1979) were consulted to identify the soil types occurring throughout the site. The locations of this soil type are described in more detail in the geology section of this document (Chapter 4, Section 4). There are several areas with Delhi Sands soil associations within the project area, and they are outlined on the Multiple Species Habitat Conservation Planning Area Map for Sensitive Biological Areas within the San Bernardino County portion of the Valley Planning Area. This map is available through San Bernardino County's Geographical Information Systems Office and a map of sensitive areas for Delhi Sands Flower-loving Fly is also provided in the Project Impacts section of this subchapter.

### *Riparian/Wetland Areas*

Of the habitat and community types occurring within the boundaries of the project area, wetlands are typically considered to be one of the most sensitive types. This vegetation heading includes riparian woodland, riparian scrub, vernal pools, and freshwater marsh. The Prado Basin is one of the best representative examples of riparian woodlands (described previously) in the valley region. Additional wetland resources may also occur along the Santa Ana and Lytle creek washes in alluvial sage scrub habitat that has adapted to frequent flooding and therefore supports a unique diversity of plant species. Further, the Chino Hills support a vide variety of habitat types including Riversidean sage scrub, riparian woodland and California walnut woodland.

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Aleutian Canada Goose *Branta canadensis leucopareia* | threatened | Central Valley is main wintering ground | nests on islands or marshes, feeds on shoots and seeds of grains and wild grasses | N,C,S |
| American Peregrine Falcon *Falco peregrinus anatum* | endangered/ protected | western Riverside and San Bernardino counties | breeds near wetlands, lakes, rivers or other water on high cliffs, banks and dunes, will also use human-made structures for nesting, feeds on other birds | N,C,S |
| Arroyo Chub *Gila orcutti* | | generally prefer slowest moving sections of streams, where bottoms are sand or mud, creek and river systems of sw Ca, coastal streams of LA and Orange Co. | chunky minnows with small mouths and moderately large eyes, gray-green back, white belly, body length usually less than 4 "; eats aquatic vegetation and invertebrates associated with such plants; well adapted for surviving summer; breed in Mar-April | |
| Arroyo Toad *Bufo microscaphus californicus* | endangered | found in intermediate sized drainages, 3rd or 4th order streams in decomposed granite, waterways with no silt, pools < 1' deep, tadpoles in open bars and flats along stream edge | where shallow pools persist until at last July, breed in pools where stream current is minimal | N,C,S |
| Bald Eagle *Haliaeetus leucocephalus* | delisted as threatened | Alaska, Canada to southern U.S. | coasts, rivers in open and forested areas, large lakes | N |
| Black Swift *Cypseloides niger* (nesting) | | nests in small colonies in steep, rocky, often moist cliffs behind or near waterfalls in deep canyons, nest made of mud mixed with plant material, feeds on flying insects, breeds in San San Bernardino, San Gabriel and San Jacinto Mts. | migrates south for winter, most absent from this area bet. Oct-April, breeds from June-Aug, lays only 1 egg per year | N |
| Bonytail Chub *Gila elegans* | endangered | found in freshwater streams and rivers | threatened by development | N,C,S |
| Brown Pelican *Pelecanus occidentalis* | endangered | common along Ca coast from June-Oct., may be on Salton Sea from July-Sept. | breeds on offshore islands | C,S |

**Table 4.8-1**

**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Burrowing Owl *Athene cunicularia* (burrow sites) | | hunts from perch, hovers, or hops after prey on the ground; uses rodent or other burrow for roosting and nesting cover, usually found in open grasslands and shrublands | eats mostly insects; also small mammals, reptiles, birds and carrion; breeding from March-Aug, average 5-6 eggs, somewhat colonial; numbers declining due to loss of grassland to agriculture, development, and poisoning of ground squirrels; predators include hawks, coyotes, domestic dogs and cats | N,C,S |
| California Mastiff Bat *Eumops perotis californicus* | | occurs in many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub and urban; catches and feeds on insects in flight, roosts in crevices in cliff faces, high buildings, trees and tunnels, requires extensive open areas with abundant roost locations; sw San Bernardino, w Riverside.. Co. | largest native bat in the US, has long, narrow wings, chocolate brown with free tail nocturnal, foraging 6-7 hours per night, roosts in small colonies of 100 or fewer, may range 15 miles in search of food, give birth from April-August, 1 young produced per year, may roost with other species of bat | N,C,S |
| California Red-legged Frog *Rana aurora draytoni* | threatened | found in slow streams and rivers, ponds, marshes, lakes, reservoirs, canals with slow or still water, need deep pools and cool water | require dense riparian vegetation in contact with or close to deep water, may go to upland forests during non-breeding season | N,C,S |
| Coachella Valley Fringe-toed Lizard *Uma inornata* | threatened | sand dunes in Coachella Valley, central Riverside Co. | burrow in sand to escape from enemies, hunt a variety of insects, require fine, loose, windblown sand | N,C,S |

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Coastal California Gnatcatcher *Polioptila californica californica* | threatened | glean insects and spiders from foliage of shrubs, roost and nest in shrubs, found in California sagebrush, patches of prickly pear, arid washes, on mesas and slopes below 2500' from e Orange and sw Riverside Co., possibly along lower, coastal slopes of San Gabriel and San Bernardino Mts., LA and San Bernardino Co. | nesting season April-June, both parents caring for young, threatened due to loss of habitat for human development | N,C,S |
| Delhi Sands Flower-loving Fly *Rhaphiomidas terminatus abdominalis* | endangered/none | found in highly specialized habitat, on sand dunes, 155 acre distribution among 8 sites in Riverside.. and San Bernardino Co. | feeds on nectar of native plants, hovers like hummingbird | N,C |
| Golden Eagle *Aquila chrysaetos* (nesting & wintering) | none/none | typically in rolling foothills, mountain areas, sage-juniper flats, desert, found over southern Ca, from sea level to over 11,000 ft, needs open areas for hunting, hunts from air or perch, may hunt in pairs, requires secluded cliffs with overhanging ledges and large trees for cover and nesting, | eats rabbits, hares and rodents, occasionally preys on domestic calves and lambs; territory size approx. 36 sq. mi., breeds from late Jan-Aug, average 2 young per year, occasionally preys on domestic calves and lambs, nest is a platform of sticks, twigs and greenery 10 feet across and 3 feet high, will reuse old nest sites | N,C,S |
| Least Bell's Vireo *Vireo bellii pusillus* (nesting) | endangered/ endangered | in thickets of willows and other low, dense valley foothill riparian habitat, found from coast inland to western edge of deserts in desert riparian habitat | active during the day, gleans insects from foliage and branches usually within 8 feet of ground, builds an open-cup nest of bark, grasses, nests from May-July with an average of 4 eggs, threatened by cowbird nest parasitism, may be nearing extinction in Cal | N,C,S |

**Table 4.8-1**

**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Long-eared Owl *Asio otus* (nesting) | none/none | requires riparian bottomlands grown to tall willows and cottonwoods, or live oak thickets and other dense stands of trees for roosting and nesting, hunts in open areas, occasionally in woodland and forested habitats | nocturnal; uses old crow, hawk, heron or squirrel nests, breeds from March-July averaging 4-5 eggs per nest; eats mostly voles and other rodents, occasionally birds, including smaller owls; threatened by loss of live oak groves | N,C,S |
| Los Angeles Pocket Mouse *Perognathus longimembris brevinasus* | species of concern/ none | preferred habitat valleys and slopes, sandy soil with pebbles, sagebrush, creosote bush and cactus; occupies arid coastal basins of southern California in grassland and coastal sage scrub; LA, San Bernardino, Riverside. Co. | small-bodied nocturnal rodent with long tail, buff upper parts, white belly, well adapted to desert life; eats green vegetation of grasses in spring, seeds the remainder of the year; search for seeds under shrubs and collect seeds in cheek pouches, obtain water from food alone; nest made of green leaves and dry roots, usually beneath shrubs; breeds Jan-Aug with 2-8 young per litter; predators include snakes, owls, predatory mammals; threatened by severe loss of habitat | N,C,S |
| Mountain Plover *Charadrius montanus* | proposed threatened | western Riverside County | does not nest in Ca, requires high-elevation grassland for nesting, feeds on large insects on ground, esp. grasshoppers | C,S |
| Mountain Yellow-legged Frog *Rana mucosa* | proposed endangered | streams, lakes and ponds in western San Bernardino and Riverside County, elevations above 5940', always found near water | eat aquatic and terrestrial insects, breed June-Aug. | N |
| Nelson's Bighorn Sheep Desert Bighorn Sheep *Ovis canadensis nelsoni* | none/none | feed in rocky barrens, meadows and low sparse brushlands, use rocky, steep terrain for escape and bedding, presence of water is critical, San San Bernardino Mts., San Gabriel Mts. | brown to grayish brown with creamy white rump and massive coiled horns in males; polygamous, rutting in Nov-Dec and lambing in steep rugged slopes and canyons from April-June; graze and browse on a wide variety of plant species, preferring green succulent grasses and forbs; threatened by disease transmitted from livestock, | N |

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Northwestern San Diego Pocket Mouse *Chaetodipus (=Perognathus) fallax fallax* | species of concern/ none | favors rocky/gravelly areas with yucca overstory, desert scrub near or in pine-juniper belt; basins and slopes on Pacific side of southern California Mts., San San Bernardino Mts., LA Co. southward | upper parts of body rich brown flecked with deep tawny color, spine-like hairs on rump, belly white, tail crested; nocturnal, forages on seeds of forbs, grasses and shrubs, collects seeds in check pouches and stores in underground burrow, obtains water from food alone; breeding March-May, average 4 young; predators include foxes, coyotes, badgers, owls and snakes | N,C,S |
| Orange-Throated Whiptail *Cnemidophorus hyperythrus* | species of concern/ none | areas with summer morning fog, low-elevation coastal scrub, chaparral, and valley-foothill hardwood habitats, prefers washes and other sandy areas with patches of brush and rocks, coastal in extreme s LA Co., sw San Bernardino Co., Orange, Riverside. Co. | active during the day, forages actively on surface and scratches through surface debris, eats many small arthropods, esp. termites, takes cover under surface objects such as rocks, logs, or in rock crevices; breeds April-Sept, with 2-3 eggs per clutch laid in loose soil; predators include snakes and nocturnal mammals | N,C,S |
| Peninsular Bighorn Sheep *Ovis canadensis cremnobates* | proposed endangered | Peninsular Ranges from the San Jacinto and Santa Rosa Ranges south into Mexico | graze and browse on a wide variety of plant species, use rocky, steep terrain for escape and bedding, require steep rocky slopes and canyons for lambing | S |
| Quino Checkerspot Butterfly *Euphydryas editha quino* | endangered | coastal sage scrub, Riverside and San Bernardino Counties | requires young host plants of *Plantago erecta*, associated species | N,C,S |

**Table 4.8-1**

**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Razorback Sucker *Xyrauchen texanus* | endangered | limited to freshwater habitats, Santa Ana River | threatened by flood control projects | N,C,S |
| Riverside Fairy Shrimp *Streptocephalus woottoni* | endangered | vernal pool habitats, Riverside and San Bernardino Co. | present for only a few weeks following spring rains, dormant majority of the year | N,C,S |
| San Bernardino Kangaroo Rat *Dipodomys merriami parvus* | endangered/ none | prefers light sandy soils across much of southern half of the state except in the Coast Ranges, alluvial scrub habitats, desert scrub, sagebrush, Joshua tree, pinon-juniper habitats, San Bernardino and Riverside.. Co. | forage under shrubs, feeding on seeds of many plants, leafy vegetation in spring, some insects; active in bright twilight, aggressively solitary; breeding may be several times in a year, from Dec-summer, litters average 4 young; predators include kit foxes, badgers, snakes, owls, gray foxes and coyotes | N,C,S |
| San Diego Desert Woodrat *Neotoma lepida intermedia* | species of concern/ none | favor rocky areas with Joshua trees, pinon-juniper, chaparral, sagebrush and desert habitats throughout southern Cal, San San Bernardino Mts. | moderate-sized rodent, pale to dark gray body washed with tawny, belly grayish to tawny, bases of hairs slate color; eat buds, fruits, seeds, bark, leaves and young shoots of many plants; build houses with twigs, sticks, cactus parts, usually against a rock crevice, or at the base of a large shrub, lined with grasses or shredded stems; aggressively solitary, breeds from Oct-May, averaging 2-3 young, may have 4 litters in a year. | N |
| San Diego Horned Lizard *Phrynosoma coronatum blainvillei* | species of concern/ none | valley-foothill hardwood, conifer, annual grass and riparian habitats, mountains of So Cal exclusive of desert regions, open country , especially sandy areas, washes, flood plains and wind-blown deposits, below 3000 ft. | body armored with spines and aggressively defensive toward potential predators, relies on camouflage for protection, bask on ground or low rocks burrow into loose soil to avoid intense heat or predators; active during the day, foraging on the ground in open areas, usually between shrubs near ant nests, eat ants, beetles, other insects; reproductive season from May-June, averaging 13 eggs; predators include leopard lizards, snakes, loggerhead shrikes and hawks | N,C,S |

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Santa Ana Speckled Dace *Rhinichthys osculus* ssp... 3 | species of concern/ none | inhabitants of cool, flowing, rocky-bottomed permanent streams and rivers, habitat among rocks and riffles | body color highly variable with speckles or blotches, pointed snout, mouth set slightly under jaw, slender body with small scales, to 3 in long; food small bottom-dwelling invertebrates; seminocturnal, hides among bottom rocks during daylight hours, forages in small groups; spawn throughout summer months, eggs are laid and fertilized among bottom rock and gravel, base of fins of both sexes turns orange to red during the breeding season | N,C,S |
| Santa Ana Sucker *Catostomus santaanae* Southern California Arroyo Chub | threatened/ none | prefer cool, unpolluted, small, rocky-bottomed shallow streams with currents ranging from swift (in canyons) to sluggish (in the bottomlands), LA, San Gabriel and Santa Ana River drainages; LA, Orange, San Bernardino and Riverside. Co. | body length to 6 in., dark back with irregular dorsal blotches, silvery belly; feeds primarily on algae; spawn from April-July, producing thousands of eggs; only native fish species still occurring in this portion of Santa Ana River, threatened by flood control projects, urbanization, nonnative fish species | N,C,S |
| Southern Rubber Boa *Charina bottae umbratica* | species of concern/ threatened | red fir, ponderosa pine, hardwood, meadow, chaparral and riparian habitats, San Bernardino and San Jacinto Mts. | feed on aquatic plants, beetles, invertebrates, fishes, frogs and carrion; active at dawn and dusk, feeds on small mammals and lizards; very secretive seeking cover in rotting logs, rocks, burrows through loose soil or decaying vegetation, may climb; breeds from April-June, young born alive in loose, well-aerated soil, under surface objects or within rotting logs; predators include hawks, owls, predatory mammals; threatened by development and recreational uses of forest habitat | N,C,S |

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTFICNAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Southwestern Pond Turtle *Clemmys marmorata pallida* | species of concern/ none | permanent ponds, lakes, streams, irrigation ditches or permanent pools, found in suitable aquatic habitat west of Sierras, along Mojave River and its tributaries, from sea level to 6000' | require basking sites such as logs, rocks, mats of floating vegetation, breed from March-August, laying 3-11 eggs, young may desiccate rapidly if conditions are hot and dry; hibernate in bottom mud during colder season; predators include fish, bullfrogs, garter snakes, wading birds and some mammals | N,C,S |
| Southwestern Willow Flycatcher *Empidonax trailii extimus* | endangered | prefer extensive thickets of low, dense willows edging on wet meadows, ponds or backwaters, lowland Ca, records sparse | feeds on flying insects, occasionally on berries and seeds; winters in S. and Cen... Am, arrives locally in May/June; breeds June-July, builds nest 1.5-10 feet high in willow, averaging 3-4 eggs; threatened by cowbird nest parasitism and habitat destruction | |
| Stephen's Kangaroo Rat *Dipodomys stephensi* | endangered/ threatened | prefer sparse perennial plant cover, annual and perennial grassland, coastal sage scrub, sagebrush habitats, found only in San Jacinto Valley, w Riverside. and s San San Bernardino Co. | moderate-sized rodent with 5 toes; excavate burrows in firm soil (neither hard nor sandy), or occupy abandoned pocket gopher burrows; breed from April-June, lining nest with dried plants, 2-3 young produced; predators include snakes, owls, predatory mammals; threatened by habitat loss due to urbanization and cultivation | N,C,S |
| Unarmored Threespine Stickleback *Gasterosteus aculeatus williamsoni* | endangered | Mojave River low elevations sites in Central Valley | coastal streams and rivers, lower and middle elevation reservoirs | |
| Vernal Pool Fairy Shrimp *Branchinecta lynchii* | endangered | found only in vernal pool habitats, Riverside and San Bernardino counties | active and breeding for brief period following spring rains, dormant for majority of the year | N,C,S |

**Table 4.8-1**
**SENSITIVE FAUNAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL/ STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION NORTH CENTRAL SOUTH |
|---|---|---|---|---|
| Western Yellow-billed Cuckoo *Coccyzus americanus occidentalis* | none/ endangered | requires densely foliated, deciduous trees and shrubs, especially willows for roosting, breeds only in river bottoms and other habitats with high humidity in or near slow-moving watercourses, backwaters or seeps; valley foothill and desert riparian habitats, along Santa Ana River, Riverside.. Co., San Bernardino Co. | feeds on grasshoppers, cicadas, caterpillars, occasionally frogs, lizards or fruit; winters in So Am., breeds from June-July, averaging 3-4 eggs per clutch, nest built 2-25 feet above ground as flimsy open cup of twigs in tree or shrub; threatened by loss of riparian habitats | N,C,S |
| White-eared Pocket Mouse *Perognathus alticola alticola* | species of concern/ none | ponderosa and Jeffrey pine habitats where bracken fern grows, occasionally in mixed chaparral and sagebrush habitats, San Bernardino Mts. | small rodent with olive-buff upper parts, white ears and underparts; burrows in loose soil, little known of reproduction, probably March-June with an average of 5 young in a nest of dried grass in an underground burrow; predators include foxes, coyotes, weasels, owls and snakes | N |
| Yellow-breasted Chat *Icteria virens* (nesting) | none/none | dense, brushy thickets and tangles near water, thick understory in riparian woodland, southern Cal coast and locally inland | eats insects and spiders, berries and other fruit; breeds May-Aug, producing 3-6 eggs in a nest 2-8 feet above the ground in dense shrubs along a stream or river; predators include falcons, small mammals and snakes; threatened by cowbird nest parasitism | N,C,S |
| Yuma Clapper Rail *Rallus longirostris yumanensis* | endangered | April-Sept. in freshwater and brackish emergent wetlands along Colorado River and around Salton Sea | nests in wetlands, forages in marshes and long rivers for crayfish, clams and insects | |

**Table 4.8-2**
**SENSITIVE FLORAL RESOURCES**

| COMMON NAME<br>*SCIENTIFIC NAME* | FEDERAL STATUS | CNPS LIST/ CODE | STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION<br>North<br>Central<br>South |
|---|---|---|---|---|---|---|
| Bristly sedge<br>*Carex comosa* | | 2/331 | | swampy places, San Bernardino Valley | narrow leafed perennial herb, growing close to ground | N,C |
| California muhly<br>*Muhlenbergia californica* | | 1B/223 | | wet places up to 7000', coastal sage scrub, chaparral, yellow pine forest, San Bernardino Valley to edge of desert | grasslike perennial herb 1-2' high, highly branched upper portion of plant, blooms July -Sept. | N,C,S |
| California Orcutt grass<br>*Orcuttia californica* | endangered | 1B/332 | | drying mud flats, vernal pools, valley grassland, Murrieta Hot Springs, western Riverside Co. | flattened grass, sometimes forming mats | S |
| Coulter's goldfields<br>*Lasthenia glabrata* ssp. *coulteri* | | 1B/232 | | salt marshes, vernal pools and damp alkaline spots, alkali sink, coastal salt marsh, Riverside & San Bernardino Co. | annual herb, blooms April-May | N,C,S |
| Coulter's saltbush<br>*Atriplex coulteri* | | 1B/222 | | somewhat alkaline low places, valley grassland, coastal sage scrub, Riverside & San Bernardino Co. | perennial herb with scaly gray leaves, favors shade, blooms March-Oct. | N,C,S |
| Gambel's water cress<br>*Rorippa gambelii* | endangered | 1B/332 | threatened | marshes, streambanks, lake margins, below 3750', Riverside & San Bernardino Co. | white-flowered, perennial herb, rhizomatous, seriously threatened by loss of habitat | N,C,S |
| Hall's monardella<br>*Monardella macrantha* ssp. *hallii* | | 1B/213 | | chaparral, woodland, forest, 1800-6000', Riverside Co., San Bernardino Mts. | perennial herb with heavy stem, triangular leaf, yellowish flower | N,C,S |
| Hot springs fimbristylis<br>*Fimbristylis thermalis* | | 2/221 | | freshwater marsh above 1500', Arrowhead Hot Springs, San Bernardino Co. | perennial herb, leaves spiraled with linear blades, slate colored flower | N |

**Table 4.8-2**
**SENSITIVE FLORAL RESOURCES**

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL STATUS | CNPS LIST/ CODE | STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION North Central South |
|---|---|---|---|---|---|---|
| Intermediate Mariposa lily *Calochortus weedii* var. *intermedius* | sp. of concern | 1B/223 | | dry rocky open slopes, hills below 2000', coastal sage scrub, valley grassland, Orange Co. | perennial herb, purplish flowers, dark- or yellow-hairy with basal leaves, blooms June-July | C,S |
| Many-stemmed dudleya *Dudleya multicaulis* | sp. of concern | 1B/123 | | dry stony places below 2000', coastal sage scrub, chaparral, western Riverside & San Bernardino Co. | perennial herb with narrow fleshy leaves arranged along stem with flowers toward the top, threatened by development | N,C,S |
| Marsh sandwort *Arenaria paludicola* | endangered | 1B/332 | endangered | swamps, freshwater marsh, below 900', San Bernardino Co. | perennial herb, grows close to ground, narrow leaves, blooms May-June | N,C |
| Munz's onion *Allium munzii* | proposed endangered | 1B/333 | | grassy openings in coastal sage scrub, 900-2700', western Riverside Co. | white flowered lily | C,S |
| Nevin's Barberry *Berberis nevinii* | federally-proposed endangered | 1B/333 | endangered | coastal sage scrub, chaparral, riparian scrub, San Timoteo Canyon near Redlands, Dripping Springs near Aguanga, San Gabriel Mts., San Bernardino Co. | large rounded shrub, 3-12 ' tall, toothed leaf margins, reddish fruit, blooms March-May | N,C |
| Parish's desert-thorn *Lycium parishii* | | 2/211 | | dry places below 2000', coastal sage scrub, creosote bush scrub, San Bernardino Valley | spiny, highly branched shrub with bell-shaped purple flowers, blooms Mar.-April | N, C |
| Parish's gooseberry *Ribes divaricatum* var. *parishii* | sp. of concern | 1B/333 | | willow thickets, swamps, coastal sage scrub, San Bernardino region | shrub to 10 ' tall, spiny arched stem with toothed leaf, pink or red flowers, blooms Mar.-April | N,C |
| Parry's spineflower *Chorizanthe parryi* var. *parryi* | sp. of concern | 3/323 | | sandy places, dry slopes and flats in coastal and desert scrubs from 1000-3600 ', chaparral, coastal sage scrub, Riverside & San Bernardino Co. | white-flowered annual blooming April-May | N,C,S |

Table 4.8-2
SENSITIVE FLORAL RESOURCES

| COMMON NAME *SCIENTIFIC NAME* | FEDERAL STATUS | CNPS LIST/ CODE | STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION North Central South |
|---|---|---|---|---|---|---|
| Pious daisy, Brewer's erigeron *Erigeron breweri* var. *bisanctus* | | 1B/223 | | open dry slopes and washes, 900-4800', San Gabriel Mts., San Bernardino Mts. | perennial herb 1-3' high | N |
| Plummer's Mariposa lily *Calochortus plummerae* | sp. of concern | 1B/223 | | dry rocky places, often in brush, below 5000', coastal sage scrub to yellow pine forest, Santa Monica Mts. to San Jacinto Mts. | perennial herb, pale pink bell shaped flowers with long yellow hairs, blooms May-July | N,C |
| Pringle's monardella, Pringle's mountainbalm *Monardella pringlei* | sp. of concern | 1A | | sandy places, coastal sage scrub, San Bernardino Co., Riverside Co. | annual herb branched near base with heavy ash-gray stems and hairy leaves, rose or purple flower, last seen in 1921, presumed extinct | N,C |
| Prostrate navarretia *Navarretia fossalis* | proposed threatened | 1B/232 | | vernal pools, ditches, 90-3900' | spreading plant with white flowers | N,C,S |
| Robinson's peppergrass *Lepidium virginicum* var. *robinsonii* | | 1B/322 | | shrublands with clay soils, below 1500', chaparral, coastal sage scrub, Riverside & San Bernardino Co. | annual herb with leaves a part of the stem, blooms Jan.-April | N,C,S |
| Salt spring checkerbloom *Sidalcea neomexicana* | | 2/221 | | alkaline springs and marshes below 4500', San Gabriel Mts., Riverside & San Bernardino Co. | fleshy-leafed perennial, rose-colored flowers | N,C,S |
| San Diego button-celery *Eryngium aristulatum* var. *parishii* | endangered | 1B/232 | | vernal pools, chaparral, west of Murrieta, Riverside Co. | small, slender annual | C,S |
| Santa Ana River woollystar *Eriastrum densifolium* ssp. *sanctorum* | endangered | 1B/333 | endangered | below 1500', coastal sage scrub, along Santa Ana River | perennial herb blooms June-Aug, | N,C,S |

**Table 4.8-2**
**SENSITIVE FLORAL RESOURCES**

| COMMON NAME<br>*SCIENTIFIC NAME* | FEDERAL STATUS | CNPS LIST/ CODE | STATE STATUS | HABITAT/ DISTRIBUTION | DISCUSSION | BASIN SECTION<br>North<br>Central<br>South |
|---|---|---|---|---|---|---|
| Slender-horned spineflower,<br>Slenderhorn spinyherb<br>*Dodecahema leptoceras* | endangered | 1B/333 | endangered | alluvial-fan habitats in chaparral, coastal sage scrub, Riverside, San Bernardino Counties | annual herb with basal leaves and very small white-pink flowers, blooms April-June | N,C,S |
| Slender Mariposa lily,<br>Clubhair Mariposa lily<br>*Calochortus clavatus* var. *gracilis* | sp. of concern | 1B/323 | | canyons below 2500', chaparral, base of San Gabriel Mts. | perennial herb, with slender stem, basal leaves and cup/bell shaped yellow flowers, blooms April-June | N |
| Smooth tarplant,<br>Spikeweed<br>*Hemizonia pungens* ssp. *laevis* | sp. of concern | 1B/233 | | grasslands below 1200' | annual herb with spiky leaves and yellow flowers | N,C,S |
| Southern mountain wild buckwheat<br>*Eriogonum kennedyi* var. *austromontanum* | threatened | 1B/223 | | dry gravel in yellow pine forest, 1900-2100', San Bernardino Mts. | perennial with white to rose-colored flowers | N |
| Thread-leafed brodiaea<br>*Brodiaea filifolia* | threatened | 1B/333 | endangered | heavy clay soil below 2000', in vernally flooded conditions, coastal sage scrub, chaparral, valley grassland, Riverside, & San Bernardino Co. | perennial herb, blooms May-June | N,C,S |
| Triple-ribbed milk-vetch<br>*Astragalus tricarinatus* | endangered | 1B/313 | | gravelly places 1400-4000', creosote bush scrub, joshua tree woodland | bushy perennial, blooms Feb.-May | N,C,S |
| Vail Lake ceanothus<br>*Ceanothus ophiochilus* | proposed threatened | 1B/333 | | rocky, north-facing slopes, ridges, chaparral around 1800', near Vail Lake, Riverside Co. | flowers pale blue or pink | C,S |

California walnut woodland occurs on upland north-facing slopes that are rarely flooded, terraced and relatively flat. Soils are shale-derived and deep. Understories to the walnut tree are composed of coastal scrub, chaparral, and non-native grass species. California walnut is rare (a CNPS Class 4 species). The series height is usually less than 10 meters. (CNPS database).

### 4.8.2.2 Flora and Faunal Resources

No biological surveys were conducted as part of this biological evaluation. The area has already been evaluated in many different environmental reports, especially those conducted for the counties of San Bernardino and Riverside. Sensitive species that have any potential of occurring within the project area boundaries that have been designated as species of concern, rare, threatened or endangered by either the USFWS or the CDFG or listed as sensitive species by the California Native Plant society are included in Tables 4.8-1 and 4.8-2 for reference purposes. Table 4.8-1 lists animals and Table 4.8-2 describes plants. This list was compiled from all occurrences identified using the CNDDB 2000, and a list of all sensitive species obtained from the USFWS for all of San Bernardino and Riverside County areas. Only when there is absolute certainty that the project area is outside of the normal habitat range for a species included on the USFWS list have species been removed from further discussion in Table 4.8-1. In some cases, it was not possible to determine if the project area was truly outside of possible habitat ranges, so as to err on the side of caution, these species were included in the list, even though the probability of occurrence for such species is so low as to be almost no probability.

### 4.8.2.3 Habitat Linkages and Biological Preserves

A biological issue of special concern is the preservation of habitat connectivity and linages. The National Park Service and the CDFG have both expressed concerns about the negative impacts to biological resources due to increasing urbanization and fragmentation of habitat areas.

In general terms, habitat connectivity and linages are important for three main reasons. First, they allow wildlife movement through all habitat areas suitable for use by a species, even those areas that are not currently being used. Second, increased connectivity allows for recolonization of areas that were historically occupied, but from which the species has been extirpated. Third, connectivity promotes the exchange of genetic material to occur between populations, which is important in preserving genetic diversity within and between populations. Fourth, connectivity is critical for large ranging mammals...which require thousands of acres of habitat to survive.

Critical wildlife movement areas within and adjacent to the project area Consist of the Santa Ana River and its tributary streams within the Chino Basin; the foothills, canyons and washes of the San Gabriel mountains to the north; the Prado Basin Reservoir Area; and Chino Hills State Park.

## 4.8.3 Project Impacts

Implementation of this project has some potential to impact biological resources. The type and the severity of the impacts are dependent on the site(s) selected and the amount of site disturbance required to install the infrastructure, wells and facilities outlined in the project description (Chapter 3 of this document). The impact evaluation discussion below has been conducted on a relatively broad and general level, leaving room for further site specific biological surveys in the future to address projects as they become better defined. A suite of mitigation measure is provided to ensure that all necessary environmental review is conducted for specific projects so as to minimize or remove impacts to sensitive biological resources.

### 4.8.3.1 Thresholds of Significance

The Initial Study Environmental Checklist Form (Appendix G of the State's CEQA Guidelines) provides recommendations for determining the significance of project-related impacts. The Checklist Form (Issue #IV, Biological Resources identifies the following criteria for determining whether a project may cause a significant adverse biological resource impact:

a. have a substantial adverse direct or indirect effect on any species identified as a candidate, sensitive, or special status species;

b. have a substantial adverse effect on riparian habitat or other sensitive natural community;

c. have a substantial adverse effect on federally protected wetlands;

d. substantially interfere with the movement of native fish or wildlife species, migratory wildlife corridors, or impede the use of native wildlife nursery sites;

e. conflict with local policies or ordinances protecting biological resources; or

f. conflict with provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved habitat conservation plan.

These thresholds of significance will be utilized in this PEIR to evaluate the potential impacts associated with implementation of this project.

The CNPS publishes and regularly updates the "Inventory or Rare and endangered Vascular Plants of California." CNPS gathers information from the CNDDB, the CDFG, and amateur and professional botanists throughout the state. Plants listed by CNPS, but not officially listed by the State, nevertheless receive protection under CEQA: that is, impacts to CNPS listed species may be considered to be significant. The CNPS plant list is attached as Appendix 8.5 of Chapter 8 to this document.

**a. Will the project substantially impact candidate, sensitive or special status species of riparian or other sensitive natural communities?**

Virtually any of the study area's plant associations may be considered "sensitive," given the fact that so much of the project area has already been impacted by urban development or other human activities. Additionally, areas may considered particularly sensitive if they occur with a significant ecological or migratory corridor as described in the subsection on Habitat Linkages and Biological Preserves; further, areas that provide habitat for listed or otherwise sensitive species should be considered particularly susceptible to potential adverse impacts relating to project implementation. Particularly sensitive areas that have been identified in relation to several endangered species such as the Arroyo Toad, Least Bell's Vireo, Southwestern Willow Flycatcher, Quino Checkerspot Butterfly, San Bernardino Kangaroo Rat, and Coastal California Gnatcatcher are shown on Figures 4.8-2 through 4.8-6 for each respective species. Any projects constructed within these areas has the potential to cause a significant impact to an endangered species, and further biological studies and mitigation are required in accordance with the mitigation measures listed below, which will avoid or mitigate impacts to a less than significant level. In addition to the sensitive areas identified in Figures 4.8-2 to 4.8-6, the Delhi Sands Flower-loving Fly is also a sensitive species with potential habitat areas identified in pink on Figure 4.8-7. Other sensitive species that have potential habitat areas defined on the map in Figure 4.8-7 are Quino Checkerspot Butterfly, San Bernardino Kangaroo Rat. These areas occupy a large portion of the Chino Basin, and thus future OBMP projects have a significant risk of impacting these species. Mitigation measures are proposed below to help minimize impacts to these species, however, the impacts must still be considered significant since the extent to which sensitive biological resources may be impacted is unknown given that the nature and location of all projects under the OBMP have not yet been fully defined.

The OBMP project has the potential to adversely impact all of the plant communities described in the environmental setting. Since the extent to which these communities may be impacted is yet unknown, potential adverse impacts must be considered significant until it can be demonstrated otherwise. Certain mitigation measures that are already in place for some habitat types are described below.

Within the project area, woodland communities are regulated by specific laws and ordinances to minimize impacts. Specifically, some riparian communities and communities containing oak trees are regulated by county or city ordinances. There are additional federal and state regulations regarding riparian/wetland areas.

Coastal sage scrub is also considered a sensitive community based on widespread awareness that this community has undergone widespread losses in the past and that this habitat type is closely related to several sensitive species. Further, the state is conducting an ongoing effort to create regionally important coastal sage scrub preserves under the Natural Communities Conservation Plan. Other regional habitat conservation plan efforts are also supportive of preserving this community type.

Grassland communities, especially non-native grasslands, have traditionally been considered less sensitive than woodlands and coastal sage scrub because they are more common. With increasing urbanization, however, their importance has increased, especially for raptors and other wide-ranging species. Native grasslands, especially, are uncommon and are considered to be particularly sensitive. The Chino Hills State Park is mostly comprised of non-native grasslands and is a preserve area. Thus, impacts to this particular community type from project implementation are not likely to be significant.

Chaparral is generally the least sensitive of the native communities within the project area since is it the most common, widespread community type. In some cases, however, chaparral may support other sensitive resources, and thus it has the potential to be considered a sensitive ecological area. It is considered a potentially significant impact if a sensitive ecological area is adversely affected by OBMP facilities.

Impacts to plant life, in general, are potentially significant since the project may result in the reduction of habitat area if land is converted from natural habitat to other uses. The impact to plant resources and sensitive species must be evaluated on a project by project basis, and could be significant given the high sensitivity of plant species both locally and regionally in the natural open space areas of the project area. The OBMP has the potential to decrease biological diversity. While construction of the OBMP facilities could have a direct impact on plant life and sensitive species if such facilities are located in or adjacent to important habitat areas, it is important to note that overall impacts to land in the Chino Basin are minimal from full implementation of the OBMP. In Section 4.2, it should be reiterated that construction of all desalter and well facilities contemplated under the OBMP would at most disturb 100 acres of the 225, 937 acres in the Chino Basin, of which over 75,000 was vacant in 1990. Thus over the next 20 years, the OBMP would potentially consume only one tenth of one percent of the open space acreage that existed in the Chino Basin in 1990.

General impacts to faunal life in the project area include potential reduction in suitable habitat types which could directly affect sensitive animal species. It would be expected that some animal species would be displaced or succumb to construction due to direct impacts or otherwise be impacted due to competition from limited adjacent holding capacities. Other animal species which are urban-adapted and not considered sensitive may be forced to relocate to other areas. Consequently a change in diversity and number of species due to build out within the project area could be a potentially significant impact resulting from the OBMP. Existing policies designed to project wildlife corridors will assist in protecting species diversity. These species would be protected through the state and federal Endangered Species Act and through future project-specific environmental review processes that could require detailed evaluations of wildlife habitat to determine the extent of project specific impacts and necessary mitigation requirements.

The amount of water that enters into the Prado Basin is an issue that must be analyzed in relation to biological resources within this area. The water level within the Prado Basin has a great potential to affect the surrounding riparian resources within this area, thus it must be closely regulated.

According to the 1978 Judgement, Orange County Water District (OCWD) has a legal entitlement to 42,000 acre-feet per year (acre-ft/year) of water from the Prado Reservoir, in addition to all stormwater flows that reach the Prado Basin. As a five year moving average, the baseflow at Prado has ranged from approximately 250,000 to 310,000 acre-ft/year since 1992. The diversion of 40,000 acre-ft/year of recycled water from discharging into Prado Basin to recharge locations within Chino Basin will not adversely impact the ability to meet any downstream entitlements since the baseflow will remain significantly greater than OCWD's entitlement. Also, several factors in the future will contribute to increases in the baseflow quantity. As the baseflow increases in volume, the diversion of 40,000 acre-ft/year of recycled water will be even less substantial proportionally, and impacts to the Prado Basin area and to OCWD will be minimal. The factors that will be contributing to future base flow increases are increases in surface runoff due to greater urbanization, and increases in total amounts of wastewater generated within the project area. The impacts to the riparian resources at Prado Dam are thus considered to be less than significant. Currently, regulators are more concerned with the possibility that too much water, rather than not enough, is reaching the Prado Basin (PEIR for Proposed Regional Plan Number 5 Project, May 1999). As the OBMP will cause a small decrease in wastewater flows reaching the Prado area, the net impacts may actually be considered to be beneficial, as opposed to adverse, for biological resources in the area.

The shift of 40,000 acre-ft/year of recycled water from discharge to recharge will be occurring gradually over the course of the OBMP timeframe. As this water is being diverted, wastewater flows will be increasing to the Prado Basin area. The following analysis provides data for both current and 2020 projected wastewater volumes. The Los Angeles County Sanitation district predicts an increase in wastewater discharge for the cities of Pomona and Upland from 22,000 to 30,000 acre-ft/year. The IEUA service area generation of wastewater flow will increase from 57,000 acre-ft/year to 112,000 acre-ft/year. Project areas within Riverside County are forecast to have increased wastewater generation by 5,000 acre-ft/year, an increase from 10,000 acre-ft/year to 15,000 acre-ft/year. In total, wastewater will increase, regardless of the proposed OBMP project, by approximately 68,000 acre-ft/year. Consequently, even with the diversion of 40,000 acre-ft/year of wastewater flows, there will still be a net increase in flows to Prado Dam, potentially on the order of 28,000 acre-ft/year (the relative amount will ultimately depend on the amount of direct beneficial use by industrial and irrigation users in the future). Regardless, however, the OBMP project has the potential to reduce the 2020 volume of water tributary to Prado Dam by 40,000 acre-ft/year of recycled water, and this action is not forecast to cause any significant environmental impacts. The decrease in the amount of total future flows reaching Prado Basin resulting from the OBMP will benefit riparian resources since the riparian resources would otherwise be flooded and destroyed due to increases in wastewater flows that will occur regardless of OBMP implementation.

A final potentially significant impact to biological resources is that new construction has the potential to introduce non-native plant materials that could prevent the reestablishment of native plant material in locations where either the species had historical range or the species has the potential to be replenished given the physical conditions of a particular setting.

All of the aforementioned potentially significant impacts can be mitigated to a less than significant level through the implementation of the proposed mitigation measures proposed below. If the project is implemented in a manner consistent will all of the applicable mitigation measures, the project will adhere with all of the already established processes and procedures guiding the protection of biological resources within the project area. If the circumstances surrounding a particular species or biological resource are different in the future and should cause biological resource impacts within the area to be deemed significant in the future, subsequent environmental documentation will be prepared and reviewed by the appropriate state agencies and/or federal agencies with jurisdiction.

### 4.8.4 Mitigation Measures

The following policies are the proposed guidelines that will function as mitigation measures to reduce impacts to biological resources in and adjacent to the Chino Basin project area. They have been abstracted and modified to fit the OBMP project fro the DEIR for the Ventura Freeway Corridor Areawide Plan.

**4.8-1 Place primary emphasis on the preservation of large, unbroken blocks of natural open space and wildlife habitat area, and protect the integrity of habitat linkages. As part of this emphasis, incorporate programs for purchase of lands, clustering of development to increase the amount of preserved open space, and assurances that the construction of pipelines and other facilities or infrastructure improvements meet standards identical to the environmental protection policies applicable to the specific project.**

**4.8-2 When determining which portion of a facility sit should be retained in open space, give emphasis to the preservation of habitat areas and linkages, avoiding destruction of viable, sensitive habitat areas and linkages as a trade-off for preserving open space for purely aesthetic purposes. Further, whenever feasible, avoid impacts and disturbances to individuals and species considered sensitive by jurisdictional agencies.**

**4.8-3 Require facility designs to be planned to protect habitat values and to preserve significant, viable habitat areas and habitat connection in their natural conditions.**

- **a. Within designated habitat areas of rare, threatened or endangered species, prohibit disturbance of protected biotic resources.**
- **b. Within riparian areas and wetlands subject to state or federal regulations (e.g. blue line streams); riparian woodlands, oak and walnut woodland, and habitat linkages, require that the vegetative resources which contribute to habitat carrying capacity (vegetative diversity, faunal resting sites, foraging areas, and food sources) are preserved in place or replaced so as no to result in an measurable reduction in the reproductive capacity of sensitive biotic resources.**
- **c. Within habitats of plants listed by the CNDDB or CNPS as "special" or "of concern," require that new facilities not result in a reduction in the number of these plants, if they are present.**

**4.8-4 Maximize the preservation of individual oak, sycamore and walnut trees within proposed development sites.**

**4.8-5 Prohibit the use of motorized vehicles within sensitive habitat areas and linkages except for crucial maintenance and/or construction activities.**

**4.8-6 Require the establishment of buffer zones adjacent to areas of preserved biological resources. Such buffer zones shall be of adequate width to protect biological resources from grading and construction activities, as well as from the long-term use of adjacent lands. Permitted land modification activities with preservation and buffer areas are to be limited to those that are consistent with the maintenance of the reproductive capacity of the identifies resources. The land uses and design of project facilities adjacent to a vegetative preservation area, as well as activities within the designated buffer area are not to be permitted to disturb natural drainage patterns to the point that vegetative resources receive too much or too little water to permit their ongoing health. In addition, landscape adjacent to areas of preserved biological resources shall be designed so as to avoid invasive species which could negatively impact the value of the preserved resource.**

**4.8-7 Require conservation or open space easements, granting of development rights, or other similar protections over biological habitats, and habitat linages being preserved in their natural state.**

**4.8-8 Prior to facility construction or installation, project specific biological resource surveys will be conducted onsite when any previously undeveloped areas may be disturbed by project implementation. If any sensitive species have the potential to occur on the site where OBMP facilities are proposed, or if previous environmental studies have not been conducted, IEUA will conduct all surveys in accordance with all established state, federal and generally accepted biological survey protocols for each potential species that may be located onsite. Further, IEUA will implement all mitigation measures recommended by jurisdictional agencies.**

**4.8-9 Mitigation measures should be determined on a project by project basis. Potential mitigation measures may include avoidance or minimization of impacts. One means of minimizing impacts to sensitive plants, for example, has included transplanting individuals out of harm's way.**

**4.8-10 The amount of water taken from or added to the Santa Ana River will be coordinated where possible to maintain the water level below the 505' elevation mark but above the 498' mark. If weather and hydrologic forecasts and reservoir conditions indicate that the pool elevation may exceed 505' because of a projected disparity between inflow and outflow, the water control manager at the Reservoir Operation Center shall take all steps necessary (including immediate release of water at the maximum possible rate to prevent the pool elevation from exceeding 505', or to reduce the amount of time the pool is above 505' (if, in fact, the maximum possible release rate does not succeed in keeping the pool elevation below 505'). This mitigation measure will help to ensure the preservation of critical habitat for the least Bell's vireo, and preservation of associated riparian resources.***

**4.8-11 Mitigation must be designed so that development of a given project will effectively benefit the species. The 2081 and 10(a) permits should be complimentary of one another to avoid conflicts between state and federal mitigation requirements. These permits will likely require land purchase, endowment funds, fencing funds, and mitigation measures. Section 7 consultations also usually include a land acquisition component.***

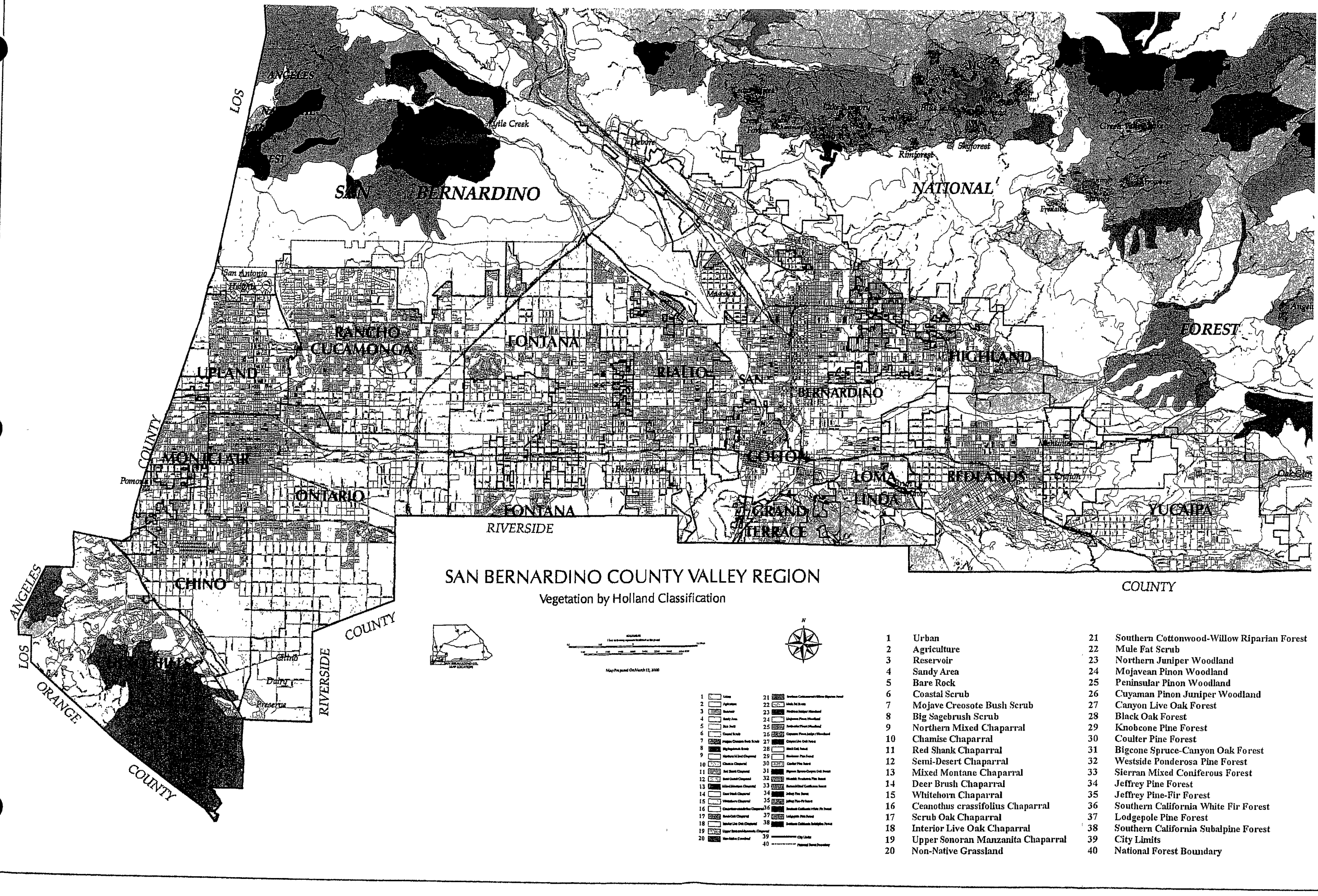
* Indicates that a modification to the mitigation measure has been made for clarification purposes in response to comments received on the DEIR.

## 4.8.5 Cumulative Impacts

Based on the evaluation in this subchapter, no significant biological resource impacts are forecast to occur due to OBMP implementation. If all potential biological impacts are fully mitigated according to all required mitigation ratio established by jurisdictional agencies, then the net cumulative impacts to these resources will be less than significant.

## 4.8.6 Unavoidable Adverse Impact

The biological resource evaluation presented above indicates that since biological impacts can be fully mitigated to a level of non-significance, no unavoidable significant adverse impacts to biological resources are forecast to occur as a result of project implementation.




## SAN BERNARDINO COUNTY VALLEY REGION

Vegetation by Holland Classification

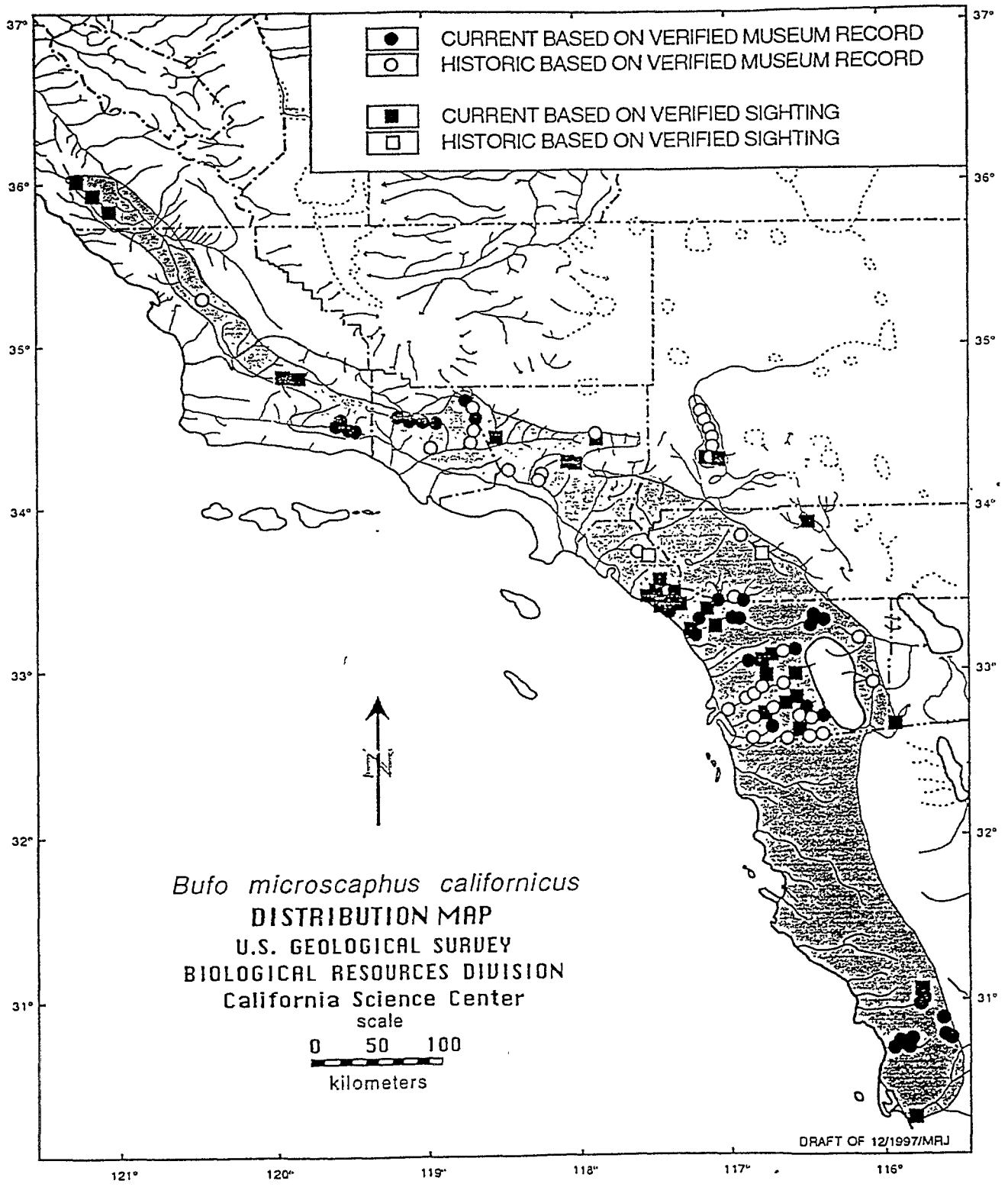
| | | | |
|---|---|---|---|
| 1 | Urban | 21 | Southern Cottonwood-Willow Riparian Forest |
| 2 | Agriculture | 22 | Mule Fat Scrub |
| 3 | Reservoir | 23 | Northern Juniper Woodland |
| 4 | Sandy Area | 24 | Mojavean Pinon Woodland |
| 5 | Bare Rock | 25 | Peninsular Pinon Woodland |
| 6 | Coastal Scrub | 26 | Cuyaman Pinon Juniper Woodland |
| 7 | Mojave Creosote Bush Scrub | 27 | Canyon Live Oak Forest |
| 8 | Big Sagebrush Scrub | 28 | Black Oak Forest |
| 9 | Northern Mixed Chaparral | 29 | Knobcone Pine Forest |
| 10 | Chamise Chaparral | 30 | Coulter Pine Forest |
| 11 | Red Shank Chaparral | 31 | Bigcone Spruce-Canyon Oak Forest |
| 12 | Semi-Desert Chaparral | 32 | Westside Ponderosa Pine Forest |
| 13 | Mixed Montane Chaparral | 33 | Sierran Mixed Coniferous Forest |
| 14 | Deer Brush Chaparral | 34 | Jeffrey Pine Forest |
| 15 | Whitehorn Chaparral | 35 | Jeffrey Pine-Fir Forest |
| 16 | Ceanothus crassifolius Chaparral | 36 | Southern California White Fir Forest |
| 17 | Scrub Oak Chaparral | 37 | Lodgepole Pine Forest |
| 18 | Interior Live Oak Chaparral | 38 | Southern California Subalpine Forest |
| 19 | Upper Sonoran Manzanita Chaparral | 39 | City Limits |
| 20 | Non-Native Grassland | 40 | National Forest Boundary |

**SAN BERNARDINO COUNTY VALLEY REGION**
**VEGETATION BY HOLLAND CLASSIFICATION**

Source: GIMS San Bernardino County, March 2000

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.8-1**

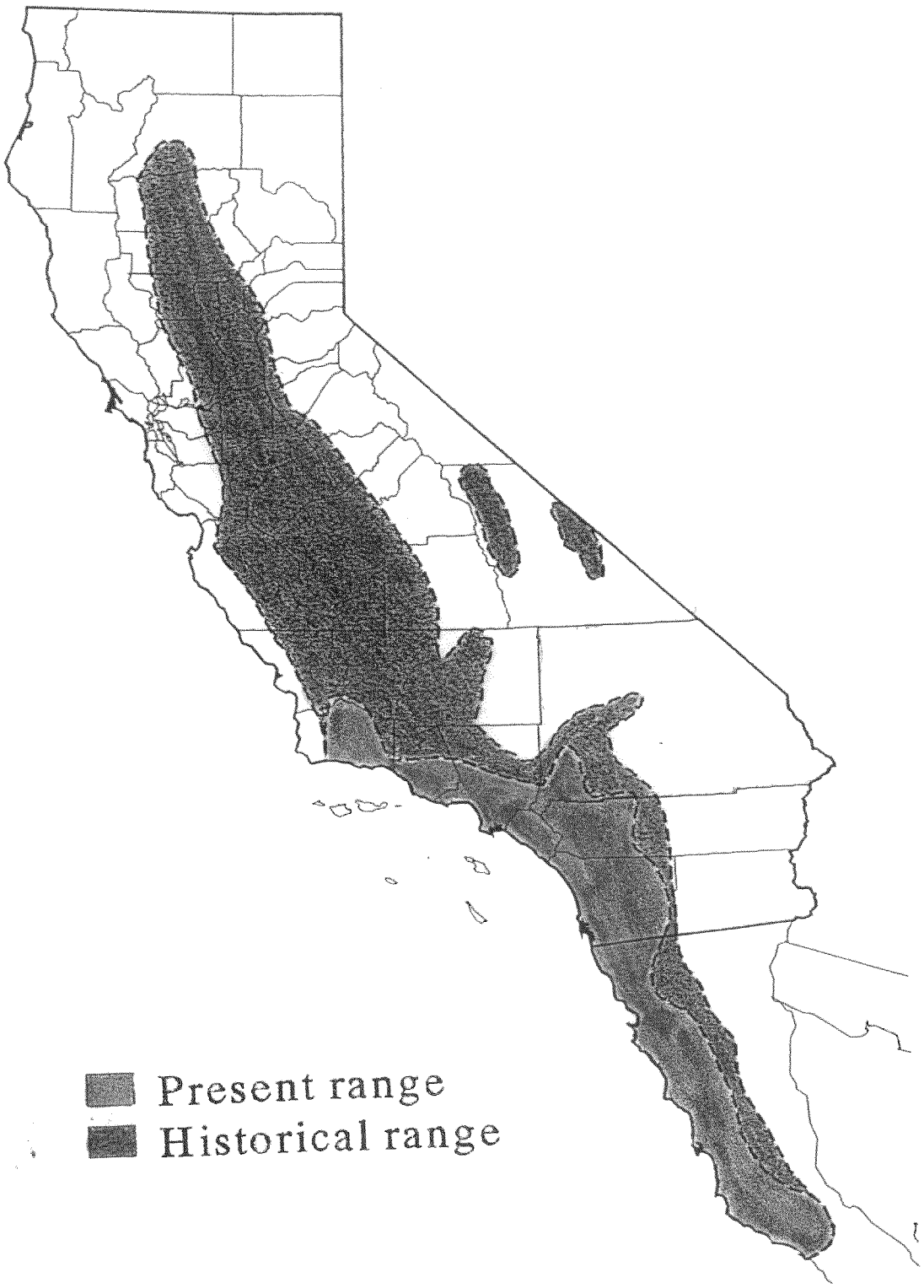



**SENSITIVE AREAS FOR ARROYO TOAD**

Source: San Bernardino County Planning Department and U.S. Fish and Wildlife Service

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Environmental Consultants

**FIGURE 4.8-2**

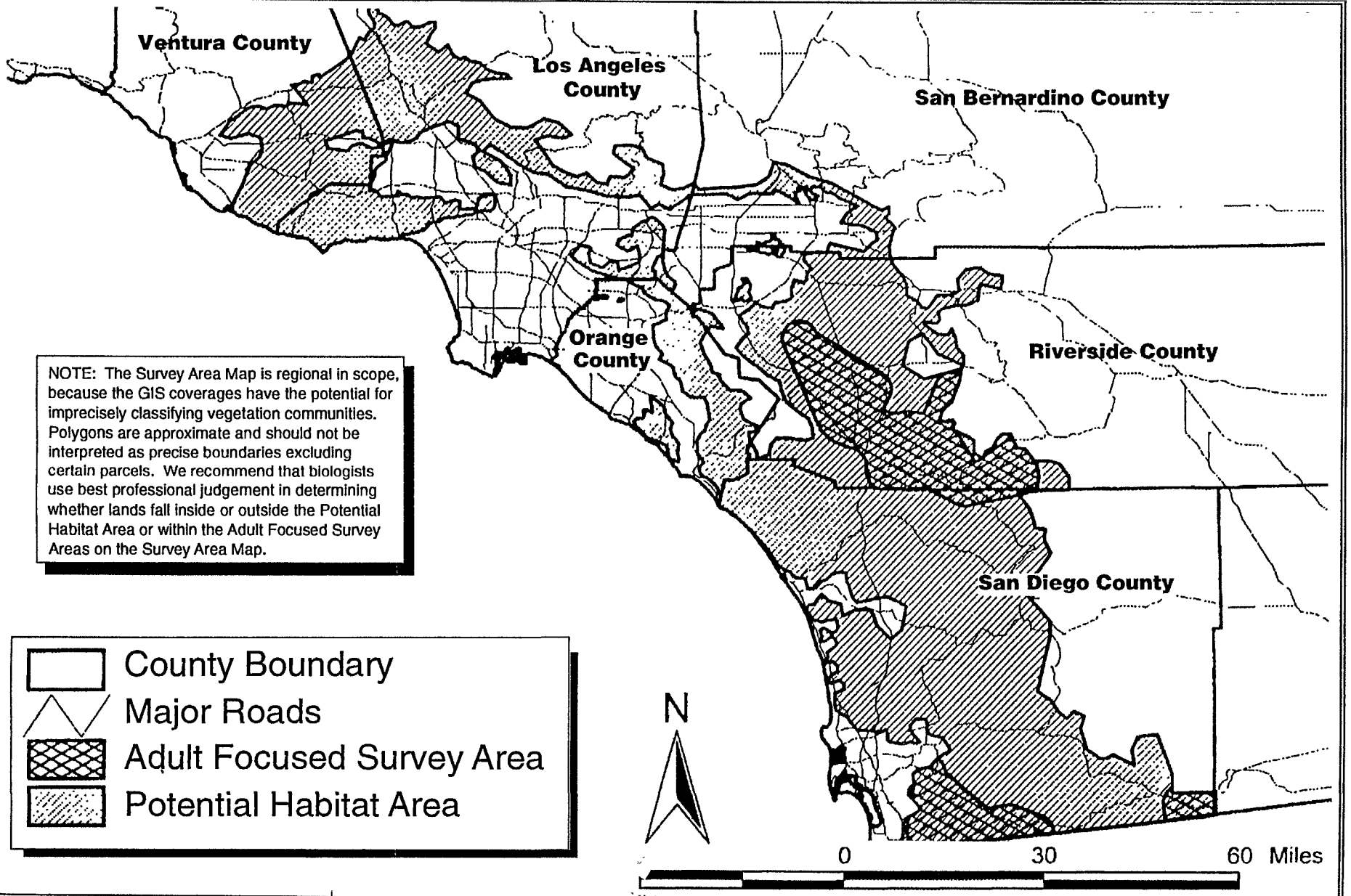



**SENSITIVE AREAS FOR LEAST BELL'S VIREO**

Source: San Bernardino County Planning Department

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.8-3**

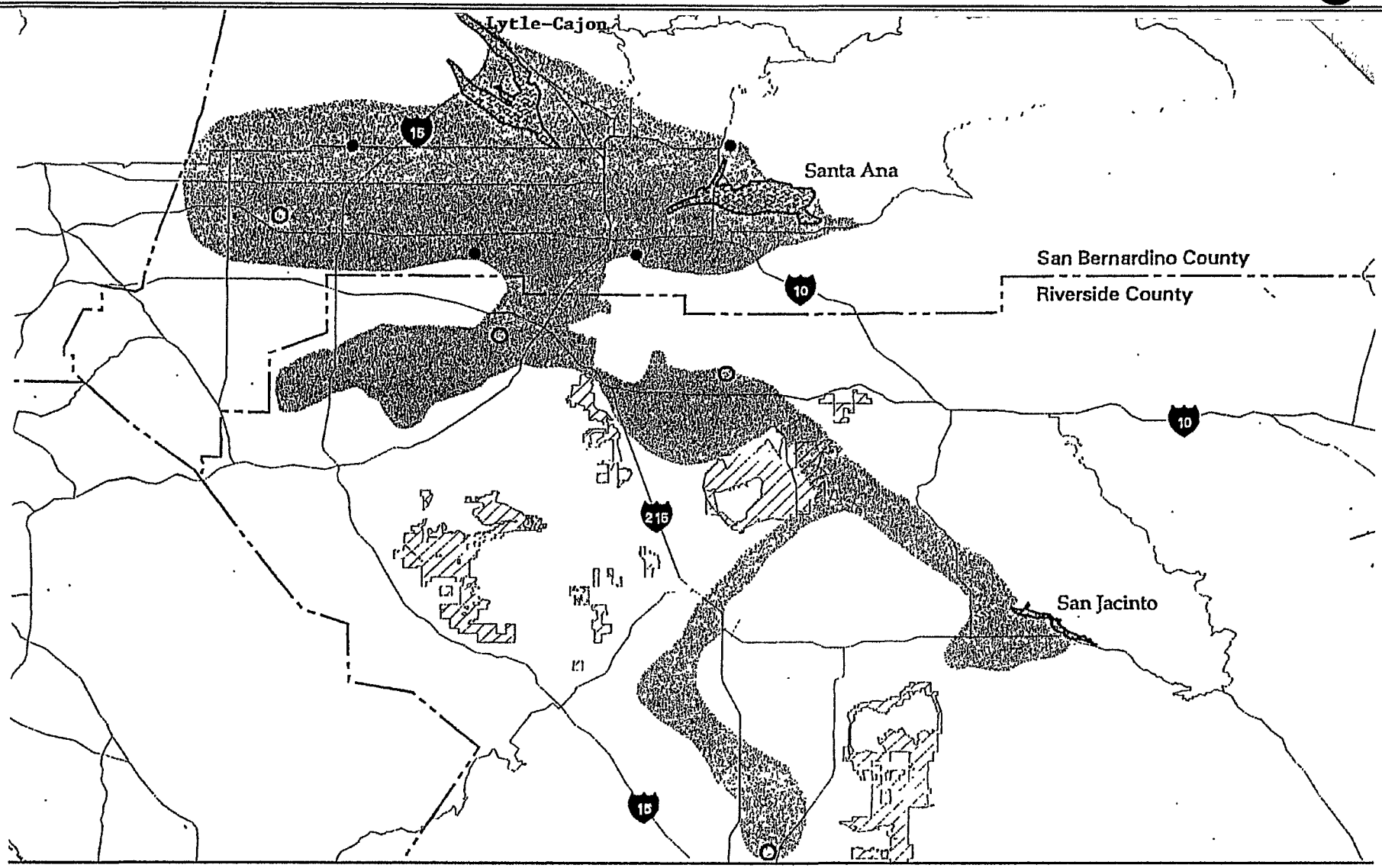



**SENSITIVE AREAS FOR QUINO CHECKERSPOT BUTTERFLY**

Source: U.S. Fish and Wildlife Service

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.8-4**

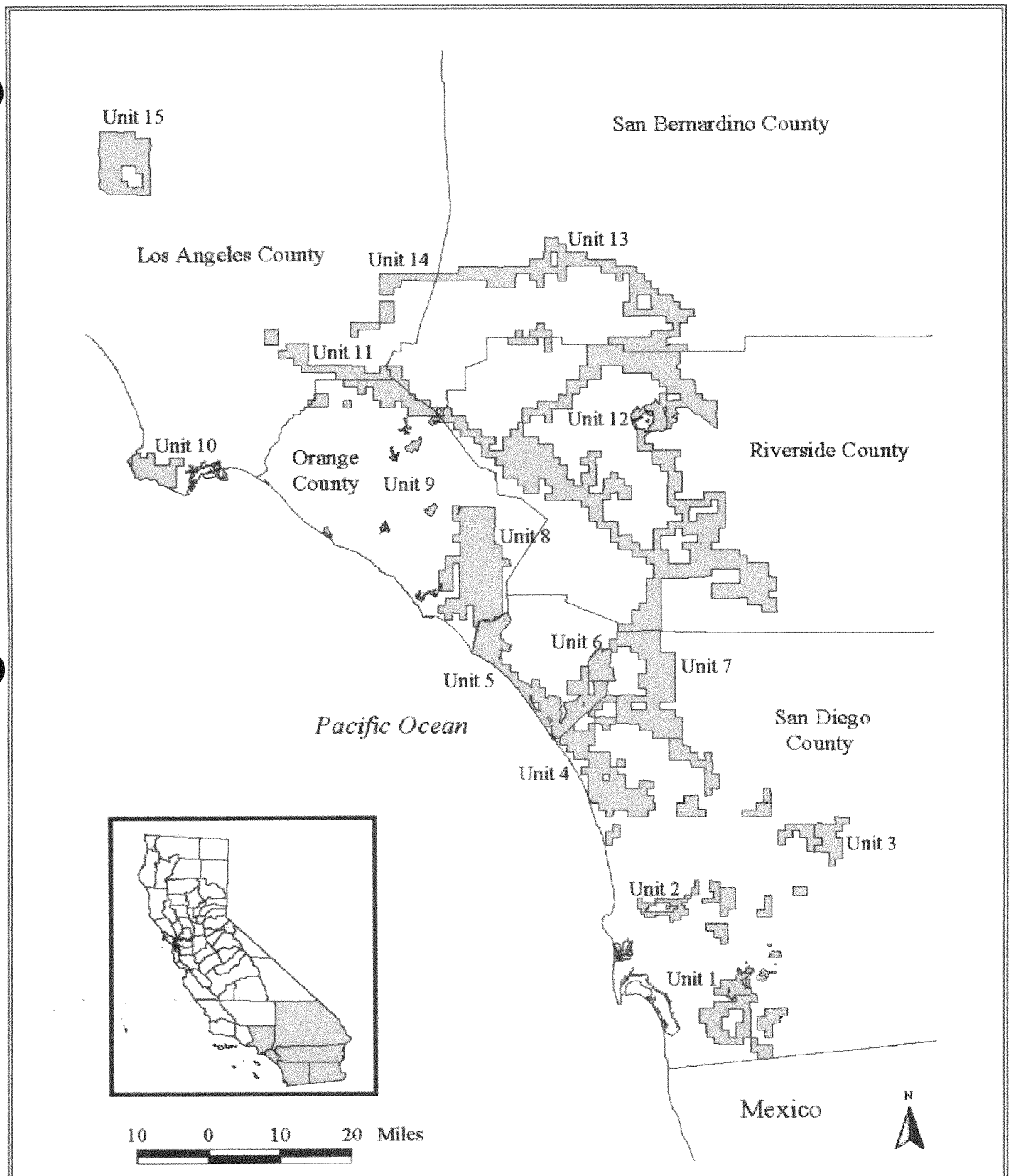



**SENSITIVE AREAS FOR SAN BERNARDINO KANGAROO RAT**

Source: U.S. Fish and Wildlife Service

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Environmental Consultants

**FIGURE 4.8-5**




**SENSITIVE AREAS FOR COASTAL CALIFORNIA GNATCATCHER**

Source: U.S. Fish and Wildlife Service Federal Register Notice

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**FIGURE 4.8-6**

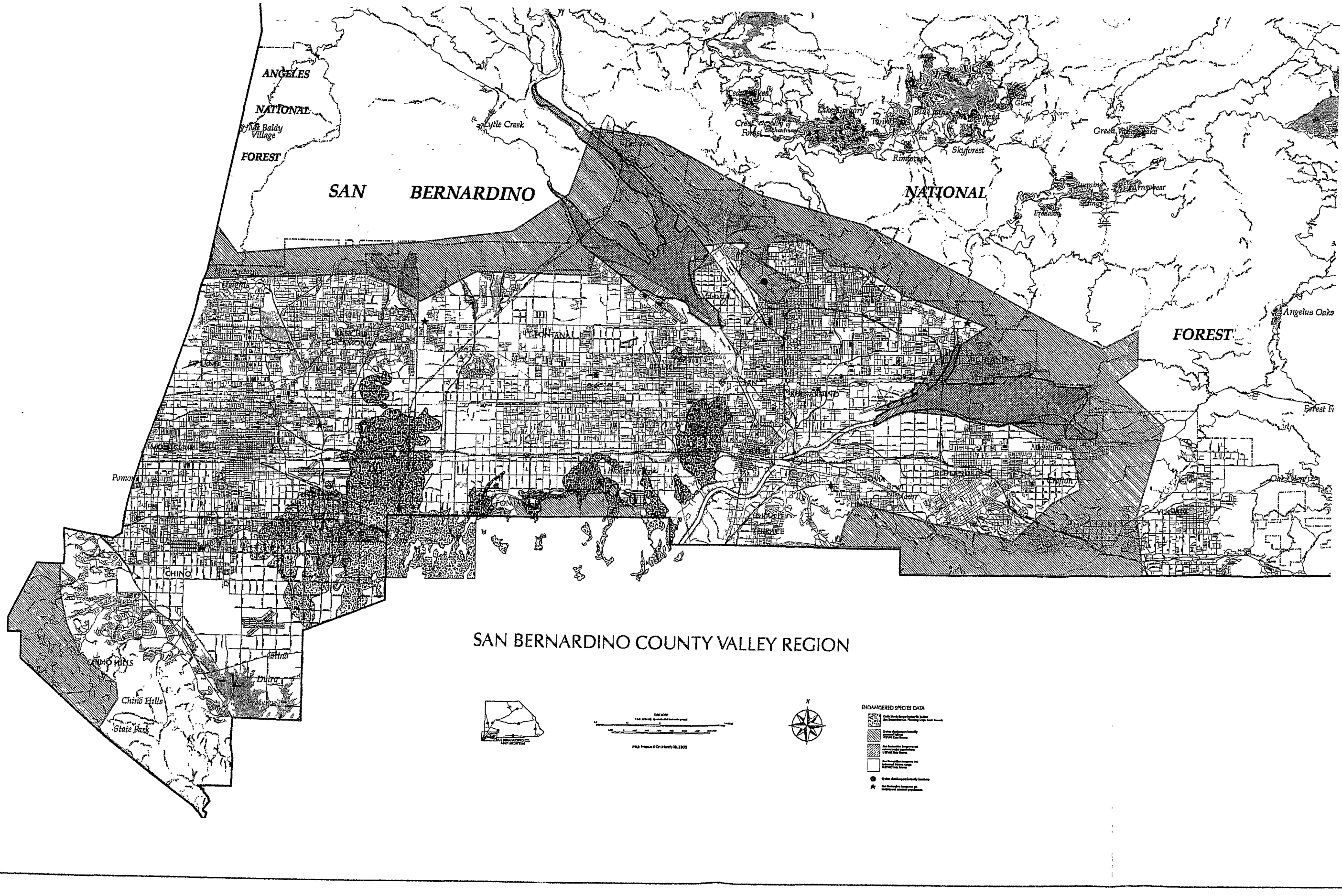



**FIGURE 4.8-7**

TOM DODSON & ASSOCIATES
Environmental Consultants

**SENSITIVE AREAS FOR ENDANGERED SPECIES IN THE VALLEY AREA**

Source: GIMS San Bernardino County, March 2000

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# 4.9 ENERGY

## 4.9.1 Introduction

This subchapter relies on data contained in the OBMP to attempt to forecast energy consumption associated with implementation of the program. The evaluation focuses on the type of energy required and the potential impacts to the systems that supply the energy.

## 4.9.2 Environmental Setting

The project area is located within the Chino Basin. While portions of the OBMP area are rural in character, the majority of the area is urbanized with energy sources readily available. Electricity is supplied by Southern California Edison Company (SCE) and natural gas is supplied by Southern California Gas Company (SCGC). Petroleum products are available in sufficient quantities throughout the area.

## 4.9.3 Project Impacts

Implementation of the OBMP will result in the consumption of energy over both the long and short term. In the short term, construction activities will consume primarily petroleum products by equipment and vehicles constructing and expanding water facilities. While construction will be ongoing for much of the life of the OBMP, construction activities are considered short term because they are not a permanent consumer of energy at any given facility or site.

Over the long term, energy will be consumed primarily by the pumps and motors needed to transport water and to operate water treatment facilities. The primary source of energy for these long-term consumptive uses will be electricity. The facilities proposed by the OBMP are not consumers of substantial amounts of natural gas.

The ultimate buildout usage of electrical power supply for OBMP facilities is estimated to be the combined total of kilowatt hour usage for desalter source water system pumps, desalter RO pumps (assuming Alternative 6A-RO only for the East, West, and SAWPA desalters), and for the treated water distribution system pumps (again for Alternative 6A with three fully operational desalters). The energy requirements for these pumping activities, respectively, are as follows. 31,649,292 kW hours (kWh); 21,510,910 kW hours; and 13,251,000 kW hours. The cost for this electrical energy is estimated to be $5,812,816. If these facilities treat a combined total of 40,000 acre-ft/year, the cost breakdown is approximately $145 per acre-foot of treated water, and approximately 1660 kW hours per acre-foot of water that is pumped, treated and delivered. The average pumping costs associated with bringing in SPW average about 3,200 kW hours per acre-foot of water delivered, and this SPW water may still require additional treatment before use. Thus the energy requirements associated with implementing the OBMP are less than without the OBMP, since a much greater volume of SPW would be necessary if many water purveyors had to import water to meet obligations. The cost

associated with the OBMP water supply plan would also be less than a water supply plan that would rely primarily on imported water sources. (personal communication with IEUA, April 19, 2000)

The total energy requirement of 66,411,202 kW hours for OBMP desalter and distribution operations is within the projected energy forecasts for the year 2007. The latest Electricity Report prepared in November of 1997 by the California Energy Commission states that SCE has existing and committed resource capacity to meet obligations up to 20,546 Megawatts for any peak demand period of time. The OBMP energy requirements are well within this capacity and will be spread out over a year's time.

Another possible idea that has been entertained under the OBMP is the capture, storage and transport of storm water from the southern portion of the basin to recharge areas above the Interstate-10 Freeway. To transport approximately 10,000 acre-ft/year of water from a recharge basin in the south over a 3-month time frame, approximately 2.2 million kWh of energy would be required, along with sizable pumps and a storage facility (possibly and existing basin). Again, this energy requirement is within the supply capacity of SCE as outlined in the 1997 Electricity Report.

### 4.9.3.1 Significance Criteria

The public service issues of concern in this evaluation are increased demand for utility capacity without adequate existing capacity or comparable increases in capacity from implementing the OBMP. The following criterion will be used to determine whether a significant utility impact will be created by the proposed project:

- The project will result in significant impacts to utilities if it causes demand for a utility to exceed the system's capacity and creates a need to develop new utility service system capacity without a means of funding the required system capacity expansion.

### 4.9.3.2 Construction Impacts

Construction activities will consume petroleum products. These products will be diesel and gasoline to power construction equipment. Virtually none of the construction activities will utilize electricity or natural gas. Based on projections provided in subsection 4.6, Air Quality, construction activities will require a relatively few pieces of equipment and based on the amount and the availability of petroleum products in the region, it is concluded that construction activities associated with this project have no potential to result in a demand that exceeds supply of petroleum products in the region.

### 4.9.3.3 Operation Impacts

Implementation of the OBMP will result in the utilization of electricity to power most of the pumps and motors required to transport and treat water. Virtually no natural gas or petroleum products will

be utilized. According to data provided in Chapter 12 of the California Energy Commissions Electricity Report, November 1997, SCE has adequate existing capacity to meet the demands for electricity through the year 2007 which is the extent of forecasting by the Energy Report.

Based on these data it is concluded that implementation of the OBMP will not create a demand for electricity that exceeds the systems capacity.

### 4.9.4 Mitigation Measures

No mitigation is proposed.

### 4.9.5 Unavoidable Adverse Impact

No unavoidable adverse impacts are identified in relation to energy supply issues.

### 4.9.6 Cumulative Impact

Implementation of the OBMP will contribute to the demand for electricity in the SCE service area. However, available data indicates that adequate existing capacity is available to meet this demand into the foreseeable future, and this is not considered to be a significant impact.

# 4.10 HAZARDS AND RISK OF UPSET

## 4.10.1 Introduction

The analysis in this section focuses on potential hazards and risks associated with implementing the OBMP ranging from construction activities to operation of facilities such as wells, desalters and other facilities. This section of the PEIR summarizes the major areas of groundwater contamination based on information contained in the OBMP for use in evaluating potential environmental impacts on contaminated areas from implementing the OBMP. This section also addresses the transport and handling of hazardous materials as part of the proposed business and industrial operations. Aside from the OBMP, the San Bernardino County Hazardous Waster Management Plan and local agency general plans have been reviewed for policies regarding management of hazardous materials and wastes and contaminated areas. Extensive additional information has been abstracted and presented with minor modifications, where appropriate, from the Kaiser Commerce Center Specific Plan EIR certified by San Bernardino County in 1999.

## 4.10.2 Environmental Setting

### 4.10.2.1 Existing Policies and Regulations

The principal agency for managing contamination from illegal or accidental releases of hazardous materials and wastes in the State of California is the Department of Toxic Substances Control (DTSC). In addition to enforcing state regulations (California Code of Regulations (CCR) Titles 17, 19, and 22), the DTSC was granted authorization from the federal EPA in 1992 to be the agency responsible for regulating the generation, transport, and disposal of hazardous waste under the authority of the Resource Conservation and Recovery Act (RCRA) in California. Other agencies that may periodically coordinate with DTSC or with the enforcement of regulations that address site activities include: Hazardous Materials Division, the San Bernardino County Fire Department, the Regional Water Quality Control Board (RWQCB), the State Water Resources Control Board, the SCAQMD, the Department of Transportation, and the California Highway Patrol.

### 4.10.2.2 Risk Associated with the Use of Hazardous Materials

Hazard vs. Risk

Worker and public health are potentially at risk whenever hazardous materials are present or will be used. It is important to differentiate between the "hazard" of these materials and the acceptability of the "risk" they pose to human health and the environment. A hazard is any situation that has the potential to cause damage to human health and the environment. The risk to human health and the environment is determined by the probability of exposure to the hazardous substance and the severity of harm such exposure would pose. The likelihood and means of exposure, in addition to the inherent toxicity of a substance, determine the degree of risk to human health. When the risk of an

activity is judged acceptable by society in relation to perceived benefits, the activity is judged to be safe.

Means of Exposure

Exposure to hazardous materials could occur in the following manner: (1) improper handling or use of hazardous materials during the course of business, particularly by untrained personnel; (2) failure of storage containment systems; (3) environmentally unsound treatment/disposal methods; (4) transportation accidents; (5) fire, explosion or other emergencies; or (6) permitted release of hazardous materials by regulatory agencies. The following factors influence the health effects of exposure to hazardous materials: the dose to which the person is exposed, the frequency of exposure, the duration of exposure, the exposure pathway (route by which a chemical enters a person's body), and the individual's unique biological susceptibility.

The means of exposure as outlined above would determine the way in which toxic materials are absorbed into the body and, therefore, the bodily organs or systems affected. The major ways in which toxic materials may enter and be absorbed by the body are through the mouth (ingestion), the skin (penetration), or the lungs (inhalation). How a hazardous substance gets into the body and what damage it causes depends on the form or physical properties of the substance (i.e., liquid, solid, gas, dust, fibers, fumes or mist). A chemical may be toxic by one route and not another.

Health effects from exposure to toxic materials may be acute or chronic. Acute effects, usually resulting from a single exposure to a toxic material, may include significant immediate damage to organs and systems in the body, and possibly death. Chronic effects, usually resulting from long term exposure to a toxic or hazardous substance, may also include systemic and organ damage, as well as birth defects, genetic damage and cancer.

Hazardous Material Handling

Hazardous materials could be utilized for operation of desalting facilities constructed as one component of implementing the OBMP. Table 4.10-1 lists federal, state and local regulatory agencies that oversee hazardous substances handling and management, and the statutes and regulations that these agencies administer. The following discussion contains a summary review of regulatory controls pertaining to hazardous materials.

## Table 4.10-1
## SUMMARY OF HAZARDOUS MATERIALS REGULATORY AUTHORITY

| Regulatory Agency | Jurisdiction | Authority |
|---|---|---|
| | *FEDERAL AGENCIES* | |
| Dept. of Transportation | Federal | Hazardous Materials Transportation Act - Code of Federal Regulations (CFR) 49 |
| Environmental Protection Agency | Federal | Federal Water Pollution Control Act<br>Clean Air Act<br>Resource Conservation & Recovery Act (RCRA)<br>Comprehensive Environmental Response, Compensation & Liability Act<br>Superfund Amendments & Reauthorization Act (SARA)<br>Federal Insecticide, Fungicide & Rodenticide Act |
| Occupational Safety and Health Administration | Federal | Occupational Safety and Health Act & CFR 29 |
| | *STATE AGENCIES* | |
| Dept. of Toxic Substances Control | State | California Code of Regulations (CCR) Titles 17, 19, & 22 |
| Dept. of Industrial Relations (CAL-OSHA) | State | California Occupational Safety & Health Act, CCR Title 8 |
| State Water Resources Control Board & Regional Water Quality Control Board | State | Porter-Cologne Water Quality Control Act<br>Underground Storage Tank Law |
| Health & Welfare Agency | State | Safe Drinking Water & Toxic Enforcement Act |
| Air Resources Board & Air Pollution Control District | State | Air Resources Act<br>AB 1807<br>Air Toxics "Hot Spots" Information and Assessment Act |
| Office of Emergency Services | State | Hazardous Materials Release Response Plans/Inventory Law<br>Acutely Hazardous Materials Law |
| Dept. of Fish and Game | State | Fish and Game Code |
| Dept. of Food and Agriculture | State | Food and Agriculture Code |
| State Fire Marshal | State | Uniform Fire Code, CCR Title 19 |
| | *COUNTY / REGIONAL AGENCIES* | |
| South Coast Air Quality Management District | South Coast Air Basin | Air Toxics "Hot Spots" Information and Assessment Act |
| San Bernardino County Fire Department of Hazardous Materials Division | County | Uniform Fire Code<br>Hazardous Waste Control Statutes, H&S 25100 et. seq.<br>Hazardous Materials Release Response Plans/Inventory Statutes, H&S 25500 et. seq.<br>Acutely Hazardous Materials Regulations, CCR Titles 19, 22, & 23<br>San Bernardino County Code |

Source: Urban Logic Consultants 1/98

### 4.10.2.3 Federal

Federal agencies that regulate hazardous and toxic materials include the EPA, the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (DOT), and the National Institutes of Health (NIH). The following federal laws and guidelines govern hazardous materials. Hazardous materials handling and management associated with the proposed project must comply with applicable regulations as follows:

- Federal Water Pollution Control Act
- Clean Air Act
- Occupational Safety and Health Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- Guidelines for Carcinogens and Biohazards
- Superfund Amendments and Reauthorization Act Title III
- Resource Conservation and Recovery Act
- Safe Drinking Water Act
- Toxic Substances Control Act

Until August 1992, the principal agency at the federal level regulating the generation, transport and disposal of hazardous waste was the EPA under the authority of the RCRA. However, effective August 1, 1992, the California Environmental Protection Agency (Cal-EPA) and the DTSC, was authorized to implement the State's hazardous waste management program in lieu of the EPA.

### 4.10.2.4 State

The Cal-EPA and the State Water Resources Control Board generally govern the use of hazardous materials and the management of hazardous waste. The California Highway Patrol (CHP) and the California Department of Transportation (Caltrans) enforce hazardous substance transportation regulations. Chemical suppliers must comply with all applicable packaging, labeling and shipping regulations.

Applicable state and local laws include the following:

- Public Safety/Fire Regulations/Building Codes
- Hazardous Waste Control Law
- Hazardous Substances Information and Training Act
- Hazardous Materials Release Response Plans and Inventory Act
- Porter-Cologne Water Quality Control Act
- Tanner Toxics Act

DTSC has primary regulatory responsibility for the management of hazardous materials/substances and the generation, transport and disposal of hazardous waste under the authority of the Hazardous Waste Control Law (HWCL). DTSC can delegate enforcement to local jurisdictions that enter into agreements with the State agency. State regulations applicable to hazardous materials are indexed agreements in Title 26 of the CCR.

### 4.10.2.5 Regional

The SCAQMD works with the CARB and is responsible for developing and implementing rules and regulations to control the emission of air toxics on a local level. The SCAQMD establishes permitting requirements, inspects emission sources, and enforces measures through educational programs and/or fines. The Santa Ana RWQCB controls the discharge of toxic materials in wastewater and from disposal facilities through the issuance of waste discharge requirements and NPDES permits under authority from the State Water Resources Control Board and the federal EPA.

### 4.10.2.6 Local

The San Bernardino County General Plan has a Hazardous Waste/Materials element which sets forth policies and actions that are meant to achieve the following goals:

- reduce the risks posed by the storage of hazardous materials in above ground tanks and containers;
- minimize the threat to residential areas from the use of hazardous materials;
- ensure that businesses locating within the County incorporate available risk management and waste minimization practices into their operations;
- minimize the risk of exposure to hazardous materials by residential and immobile populations; and
- ensure the safe transportation of hazardous materials and waste in and through San Bernardino County.

The San Bernardino County Fire Department (SBCFD) is responsible, on both the city and county level, for enforcing the State regulations governing hazardous waste generators, hazardous waste storage, and underground storage tanks, including inspections and enforcement. The SBCFD also regulates the use, storage, and disposal of hazardous materials in San Bernardino County by issuing permits, monitoring regulatory compliance, investigating complaints, and other enforcement activities. In addition to providing fire protection and emergency services to unincorporated areas of San Bernardino County, the SBCFD regulates the use and storage of hazardous materials for the County and provides emergency response in the event of accidental release of hazardous materials.

The SCCFD also administers the local Fire Code which incorporates articles of the Uniform Fire Code (UFC). The UFC is a model code setting construction standards for buildings and associated fixtures, in order to prevent or mitigate hazards resulting from fire or explosion. The SBCFD reviews technical aspects of hazardous waste site cleanups, and oversees remediation of certain contaminated sites resulting from leaking underground storage tanks. The SBCFD is also responsible for providing technical assistance to public and private entities which seek to minimize the generation of hazardous waste.

#### 4.10.2.7 Hazardous Materials Transportation

Federal

The DOT has the regulatory responsibility for the safe transportation of hazardous materials between states and to foreign countries. DOT regulations govern all means of hazardous materials transportation (except for those packages shipped by mail, which are covered by the U.S. Postal Service regulations), including transportation by rail. DOT regulations are contained in the Code of Federal Regulations Title 49.

Under RCRA, the EPA sets standards for transporters of hazardous waste. In turn, the federal government authorized the State of California to carry out EPA regulations concerning transportation of hazardous wastes originating in, or passing through, the State.

State

The State of California has adopted regulations for the intrastate movement of hazardous materials. State regulations are indexed in the CCR Title 26.

The CHP has primary responsibility for enforcing federal and State regulations related to the transport of hazardous materials over streets and highways, including hazardous materials labeling and packaging regulations. The CHP also responds to hazardous materials transportation emergencies. The goal of these regulations is to prevent leakage and spills of material in transit and to provide detailed information to clean-up crews in the event of an accident. Vehicle and equipment inspection, shipment preparation, container identification, and shipping documentation are all part of the responsibility of the CHP, which conducts regular inspections of licensed transporters to assure regulatory compliance.

Common carriers which transport hazardous materials on roadways are licensed by the CHP under conditions specified in CCR Title 26, Division 14.1 Transportation of Hazardous Material, Section 32000.5, License to Transport Hazardous Materials. This section requires licensing of every motor (common) carrier who transports, for a fee, in excess of 500 pounds of hazardous materials at one time, and every carrier, if not for hire, who carries more than 1,000 pounds of hazardous materials of

the type requiring placards. If the supplier or distributor carries fewer than 1,000 pounds of material, a license is not required.

Interstates 10, 15 and 215 are designated explosives routes according to the CHP manual *Explosive Routes and Stopping Places.*

### 4.10.2.8 Hazardous Materials Worker Safety Requirements

Federal

The Federal Occupational Safety and Health Administration (Fed/OSHA) is the agency responsible for ensuring worker safety. Fed/OSHA sets federal standards for implementation of training in the work place, exposure limits, and safety procedures in the handling of hazardous materials (as well as other hazards). Fed/OSHA also establishes criteria by which each state can implement its own health and safety program.

State

The California Department of Industrial Relations, Division of Occupational Safety and Health Administration (Cal/OSHA), assumes primary responsibility for developing and enforcing work place safety regulations within the State. Cal/OSHA standards are often more stringent than federal regulations.

Cal/OSHA regulations concerning the management of hazardous materials include requirements for safety training, availability of safety equipment, hazardous materials exposure warnings, and emergency action and fire prevention plan preparation. Cal/OSHA enforces the hazard communication program regulations, which include provisions for identifying and labeling hazardous materials, providing employees with Material Safety Data Sheets (MSDSs), describing the hazards of chemicals, and documenting employee training programs.

Both federal and state laws include special provisions for hazard communication to employees in research laboratories, including training in chemical work practices. The training, must include safe methods for handling hazardous materials, an explanation of MSDSs, use of emergency response equipment, and building emergency response plans and procedures.

### 4.10.2.9 Potentially Contaminated Areas Within the Chino Basin

As part of the OBMP's State of the Basin assessment, those wells and locations with contaminants at high enough levels to be of concern were identified. The discussion of the locations with existing concentrations of contaminant pollution from man-made sources is discussed in this section of the PEIR, rather than the Water Resource and Water Quality (Subchapter 4.5). Human activities over the past 100+ years have cause a variety of contamination within the Chino Basin. Most of the

organic contaminants and several other pollution plumes that occur within the Basin were caused by industrial activities and related population growth that began with World War II and continues through the present. The information from the OBMP is presented below with minor editing as appropriate.

Table 4.10-2 summarizes the inorganic and organic constituents that have been detected in groundwater samples from wells in the Chino Basin through July 1998. The data collection methodology and sources of data are described in detail in the OBMP, Page 2-22, but based on the total picture of contamination provided in Table 4.10-1, the contamination data represent the most comprehensive data base available to date. These data are represented in maps of the Chino Basin that illustrate the locations where the concentration of contaminants has been detected at 1/2 or above the established maximum contaminant levels. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 4.10-1), in other basins in California and other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of one µg/L and a reporting limit of 4 µg/L.

Perchlorate ($ClO_4^-$) originates as a contaminant in the environment from the solid salts of ammonium perchlorate ($NH_4ClO_4$), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion ($ClO_4^-$) is exceedingly mobile in soil and groundwater environments. It can persist for many decades under typical groundwater and surface water conditions, because of its resistance to react with other available constituents. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

At very high levels, perchlorate interferes with the function of the thyroid gland and the production of hormones necessary for normal human development. In the extreme cases, it can cause brain damage in fetuses and a potentially fatal form of anemia in adults. However, effects of chronic exposures to lower levels currently detected in groundwater are not known.

## Table 4.10-2
## CONSTITUENTS DETECTED AT OR GREATER THAN THEIR MCLs

| Constituents | Observations At or Above 1/2* MCL | Wells with Observations At or Above 1/2* MCL | Observations At or Above MCL | Wells with Observations At or Above MCL | MCL |
|---|---|---|---|---|---|
| ***Inorganic Constituents*** | | | | | |
| Aluminum | 2 | 2 | 0 | 0 | 1 mg/L |
| Arsenic | 8 | 1 | 0 | 0 | 0.05 mg/L |
| Beryllium | 7 | 5 | 2 | 1 | 0.004 mg/L |
| Boron | 122 | 47 | 48 | 19 | 1 mg/L |
| Cadmium | 17 | 8 | 5 | 4 | 0.005 mg/L |
| Chromium | 16 | 10 | 7 | 5 | 0.05 mg/L |
| Copper | 1 | 1 | 0 | 0 | 1 mg/L |
| Fluoride | 302 | 51 | 160 | 30 | 2 mg/L |
| Iron | 104 | 48 | 54 | 28 | 0.3 mg/L |
| Lead | 62 | 25 | 24 | 14 | 0.015 mg/L |
| Manganese | 317 | 45 | 285 | 24 | 0.05 mg/L |
| Mercury | 4 | 3 | 2 | 2 | 0.002 mg/L |
| Nickel | 2 | 2 | 0 | 0 | 0.1 mg/L |
| Nitrate (as N) | 4,165 | 513 | 2,053 | 322 | 10 mg/L |
| Perchlorate | 7 | 4 | 1 | 1 | 0.018 mg/L |
| Selenium | 3 | 1 | 3 | 1 | 0.05 mg/L |
| Silver | 1 | 1 | 1 | 1 | 0.1 mg/L |
| Total Dissolved Solids (TDS)[a] | 2,978 | 522 | 1,077 | 219 | 500 mg/L |
| Total Dissolved Solids (TDS)[b] | 1,077 | 219 | 119 | 44 | 1,000 mg/L |
| Zinc | 1 | 1 | 0 | 0 | 5 mg/L |
| ***Radioactivity*** | | | | | |
| Gross Alpha Particle Activity | 39 | 16 | 11 | 7 | 15 pCi/L |
| Uranium | 5 | 3 | 0 | 0 | 20 pCi/L |
| ***Volatile Organic Chemicals*** | | | | | |
| 1,1-Dichloroethane | 34 | 7 | 22 | 7 | 0.005 mg/L |
| 1,1-Dichloroethylene | 497 | 18 | 355 | 13 | 0.006 mg/L |
| 1,2-Dichloroethane | 134 | 77 | 122 | 76 | 0.0005 mg/L |
| 1,2-Dichloropropane | 1 | 1 | 0 | 0 | 0.005 mg/L |
| 1,4-Dichlorobenzene | 3 | 2 | 2 | 1 | 0.005 mg/L |
| Benzene | 155 | 89 | 43 | 23 | 0.001 mg/L |
| Carbon Tetrachloride | 1 | 1 | 1 | 1 | 0.0005 mg/L |
| cis-1,2-Dichloroethylene | 9 | 3 | 4 | 1 | 0.006 mg/L |
| Phenol | 6 | 2 | 5 | 2 | 0.005 mg/L |
| Tetrachloroethene (PCE) | 521 | 59 | 198 | 54 | 0.005 mg/L |
| Trichloroethene (TCE) | 1,022 | 85 | 699 | 74 | 0.005 mg/L |
| Vinyl chloride | 154 | 81 | 136 | 79 | 0.0005 mg/L |
| ***Semi-Volatile Organic Chemical*** | | | | | |
| Di(2-Ethlhexyl)Phthalate | 25 | 10 | 25 | 10 | 0.004 mg/L |
| ***Pesticides/Herbicides*** | | | | | |
| Dibromochloropropane (DBCP) | 1,068 | 45 | 758 | 41 | 0.0002 mg/L |
| Ethylene Dibromide (EDB) | 3 | 3 | 1 | 1 | 0.00005 mg/L |
| Lindane (gamma-BHC) | 61 | 46 | 20 | 15 | 0.0002 mg/L |
| ***Aesthetic Standards*** | | | | | |
| Foaming Agents (MBAS) | 41 | 22 | 37 | 19 | 0.5 mg/L |

(a) Recommended Secondary MCL Range of 500 mg/L
(b) Upper Secondary MCL Range of 1,000 mg/L

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and likely other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel

Perchlorate is of concern because of the existing uncertainties in: the toxicological database documenting its health effects at low levels in drinking water; the actual extent of the occurrence of perchlorate in ground and surface waters, which is compounded by some uncertainty in the validation of the analytical detection method; the efficacy of different treatment technologies for various water uses such as drinking water or agricultural application; and the extent and nature of ecological impact or transport and transformation phenomena in various environmental media.

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The U.S. Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 (µg/L). In 1997, the DHS and California EPA's Office of Environmental Health Hazard Assessment reviewed the EPA risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced but has not been brought to a vote (CA Senate Bill 1033).

Volatile Organic Compounds

Six volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells: 1,1-dichloroethene; 1,2-dichloroethane; benzene; tetrachloroethene (PCE); trichloroethene (TCE); and vinyl chloride.

TCE and PCE were/are widely used industrial solvents. TCE was commonly used for metal degreasing and was also used as a food extractant. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners used PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). The areal distributions of PCE and TCE are shown in Figures 4.10-2 and 4.10-3. 1,1-Dichloroethane, 1,1-Dichloroethene, cis-1, 2-dichloroethene, 1,2-dichloroethane, and vinyl chloride are degradation by-products of PCE and TCE and their areal distributions are shown in Figures 4.10-4 though 4.10-8.

The spatial distributions of TCE and PCE appear to be correlatable to identified point sources in the Chino Basin (see the following discussion and Figure 4.10-12.) The areal distributions of 1,2-dichloroethane and vinyl chloride appear to be more extensive than can be attributed to the point sources. 1,2-Dichloroethane is used as a lead-scavenging agent in gasoline (Oak Ridge National Laboratories, 1989) and the greater areal distribution of 1,2-dichloroethane and vinyl chloride may reflect numerous minor releases from gasoline stations, automobile service stations, et cetera. This hypothesis appears to be corroborated, in part, by the distribution of benzene, which is a minor contaminant in gasoline (see Figure 4.10-9). Gasoline used in the United States contains between 0.8 and 2 percent benzene (Oak Ridge National Laboratories, 1989).

Two pesticides/herbicides were detected at or above their MCL in more than 10 wells: dibromochloropropane (DBCP); and lindane. DBCP was used as a fumigant for citrus, other orchards and some field crops prior to being banned in 1987. The areal distribution of DBCP appears to be related to historical citrus crop production in Chino Basin (see Figures 4.10-10). Lindane is used as an insecticide on foliar plants and fruit and vegetable crops; its areal distribution is shown in Figure 4.10-11.

Point Sources of Concern

The previous discussion discussed man-made groundwater contamination conditions broadly across the entire basin. The discussion presented below describes the point source contamination anomalies associated with known point source discharges to groundwater. Figure 4.10-12 shows the location of various point sources and areas of water quality degradation associated with these sources. Each point source of contamination is described in the following text.

*Chino Airport*. The Chino Airport is located approximately four miles east of the City of Chino downtown area and six miles southwest of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (Regional Board, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL is TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L. Figure 4.10-12 shows the approximate areal extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 1990. The plume is elongate in shape, about 2,200 feet wide and extends approximately 8,000 feet from the airport's northern boundary in a south to southwestern direction.

*California Institute for Men.* The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicate that the most common VOCs detected in groundwater underlying CIM are PCE and TCE. Other VOCs detected include carbon tetrachloride, chloroform, 1,2-dichloroethene, bromodichloromethane, 1,1,1-trichloroethane, and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geomatrix Consultants, 1996). Figure 4.10-12 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of May 1996. The plume is approximately 1,000 feet wide and extends about 3,600 feet southwest.

*General Electric Flatiron Facility.* The General Electric Flatiron Facility (Flatiron Facility) occupied a site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations consisted primarily of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The Regional Board issued an investigative order to General Electric in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 µg/L. Other VOCs periodically detected, but commonly below MCLs, include PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997). Figure 4.10-12 shows the approximate areal extent of TCE in groundwater at concentrations exceeding MCLs, as of November 1997. The plume is approximately 3,000 feet wide and extends about 8,400 feet south-southwest (hydraulically downgradient) from the southern border of the site.

*General Electric Test Cell Facility.* The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avion, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicate that the most common and abundant VOC detected in groundwater is TCE. Other VOCs detected include PCE, cis-1,2-dichloroethene, 1,2-dicholoropropane, 1,1-dichloroethene, 1,1-dichloroethane, benzene, toluene and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) is 1,240 µg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) is 190 µg/L (BDM

International, 1997). Figure 4.10-12 shows the areal extent of VOC contamination exceeding federal MCLs as of March 1997. The plume is elongate in shape, about 1,000 to 1,200 feet wide and extends approximately 8,000 feet from the Test Cell Facility in a southwesterly direction.

*Kaiser Steel Fontana Steel Site*. Between 1943 and 1983, Kaiser Steel Corporation (Kaiser), operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the Regional Board issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigation and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. Figure 4.10-12 shows the approximate areal extent of the TDS/TOC groundwater plume as of November 1991. The plume is approximately 3,000 feet wide and extends about 17,000 feet southwest. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

*Milliken Sanitary Landfill*. The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). At the present time the facility is in the process of being closed. Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the release. The most common VOCs detected are TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs include vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well is 159.6 µg/L (GeoLogic Associates, 1998). Figure 4.10-12 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of April 1998. The plume is approximately 1,900 feet wide and extends about 2,000 feet south of the MSL's southern border (GeoLogic Associates, 1998).

*Municipal Wastewater Disposal Ponds*. Treated municipal wastewater has been disposed into ponds located near the current Inland Empire Utilities Agency (IEUA), at Regional Plant 1 (RP1), located

in south Ontario, and the former Regional Plant 3 (RP3), located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. The locations of these ponds are shown in Figure 4.10-12. Contaminant plumes emanating from these ponds have never been fully characterized.

*Upland Sanitary Landfill.* The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells (an upgradient well, a cross-gradient well, and a downgradient well) (City of Upland, 1998). The results of groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, cis-1,2 dichloroethene, 1,1-dichloroethane, and benzene. The 1990-95 average total VOC concentration in the downgradient monitoring well is 125 µg/L (GeoLogic Associates, 1997). Figure 4.10-12 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of April 1998. However, the plume is defined only by the three on-site monitoring wells. The plume extent may be greater than is depicted on Figure 4.10-12.

*National Priorities List Sites.* Three facilities in, or directly tributary to, the Chino Basin are on the current National Priorities List (NPL) of Superfund sites: Stringfellow; Dodson Brothers; Pacific Polishing (Figure 4.10-12). Elevated levels of TCE and its degradation by-products have been detected in groundwater in the vicinity of the Dodson Brothers Superfund site.

*TCE/PCE Anomaly – South of the Ontario Airport.* A plume containing TCE and PCE exists south of the Ontario Airport. The plume extends from approximately State Route 60 on the north, Turner Avenue on the east to Schaeffer Avenue on the south and Vineyard Avenue on the west. Figure 4.10-12 shows the approximate areal extent of the plume. The plume appears to be approximately 6,000 feet wide and 9,000 feet long. The maximum reported TCE and PCE concentrations are 142 µg/L and 2 µg/L, respectively.

### 4.10.3 Project Impacts

Implementation of the OBMP has the potential to increase hazards and risk of upset from its construction activities, limited utilization of hazardous materials, and operation of production wells in support of the desalters. Anytime construction activities are carried out, a potential exists for accidental releases of hazardous or toxic materials, particularly petroleum products. Operation of desalters in support of the OBMP may also require utilization of hazardous materials as part of routine operations. In addition, recharging groundwater in the upper and middle portions of the Chino Basin and pumping groundwater in the lower portion of the Basin for treatment to remove dissolved salts all have the ability to cause the existing groundwater contamination described above to be spread over a greater area than would occur naturally. Finally, the recharge of recycled water (treated effluent) is managed very cautiously by the State Health Department to ensure that concentrations of recycled water do not exceed a certain percentage of water pumped for municipal purposes and to ensure that the recycled water has a minimum detention time of 6-months in the ground before it is utilized for municipal water supplies. The purpose is to minimize the risk from reusing the recycled water for potable water purposes. Each of these issues is discussed below.

#### 4.10.3.1 Significance Criteria

In accordance with *CEQA Guidelines,* the effects of a project are evaluated to determine if they will result in a significant adverse impact on the environment. The criteria or standards, used to determine the significance of impacts may vary depending on the nature of the project. Impacts resulting from the implementation of the OBMP will be considered significant if they cause any of the following:

- Handling, production, disposal or treatment of hazardous materials that puts public health and safety at risk, including exposure of sensitive receptors to substantial pollutant concentrations or creation of unsafe conditions for workers or the general public.

- New hazards or additional human exposure to hazards will be created that cannot be managed so as not to pose a threat to the environment or people.

- Project-related activities increase the risk of upset (accidents) in a manner that exposes the Project Area population to greater health risks.

#### 4.10.3.2 Discussion of Hazard and Risk of Upset Impacts

**a. Will the project create a risk of accidental explosion or release of hazardous substances, including, but not limited to oil, pesticides, chemicals or radiation?**

Inherent to the use of hazardous materials is the risk of an accidental release. Because of this risk, Federal, State and local agencies have established regulations to minimize the likelihood of such occurrences. During construction or maintenance activities in support of the OBMP and during operations at primary facilities, such as desalters, fuels, oils, solvents, and other petroleum materials classified as "hazardous" will be used to support these operations. Similarly, if chlorine for the desalter facilities is stored as chlorine gas in tanks on a desalter site, the potential exists for accidental releases of this disinfection chemical.

Mitigation measures designed to reduce, control or remediate potential accidental releases must be implemented to prevent the creation of new contaminated areas that may require remediation and to minimize exposure of humans to public health risks from accidental releases. Such measures are presented in the following section. These measures are provided to reduce the potential for such accidents to occur (use of best management practices to minimize potential for accidental releases); to immediately collect and store or remove the primary source of contamination, including soils; and to remediate any residual contamination to levels that do not exceed regulatory thresholds for use, generally unrestricted use, in the future. By implementing these measures potentially significant adverse environmental impacts from accidental releases associated with implementing the OBMP can be reduced to a non-significant level of impact.

### b. Does the project have a possibility to interfere with an emergency response plan or emergency evacuation plan?

Major evacuation routes are located within the Chino Basin along major interstates, freeways and major north-south and east-west roads. The proposed project activities and facilities have no potential to permanently impact emergency evacuation plans or emergency response plans over the long-term. In the short-term, construction activities related to pipeline and other infrastructure system improvements located within existing road rights-of-way have a potential to interfere with such plans. Mitigation is identified below to ensure that roads under construction remain passable or that alternative routes are available both during daily construction and at the end of the day after construction is completed. These measures ensure that the proposed project will not significantly interfere with the existing emergency response plans or the emergency evacuation plans maintained by the local jurisdictions.

### c. Will the project create any health hazards or potential health hazards?

There are several activities associated with implementation of the OBMP that have a potential, or a perception, of creating a potential health hazard. The first activity is chemical treatment of water produced by the desalters for direct domestic use. There are a variety of treatment systems that can meet the requirements for potable water supplies. Typically, chlorine is used to treat water to ensure that bacterial concentrations are eliminated. The current desalter utilizes chlorine for treatment. If chlorine gas in storage tanks is used, as opposed to other chlorine storage mechanisms, such as hypochlorite solution, then a potential exists for an acute health risk to occur if the chlorine gas is

accidentally released. Technology, either in the form of alternative sources of chlorine or a totally different water treatment system (ultraviolet light or ozone), or through the construction of a secondary containment structure, can fully mitigate any potential significant public health risks from operating a water disinfection system. Measures are identified below which will ensure that treatment at desalters will not cause any significant health risk.

The second activity that poses a potential health risk is the recharge of recycled water to the groundwater aquifer in the Chino Basin. To minimize potential health risks from such addition of recycled water to the aquifer, the State Health Department requires a minimum 6-month detention time before the recycled water/natural groundwater mix can be extracted. Further, the maximum concentration of recycled water to natural groundwater that can be produced is 20 percent. In both cases the simple solution is to ensure that both criteria for protecting public health are met by either installing the recycled water recharge facilities at a location that will allow these criteria to be met, or by ensuring that any wells within the boundary of the 20 percent and 6-month recharge area will not be pumped for domestic purposes. Mitigation is identified below to ensure that these thresholds are protected and the recharge of recycled water can be carried out without causing any significant health risk.

No other OBMP activities have been identified as having any potential for causing significant health risks to the public.

### d. Will the project cause exposure of people to existing sources of potential health hazards?

The activities and facilities that will be implemented if the OBMP is approved do not have any potential to directly expose people to existing sources of potential health hazards. Indirectly, recharging stormwater, State Project Water or recycled water has a potential to mobilize existing contaminated plumes of groundwater and potentially cause more rapid expansion of such plumes, artificially enlarge contaminated areas, mobilize contaminants in the vadose zone as water table rises, accelerate and redirect existing plumes (both known and unknown), and/or expose existing or future wells to contamination that could cause them to be removed from production. This potential impact can be fully mitigated in two ways. First, any wells exposed to expanding contaminated plumes can be closed and their volume of production replaced. Second, and more appropriate, is to conduct modeling for recharge plumes before approving a recharge site to determine if a specific recharge site and volume of recharge can cause adverse expansion of a contaminated plume. Any locations that would cause such an adverse impact will be avoided. It is also important to monitor the recharge plume and its interaction with any nearby contaminated plume. If an adverse impact is detected in the future, the recharge can be terminated and the potential impact can be gradually abated, assuming that the monitoring system provides sufficient warning. Further production at affected wells could be terminated or alternatively, treated to a quality suitable for municipal supply. With implementation of such measures the potential for exposing people to existing sources of potential health hazards can be reduced to a non-significant level.

### e. Will the project increase fire hazards in wildland areas or in the Project Area?

The proposed project has no potential to increase fire hazards in wildland areas or in the Project Area. The proposed project is designed to enhance the existing water infrastructure systems in the Chino Basin, which is forecast to reduce fire hazards in the Project Area, not increase such hazards. Therefore, the proposed project is not forecast to adversely impact fire hazards within the Project Area. No mitigation is required.

## 4.10.4 Mitigation Measures

The following mitigation measures are recommended as conditions of project implementation:

**4.10.1** **For OBMP facilities that handle hazardous materials or generate hazardous waste the Business Plan prepared and submitted to the county or local city shall incorporate best management practices designed to minimize the potential for accidental release of such chemicals. The facility managers shall implement these measures to reduce the potential for accidental releases of hazardous materials or wastes.**

**4.10-2** **The business plan shall assess the potential accidental release scenarios and identify the equipment and response capabilities required to provide immediate containment, control and collection of any released material. Adequate funding shall be provided to acquire the necessary equipment, train personnel in responses and to obtain sufficient resources to control and prevent the spread of any accidentally released hazardous or toxic materials.**

**4.10-3** **For the storage of any acutely hazardous material at an OBMP facility, such as chlorine gas, modeling of pathways of release and potential exposure of the public to any released material shall be completed and specific measures, such as secondary containment, shall be implemented to ensure that sensitive receptors will not be exposed to significant health threats based on the toxic substance involved.**

**4.10-4** **All contaminated material shall be delivered to a licensed treatment, disposal or recycling facility that has the appropriate systems to manage the contaminated material without significant impact on the environment.**

**4.10-5** **Before determining that an area contaminated as a result of an accidental release is fully remediated, specific thresholds of acceptable clean-up shall be established and sufficient samples shall be taken within the contaminated area to verify that these clean-up thresholds have been met.**

**4.10-6** **During construction activities within existing road rights-of-way or other easements where continuous access is required, a road operation management plan shall be prepared and implemented. At a minimum this plan shall define how to minimize the amount of time spent on construction activities; how to minimize disruption of vehicle and alternative modes of traffic at all times, but particularly during periods of high traffic volumes; adequate signage and other controls, including flagpersons, to ensure that traffic can flow adequately during construction; the identification of alternative routes that can meet the traffic flow requirements of a specific area, including communication (signs, webpages, etc.) with drivers and neighborhoods where construction activities will occur; and at the end of each construction day roadways shall be prepared for continued utilization without any significant roadway hazards remaining.**

**4.10-7** **To the extent feasible, installation of pipelines or other construction activities in support of the OBMP shall not be located on major evacuation or emergency response routes within any communities in the Chino Basin. Where construction on such routes is necessary, local emergency response providers shall be contacted and emergency access and evacuation requirements shall be maintained at a level sufficient to meet their needs.**

**4.10-8** **Where alternative treatment systems are available to reduce potential health risks at OBMP facilities, such alternatives shall be selected if they meet defined technical, logistical and economic requirements for operation of such facilities.**

**4.10-9** **Prior to approving specific recycled water recharge facility locations and volumes, the extent of the aquifer area that would be removed from water production to meet potable water production requirements (6-month detention and 20% concentration in groundwater) shall be defined. If it conflicts with significant water production wells (existing or proposed), an alternative recharge location shall be selected, or wells will be closed and a new supply developed.**

**4.10-10** **Hydrogeologic studies, including modeling, will be doen for each recharge site to define the recharge impacts on existing known contaminated plumes. If modeling demonstrates that the rate of contaminated plume expansion or secondary effects associated with such expansion will adversely impact groundwater or water production capabilities, the recharge facility shall be moved to an alternative location where such impacts will not occur or impacted production facilities will be replaced.**

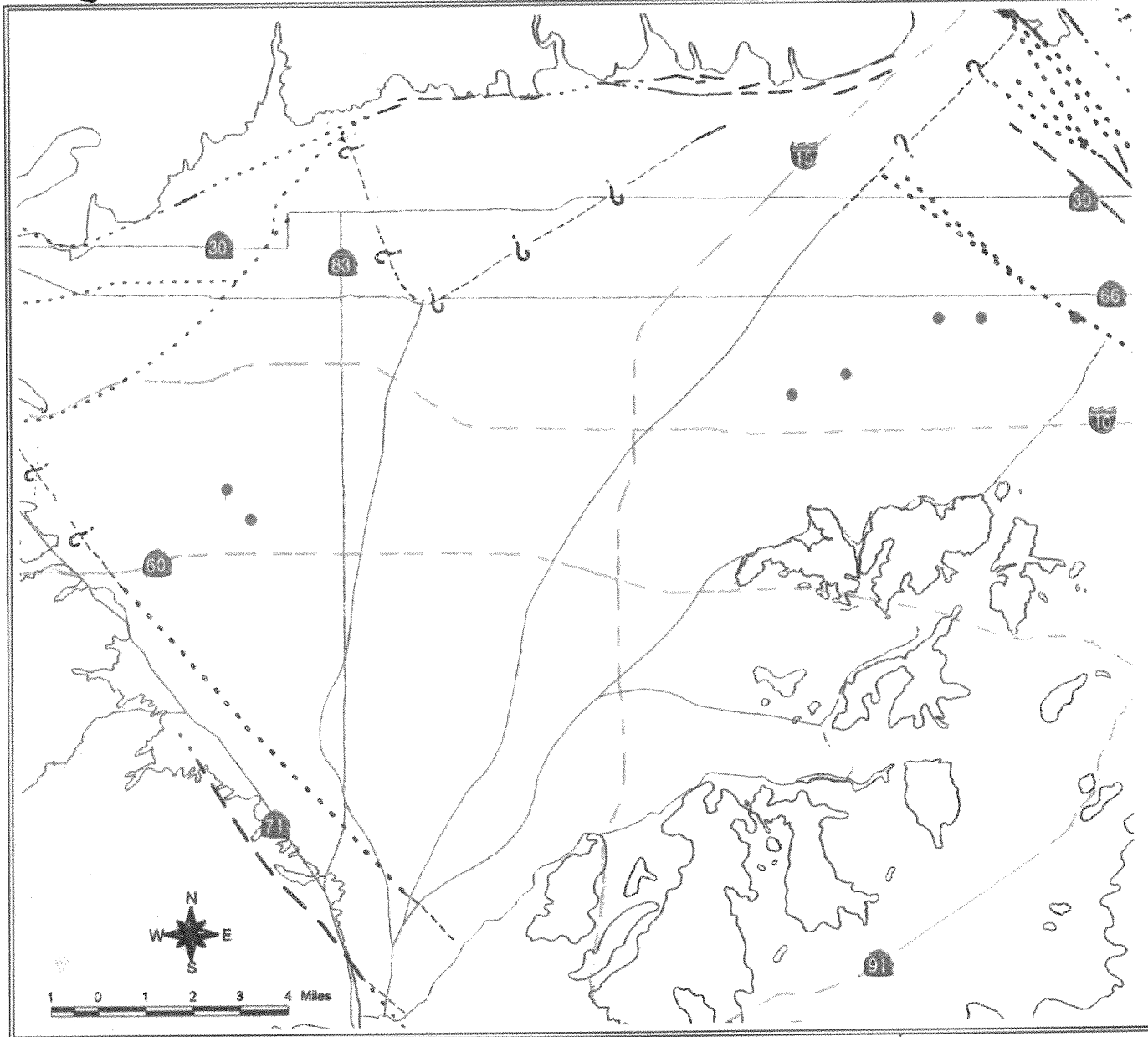
**4.10-11** **All recycled water recharge operations shall be monitored, and if impacts that were not forecast to occur demonstrate that the recharge operations are causing a significant adverse impact on the groundwater aquifer, the recycled recharge operations shall be terminated or modified to eliminate the adverse impact.**

### 4.10.5 Unavoidable Adverse Impact

The hazards, risk of upset and human health evaluation presented above indicates that the proposed project has a potential to cause adverse health risk impacts from implementing OBMP facilities and activities. It is possible to control or avoid the potential these potential health risk impacts by implementing the identified mitigation measures. Therefore, no significant unavoidable adverse hazard, risk of upset or human health impacts are forecast to occur if the proposed project and identified mitigation is implemented.

### 4.10.6 Cumulative Impact

Hazards, risk of upset and human health impacts within the Project Area are not forecast to be cumulatively significant and adverse. Each accidental release is required to be managed in a fashion that will not leave any significant residual contamination that can contribute to increased public health risk. Therefore, the proposed project has no identified potential to significantly increase the risk of such impacts beyond current levels. The proposed project will not contribute to any new cumulative adverse impacts.

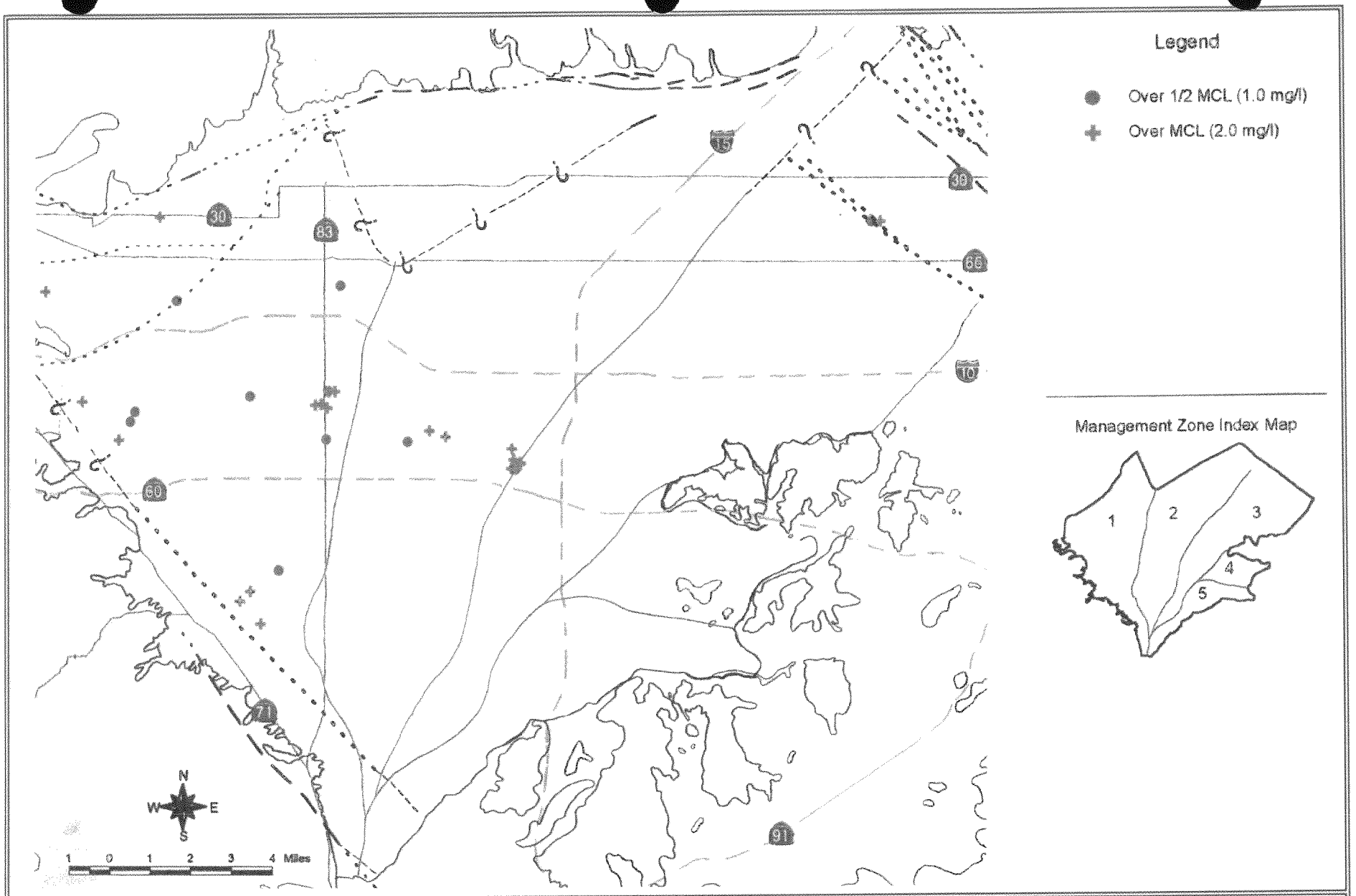



**WELLS WITH ONE OR MORE HISTORICAL PERCHLORATE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-47

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**FIGURE 4.10-1**

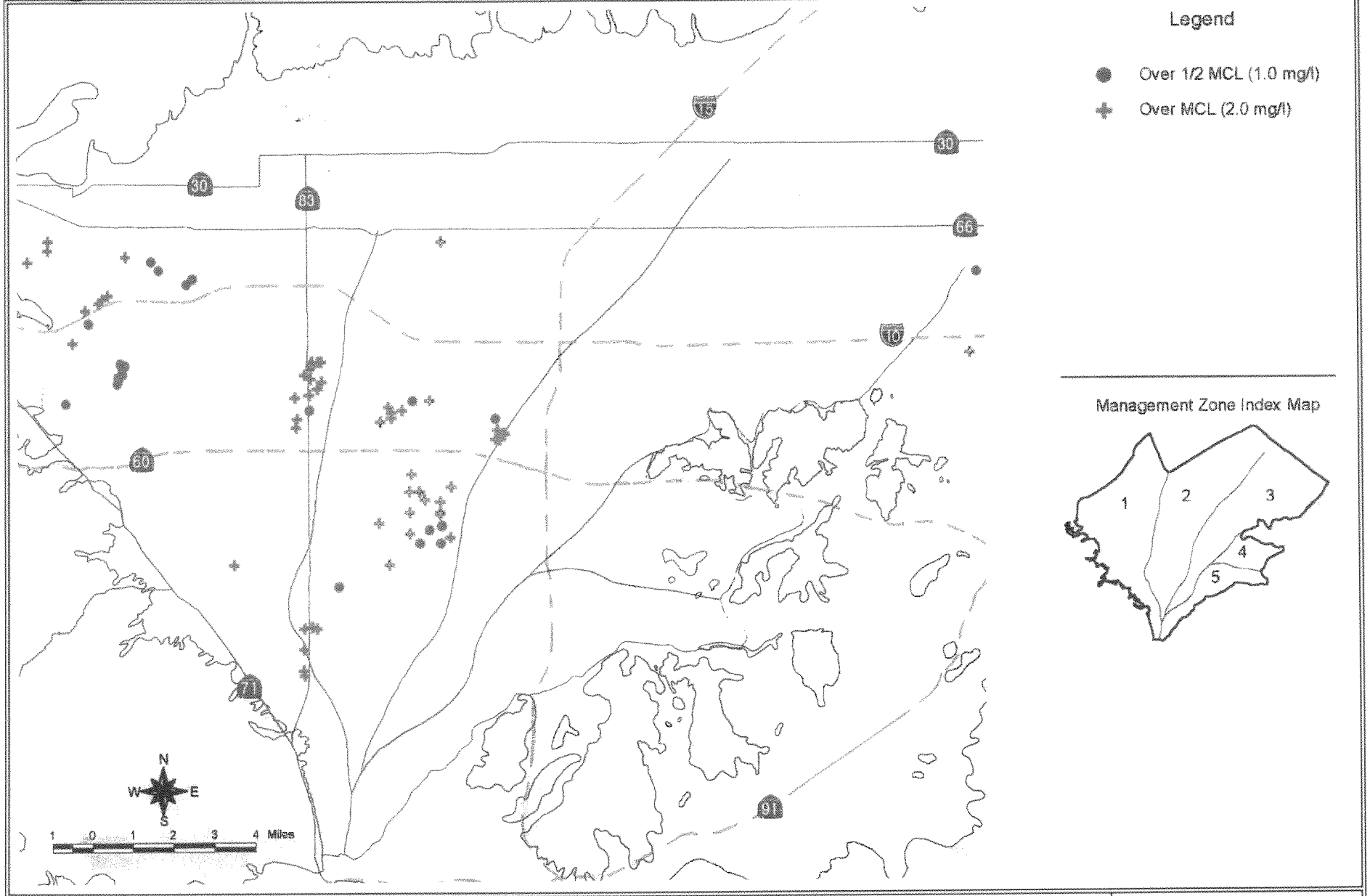



**WELLS WITH ONE OR MORE HISTORICAL TETRACHLOROETHENE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-48

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**FIGURE 4.10-2**

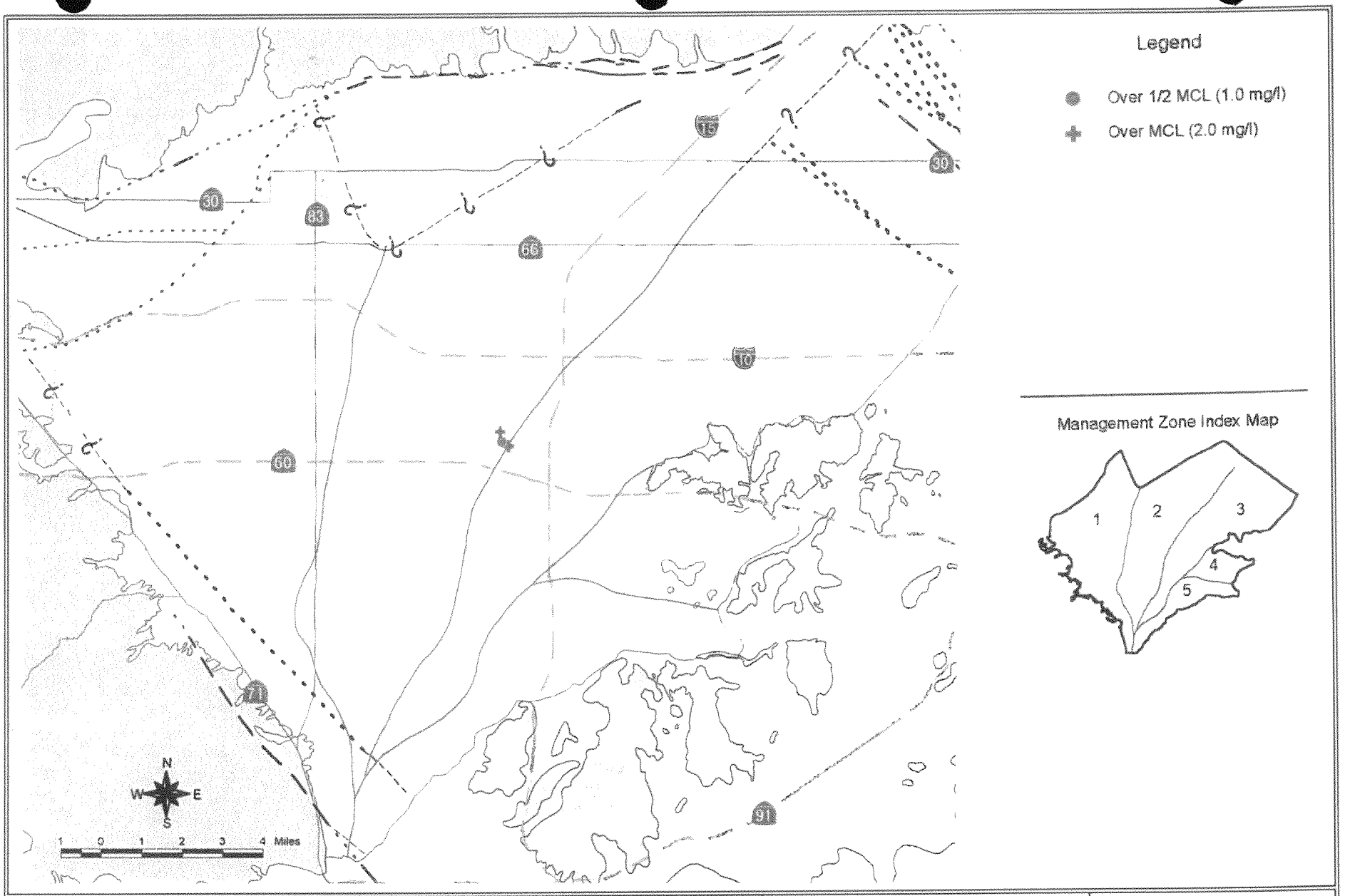



**WELLS WITH ONE OR MORE HISTORICAL TRICHLOROETHENE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-49

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**FIGURE 4.10-3**

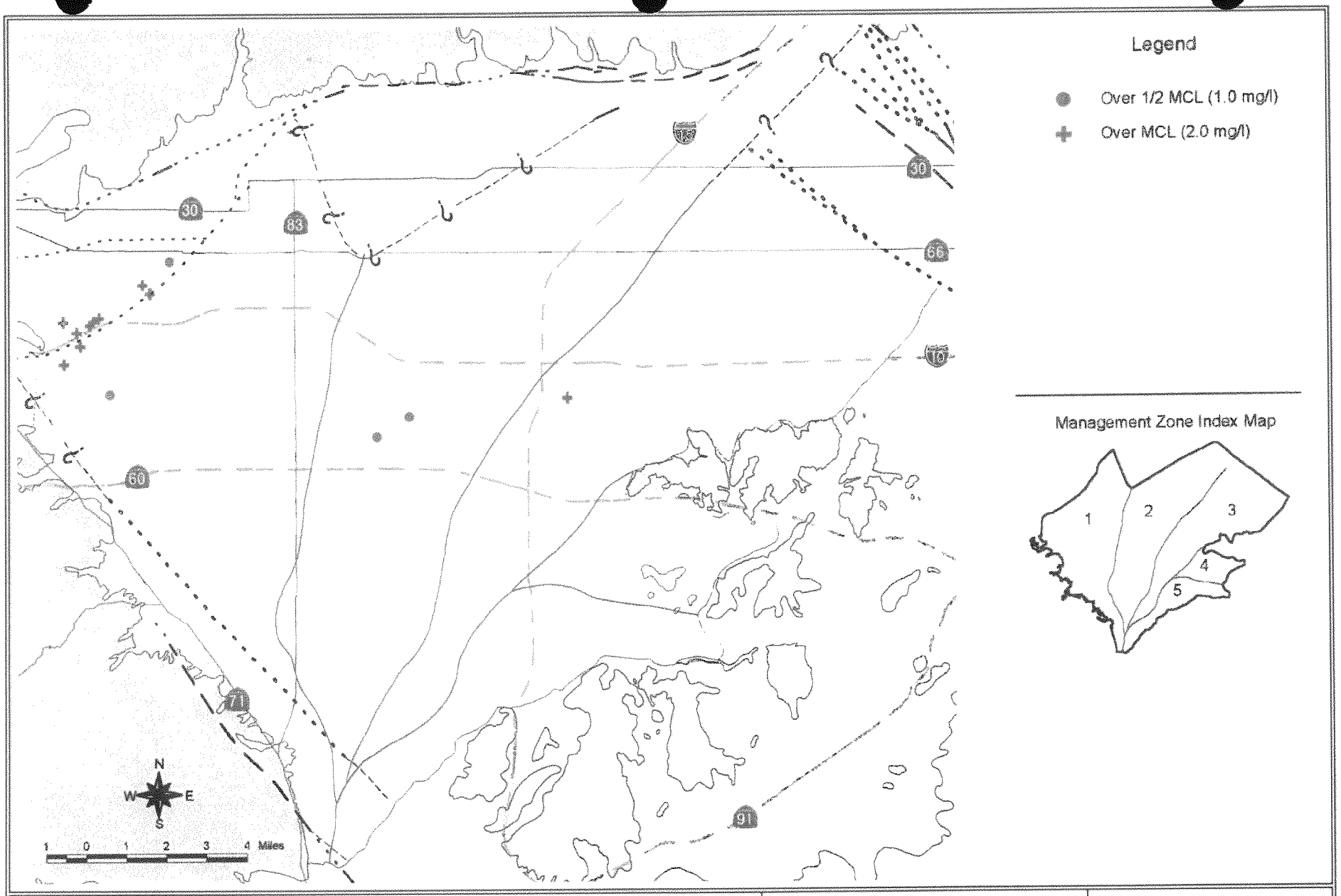



**WELLS WITH ONE OR MORE HISTORICAL 1,1-DICHLOROETHANE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-50

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**FIGURE 4.10-4**

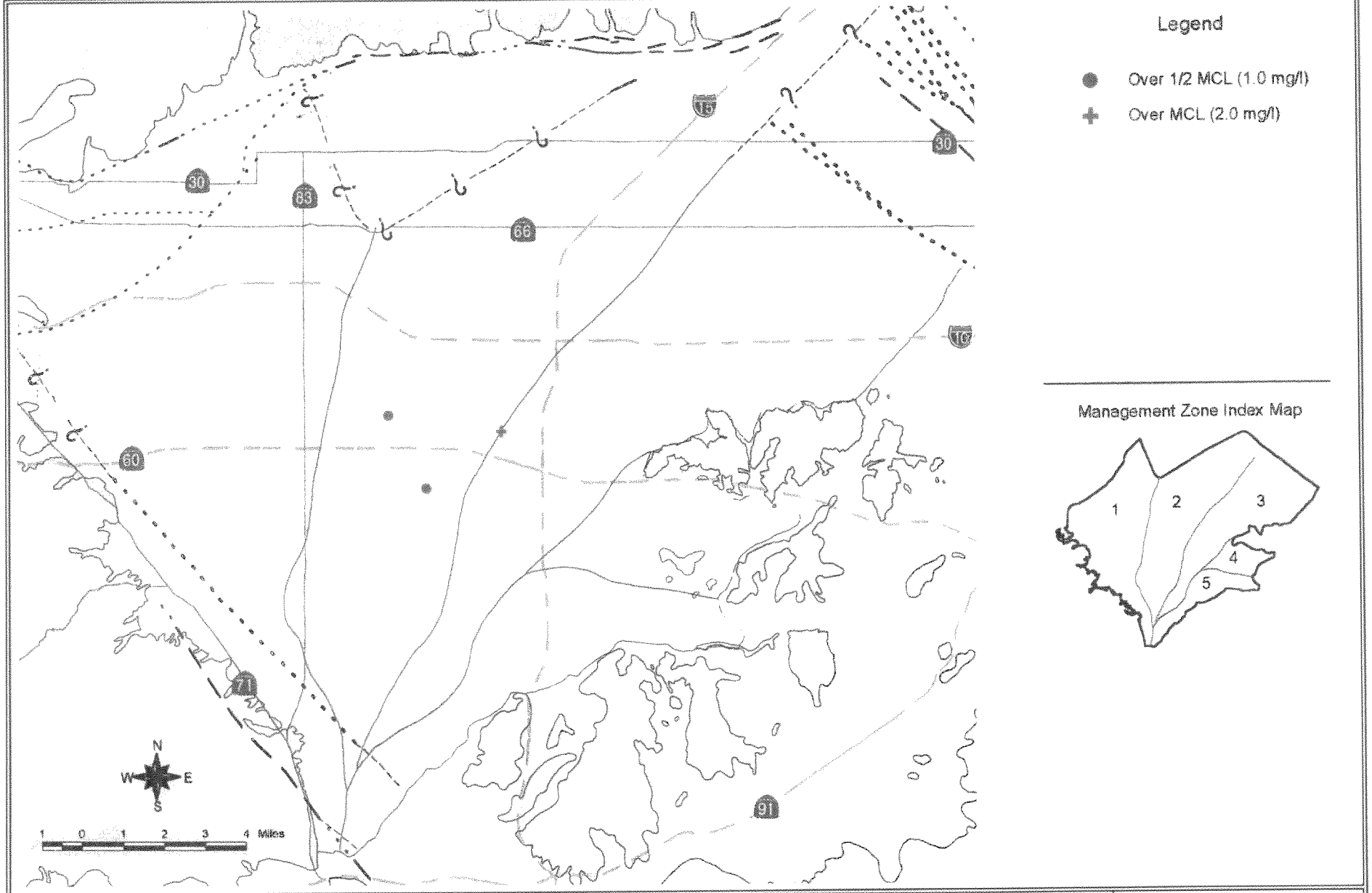



**WELLS WITH ONE OR MORE HISTORICAL 1,1-DICHLOROETHENE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-51

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**FIGURE 4.10-5**

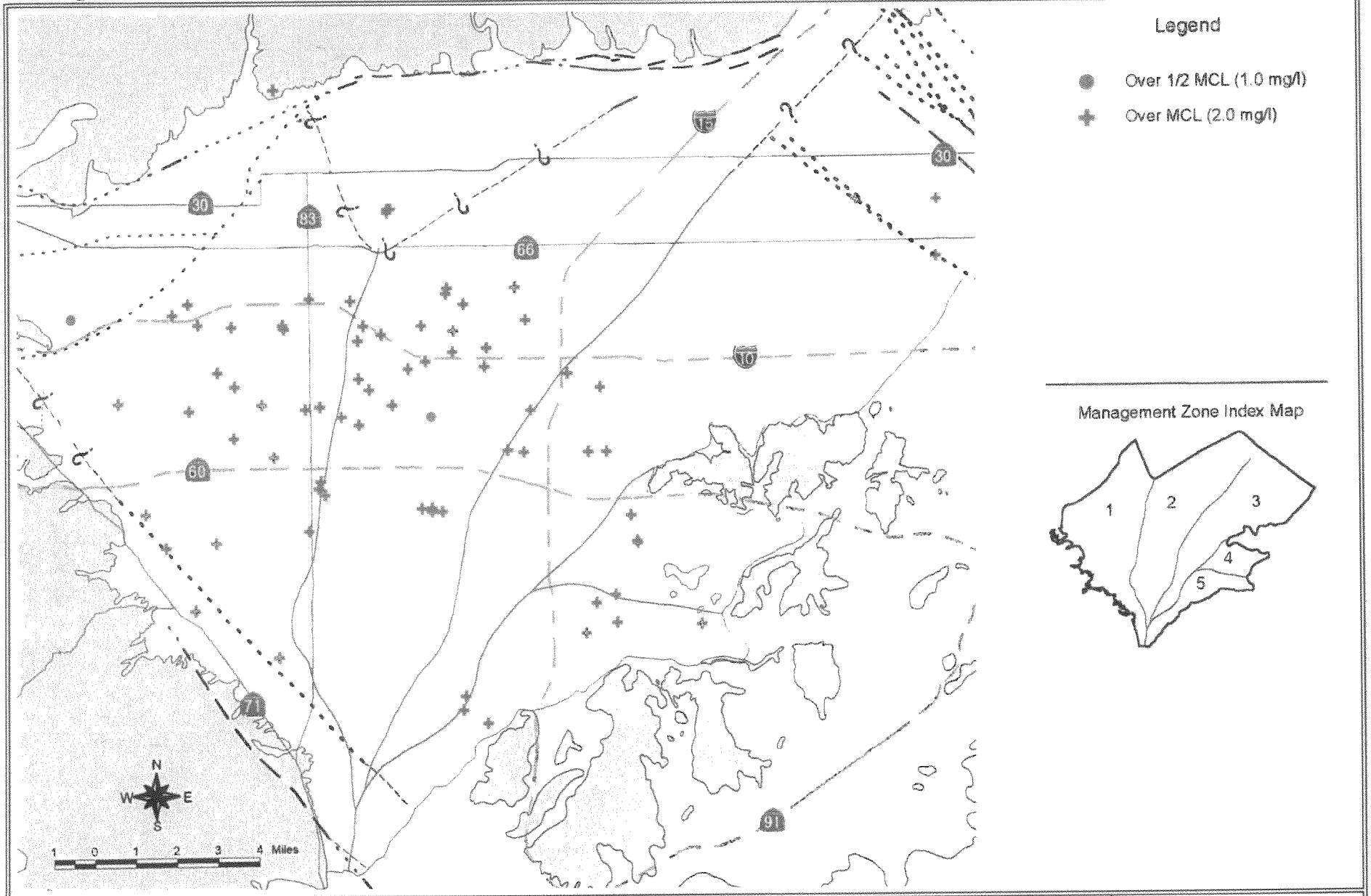



**WELLS WITH ONE OR MORE HISTORICAL CIS-1,2-DICHLORO-ETHENE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-52

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**FIGURE 4.10-6**

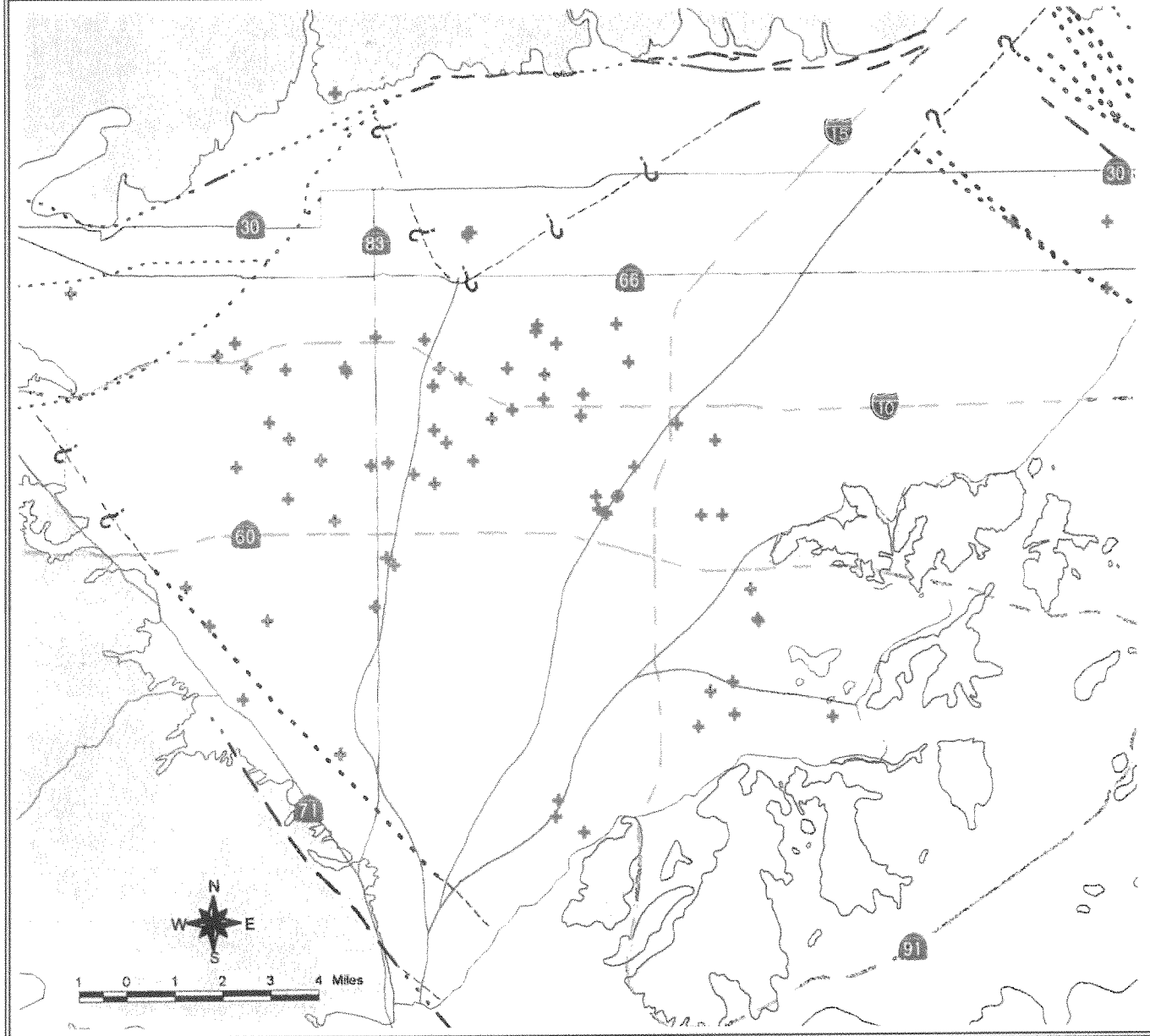



**WELLS WITH ONE OR MORE HISTORICAL 1,2-DICHLOROETHANE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-53

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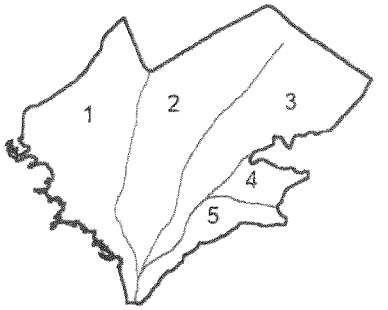
**FIGURE 4.10-7**




Legend

- Over 1/2 MCL (1.0 mg/l)
- Over MCL (2.0 mg/l)

Management Zone Index Map

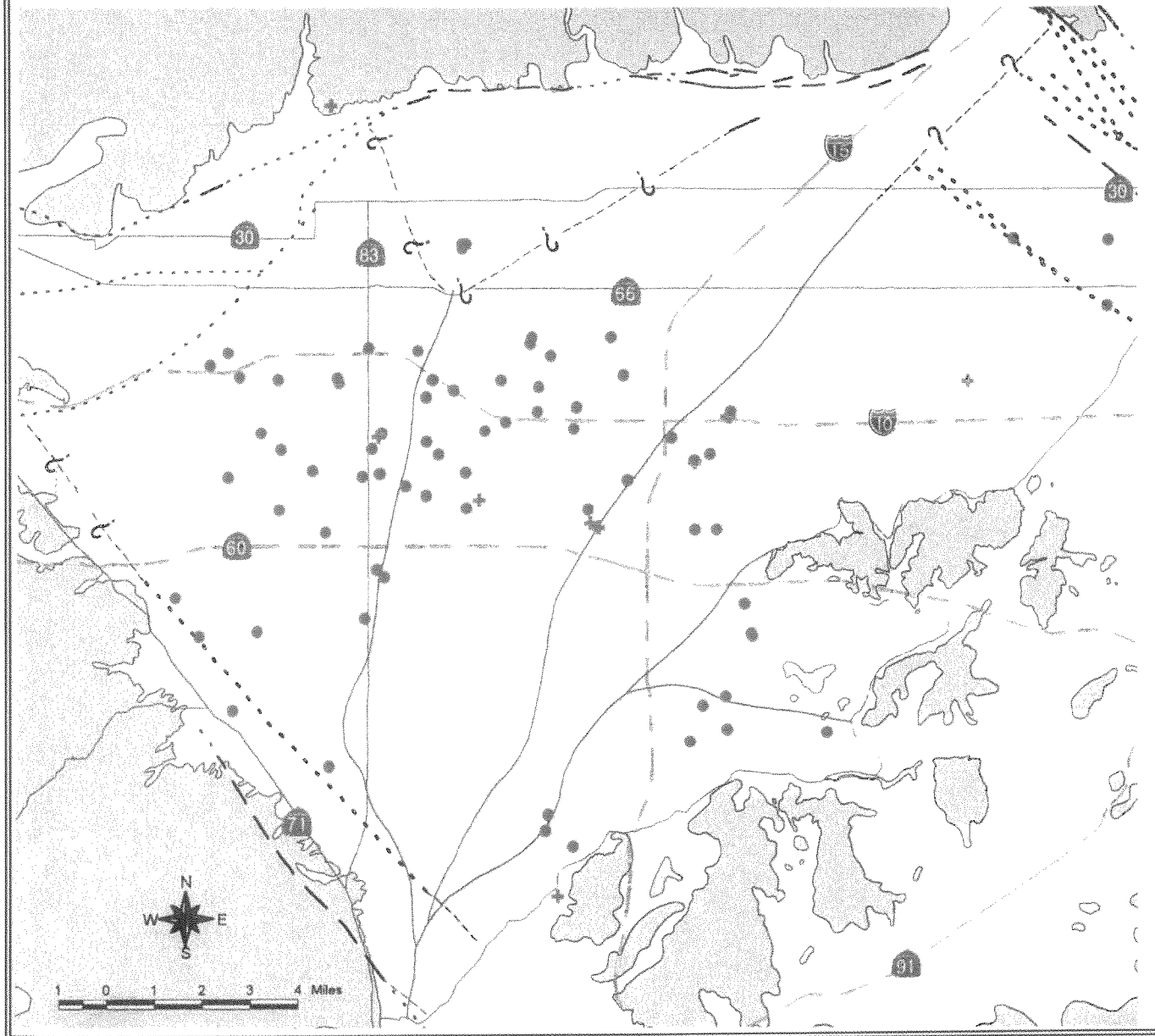



**WELLS WITH ONE OR MORE HISTORICAL VINYL CHLORIDE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-54

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**FIGURE 4.10-8**

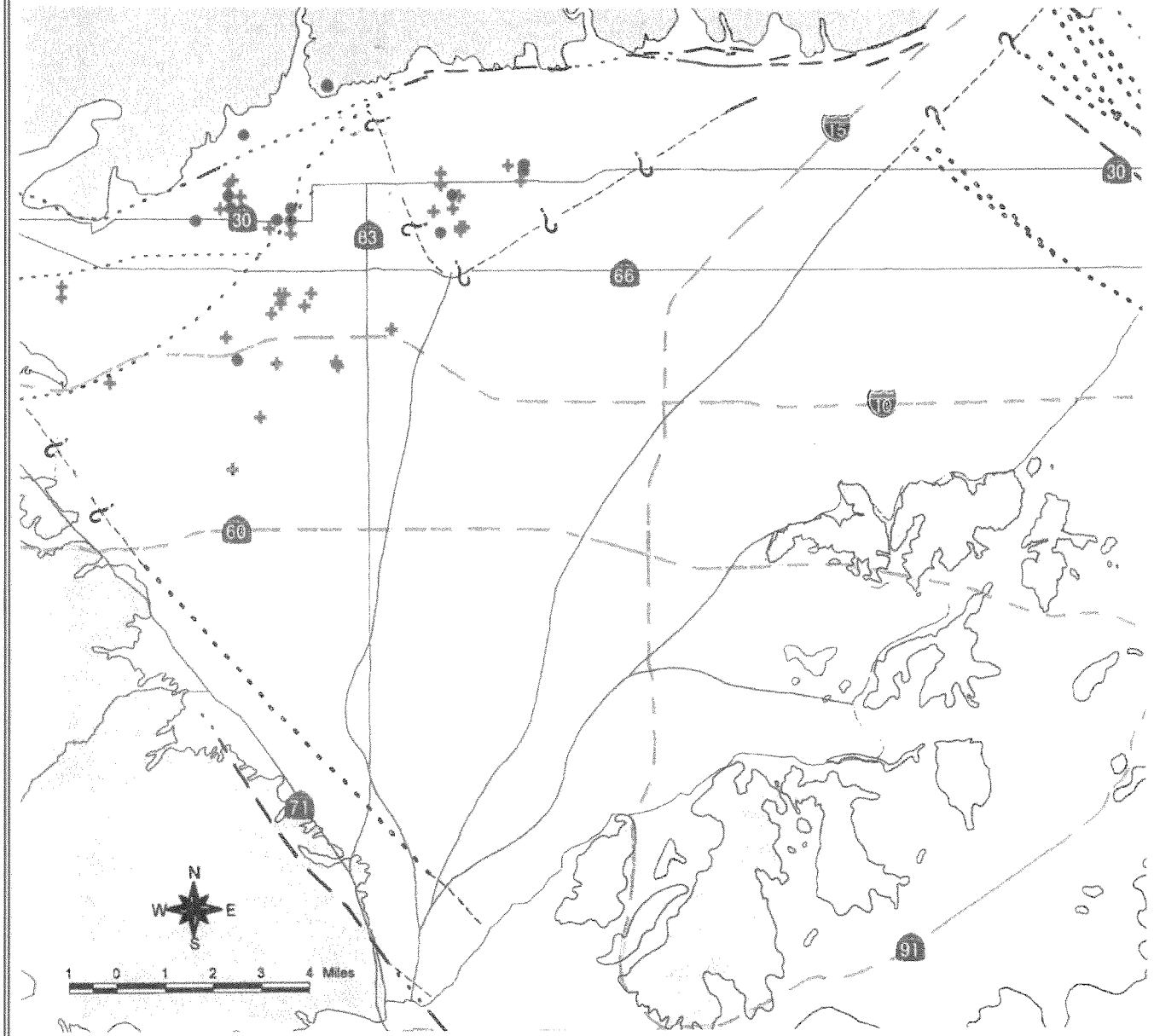



**WELLS WITH ONE OR MORE HISTORICAL BENZENE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-55

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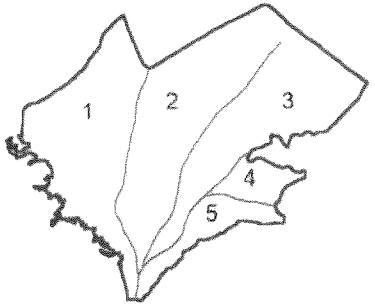
**FIGURE 4.10-9**




Legend

- Over 1/2 MCL (1.0 mg/l)
- Over MCL (2.0 mg/l)

Management Zone Index Map

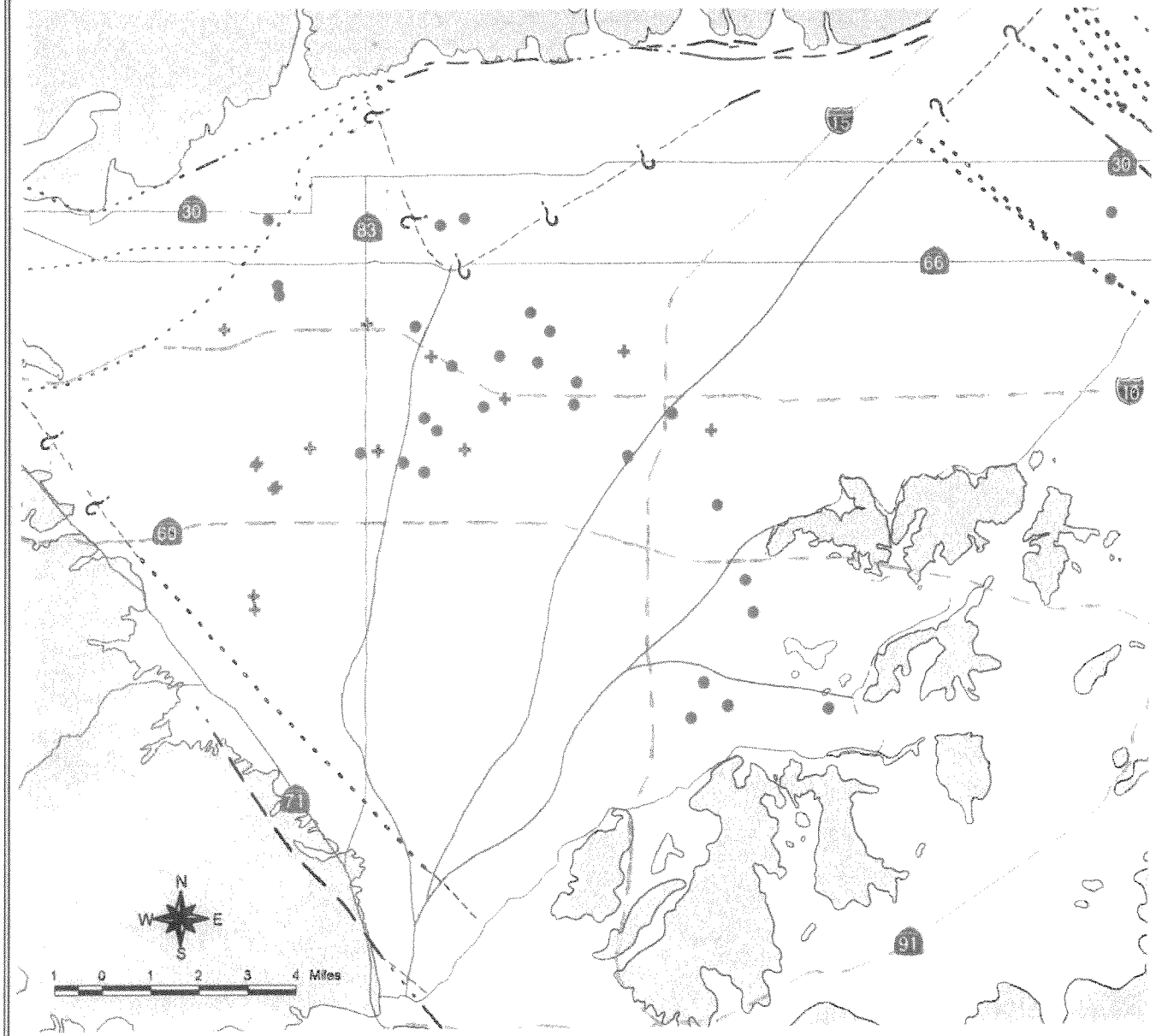



**WELLS WITH ONE OR MORE HISTORICAL DIBROMOCHLORO-PROPANE VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-56

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**FIGURE 4.10-10**

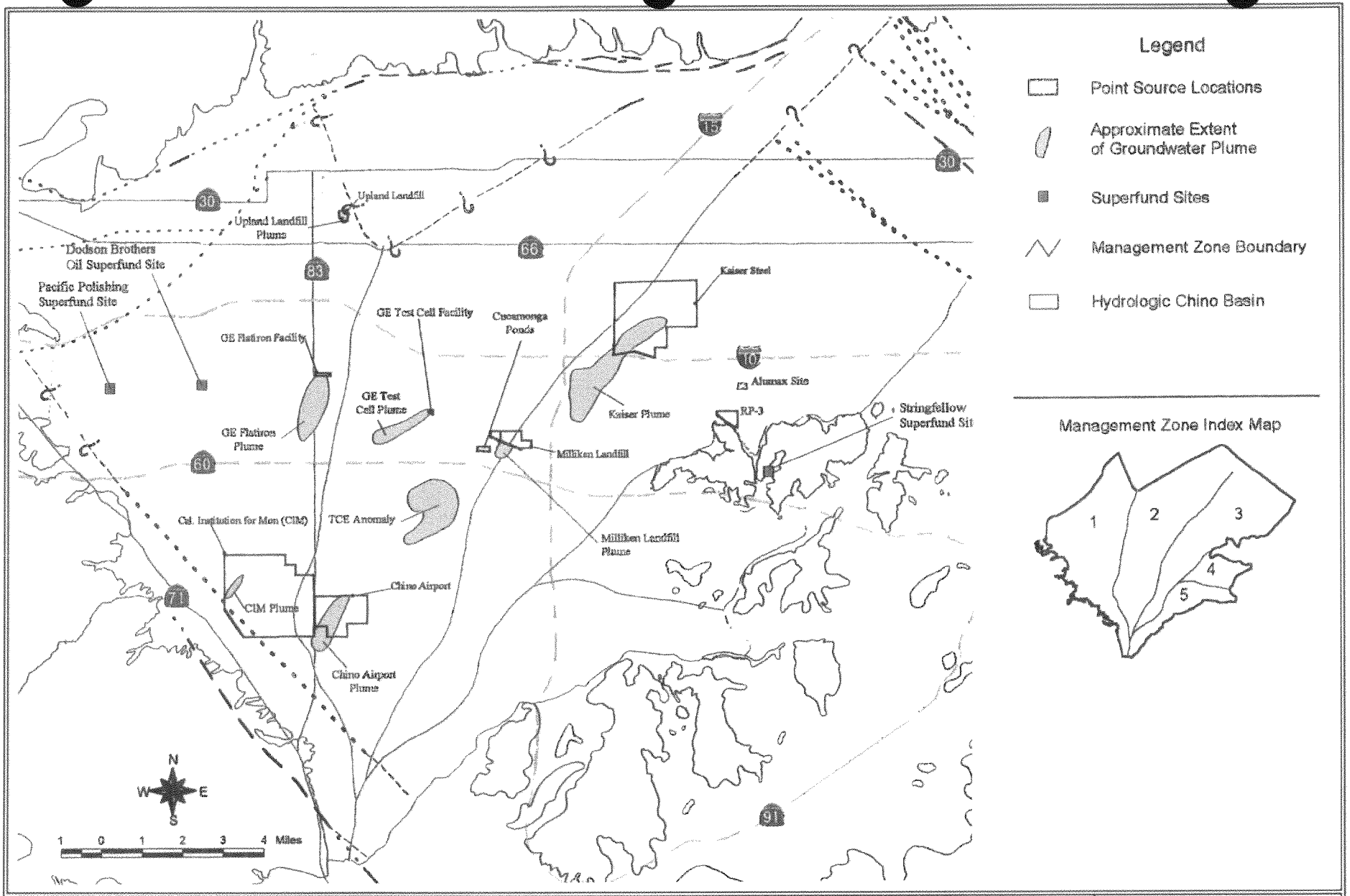



**WELLS WITH ONE OR MORE HISTORICAL LINDANE VALUES VALUES ABOVE 1/2 THE EXISTING MCL**

Source: OBMP Phase I Report, Figure 2-57

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**FIGURE 4.10-11**




**LOCATION OF KNOWN POINT SOURCES IN THE CHINO BASIN**

Source: OBMP Phase I Report, Figure 2-58

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**FIGURE 4.10-12**

# 4.11 NOISE

## 4.11.1 Introduction

The project's potential to affect the existing noise environment was included in this PEIR based on the increased level of noise generating activities associated with implementing the OBMP. Implementation of the proposed project could result in increased noise levels over both the short and long term. Short-term noise increases will be caused by construction activities and the long-term noise increases could be associated with facilities and activities operated in support of the OBMP, such as production well pumps, booster pumps and desalter operations. This subchapter relies extensively on the noise evaluations and data contained in the general plans of all the local jurisdictions within the Chino Basin and the related general plan EIRs. This evaluation focuses on the existing noise environment of the Chino Basin, particularly transportation related noise levels that occur in the area, and the potential impacts to this environment from implementing the OBMP. None of the responses to the NOP raised noise as an issue of concern, so the focus of the noise evaluation presented below is the project specific facilities and activities that may physically change the noise environment and the potential contribution of the OBMP to areawide growth on increases of noise in the future.

## 4.11.2 Environmental Setting

### 4.11.2.1 Noise Rating Terminology

A-weighted decibels (dBA, a measure of sound energy) are the most common units used for measuring the loudness of a noise source/event. The human ear has different sensitivity to different frequencies of sound (noise). A-weighting is an attempt to give the noise monitor the same frequency sensitivity as the human ear. Technically, it is the measurement of the energy being received when listening to (or monitoring) a source of noise. For example, the loudness of a highway may be 65 dBA when measured 50 feet away. The sound decreases (less energy is received by the ear) as one moves away from the source, and the same highway would have a noise level of about 62 dBA at 100 feet. The relationship between how one perceives a sound and the actual sound energy emitted by the source of noise is very complex. However, a good rule of thumb is that if a noise increases 10 dBA, its apparent loudness will double. Therefore, a noise that is 70 dBA will appear twice as loud as a 60 dBA noise.

A number of noise rating scales using A-weighted decibels are used in California for land use compatibility assessment and are described as follows:

- The Equivalent Noise Level ($L_{eq}$) scale represents the energy average noise level over a sample period of time. It represents the average decibel sound level that would contain the same amount of energy as a fluctuating sound level over the sample time period.

- The Day-Night Noise Level ($L_{dn}$) scale represents a time weighted 24-hour average noise level based on the A-weighted decibel scale. Time weighted refers to the fact that noise which occurs during certain sensitive time periods (such a the night) is penalized for occurring at these times. For the $L_{dn}$ scale, the nighttime period (10 p.m. and 7 a.m.) noises are penalized by 10 dBA.

- The Community Noise Equivalent Level (CNEL) scale is similar to the $L_{dn}$ scale except that it includes an additional 5 dBA penalty for the evening time period (7 p.m. to 10 p.m.). Both noise rating scales are used by the local jurisdictions and the State in evaluating transportation noise, including airports and roadways..

#### 4.11.2.2 Noise Standards and Criteria

Noise rating scales, noise standards, community noise assessment criteria and noise mitigation measures are discussed below to provide a brief overview of how noise is evaluated and to explain the noise standards used in the Noise Elements Participating Jurisdiction's within the Project Area. This information is needed in order to understand the existing background noise conditions in the project area.

The CNEL scale is used as the criterion for assessing the compatibility of residential land uses with transportation-related noise sources by utilizing an interior and exterior noise standard. Typical noise standards within the local jurisdiction's general plans in the Chino Basin encourage interior noise standards of 45 dBA CNEL and an exterior standard of 60-65 dBA CNEL. The local jurisdictions use land use planning decisions relative to chronic noise exposure. An annual average noise level in excess of 60-65 dB CNEL is considered an excessive exterior exposure for most residential or other noise sensitive uses, unless mitigation is implemented to achieve this level where feasible. CNEL can be expressed as a daily average or as an annual average exposure to smooth out any day to day variations in noise generation.

Although CNEL is considered when using an annual average noise exposure such as along roadways or adjacent to airports, it is also calculated over a 24-hour period. Levels above 60-65 dB CNEL are considered intrusive for outdoor recreation, relaxation or normal conversation. Such intrusion could be considered an environmentally adverse impact even if no long-term noise incompatibility is created by the noise source. Environmental studies often use a change in the noise level by some given increment as a criterion for potential impact significance. A change of 3 dBA in noise from a semi-continuous source, such as a roadway, is often defined as a perceptible, but non-significant increase. Changes of 5 dBA are commonly designated as "clearly noticeable" and may be considered a significant change in the background noise level.

Sources of noise can be divided into transportation sources and non-transportation sources. The existing noise environment within the Chino Basin is dominated primarily by transportation-related noise sources. These noise sources include traffic noise from nearby roadways, from adjacent

railroad lines and the several airports within the project area, including Cable Airport, Chino Airport, Ontario Airport, and Rialto Municipal Airport. Secondary non-transportation noise sources include industrial activity, mining, music, amplified sound and activities on private property. For example, existing industrial activity noise is audible around the California Steel Plant in Fontana in the vicinity of this site from normal operation. Regardless, the predominant noise sources are those transportation related activities.

### 4.11.2.3 Existing Noise Environment

Each city and county within the Chino Basin project area has adopted a general plan which by law must incorporate a Noise Element to define acceptable noise levels for specific types of land uses. A summary of existing noise (as depicted in each city's general plan), typical noise thresholds, and future noise levels is provided in the following text. These summaries will be compared relative to a single community's noise element in order to reduce the volume of text and supporting material that is needed to establish background noise levels throughout the project area. The City of Rialto Noise Element is presented to establish a baseline for consideration, because it includes

The primary background noise sources within the City of Rialto include vehicle traffic on roadways, aircraft operations at Rialto Municipal Airport and train traffic on the railroad tracks in the central and southern portions of the City. Table 4.11-1 provides an overview of different sound levels that could be encountered throughout the Chino Basin. Figure 4.11-1 provides a summary of the California Land Use/Noise Guidelines for exposure of specific land uses to community noise exposure. These exhibits provide background information on noise that can be used to evaluate noise impacts from future development.

Figure 4.11-2 illustrates the CNEL contours for existing roadways and railroad tracks and Table 4.11-2 provides an indication of the background noise associated with specific roadways, traffic volumes and vehicle speeds in the City of Rialto. Figure 4.11-3 illustrates the CNEL noise contours for aircraft operations at Rialto Municipal Airport in 1990. The Rialto Noise Element also includes forecasts of future noise levels which reflect the buildout of the community. Table 4.11-3 summarizes the changes in CNEL noise levels (dBA) relative to existing noise levels along roadways within the City. Note that many of the increases are absolutely significant (greater than 5 dB) and many of the roadways will have substantial additional area encompassed within the 60 and 65 dBA CNEL contours. Finally, Figure 4.11-4 shows the 2010 future airport operation contours. The area (acreage) impacted by noise contours from aircraft operations increases by only a small amount compared to roadway noise. This is because aircraft noise is being controlled and even though more operations will occur, the sound level of each operation is reduced so the area impacted remains relatively the same.

## Table 4.11-1
## TYPICAL A-WEIGHTED SOUND LEVELS

Sound Levels and Loudness of Illustrative Noises in Indoor and Outdoor Environments
(A-Scale Weighted Sound Levels)

| db(A) | Overall Level (Sound Pressure Level ~0.0002 Microbar) | Community (Outdoor) | Home or Industry | Loudness (Human Judgment of Different Sound Levels) |
|---|---|---|---|---|
| 130 | Uncomfortably | Military jet aircraft takeoff with after-burner from aircraft carrier @ 50 ft. (130) | Oxygen torch (121) | 120 dbA, 32 times as loud |
| 120<br>110 | Loud | Turbo-fan aircraft @ takeoff power @ 200 ft. (90) | Riveling machine (110)<br>Rock-n-Roll band (108-114) | 110 dbA, 16 times as loud |
| 100 | Very | Jet flyover @ 1,000 ft. (103)<br>Boeing 707, DC-8 @ 6,080 ft. before landing (106)<br>Bell J-2A helicopter @ 100 ft. (100) | | 100 dbA, 8 times as loud |
| 90 | Loud | Power mower (96)<br>Boeing 737, DC-9 @ 6,080 ft. before landing (97)<br>Motorcycle @ 25 ft. (90) | Newspaper press (97) | 90 dbA, 4 times as loud |
| 80 | | Car wash @ 20 ft. (89)<br>Prop. airplane flyover @ 1,000 ft. (88)<br>Diesel truck, 40 mph @ 50 ft. (84)<br>Diesel train, 45 mph @ 100 ft. (83) | Food blender (88)<br>Milling machine (85)<br>Garbage disposal (80) | 80 dbA, 2 times as loud |
| 70 | Moderately Loud | High urban ambient sound (80)<br>Passenger car, 65 mph @ 25 ft. (77)<br>Freeway @ 50 ft. from pavement edge, 10:00 a.m. (76 + or -6) | Living room music (76)<br>TV-audio, vacuum cleaner | 70 dbA |
| 60 | | Air conditioning unit @ 100 ft. (60) | Cash register @ 10 ft. (65-70)<br>Electric typewriter @ 10 ft. (64)<br>Dishwasher (rinse) @ 10 ft. (60)<br>Conversation (60) | 60 dbA, 1/2 as loud |
| 50 | Quiet | Large transformers @ 100 ft. (50) | | 50 dbA, 1/4 as loud |
| 40 | | Bird calls (44)<br>Lower limit urban ambient sound (40) | | 40 dbA, 1/8 as loud |
| | Just Audible | db(A) scale interrupted | | |
| 10 | Threshold of Hearing | | | |

Source: City of Rialto General Plan Update Draft MEIR, November 1991

## Table 4.11-2
## EXISTING TRAFFIC NOISE CONTOURS

| Roadway | Link | ADT ('000) | Speed (mph) | Distance to CNEL Contour (feet) | | |
|---|---|---|---|---|---|---|
| | | | | 70 CNEL | 65 CNEL | 60 CNEL |
| Interstate 10 | East of Riverside Avenue | 31.49 | 55 | 132 | 285 | 614 |
| Route 30 | Siera to Alder | 15.15 | 50 | 65 | 141 | 303 |
| | Alder to Locust | 10.584 | 50 | 51 | 111 | 238 |
| | Locust to Ayala | 14.863 | 50 | 54 | 139 | 299 |
| | Ayala to Riverside | 19.822 | 50 | 78 | 168 | 362 |
| | Riverside to Pepper | 24.486 | 55 | 110 | 236 | 509 |
| | East of Pepper | 28 | 55 | 120 | 258 | 556 |
| Baseline Road | Sierra to Palmetto | 14.988 | 50 | RW | 105 | 225 |
| | Palmetto to Ayala | 16.237 | 50 | 51 | 110 | 238 |
| | Ayala to Cactus | 17.846 | 45 | RW | 99 | 213 |
| | Cactus to Riverside | 18.735 | 45 | RW | 102 | 220 |
| | East of Riverside | 18.835 | 45 | RW | 102 | 220 |
| Foothill Road | West of Palmetto Avenue | 28.5 | 45 | 67 | 144 | 310 |
| | Palmetto to Ayala | 26.5 | 45 | 64 | 137 | 295 |
| | Ayala to Cactus | 26 | 45 | 63 | 135 | 291 |
| | Cactus to Riverside | 24.605 | 45 | 60 | 130 | 281 |
| | Riverside to Acacia | 25.5 | 45 | 60 | 130 | 280 |
| | Acacia to Pepper | 24.4 | 45 | 59 | 126 | 272 |
| | East of Pepper | 25.652 | 45 | 61 | 130 | 281 |
| Randall Avenue | Maple to Cactus | 1.798 | 40 | RW | RW | RW |
| | East of Cactus | 2.123 | 40 | RW | RW | RW |
| San Bernardino Avenue | Alder to Riverside Avenue | 1.873 | 40 | RW | RW | RW |
| | East of Riverside | 6.245 | 40 | RW | RW | 87 |
| Valley Boulevard | West of Linden | 20.67 | 40 | RW | 90 | 193 |
| | Linden to Riverside | 12.577 | 40 | RW | 64 | 139 |
| | East of Riverside | 11.69 | 40 | RW | 61 | 132 |
| Slover Avenue | West of Riverside | 5.533 | 40 | RW | RW | 80 |
| Santa Ana Avenue | West of Riverside | 1.581 | 40 | RW | RW | RW |
| Jurupa Avenue | East of Cedar | 0.79 | 40 | RW | RW | RW |
| Agua Mansa Road | South of Riverside | 7.272 | 45 | RW | 54 | 117 |
| | North of Riverside | 3.952 | 45 | RW | RW | 78 |
| Ayala Drive | Route 30 to Riverside | 3.351 | 45 | RW | RW | 70 |
| Locust Avenue | South of Riverside | .53 | 45 | RW | RW | RW |
| | North of Riverside | .53 | 45 | RW | RW | RW |
| Sierra Avenue | Baseline to Route 30 | 5.162 | 45 | RW | RW | 93 |
| | Route 30 to Casa Grande | 4.493 | 45 | RW | RW | 85 |
| | Casa Grande to Riverside | 3.656 | 45 | RW | RW | 74 |
| Cedar Avenue | Santa Ana to Slover | 21.357 | 45 | 52 | 111 | 240 |
| | South of Santa Ana | 10.693 | 45 | RW | 70 | 151 |
| Larch Avenue | Jurupa to Santa Ana | 0.381 | 35 | RW | RW | RW |
| Spruce | Santa Ana to Slover | 0.831 | 40 | RW | RW | RW |
| | Valley to San Bernardino | 3.127 | 40 | RW | RW | 55 |
| Cactus Avenue | Foothill to Baseline | 8.936 | 45 | RW | 62 | 134 |
| | South to Jurupa | 2.531 | 45 | RW | RW | 58 |
| | Baseline to Route 30 | 7.819 | 45 | RW | 57 | 123 |
| Lilac Avenue | Valley to Foothill | 2.401 | 35 | RW | RW | RW |
| Willow Avenue | Valley to Foothill | 3.35 | 35 | RW | RW | RW |
| Riverside Avenue | Agua Mansa to I-10 | 19.703 | 45 | RW | 106 | 227 |

| Roadway | Link | ADT ('000) | Speed (mph) | Distance to CNEL Contour (feet) | | |
|---|---|---|---|---|---|---|
| | | | | 70 CNEL | 65 CNEL | 60 CNEL |
| | I-10 to Merrill | 24.675 | 45 | 57 | 123 | 264 |
| | Merrill to Foothill | 18 | 40 | RW | 82 | 176 |
| | Foothill to Route 30 | 11.1113 | 45 | RW | 72 | 155 |
| | Route 30 to Cactus | 10.635 | 50 | 86 | 186 | 400 |
| | Cactus to Ayala | 3.68 | 50 | RW | 92 | 197 |
| | Ayala to Locust | 3.68 | 55 | 63 | 135 | 290 |
| | Locust to Sierra | 3.62 | 55 | 62 | 133 | 287 |
| Pepper Avenue | South of I-10 | 2.291 | 45 | RW | RW | 54 |
| Bloomington Avenue | Valley to San Bernardino | 13.9 | 50 | RW | 100 | 215 |
| | San Bernardino to Merrill | 6.619 | 50 | RW | 61 | 131 |

RW – Contour falls on roadway right-of-way.

Source: City of Rialto General Plan Update Draft MEIR, November 1991

## Table 4.11-3
## FUTURE INCREASE IN TRAFFIC NOISE OVER EXISTING

| Roadway | Link | Change in CNEL Noise Level (dBA) Over Existing |
|---|---|---|
| Interstate 10 | East of Riverside Avenue | 3.3 |
| Route 30 | Siera to Alder | 4.8 |
| | Alder to Locust | 5.9 |
| | Locust to Ayala | 4.9 |
| | Ayala to Riverside | 2.4 |
| | Riverside to Pepper | 3.3 |
| | East of Pepper | 3.0 |
| Baseline Road | Sierra to Palmetto | 3.0 |
| | Palmetto to Ayala | 2.7 |
| | Ayala to Cactus | 3.1 |
| | Cactus to Riverside | 3.0 |
| | East of Riverside | 2.6 |
| Foothill Road | West of Palmetto Avenue | 2.5 |
| | Palmetto to Ayala | 2.5 |
| | Ayala to Cactus | 2.5 |
| | Cactus to Riverside | 2.5 |
| | Riverside to Acacia | 2.5 |
| | Acacia to Pepper | 2.5 |
| | East of Pepper | 2.2 |
| Randall Avenue | Maple to Cactus | 7.8 |
| | East of Cactus | 7.2 |
| San Bernardino Avenue | Alder to Riverside Avenue | 7.2 |
| | East of Riverside | 2.9 |
| Valley Boulevard | West of Linden | 1.9 |
| | Linden to Riverside | 2.1 |
| | East of Riverside | 2.3 |
| Slover Avenue | West of Riverside | 3.2 |

| Roadway | Link | Change in CNEL Noise Level (dBA) Over Existing |
|---|---|---|
| Santa Ana Avenue | West of Riverside | 5.5 |
| Jurupa Avenue | East of Cedar | 3.6 |
| Agua Mansa Road | South of Riverside | 2.3 |
| | North of Riverside | 1.0 |
| Ayala Drive | Route 30 to Riverside | 7.4 |
| Locust Avenue | South of Riverside | 14.0 |
| | North of Riverside | 12.9 |
| Sierra Avenue | Baseline to Route 30 | 5.9 |
| | Route 30 to Casa Grande | 6.6 |
| | Casa Grande to Riverside | 2.5 |
| Cedar Avenue | Santa Ana to Slover | 3.6 |
| | South of Santa Ana | 8.0 |
| Larch Avenue | Jurupa to Santa Ana | 8.0 |
| Spruce | Santa Ana to Slover | 7.0 |
| Cactus Avenue | Foothill to Baseline | 3.3 |
| | South of Jurupa | 6.2 |
| | Baseline to Route 30 | 4.9 |
| Lilac Avenue | Valley to Foothill | 4.5 |
| Willow Avenue | Valley to Foothill | 2.5 |
| Riverside Avenue | Agua Mansa to I-10 | 2.5 |
| | I-10 to Merrill | 2.5 |
| | Merrill to Foothill | 2.4 |
| | Foothill to Route 30 | 3.1 |
| | Route 30 to Cactus | 6.8 |
| | Cactus to Ayala | 7.1 |
| | Ayala to Locust | 8.5 |
| | Locust to Sierra | 2.7 |
| Pepper Avenue | South of I-10 | 2.5 |
| Bloomington Avenue | Valley of San Bernardino | 3.3 |
| | San Bernardino to Merrill | |

Source: City of Rialto General Plan Update Draft MEIR, November 1991

The picture that is portrayed by the data is that as transportation related noises increase with buildout of a community, the amount of sensitive land uses exposed to unacceptable noise levels will significantly increase, certainly within the City of Rialto and more generally within the remainder of the communities in the Chino Basin. Note that stationary sources of noise, such as industrial operations, can generally be controlled to meet local noise standards because they are located within areas of similar use, where the noise does not pose an adverse impact, or where noise attenuation is mandatory and the impacts on any adjacent sensitive noise receptors is reduced to an acceptable level. Within the remaining communities the following noise environment was characterized in the local general plan noise elements.

City of Fontana: The City of Fontana has adopted a land use matrix (Table N-1) and interior and exterior noise standards (Table N-2) that reflect the noise guidelines contained in Figure 4.11-1. The noise environment in Fontana is dominated by motor vehicle transportation noise sources, including Interstates 10 and 15 and major east-west and north-south arterials. The existing noise contours are

shown in Figure 4.11-5 (Exhibit N-1 of the General Plan). Fontana does not have an airport, but both east-west railroad tracks traverse the City and create noise impacts, that, like Rialto, exceed 70 dBA CNEL adjacent to the track.

City of Rancho Cucamonga: The City of Rancho Cucamonga has adopted a land use matrix (Figure V-10) that reflects the noise guidelines contained in Figure 4.11-1. The noise environment in Rancho Cucamonga is also dominated by motor vehicle transportation noise sources, including Interstate 15 and major east-west and north-south arterials. The future noise contours (buildout) are shown in Figure 4.11-6 (Figure V-9 of the General Plan). Rancho Cucamonga does not have an airport, but one of the east-west railroad tracks traverses the City and creates noise impacts, that, like Rialto, exceed 70 dBA CNEL adjacent to the track.

City of Ontario: The City of Ontario has adopted a land use matrix (Figure HA-9) and interior and exterior noise standards (Table HA-2) that reflect the noise guidelines contained in Figure 4.11-1. The noise environment in Ontario is dominated by motor vehicle transportation noise sources, including Interstate 10 and Highway 60 and major east-west and north-south arterials. The existing noise contours are shown in Figure 4.11-7 (Figure HA-7 of the General Plan). The City of Ontario is impacted by the east-west railroad tracks (Union Pacific) which traverse the City and create noise impacts, that, like Rialto, exceed 70 dBA CNEL adjacent to the track. The City is also impacted by Ontario Airport (Figure 4.11-8) and, following annexation of the 8,200 acres of the Chino Agricultural Preserve, the City is impacted by aircraft operations at Chino Airport (see the following discussion).

City of Chino: The City of Chino has adopted a land use matrix (Exhibit VI-4) and interior and exterior noise standards (Exhibit VI-5) that reflect the noise guidelines contained in Figure 4.11-1. The noise environment in Chino is dominated by motor vehicle transportation noise sources, including Interstate 10 and Highway 60 and major east-west and north-south arterials. The existing noise contours are shown in Figure 4.11-9 (Exhibit VI-1 of the General Plan). The City of Chino is impacted by the east-west railroad tracks (Union Pacific) which traverse the City and create noise impacts, that, like Rialto, exceed 70 dBA CNEL adjacent to the track. The City is also impacted by aircraft operations at Chino Airport (see Figure 4.11-10).

City of Chino Hills: The City of Chino Hills has adopted a land use matrix (Table N-1) that reflects the noise guidelines contained in Figure 4.11-1. The noise environment in Chino Hills is also dominated by motor vehicle transportation noise sources, including the Chino Valley Freeway and major east-west and north-south arterials. The future noise contours (buildout) are shown in Figure 4.11-11 (Figure N-2 of the General Plan). Rancho Cucamonga does not have an airport, and none of the east-west railroad tracks traverses the City to create noise impacts.

City of Montclair: The City of Montclair's General Plan has not been updated since 1983 and the only noise data for the City is presented in Table 4.11-4 which identifies the exposure of the City's population to forecast noise levels in 1981 and 1995. No quantitative noise guidelines are contained in the Montclair General Plan. The noise environment in Montclair is also dominated by motor

vehicle transportation noise sources, including the Intestate 10 and major east-west and north-south arterials. Ontario Airport operation also impact the eastern portion of the City. Both major railways have tracks through the community which also create noise impacts comparable to that identified in the City of Rialto.

City of Upland: The City of Upland has adopted a land use matrix (Figure 10-1) that reflects the noise guidelines contained in Figure 4.11-1. The noise environment in Upland is dominated by motor vehicle transportation noise sources, including Interstate 10 and major east-west and north-south arterials. There is no existing noise contour map. The City of Upland is impacted by the east-west railroad tracks (Pacific Electric) which traverse the City and create noise impacts, that, like Rialto, exceed 70 dBA CNEL adjacent to the track. The City is also impacted by aircraft operations at Cable Airport (see Figure 4.11-12).

City of Pomona: The City of Pomona's General Plan has not been updated since 1977 and there is no current noise data for the City. No quantitative noise guidelines are contained in the Pomona General Plan. The noise environment in Pomona is also dominated by motor vehicle transportation noise sources, including the Intestate 10, Highway 60 and major east-west and north-south arterials. Brackett Field, just west of the City of Pomona, also impact the western portion of the City. Both major railways have tracks through the community which also create noise impacts comparable to that identified in the City of Rialto.

Riverside County and Norco: The Riverside County (including Norco and surrounding area) General Plan has not been updated since 1984 and there is no current noise data for these areas. Quantitative noise guidelines are contained on Figure VI-11 of the County General Plan. The noise environment in this area is also dominated by motor vehicle transportation noise sources, including the Intestate 15, Highway 60 and major east-west and north-south arterials. Noise from three airports, Corona, Ontario and Chino impact this portion of the project area. Major railways have tracks traverse these areas which also create noise impacts comparable to that identified in the City of Rialto.

San Bernardino County: San Bernardino County noise levels are evaluated as part of the Cities of Ontario and Chino which assumed responsibility for planning in these areas in 1994 as a result of expanding each City's sphere into the Chino Agricultural Preserve. The City of Ontario has annexed the whole 8,200 acres of its sphere, and the City of Chino has annexed approximately 1,500 acres to date. Noise impacts and policies are as outlined above for these cities.

## Table 4.11-4
## NOISE IMPACTS
## EXISTING CONDITIONS 1981 AND PROJECTED IMPACTS 1995

| Range of CNEL | Ontario International Airport | I-10 Freeway | Major and Secondary Arterials | Railroads | Lower Levels of Aircraft, Arterial and/or RR Noise | Total # of People Exposed to Various Levels of Noise | Percent of Total |
|---|---|---|---|---|---|---|---|
| EXISTING - 1981 | | | | | | | |
| Less than 60 dB | — | — | — | — | 4,780 | 4,780 | 17.0 |
| 60 - 65 | 10,090 | 1,570 | 1,170 | — | — | 12,830 | 45.8 |
| 65 - 70 | 7,780 | 860 | 1,090 | 40 | — | 9,770 | 34.9 |
| 70 - 75 | — | 430 | 120 | 30 | — | 580 | 2.1 |
| 75 - 80 | — | 50 | — | — | — | 50 | 0.2 |
| Total: | 17,870 | 2,910 | 2,380 | 70 | 4,780 | 28,010 | 100.0 |
| Percent of Total: | 63.8% | 10.4% | 8.5% | 0.3% | 17.0% | 100% | |
| PROJECTED - 1995 | | | | | | | |
| Less than 60 dB | — | — | — | — | 19,270 | 19,270 | 49.0 |
| 60 - 65 | 9,450 | 970 | 3,120 | — | — | 13,540 | 34.6 |
| 65 - 70 | 2,580 | 920 | 1,940 | 40 | — | 5,480 | 13.9 |
| 70 - 75 | — | 730 | 160 | 30 | — | 920 | 2.3 |
| 75 - 80 | — | 90 | — | — | — | 90 | 0.2 |
| Total: | 12,030 | 2,710 | 5,220 | 70 | 19,270 | 39,300 | 100.0 |
| Percent of Total: | 30.6% | 6.9% | 13.3% | 0.2% | 49.0% | 100% | |

Source: City of Montclair General Plan 1983

### 4.11.3 Project Impacts

The project's potential to generate noise was included in this PEIR based on the potential for specific project to cause short-term and long-term changes in the noise environment surrounding these facilities. A second issue of concern was the potential for the OBMP to contribute to the cumulative or general increase in noise that accompanies urban growth and development. Short-term noise increases could result from construction activities and the long-term noise increases could be associated with operating desalters, production well pumps and booster pumps. The implementation of the OBMP would include modifying existing and installing new recharge basins, installing monitoring wells, production wells, booster pumps (to move recycled water and desalted water), and supporting installation and operation of desalters in the southern portion of the Chino Basin. The noise issues of focus in this evaluation are those changes due to the project that may increase the existing noise levels or alter future potential noise levels along major transportation corridors within the Chino Basin.

#### 4.11.3.1 Significance Criteria

Noise impact criteria are described in detail in section 4.11.2.2 above. The following criteria will be used to determine whether noise levels have been significantly increased:

For residential areas, an exterior noise level of up to 65 dBA CNEL is permitted, if the exterior areas are substantially mitigated and the interior noise exposures do not exceed 45 dBA CNEL with windows and doors closed. If windows and doors are required to be closed to achieve an acceptable interior noise level, then the use of air conditioning or mechanical ventilation will be required.

In community noise assessments, a long-term change in noise levels greater than 3 dBA is often identified as significant, while changes less than one dBA will not be discernible to the human ear. In the range of one dBA to 3 dBA, people who are very sensitive to noise may perceive a slight change in noise level. No scientific evidence is available to support the use of 3 dBA as the significance threshold. In laboratory testing situations, humans are able to detect noise level changes of slightly less than one dBA. However, in a community situation the noise exposure is extended over a long time period, and changes in noise levels occur over years, rather than the immediate comparison made in a laboratory situation. Therefore, the level at which changes in community noise levels become intrusive, rather than discernible, is some value greater than one dBA, and 3 dBA is generally accepted as the appropriate threshold for most community noise situations.

For purposes of this evaluation, noise impacts are considered significant if the project is forecast to increase noise levels by 3 dBA (CNEL) where: (1) the existing noise levels already exceed the 65 dBA (CNEL) residential standard or (2) the project increases noise levels from below the 65 dBA (CNEL) standard to above 65 dBA (CNEL).

#### 4.11.3.2 Potential OBMP Contributions to Growth Related Noise Impacts

A detailed discussion of potential growth inducing impacts from implementing the OBMP is presented in subchapters 4.2 and 4.3. Fundamentally, regardless of whether the OBMP is implemented, individual Water Serving Agency's have identified individual actions that they can implement to meet future water demands within the Chino Basin. The OBMP provides an alternative water supply plan that provides for more efficient and effective enhancement of safe yield and water quality that will fully comply with the judgment that established the physical solution for the Chino Basin. In essence, the OBMP follows a similar path in forecasting future water supply needs and includes many of the practices and programs cited within the individual agencies Urban Water Management Plans. It is complimentary to numerous goals within the individual Plans. The OBMP, as an example seeks to promote utilizing reclaimed water supplies, developing water conservation programs and expanding recycling opportunities for the Basin.

The OBMP takes a more global approach to water demand and supply issues compared to the evaluations at a general plan or Urban Water Management Plan level and looks toward providing more effective and efficient ways to protect the viability of the entire basin. Furthermore, emphasis is placed upon programs such as recycling of water, improving water quality and the extraction of salts. The OBMP functions as one path of fulfilling the water supply demands outlined in local jurisdiction general plans and Urban Water Management Plans. As such it is growth accommodating as outlined in subchapter 4.2, but it does not in and of itself create opportunities for additional people to move to the region nor to construct additional facilities beyond those previously under consideration to accommodate the population that will locate in the area in accordance with adopted general plan visions of ultimate development within each community located in the Chino Basin.

Based on this analysis, no potential exists for implementation of the OBMP to cause or contribute to significant adverse growth in the Chino Basin, nor to any different future noise environment than forecast within each local agency's general plans discussed above.

#### 4.11.3.3 Potential Project Specific Noise Impacts

**a. Will the project increase noise exposure for sensitive receptors from new noise sources?**

*Short-Term Noise Sources*

Construction noise would be generated by any of the facilities or activities supported by the OBMP within the Chino Basin. Construction activities in support of redevelopment would have a short-term impact on ambient noise levels. Noise generated by construction equipment, including trucks, graders, back-hoes, bull-dozers, concrete mixers and portable generators can reach high levels and is typically one of the sources for the highest potential noise impact of a project. The most effective method of controlling construction noise is by local limitation of construction hours to normal week-day working hours, typically from daylight to dusk.

Noise levels at a distance of 50 feet from equipment which might be used for the excavation and construction of the proposed project are presented in Figure 4.11-13. These noise levels decrease at a rate of approximately 6 dBA for each doubling of distance. Therefore, at 100 feet from the equipment, noise levels would be about 6 dBA less than shown in Figure 4.11-13. Similarly, at 200 feet from the equipment, noise levels would be 12 dBA less than indicated in the exhibit. Intervening structures and topography would act as noise barriers and reduce noise levels further.

Since construction noise is of a temporary nature, most jurisdictions do not require such noise to be mitigated to the specific threshold levels outlined above. However, they do require operational considerations (i.e., limitation of construction hours, the muffling of construction equipment, noise complaint response programs, etc.) to minimize noise impacts during the construction process. Construction noise levels affecting sensitive receptors may exceed the significance thresholds during the day, but eliminating this source of noise at night and reducing any noise levels that might be damaging to hearing can reduce these short-term impacts to a non-significant level. Mitigation measures are identified below which ensure that construction activities do not intrude on sensitive receptors in the evening or expose such receptors to damaging levels of noise at any time. With implementation of these measures, short-term construction activities are not forecast to cause significant adverse noise impact.

*Permanent Noise Sources*

The OBMP (see Table 4.2-3) identifies a variety of future projects and activities that may cause or contribute to changes in the existing background noise levels.

For recharge basins, once operation begins the activity of discharging water and allowing it to percolate into the ground does not generate any noise that if forecast to exceed background noise levels. No adverse impact is forecast to occur from implementing recharge. Note that occasional maintenance activities associated with operating recharge basins will be similar in volume to construction activities. Such activities will be restricted to daylight hours and the level of noise generation will be comparable to that described under the discussion of short-term noise impacts above.

The installation and operation of monitoring wells is also a fairly passive source of noise generation. Once installed such wells either have automatic monitoring equipment or are visited periodically to obtain the desired data. Such activities are not forecast to exceed the sound levels of surrounding activities, such as traffic or urban activities (typically about 55 dB) from children playing, music playing, or gardening activities.

The operation of both production wells and booster pumps can generate noise levels greater than the 60-65 dBA CNEL values that are considered acceptable for noise sensitive uses. Based on extensive experience in locating production wells within urban settings, adequate sound attenuation structures are available to reduce sounds from production wells and booster pumps to levels well within the significant noise impact thresholds, including those noise levels protective of sleep during nighttime

hours. Mitigation is provided below to ensure that future production well and booster pump noise is reduced below a significance threshold in each of the communities of the Chino Basin.

The desalter will function more or less as an industrial facility (water treatment facility). Noises associated with this type of facility will range from traffic caused by arriving vehicles (employees, visitors, and deliveries) to equipment operation in the structure. If located adjacent to or in the vicinity of a sensitive noise receptor, a potential exists for future desalters to exceed the noise thresholds of a community and cause a significant adverse impact. This impact can be avoided by implementing mitigation that either incorporates noise attenuation into the design of the facility, or by locating the facility at a location where it will not conflict with adjacent uses (residential, schools, or wildlife preserves) and by either acquiring sufficient land to provide an adequate noise buffer from sensitive neighbors or constructing man-made noise attenuation buffers. After implementing such measures, any potential for significant noise impact can be reduced below the thresholds outlined above.

### b. Will the project expose people to severe noise levels?

None of the permanent activities associated with implementing the OBMP are forecast to generate any severe noise levels that could adversely impact the sensitive residential population within the Chino Basin. It is possible, but not probable, that short-term construction activities could generate severe noise levels (such as use of pile drivers), but mitigation can be implemented to reduce noise levels from such activities to levels that will not damage hearing. No additional mitigation is required.

## 4.11.4 Mitigation Measures

The evaluation of potential noise impacts presented above identified potentially significant noise impacts. The potential noise impacts from implementing the proposed project range from non-significant without mitigation to potentially significant unless mitigation or other measures are implemented. During construction, grading, site clearance and building construction activities generate the most noise. During operations/occupancy the noise analysis concluded that offsite noise impacts do have a potential to cause significant adverse impact to adjacent sensitive land uses. The following mitigation measures will be implemented to reduce noise impacts to the minimum level achievable.

**4.11-1 Construction shall be limited to the hours of 7 a.m. to 7 p.m. on Monday through Friday, and between 9 a.m. to 6 p.m. on Saturday, and shall be prohibited on Sundays and federal holidays.**

**4.11-2 All construction vehicles and fixed or mobile equipment shall be equipped with properly operating and maintained mufflers.**

**4.11-3 All employees that will be exposed to noise levels greater than 75 dB over an 8-hour period shall be provided with adequate hearing protection devices to ensure no hearing damage will result from construction activities.**

**4.11-4 If equipment is being used that can cause hearing damage at adjacent noise receptor locations (distance attenuation shall be taken into account), portable noise barriers shall be installed that are demonstrated to be adequate to reduce noise levels at receptor locations below hearing damage thresholds.**

**4.11-5 All production wells or booster pumps shall have their noise levels attenuated to 50 dBA CNEL at 50 feet from the well head.**

**4.11-6 Project design will include measures which assure adequate interior noise levels as required by Title 25 (California Noise Insulation Standards).**

**4.11-7 Require that all parking for desalter uses adjacent to residential areas be enclosed within a structure or separated by a solid wall with quality landscaping as a visual buffer.**

**4.11-8 Desalters shall be constructed and operated so that noise levels from operations do not exceed 50 dB during night hours and 65 dB averaged over the 12 hours of day time when located adjacent to existing or future sensitive land uses. This can be achieved by siting desalters a sufficient distance from sensitive noise receptors; by incorporating attenuation features in the facility or designing attenuation features at the boundary of the property.**

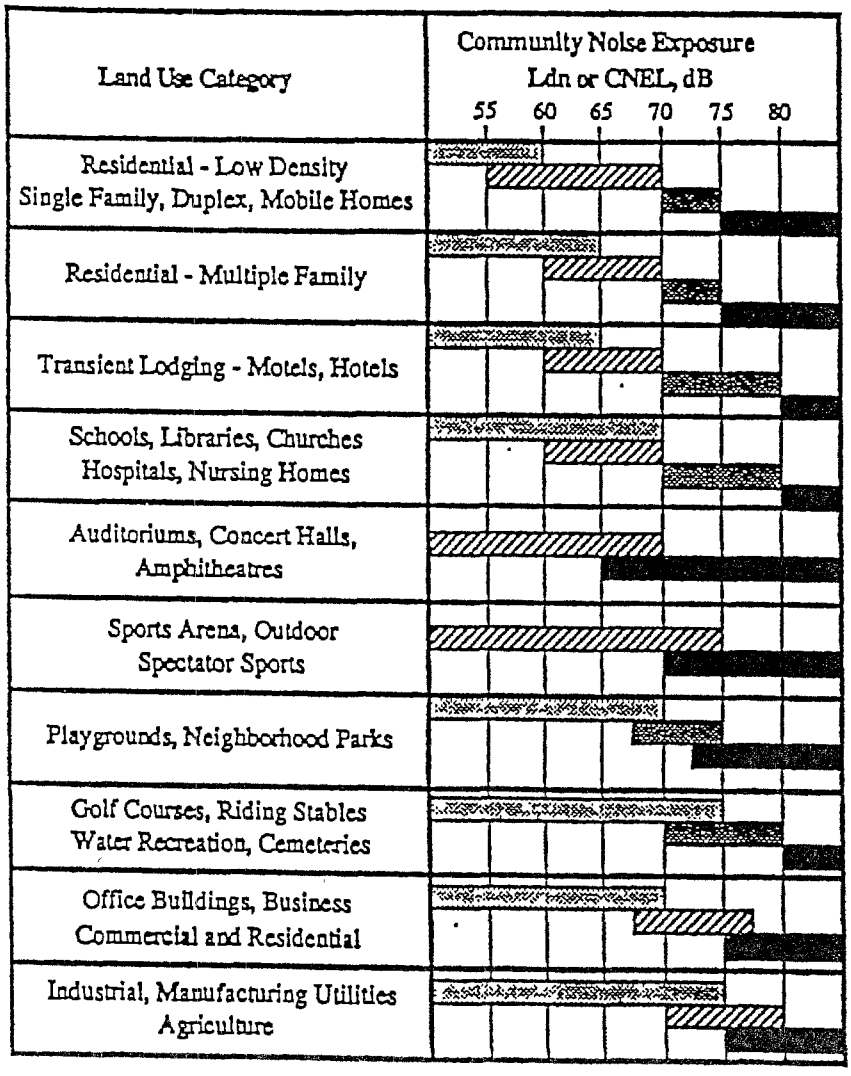
These measures ensure that implementation of the OBMP will not cause significant noise impacts during construction or cause hearing damage to employees or nearby receptors from severe noise levels. Potentially significant noise impacts where residential uses or other sensitive uses abut major facilities will have noise impacts reduced to a non-significant level by implementing the above measures.

### 4.11.5 Unavoidable Adverse Impact

The noise evaluation presented above indicates that the proposed project has a potential to cause potentially significant and unavoidable adverse noise impact from implementing certain facilities and activities.. As noted above, mitigation measures have been identified that can reduce both short-term and permanent noise impacts below a significant level.

### 4.11.6 Cumulative Impact

The noise forecast data contained in the local agency general plans demonstrates that future traffic noise levels from general growth (cumulative traffic increases) within the Chino Basin will result in significant noise impacts. However, the OBMP is not forecast to cause or contribute to such cumulative noise impacts which can be attributed to the land use mix contained in the local agency general plans and the inability to reduce potential traffic noise impacts to a non-significant level. Any traffic generated by OBMP operations (a few hundred trips per day) are considered *de minimis* contributions to this traffic related noise impact. Because implementation of the OBMP will not contribute to the cumulative increases in traffic, the proposed project is not forecast to cause a contribute to cumulatively significant noise impacts.




**Interpretation**

**Normally Acceptable**

Specified Land Use is Satisfactory, Based Upon the Assumption that Any Buildings Involved are of Normal Conventional Construction, Without Any Special Noise Insulation Requirements.

**Conditionally Acceptable**

New Construction or Development Should be Undertaken Only After a Detailed Analysis of the Noise Reduction Requirement is Made and Needed Noise Insulation Features Included in the Design. Conventional Construction, but with Closed Windows and Fresh Air Supply Systems or Air Conditioning, Will Normally Suffice.

**Normally Unacceptable**

New Construction or Development Should Generally be Discouraged. If New Construction or Development Does Proceed, a Detailed Analysis of the Noise Reduction Requirements Must be Made and Needed Noise Insulation Features Included in the Design.

**Clearly Unacceptable**

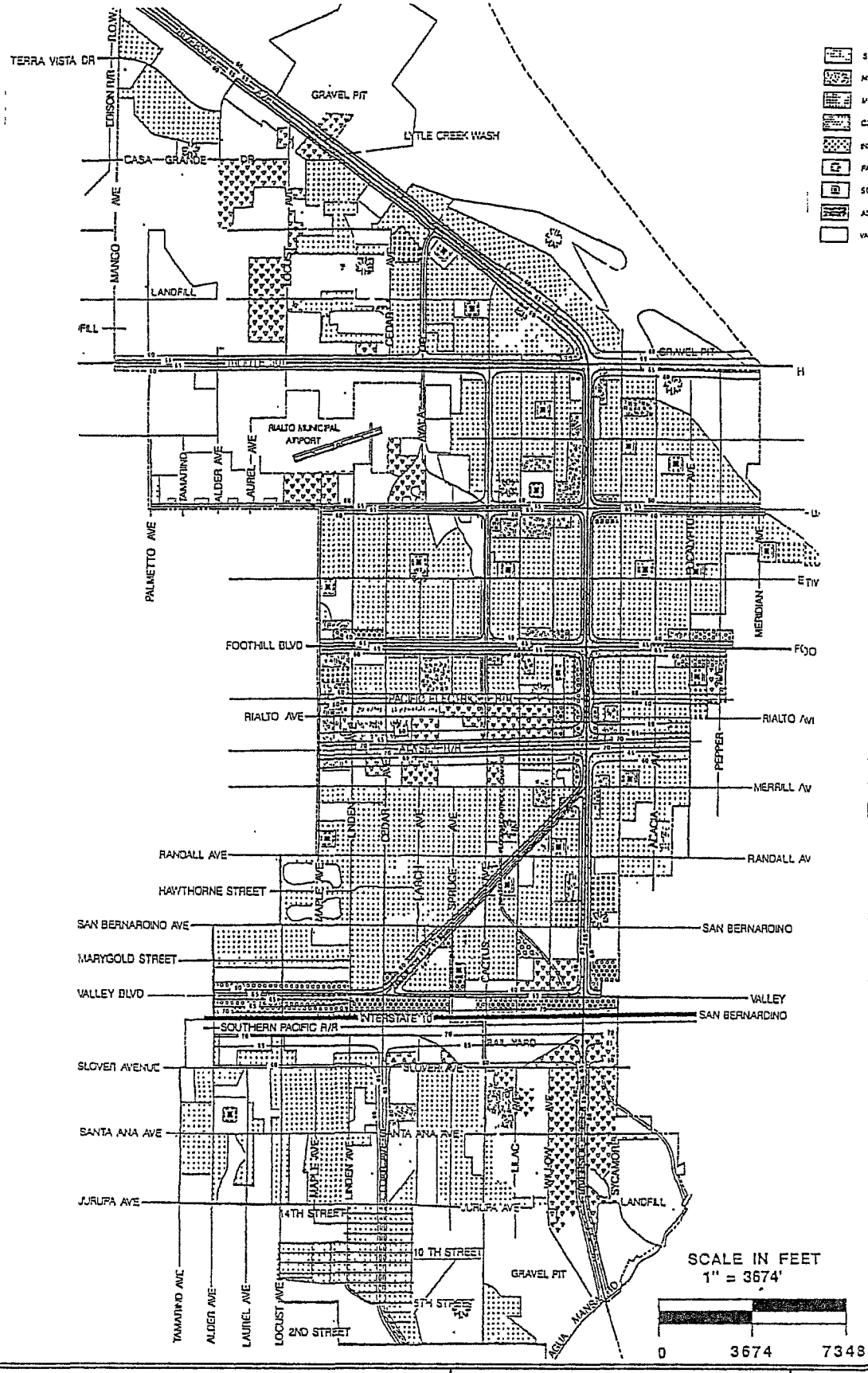
New Construction or Development Should Generally not be Undertaken.

**CALIFORNIA LAND USE / NOISE GUIDELINES**

Source: City of Rialto GP Update Draft MEIR

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-1**

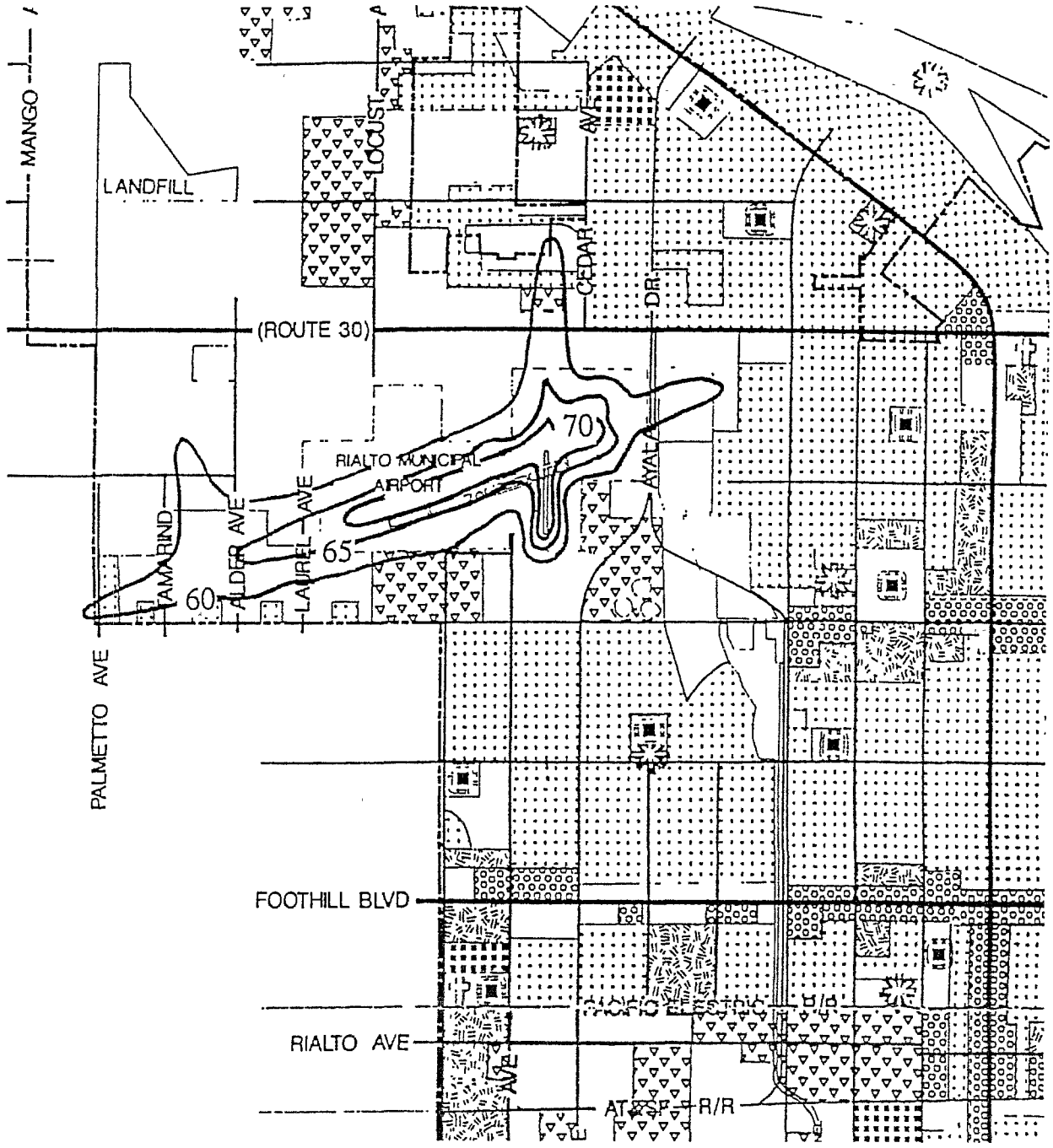



**EXISTING CNEL NOISE CONTOURS**

Source: City of Rialto GP Update Draft MEIR

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-2**

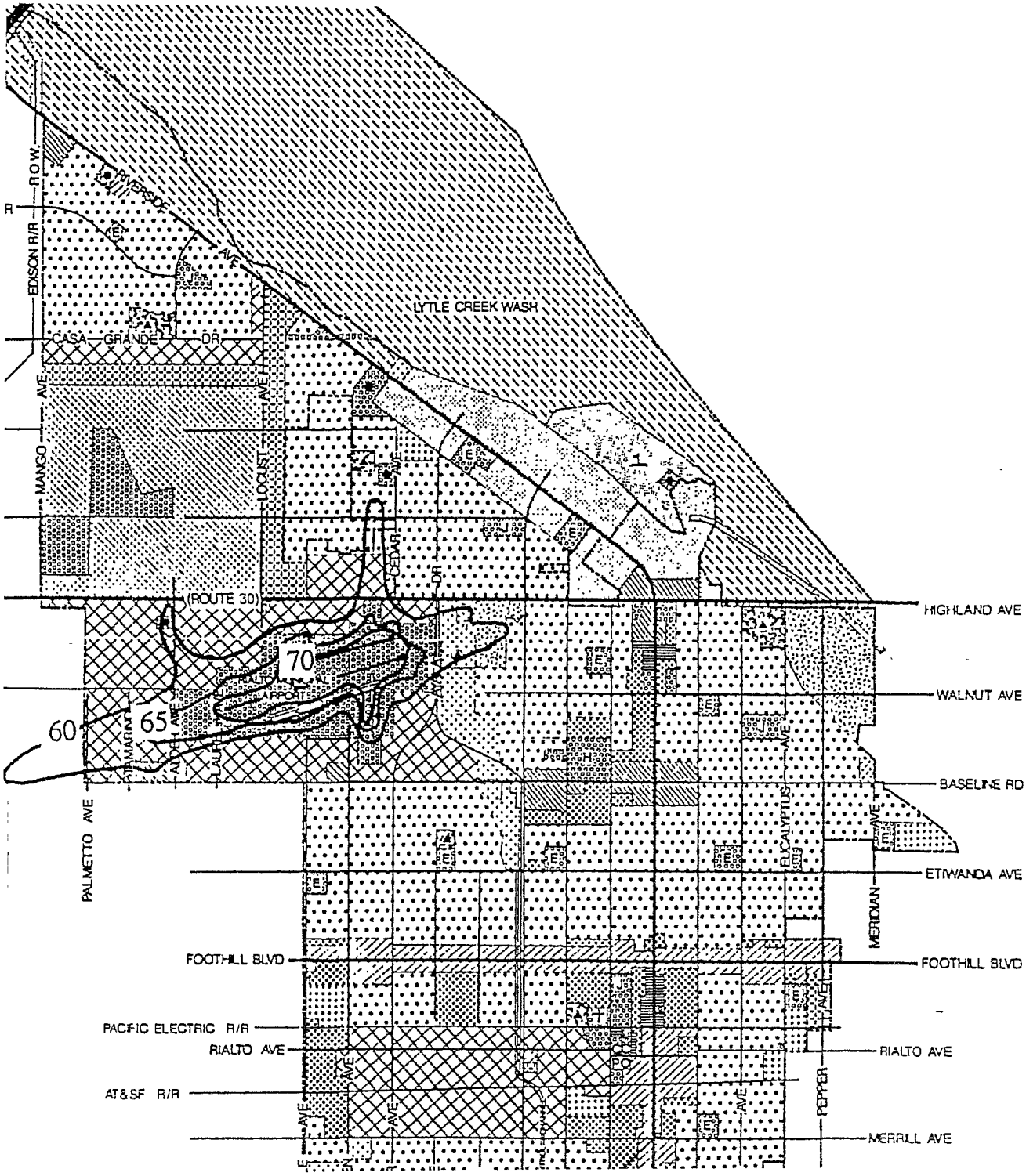



**AIRCRAFT CNEL NOISE CONTOURS (1990)**

Source: City of Rialto GP Update Draft MEIR

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-3**

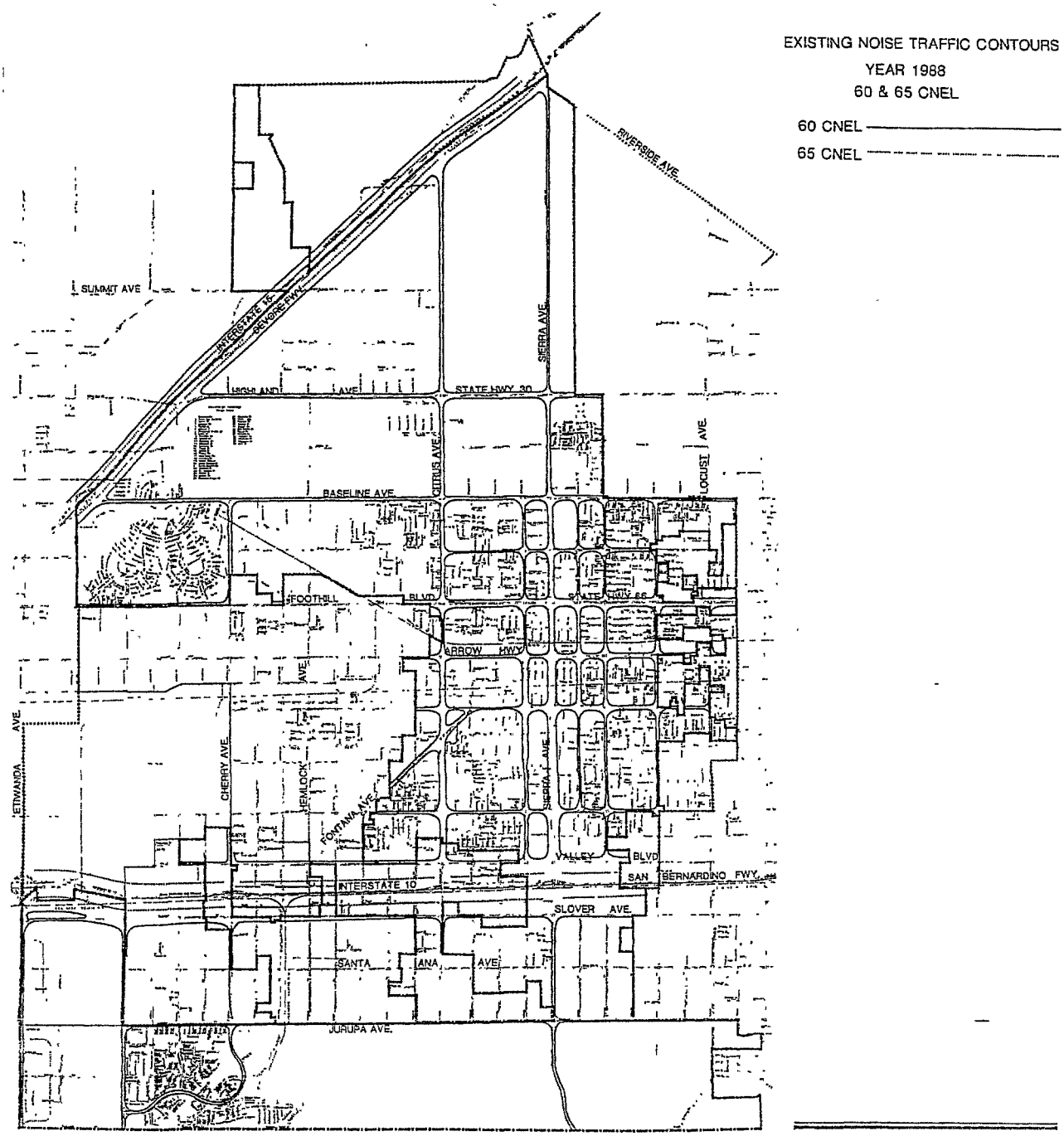



**AIRCRAFT CNEL NOISE CONTOURS (2010)**

Source: City of Rialto GP Update Draft MEIR

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-4**

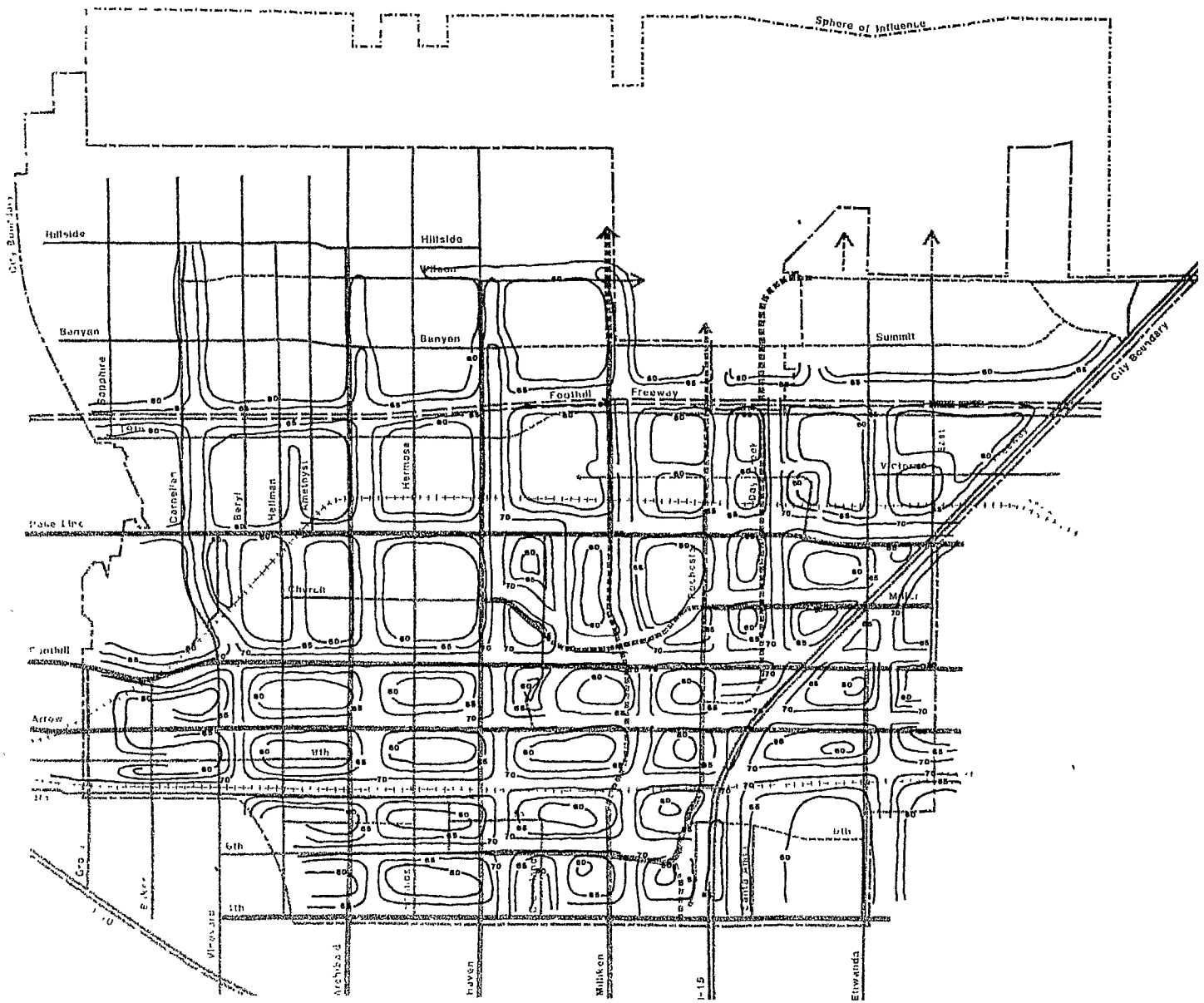



**EXISTING TRAFFIC NOISE CONTOURS**

Source: City of Fontana General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-5**




**FUTURE NOISE EXPOSURE CONTOURS**
**-- $L_{dn}$ METRIC -60- NOISE CONTOUR**

***PROPOSED FOOTHILL FREEWAY CONTOURS ASSUME 10dB ATTENUATION**

(MEASUREMENT DOES NOT INCLUDE TRAINS)

**CITY OF RANCHO CUCAMONGA**

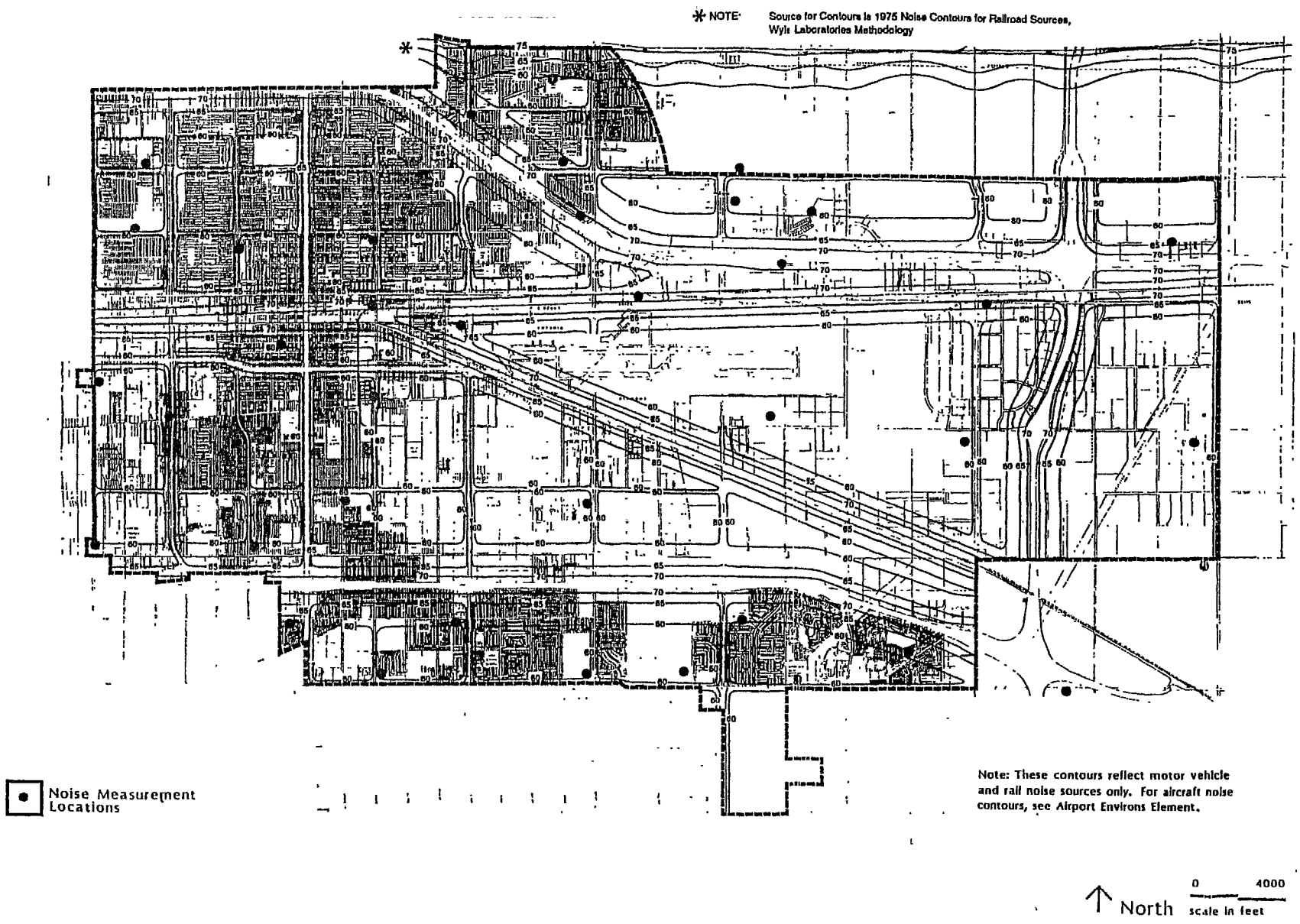
0 1000' 5000'

**FUTURE NOISE CONTOURS**

Source: City of Rancho Cucamonga General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-6**

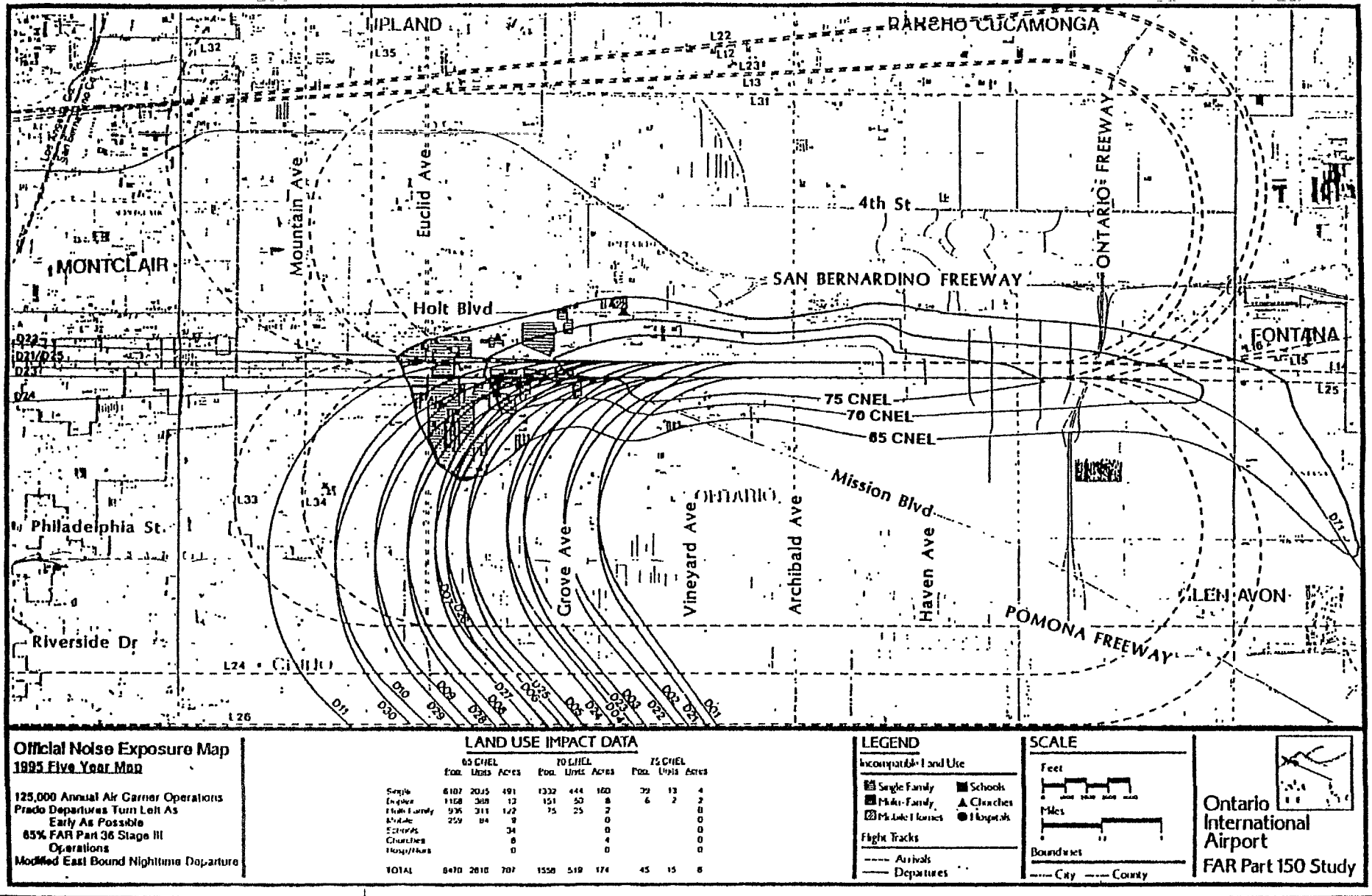



**EXISTING CNEL NOISE CONTOURS OF FREEWAYS, MAJOR ARTERIALS AND RAILROADS**

Source: City of Ontario General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-7**

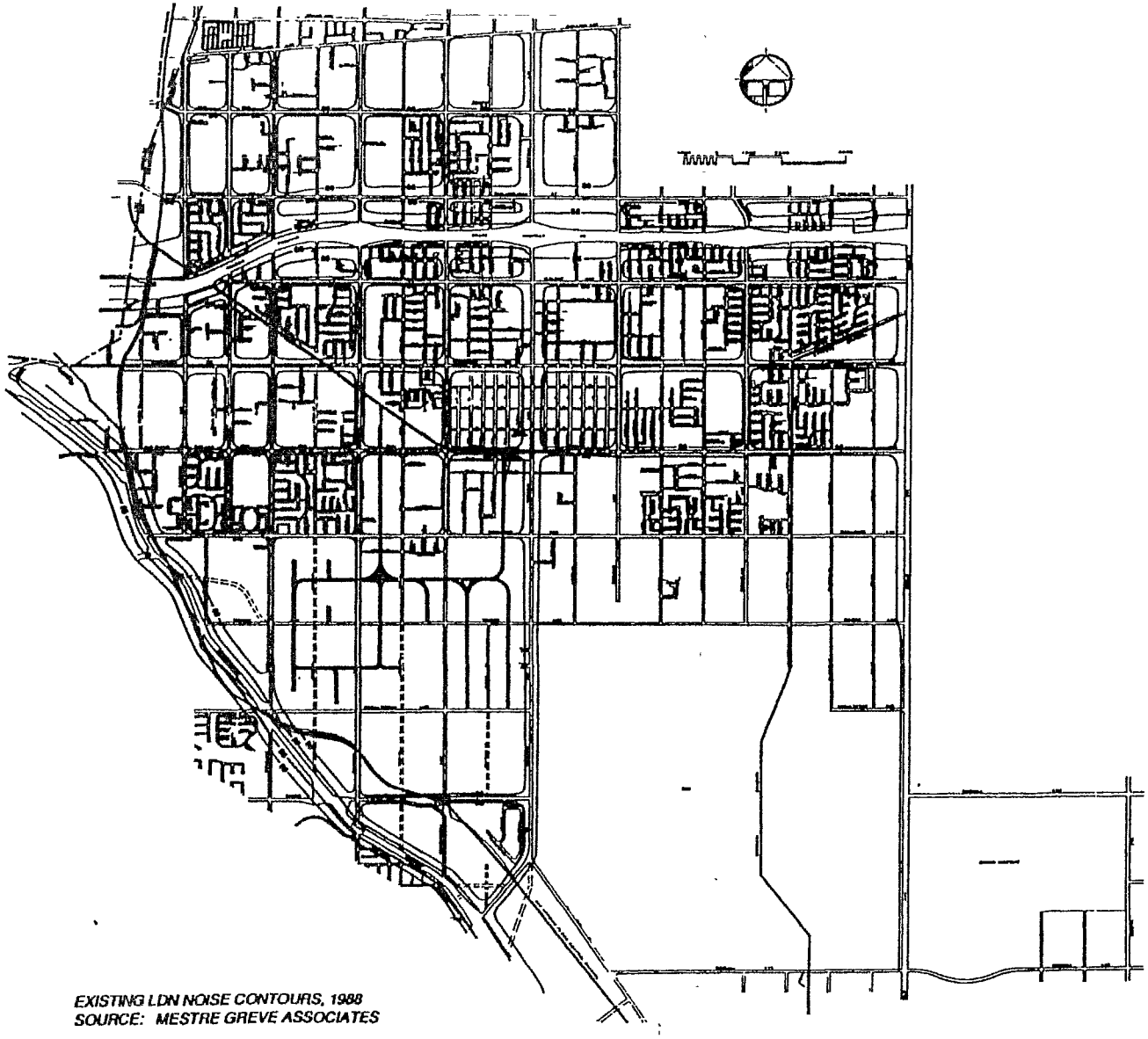



# OFFICIAL NOISE EXPOSURE MAP - 1995 FIVE YEAR MAP

Source: City of Ontario General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-8**

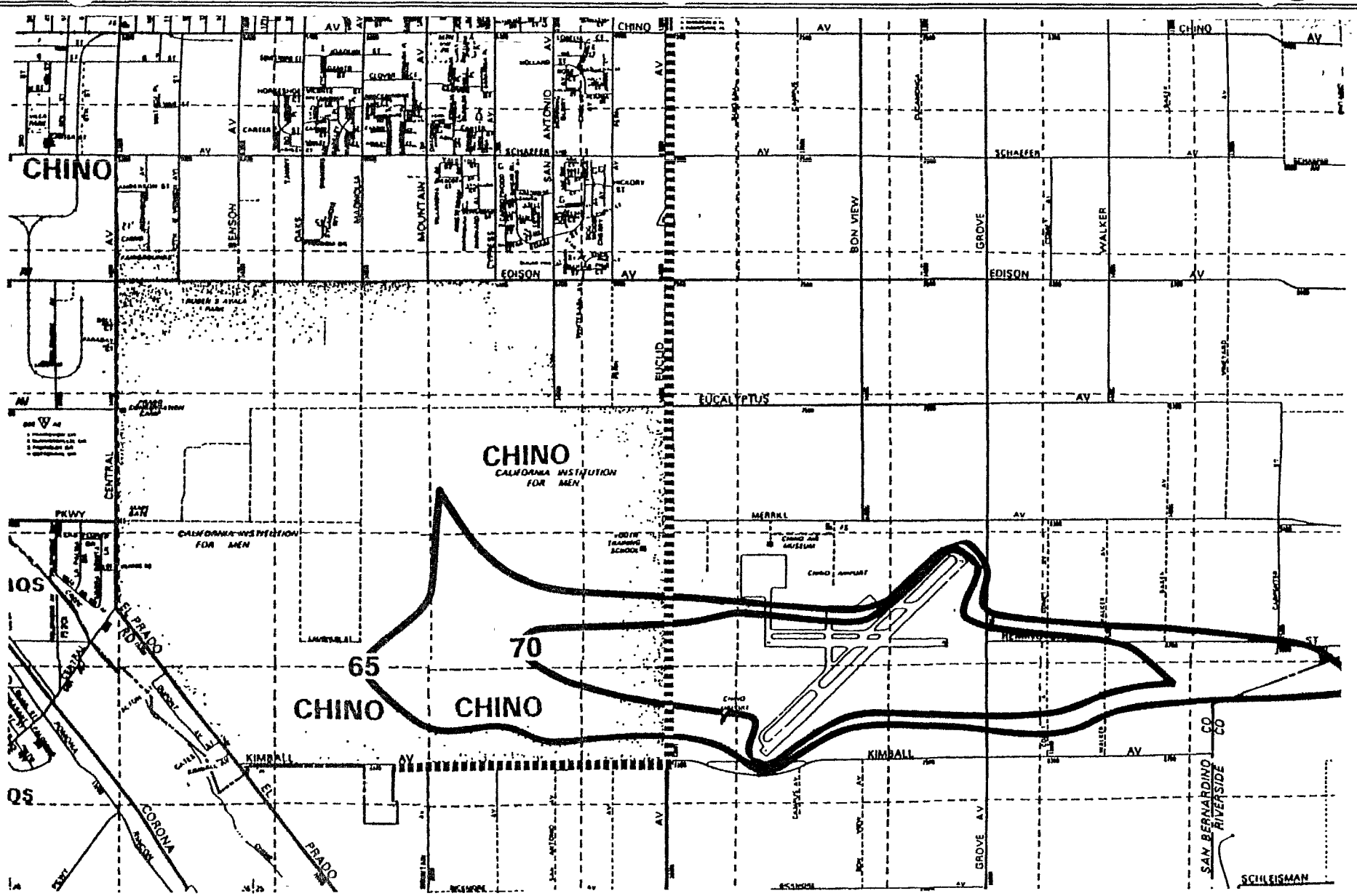



**EXISTING LDN TRAFFIC NOISE CONTOURS**

Source. City of Chino General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-9**

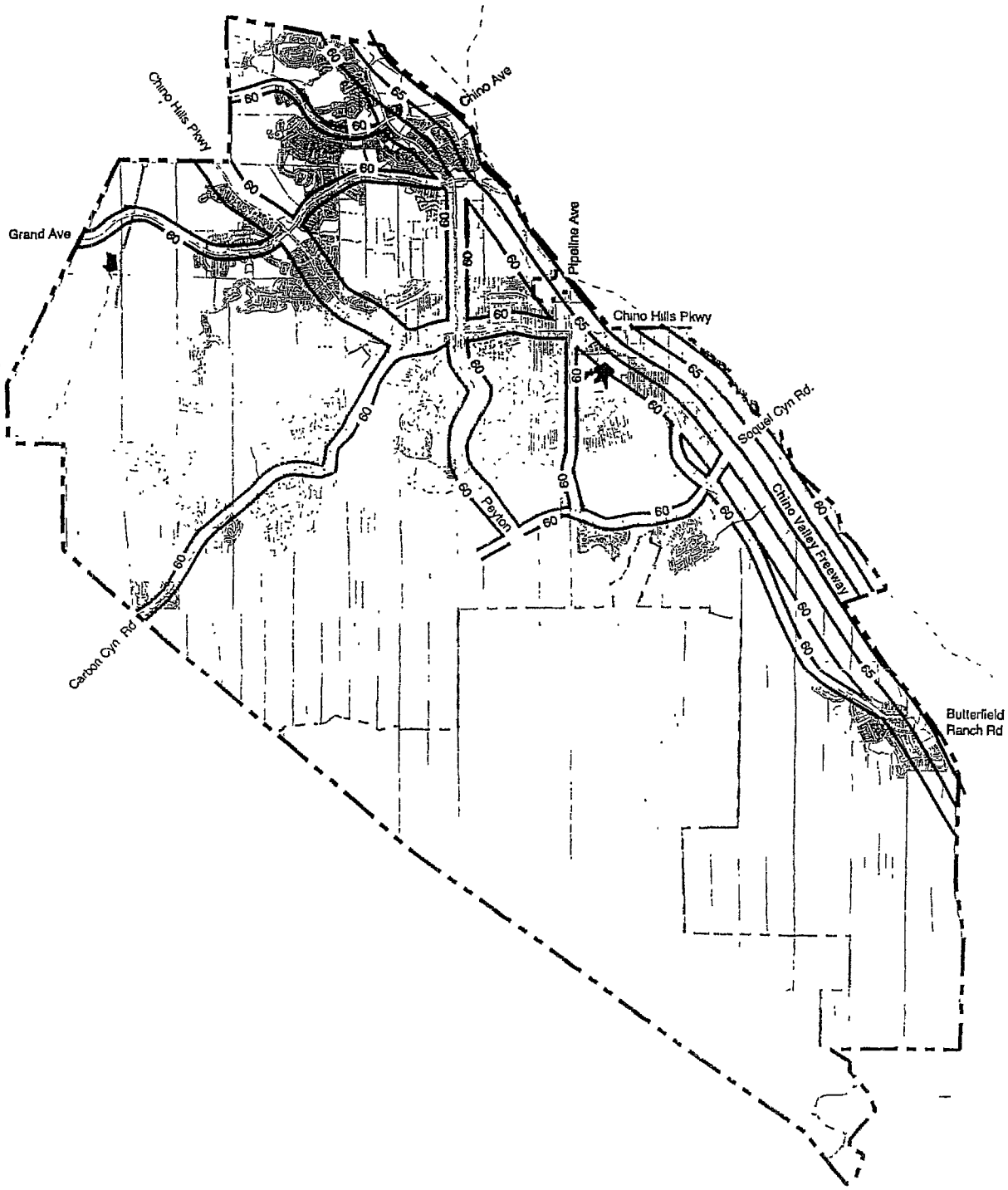



CHINO AIRPORT FUTURE CNEL NOISE CONTOURS

Source City of Chino General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-10**

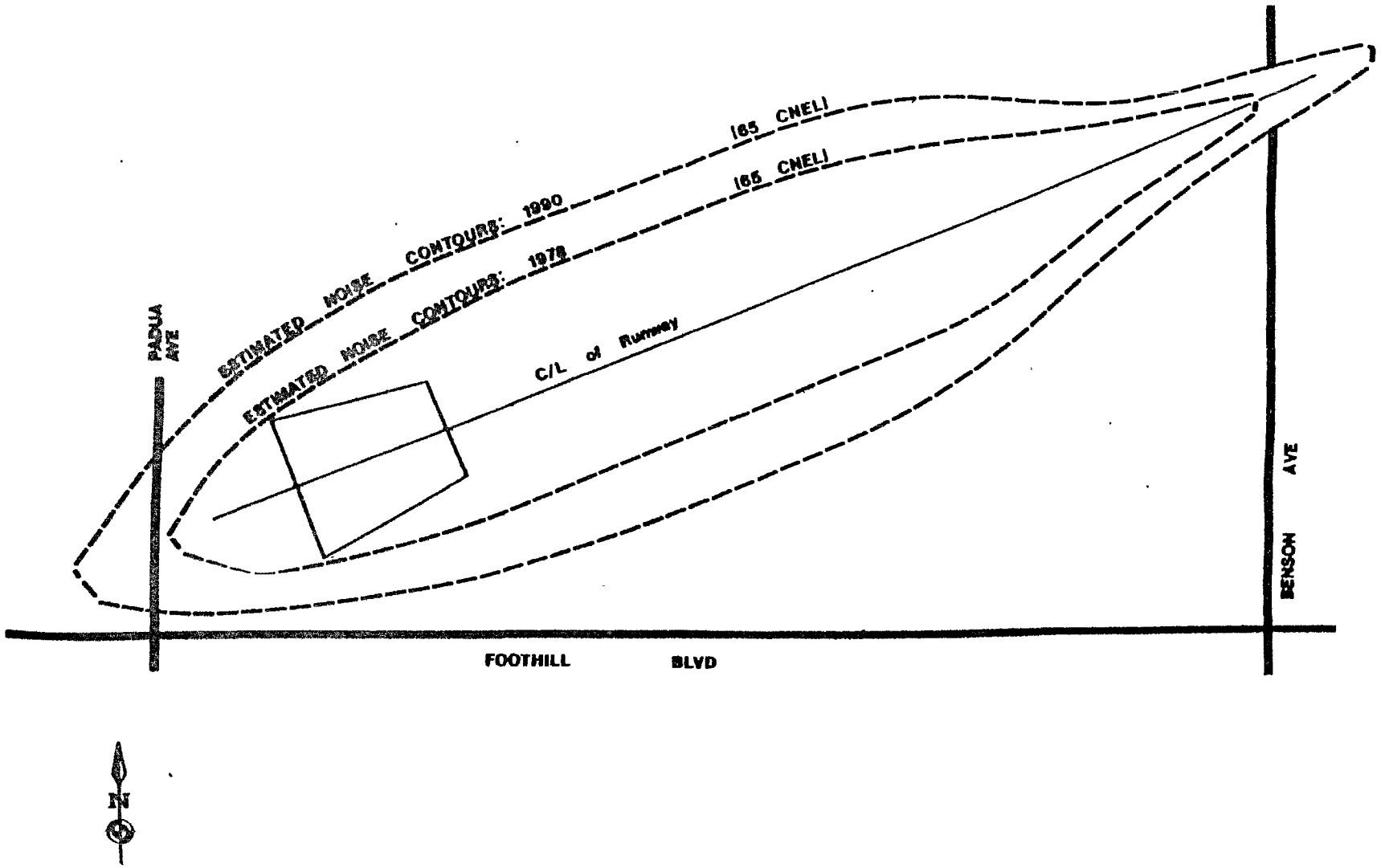



**FUTURE NOISE ENVIRONMENT**

Source: City of Chino Hills General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-11**

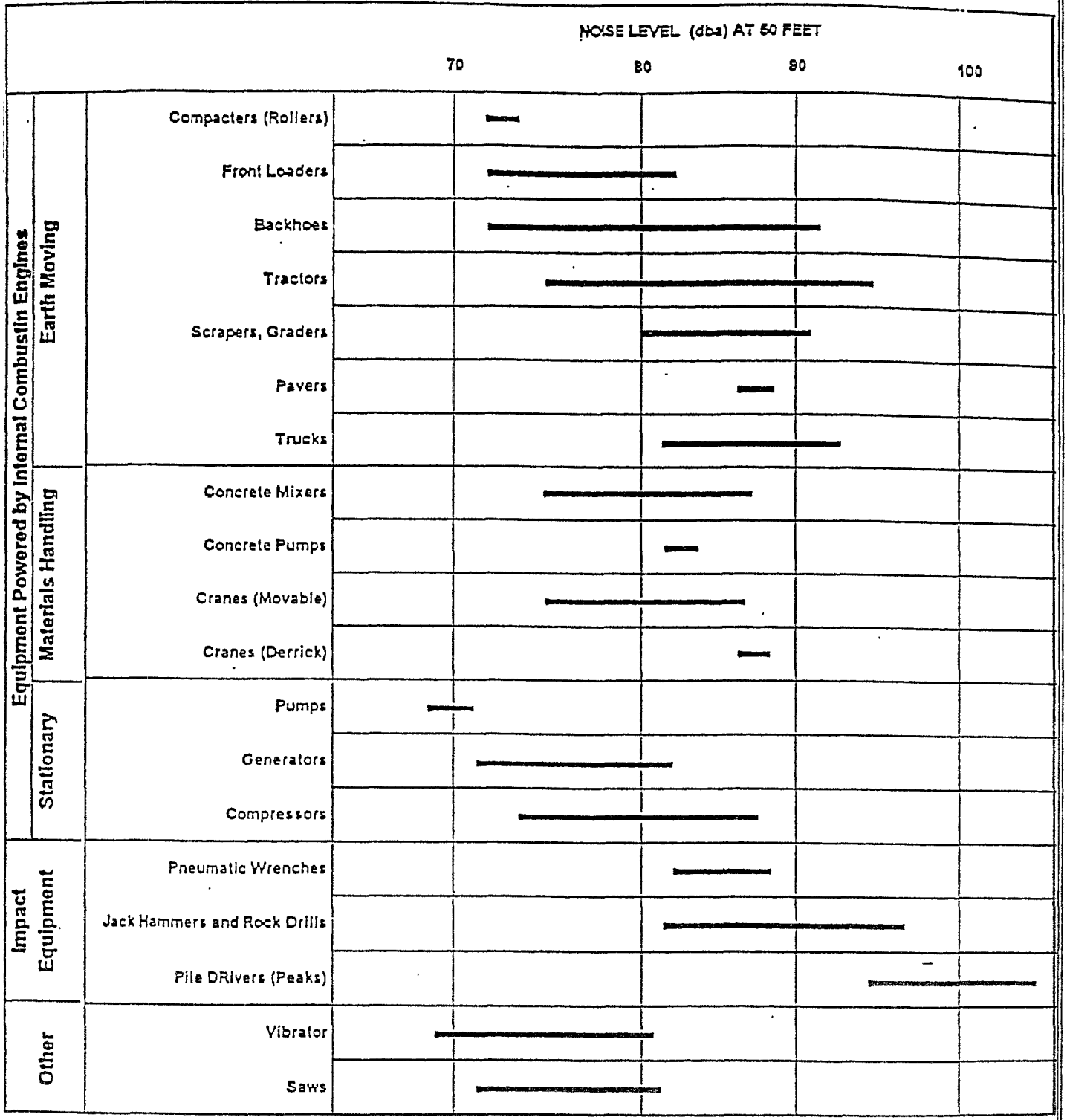



CABLE AIRPORT NOISE CONTOURS

Source: City of Upland General Plan

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-12**




Source: EPA PB 206717, Environmental Protection Agency, Dec. 31, 1971, "Noise from Construction

**CONSTRUCTION EQUIPMENT NOISE**

Source: Amendment to the Southwestern Industrial Park Specific Plan EIR

TOM DODSON & ASSOCIATES
Environmental Consultants

**FIGURE 4.11-13**

# 4.12 PUBLIC SERVICES

## 4.12.1 Introduction

This subchapter of the PEIR relies primarily upon data contained in a previous planning document prepared in support of the Chino Basin Water Resources Management Study and the general plans and other pertinent planning documents for the project area. These planning documents include the "Final Task 1 Memorandum, Water and Wastewater Planning Environment" (1993) and the general plans for the following agencies: cities of Chino Hills, Chino, Fontana, Ontario, Montclair, Norco, Pomona, Rancho Cucamonga, and Rialto; the counties of Riverside and San Bernardino; and the Southern California Association of Government publications: RCPG and RMP. The evaluation focuses on the public services supplied to the Study Area and the potential impacts to these service systems from implementing the OBMP.

## 4.12.2 Environmental Setting: Public Services

### 4.12.2.1 Police

Police protection within the proposed Study Area is provided by forces from the cities, the Riverside County Sheriff, the San Bernardino County Sheriff and the California Highway Patrol. Levels of Service are established within the General Plans for the cities and unincorporated portions of the two counties and these are met based upon the overall population of the specific jurisdiction.

### 4.12.2.2 Fire and Emergency Services

Fire and Emergency Services within the Study Area are provided by forces from the individual cities, area fire protection agencies, the Riverside County Fire Department and the San Bernardino County Fire Department. As with police protection, levels of service are established within the General Plans for the cities and unincorporated portions of the two counties and these are met based upon the overall population of the specific jurisdiction.

### 4.12.2.3 Schools

School facilities are administered through the school districts within the Study Area. The school districts work closely with the cities and unincorporated portions of the counties to ensure that adequate facilities are provided and future facilities are planned to meet the growth within their respective districts.

### 4.12.2.4 Libraries

Like parks, open space, recreational facilities and cultural opportunities, libraries contribute to the quality of life in a community. These community facilities can enhance a region's character as a

good place to live and raise a family. In addition, a good library system contributes to the quality of educational opportunities in the area. Library facilities are provided throughout the Study Area by the cities and counties. Again, these are provided according to levels of service established through the respective jurisdictions General Plans.

### 4.12.3 Project Impacts: Public Services

The implementation of the OBMP will result in direct physical change to existing land uses within the Study Area by providing a more efficient and effective water supply to meet long-term, ultimate growth and development projections within the Study Area. The public service issues of focus in this evaluation are those changes in the environment due to the project that may increase demand for public services that would exceed the capacity of the existing service system to provide at an adequate level of service.

#### 4.12.3.1 Threshold of Significance

The public service issues of concern in this evaluation are increased demand for services without adequate existing capacity or comparable increases in capacity from implementing the OBMP. The following criterion will be used to determine whether a significant public service impact will be created by the proposed project:

- The project will result in significant impacts to public services if it causes demand for a service to exceed a system's capacity and creates a need to develop new service system capacity without a means of funding the required system capacity expansion.

#### a. Will the project cause a significant demand for police protection services?

The project will not cause a significant demand for police protection services. Implementation of the OBMP will result in direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional police protection services beyond that anticipated in the jurisdiction's General Plans. The Study Area is currently served by police departments and agencies under authority of the various jurisdictions that comprise the Study Area. Aside from a threat of trespass, the type of facilities being proposed by the OBMP do not have a potential to create new demand for police services. Although probably not significant, illegal trespass can be minimized by controlling access to OBMP construction areas and operating facilities, such as recharge basins or desalters. Overall levels of police service will also be increased based upon the future population based demands of the local agencies. No potential for any significant demand for police protection services is identified. Mitigation is proposed to address trespass issues.

### b. Will the project cause a significant demand for fire protection services?

The project will not cause a significant demand for fire protection services. Implementation of the OBMP will result in direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional fire protection services beyond that anticipated in their General Plans. Fire protection is currently provided by fire departments and agencies under authority of the various jurisdictions that comprise the Study Area. Any OBMP project requiring structures will be required to meet building codes, including those related to fire protection. Mitigation is not required to reduce potential structural fire hazards to a non-significant level. Overall levels of fire service will also be increased based upon the future population based demands of the local agencies. No potential for any significant demand for fire protection services is identified and no mitigation is required.

### c. Will the project cause a significant demand for school room capacity?

The project will not cause a significant demand for school room capacity. As stated above, implementation of the OBMP will result in direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional school room capacity beyond that anticipated in the local agency's general plans. Implementation of the OBMP is not forecast to change existing land uses or increase either the number of residential units located within the Study Area or the number of students generated from the Study Area beyond that anticipated in the local agency general plans. School districts in the Study Area have adopted classroom loading standards (number of students per classroom) and collect development fees per square foot of residential, commercial and industrial development. Because the proposed project is not forecast to change land uses, or create activities that can increase demand for additional school capacity beyond that anticipated in the jurisdiction's General Plans, and because there are adopted classroom loading standards (number of students per classroom) and development fees are collected for new development, no potential for adverse impacts to schools is identified. No mitigation is required for schools on behalf of OBMP projects..

### d. Will the project cause a significant demand for library capacity?

The project will not cause a significant demand for library capacity. Implementation of the OBMP will result in direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional library capacity services beyond that anticipated in local agency general plans. Libraries are currently provided by

the County and local agencies under authority of the various jurisdictions that comprise the Study Area. OBMP projects will not produce any direct demand for library capacity or contribute to indirect demand for such services. Mitigation is not required to reduce potential library capacity impacts to a non-significant level since none is forecast to occur. Overall levels of library service will also be increased based upon the future population based the demands of the local agencies. No potential for any significant demand for library services is identified and no mitigation is required.

### 4.12.4 Mitigation Measures

The following mitigation measures are recommended as a condition of Project approval to mitigate impacts to library resources:

**4.12-1 OBMP facilities shall be fenced or otherwise have access controlled to prevent illegal trespass to attractive nuisances, such as construction sites or recharge sites.**

### 4.12.5 Unavoidable Adverse Impact

The public services impact evaluation presented above indicates that implementation of the proposed project will be consistent with the Study Area jurisdiction's general plan land use designations. Implementing the proposed project is not forecast to cause any direct or indirect significant adverse public service impacts after implementation of the mitigation measure outlined above. Therefore, no significant unavoidable adverse public services impacts are forecast to occur if the OBMP is approved and implemented for the Chino Basin.

### 4.12.6 Cumulative Impact

The OBMP activities are specifically designed to provide a more efficient and effective program for managing all of the water resources that occur within the Chino Basin. The proposed project has been evaluated as being fully consistent with the Study Area general plans and has been determined not to contribute to future growth as envisioned in the Study Area land use planning documents. This conclusion is based on two lines of reasoning: first, the OBMP replaces existing sources of water and water resources management that would have been used by individual water serving agencies to meet future growth that is envisioned in the general plans and therefore, implementing the OBMP does not remove any constraint on growth; and second, the provision of water to future development within the Chino Basin is determined to be growth accommodating, not growth inducing. The OBMP can be implemented without causing or contributing to future significant cumulative growth or development within the Chino Basin. Based upon this analysis, implementation of the proposed project is not forecast to contribute to any significant increases in demand for public service that could be considered cumulatively significant and adverse.

# 4.13 UTILITIES

## 4.13.1 Introduction

This subchapter of the PEIR addresses the above issues and has been compiled by relying primarily upon data contained in a previous planning document prepared in support of the Chino Basin Water Resources Management Study and the general plans and other pertinent planning documents for the project area. These planning documents include the "Final Task 1 Memorandum, Water and Wastewater Planning Environment" (1993) and the general plans for the following agencies: cities of Chino Hills, Chino, Fontana, Ontario, Montclair, Norco, Pomona, Rancho Cucamonga, and Rialto; the counties of Riverside and San Bernardino; and the Southern California Association of Government publications: RCPG and RMP. The evaluation focuses on the utilities supplies to utilized by the proposed project and the potential impacts to these utility systems from implementing the proposed project.

## 4.13.2 Environmental Setting: Utilities

### 4.13.2.1 Electricity/Natural Gas

Electricity

Electricity in the Study Area is provided by SCE. Utility policies allow the individual connections to purchase electricity from a variety of sources, but this electricity will still be distributed to consumers over SCE's electricity distribution system. The existing consumption of electrical energy within the Study Area has not been quantified.

The energy consumption of new buildings in California is regulated by the State Building Energy Efficiency Standards, embodied in Title 24 of the California Code of Regulations. The efficiency standards apply to new construction of both residential and non-residential buildings, and regulate energy consumption for heating, cooling, ventilation, water heating, and lighting. These building efficiency standards are enforced through the local building permit process.

Natural Gas

Available natural gas supplies are sufficient to meet the existing needs of the community. However, the availability of natural gas supplies can be affected by external influences and may not always be accessible. The amount of natural gas consumed by users within the Study Area have not been quantified.

### 4.13.2.2 Communication Services

Telephone service is provided to the Study Area by General Telephone (GTE). The total number of phone connections in the Study Area have not been quantified. GTE's system is demand responsive and it expands its phone system capacity based on commercial demand for service which it identifies through continuous evaluation and forecasts of service.

Cable television services are provided by a variety of companies through a franchise granted by the various jurisdictions. Cable television is demand responsive and the company has not encountered any constraints in providing service to residents of the Study Area. The total number of cable connections in the Study Area have not been quantified.

### 4.13.2.3 Wastewater Collection and Treatment Facilities

The following summary of wastewater collection and treatment facilities is abstracted from Chapter 2 of the OBMP. This section summarizes existing and proposed municipal wastewater treatment and disposal plans for the Chino Basin study area for the planning period of 2000 through 2020. Existing municipal wastewater treatment facilities are described briefly along with a review of present and projected wastewater flows. Future treatment and disposal plans for the study area are also discussed.

Wastewater Flow Projections

Wastewater flow projections are made using a combination of methods similar to water demand projections. Depending on the planning data available, wastewater flow projections are made using per capita-based, EDU-based, area-based, and water consumption-based methods. The per capita method uses projected populations and average unit wastewater flows per person (90-110 gallons per day per person). EDU-based projections use unit flows per equivalent dwelling unit (EDU), where an EDU is the average amount of sewage generated by a single-family residential household (about 270 gallons per day). EDUs are estimated for commercial and industrial land uses using fixture unit counts or estimated wastewater flows. Flow projections are computed by projecting future EDUs and multiplying by the unit flow per EDU. Area-based methods typically use unit flow factors for each land use type. Flows are computed by multiplying the unit factor for each land use type by the corresponding acreage and totaling the individual flows for each land use type. Water consumption-based methods compute wastewater flows based on the difference between water demand and water consumption. Water consumption is the amount of water that does not return to the sewer system and is a function of the particular land use type and water use group. Currently, most wastewater flow projections in the study area are based on either per capita or EDU methods.

*LACSD Service Area.* The Los Angeles County Sanitation Districts (LACSD) furnishes wastewater services for Pomona and Claremont. Using the SCAG-98 growth projections and a wastewater generation factor of 110 gpcd, the wastewater flows for this area are estimated to increase from 22,000 acre-ft/yr to 30,000 acre-ft/yr in 2020.

*IEUA Service Area.* IEUA develops ten-year wastewater forecasts for its service area in conjunction with its annual capital improvement plan (CIP). As part of its current CIP, IEUA also prepared a fifty-year projection of wastewater flows. These projections indicate wastewater flows will increase from 57,000 acre-ft/yr in 1997 to 112,000 acre-ft/yr in 2020. This represents an increase of 96 percent.

*Riverside County Service Area.* Wastewater collection for the portion of the study area in Riverside County is provided by several agencies including Jurupa Community Services District and Norco. Other portions are unsewered. Wastewater flows for the Riverside County area are estimated to increase from 10,000 acre-ft/yr in 1997 to 15,000 acre-ft/yr by 2020 based on projected population increases. This includes wastewater generated by unsewered areas. Additional wastewater from outside the study area is expected to be treated at the Western Riverside Regional Water Reclamation Plant. However, no estimates of these additional flows were received.

Treatment and Disposal

Seven agencies are responsible for wastewater treatment and disposal for their respective areas. In Los Angeles County, LACSD is the treatment and disposal agency. In western San Bernardino County, IEUA and the City of Upland perform this role. In the easterly portion of the study area, the City of Rialto provides this service. In Riverside County, several agencies are responsible for wastewater treatment, including the cities of Riverside and Corona, and JCSD.

There are three basic wastewater service areas within the study area. These areas include:

- LACSD System (Los Angeles County)
- IEUA System (Western San Bernardino County)
- Riverside County

*LACSD System.* The LACSD provides regional wastewater collection and treatment for most of Los Angeles County. LACSD is divided into districts that handle wastewater management within their service areas. LACSD No. 21 provides this service for the Claremont, La Verne, and Pomona service areas. Urban and industrial wastewater flows from the Los Angeles County portion of the study area are collected by the cities of Claremont, La Verne, and Pomona. This wastewater is routed to LACSD No. 21 for treatment at LACSD's Pomona Water Reclamation Plan (WRP) and San Jose Creek WRP. With the exception of recycled water used by the City of Pomona from the Pomona WRP, all wastewater reaching the sewer system is exported out of the study area. The Pomona WRP has capacity of 15 million gallons per day (MGD) and is expected to operate at that level during the planning period.

*IEUA System.* IEUA has constructed a Regional Sewerage System within its service area to collect, treat and dispose of wastewater delivered by contracting local agencies. The contracting cities and water districts are responsible for wastewater collection within their individual service areas. A

system of regional trunk and interceptor sewers that convey sewage to regional wastewater treatment plants is owned and operated by IEUA. IEUA's wastewater collection system is divided into two major service areas: the Northern Service Area and the Southern Service Area.

IEUA currently operates four wastewater treatment plants: Regional Plant No. 1 (RP1), Regional Plant No. 2 (RP2) Regional Plant No. 4 (RP4), and Carbon Canyon Water Reclamation Plant (CCWRP). A fifth regional plant, known as Regional Plant No. 3 (RP3), is no longer in service. One new treatment plant, Regional Plant No. 5 (RP5), is in the planning stages. All of these plants are or will be capable of producing effluent that meets Title 22 requirements for water reclamation. Figure 2-62 illustrates the projected flows and capacity staging of these plants. Each of these plants are described below.

Regional Plant No. 1. Although RP1 is designed to treat 44 MGD, the capacity was downrated to 32 MGD in 1992 due to more stringent permit requirements. The plant has been expanded and is presently operating at 44 MGD. A 1996 Regional Board cease and desist order requires the plant to be restored to its design capacity by 1999. RP1 is expected to operate at near its design capacity and treat wastewater flows from its service area and excess flows from RP4 until 2014. A plant expansion to about 56 MGD is planned to be on-line by 2014 to meet increased flows from its service area.

Regional Plant No. 2. RP2 serves the City of Chino and surrounding areas. A 1994 cease and desist order by the Regional Board requires the plant to be flood protected or relocated. Consequently, the plant will be potentially abandoned and its capacity replaced by a new RP5 by 2003. Solids handling facilities will continue to operate at this site.

Regional Plant No. 4. RP4 is a 7-MGD wastewater treatment facility that recently began operation. The plant will be expanded to 14 MGD by 2008 and 21 MGD by 2021. Population growth and corresponding wastewater production in the northeastern region of the District, including portions of City of Fontana and Cucamonga County Water District will determine the rate of expansion.

Carbon Canyon Water Reclamation Plant. Carbon Canyon Water Reclamation Plant (CCWRP) became operational in May 1992. CCWRP is designed to produce recycled water that can be used for non-potable purposes including industrial and irrigation uses in the western region of the Chino Basin. The initial design capacity of 10.2 MGD is planned for increase to 15.3 MGD in the year 2014. Sludge generated at the CCWRP is treated at the RP2 sludge processing facilities and will be for the foreseeable future.

Regional Plant No. 5. Growth in the southern portion of the IEUA service area will require additional treatment capacity. IEUA plans to construct a new RP5 by 2001. The initial phase of this plant will be 12 MGD of which 5 MGD will replace capacity at RP2. The new RP5 is expected to serve the San Bernardino Agricultural Preserve area as well as treating 3.6 MGD from southern Ontario. A second phase expansion to 22.5 MGD is projected to be completed by 2008 with a third phase expansion by 2021.

Western Riverside County Regional Wastewater Treatment System. The Western Riverside County Regional Wastewater Authority, a Joint Powers Authority, has constructed a regional wastewater treatment facility to serve portions of Jurupa CSD, Norco, Home Gardens Sanitary District and Western MWD. This facility is located in Western Riverside County near the intersection of McCarty Road and Hellman Avenue. This facility has an initial treatment capacity of 8.5 MGD. The treatment plant will be expanded to an ultimate capacity of 13.3 MGD. The facility provides tertiary filtration and nitrogen removal to meet projected discharge requirements. Effluent from this plant will be discharged to the Santa Ana River. Projections of flows to this plant are not available as of the date of this report.

#### 4.13.2.4 Solid Waste Disposal

Solid waste disposal sites are those facilities used for the final disposition of wastes onto land. Wastes are categorized by the State into four general types: Class I (Hazardous), Class II (Designated Wastes), Class III (Municipal) and Inert Wastes.

Solid waste from the Study Area is disposed of one of several landfills, located in both San Bernardino and Riverside Counties. The Cities and Counties are encouraging source reduction and recycling objectives that meet or exceed the requirements of State Assembly Bill 939, which mandates a 50 percent reduction in waste volumes from 1990 levels by the year 2010. In addition, hazardous waste can be landfilled or recycled at several facilities throughout the State. Any hazardous wastes generated within the Study Area are managed in accordance with existing laws and regulations. These materials are stored and handled in accordance with federal and state requirements.

#### 4.13.2.5 Water Supplies

The following summary of wastewater collection and treatment facilities is abstracted from Chapter 2 of the OBMP.

Current and Future Water Demands

The purpose of this subsection is to describe the current and projected water demands and supplies for agencies that produce groundwater from the Chino Basin. This information will serve as the basis for identifying future water resources issues in the Chino Basin area. Updated forecasts of water demands and supplies were requested from each Chino Basin water agency and industrial producer. Requested data included demands, water supply plans by individual well or source, well construction and operating data, and water production and treatment costs. Many agencies provided updated information. Where responses were incomplete, previous information developed as part of the 1995 Chino Basin Water Resources Management Study (CBWRMS) was used. The planning period for this evaluation is 2000 to 2020.

*Growth Projections*. There are several indicators of potential growth within the Chino Basin study area. These include population, housing, employment, and land use. The Southern California Association of Governments (SCAG) periodically develops population, housing, and employment projections. SCAG prepares growth projections as part of its regional transportation planning for Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties. The most recent SCAG projection is SCAG-98, which was adopted in April 1998.

The SCAG-98 projection indicates the six-county region will grow from 15.6 million people in 1994 to 22.4 million in 2015. This represents an increase 6.7 million people between 1994 and 2015 and a growth rate of 43 percent. San Bernardino and Riverside counties are projected to grow at a rate that is more than double the regional average. San Bernardino County is projected to grow from 1,558,000 people in 1994 to 2,830,000 in 2020. Riverside County is projected to increase from 1,377,000 people in 1994 to 2,816,000 in 2020.

Subchapter 4.3, Tables 4.3-1 through 4.3-3 summarize the population projections for the Chino Basin area. The SCAG projections were desegregated by city and census tract and combined by water purveyor service area. These projections indicate population will increase from 971,000 in 1994 to 1,631,000 in 2020. This is a growth rate of 68 percent or 2.6 percent per year. The population in some water service areas in the San Bernardino County portion of the Basin are projected to increase by as much as 125 percent.

Total housing is projected to increase from 284,000 units in 1994 to 496,000 in 2020, a growth rate of 75 percent. By comparing population and housing, the average occupancy is projected to decrease slightly from 3.4 to 3.3 persons per dwelling unit.

Employment is projected to increase from 316,000 jobs in 1994 to 702,000 jobs in 2020, a growth rate of 122 percent.

*Water Demand Projections.* Current water demands and supply projections form the basis for evaluating future water management programs in the Chino Basin area. Water demands are developed based on the water service areas shown in Subchapter 4.5, Table 4.5-15.

Water demand projections can be developed by several different methods. These include per capita, water duty and units of use approaches. The most frequently used methods are the per capita consumption method and the water duty method.

For this assessment, all water demands are based on information provided by the water agencies. In the absence of agency data, the assumptions in the CBWRMS have been used. These projections have been compared with the current SCAG projections. However, no adjustments to he demands have been made.

Projected water demands for the Chino Basin are presented in Subchapte 4.5, Table 4.5-17. This table indicates that Chino Basin area water demands will reach 348,000 acre-ft/yr in 2000 to 418,000 acre-ft/yr in 2020. Significant municipal water demand growth is expected to occur in the agricultural preserve area. This will result in increased demands for the Cities of Chino, Chino Hills and Ontario, and Jurupa Community Services District. Agricultural water demands are expected to decrease during the planning period as land is converted to urban uses.

Water Supply Plans

The principal water supplies in the Chino Basin area are groundwater pumped from the Chino Basin, other local groundwater and surface water, imported water purchased from Metropolitan Water District of Southern California (MWDSC) and recycled water. The amounts of water utilized from each source are based on data provided by each water purveyor. If data was not provided, the supplies area based on projections developed for the Chino Basin Water Resources Management Study (1995). Each of these sources is discussed below. Tables 4.5-19 and 4.5-20 present projected water supply plans for appropriators in the Chino Basin area. Table 4.5-16 summarizes the water demands by major source categories. Review of Table 4.5-16 shows that there will be about 40,000 to 50,000 acre-ft/yr of Chino Basin production that will incur a replenishment obligation. The replenishment obligation can be met by the recharge of imported and reclaimed water, in-lieu replenishment involving imported water, and from water in local storage accounts. In the long run, the replenishment obligation of about 40,000 to 50,000 acre-ft/yr will need to be met with imported and recycled water. Thus the imported and recycled water components in Table 4.5-17 should sum to a total of 40,000 to 50,000 acre-ft/yr higher.

*Chino Basin Groundwater*. The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. Water is reallocated from the Overlying Agricultural Pool to the Appropriative Pool when it is not put to use by the agricultural users. As agricultural production declines, the reallocations to the Appropriative Pool will increase. Total production from the Chino Basin is projected to range between 180,000 to 190,000 acre-ft/yr over the planning period. Production in excess of safe yield must be replaced through the purchase of replenishment water, which is imported into the Chino Basin, by the Watermaster.

*Other Local Supplies*. Other local water sources provide a portion of the water supplies for Chino Basin water agencies. These supplies include surface water and groundwater.

Surface Water. A number of water supply agencies, which produce groundwater from the Chino Basin, obtain a portion of their water supplies from local surface water sources. These agencies include the: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. The principal surface water sources include San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several smaller surface sources. For the most part, these surface water sources are fully developed and no significant

additional supplies are anticipated to be developed in the future. Usage is expected to rmain at 16,000-17,000 acre-ft/year.

Other Groundwater. Other local groundwater supplies represent a significant supplemental source of water for Chino Basin water agencies. Other groundwater supplies in the study area include the Claremont Heights, Live Oak, Pomona and Spadra Basins in Los Angeles County, the Riverside South and Temescal Basins in Riverside County, and the Colton-Rialto, Cucamonga, Lytle Creek Bunker Hill, and Riverside North Basins in San Bernardino County. Agencies using other local groundwater include: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, Southern California Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. These supplies may increase slightly in the future as additional wells are constructed. However, most of these sources are essentially fully developed. Descriptions of these groundwater basins were presented in the CBWRMS Final Report (1995). The aggregate supply from these basins is currently 63,000 acre-ft/yr and is projected to be 76,000 acre-ft/yr in 2020.

Imported Water. Two regional agencies are responsible for imported water deliveries within the study area: MWDSC and San Bernardino Valley Municipal Water District (SBVMWD). MWDSC is a wholesale water agency serving supplemental imported water to 27 members (city and water agencies) in portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties. This service area has a current population of more than 16 million people. Approximately one-half of the total water used throughout the entire MWDSC service area is imported water purchased from MWDSC to supplement the local water supplies in its service area. MWDSC obtains imported supplies from the Colorado River and the State Water Project (SWP). The demand for direct delivery of imported water for the Chino Basin purchased from MWDSC is projected to increase from about 68,000 acre-ft/yr in 1997 to 129,000 acre-ft/yr by 2020, an increase of about 90% percent. The demand for replenishment water in the Chino Basin could reach 40,000 acre-ft/yr by 2020 if reclaimed water is not used for replenishment or direct uses and water in local storage accounts is not available for use as replenishment.

SBVMWD is a wholesale water purveyor in the easternmost portion of the study area and adjacent portions of San Bernardino County. SBVMWD is a SWP Contractor having an entitlement of 102,600 acre-ft/yr. In addition, SBVMWD is responsible for basin management in the Bunker Hill basin. The City of Rialto and West San Bernardino County Water District obtain water from SBVMWD through its Baseline Feeder that supplies Bunker Hill groundwater (included in other groundwater above).

Recycled Water. There are several existing sources of recycled water in use within the Chino Basin study area. These are the Pomona Water Reclamation Plant (operated by the Los Angeles County Sanitation Districts), Regional Plants 1, 2 and 4, and Carbon Canyon Water Reclamation Plant operated by IEUA, Upland Hills Water Reclamation Plant operated by the City of Upland, CIM Water Reclamation Plant operated by the California Institution for Men at Chino, and Indian Hills

Water Reclamation Plant operated by Jurupa Community Services District. For this section, only existing and planned recycled water uses that will be implemented in the next two years are included in the water supply plans. This is about 11,500 acre-ft/yr.

Summary. The plans summarized in this section represent the current non-OBMP water supply plans of each individual water agency, as qualified previously. Future evaluation of these plans may indicate problems relative to their long-term feasibility. Availability of imported water supplies will have a significant effect on plan feasibility.

### 4.13.3 Project Impacts: Utilities

The implementation of the OBMP will result in direct physical change to existing land uses within the Study Area by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area. The utility issues of focus in this evaluation are those changes due to the project that may increase demand for utilities that would exceed the capacity of the existing service system to provide at an adequate level of service.

#### 4.13.3.1 Threshold of Significance

The utility issues of concern in this evaluation are increased demand for utility capacity without adequate existing capacity or comparable increases in capacity from implementing the OBMP. The following criterion will be used to determine whether a significant utility impact will be created by the proposed project:

- The project will result in significant impacts to utilities if it causes demand for a utility to exceed the system's capacity and creates a need to develop new utility service system capacity without a means of funding the required system capacity expansion.

#### a. Will the project cause a significant demand for electricity and natural gas services?

The project will not cause a significant demand for electricity or natural gas services. Implementation of the OBMP will result in a direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional electricity or natural gas service beyond that anticipated in the jurisdiction's's General Plans. Portions of the Study Area are currently served by distribution lines. New lines will need to be installed into areas where services are not currently available. No potential for any significant electricity or natural gas service system impacts are identified. No mitigation is required; however, mitigation measures are recommended as conditions of Project approval to further insure the insignificance of Project related impacts upon utility purveyors and to insure that energy conservation is practiced.

### b. Will the project cause a significant demand for communication system services?

The project will not cause a significant demand for communication service systems. Implementation of the OBMP will result in a direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for additional communication services beyond that anticipated in the jurisdiction's General Plans. Portions of the Project Area are already served by both GTE and cable service with adequate connections located in the Area. New services will need to be installed into areas where services are not currently available. The project is not forecast to create growth or new connections that would place additional demands on communication systems. No potential for any significant communication service system impacts are identified. No mitigation is required; however, mitigation measures are recommended as conditions of Project approval to further insure the insignificance of Project related impacts upon utility purveyors.

### c. Will the project cause a significant demand for wastewater collection or treatment system capacity?

The project will not cause a significant demand for wastewater collection or treatment system capacity. Implementation of the OBMP will result in a direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for wastewater collection or treatment system capacity beyond that anticipated in the jurisdiction's General Plans. The project is not forecast to create growth or new connections that would place significant demand on either the existing wastewater collection or treatment systems. No mitigation is required; however, mitigation measures are recommended as conditions of Project approval to further insure the insignificance of Project related impacts upon utility purveyors.

### d. Will the project cause a significant demand for solid waste disposal capacity?

The project will not cause a significant demand for solid waste disposal capacity. Implementation of the OBMP will result in a direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for solid waste disposal capacity beyond that anticipated in the jurisdiction's General Plans. Because the proposed project is not forecast to change land uses, increase population, or otherwise create activities that can increase demand for additional solid waste disposal capacity beyond that anticipated in the jurisdiction's General Plan land use designations, no potential for adverse impacts to the Study Area landfills are

identified. No potential for any significant solid waste disposal impacts is identified. No mitigation is required; however, mitigation measures are recommended as conditions of Project approval to further insure the insignificance of Project related impacts upon utility purveyors.

### e. Will the project cause a significant demand for water supply capacity?

The project will not cause a significant demand for water supply capacity. Implementation of the OBMP will result in a direct physical change to existing land uses within the Study Area which will facilitate indirect changes in land use by contributing to an adequate water supply to meet long-term, ultimate growth and development projections within the Study Area; however, it is not forecast to change land uses or otherwise create activities that can increase demand for water supply capacity beyond that anticipated in the jurisdiction's General Plans. The OBMP activities are specifically designed to provide a more efficient and effective program for managing all of the water resources that occur within the Chino Basin. This would serve to meet the existing and future demand of development and improve flow requirements for the Project Area. This activity could facilitate increased development; however it also designed to meet the existing development and land use designations within the Study Area. The project is not forecast to create growth or demand for new connections that would place additional demand on the existing water supply system beyond that anticipated in the jurisdiction's General Plans. No potential for any significant water supply impacts are identified. No mitigation is required; however, mitigation measures are recommended as conditions of Project approval to further insure the insignificance of Project related impacts upon utility purveyors.

## 4.13.4 Mitigation Measures

The following mitigation measures are required as conditions of Project approval, where appropriate, to further ensure the insignificance of Project related impacts upon utility purveyors and to insure that energy conservation is practiced, the following measures should be incorporated into individual projects as deemed appropriate:

Electricity

**4.13-1 Developers in the proposed Project Area should coordinate with SCE and other power companies regarding the location and phasing of required on-site electrical facilities.**

**4.13-2 Proposed building construction should comply with Title 24 of the California Administrative Code (i.e., Uniform Building Code).**

**4.13-3 Onsite electrical lines should be installed underground.**

**4.13-4 Project planners and architects should consult with SCE regarding current energy conservation techniques.**

**4.13-5 Project planners and architects should also consider the use of energy-efficient architecture and landscape design concepts which will work to reduce the long-term demands for fossil fuels. Such measures should include the following:**

- **Architectural planning and design, to the extent feasible, should take full advantage of such concepts as natural heating and/or cooling through sun and wind exposure and solar energy collection system opportunities when practical; and**

- **Landscape design should be tailored, where feasible, to the use requirements of individual structures, with the intent to minimize heat gain in summer, maximize heat gain in winter, and promote air circulation for heating and cooling purposes.**

## Natural Gas

**4.13-6 Natural gas service to the proposed Study Area should be in accordance with the appropriate purveyors policies and extension rules as required. These are on file with the California Public Utilities Commission. In addition, the following general measures are recommended:**

- **The thermal insulation installed in walls and ceilings should meet the standards established by the State of California.**

- **All buildings should be constructed in conformance with Title 24, Part 6, Division T-20, Chapter 2 of the California Administrative Code.**

- **Windowless walls for western exposures and sill orientation of buildings to use solar heating systems and efficient heating-cooling systems should be installed whenever feasible.**

- **The use of landscaping to moderate building heat gain, such as the use of deciduous trees in parking areas and on the southern and western exposures of buildings to provide shade during the summer, yet allow maximum light and heat during the winter, should be encouraged.**

- **Energy conservation methods that could be readily incorporated into a development should be conceived during the design phase of Plan related development projects. Consultation with the appropriate purveyors during the design phase will facilitate the process of adapting the project's architectural design to maximize efficient energy use.**

## Wastewater

The following mitigation measures are recommended as conditions of project approval:

**4.13-7 Wastewater treatment facilities/distribution system improvement/expansion projects shall precede or be concurrent with all growth generating projects as required to maintain adequate system capacity levels.**

While not recommended as conditions of Project approval, the following recommendations are presented for consideration and long-term implementation as appropriate:

**4.13-8 Measure 4.13-8 was determined to not apply to the OBMP, the measure has been deleted. The deletion of the measure will not have any significant effect on the implementation of the OBMP since it only applied to developer capacity fees that are in no way related to the OBMP.**

**4.13-9 All industrial and commercial users should take on-site measures to reduce the load strength of their sewage.**

Solid Waste

The following mitigation measure is recommended as a condition of project approval.

**4.13-10 All proposed development/redevelopment projects within the proposed Study Area that will generate solid waste, shall be reviewed on a project-by-project basis by the permitting jurisdiction in coordination with County landfill officials to determine the degree of impact upon remaining landfill capacity. Projects should be approved only after it is determined that the additional solid waste generated can be disposed of within existing landfill facilities.**

Water Supplies

The following mitigation measures are recommended as a conditions of approval for individual projects implemented under the OBMP:

**4.13-11 All Plan-related development/redevelopment projects including exterior landscape elements shall employ xeriscape plant design and water conservation concepts. At a minimum xeriscape requirements shall include the following:**

**a. The use of drought-tolerant species, drip irrigation systems, soil moisture sensors, and automatic irrigation systems, when appropriate.**

**b. Extensive use of mulch in all landscaped areas. Use of mulch will improve water holding capacities of the soil by reducing evaporation and erosion.**

**c. A minimal use of lawn, except to accommodate-lawn dependent uses such as playing fields. Warm-season grasses shall be used.**

**d. The use of gray water separation storage and transmission systems when feasible for irrigation purposes.**

The following measures are *not* recommended as conditions of project approval, but are presented for the decision-making body's consideration and long-term implementation, as appropriate.

**4.13-12 The conservation of water should be of significant concern to all citizens in Southern California, and some conservation proceedings are presently mandated by state legislation. As such, the following measures should be implemented for all Plan related construction projects when appropriate to comply with state legislation:**

- **Plumbing fixtures that reduce water usage should be utilized (i.e., low-volume toilet tanks, flow-control devices for faucets and shower heads) in accordance with Title 24 of the California Administrative Code.**

- **The use of drought-tolerant plant species and drip irrigation systems should be considered in order to reduce water usage.**

- **Installation of ultra-low flush toilets in all new construction should occur.**
- **Installation of low-flow showers and faucets in accordance with California Administrative Code, Title 24, Part 6, Article 1, T20-1406F should occur.***

**Recommendations to be implemented where applicable:**

**Interior**

- **Supply line pressure: recommend water pressure greater than 50 psi be reduced to 50 psi or less by means of pressure-reducing valve.**

- **Flush valve operated water closets: recommend three gallons per flush.**

- **Drinking fountains: recommend installation of self-closing valves.**

- **Pipe insulation: recommend all hot water lines in dwelling units be insulated to provide hot water quickly with less water and to prevent hot pipes from heating cold pipes.***

**Exterior**

- **Preserve and protect existing trees and shrubs. Established plants are often adapted to low water conditions and their use saves water needed to establish replacement vegetation.**

- **Group plants of similar water use to reduce over-irrigation of low-water-using plants.**

- **Provide information to occupants regarding benefits of low-water-using landscaping and sources of additional assistance.**

- **Use pervious paving material whenever feasible to reduce surface water runoff and to aid in ground water recharge.**

- **Grade slopes so that runoff of surface water is minimized.***

* Indicates that a modification to the mitigation measure has been made for clarification purposes in response to comments received on the DEIR.

## 4.13.5 Unavoidable Adverse Impact

The utility impact evaluation presented above indicates that implementation of the proposed project will be consistent with the Study Area jurisdiction's general plan land use designations. Implementing the proposed project is not forecast to cause any direct or indirect significant adverse land use impacts after implementation of the mitigation measures outlined above. Therefore, no significant unavoidable adverse utility impacts are forecast to occur if the OBMP is approved and implemented for the Chino Basin.

### 4.13.6 Cumulative Impact

The OBMP activities are specifically designed to provide a more efficient and effective program for managing all of the water resources that occur within the Chino Basin. The proposed project has been evaluated as being fully consistent with the Study Area jurisdictions general plans and has been determined not to contribute to future growth as envisioned in the Study Area jurisdictions general plans. This conclusion is based on two lines of reasoning: first, the OBMP replaces existing sources of water and water resources management that would have been used by individual water serving agencies to meet future growth that is envisioned in the general plans and therefore, implementing the OBMP does not remove any constraint on growth; and second, the provision of water to future is determined to be growth accommodating, not growth inducing. The OBMP can be implemented without causing or contributing to future significant cumulative growth or development within the Chino Basin. Based upon this analysis, implementation of the proposed project is not forecast to contribute to any significant increases in demand for utilities that could be considered cumulatively significant and adverse.

# 4.14 CULTURAL RESOURCES

## 4.14.1 Introduction

"Cultural Resources" is a term meant to encompass both archaeological, historic, and prehistoric resources. Archaeological and historic resources may occur together on the same site. Although cultural resources are in fat man-made, they occur on the landscape as a result of previous human activities, and thus must be addressed in the CEQA process in a manner similar to natural resources.

Archaeological resources are the physical remains of past human activities, and can be either prehistoric or historic in origin. Such resources include artifacts, refuse, and features in both surface and subsurface contexts, an are greater than 50 years in age and/or meet other established criteria to qualify as historic in nature.

- Prehistoric archaeological resources may include the remains of villages and campsites, food processing locations, lithic (stone) resource procurement and tool-making location, and burial and cremation areas. They may also consist of trails, rock are and geoglyphs (ground figures) and isolated artifacts. Prehistoric archaeological resources are the result of cultural activities of the ancestors and predecessors of contemporary Native Americans, and in many cases, retain special traditional and sacred significance for those people.

- Historic archaeological resources include refuse deposits such as can and bottle dumps, filled-in privy pits and cisterns, melted adobe walls and foundations, collapsed structures and associated features, and roads and trails. They may relate to mission activities, travel an exploration, early settlement, homestead activities, cattle and sheep herding, lumbering, and mining, among other themes. In San Bernardino County, historical archeological resources date from the earliest Spanish Mission activities (ca. 1770) to the turn of the century.

Historic resources are intact structures of any type that are 50 years or more of age. These resources are sometimes called the "built environment" and include houses or other structures, irrigation works, and engineering features, among other items.

Paleontological Resources are the fossil remains or traces of past life forms, including both vertebrate and invertebrate species, as well as plants. These resources are found in geologic strata conducive to their preservation, typically sedimentary formations.

All vertebrate fossils are considered to be significant; other kinds of paleontologic resources must be evaluated individually for significance depending on their potential scientific value.

Known cultural resources are those which have been identified through formal recognition on one or more of the following inventories: National Register of Historic Places, California Archaeological Inventory, California Historic Resources Inventory, California Historical Landmarks, and Points of Historic Interest.

The purpose of this EIR is to provide the Inland Empire Utilities Agency (IEUA) and other interested parties with the necessary information and analysis to determine whether the proposed undertaking would have any adverse effects on cultural resources, as defined by the National Historic Preservation Act (NHPA) Section 106 and CEQA, that may exist within the APE.

### 4.14.2 Existing Environmental Setting

The proposed project involves the possible construction and/or modification of both new and/or existing facilities; with activities including pipeline installation and possible earthmoving operations. The nature and potential location of projects within the project area is relatively uncertain at this time, however along the Baseline Feeder, the pipeline will be installed in an area that has already been previously disturbed and excavated. In most cases, pipelines will be installed along existing roadways and easements where development has already occurred, thus the chances of uncovering previously unidentified cultural resources are diminished. During desalter, well and basin construction, the chances of encountering cultural resources are greater than along existing roadways, however the actual potential of discovery at each location is substantially different in nature, and is highly site/project specific. The locations within the project area boundaries with known sensitivity for cultural resources have been identified as a result of the archival records search discussed below.

#### 4.14.2.1 Project Area History

The project area lies mostly within the traditional territory of the Gabrielino, a Native American group generally considered to be the most populous and most powerful ethnic nationality in aboriginal southern California. The Gabrielino's territory was centered in the Los Angeles Basin, but their influence spread as far as the San Joaquin Valley, the Colorado River, and Baja California. Along the eastern edge of the project area, the Gabrielino's territorial claim overlapped with the those of two other Native American groups: the Serrano of the San Bernardino Mountains, and the Luiseño of the Perris-Elsinore region. During the 19th century, a late influx of Cahuilla from the San Gorgonio Pass and Coachella Valley occurred in the present-day Riverside-San Bernardino region, further complicating the ethnic composition of the native population in the early historic period.

Although the first European explorers traveled through the vicinity as early as the 1770s, for more than half a century the arid inland area received little physical impact from the Spanish colonization activities along the Pacific coast. After the establishment of Mission San Gabriel in 1771, the project area gradually became a loosely defined mission rancho used for food production, including crops and cattle, but no Europeans are known to have settled in the area until the late 1830s. In 1834, the Mexican government, which had inherited Alta California from Spain when it gained independence

in 1821, began to dismantle the mission system through the process of secularization. Like all other former mission land holdings throughout Alta California, the rancho was divided and granted to various prominent citizens of the territory. Between 1838 and 1846, several large private ranchos was created in and around the project area, including Santa Ana del Chino, Cucamonga, Jurupa, La Sierra (Sepulveda), La Sierra (Yorba), and El Rincon. As elsewhere in southern California during the Rancho Period, cattle raising was the most prevalent economic activity on these ranchos, until the influx of American settlers eventually brought an end to this now-romanticized lifestyle during the second half of the 19th century.

In the 1880s, spurred by the completion of the competing Southern Pacific and the Santa Fe Railroads, a land boom swept through much of southern California. A large number of towns, surrounded by irrigated agricultural land, were laid out in the project area before the end of the 19th century. Following the successful introduction of the naval orange in the mid-1870s, the project area became an important part of southern California's prosperous citrus industry. In the meantime, different communities in the project area also developed distinctive local characteristics in their economic and social life. The Chino area, for example, was long known as the dairy capital of southern California, while the Rancho Cucamonga area was closely associated with vineyard cultivation and wine-making. By the mid-20th century, however, the forces of industrialization and urbanization began to rapidly alter this predominantly agrarian setting of the project area. In particular, the establishment of the Kaiser Steel Mill in the early 1940s dramatically changed the cultural landscape of the Fontana area. During the more recent decades, due to the ever increasing demand for affordable housing by commuters who work in the Greater Los Angeles area, citrus groves and vineyards have given way to housing tracts, as the cities and towns in the project area took on more and more of the characteristics of "bedroom communities."

### 4.14.2.2 Archival Records Search

The Archaeological Information Center (AIC) at the San Bernardino County Museum, Redlands, provided the records search service for this study. The AIC is the official cultural resource records repository for San Bernardino County, and as part of the California Historical Resource Information System, is established and maintained under the auspices of the Office of Historic Preservation.

During the records search, Robin Laska, AIC Assistant Coordinator, checked the Center's electronic database for previously identified historical/archaeological resources in or near the project area, and existing cultural resources reports pertaining to the vicinity. Previously identified historical/archaeological resources include properties designated as California Historical Landmarks, Points of Historical Interest, or San Bernardino County Historical Landmarks, as well as those listed in the National Register of Historic Places, the California Register of Historical Resources, or the California Historical Resource Information System. Also, areas of known and potential paleontologic sensitivity have been evaluated for this project. Maps are available at the County Museum Curator.

In addition to the search conducted for San Bernardino County, CRM Tech conducted the cultural resources search for the portion of the project area located within the boundaries of Riverside County. This summary to follow describes the results of the background research that was conducted. The results of record searches for both counties are depicted in Figures 4.14-1. The detailed reports of the record searches are available at the San Bernardino County Museum Archeological Information Center and at IEUA headquarters in Fontana.

### 4.14.2.3 Summary of Findings

Figure 4.14-1 shows the general location of sensitive cultural resource sites within the Project Area. The purple areas are known to contain sites that may be historic and prehistoric in nature. Prehistoric sites are typically food processing sites, which contain metates, manos, pestles, and mortars; campsites that contain flakes, flaked tools, food processing equipment, and possible pottery; village sites which contain a whole range of artifactual material; and other assorted isolated finds. The historic site types are usually sites where structures used to stand; farming occurred; mining took place; lumber was milled; powerlines, telephones and telegraph lines were located; power was generated; walls, canals, ditches or flood control sites were constructed; or where refuse was disposed. These sites typically contain foundations, pipes, trash, privy pits, orchards, barns, corrals, animal pens, dams and/or historic trash.

There are whole communities that have been subsumes into larger ones or just left to deteriorate. Additionally, railroad stations, railroads, and railroad grades may occur under roadways of more recent construction.

On Figure 4.14-1, several of the oldest streets in the area have been highlighted. Being some of the oldest transportation routes in the County, streets such as Foothill Boulevard, Baseline Road, Summit Avenue, etc. all have numerous old structures located along their path. Many of these structures are greater than 50 years old and qualify for consideration in the Historical Register. Areas highlighted in green on Figure 4.14-1 are known to have historic standing structures. A few of these structures are listed as California Points of Historic Interest, California Historic Landmarks, or are eligible or listed on the California Historic Register. The Bloomington Garage, the Yorba Slaughter Adobe, and the Boulder 1,2,3 Powerlines up at the northern portion of the project area are all listed on the National Register. Other historic structures locate along these old roadways include wineries, vineyards, cemeteries (both historic and prehistoric), and some old family plots and ethic plots that do not appear on any current maps.

Sensitive areas for cultural resources within Riverside County also appear on Figure 4.14-1. These areas contain similar resources to those described above for San Bernardino County.

Throughout the Chino Basin there is a significant potential for encountering cultural resources, even in pre-existing roadways where pipelines might be installed. Also, areas that have not been surveyed, but where sites can be reasonably expected to be encountered are any creek, river,

waterway, spring, foothill area, or flat area on the hills and mountains. Site in these types of locations are generally pre-historic. Historic sites can be found anywhere there is flat, arable land, old streets, old railroads, old roads, or close proximity to water or mountain areas (which are historically used for resorts, summer cattle ranching, and mining areas). (SBC AIC, April 2000)

### 4.14.3 Project Impacts

Activities requiring the excavation or movement of soil material at any location within the project area have the potential to adversely effect cultural resources. The impact evaluation presented below focuses on the proposed physical changes to site landscape and any potential adverse impacts these changes may have on the cultural resources that exist on the site. For purposes of the following analysis of cultural resource impacts, it is assumed that the project will be approved and implemented as proposed and described in the Project Description, Chapter 3 of this document.

The development of land within the project area would include installing new infrastructure systems. These water supply facilities are consistent with any land use designation, and thus could conceivably be located anywhere within the basin. The cultural resource issues of focus in this evaluation are related to the types of possible alterations in the existing substrate from construction of OBMP facilities, and the potential damage or loss of historical structures that exist within the Project Area that may be impacted from implementing this project. The project proposes construction of new facilities on approximately 728 acres of land within the project area. The exact location of project component facilities is not yet defined, thus a general evaluation of cultural resources will be conducted in order to provide guidance for the siting of future project facilities.

#### 4.14.3.1 Thresholds of Significance

The purpose of this study is to identify any cultural resources within or adjacent to the project area, and to assist the IEUA in determining whether such resources meet the official definitions of "historic resources," as provided in the California Public Resources Code, in particular CEQA.

According to PRC §5020.1(j), "historical resource' includes, but is not limited to, any object, building, site, area, place, record, or manuscript which is historically or archaeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California." Specifically, CEQA guidelines states that the term "historical resources" applies to any such resources listed in or determined to be eligible for listing the California Register of Historical Resources, included in the local register of historical resources, or determined to be historically significant by the Lead Agency (Title 14 CCR §15064.5(a) (1)-3)).

Regarding the proper criteria for the evaluation of historical significance, CEQA guidelines mandate that "a resource shall be considered by the lead agency to be 'historically significant' if the resource meets the criteria for listing on the California Register of Historical Resources" (Title 14 CCR

§15064.5(a)(3)). A resource may be listed in the California Register if it meets any of the following criteria:

(1) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
(2) Is associated with the lives of persons important in our past.
(3) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
(4) Has yielded, or may be likely to yield, information important in prehistory or history. (PRC §5024.1(c))

A significant cultural resource impact would be any one impact that resulted in the damage, disturbance or destruction of an archeological, paleontological, or other historic/cultural resource.

### a. Will the project disturb, damage, or destroy cultural resources?

The proposed project is designed to enhance and maintain water supplies and water quality within the Chino Basin, and to create the necessary infrastructure and supporting facilities to achieve these goals within the Project Area. Implementation of project-related facilities in the Project Area could encounter, destroy, or permanently alter the paleontologic sites and resources known to exist within the Project Area. The loss or significant damage to resources or their information value would be a significant impact of the proposed project. Mitigation measures have been identified below that will minimize paleontologic site damage and disturbance. Implementation of these measures can ensure that paleontological resources are managed in a manner that does not cause significant adverse impacts.

The cultural resource analysis completed for the project area indicates that there is a high probability for encountering prehistoric archaeological resources, historic archaeological resources and historic resources in certain localities within the project area boundaries. The potential for encountering cultural landscapes and ethnic landscapes is unknown at this time, as the exact site locations for OBMP facilities have yet to be defined. The mitigation measures proposed below require a thorough cultural resource evaluation prior to project implementation and provide measures to minimize impacts through avoidance, and at worst, through recovery and preservation. In this way, the potential impact to cultural resources is considered to be less than significant with the implementation of the identified measures.

Mitigation measures ensure that archaeological and historical sites and resources will not be damaged or disturbed without preserving the resources and their information value. Implementation of these measures can ensure that archaeological and historical resources are managed in a manner that reduces impacts to a less than significant level by working through the established process

defined below, by avoiding the site, or if impacts could still remain significant, then further site specific environmental documentation will be prepared by a qualified professional.

## 4.14.4 Mitigation Measures

Mitigation measures are required to reduce potential archaeological, paleontological and historical resource impacts to a non-significant level. The following mitigation measures are recommended as conditions of Project approval for projects being developed in areas that have not been previously evaluated for cultural resources.

### 4.14.4.1 Archaeology

**4.14-1 Inventory: A required basic archaeological inventory should encompass the following guidelines:**

a. **Literature and Records Search - Existing maps, site reports, site records, and previous EIRs in the region of the subject area should be researched to identify known archaeological sites and works completed in the region. All maps, EIRs, historical maps and documents, and site records should be cited in text and references. Local historical societies should also be contacted and referenced. State Information Centers will provide the bulk of this information. The San Bernardino County Archives or the Eastern Information Center at UC Riverside should be contacted.**

b. **Field Reconnaissance - Conduct a surface survey to obtain comprehensive examination of current status of the area and gather general understanding of the kinds of cultural and related phenomena present. At a minimum, all ground surfaces chosen for survey should be walked over in such a way that every foot of ground can be visually scanned. All previously recorded cultural resources should be revisited to determine their current status, and all newly discovered sites should be recorded on either State Form 422 or 523 and supplements, as appropriate. Trinomial designations will be obtained from the Information Center. For the inventory process, a compilation of all historical resources, including archaeological and historic resources older than 50 years, using appropriate State record forms, following guidelines in the California Office of Historic Preservation's handbook should be completed for all new discoveries. Two copies should be submitted to the San Bernardino County Archeological Information Center for the assignment of trinomials if discovered within San Bernardino County. Otherwise, the appropriate comparable agency in Riverside County shall be the recipient of these reports.**

c. **Report - A technical report should be prepared which fully describes both the methods and results of all efforts. Research sources should be listed, and the information summarized. The field work should be presented in detail, with all appropriate maps and graphics. Any areas not inspected with full intensity should be specified, preferably using clear, easily understood maps, and the reasons for the deficiency presented. Site records should be prepared for all new discoveries, and amendments prepared to update old records where necessary; since locational data are shielded from public access, the actual forms should be provided in the separable appendix, but the sites should be described in the main text. Each resource description should include a professional opinion of significance, with reference to the qualities or research potential which make it worthy of further consideration. Archaeological sites which need test excavation to confirm signifi-**

cance, integrity, and boundaries should be identified, and a sampling program recommended.

For each potentially significant cultural resource, possible impacts should be listed and mitigating measures developed. All standards for compliance with the CEQA requirements and those of the lead agencies should be addressed.

4.14-2 Assessment

Properties shall be evaluated using a well-understood cultural context that describes the cultural development of an area and identifies the significant patterns that properties represent. This same historic context is used to organize all identification, registration, and preservation decisions within the planning framework. To be useful in subsequent stages of the planning process, evaluation decisions must make clear the significance of the property with the historic context. Potential preservation treatments should not influence the evaluation of significance (National Park Service n.d.:35).

The nature and type of assessment will depend on the particular resource(s) and level of information for a particular region. Consequently, it is not possible to prescribe specific methods to be utilized. However, there are certain basic elements that should be included and are as follows:

a. Preparation of a Research Design - Archaeological documentation can be carried out only after defining explicit goals and a methodology for reaching them. The goals of the documentation effort directly reflect the goals of the preservation plan and the specific needs identified for the relevant historic contexts.

b. Field Studies - The implementation of the research design in the field must be flexible enough to accommodate the discovery of new or unexpected data classes or properties, or changing field conditions. An important consideration in choosing methods to be used in the field studies should be assuring full, clear, and accurate description of all field operations and observations, including excavation and recording techniques and stratigraphic or inter-site relationships.

c. Report - The assessment report should evaluate the significance and integrity of all historical resources within the project area, using criteria established in Appendix K of the CEQA Guidelines for important archaeological resources and/or CFR 60.4 for eligibility for listing on the National Register of Historic Places. The report should contain the following information and should be submitted to the San Bernardino county Archaeological Information Center or to the Eastern Information Center at UC Riverside for permanent archiving:

(1) Description of the study area;
(2) Relevant historical documentation/background research;
(3) The research design;
(4) The field studies as actually implemented, including any deviation from the research design and the reason for the changes;
(5) All field observations;
(6) Analysis and results, illustrated as appropriate with tables, maps, and graphs;
(7) Evaluation of the study in terms of the goals and objectives of the investigation, including discussion of how well the needs dictated by the planning process were served;

(8) Information on where recovered materials are curated and the satisfactory condition of those facilities to protect and to preserve the artifacts and supporting data. The County of San Bernardino requests that historical resource data and artifacts collected within this project area be permanently curated at a repository within the County.

d. In the event that a prehistoric or historic artifact over 50 years in age is encountered within the project area, especially during construction activities, all land modification activities in the immediate area of the finds should be halted and an onsite inspection should be performed immediately by a qualified archaeologist. This professional will be able to assess the find, determine its significance, and make recommendations for appropriate mitigation measures. Further, if human remains of any kind are encountered on the property, the San Bernardino or Riverside County Coroner's Office must be contacted within 24 hours of the find, and all work should be halted until a clearance is given by that office and any other involved agencies.

4.14-3 Monitoring

In situations where resources are potentially subject to direct or indirect impact and testing or data recovery is not proposed, an archaeological monitor and Native American observer/consultant should be present during subsurface work. One circumstance under which this might occur would be if a known resource was close to a area of impact and the site boundaries were ambiguous. Monitors help insure that exposed data or materials are collected and that if potentially significant cultural materials or features are encountered, they will be preserved either by realignment of the proposed facilities or by prompt evaluation and recommendations for any necessary mitigative measures.

4.14-4 Data Recovery

If an archaeological resource is found to be significant and no other preservation option is possible, mitigation of adverse effects by scientific data recovery, including analysis and reporting is the method of last resort. Such a mitigation program is usually only developed after an assessment test has been completed to identify physical parameters and cultural complexity, and formulate a research design. Each specific program would have to be developed in response to the site and potential impact, with the concurrence of the appropriate agencies and in consultation with Native American representatives.

4.14-5 Future Project Siting

Future project shall be located, whenever possible or feasible, outside of the highly sensitive cultural resource areas depicted in Figures 4.14-1. Before any projects are located, and before any construction activities begin, any proposed project that will result in ground disturbance to any area that does not have a complete cultural resource survey on record with either the AIC or the EIC offices will conduct a site specific cultural resource evaluation and report prior to any ground breaking activity. Further, if cultural resources have been identified on the site, a qualified archeologist or paleontologist will be retained to devise an excavation and/or curation plan for the resources, and a qualified cultural resource monitor will be present onsite during all construction-related activities that could potentially uncover previously undiscovered resources. This monitor will examine excavated soils and have the authority to cease construction activities if resources are un-earthed.

## 4.14.4.2 Architectural Resources

**4.14-6 Based solely upon this level of investigation and at this stage of project planning, it would be premature to propose specific mitigation measures. However, certain options can be presented presupposing a general level of knowledge regarding impacts. These options can be utilized to avoid impacts upon the cultural resources - the preferred result - or to lessen adverse effects. It should be emphasized that these options are not the only ones that may be applied. As such, these measures are not recommended as conditions of Project approval but are included for the Authority's consideration and implementation as appropriate.**

**a. Conduct a comprehensive historic building survey which is integrated with economic development programs;**

**b. Adopt a preservation ordinance and create a preservation board;**

**c. Ensure other planning programs, plans, and ordinances are compatible to the historic preservation goals and policies;**

**d. Direct existing funding sources and loan programs to historic neighborhoods in need of revitalization;**

**e. Provide incentives and direction encouraging preservation and revitalization; and**

**f. Develop ongoing programs for enhancing public appreciation of historic resources.**

**g. Project Redesign**

**A proposed project may be redesigned in either of two ways:**

**(1) Outside of site boundaries, thus avoiding impact to the site; or**
**(2) Restricting impacts to those areas of a site where previous impacts have already destroyed the integrity and research potential.**

**Other options may also apply and may include capping of the site, relocation of structures, and integration of extant buildings into project design.**

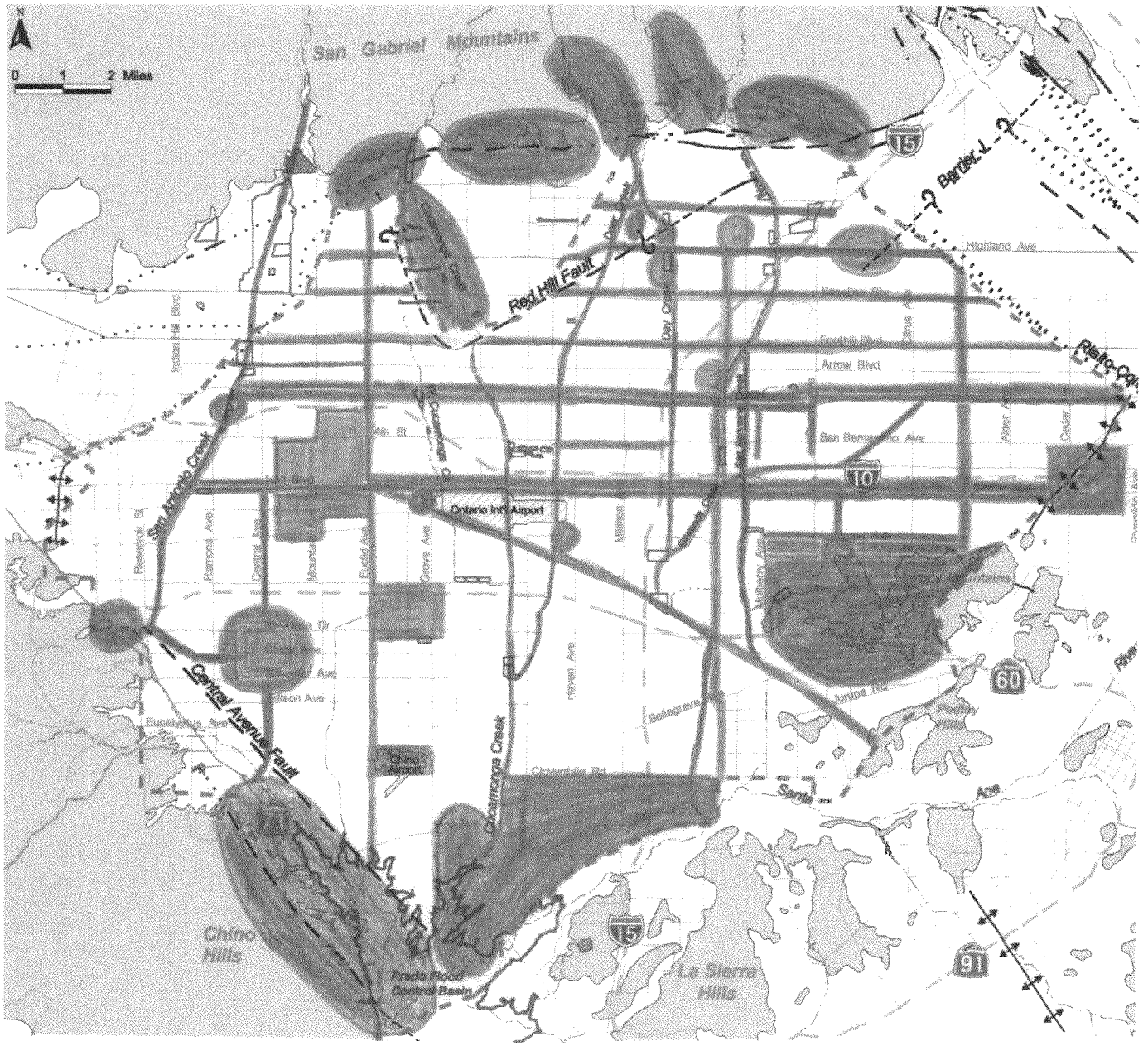
These measures ensure that the project area amendment will not cause significant impact to cultural resources. Mitigation will be accomplished through avoidance or recovery of all pertinent data from identified cultural resources sites within the Project Area. Implementing the above measures will contribute to routine environmental impacts associated with disturbing the ground during artifact and data collection.

### 4.14.5 Cumulative Impact

Cumulative cultural resource impacts can only occur when such resources are not avoided or are not recovered, evaluated and their data value placed in the broader contest of such resources. Based on the requirement to ensure that such resources are avoided or otherwise protected and evaluated, no cumulative significant cultural resource impacts are forecast to occur if the proposed project is implemented.

### 4.14.6 Unavoidable Adverse Impact

The cultural resource evaluation presented above indicates that, with implementation of appropriate mitigation measures, the proposed project will not cause any significant unavoidable adverse impacts. Therefore, no significant adverse cultural resource impacts are forecast to occur if the proposed project is implemented.




## Legend

- Sensitive Areas for Prehistoric and Historic Resources
- Sensitive Areas for Historic Structures

| | | |
|---|---|---|
| **SENSITIVE AREAS FOR CULTURAL RESOURCES**<br>Source: Archaeological and Eastern Information Centers | TOM DODSON & ASSOCIATES<br>Environmental Consultants | **FIGURE 4.14-1** |

# 4.15 AESTHETICS AND VISUAL RESOURCES

## 4.15.1 Introduction

Visual resources include natural and man-made features that give a particular environment its aesthetic qualities. Criteria used in the analysis of these resources include visual sensitivity, which is the degree of public interest in a visual resource and concern over adverse changes in its quality. Visual sensitivity is categorized in terms of high, medium or low levels.

High visual sensitivity exists in areas where views are rare, unique, or in other ways special, such as in remote or pristine environments. High-sensitivity views would generally include landscapes that have landforms, vegetative patterns, water bodies, or rock formations of unusual or outstanding quality (USAF, 1991).

This subchapter relies extensively on the aesthetics/scenic resources/open space evaluations contained in the general plans for the following: the cities of Chino, Chino Hills, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, and Upland; and the counties of Riverside and San Bernardino. The evaluation focuses on the potential aesthetic and visual resource impacts from implementing the OBMP.

## 4.15.2 Environmental Setting

### 4.15.2.1 Aesthetic and Visual Resources

Chino

The City is relatively flat as it lies on the alluvial valley floor of the Chino Basin. The City of Chino has visual access to the San Gabriel and San Bernardino Mountains to the north, the Jurupa Hills and Santa Ana Mountains to the east and south, respectively, and the Chino Hills to the west. The General Plan identifies the local mountains as providing the major scenic diversity and quality for the area. Further, it establishes General Plan Policy P5-16.1 in support of maintaining vistas. Policy P5-16.1 states "To ensure that vistas of the San Bernardino and San Gabriel Mountains and the Chino Hills are maintained for aesthetic enjoyment by City residents.

Chino Hills

Grass covered oak savannah woodland hillsides dominate the western and southern portion of the community and are a key aspect to the area's character. The hills are visible from nearly every neighborhood and major street within this community. Single-family neighborhoods penetrate into the hills in the northern half of the City, while most of the southern half is preserved as undeveloped open space. The principal component of the southern area is the Chino Hills State Park; a wilderness

park of rangeland, oak woodlands, and chaparral of which 11.7 square miles is located within the City of Chino Hills.

Fontana

The central portion of the City of Fontana is located on an alluvial plain that gently slopes south from the San Gabriel Mountains. The northern portion of the City extends into the San Gabriel foothills and the southern portion of the City extends into the Jurupa Hills. The topography varies from, characteristically flat in the central portion of the City, to gently to steep sloping hillsides in the San Gabriel foothills and Jurupa Mountains to the south. For Fontana, views of the mountains at the northern and southern borders of the City are an important component of the City's aesthetic quality.

Montclair

The Community Design Objectives of the Montclair General Plan encourage the design of road and street improvements that protect or enhance the scenic vistas and values along the city's roadsides. Additionally, the City's objectives include the development of procedures to require aesthetic treatment on all new developments.

Ontario

The City of Ontario's General Plan identifies three primary visual resources: the Euclid Corridor, Mission Boulevard and the view of the San Gabriel Mountains. It is a goal of the City to preserve and protect Ontario's scenic highways and vistas as community assets. The general plan identifies implementation policies to address scenic resources. Two such policies are within Chapter 6.3 Scenic Highways/Vistas. General Plan Policy 5.1 requires that new development respect and preserve the view opportunities of existing development in the area. General Plan Policy 5.6 requires new development to place utilities underground to the maximum extent feasible.

Pomona

Most of the developed land within the City of Pomona is located on a gently sloping alluvial fan which originates at the mouth of the San Antonio Canyon and slopes gradually to the south and southwest. Within the city limits, the average slope consists of an average two percent grade. In the Pomona area, the San Antonio alluvial fan laps into the base on the San Jose and Puente Hills. The highest point in the Pomona, at 1,381 feet above sea level, is located in the portion of the Puente Hills known as the Westmont Hills. Elephant Hill, a well-known local landmark, attains an elevation of 1,165 above sea level.

Rancho Cucamonga

The City of Rancho Cucamonga lies on the sloping alluvial plain and extends into the foothills of the San Gabriel Mountains. As the City's most prominent natural feature , the mountains run east-west and form an impressive visual boundary to the north. From the base of the mountains, in the foothills, long, open vista to the south provide spectacular views of the City and the Chino Basin watershed. Another visual topographic feature within the City is Red Hill. At approximately 1,470 feet above mean sea level, Red Hill occupies a portion of the City's western boundary directly north of Foothill Boulevard.

Rialto

The City of Rialto is located on a wide alluvial plain at the base of the Cajon Pass which separates the San Gabriel Mountains and San Bernardino Mountains. Lytle Creek forms a major open area that bounds the eastern edge of the City.. The City of Rialto included as an optional element within their General Plan a Community Design Element. The element among other issues focuses on the protection and enhancement of existing aesthetic attributes and the promotion of community design. Primary visual resources include views to the north towards the San Gabriel and San Bernardino Mountains.

Upland

As the City of Upland's name implies, it is located on the upper alluvial fan of San Antonio Creek (northern and most elevated portion of the Chino Basin) where the City extends into the San Gabriel Mountain foothills. One goal of the City of Upland is to protect and enhance the scenic attributes of Euclid Avenue, Mountain Avenue, Foothill Boulevard and Benson Avenue. An additional goal is to achieve a system of potential scenic routes that will provide for increased enjoyment and opportunity for scenic pleasure driving and travel.

Riverside County

The County of Riverside addresses aesthetic resources in their Scenic Highways Element of their General Plan. Specifically, they see the enhancement of aesthetic opportunities for residents and visitors as playing an important role in promoting tourism. The participate in the State Scenic Highways Program and have identified State Route 71 as an eligible scenic route. The portion of Riverside County located in the Chino Basin encompasses a portion of the last remaining agricultural or pastoral landscape that occurs in the Basin. The area is essentially flat, bounded on the west and south by the Chino Hills, on the east by the Jurupa Hills and on the south by the Santa Ana Mountains. Aside from the visual assets of the pastoral landscape in this area, the open landscape without structures along each street provides good quality views to the surrounding hills and mountains in all directions.

San Bernardino County

The West Valley is the most heavily developed subregion in the County of San Bernardino. The County has designated the Cucamonga Flood Channel, San Gabriel MWD Aqueduct, and the proposed State Route 30, State Route 71 and State Route 83 as official scenic corridors. The County has established a process through their General Plan to make determinations as to scenic value on a case-by-case basis. There is only limited areas in the Chino Basin, primarily in the Fontana area and the City of Chino Sphere of Influence, where extensive areas remain under County jurisdiction. The former area is dominated by an urban landscape of primarily industrial land uses and the latter area can be characterized as pastoral, very similar to the description for Riverside County.

### 4.15.2.2 Light and Glare

Light and glare within the Chino Basin project area comes from public and private lighting used generally in the commercial and industrial districts, the street lighting in residential districts, and glare from vehicular headlights. Light and glare is a problem principally when exterior lighting shines on adjacent properties and either conflicts with adjacent existing uses or creates light pollution the diminishes the quality of the night-time visual setting for an area. In addition, light and glare can create hazards if not controlled adjacent to roadways.

Chino

Lighting issues are discussed within the Chino General Plan in Chapter 5 Conservation and Open Space Element. Specifically, Action Item A5-7.3.1 states "The City shall pursue the feasibility of requiring low pressure sodium lamps for all street lights and public parking lots."

Chino Hills

Lighting and glare issues are discussed within the Chino Hills General Plan in Chapter 6 Parks, Recreation and Open Space Element. Specifically, Policy 6-4 states "Maintain lighting levels suitable for safety as well as the nighttime use of community and city-wide facilities without undue glare impacts on nearby residential areas."

Fontana

Light and glare in the City are created by a number of sources both from public and private lighting. Traffic traveling on Interstates 10 and 15 and major local roadways, creates a large amount of glare and stray light. Exterior building lights usually used for security or promotional purposes, street lights, and school outdoor lighting all create additional light and glare. While adequate lighting is necessary for traffic and safety, security, and night activities, nearby residences and undeveloped areas are sensitive to high levels of light and glare during nighttime hours. Excess glare presents a safety hazard to drivers by restricting their vision.
Rialto

The City of Rialto within its General Plan has adopted polices and guidelines to address and control impacts from light and glare that may result from new construction and the introduction of new light/glare and shade/shadow sources.

Riverside County

The County of Riverside has adopted General Plan Policies to deal with lighting and glare impacts to the Mount Palomar Observatory. Projects within a 45-mile radius of the Observatory must adhere to special standards relating to the use of low-pressure sodium lights. Additionally, it is policy of the County of Riverside to require that all new developments shield and direct lighting sources downward to minimize conflicts with adjacent land uses.

The cities of Montclair, Norco, Ontario, Pomona, Rancho Cucamonga and Upland and the County of San Bernardino do not have specific General Plan guidelines or policies dealing with light and glare issues.

## 4.15.3 Project Impacts

### 4.15.3.1 Aesthetics and Visual Resources

The implementation of the OBMP would include installing new infrastructure systems within existing communities and providing water in a more efficient and effective manner to support development of existing land uses consistent with the existing general plan and zone designations. The aesthetic and visual resource issues of focus in this evaluation are related to the alterations in the existing visual character of the visual setting that exists within the Project Area or views to external areas that may be impacted from implementing the OBMP.

The preservation and enhancement of the positive visual aspects, as well as the assurance that new development is aesthetically pleasing, are key features of the general plans within the project area. New construction has the potential to conflict with the views of and from existing neighborhoods and structures. Determination of the visual impact of new development will ultimately have to be made at the specific project level, but guidelines are discussed and established below to ensure that future OBMP facilities and activities do not cause significant adverse aesthetic impacts..

### 4.15.3.2 Significance Criteria

For this analysis the proposed project will be determined to cause significant aesthetic, visual or light/glare impacts if its implementation will cause any of the following physical changes in the environment:

- The project is not consistent with the design guidelines contained in the local jurisdiction's general plan and other local plans;

- The change in the visual setting caused by a future specific project creates a substantial contrast or negative change to the existing visual setting; and

- The installation of night lighting creates a substantial conflict with adjacent uses or causes negative changes to an existing nighttime visual setting.

### 4.15.3.3 Aesthetic and Light/Glare Impact Analysis

### a. Will the project have a significant affect on a scenic vista or scenic highway?

Future OBMP facilities will be underground (pipes), at ground level (recharge basins) and above ground in the form of typical structures that will be used to house wells or support desalter operations. The proposed project facilities and activities are not forecast to cause any significant adverse impacts to a scenic vista or scenic highway because these facilities will not be located in areas or be of a size to adversely impact such vistas or scenic highways.

There are eligible scenic highways within the OBMP project area, but no officially designated scenic highways. The County of San Bernardino does have scenic corridors within the project area and established planning standards that should be employed with development. With implementation of mitigation outlined below, development under the OBMP will be consistent with current general plan requirements for protecting scenic vistas and scenic highway visual values.

The most significant visual resources are the hills and mountains surrounding the Chino Basin and the pastoral landscape that occurs in the southern portion of the Chino Basin. The activity with the highest potential to conflict with local agency design guidelines is construction disturbance of the landscape. Such disturbance can be reduce to an acceptable level by landscaping or revegetating disturbed areas (pipelines, well pads, recharge basins, and structural developments (desalters)) either with landscaping that is consistent with local design guidelines or with native vegetation consistent with that which occurs naturally in the area.

### b. Will the project have a demonstrable negative aesthetic effect?

The proposed OBMP facilities will utilize a combination of existing facilities, underground systems and new facility (desalter and recharge basin) construction to meet its objectives. Installation of surface facilities has a potential to modify the existing view or visual setting at future specific project sites which could cause a negative visual impact. Measures outlined above can ensure that construction disturbance is mitigated by replacing vegetation and controlling potential negative aesthetic effects due to landscapes scarring. For structures, such as desalters and well housings, compliance with local agency design guidelines will ensure that new facilities do not cause significant negative aesthetic effects..

### c. Will the project create light or glare?

Some of the proposed OBMP facilities will require the installation of night lighting, possibly including areas where little or no night lighting currently exists. Glare from new light fixtures that may be installed as part of proposed Chino Basin OBMP improvements has a potential to cause a significant negative impact upon adjacent uses, including sensitive receptors such as residential, rural or wildlife habitat portions of the Project Area. Such impacts can be fully mitigated by implementing measures for street lighting and down shielded commercial lighting which are generally an accepted element of urbanization. Lighting can increase nighttime visibility and thereby achieve a greater degree of safety for motorists, residents, and business owners.

Future specific projects will include desalters and isolated well sites and these facilities may require the installation of infrastructure improvements and roadway improvements. Night lighting installed in support of future OBMP development projects will be mitigated to a non-significant level consistent with existing regulations controlling lighting requirements in each jurisdiction by controlling the amount of night light (lumens), by positioning of night lights, by selecting the appropriate type of lighting for the specific site and location, and by directing the lights through use of hoods and other directional controls.

The last potentially significant adverse light-and-glare impact relates to headlights from vehicles traveling on project area roadways. The majority of increased vehicle trips will be attributable to daytime construction and maintenance related trips to OBMP facilities in the future. The small number of nighttime trips (unquantifiable at this stage of review) is so small relative to existing trips on roadway that no significant cumulative contribution to headlight glare is anticipated to affect light sensitive receptor areas. No unusual or unique sources of light and glare are anticipated to be required in support of the OBMP..

## 4.15.4 Mitigation Measures

The scenic views from and toward the foothill and mountain areas should be protected against development impacts. This can be accomplished by carefully planning the location and extent of development and, in some cases, by clustering development to maximize open space and by encouraging the underground placement of utilities, where practicable.

**4.15-1 All surface areas disturbed by OBMP construction activities, except those area used structures or hardscapes) shall be revegetated, either with native vegetation in natural landscapes or in accordance with a landscape plan in man-made landscape areas (note that native vegetation is also eminently suited to man-made landscapes and requires less maintenance). Once construction is completed, revegetation shall begin immediately and, where a formal landscape plan is being implemented, it shall be coordinated with the local agency and the local design guidelines for consistency.**

**4.15-2 Where facilities are proposed to be located adjacent to scenic highways, corridors or other scenic features identified in local agency planning documents, OBMP facility implementation will conform with design requirements established in these planning documents.**

**4.15-3 Where facilities will disrupt views from occupied areas with significant scenic vistas, a visual simulation analysis shall be performed of the facility's impact on the important view. If the analysis identifies a significant impact on a scenic vista, the facility shall be relocated, redesigned to reduce the impact to a non-significant level, or a subsequent environmental evaluation shall be prepared.**

**4.15-4 When OBMP above ground facilities are constructed in the future, the local agency design guidelines for the project site shall be followed to the extent that they do not conflict with the engineering and budget constraints established for the facility.**

**4.15-5 All utilities for OBMP facilities shall be placed underground unless such undergrounding is not technically feasible.**

**4.15-6 Future project review and implementation shall implement the following:**

- **Use of low pressure sodium lights where security needs require such lighting to minimize impacts of glare.**
- **Height of lighting fixtures shall be lowered to the lowest level consistent with the purpose of the lighting to reduce unwanted illumination.**
- **Directing light and shielding shall be used to minimize off-site illumination.**
- **No light shall be allowed to intrude into sensitive light receptor areas.**

## 4.15.5 Unavoidable Adverse Impact

The aesthetics and visual resources evaluation presented above indicates that although the proposed project has a potential to cause changes in visual settings, no significant adverse impact to aesthetics or visual resources are forecast to occur based on implementation of mitigation measures. Therefore, no significant unavoidable adverse aesthetic or visual resource impacts are forecast to occur if the proposed project is implemented as outlined above.

## 4.15.6 Cumulative Impact

Since the proposed project has no potential to adversely impact any existing aesthetic qualities of the project area or significant views to or from the area after implementing mitigation measures, the proposed project cannot contribute to any cumulative adverse aesthetic or visual resource impacts.

# CHAPTER 5
# ALTERNATIVES

## 5.1 INTRODUCTION

The California Environmental Quality Act (CEQA) and the State CEQA Guidelines require an evaluation of alternatives to the proposed action. Section 15126(d) indicates that the "discussion of alternatives shall focus on alternatives capable of eliminating any significant adverse environmental effects or reducing them to a level of not significant..." In this case no significant adverse impacts have been identified. The State Guidelines also state that "a range of reasonable alternatives to the project....which could feasiblely attain the basic objectives of the project" and "The range of alternatives required in an EIR is governed by "rule of reason" that requires the EIR to set forth only those alternatives necessary to permit a reasoned choice."

The proposed project would implement a groundwater management program that is designed to enhance the safe yield, to improve water quality, and enhance overall management of the water resources in the ~235 square mile Chino Groundwater Basin. The objective is to enable all groundwater users to produce water from the Basin in a cost-effective manner through the implementation of the Optimum Basin Management Program (OBMP) Elements.

Much of this discussion regarding alternatives to the proposed project is abstracted from the OBMP, Phase I Report dated August 19, 1999 and the Santa Ana Watershed Authority Watershed Plan and Water Resources Plan (WRP). One of the alternatives that must be evaluated is a "no project alternative" regardless of whether it is a feasible alternative to the proposed project, i.e., would meet the project objectives or requirements. Under this alternative the environmental impacts that would occur if the proposed project is not approved and implemented are identified. Under a "baseline" or no project alternative the individual water serving agencies would proceed with implementation of their agency water master plans as these documents are currently configured. In addition to the no project alternative, two other alternatives are evaluated in this chapter. These alternatives are:

1. No Project
2. Conjunctive Use Alternative
3. Santa Ana Watershed Project Authority (SAWPA) Alternative

The following evaluation will also include identification of an environmentally superior alternative as required by the State CEQA Guidelines.

## 5.2 NO PROJECT

Under the no project alternative, the safe yield and improvement to water quality could not be assured and the program elements and activities identified in Chapter 3 of this Program Environmental Impact Report (PEIR) would not be implemented as a cohesive program. Failure to implement the OBMP would result in a violation of the Chino Basin Judgement Ruling of February 19, 1998 which directed that the OBMP be developed and ultimately implemented. The management of the Basin would revert to the water serving agencies (WSAs) listed in Table 4.5-20 under this alternative.

In most circumstances, a "no project alternative" means that no development occurs and the status quo is maintained whether it be development at a lower density or the retention of land in a natural state. In this instance, the "no project alternative" means merely that the OBMP and its program elements would not be implemented as currently envisioned and the goal of equitably financing the OBMP would not be realized. It does not negate the need for WSAs to provide water, but it will shift the context in which water can be provided to water consumers in the Chino Basin. Ultimately the Judgment will mandate that water supplies be provided in a manner that will not adversely impact Basin safe yield. However, given the forecast for loss of agricultural pool production to rising surface water the safe yield of the Basin is forecast (Subchapter 4.5) to be reduced by approximately 40,000 acre-feet per year (af/y) to about 116,000 af/y. A concurrent impact of the reduction or elimination of agricultural pool production will be a comparable increase in rising water (this assumes that desalters are not funded or constructed by other agencies) which will substantially degrade discharge into the Santa Ana River at Prado. Wildermuth's analysis concludes that a consequence of this action is likely to be a requirement by the Regional Board to reduce the concentrations of TDS and nitrates from wastewater discharges to near zero in order to balance the increase in rising water.

The ultimate vision of future growth and development within the project area has been established in the governing Study area general plans, and it is assumed in these general plans that the WSA's have identified the infrastructure required to support the growth as it occurs in the future. The WSA's are effectively forced to create urban water management plans that can accommodate such growth, at least within the limits of current or future resources that may be available. At present the WSA water supply plans rely to a large extent on water importation. As a result, the cost of future water production is likely to rise substantially, and if State Project Water has concentrations of TDS higher than 300 mg/L, a potentially significant increase in salt can occur within the Basin.

Without the OBMP, WSA's would ultimately find it necessary or be forced to construct and install facilities similar to those proposed in the OBMP, such as installation of pipelines, new wells, new spreading basins, pump stations, desalter units, storage facilities and water treatment facilities to meet future water demand and water quality needs. If not implemented through the OBMP, the Court could be forced to utilize the Department of Water Resources to impose a comparable water

management plan in the future. The costs of construction would not necessarily be economically feasible to individual jurisdictions or WSA's without the benefit of regional financing mechanisms.

It should be anticipated that implementation of groundwater management programs would occur more slowly, might never be fully realized and might have a diminished regional benefit if left to individual WSA's. There would be no difference in permitted land uses or development densities in the project area. This is because the land uses will be developed in accordance with the land use designations and development policies contained in the affected jurisdiction's general plans. One difference between the proposed project and the no project alternative is the inability to cohesively bring competing interests into alignment so that future water resources are managed to meet the overall benefit of the whole Basin, i.e., high quality and adequate water supplies to meet future needs. Some of the improvements identified within the OBMP might be developed by the individual WSA's, but not to a similar level of regional benefit.

Impacts of most natural and manmade resources that are dependent upon location would be similar under both the no project and project alternatives, but some impacts could be accelerated under the proposed project.

Under the no project scenario, the ability to attain the goals and objectives as described under Chapter 3, Project Description, in this PEIR would be virtually eliminated. The stakeholders in the Basin would be disabled in their attempt to collectively correct and mitigate conditions of water quality impairment and reduced water supplies (safe yield) to meet their build out development needs.

Project-related impacts are forecast to increase under the no project alternative in the short and mid-terms because of the lack of a coordinated approach to needed facilities within the individual service areas. Over the long-term mandatory programs could be imposed by the State to meet the Judgment's requirements and water resources and water quality might be brought under control, although this is not a foregone conclusion.

In the final analysis, the no project alternative clearly cannot be considered the environmentally superior alternative from a total environmental standpoint to the proposed project because the environmental damage from implementing water supply on a case-by-case basis is forecast to be substantially more significant than implementing the OBMP.

## 5.3 CONJUNCTIVE USE ALTERNATIVE

The conjunctive use alternative was selected by the IEUA based on a desire to meet as many of the management goals identified in the OBMP and to maintain/enhance safe yield for the Basin. The key elements of a conjunctive use program for the Basin would include:

- No maximum storage limit will be placed on local storage accounts for a period of five years ending on June 30, 2004, and water that becomes eligible for storage can be stored.

- The need for storage limits will be re-evaluated in five years based on the ability of the storing party to use the water in storage (ability to use concept) and on Watermaster's need for storage programs that provide regional benefits.

- Storage is not assignable.

- All water in local storage and other storage accounts will incur losses at a rate of 2 percent of water in storage each year starting in fiscal year 2002/03.

- The storage loss rate and safe yield will be estimated in the year 2012/13 and every ten years thereafter.

- Watermaster will develop regional conjunctive-use programs to store supplemental water for MWDSC and other entities that can cause supplemental water to be stored in the Basin.

- The regional conjunctive-use programs will provide benefits to all producers in the Basin, the people of California and the nation. Watermaster's conjunctive-use programs will take priority over conjunctive-use programs developed by others.

- Storage committed to conjunctive-use programs may consist of two parts, storage within the safe storage capacity and storage in excess of safe storage. Storage in excess of safe storage capacity will preemptively require mitigation.

- The initial target storage for Watermaster's conjunctive-use program will be 150,000 to 300,000 acre-ft within the safe storage capacity.

- Cyclic storage will be folded into conjunctive-use storage.

The Watermaster's conjunctive-use program envisions the following steps:

a. completion of an existing short-term conjunctive-use project;
b. identification of a seasonal peaking program for in Basin use and a dry year program to reduce the demand on Metropolitan Water District to 10 percent of normal summer demand (requiring 150,000 acre-ft of storage);
c. establishment of a dry-year export program; and
d. establishment of a seasonal peaking export program.

A conjunctive use program of this nature could have environmental impacts due to its operational characteristics as follows:

The placement of water into any conjunctive use storage account would be accomplished by several different means such as by in-lieu exchange, by spreading water in spreading basins or by injection wells. The delivery of water from the account to satisfy local demands or for export would be accomplished by pumping groundwater and placing it in delivery pipelines. The potential impacts from activities for the placement or delivery of water by these means were identified in Section 4.5 of the PEIR.

For a conjunctive use program with a storage account of 150,000 acre-feet, several injection wells, additional spreading basins and some system interconnections would be necessary. With regard to deliveries to a storage account, a significant amount of the deliveries could be accomplished by using surface deliveries in the winter months to satisfy local demands in-lieu of pumping groundwater to satisfy the demands. Production rates to make deliveries of water from an account of this size are not anticipated to be significantly higher than they currently are for normal peak deliveries. During times of drought when sources of supplemental water are reduced, deliveries to the account would not need to be made in the same year in which withdrawals are made, thus providing regional and statewide drought benefits in addition to the local benefits.

There are several impacts of concern for any conjunctive use program relate to localized water quality impacts, including mobilization of water quality anomalies, the number of recharge sites and site specific impacts, and the overall salt balance and rising water issues. But the most important concern is the potential for the additional water in the aquifer to rise to a sufficient elevation and encroach into the vadose zone where existing contaminants await dissolution with associated degradation of groundwater quality, particularly in the two upper subbasins.

The original analyses for the volume of water that could be stored in a conjunctive use program within the Chino Basin is 500,000 acre-feet (net). Given that the Basin is assumed to have approximately 200,000 acre-feet of *in lieu* storage at this time, the maximum conjunctive use water storage remaining in the Basin is 300,000 acre-feet.

For an expanded conjunctive use program of up to 300,000 acre-feet, it is not anticipated that significant mitigation would be required due to water quality or rising water concerns. This is because a program of this size is anticipated to be within the estimated "safe storage" area of the Basin. A program of this size, however, could require as much as 250 acres of spreading basins or a substantial number of injection wells. It could also require several miles of large pipelines to deliver water from the account, or to place water in the account. These pipelines are anticipated to be installed within existing easements and rights-of-way for this purpose. Production rates for a program of this size could be significantly higher than those necessary to satisfy local demands. However, it is anticipated that higher pumping rates will be necessary to maintain hydraulic control of the basin and minimize potential impacts from increased rising groundwater or high water levels.

There would be no difference in permitted land uses or development densities in the project area. This is because the land uses will be developed in accordance with the land use designations and development policies contained in the affected jurisdiction's General Plans.

Impacts of most natural and manmade resources would be increased by approximately 50% (estimated to be a total of about 750 acres), but as in the case of the OBMP the impacts to site specific resources would be dependent upon location as in the case of the OBMP. If the mitigation measures outlined in this PEIR are implemented for a conjunctive use program of 300,000 acre-feet, the environmental impacts should not be significantly different than that proposed by the OBMP, which would be implemented as proposed, in conjunction with the conjunctive use program.

Three potential issues will require substantial additional management attention if such a conjunctive use program is implemented. First, with so much water coming into the Basin, water managers would have to ensure that salt balance could be maintained in a concurrent time frame. The Regional Board has indicated that it does not believe the Basin has any remaining assimilative capacity and recharge with water that exceeds the existing groundwater TDS in the area of recharge will constitute a net salt increment to the Basin, regardless of whether the local water quality objectives are met. This issue is readily resolvable by monitoring TDS water quality and providing adequate desalinization of high TDS water in the lower portion of the Basin, while ensuring that Basin Plan objectives are met at the recharge site.

The second issue of concern is the effect of such a large volume of recharged water on rising water in Prado. Modeling of the Basin indicates that water recharged in the Basin will cause an increase in rising water unless the points of recharge and discharge are isolated from one another. The concept in the Basin Plan is to recharge water in the upper basins, pump some of the recharge in these areas for production, and then isolate the rising water by offsetting the difference in storage by pumping in the lower basin, in balance with reductions in agricultural production, to ensure that rising water does not increase substantially and cause a downstream impact. This is a critical balance that will require substantial modeling and monitoring data to develop. These issues are believed to be manageable, but there are numerous unknowns that will require substantial resources to effectively model, and then manage.

Finally, the recharge of 300,000 acre-feet of water in the Basin for conjunctive use will make it difficult to avoid mobilizing some of the major contaminated groundwater plumes within the Basin. This issue can be modeled and potential impacts associated with rapid expansion of plumes and loss of recharged water may be avoidable. However, it may be necessary to speed up the remediation of a contaminated groundwater plume in conjunction with a 300,000 af/y conjunctive use program. Such decisions can only be made after carefully evaluating the sites that may be used for recharging the groundwater stored as part of a conjunctive use program.

Under the expanded conjunctive use alternative there could also be additional impacts associated with air quality, biological resources, cultural resources noise, and traffic and circulation. The air quality impacts as a result of the conjunctive use alternative could increase emissions over short to mid-term time frame, but ultimately build-out would result in the same level of emissions. There would be increased noise resulting from increased construction anticipated as a result of additional basins and greater lengths of pipelines to be installed. Further, due to the increases in pipeline installations over those anticipated within the OBMP, there could be additional short-term hazards to vehicular traffic and pedestrians within construction zones.

The ability to attain the goals and objectives as described Chapter 3, Project Description in this PEIR, would be maintained under this alternative. For any conjunctive use program it would be necessary to establish some protective conditions, perhaps performance bonds, that could be used to mitigate adverse groundwater quality or rising water impacts. In any case, although the impacts for a conjunctive use program may be mitigated to a nonsignificant level, the scale of risk from such a program makes it a less environmental superior alternative compared to implementing the OBMP by itself.

In the final analysis, the conjunctive use alternative cannot be considered the environmentally superior alternative from a total environmental standpoint to the proposed project because the potential environmental damage from implementing the conjunctive use program poses greater risks, albeit similar to that from implementing the OBMP.

## 5.4 SANTA ANA WATERSHED PROJECT AUTHORITY ALTERNATIVE

The Santa Ana Watershed Project Authority (SAWPA) was formed in 1972 to plan and build facilities to protect water quality in the Santa Ana River watershed. The Santa Ana River watershed covers over 2,650 square miles of widely varying terrain within parts of San Bernardino, Riverside and Orange Counties. The organization is a joint powers agency composed of the five major water districts that share the Santa Ana River. The Authority includes the Inland Empire Utilities Agency (formerly Chino Basin Municipal Water District), Eastern Municipal Water District, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District. Note that based on recent agreements among participants, this alternative could likely be implemented in conjunction with the OBMP and its participants.

The Santa Ana Watershed Project Authority alternative is meant to be implemented in conjunction with participating agencies in the Chino Basin. It would be implemented through a coordinated program with the Watermaster and contains additional projects that could augment the OBMP. The actual agency implementing specific components of this alternative would be determined on a case-by-case basis in the future. In its responses to OBMP Draft PEIR, SAWPA indicated that, in contrast to being two totally different alternatives, their "Chino Basin Cleanup and Conjunctive Use Plan" is more reasonably considered to be a complimentary watershed-wide strategy.

Similar to the OBMP, the SAWPA program is watershed based proposing a regional program to assure a sustainable water supply for the future, while at the same time seeking to enhance the environment. The goal of the program is to make the region entirely self sufficient during drought cycles, thereby firming up the region's ability to assure a stable economy, while improving water quality, and also allowing more of the State's scarce water resources to be allocated to wildlife and agriculture during those times. The program has four major elements:

a. Enhancement of the native habitat along the river and its tributaries;
b. Desalting and treatment of contaminated brackish water to allow poor quality water to be reclaimed and used;
c. Storage of water from wet years in groundwater storage basins to be used in drought; and,
d. Conservation, including water use efficiency and reclamation

The program seeks to manage the whole of the environment by placing equal importance on native habitat enhancement while managing water supply and quality. The SAWPA alternative proposes some of the same and other similar improvements as the OBMP in that new recharge basins, new wells, pipelines and desalters are proposed for construction. The Program includes Basin clean-up, conjunctive use, ground water replenishment in addition to watershed improvement plans, habitat enhancement and wetland development programs. The environmental impacts resulting from implementation of the SAWPA alternative would be similar to those occurring as a result of the OBMP implementation.

The environmental benefits of SAWPA alternative improvements would be an expansion of native habitat restoration programs and the creation of wetlands or open space designed as part of a long-term program.

In the final analysis, the SAWPA alterative would have comparable impacts to the OBMP and is therefore not a superior environmental alternative to the OBMP in terms of the facilities and management of water resources in the Basin. However, it does include a commitment to habitat enhancement, which if actually supported, could make it the environmentally superior alternative.

## 5.5 CONCLUSION

The three alternatives to the proposed project would be feasible but, as discussed above, they would not fully meet all OBMP goals and objectives as summarized in Chapter 3. Each of the three alternatives have associated environmental impacts that will not eliminate the single significant impact identified in this PEIR, air quality. The no project and conjunctive use programs are forecast to cause worse air quality impacts due to duplication of facilities under the former alternative and increased ground disturbance under the latter alternative. The impacts of the SAWPA alternative are comparable to the OBMP. Based on the analysis contained in this chapter, the proposed project, the

OBMP, is considered along with the SAWPA alternative to be comparably the environmentally superior alternatives available that will meet project goals and objectives.

# CHAPTER 6
# TOPICAL ISSUES

## 6.1 GROWTH INDUCEMENT

Traditionally, significant growth is induced in one of three ways. In the first instance, a project is located in an isolated area and when developed it brings sufficient urban infrastructure to cause new or additional development pressure on the intervening and surrounding land. This type of induced growth leads to conversion of adjacent acreage to higher intensity uses, either unexpectedly or through accelerated development. This conversion occurs because the adjacent land becomes more suitable for development and, hence, more valuable because of the availability of the new infrastructure. This type of growth inducement is typically termed "leap frog" or "premature" development because it creates an island of higher intensity developed land within a larger area of lower intensity land use.

The OBMP will not cause or contribute to "leap frog" or "premature" development because the purpose of the OBMP is to provide an overall management strategy, tied to specific facilities and management actions, that will provide the Chino Basin with "*a groundwater management program that enhances the safe yield and the water quality of the Basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*" (Page 3-1, OBMP). The OBMP is not intended to be directly involved in supplying municipal water supplies to customers. Thus, the Program and its implementation are one step removed from actual development and provisions of adequate water supplies in support of building-out each jurisdictions' general plan.

A second type of growth inducement is caused when a project of large size, relative to the surrounding community or area, is developed within a community and impacts the surrounding community by producing a "multiplier effect," which results in substantial indirect community growth, not necessarily adjacent to the development site or of the same type of use as the project itself. This type of stimulus to community growth is typified by the development of major destination recreation facilities, such as Disney World near Orlando, Florida, or around a military base, such as the Marine Corps Air Ground Combat Center near Twentynine Palms. The proposed OBMP is not a new development that will cause growth through a "multiplier effect." Development within the project area will be consistent with growth decisions already made by local agencies governing land use decisions, and further, that the OBMP does not remove any existing constraint on future development because existing water serving agencies (WSA's) have alternative means (perhaps not as cost or environmentally effective as the OBMP) to meet future water demands. No new "large" projects are proposed and no potential for this type of growth inducement will be caused by the proposed project.

A third and more subtle type of growth inducement occurs when land use plans are established that create a potential for growth because the available land and the land uses permitted result in the attraction of new development. This type of growth inducement is also attributed to other plans developed to provide the infrastructure necessary to meet the land use objectives, or community vision, contained in the governing land use agency's General Plan. In this case, the ultimate vision of future growth and development within the project area was established in the governing Study area general plans, and it is assumed in these general plans that the WSA's have identified the infrastructure required to support the population which will be in place as growth occurs in the future. The net effect of these general plans is to create a set of expectations regarding future land use and growth that may or may not occur depending upon the actual carrying capacity of the various utility and service resources required to meet future growth. It also seems clear that the established planning process and the overall growth pressures in southern California are the primary causes of future growth, i.e. they induce the actual growth that occurs, and the various utilities, such as the WSA's, are effectively forced to create urban water management plans that can accommodate such growth, at least within the limits of current or future resources that may be available. As the RCPG analysis of water resources indicates in Section 4.2.3.1.g., there are sufficient water resources to meet future demand for the foreseeable future.

As noted above, the position taken in this document is that the utility planning process is more appropriately playing a passive (accommodating) role, not an active (inducing) role, in future growth that is dictated by local land use plans and the continuing growth of population throughout southern California. If communities within the project area chose to restrict growth and maintain a certain vision of the future as a static or slowly growing entity, the land use planning agencies (cities and counties) had the opportunity during the general planning process to establish such plans. Under such circumstances, the utility providers, including the WSA's would have designed their future service plans to accommodate a level of future growth consistent with available resources

In reality, however, the WSA's, acting as responsible water planning agencies, must plan for a level of future growth that appears to match available water resources with forecast growth through the 2010 planning horizon. At present the WSA water supply plans rely to a large extent on water importation. The OBMP provides an alternative management program for the Chino Basin that will reduce reliance on imported water and still allow the WSA to accommodate growth as envisioned in the Study area general plans. Based on this analysis, implementation of the OBMP is not considered to be a significant growth inducing action.

## 6.2 CUMULATIVE IMPACTS

The following text summarizes the cumulative impact analysis provided in Chapter 4. The intent of a cumulative impact evaluation is to provide the public and decision-makers with an understanding of a given project's contributions to area-wide or community environmental impacts when added to other or all development proposed in an area. The state CEQA Guidelines provide two alternative methods for making cumulative impact forecasts: (1) a list of past, present and reasonably

anticipated projects in the project area, or (2) the broad growth impact forecast contained in general or regional plans. Because of the planning character of this project, it will be evaluated in the context of adopted General Plans. No other projects were identified within the Project Area or vicinity that would contribute to cumulative impacts or cumulative demand for local infrastructure.

The cumulative impacts of implementing the proposed project is outlined in Chapter 4 for each environmental issue. The proposed project was evaluated in the context of the affected jurisdiction's current adopted General Plans which concluded that no significant adverse cumulative impacts would result except for the loss of agricultural lands, air quality and noise. Based on evaluations of individual issues and, specifically the OBMP's contribution to cumulative impacts, the following was concluded:

### 6.2.1 Agriculture

The project's contribution to cumulative removal of agricultural operations could be considered significant, but mitigation is provided that will allow OBMP implementation to avoid contributing to a cumulative significant loss of land currently dedicated to agricultural operations and to cumulative conversion of important farmlands and prime agricultural soils located in the southern portion of the Basin. The recent allocation of agricultural areas to the Cities of Ontario and Chino, in conjunction with recent annexations, have already committed the former agricultural preserve in the southern portion of the Chino Basin to urban uses. This commitment is not driven directly by water related issues, but indirectly the cost to continue diary operations in the Chino Basin are among the causes of agriculture shifting to alternative locations. As stated above, the OBMP could make a small contribution to demise of agriculture in the Basin, but mitigation can be implemented to reduce this cumulative contribution to a non-significant level.

### 6.2.2 Air Quality

Implementation of the OBMP will contribute pollutants into the SCAB from construction and operation of the facilities. The facilities are designed to provide an adequate water supply for the land uses and intensities identified in applicable general plans. The AQMD assumes that if growth occurs that is consistent with applicable general plans then, ambient air quality standards can be met. Because this project does not propose amendments to existing general plan land uses, it is in conformity with the AQMD and will not result in significant adverse cumulative air quality impacts.

### 6.2.3 Noise

The noise forecast data contained in the local agency general plans demonstrates that future traffic noise levels from general growth (cumulative traffic increases) within the Chino Basin will result in significant noise impacts. However, the OBMP is not forecast to cause or contribute to such cumulative noise impacts which can be attributed to the land use mix contained in the local agency general plans and the inability to reduce potential traffic noise impacts to a non-significant level.

Any traffic generated by OBMP operations (a few hundred trips per day) are considered *de minimus* contributions to this traffic related noise impact. Because implementation of the OBMP will not contribute to significantly to cumulative increases in traffic, the proposed project is not forecast to cause a contribute to cumulatively significant noise impacts.

With implementation of mitigation measures to ensure that implementation of the OBMP will not contribute to cumulative degradation of groundwater quality in the Chino Basin, the proposed project is not forecast to contribute to any significant cumulative environmental impacts.

## 6.3 IRREVERSIBLE ENVIRONMENTAL CHANGES

If the OBMP (Program) is effectively implemented, the following irreversible and/or environmental changes would be involved:

a. The construction, installation and maintenance of pipelines, new wells, pump stations, desalter units, storage facilities and water treatment facilities and other public facilities, as proposed in the Program, will involve the irreversible consumption of natural resources in the form of construction materials, water, and energy sources. Money and manpower will be expended to develop and maintain the facilities.

b. The development of individual properties in accordance with land uses designated in the Program will, for all intents and purposes, eliminate the possibility of development of the land for other uses.

c. A commitment of economic and manpower resources will be required for the long-term implementation of the Program.

d. Building materials, including forest and mineral products, will be permanently committed in construction projects related to the long-term implementation of the proposed Program.

e. Expenditures of money, manpower, and materials will be made to maintain adequate levels of public service to the greater community while those services are undergoing disruption and modification within the proposed project area.

All other potential adverse impacts from implementing the proposed project are reversible. Air emissions and water resources and water quality can be changed by both humans and nature over time by cleaning air and water and by reducing or providing alternative sources of water. Soils and geologic resources will be modified but can be modified in the future to suit different purposes. As long as the proposed project does not contribute to the loss of any endangered plant or animal species, biological resources can be maintained or enhanced with sufficient resources.

Land uses and population growth can be considered irreversible on the short term, but the growth forecast for these two issue is not considered to be attributable to the proposed project. Thus, through the incorporation of recommended mitigation measures together with the implementation of the OBMP, no significant irreversible environmental changes will be caused within the project area that can be attributable to the proposed project, and implementation of the extensive suite of mitigation measures in this document will insure that all irreversible and/or unavoidable environmental impacts, as identified above and described within Chapter 4 of this PEIR, can be adequately mitigated to a level of insignificance.

# CHAPTER 7
# PREPARATION RESOURCES

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# CHAPTER 8
# APPENDICES

## 8.1 NOTICE OF PREPARATION, COMMENT LETTERS & RESPONSES, AND SUMMARY TABLE

## 8.2 SECTIONS 15162 & 15168 OF STATE CEQA GUIDELINES

## 8.3 CURRENT REGULATORY CONTEXT FOR RECYCLED WATER RECHARGE PROJECTS

## 8.4 MWDSC'S CHINO BASIN GROUNDWATER STORAGE EIR'S BIOLOGICAL SECTION

## 8.5 CALIFORNIA NATIVE PLANT SOCIETY PLANT LIST

# APPENDIX 8.1

# NOTICE OF PREPARATION, COMMENT LETTERS & RESPONSES, AND SUMMARY TABLE

Inland Empire
UTILITIES AGENCY*

9400 Cherry Ave., Bldg. A • Fontana, CA 92335
P.O. Box 697 • Rancho Cucamonga, CA 91729
TEL (909) 357-0241 • FAX (909) 357-3884
* A Municipal Water District

Richard W. Atwater
Chief Executive Officer
General Manager

# MEMORANDUM

November 9, 1999

From: Inland Empire Utilities Agency

To: Responsible and Trustee Agencies/Interested Organizations and Individuals

Re: **Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin**

The Inland Empire Utilities Agency (IEUA or Agency) will serve as the Lead Agency under the California Environmental Quality Act (CEQA) and will coordinate the preparation of a program Environmental Impact Report (EIR) that will evaluate the implementation of the Optimum Basin Management Program for the Chino Basin. The IEUA will serve as the Lead Agency for this document based on mutual agreement with the Chino Basin Watermaster and its member agencies. This letter constitutes a Notice of Preparation (NOP) for the proposed program EIR and serves as a request for environmental information that you or your organization believes should be addressed in the program EIR. In addition to any general comments, please be sure to address the scope and content of environmental information or issues that relate to your agency's statutory responsibilities in connection with the proposed project.

**Comment Period:** Based on time limits defined by CEQA, your response should be sent at the earliest possible date, but no later than 30 days from receipt of this notice. All comments and any questions should directed to:

Inland Empire Utilities Agency
Attn: Neil W. Clifton
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335



John L. Anderson, President | Terry Catlin, Vice President | Anne W. Dunihue, Secretary/Treasurer | Wyatt L. Troxel, Director | Gene Koopman, Director

**Project Location and Characteristics:** The Optimum Basin Management Program (OBMP) encompasses the Chino Basin as shown in the attached figure. This figure illustrates the boundary of the Chino Groundwater Basin as it is legally defined in the stipulated Judgement in the case of Chino Basin Municipal Water District *vs.* the City of Chino *et. al.* The figure also shows the hydrologic boundary of the Chino Groundwater Basin, which is slightly different from the adjudicated boundary. Chino Basin is an alluvial valley that is relatively flat from east to west, sloping from north to south at a one to two percent grade. Valley elevation ranges from about 2,000 feet in the foothills to about 500 feet near Prado Dam. The principal drainage course for the Basin is the Santa Ana River. While still considered to be a single basin, the Chino Groundwater Basin has been divided up into five management zones, based upon hydrologic conditions, and into three sub-basins.

The Chino Groundwater Basin is one of the largest groundwater basins in southern California, containing about 5,000,000 acre-ft of water in storage, with an additional, unused storage capacity of about 1,000,000 acre-ft. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies from the Chino Groundwater Basin. The average annual well production is approximately 140,000 acre-feet for the Chino Groundwater Basin An additional 300 to 400 agricultural users also produce groundwater from the Basin.

The purpose of this Notice of Preparation, a project description, and a discussion of probable environmental effects are provided below for use in focusing your or your agencies comments for consideration in the program EIR.

**Purpose of the Notice of Preparation:** The purpose of this NOP is to fulfill legal notification requirements, and inform the public and CEQA Responsible and Trustee Agencies that a program EIR will be prepared. This NOP solicits agency and interested party concerns regarding the potential environmental effects of the proposed project, i.e. implementation of the OBMP. CEQA also encourages early consultation with private persons and organizations that may have information or may be concerned with any potential adverse environmental effects related to physical changes in the environment that may be caused by implementing the OBMP. Responses to the NOP that specifically focus on potentially significant environmental issues are of particular interest to the IEUA.

All written responses to the NOP will be included in the appendices to the program EIR. The content of the responses will help guide the focus and scope of the EIR in accordance with State and local agency CEQA Guidelines.



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**Project Description:** An OBMP for the Chino Groundwater Basin (Chino Basin or the Basin) has been developed pursuant to a Judgement entered in the Superior Court of the State of California on February 19, 1998. The overseeing body for guidance in the development and implementation of the OBMP is the Chino Basin Watermaster (Watermaster). This body was effectively established on July 1, 1977. The Inland Empire Utilities Agency (IEUA or the Agency) has agreed to serve as the CEQA Lead Agency for the preparation and administration of a program Environmental Impact Report (EIR).

A program EIR document has been selected for the OBMP based on the definition of a program document contained in Section 15168 of the State CEQA Guidelines which states: "A program EIR is an EIR which may be prepared on a series of actions that can be characterizes as one large project and are related either: (1) Geographically, (2) A logical parts in the chain of contemplated actions,". The OBMP clearly establishes a program that falls within the scope of a programmatic document because it defines a series of actions that are tied together within the Chino Groundwater Basin; and the proposed program actions are all designed to fulfill the goal of enhanced safe yield and improved water quality for the basin.

In order to administer water-usage for the long-term beneficial use of all component members of Watermaster, an OBMP consisting of two phases is being developed for implementation. Phase I of the OBMP consists of defining the state of the Chino Groundwater Basin, establishing goals concerning major issues identified by stakeholders, and affirming a management plan for the achievement of said goals. Phase 1 also provides a process that facilitates periodical reviews, public comments, and necessary updates. Section 2 of Phase I of the OBMP includes the identification of the physical state of the Chino Groundwater Basin, the predicted future water demands, and the determination of problematic issues associated with the management of the Chino Groundwater Basin.

Section 3 establishes the goals of the OBMP. A mission statement combined with a listing of values, issues, needs and interests deemed important by member stakeholders is also contained within this section of the OBMP. The mission statement for the OBMP is as follows:

> *The purpose of the Optimum Basin Management Program is to develop a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*



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The Goals for the OBMP are as follows:

Goal Number One is to enhance Chino Basin groundwater supplies. This goal applies not only to local groundwater, but also to all sources of water available for the enhancement of the Chino Groundwater Basin. The Program will attempt to utilize the following activities to increase basin supplies:

- Enhance recharge of storm water runoff
- Increase the recharge of recycled water
- Develop new sources of supplemental water
- Promote the direct use of recycled water
- Promote the treatment and use of degraded groundwater
- Reduce groundwater outflow
- Re-determine safe yield

Goal Number Two is to protect and enhance water quality. This goal will be accomplished by implementing activities that capture and dispose of degraded groundwater, treat degraded groundwater for beneficial use, and encourage better management of waste discharges that may adversely impact groundwater. The following are management options that have been identified to achieve this goal:

- Treat degraded groundwater to meet beneficial uses
- Monitor and manage the basin to reduce contaminants and to improve water quality
- Manage salt accumulation through dilution or blending and the export of salt
- Address problems posed by specific contaminants.

Goal Number Three is to enhance management of the Chino Groundwater Basin by means of the following activities:

- Develop policies and procedures that will encourage stable, creative and fair water resource management in the Basin
- Optimize the use of local groundwater storage
- Develop and/or encourage production patterns, well fields, treatment and water transmission facilities and alternative water supply sources to ensure maximum and equitable availability of groundwater and to minimize land subsidence
- Develop conjunctive-use programs with others to optimize the use of the Chino Basin for in-basin producers and the people of California.

Goal Number Four is to Equitably Finance the OBMP.

Included in the scoping process for the identification of OBMP goals, issues, needs, and interests, the Watermaster stakeholders' identified concerns with respect to the following categories:



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- safe yield
- native and imported water recharge
- quality and quantity
- reclaimed water
- conjunctive-use storage
- costs
- human resources and administration

Section 4 of the OBMP describes the recommended Management Program intended to oversee all aspects of the OBMP's implementation and operation. To meet the goals of the OBMP, nine program elements were established. The function of each of these program elements in the Phase I stage of the OBMP is to serve as an initial scoping exercise for the establishment of a general series of comprehensive action plans that will ultimately become the working framework under which specific projects can be evaluated and implemented. The exact methodological details for the development of each program element will be further elaborated upon as part of Phase II of the OBMP. Task Memorandums for each program element were prepared and are available in the Watermaster offices, however they are summarized in Section 4 of the OBMP. For each element, these documents describe the need and function for a specific element, a description of program element actions, element costs, implementation entities, scheduling, and phasing. The individual program elements are listed below. This list comprises the ultimate focus of Watermaster's future actions, agendas, and policies.

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program
- Program Element 9 – Develop and Implement Conjunctive-Use Programs

It is the implementation of the listed program elements where the potential occurs for the OBMP to cause physical changes in the environment and to produce potential adverse impacts to the environment. The purpose of



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preparing this program EIR is to evaluate potentially significant adverse environmental impacts from implementation of the OBMP facilities required to support the Program, and to provide means for the minimization of adverse impacts to both the natural and manmade environment.

**Potential Environmental Effects:** The OBMP outlines an overall program for managing the Chino Groundwater Basin with the goal of providing greater benefit to both human users and the environmental resources dependent upon water and groundwater. The specific capital projects that will need to be approved in the future constitute *"a series of actions that can be characterized as one large project and are related either: (1) Geographically, (2) As logical parts in the chain of contemplated actions, (3) In connection with issuance of rules, regulations, plans, or other general criteria to govern conduct of a continuing program, or (4) As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways."* (Section 15168(a) of the State CEQA Guidelines)

To provide a comprehensive evaluation in the program EIR, which will be used to examine cumulative environmental impact issues and issues not necessarily appropriate for individual projects, IEUA proposes to prepare a full scope environmental evaluation that will address all issues on a standard Initial Study Environmental Checklist Form. These issues include:

| | | |
|---|---|---|
| Land Use | Transportation/Circulation | Public Services |
| Population & Housing | Biological Resources | Utilities & Service Systems |
| Geological Problems | Energy & Mineral Resources | Aesthetics |
| Water | Hazards | Cultural Resources |
| Air Quality | Noise | Recreation |

Because IEUA is proceeding with a full scope program EIR a decision was made not to compile an Initial Study Environmental Checklist Form as permitted by State CEQA Guidelines Section 15060(d). Of the issues identified above, the following issues are considered to have the highest potential to experience significant environmental impacts that may require mitigation:

- geologic problems (subsidence or liquefaction) may be caused or exacerbated due to extraction and recharge of groundwater in support of OBMP objectives;
- biological resource impacts may be caused by ground disturbance undertaken to install the facilities required to implement the OBMP physical facilities;
- the creation and expansion of water-related facilities may affect future growth in undeveloped areas;



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- recycling reclaimed water has the potential to increase levels of Total Dissolved Solids (TDS) and adversely impact groundwater quality in the Basin;
- construction of additional facilities has the potential to conflict with existing land uses;
- operation of de-salting and treatment facilities will generate salt and other waste products that may be problematic for disposal;
- the unplanned use of flood control basins for percolation of storm water and recycled water could result in the potential for exposure of people and surrounding areas to flooding hazards;
- treatment of degraded water has the potential to generate hazardous wastes (both solid waste and air pollutants) and the potential to expose people hazardous conditions;
- construction and operation of facilities to implement program elements may have air quality impacts (fugitive dust or other emissions);
- visual resources may be affected by construction of element facilities;
- construction activities and new facility operations may generate noise that will conflict with adjacent land uses; and
- cultural resource impacts may be caused by ground disturbance undertaken to install the facilities required to implement the OBMP physical facilities.

All of the above issues will be examined in as much detail as permitted in the program EIR based on the level of detail contained in the programs identified above and based on those specific implementation projects that are sufficiently defined to allow site specific evaluation. The IEUA intends to hold both a technical agency and a public scoping meeting during the thirty day NOP comment period. A comprehensive distribution list for this NOP is attached and all agencies and interested parties on this list will be notified of the date for the scoping meetings and afforded an opportunity to attend.

Thank you in advance for any comments you may submit in response to this NOP. For agencies please include the name of a contact person in your agency. If you have any questions, please contact me at (909) 387-4124.

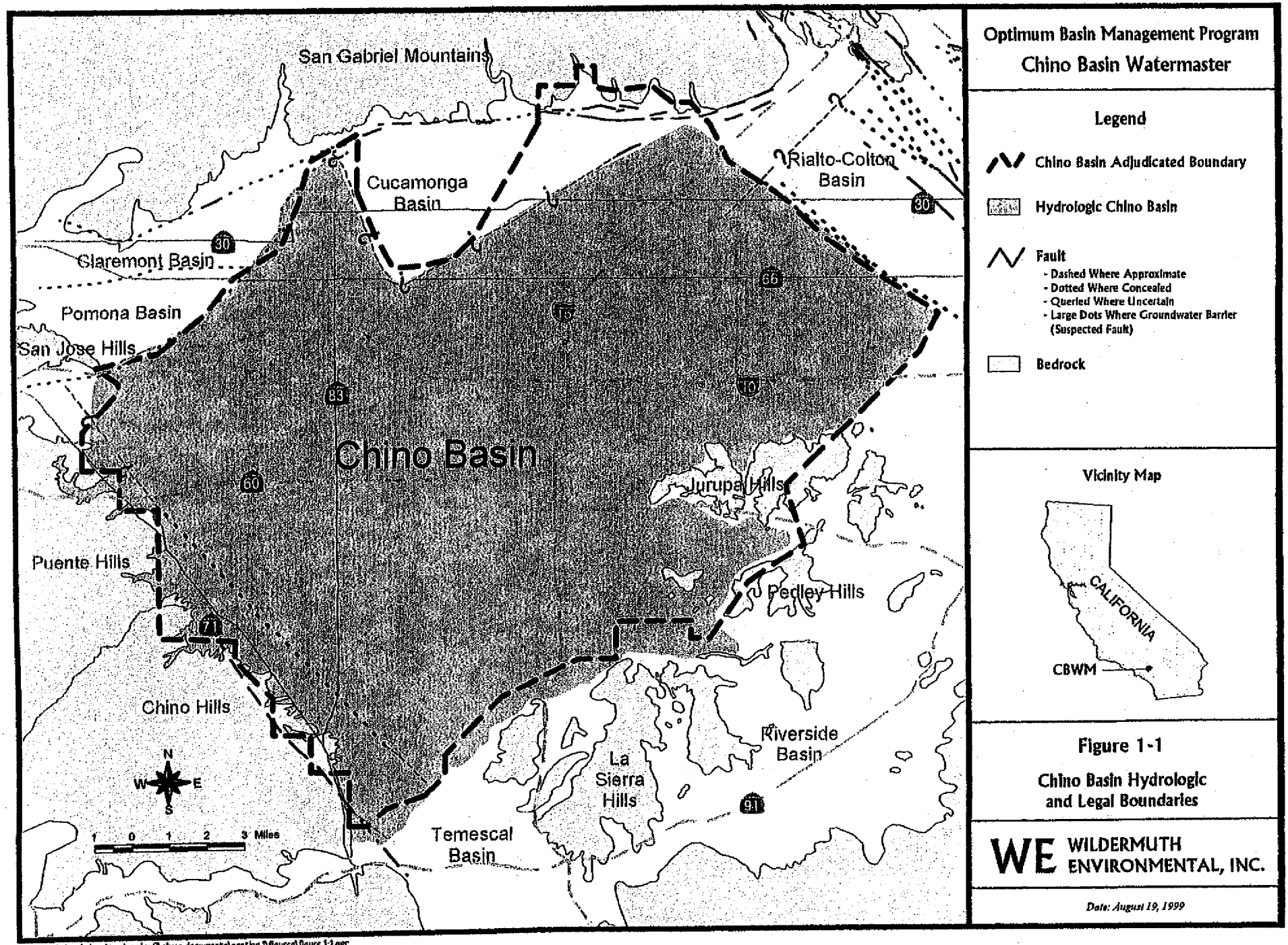
Sincerely,

Neil W. Clifton
Manager of Engineering
Energy and Water Resources

Attachments: Map, Chino Basin Hydrologic and Legal Boundaries
NOP Distribution List



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San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
San Jose Hills
Chino Basin
Jurupa Hills
Puente Hills
Pedley Hills
Chino Hills
Riverside Basin
La Sierra Hills
Temescal Basin
N
W
E
S
1 0 1 2 3 Miles
Optimum Basin Management Program
Chino Basin Watermaster
Legend
Chino Basin Adjudicated Boundary
Hydrologic Chino Basin
Fault
- Dashed Where Approximate
- Dotted Where Concealed
- Queried Where Uncertain
- Large Dots Where Groundwater Barrier (Suspected Fault)
Bedrock
Vicinity Map
CALIFORNIA
CBWM
Figure 1-1
Chino Basin Hydrologic and Legal Boundaries
WE WILDERMUTH ENVIRONMENTAL, INC.
Date: August 19, 1999

**MWD**
*METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA*

*Office of the General Manager*

December 9, 1999

INLAND EMPIRE UTILITIES AGENCY
RECEIVED
DEC - 9 1999
Original to: Engineering
Route to: B Gusten, S Gun, Clifton, Delgado, Morgan

Mr. Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana, CA 92335

Dear Mr. Neil W. Clifton:

Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin

We have received the Notice of Preparation for a Program Environmental Impact Report that will evaluate the implementation of the Optimum Basin Management Program for the Chino Basin. The Metropolitan Water District of Southern California (Metropolitan) is a potentially affected public agency. Please add my name to the mailing list to receive future documents related to this project. Metropolitan is supportive of your efforts to protect and enhance the groundwater supplies. We are looking forward to the opportunity to review your environmental document.

If you have any questions, please contact me at (213) 217-6242.

Very truly yours,

Laura J. Simonek
Principal Environmental Specialist

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Chino Basin Water Conservation District

December 8, 1999

Inland Empire Utilities Agency
c/o Tom Dodson & Associates
2150 N. Arrowhead Avenue
San Bernardino, CA 92405

Re: PEIR for the Chino Basin Watermaster's OBMP

Dear Mr. Dodson:

The Conservation District is hereby requesting that as a part of the CEQA "No Project" evaluation you determine under current (1999) pumping, recharge, and storage conditions, how much water can be annually pumped from the Chino Groundwater Basin without causing water mining to occur. Furthermore, we would ask that you evaluate what environmental and economic impacts would result from a continuation of the current pumping, recharge, and storage conditions absent any of the projects contemplated by the OBMP.

Sincerely yours,

Barrett Kehl

Barrett Kehl,
General Manager

Cc: Board of Directors
Watermaster

**DIRECTORS**
H. ERIC PETERSON
*Division 1*
JOE CASTILLO
*Division 2*
JOHN T. REDDICK
*Division 3*
PAUL HOFER
*Division 4*
JOHN VANDEN BRINK
*Division 5*
HENRY DE HAAN JR.
*Division 6*
GEOFFREY VANDEN HEUVEL
*Division 7*

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*President*
JOHN T. REDDICK
*Vice President*
JOE CASTILLO
*Treasurer*
BARRETT KEHL
*Secretary - Manager*

**DISTRICT COUNSEL**
WILLIAM BRUNICK

4594 SAN BERNARDINO STREET
P.O. BOX 2400
MONTCLAIR, CA 91763-0900
(909) 626-2711
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Chino Basin Water Conservation District

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Henry De Haan Jr.
*Division 6*
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Paul Hofer
*President*
John T. Reddick
*Vice President*
Joe Castillo
*Treasurer*
Barrett Kehl
*Secretary - Manager*

**District Counsel**
William Brunick

December 9, 1999

Inland Empire Utilities Agency
c/o Tom Dodson & Associates
2150 N. Arrowhead Avenue
San Bernardino, CA 92405

Re: PEIR for the Chino Basin Watermaster's OBMP
Potential Projects Requiring Evaluation

Dear Mr. Dodson:

In addition to the subject matter of the Conservation District's letter dated December 8, 1999, the Conservation District is hereby submits the following list of potential projects and activities that it believes should be discussed under the PEIR.

1. The environmental consequences associated with the construction and operation of new diversion works along the San Antonio Channel for the purpose of diverting, and ultimately recharging, imported water to and within the Brooks Street Basin, Montclair Basins #3 and 4, and the College Heights and Upland Basins.
2. The environmental consequences associated with the excavation, shaping and reconfiguring of the College Heights and Upland Basins to enhance their usefulness for recharge purposes.

Sincerely yours,

Barrett Kehl

Barrett Kehl,
General Manager

Cc: Board of Directors
Watermaster

4594 San Bernardino Street
P.O. Box 2400
Montclair, CA 91763-0900
(909) 626-2711
FAX (909) 626-5974

GE Corporate
Environmental Programs

David W. Thompson
Manager, Mid-Atlantic/Southeast Region
Environmental Remediation Program

General Electric Company
640 Freedom Business Center
King of Prussia, PA 19406
610 992-7890, Dial Comm 8*366-7890
Fx 610 992-7898

December 8, 1999
Project 1796.001 AT

Mr. Neil W. Clifton
Manager of Engineering
Energy and Water Resources
Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335

Subject: Comments on Notice of Preparation
Environmental Impact Report
Optimum Basin Management Program for the Chino Basin

Dear Mr. Clifton:

This letter sets forth General Electric's (GE's) response to the Inland Empire Utility Agency's (IEUA's) Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin.

GE is implementing a long-term groundwater cleanup program in Ontario, in the northwest of the Basin. The objective of the program, which started in 1987, is to contain and treat a zone of groundwater approximately 1.5 miles long by 0.5 miles wide, which contains the chemicals TCE and chromium at concentrations above drinking water standards. GE is conducting this work with the approval of the Regional Water Quality Control Board, Santa Ana Region.

GE pumps the affected groundwater, treats it to remove the chemicals in an environmentally safe manner, and then restores the beneficial use of the water to the Basin by recharging it into the Basin's aquifers. Our extraction and recharge operation is coordinated to maximize our ability to prevent the spread of the affected groundwater beyond our containment well. We have made large investments in physical facilities and operation and maintenance, and expect to make further such investments in the future, such that chemically impaired groundwater is contained and the Basin is protected.

We believe the EIR scope should include consideration of beneficial projects such as ours and potential impacts to these projects that could occur as a result of implementation of the OBMP. We are concerned that changes in recharge or extraction patterns in the Basin

could change groundwater flow patterns and could cause negative impacts on cleanup projects such as loss of containment of the affected groundwater in the Basin. Therefore, we request that the scope of IEUA's EIR be expanded to include an analysis of the potential for projects contemplated by the OBMP to adversely impact the ability to contain affected groundwater, and the potential impacts associated with loss of containment. We request that particular attention be paid to the potential impacts of proposals for increased pumping and recharge as well as shifts in the location of pumping and recharge.

If your analysis should show that the Basin could suffer adverse impacts from projects contemplated by the OBMP then we request that the EIR present potential mitigation measures.

We offer our full cooperation in the preparation of the EIR. Please do not hesitate to call Mark Gage of Geomatrix Consultants on 510-663-4202 with any questions regarding our project.

Sincerely,

David W. Thompson
Manager, Environmental Remediation Programs

DWT\rji

cc: Mark Gage, Geomatrix Consultants

FONTANA WATER COMPANY
A DIVISION OF SAN GABRIEL VALLEY WATER COMPANY
8440 NUEVO AVENUE • P.O. BOX 987, FONTANA, CALIFORNIA 92334 • (909) 822-2201

December 2, 1999

Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana, California 92335

DEC 6 1999

Attention: Mr. Neil W. Clifton
Manager of Engineering
Energy and Water Resources

Subject: Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin

Gentlemen:

This refers to the Notice of Preparation of a Program Environmental Impact Report to address Implementation of the Optimum Basin Management Program for the Chino Basin. The Notice, dated November 9, 1999, was received by Fontana Water Company on November 15, 1999. The purpose of this letter is to provide general comments for the Program EIR. However, until specific implementation activities associated with the OBMP are identified in detail, the company reserves the right to provide additional comments as specific OBMP activities occur.

Fontana Water Company, a public utility regulated by the California Public Utilities Commission, serves a population of over 120,000 in portions of the cities of Fontana, Rialto, Rancho Cucamonga, and unincorporated parts of San Bernardino County. Fontana Water Company owns and operates 17 domestic water supply wells within the Chino Basin boundary.

The EIR must fully address the potential adverse water quality and quantity impacts that may result with implementation of any of the OBMP proposed activities. It must be demonstrated that OBMP implementation will not in any way directly or indirectly limit, prohibit, curtail or otherwise affect the continued use of our existing wells, nor our ability to drill and pump new wells as needed within the company's service area.

The EIR should also examine the need for abatement of sources of groundwater contamination, such as ongoing cattle and dairy operations. For example, Program Element 6 generally refers to developing and implementing cooperative programs with the Regional Water Quality Control Board. But that element lacks definition – namely, the effects of seeking cease and desist and cleanup and abatement orders to stop groundwater contamination and further salt loading of the basin from the dairy operations. It is axiomatic that any discussion of constructing and operating de-salting treatment facilities must also include a serious examination of what can be done to greatly reduce or eliminate further salt-loading activities of the ongoing dairy operations.

The foregoing comments are provided to assist the Inland Empire Utilities Agency in preparing the Program Environmental Impact Report for implementation of the Chino Basin Optimum Basin Management Program. So that we may remain informed about the progress of the program, the Draft EIR and the final EIR and related information and materials should be sent to me at the following address:

Fontana Water Company
Attention: Mr. Michael J. McGraw, Manager
8440 Nuevo Avenue
Post Office Box 987
Fontana, California 92334

If you have any question or need additional information, please call me.

Very truly yours,

Michael J. McGraw
Manager

MJM:bl

SOUTHERN CALIFORNIA

ASSOCIATION of GOVERNMENTS

**Main Office**

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**Riverside County:** James Venable, Riverside County • Dick Kelly, Palm Desert • Charles White, Moreno Valley • Ben Lowenidge, Riverside • Andrea Puga, Corona • Ron Roberts, Temecula

**San Bernardino County:** Kathy Davis, San Bernardino County • Bill Alexander, Rancho Cucamonga • Jim Bagley, Twentynine Palms • David Eshleman, Fontana • Lee Ann Garcia, Grand Terrace • Gwenn Norton-Perry, Chino Hills • Ray Rucker, Highland

**Ventura County:** Judy Mikels, Ventura County • Donna De Paola, San Buenaventura • Andrew Fox, Thousand Oaks • Tom Young, Port Hueneme

**Riverside County Transportation Commission:** Robin Lowe, Hemet

**Ventura County Transportation Commission:** Bill Davis, Simi Valley

Printed on Recycled Paper 559-10/29/99

December 6, 1999

DEC 8 1999

Mr. Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335

RE: **Comments on the Notice of Preparation for the Draft Program Environmental Impact Report to address the Implementation of the Optimum Basin Management Program for the Chino Basin - SCAG No. I 19990539**

Dear Mr. Clifton:

Thank you for submitting the **Notice of Preparation for the Draft Program Environmental Impact Report to address the Implementation of the Optimum Basin Management Program for the Chino Basin** to SCAG for review and comment. As areawide clearinghouse for regionally significant projects, SCAG assists cities, counties and other agencies in reviewing projects and plans for consistency with regional plans.

In addition, The California Environmental Quality Act requires that EIRs discuss any inconsistencies between the proposed project and the applicable general plans and regional plans (Section 15125 [d]). If there are inconsistencies, an explanation and rationalization for such inconsistencies should be provided.

Policies of SCAG's Regional Comprehensive Plan and Guide, which may be applicable to your project, are outlined in the attachment. **We expect the Draft EIR to specifically cite the appropriate SCAG policies and address the manner in which the Project is consistent with applicable core policies or supportive of applicable ancillary policies. Please use our policy numbers to refer to them in your DEIR. Also, we would encourage you to use a side-by-side comparison of SCAG policies with a discussion of the consistent or support of the policy with the Proposed Project.**

Please provide a minimum of 45 days for SCAG to review the DEIR when this document is available. If you have any questions regarding the attached comments, please contact Jeffrey Smith, Senior Planner at (213) 236-1867. Thank you.

Sincerely,

J. DAVID STEIN
Manager, Performance Assessment and Implementation

**COMMENTS ON THE PROPOSAL
TO DEVELOP A
DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT
TO ADDRESS THE IMPLEMENTATION OF THE
OPTIMUM BASIN MANAGEMENT PROGRAM
FOR THE
CHINO BASIN
SCAG NO. I 19990539**

## PROJECT DESCRIPTION

An Optimum Basin Management Program (OBMP) has been developed pursuant to a judgement entered in the Superior Court of the State of California in February 1999. The overseeing body for the guidance in the development and implementation of the OBMP is the Chino Basin Watermaster. The OBMP will consist of two phases. Phase One, consists of defining the state of the Chino Groundwater Basin, establishing goals concerning major issues by stake holders, and affirming a management plan for the achievement of said goals. Phase Two, outlines the methodological details for the development of each program element. The Project proposes to evaluate the implementation of the Optimum Basin Management Program for the Chino Groundwater Basin.

## CONSISTENCY WITH REGIONAL COMPREHENSIVE PLAN AND GUIDE POLICIES

### Growth Management

The **Growth Management Chapter (GMC)** of the Regional Comprehensive Plan and Guide (RCPG) contains the following policies that are particularly applicable and should be addressed in the Draft EIR for the Project.

3.01 *The population, housing, and jobs forecasts, which are adopted by SCAG's Regional Council and that reflect local plans and policies, shall be used by SCAG in all phases of implementation and review*

Regional Growth Forecasts

The Draft Program EIR should reflect the most current SCAG forecasts which are the 1998 RTP (April 1998) Population, Household and Employment forecasts for the San Bernardino Associated Governments (SANBAG) subregion and Unincorporated San Bernardino County. These forecasts follow:

| SANBAG Subregion Forecasts | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Population | 1,772,700 | 2,005,400 | 2,239,600 | 2,512,800 | 2,829,800 |
| Households | 565,000 | 639,200 | 716,800 | 805,700 | 904,900 |
| Employment | 617,000 | 734,800 | 860,700 | 983,400 | 1,103,600 |

| Unincorporated San Bernardino County (SANBAG) Forecasts | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|
| Population | 424,500 | 522,200 | 623,200 | 735,600 | 874,900 |
| Households | 136,300 | 167,200 | 199,500 | 233,500 | 275,100 |
| Employment | 70,200 | 92,500 | 116,400 | 140,100 | 161,300 |

*3.03 The timing, financing, and location of public facilities, utility systems, and transportation systems shall be used by SCAG to implement the region's growth policies.*

## GMC Policies Related To The RCPG Goal To Improve The Regional Standard Of Living

The Growth Management goals to develop urban forms that enable individuals to spend less income on housing cost, that minimize public and private development costs, and that enable firms to be more competitive, strengthen the regional strategic goal to stimulate the regional economy. The evaluation of the proposed project in relation to the following policies would be intended to guide efforts toward achievement of such goals and does not infer regional interference with local land use powers.

*3.04 Encourage local jurisdictions' efforts to achieve a balance between the types of jobs they seek to attract and housing prices.*

*3.05 Encourage patterns of urban development and land use which reduce costs on infrastructure construction and make better use of existing facilities.*

*3.08 Encourage subregions to define an economic strategy to maintain the economic vitality of the subregion, including the development and use of marketing programs, and other economic incentives, which support attainment of subregional goals and policies.*

*3.09 Support local jurisdictions' efforts to minimize the cost of infrastructure and public service delivery, and efforts to seek new sources of funding for development and the provision of services.*

*3.10 Support local jurisdictions' actions to minimize red tape and expedite the permitting process to maintain economic vitality and competitiveness.*

## GMC Policies Related To The RCPG Goal To Improve The Regional Quality Of Life

The Growth Management goals to attain mobility and clean air goals and to develop urban forms that enhance quality of life, that accommodate a diversity of life styles, that preserve open space and natural resources, and that are aesthetically pleasing and preserve the character of communities, enhance the regional strategic goal of maintaining the regional quality of life. The evaluation of the proposed project in relation to the following policies would be intended to provide direction for plan implementation, and does not allude to regional mandates.

*3.11 Support provisions and incentives created by local jurisdictions to attract housing growth in job rich subregions and job growth in housing rich subregions.*

*3.12 Encourage existing or proposed local jurisdictions' programs aimed at designing land uses which encourage the use of transit and thus reduce the need for roadway expansion, reduce the number of auto trips and vehicle miles traveled, and create opportunities for residents to walk and bike.*

*3.13 Encourage local jurisdictions' plans that maximize the use of existing urbanized areas accessible to transit through infill and redevelopment.*

*3.14 Support local plans to increase density of future development located at strategic points along the regional commuter rail, transit systems, and activity centers.*

*3.15 Support local jurisdictions strategies to establish mixed-use clusters and other transit-oriented developments around transit stations and along transit corridors.*

*3.16 Encourage developments in and around activity centers, transportation corridors, underutilized infrastructure systems, and areas needing recycling and redevelopment.*

*3.17 Support and encourage settlement patterns which contain a range of urban densities.*

*3.18 Encourage planned development in locations least likely to cause environmental impact.*

*3.20 Support the protection of vital resources such as wetlands, groundwater recharge areas, woodlands, production lands, and land containing unique and endangered plants and animals.*

*3.21 Encourage the implementation of measures aimed at the preservation and protection of recorded and unrecorded cultural resources and archaeological sites.*

*3.22 Discourage development, or encourage the use of special design requirements, in areas with steep slopes, high fire, flood, and seismic hazards.*

*3.23 Encourage mitigation measures that reduce noise in certain locations, measures aimed at preservation of biological and ecological resources ,measures that would reduce exposure to seismic hazards, minimize earthquake damage, and to develop emergency response and recovery plans.*

**GMC Policies Related To The RCPG Goal To Provide Social, Political, and Cultural Equity**

The Growth Management Goal to develop urban forms that avoid economic and social polarization promotes the regional strategic goal of minimizing social and geographic disparities and of reaching equity among all segments of society. The evaluation of the proposed project in relation to the policy stated below is intended guide direction for the accomplishment of this goal, and does not infer regional mandates and interference with local land use powers.

*3.24 Encourage efforts of local jurisdictions in the implementation of programs that increase the supply and quality of housing and provide affordable housing as evaluated in the Regional Housing Needs Assessment.*

*3.25 Encourage the efforts of local jurisdictions, employers and service agencies to provide adequate training and retraining of workers, and prepare the labor force to meet the challenges of the regional economy.*

*3.26 Encourage employment development in job-poor localities through support of labor force retraining programs and other economic development measures.*

*3.27 Support local jurisdictions and other service providers in their efforts to develop*

*sustainable communities and provide, equally to all members of society, accessible and effective services such as: public education, housing, health care, social services, recreational facilities, law enforcement, and fire protection.*

**Air Quality Chapter Core Actions**

The **Air Quality Chapter** core actions related to the proposed project includes:

*5.07 Determine specific programs and associated actions needed (e.g., indirect source rules, enhanced use of telecommunications, provision of community based shuttle services, provision of demand management based programs, or vehicle-miles-traveled/emission fees) so that options to command and control regulations can be assessed.*

*5.11 Through the environmental document review process, ensure that plans at all levels of government (regional, air basin, county, subregional and local) consider air quality, land use, transportation and economic relationships to ensure consistency and minimize conflicts.*

**Water Quality Chapter Recommendations and Policy Options**

The **Water Quality Chapter** core recommendations and policy options relate to the two water quality goals: to restore and maintain the chemical, physical and biological integrity of the nation's water; and, to achieve and maintain water quality objectives that are necessary to protect all beneficial uses of all waters.

*11.02 Encourage "watershed management" programs and strategies, recognizing the primary role of local governments in such efforts.*

*11.03 Coordinate watershed management planning at the subregional level by (1) providing consistent regional data; (2) serving as a liaison between affected local, state, and federal watershed management agencies; and (3) ensuring that watershed planning is consistent with other planning objectives (e.g., transportation, air quality, water supply).*

*11.05 Support regional efforts to identify and cooperatively plan for wetlands to facilitate both sustaining the amount and quality of wetlands in the region and expediting the process for obtaining wetlands permits.*

*11.06 Clean up the contamination in the region's major groundwater aquifers since its water supply is critical to the long-term economic and environmental health of the*

*region. The financing of such clean-ups should leverage state and federal resources and minimize significant impacts on the local economy.*

*11.07 Encourage water reclamation throughout the region where it is cost-effective, feasible, and appropriate to reduce reliance on imported water and wastewater discharges. Current administrative impediments to increased use of wastewater should be addressed.*

**Open Space Chapter Ancillary Goals**

Outdoor Recreation

*9.01 Provide adequate land resources to meet the outdoor recreation needs of the present and future residents in the region and to promote tourism in the region.*

*9.02 Increase the accessibility to open space lands for outdoor recreation.*

*9.03 Promote self-sustaining regional recreation resources and facilities.*

Public Health and Safety

*9.04 Maintain open space for adequate protection of lives and properties against natural and man-made hazards.*

*9.05 Minimize potentially hazardous developments in hillsides, canyons, areas susceptible to flooding, earthquakes, wildfire and other known hazards, and areas with limited access for emergency equipment.*

*9.06 Minimize public expenditure for infrastructure and facilities to support urban type uses in areas where public health and safety could not be guaranteed.*

Resource Production

*9.07 Maintain adequate viable resource production lands, particularly lands devoted to commercial agriculture and mining operations.*

Resource Protection

*9.08 Develop well-managed viable ecosystems or known habitats of rare, threatened and endangered species, including wetlands.*

## Conclusions

All feasible measures needed to mitigate any potentially negative regional impacts associated with the proposed project should be implemented and monitored, as required by CEQA.

EUNICE M. ULLOA
Mayor

BRUCE ROBBINS
Mayor Pro Tem

# CITY of CHINO

GLENN DUNCAN
EARL C. ELROD
DENNIS YATES
Council Members

GLEN ROJAS
City Manager

December 16, 1999

Mr. Neil W. Clifton
Inland Empire Utilities Agency
P. O. Box 697
Rancho Cucamonga, CA 91729-0697

Subject: Optimum Basin Management Program – Notice of Preparation

Dear Mr. Clifton:

We have reviewed the Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program (OBMP) for the Chino Basin, dated November 9, 1999, and have the following comments describing contemplated City projects and requested additions to the scope and content:

Scope of the Environmental Review

1. The scope of the described environmental review should include adoption of the Optimum Basin Management Program by including, but not limited to, the Chino Basin Watermaster and any party to the Chino Basin Judgement.

2. The scope of the environmental review should include adoption of Memorandums of Agreement defining the actions necessary to achieve the goals of the Optimum Basin Management Program, and potential Joint Powers Agreements by including, but not limited to, the Chino Basin Watermaster and parties to the Chino Basin Judgement.

3. The scope of the environmental review should include consideration of the general plans and master facilities plans of the agencies located in the Chino Basin, and address the compatibility of these plans with the Optimum Basin Management Program.

4. The City is concerned that potential Optimum Basin Management Program projects and facilities that may be located within the City would occupy acreage that might otherwise be available for other City development. The impacts of this, including, but not limited to economic impact, should be included in the environmental review.

13220 Central Avenue, Chino, California 91710
Mailing Address: P.O. Box 667, Chino, California 91708-0667
(909) 627-7577 • (909) 591-6829 Fax

City Projects and Activities

5. The types of activities/projects contemplated by the City that may fall under the umbrella of the Optimum Basin Management Program are as follows:

   A. Groundwater production and elevation monitoring

   B. Groundwater quality monitoring

   C. Groundwater production well construction

   D. Construction of a treatment facility to remove nitrate from groundwater

   E. Construction of injection well facilities or modification of existing groundwater production well facilities for injection of water to the underlying groundwater basin (part of a conjunctive use program)

   F. Construction of recycled water distribution facilities and direct beneficial use of recycled water

   G. Recharge of recycled water (part of a regional program)

   H. Land subsidence investigations and data collection

   I. Chino Desalter retail water agency

We request that the subjects/projects/activities described in our comments above be included in the program environmental impact review for the Chino Basin Optimum Basin Management Program.

We appreciate the opportunity to review the Notice of Preparation and provide comments, and request that we receive a copy of the draft Program Environmental Impact Report document when it is available for review and comment.

We welcome the opportunity to meet with you or your consultants to discuss our plans in greater detail. Should you have any questions regarding our comments, please contact me at (909) 591-9823.

Sincerely,

DAVID G. CROSLEY, P.E.
Water & Environmental Manager

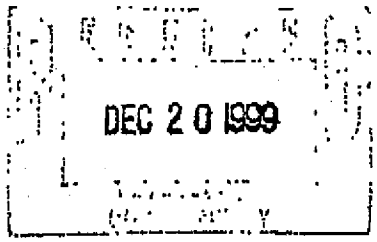
cc: Traci Stewart, Chino Basin Watermaster
Tom Dodson, Tom Dodson & Associates

THE CITY OF
# POMONA

Department of Economic Development
William I. Bopf
Director

Planning Division

Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana, CA 92335




December 17, 1999

**Subject: Notice of Preparation for Optimum Basin Management Program for the Chino Basin**

Dear Mr. Clifton:

Thank you for inviting the City of Pomona to comment on the Notice of Preparation for the above referenced project. We have reviewed the Notice of Preparation and have the following comments:

- The following issues were listed within the NOP as having the most potential to create significant impacts:
  - Geologic impacts relating to subsidence or liquefaction
  - Biological impacts
  - Impacts from recycling reclaimed water to groundwater quality
  - Construction of new facilities impacts to existing land uses
  - Increased flood hazards from percolation of storm water and recycled water
  - Increased exposure of people to hazardous waste from the treatment of degraded water
  - Air quality impacts from construction to surrounding neighborhoods within Pomona
  - Noise impacts from construction to surrounding neighborhoods within Pomona
  - Cultural impacts from ground disturbance relating to installation of new facilities

  Please include specific information and analysis within the DEIR on how the City of Pomona will be affected by these potentially significant impacts.

- The City of Pomona's drinking water is provided by underground water supplies within the City. Please evaluate within the DIER how the

City's water quality and supply will be impacted by the implementation of OBMP for the Chino Basin.

- Include information on proposed mitigation measures for those issues that have the potential to cause significant impacts to the City of Pomona.

Thank you again for allowing us to comment on the NOP for the proposed project. We look forward to reviewing the DEIR. If you need further information or have questions regarding the above comments, I can be reached at 909 620-2435.

Sincerely,

Sandra Campbell

Sandra Campbell
Assistant Planner

Cc: CN, file

\\CITY_HALL\scampbell$\Chino Basin EIR.doc

*BILL LOCKYER*
*Attorney General*

*State of California*
*DEPARTMENT OF JUSTICE*

RONALD REAGAN BUILDING
300 SOUTH SPRING STREET, SUITE 5212
LOS ANGELES, CA 90013
Public: (213) 897-2000

Facsimile: (213) 897-2802
(213) 897-2612

December 16, 1999

Neil Clifton
INLAND EMPIRE UTILITIES AGENCY
Post Office Box 698
Rancho Cucamonga, California 91729-0697

RE: Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin

Dear Mr. Clifton :

The following comments are provided in response to the above-referenced Notice of Preparation dated November 9, 1999, on behalf of the State of California and its departments or agencies that own land and/or produce groundwater in the Chino Basin. The State of California is a member of the Agricultural Pool as defined in the 1978 Chino Basin Judgment. It is my understanding that receipt of comments has been extended to December 17, 1999. Individual state agencies and departments may be submitting separate comment letters.

## DESCRIPTION OF STATE OF CALIFORNIA INTERESTS

The California Department of Corrections owns approximately 2600 acres in the Southern portion of the Chino Basin. Three correctional facilities operate on the State held property in the Basin. These facilities are the California Institution for Men(CIM), the California Institution for Women (CIW), and the Herman G. Stark Youth Training School (YTS). Among the other facilities on the CIM site is the Prison Industries dairy (PIA) that utilizes significant acreage for agricultural operations.

The California Institution for Men has nine (9) agricultural wells - (8 active) , four (4) domestic water wells, and a sewage treatment plant that provides secondary treatment to the wastewater effluent for its Minimum Support Facility, Reception Center Central and its Reception Center West facility. The CIM Reception Center East and the YTS are connected to the City of Chino's Wastewater System. CIW has four (4) inactive wells and one (1) active well and discharges its waste to the Santa Ana Regional Interceptor line to Orange County. There are plans to drill two additional domestic wells south of the Central facility and reduce pumping from two other domestic wells. These changes are being implemented to address a localized PCE contamination problem at the CIM site and, we believe, may have a positive effect on the subsidence issue.

The Department of Corrections is constructing an Ion Exchange Treatment Plant east of the

water storage reservoir on the site to address water quality problems among the three correctional facilities, including nitrates and total dissolved solids. The plant will provide domestic water treatment to soften water, lower the TDS to comply with sewage treatment plant effluent discharge requirements, will lower nitrate levels and will include a Granular Activated Carbon component for PCE and TCE removal. The plant will produce brine waste to be discharged into the SARI line.

The State of California, Department of General Services, has initiated a study of the CIM Waste Water Treatment System to determine whether the treatment plant should be expanded to accept additional sewage flows from the CIM East facility and the Youth Training School and whether tertiary treatment should be considered so that CIM's recycled water can be utilized for additional non-potable uses.

In addition to the Department of Corrections activities, the California Department of Transportation purchases its water from municipal entities instead of pumping groundwater and the California Department of Fish and Game previously utilized one well on its property. The Department of Fish and Game has filed separate comments dated December 14, 1999. The State of California, on behalf of the Department of Toxic Substances Control, presently owns the land identified as the Stringfellow superfund site and is involved in a major cleanup of the area.

**PROGRAM EIR**

The Program EIR should specifically identify the State of California and its agencies and departments owning land and producing water from the Chino Basin. The EIR should include identification of potential beneficial projects identified by the state and potential impacts to these projects, including adverse water quality and quantity impacts. The EIR should additionally address the impact of the proposed projects on the continued use of the State's existing wells and its ability to drill new wells in the vicinity of its land. Specifically, the State is interested in a discussion of the impact of the proposed wellfields and the water supply projects proposed in the Draft Water Supply Facilities Report dated November 9, 1999 on the State's wells and the surrounding groundwater.

The Program EIR should address the impact of the OBMP proposals for recharge (storm water, supplemental water, recycled water), extraction, development of new sources of supplemental water, direct use of recycled water, treatment and use of degraded groundwater, reduction of groundwater outflow, conjunctive use, basin yield maintenance , and all the additional goals identified in the Notice of Preparation, including the Program Elements 1 through 9.

The State encourages you to review prior environmental documents prepared for the Chino Basin Groundwater Storage Program by the Metropolitan Water District in 1988. Some of the concerns identified in that document may need to be revisited, including raised elevations of ground water

and increased degradation of water quality, especially in the lower portions of Chino Basin where the State of California is mainly situated.

Lastly, the EIR should address the impacts and mitigation for issues identified in the November 9th Notice of Preparation, including geologic problems, biological resource impacts, impacts from creation and expansion of water-related facilities, impact of recycling reclaimed water from increased levels of TDS and increased impairment of groundwater quality, disposal from desalting and treatment facilities, use of flood control basins for percolation of storm water and recycled water, treatment of degraded water, air quality impacts, visual, noise and cultural resource impacts by construction of program element facilities. Thank you for this opportunity to comment. The State reserves its right to submit additional comments following a more specific description of the projects to be implemented in the Program EIR.

Sincerely,

MARILYN H. LEVIN
Deputy Attorney General

For BILL LOCKYER
Attorney General

MHL:dm

LAW OFFICES OF
SUSAN M. TRAGER
A PROFESSIONAL CORPORATION
THE LANDMARK BUILDING
2100 S. E. MAIN STREET
SUITE 104
IRVINE, CALIFORNIA 92614

SUSAN M. TRAGER
MICHELE A. STAPLES

TELEPHONE
(949) 752-8071
TELECOPIER
(949) 863-0604
E-MAIL:
tragerlaw@earthlink.net

December 17, 1999

Mr. Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335

Re: Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for the Chino Basin

Dear Mr. Clifton:

We represent the Chino Land and Water Company, and have received notice of the preparation of a Program Environmental Impact Report on the Chino Basin Watermaster's Optimum Basin Management Program for the Chino Basin.

Implementation of such a program is long overdue. Chino Land and Water Company would be pleased to provide whatever information is requested.

Please forward all communications to this address.

Sincerely,

LAW OFFICES OF SUSAN M. TRAGER
A Professional Corporation

Susan M. Trager

SMT:my

cc: Mr. Jay Greening
Ms. Traci Stewart
Wayne Lemieux, Esq.

# CITY OF ONTARIO

303 EAST "B" STREET, CIVIC CENTER ONTARIO CALIFORNIA 91764-4196 (909) 986-1151
FAX (909) 391-2567

GARY C. OVITT
MAYOR

ALAN D. WAPNER
MAYOR PRO TEM

GERALD A. DuBOIS
PATRICK J. KING
PAUL E. LEON
COUNCIL MEMBERS

GREGORY C. DEVEREAUX
CITY MANAGER

MARY E. WIRTES, CMC/AAE
CITY CLERK

JAMES R. MILHISER
TREASURER

December 15, 1999

Mr. Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana, CA 92335

**RE: Notice of Preparation of a Program EIR to Address Implementation of the Optimum Basin Management Program for the Chino Basin**

Dear Mr. Clifton:

Thank you for giving us the opportunity to review the Notice of Preparation of a Program EIR to Address Implementation of the Optimum Basin Management Program for the Chino Basin. We have reviewed the project and have the following comments regarding this project.

On November 30, 1999, the City of Ontario annexed 8,200 acres of the former San Bernardino County Agricultural Preserve. The City currently has an approved General Plan for the area that will allow the development of non-agricultural uses. The EIR should address the impacts of involved with urban uses such as water run-off that is allowed in the General Plan, and the impacts associated with the anticipated population of 101,000 and their use of services and utilities such as water.

We look forward to reviewing the Program EIR to Address Implementation of the Optimum Basin Management Program for the Chino Basin. Should you have any question please call me at (909) 319-2506.

Sincerely,

ONTARIO PLANNING DEPARTMENT
Jerry L. Blum, City Planner

James A. Ragsdale

James A. Ragsdale, AICP
Principal Planner

JR:GS

THE CITY OF

# RANCHO CUCAMONGA

December 15, 1999

DEC 17 1999

Neil W. Clifton, Manager of Engineering
Inland Empire Utilities Agency
P.O. Box 697
Rancho Cucamonga, CA 91729

RE: NOTICE OF PREPARATION (NOP) OF A PROGRAM ENVIRONMENTAL IMPACT REPORT TO ADDRESS IMPLEMENTATION OF THE OPTIMUM BASIN MANAGEMENT PROGRAM FOR THE CHINO BASIN.

Dear Mr. Clifton,

Thank you for the opportunity to comment on the subject NOP. We have no comments at this time but request to remain on your mailing list regarding this matter. Also, we request to receive a copy of the Draft Environmental Impact Report when it becomes available for public review.

Once again, thank you for the notification.

COMMUNITY DEVELOPMENT DEPARTMENT
PLANNING DIVISION

Sincerely,

Brad Buller
City Planner

BB:AW\ma

Mayor William J. Alexander
Mayor Pro-Tem Diane Williams
Jack Lam, AICP City Manager

Councilmember Paul Biane
Councilmember Bob Dutton
Councilmember James V. Curatalo

10500 Civic Center Drive • P.O. Box 807 • Rancho Cucamonga, CA 91729 • (909) 477-2700 • FAX (909) 477-2849

JOHN J. SCHATZ
ATTORNEY AT LAW
P.O. BOX 7775
LAGUNA NIGUEL, CA. 92607-7775
(949) 495-3175

December 13, 1999

Neil W. Clifton
Manager of Engineering
Energy and Water Resources
Inland Empire Utilities Agency
P.O. Box 697
Rancho Cucamonga, Ca. 91729

VIA FACSIMILE

*RE: JURUPA COMMUNITY SERVICES DISTRICT'S COMMENTS CONCERNING NOTICE OF PREPARATION OF PROGRAM ENVIRONMENTAL IMPACT REPORT TO ADDRESS IMPLEMENTATION OF THE OPTIMUM BASIN MANAGEMENT PROGRAM FOR THE CHINO BASIN*

Dear Mr. Clifton:

Jurupa Community Services District provides the following comments in connection with the above captioned matter.

1. In evaluating any environmental impacts associated with recycling reclaimed water, which among other things may increase levels of Total Dissolved Solids (TDS) and adversely impact groundwater quality in the Basin, any impacts should be determined on both a specific (local) and mass-balance (regional) basis. This will provide information necessary in order to consider decisions which may be made in connection with the implementation of the OBMP that may otherwise be based on overall Basin benefits which may nonetheless result in or contribute to the degradation of individual supplies.

2. Impacts should be specifically determined for individual agency wells, with the benchmark for such determinations being historical and current salt/nitrogen concentration levels for those wells in conjunction with Regional Water Quality Control Board Subbasin discharge criteria.

3. Any cumulative TDS increases associated with recycled water recharge that may occur through the implementation of the OBMP, however mitigated through increased stormwater recharge or other means, should be determined on the basis of total volume of salts added to the Basin rather than solely in the context of the combination of mitigation and recycled water.

JOHN J. SCHATZ
ATTORNEY AT LAW

4. Determination should be made with respect to whether groundwater quality mitigation, including increased stormwater recharge and/or the location of high-quality water recharge, should presently be occurring to mitigate for existing groundwater quality conditions rather than as mitigation for additional TDS loading associated with recycled water recharge. Accompanying the determination should be an evaluation of the appropriate allocation of TDS mitigation credit, particularly considering whether such mitigation is for existing Basin water quality conditions or for additional salt loading associated with recycled water recharge.

5. To the extent this item will be addressed within the EIR, evaluation should occur with respect to overall Basin benefits derived from the implementation of OBMP projects which may negatively impact existing water supplies if such impact can be effectively mitigated on a long-term basis. Such mitigation costs should be compared against existing water supply costs and comparable alternative supplies.

Thank you for your consideration of the foregoing comments. Please contact me if clarification or discussion is desired.

Sincerely,

John J. Schatz

John J. Schatz
for: Jurupa Community Services District

JJS:bam

CCWD

Cucamonga County Water District
9641 San Bernardino Road
Rancho Cucamonga, CA 91729-0638
P.O. BOX 638 • (909) 987-2591 • FAX (909) 941-8069

ROBERT A. DeLOACH
*Secretary / General Manager*

RECEIVED
NOV 22 1999

November 17, 1999

Neil W. Clifton
INLAND EMPIRE UTILITIES AGENCY
P.O. Box 697
Rancho Cucamonga, CA 91729-0697

*Subject: Notice of Proposal – Program Environmental Impact Report for Optimum Basin Management Plan*

Dear Mr. Clifton:

I have received the Notice of Preparation ("NOP") for the subject Environmental Impact Report ("EIR"). I look forward to participating in this process.

Cucamonga County Water District is very is very supportive of IEUA acting as the lead agency in this process, and offer our assistance where required. We are concerned with the comment period specified on the first page, which is limited to 30 days upon receipt of the notice. Due to circumstances beyond our control (specifically the availability of certain key personnel who will be required to review the NOP) I would respectfully request that we be allowed to extend the comment period to January 10, 2000. It is essential that we be allowed the opportunity to respond in a thorough manner.

Please contact me so that we can discuss this in more detail.

Respectfully,

Robert A. DeLoach
General Manager

cc: Best Best & Krieger (G. Tanaka)

CERTIFIED # Z402 369 473

ROBERT NEUFELD, *President*
GEORGE A. KUYKENDALL, *Vice President*
JEROME M. WILSON, *Director*
DONALD J. KURTH, *Director*
HENRY L. STOY, *Director*

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ROBERT A. DeLOACH
*Secretary / General Manager*

December 13, 1999

Ms. Tami Fincher
TOM DODSON & ASSOCIATES
2150 N. Arrowhead Ave.
San Bernardino, Ca. 92405

*Subject: OBMP Projects*

Dear Ms. Fincher:

The Cucamonga County Water District herein responds to the noticed dated December 1, 1999, requesting preliminary information on future OBMP related projects. Under the current Phase I report, our District would envision a variety of capital projects that would specifically be constructed as a part of our long-term plans. These projects are generally described below:

* Construction of transmission lines to distribute potable and recycled water across and through our jurisdiction to other agencies;

* Expansion of our Lloyd Michael Water Treatment Plant from 45 mgd to 90 mgd;

* Conversion of our treatment facilities from conventional treatment to either 'enhanced coagulation' or ozone;

* Construction of distribution pipelines for both potable and recycled water;

* Acquisition of property to construct additional storage facilities;

* Construction of additional storage facilities for both potable and recycled water;

* Development and construction of raw water/recycled water spreading facilities (including DHS approval);

* Construction of DHS approved blending stations and treatment facilities for nitrate & TDS mitigation;

ROBERT NEUFELD *President* | GEORGE A. KUYKENDALL *Vice President* | JEROME M. WILSON *Director* | DONALD J. KURTH *Director* | HENRY L. STOY *Director*

* Construction of booster stations to facilitate transfer of potable and recycled water to higher elevations and across existing facilities;

* Construction of additional groundwater production wells;

* Development and construction of well manifold system to pump groundwater in and through MWD transmission lines; and

* Development and construction of a connection to existing MWD transmission facilities.

These projects represent a broad scope of action or implementation plan for our District resulting from the OBMP. I hope that the program EIR would be flexible enough to contemplate these and other projects. If you need additional information, please call me at your convenience.

Respectfully,

Robert A. DeLoach

cc: Best Best & Krieger

RAD:bt

STATE OF CALIFORNIA - THE RESOURCES AGENCY GRAY DAVIS, Governor

DEPARTMENT OF FISH AND GAME
Eastern Sierra - Inland Deserts Region
4775 Bird Farm Road
Chino Hills, California 91709
(909) 393-0635

December 14, 1999

Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335

DEC 15 1999

Re: **Notice of Preparation of a Program Environmental Impact Report Optimum Basin Management Program for the Chino Basin 111299-1**

Dear Mr. Clifton:

The California Department of Fish and Game (Department) thanks you for the opportunity to comment on the proposed development. The stated purpose of the Optimum Basin Management Program (OBMP) is to develop a groundwater management program that enhances the safe yield and the water quality of the basin. The proposed project has several goals: 1) enhance Chino Basin groundwater supplies, 2) protect and enhance water quality, 3) enhance management of the Chino Groundwater Basin, and 4) equitably finance the OBMP. The project includes a set of nine program elements, whose implementation may cause physical changes in the environment and produce potential adverse impacts to the environment.

In connection with this project the Department will be acting as a Trustee agency for fish, plant and wildlife resources and as a Responsible Agency regarding impacts to endangered species and issuance of 1601-1603 Streambed Alteration Agreements. Obviously, this project has the potential to significantly impact riparian resources. The Department is concerned about the increasing appropriation of in-stream flows and loss of natural riparian systems through flood control and water recharge activities. In addition, the State of California has an official policy of no net loss of wetlands.

The Department is concerned that in the project description, goals, and key elements there is no mention of biological resources. Riparian areas contain a number of endangered species and species of special concern (birds, amphibians, reptiles and

plants). This project may require permits from the Army Corps of Engineers, United States Fish and Wildlife Service and the Regional Water Quality Control Board. The Department is asking the lead agency to consult with the Department concerning the plan.

Many of the activities proposed in this project will require 1601-1603 Lake and Streambed Alteration Agreements from the Department. In order to issue these agreements the Lead Agency shall have to provide: 1) specific and detailed project descriptions, 2) inventory of direct and indirect project impacts on riparian resources, 3) alternatives analysis focusing on biological resources, 4) cumulative impact analysis on area biological resources;5) mitigation measures to avoid or reduce impacts on existing riparian resources, and 6); mitigated measures to protect riparian resources. Mitigation for the loss of riparian resources generally is at a 3:1 ratio of in-kind resources.

The Department is advising the lead agency that all potential impacts to biological resources and sensitive habitat areas be analyzed in the DEIR document, along with specific measures and alternatives to avoid or mitigate for the loss of sensitive biological resources. A 1989 statute requires that public agencies adopt reporting or monitoring programs to ensure mitigation measures are implemented. In this connection, mitigation measures have to be specific, have to be capable of being implemented and must be capable of being monitored.

The Department has several suggestions for the preparation of the DEIR:

1. Document specific direct and indirect impacts on the number and kinds of species of concern;

2. Outline specific alternatives, mitigation measures or project changes to reduce the project impact on federally endangered and State of California listed species or species of concern;

3. Discuss how open space can be used to preserve on-site biological resources;

4. Discuss avoidance measures to reduce impacts on the riparian corridors and other sensitive habitat and plant and animal species;

5. Discuss acquisition of off-site riparian and other habitat at appropriate mitigation ratios;

6. Discuss how the project does or does not conform with the state policy of no net loss of wetlands;

7. Identify potential areas of open space which might be beneficial for habitat.

8. Differentiate between multi-purpose open space and open space for habitat purposes;

9. Identify alternatives and specific mitigation measures which were considered which would reduce the significant impacts on endangered species and state species of concern;

10. The area contains critical habitat for a number of endangered species and species of special concern. How does the removal of the natural habitat and species of concern affect the regional conservation process. In critical habitat areas the preferred method of mitigation is on-site preservation not off-site mitigation or payment of fees;

The Department is a Responsible Agency if a Streambed Alteration Agreement is required. This fact should be ascertained and specified in the EIR. As a responsible agency the Department must rely on the information and analysis provided in the CEQA document to base its regulatory decisions and legal responsibility under CEQA. The Department is often unable to do so because the DEIR defers this analysis to future negotiations with the USFWS and the Department. Under CEQA the lead agency has an obligation to determine the significant impacts of a project and measures to avoid or mitigate the loss of significant resources.

Finally, the proposed Draft Environmental Impact Report should assess any impacts the proposed circulation update may have on the formulation of the Western Riverside Multi-Species Habitat Conservation Plan.

The Department concurs that an environmental impact report for this project is warranted. The following sections of this letter detail the types and content of studies necessary to evaluate the biological resources which may be present on the project site. Section 15021 of the CEQA Guidelines states:

CEQA establishes a duty for public agencies to avoid or minimize environmental damage where feasible.

(1) In regulating public or private activities, agencies are required to give major consideration to preventing environmental damage.

(2) A public agency should not approve a project as proposed if there are feasible alternatives or mitigation measures available that would substantially lessen any significant effects that the project

would have on the environment.

This particular project has the potential to have significant environmental impacts on sensitive flora and fauna resources, including Federally listed endangered species. Therefore, critical aspects of the DEIR should include an alternatives analysis which focuses on environmental resources and in-kind mitigation measures for impacts identified as significant. To enable Department staff to adequately review and comment on the proposed project, we suggest that an intensive biological study be conducted prior to any environmental or discretionary approvals. The following information should be included in any focused biological report or supplemental environmental report:

1. A complete assessment of the flora and fauna within and adjacent to the project area, with particular emphasis upon identifying endangered, threatened, and locally unique species and sensitive habitats.

   a. A thorough assessment of rare plants and rare natural communities, following the Department's May 1984 Guidelines for Assessing Impacts to Rare Plants and Rare Natural Communities (Attachment 1).

   b. A complete assessment of sensitive fish, wildlife, reptile, and amphibian species. Seasonal variations in use of the project area should also be addressed. Focused species-specific surveys, conducted at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required. Acceptable species-specific survey procedures should be developed in consultation with the Department and the U.S. Fish and Wildlife Service.

   c. Rare, threatened, and endangered species to be addressed should include all those which meet the California Environmental Quality Act (CEQA) definition (See CEQA Guidelines, 15380)

   d. The Department's California Natural Diversity Data Base in Sacramento should be contacted at (916) 327-5960 to obtain current information on any previously reported sensitive species and habitat, including Significant Natural Areas identified under Chapter 12 of the Fish and Game Code.

2. A thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts.

a. CEQA Guidelines, 15125(a), direct that knowledge of the regional setting is critical to an assessment of environmental impacts and that special emphasis should be placed on resources that are rare or unique to the region.

b. Project impacts should be analyzed relative to their effects on off-site habitats. Specifically, this should include nearby public lands, open space, adjacent natural habitats, and riparian ecosystems. Impacts to and maintenance of wildlife corridor/movement areas, including access to undisturbed habitat in adjacent areas, should be fully evaluated and provided.

c. The zoning of areas for development projects or other uses that are nearby or adjacent to natural areas may inadvertently contribute to wildlife-human interactions. A discussion of possible conflicts and mitigation measures to reduce these conflicts should be included in the environmental document.

d. A cumulative effects analysis should be developed as described under CEQA Guidelines, 15130. General and specific plans, as well as past, present, and anticipated future projects, should be analyzed relative to their impacts on similar plant communities and wildlife habitats.

e. The document should include an analysis of the effect that the project may have on completion and implementation of regional and/or subregional conservation programs. Under 2800-2840 of the Fish and Game Code, the Department, through the Natural Communities Conservation Planning (NCCP) program is coordinating with local jurisdictions, landowners, and the Federal Government to preserve local and regional biological diversity. Coastal sage scrub is the first natural community to be planned for under the NCCP program. The Department recommends that the lead agency ensure that the development of this and other proposed projects does not preclude long-term preserve planning options and that projects conform with other requirements of the NCCP program. Jurisdictions participating in the NCCP should assess specific projects for consistency with the NCCP Conservation Guidelines.

3. A range of alternatives should be analyzed to ensure that alternatives to the proposed project are fully considered and evaluated. A range of alternatives which avoid or otherwise minimize impacts to sensitive biological resources should be included. Specific alternative locations should also be evaluated in areas with lower resource sensitivity where appropriate.

a. Mitigation measures for project impacts to sensitive plants, animals, and habitats should emphasize evaluation and selection of alternatives which avoid or otherwise minimize project impacts. Off-site compensation for unavoidable impacts through acquisition and protection of high-quality habitat elsewhere should be addressed.

b. The Department considers Rare Natural Communities as threatened habitats having both regional and local significance. Thus, these communities should be fully avoided and otherwise protected from project-related impacts (Attachment 2).

c. The Department generally does not support the use of relocation, salvage, and/or transplantation as mitigation for impacts to rare, threatened, or endangered species. Department studies have shown that these efforts are experimental in nature and largely unsuccessful.

4. A California Endangered Species Act (CESA) Permit must be obtained, if the project has the potential to result in "take" of species of plants or animals listed under CESA, either during construction or over the life of the project. CESA Permits are issued to conserve, protect, enhance, and restore State-listed threatened or endangered species and their habitats. Early consultation is encouraged, as significant modification to the proposed project and mitigation measures may be required in order to obtain a CESA Permit. Revisions to the Fish and Game Code, effective January 1998, require that the Department issue a separate CEQA document for the issuance of a CESA permit unless the project CEQA document addresses all project impacts to listed species and specifies a mitigation monitoring and reporting program that will meet the requirements of a CESA permit. For these reasons, the following information is requested:

a. Biological mitigation monitoring and reporting proposals should be of sufficient detail and resolution to satisfy the requirements for a CESA Permit.

b. A Department-approved Mitigation Agreement and Mitigation Plan are required for plants listed as rare under the Native Plant Protection Act.

5. The Department opposes the elimination of watercourses and/or their channelization or conversion to subsurface drains. All wetlands and watercourses, whether intermittent or perennial, must be retained and provided with substantial setbacks which preserve the riparian and aquatic values and

maintain their value to on-site and off-site wildlife populations.

a. The Department has direct authority under Fish and Game Code 1600 set seq. In regard to any proposed activity which would divert, obstruct, or affect the natural flow or change the bed, channel, or bank of any river, stream, or lake. Early consultation is recommended, since modification of the proposed project may be required to avoid or reduce impacts to fish and wildlife resources.

b. A discussion of potential adverse impacts from any increased runoff, sedimentation, soil erosion, and/or urban pollutants on streams and watercourses on or near the project site, with mitigation measures proposed to alleviate such impacts must be included.

Thank you for this opportunity to comment. Questions regarding this letter and further coordination on these issues should be directed to Robin Maloney-Rames, Environmental Specialist III, Chino Hills, (714) 817-0585.

Sincerely,

Glenn Black

Glenn Black
Supervisor
Habitat Conservation - South
Region 6

cc: Jeff Newman, USFWS, Carlsbad

# Monte Vista

Mark N. Kinsey
GENERAL MANAGER

December 17, 1999

Mr. Neil Clifton
INLAND EMPIRE UTILITIES AGENCY
9400 Cherry Avenue
Fontana, California 92335

DEC 21 1999

**Notice of Preparation of a Program Environmental Impact Report**
**for the Optimum Basin Management Program for the Chino Groundwater Basin**

Dear Mr. Clifton:

Thank you for the opportunity to provide input to the Notice of Preparation of a Program Environmental Impact Report for the Optimum Basin Management Program (OBMP). The Monte Vista Water District is a party to the adjudication of the Chino Groundwater Basin. Our service responsibilities include the water supply delivery for distribution to consumers located within the cities of Montclair, Chino, Chino Hills, and the county of San Bernardino. Water supply to meet this demand includes a significant reliance on the Chino Groundwater Basin. Our ability to continue to rely on the Basin will, in large part, be dependent on the success of the OBMP.

As currently drafted, the OBMP provides an analysis of the existing conditions and Basin management issues facing Watermaster. It further identifies facilities to increase recharge and to improve water quality in the southern portion of the Basin. It does not, however, include the necessary procedures and mechanisms to implement Basin operational changes that are required to implement the OBMP and mitigate existing yield and water quality problems. Without implementation of several operational changes, water quality and yield within portions of the Basin will continue to degrade.

By the attached correspondence, dated September 8, 1999, the District previously submitted comments regarding Sections 1-4 of the Draft OMBP. As appropriate, please incorporate these comments into the scoping of the Draft EIR. Additional District comments for scoping purposes are provided below.



Water District
10575 Central Avenue, Post Office Box 71 • Montclair, California 91763 • (909) 624-0035 • FAX (909) 624-4725

Robb D. Quincey PRESIDENT | Josephine M. Johnson VICE PRESIDENT | Sandra S. Rose DIRECTOR | James T. Morgan DIRECTOR | Maynard B. Lenhert DIRECTOR

- **Goundwater Recharge:** The OBMP envisions the implementation of a comprehensive program to increase the capture and recharge of the Chino Groundwater Basin with "native" runoff tributary to the groundwater basin. The recharge program further identifies the need for a projected artificial recharge capacity of 80,000 acre-feet per year to maintain Basin yield.

  The need and benefits of increased natural and artifical recharge are well documented in the OBMP. The Draft EIR should complete the following analysis to establish the amount of recharge that is necessary to maintain Basin yield and water quality by hydrologic or management zone within the Basin.

  1. Determine the existing yield of each hydrologic or management zone of the Basin under two separate operational conditions; present day (baseline), and "native" recharge component of the proposed recharge master plan. Compare this information to the estimated year 2020 groundwater production for the individual hydrologic zones to determine potential hydrologic imbalances that may be present.

  2. For any identified hydrologic zone shortfall, identify the proposed method to mitigate this imbalance. The identified mitigation measures should be clearly implementable under the existing Judgment for the Chino Groundwater Basin.

  3. Repeat the analysis for the water quality component of the recharge master plan. Changes in water quality for the two noted operational conditions should be estimated, and mitigation measures established for those portions of the Basin in which the resulting water quality does not meet drinking water standards.

  4. Complete a financial assessment of the mitigation measures recommended addressing any impacts identified during the completion of the analyses identified above.

- **Impaired Areas of the Basin:** In general, the OBMP focuses almost exclusively on addressing the water quality issues associated with the southern or "agricultural" region of the Basin. The OBMP does not address other areas of the Basin that have, or face significant water quality impairment.

  Review of OBMP Report Figure 2-71 identifies a large nitrate plume located in the northwestern portion of the Basin. The plume is identified as having contaminant levels in excess of 80 percent of the Maximum Contaminant Level for nitrate (36 mg/l).

  As noted in prior District correspondence, the leading edge of the plume currently encompasses approximately 40 percent of the District's service area and threatens other producers including the cities of Upland, Pomona, Chino, and Chino Hills. Currently, several District wells have been abandoned or closed due to nitrate levels that are 2.5 to 3.5 times drinking water standards. Groundwater flow vectors in the northwestern portion of the Basin indicate that this plume will continue to move in a southwesterly direction toward the city of Pomona's groundwater production well field.

The potential impacts for this and other major water quality plumes present in the Chino Groundwater Basin should be identified, and their potential operational impacts to existing and future groundwater production established. Measures to mitigate any identified impacts should be established in the Draft EIR.

Complete implementation of the OBMP will require modification to current operational practices in the Basin. These changes are necessary to fully address and mitigate the existing water quality and yield problems in the Basin. Because the policies and mechanisms required to implement these operational changes have not been developed, the EIR process faces many challenges successfully identifying and mitigating the environmental impacts of the OBMP.

The District appreciates your efforts to support the OBMP process. Should you have any questions regarding our comments, please contact the District at your convenience.

***Monte Vista Water District***

Mark N. Kinsey
General Manager

Attachment

cc: Monte Vista Water District Board of Directors

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Monte Vista Water District

Mark N. Kinsey
GENERAL MANAGER

Calvin W. Good Jr.
CONTROLLER

Bruce Lance
LEGAL COUNSEL

September 8, 1999

Ms. Traci Stewart, Chief of Watermaster Services
CHINO BASIN WATERMASTER
Suite 109
8632 Archibald Avenue
Rancho Cucamonga, California 91730

**Optimum Basin Management Plan Report for the Chino Groundwater Basin**

The Monte Vista Water District ("District") submits the following correspondence for inclusion into the September 15, 1999 public hearing record for the Optimum Basin Management Program (OBMP) Report. District comments are designed to identify components of the OBMP Report that limit the Program's goal of optimizing the beneficial use of the Chino Groundwater Basin. The District anticipates that it will provide oral testimony at the September 15, 1999 hearing, and reserves the right to submit additional written testimony on the OBMP process.

District comments are based on review of OBMP documentation, previous written and oral comments provided by other agencies, Article X, Section 2 of the California Constitution, and review of the Judgment and its supporting documentation. Our comments have been organized into two separate categories. General comments to the OBMP Report and OBMP Summary Matrix and Recommended Action Plan are provided below. Specific comments to a given page of Section 4 of the OBMP Report are included as Attachment 1, and should be reviewed along with the referenced page, and program element of the OBMP Report.

The District is also concerned about submitting an incomplete OBMP document to the Court. The OBMP Report scheduled for review by the Court in October 1999 is lacking the necessary sections addressing OBMP Plan implementation, and cost distribution. These sections the Plan may result in modification to the scope of the OBMP actually implemented by Watermaster; the Judgment recognizes that economic considerations are part of criteria utilized in Basin management.

Given the above, the OBMP Report should be submitted to the Court as only a progress report, with a request that the Court takes action to only receive the Report.



Water District
10575 Central Avenue, Post Office Box 71 • Montclair, California 91763 • (909) 624-0035 • FAX (909) 624-4725

## OBMP REPORT

1. Groundwater Recharge. An active groundwater recharge program is necessary to ensure the optimum beneficial use of the Chino Groundwater Basin. Physical recharge as a means of maintaining Basin yield and water quality has been discussed since the beginning of the OBMP process An active groundwater recharge program is a critical component of the OBMP affecting yield, water quality, Basin storage, and conjunctive use programs.

   The Court in the *City of Chino v. Chino Basin Municipal Water District* Judgment ("Judgment") retained continuing jurisdiction over the Chino Basin adjudication under authority of Article X, Section 2 of the California Constitution which requires the waters of California to be put to beneficial use to the fullest extent of which they are capable. Current operations under the Judgment do not achieve the directive of the Constitution because, among other reasons, (1) insufficient emphasis is given to actual physical wet-water recharge of the Basin and (2) insufficient management of substitutions for wet-water recharge, such as *in lieu* recharge and production right transfers.

With minor exceptions, the Chino Basin receives recharge only through percolation of naturally occurring surface waters, primarily in the northeastern and north-central parts of the Basin. Since a major portion of total production in the Basin also occurs in the northeastern and north-central sector of the Basin, other areas of the Basin are largely cut off from the benefits of this natural recharge. Concurrently, natural recharge, which formerly occurred in the northwestern portion of the Basin, has been largely lost due to the channelization of the San Antonio Creek which conveys local runoff past the best recharge areas and generally past any possibility of beneficial use within the Chino Basin.

These physical facts are exacerbated by the failure of the current operating scheme under the Judgment to adequately regulate *in lieu* recharge and intra-basin water transfers. *In lieu* recharge does not bring in wet-water to replace overproduction within the Basin. Water is "recharged" *in situ*, while the replacement water is used on the surface. Similarly, transfer of water production rights from a party who under-uses adjudicated rights to a party who over-uses adjudicated rights, denies to the Basin the benefit of wet-water recharge to offset the overproduction by the water right transferee.

The District completed a review of the Judgment to determine whether it expresses any preference for physical replenishment of the groundwater Basin, as opposed to in-lieu recharge or intra-pool transfers. Consistent with Article X, Section 2 of the California Constitution, Sections 39-41 of the Judgement clearly provide that the overall goal of the Judgment is to achieve maximum reasonable beneficial use of the waters of the Chino Basin, taking into account both water quantity and quality considerations. These sections further grant the Watermaster broad general powers and provide for flexibility in the Judgment to achieve this goal.

Subsequent sections of the Judgment also appear to allude to preference for wet water recharge. For example, Section 50 of the Judgment provides for methods of replenishment. The section states: "Watermaster may accomplish replenishment of overproduction from the Basin **by any reasonable method**, including:

a. Spreading and percolation or injection of water in existing or new facilities...

b. In-Lieu Procedures. Watermaster may make, or cause to be made, deliveries of water for direct surface use, in lieu of groundwater production."

The fact that wet water recharge is listed first implies a preference to in-lieu procedures.

Section 49 identifies possible sources of supplemental water that may be used to recharge the Basin. The Judgment states: "Maximum beneficial use of reclaimed water shall be given high priority by Watermaster." This again implies a preference to wet-water recharge.

Section 11 of Exhibit H of the Appropriative Pool Pooling Plan provides the criteria for accomplishing replenishment by in-lieu means. The section states: "there are, or may develop, certain areas within the Chino Basin where **good management practices** dictate that recharge of the Basin be accomplished, to the extent practical, by taking surface supplies of supplemental water in lieu of groundwater otherwise subject to production as an allocated share of the Operating Safe Yield." This section again alludes to the preference of wet water recharge over in lieu means, and requires that in lieu recharge be completed only when dictated by good Basin management practices.

Section 13 of Exhibit H of the Appropriative Pool Pooling Plan addresses the criteria for the assignment or lease of an appropriative Operating Safe Yield right. The section states: "Watermaster shall not approve transfer, lease, or license of a right for exercise in an area or under conditions where such production **would be contrary to sound Basin management or detrimental to the rights or operations of other producers.**"

The Judgment requires that the Basin be operated to achieve maximum reasonable beneficial use of the waters of the Chino Basin. The Court, under the authority of Article X, Section 2 of the California Constitution, retains the authority to compel Watermaster to operate the Basin to achieve this constitutional mandate. Serious groundwater management and equity issues exist within the current operating regimen under the Judgment. These management and equity issues interfere with the optimum management of the Chino Basin to achieve the directives of the California Constitution.

The OBMP Report does not provide the necessary program mandate to require Watermaster to complete wet-water recharge as part of the management of the Basin. The OBMP Report does not require the development of criteria to determine if in lieu replenishment or production right transfers constitute sound management practices under the Judgment and the OBMP.

Wet-water recharge should be enhanced, with both native and imported supplemental water, by the development of additional recharge facilities in the various recharge zones of the Basin. In lieu recharge and water right transfers should be better regulated under the Judgment and the OBMP in order to promote the health of the Basin and to facilitate the fullest beneficial use of its water.

2. Watermaster Role in OBMP Implementation. During the OBMP process, significant discussion has occurred regarding the role of Watermaster as an implementer of OBMP related projects and facilities. There appears to be a consensus of the parties to the Judgment that Watermaster is prohibited under the Judgment from owning property and substantial capital assets.

   Under Section 17 of the Judgment, Watermaster's authority is limited to matters in the Judgment and later court orders. "Watermaster shall have and may exercise the express powers, and shall perform the duties, **as provided in this Judgment or hereafter ordered or authorized by the Court** in the exercise of the Court's continuing jurisdiction." The Watermaster's powers are derived from the court and are subject to the same limitations as the court's jurisdiction. The court maintains jurisdiction over, and only over, the parties to the action and administers the relationship among the parties in connection with the subject matter addressed by the 1978 Judgment.

   The limited authority of the Watermaster is often characterized under the rubric of "The Watermaster cannot own property." In fact, the Judgment expressly prohibits ownership of real property by the Watermaster: "Watermaster may purchase, lease, acquire, and hold all necessary facilities and equipment; **provided that it is not the intent of the Court that Watermaster acquire any interest in real property or....**" The inherent limitation on the Watermaster's power, however, is really more fundamental. The Watermaster has no corporate existence. This is more clear now that the Watermaster is not the Chino Basin Municipal Water District. Since it has no corporate existence, the Watermaster may not contract, sue, or be sued, without court consent. Only by virtue of the court's authority to compel the parties in the case to guarantee the obligations incurred by the Watermaster can goods and services be secured to carry out the Judgment.

   As part of the OBMP process, a finding from the Watermaster legal counsel concerning this issue should be prepared and incorporated into the OBMP Report. Reference in the OMBP Report to Watermaster assuming responsibility for the construction or ownership of OBMP-related facilties should be modified to reflect the limitations established in the Judgment.

## OBMP SUMMARY MATRIX AND RECOMMENDED ACTION PLAN

1. Program Element 2 – Groundwater Recharge. The District is supportive of the Chino Basin Water Conservation District's (CBWCD) efforts to provide for increased recharge of the Chino Groundwater Basin. Through their positive efforts, the Basin's knowledge and understanding of the importance of recharge has increased greatly. Program Element 2 is clearly one of the more critical components to the success of the OMBP.

By correspondence, dated August 5, 1999, the Cucamonga County Water District (CCWD) raises a number of issues regarding the CBWCD's role in implementing this element of the OBMP. As noted in the CCWD correspondence, the CBWCD service area does not encompass the larger Chino Basin region, and is generally limited to the western half of the groundwater Basin. Funding for CBWCD activities are generated through a property tax assessment levied within its service area boundaries. Use of this revenue to support recharge activities outside of the agency's service area could result in the transfer of this tax revenue to areas outside corporate boundaries of the agency. There appears to be a number of approaches available to address this issue and could include, but not be limited to, the following:

- Limit the role of the agency to those activities within its corporate boundaries. There are a number of recharge projects and activities within this area requiring implementation through the OBMP.

- Have the agency cooperatively participate with other agencies to implement OBMP recharge activities outside of the CBWCD boundaries. A cost-sharing approach could be established to address the funding issues presented above.

- Have the agency expand its service area and taxing authority to encompass the majority of the Basin's service area.

The District does not agreed with CCWD's suggestion that consideration be given to utilization of the CBWCD's tax revenue as an offset to desalter project costs. This approach could create the same issues identified above, and would result in the use of the agency's tax revenue for an activity possibly outside its service responsibilities.

2. Program Element 3/5 - Water Supply Plans For Impaired Areas of the Basin/Regional Water Supply Plans. The District is supportive of a program that maintains historic Basin production patterns and yield, while improving Basin water quality.

Program Element 3, focuses almost exclusively on addressing the water quality issues associated with the southern or "agricultural" region of the Basin. The element does not address other areas of the Basin that have, or face significant water quality impairment. Review of OBMP Report Figure 2-71 identifies a large nitrate plume located in the northwestern portion of the Basin. The plume is identified as having contaminant levels in excess of 80 percent of the Maximum Contaminant Level for nitrate (36 mg/l).

The leading edge of the plume currently encompasses approximately 40 percent of the District's service area. Several District wells have been abandoned due to nitrate levels that are 2.5 to 3.5 times drinking water standards. Groundwater flow vectors in the northwestern portion of the Basin indicate that this plume will continue to move in a southwesterly direction toward the city of Pomona's groundwater production well field. The identified plume affects implementation of OBMP Goal 1 - *Enhance Basin Water Supplies* and Goal 2 - *Protect and Enhance Water Quality*. Program Element 3 should be modified to address the other impaired regions of the Basin.

Program Element 5 - Regional Water Supply Plan, identifies facilities designed to maintain historic production patterns and yield, while improving water quality in the southern portion of the Basin. The Plan proposes to maintain current agricultural production patterns in the Basin through the delivery of groundwater supplies to meet increasing urban demand within the southern portion of the Basin. Facilities required to implement this water supply plan include groundwater production wells, water distribution systems and desalter facilities to remove excess levels of total dissolved salts and nitrates from the underlying groundwater basin. The success of this plan requires a difficult balance between program phasing and cost.

The phasing of the proposed facilities does not accurately reflect the water supply programs and demands of the identified purchasing agencies. For example, the identified water supply plan for the city of Chino Hills does not include deliveries under the water supply agreement between the District and the city. Under this agreement, the District is obligated to deliver up to 18,175 acre-feet of water to the city annually. Combined with the city's other existing water supply sources, the firm water supply for the city could exceed projected year 2020 demand by up to 10,000 acre-feet annually.

The OBMP Report should revise the regional water supply to more accurately reflect existing firm water supply plans of the identified purchasing agencies and their projected increased water demand from growth within the agricultural areas. The OBMP Report should also complete an analysis of the relationship between the proposed water supply plan and the acreage of agricultural land scheduled for annexation by these agencies. This analysis may be beneficial in determining the quantity of desalter product water purchased by the individual agencies, and in determining the phasing of proposed desalter facilities.

The District is supportive of the desalter program, and Watermaster efforts to establish a program based on equitable distribution of desalter capacity and costs. We are also encouraged and supportive of the efforts of SAWPA and IEUA to secure state and federal funding sources. Finally, we agree with CCWD that Orange County water agencies should be approached to determine their interest in either purchasing desalter product water or assisting in the funding of the project itself.

3. Program Element 6/7 - Salt Budget/Manure Management. As noted in District Attachment 1, and in CCWD's correspondence dated August 5, 1999, the Regional Water Quality Control Board is considering adoption of Tentative Order Number 99-11 for General Waste Discharge Requirements for Dairies and Related Concentrated Animal Feeding Operation, (NPDES Number CA8000336). If adopted, manure disposal practices in the Basin would become a regulatory compliance requirement for the dairy operators.

   The District does not feel that it is the responsibility of the Watermaster to subsidize regulatory compliance requirements of agencies or individual business operations. Watermaster may want to reconsider the OBMP Program Element 6/7 recommendation to subsidize manure removal within the Chino Basin region. Given the projected cost of full OBMP implementation, the proposed subsidy could be shifted to offset the cost of

implementing the water supply plan envisioned in Program Elements 3/5. The identified water supply plan would provide a salt benefit to both the Basin and to dairy and agricultural interests.

Thank you for the opportunity to provide comments to the OBMP process. The District is supportive of the process and its goal to optimize the benefical use of the Chino Groundwater Basin. The success of this endevor will depend on our collective ability to craft a program that equitably distributes costs and benefits to the parties of the Judgment. The District will remain an active participant in the OBMP process. Again, on behalf of the Monte Vista Water District, thank you for your efforts.

Sincerely,

Mark N. Kinsey
General Manager

Attachment

cc: Monte Vista Water District Board of Directors
Mr. Art Kidman, McCormick, Kidman, and Behrens

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**Attachment 1**

**Monte Vista Water District**
**Comments to OBMP Section 4 - Management and Implementation Plan**

- Page 4-4: Production Monitoring Program: The text states that "about 600 agricultural wells will be equipped with in-line totalizing flow meters." Given the fact that alternatives to the complete metering of the agricultural wells are currently under review, consideration to modifying the text to reflect this fact should be given.

- Page 4-6: Well Construction, Abandonment, and Destruction Monitoring: The text should clarify that Watermaster involvement in well abandonment will be limited to non-Appropriative Pool producers. The Appropriative Pool agencies currently follow the necessary regulations for the abandonment of production wells, and should report this information to Watermaster as part its annual reporting requirements.

- Page 4-6: Groundwater Level Monitoring: The text states that for the Appropriative Pool, the data will be collected by the "*pool member or Watermaster staff at pool member discretion.*" It is clearly within the ability of each pool member to collect the necessary information for submittal to Watermaster. The District does not support the concept of subsidizing other agency operation through this type of activity; the other pools should individually pay for the cost of Watermaster providing these services.

- Page 4-9: Program Element 2: The statement that *"some recycled water projects that are currently being planned will increase recharge when groundwater production downgradient of these proposed recharge projects is decreasing. The result will be increased outflow to the Santa Ana River and no yield improvement"* should be modified or deleted from the text. The District feels that additional analysis is required to support this conclusion.

- Page 4-10: Program Element 2: The discussion regarding recharge needs could imply that "*in-lieu*" replenishment is the preferred approach to offsetting Basin over-draft conditions. Long-term use of in-lieu replenishment has the potential to create negative yield and water quality impacts to the Basin. From review of the water supply plans developed by Watermaster, it appears that the replenishment obligation may be understated.

  The District is currently delivering 16.2 mgd of water to the city to assist in meeting its demands. To meet this obligation, it is anticipated that the District could increase its groundwater production by approximately 10,000 acre-feet per year over what is currently identified in the OBMP water supply plan. Based on this additional demand, the estimated new recharge capacity required for Management Zone 1 would increase to approximately 28,000 acre-feet per year in 2020.

- Page 4-18: Program Element 4: The finding that the city of Chino Hills *firm* year 2020 water supply source is short by an estimated 5,600 acre-feet per year needs clarification. Under the water supply agreement between the city and the District, the city has "acquired" a right for deliveries from the District's system equal to 16.22 mgd (18,175 acre-feet per year).

  Facilities to provide deliveries to the city include groundwater production wells, nitrate blending stations, and District capacity at the WFA facility located in the city of Upland. Facilities are under construction to permit the District to increase the use of groundwater supplies to meet our water supply obligation to the city. After accounting for water supply deliveries from the District, and the assumption that the city's year 2020 deliveries of desalter water remain constant at 2,240 acre-feet per year (year 2000 estimate) in 2020, the city's water supply sources could exceed projected demand by approximately 10,000 acre-feet per year.

- Page 4-23: Program Element 3: The information regarding the Inland Empire Utilities Agency requires minor updating. The current population within the IEUA service area is estimated at 700,000 people. In addition to the identified service responsibilities, the agency will begin operating the SAWPA Desalter when its becomes operational in the year 2000.

- Page 4-28: Program Element 4: The District concurs with the statement that *"increases in Management Zone 1 production may need to be matched with increases in groundwater recharge to ensure that a balance in pumping and recharge is maintained."*

  Recharge should be provided annually to maintain both yield and water quality. It may be necessary for Watermaster to provide recharge through targeted injection to assist in yield maintenance within the subsidence zone or to provide water quality benefits to the larger MZ-1 area. Procedures have already been established in the Judgment to undertake and distribute the cost to complete these activities.

- Page 4-33: Program Element 6: The Regional Water Quality Control Board is currently in the process of considering the adoption of Tentative Order Number 99-11 for General Waste Discharge Requirements for Dairies and Related Concentrated Animal Feeding Operation, (NPDES Number CA8000336). The order, if adopted, would change manure removal practices within the Chino Basin region.

  The District does not feel that it is the responsibility of the Watermaster to subsidize regulatory compliance requirements of agencies or individual business operations. Watermaster may want to reconsider the OBMP Program Element 6/7 recommendation to subsidize manure removal within the Chino Basin region.

# California Regional Water Quality Control Board

## Santa Ana Region

Winston H. Hickox
*Secretary for Environmental Protection*

Internet Address: http://www.swrcb.ca.gov/~rwqcb8
3737 Main Street, Suite 500, Riverside, California 92501-3339
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Gray Davis
*Governor*


DEC 10 1999

December 8, 1999

Mr. Neil W. Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Bldg. A
Fontana, CA 92335

**NOTICE OF PREPARATION OF A PROGRAM ENVIRONMENTAL IMPACT REPORT TO ADDRESS IMPLEMENTATION OF THE OPTIMUM BASIN MANAGEMENT PROGRAM FOR CHINO BASIN**

Dear Mr. Clifton:

We have reviewed the Notice of Preparation of a Program Environmental Impact Report to Address Implementation of the Optimum Basin Management Program for Chino Basin (NOP). Regarding the statutory concerns of the Santa Ana Regional Water Quality Control Board (Regional Board), the Draft Program Environmental Impact Report (EIR) should address the following:

I. Water Quality and Beneficial Uses

A. Mitigation of adverse impacts should be addressed.

B. The description of potential impacts of the proposed projects on surface and ground water quality and beneficial uses should address the following:

1. Any activities that could cause violations of narrative or numeric water quality objectives contained in the Regional Board's 1995 Water Quality Control Plan for the Santa Ana River Basin.

2. Proposed projects occurring upstream of or discharging into impaired waterbodies listed on the Clean Water Act Section 303(d) list may be subject to additional controls (specifically Total Maximum Daily Loads or TMDLs) pursuant to federal regulation. Depending on the proposed project, these controls could include discharge prohibitions, revisions to discharge permits, or management plans to address water quality impacts. This is especially important in the Chino Basin Watershed. Environmental documents for proposed projects need to acknowledge that these additional requirements may be imposed in the future.

3. Construction activities (including grading) that could result in water quality impacts.

4. Soil characteristics related to water quality including the potential for erosion and subsequent siltation, and any increase or decrease in percolation.

5. Impacts of toxic substances handling and disposal (if appropriate).

6. If any of the projects impact riparian or wetland habitats, a complete description of the impacts, acreage of the impacts, and any proposed mitigation should be provided.

C. One of the goals of the Optimum Basin Management Program (OBMP) is to protect and enhance water quality. The parties to the Chino Basin Judgement and other interested agencies recognize that water quality in the Chino Basin has been adversely affected by urban and agricultural activities, and that there are important political, social, and economic reasons for addressing these adverse effects at this time. Current trends in the Chino Agriculture Preserve have significant implications for water supply and water quality in Chino Basin, the Santa Ana River, and Orange County. Pumping patterns and hydrologic conditions in the southern part of the Basin will be affected as agricultural operations cease in this area over the next 10 to 20 years. The OBMP contains proposals to address these changes and the environmental impacts of these proposals should be addressed. In addition, the EIR should evaluate the environmental impacts of failing to complete certain key OBMP projects (i.e., no action alternatives will result in significant environmental changes).

II. Wastewater Disposal and Treatment

A. Types and amounts of waste materials generated by various projects should be considered.

B. Proposed waste treatment and disposal methods should be evaluated in regards to the following:

1. Treatment facilities: location, current capacity, treatment standards, master treatment facilities expansion plan (if appropriate)

2. Treatment plant collection system: location of major trunk lines and tie-ins, current capacity

3. Disposal facilities: location, capacity

C. Applications or permits required to implement waste disposal should be addressed.

D. The impact of calculated project waste volume on the capacity of existing and proposed treatment and disposal facilities should be evaluated.

II. Permits

A. Storm water runoff in the area is currently regulated by an areawide discharge permit, issued to the cities and counties under the National Pollutant Discharge Elimination System (NPDES).

B. A notice of intent (NOI) with appropriate fees for coverage of any projects under the General Construction Activity Storm Water Runoff Permit must be submitted to the State Water Resources Control Board at least 30 days prior to initiation of construction activity. This is required for any construction activity covering at least five acres.

C. The Regional Board requires an NPDES permit for any discharge of wastes to surface waters or Waste Discharge Requirements for any discharge of wastes to land.

D. If reclaimed water is to be used, Water Reclamation Requirements must be issued by the Regional Board.

We look forward to reviewing the Draft Program EIR when it becomes available. If you have any questions, please contact me at (909)782-4459 or William M. Norton at (909)782-4381.

Sincerely,

Wm. B. Rice

William B. Rice, Associate Engineering Geologist
Chino Basin Watershed Management Section

WBR/obmpnop.ltr

WESTERN MUNICIPAL WATER DISTRICT

Donald L. Harriger
General Manager

Elizabeth L. Cunnison, President
Donald L. Schroeder, Vice President
Lester E. Beston, Jr., Secretary/Treasurer
Wayne H. Holcomb, Director
Kevin D. Jeffries, Director

December 17, 1999

DEC 22 1999

Mr. Neil Clifton
Inland Empire Utilities Agency
9400 Cherry Avenue, Building A
Fontana CA 92335

NOTICE OF PREPARATION
PROGRAM EIR FOR OBMP

Western appreciates the opportunity to respond to the Notice of Preparation for the EIR for the OBMP. You will recall that we recently worked with the Utilities Agency to develop a Mitigation Agreement in connection with the Ely Basin recharge project, and to obtain necessary Court approval for that project. In December, 1998 we responded to the NOP for the Chino Basin Recycled Water Groundwater Recharge Project. The OBMP appears to include projects similar to these in nature.

It appears that the purpose of the program EIR is to assess the potential impacts of implementing a plan to manage the water resources in the Chino Basin. The plan includes interrelated projects which in the aggregate are intended to implement a management strategy expressed in terms of goals.

The OBMP concludes that the OBMP is a program that defines a series of actions that collectively have environmental consequences. The NOP further states that the actions are for the purpose of enhancing safe yield and improved water quality for the basin. The actions are delineated in the form of program elements.

The NOP concludes that implementation of program elements will create potential for physical change and adverse impacts to the environment. The NOP further concludes that specific projects that constitute a program element will require further environmental analysis in the future.

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450 Alessandro Boulevard, Riverside, California 92508
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Our comments are relative to the list of issues that are considered to have the highest potential for significant environmental impact. The list is typical of project EIRs and may not be well suited for the proposed program EIR. It may prove to be very difficult to adequately address many of the issues identified because they require more project definition than is available.

More importantly, the list is deficient with respect to issues related to safe yield and improvement of water quality. Other issues with high potential to cause significant environmental impacts that may require mitigation are:

- Changes in pattern of extraction and/or recharge may change the amount and direction of flow of existing contaminated groundwater, and thereby adversely affect adjacent groundwater levels and quality to the detriment of existing producers.

- The cumulative effect of various programs and projects may cause degradation of the surface and groundwater resources and result in non-compliance with the Basin Plan.

- Substituting treated wastewater, recharged lower in the basin, for State Project water, recharged higher in the basin, may cause quality degradation and reduce safe yield.

Western supports development of the OBMP and programs and projects that increase safe yield and improve water quality. Western will continue to support recharge projects using reclaimed wastewater when appropriately mitigated to avoid adverse water quality impacts.

The contact person in Western for this project is Donald L. Harriger, General Manager.

DONALD L. HARRIGER
General Manager

DLH:sg

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Metropolitan Water District**<br><br>Laura J. Simonek, Principal Environmental Specialist<br><br>Letter dated December 9, 1999 | • MWD is a potentially affected public agency and is supportive of efforts to protect and enhance groundwater supplies. | |
| **Chino Basin Water Conservation District**<br><br>Barrett Kehl, General Manager<br><br>Letter dated December 8 & 9, 1999 | • The No Project evaluation should include an evaluation/determination under current pumping, recharge, and storage conditions how much water can annually be pumped from the Chino Groundwater Basin without causing water mining to occur (December 8, 1999 letter).<br><br>• Environmental and Economic impacts resulting from a continuation of the current pumping, recharge, and storage conditions, absent any of the projects contemplated by the OBMP, should be evaluated in the EIR (December 8, 1999 letter). | • Construction and operation of new diversion works along the San Antonio Channel for the purpose of diverting, and ultimately recharging, imported water to and within the Brooks Street Basin, Montclair Basins #3 and #4, and the College Heights and Upland Basin (December 9, 1999 letter).<br><br>• Excavation, shaping, and reconfiguration of College Heights and Upland Basin for recharge purposes (December 9, 1999 letter). |
| **General Electric**<br><br>David W. Thompson, Manager Environmental Remediation Programs<br><br>Letter dated December 8, 1999 | • Consider Beneficial Projects such as the GE clean-up project of a region with high TCE and chromium concentrations in Ontario, California.<br><br>• Consider how extraction/recharge patterns and changes in extraction/recharge patterns may affect groundwater flow patterns (possibly affecting containment of the localized area of degraded water quality currently being pumped, treated, and recharged by GE). | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Fontana Water Company**<br><br>Michael J. McGraw, Manager<br><br>Letter dated December 2, 1999 | • The EIR must fully address potentially adverse water quality and quantity impacts that may result from the implementation of any of the OBMP proposed activities.<br><br>• The EIR must demonstrate that OBMP implementation will not in any way directly or indirectly limit, curtail or otherwise affect the continued use of our existing wells, nor our ability to drill and pump new wells as needed within the company's service area.<br><br>• Examine the need for abatement of sources of groundwater contamination such as ongoing cattle and dairy operations. (Fontana Water Company feels a more extensive definition of PR #6 is needed, along with policies for cease and desist orders for salt loading operations in the basin and for consideration of desalting treatment facilities.) | |
| **Southern California Associate of Governments**<br><br>David Stein, Manager<br>Performance Assessment and Implementation<br><br>Letter dated December 6, 1999 | • Discuss any inconsistencies between the proposed project and applicable general plans and regional plans.<br><br>• Cite and address appropriate SCAG core and ancillary policies using SCAG policy numbers and a side-by-side comparison format to evaluate consistency.<br><br>• The following topics should be reviewed and evaluated for consistency under the Regional Comprehensive Plan: Growth Management, Living Standards, Quality of Life, Social/Political/Cultural Equity, Air Quality, Water Quality, and Open Space considerations. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **California Regional Water Quality Control Board**<br><br>William B. Rice, Associate Engineering Geologist<br><br>Letter dated December 8, 1999 | • Propose mitigation for adverse impacts.<br><br>• Describe potential impacts on surface and groundwater quality and beneficial uses [specifically impacts on narrative or numeric water quality objectives listed in the 1995 Water Quality Control Plan (Region 8)].<br><br>• Consider proposed project placement and potential project impacts relative to impaired waterbodies listed under Section 303 (d) of the CWA, which may impose additional controls (e.g. TMDLs) on discharges.<br><br>• Evaluate how construction activities may result in water quality impacts.<br><br>• Describe/analyze soil characteristics related to water quality (i.e. erosion/siltation potential and changes in percolation rates).<br><br>• Evaluate impacts of toxic substances handling and disposal (if appropriate).<br><br>• Describe and provide mitigation for all impacts to riparian or wetland habitats.<br><br>• Evaluate environmental impacts associated with the various proposals in the OBMP for dealing with the transition of agricultural operations to urban uses in the southern end of the basin.<br><br>• Evaluate environmental impacts of failing to complete key OBMP projects (i.e. no-action alternatives will result in significant environmental changes.) | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **California Regional Water Quality Control Board (continued)** | • Consider types and amounts of waste materials generated by various projects and treatment and disposal methods (to be compared based on facility location, capacity, treatment standards, expansion plans for future, and position relative to major trunk lines and tie-ins).<br>• Consider applications and/or permits require to implement waste disposal and the impact of project waste volumes on the capacity of existing and proposed treatment/disposal facilities.<br>• Consider permits such as: stormwater runoff NPDES permits; NOIs; surface water or waste discharge requirements for NPDES permits; and water reclamation requirements. | |
| **City of Chino**<br><br>David G. Crosley, Water and Environmental Manager<br><br>Letter dated December 16, 1999 | • The scope of the EIR should include adoption of the OBMP by including, but not limited to the Chino Basin Watermaster and any party to the Judgment.<br>• Scope should include adoption of MOA's defining the action necessary to achieve OBMP goals and potential JPA's by including, but not limited to the Watermaster and Judgment parties.<br>• Consider General Plans and Master Facilities Plan of the agencies in the basin and address compatibility with the OBMP.<br>• Evaluate the impact (including economic) of OBMP projects occupying acreage that might otherwise be used for other City development. | Activities/project contemplated by the City of Chino for implementation under the OBMP:<br>• Groundwater production elevation and quality monitoring.<br>• Groundwater production well construction.<br>• Treatment facility construction for nitrate removal from groundwater.<br>• Construction of injection wells or modifications of existing groundwater production wells for injection (part of a conjunctive use program).<br>• Construction of recycled water distribution facilities and direct beneficial use of recycled water.<br>• Recycled water recharge (part of a regional program).<br>• Land subsidence investigations and data collection.<br>• Chino Desalter retail water agency. |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **City of Pomona**<br><br>Sandra Campbell, City Planner<br><br>Letter dated December 17, 1999 | • Requests that the issues listed in the NOP will be included in the EIR along with a discussion of how the City of Pomona will be affected.<br><br>• Discuss how Pomona's water quality and supply will be affected by the OBMP.<br><br>• Include mitigation measures for those issues that may cause significant impacts. | |
| **Western Municipal Water District**<br><br>Donald L. Harriger, General Manager<br><br>Letter dated December 17, 1999 | • There may be a difficulty in adequately addressing many of the issues identified because they require more project definition than is available at this time.<br><br>• Evaluate changes that extraction/recharge patterns may have on flow patterns of existing contaminated groundwater, and thereby adversely affect adjacent groundwater levels and quality to the detriment of existing producers.<br><br>• Evaluate cumulative effects of various programs and projects that may cause degradation of surface and groundwater resources and result in non-compliance with the Basin Plan.<br><br>• Evaluate substitution of treated wastewater, recharged lower in the basin for State Project Water, recharge higher in the basin. There may be a decrease in water quality and safe yield if this action continues. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **State of California Department of Justice**<br><br>Marilyn H. Levin, Deputy Attorney General for Bill Lockyer, Attorney General<br><br>Letter dated December 16, 1999 | • The California Department of Corrections owns approximately 2,600 acres in the Chino Basin. The CIM facility has 9 ag wells (8 active), 4 domestic wells, and a sewage treatment plant. The CIW facility has four inactive wells and one active well and discharges to the SARI line.<br><br>• California DFG and Transportation purchase from municipal entities, and the California DFG previously utilized one well on its property.<br><br>• Department of Toxic Substance Control owns the land identified as the Stringfellow superfund site and is involved in a major cleanup of the area.<br><br>• The EIR should identify the State of California and its agencies and departments owning land and producing water from the Chino Basin. The EIR should include potential impacts to these projects by OBMP facilities/activities.<br><br>• The EIR should address the impact of the proposed projects on the continued use of the state's existing wells and its ability to drill new wells in the vicinity of its land.<br><br>• Specifically the State is interested in impacts of the proposed wellfields and the water supply projects proposed in the Draft Water Supply Facilities Plan. | • Plans to drill two new domestic wells south of the central facility and to reduce pumping from two other wells to have a positive impact on the subsidence issue.<br><br>• Construction of an ion exchange treatment plant.<br><br>• Study being conducted to see if the treatment plant should be expanded and to see if tertiary treatment should be implemented. |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **State of California Department of Justice (continued)** | • The EIR should address the impact of the OBMP proposals for recharge, extraction, development of new sources of supplemental water, direct use of recycled water, treatment and use of degraded groundwater, reduction of groundwater outflow, conjunctive use, basin yield maintenance, and goals listed in the NOP.<br>• Review the MWD's 1988 Chino Basin Groundwater Storage Program environmental documents and the increased degradation of water quality in the lower portions of Chino Basin. | |
| **Chino Land and Water Company**<br>Susan M. Trager, Attorney<br>Letter dated December 17, 1999 | • Implementation of the program is long overdue and would be pleased to provide whatever information is requested. | |
| **City of Ontario**<br>James A. Ragsdale, Principal Planner<br>Letter dated December 15, 1999 | • The EIR should address the impacts involved with urban land uses such as water runoff and the impacts associated with the anticipated population of 101,000 and their use of services and utilities (such as water) for the area recently annexed by the City (8,200 acre area of the former San Bernardino County Agricultural Preserve). | |
| **City of Rancho Cucamonga**<br>Brad Buller, City Planner<br>Letter dated December 15, 1999 | • The City has no comments at this time but wishes to review the DEIR, when completed. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Jurupa Community Services District**<br><br>John L. Schatz, Attorney<br><br>Letter dated _____ | • Evaluate impacts associated with recycling reclaimed water (e.g. TDS and groundwater quality impacts) using specific (local) and mass-balanced (regional) methodologies to conduct impact determinations.<br><br>• Determine impacts for individual agency wells, using historical and current salt/nitrogen concentration levels and RWQCB sub-basin discharge criteria as benchmarks for evaluation.<br><br>• Evaluate cumulative TDS increases associated with recycled water recharge allowed under the OBMP on the basis of total volume of salts added, however, mitigated by additional storm-water recharge or other means, rather than solely in the context of mitigation and recycled water.<br><br>• Determine whether groundwater quality mitigation (including stormwater and/or other high-quality recharge) should presently be occurring to mitigate for existing groundwater quality rather than for additional TDS loading associated with recycled water recharge.<br><br>• Evaluate benefits derived from OBMP projects versus negative impacts to existing water supplies and determine if such impacts can be effectively mitigated on a long-term basis. Mitigation costs should be compared against existing water supply costs and comparable alternative supplies. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Cucamonga County Water District**<br><br>Robert A. DeLoach, General Manager<br><br>(Letter dated November 17, 1999 requests extension of the 30-day comment period to January 10, 1999.)<br><br>Comment letters dated December 13 and 17, 1999 | (Letter dated December 13, 1999)<br><br>• Consider indirect physical impacts of the financing of the OBMP to the extent that financing may affect future project implementation, and therefore, may have environmental consequences.<br><br>• Consider and evaluate the "equitable distribution" of OBMP costs among member agencies and the foreseeable consequences of inequitable financing on growth and land use if certain classes of water users are unfairly saddled with large costs. Methods for assuring that all responsible parties have the legal capacity and obligation to contribute their fair share to OBMP costs should be included in the EIR.<br><br>• If additional water is captured, stored and reused in the Basin under the OBMP, and if there is revenue generated by actions under the OBMP, the EIR should evaluate the physical impacts associated with this revenue and ensure that the parties implementing the OBMP can avail themselves of this financing option without undergoing separate CEQA review.<br><br>• Evaluate the siting of new recharge facilities in the basin with a focus on the northern half of the Chino Basin so that recharge water is not lost to the SAR before it is put to beneficial use.<br><br>• Consider the effects of possible over-extraction in the northern half of the Basin potentially preventing high-quality recharged water from flowing south and "flushing" the Basin to improve groundwater quality. | (Letter dated December 17, 1999)<br><br>Capital projects that CCWD may implement under the OBMP:<br><br>• Construction of transmission lines to distribute potable and recycled water throughout CCWD's jurisdiction and to other agencies.<br><br>• Expansion of Lloyd Michael Water Treatment Plant from 45 to 90 MGD.<br><br>• Conversion of treatment facilities from conventional treatment to either enhanced coagulation or ozone.<br><br>• Construction of distribution pipelines for both potable and recycled water.<br><br>• Acquisition of property to construct additional storage facilities followed by construction of such facilities.<br><br>• Development and construction of raw water/ recycled water spreading facilities (with DHS approval).<br><br>• Construction of DHS approved blending stations and treatment facilities for nitrate and TDS mitigation.<br><br>• Construction of booster stations to facilitate transfer of potable and recycled water to higher elevations and across existing facilities.<br><br>• Construction of groundwater production wells. |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Cucamonga County Water District (continued)** | • Examine the physical impacts of increased recharge or deceased pumping on both subsidence and non-subsidence zones within Management Zone 1.<br>• Impacts of the OBMP on the Prado Dam/ Reservoir must be examined as the OBMP will change the water levels at the dam due to increased capture and recharge further up the basin. This may impact environmentally sensitive wetland areas that may exist around the reservoir.<br>• Discuss other agency approvals such as DHS and RWQCB in light of how the OBMP fits in with their standards and regulations.<br>• Evaluate the OBMP in conjunction with the effects of RWQCB's dairy discharge requirements and manure removal standards. | • Construction of well and manifold system to pump groundwater in and through MWD transmission lines.<br>• Construct a connection to existing MWD transmission facilities. |
| **California Department of Fish and Game**<br>Glenn Black, Supervisor, Region 6<br>Letter dated December 14, 1999 | • DFG is concerned about the increasing appropriation of in-stream flow and loss of natural riparian systems through flood control and water recharge activities.<br>• DFG asks that the lead agency consult with the Department regarding permits that may be required from the ACOE, USFWS and RWQCB (1601/1603 Agreements need detailed project descriptions, inventory of direct/indirect project impacts on riparian resources, cumulative impact analysis on area biological resources, mitigation measures to avoid/reduce impacts on existing riparian resources, mitigated measures t protect riparian resources). | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **California Department of Fish and Game (continued)** | • The Department lists an extensive set of criteria to be considered in the EIR (especially open space, mitigation/monitoring plan, species of concern, and critical habitat areas).<br>• The project should avoid/minimize environmental impacts using alternative analyses and direct, indirect and cumulative impact analyses (especially for the Western Riverside Multi-Species Habitat Conservation Plan and other NCCP programs for conservation).<br>• Focused biological surveys, regarding sensitive habitats and species, should be conducted. All sensitive species/habitat in and around the area should be addressed where deemed appropriate by consultation with the Department and the USFWS. Also the NDDB search should be included.<br>• The project description/mitigation monitoring plan/impact analysis should be complete enough to allow DFG, USFWS and other agencies to determine significant impacts and to make decisions regarding permit issuance (especially for a CESA permit) whenever possible.<br>• DFG has jurisdiction over activities that would affect any river, lake or stream.<br>• The EIR should include impacts for increased runoff, sedimentation, soil erosions, and/or urban pollution to any streams or watercourses on or near the project area. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Monte Vista Water District**<br><br>Mark N. Kinsey, General Manager<br><br>Letter dated December 17, 1999 (with attached September 8, 1999 comment letter) | (Letter dated December 17, 1999)<br><br>• The Phase I OBMP report lacks the necessary procedures and mechanisms to implement Basin operational changes that are required to implement the OBMP and mitigate existing yield and water quality problems.<br><br>• The Draft EIR should determine the existing yield of each management zone under present day (baseline), and native recharge component of the proposed recharge master plan. This should be compared to the estimated 2020 groundwater production for the individual management zones to determine potential hydrologic imbalances.<br><br>• For any zonal shortfalls, the document should identify mitigation measures for the imbalances and specific implementation methods under the existing Judgment.<br><br>• Repeat bullets 1-3 analysis for water quality. Changes in conditions for the two operational conditions should be estimated and mitigation measures established for areas not meeting drinking water standards.<br><br>• Complete a financial assessment for mitigation measures recommended under the above analyses. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Monte Vista Water District (continued)** | • Address other areas in the basin besides the southern "agricultural" region that are impaired. For example: there is a large plume in the northern areas of the Basin with nitrate concentrations of 36 mg/l (2-3 times drinking water standards). Identify impacts to Upland, Pomona, Chino, and Chino Hills if the plume continues to move into groundwater production well fields. Propose measures to mitigate any identified impacts.<br><br>*(Attached Letter dated September 8, 1999)*<br><br>• The EIR should consider the impacts in-lieu of recharge versus wet-water recharge.<br><br>• The role of Watermaster in implementation of projects should be established in a finding by Watermaster's legal council to establish a policy for future consideration when dealing with multiple-party agreements for project implementation.<br><br>• For Program Element 2 (Recharge), recharge activities that are funded by member agencies should either occur within corporate boundaries or use a cost-sharing approach.<br><br>• MVWD is against using tax revenues as a mitigation form to offset desalter costs since the monies would be used for facilities outside of service area responsibilities.<br><br>• The OBMP and EIR need to address impaired areas other than the southern regions of the basin and provide mitigation/monitoring plans for these area. | |

## SUMMARY OF NOTICE OF PREPARATION, COMMENT LETTERS, ISSUES AND CONCERNS

| AGENCY OR INDIVIDUAL | ISSUES RAISED OR COMMENT | POTENTIAL PROJECTS TO BE CONSIDERED |
|---|---|---|
| **Monte Vista Water District (continued)** | • The EIR should consider the financial aspects of the phasing plan and that some of the phasing does not accurately reflect member agencies' projected needs. Plans may need to be reconsidered to better estimate/phase OBMP facilities and associated costs.<br>• The EIR may want to consider the alternative to subsidizing manure removal under Program Elements 6/7 and shift this subsidy to water supply related Program Elements 3/5, which would both improve the salt balance and benefit dairy/ag operations. | |

# RESPONSES TO OBMP
# NOTICE OF PREPARATION
# COMMENT LETTERS

The comment letters submitted to the Inland Empire Utilities Agency (IEUA) in response to the Notice of Preparation (NOP) for the preparation of the Optimum Basin Management Program (OBMP) have been compiled in this Appendix (8.1) and summarized in the summary table enclosed with Appendix 8.1. To assist the commentors to find the text of the Program Environmental Impact Report (PEIR) that addresses issues or concerns raised in a comment, the following responses have been developed. In addition, where an issue could not be addressed in the PEIR because of insufficient definition or data this is noted in the responses below. These responses are organized in the same order as the agency is listed in the summary table.

Metropolitan Water District

- Metropolitan Water Districts comment letter expressed support for the OBMP and raised no issues or concerns.

Chino Basin Water Conservation District

- Section 4.5.2 of the PEIR identifies current pumping, recharge and storage conditions and the volume of water that can be pumped without contributing to Chino Basin overdraft. The current safe yield is estimated to be about 156,000 acre-feet per year (af/y), but under the no project alternative (baseline condition) the safe yield value could drop to approximately 116,000 af/y.

- Environmental effects of continuing baseline condition are presented in both Subchapter 4.5.3 and Chapter 5.

General Electric

- Although the remediation of a contaminated plume of water is the responsibility of the responsible party, the clean-up of any contamination, including that being carried out by the company, will clearly benefit the basin by making additional high quality water available within the Basin over time and it will eliminate a existing constraint to installation of domestic water production wells within the contaminated areas which are discussed in Subchapters 4.5 and 4.10.

- Please refer to the discussion of water quality and flow pattern impacts on groundwater quality anomalies in Subchapter 4.5 and 4.10.

Fontana Water Company

- Please refer to the water quality and quantity impact discussions in Subchapter 4.5.

- Please refer to Subchapter 4.5 for a discussion of the effects of recharging recycled water and related limitations on future access to groundwater in the Chino Basin.

- The need to abate water quality anomalies (contaminated groundwater plumes) is considered self-evident. Please refer to Subchapter 4.5 which discusses the OBMP effects on such anomalies. Potential OBMP efforts at remediating water quality anomalies are still being defined and specific abatement efforts and related environmental effects will have to be reviewed in future tier of review.

Southern California Association of Governments (SCAG)

- Refer to Subchapter 4.2 for a discussion of general plan consistency issues

- The OBMP does not lend itself to a side-by-side comparison with SCAG policies. Those policy issues pertinent to the OBMP are addressed in Subchapter 4.2.

- The growth management plan, air quality, and water quality issues are addressed in more detail in their respective subchapters.

- Aside from seeking to assure adequate future public water supply, the OBMP does not affect living standards, quality of life, socio-political or open space issues.

Santa Ana Regional Water Quality Control Board

- Mitigation measures are summarized in Chapter 1 of the PEIR and discussed in each subchapter in Chapter 4.

- Please refer to Subchapter 4.5 for a discussion of surface and groundwater quality issues.

- Please refer to Subchapters 4.5 and 4.10 for a discussion of OBMP effects on impaired water bodies.

- Please refer to Subchapter 4.5 which addresses construction impacts on water quality.

- Subchapters 4.4 and 4.5 address soil issues.

- Subchapters 4.5 and 4.10 addresses toxic substance issues.

- Subchapter 4.8 addresses biology issues and mitigation measures.

- Subchapter 4.5 addresses effects of agricultural land use transitions on water quality.

- The effects of not implementing the OBMP are addressed in Subchapter 4.5 and Chapter 5.

- Waste material issues are addressed in both Subchapters 4.5 and 4.10.

- Wastewater issues are discussed in Subchapters 4.5 and 4.13.

- Other permits are addressed in Subchapters 4.5, 4.8 and 4.10

City of Chino

- Please refer to Chapters 2 and 3. The PEIR has been structured to allow any party to adopt the OBMP and certify the EIR for their own programs.

- The programmatic character of this would allow it to be used for any future decisions in support of the OBMP.

- Please refer to Subchapter 4.2 for a discussion of general plan consistency and Subchapters 4.5 and 4.13 for a discussion of water facilities.

- A discussion of OBMP effects on acreage available for private development is presented in Subchapter 4.2. Until specific locations for facilities are identified it is not possible to evaluate whether any economic impact will occur or what the level of economic impact o a specific community may be in the future.

Monte Vista Water District

- The comment about procedures and mechanisms is noted. Actual implementation of the OBMP will be facilitated by completion of the CEQA review. Please refer to Chapter 4.5 for a discussion of all water issues. Where specific issues are not addressed, the data to conduct an evaluation is not yet available.

- Offsetting zonal shortfalls is a function of OBMP implementation in the future, and potential environmental effects from implementation will be mitigated as summarized in Chapter 1 of the PEIR.

- Please refer to Subchapter 4.5 and 4.10 for a discussion of water quality issues.

- Mitigation requirements will be determined by the specific characteristics of a proposed project and a specific location. It is not possible to generically assess the financial effects of mitigation measures since they will be dependent on date that is not available, and therefore, speculative.

- Water quality anomalies are addressed in Subchapters 4.5 and 4.10.

- The use of in-lieu water as recharge does not actually have any direct physical impact, it is solely an accounting process which could cause an inaccurate accounting of safe yield and actual water in the Basin. Wet water recharge issues are addressed in Subchapter 4.5 of the PEIR.

- The comment regarding Program Element 2 activities is acknowledged, but does not raise an environmental issue requiring response.

- Again, the comment regarding tax revenues is noted but does not have any identifiable physical effects on the environment.

- Subchapter 4.5 and 4.10 address the water quality anomalies in the whole Basin.

- The issue of phasing plans and financial aspects of such plans has no identifiable physical effects that can be evaluated in this PEIR.

- The manure removal subsidy has been eliminated and therefore is not considered in this PEIR.

City of Pomona

- Based on the whole of the analysis in the PEIR, the only potential impact that cannot be mitigated to a nonsignificant level from implementing the OBMP is short-term air quality impacts associated with construction activities. Therefore, the effects on the City (since no major facilities will be implemented in the City) are not forecast to be significant.

- The water supply and water quality issues for the City are linked to the implementation of the OBMP. The EIR analysis indicates that overall safe yield will be protected and enhanced by the proposed OBMP and water quality will also be preserved or enhanced.

- Detailed mitigation measures are summarized in Chapter 1 and listed in each of the Chapter 4 subchapters.

Western Municipal Water District

- Your comment regrading how "ripe" each of the issues is for evaluation is valid, but the PEIR contains a detailed evaluation of the potential impacts of the program outlined in the OBMP which allows adequate evaluation of impacts for the current level of definition.

- Please refer to Chapter 4.5 and 4.10 for a discussion of the effects on existing water quality anomalies.

- Please refer to Chapter 4.5 for a discussion of the effects on groundwater resources.

- Water quality issues associated with recharge of both State Project Water and recycled water is provided in Subchapter 4.5.

State Department of Justice

- Comments regarding existing Department of Corrections facilities is noted.

- Comments regarding DFG and DOT are also noted.

- Comments regarding DTSC projects associated with the Stringfellow superfund site are noted.

- The analysis of impacts in all of the PEIR sections characterizes OBMP impacts, including those impacts in the area of State facilities.

- Specific impacts such as those associated with a specific well or continued use of existing wells cannot be evaluated at a specific level. This can only occur when specific projects are proposed. However, the general impacts to groundwater throughout the Basin are characterized for OBMP programs in Subchapters 4.5 and 4.10.

- Please refer to the previous comment.

- Please refer to Subchapters 4.5 regarding the water resource impacts identified in this comment.

- The data indicates that a conjunctive use program as large in scope as evaluated in the 1988 document has a potential for significant impacts associated with capture and transport of contaminants in the vadose zone.

Chino Land and Water Company

- Your comment is noted and appreciated.

City of Ontario

- Growth impacts, impacts associated with conversion of agricultural lands and urbanization of Ontario's recent Chino Agricultural Preserve annexation area are addressed in Subchapters 4.2, 4.3, and 4.5.

City of Rancho Cucamonga

- Your comment is noted and a DEIR is being provided for the City's review.

Jurupa Community Services District

- Please refer to Subchapter 4.5 for an evaluation of recycled water recharge impacts. Note that general or program impacts can be forecast, but site specific impacts must be evaluated when specific projects are proposed.

- It is not possible to evaluate the effects of individual agency wells in a Basin the encompasses 351+ square miles of area. However, an overall salt and nitrogen balance for the Basin is discussed in Subchapter 4.5 and 5 regarding future activities of the OBMP and the baseline no project case for these constituents.

- Cumulative TDS increases are addressed from a perspective of offsetting the net increment of salt removal. The data regarding salt balance is provided in Subchapter 4.5.

- The OBMP identifies the need for substantial salt removal through operating several desalters, up to 40,000 af/y. The OBMP clearly indicates that recharge with stormwater, including urban generated stormwater, will benefit the Basin. See Subchapter 4.5.

- Please refer to Subchapter 4.5 which clearly indicates that with implementation of the OBMP water supplies will be maintained and no mitigation is required. If the no project, baseline condition, is maintained, it is highly likely that significant adverse impacts to the Basin are forecast to occur and substantial mitigation is likely to be required. Mitigation costs cannot be correlated with physical changes in the environment and are, therefore, not a subject for CEQA review.

Cucamonga County Water District

- The OBMP is too general at this stage of review allow a comparison of future project implementation schedules or financing commitments. Even indirect physical impacts of financing,, if they exist, are beyond the scope forecasting at this time.

- As the District is aware, an agreement on OBMP implementation principles has been reached and it is beyond the scope of the OBMP PEIR to evaluate the "equitable distribution" of OBMP costs, primarily because such costs cannot be effectively predicted at this stage of the OBMP review.

- Again, the sharing of revenue for increased safe yield is not a PEIR issue and this issue appears to have been addressed as part of the political process with the recent development of the memorandum of principles.

- Please refer to Subchapter 4.5 for a general evaluation of the OBMP recharge program.

- The isolation of the northern half of the Basin from the southern half of the Basin by overextraction was beyond the scope of the evaluation in this PEIR and it is not a component of the OBMP.

- The subsidence issues is evaluated as part of Subchapters 4.4 and 4.5.

- The water level issue at Prado Dam is evaluated as part of Subchapter 4.5.

- Other agency approvals are discussed in each of the relevant subchapters that discuss implementation of the OBMP. For example, DHS and RWQCB requirements are addressed as part of Subchapter 4.5 and biological agency requirements are addressed in Subchapter 4.8 and hazardous material handling issues are addressed in Subchapter 4.10.

- OBMP implementation assumes implementation of the dairy discharge and manure removal standards and the impacts forecast in Subchapter 4.5 reflect these considerations.

California Department of Fish and Game

- The data in Subchapter 4.5 clearly indicates that future surface flows, mostly produced by wastewater treatment will provide more water for riparian habitat, than less. The OBMP proposes to capture storm flows and to meet the goals of the U. S. Fish and Wildlife Service (see Subchapter 4.8) in reducing the total pool of water which at present may actually be harming riparian habitat and contributing to type conversion to aquatic habitat. The overall OBMP program is designed to benefit biological resources, and site specific biological resource impacts for future specific projects will be evaluated with a focus on potential impacts to endangered or otherwise sensitive biological resources.

- The commitment is made for consultation with appropriate agencies regarding permits for biological resource impacts in Subchapter 4.8.

- Please refer to Subchapter 4.8 for a discussion of mitigation, species of concern and critical habitat areas. Mitigation monitoring will be implemented as required by CEQA and open space issues will be fully considered when specific projects are evaluated in the future.

- Mitigation measures summarized in Chapter 1 and further discussed for biological resources in Subchapter 4.8 emphasize avoidance and minimization of site specific resource impacts, including biological resources. All conservation plans will be given careful consideration prior to implementation of any specific project as recommended in this comment and identified in mitigation measures in Subchapter 4.8.

- Focused surveys will be a key component of future site specific reviews for OBMP facilities as outlined in Subchapter 4.8.

- The proposed project is a program that will be implemented over a long-period of time. The PEIR identifies approximately 500+ acres of impact for all facilities in the future, including many sites that are already disturbed. The NDDB and FWS list of species for the project area are included in the PEIR, Subchapter 4.8.

- DFG jurisdiction over OBMP activities that would cause alterations in streams or lakes has been acknowledged and future OBMP activities will be coordinated with DFG as specific projects are defined.

- For potential impacts due to changes in runoff and potential soil erosion, impacts and mitigation measures, written as performance standards are incorporated into the PEIR, Subchapter 4.5.

# APPENDIX 8.2

# SECTIONS 15162 & 15168 OF STATE CEQA GUIDELINES

some effects for which mitigation will not be feasible at an early step of approving a particular development project, and the section would allow a Lead Agency to defer mitigation of that kind of effect to a later step. Such effects may include site specific effects such as aesthetics or parking, depending on the circumstances. At the same time, this section makes clear that tiering does not excuse the Lead Agency from analyzing reasonably foreseeable significant effects, or justify deferring analysis to a later tier EIR or Negative Declaration.

Where tiering is used, the Lead Agency will need to determine whether, in the light of changing circumstances, the EIR prepared earlier in the process would still provide an adequate description of the broad effects considered at that stage. Tiering enables an agency to rely upon the analysis contained in a previous document when it adequately addresses a later project. Subdivision (e) describes what is meant by 'adequately addressed' in such a way as to ensure that prior mitigation measures will be applied to the later project.

To make the process understandable, any EIR or Negative Declaration using the tiering principle must refer to the prior EIR, state where a copy of that document may be examined, and state that tiering is being used.

### 15153 Use of an EIR from an Earlier Project

(a) The lead agency may employ a single EIR to describe more than one project, if such projects are essentially the same in terms of environmental impact. Further, the lead agency may use an earlier EIR prepared in connection with an earlier project to apply to a later project, if the circumstances of the projects are essentially the same.

(b) When a lead agency proposes to use an EIR from an earlier project as the EIR for a separate, later project, the lead agency shall use the following procedures:

(1) The lead agency shall review the proposed project with an initial study, using incorporation by reference if necessary, to determine whether the EIR would adequately describe:

(A) The general environmental setting of the project,

(B) The significant environmental impacts of the project, and

(C) Alternatives and mitigation measures related to each significant effect.

(2) If the lead agency believes that the EIR would meet the requirements of subsection (1), it shall provide public review as provided in Section 15087 stating that it plans to use the previously prepared EIR as the draft EIR for this project. The notice shall include as a minimum:

(A) An identification of the project with a brief description;

(B) A statement that the agency plans to use a certain EIR prepared for a previous project as the EIR for this project;

(C) A listing of places where copies of the EIR may be examined; and

(D) A statement that the key issues involving the EIR are whether the EIR should be used for this project and whether there are any additional, reasonable alternatives or mitigation measures that should be considered as ways of avoiding or the project.

(3) The lead agency shall prepare responses to comments received during the review period.

(4) Before approving the project, the decisionmaker in the lead agency shall:

(A) Consider the information in the EIR including comments received during the review period and responses to those comments,

(B) Decide either on its own or on a staff recommendation whether the EIR is adequate for the project at hand, and

(C) Make or require certification to be made as described in Section 15090.

(D) Make findings as provided in Sections 15091 and 15093 as necessary.

(5) After making a decision on the project, the lead agency shall file a notice of determination.

(c) An EIR prepared for an earlier project may also be used as part of an initial study to document a finding that a later project will not have a significant effect. In this situation a negative declaration will be prepared.

(d) An EIR prepared for an earlier project shall not be used as the EIR for a later project if any of the conditions described in Section 15162 would require preparation of a subsequent or supplemental EIR.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21100, 21151, and 21166, Public Resources Code.

**Discussion:** The purpose of this section is to grant Lead Agencies clear authority to use an EIR prepared for one project over again for a second project which has essentially the same impacts as the project for which the EIR was originally prepared. The section places necessary conditions on the use of a prior EIR to avoid abuse of this approach. Where two projects are essentially the same in terms of environmental impact, there is little reason to require preparation of a separate EIR for the second project.

Subsection (b) prescribes the procedures for an agency to use in implementing this authority. Use of a Negative Declaration is not appropriate. Although a Negative Declaration does state than an EIR will not be prepared, the reason for preparing a Negative Declaration is that the project will not have a significant effect. An EIR is needed if the project may have a significant effect although under some circumstances a previously prepared EIR may be used as the basis for review. The procedures prescribed in subsection (b) should reduce the confusion that has often been experienced in this situation.

This section is different from tiering in that this process does not involve a series of approvals moving from the general to the specific with EIRs omitting issues fully addressed at the earlier stages. The use of a previously prepared EIR is most appropriate where an EIR was prepared earlier for a project very similar to the one currently being examined by the Lead Agency.

### 15154 Projects Near Airports

(a) When a lead agency prepares an EIR for a project within the boundaries of a comprehensive airport land use plan or, if a comprehensive airport land use plan has not been adopted for a project within two nautical miles of a public airport or public use airport, the agency shall utilize the Airport Land Use Planning Handbook published by Caltrans' Division of Aeronautics to assist in the preparation of the EIR relative to potential airport-related safety hazards and noise problems.

(b) A lead agency shall not adopt a negative declaration or mitigated negative declaration for a project described in subsection (a) unless the lead agency considers whether the project will result in a safety hazard or noise problem for persons using the airport or for persons residing or working in the project area.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Section 21096, Public Resources Code.

## Article 11. Types of EIRs Sections 15160 to 15170

### 15160 General

This article describes a number of examples of variations in EIRs as the documents are tailored to different situations and intended uses. These variations are not exclusive. Lead agencies may use other variations consistent with the guidelines to meet the needs of other circumstances. All EIRs must meet the content requirements discussed in Article 9 beginning with Section 15120.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21061, 21100, and 21151, Public Resources Code.

### 15161 Project EIR

The most common type of EIR examines the environmental impacts of a specific development project. This type of EIR should focus primarily on the changes in the environment that would result from the development project. The EIR shall examine all phases of the project including planning, construction, and operation.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21061, 21100, and 21151, Public Resources Code.

### 15162 Subsequent EIRs and Negative Declarations

(a) When an EIR has been certified or a negative declaration adopted for a project, no subsequent EIR shall be prepared for that project unless the lead agency determines, on the basis of substantial evidence in the light of the whole record, one or more of the following:

(1) Substantial changes are proposed in the project which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;

(2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or

(3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR was certified as complete or the negative declaration was adopted, shows any of the following:

(A) The project will have one or more significant effects not discussed in the previous EIR or negative declaration;

(B) Significant effects previously examined will be substantially more severe than shown in the previous EIR;

(C) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or

(D) Mitigation measures or alternatives which are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

(b) If changes to a project or its circumstances occur or new information becomes available after adoption of a negative declaration, the lead agency shall prepare a subsequent EIR if required under subsection (a). Otherwise the lead agency shall determine whether to prepare a subsequent negative declaration, an addendum, or no further documentation.

(c) Once a project has been approved, the lead agency's role in project approval is completed, unless further discretionary approval on that project is required. Information appearing after an approval does not require reopening of that approval. If after the project ~~was~~ is approved, any of ~~prior to the occurrence of~~ the conditions described in ~~S~~subsection (a) occurs, a ~~the~~ subsequent EIR or negative declaration shall only be prepared by the public agency which grants the next discretionary approval for the project, if any. In this situation no other responsible agency shall grant an approval for the project until the subsequent EIR has been certified or subsequent negative declaration adopted.

(d) A subsequent EIR or subsequent negative declaration shall be given the same notice and public review as required under Section 15087 or Section 15072. A subsequent EIR or negative declaration shall state where the previous document is available and can be reviewed.

**Note:** Authority cited: Public Resources Code Sections 21083 and 21087. Reference: Section 21166, Public Resources Code; *Bowman v. City of Petaluma* (1986) 185 Cal. App.3d 1065 ~~(1986)~~; ~~and~~ *Benton v. Board of Supervisors* (1991) 226 Cal.App.3d 1467 ~~(1991)~~; and *Fort Mojave Indian Tribe v. California Department of Health Services et al,* (1995) 38 Cal.App.4th 1574

**Discussion:** This section implements the requirements in Section 21166 of CEQA which limit preparation of a subsequent EIR to certain situations. This section provides interpretation of the three situations in which the statute requires preparation of a subsequent EIR. These interpretations are necessary to add certainty to the process.

This section also clarifies that a subsequent EIR may be prepared where a negative declaration had previously been adopted. Further, a subsequent negative declaration may be adopted where none of the situations described in subsection (a) have occurred.

Subsections (b) and (c) explain which agency would have responsibility for preparing a subsequent EIR under different circumstances. A subsequent EIR must, of course, receive the same circulation and review as the previous EIR.

*Fund for Environmental Defense v. Orange* (1988) 204 Cal.App.3d 1538, contains a discussion of the application of §15162 and §15163. The Court in *Bowman v. Petaluma* (1986) 185 Cal.App.3d 1065 distinguished requirements for a subsequent EIR from the threshold required for initial EIR preparation, saying "whereas §15064 (§21151 PRC) requires an EIR if the initial project may have a significant effect on the environment, §15162 (§21166 PRC) indicates a quite different intent, namely, to restrict the powers of agencies by prohibiting them from requiring a subsequent or supplemental EIR unless "substantial changes" in the project or its circumstances will require major revisions to the EIR. §15162 (§21166 PRC) comes into play precisely because in-depth review has already occurred, the time for challenging the sufficiency of the original EIR has long since expired, and the question is whether circumstances have changed enough to justify repeating a substantial portion of the process.

### 15163 Supplement to an EIR

(a) The lead or responsible agency may choose to prepare a supplement to an EIR rather than a subsequent EIR if:

(1) Any of the conditions described in Section 15162 would require the preparation of a subsequent EIR, and

(2) Only minor additions or changes would be necessary to make the previous EIR adequately apply to the project in the changed situation.

(b) The supplement to the EIR need contain only the information necessary to make the previous EIR adequate for the project as revised.

(c) A supplement to an EIR shall be given the same kind of notice and public review as is given to a draft EIR under Section 15087.

(d) A supplement to an EIR may be circulated by itself without recirculating the previous draft or final EIR.

(e) When the agency decides whether to approve the project, the decision-making body shall consider the previous EIR as revised by the supplemental EIR. A finding under Section 15091 shall be made for each significant effect shown in the previous EIR as revised.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Section 21166, Public Resources Code.

**Discussion:** This section provides a short-form method where only minor additions or changes would be necessary in the previous EIR to make that EIR apply in the changed situation. The section also provides essential interpretations of how to handle public notice, public review, and circulation of the supplement.

A supplement to an EIR may be distinguished from a subsequent EIR by the following: a supplement augments a previously certified EIR to the extent necessary to address the conditions described in section 15162 and to examine mitigation and project alternatives accordingly. It is intended to revise the previous EIR through supplementation. A subsequent EIR, in contrast, is a complete EIR which focuses on the conditions described in section 15162.

### 15164 Addendum to an EIR or Negative Declaration

(a) The lead agency or a responsible agency shall prepare an addendum to a previously certified EIR if some changes or additions are necessary but none of the conditions described in Section 15162 calling for preparation of a subsequent EIR have occurred.

(b) An addendum to an adopted negative declaration may be prepared if only minor technical changes or additions are necessary or none of the conditions described in Section 15162 calling for the preparation of a subsequent EIR or negative declaration have occurred.

(c) An addendum need not be circulated for public review but can be included in or attached to the final EIR or adopted negative declaration.

(d) The decision-making body shall consider the addendum with the final EIR or adopted negative declaration prior to making a decision on the project.

(e) A brief explanation of the decision not to prepare a subsequent EIR pursuant to Section 15162 should be included in an addendum to an EIR, the lead agency's findings on the project, or elsewhere in the record. The explanation must be supported by substantial evidence.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Section 21166, Public Resources Code; *Bowman v. City of Petaluma* (1986) 185 Cal.App.3d 1065 ~~(1986)~~; and *Benton v. Board of Supervisors* (1991) 226 Cal.App. 3d 1467 ~~(1991)~~

**Discussion:** This section is designed to provide clear authority for an addendum as a way of making minor corrections in EIRs and negative declarations without recirculating the EIR or negative declaration.

### 15165 Multiple and Phased Projects

Where individual projects are, or a phased project is, to be undertaken and where the total undertaking comprises a project with significant environmental effect, the lead agency shall prepare a single program EIR for the ultimate project as described in Section 15168. Where an individual project is a necessary precedent for action on a larger project, or commits the lead agency to a larger project, with significant environmental effect, an EIR must address itself to the scope of the larger project. Where one project is one of several similar projects of a public agency, but is not deemed a part of a larger undertaking or a larger project, the agency may prepare one EIR for all projects, or one for each project, but shall in either case comment upon the cumulative effect.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21061, 21100, and 21151, Public Resources Code; *Whitman v. Board of Supervisors*, 88 Cal.App.3d 397 (1979).

**Discussion:** This section follows the principle that the EIR on a project must show the big picture of what is involved. If the approval of one particular activity

could be expected to lead to many other activities being approved in the same general area, the EIR should examine the expected effects of the ultimate environmental changes. This section is consistent with the *Whitman* decision cited in the note interpreting CEQA.

### 15166 EIR as Part of a General Plan

(a) The requirements for preparing an EIR on a local general plan, element, or amendment thereof will be satisfied by using the general plan, or element document, as the EIR and no separate EIR will be required, if:

(1) The general plan addresses all the points required to be in an EIR by Article 9 of these guidelines, and

(2) The document contains a special section or a cover sheet identifying where the general plan document addresses each of the points required.

(b) Where an EIR rather than a negative declaration has been prepared for a general plan, element, or amendment thereto, the EIR shall be forwarded to the State Clearinghouse for review. The requirement shall apply regardless of whether the EIR is prepared as a separate document or as a part of the general plan or element document.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Sections 21003, 21061, 21083, 21100, 21104, 21151, and 21152, Public Resources Code.

**Discussion:** A separate section is provided to authorize combining the general plan document with the EIR. This section allows the use of the general plan document as the EIR if the document contains a special section or a cover sheet identifying where each of the points required in an EIR may be found. This section also identifies the special requirement for an EIR on a general plan to be submitted to the State Clearinghouse for review as a project of areawide, regional, or statewide significance as provided in Section 15207.

### 15167 Staged EIR

(a) Where a large capital project will require a number of discretionary approvals from government agencies and one of the approvals will occur more than two years before construction will begin, a staged EIR may be prepared covering the entire project in a general form. The staged EIR shall evaluate the proposal in light of current and contemplated plans and produce an informed estimate of the environmental consequences of the entire project. The aspect of the project before the public agency for approval shall be discussed with a greater degree of specificity.

(b) When a staged EIR has been prepared, a supplement to the EIR shall be prepared when a later approval is required for the project, and the information available at the time of the later approval would permit consideration of additional environmental impacts, mitigation measures, or reasonable alternatives to the project.

(c) Where a statute such as the Warren-Alquist Energy Resources Conservation and Development Act provides that a specific agency shall be the lead agency for a project and requires the lead agency to prepare an EIR, a responsible agency which must grant an approval for the project before the lead agency has completed the EIR may prepare and consider a staged EIR.

(d) An agency requested to prepare a staged EIR may decline to act as the lead agency if it determines, among other factors, that:

(1) Another agency would be the appropriate lead agency; and

(2) There is no compelling need to prepare a staged EIR and grant an approval for the project before the appropriate lead agency will take its action on the project.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Section 21003, Public Resources Code.

**Discussion:** The staged EIR was developed as a device to deal with the problem of a large development project which would require many years for planning, engineering, and construction but would need a number of approvals from public agencies before the final plans for the project would be available. Where those final plans would not be available, the Lead Agency preparing an EIR for one of the early approvals would have difficulty providing enough information about the project to evaluate the effects of the entire project as would otherwise be required.

The device of the staged EIR provides a special relaxation of the requirement for the EIR on a development project to examine the entire project in detail. To make up for this lack of detail with the early approval, the section requires preparation of a supplement with later approvals when additional information becomes available. The section also allows this device to be used in the troublesome situation where an agency with limited control over the project is asked to grant the first approval for the project long before the normal Lead Agency would be called upon to act. The Responsible Agency needs some document to use in order to comply with CEQA. At the same time, due to its limited control over the project, it would not be a prime candidate for being Lead Agency. This approach allows the Responsible Agency to do a limited EIR examining the effects of its approval but noting in a general way the larger scope of the project and the general environmental effects expected.

### 15168 Program EIR

(a) General. A program EIR is an EIR which may be prepared on a series of actions that can be characterized as one large project and are related either:

(1) Geographically,

(2) As logical parts in the chain of contemplated actions,

(3) In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program, or

(4) As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways.

(b) Advantages. Use of a program EIR can provide the following advantages. The program EIR can:

(1) Provide an occasion for a more exhaustive consideration of effects and alternatives than would be practical in an EIR on an individual action,

(2) Ensure consideration of cumulative impacts that might be slighted in a case-by-case analysis,

(3) Avoid duplicative reconsideration of basic policy considerations,

(4) Allow the lead agency to consider broad policy alternatives and programwide mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts,

(5) Allow reduction in paperwork.

(c) Use with Later Activities. Subsequent activities in the program must be examined in the light of the program EIR to determine whether an additional environmental document must be prepared.

(1) If a later activity would have effects that were not examined in the program EIR, a new initial study would need to be prepared leading to either an EIR or a negative declaration.

(2) If the agency finds that pursuant to Section 15162, no new effects could occur or no new mitigation measures would be required, the agency can approve the activity as being within the scope of the project covered by the program EIR, and no new environmental document would be required.

(3) An agency shall incorporate feasible mitigation measures and alternatives developed in the program EIR into subsequent actions in the program.

(4) Where the subsequent activities involve site specific operations, the agency should use a written checklist or similar device to document the evaluation of the site and the activity to determine whether the environmental effects of the operation were covered in the program EIR.

(5) A program EIR will be most helpful in dealing with subsequent activities if it deals with the effects of the program as specifically and comprehensively as possible. With a good and detailed analysis of the program, many subsequent activities could be found to be within the scope of the project described in the program EIR, and no further environmental documents would be required.

(d) Use with Subsequent EIRs and Negative Declarations. A program EIR can be used to simplify the task of preparing environmental documents on later parts of the program. The program EIR can:

(1) Provide the basis in an initial study for determining whether the later activity may have any significant effects.

(2) Be incorporated by reference to deal with regional influences, secondary effects, cumulative impacts, broad alternatives, and other factors that apply to the program as a whole.

(3) Focus an EIR on a subsequent project to permit discussion solely of new effects which had not been considered before.

(e) Notice with Later Activities. When a law other than CEQA requires public notice when the agency later proposes to carry out or approve an activity within the program and to rely on the program EIR for CEQA compliance, the notice for the activity shall include a statement that:

(1) This activity is within the scope of the program approved earlier, and

(2) The program EIR adequately describes the activity for the purposes of CEQA.

**Note:** Authority cited: Sections 21083 and 21087, Public Resources Code. Reference: Section 21003,

# APPENDIX 8.3

# CURRENT REGULATORY CONTEXT FOR RECYCLED WATER RECHARGE PROJECTS

STATE OF CALIFORNIA - HEALTH AND HUMAN SERVICES AGENCY GRAY DAVIS, Governor

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April 21, 2000

Mr. Dennis Dickerson
California Regional Water Quality Control Board
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Los Angeles, CA 90013

Dear Mr. Dickerson:

SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT

The Upper San Gabriel Valley Municipal Water District (USGVMWD) and the San Gabriel Valley Municipal Water District (SGVMWD) have requested that the State of California, Department of Health Services (Department) consider the San Gabriel Valley Recycled Water Demonstration Project (Demonstration Project) for approval. The Demonstration Project involves the spreading of up to 10,000 acre-feet per year of tertiary treated effluent into the San Gabriel River for groundwater recharge of the San Gabriel Basin. The tertiary treated effluent will come from the San Jose Creek Water Reclamation Plant (SJCWRP), which is operated by the County Sanitation Districts of Los Angeles County (CSDLAC).

Enclosed is a summary of the Department's review and evaluation (Enclosure 1) of the Demonstration Project. The Department has reviewed the "Engineering Report" dated January 1998, the "Groundwater Impact Assessment" dated September 1996, the "Environmental Assessment and Initial Study" dated April 1998, the "Responses to Technical Issues Raised by California Department of Health Services" dated August 1998, the "Responses to the California Department of Health Services letter dated November 17, 1998" dated February 1999, and the Technical Memoranda Nos. 1, 2, and 3 dated January 2000, as later revised, to address the concerns raised at the Department's public hearing held on April 27, 1999. Based on these, the Department recommends that the Los Angeles Regional Water Quality Control Board (LARWQCB) adopt as requirements for the Demonstration Project all of the following conditions on which this Department's findings of non-impairment of the receiving aquifers are based. These conditions are as follows:

RECYCLED WATER QUALITY REQUIREMENTS

1. The recycled water spread shall meet all maximum contaminant levels and requirements as specified in Chapter 15, Title 22, California Code of Regulations (CCR), Domestic Water Quality and Monitoring, Table 64431-A, Section 64443

(Table 4) and Tables 64444-A and 64449-A and B. These requirements are for general mineral, general physical, inorganic chemicals (except nitrogen compounds), radiological chemicals and organic chemicals. The recycled water shall be monitored quarterly prior to spreading. Compliance shall be based on an annual average of quarterly grab or 24-hour composite samples. At least one sample shall be collected and analyzed for all the constituents above prior to the commencement of spreading of recycled water to demonstrate the effectiveness of the treatment process. The results of the analyses shall be submitted to the LARWQCB and the Department prior to the commencement of spreading.

2. The monitoring conducted in accordance with Condition No. 1 above shall include analysis of and reporting for any contaminant for which the Department has established an Action Level (AL). Any result at or above the AL or above a Public Health Goal (PHG) for the constituents listed in Condition No. 1 shall result in submission of a report describing the actions the USGVMWD and the CSDLAC will take to evaluate the sources, the levels, and the means to reliably reduce the levels of the contaminant identified.

3. The SJCWRP, operated by the CSDLAC, will provide the recycled water for the Demonstration Project. The SJCWRP provides disinfected tertiary treated water. The processes at the SJCWRP consists of primary sedimentation, secondary treatment through conventional air activated sludge and clarification, and tertiary treatment consisting of in-line coagulation and direct filtration, followed by disinfection by chlorine gas. Replacement of the equipment specified in the Engineering Report or major modifications to the treatment train as described shall be subject to review and approval by the Department and the LARWQCB.

4. At all times, all recycled water spread shall have been adequately oxidized, filtered, and disinfected.

5. There shall be no bypassing of untreated or partially treated wastewater from the SJCWRP or any intermediate unit processes for groundwater recharge to the San Gabriel River.

SOURCE CONTROL PROGRAM

6. The CSDLAC shall continue to maintain and make more effective their industrial waste pretreatment program to ensure the control of the discharge of toxic wastes from point sources. The pretreatment program is subject to the oversight, regulation, and approval of the United States Environmental Protection Agency (USEPA) and the LARWQCB.

SAN JOSE CREEK WATER RECLAMATION PLANT

7. Within 90 days of issuance of the water reclamation requirements (permit) by the LARWQCB, the monitoring program for the SJCWRP effluent shall be submitted to the LARWQCB and the Department for review and approval. This plan will describe in detail the sampling locations, the types of samples and analyses (including viruses, N-nitrosodimethylamine or NDMA, unregulated organic and inorganic chemicals) and the minimum frequency of analyses for all constituents to be monitored, detection limits and analytical test methods.

8. The effluent from the SJCWRP used for this project shall not exceed a total organic carbon (TOC) of 0.016 g/L (daily sampling), suspended solids (SS) of 15 mg/L (daily sampling), and biochemical oxygen demand (BOD) of 20 mg/L (weekly sampling), after the filtration process, determined from 24-hour composite samples. Compliance with this requirement shall be determined monthly based on the average of the results for all 24-hour samples collected during the month. If the above parameters exceed their respective levels, then the CSDLAC shall submit a report to the Department and the LARWQCB documenting the actions that will be undertaken to bring the parameters back to the appropriate levels and avoid future violations of these requirements.

9. The turbidity of the filtered wastewater shall not exceed an average of 2 Nephelometric Turbidity Units (NTU), based on a daily average of 4-hour readings, 5 NTU more than 5 percent of the time, or 10 NTU at any time. If the turbidity of the recycled water exceeds the respective levels, then the CSDLAC shall submit a report documenting the actions that will be undertaken to bring the turbidity back to the appropriate levels and avoid future violations of these requirements. The turbidity measurements shall be continuous.

10. The disinfected wastewater shall not exceed a 7-day median of 2.2 total coliform organisms per 100 mL and 23 total coliform organisms per 100 mL at any time. A chlorine contact time multiplied by a residual combined chlorine residual (CT) of 450 mg/L-minutes from a combination of SJCWRP CT plus the CT of the pipeline is required unless submitted documentation to the Department substantiates the reliability and effectiveness of virus interaction and coliform destruction at the SJCWRP with CTs less than 450 mg/L-minutes. Failure to meet these requirements shall require the submission of a report describing the cause of the failure and the corrective actions taken to avoid future violations of these requirements. Failure to meet the 7-day median coliform requirements for two consecutive days shall result in the suspension of the spreading of recycled water until such time that the cause of the failure has been identified and corrected.

11. The CSDLAC and /or the USGVMWD shall conduct a study to evaluate the presence of NDMA in SJCWRP recycled water used for groundwater recharge. One sample per quarter shall be collected and analyzed for NDMA after the disinfection process and prior to spreading. At any time NDMA is detected in the SJCWRP product water, resampling shall be implemented to confirm the detection. The study shall consider the effects of treatment, the effects of natural ultra-violet light during percolation, and the effects of soil aquifer treatment on NDMA concentrations. The study shall evaluate the potential sources of NDMA to the SJCWRP including industrial, commercial, residential users of the system and discharges from groundwater cleanups. The study shall consider the impact and significance of the findings and, as determined by the Department, reduction of the level of NDMA in the recycled water. The study and information obtained shall be compiled and submitted to the LARWQCB and the Department.

12. There shall be no cross-connection between the recycled water treatment, distribution or spreading system and the potable water supply. Proper separation and or backflow prevention devices shall be employed as appropriate.

REPORTING REQUIREMENTS

13. All results of analyses for compliance purposes shall be submitted monthly to the Department on a computer disk (or e-mail) and summarized in a Microsoft Excel spreadsheet. Similar submittals shall be made to the LARWQCB in the method as the LARWQCB determines. The data shall be summarized to demonstrate compliance with water recycling requirements.

14. The CSDLAC and the USGVMWD shall submit an annual report of the monitoring results to the LARWQCB and the Department. This report shall include an assessment of the current knowledge of the health effects, research status, analytical methods of the unknown or unquantified contaminants such as drugs and pharmaceuticals, endocrine disruptors, disinfection by-products, viruses, unregulated organic chemicals (Chapter 15, Title 22, CCR, Tables 64450-A, B, and C), unregulated inorganic chemicals (Chapter 15, Title 22, CCR, Table 64450-D), antibiotic resistant bacteria as well as the effects of residual antibiotics on environmental bacteria, and unknown organics.

## RECHARGE SITE REQUIREMENTS

*Maximum Recycled Water Contribution*

15. The total nitrogen concentration of the recycled water spread shall not exceed 10 mg/L as nitrogen prior to reaching the regional groundwater table, based on weekly samples. If the total nitrogen concentration exceeds the 10 mg/L as nitrogen limit, confirmation sampling shall be implemented immediately, within 24 hours. If the average of the original sample and the confirmation sample is greater than 10 mg/L, then the Department, the LARWQCB, and potentially affected public water systems lying within a 5-year time of travel from the monitoring wells shall be notified. Any confirmed exceedance of the 10 mg/L as nitrogen limit shall require the submission of a report documenting the actions that will be undertaken to reduce the level of total nitrogen in the recycled water.

16. The effectiveness of the soil-aquifer treatment shall be verified once per year, and more intensely at the initiation of the Demonstration Project (the first year). This verification shall involve the recharge of 100% recycled water and tracking of the change in the TOC concentration in the groundwater mound over time. The intensive monitoring shall initiate before recharge, when there is no recycled water mound, continue as the recycled water recharge operation is implemented, as the recycled water mound is formed, continue as the steady state is achieved, as the recycled water mound is fully developed, and continue through and beyond the cessation of the recharge operation, as the recycled water mound dissipates. The intensive monitoring shall include, but not be limited to, monitoring of the recycled water mound and defining the limits of the soil aquifer treatment. The recycled water mound shall be monitored at representative locations, such as the location with the highest percolation rate. The intensity of the monitoring program may be reduced at later years as the consistency of the data allows. A monitoring plan for the verification testing shall be developed and submitted to the LARWQCB and the Department for review and approval. The initial plan shall be submitted prior to startup of the Demonstration Project.

    The allowable TOC in the recycled water mound above the regional groundwater table except during the verification testing shall not exceed 5 mg/L. If the TOC exceeds the 5 mg/L TOC limit, the Department and the LARWQCB shall be immediately notified. Further discharge of recycled water shall not occur without approval from the Department.

    During the periods when recycled water is spread (except during the verification testing), weekly samples shall be collected from the mound for TOC analyses. A

determination shall be made of the percent recycled water in the mound at the time of sampling.

17. The Los Angeles County Department of Public Works (LACDPW), who is responsible for spreading local water in the river, shall recharge water to the extent practicable in the San Gabriel River. Refer to the attached map for the spreading area. Also, USGVMWD shall enter into an agreement to have the Mosquito and Vector Control District manage a program to prevent/mitigate possible vectors resulting from this project prior to commencement of spreading.

18. The amount of recycled water spread in the San Gabriel River within a 5-year period shall not exceed 20 percent of the blend of all waters in the river. The percentage of recycled water shall be based on a 5-year average of yearly determinations. Recycled water spreading operations shall be implemented only during times when the San Gabriel River is dry and shall be confined only within the defined recharge spreading area (see the attached schematic).

19. The maximum percentage of recycled water in any aquifer outside a 500-foot radius of the recharge area shall not exceed 20-percent.

20. An operations plan shall be developed and submitted annually by the USGVMWD and the CSDLAC to the LARWQCB and the Department for review and approval. This operations plan shall describe how the maximum percent recycled water requirement of 20-percent will be met for the coming year. This plan shall include, but not be limited to, monitoring wells, recycled water spreading, local water spreading and existing conditions in the groundwater basins. The operations plan shall also include routine testing procedures for the integrity of the recycled water treatment processes, maintenance and calibration schedules for all monitoring equipment, process alarm set points, and response procedures for all alarms. The operations plan shall be subject to the review and approval by the Department and the LARWQCB prior to the commencement of recycled water spreading.

21. The amount of recycled water that is spread in the defined spreading area as shown on the attached map, shall not exceed 10,000 acre-feet per year. Any proposal to increase the amount of recycled water spread shall be accompanied by an engineering report that addresses, at a minimum, treatment process reliability and redundancy, documentation that the project will continue to meet the 20 percent contribution and travel time requirements and an evaluation of cumulative impacts of the groundwater recharge activities.

22. All piping intended to carry recycled water shall be marked or identified in accordance with Section 116815 of the California Health and Safety Code (H&SC). All appurtenances and equipment intended for the delivery of reclaimed shall be identified in accordance with the Guidelines for Distribution of Nonpotable Water published by the California-Nevada Section of the American Water Works Association. All underground piping intended to carry recycled water shall be separated from potable water piping in accordance with Chapter 16 of Title 22, CCR and Department guidelines.

23. The proponents of the project must provide acceptable mitigation measures, such as replacement water supply, that are acceptable to any owner of a well that has been adversely impacted by this Demonstration Project and as approved by the Department.

*Minimum Depth-to-Groundwater Requirement*

24. A minimum depth-to-groundwater of 20 feet must be maintained from the bottom of the San Gabriel River to the top of the water table based on averaging the previous 30 daily depth-to-groundwater measurements taken when recycled water is being discharged into the San Gabriel River. Anytime the average depth-to-groundwater is less than 20 feet, the discharge of recycled water into the San Gabriel River shall be suspended until the depth-to-groundwater measurement exceeds 20 feet.

*Minimum Retention Time Underground and Horizontal Separation*

25. An ordinance, resolution or other means shall be adopted to prevent the use of groundwater for drinking water within an area where the retention time is less than 6 months, the amount of recycled water is greater than 20 percent, and within 500 horizontal feet of the recycled water spreading area, whichever is farthest, prior to commencement of spreading.

26. The recycled water shall be retained underground for a minimum of 6 months prior to being withdrawn at a domestic water supply well. Determination of retention time shall include monthly monitoring for general mineral concentrations at all monitoring wells and potentially affected downgradient domestic wells. Detailed procedures for determining retention time shall be included in the operations plan.

27. The horizontal separation from the San Gabriel River to the nearest domestic water supply well shall be greater than 500 feet, or the estimated 6-month travel distance, or where the aquifer has less than 20 percent recycled water,

whichever is the greatest distance. The area of separation shall be referred to as the "no-pump zone".

*Monitoring Wells*

28. Daily samples shall be collected from the recycled water mound monitoring and sampling wells, SW-A and SW-B, located in the recharge water mound, and analyzed for TOC. Samples shall also be collected weekly and analyzed for total nitrogen. These wells shall be constructed to collect samples from the recycled water mound above or at the top of the groundwater table.

29. Samples shall be collected from monitoring wells 1, 2, 3, 4, and 5, located along the banks of the San Gabriel River, at least monthly and analyzed for TOC. Samples shall also be collected weekly and analyzed for total nitrogen. As a minimum, the monitoring wells shall be located at points one quarter and one-half of the distance (plus or minus ten percent) from the recharge area to the nearest domestic water supply well.

30. The depth-to-groundwater shall be measured every day reclaimed water is present in the San Gabriel River by 5 existing monitoring wells located within 100 feet of the recharge area.

ENGINEERING REPORT

31. The USGVMWD shall submit an engineering report to the Department and the LARWQCB after one year of recycled water spreading operation to document and demonstrate that the criteria for treatment provided, effluent quality and quantity of recycled water spread, retention time underground and distance to the point of extraction are being met.

32. After five years of operation, the USGVMWD shall submit a completed engineering report to the LARWQCB and the Department evaluating the compliance with the minimum retention time underground and the maximum recycled water contribution requirements.

These recommendations are only for the duration of the demonstration study. After reviewing the engineering report required in Condition No. 32 above, the Department will make recommendations regarding future recharge activities in the San Gabriel River. The aforementioned conditions and the finding of non-impairment of the groundwater aquifer are based upon current knowledge. If conditions change or future information shows otherwise, the Department may recommend modification or cessation of the recharge project.

We would be available to discuss these recommendations prior to and during the Board meeting when this item is scheduled.

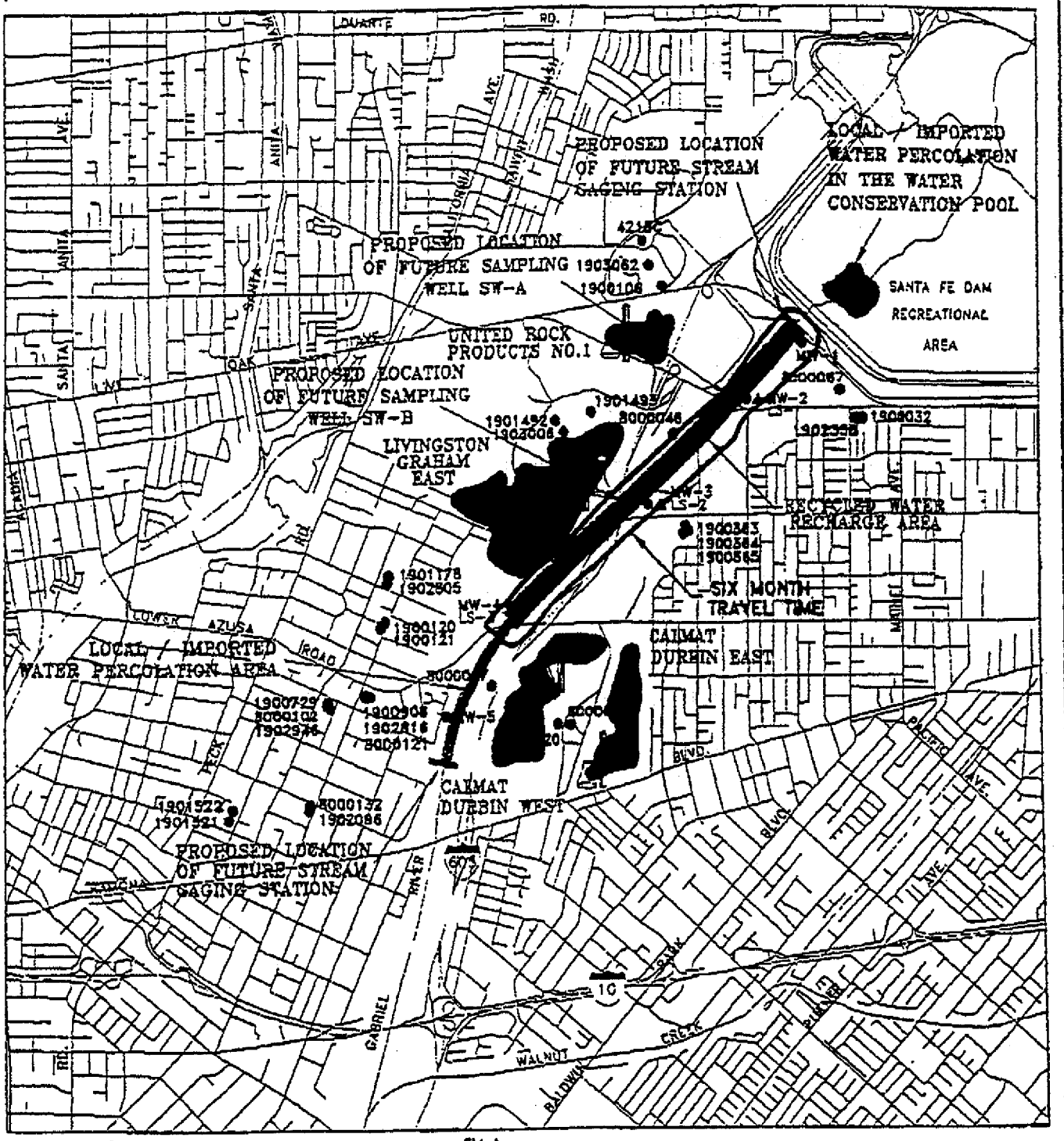
Sincerely,

Gary H. Yamamoto

Gary H. Yamamoto, P.E. Chief
South Coastal Region
Drinking Water Field Operations Branch

Enclosure (1)

cc: USGVMWD
SGVMWD
CSDLAC
LACDPW
ASL Consulting Engineers, Inc.




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**UPPER SAN GABRIEL / SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICTS**

# SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT

# SUMMARY OF THE DEPARTMENT OF HEALTH SERVICES REVIEW AND EVALUATION OF THE SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT

Enclosure No. 1

# SUMMARY OF THE DEPARTMENT OF HEALTH SERVICES REVIEW AND EVALUATION OF THE SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT

The Upper San Gabriel Valley Municipal Water District (USGVMWD) and the San Gabriel Valley Municipal Water District (SGVMWD) have requested that the State of California, Department of Health Services (Department) consider the San Gabriel Valley Recycled Water Demonstration Project (Demonstration Project) for approval. The Demonstration Project involves the spreading of up to 10,000 acre-feet per year of tertiary treated effluent into the San Gabriel River for groundwater recharge of the San Gabriel Basin. The tertiary treated effluent will come from the San Jose Creek Water Reclamation Plant (SJCWRP), which is operated by the County Sanitation Districts of Los Angeles County (CSDLAC).

This is a summary of the Department's review and evaluation of the Demonstration Project. The Department has reviewed the "Engineering Report" dated January 1998, the "Groundwater Impact Assessment" dated September 1996, the "Environmental Assessment and Initial Study" dated April 1998, the "Responses to Technical Issues Raised by California Department of Health Services" dated August 1998, the "Responses to the California Department of Health Services Letter Dated November 17, 1998" dated February 1999.

On April 27, 1999, the Department conducted a public hearing in El Monte, California to consider the USGVMWD and the SGVMWD Demonstration Project. The hearing panel included:

Hearing Officer:
Gary H. Yamamoto, P.E., Chief of the South Coastal Region of the Drinking Water Field Operation Branch, Department of Health Services.

Panel Members:
Robert G. Berlien, P.E., General Manager of the USGVMWD
Michael G. Hoover, P.E., Program Manager, HYA/Dames & Moore Company
Tom Peters, Project Consultant, CH2M Hill
Earle Hartling, County Sanitation Districts of Los Angeles County

A presentation of the proposed Demonstration Project was made by Robert G. Berlien. This was followed by statements made by members of the audience in attendance. A complete recording of the hearing is available at the USGVMWD/SGVMWD. In addition, written comments were received during a two week period following the hearing. The written comments are also available for review.

In a letter to Mr. Berlien dated August 18, 1999, Mr. Yamamoto indicated that there were several issues mentioned in the public hearing and subsequent written comments that should be addressed by the project proponents through the development of technical memos. In January 2000, ASL Consulting Engineers (ASL) submitted three technical memos addressing the issues that had been raised. These memos comprise part of the written record of the hearing and the basis for the Findings of Fact attached hereto.

**FINDINGS OF FACT**
**IN REGARD TO THE SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT**

1. Section 60320, Title 22, of the California Code of Regulations (CCR), requires that recycled water may only be used for groundwater recharge of domestic water supply aquifers by surface spreading if the Department finds that the recharge water will be at all times of a quality that fully protects public health.

2. Section 60320, Title 22, CCR, requires the Department to make recommendations to the California Regional Water Quality Control Board after conducting a public hearing and considering all relevant aspects including treatment provided, effluent quality and quantity, spreading area operations, soil characteristics, hydrogeology, residence time and distance to withdrawal.

3. The San Gabriel Valley water supply consists of both groundwater and imported Colorado River and State Water Project water. As imported water becomes more expensive and less accessible, and the population in the area increases, the Upper San Gabriel Valley Municipal Water District and the San Gabriel Valley Municipal Water District are pursuing water recycling projects so that the San Gabriel Valley is less dependent on an imported water supply.

4. The San Gabriel Valley Recycled Water Demonstration Project (Demonstration Project) involves recharging of up to 10,000 acre-feet of recycled water per year into the Main San Gabriel Groundwater Basin (Basin) through the San Gabriel River for five years. At the end of the five years of operation, the USGVMWD/SGVMWD will submit a complete engineering report to the LARWQCB and the Department to demonstrate that the recharge of recycled water does not significantly affect the hydrogeology, water quality, and management of water resources in the Basin.

5. In January 1998, a draft Engineering Report was prepared for the Demonstration Project. Subsequent to its submittal, two additional documents were prepared: "Responses to Technical Issues Raised by California Department of Health Services" dated August 1998, and "Responses to California Department of Health Services Letter dated November 17, 1998" dated February 1999. In January 2000, three additional technical memos were prepared to address issues and concerns raised during the public hearing (April 27, 1999) process and contained in a letter from the Department to USGVMWD dated August 18, 1999. The additional documents modify or expand for clarification certain elements of the Engineering Report and address the status of issues raised during the public hearing process.

6. The monitoring program for the Demonstration Project is described in Section 10 of the "Draft Engineering Report for the San Gabriel Valley Recycled Water Demonstration Project" dated January 1998.

7. The San Jose Creek Water Reclamation Plant (SJCWRP), operated by the County Sanitation Districts of Los Angeles County (CSDLAC), will provide the recycled water for the Demonstration Project. The SJCWRP provides disinfected tertiary treated water. The processes at the SJCWRP consist of primary sedimentation, secondary treatment through conventional air activated sludge and clarification, and tertiary treatment consisting of in-line coagulation and direct filtration, followed by disinfection by chlorine gas.

8. The recycled water leaving the SJCWRP meets all drinking water chemical standards.

9. The CSDLAC has established an industrial waste pretreatment program to ensure in part that their treatment facilities comply with waste discharge and water reclamation requirements. The source control program has been approved by the U.S. Environmental Protection Association (EPA).

10. Daily monitoring of the SJCWRP final effluent indicates that the daily average turbidity has ranged from 0.7 Nephelometric Turbidity Units (NTU) to 2.7 NTU over the period of 1/1/96 to 12/31/98.

11. A chlorine contact time multiplied by a residual combined chlorine residual (CT) of 450 mg/L-minutes can be obtained by combining the CT from the SJCWRP with the CT of the project transmission pipeline. However, CSDLAC has submitted documentation to the Department regarding the reliability and effectiveness of the virus inactivation and coliform destruction performance of the disinfection process utilized at SJCWRP with CTs less than 450 mg/L-minutes.

12. Daily monitoring of the SJCWRP final effluent indicates that the total coliform MPN per 100 ml has ranged from <1 to 158 over the period of 1/1/96 to 12/31/98, but that the 7-day median limit of 2.2 coliforms per 100 mL has not been exceeded. Only one confirmed positive virus identification has been made during the past 20 years with over 1,000 analyses performed.

13. Many in the scientific community have raised the issue of the development of antibiotic-resistant bacteria because of the extensive and sometimes improper use of antibiotics by people or in cleaning products. However, antibiotic resistant bacteria have not been found to be resistant to standard wastewater disinfection practices and properly treated wastewater effluent is not considered to be a pathway for their dissemination or propagation.

    Concern has also been expressed for the possibility that unreacted antibiotics may pass through wastewater treatment facilities and enter the environment, thereby exposing natural bacteria to extremely low levels of antibiotics. It has been hypothesized that natural bacteria exposed to antibiotics in this manner

may become resistant to the antibiotics and therefore be able to survive more effectively in the environment or in mammals with which they may come into contact. There is no known field data to substantiate this hypothesis, but the issue will be kept under surveillance.

14. To ensure that the SJCWRP West is producing water that meets the requirements contained in the RWQCB permit, CSDLAC proposes to analyze the constituents listed in the proposed draft Title 22 regulations during operation of the Demonstration Project. In addition, a draft operations plan titled "Filtration, Coagulation and Chlorination Alarms" describes the alarms for secondary effluent, effluent filters and disinfection system that directly relate to the production of high quality effluent for groundwater replenishment. This draft is contained in Section 4 of "Responses to California Department of Health Services Letter Dated November 17, 1998".

15. Recycled water contains varying amounts of unidentified trace organic compounds depending on the degree of treatment applied. The long-term health effects of the unidentified organic chemicals are not known. A Scientific Advisory Panel (SAP) assembled by the State of California to evaluate the recharge of groundwater with recycled water recommended in its 1987 report that the amount of organic chemicals in recycled water used to recharge groundwater used for drinking be limited because of health concerns.

16. In the absence of a generally accepted measure of organic compounds of public health significance, Total Organic Carbon (TOC) is considered by the Department to be a reasonable surrogate measure of the organic chemicals present in wastewater after treatment.

17. The SAP indicated that reducing TOC to one mg/L or less would minimize concern about the presence of individual chemicals that could pose a threat to health. The Department concurs with the SAP and that no domestic water supply well should extract groundwater with more than one mg/L TOC of wastewater origin.

18. Monitoring of the SJCWRP West effluent indicates that the TOC has ranged from 7.68 mg/L to 12 mg/L during the period of January 1996 to December 1998. Data from historic reclaimed water spreading operations indicates that TOC is significantly reduced during the percolation of the water through the unsaturated zone as well as during travel through aquifers.

19. Extremely low concentrations (parts per trillion) of drugs and pharmaceuticals, including endocrine disrupters, have been detected in streams, water supplies, and wastewater effluents in recent years. The U. S. Food and Drug Administration requires manufacturers to use models to predict environmental concentrations for drugs and to conduct an environmental assessment if

concentrations are expected to exceed 1 part per billion (ppb). There is currently no information on whether low level exposure through drinking water has any health implications. Research studies to evaluate such potential risks are currently being designed and will be initiated by year 2001. At this time, there is no reason to believe that products that are considered safe to ingest at high concentrations will cause any adverse health reaction at extremely low concentrations.

20. Concerns have been raised over the possible occurrence of low concentrations of organic compounds in reclaimed water that may have health significance as cancer causing agents at very high concentrations. Three that are currently being reviewed are perchlorate, methyl-tertiary-butyl ether (MTBE) and nitrosodimethylamine (NDMA). Perchlorate has not been found in the SJCWRP effluent based on a detection limit of 4 ug/L. MTBE is occasionally found but at concentrations that average less than the current secondary MCL of 5 ug/L. NDMA has been found in secondary effluent at concentrations from 5 to 38 ng/L but is not found in detectable concentrations in the spreading basins or in well waters after percolation. Additional research work will be done regarding the risks and persistence of NDMA during the operation of the demonstration project.

21. Draft Title 22 regulations include the criteria that the percentage of reclaimed water in drinking water aquifers must not be greater than 20 percent over a five year period (i.e. the ratio of reclaimed water to native groundwater at a potable water well must not exceed more than one part in five).

22. The USGVMWD performed infiltration tests at eight test sites located between the Santa Fe Dam and Ramona Boulevard. Test results indicate that initial (within the first hour) infiltration rates of soils tested range from 3 to 85 feet per day. The rate of 85 feet per day occurred in an area characterized by relatively uniform grain-sized sand just downstream of one of the several drop structures along the subject reach of the river. A subsequent test was performed in an area adjacent to this test site and the percolation rate was less than 36 feet per day.

23. The draft Title 22 revisions propose that the maximum permissible initial infiltration rate for surface spreading of recycled water will be 36 feet per day. Because this rate was exceeded at one of the test sites, it was instead agreed by the Department and USGVMWD to establish a TOC removal/performance requirement.

24. Monitoring of the SJCWRP West effluent indicates that the Total Nitrogen level has ranged from 11.07 mg/L to 19.01 mg/L during the period of January 1996 to December 1998.

25. The monitoring wells used for monitoring TOC will be used for weekly sampling of nitrogen concentration. These wells will be used to demonstrate that the Total Nitrogen content of the recycled water is less than the MCL of 10 mg/L prior to reaching the groundwater table.

26. For the Demonstration Project, the Department requires that the depth-to-groundwater must be at least 20 feet below the bottom of the San Gabriel River.

27. It is predicted that the height of water table mounding from the Demonstration Project will be well below (approximately 30 feet) the minimum depth-to-groundwater requirement of 20 feet. However, this depth will be monitored daily during the operation of the Demonstration Project utilizing data collected from five wells within 100 feet of the recharge area.

28. Establishment of the no-pumping zone will insure that there are no potable water supply wells within the 6-month travel area, 20 percent recycled water content, or 500 horizontal feet (which ever is the greater). The reclaimed water produced at any potable water well will traveled through the aquifer for longer than the required 6 months.

29. The USGVMWD and San Gabriel Valley Mosquito and Vector Control District (MVCD) have agreed to enter into an agreement to have the MVCD manage a program to prevent/mitigate mosquitoes, black flies, and any other possible vectors that may result from the Demonstration Project upon receiving regulatory approval.

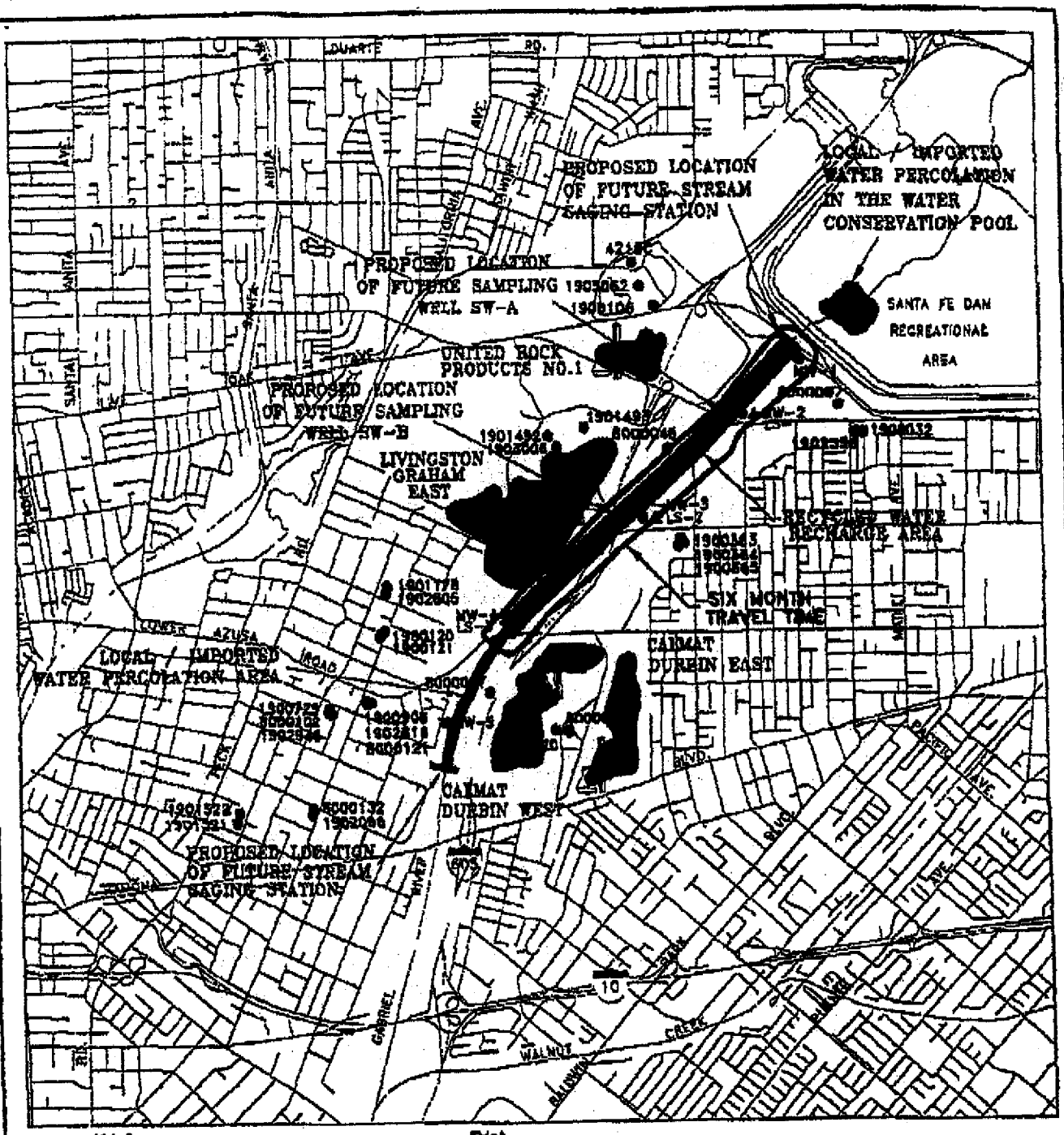
30. The project will not violate any tenants of current environmental justice concerns because it will impact a large area and will not adversely impact any specific sub-group.

Gary H. Yamamoto

Apr. 21, 2000

Gary H. Yamamoto, P.E., Chief
South Coastal Region
Drinking Water Field Operations Branch
Department of Health Services Hearing Officer

Date




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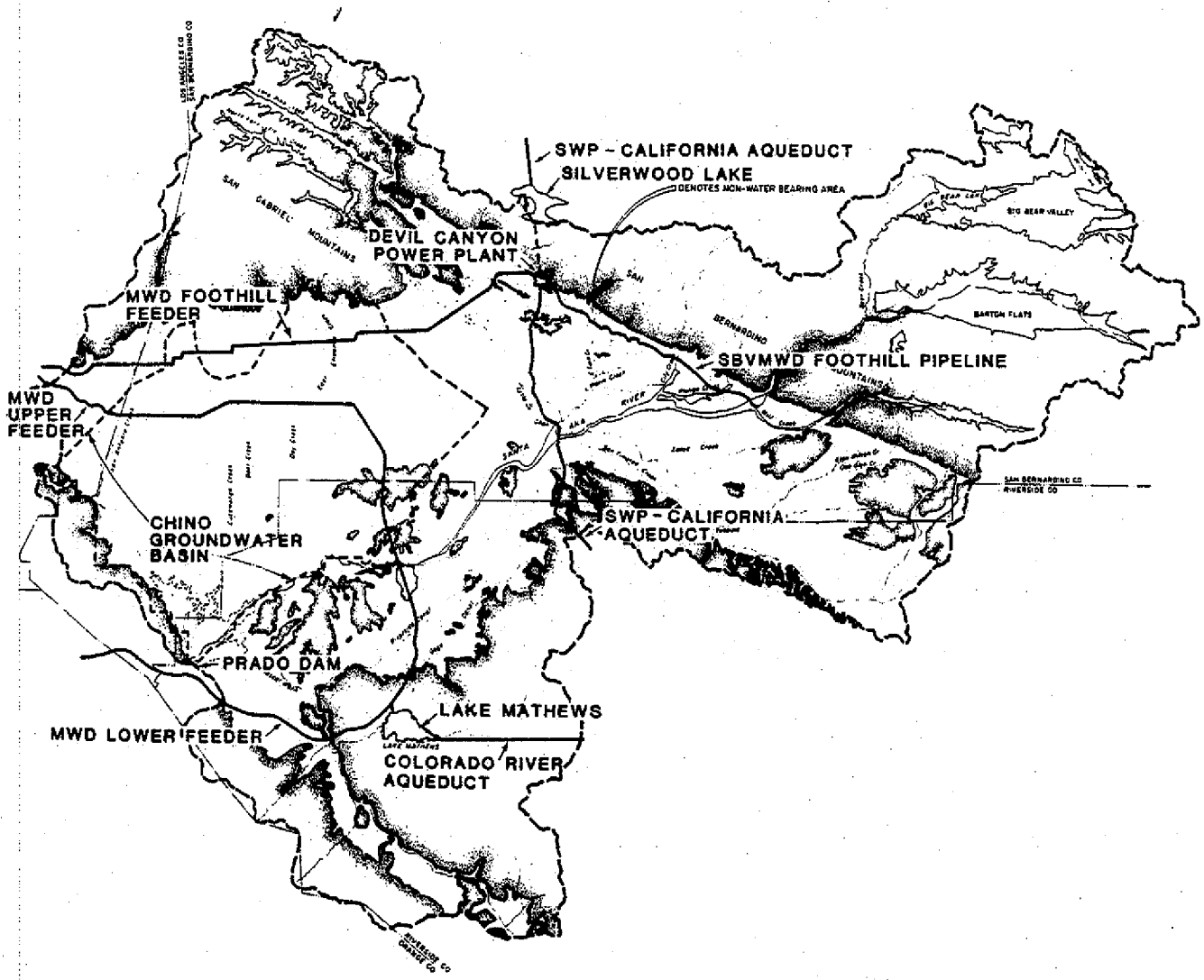
UPPER SAN GABRIEL / SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICTS

# SAN GABRIEL VALLEY RECYCLED WATER DEMONSTRATION PROJECT

# APPENDIX 8.4

# MWDSC'S CHINO BASIN GROUNDWATER STORAGE EIR'S BIOLOGICAL SECTION

# CHINO BASIN GROUNDWATER STORAGE PROGRAM
# DRAFT ENVIRONMENTAL IMPACT REPORT




METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

JUNE 1988

REPORT NUMBER 975

Conservation alternatives at Prado Reservoir include the allowance of a maximum conservation pool of 514 ft above MSL rather than 512 ft above MSL (USACE, 1986). However, the previous feasibility study indicated that it was more economical to increase the diversion and recharge capacity of the spreading basins than to further increase the height of Prado Dam only for conservation benefits.

## EXISTING BIOLOGICAL RESOURCES

This section describes biological resources in areas potentially affected by the Storage Program. These include Prado Basin and the Santa Ana River, along the Chino Valley Pipeline alignment, at existing spreading basins, and in proposed well field areas.

### Prado Basin And Santa Ana River

The Storage Program area lies 30 to 40 miles upstream from the mouth of the Santa Ana River. The limited natural history literature available for the area deals almost exclusively with the Prado Basin portion of the area behind Prado Dam. This area could be affected by the Storage Program and is described below.

Prado Basin is defined as the area behind the dam to an elevation of 566 ft; an area of approximately 11,000 acres (Zembal and Kramer, 1984). Over 4,000 acres of this area is covered with riparian vegetation of which 2,000 to 2,500 acres is dense riparian habitat dominated by monotypic willow woodland (Salix goodingii), within the Prado Dam inundation area which historically was not present (USACE, 1980).

The primary effects of the Storage Program will, with increased water storage, be an increase in groundwater level and baseflow in recharge years and a return to existing baseflows and groundwater levels in extraction years when the stored water is

withdrawn from the basin. The magnitude of groundwater storage and/or withdrawal will vary from year-to-year based on SWP water availability for recharge and demand from Metropolitan's member agencies. The baseline condition has been evaluated with these potential effects in mind.

Vegetation and Wildlife Habitat. A total of 311 species of vascular plants, belonging to 65 families, were identified by Zembal and Kramer (1980), who designated 15 habitat types within the Prado Basin. Of these, there are three major vegetational communities within the basin. First is the extensive (>4,000 acres) riparian habitat that occurs in the low lying sections of the basin and along the Santa Ana River and streams running into the basin. The riparian habitat is dominated by extensive stands of black willow (Salix goodingii) with occasional smaller stands of arroyo willow (Salix lasiolepis). There are scattered stands of tall cottonwoods (Populus fremontii) and a single stand of sycamore (Platanus racemosa). The second major vegetation type is upland habitat, found on the surrounding hills, that consists of low shrubs characteristic of coastal sage scrub, plus grasses and exotic weeds, and has been heavily impacted by agriculture and grazing of cattle. A third distinct community consists of the aquatic and semi-aquatic plants living in permanent streams and artificial duck ponds, and in intermittently filled reservoirs and streams within the basin.

Wildlife. The wildlife in the Prado Basin occurs in association with specific habitats and can readily be characterized for the three major vegetational communities discussed above. This section is based on two days of general field work and the recent thorough study of the wildlife within the Prado Basin and adjacent Santa Ana River canyon by the U.S. Fish and Wildlife Service (USFWS) (Zembal and Kramer, 1984), and other references as noted.

The aquatic habitat is host to ten species of fish, but these consist entirely of species introduced either accidentally, such as goldfish (Carassius auratus), or intentionally purpose for sportfishing, such as Brown bullhead (Ictalurus nebulosus), bluegill (Lepomis macrochirus), and largemouth bass (Micropterus salmoides) (Wells and Diana, 1975). Among the amphibians there are also two introduced species, the bullfrog (Rana catesbeiana) and African clawed frog (Xenopus laevis). The latter, a common inhabitant of ponds within the basin, is highly predacious and has caused the near extinction of a number of aquatic species, including the native red-legged frog (Rana aurora), a very rare resident in the basin. The western pond turtle (Clemmys marmorata) is also resident in the basin. Waterbirds associated with the aquatic community include breeding colonies of great blue heron (Ardea herodias) and black-crowned night heron (Nycticorax nycticorax), as well as many wintering species of herons, geese, and 16 species of ducks. Osprey (Pandion haliaetus) have been observed occasionally.

The wildlife of the upland shrublands consists of a variety of reptiles, mammals, and birds characteristic of open areas and grasslands. Among the reptiles is the San Diego horned lizard (Phrynosoma coronatum blainvillei), a category 2 candidate for Federal endangered species listing (Table 4-16). Birds of this habitat include a variety of insectivorous and granivorous species. These include western meadowlark (Sturnella neglecta), western kingbird (Tyrannus vociferans) and several species of sparrows. During winter months, a large number and variety of raptors regularly hunt over the open upland fields within the Prado Basin. These include several sensitive species such as black-shouldered kite (Elanus caeruleus), northern harrier (Cicus cyaneus) and golden eagle (Aquila chrysaetos). Burrowing owls (Athena cunicularia), also considered sensitive, are resident within the grassy areas of the basin, and a flock of Canada geese (Branta canadensis)

TABLE 4-16
LISTING OF SPECIAL STATUS SPECIES
FOUND IN THE STORAGE PROGRAM STUDY AREA

| | Listed Species | | Federal Candidates[3,4] | |
|---|---|---|---|---|
| | Federal[1] | State[2] | Category 1 | Category 2 |
| Bald Eagle | X | X | | |
| Peregrine Falcon | X | X | | |
| Yellow-billed Cuckoo | | X | | X |
| Least Bell's Vireo | | X | X | |
| San Diego Horned Lizard | | | | X |
| Many-stemmed Live-Forever | | | | X |
| Swainson's Hawk | | X | | |

| | Sensitive Species | | Audubon[7] | |
|---|---|---|---|---|
| | FWS[5] | CDFG[6] | Blue List | Special Concern |
| Western Greve | | | X | |
| Double-crested Cormorant | | X | | |
| American Bittern | | | X | |
| Least Bittern | | X | X | |
| White-faced Ibis | X | X | | |
| Turkey Vulture | | | | X |
| Osprey | | X | | X |
| Northern Harrier | | X | X | |
| Sharp-shinned Hawk | | X | X | |
| Cooper's Hawk | | X | | X |
| Red-shouldered Hawk | | | X | |
| Swainson's Hawk | | X | X | |
| Golden Eagle | | X | | |
| Common Barn-owl | | | | X |
| Western Screech-owl | | | | X |
| Burrowing Owl | | X | | X |
| Long-eared Owl | | X | | |
| Willet | | | | X |
| Hairy Woodpecker | | | X | |
| Willow Flycatcher | X | X | X | |
| Bewick's Wren | | | X | |
| Western Bluebird | X | | | X |
| Mountain Bluebird | | | | X |
| Loggerhead Shrike | X | | X | |
| Yellow Warbler | X | X | X | |
| Yellow-breasted Chat | | X | | |

[1]USFWS 1983a
[2]CDFG 1980
[3]USFWS 1983b
[4]USFWS 1983c
[5]USFWS 1982a
[6]Remsen 1979
[7]Tate and Tate 1982
From Zembel and Kramer, 1984

regularly winters in the basin, feeding on shoots of grasses i the upland areas. Mammals of the upland areas include many rodents, with pocket gophers (Thomomys bottae) and California ground squirrel (Spermophilus beecheyi) abundant. Coyote (Canis latrans) is the one common large predator.

The riparian area within the Prado Basin is extensive, coverin the low lying areas just above Prado Dam as well as stream and river channels entering the basin. Most of the riparian habitat is covered by dense monotypic willow woodland. The region regularly inundated behind the dam contains a low diversity of weedy species and dead willows.

Wildlife of the riparian community includes a variety of amphibians, such as garden slender salamander (Batrachoseps major) and Pacific tree frog (Hyla regilla). Mammals within this habitat include bobcat (Felis rufus), mule deer (Odocoileus hemionus), racoon (procyon lotor) and opossum (Didelphis virginians).

Birds are numerous in the willow riparian habitat both as wintering and breeding species. Among the breeding birds are several species of special concern which are considered in the following section. Of the 171 species of birds observed in Prado Basin by Zembal and Kramer (1984), 100 were associated with riparian and open-water habitats. Several species nesting near or on the ground are adversely affected when the willow woodland is inundated during the breeding season. Affected species include common yellowthroat (Geothlypis trichas), song sparrow (Melospiza melodia), yellow-breasted chat (Icteria virens) and least Bell's vireo (Vireo bellii pusillus).

Threatened, Endangered, and Other Special Status Species. Special status species found in the Prado Basin are summarized in Table 4-16. Three species of birds are listed as both State and Federal endangered species: bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus) and least

Bell's vireo, which although listed as a category 2 candidate species in the table from Zembal and Kramer (1984) was listed as Federally endangered in June, 1986. Two other birds, Swainson's hawk (Buteo swainsoni) and yellow-billed cuckoo (Coccyzus americanus) are listed by the State as Endangered; the latter species is also a category 2 candidate for Federal listing. There are two additional category 2 candidate species for Federal listing: the San Diego horned lizard and a plant, the many-stemmed live-forever (Dudleya multicaulis).

An additional 25 species of birds occurring in the Prado Basin are listed as sensitive species by the U.S. Fish and Wildlife Service, California Department of Fish and Game, and/or Audubon Society (Table 4-16). Of the endangered and sensitive species, four species are known to breed in the willow woodland in the Prado Basin: yellow warbler (Dendroica petechia), willow flycatcher (Empidonax traillii), yellow-billed cuckoo, and least Bell's vireo. Least Bell's vireos were more numerous formerly but have been reduced in number throughout their range by two major factors. The common factors adversely impacting these species are loss of riparian habitat throughout their range and decrease in nesting success caused by parasitism from brown-headed cowbirds. Of all the special status species found within the Prado Basin, the least Bell's vireo deserves special attention as Prado basin contains a significant portion of the population of this species and the basin is proposed as critical habitat for the species.

Status of Least Bell's Vireo. The least Bell's vireo (Vireo bellii pusillus) is a small migratory songbird that breeds in riparian habitat from Central California southward into northern Baja California. The species has declined from its abundance in former times due to habitat loss and to brood parasitism by the brown-headed cowbird, a species that has increased in numbers since the introduction of horses and cattle to California. Because of its rarity, the least Bell's vireo was listed as endangered by the State of California in

1980 and as a Federal endangered species on June 2, 1986 (USFWS 1985, 1986). Critical habitat was not designated at the time, but under the Endangered Species Act must be designated within one year of listing of a species.

A species listed as endangered is protected by law from any harassment or harm. Areas designated as critical habitat are protected from disturbance or destruction whether or not vireos are present in the area. The amount of habitat designated as critical habitat is designed to be sufficient for an endangered species to increase in numbers to the point where it no longer requires endangered status.

The proposed critical habitat area for the least Bell's vireo consists of ten areas in Southern California; one in Santa Barbara County, one area (Santa Clara River) that involves both Los Angeles and Ventura Counties, one area (Prado Basin) that involves both Riverside and San Bernardino Counties, and seven areas in San Diego County. These ten proposed critical habitat areas involve about 43,000 acres and include about 75 percent of the known population of least Bell's vireo. The rest of the population occurs scattered in small areas that contain few vireos. A complete survey of one of the San Diego County areas, the Sweetwater River, is underway under the auspices of the San Diego Association of Governments and CALTRANS. This report will be finished in 1987. Although no general surveys of the other proposed critical habitat areas are currently in progress, biological studies of several of the other areas have been completed.

One of the proposed critical habitat areas for least Bell's vireo consists of the Prado Basin and a section of the Santa Ana River immediately upstream from Prado Dam. The proposed critical habitat area includes "All lands below the 543-foot contour....within the Prado Flood control Basin (upstream from Prado Dam)" (USFWS 1985, p. 18972). In addition, map

coordinates that bound about 12 miles of the Santa Ana River upstream from Prado Dam also identify critical habitat area.

At the time the critical areas were proposed, it was thought that "vireos obtain all their survival [sic] needs (food, cover, nest sites, nestling and fledgling protection) within the riparian zone" (USFWS 1985, p. 18971). However, subsequent studies have provided additional information on vireo behavior. When the least Bell's vireo was listed, it was known that "birds forage in riparian and adjoining chaparral habitat" (USFWS 1986, p. 16474). Such foraging in adjoining habitat can extend up to 300 yards from the nest site.

Much of what is known about the behavior of least Bell's vireos was obtained from populations that were reduced in numbers by cowbird parasitism. In the last few years, studies of populations freed from parasitism by programs for trapping cowbirds have revealed additional information about vireo behavior. Some of this information is of great relevance to management plans for the least Bell's vireo.

Recent studies have shown that as vireo nest success increased in an area due to cowbird elimination, the additional vireos tended to nest in the same area where they fledged, increasing the density in that area, rather than colonizing new areas. This phenomenon of site tenacity (preference for the area where an individual was fledged) means that while it will be fairly easy, through the elimination of cowbirds, to increase vireo density in areas where they already exist, it will be harder to get vireos to recolonize other areas of seemingly suitable habitat where they do not now exist. For this reason, plans to increase vireo populations have focused on a few large areas of suitable habitat where vireo populations are currently found rather than on other areas of suitable habitat that lack vireos. When critical habitat areas were proposed, it was known that least Bell's vireos nested preferentially in dense riparian habitat, preferring young willow thickets. As vireo

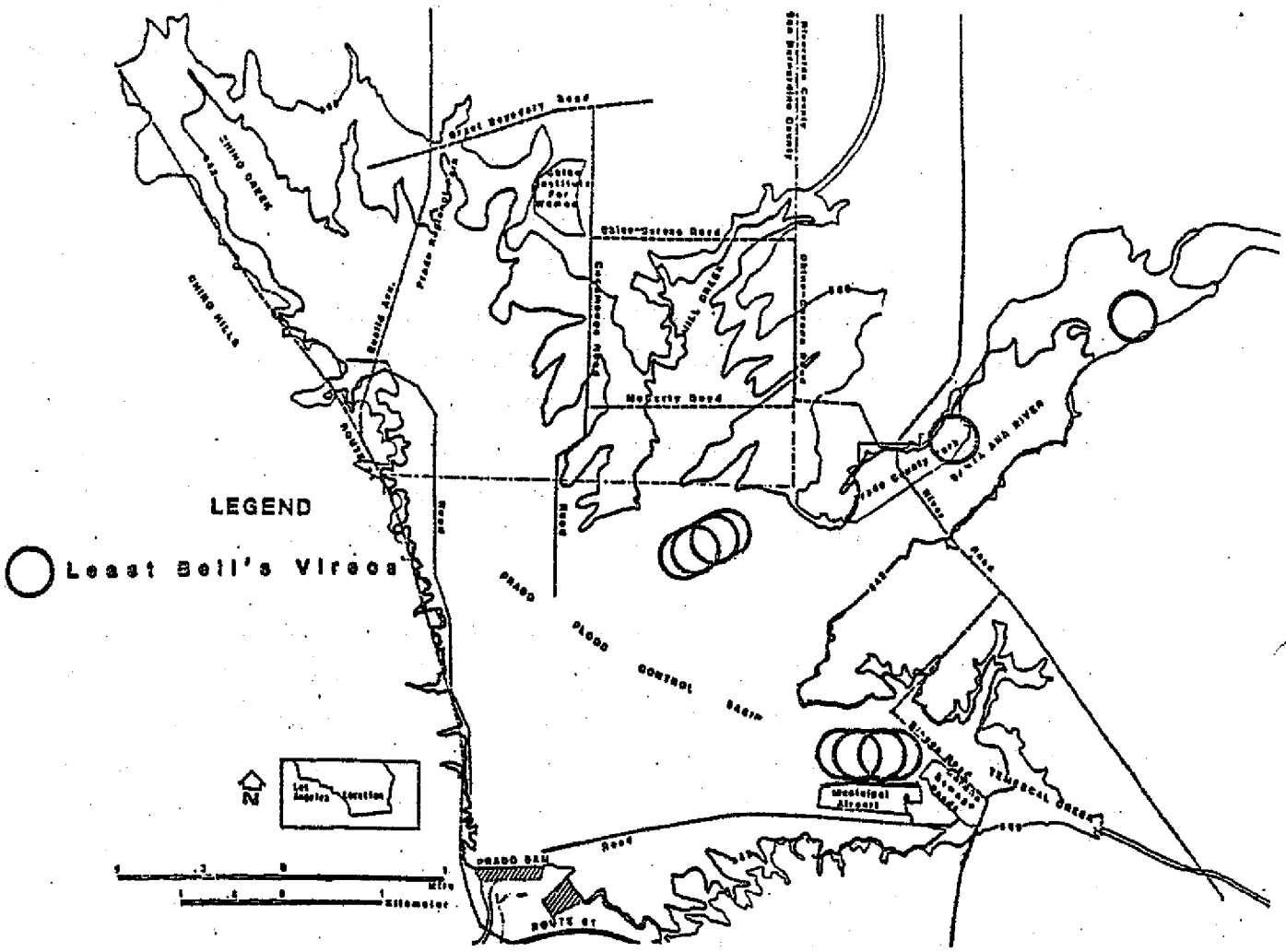
numbers increased with the elimination of cowbirds, vireos were found to be less selective as to riparian habitat type. It would seem that their past preference for young, dense willow thickets was due in part to the vegetational density of this habitat being the best protection against cowbird parasitism. With the elimination of cowbirds, other riparian habitats became acceptable to vireos.

A biological survey of the Prado Basin was conducted by the USFWS during the summer of 1983 (Zembal and Kramer, 1984). This survey found 25 territorial male least Bell's vireos (a singing male is considered evidence of nesting). One of these was in riparian habitat along the Santa Ana River downstream from Prado Dam. All other males were within the proposed critical habitat area within the Prado Basin and along the Santa Ana River upstream of the basin (Figure 4-29).

The Prado Basin is home to one of the four largest remaining populations of least Bell's vireo. As it is also one of the largest areas of riparian habitat among the proposed critical habitat areas, the protection and improvement of this area for least Bell's vireo is an essential part of the recovery plan for this species.

**Chino Valley Pipeline**

For most of its length, the proposed alignment is in existing streets in residential or commercial areas, where no native vegetation or wildlife occur. Only the section between the southern end of Wheeler Avenue and the A.T. and S.F. Railroad right-of-way, where the alignment turns east, traverses an open graded field. This section is approximately 900 feet long. The field is characterized by a mix of native and introduced grasses, providing habitat, between discings, for grassland species of birds and rodents. The habitat is not considered to be significant because of its highly disturbed condition.




SOURCE: ZEMBAL AND KRAMER, 1986, Pg. 43

LOCATION OF TERRITORIAL MALE LEAST BELL'S VIREOS
FIGURE 4-29

If the alignment, alternatively, goes from 3rd and Wheeler, east to Park, then south on Park to Arrow Highway and east, then the entire pipeline would be laid in roadways and no biological resources would be expected to be encountered.

At the eastern end of the pipeline, all three alternatives would place the line in the streets.

For alignments in streets, potentially affected biologic resources would be negligible, the vegetation limited to ornamental plants and non-native grasses, and animals to suburban bird species. No rare, threatened, or endangered species would be impacted.

**Existing Spreading Basins**

If spreading basins were kept full of water and not maintained, a lake and lakeside habitat would develop. Fish do enter the basins from the aqueduct. Because the basins are periodically drained and sediment excavated, and weeds removed to maintain percolation rates, however, such habitat is effectively inhibited. Periodic draining is also necessary to control populations of midge flies and other water-associated flying insects. As a result, the basins are not considered to contain significant biological resources.

**Well Field Areas**

The wellfields have not been precisely defined and well sites have not yet been determined. The general areas are characterized by agriculture, with growing areas of industrial and suburban development. These land uses do not contain significant biological resources because virtually all natural vegetation has been removed.

There should be no loss of agricultural crops as the wells and pipelines would be in existing rights-of-way wherever

possible. The finished wells would each occupy an area perhaps 20 ft by 20 ft adjacent to a roadway. The acreage required for the entire wellfield would be negligible.

## Future Condition Of Biological Resources Without the Storage Program

Prado Reservoir. Future conditions of the riparian and aquatic vegetation and wildlife habitat may remain relatively unaltered in the future. Urbanization in and immediately adjacent to these habitat types in the Prado Basin area is unlikely because the land is owned or controlled by the USACE in the Prado Dam inundation area and the Dairy Trust in the surrounding upland. Urbanization in the upstream portions of San Bernardino County may result in increased flow of reduced water quality. Certain related projects will affect biological resources, as described below.

The proposed Seven Oaks Dam on the upper Santa Ana River would reduce the frequency and magnitude of flooding in the Chino Basin, USACE 1985). Reduced flooding is predicted to decrease the frequency and extent of removal of willows and other riparian vegetation by floods. These changes in surface flow regime should result in an increase in the extent and duration of mature willow woodland in the current riparian zone. There would be a concomitant decrease in the extent of young, dense, willow thickets that develop in the first few years after a flood has scoured away streamside vegetation. Such young dense willows are the preferred habitat of the endangered least Bells' vireo. Specific impacts of the Seven Oaks Dam on the biological resources downstream in the Prado Basin were not considered in the 1985 Final Supplemental Environmental Impact Statement (USACE 1985). Studies to assess the downstream impacts are planned for 1987 by the USACE.

Raising the Prado Dam spillway would significantly increase the potential inundation area behind the dam. Seasonal inundation

of a greater portion of the riparian habitat would reduce the understory species and associated dense near-ground habitat, used by species such as the least Bell's vireo. Inundation during the growing season is known to have serious negative effects on many riparian plant species because of decreased oxygen concentration in the root zone in saturated soil (Teskey and Hinckley 1980). One unpublished study reports that black willows in the central valley of California had 100 percent survival after 60 days of constant total submersion (Walters, et al., 1980). No information on number and size of the willows or season of inundation in the study is available. However, this study suggests that temporary inundation in the winter in Prado Basin would probably not kill willows unless the water was present continuously for significantly more than two months.

Water conservation storage in Prado Reservoir as proposed by OCWD would result in inundation of extensive areas of Prado Basin for up to 10 months per year. Walters, et al. (1980) list black willow as a flood tolerant species, defined by them as "trees which can withstand flooding for most of one growing season. Some new root development can be expected during this period." They list sycamore and cottonwood as intermediately tolerant of flooding, defined by them as "species which are able to survive flooding for periods between one to three months during the growing season. The root systems of these plants may produce few new roots or will be dormant during the flooded period." Consequently, inundation of the duration required by a water conservation project probably would kill all willows and other riparian vegetation inundated and drastically reduce the extent and quality of the willow woodland adversely impacting the many species of vertebrates, including the endangered least Bell's vireo, dependent on willow woodland and extensive areas of associated riparian vegetation. The extensive inundation of the reservoir would probably enhance the use of the area by birds dependent on open water, such as ducks, geese, herons, and egrets.

Chino Valley Pipeline. The future biological conditions in the absence of the project along the Chino Valley Pipeline, at the spreading basins and well field area will be essentially as at present. As the wellfield area develops, land use will continue to change from agriculture to industrial and suburban. Natural biological resources will continue to be essentially absent.

## CULTURAL RESOURCES

In June and July 1987, Scientific Resource Surveys, Inc. (SRS) conducted a literature search, records check, field reconnaissance and prepared a cultural resources survey report for the proposed project facilities sites, and for Prado Dam where cumulative impacts are a consideration. This report is included as Appendix F hereafter, and contains a detailed discussion of the cultural history of the Storage Program area. A summary of the results of these investigations follows.

The cultural resources analysis was organized into several tasks based on the facilities locations proposed and potential related impact areas as outlined below.

- well field and connecting pipelines routes,
- Chino Valley Pipeline alignment,
- Wells along the Etiwanda Pipeline alignment, and
- Prado Basin.

### Well Field and Pipelines

No prehistoric cultural resources were identified within the well field and pipeline potential site areas as a result of the survey. Twenty historical structures more than 50 years old were identified based on stylistic characteristics, but none appear to be significant, based on National Register criteria.

# APPENDIX 8.5

# CALIFORNIA NATIVE PLANT SOCIETY (CNPS) PLANT LIST

*California Department of Fish and Game*
*Natural Diversity Database*

# *SPECIAL PLANTS LIST*

*January 2000*

Citation: California Department of Fish and Game, Natural Diversity Database. January, 2000 Special Plants List. Biannual publication, Mimeo., 119p.

# SPECIAL PLANTS

"Special Plants" is a broad term used to refer to all the plant taxa inventoried by the Department of Fish and Game's California Natural Diversity Database (CNDDB), regardless of their legal or protection status. Special Plant taxa are species, subspecies, or varieties that fall into one or more of the following categories:

- Officially listed by California or the Federal Government as Endangered, Threatened, or Rare;
- A candidate for state or federal listing as Endangered, Threatened, or Rare;
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines;
- A Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Forest Service Sensitive Species;
- Taxa listed in the California Native Plant Society's *Inventory of Rare and Endangered Vascular Plants of California*;
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation;
- Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California; and
- Taxa closely associated with a habitat that is declining in California at an alarming rate (e.g., wetlands, riparian, old growth forests, desert aquatic systems, native grasslands, valley shrubland habitats, vernal pools, etc.).

**This list contains taxa that are actively inventoried by the CNDDB (Note: a "yes" in the right column of the list) as well as an almost equal number of taxa which it tracks but as yet has no computerized site information.** For the latter taxa, we maintain site and other information in manual files. These plants will be added to the computerized inventory as time permits or when we have enough information to determine that they fulfill our rarity and/or endangerment criteria. For more copies of this list or other CNDDB information, call (916) 324-3812.

# ELEMENT RANKING

## GLOBAL RANKING

The *global rank* (G-rank) is a reflection of the overall condition of an element throughout its global range.

### SPECIES OR NATURAL COMMUNITY LEVEL

**G1** = Less than 6 viable element occurrences (EOs) OR less than 1,000 individuals OR less than 2,000 acres.
**G2** = 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres.
**G3** = 21-100 EOs OR 3,000-10,000 individuals OR 10,000-50,000 acres.
**G4** = Apparently secure; this rank is clearly lower than G3 but factors exist to cause some concern; i.e., there is some threat, or somewhat narrow habitat.
**G5** = Population or stand demonstrably secure to ineradicable due to being commonly found in the world.

### SUBSPECIES LEVEL

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.
For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked G2TI. The G-rank refers to the whole species range i.e., *Chorizanthe robusta*. The T-rank refers only to the global condition of var. *hartwegii*.

## STATE RANKING

The *state rank* (S-rank) is assigned much the same way as the global rank, except state ranks in California often also contain a threat designation attached to the S-rank.

**S1** = Less than 6 EOs OR less than 1,000 individuals OR less than 2,000 acres
- S1.1 = very threatened
- S1.2 = threatened
- S1.3 = no current threats known

**S2** = 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres
- S2.1 = very threatened
- S2.2 = threatened
- S2.3 = no current threats known

**S3** = 21-100 EOs or 3,000-10,000 individuals OR 10,000-50,000 acres
- S3.1 = very threatened
- S3.2 = threatened
- S3.3 = no current threats known

**S4** = Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat. NO THREAT RANK.

**S5** = Demonstrably secure to ineradicable in California. NO THREAT RANK.

## Notes:

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a **bird's eye or aerial view** when ranking sensitive elements rather than simply counting EOs.

2. Uncertainty about the rank of an element is expressed in two major ways:

   By expressing the rank as a **range** of values: e.g., S2S3 means the rank is somewhere between S2 and S3.

   By adding a **?** to the rank: e.g., S2? This represents more certainty than S2S3, but less than S2.

3. Other symbols

   - GH — All sites are **historical**; the element has not been seen for at least 20 years, but suitable habitat still exists (SH = All California sites are historical).
   - GX — All sites are **extirpated**; this element is extinct in the wild (SX = All California sites are extirpated).
   - GXC — Extinct in the wild; exists in cultivation.
   - G1Q — The element is very rare, but there are **taxonomic questions** associated with it.

# The California Native Plant Society's (CNPS) Lists and R-E-D Code[1]

1A. Presumed extinct in California
1B. Rare or Endangered in California and elsewhere
2. Rare or Endangered in California, more common elsewhere
3. Plants for which we need more information - Review list
4. Plants of limited distribution - Watch list

**List 1A: Plants presumed Extinct in California**

The 37 plants of List 1A are presumed extinct because they have not been seen or collected in the wild in California for many years. Although most of them are restricted to California, a few are found in other states as well. In many cases, repeated attempts have been made to rediscover these plants by visiting known historical locations. Note the difference between "extinct" and "extirpated." A plant is extirpated if it has been locally eliminated, but it may be doing well elsewhere in its range. The NDDB further splits this group of plants into those that are statewide historical (SH) and those that are extinct in the state (SX).

All of the plants constituting List 1A meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and are eligible for state listing. If these taxa are rediscovered, they should be fully considered during preparation of environmental documents relating the California Environmental Quality Act (CEQA).

**List 1B: Plants Rare, Threatened, or Endangered in California and elsewhere.**

The 857 plants of List 1B are rare throughout their range. All but a few are endemic to California. All of them are judged to be vulnerable under present circumstances or to have a high potential for becoming so because of their limited or vulnerable habitat, their low numbers of individuals per population (even though they may be wide ranging), or their limited number of populations. Most of the plants of List 1B have declined significantly since the arrival of non-indigenous humanity in California.

All of the plants constituting List 1B meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and are eligible for state listing. List 1B plants should be fully considered during preparation of environmental documents relating to CEQA.

**List 2: Plants Rare, Threatened, or Endangered in California, but more common elsewhere**

Except for being common beyond the boundaries of California, the 272 plants of List 2 would have appeared on List 1B. From the federal perspective, plants common in other states or countries are not eligible for consideration under the provisions of the Endangered Species Act. Until 1979, a similar policy was followed in California. However, after the passage of the Native Plant Protection Act, plants were considered for protection without regard to their distribution outside the state.

All of the plants constituting List 2 meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and are eligible for state listing. List 2 plants should be fully considered during preparation of environmental documents relating to CEQA.

**List 3: Plants about which we need more information - A Review list**

The 47 plants that comprise List 3 are united by one common theme--we lack the necessary information to assign them to one of the other lists or to reject them.

Some of the plants constituting List 3 meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and are eligible for state listing. We recommend that List 3 plants be evaluated for consideration during preparation of environmental documents relating to CEQA.

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[1] Excerpted and modified from Skinner, M.W. and B.M. Pavlik. 1994. *CNPS Inventory of Rare and Endangered Vascular Plants of California*, Fifth edition. CNPS Special Publication No. 1, Sacramento, California.

**List 4: Plants of limited distribution - A Watch list**

The 532 plants in this category are of limited distribution or infrequent throughout a broader area in California, and their vulnerability or susceptibility to threat appears low at this time. While CNPS cannot call these plants "rare" from a statewide perspective, they are uncommon enough that their status should be monitored regularly. Should the degree of endangerment or rarity of a List 4 plant change, it will be transferred to a more appropriate list or deleted from consideration.

Very few of the plants constituting List 4 meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act) or Secs. 2062 and 2067 (California Endangered Species Act) of the California Department of Fish and Game Code, and few, if any, are eligible for state listing. Nevertheless, many of them are significant locally, and we recommend that List 4 plants be evaluated for consideration during preparation of environmental documents relating to CEQA. This may be particularly appropriate for the type locality of a List 4 plant, for populations at the periphery of a species' range or in areas where the taxon is especially uncommon or has sustained heavy losses, or for populations exhibiting unusual morphology or occurring on unusual substrates.

**The R-E-D Code**

Even before the publication of the first edition of the *CNPS Inventory*, CNPS determined that attempts to categorize plants solely on the degree of threat, as embodied in such terms as rare, threatened, or endangered, were too restrictive. This is so primarily because the question of rarity frequently interferes with the question of endangerment. With few exceptions, endangered plants are also rare. However, some plants of more widespread occurrence are endangered and their numbers have declined because of commercial or private exploitation for horticultural use. Many cacti, lilies, orchids, succulents, and insectivorous plants fall into this category. In other cases, very rare plants occur in stable habitants such as alpine fell fields. Typically these plants cannot realistically be described as endangered, except perhaps through stochastic extinction associated with small population sizes or numbers.

In an attempt to increase the refinement of assigning plants to categories, CNPS uses a scheme that combines three complementary elements that are scored independently. These components are: **rarity (R)**, which addresses the extent of the plant, both in terms of numbers of individuals and the nature and extent of distribution; **endangerment(E)**, which embodies the perception of the plant's vulnerability to extinction for any reason; and **distribution (D)**, which focuses on the overall range of the plant.

Together these three elements form the R-E-D Code. Each element in the code is divided into three classes or degrees of concern, represented by the numbers 1, 2, or 3. In each case, higher numbers indicate greater concern. The system is summarized as follows:

**R (Rarity)**

1 Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time

2 Distributed in a limited number of occurrences, occasionally more if each occurrence is small

3 Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported

**E (Endangerment)**

1 Not endangered

2 Endangered in a portion of its range

3 Endangered throughout it range

**D (Distribution)**

1 More or less widespread outside California

2 Rare outside California

3 Endemic to California

For example, an R-E-D Code of 3-3-3 indicates that the plant in question is limited to one population or several restricted ones, that it is endangered throughout its range, and that it is endemic to California.

State of California
THE RESOURCES AGENCY
Department of Fish and Game
May 4, 1984
Revised August 15, 1997

# GUIDELINES FOR ASSESSING THE EFFECTS OF PROPOSED DEVELOPMENTS ON RARE AND ENDANGERED PLANTS AND PLANT COMMUNITIES

The following recommendations are intended to help those who prepare and review environmental documents determine when a botanical survey is needed, who should be considered qualified to conduct such surveys, how field surveys should be conducted, and what information should be contained in the survey report. The Department may recommend that lead agencies not accept the results of surveys that are not conducted according to these guidelines.

1. Botanical surveys that are conducted to determine the environmental effects of a proposed development should be directed to all rare, threatened and endangered plants and plant communities. Rare, threatened, and endangered plants are not necessarily limited to those species which have been "listed" by state and federal agencies but should include any species that, based on all available data, can be shown to be rare and/or endangered under the following definitions:

   A species, subspecies, or variety of plant is "endangered" when the prospects of its survival and reproduction are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition, or disease. A plant is "threatened" when it is likely to become endangered in the foreseeable future in the absence of protection measures. A plant is "rare" when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.

   Rare plant communities are those communities that are of highly limited distribution. These communities may or may not contain rare, threatened, or endangered species. The most current version of the California Natural Diversity Data Base's Outline of Terrestrial Communities in California may be used as a guide to the names and status of communities.

2. It is appropriate to conduct a botanical field survey to determine if, or the extent that, rare, threatened, or endangered plants will be affected by a proposed project when:

   a. Based on an initial biological assessment, natural vegetation occurs on the site and it is unknown if rare, threatened, or endangered plants or habitats occur on the site; or

   b. Rare plants have historically been identified on the project site, but adequate information for impact assessment is lacking.

3. Botanical consultants should possess the following qualifications:

   a. Experience conducting floristic field surveys;

   b. Knowledge of plant taxonomy and plant ecology;

   c. Familiarity with the plants of the area, including rare, threatened, and endangered species; and

   d. Familiarity with the appropriate state and federal statutes related to plants and plant collecting.

4. Field surveys should be conducted in a manner that will locate any rare, threatened, or endangered species that may be present. Specifically, rare, threatened, or endangered plant surveys should be:

   a. Conducted in the field at the proper time of year when rare, threatened, or endangered species are both evident and identifiable. Usually, this is when the plants are flowering.

      Additionally, field surveys should be conducted with a sufficient number of visits spaced throughout the growing season to accomplish a floristic survey of the site (see 4.b.). When rare, threatened, or endangered plants are known to occur in the type(s) of habitat present in the project area, nearby accessible occurrences of the plants (reference sites) should be observed to determine that the species are identifiable at the time of the survey.

b. Floristic in nature. A complete species list should be included in every botanical survey report.

c. Conducted in a manner that is consistent with conservation ethics. Collections of rare, threatened, or endangered species, or suspected rare, threatened, or endangered species (voucher specimens) should be made only when such actions would not jeopardize the continued existence of the population and in accordance with applicable state and federal permit requirements. A collecting permit from the Plant Conservation Program of DFG is required for collection of state-listed plant species. Voucher specimens should be deposited at recognized public herbaria for future reference. Photography should be used to document plant identification and habitat whenever possible, but especially when the population cannot withstand collection of voucher specimens.

d. Conducted using systematic field techniques in all habitats of the site to ensure a thorough coverage of potential impact areas.

e. Well documented. When a rare, threatened, or endangered plant (or rare plant community) is located, a California Native Species (or Community) Field Survey Form or equivalent written form, accompanied by a copy of the appropriate portion of a 7.5' minute topographic map with the occurrence mapped, should be completed and submitted to the Natural Diversity Database.

5. Reports of botanical field surveys should be included in or with environmental assessments, negative declarations, EIRs and EISs, and should contain the following information:

a. Project description, including a detailed map of the project location and study area.

b. A written description of biological setting referencing the community nomenclature used and a vegetation map.

c. Detailed description of survey methodology.

d. Dates of field surveys and total person-hours spent on field surveys.

e. Results of survey (including detailed maps).

f. An assessment of potential impacts.

g. Discussion of the importance of rare, threatened, or endangered plant populations with consideration of nearby populations and total species distribution.

h. Recommended measures to avoid impacts.

I. List of all species occurring on the project site.

j. Description of reference site(s) visited and phenological development of rare, threatened, or endangered plant(s).

k. Copies of all California Native Species Field Survey Forms or Natural Community Field Survey Forms.

l. Name(s) of field investigator(s).

l. References cited, persons contacted, herbaria visited, and disposition of voucher specimens.

# California Department of Fish and Game, Natural Diversity Data Base
## Special Plants List

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ABIES AMABILIS*<br>PACIFIC SILVER FIR<br>PGPIN01010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 2<br>**Code:** 211 |
| *ABIES BRACTEATA*<br>BRISTLECONE FIR<br>PGPIN01030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2? | **List:** 4<br>**Code:** 113 |
| *ABIES LASIOCARPA VAR LASIOCARPA*<br>SUBALPINE FIR<br>PGPIN01072 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S3.3 | **List:** 2<br>**Code:** 211 |
| *ABRONIA ALPINA*<br>RAMSHAW MEADOWS ABRONIA<br>PDNYC01020 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ABRONIA MARITIMA*<br>RED SAND-VERBENA<br>PDNYC010E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3? | **List:** 4<br>**Code:** 122 |
| *ABRONIA NANA SSP COVILLEI*<br>COVILLE'S DWARF ABRONIA<br>PDNYC010H1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3T4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *ABRONIA UMBELLATA SSP BREVIFLORA*<br>PINK SAND-VERBENA<br>PDNYC010N2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 222 |
| *ACANTHOMINTHA DUTTONII*<br>SAN MATEO THORN-MINT<br>PDLAM01040 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ACANTHOMINTHA ILICIFOLIA*<br>SAN DIEGO THORN-MINT<br>PDLAM01010 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 232 |
| *ACANTHOMINTHA LANCEOLATA*<br>SANTA CLARA THORN-MINT<br>PDLAM01020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ACANTHOMINTHA OBOVATA SSP CORDATA*<br>HEART-LEAVED THORN-MINT<br>PDLAM01033 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3?<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *ACANTHOMINTHA OBOVATA SSP OBOVATA*<br>SAN BENITO THORN-MINT<br>PDLAM01032 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T3<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *ACHNATHERUM ARIDUM*<br>MORMON NEEDLE GRASS<br>PMPOA5X010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 211 |
| *ACHNATHERUM DIEGOENSE*<br>SAN DIEGO COUNTY NEEDLE GRASS<br>PMPOA5X0B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ACHNATHERUM LEMMONII VAR PUBESCENS*<br>PUBESCENT NEEDLE GRASS<br>PMPOA5X0F2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S1.2? | **List:** 3<br>**Code:** 323 |
| *ACLEISANTHES LONGIFLORA*<br>ANGEL TRUMPETS<br>PDNYC02040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ADOLPHIA CALIFORNICA*<br>CALIFORNIA ADOLPHIA<br>PDRHA01010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.1 | **List:** 2<br>**Code:** 121 |
| *AGAVE SHAWII*<br>SHAW'S AGAVE<br>PMAGA010P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *AGAVE UTAHENSIS*<br>UTAH AGAVE<br>PMAGA010S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3? | **List:** 4<br>**Code:** 122 |
| *AGERATINA SHASTENSIS*<br>SHASTA AGERATINA<br>PDASTBX0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2G3<br>**State:** S2S3 | **List:** 4<br>**Code:** 113 |
| *AGROSTIS BLASDALEI*<br>BLASDALE'S BENT GRASS<br>PMPOA04060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *AGROSTIS CLIVICOLA VAR CLIVICOLA*<br>COASTAL BLUFF BENT GRASS<br>PMPOA040A1 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T3<br>**State:** S3? | **List:**<br>**Code:** |
| *AGROSTIS CLIVICOLA VAR PUNTA-REYESENSIS*<br>PT REYES BENT GRASS<br>PMPOA040A2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T1<br>**State:** S1.2 | **List:**<br>**Code:** |
| *AGROSTIS HENDERSONII*<br>HENDERSON'S BENT GRASS<br>PMPOA040K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1Q<br>**State:** S1.1 | **List:** 3<br>**Code:** 322 |
| *AGROSTIS HOOVERI*<br>HOOVER'S BENT GRASS<br>PMPOA040M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *AGROSTIS HUMILIS*<br>MOUNTAIN BENT GRASS<br>PMPOA040P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ALLIUM ATRORUBENS VAR ATRORUBENS*<br>GREAT BASIN ONION<br>PMLIL02061 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 2<br>**Code:** 211 |
| *ALLIUM BOLANDERI VAR MIRABILE*<br>WONDERFUL ONION<br>PMLIL02093 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5T3<br>**State:** S2? | **List:**<br>**Code:** |
| *ALLIUM FIMBRIATUM VAR PURDYI*<br>PURDY'S ONION<br>PMLIL020Y7 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4T3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ALLIUM HICKMANII*<br>HICKMAN'S ONION<br>PMLIL02140 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ALLIUM HOFFMANII*<br>BEEGUM ONION<br>PMLIL02150 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ALLIUM HOWELLII VAR CLOKEYI*<br>MT. PINOS ONION<br>PMLIL02161 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3? | **List:** 4<br>**Code:** 113 |
| *ALLIUM JEPSONII*<br>JEPSON'S ONION<br>PMLIL022V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ALLIUM MUNZII*<br>MUNZ'S ONION<br>PMLIL022Z0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ALLIUM NEVADENSE*<br>NEVADA ONION<br>PMLIL021J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ALLIUM PARISHII*<br>PARISH'S ONION<br>PMLIL021N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 112 |
| *ALLIUM PENINSULARE VAR FRANCISCANUM*<br>SAN FRANCISCO ONION<br>PMLIL021R1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T2?<br>**State:** S2? | **List:**<br>**Code:** |
| *ALLIUM SANBORNII VAR CONGDONII*<br>CONGDON'S ONION<br>PMLIL02211 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ALLIUM SANBORNII VAR SANBORNII*<br>SANBORN'S ONION<br>PMLIL02212 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *ALLIUM SHARSMITHAE*<br>SHARSMITH'S ONION<br>PMLIL020Y9 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2? | **List:** 1B<br>**Code:** 213 |
| *ALLIUM SHEVOCKII*<br>SPANISH NEEDLE ONION<br>PMLIL022M0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ALLIUM SISKIYOUENSE*<br>SISKIYOU ONION<br>PMLIL02280 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3? | **List:** 4<br>**Code:** 111 |
| *ALLIUM TRIBRACTEATUM*<br>THREE-BRACTED ONION<br>PMLIL022D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ALLIUM TUOLUMNENSE*<br>RAWHIDE HILL ONION<br>PMLIL022W0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ALLIUM YOSEMITENSE*<br>YOSEMITE ONION<br>PMLIL022L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ALOPECURUS AEQUALIS VAR SONOMENSIS*<br>SONOMA ALOPECURUS<br>PMPOA07012 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *AMBROSIA CHENOPODIIFOLIA*<br>SAN DIEGO BUR-SAGE<br>PDAST0C080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.1 | **List:** 2<br>**Code:** 221 |
| *AMBROSIA PUMILA*<br>SAN DIEGO AMBROSIA<br>PDAST0C0M0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *AMMOSELINUM GIGANTEUM*<br>DESERT SAND-PARSLEY<br>PDAPI05020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** SH | **List:** 2<br>**Code:** 311 |
| *AMSINCKIA GRANDIFLORA*<br>LARGE-FLOWERED FIDDLENECK<br>PDBOR01050 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *AMSINCKIA LUNARIS*<br>BENT-FLOWERED FIDDLENECK<br>PDBOR01070 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *AMSINCKIA VERNICOSA VAR FURCATA*<br>FORKED FIDDLENECK<br>PDBOR01030 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ANDROSACE ELONGATA SSP ACUTA*<br>CALIFORNIA ANDROSACE<br>PDPRI02031 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?T3?<br>**State:** S3.2? | **List:** 4<br>**Code:** 122 |
| *ANDROSACE FILIFORMIS*<br>SLENDER-STEMMED ANDROSACE<br>PDPRI02040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1? | **List:** 2<br>**Code:** 311 |
| *ANDROSTEPHIUM BREVIFLORUM*<br>SMALL-FLOWERED ANDROSTEPHIUM<br>PMLIL06010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ANGELICA CALLII*<br>CALL'S ANGELICA<br>PDAPI07060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *ANTENNARIA FLAGELLARIS*<br>STOLONIFEROUS PUSSYTOES<br>PDAST0H0W0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *ANTENNARIA MARGINATA*<br>WHITE-MARGINED EVERLASTING<br>PDAST0H1G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ANTENNARIA PULCHELLA*<br>BEAUTIFUL PUSSY-TOES<br>PDAST0H1H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ANTENNARIA SUFFRUTESCENS*<br>EVERGREEN EVERLASTING<br>PDAST0H0S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3? | **List:** 4<br>**Code:** 112 |
| *ANTIRRHINUM CYATHIFERUM*<br>DEEP CANYON SNAPDRAGON<br>PDSCR2R010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ANTIRRHINUM OVATUM*<br>OVAL-LEAVED SNAPDRAGON<br>PDSCR2K010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ANTIRRHINUM SUBCORDATUM*<br>DIMORPHIC SNAPDRAGON<br>PDSCR2S070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *ANTIRRHINUM VIRGA*<br>TALL SNAPDRAGON<br>PDSCR2S090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *APHANISMA BLITOIDES*<br>APHANISMA<br>PDCHE02010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 222 |
| *ARABIS ACULEOLATA*<br>WALDO ROCK CRESS<br>PDBRA06010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *ARABIS BLEPHAROPHYLLA*<br>COAST ROCK CRESS<br>PDBRA06040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *ARABIS BODIENSIS*<br>BODIE HILLS ROCK CRESS<br>PDBRA06240 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 212 |
| *ARABIS BREWERI VAR PECUNIARIA*<br>SAN BERNARDINO ROCK CRESS<br>PDBRA06053 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ARABIS COBRENSIS*<br>MASONIC ROCK CRESS<br>PDBRA06080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 311 |
| *ARABIS CONSTANCEI*<br>CONSTANCE'S ROCK CRESS<br>PDBRA06090 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *ARABIS DISPAR*<br>PINYON ROCK CRESS<br>PDBRA060F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.3 | **List:** 2<br>**Code:** 211 |
| *ARABIS FERNALDIANA VAR STYLOSA*<br>STYLOSE ROCK CRESS<br>PDBRA060K2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4T2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *ARABIS HOFFMANNII*<br>HOFFMANN'S ROCK CRESS<br>PDBRA060V0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ARABIS JOHNSTONII*<br>JOHNSTON'S ROCK CRESS<br>PDBRA060Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ARABIS KOEHLERI VAR STIPITATA*<br>KOEHLER'S STIPITATE ROCK CRESS<br>PDBRA060Z2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *ARABIS MACDONALDIANA*<br>MCDONALD'S ROCK CRESS<br>PDBRA06150 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 232 |
| *ARABIS MICROPHYLLA VAR MICROPHYLLA*<br>SMALL-LEAVED ROCK CRESS<br>PDBRA06162 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ARABIS MODESTA*<br>MODEST ROCK CRESS<br>PDBRA06180 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3? | **List:** 4<br>**Code:** 112 |
| *ARABIS OREGANA*<br>OREGON ROCK CRESS<br>PDBRA061A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4Q<br>**State:** S3.3? | **List:** 4<br>**Code:** 111 |
| *ARABIS PARISHII*<br>PARISH'S ROCK CRESS<br>PDBRA061C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARABIS PINZLAE*<br>PINZL'S ROCK CRESS<br>PDBRA06270 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *ARABIS PULCHRA VAR MUNCIENSIS*<br>DARWIN ROCK CRESS<br>PDBRA061M3 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ARABIS PYGMAEA*<br>TULARE COUNTY ROCK CRESS<br>PDBRA061N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G1G2<br>**State:** S1S2 | **List:** 4<br>**Code:** 113 |
| *ARABIS RIGIDISSIMA VAR DEMOTA*<br>CARSON RANGE ROCK CRESS<br>PDBRA061R1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *ARABIS RIGIDISSIMA VAR RIGIDISSIMA*<br>TRINITY MOUNTAINS ROCK CRESS<br>PDBRA061R2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ARABIS SERPENTINICOLA*<br>PRESTON PEAK ROCK CRESS<br>PDBRA061U0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1Q<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ARABIS SHOCKLEYI*<br>SHOCKLEY'S ROCK CRESS<br>PDBRA061V0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *ARABIS TIEHMII*<br>TIEHM'S ROCK CRESS<br>PDBRA06280 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ARCTOMECON MERRIAMII*<br>WHITE BEAR POPPY<br>PDPAP02030 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>222 |
| *ARCTOSTAPHYLOS ANDERSONII*<br>SANTA CRUZ MANZANITA<br>PDERI04030 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2? | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS AURICULATA*<br>MT. DIABLO MANZANITA<br>PDERI04040 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>313 |
| *ARCTOSTAPHYLOS BAKERI SSP BAKERI*<br>BAKER'S MANZANITA<br>PDERI04221 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G2T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ARCTOSTAPHYLOS BAKERI SSP SUBLAEVIS*<br>THE CEDARS MANZANITA<br>PDERI04222 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>Rare | **Global:**<br>**State:** | G2T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS CANESCENS SSP SONOMENSIS*<br>SONOMA MANZANITA<br>PDERI04066 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS CATALINAE*<br>SANTA CATALINA ISLAND MANZANITA<br>PDERI04070 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS CONFERTIFLORA*<br>SANTA ROSA ISLAND MANZANITA<br>PDERI040A0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G1<br>S1 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS CRUZENSIS*<br>ARROYO DE LA CRUZ MANZANITA<br>PDERI040B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS DENSIFLORA*<br>VINE HILL MANZANITA<br>PDERI040C0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ARCTOSTAPHYLOS EDMUNDSII*<br>LITTLE SUR MANZANITA<br>PDERI04260 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS GABRIELENSIS*<br>SAN GABRIEL MANZANITA<br>PDERI042P0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS GLANDULOSA SSP CRASSIFOLIA*<br>DEL MAR MANZANITA<br>PDERI040E8 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *ARCTOSTAPHYLOS GLUTINOSA*<br>SCHREIBER'S MANZANITA<br>PDERI040G0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS HISPIDULA*<br>HOWELL'S MANZANITA<br>PDERI04230 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 4<br>122 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ARCTOSTAPHYLOS HOOKERI SSP FRANCISCANA*<br>FRANCISCAN MANZANITA<br>PDERI040J3 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3TXC<br>SX | **List:**<br>**Code:** | 1A<br>* |
| *ARCTOSTAPHYLOS HOOKERI SSP HEARSTIORUM*<br>HEARST'S MANZANITA<br>PDERI040J4 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G3T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS HOOKERI SSP HOOKERI*<br>HOOKER'S MANZANITA<br>PDERI040J1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3T2<br>S2? | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS HOOKERI SSP MONTANA*<br>MT. TAMALPAIS MANZANITA<br>PDERI040J5 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T2<br>S2.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ARCTOSTAPHYLOS HOOKERI SSP RAVENII*<br>PRESIDIO MANZANITA<br>PDERI040J2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G3T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ARCTOSTAPHYLOS HOOVERI*<br>HOOVER'S MANZANITA<br>PDERI040K0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3? | **List:**<br>**Code:** | 4<br>113 |
| *ARCTOSTAPHYLOS IMBRICATA*<br>SAN BRUNO MOUNTAIN MANZANITA<br>PDERI040L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ARCTOSTAPHYLOS KLAMATHENSIS*<br>KLAMATH MANZANITA<br>PDERI041R0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS LUCIANA*<br>SANTA LUCIA MANZANITA<br>PDERI040N0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ARCTOSTAPHYLOS MALLORYI*<br>MALLORY'S MANZANITA<br>PDERI04065 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3Q<br>S3.3? | **List:**<br>**Code:** | 4<br>113 |
| *ARCTOSTAPHYLOS MANZANITA SSP LAEVIGATA*<br>CONTRA COSTA MANZANITA<br>PDERI04273 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2<br>S2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS MENDOCINOENSIS*<br>PYGMY MANZANITA<br>PDERI04280 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G1<br>S1? | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS MEWUKKA SSP TRUEI*<br>TRUE'S MANZANITA<br>PDERI041P0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?T3Q<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *ARCTOSTAPHYLOS MONTARAENSIS*<br>MONTARA MANZANITA<br>PDERI040L2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ARCTOSTAPHYLOS MONTEREYENSIS*<br>MONTEREY MANZANITA<br>PDERI040R0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ARCTOSTAPHYLOS MORROENSIS*<br>MORRO MANZANITA<br>PDERI040S0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 233 |
| *ARCTOSTAPHYLOS MYRTIFOLIA*<br>IONE MANZANITA<br>PDERI04240 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARCTOSTAPHYLOS NISSENANA*<br>NISSENAN MANZANITA<br>PDERI040V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ARCTOSTAPHYLOS NORTENSIS*<br>DEL NORTE MANZANITA<br>PDERI04092 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *ARCTOSTAPHYLOS OBISPOENSIS*<br>BISHOP MANZANITA<br>PDERI040X0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3? | **List:** 4<br>**Code:** 113 |
| *ARCTOSTAPHYLOS OSOENSIS*<br>OSO MANZANITA<br>PDERI042S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2? | **List:** 1B<br>**Code:** 333 |
| *ARCTOSTAPHYLOS OTAYENSIS*<br>OTAY MANZANITA<br>PDERI040Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ARCTOSTAPHYLOS PACIFICA*<br>PACIFIC MANZANITA<br>PDERI040Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G?Q<br>**State:** S? | **List:**<br>**Code:** |
| *ARCTOSTAPHYLOS PAJAROENSIS*<br>PAJARO MANZANITA<br>PDERI04100 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *ARCTOSTAPHYLOS PALLIDA*<br>PALLID MANZANITA<br>PDERI04110 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *ARCTOSTAPHYLOS PECHOENSIS*<br>PECHO MANZANITA<br>PDERI04140 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2? | **List:** 1B<br>**Code:** 233 |
| *ARCTOSTAPHYLOS PENINSULARIS SSP PENINSULARIS*<br>PENINSULAR MANZANITA<br>PDERI04151 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2T2<br>**State:** S2? | **List:** 2<br>**Code:** 311 |
| *ARCTOSTAPHYLOS PILOSULA*<br>SANTA MARGARITA MANZANITA<br>PDERI04160 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ARCTOSTAPHYLOS PUMILA*<br>SANDMAT MANZANITA<br>PDERI04180 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ARCTOSTAPHYLOS PURISSIMA*<br>LA PURISIMA MANZANITA<br>PDERI041A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2? | **List:** 1B<br>**Code:** 233 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ARCTOSTAPHYLOS RAINBOWENSIS*<br>RAINBOW MANZANITA<br>PDERI042T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ARCTOSTAPHYLOS REFUGIOENSIS*<br>REFUGIO MANZANITA<br>PDERI041B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2? | **List:** 1B<br>**Code:** 223 |
| *ARCTOSTAPHYLOS REGISMONTANA*<br>KINGS MOUNTAIN MANZANITA<br>PDERI041C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3? | **List:** 4<br>**Code:** 113 |
| *ARCTOSTAPHYLOS RUDIS*<br>SAND MESA MANZANITA<br>PDERI041E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARCTOSTAPHYLOS SILVICOLA*<br>BONNY DOON MANZANITA<br>PDERI041F0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARCTOSTAPHYLOS STANFORDIANA SSP DECUMBENS*<br>RINCON MANZANITA<br>PDERI041G4 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ARCTOSTAPHYLOS STANFORDIANA SSP RAICHEI*<br>RAICHE'S MANZANITA<br>PDERI041G2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2?<br>**State:** S2? | **List:** 1B<br>**Code:** 233 |
| *ARCTOSTAPHYLOS TOMENTOSA SSP DACITICOLA*<br>DACITE MANZANITA<br>PDERI041HD **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ARCTOSTAPHYLOS TOMENTOSA SSP EASTWOODIANA*<br>EASTWOOD'S MANZANITA<br>PDERI041H4 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2?<br>**State:** S2? | **List:** 1B<br>**Code:** 233 |
| *ARCTOSTAPHYLOS TOMENTOSA SSP INSULICOLA*<br>ISLAND MANZANITA<br>PDERI041H5 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ARCTOSTAPHYLOS TOMENTOSA SSP SUBCORDATA*<br>SANTA CRUZ ISLAND MANZANITA<br>PDERI041H7 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ARCTOSTAPHYLOS VIRGATA*<br>MARIN MANZANITA<br>PDERI041K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARCTOSTAPHYLOS VIRIDISSIMA*<br>WHITE-HAIRED MANZANITA<br>PDERI041L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *ARCTOSTAPHYLOS WELLSII*<br>WELLS'S MANZANITA<br>PDERI042B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.1? | **List:** 1B<br>**Code:** 233 |
| *ARENARIA MACRADENIA VAR KUSCHEI*<br>FOREST CAMP SANDWORT<br>PDCAR040K4 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2?<br>**State:** S2? | **List:** 3<br>**Code:** ??3 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ARENARIA PALUDICOLA*<br>MARSH SANDWORT<br>PDCAR040L0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *ARENARIA URSINA*<br>BIG BEAR VALLEY SANDWORT<br>PDCAR040R0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ARGYROCHOSMA LIMITANEA VAR LIMITANEA*<br>CLOAK FERN<br>PPADI0N051 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G7T3T4<br>**State:** S2.3 | **List:** 2<br>**Code:** 311 |
| *ARISTOCAPSA INSIGNIS*<br>INDIAN VALLEY SPINEFLOWER<br>PDPGN0U010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2? | **List:** 4<br>**Code:** 123 |
| *ARNICA CERNUA*<br>SERPENTINE ARNICA<br>PDAST0Q040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ARNICA FULGENS*<br>HILLSIDE ARNICA<br>PDAST0Q090 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2 | **List:** 2<br>**Code:** 311 |
| *ARNICA SORORIA*<br>TWIN ARNICA<br>PDAST0Q0L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S2.3 | **List:** 2<br>**Code:** 211 |
| *ARNICA SPATHULATA*<br>KLAMATH ARNICA<br>PDAST0Q0M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ARNICA VENOSA*<br>SHASTA COUNTY ARNICA<br>PDAST0Q0Q0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ARNICA VISCOSA*<br>MT. SHASTA ARNICA<br>PDAST0Q0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ARTEMISIA PALMERI*<br>SAN DIEGO SAGEWORT<br>PDAST0S160 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2.1 | **List:** 2<br>**Code:** 221 |
| *ASARUM MARMORATUM*<br>MARBLED WILD-GINGER<br>PDARI02070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ASCLEPIAS SOLANOANA*<br>SERPENTINE MILKWEED<br>PDASC021R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ASPIDOTIS CARLOTTA-HALLIAE*<br>CARLOTTA HALL'S LACE FERN<br>PPADI07020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ASPLENIUM SEPTENTRIONALE*<br>NORTHERN SPLEENWORT<br>PPASP021F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S2.3 | **List:** 2<br>**Code:** 311 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ASPLENIUM TRICHOMANES SSP TRICHOMANES*<br>MAIDENHAIR SPLEENWORT<br>PPASP021K2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2.3 | **List:** 2<br>**Code:** 311 |
| *ASPLENIUM TRICHOMANES-RAMOSUM*<br>GREEN SPLEENWORT<br>PPASP02250 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ASTER GREATAE*<br>GREATA'S ASTER<br>PDAST0T1F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ASTER LENTUS*<br>SUISUN MARSH ASTER<br>PDAST0T540 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ASTRAGALUS AGNICIDUS*<br>HUMBOLDT MILK-VETCH<br>PDFAB0F080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS ALBENS*<br>CUSHENBURY MILK-VETCH<br>PDFAB0F0A0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS ALLOCHROUS VAR PLAYANUS*<br>PLAYA MILK-VETCH<br>PDFAB0F0C1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3?Q<br>**State:** S1.2 | **List:** 2<br>**Code:** 221 |
| *ASTRAGALUS ANXIUS*<br>TROUBLED MILK-VETCH<br>PDFAB0FBD0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *ASTRAGALUS ARGOPHYLLUS VAR ARGOPHYLLUS*<br>SILVER-LEAVED MILK-VETCH<br>PDFAB0F0S1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *ASTRAGALUS ATRATUS VAR MENSANUS*<br>DARWIN MESA MILK-VETCH<br>PDFAB0F0Z3 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ASTRAGALUS BICRISTATUS*<br>CRESTED MILK-VETCH<br>PDFAB0F1A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ASTRAGALUS BRAUNTONII*<br>BRAUNTON'S MILK-VETCH<br>PDFAB0F1G0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ASTRAGALUS BREWERI*<br>BREWER'S MILK-VETCH<br>PDFAB0F1J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ASTRAGALUS CIMAE VAR CIMAE*<br>CIMA MILK-VETCH<br>PDFAB0F231 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *ASTRAGALUS CLARIANUS*<br>CLARA HUNT'S MILK-VETCH<br>PDFAB0F240 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ASTRAGALUS CLEVELANDII*<br>CLEVELAND'S MILK-VETCH<br>PDFAB0F250 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *ASTRAGALUS CROTALARIAE*<br>SALTON MILK-VETCH<br>PDFAB0F2K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ASTRAGALUS DEANEI*<br>DEAN'S MILK-VETCH<br>PDFAB0F2R0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS DOUGLASII VAR PERSTRICTUS*<br>JACUMBA MILK-VETCH<br>PDFAB0F303 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ASTRAGALUS ERTTERAE*<br>WALKER PASS MILK-VETCH<br>PDFAB0FB30 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ASTRAGALUS FUNEREUS*<br>BLACK MILK-VETCH<br>PDFAB0F3K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *ASTRAGALUS GEYERI VAR GEYERI*<br>GEYER'S MILK-VETCH<br>PDFAB0F3M1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *ASTRAGALUS GILMANII*<br>GILMAN'S MILK-VETCH<br>PDFAB0F3R0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3?<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *ASTRAGALUS INSULARIS VAR HARWOODII*<br>HARWOOD'S MILK-VETCH<br>PDFAB0F491 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *ASTRAGALUS INVERSUS*<br>SUSANVILLE MILK-VETCH<br>PDFAB0F4A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ASTRAGALUS JAEGERIANUS*<br>LANE MOUNTAIN MILK-VETCH<br>PDFAB0F4F0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS JOHANNIS-HOWELLII*<br>LONG VALLEY MILK-VETCH<br>PDFAB0F4H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ASTRAGALUS KENTROPHYTA VAR DANAUS*<br>SWEETWATER MOUNTAINS MILK-VETCH<br>PDFAB0F4J2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T2T3<br>**State:** S? | **List:** 4<br>**Code:** 113 |
| *ASTRAGALUS KENTROPHYTA VAR ELATUS*<br>SPINY-LEAVED MILK-VETCH<br>PDFAB0F4J4 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S1.2 | **List:** 2<br>**Code:** 221 |
| *ASTRAGALUS LENTIFORMIS*<br>LENS-POD MILK-VETCH<br>PDFAB0F4P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ASTRAGALUS LENTIGINOSUS VAR ANTONIUS*<br>SAN ANTONIO MILK-VETCH<br>PDFAB0FB92 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1? | **List:**<br>**Code:** | 1B<br>313 |
| *ASTRAGALUS LENTIGINOSUS VAR BORREGANUS*<br>BORREGO MILK-VETCH<br>PDFAB0FB95 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T4T5<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *ASTRAGALUS LENTIGINOSUS VAR COACHELLAE*<br>COACHELLA VALLEY MILK-VETCH<br>PDFAB0FB97 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G5T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS LENTIGINOSUS VAR KERNENSIS*<br>KERN PLATEAU MILK-VETCH<br>PDFAB0FB98 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3?<br>S2.2? | **List:**<br>**Code:** | 2<br>221 |
| *ASTRAGALUS LENTIGINOSUS VAR MICANS*<br>SHINING MILK-VETCH<br>PDFAB0FB9C **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1Q<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ASTRAGALUS LENTIGINOSUS VAR PISCINENSIS*<br>FISH SLOUGH MILK-VETCH<br>PDFAB0FB9E **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>None | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ASTRAGALUS LENTIGINOSUS VAR SESQUIMETRALIS*<br>SODAVILLE MILK-VETCH<br>PDFAB0FB9K **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *ASTRAGALUS LENTIGINOSUS VAR SIERRAE*<br>BIG BEAR VALLEY MILK-VETCH<br>PDFAB0FB9L **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1? | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS LEUCOLOBUS*<br>BIG BEAR VALLEY WOOLLYPOD<br>PDFAB0F4T0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS MACRODON*<br>SALINAS MILK-VETCH<br>PDFAB0F520 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ASTRAGALUS MAGDALENAE VAR PEIRSONII*<br>PEIRSON'S MILK-VETCH<br>PDFAB0F532 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>Endangered | **Global:**<br>**State:** | G3G4T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>222 |
| *ASTRAGALUS MIGUELENSIS*<br>SAN MIGUEL ISLAND MILK-VETCH<br>PDFAB0F5C0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3? | **List:**<br>**Code:** | 4<br>113 |
| *ASTRAGALUS MOJAVENSIS VAR HEMIGYRUS*<br>CURVED-POD MILK-VETCH<br>PDFAB0F5J1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T2<br>SH | **List:**<br>**Code:** | 1A<br>* |
| *ASTRAGALUS MONOENSIS VAR MONOENSIS*<br>MONO MILK-VETCH<br>PDFAB0F5N1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G2T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS MONOENSIS VAR RAVENII*<br>RAVEN'S MILK-VETCH<br>PDFAB0F5N2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T1Q<br>S1.3 | **List:**<br>**Code:** | 1B<br>313 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ASTRAGALUS NEVINII*<br>SAN CLEMENTE ISLAND MILK-VETCH<br>PDFAB0F5X0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS NUTANS*<br>PROVIDENCE MOUNTAINS MILK-VETCH<br>PDFAB0F620 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ASTRAGALUS OOCARPUS*<br>SAN DIEGO MILK-VETCH<br>PDFAB0F6B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ASTRAGALUS OOPHORUS VAR LAVINII*<br>LAVIN'S MILK-VETCH<br>PDFAB0F6C4 **Records in NDDB:** *No* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T1<br>S1 | **List:**<br>**Code:** | 1B<br>322 |
| *ASTRAGALUS PACHYPUS VAR JAEGERI*<br>JAEGER'S MILK-VETCH<br>PDFAB0F6G1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G?T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ASTRAGALUS PAUPERCULUS*<br>DEPAUPERATE MILK-VETCH<br>PDFAB0F6N0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ASTRAGALUS PLATYTROPIS*<br>BROAD-KEELED MILK-VETCH<br>PDFAB0F6X0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S1.2 | **List:**<br>**Code:** | 2<br>221 |
| *ASTRAGALUS PREUSSII VAR LAXIFLORUS*<br>LANCASTER MILK-VETCH<br>PDFAB0F721 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T2T3<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *ASTRAGALUS PREUSSII VAR PREUSSII*<br>PREUSS'S MILK-VETCH<br>PDFAB0F722 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T4<br>S1.2 | **List:**<br>**Code:** | 2<br>311 |
| *ASTRAGALUS PSEUDIODANTHUS*<br>TONOPAH MILK-VETCH<br>PDFAB0F750 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>322 |
| *ASTRAGALUS PULSIFERAE VAR PULSIFERAE*<br>PULSIFER'S MILK-VETCH<br>PDFAB0F783 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>212 |
| *ASTRAGALUS PULSIFERAE VAR SUKSDORFII*<br>SUKSDORF'S MILK-VETCH<br>PDFAB0F782 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T3<br>S3? | **List:**<br>**Code:** | 1B<br>312 |
| *ASTRAGALUS PYCNOSTACHYUS VAR LANOSISSIMUS*<br>VENTURA MARSH MILK-VETCH<br>PDFAB0F7B1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Proposed Endangered<br>Candidate | **Global:**<br>**State:** | G3?T1<br>S1.1 | **List:**<br>**Code:** | 1A<br>* |
| *ASTRAGALUS RATTANII VAR JEPSONIANUS*<br>JEPSON'S MILK-VETCH<br>PDFAB0F7E1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ASTRAGALUS RATTANII VAR RATTANII*<br>RATTAN'S MILK-VETCH<br>PDFAB0F7E2 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ASTRAGALUS SERENOI VAR SHOCKLEYI*<br>NAKED MILK-VETCH<br>PDFAB0F802 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S2? | **List:** 2<br>**Code:** 221 |
| *ASTRAGALUS SHEVOCKII*<br>SHEVOCK'S MILK-VETCH<br>PDFAB0F850 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *ASTRAGALUS SUBVESTITUS*<br>KERN COUNTY MILK-VETCH<br>PDFAB0F8M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ASTRAGALUS TENER VAR FERRISIAE*<br>FERRIS'S MILK-VETCH<br>PDFAB0F8R3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS TENER VAR TENER*<br>ALKALI MILK-VETCH<br>PDFAB0F8R1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ASTRAGALUS TENER VAR TITI*<br>COASTAL DUNES MILK-VETCH<br>PDFAB0F8R2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ASTRAGALUS TRASKIAE*<br>TRASK'S MILK-VETCH<br>PDFAB0F910 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ASTRAGALUS TRICARINATUS*<br>TRIPLE-RIBBED MILK-VETCH<br>PDFAB0F920 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *ASTRAGALUS UMBRATICUS*<br>BALD MOUNTAIN MILK-VETCH<br>PDFAB0F990 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ASTRAGALUS WEBBERI*<br>WEBBER'S MILK-VETCH<br>PDFAB0F9J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ASTROLEPIS COCHISENSIS*<br>SCALY CLOAK FERN<br>PPADI0P010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1S2 | **List:** 2<br>**Code:** 211 |
| *ATRIPLEX CORDULATA*<br>HEARTSCALE<br>PDCHE040B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2?<br>**State:** S2.2? | **List:** 1B<br>**Code:** 223 |
| *ATRIPLEX CORONATA VAR CORONATA*<br>CROWNSCALE<br>PDCHE040C3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ATRIPLEX CORONATA VAR NOTATIOR*<br>SAN JACINTO VALLEY CROWNSCALE<br>PDCHE040C2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ATRIPLEX COULTERI*<br>COULTER'S SALTBUSH<br>PDCHE040E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ATRIPLEX DEPRESSA*<br>BRITTLESCALE<br>PDCHE042L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ATRIPLEX GARDNERI VAR FALCATA*<br>FALCATE SALTBUSH<br>PDCHE040J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4Q<br>**State:** S1.2 | **List:**<br>**Code:** |
| *ATRIPLEX JOAQUINIANA*<br>SAN JOAQUIN SALTBUSH<br>PDCHE041F3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ATRIPLEX MINUSCULA*<br>LESSER SALTSCALE<br>PDCHE042M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ATRIPLEX PACIFICA*<br>SOUTH COAST SALTSCALE<br>PDCHE041C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3G4<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *ATRIPLEX PARISHII*<br>PARISH'S BRITTLESCALE<br>PDCHE041D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2?<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *ATRIPLEX PERSISTENS*<br>PERSISTENT-FRUITED SALTSCALE<br>PDCHE042P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S? | **List:**<br>**Code:** |
| *ATRIPLEX SERENANA VAR DAVIDSONII*<br>DAVIDSON'S SALTSCALE<br>PDCHE041T1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2?<br>**State:** S2? | **List:** 1B<br>**Code:** 322 |
| *ATRIPLEX SUBTILIS*<br><br>PDCHE042T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1G2<br>**State:** S1S2 | **List:**<br>**Code:** |
| *ATRIPLEX TULARENSIS*<br>BAKERSFIELD SMALLSCALE<br>PDCHE04240 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ATRIPLEX VALLICOLA*<br>LOST HILLS CROWNSCALE<br>PDCHE04250 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *AYENIA COMPACTA*<br>AYENIA<br>PDSTE01020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 2<br>**Code:** 211 |
| *AZOLLA MEXICANA*<br>MEXICAN MOSQUITO FERN<br>PPAZO01030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.2? | **List:** 4<br>**Code:** 121 |
| *BACCHARIS MALIBUENSIS*<br>MALIBU BACCHARIS<br>PDAST0W0W0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *BACCHARIS PLUMMERAE SSP GLABRATA*<br>SAN SIMEON BACCHARIS<br>PDAST0W0D1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *BACCHARIS PLUMMERAE SSP PLUMMERAE*<br>PLUMMER'S BACCHARIS<br>PDAST0W0D2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *BACCHARIS VANESSAE*<br>ENCINITAS BACCHARIS<br>PDAST0W0P0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |
| *BALSAMORHIZA HOOKERI VAR LANATA*<br>WOOLLY BALSAMROOT<br>PDAST11047 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *BALSAMORHIZA MACROLEPIS VAR MACROLEPIS*<br>BIG-SCALE BALSAMROOT<br>PDAST11061 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *BALSAMORHIZA SERICEA*<br>SILKY BALSAMROOT<br>PDAST110C0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4Q<br>**State:** S2.3? | **List:** 4<br>**Code:** 212 |
| *BENSONIELLA OREGONA*<br>BENSONIELLA<br>PDSAX02010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 332 |
| *BERBERIS FREMONTII*<br>FREMONT BARBERRY<br>PDBER06060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 3<br>**Code:** ??1 |
| *BERBERIS NEVINII*<br>NEVIN'S BARBERRY<br>PDBER060A0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *BERBERIS PINNATA SSP INSULARIS*<br>ISLAND BARBERRY<br>PDBER060B2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *BERGEROCACTUS EMORYI*<br>GOLDEN-SPINED CEREUS<br>PDCAC11010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.1 | **List:** 2<br>**Code:** 221 |
| *BLENNOSPERMA BAKERI*<br>SONOMA SUNSHINE<br>PDAST1A010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |
| *BLENNOSPERMA NANUM VAR ROBUSTUM*<br>POINT REYES BLENNOSPERMA<br>PDAST1A022 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *BLEPHARIDACHNE KINGII*<br>KING'S EYELASH GRASS<br>PMPOA0X020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 211 |
| *BLEPHARIZONIA PLUMOSA SSP PLUMOSA*<br>BIG TARPLANT<br>PDAST1C011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *BLOOMERIA HUMILIS*<br>DWARF GOLDENSTAR<br>PMLIL0B020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *BOLANDRA CALIFORNICA*<br>SIERRA BOLANDRA<br>PDSAX03010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *BOSCHNIAKIA HOOKERI*<br>SMALL GROUNDCONE<br>PDORO01010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 311 |
| *BOTRYCHIUM ASCENDENS*<br>UPSWEPT MOONWORT<br>PPOPH010S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *BOTRYCHIUM CRENULATUM*<br>SCALLOPED MOONWORT<br>PPOPH010L0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S1.2 | **List:** 1B<br>**Code:** 212 |
| *BOTRYCHIUM LUNARIA*<br>COMMON MOONWORT<br>PPOPH01080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 311 |
| *BOTRYCHIUM MINGANENSE*<br>MINGAN MOONWORT<br>PPOPH010R0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *BOTRYCHIUM MONTANUM*<br>WESTERN GOBLIN<br>PPOPH010K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *BOTRYCHIUM PINNATUM*<br>NORTHWESTERN MOONWORT<br>PPOPH010V0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *BOUTELOUA TRIFIDA*<br>RED GRAMA<br>PMPOA100L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S2? | **List:** 2<br>**Code:** 311 |
| *BOYKINIA ROTUNDIFOLIA*<br>ROUND-LEAVED BOYKINIA<br>PDSAX04050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *BRODIAEA CORONARIA SSP ROSEA*<br>INDIAN VALLEY BRODIAEA<br>PMLIL0C032 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *BRODIAEA FILIFOLIA*<br>THREAD-LEAVED BRODIAEA<br>PMLIL0C050 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *BRODIAEA INSIGNIS*<br>KAWEAH BRODIAEA<br>PMLIL0C060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *BRODIAEA KINKIENSIS*<br>SAN CLEMENTE ISLAND BRODIAEA<br>PMLIL0C080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *BRODIAEA ORCUTTII*<br>ORCUTT'S BRODIAEA<br>PMLIL0C0B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.1 | **List:** 1B<br>**Code:** 132 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *BRODIAEA PALLIDA*<br>CHINESE CAMP BRODIAEA<br>PMLIL0C0C0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *BURSERA MICROPHYLLA*<br>ELEPHANT TREE<br>PDBUR01020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.3 | **List:** 2<br>**Code:** 321 |
| *CALAMAGROSTIS BOLANDERI*<br>BOLANDER'S REED GRASS<br>PMPOA17010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALAMAGROSTIS CRASSIGLUMIS*<br>THURBER'S REED GRASS<br>PMPOA17070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *CALAMAGROSTIS FOLIOSA*<br>LEAFY REED GRASS<br>PMPOA170C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CALAMAGROSTIS OPHITIDIS*<br>SERPENTINE REED GRASS<br>PMPOA170V0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALANDRINIA BREWERI*<br>BREWER'S CALANDRINIA<br>PDPOR01020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2? | **List:** 4<br>**Code:** 122 |
| *CALANDRINIA MARITIMA*<br>SEASIDE CALANDRINIA<br>PDPOR09020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *CALLIANDRA ERIOPHYLLA*<br>FAIRYDUSTER<br>PDFAB0N040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.3? | **List:** 2<br>**Code:** 311 |
| *CALOCHORTUS CATALINAE*<br>CATALINA MARIPOSA LILY<br>PMLIL0D080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CALOCHORTUS CLAVATUS VAR AVIUS*<br>PLEASANT VALLEY MARIPOSA LILY<br>PMLIL0D095 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *CALOCHORTUS CLAVATUS VAR CLAVATUS*<br>CLUB-HAIRED MARIPOSA LILY<br>PMLIL0D091 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALOCHORTUS CLAVATUS VAR GRACILIS*<br>SLENDER MARIPOSA LILY<br>PMLIL0D096 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.1? | **List:** 1B<br>**Code:** 323 |
| *CALOCHORTUS CLAVATUS VAR RECURVIFOLIUS*<br>ARROYO DE LA CRUZ MARIPOSA LILY<br>PMLIL0D098 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CALOCHORTUS DUNNII*<br>DUNN'S MARIPOSA LILY<br>PMLIL0D0C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CALOCHORTUS EXCAVATUS* | **Federal:** | Species of concern | **Global:** | G3 | **List:** | 1B |
| INYO COUNTY STAR-TULIP | **State:** | None | **State:** | S3.1 | **Code:** | 233 |
| PMLIL0D0F0 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS GREENEI* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| GREENE'S MARIPOSA LILY | **State:** | None | **State:** | S2.2 | **Code:** | 322 |
| PMLIL0D0H0 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS LONGEBARBATUS VAR LONGEBARBATUS* | **Federal:** | Species of concern | **Global:** | G3T3 | **List:** | 1B |
| LONG-HAIRED STAR-TULIP | **State:** | None | **State:** | S3.2 | **Code:** | 122 |
| PMLIL0D0R1 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS MONANTHUS* | **Federal:** | Species of concern | **Global:** | GH | **List:** | 1A |
| SINGLE-FLOWERED MARIPOSA LILY | **State:** | None | **State:** | SH | **Code:** | * |
| PMLIL0D0W0 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS OBISPOENSIS* | **Federal:** | None | **Global:** | G2 | **List:** | 1B |
| SAN LUIS MARIPOSA LILY | **State:** | None | **State:** | S2.2 | **Code:** | 223 |
| PMLIL0D110 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS PALMERI VAR MUNZII* | **Federal:** | Species of concern | **Global:** | G2T1 | **List:** | 1B |
| MUNZ'S MARIPOSA LILY | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PMLIL0D121 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS PALMERI VAR PALMERI* | **Federal:** | Species of concern | **Global:** | G2T2 | **List:** | 1B |
| PALMER'S MARIPOSA LILY | **State:** | None | **State:** | S2.2 | **Code:** | 223 |
| PMLIL0D122 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS PANAMINTENSIS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| PANAMINT MARIPOSA LILY | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PMLIL0D130 **Records in NDDB:** *No* | | | | | | |
| *CALOCHORTUS PERSISTENS* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| SISKIYOU MARIPOSA LILY | **State:** | Rare | **State:** | S1.1 | **Code:** | 333 |
| PMLIL0D140 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS PLUMMERAE* | **Federal:** | Species of concern | **Global:** | G3 | **List:** | 1B |
| PLUMMER'S MARIPOSA LILY | **State:** | None | **State:** | S3.2 | **Code:** | 223 |
| PMLIL0D150 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS PULCHELLUS* | **Federal:** | None | **Global:** | G2 | **List:** | 1B |
| MT. DIABLO FAIRY-LANTERN | **State:** | None | **State:** | S2.2 | **Code:** | 223 |
| PMLIL0D160 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS RAICHEI* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| THE CEDARS FAIRY-LANTERN | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PMLIL0D1L0 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS SIMULANS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| SAN LUIS OBISPO MARIPOSA LILY | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PMLIL0D170 **Records in NDDB:** *No* | | | | | | |
| *CALOCHORTUS STRIATUS* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| ALKALI MARIPOSA LILY | **State:** | None | **State:** | S2.2 | **Code:** | 222 |
| PMLIL0D190 **Records in NDDB:** *Yes* | | | | | | |
| *CALOCHORTUS TIBURONENSIS* | **Federal:** | Threatened | **Global:** | G1 | **List:** | 1B |
| TIBURON MARIPOSA LILY | **State:** | Threatened | **State:** | S1.2 | **Code:** | 333 |
| PMLIL0D1C0 **Records in NDDB:** *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CALOCHORTUS UMBELLATUS*<br>OAKLAND STAR-TULIP<br>PMLIL0D1E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CALOCHORTUS WEEDII VAR INTERMEDIUS*<br>INTERMEDIATE MARIPOSA LILY<br>PMLIL0D1J1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CALOCHORTUS WEEDII VAR VESTUS*<br>LATE-FLOWERED MARIPOSA LILY<br>PMLIL0D1J2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CALOCHORTUS WESTONII*<br>SHIRLEY MEADOWS STAR-TULIP<br>PMLIL0D1M0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CALYCADENIA HOOVERI*<br>HOOVER'S CALYCADENIA<br>PDAST1P040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 213 |
| *CALYCADENIA OPPOSITIFOLIA*<br>BUTTE COUNTY CALYCADENIA<br>PDAST1P070 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALYCADENIA TRUNCATA SSP MICROCEPHALA*<br>SNOW MOUNTAIN CALYCADENIA<br>PDAST1P0A1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.2? | **List:**<br>**Code:** |
| *CALYCADENIA VILLOSA*<br>DWARF CALYCADENIA<br>PDAST1P0B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CALYPTRIDIUM PARRYI VAR HESSEAE*<br>SANTA CRUZ MOUNTAINS PUSSYPAWS<br>PDPOR09052 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2?T?<br>**State:** S? | **List:** 3<br>**Code:** ??3 |
| *CALYPTRIDIUM PULCHELLUM*<br>MARIPOSA PUSSYPAWS<br>PDPOR09060 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CALYPTRIDIUM QUADRIPETALUM*<br>FOUR-PETALED PUSSYPAWS<br>PDPOR09080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALYSTEGIA ATRIPLICIFOLIA SSP BUTTENSIS*<br>BUTTE COUNTY MORNING-GLORY<br>PDCON04012 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G?T?<br>**State:** S? | **List:** 3<br>**Code:** ??3 |
| *CALYSTEGIA COLLINA SSP OXYPHYLLA*<br>MT. SAINT HELENA MORNING-GLORY<br>PDCON04032 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CALYSTEGIA COLLINA SSP VENUSTA*<br>SOUTH COAST RANGE MORNING-GLORY<br>PDCON04034 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *CALYSTEGIA MACROSTEGIA SSP AMPLISSIMA*<br>ISLAND MORNING-GLORY<br>PDCON04081 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CALYSTEGIA MALACOPHYLLA VAR BERRYI*<br>BERRY'S MORNING-GLORY<br>PDCON040K2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CALYSTEGIA PEIRSONII*<br>PEIRSON'S MORNING-GLORY<br>PDCON040A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CALYSTEGIA SEPIUM SSP BINGHAMIAE*<br>SANTA BARBARA MORNING-GLORY<br>PDCON040E6 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T<br>**State:** SH | **List:** 1B<br>**Code:** 333 |
| *CALYSTEGIA STEBBINSII*<br>STEBBINS'S MORNING-GLORY<br>PDCON040H0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CALYSTEGIA SUBACAULIS SSP EPISCOPALIS*<br>CAMBRIA MORNING-GLORY<br>PDCON040J1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G?T1<br>**State:** S1? | **List:** 1B<br>**Code:** 323 |
| *CAMISSONIA BENITENSIS*<br>SAN BENITO EVENING-PRIMROSE<br>PDONA03030 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CAMISSONIA BOOTHII SSP ALYSSOIDES*<br>PINE CREEK EVENING-PRIMROSE<br>PDONA03051 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CAMISSONIA BOOTHII SSP BOOTHII*<br>BOOTH'S EVENING-PRIMROSE<br>PDONA03052 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CAMISSONIA GUADALUPENSIS SSP CLEMENTINA*<br>SAN CLEMENTE ISLAND EVENING-PRIMROSE<br>PDONA030M1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CAMISSONIA HARDHAMIAE*<br>HARDHAM'S EVENING-PRIMROSE<br>PDONA030N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1Q<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CAMISSONIA INTEGRIFOLIA*<br>KERN RIVER EVENING-PRIMROSE<br>PDONA030T0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CAMISSONIA KERNENSIS SSP KERNENSIS*<br>KERN COUNTY EVENING-PRIMROSE<br>PDONA030V2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CAMISSONIA LEWISII*<br>LEWIS'S EVENING-PRIMROSE<br>PDONA030X0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?<br>**State:** S? | **List:** 3<br>**Code:** ??2 |
| *CAMISSONIA MINOR*<br>NELSON'S EVENING-PRIMROSE<br>PDONA03110 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CAMISSONIA SIERRAE SSP ALTICOLA*<br>MONO HOT SPRINGS EVENING-PRIMROSE<br>PDONA031H1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CAMISSONIA TANACETIFOLIA SSP QUADRIPERFORATA*<br>SIERRA VALLEY EVENING-PRIMROSE<br>PDONA031M1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.2 | **List:**<br>**Code:** | 4<br>113 |
| *CAMPANULA CALIFORNICA*<br>SWAMP HAREBELL<br>PDCAM02060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>123 |
| *CAMPANULA EXIGUA*<br>CHAPARRAL HAREBELL<br>PDCAM020A0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CAMPANULA SCABRELLA*<br>ROUGH HAREBELL<br>PDCAM020U0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *CAMPANULA SHARSMITHIAE*<br>SHARSMITH'S HAREBELL<br>PDCAM02100 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>333 |
| *CAMPANULA SHETLERI*<br>CASTLE CRAGS HAREBELL<br>PDCAM020W0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.3 | **List:**<br>**Code:** | 1B<br>313 |
| *CAMPANULA WILKINSIANA*<br>WILKIN'S HAREBELL<br>PDCAM020Z0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *CANBYA CANDIDA*<br>PYGMY POPPY<br>PDPAP05020 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *CARDAMINE NUTTALLII VAR GEMMATA*<br>YELLOW-TUBERED TOOTHWORT<br>PDBRA0K180 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T2?<br>S2.2 | **List:**<br>**Code:** | 1B<br>312 |
| *CARDAMINE PACHYSTIGMA VAR DISSECTIFOLIA*<br>DISSECTED-LEAVED TOOTHWORT<br>PDBRA0K1B1 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G?T3?<br>S2S3 | **List:**<br>**Code:** | 3<br>??3 |
| *CAREX ALBIDA*<br>WHITE SEDGE<br>PMCYP030D0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CAREX CALIFORNICA*<br>CALIFORNIA SEDGE<br>PMCYP032D0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S2? | **List:**<br>**Code:** | 2<br>311 |
| *CAREX COMOSA*<br>BRISTLY SEDGE<br>PMCYP032Y0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S1.1 | **List:**<br>**Code:** | 2<br>331 |
| *CAREX CONGDONII*<br>CONGDON'S SEDGE<br>PMCYP03320 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CAREX DAVYI*<br>DAVY'S SEDGE<br>PMCYP033H0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CAREX ELEOCHARIS*<br>SPIKERUSH SEDGE<br>PMCYP03450 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S2? | **List:** 2<br>**Code:** 211 |
| *CAREX GEYERI*<br>GEYER'S SEDGE<br>PMCYP03540 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *CAREX GIGAS*<br>SISKIYOU SEDGE<br>PMCYP03560 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *CAREX HALLIANA*<br>HALL'S SEDGE<br>PMCYP035M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *CAREX HYSTRICINA*<br>BOTTLEBRUSH SEDGE<br>PMCYP036D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1? | **List:** 2<br>**Code:** 331 |
| *CAREX INCURVIFORMIS VAR DANAENSIS*<br>DANA'S SEDGE<br>PMCYP036G1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CAREX LASIOCARPA*<br>SLENDER SEDGE<br>PMCYP03720 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *CAREX LEPTALEA*<br>FLACCID SEDGE<br>PMCYP037E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 321 |
| *CAREX LIMOSA*<br>SHORE SEDGE<br>PMCYP037K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3? | **List:** 2<br>**Code:** 221 |
| *CAREX LIVIDA*<br>LIVID SEDGE<br>PMCYP037L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *CAREX NORVEGICA*<br>SCANDINAVIAN SEDGE<br>PMCYP039D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *CAREX OBISPOENSIS*<br>SAN LUIS OBISPO SEDGE<br>PMCYP039J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CAREX PARRYANA VAR HALLII*<br>HALL'S SEDGE<br>PMCYP035N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T4?<br>**State:** S1.3 | **List:** 2<br>**Code:** 211 |
| *CAREX PETASATA*<br>LIDDON'S SEDGE<br>PMCYP03AE0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 211 |
| *CAREX PRATICOLA*<br>MEADOW SEDGE<br>PMCYP03B20 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CAREX SCOPARIA*<br>POINTED BROOM SEDGE<br>PMCYP03C90 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 321 |
| *CAREX SHELDONII*<br>SHELDON'S SEDGE<br>PMCYP03CE0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 211 |
| *CAREX TIOGANA*<br>TIOGA PASS SEDGE<br>PMCYP03GP0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *CAREX TOMPKINSII*<br>TOMPKINS'S SEDGE<br>PMCYP03DR0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CAREX VULPINOIDEA*<br>FOX SEDGE<br>PMCYP03EN0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3? | **List:** 2<br>**Code:** 221 |
| *CARLOWRIGHTIA ARIZONICA*<br>ARIZONA CARLOWRIGHTIA<br>PDACA07010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 321 |
| *CARNEGIEA GIGANTEA*<br>SAGUARO<br>PDCAC12010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *CARPENTERIA CALIFORNICA*<br>TREE-ANEMONE<br>PDHDR04010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Threatened | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CASTELA EMORYI*<br>CRUCIFIXION THORN<br>PDSIM03030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 211 |
| *CASTILLEJA AFFINIS SSP NEGLECTA*<br>TIBURON INDIAN PAINTBRUSH<br>PDSCR0D260 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CASTILLEJA AMBIGUA SSP HUMBOLDTIENSIS*<br>HUMBOLDT BAY OWL'S-CLOVER<br>PDSCR0D402 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CASTILLEJA CAMPESTRIS SSP SUCCULENTA*<br>SUCCULENT OWL'S-CLOVER<br>PDSCR0D3Z1 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G4?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CASTILLEJA CINEREA*<br>ASH-GRAY INDIAN PAINTBRUSH<br>PDSCR0D0H0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CASTILLEJA GLEASONII*<br>MT. GLEASON INDIAN PAINTBRUSH<br>PDSCR0D140 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CASTILLEJA GRISEA*<br>SAN CLEMENTE ISLAND INDIAN PAINTBRUSH<br>PDSCR0D160 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CASTILLEJA HISPIDA SSP BREVILOBATA*<br>SHORT-LOBED INDIAN PAINTBRUSH<br>PDSCR0D0A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *CASTILLEJA LANATA SSP HOLOLEUCA*<br>WHITE-FELTED INDIAN PAINTBRUSH<br>PDSCR0D1L1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *CASTILLEJA LASIORHYNCHA*<br>SAN BERNARDINO MOUNTAINS OWL'S-CLOVER<br>PDSCR0D410 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *CASTILLEJA LATIFOLIA*<br>MONTEREY INDIAN PAINTBRUSH<br>PDSCR0D1P0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CASTILLEJA MENDOCINENSIS*<br>MENDOCINO COAST INDIAN PAINTBRUSH<br>PDSCR0D3N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CASTILLEJA MINIATA SSP ELATA*<br>SISKIYOU INDIAN PAINTBRUSH<br>PDSCR0D0T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S3.2 | **List:** 2<br>**Code:** 121 |
| *CASTILLEJA MOLLIS*<br>SOFT-LEAVED INDIAN PAINTBRUSH<br>PDSCR0D230 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CASTILLEJA MONTIGENA*<br>HECKARD'S INDIAN PAINTBRUSH<br>PDSCR0D3G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CASTILLEJA PLAGIOTOMA*<br>MOJAVE INDIAN PAINTBRUSH<br>PDSCR0D2J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CASTILLEJA SCHIZOTRICHA*<br>SPLIT-HAIR INDIAN PAINTBRUSH<br>PDSCR0D2Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *CASTILLEJA ULIGINOSA*<br>PITKIN MARSH INDIAN PAINTBRUSH<br>PDSCR0D380 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** GXQ<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *CAULANTHUS AMPLEXICAULIS VAR BARBARAE*<br>SANTA BARBARA JEWEL-FLOWER<br>PDBRA0M012 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3?T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *CAULANTHUS CALIFORNICUS*<br>CALIFORNIA JEWEL-FLOWER<br>PDBRA31010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CAULANTHUS HETEROPHYLLUS VAR PSEUDOSIMULANS*<br>BUCK'S JEWEL-FLOWER<br>PDBRA0M0B1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T2T3<br>**State:** S2S3 | **List:**<br>**Code:** |
| *CAULANTHUS SIMULANS*<br>PAYSON'S JEWEL-FLOWER<br>PDBRA0M0H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CAULANTHUS STENOCARPUS* | **Federal:** | Species of concern | **Global:** | G?Q | **List:** | |
| SLENDER-POD JEWEL-FLOWER | **State:** | Rare | **State:** | S? | **Code:** | |
| PDBRA0M0J0 **Records in NDDB:** *Yes* | | | | | | |
| *CAULOSTRAMINA JAEGERI* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| JAEGER'S CAULOSTRAMINA | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PDBRA0N010 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS CONFUSUS* | **Federal:** | Species of concern | **Global:** | G5T2Q | **List:** | 1B |
| RINCON RIDGE CEANOTHUS | **State:** | None | **State:** | S2.1 | **Code:** | 333 |
| PDRHA041K0 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS CUNEATUS VAR RIGIDUS* | **Federal:** | Species of concern | **Global:** | G5T3 | **List:** | 4 |
| MONTEREY CEANOTHUS | **State:** | None | **State:** | S3.2 | **Code:** | 123 |
| PDRHA04067 **Records in NDDB:** *No* | | | | | | |
| *CEANOTHUS CYANEUS* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| LAKESIDE CEANOTHUS | **State:** | None | **State:** | S2.2 | **Code:** | 322 |
| PDRHA04070 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS DIVERGENS* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| CALISTOGA CEANOTHUS | **State:** | None | **State:** | S2.2 | **Code:** | 323 |
| PDRHA04161 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS FERRISAE* | **Federal:** | Endangered | **Global:** | G1 | **List:** | 1B |
| COYOTE CEANOTHUS | **State:** | None | **State:** | S1.1 | **Code:** | 333 |
| PDRHA040C0 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS FOLIOSUS VAR VINEATUS* | **Federal:** | Species of concern | **Global:** | G3T1 | **List:** | 1B |
| VINE HILL CEANOTHUS | **State:** | None | **State:** | S1? | **Code:** | 333 |
| PDRHA040D6 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS FRESNENSIS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| FRESNO CEANOTHUS | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRHA040E0 **Records in NDDB:** *No* | | | | | | |
| *CEANOTHUS GLORIOSUS VAR GLORIOSUS* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| POINT REYES CEANOTHUS | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRHA040F2 **Records in NDDB:** *No* | | | | | | |
| *CEANOTHUS GLORIOSUS VAR PORRECTUS* | **Federal:** | Species of concern | **Global:** | G3T2 | **List:** | 1B |
| MT. VISION CEANOTHUS | **State:** | None | **State:** | S2.2 | **Code:** | 313 |
| PDRHA040F7 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS HEARSTIORUM* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| HEARST'S CEANOTHUS | **State:** | Rare | **State:** | S1.2 | **Code:** | 323 |
| PDRHA040J0 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS MARITIMUS* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| MARITIME CEANOTHUS | **State:** | Rare | **State:** | S2.2 | **Code:** | 323 |
| PDRHA040T0 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS MASONII* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| MASON'S CEANOTHUS | **State:** | Rare | **State:** | S1.3 | **Code:** | 323 |
| PDRHA040F6 **Records in NDDB:** *Yes* | | | | | | |
| *CEANOTHUS MEGACARPUS VAR INSULARIS* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| ISLAND CEANOTHUS | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRHA040W1 **Records in NDDB:** *No* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CEANOTHUS OPHIOCHILUS*<br>VAIL LAKE CEANOTHUS<br>PDRHA041M0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CEANOTHUS PURPUREUS*<br>HOLLY-LEAVED CEANOTHUS<br>PDRHA04160 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CEANOTHUS RODERICKII*<br>PINE HILL CEANOTHUS<br>PDRHA04190 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CEANOTHUS SONOMENSIS*<br>SONOMA CEANOTHUS<br>PDRHA04068 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CEANOTHUS VERRUCOSUS*<br>WART-STEMMED CEANOTHUS<br>PDRHA041J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 2<br>**Code:** 121 |
| *CERCOCARPUS BETULOIDES VAR BLANCHEAE*<br>ISLAND MOUNTAIN-MAHOGANY<br>PDROS08022 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CERCOCARPUS TRASKIAE*<br>CATALINA ISLAND MOUNTAIN-MAHOGANY<br>PDROS08030 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHAENACTIS CARPHOCLINIA VAR PEIRSONII*<br>PEIRSON'S PINCUSHION<br>PDAST20042 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 213 |
| *CHAENACTIS DOUGLASII VAR ALPINA*<br>ALPINE DUSTY MAIDENS<br>PDAST20065 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *CHAENACTIS PARISHII*<br>PARISH'S CHAENACTIS<br>PDAST200D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *CHAENACTIS SUFFRUTESCENS*<br>SHASTA CHAENACTIS<br>PDAST200H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 1B<br>**Code:** 213 |
| *CHAMAEBATIA AUSTRALIS*<br>SOUTHERN MOUNTAIN MISERY<br>PDROS0A010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *CHAMAESYCE ARIZONICA*<br>ARIZONA SPURGE<br>PDEUP0D060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 211 |
| *CHAMAESYCE HOOVERI*<br>HOOVER'S SPURGE<br>PDEUP0D150 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CHAMAESYCE OCELLATA SSP RATTANII*<br>STONY CREEK SPURGE<br>PDEUP0D1P1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CHAMAESYCE PLATYSPERMA*<br>FLAT-SEEDED SPURGE<br>PDEUP0D1X0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S1.2? | **List:** 1B<br>**Code:** 322 |
| *CHEILANTHES WOOTONII*<br>WOOTON'S LACE FERN<br>PPADI090S0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 211 |
| *CHENOPODIUM SIMPLEX*<br>LARGE-SEEDED GOOSEFOOT<br>PDCHE091P0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CHLOROGALUM GRANDIFLORUM*<br>RED HILLS SOAPROOT<br>PMLIL0G020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CHLOROGALUM POMERIDIANUM VAR MINUS*<br>DWARF SOAPROOT<br>PMLIL0G042 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *CHLOROGALUM PURPUREUM VAR PURPUREUM*<br>PURPLE AMOLE<br>PMLIL0G051 **Records in NDDB:** *Yes* | **Federal:** Proposed Threatened<br>**State:** None | **Global:** G1T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHLOROGALUM PURPUREUM VAR REDUCTUM*<br>CAMATTA CANYON AMOLE<br>PMLIL0G052 **Records in NDDB:** *Yes* | **Federal:** Proposed Threatened<br>**State:** Rare | **Global:** G1T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHORIZANTHE BILOBA VAR IMMEMORA*<br>SAN BENITO SPINEFLOWER<br>PDPGN04025 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T1?<br>**State:** S1? | **List:** 1B<br>**Code:** 223 |
| *CHORIZANTHE BLAKLEYI*<br>BLAKLEY'S SPINEFLOWER<br>PDPGN04030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CHORIZANTHE BREWERI*<br>BREWER'S SPINEFLOWER<br>PDPGN04050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 313 |
| *CHORIZANTHE CUSPIDATA VAR CUSPIDATA*<br>SAN FRANCISCO BAY SPINEFLOWER<br>PDPGN04081 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CHORIZANTHE CUSPIDATA VAR VILLOSA*<br>WOOLLY-HEADED SPINEFLOWER<br>PDPGN04082 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *CHORIZANTHE DOUGLASII*<br>DOUGLAS'S SPINEFLOWER<br>PDPGN040A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CHORIZANTHE HOWELLII*<br>HOWELL'S SPINEFLOWER<br>PDPGN040C0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CHORIZANTHE LEPTOTHECA*<br>PENINSULAR SPINEFLOWER<br>PDPGN040D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CHORIZANTHE ORCUTTIANA*<br>ORCUTT'S SPINEFLOWER<br>PDPGN040G0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHORIZANTHE PALMERI*<br>PALMER'S SPINEFLOWER<br>PDPGN040H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *CHORIZANTHE PARRYI VAR FERNANDINA*<br>SAN FERNANDO VALLEY SPINEFLOWER<br>PDPGN040J1 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1A<br>**Code:** * |
| *CHORIZANTHE PARRYI VAR PARRYI*<br>PARRY'S SPINEFLOWER<br>PDPGN040J2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2?<br>**State:** S2.2 | **List:** 3<br>**Code:** ?23 |
| *CHORIZANTHE POLYGONOIDES VAR LONGISPINA*<br>LONG-SPINED SPINEFLOWER<br>PDPGN040K1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *CHORIZANTHE PROCUMBENS*<br>PROSTRATE SPINEFLOWER<br>PDPGN040L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S3.2? | **List:** 4<br>**Code:** 122 |
| *CHORIZANTHE PUNGENS VAR HARTWEGIANA*<br>BEN LOMOND SPINEFLOWER<br>PDPGN040M1 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |
| *CHORIZANTHE PUNGENS VAR PUNGENS*<br>MONTEREY SPINEFLOWER<br>PDPGN040M2 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CHORIZANTHE RECTISPINA*<br>STRAIGHT-AWNED SPINEFLOWER<br>PDPGN040N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *CHORIZANTHE ROBUSTA VAR HARTWEGII*<br>SCOTT'S VALLEY SPINEFLOWER<br>PDPGN040Q1 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHORIZANTHE ROBUSTA VAR ROBUSTA*<br>ROBUST SPINEFLOWER<br>PDPGN040Q2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHORIZANTHE SPINOSA*<br>MOJAVE SPINEFLOWER<br>PDPGN040R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CHORIZANTHE VALIDA*<br>SONOMA SPINEFLOWER<br>PDPGN040V0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CHORIZANTHE WHEELERI*<br>WHEELER'S SPINEFLOWER<br>PDPGN040Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CHORIZANTHE XANTI VAR LEUCOTHECA*<br>WHITE-BRACTED SPINEFLOWER<br>PDPGN040Z1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CHRYSOTHAMNUS GRAMINEUS*<br>PANAMINT ROCK-GOLDENROD<br>PDAST2C0H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *CIRSIUM ANDREWSII*<br>FRANCISCAN THISTLE<br>PDAST2E050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CIRSIUM CILIOLATUM*<br>ASHLAND THISTLE<br>PDAST2E0P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Endangered | **Global:** G3Q<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *CIRSIUM CRASSICAULE*<br>SLOUGH THISTLE<br>PDAST2E0U0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 323 |
| *CIRSIUM FONTINALE VAR CAMPYLON*<br>MT. HAMILTON THISTLE<br>PDAST2E0F0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CIRSIUM FONTINALE VAR FONTINALE*<br>FOUNTAIN THISTLE<br>PDAST2E161 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CIRSIUM FONTINALE VAR OBISPOENSE*<br>CHORRO CREEK BOG THISTLE<br>PDAST2E162 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CIRSIUM HYDROPHILUM VAR HYDROPHILUM*<br>SUISUN THISTLE<br>PDAST2E1G1 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CIRSIUM HYDROPHILUM VAR VASEYI*<br>MT. TAMALPAIS THISTLE<br>PDAST2E1G2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CIRSIUM LONCHOLEPIS*<br>LA GRACIOSA THISTLE<br>PDAST2E1N0 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** Threatened | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 323 |
| *CIRSIUM OCCIDENTALE VAR COMPACTUM*<br>COMPACT COBWEBBY THISTLE<br>PDAST2E1Z1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CIRSIUM PRAETERIENS*<br>PALO ALTO THISTLE<br>PDAST2E2B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GX<br>**State:** SX | **List:**<br>**Code:** |
| *CIRSIUM RHOTHOPHILUM*<br>SURF THISTLE<br>PDAST2E2J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Threatened | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *CLARKIA AMOENA SSP WHITNEYI*<br>WHITNEY'S FAREWELL-TO-SPRING<br>PDONA05025 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CLARKIA AUSTRALIS*<br>SMALL'S SOUTHERN CLARKIA<br>PDONA05040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CLARKIA BILOBA SSP AUSTRALIS*<br>MARIPOSA CLARKIA<br>PDONA05051 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *CLARKIA BOREALIS SSP ARIDA*<br>SHASTA CLARKIA<br>PDONA05061 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G?T1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CLARKIA BOREALIS SSP BOREALIS*<br>NORTHERN CLARKIA<br>PDONA05062 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CLARKIA BREWERI*<br>BREWER'S CLARKIA<br>PDONA05080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *CLARKIA CONCINNA SSP AUTOMIXA*<br>SANTA CLARA RED RIBBONS<br>PDONA050A1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *CLARKIA CONCINNA SSP RAICHEI*<br>RAICHE'S RED RIBBONS<br>PDONA050A2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?T1<br>**State:** S1.1? | **List:** 1B<br>**Code:** 313 |
| *CLARKIA DELICATA*<br>DELICATE CLARKIA<br>PDONA050D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2G3<br>**State:** S1? | **List:** 2<br>**Code:** 121 |
| *CLARKIA EXILIS*<br>SLENDER CLARKIA<br>PDONA050G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CLARKIA FRANCISCANA*<br>PRESIDIO CLARKIA<br>PDONA050H0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CLARKIA GRACILIS SSP ALBICAULIS*<br>WHITE-STEMMED CLARKIA<br>PDONA050J1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S2.2? | **List:** 1B<br>**Code:** 323 |
| *CLARKIA IMBRICATA*<br>VINE HILL CLARKIA<br>PDONA050K0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CLARKIA JOLONENSIS*<br>JOLON CLARKIA<br>PDONA050L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CLARKIA LEWISII*<br>LEWIS'S CLARKIA<br>PDONA050N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CLARKIA LINGULATA*<br>MERCED CLARKIA<br>PDONA050P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CLARKIA MILDREDIAE*<br>MILDRED'S CLARKIA<br>PDONA050Q0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CLARKIA MOSQUINII SSP MOSQUINII*<br>MOSQUIN'S CLARKIA<br>PDONA050S1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CLARKIA MOSQUINII SSP XEROPHILA*<br>ENTERPRISE CLARKIA<br>PDONA050S2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CLARKIA ROSTRATA*<br>BEAKED CLARKIA<br>PDONA050Y0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>213 |
| *CLARKIA SPECIOSA SSP IMMACULATA*<br>PISMO CLARKIA<br>PDONA05111 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Rare | **Global:**<br>**State:** | G3T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CLARKIA SPRINGVILLENSIS*<br>SPRINGVILLE CLARKIA<br>PDONA05120 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>323 |
| *CLARKIA TEMBLORIENSIS SSP CALIENTENSIS*<br>VASEK'S CLARKIA<br>PDONA05141 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CLARKIA VIRGATA*<br>SIERRA CLARKIA<br>PDONA05160 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CLARKIA XANTIANA SSP PARVIFLORA*<br>KERN CANYON CLARKIA<br>PDONA05181 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CLAYTONIA LANCEOLATA VAR PEIRSONII*<br>PEIRSON'S SPRING BEAUTY<br>PDPOR03097 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CLAYTONIA MEGARHIZA*<br>FELL-FIELDS CLAYTONIA<br>PDPOR030A0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?<br>S2S3 | **List:**<br>**Code:** | 2<br>211 |
| *CLAYTONIA PALUSTRIS*<br>MARSH CLAYTONIA<br>PDPOR030S0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CLAYTONIA UMBELLATA*<br>GREAT BASIN CLAYTONIA<br>PDPOR030P0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5?<br>S1.3 | **List:**<br>**Code:** | 1B<br>312 |
| *CLEOMELLA HILLMANII*<br>HILLMAN'S CLEOMELLA<br>PDCPP04030 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3?<br>S1? | **List:**<br>**Code:** | |
| *COCHLEARIA OFFICINALIS VAR ARCTICA*<br>ARCTIC SPOONWORT<br>PDBRA0S032 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3T4<br>S1.3 | **List:**<br>**Code:** | 2<br>311 |
| *COLLINSIA CORYMBOSA*<br>ROUND-HEADED CHINESE HOUSES<br>PDSCR0H060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *COLLINSIA MULTICOLOR*<br>SAN FRANCISCO COLLINSIA<br>PDSCR0H0B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 113 |
| *COLLOMIA DIVERSIFOLIA*<br>SERPENTINE COLLOMIA<br>PDPLM02020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *COLLOMIA LARSENII*<br>TALUS COLLOMIA<br>PDPLM02014 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *COLLOMIA RAWSONIANA*<br>FLAMING TRUMPET<br>PDPLM02080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *COLLOMIA TRACYI*<br>TRACY'S COLLOMIA<br>PDPLM020B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *COLUBRINA CALIFORNICA*<br>LAS ANIMAS COLUBRINA<br>PDRHA05030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *COMAROSTAPHYLIS DIVERSIFOLIA SSP DIVERSIFOLIA*<br>SUMMER HOLLY<br>PDERI0B011 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *CONDALIA GLOBOSA VAR PUBESCENS*<br>SPINY ABROJO<br>PDRHA06031 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *CONVOLVULUS SIMULANS*<br>SMALL-FLOWERED MORNING-GLORY<br>PDCON05060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *CORALLORHIZA TRIFIDA*<br>NORTHERN CORALROOT<br>PMORC0M050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *CORDYLANTHUS CAPITATUS*<br>YAKIMA BIRD'S-BEAK<br>PDSCR0J030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 121 |
| *CORDYLANTHUS EREMICUS SSP EREMICUS*<br>DESERT BIRD'S-BEAK<br>PDSCR0J042 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3? | **List:** 4<br>**Code:** 113 |
| *CORDYLANTHUS EREMICUS SSP KERNENSIS*<br>KERN PLATEAU BIRD'S-BEAK<br>PDSCR0J043 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3? | **List:** 4<br>**Code:** 113 |
| *CORDYLANTHUS MARITIMUS SSP MARITIMUS*<br>SALT MARSH BIRD'S-BEAK<br>PDSCR0J0C2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *CORDYLANTHUS MARITIMUS SSP PALUSTRIS*<br>POINT REYES BIRD'S-BEAK<br>PDSCR0J0C3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CORDYLANTHUS MOLLIS SSP HISPIDUS*<br>HISPID BIRD'S-BEAK<br>PDSCR0J0D1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>233 |
| *CORDYLANTHUS MOLLIS SSP MOLLIS*<br>SOFT BIRD'S-BEAK<br>PDSCR0J0D2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Rare | **Global:**<br>**State:** | G2T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CORDYLANTHUS NIDULARIUS*<br>MT. DIABLO BIRD'S-BEAK<br>PDSCR0J0F0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>333 |
| *CORDYLANTHUS ORCUTTIANUS*<br>ORCUTT'S BIRD'S-BEAK<br>PDSCR0J0G0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2?<br>S1.1 | **List:**<br>**Code:** | 2<br>331 |
| *CORDYLANTHUS PALMATUS*<br>PALMATE-BRACTED BIRD'S-BEAK<br>PDSCR0J0J0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *CORDYLANTHUS PARVIFLORUS*<br>PURPLE BIRD'S-BEAK<br>PDSCR0J0K0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4G5<br>S1S2 | **List:**<br>**Code:** | 2<br>311 |
| *CORDYLANTHUS RIGIDUS SSP LITTORALIS*<br>SEASIDE BIRD'S-BEAK<br>PDSCR0J0P2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>233 |
| *CORDYLANTHUS TECOPENSIS*<br>TECOPA BIRD'S-BEAK<br>PDSCR0J0Q0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S1.2 | **List:**<br>**Code:** | 1B<br>322 |
| *CORDYLANTHUS TENUIS SSP BARBATUS*<br>FRESNO COUNTY BIRD'S-BEAK<br>PDSCR0J0S4 **Records in NDDB:** *No* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T3<br>S3.3? | **List:**<br>**Code:** | 4<br>113 |
| *CORDYLANTHUS TENUIS SSP BRUNNEUS*<br>SERPENTINE BIRD'S-BEAK<br>PDSCR0J0S1 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CORDYLANTHUS TENUIS SSP CAPILLARIS*<br>PENNELL'S BIRD'S-BEAK<br>PDSCR0J0S2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Rare | **Global:**<br>**State:** | G4T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CORDYLANTHUS TENUIS SSP PALLESCENS*<br>PALLID BIRD'S-BEAK<br>PDSCR0J0S3 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *COREOPSIS HAMILTONII*<br>MT. HAMILTON COREOPSIS<br>PDAST2L0C0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *COREOPSIS MARITIMA*<br>SEA DAHLIA<br>PDAST2L0L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S2.2 | **List:**<br>**Code:** | 2<br>221 |
| *CORETHROGYNE FILAGINIFOLIA VAR INCANA*<br>SAN DIEGO SAND ASTER<br>PDAST2M025 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>222 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *CORETHROGYNE FILAGINIFOLIA VAR LINIFOLIA*<br>DEL MAR MESA SAND ASTER<br>PDAST2M027 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *CORETHROGYNE LEUCOPHYLLA*<br>BRANCHING BEACH ASTER<br>PDAST2M030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *CORYDALIS CASEANA SSP CASEANA*<br>SIERRA CORYDALIS<br>PDFUM03043 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CREPIS RUNCINATA SSP HALLII*<br>HALL'S MEADOW HAWKSBEARD<br>PDAST2R0KB **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S2? | **List:** 2<br>**Code:** 331 |
| *CROSSOSOMA CALIFORNICUM*<br>CATALINA CROSSOSOMA<br>PDCRO02020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *CROTON WIGGINSII*<br>WIGGINS'S CROTON<br>PDEUP0H140 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G3<br>**State:** S1.2 | **List:** 2<br>**Code:** 221 |
| *CRYPTANTHA CLEVELANDII VAR DISSITA*<br>SERPENTINE CRYPTANTHA<br>PDBOR0A0H2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5TH<br>**State:** SH | **List:** 1B<br>**Code:** 223 |
| *CRYPTANTHA CLOKEYI*<br>CLOKEY'S CRYPTANTHA<br>PDBOR0A211 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *CRYPTANTHA COSTATA*<br>RIBBED CRYPTANTHA<br>PDBOR0A0M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *CRYPTANTHA CRINITA*<br>SILKY CRYPTANTHA<br>PDBOR0A0Q0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *CRYPTANTHA CRYMOPHILA*<br>SUBALPINE CRYPTANTHA<br>PDBOR0A0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CRYPTANTHA EXCAVATA*<br>DEEP-SCARRED CRYPTANTHA<br>PDBOR0A0W0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *CRYPTANTHA GANDERI*<br>GANDER'S CRYPTANTHA<br>PDBOR0A120 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *CRYPTANTHA HOLOPTERA*<br>WINGED CRYPTANTHA<br>PDBOR0A180 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S? | **List:** 4<br>**Code:** 112 |
| *CRYPTANTHA HOOVERI*<br>HOOVER'S CRYPTANTHA<br>PDBOR0A190 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CRYPTANTHA MARIPOSAE*<br>MARIPOSA CRYPTANTHA<br>PDBOR0A1Q0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CRYPTANTHA RATTANII*<br>RATTAN'S CRYPTANTHA<br>PDBOR0A2H0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *CRYPTANTHA ROOSIORUM*<br>BRISTLECONE CRYPTANTHA<br>PDBOR0A2L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CRYPTANTHA SCOPARIA*<br>GRAY CRYPTANTHA<br>PDBOR0A2Q0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *CRYPTANTHA TRASKIAE*<br>TRASK'S CRYPTANTHA<br>PDBOR0A370 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CRYPTANTHA TUMULOSA*<br>NEW YORK MOUNTAINS CRYPTANTHA<br>PDBOR0A380 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *CUPRESSUS ABRAMSIANA*<br>SANTA CRUZ CYPRESS<br>PGCUP04080 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>323 |
| *CUPRESSUS ARIZONICA SSP NEVADENSIS*<br>PIUTE CYPRESS<br>PGCUP04012 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *CUPRESSUS BAKERI*<br>BAKER'S CYPRESS<br>PGCUP04020 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 4<br>122 |
| *CUPRESSUS FORBESII*<br>TECATE CYPRESS<br>PGCUP040C0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>322 |
| *CUPRESSUS GOVENIANA SSP GOVENIANA*<br>GOWEN CYPRESS<br>PGCUP04031 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>None | **Global:**<br>**State:** | G2T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CUPRESSUS GOVENIANA SSP PIGMAEA*<br>PYGMY CYPRESS<br>PGCUP04032 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>123 |
| *CUPRESSUS MACROCARPA*<br>MONTEREY CYPRESS<br>PGCUP04060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *CUPRESSUS NOOTKATENSIS*<br>ALASKA CEDAR<br>PGCUP03020 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *CUPRESSUS STEPHENSONII*<br>CUYAMACA CYPRESS<br>PGCUP040B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *CUSICKIELLA QUADRICOSTATA* | **Federal:** | Species of concern | **Global:** | G3 | **List:** | 1B |
| BODIE HILLS CUSICKIELLA | **State:** | None | **State:** | S2.2 | **Code:** | 222 |
| PDBRA2V010 **Records in NDDB:** *Yes* | | | | | | |
| *CYMOPTERUS DESERTICOLA* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| DESERT CYMOPTERUS | **State:** | None | **State:** | S2.2 | **Code:** | 323 |
| PDAPI0U090 **Records in NDDB:** *Yes* | | | | | | |
| *CYMOPTERUS GILMANII* | **Federal:** | None | **Global:** | G3? | **List:** | 2 |
| GILMAN'S CYMOPTERUS | **State:** | None | **State:** | S2.2 | **Code:** | 211 |
| PDAPI0U0C0 **Records in NDDB:** *Yes* | | | | | | |
| *CYMOPTERUS RIPLEYI* | **Federal:** | None | **Global:** | G3 | **List:** | 2 |
| RIPLEY'S CYMOPTERUS | **State:** | None | **State:** | S1.2 | **Code:** | 321 |
| PDAPI0U0X0 **Records in NDDB:** *Yes* | | | | | | |
| *CYNANCHUM UTAHENSE* | **Federal:** | None | **Global:** | G4 | **List:** | 4 |
| UTAH VINE MILKWEED | **State:** | None | **State:** | S3.3 | **Code:** | 111 |
| PDASC050M0 **Records in NDDB:** *No* | | | | | | |
| *CYPRIPEDIUM CALIFORNICUM* | **Federal:** | None | **Global:** | G3G4 | **List:** | 4 |
| CALIFORNIA LADY'S-SLIPPER | **State:** | None | **State:** | S3.2 | **Code:** | 122 |
| PMORC0Q040 **Records in NDDB:** *No* | | | | | | |
| *CYPRIPEDIUM FASCICULATUM* | **Federal:** | Species of concern | **Global:** | G4 | **List:** | 4 |
| CLUSTERED LADY'S-SLIPPER | **State:** | None | **State:** | S3.2 | **Code:** | 122 |
| PMORC0Q060 **Records in NDDB:** *No* | | | | | | |
| *CYPRIPEDIUM MONTANUM* | **Federal:** | None | **Global:** | G4 | **List:** | 4 |
| MOUNTAIN LADY'S-SLIPPER | **State:** | None | **State:** | S3.2 | **Code:** | 112 |
| PMORC0Q080 **Records in NDDB:** *No* | | | | | | |
| *DALEA ORNATA* | **Federal:** | None | **Global:** | G4G5 | **List:** | 2 |
| ORNATE DALEA | **State:** | None | **State:** | S1.3 | **Code:** | 331 |
| PDFAB1A150 **Records in NDDB:** *Yes* | | | | | | |
| *DARLINGTONIA CALIFORNICA* | **Federal:** | None | **Global:** | G4 | **List:** | 4 |
| CALIFORNIA PITCHERPLANT | **State:** | None | **State:** | S3.2 | **Code:** | 121 |
| PDSAR01010 **Records in NDDB:** *No* | | | | | | |
| *DEDECKERA EUREKENSIS* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| JULY GOLD | **State:** | Rare | **State:** | S2.2 | **Code:** | 213 |
| PDPGN06010 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM BAKERI* | **Federal:** | Proposed Endangered | **Global:** | G1 | **List:** | 1B |
| BAKER'S LARKSPUR | **State:** | Rare | **State:** | S1.1 | **Code:** | 333 |
| PDRAN0B050 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM CALIFORNICUM SSP INTERIUS* | **Federal:** | Species of concern | **Global:** | G3T2 | **List:** | 1B |
| HOSPITAL CANYON LARKSPUR | **State:** | None | **State:** | S2? | **Code:** | 323 |
| PDRAN0B0A2 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM GYPSOPHILUM SSP GYPSOPHILUM* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| GYPSUM-LOVING LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRAN0B0S1 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM GYPSOPHILUM SSP PARVIFLORUM* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| SMALL-FLOWERED GYPSUM-LOVING LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRAN0B0S2 **Records in NDDB:** *No* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *DELPHINIUM HANSENII SSP EWANIANUM* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| EWAN'S LARKSPUR | **State:** | None | **State:** | S3.2 | **Code:** | 123 |
| PDRAN0B0T2 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM HESPERIUM SSP CUYAMACAE* | **Federal:** | Species of concern | **Global:** | G4T2 | **List:** | 1B |
| CUYAMACA LARKSPUR | **State:** | Rare | **State:** | S2.2 | **Code:** | 223 |
| PDRAN0B0U1 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM HUTCHINSONIAE* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| HUTCHINSON'S LARKSPUR | **State:** | None | **State:** | S2.2 | **Code:** | 323 |
| PDRAN0B0V0 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM INOPINUM* | **Federal:** | None | **Global:** | G3 | **List:** | 1B |
| UNEXPECTED LARKSPUR | **State:** | None | **State:** | S3.2 | **Code:** | 223 |
| PDRAN0B0W0 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM LUTEUM* | **Federal:** | Proposed Endangered | **Global:** | G1 | **List:** | 1B |
| YELLOW LARKSPUR | **State:** | Rare | **State:** | S1.1 | **Code:** | 333 |
| PDRAN0B0Z0 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM PARISHII SSP SUBGLOBOSUM* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| SONORAN DESERT LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 112 |
| PDRAN0B1A3 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM PARRYI SSP BLOCHMANIAE* | **Federal:** | Species of concern | **Global:** | G4T2 | **List:** | 1B |
| DUNE LARKSPUR | **State:** | None | **State:** | S2.2 | **Code:** | 323 |
| PDRAN0B1B1 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM PARRYI SSP PURPUREUM* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| MT. PINOS LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRAN0B1B5 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM PURPUSII* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| KERN COUNTY LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRAN0B1G0 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM RECURVATUM* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| RECURVED LARKSPUR | **State:** | None | **State:** | S2.2 | **Code:** | 123 |
| PDRAN0B1J0 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM STACHYDEUM* | **Federal:** | None | **Global:** | G5 | **List:** | 4 |
| SPIKED LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 111 |
| PDRAN0B1Q0 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM ULIGINOSUM* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| SWAMP LARKSPUR | **State:** | None | **State:** | S3.2 | **Code:** | 123 |
| PDRAN0B1V0 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM UMBRACULORUM* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| UMBRELLA LARKSPUR | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDRAN0B1W0 **Records in NDDB:** *No* | | | | | | |
| *DELPHINIUM VARIEGATUM SSP KINKIENSE* | **Federal:** | Endangered | **Global:** | G4T1 | **List:** | 1B |
| SAN CLEMENTE ISLAND LARKSPUR | **State:** | Endangered | **State:** | S1.1 | **Code:** | 333 |
| PDRAN0B1X3 **Records in NDDB:** *Yes* | | | | | | |
| *DELPHINIUM VARIEGATUM SSP THORNEI* | **Federal:** | Species of concern | **Global:** | G4T1 | **List:** | 1B |
| THORNE'S ROYAL LARKSPUR | **State:** | None | **State:** | S1.1 | **Code:** | 333 |
| PDRAN0B1X2 **Records in NDDB:** *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
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| *DENDROMECON HARFORDII VAR HARFORDII*<br>CHANNEL ISLAND TREE POPPY<br>PDPAP08020 **Records in NDDB:** *No* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T3Q<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *DENDROMECON HARFORDII VAR RHAMNOIDES*<br>ISLAND TREE POPPY<br>PDPAP08012 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T1Q<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *DESCHAMPSIA ATROPURPUREA*<br>MOUNTAIN HAIR GRASS<br>PMPOA6M010 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *DICENTRA FORMOSA SSP OREGANA*<br>OREGON BLEEDING HEART<br>PDFUM04052 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T4<br>S3.2 | **List:**<br>**Code:** | 4<br>122 |
| *DICENTRA NEVADENSIS*<br>TULARE COUNTY BLEEDING HEART<br>PDFUM04060 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *DICHANTHELIUM LANUGINOSUM VAR THERMALE*<br>GEYSERS DICHANTHELIUM<br>PMPOA24025 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *DICHONDRA OCCIDENTALIS*<br>WESTERN DICHONDRA<br>PDCON08060 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?<br>S3.2 | **List:**<br>**Code:** | 4<br>121 |
| *DIMERESIA HOWELLII*<br>DOUBLET<br>PDAST2Z010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *DIRCA OCCIDENTALIS*<br>WESTERN LEATHERWOOD<br>PDTHY03010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2G3<br>S2S3 | **List:**<br>**Code:** | 1B<br>223 |
| *DISSANTHELIUM CALIFORNICUM*<br>CALIFORNIA DISSANTHELIUM<br>PMPOA29010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | GH<br>SH | **List:**<br>**Code:** | 1A<br>* |
| *DITAXIS CALIFORNICA*<br>CALIFORNIA DITAXIS<br>PDEUP08050 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *DITAXIS CLARIANA*<br>GLANDULAR DITAXIS<br>PDEUP080L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4G5<br>S1S2 | **List:**<br>**Code:** | 2<br>321 |
| *DITHYREA MARITIMA*<br>BEACH SPECTACLEPOD<br>PDBRA10020 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Threatened | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>332 |
| *DODECAHEMA LEPTOCERAS*<br>SLENDER-HORNED SPINEFLOWER<br>PDPGN0V010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *DOWNINGIA CONCOLOR VAR BREVIOR*<br>CUYAMACA LAKE DOWNINGIA<br>PDCAM06041 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G4T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *DOWNINGIA PUSILLA*<br>DWARF DOWNINGIA<br>PDCAM060C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 2<br>**Code:** 121 |
| *DRABA ASTEROPHORA VAR ASTEROPHORA*<br>TAHOE DRABA<br>PDBRA110D1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *DRABA ASTEROPHORA VAR MACROCARPA*<br>CUP LAKE DRABA<br>PDBRA110D2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *DRABA AUREOLA*<br>GOLDEN DRABA<br>PDBRA110F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *DRABA CALIFORNICA*<br>CALIFORNIA DRABA<br>PDBRA11380 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *DRABA CANA*<br>HOARY DRABA<br>PDBRA110M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *DRABA CARNOSULA*<br>MT. EDDY DRABA<br>PDBRA112T0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *DRABA CRUCIATA*<br>MINERAL KING DRABA<br>PDBRA110U0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *DRABA HOWELLII*<br>HOWELL'S DRABA<br>PDBRA11150 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *DRABA INCRASSATA*<br>SWEETWATER MOUNTAINS DRABA<br>PDBRA113G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *DRABA MONOENSIS*<br>WHITE MOUNTAINS DRABA<br>PDBRA113B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *DRABA PTEROSPERMA*<br>WINGED-SEED DRABA<br>PDBRA11230 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *DRABA SHARSMITHII*<br>MT. WHITNEY DRABA<br>PDBRA113F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *DRABA SIERRAE*<br>SIERRA DRABA<br>PDBRA112A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *DRABA SUBUMBELLATA*<br>MOUND DRABA<br>PDBRA11370 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *DROSERA ANGLICA*<br>ENGLISH SUNDEW<br>PDDRO02010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S2S3 | **List:**<br>**Code:** | 2<br>211 |
| *DRYOPTERIS FILIX-MAS*<br>MALE FERN<br>PPDRY0A0B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S1.3 | **List:**<br>**Code:** | 2<br>311 |
| *DUDLEYA ABRAMSII SSP AFFINIS*<br>SAN BERNARDINO MOUNTAINS DUDLEYA<br>PDCRA04013 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *DUDLEYA ABRAMSII SSP BETTINAE*<br>SAN LUIS OBISPO SERPENTINE DUDLEYA<br>PDCRA04011 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>313 |
| *DUDLEYA ABRAMSII SSP MURINA*<br>SAN LUIS OBISPO DUDLEYA<br>PDCRA04012 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3T3<br>S3.2 | **List:**<br>**Code:** | 4<br>113 |
| *DUDLEYA ABRAMSII SSP PARVA*<br>CONEJO DUDLEYA<br>PDCRA04016 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>None | **Global:**<br>**State:** | G3T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>323 |
| *DUDLEYA ALAINAE*<br>BANNER DUDLEYA<br>PDCRA040X0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G1Q<br>S1? | **List:**<br>**Code:** | 3<br>323 |
| *DUDLEYA ATTENUATA SSP ORCUTTII*<br>ORCUTT'S DUDLEYA<br>PDCRA04031 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T2<br>S1.1 | **List:**<br>**Code:** | 2<br>331 |
| *DUDLEYA BLOCHMANIAE SSP BLOCHMANIAE*<br>BLOCHMAN'S DUDLEYA<br>PDCRA04051 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>222 |
| *DUDLEYA BLOCHMANIAE SSP BREVIFOLIA*<br>SHORT-LEAVED DUDLEYA<br>PDCRA04060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G2T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *DUDLEYA BLOCHMANIAE SSP INSULARIS*<br>SANTA ROSA ISLAND DUDLEYA<br>PDCRA04052 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *DUDLEYA CALCICOLA*<br>LIMESTONE SIERRA DUDLEYA<br>PDCRA04014 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *DUDLEYA CANDELABRUM*<br>CANDLEHOLDER DUDLEYA<br>PDCRA04080 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *DUDLEYA CYMOSA SSP COSTAFOLIA*<br>PIERPOINT SPRINGS DUDLEYA<br>PDCRA040A2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *DUDLEYA CYMOSA SSP CREBRIFOLIA*<br>SAN GABRIEL RIVER DUDLEYA<br>PDCRA040A8 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>313 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *DUDLEYA CYMOSA SSP MARCESCENS*<br>MARCESCENT DUDLEYA<br>PDCRA040A3 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Rare | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *DUDLEYA CYMOSA SSP OVATIFOLIA*<br>SANTA MONICA MOUNTAINS DUDLEYA<br>PDCRA040A5 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G5T2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *DUDLEYA DENSIFLORA*<br>SAN GABRIEL MOUNTAINS DUDLEYA<br>PDCRA040B0 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *DUDLEYA GNOMA*<br>MUNCHKIN DUDLEYA<br>PDCRA040W0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *DUDLEYA GREENEI*<br>GREENE'S DUDLEYA<br>PDCRA040E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *DUDLEYA MULTICAULIS*<br>MANY-STEMMED DUDLEYA<br>PDCRA040H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *DUDLEYA NESIOTICA*<br>SANTA CRUZ ISLAND DUDLEYA<br>PDCRA040J0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Rare | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *DUDLEYA SAXOSA SSP SAXOSA*<br>PANAMINT DUDLEYA<br>PDCRA040N2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *DUDLEYA SETCHELLII*<br>SANTA CLARA VALLEY DUDLEYA<br>PDCRA040AC **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *DUDLEYA STOLONIFERA*<br>LAGUNA BEACH DUDLEYA<br>PDCRA040P0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Threatened | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *DUDLEYA TRASKIAE*<br>SANTA BARBARA ISLAND DUDLEYA<br>PDCRA040Q0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *DUDLEYA VARIEGATA*<br>VARIEGATED DUDLEYA<br>PDCRA040R0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *DUDLEYA VERITYI*<br>VERITY'S DUDLEYA<br>PDCRA040U0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *DUDLEYA VIRENS*<br>BRIGHT GREEN DUDLEYA<br>PDCRA040S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 222 |
| *DUDLEYA VISCIDA*<br>STICKY DUDLEYA<br>PDCRA040T0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ECHINOCEREUS ENGELMANNII VAR HOWEI*<br>HOWE'S HEDGEHOG CACTUS<br>PDCAC06035 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ELEOCHARIS PARVULA*<br>SMALL SPIKERUSH<br>PMCYP091G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ELEOCHARIS QUADRANGULATA*<br>FOUR-ANGLED SPIKERUSH<br>PMCYP091J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *ELYMUS CALIFORNICUS*<br>CALIFORNIA BOTTLE-BRUSH GRASS<br>PMPOA2H0W0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ELYMUS SCRIBNERI*<br>SCRIBNER'S WHEAT GRASS<br>PMPOA2H170 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 211 |
| *EMPETRUM NIGRUM SSP HERMAPHRODITUM*<br>BLACK CROWBERRY<br>PDEMP03021 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2? | **List:** 2<br>**Code:** 321 |
| *ENCELIOPSIS COVILLEI*<br>PANAMINT DAISY<br>PDAST3G020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 323 |
| *ENCELIOPSIS NUDICAULIS*<br>NAKED-STEMMED DAISY<br>PDAST3G030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2S3 | **List:** 4<br>**Code:** 111 |
| *ENNEAPOGON DESVAUXII*<br>NINE-AWNED PAPPUS GRASS<br>PMPOA2J010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 311 |
| *EPILOBIUM HOWELLII*<br>SUBALPINE FIREWEED<br>PDONA06180 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *EPILOBIUM LUTEUM*<br>YELLOW WILLOWHERB<br>PDONA060H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 2<br>**Code:** 311 |
| *EPILOBIUM NIVIUM*<br>SNOW MOUNTAIN WILLOWHERB<br>PDONA060M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *EPILOBIUM OREGANUM*<br>OREGON FIREWEED<br>PDONA060P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *EPILOBIUM RIGIDUM*<br>SISKIYOU MOUNTAINS WILLOWHERB<br>PDONA060V0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *EPILOBIUM SEPTENTRIONALE*<br>HUMBOLDT COUNTY FUCHSIA<br>PDONA06110 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *EPILOBIUM SISKIYOUENSE*<br>SISKIYOU FIREWEED<br>PDONA06100 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 312 |
| *EQUISETUM PALUSTRE*<br>MARSH HORSETAIL<br>PPEQU01050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 3<br>**Code:** 3?1 |
| *EREMALCHE KERNENSIS*<br>KERN MALLOW<br>PDMAL0C031 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIASTRUM BRANDEGEAE*<br>BRANDEGEE'S ERIASTRUM<br>PDPLM03020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *ERIASTRUM DENSIFOLIUM SSP SANCTORUM*<br>SANTA ANA RIVER WOOLLYSTAR<br>PDPLM03035 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIASTRUM HOOVERI*<br>HOOVER'S ERIASTRUM<br>PDPLM03070 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIASTRUM LUTEUM*<br>YELLOW-FLOWERED ERIASTRUM<br>PDPLM03080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIASTRUM TRACYI*<br>TRACY'S ERIASTRUM<br>PDPLM030C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *ERIASTRUM VIRGATUM*<br>VIRGATE ERIASTRUM<br>PDPLM030D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERICAMERIA CUNEATA VAR MACROCEPHALA*<br>LAGUNA MOUNTAINS GOLDENBUSH<br>PDAST3L062 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2?<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERICAMERIA FASCICULATA*<br>EASTWOOD'S GOLDENBUSH<br>PDAST3L080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ERICAMERIA GILMANII*<br>GILMAN'S GOLDENBUSH<br>PDAST3L0P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ERICAMERIA OPHITIDIS*<br>SERPENTINE GOLDENBUSH<br>PDAST3L0S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERICAMERIA PALMERI SSP PALMERI*<br>PALMER'S GOLDENBUSH<br>PDAST3L0C1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2T3<br>**State:** S1.2 | **List:** 2<br>**Code:** 221 |
| *ERIGERON AEQUIFOLIUS*<br>HALL'S DAISY<br>PDAST3M030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERIGERON ANGUSTATUS*<br>NARROW-LEAVED DAISY<br>PDAST3M5G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2? | **List:** 1B<br>**Code:** 223 |
| *ERIGERON BIOLETTII*<br>STREAMSIDE DAISY<br>PDAST3M5H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3? | **List:** 3<br>**Code:** ??3 |
| *ERIGERON BLOCHMANIAE*<br>BLOCHMAN'S LEAFY DAISY<br>PDAST3M5J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *ERIGERON BLOOMERI VAR NUDATUS*<br>WALDO DAISY<br>PDAST3M0M2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S2? | **List:** 2<br>**Code:** 211 |
| *ERIGERON BREWERI VAR BISANCTUS*<br>PIOUS DAISY<br>PDAST3M0P5 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *ERIGERON BREWERI VAR JACINTEUS*<br>SAN JACINTO MOUNTAINS DAISY<br>PDAST3M0P3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIGERON CALVUS*<br>BALD DAISY<br>PDAST3M083 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1Q<br>**State:** S1 | **List:** 1B<br>**Code:** 333 |
| *ERIGERON CERVINUS*<br>SISKIYOU DAISY<br>PDAST3M0U0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ERIGERON DECUMBENS VAR ROBUSTIOR*<br>ROBUST DAISY<br>PDAST3M134 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIGERON ELEGANTULUS*<br>VOLCANIC DAISY<br>PDAST3M190 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ERIGERON INORNATUS VAR CALIDIPETRIS*<br>HOT ROCK DAISY<br>PDAST3M1Z1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIGERON INORNATUS VAR KEILII*<br>KEIL'S DAISY<br>PDAST3M1Z2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *ERIGERON MARIPOSANUS*<br>MARIPOSA DAISY<br>PDAST3M5L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *ERIGERON MISER*<br>STARVED DAISY<br>PDAST3M2K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERIGERON MULTICEPS*<br>KERN RIVER DAISY<br>PDAST3M2N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERIGERON PARISHII*<br>PARISH'S DAISY<br>PDAST3M310 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *ERIGERON PETROPHILUS VAR SIERRENSIS*<br>NORTHERN SIERRA DAISY<br>PDAST3M351 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIGERON PETROPHILUS VAR VISCIDULUS*<br>KLAMATH DAISY<br>PDAST3M352 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ERIGERON SANCTARUM*<br>SAINT'S DAISY<br>PDAST3M3R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIGERON SERPENTINUS*<br>SERPENTINE DAISY<br>PDAST3M5M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ERIGERON SUPPLEX*<br>SUPPLE DAISY<br>PDAST3M3Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ERIGERON UNCIALIS VAR UNCIALIS*<br>LIMESTONE DAISY<br>PDAST3M452 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G?T3?<br>**State:** S1 | **List:** 2<br>**Code:** 321 |
| *ERIODICTYON ALTISSIMUM*<br>INDIAN KNOB MOUNTAINBALM<br>PDHYD04010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2Q<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ERIODICTYON ANGUSTIFOLIUM*<br>NARROW-LEAVED YERBA SANTA<br>PDHYD04020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ERIODICTYON CAPITATUM*<br>LOMPOC YERBA SANTA<br>PDHYD04040 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ERIOGONUM ALPINUM*<br>TRINITY BUCKWHEAT<br>PDPGN08060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 313 |
| *ERIOGONUM APRICUM VAR APRICUM*<br>IONE BUCKWHEAT<br>PDPGN080F1 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ERIOGONUM APRICUM VAR PROSTRATUM*<br>IRISH HILL BUCKWHEAT<br>PDPGN080F2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIOGONUM ARGILLOSUM*<br>CLAY-LOVING BUCKWHEAT<br>PDPGN080J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM BIFURCATUM*<br>FORKED BUCKWHEAT<br>PDPGN080R0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ERIOGONUM BREEDLOVEI VAR BREEDLOVEI*<br>BREEDLOVE'S BUCKWHEAT<br>PDPGN080V1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ERIOGONUM BREEDLOVEI VAR SHEVOCKII*<br>THE NEEDLES BUCKWHEAT<br>PDPGN080V2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3T3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ERIOGONUM BUTTERWORTHIANUM*<br>BUTTERWORTH'S BUCKWHEAT<br>PDPGN080X0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G1<br>S1.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ERIOGONUM CONGDONII*<br>CONGDON'S BUCKWHEAT<br>PDPGN081A0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ERIOGONUM CONTIGUUM*<br>REVEAL'S BUCKWHEAT<br>PDPGN081B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3G3<br>S2? | **List:**<br>**Code:** | 2<br>211 |
| *ERIOGONUM CROCATUM*<br>CONEJO BUCKWHEAT<br>PDPGN081G0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ERIOGONUM DICLINUM*<br>JAYNES CANYON BUCKWHEAT<br>PDPGN081S0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *ERIOGONUM EASTWOODIANUM*<br>EASTWOOD'S BUCKWHEAT<br>PDPGN081V0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3Q<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ERIOGONUM EREMICOLA*<br>WILDROSE CANYON BUCKWHEAT<br>PDPGN08210 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ERIOGONUM ERICIFOLIUM VAR THORNEI*<br>THORNE'S BUCKWHEAT<br>PDPGN08233 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G3T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ERIOGONUM FOLIOSUM*<br>LEAFY BUCKWHEAT<br>PDPGN08290 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>SH | **List:**<br>**Code:** | 1B<br>222 |
| *ERIOGONUM GIGANTEUM VAR COMPACTUM*<br>SANTA BARBARA ISLAND BUCKWHEAT<br>PDPGN082A1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G2T2<br>S2.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ERIOGONUM GIGANTEUM VAR FORMOSUM*<br>SAN CLEMENTE ISLAND BUCKWHEAT<br>PDPGN082A2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ERIOGONUM GILMANII*<br>GILMAN'S BUCKWHEAT<br>PDPGN082B0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ERIOGONUM GOSSYPINUM*<br>COTTONY BUCKWHEAT<br>PDPGN082E0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERIOGONUM GRANDE VAR GRANDE*<br>ISLAND BUCKWHEAT<br>PDPGN082J1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM GRANDE VAR RUBESCENS*<br>RED-FLOWERED BUCKWHEAT<br>PDPGN082J2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM GRANDE VAR TIMORUM*<br>SAN NICOLAS ISLAND BUCKWHEAT<br>PDPGN082J3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G3T2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |
| *ERIOGONUM HEERMANNII VAR FLOCCOSUM*<br>CLARK MOUNTAIN BUCKWHEAT<br>PDPGN082P3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM HEERMANNII VAR OCCIDENTALE*<br>WESTERN HEERMANN'S BUCKWHEAT<br>PDPGN082P6 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM HIRTELLUM*<br>KLAMATH MOUNTAIN BUCKWHEAT<br>PDPGN082T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 213 |
| *ERIOGONUM HOFFMANNII VAR HOFFMANNII*<br>HOFFMANN'S BUCKWHEAT<br>PDPGN082V1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM HOFFMANNII VAR ROBUSTIUS*<br>ROBUST HOFFMANN'S BUCKWHEAT<br>PDPGN082V2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM INTRAFRACTUM*<br>JOINTED BUCKWHEAT<br>PDPGN08360 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM KELLOGGII*<br>KELLOGG'S BUCKWHEAT<br>PDPGN083A0 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** Endangered | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *ERIOGONUM KENNEDYI VAR ALPIGENUM*<br>SOUTHERN ALPINE BUCKWHEAT<br>PDPGN083B1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERIOGONUM KENNEDYI VAR AUSTROMONTANUM*<br>SOUTHERN MOUNTAIN BUCKWHEAT<br>PDPGN083B2 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ERIOGONUM KENNEDYI VAR PINICOLA*<br>KERN BUCKWHEAT<br>PDPGN083B4 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIOGONUM LIBERTINI*<br>DUBAKELLA MOUNTAIN BUCKWHEAT<br>PDPGN083M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM LUTEOLUM VAR CANINUM*<br>TIBURON BUCKWHEAT<br>PDPGN083S1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3Q<br>**State:** S3.2 | **List:** 3<br>**Code:** ?23 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *ERIOGONUM MICROTHECUM VAR CORYMBOSOIDES*<br>SAN BERNARDINO BUCKWHEAT<br>PDPGN083W3 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ERIOGONUM MICROTHECUM VAR JOHNSTONII*<br>JOHNSTON'S BUCKWHEAT<br>PDPGN083W5 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ERIOGONUM MICROTHECUM VAR LAPIDICOLA*<br>INYO MOUNTAINS BUCKWHEAT<br>PDPGN083W6 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *ERIOGONUM MICROTHECUM VAR PANAMINTENSE*<br>PANAMINT MOUNTAINS BUCKWHEAT<br>PDPGN083W9 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T2<br>S2.3 | **List:**<br>**Code:** | 1B<br>313 |
| *ERIOGONUM NERVULOSUM*<br>SNOW MOUNTAIN BUCKWHEAT<br>PDPGN08440 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ERIOGONUM NORTONII*<br>PINNACLES BUCKWHEAT<br>PDPGN08470 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.3 | **List:**<br>**Code:** | 1B<br>213 |
| *ERIOGONUM NUDUM VAR DECURRENS*<br>BEN LOMOND BUCKWHEAT<br>PDPGN08492 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>333 |
| *ERIOGONUM NUDUM VAR INDICTUM*<br>PROTRUDING BUCKWHEAT<br>PDPGN08494 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *ERIOGONUM NUDUM VAR MURINUM*<br>MOUSE BUCKWHEAT<br>PDPGN08495 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *ERIOGONUM NUDUM VAR PARALINUM*<br>DEL NORTE BUCKWHEAT<br>PDPGN08498 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T4?<br>S2? | **List:**<br>**Code:** | 2<br>221 |
| *ERIOGONUM NUDUM VAR REGIRIVUM*<br>KINGS RIVER BUCKWHEAT<br>PDPGN0849F **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *ERIOGONUM NUTANS*<br>NODDING BUCKWHEAT<br>PDPGN084B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S2.2 | **List:**<br>**Code:** | 2<br>211 |
| *ERIOGONUM OCHROCEPHALUM VAR ALEXANDERAE*<br>ALEXANDER'S BUCKWHEAT<br>PDPGN084C5 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?T3<br>S2? | **List:**<br>**Code:** | 2<br>321 |
| *ERIOGONUM OVALIFOLIUM VAR EXIMIUM*<br>BROWN-MARGINED BUCKWHEAT<br>PDPGN084FD **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *ERIOGONUM OVALIFOLIUM VAR VINEUM*<br>CUSHENBURY BUCKWHEAT<br>PDPGN084F8 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERIOGONUM PENDULUM*<br>WALDO BUCKWHEAT<br>PDPGN084Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *ERIOGONUM POLYPODUM*<br>TULARE COUNTY BUCKWHEAT<br>PDPGN084U0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM PRATTENIANUM VAR AVIUM*<br>KETTLE DOME BUCKWHEAT<br>PDPGN084V1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM PROCIDUUM*<br>PROSTRATE BUCKWHEAT<br>PDPGN084W0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ERIOGONUM PUBERULUM*<br>DOWNY BUCKWHEAT<br>PDPGN084X0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ERIOGONUM SHOCKLEYI VAR SHOCKLEYI*<br>SHOCKLEY'S BUCKWHEAT<br>PDPGN085E2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ERIOGONUM SISKIYOUENSE*<br>SISKIYOU BUCKWHEAT<br>PDPGN085F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM STRICTUM VAR GREENEI*<br>GREENE'S BUCKWHEAT<br>PDPGN085L3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM TEMBLORENSE*<br>TEMBLOR BUCKWHEAT<br>PDPGN085P0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM TERNATUM*<br>TERNATE BUCKWHEAT<br>PDPGN085R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ERIOGONUM TRIPODUM*<br>TRIPOD BUCKWHEAT<br>PDPGN085Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM TRUNCATUM*<br>MT. DIABLO BUCKWHEAT<br>PDPGN085Z0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *ERIOGONUM TWISSELMANNII*<br>TWISSELMANN'S BUCKWHEAT<br>PDPGN08610 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ERIOGONUM UMBELLATUM VAR GLABERRIMUM*<br>GREEN BUCKWHEAT<br>PDPGN086U2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2?<br>**State:** S1.2 | **List:** 2<br>**Code:** 311 |
| *ERIOGONUM UMBELLATUM VAR HUMISTRATUM*<br>MT. EDDY BUCKWHEAT<br>PDPGN086U4 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERIOGONUM UMBELLATUM VAR JUNIPORINUM*<br>JUNIPER BUCKWHEAT<br>PDPGN086U6 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S1S2 | **List:** 2<br>**Code:** 311 |
| *ERIOGONUM UMBELLATUM VAR MINUS*<br>ALPINE SULFUR-FLOWERED BUCKWHEAT<br>PDPGN086U7 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERIOGONUM UMBELLATUM VAR TORREYANUM*<br>DONNER PASS BUCKWHEAT<br>PDPGN086U9 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ERIOGONUM VESTITUM*<br>IDRIA BUCKWHEAT<br>PDPGN08640 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOGONUM WRIGHTII VAR OLANCHENSE*<br>OLANCHA PEAK BUCKWHEAT<br>PDPGN086D3 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ERIONEURON PILOSUM*<br>HAIRY ERIONEURON<br>PMPOA2S020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *ERIOPHYLLUM CONGDONII*<br>CONGDON'S WOOLLY SUNFLOWER<br>PDAST3N030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 213 |
| *ERIOPHYLLUM JEPSONII*<br>JEPSON'S WOOLLY SUNFLOWER<br>PDAST3N040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 113 |
| *ERIOPHYLLUM LANATUM VAR HALLII*<br>FORT TEJON WOOLLY SUNFLOWER<br>PDAST3N058 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIOPHYLLUM LANATUM VAR OBOVATUM*<br>SOUTHERN SIERRA WOOLLY SUNFLOWER<br>PDAST3N05D **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ERIOPHYLLUM LATILOBUM*<br>SAN MATEO WOOLLY SUNFLOWER<br>PDAST3N060 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERIOPHYLLUM MOHAVENSE*<br>BARSTOW WOOLLY SUNFLOWER<br>PDAST3N070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ERIOPHYLLUM NEVINII*<br>NEVIN'S WOOLLY SUNFLOWER<br>PDAST3N090 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERIOPHYLLUM NUBIGENUM*<br>YOSEMITE WOOLLY SUNFLOWER<br>PDAST3N0A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERYNGIUM ARISTULATUM VAR HOOVERI*<br>HOOVER'S BUTTON-CELERY<br>PDAPI0Z043 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1? | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERYNGIUM ARISTULATUM VAR PARISHII*<br>SAN DIEGO BUTTON-CELERY<br>PDAPI0Z042 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G5T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 232 |
| *ERYNGIUM CONSTANCEI*<br>LOCH LOMOND BUTTON-CELERY<br>PDAPI0Z0W0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERYNGIUM PINNATISECTUM*<br>TUOLUMNE BUTTON-CELERY<br>PDAPI0Z0P0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERYNGIUM RACEMOSUM*<br>DELTA BUTTON-CELERY<br>PDAPI0Z0S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G2Q<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *ERYNGIUM SPINOSEPALUM*<br>SPINY-SEPALED BUTTON-CELERY<br>PDAPI0Z0Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ERYSIMUM AMMOPHILUM*<br>COAST WALLFLOWER<br>PDBRA16010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ERYSIMUM CAPITATUM SSP ANGUSTATUM*<br>CONTRA COSTA WALLFLOWER<br>PDBRA16052 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERYSIMUM CAPITATUM SSP LOMPOCENSE*<br>SAN LUIS OBISPO WALLFLOWER<br>PDBRA160M3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERYSIMUM FRANCISCANUM*<br>SAN FRANCISCO WALLFLOWER<br>PDBRA160A0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERYSIMUM INSULARE SSP INSULARE*<br>ISLAND WALLFLOWER<br>PDBRA160D1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *ERYSIMUM INSULARE SSP SUFFRUTESCENS*<br>SUFFRUTESCENT WALLFLOWER<br>PDBRA160D2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERYSIMUM MENZIESII SSP EUREKENSE*<br>HUMBOLDT BAY WALLFLOWER<br>PDBRA160E2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G3T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *ERYSIMUM MENZIESII SSP MENZIESII*<br>MENZIES'S WALLFLOWER<br>PDBRA160E1 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G3T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *ERYSIMUM MENZIESII SSP YADONII*<br>YADON'S WALLFLOWER<br>PDBRA160E4 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G3T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *ERYSIMUM TERETIFOLIUM*<br>SANTA CRUZ WALLFLOWER<br>PDBRA160N0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ERYTHRONIUM CITRINUM VAR CITRINUM*<br>LEMON-COLORED FAWN LILY<br>PMLIL0U041 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ERYTHRONIUM CITRINUM VAR RODERICKII*<br>SCOTT MOUNTAINS FAWN LILY<br>PMLIL0U042 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *ERYTHRONIUM HELENAE*<br>ST. HELENA FAWN LILY<br>PMLIL0U060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *ERYTHRONIUM HENDERSONII*<br>HENDERSON'S FAWN LILY<br>PMLIL0U070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *ERYTHRONIUM HOWELLII*<br>HOWELL'S FAWN LILY<br>PMLIL0U080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 4<br>**Code:** 112 |
| *ERYTHRONIUM KLAMATHENSE*<br>KLAMATH FAWN LILY<br>PMLIL0U090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ERYTHRONIUM PLURIFLORUM*<br>SHUTEYE PEAK FAWN LILY<br>PMLIL0U0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 213 |
| *ERYTHRONIUM PUSATERII*<br>KAWEAH FAWN LILY<br>PMLIL0U0R0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *ERYTHRONIUM TAYLORI*<br>PILOT RIDGE FAWN LILY<br>PMLIL0U0S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *ERYTHRONIUM TUOLUMNENSE*<br>TUOLUMNE FAWN LILY<br>PMLIL0U0H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *ESCHSCHOLZIA HYPECOIDES*<br>SAN BENITO POPPY<br>PDPAP0A060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ESCHSCHOLZIA LEMMONII SSP KERNENSIS*<br>TEJON POPPY<br>PDPAP0A071 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.1? | **List:** 1B<br>**Code:** 333 |
| *ESCHSCHOLZIA MINUTIFLORA SSP TWISSELMANNII*<br>RED ROCK POPPY<br>PDPAP0A093 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *ESCHSCHOLZIA PROCERA*<br>KERNVILLE POPPY<br>PDPAP0A0B0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G1G2Q<br>**State:** S1S2 | **List:** 3<br>**Code:** ??3 |
| *ESCHSCHOLZIA RAMOSA*<br>ISLAND POPPY<br>PDPAP0A0C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ESCHSCHOLZIA RHOMBIPETALA*<br>DIAMOND-PETALED CALIFORNIA POPPY<br>PDPAP0A0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1A<br>**Code:** * |
| *ESCOBARIA VIVIPARA VAR ALVERSONII*<br>FOXTAIL CACTUS<br>PDCAC0X0G0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ESCOBARIA VIVIPARA VAR ROSEA*<br>VIVIPAROUS FOXTAIL CACTUS<br>PDCAC0X0G8 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *EUCNIDE RUPESTRIS*<br>ROCK NETTLE<br>PDLOA02020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.2? | **List:** 2<br>**Code:** 321 |
| *EUPHORBIA EXSTIPULATA VAR EXSTIPULATA*<br>CLARK MOUNTAIN SPURGE<br>PDEUP0Q0P1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.3 | **List:** 2<br>**Code:** 331 |
| *EUPHORBIA MISERA*<br>CLIFF SPURGE<br>PDEUP0Q1B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.2 | **List:** 2<br>**Code:** 221 |
| *FENDLERELLA UTAHENSIS*<br>YERBA DESIERTO<br>PDHDR08010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *FEROCACTUS VIRIDESCENS*<br>SAN DIEGO BARREL CACTUS<br>PDCAC08060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4<br>**State:** S3.1 | **List:** 2<br>**Code:** 131 |
| *FIMBRISTYLIS THERMALIS*<br>HOT SPRINGS FIMBRISTYLIS<br>PMCYP0B0N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *FRANKENIA PALMERI*<br>PALMER'S FRANKENIA<br>PDFRA01040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *FREMONTODENDRON DECUMBENS*<br>PINE HILL FLANNELBUSH<br>PDSTE03030 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *FREMONTODENDRON MEXICANUM*<br>MEXICAN FLANNELBUSH<br>PDSTE03020 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *FRITILLARIA AFFINIS VAR TRISTULIS*<br>MARIN CHECKER LILY<br>PMLIL0V0P1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *FRITILLARIA AGRESTIS*<br>STINKBELLS<br>PMLIL0V010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *FRITILLARIA BIFLORA VAR INEZIANA*<br>HILLSBOROUGH CHOCOLATE LILY<br>PMLIL0V031 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *FRITILLARIA BRANDEGEI*<br>GREENHORN FRITILLARY<br>PMLIL0V040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *FRITILLARIA EASTWOODIAE*<br>BUTTE COUNTY FRITILLARY<br>PMLIL0V060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3Q<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *FRITILLARIA FALCATA*<br>TALUS FRITILLARY<br>PMLIL0V070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 333 |
| *FRITILLARIA LILIACEA*<br>FRAGRANT FRITILLARY<br>PMLIL0V0C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *FRITILLARIA OJAIENSIS*<br>OJAI FRITILLARY<br>PMLIL0V0N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *FRITILLARIA PLURIFLORA*<br>ADOBE-LILY<br>PMLIL0V0F0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *FRITILLARIA PURDYI*<br>PURDY'S FRITILLARY<br>PMLIL0V0H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *FRITILLARIA RODERICKII*<br>RODERICK'S FRITILLARY<br>PMLIL0V0M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Endangered | **Global:** G1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *FRITILLARIA STRIATA*<br>STRIPED ADOBE-LILY<br>PMLIL0V0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Threatened | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *FRITILLARIA VIRIDEA*<br>SAN BENITO FRITILLARY<br>PMLIL0V0L0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *GALIUM ANDREWSII SSP GATENSE*<br>SERPENTINE BEDSTRAW<br>PDRUB0N032 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *GALIUM ANGUSTIFOLIUM SSP BORREGOENSE*<br>BORREGO BEDSTRAW<br>PDRUB0N042 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G5T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 323 |
| *GALIUM ANGUSTIFOLIUM SSP GABRIELENSE*<br>SAN ANTONIO CANYON BEDSTRAW<br>PDRUB0N044 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM ANGUSTIFOLIUM SSP GRACILLIMUM*<br>SLENDER BEDSTRAW<br>PDRUB0N04B **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *GALIUM ANGUSTIFOLIUM SSP JACINTICUM*<br>SAN JACINTO MOUNTAINS BEDSTRAW<br>PDRUB0N04C **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *GALIUM ANGUSTIFOLIUM SSP ONYCENSE*<br>ONYX PEAK BEDSTRAW<br>PDRUB0N048 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM BUXIFOLIUM*<br>BOX BEDSTRAW<br>PDRUB0N0D0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *GALIUM CALIFORNICUM SSP LUCIENSE*<br>CONE PEAK BEDSTRAW<br>PDRUB0N0E3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *GALIUM CALIFORNICUM SSP MIGUELENSE*<br>SAN MIGUEL ISLAND BEDSTRAW<br>PDRUB0N0E5 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *GALIUM CALIFORNICUM SSP PRIMUM*<br>CALIFORNIA BEDSTRAW<br>PDRUB0N0E6 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *GALIUM CALIFORNICUM SSP SIERRAE*<br>EL DORADO BEDSTRAW<br>PDRUB0N0E7 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *GALIUM CATALINENSE SSP ACRISPUM*<br>SAN CLEMENTE ISLAND BEDSTRAW<br>PDRUB0N0F1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *GALIUM CATALINENSE SSP CATALINENSE*<br>SANTA CATALINA ISLAND BEDSTRAW<br>PDRUB0N0F2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *GALIUM CLEMENTIS*<br>SANTA LUCIA BEDSTRAW<br>PDRUB0N0H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM CLIFTONSMITHII*<br>SANTA BARBARA BEDSTRAW<br>PDRUB0N0J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM GLABRESCENS SSP MODOCENSE*<br>MODOC BEDSTRAW<br>PDRUB0N0T2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *GALIUM GRANDE*<br>SAN GABRIEL BEDSTRAW<br>PDRUB0N0V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *GALIUM HARDHAMIAE*<br>HARDHAM'S BEDSTRAW<br>PDRUB0N0Y0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *GALIUM HILENDIAE SSP CARNEUM*<br>PANAMINT MOUNTAINS BEDSTRAW<br>PDRUB0N0Z1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM HILENDIAE SSP KINGSTONENSE*<br>KINGSTON MOUNTAINS BEDSTRAW<br>PDRUB0N0Z3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *GALIUM HYPOTRICHIUM SSP TOMENTELLUM*<br>TELESCOPE PEAK BEDSTRAW<br>PDRUB0N126 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *GALIUM JEPSONII*<br>JEPSON'S BEDSTRAW<br>PDRUB0N130 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM JOHNSTONII*<br>JOHNSTON'S BEDSTRAW<br>PDRUB0N140 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM MUNZII*<br>MUNZ'S BEDSTRAW<br>PDRUB0N1G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *GALIUM NUTTALLII SSP INSULARE*<br>NUTTALL'S ISLAND BEDSTRAW<br>PDRUB0N1K1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GALIUM OREGANUM*<br>OREGON BEDSTRAW<br>PDRUB0N1N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2S3 | **List:** 3<br>**Code:** 3?1 |
| *GALIUM SERPENTICUM SSP SCOTTICUM*<br>SCOTT MOUNTAIN BEDSTRAW<br>PDRUB0N1Y6 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *GALIUM SERPENTICUM SSP WARNERENSE*<br>WARNER MOUNTAINS BEDSTRAW<br>PDRUB0N1Y8 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *GALIUM WRIGHTII*<br>WRIGHT'S BEDSTRAW<br>PDRUB0N2F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *GALVEZIA SPECIOSA*<br>ISLAND SNAPDRAGON<br>PDSCR2H010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *GENTIANA AFFINIS VAR PARVIDENTATA*<br>SMALL-TOOTHED PRAIRIE GENTIAN<br>PDGEN06013 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3?Q<br>**State:** S1S2 | **List:** 3<br>**Code:** ??1 |
| *GENTIANA FREMONTII*<br>MOSS GENTIAN<br>PDGEN060Y0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.3 | **List:** 2<br>**Code:** 311 |
| *GENTIANA PLURISETOSA*<br>KLAMATH GENTIAN<br>PDGEN060V0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *GENTIANA PROSTRATA*<br>PYGMY GENTIAN<br>PDGEN060M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *GENTIANA SETIGERA*<br>MENDOCINO GENTIAN<br>PDGEN060S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 332 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *GERAEA VISCIDA*<br>STICKY GERAEA<br>PDAST42020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *GEUM ALEPPICUM*<br>ALEPPO AVENS<br>PDROS0S010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2? | **List:** 2<br>**Code:** 321 |
| *GILIA CARUIFOLIA*<br>CARAWAY-LEAVED GILIA<br>PDPLM040C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *GILIA LATIFLORA SSP CUYAMENSIS*<br>CUYAMA GILIA<br>PDPLM040T2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *GILIA MACULATA*<br>LITTLE SAN BERNARDINO MOUNTAINS GILIA<br>PDPLM041Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *GILIA NEVINII*<br>NEVIN'S GILIA<br>PDPLM04160 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *GILIA RIPLEYI*<br>RIPLEY'S GILIA<br>PDPLM041E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2G3<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *GILIA TENUIFLORA SSP ARENARIA*<br>SAND GILIA<br>PDPLM041P2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *GILIA TENUIFLORA SSP HOFFMANNII*<br>HOFFMANN'S SLENDER-FLOWERED GILIA<br>PDPLM041P3 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G3T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *GILMANIA LUTEOLA*<br>GOLDEN CARPET<br>PDPGN0A010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *GITHOPSIS DIFFUSA SSP FILICAULIS*<br>MISSION CANYON BLUECUP<br>PDCAM07023 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3T4<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *GLOSSOPETALON PUNGENS*<br>PUNGENT GLOSSOPETALON<br>PDCRO04020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *GLYCERIA GRANDIS*<br>AMERICAN MANNA GRASS<br>PMPOA2Y080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *GOODMANIA LUTEOLA*<br>GOLDEN GOODMANIA<br>PDPGN0B010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *GRAPHIS SAXORUM*<br>BAJA ROCK LICHEN<br>NLTES29470 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2? | **List:**<br>**Code:** |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *GRATIOLA HETEROSEPALA*<br>BOGGS LAKE HEDGE-HYSSOP<br>PDSCR0R060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Endangered | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 122 |
| *GRINDELIA FRAXINO-PRATENSIS*<br>ASH MEADOWS GUMPLANT<br>PDAST47080 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *GRINDELIA HIRSUTULA VAR HALLII*<br>SAN DIEGO GUMPLANT<br>PDAST470D4 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *GRINDELIA HIRSUTULA VAR MARITIMA*<br>SAN FRANCISCO GUMPLANT<br>PDAST470D3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 223 |
| *GRINDELIA STRICTA VAR ANGUSTIFOLIA*<br>MARSH GUMPLANT<br>PDAST470Y2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HACKELIA AMETHYSTINA*<br>AMETHYST STICKSEED<br>PDBOR0G010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HACKELIA BREVICULA*<br>POISON CANYON STICKSEED<br>PDBOR0G040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *HACKELIA CUSICKII*<br>CUSICK'S STICKSEED<br>PDBOR0G090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *HACKELIA SHARSMITHII*<br>SHARSMITH'S STICKSEED<br>PDBOR0G0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 2<br>**Code:** 211 |
| *HALIMOLOBOS VIRGATA*<br>VIRGATE HALIMOLOBOS<br>PDBRA1A040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *HARPAGONELLA PALMERI*<br>PALMER'S GRAPPLINGHOOK<br>PDBOR0H010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4<br>**State:** S3.1 | **List:** 2<br>**Code:** 121 |
| *HAZARDIA CANA*<br>SAN CLEMENTE ISLAND HAZARDIA<br>PDAST4H020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *HAZARDIA DETONSA*<br>ISLAND HAZARDIA<br>PDAST4H030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HAZARDIA ORCUTTII*<br>ORCUTT'S HAZARDIA<br>PDAST4H070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *HELIANTHELLA CASTANEA*<br>DIABLO HELIANTHELLA<br>PDAST4M020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *HELIANTHEMUM GREENEI* | Federal: | Threatened | Global: | G2 | List: | 1B |
| ISLAND RUSH-ROSE | State: | None | State: | S2.2 | Code: | 323 |
| PDCIS02090 Records in NDDB: *Yes* | | | | | | |
| *HELIANTHEMUM SUFFRUTESCENS* | Federal: | None | Global: | G2Q | List: | 3 |
| BISBEE PEAK RUSH-ROSE | State: | None | State: | S2.2 | Code: | 223 |
| PDCIS020F0 Records in NDDB: *Yes* | | | | | | |
| *HELIANTHUS EXILIS* | Federal: | None | Global: | G3Q | List: | 4 |
| SERPENTINE SUNFLOWER | State: | None | State: | S3.2 | Code: | 123 |
| PDAST4N1J0 Records in NDDB: *No* | | | | | | |
| *HELIANTHUS NIVEUS SSP TEPHRODES* | Federal: | Species of concern | Global: | G4T3 | List: | 1B |
| ALGODONES DUNES SUNFLOWER | State: | Endangered | State: | S1.2 | Code: | 322 |
| PDAST4N0Z2 Records in NDDB: *Yes* | | | | | | |
| *HELIANTHUS NUTTALLII SSP PARISHII* | Federal: | Species of concern | Global: | G5TH | List: | 1A |
| LOS ANGELES SUNFLOWER | State: | None | State: | SH | Code: | * |
| PDAST4N102 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA ARIDA* | Federal: | Species of concern | Global: | G1 | List: | 1B |
| RED ROCK TARPLANT | State: | Rare | State: | S1.2 | Code: | 323 |
| PDAST4R010 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA CLEMENTINA* | Federal: | None | Global: | G3 | List: | 4 |
| ISLAND TARPLANT | State: | None | State: | S3.3 | Code: | 113 |
| PDAST4R040 Records in NDDB: *No* | | | | | | |
| *HEMIZONIA CONGESTA SSP CALYCULATA* | Federal: | None | Global: | G5T3 | List: | 4 |
| MENDOCINO TARPLANT | State: | None | State: | S3.3 | Code: | 113 |
| PDAST4R030 Records in NDDB: *No* | | | | | | |
| *HEMIZONIA CONGESTA SSP LEUCOCEPHALA* | Federal: | None | Global: | G5T2T3 | List: | 3 |
| HAYFIELD TARPLANT | State: | None | State: | S2S3 | Code: | ??3 |
| PDAST4R0V0 Records in NDDB: *No* | | | | | | |
| *HEMIZONIA CONGESTA SSP TRACYI* | Federal: | None | Global: | G5T3 | List: | 4 |
| TRACY'S TARPLANT | State: | None | State: | S3.3 | Code: | 113 |
| PDAST4R0H3 Records in NDDB: *No* | | | | | | |
| *HEMIZONIA CONJUGENS* | Federal: | Threatened | Global: | G1 | List: | 1B |
| OTAY TARPLANT | State: | Endangered | State: | S1.1 | Code: | 332 |
| PDAST4R070 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA FLORIBUNDA* | Federal: | Species of concern | Global: | G3 | List: | 1B |
| TECATE TARPLANT | State: | None | State: | S2.2 | Code: | 222 |
| PDAST4R0B0 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA HALLIANA* | Federal: | None | Global: | G1 | List: | 1B |
| HALL'S TARPLANT | State: | None | State: | S1.1 | Code: | 333 |
| PDAST4R0C0 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA INCRESCENS SSP VILLOSA* | Federal: | Proposed Endangered | Global: | G5T1 | List: | 1B |
| GAVIOTA TARPLANT | State: | Endangered | State: | S1.1 | Code: | 333 |
| PDAST4R0U3 Records in NDDB: *Yes* | | | | | | |
| *HEMIZONIA MINTHORNII* | Federal: | Species of concern | Global: | G2 | List: | 1B |
| SANTA SUSANA TARPLANT | State: | Rare | State: | S2.2 | Code: | 223 |
| PDAST4R0J0 Records in NDDB: *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *HEMIZONIA MOHAVENSIS*<br>MOJAVE TARPLANT<br>PDAST4R0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1A<br>**Code:** * |
| *HEMIZONIA PARRYI SSP AUSTRALIS*<br>SOUTHERN TARPLANT<br>PDAST4R020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 332 |
| *HEMIZONIA PARRYI SSP CONGDONII*<br>CONGDON'S TARPLANT<br>PDAST4R0P1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *HEMIZONIA PUNGENS SSP LAEVIS*<br>SMOOTH TARPLANT<br>PDAST4R0E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *HERISSANTIA CRISPA*<br>CURLY HERISSANTIA<br>PDMAL0F010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *HESPEREVAX SPARSIFLORA VAR BREVIFOLIA*<br>SHORT-LEAVED EVAX<br>PDASTE5011 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *HESPEROLINON ADENOPHYLLUM*<br>GLANDULAR WESTERN FLAX<br>PDLIN01010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HESPEROLINON BICARPELLATUM*<br>TWO-CARPELLATE WESTERN FLAX<br>PDLIN01020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HESPEROLINON BREWERI*<br>BREWER'S WESTERN FLAX<br>PDLIN01030 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HESPEROLINON CONGESTUM*<br>MARIN WESTERN FLAX<br>PDLIN01060 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Threatened | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *HESPEROLINON DIDYMOCARPUM*<br>LAKE COUNTY WESTERN FLAX<br>PDLIN01070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *HESPEROLINON DRYMARIOIDES*<br>DRYMARIA-LIKE WESTERN FLAX<br>PDLIN01090 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *HESPEROLINON SP NOV "SERPENTINUM"*<br>NAPA WESTERN FLAX<br>PDLIN010D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *HESPEROLINON TEHAMENSE*<br>TEHAMA COUNTY WESTERN FLAX<br>PDLIN010C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *HETEROTHECA SHEVOCKII*<br>SHEVOCK'S HAIRY GOLDEN-ASTER<br>PDAST4V0T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *HEUCHERA ABRAMSII*<br>ABRAMS'S ALUMROOT<br>PDSAX0E010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HEUCHERA BREVISTAMINEA*<br>LAGUNA MOUNTAINS ALUMROOT<br>PDSAX0E050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *HEUCHERA CHLORANTHA*<br>GREEN-FLOWERED ALUMROOT<br>PDSAX0E080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** SH | **List:** 2<br>**Code:** 311 |
| *HEUCHERA DURANII*<br>DURAN'S ALUMROOT<br>PDSAX0E0A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.3 | **List:** 1B<br>**Code:** 212 |
| *HEUCHERA ELEGANS*<br>URN-FLOWERED ALUMROOT<br>PDSAX0E0C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HEUCHERA HIRSUTISSIMA*<br>SHAGGY-HAIRED ALUMROOT<br>PDSAX0E0J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *HEUCHERA MAXIMA*<br>ISLAND ALUMROOT<br>PDSAX0E0M0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HEUCHERA PARISHII*<br>PARISH'S ALUMROOT<br>PDSAX0E0S0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *HEUCHERA RUBESCENS VAR VERSICOLOR*<br>SAN DIEGO COUNTY ALUMROOT<br>PDSAX0E106 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2T3<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *HIBISCUS LASIOCARPUS*<br>ROSE-MALLOW<br>PDMAL0H0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *HIEROCHLOE ODORATA*<br>VANILLA-GRASS<br>PMPOA35040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *HOLOCARPHA MACRADENIA*<br>SANTA CRUZ TARPLANT<br>PDAST4X020 **Records in NDDB:** *Yes* | **Federal:** Proposed Threatened<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |
| *HOLOCARPHA VIRGATA SSP ELONGATA*<br>GRACEFUL TARPLANT<br>PDAST4X041 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *HORDEUM INTERCEDENS*<br>VERNAL BARLEY<br>PMPOA380E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?<br>**State:** S3S4 | **List:** 3<br>**Code:** ?22 |
| *HORKELIA BOLANDERI*<br>BOLANDER'S HORKELIA<br>PDROS0W010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *HORKELIA CONGESTA SSP NEMOROSA*<br>JOSEPHINE HORKELIA<br>PDROS0W032 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *HORKELIA CUNEATA SSP SERICEA*<br>KELLOGG'S HORKELIA<br>PDROS0W043 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *HORKELIA HENDERSONII*<br>HENDERSON'S HORKELIA<br>PDROS0W090 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *HORKELIA HISPIDULA*<br>WHITE MOUNTAINS HORKELIA<br>PDROS0W0A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *HORKELIA MARINENSIS*<br>POINT REYES HORKELIA<br>PDROS0W0B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 313 |
| *HORKELIA PARRYI*<br>PARRY'S HORKELIA<br>PDROS0W0C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HORKELIA SERICATA*<br>HOWELL'S HORKELIA<br>PDROS0W0D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *HORKELIA TENUILOBA*<br>THIN-LOBED HORKELIA<br>PDROS0W0E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *HORKELIA TRUNCATA*<br>RAMONA HORKELIA<br>PDROS0W0G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.3 | **List:** 1B<br>**Code:** 312 |
| *HORKELIA TULARENSIS*<br>KERN PLATEAU HORKELIA<br>PDROS0W0H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *HORKELIA WILDERAE*<br>BARTON FLATS HORKELIA<br>PDROS0W0J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *HORKELIA YADONII*<br>SANTA LUCIA HORKELIA<br>PDROS0W0K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *HOWELLIA AQUATILIS*<br>WATER HOWELLIA<br>PDCAM0A010 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:**<br>**Code:** |
| *HULSEA BREVIFOLIA*<br>SHORT-LEAVED HULSEA<br>PDAST4Z020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HULSEA CALIFORNICA*<br>SAN DIEGO SUNFLOWER<br>PDAST4Z030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *HULSEA MEXICANA*<br>MEXICAN HULSEA<br>PDAST4Z050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *HULSEA VESTITA SSP CALLICARPHA*<br>BEAUTIFUL HULSEA<br>PDAST4Z074 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *HULSEA VESTITA SSP GABRIELENSIS*<br>SAN GABRIEL MOUNTAINS SUNFLOWER<br>PDAST4Z075 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *HULSEA VESTITA SSP INYOENSIS*<br>INYO HULSEA<br>PDAST4Z073 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2T3<br>**State:** S1.2 | **List:** 2<br>**Code:** 221 |
| *HULSEA VESTITA SSP PARRYI*<br>PARRY'S SUNFLOWER<br>PDAST4Z076 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ILIAMNA BAKERI*<br>BAKER'S GLOBE MALLOW<br>PDMAL0K010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *ILIAMNA LATIBRACTEATA*<br>CALIFORNIA GLOBE MALLOW<br>PDMAL0K040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *IPOMOPSIS EFFUSA*<br>BAJA CALIFORNIA IPOMOPSIS<br>PDPLM060U0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *IPOMOPSIS TENUIFOLIA*<br>SLENDER-LEAVED IPOMOPSIS<br>PDPLM060J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *IRIS BRACTEATA*<br>SISKIYOU IRIS<br>PMIRI09020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *IRIS HARTWEGII SSP COLUMBIANA*<br>TUOLUMNE IRIS<br>PMIRI090D2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *IRIS INNOMINATA*<br>DEL NORTE COUNTY IRIS<br>PMIRI090F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *IRIS MUNZII*<br>MUNZ'S IRIS<br>PMIRI090M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *IRIS TENAX SSP KLAMATHENSIS*<br>ORLEANS IRIS<br>PMIRI090Z2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G? T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ISOCOMA ARGUTA*<br>CARQUINEZ GOLDENBUSH<br>PDAST57050 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ISOCOMA MENZIESII VAR DECUMBENS*<br>DECUMBENT GOLDENBUSH<br>PDAST57091 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ISOCOMA MENZIESII VAR DIABOLICA*<br>SATAN'S GOLDENBUSH<br>PDAST57092 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *IVA HAYESIANA*<br>SAN DIEGO MARSH-ELDER<br>PDAST580A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3?<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *IVESIA APERTA VAR APERTA*<br>SIERRA VALLEY IVESIA<br>PDROS0X011 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *IVESIA APERTA VAR CANINA*<br>DOG VALLEY IVESIA<br>PDROS0X012 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *IVESIA ARGYROCOMA*<br>SILVER-HAIRED IVESIA<br>PDROS0X020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *IVESIA ARIZONICA VAR ARIZONICA*<br>YELLOW IVESIA<br>PDROS0X0R1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2? | **List:** 3<br>**Code:** ??1 |
| *IVESIA BAILEYI VAR BAILEYI*<br>BAILEY'S IVESIA<br>PDROS0X031 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S1.3 | **List:** 2<br>**Code:** 321 |
| *IVESIA BAILEYI VAR BENEOLENS*<br>OWYHEE IVESIA<br>PDROS0X032 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *IVESIA CALLIDA*<br>TAHQUITZ IVESIA<br>PDROS0X040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *IVESIA CAMPESTRIS*<br>FIELD IVESIA<br>PDROS0X050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *IVESIA JAEGERI*<br>JAEGER'S IVESIA<br>PDROS0X080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *IVESIA KINGII VAR KINGII*<br>ALKALI IVESIA<br>PDROS0X092 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 312 |
| *IVESIA LONGIBRACTEATA*<br>CASTLE CRAGS IVESIA<br>PDROS0X0U0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *IVESIA PANICULATA*<br>ASH CREEK IVESIA<br>PDROS0X0S0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 213 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *IVESIA PATELLIFERA*<br>KINGSTON MOUNTAINS IVESIA<br>PDROS0X0Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *IVESIA PICKERINGII*<br>PICKERING'S IVESIA<br>PDROS0X0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *IVESIA SERICOLEUCA*<br>PLUMAS IVESIA<br>PDROS0X0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *IVESIA UNGUICULATA*<br>YOSEMITE IVESIA<br>PDROS0X0N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *IVESIA WEBBERI*<br>WEBBER'S IVESIA<br>PDROS0X0Q0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 332 |
| *JAMESIA AMERICANA VAR ROSEA*<br>ROSY-PETALLED CLIFFBUSH<br>PDHDR02019 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *JEPSONIA HETERANDRA*<br>FOOTHILL JEPSONIA<br>PDSAX0J010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *JEPSONIA MALVIFOLIA*<br>ISLAND JEPSONIA<br>PDSAX0J020 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *JUGLANS CALIFORNICA*<br>SOUTHERN CALIFORNIA BLACK WALNUT<br>PDJUG02020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *JUGLANS HINDSII*<br>NORTHERN CALIFORNIA BLACK WALNUT<br>PDJUG02040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *JUNCUS ACUTUS SSP LEOPOLDII*<br>SOUTHWESTERN SPINY RUSH<br>PMJUN01051 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *JUNCUS DUDLEYI*<br>DUDLEY'S RUSH<br>PMJUN01390 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *JUNCUS DURANII*<br>DURAN'S RUSH<br>PMJUN013T0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *JUNCUS HEMIENDYTUS VAR ABJECTUS*<br>CENTER BASIN RUSH<br>PMJUN011F1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *JUNCUS LEIOSPERMUS VAR AHARTII*<br>AHART'S DWARF RUSH<br>PMJUN011L1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *JUNCUS LEIOSPERMUS VAR LEIOSPERMUS*<br>RED BLUFF DWARF RUSH<br>PMJUN011L2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *JUNCUS MARGINATUS VAR MARGINATUS*<br>RED-ANTHERED RUSH<br>PMJUN011S1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2S3 | **List:** 2<br>**Code:** 321 |
| *JUNCUS NODOSUS*<br>KNOTTED RUSH<br>PMJUN01210 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *JUNCUS REGELII*<br>REGEL'S RUSH<br>PMJUN012D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *JUNCUS SUPINIFORMIS*<br>HAIR-LEAVED RUSH<br>PMJUN012R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *KOBRESIA BELLARDII*<br>SEEP KOBRESIA<br>PMCYP0F050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *KOEBERLINIA SPINOSA SSP TENUISPINA*<br>CROWN-OF-THORNS<br>PDCPP05012 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *LASTHENIA BURKEI*<br>BURKE'S GOLDFIELDS<br>PDAST5L010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LASTHENIA CONJUGENS*<br>CONTRA COSTA GOLDFIELDS<br>PDAST5L040 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LASTHENIA GLABRATA SSP COULTERI*<br>COULTER'S GOLDFIELDS<br>PDAST5L0A1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T3<br>**State:** S2.1 | **List:** 1B<br>**Code:** 232 |
| *LASTHENIA LEPTALEA*<br>SALINAS VALLEY GOLDFIELDS<br>PDAST5L0B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LATHYRUS BIFLORUS*<br>TWO-FLOWERED PEA<br>PDFAB25180 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *LATHYRUS DELNORTICUS*<br>DEL NORTE PEA<br>PDFAB25070 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LATHYRUS GLANDULOSUS*<br>STICKY PEA<br>PDFAB251A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LATHYRUS JEPSONII VAR JEPSONII*<br>DELTA TULE PEA<br>PDFAB250D2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LATHYRUS PALUSTRIS*<br>MARSH PEA<br>PDFAB250P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |
| *LATHYRUS SPLENDENS*<br>PRIDE-OF-CALIFORNIA<br>PDFAB250Z0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LATHYRUS SULPHUREUS VAR ARGILLACEUS*<br>DUBIOUS PEA<br>PDFAB25101 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T?<br>**State:** S1S2 | **List:** 3<br>**Code:** 3?3 |
| *LAVATERA ASSURGENTIFLORA SSP ASSURGENTIFLORA*<br>ISLAND MALLOW<br>PDMAL0N021 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LAVATERA ASSURGENTIFLORA SSP GLABRA*<br>SOUTHERN ISLAND MALLOW<br>PDMAL0N022 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *LAYIA CARNOSA*<br>BEACH LAYIA<br>PDAST5N010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LAYIA DISCOIDEA*<br>RAYLESS LAYIA<br>PDAST5N030 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 233 |
| *LAYIA HETEROTRICHA*<br>PALE-YELLOW LAYIA<br>PDAST5N070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LAYIA JONESII*<br>JONES'S LAYIA<br>PDAST5N090 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *LAYIA LEUCOPAPPA*<br>COMANCHE POINT LAYIA<br>PDAST5N0A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LAYIA MUNZII*<br>MUNZ'S TIDY-TIPS<br>PDAST5N0B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *LAYIA SEPTENTRIONALIS*<br>COLUSA LAYIA<br>PDAST5N0F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LEGENERE LIMOSA*<br>LEGENERE<br>PDCAM0C010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 233 |
| *LEMBERTIA CONGDONII*<br>SAN JOAQUIN WOOLLYTHREADS<br>PDASTA8010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 323 |
| *LEPECHINIA CARDIOPHYLLA*<br>HEART-LEAVED PITCHER SAGE<br>PDLAM0V020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *LEPECHINIA FRAGRANS*<br>FRAGRANT PITCHER SAGE<br>PDLAM0V030 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *LEPECHINIA GANDERI*<br>GANDER'S PITCHER SAGE<br>PDLAM0V040 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.3 | **List:**<br>**Code:** | 1B<br>312 |
| *LEPIDIUM FLAVUM VAR FELIPENSE*<br>BORREGO VALLEY PEPPER-GRASS<br>PDBRA1M0B1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LEPIDIUM JAREDII SSP ALBUM*<br>PANOCHE PEPPER-GRASS<br>PDBRA1M0G2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LEPIDIUM JAREDII SSP JAREDII*<br>JARED'S PEPPER-GRASS<br>PDBRA1M0G1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LEPIDIUM LATIPES VAR HECKARDII*<br>HECKARD'S PEPPER-GRASS<br>PDBRA1M0K1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LEPIDIUM VIRGINICUM VAR ROBINSONII*<br>ROBINSON'S PEPPER-GRASS<br>PDBRA1M114 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2?<br>SH | **List:**<br>**Code:** | 1B<br>322 |
| *LEPTODACTYLON CALIFORNICUM SSP TOMENTOSUM*<br>FUZZY PRICKLY PHLOX<br>PDPLM08021 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *LEPTODACTYLON JAEGERI*<br>SAN JACINTO PRICKLY PHLOX<br>PDPLM08030 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *LESQUERELLA KINGII SSP BERNARDINA*<br>SAN BERNARDINO MOUNTAINS BLADDERPOD<br>PDBRA1N0W1 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G5T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *LESSINGIA ARACHNOIDEA*<br>CRYSTAL SPRINGS LESSINGIA<br>PDAST5S0C0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LESSINGIA GERMANORUM*<br>SAN FRANCISCO LESSINGIA<br>PDAST5S0D0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *LESSINGIA GLANDULIFERA VAR TOMENTOSA*<br>WARNER SPRINGS LESSINGIA<br>PDAST5S022 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4?T2?<br>S1.1? | **List:**<br>**Code:** | 2<br>311 |
| *LESSINGIA HOLOLEUCA*<br>WOOLLY-HEADED LESSINGIA<br>PDAST5S030 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3? | **List:**<br>**Code:** | 3<br>??3 |
| *LESSINGIA MICRADENIA VAR GLABRATA*<br>SMOOTH LESSINGIA<br>PDAST5S062 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LESSINGIA MICRADENIA VAR MICRADENIA*<br>TAMALPAIS LESSINGIA<br>PDAST5S063 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *LESSINGIA OCCIDENTALIS*<br>WESTERN LESSINGIA<br>PDAST15010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LESSINGIA TENUIS*<br>SPRING LESSINGIA<br>PDAST5S0B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LEWISIA BRACHYCALYX*<br>SHORT-SEPALED LEWISIA<br>PDPOR04010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LEWISIA CANTELOVII*<br>CANTELOW'S LEWISIA<br>PDPOR04020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *LEWISIA CONGDONII*<br>CONGDON'S LEWISIA<br>PDPOR04040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** Rare | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LEWISIA COTYLEDON VAR HECKNERI*<br>HECKNER'S LEWISIA<br>PDPOR04052 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LEWISIA COTYLEDON VAR HOWELLII*<br>HOWELL'S LEWISIA<br>PDPOR04053 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T4Q<br>**State:** S3? | **List:** 3<br>**Code:** 222 |
| *LEWISIA DISEPALA*<br>YOSEMITE LEWISIA<br>PDPOR04060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *LEWISIA LONGIPETALA*<br>LONG-PETALED LEWISIA<br>PDPOR040K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 313 |
| *LEWISIA OPPOSITIFOLIA*<br>OPPOSITE-LEAVED LEWISIA<br>PDPOR040B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *LEWISIA SERRATA*<br>SAW-TOOTHED LEWISIA<br>PDPOR040E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 333 |
| *LEWISIA STEBBINSII*<br>STEBBINS'S LEWISIA<br>PDPOR040G0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *LILAEOPSIS MASONII*<br>MASON'S LILAEOPSIS<br>PDAPI19030 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *LILIUM BOLANDERI*<br>BOLANDER'S LILY<br>PMLIL1A010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LILIUM HUMBOLDTII SSP HUMBOLDTII*<br>HUMBOLDT LILY<br>PMLIL1A071 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LILIUM HUMBOLDTII SSP OCELLATUM*<br>OCELLATED HUMBOLDT LILY<br>PMLIL1A072 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LILIUM KELLOGGII*<br>KELLOGG'S LILY<br>PMLIL1A0A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LILIUM MARITIMUM*<br>COAST LILY<br>PMLIL1A0C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *LILIUM OCCIDENTALE*<br>WESTERN LILY<br>PMLIL1A0G0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 332 |
| *LILIUM PARDALINUM SSP PITKINENSE*<br>PITKIN MARSH LILY<br>PMLIL1A0H3 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LILIUM PARDALINUM SSP VOLLMERI*<br>VOLLMER'S LILY<br>PMLIL1A0H2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LILIUM PARDALINUM SSP WIGGINSII*<br>WIGGINS' LILY<br>PMLIL1A0S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LILIUM PARRYI*<br>LEMON LILY<br>PMLIL1A0J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *LILIUM RUBESCENS*<br>REDWOOD LILY<br>PMLIL1A0N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LILIUM WASHINGTONIANUM SSP PURPURASCENS*<br>PURPLE-FLOWERED WASHINGTON LILY<br>PMLIL1A0R2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LIMNANTHES BAKERI*<br>BAKER'S MEADOWFOAM<br>PDLIM02020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LIMNANTHES DOUGLASII SSP SULPHUREA*<br>POINT REYES MEADOWFOAM<br>PDLIM02038 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *LIMNANTHES FLOCCOSA SSP BELLINGERIANA*<br>BELLINGER'S MEADOWFOAM<br>PDLIM02041 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *LIMNANTHES FLOCCOSA SSP CALIFORNICA*<br>BUTTE COUNTY MEADOWFOAM<br>PDLIM02042 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LIMNANTHES FLOCCOSA SSP FLOCCOSA*<br>WOOLLY MEADOWFOAM<br>PDLIM02043 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3?<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *LIMNANTHES GRACILIS SSP PARISHII*<br>PARISH'S MEADOWFOAM<br>PDLIM02052 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LIMNANTHES VINCULANS*<br>SEBASTOPOL MEADOWFOAM<br>PDLIM02090 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *LIMOSELLA SUBULATA*<br>DELTA MUDWORT<br>PDSCR10050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S2.1 | **List:** 2<br>**Code:** 231 |
| *LINANTHUS ACICULARIS*<br>BRISTLY LINANTHUS<br>PDPLM09010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LINANTHUS AMBIGUUS*<br>SERPENTINE LINANTHUS<br>PDPLM09020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LINANTHUS ARENICOLA*<br>SAND LINANTHUS<br>PDPLM09040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2.2 | **List:** 2<br>**Code:** 121 |
| *LINANTHUS BELLUS*<br>DESERT BEAUTY<br>PDPLM09070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2G3<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *LINANTHUS CONCINNUS*<br>SAN GABRIEL LINANTHUS<br>PDPLM090D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2? | **List:** 1B<br>**Code:** 323 |
| *LINANTHUS FLORIBUNDUS SSP HALLII*<br>SANTA ROSA MOUNTAINS LINANTHUS<br>PDPLM090J3 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LINANTHUS GRANDIFLORUS*<br>LARGE-FLOWERED LINANTHUS<br>PDPLM090K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *LINANTHUS JEPSONII*<br>JEPSON'S LINANTHUS<br>PDPLM09140 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:**<br>**Code:** |
| *LINANTHUS KILLIPII*<br>BALDWIN LAKE LINANTHUS<br>PDPLM090N0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LINANTHUS NUTTALLII SSP HOWELLII*<br>MT. TEDOC LINANTHUS<br>PDPLM090V4 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LINANTHUS OBLANCEOLATUS*<br>SIERRA NEVADA LINANTHUS<br>PDPLM090W0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LINANTHUS ORCUTTII*<br>ORCUTT'S LINANTHUS<br>PDPLM090X0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4<br>**State:** S2.3 | **List:** 1B<br>**Code:** 312 |
| *LINANTHUS PYGMAEUS SSP PYGMAEUS*<br>PYGMY LINANTHUS<br>PDPLM09102 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *LINANTHUS RATTANII*<br>RATTAN'S LINANTHUS<br>PDPLM09110 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LINANTHUS SERRULATUS*<br>MADERA LINANTHUS<br>PDPLM09130 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1? | **List:** 1B<br>**Code:** 223 |
| *LISTERA CORDATA*<br>HEART-LEAVED TWAYBLADE<br>PMORC1N060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *LITHOPHRAGMA MAXIMUM*<br>SAN CLEMENTE ISLAND WOODLAND STAR<br>PDSAX0M070 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LOEFLINGIA SQUARROSA VAR ARTEMISIARUM*<br>SAGEBRUSH LOEFLINGIA<br>PDCAR0E011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *LOMATIUM CILIOLATUM VAR HOOVERI*<br>HOOVER'S LOMATIUM<br>PDAPI1B082 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LOMATIUM CONGDONII*<br>CONGDON'S LOMATIUM<br>PDAPI1B0B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LOMATIUM ENGELMANNII*<br>ENGELMANN'S LOMATIUM<br>PDAPI1B0K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LOMATIUM FOENICULACEUM SSP INYOENSE*<br>INYO LOMATIUM<br>PDAPI1B0M4 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LOMATIUM HENDERSONII*<br>HENDERSON'S LOMATIUM<br>PDAPI1B0T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S2.2 | **List:** 2<br>**Code:** 311 |
| *LOMATIUM HOWELLII*<br>HOWELL'S LOMATIUM<br>PDAPI1B0U0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LOMATIUM INSULARE*<br>SAN NICOLAS ISLAND LOMATIUM<br>PDAPI1B0W0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 222 |
| *LOMATIUM MARTINDALEI*<br>COAST RANGE LOMATIUM<br>PDAPI1B140 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.3 | **List:** 2<br>**Code:** 211 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LOMATIUM OBSERVATORIUM*<br>MT. HAMILTON LOMATIUM<br>PDAPI1B2J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:**<br>**Code:** |
| *LOMATIUM PARVIFOLIUM*<br>SMALL-LEAVED LOMATIUM<br>PDAPI1B1F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *LOMATIUM PECKIANUM*<br>PECK'S LOMATIUM<br>PDAPI1B1G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *LOMATIUM RAVENII*<br>RAVEN'S LOMATIUM<br>PDAPI1B1L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *LOMATIUM REPOSTUM*<br>NAPA LOMATIUM<br>PDAPI1B1M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LOMATIUM RIGIDUM*<br>STIFF LOMATIUM<br>PDAPI1B1N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LOMATIUM SHEVOCKII*<br>OWENS PEAK LOMATIUM<br>PDAPI1B2C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LOMATIUM STEBBINSII*<br>STEBBINS'S LOMATIUM<br>PDAPI1B1V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *LOMATIUM TRACYI*<br>TRACY'S LOMATIUM<br>PDAPI1B1Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LOTUS ARGOPHYLLUS VAR ADSURGENS*<br>SAN CLEMENTE ISLAND BIRD'S-FOOT TREFOIL<br>PDFAB2A041 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LOTUS ARGOPHYLLUS VAR NIVEUS*<br>SANTA CRUZ ISLAND BIRD'S-FOOT TREFOIL<br>PDFAB2A048 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LOTUS ARGYRAEUS VAR MULTICAULIS*<br>SCRUB LOTUS<br>PDFAB2A052 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LOTUS ARGYRAEUS VAR NOTITIUS*<br>PROVIDENCE MOUNTAINS LOTUS<br>PDFAB2A053 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 213 |
| *LOTUS CRASSIFOLIUS VAR OTAYENSIS*<br>OTAY MOUNTAIN LOTUS<br>PDFAB2A092 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LOTUS DENDROIDEUS VAR DENDROIDEUS*<br>ISLAND BROOM<br>PDFAB2A1G1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *LOTUS DENDROIDEUS VAR TRASKIAE* | **Federal:** | Endangered | **Global:** | G4T2 | **List:** | 1B |
| SAN CLEMENTE ISLAND LOTUS | **State:** | Endangered | **State:** | S2.1 | **Code:** | 333 |
| PDFAB2A1G2 **Records in NDDB:** *Yes* | | | | | | |
| *LOTUS DENDROIDEUS VAR VEATCHII* | **Federal:** | None | **Global:** | G4T3? | **List:** | 4 |
| SAN MIGUEL ISLAND DEERWEED | **State:** | None | **State:** | S3.3 | **Code:** | 112 |
| PDFAB2A1G3 **Records in NDDB:** *No* | | | | | | |
| *LOTUS HAYDONII* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| PYGMY LOTUS | **State:** | None | **State:** | S3.3 | **Code:** | 112 |
| PDFAB2A0H0 **Records in NDDB:** *No* | | | | | | |
| *LOTUS NUTTALLIANUS* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| NUTTALL'S LOTUS | **State:** | None | **State:** | S1.1 | **Code:** | 332 |
| PDFAB2A0V0 **Records in NDDB:** *Yes* | | | | | | |
| *LOTUS OBLONGIFOLIUS VAR CUPREUS* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| COPPER-FLOWERED BIRD'S-FOOT TREFOIL | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDFAB2A0W1 **Records in NDDB:** *No* | | | | | | |
| *LOTUS RUBRIFLORUS* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| RED-FLOWERED LOTUS | **State:** | None | **State:** | S1.1 | **Code:** | 333 |
| PDFAB2A150 **Records in NDDB:** *Yes* | | | | | | |
| *LOTUS YOLLABOLLIENSIS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| YOLLA BOLLY MOUNTAINS BIRD'S-FOOT TREFOIL | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDFAB2A1F0 **Records in NDDB:** *No* | | | | | | |
| *LUPINUS ALBIFRONS VAR ABRAMSII* | **Federal:** | None | **Global:** | G5T1Q | **List:** | 3 |
| ABRAM'S LUPINE | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PDFAB2B010 **Records in NDDB:** *No* | | | | | | |
| *LUPINUS ANTONINUS* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| ANTHONY PEAK LUPINE | **State:** | None | **State:** | S1.3 | **Code:** | 313 |
| PDFAB2B0C0 **Records in NDDB:** *Yes* | | | | | | |
| *LUPINUS CERVINUS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| SANTA LUCIA LUPINE | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDFAB2B0X0 **Records in NDDB:** *No* | | | | | | |
| *LUPINUS CITRINUS VAR CITRINUS* | **Federal:** | Species of concern | **Global:** | G2T2 | **List:** | 1B |
| ORANGE LUPINE | **State:** | None | **State:** | S2.2 | **Code:** | 123 |
| PDFAB2B103 **Records in NDDB:** *Yes* | | | | | | |
| *LUPINUS CITRINUS VAR DEFLEXUS* | **Federal:** | Species of concern | **Global:** | G2T1 | **List:** | 1B |
| MARIPOSA LUPINE | **State:** | Threatened | **State:** | S1.2 | **Code:** | 323 |
| PDFAB2B102 **Records in NDDB:** *Yes* | | | | | | |
| *LUPINUS CONSTANCEI* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| THE LASSICS LUPINE | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PDFAB2B490 **Records in NDDB:** *Yes* | | | | | | |
| *LUPINUS CROCEUS VAR PILOSELLUS* | **Federal:** | None | **Global:** | G?T3 | **List:** | 4 |
| SAFFRON-FLOWERED LUPINE | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDFAB2B162 **Records in NDDB:** *No* | | | | | | |
| *LUPINUS DALESIAE* | **Federal:** | None | **Global:** | G3 | **List:** | 1B |
| QUINCY LUPINE | **State:** | None | **State:** | S3.2 | **Code:** | 223 |
| PDFAB2B1A0 **Records in NDDB:** *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LUPINUS DURANII*<br>MONO LAKE LUPINE<br>PDFAB2B1E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LUPINUS ELATUS*<br>SILKY LUPINE<br>PDFAB2B1F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS EXCUBITUS VAR JOHNSTONII*<br>INTERIOR BUSH LUPINE<br>PDFAB2B1J4 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS EXCUBITUS VAR MEDIUS*<br>MOUNTAIN SPRINGS BUSH LUPINE<br>PDFAB2B1J5 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *LUPINUS EXIMIUS*<br>SAN MATEO TREE LUPINE<br>PDFAB2B0E2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G2?Q<br>**State:** S2.2 | **List:** 3<br>**Code:** 223 |
| *LUPINUS GRACILENTUS*<br>SLENDER LUPINE<br>PDFAB2B1R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS GUADALUPENSIS*<br>GUADALUPE ISLAND LUPINE<br>PDFAB2B1T0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *LUPINUS HOLMGRENANUS*<br>HOLMGREN'S LUPINE<br>PDFAB2B1Y0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *LUPINUS LAPIDICOLA*<br>MT. EDDY LUPINE<br>PDFAB2B280 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS LEPIDUS VAR CULBERTSONII*<br>HOCKETT MEADOWS LUPINE<br>PDFAB2B171 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *LUPINUS LUDOVICIANUS*<br>SAN LUIS OBISPO COUNTY LUPINE<br>PDFAB2B2G0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *LUPINUS MAGNIFICUS VAR GLARECOLA*<br>COSO MOUNTAINS LUPINE<br>PDFAB2B2K1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS MAGNIFICUS VAR HESPERIUS*<br>MCGEE MEADOWS LUPINE<br>PDFAB2B2K2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS MAGNIFICUS VAR MAGNIFICUS*<br>PANAMINT MOUNTAINS LUPINE<br>PDFAB2B2K3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3TH<br>**State:** SH | **List:** 1B<br>**Code:** 313 |
| *LUPINUS MILO-BAKERI*<br>MILO BAKER'S LUPINE<br>PDFAB2B4E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Threatened | **Global:** G1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 233 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *LUPINUS NIPOMENSIS*<br>NIPOMO MESA LUPINE<br>PDFAB2B111 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LUPINUS PADRE-CROWLEYI*<br>FATHER CROWLEY'S LUPINE<br>PDFAB2B2Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *LUPINUS PEIRSONII*<br>PEIRSON'S LUPINE<br>PDFAB2B330 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *LUPINUS SERICATUS*<br>COBB MOUNTAIN LUPINE<br>PDFAB2B3J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LUPINUS SPECTABILIS*<br>SHAGGYHAIR LUPINE<br>PDFAB2B3P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *LUPINUS TIDESTROMII*<br>TIDESTROM'S LUPINE<br>PDFAB2B3Y0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *LUPINUS TRACYI*<br>TRACY'S LUPINE<br>PDFAB2B3Z0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *LUPINUS UNCIALIS*<br>LILLIPUT LUPINE<br>PDFAB2B410 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.1 | **List:**<br>**Code:** |
| *LYCIUM BREVIPES VAR HASSEI*<br>SANTA CATALINA ISLAND DESERT-THORN<br>PDSOL0G0N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *LYCIUM PARISHII*<br>PARISH'S DESERT-THORN<br>PDSOL0G0D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *LYCIUM VERRUCOSUM*<br>SAN NICOLAS ISLAND DESERT-THORN<br>PDSOL0G0M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GXQ<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *LYCOPODIELLA INUNDATA*<br>BOG CLUB-MOSS<br>PPLYC03060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1? | **List:** 2<br>**Code:** 321 |
| *LYCOPODIUM CLAVATUM*<br>RUNNING-PINE<br>PPLYC01080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *LYCOPUS UNIFLORUS*<br>NORTHERN BUGLEWEED<br>PDLAM0X080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *LYCURUS PHLEOIDES VAR PHLEOIDES*<br>WOLFTAIL<br>PMPOA3W011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S1? | **List:** 2<br>**Code:** 321 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *LYONOTHAMNUS FLORIBUNDUS SSP ASPLENIIFOLIUS*<br>SANTA CRUZ ISLAND IRONWOOD<br>PDROS12011 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *LYONOTHAMNUS FLORIBUNDUS SSP FLORIBUNDUS*<br>SANTA CATALINA ISLAND IRONWOOD<br>PDROS12012 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *LYROCARPA COULTERI VAR PALMERI*<br>COULTER'S LYREPOD<br>PDBRA1R012 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T4<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *MACHAERANTHERA ASTEROIDES VAR LAGUNENSIS*<br>MOUNT LAGUNA ASTER<br>PDAST64131 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G5T2T3<br>S1.1 | **List:**<br>**Code:** | 2<br>331 |
| *MACHAERANTHERA CANESCENS VAR ZIEGLERI*<br>ZIEGLER'S ASTER<br>PDAST640B2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *MACHAERANTHERA JUNCEA*<br>RUSH-LIKE BRISTLEWEED<br>PDAST641A0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *MADIA DORIS-NILESIAE*<br>NILES'S MADIA<br>PDAST650L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *MADIA HALLII*<br>HALL'S MADIA<br>PDAST650A0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *MADIA NUTANS*<br>NODDING MADIA<br>PDAST650D0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *MADIA RADIATA*<br>SHOWY MADIA<br>PDAST650E0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>233 |
| *MADIA STEBBINSII*<br>STEBBINS'S MADIA<br>PDAST650K0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>323 |
| *MADIA YOSEMITANA*<br>YOSEMITE MADIA<br>PDAST650J0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G2G3<br>S2S3 | **List:**<br>**Code:** | 3<br>723 |
| *MAHONIA SONNEI*<br>TRUCKEE BARBERRY<br>PDBER060F0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G?Q<br>S? | **List:**<br>**Code:** | |
| *MALACOTHAMNUS ABBOTTII*<br>ABBOTT'S BUSH MALLOW<br>PDMAL0Q010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *MALACOTHAMNUS ABORIGINUM*<br>INDIAN VALLEY BUSH MALLOW<br>PDMAL0Q020 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 1B<br>223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MALACOTHAMNUS ARCUATUS*<br>ARCUATE BUSH MALLOW<br>PDMAL0Q0E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS CLEMENTINUS*<br>SAN CLEMENTE ISLAND BUSH MALLOW<br>PDMAL0Q030 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *MALACOTHAMNUS DAVIDSONII*<br>DAVIDSON'S BUSH MALLOW<br>PDMAL0Q040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 223 |
| *MALACOTHAMNUS FASCICULATUS VAR NESIOTICUS*<br>SANTA CRUZ ISLAND BUSH MALLOW<br>PDMAL0Q061 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G4T1Q<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *MALACOTHAMNUS GRACILIS*<br>SLENDER BUSH MALLOW<br>PDMAL0Q0J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS HALLII*<br>HALL'S BUSH MALLOW<br>PDMAL0Q0F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1Q<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *MALACOTHAMNUS HELLERI*<br>HELLER'S BUSH MALLOW<br>PDMAL0Q0G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS JONESII*<br>JONES'S BUSH MALLOW<br>PDMAL0Q090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS MENDOCINENSIS*<br>MENDOCINO BUSH MALLOW<br>PDMAL0Q0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *MALACOTHAMNUS NIVEUS*<br>SAN LUIS OBISPO COUNTY BUSH MALLOW<br>PDMAL0Q0H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS PALMERI VAR INVOLUCRATUS*<br>CARMEL VALLEY BUSH MALLOW<br>PDMAL0Q0B1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 123 |
| *MALACOTHAMNUS PALMERI VAR LUCIANUS*<br>ARROYO SECO BUSH MALLOW<br>PDMAL0Q0B2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1Q<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *MALACOTHAMNUS PALMERI VAR PALMERI*<br>SANTA LUCIA BUSH MALLOW<br>PDMAL0Q0B5 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHAMNUS PARISHII*<br>PARISH'S BUSH MALLOW<br>PDMAL0Q0C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *MALACOTHRIX FOLIOSA*<br>LEAFY MALACOTHRIX<br>PDAST66060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MALACOTHRIX INCANA*<br>DUNEDELION<br>PDAST66070 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MALACOTHRIX INDECORA*<br>SANTA CRUZ ISLAND MALACOTHRIX<br>PDAST660J0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *MALACOTHRIX SAXATILIS VAR ARACHNOIDEA*<br>CARMEL VALLEY MALACOTHRIX<br>PDAST660C2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *MALACOTHRIX SQUALIDA*<br>ISLAND MALACOTHRIX<br>PDAST660K0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *MALAXIS MONOPHYLLOS SSP BRACHYPODA*<br>ADDER'S-MOUTH<br>PMORC1R010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G?T4<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *MALPERIA TENUIS*<br>BROWN TURBANS<br>PDAST67010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *MARINA ORCUTTII VAR ORCUTTII*<br>CALIFORNIA MARINA<br>PDFAB2F031 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G?T1T2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *MARSILEA OLIGOSPORA*<br>NELSON'S PEPPERWORT<br>PPMAR010B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3? | **List:** 3<br>**Code:** ??1 |
| *MATELEA PARVIFOLIA*<br>SPEARLEAF<br>PDASC0A0J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S2.3 | **List:** 2<br>**Code:** 311 |
| *MAURANDYA ANTIRRHINIFLORA SSP ANTIRRHINIFLORA*<br>VIOLET TWINING SNAPDRAGON<br>PDSCR2M011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T3?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *MAURANDYA PETROPHILA*<br>ROCK LADY<br>PDSCR2J010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 323 |
| *MECONELLA OREGANA*<br>OREGON MECONELLA<br>PDPAP0G030 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G?<br>**State:** SH | **List:**<br>**Code:** |
| *MELICA SPECTABILIS*<br>PURPLE ONION GRASS<br>PMPOA3X0G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *MENTZELIA HIRSUTISSIMA*<br>HAIRY STICKLEAF<br>PDLOA030K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *MERTENSIA BELLA*<br>OREGON LUNGWORT<br>PDBOR0N040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2S3 | **List:** 2<br>**Code:** 321 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MICROPUS AMPHIBOLUS*<br>MT. DIABLO COTTONWEED<br>PDAST6D030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MICROSERIS BOREALIS*<br>NORTHERN MICROSERIS<br>PDAST6E030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *MICROSERIS DOUGLASII VAR PLATYCARPHA*<br>SMALL-FLOWERED MICROSERIS<br>PDAST6E062 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *MIMULUS ACUTIDENS*<br>KINGS RIVER MONKEYFLOWER<br>PDSCR1B010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2Q<br>**State:** S2? | **List:** 3<br>**Code:** ??3 |
| *MIMULUS ARIDUS*<br>LOW BUSH MONKEYFLOWER<br>PDSCR22040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *MIMULUS BRACHIATUS*<br>SERPENTINE MONKEYFLOWER<br>PDSCR1B0H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G2Q?<br>**State:** S2 | **List:** 3<br>**Code:** ??3 |
| *MIMULUS BRANDEGEI*<br>SANTA CRUZ ISLAND MONKEYFLOWER<br>PDSCR1B0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *MIMULUS CLEVELANDII*<br>CLEVELAND'S BUSH MONKEYFLOWER<br>PDSCR22010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *MIMULUS DIFFUSUS*<br>PALOMAR MONKEYFLOWER<br>PDSCR1B0Z0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *MIMULUS EXIGUUS*<br>SAN BERNARDINO MOUNTAINS MONKEYFLOWER<br>PDSCR1B140 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *MIMULUS FILICAULIS*<br>SLENDER-STEMMED MONKEYFLOWER<br>PDSCR1B150 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *MIMULUS FLEMINGII*<br>ISLAND BUSH MONKEYFLOWER<br>PDSCR1B320 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS GLABRATUS SSP UTAHENSIS*<br>UTAH MONKEYFLOWER<br>PDSCR1B1A6 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.1 | **List:** 2<br>**Code:** 321 |
| *MIMULUS GLAUCESCENS*<br>SHIELD-BRACTED MONKEYFLOWER<br>PDSCR1B1B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS GRACILIPES*<br>SLENDER-STALKED MONKEYFLOWER<br>PDSCR1B1C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MIMULUS GRAYI*<br>GRAY'S MONKEYFLOWER<br>PDSCR1B1D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS INCONSPICUUS*<br>SMALL-FLOWERED MONKEYFLOWER<br>PDSCR1B1F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS LACINIATUS*<br>CUT-LEAVED MONKEYFLOWER<br>PDSCR1B1L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS MICROPHYLLUS*<br>SMALL-LEAVED MONKEYFLOWER<br>PDSCR1B300 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS MOHAVENSIS*<br>MOJAVE MONKEYFLOWER<br>PDSCR1B1V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *MIMULUS NORRISII*<br>KAWEAH MONKEYFLOWER<br>PDSCR1B2Y0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *MIMULUS NUDATUS*<br>BARE MONKEYFLOWER<br>PDSCR1B200 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS PICTUS*<br>CALICO MONKEYFLOWER<br>PDSCR1B240 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *MIMULUS PULCHELLUS*<br>PANSY MONKEYFLOWER<br>PDSCR1B280 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS PURPUREUS*<br>PURPLE MONKEYFLOWER<br>PDSCR1B2B0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1?<br>**State:** S1.1 | **List:** 2<br>**Code:** 231 |
| *MIMULUS PYGMAEUS*<br>EGG LAKE MONKEYFLOWER<br>PDSCR1B2C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 1B<br>**Code:** 212 |
| *MIMULUS RATTANII SSP DECURTATUS*<br>SANTA CRUZ COUNTY MONKEYFLOWER<br>PDSCR1B2D2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *MIMULUS RUPICOLA*<br>DEATH VALLEY MONKEYFLOWER<br>PDSCR1B2H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MIMULUS SHEVOCKII*<br>KELSO CREEK MONKEYFLOWER<br>PDSCR1B2Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *MIMULUS SUBSECUNDUS*<br>ONE-SIDED MONKEYFLOWER<br>PDSCR1B2K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MIMULUS TRASKIAE*<br>SANTA CATALINA ISLAND MONKEYFLOWER<br>PDSCR1B2P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *MIMULUS WHIPPLEI*<br>WHIPPLE'S MONKEYFLOWER<br>PDSCR1B2U0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *MINUARTIA DECUMBENS*<br>THE LASSICS SANDWORT<br>PDCAR0G0Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *MINUARTIA HOWELLII*<br>HOWELL'S SANDWORT<br>PDCAR0G0F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *MINUARTIA OBTUSILOBA*<br>ALPINE SANDWORT<br>PDCAR0G0N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *MINUARTIA ROSEI*<br>PEANUT SANDWORT<br>PDCAR0G0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *MINUARTIA STOLONIFERA*<br>SCOTT MOUNTAIN SANDWORT<br>PDCAR0G110 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *MIRABILIS TENUILOBA*<br>SLENDER-LOBED FOUR-O'CLOCK<br>PDNYC0A150 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *MOBERGIA CALCULIFORMIS*<br>LIGHT GRAY LICHEN<br>NLTES41770 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *MONARDELLA ANTONINA SSP ANTONINA*<br>SAN ANTONIO HILLS MONARDELLA<br>PDLAM18011 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3Q<br>**State:** S3? | **List:** 3<br>**Code:** ??3 |
| *MONARDELLA ANTONINA SSP BENITENSIS*<br>SAN BENITO MONARDELLA<br>PDLAM18012 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MONARDELLA BENEOLENS*<br>SWEET-SMELLING MONARDELLA<br>PDLAM180U0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *MONARDELLA CANDICANS*<br>SIERRA MONARDELLA<br>PDLAM18050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MONARDELLA CINEREA*<br>GRAY MONARDELLA<br>PDLAM18060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MONARDELLA CRISPA*<br>CRISP MONARDELLA<br>PDLAM18070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MONARDELLA DOUGLASII SSP VENOSA*<br>VEINY MONARDELLA<br>PDLAM18082 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *MONARDELLA FOLLETTII*<br>FOLLETT'S MONARDELLA<br>PDLAM180W0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *MONARDELLA FRUTESCENS*<br>SAN LUIS OBISPO MONARDELLA<br>PDLAM180X0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *MONARDELLA HYPOLEUCA SSP LANATA*<br>FELT-LEAVED MONARDELLA<br>PDLAM180A2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *MONARDELLA LEUCOCEPHALA*<br>MERCED MONARDELLA<br>PDLAM180C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *MONARDELLA LINOIDES SSP OBLONGA*<br>FLAX-LIKE MONARDELLA<br>PDLAM180D2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *MONARDELLA LINOIDES SSP VIMINEA*<br>WILLOWY MONARDELLA<br>PDLAM180D4 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G5T3<br>**State:** S2.1 | **List:** 1B<br>**Code:** 232 |
| *MONARDELLA MACRANTHA SSP HALLII*<br>HALL'S MONARDELLA<br>PDLAM180E1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 1B<br>**Code:** 213 |
| *MONARDELLA NANA SSP LEPTOSIPHON*<br>SAN FELIPE MONARDELLA<br>PDLAM180F2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4G5T2<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *MONARDELLA PALMERI*<br>PALMER'S MONARDELLA<br>PDLAM180H0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MONARDELLA PRINGLEI*<br>PRINGLE'S MONARDELLA<br>PDLAM180J0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *MONARDELLA ROBISONII*<br>ROBISON'S MONARDELLA<br>PDLAM180K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *MONARDELLA STEBBINSII*<br>STEBBINS'S MONARDELLA<br>PDLAM180L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *MONARDELLA UNDULATA*<br>CURLY-LEAVED MONARDELLA<br>PDLAM180N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *MONARDELLA VILLOSA SSP GLOBOSA*<br>ROBUST MONARDELLA<br>PDLAM180P7 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *MONARDELLA VIRIDIS SSP SAXICOLA*<br>ROCK MONARDELLA<br>PDLAM180Q1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *MONARDELLA VIRIDIS SSP VIRIDIS*<br>GREEN MONARDELLA<br>PDLAM180Q2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *MONOTROPA UNIFLORA*<br>INDIAN-PIPE<br>PDMON03030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |
| *MONTIA HOWELLII*<br>HOWELL'S MONTIA<br>PDPOR05070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2?<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *MUCRONEA CALIFORNICA*<br>CALIFORNIA SPINEFLOWER<br>PDPGN0F010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2? | **List:** 4<br>**Code:** 123 |
| *MUHLENBERGIA APPRESSA*<br>APPRESSED MUHLY<br>PMPOA48020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3? | **List:** 2<br>**Code:** 221 |
| *MUHLENBERGIA ARSENEI*<br>TOUGH MUHLY<br>PMPOA48060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 211 |
| *MUHLENBERGIA CALIFORNICA*<br>CALIFORNIA MUHLY<br>PMPOA480A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1B<br>**Code:** 223 |
| *MUHLENBERGIA FRAGILIS*<br>DELICATE MUHLY<br>PMPOA480Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *MUHLENBERGIA PAUCIFLORA*<br>FEW-FLOWERED MUHLY<br>PMPOA48170 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *MUILLA CLEVELANDII*<br>SAN DIEGO GOLDENSTAR<br>PMLIL1H010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 222 |
| *MUILLA CORONATA*<br>CROWNED MUILLA<br>PMLIL1H020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 122 |
| *MUNROA SQUARROSA*<br>FALSE BUFFALO-GRASS<br>PMPOA49010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *MYOSURUS MINIMUS SSP APUS*<br>LITTLE MOUSETAIL<br>PDRAN0H031 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2Q<br>**State:** S2.2 | **List:** 3<br>**Code:** 232 |
| *NAMA DICHOTOMUM VAR DICHOTOMUM*<br>FORKED PURPLE MAT<br>PDHYD0A061 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *NAMA STENOCARPUM*<br>MUD NAMA<br>PDHYD0A0H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *NAVARRETIA ERIOCEPHALA*<br>HOARY NAVARRETIA<br>PDPLM0C060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *NAVARRETIA FOSSALIS*<br>SPREADING NAVARRETIA<br>PDPLM0C080 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 232 |
| *NAVARRETIA HETERANDRA*<br>TEHAMA NAVARRETIA<br>PDPLM0C0A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *NAVARRETIA JAREDII*<br>PASO ROBLES NAVARRETIA<br>PDPLM0C0Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *NAVARRETIA JEPSONII*<br>JEPSON'S NAVARRETIA<br>PDPLM0C0D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *NAVARRETIA LEUCOCEPHALA SSP BAKERI*<br>BAKER'S NAVARRETIA<br>PDPLM0C0E1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *NAVARRETIA LEUCOCEPHALA SSP PAUCIFLORA*<br>FEW-FLOWERED NAVARRETIA<br>PDPLM0C0E4 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G3T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *NAVARRETIA LEUCOCEPHALA SSP PLIEANTHA*<br>MANY-FLOWERED NAVARRETIA<br>PDPLM0C0E5 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *NAVARRETIA MYERSII SSP DEMINUTA*<br><br>PDPLM0C0X2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1T1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *NAVARRETIA MYERSII SSP MYERSII*<br>PINCUSHION NAVARRETIA<br>PDPLM0C0X1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *NAVARRETIA NIGELLIFORMIS SSP RADIANS*<br>SHINING NAVARRETIA<br>PDPLM0C0J2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *NAVARRETIA PENINSULARIS*<br>BAJA NAVARRETIA<br>PDPLM0C0L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *NAVARRETIA PROLIFERA SSP LUTEA*<br>YELLOW BUR NAVARRETIA<br>PDPLM0C0N1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *NAVARRETIA ROSULATA*<br>MARIN COUNTY NAVARRETIA<br>PDPLM0C0Z0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2? | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *NAVARRETIA SETILOBA* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| PIUTE MOUNTAINS NAVARRETIA | **State:** | None | **State:** | S1.1 | **Code:** | 333 |
| PDPLM0C0S0 **Records in NDDB:** *Yes* | | | | | | |
| *NAVARRETIA SUBULIGERA* | **Federal:** | None | **Global:** | G4 | **List:** | 4 |
| AWL-LEAVED NAVARRETIA | **State:** | None | **State:** | S3.3 | **Code:** | 112 |
| PDPLM0C0U0 **Records in NDDB:** *No* | | | | | | |
| *NEMACAULIS DENUDATA VAR DENUDATA* | **Federal:** | None | **Global:** | G4T3? | **List:** | 2 |
| COAST WOOLLY-HEADS | **State:** | None | **State:** | S1S2 | **Code:** | 221 |
| PDPGN0G011 **Records in NDDB:** *Yes* | | | | | | |
| *NEMACAULIS DENUDATA VAR GRACILIS* | **Federal:** | None | **Global:** | G4T3? | **List:** | 2 |
| SLENDER WOOLLY-HEADS | **State:** | None | **State:** | S2S3 | **Code:** | 221 |
| PDPGN0G012 **Records in NDDB:** *Yes* | | | | | | |
| *NEMACLADUS GRACILIS* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| SLENDER NEMACLADUS | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDCAM0F030 **Records in NDDB:** *No* | | | | | | |
| *NEMACLADUS TWISSELMANNII* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| TWISSELMANN'S NEMACLADUS | **State:** | Rare | **State:** | S1.2 | **Code:** | 323 |
| PDCAM0F0D0 **Records in NDDB:** *Yes* | | | | | | |
| *NEMOPHILA PARVIFLORA VAR QUERCIFOLIA* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| OAK-LEAVED NEMOPHILA | **State:** | None | **State:** | S3.3 | **Code:** | 112 |
| PDHYD0B073 **Records in NDDB:** *No* | | | | | | |
| *NEOSTAPFIA COLUSANA* | **Federal:** | Threatened | **Global:** | G3 | **List:** | 1B |
| COLUSA GRASS | **State:** | Endangered | **State:** | S3.1 | **Code:** | 133 |
| PMPOA4C010 **Records in NDDB:** *Yes* | | | | | | |
| *NEVIUSIA CLIFTONII* | **Federal:** | None | **Global:** | G1 | **List:** | 1B |
| SHASTA SNOW-WREATH | **State:** | None | **State:** | S1.2 | **Code:** | 323 |
| PDROS14020 **Records in NDDB:** *Yes* | | | | | | |
| *NITROPHILA MOHAVENSIS* | **Federal:** | Endangered | **Global:** | G1 | **List:** | 1B |
| AMARGOSA NITROPHILA | **State:** | Endangered | **State:** | S1.1 | **Code:** | 332 |
| PDCHE0G010 **Records in NDDB:** *Yes* | | | | | | |
| *NOLINA CISMONTANA* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | |
| CALIFORNIA BEARGRASS | **State:** | None | **State:** | S1.1 | **Code:** | |
| PMAGA080E0 **Records in NDDB:** *No* | | | | | | |
| *NOLINA INTERRATA* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| DEHESA NOLINA | **State:** | Endangered | **State:** | S1.1 | **Code:** | 332 |
| PMAGA08070 **Records in NDDB:** *Yes* | | | | | | |
| *OENOTHERA CAESPITOSA SSP CRINITA* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| CAESPITOSE EVENING-PRIMROSE | **State:** | None | **State:** | S3.2 | **Code:** | 121 |
| PDONA0C063 **Records in NDDB:** *No* | | | | | | |
| *OENOTHERA CALIFORNICA SSP EUREKENSIS* | **Federal:** | Endangered | **Global:** | G4?T1 | **List:** | 1B |
| EUREKA DUNES EVENING-PRIMROSE | **State:** | Rare | **State:** | S1.2 | **Code:** | 323 |
| PDONA0C071 **Records in NDDB:** *Yes* | | | | | | |
| *OENOTHERA DELTOIDES SSP HOWELLII* | **Federal:** | Endangered | **Global:** | G5T1 | **List:** | 1B |
| ANTIOCH DUNES EVENING-PRIMROSE | **State:** | Endangered | **State:** | S1.1 | **Code:** | 333 |
| PDONA0C0B4 **Records in NDDB:** *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *OENOTHERA WOLFII*<br>WOLF'S EVENING-PRIMROSE<br>PDONA0C1K0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *OPHIOGLOSSUM CALIFORNICUM*<br>CALIFORNIA ADDER'S-TONGUE<br>PPOPH020G0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.2 | **List:**<br>**Code:** | 4<br>122 |
| *OPHIOGLOSSUM PUSILLUM*<br>NORTHERN ADDER'S-TONGUE<br>PPOPH020F0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S1.2 | **List:**<br>**Code:** | 1A<br>* |
| *OPUNTIA BASILARIS VAR BRACHYCLADA*<br>SHORT-JOINT BEAVERTAIL<br>PDCAC0D053 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *OPUNTIA BASILARIS VAR TRELEASEI*<br>BAKERSFIELD CACTUS<br>PDCAC0D055 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G5T2<br>S2.1 | **List:**<br>**Code:** | 1B<br>333 |
| *OPUNTIA CURVOSPINA*<br>CURVED-SPINE BEAVERTAIL<br>PDCAC0D270 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G?<br>S2S3 | **List:**<br>**Code:** | 2<br>221 |
| *OPUNTIA FRAGILIS*<br>BRITTLE PRICKLY-PEAR<br>PDCAC0D0H0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4G5<br>SH | **List:**<br>**Code:** | 2<br>331 |
| *OPUNTIA MUNZII*<br>MUNZ'S CHOLLA<br>PDCAC0D0V0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>313 |
| *OPUNTIA PARRYI VAR SERPENTINA*<br>SNAKE CHOLLA<br>PDCAC0D0Y2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3T2<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *OPUNTIA PULCHELLA*<br>BEAUTIFUL CHOLLA<br>PDCAC0D120 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S2S3 | **List:**<br>**Code:** | 2<br>221 |
| *OPUNTIA WIGGINSII*<br>WIGGINS'S CHOLLA<br>PDCAC0D1P0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3Q<br>S1.2? | **List:**<br>**Code:** | 3<br>312 |
| *OPUNTIA WOLFII*<br>WOLF'S CHOLLA<br>PDCAC0D2R0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4?<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ORCUTTIA CALIFORNICA*<br>CALIFORNIA ORCUTT GRASS<br>PMPOA4G010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>332 |
| *ORCUTTIA INAEQUALIS*<br>SAN JOAQUIN VALLEY ORCUTT GRASS<br>PMPOA4G060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Threatened<br>Endangered | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>233 |
| *ORCUTTIA PILOSA*<br>HAIRY ORCUTT GRASS<br>PMPOA4G040 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>233 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *ORCUTTIA TENUIS*<br>SLENDER ORCUTT GRASS<br>PMPOA4G050 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Endangered | **Global:** G3<br>**State:** S3.1 | **List:** 1B<br>**Code:** 233 |
| *ORCUTTIA VISCIDA*<br>SACRAMENTO ORCUTT GRASS<br>PMPOA4G070 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *OREONANA PURPURASCENS*<br>PURPLE MOUNTAIN-PARSLEY<br>PDAPI1G020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *OREONANA VESTITA*<br>WOOLLY MOUNTAIN-PARSLEY<br>PDAPI1G030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *ORNITHOSTAPHYLOS OPPOSITIFOLIA*<br>BAJA CALIFORNIA BIRDBUSH<br>PDERI0W010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *OROBANCHE PARISHII SSP BRACHYLOBA*<br>SHORT-LOBED BROOM-RAPE<br>PDORO040A2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *OROBANCHE VALIDA SSP HOWELLII*<br>HOWELL'S BROOMRAPE<br>PDORO040G1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *OROBANCHE VALIDA SSP VALIDA*<br>ROCK CREEK BROOMRAPE<br>PDORO040G2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *ORTHOCARPUS CUSPIDATUS SSP CUSPIDATUS*<br>SISKIYOU MOUNTAINS ORTHOCARPUS<br>PDSCR1H081 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *ORTHOCARPUS PACHYSTACHYUS*<br>SHASTA ORTHOCARPUS<br>PDSCR1H0L0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1A<br>**Code:** * |
| *ORYCTES NEVADENSIS*<br>NEVADA ORYCTES<br>PDSOL0Q010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *OXYTHECA CARYOPHYLLOIDES*<br>CHICKWEED OXYTHECA<br>PDPGN0J010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *OXYTHECA EMARGINATA*<br>WHITE-MARGINED OXYTHECA<br>PDPGN0J030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *OXYTHECA PARISHII VAR ABRAMSII*<br>ABRAMS'S OXYTHECA<br>PDPGN0J041 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *OXYTHECA PARISHII VAR CIENEGENSIS*<br>CIENEGA SECA OXYTHECA<br>PDPGN0J042 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *OXYTHECA PARISHII VAR GOODMANIANA*<br>CUSHENBURY OXYTHECA<br>PDPGN0J043 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G4?T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *OXYTHECA WATSONII*<br>WATSON'S OXYTHECA<br>PDPGN0J070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 2<br>**Code:** 321 |
| *OXYTROPIS DEFLEXA VAR SERICEA*<br>BLUE PENDENT-POD OXYTROPE<br>PDFAB2X053 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *PALAFOXIA ARIDA VAR GIGANTEA*<br>GIANT SPANISH-NEEDLE<br>PDAST6T012 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S1.2 | **List:** 1B<br>**Code:** 212 |
| *PARONYCHIA AHARTII*<br>AHART'S PARONYCHIA<br>PDCAR0L0V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PARVISEDUM LEIOCARPUM*<br>LAKE COUNTY STONECROP<br>PDCRA0F020 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PEDICULARIS BRACTEOSA VAR FLAVIDA*<br>YELLOWISH LOUSEWORT<br>PDSCR1K044 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PEDICULARIS CENTRANTHERA*<br>DWARF LOUSEWORT<br>PDSCR1K070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.2 | **List:** 2<br>**Code:** 311 |
| *PEDICULARIS CONTORTA*<br>CURVED-BEAK LOUSEWORT<br>PDSCR1K090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PEDICULARIS CRENULATA*<br>SCALLOPED-LEAVED LOUSEWORT<br>PDSCR1K0A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.2 | **List:** 2<br>**Code:** 311 |
| *PEDICULARIS DUDLEYI*<br>DUDLEY'S LOUSEWORT<br>PDSCR1K0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *PEDICULARIS HOWELLII*<br>HOWELL'S LOUSEWORT<br>PDSCR1K0J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *PELLAEA TRUNCATA*<br>CLIFF BRAKE<br>PPADI0H0C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 211 |
| *PENSTEMON ALBOMARGINATUS*<br>WHITE-MARGINED BEARDTONGUE<br>PDSCR1L070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *PENSTEMON BARNEBYI*<br>BARNEBY'S BEARDTONGUE<br>PDSCR1L0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S1.2 | **List:** 2<br>**Code:** 331 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PENSTEMON CALCAREUS*<br>LIMESTONE BEARDTONGUE<br>PDSCR1L100 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 2<br>**Code:** 211 |
| *PENSTEMON CALIFORNICUS*<br>CALIFORNIA BEARDTONGUE<br>PDSCR1L110 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |
| *PENSTEMON CINEREUS*<br>GRAY BEARDTONGUE<br>PDSCR1L354 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PENSTEMON CINICOLA*<br>ASH BEARDTONGUE<br>PDSCR1L1B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2? | **List:** 4<br>**Code:** 121 |
| *PENSTEMON CLEVELANDII VAR CONNATUS*<br>SAN JACINTO BEARDTONGUE<br>PDSCR1L1D2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PENSTEMON FILIFORMIS*<br>THREAD-LEAVED BEARDTONGUE<br>PDSCR1L2A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 1B<br>**Code:** 213 |
| *PENSTEMON FRUTICIFORMIS VAR AMARGOSAE*<br>DEATH VALLEY BEARDTONGUE<br>PDSCR1L2F2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *PENSTEMON HETERODOXUS VAR SHASTENSIS*<br>SHASTA BEARDTONGUE<br>PDSCR1L5Q0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PENSTEMON NEWBERRYI VAR SONOMENSIS*<br>SONOMA BEARDTONGUE<br>PDSCR1L483 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *PENSTEMON PAPILLATUS*<br>INYO BEARDTONGUE<br>PDSCR1L4L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PENSTEMON PERSONATUS*<br>CLOSED-THROATED BEARDTONGUE<br>PDSCR1L4Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *PENSTEMON PURPUSII*<br>SNOW MOUNTAIN BEARDTONGUE<br>PDSCR1L590 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PENSTEMON RATTANII VAR KLEEI*<br>SANTA CRUZ MOUNTAINS BEARDTONGUE<br>PDSCR1L5B1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *PENSTEMON STEPHENSII*<br>STEPHENS'S BEARDTONGUE<br>PDSCR1L5W0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 223 |
| *PENSTEMON THURBERI*<br>THURBER'S BEARDTONGUE<br>PDSCR1L680 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.2? | **List:** 4<br>**Code:** 121 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PENSTEMON TRACYI*<br>TRACY'S BEARDTONGUE<br>PDSCR1L6A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *PENTACHAETA BELLIDIFLORA*<br>WHITE-RAYED PENTACHAETA<br>PDAST6X030 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PENTACHAETA EXILIS SSP AEOLICA*<br>SLENDER PENTACHAETA<br>PDAST6X041 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PENTACHAETA LYONII*<br>LYON'S PENTACHAETA<br>PDAST6X060 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PERIDERIDIA BACIGALUPII*<br>BACIGALUPI'S YAMPAH<br>PDAPI1N020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *PERIDERIDIA GAIRDNERI SSP GAIRDNERI*<br>GAIRDNER'S YAMPAH<br>PDAPI1N062 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *PERIDERIDIA LEPTOCARPA*<br>NARROW-SEEDED YAMPAH<br>PDAPI1N0A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *PERIDERIDIA PARISHII SSP PARISHII*<br>PARISH'S YAMPAH<br>PDAPI1N0C2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3T4<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *PERIDERIDIA PRINGLEI*<br>ADOBE YAMPAH<br>PDAPI1N0D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PERITYLE INYOENSIS*<br>INYO ROCK DAISY<br>PDAST700F0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PERITYLE VILLOSA*<br>HANAUPAH ROCK DAISY<br>PDAST700V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *PETALONYX THURBERI SSP GILMANII*<br>DEATH VALLEY SANDPAPER-PLANT<br>PDLOA04041 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 323 |
| *PETERIA THOMPSONIAE*<br>SPINE-NODED MILK VETCH<br>PDFAB32020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *PHACELIA AMABILIS*<br>SALINE VALLEY PHACELIA<br>PDHYD0C040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1Q<br>**State:** S1 | **List:** 3<br>**Code:** 313 |
| *PHACELIA ANELSONII*<br>AVEN NELSON'S PHACELIA<br>PDHYD0C060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2G3<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PHACELIA ARGENTEA*<br>SAND DUNE PHACELIA<br>PDHYD0C070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *PHACELIA CILIATA VAR OPACA*<br>MERCED PHACELIA<br>PDHYD0C0S2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *PHACELIA CINEREA*<br>ASHY PHACELIA<br>PDHYD0C0T0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *PHACELIA COOKEI*<br>COOKE'S PHACELIA<br>PDHYD0C0Y0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PHACELIA DALESIANA*<br>SCOTT MOUNTAIN PHACELIA<br>PDHYD0C140 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 123 |
| *PHACELIA EXILIS*<br>TRANSVERSE RANGE PHACELIA<br>PDHYD0C4Y0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PHACELIA FLORIBUNDA*<br>MANY-FLOWERED PHACELIA<br>PDHYD0C1G0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *PHACELIA GREENEI*<br>SCOTT VALLEY PHACELIA<br>PDHYD0C1V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *PHACELIA INSULARIS VAR CONTINENTIS*<br>NORTH COAST PHACELIA<br>PDHYD0C2B1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PHACELIA INSULARIS VAR INSULARIS*<br>NORTHERN CHANNEL ISLANDS PHACELIA<br>PDHYD0C2B2 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |
| *PHACELIA INUNDATA*<br>PLAYA PHACELIA<br>PDHYD0C2E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 2<br>**Code:** 211 |
| *PHACELIA INYOENSIS*<br>INYO PHACELIA<br>PDHYD0C2F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PHACELIA LEONIS*<br>SISKIYOU PHACELIA<br>PDHYD0C2N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 212 |
| *PHACELIA MOHAVENSIS*<br>MOJAVE PHACELIA<br>PDHYD0C310 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PHACELIA MONOENSIS*<br>MONO COUNTY PHACELIA<br>PDHYD0C4V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.1 | **List:** 1B<br>**Code:** 332 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PHACELIA MUSTELINA*<br>DEATH VALLEY ROUND-LEAVED PHACELIA<br>PDHYD0C330 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S1.3 | **List:** 1B<br>**Code:** 212 |
| *PHACELIA NASHIANA*<br>CHARLOTTE'S PHACELIA<br>PDHYD0C350 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 123 |
| *PHACELIA NOVENMILLENSIS*<br>NINE MILE CANYON PHACELIA<br>PDHYD0C3A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *PHACELIA OROGENES*<br>MOUNTAIN PHACELIA<br>PDHYD0C3C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PHACELIA PARISHII*<br>PARISH'S PHACELIA<br>PDHYD0C3G0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *PHACELIA PHACELIOIDES*<br>MT. DIABLO PHACELIA<br>PDHYD0C3Q0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 223 |
| *PHACELIA PULCHELLA VAR GOODDINGII*<br>GOODDING'S PHACELIA<br>PDHYD0C3V1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2T3<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *PHACELIA SERICEA VAR CILIOSA*<br>BLUE ALPINE PHACELIA<br>PDHYD0C4A1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S1.3? | **List:** 2<br>**Code:** 211 |
| *PHACELIA STEBBINSII*<br>STEBBINS'S PHACELIA<br>PDHYD0C4D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *PHACELIA STELLARIS*<br>BRAND'S PHACELIA<br>PDHYD0C510 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *PHACELIA SUAVEOLENS SSP KECKII*<br>SANTIAGO PEAK PHACELIA<br>PDHYD0C4G1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *PHASEOLUS FILIFORMIS*<br>SLENDER-STEM BEAN<br>PDFAB330P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *PHLOX DISPERSA*<br>HIGH SIERRA PHLOX<br>PDPLM0D0M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *PHLOX DOLICHANTHA*<br>BIG BEAR VALLEY PHLOX<br>PDPLM0D0P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *PHLOX HIRSUTA*<br>YREKA PHLOX<br>PDPLM0D100 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PHLOX MUSCOIDES*<br>MOSS PHLOX<br>PDPLM0D115 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *PHOLISMA SONORAE*<br>SAND FOOD<br>PDLNN02020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S1.2 | **List:** 1B<br>**Code:** 222 |
| *PHOLISTOMA AURITUM VAR ARIZONICUM*<br>ARIZONA PHOLISTOMA<br>PDHYD0D011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *PHYSALIS LOBATA*<br>LOBED GROUND-CHERRY<br>PDSOL0T010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *PICEA ENGELMANNII*<br>ENGELMANN SPRUCE<br>PGPIN03030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *PILOSTYLES THURBERI*<br>THURBER'S PILOSTYLES<br>PDRAF01010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PINGUICULA VULGARIS SSP MACROCERAS*<br>HORNED BUTTERWORT<br>PDLNT01041 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2T3<br>**State:** S3.2? | **List:** 2<br>**Code:** 121 |
| *PINUS CONTORTA SSP BOLANDERI*<br>BOLANDER'S BEACH PINE<br>PGPIN04081 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 123 |
| *PINUS EDULIS*<br>TWO-NEEDLE PINYON PINE<br>PGPIN040C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5Q<br>**State:** S1.3? | **List:** 3<br>**Code:** 311 |
| *PINUS LONGAEVA*<br>BRISTLECONE PINE<br>PGPIN04180 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PINUS RADIATA*<br>MONTEREY PINE<br>PGPIN040V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *PINUS TORREYANA SSP INSULARIS*<br>SANTA ROSA ISL. TORREY PINE<br>PGPIN04151 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PINUS TORREYANA SSP TORREYANA*<br>TORREY PINE<br>PGPIN04152 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *PIPERIA CANDIDA*<br>WHITE-FLOWERED REIN ORCHID<br>PMORC1X050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PIPERIA MICHAELII*<br>PURPLE-FLOWERED PIPERIA<br>PMORC1X041 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *PIPERIA YADONII*<br>YADON'S REIN ORCHID<br>PMORC1X070 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PIPTATHERUM MICRANTHUM*<br>SMALL-FLOWERED RICE GRASS<br>PMPOA4J070 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *PITYOPUS CALIFORNICUS*<br>CALIFORNIA PINEFOOT<br>PDMON05010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *PLAGIOBOTHRYS CHORISIANUS VAR CHORISIANUS*<br>CHORIS'S POPCORN-FLOWER<br>PDBOR0V061 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3T2?Q<br>**State:** S2? | **List:** 3<br>**Code:** 223 |
| *PLAGIOBOTHRYS DIFFUSUS*<br>SAN FRANCISCO POPCORN-FLOWER<br>PDBOR0V080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PLAGIOBOTHRYS GLABER*<br>HAIRLESS POPCORN-FLOWER<br>PDBOR0V0B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *PLAGIOBOTHRYS GLOMERATUS*<br>MAMMOTH POPCORN-FLOWER<br>PDBOR0V1A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G?<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |
| *PLAGIOBOTHRYS GLYPTOCARPUS VAR MODESTUS*<br>CEDAR CREST POPCORN-FLOWER<br>PDBOR0V0C2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3THQ<br>**State:** SH | **List:** 3<br>**Code:** 3?3 |
| *PLAGIOBOTHRYS HYSTRICULUS*<br>BEARDED POPCORN-FLOWER<br>PDBOR0V0H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *PLAGIOBOTHRYS LITHOCARYUS*<br>MAYACAMAS POPCORN-FLOWER<br>PDBOR0V0P0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *PLAGIOBOTHRYS MOLLIS VAR VESTITUS*<br>PETALUMA POPCORN-FLOWER<br>PDBOR0V0Q2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4?TX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *PLAGIOBOTHRYS MYOSOTOIDES*<br>FORGET-ME-NOT POPCORN-FLOWER<br>PDBOR0V0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *PLAGIOBOTHRYS SALSUS*<br>DESERT POPCORN-FLOWER<br>PDBOR0V0X0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S1.2? | **List:** 2<br>**Code:** 321 |
| *PLAGIOBOTHRYS STRICTUS*<br>CALISTOGA POPCORN-FLOWER<br>PDBOR0V120 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Threatened | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *PLAGIOBOTHRYS UNCINATUS*<br>HOOKED POPCORN-FLOWER<br>PDBOR0V170 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *PLATYSTEMON CALIFORNICUS VAR CILIATUS*<br>SANTA BARBARA ISLAND CREAM CUPS<br>PDPAP0J022 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G5T1<br>S1.3 | **List:**<br>**Code:** | 1B<br>313 |
| *PLEUROPOGON CALIFORNICUS VAR DAVYI*<br>DAVY'S SEMAPHORE GRASS<br>PMPOA7Y012 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *PLEUROPOGON HOOVERIANUS*<br>NORTH COAST SEMAPHORE GRASS<br>PMPOA7Y031 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Rare | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>323 |
| *PLEUROPOGON REFRACTUS*<br>NODDING SEMAPHORE GRASS<br>PMPOA7Y032 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.2? | **List:**<br>**Code:** | 4<br>121 |
| *POA ABBREVIATA SSP MARSHII*<br>MARSH'S BLUE GRASS<br>PMPOA4Z013 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T2<br>S1.3 | **List:**<br>**Code:** | 2<br>311 |
| *POA ABBREVIATA SSP PATTERSONII*<br>PATTERSON'S BLUE GRASS<br>PMPOA4Z1Y0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5?T5<br>S1.3 | **List:**<br>**Code:** | 2<br>311 |
| *POA ATROPURPUREA*<br>SAN BERNARDINO BLUE GRASS<br>PMPOA4Z0A0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *POA NAPENSIS*<br>NAPA BLUE GRASS<br>PMPOA4Z1R0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *POA PIPERI*<br>PIPER'S BLUE GRASS<br>PMPOA4Z200 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *POA RHIZOMATA*<br>TIMBER BLUE GRASS<br>PMPOA4Z250 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *PODISTERA NEVADENSIS*<br>SIERRA PODISTERA<br>PDAPI1T030 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>123 |
| *POGOGYNE ABRAMSII*<br>SAN DIEGO MESA MINT<br>PDLAM1K010 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Endangered | **Global:**<br>**State:** | G2<br>S2.1 | **List:**<br>**Code:** | 1B<br>233 |
| *POGOGYNE CLAREANA*<br>SANTA LUCIA MINT<br>PDLAM1K020 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G1<br>S1.2 | **List:**<br>**Code:** | 1B<br>323 |
| *POGOGYNE DOUGLASII SSP PARVIFLORA*<br>DOUGLAS'S POGOGYNE<br>PDLAM1K032 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G?T3?Q<br>S3.2 | **List:**<br>**Code:** | 3<br>123 |
| *POGOGYNE FLORIBUNDA*<br>PROFUSE-FLOWERED POGOGYNE<br>PDLAM1K070 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 1B<br>223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *POGOGYNE NUDIUSCULA*<br>OTAY MESA MINT<br>PDLAM1K040 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *POLEMONIUM CHARTACEUM*<br>MASON'S SKY PILOT<br>PDPLM0E060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *POLIOMINTHA INCANA*<br>FROSTED MINT<br>PDLAM1L020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *POLYGALA CORNUTA VAR FISHIAE*<br>FISH'S MILKWORT<br>PDPGL020B2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *POLYGALA HETERORHYNCHA*<br>NOTCH-BEAKED MILKWORT<br>PDPGL02270 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.3 | **List:** 1B<br>**Code:** 212 |
| *POLYGALA SUBSPINOSA*<br>SPINY MILKWORT<br>PDPGL021Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.2 | **List:** 2<br>**Code:** 221 |
| *POLYGONUM BIDWELLIAE*<br>BIDWELL'S KNOTWEED<br>PDPGN0L0C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *POLYGONUM HICKMANII*<br>SCOTTS VALLEY POLYGONUM<br>PDPGN0L310 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** None | **Global:** G1<br>**State:** S1.1? | **List:**<br>**Code:** |
| *POLYGONUM MARINENSE*<br>MARIN KNOTWEED<br>PDPGN0L1C0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1Q<br>**State:** S1.1 | **List:** 3<br>**Code:** 333 |
| *POLYGONUM POLYGALOIDES SSP ESOTERICUM*<br>MODOC COUNTY KNOTWEED<br>PDPGN0L1Y2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *POLYSTICHUM KRUCKEBERGII*<br>KRUCKEBERG'S SWORD FERN<br>PPDRY0R0C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *POLYSTICHUM LONCHITIS*<br>HOLLY FERN<br>PPDRY0R0F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2? | **List:** 3<br>**Code:** ??1 |
| *POPULUS ANGUSTIFOLIA*<br>NARROW-LEAVED COTTONWOOD<br>PDSAL01020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 321 |
| *PORTULACA HALIMOIDES*<br>DESERT PORTULACA<br>PDPOR06040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 121 |
| *POTAMOGETON EPIHYDRUS SSP NUTTALLII*<br>NUTTALL'S PONDWEED<br>PMPOT03081 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5Q<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *POTAMOGETON FILIFORMIS*<br>SLENDER-LEAVED PONDWEED<br>PMPOT03090 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *POTAMOGETON FOLIOSUS VAR FIBRILLOSUS*<br>FIBROUS PONDWEED<br>PMPOT030B1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2T3<br>**State:** S1S2 | **List:** 2<br>**Code:** 311 |
| *POTAMOGETON PRAELONGUS*<br>WHITE-STEMMED PONDWEED<br>PMPOT030V0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 311 |
| *POTAMOGETON ROBBINSII*<br>ROBBINS'S PONDWEED<br>PMPOT030Z0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *POTAMOGETON ZOSTERIFORMIS*<br>EEL-GRASS PONDWEED<br>PMPOT03160 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *POTENTILLA BASALTICA*<br>BLACK ROCK POTENTILLA<br>PDROS1B270 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *POTENTILLA CONCINNA*<br>ALPINE CINQUEFOIL<br>PDROS1B0F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *POTENTILLA CRISTAE*<br>CRESTED POTENTILLA<br>PDROS1B2F0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *POTENTILLA GLANDULOSA SSP EWANII*<br>EWAN'S CINQUEFOIL<br>PDROS1B0S3 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *POTENTILLA HICKMANII*<br>HICKMAN'S CINQUEFOIL<br>PDROS1B0U0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *POTENTILLA MOREFIELDII*<br>MOREFIELD'S CINQUEFOIL<br>PDROS1B2R0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 213 |
| *POTENTILLA MULTIJUGA*<br>BALLONA CINQUEFOIL<br>PDROS1B120 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GX<br>**State:** SX | **List:** 1A<br>**Code:** * |
| *POTENTILLA NEWBERRYI*<br>NEWBERRY'S CINQUEFOIL<br>PDROS1B130 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *POTENTILLA RIMICOLA*<br>CLIFF CINQUEFOIL<br>PDROS1B2G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S1S2 | **List:** 1B<br>**Code:** 212 |
| *PROBOSCIDEA ALTHAEIFOLIA*<br>DESERT UNICORN-PLANT<br>PDPED06010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *PRUNUS FASCICULATA VAR PUNCTATA* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| SAND ALMOND | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PDROS1C0E2 **Records in NDDB:** *No* | | | | | | |
| *PSEUDOBAHIA BAHIIFOLIA* | **Federal:** | Endangered | **Global:** | G2 | **List:** | 1B |
| HARTWEG'S GOLDEN SUNBURST | **State:** | Endangered | **State:** | S2.1 | **Code:** | 233 |
| PDAST7P010 **Records in NDDB:** *Yes* | | | | | | |
| *PSEUDOBAHIA PEIRSONII* | **Federal:** | Threatened | **Global:** | G2 | **List:** | 1B |
| SAN JOAQUIN ADOBE SUNBURST | **State:** | Endangered | **State:** | S2.1 | **Code:** | 233 |
| PDAST7P030 **Records in NDDB:** *Yes* | | | | | | |
| *PSILOCARPHUS BREVISSIMUS VAR MULTIFLORUS* | **Federal:** | None | **Global:** | G4T3 | **List:** | 4 |
| DELTA WOOLLY-MARBLES | **State:** | None | **State:** | S3.2? | **Code:** | 123 |
| PDAST7R012 **Records in NDDB:** *No* | | | | | | |
| *PSILOCARPHUS ELATIOR* | **Federal:** | None | **Global:** | G4Q | **List:** | 4 |
| TALL WOOLLY-MARBLES | **State:** | None | **State:** | S3.3 | **Code:** | 111 |
| PDAST7R020 **Records in NDDB:** *No* | | | | | | |
| *PSILOCARPHUS TENELLUS VAR GLOBIFERUS* | **Federal:** | None | **Global:** | G4T4 | **List:** | 4 |
| ROUND WOOLLY-MARBLES | **State:** | None | **State:** | S3.2 | **Code:** | 121 |
| PDAST7R043 **Records in NDDB:** *No* | | | | | | |
| *PSORALIDIUM LANCEOLATUM* | **Federal:** | None | **Global:** | G5 | **List:** | |
| LANCE-LEAVED SCURF-PEA | **State:** | None | **State:** | S1 | **Code:** | |
| PDFAB5M030 **Records in NDDB:** *Yes* | | | | | | |
| *PSOROTHAMNUS ARBORESCENS VAR ARBORESCENS* | **Federal:** | None | **Global:** | G5T3 | **List:** | 4 |
| MOJAVE INDIGO-BUSH | **State:** | None | **State:** | S3.3 | **Code:** | 111 |
| PDFAB3C011 **Records in NDDB:** *No* | | | | | | |
| *PUCCINELLIA CALIFORNICA* | **Federal:** | None | **Global:** | G3 | **List:** | 4 |
| SIERRA NEVADA ALKALI GRASS | **State:** | None | **State:** | S3.3 | **Code:** | 113 |
| PMPOA61010 **Records in NDDB:** *No* | | | | | | |
| *PUCCINELLIA HOWELLII* | **Federal:** | Species of concern | **Global:** | G1 | **List:** | 1B |
| HOWELL'S ALKALI GRASS | **State:** | None | **State:** | S1.1 | **Code:** | 333 |
| PMPOA531A0 **Records in NDDB:** *Yes* | | | | | | |
| *PUCCINELLIA PARISHII* | **Federal:** | Species of concern | **Global:** | G2 | **List:** | 1B |
| PARISH'S ALKALI GRASS | **State:** | None | **State:** | S1.1 | **Code:** | 332 |
| PMPOA530T0 **Records in NDDB:** *Yes* | | | | | | |
| *PUCCINELLIA PUMILA* | **Federal:** | None | **Global:** | G4? | **List:** | 2 |
| DWARF ALKALI GRASS | **State:** | None | **State:** | S1.1? | **Code:** | 321 |
| PMPOA531B0 **Records in NDDB:** *Yes* | | | | | | |
| *PYRROCOMA LUCIDA* | **Federal:** | None | **Global:** | G1 | **List:** | 1B |
| STICKY PYRROCOMA | **State:** | None | **State:** | S1.2 | **Code:** | 313 |
| PDASTDT0E0 **Records in NDDB:** *Yes* | | | | | | |
| *PYRROCOMA RACEMOSA VAR CONGESTA* | **Federal:** | None | **Global:** | G5T4 | **List:** | 4 |
| DEL NORTE PYRROCOMA | **State:** | None | **State:** | S3.3 | **Code:** | 111 |
| PDASTDT0F4 **Records in NDDB:** *No* | | | | | | |
| *PYRROCOMA UNIFLORA VAR GOSSYPINA* | **Federal:** | Species of concern | **Global:** | G5T2 | **List:** | 1B |
| BEAR VALLEY PYRROCOMA | **State:** | None | **State:** | S2.2 | **Code:** | 223 |
| PDASTDT0K1 **Records in NDDB:** *Yes* | | | | | | |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *QUERCUS DUMOSA*<br>NUTTALL'S SCRUB OAK<br>PDFAG050D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.1 | **List:** 1B<br>**Code:** 232 |
| *QUERCUS ENGELMANNII*<br>ENGELMANN OAK<br>PDFAG050K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *QUERCUS PARVULA VAR PARVULA*<br>SANTA CRUZ ISLAND OAK<br>PDFAG051Q1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *QUERCUS TOMENTELLA*<br>ISLAND OAK<br>PDFAG05250 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *RAILLARDELLA PRINGLEI*<br>SHOWY RAILLARDELLA<br>PDAST7X030 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *RAILLARDIOPSIS MUIRII*<br>MUIR'S RAILLARDELLA<br>PDASTDU010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *RAILLARDIOPSIS SCABRIDA*<br>SCABRID RAILLARDELLA<br>PDASTDU020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *RANUNCULUS HYDROCHAROIDES*<br>FROG'S-BIT BUTTERCUP<br>PDRAN0L190 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *RANUNCULUS LOBBII*<br>LOBB'S AQUATIC BUTTERCUP<br>PDRAN0L1J0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *RHUS TRILOBATA VAR SIMPLICIFOLIA*<br>SINGLE-LEAVED SKUNKBRUSH<br>PDANA080B5 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *RHYNCHOSPORA ALBA*<br>WHITE BEAKED-RUSH<br>PMCYP0N010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *RHYNCHOSPORA CALIFORNICA*<br>CALIFORNIA BEAKED-RUSH<br>PMCYP0N060 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *RHYNCHOSPORA GLOBULARIS VAR GLOBULARIS*<br>ROUND-HEADED BEAKED-RUSH<br>PMCYP0N0W1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *RIBES AMARUM VAR HOFFMANNII*<br>BITTER GOOSEBERRY<br>PDGRO02012 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?T2T3<br>**State:** S2S3 | **List:** 3<br>**Code:** ??3 |
| *RIBES CANTHARIFORME*<br>MORENO CURRANT<br>PDGRO02070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |

| Scientific Name, Common Name, Element Code | Listing Status | | Rank | | CNPS | |
|---|---|---|---|---|---|---|
| *RIBES DIVARICATUM VAR PARISHII*<br>PARISH'S GOOSEBERRY<br>PDGRO020F3 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G4T1<br>S1.1 | **List:**<br>**Code:** | 1B<br>333 |
| *RIBES HUDSONIANUM VAR PETIOLARE*<br>WESTERN BLACK CURRANT<br>PDGRO020N2 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5T3T4<br>S1.3 | **List:**<br>**Code:** | 2<br>311 |
| *RIBES LAXIFLORUM*<br>TRAILING BLACK CURRANT<br>PDGRO020V0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G5<br>S3.3 | **List:**<br>**Code:** | 4<br>111 |
| *RIBES MARSHALLII*<br>MARSHALL'S GOOSEBERRY<br>PDGRO020Z0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *RIBES MENZIESII VAR IXODERME*<br>AROMATIC CANYON GOOSEBERRY<br>PDGRO02104 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G4T3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *RIBES SERICEUM*<br>SANTA LUCIA GOOSEBERRY<br>PDGRO021F0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *RIBES THACHERIANUM*<br>SANTA CRUZ ISLAND GOOSEBERRY<br>PDGRO02109 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>223 |
| *RIBES TULARENSE*<br>SEQUOIA GOOSEBERRY<br>PDGRO021L0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G2<br>S2.2 | **List:**<br>**Code:** | 1B<br>313 |
| *RIBES VIBURNIFOLIUM*<br>SANTA CATALINA ISLAND CURRANT<br>PDGRO021P0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>112 |
| *RIBES VICTORIS*<br>VICTOR'S GOOSEBERRY<br>PDGRO021Q0 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.3 | **List:**<br>**Code:** | 4<br>113 |
| *ROMNEYA COULTERI*<br>COULTER'S MATILIJA POPPY<br>PDPAP0L010 **Records in NDDB:** *No* | **Federal:**<br>**State:** | None<br>None | **Global:**<br>**State:** | G3<br>S3.2 | **List:**<br>**Code:** | 4<br>123 |
| *RORIPPA COLUMBIAE*<br>COLUMBIA YELLOW CRESS<br>PDBRA27060 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>None | **Global:**<br>**State:** | G3<br>S1.1 | **List:**<br>**Code:** | 1B<br>322 |
| *RORIPPA GAMBELII*<br>GAMBEL'S WATER CRESS<br>PDBRA270V0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Endangered<br>Threatened | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *RORIPPA SUBUMBELLATA*<br>TAHOE YELLOW CRESS<br>PDBRA270M0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Candidate<br>Endangered | **Global:**<br>**State:** | G1<br>S1.1 | **List:**<br>**Code:** | 1B<br>332 |
| *ROSA MINUTIFOLIA*<br>SMALL-LEAVED ROSE<br>PDROS1J1B0 **Records in NDDB:** *Yes* | **Federal:**<br>**State:** | Species of concern<br>Endangered | **Global:**<br>**State:** | G3<br>S1.1 | **List:**<br>**Code:** | 2<br>331 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *RUBUS GLAUCIFOLIUS VAR GANDERI*<br>CUYAMACA RASPBERRY<br>PDROS1K2N1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1Q<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *RUBUS NIVALIS*<br>SNOW DWARF BRAMBLE<br>PDROS1K4S0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *RUMEX VENOSUS*<br>WINGED DOCK<br>PDPGN0P1K0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3 | **List:**<br>**Code:** |
| *RUPERTIA HALLII*<br>HALL'S RUPERTIA<br>PDFAB62010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *RUPERTIA RIGIDA*<br>PARISH'S RUPERTIA<br>PDFAB62030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *SAGITTARIA SANFORDII*<br>SANFORD'S ARROWHEAD<br>PMALI040Q0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *SALIX BEBBIANA*<br>GRAY WILLOW<br>PDSAL020E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.3? | **List:** 2<br>**Code:** 211 |
| *SALIX BRACHYCARPA SSP BRACHYCARPA*<br>SHORT-FRUITED WILLOW<br>PDSAL020H5 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *SALIX DELNORTENSIS*<br>DEL NORTE WILLOW<br>PDSAL023F0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *SALIX RETICULATA SSP NIVALIS*<br>SNOW WILLOW<br>PDSAL022J2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T?<br>**State:** S1.3 | **List:** 2<br>**Code:** 211 |
| *SALVIA BRANDEGEI*<br>BRANDEGEE'S SAGE<br>PDLAM1S080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *SALVIA DORRII VAR INCANA*<br>FLESHY SAGE<br>PDLAM1S0G8 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T5Q<br>**State:** S1S2 | **List:** 3<br>**Code:** ??1 |
| *SALVIA EREMOSTACHYA*<br>DESERT SAGE<br>PDLAM1S0K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *SALVIA FUNEREA*<br>DEATH VALLEY SAGE<br>PDLAM1S0M0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *SALVIA GREATAE*<br>OROCOPIA SAGE<br>PDLAM1S0P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 213 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SALVIA MUNZII*<br>MUNZ'S SAGE<br>PDLAM1S140 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *SANGUISORBA OFFICINALIS*<br>GREAT BURNET<br>PDROS1L060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *SANICULA HOFFMANNII*<br>HOFFMANN'S SANICLE<br>PDAPI1Z090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SANICULA MARITIMA*<br>ADOBE SANICLE<br>PDAPI1Z0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 333 |
| *SANICULA PECKIANA*<br>PECK'S SANICLE<br>PDAPI1Z0E0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *SANICULA SAXATILIS*<br>ROCK SANICLE<br>PDAPI1Z0H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SANICULA TRACYI*<br>TRACY'S SANICLE<br>PDAPI1Z0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 123 |
| *SANVITALIA ABERTII*<br>ABERT'S SANVITALIA<br>PDAST89010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *SATUREJA CHANDLERI*<br>SAN MIGUEL SAVORY<br>PDLAM08030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2? | **List:** 4<br>**Code:** 122 |
| *SAUSSUREA AMERICANA*<br>AMERICAN SAW-WORT<br>PDAST8B020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2? | **List:** 2<br>**Code:** 321 |
| *SAXIFRAGA CESPITOSA*<br>TUFTED SAXIFRAGE<br>PDSAX0U0C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SAXIFRAGA HOWELLII*<br>HOWELL'S SAXIFRAGE<br>PDSAX0U0T0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *SAXIFRAGA NUTTALLII*<br>NUTTALL'S SAXIFRAGE<br>PDSAX0U160 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *SAXIFRAGA RUFIDULA*<br>RUSTY SAXIFRAGE<br>PDSAX0U1H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SCHEUCHZERIA PALUSTRIS VAR AMERICANA*<br>AMERICAN SCHEUCHZERIA<br>PMSCH02011 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SCIRPUS CLEMENTIS*<br>YOSEMITE BULRUSH<br>PMCYP0Q090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SCIRPUS HETEROCHAETUS*<br>SLENDER BULRUSH<br>PMCYP0Q0T0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SCIRPUS PUMILUS*<br>DWARF BULRUSH<br>PMCYP0Q1B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *SCIRPUS SUBTERMINALIS*<br>WATER BULRUSH<br>PMCYP0Q1G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *SCLEROCACTUS POLYANCISTRUS*<br>MOJAVE FISH-HOOK CACTUS<br>PDCAC0J050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *SCLEROPOGON BREVIFOLIUS*<br>BURRO GRASS<br>PMPOA5G010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SCROPHULARIA ATRATA*<br>BLACK-FLOWERED FIGWORT<br>PDSCR1S010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SCROPHULARIA VILLOSA*<br>SANTA CATALINA FIGWORT<br>PDSCR1S0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SCUTELLARIA BOLANDERI SSP AUSTROMONTANA*<br>SOUTHERN SKULLCAP<br>PDLAM1U0A1 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S2.2? | **List:** 1B<br>**Code:** 223 |
| *SCUTELLARIA GALERICULATA*<br>MARSH SKULLCAP<br>PDLAM1U0J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *SCUTELLARIA HOLMGRENIORUM*<br>HOLMGREN'S SKULLCAP<br>PDLAM1U1C0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S2.3 | **List:** 3<br>**Code:** 312 |
| *SCUTELLARIA LATERIFLORA*<br>BLUE SKULLCAP<br>PDLAM1U0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *SEDUM ALBOMARGINATUM*<br>FEATHER RIVER STONECROP<br>PDCRA0A030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SEDUM DIVERGENS*<br>CASCADE STONECROP<br>PDCRA0A0B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SEDUM EASTWOODIAE*<br>RED MOUNTAIN STONECROP<br>PDCRA0A1S0 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SEDUM LAXUM SSP FLAVIDUM*<br>PALE YELLOW STONECROP<br>PDCRA0A0L2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SEDUM LAXUM SSP HECKNERI*<br>HECKNER'S STONECROP<br>PDCRA0A0L3 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *SEDUM NIVEUM*<br>DAVIDSON'S STONECROP<br>PDCRA0A0R0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *SEDUM OBLANCEOLATUM*<br>APPLEGATE STONECROP<br>PDCRA0A0T0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 332 |
| *SEDUM PARADISUM*<br>CANYON CREEK STONECROP<br>PDCRA0A0U3 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 323 |
| *SELAGINELLA ASPRELLA*<br>BLUISH SPIKE-MOSS<br>PPSEL01060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *SELAGINELLA CINERASCENS*<br>ASHY SPIKE-MOSS<br>PPSEL01090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *SELAGINELLA DENSA VAR SCOPULORUM*<br>ROCKY MOUNTAIN SPIKE-MOSS<br>PPSEL010C2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T4?<br>**State:** S2S3 | **List:** 3<br>**Code:** ??1 |
| *SELAGINELLA EREMOPHILA*<br>DESERT SPIKE-MOSS<br>PPSEL010G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *SELAGINELLA LEUCOBRYOIDES*<br>MOJAVE SPIKE-MOSS<br>PPSEL010P0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 113 |
| *SELINOCARPUS NEVADENSIS*<br>DESERT WING-FRUIT<br>PDNYC0F040 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3 | **List:** 2<br>**Code:** 311 |
| *SENECIO APHANACTIS*<br>RAYLESS RAGWORT<br>PDAST8H060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *SENECIO BERNARDINUS*<br>SAN BERNARDINO RAGWORT<br>PDAST8H0E0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SENECIO CLEVELANDII VAR CLEVELANDII*<br>CLEVELAND'S RAGWORT<br>PDAST8H0R1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SENECIO CLEVELANDII VAR HETEROPHYLLUS*<br>RED HILLS RAGWORT<br>PDAST8H0R2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SENECIO EURYCEPHALUS VAR LEWISROSEI*<br>CUT-LEAVED RAGWORT<br>PDAST8H182 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SENECIO GANDERI*<br>GANDER'S RAGWORT<br>PDAST8H1F0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SENECIO HYDROPHILOIDES*<br>SWEET MARSH RAGWORT<br>PDAST8H400 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2S3 | **List:** 3<br>**Code:** ??1 |
| *SENECIO IONOPHYLLUS*<br>TEHACHAPI RAGWORT<br>PDAST8H1T0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SENECIO LAYNEAE*<br>LAYNE'S RAGWORT<br>PDAST8H1V0 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SENECIO MACOUNII*<br>SISKIYOU MOUNTAINS RAGWORT<br>PDAST8H1Z0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *SENECIO PATTERSONENSIS*<br>MONO RAGWORT<br>PDAST8H2C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SENNA COVESII*<br>COVES'S CASSIA<br>PDFAB491X0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5?<br>**State:** S2.2 | **List:** 2<br>**Code:** 221 |
| *SIBARA FILIFOLIA*<br>SANTA CRUZ ISLAND ROCK CRESS<br>PDBRA2A020 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SIBAROPSIS HAMMITTII*<br>HAMMITT'S CLAY-CRESS<br>PDBRA32010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G1G2<br>**State:** S1S2 | **List:**<br>**Code:** |
| *SIDALCEA CALYCOSA SSP RHIZOMATA*<br>POINT REYES CHECKERBLOOM<br>PDMAL11012 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SIDALCEA COVILLEI*<br>OWENS VALLEY CHECKERBLOOM<br>PDMAL11040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 233 |
| *SIDALCEA HICKMANII SSP ANOMALA*<br>CUESTA PASS CHECKERBLOOM<br>PDMAL110A1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *SIDALCEA HICKMANII SSP HICKMANII*<br>HICKMAN'S CHECKERBLOOM<br>PDMAL110A2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *SIDALCEA HICKMANII SSP PARISHII*<br>PARISH'S CHECKERBLOOM<br>PDMAL110A3 **Records in NDDB:** *Yes* | **Federal:** Candidate<br>**State:** Rare | **Global:** G3T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SIDALCEA HICKMANII SSP VIRIDIS*<br>MARIN CHECKERBLOOM<br>PDMAL110A4 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3T2<br>**State:** S2.2? | **List:** 1B<br>**Code:** 313 |
| *SIDALCEA KECKII*<br>KECK'S CHECKERBLOOM<br>PDMAL110D0 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SIDALCEA MALACHROIDES*<br>MAPLE-LEAVED CHECKERBLOOM<br>PDMAL110E0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *SIDALCEA MALVIFLORA SSP PATULA*<br>SISKIYOU CHECKERBLOOM<br>PDMAL110F9 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 322 |
| *SIDALCEA NEOMEXICANA*<br>SALT SPRING CHECKERBLOOM<br>PDMAL110J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |
| *SIDALCEA OREGANA SSP EXIMIA*<br>COAST CHECKERBLOOM<br>PDMAL110K9 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *SIDALCEA OREGANA SSP HYDROPHILA*<br>MARSH CHECKERBLOOM<br>PDMAL110K2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T2<br>**State:** S2? | **List:** 1B<br>**Code:** 223 |
| *SIDALCEA OREGANA SSP VALIDA*<br>KENWOOD MARSH CHECKERBLOOM<br>PDMAL110K5 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SIDALCEA PEDATA*<br>BIRD-FOOT CHECKERBLOOM<br>PDMAL110L0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SIDALCEA ROBUSTA*<br>BUTTE COUNTY CHECKERBLOOM<br>PDMAL110P0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SIDALCEA STIPULARIS*<br>SCADDEN FLAT CHECKERBLOOM<br>PDMAL110R0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SILENE CAMPANULATA SSP CAMPANULATA*<br>RED MOUNTAIN CATCHFLY<br>PDCAR0U0A2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Endangered | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 333 |
| *SILENE INVISA*<br>CAMOUFLAGE CAMPION<br>PDCAR0U0S0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S4.2 | **List:** 4<br>**Code:** 123 |
| *SILENE MARMORENSIS*<br>MARBLE MOUNTAIN CAMPION<br>PDCAR0U0Z0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *SILENE OCCIDENTALIS SSP LONGISTIPITATA*<br>WESTERN CAMPION<br>PDCAR0U161 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1Q<br>**State:** S1? | **List:** 3<br>**Code:** ??3 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *SILENE SUKSDORFII*<br>CASCADE ALPINE CAMPION<br>PDCAR0U1W0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.3 | **List:** 2<br>**Code:** 211 |
| *SILENE VERECUNDA SSP VERECUNDA*<br>SAN FRANCISCO CAMPION<br>PDCAR0U213 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *SMELOWSKIA OVALIS VAR CONGESTA*<br>LASSEN PEAK SMELOWSKIA<br>PDBRA2D041 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *SMILAX JAMESII*<br>ENGLISH PEAK GREENBRIAR<br>PMSMI010D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |
| *SOLANUM CLOKEYI*<br>ISLAND NIGHTSHADE<br>PDSOL0Z281 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *SOLANUM WALLACEI*<br>WALLACE'S NIGHTSHADE<br>PDSOL0Z280 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3Q<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *SOLIDAGO GIGANTEA*<br>SMOOTH GOLDENROD<br>PDAST8P0Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2? | **List:** 2<br>**Code:** 321 |
| *SOLIDAGO GUIRADONIS*<br>GUIRADO'S GOLDENROD<br>PDAST8P0T0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *SPARGANIUM NATANS*<br>SMALL BUR-REED<br>PMSPA01090 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *SPARTINA GRACILIS*<br>ALKALI CORD GRASS<br>PMPOA5S060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *SPHAERALCEA RUSBYI VAR EREMICOLA*<br>RUSBY'S DESERT-MALLOW<br>PDMAL140L1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 323 |
| *SPHENOPHOLIS OBTUSATA*<br>PRAIRIE WEDGE GRASS<br>PMPOA5T030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 211 |
| *STANLEYA VIRIDIFLORA*<br>GREEN PRINCE'S PLUME<br>PDBRA2E060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2? | **List:**<br>**Code:** |
| *STEBBINSOSERIS DECIPIENS*<br>SANTA CRUZ MICROSERIS<br>PDAST6E050 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *STELLARIA LONGIFOLIA*<br>LONG-LEAVED STARWORT<br>PDCAR0X0M0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *STELLARIA OBTUSA*<br>OBTUSE STARWORT<br>PDCAR0X0U0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.3? | **List:** 2<br>**Code:** 311 |
| *STENOTUS LANUGINOSUS*<br>WOOLLY STENOTUS<br>PDASTCX010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *STEPHANOMERIA BLAIRII*<br>BLAIR'S STEPHANOMERIA<br>PDAST8U0K0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS ALBIDUS SSP ALBIDUS*<br>METCALF CANYON JEWEL-FLOWER<br>PDBRA2G011 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *STREPTANTHUS ALBIDUS SSP PERAMOENUS*<br>MOST BEAUTIFUL JEWEL-FLOWER<br>PDBRA2G012 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *STREPTANTHUS BATRACHOPUS*<br>TAMALPAIS JEWEL-FLOWER<br>PDBRA2G050 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *STREPTANTHUS BERNARDINUS*<br>LAGUNA MOUNTAINS JEWEL-FLOWER<br>PDBRA2G060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 212 |
| *STREPTANTHUS BRACHIATUS SSP BRACHIATUS*<br>SOCRATES MINE JEWEL-FLOWER<br>PDBRA2G072 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS BRACHIATUS SSP HOFFMANII*<br>FREED'S JEWEL-FLOWER<br>PDBRA2G071 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS CALLISTUS*<br>MT. HAMILTON JEWEL-FLOWER<br>PDBRA2G0A0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *STREPTANTHUS CAMPESTRIS*<br>SOUTHERN JEWEL-FLOWER<br>PDBRA2G0B0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 212 |
| *STREPTANTHUS CORDATUS VAR PIUTENSIS*<br>PIUTE MOUNTAINS JEWEL-FLOWER<br>PDBRA2G0D2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G5T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS DREPANOIDES*<br>SICKLE-FRUIT JEWEL-FLOWER<br>PDBRA2G200 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *STREPTANTHUS FARNSWORTHIANUS*<br>FARNSWORTH'S JEWEL-FLOWER<br>PDBRA2G0G0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *STREPTANTHUS FENESTRATUS*<br>TEHIPITE VALLEY JEWEL-FLOWER<br>PDBRA2G0H0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 213 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *STREPTANTHUS GLANDULOSUS SSP PULCHELLUS*<br>MT. TAMALPAIS JEWEL-FLOWER<br>PDBRA2G0J2 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *STREPTANTHUS GLANDULOSUS VAR HOFFMANII*<br>SECUND JEWEL-FLOWER<br>PDBRA2G0J4 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T1Q<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *STREPTANTHUS GRACILIS*<br>ALPINE JEWEL-FLOWER<br>PDBRA2G0K0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *STREPTANTHUS HISPIDUS*<br>MT. DIABLO JEWEL-FLOWER<br>PDBRA2G0M0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 313 |
| *STREPTANTHUS HOWELLII*<br>HOWELL'S JEWEL-FLOWER<br>PDBRA2G0N0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2<br>**State:** S1.2 | **List:** 1B<br>**Code:** 322 |
| *STREPTANTHUS INSIGNIS SSP LYONII*<br>ARBURUA RANCH JEWEL-FLOWER<br>PDBRA2G0Q1 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3G4T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS MORRISONII*<br>SEE INDIVIDUAL SUBSPECIES!<br>PDBRA2G0S0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2Q<br>**State:** S2 | **List:**<br>**Code:** |
| *STREPTANTHUS MORRISONII SSP ELATUS*<br>THREE PEAKS JEWEL-FLOWER<br>PDBRA2G0S1 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS MORRISONII SSP HIRTIFLORUS*<br>DORR'S CABIN JEWEL-FLOWER<br>PDBRA2G0S2 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS MORRISONII SSP KRUCKEBERGII*<br>KRUCKEBERG'S JEWEL-FLOWER<br>PDBRA2G0S4 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS MORRISONII SSP MORRISONII*<br>MORRISON'S JEWEL-FLOWER<br>PDBRA2G0S3 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G2T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *STREPTANTHUS NIGER*<br>TIBURON JEWEL-FLOWER<br>PDBRA2G0T0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *STREPTANTHUS OLIGANTHUS*<br>MASONIC MOUNTAIN JEWEL-FLOWER<br>PDBRA2G0V0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *STREPTANTHUS SP NOV "PIT RIVER"*<br>PIT RIVER JEWEL-FLOWER<br>PDBRA2G300 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G1?<br>**State:** S1? | **List:**<br>**Code:** |
| *STYLOCLINE CITROLEUM*<br>OIL NESTSTRAW<br>PDAST8Y070 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *STYLOCLINE MASONII*<br>MASON'S NESTSTRAW<br>PDAST8Y080 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *STYLOCLINE SONORENSIS*<br>MESQUITE NESTSTRAW<br>PDAST8Y060 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G5<br>**State:** SH | **List:** 2<br>**Code:** 331 |
| *SUAEDA CALIFORNICA*<br>CALIFORNIA SEABLITE<br>PDCHE0P020 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *SUAEDA ESTEROA*<br>ESTUARY SEABLITE<br>PDCHE0P0D0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S2.2 | **List:** 4<br>**Code:** 121 |
| *SUAEDA TAXIFOLIA*<br>WOOLLY SEABLITE<br>PDCHE0P0L0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3?<br>**State:** S2S3 | **List:** 4<br>**Code:** 121 |
| *SULCARIA ISIDIIFERA*<br>SPLITTING YARN LICHEN<br>NLTEST0020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:**<br>**Code:** |
| *SWALLENIA ALEXANDRAE*<br>EUREKA VALLEY DUNE GRASS<br>PMPOA5Y010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *SWERTIA FASTIGIATA*<br>CLUSTERED GREEN GENTIAN<br>PDGEN05050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S2.2 | **List:** 2<br>**Code:** 321 |
| *SWERTIA NEGLECTA*<br>PINE GREEN-GENTIAN<br>PDGEN05080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3? | **List:** 4<br>**Code:** 113 |
| *SYNTRICHOPAPPUS LEMMONII*<br>LEMMON'S SYNTRICHOPAPPUS<br>PDAST90020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *SYSTENOTHECA VORTRIEDEI*<br>VORTRIEDE'S SPINEFLOWER<br>PDPGN0W010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *TARAXACUM CALIFORNICUM*<br>CALIFORNIA DANDELION<br>PDAST93050 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 323 |
| *TAUSCHIA GLAUCA*<br>GLAUCOUS TAUSCHIA<br>PDAPI27020 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *TAUSCHIA HOWELLII*<br>HOWELL'S TAUSCHIA<br>PDAPI27050 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 312 |
| *TETRACOCCUS DIOICUS*<br>PARRY'S TETRACOCCUS<br>PDEUP1C010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 322 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *TETRACOCCUS ILICIFOLIUS*<br>HOLLY-LEAVED TETRACOCCUS<br>PDEUP1C030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *TETRADYMIA ARGYRAEA*<br>STRIPED HORSEBRUSH<br>PDAST95010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *TETRADYMIA SPINOSA*<br>SPINY HORSEBRUSH<br>PDAST95080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:**<br>**Code:** |
| *TEXOSPORIUM SANCTI-JACOBI*<br>WOVEN-SPORED LICHEN<br>NLTEST7980 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2?<br>**State:** S1.1 | **List:**<br>**Code:** |
| *THAMNOLIA VERMICULARIS*<br>THAMNOLIA LICHEN<br>NLTES43860 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G?<br>**State:** S1.1 | **List:**<br>**Code:** |
| *THELYPODIUM BRACHYCARPUM*<br>SHORT-PODDED THELYPODIUM<br>PDBRA2N010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *THELYPODIUM HOWELLII SSP HOWELLII*<br>HOWELL'S THEYLPODIUM<br>PDBRA2N051 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2?T1<br>**State:** S1.3? | **List:**<br>**Code:** |
| *THELYPODIUM MILLEFLORUM*<br>THOUSAND-FLOWERED THELYPODIUM<br>PDBRA2N0A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2? | **List:**<br>**Code:** |
| *THELYPODIUM STENOPETALUM*<br>SLENDER-PETALED THELYPODIUM<br>PDBRA2N0F0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *THELYPTERIS PUBERULA VAR SONORENSIS*<br>SONORAN MAIDEN FERN<br>PPTHE05192 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T3T4<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *THERMOPSIS CALIFORNICA VAR ARGENTATA*<br>SILVERY FALSE LUPINE<br>PDFAB3Z05A **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *THERMOPSIS CALIFORNICA VAR SEMOTA*<br>VELVETY FALSE LUPINE<br>PDFAB3Z053 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *THERMOPSIS GRACILIS*<br>SLENDER FALSE LUPINE<br>PDFAB3Z0C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4Q<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *THERMOPSIS MACROPHYLLA*<br>SANTA YNEZ FALSE LUPINE<br>PDFAB3Z050 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *THERMOPSIS ROBUSTA*<br>ROBUST FALSE LUPINE<br>PDFAB3Z0D0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G2Q<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *THLASPI CALIFORNICUM*<br>KNEELAND PRAIRIE PENNYCRESS<br>PDBRA2P041 **Records in NDDB:** *Yes* | **Federal:** Proposed Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *THYSANOCARPUS CONCHULIFERUS*<br>SANTA CRUZ ISLAND FRINGEPOD<br>PDBRA2Q060 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *TIARELLA TRIFOLIATA VAR TRIFOLIATA*<br>TRIFOLIATE LACEFLOWER<br>PDSAX10031 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T5<br>**State:** S2S3 | **List:** 3<br>**Code:** ??1 |
| *TONESTUS EXIMIUS*<br>TAHOE TONESTUS<br>PDASTE0030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *TONESTUS LYALLII*<br>LYALL'S TONESTUS<br>PDASTE0050 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *TOWNSENDIA PARRYI*<br>PARRY'S TOWNSENDIA<br>PDAST9C0J0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *TRACYINA ROSTRATA*<br>BEAKED TRACYINA<br>PDAST9D010 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 313 |
| *TRICHOCORONIS WRIGHTII VAR WRIGHTII*<br>WRIGHT'S TRICHOCORONIS<br>PDAST9F031 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *TRICHOSTEMA AUSTROMONTANUM SSP COMPACTUM*<br>HIDDEN LAKE BLUECURLS<br>PDLAM22022 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** None | **Global:** G5T1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *TRICHOSTEMA MICRANTHUM*<br>SMALL-FLOWERED BLUECURLS<br>PDLAM22080 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *TRICHOSTEMA OVATUM*<br>SAN JOAQUIN BLUECURLS<br>PDLAM220A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *TRICHOSTEMA RUBISEPALUM*<br>HERNANDEZ BLUECURLS<br>PDLAM220C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *TRIENTALIS ARCTICA*<br>ARCTIC STARFLOWER<br>PDPRI0A030 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *TRIFOLIUM AMOENUM*<br>SHOWY INDIAN CLOVER<br>PDFAB40040 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *TRIFOLIUM BOLANDERI*<br>BOLANDER'S CLOVER<br>PDFAB400G0 **Records in NDDB:** *No* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *TRIFOLIUM BUCKWESTIORUM*<br>SANTA CRUZ CLOVER<br>PDFAB402W0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *TRIFOLIUM GRACILENTUM VAR PALMERI*<br>SOUTHERN ISLAND CLOVER<br>PDFAB40102 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 122 |
| *TRIFOLIUM HOWELLII*<br>HOWELL'S CLOVER<br>PDFAB40140 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *TRIFOLIUM JOKERSTII*<br>BUTTE COUNTY GOLDEN CLOVER<br>PDFAB40310 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:**<br>**Code:** |
| *TRIFOLIUM LEMMONII*<br>LEMMON'S CLOVER<br>PDFAB401C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4?<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *TRIFOLIUM MACILENTUM VAR DEDECKERAE*<br>DEDECKER'S CLOVER<br>PDFAB400Q0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G?T2<br>**State:** S2.3 | **List:** 1B<br>**Code:** 313 |
| *TRIFOLIUM POLYODON*<br>PACIFIC GROVE CLOVER<br>PDFAB402H0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** Rare | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *TRIFOLIUM TRICHOCALYX*<br>MONTEREY CLOVER<br>PDFAB402J0 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *TRILLIUM OVATUM SSP OETTINGERI*<br>SALMON MOUNTAINS WAKEROBIN<br>PMLIL200M1 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.2 | **List:** 4<br>**Code:** 123 |
| *TRIMORPHA ACRIS VAR DEBILIS*<br>NORTHERN DAISY<br>PDASTE1012 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T4<br>**State:** S2S3 | **List:** 2<br>**Code:** 211 |
| *TRIPHYSARIA FLORIBUNDA*<br>SAN FRANCISCO OWL'S-CLOVER<br>PDSCR2T010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *TRIPTEROCALYX CRUX-MALTAE*<br>KELLOGG'S SANDVERBENA<br>PDNYC0G020 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.2 | **List:**<br>**Code:** |
| *TRITELEIA CLEMENTINA*<br>SAN CLEMENTE ISLAND TRITELEIA<br>PMLIL21020 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G1<br>**State:** S1.2 | **List:** 1B<br>**Code:** 323 |
| *TRITELEIA CROCEA VAR CROCEA*<br>YELLOW TRITELEIA<br>PMLIL21031 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T4<br>**State:** S3.3 | **List:** 4<br>**Code:** 112 |
| *TRITELEIA CROCEA VAR MODESTA*<br>TRINITY MOUNTAINS TRITELEIA<br>PMLIL21032 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |

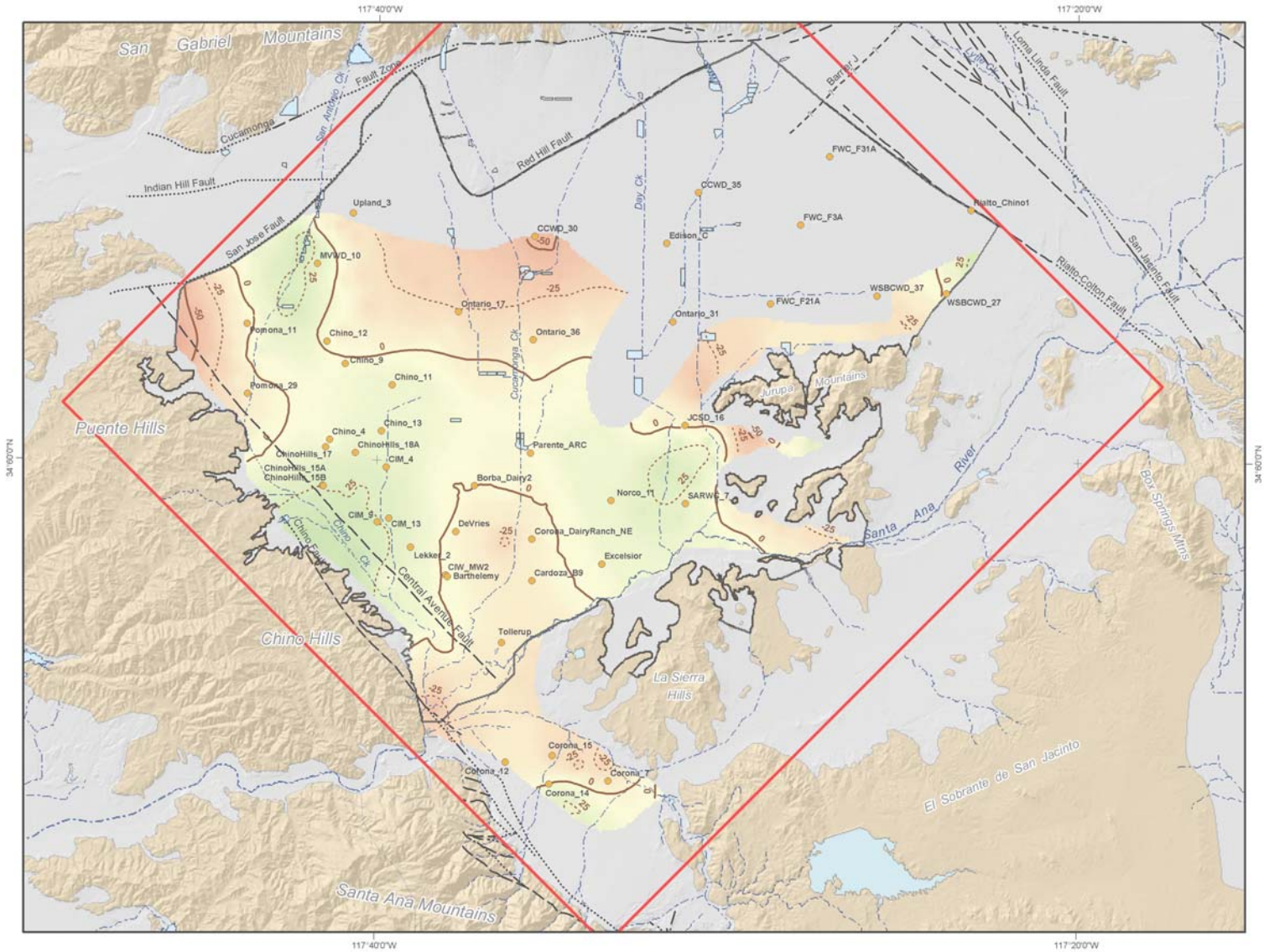
| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *TRITELEIA GRANDIFLORA SSP HOWELLII*<br>HOWELL'S TRITELEIA<br>PMLIL21080 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.2? | **List:**<br>**Code:** |
| *TRITELEIA HENDERSONII VAR HENDERSONII*<br>HENDERSON'S TRITELEIA<br>PMLIL21073 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G?T2?<br>**State:** S1.2 | **List:** 2<br>**Code:** 321 |
| *TRITELEIA IXIOIDES SSP COOKII*<br>COOK'S TRITELEIA<br>PMLIL210A2 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5T3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *TROPIDOCARPUM CAPPARIDEUM*<br>CAPER-FRUITED TROPIDOCARPUM<br>PDBRA2R010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** GH<br>**State:** SH | **List:** 1A<br>**Code:** * |
| *TUCTORIA GREENEI*<br>GREENE'S TUCTORIA<br>PMPOA6N010 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Rare | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 233 |
| *TUCTORIA MUCRONATA*<br>CRAMPTON'S TUCTORIA<br>PMPOA6N020 **Records in NDDB:** *Yes* | **Federal:** Endangered<br>**State:** Endangered | **Global:** G1<br>**State:** S1.1 | **List:** 1B<br>**Code:** 333 |
| *VACCINIUM COCCINEUM*<br>SISKIYOU MOUNTAINS HUCKLEBERRY<br>PDERI181N0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5Q<br>**State:** S2.2? | **List:** 3<br>**Code:** 21? |
| *VACCINIUM SCOPARIUM*<br>LITTLE-LEAVED HUCKLEBERRY<br>PDERI180Y0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S2.2? | **List:** 2<br>**Code:** 221 |
| *VANCOUVERIA CHRYSANTHA*<br>SISKIYOU INSIDE-OUT-FLOWER<br>PDBER09010 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 212 |
| *VERATRUM FIMBRIATUM*<br>FRINGED FALSE HELLEBORE<br>PMLIL25030 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *VERATRUM INSOLITUM*<br>SISKIYOU FALSE HELLEBORE<br>PMLIL25040 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |
| *VERBENA CALIFORNICA*<br>CALIFORNIA VERVAIN<br>PDVER0N050 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Threatened | **Global:** G2<br>**State:** S2.1 | **List:** 1B<br>**Code:** 333 |
| *VERBESINA DISSITA*<br>CROWNBEARD<br>PDAST9R050 **Records in NDDB:** *Yes* | **Federal:** Threatened<br>**State:** Threatened | **Global:** G3<br>**State:** S1.1 | **List:** 1B<br>**Code:** 332 |
| *VERONICA COPELANDII*<br>COPELAND'S SPEEDWELL<br>PDSCR200B0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *VERONICA CUSICKII*<br>CUSICK'S SPEEDWELL<br>PDSCR200C0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S3.3 | **List:** 4<br>**Code:** 111 |

| Scientific Name, Common Name, Element Code | Listing Status | Rank | CNPS |
|---|---|---|---|
| *VIGUIERA LACINIATA*<br>SAN DIEGO COUNTY VIGUIERA<br>PDAST9T060 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S3.2 | **List:** 4<br>**Code:** 121 |
| *VIOLA AUREA*<br>GOLDEN VIOLET<br>PDVIO04420 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3G4<br>**State:** S2S3 | **List:** 2<br>**Code:** 221 |
| *VIOLA LANGSDORFII*<br>LANGSDORF'S VIOLET<br>PDVIO04100 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4<br>**State:** S1.1 | **List:** 2<br>**Code:** 331 |
| *VIOLA PALUSTRIS*<br>MARSH VIOLET<br>PDVIO041G0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1S2 | **List:** 2<br>**Code:** 321 |
| *VIOLA PINETORUM SSP GRISEA*<br>GREY-LEAVED VIOLET<br>PDVIO04431 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G4G5T1<br>**State:** S1.3 | **List:** 1B<br>**Code:** 313 |
| *VIOLA PRIMULIFOLIA SSP OCCIDENTALIS*<br>WESTERN BOG VIOLET<br>PDVIO040Y2 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G4T2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *VIOLA TOMENTOSA*<br>WOOLLY VIOLET<br>PDVIO04280 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.2 | **List:** 1B<br>**Code:** 223 |
| *WISLIZENIA REFRACTA SSP REFRACTA*<br>JACKASS-CLOVER<br>PDCPP09013 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5T5?<br>**State:** S1.2? | **List:** 2<br>**Code:** 321 |
| *WOODSIA PLUMMERAE*<br>PLUMMER'S WOODSIA<br>PPDRY0U0A0 **Records in NDDB:** *Yes* | **Federal:** None<br>**State:** None | **Global:** G5<br>**State:** S1.3? | **List:** 2<br>**Code:** 311 |
| *WYETHIA ELATA*<br>HALL'S WYETHIA<br>PDAST9X050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *WYETHIA LONGICAULIS*<br>HUMBOLDT COUNTY WYETHIA<br>PDAST9X0A0 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G3<br>**State:** S3.3 | **List:** 4<br>**Code:** 113 |
| *WYETHIA RETICULATA*<br>EL DORADO COUNTY MULE EARS<br>PDAST9X0D0 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *XYLORHIZA COGNATA*<br>MECCA-ASTER<br>PDASTA1010 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G2<br>**State:** S2.2 | **List:** 1B<br>**Code:** 223 |
| *XYLORHIZA ORCUTTII*<br>ORCUTT'S WOODY-ASTER<br>PDASTA1040 **Records in NDDB:** *Yes* | **Federal:** Species of concern<br>**State:** None | **Global:** G3<br>**State:** S2.2 | **List:** 1B<br>**Code:** 222 |
| *ZIGADENUS MICRANTHUS VAR FONTANUS*<br>SEEP DEATH CAMAS<br>PMLIL28050 **Records in NDDB:** *No* | **Federal:** None<br>**State:** None | **Global:** G4T3?<br>**State:** S3? | **List:**<br>**Code:** |

OPTIMUM BASIN MANAGEMENT PROGRAM

# Chino Basin Dry-Year Yield Program Modeling Report

## Volume III




*Prepared for:*

**Chino Basin Watermaster &**
**Inland Empire Utilities Agency**

*under a Subcontract Agreement with:*

**Black & Veatch Corp.**

*Prepared by:*


WILDERMUTH ENVIRONMENTAL, INC.
*23692 Birtcher Drive*
*Lake Forest, CA 92630*
*949.420.3030*

# OPTIMUM BASIN MANAGEMENT PROGRAM

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Wildermuth Environmental, Inc.

July 2003






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# ACRONYM AND ABBREVIATIONS LIST

| | |
|---|---|
| µg/L | micrograms per liter |
| 1,1-DCA | 1,1-dichloroethane |
| 1,1-DCE | 1,1-dichloroethene |
| 1,1,1-TCA | 1,1,1-trichloroethane |
| 1,2,3-TCP | 1,2,3-trichloropropane |
| 1,2-DCA | 1,2-dichloroethane |
| AL | Action Level |
| ASTM | American Society for Testing and Materials |
| BNA | base/neutral/acid-extractable organic chemicals |
| CA | California |
| CBFIP | Chino Basin Facilities Improvement Project |
| CBWCD | Chino Basin Water Conservation District |
| Watermaster | Chino Basin Watermaster |
| CBWRMS | Chino Basin Water Resources Management Study |
| CCWD | Cucamonga County Water District |
| CDA | Chino Desalter Authority |
| CDFM | cumulative departure from the mean |
| CIM | California Institution for Men |
| CIMIS | California Irrigation Management Information System |
| *cis*-1,2-DCE | *cis*-1,2-dichloroethene |
| CMP | Comprehensive Water Quality Monitoring Program |
| CN | cyanide |
| COC | Constituents of Concern |
| DBCP | 1,2-dibromo-3-chloropropane |
| DHS | California Department of Health Services |
| DLR | Detection Limit for Reporting |
| DOE | Department of Energy |
| DPt | deep percolation of precipitation and applied water |
| DTSC | Department of Toxic Substances Control |
| DWR | California Department of Water Resources |
| EDB | 1,2-dibromoethane |
| EMP | Evaluation Monitoring Program |

# ACRONYM AND ABBREVIATIONS LIST

| | |
|---|---|
| EPA | US Environmental Protection Agency |
| ESRI | Environmental Systems Research Institute |
| FC | field capacity |
| FWC | Fontana Water Company |
| GE | General Electric |
| GIS | Geographic Information System |
| GSS | Geosciences Support Services, Inc. |
| GV | Groundwater Vistas |
| IEUA | Inland Empire Utilities Agency |
| InSAR | Synthetic Aperture Radar Interferometry |
| JCSD | Jurupa Community Services District |
| JMM | James M. Montgomery, Consulting Engineers, Inc. now dba as MWH |
| MCL | maximum contaminant level |
| MCLG | Maximum Contaminant Level Goal |
| mg/L | milligrams per liter |
| mL | milliliter |
| MODFLOW | MODular three-dimensional finite-difference groundwater FLOW model |
| MSL | Milliken Sanitary Landfill |
| MTBE | methyl tertiary butyl ether |
| MVSL | Mid Valley Sanitary Landfill |
| MVWD | Monte Vista Water District |
| MW | Monitoring Well |
| MWD | Metropolitan Water District of Southern California |
| MWDSC | Metropolitan Water District of Southern California |
| MZ | management zone |
| ND | not detected |
| NDMA | N-nitrosodimethylamine |
| $NO_3$ | nitrate |
| NPL | National Priorities List |
| OBMP | Optimum Basin Management Program |
| PCB | Polychlorinated Biphenyls |
| PCE | tetrachloroethene |
| PWMP | Private Well Monitoring Program |

# ACRONYM AND ABBREVIATIONS LIST

| | |
|---|---|
| QA | quality assurance |
| RfD | reference dose |
| RP1 | Regional Plant 1 |
| RP2 | Regional Plant 2 |
| RP3 | Regional Plant 3 |
| RP4 | Regional Plant 4 |
| RWQCB | Regional Water Quality Control Board |
| SARWC | Santa Ana River Water Company |
| SBCFCD | San Bernardino County Flood Control District |
| SCS | Soil Conservation Service |
| SM | Standard Methods |
| SMt | $SM_t$ is the soil moisture at the time t |
| SOILH2O | soil moisture accounting module for WLAM |
| SWQIS | State Water Quality Information System |
| SWRCB | State Water Resources Control Board |
| TCE | trichloroethene |
| TDS | total dissolved solids |
| TIN | total inorganic nitrogen |
| TOC | total organic carbon |
| TON | threshold odor number |
| TVMWD | Three Valleys Municipal Water District |
| UCMR | Unregulated Chemicals Monitoring Requirements |
| USEPA | US Environmental Protection Agency |
| USGS | US Geological Survey |
| USL | Upland Sanitary Landfill |
| VOC | Volatile Organic Chemicals |
| WCI | Water Character Index |
| WEI | Wildermuth Environmental, Inc. |
| WLAM | Wasteload Allocation Model |
| WMWD | Western Municipal Water District |
| WQS | water quality standard |

# 1. INTRODUCTION

## 1.1 Background and Purpose

The primary objective of this investigation is to develop and apply models to estimate specific impacts of the dry-year yield program on the Chino Basin. The impacts evaluated in this investigation include groundwater-level impacts during the put, hold, and take periods; the losses of water from increases in groundwater storage; and the change in direction and speed of known water quality anomalies. Dry-year yield as used herein is groundwater storage and recovery program where supplemental water is stored in the Chino Basin during years of surplus supplemental water and is extracted from the basin in years when the availability of supplemental water is limited. The specific dry-year yield program investigated in this effort is a 100,000 acre-ft storage program that was developed jointly by the Chino Basin Watermaster (CBWM), Inland Empire Utilities Agency (IEUA) and the Metropolitan Water District of Southern California (Metropolitan).

Black and Veatch Corporation was the lead consultant in the development of the facility and related operating plans for the dry-year yield program. Starting in February of 2002, Black and Veatch developed a series of preliminary dry-year yield plans with the participating water agencies. These plans were subsequently refined through an exhaustive series of meetings and engineering studies. The investigation reported herein is an assessment of the groundwater-related impacts from the proposed dry-year yield facility and operating plans. Black and Veatch is preparing a report that describes the facility and operating plans for the CBWM-IEUA-Metropolitan 100,000 acre-ft dry-year yield program. The Black and Veatch report will be available in late July or August of 2003.

The model developed herein is referred to throughout the text as the 2003 Watermaster model. This model can be used to support Watermaster's decision processes for future expanded storage and recovery programs and other groundwater management activities of the Watermaster.

## 1.2 Report Organization

This report contains the following sections:

| Section | Contents |
|---|---|
| 1 | *Section 1 Introduction* |
| 2 | *Section 2 Geology and Hydrogeology* is a complete update to the geology and hydrogeology section of the Optimum Basin Management Program (OBMP) Phase 1 Report WEI, 1999). This section describes the aquifer system in the Chino Basin and the basic structural framework of the Chino Basin groundwater model. |
| 3 | *Section 3 Groundwater Quality* is a complete update of the groundwater quality conditions section of the *OBMP Phase 1 Report* (WEI, 1999) and the *OBMP Initial State of the Basin Report* (WEI 2002). This section describes existing and past water quality conditions for constituents of interest in the Chino Basin, and it describes previously characterized and uncharacterized water quality anomalies. |
| 4 | *Section 4 Conceptual Model* is description of the spatial and temporal scope of the 2003 Watermaster Model and includes a summary description of the recharge and discharge components of the basin. |

| Section | Contents |
|---|---|
| 5 | *Section 5 Model Description* is a summary description of the modeling tools used in this investigation and the integration of these tools into the 2003 Watermaster Model. |
| 6 | *Section 6 Model Calibration* describes calibration strategy and results for the 2003 Watermaster Model. |
| 7 | *Section 7 Dry-Year Yield Program Impacts* describes the planning basis for baseline OBMP conditions, the simulation of a baseline scenario representing the implementation of the OBMP without the dry-year yield program, the simulation of the dry-year yield program, the impacts of the dry-year yield program, and the determination of material physical injury from the dry-year yield program. |
| 8 | *References* |
| Appendices | *Appendix A Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period*<br><br>*Appendix B Groundwater Model Projected Time Histories at Wells for Baseline Scenario*<br><br>*Appendix C Groundwater Model Projected Time Histories at Wells for the Dry-Year Yield Scenario*<br><br>*Appendix D Planning Information Prepared By Black & Veatch – Asset Inventory and Water Supply Plans for Producers Participating in the Dry Year Yield Program* |

# 2. GEOLOGY AND HYDROGEOLOGY

## 2.1 Geologic Setting

The Chino Basin was formed as a result of tectonic activity along major fault zones. It is part of a larger, broad, alluvial-filled valley located between the San Gabriel/San Bernardino Mountains to the north (Transverse Ranges) and the elevated Perris Block/San Jacinto Mountains to the south (Peninsular Ranges). The Santa Ana River is the main tributary draining the valley and, hence, the valley is commonly referred to as the Upper Santa Ana Valley. Chino Basin is located in the western portion of this valley as shown on Figure 2-1.

The major faults in the Chino Basin area – the Cucamonga Fault Zone, the Rialto-Colton Fault, the Red Hill Fault, the San Jose Fault, and the Chino Fault – are at least in part responsible for the uplift of the surrounding mountains and the depression of Chino Basin. The bottom of the basin – the effective base of the freshwater aquifer – consists of impermeable sedimentary and igneous bedrock formations that are exposed at the surface in the surrounding mountains and hills. Sediments eroded from the surrounding mountains have filled Chino Basin to provide the reservoirs for groundwater. In the deepest portions of Chino Basin, these sediments are greater than 1,000 ft thick.

The major faults also are significant in that they are known barriers to groundwater flow within the aquifer sediments and, hence, define some of the external boundaries of the basin by influencing the magnitude and direction of groundwater flow. The location of the major faults and their spatial relation to Chino Basin are shown in Figure 2-1. These faults, their effects on groundwater movement, and the hydrogeology of the general Chino Basin area have been documented by various entities and authors (Eckis, 1934; Gleason, 1947; Burnham, 1953; MacRostie and Dolcini, 1959; Dutcher & Garrett, 1963; Gosling, 1966; DWR, 1970; Woolfenden and Kadhim, 1997).

## 2.2 Stratigraphy

In this report, the stratigraphy of Chino Basin is divided into two natural divisions: (1) the pervious formations that comprise the groundwater reservoirs are termed the *water-bearing sediments* and (2) the less pervious formations that enclose the groundwater reservoirs are termed the *consolidated bedrock*. The consolidated bedrock is further differentiated as (a) metamorphic and igneous rocks of the basement complex, overlain in places by (b) consolidated sedimentary rocks. The water-bearing sediments overlie the consolidated bedrock, with the bedrock formations coming to the surface in the surrounding hills and highlands. Below, these geologic formations are described in stratigraphic order, the oldest formations first.

{It should be noted that the terms used throughout this report to describe bedrock, such as "consolidated," "non-water-bearing," and "impermeable," are used in a relative sense. The water content and permeability of these bedrock formations, in fact, is not zero. However, the primary point is that the permeability of the geologic formations in the areas flanking the basin is much less than the aquifers in the groundwater basin.}

### 2.2.1 Consolidated Bedrock

The *consolidated bedrock* formations of the Chino Basin area include the basement complex that is comprised of crystalline igneous and metamorphic rocks of pre-Tertiary age, the marine sedimentary and volcanic strata of late Cretaceous to late Tertiary age, and the continental deposits of late Pliocene to

middle-Pleistocene age. Figure 2-2 shows the surface outcrops of the consolidate bedrock formations that surround Chino Basin. Note that the basement complex is the exposed bedrock north and southeast of the Chino Basin. Consolidated sedimentary rocks are the exposed bedrock west of Chino Basin.

The bedrock formations also occur at depth, underlying the water-bearing sediments of Chino Basin. Pervious strata or fracture zones in the bedrock formations may yield water to wells locally; however, the storage capacity is typically inadequate for sustained production. Figure 2-2 shows the contact between the bedrock formations and the water-bearing sediments as equal elevation contour lines – referred to herein as the base of the freshwater aquifer. The contours were originally generated by DWR (1970) and modified based on work performed for this study. Note that the base of the freshwater aquifer forms an irregular bowl-shaped depression, with its deepest areas located in the central portions of Chino Basin.

Eckis (1934) speculated that the contact between the consolidated bedrock and the water-bearing sediments is unconformable, as indicated by an ever-present weathered zone in the consolidated bedrock directly underlying the contact with the water-bearing sediments. This observed relationship suggests that the consolidated bedrock in the Chino Basin area was undergoing erosion prior to deposition of the water-bearing sediments.

Well boreholes have penetrated the various bedrock formations in Chino Basin. Figure 2-2 shows the locations of these boreholes, and the type of bedrock penetrated. Much like the bedrock surface exposures that surround Chino Basin, the basement complex is typically the bedrock formation first penetrated on the east side of Chino Basin, and sedimentary rocks are typically the bedrock formations first penetrated on the west side of Chino Basin. The nature of the buried contact between the basement complex and the sedimentary bedrock is largely unknown, but is likely an angular unconformity or a fault contact, and strikes north-south through the central portions of Chino Basin.

The general character of the consolidated bedrock formations is known from drillers' logs and surface outcrops, and is described below.

#### *2.2.1.1 Basement Complex*

The basement complex consists of deformed and re-crystallized metamorphic rocks that have been invaded and displaced in places by huge masses of granitic and related igneous rocks. The intrusive granitic rocks, which make up most of the basement complex, were emplaced about 110 million years ago in the late Middle Cretaceous (Larsen, 1958). These rocks were subsequently uplifted and exposed by erosion, as presently seen in the San Gabriel Mountains and in the uplands of the Perris block (Jurupa Mountains and La Sierra Hills). They have been the major source of detritus to the younger sedimentary formations, in particular, to the water-bearing sediments of Chino Basin.

#### *2.2.1.2 Undifferentiated Pre-Pliocene Formations*

Outcropping along the western margin of Chino Basin (in the Chino and Puente Hills) are consolidated sedimentary and volcanic rocks that unconformably overlie the basement complex. They consist of well-stratified marine sandstones, conglomerates, and shales, and interlayered lava flows that range in age from late Cretaceous to Miocene. According to Durham and Yerkes (1965), this sequence reaches a total stratigraphic thickness of more than 24,000 feet in the Puente Hills and is down-warped more than 8,000 feet below sea level in the Prado Dam area. Wherever mapped, these strata are folded and faulted and in most places dip from 20 to 60 degrees.

#### *2.2.1.3 Plio-Pleistocene Formations*

Overlying the older consolidated bedrock formations is a thick series of semi-consolidated clays, sands, and gravels of marine and non-marine origin. These sediments have been named the Fernando Group (Eckis, 1934), and outcrop in two general locations of the study area: the Chino Hills on the western margin of Chino Basin and in the San Timoteo Badlands southeast of Chino Basin. In surface outcrop, the entire Group is mapped as consolidated bedrock for this study, and is likely the first bedrock penetrated in southwest Chino Basin. However, the upper portion of the Fernando Group is more permeable than the lower portion, and thus represents in the subsurface, a gradual transition from the non-water-bearing consolidated rocks to the water-bearing sediments. Furthermore, the upper Fernando sediments are similar in texture and composition to the overlying water-bearing sediments, which complicates the distinction between the formations from borehole data.

### 2.2.2 Water-Bearing Sediments

Beginning in the Pleistocene and continuing to the present, an intense episode of faulting depressed the Chino Basin area and uplifted the surrounding mountains and hills. Detritus eroded from the mountains were transported and deposited in Chino Basin atop the consolidated sedimentary and crystalline bedrock as interbedded, discontinuous layers of gravel, sand, silt, and clay to form the *water-bearing sediments*.

The water-bearing sediments can be differentiated into the Older Alluvium of Pleistocene age and Younger Alluvium of Holocene age. The general character of these formations is known from driller's logs and surface outcrops, and is described below.

#### *2.2.2.1 Older Alluvium*

The Older Alluvium varies in thickness from about 200 feet thick near the southwestern end of Chino Basin to over 1,100 feet thick southwest of Fontana, and averages about 500 feet throughout Chino Basin. It is commonly distinguishable in surface outcrop by its red-brown or brick-red color, and is generally more weathered than the overlying Younger Alluvium. Pumping capacities of wells completed in the Older Alluvium range between 500 and 1,500 gallons per minute (gpm). Capacities exceeding 1,000 gpm are common, with some modern production wells test-pumped at over 4,000 gpm (*e.g.*, Ontario Wells 30 and 31 in southeastern Ontario). In the southern part of Chino Basin where sediments tend to be more clayey, wells generally yield 100 to 1,000 gpm.

#### *2.2.2.2 Younger Alluvium*

The Younger Alluvium occupies streambeds, washes, and other areas of recent sedimentation. Oxidized particles tend to be flushed out of the sediments during transport, and the Younger Alluvium is commonly light yellow, brown, or gray. It consists of rounded fragments derived from erosion of bedrock, from reworked Older Alluvium, and from the mechanical breakdown of larger fragments within the Younger Alluvium itself. The Younger Alluvium varies in thickness from over 100 feet near the mountains to a just few feet south of Interstate 10, and generally covers most of the northern half of Chino Basin in undisturbed areas. The Younger Alluvium is not saturated and thus does not yield water directly to wells. Water percolates readily in the Younger Alluvium and most of the large spreading basins are located in the Younger Alluvium.

## 2.3 Groundwater Occurrence and Movement

The physical nature of the groundwater reservoirs of Chino Basin is describe below with regard to basin boundaries, recharge, groundwater flow, discharge, distinct aquifer systems, hydrostratigraphy, aquifer properties, and internal faults.

### 2.3.1 Chino Basin Boundaries

The physical boundaries of the Chino Basin are shown on Figure 2-1 and include:

- **Red Hill Fault to the north.** The Red Hill Fault is a recently active fault evidenced by recognizable fault scarps such as Red Hill at the extreme southern extent of the fault near Foothill Boulevard. The fault is a known barrier to groundwater flow and groundwater elevation differences on the order of several hundred feet on opposite sides of the fault are typical (Eckis, 1934; DWR, 1970). Groundwater seeps across the Red Hill Fault as underflow from the Cucamonga Basin to the Chino Basin, especially during periods of high groundwater elevations within the Cucamonga Basin.
- **San Jose Fault to the northwest.** The San Jose Fault is known as an effective barrier to groundwater flow with groundwater elevation differences on the order of several hundred feet on opposite sides of the fault (Eckis, 1934; DWR, 1970). Groundwater seeps across the San Jose Fault as underflow from the Claremont and Pomona basins to the Chino Basin, especially during periods of high groundwater elevations within the Pomona and Claremont Heights basins.
- **Groundwater divide to the west.** A natural groundwater divide near Pomona separates the Chino Basin from the Spadra Basin in the west. The divide, which extends from the eastern tip of the San Jose Hills southward to the Puente Hills, is produced by groundwater seepage from the Pomona Basin across the southern portion of the San Jose Fault (Eckis, 1934).
- **Puente Hills/Chino Hills to the southwest.** The Chino Fault extends from the northwest to the southeast along the western boundary of the Chino Basin. It is, in part, responsible for uplift of the Puente Hills and Chino Hills, which form a continuous belt of low hills west of the fault. The Chino and Puente Hills, primarily composed of consolidated sedimentary rocks, form an impermeable barrier to groundwater flow.
- **Flow system boundary with Temescal basin to the south.** Comparison of groundwater elevation contour maps over time suggests a consistent distinction between flow systems within the lower Chino Basin and Temescal Basin. As groundwater within Chino Basin flows southwest into the Prado Basin area, it converges with groundwater flowing northwest out of the Temescal Valley (Temescal Basin). These groundwaters commingle and flow southwest toward Prado Dam and can rise to become surface water in Prado Basin. This area of convergence of Chino and Temescal groundwaters is indistinct and probably varies with changes in climate and production patterns. As a result, the boundary that separates Chino Basin from Temescal Basin was drawn along the legal boundary of the Chino Basin (Chino Basin Municipal Water District v. City of Chino *et al.*, San Bernardino Superior Court, No. 164327).
- **La Sierra Hills to the south.** The La Sierra Hills outcrop south of the Santa Ana River and are primarily composed of impermeable bedrock and form a barrier to groundwater flow between the Chino Basin and the Arlington and Riverside basins.
- **Shallow bedrock at the Riverside Narrows to the southeast.** Between the communities of Pedley and Rubidoux, the impermeable bedrock that outcrops on either side of the Santa Ana River narrows considerably. In addition, the alluvial thickness underlying the Santa Ana River thins to approximately 100 feet or less (*i.e.*, shallow bedrock). This area of narrow and shallow bedrock along the Santa Ana River is commonly referred to as the Riverside Narrows. Groundwater upgradient of the Riverside

Narrows within the Riverside basins is forced to the surface to become rising water within the Santa Ana River (Eckis, 1934). Downstream of the Riverside Narrows, the bedrock configuration widens and deepens, and surface water within the Santa Ana River can infiltrate to become groundwater in Chino Basin.

- **Jurupa Mountains and Pedley Hills to the southeast.** The Jurupa Mountains and Pedley Hills are primarily composed of impermeable bedrock and form a barrier to groundwater flow that separates the Chino Basin from the Riverside basins.
- **Bloomington Divide to the east.** A flattened mound of groundwater exists beneath the Bloomington area as a likely result of groundwater flow from the Rialto-Colton basin through a gap in the Rialto-Colton Fault north of Slover Mountain (Dutcher and Moyle, 1963; Gosling, 1966; DWR, 1970). This mound of groundwater extends from the gap in the Rialto-Colton Fault to the southwest towards the northeast tip of the Jurupa Mountains. Groundwater to the northwest of this divide recharges the Chino Basin and flows westward staying north of the Jurupa Mountains. Groundwater southeast of the divide recharges the Riverside basins and flows southwest towards the Santa Ana River.
- **Rialto-Colton Fault to the northeast.** The Rialto-Colton Fault separates the Rialto-Colton Basin from the Chino and Riverside basins. The fault is a known barrier to groundwater flow along much of its length – especially in its northern reaches (south of Barrier J) where groundwater elevations can be hundreds of feet higher within the Rialto-Colton Basin (Dutcher and Garrett, 1963; DWR, 1970; Woolfenden and Kadhim, 1997). The disparity in groundwater elevations across the fault decreases to the south. To the north of Slover Mountain, a gap in the Rialto-Colton Fault exists. Groundwater within the Rialto-Colton Basin passes through this gap to form a broad groundwater mound (divide) in the vicinity of Bloomington and, hence, is called the Bloomington Divide (Dutcher and Moyle, 1963; Gosling, 1966; DWR, 1970).
- **Extension of the Rialto-Colton Fault north of Barrier J.** Little well data exist to support the extension of the Rialto-Colton Fault north of Barrier J (although hydraulic gradients are steep through this area). Groundwater flowing south out of Lytle Creek Canyon, in part, is deflected by Barrier J and likely flows across the extension of the Rialto-Colton Fault north of Barrier J and into the Chino Basin.

### 2.3.2 Groundwater Recharge, Flow, and Discharge

Predominant recharge to the groundwater reservoirs of Chino Basin is from percolation of direct precipitation and infiltration of stream flow within tributaries exiting the surrounding mountains and hills and within the Santa Ana River. The following is a list of all potential sources of recharge in Chino Basin:

- Infiltration of flow (and, locally, imported water) within unlined stream channels overlying the basin.
- Infiltration of storm water flow and municipal wastewater discharges within the channel of the Santa Ana River.
- Underflow from the saturated sediments and fractures within the bounding mountains and hills.
- Artificial recharge at spreading grounds of storm water, imported water, and recycled water.
- Underflow from seepage across the bounding faults, including the Red Hill Fault (from Cucamonga Basin), the San Jose Fault (from the Claremont Heights and Pomona basins), and the Rialto-Colton Fault (from the Rialto-Colton Basin).
- Intermittent underflow from the Temescal Basin.
- Deep percolation of precipitation and returns from use.

In general, groundwater flow mimics surface drainage patterns: from the forebay areas of high elevation (areas in the north and east flanking the San Gabriel and Jurupa Mountains) towards areas of discharge near the Santa Ana River within Prado Flood Control Basin. Figure 2-3 is a groundwater elevation contour map for Fall 2000 that shows this general groundwater flow pattern (perpendicular to the contours). Comparing this contour map to groundwater elevation contour maps from other periods shows similar flow paths, indicating consistent flow systems within Chino Basin (WEI, 2000).

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct hydrologic units. Each flow system can be considered a *management zone*. Each management zone has a unique hydrology, and water resource management activities that occur in one management zone have limited impact on the other management zones.

Figure 2-3 shows the location of the five management zones in Chino Basin that were developed during the TIN/TDS Study (WEI, 2000) of which the Watermaster, the Chino Basin Water Conservation District (CBWCD), and the Inland Empire Utilities Agency (IEUA) were study participants. Nearing the southwestern (lowest) portion of Chino Basin, these flows systems become less distinct as all groundwater flow within Chino Basin converges and rises beneath Prado Basin. In detail, groundwater discharge throughout Chino Basin primarily occurs via:

- Groundwater production.
- Rising water within Prado Basin (and potentially other locations along the Santa Ana River depending on climate and season).
- Evapotranspiration within Prado Basin (and potentially other locations along the Santa Ana River depending on climate and season) where groundwater is near or at the ground surface.
- Intermittent underflow to the Temescal Basin.

### 2.3.3 Aquifer Systems

The saturated sediments within Chino Basin comprise one groundwater reservoir, but the reservoir can be sub-divided into distinct aquifer systems based on the physical and hydraulic characteristics of the aquifer system sediments and the contained groundwater. These aquifer systems include a *shallow aquifer system* and at least one *deep aquifer system*.

The sediments that comprise the shallow aquifer system are saturated in the southern portion of Chino Basin, but are unsaturated in the northern forebay regions where they provide a thick vadose zone for percolating groundwater (see Figure 2-3). The sediments that comprise the deep aquifer system are always at least partially saturated, but pinch out near bedrock outcrops and in the southern-most portion of Chino Basin. Section 2.3.4 describes and illustrates the detailed configurations of the shallow and deep aquifer systems.

The shallow aquifer system is generally characterized by unconfined to semi-confined groundwater conditions, high permeability within its sand and gravel units, and high concentrations of dissolved solids and nitrate. The deep aquifer system is generally characterized by confined groundwater conditions, lower permeability within its sand and gravel units, and lower concentrations of dissolved solids and nitrate. Where both aquifer systems are present and saturated, hydraulic head tends to be higher in the shallow aquifer system, indicating a downward vertical hydraulic gradient.

To illustrate the above generalizations, Figure 2-4 shows the location of Well 1A and Well 1B owned by the City of Chino Hills. These two wells are physically located within 30 feet of each other on the west side of Chino Basin, but their non-pumping water-level time histories are dramatically different. Figure 2-5 is a water-level time history of Well 1A (perforated within the shallow aquifer system), which maintains a relatively stable water level that fluctuates annually by about 20 feet (and a maximum of about 50 feet), probably in response to seasonal production and recharge. Comparatively, Well 1B (perforated within the deep aquifer system) displays a wildly fluctuating piezometric level that can vary seasonally by as much as 250 feet. The water level fluctuations observed in the deep aquifer system are typical of confined groundwater conditions where relatively small changes in storage can generate large changes in piezometric levels. Invariably, piezometric head is lower in the deep well (1B).

Wells 1A and 1B also display significant differences in water quality. Nitrate concentrations in 1A and 1B averaged 7 mg/L and 1 mg/L, respectively from 1997 to 2002. Total dissolved solids concentrations in 1A and 1B averaged 288 mg/L and 175 mg/L, respectively from 1997 to 2002. Arsenic concentrations are relatively high in the deep aquifer system (average of 66 ug/L in Well 1B from 1997 to 2002 compared to non-detectable in Well 1A). Similar water quality disparities have been noted between deep and shallow groundwater in the area of the Chino-1 Desalter well field (see Figure 2-4) and its eastward expansion currently under construction (Fox, 1990; GSS, 2001; Dennis Williams, GSS, pers. comm., 2003).

Also shown in Figure 2-4 – near Wells 1A and 1B – is Chino Basin Watermaster's recently constructed Ayala Park Extensometer facility. At this facility are 11 piezometers with screens of 5-20 feet in length that were completed at various depths that range from 139 to 1,229 feet below ground surface (ft bgs). Slug tests were performed at a number of these piezometers to, among other objectives, determine the permeabilities of the sediments at various depths within the total aquifer-system. In general, the piezometers in the shallow aquifer-system (less than about 350 ft bgs) display relatively high hydraulic conductivities of 20 to 27 ft/day. The piezometers within the deep aquifer-system display relatively low hydraulic conductivities of 1.6 to 0.5 ft/day. A notable exception is a piezometer completed in a gravelly sand in the uppermost portion of the deep aquifer-system (438 to 448 ft bgs) that displays a relatively high hydraulic conductivity of 48 ft/day, indicating the existence of some higher permeability zones within the deep aquifer-system.

The distinction between aquifer systems is most pronounced within the west-southwest portions of Chino Basin. This is likely because of the relative abundance of fine-grained sediments in the southwest (multiple layers of clays and silts). Groundwater flowing from high-elevation forebay areas in the north and east becomes confined beneath these fine-grained sediments in the west-southwest, which effectively isolate the shallow aquifer system from the deep aquifer system(s).

The three-dimensional extent of these fine-grained sedimentary units and their effectiveness as confining layers has never been mapped in detail across Chino Basin. However, the following data, shown on Figure 2-4, can be used to estimate the lateral extent of these units:

- Historical flowing-artesian conditions were mapped in the early 1900s in the southwest portion of Chino Basin (Mendenhall, 1905, 1908; Fife *et al.*, 1976), which indicates the existence of confining layers in these areas.
- Remote sensing studies were conducted to analyze land subsidence in Chino Basin (Peltzer, 1999a, 1999b). These studies employed Synthetic Aperture Radar Interferometry (InSAR), which utilizes radar imagery from an Earth-orbiting spacecraft to map ground surface deformation. InSAR has indicated the occurrence of persistent subsidence across the western portion of Chino Basin from 1992

to 2000 – likely due to the compaction of fine-grained sediments as a result of lower pore pressures within the aquifer system (WEI, 2002). The southern extent of persistent subsidence is currently unknown because InSAR data is difficult to obtain in areas of agricultural land uses, but may extend southward to encompass the historical artesian area.

North and east of these areas, the distinction between aquifer systems is less pronounced because:

- the fine-grained layers in the west-southwest thin and/or pinch-out to the north and east, and
- much of the shallow aquifer system is unsaturated in the forebay regions of Chino Basin.

Geologic descriptions from driller's logs in Chino Basin confirm the predominance of fine-grained sediments in the west-southwest portion of Chino Basin, and the predominance of coarser-grained sediments in the north and east portions of Chino Basin. These observations are described and illustrated in more detail in the following two sections (2.3.4 – Hydrostratigraphy and 2.3.5 – Aquifer Properties).

### 2.3.4 Hydrostratigraphy

As described in Section 2.2.2, the water-bearing sediments of Chino Basin are composed of interbedded, discontinuous layers of gravel, sand, silt, and clay. These layers and their geometries are too numerous and complex to characterized on a basin-wide scale. A simplified geologic model is needed to characterize the three-dimensional distribution of the water-bearing sediments and their hydrogeologic properties for input to a numerical groundwater flow model.

In order to develop this conceptual model, 10 hydrogeologic cross-sections were constructed across Chino Basin. The plan-view locations of eight cross-sections are shown in Figure 2-6 and the profile-view cross-sections are shown in Figures 2-7 through 2-14. Plotted on these cross-sections are selected well and borehole data, including borehole lithology, short-normal resistivity logs, well casing perforations, and water levels.

Through analyses of these cross-sections and other hydrogeologic data, the water-bearing sediments were grouped into three hydrostratigraphic units (layers):

- *Layer 1* consists of the upper 200-300 feet of sediments, and is generally representative of the shallow aquifer-system (see Section 2.3.3). Layer 1 sediments are typically coarse-grained (sand and gravel layers) and, where saturated, transmit large quantities of groundwater to wells due to high hydraulic conductivities. On the west side of Chino Basin, Layer 1 sediments are composed of a greater fraction of finer-grained sediments (silt and clay layers), especially in the uppermost 100 feet.
- *Layer 2* consists of 200-500 feet of sediments underlying Layer 1, and is representative of the upper portion of the deep aquifer system (see Section 2.3.3). On the west side of Chino Basin, Layer 2 sediments are primarily fine-grained (silt and clay layers) with few interbedded sand and gravel layers. Layer 2 sediments become increasingly coarse-grained in the northern and eastern portions of Chino Basin, and as a result, the distinction between Layer 1 and Layer 2 sediments becomes less pronounced.
- *Layer 3* consists of 100-500 feet of sediments underlying Layer 2, and is representative of the lower portion of the deep aquifer system (see Section 2.3.3). The distribution of Layer 3 sediments is limited to the deepest (central) portions of Chino Basin, with "pinch-out" toward the basin margins. Layer 3 sediments are typically coarse-grained (sand and gravel layers), but due to their greater age, consolidation, and state of weathering, these sediments have lower permeability than the coarse-

grained sediments of Layer 1 and 2. Layer 3 sediments, in places, may include the upper portion of the continental deposits of the Fernando Group.

The top and bottom elevations of the three layers were brought into a Geographic Information System (GIS) as point values. These elevation values were then used as input to create a series of grids that represent the three-dimensional conceptual model of the water-bearing sediments of Chino Basin.

### 2.3.5 Aquifer Properties

The aquifer properties of critical importance for this study are effective porosity (specific yield) and hydraulic conductivity.

#### *2.3.5.1 Effective Porosity*

The effective porosity of the water-bearing sediments in Chino Basin was estimated through the analysis of lithologic descriptions from driller's logs. Watermaster maintains a library of driller's logs of all known well boreholes that have been drilled in Chino Basin. The lithologic descriptions from the driller's logs were input into a relational database along with corresponding US Geological Survey (USGS) estimates of effective porosity by sediment type (Johnson, 1967).

Effective porosity was averaged at each borehole for each layer. These values were plotted and gridded using a Kriging method within the ArcGIS Spatial Analyst extension for each layer, and are shown in Figures 2-15 through 2-17.

Figure 2-15 displays average effective porosity for Layer 1. Average effective porosities are highest, ranging up to 20 percent, in the northern (Upland) and eastern (Fontana) portions of Chino. A belt of similarly high effective porosity runs north of and parallels the Santa Ana River near Norco. This belt may represent coarse-grained sediments deposited by an ancestral Santa Ana River. Average effective porosities are lowest, ranging down to 6 percent, on the west side of Chino Basin (Pomona and Chino). This area of relatively low effective porosity overlaps the historical artesian area, and may represent fine-grained sediments that historically acted as confining layers.

Figure 2-16 displays average effective porosity for Layer 2. As with Layer 1, average effective porosities are highest, ranging up to 20 percent, in the northern (Upland) and eastern (Fontana) portions of Chino Basin. A belt of similarly high effective porosity runs north of the Jurupa Mountains from Fontana to Norco. As with Layer 1, this belt may represent coarse-grained sediments deposited by an ancestral Santa Ana River. Average effective porosities are lowest, ranging down to 3 percent, on the west side of Chino Basin (Pomona, Chino, and west Ontario). This area of relatively low effective porosity overlaps the historical artesian area and the area of historical subsidence as indicated by InSAR, and may represent fine-grained sediments that have experienced compaction due to reduced pore pressures.

Figure 2-17 displays average effective porosity for Layer 3. Again, the primary observation is coarser-grained sediments comprising the east side of Chino Basin, and finer-grained sediments comprising the west side.

#### *2.3.5.2 Hydraulic Conductivity*

The hydraulic conductivity of water-bearing sediments is a measure of its capacity to transmit water. Generally, sands and gravels have high hydraulic conductivities while clays and silts have low hydraulic

conductivities. Since the effective porosity figures (Figure 2-15 through 2-17) were created from lithologic descriptions of well bore cuttings, they also qualitatively indicate the distribution of hydraulic conductivity of the water-bearing sediments. On average, hydraulic conductivities are highest in the northern (Upland) and eastern (Fontana) portions of Chino Basin. A belt of similarly high hydraulic conductivity runs north of the Jurupa Mountains from Fontana to Norco. Average hydraulic conductivities are lowest on the west side of Chino Basin (Pomona, Chino, and west Ontario). Generally, hydraulic conductivities decrease with depth because deeper sediments typically have experienced a greater degree of secondary alteration (*e.g.* weathering of feldspars to clay minerals, cementation of pore space, *et cetera*). Sections 6 and 7 will discuss and illustrate the distribution of hydraulic conductivity in Chino Basin in more detail.

### 2.3.6 Internal Faults

- Barrier "J" - Barrier "J" appears to be a significant impediment to groundwater flow in the Rialto Basin. However, there is no conclusive evidence that Barrier "J" acts as barrier in the Chino Basin. The displacement in the effective base of the aquifer in the Chino Basin and barrier effects in Rialto Basin suggest potential for Barrier "J" to be a groundwater barrier in the Chino Basin.
- Central Avenue Fault - The effect of the Central Avenue fault on groundwater flow is unknown. The sediments west of the fault are generally finer than the sediments east of the fault and it unclear if the relatively poor production capabilities of the area west of the fault are the result of marginal aquifer properties, the Central Avenue fault acting as a hydrologic barrier, or both.

## 2.4 Groundwater Levels

### 2.4.1 Groundwater Level Monitoring

Various entities have collected groundwater-level data in the past. Municipal and agricultural water supply entities have historically collected groundwater-level data in programs that range from irregular, study-oriented measurements to long-term periodic measurements. Groundwater-level measurements were made for specific investigations such as various California Department of Water Resources (DWR) studies, the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), and the Chino Basin Judgment (Chino Basin Municipal Water District vs. City of Chino *et al.*). The spatial extent and temporal history of groundwater-level measurements south of State Route 60 have, until recently, always been less than north of State Route 60. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater-level measurements in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, the water level monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR.

Watermaster conducted its first large-scale groundwater-level monitoring program for the Chino Basin in the spring of 1986. In 1989, Watermaster initiated a more regular monitoring program for Chino Basin with groundwater-level measurements obtained in 1990, and periodically thereafter through 1997.

Since 1998 and pursuant to implementation of the Optimum Basin Management Program (OBMP), Watermaster has developed and implemented three groundwater-level monitoring programs:

- Basin-wide;
- Chino-1 Desalter; and

- Chino-2 Desalter.

A fourth program is currently being implemented for Management Zone 1 to support subsidence and fissuring investigations.

These Watermaster programs typically rely on municipal producers and other government agencies to supply their groundwater-level measurements on a cooperative basis. Watermaster staff supplements these data with groundwater-level measurements collected by staff, primarily south of State Route 60. Chino Basin was initially canvassed for all wells capable of yielding a groundwater-level measurement, and these wells were included in at least one of the four groundwater-level monitoring programs. Measurement frequencies range from twice per year for the Basin-wide program, to twice a month for the Desalter programs. Water levels at some wells participating in the MZ-1 monitoring program are recorded by pressure transducers once every 15 minutes. Watermaster digitizes all of these recent measurements and has combined the measurements from all known sources into a relational database that is maintained at Watermaster's office.

### 2.4.2 Historical Groundwater Levels

This section describes the groundwater-level time histories in the Chino Basin by management zone and characterizes the differences between management zones. Figure 2-18 illustrates the location of wells whose groundwater-level time histories are discussed herein and the management zone boundaries. The wells were selected based on length of record, completeness of record, and geographical distribution. Wells discussed herein are identified by their owner and local name designation if a municipal well, and by state well location if a private well.

The behavior of groundwater levels at specific wells is compared to climate, to pre- and post-Judgment periods, and to other factors as appropriate. {Note: the short-term groundwater-level fluctuations shown in the following figures are caused by including static and dynamic observations in the groundwater-level time histories.}

For comparison to climate, the cumulative departure from mean precipitation (CDFM) is plotted on all water-level time history figures. Positive sloping lines on the CDFM curve imply wet years or wet periods. Negatively sloping lines imply dry years or dry periods. For example, the period between 1937 to 1944, 1978 to 1983, and 1993-1998 are wet periods, and are represented as positively sloping lines. The period 1945 through 1977 is a drought period and is represented as a negatively sloping line, punctuated with a few wet years (positively sloped in 1952, 1958, and 1969).

The implementation of the Chino Basin Judgment in 1978 is evident in most of the water-level time histories because it corresponded with (1) the management of groundwater production, (2) the initiation of groundwater replenishment with imported water, and (3) the reduction in pumping due to increased direct use of imported surface water.

- **Management Zone 1.** Upland-7, Monte Vista Water District well MVWD-4, and Pomona-6 (Figure 2-19) illustrate typical groundwater-level time histories in the northern half of Management Zone 1. Water levels in these wells followed the climatic trends very closely, with little or no lag in water-level response to major climatic changes. This quick response may be due to rapid infiltration through a thick coarse-grained vadose zone, changes in groundwater demand (pumping) because of surface water availability, or both. Prior to the Judgment (1978), these time histories show that the northern half of MZ-1 was experiencing overdraft, as water levels declined by as much as 200 feet from 1945 to 1977.

After the Judgment, water levels recovered in these wells, especially during the 1978 to 1983 wet period. Over the last 10 years (1992 to 2002), water levels were relatively stable with a slight decline in the most recent dry years (1998 to 2002).

Chino-4 illustrates a typical groundwater-level time histories in the southern half of MZ-1. Water levels in this well do not follow climatic trends closely, as shown by declining water levels during the relatively wet 1993 to 1998 period. This observation is likely due to the fine-grained texture of the aquifer-system sediments that inhibit rapid recharge to this area. During the last 10 years (1992 to 2002), water levels were relatively stable with a slight decline in the most recent dry years (1998 to 2002). Few wells in this region have water-level time histories that extend back prior to the Judgment (1978).

Not shown in Figure 2-19 are water-level time histories from wells in the southern half of MZ-1 that are perforated solely in the deep aquifer-system. Recall from Section 2.3.3 that two very distinct aquifer systems exist in this area. Chino Hills-1B is one of these deep aquifer-system wells, and its water-level time history is shown in Figure 2-5. During the last 10 years (1992 to 2002), water levels in the deep aquifer-system fluctuated seasonally by up to 250 feet, but stayed relatively stable within this range over the 10-year period. Most of these deep wells were drilled in 1990, so little water-level data exists prior to 1990 for the deep aquifer-system.

- **Management Zone 2.** Few wells exist in the northern forebay portions of MZ-2 in part because of great depths to groundwater. CCWD-CB4 and Ontario-7 (Figure 2-20) illustrate typical groundwater-level time histories in the central portion of Management Zone 2. Water levels in these wells followed the climatic trends, but with a significant lag in water-level response to major climatic changes (2 to 4 years). This lag in water-level response to climate is likely due to a thick vadose zone (300 to 400 feet) and the significant distance to the primary recharge areas in the north (5 to 8 miles to the San Sevaine and Etiwanda Spreading Grounds). Prior to the Judgment (1978), these time histories show that the central portion of MZ-2 was in overdraft as water levels declined by as much as 130 feet during the period of 1930 to 1977, with water levels showing little or no response to wet years until 1978. After the Judgment, water levels at these wells increased slightly (10 to 20 feet) until about 1990. This post-Judgment increase is probably due to the combination of 1978 to 1983 wet period, reduction in overdraft following the implementation of the Judgment, the start of artificial replenishment with imported water in the San Sevaine and Etiwanda basins, and the increased use of imported surface water. During the last 10 years (1992 to 2002), water levels declined slightly (10 to 20 feet), even during and after the 1993-1998 wet period.

  2S/7W-9M1 and 2S/7W-21C illustrate typical groundwater-level time histories for wells in the southern half of MZ-2. Prior to the Judgment (1978), and similar to the wells in the central portion of MZ-2, these time histories show that the southern half of MZ-2 was in overdraft as water levels declined by as much as 80 feet during the period of 1930 to 1974. Water levels showed little or no response to wet years. During the last 10 years (1992 to 2002), water levels declined by about 20 feet, with most of this decline occurring since 1999. This most recent decline in water levels may be in part related to the onset of pumping at the Chino Basin Desalter well field.

- **Management Zone 3.** Fontana Water Company wells FWC-FU28 and FWC-F3A (Figure 2-21) illustrate typical groundwater-level time histories in the upgradient eastern portion of Management Zone 3. Water levels in these wells followed the climatic trends, but with a significant lag in water-level response to major climatic changes (1 to 2 years). This lag in water-level response to climate is likely due to a thick vadose zone (~400 feet) and the absence of nearby sources of recharge. Prior to the Judgment (1978), these time histories show that the eastern portion of MZ-3 was in overdraft as water levels declined by as much as 70 feet during the period of 1930 to 1977, with water levels showing little or no response to wet years. After the Judgment, water levels at these wells increased slightly (20 to 30 feet) until about 1990. This post-Judgment increase was probably due to the

combination of the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Judgment, and the increased use of imported surface water. During the last 10 years (1992 to 2002), water levels were relatively stable but have declined slightly (10 to 20 feet) since about 1998.

JCSD-18 and JCSD-19 illustrate typical groundwater-level time histories for wells in the central portion of MZ-3. Prior to the Judgment (1978), and similar to the wells in the upgradient eastern portion of MZ-3, these time histories show that the central portion of MZ-3 was in overdraft as water levels declined by as much as 75 feet during the period of 1930 to 1977. Water levels showed little or no response to wet years. During the last 10 years (1992 to 2002), water levels remained relatively stable.

2S/7W-34H1 and 2S/7W-27 illustrate typical groundwater-level time histories for wells in the downgradient southern portion of MZ-3. Water levels in these wells followed the climatic trends with little or no lag in water-level response to major climatic changes – possibly due to their close proximity to the Santa Ana River. Prior to the Judgment (1978), these time histories show that the southern portion of MZ-3 was in overdraft as water levels declined by about 20 feet during the period of 1930 to 1977. During the last 10 years (1992 to 2002), water levels have declined by about 10-30 feet, with most of this decline occurring since 1999. This most recent decline in water levels may be in part related to the onset of pumping at the Chino Basin Desalter well field.

- **Management Zone 4.** 2S/6W-16B2, 2S/6W-13B6 and 2S/6W-14C2 (Figure 2-22) illustrate typical groundwater-level time histories in Management Zone 4. Water levels in these wells followed the climatic trends with little or no lag in water-level response to major climatic changes. These rapid responses to climatic trends is likely because MZ-4 is within a narrow valley bounded by bedrock hills, and its primary source of recharge is percolation of precipitation and storm flow in unlined channels that exit the bounding hills. Prior to the Judgment (1978), these time histories show that MZ-4 was in slight overdraft as water levels declined by about 20 feet during the period of 1945 to 1977. After the Judgment, water levels at these wells increased slightly (~10 feet) and have remained relatively stable and have continued to follow precipitation trends closely.
- **Management Zone 5.** JCSD-Limonite1, SARWC-7, Norco-11, and 2S/7W-36A (Figure 2-23) illustrate typical groundwater-level time histories in Management Zone 5, which parallels the Santa Ana River in Chino Basin. Water levels in these wells followed the climatic trends with little or no lag in water-level response to major climatic changes. However, the magnitude of water-level responses to changes in climate and/or groundwater production is less in MZ-5 than at wells in other management zones – likely because the close proximity of the perennial Santa Ana River has a stabilizing effect on groundwater levels. Prior to the Judgment (1978), these time histories show that MZ-5 was in slight overdraft as water levels declined in some wells by about 25 feet during the period of 1953 to 1977. After the Judgment, water levels at these wells recovered to their 1953 levels during the 1978 to 1983 wet period. After the Judgment, water levels were relatively stable but have declined slightly (by 10 feet or less) since 2000.

# 3. GROUNDWATER QUALITY

## 3.1 Background

Chino Basin groundwater is not only a critical resource to overlying producers of water; it is a critical resource to the entire Santa Ana Watershed. From a regulatory perspective, the use of Chino Basin groundwater to serve potable demands will be limited by drinking water standards, groundwater basin water quality objectives, and Santa Ana River water quality objectives. In August 1999, Phase 1 of the OBMP established a necessity for conducting groundwater quality and water level monitoring in order to obtain current water quality and water level data in Chino Basin (WEI, 1999). These data are necessary to define and evaluate specific strategies and locations for the mitigation of nitrate, total dissolved solids (TDS), and other constituents of concern (COCs), new recharge sites, and pumping patterns resulting from the implementation of the OBMP.

## 3.2 Water Quality Monitoring Programs

In the past, various entities have collected groundwater quality data. Municipal and agricultural water supply entities have collected groundwater quality data to comply with the Department of Health Services' requirements under Title 22 or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the California Department of Water Resources (DWR), by participants in the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), by dischargers under orders from the RWQCB, and by the County of San Bernardino. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely, except for monitoring conducted by the cities of Chino, Chino Hills, and Norco, the Jurupa Community Services District (JCSD), and the Santa Ana River Water Company (SARWC). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (MWDSC) conducted the first comprehensive survey of groundwater quality covering all constituents regulated in California Code of Regulations Title 22.

In 1989, Watermaster initiated a regular monitoring program for Chino Basin. Groundwater quality data were obtained in 1990 and periodically from then on until 1998. Thereafter, Watermaster implemented an aggressive monitoring program as part of the OBMP implementation. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster supplements this data with data obtained through its sampling and analysis program in the area generally south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under the orders of the Regional Water Quality Control Board (RWQCB), the California Department of Toxic Substances Control (DTSC), and others. Watermaster has combined previously digitized groundwater quality data from all known sources into a comprehensive database.

### 3.2.1 Title 22 Compliance Monitoring

Water quality samples from wells operated by members of the Appropriative Pool and some members of the overlying Non-agricultural Pool are typically collected as part of the formalized monitoring programs. Constituents include those: (i) regulated for drinking water purposes in the *California Code of Regulations, Title 22;* (ii) regulated in the *1995 Water Quality Control Plan for the Santa Ana River Basin* (Basin Plan); or (iii) that are of special interest to the pumper.

### 3.2.2 Historical Water Quality Monitoring Programs for Private Wells

Historically, private wells were sampled less methodically and less frequently than wells owned by members of the Appropriative Pool. In addition, Watermaster had a limited groundwater quality monitoring program in the southern part of Chino Basin, wherein general minerals and physical properties were measured at about 60 wells. There is little historical groundwater quality information for most of the 600 private wells in the southern part of Chino Basin; thus, the historic water quality of groundwater being produced at a majority of the wells in Chino Basin is unknown. Prior to the recently completed *Comprehensive Water Quality Monitoring Program* discussed in Section 3.2.3, there was only one other monitoring program to date that included a systematic water quality sampling program of the private wells in the southern portion of the Chino Basin:

- In 1986, the MWDSC (1988) sampled 149 wells in Chino Basin, including 45 privately-owned wells in the southern portion of the Chino Basin. These wells were analyzed for major cations and anions, general physical parameters, volatile organic chemicals (VOCs), base/neutral/acid-extractable organic chemicals (BNAs), organochlorine pesticides and polychlorinated biphenyls (PCBs), organophosphorous pesticides, carbamate pesticides, and triazine herbicides and soil fumigants.

### 3.2.3 Comprehensive Water Quality Monitoring Program (1999 – 2001)

Watermaster developed the OBMP in 1999 (WEI, 1999), and the Peace Agreement that implemented the OBMP in 2000. The OBMP established management goals for Watermaster. The management plan in the OBMP describes actions that, when implemented, will achieve the goals of the OBMP. These actions are referred to as Program Elements. A groundwater quality monitoring program is a key part of the OBMP; hence, *Program Element 1 – Develop and Implement a Comprehensive Monitoring Program*. Watermaster developed and conducted the Comprehensive Water Quality Monitoring Program to provide comprehensive long-term information on groundwater quality for use in managing the groundwater basin.

The Comprehensive Water Quality Monitoring Program (CMP) consisted of a water quality sampling and analysis from all known active production and monitoring wells in the Chino Basin. Watermaster staff obtained and analyzed samples from all known and active private wells, and obtained water quality for all other known and active wells from cooperating well owners. From October 1999 to March 2001, Watermaster sampled 602 private wells for the private well monitoring program (PWMP) portion of the CMP (The PWMP is a subset of the CMP). These wells were analyzed for:

- general mineral analyses (including cation and anion balances);
- general physical analyses;
- dissolved inorganic chemical analyses;
- perchlorate (US Environmental Protection Agency [US EPA] 300.0-IC);
- VOCs, including MTBE (US EPA 524.2);
- semivolatile organic compounds (US EPA 525.2);
- cyanide (SM 4500 CN-F);
- 1,2-dibromo-3-chloropropane (DBCP)/1,2-dibromoethane (EDB)/1,2,3-trichloropropane (US EPA 504.1); and
- gross alpha and beta (US EPA 900.0).

All known active private wells within the Agricultural Pool of the Chino Basin were selected for sampling; active, as defined by DWR, is "an operating water well." For each of the two years in the monitoring program, wells were selected to provide sufficient areal coverage of the entire southern portion of the Chino Basin. Wells that are clustered together were sampled during the same period, as often as possible, in order to avoid return trips to the same site. In addition, wells along the same street were grouped together, when possible, in order to increase the speed and efficiency of the sample collection.

The selected wells for Year 1 of the PWMP were located approximately within the capture zones of existing and proposed well fields for desalter facilities. Wells known to be within another entity's regular monitoring program were excluded from the PWMP, but the data collected by the other entities were added to the program data set, if available (*e.g.*, California Institution for Men [CIM] wells).

### 3.2.4 205(j) Groundwater Monitoring Program

The Chino Basin 205(j) Groundwater Monitoring Program (CB205JMP) provided an evaluation of water levels and water quality in the groundwater of Chino Basin. Approximately 200 wells located in the southern portion of the Chino Basin were sampled. The water quality data included general minerals with a focus on TDS and nitrogen species. The collected water quality and water level data were used to develop detailed water quality and water level contour maps.

Partial funding for the CB205JMP was provided through the California State Water Resources Control Board (SWRCB) under Section 205(j) of the Federal Clean Water Act, Agreement Number 00-199-250-0. Funding from the 205(j) grant program was used to partially offset the cost for the necessary water quality and water level monitoring at 200 wells located in the southern portion of Chino Basin in the capture zone of Chino-1 and Chino-2 Desalters. The sampling program took place from February 2002 to June 2002.

### 3.2.5 Chino Basin Groundwater Quality Monitoring Program (2002/2003)

Continued monitoring of water levels and water quality influent to the desalter well fields is critical to optimizing the performance of these treatment facilities. Water levels will be measured at least once annually. All private wells are proposed to be sampled for general mineral and general physical parameters at least once every three years. In addition to these parameters, the following constituents are included in the on-going groundwater quality monitoring program:

- Perchlorate (all wells). Perchlorate is a contaminant of state and national prominence and importance. Perchlorate was detected in several private wells in the PWMP and, therefore, all private wells will be re-tested for perchlorate so that an accurate distribution of the contaminant can be made.
- 1,2,3-Trichloropropane (all wells). 1,2,3-TCP has a new California Action Level (AL) of 0.005 µg/L. The detection limit for 1,2,3-TCP in the previous monitoring program was 50 µg/L and there was 1,2,3-TCP detected at greater than that detection limits. Because 1,2,3-TCP may be a basin-wide water quality issue, all wells are being re-tested at a lower detection limit – 0.005 µg/L.
- VOCs (wells within or near VOC plumes). Those wells that were within VOC plumes or were within 1000 feet of the suspected edge of a plume will be re-tested for VOCs.
- Hexavalent chromium, silica, strontium, barium, total and fecal coliforms (selected wells). These constituents were added during the PWMP, and hence, not all wells were tested for these constituents

during that monitoring program. Those wells that were not tested for these constituents will be tested during this three year monitoring program.

To date, Watermaster staff have sampled 100 out of 200 private wells that will be monitored in 2002/2003. After the approximately 600 private wells are sampled over the next three years, Watermaster will have two recent, comprehensive groundwater quality sampling rounds in Chino Basin. The second comprehensive round will be used to corroborate tentative conclusions drawn from analyses of the first round of the CMP. At that time, a determination as to the nature of a long-term groundwater quality monitoring program will be made.

## 3.3 Information Management

As with groundwater level and groundwater production data, groundwater quality data are being managed by Watermaster in order to perform the requisite scientific and engineering analyses to ensure that the goals of the OBMP are being met. Watermaster has a relational database that contains information on well location, construction, lithology, specific capacity, groundwater level, and water quality. Historical water quality data for the period prior to the mid 1980s were obtained from the DWR and were supplemented with data from producers in the Appropriative and Overlying Non-Agricultural Pools and others. For the period from the mid 1980s forward, Watermaster loaded the database with water quality data from its own sampling programs, the State of California database – State Water Quality Information System (SWQIS), and from other cooperators.

## 3.4 Groundwater Quality in Chino Basin

Figure 3-1 shows all wells in that have groundwater quality monitoring results for the period ranging from 1997 to 2002. The locations of existing and proposed desalter supply wells are shown in Figure 3-1 for areal reference.

Inorganic and organic constituents that were detected in groundwater samples from wells in the Chino Basin through 2002 were analyzed synoptically; the analysis contained all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. However, the data do represent the most comprehensive information available to date. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Additionally, groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

As discussed previously, the database includes both production wells and monitoring wells, including many monitoring wells associated with the Stringfellow NPL Site. However, much of the monitoring well data from the Mid-Valley Landfill have been removed from Watermaster's database, pending resolution of quality control issues for electronic data transmitted from the County of San Bernardino.

The following constituents exceeded water quality criteria for more than 10 wells in Chino Basin for the approximate 5-year period January 1997 through June 2002:

| Analyte Group/Constituent | Wells with Exceedances |
|---|---|
| ***Inorganic Constituents*** | |
| total dissolved solids | 467 |
| nitrate | 617 |
| aluminum | 91 |
| arsenic | 12 |
| chloride | 45 |
| fluoride | 12 |
| iron | 83 |
| manganese | 41 |
| perchlorate | 140 |
| sulfate | 72 |
| ***General Physical*** | |
| color | 13 |
| pH | 24 |
| odor | 17 |
| ***Chlorinated VOCs*** | |
| 1,1-dichloroethene | 12 |
| 1,2,3-trichloropropane | 40 |
| 1,2-dichloroethane | 16 |
| *cis*-1,2-dichloroethene | 15 |
| tetrachloroethene (PCE) | 37 |
| trichloroethene (TCE) | 119 |
| ***Radiological*** | |
| gross alpha | 156 |
| total radon 222 | 23 |

The following inorganic constituents were detected at or above their MCL in more than 10 wells:

- total dissolved solids
- nitrate
- aluminum
- arsenic
- chloride
- fluoride
- iron
- manganese
- perchlorate
- sulfate

TDS, nitrate, arsenic, and perchlorate are discussed below in some detail. With the exception of perchlorate, all of the other inorganic constituents occur naturally in groundwater.

Chloride, sulfate, iron, and manganese all exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS.

The concentrations of aluminum, arsenic, fluoride, iron, and manganese depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature. Based on the available data, none of these constituents except aluminum and iron showed a spatial pattern throughout Chino Basin. Aluminum and iron were both high in the Stringfellow plume. This may be an artifact of the sampling methodology – relatively high concentrations of aluminum, iron, and trace metals are often the result of dissolution of aluminosilicate particulate matter and colloids caused by the acid preservative in unfiltered samples.

Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). However, site-specific monitoring wells may reveal point sources (*e.g.*, wells near landfills have shown relatively high concentrations of manganese).

Color, odor, and pH were detected at greater than their secondary MCLs (or outside the range in the case of pH) in more than 10 wells in the last 5 years. These parameters should not limit water quality in Chino Basin.

### 3.4.1 Total Dissolved Solids

In Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L. For irrigation uses, TDS should generally be less than 700 mg/L. The RWQCB has established TDS limitations for all municipal wastewater plants that discharge recycled water to the Santa Ana River. However, a problem arises in that TDS concentrations increase through municipal use, typically by about 150 to 250 mg/L. The TDS limitations for water recycling plants that discharge to the Santa Ana River in the Chino Basin are listed below:

| Plant | TDS Limit (mg/L) |
|---|---|
| IEUA RP1 | 540 |
| IEUA RP2 | 610 |
| IEUA Carbon Canyon | 555 |
| IEUA RP4 | 505 |
| Western Riverside Regional | 625 |
| City of Riverside | 650 |
| Jurupa Indian Hills | 650 |

Generally, the TDS concentration in source (drinking) water must be kept well below 500 mg/L (preferably less than 300 mg/L) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets RWQCB limitations.

TDS concentrations in the northeast part of Chino Basin range from about 170 to about 300 mg/L for the pre-1980 period ranging, with typical concentrations in the mid to low 200s. TDS concentrations in excess of 200 mg/L would indicate degradation from overlying land use. With a few exceptions, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation; for instance, the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near the IEUA Regional Plant No. 1 (RP1) in South Ontario.

The impacts of agriculture on TDS in groundwater are primarily caused by fertilizer use on crops, consumptive use, and dairy waste disposal. As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/L, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/L, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

TDS concentrations in groundwater have either increased slightly or remained relatively constant in the northern part of the Chino-North Management Zone (MZ). TDS concentrations are significantly higher in the southern part of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin Management Zone (PBMZ). In these areas, TDS concentrations typically exceed the 500 mg/L recommended MCL and frequently exceed the upper limit of 1,000 mg/L.

In the figures that depict distributions of water quality in Chino Basin, the following convention is typically followed in setting the class intervals in the legend (where WQS is the applicable water quality standard. Variations from this convention may be employed to highlight certain aspects of the data.

| Symbol | Class Interval |
|---|---|
| ○ | Not Detected |
| ● | <0.5•WQS, but detected |
| ● | 0.5•WQS to WQS |
| ● | WQS to 2•WQS |
| ● | 2•WQS to 4•WQS |
| ● | > 4•WQS |

Figures 3-2 through 3-4 show the distribution of TDS concentrations in Chino Basin for three periods:

- pre-1980;

- 1981 through 1997; and
- 1998 through 2002.

In Figure 3-2 (pre-1980), the TDS concentrations in the northern portion (north of the 60 Freeway) of the Chino-North MZ are generally less than 250 mg/L. TDS concentrations south of the 60 Freeway were typically in the range of 250 to 500 mg/L with the exception of the following areas, which have higher TDS concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP1 discharge point. This pattern is replicated in the period ranging from 1981 to 1997 (Figure 3-3), with the following change:

- More wells in the southern Chino Basin area have TDS concentrations in the 500 to 1000 and 1000 to 2000 mg/L class intervals.

Figure 3-4 shows the distribution of TDS concentrations in Chino Basin for the 1998-2002 period. This sampling period reflects the addition of PWMP data in the southern part of Chino Basin. As shown on the map, the distribution of private wells in the PWMP by class intervals is:

| Class Interval | Number of Wells |
|---|---|
| < 125 mg/L | 0 |
| 125 – 250 mg/L | 35 |
| 250 –500 mg/L | 134 |
| 500 – 1000 mg/L | 222 |
| 1000 – 2000 mg/L | 208 |
| > 2000 mg/L | 13 |

Seventy-two percent of the private wells in the PWMP (443 wells) had TDS concentrations greater than the secondary MCL. In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality. However, there is a paucity of information concerning well construction/perforation intervals; therefore, the vertical differences in water quality are currently unverifiable.

### 3.4.2 Nitrate-Nitrogen

In Title 22, nitrate is regulated in drinking water with an MCL of 10 mg/L (as nitrogen). [As discussed previously, the data queried from the database are a combination of data from the Watermaster database and the State of California database (SWQIS). By convention, all nitrate values are reported in this document as nitrate-nitrogen ($NO_3$-N). Hence, the values of nitrate-nitrogen reported in this document should be compared with an MCL of 10 mg/L.] Nitrate measurements in the surface water flows of the San Gabriel Mountains and in the groundwater near the foot of these mountains are generally less than 0.5 mg/L (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/L may indicate degradation from overlying land use. Similar to TDS, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of the Chino-North MZ; and

- Dairy areas in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ (PBMZ).

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of the Chino-North MZ over the period ranging from 1960 to the present. These are areas formerly occupied by citrus groves and vineyards. Nitrate concentrations underlying these areas rarely exceed 20 mg/L (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the PBMZ. These are areas where land use was progressively converted from irrigated/non-irrigated agricultural land to dairies, and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L.

Figures 3-5 through 3-7 show the distribution of nitrate-nitrogen concentrations in Chino Basin for three periods:

- pre-1980;
- 1981 through 1997; and
- 1998 through 2002.

In Figure 3-5 (pre-1980), most of the nitrate concentrations in the northern portions (north of the 60 Freeway) of Chino-North MZ are generally less than 5 mg/L. However, the Pomona-Claremont area (up to 25 mg/L), the eastern Fontana area (up to 10 mg/L), and the Cucamonga Basin (up to 25 mg/L), all have elevated nitrate concentrations. The following areas, south of the 60 Freeway, have somewhat elevated nitrate concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP1 discharge point (Figure 3-5).

This pattern is generally replicated in the period ranging from 1981 to 1997 (Figure 3-6); however, several wells in the southern portion of Chino Basin have nitrate concentrations greater than the MCL and 21 wells exceed 50 mg/L (5 times the MCL).

Figure 3-7 shows the distribution of nitrate concentrations in Chino Basin for the post-1997 period. This sampling period primarily reflects the PWMP data in the southern portion of Chino Basin. As shown on the map, the distribution of wells in the southern Chino Basin area by class intervals is:

| Class Interval | Number of Wells |
|---|---|
| < 2.5 mg/L | 14 |
| 2.5 – 5 mg/L | 35 |
| 5 –10 mg/L | 52 |
| 10 – 25 mg/L | 141 |
| 25 – 50 mg/L | 171 |
| > 50 mg/L | 197 |

About eighty-three percent of the private wells in the PWMP (101 wells) had nitrate concentrations greater than the MCL and 60 percent are more than 2.5 times greater than the MCL.

### 3.4.3 Water Character Index

Water character index (WCI) is a parameter that can be used to generally characterize groundwater. WCI is a unitless parameter that provides a numerical estimation of water character. WCI is used to assess the ionic distribution of constituents in a water sample. This is analogous to a trilinear or Piper diagram, which is a graphical means of displaying the ratios of the principal ionic constituents in water (Piper, 1944; Watson and Burnett, 1995). Water character is defined by the following equation:

$$WCI = 100 \cdot \left( \left\{ \frac{Ca + Mg}{Na + K} \right\} + \left\{ \frac{CO_3 + HCO_3}{Cl + SO_4} \right\} \right)$$

Where Ca, Mg, *et cetera*, are expressed in terms of milliequivalents per liter (meq/L) rather than milligrams per liter (mg/L). The first term on the right hand side of the equation is the ratio of divalent to monovalent cations and the second term on the right hand side of the equation is a ratio of carbonate character to chloride/sulfate character. The utility of the WCI method, compared with a Stiff or Piper/trilinear diagram, is that many data points can be plotted as time histories for a given well or surface water station. The points can also be plotted to show areal and spatial distributions of water character.

Figure 3-8 is a representation of the distribution of WCI using average data for the period 1997 through 2002. Wells in the Fontana area of Chino Basin typically have a WCI greater than 600, which is representative of native groundwater (calcium-bicarbonate water character). The wells along the Santa Ana River have WCI values less than 400, which reflects the influence of wastewater in the Santa Ana River (more sodium-chloride-sulfate character). In the reach of the Santa Ana River northwest of La Sierra Hills, the river recharges the groundwater basin, with the recharged water flowing westward and along the river. This is shown by the lower WCI values (less than 400) in wells immediately northwest of the river in this reach. Wells with WCI values from 200 to 600 further to the northwest probably reflects mingling of groundwater and water recharged from river.

### 3.4.4 Other Constituents of Concern

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, manganese, and perchlorate. In addition, radon and gross alpha, while naturally-occurring, are found above their MCLs in Chino Basin. Chromium and hexavalent chromium may be problematic, depending on the promulgation of future standards.

#### *3.4.4.1 VOCs*

*Volatile Organic Chemicals*. The following six volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- 1,1-dichloroethene;
- 1,2-dichloroethane;
- 1,2,3-trichloropropane;
- cis-1,2-dichloroethene;

- tetrachloroethene (PCE); and
- trichloroethene (TCE).

TCE and PCE were/are widely used industrial solvents. TCE was commonly used for metal degreasing and as a food extractant. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners use PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). The areal distributions of PCE and TCE are shown in Figures 3-9 and 3-10. 1,1-Dichloroethene (1,1-DCE), 1,2-dichloroethane (1,2-DCA), and *cis*-1,2-dichloroethene (*cis*-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988), and their areal distributions are shown in Figures 3-11 though 3-13. 1,1-DCE and *cis*-1,2-DCE are formed by the reductive dehalogenation of TCE. 1,2-DCA is the by-product of the transformation of the carbon-carbon double bond in a *cis*-1,2-DCE or *trans*-1,2-DCE molecule to a carbon-carbon single bond. The spatial distributions of TCE and PCE and their by-products appear to be associated with identified point sources in the Chino Basin (see Section 3.5).

1,2,3-Trichloropropane (12,3,-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, extractive agent, paint and varnish remover, cleaning and degreasing agent, and as an intermediate in the synthesis of other chemicals (*e.g.*, pesticides).

The current California State Action Level for 1,2,3-TCP is 0.005 µg/L. The adoption of the Unregulated Chemicals Monitoring Requirements (UCMR) regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to the DHS, some utilities moved ahead with monitoring and the samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 µg/L do not provide DHS with adequate information needed for possible standard setting. New methodologies to analyze for 1,2,3-TCP with a DLR of 0.005 µg/L have since been developed and the DHS is requesting that any utility with 1,2,3-TCP findings of nondetect with reporting levels of 0.01 µg/L or higher do follow-up sampling using a DLR of 0.005 ug/L. Private wells in the PWMP in 1999 through 2001 were analyzed for 1,2,3-TCP at a DLR of 50 µg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, all private wells are being re-tested at a lower detection limit – 0.005 µg/L.

Figures 3-14 and 3-15 show the distribution of 1,2,3-trichloropropane in Chino Basin, based on the data limitations discussed previously. Figure 3-14 uses the legend convention typically employed throughout this report. However, all of the previously detected values were using a method with a DLR of 50 µg/L, and, therefore, any detection would be 10,000 times the Action Level. Figure 3-15 uses an expanded legend by defining different class intervals. Figure 3-15 shows that the very high values of 1,2,3-TCP are associated with the Chino Airport VOC plume. In addition, there is a cluster of wells that have 1,2,3-TCP in concentrations greater than the Action Level north of the Chino Airport.

#### *3.4.4.2 Arsenic*

The current arsenic MCL is 50 µg/L. In January 2001, EPA mandated that compliance with the new federal arsenic MCL of 10 µg/L would be required by 2006. After adopting 10 µg/L as the new standard for arsenic in drinking water, the US EPA decided to review the decision to ensure that the final standard was based on sound science and accurate estimates of costs and benefits. In October 2001, the US EPA decided to move forward with implementing the 10 µg/L standard for arsenic in drinking water (US EPA,

2001). Figure 3-16 shows the distribution of arsenic in Chino Basin. Three wells in the PWMP had arsenic concentrations that exceed the 2006 MCL. Five wells in the City of Chino Hills area have concentrations of arsenic that exceed the 2006 MCL, with three wells having exceeded the current MCL of 50 µg/L. Higher concentrations of arsenic in this area are found at depths greater than about 350 feet below ground surface:

| Well | Arsenic Concentrations 1997 – 2002 (mg/L) | | | Perforated Intervals (ft bgs) |
|---|---|---|---|---|
| | Minimum | Maximum | Average | |
| Chino Hills 16A | ND | 67 | 39 | 430 – 940 |
| Chino Hills 19 | 11 | 25 | 19 | 340 – 420<br>460 – 760<br>800 – 1000 |
| Chino Hills 14 | 26 | 37 | 31 | 350 – 860 |
| Chino Hills 15B | 15 | 72 | 56 | 360 – 440<br>480 – 900 |
| Chino Hills 1B | 58 | 80 | 66 | 440 – 470<br>490 – 610<br>720 – 900<br>940 – 1180 |

Chino Hills 1A is a production well that is located about 30 feet from Chino Hills 1B, the well with the highest concentration of arsenic in the period from 1997 to 2002. During this period samples from Chino Hills 1A (perforated interval: 166 – 317 ft bgs) were all non-detect.

#### *3.4.4.4 Manganese*

Manganese is a naturally-occurring element that is a component of over 100 minerals. Because of the natural release of manganese into the environment by the weathering of manganese-rich rocks and sediments, manganese occurs ubiquitously at low levels in soil, water, air, and food. Manganese compounds are used in a variety of products and applications including water and wastewater treatment, matches, dry-cell batteries, fireworks, fertilizer, varnish, livestock supplements, and as precursors for other manganese compounds. Manganese is often found near landfills, especially when oxidation-reduction conditions promote its mobility in groundwater. that Neither manganese nor any manganese compounds are regulated in drinking water. However, manganese has a non-enforceable, secondary MCL 0.05 mg/L. High concentrations of manganese in groundwater have been observed along the Santa Ana River in Reach 3, scattered throughout the southern portion of Chino Basin and near the Milliken Landfill (Figure 3-17).

#### *3.4.4.5 Perchlorate*

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 3-18), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low

enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate ($ClO_4^-$) originates as a contaminant in the environment from the solid salts of ammonium perchlorate ($NH_4ClO_4$), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion ($ClO_4^-$) is exceedingly mobile in soil and groundwater environments. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and possibly in other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel.

Speculation has arisen that perchlorate in groundwater may be the result of using "Chilean fertilizer" for agricultural purposes. The EPA recently completed a comprehensive survey of fertilizers and other raw materials for perchlorate to determine whether these could be significant contributors to environmental perchlorate contamination (Urbansky *et al.*, 2001). Four laboratories analyzed 48 fertilizer products from manufacturers of major commodity chemicals. Samples were collected from representative sites in the United States during the spring of 2000.

> Except for those products derived from Chilean caliche (a natural perchlorate source), the specific natures of the manufacturing processes suggest that perchlorate should not be present in most fertilizers. Chilean nitrate salts constitute about 0.14% of U.S. fertilizer application. Perchlorate was positively detected only in those materials known to be derived from Chilean caliche. The data obtained here fail to suggest that fertilizers contribute to environmental perchlorate contamination other than in the case of natural saltpeters or their derivatives. (Urbansky *et al.*, 2001)

In addition, fertilizers derived from Chilean caliche are used in small quantities, on specialized crops, including tobacco, cotton, fruits, and vegetables (Renner, 1999).

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The US Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 (µg/L). In 1997, the DHS and the California EPA's Office of Environmental Health Hazard Assessment reviewed the EPA's risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for

perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced, but has not been brought to a vote (CA Senate Bill 1033).

The California DHS (2002a) has stated that perchlorate in groundwater in California likely reflects its use in the aerospace industry as a solid rocket propellant (in the form of ammonium perchlorate). To protect the public from perchlorate's adverse health effects – and in the absence of a drinking water standard for the contaminant – DHS established an action level of 18 µg/L, which was derived from available risk assessments. "Following the release of US EPA's 2002 draft risk evaluation, DHS concluded that its AL needed to be revised downward. Accordingly, on January 18, 2002, DHS reduced the perchlorate AL to 4 µg/L, the lower of the 4- to 18-µg/L range. The 4-µg/L AL also corresponds to the current detection limit for purposes of reporting (DLR)" (DHS, 2002c).

Historical values of perchlorate exceeding the State Action Level have occurred in the following areas of Chino Basin (Figure 3-18):

- There is a significant perchlorate plume in the Rialto-Colton and Chino Basins. The source of the plume is being investigated by the RWQCB and it appears to be located near the Mid-Valley Sanitary Landfill. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29).
- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.
- City of Pomona well field (source unknown).
- Wells in the City of Ontario Water Service Area, south of the Ontario Airport (source(s) unknown).
- Scattered wells in the Monte Vista Water Service Area (source(s) unknown).
- Scattered wells in the City of Chino Water Service Area (source(s) unknown).

#### *3.4.4.6 Radon and Gross Alpha*

Radon is a radioactive gas found in nature. It has no color, odor, or taste and is chemically inert. It's source is uranium – as the uranium molecule decays to form stable lead, a process taking many, many years, it changes from one radioactive element to another in a sequence known as the Uranium Decay Cycle. Partway through this cycle, the element radium becomes radon, which, as a gas moves up through the soil to atmosphere. Uranium is found in most soils and in granite. Radon may be found in drinking water and indoor air. Some people who are exposed to radon in drinking water may have an increased risk of getting cancer over the course of their lifetime, especially lung cancer. The US EPA has established a proposed MCL of 300 pCi/L (Macler, 2000).

Similarly, alpha radiation is a type of energy released when certain radioactive elements decay or break down. For example, uranium and thorium are two radioactive elements found naturally in the earth's crust. Over billions of years, these two elements slowly change form and produce "decay products" such as radium and radon. During this change process, energy is released. One form of this energy is alpha radiation.

Higher concentrations of radon and gross alpha in groundwater typically occur near granitic bedrock outcrops; one might expect to see higher occurrences of these constituents near the San Gabriel Mountains, Jurupa Hills, Puente Hills, and Chino Hills and along fault zones – Rialto-Colton Fault, San Jose Fault, and the Red Hill Fault. While the areal distributions of radon and gross alpha do not show the expected pattern, there are no spatial patterns or outside evidence to suggest a source other than naturally-occurring (Figures 3-19 and 3-20).

## 3.5 Point Sources of Concern

The previous water quality discussion broadly described water quality conditions across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 3-21 shows the location of various point sources and areas of water quality degradation associated with these sources.

### 3.5.1 Chino Airport

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL was TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 μg/L.

Figure 3-21 shows the approximate areal extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 2002. The plume is elongate in shape, up to 3,600 feet wide and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction. During the period from 1997 to 2002, the maximum TCE concentration in groundwater detected at an individual well within the Chino Airport plume was 570 μg/L.

The County of San Bernardino has recently submitted a work plan to the Regional Board for installing up to five monitoring wells at and around Chino Airport in Summer 2003.

### 3.5.2 California Institute for Men

The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue, and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 μg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicated that the most common VOCs detected in

groundwater underlying CIM were PCE and TCE. Other VOCs detected included carbon tetrachloride, chloroform, 1,2-DCE, bromodichloromethane, 1,1,1-trichloroethane (1,1,1-TCA), and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geomatrix Consultants, 1996).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 2,900 feet wide and extends about 5,800 feet from north to south. During the period from 1997 to 2002, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 1,990 µg/L and 141 µg/L, respectively.

### 3.5.3 General Electric Flatiron Facility

The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations primarily consisted of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The RWQCB issued an investigative order to General Electric (GE) in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 µg/L. Other VOCs periodically detected, but commonly below MCLs, included PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997).

Figure 3-21 shows the approximate areal extent of TCE in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 3,400 feet wide and extends about 9,000 feet south-southwest (hydraulically downgradient) from the southern border of the site. During the period from 1997 to 2002, the maximum TCE and total dissolved chromium concentrations in groundwater detected at an individual well within the Flatiron Facility plume were 7,990 µg/L and 1,700 µg/L, respectively.

### 3.5.4 General Electric Test Cell Facility

The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avon, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicated that the most common and abundant VOC detected in groundwater beneath the Test Cell Facility was TCE. Other VOCs detected included PCE, *cis*-1,2-DCE, 1,2-dicholoropropane, 1,1-DCE, 1,1-DCA, benzene, toluene, and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) was 1,240 µg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) was 190 µg/L (BDM International, 1997).

Figure 3-21 shows the areal extent of VOC contamination exceeding federal MCLs as of 2002. The plume is elongate in shape, up to 2,400 feet wide and extends approximately 10,300 feet from the Test Cell Facility in a southwesterly direction. During the period from 1997 to 2002, the maximum TCE and

PCE concentrations in groundwater detected at an individual well within the Test Cell Facility plume were 1,100 µg/L and 29 µg/L, respectively.

### 3.5.5 Kaiser Steel Fontana Steel Site

Between 1943 and 1983, the Kaiser Steel Corporation (Kaiser) operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the RWQCB issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigations and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

Figure 3-21 shows the approximate areal extent of the TDS/TOC groundwater plume as of 2002. Based on a limited number of wells, including City of Ontario Well No. 30, the plume is up to 3,400 feet wide and extends about 17,500 feet from northeast to southwest.

### 3.5.6 Mid-Valley Sanitary Landfill

The Mid-Valley Sanitary Landfill (MVSL) is a Class III Municipal Solid Waste Management Unit located at 2390 North Adler Avenue in the City of Rialto. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. VOCs and perchlorate have been detected in groundwater beneath and downgradient from the MVSL. The most common and abundant VOCs in groundwater are PCE, 1,1-DCA, and 1,1-DCE. TCE, cis-1,2-DCE, 1,2-DCA, vinyl chloride, and benzene also have been detected. The VOC plume from the MVSL does not appear to extend into the Chino Basin as of 2002 (Figure 3-21).

Perchlorate has been detected in the Rialto-Colton and Chino Basins (Figure 3-18). The sources of the perchlorate plume are being investigated by the RWQCB and it appears that one set of sources is located near the MVSL. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29). The perchlorate plume appears to migrate initially to the southeast prior to moving to the southwest in the direction of regional groundwater flow. The local groundwater flow direction at the landfill is to the southeast, potentially influenced by the Alder Avenue Barrier (GeoLogic, 2002). The perchlorate plume in the Rialto Basin appears to extend well into the Chino Basin, crossing the Rialto-Colton Fault. The plume is about seven miles long from the middle of the Mid-Valley Sanitary Landfill.

### 3.5.7 Milliken Sanitary Landfill

The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is

owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicated that VOCs are the major constituents of the release. The most common VOCs detected were TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs included vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well was 159.6 µg/L (GeoLogic Associates, 1998).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 1,800 feet wide and extends about 2,100 feet south of the MSL's southern border. During the period from 1997 to 2002, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the MSL plume were 64 µg/L and 81 µg/L, respectively.

### 3.5.8 Municipal Wastewater Disposal Ponds

Treated municipal wastewater has been disposed into ponds located near the current IEUA Regional Plant 1 (RP1), located in south Ontario, and the former Regional Plant 3 (RP3), located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and the IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. Contaminant plumes emanating from these ponds have never been fully characterized.

### 3.5.9 Upland Sanitary Landfill

The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15$^{th}$ Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells, an upgradient well, a cross-gradient well, and a downgradient well (City of Upland, 1998). The results of historic groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from historic groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, *cis*-1,2-DCE, 1,1-DCA, and benzene.

The 1990 to 1995 average total VOC concentration in the downgradient monitoring well is 125 µg/L (GeoLogic Associates, 1997).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. However, the plume is defined only by the three on-site monitoring wells. The extent of the plume may be greater than currently depicted in Figure 3-21. During the period from 1997 to 2002, the maximum TCE and PCE concentrations detected in the downgradient monitoring well within the USL plume were 4.2 µg/L and 16 µg/L, respectively.

### 3.5.10 Un-named VOC Plume – South of the Ontario Airport

A VOC plume containing primarily TCE exists south of the Ontario Airport. The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. Figure 3-21 shows the approximate areal extent of the plume as of 2002. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1997 to 2002, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 µg/L.

### 3.5.11 Stringfellow NPL Site

One facility in the Chino Basin is on the current National Priorities List (NPL) of Superfund sites. The Stringfellow site is located in Pyrite Canyon, north of Highway 60, near the community of Glen Avon, in Riverside County (Figure 3-21). From 1956 until 1972, the 17-acre Stringfellow site was operated as a hazardous waste disposal facility. More than 34 million gallons of industrial waste, primarily from metal finishing, electroplating, and pesticide production were deposited at the site (USEPA, 2001). A groundwater plume of site-related contaminants exists underneath portions of the Glen Avon area. Groundwater at the site contains various VOCs, perchlorate, N-nitrosodimethylamine (NDMA), and heavy metals such as cadmium, nickel, chromium, and manganese. Soil in the original disposal area is contaminated with pesticides, PCBs, sulfates, and heavy metals. The original disposal area is now covered with a barrier and fenced. Contamination at the Stringfellow site has been addressed by cleanup remedies described in four US Environmental Protection Agency (USEPA) Records of Decision. These cleanup actions have focused on control of the source of contamination, installation of an onsite pretreatment plant, cleanup of the lower part of Pyrite Canyon, and cleanup of the community groundwater area.

Figure 3-21 shows the approximate areal extent of the Stringfellow plume as of 2002. The plume is elongate in shape, up to 6,000 feet wide and extends approximately 22,500 feet from the original disposal area in a southwesterly direction. During the period from 1997 to 2002, the maximum total VOC concentration detected in the Stringfellow plume was 1,241 µg/L.

## 3.6 Current State of Groundwater Quality in Chino Basin

As discussed in Section 1, the baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of OBMP implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP. In terms of TDS and nitrate, the initial state of groundwater quality in Chino Basin is illustrated by Figures 3-4 and 3-7. These figures were developed from data derived from Watermaster's water quality database. This database can be queried in future studies to determine the state of the basin's groundwater quality for any constituent.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Twenty-eight percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations below the secondary MCL. In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting that there is a vertical stratification of water quality. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL.

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. As discussed in Sections 3.4.4.1 and Section 3.5, there are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate (MVSL area, Stringfellow, *et cetera*) as well as what appears to be non-point source related perchlorate contamination from currently undetermined sources. Arsenic at levels above WQS appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.

# 4. CONCEPTUAL MODEL

The purpose of building a conceptual model is to simplify the modeling problem and organize the associated field data so that the system can be analyzed (Anderson and Woessner, 1992). The groundwater system is too complicated to simulate directly; therefore, it must be simplified as much as possible and yet retain enough complexity for the model to adequately reproduce the real system's behavior. Long-term regional groundwater flow and quality projections require the determination of hydrologic components and definition of the horizontal and vertical flow regimes within the system.

There are four elements in the building of the conceptual model:

- definition of the model domain and hydrostratigraphic units;
- specification of the boundary conditions;
- preparation of a hydrologic budget; and
- definition of flow systems.

## 4.1 Model Domain and Hydrostratigraphic Units

The model domain consists of the Chino and Temescal groundwater basins. The adjacent groundwater basins contribute some groundwater inflow to the Chino and Temescal basins. Figure 2-1 shows the location of the Chino Basin and adjacent groundwater basins.

A hydrostratigraphic unit is part of formation or group of formations that can be grouped into aquifers and associated confining layers. The hydrostratigraphic units described in Section 2, and shown in Figures 2-7 through 2-14, were used to define the three major water bearing units in the conceptual model, and are referred to herein as Layers 1, 2, and 3. The spatial extent of each layer is shown in Figures 2-15 to 2-17 for layers 1 to 3, respectively.

## 4.2 Specification of Boundary Conditions

Numerical models require the specification of boundary conditions for each time step of the simulation; for example, groundwater elevation and/or flux along the boundary of the model. In addition, there are internal boundaries such as groundwater barriers and streams that groundwater can either discharge to or be recharged from.

### 4.2.1 External Boundaries

The external boundaries of the model are all defined as constant flux boundaries and are either set to zero or to positive values. Figure 4-1 shows the boundary of the model area and identifies the various boundary flow areas that were assumed in the model.

### 4.2.2 Internal Boundaries

There are two faults within the model domain that have been considered potential barriers to groundwater flow – the Central Avenue Fault and Barrier J. These faults are not included as barriers in the current implementation of the model; however, they may be included in subsequent refinements to the model.

The Santa Ana River and some of its tributaries in the southern part of Chino Basin form an internal boundary where groundwater can either discharge to surface water or surface water can recharge groundwater. The Santa Ana River and its tributaries that need to be simulated dynamically with the

groundwater flow system are shown in Figure 4-1. The tributaries include Chino, Mill, Day, San Sevaine, and Temescal Creeks, as well as a few smaller drainages. The streambed or stream flow elevation in the stream system acts as a fixed or nearly-fixed boundary elevation and can have a strong influence on groundwater elevations in the area of the stream system.

## 4.3 Preparation of Hydrologic Budget

Preparing the hydrologic budget consists of estimating the magnitude and location of the major recharges to and discharges from (collectively referred to herein as hydrologic components) the model domain. The hydrologic components are the forcing functions in the model; that is, they are the major cause of change in groundwater elevation, contaminant occurrence and movement, and groundwater discharge to surface water. WEI used specialized modeling tools and other means to develop the hydrologic components. Some of these components were refined during calibration – the final calibration values are included in this discussion. The hydrologic budget terms are geographically characterized by the management zones that have been defined in the proposed 2003 Water Quality Control Plan for the Santa Ana Watershed (hereafter the 2003 Basin Plan). The proposed 2003 Basin Plan will likely be approved in October 2003 about the time this report is finalized. This convention was adopted to facilitate review of this document consistent with management activities that are contained in the 2003 Basin Plan and specifically to the concept of *hydraulic control* that is discussed later in *Section 7 Dry-Year Yield Program Impacts*. Figure 4-2 shows the management zones delineated in the 2003 Basin Plan. These management zones are:

- Chino North MZ
- Chino East MZ
- Chino South MZ
- Prado Basin (PBMZ)
- Temescal MZ

The Chino North MZ includes most of Watermaster's Management Zones 1, 2, and 3. The Chino East MZ is identical to Watermaster's Management Zone 4. Chino South MZ consists of the eastern majority of Watermaster's Management Zone 5. The PBMZ consists of the southern ends of Watermaster's Management Zones 1, 2, and 3, the western end of Watermaster's Management Zone 5 and a portion of the Temescal Basin. The PBMZ generally consists of the area below elevation 566 mean sea level (MSL) and corresponds to the maximum pool level of Prado reservoir.

### 4.3.1 Recharge Components

#### *4.3.1.1 Subsurface Inflow*

Figure 4-1 shows the locations of defined boundary segments that are assumed to have subsurface inflow. The assumed boundary inflow areas, their initial values, the source of the initial values, and the values derived in calibration are listed in Table 4-1. Initial estimates of boundary flow were developed from previous modeling investigations (CDM, 1984; Montgomery Watson, 1993). Subsurface inflow is assumed constant over time for each segment and with about 18,600 acre feet per year (acre-ft/yr) in the Chino management zones and about 2,500 acre-ft/yr in the Temescal MZ for a total of about 21,100 acre-ft/yr for the model area. Subsurface inflow was assumed constant over the calibration period because groundwater levels across the boundaries do not change rapidly and these inflows are not great in magnitude compared with the groundwater flow systems to which they contribute.

Subsurface inflow from one management zone to an adjacent management zone does occur and is computed by the 2003 Watermaster Model.

#### *4.3.1.2 Streambed Recharge*

Streambed recharge occurs in unlined stream channels and in flood control and water recharge basins. Most of the major stream channels in the Chino Basin are concrete-lined as of March 2003. In the case of future projections, all of the stream channels will be concrete-lined. Figure 4-2 shows the location of flood control and recharge basins, and major stream channels.

WEI used the Wasteload Allocation Model (WLAM) developed by WEI (2002) to estimate the storm water recharge in stream channels and in flood control and recharge basins. The WLAM was developed from the Chino Basin Watermaster Recharge Model, which was also developed by WEI (Wildermuth, 1998; WEI, 2001). The WLAM contains two modules – RUNOFF and ROUTER. RUNOFF estimates daily runoff from discrete drainage areas. ROUTER routes runoff from each drainage area through the drainage system and calculates, among many things, discharge and recharge in channels and in flood control and recharge basins. The drainage areas within the Chino Basin are shown in Figure 4-3. Other important data used in the WLAM include precipitation data, Soil Conservation Service (SCS) hydrologic soil types, land use, and physical properties of the drainage system (channel geometry, slope, lining, *etc.*). Figures 4-3 through 4-5 show the location of precipitation stations used herein, the spatial distribution of hydrologic soil types, and the 1993 land uses that were used in this analysis. The reader is referred to *TIN/TDS Study – Phase 2B of the Santa Ana Watershed, Wasteload Allocation Investigation, Final Technical Memorandum* (WEI, 2002) for a discussion of the capabilities, conceptual design, data, and an example application of the WLAM. Table 4-2 lists the time history of storm water recharge in stream channels and in flood control and recharge basins. Over the period 1988/1989 through 2000/2001, about 5,600 acre-ft of storm water recharged the Chino Basin through recharge basins and about 2,800 acre-ft of storm water recharged the unlined channels in Etiwanda and San Sevaine Creeks upstream of channel improvements.

#### *4.3.1.3 Deep Percolation of Precipitation and Applied Water*

WEI estimated the deep percolation of precipitation and applied water together. Deep percolation of precipitation and applied water was assumed to occur when soil moisture exceeded field capacity for the soil. Field capacity is the maximum volume of water that can be stored in the soil zone against the force of gravity. Soil moisture volume in excess of field capacity is assumed to percolate beyond the root zone and migrate through the vadose zone to the saturated zone. A soil moisture accounting module (SOILH2O) was developed and incorporated into the WLAM model structure. The WLAM Runoff module computes the volume of precipitation that infiltrates the soil. The SOILH2O module combines the volume of precipitation that infiltrates the soil with the volume of applied (irrigation) water. Soil moisture is modeled as follows:

$$SM_{t+1} = SM_t + I_{t \text{ to } t+1} - E_{t \text{ to } t+1}$$

If $SM_{t+1} < FC$ $\quad DP_{t \text{ to } t+1} = 0$

If $SM_{t+1} > FC$ $\quad DP_{t \text{ to } t+1} = SM_{t+1} - FC$ and

$\quad SM_{t+1} = FC$

where:

$SM_t$ is the soil moisture at the time t
$I_{t \text{ to } t+1}$ is the infiltration from precipitation and applied water that occurs between time t to t+1
$E_{t \text{ to } t+1}$ is the evapotranspiration that occurs between
$DP_{t \text{ to } t+1}$ is the deep percolation of precipitation and applied water
FC is field capacity

Applied water for urban areas was estimated from reports, prepared by IEUA, that show the volume of water produced by each water purveyor in their service area and the volume of sewage produced by each purveyor. The difference was assumed to be equal to applied water. This information was estimated for the Three Valleys Municipal Water District (TVMWD) and the Western Municipal Water District (WMWD) service areas. Evapotranspiration was estimated for various vegetation types based on unit water use rates and California Irrigation Management Information System (CIMIS) data. Table 4-3 lists the time history of deep percolation of precipitation and applied water by 2003 Basin Plan management zone that were used in the 2003 Watermaster Model.

#### *4.3.1.4 Supplemental Water Recharge*

Supplemental water is recharged in the Chino Basin by the Chino Basin Watermaster pursuant to the 1978 Chino Basin Judgment and the 2000 Peace Agreement. Table 4-4 lists the annual time history of supplemental water recharge by the Chino Basin Watermaster. All supplemental water recharge done by Watermaster occurs in the Chino North MZ in the Montclair, San Sevaine and Etiwanda recharge basins. IEUA has recharged about 500 acre-ft/yr of recycled water in the Ely Basin since 1999/2000.

The City of Corona discharged almost all of its recycled water to ponds located in the Temescal MZ and the PBMZ. Half of the water was assumed to be recharged in the Temescal MZ and half of the water assumed to be recharged in the PBMZ. Table 4-4 lists the annual time history of recycled water recharge by the City of Corona.

### 4.3.2 Discharge

#### *4.3.2.1 Subsurface Outflow*

The only places where subsurface outflow could occur in the Chino Basin are to the Temescal Basin and underflow at Prado dam. Historical groundwater levels in Temescal Basin have caused groundwater outflow into the Chino Basin. However, it is theoretically possible for groundwater levels in the Temescal Basin to drop to levels where small amounts of groundwater outflow from Chino to Temescal Basin could occur. The Army Corps of Engineers constructed a grout curtain under Prado dam. As such, the subsurface outflow from Chino Basin at Prado dam is assumed negligible. Subsurface outflow out of the model domain area was assumed to be zero. Subsurface outflow from one management zone to an adjacent management zone does occur and is computed by the 2003 Watermaster Model.

#### *4.3.2.2 Rising Groundwater*

Rising groundwater can occur in the Santa Ana River and its tributaries in the Southern Chino Basin when the piezometric level of groundwater under the river exceeds the elevation of the streambed. Rising groundwater varies seasonally being greater in the winter and less in the summer. Rising groundwater cannot be directly measured from existing monitoring programs. The available data consist of surface

water discharge monitoring stations at the MWD Crossing, just below Prado Dam, and the following tributaries: Chino Creek, Cucamonga Creek, and Temescal Creek. Other measured non-tributary discharges include recycled water discharges from the Cities of Corona and Riverside, the IEUA, and Western Riverside Regional, and occasionally Arlington Desalter discharge and State Project water discharges to San Antonio Creek in Upland. Between the MWD Crossing and Prado Dam, there are no measurements of surface water discharge that can be used to define reaches of rising groundwater or streambed recharge. The great stands of riparian vegetation in along the Santa Ana River and the Prado Reservoir area are likely to contribute to the seasonal variation of base flow in the Santa Ana River and may impact rising groundwater in the Prado Reservoir area. Rising groundwater estimates were made during model calibration.

#### *4.3.2.3 Evapotranspiration by Riparian Vegetation*

WEI performed a literature review of a select group of studies, conducted elsewhere in the southwestern United States, to develop annual water use rates for riparian vegetation. These studies were identified and reviewed by the USGS in *Riparian Vegetation and its Water Use During 1995 along the Mojave River, Southern California* (Lines and Bilhorn, 1996). The USGS developed estimates of riparian water use in the Mojave area by transferring estimates of riparian water use from other areas in the southwestern United States based on climatic factors. In a similar way, the Mojave estimates were transferred to the Chino Basin area. WEI collected reference evapotranspiration data from CIMIS for the Mojave area (Barstow and Victorville) and for the upper Santa Ana watershed (UC Riverside, Claremont, and Pomona). The reference evapotranspiration at the UC Riverside station was compared to the reference evapotranspiration at the Barstow and Victorville CIMIS stations and found to be about 83 percent of, or about 17 percent less than, the Mojave area reference evapotranspiration. Table 4-5a contains estimates of annual unit riparian water use for the Santa Ana River and tributaries in the Chino Basin area. A value of 41 inches per year of consumptive use (corresponding to cottonwoods, willows, and baccharis at 71 to 100 percent areal density) was assumed to apply to all riparian vegetation in the model area.

There is great variation in riparian water demand throughout the year, with demands being the greatest in July and August and the least in January and February. The monthly distribution of riparian water demand was estimated from *Bulletin 50, Use of Water by Native Vegetation* (Department of Public Works, Division of Water Resources, State of California 1942). Table 4-5b shows the monthly distribution for tules and willows from *Bulletin 50*, their combined average monthly evapotranspiration, and monthly distribution as a percentage of annual water use. The annual values listed in Table 4-5a were distributed monthly based on the monthly distribution shown in Table 4-5b. Figure 4-7 shows the areal extent of riparian vegetation in the Chino Basin based on digital air-photos taken in February 2002. Riparian vegetation covers approximately 6467 acres in the Chino South, Prado Basin, and Temescal MZs. The water demand by riparian vegetation in this area was initially estimated to be about 22,000 acre-ft/yr and was assumed constant over the period 1989/1990 through 2000/2001.

#### *4.3.2.4 Pumping*

Estimates of groundwater pumping were developed from the records of the Chino Basin Watermaster for the Chino Basin and from the non-verified pumping records compiled by WMWD for the Temescal Basin. Watermaster determined the physical location of wells in the Chino Basin using Global Positioning System (GPS) technology. The locations of wells in the Temescal Basin were digitized from well location maps prepared by WMWD and the City of Corona. Figure 4-8 shows the location of wells that have been active during the period of 1989/1990 to the present. The assignment of pumping to the various model

layers is primarily based on well construction data. If well construction data were not available, pumping was assigned to model layers based on groundwater level and water quality data. Table 4-6 lists the annual groundwater pumping from the Chino and Temescal Basins for the period 1989/1990 through 2000/2001.

#### *4.3.3 Balance of Recharge and Discharge*

Tables 6-2a through 6-2e contain the recharge and discharge components and the balance for the period 1989/1990 through 2000/2001, which is the calibration period of the model. These tables are based on estimates of recharge and discharge that are the result of data collection and modeling and include the final calibration results. These tables will be discussed in Section 6.

## 4.4 Definition of Flow Systems

There are two flow system types that are interest in the evaluation of dry-year yield programs – the vadose zone and the saturated zone. Their importance is described below.

### 4.4.1 Vadose Zone

The vadose zone is the part of the aquifer that extends from the water table surface to the soil zone near the ground surface. In this zone, the void space contains water and gases; the movement of water is primarily vertical. In areas where the vadose zone is recharged by deep percolation of precipitation and applied water, the seepage rate through the vadose zone is very slow. In areas that receive large recharge volumes from recharge basins or streambed recharge, the seepage rate can be quite rapid as the vadose zone becomes locally saturated. Montgomery Watson estimated that the seepage rate was less than 10 ft/yr in areas where citrus was cultivated and recharge consisted of deep percolation of precipitation and applied water (JMM, 1989). By contrast the Montclair and San Sevaine recharge basins have recharged thousands of acre-ft per year of imported water over small areas where the underlying volume in the vadose zone is a fraction of the annual recharge – the implication being that the seepage rates are hundreds of feet per year when the rate of recharge is large.

In Section 2.5, it is reported that there is only a slight seasonal variation in groundwater levels in the Chino Basin and that there is a delayed response to a significant wet year or cumulative wet years. This occurs, in part, because the vadose zone is thick and acts like a regulating reservoir. The vadose zone smoothes out the variability of deep percolation of precipitation and applied water from extreme wet and dry periods. The hydraulic implications of the vadose zone for the dry-year yield program are that:

- increased recharge from the deep percolation of precipitation and applied water during wet years will not greatly increase groundwater levels when groundwater is *put* into the dry-year yield program account; and
- decreased recharge from the deep percolation of precipitation and applied water during dry years will not exacerbate groundwater levels when groundwater is produced from the dry-year yield program account.

In Section 3.3.5, the water quality implication of the vadose zone was discussed and it is stated that Watermaster considers that the proposed program to use 100,000 acre-ft of storage will not cause a significant release of contaminants to the saturated zone. Consequently, modeling of the vadose zone was not included in this investigation.

### 4.4.2 Saturated Zone

The saturated zone consists of the saturated part of the aquifer ranging from the water table to the effective base of the aquifer. In Section 2, there is considerable discussion on the occurrence and flow of groundwater in the saturated zone. Watermaster had divided the basin into five management zones that are based on the hydrology of the basin. These management zones are shown in Figure 2-3. For the remainder of this report we will use the management zone delineations in the 2003 Basin Plan. Most of the storage used in the dry-year yield program will occur in the Chino North MZ. The aquifer system in this management zone consists of three layers. In the northern parts of the Chino North MZ, the top layer (layer 1) is dry, and in some areas the top layer and middle layer (layer 2) are dry. Groundwater can flow vertically between layers in response to pressure gradients, which are caused mostly by pumping.

In the western part of the Chino Basin underlying the City of Chino and extending slightly north, east, and south of the city, there are several fine-grained layers that act as confining units. Layers 2 and 3 in this area have limited recharge and the area has been subject to subsidence and fissuring. East of this area, the aquifer materials become coarser, aquifers are readily recharged, and there has been little or no observed subsidence. Groundwater levels need to be managed very carefully in the City of Chino area to prevent additional subsidence and ground fissuring. There is greater flexibility in groundwater level management in the other areas of the basin.

There could be some outflow from Chino North and Chino South MZs to the PBMZ, and subsequently to the Santa Ana River or its tributaries. The Temescal MZ can also contribute outflow to the PBMZ, and subsequently to the Santa Ana River or its tributaries.

Given the above, the saturated zone must be represented in the model as a three-dimensional flow system to show the impacts of OBMP and related activities in the western Chino Basin. The groundwater system must be dynamically coupled to the overlying stream system in the southern part of Chino Basin to estimate the impacts of OBMP and related activities on groundwater discharge to the Santa Ana River and subsequent impacts on safe yield and downstream water quality.

# 5. MODEL DESCRIPTION

Several models were used in combination to estimate the impacts of the proposed 100,000 acre-ft dry-year yield program. MODFLOW and MODPATH were used to estimate the groundwater and surface water response to the dry-year yield program. Other models and codes were used to support MODFLOW and MODPATH. Groundwater Vistas (Version 3) was the modeling software environment, and was used as a graphical design and analysis system for MODFLOW and MODPATH. ArcMAP 8.2 was used as a pre- and post-processing tool to manipulate input data and output results. The WLAM was used to estimate some of the hydrologic components and is discussed in Section 4.

## 5.1 MODFLOW

MODFLOW is a MODular three-dimensional finite-difference groundwater FLOW model. Several versions of MODFLOW have been developed by the USGS and released to the public domain. The most recent version is MODFLOW-2000, which is a major update that fully integrates parameter estimation. Comprehensive documentation of MODFLOW-2000 can be found on the World Wide Web at:

http://water.usgs.gov/software/modflow-2000.html

MODPATH, also developed by the USGS, is a three-dimensional, particle-tracking, post-processing code that works with output files from steady-state or transient ground-water flow simulations by MODFLOW. Comprehensive documentation of MODPATH can be found on the World Wide Web at:

http://water.usgs.gov/software/modpath.html

## 5.2 Groundwater Vistas

Groundwater Vistas (GV) is a groundwater modeling environment created for the Microsoft Windows platform by Environmental Simulations, Inc. In this investigation, it served as modeling design system and a graphical analysis tool for MODFLOW and MODPATH. GV can read and export Environmental Systems Research Institute (ESRI) shapefiles, which allowed for the creation of input data and the display of output results in ArcMAP 8.2. Comprehensive documentation of GV can be found on the World Wide Web at:

http://www.groundwatermodels.com/software/SoftwareDesc.asp?software_desc_id=19&software_id=6

## 5.3 Relationships between MODFLOW, other Models and Data

The complete modeling environment developed and used herein is referred hereafter as the 2003 Watermaster Model. Figure 5-1 shows the relationship between all the models and computer codes that were used in the 2003 Watermaster Model of the Chino Basin. The 2003Watermaster Model is a modeling system that incorporates complex hydrological processes, vast amounts of data, and sophisticated computer simulation programs.

A series of surface water hydrology models were used to estimate recharge through the land surface in areas where there is no dynamic interaction between surface water and groundwater. These surface water hydrology models are incorporated in the WLAM and include RUNOFF, ROUTER, and SOILH2O. These models estimate the surface water discharge, surface water recharge, and the deep percolation of precipitation and applied water. These models feed data into another program called RECHARGE INTEGRATOR that creates recharge files compatible with MODFLOW. Other data used by

RECHARGE INTEGRATOR include subsurface boundary flows from adjacent basins and the artificial recharge of imported and recycled water.

ArcMAP 8.2, FORTRAN, and SQL programs were created to manipulate Watermaster's database and files and convert them to files compatible with GV, MODFLOW, and MODPATH. The resulting data were combined with the data from RECHARGE INTEGRATOR and were assembled to create the input files for MODFLOW.

MODFLOW was then run and it produced output files that contain groundwater elevations and velocities for each cell, surface water discharge estimates, and water budget terms. The groundwater level, surface water discharge, and water budget terms were processed in ArcMAP 8.2 and Microsoft Excel. The groundwater velocity estimates were used in MODPATH.

MODPATH is a companion program to MODFLOW that uses a particle-tracking technique to predict the movement of water quality anomalies. The coordinates of water quality anomalies at the start of the simulation and the groundwater velocity estimates from MODFLOW were input to MODPATH. MODPATH subsequently estimates the movement of the water quality anomalies. The results of the MODPATH simulation were processed in ArcMAP 8.2.

## 5.4 Implementation of Conceptual Model

### 5.4.1 Calibration Period and Time Step

The calibration period was October 1989 through September 2001 a period of twelve years. This period was chosen for two reasons that include:

- Pumping data – the pumping data recorded by Watermaster during this period is more accurate than in past years due to more complete reporting by the agricultural producers.
- Recharge conditions – the availability and quality of data to estimate recharge from precipitation and applied water and storm water is greater than prior to this period.

As noted in Section 2, groundwater levels have been generally stable since the Judgment was implemented in 1978. Extending the calibration backward in time using data of lesser quality will not improve the calibration. Figure 5-2 shows cumulative departure from the mean precipitation for a long-term precipitation stations in Ontario and Fontana. Figure 5-2 also illustrates the period since the judgment and the calibration period. Statistics, relating the period of record to the calibration period, are summarized below.

| Station ID<br>Location | SBC 1026<br>Ontario | | SBC 2194<br>Fontana | |
|---|---|---|---|---|
| Period of Record | 1934 to 2001 | 1990 to 2001 | 1926 to 2001 | 1990 to 2001 |
| Average (inches) | 16.62 | 15.42 | 16.71 | 16.55 |
| Maximum (inches) | 37.22 | 32.38 | 37.84 | 32.28 |
| Minimum (inches) | 6.10 | 6.36 | 3.98 | 7.64 |
| Standard Deviation (inches) | 8.14 | 7.68 | 7.59 | 8.35 |
| Coefficient of Variation | 49.01% | 49.82% | 45.45% | 50.45% |

The statistics for the period of record and the calibration period are reasonably close; however, it is apparent from Figure 5-2 that the historical record contains periods that are substantially wetter and drier than in the calibration period. Section 7 will present a technique to develop an expected value recharge hydrology that incorporates the range of historical precipitation over the Chino Basin area and future land use and drainage conditions.

The time step used in MODFLOW was 91.3 days or one-quarter of a year. This time step corresponds to the production reporting time period used by Watermaster.

### 5.4.2 Geometry

#### *5.4.2.1 Grid Size and Layout*

Figure 5-3 shows the 2003 Watermaster grid orientation relative the Chino Basin. The model grid consists of cells arranged in rows and columns as required by MODFLOW. Each cell is square and 200 feet on edge.

#### *5.4.2.2 Effective and Ineffective Cells*

Not all the cells are used in the model. Cells located outside of the modeled area of the Chino and Temescal Basins are "turned off" and are called inactive or ineffective – the model does not compute heads or groundwater flux at these cells. The cells located in the Chino and Temescal Basins are "turned on" and are called active or effective cells. Figures 5-4, 5-5 and 5-6 show the locations of effective cells for Model Layers 1, 2 and 3, respectively. Recall from Section 2, that Layer 1 is the top layer and that Layer 3 is the bottom layer.

#### *5.4.2.3 Stream Representation*

The sources of surface water in Chino Basin include storm water runoff, urban dry-weather runoff, and non-tributary discharges that include: publicly-owned treatment works (POTW) discharges, Lake Elsinore overflows through Temescal Creek, Arlington desalter discharges through Temescal Creek, and State Water Project (SWP) water through San Antonio Creek. With the exception of the Santa Ana River inflow to the Chino Basin at Riverside Narrows, all storm water estimates were made with the WLAM. The non-tributary inflows were estimated from discharge data provided by the dischargers and the USGS. The Santa Ana River inflow to the Chino Basin at Riverside Narrows was estimated from USGS data. The locations of these discharge points are shown in Figure 5-7.

The streams represented in the 2003 Watermaster Model include San Antonio, Chino, West Cucamonga, Cucamonga, Mill, Deer, Day, Etiwanda, San Sevaine and Temescal Creeks and their tributaries, and the Santa Ana River. Regulating structures including dams, debris basins, detention basins, recharge basins, and diversion works have been incorporated into the simulation.

Stream reaches where dynamic stream and groundwater interaction could occur are delineated in Figure 5-7. These reaches are located in the southern part of the Chino Basin and Temescal Basin where the groundwater levels are near the streambed. In these reaches, recharge and rising water are a function of stream discharge, water level in streams, and underlying groundwater levels. Recharge and rising water discharges are estimated by MODFLOW in these stream reaches.

The remaining stream segments and associated recharge facilities are also shown in Figure 5-7. These reaches are located north of the Santa Ana River and where groundwater levels are sufficiently below the land surface so that groundwater levels have no effect on recharge. In these reaches, recharge estimates were developed from the WLAM and USGS stream gage data on a daily time step and were aggregated to the 91.3-day time step required used in the groundwater model.

#### *5.4.2.4 Initial Aquifer Properties*

The aquifer properties included in the model are horizontal hydraulic conductivity, vertical hydraulic conductivity, storage coefficient, and specific yield. The reader is referred to *Groundwater* (Freeze and Cherry, 1979) and/or other textbooks covering groundwater for descriptions of these properties and their physical meaning. Initial estimates of these aquifer properties are necessary to start the calibration. Initial estimates were developed from Watermaster's *Rapid Assessment Model* and the modeling work done to support the design of the Chino-1 Desalter expansion and Chino-2 Desalter (Geoscience, 2001). Subsequently, the values of the properties were changed through calibration. The final values of the aquifer properties are discussed in *Section 6 Model Calibration*.

### 5.4.3 Recharge and Discharge

Recharge and discharge in the model area were described in Section 4. The recharge components, with the exception of stream recharge in the Santa Ana River and its tributaries that are simulated directly in the model, were assigned to specific model cells.

Similarly, the discharge components, with the exception of groundwater discharge to the Santa Ana River and its tributaries that are simulated directly in the model, were assigned to specific cells. The assignment of pumping from a well to specific layers and the cell within each layer was based on the screened

interval and depth of the well, and the hydraulic conductivity of the layers in which the well was screened.

### 5.4.4 Initial Conditions

The initial condition for the model corresponds to October 1989 and consists of groundwater levels for effective cells in the model domain. A groundwater elevation map was prepared for the Chino Basin for October 1989 and is shown in Figure 5-8. The resulting groundwater levels were assigned to individual cells of the model. For a given location, the groundwater levels were assumed the same in each layer at the start of the calibration.

# 6. MODEL CALIBRATION

## 6.1 Calibration Strategy

Models are built to represent the physical system – not all of it, just what is necessary to simulate the important processes that govern it and that are important for the evaluation of specific management plans. Calibration is a process of the adjusting of independent variables within the model so that the model is capable of reproducing the response of the physical system to a known set of stresses. Given confidence in the calibration, the model can be used to estimate the behavior of the physical system for a different set of stresses. There are as many approaches to calibration as there are investigators. The approach used herein is elegantly simple and makes the best use of available data. Two main criteria were used for calibration: matching groundwater level histories at wells and matching the surface water discharge time history for the Santa Ana River at Prado Dam.

### 6.1.1 Matching Groundwater Levels at Wells

Matching groundwater levels at wells is an obvious approach. Model projections at well locations are simply compared to observations. Model estimates are temporally averaged – about 91 days over time, and spatially over a 200-foot by 200-ft cell. Water level measurements at wells are temporally specific to the moment of measurement, composited over as many as three layers, and can vary greatly over 91 days. Thus, there should be some differences attributable to model scale. The calibration process adopted herein was to:

- compare the observed groundwater level at a well to the computed groundwater levels for each layer in the cell in which the well was screened; and
- make adjustments as necessary to trial estimates of aquifer properties to improve the match between model-predicted and observed groundwater levels.

Wells were selected as model calibration targets based on:

- rigorous analysis of the continuity and quality of the water-level time history data;
- spatial well location; and
- well screen interval(s) relative to the model layering.

Water-level time histories for all wells in Chino Basin and Temescal Basin were plotted and analyzed. In order for a well to be selected as a calibration target, its time history was inspected for data density and continuity during the calibration period (1989-2001). Preference was given to wells with monthly or quarterly data, which is the typical data collection routine of municipal well owners. The quality of the data was determined through a visual analysis of the well's water-level time history, and through comparison with time histories of other nearby, similarly-constructed wells.

Figure 6-1 shows the location of the 45 wells used as model calibration targets. Note that the calibration target wells are located across the entire extent of the Chino Basin. City of Corona wells were used in the Temescal Basin. In addition, note the higher density of calibration target wells on the west side of Chino Basin. Because the west side of Chino Basin is comprised of at least two distinct aquifer-systems with significant head differences and head responses to pumping (see Section 2.3.3), it was necessary to select a greater number of wells in this area (with the appropriate screen intervals) to represent the shallow and deep aquifer-systems.

### 6.1.2 Matching Santa Ana River Discharge at Prado Dam

One of the key issues for the dry-year yield program is the impact of the dry-year yield program on rising groundwater. Through the OBMP, Watermaster is trying to maximize the yield of the Chino Basin by minimizing groundwater outflow in the Prado Basin area and by maximizing groundwater recharge in the Santa Ana River upstream of Prado Dam. The operation of the dry-year yield program needs to consider minimizing outflow to the Santa Ana River when water is being stored for dry-year use. To this end, the 2003 Watermaster Model was designed to simulate the surface water and groundwater interaction in the Santa Ana River and its tributaries in the lower Chino Basin. The calibration process adopted herein was to:

- compare the observed Santa Ana River discharge at Prado Dam to model-predicted discharges; and
- make adjustments as necessary to trial estimates of aquifer properties and streambed percolation rates to improve the match between model-predicted and observed surface water discharge.

The observed data for the Santa Ana River at Prado Dam was obtained from the USGS-published daily discharge data for Station 11074000. The location of Station 11074000 is shown in Figure 6-1.

## 6.2. Calibration Results

The initial calibration simulations were devoted to debugging input files and to ensuring that the hydrology for the model was correct. Subsequent calibration simulations focused on adjusting aquifer parameters to improve the match between observed and model-projected groundwater levels and Santa Ana River discharge at Prado Dam

### 6.2.1 Groundwater Levels at Wells

Appendix A contains plots of groundwater level time histories of observed and model-projected groundwater levels for 41 wells in the Chino Basin and four wells in the Temescal Basin. Figures 6-2 to 6-14 are a subset of these wells and include:

- Fontana Water Company F3A
- Cucamonga County Water District No. 30
- Ontario No. 17
- Upland No. 3
- Monte Vista Water District No. 10
- Pomona No. 11
- Chino No. 9
- Chino Hills No. 18A
- California Institution for Men No. 4
- Jurupa Community Services District No. 16
- Norco No. 11
- Parente ARC
- Excelsior

With few exceptions, the match of model-predicted groundwater levels to observed levels in the Chino Basin is excellent. The notable exceptions include Monte Vista Water District (MVWD) No. 10 and the Chino Hills wells 15B and 17. The 2003 Watermaster Model predicts groundwater levels at MVWD No 10 that are 20 to 40 feet higher than observed. Upon review of all the data and the conceptual model, the plausible explanations for these differences include the presence of a local-scale geologic feature that is not represented in the model or errors in the observed groundwater level data (incorrect qualification of the data, measurement error, or error in reference elevation).

The Chino Hills wells 15B and 17are perforated in the deeper aquifers in the City of Chino area. New data, available from Watermaster's Ayala Park piezometers that became available after the development of the conceptual model indicates that groundwater levels in the aquifers produced by Chino Hills wells 15B and 17 recover very slowly, hydraulic conductivity is low, and that the area has limited recharge. Upon review of all the data and the conceptual model, the plausible explanations for the differences include: the temporal and spatial scale of the model may be too large to compute representative groundwater levels at these wells; the conceptual model needs to be updated to include new data from the Ayala Park piezometers; and/or errors in the observed groundwater level data (incorrect qualification of the data, measurement error, or error in reference elevation). Watermaster plans to conduct pump tests on some deep wells in this area in the Fall 2003 as part of the implementation of the Interim Management Plan for Management Zone 1 (WEI, 2003). Watermaster should attempt a local calibration of the 2003 Watermaster Model in the City of Chino area in early 2004 using these pump test data.

The match of model-predicted groundwater levels to observed levels in the Temescal Basin is excellent.

### 6.2.2 End of Calibration Groundwater Levels

Figures 6-15a, 6-15b, and 6-15c illustrate the model-estimated groundwater levels for Layers 1, 2 and 3, respectively. In the eastern two-thirds of the Chino Basin, there is very little difference between groundwater levels in Layers 1, 2, and 3 where the layers are saturated. In the western part of the Chino Basin underlying the City of Chino and in the areas extending slightly north, east, and south of the City, there are several fine-grained layers that act as confining units and significant differences in groundwater levels between the layers are being predicted by the model.

Figures 6-16a, 6-16b, and 6-16c illustrate the model-predicted change in groundwater levels over the period 1989/1990 through 2000/2001 for Layers 1, 2, and 3, respectively. Some of the groundwater level changes shown on the boundaries of the western, northeastern and Prado Dam reservoir parts of the Chino Basin may be caused in part by errors in groundwater elevations assumed for the start of the calibration in Fall 1989. These are areas where groundwater levels were extrapolated to estimate the initial groundwater levels. As such, the change in groundwater levels in these areas may be modeling artifacts and not real changes in groundwater levels.

A pumping depression is starting to form in the area of the Chino-1 Desalter well field. Model-projected and observed groundwater levels have declined during the calibration period in the north central and northeastern parts of Chino Basin, and in an area adjacent to the Jurupa Hills where JCSD pumps heavily. Model-projected and observed groundwater levels have increased slightly on the western edge of Chino Basin near the City of Chino and in the area north of the Santa Ana River near Jurupa.

### 6.2.3 Santa Ana River Discharge at Prado Dam

Table 6-1 lists the model projected and observed discharges for the Santa Ana River at Prado Dam. This information is plotted in histogram form in Figure 6-17a and in a regression form (measured vs. model projected) in Figure 6-17b. The calibration is excellent. The average difference is about 5 percent and the average absolute difference is about 10 percent. The greater differences occur due to stormwater runoff and not streambed recharge and rising groundwater. The coefficient of determination ($R^2$) is the fraction of variance in the observed data that is predicted by the model. As a result of this calibration, the coefficient of determination is 0.96, which means that the model reproduces 96 percent of the variance in the observed data. This is an excellent result.

### 6.2.4 Final Aquifer Properties

The aquifer properties estimated from calibration are shown graphically as follows

- Figures 6-18a, 6-18b and 6-18c illustrate the spatial distribution of hydraulic conductivity for Layers 1, 2, and 3, respectively
- Figures 6-19a, 6-19b, and 6-19c illustrate the spatial distribution of vertical hydraulic conductivity for Layers 1, 2, and 3, respectively
- Figures 6-20a, 6-20b, and 6-20c illustrate the spatial distribution of specific yield for Layers 1, 2, and 3 respectively

The storage coefficient was assumed to be 0.0001 for the entire model domain.

### 6.2.5 Hydrologic Balance

The hydrologic balance for the 2003 Watermaster Model that was a result of this calibration is shown by management zone in Tables 6-2a through 6-2e. Most of the recharge components were independent of the groundwater model with the exception being recharge of Santa Ana River and its tributaries near the river where groundwater levels can influence recharge and rising groundwater. That most of the recharge components were independently estimated and contribute to an excellent groundwater calibration strongly implies that these independent recharge estimates are reasonably accurate for the calibration period.

The hydrologic balance includes estimates of groundwater flow between management zones. Of particular interest is the groundwater flow from Chino North, Chino South, and Temescal MZs to the PBMZ and subsequent contributions to rising water at Prado Dam. Table 6-3 lists the inflow components to the PBMZ and includes a reckoning of the volumes of rising water at Prado Dam from the inflowing management zones. These estimates were made by assuming that half of the stream flow recharge in the PBMZ contributes to rising water and that remaining rising water is allocated to the inflowing management zone based on the magnitude of groundwater inflow to the PBMZ. Over the calibration period, the average rising water contribution from the Chino North and Chino South MZs is estimated to be 2,300 acre-ft/yr and 700 acre-ft/yr, respectively, or about 3,000 acre-ft/yr from the Chino Basin.

The total storage in the Chino Basin declined during the calibration period from a high of 6,220,000 acre-ft in Fall 1989 to 5,940,000 acre-ft in Fall 2001 – a decline of about 280,000 acre-ft. Figure 6-18 shows the estimated groundwater storage for the Chino Basin during the calibration period. A part of this decline is a modeling artifact due to assumed initial groundwater levels on the margins of Chino Basin. After 1993, there is a monotonic drop in storage. Analysis of Tables 6-2a through 6-2e indicates that this

decline in storage is almost completely in the Chino North MZ and is caused by increased groundwater production after 1993.

# 7. DRY-YEAR YIELD PROGRAM IMPACTS

## 7.1 Dry-Year Yield Evaluation Criteria

The calibrated 2003 Watermaster Model was used to evaluate the magnitude of groundwater level and storage changes throughout Chino Basin, the change in direction and speed of specific known water quality anomalies, and the losses from storage when dry-year yield program water is stored. This was accomplished by determining and simulating a baseline and a dry-year yield scenario. The planning period used in this analysis consisted of the 25-year period from October 2003 through September 2028. This period corresponds approximately to the 25-year period of the dry-year yield agreement among Chino Basin Watermaster, IEUA, and Metropolitan Water District of Southern California (Metropolitan). The impacts listed above were estimated by:

- Preparing maps that show the maximum differences in groundwater levels at the point of peak storage and at the end of a dry-year yield extraction period. Time histories at the same wells used in the calibration were plotted to show local impacts at each of these wells.
- Preparing maps that show the plume migration tracks for the baseline and dry-year yield scenarios over the planning period. Each plume was modeled as though the contaminant of concern was a conservative (non-sorbing, non-degrading) constituent using MODPATH.
- Preparing time histories of Santa Ana River discharge for the baseline and dry-year yield scenarios and comparing these time histories for the planning period. The total water lost from storage will be estimated by subtracting the baseline time history from the dry-year yield time history.

## 7.2 Scenario Descriptions

The baseline and dry-year yield scenarios are described herein. The duration of each scenario is 25 years and corresponds to the duration of the dry-year yield program agreement.

### 7.2.1 Recharge Hydrology for the Planning Period

The recharge hydrology for the baseline and dry-year yield scenarios was modified to current and future conditions as described below.

#### *7.2.1.1 Subsurface Inflow*

Subsurface inflow for the baseline and dry-year yield scenarios was assumed identical to the values used in the calibration period of 1989/1990 through 2000/2001.

#### *7.2.1.2 Streambed Recharge*

The WLAM was used to estimate recharge in the stream reaches and recharge basins where the groundwater levels can be safely assumed not to affect recharge. Storm water recharge was increased to reflect the completion of the Chino Basin Facilities Improvement Project (CBFIP). Watermaster currently estimates that the increase in recharge due to the CBFIP will average about 12,000 acre-ft/yr and this estimate was used for both baseline and dry-year yield scenarios.

Recycled water discharges to the Santa Ana River from recycling plants were modified to reflect growth in these discharges based on projections made by the dischargers in *TIN/TDS Study – Phase 2B of the Santa Ana Watershed, Wasteload Allocation Investigation, Final Technical Memorandum* (WEI, 2002). This subsequently affects the model-computed recharge in the lower Chino Basin. Recycled water discharge estimates were increased linearly from 2004 to 2020 and were held constant after 2020 at

projected 2020 discharges. Table 7-1 shows the 2004 and 2020 projected recycled water discharge used in the baseline and dry-year yield scenarios.

#### *7.2.1.3 Deep Percolation of Precipitation and Applied Water*

The deep percolation of precipitation and applied water was computed using the WLAM as done in calibration with the following differences. The land use for 1993 that was used in the model calibration was updated using 2002 digital air photos and was assumed to represent 2003 conditions. Year 2020 land use conditions were estimated by assuming all undeveloped land in 2002 was developed. Deep percolation of precipitation and applied water was estimated for each year in the baseline and dry-year yield scenarios as follows:

1. Estimate the annual deep percolation of precipitation and applied water for 2003 and 2020 land use conditions from the precipitation record of 1989/1990 through 2000/2001
2. Develop a regression equation for the annual deep percolation of precipitation and applied water estimates to annual precipitation at a precipitation gage with a long record – in this case, the Ontario Fire Station with a record of 65 years.
3. Use the regression equation to estimate a 65-year time series of annual deep percolation of precipitation and applied water.
4. Compute the average deep percolation of precipitation and applied water from the 65-year record and use that value for 2003.
5. Repeat steps 1 through 4 using 2020 land use conditions and use the resulting average for 2020 and each year thereafter.
6. For each year between 2003 and 2020, estimate the deep percolation of precipitation and applied water by linear interpolation.

The resulting estimates of deep percolation of precipitation and applied water are *expected value* estimates for any given year. These estimates assume a gradual increase in recharge and that the vadose zone will buffer year-to-year variations from wet and dry periods. The deep percolation of precipitation and applied water estimates are identical for the baseline and dry-year yield scenarios.

#### *7.2.1.4 Supplemental Water Recharge*

Supplemental water is recharged in the Chino Basin by the Chino Basin Watermaster pursuant to the 1978 Chino Basin Judgment (Case No. RCV 51010, Chino Basin Municipal Water District *vs*. City of Chino *et al.*) and the 2000 Peace Agreement. Table 7-2 lists the future estimates of supplemental water recharge for the baseline scenario for the Chino North MZ and shows the locations of this recharge. The allocation of recharge to individual recharge facilities is based on the requirement to balance recharge and discharge as described in the OBMP Peace Agreement that was executed in July 2000. This is described in more detail below.

Recharge of recycled water in the Temescal MZ and PBMZ were assumed to total 9,000 acre-ft/yr (per Don Williams, City of Corona). The supplemental water recharge estimates are identical for the baseline and dry-year yield scenarios.

### 7.2.2 Baseline OBMP Scenario

The baseline scenario is based on a modified version of water supply plan from the Implementation Plan in the OBMP Peace Agreement (July 2000). The water supply plan from the Implementation Plan contains future groundwater production plans for all producers in the Chino Basin. Black and Veatch modified the water supply plan for those water purveyors that are participating in the dry-year yield program and WEI used the water supply plan from the Implementation Plan data for the remaining producers.

Water purveyors participating in the dry-year yield program include the Cities of Chino, Chino Hills, Ontario, Pomona and Upland, the Cucamonga County Water District, and the Monte Vista Water District. Appendix D contains information on the well capacities for these purveyors. Appendix D also includes the water supply plan for these entities for the baseline scenario. Figure 7-1 shows the baseline groundwater production time history. Groundwater production in the basin ranges from 196,000 acre-ft/yr in 2003/2004 to about 210,000 acre-ft/yr in 2019/2020 and thereafter.

Watermaster's replenishment obligation was estimated using the following assumptions pursuant to the Judgment, the OBMP and the OBMP Peace Agreement:

- The initial increase in stormwater recharge that is anticipated from the CBFIP is about 12,000 acre-ft/yr with a goal of about 20,000 acre-ft/yr.
- OBMP desalter capacity is increased from the current level of 8 million gallons per day (mgd) in 2002/2003 to 40 mgd as per the water supply plan from the Implementation Plan. The desalters will have a replenishment obligation equal to their groundwater production. Half of this replenishment obligation will come from decreased rising water and new induced streambed recharge in the Santa Ana River.
- The Judgment allows a 5,000 acre-ft/yr overdraft of Chino Basin through 2017.

Table 7-2 contains the replenishment obligation pursuant to the Judgment and the OBMP Peace Agreement, and ranges from about 30,000 acre-ft/yr in 2003/2004 to about 34,000 acre-ft/yr in 2019/2020 and is constant thereafter. An analysis of actual recent production in the Chino Basin suggests that the production and replenishment estimated in Table 7-2 may be slightly higher than will actually occur in first few years of the baseline scenario. For consistency with the OBMP planning documents, the production and replenishment estimates in Table 7-2 were used.

The locations and magnitude of recharge shown in Table 7-2 were based on the requirements of the Peace Agreement to balance recharge and discharge in every area and sub-area. This requirement must be met over some period of time and was interpreted herein as a long-term requirement. Thus, in an individual season or year there might not be a balance between recharge and discharge. This requirement is critical to the management of the subsidence-prone area in the western part of the Chino Basin. Watermaster is currently involved in an investigation to develop a management program for this subsidence-prone area. Until that management program is developed it was assumed herein that Watermaster replenishment and groundwater production would be managed such that groundwater levels would remain near or above current levels. Current groundwater levels were assumed to be the groundwater levels at the end of the calibration period of the 2003 Watermaster Model – that is, Fall 2001. Replenishment in the rest of the basin would be managed to maximize replenishment of the desalter from a combination of reduced rising water to the Santa Ana River and increased streambed recharge from the Santa Ana River.

### 7.2.3 Dry-Year Yield Scenario

The dry-year yield scenario is identical the baseline scenario except that the production pattern for the purveyors involved in the program has been modified to allow puts to occur by *in lieu* recharge. During put years, the participating purveyors will reduce their pumping by up to 25,000 acre-ft and use surface water from Metropolitan in lieu of Chino Basin groundwater. During take years, the participating purveyors will reduce their demands on Metropolitan and produce up to an additional 33,000 acre-ft of groundwater. Figure 7-1 shows the time history of pumping provided by Black and Veatch for evaluation of the dry-year yield scenario. Total pumping over the planning period is the same as the baseline scenario. Watermaster replenishment for the dry-year yield scenario is identical to the baseline scenario that is shown in Table 7-2.

## 7.3 Evaluation of the Baseline OBMP Scenario

### 7.3.1 Groundwater Levels

Figures 6-15a, 6-15b, and 6-15c illustrate the assumed groundwater levels for start of the baseline scenario in Fall 2003 for Layers 1, 2, and 3, respectively. Figures 7-2a, 7-2b, and 7-2c illustrate the model-estimated groundwater levels for the end of the baseline scenario in Fall 2028 for Layers 1, 2, and 3, respectively. The orientation of the groundwater contours in the vicinity of the Santa Ana River in Figure 7-2a suggests Santa Ana River streambed recharge is occurring. Appendix B contains projected groundwater level time histories for the baseline scenario for all the wells that were used in the calibration.

Figures 7-3a, 7-3b, and 7-3c illustrate the model-estimated change in groundwater level over the 25-year planning period for the baseline scenario. Throughout the duration of the baseline scenario, groundwater levels in the western part of the Chino Basin remain near or above the Fall 2001 groundwater levels. Groundwater levels in the other parts of Chino Basin declined over the planning period to levels that support decreased rising water to the Santa Ana River and increased streambed recharge from the Santa Ana River. Groundwater levels declined the most in the Fontana area – as much as 30 to 40 feet near the far eastern edge of the Fontana area. In the subsidence-prone area in the western part of Chino Basin, groundwater levels showed almost no change. The area north of the subsidence-prone area showed a slight increase in groundwater levels due to the shifting of Watermaster's replenishment to this area as shown in Table 7-2. The effect of the desalters is evident in the south-central part of Chino Basin where groundwater levels declined in excess of 25 feet.

### 7.3.2 Movement of Water Quality Anomalies

Figure 7-4 illustrates the locations of point source groundwater contaminant plumes in Chino Basin at the beginning of the 25-year planning period, and their estimated locations at the end of the planning period for both the baseline and dry-year yield scenarios. The current locations of the plumes were mapped from recent data (2002) and are described in Section 3.5. These current locations were assumed to be the initial plume locations at the start of the planning period. Particles were placed along the margins of the plumes, and MODFLOW, a particle-tracking code, was used to simulate the movement and final locations of the plumes. Note that this particle-tracking simulation of contaminant movement in groundwater does not simulate groundwater and contaminant dispersion, contaminant sorption to soil particles, or any persistent contaminant source term. The simulation results for the baseline scenario are discussed below for each contaminant plume (see Figure 7-4 while reading):

- ***Chino Airport*** – At the beginning of the planning period, the Chino Airport plume underlies and extends southwest of the Chino Airport. During the baseline scenario, the leading edge of the plume traveled approximately 1.75 miles in the southeasterly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and local groundwater pumping at desalter wells and other local wells. The plume location at the end of the planning period is south and east of Pine and Euclid Avenues, underlying the northern reaches of Prado Flood Control Basin. The County of San Bernardino is under a Cleanup and Abatement order to remediate this plume. It is unlikely that this plume will be allowed to migrate as shown herein. The County will likely be required to install new wells and a treatment system to control and remove this plume.
- ***CIM*** – At the beginning of the planning period, the CIM plume underlies the western portion CIM property, just east of Central Avenue. During the baseline scenario, the leading edge of the plume traveled approximately 2 miles in the southeasterly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and local groundwater pumping at desalter wells and other local wells. The plume location at the end of the planning period is east of Prado Avenue and north of Pine Avenue, slightly upgradient of the northern reaches of Prado Flood Control Basin. CIM is under a Cleanup and Abatement order to remediate this plume. It is unlikely that this plume will be allowed to migrate as shown herein. CIM has installed wells and a treatment system to control and remove this plume.
- ***GE Flatiron*** – At the beginning of the planning period, the GE Flatiron plume extends south of Mission Boulevard along Euclid Avenue. During the baseline scenario, the leading edge of the plume traveled approximately 0.5 miles in the southerly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient, local groundwater pumping, and recharge at the Ely Basins. The recharge at Ely Basins deflects the plume to the northwest. The leading edge location at the end of the planning period extends south of State Highway 60 between Euclid and Grove Avenues. GE is under a Cleanup and Abatement order to remediate this plume. It is unlikely that this plume will be allowed to migrate as shown herein. GE has installed wells and a treatment system to control and remove this plume.
- ***GE Test Cell*** – At the beginning of the planning period, the GE Test Cell plume is located south of Ontario Airport, extending southwest of Mission Boulevard to Grove Avenue. During the baseline scenario, the leading edge of the plume traveled approximately 0.6 miles in the southwesterly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and local groundwater pumping. The leading edge location at the end of the planning period directly underlies State Highway 60 just west of Euclid Avenue. GE is under a Cleanup and Abatement order to remediate this plume. It is unlikely that this plume will be allowed to migrate as shown herein. GE will likely be required to install new wells and a treatment system to control and remove this plume.
- ***Kaiser*** – The location of the Kaiser plume on Figure 7-4 was estimated by past modeling studies through the mid 1980's and was updated through the 2003 Watermaster Model calibration through 2001. Kaiser stopped monitoring in the early 1990's. Thus, the projection described herein is very approximate. At the beginning of the planning period, the elongated Kaiser plume extends in a southeasterly direction from the former Kaiser Steel site to Mission Boulevard. During the baseline scenario, the leading edge of the plume traveled approximately 1.25 miles in the southerly direction, and becomes elongated in an east-west direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and groundwater pumping at wells owned by Jurupa Community Services District. The plume location at the end of the planning period is aligned along State Highway 60 from about Interstate 15 on the west to about Etiwanda Avenue on the east.
- ***Milliken Landfill*** – At the beginning of the planning period, the Milliken Landfill plume extends southwest from the landfill site, just south of Mission Boulevard. During the baseline scenario, the

leading edge of the plume traveled approximately 1.4 miles in the southwesterly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and local groundwater pumping. The plume location at the end of the planning period is just southeast of the intersection of Riverside Drive and Haven Avenue. It is unlikely that this plume will be allowed to migrate as shown herein. The RWQCB will require the County of San Bernardino to remediate this plume if it presents a threat to offsite wells.

- ***Upland Landfill*** – At the beginning of the planning period, the Upland Landfill plume extends just south from the landfill site, north of Foothill Boulevard. During the baseline scenario, the leading edge of the plume traveled approximately 1 mile in the southwesterly direction. The primary factors affecting plume migration during the simulation are the regional hydraulic gradient and local groundwater pumping. The plume location at the end of the planning period is located north of the intersection of Interstate 10 and Euclid Avenue. It is unlikely that this plume will be allowed to migrate as shown herein. The RWQCB will require the City of Upland to remediate this plume if it presents a threat to offsite wells.
- ***Un-named VOC Plume*** – At the beginning of the planning period, the Un-named VOC plume underlies a broad area south of Riverside Drive, north of Kimball Avenue, west of Grove Avenue, and east of Archibald Avenue. During the baseline scenario, the leading edge of the plume did not travel south of its initial (current) position. The plume was largely consumed by production at the Chino-1 Desalter well field. The remarkable decrease in plume size during the planning period is largely a result of the assumed absence of a VOC source accompanied by desalter pumping and treatment.
- ***Stringfellow*** – At the beginning of the planning period, the Stringfellow plume underlies Pyrite Creek and extends from the Jurupa Mountains in a southwesterly direction. Perchlorate has been detected in groundwater as far south as the Santa Ana River (see Figure 7-4). During the baseline scenario, the leading edge of the plume traveled approximately 3 miles in the northwesterly direction to be consumed by the Chino-2 Desalter well field. The primary factors affecting plume migration during the simulation are recharge along the Santa Ana River and groundwater pumping at desalter wells. . It is unlikely that this plume will be allowed to migrate as shown herein. The DTSC is currently investigating the perchlorate plume emanating from the Stringfellow site and will likely require the dischargers associated with Stringfellow to remediate this plume prior to the plume impacting the desalter wells.

### 7.3.3 Hydrologic Balance and Storage

The hydrologic balance for the baseline scenario is shown by management zone in Tables 7-3a through 7-3e. The hydrologic balance includes estimates of groundwater flow between management zones. Of particular interest is the groundwater flow from Chino North, Chino South, and Temescal MZs to the PBMZ and subsequent contributions to rising water at Prado Dam. The subsurface outflow from Chino North MZ to the PBMZ decreased over time by about 5,500 acre-ft/yr. The stream recharge in the Chino South MZ increased about 12,000 acre-ft/yr from whence it flows to the desalter well field. The 2003 Watermaster Model projected that the yield of Chino Basin will increase about 17,500 acre-ft through the recharge plan described in Table 7-2 and the construction and operation of the desalters.

Table 7-4 lists the inflow components to the PBMZ and includes a reckoning of the volumes of rising water at Prado Dam from the inflowing management zones. These estimates were made by assuming that half of the stream flow recharge in the PBMZ contributes to rising water and that remaining rising water is allocated to the inflowing management zone based on the magnitude of groundwater inflow to the PBMZ. For the baseline scenario, the average rising water contribution from the Chino North and Chino

South MZs is estimated to be about 400 acre-ft/yr and 100 acre-ft/yr, respectively, or about 500 acre-ft/yr from the Chino Basin.

Table 7-5 and Figure 7-6 show the estimated time history of Santa Ana River discharge by calendar quarter for the planning period. The increase in discharge over time is cause by increases in recycled water discharged to the Santa Ana River and is not related to the operation of the Chino Basin in the baseline scenario. The operation of the Chino Basin in the baseline scenario is projected to reduce the rate of increase in discharge of the Santa Ana River over time.

The total storage in the Chino Basin declined monotonically during the baseline scenario from a high of 5,940,000 acre-ft in Fall 2003 to 5,730,000 acre-ft in Fall 2028 – a decline of about 210,000 acre-ft. Figure 7-12 shows the estimated groundwater storage for the Chino Basin during the planning period. The modeling results suggest that the total storage in the basin appears to be asymptotically approaching a level near 5,700,000 acre-ft. The modeling results suggest that less than half of the replenishment will come from decreased rising water and new induced streambed recharge in the Santa Ana River.

## 7.4 Evaluation of the Dry-Year Yield Program Impacts

### 7.4.1 Change in Groundwater Levels

Figures 6-15a, 6-15b, and 6-15c illustrate the assumed groundwater levels for start of the baseline scenario in Fall 2003 for Layers 1, 2, and 3, respectively. Figures 7-7a, 7-7b, and 7-7c illustrate the model-estimated groundwater levels for the end of the dry-year yield scenario in Fall 2028 for Layers 1, 2, and 3, respectively. The orientation of the groundwater contours in the vicinity of the Santa Ana River in Figure 7-7a suggests significant Santa Ana River streambed recharge is occurring. Appendix C contains projected groundwater level time histories for all the wells that were used in the calibration.

Figures 7-8a, 7-8b, and 7-8c illustrate the model-estimated change in groundwater levels over the 25-year planning period for the dry-year yield scenario. Throughout the duration of the dry-year yield scenario, groundwater levels in the western part of the Chino Basin remain near or above the Fall 2001 groundwater levels. Basin-wide, the general spatial trend water level changes follows that of the baseline scenario with some differences caused by the operation of the dry-year yield program:

- At the point of maximum storage during the dry-year yield program (2007), water levels are higher basin-wide compared to the baseline – especially in the northern and western portions of Chino Basin. In particular, Figures 7-10a, 7-10b, and 7-10c show that in 2007 water levels are about 10-30 feet higher in the area north of the Turner Basins and in the vicinity of CCWD's Chino Basin well field, and within most of MZ-1 – especially in the Montclair and Pomona areas.
- At the conclusion of a three-year extraction period during the dry-year yield program (2018), water levels are lower basin-wide compared to the baseline – especially in the northern portions of Chino Basin. In particular, Figures 7-11a, 7-11b, and 7-11c show that in 2018 water levels are about 10-25 feet lower in the area north of the Turner Basins and in the vicinity of CCWD's Chino Basin well field, and in the area surrounding the Montclair Basins. Overall, the total storage in the Chino Basin at the end of the three-year extraction period is about the same as the baseline storage for the same point in time – 2018.
- At the conclusion of the dry-year yield program (2028), water levels are lower compared to the baseline in some northern portions of the Chino Basin. In particular, Figures 7-9a, 7-9b, and 7-9c show that in 2028 water levels are 20-30 feet lower in the area north of the Turner Basins and in the

vicinity of CCWD's Chino Basin well field, and in the area surrounding the Montclair Basins. Overall, the total storage in the Chino Basin at the end of the three-year extraction period is about the same as the baseline storage for the same point in time – 2028.

### 7.4.2 Change in Movement of Water Quality Anomalies

Figure 7-4 shows the simulated location of the groundwater contaminant plumes in Chino Basin at the end of the planning period (2028) for the both the baseline and dry-year yield scenarios. All plume locations are virtually identical for both scenarios, indicating that the change in direction and speed of movement of these plumes caused by the dry-year yield program is not significant.

### 7.4.3 Changes in Hydrologic Balance and Storage

The hydrologic balance for the dry-year yield scenario is almost identical to the baseline with subtle differences showing up in reduced streambed recharge in Chino South MZ and the time history of storage. Table 7-5 shows the estimated time history of Santa Ana River discharge, by calendar quarter, for the baseline and dry-year yield scenarios. Table 7-5 also shows the difference in surface water discharge caused by the dry-year yield Program. The dry-year yield program increases the discharge in the Santa Ana River by a total of about 16,000 acre-ft over the 25-year period and is equivalent to an average increase of about a 1 cubic feet per second (cfs) in the Santa Ana River discharge, or about one quarter of one percent of the total discharge in the Santa Ana River. The water quality impacts associated with this change in discharge are negligible.

The total storage in the Chino Basin declined similarly to the baseline scenario; however, the storage levels varied more abruptly due to the "put" and "take" periods – The decline in storage was at a lower rate during "put" periods and dropped more steeply during "take" periods. This is demonstrated in Figure 7-12.

The OBMP Peace agreement defines the *operational storage requirement* as the storage or volume in the Chino Basin that is necessary to maintain safe yield and sets an initial estimate of the *operational storage requirement* at 5,300,000 acre-ft which corresponded to the then estimated storage in the year 2000. The year 2000 estimate of storage developed from the baseline scenario is about 5,980,000 acre-ft. The *safe storage* was defined as the maximum storage in the basin that will not cause significant water quality and high-groundwater related problems. The *safe storage capacity* is the difference between the *operational storage requirement* and the *safe storage* and thus was initially set at 500,000 acre-ft. Thus, *safe storage* was initially estimated at 5,800,000 acre-ft. Given the revised year 2000 estimate of storage, *safe storage* is about 6,480,000 acre-ft.

The *safe storage capacity* in the OBMP Peace Agreement was set at 500,000 acre-ft based on the observation that the change in storage during the base period for the determination of the safe yield (1965 through 1974) was at about 400,000 acre-ft and that the storage in the basin was declining prior to the base period. It seemed reasonable that the basin could be operated at these prior levels without causing significant water quality and high-groundwater related problems. The recharge and production plans in the OBMP that are represented in the baseline scenario will result in the basin being operated at lower groundwater levels than that envisioned during the development of the OBMP. Thus, the concept of *safe storage* is not relevant for the CBWM-IEUA-Metropolitan proposed dry-year yield program analyzed herein. In fact, the maximum storage reached during the dry-year yield scenario is 5,950,000 which is about the storage reached in 2000 and is otherwise less than the storage level of the year 2000. The effect

on yield from the lowering of storage will be to increase yield by minimizing groundwater losses to the River at Prado Dam and by increasing the recharge of the basin from the Santa Ana River. Thus, the dry-dear yield program is entirely consistent with the goals of the OBMP and the storage management program in the OBMP Peace Agreement.

### 7.4.4 Material Physical Injury

Three tests were used to determine if the proposed dry-year yield program would result in material physical injury to any of the Parties to the Judgment or to Chino Basin itself:

- Groundwater levels problems including:
  - Increased groundwater-level related problems such as groundwater rising causing injury to structures or agriculture, liquefaction, and the mobilization of contaminants in the vadose zone.
  - Decreased groundwater-level related problems such as excessive groundwater production costs, excessive loss of production capacity, and subsidence.
- Redirection and transport of known water quality anomalies
- Losses from storage to increased rising groundwater in the lower Chino Basin that in turn could degrade the water quality in the Santa Ana River and reduce the yield of the Chino Basin.

These are the same tests that were used in the OBMP Program Environmental Impact Report (IEUA, 2000).

#### *7.4.4.1 Groundwater Level Problems*

There is no material physical injury to a Party to the Judgment or Chino Basin from the projected groundwater level changes from either the baseline or dry-year yield scenarios. The only location where a significant increase in groundwater level occurs in the baseline scenario is in the vicinity of the recharge basins in Upland and Montclair (College Heights, Upland, Montclair, and Brooks Street Basins) where the depth to water is 300 feet or greater.

Under the baseline scenario, groundwater levels are projected to remain about unchanged in the western third of the basin. Groundwater levels decrease about 15 to 20 feet in the center of Chino Basin and decrease up to 40 feet at the far eastern edge of the basin, north of the Jurupa Hills. Groundwater levels are projected to decline 25 feet or more in the vicinity of the OBMP Desalter well fields. Slight increases in production costs will occur and slight decreases in production capacity might occur. The added cost of production will more than be offset by the savings provided by the avoided purchase of supplemental water for Desalter replenishment. Production costs could increase about $3.50 per acre-ft (assuming $0.10 per kilowatt-hour (KWHR), 60 percent pumping efficiency, and an average additional lift of 20 feet). The producers that are impacted by operating the basin about 20 feet lower under the baseline scenario are the City of Ontario, Cucamonga County Water District, Fontana Water Company, and Jurupa Community Water District, whose combined production averages about 80,000 acre-ft during the baseline scenario. The increased power cost totals about $240,000 per year. Operating the basin at this lower level avoids the cost of purchasing about 24,600 acre-ft/yr of supplemental water at a cost of about $6,000,000 if the supplemental water consisted of SWP water and about $2,000,000 if it were recycled water. The power cost for producing groundwater with the dry-year yield program would be slightly less than the baseline because Chino Basin will be operated at slightly higher levels.

Under the baseline and dry-year yield scenarios, the groundwater levels in the subsidence-prone part of Chino Basin are projected to remain near or above current levels. This occurs because of the recharge program described in Table 7-2 and because groundwater pumping patterns in the subsidence-prone area were adjusted to maintain groundwater levels near or above current levels. This is a minimum necessary condition to minimize subsidence and ground fissuring in this area. Groundwater levels in this area should be managed using this criterion until Watermaster can implement a long-term management program for subsidence; after which groundwater levels in this area would be managed according to the long-term management program. The design and operation of the final dry-year yield program should be required to maintain groundwater levels near or above current groundwater levels until the long-term management program is implemented; and will need to maintain groundwater levels according to the long-term management program.

#### *7.4.4.2 Redirection and Transport of Known Water Quality Anomalies*

There is no material physical injury related to the redirection and transport of known groundwater contaminant plumes from the operation of the dry-year yield program. The model-projected change in direction and speed of movement of these plumes caused by the dry-year yield program is not significant.

#### *7.4.4.3 Losses from Storage*

There is no material physical injury related to losses of water from storage. The dry-year yield Agreement contains provisions for the Watermaster and IEUA to assess Metropolitan for these losses if they occur. From a financial perspective, Watermaster and IEUA are kept whole and there will be no loss of yield from Chino Basin. The model projects a slight outflow with the dry-year yield program that is primarily a decrease in recharge from the Santa Ana River and not an increased outflow. Therefore, there will be no water quality impact to the Santa Ana River. In the development of the dry-year yield scenario, Black & Veatch assumed that the losses from storage would be about two percent annually of the water stored in the dry-year yield account. The model projections suggest that this loss rate is reasonable although the actual loss rate could be as low as one percent.

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**Figure A-1**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Rialto – Chino No. 1**

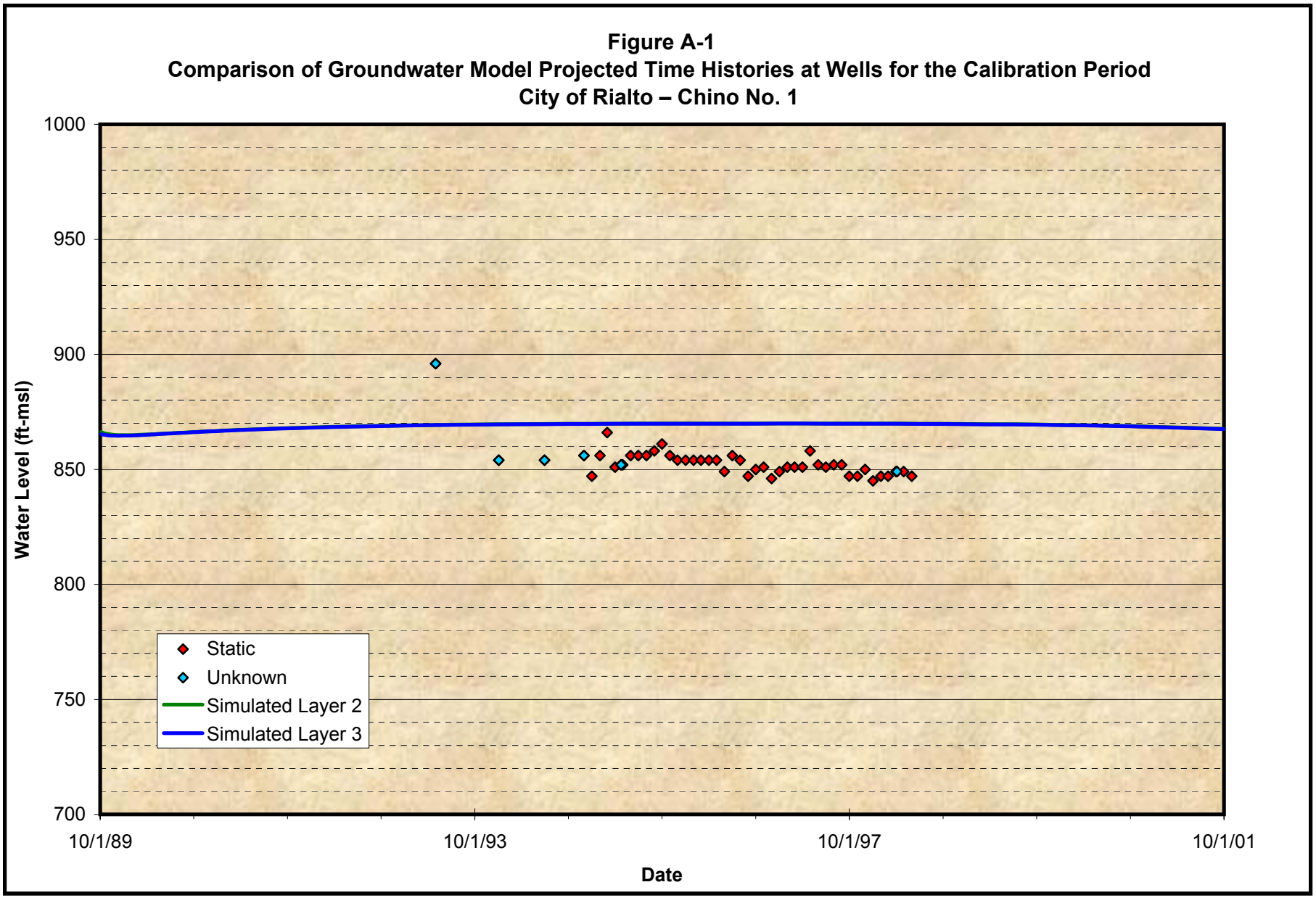


**Figure A-2**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**West San Bernardino County Water District – No. 27**

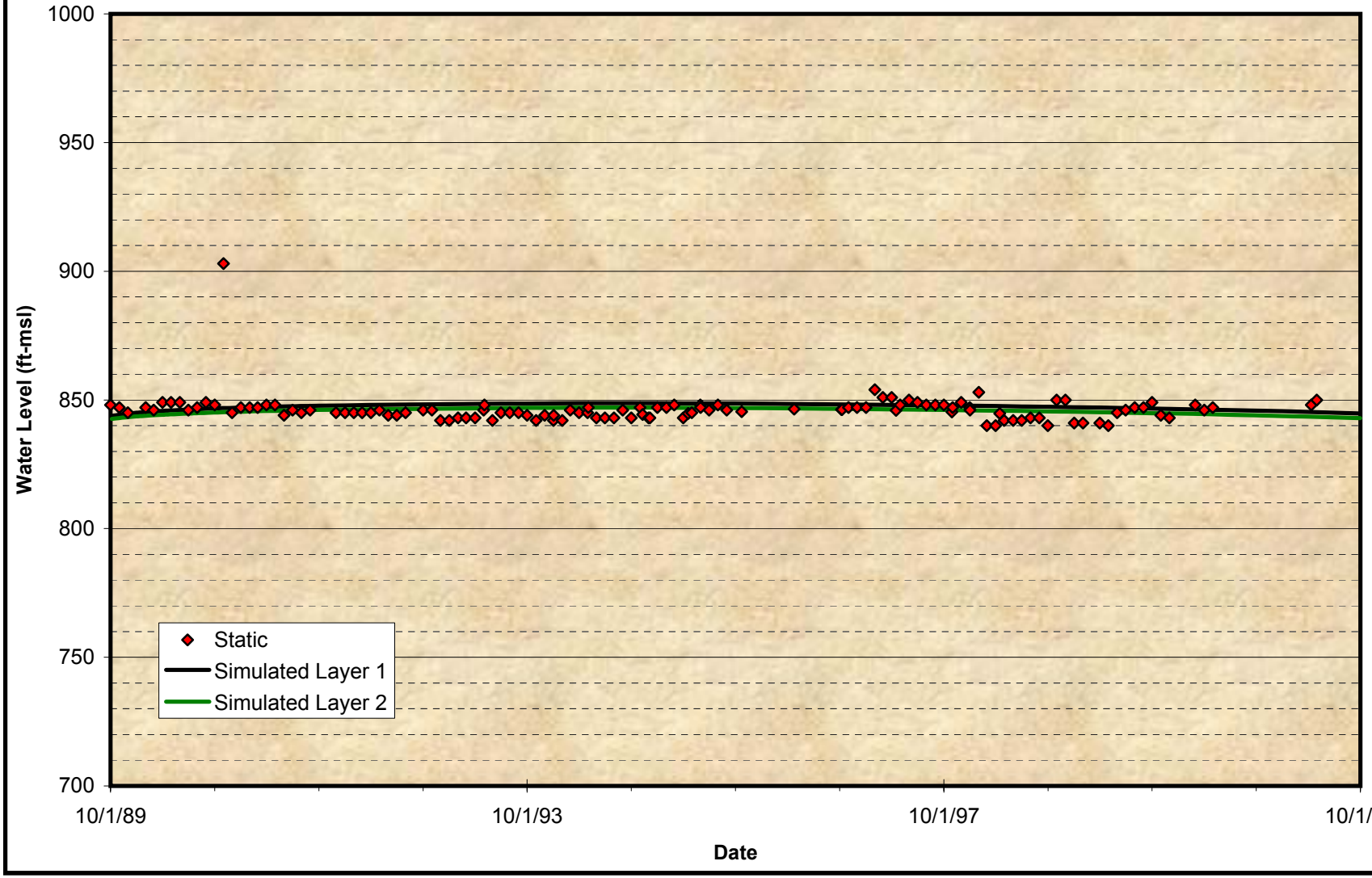


**Figure A-3**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**West San Bernardino County Water District – No. 37**

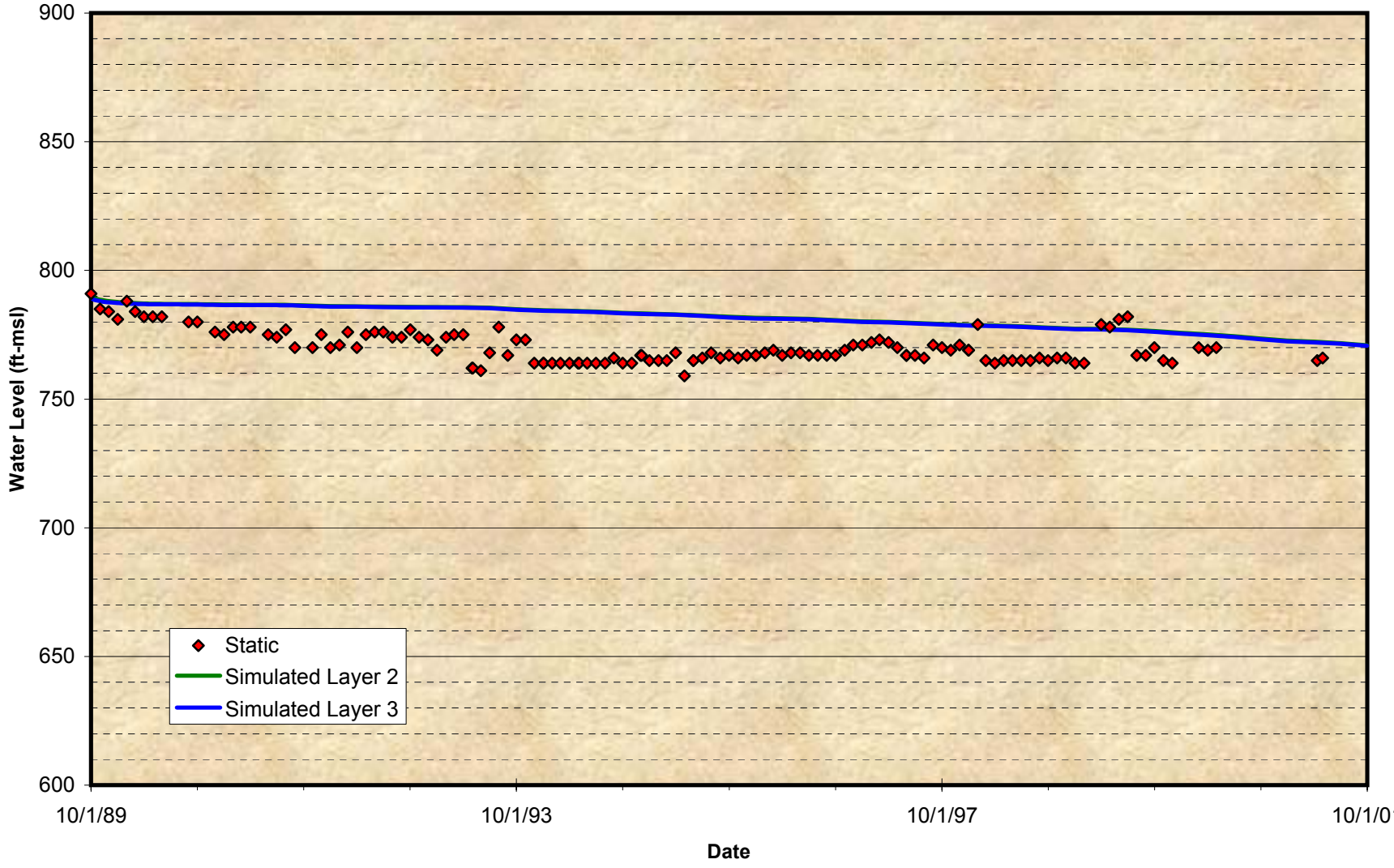


**Figure A-4**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Fontana Water Company – No. F31A**

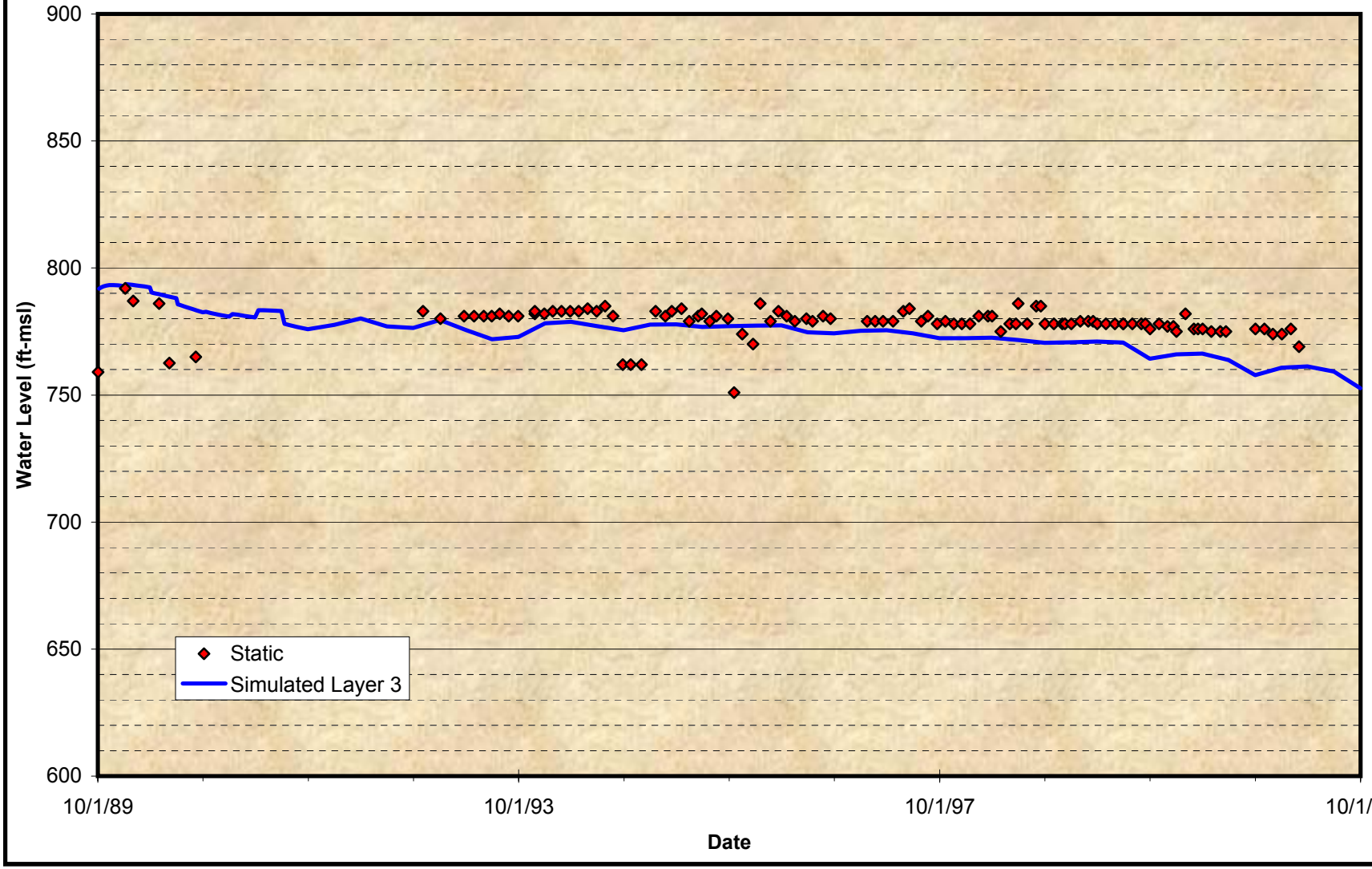


**Figure A-5**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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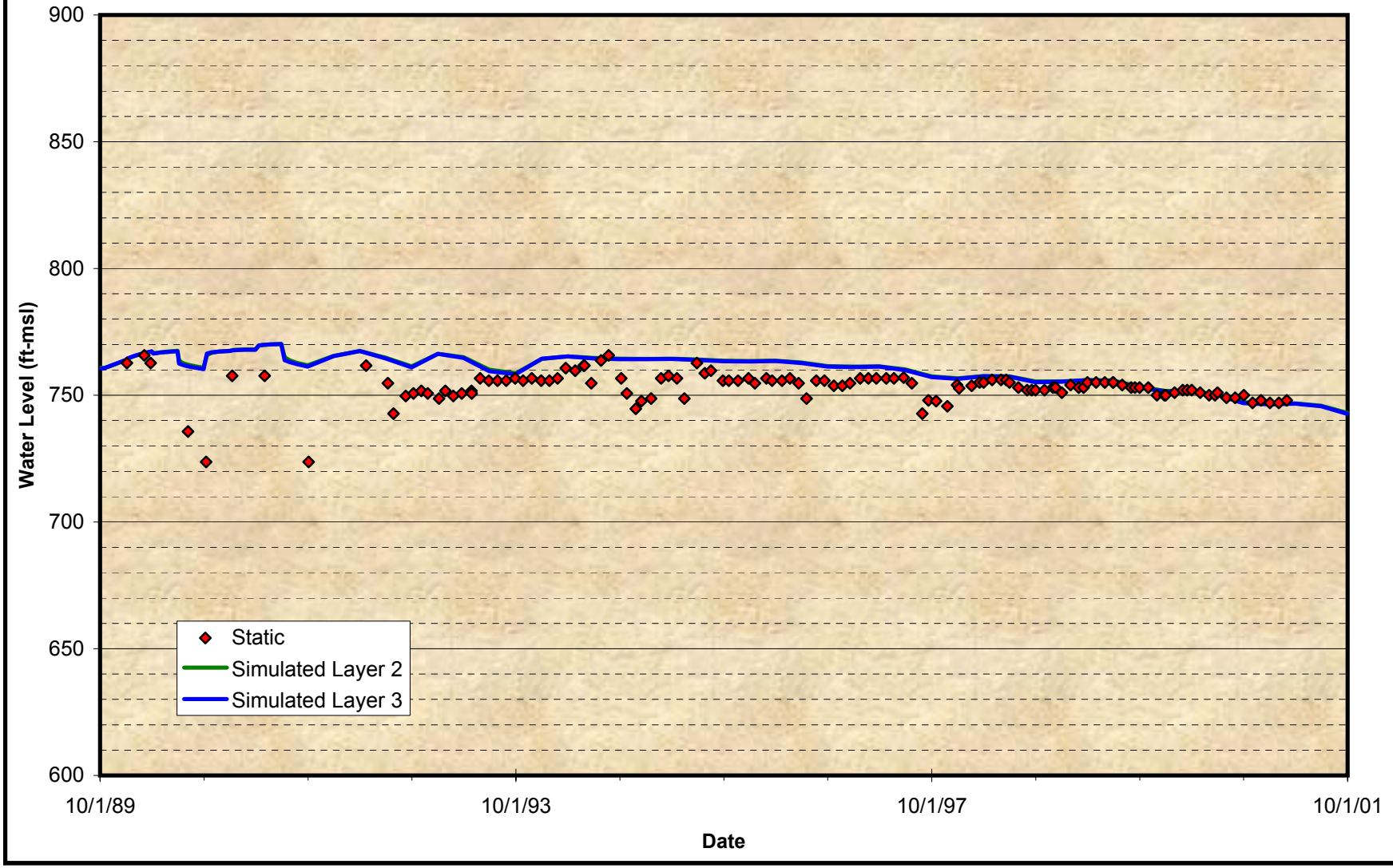


**Figure A-6**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Fontana Water Company – No. F21A**

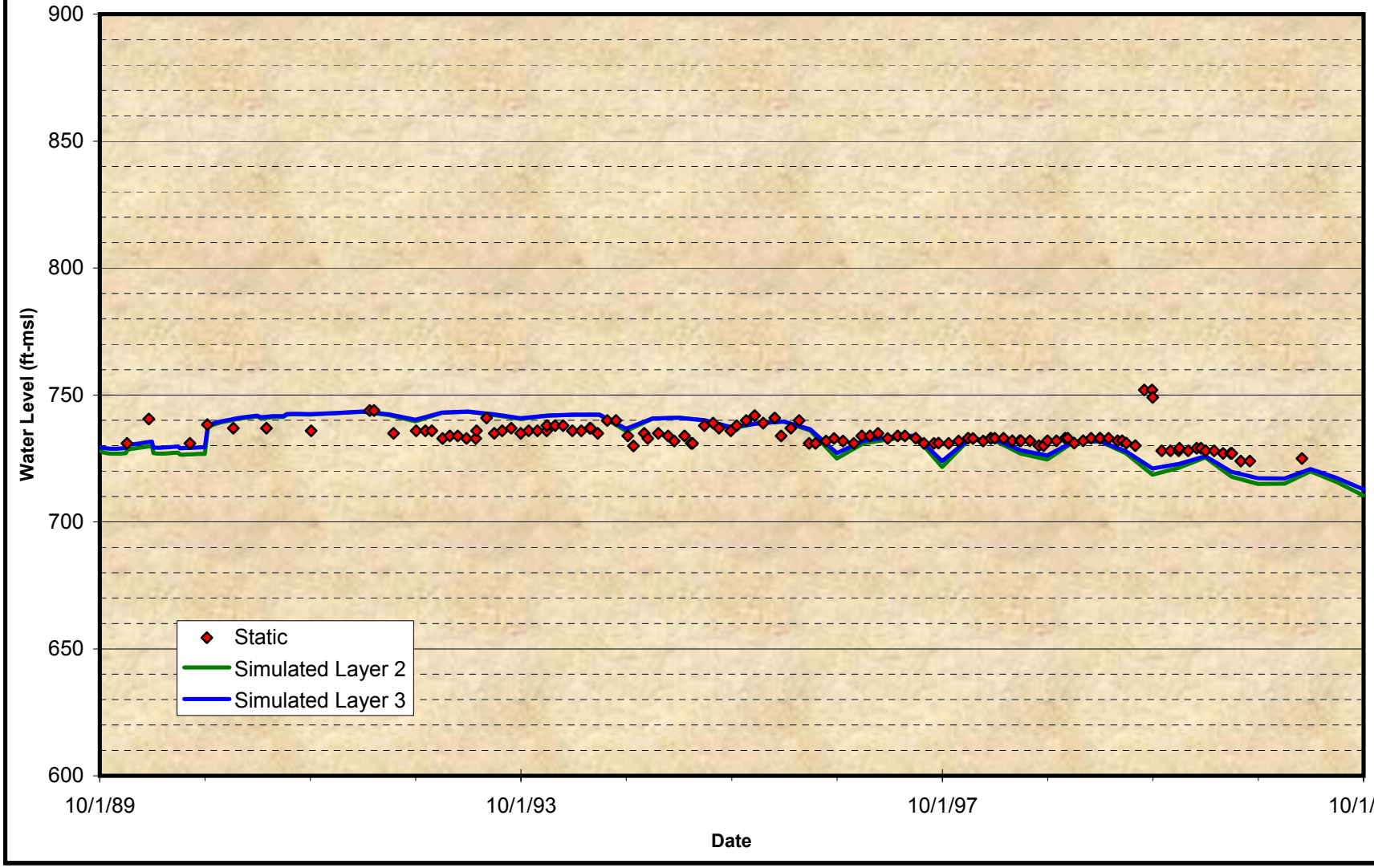


**Figure A-7**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Cucamonga County Water District – No. CB-35**

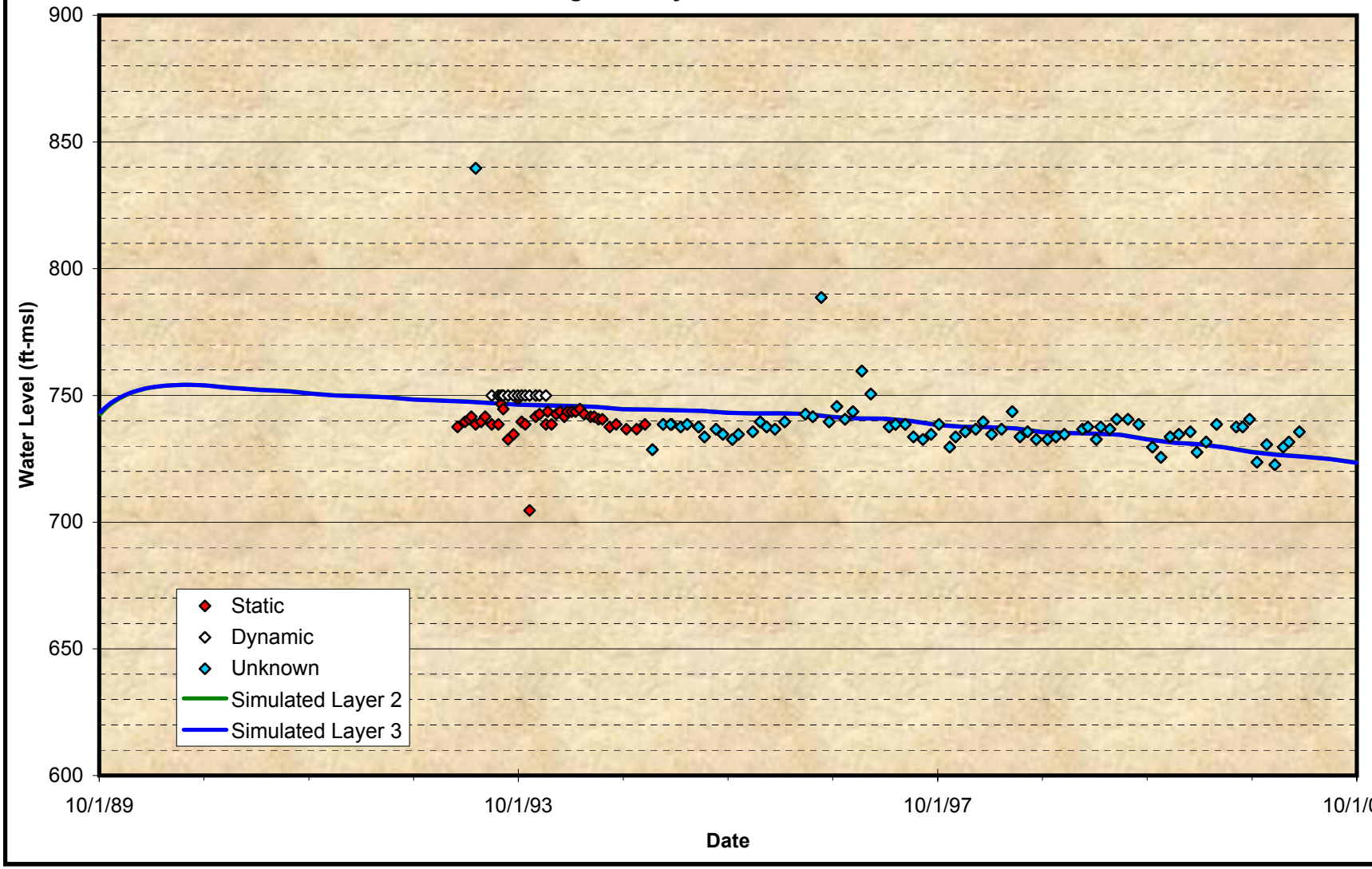


**Figure A-8**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Southern California Edison – Well C**

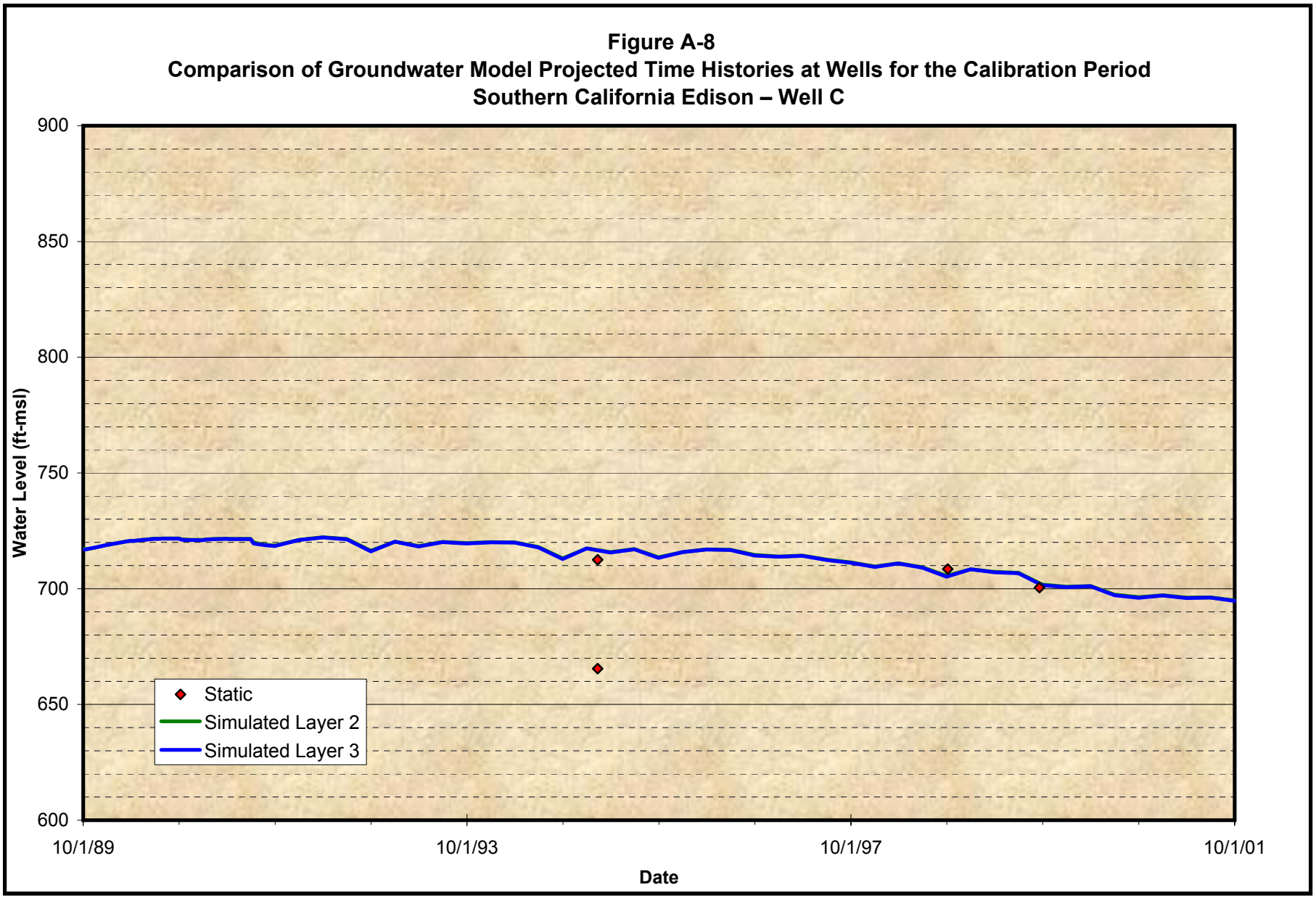


**Figure A-9**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Ontario – No. 31**

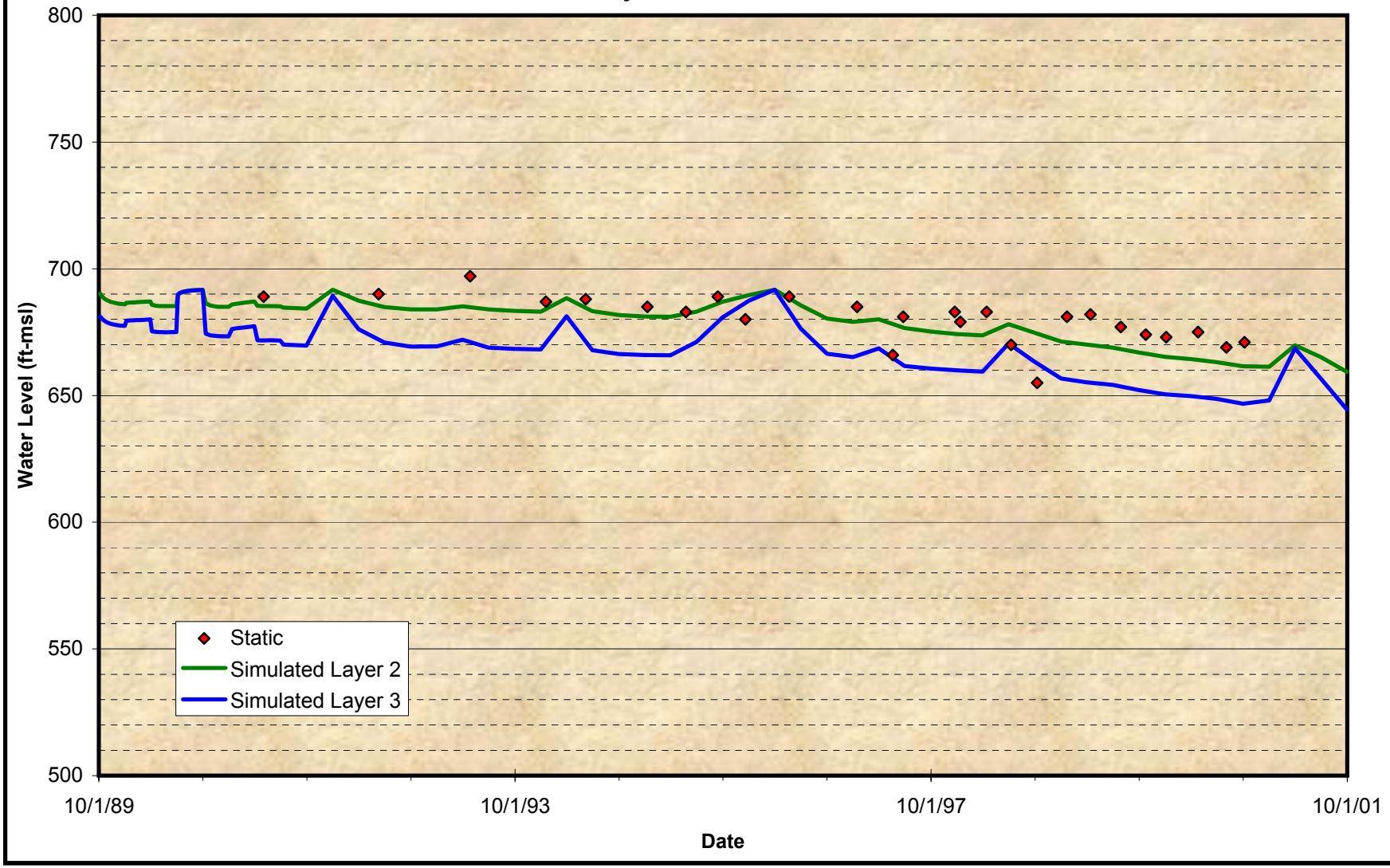


**Figure A-10**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Cucamonga County Water District – No. 30**

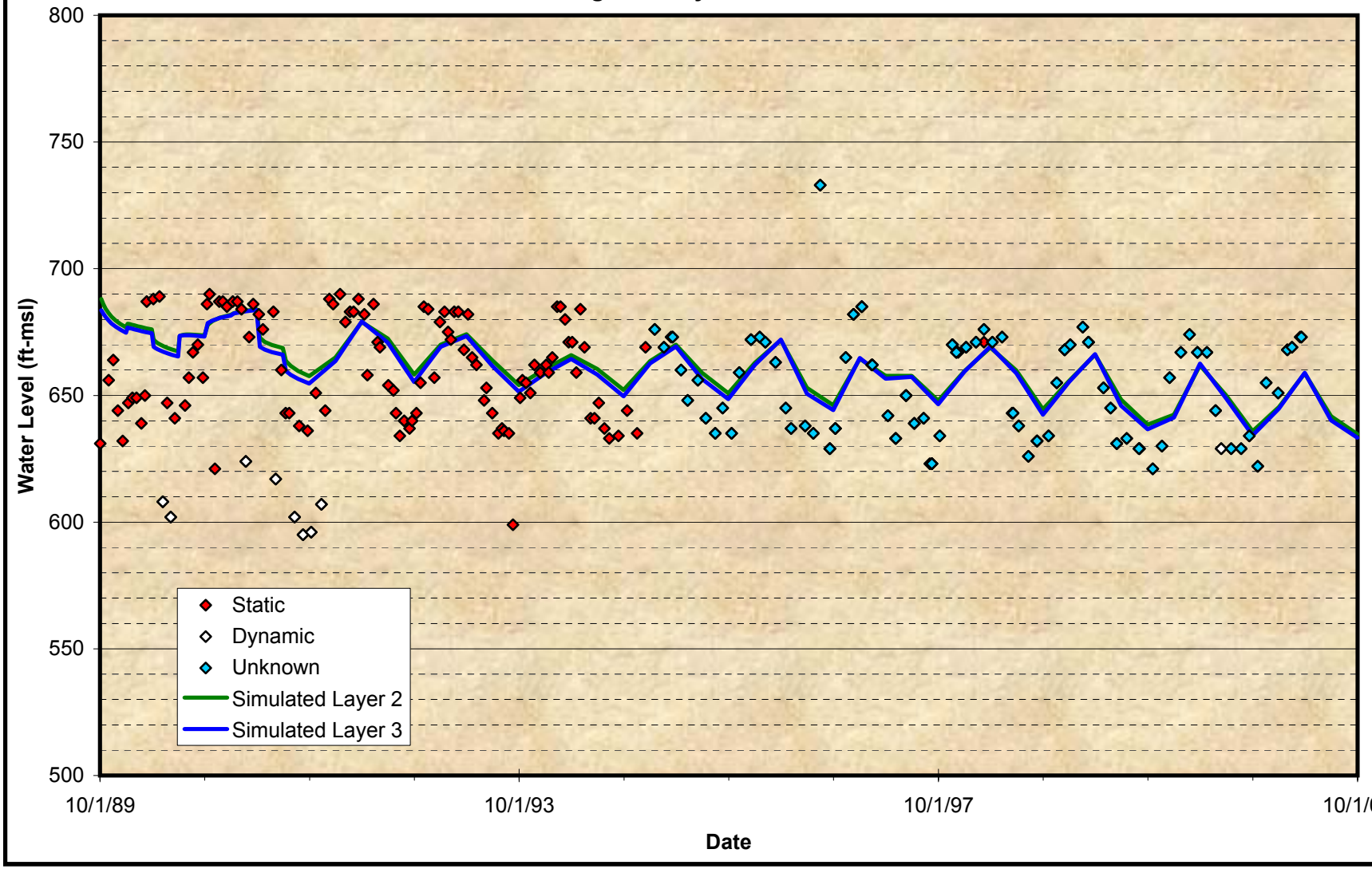


**Figure A-11**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Ontario – No. 36**

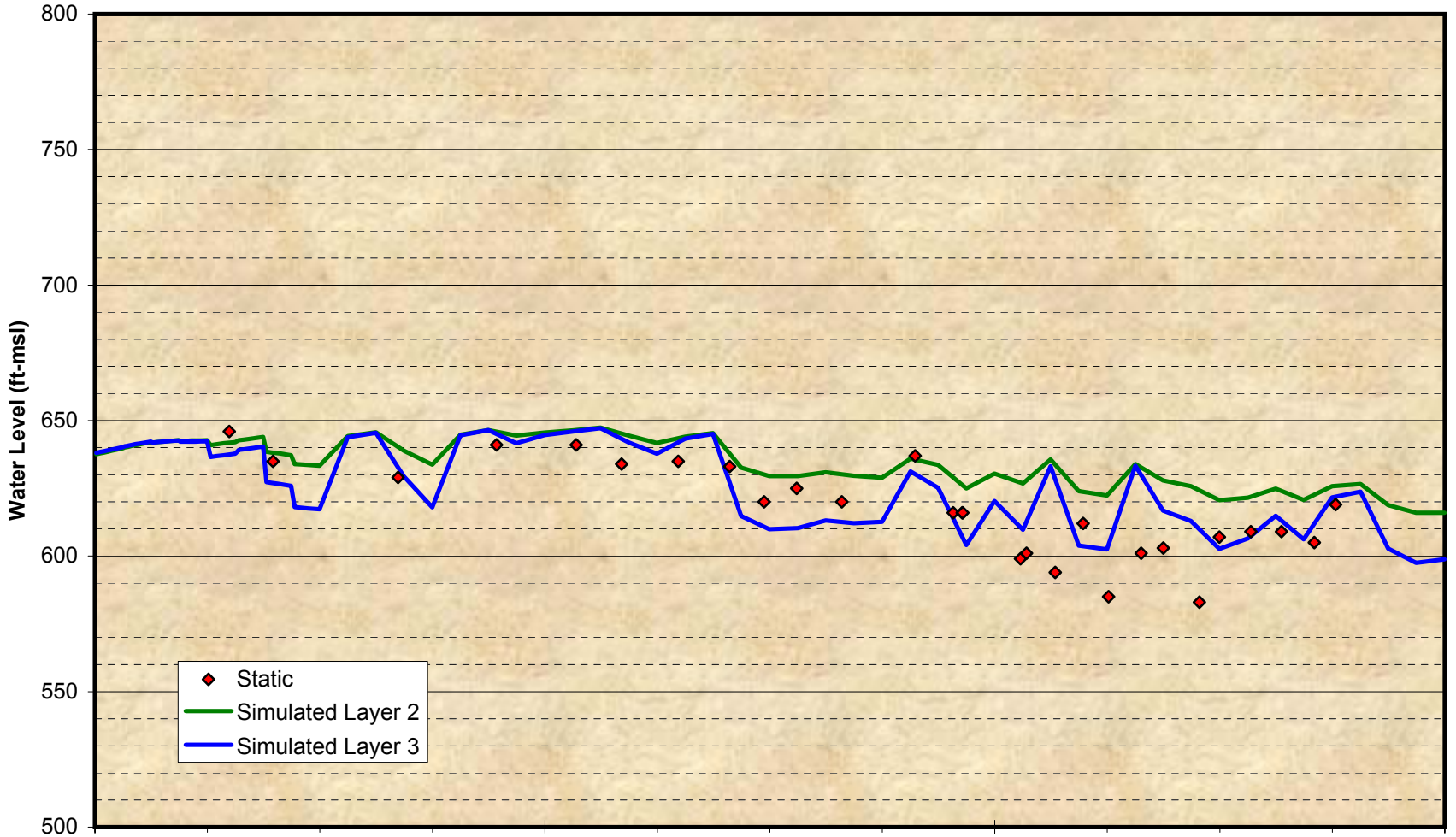


**Figure A-12**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Ontario – No. 17**

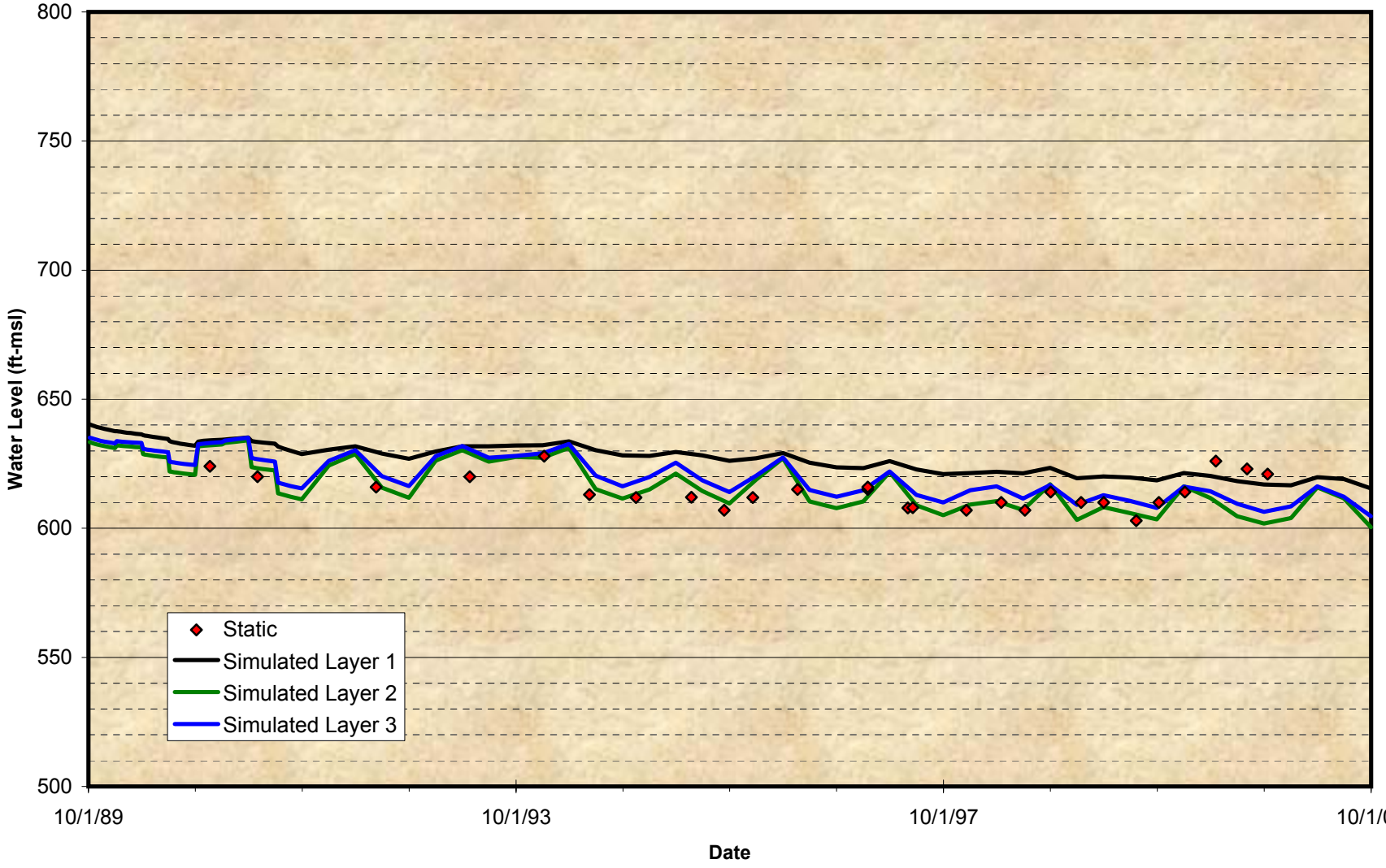


**Figure A-13**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Upland – No. 3**

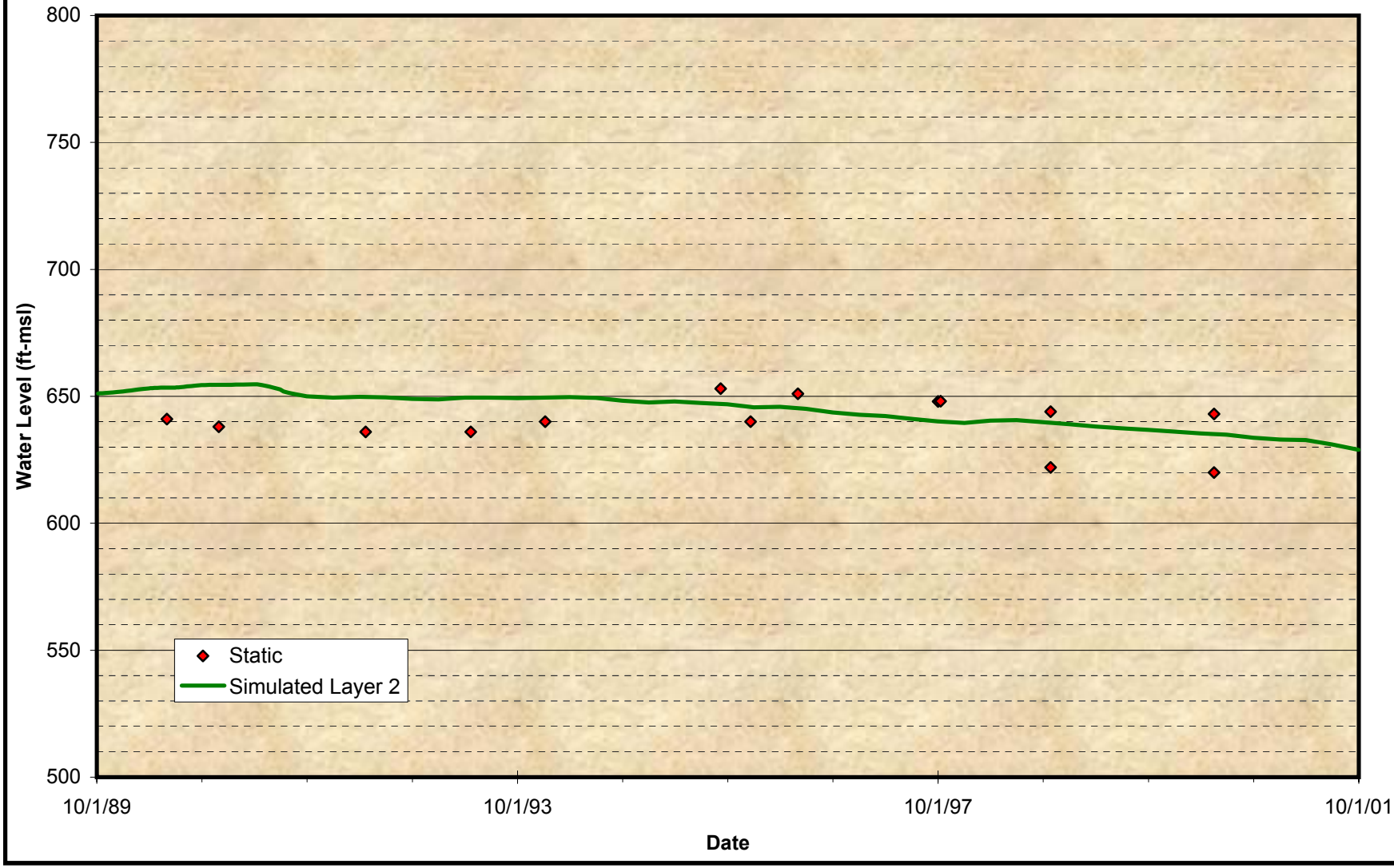


**Figure A-14**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Monte Vista Water District – No. 10**

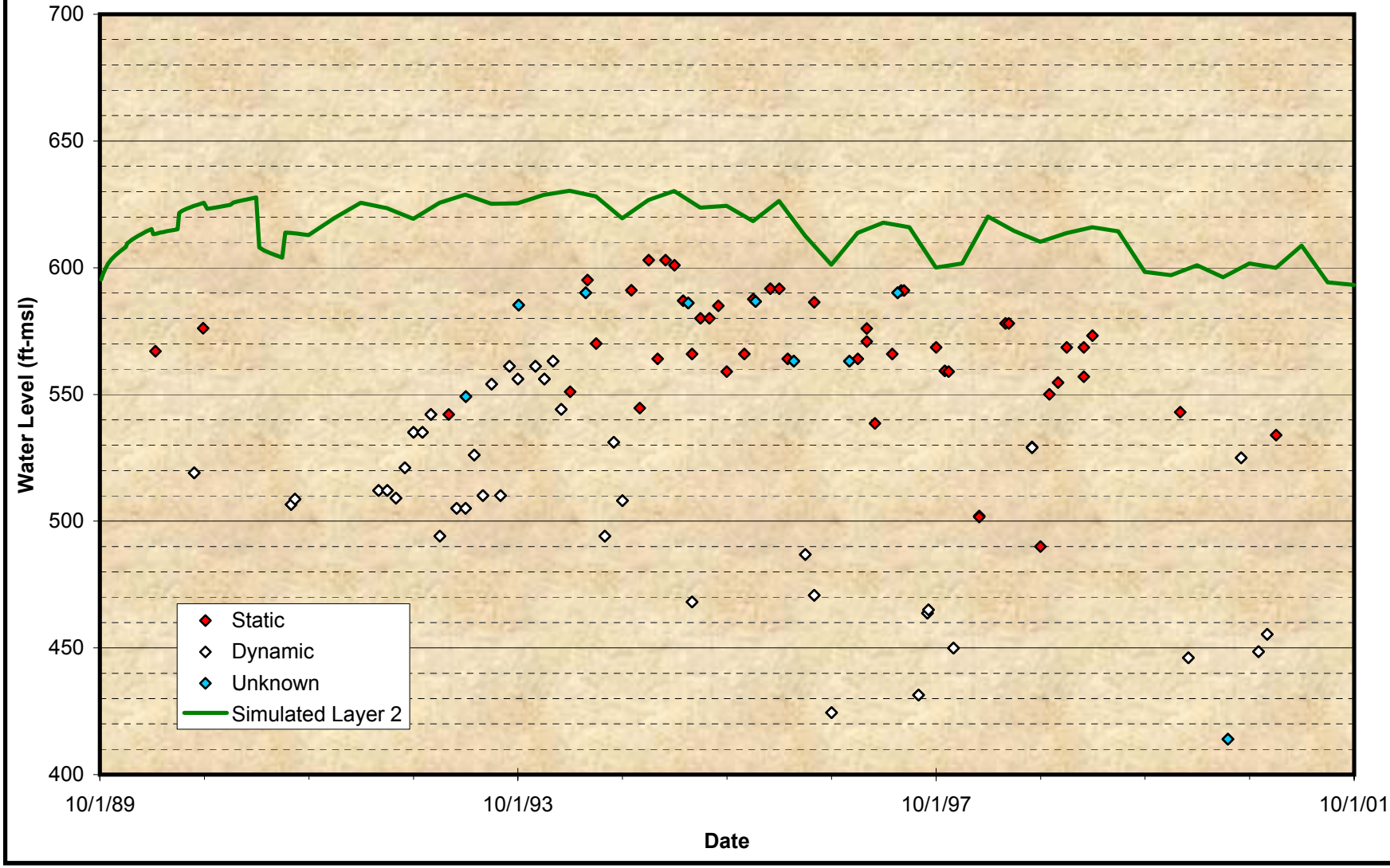


**Figure A-15**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Pomona – No. 11**

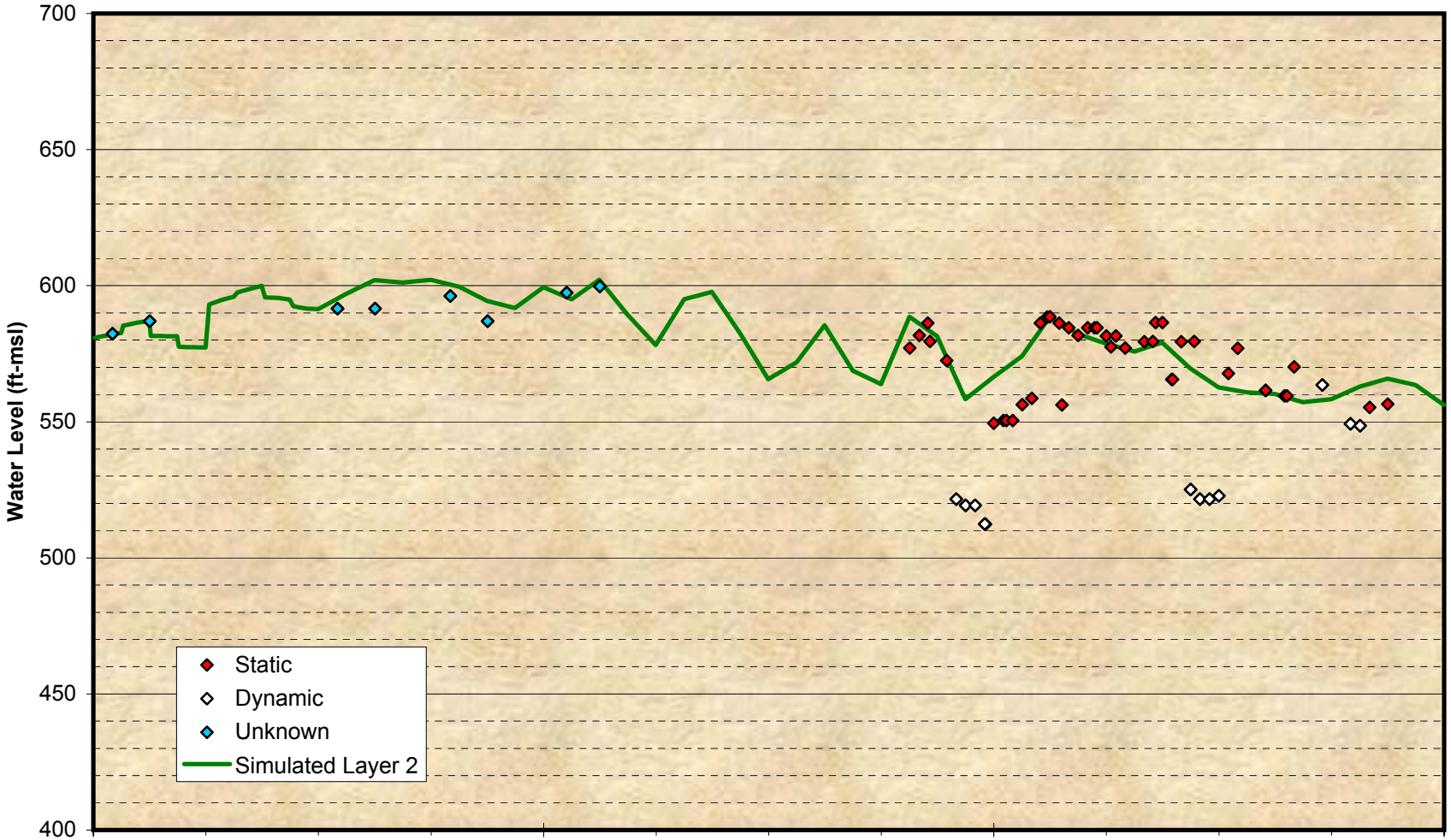


**Figure A-16**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino – No. 12**

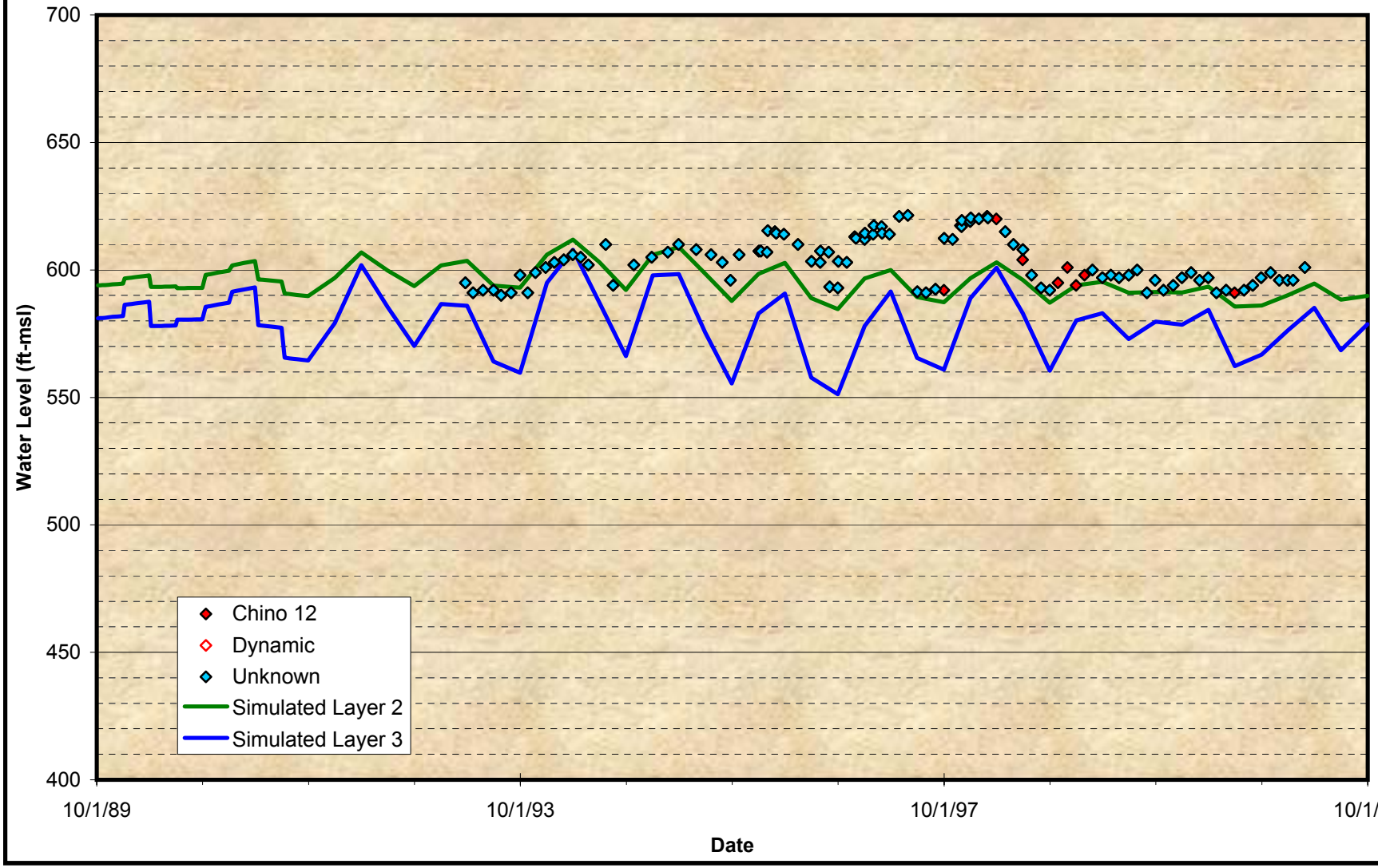


**Figure A-17**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino – No. 9**

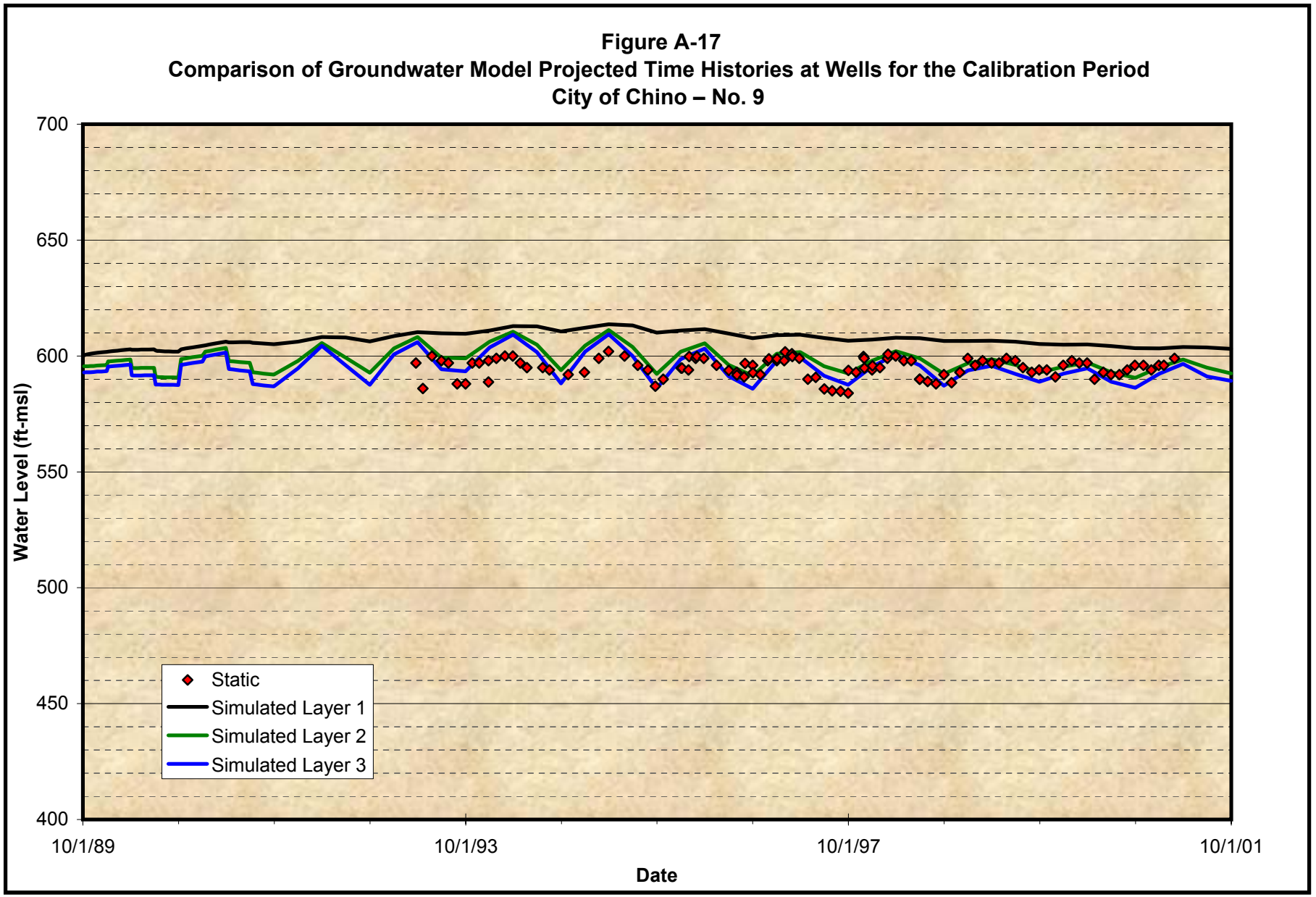


**Figure A-18**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Pomona – No. 29**

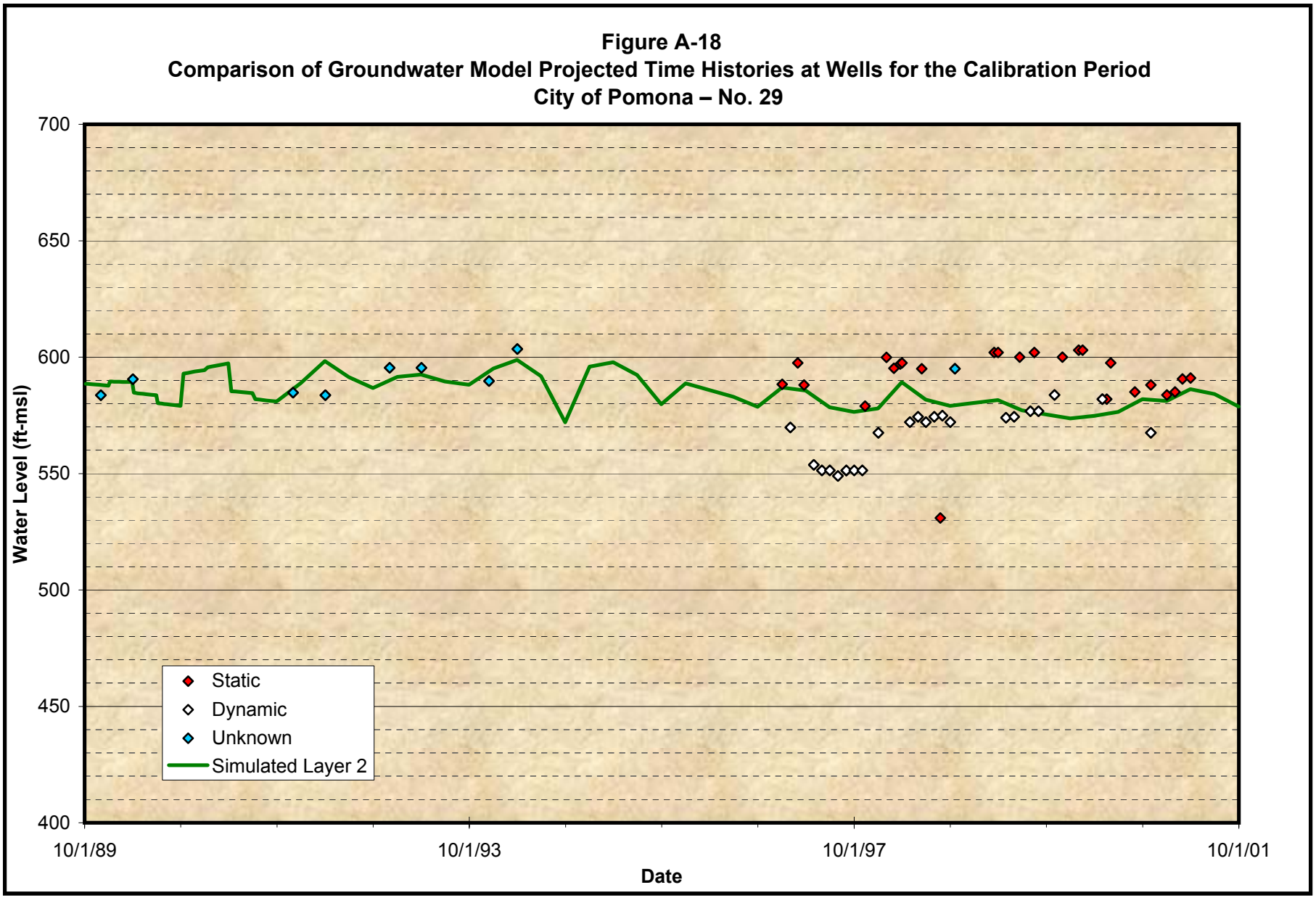


**Figure A-19**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino – No. 11**

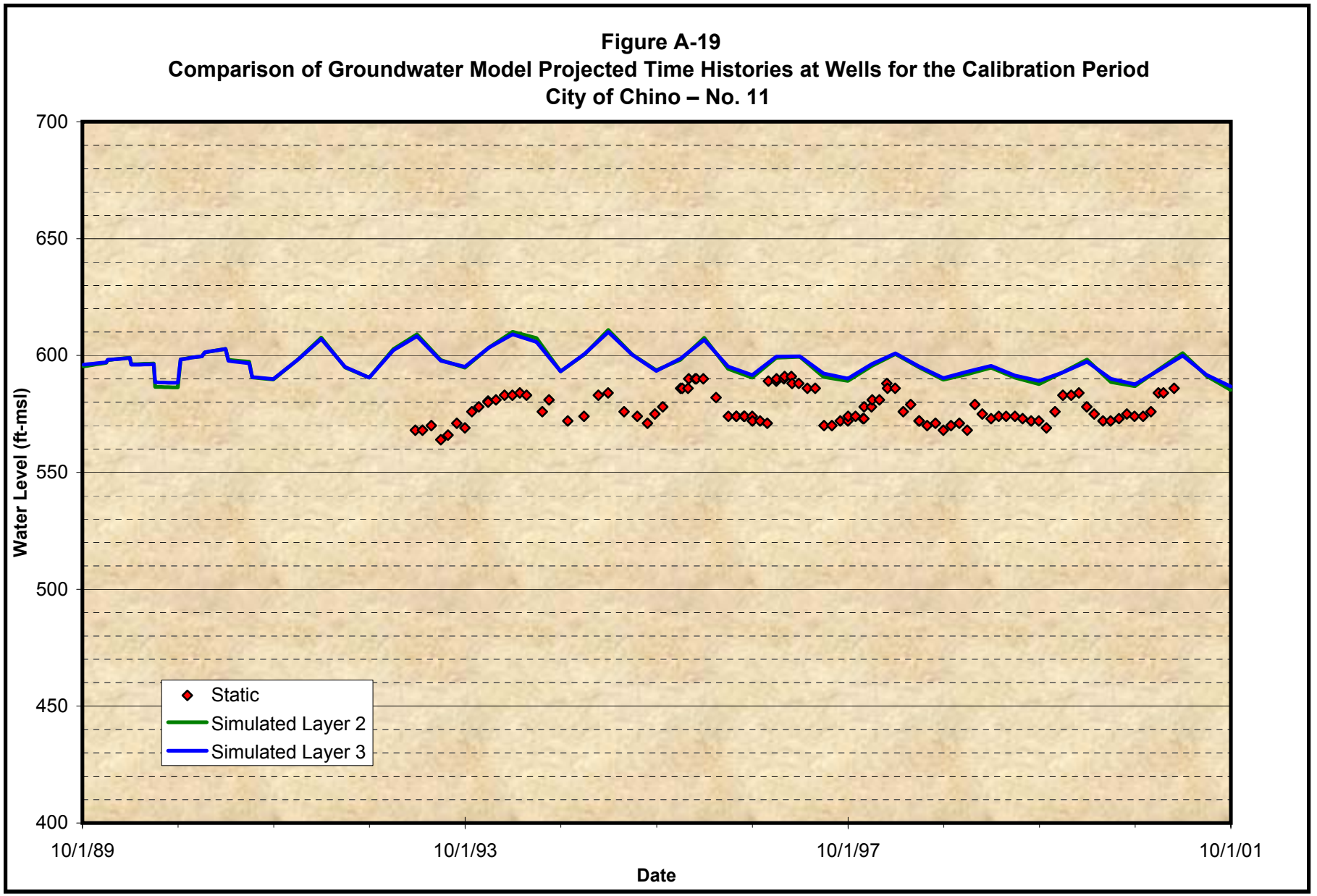


**Figure A-20**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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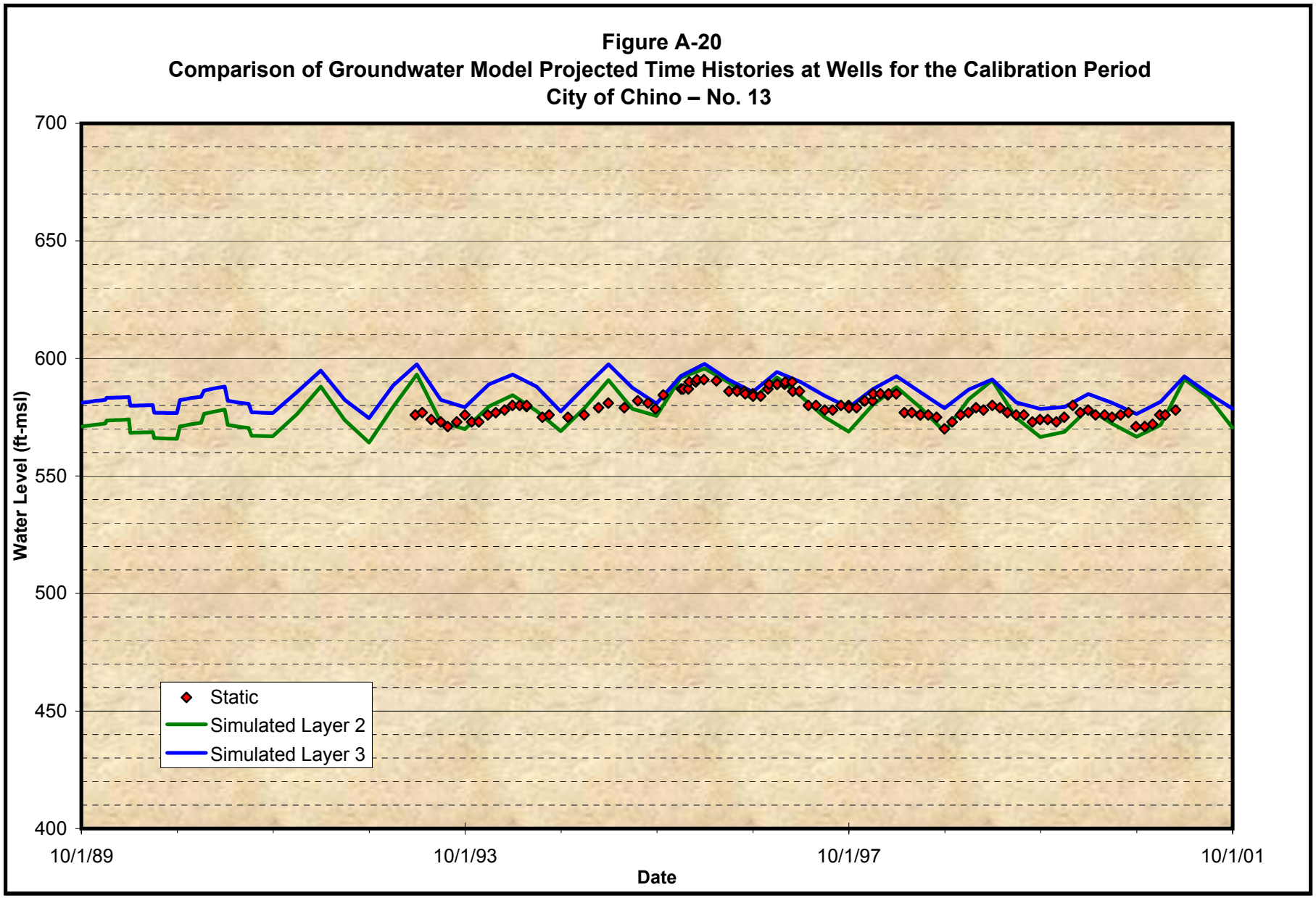


**Figure A-21**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino – No. 4**

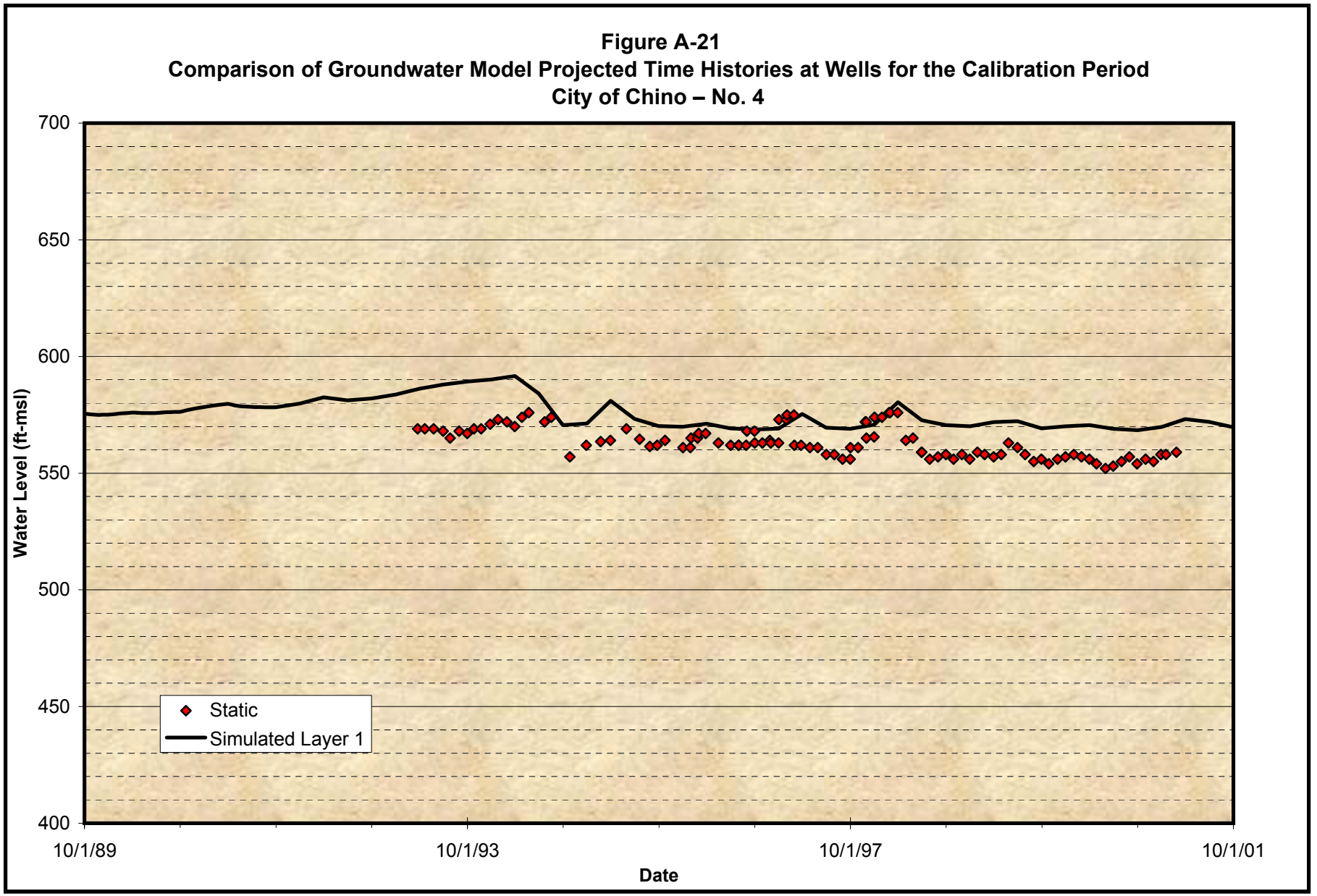


**Figure A-22**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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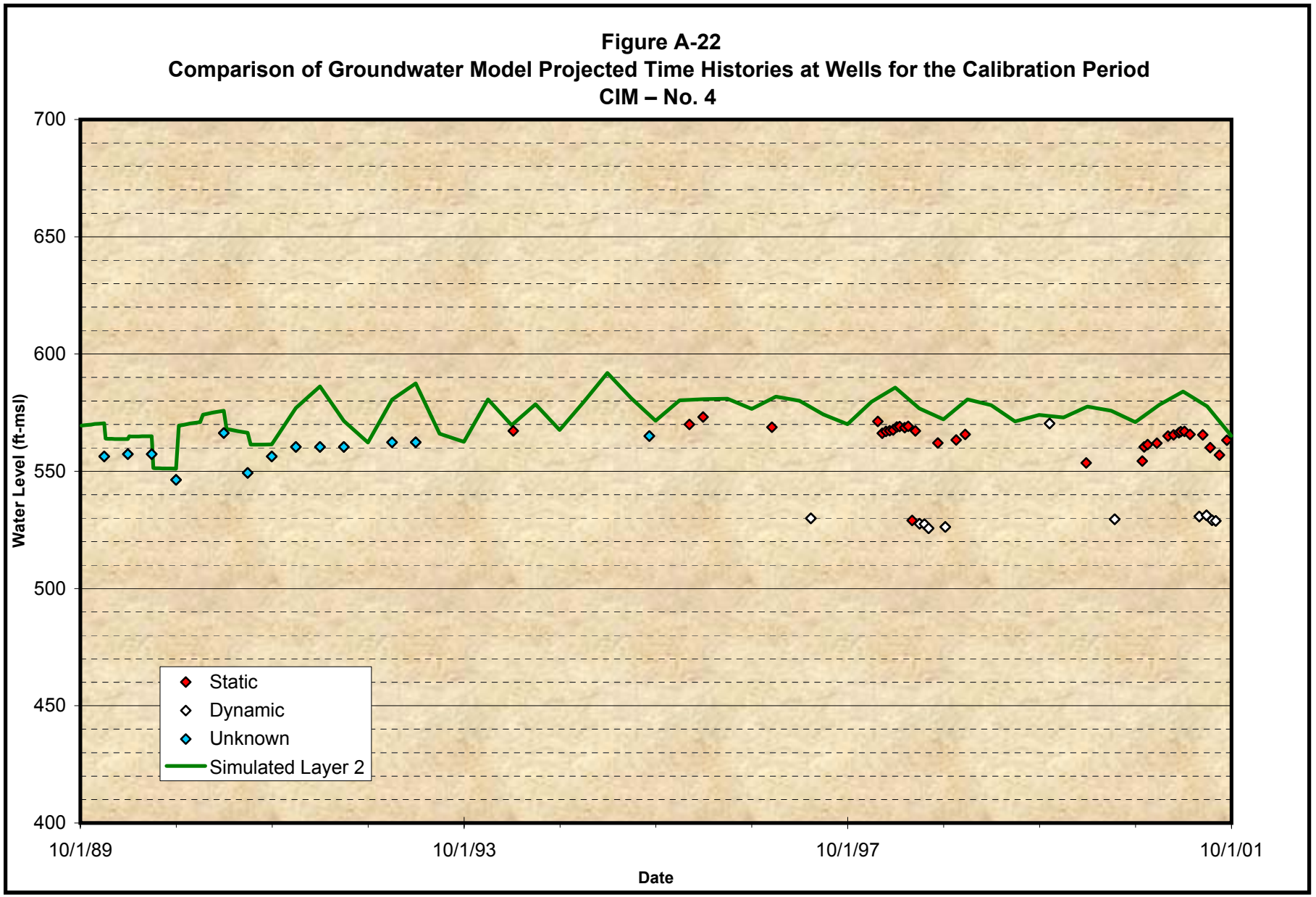


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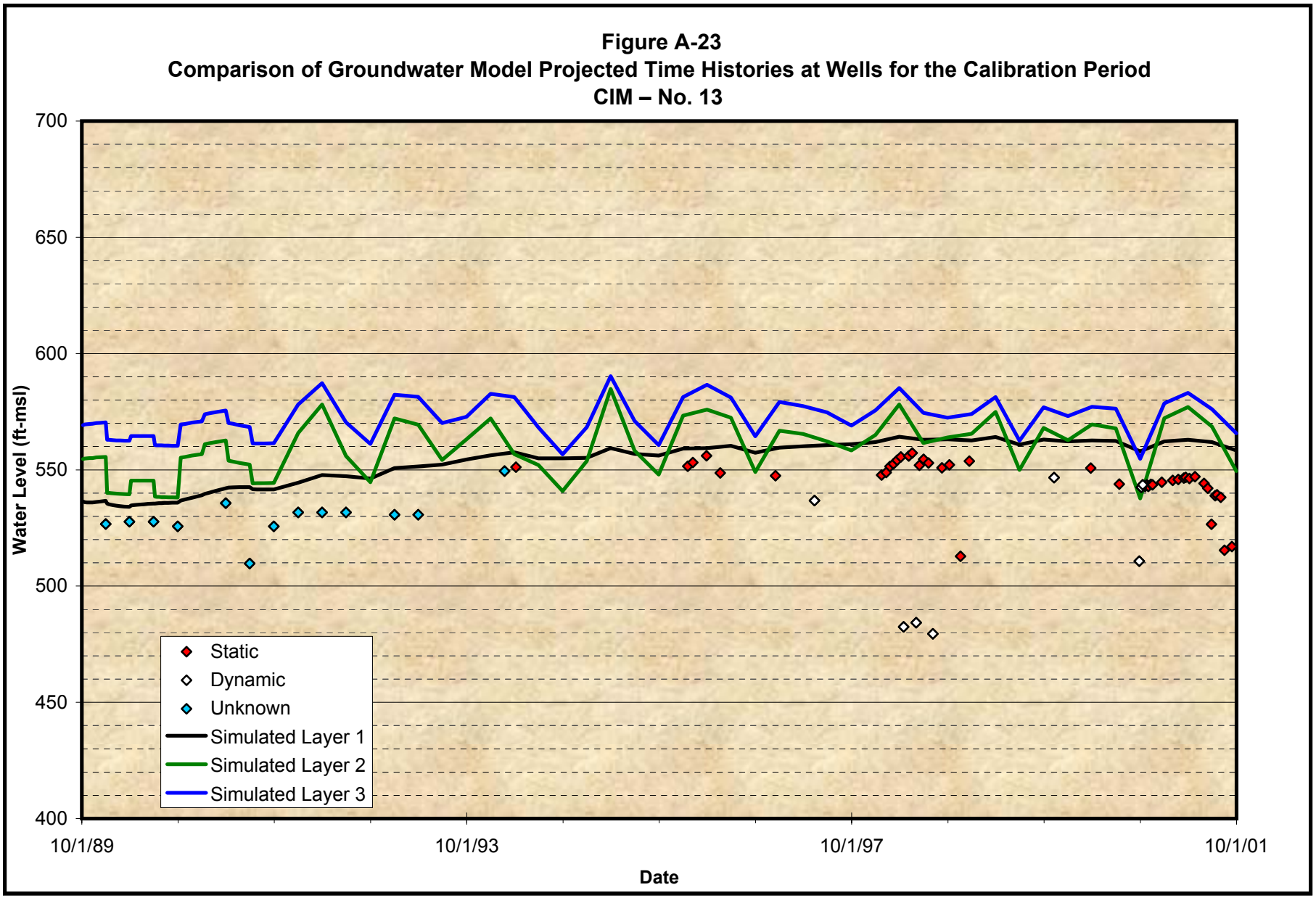


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**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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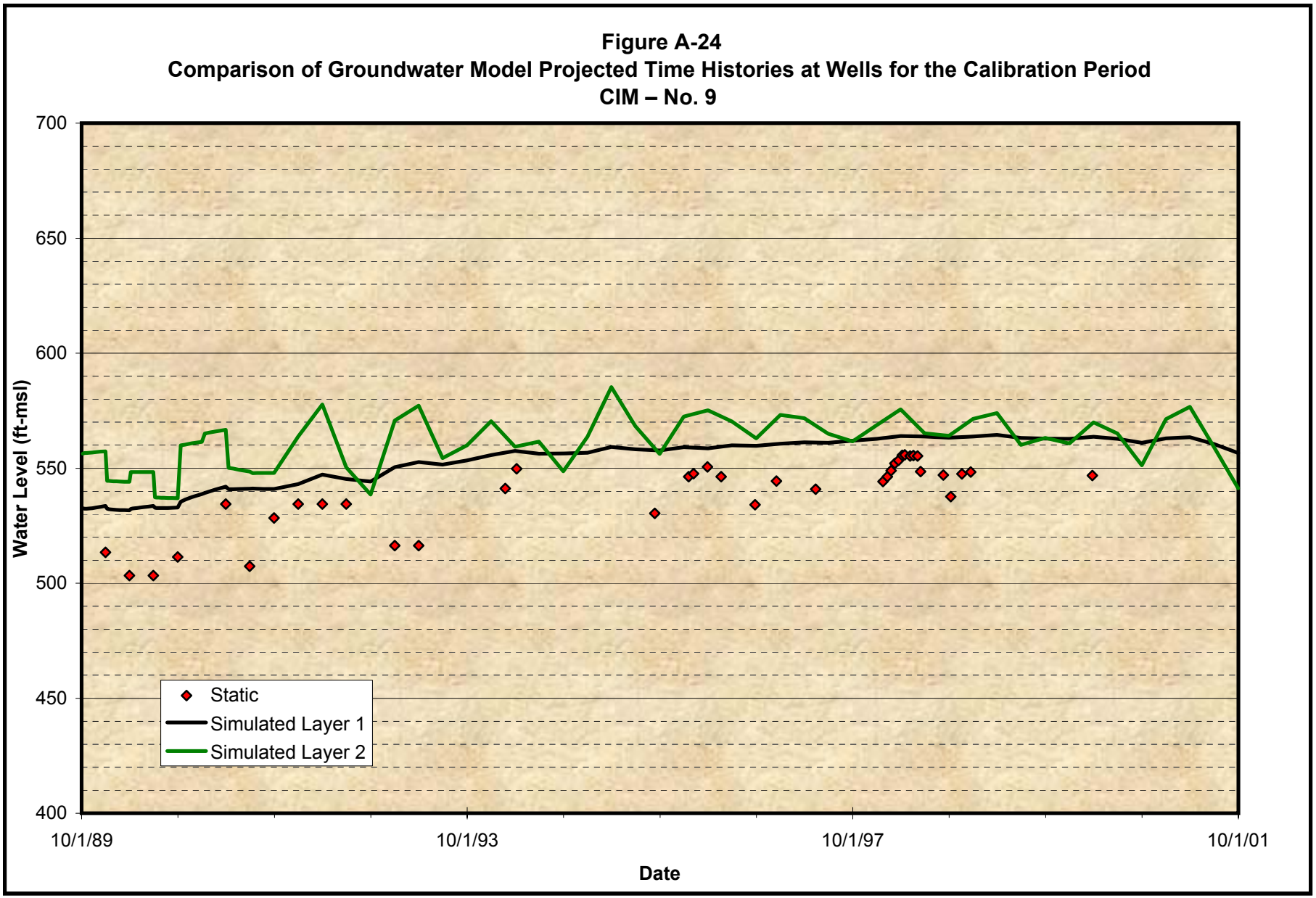


**Figure A-25**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino Hills – No. 18A**

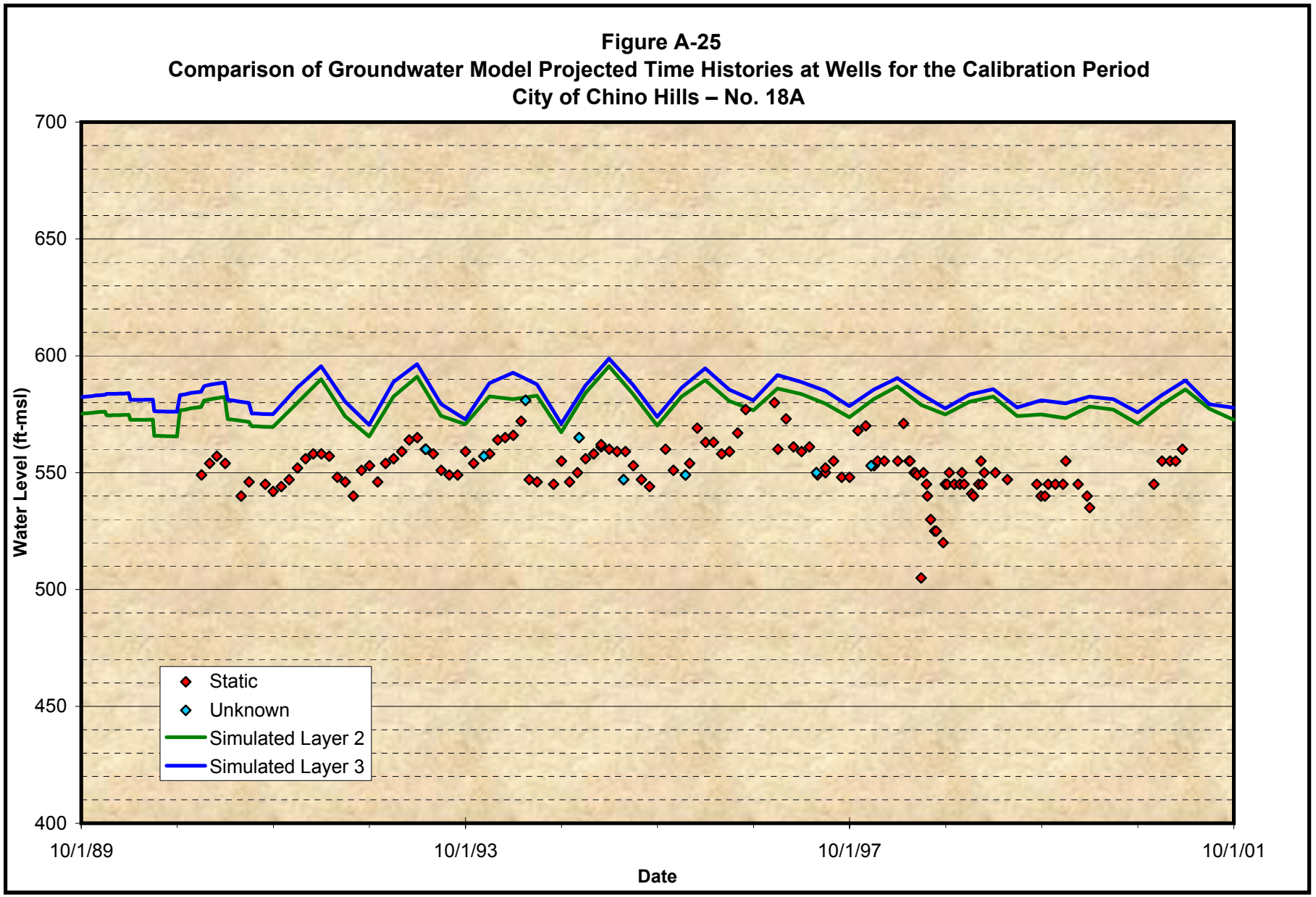


**Figure A-26**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino Hills – No. 17**

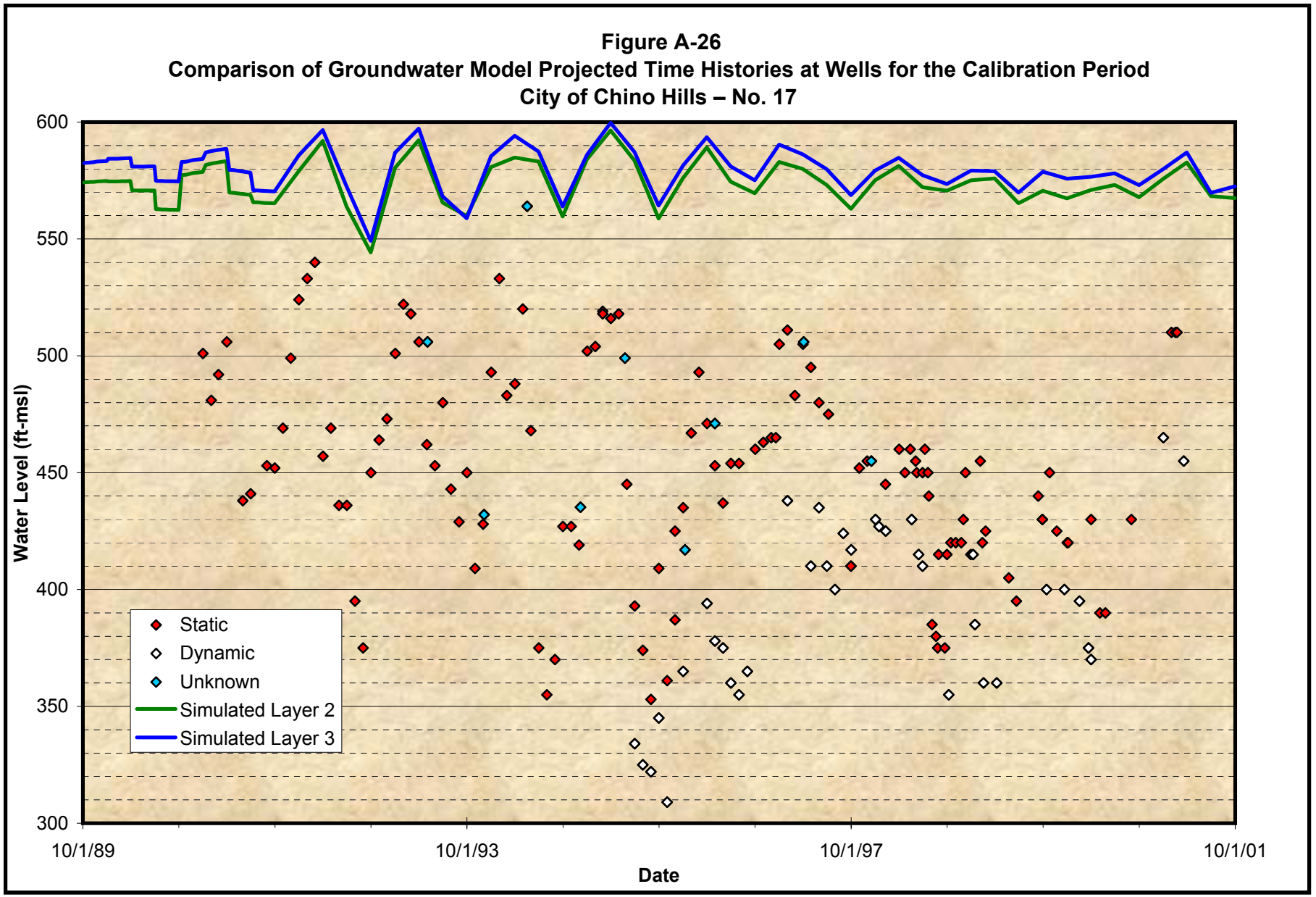


**Figure A-27**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino Hills – No. 15A**

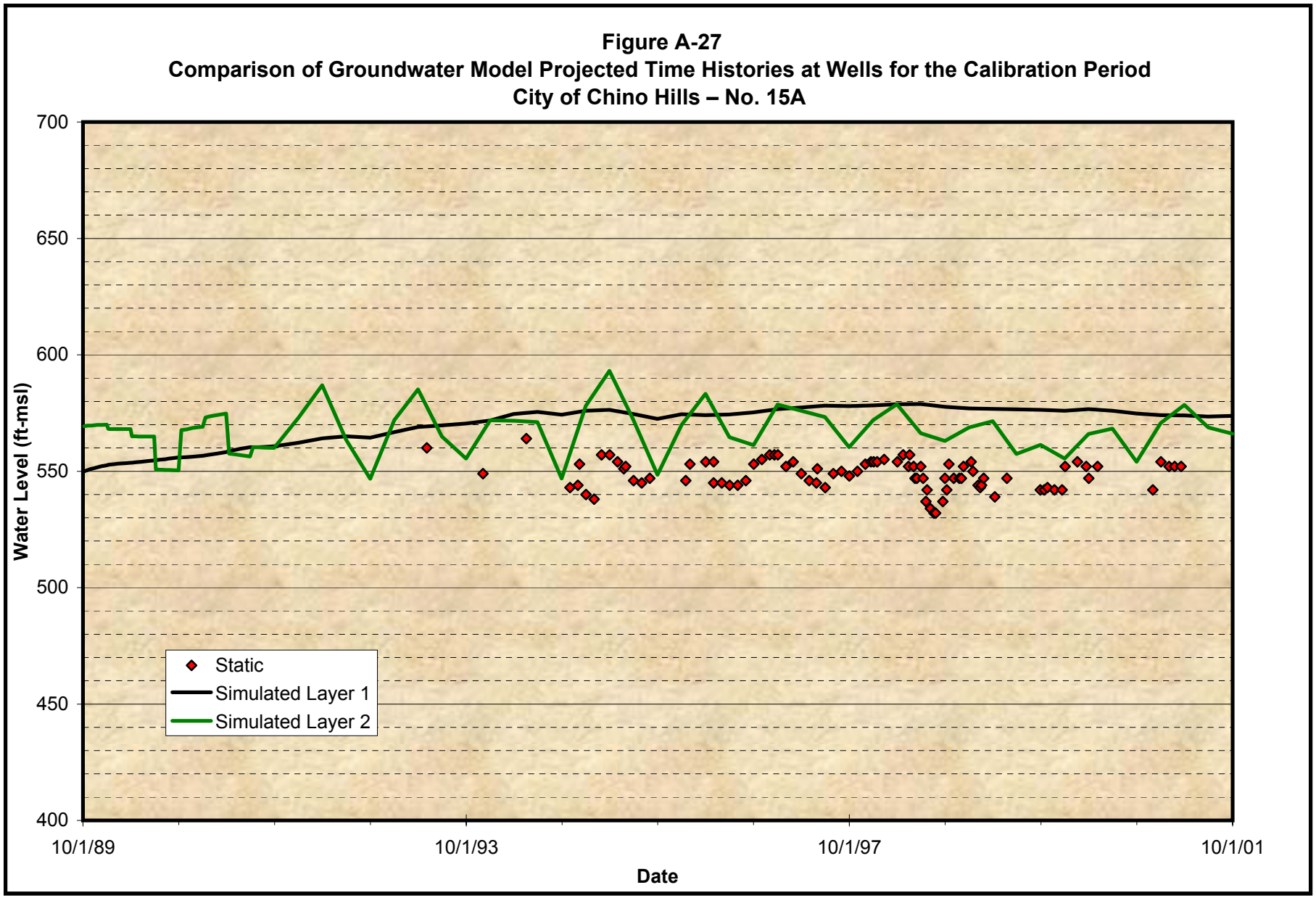


**Figure A-28**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Chino Hills – No. 15B**

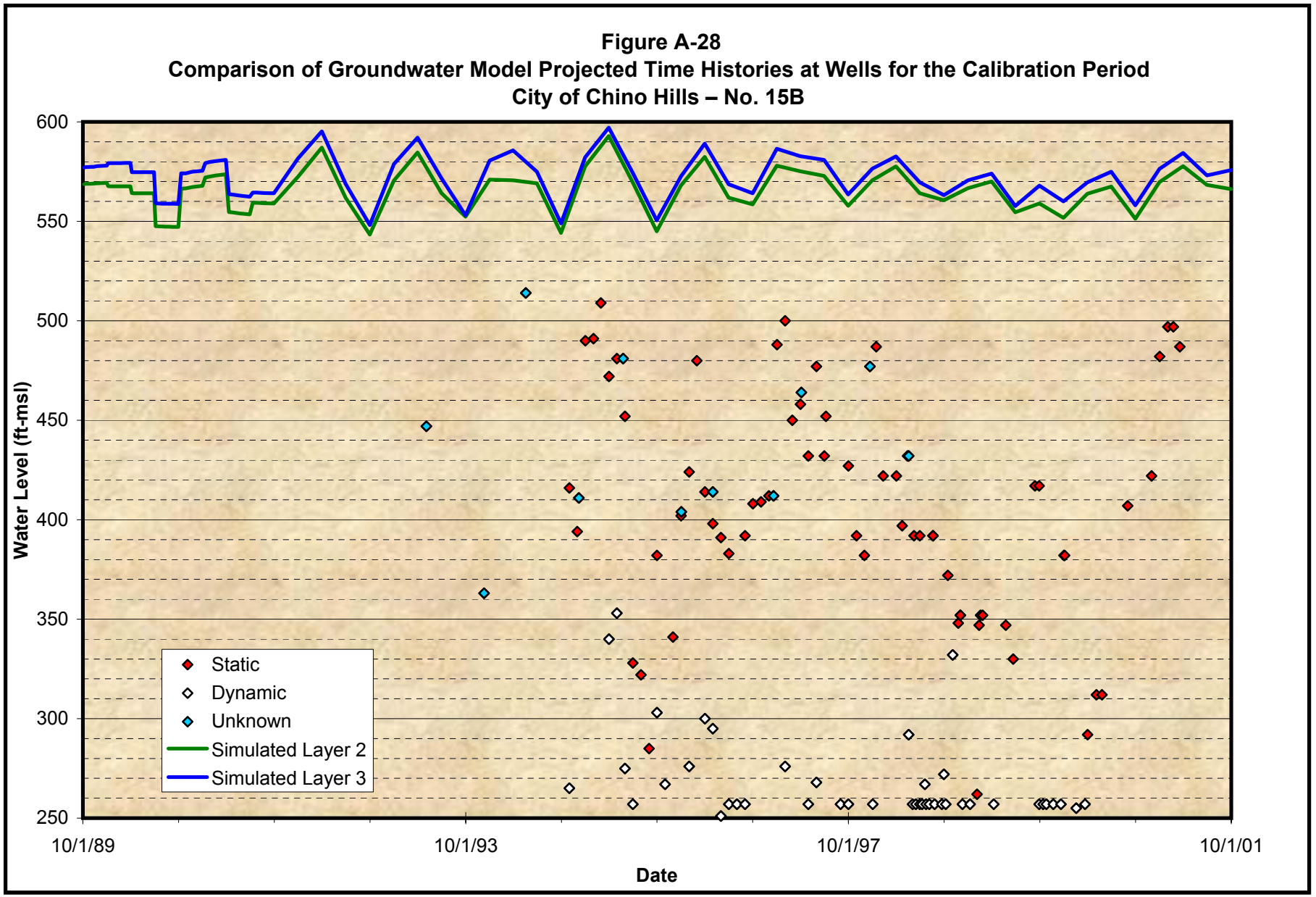


**Figure A-29**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Santa Ana River Water Company – No. 7**

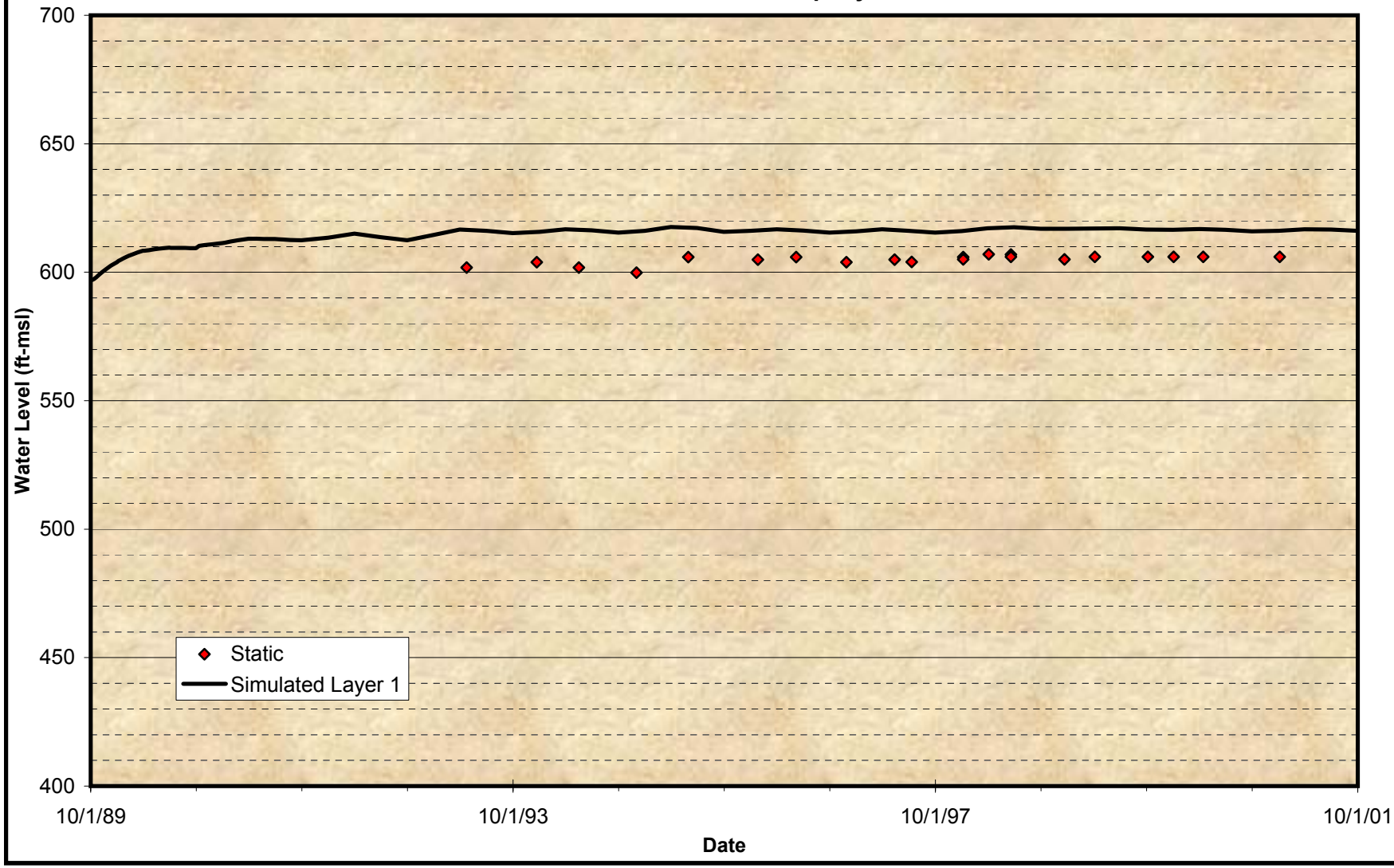


**Figure A-30**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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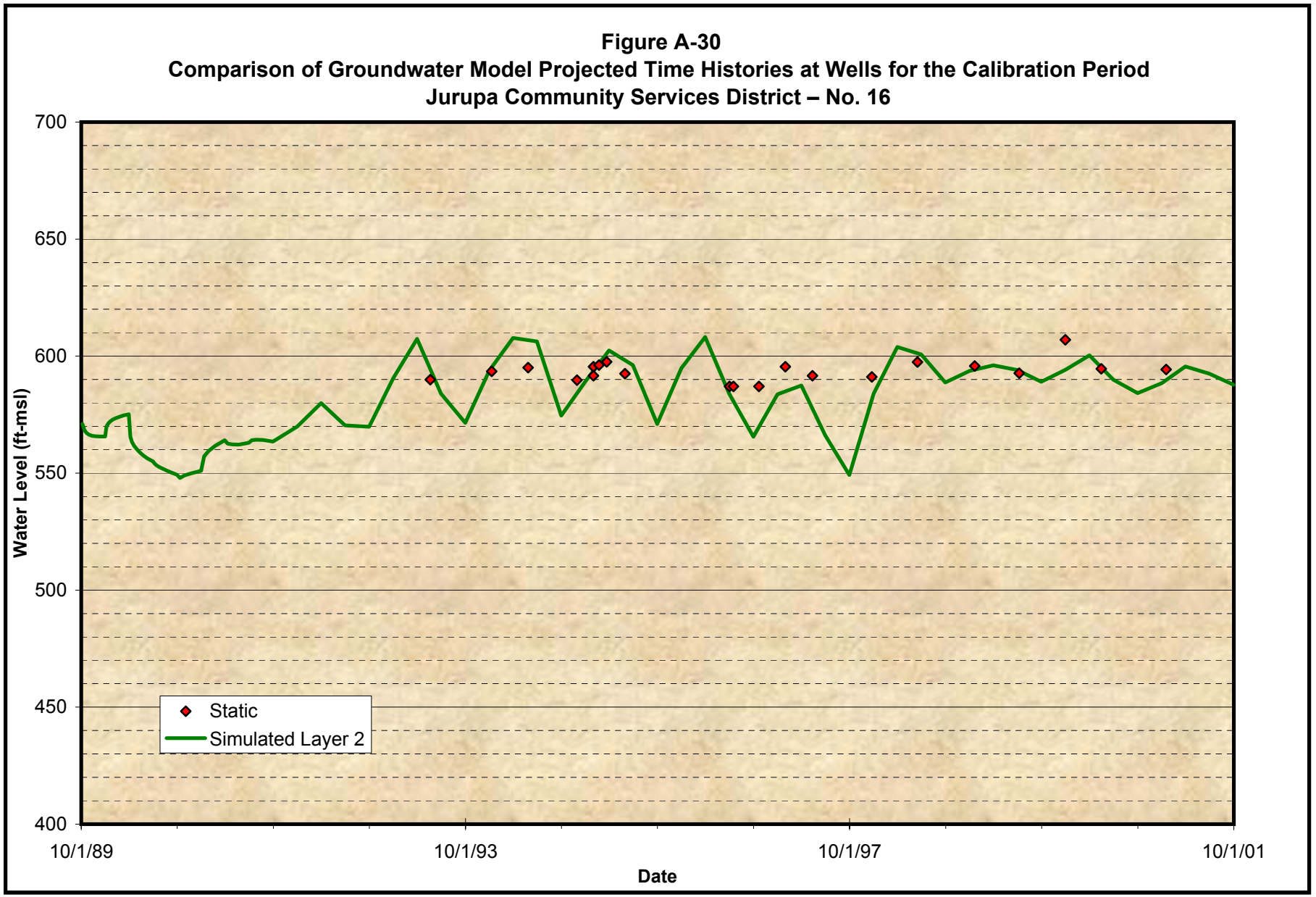


**Figure A-31**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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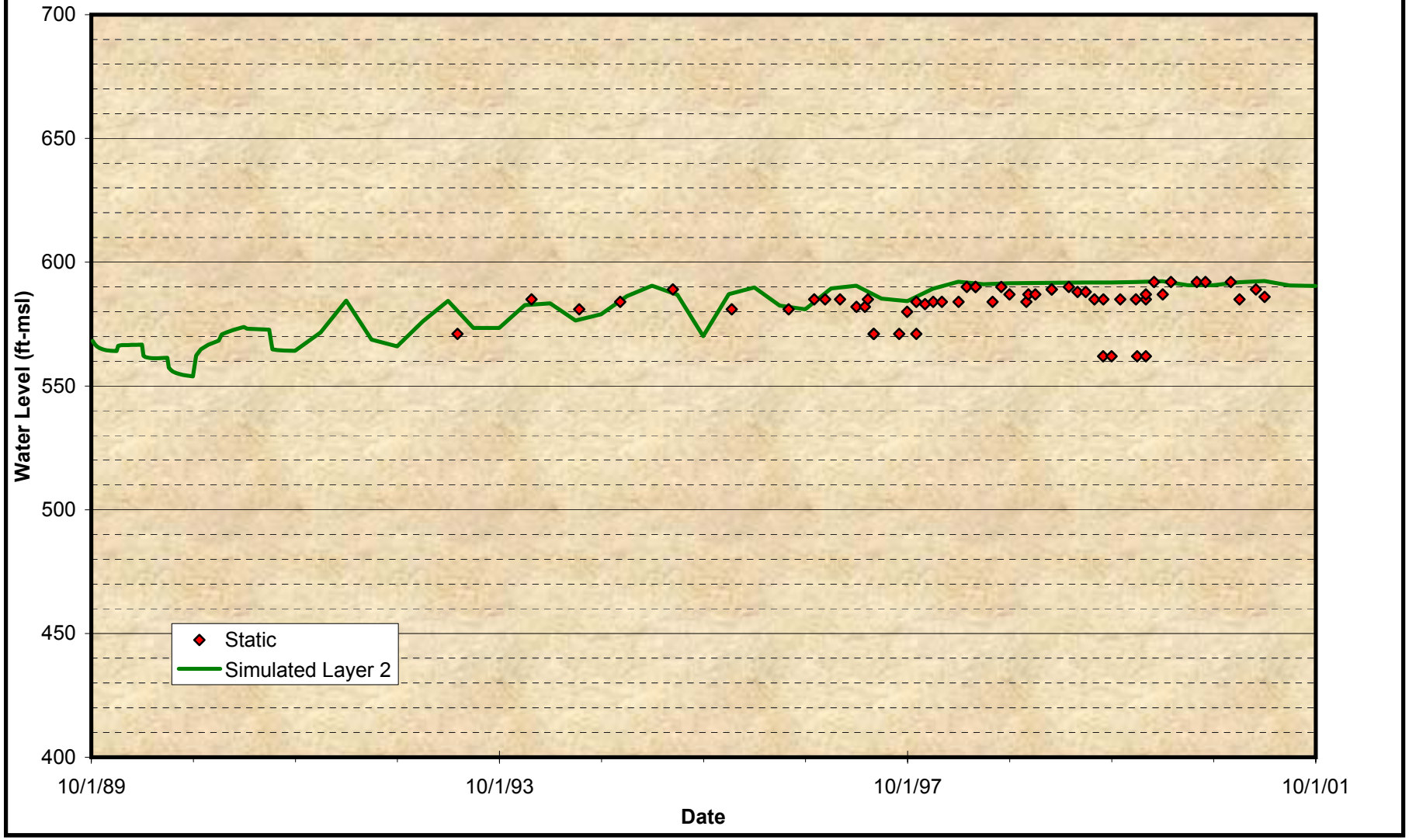


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**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
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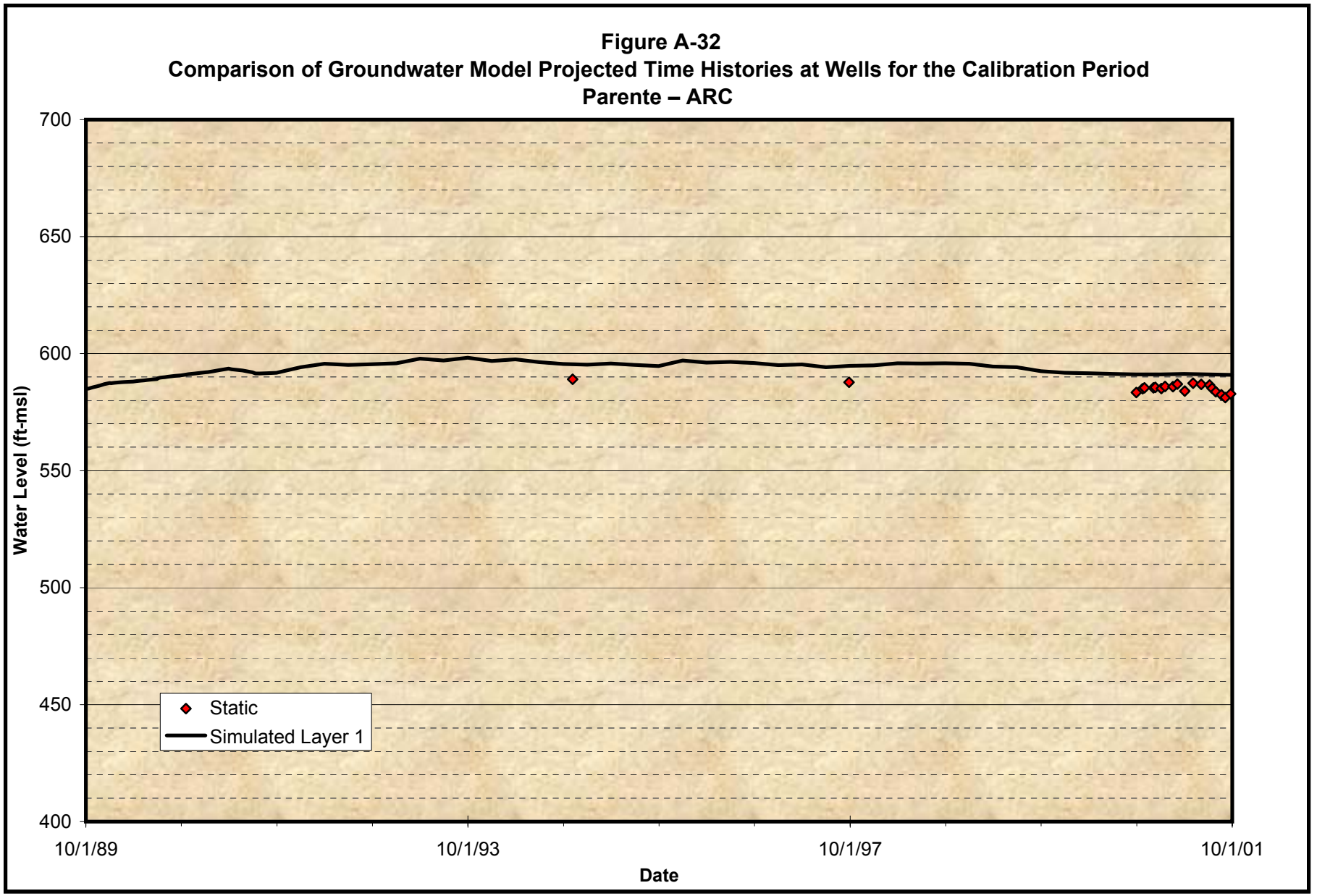


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**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Excelsior**

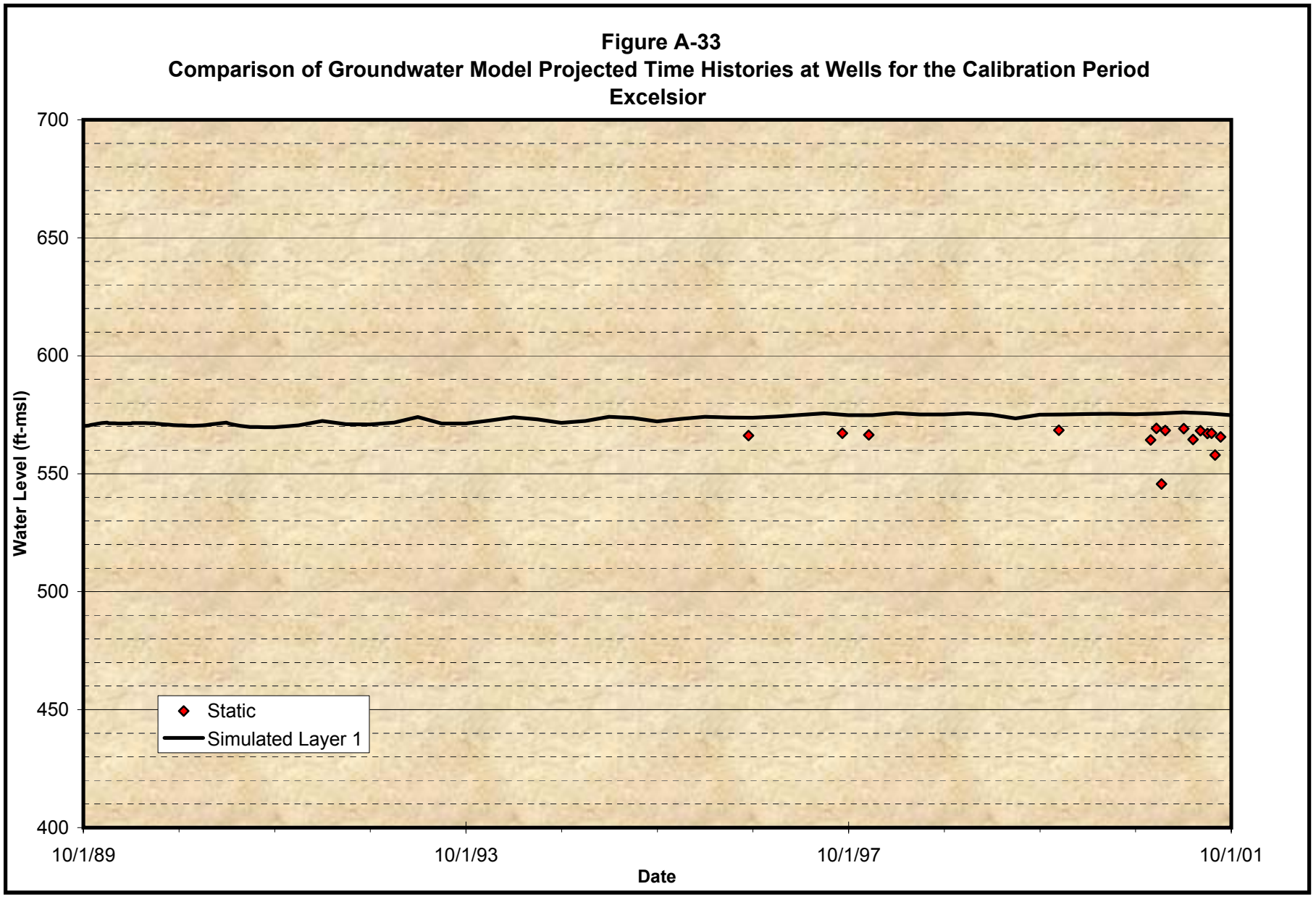


**Figure A-34**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Cardoza – No. B9**

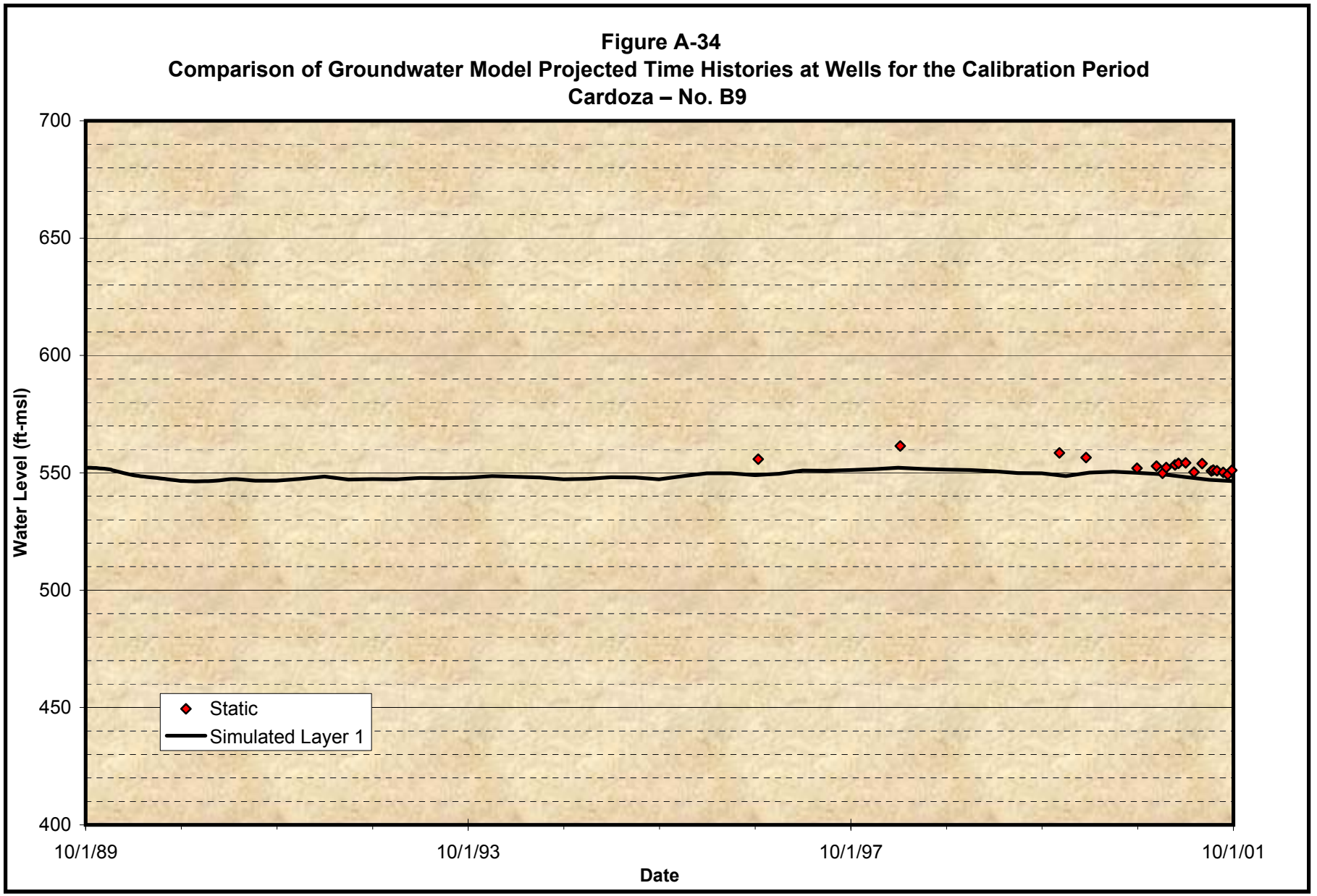


**Figure A-35**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Borba Dairy – No. 2**

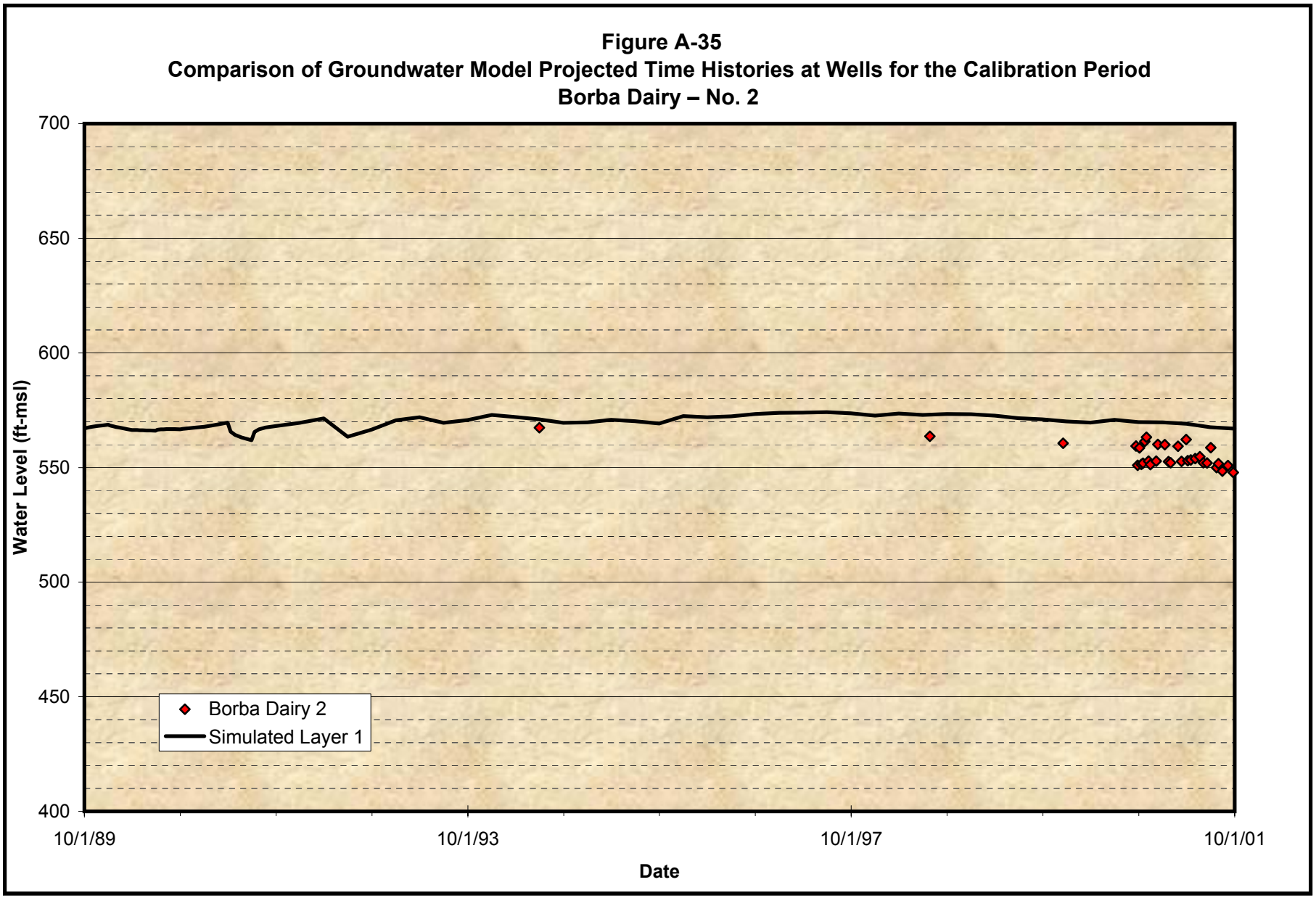


**Figure A-36**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Corona Dairy Ranch**

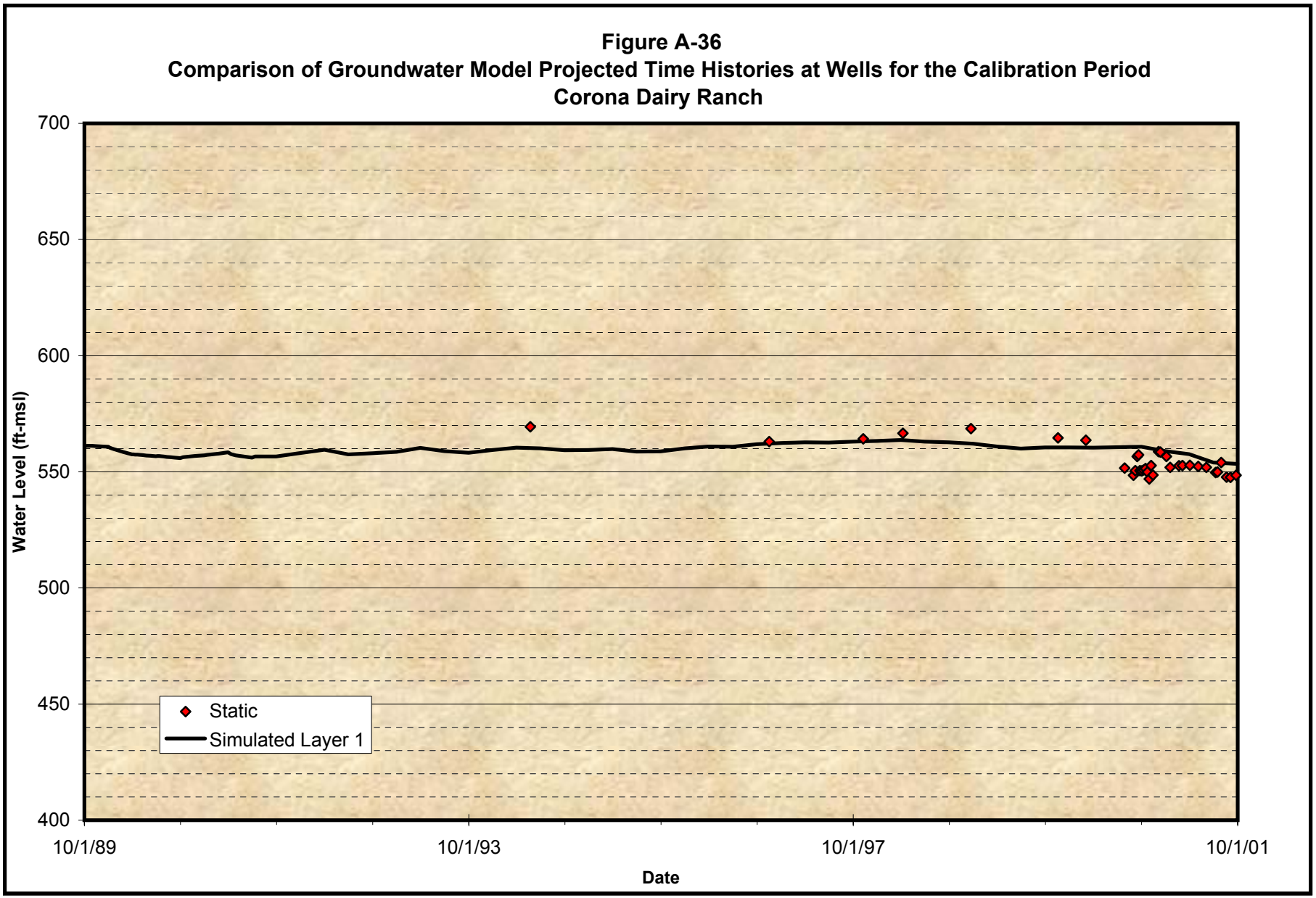


**Figure A-37**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**DeVries**

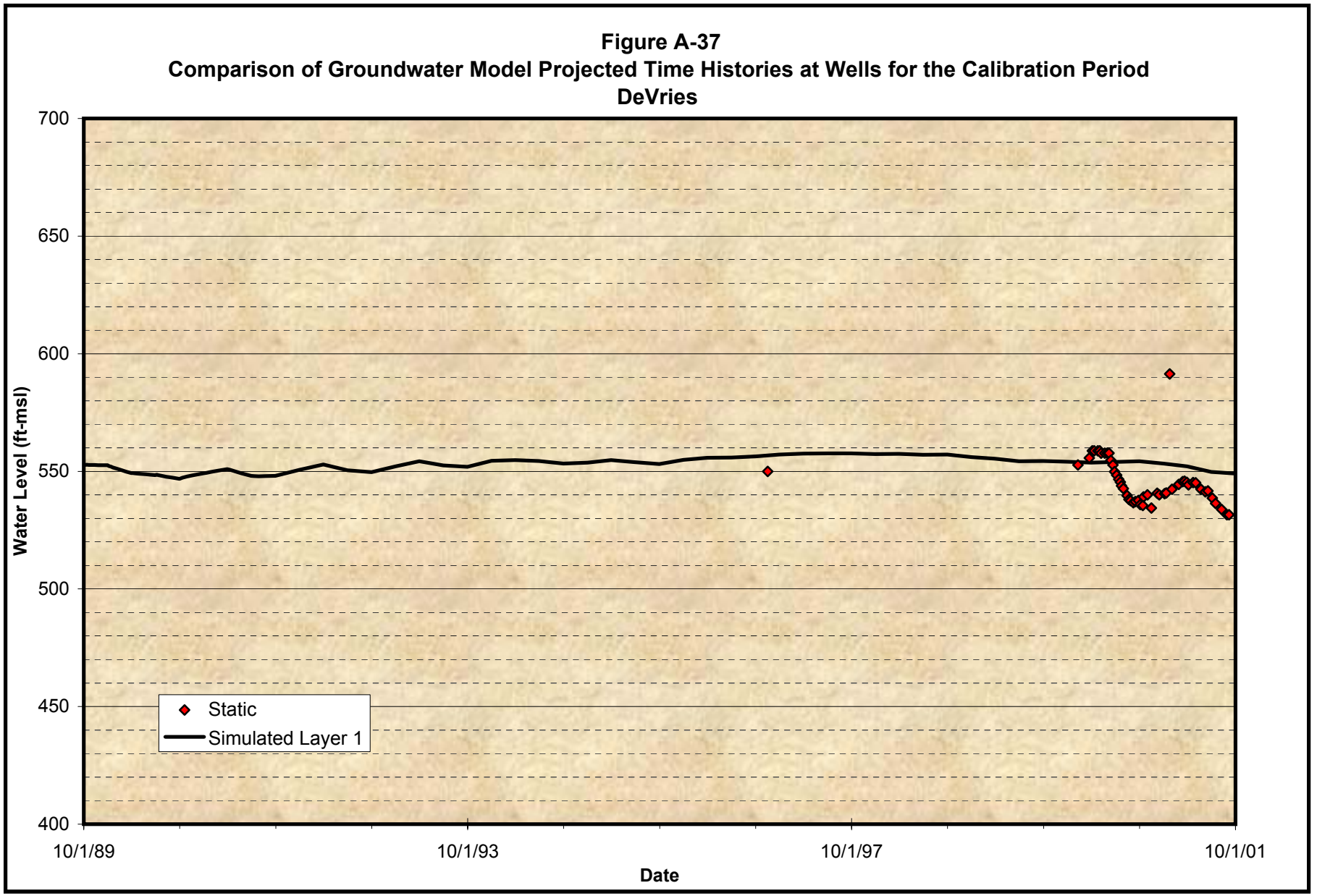


**Figure A-38**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**CIW – Monitoring Well No. 2**

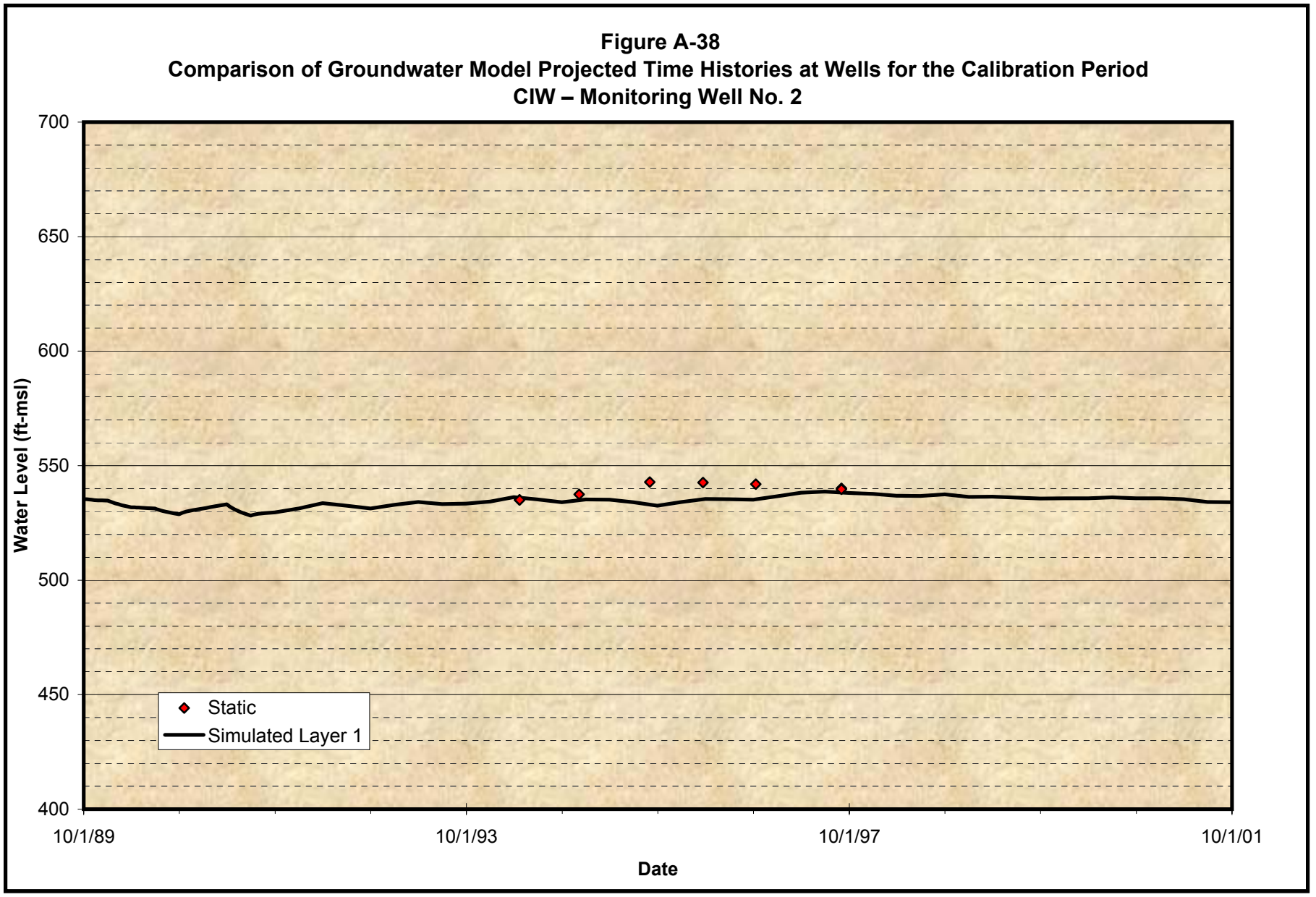


**Figure A-39**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Barthelemy**

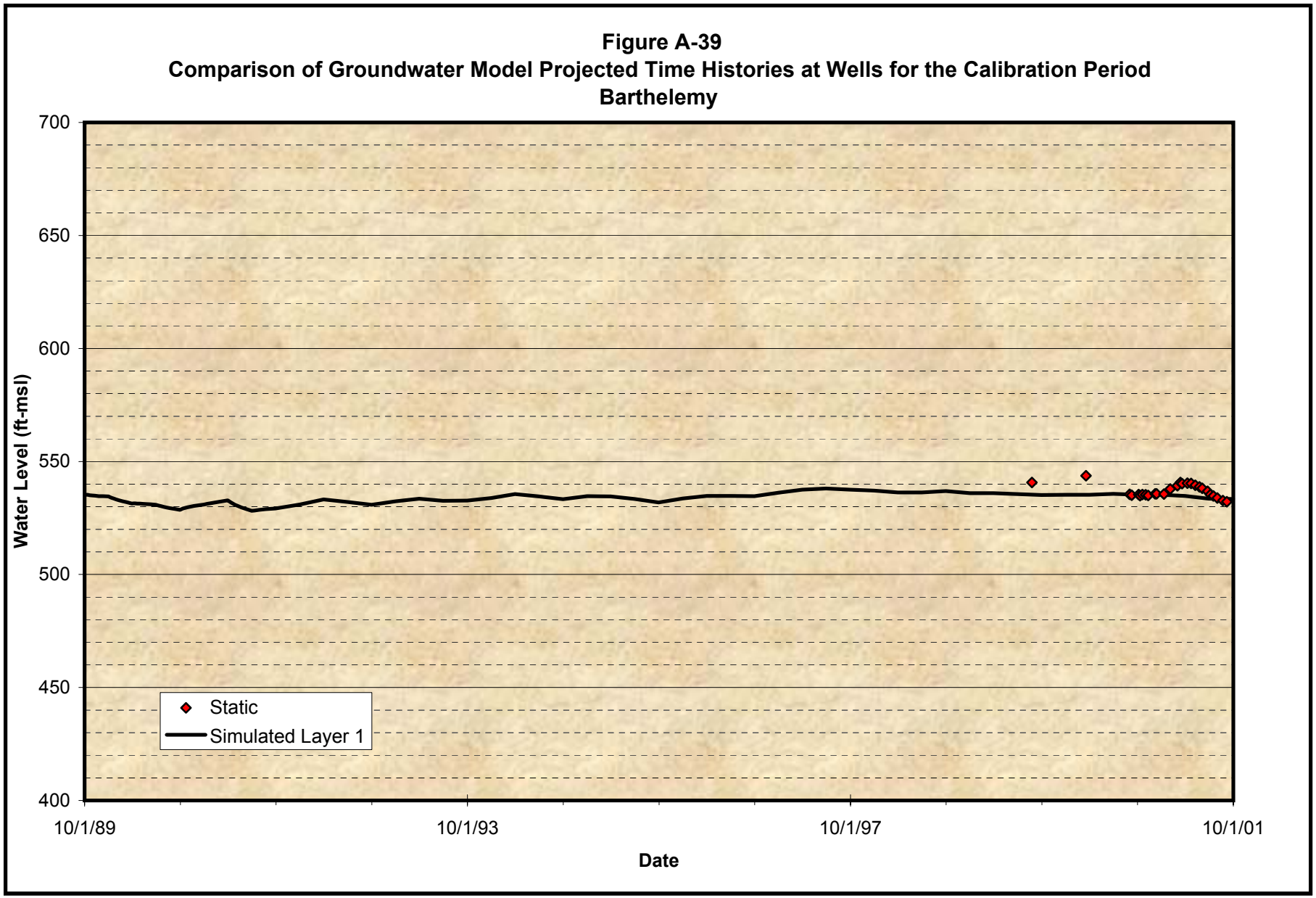


**Figure A-40**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Lekkerkerker – No. 2**

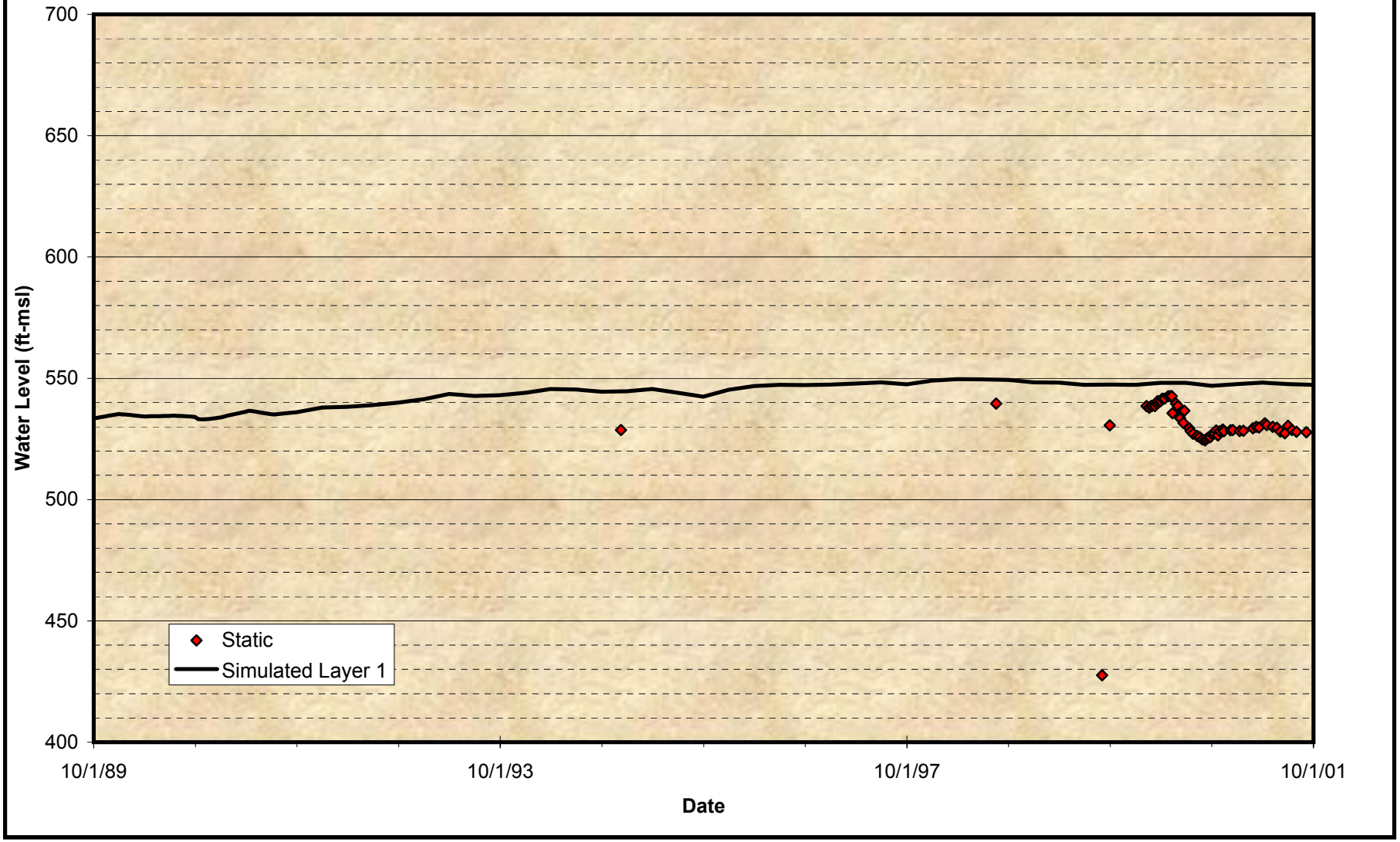


**Figure A-41**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**Tollerup**

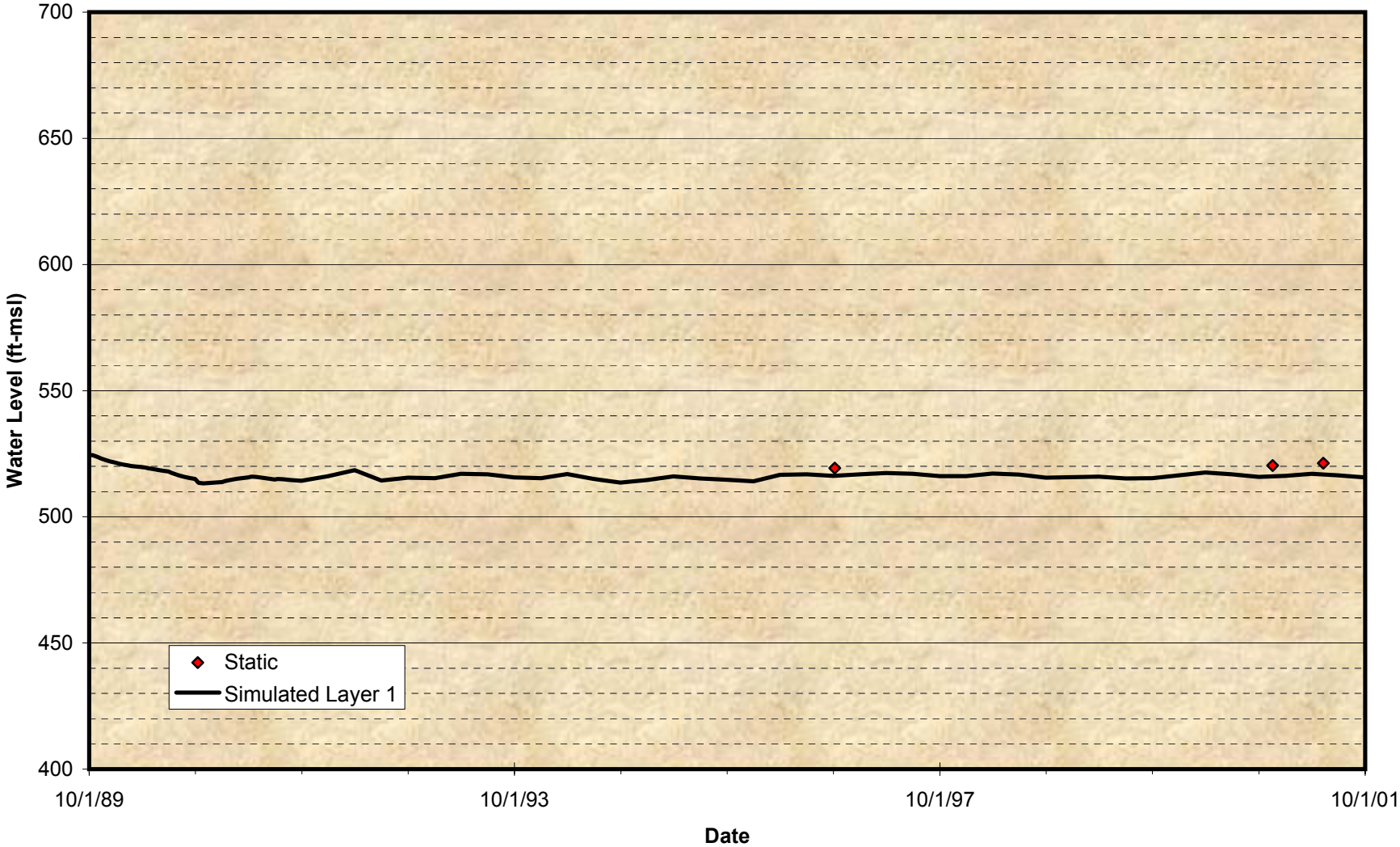


**Figure A-42**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Corona – No. 7**

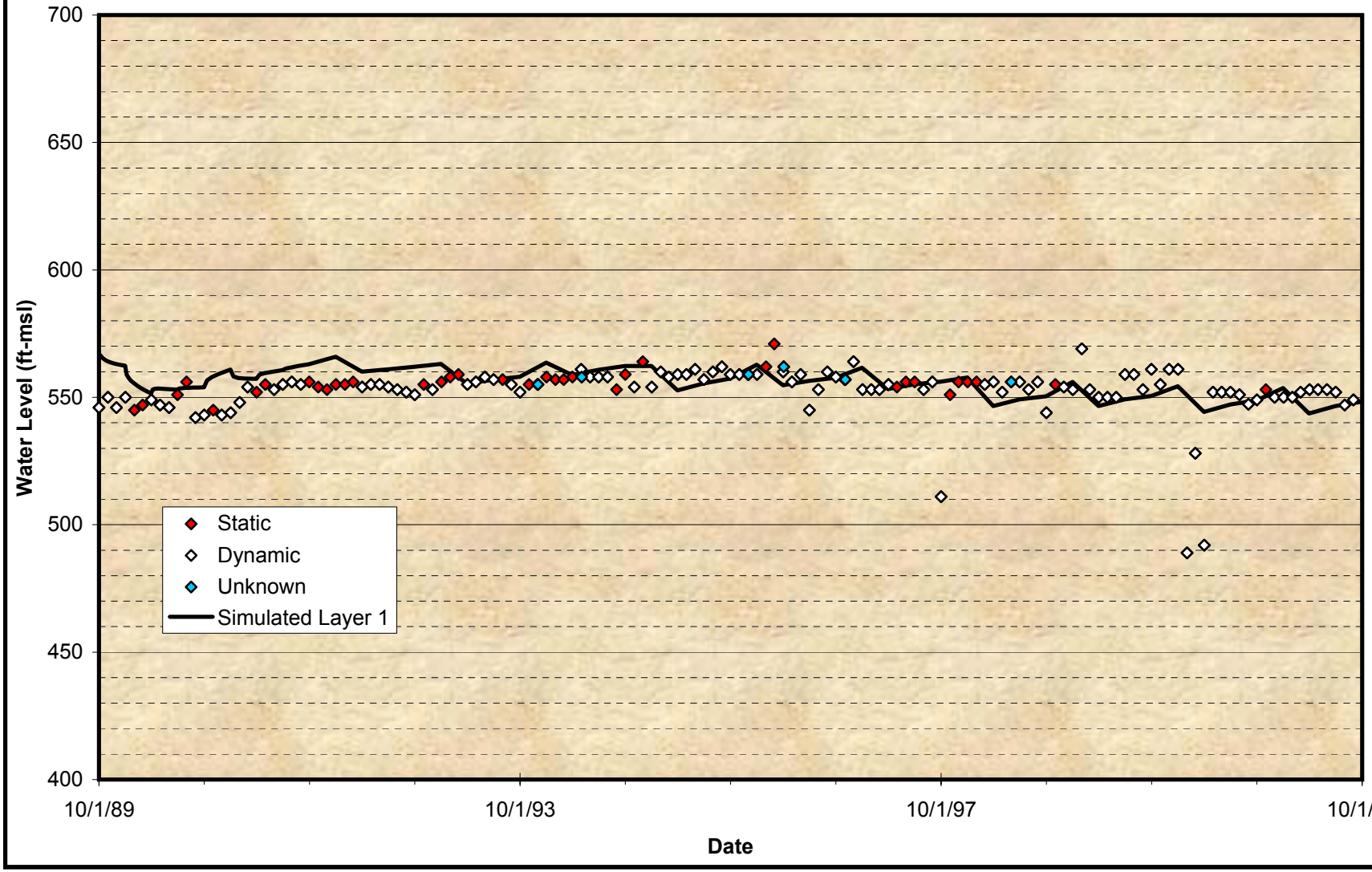


**Figure A-43**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Corona – No. 14**

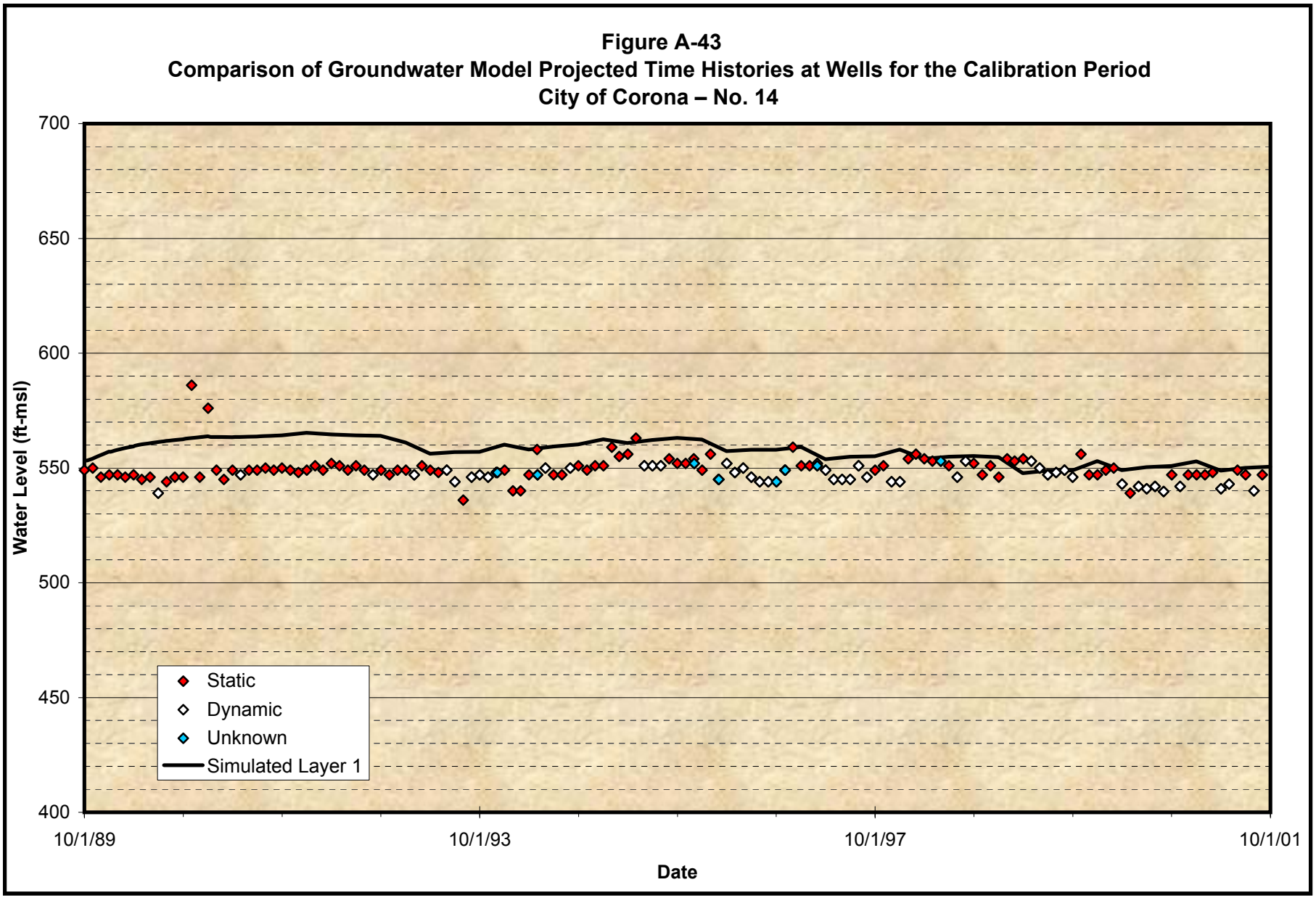


**Figure A-44**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Corona – No. 15**

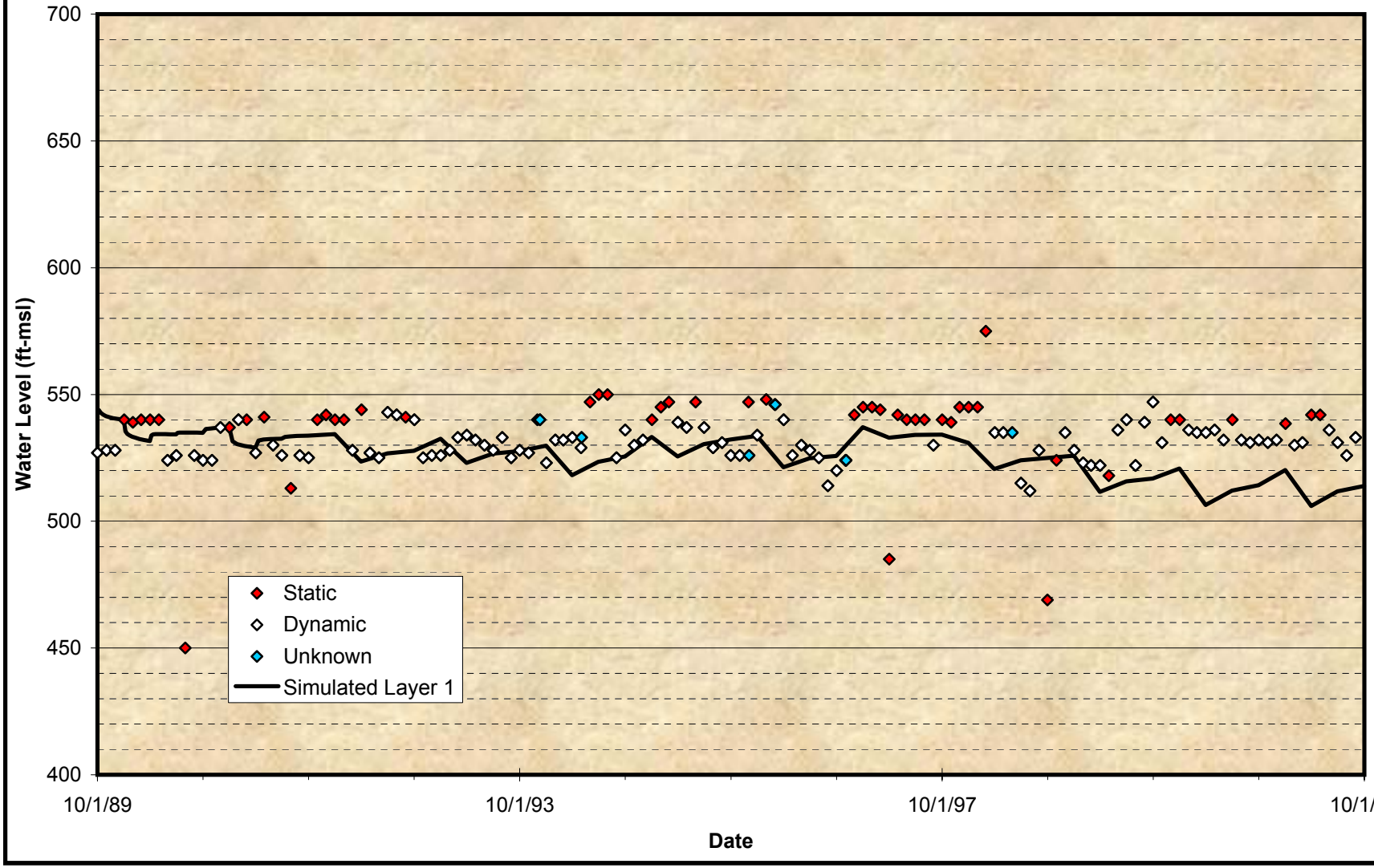


**Figure A-45**
**Comparison of Groundwater Model Projected Time Histories at Wells for the Calibration Period**
**City of Corona – No. 12**

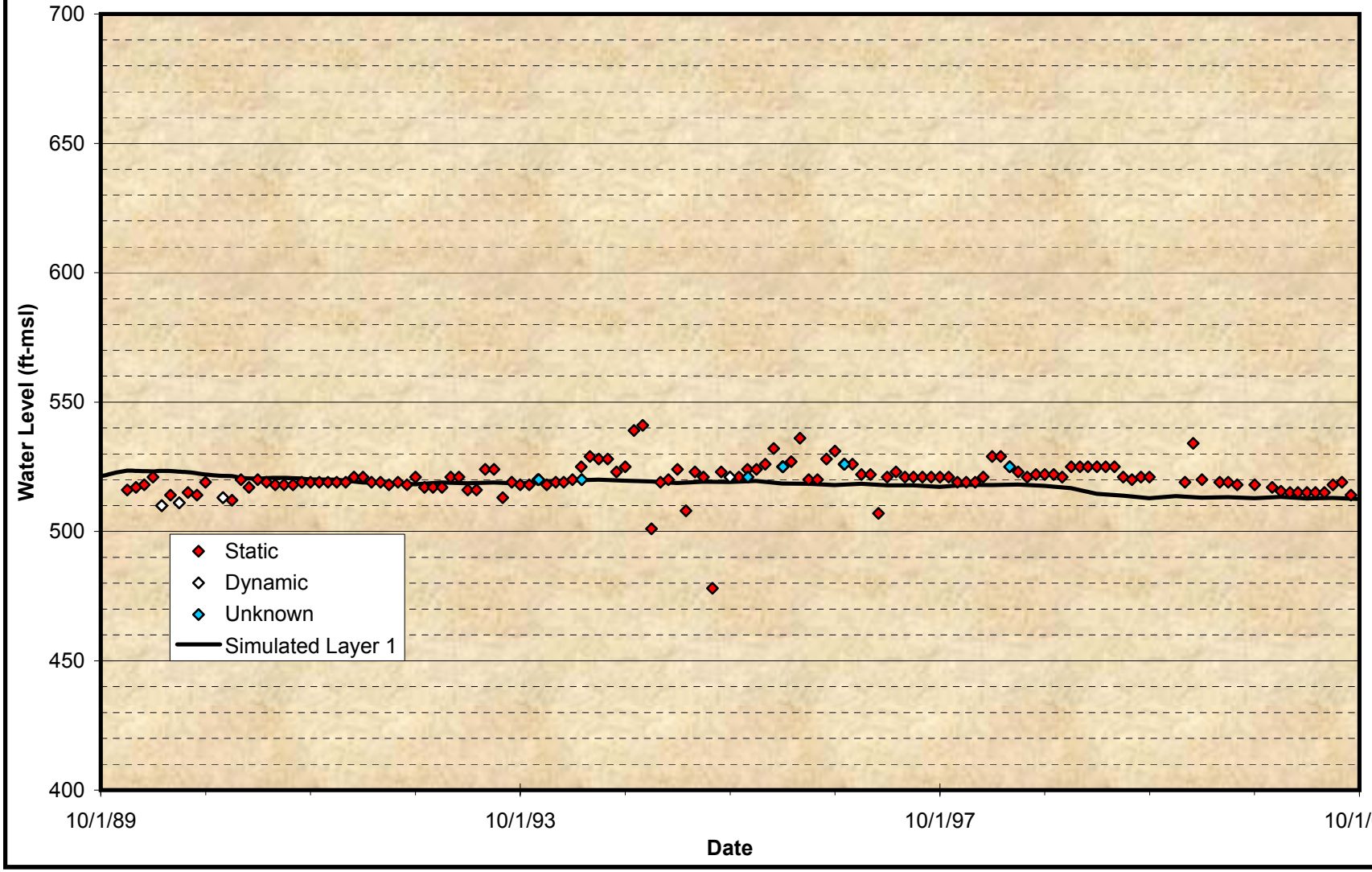


**Figure B-1**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**City of Rialto – Chino No. 1**

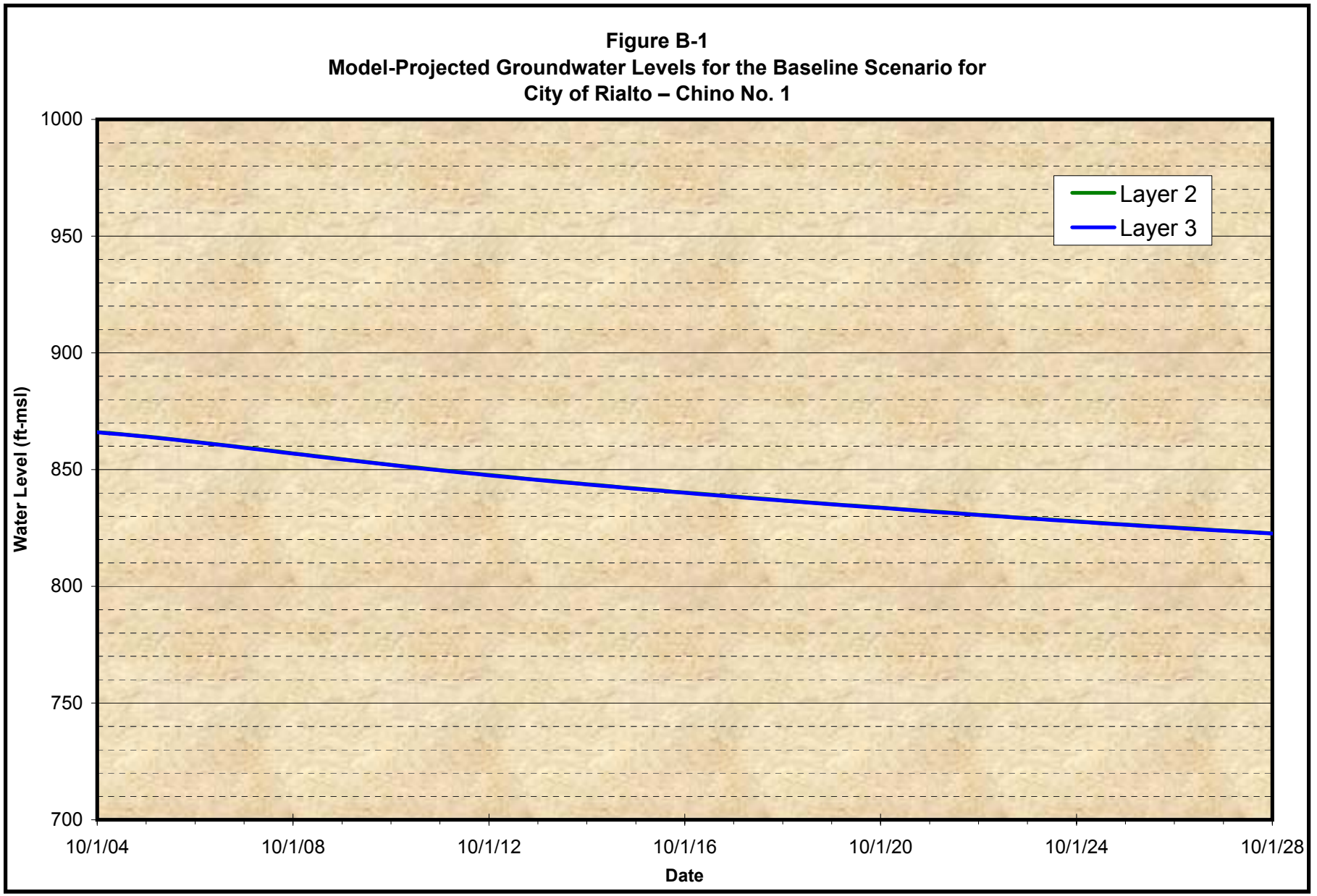


**Figure B-2**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**West San Bernardino County Water District – No. 27**

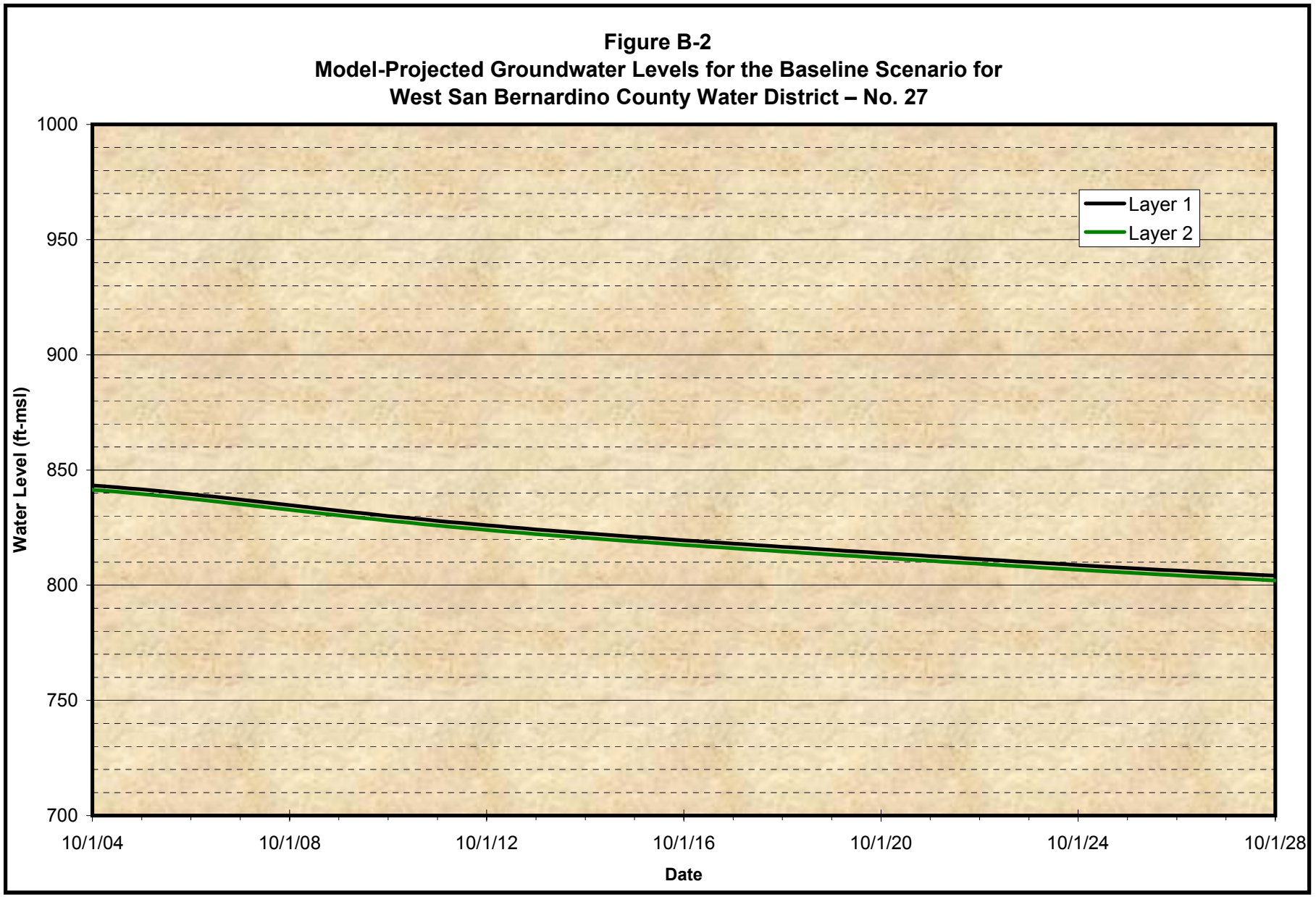


**Figure B-3**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**West San Bernardino County Water District – No. 37**

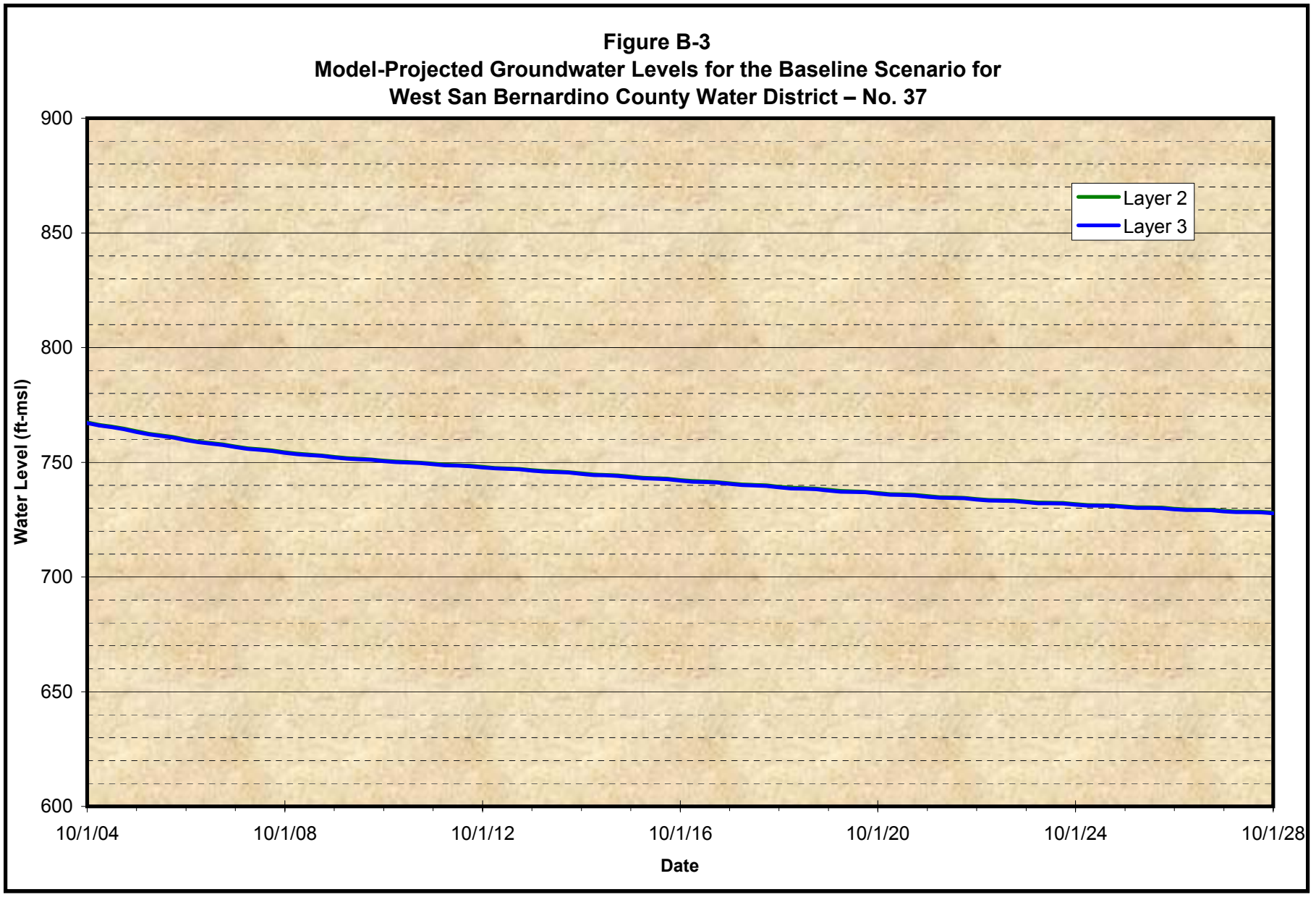


**Figure B-4**
**Model-Projected Groundwater Levels for the Baseline Scenario for Fontana Water Company – No. F31A**

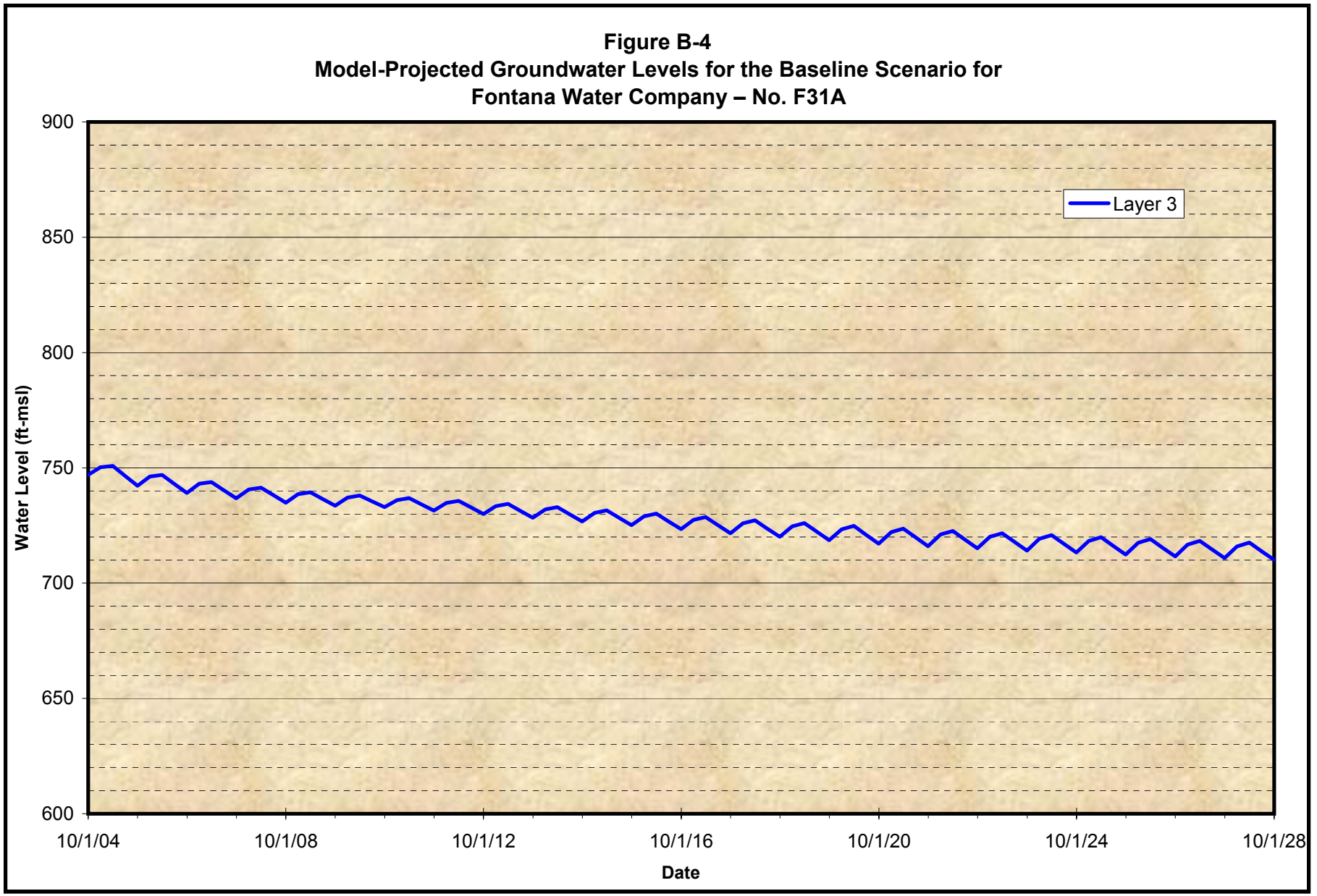


**Figure B-5**
**Model-Projected Groundwater Levels for the Baseline Scenario for Fontana Water Company – No. F3A**

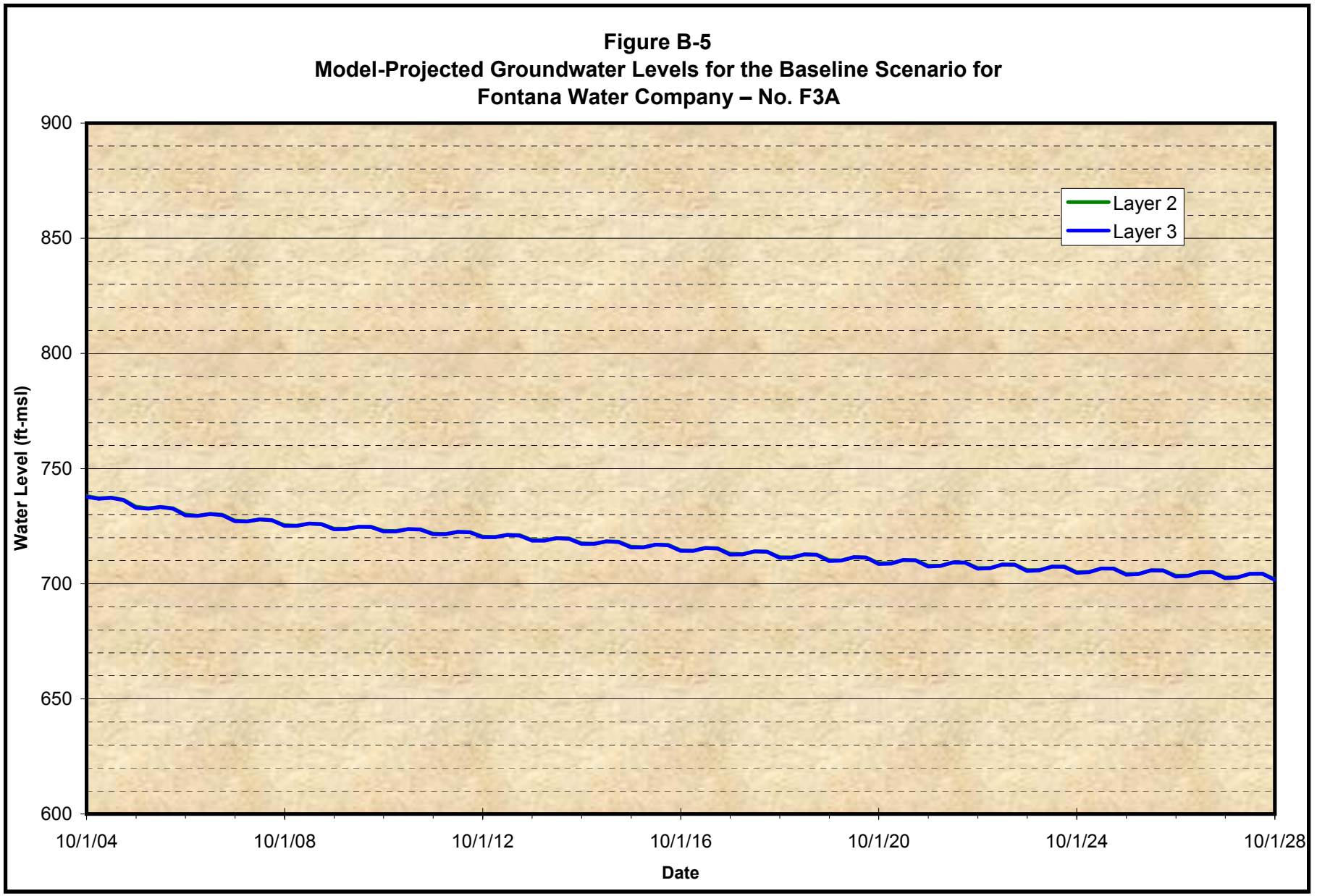


**Figure B-6**
**Model-Projected Groundwater Levels for the Baseline Scenario for Fontana Water Company – No. F21A**

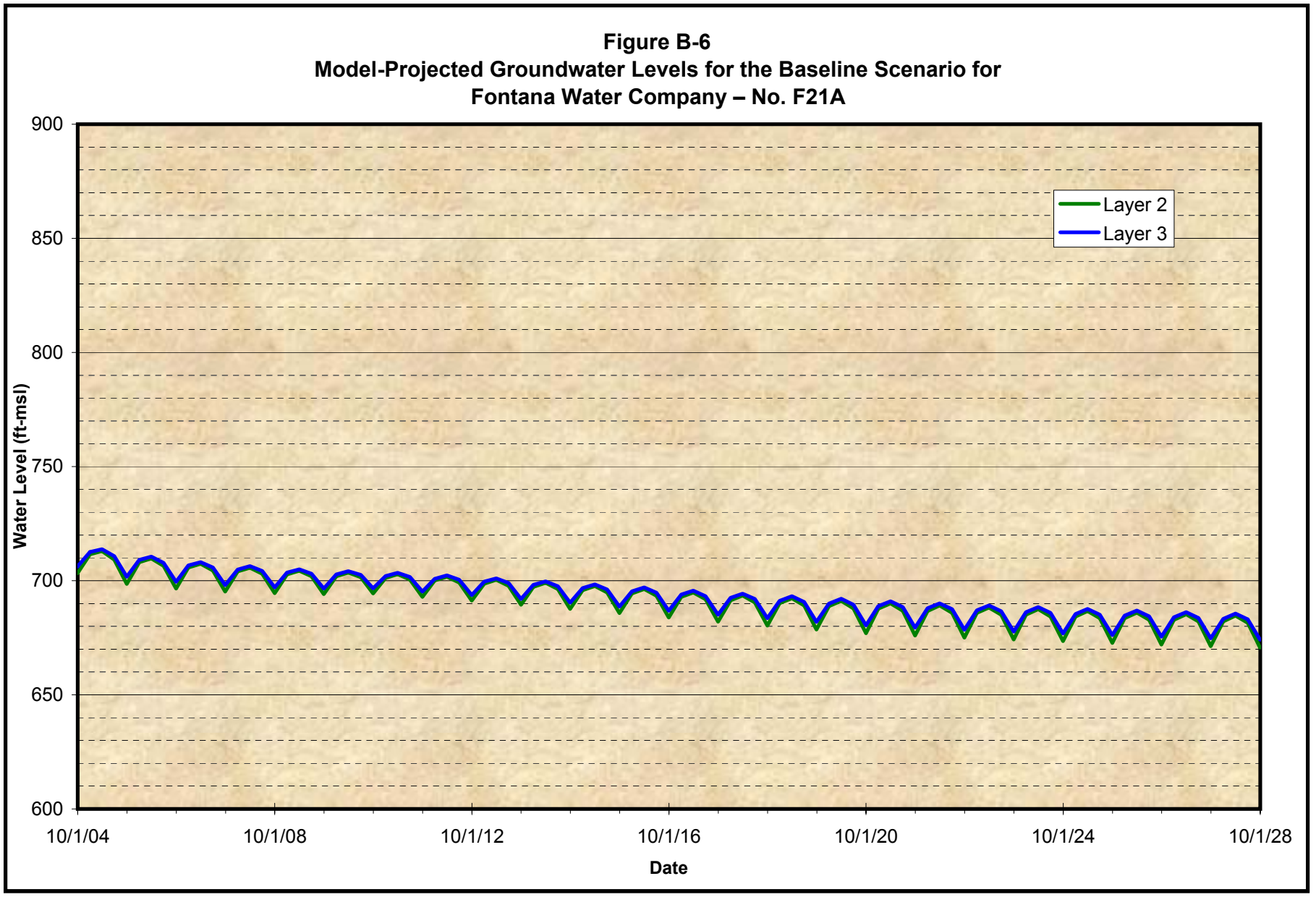


**Figure B-7**
**Model-Projected Groundwater Levels for the Baseline Scenario for Cucamonga County Water District – No. CB-35**

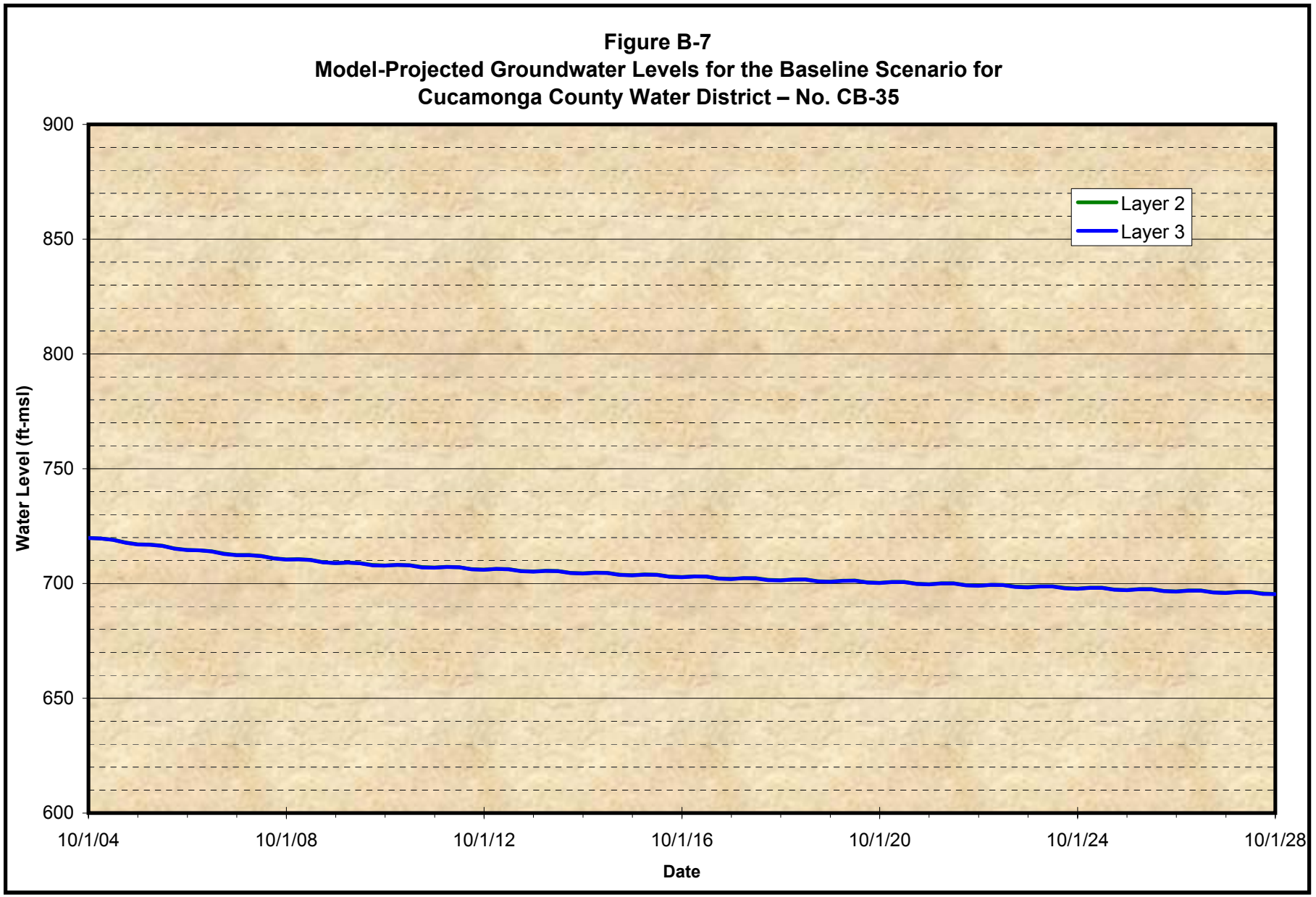


**Figure B-8**
**Model-Projected Groundwater Levels for the Baseline Scenario for Southern California Edison – Well C**

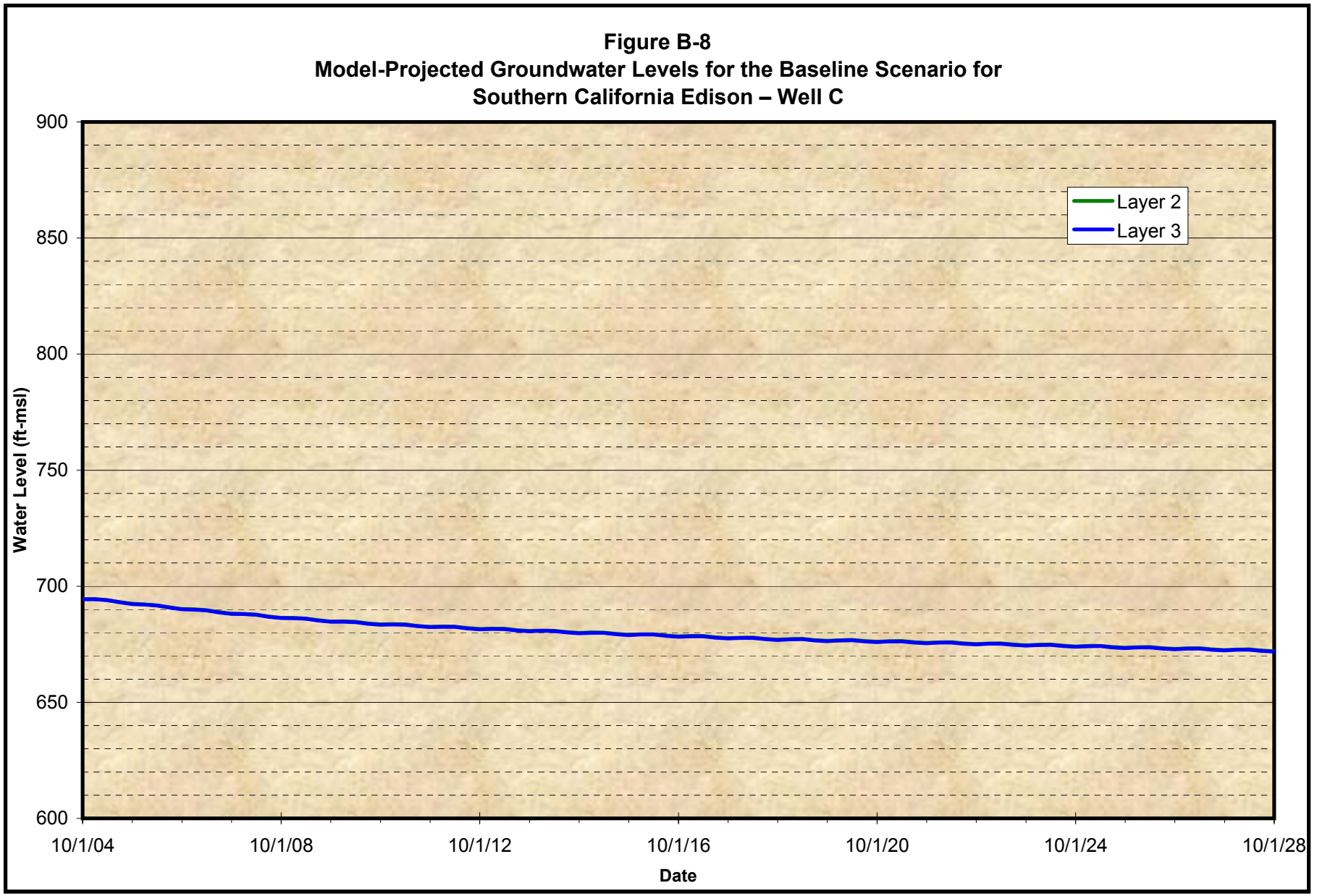


**Figure B-9**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Ontario – No. 31**

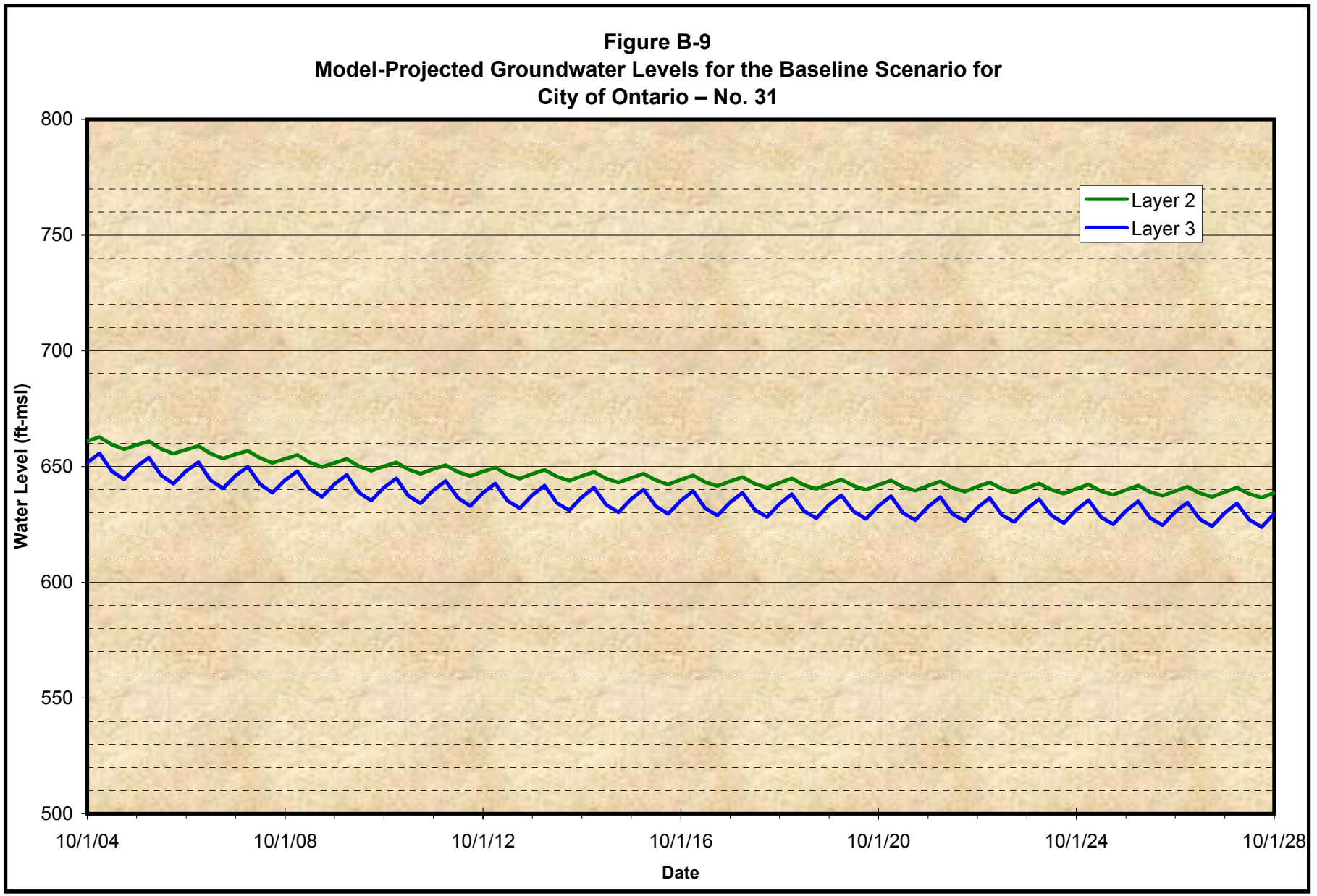


**Figure B-10**
**Model-Projected Groundwater Levels for the Baseline Scenario for Cucamonga County Water District – No. 30**

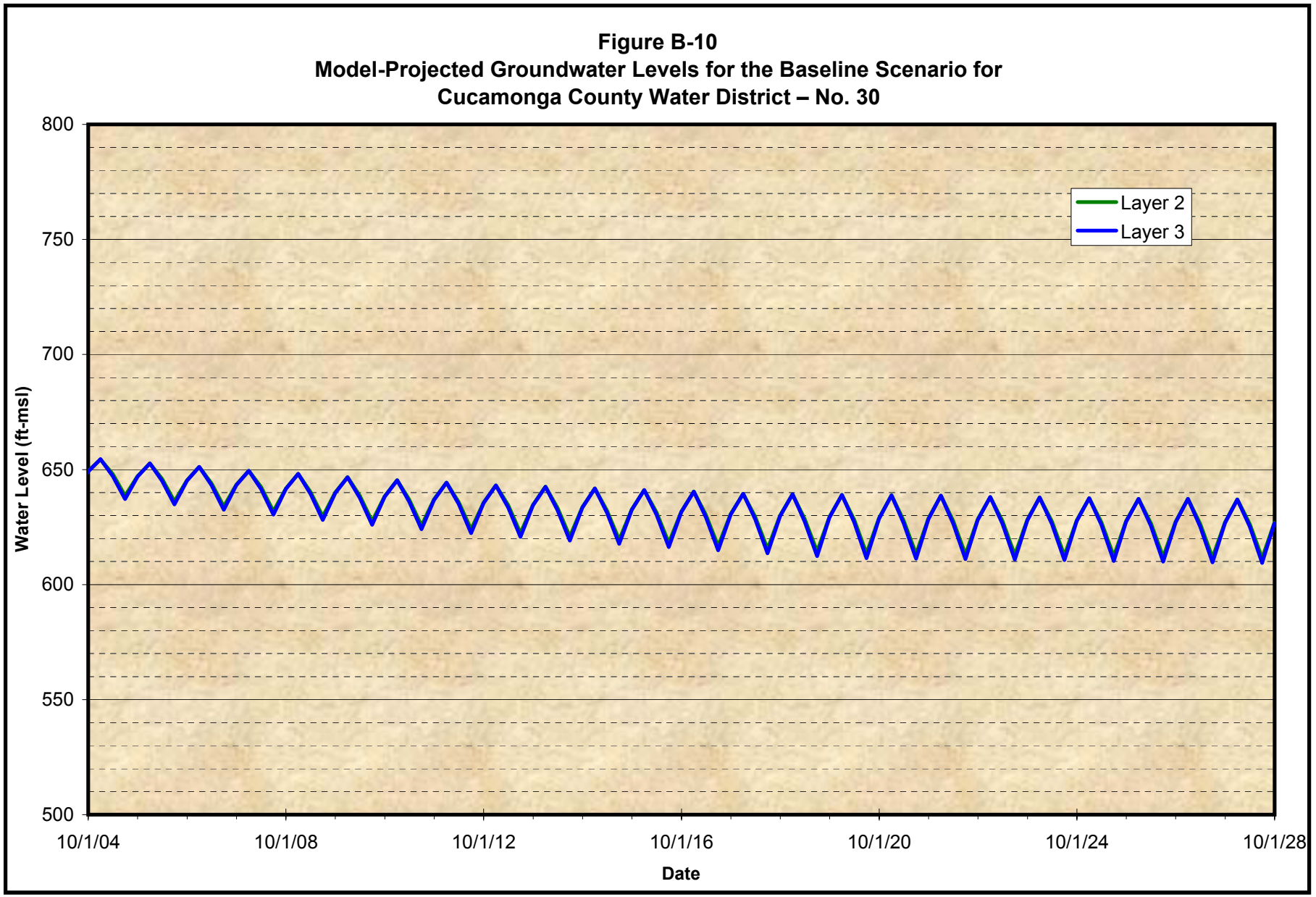


**Figure B-11**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Ontario – No. 36**

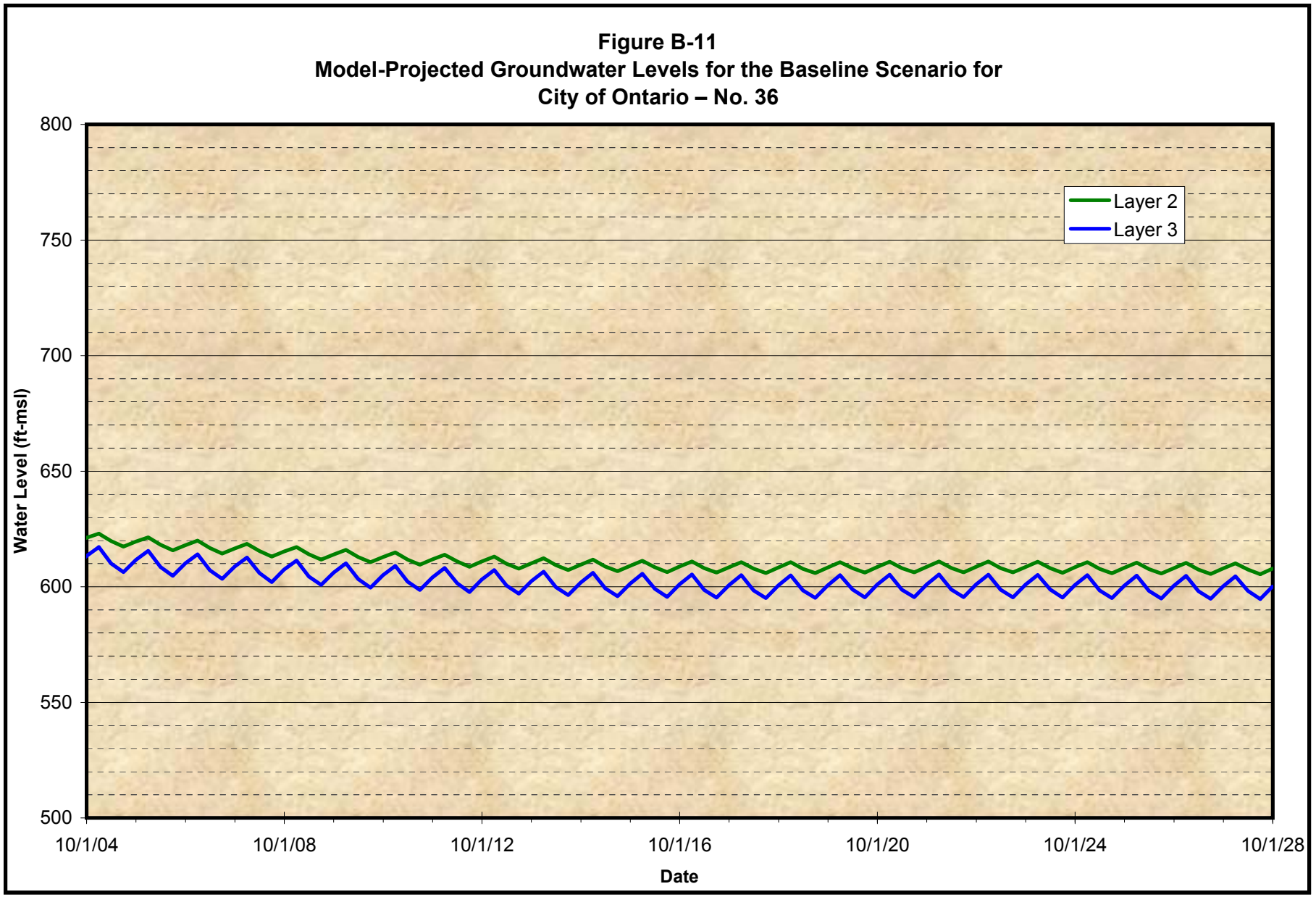


**Figure B-12**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**City of Ontario – No. 17**

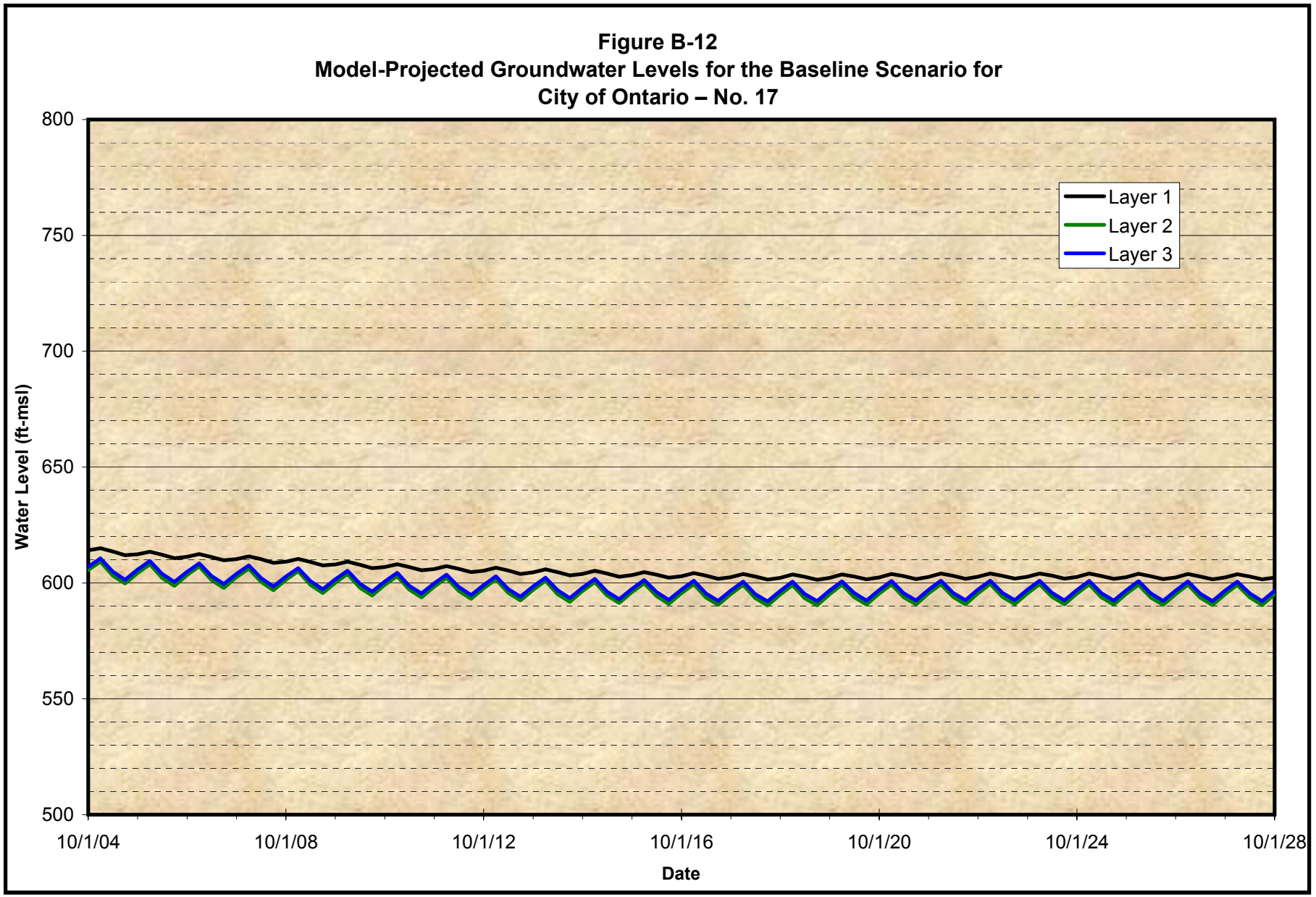


**Figure B-13**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Upland – No. 3**

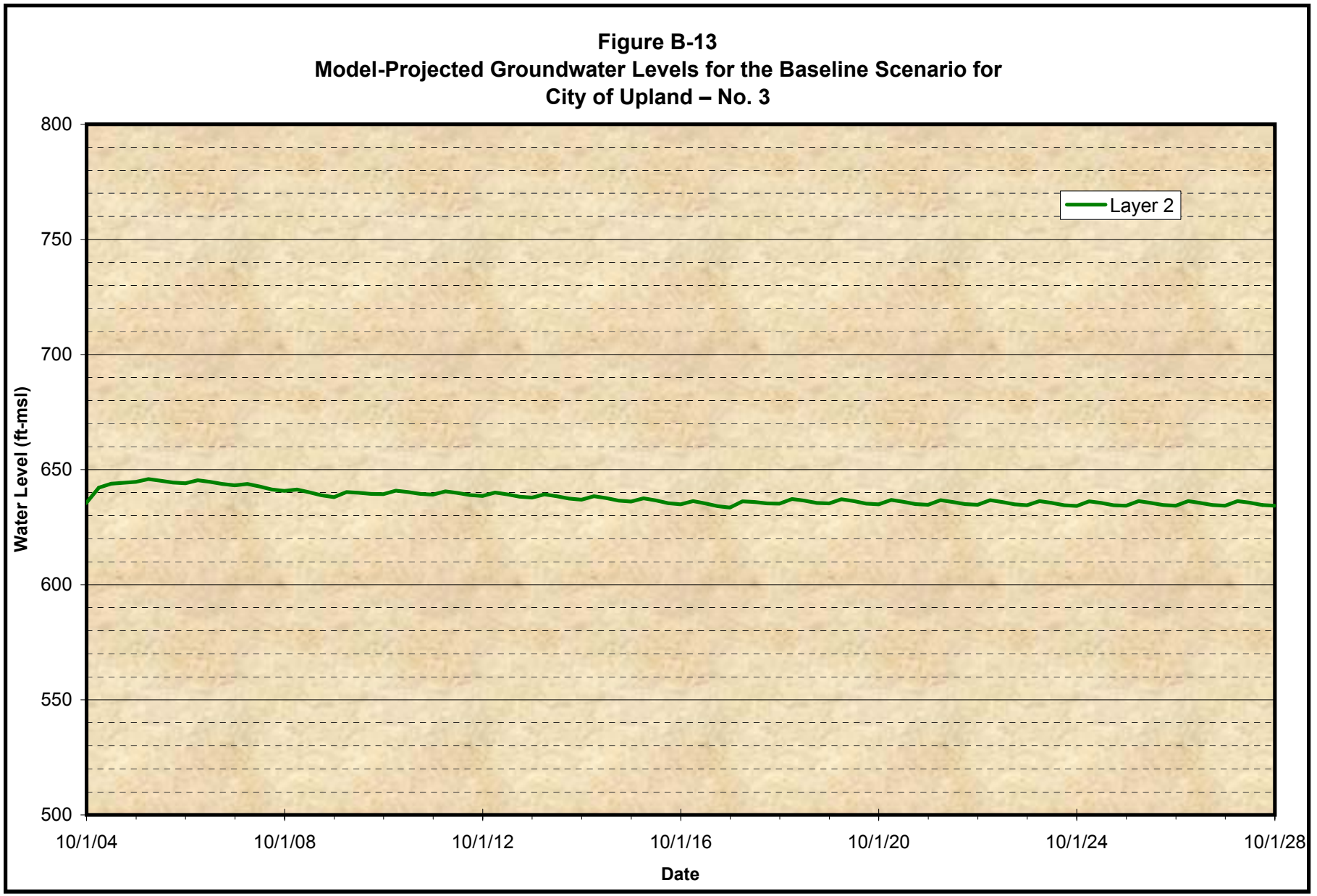


**Figure B-14**
**Model-Projected Groundwater Levels for the Baseline Scenario for Monte Vista Water District – No. 10**

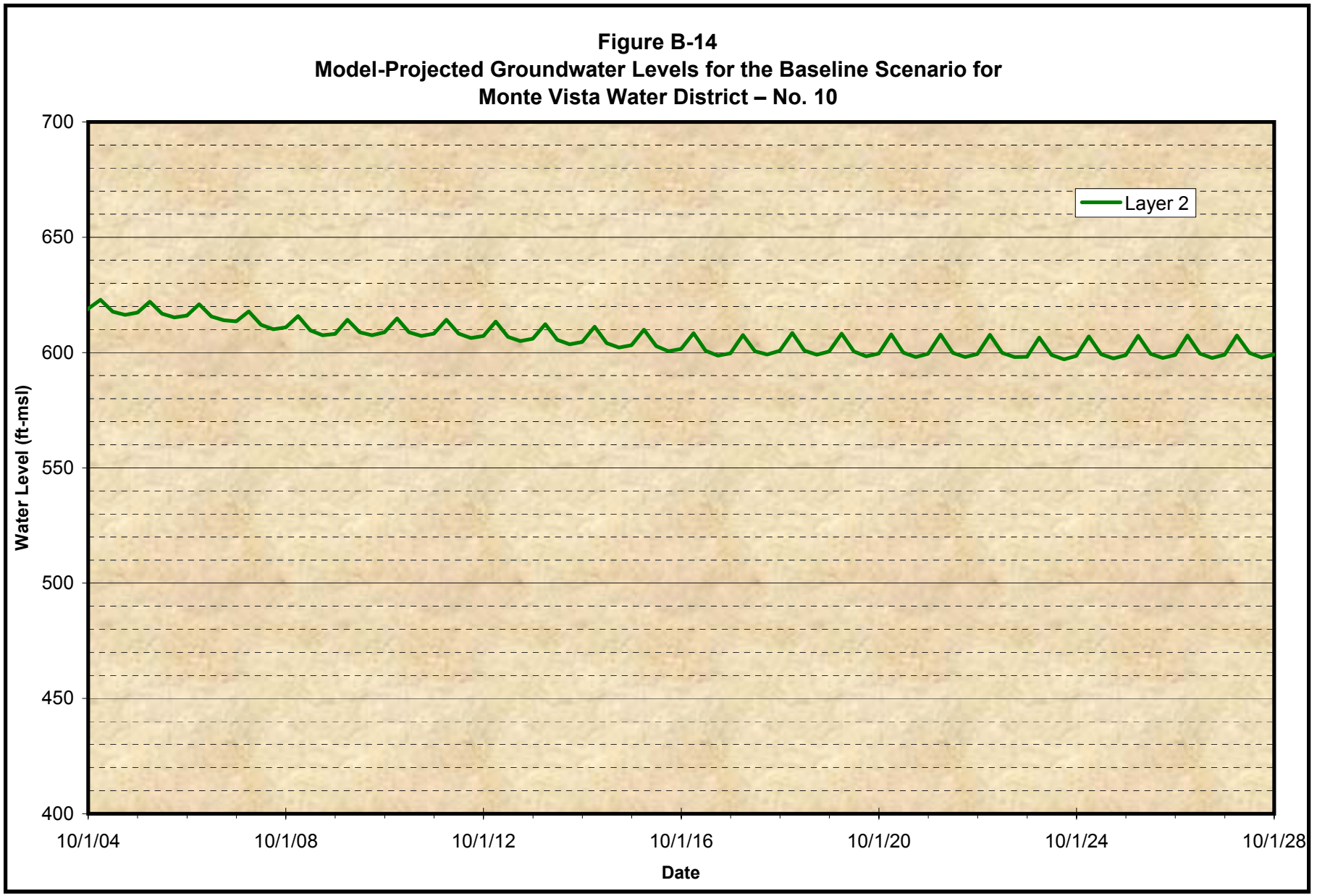


**Figure B-15**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Pomona – No. 11**

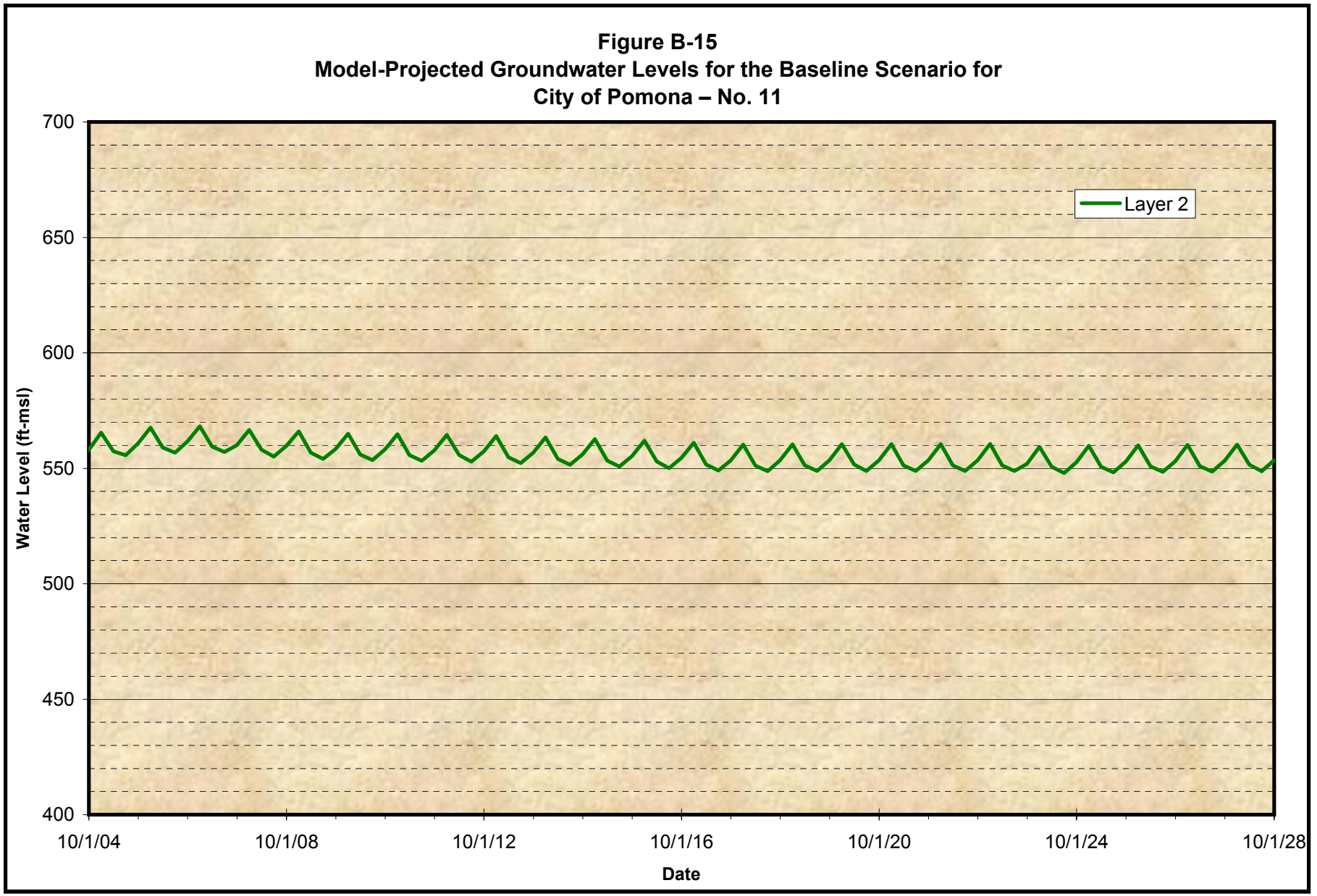


**Figure B-16**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino – No. 12**

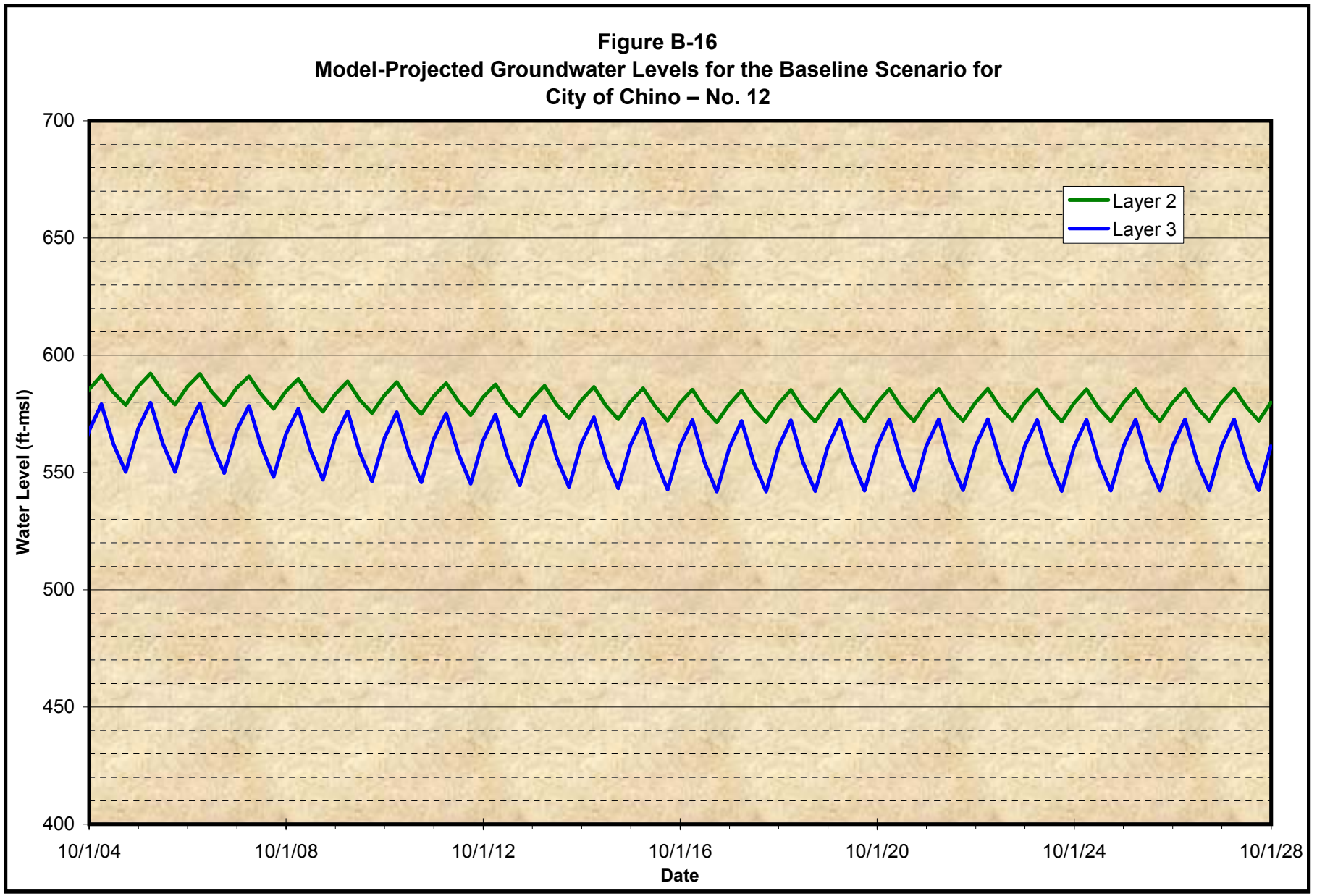


**Figure B-17**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino – No. 9**

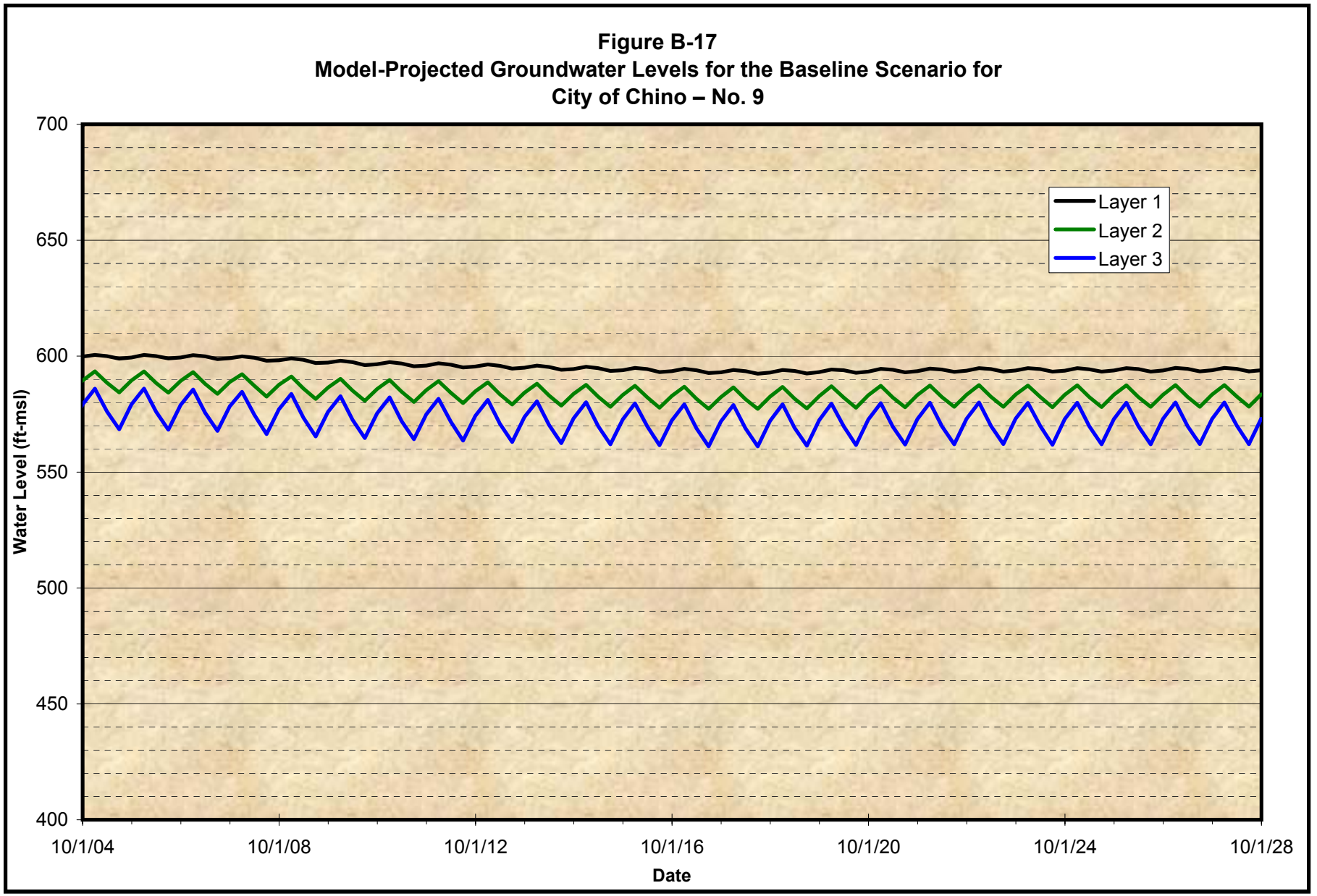


**Figure B-18**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**City of Pomona – No. 29**

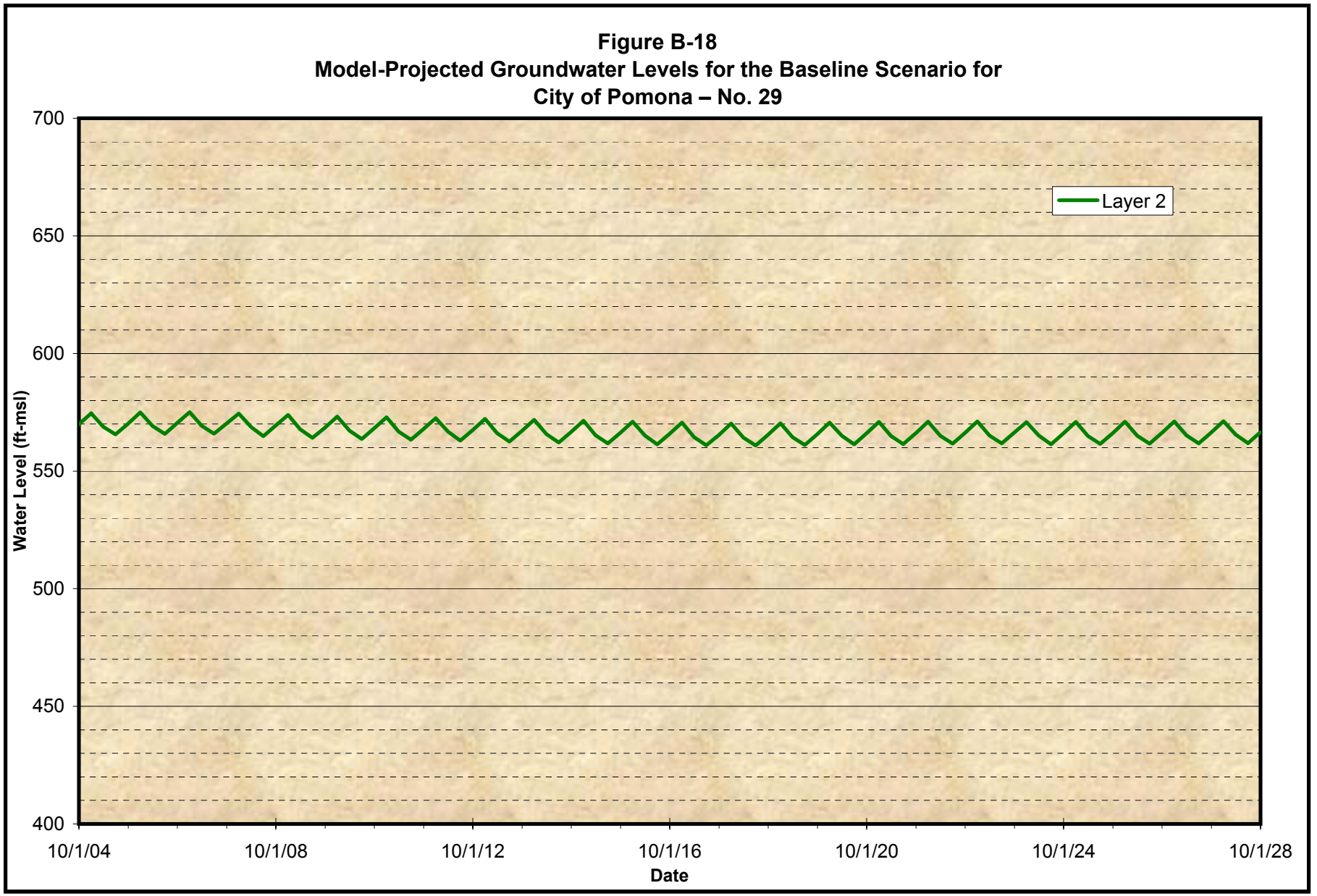


**Figure B-19**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino – No. 11**

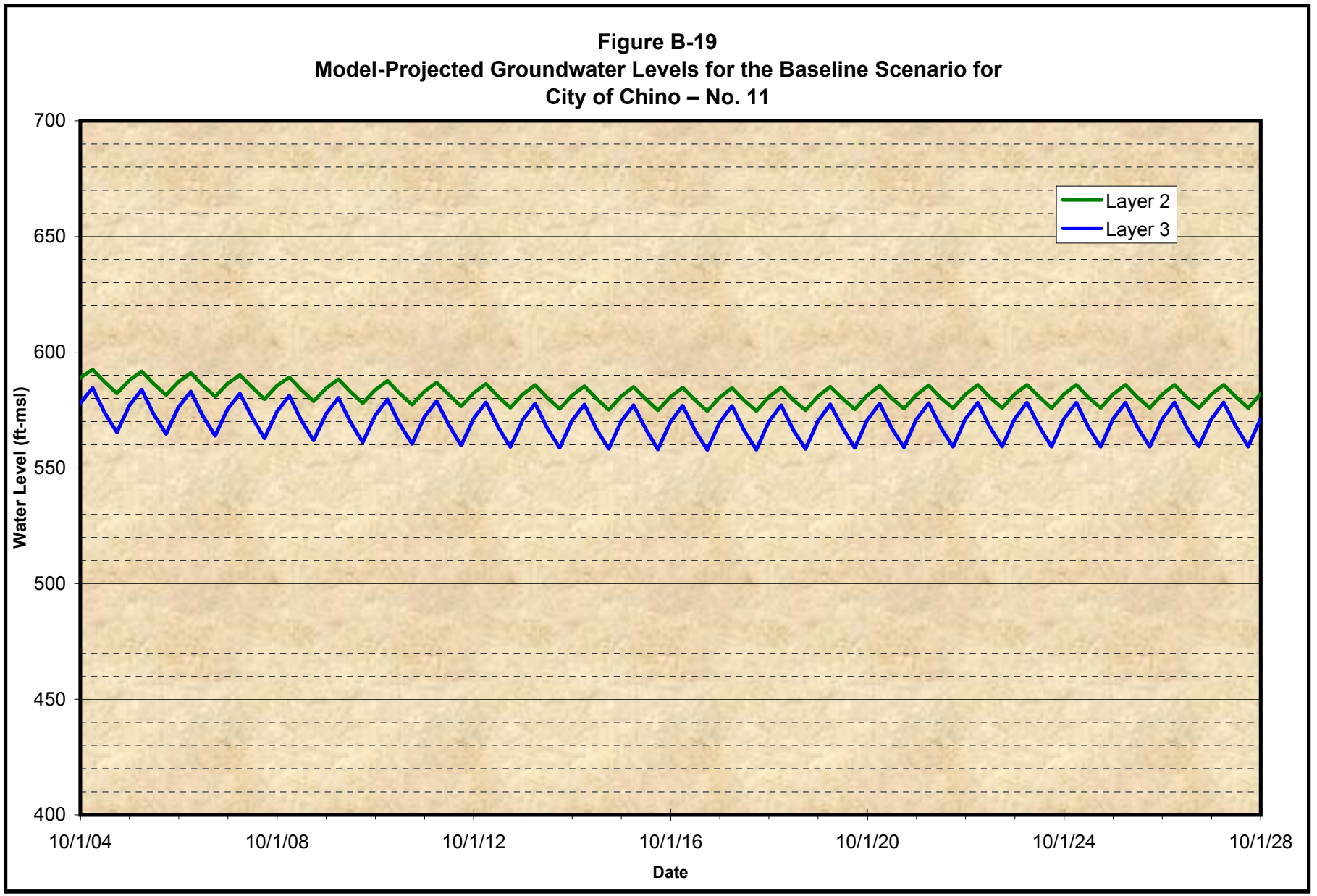


**Figure B-20**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino – No. 13**

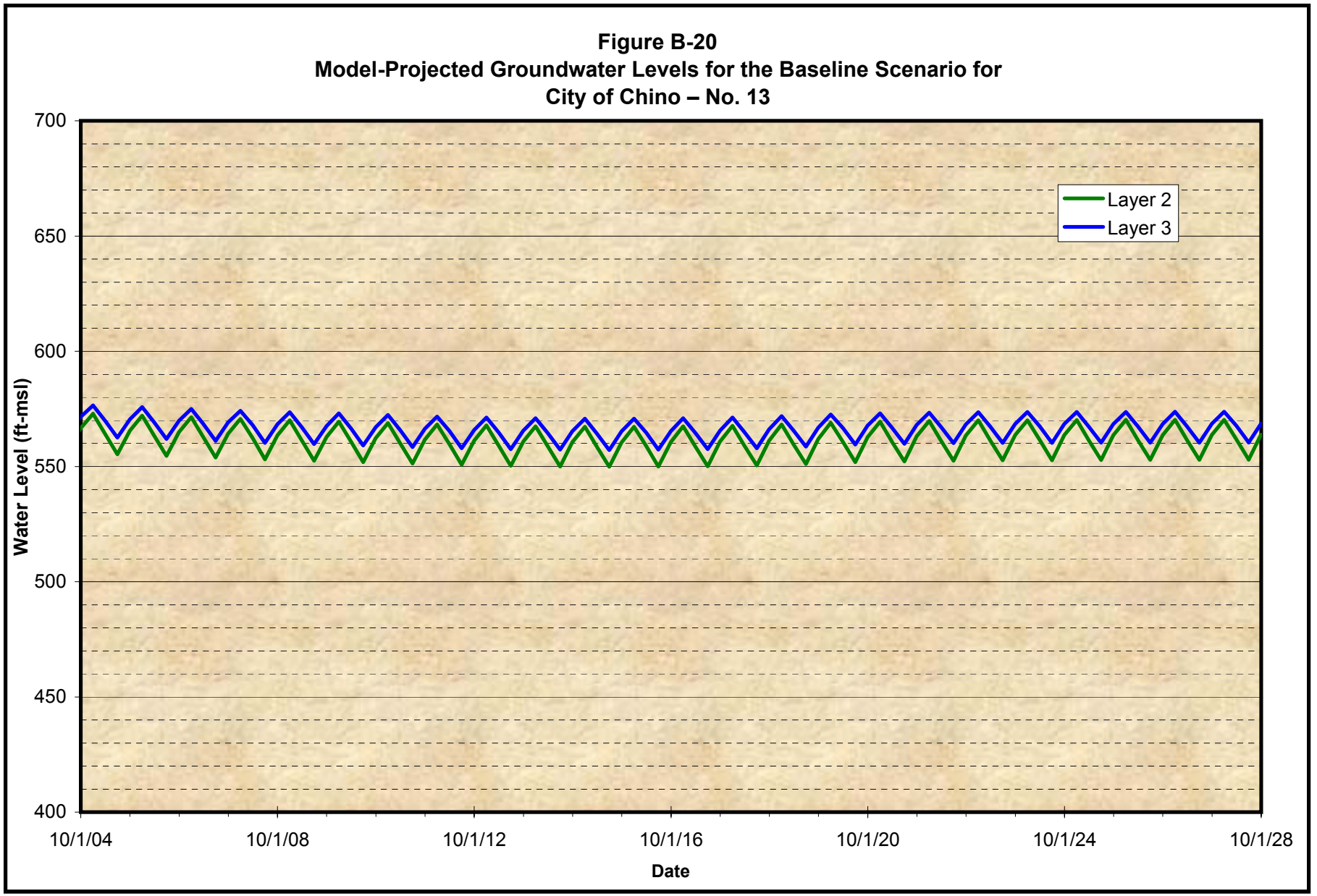


**Figure B-21**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino – No. 4**

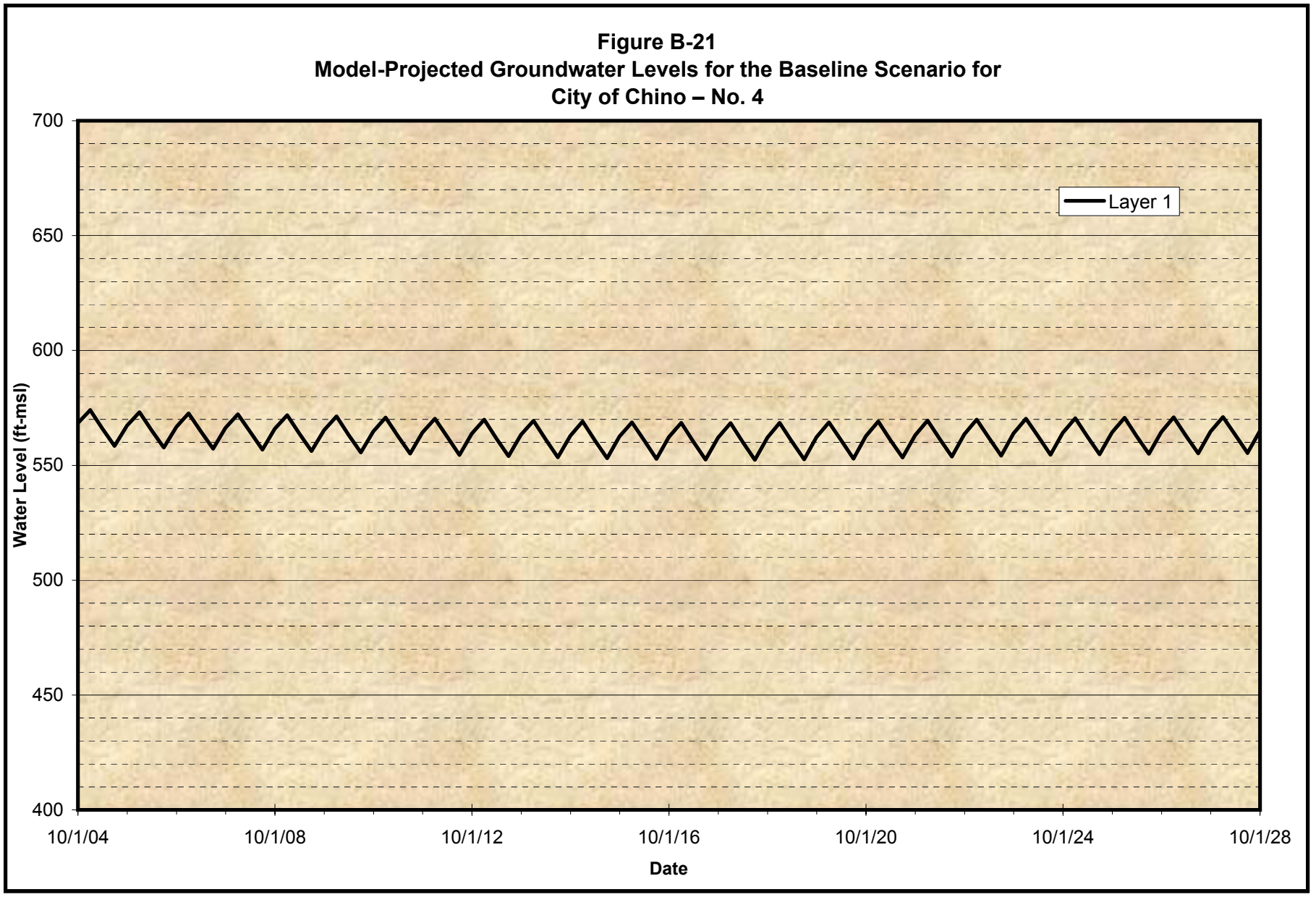


**Figure B-22**
**Model-Projected Groundwater Levels for the Baseline Scenario for CIM – No. 4**

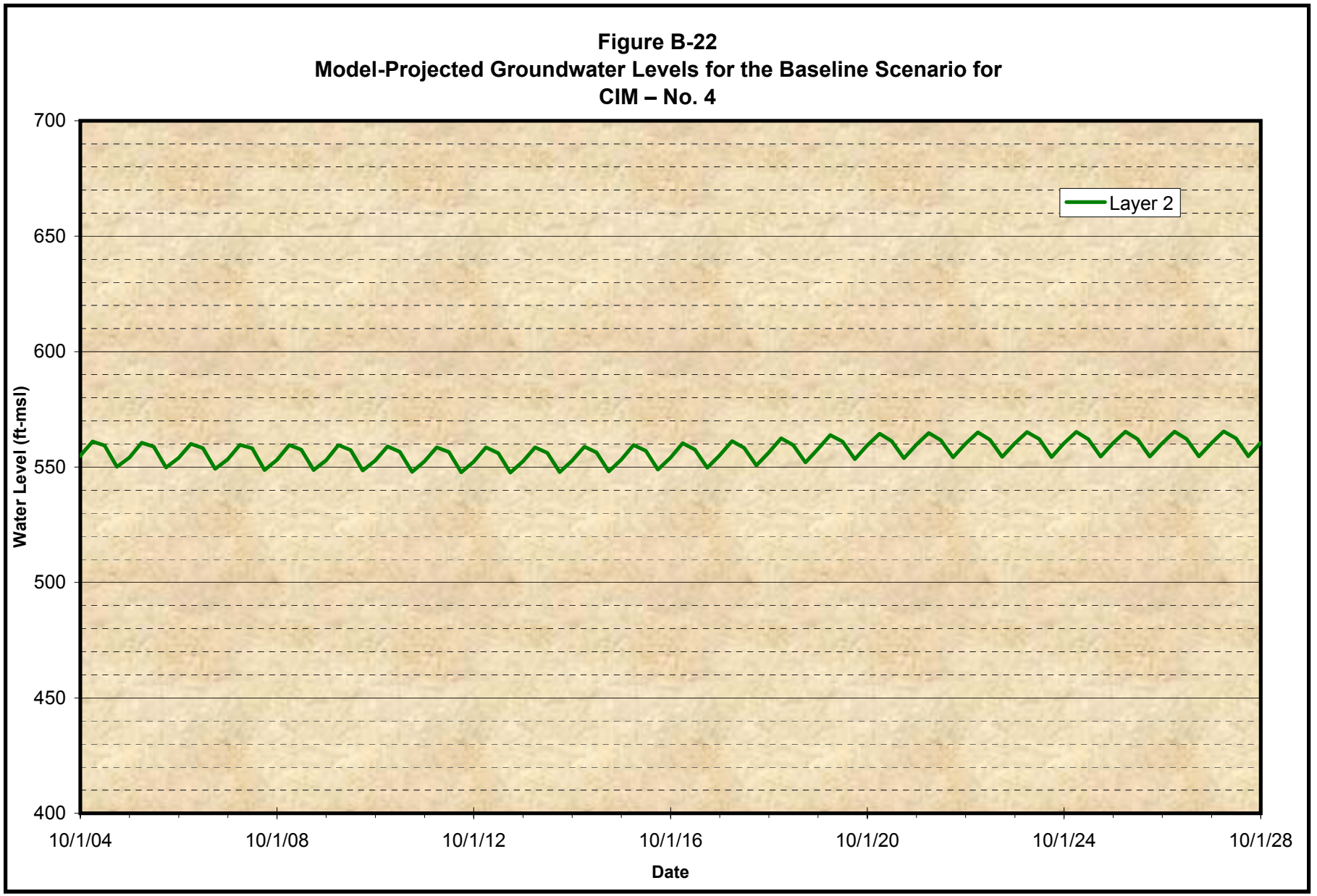


**Figure B-23**
**Model-Projected Groundwater Levels for the Baseline Scenario for CIM – No. 13**

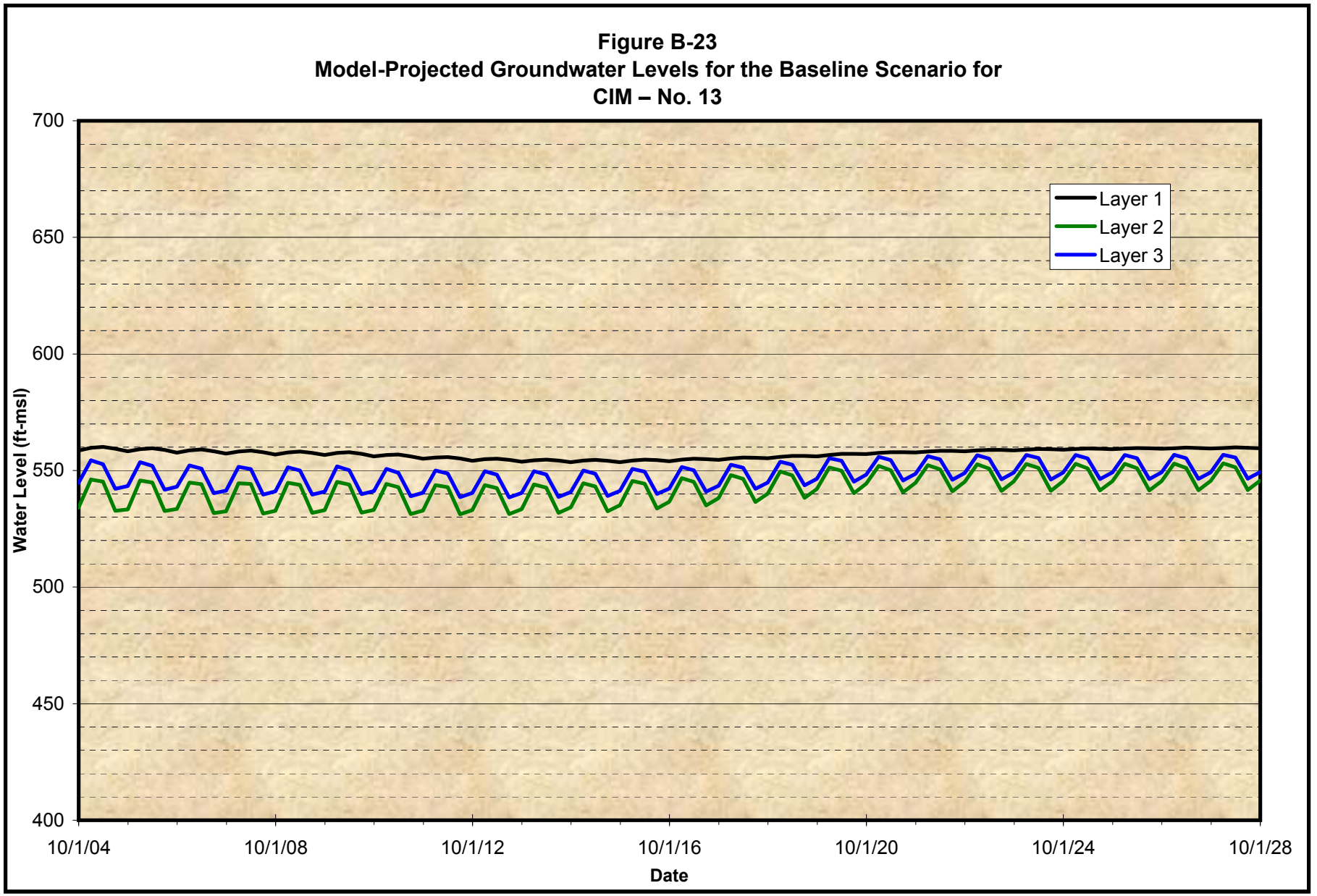


**Figure B-24**
**Model-Projected Groundwater Levels for the Baseline Scenario for CIM – No. 9**

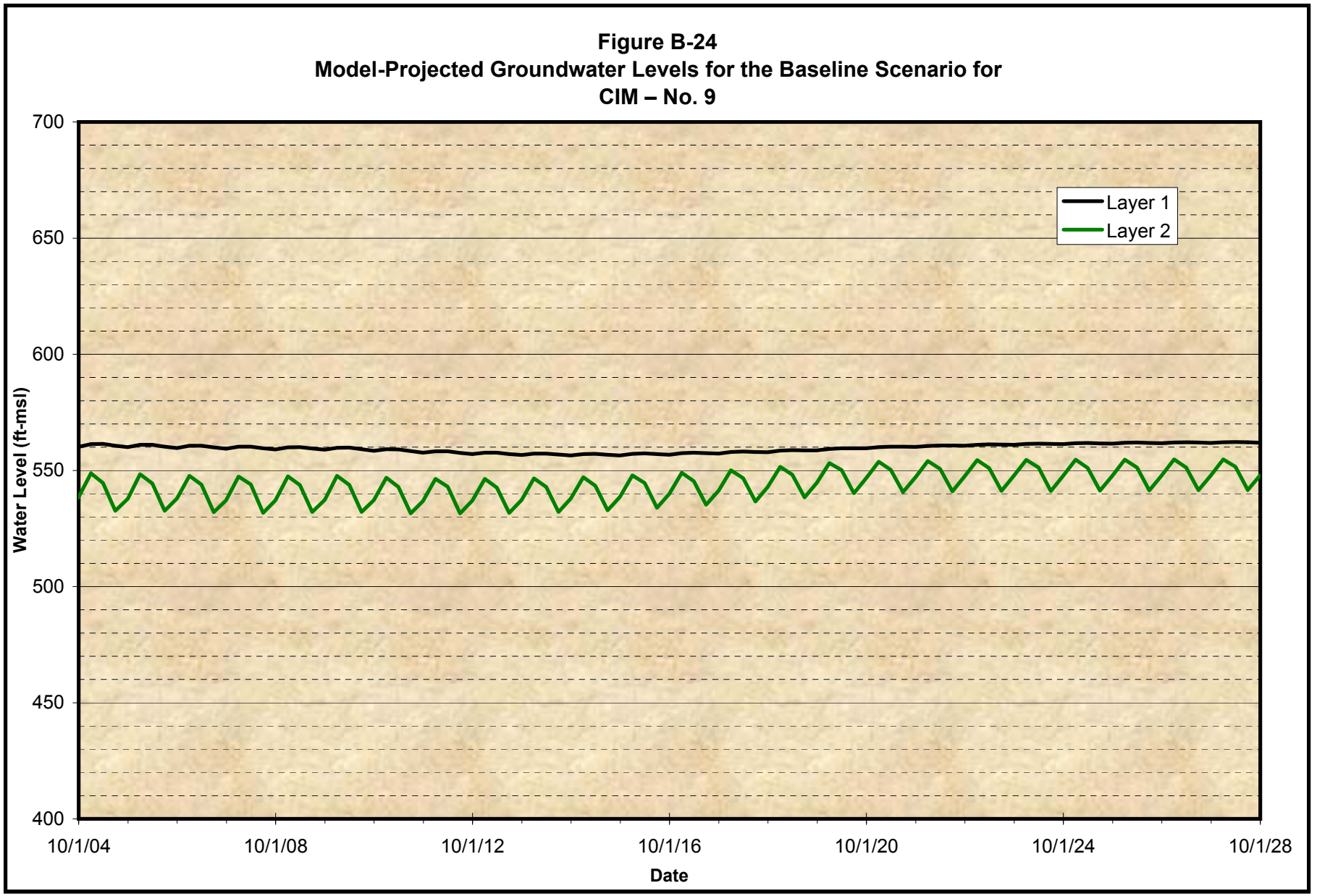


**Figure B-25**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino Hills – No. 18A**

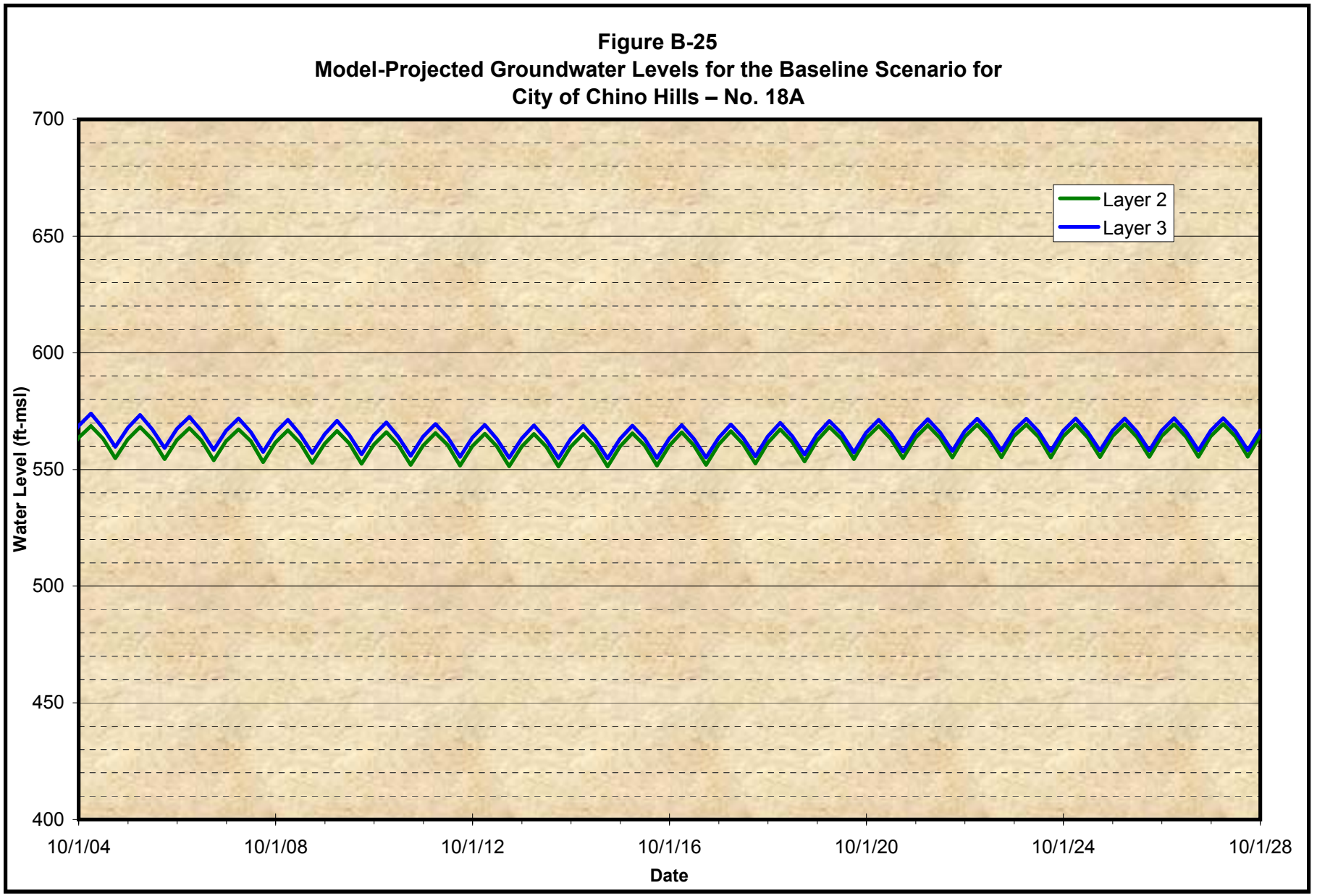


**Figure B-26**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino Hills – No. 17**

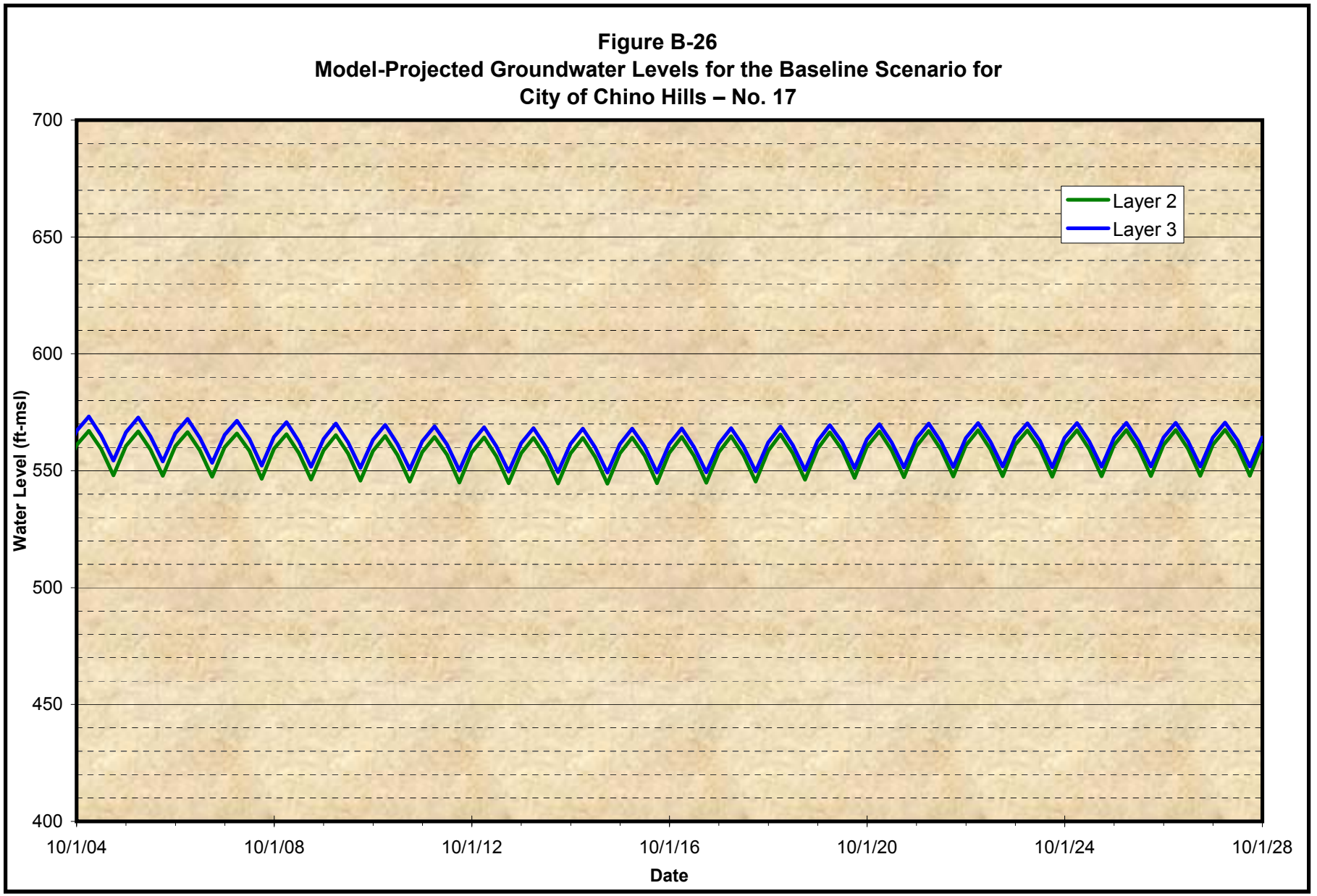


**Figure B-27**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino Hills – No. 15A**

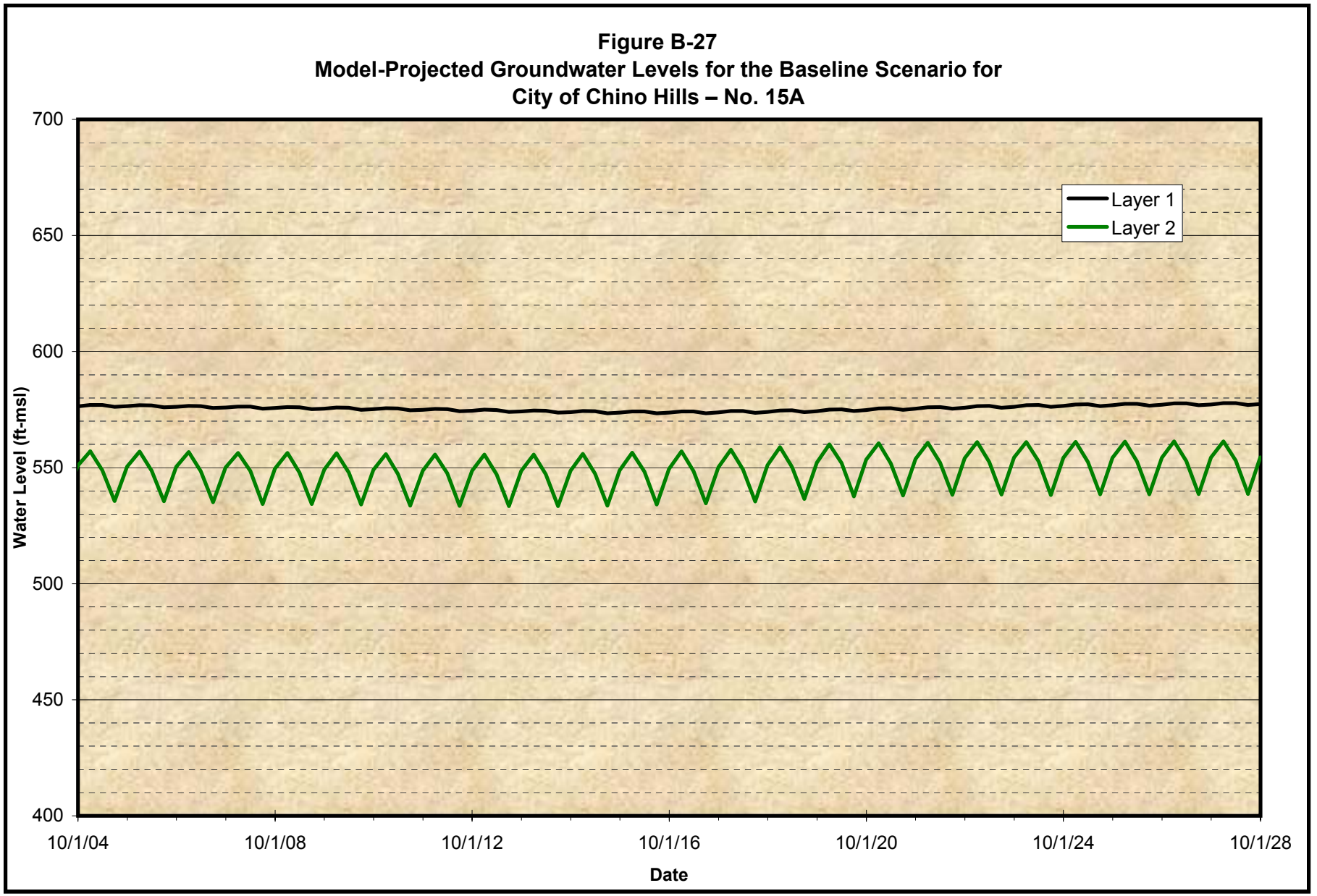


**Figure B-28**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Chino Hills – No. 15B**

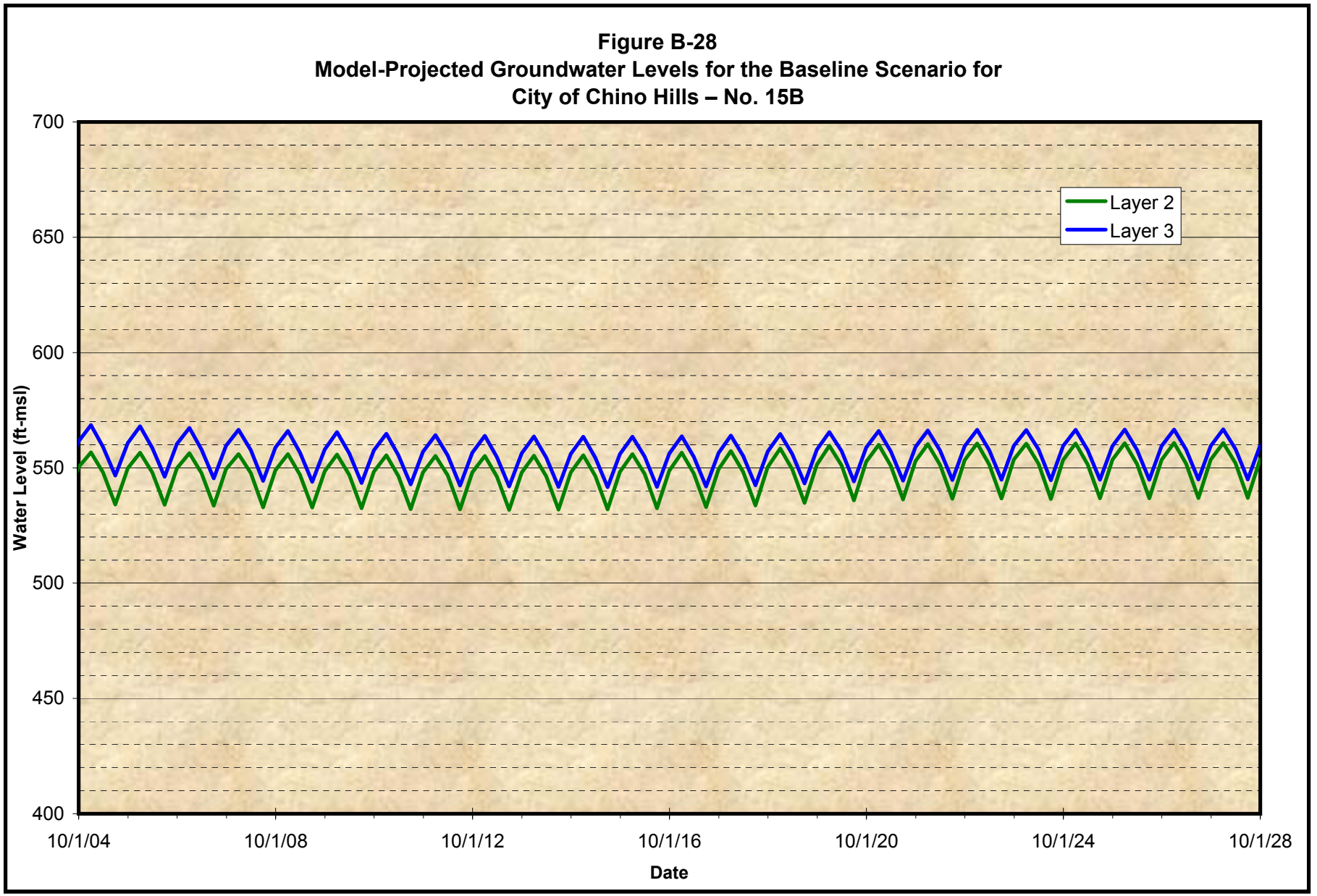


**Figure B-29**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**Santa Ana River Water Company – No. 7**

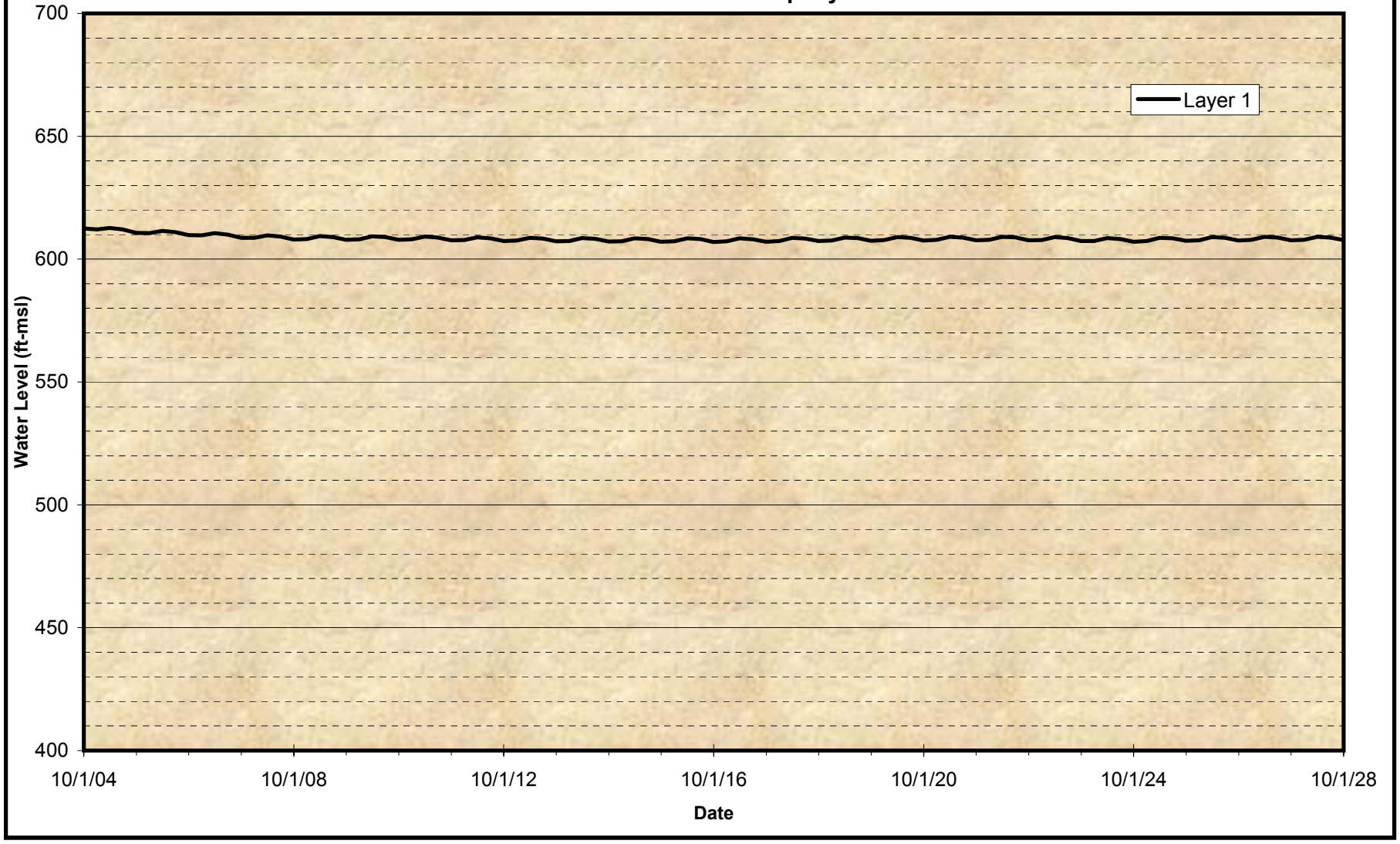


**Figure B-30**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**Jurupa Community Services District – No. 16**

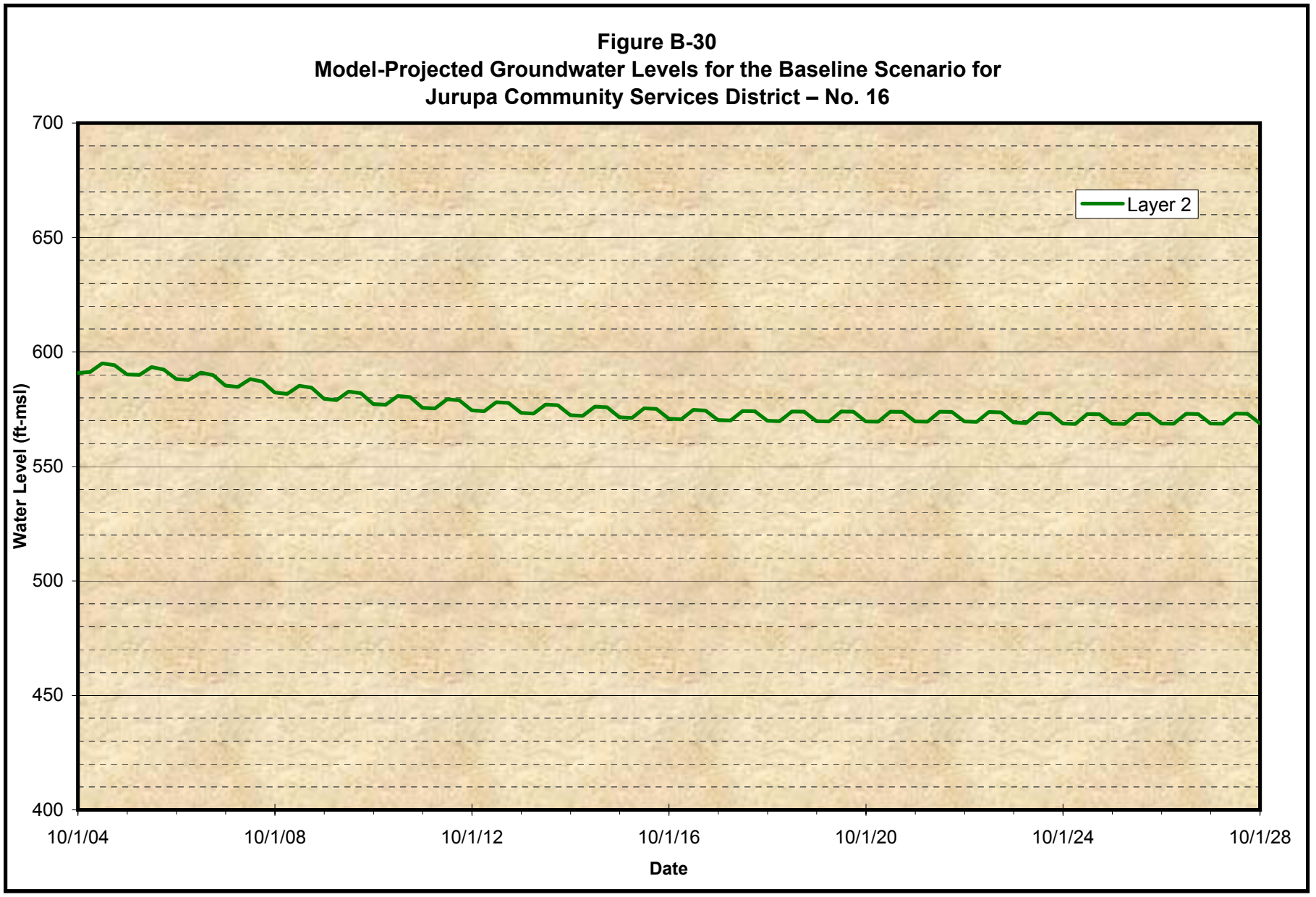


**Figure B-31**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Norco – No. 11**

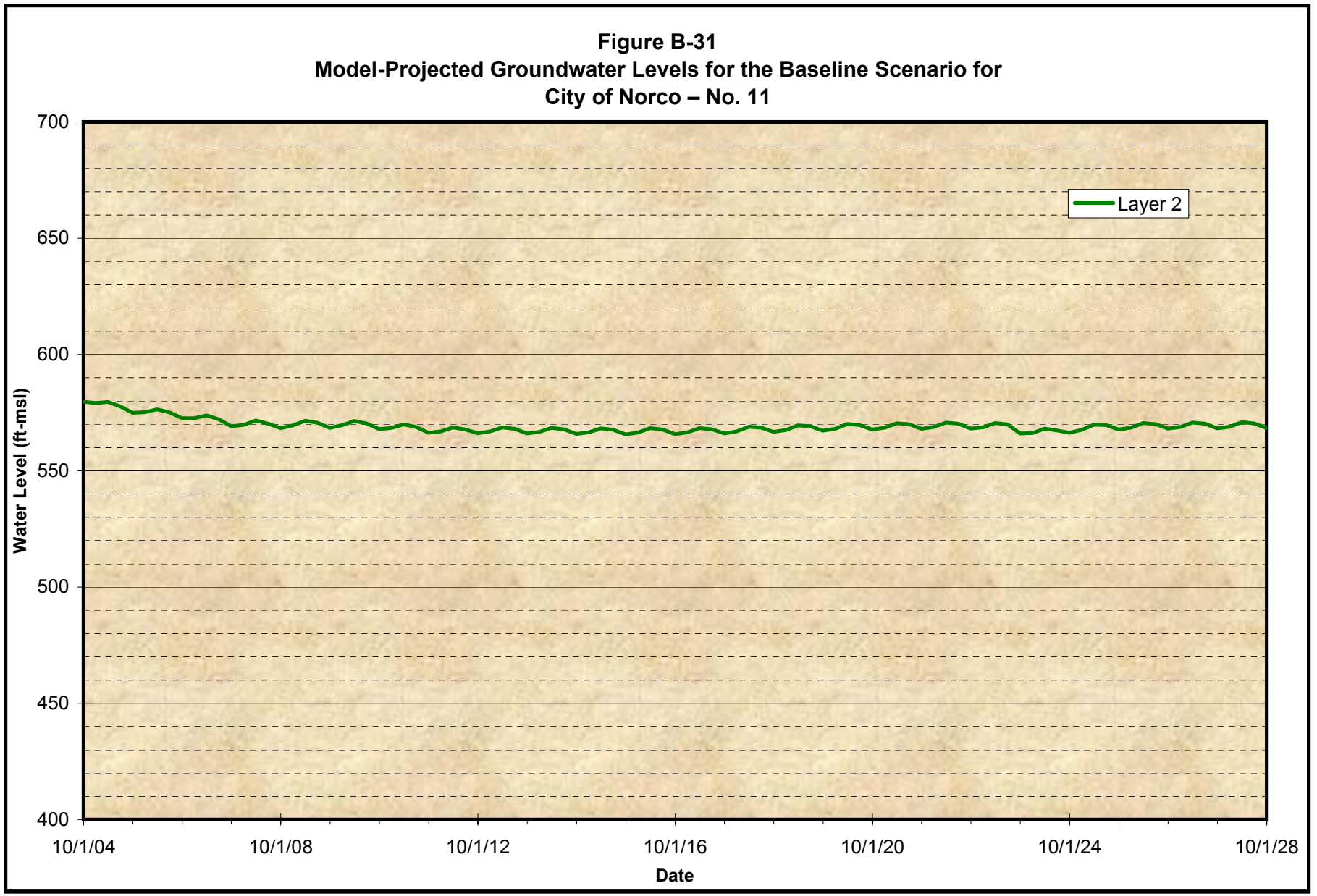


**Figure B-32**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Parente – ARC**

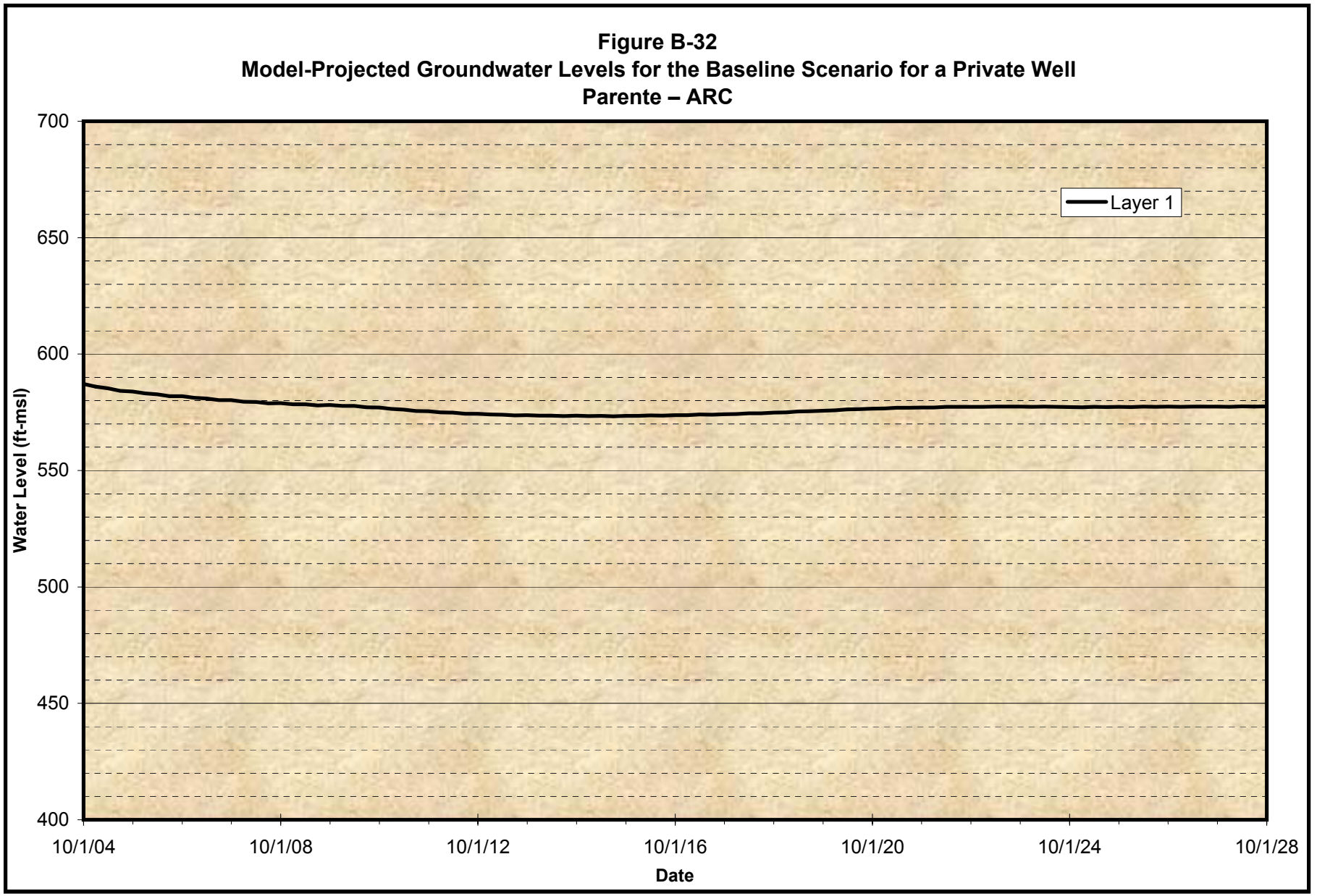


**Figure B-33**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Excelsior**

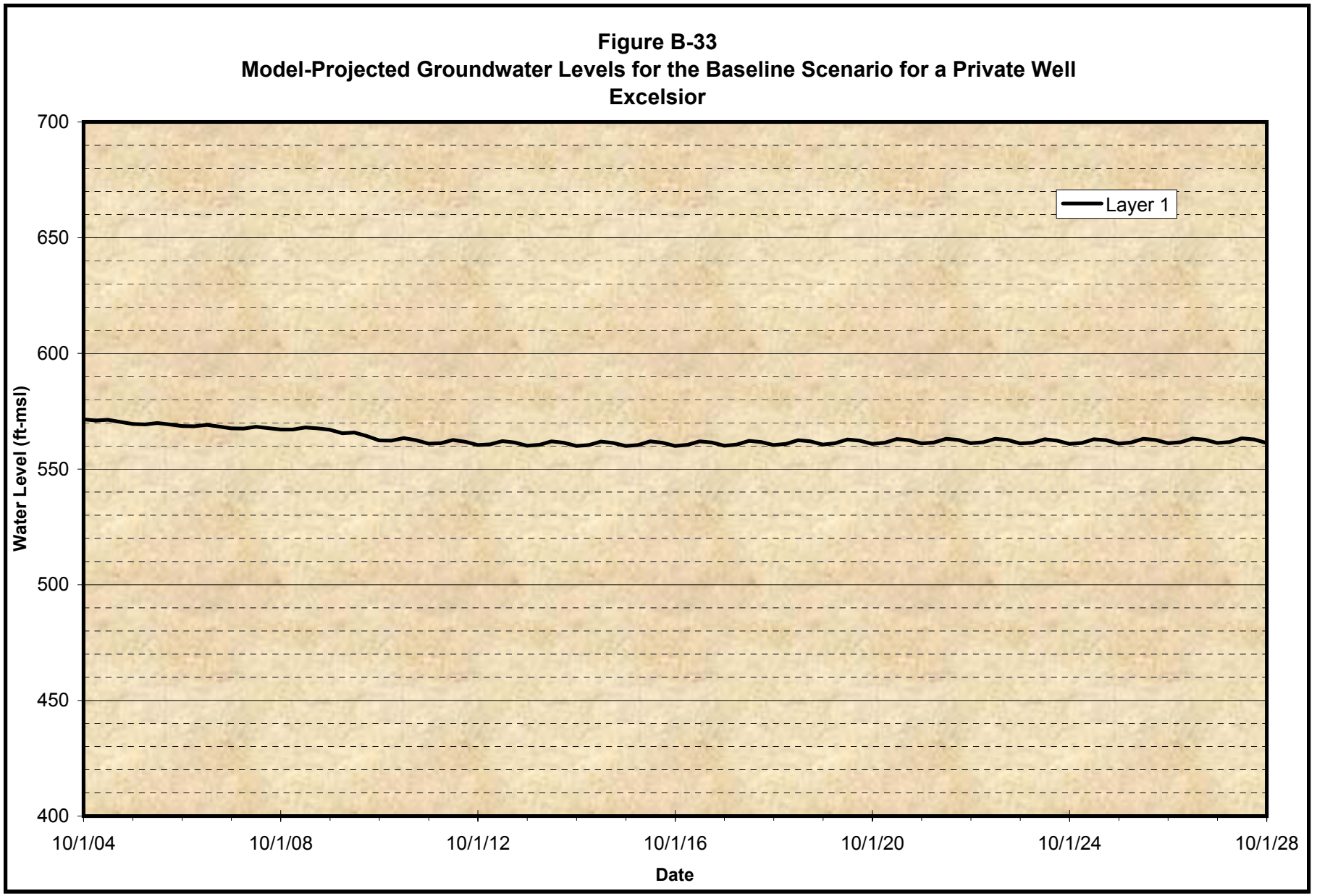


**Figure B-34**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Cardoza – No. B9**

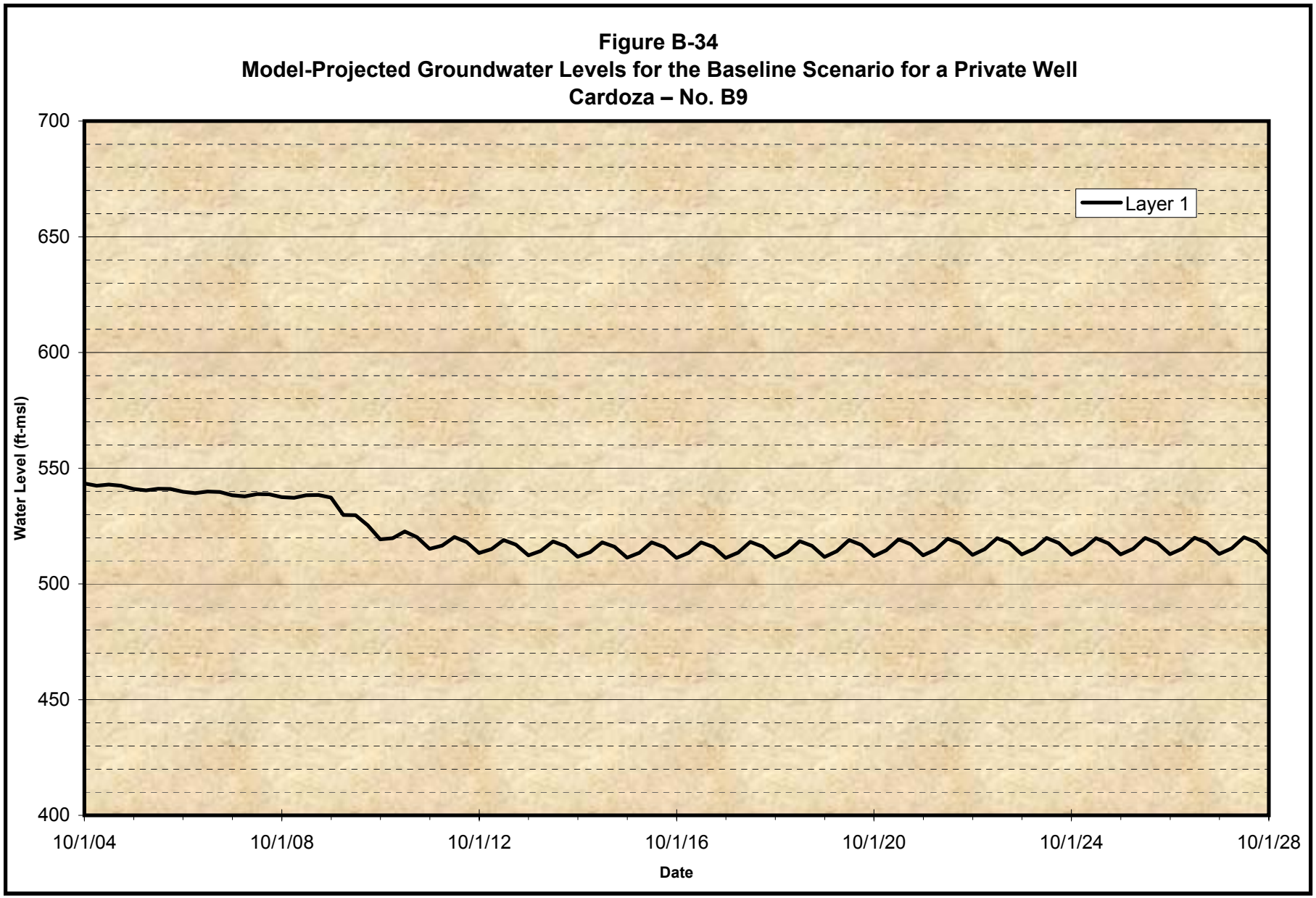


**Figure B-35**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Borba Dairy – No. 2**

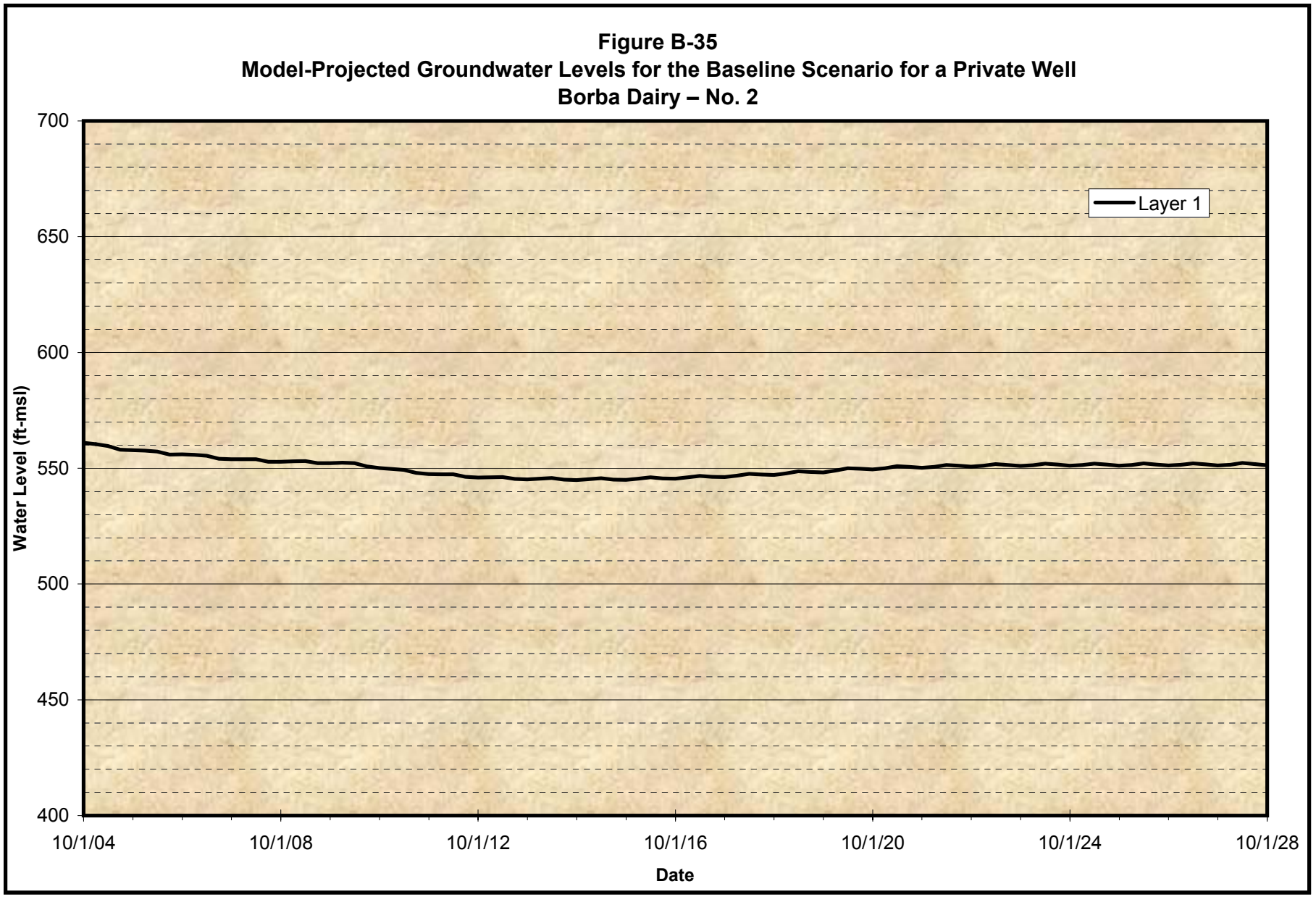


**Figure B-36**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Corona Dairy Ranch**

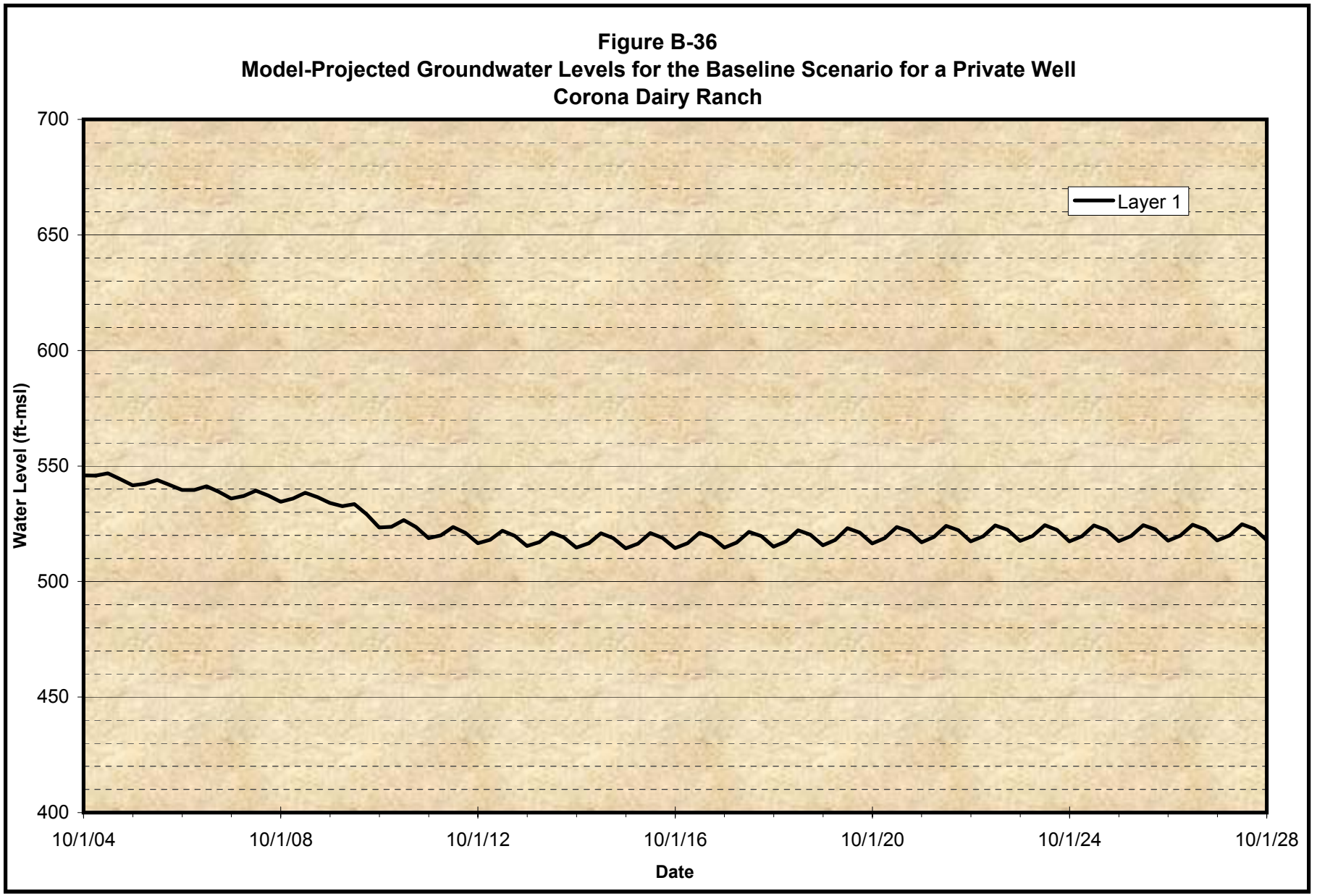


**Figure B-37**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**DeVries**

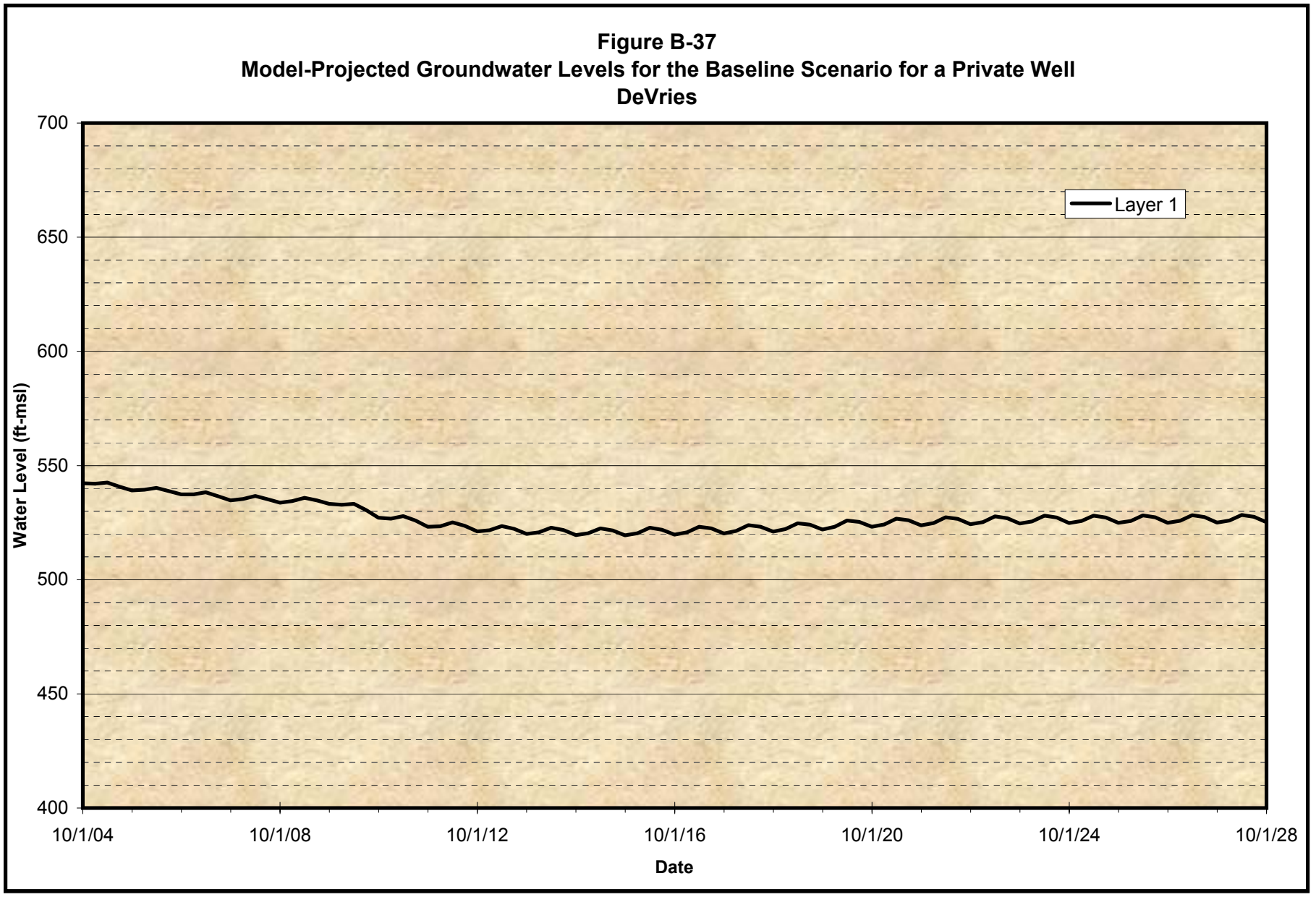


**Figure B-39**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Barthelemy**

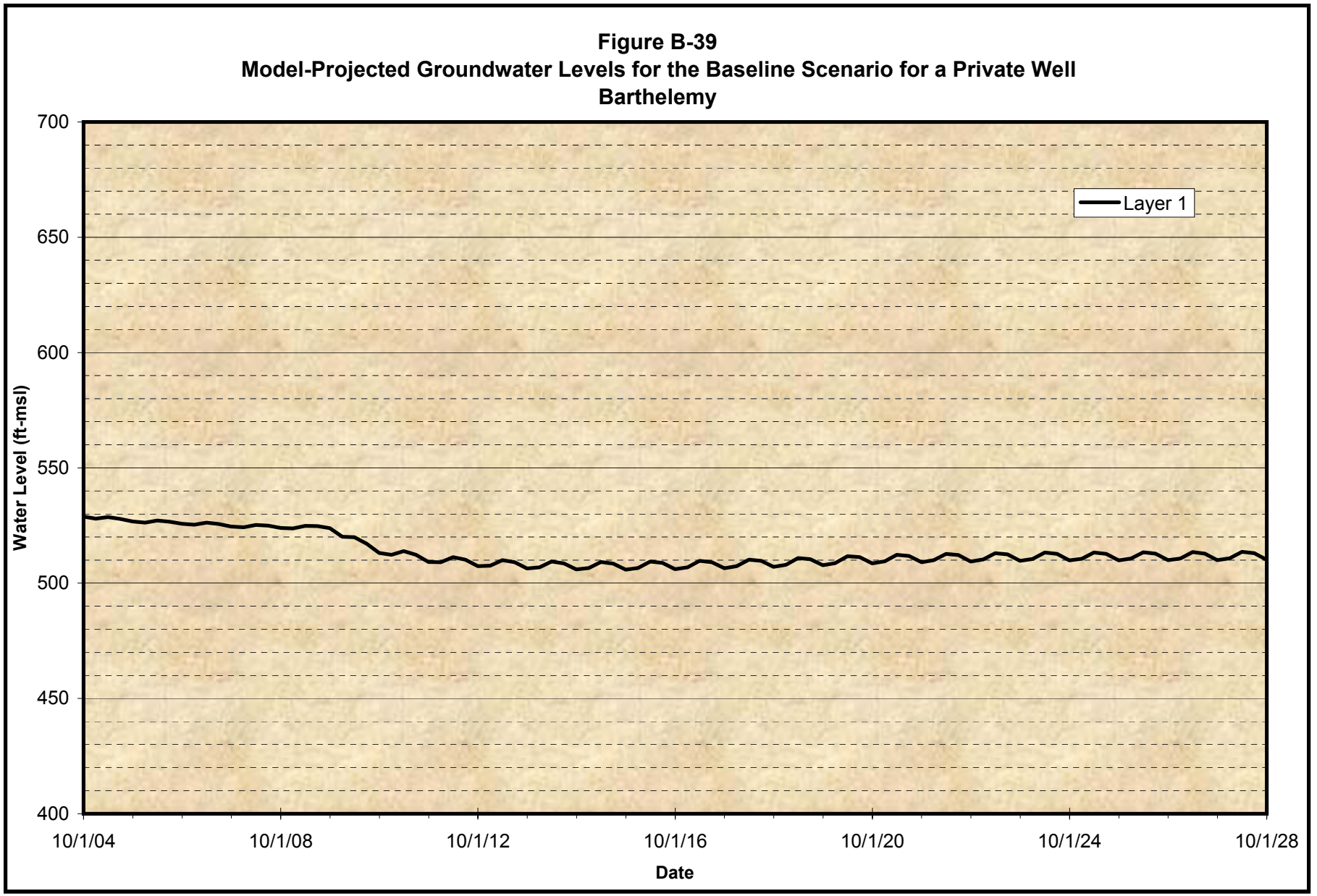


**Figure B-38**
**Model-Projected Groundwater Levels for the Baseline Scenario for**
**CIW – Monitoring Well No. 2**

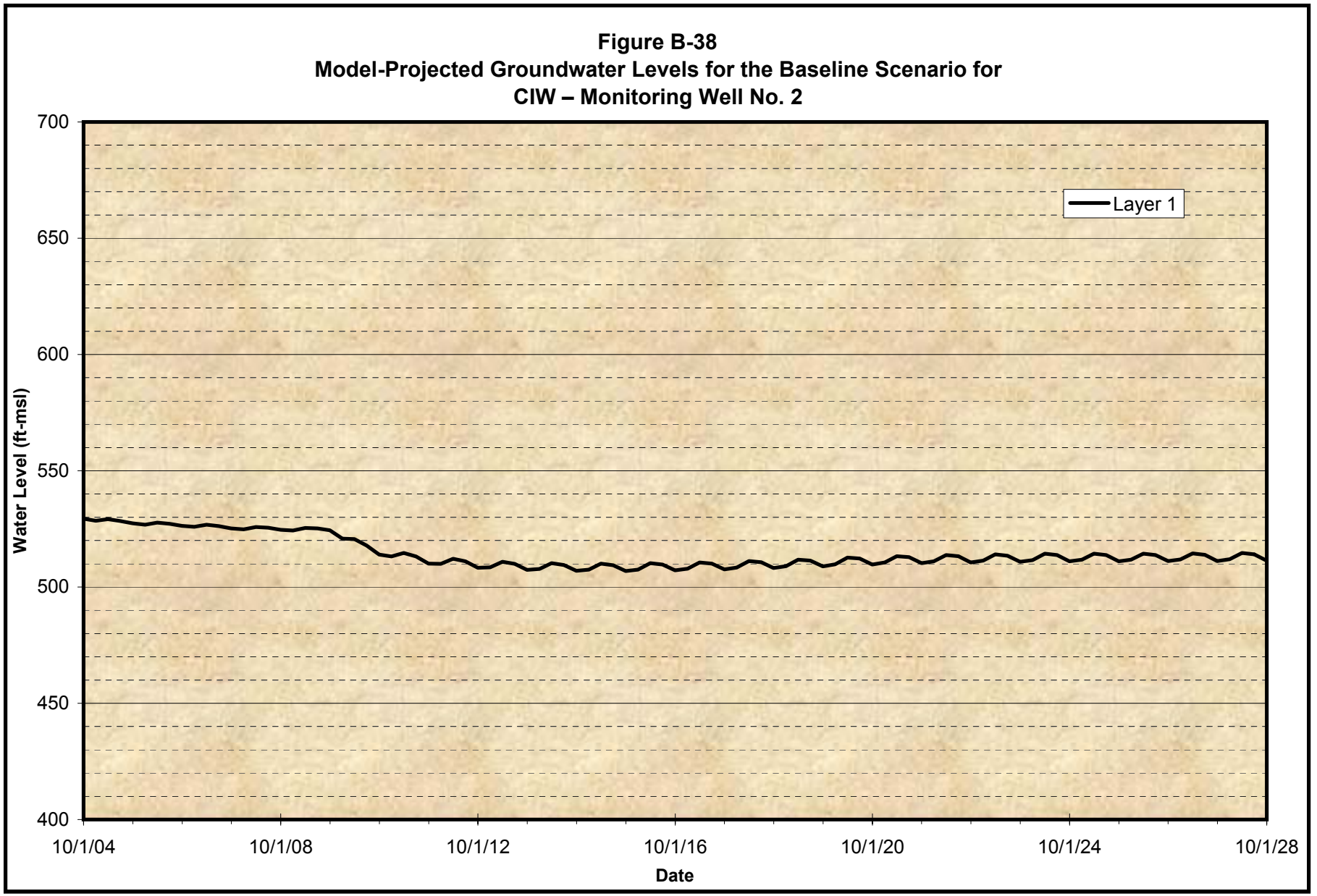


**Figure B-40**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Lekkerkerker – No. 2**

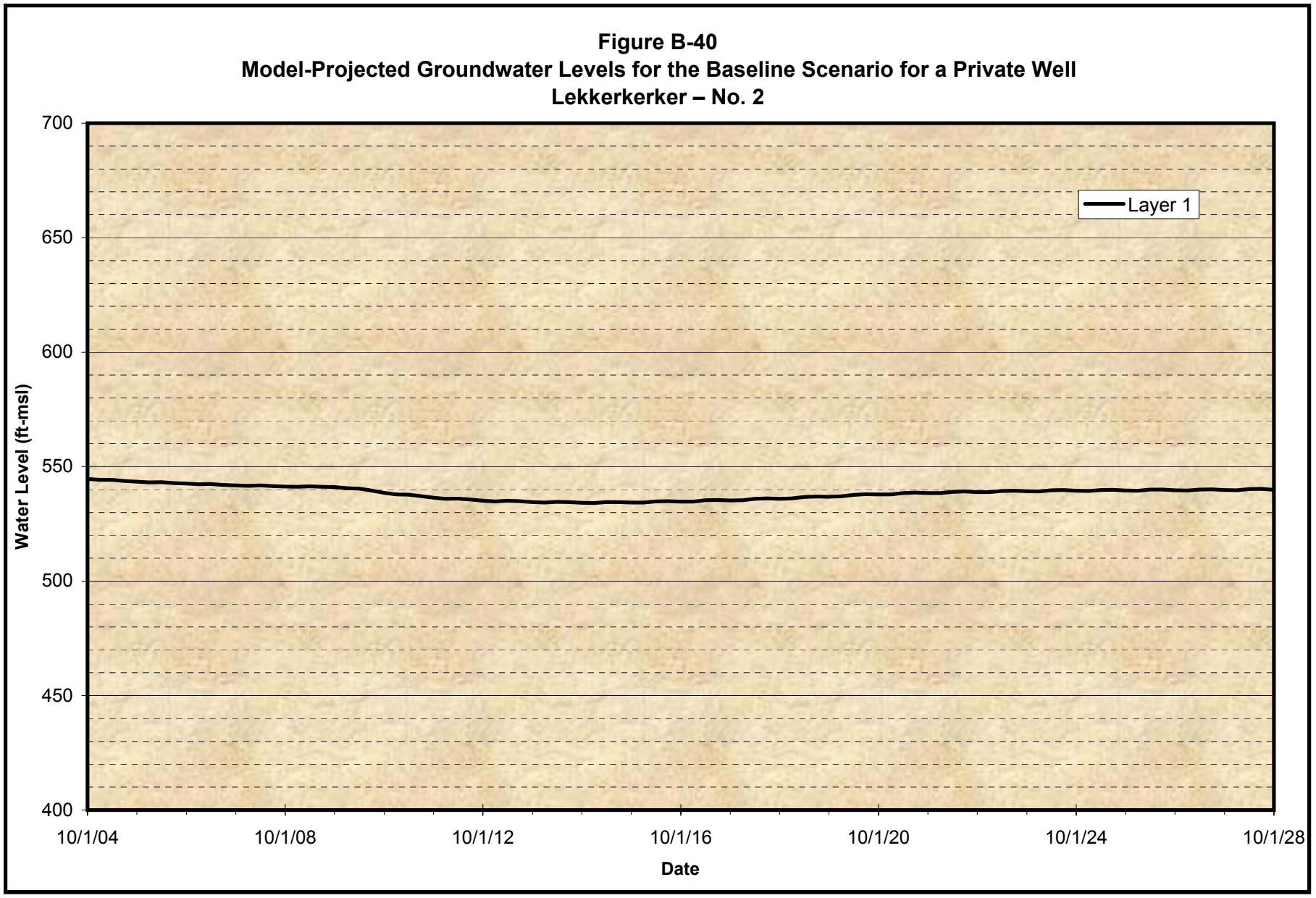


**Figure B-41**
**Model-Projected Groundwater Levels for the Baseline Scenario for a Private Well**
**Tollerup**

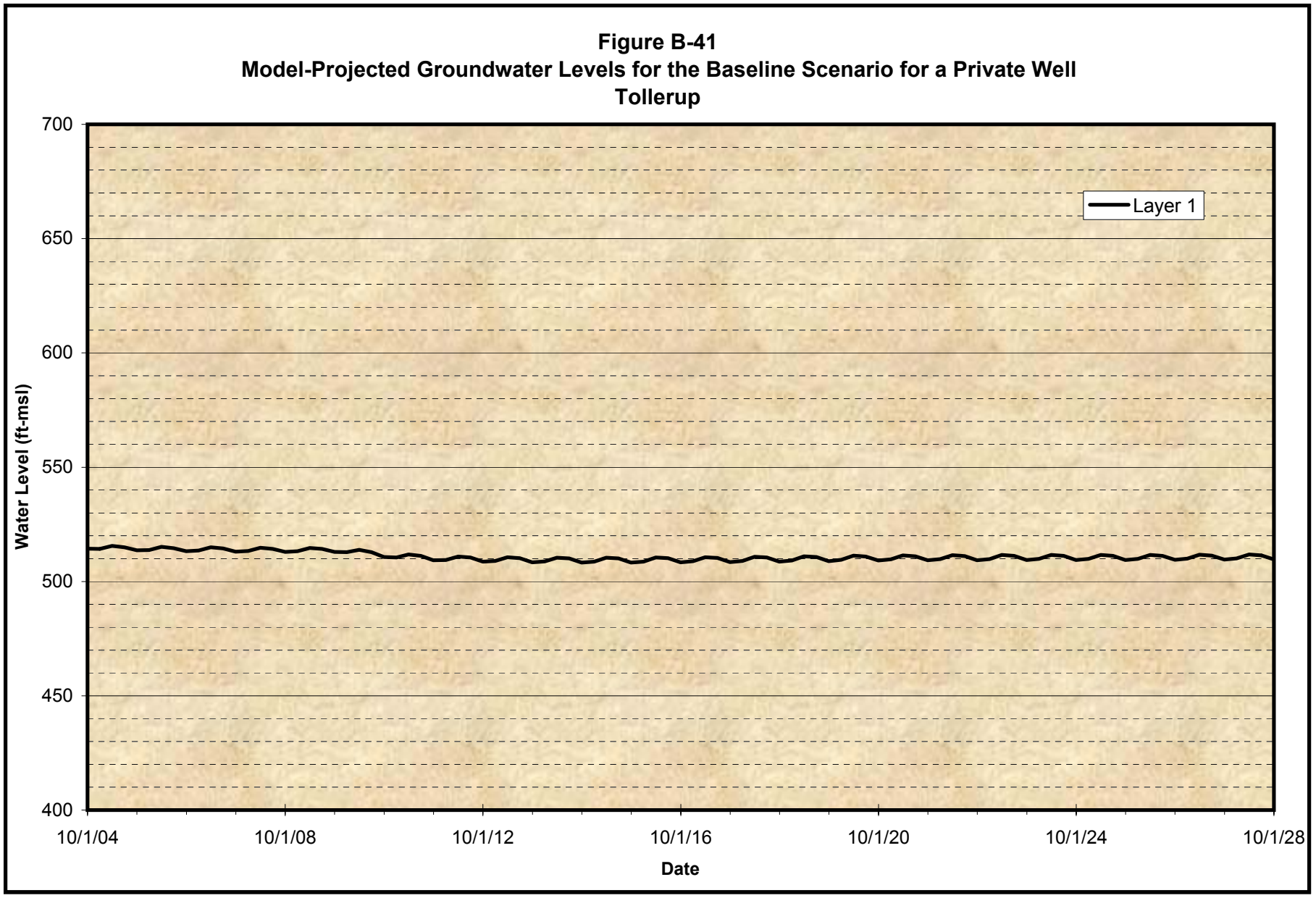


**Figure B-42**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Corona – No. 7**

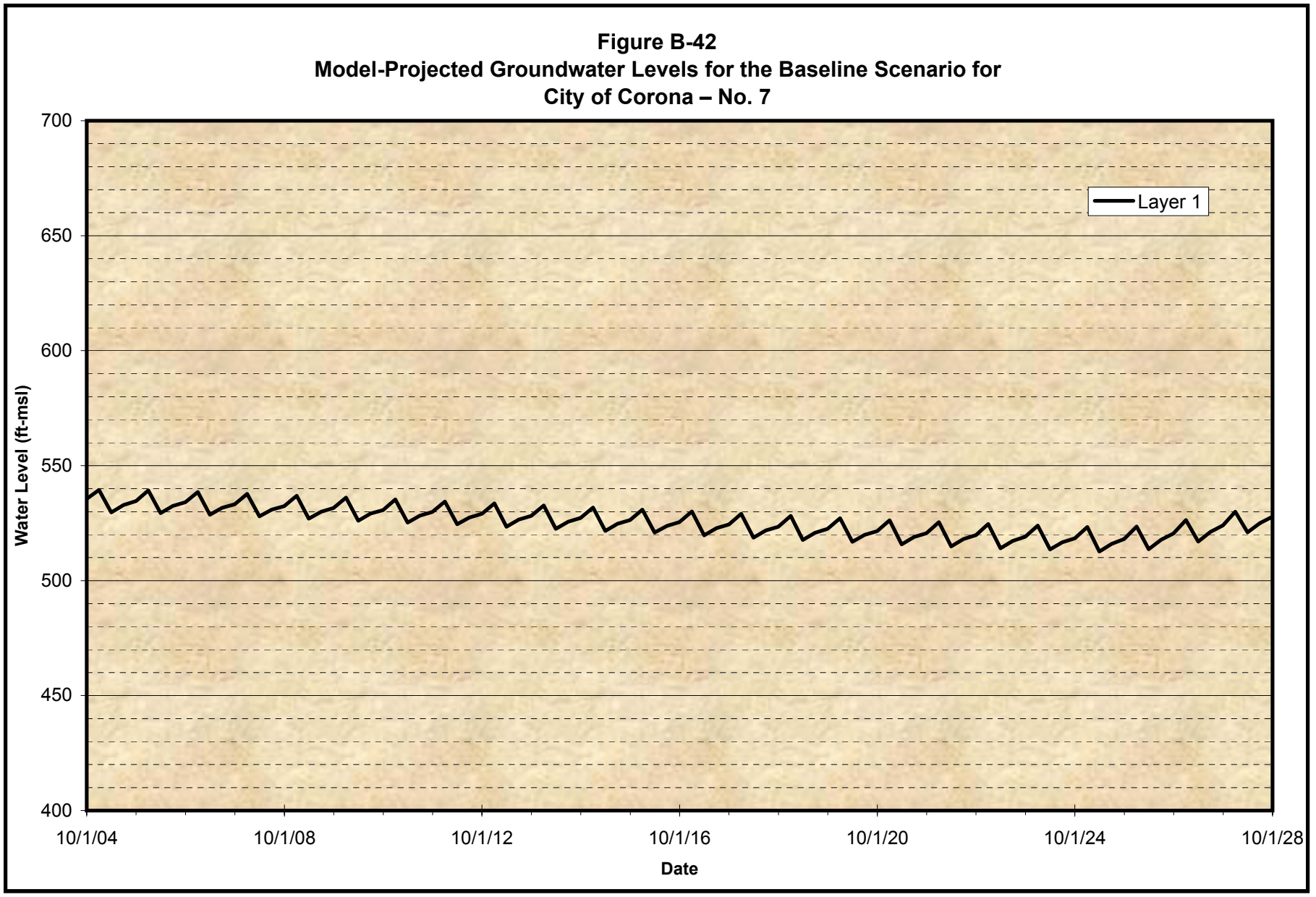


**Figure B-43**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Corona – No. 14**

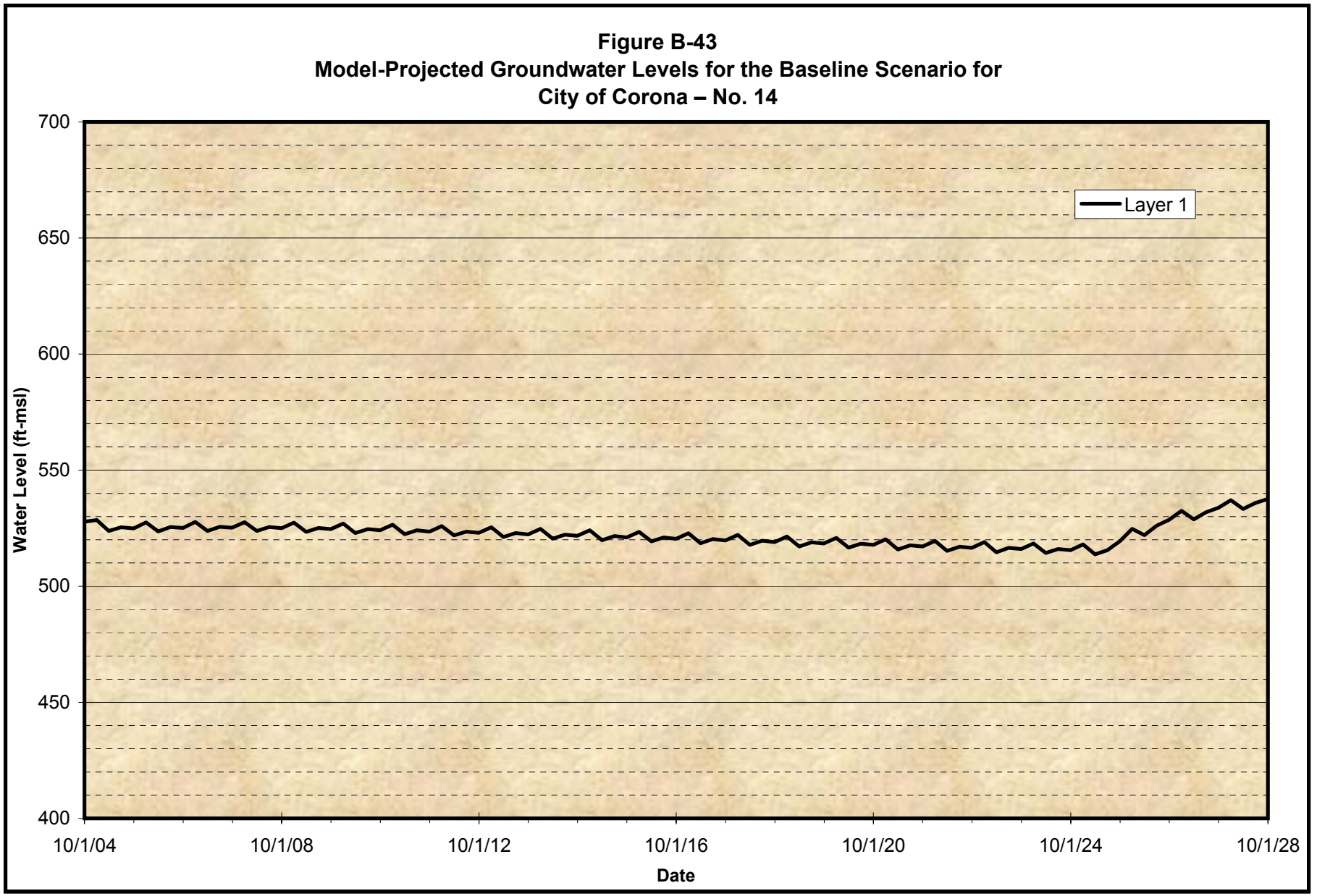


**Figure B-44**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Corona – No. 15**

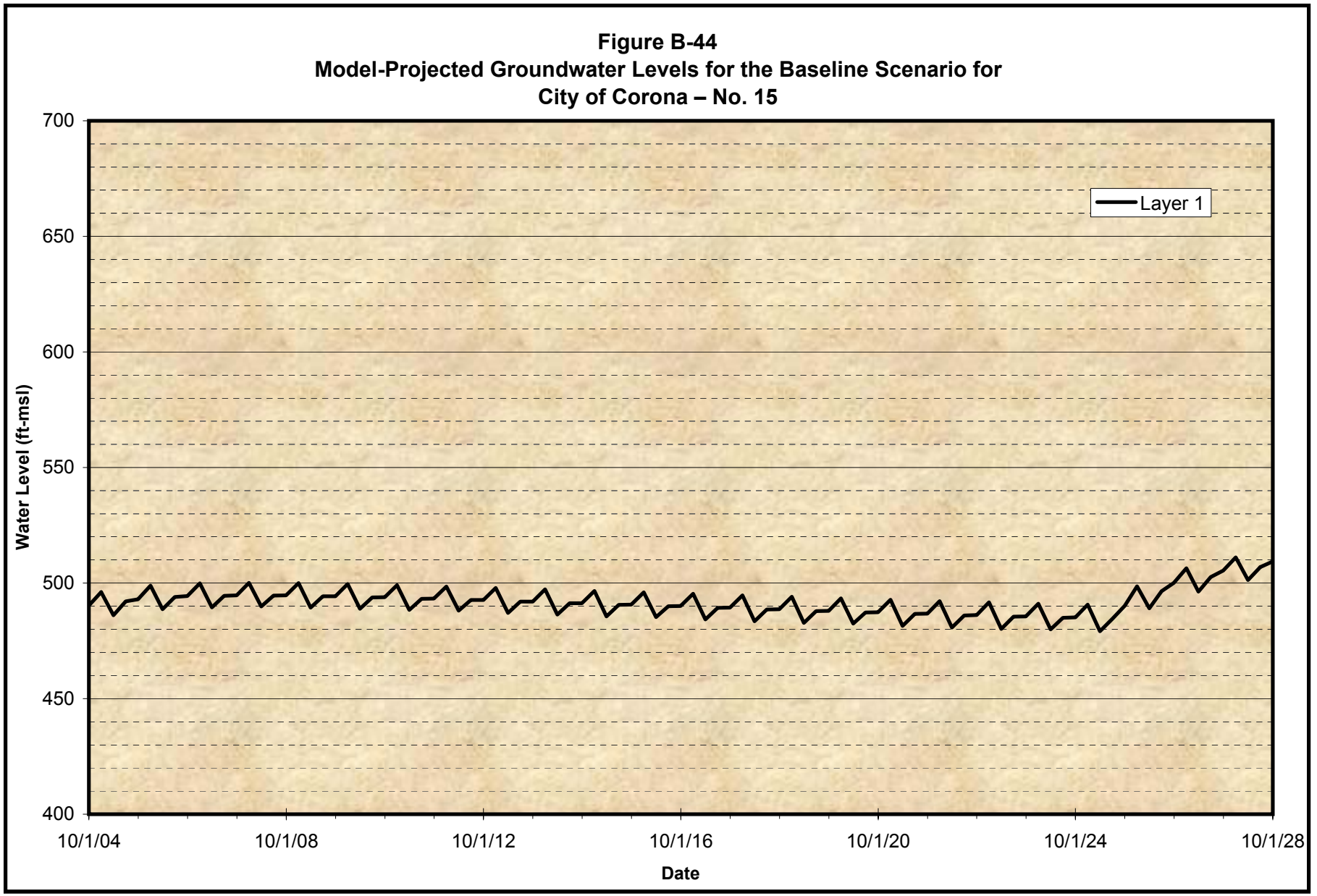


**Figure B-45**
**Model-Projected Groundwater Levels for the Baseline Scenario for City of Corona – No. 12**

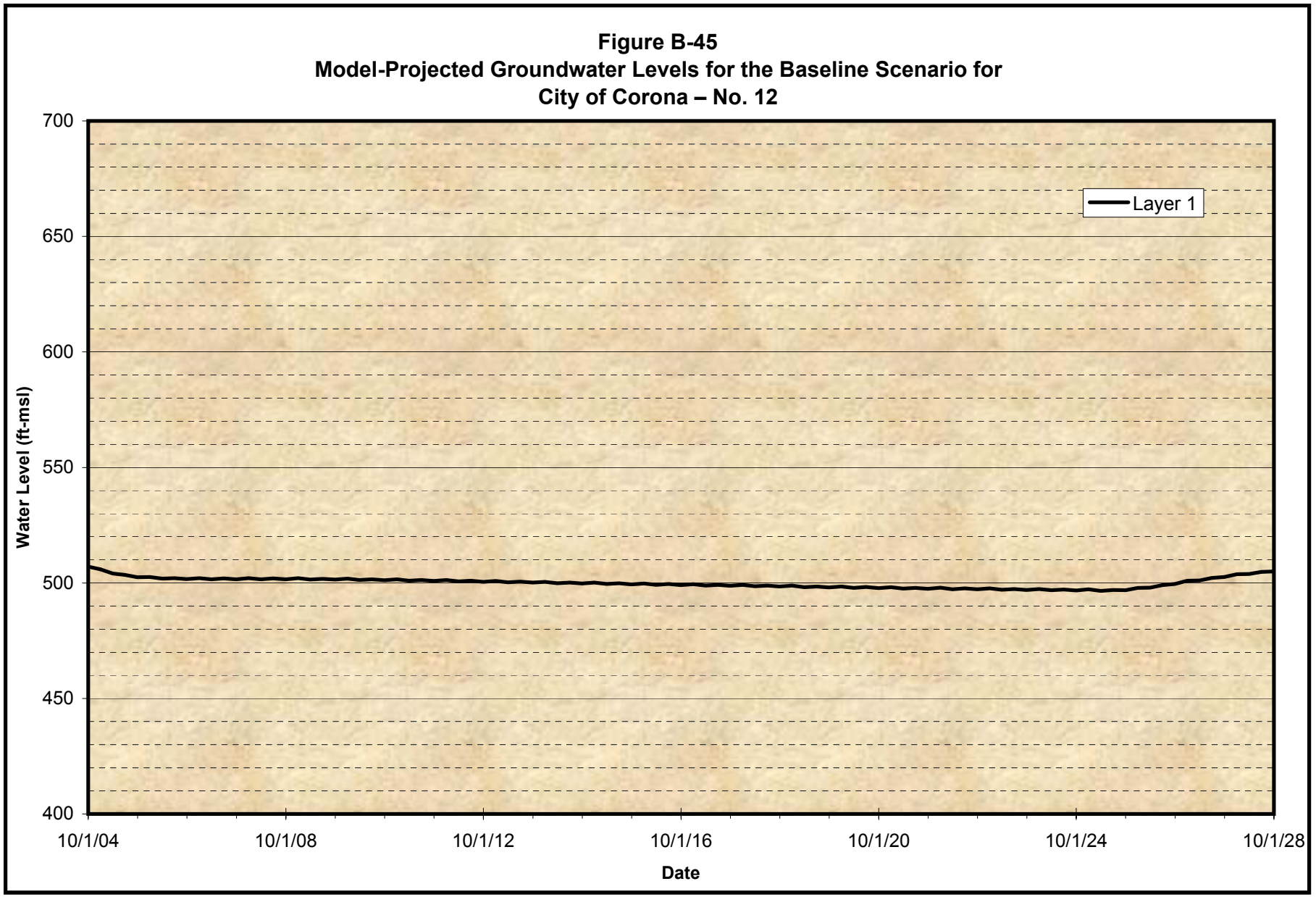


**Figure C-1**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Rialto – Chino No. 1**

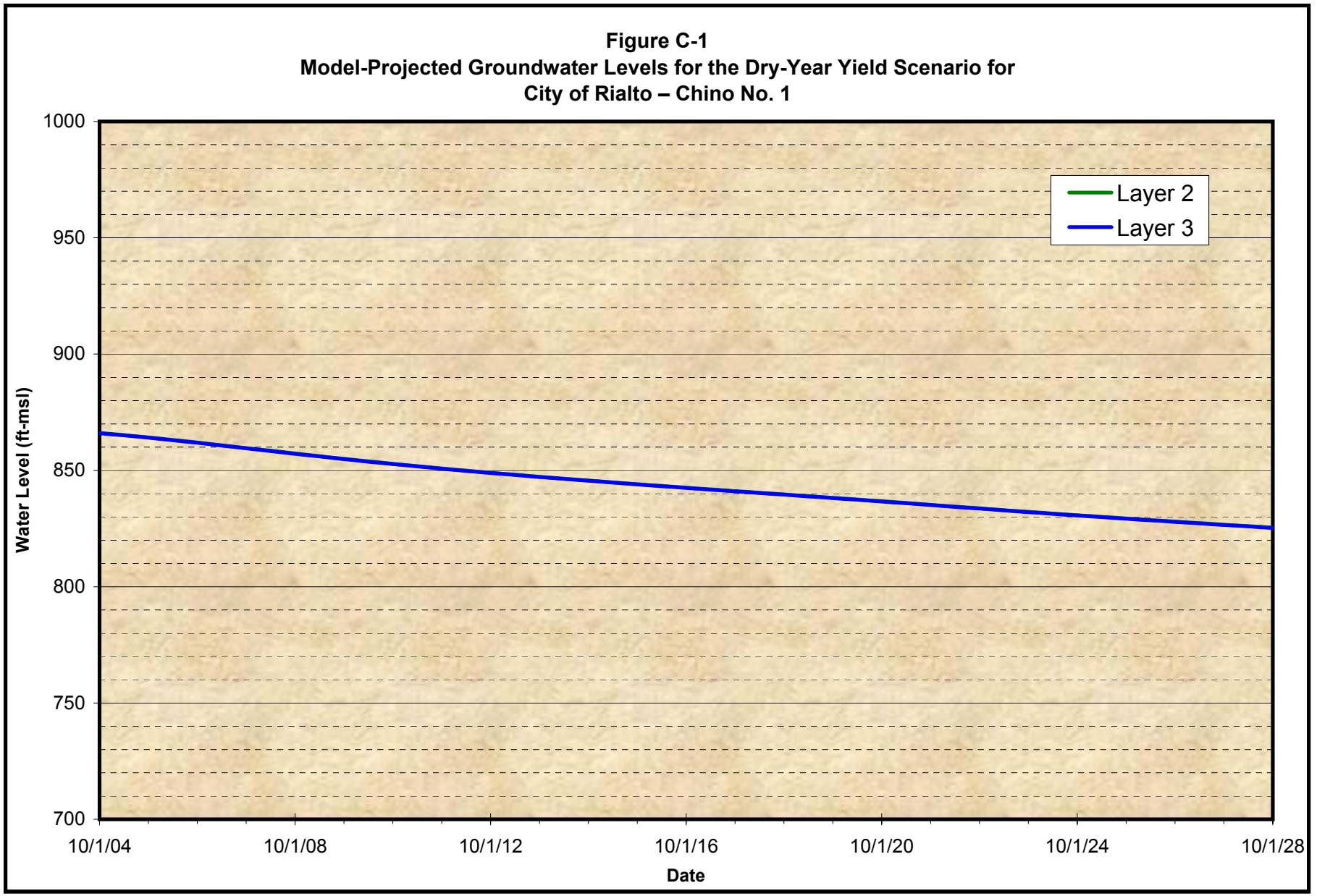


**Figure C-2**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for West San Bernardino County Water District – No. 27**

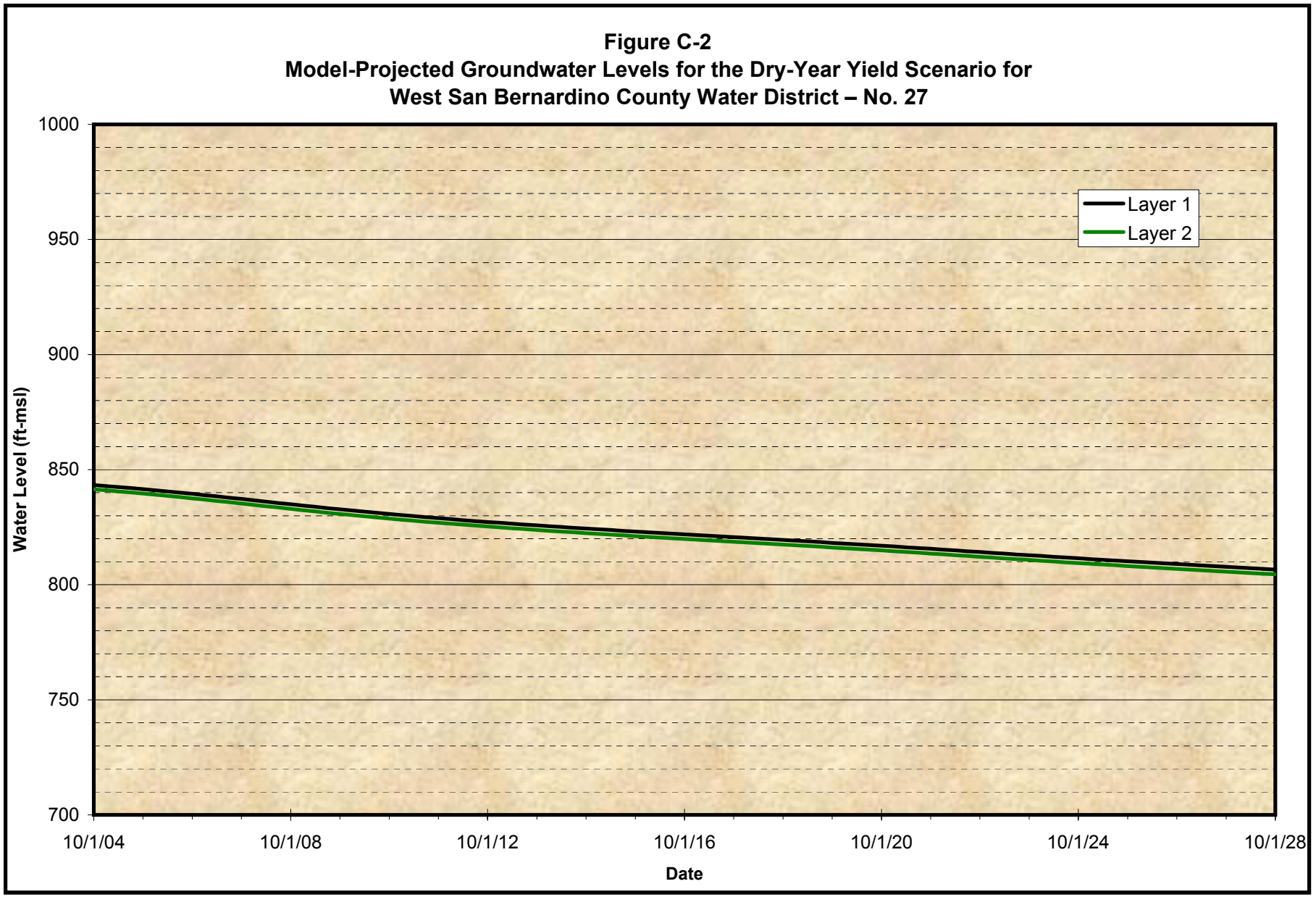


**Figure C-3**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for West San Bernardino County Water District – No. 37**

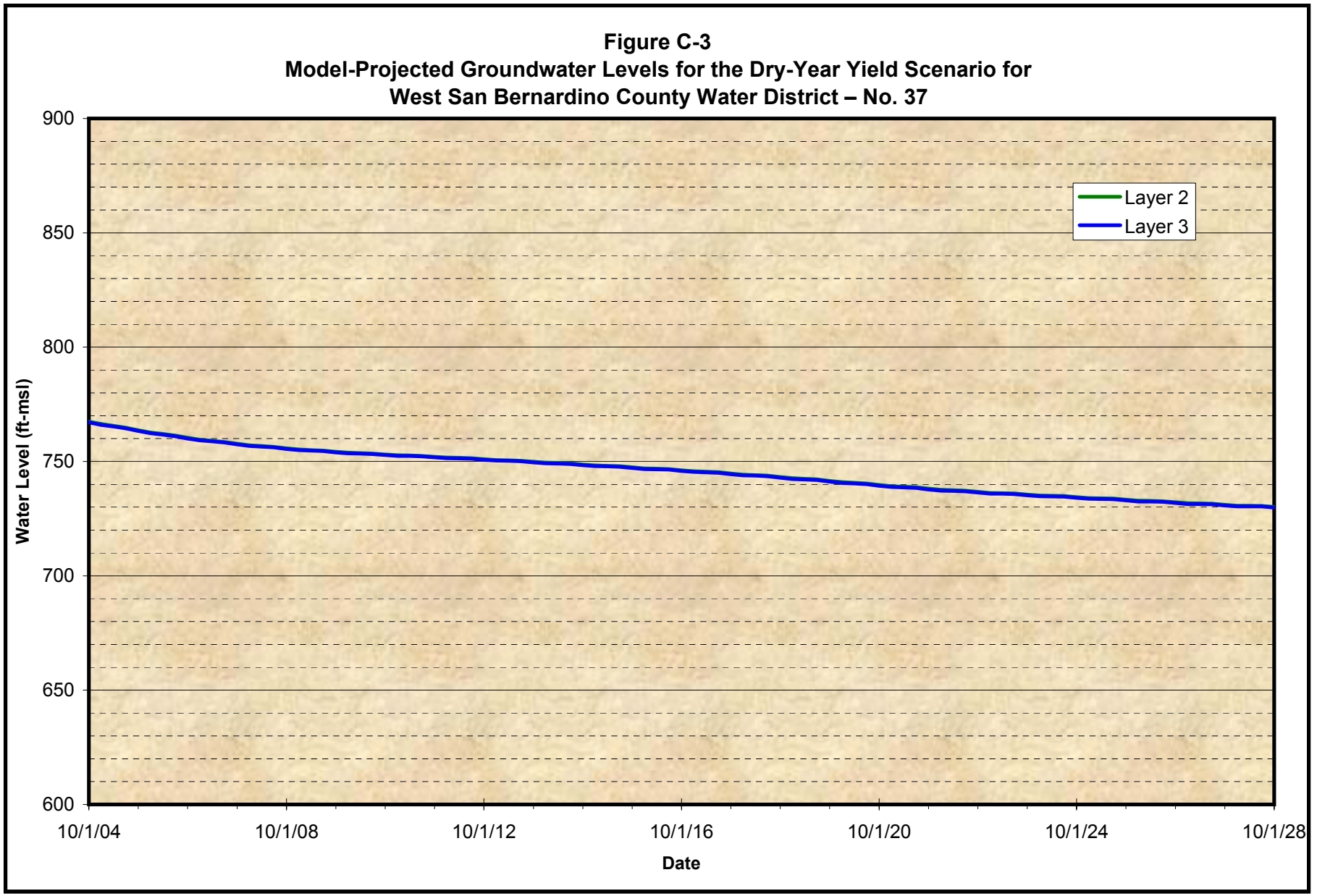


**Figure C-4**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Fontana Water Company – No. F31A**

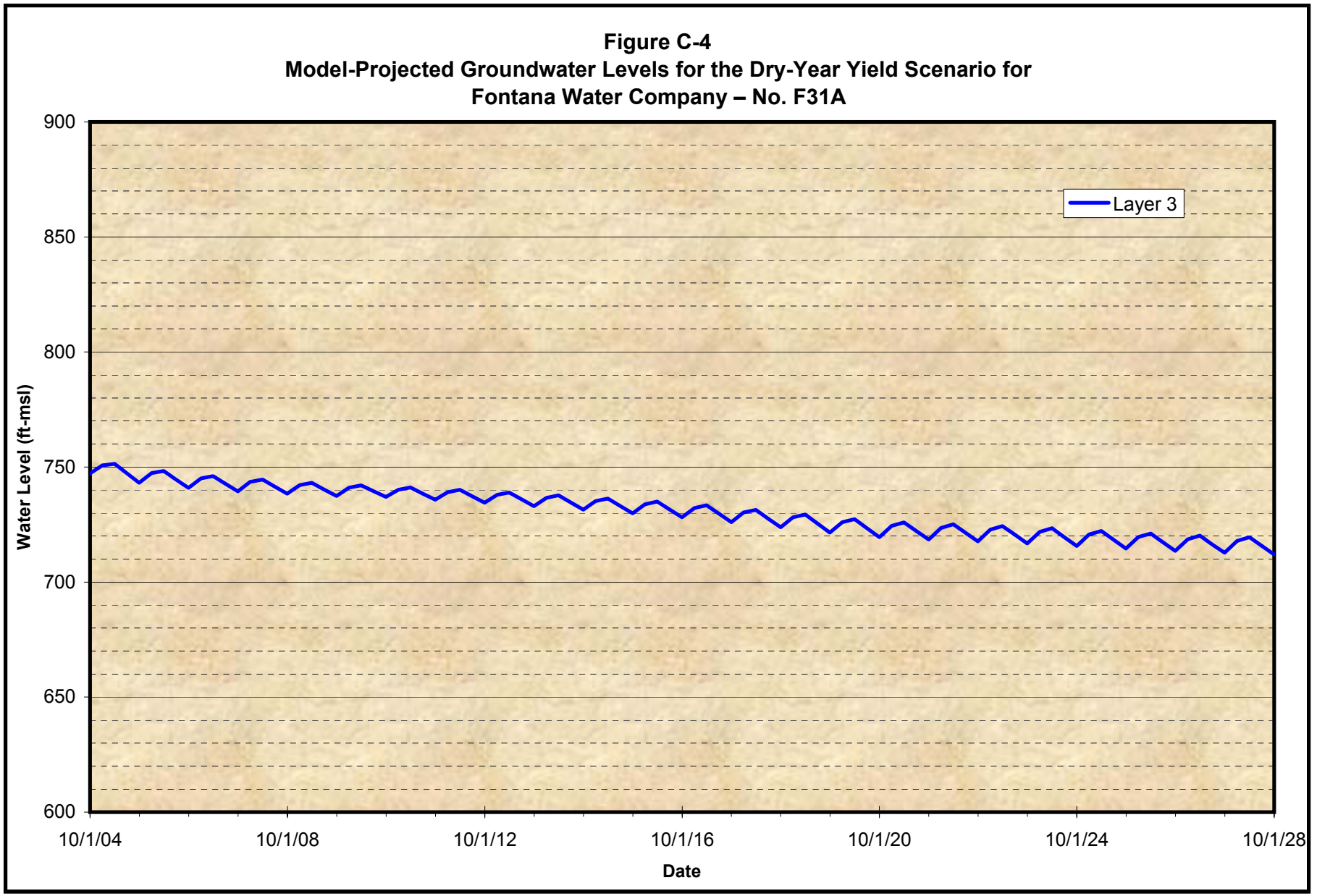


**Figure C-5**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Fontana Water Company – No. F3A**

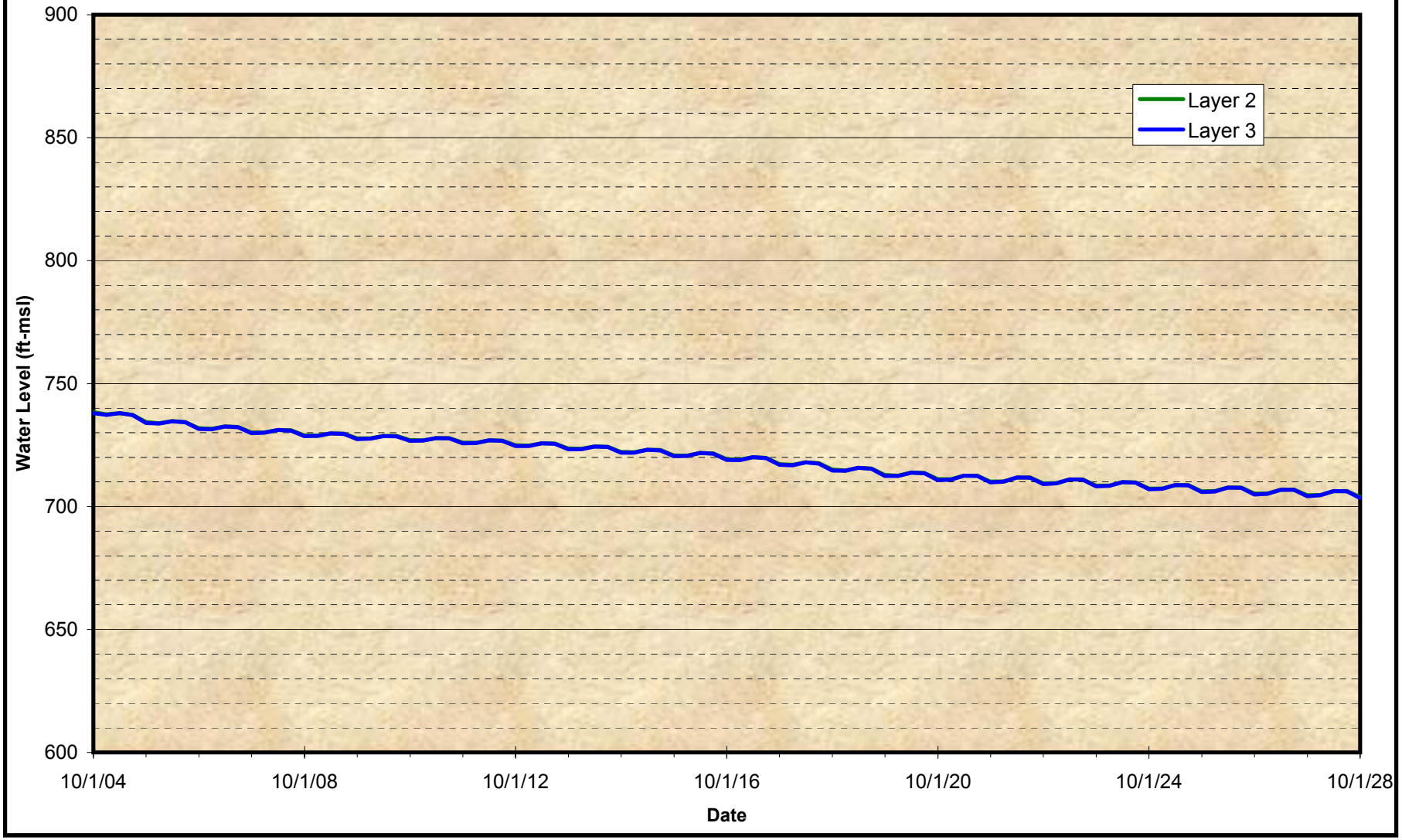


**Figure C-6**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Fontana Water Company – No. F21A**

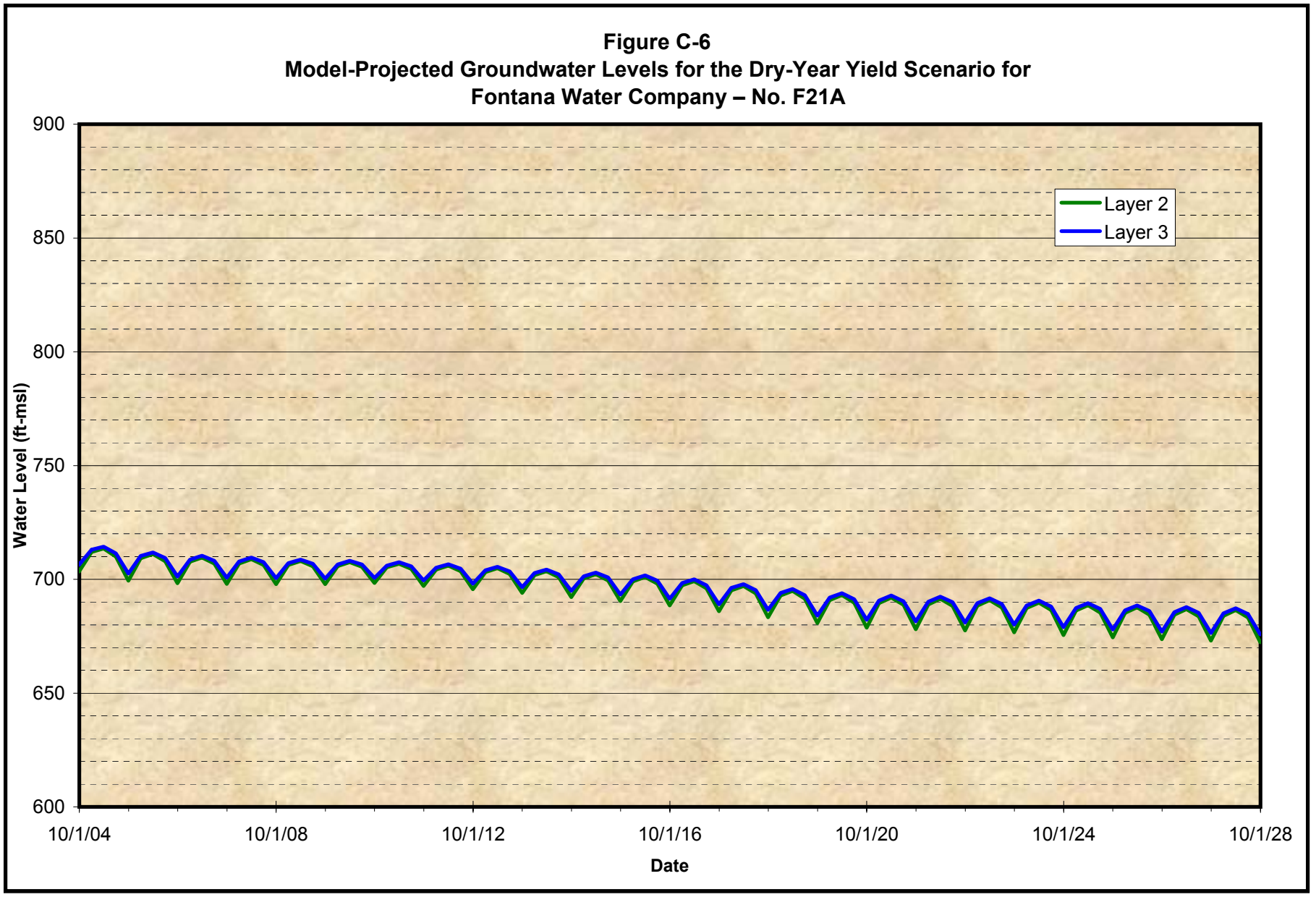


**Figure C-7**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Cucamonga County Water District – No. CB-35**

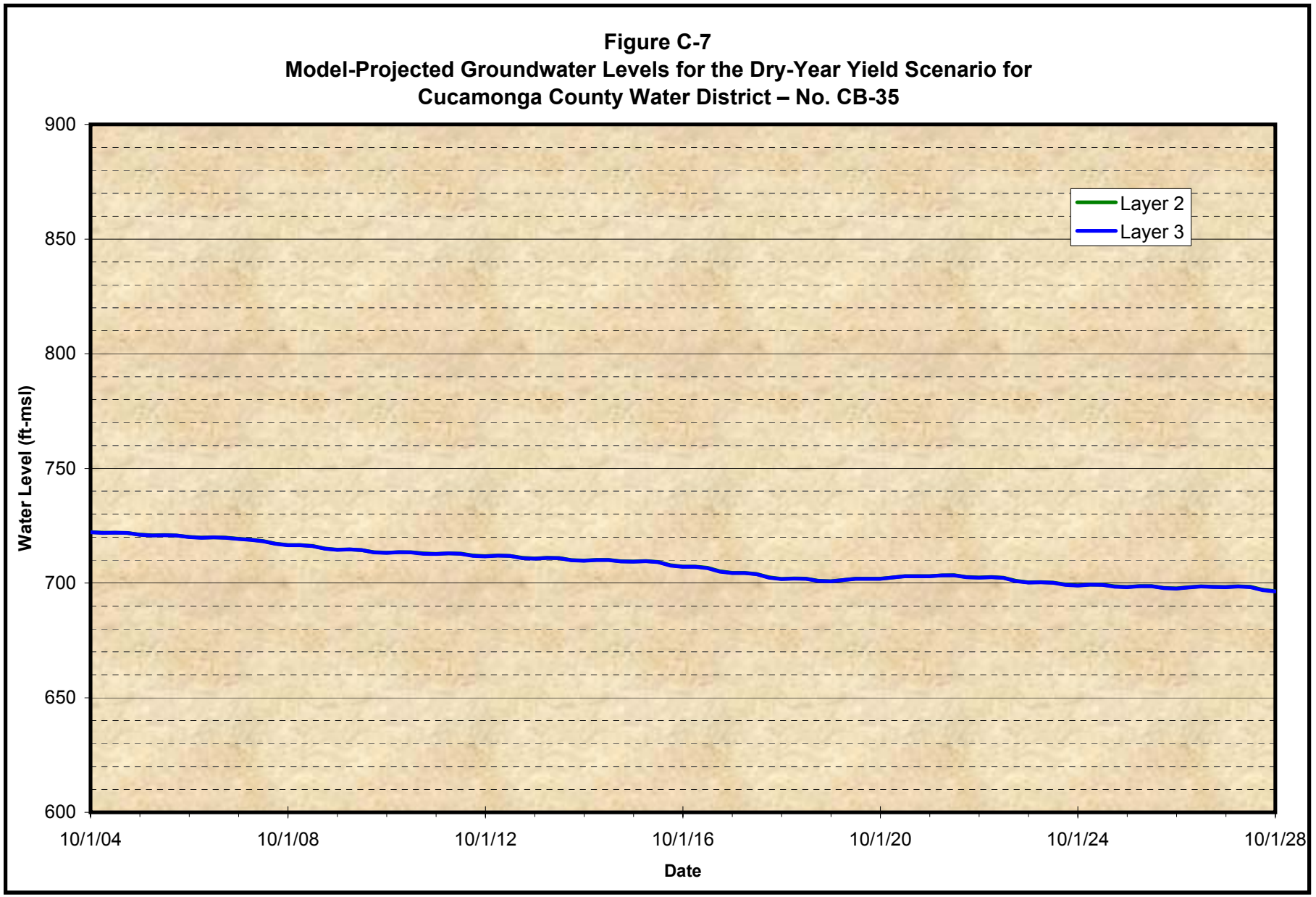


**Figure C-8**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Southern California Edison – Well C**

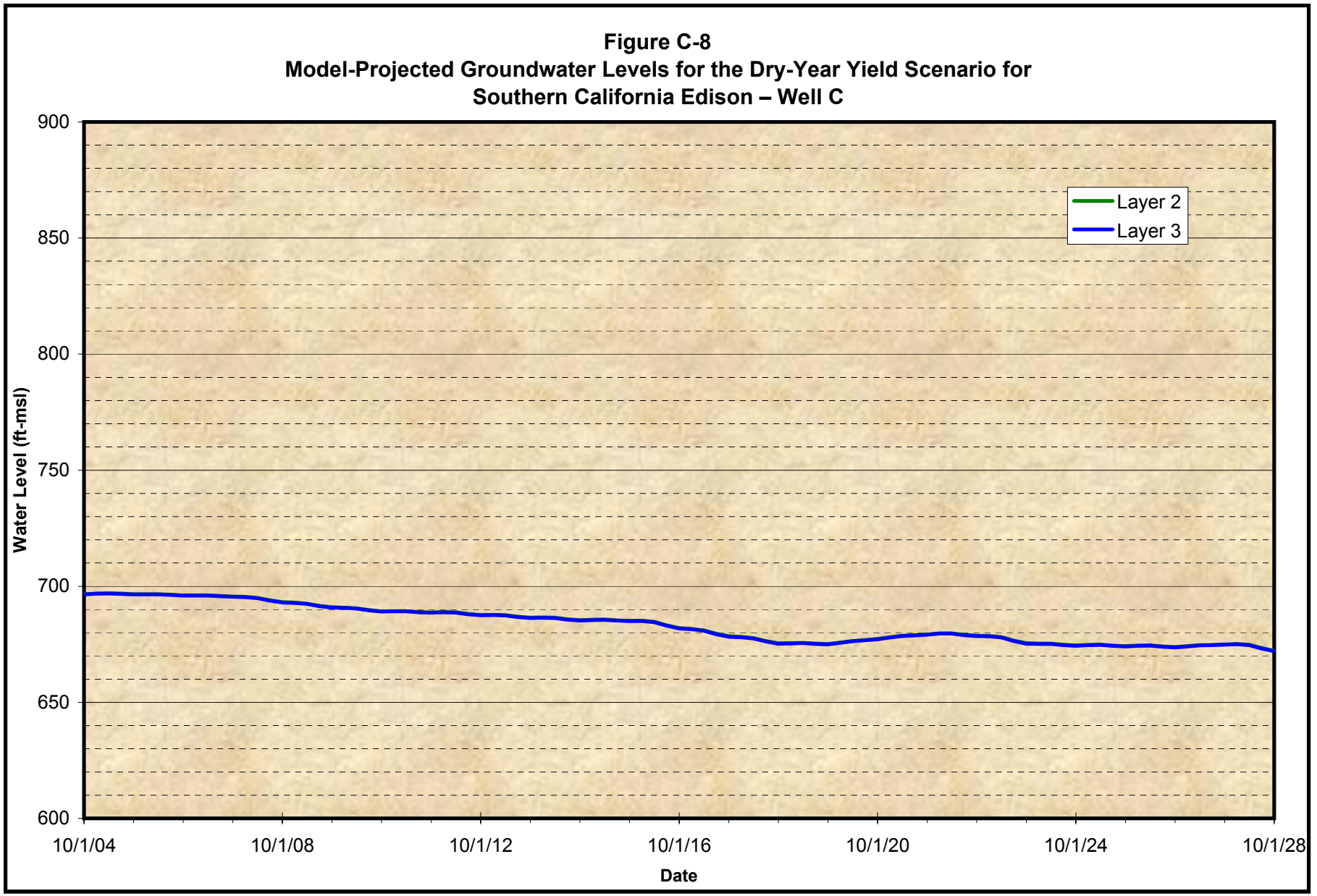


**Figure C-9**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Ontario – No. 31**

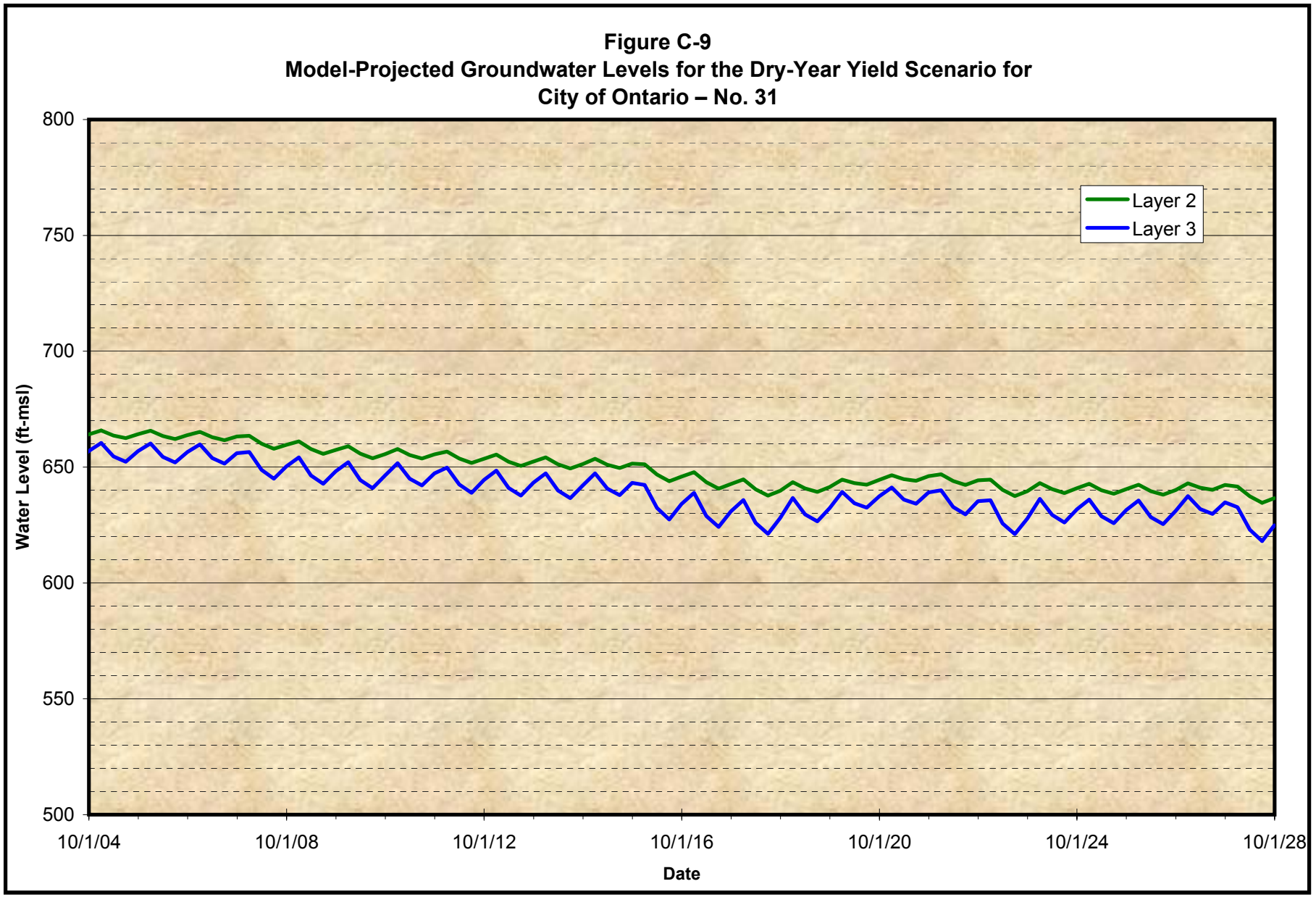


**Figure C-10**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Cucamonga County Water District – No. 30**

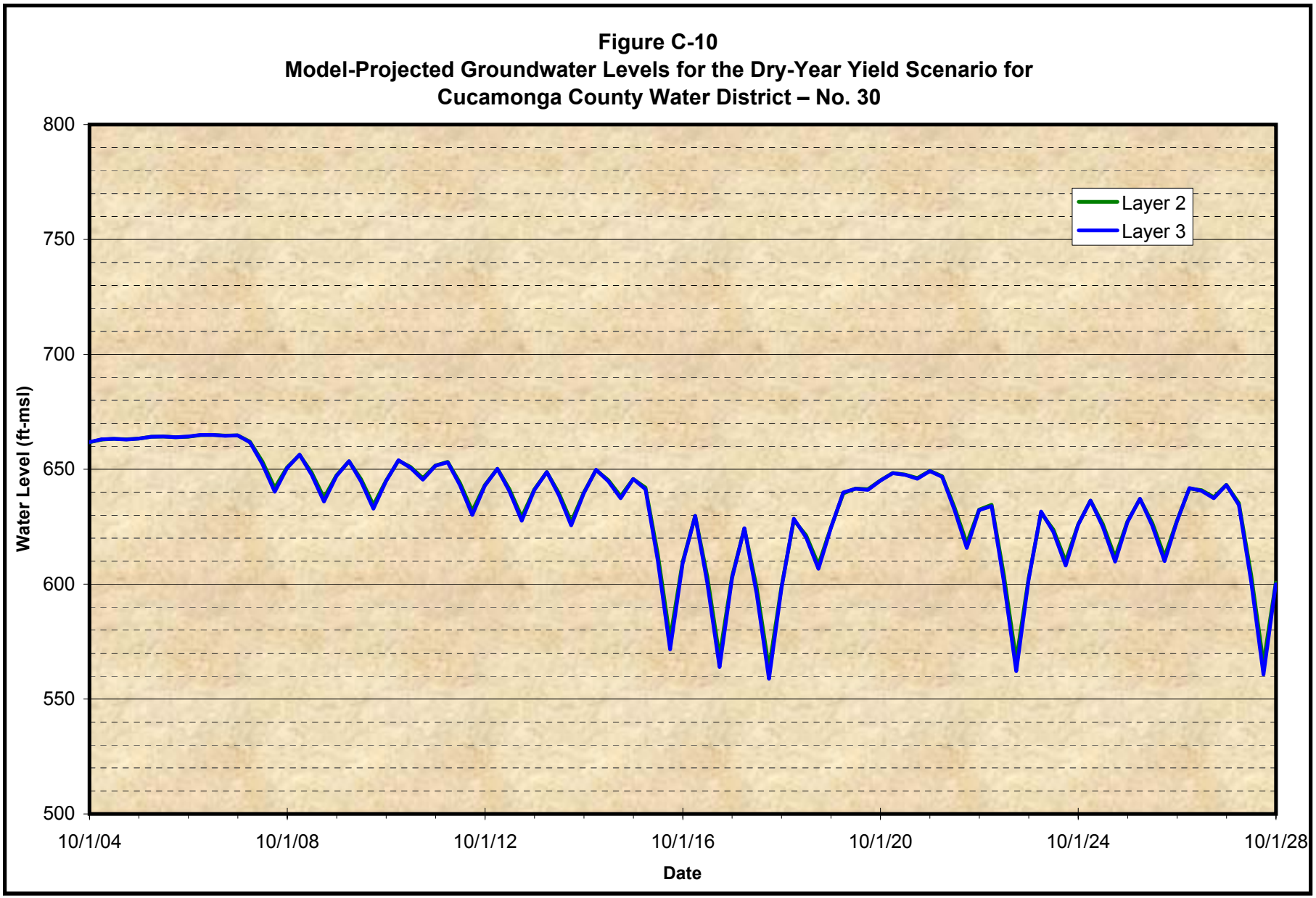


**Figure C-11**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Ontario – No. 36**

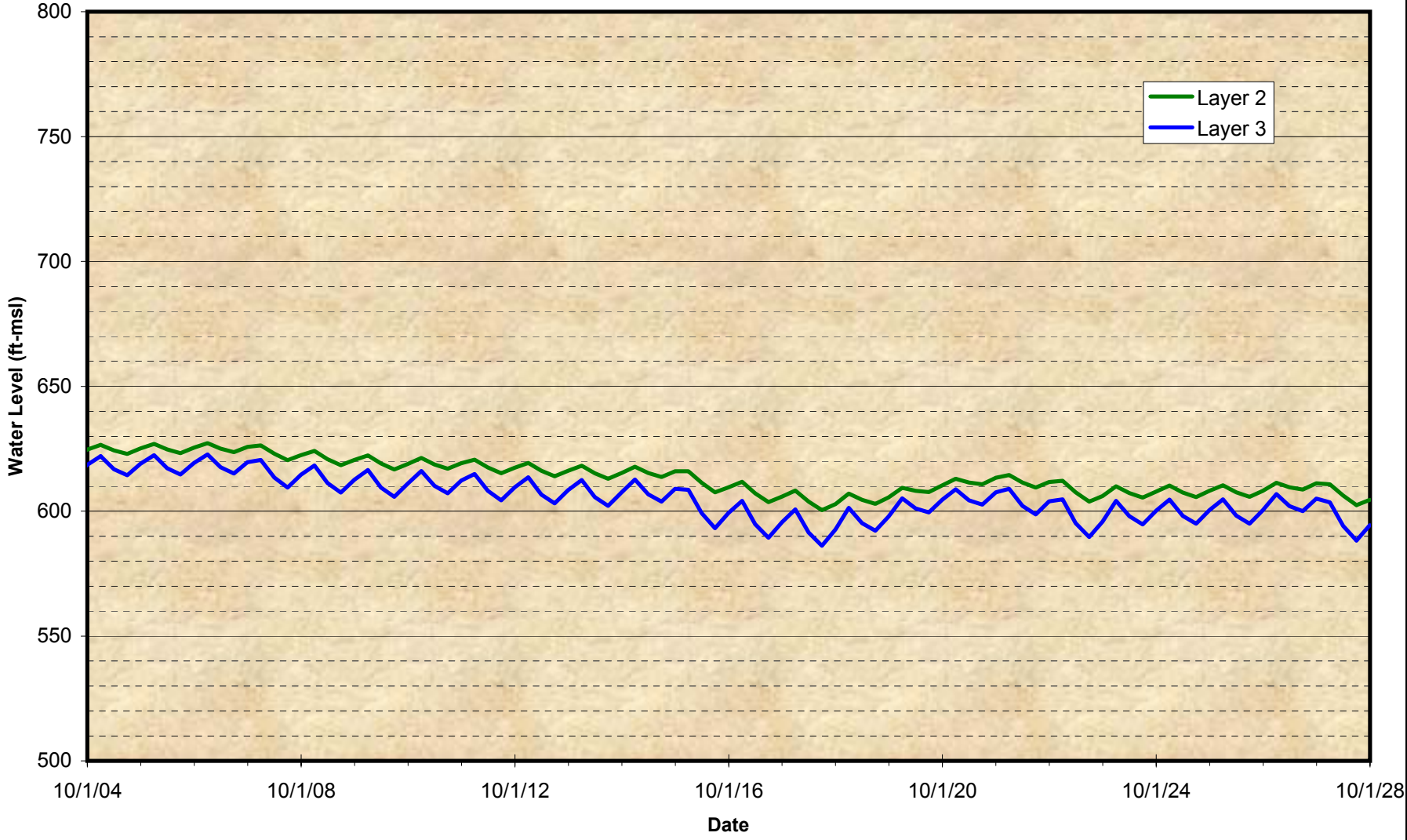


**Figure C-12**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Ontario – No. 17**

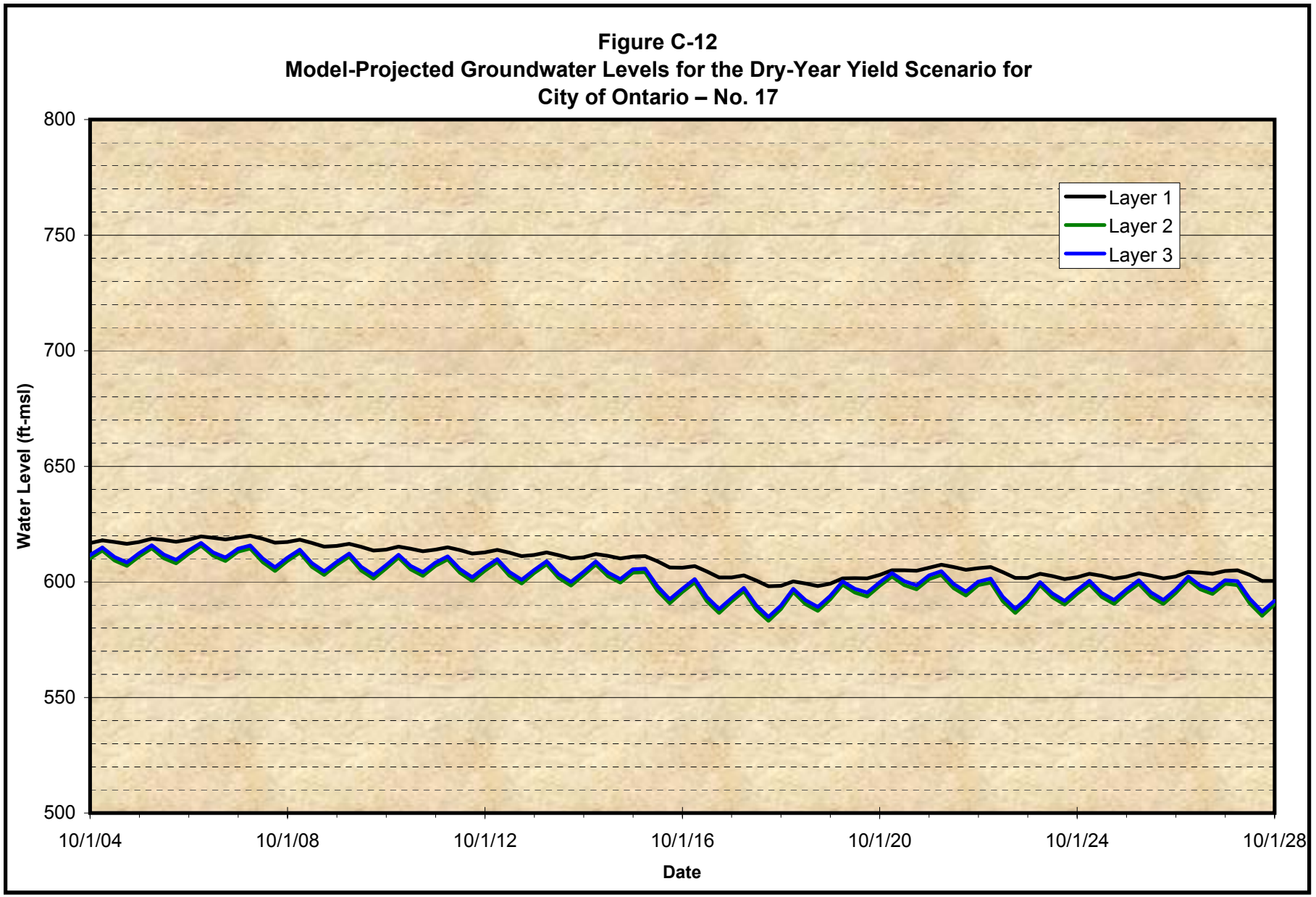


**Figure C-13**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Upland – No. 3**

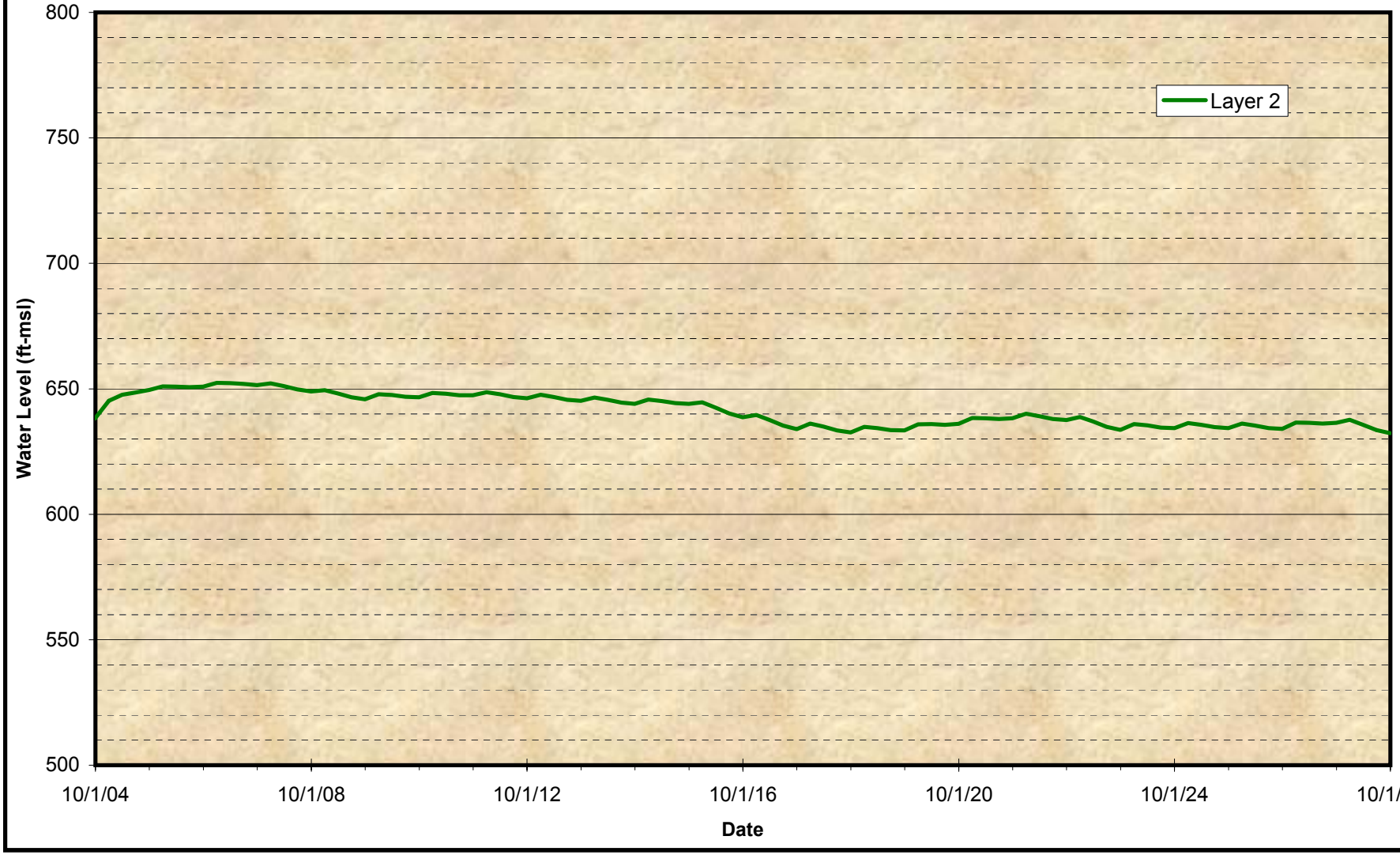


**Figure C-14**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Monte Vista Water District – No. 10**



**Figure C-15**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Pomona – No. 11**

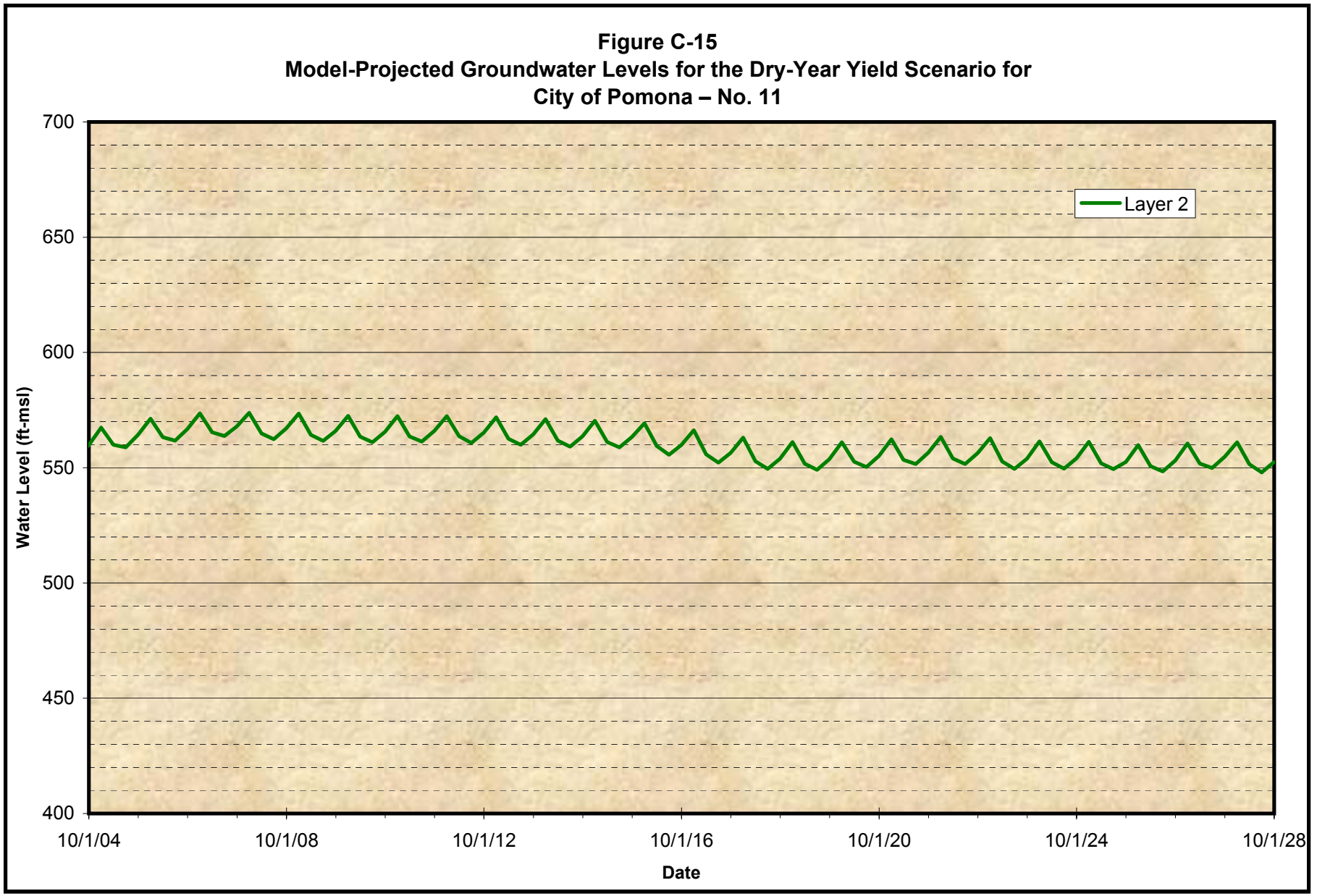


**Figure C-16**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino – No. 12**

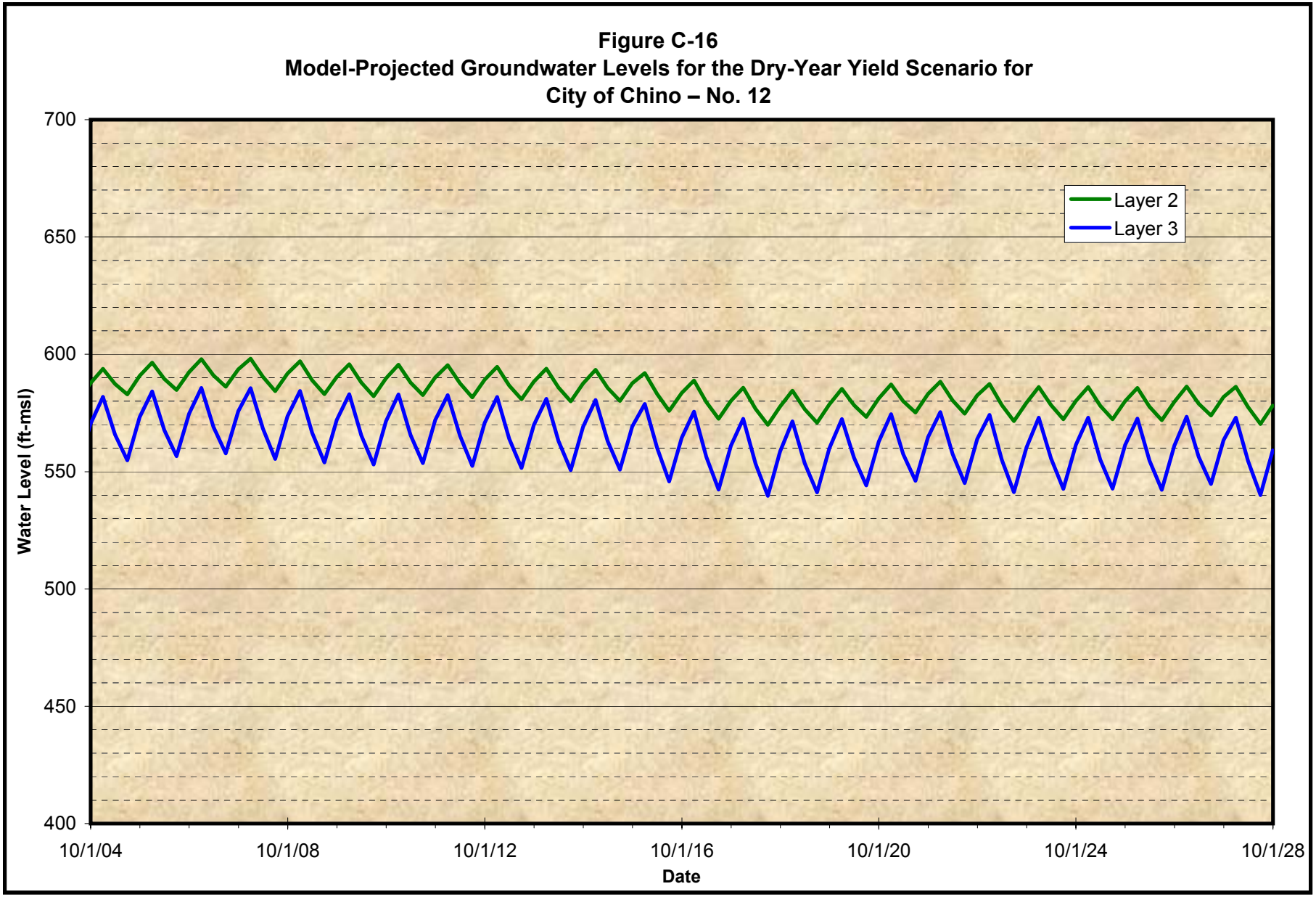


**Figure C-17**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino – No. 9**

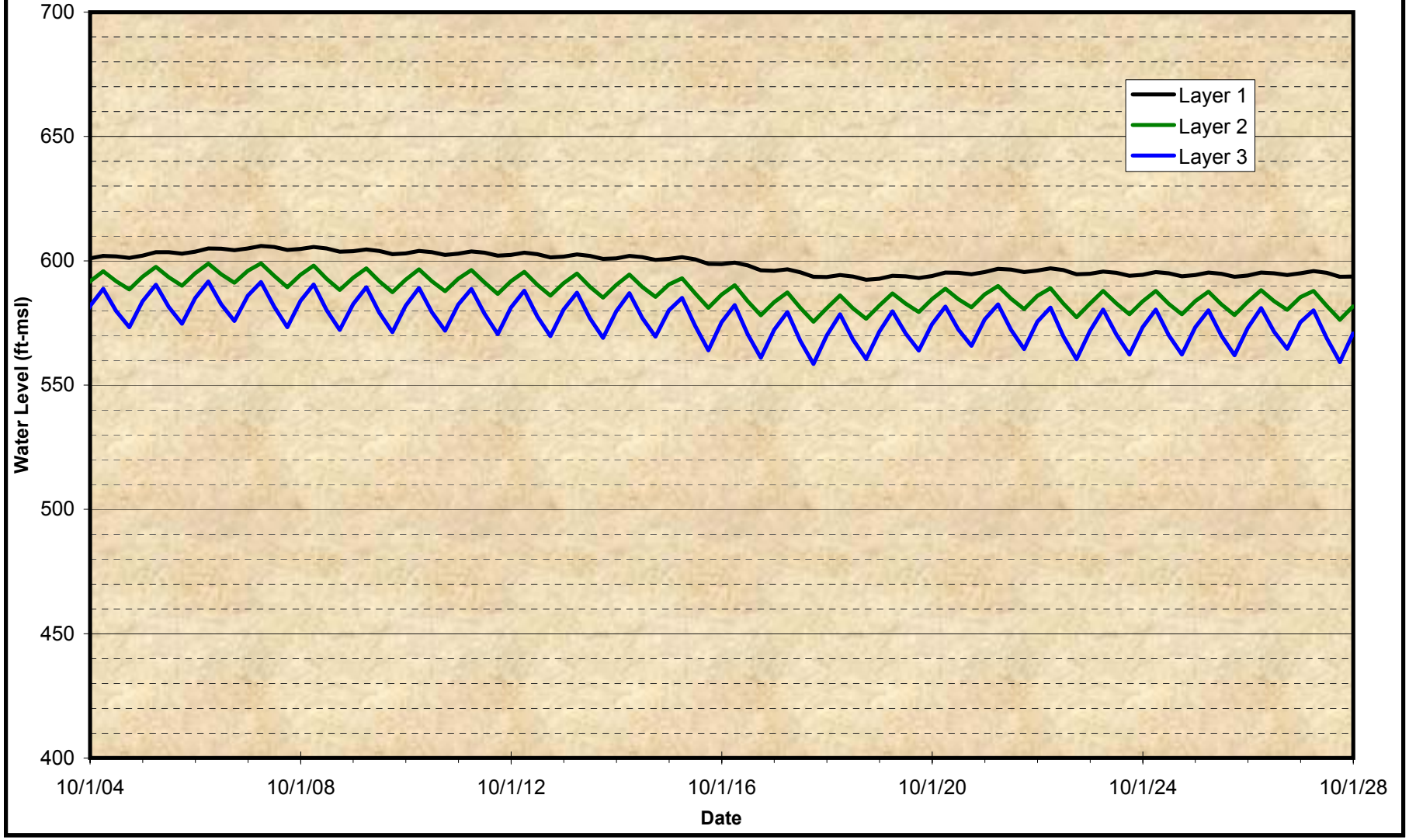


**Figure C-18**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Pomona – No. 29**

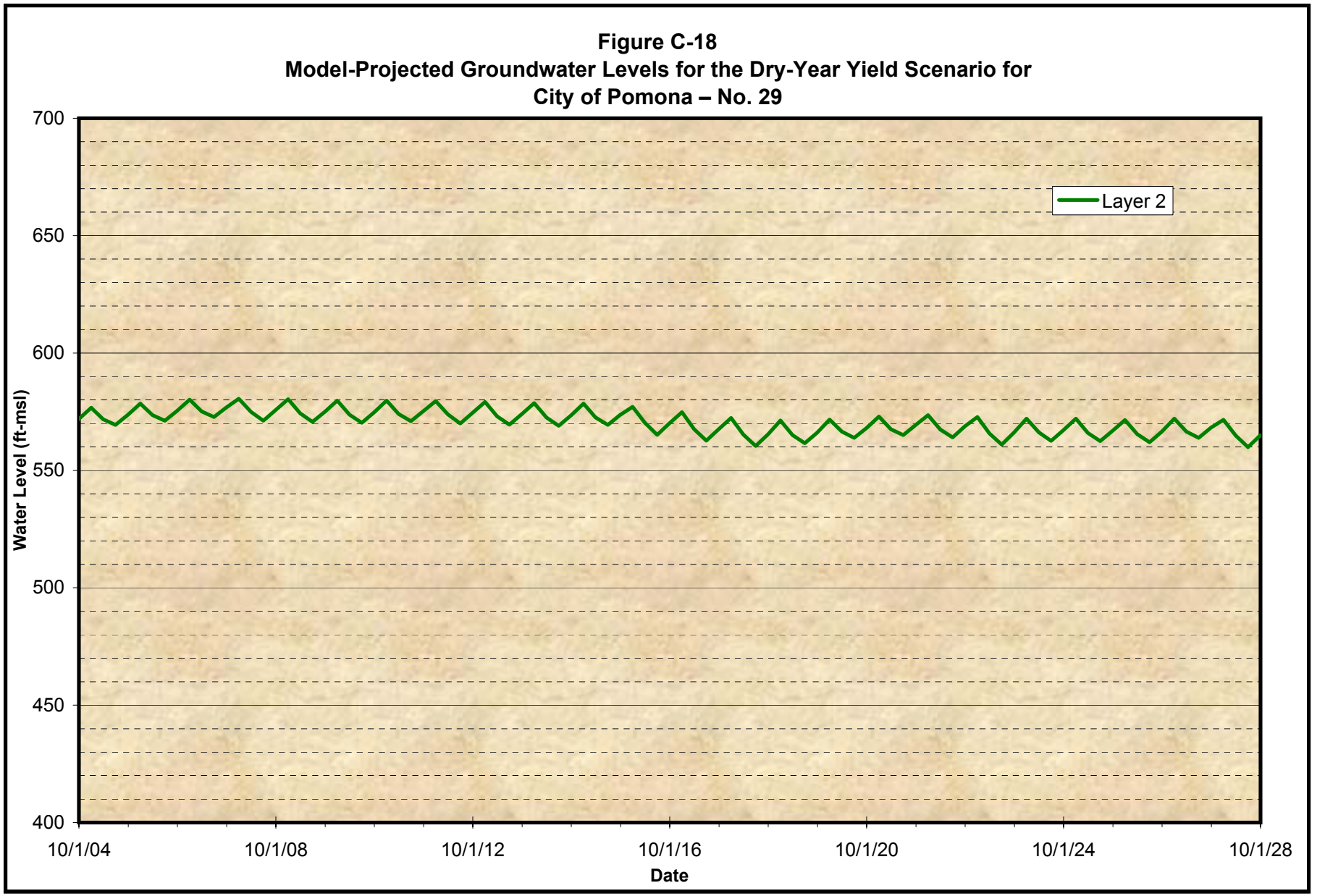


**Figure C-19**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino – No. 11**

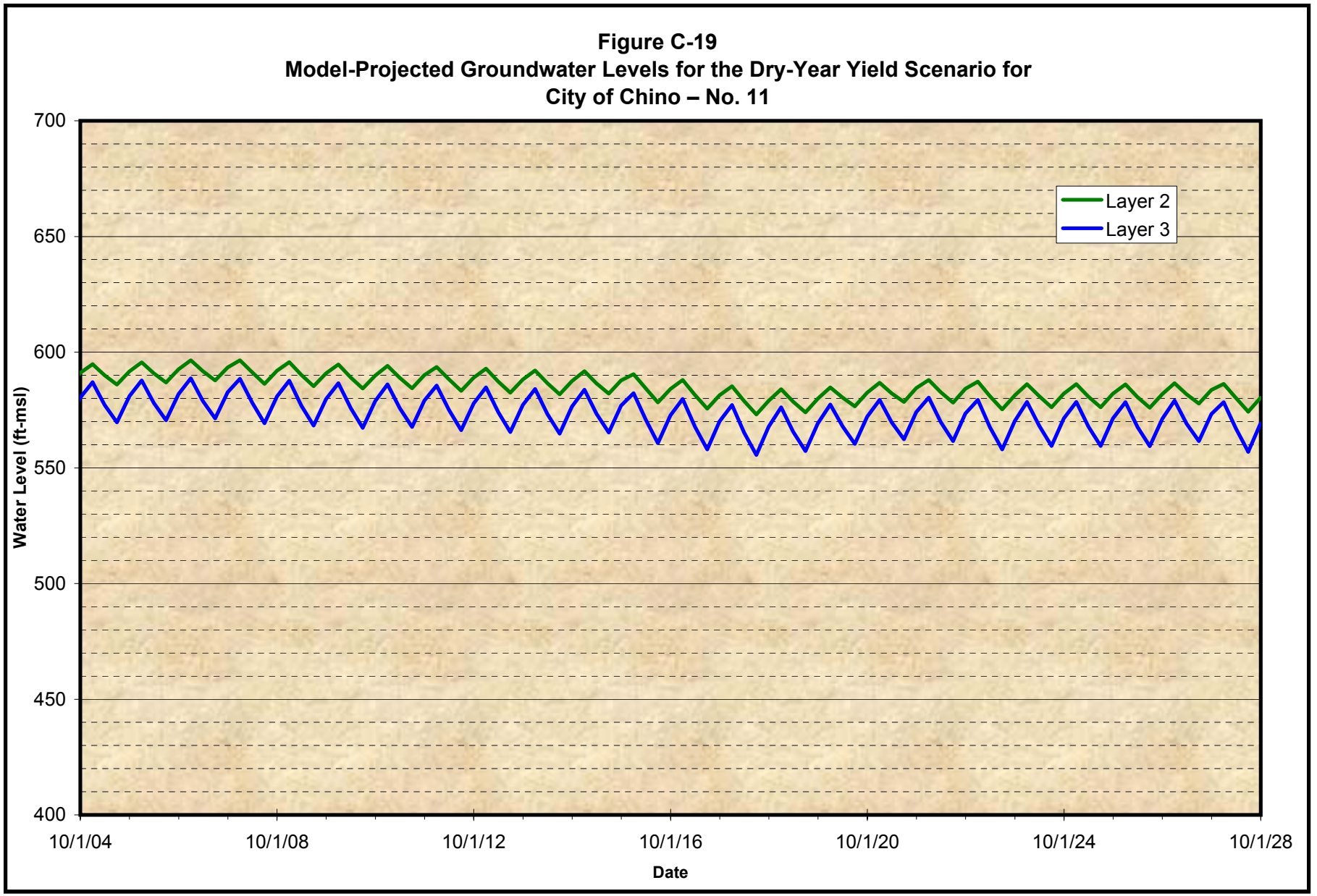


**Figure C-20**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino – No. 13**

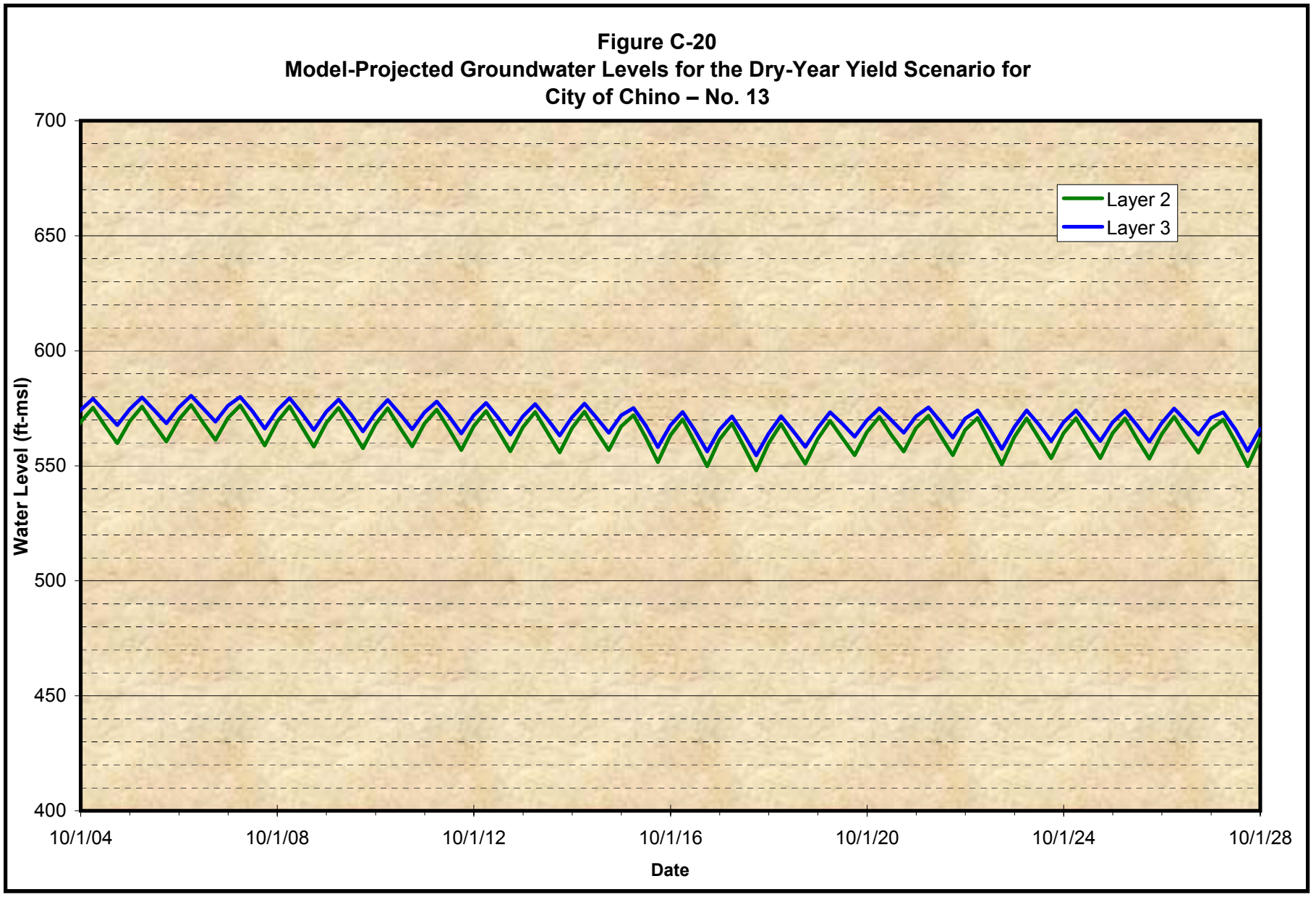


**Figure C-21**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino – No. 4**

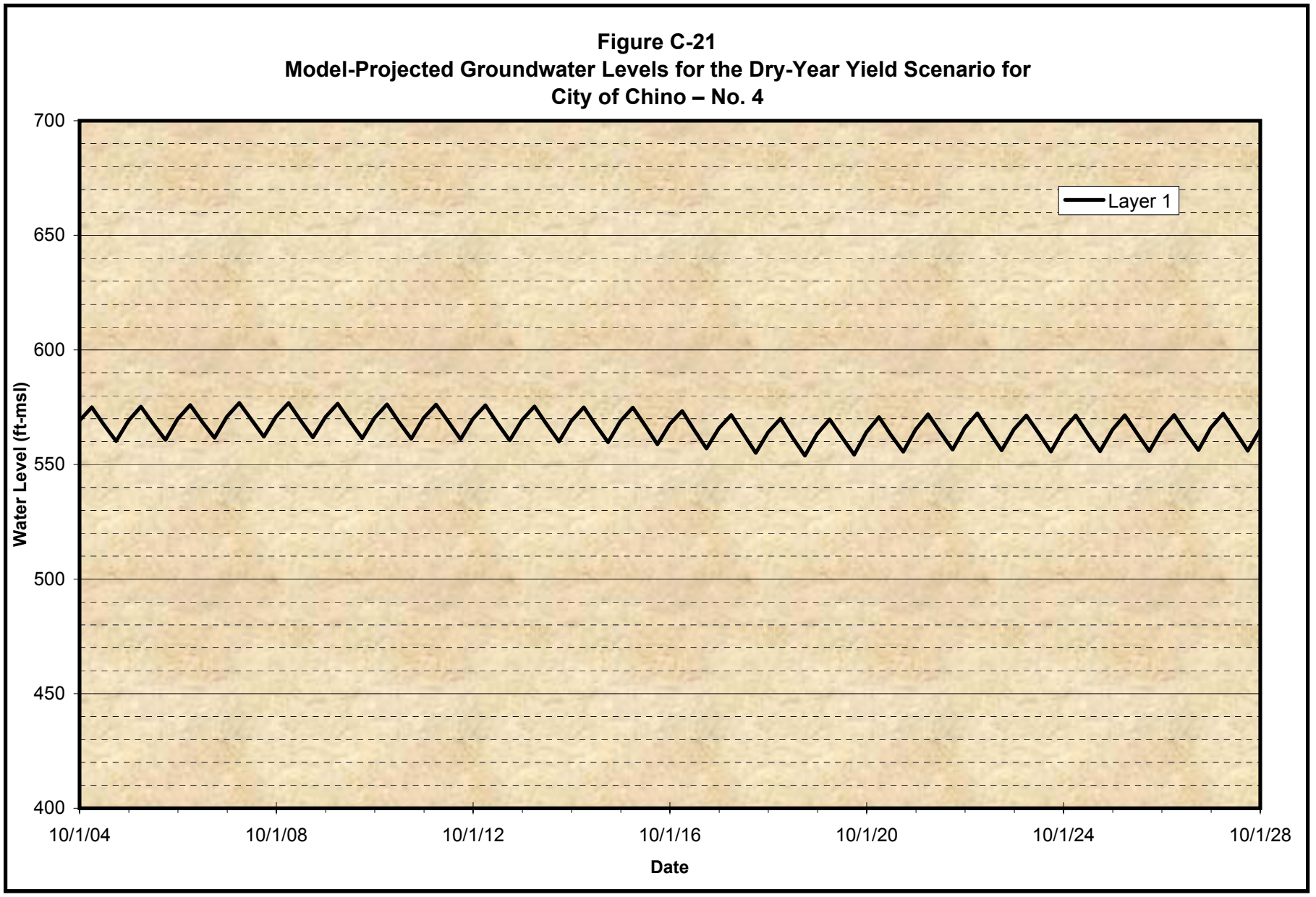


**Figure C-22**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for CIM – No. 4**

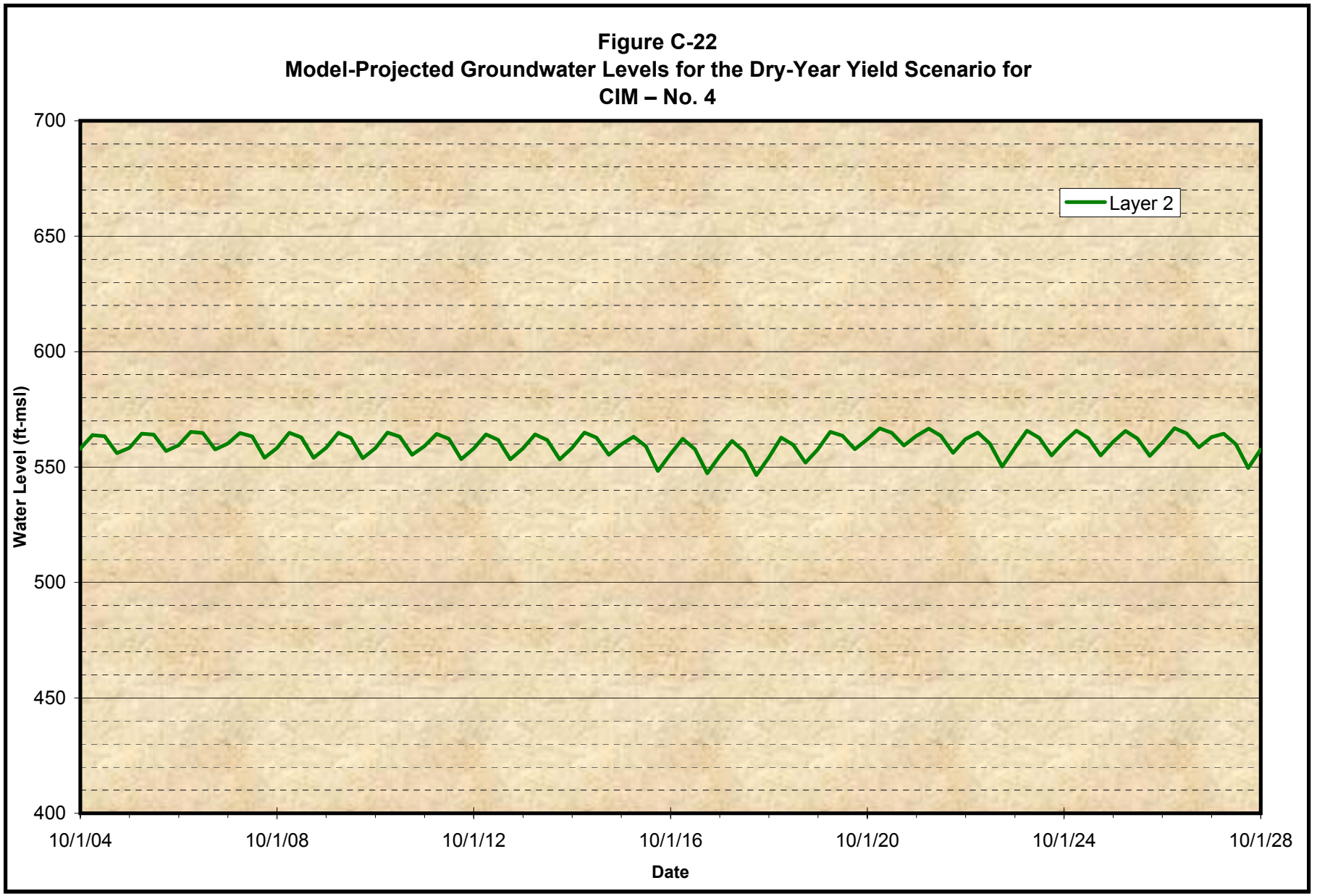


**Figure C-23**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for CIM – No. 13**

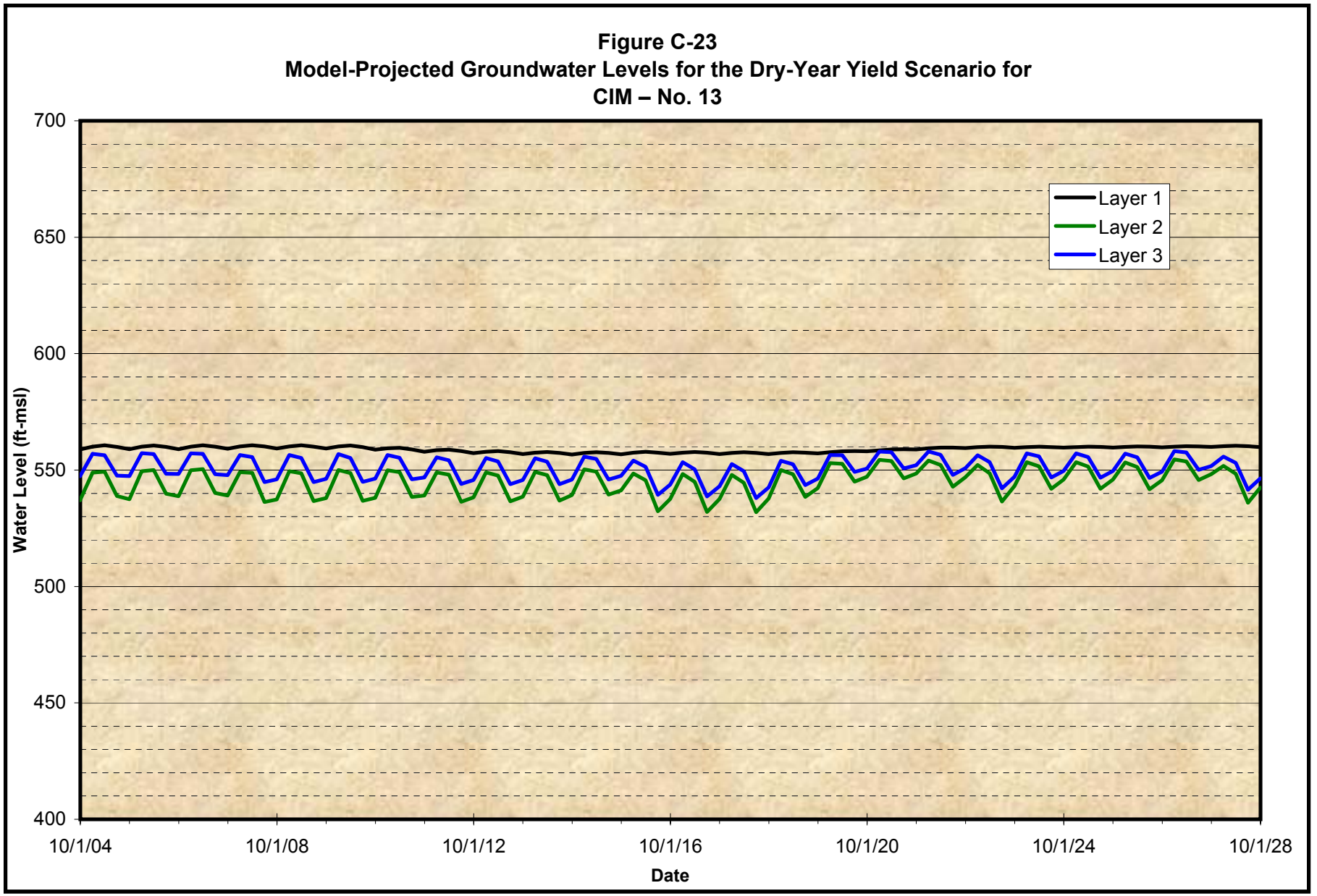


**Figure C-24**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for CIM – No. 9**

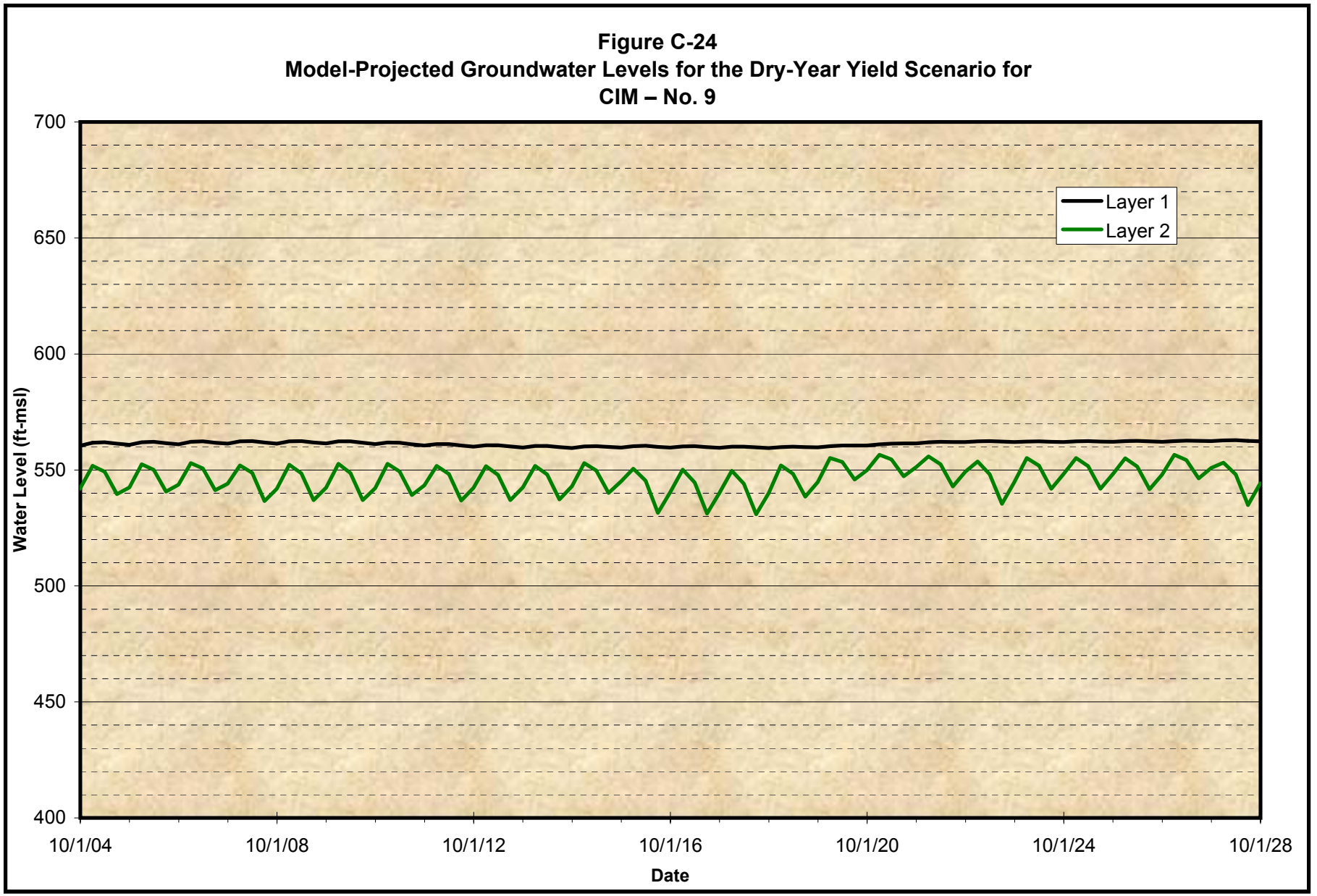


**Figure C-25**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino Hills – No. 18A**

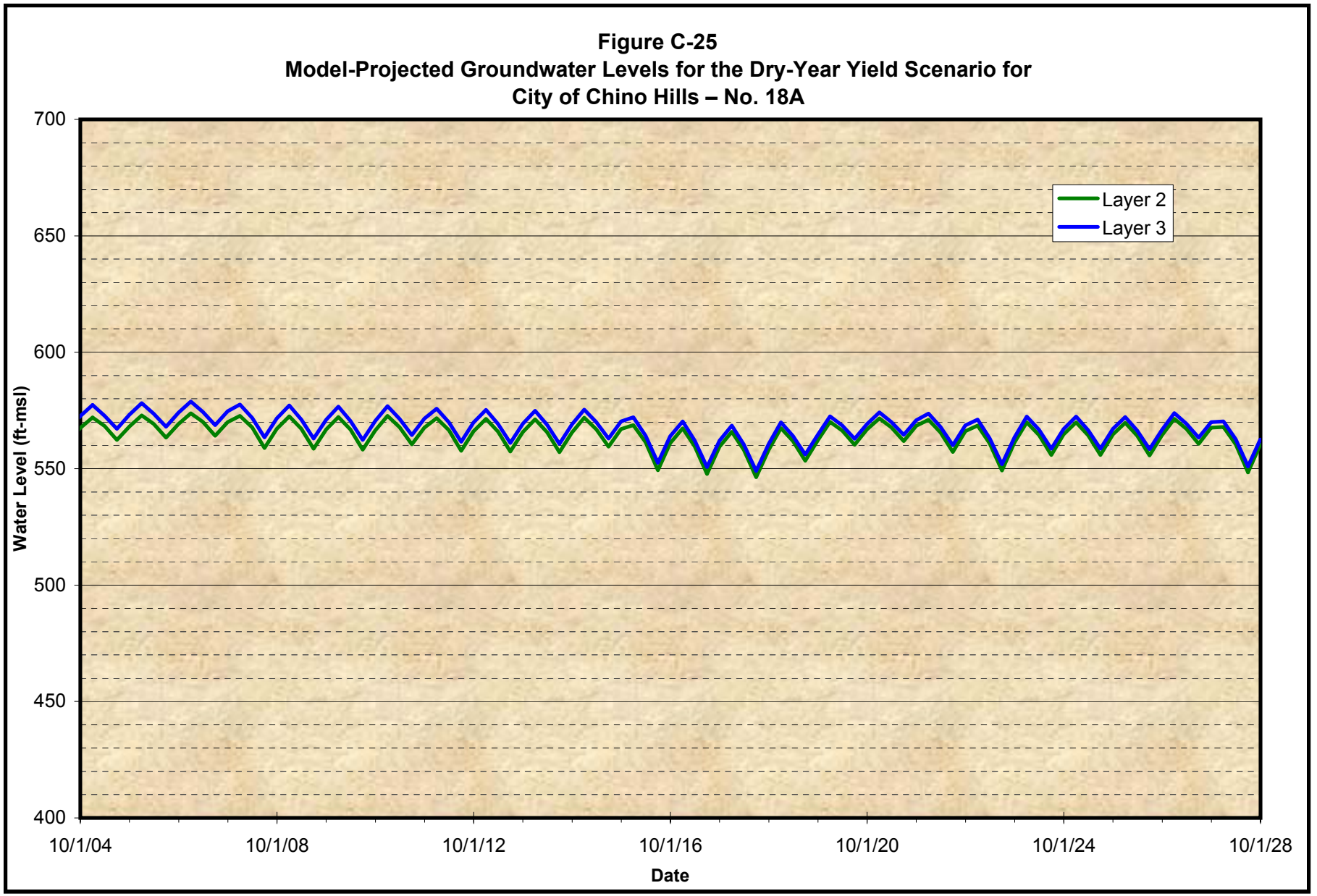


**Figure C-26**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino Hills – No. 17**

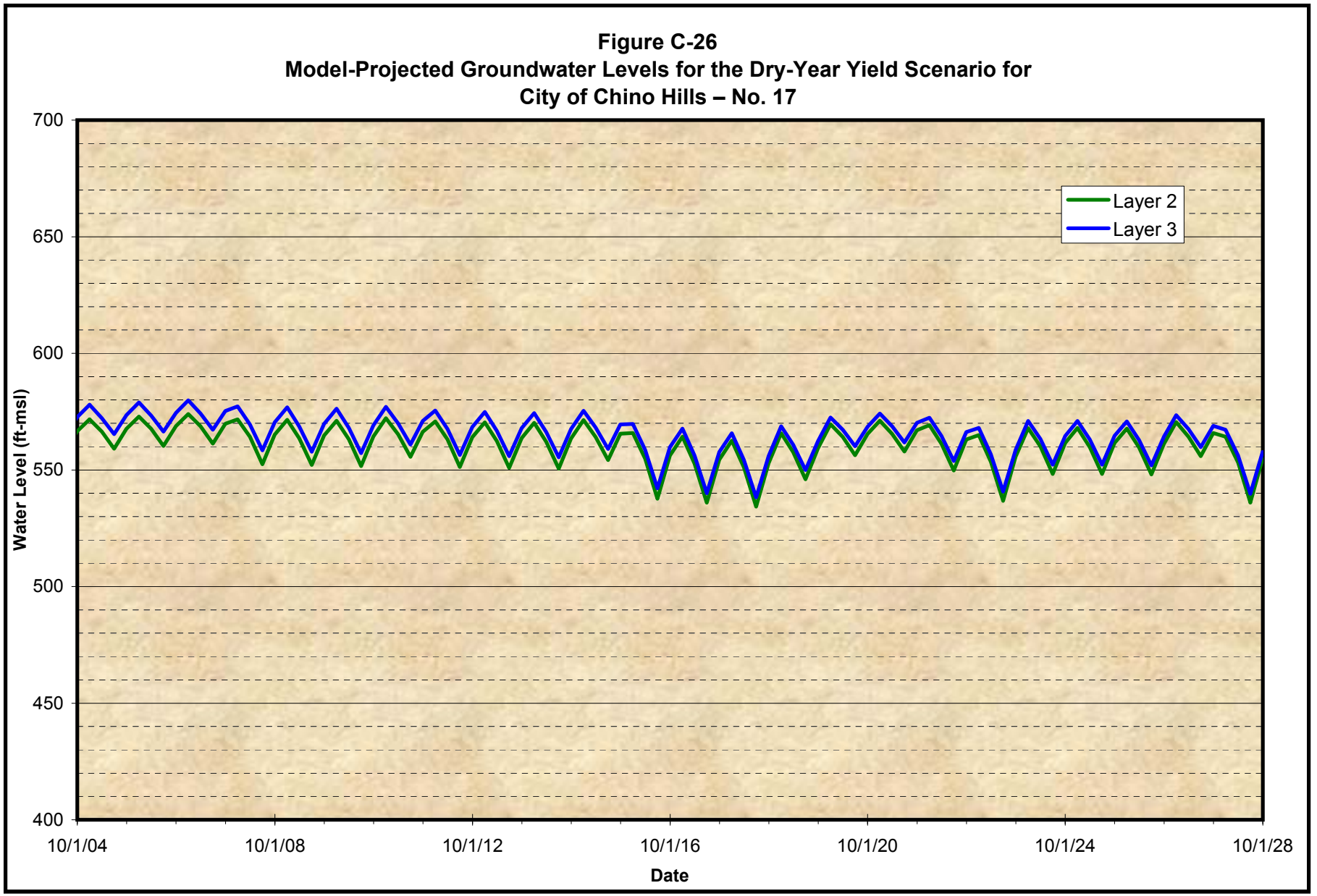


**Figure C-27**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino Hills – No. 15A**

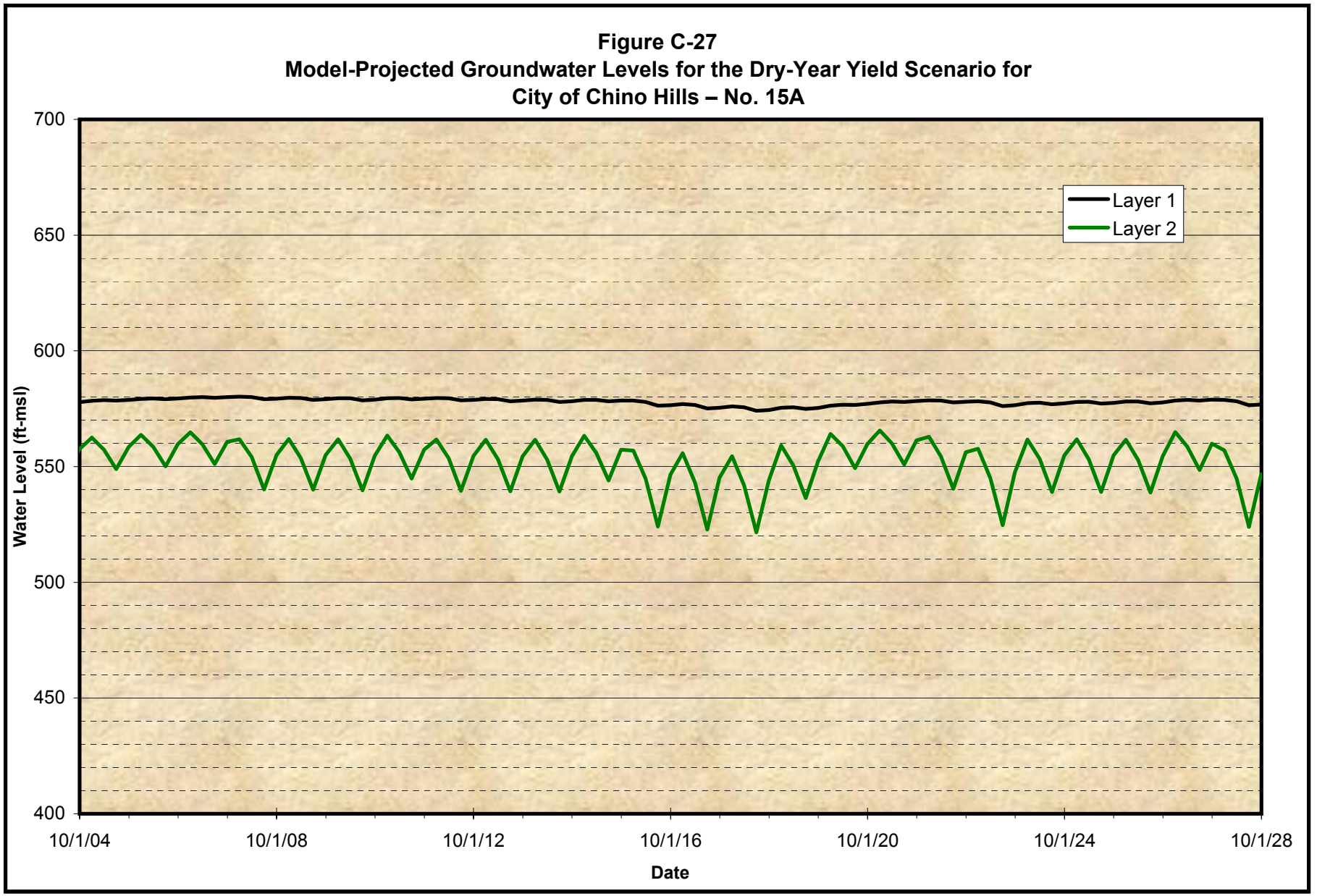


**Figure C-28**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Chino Hills – No. 15B**

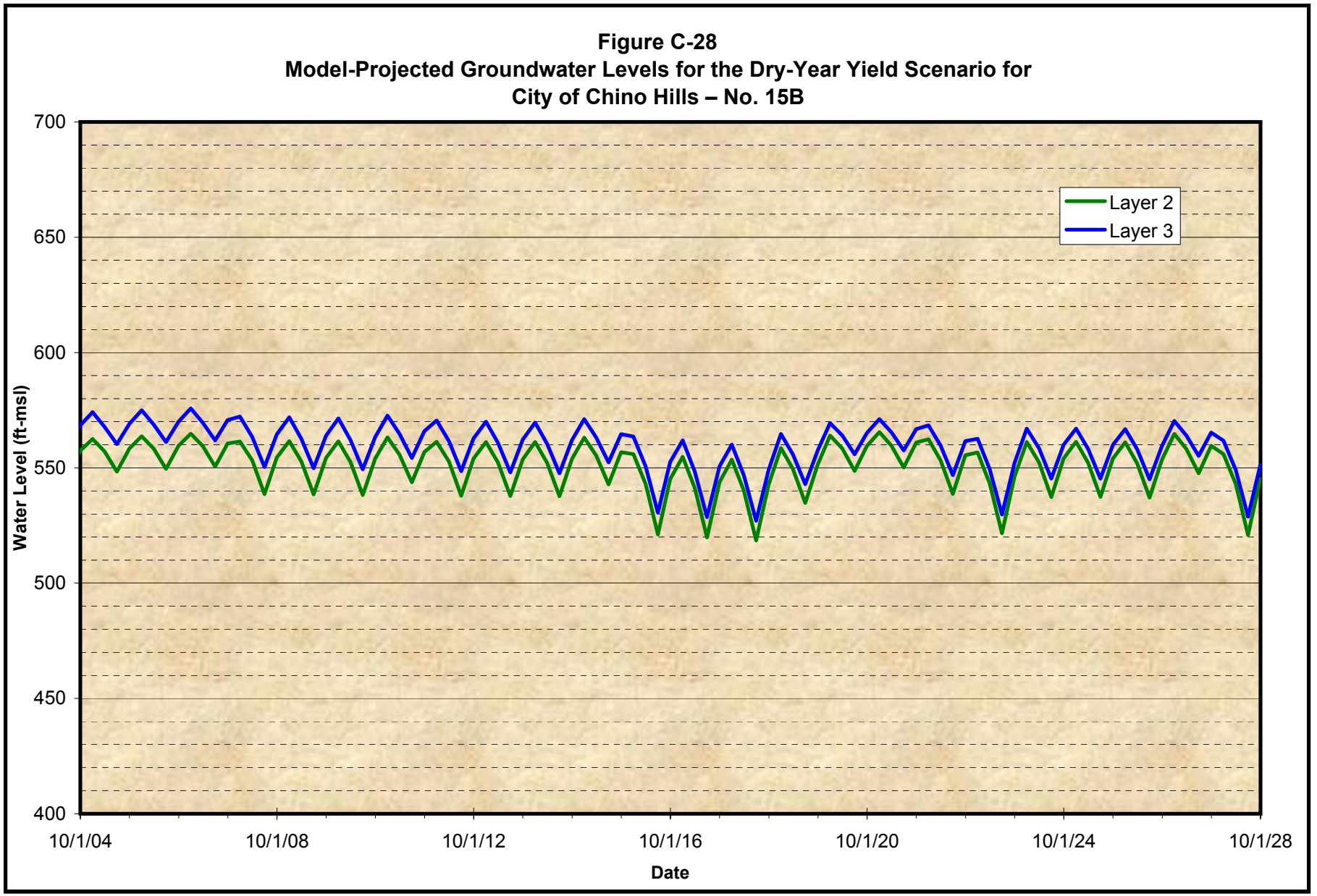


**Figure C-29**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Santa Ana River Water Company – No. 7**

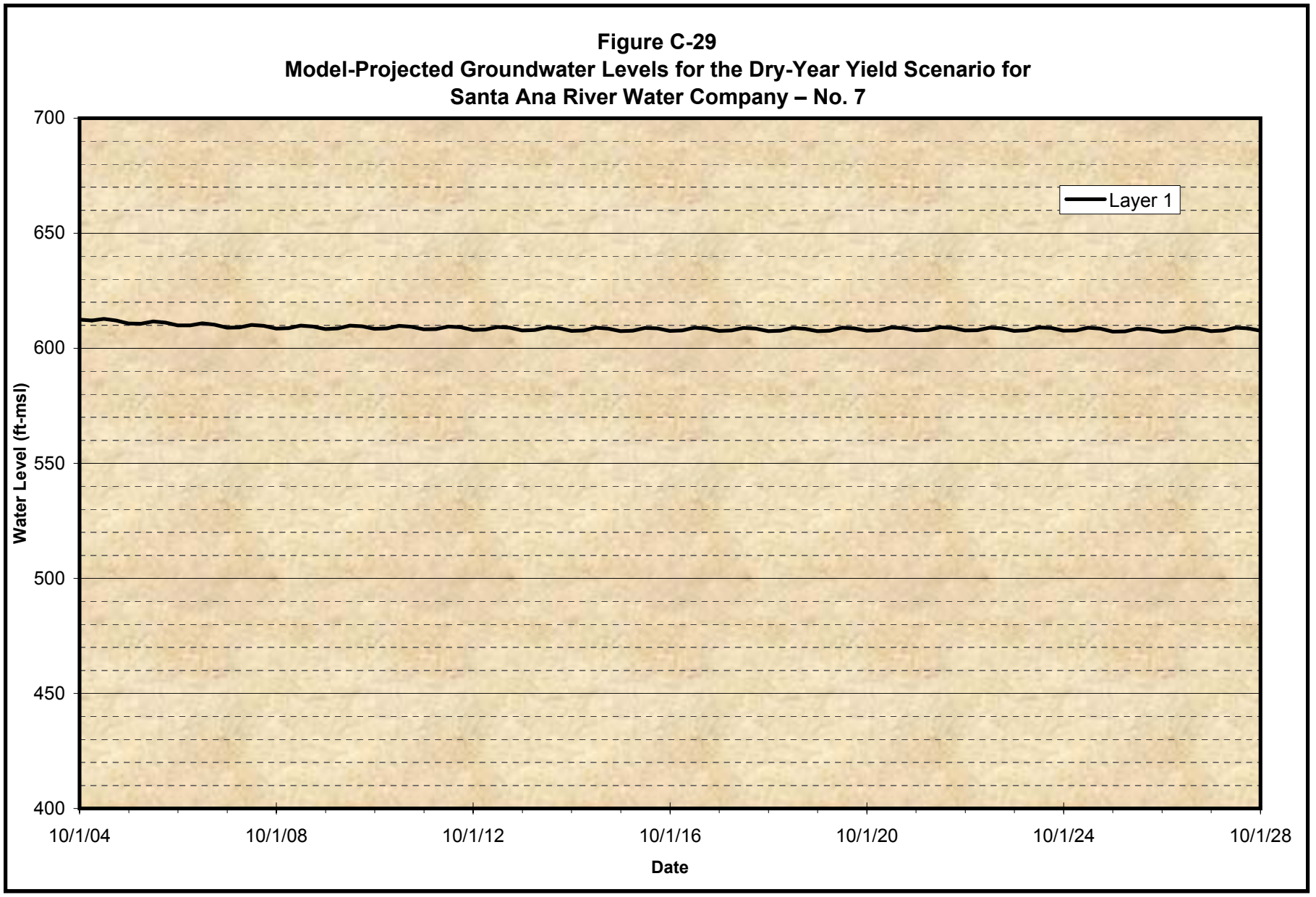


**Figure C-30**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for Jurupa Community Services District – No. 16**

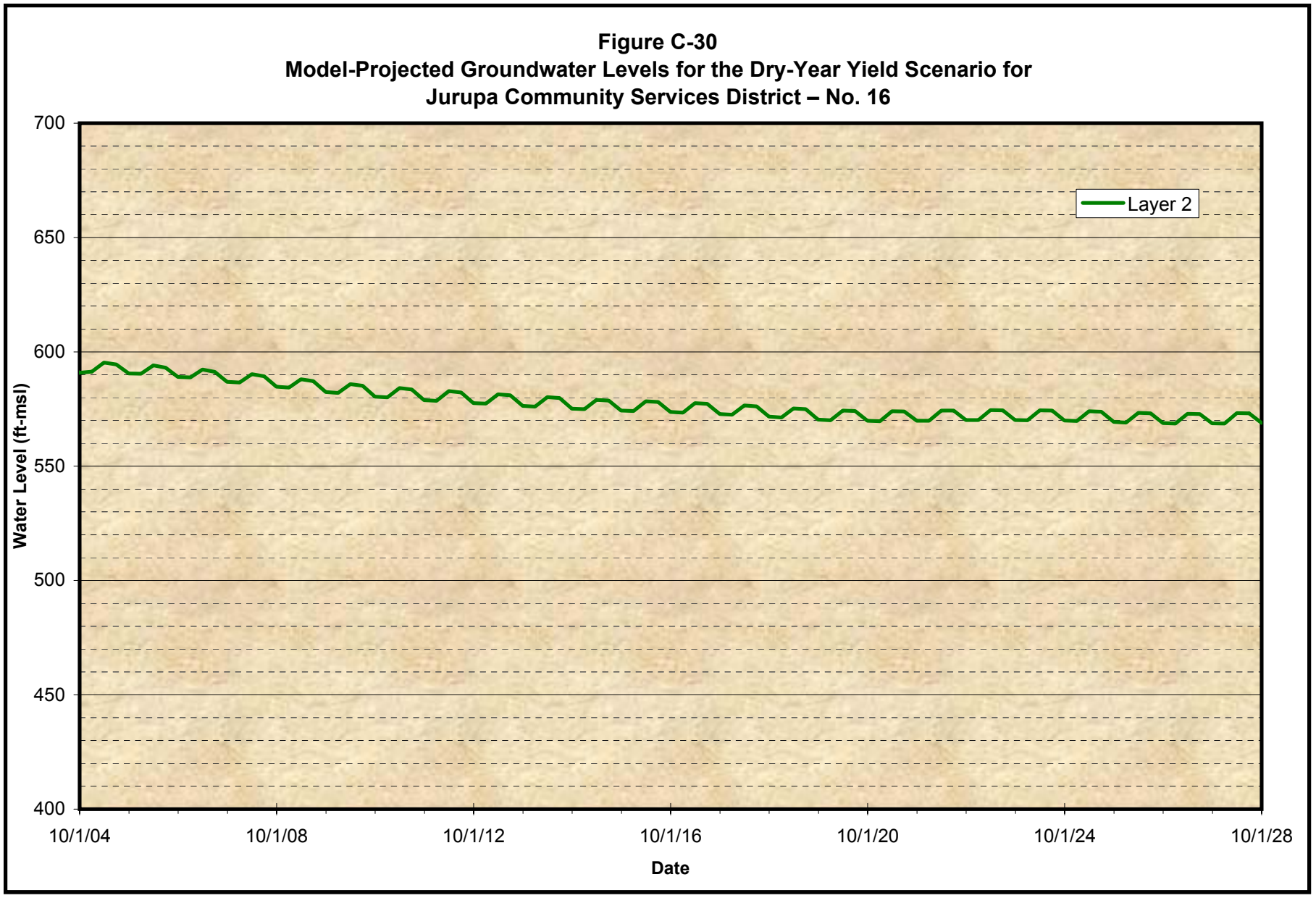


**Figure C-31**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Norco – No. 11**

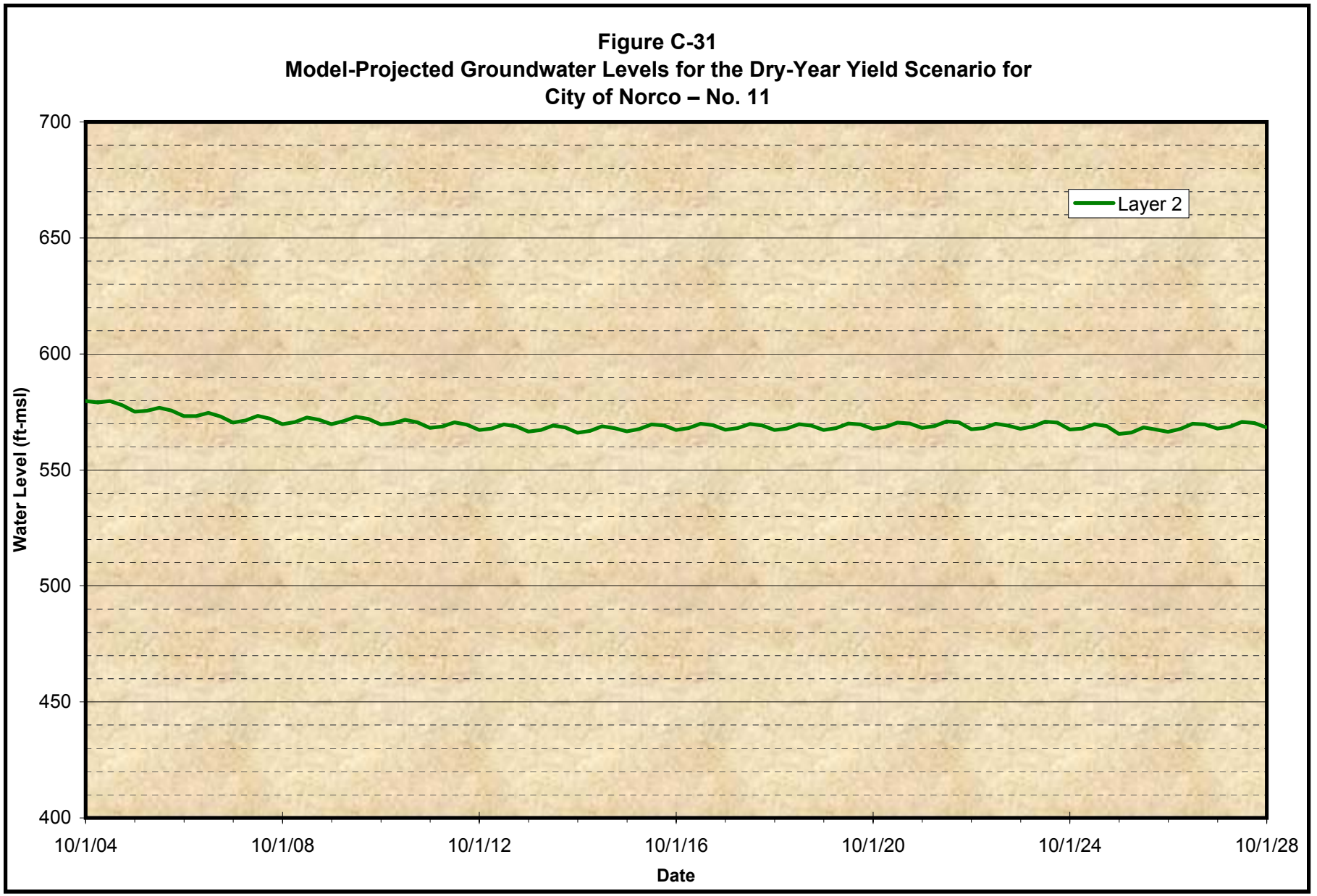


**Figure C-32**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Parente – ARC**

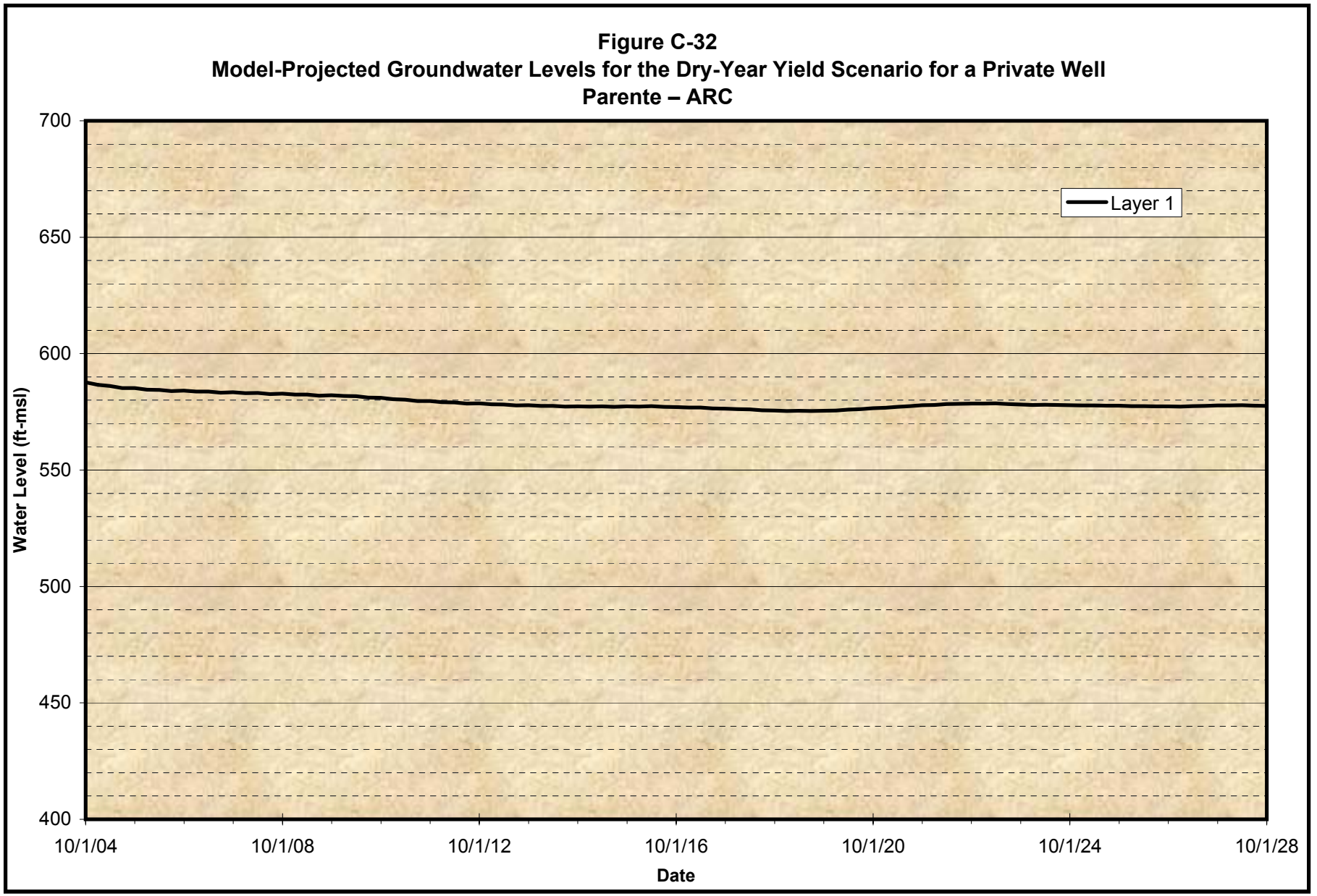


**Figure C-33**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Excelsior**

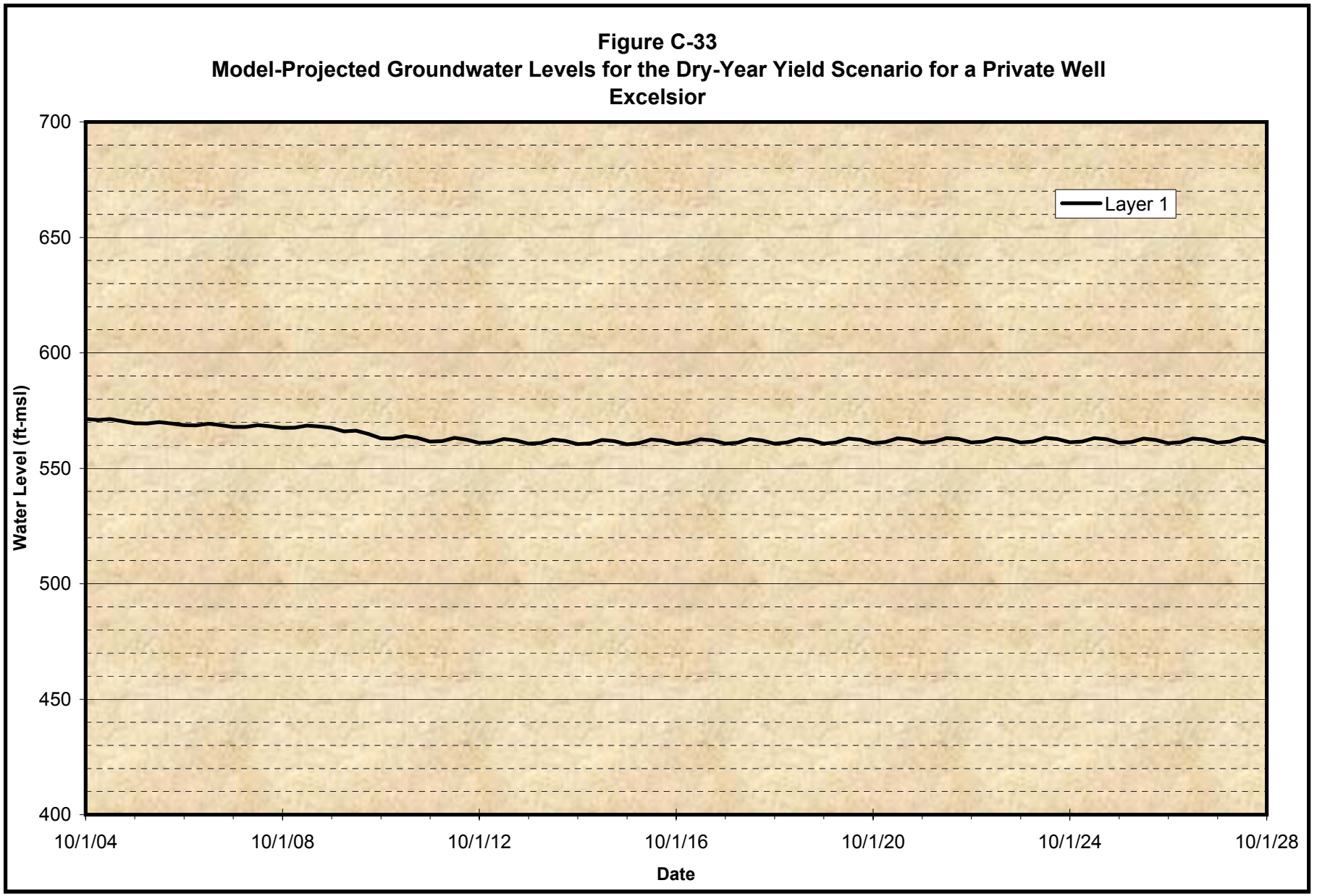


**Figure C-34**
**Model-Projected Groundwater Levels for the Baseline Dry-Year Yield for a Private Well**
**Cardoza – No. B9**

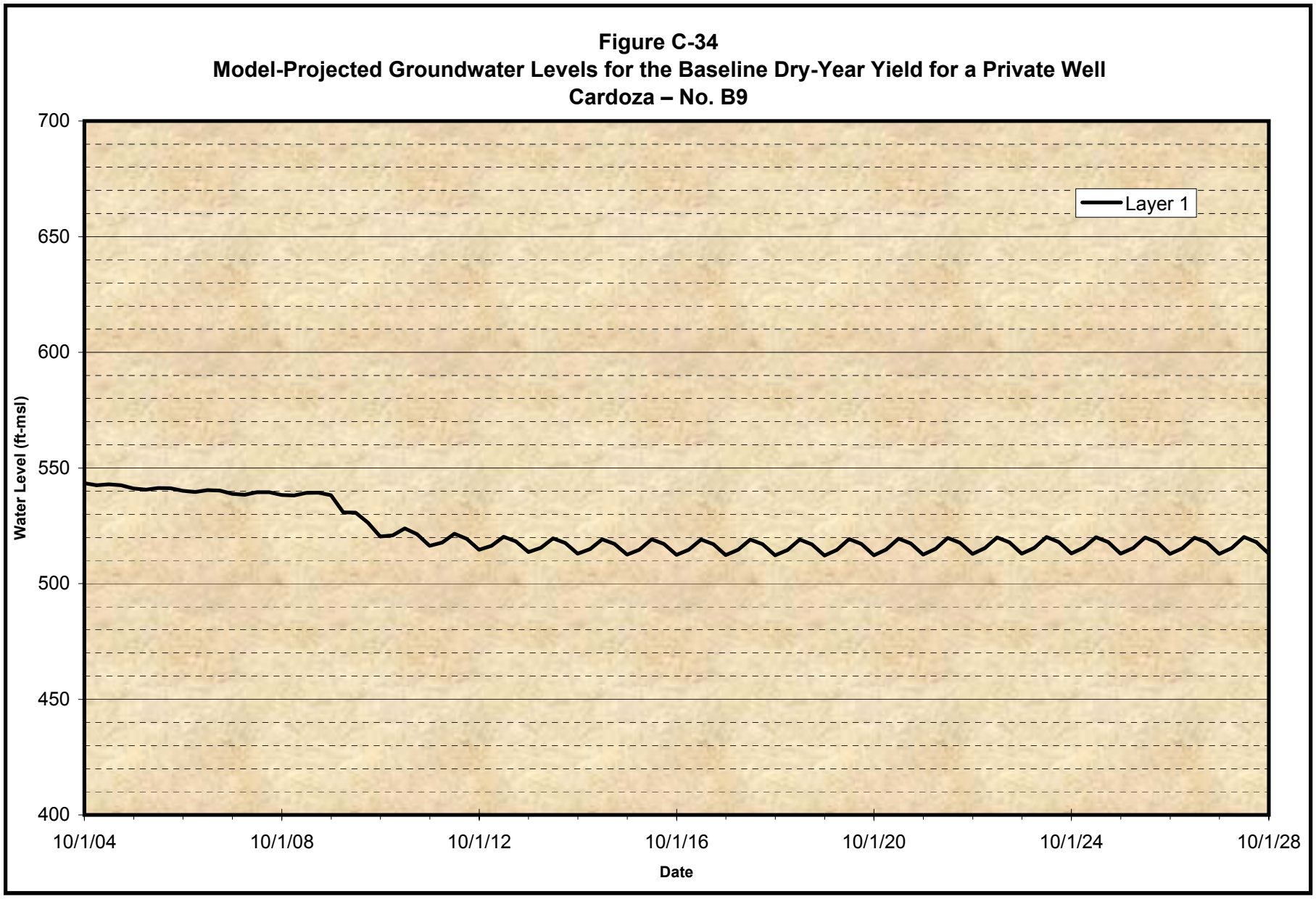


**Figure C-35**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Borba Dairy – No. 2**

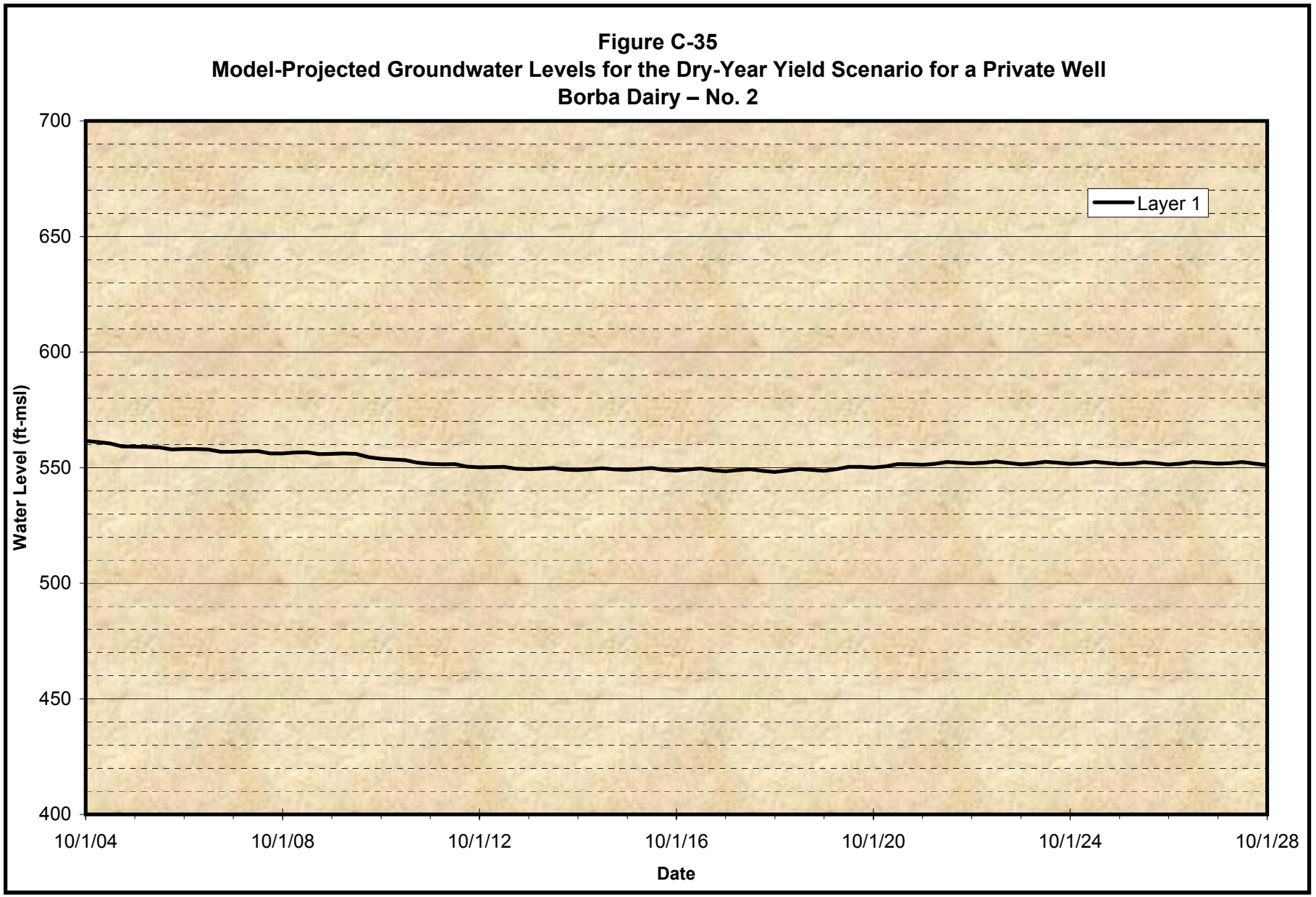


**Figure C-36**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Corona Dairy Ranch**

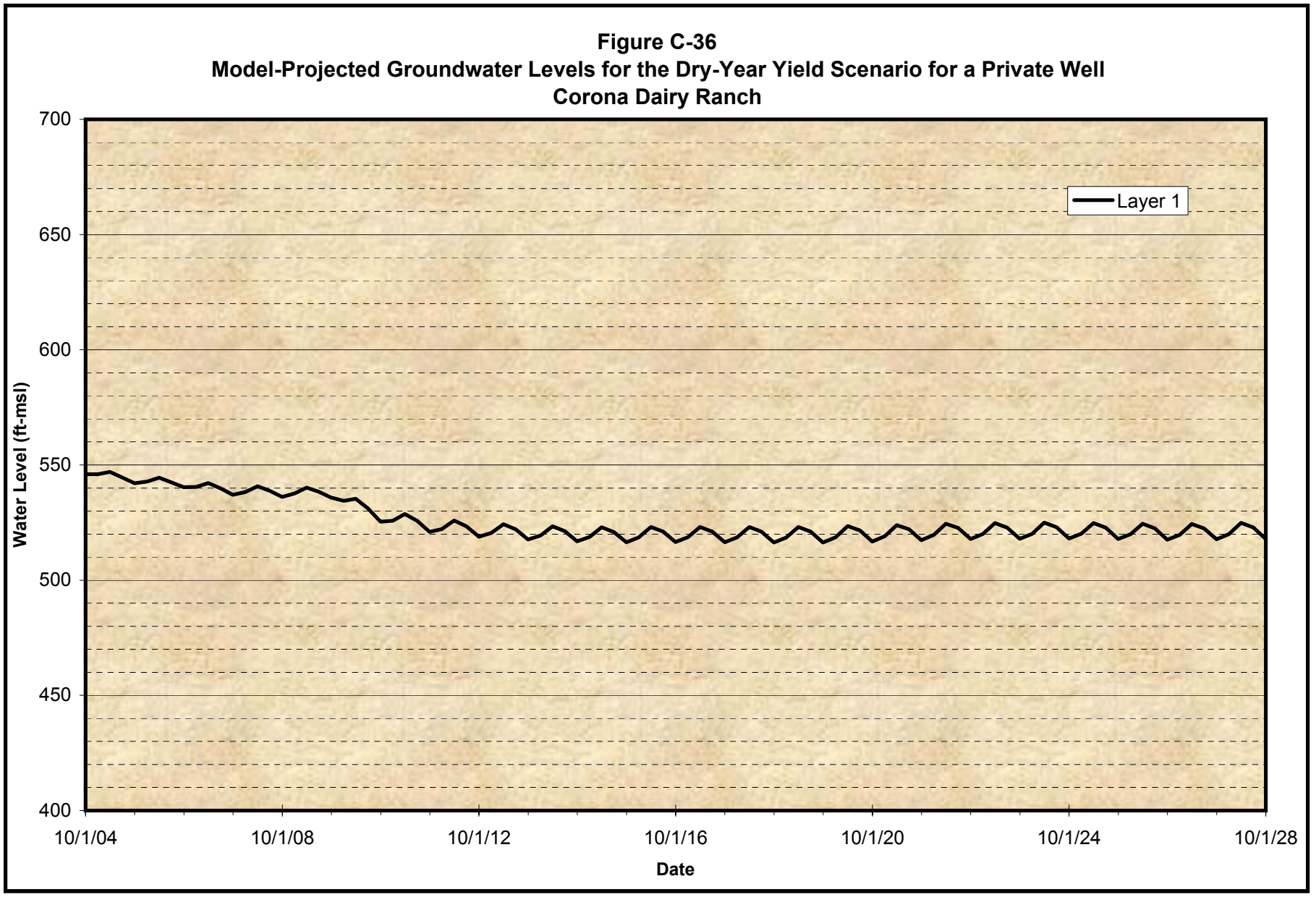


**Figure C-37**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**DeVries**



**Figure C-38**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for CIW – Monitoring Well No. 2**

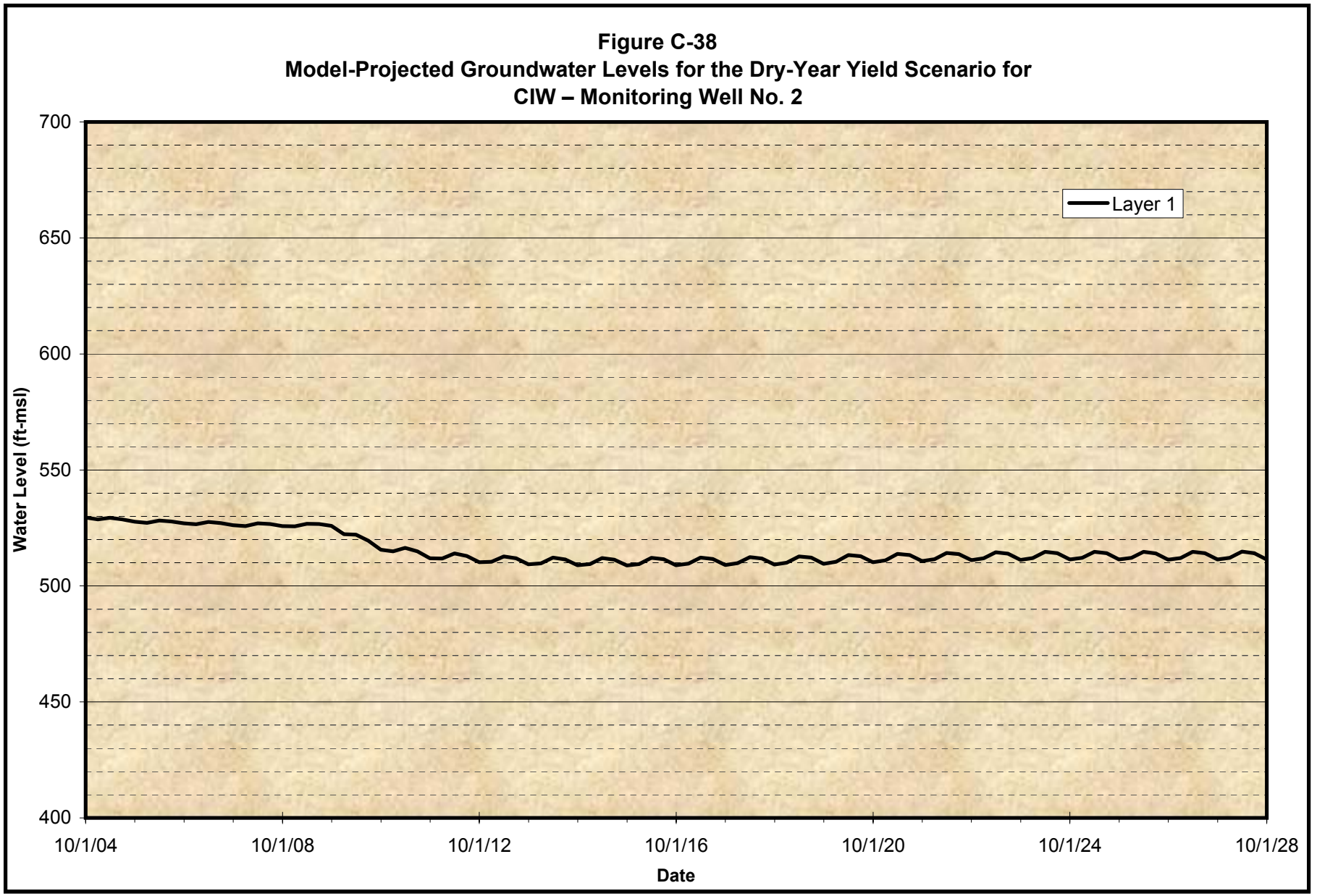


**Figure C-39**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Barthelemy**

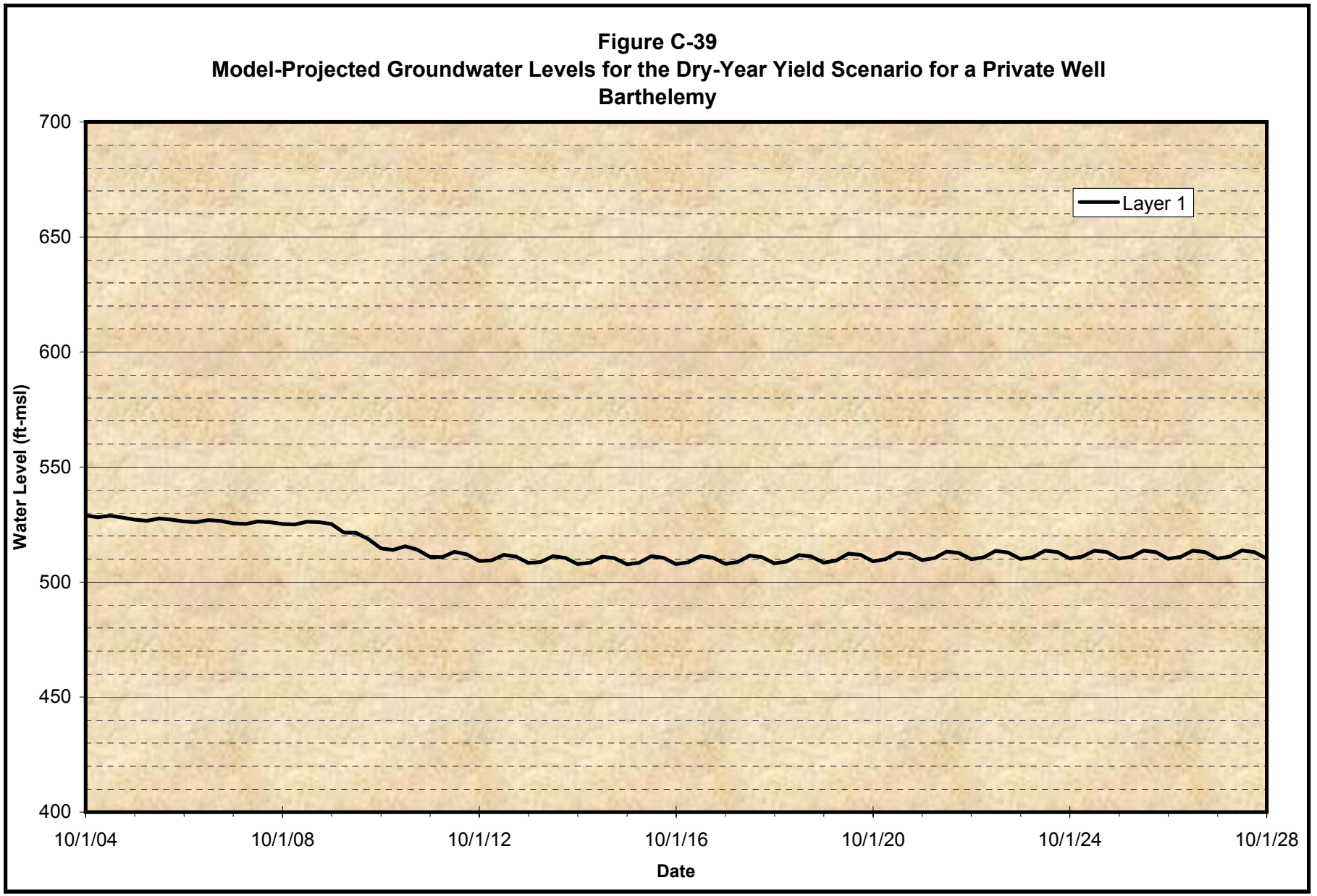


**Figure C-40**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Lekkerkerker – No. 2**

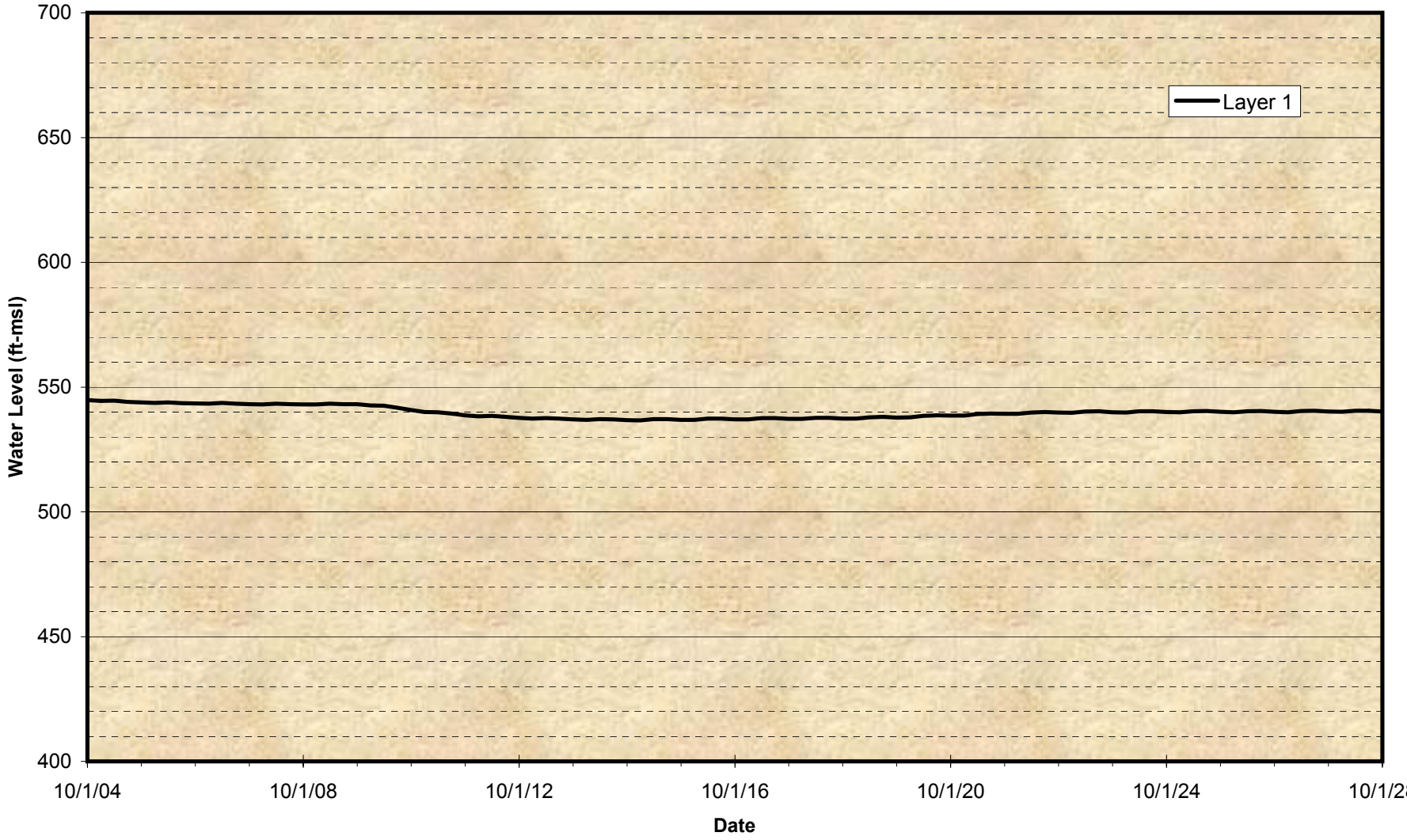


**Figure C-41**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for a Private Well**
**Tollerup**

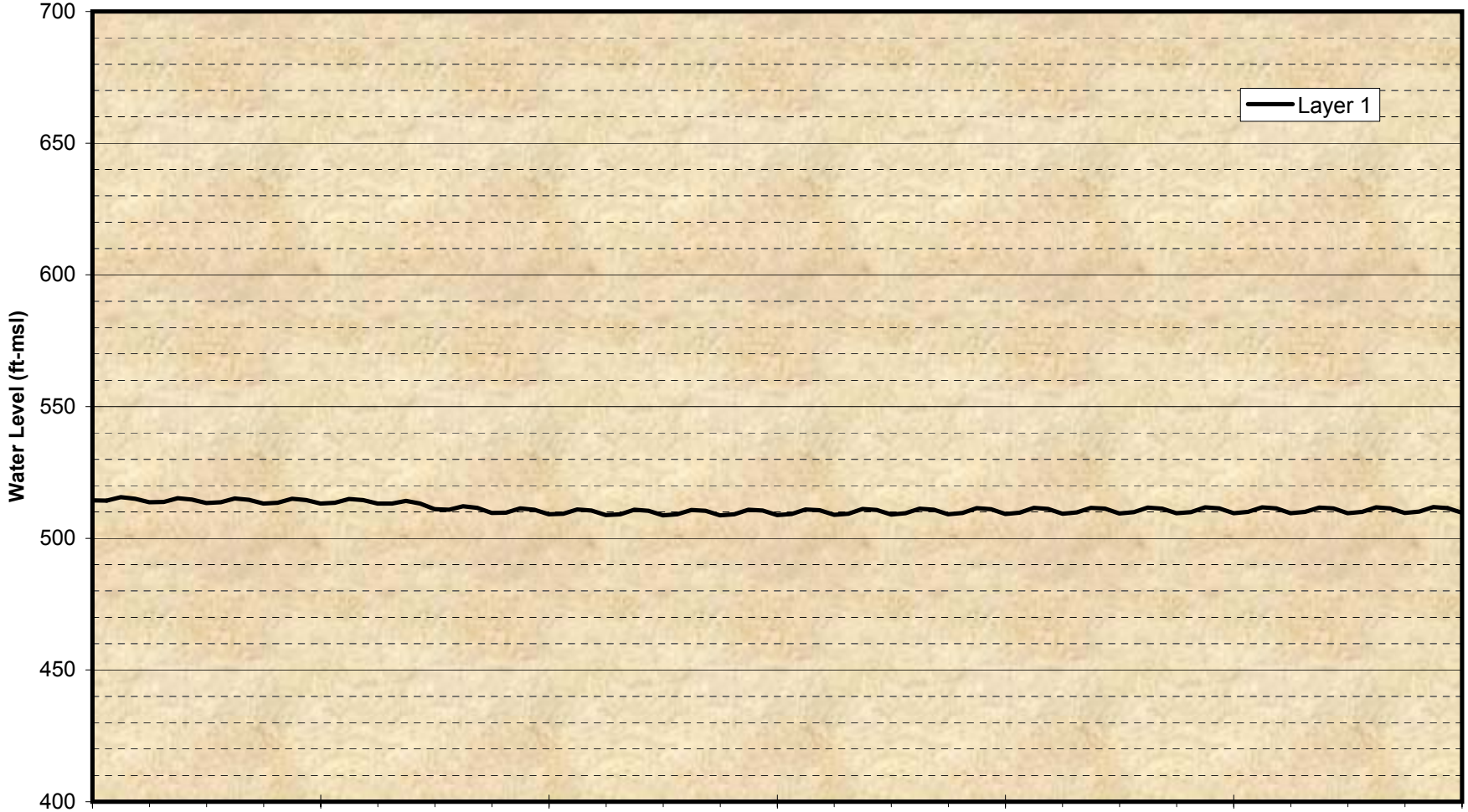


**Figure C-42**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Corona – No. 7**

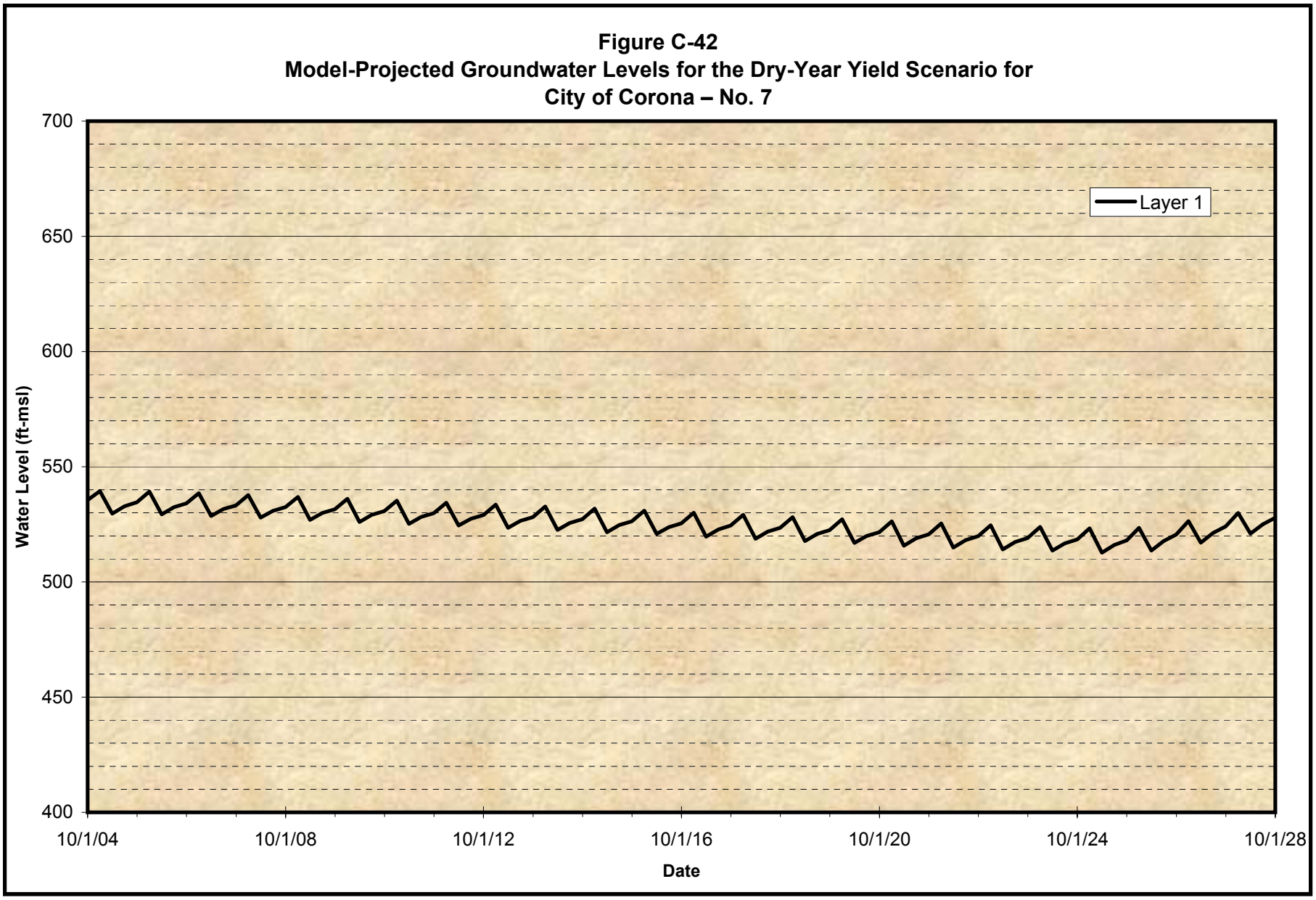


**Figure C-43**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Corona – No. 14**

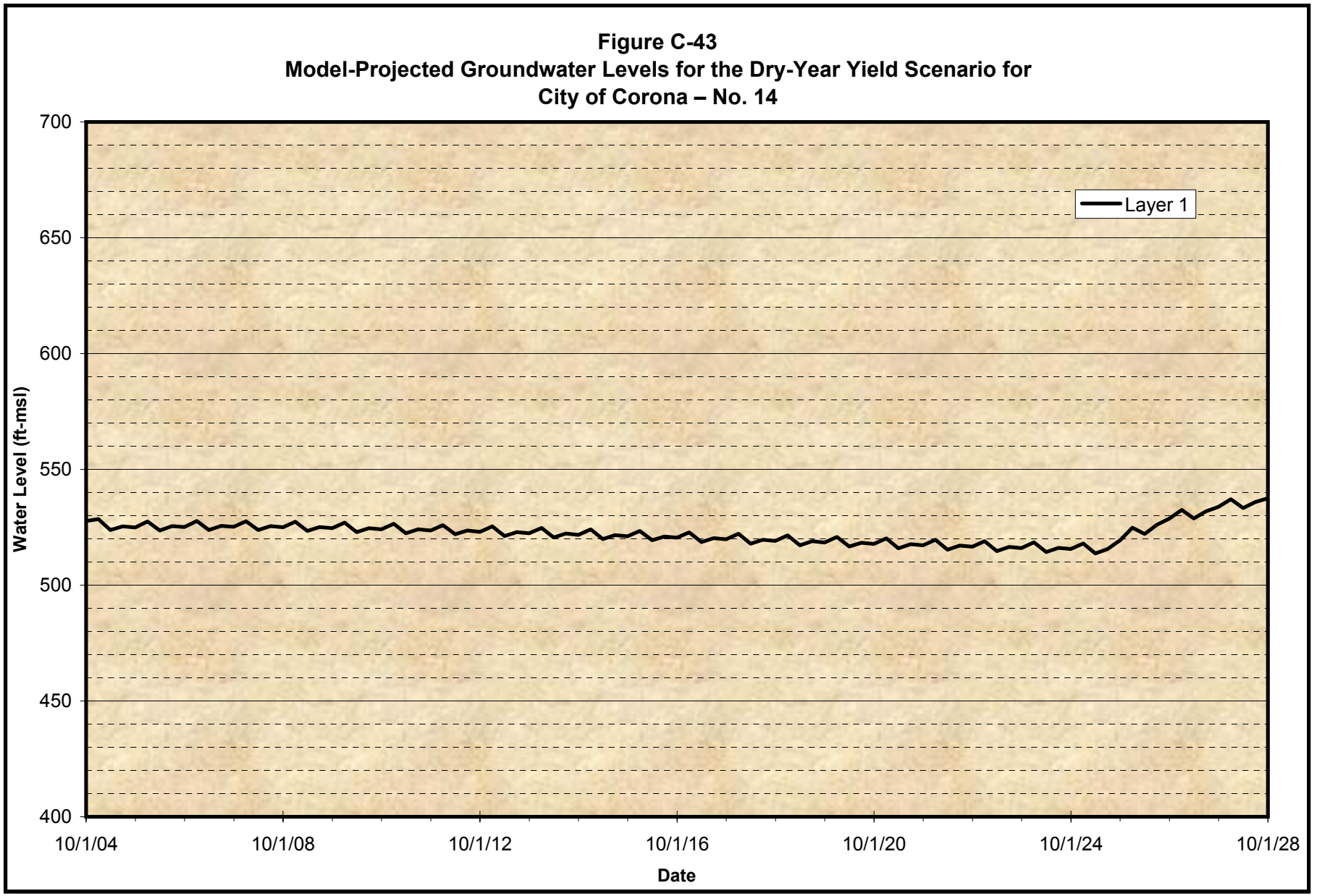


**Figure C-44**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Corona – No. 15**

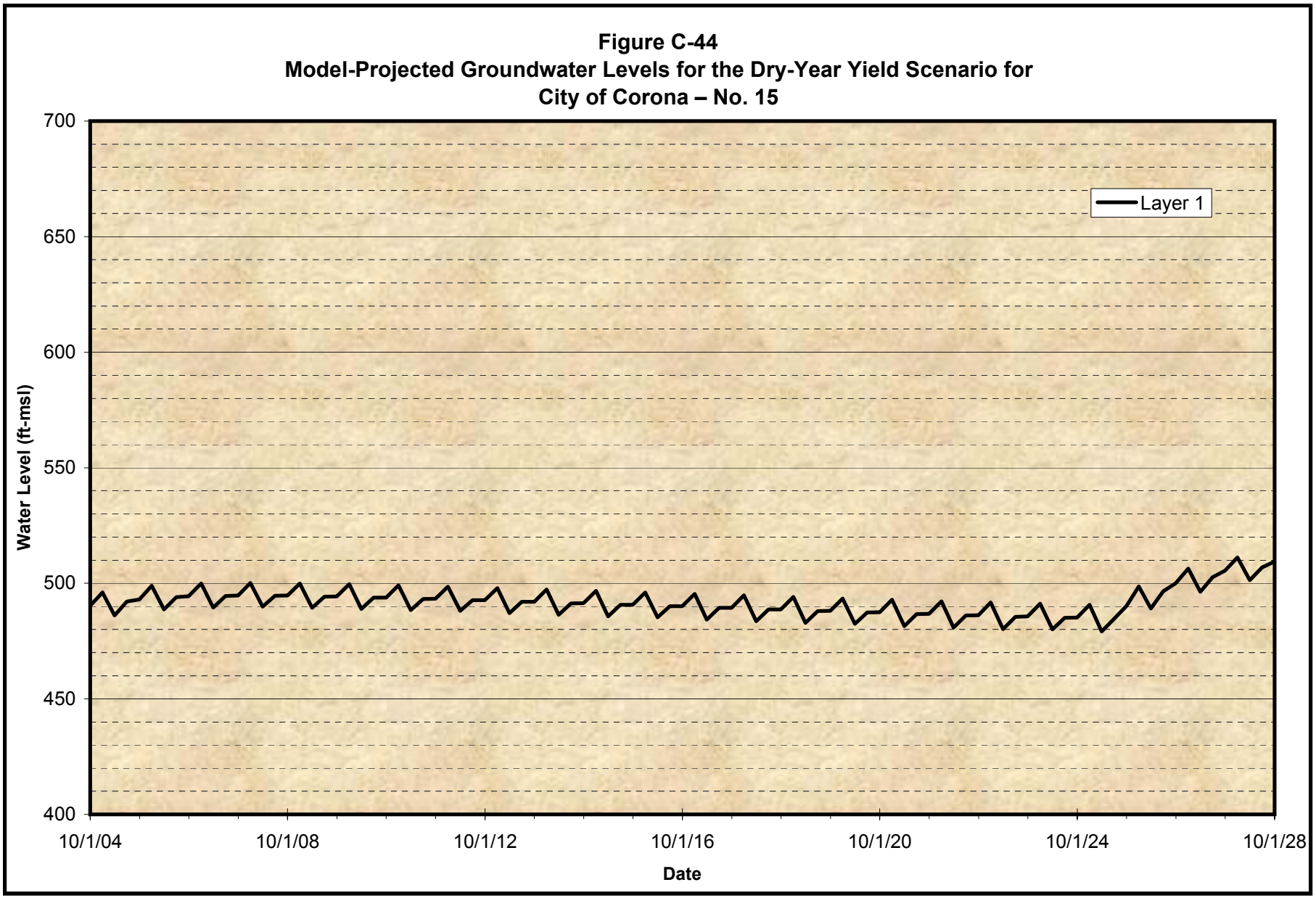
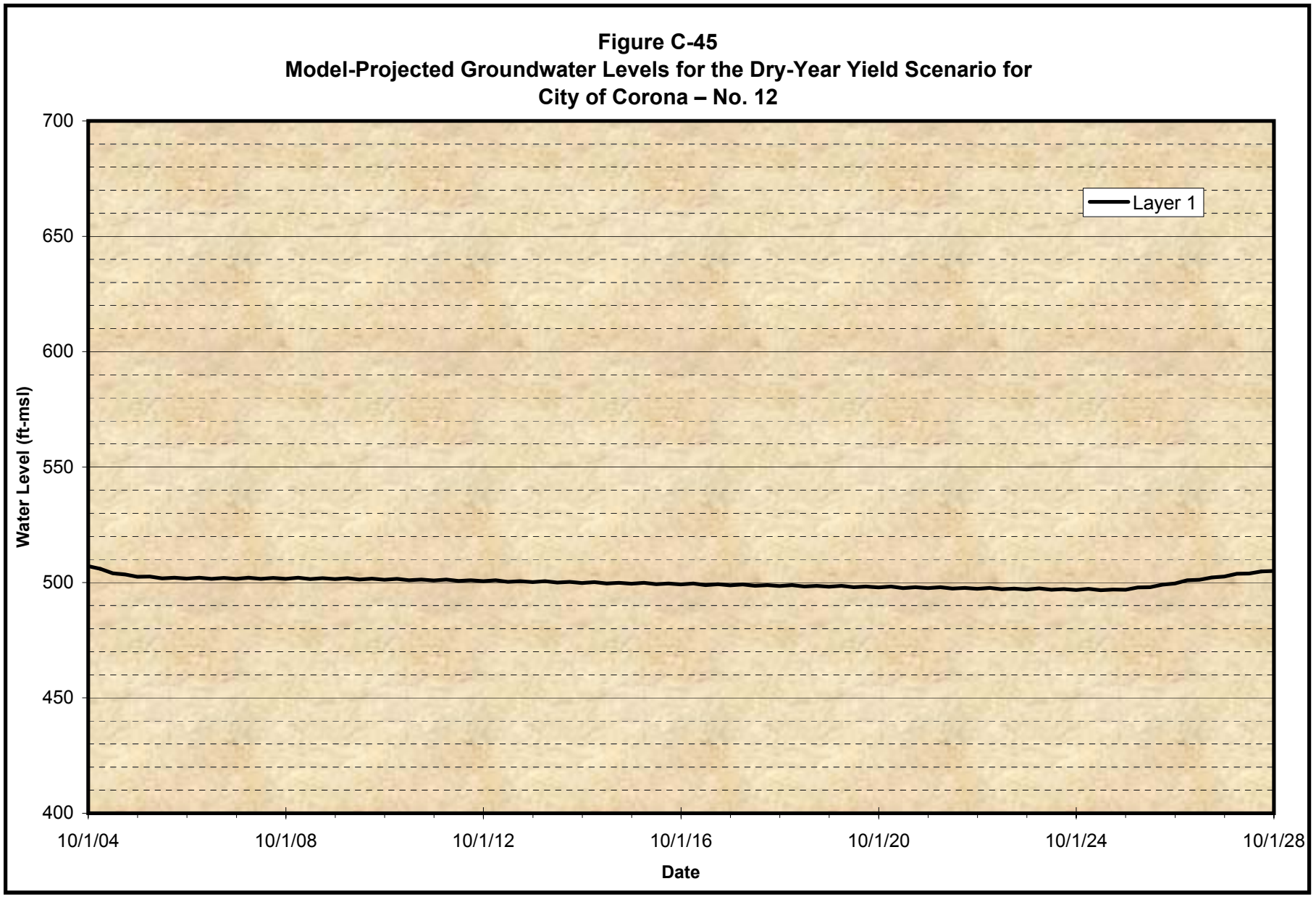


**Figure C-45**
**Model-Projected Groundwater Levels for the Dry-Year Yield Scenario for City of Corona – No. 12**



**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## City of Chino

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 3 | | Inactive - still equipped | | | | | | |
| 4 | 750 | | 750 | 0 | 0 | 750 | 0 | 750 |
| 5 | 1,300 | Nitrate | 1,300 | 0 | 1,300 | 0 | 0 | 1,300 |
| 6 | 950 | | 950 | 0 | 0 | 950 | 0 | 950 |
| 7 | Inactive - equip. may be removed. Shutdown due to interference w/ CH 17 | | | | | | | |
| 9 | 2,450 | Nitrate | 2,450 | 0 | 2,450 | 0 | 0 | 2,450 |
| 10 | 1,500 | Perchlorate | 1,500 | 0 | 1,500 | 0 | 0 | 1,500 |
| 11 | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| 12 | 2,250 | Perchlorate | 2,250 | 0 | 2,250 | 0 | 0 | 2,250 |
| 13 | 1,450 | Nitrate | 1,450 | 0 | 1,450 | 0 | 1,450 | 0 |
| 14 | 2,300 | Nitrate | 2,300 | 0 | 2,300 | 0 | 0 | 2,300 |
| 15 | Incomplete drill hole - never developed in subsidence area | | | | | | | |
| Total | 14,950 | | 14,950 | 0 | 11,250 | 3,700 | 1,450 | 13,500 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 4 | 33.3 | 2.8 | 0.0 | 0.0 | 0.000 |
| 5 | 41.9 | 12.0 | 8.3 | 0.0 | 0.000 |
| 6 | 31.1 | 3.0 | 0.0 | 0.0 | 0.000 |
| 7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 9 | 77.4 | 2.6 | 14.9 | 0.0 | 0.000 |
| 10 | 95.4 | 2.6 | 21.0 | 0.0 | 0.000 |
| 11 | 31.5 | 3.8 | 0.0 | 0.0 | 0.000 |
| 12 | 78.3 | 3.1 | 13.0 | 0.0 | 0.020 |
| 13 | 59.0 | 2.4 | 0.0 | 0.0 | 0.000 |
| 14 | 58.1 | 3.1 | 12.0 | 0.0 | 0.000 |
| 15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 67% | 9% | 66% | 0% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | | Capacity, AFY | |
|---|---|---|---|---|
| | Contractural | Maximum | Contractural | Maximum |
| WFA JPA | 4.78 | 10 | 5354 | 11200 |

| Desalter Name | Capacity, AFY |
|---|---|
| Chino I | 3000 |
| Chino I Expansion | 2000 |

Total prod. capacity gpm
Peak day capacity gpm
Peak hour capacity gpm

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## CCWD

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 1 | 1,500 | | 1,500 | 0 | 0 | 1,500 | 0 | 1,500 |
| 3 | 800 | | 800 | 0 | 0 | 800 | 0 | 800 |
| 4 | 1,500 | | 1,500 | 0 | 0 | 1,500 | 0 | 1,500 |
| 5 | 1,900 | | 1,900 | 0 | 0 | 1,900 | 0 | 1,900 |
| 8 | 1,300 | | 0 | 1,300 | 0 | 1,300 | 0 | 1,300 |
| 10 | 700 | | 0 | 700 | 0 | 700 | 0 | 700 |
| 12 | 1,700 | DBCP (0.21 ug/l) | 0 | 1,700 | 1,700 | 0 | 0 | 1,700 |
| 13 | 400 | | 0 | 400 | 0 | 400 | 0 | 400 |
| 15 | 1,500 | Nitrate (99 mg/l) | 0 | 1,500 | 1,500 | 0 | 0 | 1,500 |
| 16 | 900 | Nitrate (48 mg/l) | 0 | 900 | 900 | 0 | 0 | 900 |
| 17 | 900 | Nitrate (88 mg/l) DBCP (0.65 ug/l) | 0 | 900 | 900 | 0 | 0 | 900 |
| 18 | 0 | Monitoring Well/Nitrates & DBCPs | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 900 | | 0 | 900 | 0 | 900 | 0 | 900 |
| 20 | 900 | Nitrate (80 mg/l) DBCP (1.1 ug/l) | 0 | 900 | 900 | 0 | 0 | 900 |
| 21 | 2,400 | Nitrate (51 mg/l) DBCP (0.81 ug/l) | 0 | 2,400 | 2,400 | 0 | 0 | 2,400 |
| 22 | 1,600 | | 0 | 1,600 | 0 | 1,600 | 0 | 1,600 |
| 23 | 800 | Nitrate (72 mg/l) | 0 | 800 | 800 | 0 | 0 | 800 |
| 24 | 2,100 | | 0 | 2,100 | 0 | 2,100 | 0 | 2,100 |
| 26 | 1,100 | | 0 | 1,100 | 0 | 1,100 | 0 | 1,100 |
| 30 | 1,900 | | 1,900 | 0 | 0 | 1,900 | 0 | 1,900 |
| 31 | 900 | Nitrate (90 mg/l) | 0 | 900 | 900 | 0 | 0 | 900 |
| 33 | 400 | Nitrate (62 mg/l) DBCP (0.74 ug/l) | 0 | 400 | 400 | 0 | 0 | 400 |
| 34 | 2,000 | Nitrate (58 mg/l) DBCP (0.97 ug/l) | 0 | 2,000 | 2,000 | 0 | 0 | 2,000 |
| 38 | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| Total | 30,100 | | 9,600 | 20,500 | 12,400 | 17,700 | 0 | 30,100 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1 | 71.1 | 3.3 | 7.5 | 0.0 | 0.000 |
| 3 | 27.0 | 2.7 | 0.0 | 0.0 | 0.000 |
| 4 | 16.2 | 2.1 | 0.0 | 0.0 | 0.000 |
| 5 | 4.1 | 4.5 | 0.0 | 0.0 | 0.000 |
| 8 | 99.5 | 4.4 | 0.0 | 0.0 | 0.640 |
| 10 | 60.8 | 7.0 | 0.0 | 0.0 | 0.790 |
| 12 | 46.8 | 7.0 | 0.0 | 0.0 | 0.380 |
| 13 | 30.2 | 2.9 | 0.0 | 0.0 | 0.022 |
| 15 | 112.5 | 2.6 | 0.0 | 0.0 | 0.190 |
| 16 | 55.4 | 3.7 | 0.0 | 0.0 | 0.040 |
| 17 | 92.0 | 3.3 | 5.2 | 0.0 | 1.500 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 19 | 33.8 | 3.3 | 0.0 | 0.0 | 0.057 |
| 20 | 91.4 | 4.4 | 6.5 | 0.0 | 1.000 |
| 21 | 54.9 | 5.3 | 0.0 | 0.0 | 1.000 |
| 22 | 48.6 | 13.6 | 0.0 | 0.0 | 0.400 |
| 23 | 92.7 | 2.5 | 0.0 | 0.0 | 0.040 |
| 24 | 15.3 | 4.0 | 0.0 | 0.0 | 0.020 |
| 26 | 30.6 | 3.6 | 0.0 | 0.0 | 0.023 |
| 30 | 37.6 | 3.3 | 5.2 | 0.0 | 0.000 |
| 31 | 97.2 | 2.3 | 6.0 | 0.0 | 0.170 |
| 33 | 59.4 | 2.7 | 4.0 | 0.0 | 0.980 |
| 34 | 66.1 | 4.6 | 0.0 | 0.0 | 1.200 |
| 38 | N/A | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 65% | 5% | 20% | 0% | 40% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | Capacity, AFY |
|---|---|---|
| Lloyd Michael | 60.00 | 67200 |
| Royer/Nesbit | 11.50 | 12880 |
| Arthur H. Bridge | 4.00 | 4480 |

| | | |
|---|---|---|
| Total prod. capacity | 52,429 | gpm |
| Peak day capacity | 32,985 | gpm |
| Peak hour capacity | 32,985 | gpm |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## City of Chino Hills

Groundwater Production Capacity

| | | | Location | | Water Quality | | Subsidence, etc. | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 1A | 800 | Nitrate | 800 | 0 | 0 | 800 | 800 | 0 |
| 1B | 550 | Arsenic (110ppb) | 550 | 0 | 550 | 0 | 550 | 0 |
| 7A | 400 | Nitrate | 400 | 0 | 0 | 400 | 0 | 400 |
| 7B | 550 | Nitrate | 550 | 0 | 0 | 550 | 0 | 550 |
| 7D | 375 | not in use/not operable (sand) | 375 | 0 | 0 | 375 | 0 | 375 |
| 13 | 500 | Stand-by | 500 | 0 | 500 | 0 | 0 | 500 |
| 14 | 400 | not in use due to Arsenic | 400 | 0 | 400 | 0 | 400 | 0 |
| 15 | 1,300 | Arsenic | 1,300 | 0 | 1,300 | 0 | 1,300 | 0 |
| 16 | 700 | Arsenic | 700 | 0 | 700 | 0 | 700 | 0 |
| 17 | 800 | Arsenic | 800 | 0 | 0 | 800 | 800 | 0 |
| 19 | 1,300 | Arsenic | 1,300 | 0 | 1,300 | 0 | 1,300 | 0 |
| Total | 7,300 | | 7,300 | 0 | 4,750 | 2,550 | 5,850 | 1,450 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1A | 43.7 | 2.0 | 0.0 | 0.0 | 0.000 |
| 1B | 11.7 | 110.0 | 0.0 | 0.0 | 0.000 |
| 7A | 42.8 | 0.0 | 0.0 | 0.0 | 0.000 |
| 7B | 43.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 7D | 0.0 | 20.0 | 0.0 | 0.0 | 0.000 |
| 13 | 121.5 | 3.0 | 0.0 | 0.0 | 0.000 |
| 14 | 59.4 | 60.0 | 0.0 | 0.0 | 0.000 |
| 15 | 14.9 | 58.8 | 0.0 | 0.0 | 0.000 |
| 16 | 3.1 | 67.0 | 0.0 | 0.0 | 0.000 |
| 17 | 16.7 | 8.0 | 0.0 | 0.0 | 0.000 |
| 19 | 21.3 | 25.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 12% | 63% | 0% | 0% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | Capacity, AFY |
|---|---|---|
| WFA JPA | 12.72 | 14246 |

| Desalter Name | Capacity, AFY |
|---|---|
| Chino I | 2000 |
| Chino I Expansion | 2200 |

| | | |
|---|---|---|
| Total prod. capacity | 15,486 | gpm |
| Peak day capacity | 22.30 | mgd |
| Peak hour capacity | 0.93 | mgd |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## MVWD

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 1* | 685 | inactive--Nitrate > 90ppm (est) | 685 | 0 | 685 | 0 | 0 | 685 |
| 2 | 1,050 | inactive--Nitrate > 80ppm (est) | 1,050 | 0 | 1,050 | 0 | 0 | 1,050 |
| 4* | 850 | Nitrate; 60ppm | 850 | 0 | 850 | 0 | 0 | 850 |
| 5 | 1,500 | | 1,500 | 0 | 0 | 1,500 | 0 | 1,500 |
| 6 | 1,000 | Nitrate; 47ppm | 1,000 | 0 | 1,000 | 0 | 0 | 1,000 |
| 9* | 1,000 | inactive--Nitrate > 90ppm (est) | 1,000 | 0 | 1,000 | 0 | 0 | 1,000 |
| 10 | 1,100 | Nitrate; 56ppm | 1,100 | 0 | 1,100 | 0 | 0 | 1,100 |
| 11 | 1,000 | | 1,000 | 0 | 0 | 1,000 | 0 | 1,000 |
| 12* | 1,000 | inactive--Nitrate > 90ppm (est) | 1,000 | 0 | 1,000 | 0 | 0 | 1,000 |
| 19 | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| 20 | 1,200 | | 1,200 | 0 | 0 | 1,200 | 0 | 1,200 |
| 22 | ? | Out of Service | ? | 0 | 0 | 0 | ? | 0 |
| 23 | ? | Out of Service | ? | 0 | 0 | 0 | ? | 0 |
| 26 | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| 27 | 2,000 | Nitrate; 55ppm | 2,000 | 0 | 2,000 | 0 | 0 | 2,000 |
| 28 | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| Total | 18,385 | | 18,385 | 0 | 8,685 | 9,700 | 0 | 18,385 |

Notes:
1. Wells 1,9&12 are scheduled for reactivation; equipment pulled; engineering investigation underway; Well 1 part of MWD dry-year yield program
* Possible wells for MV aquifer storage recovery program - WFA plant to use MO Benson Feeder

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1* | 141.3 | 0.0 | 0.0 | 0.0 | 0.180 |
| 2 | 80.0 | 2.2 | 0.0 | 0.0 | 0.064 |
| 4* | 89.1 | 0.0 | 0.0 | 0.0 | 1.000 |
| 5 | 46.4 | 3.0 | 0.0 | 0.0 | 0.000 |
| 6 | 67.1 | 0.0 | 0.0 | 1.2 | 0.033 |
| 9* | 121.1 | 0.0 | 0.0 | 0.0 | 0.370 |
| 10 | 74.3 | 3.5 | 0.0 | 0.8 | 0.073 |
| 11 | 40.5 | 0.0 | 3.2 | 0.9 | 0.000 |
| 12* | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 19 | 19.3 | 7.1 | 0.0 | 0.0 | 0.012 |
| 20 | 17.0 | 2.1 | 0.0 | 0.0 | 0.000 |
| 22 | 28.8 | 0.0 | 0.0 | 0.0 | 0.000 |
| 23 | 25.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| 26 | 14.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 27 | 55.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 28 | 16.0 | 4.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 50% | 0% | 0% | 17% | 10% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | Capacity, AFY |
|---|---|---|
| WFA JPA | 19.44 | 21773 |

| | | |
|---|---|---|
| Total prod. capacity | | |
| Peak day capacity | 19.4 | mgd |
| Peak hour capacity | 19.4 | mgd |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## City of Pomona

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Inoperable | Operable |
| 1 | 0 | To be abandoned | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1,070 | | 1,070 | 0 | 0 | 1,070 | 0 | 1,070 |
| 3 | 600 | | 0 | 600 | 0 | 600 | 0 | 600 |
| 4 | 525 | NO3, CLO4, CR | 525 | 0 | 525 | 0 | 0 | 525 |
| 5B | 800 | | 800 | 0 | 0 | 800 | 0 | 800 |
| 6 | 900 | NO3, CLO4 | 900 | 0 | 900 | 0 | 0 | 900 |
| 7 | 700 | Online by Jan 2003 | 0 | 700 | 0 | 700 | 0 | 700 |
| 8 | 1,000 | Online by Jan 2003 | 0 | 1,000 | 0 | 1,000 | 0 | 1,000 |
| 9 | 300 | | 0 | 300 | 0 | 300 | 0 | 300 |
| 10 | 800 | NO3 | 800 | 0 | 800 | 0 | 0 | 800 |
| 11 | 500 | NO3, CLO4, VOC, CR | 500 | 0 | 500 | 0 | 0 | 500 |
| 12 | 650 | NO3, CLO4, VOC, CR | 650 | 0 | 650 | 0 | 0 | 650 |
| 13 | 220 | | 0 | 220 | 0 | 220 | 0 | 220 |
| 14 | 500 | NO3, CLO4, VOC | 500 | 0 | 500 | 0 | 0 | 500 |
| 15 | 470 | NO3, CLO4 | 470 | 0 | 470 | 0 | 0 | 470 |
| 16 | 770 | NO3, CLO4 | 770 | 0 | 770 | 0 | 0 | 770 |
| 17 | 490 | NO3, CLO4 | 490 | 0 | 490 | 0 | 0 | 490 |
| 18 | 530 | NO3, CLO4 | 530 | 0 | 530 | 0 | 0 | 530 |
| 20 | 600 | Online by Jan 2004 | 0 | 600 | 0 | 600 | 0 | 600 |
| 21 | 820 | NO3 - Online by June 2003 | 820 | 0 | 820 | 0 | 0 | 820 |
| 22 | 0 | Abandon | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 940 | NO3, VOC | 940 | 0 | 940 | 0 | 0 | 940 |
| 24 | 400 | NO3, VOC - Online by June 2003 | 400 | 0 | 400 | 0 | 0 | 400 |
| 25 | 850 | NO3 | 850 | 0 | 850 | 0 | 0 | 850 |
| 26 | 580 | not installed/NO3 | 580 | 0 | 580 | 0 | 0 | 580 |
| 27 | 800 | | 800 | 0 | 0 | 800 | 0 | 800 |
| 28 | 340 | | 0 | 340 | 0 | 340 | 0 | 340 |
| 29 | 400 | NO3 | 400 | 0 | 400 | 0 | 0 | 400 |
| 30 | 200 | | 200 | 0 | 0 | 200 | 0 | 200 |
| 32 | 600 | Online by Jan 2004 | 0 | 600 | 0 | 600 | 0 | 600 |
| 33 | 0 | Pumps to recycled water | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 1,020 | NO3, CLO4 | 1,020 | 0 | 1,020 | 0 | 0 | 1,020 |
| 35 | 670 | | 670 | 0 | 0 | 670 | 0 | 670 |
| 36 | 1,000 | NO3 - Online by June 2003 | 1,000 | 0 | 1,000 | 0 | 0 | 1,000 |
| 37 | 0 | Offline due to water quality | 0 | 0 | 0 | 0 | 0 | 0 |
| T-1 | 300 | | 0 | 300 | 0 | 300 | 0 | 300 |
| T-2 | 230 | | 0 | 230 | 0 | 230 | 0 | 230 |
| T-3 | 330 | | 0 | 330 | 0 | 330 | 0 | 330 |
| T-4 | 200 | | 0 | 200 | 0 | 200 | 0 | 200 |
| Total | 21,105 | | 15,685 | 5,420 | 12,145 | 8,960 | 0 | 21,105 |

0.30111348

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 2 | 59.0 | 0.0 | 8.1 | 0.0 | 0.000 |
| 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 4 | 62.6 | 0.0 | 13.5 | 1.0 | 0.000 |
| 5B | 49.1 | 3.2 | 7.2 | 0.0 | 0.000 |
| 6 | 94.1 | 0.0 | 16.3 | 1.2 | 0.000 |
| 7 | 34.7 | 0.0 | 7.8 | 0.0 | 0.000 |
| 8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 10 | 52.7 | 0.0 | 9.5 | 0.0 | 0.000 |
| 11 | 94.1 | 0.0 | 17.0 | 12.0 | 0.000 |
| 12 | 112.1 | 3.0 | 19.0 | 9.3 | 0.000 |
| 13 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 14 | 83.7 | 0.0 | 13.2 | 9.0 | 0.000 |
| 15 | 80.6 | 1.7 | 13.0 | 8.8 | 0.000 |
| 16 | 97.7 | 0.0 | 19.0 | 1.9 | 0.000 |
| 17 | 89.6 | 2.2 | 16.0 | 1.0 | 0.000 |
| 18 | 89.6 | 0.0 | 16.0 | 4.3 | 0.000 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 21 | 46.4 | 1.1 | 0.0 | 3.0 | 0.000 |
| 22 | 0.0 | 0.0 | 0.0 | 0.2 | 0.000 |
| 23 | 70.2 | 0.0 | 10.0 | 12.0 | 0.000 |
| 24 | 43.7 | 11.0 | 0.0 | 5.3 | 0.000 |
| 25 | 45.5 | 2.2 | 5.0 | 4.1 | 0.000 |
| 26 | 94.1 | 1.2 | 8.0 | 0.0 | 0.000 |
| 27 | 98.6 | 2.5 | 0.0 | 0.0 | 0.000 |
| 28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 29 | 47.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 30 | 12.9 | 12.0 | 0.0 | 0.0 | 0.000 |
| 32 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 34 | 69.3 | 3.0 | 16.1 | 0.0 | 0.000 |
| 35 | 11.4 | 14.7 | 4.9 | 0.0 | 0.000 |
| 36 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 37 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| T-1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| T-2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| T-3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| T-4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 64% | 6% | 60% | 40% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | Capacity, AFY | |
|---|---|---|---|
| TVMWD Weymouth | 49.70 | 55664 | Not operated by Pomona |
| AIX Plant | 15.00 | 16800 | GROUNDWATER TRTMT ONLY; 9 MGD Treated / 6 MGD By-Pass |

| | | |
|---|---|---|
| Total prod. capacity | 10,416 | gpm, blended (AIX only) |
| Peak day capacity | 15.00 | mgd, blended (AIX only) |
| Peak hour capacity | 625,000 | gph, blended (AIX only) |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## City of Ontario

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 3 | 925 | 4.2 ppm ClO4 | 925 | 0 | 925 | 0 | 0 | 925 |
| 4 | 1,240 | Inactive - high nitrates (46 ppm) | 1,240 | 0 | 1,240 | 0 | 0 | 1,240 |
| 9 | 1,770 | Inactive - high nitrates (57 ppm) | 1,770 | 0 | 1,770 | 0 | 0 | 1,770 |
| 11 | 1,360 | | 1,360 | 0 | 0 | 1,360 | 0 | 1,360 |
| 15 | 1,615 | | 1,615 | 0 | 0 | 1,615 | 0 | 1,615 |
| 16 | 650 | | 650 | 0 | 0 | 650 | 0 | 650 |
| 17 | 1,400 | | 1,400 | 0 | 0 | 1,400 | 0 | 1,400 |
| 18 | 1,200 | Inactive - high nitrates (53 ppm) | 1,200 | 0 | 1,200 | 0 | 0 | 1,200 |
| 19 | 560 | high nitrate of 45 ppm | 560 | 0 | 560 | 0 | 0 | 560 |
| 20 | 800 | | 800 | 0 | 0 | 800 | 0 | 800 |
| 24 | 1,920 | | 1,920 | 0 | 0 | 1,920 | 0 | 1,920 |
| 25 | 1,410 | | 1,410 | 0 | 0 | 1,410 | 0 | 1,410 |
| 26 | 925 | | 925 | 0 | 0 | 925 | 0 | 925 |
| 27 | 1,025 | | 1,025 | 0 | 0 | 1,025 | 0 | 1,025 |
| 29 | 2,375 | | 2,375 | 0 | 0 | 2,375 | 0 | 2,375 |
| 30 | 2,400 | Acitve w/monitoring for Hg & TDS | 2,400 | 0 | 0 | 2,400 | 0 | 2,400 |
| 31 | 2,875 | | 2,875 | 0 | 0 | 2,875 | 0 | 2,875 |
| 33 | 2,940 | Inactive - TCE and chromium | 2,940 | 0 | 2,940 | 0 | 0 | 2,940 |
| 34 | 1,750 | | 1,750 | 0 | 0 | 1,750 | 0 | 1,750 |
| 35 | 1,950 | | 1,950 | 0 | 0 | 1,950 | 0 | 1,950 |
| 36 | 1,310 | | 1,310 | 0 | 0 | 1,310 | 0 | 1,310 |
| 37 | 3,010 | | 3,010 | 0 | 0 | 3,010 | 0 | 3,010 |
| 38 | 2,475 | | 2,475 | 0 | 0 | 2,475 | 0 | 2,475 |
| 39 | 2,250 | | 2,250 | 0 | 0 | 2,250 | 0 | 2,250 |
| Total | 40,135 | | 40,135 | 0 | 8,635 | 31,500 | 0 | 40,135 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 3 | 14.1 | 5.0 | 0.0 | 0.0 | 0.000 |
| 4 | 59.0 | 2.0 | 0.0 | 0.0 | 0.000 |
| 9 | 58.1 | 2.5 | 0.0 | 0.0 | 0.000 |
| 11 | 4.4 | 3.0 | 0.0 | 0.0 | 0.000 |
| 15 | 24.1 | 3.0 | 0.0 | 0.0 | 0.000 |
| 16 | 4.2 | 2.9 | 0.0 | 0.7 | 0.000 |
| 17 | 17.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| 18 | 107.6 | 3.4 | 5.0 | 0.0 | 0.000 |
| 19 | 45.9 | 2.7 | 0.0 | 0.0 | 0.000 |
| 20 | 9.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| 24 | 4.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 25 | 8.9 | 0.0 | 0.0 | 0.0 | 0.000 |
| 26 | 8.1 | 0.0 | 0.0 | 0.0 | 0.000 |
| 27 | 10.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 29 | 4.9 | 2.3 | 0.0 | 0.0 | 0.000 |
| 30 | 16.3 | 4.0 | 6.0 | 6.0 | 0.000 |
| 31 | 23.3 | 0.0 | 0.0 | 0.0 | 0.000 |
| 33 | 5.4 | 3.4 | 0.0 | 1.0 | 0.000 |
| 34 | 6.2 | 3.0 | 0.0 | 0.0 | 0.000 |
| 35 | 4.9 | 3.0 | 0.0 | 0.0 | 0.000 |
| 36 | 4.4 | 0.0 | 0.0 | 0.0 | 0.000 |
| 37 | 8.6 | 0.0 | 0.0 | 1.7 | 0.000 |
| 38 | 3.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 39 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 12% | 0% | 9% | 22% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | Capacity, AFY | |
|---|---|---|---|
| WFA JPA | 25.43 | 28482 | |
| John Galvin WTP | 8.00 | 8960 | (inactive) |

| Desalter Name | Capacity, AFY |
|---|---|
| Chino I | 1500 |
| Chino II | 3500 |

| | | |
|---|---|---|
| Total prod. capacity | 17,660 | gpm |
| Peak day capacity | | gpm |
| Peak hour capacity | | gpm |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## City of Upland

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 1A | 1,084 | six | 0 | 1,084 | 0 | 1,084 | 0 | 1,084 |
| 2 | 565 | six | 0 | 565 | 0 | 565 | 0 | 565 |
| 3 | 700 | chino | 700 | 0 | 700 | 0 | 0 | 700 |
| 5 | 923 | six | 0 | 923 | 0 | 923 | 0 | 923 |
| 7A | 980 | chino | 980 | 0 | 0 | 980 | 0 | 980 |
| 8 | 700 | chino | 700 | 0 | 700 | 0 | 0 | 700 |
| 9 | 0 | chino; out of service | 0 | 0 | 0 | 0 | 0 | |
| 13 | 850 | chino | 850 | 0 | 850 | 0 | 0 | 850 |
| 15 | 1,500 | cucamonga | 0 | 1,500 | 0 | 1,500 | 0 | 1,500 |
| 16 | 1,000 | chino | 1,000 | 0 | 0 | 1,000 | 1,000 | 0 |
| 17 | 1,065 | six | | 1,065 | 0 | 1,065 | 0 | 1,065 |
| 20 | 700 | chino | 700 | 0 | 0 | 700 | 0 | 700 |
| Total | 10,067 | | 4,930 | 5,137 | 2,250 | 7,817 | 1,000 | 9,067 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1A | 3.1 | 2.0 | 0.0 | 0.0 | 0.000 |
| 2 | 3.1 | 2.0 | 0.0 | 0.0 | 0.000 |
| 3 | 108.0 | 2.5 | 0.0 | 0.0 | 1.000 |
| 5 | 10.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 7A | 23.0 | 0.0 | 0.0 | 2.8 | 0.019 |
| 8 | 111.6 | 10.5 | 0.0 | 0.0 | 1.100 |
| 9 | 79.7 | 0.0 | 0.0 | 13.4 | 0.000 |
| 13 | 107.6 | 2.5 | 0.0 | 0.0 | 1.270 |
| 15 | 10.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 16 | 10.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 17 | 17.0 | 2.5 | 0.0 | 0.0 | 0.000 |
| 20 | 35.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 22% | 7% | 0% | 10% | 22% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | | Capacity, AFY | |
|---|---|---|---|---|
| WFA JPA | 18.63 | | 20866 | |
| San Antonio Canyon T | 6.00 | | 6720 | SURFACE WATER TRTMT ONLY |
| Total prod. capacity | 17,104 | gpm | | |
| Peak day capacity | 19.30 | mgd | | |
| Peak hour capacity | 13,403 | gpm | | |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## Fontana

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| F2A | 2,800 | | 2,800 | 0 | 0 | 2,800 | 0 | 2,800 |
| F3A | 2,100 | Inactive by DOHS (Nitrate, CLO4) | 2,100 | 0 | 2,100 | 0 | 0 | 2,100 |
| F4A | 1,700 | Nitrate - Blended; CLO4, Arsenic | 1,700 | 0 | 1,700 | 0 | 0 | 1,700 |
| F7A | 1,650 | | 1,650 | 0 | 0 | 1,650 | 0 | 1,650 |
| F10B | 2,050 | PCE - Treated | 0 | 2,050 | 2,050 | 0 | 0 | 2,050 |
| F10C | 2,100 | Drilled. Online in a few months | 0 | 2,100 | 0 | 2,100 | 0 | 2,100 |
| F13A | 1,800 | | 0 | 1,800 | 0 | 1,800 | 0 | 1,800 |
| F13B | 2,200 | | 0 | 2,200 | 0 | 2,200 | 0 | 2,200 |
| F15A | 1,200 | | 1,200 | 0 | 0 | 1,200 | 0 | 1,200 |
| F17B | 2,200 | CLO4 | 2,200 | 0 | 2,200 | 0 | 0 | 2,200 |
| F17C | 2,850 | Nitrate - Out of Service | 2,850 | 0 | 2,850 | 0 | 0 | 2,850 |
| F18A | 2,400 | CLO4 | 2,400 | 0 | 2,400 | 0 | 0 | 2,400 |
| F21A | 1,400 | | 1,400 | 0 | 0 | 1,400 | 0 | 1,400 |
| F22A | 2,250 | | 2,250 | 0 | 0 | 2,250 | 0 | 2,250 |
| F23A | 2,400 | | 2,400 | 0 | 0 | 2,400 | 0 | 2,400 |
| F24A | 2,100 | | 2,100 | 0 | 0 | 2,100 | 0 | 2,100 |
| F25A | 3,000 | Inactive by DOHS (Nitrate, CLO4) | 3,000 | 0 | 3,000 | 0 | 0 | 3,000 |
| F26A | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| F27A | 475 | | 0 | 475 | 0 | 475 | 0 | 475 |
| F28A | 850 | | 0 | 850 | 0 | 850 | 0 | 850 |
| F29A | 550 | | 0 | 550 | 0 | 550 | 0 | 550 |
| F30A | 2,000 | | 2,000 | 0 | 0 | 2,000 | 0 | 2,000 |
| F31A | 1,650 | | 1,650 | 0 | 0 | 1,650 | 0 | 1,650 |
| F32A | 650 | | 0 | 650 | 0 | 650 | 0 | 650 |
| F33A | 925 | | 0 | 925 | 0 | 925 | 0 | 925 |
| F34A | 550 | | 0 | 550 | 0 | 550 | 0 | 550 |
| F35A | 1,800 | CLO4 | 1,800 | 0 | 1,800 | 0 | 0 | 1,800 |
| F36A | 2,100 | | 0 | 2,100 | 0 | 2,100 | 0 | 2,100 |
| F37A | 1,450 | | 1,450 | 0 | 0 | 1,450 | 0 | 1,450 |
| F40A | 825 | | 0 | 825 | 0 | 825 | 0 | 825 |
| F41A | 950 | | 0 | 950 | 0 | 950 | 0 | 950 |
| F42A | 450 | | 0 | 450 | 0 | 450 | 0 | 450 |
| F44A | 2,700 | Drilled. Online in a few months | 2,700 | 0 | 0 | 2,700 | 0 | 2,700 |
| F44B | 2,700 | Under construction | 2,700 | 0 | 0 | 2,700 | 0 | 2,700 |
| F44C | 2,700 | Under construction | 2,700 | 0 | 0 | 2,700 | 0 | 2,700 |
| F49A | 2,500 | TCE treated via GAC at F10 | 0 | 2,500 | 0 | 2,500 | 0 | 2,500 |
| Total | 64,025 | | 45,050 | 18,975 | 18,100 | 45,925 | 0 | 64,025 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| F2A | 19.8 | 0.0 | 0.0 | 0.0 | 0.000 |
| F3A | 50.0 | 0.0 | 9.4 | 0.0 | 0.000 |
| F4A | 83.7 | 10.1 | 14.1 | 0.0 | 0.000 |
| F7A | 56.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| F10B | 21.6 | 0.0 | 0.0 | 8.4 | 0.000 |
| F10C | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F13A | 8.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F13B | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F15A | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F17B | 49.5 | 0.0 | 13.2 | 0.0 | 0.000 |
| F17C | 55.8 | 0.0 | 12.0 | 0.0 | 0.000 |
| F18A | 28.8 | 0.0 | 17.3 | 0.0 | 0.000 |
| F21A | 17.3 | 0.0 | 0.0 | 0.0 | 0.000 |
| F22A | 10.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| F23A | 16.2 | 0.0 | 0.0 | 0.0 | 0.000 |
| F24A | 7.6 | 2.7 | 0.0 | 2.0 | 0.000 |
| F25A | 50.0 | 0.0 | 7.7 | 0.0 | 0.000 |
| F26A | 19.8 | 0.0 | 0.0 | 0.0 | 0.000 |
| F27A | 3.1 | 0.0 | 0.0 | 0.0 | 0.000 |
| F28A | 5.9 | 5.2 | 0.0 | 0.0 | 0.000 |
| F29A | 6.2 | 6.0 | 0.0 | 0.0 | 0.000 |
| F30A | 27.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| F31A | 20.3 | 0.0 | 0.0 | 0.0 | 0.000 |
| F32A | 5.0 | 7.3 | 0.0 | 0.0 | 0.000 |
| F33A | 3.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| F34A | 8.0 | 3.6 | 0.0 | 0.0 | 0.000 |
| F35A | 21.6 | 0.0 | 7.8 | 0.0 | 0.011 |
| F36A | 14.1 | 0.0 | 0.0 | 0.0 | 0.000 |
| F37A | 29.9 | 4.0 | 0.0 | 0.0 | 0.000 |
| F40A | 6.3 | 3.3 | 0.0 | 0.0 | 0.000 |
| F41A | 5.5 | 2.3 | 0.0 | 0.0 | 0.000 |
| F42A | 6.4 | 0.0 | 0.0 | 0.0 | 0.000 |
| F44A | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F44B | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F44C | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| F49A | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 21% | 3% | 25% | 6% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd | | Capacity, AFY | |
|---|---|---|---|---|
| Sand Hill WTP | 20.00 | | 22400 | SURFACE WATER TRTMT |
| | | | | |
| Total prod. capacity | 13,888 | gpm | | |
| Peak day capacity | 20.00 | mgd | | |
| Peak hour capacity | 13,888 | gpm | | |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN OPTIMUM BASIN MANAGEMENT PROGRAM**
STORAGE AND RECOVERY PROGRAM
Asset Inventory

## JCSD

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 1 | 800 | Nitrates, TDS | 800 | 0 | 800 | 0 | 0 | 800 |
| 6 | 1,500 | Nitrates 42 Mg/L | 1,500 | 0 | 1,500 | 0 | 0 | 1,500 |
| 8 | 1,700 | Nitrates | 1,700 | 0 | 1,700 | 0 | 0 | 1,700 |
| 11 | 1,100 | Nitrates | 1,100 | 0 | 1,100 | 0 | 0 | 1,100 |
| 12 | 1,100 | Nitrates | 1,100 | 0 | 1,100 | 0 | 0 | 1,100 |
| 13 | 2,800 | | 2,800 | 0 | 0 | 2,800 | 0 | 2,800 |
| 14 | 2,100 | Nitrates 45 Mg/L | 2,100 | 0 | 2,100 | 0 | 0 | 2,100 |
| 15 | 900 | | 900 | 0 | 0 | 900 | 0 | 900 |
| 16 | 2,100 | Nitrates | 2,100 | 0 | 2,100 | 0 | 0 | 2,100 |
| 17 | 3,600 | | 3,600 | 0 | 0 | 3,600 | 0 | 3,600 |
| 18 | 1,500 | | 1,500 | 0 | 0 | 1,500 | 0 | 1,500 |
| 19 | 1,200 | | 1,200 | 0 | 0 | 1,200 | 0 | 1,200 |
| 20 | 1,000 | | 1,000 | 0 | 0 | 1,000 | 0 | 1,000 |
| Total | 21,400 | | 21,400 | 0 | 10,400 | 11,000 | 0 | 21,400 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 1 | 22.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 6 | 21.9 | 0.0 | 0.0 | 0.0 | 0.000 |
| 8 | 85.5 | 0.0 | 0.0 | 0.0 | 0.000 |
| 11 | 88.7 | 20.0 | 0.0 | 0.7 | 0.000 |
| 12 | 122.0 | 20.0 | 0.0 | 0.0 | 0.000 |
| 13 | 16.2 | 0.0 | 0.0 | 0.0 | 0.000 |
| 14 | 41.9 | 0.0 | 0.0 | 0.0 | 0.000 |
| 15 | 28.8 | 0.0 | 0.0 | 0.0 | 0.000 |
| 16 | 111.6 | 0.0 | 0.0 | 0.0 | 0.000 |
| 17 | 24.4 | 0.0 | 0.0 | 1.0 | 0.000 |
| 18 | 21.3 | 0.0 | 0.0 | 2.6 | 0.000 |
| 19 | 8.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| % of prod. >MCL | 28% | 10% | 0% | 29% | 0% |

Imported Water Treatment Plant Capacity

| Plant Name | Capacity, mgd |
|---|---|
| None | |

| Desalter Name | Capacity, AFY |
|---|---|
| Chino I | 2700 |
| Chino II | 5500 |

| | | |
|---|---|---|
| Total prod. capacity | 1,984 | gpm |
| Peak day capacity | 2.86 | mgd |
| Peak hour capacity | 0.12 | mgd |

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

## SAWC

Groundwater Production Capacity

| | | | Location | | Water Quality | | Other | |
|---|---|---|---|---|---|---|---|---|
| Well No. | Design Capacity, gpm | Comments | In Basin | Out of Basin | Impaired | Unimpaired | Impaired | Unimpaired |
| 2 | 850 | | 0 | 850 | 0 | 850 | 0 | 850 |
| 3 | 1,225 | Nitrate | 0 | 1,225 | 1,225 | 0 | 0 | 1,225 |
| 12 | 700 | Nitrate | 700 | 0 | 700 | 0 | 0 | 700 |
| 15 | 600 | | 600 | 0 | 0 | 600 | 0 | 600 |
| 18 | 2,100 | pump not installed/Nitrate | 2,100 | 0 | 2,100 | 0 | 0 | 2,100 |
| 22 | 900 | | 0 | 900 | 0 | 900 | 0 | 900 |
| 24 | 1,650 | Nitrate | 0 | 1,650 | 1,650 | 0 | 0 | 1,650 |
| 26 | 700 | | 0 | 700 | 0 | 700 | 0 | 700 |
| 27A | 750 | | 0 | 750 | 0 | 750 | 0 | 750 |
| 31 | 2,350 | DBCP & Nitrate | 0 | 2,350 | 2,350 | 0 | 0 | 2,350 |
| 32 | 280 | | 0 | 280 | 0 | 280 | 0 | 280 |
| Total | 10,005 | | 1,300 | 8,705 | 5,925 | 4,080 | 0 | 10,005 |

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Well No. | Nitrate (mg/L) | Arsenic (µg/L) | Perchlorate (µg/L) | VOCs (µg/L) | DBCP (µg/L) |
| 2 | 15.6 | 2.7 | 0.0 | 0.0 | 0.015 |
| 3 | 15.0 | 2.4 | 0.0 | 0.0 | 0.380 |
| 12 | 56.7 | 0.0 | 0.0 | 0.0 | 0.000 |
| 15 | 15.1 | 0.0 | 0.0 | 0.0 | 0.000 |
| 18 | 130.1 | 0.0 | 0.0 | 0.0 | 0.000 |
| 22 | 16.7 | 6.6 | 0.0 | 0.0 | 0.140 |
| 24 | 16.0 | 2.1 | 0.0 | 0.0 | 0.220 |
| 26 | 14.9 | 0.0 | 0.0 | 0.0 | 0.000 |
| 27A | 0.0 | 0.0 | 0.0 | 0.0 | 0.000 |
| 31 | 52.2 | 2.9 | 0.0 | 0.0 | 1.280 |
| 32 | 4.4 | 0.0 | 0.0 | 0.0 | 0.380 |
| % of prod. >MCL | 51% | 0% | 0% | 0% | 55% |

Imported Water Treatment Plant Capacity

Not applicable at this time. Just beginning to assess feasibility.

Transmission Capacity

| Source | Peak hour, gpm | Peak day, gpm |
|---|---|---|
| Groundwater | | |
| Imported | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | City of Chino | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 4,603 | 9,645 | 5,349 | 10 | 100 | 15,103 | 9,645 | 5,349 | 10 | 100 | 15,103 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 4,603 | 9,662 | 5,241 | 3,000 | 148 | 18,051 | 9,662 | 5,241 | 3,000 | 148 | 18,051 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 4,603 | 9,680 | 5,134 | 3,000 | 195 | 18,009 | 9,680 | 5,134 | 3,000 | 195 | 18,009 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 4,603 | 9,698 | 5,027 | 3,000 | 243 | 17,967 | 9,698 | 5,027 | 3,000 | 243 | 17,967 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 4,603 | 9,716 | 4,919 | 5,000 | 290 | 19,925 | 7,443 | 7,192 | 5,000 | 290 | 19,925 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 4,603 | 9,733 | 4,812 | 5,000 | 338 | 19,883 | 7,461 | 7,084 | 5,000 | 338 | 19,883 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 4,603 | 9,751 | 4,704 | 5,000 | 385 | 19,840 | 7,478 | 6,977 | 5,000 | 385 | 19,840 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 4,603 | 9,769 | 4,597 | 5,000 | 433 | 19,798 | 7,496 | 6,869 | 5,000 | 433 | 19,798 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 4,603 | 9,787 | 4,489 | 5,000 | 480 | 19,756 | 9,787 | 4,489 | 5,000 | 480 | 19,756 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 4,603 | 9,805 | 4,382 | 5,000 | 528 | 19,714 | 9,805 | 4,382 | 5,000 | 528 | 19,714 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 4,603 | 9,822 | 4,274 | 6,550 | 575 | 21,222 | 9,822 | 4,274 | 6,550 | 575 | 21,222 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 4,603 | 9,840 | 4,167 | 6,550 | 623 | 21,180 | 8,794 | 5,213 | 6,550 | 623 | 21,180 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 4,603 | 9,858 | 4,060 | 6,550 | 670 | 21,137 | 9,858 | 4,060 | 6,550 | 670 | 21,137 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 4,603 | 9,876 | 3,952 | 6,550 | 718 | 21,095 | 9,876 | 3,952 | 6,550 | 718 | 21,095 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 4,603 | 9,893 | 3,845 | 6,550 | 765 | 21,053 | 9,893 | 3,845 | 6,550 | 765 | 21,053 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 4,603 | 9,911 | 3,737 | 6,550 | 813 | 21,011 | 9,009 | 4,640 | 6,550 | 813 | 21,011 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 4,603 | 9,929 | 3,630 | 6,550 | 860 | 20,969 | 12,929 | 630 | 6,550 | 860 | 20,969 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 4,603 | 9,947 | 3,522 | 6,550 | 908 | 20,927 | 12,947 | 522 | 6,550 | 908 | 20,927 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 4,603 | 9,964 | 3,415 | 6,550 | 955 | 20,884 | 12,964 | 415 | 6,550 | 955 | 20,884 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 4,603 | 9,982 | 3,307 | 6,550 | 1,003 | 20,842 | 9,982 | 3,307 | 6,550 | 1,003 | 20,842 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 7,727 | 5,473 | 6,550 | 1,050 | 20,800 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 7,727 | 5,473 | 6,550 | 1,050 | 20,800 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 13,000 | 200 | 6,550 | 1,050 | 20,800 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 8,158 | 5,042 | 6,550 | 1,050 | 20,800 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 4,603 | 10,000 | 3,200 | 6,550 | 1,050 | 20,800 | 13,000 | 200 | 6,550 | 1,050 | 20,800 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | City of Chino Hills | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 11,313 | 3,366 | 11,777 | 775 | 400 | 16,318 | 3,366 | 11,777 | 775 | 400 | 16,318 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 11,313 | 3,378 | 11,338 | 2,000 | 511 | 17,227 | 3,378 | 11,338 | 2,000 | 511 | 17,227 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 11,313 | 3,390 | 10,899 | 2,000 | 621 | 16,911 | 3,390 | 10,899 | 2,000 | 621 | 16,911 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 11,313 | 3,403 | 10,460 | 2,000 | 732 | 16,594 | 3,403 | 10,460 | 2,000 | 732 | 16,594 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 11,313 | 3,415 | 10,021 | 4,200 | 842 | 18,478 | 1,900 | 11,537 | 4,200 | 842 | 18,478 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 11,313 | 3,427 | 9,583 | 4,200 | 953 | 18,162 | 1,912 | 11,098 | 4,200 | 953 | 18,162 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 11,313 | 3,439 | 9,144 | 4,200 | 1,063 | 17,846 | 1,924 | 10,659 | 4,200 | 1,063 | 17,846 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 11,313 | 3,451 | 8,705 | 4,200 | 1,174 | 17,530 | 1,936 | 10,220 | 4,200 | 1,174 | 17,530 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 11,313 | 3,464 | 8,266 | 4,200 | 1,284 | 17,214 | 3,464 | 8,266 | 4,200 | 1,284 | 17,214 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 11,313 | 3,476 | 7,827 | 4,200 | 1,395 | 16,898 | 3,476 | 7,827 | 4,200 | 1,395 | 16,898 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 11,313 | 3,488 | 7,388 | 7,540 | 1,505 | 19,921 | 3,488 | 7,388 | 7,540 | 1,505 | 19,921 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 11,313 | 3,500 | 6,950 | 7,540 | 1,616 | 19,605 | 2,803 | 7,647 | 7,540 | 1,616 | 19,605 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 11,313 | 3,512 | 6,511 | 7,540 | 1,726 | 19,289 | 3,512 | 6,511 | 7,540 | 1,726 | 19,289 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 11,313 | 3,525 | 6,072 | 7,540 | 1,837 | 18,973 | 3,525 | 6,072 | 7,540 | 1,837 | 18,973 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 11,313 | 3,537 | 5,633 | 7,540 | 1,947 | 18,657 | 3,537 | 5,633 | 7,540 | 1,947 | 18,657 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 11,313 | 3,549 | 5,194 | 7,540 | 2,058 | 18,341 | 2,947 | 5,796 | 7,540 | 2,058 | 18,341 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 11,313 | 3,561 | 4,755 | 7,540 | 2,168 | 18,025 | 5,561 | 2,755 | 7,540 | 2,168 | 18,025 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 11,313 | 3,573 | 4,317 | 7,540 | 2,279 | 17,708 | 5,573 | 2,317 | 7,540 | 2,279 | 17,708 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 11,313 | 3,586 | 3,878 | 7,540 | 2,389 | 17,392 | 5,586 | 1,878 | 7,540 | 2,389 | 17,392 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 11,313 | 3,598 | 3,439 | 7,540 | 2,500 | 17,076 | 3,598 | 3,439 | 7,540 | 2,500 | 17,076 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 2,095 | 4,515 | 7,540 | 2,610 | 16,760 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 2,095 | 4,515 | 7,540 | 2,610 | 16,760 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 5,610 | 1,000 | 7,540 | 2,610 | 16,760 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 2,382 | 4,228 | 7,540 | 2,610 | 16,760 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 11,313 | 3,610 | 3,000 | 7,540 | 2,610 | 16,760 | 5,610 | 1,000 | 7,540 | 2,610 | 16,760 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | CCWD | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 20,850 | 6,195 | 29,460 | 0 | 14,200 | 49,854 | 6,195 | 29,460 | 0 | 14,200 | 49,854 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 20,850 | 6,393 | 29,941 | 0 | 14,427 | 50,762 | 6,393 | 29,941 | 0 | 14,427 | 50,762 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 20,850 | 6,591 | 30,423 | 0 | 14,654 | 51,669 | 6,591 | 30,423 | 0 | 14,654 | 51,669 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 20,850 | 6,790 | 30,905 | 0 | 14,882 | 52,576 | 6,790 | 30,905 | 0 | 14,882 | 52,576 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 20,850 | 6,988 | 31,387 | 0 | 15,109 | 53,484 | (588) | 38,963 | 0 | 15,109 | 53,484 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 20,850 | 7,186 | 31,869 | 0 | 15,336 | 54,391 | (390) | 39,444 | 0 | 15,336 | 54,391 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 20,850 | 7,384 | 32,351 | 0 | 15,563 | 55,298 | (191) | 39,926 | 0 | 15,563 | 55,298 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 20,850 | 7,583 | 32,832 | 0 | 15,790 | 56,205 | 7 | 40,408 | 0 | 15,790 | 56,205 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 20,850 | 7,781 | 33,314 | 0 | 16,018 | 57,113 | 7,781 | 33,314 | 0 | 16,018 | 57,113 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 20,850 | 7,979 | 33,796 | 0 | 16,245 | 58,020 | 7,979 | 33,796 | 0 | 16,245 | 58,020 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 20,850 | 8,177 | 34,278 | 0 | 16,472 | 58,927 | 8,177 | 34,278 | 0 | 16,472 | 58,927 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 20,850 | 8,376 | 34,760 | 0 | 16,699 | 59,835 | 4,890 | 38,246 | 0 | 16,699 | 59,835 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 20,850 | 8,574 | 35,241 | 0 | 16,926 | 60,742 | 8,574 | 35,241 | 0 | 16,926 | 60,742 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 20,850 | 8,772 | 35,723 | 0 | 17,154 | 61,649 | 8,772 | 35,723 | 0 | 17,154 | 61,649 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 20,850 | 8,970 | 36,205 | 0 | 17,381 | 62,556 | 8,970 | 36,205 | 0 | 17,381 | 62,556 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 20,850 | 9,169 | 36,687 | 0 | 17,608 | 63,464 | 6,160 | 39,695 | 0 | 17,608 | 63,464 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 20,850 | 9,367 | 37,169 | 0 | 17,835 | 64,371 | 19,367 | 27,169 | 0 | 17,835 | 64,371 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 20,850 | 9,565 | 37,651 | 0 | 18,062 | 65,278 | 19,565 | 27,651 | 0 | 18,062 | 65,278 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 20,850 | 9,763 | 38,132 | 0 | 18,290 | 66,185 | 19,763 | 28,132 | 0 | 18,290 | 66,185 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 20,850 | 9,962 | 38,614 | 0 | 18,517 | 67,093 | 9,962 | 38,614 | 0 | 18,517 | 67,093 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 2,584 | 46,672 | 0 | 18,744 | 68,000 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 2,584 | 46,672 | 0 | 18,744 | 68,000 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 10,160 | 39,096 | 0 | 18,744 | 68,000 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 20,160 | 29,096 | 0 | 18,744 | 68,000 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 10,160 | 39,096 | 0 | 18,744 | 68,000 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 10,160 | 39,096 | 0 | 18,744 | 68,000 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 10,160 | 39,096 | 0 | 18,744 | 68,000 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 4,020 | 45,236 | 0 | 18,744 | 68,000 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 20,850 | 10,160 | 39,096 | 0 | 18,744 | 68,000 | 20,160 | 29,096 | 0 | 18,744 | 68,000 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | MVWD | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 3,268 | 9,176 | 2,805 | 0 | 0 | 11,981 | 9,176 | 2,805 | 0 | 0 | 11,981 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 3,268 | 9,370 | 2,690 | 0 | 55 | 12,115 | 9,370 | 2,690 | 0 | 55 | 12,115 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 3,268 | 9,564 | 2,575 | 0 | 110 | 12,249 | 9,564 | 2,575 | 0 | 110 | 12,249 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 3,268 | 9,759 | 2,459 | 0 | 165 | 12,383 | 9,759 | 2,459 | 0 | 165 | 12,383 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 3,268 | 9,953 | 2,344 | 0 | 220 | 12,517 | 6,922 | 5,374 | 0 | 220 | 12,517 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 3,268 | 10,147 | 2,229 | 0 | 275 | 12,651 | 7,117 | 5,259 | 0 | 275 | 12,651 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 3,268 | 10,341 | 2,114 | 0 | 330 | 12,785 | 7,311 | 5,144 | 0 | 330 | 12,785 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 3,268 | 10,535 | 1,998 | 0 | 385 | 12,919 | 7,505 | 5,029 | 0 | 385 | 12,919 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 3,268 | 10,730 | 1,883 | 0 | 440 | 13,053 | 10,730 | 1,883 | 0 | 440 | 13,053 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 3,268 | 10,924 | 1,768 | 0 | 495 | 13,187 | 10,924 | 1,768 | 0 | 495 | 13,187 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 3,268 | 11,118 | 1,653 | 0 | 550 | 13,321 | 11,118 | 1,653 | 0 | 550 | 13,321 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 3,268 | 11,312 | 1,537 | 0 | 605 | 13,454 | 9,918 | 2,932 | 0 | 605 | 13,454 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 3,268 | 11,506 | 1,422 | 0 | 660 | 13,588 | 11,506 | 1,422 | 0 | 660 | 13,588 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 3,268 | 11,701 | 1,307 | 0 | 715 | 13,722 | 11,701 | 1,307 | 0 | 715 | 13,722 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 3,268 | 11,895 | 1,192 | 0 | 770 | 13,856 | 11,895 | 1,192 | 0 | 770 | 13,856 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 3,268 | 12,089 | 1,076 | 0 | 825 | 13,990 | 10,886 | 2,280 | 0 | 825 | 13,990 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 3,268 | 12,283 | 961 | 0 | 880 | 14,124 | 16,283 | (3,039) | 0 | 880 | 14,124 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 3,268 | 12,477 | 846 | 0 | 935 | 14,258 | 16,477 | (3,154) | 0 | 935 | 14,258 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 3,268 | 12,672 | 731 | 0 | 990 | 14,392 | 16,672 | (3,270) | 0 | 990 | 14,392 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 3,268 | 12,866 | 615 | 0 | 1,045 | 14,526 | 12,866 | 615 | 0 | 1,045 | 14,526 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 10,030 | 3,530 | 0 | 1,100 | 14,660 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 10,030 | 3,530 | 0 | 1,100 | 14,660 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 13,060 | 500 | 0 | 1,100 | 14,660 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 17,060 | (3,500) | 0 | 1,100 | 14,660 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 13,060 | 500 | 0 | 1,100 | 14,660 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 13,060 | 500 | 0 | 1,100 | 14,660 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 13,060 | 500 | 0 | 1,100 | 14,660 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 10,604 | 2,956 | 0 | 1,100 | 14,660 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 3,268 | 13,060 | 500 | 0 | 1,100 | 14,660 | 17,060 | (3,500) | 0 | 1,100 | 14,660 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | City of Ontario | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 7,219 | 34,598 | 9,080 | 1,500 | 840 | 46,018 | 34,598 | 9,080 | 1,500 | 840 | 46,018 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 7,219 | 34,558 | 9,657 | 1,500 | 966 | 46,682 | 34,558 | 9,657 | 1,500 | 966 | 46,682 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 7,219 | 34,518 | 10,235 | 1,500 | 1,092 | 47,345 | 34,518 | 10,235 | 1,500 | 1,092 | 47,345 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 7,219 | 34,478 | 10,812 | 1,500 | 1,218 | 48,009 | 34,478 | 10,812 | 1,500 | 1,218 | 48,009 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 7,219 | 34,439 | 11,390 | 1,500 | 1,344 | 48,672 | 28,378 | 17,451 | 1,500 | 1,344 | 48,672 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 7,219 | 34,399 | 11,967 | 1,500 | 1,470 | 49,336 | 28,338 | 18,028 | 1,500 | 1,470 | 49,336 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 7,219 | 34,359 | 12,545 | 1,500 | 1,596 | 50,000 | 28,298 | 18,606 | 1,500 | 1,596 | 50,000 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 7,219 | 34,319 | 13,122 | 5,000 | 1,722 | 54,163 | 28,258 | 19,183 | 5,000 | 1,722 | 54,163 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 7,219 | 34,279 | 13,700 | 5,000 | 1,848 | 54,827 | 34,279 | 13,700 | 5,000 | 1,848 | 54,827 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 7,219 | 34,239 | 14,277 | 5,000 | 1,974 | 55,490 | 34,239 | 14,277 | 5,000 | 1,974 | 55,490 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 7,219 | 34,199 | 14,855 | 12,710 | 2,100 | 63,864 | 34,199 | 14,855 | 12,710 | 2,100 | 63,864 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 7,219 | 34,159 | 15,432 | 12,710 | 2,226 | 64,528 | 31,370 | 18,221 | 12,710 | 2,226 | 64,528 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 7,219 | 34,119 | 16,010 | 12,710 | 2,352 | 65,191 | 34,119 | 16,010 | 12,710 | 2,352 | 65,191 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 7,219 | 34,079 | 16,587 | 12,710 | 2,478 | 65,855 | 34,079 | 16,587 | 12,710 | 2,478 | 65,855 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 7,219 | 34,039 | 17,165 | 12,710 | 2,604 | 66,518 | 34,039 | 17,165 | 12,710 | 2,604 | 66,518 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 7,219 | 34,000 | 17,742 | 12,710 | 2,730 | 67,182 | 31,593 | 20,149 | 12,710 | 2,730 | 67,182 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 7,219 | 33,960 | 18,320 | 12,710 | 2,856 | 67,846 | 41,960 | 10,320 | 12,710 | 2,856 | 67,846 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 7,219 | 33,920 | 18,897 | 12,710 | 2,982 | 68,509 | 41,920 | 10,897 | 12,710 | 2,982 | 68,509 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 7,219 | 33,880 | 19,475 | 12,710 | 3,108 | 69,173 | 41,880 | 11,475 | 12,710 | 3,108 | 69,173 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 7,219 | 33,840 | 20,052 | 12,710 | 3,234 | 69,836 | 33,840 | 20,052 | 12,710 | 3,234 | 69,836 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 27,739 | 26,691 | 12,710 | 3,360 | 70,500 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 27,739 | 26,691 | 12,710 | 3,360 | 70,500 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 41,800 | 12,630 | 12,710 | 3,360 | 70,500 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 28,888 | 25,542 | 12,710 | 3,360 | 70,500 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 7,219 | 33,800 | 20,630 | 12,710 | 3,360 | 70,500 | 41,800 | 12,630 | 12,710 | 3,360 | 70,500 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | City of Pomona | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 2,740 | 17,963 | 2,899 | 0 | 15,960 | 36,822 | 17,963 | 2,899 | 0 | 15,960 | 36,822 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 2,740 | 18,020 | 3,106 | 0 | 15,960 | 37,086 | 18,020 | 3,106 | 0 | 15,960 | 37,086 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 2,740 | 18,077 | 3,313 | 0 | 15,960 | 37,350 | 18,077 | 3,313 | 0 | 15,960 | 37,350 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 2,740 | 18,134 | 3,521 | 0 | 15,960 | 37,614 | 18,134 | 3,521 | 0 | 15,960 | 37,614 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 2,740 | 18,191 | 3,728 | 0 | 15,960 | 37,879 | 15,918 | 6,001 | 0 | 15,960 | 37,879 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 2,740 | 18,248 | 3,935 | 0 | 15,960 | 38,143 | 15,975 | 6,208 | 0 | 15,960 | 38,143 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 2,740 | 18,304 | 4,142 | 0 | 15,960 | 38,407 | 16,032 | 6,415 | 0 | 15,960 | 38,407 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 2,740 | 18,361 | 4,350 | 0 | 15,960 | 38,671 | 16,088 | 6,622 | 0 | 15,960 | 38,671 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 2,740 | 18,418 | 4,557 | 0 | 15,960 | 38,935 | 18,418 | 4,557 | 0 | 15,960 | 38,935 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 2,740 | 18,475 | 4,764 | 0 | 15,960 | 39,199 | 18,475 | 4,764 | 0 | 15,960 | 39,199 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 2,740 | 18,532 | 4,971 | 0 | 15,960 | 39,463 | 18,532 | 4,971 | 0 | 15,960 | 39,463 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 2,740 | 18,589 | 5,179 | 0 | 15,960 | 39,727 | 17,543 | 6,224 | 0 | 15,960 | 39,727 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 2,740 | 18,645 | 5,386 | 0 | 15,960 | 39,991 | 18,645 | 5,386 | 0 | 15,960 | 39,991 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 2,740 | 18,702 | 5,593 | 0 | 15,960 | 40,255 | 18,702 | 5,593 | 0 | 15,960 | 40,255 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 2,740 | 18,759 | 5,800 | 0 | 15,960 | 40,519 | 18,759 | 5,800 | 0 | 15,960 | 40,519 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 2,740 | 18,816 | 6,008 | 0 | 15,960 | 40,784 | 17,913 | 6,910 | 0 | 15,960 | 40,784 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 2,740 | 18,873 | 6,215 | 0 | 15,960 | 41,048 | 21,873 | 3,215 | 0 | 15,960 | 41,048 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 2,740 | 18,930 | 6,422 | 0 | 15,960 | 41,312 | 21,930 | 3,422 | 0 | 15,960 | 41,312 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 2,740 | 18,986 | 6,629 | 0 | 15,960 | 41,576 | 21,986 | 3,629 | 0 | 15,960 | 41,576 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 2,740 | 19,043 | 6,837 | 0 | 15,960 | 41,840 | 19,043 | 6,837 | 0 | 15,960 | 41,840 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 16,827 | 9,317 | 0 | 15,960 | 42,104 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 16,827 | 9,317 | 0 | 15,960 | 42,104 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 19,100 | 7,044 | 0 | 15,960 | 42,104 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 22,100 | 4,044 | 0 | 15,960 | 42,104 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 19,100 | 7,044 | 0 | 15,960 | 42,104 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 19,100 | 7,044 | 0 | 15,960 | 42,104 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 19,100 | 7,044 | 0 | 15,960 | 42,104 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 17,258 | 8,886 | 0 | 15,960 | 42,104 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 2,740 | 19,100 | 7,044 | 0 | 15,960 | 42,104 | 22,100 | 4,044 | 0 | 15,960 | 42,104 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

**CHINO BASIN DRY YEAR YIELD PROGRAM**
25-YEAR WATER SUPPLY PLAN

Storage losses @ 2%

| | Storage Party Account (AF) | | | | | | City of Upland | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | No Program | | | | | With DYY Program | | | | |
| Year | P/T/H/PFL | Storage | Withdrawal | Ann. Loss | Cum. Loss | Level | Baseline | GW | Imported | CDA | Other | Total | GW | Imported | CDA | Other | Total |
| 2000 | -- | 0 | 0 | 0 | 0 | 0 | 3,141 | 6,173 | 5,217 | 0 | 10,612 | 22,002 | 6,173 | 5,217 | 0 | 10,612 | 22,002 |
| 2001 | -- | 0 | 0 | 0 | 0 | 0 | 3,141 | 6,092 | 5,336 | 0 | 10,793 | 22,220 | 6,092 | 5,336 | 0 | 10,793 | 22,220 |
| 2002 | -- | 0 | 0 | 0 | 0 | 0 | 3,141 | 6,011 | 5,454 | 0 | 10,974 | 22,439 | 6,011 | 5,454 | 0 | 10,974 | 22,439 |
| 2003 | -- | 0 | 0 | 0 | 0 | 0 | 3,141 | 5,930 | 5,573 | 0 | 11,155 | 22,657 | 5,930 | 5,573 | 0 | 11,155 | 22,657 |
| 2004 | p | 25,000 | 0 | 250 | 250 | 24,750 | 3,141 | 5,848 | 5,692 | 0 | 11,336 | 22,876 | 3,576 | 7,964 | 0 | 11,336 | 22,876 |
| 2005 | p | 25,000 | 0 | 745 | 995 | 49,005 | 3,141 | 5,767 | 5,810 | 0 | 11,517 | 23,094 | 3,495 | 8,083 | 0 | 11,517 | 23,094 |
| 2006 | p | 25,000 | 0 | 1,230 | 2,225 | 72,775 | 3,141 | 5,686 | 5,929 | 0 | 11,697 | 23,312 | 3,413 | 8,202 | 0 | 11,697 | 23,312 |
| 2007 | p | 25,000 | 0 | 1,705 | 3,931 | 96,069 | 3,141 | 5,605 | 6,048 | 0 | 11,878 | 23,531 | 3,332 | 8,320 | 0 | 11,878 | 23,531 |
| 2008 | h | 0 | 0 | 1,921 | 5,852 | 94,148 | 3,141 | 5,524 | 6,166 | 0 | 12,059 | 23,749 | 5,524 | 6,166 | 0 | 12,059 | 23,749 |
| 2009 | h | 0 | 0 | 1,883 | 7,735 | 92,265 | 3,141 | 5,443 | 6,285 | 0 | 12,240 | 23,968 | 5,443 | 6,285 | 0 | 12,240 | 23,968 |
| 2010 | h | 0 | 0 | 1,845 | 9,580 | 90,420 | 3,141 | 5,362 | 6,404 | 0 | 12,421 | 24,186 | 5,362 | 6,404 | 0 | 12,421 | 24,186 |
| 2011 | pfl | 11,504 | 0 | 1,923 | 1,923 | 100,000 | 3,141 | 5,280 | 6,522 | 0 | 12,602 | 24,404 | 4,235 | 7,568 | 0 | 12,602 | 24,404 |
| 2012 | h | 0 | 0 | 2,000 | 3,923 | 98,000 | 3,141 | 5,199 | 6,641 | 0 | 12,783 | 24,623 | 5,199 | 6,641 | 0 | 12,783 | 24,623 |
| 2013 | h | 0 | 0 | 1,960 | 5,883 | 96,040 | 3,141 | 5,118 | 6,759 | 0 | 12,964 | 24,841 | 5,118 | 6,759 | 0 | 12,964 | 24,841 |
| 2014 | h | 0 | 0 | 1,921 | 7,804 | 94,119 | 3,141 | 5,037 | 6,878 | 0 | 13,145 | 25,060 | 5,037 | 6,878 | 0 | 13,145 | 25,060 |
| 2015 | pfl | 9,928 | 0 | 1,982 | 1,982 | 102,065 | 3,141 | 4,956 | 6,997 | 0 | 13,326 | 25,278 | 4,053 | 7,899 | 0 | 13,326 | 25,278 |
| 2016 | t | 0 | 33,000 | 1,711 | 3,693 | 67,354 | 3,141 | 4,875 | 7,115 | 0 | 13,506 | 25,496 | 7,875 | 4,115 | 0 | 13,506 | 25,496 |
| 2017 | t | 0 | 33,000 | 1,017 | 4,710 | 33,337 | 3,141 | 4,793 | 7,234 | 0 | 13,687 | 25,715 | 7,793 | 4,234 | 0 | 13,687 | 25,715 |
| 2018 | t | 0 | 33,000 | 337 | 5,047 | 0 | 3,141 | 4,712 | 7,353 | 0 | 13,868 | 25,933 | 7,712 | 4,353 | 0 | 13,868 | 25,933 |
| 2019 | h | 0 | 0 | 0 | 5,047 | 0 | 3,141 | 4,631 | 7,471 | 0 | 14,049 | 26,152 | 4,631 | 7,471 | 0 | 14,049 | 26,152 |
| 2020 | p | 25,000 | 0 | 250 | 5,297 | 24,750 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 2,277 | 9,863 | 0 | 14,230 | 26,370 |
| 2021 | p | 25,000 | 0 | 745 | 6,042 | 49,005 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 2,277 | 9,863 | 0 | 14,230 | 26,370 |
| 2022 | h | 0 | 0 | 980 | 7,022 | 48,025 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 4,550 | 7,590 | 0 | 14,230 | 26,370 |
| 2023 | t | 0 | 33,000 | 631 | 7,652 | 14,395 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 7,550 | 4,590 | 0 | 14,230 | 26,370 |
| 2024 | h | 0 | 0 | 288 | 7,940 | 14,107 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 4,550 | 7,590 | 0 | 14,230 | 26,370 |
| 2025 | h | 0 | 0 | 282 | 8,222 | 13,825 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 4,550 | 7,590 | 0 | 14,230 | 26,370 |
| 2026 | h | 0 | 0 | 276 | 8,499 | 13,548 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 4,550 | 7,590 | 0 | 14,230 | 26,370 |
| 2027 | pfl | 20,263 | 0 | 474 | 474 | 33,337 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 2,708 | 9,432 | 0 | 14,230 | 26,370 |
| 2028 | t | 0 | 33,000 | 337 | 810 | 0 | 3,141 | 4,550 | 7,590 | 0 | 14,230 | 26,370 | 7,550 | 4,590 | 0 | 14,230 | 26,370 |
| | | 191,694 | 165,000 | | | | | | | | | | | | | | |
| | | | 26,694 | | | | | | | | | | | | | | |

# Chino Basin Watermaster
# Status Report No. 11

**(Covering March 2004 through May 2004)**

**June 2004**

# OPTIMUM BASIN MANAGEMENT PROGRAM

*In its Order of September 28, 2000, extending the term of the nine-member Watermaster Board, the Court ordered Watermaster to provide semiannual reports regarding the progress of OBMP implementation. In Status Report Number 4, filed with the Court on September 30, 2002, Watermaster notified the Court that Watermaster intended to accelerate voluntarily the reporting schedule because of the rapid pace of OBMP implementation. By a subsequent Order of October 17, 2002, the Court added additional reporting items to the quarterly report.*

*This Status Report Number 11 is filed pursuant to this revised schedule and reports on the period from March 1, 2004 to May 31, 2004.*

## PROGRAM ELEMENT 1 – DEVELOP AND IMPLEMENT COMPREHENSIVE MONITORING PROGRAM

### Groundwater-Level Monitoring

BACK-GROUND

Watermaster has three active groundwater-level monitoring programs operating in the Chino Basin – a semiannual basin-wide program; an intensive key well monitoring program associated with the Chino I / II Desalter well fields and the Hydraulic Control Monitoring Program (HCMP); and an intensive piezometric monitoring program associated with land subsidence and ground fissuring (see Land Surface Monitoring below) in Management Zone 1 (MZ1).

THIS PERIOD

For the semiannual program, Watermaster staff manually measures water levels in approximately 340 agricultural wells twice per year. In conjunction with the semiannual program, Watermaster staff manually measures water levels at about 112 key wells in the south portion of the Basin and around the Chino I / II Desalter well fields once per month. During the reporting period, Watermaster staff installed a pressure transducer/data logger in 10 of these key wells to automatically record water levels once every 15 minutes. For the MZ-1 program, Watermaster consultants collect groundwater level data at 35 wells in the southern portion of MZ1. Data are collected manually at MZ1 wells once every two months, and automatically once every 15 minutes using a pressure transducer/data logger installed at each well.

These Watermaster programs also rely on municipal producers, other government agencies, and private entities to supply their groundwater level measurements on a cooperative basis. Watermaster digitizes all these measurements and combines them into a relational database maintained at Watermaster's office.

TO COME

During fiscal year 2004/05, Watermaster staff will expand the use of pressure transducers/data loggers within the key well program. Watermaster staff will purchase and install about 30 additional pressure transducers/data loggers at wells in the key well program and at selected wells in the northern portions of Chino Basin where highly-detailed groundwater level data is scarce.

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Watermaster, Inland Empire Utilities Agency (IEUA), Orange County Water District (OCWD), and the Santa Ana Regional Water Quality Control Board (RWQCB) have agreed to construct nine new monitoring wells as part of the piezometric monitoring element of the HCMP. These monitoring wells are necessary because existing well locations and well construction are not sufficient to measure the extent of hydraulic control in the vicinity of the Desalter well fields and because of the loss of monitoring use of agricultural wells as these wells are destroyed in the conversion of land use from agriculture to urban uses. The objective of these new wells is to document the creation of a regional depression in the piezometric surface, for both the shallow and deep aquifer systems, as a result of Desalter pumping. These wells will be installed during fiscal year 2004/05.

Watermaster and IEUA are planning to construct a number of monitoring wells at recharge basins to monitor the influence of recharge on groundwater levels in general, and to monitor the water quality resulting from the recharge of supplemental and storm waters. At least one monitoring well will be installed down-gradient of each recharge facility that receives recycled water. The construction schedule will be determined during the next reporting period.

**Groundwater-Quality Monitoring**

BACK-GROUND **Prioritizing Wells to Serve Multiple Purposes.** The private wells chosen for the 2003-04 water quality monitoring program are located primarily between Interstate 60 and the Santa Ana River (SAR).

**Water Quality Analyses**

- All groundwater samples are analyzed for general mineral and general physical parameters.

ON-GOING
- Wells within or near the two volatile organic compound (VOC) plumes south of the Ontario and Chino Airports are being analyzed for VOCs, in addition to the general minerals and general physical parameters.

- All private wells in the key well program are being analyzed for perchlorate because of its widespread occurrence in the 1999-2001 sampling program, and the concerns expressed by appropriators faced with expensive ion exchange treatment costs for perchlorate-contaminated wells.

THIS PERIOD **Sampling Program of Selected Private Wells**. Watermaster developed its streamlined, key-well water quality monitoring program in which approximately 114 private "key wells" are sampled bi-annually (i.e. once every two years) in the southern portion of Chino Basin. Therefore, approximately 57 wells will be sampled on an annual basis. The steps taken in determining the key wells were:

- The basin was divided into a grid, with each cell being 2000 square meters ($m^2$).
- For each grid cell, the average TDS and $NO_3$ values were calculated (using the last five years of available data).

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- The water quality of each individual well was examined. Wells most closely matching the average constituent concentrations were chosen as representative. One to two wells in each grid square were retained (The wells not chosen in the key well program, but still matching these criteria are the alternate wells for each grid cell). Preference was given to wells with the following characteristics:
  - Known construction;
  - Choice as a groundwater level key well;
  - Likelihood of surviving the regional development.
- Basin-wide TDS and $NO_3$ arithmetic averages were recalculated using just the key wells and compared to the total basin arithmetic averages. New maps were made representing the water quality conditions of the key wells and qualitatively compared to the original basin maps.

Watermaster has developed a comprehensive water quality program, whereby water quality data from other sources are routinely collected, quality-control checked and loaded into Watermaster's database. Data sources included:

- Appropriators
- Department of Health Services (DHS) – these data are currently downloaded from DHS annually
- Department of Toxic Substance Control (DTSC) for the Stringfellow Acid Pits
- Regional Water Quality Control Board (RWQCB) for water quality data associated with sites under Cleanup and Abatement Orders (CAO).

TO COME Watermaster is working closely with Appropriator Pool members and their state-certified contract laboratories in order to obtain water quality data as an electronic data deliverable (EDD). These data would be transmitted either directly from the laboratory or from the Appropriator, after their QA/QC check of the laboratory data. The EDDs will enhance the quality and timeliness of the Watermaster's database.

**Groundwater-Production Monitoring**

BACK - GROUND **Monitoring of Agricultural Production Wells.** Initially production monitoring involved the installation of meters on wells operated by members of the Agricultural Pool. As of the end of this period, Watermaster counted about 517 active agricultural wells and has equipped 403 of these wells with operating meters. The other 114 wells have or will become inactive within 18-24 months because of urban development in the south Chino area.

ON GOING **All Producing Wells Are Monitored Quarterly.** Watermaster staff reads the newly installed and/or rehabilitated meters on the agricultural wells quarterly. A "water duty" method is used to estimate production at agricultural wells that do not have meters.

TO COME **Need For Water Use/Disposal Form To Be Reviewed.** The OBMP Implementation Plan includes a provision that requires the agricultural producers to submit a water use/disposal form describing the sources of water used by each producer and how that water is disposed of after each use. Filling out the water use and disposal form and reporting the

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results have not been implemented. Watermaster will initiate discussions of the need for this form with the Water Quality Committee.

**Surface-Water Monitoring**

BACK-GROUND **Measure Water Quality and Water Levels In Recharge Basins.** Watermaster conducts a surface water monitoring program to characterize the water quality of water in recharge basins and the water levels in some of these basins. The purpose of this program is to estimate the volume and quality of recharge. This information will be used in subsequent years to estimate the safe yield of the Basin and for other management purposes.

ON GOING Currently, Watermaster monitors the water quality in 20 basins: Upland, Declez, Etiwanda Spreading Grounds, Victoria, Hickory, Lower Day Lower, Banana, Ely 1, Ely 3, Wineville, San Sevaine 1, San Sevaine 5, Turner 1, Princeton, Montclair 1, Montclair 2, Montclair 3, Montclair 4, Brooks, and Grove. Generally, the water quality samples are taken after storm events, i.e., during the period from November 1 through March 30; however, monitoring of nuisance flows also occurs. Each basin has been sampled three to five times each year. Next fiscal year the sampling rate will substantially increase for basins that are scheduled to receive recycled water.

THIS PERIOD Immediately following the storm event of March 1, 2004, Watermaster staff sampled the storm water captured in Ely Basins 1 & 3, Montclair Basins 1 & 2, San Sevaine Basins 1 & 5, Lower Day Basin, and Victoria Basin.

BACK-GROUND **Surface Water Monitoring for Santa Ana River Began In June 2003**. One of the goals of the OBMP is to maximize Chino Basin yield. A key component in maximizing yield is to minimize groundwater discharge into the SAR. Watermaster developed a surface water monitoring program for the SAR that, in conjunction with Watermaster groundwater monitoring programs, is used to characterize those reaches of the River that are gaining water from the Basin, and to determine if significant discharge of Chino Basin groundwater to the SAR is occurring. A conceptual monitoring plan involving IEUA, OCWD, the RWQCB, and Watermaster was finalized. These agencies determined that the conceptual monitoring plan was adequate and developed a detailed work plan to implement a surface water and groundwater monitoring program. The work plan was completed in June 2003, and year-round water quality sampling and flow monitoring in the SAR have begun.

ON GOING Watermaster now measures the SAR flow and selected water quality parameters as key elements of the HCMP. Watermaster collects water quality samples and measures flow at the four Santa Ana River stations (Van Buren, Etiwanda, Hamner, and River Road) plus another eight locations on tributaries, year round on a bi-weekly basis. In addition, Watermaster obtains discharge data from permanent USGS and OCWD stream gauge locations on the SAR and its tributaries. Discharge and water quality data from publicly owned treatment works (POTWs) that discharge to the SAR in this reach are obtained from the POTWs.

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## Land-Surface Monitoring

BACK-GROUND

**Multifaceted Approach.** Watermaster staff developed a multifaceted land surface monitoring program to develop data for a long-term management plan for land subsidence in Management Zone 1 (MZ1). The monitoring program consists of three main elements:

1. An aquifer system monitoring facility is located in the southern portion of MZ1, an area that has experienced concentrated and differential land subsidence and ground fissuring. A major component of the aquifer system monitoring facility is a cluster of multiple depth piezometers that measure water level and pressure changes at 11 different depths. Another major component is a dual borehole extensometer that measures deformation within the aquifer system at deep and shallow levels. Together, the two components correlate the hydraulic and mechanical responses of the aquifer system to different aquifer stresses, such as pumping at wells.

2. Synthetic aperture radar interferometry (InSAR) measures land surface deformation across the entire Chino Basin using remote sensing techniques.

3. Benchmark surveys along selected profiles of the Chino Basin. The benchmark surveys (1) establish a datum from which to measure future land surface deformation, (2) "ground-truth" the InSAR data, (3) allow determination of historical subsidence at any historical benchmarks that can be recovered, and (4) evaluate the effectiveness of the long-term management plan.

ON GOING

**Depth Specific Data.** Permanent transducers and data logging equipment are recording depth specific groundwater level data at the Ayala Park piezometers. Transducers also are recording groundwater level data at wells owned by the cities of Chino and Chino Hills and the California Institution for Men (CIM). These transducers record groundwater levels at all wells once every 15 minutes, and also record "on/off" pumping cycles at the active production wells.

BACK-GROUND

**Deep Aquifer-System Stress Test**. In October and November 2003, Watermaster attempted to conduct a controlled, deep aquifer system stress test. In summary, the test called for constant discharge from four wells owned by the City of Chino Hills (**CH-1B, CH-15B, CH-17,** and **CH19**), while most other wells in the area were to remain off. These wells have similar perforated intervals from about 300-1,100 ft-bgs and primarily influence water levels in the deep and confined portions of the aquifer system – deeper than about 300 ft-bgs.

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The primary objective of this stress test was to transition the deformation of aquifer system sediments from elastic compression to inelastic compaction. If accomplished, it would have provided "threshold" piezometric heads at the extensometer location that should not be approached in the future to avoid permanent (inelastic) compaction within the aquifer system. It would have also helped to constrain estimates of key aquifer system parameters that could be used in later modeling efforts.

The primary objective was not accomplished during this test because two of the proposed pumping wells (**CH-1B** and **CH-15B**) could not pump directly into the Chino Hills' distribution system because of high arsenic concentrations. A third well (**CH-17**) had to be

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turned off during the test because of mechanical problems. As a result, piezometric heads did not drop below the "threshold" levels to cause inelastic compaction within the confined portions of the aquifer system.

Nonetheless, valuable piezometric data was collected that revealed a potential groundwater barrier within the sediments below about 300 ft-bgs. This barrier approximately coincides with the location of the historic zone of ground fissuring as evidenced by a lack of water level response in **CH-18** (east of the fissure zone) due to pumping at **CH-19** (west of the fissure zone). That these features are coincident spatially suggests a cause-and-effect relationship between the barrier, the steep gradient of subsidence across the barrier as indicated by InSAR, and the ground fissuring.

THIS PERIOD

**Shallow Aquifer System Stress Test.** In May and June 2004, Watermaster attempted to conduct a controlled, shallow aquifer system stress test. In summary, the test called for constant discharge from three wells owned by the cities of Chino (Wells 4 and 6) and Chino Hills (**CH-1A**), while most other wells in the area were to remain off. These wells have similar perforated intervals from about 160-375 ft-bgs and primarily influence water levels in the shallow, un- to semi-confined portions of the aquifer system – shallower than about 300 ft-bgs.

The primary objective of this stress test was to constrain estimates of key aquifer system parameters that could be used in later modeling efforts. In addition, the data can be used to test for the existence of the groundwater barrier (discussed above) within the shallow aquifer system sediments.

Unseasonably warm weather and a temporary shut down of the Rialto Pipeline (imported water) caused the cities to turn on these pumping wells contrary to the pumping test schedule, and to turn on nearby deep wells later in the test period. Nonetheless, valuable piezometric data were collected and are currently being analyzed.

THIS PERIOD

**Deep piezometer rehabilitation**. During the summer drawdown in the 2003 it became evident that some degree of intercommunication was developing among the piezometers in the deep cluster (PB) at Ayala Park, and that the deepest piezometer, **PB-1,** and perhaps others, were also intermittently communicating with the much higher heads in the shallow aquifer system. The leakage apparently is occurring through faulty joints in the two-inch PVC casings, although actual breaks in the casings may also exist. Evidence suggests that many of the problems may result from defects in the casing of PB-1 that allow leakage directly into the gravel envelopes around the screened intervals of shallower piezometers. To the extent that this is true, repair of PB-1 may solve most of the problems.

Rehabilitation of the PB piezometers is currently being undertaken, using a "well-in-a-well" construction technique. This involves filling the screened interval (5 to 20 ft) of the piezometer casing with coarse, highly permeable sand, which is then topped with about 10 ft of graded medium to very fine sand and silt to form a filter cap of very low permeability. A 1-inch inner pipe, the well within the well, is jetted through the filter cap to communicate effectively with the original gravel envelope and surrounding formation. Before final jetting down into position, the inner pipe, temporarily set about 20 ft above the screen, allows water standing in the 2-inch casing to be displaced to the surface while a

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sealing bentonite grout is pumped down the annulus between the 2-inch casing and the inner pipe.

This technique has been tested and refined by experimenting in **PB-6**, the shallowest of the deep piezometer cluster. Preliminary evaluation indicates that the procedure closed a known communication between **PB-5 and PB-6**. Based on the results at **PB-6**, Watermaster will attempt to rehabilitate **PB-1** using similar methodologies (see below).

TO COME

**Deep Aquifer System Stress Test.** The most critical current objective of the aquifer system monitoring element of the IMP is to transition the deformation of aquifer system sediments from elastic compression to inelastic compaction (see discussion above). Watermaster is proposing to conduct another controlled, deep aquifer system stress test during the months of September and October 2004 to accomplish this objective. In summary, the test calls for constant discharge from four wells owned by the City of Chino Hills (**CH-1B, CH-15B, CH-17, and CH-19**), while most other wells in the area are to remain off.

Recall that **CH-1B** and **CH-15B** have relatively high concentrations of arsenic that do not allow for pumping these wells directly into Chino Hills' distribution system. Yet, it is imperative that these wells participate in the stress test in an attempt to transition the aquifer system deformation to inelastic compaction. Options to include these wells is the stress test include: (1) installation of temporary or semi-permanent arsenic removal facilities at the well heads, and/or (2) pumping directly to storm drains which flow to Prado Basin and ultimately to Orange County Water District's Santa Ana River recharge facilities in Anaheim. The feasibility and cost of each option are being researched and discussed with various vendors, the City of Chino Hills, permitting agencies, and the MZ-1 Technical Committee.

**Deep piezometer rehabilitation.** Rehabilitation of **PB-1** is scheduled to be undertaken on or about June 23, 2004 when the equipment and personnel of the contractor, Well Development Corporation, are next available. After repair of **PB-1**, WEI will conduct slug tests to confirm the effectiveness of the procedure and the need, if any, for similar repairs in other piezometers.

Background

**InSAR.** The objective of this task is to characterize ground surface deformation in Chino Basin using Synthetic Aperture Radar Interferometry (InSAR). This analysis will be performed for a historical period (1992-2003) and on an on-going basis thereafter. The advantage of InSAR is that it provides an aerially continuous representation of land surface deformation. These data are planned to be used to: (1) characterize the time history of land surface deformation in greater spatial and temporal detail than can be accomplished from the available historical ground level survey data, (2) calibrate computer simulation models of subsidence and groundwater flow, and (3) assist in the evaluation of the effectiveness of the long term management plan.

THIS PERIOD

During this reporting period, Vexcel Corporation of Boulder, Colorado – a company that specializes in remote sensing and radar technologies conducted a "proof of concept" study of historical SAR data that was acquired over the MZ-1 area. The objective of this study was to generate cumulative displacement maps over relatively short time steps (months). If deemed successful, a comprehensive analysis of all historical SAR data

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(1992-2003) would be performed to characterize in detail the time history of subsidence in MZ-1.

In this "proof of concept" study, five SAR images acquired from September 1992 to November 1993 were processed to create four interferograms:

- September 1992—April 1993
- April 1993 – September 1993
- September 1993 – October 1993
- October 1993 – November 1993

The first interferogram (September 1992 – April 1993) was incoherent and unusable. The remaining three interferograms were coherent, and allowed for the creation of three cumulative displacement maps:

- April – September 1993
- April – October 1993
- April – November 1993

The major features to note in these cumulative displacement maps are:

1. A north-south trending trough of subsidence extends northwest of the Ayala Park Extensometer, and depicts maximum subsidence of about 2.4 inches during the April – November 1993 period in the vicinity of the intersection of Central Avenue and Schaefer Avenue. This pattern and magnitude of subsidence are consistent with past InSAR and ground level survey analyses.

2. The coincidence of the north-south trending fissure zone (which was active during this general time period) and the sharp eastern edge of the trough of subsidence. This locational coincidence suggests a cause-and-effect relationship that may also be related to an underlying groundwater barrier within the deep aquifer system sediments (see Aquifer System Monitoring section below).

3. The slight differences between maps that depict the relatively small displacements that occurred from September to November can be recognized through this analysis. The recognition of these displacements at relatively short time steps (months) demonstrates the capability of this method to further resolve the time history of subsidence over the period of available SAR data (1992-2003).

4. An increasing number of "no data" cells as the maps progress through time. This is a result of incoherent cells in an interferogram in areas that were previously coherent in all prior interferograms. This phenomenon will progressively add "no

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data" cells to the cumulative displacement maps. However, in the opinion of Vexcel, the final map will still provide useful and spatially continuous data in areas that typically provide coherence data (e.g. urban areas).

5. The large area of "no data" in the agricultural areas of Chino Basin. The analysis did not improve the coherence of the data in these agricultural areas, as was hoped.

TO COME

The MZ-1 Technical Committee reviewed the findings of the proof of concept InSAR analysis and recommended to the Watermaster to proceed with the analysis of the entire historical record. This work will be completed by the end of 2004. The contract deliverable will include a presentation of the analysis results by the InSAR consultant.

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**Benchmark Surveys**

BACK GROUND

The Interim Monitoring Program (IMP) work plan called for the deep extensometer, which is anchored in sedimentary bedrock at about 1,400 ft bgs, to be used as the "starting benchmark" for all survey loops. To accomplish this, a Class-A benchmark was constructed outside the extensometer building to serve as the practical (*i.e.* actual) starting benchmark. To link this benchmark to the deep extensometer pipe, each survey event is begun by referencing the benchmark to a marked spot on one of the piers that supports the extensometer instrument platform. These piers and the instrument platform represent a stable ground surface datum that is used to measure relative vertical displacement between the ground surface and the deep extensometer pipe (recorded every 15 minutes). The vertical displacement recorded at the deep extensometer between survey events, in addition to any vertical displacement measured between the starting benchmark and the pier, is then used to calculate the elevation at the starting benchmark outside the extensometer building. Then, relative vertical displacement between benchmarks is measured across the entire work to obtain current elevations. These comprehensive surveys are planned to be repeated annually during spring season of highest regional water levels.

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A key element of the MZ-1 benchmark network is the array of closely spaced benchmarks that have been established across the historic fissure zone in the immediate vicinity of the Ayala Park extensometers (Ayala Park array). At this array, located along Edison and Eucalyptus Avenues, the IMP work plan calls for the semiannual measuring of both vertical and horizontal displacements. These horizontal and vertical displacements are expected to define two-dimensional profiles of land surface deformation that can be related to the vertical distribution of aquifer system compaction and expansion that is being recorded continuously at the extensometers. These surveys are repeated semi-annually during the late spring and early fall periods of highest and lowest water levels – in an attempt to monitor fissure movement that may be associated with elastic and/or inelastic aquifer deformation.

THIS PERIOD

In late April 2004, AE performed the annual survey event across the entire network of benchmark monuments, including the measurements of horizontal displacements at the Ayala Park Array of monuments. These data are currently being processed by AE for upload to the MZ-1 database.

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TO COME

The results of the ground level surveys to date will be presented to the MZ-1 Technical Committee at its July 21, 2004 meeting. Also at this meeting, the project manager from AE will make a presentation to describe survey methodologies, accuracy, results, and challenges, as well as to answer questions. The written results will be presented in the next MZ-1 progress report due to the MZ-1 Technical Committee at its August 25, 2004 meeting.

**Well Construction, Abandonment, and Destruction Monitoring**

BACK-GROUND

Watermaster staff monitors the condition of wells on a regular basis. Wells that may be improperly abandoned/destroyed are reported to Riverside and San Bernardino Counties as they are discovered.

Watermaster staff inspected 150 suspect wells during a 2002-03 field inspection and determined that 113 of these wells were properly abandoned and 37 wells will require some modification to meet the standard for a properly abandoned well. A well repair/abandonment program was prepared and approved by Watermaster. Watermaster continues to develop a wellhead protection program and makes recommendations on closure of abandoned wells. Ongoing land development will require continued well abandonment activity by Watermaster.

## PROGRAM ELEMENT 2 – DEVELOP AND IMPLEMENT COMPREHENSIVE RECHARGE PROGRAM

*A centerpiece of the OBMP is enhancement of the Basin recharge capacity, so that high quality storm water and available recycled water can be retained in the Basin.*

**Recharge Facilities Improvement Project (Seven Bid Packages)**

**Bid Package No. 1—Reconfiguration of Banana, College Heights, Lower Day, RP3 and Turner Basins**

Completed

Bid Package No. 1, which included major earthwork at Banana, College Heights, Lower Day, RP-3, and Turner Basins, was awarded to LTE Excavating on March 24, 2003. Work was scheduled for completion by November 15, 2003, but was delayed while awaiting delivery of sluice gates and their actuator assemblies. At the end of this quarter, the final "punch list" of corrections was completed, and the bid package was accepted on May 12, 2004

**Bid Package No. 2 – Basin Improvements (3 ea), Drop Inlets (3 ea), and Rubber Dams (4 ea)**

BACK-GROUND

Bid Package No. 2 consisted of construction of the drop inlet structures for Brooks Street Basin, Turner Basin; and Victoria Basin; rubber dams for College Heights/Upland Basins, Turner No.1 Basin, Lower Day Basin, and RP-3 Basin; and various improvements at Declez Basin, Ely Basin, and 8th Street Basin. This package was awarded to Banshee Construction with work beginning on July 16, 2003. The contract required that work in the storm channels be completed by October 15, 2003 and that the rubber dams be operational by December 31, 2003. Work on this contract was scheduled to be completed

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by March 15, 2004; however, rain delays slowed completion of excavation and soil cement berms.

THIS PERIOD

During this quarter, work on final excavation and the soil cement berms was completed. A "punch list" of corrections was generated, and the contractor is completing those items.

THIS PERIOD

**Bid Package No. 3 – Jurupa Basin to RP-3 Force Main**

Bid Package No. 3 involves construction of approximately 11,000 linear feet of 36-inch CML&C force main between Jurupa Basin and RP-3 Basin. The force main will be used to convey storm water, imported water, and recycled water between the pump station at Jurupa Basin and the RP-3 Basins. This package was awarded to W. A. Rasic Construction Company with work beginning on August 6, 2003. The Contractor anticipates a construction period of 12 months with completion of the pipeline in July 2004.

THIS PERIOD

**Bid Package No. 4 – Jurupa Basin to RP-3 Pump Station**

Bid Package No. 4 consists of construction of the Jurupa Pump Station, 100 feet of 48-inch pipeline, and 400 feet of 36 inch, CML&C steel force main. The package was awarded to LT Engineering with work beginning on February 19, 2004. The Contractor anticipates a construction period of 8 months with completion in November 2004.

**Bid Package No. 5 – SCADA System**

THIS PERIOD

This bid package includes the SCADA system and electrical improvements at all the basins. The 100 percent design was submitted, reviewed, and sent out for bid in January 2004. Because of the poor response, the package was re-bid in February 2004, and was awarded to Denboer Engineering on February 24, 2004. The contractor anticipates a construction period of 8 months with completion in November 2004.

**Bid Package No. 6 – MWD Turnout Design**

THIS PERIOD

This bid package covers the construction of three new MWD turnouts: CB-11TB and CB-15T on the Rialto Pipeline, and CB-18 on the Etiwanda Intertie near San Sevaine Channel. MWD provided various drawings, specifications, and other information needed to complete the three designs. This package was awarded to Griffith Construction with work beginning on February 4, 2004. The contractor anticipates a construction period of 6 1/2 months with completion in August 2004.

TO COME

**Bid Package No. 7 – Priority, Funding and Scope of Misc. Projects**

This bid package will complete miscellaneous projects not included in the previous bid packages. Among the projects being considered for this bid package are:

- Habitat Mitigation Area at RP-3
- Upland Basin Improvements
- Victoria Basin Improvements

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- Hickory Rubber Dam, Pump Station and Force Main
- Miscellaneous Projects

The various projects will be prioritized and those that offer the greatest benefits to groundwater recharge will be included in the bid package depending on available funding after construction of the other six bid packages. Designs for Bid Package 7 are complete and it is expected to be awarded by July 2004.

THIS PERIOD

**Groundwater Recharge Coordinating Committee (GRCC)**

The GRCC meets monthly to monitor and coordinate the Recharge Facilities Improvement Project, focusing on design issues, construction management, and operations manuals. Watermaster's FY2003-04 budget provides $440,000 for current operation and maintenance activities.

In addition to design review, the GRCC has initiated work on individual operations and maintenance plans for all the recharge basins, as well as obtaining regulatory agency approvals and permits.

## PROGRAM ELEMENT 3 – DEVELOP AND IMPLEMENT WATER SUPPLY PLAN FOR THE IMPAIRED AREAS OF THE BASIN; AND

## PROGRAM ELEMENT 5 – DEVELOP AND IMPLEMENT REGIONAL SUPPLEMENTAL WATER PROGRAM

*These program elements focus on the shift of production in the southern end of the Basin away from agricultural uses and toward urban uses. Without the OBMP, this land use conversion would result in a decrease in production in the southern end of the Basin, ultimately leading to rising water levels. If groundwater levels in the southern end of the Basin rise too high, then water may "spill" out of the Basin into the Santa Ana River. Such uncontrolled spillage caps the overall Safe Yield of the Basin. The Basin can be managed to avoid this possibility.*

*Directly tied to the threat of rising water levels in the southern area is the diminished desire of appropriators in the southern end of the Basin to pump water because of impaired water quality. The ability to compensate for the loss of agricultural production with increased appropriative production is inhibited because of these water quality concerns. Greater appropriative production in this area therefore requires water treatment, an issue addressed through the construction of desalter facilities.*

**The Chino I/II Desalters**

BACK-GROUND

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The Chino I Desalter was originally constructed by SAWPA to provide 8.1 million gallons per day (MGD) of product water using reverse osmosis treatment. The project also included extraction wells, raw water pipeline, and product water pipelines and pump stations.

THIS PERIOD

Chino I Expansion/Chino II Desalter. This expansion includes the construction of an additional 4.9 MGD of parallel treatment capacity (nitrate removal via ion exchange) at Chino I and 10 MGD of similar ion exchange at the Chino II Desalter. A construction contract was signed and construction is underway with completion scheduled for February 2005.

ON GOING

Chino I Desalter Other Improvements. Other facilities either under design or construction include three new extraction wells (construction completed), a raw water pipeline (construction started), a Chino Hills pump station and product water pipeline (construction underway), and a volatile organic compound (VOC) treatment system (construction started) ahead of the ion exchange treatment.

ON GOING

Chino II Desalter Other Improvements. Other facilities either under design or construction include nine new extraction wells (five under construction, four wells in design), two raw water pipelines (design phase), two product water pipelines (one under construction, one in design), and site improvements (construction underway).

All the projects underway to expand the Chino I/II Desalters should be completed by February 2005.

## PROGRAM ELEMENT 4 – DEVELOP AND IMPLEMENT COMPREHENSIVE GROUNDWATER MANAGEMENT PLAN FOR MANAGEMENT ZONE 1

*Program Element 4 details the steps undertaken by Watermaster to reduce or abate subsidence and fissuring in Management Zone 1.*

THIS PERIOD

**The MZ1 Technical Committee Meeting – March 10, 2004.** Committee representatives were informed of the status of the various efforts to implement the monitoring program (see Land Surface Monitoring of Program Element 1), and were briefed on the results of the aquifer stress test begun on October 1, 2003. The meeting focused on the GPS survey of the extensometer location, the Associated Engineers (AE) semi annual survey of the Ayala Park Array of benchmarks, the Vexcel cost estimate and schedule for the InSAR studies, and the extensometer results from the Comprehensive Pumping Test.

The elevation of the starting benchmark at the extensometer was established by Associated Engineers (AE) through the use of GPS receivers, and from there established the horizontal and vertical position of 24 monuments in the area of greatest subsidence. AE will continue to perform and report on their semi-annual (April and October) survey of the 24 monuments. These horizontal and vertical displacements will provide two-dimensional profiles of land surface deformation that then can be related to the vertical distribution of aquifer system compaction and expansion recorded by the extensometers.

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Vexcel provided a cost estimate and schedule for a decade (1993-2002) of InSAR data. As a "proof of concept," Vexcel analyzed the data for a single year (1993) and provided interferograms for three time periods using 1993 data.

Data from the extensometer from July 15, 2003 through March 1, 2004 were presented; and appeared to show excellent correlation with piezometric data from PA-7. A stress-strain diagram was developed for the drawdown (July 15-Nov 1, 2003) and recovery (after Nov, 2003) periods. The stress-strain diagram appears to show that deformation is primarily elastic compression and expansion within the aquifer system sediments, but complete results will not be available until July 15, 2004. Data from piezometer B recording at a depth of 500-1200' logs, were sporadically irregular and concern centered on possible leaking joints which allow water from the well column to leak out into the gravel layers at shallower elevations. Negotiations were opened with WDC, the well installer, to correct the leakage either with well packers or a "well-within-a-well."

**Voluntary Forbearance.** The City of Chino and the City of Chino Hills submitted certifications documenting their respective voluntary participation in forbearance of groundwater production. Through the end of May 2004, the City of Chino submitted documentation of pumping reductions of 1495 acre-feet toward its forbearance goal of 1,500 acre-feet for 2003/2004. The City of Chino Hills submitted documentation of forbearance of 667 acre-feet through January 2004.

| Agency | Forbearance through May 2004 | Forbearance Goal 2003/2004 |
|---|---|---|
| City Of Chino | 1495 acre-feet | 1,500 acre-feet |
| City Of Chino Hills | 667 acre-feet | 1,500 acre-feet |

TO COME **Pending Legal Actions Regarding Subsidence.** In its October 17, 2002 Order, the Court ordered Watermaster to keep the Court apprised of any legal actions that could question the Court's jurisdiction over subsidence. Watermaster is not aware at this time of any such actions. The hearing regarding the City of Chino's Paragraph 15 Motion concerning subsidence was continued by the court until August, 2004.

## PROGRAM ELEMENT 6 – DEVELOP AND IMPLEMENT COOPERATIVE PROGRAMS WITH THE REGIONAL WATER QUALITY CONTROL BOARD, SANTA ANA REGION (REGIONAL BOARD) AND OTHER AGENCIES TO IMPROVE BASIN MANAGEMENT; AND

## PROGRAM ELEMENT 7 – DEVELOP AND IMPLEMENT SALT MANAGEMENT PROGRAM

*The "water quality committee" as envisioned in the OBMP Implementation Plan has been formally constituted. Since the development of the OBMP, Watermaster has worked closely with the Regional Water Quality Control Board, the Department of Toxic Substances Control, and others to define water quality challenges and to refine the water quality management criteria in the Chino Basin. Watermaster continues to review water*

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*quality conditions in the Basin and to consider future water quality management activities beyond the Chino Basin desalting program.*

BACK-GROUND

**Water Quality Management.** In response to the results of RWQCB and Watermaster's groundwater quality monitoring programs (Program Element 1) Watermaster has refined its water quality monitoring to focus on the following key areas:

- Watermaster is identifying and characterizing water quality anomalies, such as the VOC anomaly south of the Ontario International Airport (OIA). Status Reports on each of the anomalies were developed by Watermaster and were presented to the Water Quality Committee for their review.
- Watermaster staff continues to participate in the process of developing TMDLs for Reach 3 of the Santa Ana River and other water bodies in the lower Chino Basin. No progress has been made during the last quarter because of the State budget crisis and the staffing issues at the RWQCB.
- Watermaster staff is assisting the RWQCB with research, monitoring, and the crafting of investigative and cleanup and abatement orders for potential dischargers involved with the OIA. Watermaster staff receives and reviews all reports that are produced by dischargers that are conducting investigations under order by the RWQCB and the Department of Toxic Substances Control (DTSC).

**Water Quality Committee**

THIS PERIOD

Watermaster staff and consultants continue to update our understanding of the contaminants of concern in the various plumes, and the extent of their migration. In addition, Wildermuth Environmental continued their analysis of the environmental records search performed by EDR. This consisted of a query of state and federal databases of known users and dischargers of potentially hazardous chemicals. Watermaster is analyzing the areal relationship of potential sources of perchlorate with downgradient impacted production wells. On March 30, 2004, Black & Veatch delivered their "Draft Technical Memorandum –Treatment Technology Review" which analyses current and emerging treatment technologies for specific contaminants of concern in the Chino Basin; including nitrates, perchlorate, arsenic, and specific VOCs.

With respect to the VOC plume at OIA, Wildermuth Environmental completed their data gathering effort at the RWQCB and prepared draft Letters of Notification/Cleanup and Abatement Orders for review by the RWQCB prior to their mailing to identified potential dischargers. At the Chino Airport VOC plume, Watermaster obtained permission from private well owners to release VOC water quality data to Tetra Tech, a consulting engineering firm performing quarterly groundwater monitoring of the VOC plume immediately southwest of the airport property. Tetra Tech is under contract to the County of San Bernardino, Department of Architecture and Engineering, the owner and operator of Chino Airport, and is attempting to determine the source of the VOC plume. Watermaster's water level and water quality monitoring program over the last several years has resulted in a robust database that can be used by Watermaster and other stakeholders in the basin to answer these kinds of questions.

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**Watermaster and Regional Board Propose TDS and Nitrogen Objectives to Promote Maximum Benefit of Waters Available to the Chino Basin**

BACK-GROUND

Watermaster staff has been working with the Total Dissolved Solids (TDS)/ Nitrogen (N) Task Force to revise the subbasin boundaries, and the TDS and N objectives for the Chino Basin to promote maximum beneficial use of waters in the Basin (as opposed to the Regional Board's current, more rigid anti-degradation based objectives). The maximum beneficial use approach will increase water supplies and lower costs over time while meeting water quality requirements. In December 2002, Watermaster proposed specific water-quality management zone boundaries, and N and TDS objectives for the Chino Basin to the RWQCB at a workshop regarding the Basin Plan update. The TDS/N Task Force and the RWQCB reacted favorably to the Watermaster proposal and incorporated Watermaster recommendations in the TDS/N Basin Plan Amendment dated November 21, 2003.

THIS PERIOD

The Basin Plan Amendment incorporating the sub-basin boundaries and maximum beneficial use concept was adopted by the RWQCB on January 24, 2004, (RWQCB Basin Plan Amendment, and Attachment to Resolution No. R8-2004-001). Watermaster staff immediately developed and submitted surface water and groundwater monitoring programs to the RWQCB on February 21, 2004. These monitoring programs will measure the progress of CBWM and IEUA in achieving the "maximum benefit" goal for TDS/TIN in the Chino and Cucamonga Basins. The Basin Plan amendment has been favorably reviewed by the State Water Resources Control Board and the Office of Administrative Law. The State Board will likely approve the Basin Plan amendment at their September 2004 meeting.

BACK-GROUND

**Cooperative Effort to Determine State of Hydraulic Control.** One outstanding issue regarding the Basin Plan changes was to develop a monitoring plan to evaluate the state of hydraulic control in the southern end of the Basin. Hydraulic control is one tool that can be used to maximize the safe yield of the Basin. Watermaster staff developed a monitoring program for OBMP purposes and described this effort in the Initial State of the Basin Report (October 2002). The execution of this monitoring program is included in Program Element 1. Watermaster and IEUA have collaborated with OCWD and the RWQCB to select existing wells and to site nine new multi-piezometer wells that will be used to monitor and assess the state of hydraulic control.

THIS PERIOD

In addition to being a core element of the OBMP, hydraulic control is a requirement of the Basin Plan Amendment. Watermaster, OCWD, and RWQCB staffs developed a conceptual monitoring program in June 2003 to assess the state of hydraulic control and to provide information to Watermaster to manage future production and recharge. The final work plan for the Hydraulic Control Monitoring Program was completed in May 2004, and implementation is now occurring. This program will change over time as new information is developed and will last for several years. The coordination and review of the hydraulic control monitoring data and the development of management programs to maintain hydraulic control have been added to Program Elements 6 and 7.

Watermaster and IEUA have committed to the construction of nine new multi-piezometer wells during fiscal year 2004/05. Watermaster filed an application for $250,000 from the Local Groundwater Assistance Fund, sponsored by the California Department of Water

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Resources (DWR). Watermaster received notice that the DWR will award the full $250,000 to Watermaster. This funding will support construction of two piezometric monitoring wells that, in addition to some existing wells, would be used for monitoring and assessing the state of hydraulic control. In addition to the DWR funding, IEUA and Watermaster have secured about $400,000 from the U.S. Bureau of Reclamation for new monitoring wells for the HCMP.

THIS PERIOD

Watermaster and IEUA obtained approval by OCWD and the RWQCB for the nine wells sites; completed draft plans and specifications for the new multi-piezometer monitoring wells; and began the site engineering/acquisition process for the nine wells. In addition, these agencies prepared and signed an "Agreement for Cooperative Efforts in."

TO COME

During the next reporting period, Watermaster/IEUA will obtain finalize bid documents, and select drillers for the nine wells.

### Salt Budget Tool To Establish TDS Objectives

BACKGROUND

Watermaster has developed a salt budget tool to estimate the current and future salt loads to the Basin and the salt benefits of the OBMP. This tool was used to establish TDS objectives for the northern part of the Basin based on maximum beneficial use of water available to the region. These projections were based on the water supply plan in the Implementation Plan and include alternative recycled water and State Project water recharge scenarios. Watermaster consultants prepared a letter report (February 20, 2004) describing the salt budget and the Chino Basin Maximum Benefit Commitment. The commitments require Watermaster and IEUA to take specific actions triggered by ambient water quality and other time-certain conditions. An implementation schedule is specified, with the RWQCB responsible for overseeing compliance.

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## PROGRAM ELEMENT 8 – DEVELOP AND IMPLEMENT GROUNDWATER STORAGE MANAGEMENT PROGRAM; AND

## PROGRAM ELEMENT 9 – DEVELOP AND IMPLEMENT STORAGE AND RECOVERY PROGRAM

*This section summarizes the work accomplished to date and the work planned over the next few months for the Chino Basin Dry Year Yield (DYY) and Storage and Recovery Programs. The DYY Program is a conjunctive use program between the Metropolitan Water District of Southern California (MWDSC) and several Basin appropriators, which would develop a maximum of 100,000 acre-feet of storage. These Programs also explore the potential for using up to 500,000 acre-feet of storage capacity.*

BACK-GROUND

**Completed Preliminary Design Report.** The first draft of the DYY Preliminary Design Report was completed in July 2003 and submitted to Watermaster. The DYY Program documentation is organized into four volumes: Volumes I and II, prepared by Black &

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Veatch, comprise the Preliminary Design Report (PDR). Volume I describes the background information and design objectives of the Program, while Volume II describes the facilities to be designed to help the agencies meet their shift obligation. Volume III presents the groundwater modeling report developed by Wildermuth Environmental, Inc., and Volume IV contains the CEQA Findings of Consistency environmental documentation prepared by Tom Dodson and Associates.

ON GOING

**DYY Shift Obligation**. Participants in the DYY Program will be required to reduce (shift) their imported water usage by a predetermined amount during a dry year. Each participating agency will have a specific shift obligation that, when added together, will provide MWDSC with 33,000 acre-feet of dry year yield. The shift obligations were determined through meetings and correspondence among IEUA, Watermaster, Black & Veatch, and representatives from each participating agency.

The nine participating agencies are as follows:

| | |
|---|---|
| • City of Chino | • Monte Vista Water District (MVWD) |
| • City of Chino Hills | • City of Ontario |
| • Cucamonga Valley Water District (CVWD) | • City of Pomona |
| • City of Upland | |
| • Jurupa Community Services District (JCSD) | |

**Facility Requirements and Site Selection**. A preliminary screening of potential sites identified the most feasible locations for the DYY Program facilities. The information was presented to the agencies and a final selection was made. The Program facilities consist of five new ion exchange (IX) facilities, expansion of two existing IX facilities, construction of seven new non-water quality impaired wells, and two new perchlorate wellhead treatment facilities. The new wellhead IX facilities would contribute approximately 18,000 acre-feet of dry year yield, while the new well facilities would contribute approximately 15,000 acre-feet of additional yield. The total capital cost for the facilities is estimated to be $38 million. MWDSC will contribute approximately $27 million. The Groundwater Storage Program Funding Agreement between MWDSC, IEUA, Three Valleys Municipal Water District (TVMWD), and Watermaster was signed in July 2003.

ON GOING

**Final Design of PDR Facilities**. The designs for the facilities outlined in the PDR are either under way, completed, or will commence shortly. All design documents are scheduled to be completed by September 2004.

BACK-GROUND

**Final Approval of DYY Storage Account**. Pursuant to Article X of Watermaster's Rules and Regulations, IEUA submitted an Application to enter into a Storage and Recovery Program Storage Agreement. This Application was approved unanimously by all Pools and received unanimous approval from the Advisory Committee and Board on October 23, 2003. Watermaster and IEUA developed a storage agreement pursuant to the Application and processed that agreement through the Watermaster approval process in March 2004. The agreement was submitted to the Court for approval. Prior to Court approval, MWDSC is utilizing its existing Trust Storage Account with the intention of

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transferring its water stored in the Trust Account into the DYY account upon approval of the Storage Agreement.

BACK-GROUND

**Groundwater Modeling**. The new Chino Basin groundwater model was completed and the draft modeling report was submitted to Watermaster in July 2003. In addition to evaluating the effects of the DYY program on the Basin, the model was used to:

- Develop draft future replenishment and wet water recharge criteria based on requirements described in the Section 7.1b of the Watermaster Rules and Regulations regarding the balance of recharge and discharge. (See Wildermuth, Analysis of Supplemental Water Recharge Pursuant to the Peace Agreement. To be filed with the Court.)
- Evaluate the cumulative effects of transfers among the Parties as described in Section 9.3 of the Watermaster Rules and Regulations. (See Wildermuth, Evaluation of the Cumulative Effects of Transfers Pursuant to the Peace Agreement. To be filed with the Court.)
- Describe pumping patterns in Management Zone 1 that will not reduce piezometric levels below current conditions.

These management criteria were incorporated into the DYY program. The results of this work were presented to the Pool Committees, Advisory Committee, and the Watermaster Board in June and August 2003, and the final report was submitted in September 2003.

BACK-GROUND

**Engineering Review and Determination of the Operational Storage Requirement and Safe Storage.** The Operational Storage Requirement was defined in the Peace Agreement as part of the storage in the Chino Basin "necessary to maintain the safe yield" of the Basin (Peace Agreement, Exhibit B – Implementation Plan, page 37). Safe storage is the maximum storage in the Basin that can occur without significant water quality and high groundwater related problems. The draft results of this work were presented to the Pool Committees, Advisory Committee, and the Watermaster Board in August 2003.

ON-GOING

**Other Uses of the Groundwater Model in the OBMP Implementation.** The groundwater model is currently being used to investigate alternative management strategies including reduced storage in the eastern part of the basin, expanded storage and recovery programs, and assessing hydraulic control with various appropriator proposed pumping alternatives in the southern Chino Basin.

## CONCLUSION

THIS PERIOD

This has been an active reporting period for Watermaster, with major activities on a number of issues:

- Construction on Bid Packages 1 and 2 of the Recharge Facilities Improvement Project was completed, and construction on Bid Packages 3-6 is progressing on

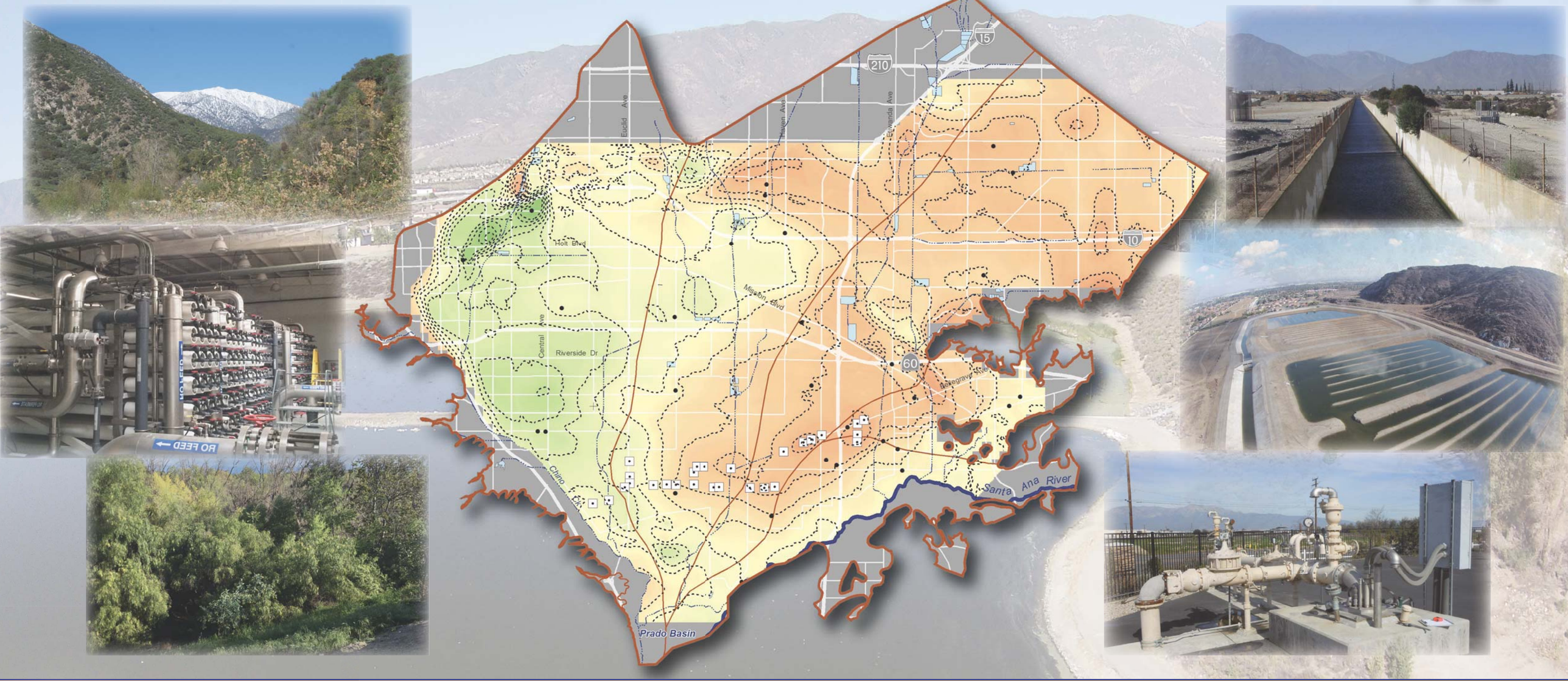
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schedule. Demonstration projects for recharge in College Heights and Brooks Basins were undertaken.

- The groundwater level and quality monitoring programs have been reorganized to better support new initiatives, such as MZ1, HCMP, Nitrogen Loss, and Desalter Expansion. Selected wells are being equipped with automatic measuring and recording devices to continually collect water level data at wells at frequent intervals. Current field sampling and laboratory analyses have transitioned to the new monitoring program.
- Updated status reports were developed for Chino Basin plumes at Kaiser, GE Flat Iron, GE Test Cell, OIA and Chino Airport. An initial evaluation of potential perchlorate sources and plumes was undertaken based on an EDR database.
- Data from the Ayala Park Extensometer indicated that deformation within the aquifer system sediments has been primarily elastic compression and expansion during the 2003 pumping season and the 2003/04 recovery season. Additional test protocols are being developed for FY2004-05.
- The semi-annual benchmark survey was completed in April 2004, and the "proof of concept" InSAR study was successfully concluded.

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# Chino Basin Optimum Basin Management Program
# 2016 State of the Basin Report




WEI
WILDERMUTH ENVIRONMENTAL, INC.

*prepared for*

**Chino Basin Watermaster**

*June 2017*

CHINO BASIN WATERMASTER

# 2016 State of the Basin Report

## June 2017

***Prepared for:***

***Prepared by:***

WILDERMUTH ENVIRONMENTAL, INC.

Front cover left photo collage – top to bottom: Mount Baldy as seen from San Antonio Canyon, Chino-I Desalter treatment facility, Santa Ana River at River Road. Front cover center imagery: Map showing: the Chino Basin hydrologic boundary, the Santa Ana River, the Chino Basin desalter wells, and the groundwater level change from spring 2000 to spring 2016. Front cover right photo collage – top to bottom: San Antonio Creek Channel near W. Arrow Route, RP3 recharge facility, Chino-II Well 6. Front cover background photo: Victoria recharge facility. Back cover photo: San Gabriel Mountains as seen from Day Creek Canyon.

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## Acronyms, Abbreviations, and Initialisms

| | | | | | |
|---|---|---|---|---|---|
| µg/L | micrograms per liter | ft-bgs | feet below ground surface | PE | Program Element |
| 1,1-DCE | 1,1-dichloroethene | ft-brp | feet below reference point | PRISM | Parameter-Elevation Regressions on Independent Slope Model |
| 1,2,3-TCP | 1,2,3-trichloropropane | FY | fiscal year | PRP | potentially responsible party |
| 1,2-DCA | 1,2-dichloroethane | GE | General Electric | ROD | Record of Decision |
| 2013 RMPU | 2013 Amendment to the 2010 Recharge Master Plan Update | GIS | Geographic Information System | RP | Regional Plant |
| acre-ft | acre-feet | GLMC | Ground-Level Monitoring Committee | RWQCB | Regional Water Quality Control Board |
| acre-ft/yr | acre-feet per year | GMZ | Groundwater Management Zone | SARWC | Santa Ana River Water Company |
| ASR | Aquifer Storage Recovery | HCMP | Hydraulic Control Monitoring Program | SWRCB | State Water Resources Control Board |
| AWQ | ambient water quality | IEUA | Inland Empire Utilities Agency | TCE | trichloroethene |
| Basin Plan | Water Quality Control Plan for the Santa Ana River Basin | IMP | Interim Monitoring Program | TDS | total dissolved solids |
| BM | bench mark | InSAR | Synthetic Aperture Radar Interferometry | TOC | Total Organic Carbon |
| CAO | Cleanup and Abatement Order | JCSD | Jurupa Community Services District | UCMR | Unregulated Chemicals Requiring Monitoring |
| CBDC | Chino Basin Data Collection | KM | kilometer | USGS | US Geological Survey |
| CCWF | Chino Creek Well Field | MCL | maximum contaminant level | VOC | volatile organic compound |
| CCWRF | Carbon Canyon Water Reclamation Facility | mg/L | milligrams per liter | Watermaster | Chino Basin Watermaster |
| CCX | Chino Creek Extensometer | MSL | Milliken Sanitary Landfill | WEI | Wildermuth Environmental, Inc. |
| CDA | Chino Basin Desalter Authority | MVWD | Monte Vista Water District | WQS | Water Quality Standard |
| CDFM | cumulative departure from mean | MWDSC | Metropolitan Water District of Southern California | XRef | anonymous well reference ID |
| CIM | California Institution for Men | MZ | Management Zone | | |
| COPC | constituent of potential concern | NAWQA | National Water Quality Assessment Program | | |
| DDW | California State Board Division of Drinking Water | ND | non-detect | | |
| DLR | detection limit for reporting | NDMA | N-nitrosodimethylamine | | |
| DTSC | California Department of Toxic Substances Control | NL | Notification Level | | |
| DWR | California Department of Water Resources | $NO_3$ - N | nitrate expressed as nitrogen | | |
| DYY | Dry Year Yield | NPL | National Priorities List | | |
| EDM | Electronic Distance Measurement | OBMP | Optimum Basin Management Program | | |
| EPA | US Environmental Protection Agency | OIA | Ontario International Airport | | |
| ET | Evapotranspiration | PBHSP | Prado Basin Habitat Sustainability Program | | |
| $ET_o$ | Potential Evapotranspiration | PBMZ | Prado Basin Management Zone | | |
| ft | feet | PCE | tetrachloroethene | | |

The Chino Basin Optimum Basin Management Program (OBMP) was developed pursuant to the Judgment (*Chino Basin Municipal Water District v. City of Chino, et al.*) and a ruling by the Court on February 19, 1998 (WEI, 1999). The OBMP maps a strategy that provides for the enhanced yield of the Chino Basin and seeks to provide reliable, high-quality, water supplies for the development that is expected to occur within the Basin. The OBMP Implementation Plan is the court approved governing document for achieving the goals defined in the OBMP. The OBMP Implementation Plan includes the following Program Elements (PE):

*Program Element 1 – Develop and Implement a Comprehensive Monitoring Program*

*Program Element 2 – Develop and Implement a Comprehensive Recharge Program*

*Program Element 3 – Develop and Implement a Water Supply Plan for the Impaired Areas of the Basin*

*Program Element 5 – Develop and Implement a Regional Supplemental Water Program*

*Program Element 4 – Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1*

*Program Element 6 – Develop and Implement Cooperative Programs with the Regional Board and Other Agencies to Improve Basin Management*

*Program Element 7 – Develop and Implement a Salt Management Program*

*Program Element 8 – Develop and Implement a Groundwater Storage Management Program*

*Program Element 9 – Develop and Implement Conjunctive Use Programs*

A fundamental component in the implementation of each of the OBMP PEs is the monitoring performed in accordance with *PE 1*, which includes the monitoring of basin hydrology, pumping, recharge, groundwater levels, groundwater quality, and ground-level movement. The monitoring is performed by basin pumpers, Chino Basin Watermaster (Watermaster) staff and other cooperating entities. Watermaster staff collects and compiles the monitoring data into relational databases to support data analysis and reporting.

As a reporting mechanism and pursuant to the OBMP Phase 1 Report, the Peace Agreement and the associated OBMP Implementation Plan, and the November 15, 2001 Court Order, Watermaster staff prepares a *State of the Basin Report* every two years. In October 2002, Watermaster completed the *Initial State of the Basin Report* (WEI, 2002). The baseline for this report was on or about July 1, 2000—the point in time that represents the adoption of the Peace Agreement and the start of OBMP implementation. Subsequent *State of the Basin Reports* (WEI, 2005a; 2007a; 2009a; 2011c; 2013a; 2015b) were used to:

- describe the then-current state of the Basin with respect to hydrology, production, recharge, groundwater levels, groundwater quality, and ground-level movement; and
- demonstrate the progress made since July 1, 2000 related to activities such as: production meter installation, desalter planning and engineering, recharge assessments, recharge master planning, hydraulic control, expansion of monitoring programs for groundwater levels and quality, and the monitoring and management of land subsidence.

This 2016 *State of the Basin Report* is an atlas-style document. It consists of detailed exhibits that characterize current Basin conditions related to hydrology, groundwater production and recharge, groundwater levels, groundwater quality and ground-level monitoring as of the end of fiscal year (FY) 2015-2016. In many of these exhibits, the data are characterized as they relate to the Management Zones (MZs) defined in the OBMP or the Groundwater Management Zones (GMZs) defined by the Santa Ana Regional Water Quality Control Board (RWQCB) for the purposes of managing groundwater quality. Exhibit 1-1 is a map of these management boundaries and how they relate to each other. Exhibit 1-2 shows the water service area boundaries for the major municipal producers in the Chino Basin related to the OBMP MZs.

The exhibits in this report are grouped into the following sections:

*Hydrologic Conditions:* This section contains exhibits that characterize the state of the Chino Basin as it relates to land use, hydrology and climate (e.g. precipitation, temperature and evaporation). This information provides a context for understanding the other changes in the Basin that are managed through the OBMP.

*Basin Production and Recharge:* This section contains exhibits that characterize groundwater production and recharge over time and space, including progress towards the expansion of the Chino Basin Desalters and the Chino Basin Groundwater Recharge Program. This information is useful in understanding historical changes in groundwater levels and quality.

*Groundwater Levels:* This section contains exhibits that characterize groundwater flow patterns and the change in groundwater elevations since 2000. The section includes groundwater-elevation maps for spring 2000, spring 2014, and spring 2016; and groundwater-elevation change maps for 2000 to 2016 and 2014 to 2016. The section also includes characterizations of the time history of groundwater levels throughout the Chino Basin and correlates the change in groundwater levels to observed precipitation, recharge, and pumping patterns.

*Groundwater Quality:* This section contains exhibits that characterize the groundwater quality across the Chino Basin. The constituents characterized include TDS, nitrate, and other constituents of concern, such as volatile organic compounds. This characterization includes maps of the spatial distribution of constituent concentrations, updated delineations of known point-source contaminant plumes across the Basin, and time-series charts that characterize TDS and nitrate concentration trends in the OBMP MZs since 1972.

*Ground-Level Monitoring:* This section contains exhibits that characterize the history of land subsidence and ground fissuring and the current state of ground-level movement in the Chino Basin as understood through the Watermaster's ground-level monitoring program. This characterization includes an assessment of ground-level movement in each of the five Areas of Subsidence Concern.

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

San Antonio Ck

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Foothill Blvd

Day Ck

Haven Ave

Euclid Ave

Central Ave

Holt Blvd

Eliwanda Ave

San Sevaine Ck

MZ1

MZ2

MZ3

MZ4

MZ5

Chino-North

Chino-East

Chino-South

Prado Basin

Mission Blvd

Riverside Dr

Cucamonga Ck

Jurupa Mountains

Bellegrave Ave

Limonite Ave

Chino Ck

Puente Hills

La Sierra Hills

Van Buren Blvd

Arlington Basin

Temescal Basin

15

210

215

71

10

91

While the Chino Basin is considered one basin from geologic and legal perspectives, the OBMP delineated five management zones (MZs) based on groundwater flow systems that function as distinct hydrologic units. Each MZ has unique hydrology and water resource management activities that have limited impacts on the other MZs. Management, monitoring and reporting activities for these management zones are discussed throughout this State of the Basin Report.

The Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) defines groundwater management zones (GMZs) for managing water quality to protect beneficial uses. A 2004 Basin Plan Amendment to the Basin Plan that updated the region's Salt and Nutrient Management Plan included antidegradation water quality objectives for total dissolved solids (TDS) and nitrate as nitrogen (hereafter, nitrate). The antidegradation GMZs boundaries map to the five Chino Basin MZs, excluding the Prado Basin MZ. Also included in the Basin Plan were alternative, less-stringent "maximum-benefit" objectives for TDS and nitrate for the "Chino-North" GMZ, which is a GMZ that combines OBMP MZ1, MZ2, and MZ3 north of the Prado Basin. The adoption of the maximum-benefit objectives enabled the reuse and recharge of recycled water throughout the Chino Basin and saved the Watermaster Parties millions of dollars in mitigation requirements that would have occurred under the low-TDS antidegradation objectives. The ongoing application of the maximum-benefit objectives is contingent upon the implementation of monitoring and water quality improvement programs. These projects and programs are termed the "Chino Basin maximum-benefit commitments" and are listed in Table 5-8a of the Basin Plan:

http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/docs/chapter5.pdf

OBMP Management Zones

Maximum Benefit Management Zones

MZ1

MZ2

MZ3

MZ4

MZ5

Chino North

Chino East

Prado Basin

Chino South

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

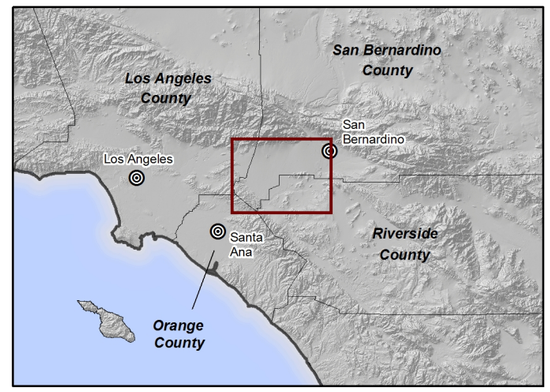
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM

Date: 6/5/2017

Document Name: Exhibit_1-1_ChinoGWbasins

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin

*Introduction*

**Chino Groundwater Basin**

*OBMP and Maximum Benefit Management Zones*

**Exhibit 1-1**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Golden State Water Company

San Antonio Water Company

Cucamonga Basin

Cucamonga Fault Zone

City of Upland

Claremont Basin

Red Hill Fault

Cucamonga Valley Water District

Indian Hill Fault

Pomona Basin

San Jose Fault

Fontana Water Company

Marygold Mutual Water Company

City of Pomona

Monte Vista Water District

West Valley Water District

City of Ontario

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Puente Hills

City of Chino

Santa Ana River Water Company

Chino Fault

City of Chino Hills

Chino Hills

Jurupa Community Services District

City of Norco

La Sierra Hills

Arlington Basin

Temescal Basin

El Sobrante de San Jacinto

West Valley Water District

Rialto-Colton Basin

Barrier J

Lytle Ck

Loma Linda Fault

San Jacinto Fault

Rialto-Colton Fault

Foothill Blvd

Holt Blvd

Riverside Dr

Limonite Ave

Mission Blvd

Bellegrave Ave

Van Buren Blvd

Victoria Ave

Santa Ana River

Euclid Ave

Haven Ave

Day Ck

Etiwanda Ave

Sierra Ave

Riverside Ave

Central Ave

San Antonio Ck

Cucamonga Ck

San Sevaine Ck

Chino Ck

15 10 71 210 215 60 91

OBMP Management Zones

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

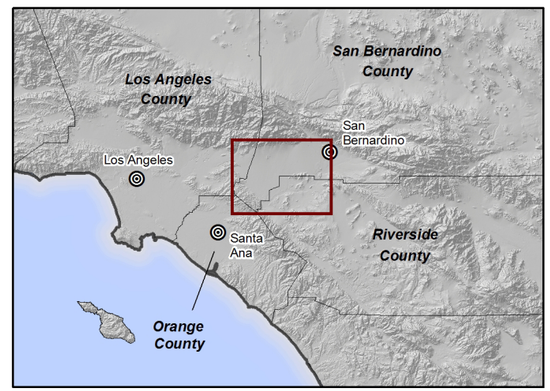
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/26/2017
Document Name: Exhibit_1-2_WSA

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Introduction*

# Water Service Areas of the Major Municipal Producers in the Chino Basin

**Exhibit 1-2**

This section contains six exhibits that illustrate important hydrologic concepts to aid in the understanding of contemporary water management issues in the Chino Basin.

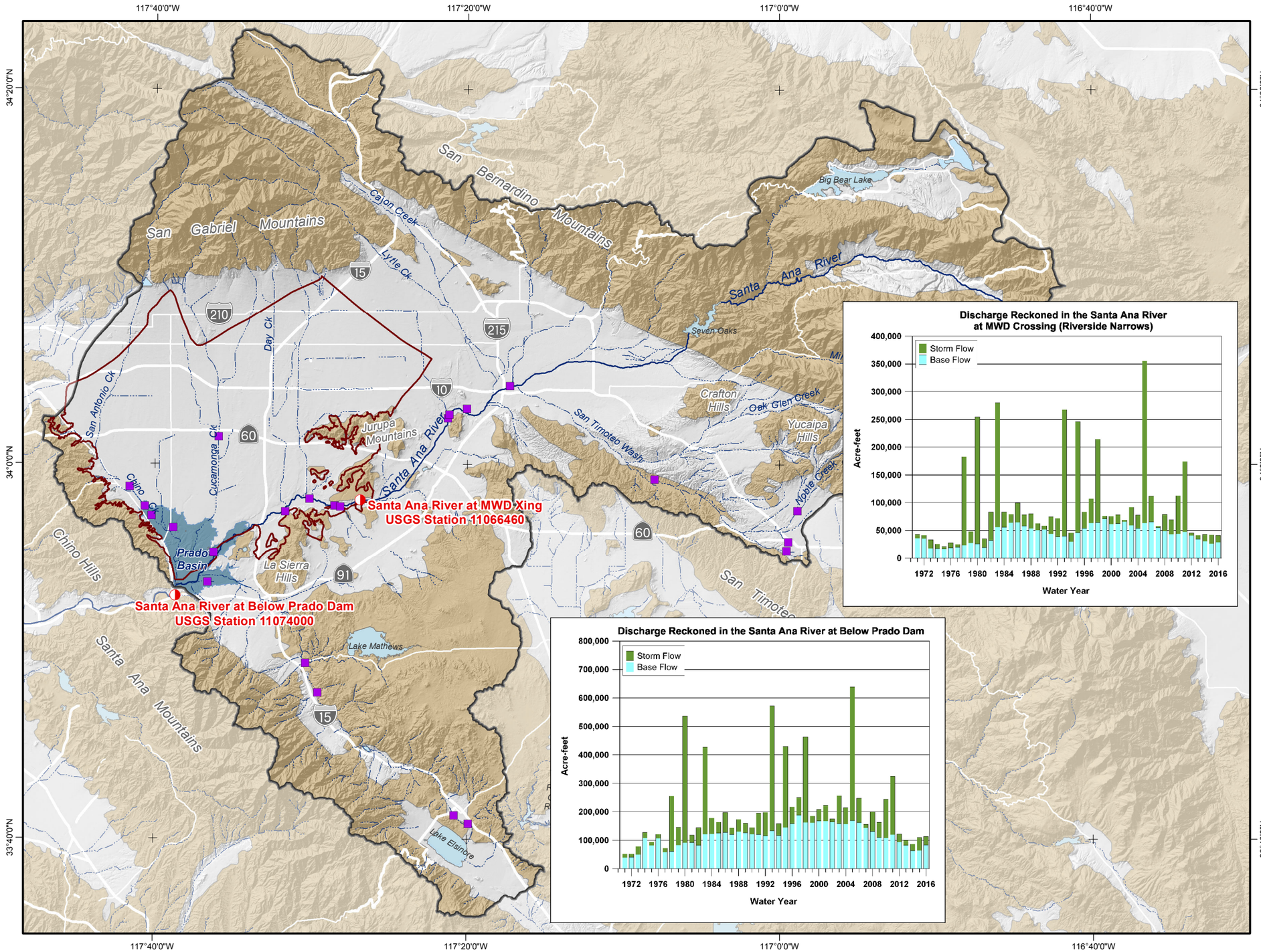
Significant hydrologic investigations have been completed in the Chino Basin that have: resulted in increases in stormwater recharge (WEI, 2013b); produced estimates of annual net recharge and Safe Yield (WEI, 2015d); and developed the relationship of desalter production and desalter-induced recharge (WEI, 2015d). The information presented herein was mostly drawn from these investigations and some information is being published here for the first time. Apart from Exhibit 2-1, each exhibit contains text that describes and interprets the m and charts included in them.

Exhibit 2-1 shows the location of the Chino Basin within the Upper Santa Ana River Watershed and the location of two key stream-gaging stations in the Chino Basin. Daily discharge data measured at the USGS gaging stations on the Santa Ana River at Riverside Narrows (*Santa Ana River at MWD Xing*) and at Prado Dam (*Santa Ana River at Below Prado Dam*) characterize the discharge of the Santa Ana River as it enters and exits the Chino Basin. The relationship of groundwater management activities in the Chino Basin and streambed infiltration of the Santa Ana River discharge was incorporated into the Chino Basin OBMP. The Santa Ana River discharge is composed of storm flow and base flow. Storm flow is discharge that is the direct result of runoff from precipitation. Base flow is the difference between the total measured discharge and storm flow, and it consists of discharge from wastewater treatment plants and rising groundwater. The locations of the USGS gaging stations and the wastewater treatment plant discharge locations are shown in this exhibit. Base flow is a significant source of recharge to the Chino Basin.

The annual discharge hydrographs for the Santa Ana River at Riverside Narrows and at Prado Dam are also shown in this exhibit. The annual discharge values have been divided into storm and base flows. The base flow time series tends to increase over time following the conversion of land uses to urban and industrial uses until the onset of the great recession in 2008. Base flow increases with land uses conversions to urban and industrial uses during this period because the improved land uses were sewered and the resulting wastewater was discharged to the River. After 2008, base flow declined due to decreased water use resulting from the recession and drought; and, specific to the Chino Basin, due to decreased wastewater discharge to the River as a result of increasing recycled water reuse.

The total Santa Ana River discharge entering the Chino Basin at the Riverside Narrows has matched or exceeded 50,000 acre-ft/yr since 1983 except for 1994 and after 2010. Part of the decrease in base flow at the Riverside Narrows after 2010 is due to a decrease in recharge in the Riverside Basin upstream of the Riverside Narrows and groundwater pumping in the Riverside Basin, the combined effect of which is the decrease in rising groundwater just upstream of the Riverside Narrows.

The total Santa Ana River discharge exiting the Chino Basin at Prado Dam has matched or exceeded 100,000 acre-ft/yr since 1983 except for 1994 and after 2010. The base flow leaving the Chino Basin is about twice the base flow entering the Basin due to the combined wastewater treatment plant discharges of the Cities of Corona and Riverside, the Inland Empire Utilities Agency (IEUA) and the West Riverside County Wastewater Reclamation Authority. The decrease in base flow exiting the Basin after 2005 is due to: the decrease in baseflow entering the Basin at the Riverside Narrows; decreases in wastewater discharges due to water conservation and recycled water reuse; and increased streambed infiltration caused by increased groundwater production in the southern Chino Basin. The increase in streambed infiltration after 2000 is defined to be desalter-induced recharge. The increase in desalter-induced recharge is a key component of the OBMP.




USGS Stream-gaging Station

Wastewater Treatment Plant Discharge Locations

Santa Ana River Watershed Tributary to Prado Dam (Upper Watershed)

Chino Basin Hydrologic Boundary

Streams & Flood Control Channels

Santa Ana River

Lakes and Reservoirs

Prado Basin

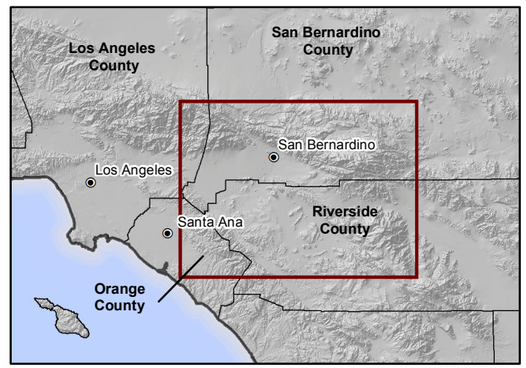
## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks




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Author: GAR
Date: 6/27/2017
Document Name: Exhibit_2-1_SARWtrsd

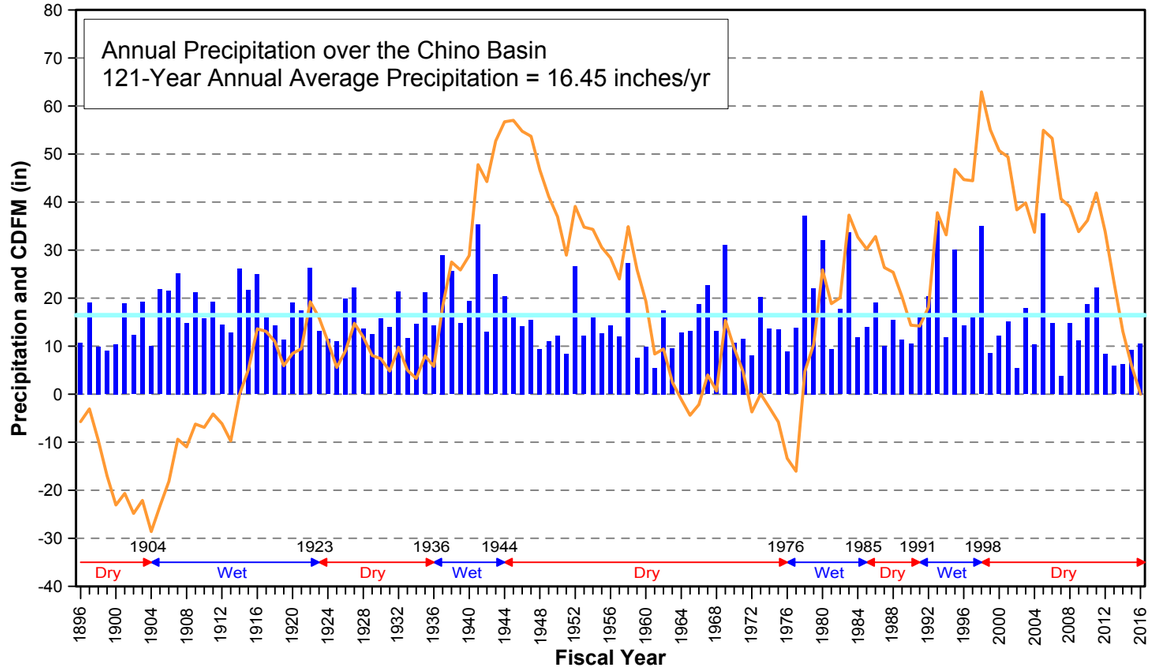
0 5 10 15 Miles

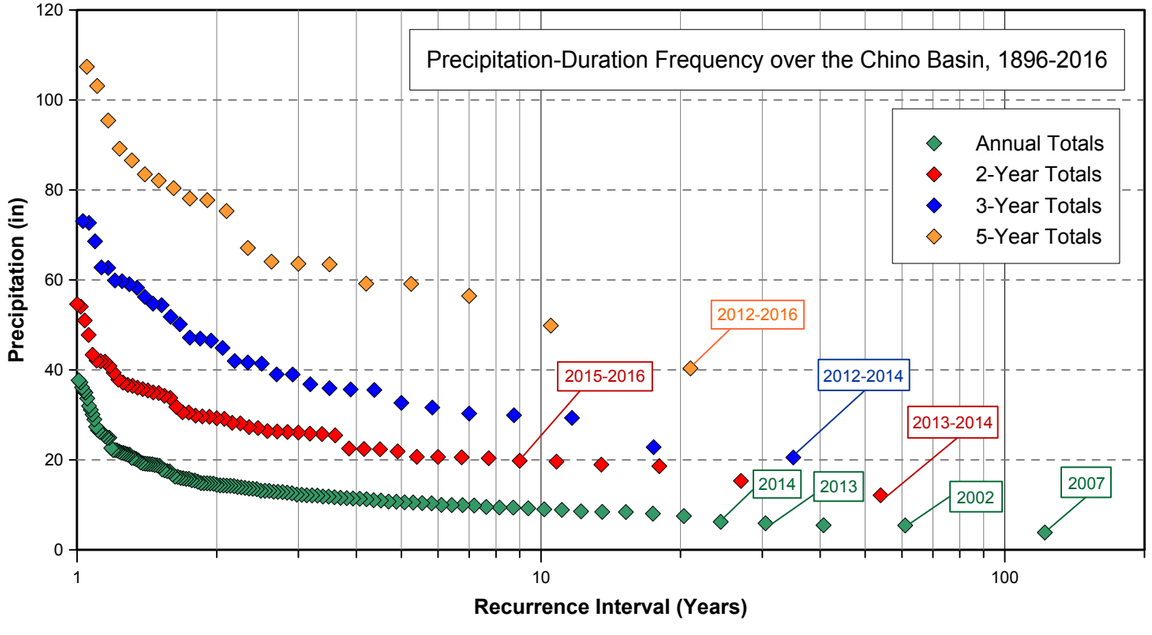
0 10 20 KM

2016 State of the Basin
Hydrologic Conditions

# Santa Ana River Watershed Tributary to Prado Dam

## Exhibit 2-1




Precipitation is a major source of groundwater recharge for the Basin through the deep infiltration of precipitation and applied water and stormwater recharge in streams and recharge facilities. The chart on the upper left contains the long-term precipitation time series for average annual precipitation. These annual precipitation estimates are based on an areal average over the Chino Basin created from gridded monthly precipitation estimates prepared by the PRISM Climate Group covering the period 1895 through 2016. The chart contains the fiscal year precipitation totals, a horizontal bar indicating the long-term average annual precipitation of 16.45 inches, and the cumulative departure from mean (CDFM) precipitation. The CDFM plot is a useful way to characterize the occurrence and magnitude of wet and dry periods: positive sloping segments (trending upward from left to right) indicate wet periods and negative sloping segments (trending downward from left to right) indicate dry periods. The wet and dry periods are labeled at the bottom of the chart. The ratio of dry years to wet years is about three to two. That is, for every ten years, about six years will have below average precipitation and four years will have greater than average precipitation. That said, 1945 through 1976 was a 32-year dry period, punctuated by only five years of above average precipitation; a dry-to-wet year ratio of about six to one. The period 1999 through 2016 was an 18-year dry period punctuated with three wet years; a dry-to-wet year ratio of also about six to one. Dry periods tend to be long and very dry and wet periods tend to relatively shorter and very wet (see for example 1938 through 1944 and 1978 through 1983).

The chart on the lower left contains annual precipitation frequency estimates for durations of one, two, three and five-year periods. A recurrence interval is the average number of periods between recurrence of a period totaling equal to or less than the total given precipitation value. For example, 2013-2014, the driest two-year span on record, has a recurrence interval of 54 years, which means that based on the historical data, a two-year period with less than or equal to 12 inches will only occur once every 54 years. The chart shows that four of the five driest years on record occurred in the current 1999 through 2016 dry period; and that the driest consecutive two, three and five-year periods have all occurred during the current drought. The OBMP implementation period corresponds with this drought.

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Date: 06/27/2017
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Annual Precipitation (inches)

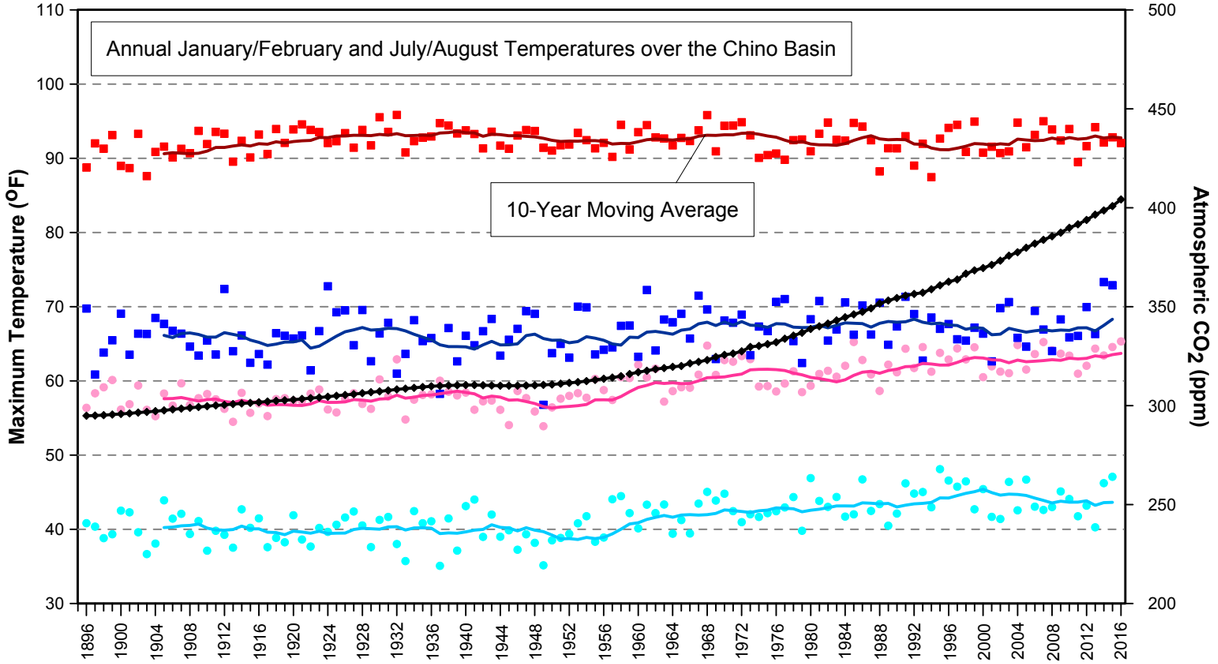
Long-Term Average Annual Precipitation (inches)

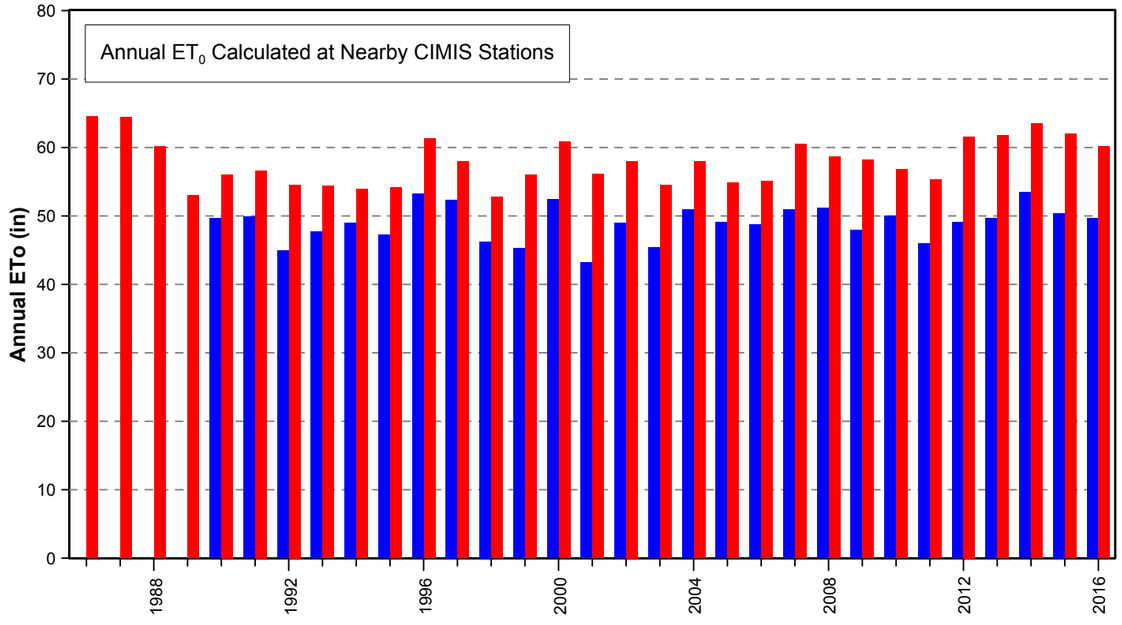
Cumulative Departure from Mean Precipitation

**2016 State of the Basin**
Hydrologic Conditions

## Characterization of Long-Term Annual Precipitation over the Chino Basin

**Exhibit 2-2**




Surface temperatures have been increasing since about 1950. The chart on the upper left shows the time history of the average maximum and minimum temperature for the combined months of January and February and the combined months of July and August. The data used to generate this chart are based on observed daily maximum and minimum temperatures converted to monthly statistics and interpolated by the PRISM Climate Group to produce a gridded monthly maximum and minimum temperature estimates. Also shown on this chart is a complete record of atmospheric carbon dioxide concentrations assembled from multiple sources:

- Values prior to 1959 are estimated from an analysis of the Law Dome DE08 and DE08-2 ice cores in Antarctica - Acquired from the Carbon Dioxide Information Analysis Center - http://cdiac.ornl.gov/trends/co2/law dome.html (Accessed on June 6, 2017.)

- Values after 1959 are from values directly measured at the Mauna Loa Observatory in Hawaii - Acquired from the National Oceanic and Atmospheric Association's Earth Systems Research Laboratory - https://www.esrl.noaa.gov/gmd/ccgg/trends/full.html (Accessed on June 5, 2017.)

The January-February and July-August maximum temperature time series do not appear to have long-term increasing or decreasing trend. The January-February and July-August minimum temperature time series do not appear have a long-term increasing or decreasing trend until about 1950 after which there is a clear increasing trend with the temperature in both time series increasing about 4 to 5 degrees Fahrenheit over the period 1950 through 2016. The increase in minimum temperatures during this period appear to correlate with the increase in atmospheric carbon dioxide. The significance of the increasing temperature to Chino Basin groundwater management lies in the temperature influence on evapotranspiration (ET): ET increases with increasing temperature. Increasing temperature will increase total water demand and potentially decrease the deep infiltration of precipitation and applied water, which is a significant contributor to net recharge and safe yield of the Chino Basin. Increasing water demand could also cause an increase in groundwater production and demand for replenishment water, which could either come from imported water or groundwater storage.

The chart on the lower left shows the annual potential ET ($ET_0$) as computed at the California Irrigation Management Information System for stations in Pomona and Riverside. The reported ET values are computed from measurements of solar radiation, temperature, humidity and wind speed. $ET_0$ is not directly measured. It is unclear from these time series data that $ET_0$ is increasing. The trends in $ET_0$, when they become more apparent will need to be included in future hydrologic evaluations of the Chino Basin.

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Wildermuth Environmental, Inc.

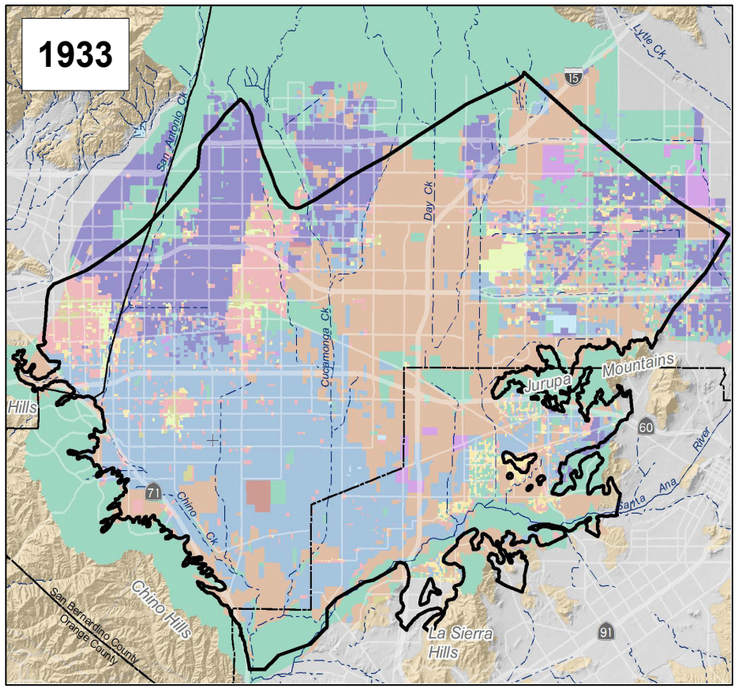
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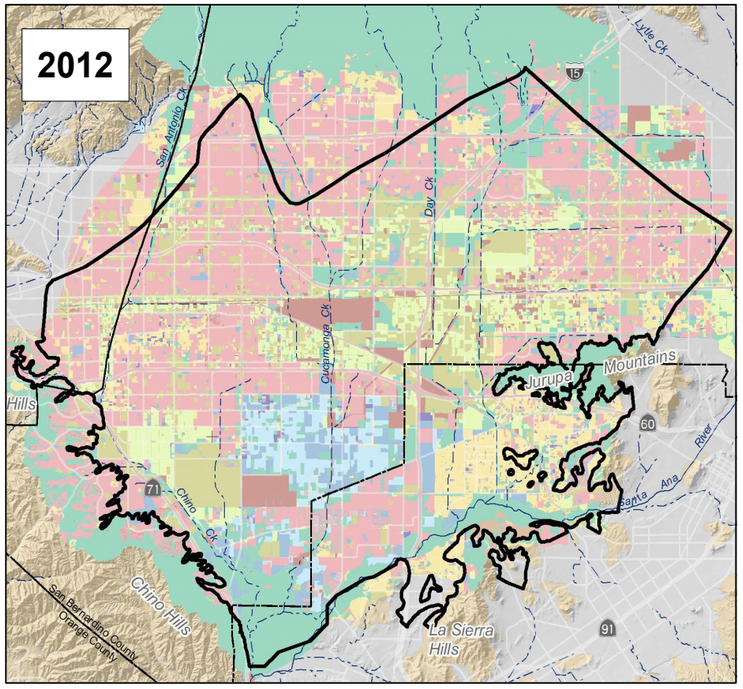
- Average Max Temp (Jul-Aug)
- Average Min Temp (Jul-Aug)
- Average Max Temp (Jan-Feb)
- Average Min Temp (Jan-Feb)
- Annual Average Measured/Estimated Atmospheric $CO_2$ Concentration - Various Sources
- Annual $ET_0$ at Pomona Station
- Annual $ET_0$ at UCR Station



**Long-Term Temperature and $ET_0$ in the Chino Basin**

**Exhibit 2-3**

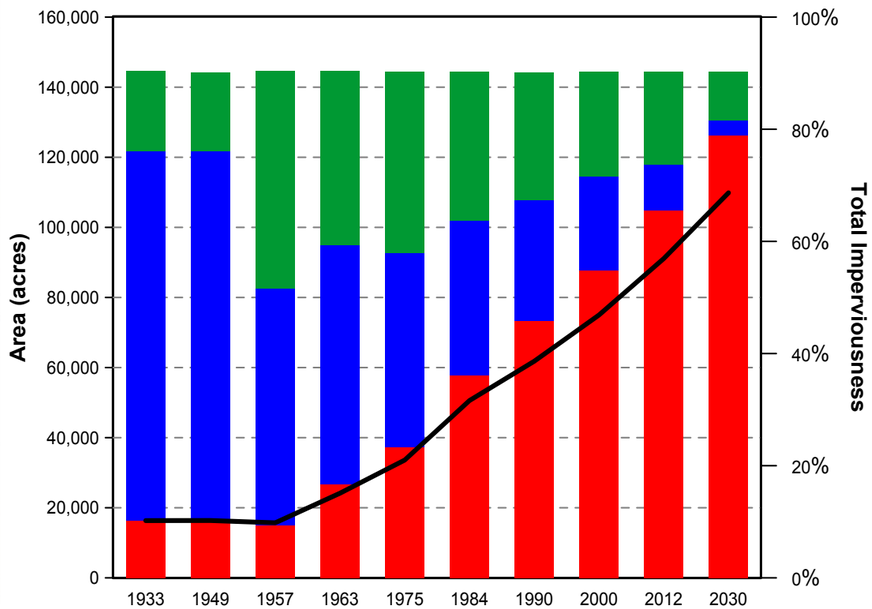



**Land Use Categories**

- Non-Irrigated Field Crops, Pasture, Fruit and Nuts
- Irrigated Field Crops, Pasture, Fruit and Nuts
- Irrigated and Non-Irrigated Citrus
- Irrigated Vineyard
- Non-Irrigated Vineyard
- Dairies and Feedlots
- Urban Residential
- Special Impervious
- Native Vegetation
- Low Density Urban Residential
- Commercial
- Industrial

**Historical and Projected Disctribution of Land Use in the Chino Basin**




The watershed surface that is tributary to and overlies the Chino Basin and the water management practices over this surface have changed dramatically over the last 80 years. The land use, water management, and drainage conditions that are tributary to and overlie the Basin at a specific time are referred to collectively as the cultural condition of the basin. The types of land uses that overlie a groundwater basin have a profound impact on recharge. The land use transition from natural to agricultural uses and subsequently to developed urban uses radically changes the amount of recharge to the basin. Furthermore, irrigation practices change over time in response to agricultural economics (e.g. demand for various agricultural products, commodity prices, production costs, etc.), regulatory requirements, technology, and the availability and cost of water. Urbanization increases the amount of imperviousness, decreasing the irrigable and permeable areas, which allow irrigation return flows and precipitation to infiltrate through the soil, and conversely increases the amount of stormwater produced on the land surface. Drainage improvements associated with the transition from natural and agricultural uses to urban uses reduce the recharge of stormwater: channels and streams in the Chino Basin were concrete-lined to move stormwater efficiently through the watershed to the Santa Ana River.

With few exceptions, as land is converted from natural undeveloped conditions to human uses, it becomes more impervious and produces more stormwater runoff. Historically, when land use has converted from natural and agricultural uses to urban uses, imperviousness has increased from near zero to between 60 and almost 100 percent, depending on the specific land use. Land use maps for 1933 and 2012 are shown to the left. Also shown is a chart that summarizes land use into three broad categories: urban, agricultural and native/undeveloped. The chart also shows the change (and projected change) in estimated total imperviousness in the Chino Basin associated with the transitioning land uses over time from 1933 to 2030. This later chart is based on land use mapping for the years shown on the x-axis and projected land use from the land use control agencies. The land use was predominantly in an agricultural and undeveloped state until about 1984: urban uses accounted for about 10 percent from 1933 through 1957, grew steadily thereafter to about 26 percent in 1975, and reached about 57 percent in 2012. At build-out, the fraction of the Chino Basin that is projected to be impervious is about 70 percent. Based on an investigation to recalculate the Chino Basin Safe Yield, the impact of these land use changes reduced the deep infiltration of precipitation and applied water from about 140,000 acre-ft/yr in the period 1930 through 1940 to less than 100,000 acre-ft/yr by and after 2000 (WEI, 2015d).

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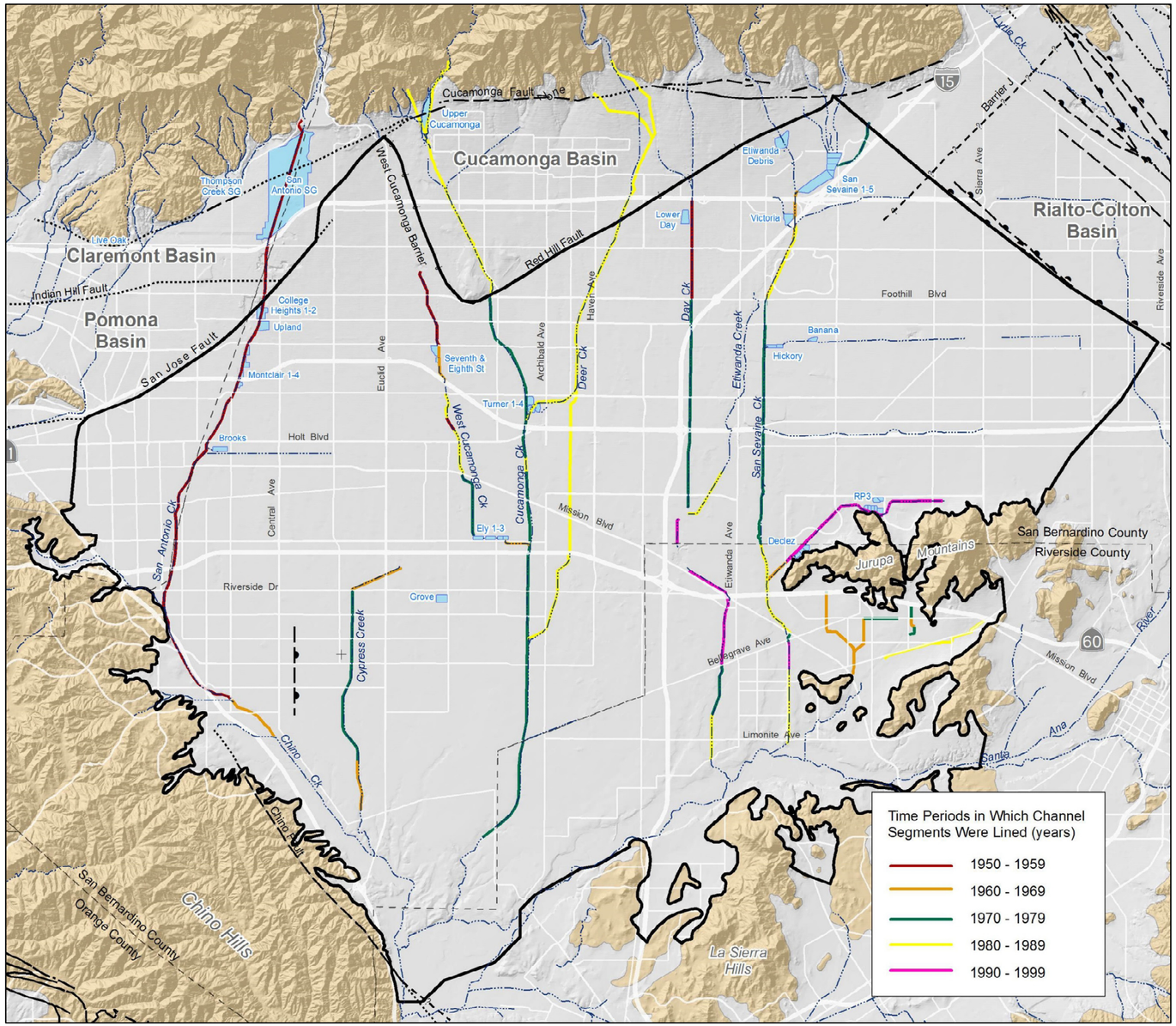
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Date: 06/27/2017
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- Urban
- Agricultural
- Native and Undeveloped
- Total Imperviousness

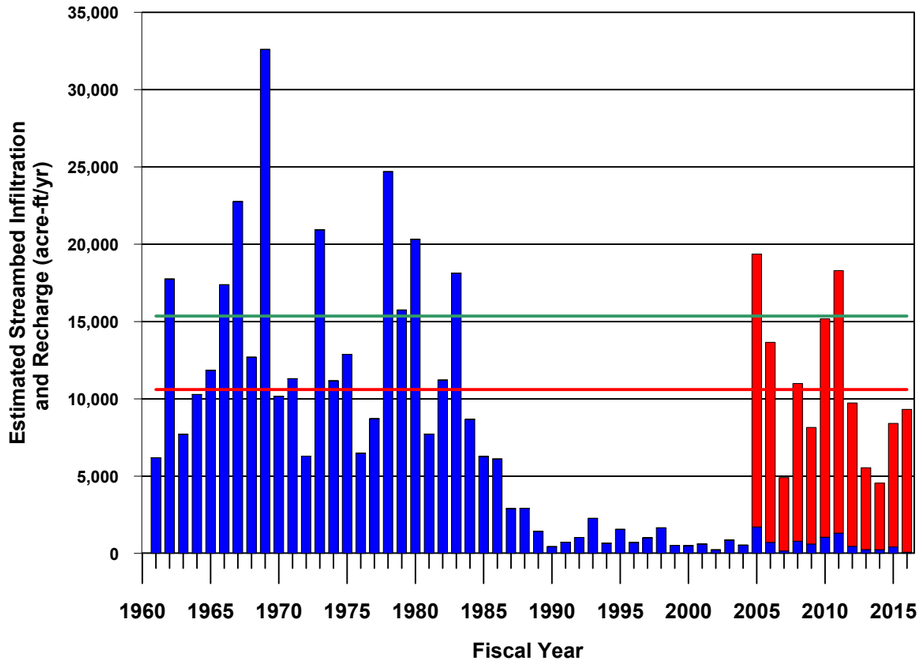
**2016 State of the Basin**
Hydrologic Conditions

**Land Use Changes within the Chino Basin**

**Exhibit 2-4**




**Estimated Streambed Infiltration for the Santa Ana River Tributaries in the Chino Basin and Increased Recharge Resulting from Recharge Master Plans, Fiscal Year 1961-2016**




Drainage improvements were incorporated into the urban landscape in the Chino Basin to convey stormwater rapidly, safely, and efficiently from the land surface through urban developments, and to discharge stormwater away from urbanized areas. Until the late 1990s there was little or no thought as to the value of the stormwater that discharged out of the Chino Basin. The map to the left shows the stream systems that start in the San Gabriel Mountains and flow from the north to the south, crossing the Cucamonga, Chino, and Six Basins. From about 1957 to the present, the drainage areas overlying the valley floor have been almost completely converted to urban uses, and almost all the streams have been converted from unlined to concrete-lined channels. The above chart illustrates the estimated stormwater recharge in the Chino Basin (dark blue bars) for the Santa Ana River tributaries that flow south over the Chino Basin for the period 1961 through 2016. The lining of these channels has almost eliminated stormwater recharge in the Chino and Cucamonga Basins after 1984. The red bars indicate the estimated increase in stormwater recharge due to the construction of stormwater recharge improvements from the 2002 Recharge Master Plan. The horizonal red bar indicates the long-term average stormwater recharge after completion of the 2002 Recharge Master Plan projects: the 2002 Recharge Master Plan projects have replaced some of the recharge lost with channel lining. The horizontal green bar indicates the expected average stormwater recharge after the projects identified in the 2013 Amendment to the 2010 Recharge Master Plan Update (2013 RMPU) are completed, which is expected to be in 2020.

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Wildermuth Environmental Inc

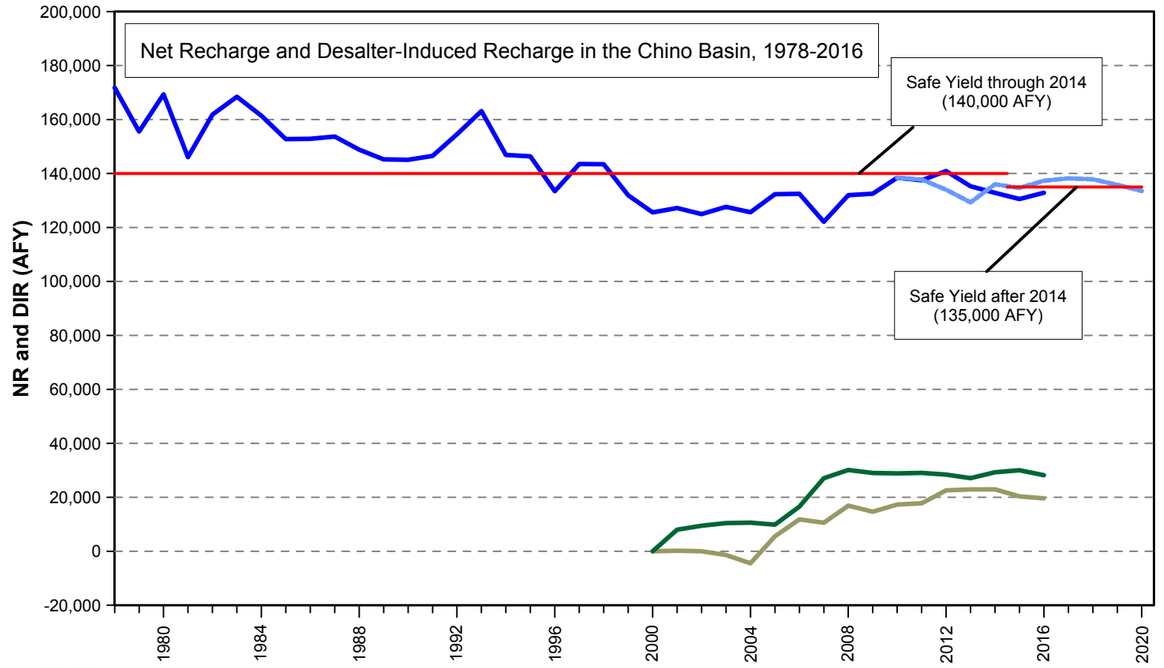
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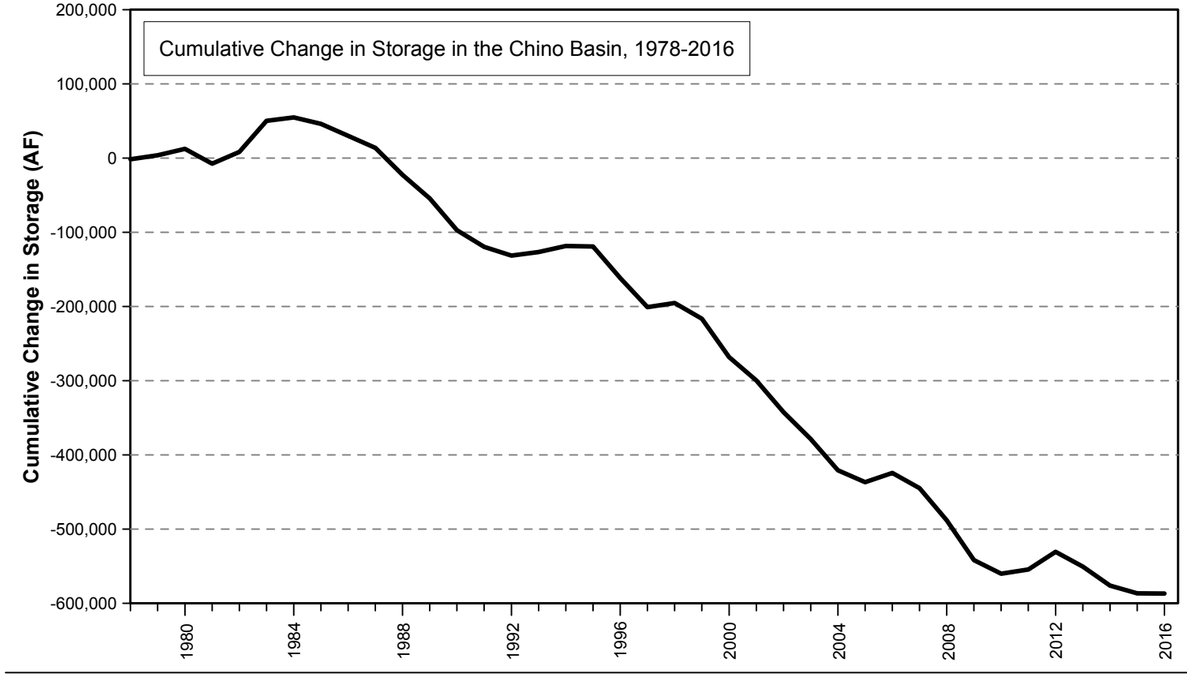
- Estimated Streambed Infiltration
- Stormwater Recharge Resulting from Implementation of the 2002 RMP
- Average Annual Total Stormwater Recharge with the 2002 RMP
- Average Annual Total Stormwater Recharge After Completion of the 2013 RMPU Projects



**History of Channel Lining and Streambed Infiltration in the Chino Basin**

**Exhibit 2-5**




Watermaster began the technical work to recalculate the Safe Yield in 2011 and completed that work in 2015 (WEI, 2015d). Subsequently, the Court with continuing jurisdiction in the Judgment issued a ruling on April 28, 2017 changing the Safe Yield from 140,000 acre-ft/yr to 135,000 acre-ft/yr. The Safe Yield is based on an average net recharge for the period 2011 through 2020 as projected with the Chino Basin Watermaster model. The Safe Yield is based on existing and projected cultural conditions and an associated expected-value hydrology. The chart to the upper left shows the time history of net recharge starting with the beginning of the Judgment period through 2011 from the model calibration, the net recharge estimated with the model for 2012 through 2016 based on historical conditions for 2012 through 2016, and the projected net recharge that was used to recalculate the Safe Yield for the period 2011 through 2020. The projected average annual net recharge for the period 2011 through 2020 is 135,000 acre-ft/yr and the average annual net recharge for 2011 through 2016 based on historical basin operations is also about 135,000 acre-ft/yr.

In the development of the OBMP it was determined that a groundwater production and desalting program in the lower Chino Basin was necessary to preserve and enhance Safe Yield during and after the period that agricultural land uses converted to urban uses. The first desalter began production in 2001 and desalter production gradually increased to about 30,000 acre-ft/yr in 2008 and maintained that level to the present. The desalter production will reach about 40,000 acre-ft/yr in 2018. This same chart also shows the time history of desalter production and desalter induced recharge (DIR). DIR is the amount of induced recharge from the Santa Ana River relative to the Santa Ana River recharge that occurred on June 2000. Cumulatively, DIR is approximately greater than 50 percent of desalter production.

The chart to the lower left shows the cumulative change in storage starting with the beginning of the Judgment period through 2016. The change in storage for the OBMP period starting in July 1, 2000 through June 30, 2016 is about -319,000 acre-ft. The authorized change in storage for this period was -404,000 acre-ft and consisted of -323,800 acre-ft of reoperation and other authorized dedications from storage and -80,000 acre-ft of controlled overdraft that was allocated to Appropriator parties pursuant to the Judgment.

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WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: GAR
Date: 06/27/2017
File: Exhibit_2-6_WB.grf

- Cumulative Change in Storage
- Historical Net Recharge
- Model-Projected Net Recharge (Scenario 5A4)
- Desalter-Induced Recharge
- Desalter Production

2016 State of the Basin
Hydrologic Conditions

**Net Recharge, Desalter-Induced Recharge, and Cumulative Change in Storage in the Chino Basin**

**Exhibit 2-6**

The accurate accounting of groundwater production and artificial recharge is vital to the management of the Chino Basin. Several of the Program Elements of the OBMP have been developed to address these needs, primarily *OBMP Program Element (PE) 1 – Develop and Implement a Comprehensive Monitoring Program* and *PE 2 – Develop and Implement Comprehensive Recharge Program*. Estimates of production and recharge are essential inputs to inform re-determinations of the Safe Yield of the Chino Basin, which are scheduled to occur every ten years. The exhibits in this section characterize the physical state of the Chino Basin with respect to groundwater production and artificial recharge.

**Groundwater Production.** Since its establishment in 1978, Watermaster has collected information to estimate total groundwater production from the Chino Basin. The Watermaster Rules and Regulations require groundwater producers that produce in excess of 10 acre-feet per year (acre-ft/yr) to install and maintain meters on their well(s). Well owners that pump less than 10 acre-ft/yr are considered "minimal producers" and are not required to meter or report to the Watermaster. When the OBMP was adopted, many of the Agricultural Pool wells did not have properly functioning meters installed, so Watermaster initiated a meter installation program for these wells as part of *PE 1*. Meters were installed at most agricultural wells by 2003. Watermaster staff visit and record production data from the meters at these wells on a quarterly basis. For the remaining unmetered Agricultural Pool wells, including minimal producer wells, Watermaster applies a "water duty" method to estimate their production on an annual basis. Members of the Appropriative, and Overlying Non-Agricultural Pool, and Chino Basin Desalter Authority record their own meter data and submit them to Watermaster staff on a quarterly basis. All Chino Basin production data are checked for accuracy and stored in Watermaster's relational database. Watermaster summarizes and reports the groundwater production based on their fiscal year (FY), July 1 to June 30. Watermaster uses reported production to quantify and levy assessments pursuant to the Judgment. Exhibit 3-1 shows the locations of all active production wells, symbolized by Pool, in the Chino Basin during FY 2015/2016.

Prior to the widespread metering of Agricultural Pool production wells, Agricultural Pool production estimates in Watermaster's database are believed to have been consistently under-reported. For the development of the 2013 Chino Basin Groundwater Model (WEI, 2015d), agricultural production prior to FY 2001/2002 was estimated based on historical land use data and the applied water requirements for those land uses. Exhibit 3-2 shows two bar charts depicting the annual groundwater production by Pool for FY 1977/1978 through 2015/2016: Exhibit 3-2a shows the estimated production by Pool as recorded in Watermaster's database; Exhibit 3-2b shows the same production values as 3-2a except Agricultural Pool production totals prior to FY 2001/2002 are replaced with the volumes estimated for the 2013 Chino Basin Groundwater Model. Based on the dataset that includes model estimations (Exhibit 3-2b), total annual groundwater production in the Chino Basin has ranged from a maximum of about 191,000 acre-ft during FY 1980/1981 to a minimum of about 146,000 acre-ft during FY 1997/1998 and has averaged about 172,000 acre-ft/yr.

The remaining characterizations of production data in this report are based on Watermaster's records (Exhibit 3-2a). Total annual groundwater production has ranged from a maximum of about 189,000 acre-ft during FY 2008/2009 to a minimum of about 123,000 acre-ft during FY 1982/1983 and has averaged about 154,000 acre-ft/yr. Since FY 1977/1978, Agricultural Pool production has decreased nearly 70,000 acre-ft—declining in proportion to the decline in total production—from 55 percent of total production in FY 1977/1978 to 12 percent in FY 2015/2016. During the same period, Appropriative Pool production increased by about 38,900 acre-ft—from 39 percent of total production in FY 1977/1978 to 87 percent as of FY 2015/2016—inclusive of the production at the Chino Desalter Authority (CDA) wells. Production in the Overlying Non-Agricultural Pool declined from about six percent of total production in FY 1977/1978 to less than two percent as of FY 2015/2016.

The spatial distribution of production has also shifted since 1978. Exhibits 3-3 through 3-5 are maps that illustrate the location and magnitude of groundwater production at wells in the Chino Basin for FYs 1977/1978 (Watermaster established), 1999/2000 (commencement of the OBMP), and 2015/2016 (current conditions).

The decline in agricultural production in the southern half of the Chino Basin has gradually been replaced by production at the CDA wells since FY 2000/2001. The CDA wells and treatment facilities were developed as part of *OBMP PE 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin* and *PE 5 – Develop and Implement Regional Supplemental Water Program*. The desalters are meant to enhance water supply reliability and improve groundwater quality in the Chino Basin. Exhibit 3-6 is a map that displays the locations of current and future desalter wells and treatment facilities. This exhibit also summarizes the history of desalter production in the southern portion of the Chino Basin and its nexus to the OBMP goals.

**Artificial Recharge.** Watermaster also improves water supply reliability and water quality in the Chino Basin through the execution of *OBMP PE 2*. The comprehensive recharge program has been developed through a recharge master planning process that began in 1998 to increase the recharge of local and supplemental waters in the Chino Basin. Since the *Recharge Master Plan Phase II* report was developed in 2001 (WEI, 2001), Watermaster has partnered with the Inland Empire Utilities Agency, San Bernardino County Flood Control District, and Chino Basin Water Conservation District to construct and/or improve recharge facilities in the Chino Basin, in accordance with the Recharge Master Plan and the Four-Party Agreement (2003). The Peace Agreement required the preparation of a recharge master plan update no more than every five years; the most recent recharge master plan update is the *2013 Amendment to the 2010 Recharge Master Plan Update* (WEI, 2013). A primary goal of the recharge master plan is to increase the capacity for and recharge of storm water, imported water, and recycled water in the Chino Basin. Exhibit 3-7 shows the network of groundwater recharge facilities in the Chino Basin, a time history of the magnitude and types of groundwater recharge since FY 2004/2005 (when the Chino Basin Recycled Water Groundwater Recharge Program was initiated), and a summary of the groundwater recharge programs and recharge master planning. Exhibit 3-8 is a tabulation of annual recharge by water type and recharge basin for FY 2000/2001 through FY 2015/2016.

In addition to the expansion of managed artificial recharge with recycled water, the direct use of recycled water has increased in the Chino Basin since the late 1990s. The development of recycled water as a locally reliable water supply serves as part of the water supply plan and regional supplemental water program, outlined in *OBMP PEs 3 and 5*. Exhibit 3-9 shows the location and magnitude of recycled water direct use in FY 2015/2016 and a time history of the direct use of recycled water from FY 2000/2001 through FY 2015/2016.

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains
Cucamonga Fault Zone
San Antonio Ck
Cucamonga Basin
Claremont Basin
Indian Hill Fault
Pomona Basin
San Jose Fault
Red Hill Fault
Haven Ave
Day Ck
Etiwanda Ave
Euclid Ave
Central Ave
Holt Blvd
Foothill Blvd
Barrier J
Sierra Ave
Rialto-Colton Basin
Riverside Ave
Loma Linda Fault
Waterman Ave
San Jacinto Fault
Rialto-Colton Fault
Mission Blvd
Cucamonga Ck
Riverside Dr
Jurupa Mountains
San Bernardino County
Riverside County
Riverside Basins
Puente Hills
Chino Fault
Chino Ck
Chino Hills
San Bernardino County
Orange County
Prado Basin
Temescal Basin
Bellegrave Ave
Limonite Ave
Santa Ana River
71
15
210
10
215
60

During FY 2015/2016, there were a total of 458 active production wells in the Chino Basin. Total production was about 148,500 acre-ft and was divided as follows:

**Agricultural Pool:** 17,400 acre-ft, which is 12 percent of total production
**Overlying Non-Agricultural Pool:** 2,700 acre-ft, which is two percent of total production
**Appropriative Pool:** 100,300 acre-ft, which is 68 percent of total production
**Chino Basin Desalters:** 28,200 acre-ft, which is 19 percent of total production

Exhibits 3-2 through 3-5 characterize how production has changed over time, by producer type, and spatially across the Chino Basin.

## Groundwater Production Wells by Pool

- Agricultural Pool (Pool 1 - 303 Wells)
- Overlying Non-Agricultural Pool (Pool 2 - 13 Wells)
- Appropriative Pool (Pool 3 - 116 Wells)
- Chino Basin Desalter Authority (27 Wells)

OBMP Management Zones (1, 2, 3, 4, 5)

Streams & Flood Control Channels

Flood Control & Conservation Basins

### *Geology*

Water-Bearing Sediments

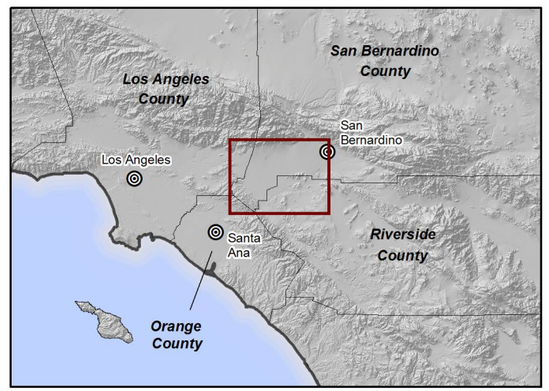
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT
Date: 5/26/2017
Document Name: Exhibit_3-1_ActiveProd_Wells

0 2 4 Miles
0 3 6 KM

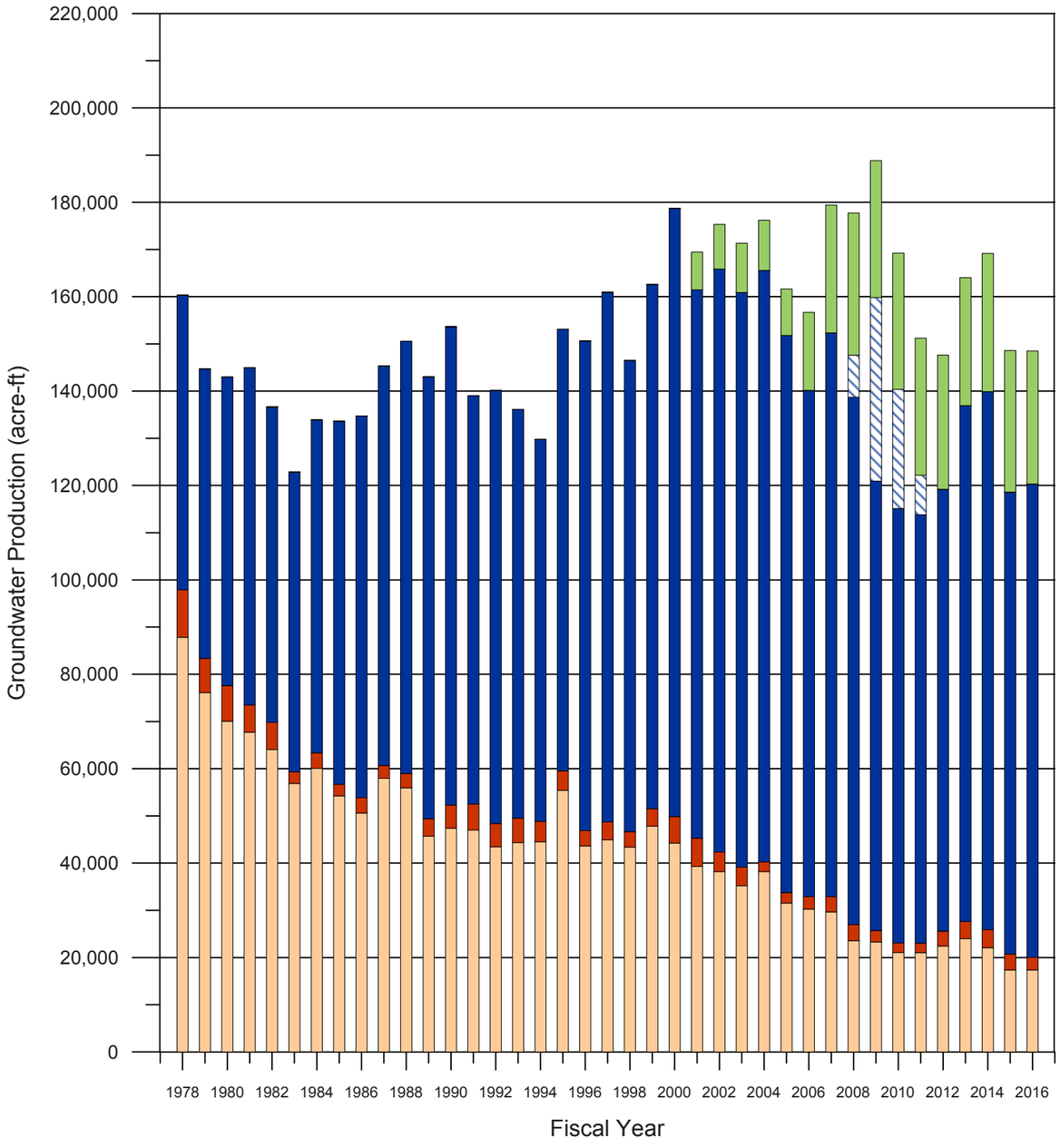
2016 State of the Basin
*Basin Production and Recharge*

# Active Groundwater Production Wells

*Fiscal Year 2015/2016*

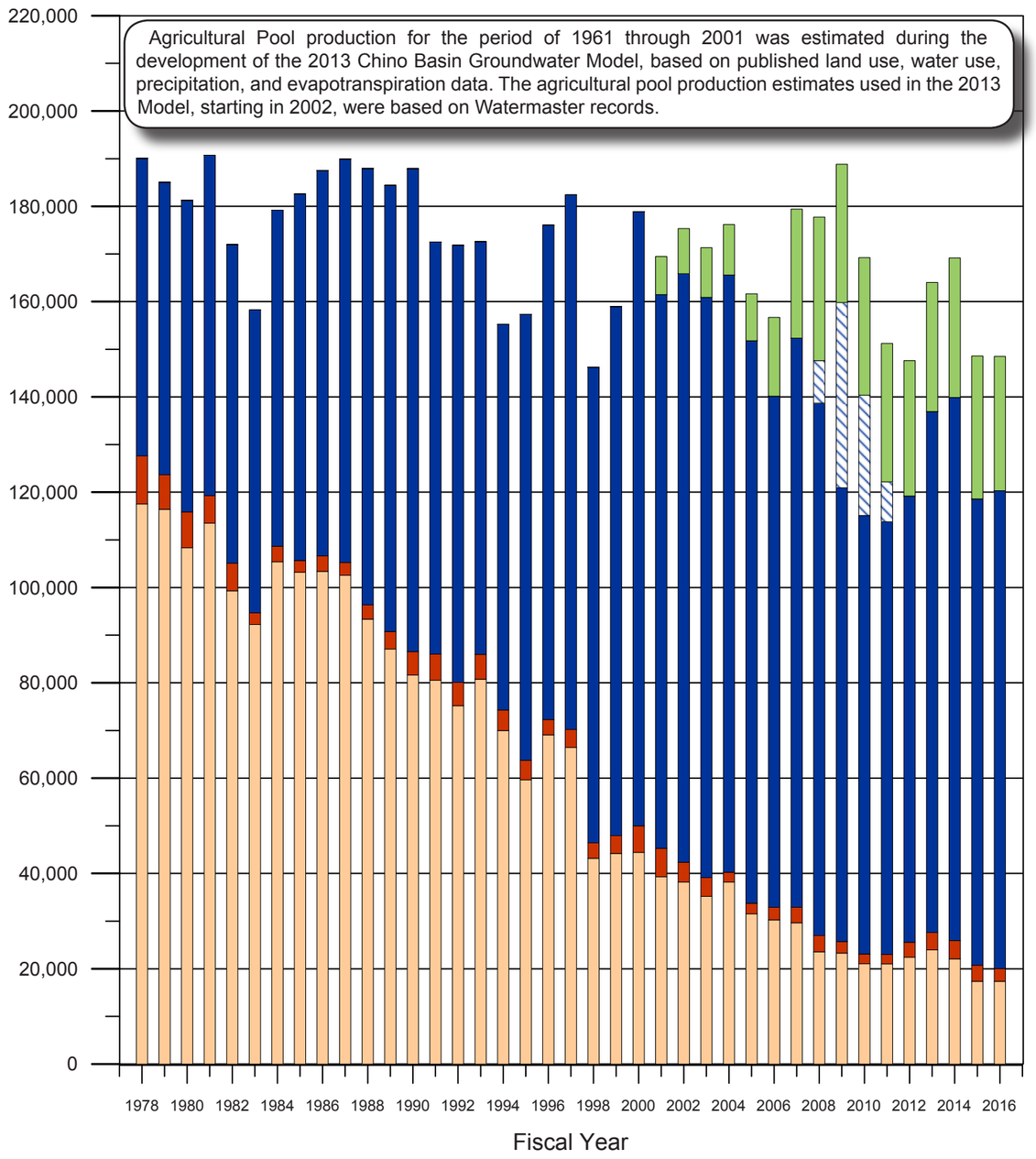
**Exhibit 3-1**

## 3-2a
## Groundwater Production by Pool in the Chino Basin
## Agricultural Pool Production Amounts from Watermaster Database




## 3-2b
## Groundwater Production by Pool in the Chino Basin with
## Agricultural Pool Production Amounts from the Chino Basin Model Prior to 2002

Agricultural Pool production for the period of 1961 through 2001 was estimated during the development of the 2013 Chino Basin Groundwater Model, based on published land use, water use, precipitation, and evapotranspiration data. The agricultural pool production estimates used in the 2013 Model, starting in 2002, were based on Watermaster records.




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC

Author: EM
Date: 06/05/2017
File: Exhibit_3-2_Production by Pool

- Agricultural Pool
- Overlying Non-Agricultural Pool
- Appropriative Pool
- Appropriative Pool - MWDSC Dry Year Yield Program
- Chino Basin Desalter Authority

CHINO BASIN WATERMASTER
Pioneers in Basin Management

**2016 State of the Basin**
*Basin Production and Recharge*

**Distribution of Groundwater Production**
*Fiscal Year 1978 to 2016*

**Exhibit 3-2**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

San Antonio Ck

Claremont Basin

Indian Hill Fault

Red Hill Fault

Pomona Basin

San Jose Fault

Haven Ave

Day Ck

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Foothill Blvd

Etiwanda Ave

Euclid Ave

Central Ave

Holt Blvd

Mission Blvd

Cucamonga Ck

Riverside Dr

Jurupa Mountains

San Bernardino County

Puente Hills

Chino Fault

Chino Ck

Limonite Ave

Chino Hills

San Bernardino County

Orange County

Prado Basin

La Sierra Hills

Temescal Basin

Arlington Basin

15

210

215

10

71

91

Total production in FY 1977/78, the year Watermaster was established, was about 160,300 acre-ft, based on the estimates in Watermaster's database. Production was distributed as follows:

**Agricultural Pool**: 87,800 acre-ft, which is 55 percent of total production
**Overlying Non-Agricultural Pool**: 10,100 acre-ft, which is six percent of total production
**Appropriative Pool:** 62,400 acre-ft, which is 39 percent of total production

In the lower half of the Basin, south of Highway 60, production was about 93,500 acre-ft, accounting for about 59 percent of total production. North of Highway 60, production was about 65,300 acre-ft, accounting for about 41 percent of total production.

The groundwater production estimates made for the 2013 Chino Basin Groundwater Model, shown in Exhibit 3-2b, suggest that total production in this year was about 190,000 acre-ft and that Agricultural Pool production was under-reported by about 30,000 acre-ft. The 30,000 acre-ft of unreported Agricultural Pool production was primarily pumped south of Highway 60.

Groundwater Production
Fiscal Year 1977/1978 (acre-ft)

- < 10
- 10 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- > 5,000

OBMP Management Zones

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

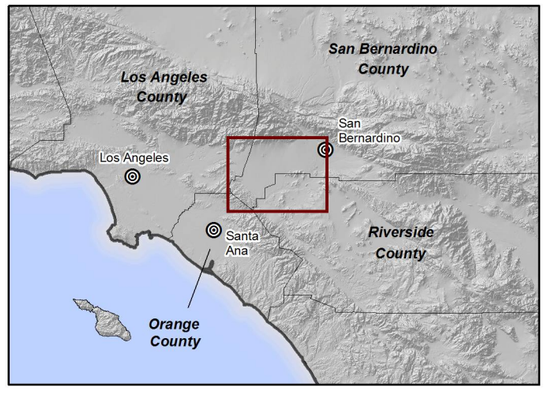
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 5/26/2017
Document Name: Exhibit_3-3_Prod_FY78

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Basin Production and Recharge*

## Groundwater Production by Well

*Fiscal Year 1977/1978*

**Exhibit 3-3**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

San Antonio Ck

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Haven Ave

Day Ck

Euclid Ave

Central Ave

Etiwanda Ave

Barrier J

Sierra Ave

Lorna Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Foothill Blvd

Holt Blvd

Mission Blvd

Cucamonga Ck

Riverside Dr

Jurupa Mountains

San Bernardino County

Riverside County

Riverside-Basins

Mission Blvd

River

Belgrave Ave

Puente Hills

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

La Sierra Hills

Temescal Basin

15

210

215

10

71

60

Total production in FY 1999/2000, the first year of OBMP implementation, was about 178,700 acre-ft, based on Watermaster records. Production was distributed as follows:

**Agricultural Pool:** 44,200 acre-ft, which is 25 percent of total production
**Overlying Non-Agricultural Pool:** 5,600 acre-ft, which is three percent of total production
**Appropriative Pool:** 128,900 acre-ft, which is 72 percent of total production

Between FY 1977/1978 and FY 1999/2000, groundwater production shifted north, with groundwater production south of Highway 60 declining from 59 to 31 percent of total production. North of Highway 60, production increased from 41 to 69 percent of total production. The shift in production was a result of land use transitions: south of Highway 60, irrigated agricultural land had been largely replaced by dairies, which have lower water use requirements; north of Highway 60, Appropriative Pool production increased concurrent with urbanization.

By FY 1999/2000, reported Agricultural Pool production was consistent with the production used in the 2013 Chino Basin Groundwater Model that was estimated based on land use and applied water requirements.

## Groundwater Production
## Fiscal Year 1999/2000 (acre-ft)

- < 10
- 10 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- > 5,000

OBMP Management Zones

Streams & Flood Control Channels

Flood Control & Conservation Basins

### Geology

*Water-Bearing Sediments*

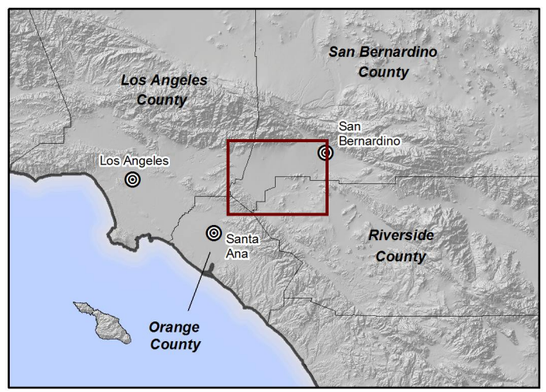
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/26/2017
Document Name: Exhibit_3-4_Prod_FY00

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Basin Production and Recharge*

# Groundwater Production by Well
*Fiscal Year 1999/2000*

**Exhibit 3-4**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

San Antonio Ck

Red Hill Fault

Haven Ave

Day Ck

Euclid Ave

Central Ave

Holt Blvd

Etiwanda Ave

Foothill Blvd

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Mission Blvd

Cucamonga Ck

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Puente Hills

Riverside Dr

Beleagrave Ave

Limonite Ave

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

La Sierra Hills

Temescal Basin

Santa Ana River

71

15

210

215

10

60

Total production in FY 2015/2016 was about 148,500 acre-ft. After the Chino Desalter Authority wells were constructed and came online south of Highway 60 (see Exhibit 3-6), in FY 1999/2000, the spatial distribution of pumping began to shift: south of Highway 60, production increased from 31 to 35 percent of total basin production; and north of Highway 60, production decreased from 69 to 65 percent of total basin production.

The number of wells producing greater than 1,000 acre-ft/yr increased since FY 1977/1978 and FY 1999/2000. This is due to the increase in urbanization, which tends to result in production that is concentrated over fewer wells than normally occurs with agricultural production in the Chino Basin. The construction and operation of the desalters, most of which produce more than 1,000 acre-ft/yr, also contributed to this increase.

Since 2007, groundwater production has declined in the Chino Basin. This is primarily due to the economic downturn, drought conditions, and state-mandated water conservation measures.

Groundwater Production
Fiscal Year 2015/2016 (acre-ft)

- < 10
- 10 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- > 5,000




OBMP Management Zones

Chino Basin Desalter Wells

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 5/26/2017
Document Name: Exhibit_3-5_Prod_FY16

0 2 4 Miles
0 3 6 KM

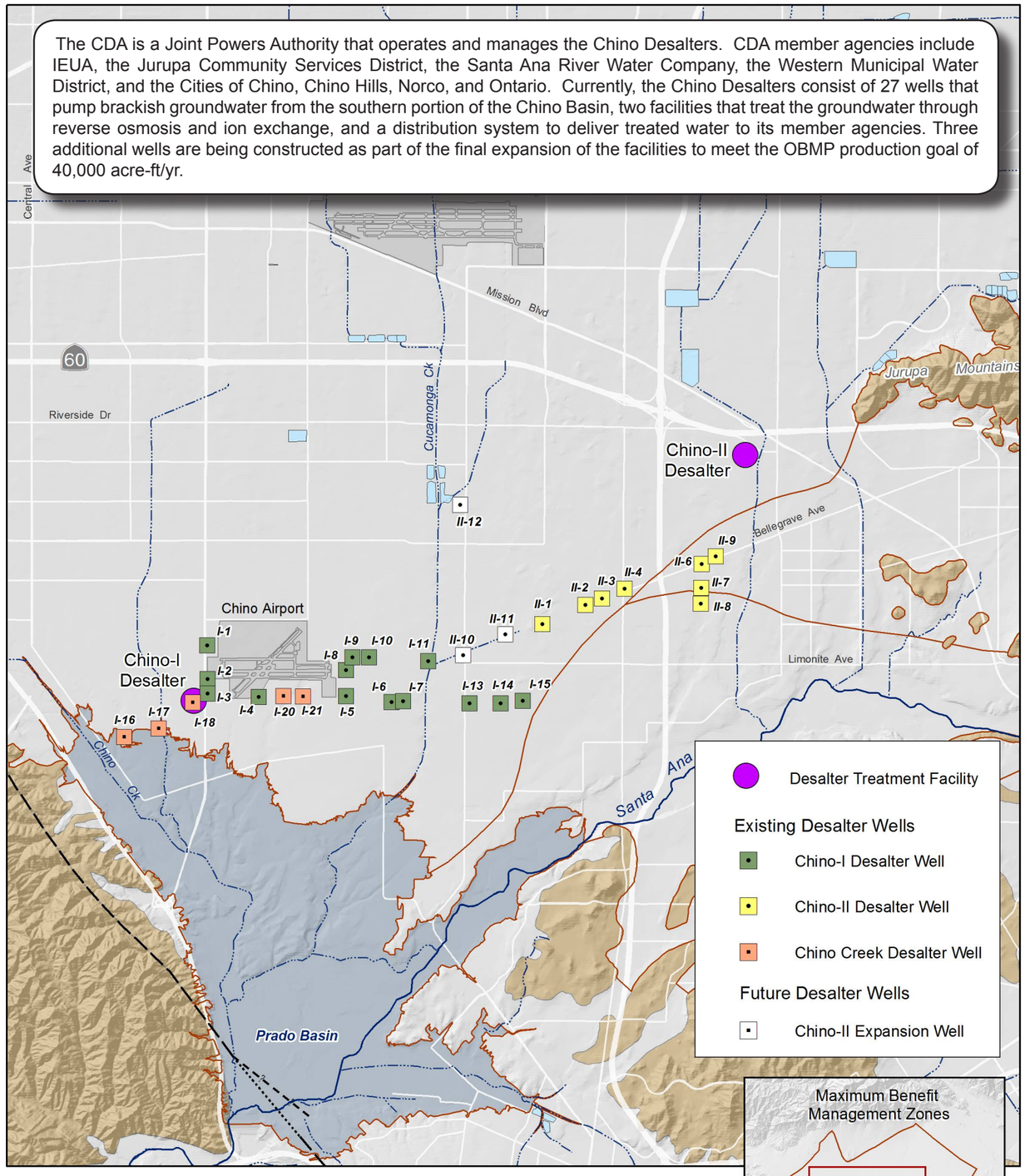
2016 State of the Basin
*Basin Production and Recharge*

# Groundwater Production by Well

*Fiscal Year 2015/2016*

**Exhibit 3-5**

The CDA is a Joint Powers Authority that operates and manages the Chino Desalters. CDA member agencies include IEUA, the Jurupa Community Services District, the Santa Ana River Water Company, the Western Municipal Water District, and the Cities of Chino, Chino Hills, Norco, and Ontario. Currently, the Chino Desalters consist of 27 wells that pump brackish groundwater from the southern portion of the Chino Basin, two facilities that treat the groundwater through reverse osmosis and ion exchange, and a distribution system to deliver treated water to its member agencies. Three additional wells are being constructed as part of the final expansion of the facilities to meet the OBMP production goal of 40,000 acre-ft/yr.



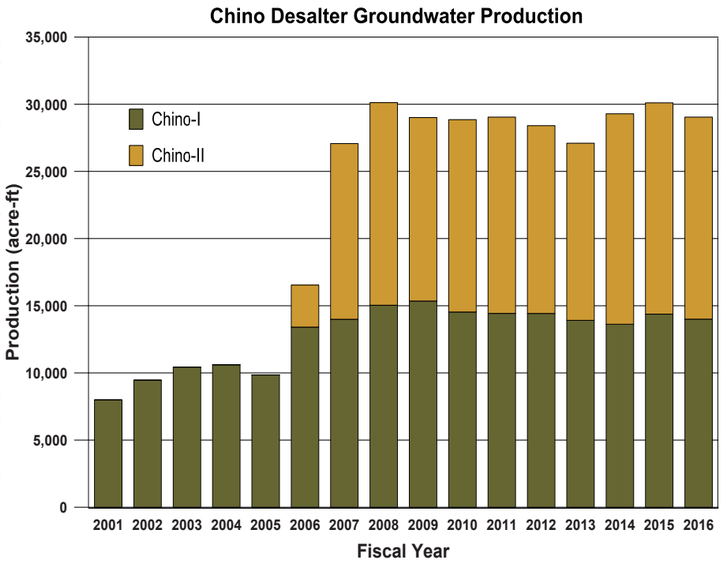

The need for the Chino Desalters was described in the OBMP Phase 1 Report. Throughout the 20th century, land uses in the southern portion of the Chino Basin were primarily agricultural. Over time, groundwater quality degraded in this area, and it is currently not suitable for municipal use unless it is treated to reduce TDS, nitrate, and other contaminant concentrations. The OBMP recognized that urban land uses and their water demands would ultimately replace agriculture and that if municipal pumping did not replace the decreased agricultural pumping, groundwater levels would rise and discharge to the Santa Ana River. The potential consequences would be the loss of Safe Yield in the Chino Basin and the degradation of the quality of the Santa Ana River, which could impact the downstream beneficial uses in Orange County. Mitigating the loss of yield and the subsequent degradation of water quality would come with high costs to the Chino Basin parties.

The Chino Desalters were designed to replace the expected decrease in agricultural production and accomplish the following objectives: meet emerging municipal demands in the Chino Basin, maintain or enhance Safe Yield, remove groundwater contaminants, and protect the beneficial uses of the Santa Ana River. Pursuant to the OBMP and Peace Agreement, Watermaster's goal for desalter production was set at 40,000 acre-ft/yr. The plans for the Chino Desalters also became a fundamental component of the salt and nutrient management plan for the Chino Basin, also known as the maximum benefit program, which is written into the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan).

In 2004, the Regional Board adopted the maximum-benefit program, which raised the groundwater quality objectives in the Chino Basin to allow for the large-scale implementation of recycled-water reuse in the Chino Basin for both direct use and recharge. In exchange, Watermaster and the IEUA made nine "maximum-benefit commitments" that would assure the protection of beneficial uses in the Chino Basin and of the Santa Ana River. The operation of the Chino Desalters is fundamental to the maximum benefit program through the attainment of "Hydraulic Control" in the southern portion of Chino Basin—four of the nine maximum benefit commitments are related to the Desalters and Hydraulic Control. Hydraulic Control is achieved when groundwater discharge from the Chino-North Management Zone to Prado Basin is eliminated or reduced to de minimis levels by pumping at the Chino Desalter wells.

The first desalter facility and well field, the Chino-I Desalter, began operating in 2000 and had an original design capacity of 8 mgd (about 9,000 acre-ft/yr). In 2005, Chino-I was expanded to a capacity of 14 mgd (about 17,000 acre-ft/yr). The Chino-II Desalter began operating in June 2006 at a capacity of 15 mgd (about 16,000 acre-ft/yr). The CDA recently completed the construction of five Chino Creek Well Field (CCWF) wells in 2012. Production at some of the CCWF wells began in late FY 2014 and commenced at the other CCWF wells in early 2016, reaching the level of production required to achieve Hydraulic Control. Currently, the Chino-I and Chino-II Desalters produce almost 30,000 acre-ft/yr of groundwater. The chart below shows annual groundwater-production for the Chino Desalters. The final expansion of the Chino Desalters to achieve the OBMP goal of 40,000 acre-ft/yr of production includes the construction of three wells in the south-central portion of the Chino Basin that will feed into the Chino-II Desalter. These wells are anticipated to begin production in 2017.

Pursuant to the Peace II Agreement, Watermaster initiated additional controlled overdraft, referred to as "re-operation," to ensure the attainment of Hydraulic Control. As described in the Peace II Agreement, re-operation is the process through which, pursuant to a Judgment amendment, Watermaster will engage in the controlled overdraft of 400,000 acre-ft through 2030, allocated specifically to meet the replenishment obligation of the desalters (WEI, 2009b). Previous investigations have shown that re-operation is required to achieve Hydraulic Control (WEI, 2007c). Re-operation water is divided into two tranches: the first tranche of 225,000 acre-ft is dedicated to the replenishment obligation created by the desalters that existed in 2007; the second tranche of 175,000 acre-ft will be used at a rate of 10,000 acre-ft/yr through 2030 for the replenishment obligation of the post 2007 desalter capacity expansion to achieve a production rate of 40,000 acre-ft/yr.




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT
Date: 20170413
File: Exhibit_3-6_Desalters

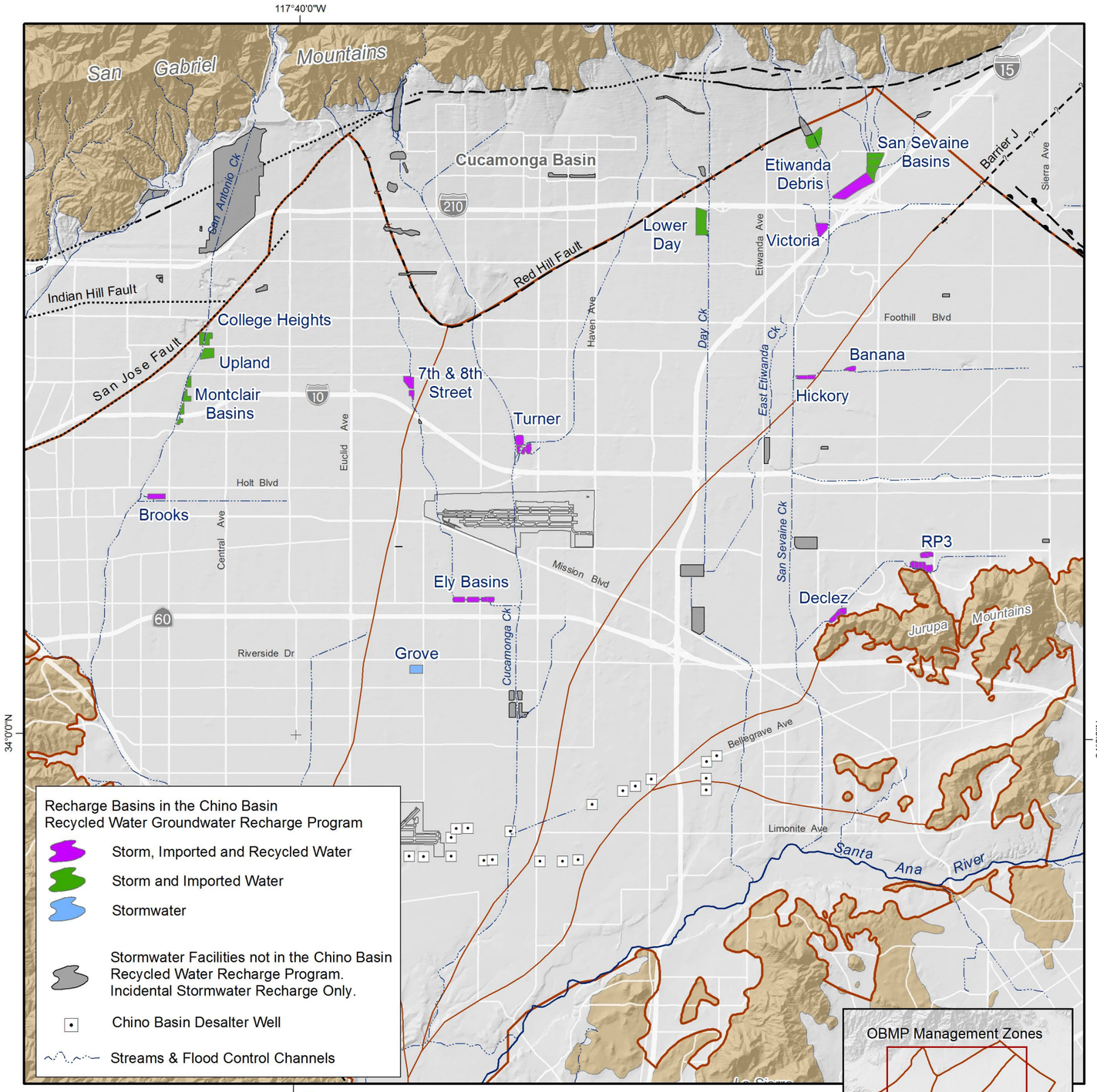
0 1 2 Miles
0 2 4 KM

2016 State of the Basin
*Basin Production and Recharge*

## Chino Basin Desalter Well Production

*Fiscal Year 2015/2016*

**Exhibit 3-6**




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 20170413
File: Exhibit_3-7_RechargeBasins

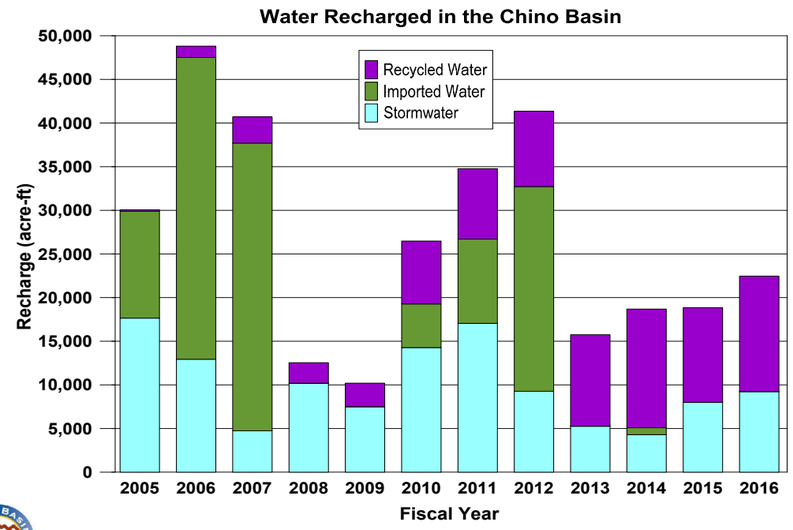
The IEUA, Watermaster, the Chino Basin Water Conservation District, and the San Bernardino County Flood Control District are partners in the planning and implementation of groundwater recharge programs in the Chino Basin. Increasing groundwater recharge is an integral part of the OBMP's objective to enhance water supply reliability and improve groundwater quality, and it is essential for compliance with the maximum benefit salt and nutrient management program. Four types of water are recharged at 17 recharge facilities across the Chino Basin: imported water, storm water, urban runoff, and recycled water. The types of water recharged at each basin are shown in the map to the left.

The IEUA records the daily volumes of all types of water routed to the recharge basins. Since about 2004, sensors have been installed at most of the recharge basins to monitor stage. The data are used to calculate the volume of captured storm water, which is important for Watermaster accounting.

Watermaster maintains a database of the monthly recharge volumes by water type and recharge location. The chart below shows annual recharge by water type since the initiation of the recharge program in FY 2004/2005 (urban runoff is included with stormwater). Exhibit 3-8 is a tabulation of the annual recharge by recharge basin and water type for FY 2000/2001 through FY 2015/2016. Notably, recycled water has become a significant portion of annual recharge, totaling 13,200 acre-ft in FY2015/2016 and averaging about 11,400 acre-ft/yr over the past five years. This increase in recharge reduces the need for and dependence on imported water by parties in the Chino Basin.

The magnitude of imported water recharge can fluctuate significantly due to its availability and need. Conjunctive use storage projects can also result in the recharge of large volumes of imported water. During FYs 2004/2005 through 2006/2007, imported water recharge was well above average because the MWDSC was doing a "put" operation pursuant to the Dry Year Yield (DYY) conjunctive use storage program. In FY 2011/2012, about 23,500 acre-ft of imported water was recharged in the Chino Basin due to the availability of low-cost Tier 1 water from MWDSC. Other years have little to no imported water recharge, generally due to drought conditions resulting in limited availability of this low-cost Tier 1 water.

Through recharge master planning and implementation, Watermaster and the IEUA develop projects to enhance the recharge of storm and supplemental waters in the Chino Basin. The initial recharge master plan was developed in 2002; its current version is the 2013 Amendment to the 2010 Recharge Master Plan Update (2013 RMPU) (WEI, 2013b). The projects selected for implementation in the 2013 RMPU involve improvements to existing recharge facilities and the construction of new facilities and will increase the recharge of storm water and urban water runoff by 4,900 acre-ft/yr and increase recycled water recharge capacity by 7,100 acre-ft/yr. These projects are expected to be fully constructed and operational by 2020.




## Groundwater Recharge in the Chino Basin

**2016 State of the Basin**
*Basin Production and Recharge*

**Exhibit 3-7**

**Exhibit 3-8**
**Summary of Annual Wet Water Recharge Records in the Chino Basin**
**(acre-ft)**

| Basin Name | FY 2000/2001 | | | | FY 2001/2002 | | | | FY 2002/2003 | | | | FY 2003/2004 | | | | FY 2004/2005 | | | | FY 2005/2006 | | | | FY 2006/2007 | | | | FY 2007/2008 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total |
| MVWD ASR Well | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| College Heights Basins | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 5,326 | 0 | 5,434 | 1 | 3,125 | 0 | 3,126 | 172 | 0 | 0 | 172 |
| Upland Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 989 | 0 | 0 | 989 | 214 | 5,985 | 0 | 6,199 | 195 | 7,068 | 0 | 7,263 | 312 | 0 | 0 | 312 |
| Montclair Basins | NM | 6,530 | 0 | 6,530 | NM | 6,500 | 0 | 6,500 | NM | 6,499 | 0 | 6,499 | NM | 3,558 | 0 | 3,558 | 3,350 | 7,887 | 0 | 11,237 | 1,296 | 5,579 | 0 | 6,875 | 355 | 10,681 | 0 | 11,036 | 859 | 0 | 0 | 859 |
| Brooks Street Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 1,776 | 0 | 0 | 1,776 | 524 | 2,032 | 0 | 2,556 | 205 | 1,604 | 0 | 1,809 | 475 | 0 | 0 | 475 |
| 7th and 8th Street Basins | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 620 | 0 | 0 | 620 | 1,271 | 0 | 0 | 1,271 | 640 | 0 | 0 | 640 | 959 | 0 | 1,054 | 2,013 |
| Ely Basins | NM | 0 | 500 | 500 | NM | 0 | 505 | 505 | NM | 0 | 185 | 185 | NM | 0 | 49 | 49 | 2,010 | 0 | 158 | 2,168 | 1,531 | 0 | 188 | 1,719 | 631 | 0 | 466 | 1,097 | 1,603 | 0 | 562 | 2,165 |
| Grove Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133 | 0 | 0 | 133 | 166 | 0 | 0 | 166 | 326 | 0 | 0 | 326 |
| Turner Basins | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 1,428 | 310 | 0 | 1,738 | 2,575 | 346 | 0 | 2,921 | 406 | 313 | 1,237 | 1,956 | 1,542 | 0 | 0 | 1,542 |
| Lower Day Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 2,798 | 107 | 0 | 2,905 | 624 | 2,810 | 0 | 3,434 | 78 | 2,266 | 0 | 2,344 | 303 | 0 | 0 | 303 |
| Etiwanda Debris Basins | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 2,812 | 0 | 2,812 | 0 | 2,137 | 0 | 2,137 | 20 | 2,488 | 0 | 2,508 | 0 | 1,160 | 0 | 1,160 | 10 | 0 | 0 | 10 |
| Victoria Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 330 | 0 | 0 | 330 | 260 | 0 | 0 | 260 | 427 | 0 | 0 | 427 |
| San Sevaine | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 1,211 | 0 | 1,211 | 2,830 | 1,621 | 0 | 4,451 | 2,072 | 9,172 | 0 | 11,244 | 244 | 5,749 | 0 | 5,993 | 749 | 0 | 0 | 749 |
| Hickory Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 298 | 197 | 0 | 495 | 438 | 636 | 586 | 1,660 | 536 | 212 | 647 | 1,395 | 949 | 0 | 567 | 1,516 |
| Banana Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 425 | 0 | 0 | 425 | 300 | 193 | 529 | 1,022 | 226 | 783 | 643 | 1,653 | 278 | 0 | 157 | 435 |
| RP-3 Basins | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 1,105 | 0 | 0 | 1,105 | 767 | 0 | 0 | 767 | 802 | 0 | 0 | 802 | 511 | 0 | 0 | 511 |
| Declez Basin | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | NM | 0 | 0 | 0 | 19 | 0 | 0 | 19 | 737 | 0 | 0 | 737 | 0 | 0 | 0 | 0 | 730 | 0 | 0 | 730 |
| Totals: | NM | 6,530 | 500 | 7,030 | NM | 6,500 | 505 | 7,005 | NM | 6,499 | 185 | 6,684 | NM | 7,582 | 49 | 7,631 | 17,648 | 12,258 | 158 | 30,065 | 12,940 | 34,567 | 1,303 | 48,810 | 4,745 | 32,960 | 2,993 | 40,698 | 10,205 | 0 | 2,340 | 12,545 |

| Basin Name | FY 2008/2009 | | | | FY 2009/2010 | | | | FY 2010/2011 | | | | FY 2011/2012 | | | | FY 2012/2013 | | | | FY 2013/2014 | | | | FY 2014/2015 | | | | FY 2015/2016 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total | SW | IW | RW | Total |
| MVWD ASR Well | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 186 | 0 | 186 | 0 | 889 | 0 | 889 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| College Heights Basins | 0 | 0 | 0 | 0 | 65 | 382 | 0 | 447 | 593 | 559 | 0 | 1,152 | 4 | 578 | 0 | 582 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Upland Basin | 274 | 0 | 0 | 274 | 532 | 0 | 0 | 532 | 1,308 | 899 | 0 | 2,207 | 222 | 2,118 | 0 | 2,340 | 119 | 0 | 0 | 119 | 95 | 0 | 0 | 95 | 325 | 0 | 0 | 325 | 425 | 0 | 0 | 425 |
| Montclair Basins | 611 | 0 | 0 | 611 | 937 | 4,592 | 0 | 5,529 | 1,762 | 3,672 | 0 | 5,434 | 703 | 11,893 | 0 | 12,596 | 204 | 0 | 0 | 204 | 416 | 0 | 0 | 416 | 411 | 0 | 0 | 411 | 441 | 0 | 0 | 441 |
| Brooks Street Basin | 434 | 0 | 1,605 | 2,039 | 666 | 0 | 1,695 | 2,361 | 628 | 0 | 1,373 | 2,001 | 363 | 561 | 836 | 1,760 | 115 | 0 | 1,505 | 1,620 | 112 | 0 | 1,308 | 1,420 | 198 | 0 | 1,011 | 1,209 | 182 | 0 | 1,215 | 1,397 |
| 7th and 8th Street Basins | 1139 | 0 | 352 | 1,491 | 1,744 | 6 | 1,067 | 2,817 | 1,583 | 543 | 1,871 | 3,997 | 1,047 | 572 | 641 | 2,260 | 751 | 0 | 2,261 | 3,012 | 441 | 5 | 1,423 | 1,869 | 1,751 | 0 | 48 | 1,799 | 921 | 0 | 1,470 | 2,391 |
| Ely Basins | 927 | 0 | 364 | 1,291 | 1,164 | 0 | 246 | 1,410 | 1,415 | 83 | 757 | 2,255 | 1,096 | 885 | 393 | 2,374 | 568 | 0 | 1,378 | 1,946 | 548 | 0 | 3,298 | 3,846 | 183 | 0 | 1,751 | 1,934 | 1,506 | 0 | 1,012 | 2,518 |
| Grove Basin | 405 | 0 | 0 | 405 | 351 | 0 | 0 | 351 | 431 | 0 | 0 | 431 | 400 | 0 | 0 | 400 | 177 | 0 | 0 | 177 | 258 | 0 | 0 | 258 | 481 | 0 | 0 | 481 | 471 | 0 | 0 | 471 |
| Turner Basins | 1200 | 0 | 171 | 1,371 | 2,220 | 0 | 397 | 2,617 | 2,308 | 0 | 53 | 2,361 | 1,879 | 199 | 1,034 | 3,112 | 1,120 | 0 | 176 | 1,296 | 596 | 0 | 1,565 | 2,161 | 1,289 | 0 | 948 | 2,237 | 1,616 | 0 | 1,958 | 3,574 |
| Lower Day Basin | 168 | 0 | 0 | 168 | 540 | 3 | 0 | 543 | 703 | 894 | 0 | 1,597 | 158 | 1,439 | 0 | 1,597 | 106 | 0 | 0 | 106 | 114 | 28 | 0 | 142 | 341 | 0 | 0 | 341 | 281 | 0 | 0 | 281 |
| Etiwanda Debris Basins | 28 | 0 | 0 | 28 | 775 | 7 | 0 | 782 | 1,213 | 147 | 0 | 1,360 | 100 | 567 | 0 | 667 | 33 | 0 | 0 | 33 | 45 | 0 | 0 | 45 | 27 | 0 | 0 | 27 | 83 | 0 | 0 | 83 |
| Victoria Basin | 250 | 0 | 0 | 250 | 494 | 2 | 0 | 496 | 461 | 69 | 773 | 1,303 | 221 | 281 | 665 | 1,167 | 94 | 0 | 842 | 936 | 192 | 0 | 1,379 | 1,571 | 306 | 0 | 931 | 1,237 | 343 | 0 | 635 | 978 |
| San Sevaine | 225 | 0 | 0 | 225 | 993 | 0 | 0 | 993 | 1,049 | 1,707 | 396 | 3,152 | 436 | 1,228 | 513 | 2,177 | 147 | 0 | 575 | 722 | 162 | 0 | 274 | 436 | 330 | 0 | 1 | 331 | 585 | 0 | 0 | 585 |
| Hickory Basin | 199 | 0 | 46 | 245 | 700 | 7 | 856 | 1,563 | 371 | 10 | 776 | 1,157 | 258 | 515 | 783 | 1,556 | 199 | 0 | 874 | 1,073 | 171 | 13 | 1,920 | 2,104 | 243 | 0 | 2,034 | 2,277 | 184 | 0 | 575 | 759 |
| Banana Basin | 383 | 0 | 40 | 423 | 416 | 0 | 898 | 1,314 | 149 | 0 | 267 | 416 | 247 | 0 | 1,915 | 2,162 | 114 | 0 | 670 | 784 | 87 | 24 | 1,071 | 1,182 | 197 | 0 | 1,148 | 1,345 | 365 | 0 | 2,106 | 2,471 |
| RP-3 Basins | 613 | 0 | 106 | 719 | 1,902 | 1 | 2,051 | 3,954 | 2,201 | 882 | 1,799 | 4,882 | 1,339 | 1,724 | 1,789 | 4,852 | 1,021 | 0 | 2,198 | 3,219 | 717 | 350 | 1,355 | 2,422 | 1,030 | 0 | 2,968 | 3,998 | 1,226 | 0 | 3,282 | 4,508 |
| Declez Basin | 656 | 0 | 0 | 656 | 774 | 0 | 0 | 774 | 877 | 0 | 0 | 877 | 798 | 0 | 65 | 863 | 530 | 0 | 0 | 530 | 341 | 374 | 0 | 715 | 895 | 0 | 0 | 895 | 607 | 0 | 969 | 1,576 |
| Totals: | 7,512 | 0 | 2,684 | 10,196 | 14,273 | 5,000 | 7,210 | 26,483 | 17,052 | 9,650 | 8,065 | 34,767 | 9,271 | 23,449 | 8,634 | 41,354 | 5,298 | 0 | 10,479 | 15,777 | 4,299 | 795 | 13,593 | 18,687 | 8,007 | 0 | 10,840 | 18,847 | 9,236 | 0 | 13,222 | 22,458 |

NM - Not measured SW - Surface Water IW - Imported Water RW - Recycled Water FY - Fiscal Year

The exhibits in this section show the physical state of the Chino Basin with respect to changes in groundwater levels since the Judgment and OBMP implementation. The groundwater-level data used to generate these exhibits were collected and compiled as part of Watermaster's groundwater-level monitoring program.

Prior to OBMP implementation, there was no formal groundwater-level monitoring program in the Chino Basin. Problems with historical groundwater-level monitoring included an inadequate areal distribution of wells that were monitored, short time histories, questionable data quality, and insufficient resources to develop and conduct a comprehensive program. The OBMP defined a new, comprehensive, basin-wide groundwater-level monitoring program pursuant to *OBMP Program Element 1 – Develop and Implement a Comprehensive Monitoring Program* to support the activities in other Program Elements, such as *Program Element 4 – Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1*. The monitoring program has been refined over time to increase efficiency and to satisfy the evolving needs of the Watermaster and the Inland Empire Utilities Agency (IEUA), such as new regulatory requirements.

Currently, the groundwater-level monitoring program supports many Watermaster functions, such as the periodic reassessment of Safe Yield, the monitoring and management of land subsidence, and the assessment of Hydraulic Control. The data are also used to update and re-calibrate Watermaster's groundwater-flow model, to understand directions of groundwater flow, to estimate storage changes, to interpret groundwater-quality data, to identify areas of the basin where recharge and discharge are not in balance, and to monitor changes in groundwater levels in the Prado Basin where riparian vegetation is consumptively using shallow groundwater.

Exhibit 4-1 shows the locations and measurement frequencies of all wells currently in Watermaster's groundwater-level monitoring program. The groundwater-level data collected at these wells were used to create groundwater-elevation contour maps for the shallow aquifer system in the Chino Basin for spring 2000 (Exhibit 4-2), spring 2014 (Exhibit 4-3), and spring 2016 (Exhibit 4-4). These contour maps indicate direction of groundwater flow, which is perpendicular to the contours from high elevations to low elevations. The contour maps were subtracted from each other to show how groundwater levels have changed during the OBMP implementation: Exhibit 4-5 shows the change from spring 2000 to spring 2016—the total 16-year period of OBMP implementation; Exhibit 4-6 shows the change from spring 2014 to spring 2016—the two-year period since the last State of the Basin analysis. The changes in groundwater levels are illustrative of changes in groundwater storage.

Figures 4-7 and 4-8 speak to the recent achievement of Hydraulic Control in the southern portion of Chino Basin in 2016. Achieving "Hydraulic Control" is an important objective of Watermaster, the IEUA, and the Regional Water Quality Control Board (RWQCB). Hydraulic Control is achieved when groundwater discharge from the Chino-North management zone to Prado Basin is eliminated or reduced to *de minimis* levels. *De minimis* discharge is defined as less than 1,000 acre-ft/yr. The RWQCB made achieving Hydraulic Control a commitment for the Watermaster and the IEUA in the Basin Plan (RWQCB, 2004) in exchange for relaxed groundwater-quality objectives in Chino-North. These objectives, called "maximum-benefit" objectives, allow for the implementation of recycled-water reuse in the Chino Basin for both direct use and recharge while simultaneously assuring the protection of the beneficial uses of the Chino Basin and the Santa Ana River. Achieving Hydraulic Control also enhances the yield of the Chino Basin by controlling groundwater levels in its southern portion, which has the effect of reducing outflow as rising groundwater and increasing streambed recharge in the Santa Ana River. These figures include a brief interpretation of the state of Hydraulic Control. For an in-depth discussion of Hydraulic Control, see *Chino Basin Maximum Benefit Monitoring Program 2016 Annual Report* (WEI, 2017).

Exhibit 4-9 shows the location of selected wells across the Chino Basin that have long time-histories of water levels. The time-histories describe long-term trends in groundwater levels in the OBMP management zones. The wells were selected based on geographic location within the management zone, well-screen intervals, and the length, density, and quality of the water-level records. Exhibits 4-10 through 4-14 are water-level time-series charts for these wells grouped by management zone for the period of 1978 to 2016. These exhibits compare the behavior of water levels to trends in precipitation, groundwater production, and recharge, which reveals cause-and-effect relationships.

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Indian Hill Fault

San Antonio Ck

Red Hill Fault

Pomona Basin

San Jose Fault

Euclid Ave

Haven Ave

Day Ck

Etiwanda Ave

Foothill Blvd

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Holt Blvd

Central Ave

Riverside Dr

Mission Blvd

San Sevaine Ck

Cucamonga Ck

Jurupa Mountains

Bellegrave Ave

Mission Blvd

Santa Ana River

San Bernardino County

Riverside County

Puente Hills

Limonite Ave

Riverside Basins

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

La Sierra Hills

Temescal Basin

71

15

210

215

10

60

To support OBMP implementation, Watermaster conducts a comprehensive groundwater-level monitoring program. In FY 2015/2016, about 1,250 wells comprised Watermaster's groundwater-level monitoring program. At about 1,000 of these wells, well owners measure water levels and provide data to Watermaster. These well owners include municipal water agencies, private water companies, the California Department of Toxic Substance Control (DTSC), the County of San Bernardino, and various private consulting firms. The remaining 250 wells are private or dedicated monitoring wells that are mostly located in the southern portion of the Basin. Watermaster staff measures water levels at these wells once a month or with pressure transducers that record water levels once every 15 minutes. These wells were preferentially selected to assist in Watermaster's monitoring programs, such as Hydraulic Control, Prado Basin habitat sustainability, and land subsidence. All groundwater-level data are collected, compiled, and checked by Watermaster staff, and uploaded to a centralized relational database that can be accessed online through HydroDaVE$^{SM}$.

## Basin-Wide Groundwater Level Monitoring Program

*Wells symbolized by Measurement Frequency*

- Monthly Measurement by CBWM (81 wells)
- Measurement by Transducer - Every 15 Minutes (163 wells)
- Owner Measures at Various Frequencies (1041 wells)




OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

### *Geology*

Water-Bearing Sediments

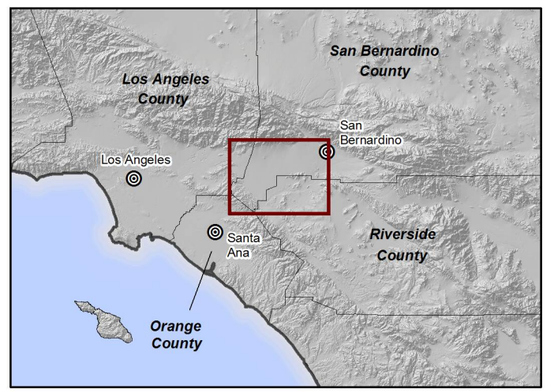
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: NWS

Date: 6/2/2017

Document Name: Exhibit_4-1_WL with wells

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin

*Groundwater Levels*

## Groundwater Level Monitoring Network

*Well Location and Measurement Frequency During Fiscal Year 2015/2016*

**Exhibit 4-1**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

San Antonio Ck

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Euclid Ave

Haven Ave

Day Ck

Etiwanda Ave

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

15

210

215

10

71

60

Foothill Blvd

Holt Blvd

Mission Blvd

Riverside Dr

Limonite Ave

Belegrave Ave

Central Ave

Cucamonga Ck

San Sevaine Ck

Chino Ck

Chino Fault

Santa Ana River

Jurupa Mountains

Puente Hills

Chino Hills

Prado Basin

Temescal Basin

Riverside Basins

San Bernardino County

Riverside County

Orange County

F-30A

F-3A

CVWD-5

CVWD-3

MVWD-10

O-24

O-29

P-6

Offsite MW4

C-5

OW-11

Mil M-6B

JCSD-14

JCSD-10

FC-752A2

FC-932A2

XRef 404

XRef 425

XRef 4513

XRef 4802

HCMP-9/1

SARWC-7

SARWC-11

HCMP-8/1

HCMP-2

HCMP-7/1

CH-15A

CH-1B

Archibald 1

750 725 700 675 650 625 600 575 550 525 775 800 825 850

This map displays contours of equal groundwater elevation across the Chino Basin during the spring of 2000—just prior to OBMP implementation. Two distinct aquifer systems exist in Chino Basin: a shallow unconfined to semi-confined aquifer system and a deeper confined aquifer system. The groundwater elevations shown on this map (and Exhibits 4-3, 4-4, 4-7, and 4-8) were drawn based on measured groundwater levels and represent the shallow aquifer system.

Groundwater flows from higher to lower elevations with flow direction perpendicular to the contours. The groundwater-elevation contours on this map indicate that in 2000 groundwater was flowing in a south-southwest direction from the primary areas of recharge in the northern parts of the Basin toward the Prado Basin in the south. There were notable pumping depressions in the groundwater-level surface that interrupted the general flow patterns in the northern portion of MZ1 (Montclair and Pomona areas) and directly west of the Jurupa Mountains in the vicinity of the Jurupa Community Services District's (JCSD) main well field. Pumping at the desalter wells had not yet begun in spring of 2000.

800 775 — Groundwater-Elevation Contours (feet above mean sea-level)

Boundary of Contoured Area (contours are not shown outside of this boundary due to lack of groundwater-level data)

Well With a Groundwater-Level Time History Plotted on Exhibits 4-10 through 4-14

1 2 3 4 5 — OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/26/2017
Document Name: Exhibit_4-2_sp2000

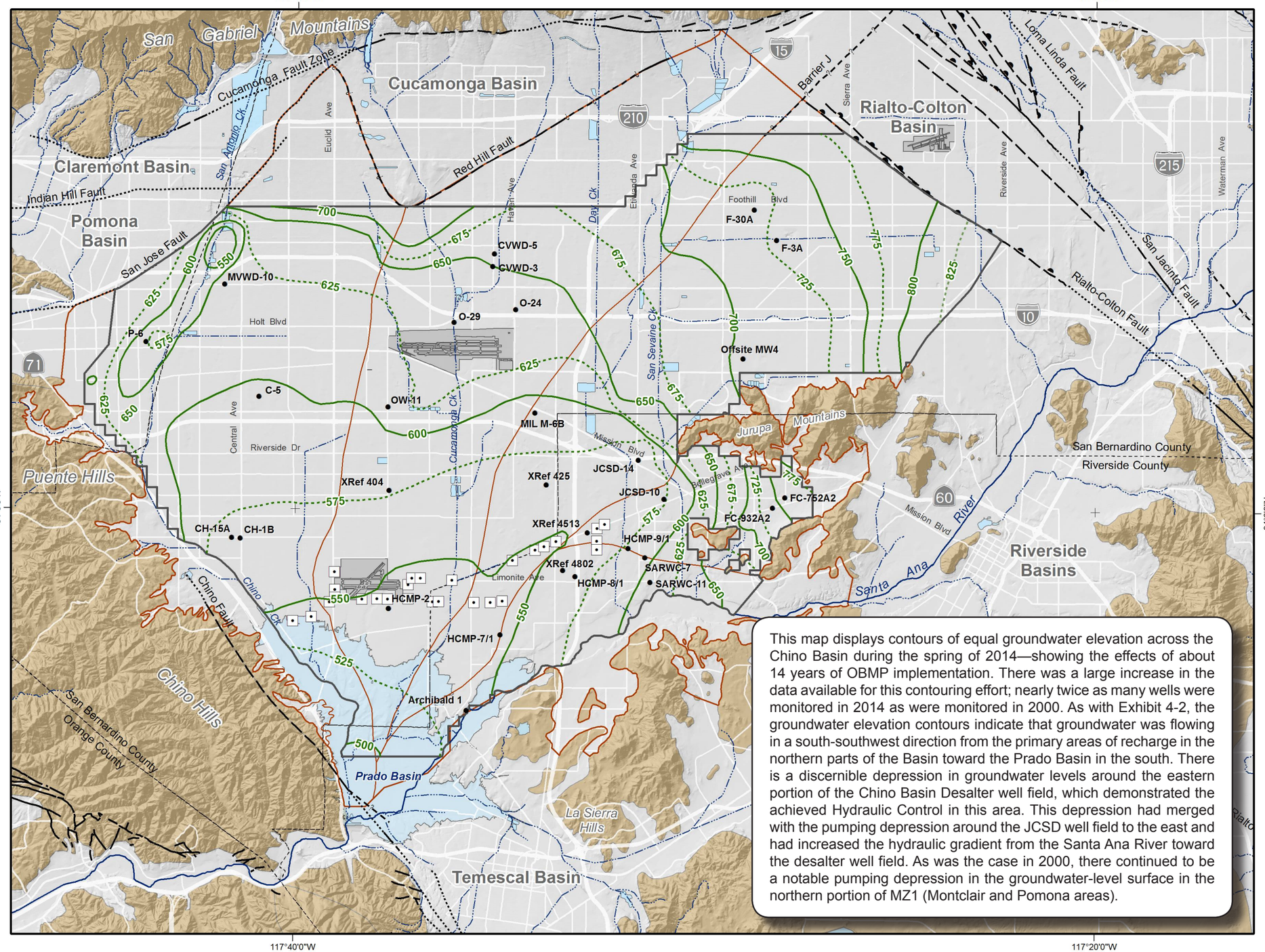
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

# Groundwater-Elevation Contours in Spring 2000

*Shallow Aquifer System*

**Exhibit 4-2**




This map displays contours of equal groundwater elevation across the Chino Basin during the spring of 2014—showing the effects of about 14 years of OBMP implementation. There was a large increase in the data available for this contouring effort; nearly twice as many wells were monitored in 2014 as were monitored in 2000. As with Exhibit 4-2, the groundwater elevation contours indicate that groundwater was flowing in a south-southwest direction from the primary areas of recharge in the northern parts of the Basin toward the Prado Basin in the south. There is a discernible depression in groundwater levels around the eastern portion of the Chino Basin Desalter well field, which demonstrated the achieved Hydraulic Control in this area. This depression had merged with the pumping depression around the JCSD well field to the east and had increased the hydraulic gradient from the Santa Ana River toward the desalter well field. As was the case in 2000, there continued to be a notable pumping depression in the groundwater-level surface in the northern portion of MZ1 (Montclair and Pomona areas).

800 775 Groundwater-Elevation Contours (feet above mean sea-level)

Boundary of Contoured Area (contours are not shown outside of this boundary due to lack of groundwater-level data)

Well with a Groundwater-Level Time History Plotted on Exhibits 4-10 through 4-14

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

### Geology

*Water-Bearing Sediments*

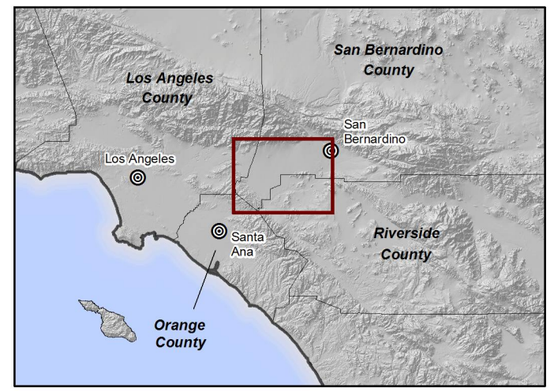
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-3_sp2014

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

# Groundwater Elevation Contours in Spring 2014

*Shallow Aquifer System*

**Exhibit 4-3**

117°40'0"W

117°20'0"W

34°0'0"N

Groundwater-Elevation Contours
(feet above mean sea-level)

Boundary of Contoured Area
(contours are not shown outside of this boundary due to lack of groundwater-level data)

Well with a Groundwater-Level Time History Plotted on Exhibits 4-10 through 4-14

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

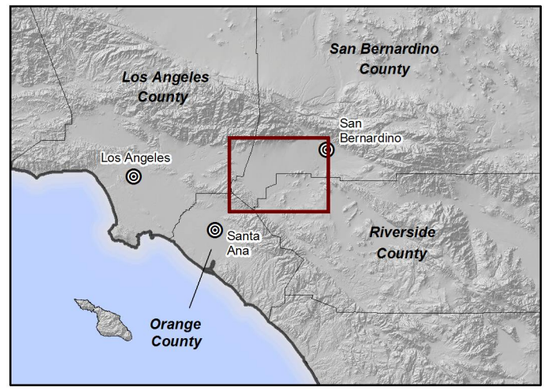
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain




This map displays contours of equal groundwater elevation across the Chino Basin during the spring of 2016—showing the effects of about 16 years of OBMP implementation. The contours are generally consistent with the groundwater-elevation contours for spring 2014, indicating regional groundwater flow in a south-southwest direction from the primary areas of recharge in the northern parts of the Basin toward the Prado Basin in the south. There continued to be a discernible depression in groundwater levels around the eastern portion of the Chino Basin Desalter well field, which demonstrates the achievement of Hydraulic Control in this area. This depression merged with the pumping depression around the JCSD well field to the east and increased the hydraulic gradient from the Santa Ana River toward the desalter well field. As was the case in 2000 and 2014, there continued to be a notable pumping depression in the groundwater-level surface in the northern portion of MZ1 (Montclair and Pomona areas).

Prepared by:
WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-4_sp2016

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

# Groundwater-Elevation Contours in Spring 2016

*Shallow Aquifer System*

**Exhibit 4-4**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Pomona Basin

Rialto-Colton Basin

Barrier J

Indian Hill Fault

San Jose Fault

Red Hill Fault

Loma Linda Fault

San Jacinto Fault

Rialto-Colton Fault

San Antonio Ck

Euclid Ave

Haven Ave

Day Ck

Etiwanda Ave

Sierra Ave

Riverside Ave

Waterman Ave

Central Ave

San Sevaine Ck

Cucamonga Ck

Mission Blvd

Holt Blvd

Riverside Dr

Limonite Ave

Telegraph Rd

Jurupa Mountains

Puente Hills

Chino Hills

Chino Fault

Chino Ck

Prado Basin

Temescal Basin

Santa Ana River

Riverside Basins

San Bernardino County

Riverside County

Orange County

71 15 210 10 215 60

F-30A
F-3A
CVWD-5
CVWD-3
MWD-10
P-6
O-29
O-24
C-5
OW-11
Offsite MW4
MIL M-6B
JCSD-14
JCSD-10
XRef 425
XRef 404
XRef 4513
XRef 4802
HCMP-9/1
HCMP-8/1
HCMP-7/1
HCMP-2
SARWC-7
SARWC-11
FC-752A2
FC-932A2
CH-15A
CH-1B
Archibald 1

This map shows the change in groundwater elevation during the 16-year period of OBMP implementation—spring 2000 to spring 2016. This map was created by subtracting a rasterized grid created from the groundwater elevations for spring 2000 (Exhibit 4-2) from a rasterized grid created from the groundwater elevations for spring 2016 (Exhibit 4-4).

Groundwater levels have increased in the western portion of the basin. Groundwater levels have decreased in the central and eastern portions of the basin, and around the eastern portion of the Chino Desalter well field in the south. The changes in groundwater elevation shown here are consistent with projections from the Watermaster's groundwater modeling efforts (WEI, 2003a; 2007c; 2015d) that simulated the changes in the groundwater levels and flow patterns from the production and recharge strategies described in the Judgment, OBMP, Peace Agreement, and Peace II Agreement. These strategies include: desalter production in the southern portion of the Basin; controlled overdraft through Basin Re-operation to achieve Hydraulic Control; subsidence management in MZ1; mandatory recharge of Supplemental Water in MZ1 to improve the balance of recharge and discharge; and facilities improvements to enhance the recharge of storm, recycled, and imported waters.

Contour of Groundwater-Level Change (ft)
Spring 2000 to Spring 2016

Groundwater-Level Change (ft)
Spring 2000 to Spring 2016

+120 Increase

-120 Decrease

Area not included in the change calculation due to lack a of groundwater-level data

Well With a Groundwater-Level Time History Plotted on Exhibits 4-10 through 4-14

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

**Geology**

*Water-Bearing Sediments*

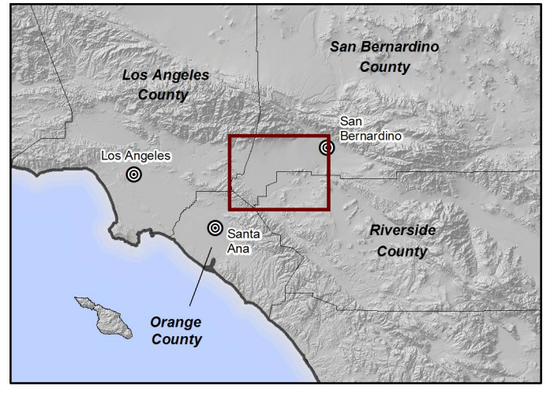
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-5_change00-16

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

# Groundwater-Level Change from Spring 2000 to Spring 2016

*Shallow Aquifer System*

**Exhibit 4-5**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Rialto-Colton Basin

Claremont Basin

Pomona Basin

Puente Hills

Chino Hills

Jurupa Mountains

Riverside Basins

Prado Basin

Temescal

La Sierra

San Antonio Ck

Red Hill Fault

Indian Hill Fault

San Jose Fault

Barrier J

Loma Linda Fault

Rialto-Colton Fault

San Jacinto Fault

Chino Fault

San Sevaine Ck

Day Ck

Chino Ck

Santa Ana River

Euclid Ave

Haven Ave

Etiwanda Ave

Sierra Ave

Riverside Ave

Waterman Ave

Foothill Blvd

Holt Blvd

Mission Blvd

Central Ave

Riverside Dr

Limonite Ave

Bellegrave Ave

Van Buren Blvd

Victoria Ave

71 15 210 215 10 60 91

F-30A
F-3A
CVWD-5
CVWD-3
MVWD-10
O-29
O-24
P-6
C-5
OW-11
Offsite MW4
MIL M-6B
JCSD-14
JCSD-10
FC-752A2
FC-932A2
XRef 404
XRef 425
XRef 4513
XRef 4802
HCMP-9/1
HCMP-8/1
HCMP-7/1
HCMP-2/1
HCMP-2
SARWC-7
SARWC-11
CH-15A
CH-1B
Archibald 1

San Bernardino County
Riverside County
Orange County

This map shows the change in groundwater elevation for the two-year period since the last State of the Basin Report—spring 2014 to spring 2016. The map was created by subtracting a rasterized grid created from the groundwater elevations for spring 2014 (Exhibit 4-3) from a rasterized grid created from the groundwater elevations for spring 2016 (Exhibit 4-4). Groundwater levels have changed by less than 10 feet across most of the basin during this two-year period. Groundwater levels have increased in western portion of the basin, and decreased in the central and eastern portions of the basin—consistent with the long-term changes in groundwater levels during 2000-2016 shown on Exhibit 4-5.

Contour of Groundwater-Level Change (ft)
Spring 2014 to Spring 2016

Groundwater-Level Change (ft)
Spring 2014 to Spring 2016

+120 Increase

-120 Decrease

Area not included in the change calculation due to lack a of groundwater-level data

Well With a Groundwater-Level Time History Plotted on Exhibits 4-10 through 4-14

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

**Geology**

*Water-Bearing Sediments*

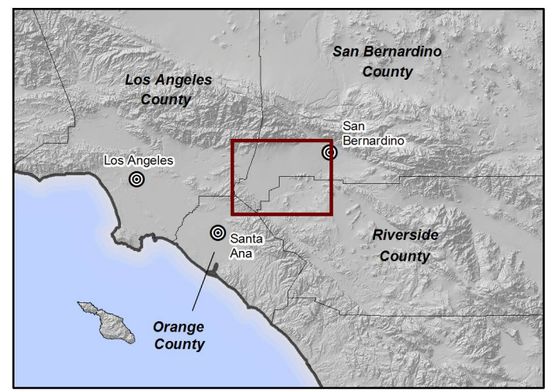
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-6_change14-16

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

**Groundwater-Level Change from Spring 2014 to Spring 2016**

*Shallow Aquifer System*

**Exhibit 4-6**

117°40'0"W

34°0'0"N

Chino Ave
Schaefer Ave
Edison Ave
Merrill Ave
Limonite Ave
Kimball Ave
Bellegrave Ave
Ramona Ave
Central Ave
Mountain Ave
Euclid Ave
Grove Ave
Cucamonga Ck
Archibald Ave
Haven Ave
Hamner Ave
Etiwanda Ave
San Sevaine Ck
Day Ck
Chino Ck
Chino Fault
Santa Ana River
71
15

585 588 590 554 564 581 572 565 561 603 606 306 543 579 586 573 574 554 555 593 607 565 571 575 562 566 567 564 566 595 551 555 539 550 560 598 528 553 553 531 527 520 530 545 559 513 509

600 590 580 570 560 550 545 540 530 520 510

Hydraulic Control is a Regional Board requirement that allows for the reuse and recharge of recycled water in the Chino Basin. Hydraulic Control is defined as eliminating groundwater discharge from the Chino-North MZ to the Prado Basin MZ, or controlling the discharge to de minimis levels of less than 1,000 acre-ft/yr. Hydraulic Control is to be achieved and maintained via drawdown of groundwater levels caused by pumping at the Chino Basin Desalter wells.

This map illustrates groundwater elevation and flow directions in the southern Chino Basin prior to the commencement of pumping at the Chino Basin Desalter wells (Spring 2000). The groundwater-elevation contours depict regional groundwater flow from the northeast to the southwest under a hydraulic gradient that steepens slightly south of the current location of the Chino-I Desalter well field. This map is consistent with the conceptual model of the Chino Basin, wherein groundwater flows from areas of recharge in the north/northeast toward areas of discharge in the south near the Prado Basin and the Santa Ana River. Pumping at the Chino-I Desalter well field began in late spring to early summer 2000, so its effects on groundwater levels are not apparent on this map.

117°40'0"W

800 775 Groundwater-Elevation Contours (feet above mean sea-level)

*Water-Level Qualification Symbol Code (Showing Groundwater Elevation)*
- Static
- Recovering
- Estimated Static
- Dynamic

*Aquifer Layer Where Well Casing is Perforated*
- Layer 1
- Layers 1 & 2
- Layer 2
- Layers 2 & 3
- Layer 3
- Layers 1 & 2 & 3
- Unknown Well Construction

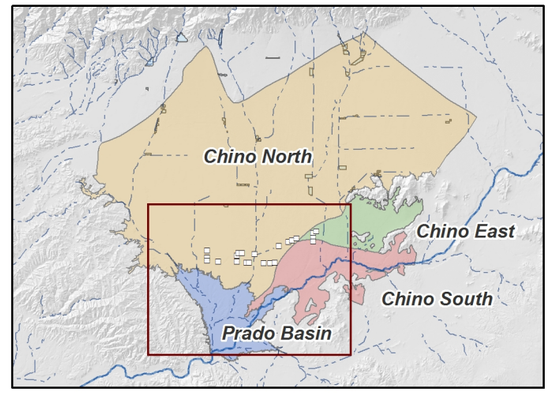
Future Location of Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

*Maximum Benefit Management Zones*
- Chino-North
- Chino-South
- Chino-East
- Prado Basin

*Faults*
- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:
WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 6/26/2017
Document Name: Exhibit_4-7_HCMP_00

N

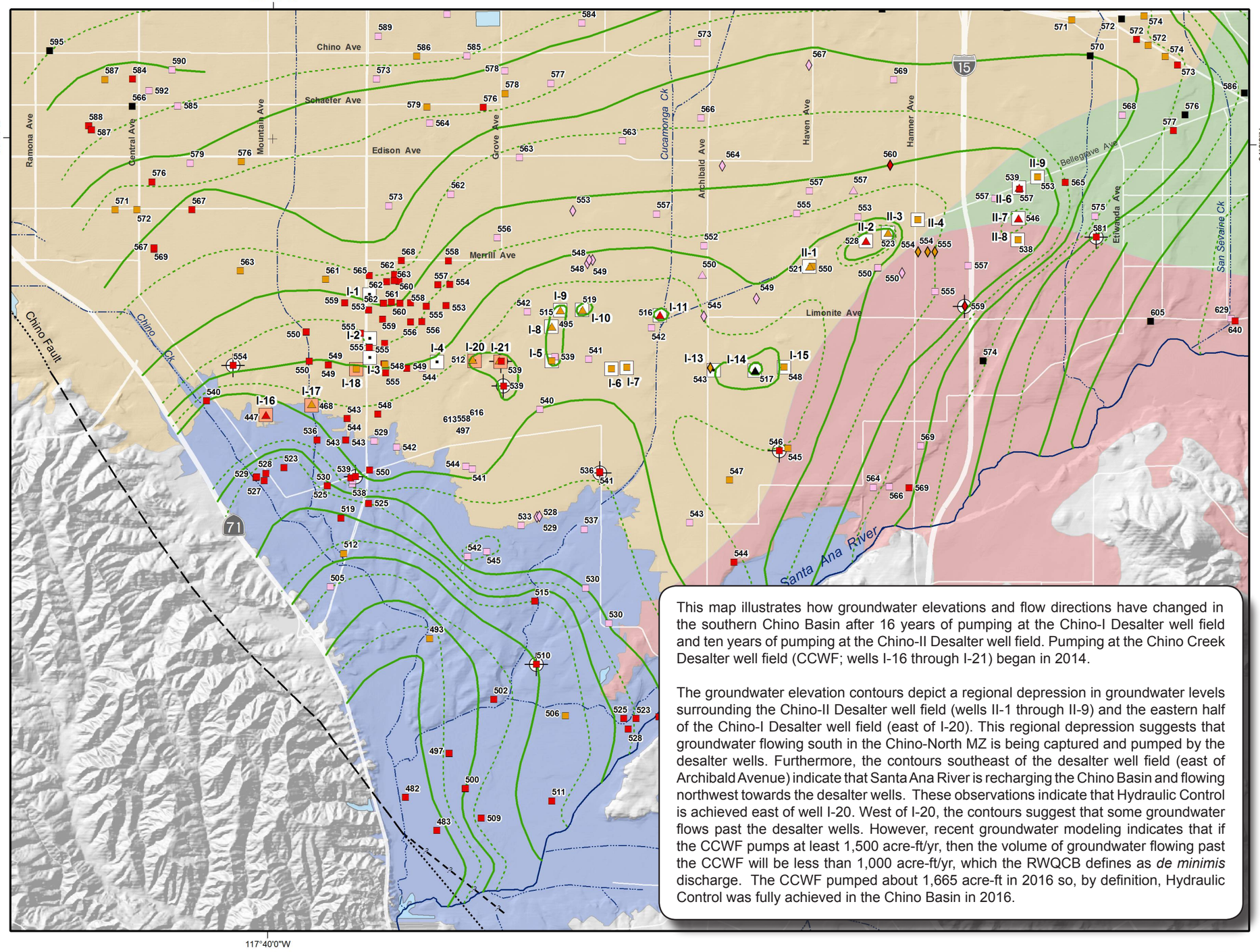
0 1 2 Miles
0 1 2 3 KM

2016 State of the Basin
*Groundwater Levels*

# State of Hydraulic Control in Spring 2000

*Shallow Aquifer System*

**Exhibit 4-7**




This map illustrates how groundwater elevations and flow directions have changed in the southern Chino Basin after 16 years of pumping at the Chino-I Desalter well field and ten years of pumping at the Chino-II Desalter well field. Pumping at the Chino Creek Desalter well field (CCWF; wells I-16 through I-21) began in 2014.

The groundwater elevation contours depict a regional depression in groundwater levels surrounding the Chino-II Desalter well field (wells II-1 through II-9) and the eastern half of the Chino-I Desalter well field (east of I-20). This regional depression suggests that groundwater flowing south in the Chino-North MZ is being captured and pumped by the desalter wells. Furthermore, the contours southeast of the desalter well field (east of Archibald Avenue) indicate that Santa Ana River is recharging the Chino Basin and flowing northwest towards the desalter wells. These observations indicate that Hydraulic Control is achieved east of well I-20. West of I-20, the contours suggest that some groundwater flows past the desalter wells. However, recent groundwater modeling indicates that if the CCWF pumps at least 1,500 acre-ft/yr, then the volume of groundwater flowing past the CCWF will be less than 1,000 acre-ft/yr, which the RWQCB defines as *de minimis* discharge. The CCWF pumped about 1,665 acre-ft in 2016 so, by definition, Hydraulic Control was fully achieved in the Chino Basin in 2016.

-800- Groundwater-Elevation Contours
.775. (feet above mean sea-level)

*Water-Level Qualification Symbol Code (Showing Groundwater Elevation)*

- Measured Static
- Interpolated Static
- Dynamic, Recovering, or Activity Unknown

*Aquifer Layer Where Well Casing is Perforated Color Code*

- Layer 1
- Layers 1 & 2
- Layers 1 & 2 & 3
- Unknown Well Construction

- HCMP Monitoring Well
- Chino Basin Desalter Well
- Chino Creek Desalter Well

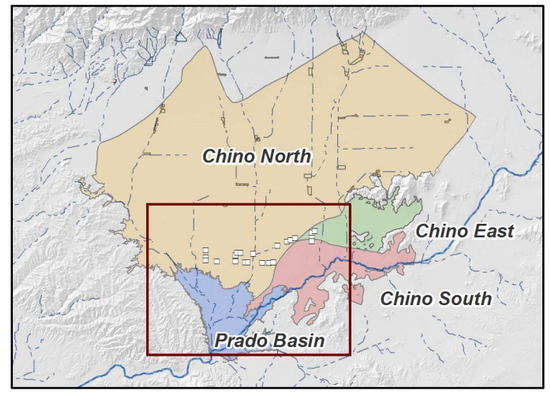
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

*Maximum Benefit Management Zones*

- Chino-North
- Chino-East
- Chino-South
- Prado Basin

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:
WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-8_HCMP_16

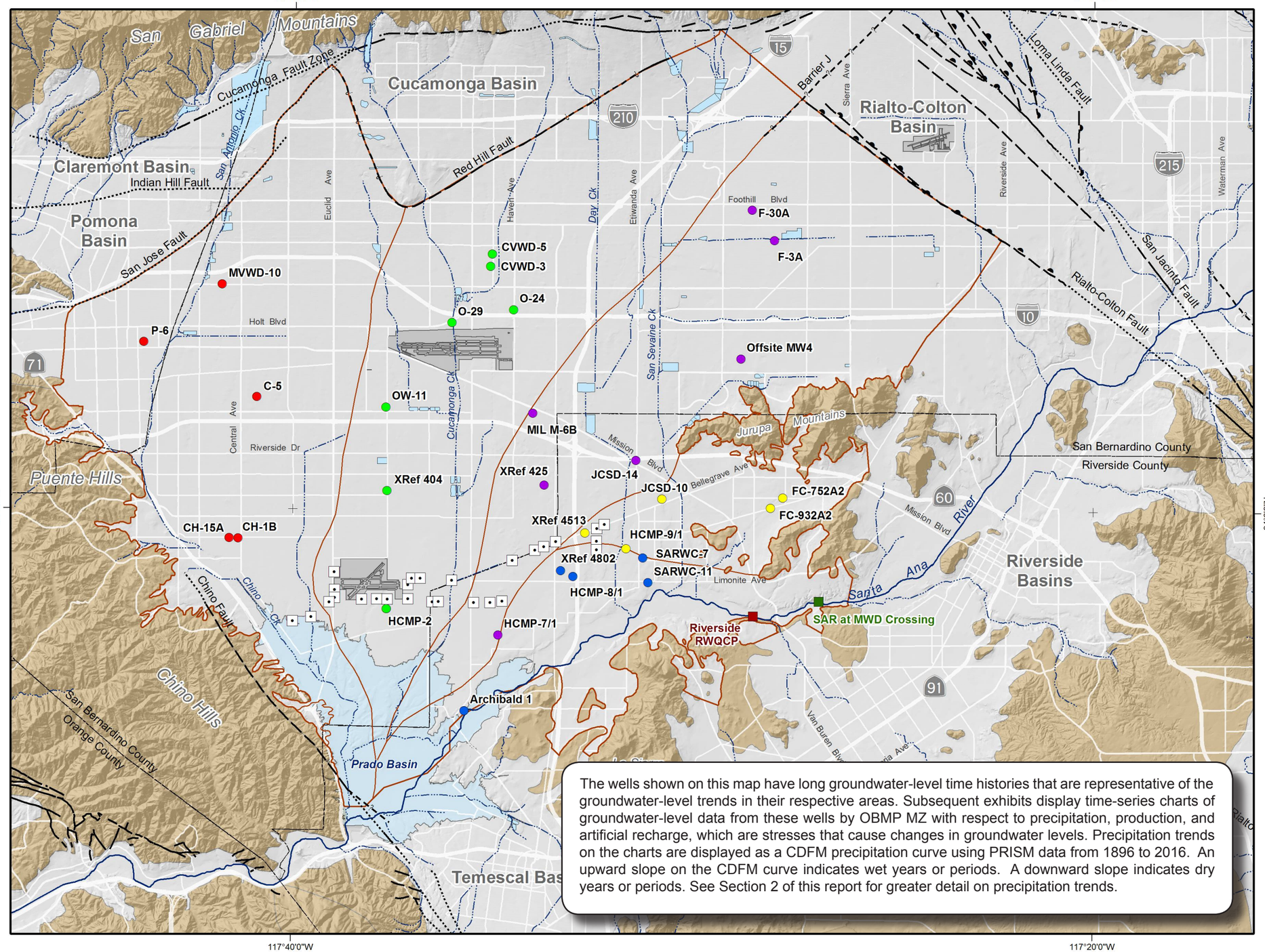
0 1 2 Miles
0 1 2 3 KM

2016 State of the Basin
*Groundwater Levels*

# State of Hydraulic Control in Spring 2016

*Shallow Aquifer System*

**Exhibit 4-8**




The wells shown on this map have long groundwater-level time histories that are representative of the groundwater-level trends in their respective areas. Subsequent exhibits display time-series charts of groundwater-level data from these wells by OBMP MZ with respect to precipitation, production, and artificial recharge, which are stresses that cause changes in groundwater levels. Precipitation trends on the charts are displayed as a CDFM precipitation curve using PRISM data from 1896 to 2016. An upward slope on the CDFM curve indicates wet years or periods. A downward slope indicates dry years or periods. See Section 2 of this report for greater detail on precipitation trends.

Wells With a Groundwater-Level Time History Plotted on Exhibit 4-10 through Exhibit 4-14

- Wells in MZ1
- Wells in MZ2
- Wells in MZ3
- Wells in MZ4
- Wells in MZ5

Surface-Water Monitoring Sites Plotted on Exhibit 4-14

- Wastewater Discharge Location
- USGS Gaging Station




OBMP Management Zones

- Chino Basin Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

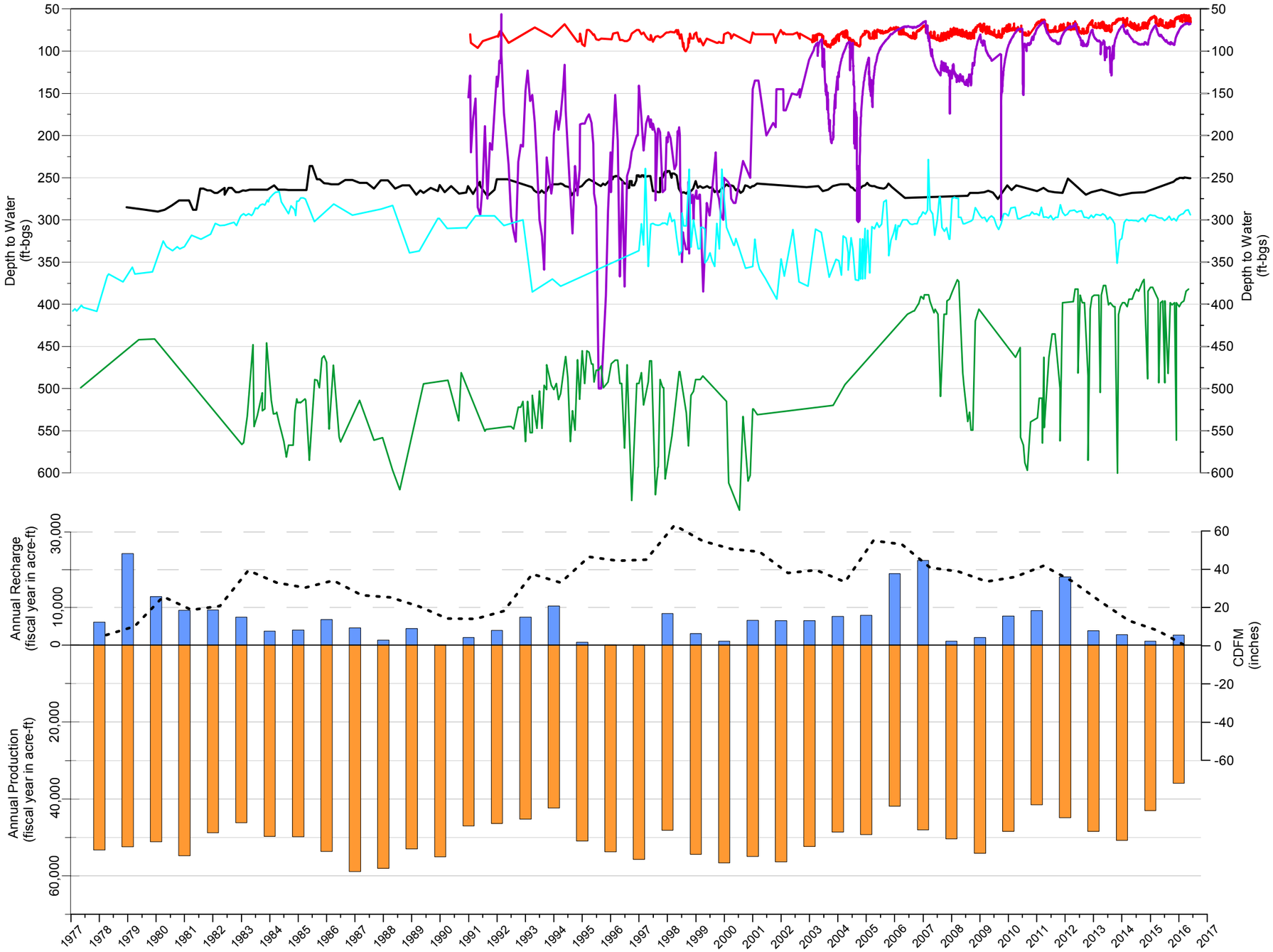
Author: EM
Date: 6/5/2017
Document Name: Exhibit_4-9_WLTime_His

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Levels*

**Wells Used to Characterize Long-Term Trends in Groundwater Levels Versus Precipitation, Production, and Recharge**

**Exhibit 4-9**




Water levels at wells MVWD-10, P-6, and C-5 are representative of groundwater-level trends in the central and northern portions of MZ1. During the implementation of the OBMP from 2000 to 2016, groundwater levels at MVWD-10 and P-6 increased by about 130 and 35 feet respectively, although this was a relatively dry period. The changes in groundwater levels in this area are due to a general decline in groundwater production from this area, the "put and take" cycles associated with Metropolitan Water District of Southern California's Dry-Year Yield storage program in Chino Basin, mandatory recharge of Supplemental Water in MZ1 to improve the balance of recharge and discharge; and facilities improvements to enhance the recharge of storm, recycled, and imported waters. For well C-5, groundwater levels remained relatively stable from 2000 to 2016, fluctuating by about +/- 10 feet.

Water levels at well CH-1B are representative of groundwater-level trends in the deep, confined aquifer system in the southern portion of MZ1. Water levels at this well are influenced by pumping from nearby wells that are also screened within the deep aquifer system. During the 1990s, water levels at this well declined by up to 200 feet due to increased pumping from the deep aquifer system in this area. From 2000 to 2007, water levels at this well increased primarily due to: decreased pumping from the deep aquifer system associated with poor groundwater quality; and the management of land subsidence (WEI, 2007b). Since 2007, water levels at this well have remained relatively stable, fluctuating annually by about +/- 25 feet due to the seasonal production patterns from the deep aquifer system in this area.

Water levels at well CH-15A are representative of groundwater-level trends in the shallow, unconfined aquifer system in the southern portion of MZ1. Historically, water levels in CH-15A were stable, fluctuating between 80 to 90 ft-bgs in response to nearby pumping. Since 2000, water levels have risen by about 20 feet, which is partly due to the increasing availability of recycled water for direct uses that result in a decrease in local pumping.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 06/27/2017
File: Exhibit_4-10_MZ1.grf

Groundwater Levels at Wells (Perforated Interval Depth)

- MVWD 10 (540-1,084 ft-bgs)
- P-6 (536-1,050 ft-bgs)
- C-5 (430-1,078 ft-bgs)
- CH-1B (440-1,180 ft-bgs)
- CH-15A (190-310 ft-bgs)

Production, Recharge, and Precipitation

- Recharge of Imported Water and Recycled Water at Basins in MZ1
- Groundwater Production from Wells in MZ1
- CDFM Precipitation Plot using PRISM 4-km grid for 1896-2016 (Spatial Average for Chino Basin)

Chino Basin Watermaster
Partners in Basin Management

**2016 State of the Basin**
Groundwater Levels

**Time-Series Chart of Groundwater Levels Versus Precipitation, Production, and Recharge**
***MZ1 - 1978 to 2016***

**Exhibit 4-10**

Water levels at wells CVWD-3 and CVWD-5 are representative of groundwater-level trends in the northern portion of MZ2. Water levels increased from 1978 to about 1990, likely due to a combination of the 1978 to 1983 wet period, decreased production following the execution of the Judgment, and the initiation of the artificial recharge of imported water in the San Sevaine and Etiwanda Basins. From 1990 to 2010, water levels progressively declined by about 75 feet due to increased production in the region. From 2010 to 2014, water levels increased by about 30 feet, likely due to decreased production and increased recharge at the San Sevaine and Victoria basins. From 2014 to 2016 water levels decreased by about 30 feet, likely in response to decreased recharge and increased production in the region.

Water levels at wells O-29 and O-24 are representative of groundwater-level trends in the upper-central portion of MZ2, and experienced a similar history of groundwater-level changes as the wells in the northern portion of MZ2.

Water level data at wells OW-11 and XRef 404 are representative of trends in the lower-central portion of MZ2. Well OW-11 is located adjacent to the Ely Basins, and well XRef 404 is located in the region south of the all the recharge basins in MZ2 and north of the Chino Basin Desalter wells. From 2000 to 2004, water levels at both wells decreased by a few feet, likely due to a combination of a dry period increases in production in MZ2, and very little artificial recharge. From 2005 to 2016, water levels increased at OW-11 and XRef 404 by up to ten feet, likely due to decreased production and increased recharge in MZ2.

Water levels at wells HCMP-2/1 (shallow aquifer) and HCMP-2/2 (deep aquifer) are representative of groundwater-level trends in the southern portion of MZ2, just south of the Chino-I Desalter wells. One of the objectives of the desalter well field is to cause the lowering of groundwater levels to achieve Hydraulic Control of the Chino Basin (see Exhibits 4-7 and 4-8 for further explanation of Hydraulic Control). The Chino-I Desalter well field began pumping in late 2000. Since 2005, when these wells were constructed, groundwater levels in this area have declined by about five feet.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 06/27/2017
File: Exhibit_4-11.grf

Groundwater Levels at Wells (Perforated Interval Depth)

- CVWD-5 (538-1,238 ft-bgs)
- CVWD-3 (341-810 ft-bgs)
- O-29 (400-1,095 ft-bgs)
- O-24 (484-952 ft-bgs)
- OW-11 (323-333 ft-bgs)
- XRef 404 (274-354 ft-bgs)
- HCMP-2/2 (296-316 ft-bgs)
- HCMP-2/1 (124-164 ft-bgs)

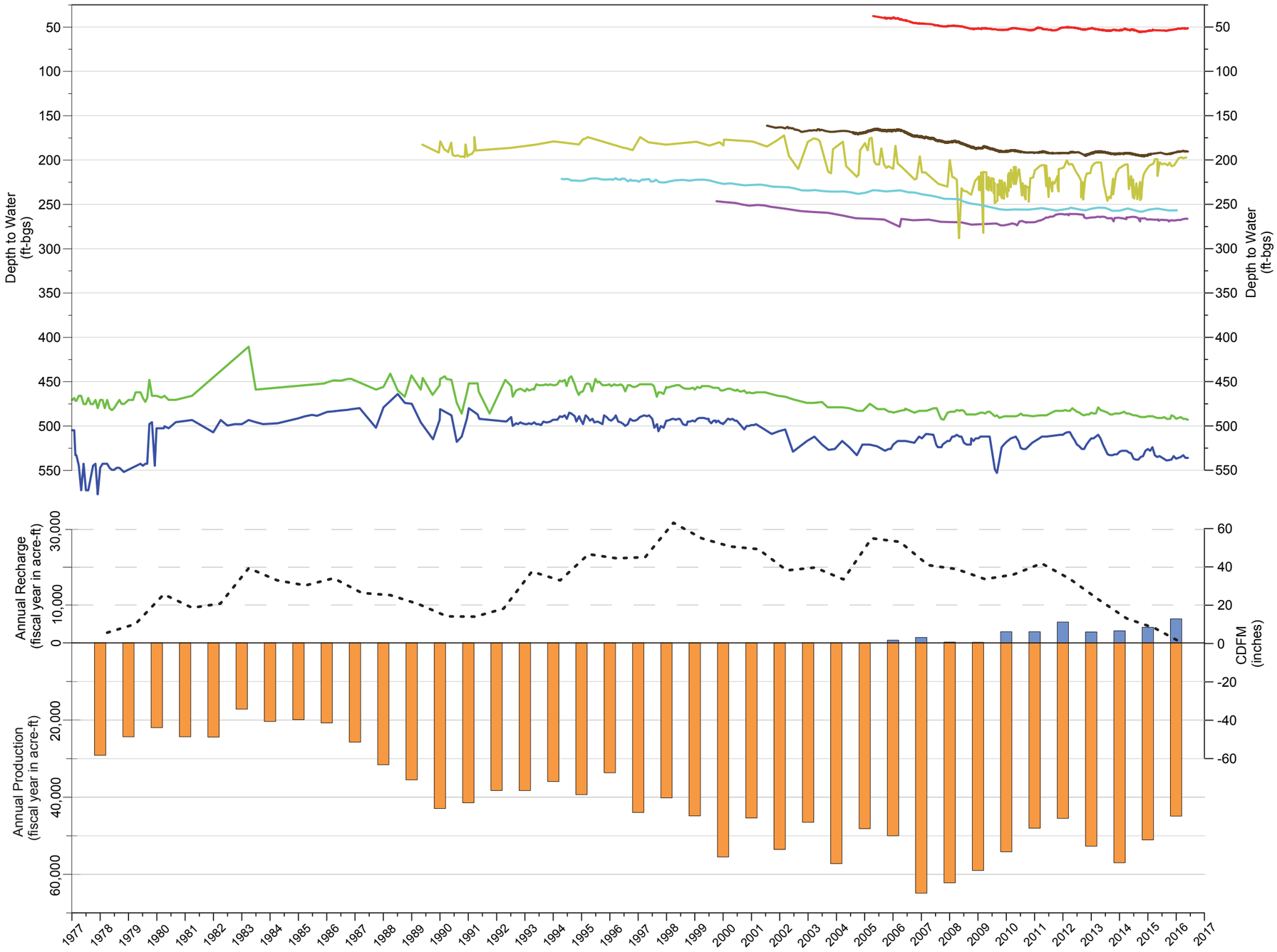
Production, Recharge, and Precipitation

- Recharge of Imported Water and Recycled Water at Basins in MZ2
- Groundwater Production from Wells in MZ2
- CDFM Precipitation Plot using PRISM 4-km grid for 1896-2016 (Spatial Average for Chino Basin)

**2016 State of the Basin**
Groundwater Levels

**Time-Series Chart of Groundwater Levels Versus Precipitation, Production, and Recharge**
***MZ2 - 1978 to 2016***

**Exhibit 4-11**




Water levels at wells F-30A and F-3A are representative of groundwater-level trends in the northeastern portions of MZ3. From 2000 to 2009, water levels declined by approximately 25-30 feet due to a dry climatic period and increased pumping in MZ3. From 2009 to 2012, water levels at these wells stabilized, likely due to decreased production and increasing artificial recharge. Since 2012, water levels at these wells declined by about 10 to 20 feet as groundwater production increased during a dry period.

Water levels at wells Offsite MW4, Mill M-6B, JCSD-14, and XRef 425 are representative of groundwater-level trends in the central portion of MZ3. From 2000 to 2010, groundwater levels in this area progressively declined by about 30 feet due to a dry period and increased pumping in MZ3. From 2010 to 2016, groundwater levels stabilized, neither decreasing or increasing by more than 15 feet, likely due to reduced production and increases in artificial recharge. Water levels at Offsite MW4 increased by about 10 feet from 2010 to 2012, which was likely due to improvements to the RP3 recharge basins which allowed for increases in storm-water and recycled water recharge.

Water levels at well HCMP-7/1 are representative of groundwater-level trends in the southernmost portion of MZ3—just south of the Chino-II Desalter well field and just north of the Santa Ana River. From 2005 to 2010, water levels at this well declined by about 15 feet, mainly due to the onset of pumping at the Chino-II Desalter well field. From 2011 to 2016, water levels stabilized, fluctuating by about +/- 2 feet.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 06/27/2017
File: Exhibit_4-12.grf

Groundwater Levels at Wells (Perforated Interval Depth)

- F-30A (507-864 ft-bgs)
- F-3A (380-854 ft-bgs)
- Offsite MW4 (222-282 ft-bgs)
- Mill M-06B (255-275 ft-bgs)
- JCSD-14 (210-370 ft-bgs)
- XRef 425 (no perf data)
- HCMP-7/1 (70-110 ft-bgs)

Production, Recharge, and Precipitation

- Recharge of Imported Water and Recycled Water at Basins in MZ3
- Groundwater Production from Wells in MZ3
- CDFM Precipitation Plot using PRISM 4-km grid for 1896-2016 (Spatial Average for Chino Basin)

Chino Basin Watermaster
Partners in Basin Management

**2016 State of the Basin**
Groundwater Levels

**Time-Series Chart of Groundwater Levels Versus Precipitation, Production, and Recharge**
***MZ3 - 1978 to 2016***

**Exhibit 4-12**

Water levels at wells JCSD-10, XRef 4513, and HCMP-9/1 are representative of groundwater-level trends in the western portion of MZ4—in the vicinity of the major well fields of the JCSD and the Chino-II Desalter. Water levels at JCSD-10 and XRef 4513 began to decrease around 2000 and show a notable acceleration in the decline of groundwater-levels around 2006 when pumping at Chino-II Desalter wells commenced. A similar decrease is seen in HCMP-9/1, where water levels declined by about 20 feet since the well's construction in 2005. Overall in this portion of MZ4, water levels have declined by about 35 feet since 2000 due to a dry climatic period and increased pumping. The decline of groundwater levels seen at these wells is necessary to achieve Hydraulic Control of the Chino Basin (see Exhibits 4-7 and 4-8 for further explanation of Hydraulic Control). The decline of groundwater levels in this area is also a concern of the JCSD with regard to production sustainability at its wells.

Water levels at wells FC-752A2 and FC-932A2 are representative of groundwater-level trends in the eastern portion of MZ4. From 2000 to 2016, the water levels at these wells declined by about ten feet, likely in response to the dry period.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 06/27/2017
File: Exhibit_4-13_MZ4.grf

Groundwater Levels at Wells (Perforated Interval Depth)

- JCSD-10 (no perf data)
- XRef 4513 (no perf data)
- HCMP-9/1 (110-150 ft-bgs)
- FC-752A2 (no perf data)
- FC-932A2 (no perf data)

Production, Recharge, and Precipitation

- Recharge of Imported Water and Recycled Water at Basins in MZ4
- Groundwater Production from Wells in MZ4
- CDFM Precipitation Plot using PRISM 4-km grid for 1896-2016 (Spatial Average for Chino Basin)

2016 State of the Basin
Groundwater Levels

**Time-Series Chart of Groundwater Levels Versus Precipitation, Production, and Recharge**
***MZ4 - 1978 to 2016***

**Exhibit 4-13**

MZ5 is a groundwater flow system that parallels the Santa Ana River. The discharge of the Santa Ana River shown on this chart is the total flow measured at the USGS gage SAR at MWD Crossing and the total effluent discharged to the Santa Ana River from the City of Riverside's wastewater treatment plant. This discharge represents the total potential volume of Santa Ana River water that can recharge the Chino Basin in MZ5.

Water levels at wells XRef 4802, SARWC-7, SARWC-11, and HCMP-8/1 are representative of groundwater levels in the eastern portion of MZ5, where the Santa Ana River is recharging the Chino Basin. From 2005 to 2016, water levels at these wells progressively declined by about 8 to 30 feet. This decline of groundwater-levels coincided with increased pumping at the Chino Basin Desalter well field, which has helped to achieve Hydraulic Control in this portion of the Chino Basin. This decline of groundwater-levels also indicates that recharge of the Santa Ana River to the Chino Basin in this area has increased.

Water levels at the Archibald-1 well are representative of groundwater levels in the southwestern portion of MZ5, where groundwater is very near the ground surface and could be rising to become flow in the Santa Ana River. Water levels at this near-river well have not changed by more than 15 feet since monitoring began in 2000.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 06/27/2017
File: Exhibit_4-14_MZ5.grf

Groundwater Levels at Wells (Perforated Interval Depth)

- XRef 4802 (no perf data)
- SARWC-07 (100-172 ft-bgs)
- HCMP-8/1 (75-115 ft-bgs)
- SARWC-11 (75-230 ft-bgs)
- Archibald 1 (75-85 ft-bgs)

Production, Recharge, and Precipitation

- Flow of the *Santa Ana River at MWD Xing*
- Discharge from the City of Riverside WWTP
- Groundwater Production from Wells in MZ5
- CDFM Precipitation Plot using PRISM 4-km grid for 1896-2016 (Spatial Average for Chino Basin)

**2016 State of the Basin**
Groundwater Levels

# Time-Series Chart of Groundwater Levels Versus Precipitation, Production, and Recharge
## *MZ5 - 1978 to 2016*

**Exhibit 4-14**

The exhibits in this section show the physical state of the Chino Basin with respect to groundwater quality, using data from the Chino Basin groundwater-quality monitoring programs.

Prior to OBMP implementation, historical groundwater-quality data were obtained from the California Department of Water Resources (DWR) and supplemented with data from some producers in the Appropriative Pool and some data from the State of California Department of Public Health (now the California State Water Resources Control Board Division of Drinking Water [DDW]). As part of the OBMP implementation *Program Element 1 – Develop and Implement a Comprehensive Monitoring Program,* Watermaster began conducting a more robust water quality monitoring program to support the activities in other Program Elements such as *Program Element 6 – Develop and Implement Cooperative Programs with the Regional Board and Other Agencies to Improve Basin Management* and *Program Element 7 – Develop and Implement Salt Management Program*.

In 1999, Watermaster initiated the comprehensive monitoring program to perform systematic sampling of private wells south of State Route 60 in the Chino Basin. By 2001, Watermaster had sampled all known wells at least once to develop a robust baseline dataset. Since that time Watermaster has continued its sampling and data collection efforts and is constantly evaluating and revising the monitoring programs as wells are abandoned or destroyed due to urban development. The details of the groundwater monitoring programs as of FY 2015/16 are described below.

**Chino Basin Data Collection (CBDC)**. Watermaster routinely and proactively collects groundwater-quality data from well owners, such as municipal producers and government agencies. Groundwater-quality data are also obtained from special studies and monitoring that takes place under the orders of the Regional Water Quality Control Board (RWQCB)—such as for landfills and other groundwater quality investigations, the Department of Toxic Substances Control (DTSC), the USGS, and others. These data are collected from the well owners and monitoring entities twice per year. In 2016, data was collected for over 780 wells as part of the CBDC program.

**Watermaster Field Groundwater Quality Monitoring Programs.** Watermaster continues to sample privately-owned wells and its own monitoring wells on a routine basis as follows:

- ***Private Wells***. Currently, about 100 private wells, located predominantly in the southern portion of the Basin are sampled at various frequencies based on their proximity to known point-source contamination plumes. 89 wells are sampled on a triennial basis, and 20 wells near contaminant plumes are sampled on an annual basis.

***Watermaster Monitoring Wells.*** Watermaster collects groundwater quality samples from a total of about 22 multi-nested monitoring wells located throughout the southern Chino Basin. These include nine nested HCMP monitoring wells constructed to support the demonstration of Hydraulic Control, nine sites constructed to support the Prado Basin Habitat Sustainability Program, and four sites that fill spatial data gaps near contamination plumes in MZ3. Each nested well site contains up to three wells in the borehole. The HCMP and MZ3 wells are sampled annually. The PBHSP wells are sampled quarterly.

***Other wells***. Watermaster collects quarterly samples from four near-river wells to characterize the interaction of the Santa Ana River and groundwater. These shallow monitoring wells along the Santa Ana River consist of two former US Geological Survey (USGS) National Water Quality Assessment Program (NAWQA) wells (Archibald 1 and Archibald 2) and two Santa Ana River Water Company (SARWC) wells (well 9 and well 11).

All groundwater-quality data are checked by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE$^{SM}$. The data are used to: comply with two of its maximum-benefit salinity management commitments—the triennial ambient water quality re-computation and the analysis of hydraulic control, prepare Watermaster's biennial SOB report (this report), support ground-water modeling, characterize non-point source contamination and plumes associated with point-source discharges, and characterize long-term trends in water quality.

In this section, groundwater-quality data for the five-year period from July 2011 to June 2016 were analyzed synoptically and temporally to characterize current water quality. The analysis does not represent a programmatic investigation of potential sources of chemical constituents in the Basin. The wells with data over this five-year period are shown in Exhibit 5-1.

First, Groundwater quality is characterized with respect to constituents where groundwater exceeds Primary or Secondary California Maximum Contaminant Levels (MCLs), or Notification Levels (NLs). Wells with constituent concentrations greater than a Primary MCL represent areas of concern and the spatial distribution of these wells indicates areas in the Basin where groundwater may be impaired from a beneficial use standpoint. Exhibit 5-2 characterizes the number of wells in the Basin that exceed Primary or Secondary MCLs and Exhibits 5-3 through 5-11 show the areal distribution of constituent concentrations for constituents of potential concern (COPC) described in Exhibit 5-2.

Several of the constituents in Exhibits 5-3 through 5-11 are associated with known point-source discharges to groundwater. Understanding point sources of concern in the Chino Basin is critical to the overall management of groundwater quality to ensure that Chino Basin groundwater remains a sustainable resource. Watermaster closely monitors information, decisions, cleanup activities, and monitoring data pertaining to point-source contamination within the Chino Basin. The following is a list of the regulatory and voluntary groundwater-quality contamination monitoring efforts in the Chino Basin that are tracked by Watermaster, the locations of which are shown in Exhibit 5-15.

- Alumax Aluminum Recycling Facility
  **Constituents of Concern:** TDS, sulfate, nitrate, chloride
  **Order:** RWQCB Cleanup and Abatement Order 99-38

- Alger Manufacturing Co.
  **Constituents of Concern:** volatile organic chemicals (VOCs)
  **Order:** Voluntary Cleanup and Monitoring

- Chino Airport
  **Constituents of Concern:** VOCs
  **Order:** RWQCB Cleanup and Abatement Order 90-134

- California Institute for Men (No Further Action status, as of 2/17/2009)
  **Constituents of Concern:** VOCs
  **Order:** Voluntary Cleanup and Monitoring

- Former Crown Coach International Facility
  **Constituents of Concern:** VOCs and Solvents
  **Order:** Voluntary Cleanup and Monitoring

- General Electric Flatiron Facility
  **Constituents of Concern:** VOCs and hexavalent chromium
  **Order:** Voluntary Cleanup and Monitoring

- **General Electric Test Cell Facility**
  **Constituents of Concern:** VOCs
  **Order:** Voluntary Cleanup and Monitoring

- Former Kaiser Steel Mill
  **Constituents of Concern:** TDS, total organic carbon (TOC), VOCs
  **Order:** RWQCB Order No. 91-40 Closed. Kaiser granted capacity in the Chino II Desalter to remediate.

- Former Kaiser Steel Mill – CCG Property
  **Constituents of Concern:** chromium, hexavalent chromium, other metals, VOCs
  **Order:** DTSC Consent Order 00/01-001

- Milliken Sanitary Landfill
  **Constituents of Concern:** VOCs
  **Order:** RWQCB Order No. 81-003

- Upland Sanitary Landfill
  **Constituents of Concern:** VOCs
  **Order** RWQCB Order No 98-99-07

- South Archibald Plume
  **Constituents of Concern:** VOCs
  **Order:** This plume is currently being voluntarily investigated by a group of potentially responsible parties per seven Draft Cleanup and Abatement Orders

- Stringfellow NPL Site
  **Constituents of Concern:** VOCs, perchlorate, N-nitrosodimethylamine (NDMA), trace metals
  **Order:** The Stringfellow Site is the subject of US Environmental Protection Agency (EPA) Records of Decision (RODs): EPA/ROD/R09-84/007, EPA/ROD/R09-83/005, EPA/ROD/R09-87/016, and EPA/ROD/R09-90/048.

Every two years, Watermaster uses the data collected as part of its monitoring programs and other information to delineate the extent of the plumes associated with VOC contamination. Exhibits 5-12 and 5-13 show the current delineation and chemical differentiation of the VOC plumes. Exhibits 5-14 and 5-15 show more detailed information about the Chino Airport and South Archibald plumes, the monitoring and remediation activities for which are tracked and reported on by the Watermaster on a quarterly basis.

Exhibit 5-16 shows all the known point sources of potential contamination in the Chino Basin as of 2016 based on the SWRCB's GeoTracker and EnviroStor websites. GeoTracker is the State Board's online data-management system for compliance data collected for contamination sites with confirmed or potential impacts to groundwater. This includes locations where there have been unauthorized discharges of waste to land, or unauthorized releases of hazardous substances from underground storage tanks. EnviroStor is the DTSC's online data-management system for permitted hazardous waste facilities. In 2014, Watermaster performed a comprehensive review of the GeoTracker and EnviroStor databases to identify sites in the Chino Basin that may have an impact on groundwater quality but have not been previously tracked by the Watermaster. Watermaster reviews the GeoTracker and Envirostor databases annually to track the status of previously identified sites, identify new sites with potential or confirmed groundwater contamination, and add new data to Watermaster's database.

The remaining exhibits in this section display the long-term trends in groundwater quality in the Basin with respect to TDS and nitrate concentrations. The management of TDS and nitrate concentrations is essential to the Watermaster's maximum-benefit salt and nutrient management plan. In 2002, Watermaster proposed that the Regional Board adopt alternative maximum-benefit water quality objectives for the Chino-North Management Zone that were higher than the antidegradation water quality objectives for MZ-1, MZ-2, and MZ-3. The proposed objectives were approved by the Regional Board and incorporated into the Basin Plan in 2004 (RWQCB, 2004). The maximum-benefit objectives enabled the Watermaster and IEUA to implement recycled water recharge and reuse throughout the Chino Basin. The application of the maximum-benefit objectives is contingent upon the implementation of specific projects and programs by Watermaster and the IEUA known as the "Chino Basin maximum-benefit commitments." The commitments include requirements for basin-wide monitoring of groundwater quality, and the triennial recomputation of ambient TDS and nitrate. They also require the development of plans and schedules for water quality improvement programs when current ambient TDS exceeds the maximum-benefit objective, or when recycled water used for recharge and irrigation exceeds the discharge limitations listed in the IEUA's recycled water discharge and reuse permits. Exhibits 5-17 and 5-18 show trends in the ambient water quality determinations for TDS and nitrate, and Exhibits 5-19 through Exhibit 5-27 show the TDS and nitrate concentration time histories for selected wells from 1972 to 2016. These time histories illustrate groundwater-quality variations and trends within each management zone and the current state of groundwater quality compared to those historical trends.

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Pomona Basin

Rialto-Colton Basin

Indian Hill Fault

San Jose Fault

Red Hill Fault

San Antonio Ck

Day Ck

Cucamonga

Barrier J

Sierra Ave

Loma Linda Fault

Riverside Ave

Waterman Ave

Haven Ave

Euclid Ave

Central Ave

Eliwanda Ave

Foothill Blvd

Holt Blvd

Mission Blvd

Riverside Dr

Belegrave Ave

San Jacinto Fault

Rialto-Colton Fault

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Santa Ana River

Puente Hills

Chino Hills

Chino Fault

Chino

San Bernardino County

Orange County

Prado Basin

Temescal Basin

Van Buren

Limonite Ave

71

15

210

10

60

215

Watermaster's current water quality monitoring program relies on municipal producers, government agencies, and others to supply their groundwater-quality data on a cooperative basis. Watermaster supplements these data with through its own sampling and analysis program of private wells and monitoring wells in the area generally south of Highway 60. All groundwater-quality data are collected and checked by Watermaster staff and uploaded to a centralized data management system that can be accessed online through HydroDaVE℠. For the July 2011 to June 2016 period, water quality data were available at a total of 1,358 wells within the Chino Basin. Of these, 828 wells were sampled in Fiscal Year 2016.

## Wells with Groundwater-Quality Monitoring Data During June 2011 to June 2016

- Monitoring (1074 wells)
- Municipal (280 wells)
- Private (167 wells)
- Chino Basin Desalter Wells

OBMP Management Zones

Streams & Flood Control Channels

Flood Control & Conservation Basins

### *Geology*

Water-Bearing Sediments

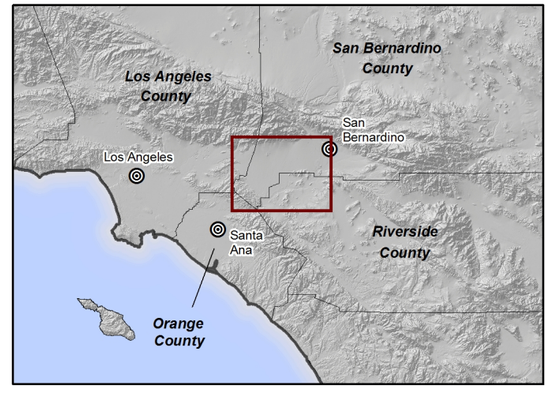
- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: NWS

Date: 6/26/2017

Document Name: Exhibit_5-1_WQ_Wells

0 2 4 Miles

0 3 6 KM

2016 State of the Basin

*Groundwater Quality*

**Wells with Groundwater Quality Data**

*July 2011 to June 2016*

**Exhibit 5-1**

| Primary Contaminant | | |
|---|---|---|
| Analyte | California MCL | Number of Wells with Exceedance |
| 1,1,2-Trichloroethane | 5 ug/L | 1 |
| 1,1-Dichloroethane | 5 ug/L | 2 |
| 1,1-Dichloroethene (1,1-DCE) | 6 ug/L | 16 |
| 1,2,4-Trichlorobenzene | 5 ug/L | 34 |
| 1,2-Dibromo-3-chloropropane | 0.2 ug/L | 5 |
| 1,2-Dichlorobenzene | 600 ug/L | 47 |
| 1,2-Dichloroethane | 0.5 ug/L | 64 |
| 1,2-Dichloropropane | 5 ug/L | 2 |
| 1,4-Dichlorobenzene | 5 ug/L | 110 |
| Aluminum | 1 mg/L | 94 |
| Antimony | 6 ug/L | 1 |
| Arsenic[1] | 0.01 mg/L | 71 |
| Barium | 1 mg/L | 13 |
| Benzene | 1 ug/L | 98 |
| Beryllium | 0.004 mg/L | 21 |
| Bromate | 0.01 mg/L | 9 |
| Cadmium | 0.005 mg/L | 57 |
| Carbon Tetrachloride | 0.5 ug/L | 12 |
| Chlorobenzene | 70 ug/L | 73 |
| Chromium (VI)[1] | 10 ug/L | 91 |
| Chromium[1] | 50 ug/L | 193 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 6 ug/L | 61 |
| Copper | 1.3 mg/L | 20 |
| Cyanide | 150 ug/L | 2 |
| Di(2-ethylhexyl)phthalate | 4 ug/L | 28 |
| Dichloromethane (Freon 30) | 5 ug/L | 108 |
| Ethylbenzene | 300 ug/L | 51 |
| Fluoride | 2 mg/L | 53 |
| Gross Alpha | 15 pCi/L | 12 |
| Heptachlor | 0.01 ug/L | 1 |
| Heptachlor Epoxide | 0.01 ug/L | 2 |
| Lead | 0.015 mg/L | 27 |
| Mercury | 0.002 mg/L | 3 |
| Methyl Tert-Butyl Ether (MTBE) | 13 ug/L | 76 |
| Nickel | 0.1 mg/L | 65 |
| Nitrate-Nitrogen[1] | 10 mg/L | 606 |
| Nitrite-Nitrogen | 1 mg/L | 26 |
| Pentachlorophenol | 1 ug/L | 1 |
| Perchlorate[1] | 6 ug/L | 457 |
| Ra 226 + Ra 228 | 5 pCi/L | 1 |
| Selenium | 0.05 mg/L | 9 |
| Tetrachloroethene (PCE)[1] | 5 ug/L | 110 |
| Thallium | 2 ug/L | 7 |
| Toluene | 150 ug/L | 38 |
| Total Xylene | 1750 ug/L | 24 |
| Trichloroethylene (TCE)[1] | 5 ug/L | 285 |
| Uranium | 20 pCi/L | 1 |
| Vinyl Chloride | 0.5 ug/L | 6 |

[1] Analytes chosen as COPC's based on spatial distribution of exceedances across the Chino Basin not associated with point source contaminant plumes

| Secondary Contaminant | | |
|---|---|---|
| Analyte | California MCL | Number of Wells with Exceedance |
| Aluminum | 1 mg/L | 121 |
| Chloride | 500 mg/L | 6 |
| Copper | 1.3 mg/L | 22 |
| Iron | 0.3 mg/L | 344 |
| Manganese | 0.05 mg/L | 287 |
| Methyl Tert-Butyl Ether (MTBE) | 13 ug/L | 98 |
| Odor | 3 TON | 2 |
| Specific Conductance | 1600 uS/cm | 120 |
| Sulfate | 250 mg/L | 134 |
| TDS[1] | 1000 mg/L | 122 |
| Turbidity | 5 NTU | 59 |
| Zinc | 5 mg/L | 30 |

All groundwater-quality data from the Chino Basin for the five-year period of July 2011 through June 2016 were analyzed for exceedances of Primary or Secondary California Maximum Contaminant Levels (MCLs) and Notification Levels (NLs). Primary MCLs are enforceable drinking water standards set by the DDW to protect the public from potential negative health effects associated with constituents of concern. Secondary MCLs are drinking water standards set by the DDW on the basis of undesirable aesthetic, cosmetic, or technical effects caused by a respective constituent. Notification Levels (NLs) are set by the DDW as a health advisory level for un-regulated contaminants and to monitor concentrations where there exists potential for negative health impacts, but the impacts and concentrations of concern are not well established. Constituents monitored under an NL may eventually become regulated as an MCL, pending formal regulatory review. HydroDaVESM was used to create an exceedance report for wells in the Chino Basin. The tables shown here list the number of wells in the Chino Basin with sample results during the reporting period that exceed CA Primary or Secondary MCLs.

Exhibits 5-3 through 5-14 are maps of the Chino Basin depicting the spatial distribution of wells with exceedances for constituents of potential concern. The constituents of potential concern are defined as follows:

- Constituents associated with salt and nutrient management planning (i.e. total dissolved solids [TDS] and nitrate).
- Constituents where a primary MCL was exceeded in twenty or more wells from July 2011 to June 2016 and where the majority of wells with exceedances are not primarily exclusive to known point source contamination plumes (i.e. the Stringfellow NPL Site, Milliken Landfill, etc.). These constituents include nitrate, perchlorate, total chromium, hexavalent chromium, arsenic, trichloroethene (TCE), and tetrachloroethene (PCE).
- Constituents for which the California DDW is in the process of developing an MCL that may impact future beneficial uses of groundwater. This includes 1,2,3-trichloropropane (1,2,3-TCP), which currently is monitored under a NL.

In each exhibit, the water-quality standard is defined in the legend, and each well is symbolized by the maximum concentration value measured during the reporting period. The following class interval convention is applied to each water quality standard:

| Symbol | Class Interval |
|---|---|
| ○ | Not Detected |
| ● | <0.5x WQS[1], but detected |
| ● | 0.5x WQS to WQS |
| ● | WQS to 2x WQS |
| ● | 2x WQS to 4x WQS |
| ● | > 4x WQS |

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Rialto-Colton Basin

Barrier J

Lytle Ck

Loma Linda Fault

San Antonio Ck

Haven Ave

Day Ck

Etiwanda Ave

Sierra Ave

Riverside Ave

Foothill Blvd

San Jacinto Fault

Rialto-Colton Fault

Euclid Ave

Central Ave

Holt Blvd

Mission Blvd

Cucamonga Ck

Riverside Dr

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Puente Hills

Beleagrave Ave

Limonite Ave

Santa Ana River

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

15

210

215

10

71

60

TDS is regulated as a secondary contaminant with a secondary California MCL of 500 milligrams per liter (mg/L). From 2011 to 2016, TDS was measured at 570 wells in the Chino Basin. Of these, 357, or 63%, have five-year maximum values that exceed the Secondary CA MCL. The highest five-year maximum TDS concentrations are anomalous and located near the Jurupa Mountains, within the Stringfellow NPL site, and range from 5,300 to 23,000 mg/L. Exclusive of these anomalous concentrations, the five-year maximum TDS concentrations range from 190 mg/L to 4,600 mg/L with average and median values of 778 mg/L and 640 mg/L, respectively. The wells with the highest TDS concentrations in this range are predominantly located south of Highway 60 in the area of historic and current agricultural land uses, including irrigated agriculture and dairies. Agricultural land uses impact the TDS concentration in groundwater through the disposal of dairy waste via land application and discharge to ponds, the use of fertilizer on crops, and the concentrating effects of the consumptive use of applied water for irrigation.

Total Dissolved Solids (TDS) (mg/L)

- < 125
- 125 - 250
- 250 - 500
- 500 - 1,000
- 1,000 - 2,000
- > 2,000

Secondary US EPA MCL = 500 mg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-3_TDS

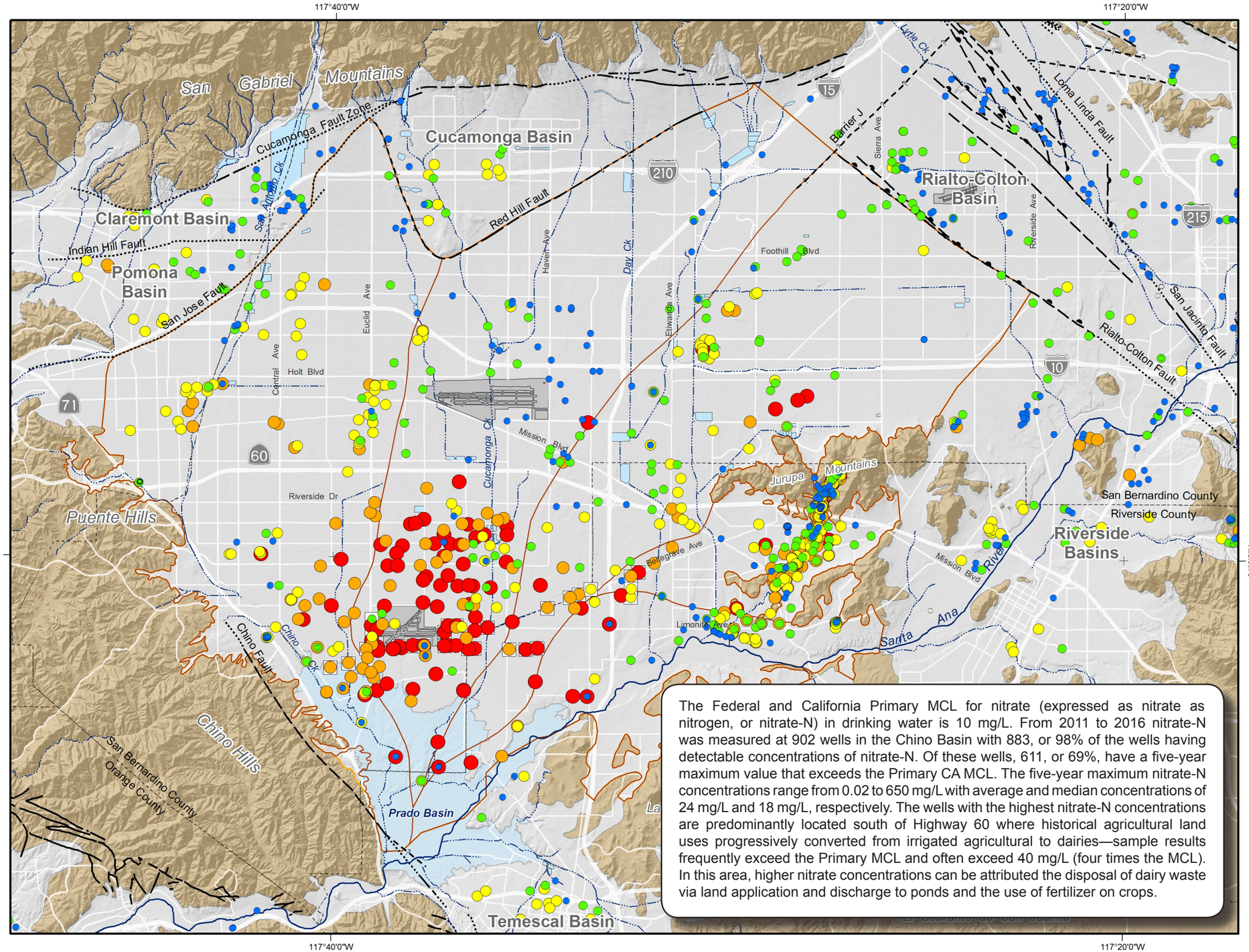
0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

## Total Dissolved Solids (TDS) in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-3**




The Federal and California Primary MCL for nitrate (expressed as nitrate as nitrogen, or nitrate-N) in drinking water is 10 mg/L. From 2011 to 2016 nitrate-N was measured at 902 wells in the Chino Basin with 883, or 98% of the wells having detectable concentrations of nitrate-N. Of these wells, 611, or 69%, have a five-year maximum value that exceeds the Primary CA MCL. The five-year maximum nitrate-N concentrations range from 0.02 to 650 mg/L with average and median concentrations of 24 mg/L and 18 mg/L, respectively. The wells with the highest nitrate-N concentrations are predominantly located south of Highway 60 where historical agricultural land uses progressively converted from irrigated agricultural to dairies—sample results frequently exceed the Primary MCL and often exceed 40 mg/L (four times the MCL). In this area, higher nitrate concentrations can be attributed the disposal of dairy waste via land application and discharge to ponds and the use of fertilizer on crops.

Nitrate-Nitrogen (NO3-N) (mg/L)

- ND
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

Primary US EPA MCL = 10 mg/L
Primary CA MCL = 10 mg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

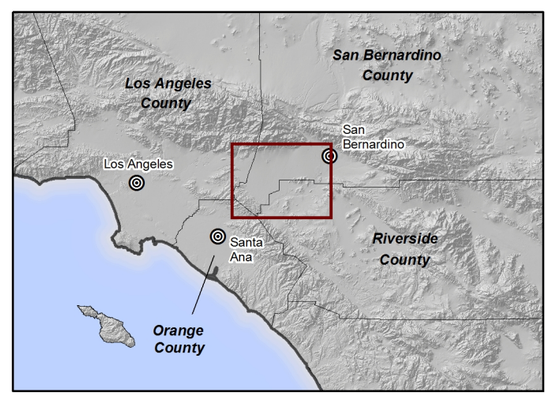
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-4_NO3

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

## Nitrate as Nitrogen ($NO_3$-N) in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-4**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

San Antonio Ck

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Haven Ave

Day Ck

Etiwanda Ave

Euclid Ave

Central Ave

Holt Blvd

Foothill Blvd

Lytle Ck

Barrier J

Sierra Ave

Rialto-Colton Basin

Riverside Ave

Lomna Linda Fault

San Jacinto Fault

Rialto-Colton Fault

Mission Blvd

Cucamonga Ck

Riverside Dr

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Puente Hills

Beregrave Ave

Limonite Ave

Santa Ana River

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

15

210

215

10

71

60

Perchlorate is a regulated drinking water contaminant in California with a Primary MCL of 6 micrograms per liter (µg/L). From 2011 to 2016, perchlorate was measured at 922 wells in Chino Basin, with 632, or 68%) having detectable concentrations. Of these, 460, or 73%, have a five-year maximum value that exceeds the Primary CA MCL. The five-year maximum perchlorate concentrations range from 0.07 to 6,400 µg/L with average and median concentrations of 409 and 12 µg/L, respectively. Perchlorate in groundwater can originate from synthetic and natural sources. Synthetic perchlorate, such as ammonium perchlorate, is used in the manufacturing of solid propellants used for rockets, missiles, and fireworks. The majority of the wells with a five-year maximum perchlorate concentration that is more than twice the MCL are monitoring wells associated with the Stringfellow NPL site where a perchlorate plume of synthetic nature extends from the Jurupa Mountains downgradient to Limonite Avenue. Natural perchlorate, such as that derived from the Chilean caliche used in Chilean nitrate fertilizer, was imported into the Chino Basin in the early 1900s by the citrus industry, which covered the north, west, and central portions of the basin. A perchlorate isotope investigation performed by Watermaster in 2006 confirmed that most of the perchlorate in the west and central portions of the Chino Basin was derived from Chilean nitrate fertilizer.

Perchlorate (µg/L)

- ND
- < 3
- 3 - 6
- 6 - 12
- 12 - 24
- > 24

CA Primary MCL = 6 µg/L




OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-5_CLO4

0 2 4 Miles

0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# Perchlorate in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-5**

117°40'0"W

117°20'0"W

34°0'0"N

Total Chromium (µg/L)

- ND
- < 25
- 25 - 50
- 50 - 100
- 100 - 200
- > 200

Primary US EPA MCL = 100 µg/L
Primary CA MCL = 50 µg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

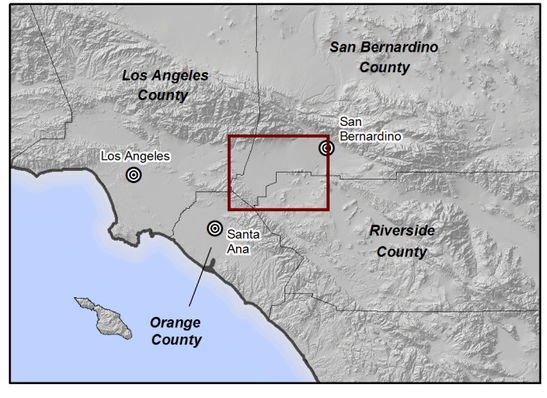
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Total Chromium is a regulated drinking water contaminant in California with a Primary MCL of 50 µg/L. Total Chromium in groundwater consists of trivalent and hexavalent chromium, deriving from both natural and anthropogenic sources, such as dye, paint pigments, and chrome plating liquid wastes. Most chromium in the environment exists as the trivalent ion,; however, under oxidizing conditions, the hexavalent ion may form and dissolve in water (CA SWRCB, 2016). While trace amounts of trivalent chromium are required for maintaining human health, hexavalent chromium is a known carcinogen. From 2011 to 2016, 891 wells in the Chino Basin were sampled for total chromium with 787, or 88%, having detectable concentrations. Of these wells, 146, or 19%, have a five-year maximum value that exceeds the Primary CA MCL. The five-year maximum chromium concentrations range from 0.51 to 1,200,000 µg/L with average and median concentrations of 9,934 and 10 µg/L respectively.

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-6_Cr

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# Total Chromium in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-6**

117°40'0"W

117°20'0"W

34°0'0"N

Hexavalent Chromium (µg/L)

- ND
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

Primary CA MCL = 10 µg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain

San Gabriel Mountains
Cucamonga Fault Zone
San Antonio Ck
Cucamonga Basin
Claremont Basin
Indian Hill Fault
Pomona Basin
San Jose Fault
Red Hill Fault
Haven Ave
Day Ck
Etiwanda Ave
Foothill Blvd
Lytle Ck
Barrier J
Sierra Ave
Rialto-Colton Basin
Riverside Ave
Loma Linda Fault
San Jacinto Fault
Rialto-Colton Fault
Euclid Ave
Central Ave
Holt Blvd
Mission Blvd
Cucamonga Ck
Riverside Dr
Jurupa Mountains
San Bernardino County
Riverside County
Riverside Basins
Santa Ana River
Limonite Ave
Puente Hills
Chino Fault
Chino Ck
Chino Hills
San Bernardino County
Orange County
Prado Basin
Temescal Basin

Hexavalent chromium is a newly regulated drinking water contaminant in California with a Primary MCL of 10 µg/L. In July 2014, the DDW adopted this Primary MCL and required that all public drinking water supply wells be sampled for hexavalent chromium within six months. In 2016, this mandated MCL was challenged in court by the California Manufacturers and Technology Association and the Solano County Taxpayers Association; they are petitioning that the MCL is too low to allow for economically feasible compliance (Superior Court of California, County of Sacramento; case #34-2015-80001850).

From 2011 to 2016, 884 wells in the Chino Basin were sampled for Hexavalent Chromium with 777, or 89%, having detectable concentrations. Of these wells, 92, or 12%, have a five-year maximum concentration exceeding the Primary CA MCL. The five-year maximum hexavalent chromium concentrations range from 0.01 to 14,000 µg/L with average and median concentrations of 59 and 2.6 µg/L respectively. The highest observed concentrations of hexavalent chromium are at wells associated with the GE Flat Iron Plume, the Stringfellow Plume, the Former Kaiser Steel Mill-CCG Property, and the Milliken Landfill.




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-7_HexCr

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

## Hexavalent Chromium in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-7**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

San Antonio Ck

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Haven Ave

Day Ck

Etiwanda Ave

Foothill Blvd

Lytle Ck

Barrier J

Sierra Ave

Rialto-Colton Basin

Riverside Ave

Loma Linda Fault

San Jacinto Fault

Rialto-Colton Fault

Euclid Ave

Central Ave

Holt Blvd

Mission Blvd

Cucamonga Ck

Riverside Dr

Puente Hills

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Mission Blvd

Santa Ana River

Beleagrave Ave

Limonite Ave

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

15

210

215

10

71

60

Arsenic is a regulated drinking water contaminant in California with a Primary MCL of 10 µg/L. Arsenic in groundwater is made up of both natural and anthropogenic sources. Most arsenic contamination derives from manufacturing processes with significant sources from ore mining operations. From 2011 to 2016, 633 wells in Chino Basin were sampled for Arsenic with 426, or 67%, having detectable concentrations. Of these wells 73, or 17%, have a five-year maximum concentration exceeding the CA Primary MCL. The five-year maximum concentrations range from 0.14 to 4200 µg/L with average and median concentrations of 26.8 and 2.9 µg/L, respectively. Most of the exceedances occur within the general area of point source contamination sites. The higher arsenic concentrations in the City of Chino/Chino Hills area occur in the deeper aquifer at depths greater than about 350 ft-bgs; these higher arsenic concentrations are thought to be of natural, geologic origin.

Arsenic (µg/L)

- ND
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

Primary US EPA MCL = 10 µg/L
Primary CA MCL = 10 µg/L




OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-8_Ar

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# Arsenic in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-8**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Indian Hill Fault

San Antonio Ck

Red Hill Fault

Pomona Basin

San Jose Fault

Haven Ave

Day Ck

Foothill Blvd

Euclid Ave

Central Ave

Holt Blvd

Etiwanda Ave

Lytle Ck

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

San Jacinto Fault

Rialto-Colton Fault

Mission Blvd

Cucamonga

Riverside Dr

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Puente Hills

Bellegrave Ave

Limonite Ave

Santa Ana River

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

15

210

215

10

71

60

TCE is a regulated drinking water contaminant in California with a Primary MCL of 5 µg/L. TCE, along with PCE, is an industrial solvent that has been widely used as a metal degreaser in the aviation, automotive, and other metal working industries. From 2011-2016, 1174 wells in Chino Basin were sampled for TCE, with 471, or 40%, having detectable concentrations. Of these wells, 287, or 61%, have a five-year maximum concentration exceeding the CA Primary MCL. The five-year maximum concentrations range from 0.18 to 330,000 µg/L with average and median concentrations of 3,038 and 13 µg/L respectively. Wells with detectable levels of TCE occur predominantly in monitoring well clusters associated with known VOC point-source contamination sites, such as the Milliken Landfill, GE Flat Iron facility, GE Test Cell facility, South Archibald plume, Chino Airport, and Stringfellow NPL site.

Trichloroethene (µg/L)

- ND
- < 2.5
- 2.5 - 5
- 5 - 10
- 10 - 20
- > 20

Primary US EPA MCL = 5 µg/L
Primary CA MCL = 5 µg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/31/2017
Document Name: Exhibit_5-9_TCE

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# Trichloroethene (TCE) in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-9**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

San Antonio Ck

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

Red Hill Fault

Haven Ave

Day Ck

Etiwanda Ave

Euclid Ave

Central Ave

Holt Blvd

Foothill Blvd

Lytle Ck

Barrier J

Sierra Ave

Rialto-Colton Basin

Riverside Ave

Loma Linda Fault

San Jacinto Fault

Rialto-Colton Fault

15

210

215

10

71

60

Mission Blvd

Cucamonga

Riverside Dr

Puente Hills

Jurupa Mountains

San Bernardino County

Riverside County

Riverside Basins

Beleagrave Ave

Limonite Ave

Mission Blvd

Santa Ana River

Chino Fault

Chino Ck

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

PCE is a regulated drinking water contaminant in California with a Primary MCL of 5 µg/L. PCE, as with TCE, is an industrial solvent that has been widely used as a metal degreaser in the aviation, automotive, and other metal working industries. PCE is also commonly used in the dry-cleaning industry. From 2011 to 2016, 1168 wells in Chino Basin were sampled for PCE with 225, or 19%, having detectable concentrations. Of these wells, 110, or 49%, have concentrations exceeding the CA Primary MCL. The five-year maximum concentrations range from 0.13 to 17,000 µg/L with average and median concentrations of 233 and 4.7 µg/L, respectively. Wells with detectable levels of PCE occur predominantly in well clusters associated with known VOC point-source contamination sites, such as the Milliken Landfill, GE Flat Iron facility, GE Test Cell facility, Alger Manufacturing Facility, Chino Airport, California Institute for Men (CIM), former Crown Coach Facility, and Stringfellow NPL site.

Tetrachloroethene (µg/L)

- ND
- < 2.5
- 2.5 - 5
- 5 - 10
- 10 - 20
- > 20

Primary US EPA MCL = 5 µg/L
Primary CA MCL = 5 µg/L

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

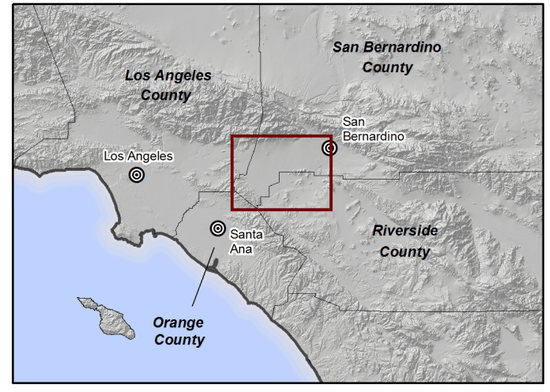
Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/5/2017
Document Name: Exhibit_5-10_PCE

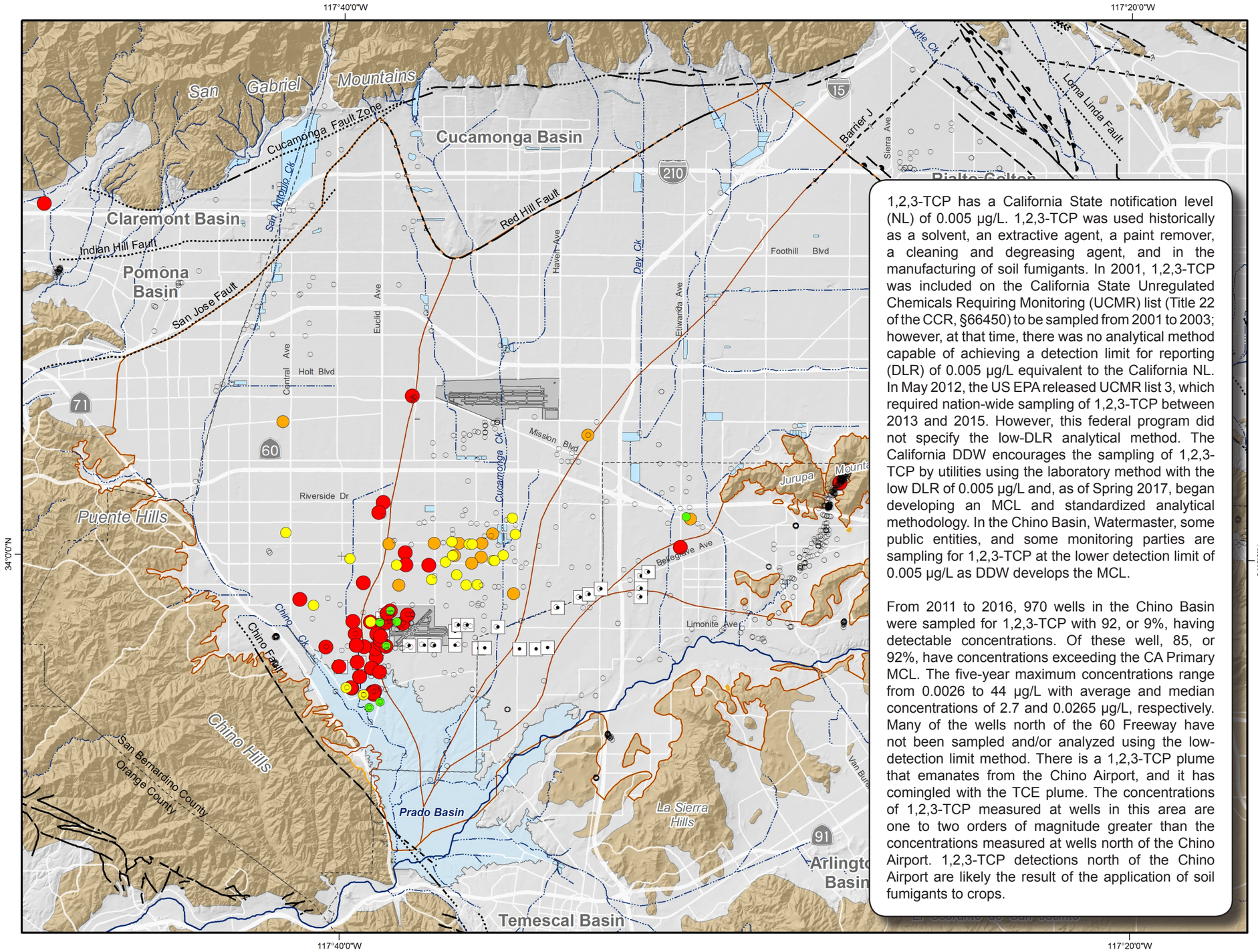
0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# Tetrachloroethene (PCE) in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-10**




1,2,3-TCP has a California State notification level (NL) of 0.005 µg/L. 1,2,3-TCP was used historically as a solvent, an extractive agent, a paint remover, a cleaning and degreasing agent, and in the manufacturing of soil fumigants. In 2001, 1,2,3-TCP was included on the California State Unregulated Chemicals Requiring Monitoring (UCMR) list (Title 22 of the CCR, §66450) to be sampled from 2001 to 2003; however, at that time, there was no analytical method capable of achieving a detection limit for reporting (DLR) of 0.005 µg/L equivalent to the California NL. In May 2012, the US EPA released UCMR list 3, which required nation-wide sampling of 1,2,3-TCP between 2013 and 2015. However, this federal program did not specify the low-DLR analytical method. The California DDW encourages the sampling of 1,2,3-TCP by utilities using the laboratory method with the low DLR of 0.005 µg/L and, as of Spring 2017, began developing an MCL and standardized analytical methodology. In the Chino Basin, Watermaster, some public entities, and some monitoring parties are sampling for 1,2,3-TCP at the lower detection limit of 0.005 µg/L as DDW develops the MCL.

From 2011 to 2016, 970 wells in the Chino Basin were sampled for 1,2,3-TCP with 92, or 9%, having detectable concentrations. Of these well, 85, or 92%, have concentrations exceeding the CA Primary MCL. The five-year maximum concentrations range from 0.0026 to 44 µg/L with average and median concentrations of 2.7 and 0.0265 µg/L, respectively. Many of the wells north of the 60 Freeway have not been sampled and/or analyzed using the low-detection limit method. There is a 1,2,3-TCP plume that emanates from the Chino Airport, and it has comingled with the TCE plume. The concentrations of 1,2,3-TCP measured at wells in this area are one to two orders of magnitude greater than the concentrations measured at wells north of the Chino Airport. 1,2,3-TCP detections north of the Chino Airport are likely the result of the application of soil fumigants to crops.

1,2,3-Trichloropropane (µg/L)

- ND
- < 0.0025
- 0.0025 - 0.005
- 0.005 - 0.01
- 0.01 - 0.02
- > 0.02

California Notification Level = 0.005 µg/L




OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 5/26/2017
Document Name: Exhibit_5-11_TCP

0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# 1,2,3-Trichloropropane (1,2,3-TCP) in Groundwater

*Maximum Concentration (July 2011 to June 2016)*

**Exhibit 5-11**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose Fault

San Antonio Ck.

Upland Landfill

Red Hill Fault

Haven Ave

Day Ck.

Etiwanda Ave

Foothill Blvd

Former Kaiser Steel Mill - CCG Property (Metals, VOCS) No Delineation

Rialto (Perchlorate)

Rialto-Colton Basin

Barrier J

Sierra Ave

Riverside Ave

Loma Linda Fault

Waterman Ave

San Jacinto Fault

Rialto-Colton Fault

Euclid Ave

Alger Manufacturing Inc.

Holt Blvd

Central Ave

Pomona Area Plume

GE Flatiron Plume

GE Test Cell Plume

Cucamonga Ck.

Mission Blvd

Former Kaiser Steel Mill Plume (TDS, TOC)

Former Alumax Facility (TDS, Cl) No Delineation

Milliken Landfill Plume

Jurupa Mountains

Stringfellow Plume (VOC)

Former Crown Coach Facility

Riverside Dr

Puente Hills

Chino Institution for Men Plume

South Archibald Plume

Belegrave Ave

Stringfellow Plume (Perchlorate)

Limonite Ave

San Bernardino County

Riverside County

Riverside Basins

Mission Blvd

Santa Ana River

Chino Fault

Chino Ck.

Chino Airport Plume

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Ba

71 15 210 215 10 60

117°40'0"W

117°20'0"W

34°0'0"N

The plumes characterized by color ramp represent the most recent characterization of the primary contaminant of concern, as delineated by Watermaster for this report. The spatial extent of the VOC contamination was delineated based on the five-year maximum concentrations of the primary contaminant of concern for the period of July 2011 to June 2016. The primary VOC contaminant of concern in these plumes is TCE with the exception of the CIM plume, which is PCE. The VOC plumes associated with the Upland Landfill, the former Crown Coach Facility, and the Alger Manufacturing Facility are of limited geographical extent at the scale of this map, so only their general locations are labeled.

Other contamination plumes in the Chino Basin include the Kaiser Steel Mill, the Alumax Facility, and the Stringfellow NPL Site, which are labeled by name and the primary contaminants associated with the sites. The former Kaiser Steel Mill TDS and total organic carbon (TOC) plume was delineated in 2008 during a study to characterize groundwater quality in MZ3 (WEI, 2008b). The Stringfellow perchlorate plume was delineated in the most current remediation evaluation report for the site (Kleinfelder, 2016). There are no plume delineations for the contamination associated with the former Kaiser Steel Mill – CCG Property or the former Alumax Facility.

VOC Concentration (µg/L)

- > 0 to ≤ 5
- > 5 to ≤ 10
- > 10 to ≤ 20
- > 20 to ≤ 50
- > 50 to ≤ 100
- > 100 to ≤ 200
- > 200 to ≤ 500
- > 500

The VOC plumes shown on this map are generalized illustrations of the estimated spatial extent of TCE or PCE, based on the maximum concentration measured at wells over the five-year period of July 2011 to June 2016. The VOC plume illustrations were created with the Geostatistical Analyst extension in ESRI's ArcGIS 10.4 using an ordinary kriging interpolation model with model input parameter estimation and optimization performed by semivariogram analysis in Golden Software's Surfer 8.09. Interpretations of the plume extent and boundary delineation were made based on measured concentrations and local groundwater flow patterns as predicted by the Chino Basin groundwater flow model.

**VOC Plumes Labeled in Red by Name**

**Other Plumes - Labeled in Blue by Name and Dominant Contaminant**

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT
Date: 20160523
File: Exhibit_5-14_Plumes.mxd

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

**Delineation of Groundwater Contamination Plumes and Point Sources of Concern**

**Exhibit 5-12**

117°40'0"W

34°0'0"N

Pomona Plume

GE Flat Iron Plume

Alger Plume

Milliken Landfill

GE Test Cell Plume

Cucamonga Ck

Mission Blvd

60

Archibald South Plume

Former Crown Coach Site

Chino Institution for Men (CIM)

Chino Airport Plume

These VOC composition pie charts show the relative percentages of VOCs measured at wells within each of the plumes on Exhibit 5-12. The data represent the most current sampling event over the five-year period of July 2011 to June 2016. The chemical differentiation of these plumes can be understood by comparing the proportions of TCE, PCE, and their breakdown by-products. For example, the Milliken Landfill plume and the GE Test Cell plume north of the Ontario Airport have significant concentrations of both TCE and PCE and the presence of breakdown products, whereas the South Archibald plume is predominantly comprised of TCE. This demonstrates that there is no intermingling of these plumes.

117°40'0"W

Percent of Detectable TCE, PCE, and their Degradation By-Products During the Last Sample

- 1,1,1-Trichloroethane
- 1,1-Dichloroethane
- 1,1-Dichloroethene
- 1,2-Dichloroethane
- cis-1,2-Dichloroethene
- Tetrachloroethene (PCE)
- trans-1,2-Dichloroethene
- Trichloroethene (TCE)
- Vinyl Chloride

Sample Size (Based on the Sum of TCE, PCE, and their Degradation By-Products [µg/L])

- 0.01 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- > 50

- Wells with Non-Detect Results for VOCs During Last Sample Event
- Chino Basin Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

***Geology***

*Water-Bearing Sediments*

- Quaternary Alluvium

*Consolidated Bedrock*

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 5/31/2017
Document Name: Exhibit_5-13_PieChart

0 0.5 1 1.5 2 4 Miles

0 0.75 1.5 2.25 3 6 KM

2016 State of the Basin
*Groundwater Quality*

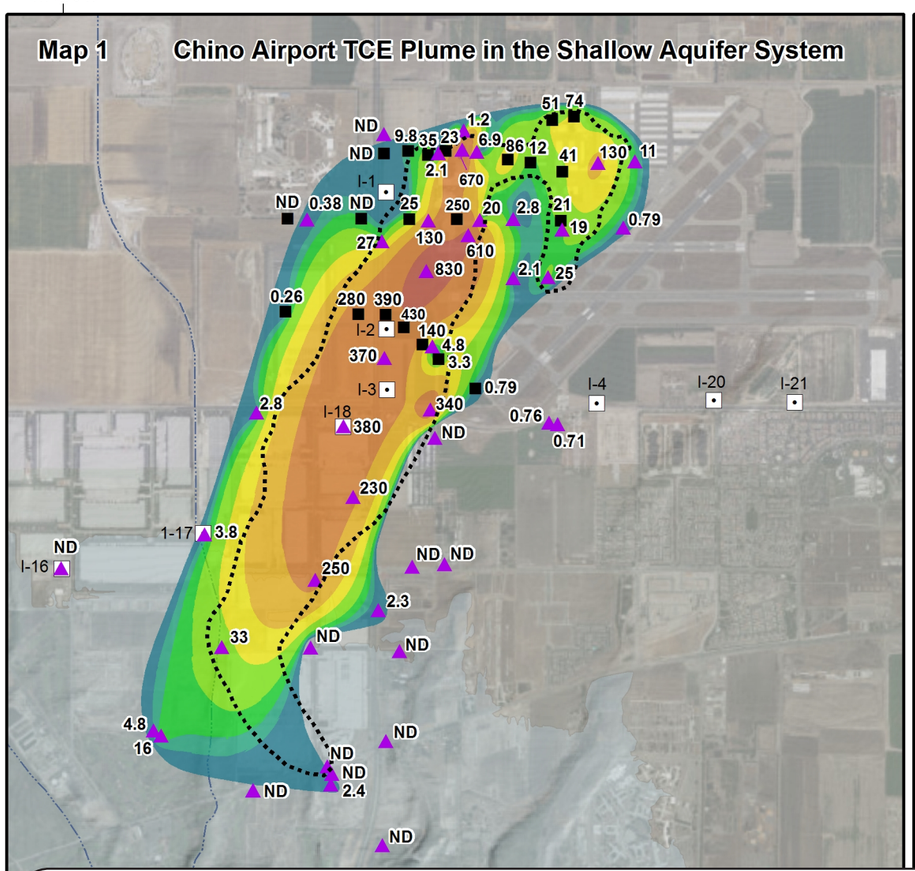
# VOC Composition Charts

*Wells Within and Adjacent to VOC Plumes*

**Exhibit 5-13**

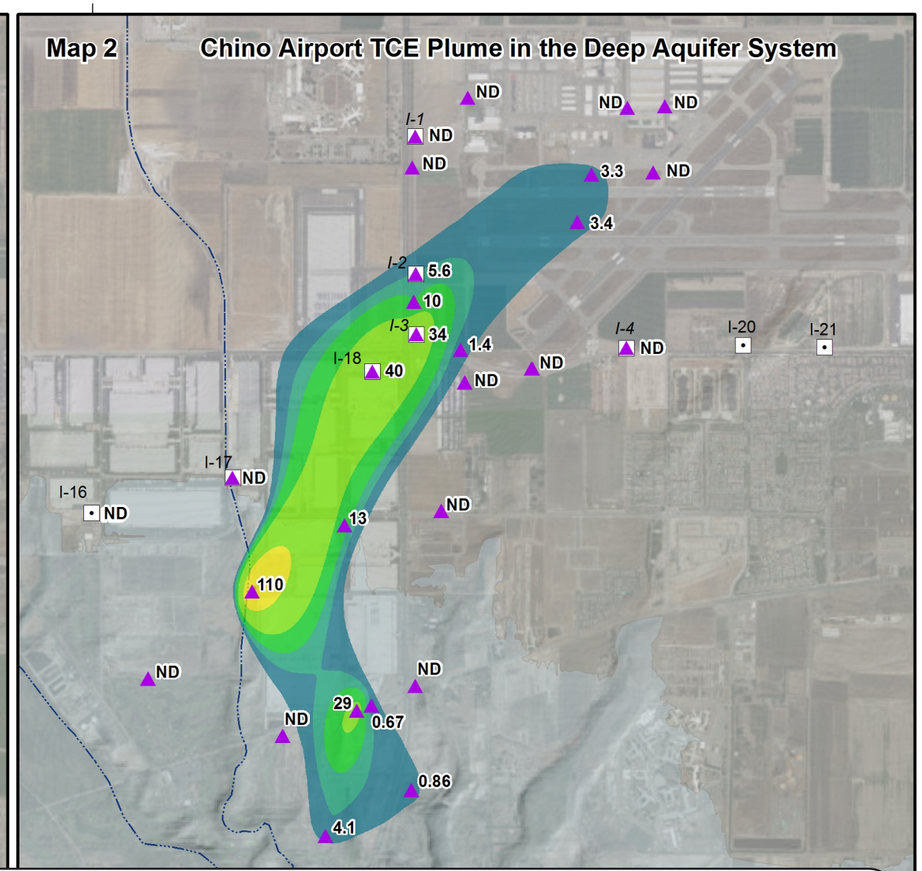
117°40'0"W

## Map 1 Chino Airport TCE Plume in the Shallow Aquifer System




117°40'0"W

## Map 2 Chino Airport TCE Plume in the Deep Aquifer System




The Chino Airport TCE Plume is located in the southwestern portion of the Chino Basin within the City of Chino. The County of San Bernardino Department of Airports is identified as the responsible party for the Chino Airport Plume, and the RWQCB has issued CAO No. 90-134 and CAO No. R8-2008-0064, ordering the County to characterize the extent of the plume and prepare a remedial action plan. From 1991 to 1992, ten inactive underground storage tanks and 310 containers of hazardous waste were removed. Since 2003, the County has constructed a total of 75 monitoring wells and conducted extensive investigations to characterize the soil and groundwater contamination associated with the Chino Airport. Recent investigative work included: piezocone-penetrometer tests, vertical-aquifer-profiling (VAP) borings with depth-discrete groundwater sampling, soil-gas probe sampling, high-resolution soil sampling and analysis, real-time data analysis, and three-dimensional contaminant distribution modeling. In August 2016, the County completed a Draft Feasibility Study that identifies remedial action objectives and evaluates remediation alternatives. The recommended remediation alternative is a groundwater pump-and-treat system to provide hydraulic containment of the contamination originating from the Chino Airport.

The County conducts quarterly, annual, or biennial water-quality monitoring and quarterly water-level monitoring at the 75 monitoring wells constructed to date, and characterizes the extent of the plume vertically in multiple cross-sectional views, and laterally in an areal view, using the data collected from their monitoring program. The most recent characterization of the TCE plume prepared by the County was published in 2016 (Tetra Tech, 2016) and is shown here compared to Watermaster's delineation of the plume.

Watermaster collects groundwater-quality data in and surrounding the plume at private wells, monitoring wells, and CDA production wells. The multiple-depth, groundwater-quality monitoring at wells and borings in and to the south of the Chino Airport has allowed for TCE to be characterized horizontally and vertically. TCE has been detected in both the shallow unconfined aquifer system and the deeper confined aquifer system. TCE is more thoroughly characterized in the shallow aquifer system than in the deep aquifer system. Watermaster's plume characterizations are based on the maximum concentrations measured at wells from July 2011 to June 2016.

IGN, and the GIS User Community

117°40'0"W

VOC Concentration (µg/L)

- > 0 to ≤ 5
- > 5 to ≤ 10
- > 10 to ≤ 20
- > 20 to ≤ 50
- > 50 to ≤ 100
- > 100 to ≤ 200
- > 200 to ≤ 500

The VOC plumes shown on this map are generalized illustrations of the estimated spatial extent of TCE or PCE, based on the maximum concentration measured at wells over the five-year period of July 2011 to June 2016. The VOC plume illustrations were created with the Geostatistical Analyst extension in ESRI's ArcGIS 10.4 using an ordinary kriging interpolation model with model input parameter estimation and optimization performed by semivariogram analysis in Golden Software's Surfer 8.09. Interpretations of the plume extent and boundary delineation were made based on measured concentrations and local groundwater flow patterns as predicted by the Chino Basin groundwater flow model.

TCE MCL = 5 µg/L

Extent of TCE Plume with Concentrations Greater than or Equal to 5 ug/L as Delineated by the County in 2016 Using Their Data (February 2016 Monitoring Report)

5 Wells & Maximum TCE Concentration (µg/L) for July 2011 to June 2016

5 Location of Depth-Specific Vertical Aquifer Profile Samples & Maximum TCE Concentration (µg/L) at that Location During 2013 to 2014 Sampling

*ND = TCE was Non-Detect in Samples from July 2011 to June 2016*

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT
Date: 20170523
File: Exhibit_5-14.mxd

0 0.5 1 1.5 Miles

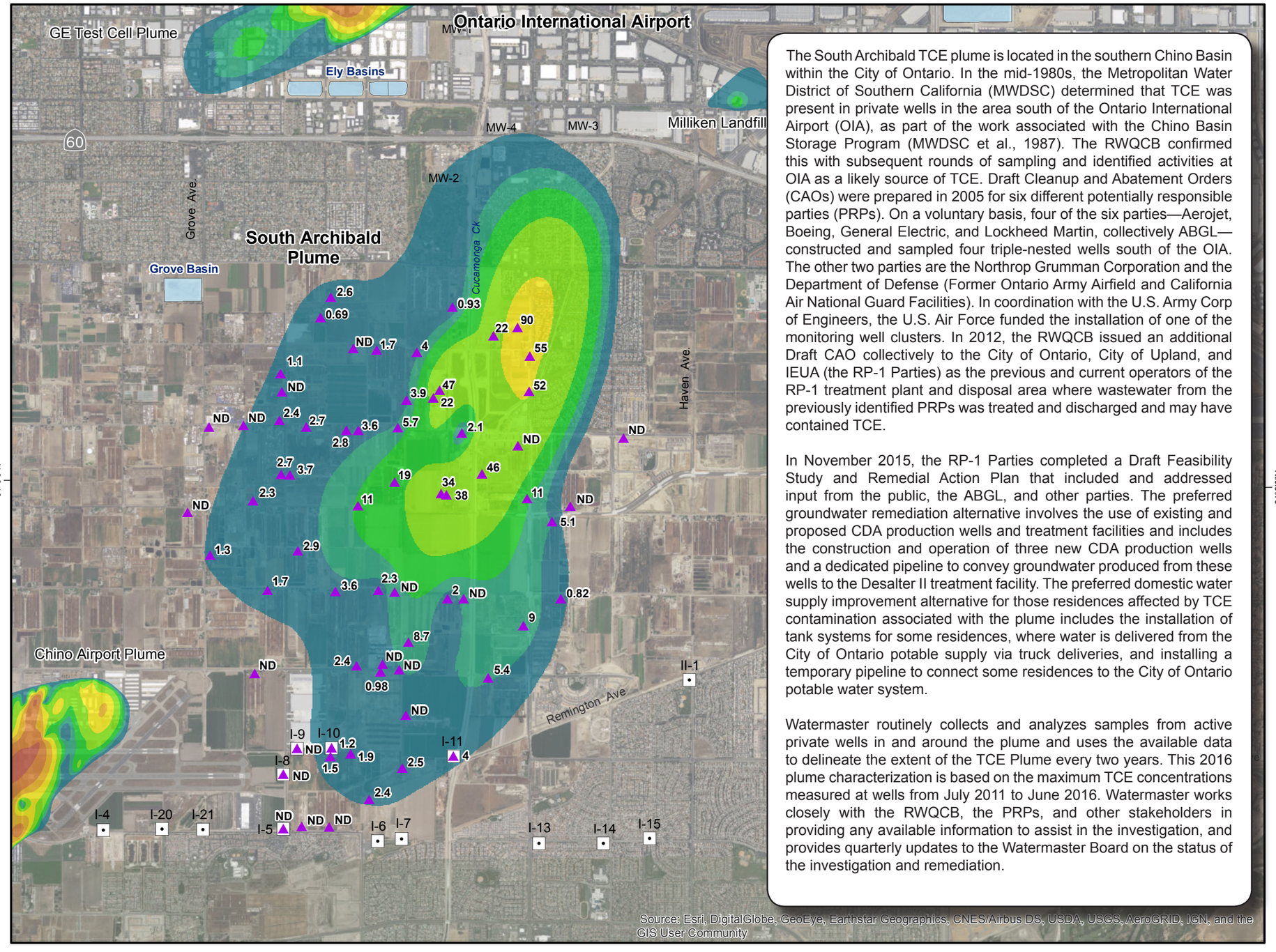
0 0.25 0.5 1 1.5 2 KM

2016 State of the Basin
*Groundwater Quality*

**Chino Airport TCE Plume**

*Shallow and Deep Aquifers*

**Exhibit 5-14**




The South Archibald TCE plume is located in the southern Chino Basin within the City of Ontario. In the mid-1980s, the Metropolitan Water District of Southern California (MWDSC) determined that TCE was present in private wells in the area south of the Ontario International Airport (OIA), as part of the work associated with the Chino Basin Storage Program (MWDSC et al., 1987). The RWQCB confirmed this with subsequent rounds of sampling and identified activities at OIA as a likely source of TCE. Draft Cleanup and Abatement Orders (CAOs) were prepared in 2005 for six different potentially responsible parties (PRPs). On a voluntary basis, four of the six parties—Aerojet, Boeing, General Electric, and Lockheed Martin, collectively ABGL—constructed and sampled four triple-nested wells south of the OIA. The other two parties are the Northrop Grumman Corporation and the Department of Defense (Former Ontario Army Airfield and California Air National Guard Facilities). In coordination with the U.S. Army Corp of Engineers, the U.S. Air Force funded the installation of one of the monitoring well clusters. In 2012, the RWQCB issued an additional Draft CAO collectively to the City of Ontario, City of Upland, and IEUA (the RP-1 Parties) as the previous and current operators of the RP-1 treatment plant and disposal area where wastewater from the previously identified PRPs was treated and discharged and may have contained TCE.

In November 2015, the RP-1 Parties completed a Draft Feasibility Study and Remedial Action Plan that included and addressed input from the public, the ABGL, and other parties. The preferred groundwater remediation alternative involves the use of existing and proposed CDA production wells and treatment facilities and includes the construction and operation of three new CDA production wells and a dedicated pipeline to convey groundwater produced from these wells to the Desalter II treatment facility. The preferred domestic water supply improvement alternative for those residences affected by TCE contamination associated with the plume includes the installation of tank systems for some residences, where water is delivered from the City of Ontario potable supply via truck deliveries, and installing a temporary pipeline to connect some residences to the City of Ontario potable water system.

Watermaster routinely collects and analyzes samples from active private wells in and around the plume and uses the available data to delineate the extent of the TCE Plume every two years. This 2016 plume characterization is based on the maximum TCE concentrations measured at wells from July 2011 to June 2016. Watermaster works closely with the RWQCB, the PRPs, and other stakeholders in providing any available information to assist in the investigation, and provides quarterly updates to the Watermaster Board on the status of the investigation and remediation.

TCE Concentration (µg/L)

- > 0 to ≤ 5
- > 5 to ≤ 10
- > 10 to ≤ 20
- > 20 to ≤ 50
- > 50 to ≤ 100
- > 100 to ≤ 200
- > 200 to ≤ 500
- > 500

The VOC plumes shown on this map are generalized illustrations of the estimated spatial extent of TCE, based on maximum concentration measured from July 2011 to June 2016. The VOC plume illustrations were created with the Geostatistical Analyst extension in ESRI's ArcGIS 10.4 using an ordinary kriging interpolation model with model input parameter estimation and optimization performed by semivariogram analysis in Golden Software's Surfer 8.09. Interpretations of the plume extent and boundary delineation were made based on measured concentrations and local groundwater flow patterns as predicted by the Chino Basin groundwater flow model.

TCE MCL = 5 µg/L

5 Wells & MaximumTCE Concentration (ug/L) from July 2011 to June 2016

*ND = TCE was Non Detect in Samples from July 2009 to June 2014*

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins




Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT
Date: 20170526
File: Exhibit_5-15_SouthArchibald

0 0.5 1 1.5 Miles

0 0.25 0.5 1 1.5 2 KM

2016 State of the Basin
*Groundwater Quality*

**South Archibald TCE Plume**

**Exhibit 5-15**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault Zone

Cucamonga Basin

Claremont Basin

Rialto-Colton Basin

Rialto (Perchlorate)

Upland Landfill

Red Hill Fault

Indian Hill Fault

San Jose Fault

Pomona Basin

Alger Manufacturing Inc.

Pomona Area Plume

GE Flat Iron Plume

GE Test Cell Plume

Former Kaiser Steel Mill - CCG (Metals, VOCS)

Former Alumax Facility (TDS, Cl)

Former Kaiser Steel Mill Plume (TDS, TOC)

Milliken Landfill Plume

Stringfellow (VOC)

Stringfellow (Perchlorate)

South Archibald Plume

Chino Institution for Men Plume

Chino Airport Plume

Former Crown Coach Facility

Puente Hills

Chino Hills

Chino Fault

Prado Basin

Temescal Basin

Riverside Basins

Rialto-Colton Fault

San Jacinto Fault

Barrier J

Santa Ana River

Day Ck

Cucamonga Ck

Chino Ck

San Antonio Ck

Foothill Blvd

Holt Blvd

Riverside Dr

Mission Blvd

Limonite Ave

Belegrave Ave

Euclid Ave

Haven Ave

Etiwanda Ave

Sierra Ave

Riverside Ave

Waterman Ave

Central Ave

15

210

215

10

71

60

In 2014, Watermaster performed an extensive review the GeoTracker and EnviroStor databases to identify all sites in the Chino Basin that have the potential to impact groundwater quality. A total of 775 sites were identified in the Chino Basin. The sites are categorized by site status, open or closed case, and the contaminated media, groundwater, soil, air, or not identified. As summarized in the table, 244 sites were identified as having the potential to impact groundwater quality, shown on this map. This characterization is updated annually. As of 2016, 45 of the 244 sites have water quality data available on the GeoTracker website. 14 of these 45 sites are open sites that are actively monitored and 31 are closed sites. Watermaster downloads all new monitoring data for the open sites about twice per year. For more information about GeoTracker, see:

http://www.swrcb.ca.gov/ust/electronic_submittal/about.shtml
http://www.waterboards.ca.gov/water_issues/programs/gama/docs/geotracker_factsheet.pdf

## GeoTracker and EnviroStor Sites

*Site Status (Symbol)*

- Open Site
- Closed Site

*Contaminated Media (Color)*

- Groundwater (potential or confirmed)
- No Media Established, but Potentail Impacts to Groundwater Quality

- VOC Plumes Delineated in 2016
  **- Labeled in Purple by Name**
- Other Plumes
  **- Labeled in Blue by Name and Dominant Contaminants**

* Plumes that are too small to be delineated at this map extent, or are not delineated, are labeled with a line indicating the general location of the point-source site




OBMP Management Zones

- Streams & Flood Control Channels
- Flood Control & Conservation Basins

***Geology***

- Quaternary Alluvium

*Consolidated Bedrock*

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Concealed
- Location Approximate
- Location Uncertain
- Approximate Location of Groundwater Barrier




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: CS
Date: 6/1/2017
Document Name: Exhibit_5-16_GeoTracker_Enviro

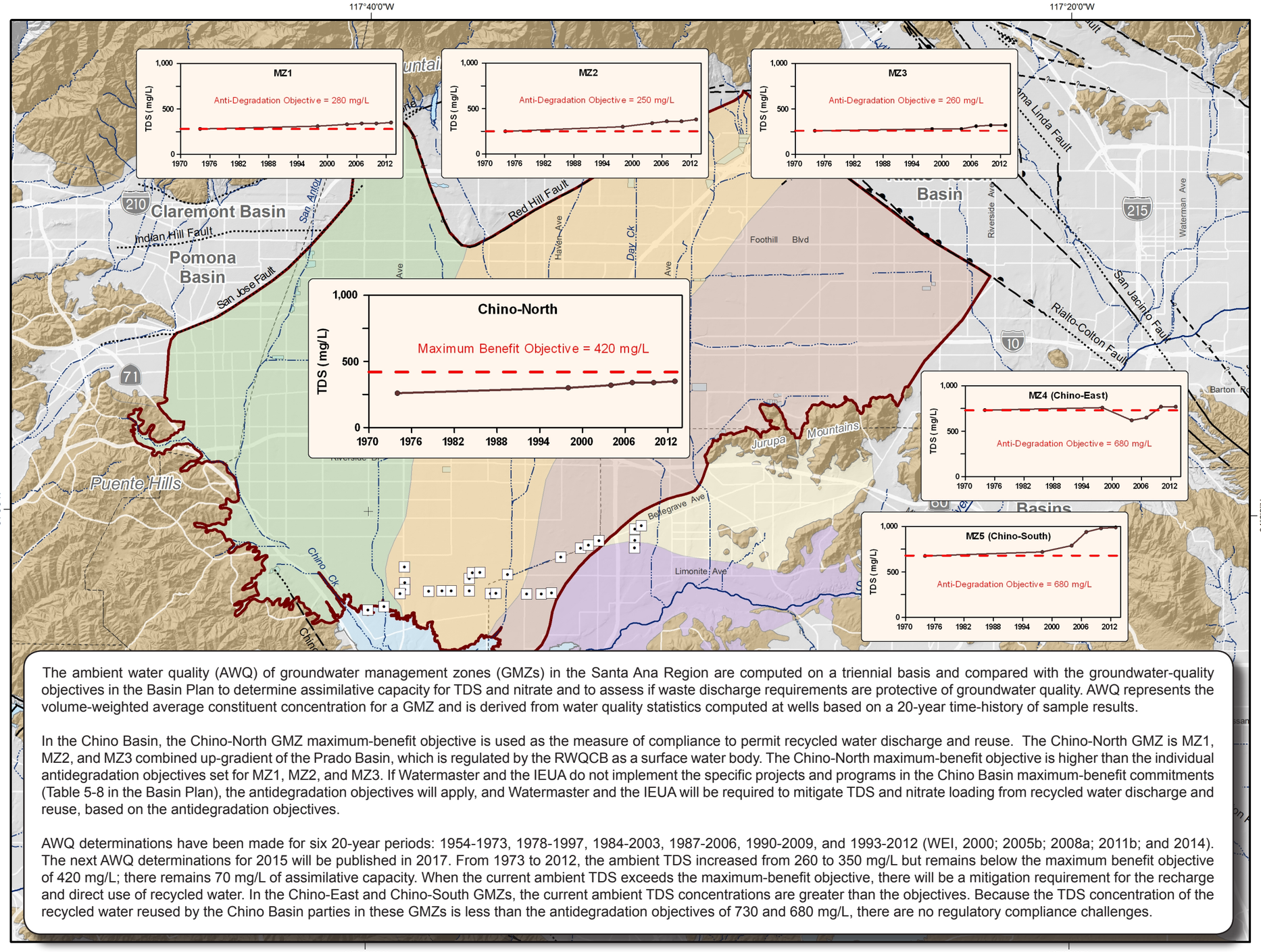
0 2 4 Miles
0 3 6 KM

2016 State of the Basin
*Groundwater Quality*

# GeoTracker and EnviroStor Sites in the Chino Basin

*Site Status and Contaminated Media*

**Exhibit 5-16**

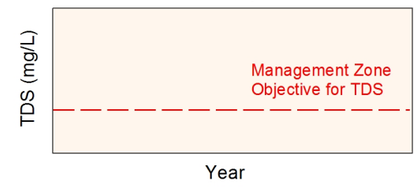



The ambient water quality (AWQ) of groundwater management zones (GMZs) in the Santa Ana Region are computed on a triennial basis and compared with the groundwater-quality objectives in the Basin Plan to determine assimilative capacity for TDS and nitrate and to assess if waste discharge requirements are protective of groundwater quality. AWQ represents the volume-weighted average constituent concentration for a GMZ and is derived from water quality statistics computed at wells based on a 20-year time-history of sample results.

In the Chino Basin, the Chino-North GMZ maximum-benefit objective is used as the measure of compliance to permit recycled water discharge and reuse. The Chino-North GMZ is MZ1, MZ2, and MZ3 combined up-gradient of the Prado Basin, which is regulated by the RWQCB as a surface water body. The Chino-North maximum-benefit objective is higher than the individual antidegradation objectives set for MZ1, MZ2, and MZ3. If Watermaster and the IEUA do not implement the specific projects and programs in the Chino Basin maximum-benefit commitments (Table 5-8 in the Basin Plan), the antidegradation objectives will apply, and Watermaster and the IEUA will be required to mitigate TDS and nitrate loading from recycled water discharge and reuse, based on the antidegradation objectives.

AWQ determinations have been made for six 20-year periods: 1954-1973, 1978-1997, 1984-2003, 1987-2006, 1990-2009, and 1993-2012 (WEI, 2000; 2005b; 2008a; 2011b; and 2014). The next AWQ determinations for 2015 will be published in 2017. From 1973 to 2012, the ambient TDS increased from 260 to 350 mg/L but remains below the maximum benefit objective of 420 mg/L; there remains 70 mg/L of assimilative capacity. When the current ambient TDS exceeds the maximum-benefit objective, there will be a mitigation requirement for the recharge and direct use of recycled water. In the Chino-East and Chino-South GMZs, the current ambient TDS concentrations are greater than the objectives. Because the TDS concentration of the recycled water reused by the Chino Basin parties in these GMZs is less than the antidegradation objectives of 730 and 680 mg/L, there are no regulatory compliance challenges.

Time-Series of
Ambient Water Quality Determinations




Anti-Degradation Management Zones and Chino-North
Maximum Benefit Management Zone




Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

*Water-Bearing Sediments*

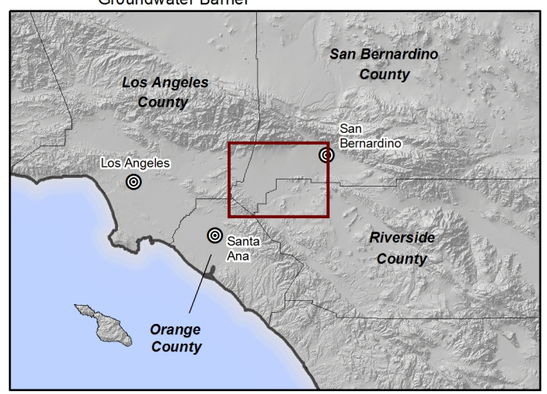
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain
Location Approximate
Approximate Location of Groundwater Barrier
Location Concealed
Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

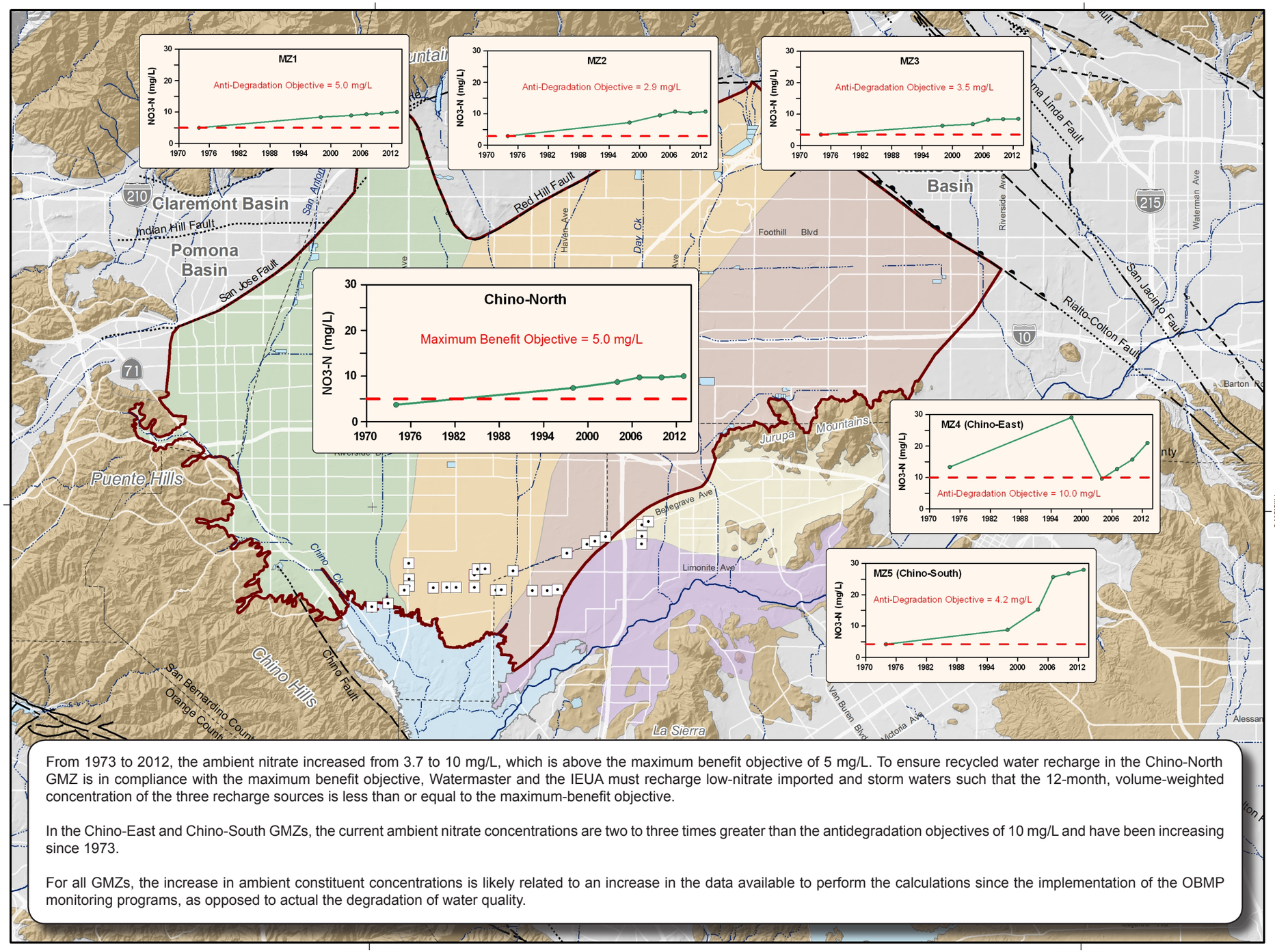
Author: RT
Date: 6/5/2017
Document Name: Exhibit_5-17_AWQ_TDS

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

**Trends in Ambient Water Quality Determinations for Total Dissolved Solids (TDS) By Management Zone**

**Exhibit 5-17**

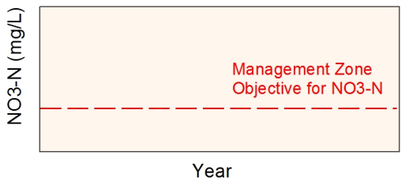



From 1973 to 2012, the ambient nitrate increased from 3.7 to 10 mg/L, which is above the maximum benefit objective of 5 mg/L. To ensure recycled water recharge in the Chino-North GMZ is in compliance with the maximum benefit objective, Watermaster and the IEUA must recharge low-nitrate imported and storm waters such that the 12-month, volume-weighted concentration of the three recharge sources is less than or equal to the maximum-benefit objective.

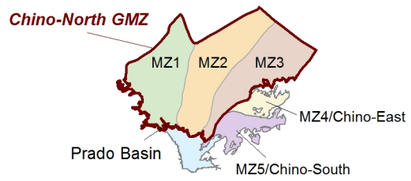
In the Chino-East and Chino-South GMZs, the current ambient nitrate concentrations are two to three times greater than the antidegradation objectives of 10 mg/L and have been increasing since 1973.

For all GMZs, the increase in ambient constituent concentrations is likely related to an increase in the data available to perform the calculations since the implementation of the OBMP monitoring programs, as opposed to actual the degradation of water quality.

Time-Series of
Ambient Water Quality Determinations




Anti-Degradation Management Zones and Chino-North
Maximum Benefit Management Zone




Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

***Geology***

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

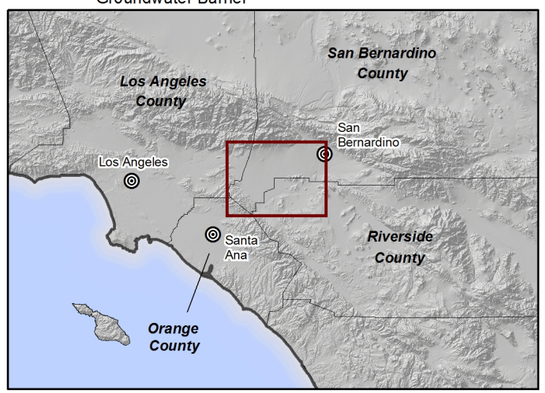
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

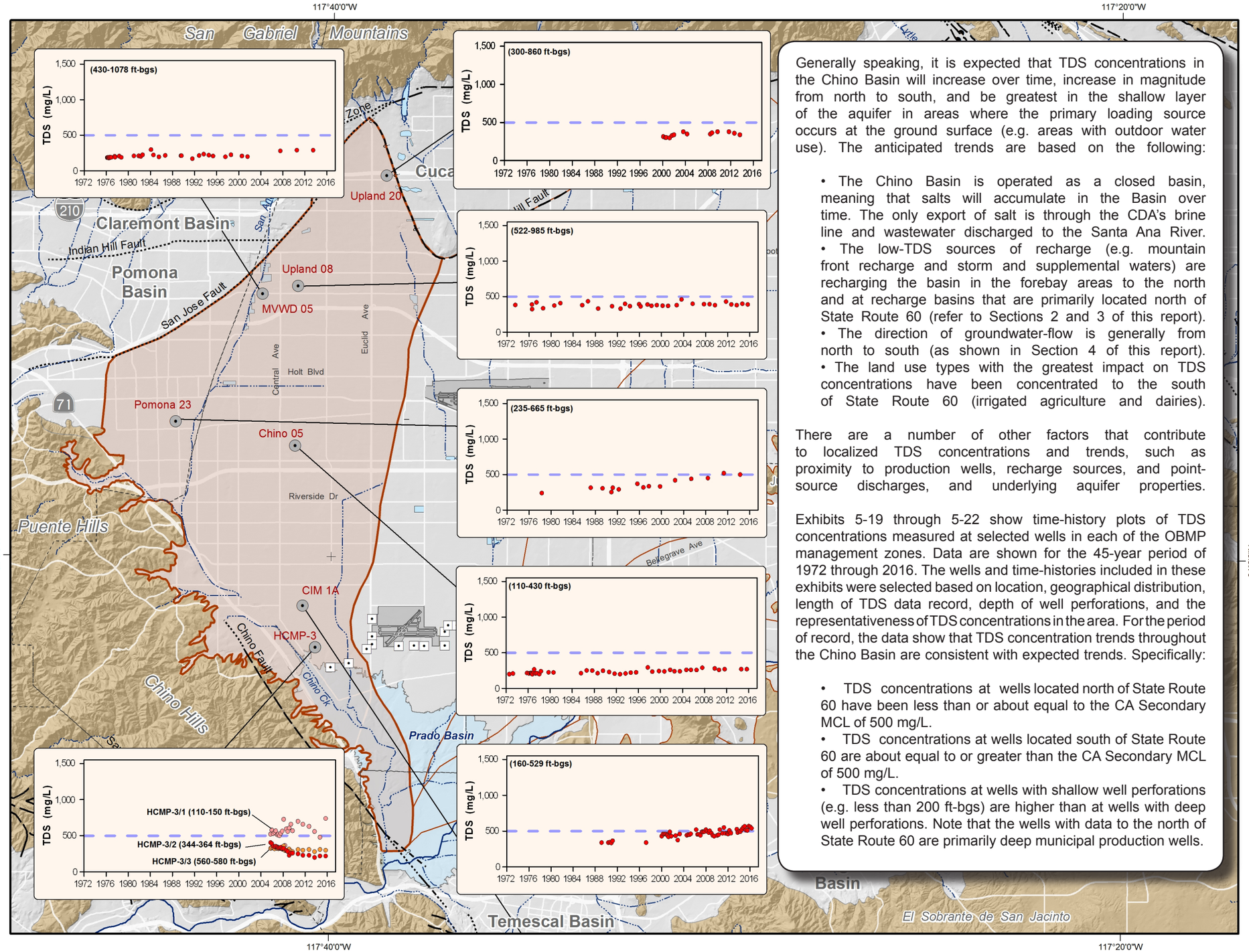
Author: RT
Date: 6/5/2017
Document Name: Exhibit_5-18_AWQ_NO3

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

**Trends in Ambient Water Quality Determinations for Nitrate as Nitrogen ($NO_3$-N) By Management Zone**

**Exhibit 5-18**




Generally speaking, it is expected that TDS concentrations in the Chino Basin will increase over time, increase in magnitude from north to south, and be greatest in the shallow layer of the aquifer in areas where the primary loading source occurs at the ground surface (e.g. areas with outdoor water use). The anticipated trends are based on the following:

- The Chino Basin is operated as a closed basin, meaning that salts will accumulate in the Basin over time. The only export of salt is through the CDA's brine line and wastewater discharged to the Santa Ana River.
- The low-TDS sources of recharge (e.g. mountain front recharge and storm and supplemental waters) are recharging the basin in the forebay areas to the north and at recharge basins that are primarily located north of State Route 60 (refer to Sections 2 and 3 of this report).
- The direction of groundwater-flow is generally from north to south (as shown in Section 4 of this report).
- The land use types with the greatest impact on TDS concentrations have been concentrated to the south of State Route 60 (irrigated agriculture and dairies).

There are a number of other factors that contribute to localized TDS concentrations and trends, such as proximity to production wells, recharge sources, and point-source discharges, and underlying aquifer properties.

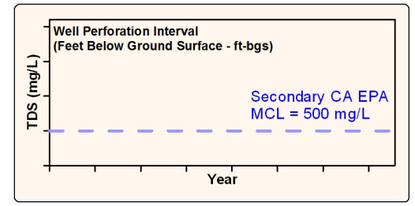
Exhibits 5-19 through 5-22 show time-history plots of TDS concentrations measured at selected wells in each of the OBMP management zones. Data are shown for the 45-year period of 1972 through 2016. The wells and time-histories included in these exhibits were selected based on location, geographical distribution, length of TDS data record, depth of well perforations, and the representativeness of TDS concentrations in the area. For the period of record, the data show that TDS concentration trends throughout the Chino Basin are consistent with expected trends. Specifically:

- TDS concentrations at wells located north of State Route 60 have been less than or about equal to the CA Secondary MCL of 500 mg/L.
- TDS concentrations at wells located south of State Route 60 are about equal to or greater than the CA Secondary MCL of 500 mg/L.
- TDS concentrations at wells with shallow well perforations (e.g. less than 200 ft-bgs) are higher than at wells with deep well perforations. Note that the wells with data to the north of State Route 60 are primarily deep municipal production wells.

MZ1 Boundary Area

Representative MZ1 Wells

Total Dissolved Solids (TDS) Concentration







OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Recharge Basins and Spreading Grounds

***Geology***

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

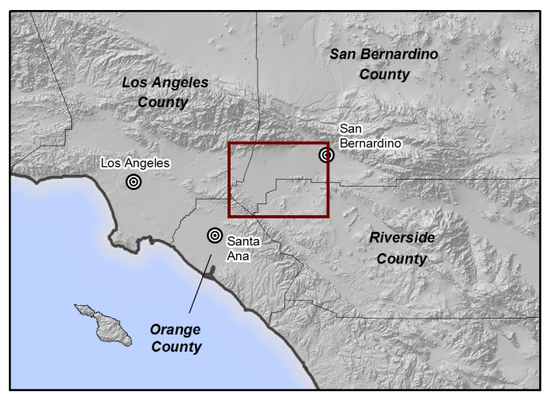
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-19_MZ1_TDS

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

**Chino Basin Management Zone 1**

*Trends in Total Dissolved Solids Concentrations*

**Exhibit 5-19**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Basin

Pomona Basin

Rialto-Colton Basin

Arlington Basin

Temescal Basin

El Sobrante de San Jacinto

Puente Hills

Jurupa Mountains

San Bernardino County

Riverside County

Orange County

Barrier J

Red Hill Fault

Indian Hill Fault

San Jose Fault

Chino Fault

Loma Linda Fault

San Jacinto Fault

Lytle Ck

Day Ck

Cucamonga Ck

Chino Ck

Haven Ave

Etiwanda Ave

Sierra Ave

Foothill Blvd

Mission Blvd

Riverside Dr

Bellegrave Ave

Limonite Ave

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CVWD 05

Ont 24

Ont 40

Ont 17

XRef 281

XRef 29

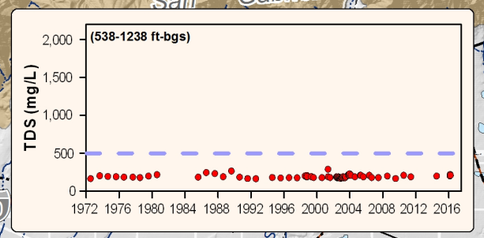
I-4

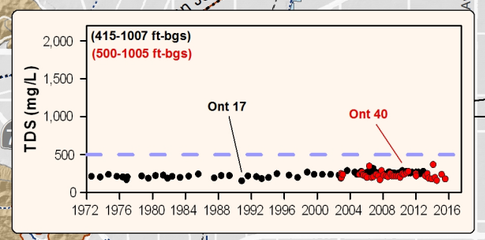
HCMP-1

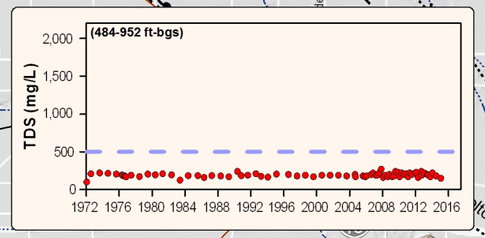
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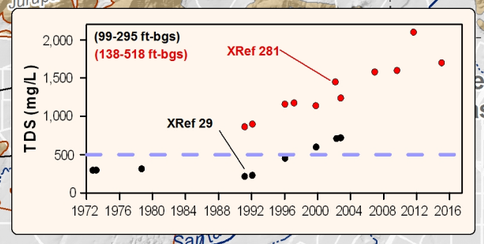
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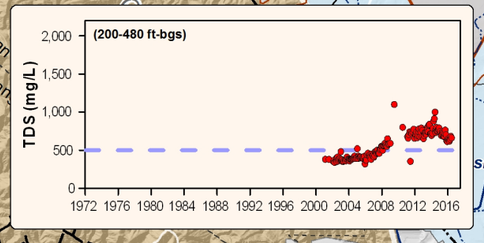
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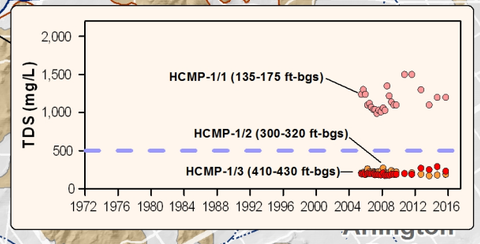


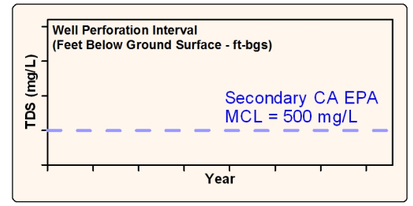




(200-480 ft-bgs)

MZ2 Boundary Area

Representative MZ2 Wells

Total Dissolved Solids (TDS) Concentration







OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-20_MZ2_TDS

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 2

*Trends in Total Dissolved Solids Concentrations*

**Exhibit 5-20**

117°40'0"W

117°20'0"W

34°0'0"N

(378-810 ft-bgs)

(400-980 ft-bgs)

(100-310 ft-bgs)

(225-275 ft-bgs)

(85-275 ft-bgs)

HCMP-1/1 (135-175 ft-bgs)

HCMP-1/2 (300-320 ft-bgs)

HCMP-1/3 (410-430 ft-bgs)

TDS (mg/L)

3,000 2,500 2,000 1,500 1,000 500 0

1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

San Gabriel Mountains

Cucamonga Fault

San Antonio Ck

Claremont Basin

Indian Hill Fault

Pomona Basin

Puente Hills

Chino Fault

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

Red Hill

Haven Ave

Day Ck

Etiwanda Ave

Foothill Blvd

F37A

Cnt 31

JCSD 16

CDA I-15

XRef 4649

HCMP-6

Mission Blvd

Cucamonga Ck

Jurupa Mountains

Belegrave Ave

Limonite Ave

Chino Ck

Barrier J

Sierra Ave

Loma Linda Fault

Rialto-Colton Basin

Riverside Ave

Rialto-Colton Fault

San Jacinto

15

210

71

10

215

MZ3 Boundary Area

Representative MZ3 Wells

Total Dissolved Solids (TDS) Concentrations

Well Perforation Interval
(Feet Below Ground Surface - ft-bgs)

Secondary CA EPA
MCL = 500 mg/L

Year

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT

Date: 6/5/2017

Document Name: Exhibit_5-21_MZ3_TDS

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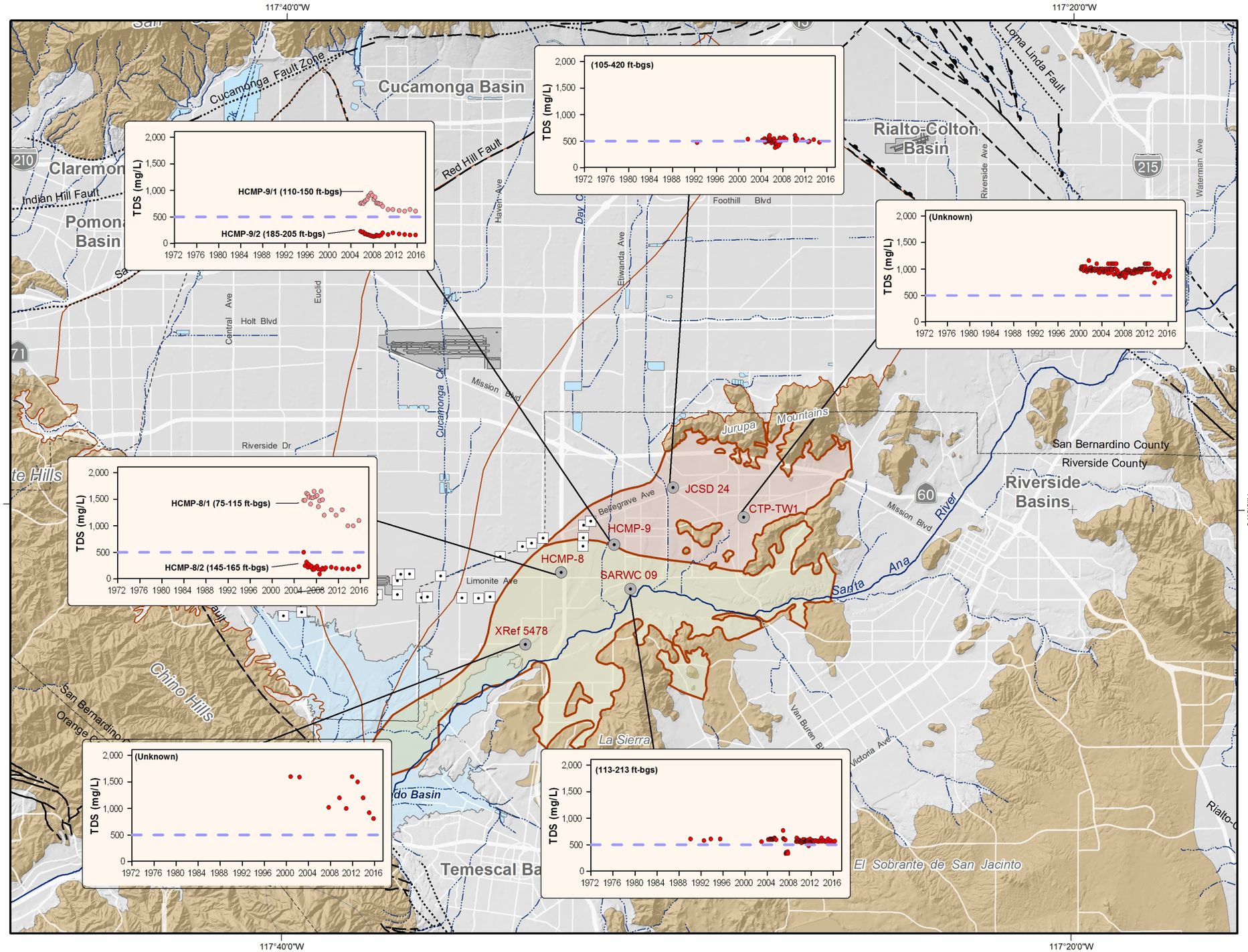
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 3

*Trends in Total Dissolved Solids Concentrations*

**Exhibit 5-21**

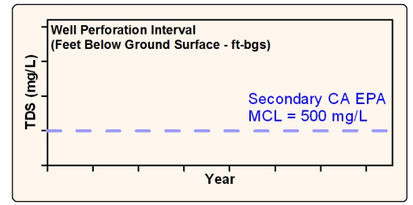



MZ4 Boundary Area

MZ5 Boundary Area

Representative MZ4 and MZ5 Wells

Total Dissolved Solids (TDS) Concentrations







OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Recharge Basins and Spreading Grounds

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

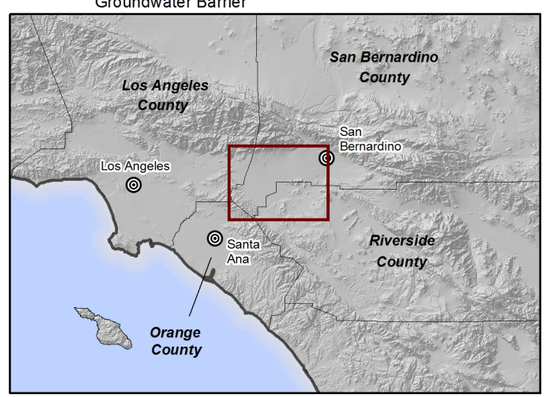
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-22_MZ4_5_TDS

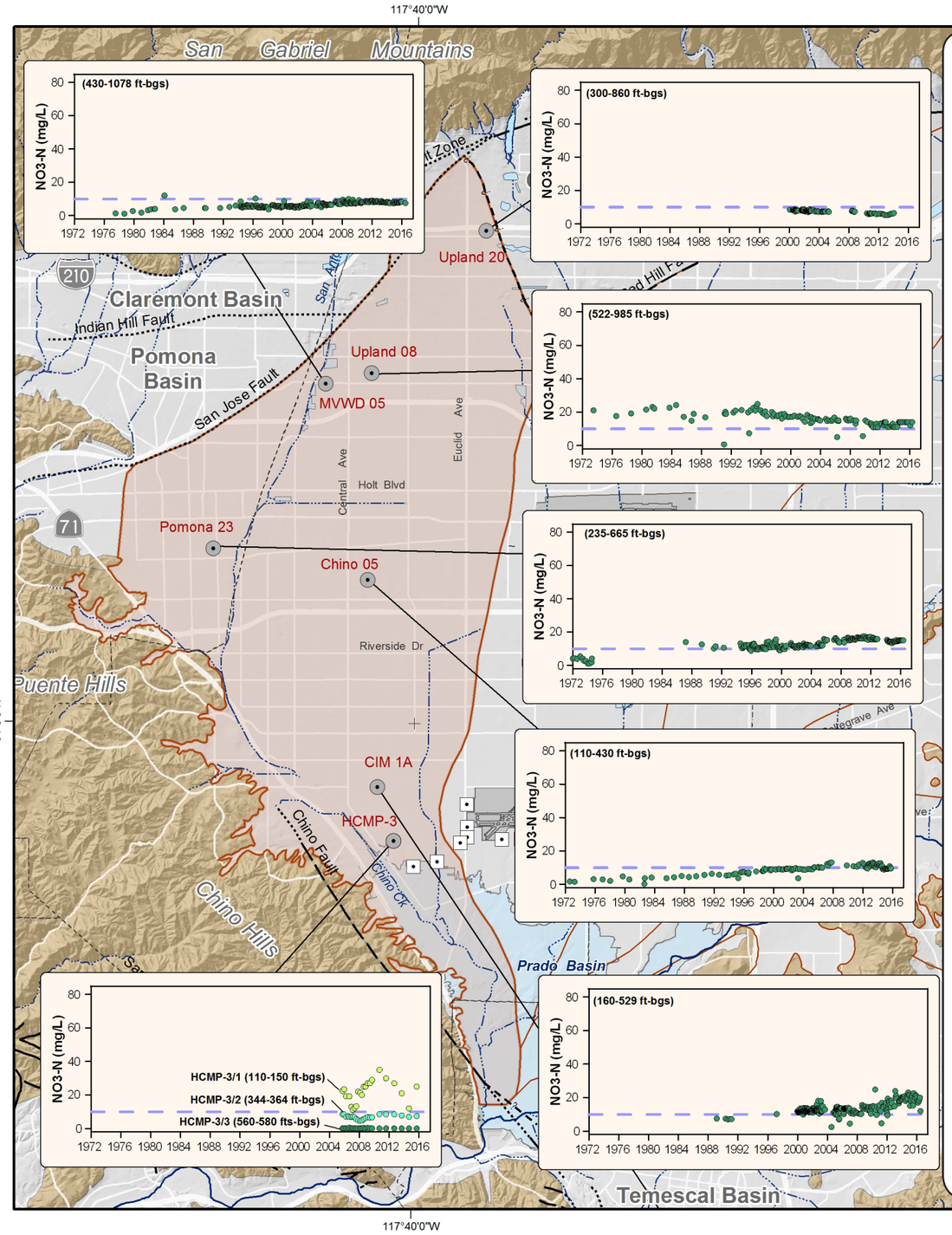
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 4 and Zone 5

*Trends in Total Dissolved Solids Concentrations*

**Exhibit 5-22**




Generally speaking, it is expected that nitrate concentrations in the Chino Basin will increase over time, increase in magnitude from north to south, and be greatest in the shallow layer of the aquifer in areas where the primary loading source occurs at the ground surface (e.g. areas with outdoor water use). One exception to the increasing trend might occur in north-western area of the Chino Basin; decreasing trends in nitrate, compared to historical values, may occur in some areas as the groundwater recovers from historical loading from agricultural land uses. The anticipated trends are based on the following:

- The Chino Basin is operated as a closed basin, meaning that salts will accumulate in the basin over time. The only export of salt is through the CDA's brine line and wastewater discharged to the Santa Ana River.
- The low-nitrogen sources of recharge (e.g. mountain front recharge and storm water) are recharging the basin in the fore-bay areas to the north and at recharge basins that are primarily located north of State Route 60 (refer to Sections 2 and 3 of this report).
- The direction of groundwater-flow is generally from north to south (as shown in Section 4 of this report).
- The current land use types with the greatest impact on nitrate concentrations are concentrated south of State Route 60 (irrigated agriculture and dairies).
- Historically, the north-west areas of the Chino Basin contained agricultural land use types, particularly irrigated citrus that relied heavily on fertilizers. As the agricultural land uses converted to urban uses, the high-nitrate loading at the ground surface has been replaced with lower-nitrate returns from outdoor water use, low-nitrate boundary inflows and storm water recharge.

There are a number of other factors that contribute to localized nitrate concentrations and trends, such as proximity to production wells, recharge sources, and point-source discharges, and underlying aquifer properties.

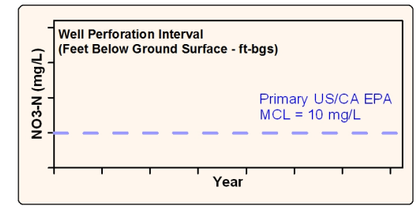
Exhibits 5-23 through 5-26 show time-history plots of nitrate concentrations measured at selected wells in each of the OBMP management zones. Data are shown for the 45-year period of 1972 through 2016. The wells and time-histories included in these exhibits were selected based on location, geographical distribution, length of nitrate data record, depth of well perforations, and the representativeness of nitrate concentrations in the area. For the period of record, the data show that the nitrate concentration trends throughout the Chino Basin are consistent with expected trends. Specifically:

- Nitrate concentrations at wells located north of State Route 60 have been less than or about equal to the CA Primary MCL of 10 mg/L.
- Nitrate concentrations at wells located south of State Route 60 are about equal to or greater than the CA Primary MCL of 10 mg/L.
- Nitrate concentrations at wells with shallow well perforations (e.g. less than 200 ft-bgs) are higher than those at wells with deep well perforations. Note that the wells with data to the north of State Route 60 are primarily deep municipal production wells.

MZ1 Boundary Area

Representative MZ1 Wells

Nitrate as Nitrogen (NO3-N) Concentration







OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

### Geology

*Water-Bearing Sediments*

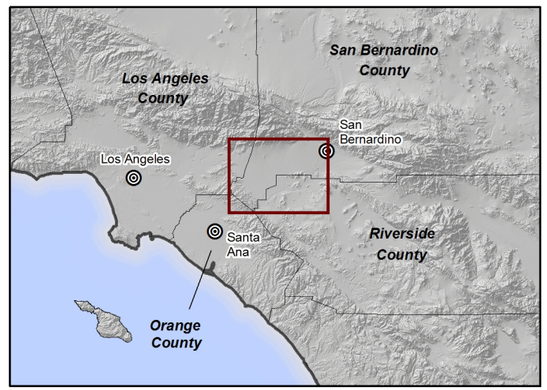
Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-23_MZ1_NO3

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

## Chino Basin Management Zone 1

*Trends in Nitrate Concentrations*

**Exhibit 5-23**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Basin

Pomona Basin

Rialto-Colton Basin

Puente Hills

Prado Basin

Temescal Basin

El Sobrante de San Jacinto

Jurupa Mountains

Red Hill Fault

San Jose Fault

Chino Fault

Rialto-Colton Fault

San Jacinto Fault

Loma Linda Fault

Barrier J

CVWD 05

Ont 24

Ont 40

Ont 17

XRef 281

XRef 29

I-4 HCMP-1

Day Ck

Cucamonga Ck

Chino Ck

Haven Ave

Etiwanda Ave

Sierra Ave

Riverside Ave

Mission Blvd

Riverside Dr

Limonite Ave

Belgrave Ave

Little Ck

Santa

(538-1238 ft-bgs)

(484-952 ft-bgs)

(415-1007 ft-bgs)

(500-1005 ft-bgs)

(99-295 ft-bgs)

(138-518 ft-bgs)

(200-480 ft-bgs)

HCMP-1/1 (135-175 ft-bgs)

HCMP-1/2 (300-320 ft-bgs)

HCMP-1/3 (410-430 ft-bgs)

NO3-N (mg/L)

1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

MZ2 Boundary Area

Representative MZ2 Wells

Nitrate as Nitrogen (NO3-N) Concentration

Well Perforation Interval
(Feet Below Ground Surface - ft-bgs)

Primary US/CA EPA MCL = 10 mg/L

Year

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain

San Bernardino County

Los Angeles County

Orange County

Riverside County

Los Angeles

San Bernardino

Santa Ana

Prepared by:

WEI Wildermuth Environmental, Inc.

Author: RT

Date: 6/1/2017

Document Name: Exhibit_5-24_MZ2_NO3

0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 2

*Trends in Nitrate Concentrations*

**Exhibit 5-24**

117°40'0"W

117°20'0"W

34°0'0"N

San Gabriel Mountains

Cucamonga Fault

San Antonio Ck

Claremont Basin

Indian Hill Fault

Pomona Basin

San Jose

Cam

Puente Hills

Chino Ck

Chino Fault

Chino Hills

San Bernardino County

Orange County

Prado Basin

Temescal Basin

Rialto-Colton Basin

Barrier J

Sierra Ave

Loma Linda Fault

Riverside Ave

Foothill Blvd

Haven Ave

Day Ck

Etiwanda Ave

Rialto-Colton Fault

San Jacinto

F37A

Ont 31

JCSD 16

CDA I-15

XRef 4649

HCMP-6

Mission Blvd

Jurupa

Belegrave Ave

Limonite Ave

Van Buren Blvd

Victoria Ave

El Sobrante de San Jacinto

(378-810 ft-bgs)

(400-980 ft-bgs)

(100-310 ft-bgs)

(225-275 ft-bgs)

(85-275 ft-bgs)

HCMP-6/1 (60-100 ft-bgs)

HCMP-6/2 (276-296 ft-bgs)

HCMP-6/3 (462-482 ft-bgs)

NO3-N (mg/L)

1972 1976 1980 1984 1988 1992 1996 2000 2004 2008 2012 2016

MZ3 Boundary Area

Representative MZ3 Wells

Nitrate as Nitrogen (NO3-N) Concentrations

Well Perforation Interval
(Feet Below Ground Surface - ft-bgs)

Primary US/CA EPA
MCL = 10 mg/L

Year

OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

**Geology**

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

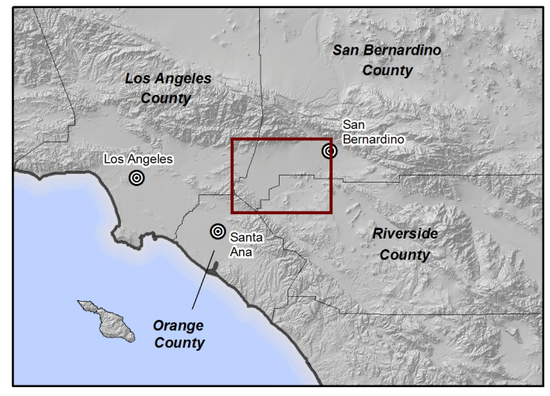
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-25_MZ3_NO3

0 1 2 3 4 5 Miles

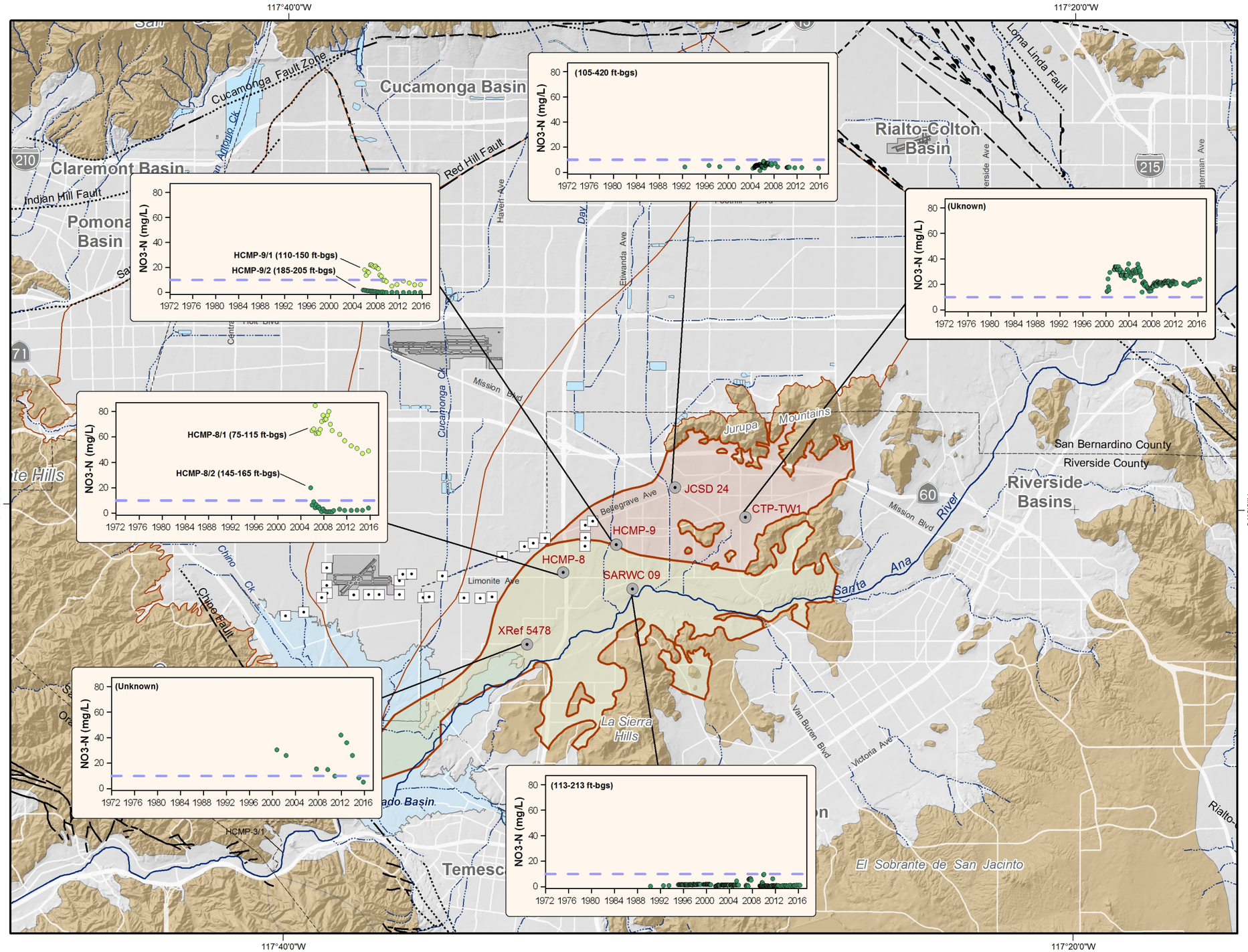
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 3

*Trends in Nitrate Concentrations*

**Exhibit 5-25**

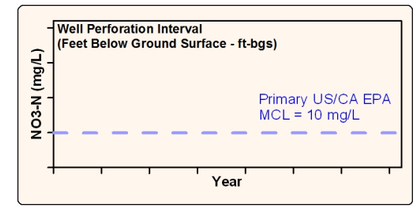



MZ4 Boundary Area

MZ5 Boundary Area

Representative MZ4 and MZ5 Wells

Nitrate as Nitrogen (NO3-N) Concentrations







OBMP Management Zones

Chino Basin Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

## Geology

*Water-Bearing Sediments*

Quaternary Alluvium

*Consolidated Bedrock*

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

*Faults*

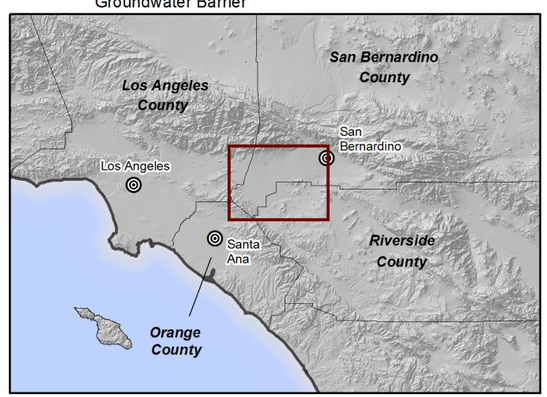
Location Certain

Location Approximate

Approximate Location of Groundwater Barrier

Location Concealed

Location Uncertain




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 6/1/2017
Document Name: Exhibit_5-26_MZ4_5_NO3

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2016 State of the Basin
*Groundwater Quality*

# Chino Basin Management Zone 4 and Zone 5

*Trends in Nitrate Concentrations*

**Exhibit 5-26**

This section contains exhibits that characterize the history of land subsidence and ground fissuring and the current state of ground-level movement in the Chino Basin as understood through the Watermaster's ground-level monitoring program.

One of the earliest indications of land subsidence in Chino Basin was the appearance of ground fissures in the City of Chino. These fissures appeared as early as 1973, but an accelerated occurrence of ground fissuring ensued after 1991 and resulted in damaged infrastructure.

In 1999, the OBMP Phase I Report (WEI, 1999) identified pumping-induced decline of piezometric levels and subsequent aquifer-system compaction as the most likely cause of land subsidence and ground fissuring observed in MZ1. Program Element 1 – *Develop and Implement a Comprehensive Monitoring Program* called for basin-wide analysis of ground-motion via ground-level surveys and remote sensing (InSAR) and ongoing monitoring based on the analysis of the ground-motion data. Program Element 4 – *Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1* called for the development and implementation of an interim management plan for MZ1 that would:

- Minimize subsidence and fissuring in the short-term.
- Collect the information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring.
- Formulate a management plan to monitor and manage ground-level movement to abate future subsidence and fissuring or reduce it to tolerable levels.

In 2000, the Implementation Plan for the Peace Agreement called for an aquifer-system and land-subsidence investigation in the southwestern portion of MZ1 to support the development of a management plan for MZ1 (second and third bullets above). This investigation was titled the MZ1 Interim Monitoring Program (IMP). From 2001 to 2005, Watermaster developed, coordinated, and conducted the IMP under the guidance of the MZ1 Technical Committee, which was composed of representatives from all major producers in MZ1 and their technical consultants. The investigation methods, results, and conclusions are described in detail in the *MZ1 Summary Report* (WEI, 2006). The investigation provided enough information for Watermaster to develop Guidance Criteria for MZ1 that, if followed, would minimize the potential for subsidence and fissuring in the investigation area. The Guidance Criteria also formed the basis for the *MZ1 Subsidence Management Plan* (MZ1 Plan) (WEI, 2007b).

The MZ1 Plan was developed by the MZ1 Technical Committee and approved by Watermaster in October 2007. In November 2007, the California Superior Court for the County of San Bernardino, which retains continuing jurisdiction over the Chino Basin adjudication, approved the MZ1 Plan and ordered its implementation. The MZ1 Plan calls for: the continued scope and frequency of monitoring implemented within the MZ1 Managed Area during the IMP and expanded monitoring of the aquifer-system and ground-motion in other areas of the Chino Basin where the IMP indicated concern for future subsidence and ground fissuring. The so-called Areas of Subsidence Concern include the Central MZ1, Northwest MZ1, Northeast, and Southeast Areas.

Watermaster's current ground-level monitoring program includes:

- *Piezometric Levels*. Piezometric levels are an important part of the ground-level monitoring program because piezometric changes are the mechanism for aquifer-system deformation and land subsidence. Watermaster monitors piezometric levels at high frequency at about 60 wells as part of its ground-level monitoring program. A pressure-transducer/data-logger is installed at each of these wells and records one water-level measurement every 15 minutes. Data loggers also record depth-specific piezometric levels at the piezometers located at Watermaster's Ayala Park Extensometer and Chino Creek Extensometer facilities once every 15 minutes.
- *Aquifer-System Deformation*. The vertical deformation of the aquifer-system is measured and recorded with borehole extensometers. In 2003, Watermaster installed the Ayala Park Extensometer in the Managed Area to support the IMP. At this facility, two extensometers are completed to depths of 550 ft-bgs and 1,400 ft-bgs. In 2012, Watermaster installed the Chino Creek Extensometer facility (CCX) in the Southeast Area to understand the effects of pumping at the newly constructed Chino Creek Well Field (CCWF). The CCX also consists of two extensometers: one completed to a depth of 140 ft-bgs and the other to 610 ft-bgs. Both extensometer facilities record the vertical component of aquifer-system compression and expansion once every 15 minutes—synchronized with the piezometric measurements to understand the relationships between piezometric changes and aquifer-system deformation.
- *Vertical Ground-Motion*. Watermaster monitors vertical ground-motion via traditional elevation surveys at benchmark monuments and the remote sensing (InSAR) techniques established during the IMP. Elevation surveys are typically conducted in the MZ1 Managed Area, Southeast Area, and Northwest MZ1 Area once per year. InSAR is the only monitoring technique being employed outside of these areas. Vertical ground-motion displacement data based on InSAR is collected and analyzed once per year.
- *Horizontal Ground-Surface Deformation*. Watermaster monitors horizontal ground-surface deformation across areas that are experiencing differential land subsidence to understand the potential threats and locations of ground fissuring. These data are obtained by electronic distance measurements (EDMs) between benchmark monuments in two areas: across the historical zone of ground fissuring in the MZ1 Managed Area and across the San Jose Fault Zone in Northwest MZ1.

Exhibits 6-1 through 6-3 illustrate the historical occurrence of vertical ground-motion in the Chino Basin, as interpreted from InSAR and ground-level surveys. These maps demonstrate that land subsidence concerns are primarily confined to the west side of the Chino Basin.

The land subsidence that has occurred in the Chino Basin was mainly controlled by changes in piezometric levels, which, in turn, were mainly controlled by pumping and recharge. Exhibits 6-4 through 6-8 show the relationships between groundwater pumping, recharge, recycled water reuse, piezometric levels, and vertical ground-motion in the MZ1 Managed Area and the other Areas of Subsidence Concern. These graphics can reveal cause-and-effect relationships and the current state and nature of vertical ground-motion.

Watermaster convenes a Ground-Level Monitoring Committee (GLMC) annually to review and interpret the data from the ground-level monitoring program. The GLMC prepares annual reports that include recommendations for changes to the monitoring program and/or the MZ1 Plan, if such changes are deemed necessary to minimize or abate the occurrence of land subsidence and ground fissuring.

Based on the data collected and analyzed for the ground-level monitoring program, the GLMC became increasingly concerned with

the occurrence of persistent differential subsidence in Northwest MZ1. In 2014, the GLMC recommended that the MZ1 Plan be updated to include a subsidence management plan for Northwest MZ1 with the long-term objective of minimizing or abating the occurrence of the differential land subsidence. In 2015, Watermaster updated the MZ1 Plan to more accurately reflect Watermaster's current and future efforts to monitor and manage land subsidence, including the effort to develop a subsidence management plan for Northwest MZ1, and the MZ1 Plan was renamed the *Chino Basin Subsidence Management Plan* (WEI, 2015c).

This new effort in Northwest MZ1 is an example of adaptive management of land subsidence based on monitoring data, and includes the following upcoming activities:

- To better understand the extent, rate, and causes of the subsidence in Northwest MZ1, the GLMC and Watermaster have increased monitoring efforts to include the installation of benchmark monuments across Northwest MZ1, performing annual elevation surveys at the benchmarks, performing EDMs between benchmarks across the San Jose Fault, and expanding the high-frequency measurement of piezometric levels at wells.
- Aquifer-system compaction may be occurring (or may have occurred historically) at specific depths within Northwest MZ1, caused by depth-specific piezometric changes. Depth-specific data, obtained from piezometers and extensometers, are critical to understanding how groundwater production and recharge affect piezometric levels and the deformation of the aquifer-system, which is the understanding needed to develop a subsidence management plan. Watermaster has identified a site for a new extensometer facility in Northwest MZ1 and is currently preparing technical specifications for the drilling and construction of the Pomona Extensometer Facility. This facility is expected to be collecting piezometric and aquifer-system deformation data by 2018. The subsidence management plan for Northwest MZ1 is expected to be completed by 2021.

117°40'0"W

34°0'0"N

Pomona Basin

San Jose Fault

Los Angeles County

San Bernardino County

Monte Vista Ave

Central Ave

Euclid Ave

Pipeline Ave

Ramona Ave

Holt Blvd

Philadelphia St

Riverside Dr

Chino Ave

Schaefer Ave

Eucalyptus Ave

Mission Blvd

Haven Ave

Deer Ck

Day Ck

West Cucamonga Ck

San Antonio Ck

Cypress Chnl

Chino Ck

Chino Fault

10

15

60

71

-0.6 -0.8 -1.2 -1.4 -1 -0.2 -1.6 -1.2 -2 -1 -0.2 -0.4 0

Area of Significant Historical Subsidence as Measured by InSAR

Ground Fissures (1973)

Ground Fissures (early 1990s)

This map displays the historical deformation of the land surface in the western Chino Basin from the late 1980s to the late 1990s—specifically, vertical ground-motion and ground fissuring. One of the earliest indications of land subsidence in the Chino Basin was the appearance of ground fissures in the City of Chino. These fissures appeared as early as 1973, but an accelerated occurrence of ground fissuring ensued after 1991 and resulted in damage to existing infrastructure. The monitoring programs and scientific studies that followed attributed the fissuring phenomenon to differential land subsidence caused by pumping of the underlying aquifer-system and the consequent drainage and compaction of aquitard sediments.

In 2003, Watermaster constructed a sophisticated monitoring facility—the Ayala Park Extensometer Facility—that provided the critical information to develop the MZ1 Plan called for in Program Element 4 of the OBMP. This map shows the delineation of the Managed Area defined in the MZ1 Plan, where the local pumpers voluntarily manage pumping such that piezometric levels do not decline below the Guidance Criteria at an index well located at the Ayala Park Extensometer Facility. Pursuant to the MZ1 Plan, and the subsequent Subsidence Management Plan, Watermaster implements a comprehensive program of monitoring and assessment, and updates to the plan, as necessary, to minimize or abate the future occurrence of land subsidence and ground fissuring.

Contours of Relative Change in Land Surface Altitude as Measured by Leveling Surveys 1987 to 1999

0.0 ft

-2.2 ft

Relative Change in Land Surface Altitude as Measured by InSAR Oct-1993 to Dec-1995

+ 1 ft

0

- 1 ft

InSAR absent or incoherent

Managed Area

Ayala Park Extensometer (Constructed in 2003)

Active Production Wells by Owner - 1987 to 1999

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Golden State Water Company
- Monte Vista Water District
- San Antonio Water Company
- California Institution for Men

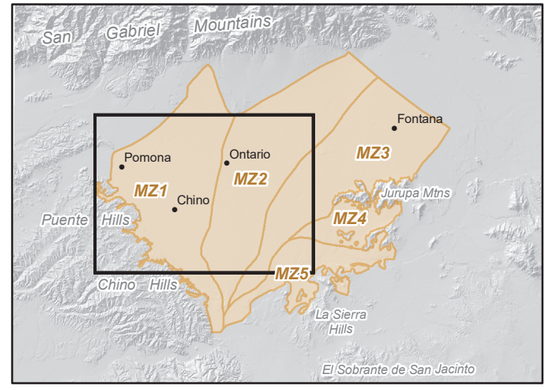
OBMP Management Zones

Flood Control and Conservation Basins

Ground Fissures

Approximate Location of the Riley Barrier

Fault - Solid where accurately located. Dashed where approximately located; dotted where concealed.




# Historical Land Surface Deformation in Management Zone 1

*Leveling Surveys (1987 to 1999) and InSAR (1993 to 1995)*

**Exhibit 6-1**

Prepared by:

WEI Wildermuth Environmental, Inc.

Author: EM
Date: 6/5/2017
Document Name: Exhibit_6-1_InSAR_v3

0 2 4 Miles

0 2 4 Kilometers

**2016 State of the Basin**
*Ground-Level Monitoring*

117°40'0"W

34°0'0"N

Cucamonga Basin

Rialto-Colton Basin

Claremont Heights Basins

Pomona Basin

Northwest MZ1 Area

Northeast Area

Central MZ1 Area

Southeast Area

Managed Area

Indian Hill Fault

San Jose Fault

Red Hill Fault

Rialto-Colton Fault

Barrier J

Ground Fissures (1973)

Ground Fissures (early 1990s)

Chino Fault

Foothill Blvd

Holt Blvd

Mission Blvd

Philadelphia St

Riverside Dr

Chino Ave

Schaefer Ave

Edison Ave

Eucalyptus Ave

Kimball Ave

Euclid Ave

Haven Ave

Etiwanda Ave

Sierra Ave

Ramona Ave

Central Ave

Day Ck

Chino Ck

Cucamonga Ck

Santa Ana

San Bernardino County

Riverside County

210

10

60

71

This map displays vertical ground-motion across the entire Chino Basin, as measured by InSAR, from 2005 to 2010. InSAR is generally coherent and useful in the northern urbanized areas of the Chino Basin and generally less coherent and not as useful in agricultural or undeveloped open space areas. This pattern of "coherence" relative to land use is typical of InSAR. Vertical ground-motion measured by InSAR were used by Watermaster to delineate other Areas of Subsidence Concern.

Historically, the Managed Area experienced the most land subsidence—over two feet of subsidence from 1987 to 1999. From 2005 to 2010, vertical ground-motion measured by InSAR showed less than 0.1 ft of subsidence in this area, which indicates that land subsidence is successfully being managed here. In the northeastern areas of the Chino Basin, such as in the Cities of Fontana and Rancho Cucamonga, vertical ground-motion measured by InSAR was relatively minor from 2005 to 2010. Vertical ground-motion was greatest in the Northwest MZ1 Area where up to 0.4 feet of subsidence was measured from 2005 to 2010.

Geologic faults that cut through the aquifer-system can act as barriers to groundwater flow and, hence, can cause the occurrence of differential subsidence. In the Managed Area, historical ground fissuring has been linked to the occurrence of differential subsidence. The vertical ground-motion measured by InSAR shows a steep gradient of subsidence across the San Jose Fault in the Northwest MZ1 Area, indicating the potential for the accumulation of horizontal strain in the shallow sediments and a threat of ground fissuring. Ground fissuring is the main subsidence-related threat to infrastructure.

Relative Change in Land Surface Altitude
as Measured by InSAR
June 2005 to September 2010

+ 0.5 ft
0
-0.25
- 0.5 ft

InSAR absent or incoherent

Managed Area

Areas of Subsidence Concern

Ayala Park Extensometer

OBMP Management Zones

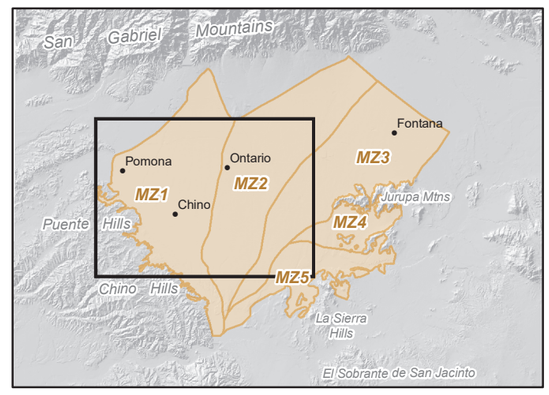
Flood Control and Conservation Basins

Ground Fissures

Approximate Location of the Riley Barrier

Approximate Location of Groundwater Barrier

Fault - Solid where accurately located. Dashed where approximately located; dotted where concealed




Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: EM
Date: 6/1/2017
Document Name: Exhibit_6-2_InSAR_v2

0 2 4 Miles

0 2 4 Kilometers

2016 State of the Basin
*Ground-Level Monitoring*

**Vertical Ground-Motion as Measured by InSAR**
*2005 to 2010*

**Exhibit 6-2**

117°40'0"W

34°0'0"N

Northwest MZ1 Area

Central MZ1 Area

Northeast Area

Managed Area

C

B

A

D

P-27

BM B-403

P-30

MV-10

MV-13

MV-1

MV-8

P-18

MV-2

C-3

C-10

MV-24

C-5

BM 121/49

BM 125/49

C-11

O-15

O-5

O-34

O-25

O-36

BM 133/61

C-13

C-4

BM 137/53

BM 137/61

XRef 8591

XRef 8590

CH-18A

PA-7

CH-1B

XRef 8589

XRef 8588

BM 157/71

CCPA-1

CCPA-2

HCMP-1/1

HCMP-1/2

XRef 18

San Jose Fault

Chino Fault

Euclid Ave

Ramona Ave

Central Ave

Philadelphia St

Holt Blvd

Hawen Ave

Day Ck

Mission Blvd

Etiwanda Ave

Riverside Dr

Chino Ave

Schaefer Ave

Edison Ave

Eucalyptus Ave

Kimball Ave

Cucamonga Ck

Chino Ck

Los Angeles County

San Bernardino County

10

15

60

71

This map displays the most recent measurements of vertical ground-motion measured by InSAR for the western half of the Chino Basin, from March 2011 to January 2016. The InSAR indicates minor land subsidence occurred across most of the Managed Area and Areas of Subsidence Concern. Approximately 0.12 feet of subsidence was measured by InSAR in the Managed Area, indicating subsidence management continues to be successful here. The greatest subsidence continued to occur in the Northwest MZ1 Area, where up to 0.26 ft of subsidence was measured by InSAR. InSAR continues to show a steep gradient of subsidence across the San Jose Fault, indicating the potential for the accumulation of horizontal strain in the shallow sediments and a threat of ground fissuring.

This map also shows selected wells with piezometric level records, as well as the locations of select ground-level survey benchmark monuments within the Managed Area and the other Areas of Subsidence Concern. The exhibits that follow describe the history of land subsidence in each area, the current state of land subsidence, and the possible cause-and-effect relationships between pumping and recharge, piezometric levels, and vertical ground-motion.

Relative Change in Land Surface Altitude
as Measured by InSAR
March 2011 to January 2016

+ 0.5 ft
0
-0.25
- 0.5 ft

InSAR absent or incoherent

Wells with Piezometric Level Time-Histories Plotted on Exhibits 6-4 to 6-8

InSAR Time-History Point Plotted on Exhibits 6-4 to 6-8

Ground-Level Survey Benchmark Time-History Point Plotted on Exhibits 6-4 to 6-8

Managed Area

Areas of Subsidence Concern

Ayala Park Extensometer

Chino Creek Extensometer

Chino-1/Chino-II Desalter Well

Chino Creek Desalter Well

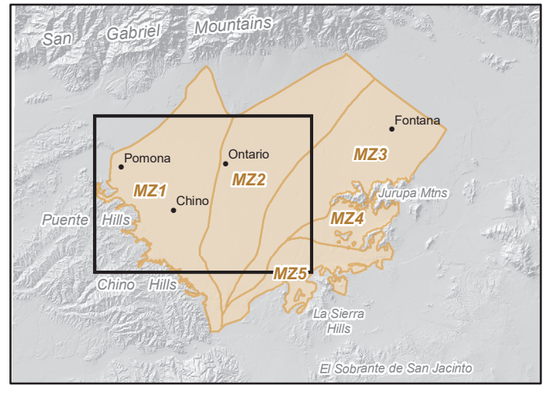
OBMP Management Zones

Flood Control and Conservation Basins

Ground Fissures

Approximate Location of the Riley Barrier

Fault - Solid where accurately located. Dashed where approximately located; dotted where concealed




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Author: EM
Date: 6/5/2017
Document Name: Exhibit_6-3_InSAR_v3

0 2 4 Miles

0 2 4 Kilometers

2016 State of the Basin
*Ground-Level Monitoring*

# Vertical Ground-Motion as Measured by InSAR
*2011 to 2016*

## Exhibit 6-3

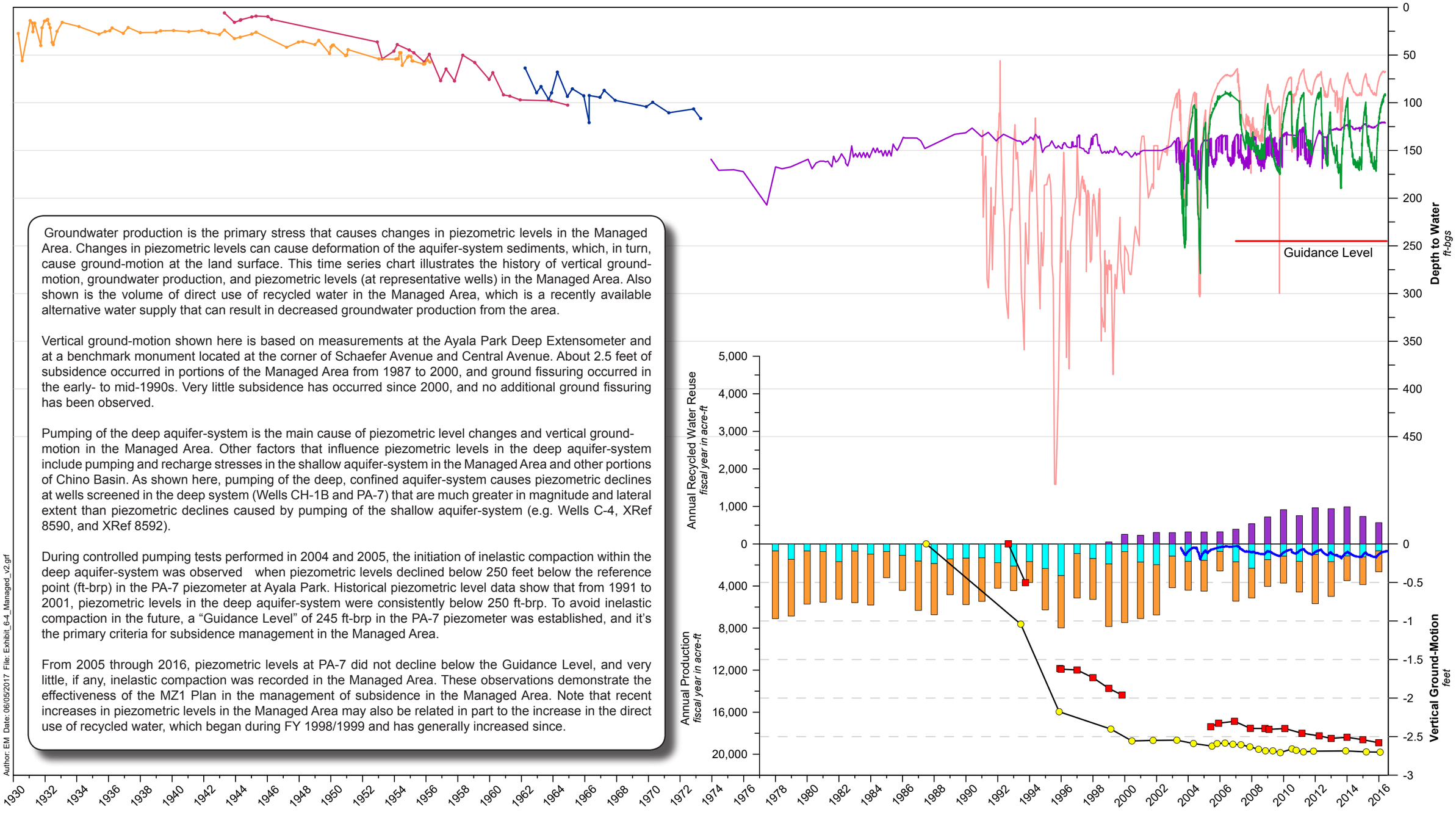
Groundwater production is the primary stress that causes changes in piezometric levels in the Managed Area. Changes in piezometric levels can cause deformation of the aquifer-system sediments, which, in turn, cause ground-motion at the land surface. This time series chart illustrates the history of vertical ground-motion, groundwater production, and piezometric levels (at representative wells) in the Managed Area. Also shown is the volume of direct use of recycled water in the Managed Area, which is a recently available alternative water supply that can result in decreased groundwater production from the area.

Vertical ground-motion shown here is based on measurements at the Ayala Park Deep Extensometer and at a benchmark monument located at the corner of Schaefer Avenue and Central Avenue. About 2.5 feet of subsidence occurred in portions of the Managed Area from 1987 to 2000, and ground fissuring occurred in the early- to mid-1990s. Very little subsidence has occurred since 2000, and no additional ground fissuring has been observed.

Pumping of the deep aquifer-system is the main cause of piezometric level changes and vertical ground-motion in the Managed Area. Other factors that influence piezometric levels in the deep aquifer-system include pumping and recharge stresses in the shallow aquifer-system in the Managed Area and other portions of Chino Basin. As shown here, pumping of the deep, confined aquifer-system causes piezometric declines at wells screened in the deep system (Wells CH-1B and PA-7) that are much greater in magnitude and lateral extent than piezometric declines caused by pumping of the shallow aquifer-system (e.g. Wells C-4, XRef 8590, and XRef 8592).

During controlled pumping tests performed in 2004 and 2005, the initiation of inelastic compaction within the deep aquifer-system was observed when piezometric levels declined below 250 feet below the reference point (ft-brp) in the PA-7 piezometer at Ayala Park. Historical piezometric level data show that from 1991 to 2001, piezometric levels in the deep aquifer-system were consistently below 250 ft-brp. To avoid inelastic compaction in the future, a "Guidance Level" of 245 ft-brp in the PA-7 piezometer was established, and it's the primary criteria for subsidence management in the Managed Area.

From 2005 through 2016, piezometric levels at PA-7 did not decline below the Guidance Level, and very little, if any, inelastic compaction was recorded in the Managed Area. These observations demonstrate the effectiveness of the MZ1 Plan in the management of subsidence in the Managed Area. Note that recent increases in piezometric levels in the Managed Area may also be related in part to the increase in the direct use of recycled water, which began during FY 1998/1999 and has generally increased since.




Author: EM Date: 06/05/2017 File: Exhibit 6-4_Managed_v2.grf

Piezometric Levels at Wells (Top-Bottom Screen Interval)

Shallow Aquifer-System
- C-4 (160-275 ft-bgs)
- XRef 8590 (80-225 ft-bgs)
- XRef 8591 (unknown)
- XRef 8592 (90-230 ft-bgs)

Deep Aquifer-Sytem
- CH-1B (440-1,180 ft-bgs)
- PA-7 (438-448 ft-bgs)

Vertical Ground-Motion (Cumulative Displacement)
- InSAR Point A (see Exhibit 6-3)
- BM 137/53
- Ayala Park Deep Extensometer Measures between: 30 and 1,440 ft-bgs

Recycled Water Direct Reuse

Groundwater Production
- Shallow Aquifer or Unknown Aquifer
- Deep Aquifer or Both Aquifers

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*Ground-Level Monitoring*

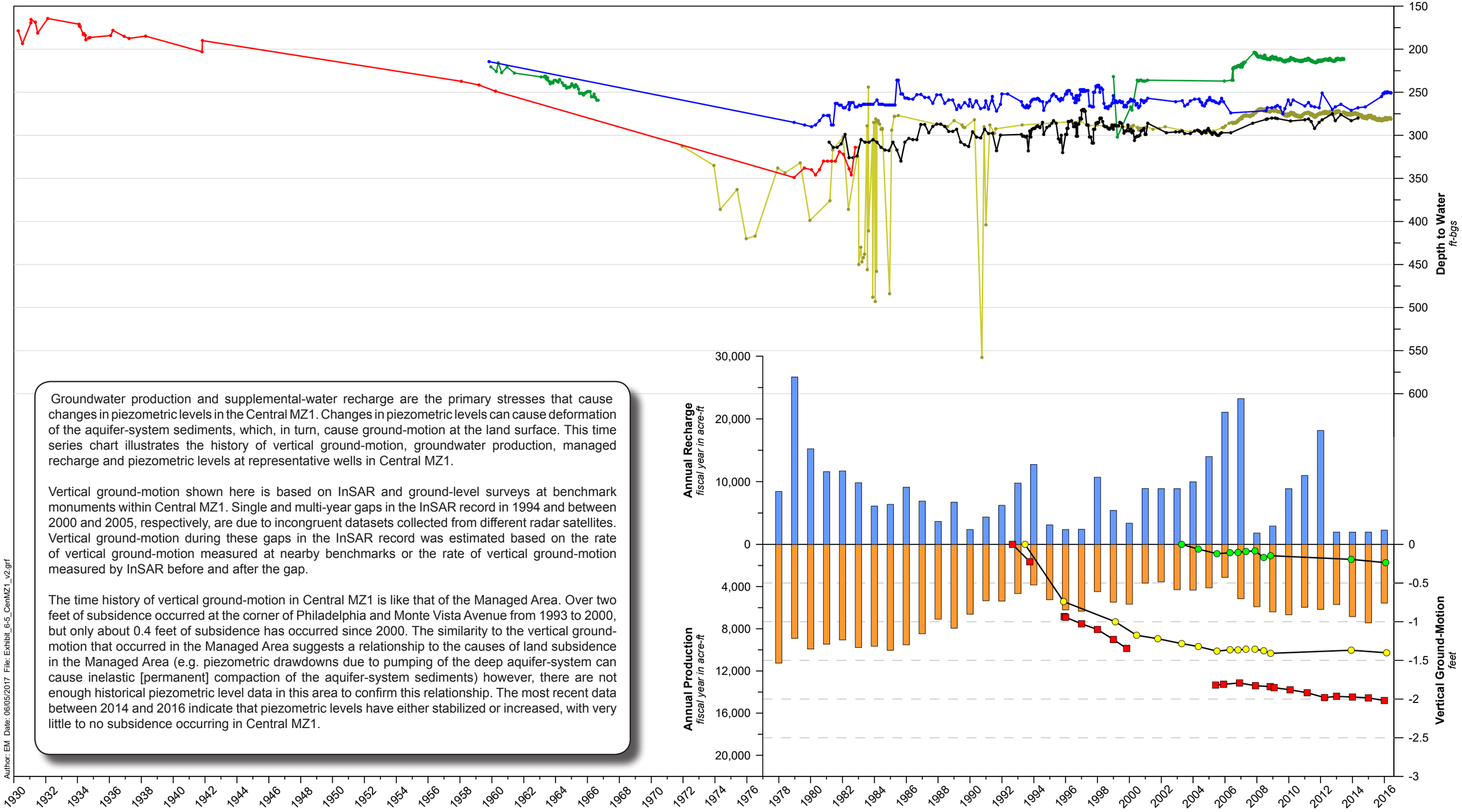
# The History of Land Subsidence in the MZ1 Managed Area

**Exhibit 6-4**

Groundwater production and supplemental-water recharge are the primary stresses that cause changes in piezometric levels in the Central MZ1. Changes in piezometric levels can cause deformation of the aquifer-system sediments, which, in turn, cause ground-motion at the land surface. This time series chart illustrates the history of vertical ground-motion, groundwater production, managed recharge and piezometric levels at representative wells in Central MZ1.

Vertical ground-motion shown here is based on InSAR and ground-level surveys at benchmark monuments within Central MZ1. Single and multi-year gaps in the InSAR record in 1994 and between 2000 and 2005, respectively, are due to incongruent datasets collected from different radar satellites. Vertical ground-motion during these gaps in the InSAR record was estimated based on the rate of vertical ground-motion measured at nearby benchmarks or the rate of vertical ground-motion measured by InSAR before and after the gap.

The time history of vertical ground-motion in Central MZ1 is like that of the Managed Area. Over two feet of subsidence occurred at the corner of Philadelphia and Monte Vista Avenue from 1993 to 2000, but only about 0.4 feet of subsidence has occurred since 2000. The similarity to the vertical ground-motion that occurred in the Managed Area suggests a relationship to the causes of land subsidence in the Managed Area (e.g. piezometric drawdowns due to pumping of the deep aquifer-system can cause inelastic [permanent] compaction of the aquifer-system sediments) however, there are not enough historical piezometric level data in this area to confirm this relationship. The most recent data between 2014 and 2016 indicate that piezometric levels have either stabilized or increased, with very little to no subsidence occurring in Central MZ1.




Piezometric Levels at Wells
(Top-Bottome Screen Interval)

- C-3 (230-245 ft-bgs)
- C-5 (430-1,100 ft-bgs)
- C-10 (355-1,090 ft-bgs)
- MV-2 (397-962 ft-bgs)
- MV-24 (244-420 ft-bgs)

Vertical Ground-Motion
(Cumulative Displacement)

- InSAR Point B (see Exhibit 6-3)
- BM 125/49
- BM 121/49

- Recharge of Recycled Water, Storm-water,* and Imported Water at the College Heights, Upland, Montclair, and Brooks Recharge Basins; and, at MVWD ASR Wells
  *Storm-water is an estimated amount prior to fiscal year 2004/05
- Groundwater Production

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# The History of Land Subsidence in the Central MZ1 Area

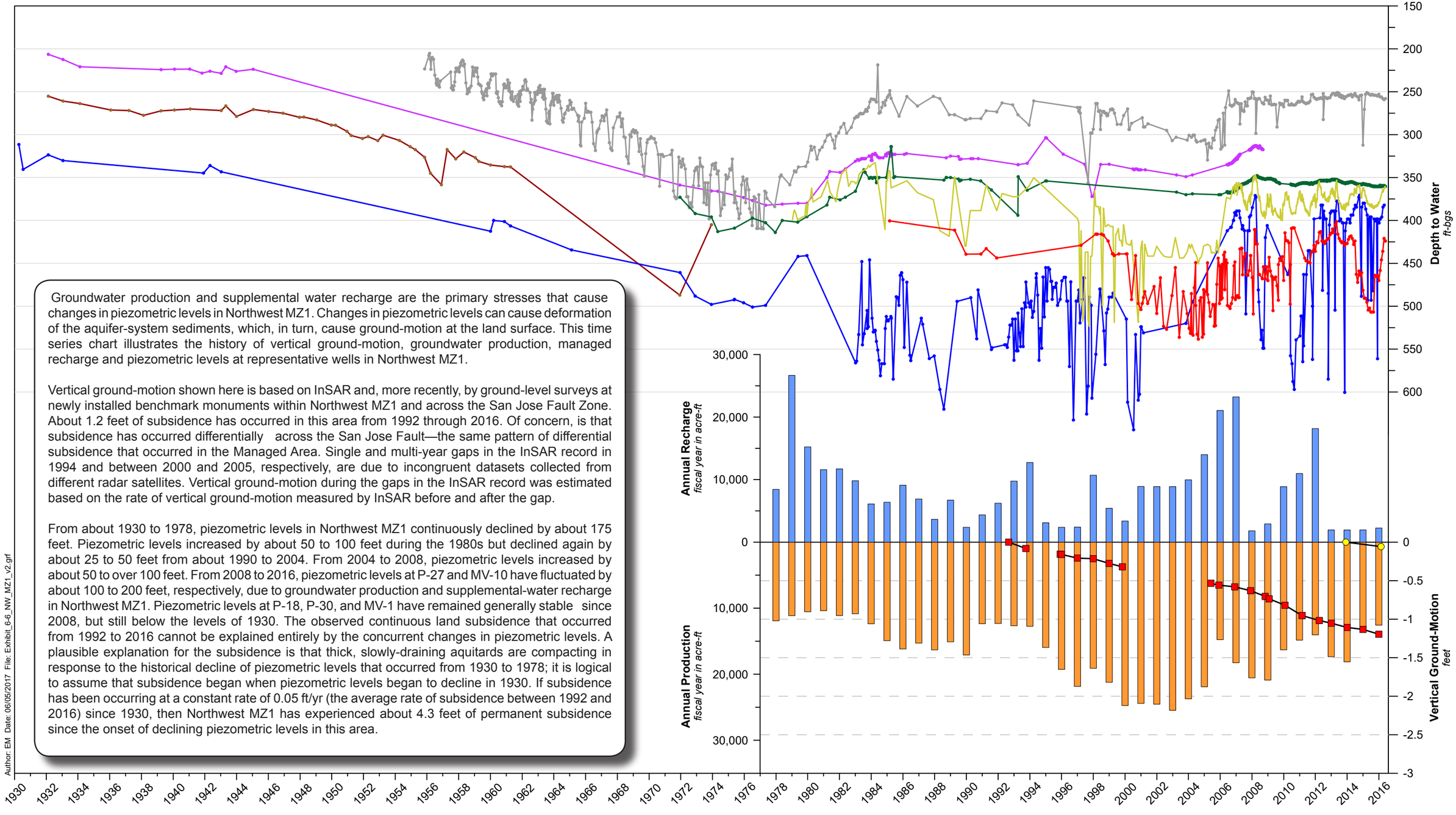
**Exhibit 6-5**

Author: EM Date: 06/05/2017 File: Exhibit_6-5_CenMZ1_v2.grf

Groundwater production and supplemental water recharge are the primary stresses that cause changes in piezometric levels in Northwest MZ1. Changes in piezometric levels can cause deformation of the aquifer-system sediments, which, in turn, cause ground-motion at the land surface. This time series chart illustrates the history of vertical ground-motion, groundwater production, managed recharge and piezometric levels at representative wells in Northwest MZ1.

Vertical ground-motion shown here is based on InSAR and, more recently, by ground-level surveys at newly installed benchmark monuments within Northwest MZ1 and across the San Jose Fault Zone. About 1.2 feet of subsidence has occurred in this area from 1992 through 2016. Of concern, is that subsidence has occurred differentially across the San Jose Fault—the same pattern of differential subsidence that occurred in the Managed Area. Single and multi-year gaps in the InSAR record in 1994 and between 2000 and 2005, respectively, are due to incongruent datasets collected from different radar satellites. Vertical ground-motion during the gaps in the InSAR record was estimated based on the rate of vertical ground-motion measured by InSAR before and after the gap.

From about 1930 to 1978, piezometric levels in Northwest MZ1 continuously declined by about 175 feet. Piezometric levels increased by about 50 to 100 feet during the 1980s but declined again by about 25 to 50 feet from about 1990 to 2004. From 2004 to 2008, piezometric levels increased by about 50 to over 100 feet. From 2008 to 2016, piezometric levels at P-27 and MV-10 have fluctuated by about 100 to 200 feet, respectively, due to groundwater production and supplemental-water recharge in Northwest MZ1. Piezometric levels at P-18, P-30, and MV-1 have remained generally stable since 2008, but still below the levels of 1930. The observed continuous land subsidence that occurred from 1992 to 2016 cannot be explained entirely by the concurrent changes in piezometric levels. A plausible explanation for the subsidence is that thick, slowly-draining aquitards are compacting in response to the historical decline of piezometric levels that occurred from 1930 to 1978; it is logical to assume that subsidence began when piezometric levels began to decline in 1930. If subsidence has been occurring at a constant rate of 0.05 ft/yr (the average rate of subsidence between 1992 and 2016) since 1930, then Northwest MZ1 has experienced about 4.3 feet of permanent subsidence since the onset of declining piezometric levels in this area.




Author: EM Date: 06/05/2017 File: Exhibit_6-6_NW_MZ1_v2.grf

Piezometeric Levels at Wells
(Top-Bottom Screen Interval)

- MV-1 (245-472 ft-bgs)
- MV-8 (225-447 ft-bgs)
- MV-10 (520-1,084 ft-bgs)
- MV-13 (203-475 ft-bgs)
- P-18 (307-660 ft-bgs)
- P-27 (472-849 ft-bgs)
- P-30 (565-875 ft-bgs)

Vertical Ground-Motion
(Cumulative Displacement)

- InSAR Point C (see Exhibit 6-3)
- BM B-403

- Recharge of Recycled Water, Storm-water,* and Imported Water at the College Heights, Upland, Montclair, and Brooks Recharge Basins; and, at MVWD ASR Wells
  *Storm-water is an estimated amount prior to fiscal year 2004/05
- Groundwater Production

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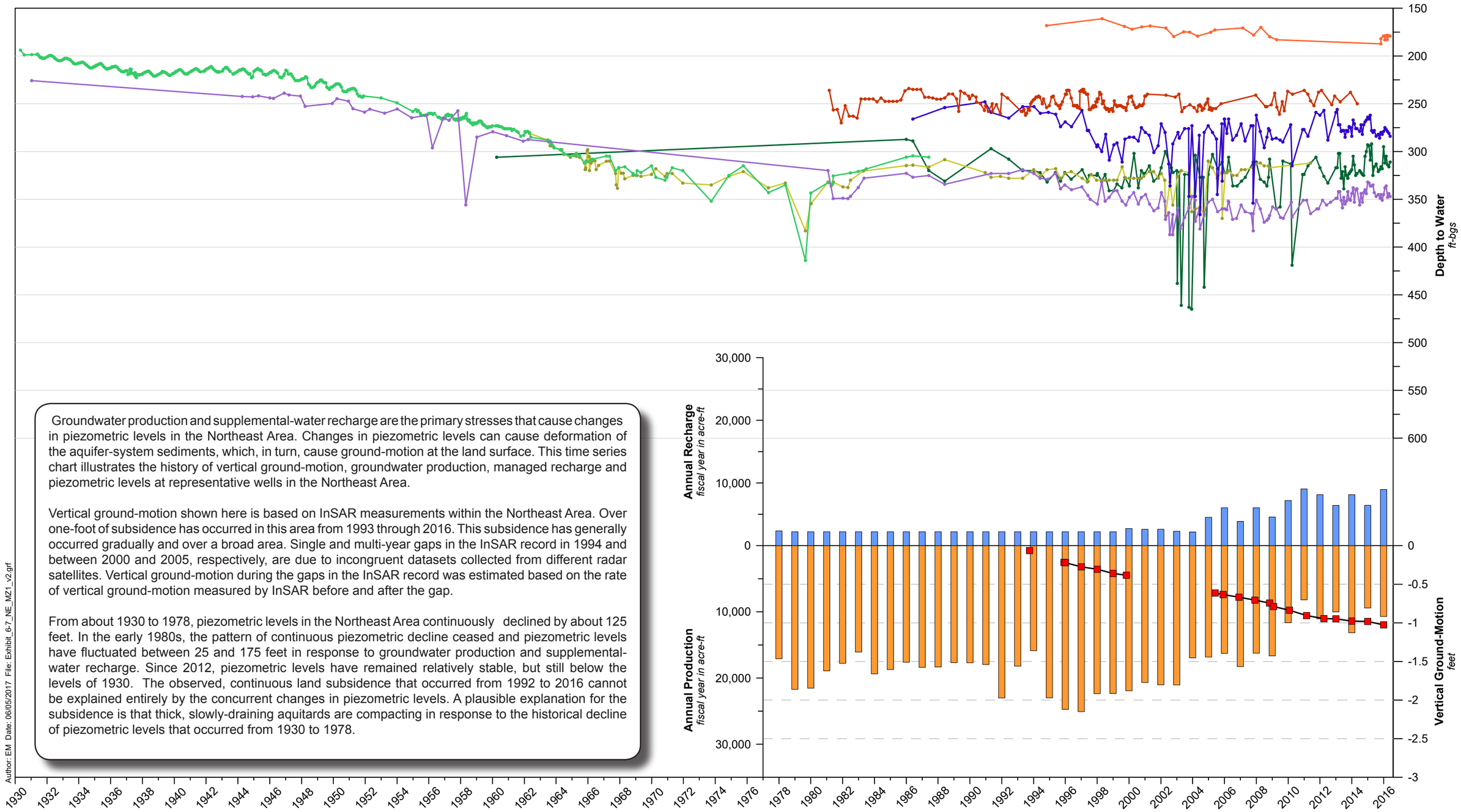
# The History of Land Subsidence in the Northwest MZ1 Area

**Exhibit 6-6**

Groundwater production and supplemental-water recharge are the primary stresses that cause changes in piezometric levels in the Northeast Area. Changes in piezometric levels can cause deformation of the aquifer-system sediments, which, in turn, cause ground-motion at the land surface. This time series chart illustrates the history of vertical ground-motion, groundwater production, managed recharge and piezometric levels at representative wells in the Northeast Area.

Vertical ground-motion shown here is based on InSAR measurements within the Northeast Area. Over one-foot of subsidence has occurred in this area from 1993 through 2016. This subsidence has generally occurred gradually and over a broad area. Single and multi-year gaps in the InSAR record in 1994 and between 2000 and 2005, respectively, are due to incongruent datasets collected from different radar satellites. Vertical ground-motion during the gaps in the InSAR record was estimated based on the rate of vertical ground-motion measured by InSAR before and after the gap.

From about 1930 to 1978, piezometric levels in the Northeast Area continuously declined by about 125 feet. In the early 1980s, the pattern of continuous piezometric decline ceased and piezometric levels have fluctuated between 25 and 175 feet in response to groundwater production and supplemental-water recharge. Since 2012, piezometric levels have remained relatively stable, but still below the levels of 1930. The observed, continuous land subsidence that occurred from 1992 to 2016 cannot be explained entirely by the concurrent changes in piezometric levels. A plausible explanation for the subsidence is that thick, slowly-draining aquitards are compacting in response to the historical decline of piezometric levels that occurred from 1930 to 1978.




Piezometeric Levels at Wells
(Top-Bottom Screen Interval)

- O-5 (360-470 ft-bgs)
- O-15 (474-966 ft-bgs)
- O-25 (370-903 ft-bgs)
- O-34 (522-1,092 ft-bgs)
- O-36 (530-1,000 ft-bgs)
- C-11 (390-910 ft-bgs)
- XRef 18 (unknown)

Vertical Ground-Motion
(Cumulative Displacement)

- InSAR Point D (see Exhibit 6-3)

- Recharge of Recycled, Storm-water,* and Imported Water at the Ely, Grove, Turner, 7th Street and 8th Street Recharge Basins
  *Storm-water is an estimated amount prior to fiscal year 2004/05
- Groundwater Production

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# The History of Land Subsidence in the Northeast Area

**Exhibit 6-7**

Author: EM Date: 06/05/2017 File: Exhibit_6-7_NE_MZ1_v2.grf

Groundwater production and supplemental-water recharge are the primary stresses that cause changes in piezometric levels in the Southeast Area. Changes in piezometric levels can cause deformation of the aquifer-system sediments, which, in turn, cause ground-motion at the land surface. This time series chart illustrates the history of vertical ground-motion, groundwater production, managed recharge and piezometric levels at representative wells in the Northeast Area. Also shown is the direct use of recycled water in the Southeast Area, which is a recently available alternative water supply that can result in decreased groundwater production from the area.

The first ground fissures documented in the Chino Basin occurred in the Southeast Area in the early 1970s, but ground fissuring has not been observed in the area since.

Vertical ground-motion shown here is based on vertical ground-level surveys at benchmark monuments within the Southeast Area between 1987 and 2016. InSAR is typically incoherent (not measurable) in the Southeast Area because agricultural land uses. In the northern portion of the Southeast Area, the ground-level surveys indicate that about 0.5 ft of subsidence occurred from 1987 to 2016. Very little subsidence, if any, occurred from 2014 to 2016. In the southern portion of the Southeast Area, near the intersection of Euclid Avenue and Kimball Avenue, where the Chino-I Desalter wells pump groundwater from the deep confined aquifer-system, the ground-level surveys indicated that about 0.25 feet of land subsidence occurred from 2000 to 2006. The Chino-I Desalter wells began pumping in 2000 and likely caused a localized decline of piezometric levels within the deep aquifer-system, which may have caused the observed land subsidence in this area between 2000 and 2006. Watermaster installed the CCX facility in this area in 2012 to characterize the occurrence and mechanisms of the subsidence near the Chino-I Desalter well field and record the effects of new pumping at the CCWF on piezometric levels and land subsidence. Pumping at the CCWF wells commenced in 2014. The CCX began collecting data in July 2012 and, to date, has recorded no aquifer-system compaction.

From about 1930 to 1990, piezometric levels in the Southeast Area have continuously declined by about 100 feet. Since the 1990s, piezometric levels have been generally stable, with piezometric levels fluctuating between about 10 and 20 feet in response to groundwater production and supplemental-water recharge. Recent increases in piezometric levels in the area may be related in part to the increase in the direct use of recycled water. However, piezometric levels still remain below the levels of 1930. The observed slow but continuous land subsidence from 1987 to 2016 is not explained by the concurrent relatively stable piezometric levels. A plausible explanation for the subsidence in this area is that thick, slowly draining aquitards are compacting in response to the historical decline of piezometric levels that occurred prior to 1990.

Author: EM Date: 06/05/2017 File: Exhibit_6-8_SE_MZ1_v2.gff

Depth to Water
*ft-bgs*

0
50
100
150
200
250
300
350
400
450

Annual Recycled Water Reuse
*fiscal year in acre-ft*

30,000
20,000
10,000
0

Annual Production
*fiscal year in acre-ft*

10,000
20,000
30,000

Vertical Ground-Motion
*feet*

0
-0.5
-1
-1.5
-2
-2.5
-3

1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016

Piezometric Levels at Wells (Top-Bottom Screen Interval)
- C-13 (290-720 ft-bgs)
- CH-18A (420-980 ft-bgs)
- HCMP-1/1 (135-175 ft-bgs)
- HCMP-1/2 (300-320 ft-bgs)
- XRef 8588 (unknown)
- XRef 8589 (unknown)
- CCPA-1 1230583
- CCPA-2 1230584

Vertical Ground-Motion
(Cumulative Displacement)
- BM 133/61
- BM 137/61
- BM 157/71
- CCX-2 Extensometer
  Measures between: 50 and 610 ft-bgs

- Recycled Water Direct Reuse
- Groundwater Production
- Groundwater Production from Desalter Wells in the Upper Aquifer
- Groundwater Production from Desalter Wells in the Lower Aquifer

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# The History of Land Subsidence in the Southeast Area

**Exhibit 6-8**

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# CHINO BASIN WATERMASTER

# APPROVED 2017/2018 ASSESSMENT PACKAGE
# (PRODUCTION YEAR 2016/2017)

## NOVEMBER 16, 2017

Chino Basin Watermaster

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Pool 2 Water Transaction Summary ..... 16A

**Appendix A: Pool 3 Water Production Detail**

**Appendix B: Desalter Replenishment Accounting**

**Assessment Package References and Definitions**

**Assessment Package Notes**

# CHINO BASIN WATERMASTER
## ASSESSMENT CALCULATION
## FISCAL YEAR 2017/18
## INCLUDES "10% ADMINISTRATIVE AND 15% OBMP/PROJECT OPERATING RESERVES"

Column [2J] Column [14H]

| PRODUCTION BASIS | | FY 2016/17 BUDGET | FY 2017/18 BUDGET | ASSESSMENT | APPROPRIATIVE POOL | | AGRICULTURAL POOL | | NON-AG POOL | |
|---|---|---|---|---|---|---|---|---|---|---|
| **2015/16 Production & Exchanges in Acre-Feet (Actuals)** | | | | 119,475.939 | 89,906.000 | 75.250% | 26,167.031 | 21.902% | 3,402.908 | 2.848% |
| **2016/17 Production & Exchanges in Acre-Feet (Actuals)** | | | | 113,323.292 | 82,269.159 | 72.597% | 26,862.554 | 23.704% | 4,191.579 | 3.699% |
| **BUDGET** | | | | | **General Administration** | **OBMP** | **General Administration** | **OBMP** | **General Administration** | **OBMP** |
| Administration, Advisory Committee & Watermaster Board[1] | | $1,938,787 | $2,043,498 | $2,043,498 | $1,483,516 | | $484,398 | | $75,584 | |
| OBMP & Implementation Projects[1] | | 5,109,883 | 6,305,824 | 6,305,824 | | 4,577,831 | | 1,494,755 | | 233,239 |
| **General Admin & OBMP Assessments** | | $7,048,670 | $8,349,322 | 8,349,322 | 1,483,516 | 4,577,831 | 484,398 | 1,494,755 | 75,584 | 233,239 |
| **TOTAL BUDGET** | | | | 8,349,322 | 1,483,516 | 4,577,831 | 484,398 | 1,494,755 | 75,584 | 233,239 |
| Less: Budgeted Interest Income | | (19,891) | (39,906) | (39,906) | | (28,971) | | (9,460) | | (1,476) |
| Less: Contributions from Outside Agencies | | (158,923) | (191,626) | (191,626) | | (139,114) | | (45,424) | | (7,088) |
| **Subtotal: CASH DEMAND** | | 6,869,856 | 8,117,790 | 8,117,790 | 1,483,516 | 4,409,746 | 484,398 | 1,439,871 | 75,584 | 224,675 |
| **Less: SB 222 FUND USE [2]** | | (158,251) | 0 | 0 | | 0 | | 0 | | 0 |
| **Subtotal: CASH DEMAND AFTER SB 222 FUND USE** | | 6,711,605 | 8,117,790 | 8,117,790 | 1,483,516 | 4,409,746 | 484,398 | 1,439,871 | 75,584 | 224,675 |
| **Add: OPERATING RESERVE** | | | | | | | | | | |
| Administrative (10%) | 10% | 193,879 | 204,350 | $204,350 | $148,352 | | $48,440 | | $7,558 | |
| OBMP (15%) | 15% | 766,482 | 945,874 | 945,874 | | 686,675 | | 224,213 | | 34,986 |
| **Subtotal: OPERATING RESERVE** | | 960,361 | 1,150,224 | 1,150,224 | 148,352 | 686,675 | 48,440 | 224,213 | 7,558 | 34,986 |
| **Less: Cash Balance On Hand Available for Assessments [3]** | | (960,361) | (1,150,224) | (1,150,224) | (148,352) | (686,675) | (48,440) | (224,213) | (7,558) | (34,986) |
| **Total: CASH REQUIRED TO BE ASSESSED** | | $6,711,605 | $8,117,790 | **$8,117,790** | $1,483,516 | $4,409,746 | $484,398 | $1,439,871 | $75,584 | $224,675 |
| Current Year Assessments | | | | | | | | | | |
| General Administration/OBMP Assessments (Minimum $5.00 Per Producer) | A | | Per Acre-Foot | | **$18.03** | **$53.60** | **$18.03** | **$53.60** | **$18.03** | **$53.60** |
| **Grand Total** | | | | | | **$71.63** | | **$71.63** | | **$71.63** |
| Prior Year Assessments, (Actuals) Information Only | B | | Per Acre-Foot | | $16.23 | $39.95 | $16.23 | $39.95 | $16.23 | $39.95 |
| Grand Total | | | | | | $56.18 | | $56.18 | | $56.18 |
| Variance Between Proposed Assessments and Prior Year Assessments | A - B | | | | $1.80 | $13.65 | $1.80 | $13.65 | $1.80 | $13.65 |
| Grand Total | | | | | | $15.45 | | $15.45 | | $15.45 |
| Estimated Assessment as of "Approved" Budget May 25, 2017, Information Only | | | | | $16.25 | $50.84 | $16.25 | $50.84 | $16.25 | $50.84 |
| Grand Total | | | | | | $67.09 | | $67.09 | | $67.09 |

Column [1C] Column [1B] Column [1E] Column [1F] Column [13C] Column [13B]

[1] Total costs are allocated to Pools by actual production percentages. Does not include Recharge Debt Payment, Recharge Improvement Projects or Replenishment Water purchases.

[2] Support and approval received from IEUA on August 31, 2016 that the remainder of the SB 222 funds be used "to pay for studies and investigations that aid in implementing the OBMP."

[3] June 30th fund balance (estimated) less funds required for Operating Reserves, Agricultural Pool Reserves, and Carryover replenishment obligations.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Assessment Fee Summary

| | AF Production and Exchanges | Appropriative Pool $18.03 AF/Admin | Appropriative Pool $53.60 AF/OBMP | Ag Pool SY Reallocation AF Total Reallocation | Ag Pool SY Reallocation $484,397.99 $8.66 AF/Admin | Ag Pool SY Reallocation $1,439,870.99 $25.74 AF/OBMP | Replenishment Assessments AF/15% | Replenishment Assessments $567.80 AF/85% | Replenishment Assessments $668.00 AF/100% | 85/15 Water Transaction Activity 15% Producer Credits | 85/15 Water Transaction Activity 15% Pro-rated Debits | CURO Adjustment | ASSESSMENTS DUE Total Production Based | Pomona Credit | Recharge Debt Payment | Recharge Imprvmnt Project | Other Adjustments | Total Due |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead Mtn Spring Water Co | *367.348* | 6,623.28 | 19,689.85 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 22,079.23 | 48,392.37 | 0.00 | 0.00 | 0.00 | 0.00 | 48,392.37 |
| Chino Hills, City Of | *2,152.027* | 38,801.05 | 115,348.65 | *2,276.023* | 19,709.53 | 58,586.50 | 39.22 | 0.00 | 0.00 | 0.00 | 30,893.08 | 2.75 | 263,380.78 | 2,567.35 | 19,847.09 | 109,329.89 | 0.00 | 395,125.10 |
| Chino, City Of | *388.940* | 7,012.59 | 20,847.18 | *9,951.258* | 86,174.28 | 256,152.68 | 7.09 | 0.00 | 0.00 | 0.00 | 5,583.37 | 0.50 | 375,777.68 | 4,904.69 | 37,916.14 | 208,865.23 | 0.00 | 627,463.74 |
| Cucamonga Valley Water District | *16,561.990* | 298,612.68 | 887,722.66 | *2,530.177* | 21,910.41 | 65,128.61 | 301.81 | 0.00 | 0.00 | 0.00 | 237,753.00 | 21.20 | 1,511,450.37 | 4,400.69 | 34,019.90 | 187,402.39 | 0.00 | 1,737,273.35 |
| Desalter Authority | *28,252.803* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Fontana Union Water Company | *0.000* | 0.00 | 0.00 | *3,500.687* | 30,314.68 | 90,110.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 120,424.93 | 7,771.37 | 60,077.26 | 330,942.23 | 0.00 | 519,215.79 |
| Fontana Water Company | *13,250.493* | 238,906.39 | 710,226.42 | *764.188* | 6,617.59 | 19,670.76 | 241.46 | 0.00 | 0.00 | (1,018,634.54) | 190,215.33 | 16.96 | 147,260.38 | 1.33 | 10.31 | 56.78 | 0.00 | 147,328.80 |
| Fontana, City Of | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Golden State Water Company | *850.347* | 15,331.76 | 45,578.60 | *225.231* | 1,950.42 | 5,797.61 | 15.50 | 0.00 | 0.00 | (10,426.43) | 12,207.02 | 1.09 | 70,455.56 | 500.00 | 3,865.31 | 21,292.50 | 0.00 | 96,113.37 |
| Jurupa Community Services District | *11,023.217* | 198,748.60 | 590,844.43 | *14,500.855* | 125,572.14 | 373,262.65 | 200.88 | 0.00 | 0.00 | 0.00 | 158,242.03 | 14.11 | 1,446,884.83 | 2,506.01 | 19,372.95 | 106,718.01 | 0.00 | 1,575,481.80 |
| Marygold Mutual Water Company | *618.563* | 11,152.69 | 33,154.98 | *358.868* | 3,107.67 | 9,237.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (65.45) | 56,587.41 | 796.67 | 6,158.73 | 33,926.05 | 0.00 | 97,468.86 |
| Monte Vista Irrigation Company | *0.000* | 0.00 | 0.00 | *370.580* | 3,209.09 | 9,539.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12,748.09 | 822.67 | 6,359.73 | 35,033.26 | 0.00 | 54,963.75 |
| Monte Vista Water District | *6,864.954* | 123,775.12 | 367,961.53 | *2,703.713* | 23,413.17 | 69,595.56 | 125.10 | 0.00 | 0.00 | 0.00 | 98,548.75 | 8.79 | 683,428.02 | 5,864.70 | 45,337.54 | 249,746.83 | 0.00 | 984,377.08 |
| Niagara Bottling, LLC | *1,531.557* | 27,613.97 | 82,091.46 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 | 622,280.08 | 0.00 | 0.00 | 78,408.57 | 810,394.07 | 0.00 | 0.00 | 0.00 | 0.00 | 810,394.07 |
| Nicholson Trust | *0.000* | 0.00 | 0.00 | *2.102* | 18.20 | 54.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 72.31 | 4.67 | 36.08 | 198.73 | 0.00 | 311.78 |
| Norco, City Of | *0.000* | 0.00 | 0.00 | *110.513* | 957.00 | 2,844.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3,801.69 | 245.34 | 1,896.58 | 10,447.52 | 0.00 | 16,391.12 |
| Ontario, City Of | *18,970.222* | 342,033.10 | 1,016,803.90 | *8,528.890* | 73,857.09 | 219,539.89 | 345.69 | 0.00 | 0.00 | 0.00 | 272,323.99 | 24.28 | 1,924,927.94 | 13,828.07 | 106,899.08 | 588,865.38 | 0.00 | 2,634,520.47 |
| Pomona, City Of | *8,066.802* | 145,444.44 | 432,380.59 | *6,142.494* | 53,191.77 | 158,112.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 789,129.10 | (53,030.93) | 105,414.80 | 580,689.06 | 0.00 | 1,422,202.03 |
| San Antonio Water Company | *537.746* | 9,695.56 | 28,823.19 | *825.246* | 7,146.33 | 21,242.44 | 9.80 | 0.00 | 0.00 | 0.00 | 7,719.53 | 0.69 | 74,637.53 | 1,832.01 | 14,162.51 | 78,015.72 | 0.00 | 168,647.76 |
| San Bernardino, County of (Shootin | *13.037* | 235.06 | 698.78 | *0.000* | 0.00 | 0.00 | 0.24 | 7,402.41 | 0.00 | 0.00 | 187.15 | 519.95 | 9,043.59 | 0.00 | 0.00 | 0.00 | 0.00 | 9,043.59 |
| Santa Ana River Water Company | *0.000* | 0.00 | 0.00 | *712.630* | 6,171.12 | 18,343.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 24,514.74 | 1,582.01 | 12,229.85 | 67,369.47 | 0.00 | 105,696.06 |
| Upland, City Of | *1,071.916* | 19,326.65 | 57,454.70 | *1,562.201* | 13,528.09 | 40,212.20 | 19.53 | 0.00 | 0.00 | 0.00 | 15,387.72 | 1.37 | 145,930.26 | 3,468.02 | 26,809.81 | 147,684.78 | 0.00 | 323,892.86 |
| West End Consolidated Water Co | *0.000* | 0.00 | 0.00 | *518.932* | 4,493.76 | 13,357.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 17,851.45 | 1,152.01 | 8,905.68 | 49,057.92 | 0.00 | 76,967.06 |
| West Valley Water District | *0.000* | 0.00 | 0.00 | *352.862* | 3,055.66 | 9,082.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12,138.58 | 783.34 | 6,055.66 | 33,358.25 | 0.00 | 52,335.83 |
| | ***110,521.962*** | **1,483,312.93** | **4,409,626.92** | ***55,937.450*** | **484,397.99** | **1,439,870.99** | **1,306.30** | **7,402.41** | **622,280.08** | **(1,029,060.96)** | **1,029,060.96** | **101,034.03** | **8,549,231.64** | **0.00** | **515,374.99** | **2,839,000.00** | **0.00** | **11,903,606.63** |
| | **1A** | **1B** | **1C** | **1D** | **1E** | **1F** | **1G** | **1H** | **1I** | **1J** | **1K** | **1L** | **1M** | **1N** | **1O** | **1P** | **1Q** | **1R** |

p1:
1) Pursuant to Paragraph 5.4(b) of the Peace Agreement, the City of Pomona shall be allowed a credit of up to $2 million against OBMP Assessments through 2030. This equates to $66,667 per year. TVMWD elected to discontinue payment of the "Pomona Credit," effective FY 2012/2013. It is now paid by the Appropriative Pool Parties, allocated on % OSY.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Water Production Summary

| | *Percent of Operating Safe Yield* | Carryover Beginning Balance | Prior Year Adjust-ments | Assigned Share of Operating Safe Yield | Net Ag Pool Reallocation | Water Transaction Activity | Stormwater New Yield | Other Adjust-ments | Annual Production Right | Actual Fiscal Year Production | Storage and Recovery Program(s) | Total Production and Exchanges | Net Over-Production | | Under Production Balances | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 85/15% | 100% | Total Under-Produced | Carryover: Next Year Begin Bal | To Excess Carryover Account |
| Arrowhead Mtn Spring Water Co | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 891.687 | 0.000 | 0.000 | 891.687 | 367.348 | 0.000 | 367.348 | 0.000 | 0.000 | 524.339 | 0.000 | 524.339 |
| Chino Hills, City Of | *3.851%* | 2,111.422 | 0.000 | 2,111.422 | 2,276.023 | 0.000 | 0.000 | 0.000 | 6,498.867 | 2,152.027 | 0.000 | 2,152.027 | 0.000 | 0.000 | 4,346.840 | 2,111.422 | 2,235.418 |
| Chino, City Of | *7.357%* | 4,033.857 | 0.000 | 4,033.857 | 9,951.258 | 0.000 | 0.000 | 0.000 | 18,018.972 | 388.940 | 0.000 | 388.940 | 0.000 | 0.000 | 17,630.032 | 4,033.857 | 13,596.175 |
| Cucamonga Valley Water District | *6.601%* | 2,787.430 | 0.000 | 3,619.454 | 2,530.177 | 7,624.929 | 0.000 | 0.000 | 16,561.990 | 16,561.990 | 0.000 | 16,561.990 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Desalter Authority | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 28,252.803 | 0.000 | 28,252.803 | 0.000 | 28,252.803 | 0.000 | 0.000 | 0.000 |
| Fontana Union Water Company | *11.657%* | 0.000 | 0.000 | 6,391.736 | 3,500.687 | (9,892.423) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Water Company | *0.002%* | 1.000 | 0.000 | 1.000 | 764.188 | 18,000.000 | 0.000 | 0.000 | 18,766.188 | 13,250.493 | 0.000 | 13,250.493 | 0.000 | 0.000 | 5,515.694 | 1.000 | 5,514.694 |
| Fontana, City Of | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden State Water Company | *0.750%* | 38.605 | 0.000 | 411.476 | 225.231 | 258.000 | 0.000 | 0.000 | 933.312 | 850.347 | 0.000 | 850.347 | 0.000 | 0.000 | 82.965 | 82.965 | 0.000 |
| Jurupa Community Services District | *3.759%* | 2,061.118 | 0.000 | 2,061.118 | 14,500.855 | 1,180.450 | 0.000 | 0.000 | 19,803.541 | 11,023.217 | 0.000 | 11,023.217 | 0.000 | 0.000 | 8,780.324 | 2,061.118 | 6,719.206 |
| Marygold Mutual Water Company | *1.195%* | 287.020 | 0.000 | 655.317 | 358.868 | 0.000 | 0.000 | 0.000 | 1,301.205 | 618.563 | 0.000 | 618.563 | 0.000 | 0.000 | 682.641 | 655.317 | 27.323 |
| Monte Vista Irrigation Company | *1.234%* | 676.759 | 0.000 | 676.759 | 370.580 | 0.000 | 0.000 | 0.000 | 1,724.098 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,724.098 | 676.759 | 1,047.339 |
| Monte Vista Water District | *8.797%* | 4,823.954 | 0.000 | 4,823.954 | 2,703.713 | 638.000 | 0.000 | 0.000 | 12,989.621 | 6,864.954 | 0.000 | 6,864.954 | 0.000 | 0.000 | 6,124.666 | 4,823.954 | 1,300.712 |
| Niagara Bottling, LLC | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 600.000 | 0.000 | 0.000 | 600.000 | 1,531.557 | 0.000 | 1,531.557 | 0.000 | 931.557 | 0.000 | 0.000 | 0.000 |
| Nicholson Trust | *0.007%* | 1.493 | 0.000 | 4.000 | 2.102 | 0.000 | 0.000 | 0.000 | 7.595 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 7.595 | 4.000 | 3.594 |
| Norco, City Of | *0.368%* | 201.545 | 0.000 | 201.545 | 110.513 | 0.000 | 0.000 | 0.000 | 513.603 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 513.602 | 201.545 | 312.057 |
| Ontario, City Of | *20.742%* | 11,373.816 | 0.000 | 11,373.816 | 8,528.890 | 673.479 | 0.000 | 0.000 | 31,950.001 | 18,970.222 | 0.000 | 18,970.222 | 0.000 | 0.000 | 12,979.778 | 11,373.816 | 1,605.961 |
| Pomona, City Of | *20.454%* | 11,215.852 | 0.000 | 11,215.852 | 6,142.494 | 0.000 | 0.000 | 0.000 | 28,574.198 | 8,066.802 | 0.000 | 8,066.802 | 0.000 | 0.000 | 20,507.396 | 11,215.852 | 9,291.544 |
| San Antonio Water Company | *2.748%* | 323.270 | 0.000 | 1,506.888 | 825.246 | (900.000) | 0.000 | 0.000 | 1,755.404 | 537.746 | 0.000 | 537.746 | 0.000 | 0.000 | 1,217.658 | 1,217.658 | 0.000 |
| San Bernardino, County of (Shooting P | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 13.037 | 0.000 | 13.037 | 13.037 | 0.000 | 0.000 | 0.000 | 0.000 |
| Santa Ana River Water Company | *2.373%* | 1,301.374 | 0.000 | 1,301.374 | 712.630 | (1,100.000) | 0.000 | 0.000 | 2,215.378 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2,215.378 | 1,301.374 | 914.004 |
| Upland, City Of | *5.202%* | 2,852.401 | 0.000 | 2,852.401 | 1,562.201 | (4,087.586) | 0.000 | 0.000 | 3,179.417 | 1,071.916 | 0.000 | 1,071.916 | 0.000 | 0.000 | 2,107.501 | 2,107.501 | 0.000 |
| West End Consolidated Water Co | *1.728%* | 947.714 | 0.000 | 947.714 | 518.932 | (1,612.414) | 0.000 | 0.000 | 801.946 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 801.946 | 801.946 | 0.000 |
| West Valley Water District | *1.175%* | 644.317 | 0.000 | 644.317 | 352.862 | 0.000 | 0.000 | 0.000 | 1,641.496 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,641.496 | 644.317 | 997.179 |
| | ***100.00%*** | **45,682.947** | **0.000** | **54,834.000** | **55,937.450** | **12,274.122** | **0.000** | **0.000** | **168,728.519** | **110,521.962** | **0.000** | **110,521.962** | **13.037** | **29,184.360** | **87,403.949** | **43,314.401** | **44,089.545** |
| Less Desalter Authority Production | | | | | | | | | | **28,252.803** | | **28,252.803** | | **28,252.803** | | | |
| Total Less Desalter Authority Production | | | | | | | | | | **82,269.159** | | **82,269.159** | | **931.557** | | | |
| | **2A** | **2B** | **2C** | **2D** | **2E** | **2F** | **2G** | **2H** | **2I** | **2J** | **2K** | **2L** | **2M** | **2N** | **2O** | **2P** | **2Q** |

p2:
1) The Restated Judgment allowed an accumulated overdraft of 200,000 AF over 40 years. The total Operating Safe Yield will be 49,834 AF as of production year 2017/18.
2) On October 24, 2016, Monte Vista Water District had requested to place this year's Recharged Recycled Water into their Annual Account to "secure sufficient production rights" due to projected increase in groundwater production for the year.
3) Due to the ongoing Safe Yield Recalculation process and related questions as to the proper method for allocating Stormwater New Yield, 0 AF will be allocated during 2016/17. When the Safe Yield Recalculation and Stormwater New Yield allocation matters are resolved, the 2016/17 allocation will be recalculated, if necessary, and credited, if necessary.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Local Excess Carry Over Storage Account Summary

| | Excess Carry Over Account (ECO) | | | | | |
|---|---|---|---|---|---|---|
| | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | From Supplemental Storage | From Under-Production | Ending Balance |
| Arrowhead Mtn Spring Water Co | 0.000 | 0.000 | 0.000 | 0.000 | 524.339 | 524.339 |
| Chino Hills, City Of | 8,324.717 | (5.827) | 27.863 | 0.000 | 2,235.418 | 10,582.171 |
| Chino, City Of | 74,352.355 | (52.046) | (399.260) | 0.000 | 13,596.175 | 87,497.224 |
| Cucamonga Valley Water District | 44,855.775 | (31.399) | (3,232.506) | 0.000 | 0.000 | 41,591.870 |
| Desalter Authority | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Union Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Water Company | 2,946.211 | (2.062) | (5,514.694) | 0.000 | 5,514.694 | 2,944.149 |
| Fontana, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden State Water Company | 1,177.867 | (0.824) | 0.000 | 0.000 | 0.000 | 1,177.043 |
| Jurupa Community Services District | 19,305.277 | (13.513) | 0.000 | 0.000 | 6,719.206 | 26,010.970 |
| Marygold Mutual Water Company | 615.741 | (0.431) | 0.000 | 0.000 | 27.323 | 642.633 |
| Monte Vista Irrigation Company | 6,958.144 | (4.870) | 0.000 | 0.000 | 1,047.339 | 8,000.613 |
| Monte Vista Water District | 8,474.427 | (5.932) | (458.000) | 638.000 | 1,300.712 | 9,949.207 |
| Niagara Bottling, LLC | 0.000 | 0.000 | (600.000) | 600.000 | 0.000 | 0.000 |
| Nicholson Trust | 1.094 | 0.000 | 0.000 | 0.000 | 3.594 | 4.688 |
| Norco, City Of | 3,584.642 | (2.509) | (2,000.000) | 0.000 | 312.057 | 1,894.190 |
| Ontario, City Of | 38,948.088 | (27.263) | 0.000 | 0.000 | 1,605.961 | 40,526.786 |
| Pomona, City Of | 34,375.937 | (24.063) | (4,112.219) | 0.000 | 9,291.544 | 39,531.199 |
| San Antonio Water Company | 1,378.550 | (0.964) | 0.000 | 0.000 | 0.000 | 1,377.586 |
| San Bernardino, County of (Shooting | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Santa Ana River Water Company | 3,432.699 | (2.402) | 0.000 | 0.000 | 914.004 | 4,344.301 |
| Upland, City Of | 18,937.868 | (13.256) | 0.000 | 0.000 | 0.000 | 18,924.612 |
| West End Consolidated Water Co | 4,882.090 | (3.417) | 0.000 | 0.000 | 0.000 | 4,878.673 |
| West Valley Water District | 7,205.671 | (5.043) | (500.000) | 0.000 | 997.179 | 7,697.807 |
| | **279,757.153** | **(195.821)** | **(16,788.816)** | **1,238.000** | **44,089.545** | **308,100.061** |
| | **3A** | **3B** | **3C** | **3D** | **3E** | **3F** |

p3:
1) Hydraulic Control was achieved on February 1, 2016. Pursuant to Paragraph 7.4(b) of the Peace II Agreement, Storage Loss is now calculated at 0.07%.
2) On October 24, 2016, Monte Vista Water District had requested to place this year's Recharged Recycled Water into their Annual Account to "secure sufficient production rights" due to projected increase in groundwater production for the year.
3) In October 2017, Niagara transferred 600.00 AF from their Supplemental Storage Account to offset their Production Year 2016/2017 overproduction obligations.
4) On September 8, 2017, Fontana Water Company had requested that their underproduced water for Production Year 2016/2017 be transferred to offset their share of Desalter Replenishment Obligation.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Local Supplemental Storage Account Summary

| | Recharged Recycled Account | | | | | Quantified (Pre 7/1/2000) Account | | | | | New (Post 7/1/2000) Account | | | | | Combined |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beginning Balance | 0.07% Storage Loss | Current Recharged Recycled | Transfer to ECO Account | Ending Balance | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | Transfer to ECO Account | Ending Balance | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | Transfer to ECO Account | Ending Balance | Ending Balance |
| Arrowhead Mtn Spring Water Co | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Chino Hills, City Of | 6,297.869 | (4.408) | 1,321.000 | 0.000 | 7,614.461 | 4,802.868 | (3.362) | 0.000 | 0.000 | 4,799.506 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 12,413.967 |
| Chino, City Of | 7,332.550 | (5.132) | 0.000 | 0.000 | 7,327.418 | 1,054.710 | (0.738) | 0.000 | 0.000 | 1,053.972 | 1,932.027 | (1.352) | 0.000 | 0.000 | 1,930.675 | 10,312.065 |
| Cucamonga Valley Water District | 16,543.391 | (11.580) | 3,693.000 | 0.000 | 20,224.811 | 10,723.360 | (7.506) | 0.000 | 0.000 | 10,715.854 | 639.694 | (0.447) | 0.000 | 0.000 | 639.247 | 31,579.912 |
| Desalter Authority | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Union Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 310.937 | (0.217) | 0.000 | 0.000 | 310.720 | 310.720 |
| Fontana, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden State Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,392.890 | (0.975) | 0.000 | 0.000 | 1,391.915 | 57.361 | (0.040) | 0.000 | 0.000 | 57.321 | 1,449.236 |
| Jurupa Community Services District | 4,364.709 | (3.055) | 950.000 | 0.000 | 5,311.654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 987.157 | (0.691) | 0.000 | 0.000 | 986.466 | 6,298.120 |
| Marygold Mutual Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,531.005 | (1.071) | 0.000 | 0.000 | 1,529.934 | 95.885 | (0.067) | 0.000 | 0.000 | 95.818 | 1,625.752 |
| Monte Vista Irrigation Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5,663.241 | (3.964) | 0.000 | 0.000 | 5,659.277 | 324.064 | (0.226) | 0.000 | 0.000 | 323.838 | 5,983.115 |
| Monte Vista Water District | 3,081.672 | (2.157) | 638.000 | (638.000) | 3,079.515 | 3,385.982 | (2.370) | 0.000 | 0.000 | 3,383.612 | 2,126.929 | (1.488) | 0.000 | 0.000 | 2,125.441 | 8,588.568 |
| Niagara Bottling, LLC | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2,067.554 | (1.447) | 0.000 | (600.000) | 1,466.107 | 1,466.107 |
| Nicholson Trust | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Norco, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 96.645 | (0.067) | 0.000 | 0.000 | 96.578 | 96.578 |
| Ontario, City Of | 28,569.789 | (19.998) | 5,914.000 | 0.000 | 34,463.791 | 8,072.685 | (5.650) | 0.000 | 0.000 | 8,067.035 | 4,820.509 | (3.374) | 0.000 | 0.000 | 4,817.135 | 47,347.961 |
| Pomona, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 10,942.665 | (7.659) | 0.000 | 0.000 | 10,935.006 | 1,564.226 | (1.094) | 0.000 | 0.000 | 1,563.132 | 12,498.138 |
| San Antonio Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,181.718 | (0.827) | 1,020.962 | 0.000 | 2,201.853 | 2,201.853 |
| San Bernardino, County of (Shooting Park) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Santa Ana River Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 482.424 | (0.337) | 0.000 | 0.000 | 482.087 | 482.087 |
| Upland, City Of | 6,983.833 | (4.888) | 1,418.000 | 0.000 | 8,396.945 | 5,819.449 | (4.073) | 0.000 | 0.000 | 5,815.376 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 14,212.321 |
| West End Consolidated Water Co | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 453.796 | (0.317) | 0.000 | 0.000 | 453.479 | 453.479 |
| West Valley Water District | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 308.572 | (0.216) | 0.000 | 0.000 | 308.356 | 308.356 |
| | **73,173.813** | **(51.218)** | **13,934.000** | **(638.000)** | **86,418.595** | **53,388.855** | **(37.368)** | **0.000** | **0.000** | **53,351.487** | **17,449.498** | **(12.207)** | **1,020.962** | **(600.000)** | **17,858.253** | **157,628.335** |
| | **4A** | **4B** | **4C** | **4D** | **4E** | **4F** | **4G** | **4H** | **4I** | **4J** | **4K** | **4L** | **4M** | **4N** | **4O** | **4P** |

**86,418.595** [ 4E ] **+ 17,858.253** [ 4O ] **= 104,276.848 ***

** See footnotes #3 and #4 below.*

p4:
1) Hydraulic Control was achieved on February 1, 2016. Pursuant to Paragraph 7.4(b) of the Peace II Agreement, Storage Loss is now calculated at 0.07%.
2) On October 24, 2016, Monte Vista Water District had requested to place this year's Recharged Recycled Water into their Annual Account to "secure sufficient production rights" due to projected increase in groundwater production for the year.
3) Peace Agreement Paragraph 5.2(b)(iv) states "Watermaster shall approve the Local Storage agreement so long as: (1) the total quantity of Supplemental Water authorized to be held in Local Storage under all then existing Local Storage agreements for all parties to the Judgment does not exceed the cumulative total of 50,000 acre-feet… Watermaster may approve a proposed agreement with conditions that mitigate any threatened or potential Material Physical Injury."
4) Second Amendment to Peace Agreement Section 2 increases the cumulative total from 50,000 acre-feet to 100,000 acre-feet.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Other Storage and Replenishment Accounts Summary

**Desalter Replenishment:**

| | Beginning Balance | Storage Loss | Transfers To | Transfers From | Ending Balance |
|---|---|---|---|---|---|
| Re-Op Offset Pre-Peace II / CDA | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Re-Op Offset Peace II Expansion | 173,382.703 | 0.000 | 0.000 | (1,527.215) | 171,855.488 |
| Non-Ag Dedication | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Non-Ag 10% Haircut | 0.000 | 0.000 | 735.034 | (735.034) | 0.000 |
| **Preemptive Replenishment** | | | | | |
| Ontario, City Of | 3,322.247 | 0.000 | 0.000 | 0.000 | 3,322.247 |
| Jurupa Community Services District | 2,360.783 | 0.000 | 0.000 | 0.000 | 2,360.783 |
| Chino, City Of | 1,416.470 | 0.000 | 0.000 | 0.000 | 1,416.470 |
| **Replenishment Purchase** | | | | | |
| West Valley Water District | 0.000 | 0.000 | 35.251 | 0.000 | 35.251 |
| Santa Ana River Water Company | 0.000 | 0.000 | 71.683 | 0.000 | 71.683 |
| San Bernardino, County of (Shooting Park) | 0.000 | 0.000 | 0.398 | 0.000 | 0.398 |
| Niagara Bottling, LLC | 35.515 | 0.000 | 0.000 | 0.000 | 35.515 |
| Marygold Mutual Water Company | 0.000 | 0.000 | 72.217 | 0.000 | 72.217 |
| Arrowhead Mtn Spring Water Co | 0.000 | 0.000 | 12.812 | 0.000 | 12.812 |
| **Replenishment Transfers** | | | | | |
| Fontana Water Company | 0.000 | 0.000 | 5,514.694 | 0.000 | 5,514.694 |
| | **5A** | **5B** | **5C** | **5D** | **5E** |

**Storage and Recovery:**

| | Beginning Balance | Storage Loss | Transfers To | Transfers From | Ending Balance |
|---|---|---|---|---|---|
| MWD DYY / CUP | 0.000 | 0.000 | 6,314.900 | 0.000 | 6,314.900 |
| | **5F** | **5G** | **5H** | **5I** | **5J** |

p5:
1) Beginning in Production Year 2016/2017, the "10% Haircut" from the Non-Agricultural Pool is to be utilized to offset the overall Desalter Replenishment Obligation. (See Appendix B)

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Water Transaction Summary

| | Water Transactions | | | | |
|---|---|---|---|---|---|
| | Assigned Rights | General Transfer | Transfers (To) / From ECO Account | Transfers (To) Desalter Replenishment | Total Water Transactions |
| Arrowhead Mtn Spring Water Co | 891.687 | 0.000 | 0.000 | 0.000 | 891.687 |
| Chino Hills, City Of | 27.863 | 0.000 | (27.863) | 0.000 | 0.000 |
| Chino, City Of | (399.260) | 0.000 | 399.260 | 0.000 | 0.000 |
| Cucamonga Valley Water District | (5,500.000) | 9,892.423 | 3,232.506 | 0.000 | 7,624.929 |
| Desalter Authority | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Union Water Company | 0.000 | (9,892.423) | 0.000 | 0.000 | (9,892.423) |
| Fontana Water Company | 18,000.000 | 0.000 | 5,514.694 | (5,514.694) | 18,000.000 |
| Fontana, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden State Water Company | 258.000 | 0.000 | 0.000 | 0.000 | 258.000 |
| Jurupa Community Services District | 1,180.450 | 0.000 | 0.000 | 0.000 | 1,180.450 |
| Marygold Mutual Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Monte Vista Irrigation Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Monte Vista Water District | 180.000 | 0.000 | 458.000 | 0.000 | 638.000 |
| Niagara Bottling, LLC | 0.000 | 0.000 | 600.000 | 0.000 | 600.000 |
| Nicholson Trust | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Norco, City Of | (2,000.000) | 0.000 | 2,000.000 | 0.000 | 0.000 |
| Ontario, City Of | 673.479 | 0.000 | 0.000 | 0.000 | 673.479 |
| Pomona, City Of | (4,112.219) | 0.000 | 4,112.219 | 0.000 | 0.000 |
| San Antonio Water Company | (900.000) | 0.000 | 0.000 | 0.000 | (900.000) |
| San Bernardino, County of (Shooting Park) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Santa Ana River Water Company | (1,100.000) | 0.000 | 0.000 | 0.000 | (1,100.000) |
| Upland, City Of | (4,087.586) | 0.000 | 0.000 | 0.000 | (4,087.586) |
| West End Consolidated Water Co | (1,612.414) | 0.000 | 0.000 | 0.000 | (1,612.414) |
| West Valley Water District | (500.000) | 0.000 | 500.000 | 0.000 | 0.000 |
| | **1,000.000** | **0.000** | **16,788.816** | **(5,514.694)** | **12,274.122** |
| | **6A** | **6B** | **6C** | **6D** | **6E** |

p6:
1) On October 24, 2016, Monte Vista Water District had requested to place this year's Recharged Recycled Water into their Annual Account to "secure sufficient production rights" due to projected increase in groundwater production for the year.

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Water Transaction Detail

Assessment Year 2017-2018 (Production Year 2016-2017)

### Standard Transactions

| To: | From: | Date of Submittal | Quantity | $ / Acre Feet | Total $ | If 85/15 Rule Applies: 85% | 15% | WM Pays |
|---|---|---|---|---|---|---|---|---|
| Cucamonga Valley Water District | Pomona, City Of Storage Account | 5/3/2017 | 4,000.000 | 550.00 | $2,200,000.00 | | | |
| | West Valley Water District Storage Account | 5/3/2017 | 500.000 | 520.00 | $260,000.00 | | | |
| Fontana Water Company | Cucamonga Valley Water District Storage Account | 1/30/2017 | 3,000.000 | 540.00 | $1,620,000.00 | $1,377,000.00 | $243,000.00 | Fontana Water Company |
| | Cucamonga Valley Water District Annual Account | 5/3/2017 | 4,000.000 | 550.00 | $2,200,000.00 | $1,870,000.00 | $330,000.00 | Fontana Water Company |
| | Cucamonga Valley Water District Annual Account | 5/3/2017 | 3,000.000 | 520.00 | $1,560,000.00 | $1,326,000.00 | $234,000.00 | Fontana Water Company |
| | Norco, City Of Storage Account | 12/7/2016 | 2,000.000 | 565.00 | $1,130,000.00 | $960,500.00 | $169,500.00 | Fontana Water Company |
| | Upland, City Of Annual Account | 6/14/2017 | 484.305 | 580.00 | $280,896.90 | $238,762.37 | $42,134.54 | Fontana Water Company |
| | Upland, City Of Annual Account | 6/14/2017 | 5,515.695 | 580.00 | $3,199,103.10 | | | |
| Golden State Water Company | Upland, City Of Annual Account | 5/24/2017 | 119.844 | 580.00 | $69,509.52 | $59,083.09 | $10,426.43 | Golden State Water Company |
| | West End Consolidated Water Co Annual Account | 5/24/2017 | 138.156 | 49.00 | $6,769.64 | | | |
| | *85/15 Rule does not apply -- method of utilizing West End shares.* | | | | | | | |

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Water Transaction Detail

Assessment Year 2017-2018 (Production Year 2016-2017)

### Standard Transactions

| To: | From: | Date of Submittal | Quantity | $ / Acre Feet | Total $ | If 85/15 Rule Applies: 85% | 15% | WM Pays |
|---|---|---|---|---|---|---|---|---|
| Jurupa Community Services District | Santa Ana River Water Company Annual Account | 3/1/2017 | 1,100.000 | 520.00 | $572,000.00 | | | |
| | Santa Ana River Water Company Storage Account | 3/1/2017 | 11.866 | 570.00 | $6,763.62 | | | |
| Monte Vista Water District | San Antonio Water Company Annual Account | 5/22/2017 | 180.000 | 222.16 | $39,988.80 | | | |
| | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | | |
| Ontario, City Of | Chino, City Of Storage Account | 4/17/2017 | 399.260 | 0.00 | $0.00 | | | |
| | Pomona, City Of Storage Account | 8/18/2016 | 112.219 | 0.00 | $0.00 | | | |
| | San Antonio Water Company Annual Account | 5/22/2017 | 162.000 | 222.16 | $35,989.92 | | | |
| | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | | |
| TAMCO | Ameron International Corp. Annual Account | 11/30/2016 | 27.619 | 0.00 | $0.00 | | | |
| | *A one time transfer of 27.619 AF from Annual Carry Over balance due to November 2016 settlement.* | | | | | | | |
| | Ameron International Corp. Storage Account | 11/30/2016 | 169.358 | 0.00 | $0.00 | | | |
| | *A one time transfer of 169.358 from ECO Storage Account due to November 2016 settlement.* | | | | | | | |
| Upland, City Of | San Antonio Water Company Annual Account | 5/22/2017 | 558.000 | 222.16 | $123,965.28 | | | |
| | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | | |
| | West End Consolidated Water Co Annual Account | 5/24/2017 | 1,474.258 | 49.00 | $72,238.64 | | | |
| | *85/15 Rule does not apply -- method of utilizing West End shares.* | | | | | | | |
| | | | **26,952.580** | | **$13,377,225.43** | **$5,831,345.46** | **$1,029,060.96** | |

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Water Transaction Detail

Assessment Year 2017-2018 (Production Year 2016-2017)

## Exhibit G Transactions

| To: | From: | Date of Submittal | Quantity | $ / Acre Feet | Total $ | If 85/15 Rule Applies: 85% | 15% | WM Pays |
|---|---|---|---|---|---|---|---|---|
| Watermaster (Exhibit G Non-Ag Transfers) | NRG California South LP<br>*Exhibit "G" water sale, sold from storage account.* | 12/31/2016 | -1,000.000 | | | | | |
| Arrowhead Mtn Spring Water Co | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 891.687 | 570.00 | $508,261.59 | | | |
| Chino Hills, City Of | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 27.863 | 570.00 | $15,881.91 | | | |
| Jurupa Community Services District | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 68.584 | 570.00 | $39,092.88 | | | |
| Santa Ana River Water Company | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 11.866 | 570.00 | $6,763.62 | | | |
| | | | **1,000.000** | | **$570,000.00** | | | |

**Total 15% Credits from all Transactions:** **$1,029,060.96**

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Water Transaction Detail

Assessment Year 2017-2018 (Production Year 2016-2017)

### Applied Recurring Transactions:

| From: | To: | Quantity | $ / Acre Feet | |
|---|---|---|---|---|
| Fontana Union Water Company<br>Annual Account - Assigned Rights | Cucamonga Valley Water District<br>Annual Account - Assigned Rights | All | 0.00 | *Transfer FUWC water transfer rights to CVWD.* |
| Fontana Union Water Company<br>Annual Account - Transfer (To) / From | Cucamonga Valley Water District<br>Annual Account - Transfer (To) / From | All | 0.00 | *Transfer FUWC water transfer rights to CVWD.* |
| Fontana Union Water Company<br>Annual Account - 32,800 AF Early Transfer | Cucamonga Valley Water District<br>Annual Account - Transfer (To) / From | All | 0.00 | *Transfer FUWC Ag Pool Reallocation Early Transfer to CVWD.* |
| Fontana Union Water Company<br>Annual Account - Diff - Potential vs. Net | Cucamonga Valley Water District<br>Annual Account - Transfer (To) / From | All | 0.00 | *Transfer FUWC Ag Pool Reallocation Difference (Potential vs. Net) to CVWD.* |
| Fontana Union Water Company<br>Annual Account - Stormwater New Yield | Cucamonga Valley Water District<br>Annual Account - Transfer (To) / From | All | 0.00 | *Transfer FUWC New Yield to CVWD.* |
| Fontana Union Water Company<br>Annual Account - Assigned Share of Operating Safe Yield | Cucamonga Valley Water District<br>Annual Account - Transfer (To) / From | All | 0.00 | *Transfer FUWC Share of Safe Yield to CVWD.* |

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p7:
1) The Water Transaction between Fontana Water Company and the City of Upland submitted on 6/14/2017 for the amount of 6,000 AF was split because the amount purchased exceeds what is required to satisfy overproduction; the 85/15 Rule only applies to the portion that satisfies overproduction per the direction of the Appropriative Pool on November 2, 2011.

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Analysis of the Application of the 85/15 Rule to Water Transfers

Assessment Year 2017-2018 (Production Year 2016-2017)

| To | (Over)/Under Production Excluding Water Transfer(s) | From | Date of Submittal | Transfer Quantity | Is Buyer an 85/15 Party? | Is Transfer Being Placed into Annual Account? | Is Purpose of Transfer to Utilize SAWCO or West End Shares? | Amount of Transfer Eligible for 85/15 Rule |
|---|---|---|---|---|---|---|---|---|
| Watermaster (Exhibit G Non-Ag Transfers) | 0.000 | NRG California South LP | 12/31/2016 | 1,000.000 | No | No | No | 0.000 |
| | | *Exhibit "G" water sale, sold from storage account.* | | | | | | |
| Arrowhead Mtn Spring Water Co | (367.348) | Watermaster (Exhibit G Non-Ag Transfer) | 3/1/2017 | 891.687 | No | Yes | No | 0.000 |
| | | *Exhibit "G" Purchase* | | | | | | |
| Chino Hills, City Of | 4,346.840 | Watermaster (Exhibit G Non-Ag Transfer) | 3/1/2017 | 27.863 | Yes | No | No | 0.000 |
| | | *Exhibit "G" Purchase* | | | | | | |
| Cucamonga Valley Water District | 2,267.494 | Pomona, City Of Storage Account | 5/3/2017 | 4,000.000 | Yes | Yes | No | 0.000 |
| | | West Valley Water District Storage Account | 5/3/2017 | 500.000 | Yes | Yes | No | 0.000 |
| Fontana Water Company | (12,484.305) | Cucamonga Valley Water District Storage Account | 1/30/2017 | 3,000.000 | Yes | Yes | No | 3,000.000 |
| | | Cucamonga Valley Water District Annual Account | 5/3/2017 | 4,000.000 | Yes | Yes | No | 4,000.000 |
| | | Cucamonga Valley Water District Annual Account | 5/3/2017 | 3,000.000 | Yes | Yes | No | 3,000.000 |
| | | Norco, City Of Storage Account | 12/7/2016 | 2,000.000 | Yes | Yes | No | 2,000.000 |
| | | Upland, City Of Annual Account | 6/14/2017 | 484.305 | Yes | Yes | No | 484.305 |
| | | Upland, City Of Annual Account | 6/14/2017 | 5,515.695 | Yes | Yes | No | 0.000 |

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Analysis of the Application of the 85/15 Rule to Water Transfers

Assessment Year 2017-2018 (Production Year 2016-2017)

| To | (Over)/Under Production Excluding Water Transfer(s) | From | Date of Submittal | Transfer Quantity | Is Buyer an 85/15 Party? | Is Transfer Being Placed into Annual Account? | Is Purpose of Transfer to Utilize SAWCO or West End Shares? | Amount of Transfer Eligible for 85/15 Rule |
|---|---|---|---|---|---|---|---|---|
| Golden State Water Company | (175.035) | Upland, City Of<br>Annual Account | 5/24/2017 | 119.844 | Yes | Yes | No | 119.844 |
| | | West End Consolidated Water Co<br>Annual Account | 5/24/2017 | 138.156 | Yes | Yes | Yes | 0.000 |
| | | *85/15 Rule does not apply -- method of utilizing West End shares.* | | | | | | |
| Jurupa Community Services District | 7,599.874 | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 68.584 | Yes | Yes | No | 0.000 |
| | | Santa Ana River Water Company<br>Annual Account | 3/1/2017 | 1,100.000 | Yes | Yes | No | 0.000 |
| | | Santa Ana River Water Company<br>Storage Account | 3/1/2017 | 11.866 | Yes | Yes | No | 0.000 |
| Monte Vista Water District | 5,486.667 | San Antonio Water Company<br>Annual Account | 5/22/2017 | 180.000 | Yes | No | Yes | 0.000 |
| | | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | |
| Ontario, City Of | 12,306.300 | Chino, City Of<br>Storage Account | 4/17/2017 | 399.260 | Yes | Yes | No | 0.000 |
| | | Pomona, City Of<br>Storage Account | 8/18/2016 | 112.219 | Yes | Yes | No | 0.000 |
| | | San Antonio Water Company<br>Annual Account | 5/22/2017 | 162.000 | Yes | Yes | Yes | 0.000 |
| | | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | |
| Santa Ana River Water Company | 3,315.378 | Watermaster (Exhibit G Non-Ag Transfer)<br>*Exhibit "G" Purchase* | 3/1/2017 | 11.866 | Yes | No | No | 0.000 |

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Analysis of the Application of the 85/15 Rule to Water Transfers

Assessment Year 2017-2018 (Production Year 2016-2017)

| To | (Over)/Under Production Excluding Water Transfer(s) | From | Date of Submittal | Transfer Quantity | Is Buyer an 85/15 Party? | Is Transfer Being Placed into Annual Account? | Is Purpose of Transfer to Utilize SAWCO or West End Shares? | Amount of Transfer Eligible for 85/15 Rule |
|---|---|---|---|---|---|---|---|---|
| TAMCO | (151.279) | Ameron International Corp. Storage Account | 11/30/2016 | 169.358 | No | No | No | 0.000 |
| | | *A one time transfer of 169.358 from ECO Storage Account due to November 2016 settlement.* | | | | | | |
| | | Ameron International Corp. Annual Account | 11/30/2016 | 27.619 | No | Yes | No | 0.000 |
| | | *A one time transfer of 27.619 AF from Annual Carry Over balance due to November 2016 settlement.* | | | | | | |
| Upland, City Of | 6,195.087 | San Antonio Water Company Annual Account | 5/22/2017 | 558.000 | Yes | Yes | Yes | 0.000 |
| | | *85/15 Rule does not apply -- method of utilizing SAWCO shares.* | | | | | | |
| | | West End Consolidated Water Co Annual Account | 5/24/2017 | 1,474.258 | Yes | Yes | Yes | 0.000 |
| | | *85/15 Rule does not apply -- method of utilizing West End shares.* | | | | | | |

p8:
1) The Water Transaction between Fontana Water Company and the City of Upland submitted on 6/14/2017 for the amount of 6,000 AF was split because the amount purchased exceeds what is required to satisfy overproduction; the 85/15 Rule only applies to the portion that satisfies overproduction per the direction of the Appropriative Pool on November 2, 2011.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Watermaster Replenishment Calculation

| Cost of Replenishment Water per acre foot: | |
|---|---|
| Watermaster Replenishment Cost | $666.00 |
| Projected Spreading - OCWD Connection Fee | $2.00 |
| Projected Spreading - IEUA Surcharge | $0.00 |
| Pre-purchased Credit | $0.00 |
| ***Total Replenishment Cost per acre foot*** | **$668.00** |

| **Replenishment Obligation:** | **AF @ $668.00** | **15%** | **85%** | **Total** |
|---|---|---|---|---|
| Appropriative - 100 | 931.557 | | | $622,280.08 |
| Appropriative - 15/85 | 13.037 | $1,306.31 | $7,402.41 | $8,708.72 |
| Non-Agricultural - 100 | 8.163 | | | $5,452.88 |
| | **952.757** | | | **$636,441.68** |

| Company | AF Production and Exchanges | 85/15 Producers | Percent of Total 85/15 Producers | 15% Replenishment Assessment | 15% Water Transaction Debits |
|---|---|---|---|---|---|
| Arrowhead Mtn Spring Water Co | 367.348 | | | - | - |
| Chino Hills, City Of | 2,152.027 | 2,152.027 | 3.002% | $39.22 | $30,893.08 |
| Chino, City Of | 388.940 | 388.940 | 0.543% | $7.09 | $5,583.37 |
| Cucamonga Valley Water District | 16,561.990 | 16,561.990 | 23.104% | $301.81 | $237,753.00 |
| Desalter Authority | 28,252.803 | | | - | - |
| Fontana Union Water Company | 0.000 | 0.000 | 0.000% | - | $0.00 |
| Fontana Water Company | 13,250.493 | 13,250.493 | 18.484% | $241.46 | $190,215.33 |
| Fontana, City Of | 0.000 | | | - | - |
| Golden State Water Company | 850.347 | 850.347 | 1.186% | $15.50 | $12,207.02 |
| Jurupa Community Services District | 11,023.217 | 11,023.217 | 15.377% | $200.88 | $158,242.03 |
| Marygold Mutual Water Company | 618.563 | | | - | - |
| Monte Vista Irrigation Company | 0.000 | 0.000 | 0.000% | - | $0.00 |
| Monte Vista Water District | 6,864.954 | 6,864.954 | 9.577% | $125.10 | $98,548.75 |
| Niagara Bottling, LLC | 1,531.557 | | | - | - |
| Nicholson Trust | 0.000 | 0.000 | 0.000% | - | $0.00 |
| Norco, City Of | 0.000 | 0.000 | 0.000% | - | $0.00 |
| Ontario, City Of | 18,970.222 | 18,970.222 | 26.463% | $345.69 | $272,323.99 |
| Pomona, City Of | 8,066.802 | | | - | - |
| San Antonio Water Company | 537.746 | 537.746 | 0.750% | $9.80 | $7,719.53 |
| San Bernardino, County of (Shootin | 13.037 | 13.037 | 0.018% | $0.24 | $187.15 |
| Santa Ana River Water Company | 0.000 | 0.000 | 0.000% | - | $0.00 |
| Upland, City Of | 1,071.916 | 1,071.916 | 1.495% | $19.53 | $15,387.72 |
| West End Consolidated Water Co | 0.000 | 0.000 | 0.000% | - | $0.00 |
| West Valley Water District | 0.000 | 0.000 | 0.000% | - | $0.00 |
| *** Fee assessment total is 15% of Appropriative 15/85 replenishment obligation* | **110,521.962** | **71,684.889** | ** | **$1,306.30** | **$1,029,060.96** |
| | | | | *Transfers to* **1G** | *Transfers to* **1K** |

p9:
1) The "Watermaster Replenishment Cost" listed is MWD's 2017 Tier 1 Full Service Untreated Rate.
2) There is no "Projected Spreading - IEUA Surcharge"; an RTS charge will be applied for Assessment Years 16/17 and 17/18 over a period of ten years beginning with Assessment Year 18/19.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Watermaster Cumulative Unmet Replenishment Obligation (CURO)

| Remaining Replenishment Obligation: | AF |
|---|---|
| Appropriative - 100 | 0.399 |
| Appropriative - 15/85 | 0.002 |
| Non-Agricultural - 100 | 0.008 |
| | **0.409** |

| Replenishment Rate | |
|---|---|
| 2017 Rate | $668.00 |
| 2016 Rate | $596.00 |

### Pool 3 Appropriative

| Company | Outstanding Obligation (AF) | Fund Balance ($) | Outstanding Obligation ($) | *AF Production and Exchanges* | 85/15 Producers | Percent | 15% | 85% | 100% | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Arrowhead Mtn Spring Water Co | 0.089 | ($22,019.78) | $22,079.23 | *367.348* | | | | | $22,079.23 | $22,079.23 |
| Chino Hills, City Of | 0.000 | $0.00 | $0.00 | *2,152.027* | 2,152.027 | 3.002% | $2.75 | $0.00 | | $2.75 |
| Chino, City Of | 0.000 | $0.00 | $0.00 | *388.940* | 388.940 | 0.543% | $0.50 | $0.00 | | $0.50 |
| Cucamonga Valley Water District | 0.000 | $0.00 | $0.00 | *16,561.990* | 16,561.990 | 23.104% | $21.20 | $0.00 | | $21.20 |
| Desalter Authority | 0.000 | $0.00 | $0.00 | *28,252.803* | | | | | | $0.00 |
| Fontana Union Water Company | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| Fontana Water Company | 0.000 | $0.00 | $0.00 | *13,250.493* | 13,250.493 | 18.484% | $16.96 | $0.00 | | $16.96 |
| Fontana, City Of | 0.000 | $0.00 | $0.00 | *0.000* | | | | | $0.00 | $0.00 |
| Golden State Water Company | 0.000 | $0.00 | $0.00 | *850.347* | 850.347 | 1.186% | $1.09 | $0.00 | | $1.09 |
| Jurupa Community Services District | 0.000 | $0.00 | $0.00 | *11,023.217* | 11,023.217 | 15.377% | $14.11 | $0.00 | | $14.11 |
| Marygold Mutual Water Company | 0.000 | $65.45 | ($65.45) | *618.563* | | | | | ($65.45) | ($65.45) |
| Monte Vista Irrigation Company | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| Monte Vista Water District | 0.000 | $0.00 | $0.00 | *6,864.954* | 6,864.954 | 9.577% | $8.79 | $0.00 | | $8.79 |
| Niagara Bottling, LLC | 0.310 | ($78,201.49) | $78,408.57 | *1,531.557* | | | | | $78,408.57 | $78,408.57 |
| Nicholson Trust | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| Norco, City Of | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| Ontario, City Of | 0.000 | $0.00 | $0.00 | *18,970.222* | 18,970.222 | 26.463% | $24.28 | $0.00 | | $24.28 |
| Pomona, City Of | 0.000 | $0.00 | $0.00 | *8,066.802* | | | | | $0.00 | $0.00 |
| San Antonio Water Company | 0.000 | $0.00 | $0.00 | *537.746* | 537.746 | 0.750% | $0.69 | $0.00 | | $0.69 |
| San Bernardino, County of (Shooting Par | 0.002 | ($610.35) | $611.69 | *13.037* | 13.037 | 0.018% | $0.02 | $519.93 | | $519.95 |
| Santa Ana River Water Company | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| Upland, City Of | 0.000 | $0.00 | $0.00 | *1,071.916* | 1,071.916 | 1.495% | $1.37 | $0.00 | | $1.37 |
| West End Consolidated Water Co | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| West Valley Water District | 0.000 | $0.00 | $0.00 | *0.000* | 0.000 | 0.000% | $0.00 | $0.00 | | $0.00 |
| **Pool 3 Appropriative Total** | **0.401** | **($100,766.17)** | **$101,034.04** | ***110,521.962*** | **71,684.889** | ** | **$91.75** | **$519.93** | **$100,422.35** | **$101,034.03** |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Watermaster Cumulative Unmet Replenishment Obligation (CURO)

| Remaining Replenishment Obligation: | AF |
|---|---|
| Appropriative - 100 | 0.399 |
| Appropriative - 15/85 | 0.002 |
| Non-Agricultural - 100 | 0.008 |
| | **0.409** |

| Replenishment Rate | |
|---|---|
| 2017 Rate | $668.00 |
| 2016 Rate | $596.00 |

### Pool 2 Non-Agricultural

| Company | Outstanding Obligation (AF) | Fund Balance ($) | Outstanding Obligation ($) |
|---|---|---|---|
| Ameron International Corp. | 0.000 | $0.00 | $0.00 |
| Aqua Capital Management LP | 0.000 | $47.83 | ($47.83) |
| California Speedway Corp. (Auto Club Sp | 0.000 | $0.00 | $0.00 |
| California Steel Industries, Inc. (CSI) | 0.000 | $0.00 | $0.00 |
| Calmat Co., a Division of Vulcan Material | 0.000 | $0.00 | $0.00 |
| CCG Ontario, LLC | 0.000 | $0.00 | $0.00 |
| General Electric Co. (GE) | 0.000 | ($3.90) | $3.90 |
| Hamner Park Associates (Swan Lake M | 0.000 | $0.00 | $0.00 |
| Kaiser Ventures, Inc. | 0.000 | $0.00 | $0.00 |
| KCO, LLC / The Koll Company | 0.000 | $0.00 | $0.00 |
| Loving Savior Of The Hills Lutheran Chur | 0.000 | $0.00 | $0.00 |
| Monte Vista Water District (Non-Ag) | 0.000 | $0.00 | $0.00 |
| NRG California South LP | 0.000 | $0.00 | $0.00 |
| Ontario, City of (Non-Ag) | 0.000 | $0.00 | $0.00 |
| Praxair, Inc. | 0.000 | $0.00 | $0.00 |
| Riboli Family / San Antonio Winery | 0.001 | ($246.33) | $247.00 |
| San Bernardino, County of (Chino Airport | 0.000 | $0.00 | $0.00 |
| Southern California Edison Co. (SCE) | 0.000 | $0.00 | $0.00 |
| Southern Service Co. (Angelica) | 0.003 | ($676.17) | $678.17 |
| Space Center Mira Loma, Inc. | 0.000 | $0.00 | $0.00 |
| Sunkist Growers, Inc. | 0.000 | $0.00 | $0.00 |
| TAMCO | 0.004 | ($1,114.59) | $1,117.26 |
| West Venture Development Co. | 0.000 | $0.00 | $0.00 |
| **Pool 2 Non-Agricultural Total** | **0.008** | **($1,993.16)** | **$1,998.50** |

p10:
1) There is no IEUA Surcharge in the 2017 Rate; an RTS charge will be applied for Assessment Years 16/17 and 17/18 over a period of ten years beginning with Assessment Year 18/19.

## Chino Basin Watermaster Asssessment Breakdown

# 2017-2018 Land Use Conversion Summary

Assessment Year 2017-2018 (Production Year 2016-2017)

**AGRICULTURAL POOL SUMMARY IN ACRE FEET**

| | |
|---|---|
| Agricultural Pool Safe Yield | 82,800.000 |
| Agricultural Total Pool Production | (26,862.554) |
| Early Transfer | (32,800.000) |
| Total Conversions | (28,295.612) |
| Under(Over) Production: | **(5,158.166)** |

| | | Acres Converted @ 1.3 af/ac | | Total Prior to Peace Agrmt Converted AF | Acres Converted @ 2.0 af/ac | | Total Land Use Conversions Acre-Feet |
|---|---|---|---|---|---|---|---|
| | Prior Converted | Acres | Acre Feet | | Acres | Acre Feet | |
| Chino Hills, City Of | 0.000 | 670.266 | 871.346 | 871.346 | 175.714 | 351.428 | 1,222.774 |
| Chino, City Of | 196.235 | 1,454.750 | 1,891.175 | 2,087.410 | 3,184.194 | 6,368.388 | 8,455.798 |
| Cucamonga Valley Water District | 0.000 | 460.280 | 598.364 | 598.364 | 0.000 | 0.000 | 598.364 |
| Fontana Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 417.000 | 834.000 | 834.000 |
| Jurupa Community Services District | 0.000 | 2,756.920 | 3,583.996 | 3,583.996 | 5,510.538 | 11,021.076 | 14,605.072 |
| Monte Vista Water District | 0.000 | 28.150 | 36.595 | 36.595 | 15.510 | 31.020 | 67.615 |
| Ontario, City Of | 209.400 | 527.044 | 685.157 | 894.557 | 808.716 | 1,617.432 | 2,511.989 |
| | **405.635** | **5,897.410** | **7,666.633** | **8,072.268** | **10,111.672** | **20,223.344** | **28,295.612** |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 3 Agricultural Pool Reallocation Summary

| | | Reallocation of Agricutural Pool Safe Yield | | | | | |
|---|---|---|---|---|---|---|---|
| | *% Share of Operating Safe Yield* | 32,800 AF Early Transfer | Land Use Conver-sions | Potential for Reallocation (AF) | *Percent of Ag Pool Reallocation* | Difference: Potential vs. Net | Net Ag Pool Reallocation |
| Arrowhead Mtn Spring Water Co | *0.000%* | 0.000 | 0.000 | 0.000 | *0.000%* | 0.000 | 0.000 |
| Chino Hills, City Of | *3.851%* | 1,263.128 | 1,222.774 | 2,485.902 | *4.069%* | (209.879) | 2,276.023 |
| Chino, City Of | *7.357%* | 2,413.096 | 8,455.798 | 10,868.894 | *17.790%* | (917.636) | 9,951.258 |
| Cucamonga Valley Water District | *6.601%* | 2,165.128 | 598.364 | 2,763.492 | *4.523%* | (233.315) | 2,530.177 |
| Desalter Authority | *0.000%* | 0.000 | 0.000 | 0.000 | *0.000%* | 0.000 | 0.000 |
| Fontana Union Water Company | *11.657%* | 3,823.496 | 0.000 | 3,823.496 | *6.258%* | (322.809) | 3,500.687 |
| Fontana Water Company | *0.002%* | 0.656 | 834.000 | 834.656 | *1.366%* | (70.468) | 764.188 |
| Fontana, City Of | *0.000%* | 0.000 | 0.000 | 0.000 | *0.000%* | 0.000 | 0.000 |
| Golden State Water Company | *0.750%* | 246.000 | 0.000 | 246.000 | *0.403%* | (20.769) | 225.231 |
| Jurupa Community Services District | *3.759%* | 1,232.952 | 14,605.072 | 15,838.024 | *25.923%* | (1,337.169) | 14,500.855 |
| Marygold Mutual Water Company | *1.195%* | 391.960 | 0.000 | 391.960 | *0.642%* | (33.092) | 358.868 |
| Monte Vista Irrigation Company | *1.234%* | 404.752 | 0.000 | 404.752 | *0.662%* | (34.172) | 370.580 |
| Monte Vista Water District | *8.797%* | 2,885.416 | 67.615 | 2,953.031 | *4.833%* | (249.318) | 2,703.713 |
| Niagara Bottling, LLC | *0.000%* | 0.000 | 0.000 | 0.000 | *0.000%* | 0.000 | 0.000 |
| Nicholson Trust | *0.007%* | 2.296 | 0.000 | 2.296 | *0.004%* | (0.194) | 2.102 |
| Norco, City Of | *0.368%* | 120.704 | 0.000 | 120.704 | *0.198%* | (10.191) | 110.513 |
| Ontario, City Of | *20.742%* | 6,803.376 | 2,511.989 | 9,315.365 | *15.247%* | (786.475) | 8,528.890 |
| Pomona, City Of | *20.454%* | 6,708.912 | 0.000 | 6,708.912 | *10.981%* | (566.418) | 6,142.494 |
| San Antonio Water Company | *2.748%* | 901.344 | 0.000 | 901.344 | *1.475%* | (76.098) | 825.246 |
| San Bernardino, County of (Shooting | *0.000%* | 0.000 | 0.000 | 0.000 | *0.000%* | 0.000 | 0.000 |
| Santa Ana River Water Company | *2.373%* | 778.344 | 0.000 | 778.344 | *1.274%* | (65.714) | 712.630 |
| Upland, City Of | *5.202%* | 1,706.256 | 0.000 | 1,706.256 | *2.793%* | (144.055) | 1,562.201 |
| West End Consolidated Water Co | *1.728%* | 566.784 | 0.000 | 566.784 | *0.928%* | (47.852) | 518.932 |
| West Valley Water District | *1.175%* | 385.400 | 0.000 | 385.400 | *0.631%* | (32.538) | 352.862 |
| | ***100.000%*** | **32,800.000** | **28,295.612** | **61,095.612** | ***100.000%*** | **(5,158.162)** | **55,937.450** |
| | **12A** | **12B** | **12C** | **12D** | **12E** | **12F** | **12G** |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 2 Assessment Fee Summary

| | | Non-Agricultural Pool | | Replenishment Assessments | | | | |
|---|---|---|---|---|---|---|---|---|
| | *AF Production* | $18.03 AF/Admin | $53.60 AF/OBMP | *AF Exceeding Annual Right* | $668.00 Per AF | CURO Adjustment | Other Adjustments | Total Assessments Due |
| Ameron International Corp. | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 |
| Aqua Capital Management LP | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | (47.83) | 0.00 | (47.83) |
| California Speedway Corp. (Auto Club Speedway) | *410.453* | 7,400.47 | 22,000.28 | *0.000* | 0.00 | 0.00 | 0.00 | 29,400.75 |
| California Steel Industries, Inc. (CSI) | *1,298.227* | 23,407.03 | 69,584.97 | *0.000* | 0.00 | 0.00 | 0.00 | 92,992.00 |
| Calmat Co., a Division of Vulcan Materials Co. | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 |
| CCG Ontario, LLC | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 |
| General Electric Co. (GE) | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 3.90 | 0.00 | 3.90 |
| Hamner Park Associates (Swan Lake MHP) | *412.082* | 7,429.84 | 22,087.60 | *0.000* | 0.00 | 0.00 | 0.00 | 29,517.43 |
| Monte Vista Water District (Non-Ag) | *17.784* | 320.65 | 953.22 | *0.000* | 0.00 | 0.00 | 0.00 | 1,273.87 |
| NRG California South LP | *211.080* | 3,805.77 | 11,313.89 | *0.000* | 0.00 | 0.00 | 0.00 | 15,119.66 |
| Ontario, City of (Non-Ag) | *1,647.489* | 29,704.23 | 88,305.41 | *0.000* | 0.00 | 0.00 | 0.00 | 118,009.64 |
| Praxair, Inc. | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 |
| Riboli Family / San Antonio Winery | *5.183* | 93.45 | 277.81 | *5.183* | 3,462.24 | 247.00 | 0.00 | 4,080.50 |
| San Bernardino, County of (Chino Airport) | *51.143* | 922.11 | 2,741.26 | *0.000* | 0.00 | 0.00 | 0.00 | 3,663.37 |
| Southern Service Co. (Angelica) | *19.890* | 358.62 | 1,066.10 | *2.980* | 1,990.64 | 678.17 | 0.00 | 4,093.53 |
| Space Center Mira Loma, Inc. | *93.708* | 1,689.56 | 5,022.75 | *0.000* | 0.00 | 0.00 | 0.00 | 6,712.30 |
| TAMCO | *24.540* | 442.46 | 1,315.34 | *0.000* | 0.00 | 1,117.26 | 0.00 | 2,875.06 |
| West Venture Development Co. | *0.000* | 0.00 | 0.00 | *0.000* | 0.00 | 0.00 | 0.00 | 0.00 |
| | ***4,191.579*** | **75,574.16** | **224,668.63** | ***8.163*** | **5,452.88** | **1,998.50** | **0.00** | **307,694.18** |
| | **13A** | **13B** | **13C** | **13D** | **13E** | **13F** | **13G** | **13H** |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 2 Water Production Summary

| | *Percent of Safe Yield* | Carryover Beginning Balance | Prior Year Adjust-ments | Assigned Share of Safe Yield (AF) | Water Transaction Activity | Other Adjust-ments | Annual Production Right | Actual Fiscal Year Production | Net Over Production | Under Production Balances | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Under-Produced | Carryover: Next Year Begin Bal | To Excess Carryover Account |
| Ameron International Corp. | *0.752%* | 82.858 | 0.000 | 55.239 | (33.143) | 0.000 | 104.954 | 0.000 | 0.000 | 104.954 | 55.239 | 49.714 |
| Aqua Capital Management LP | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| California Speedway Corp. (Auto Cl | *13.605%* | 1,000.000 | 0.000 | 1,000.000 | (100.000) | 0.000 | 1,900.000 | 410.453 | 0.000 | 1,489.547 | 1,000.000 | 489.547 |
| California Steel Industries, Inc. (CSI | *21.974%* | 1,615.137 | 0.000 | 1,615.137 | (161.513) | 0.000 | 3,068.761 | 1,298.227 | 0.000 | 1,770.533 | 1,615.137 | 155.395 |
| Calmat Co., a Division of Vulcan Ma | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| CCG Ontario, LLC | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| General Electric Co. (GE) | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hamner Park Associates (Swan Lak | *6.316%* | 464.240 | 0.000 | 464.240 | (46.424) | 0.000 | 882.056 | 412.082 | 0.000 | 469.974 | 464.240 | 5.733 |
| Monte Vista Water District (Non-Ag) | *0.680%* | 32.418 | 0.000 | 50.000 | (5.000) | 0.000 | 77.418 | 17.784 | 0.000 | 59.634 | 50.000 | 9.634 |
| NRG California South LP | *12.986%* | 954.540 | 0.000 | 954.540 | (95.454) | 0.000 | 1,813.626 | 211.080 | 0.000 | 1,602.546 | 954.540 | 648.006 |
| Ontario, City of (Non-Ag) | *39.601%* | 2,910.788 | 0.000 | 2,910.788 | (291.079) | 0.000 | 5,530.497 | 1,647.489 | 0.000 | 3,883.008 | 2,910.788 | 972.219 |
| Praxair, Inc. | *0.014%* | 1.000 | 0.000 | 1.000 | (0.100) | 0.000 | 1.900 | 0.000 | 0.000 | 1.900 | 1.000 | 0.899 |
| Riboli Family / San Antonio Winery | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5.183 | 5.183 | 0.000 | 0.000 | 0.000 |
| San Bernardino, County of (Chino A | *1.821%* | 133.870 | 0.000 | 133.870 | (13.387) | 0.000 | 254.353 | 51.143 | 0.000 | 203.210 | 133.870 | 69.340 |
| Southern Service Co. (Angelica) | *0.256%* | 0.000 | 0.000 | 18.789 | (1.879) | 0.000 | 16.910 | 19.890 | 2.980 | 0.000 | 0.000 | 0.000 |
| Space Center Mira Loma, Inc. | *1.417%* | 0.003 | 0.000 | 104.121 | (10.412) | 0.000 | 93.711 | 93.708 | 0.000 | 0.003 | 0.003 | 0.000 |
| TAMCO | *0.579%* | 0.000 | 0.000 | 42.619 | 23.357 | 0.000 | 65.976 | 24.540 | 0.000 | 41.436 | 41.436 | 0.000 |
| West Venture Development Co. | *0.000%* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | ***100.00%*** | **7,194.854** | **0.000** | **7,350.343** | **(735.034)** | **0.000** | **13,810.162** | **4,191.579** | **8.163** | **9,626.745** | **7,226.253** | **2,400.487** |
| | **14A** | **14B** | **14C** | **14D** | **14E** | **14F** | **14G** | **14H** | **14I** | **14J** | **14K** | **14L** |

p14:
1) The annual transfer of 10 percent of the Non-Ag Safe Yield included in Column [14E] is now being utilized to offset the overall Desalter Replenishment Obligation in accordance with the Peace II Agreement Section 6.2.
2) In November 2016, Ameron International Corp. and TAMCO had reached a settlement which resulted in the following transfers from Ameron to TAMCO; 27.619 AF of Assigned Share of Operating Safe Yield, 27.619 AF of carryover balance from the previous year, and 169.358 AF of stored water.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 2 Local Storage Accounts Summary

| | Local Storage Account | | | | Local Excess Carry Over Storage Account (ECO) | | | | | | Local Supplemental Storage Account | | | | | Combined |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | Ending Balance | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | From Local Storage | From Under-Production | Ending Balance | Beginning Balance | 0.07% Storage Loss | Transfers To / (From) | Transfers (To) / From ECO Account | Ending Balance | Ending Balance |
| Ameron International Corp. | 508.080 | (0.355) | (507.725) | 0.000 | 0.000 | 0.000 | (169.358) | 507.725 | 49.714 | 388.081 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 388.081 |
| Aqua Capital Management LP | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| California Speedway Corp. (Auto Club Speedway) | 668.720 | (0.468) | (668.252) | 0.000 | 0.000 | 0.000 | 0.000 | 668.252 | 489.547 | 1,157.799 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,157.799 |
| California Steel Industries, Inc. (CSI) | 1,600.326 | (1.120) | (1,599.206) | 0.000 | 0.000 | 0.000 | 0.000 | 1,599.206 | 155.395 | 1,754.601 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,754.601 |
| Calmat Co., a Division of Vulcan Materials Co. | 5.012 | (0.003) | (5.009) | 0.000 | 0.000 | 0.000 | 0.000 | 5.009 | 0.000 | 5.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 5.009 |
| CCG Ontario, LLC | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| General Electric Co. (GE) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hamner Park Associates (Swan Lake MHP) | 1,322.712 | (0.925) | (1,321.787) | 0.000 | 0.000 | 0.000 | 0.000 | 1,321.787 | 5.733 | 1,327.520 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,327.520 |
| Monte Vista Water District (Non-Ag) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 9.634 | 9.634 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 9.634 |
| NRG California South LP | 1,792.912 | (1.255) | (1,791.657) | 0.000 | 0.000 | 0.000 | (1,000.000) | 1,791.657 | 648.006 | 1,439.663 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1,439.663 |
| Ontario, City of (Non-Ag) | 3,971.041 | (2.779) | (3,968.262) | 0.000 | 0.000 | 0.000 | 0.000 | 3,968.262 | 972.219 | 4,940.481 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4,940.481 |
| Praxair, Inc. | 60.027 | (0.042) | (59.985) | 0.000 | 0.000 | 0.000 | 0.000 | 59.985 | 0.899 | 60.884 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 60.884 |
| Riboli Family / San Antonio Winery | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| San Bernardino, County of (Chino Airport) | 20.415 | (0.014) | (20.401) | 0.000 | 0.000 | 0.000 | 0.000 | 20.401 | 69.340 | 89.741 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 89.741 |
| Southern Service Co. (Angelica) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Space Center Mira Loma, Inc. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TAMCO | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 169.358 | 0.000 | 0.000 | 169.358 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 169.358 |
| West Venture Development Co. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | **9,949.245** | **(6.961)** | **(9,942.284)** | **0.000** | **0.000** | **0.000** | **(1,000.000)** | **9,942.284** | **2,400.487** | **11,342.771** | **0.000** | **0.000** | **0.000** | **0.000** | **0.000** | **11,342.771** |
| | **15A** | **15B** | **15C** | **15D** | **15E** | **15F** | **15G** | **15H** | **15I** | **15J** | **15K** | **15L** | **15M** | **15N** | **15O** | **15P** |

p15:
1) The Non-Agricultural Pool's Local Storage Account has been made into two separate storage accounts, the Local Excess Carryover Storage Account and the Local Supplemental Storage Account. The Local Excess Carryover Storage Account will function exactly the same way as the original Local Storage Account. The Local Supplemental Storage Account will be used for storing non-native water in the Basin. To illustrate this transition, all three accounts are shown in this year's Assessment Package. Next year's Assessmnet Package will only have the two new accounts.
2) Ameron International Corp. transferred 169.358 AF from their ECO storage account to TAMCO's ECO storage account as part of their November 2016 settlement.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Pool 2 Water Transaction Summary

| | | | Water Transactions | | | |
|---|---|---|---|---|---|---|
| | Percent of Safe Yield | Assigned Share of Safe Yield (AF) | 10% to Desalter Replenishment Obligation | Transfers (To) / From ECO Account | Exhibit G Water Sales and General Transfers | Total Water Transactions |
| Ameron International Corp. | 0.752% | 55.239 | (5.524) | 169.358 | (196.977) | (33.143) |
| Aqua Capital Management LP | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| California Speedway Corp. (Auto Club | 13.605% | 1,000.000 | (100.000) | 0.000 | 0.000 | (100.000) |
| California Steel Industries, Inc. (CSI) | 21.974% | 1,615.137 | (161.513) | 0.000 | 0.000 | (161.513) |
| Calmat Co., a Division of Vulcan Materi | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| CCG Ontario, LLC | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| General Electric Co. (GE) | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hamner Park Associates (Swan Lake M | 6.316% | 464.240 | (46.424) | 0.000 | 0.000 | (46.424) |
| Monte Vista Water District (Non-Ag) | 0.680% | 50.000 | (5.000) | 0.000 | 0.000 | (5.000) |
| NRG California South LP | 12.986% | 954.540 | (95.454) | 1,000.000 | (1,000.000) | (95.454) |
| Ontario, City of (Non-Ag) | 39.601% | 2,910.788 | (291.079) | 0.000 | 0.000 | (291.079) |
| Praxair, Inc. | 0.014% | 1.000 | (0.100) | 0.000 | 0.000 | (0.100) |
| Riboli Family / San Antonio Winery | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| San Bernardino, County of (Chino Airpo | 1.821% | 133.870 | (13.387) | 0.000 | 0.000 | (13.387) |
| Southern Service Co. (Angelica) | 0.256% | 18.789 | (1.879) | 0.000 | 0.000 | (1.879) |
| Space Center Mira Loma, Inc. | 1.417% | 104.121 | (10.412) | 0.000 | 0.000 | (10.412) |
| TAMCO | 0.579% | 42.619 | (4.262) | (169.358) | 196.977 | 23.357 |
| West Venture Development Co. | 0.000% | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | **100.000%** | **7,350.343** | **(735.034)** | **1,000.000** | **(1,000.000)** | **(735.034)** |
| | **16A** | **16B** | **16C** | **16D** | **16E** | **16F** |

p16:
1) Transfers in Column [16B] include the annual transfer of 10 percent of the Non-Ag Safe Yield to be utilized to offset the overall Desalter Replenishment Obligation in accordance with the Peace II Agreement Section 6.2.
2) Ameron International Corp. transferred 169.358 AF from their ECO storage account to TAMCO's ECO storage account, and 27.619 AF from their Annual Account to TAMCO's Annual Account, as part of their November 2016 settlement.

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Appendix A: Pool 3 Water Production Detail

| | Physical Production | Voluntary Agreements (w/ Ag) | Assignments (w/ Non-Ag) | Other Adjustments | Actual FY Production (Assmnt Pkg Column 2J) |
|---|---|---|---|---|---|
| Arrowhead Mtn Spring Water Co | 367.348 | 0.000 | 0.000 | 0.000 | 367.348 |
| Chino Hills, City Of | 2,246.284 | (94.257) | 0.000 | 0.000 | 2,152.027 |
| Chino, City Of | 4,971.503 | (4,531.420) | (51.143) | 0.000 | 388.940 |
| Cucamonga Valley Water District | 16,561.990 | 0.000 | 0.000 | 0.000 | 16,561.990 |
| Desalter Authority | 28,284.211 | 0.000 | 0.000 | (31.408) | 28,252.803 |
| Fontana Union Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Fontana Water Company | 13,250.493 | 0.000 | 0.000 | 0.000 | 13,250.493 |
| Fontana, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Golden State Water Company | 850.347 | 0.000 | 0.000 | 0.000 | 850.347 |
| Jurupa Community Services District | 11,497.599 | 0.000 | (505.790) | 31.408 | 11,023.217 |
| Marygold Mutual Water Company | 618.563 | 0.000 | 0.000 | 0.000 | 618.563 |
| Metropolitan Water District | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Monte Vista Irrigation Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Monte Vista Water District | 7,086.159 | (125.309) | (17.784) | (78.112) | 6,864.954 |
| Niagara Bottling, LLC | 1,531.557 | 0.000 | 0.000 | 0.000 | 1,531.557 |
| Nicholson Trust | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Norco, City Of | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Ontario, City Of | 24,839.724 | (4,222.013) | (1,647.489) | 0.000 | 18,970.222 |
| Pomona, City Of | 8,066.802 | 0.000 | 0.000 | 0.000 | 8,066.802 |
| San Antonio Water Company | 537.746 | 0.000 | 0.000 | 0.000 | 537.746 |
| San Bernardino, County of (Shooting | 13.037 | 0.000 | 0.000 | 0.000 | 13.037 |
| Santa Ana River Water Company | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Upland, City Of | 1,259.776 | 0.000 | 0.000 | (187.860) | 1,071.916 |
| West End Consolidated Water Co | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| West Valley Water District | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | **121,983.139** | **(8,972.999)** | **(2,222.206)** | **(265.972)** | **110,521.962** |
| Less Desalter Authority Production | | | | | **28,252.803** |
| Total Less Desalter Authority Production | | | | | **82,269.159** |

Other Adj:
1) CDA provided 31.408 AF to JCSD.
2) MVWD received credit of 78.112 AF due to Pump-to-Waste activities.
3) Upland received credit of 187.860 AF due to Pump-to-Waste activities.

**Assessment Package Appendix B**

**Desalter Replenishment Accounting, Shortfall Deducted from the Pre-Peace II Desalters Re-Operation Account[1]**

**Per Peace II Agreement, Section 6.2 (PIIA, 6.2)**

**(Acre-Feet)**

| Production Year | Desalter Production | | | Desalter Replenishment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Controlled Overdraft / Re-Op, PIIA, 6.2(a)(vi) | | | | |
| | Pre-Peace II Desalter Production | Peace II Desalter Expansion Production[2] | Total | Desalter (aka Kaiser) Account PIIA, 6.2(a)(i) | Paragraph 31 Settlement Agreements Dedication[3] PIIA, 6.2(a)(ii) | **Desalter Induced Recharge[4] (DIR) PIIA, 6.2(a)(iii)** | "Leave Behind" Losses PIIA, 6.2(a)(iv) | Safe Yield Contributed by Parties PIIA, 6.2(a)(v) | Allocation to Pre-Peace II Desalters[5] | Allocation for Peace II Desalter Expansion[6] | Balance | Non-Ag OBMP Assessment (10% Haircut)[7] PIIA, 6.2(b)(i) | Residual Replenishment Obligation[5, 8, 9] |
| 2001 | 7,989 | 0 | 7,989 | 3,995 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 3,995 |
| 2002 | 9,458 | 0 | 9,458 | 4,729 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 4,729 |
| 2003 | 10,439 | 0 | 10,439 | 5,219 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 5,219 |
| 2004 | 10,605 | 0 | 10,605 | 5,303 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 5,303 |
| 2005 | 9,854 | 0 | 9,854 | 4,927 | 0 | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 4,927 |
| 2006 | 16,476 | 0 | 16,476 | 11,579 | 0 | **0** | 0 | 0 | 0 | 0 | 400,000 | 0 | 4,897 |
| 2007 | 26,356 | 0 | 26,356 | 608 | 4,273 | **0** | 0 | 0 | 21,475 | 0 | 378,525 | 0 | 0 |
| 2008 | 26,972 | 0 | 26,972 | 0 | 0 | **0** | 0 | 0 | 26,972 | 0 | 351,553 | 0 | 0 |
| 2009 | 32,920 | 0 | 32,920 | 0 | 0 | **0** | 0 | 0 | 61,989 | 0 | 289,564 | 0 | -29,069 |
| 2010 | 28,517 | 0 | 28,517 | 0 | 0 | **0** | 0 | 0 | 28,517 | 0 | 261,047 | 0 | 0 |
| 2011 | 29,319 | 0 | 29,319 | 0 | 0 | **0** | 0 | 0 | 29,319 | 0 | 231,729 | 0 | 0 |
| 2012 | 28,379 | 0 | 28,379 | 0 | 0 | **0** | 0 | 0 | 28,379 | 0 | 203,350 | 0 | 0 |
| 2013 | 27,062 | 0 | 27,062 | 0 | 0 | **0** | 0 | 0 | 27,062 | 0 | 176,288 | 0 | 0 |
| 2014 | 29,228 | 15 | 29,243 | 0 | 0 | **0** | 0 | 0 | 1,288 | 15 | 174,985 | 0 | 27,940 |
| 2015 | 29,541 | 449 | 29,990 | 0 | 0 | **0** | 0 | 0 | 0 | 449 | 174,537 | 0 | 29,541 |
| 2016 | 27,009 | 1,154 | 28,163 | 0 | 0 | **0** | 0 | 0 | 0 | 1,154 | 173,383 | 0 | 27,009 |
| 2017 | 26,726 | 1,527 | 28,253 | 0 | 0 | **0** | 0 | 0 | 0 | 1,527 | 171,855 | 735 | **25,991** |
| 2018 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 161,855 | 735 | 29,265 |
| 2019 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 151,855 | 735 | 29,265 |
| 2020 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 141,855 | 735 | 29,265 |
| 2021 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 131,855 | 735 | 29,265 |
| 2022 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 121,855 | 735 | 29,265 |
| 2023 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 111,855 | 735 | 29,265 |
| 2024 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 101,855 | 735 | 29,265 |
| 2025 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 91,855 | 735 | 29,265 |
| 2026 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 81,855 | 735 | 29,265 |
| 2027 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 71,855 | 735 | 29,265 |
| 2028 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 61,855 | 735 | 29,265 |
| 2029 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 51,855 | 735 | 29,265 |
| 2030 | 30,000 | 10,000 | 40,000 | 0 | 0 | **0** | 0 | 0 | 0 | 10,000 | 41,855 | 735 | 29,265 |
| Totals | 766,848 | 133,145 | 899,993 | 36,360 | 4,273 | **0** | 0 | 0 | 225,000 | 133,145 | | 10,290 | 490,925 |
| | | | | | | | | | (225,000 available) | (175,000 available) | | | |

1. Table format and content: WEI, Response to Condition Subsequent Number 7, November 2008.

2. Peace II Desalter Expansion expected to increase total desalter production in October 2015.

3. 3,956.877 acre-feet + 316.177 acre-feet added as Non-Ag dedicated stored water per Paragraph 31 Settlement Agreements. Per Agreements, the water is deemed to have been dedicated as of June 30, 2007.

**4. The projection of the Desalter Induced Recharge (DIR), previously referred to as the Santa Ana River Underflow New Yield (SARUNY), in the table is shown as zero for each year. In the near future, through the modeling work and Safe Yield Redetermination process, Watermaster will determine the DIR and will produce a new schedule.**

5. Six years of Desalter tracking (Production Year 2000/2001 through Production Year 2005/2006) may have incorrectly assumed that a significant portion of Desalter production was being offset by Desalter Induced Recharge. Condition Subsequent 7 included an adjustment of 29,070 AF against Desalter replenishment in Production Year 2008/2009.

6. The Peace I Agreement terminates in 2030. Per this schedule, the Peace II Desalter expansion would not fully utilize its available 175,000 acre-feet.

7. For the first 10 years following the Peace II Agreement (2006/2007 through 2015/2016), the Non-Ag "10% Haircut" water is apportioned among the specific seven members of the Appropriative Pool, per PIIA 9.2(a). In the eleventh year and in each year thereafter, it is dedicated to Watermaster to further offset desalter replenishment. However, to the extent there is no remaining desalter replenishment obligation in any year after applying the offsets set forth in 6.2(a), it will be distributed pro rata among the members of the Appropriative Pool based upon each Producer's combined total share of OSY and the previous year's actual production.

8. Per the Peace II Agreement, Section 6.2(b)(ii), the residual replenishment assessment is against the Appropriative Pool, pro-rata based on each Producer's combined total share of OSY and the previous year's actual production.

**9. Through production year 2016/17, the desalter replenishment obligation could be as high as 110,481 AF. Due to the ongoing Safe Yield Redetermination process and related DIR matter, the desalter replenishment obligation is not being assessed at this time. When the Safe Yield Redetermination and DIR matters are resolved, the desalter replenishment obligation will be recalculated, if necessary, and assessed, if necessary.**

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 1A | AF Production and Exchanges | Total production and exchanges. Copied from [2L]. |
| 1B | Appropriative Pool—AF/Admin | Production and Exchanges [1A] <times> per acre-foot Admin fee. |
| 1C | Appropriative Pool—AF/OBMP | Production and Exchanges [1A] <times> per acre-foot OBMP fee. |
| 1D | Ag Pool SY Reallocation—AF Total Reallocation | Reallocation of Ag Pool Safe Yield. Copied from [2E] and [12G]. |
| 1E | Ag Pool SY Reallocation—AF/Admin | Party Ag Pool reallocation [1D] <divided by> Total Ag Pool Reallocation [1D Total] <times> total dollar amount needed for Ag Pool Administration. |
| 1F | Ag Pool SY Reallocation—AF/OBMP | Party Ag Pool reallocation [1D] <divided by> Total Ag Pool Reallocation [1D Total] <times> total dollar amount needed for Ag Pool OBMP. |
| 1G | Replenishment Assessments—AF/15% | For Parties participating in the 85/15 Rule: Percentage of total 85/15 participant production <times> required credit amount. Copied from Page 9A. |
| 1H | Replenishment Assessments—AF/85% | For parties participating in the 85/15 Rule: Total volume overproduced [2M] <times> 85% of the replenishment rate. |
| 1I | Replenishment Assessments—AF/100% | For parties not participating in the 85/15 Rule: Total volume overproduced [2N] <times> 100% of the replenishment rate. |
| 1J | 85/15 Water Transaction Activity—15% Producer Credits | For parties participating in the 85/15 Rule: Credit amount equals 15% of the cost of the water purchased. Total copied from Page 7D. |
| 1K | 85/15 Water Transaction Activity—15% Pro-rated Debits | For parties participating in the 85/15 Rule: Percentage of total 85/15 participant production <times> required credit amount. Copied from Page 9A. |
| 1L | CURO Adjustment | Monetary amount needed (or to be credited) for each Party's Cumulative Unmet Replenishment Obligation (CURO). Calculated on Page 10A. |
| 1M | ASSESSMENTS DUE—Total Production Based | Total fees assessed based on Party production. [1B] + [1C] + [1E] + [1F] + [1G] + [1H] + [1I] + [1J] + [1K] + [1L]. |
| 1N | ASSESSMENTS DUE—Pomona Credit | Debit amount to Pomona <times> -1 <times> percent share of Operating Safe Yield [2A]. |
| 1O | ASSESSMENTS DUE—Recharge Debt Payment | Total recharge debt payment <times> percent share of Operating Safe Yield [2A]. |
| 1P | ASSESSMENTS DUE—Recharge Improvement Project | Total Recharge Improvement Project <times> Percent Share of Operating Safe Yield [2A]. |
| 1Q | ASSESSMENTS DUE—Other Adjustments | Used as necessary for any other monetary adjustments needed to the Assessment Package. |
| 1R | ASSESSMENTS DUE—Total Due | Total assessments. [1M] + [1N] + [1O] + [1P] + [1Q]. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 2A | Percent of Operating Safe Yield | The Party's yearly percentage of Operating Safe Yield. |
| 2B | Carryover Beginning Balance | The beginning balance in each Annual Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 2C | Prior Year Adjustments | This number reflects the adjusted production rights from a previous Assessment Package, in the event that corrections are needed. |
| 2D | Assigned Share of Operating Safe Yield | The Party's yearly volume of Operating Safe Yield. |
| 2E | Net Ag Pool Reallocation | Reallocation of Ag Pool Safe Yield. Copied from [12G]. The calculations that lead to this are made on Page 12A. |
| 2F | Water Transaction Activity | Water transactions. Copied from [6D]. The calculations that lead to this are made on Page 6A. |
| 2G | Stormwater New Yield | Stormwater New Yield <times> percent share of Operating Safe Yield [2A]. |
| 2H | Other Adjustments | This number reflects adjusted production rights, in the event that corrections are needed. |
| 2I | Annual Production Right | Current Year Production Right. [2B] + [2C] + [2D] + [2E] + [2F] + [2G] + [2H]. |
| 2J | Actual Fiscal Year Production | Fiscal year production, including Assignments and Voluntary Agreements, from CBWM's production system (as verified by each Party on their Water Activity Report). Includes a sub note subtracting Desalter production. See Appendix A. |
| 2K | Storage and Recovery Program(s) | Total exchanges for the period (July 1- June 30) including MZ1 forbearance and DYY deliveries (as reported to CBWM by IEUA and TVMWD and as verified by each Party on their Water Activity Report). A DYY in lieu “put” is shown as a positive number and a DYY “take” is shown as a negative number. |
| 2L | Total Production and Exchanges | Actual production [2J] <plus> Storage and Recovery exchanges [2K]. Includes a sub note subtracting Desalter production. Also known as Assessable Production. |
| 2M | Net Over-Production—85/15% | For 85/15 Rule participants: Production rights [2I] <minus> total production and exchanges [2L], equaling less than zero. |
| 2N | Net Over-Production—100% | For non-85/15 Rule participants: Production rights [2I] <minus> total production and exchanges [2L], equaling less than zero. Includes a sub note subtracting Desalter production. |
| 2O | Under Production Balances—Total Under-Produced | Production rights [2I] <minus> total production and exchanges [2L], equaling more than zero. |
| 2P | Under Production Balances—Carryover: Next Year Begin Bal | Either total under-produced [2O] or share of Operating Safe Yield [2D], whichever is less. |
| 2Q | Under Production Balances—To Excess Carryover Account | Total under produced [2O] <minus> Carryover to next year [2P], equaling more than zero. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 3A | Excess Carry Over Account (ECO)—Beginning Balance | The beginning balance in each ECO account. This carries forward from the ending balance in the previous period Assessment Package. |
| 3B | Excess Carry Over Account (ECO)—0.07% Storage Loss | Beginning balance [3A] <times> -0.0007. |
| 3C | Excess Carry Over Account (ECO)—Transfers To / (From) | Total of water transferred to and from ECO and the Annual Account. |
| 3D | Excess Carry Over Account (ECO)—From Supplemental Storage | Total of water transferred to and from Local Supplemental Storage accounts, as shown on Page 4A. |
| 3E | Excess Carry Over Account (ECO)—From Under-Production | Total of water transferred from the Annual Account due to under production. Copied from [2Q]. |
| 3F | Excess Carry Over Account (ECO)—Ending Balance | The current balance in each ECO account. [3A] + [3B] + [3C] + [3D] + [3E]. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 4A | Recharged Recycled Account—Beginning Balance | The beginning balance in each Recharged Recycled Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 4B | Recharged Recycled Account—0.07% Storage Loss | Beginning balance [4A] <times> -0.0007. |
| 4C | Recharged Recycled Account—Current Recharged Recycled | Total recharged recycled water credited to each Party for the year, as provided by IEUA. |
| 4D | Recharged Recycled Account—Transfer to ECO Account | Total of water transferred to the ECO Account, as shown on Page 3A. |
| 4E | Recharged Recycled Account—Ending Balance | The current balance in each Recharged Recycled account. [4A] + [4B] + [4C] + [4D]. |
| 4F | Quantified (Pre 7/1/2000) Account—Beginning Balance | The beginning balance in each Quantified Supplemental Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 4G | Quantified (Pre 7/1/2000) Account—0.07% Storage Loss | Beginning balance [4F] <times> -0.0007. |
| 4H | Quantified (Pre 7/1/2000) Account—Transfers To / (From) | Total of water transferred to and from the Annual Account. |
| 4I | Quantified (Pre 7/1/2000) Account—Transfer to ECO Account | Total of water transferred to the ECO Account, as shown on Page 3A. |
| 4J | Quantified (Pre 7/1/2000) Account—Ending Balance | The current balance in each Quantified Supplemental account. [4F] + [4G] + [4H] + [4I]. |
| 4K | New (Post 7/1/2000) Account—Beginning Balance | The beginning balance in each New Supplemental Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 4L | New (Post 7/1/2000) Account—0.07% Storage Loss | Beginning balance [4K] <times> -0.0007. |
| 4M | New (Post 7/1/2000) Account—Transfers To / (From) | Total of water transferred to and from the Annual Account. |
| 4N | New (Post 7/1/2000) Account—Transfer to ECO Account | Total of water transferred to the ECO Account, as shown on Page 3A. |
| 4O | New (Post 7/1/2000) Account—Ending Balance | The current balance in each New Supplemental Account. [4K] + [4L] + [4M] + [4N]. |
| 4P | Combined—Ending Balance | The combined amount in all supplemental storage accounts [4E] + [4J] + [4O]. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 5A | Desalter Replenishment—Beginning Balance | The beginning balances in each Desalter Replenishment account. These numbers carry forward from the ending balances in the previous period Assessment Package. "Re-Operation Offset: Pre-Peace II Desalters" had an original beginning balance of 225,000.000 AF and "Re-Operation Offset: Peace II Expansion" had an original beginning balance of 175,000.000 AF. |
| 5B | Desalter Replenishment—Storage Loss | Beginning balance [5A] <times> -(loss %). There is no loss assessed on the native Basin water allocated to offset Desalter production as a result of Basin Reoperation as approved in the Peace II Agreement. Per the "Preemptive Replenishment" agreements, no losses are deducted against these accounts. |
| 5C | Desalter Replenishment—Transfers To | Total of water transferred to each Desalter Replenishment account. |
| 5D | Desalter Replenishment—Transfers From | Total of water transferred from each Desalter Replenishment account. |
| 5E | Desalter Replenishment—Ending Balance | The current balance in each Desalter Replenishment account. [5A] + [5B] + [5C] + [5D]. |
| 5F | Storage and Recovery—Beginning Balance | The beginning balance in the Storage and Recovery (DYY) Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 5G | Storage and Recovery—Storage Loss | Beginning balance [5F] <times> -(loss %). |
| 5H | Storage and Recovery—Transfers To | Total of water transferred to the Storage and Recovery Account ("puts"). |
| 5I | Storage and Recovery—Transfers From | Total of water transferred from the Storage and Recovery Account ("takes"). |
| 5J | Storage and Recovery—Ending Balance | The current balance in the Storage and Recovery Account. [5F] + [5G] + [5H] + [5I]. |

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 6A | Water Transactions—Assigned Rights | Total of assigned transactions for this period, including annual water transfers/leases between Appropriators and/or from Appropriators to Watermaster for replenishment purposes, and also the Exhibit "G" physical solution transfers from the Non-Ag Pool. Detailed in Pages 7A-7D. |
| 6B | Water Transactions—General Transfer | Total of water transfers between Parties for this period. |
| 6C | Water Transactions—Transfers (To) / From ECO Account | Total of water transferred between the Annual Account and ECO Account. |
| 6D | Water Transactions—Transfers (To) Desalter Replenishment | Total of water transferred from the ECO Account to the Desalter Replenishment Obligation. |
| 6E | Water Transactions—Total Water Transactions | Total water transactions. [6A]+ [6B] + [6C] + [6D]. This column is used to populate [2F]. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 12A | % Share of Operating Safe Yield | The Party's yearly percentage of Operating Safe Yield. Copied from [2A]. |
| 12B | Reallocation of Agricultural Pool Safe Yield—32,800 AF Early Transfer | The Party's percent share of Operating Safe Yield [12A] multiplied by 32,800. |
| 12C | Reallocation of Agricultural Pool Safe Yield—Land Use Conversions | Total land use conversions claimed on Page 11A (as verified by each Party on their Water Activity Report). |
| 12D | Reallocation of Agricultural Pool Safe Yield—Potential for Reallocation (AF) | The Agricultural Pool Reallocation amount potentially available to each Appropriator. [12B] + [12C]. |
| 12E | Reallocation of Agricultural Pool Safe Yield—Percent of Ag Pool Reallocation | Each Party's pro rata share of the potential for reallocation [12D] from the total of [12D]. |
| 12F | Reallocation of Agricultural Pool Safe Yield—Difference: Potential vs. Net | The total over or under Agricultural Pool Reallocation (from Page 11A) <times> each Party's percent of Ag Pool reallocation [12E]. |
| 12G | Reallocation of Agricultural Pool Safe Yield—Net Ag Pool Reallocation | Net Agricultural Pool Reallocation to each Party. [12D] + [12F]. This column is used to populate [2E]. |

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 13A | AF Production | Actual fiscal year production by each Party. Copied from [14H]. |
| 13B | Non-Agricultural Pool—AF/Admin | Production [13A] <times> per acre-foot Admin fee. |
| 13C | Non-Agricultural Pool —AF/OBMP | Production [13A] <times> per acre-foot OBMP fee. |
| 13D | Replenishment Assessments—AF Exceeding Annual Right | Over-production for each Party beyond their annual production right. Copied from [14I]. |
| 13E | Replenishment Assessments—Per AF | Amount overproduced [13D] <times> the current replenishment rate. |
| 13F | CURO Adjustment | Monetary amount needed (or to be credited) for each Party's Cumulative Unmet Replenishment Obligation (CURO). Calculated on Page 10B. |
| 13G | Other Adjustments | Used as necessary for any other monetary adjustments needed to the Assessment Package. |
| 13H | Total Assessments Due | Total fees assessed based on Party production. [13B] + [13C] + [13E] + [13F] + [13G]. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 14A | Percent of Safe Yield | The Party's yearly percentage of Safe Yield. |
| 14B | Carryover Beginning Balance | The beginning balance in each Annual Account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 14C | Prior Year Adjustments | This number reflects the adjusted production rights from a previous Assessment Package, in the event that corrections are needed. |
| 14D | Assigned Share of Safe Yield (AF) | The Party's yearly volume of Safe Yield. |
| 14E | Water Transaction Activity | Total of one-time water transfers between Parties for this period, including the annual transfer of 10-percent of the Non-Ag Safe Yield to be utilized to offset the overall Desalter Replenishment Obligation, as stated in the Peace II Agreement, and Exhibit G. |
| 14F | Other Adjustments | This number reflects adjusted production rights, in the event that corrections are needed. |
| 14G | Annual Production Right | Current Year Production Right. [14B] + [14C] + [14D] + [14E] + [14F]. |
| 14H | Actual Fiscal Year Production | Fiscal year production, including Assignments, from CBWM's production system (as verified by each Party on their Water Activity Report). Also known as Assessable Production. |
| 14I | Net Over Production | Over-production, if any, for each Party beyond their annual production right. [14H] – [14G], equaling more than zero. |
| 14J | Under Production Balances—Total Under-Produced | Production rights [14G] <minus> production [14H], equaling more than zero. |
| 14K | Under Production Balances—Carryover: Next Year Begin Bal | Either total under-produced [14J] or share of Safe Yield [14D], whichever is less. |
| 14L | Under Production Balances—To Excess Carryover Account | Total under-produced [14J] <minus> Carryover to next year [14K], equaling more than zero. |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 15A | Local Storage Account—Beginning Balance | The beginning balance in each Local Storage account. This number carries forward from the ending balance in the previous period Assessment Package. |
| 15B | Local Storage Account—0.07% Storage Loss | Beginning balance [15A] <times> -0.0007. |
| 15C | Local Storage Account—Transfers To / (From) | Total of water transferred to and from the Annual Account. |
| 15D | Local Storage Account—Ending Balance | The current balance in each Local Storage Account. [15A] + [15B] + [15C]. |
| 15E | Excess Carry Over Account—Beginning Balance | The beginning balance in each ECO account. This number will carry forward from the ending balance in the previous period Assessment Package. |
| 15F | Excess Carry Over Account—0.07% Storage Loss | Beginning balance [15E] <times> -0.0007. |
| 15G | Excess Carry Over Account—Transfers To / (From) | Total of water transferred to and from ECO and the Annual Account. |
| 15H | Excess Carry Over Account—From Local Storage | Total water transferred from Local Storage Account. |
| 15I | Excess Carry Over Account—From Under-Production | Total of water transferred from the Annual Account due to under production. Copied from [14L]. |
| 15J | Excess Carry Over Account—Ending Balance | The current balance in each ECO account. [15E] + [15F] + [15G] + [15H] + [15I] |
| 15K | Supplemental Account—Beginning Balance | The beginning balance in each Supplemental Account. This number will carry forward from the ending balance in the previous period Assessment Package. |
| 15L | Supplemental Account—0.07% Storage Loss | Beginning balance [15K] <times> -0.0007. |
| 15M | Supplemental Account—Transfers To / (From) | Total of water transferred to and from the Annual Account. |
| 15N | Supplemental Account—Transfers (To) / From ECO Account | Total of water transferred to the ECO Account, as shown on Page 14A. |
| 15O | Supplemental Account—Ending Balance | The current balance in each Supplemental Account. [15K] + [15L] + [15M] + [15N]. |
| 15P | Combined—Ending Balance | The combined amount in all local storage accounts. [15D] + [15J] + [15O] |

Chino Basin Watermaster

# Assessment Package References and Definitions

| REPORT REFERENCE | NAME | DESCRIPTION |
|---|---|---|
| 16A | Water Transactions—Percent of Safe Yield | The Party's yearly percentage of Operating Safe Yield. |
| 16B | Water Transactions—Assigned Share of Safe Yield (AF) | The Party's yearly volume of Operating Safe Yield. |
| 16C | Water Transactions—10% to Desalter Replenishment Obligation | Operating Safe Yield [16B] <times> -0.1 |
| 16D | Water Transactions— Transfers (To) / From ECO Account | Total of water transferred between the Annual Account and ECO Account. |
| 16E | Water Transactions— Exhibit G Water Sales and General Transfers | Total of water transfers between Parties for this period including Exhibit G Water Sales. |
| 16F | Water Transactions— Total Water Transactions | Total water transactions. [16C] + [16D] + [16E]. This column is used to populate [14E]. |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Assessment Package Notes

| Company | Account | Note |
|---|---|---|
| App A | | Other Adjustments include water provided to another Appropriator, pump-to-waste that has been captured in a recharge basin, and ASR injection of native water. |
| pg01 | | Recharge Debt Project expenses [1O] and Recharge Improvement Project expenses [1P] are each allocated on % OSY, based on the approved budget. |
| pg02 (a) | | Stormwater New Yield is allocated to the Appropriators based on their % OSY. Watermaster has completed the process for correction of prior over-allocation that was documented through Condition Subsequent 7. |
| pg02 (b) | | Column [2J], "Actual Fiscal Year Production," includes physical production, Voluntary Agreements, Assignments, and, if applicable, other adjustments. A detailed breakdown can be found in Appendix A. |
| pg03<br>pg04 | | The Assessment Package database is set up so that all water must go through the Party Annual Accounts on the way to or from ECO Storage Accounts, and through the ECO Storage Accounts on the way to or from Supplemental Storage Accounts. |
| pg05 (a) | | "Re-Operation Offset: Pre-Peace II Desalters" had a starting balance of 225,000.000 AF. The account will need adjustment following the current modeling and Safe Yield Redetermination work (i.e. DIR) and will be adjusted in the next Assessment Package. |
| pg05 (b) | | The 29,070 AF correction required by Condition Subsequent 7 has been included in the "Re-Operation Offset: Pre-Peace II Desalters". (See Appendix B) |
| pg05 (c) | | "Re-Operation Offset: Peace II Expansion" had an original beginning balance of 175,000.000 AF. The "Transfer From" amount includes Expansion production for this year. The table shows information under existing rules. |
| pg05 (d) | | There is no loss assessed on the native Basin water allocated to offset Desalter production as a result of Basin Reoperation as approved in the Peace II Agreement. |
| pg05 (e) | | Chino, Ontario, and JCSD Preemptive Replenishment Agreement water is shown. Per the Agreements, no losses are deducted against these accounts. |
| pg05 (f) | | "Non-Ag Dedication" was used in a prior Assessment Package to indicate Non-Ag Pool desalter dedication. |
| pg06 | | Transfers in Column [6A] include annual water transfers/leases between Appropriators and/or from Appropriators to Watermaster for replenishment purposes. Also included are the Exhibit "G" physical solution transfers from the Non-Ag Pool. |

## Assessment Year 2017-2018 (Production Year 2016-2017)

# Assessment Package Notes

| Company | Account | Note |
|---|---|---|
| pg08 | | The column titled "(Over)/Under Production Excluding Water Transfer(s)" excludes Exhibit "G" water sales and water transfers between Appropriators and to Watermaster (if any). ([2B]+[2C]+[2D]+[2E]+[6B]-[2J]) |
| pg09 | | The “15% Water Transaction Debits” total is the “Total 15% Credits from all Transactions” from Page 7C. |
| pg10 (a) | | The financial Outstanding Obligations are reconciled on pages 10A and 10B. |
| pg10 (b) | | Fund Balance is maintained on a spreadsheet by Watermaster. |
| pg10 (c) | | Outstanding Obligation is calculated by multiplying Outstanding Obligation (AF) by the current rate, reduced by the Fund |
| pg11 | | "Agricultural Total Pool Production" includes Voluntary Agreements between Appropriators and Agricultural Pool Parties. |
| pg14 (a) | | Transfers in Column [14E] include the annual transfer of 10 percent of the Non-Ag Safe Yield to be utilized to offset the overall Desalter Replenishment Obligation in accordance with the Peace II Agreement Section 6.2, and also the Exhibit "G" physical so |
| pg14 (b) | | Column [14H], "Actual Fiscal Year Production," includes physical production and Assignments between Appropriators and Non-Ag Pool Parties. |
| pg15 (a) | | Hydraulic Control was achieved on February 1, 2016. Pursuant to Paragraph 7.4(b) of the Peace II Agreement, Storage Loss is now calculated at 0.07%. |
| pg15 (b) | | When applicable, column [15G] includes the Exhibit "G" physical solution transfers to the Appropriative Pool. (See Page 7C) |

# Optimum Basin Management Program

## Staff Status Report 2018-1: January to June 2018

CHINO BASIN WATERMASTER

Optimum Basin Management Program

### Highlighted Activities

- During this reporting period, Watermaster manually measured 400 water levels at about 70 private wells throughout the Chino Basin, conducted two quarterly download events at about 125 wells containing pressure transducers, collected 44 groundwater-quality samples from dedicated monitoring wells, and collected four surface-water quality samples.
- Pursuant to a monitoring and mitigation requirement of the Peace II Subsequent Environmental Impact Report, Watermaster, the Inland Empire Utilities Agency (IEUA), and the Orange County Water District (OCWD) continued to implement the Prado Basin Habitat Sustainability Program (PBHSP). During this reporting period, Watermaster collected two quarters of groundwater-quality samples, and conducted two quarterly downloads of pressure transducers that measure water levels at the 18 PBHSP monitoring wells. The Prado Basin Habitat Sustainability Committee (PBHSC) prepared the second annual report: *Annual Report of the Prado Basin Habitat Sustainability Committee for Water Year 2017*.
- Pursuant to the *Chino Basin Subsidence Management Plan*, Watermaster continued to implement the Ground-Level Monitoring Program and began drafting the *2017 Annual Report of the Ground-Level Monitoring Committee*, which analyzes and interprets data from the monitoring program and recommends future monitoring and testing activities. Watermaster also executed the "proof of concept" to test the sonar water-level measuring technique for the Ground-Level Monitoring Program.
- Watermaster and the IEUA are continuing to implement the 2013 Amendment to the 2010 Recharge Master Plan Update (2013 RMPU) pursuant to the October 2013 Court Order authorizing its implementation. During the reporting period, the IEUA selected contractors to install monitoring wells and construct the San Sevaine Basin improvements. Construction of the San Sevaine Basin Improvements began in September 2017 and is expected to be completed in September 2018. The 85 percent design plans and specifications were completed for the Wineville/Jurupa/RP3 Basins, Montclair Basins, Lower Day Basin, and Victoria Basin projects from the 2013 RMPU.
- During this reporting period, Watermaster and the IEUA recharged a total of 15,378 acre-feet of water: 4,043 acre-feet of stormwater, 5,689 acre-feet of recycled water, and 5,646 acre-feet of imported water.
- Watermaster staff continued to investigate and assess the groundwater basin response to the planned use of Managed Storage (storage space used by the Watermaster Parties that includes carryover, excess carryover, and local supplemental waters) and potential storage and recovery plans. Watermaster updated its modeling tools and planning projections, and completed an assessment of material physical injury (MPI) for the use of Managed Storage. During this reporting period Watermaster evaluated the use of storage space in the range of 700,000 acre-feet to 1,000,000 acre-feet.

### Important Court Hearings and Orders

- January 12, 2018—Hearing re Request for Court to Amend the Annual Reporting Schedule for the Ground-Level Monitoring Committee.
- January 12, 2018—Order re Request for Court to Amend the Annual Reporting Schedule for the Ground-Level Monitoring Committee.



## Program Element 1: Develop and Implement a Comprehensive Monitoring Program

Fundamental to the implementation of each of the OBMP Program Elements are the monitoring and data collection efforts performed in accordance with Program Element 1, which includes monitoring basin hydrology, production, recharge, groundwater levels, groundwater quality, and ground-level movement. Various monitoring programs have and will continue to be refined over time to satisfy the evolving needs of Watermaster and the IEUA, such as new regulatory requirements and improved data coverage. Monitoring is performed by basin pumpers, Watermaster staff and other cooperating entities as follows.

### *Groundwater Level Monitoring*

The basin-wide groundwater-level monitoring program initiated by Watermaster supports many of the Watermaster functions, such as the periodic reassessment of Safe Yield, the monitoring and management of ground-level movement, the analysis of desalter pumping impacts at private wells, the analysis of the implementation of the Peace II Agreement on groundwater levels and riparian vegetation in Prado Basin, the triennial re-computation of ambient water quality mandated by the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan), and the assessment of Hydraulic Control—a maximum-benefit commitment in the Basin Plan. The data are also used to update and recalibrate Watermaster's computer-simulation groundwater-flow model, to understand groundwater flow directions, to compute storage changes, to support interpretations of water quality data, and to identify areas of the basin where recharge and discharge are not in balance.



Setting a Transducer to Record Water Level Data

The current groundwater-level monitoring program is comprised of about 1,100 wells. At about 900 of these wells, water levels are measured by well owners, which include municipal water agencies, the California Department of Toxic Substances Control (DTSC), the Counties, and various private consulting firms. Watermaster collects these water level data at least semi-annually. At the remaining 200 wells, water levels are measured by Watermaster staff using manual methods once per month or by using pressure transducers that record data once every 15 minutes. These wells are mainly Agricultural Pool wells or dedicated monitoring wells located south of the 60 freeway.

All groundwater-level data are checked and uploaded to a centralized database management system that can be accessed online through HydroDaVE℠. During this reporting period, Watermaster measured about 400 manual water levels at about 70 wells throughout the Chino Basin and conducted two quarterly downloads of 125 pressure transducers installed in private, municipal, and monitoring wells. Additionally, Watermaster compiled all available groundwater-level data from well owners in the basin for the October 2017 to March 2018 period.

### *Groundwater Quality Monitoring*

Watermaster initiated a comprehensive groundwater-quality monitoring program in which the obtained data may be used by Watermaster for: the biennial State of the Basin report; the triennial ambient water quality update; the demonstration of Hydraulic Control, monitoring nonpoint-source groundwater contamination and plumes associated with point-source discharges, and assessing the overall health of the groundwater basin. Groundwater-quality data are also used in conjunction with numerical models to assist Watermaster and other parties in evaluating proposed salinity management and groundwater remediation strategies. The details of the groundwater-quality monitoring programs as of fiscal year 2017/18 are described below.

**Chino Basin Data Collection (CBDC)**. Watermaster routinely and proactively collects groundwater-quality data from well owners, such as municipal producers and government agencies. Groundwater-quality data are also obtained from special studies and monitoring that takes place under orders of the Santa Ana Regional Water Quality Control Board (Regional Board)—such as for landfills and other groundwater quality investigations, the Department of Toxic Substances Control (DTSC), the US Geological Survey (USGS), and others. These data are collected from well owners and monitoring entities at least twice per year. Data is collected for about 840 wells as part of the CBDC program. During this reporting period, Watermaster compiled data collected for the CBDC program for the July to December 2017 period.

**Watermaster Field Groundwater Quality Monitoring Programs.** Watermaster continues to sample privately owned wells and its own monitoring wells on a routine basis as follows:

1. *Private Wells.* About 95 private wells, located predominantly in the southern portion of the basin, are sampled at various frequencies based on their proximity to known point-source contamination plumes. 8 wells near contaminant plumes are sampled on an annual basis, and the remaining 86 wells are sampled on a triennial basis.

## Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

2. *Watermaster Monitoring Wells*. Watermaster collects groundwater quality samples from a total of 21 multi-nested monitoring wells located throughout the Chino Basin. These nested wells include nine HCMP monitoring well sites constructed to support the demonstration of Hydraulic Control in the southern Chino Basin, nine sites constructed to support the PBHSP in the Prado Basin region, and three sites that fill spatial data gaps near contamination plumes in MZ-3. Each nested well site contains up to four wells in the borehole. Additionally, Watermaster samples one single-casing well in MZ-3. Currently, the HCMP and MZ-3 wells are sampled annually, and the PBHSP wells are sampled quarterly.
3. *Other wells*. Watermaster collects quarterly samples from four near-river wells to characterize the interaction of the Santa Ana River and groundwater. These shallow monitoring wells along the Santa Ana River consist of two former USGS National Water Quality Assessment Program wells (Archibald 1 and Archibald 2) and two Santa Ana River Water Company wells (well 9 and well 11).

During this reporting period, Watermaster collected 44 groundwater-quality samples from 22 dedicated monitoring wells. All groundwater-quality data are checked by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE$^{sm}$.

### *Groundwater Production Monitoring*

As of the end of this reporting period, there were a total of 501 producing wells, 292 of which were for agricultural uses. Many active agricultural production wells are metered. Watermaster reads the meters on a quarterly basis and enters the production data into Watermaster's relational database, which can be accessed online through HydroDaVE$^{sm}$.



Reading a Meter on an Agricultural Well

### *Surface Water Monitoring in the Santa Ana River*

Watermaster collects grab water quality samples at two sites along the Santa Ana River (Santa Ana River at River Road and Santa Ana River at Etiwanda) on a quarterly basis. Along with data collected at four wells near the Santa Ana River, these data are used to characterize the interaction between the Santa Ana River and nearby groundwater. During this reporting period, Watermaster collected four surface-water quality samples.

### *Prado Basin Habitat Sustainability Program (PBHSP)*

Mitigation Measure 4.4-3 from the Peace II SEIR requires that Watermaster and the IEUA, in collaboration with OCWD, form a committee, the PBHSC, and develop and implement an Adaptive Management Plan for the PBHSP. The PBHSC is open to all interested participants, including the Watermaster Parties, IEUA member agencies, OCWD, and other interested stakeholders. The objective of the PBHSP is to ensure that riparian habitat in the Prado Basin is not adversely impacted by the implementation of Peace II activities. Currently, the PBHSP consists of a monitoring program and annual reporting on the results of the monitoring program. The monitoring program includes an assessment of the riparian habitat and all factors that could potentially impact the riparian habitat, including those factors affected by Peace II activities, such as changes in groundwater levels. Sixteen monitoring wells at nine sites were constructed in 2015 to support the PBHSP. Two existing wells are also monitored as part of the PBHSP. The PBHSC developed the Adaptive Management Plan of the PBHSP to describe an initial monitoring program and a process to modify the monitoring program and/or implement mitigation strategies, as necessary.

During the reporting period, Watermaster performed the following tasks:

- Conducted the groundwater monitoring program, which included the quarterly collection of groundwater-level and groundwater-quality data from the PHBSP monitoring wells.
- Prepared a memorandum titled: *Recommended Scope and Budget of the Prado Basin Habitat Sustainability Program for Fiscal year 2018/19*. This memorandum was used by Watermaster and the IEUA to develop and approve their respective fiscal year 2018/19 budgets.

## Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

- Prepared the second annual report: *Annual Report of the Prado Basin Habitat Sustainability Committee for Water Year 2017*. The main conclusion of the annual report was that, at this time, there was no observed degradation of riparian habitat that was contemporaneous with the implementation of the Peace II Agreement.
- Conducted two meetings of the PBHSC:
  - On March 12, 2018 to present the Recommended Scope and Budget of the PBHSP for fiscal year 2018/19.
  - On May 9, 2018 to present the draft Annual Report of the PBHSC for water year 2017.

### *Chino Basin Groundwater Recharge Monitoring Program*

Watermaster, the IEUA, the Chino Basin Water Conservation District, and the San Bernardino County Flood Control District jointly sponsor the Chino Basin Groundwater Recharge Program. This is a comprehensive water supply program to enhance water supply reliability and improve groundwater quality in local drinking water wells by increasing the recharge of storm, imported, and recycled waters. The recharge program is regulated under Regional Board Order No. R8-2007-0039 and Monitoring and Reporting Program No. R8-2007-0039.

Watermaster and the IEUA measure the quantity of storm and supplemental water that enters recharge basins using pressure transducers or staff gauges. Staff also collect weekly water quality samples from recharge basins actively recharging recycled water and from lysimeters installed within those recharge basins. Imported water quality data for State Water Project water are obtained from the Metropolitan Water District of Southern California (MWDSC) and recycled water quality data for RP-1 and RP-4 treatment plant effluents are obtained from the IEUA. Combining measured flow data with respective water quality data enables the calculation of the blended water quality of the recharge sources in each recharge basin and the assessment of adequate dilution of recycled water, as required by the recycled water recharge permits held with the Department of Drinking Water (DDW). The recharge measurements are also used to estimate the New Yield to the Chino Basin due to recharge activities.

**Monitoring Activities.** During this reporting period, the IEUA performed its ongoing monitoring program to measure and record recharge volumes and to collect stormwater quality samples pursuant to its permit requirements. Also, during this reporting period, approximately 84 recharge basin and lysimeter samples were collected for water quality analysis, and 28 recycled water samples were collected for alternative water quality monitoring plans, including the application of a correction factor for soil-aquifer treatment, determined from each recharge basin's startup period. Monitoring wells located downgradient of the recharge basins were sampled, at a minimum, on a quarterly basis; that said, some monitoring wells were sampled more frequently during the reporting period for a total of 126 samples.



San Sevaine 5 Basin

**Reporting.** Watermaster and the IEUA completed the following compliance reports concerning the recharge program during the reporting period:

- 4Q-2017 Quarterly Report, submitted to the RWQCB – February 2018
- 1Q-2018 Quarterly Report, submitted to the RWQCB – May 2018
- 2017 Annual Report, submitted to the RWQCB – May 2018

### *Ground-Level Monitoring*

To address the historical occurrence of land subsidence and ground fissuring in the Chino Basin, Watermaster prepared and submitted a subsidence management plan (known as the MZ-1 Plan) to the Court for approval, and in November 2007, the Court ordered its implementation (see Program Element 4 in this report for more on the MZ-1 Plan implementation). The MZ-1 Plan required several monitoring and mitigation measures to minimize or abate the future occurrence of land subsidence and ground fissuring. These measures and activities included:

- Continuing the scope and frequency of monitoring within the so-called Managed Area that was conducted during the period when the MZ-1 Plan was being developed.

## Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

- Expanding the monitoring of the aquifer system and ground-level movement into other areas of MZ-1 and the Chino Basin where data indicate concern for future subsidence and ground fissuring (Areas of Subsidence Concern).
- Monitoring of horizontal strain across the historical zone of ground fissuring.
- Conducting additional testing and monitoring to refine the MZ-1 Guidance Criteria for subsidence management (e.g. the Long-Term Pumping Test).
- Developing alternative pumping plans for the MZ-1 producers impacted by the MZ-1 Plan.
- Constructing and testing a lower-cost cable extensometer facility at Ayala Park.
- Evaluating and comparing ground-level surveying and Interferometric Synthetic Aperture Radar (InSAR), and recommending future monitoring protocols for both techniques.
- Conducting an aquifer storage recovery (ASR) feasibility study at a City of Chino Hills production well within the MZ-1 Managed Area (Well 16).

Since the initial MZ-1 Plan was adopted in 2007, Watermaster has conducted the annual Ground-Level Monitoring Program (GLMP). The main results of the GLMP are: very little permanent land subsidence has occurred in the MZ-1 Managed Area, indicating that subsidence is being successfully managed in this area, and land subsidence has been occurring in the Northwest MZ-1 Area. One concern is that subsidence in Northwest MZ-1 has occurred differentially across the San Jose Fault, following the same pattern of differential subsidence that occurred in the MZ-1 Managed Area during the time of ground fissuring.

Based on these observations, Watermaster determined that the subsidence management plan needed to be updated to include a *Subsidence Management Plan for the Northwest MZ-1 Area* with the long-term objective of minimizing or abating the occurrence of the differential land subsidence. Thus, Watermaster expanded the GLMP into the Northwest MZ-1 Area and prepared an updated *Chino Basin Subsidence Management Plan* (SMP), which included the *Work Plan to Develop a Subsidence-Management Plan for the Northwest MZ-1 Area* (Work Plan) as an appendix.

During this reporting period, Watermaster undertook the following SMP activities:

- Continued high-resolution water-level monitoring at wells within the Managed Area and within the Areas of Subsidence Concern. All monitoring equipment is inspected at least quarterly and is repaired and/or replaced as necessary. The data collected were checked and analyzed to assess the functionality of the monitoring equipment and for compliance with the SMP.
- Performed monthly routine maintenance, data collection, and verification at the Ayala Park and Chino Creek extensometer facilities.
- Performed the ground level surveys for the benchmark network in the Managed Area and Areas of Subsidence Concern: Southeast, Northeast, Northwest Areas, and the San Jose Fault Zone.
- Continued implementation of the Work Plan:
    - Collected, processed, and checked groundwater-level data and production data from wells in the Northwest MZ-1 Study Area on monthly basis.
    - Continued to coordinate SCADA integration with MVWD to install water-level monitoring devices, connect the devices to MVWD's SCADA system, and execute the "proof of concept" to test the sonar water-level measuring technique in MVWD well 33.
    - Executed the "proof of concept" to test the sonar water-level measuring technique in City of Pomona well 27 (P-27). The sonar method was unsuccessful in well P-27. Subsequent correspondence and an in-person meeting was conducted with the City of Pomona staff to identify inactive and active production wells that can be safely equipped with pressure transducers in-lieu of using sonar.

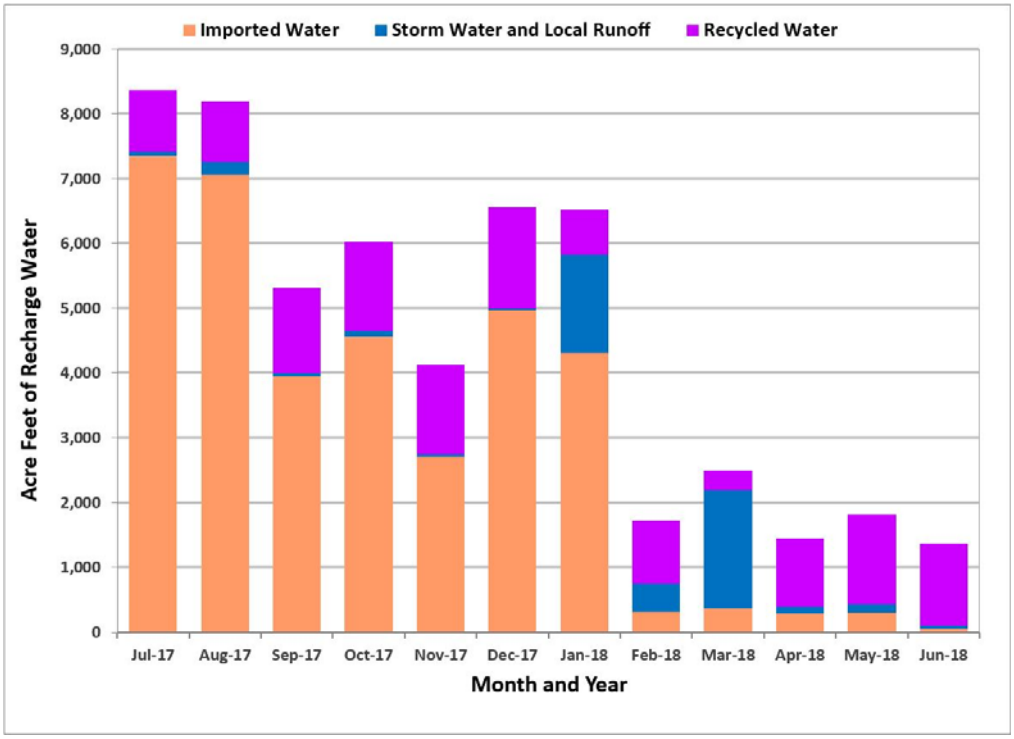
## Program Element 1: Develop and Implement a Comprehensive Monitoring Program (Continued)

- Corresponded and conducted an in-person meeting with City of Pomona and Tom Dodson & Associates staff to discuss ensuring CEQA compliance for the Pomona Extensometer facility's two dual-nested piezometers.
- Conducted bi-weekly to weekly conference calls with City of Pomona to discuss the technical specifications, permitting, right of entry, and the bidding package for the Pomona Extensometer facility's two dual-nested piezometers.

- Prepared to implement the Long-Term Pumping Test, described in the SMP, to test and refine the Guidance Level for the Managed Area. The test requires the City of Chino Hills to pump wells CH-15B and CH-17 such that they cause water levels at PA-7 to decline below the Guidance Level. The recovery phase of the test includes groundwater injection cycles at City of Chino Hills well CH-16. The groundwater production data, as of July, from the City of Chino Hills wells CH-15B, CH-16, and CH-17 is only available through the end of fiscal year 2017/18's third quarter. Based on the available data, these wells were not operational between January 1, 2018 and June 30, 2018.

## Program Element 2: Develop and Implement a Comprehensive Recharge Program

The objectives of the comprehensive recharge program include enhancing the yield of the Chino Basin through the development and implementation of a Recharge Master Plan to improve, expand, and construct recharge facilities that enable the recharge of storm, recycled, and imported waters; to ensure a balance of recharge and discharge in the Chino Basin management zones; and to ensure that sufficient storm and imported waters are recharged to comply with the recycled water dilution requirements in Watermaster and the IEUA's recycled water recharge permits.




Pursuant to PE2 of the OBMP, Watermaster and the IEUA partnered with the San Bernardino County Flood Control District and the Chino Basin Water Conservation District to construct and/or improve eighteen recharge sites. This project is known as the Chino Basin Facilities Improvement Project (CBFIP). The average annual stormwater recharge of the CBFIP facilities is approximately 10,000 acre-feet per year, the supplemental "wet"[1] water recharge capacity ranges is about 70,200 acre-feet per year, and the in-lieu supplemental water recharge capacity ranges from 17,700 to 49,900 acre-feet per year. In addition to the CBFIP facilities, the Monte Vista Water District has five ASR wells with a demonstrated well injection capacity of 5,500 acre-feet per year. The current total supplemental water recharge capacity ranges from 93,380 to 116,580 acre-feet per year, which is greater than the projected supplemental water recharge capacity required by Watermaster.

In 2008, Watermaster began preparing the *2010 Recharge Master Plan Update* (2010 RMPU) pursuant to the December 21, 2007 Court Order (the Peace II Agreement) to complete a Recharge Master Plan Update by July 1, 2010. In October 2010, the Court accepted the 2010 RMPU as satisfying the condition and ordered that certain recommendations of the 2010 RMPU be implemented. In November 2011, Watermaster reported its progress to the Court pursuant to the October 2010 Court Order, and in

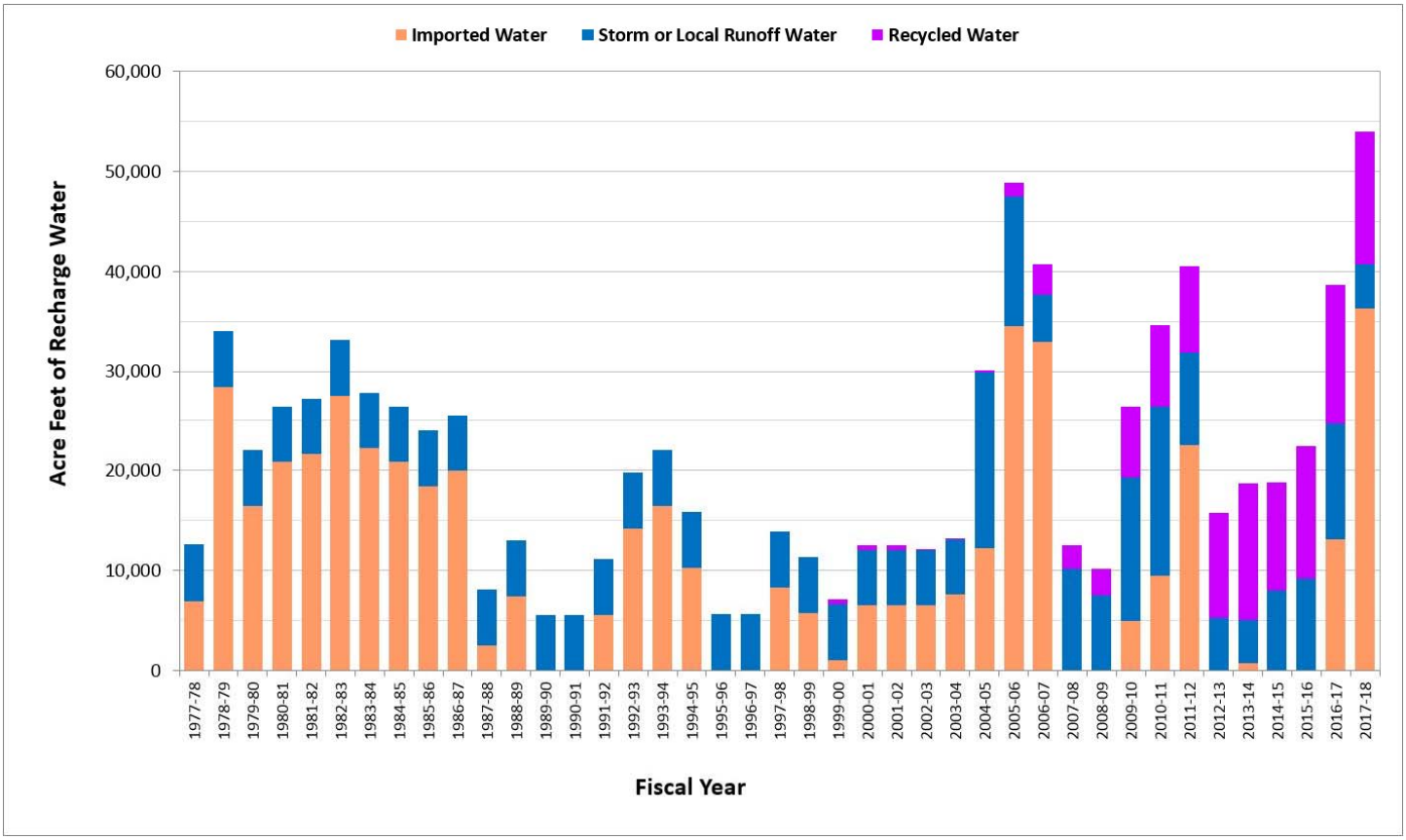
[1]The modifier "wet" means actual physical water is being recharged in spreading basins as opposed to the dedication of water from storage or in-lieu recharge.

## Program Element 2: Develop and Implement a Comprehensive Recharge Program (Continued)

December 2011, the Court issued an order directing Watermaster to continue with its implementation of the 2010 RMPU per its October 2010 order but with a revised schedule. On December 15, 2011, the Watermaster Board moved to:

> "approve that within the next year there will be the completion of [a] Recharge Master Plan Update, there will be the development of an Implementation Plan to address balance issues within the Chino Basin subzones, and the development of a Funding Plan, as presented."

This motion led to the development of an update to the 2010 RMPU, and in 2012, Watermaster staff sent out a "call for projects" to the Watermaster Parties, seeking their recommendations for recharge improvement projects that should be considered in the update. The *2013 Amendment to the 2010 Recharge Master Plan Update* (2013 RMPU) outlines the recommended projects to be implemented by Watermaster and the IEUA and lays out the implementation and financing plans. The 2013 RMPU report was approved by the Watermaster Board in September 2013 and filed with the Court in October 2013. In December 2013, the Court approved the 2013 RMPU except for Section 5, which dealt with the accounting for new recharge from Municipal Separate Stormwater Sewer Systems; Section 5 was later approved by the Court in April 2014.




During this reporting period, Watermaster staff began drafting the 2018 Recharge Master Plan Update (2018 RMPU), which is due to the Court by October 2018.

**2013 RMPU Implementation.** Watermaster and the IEUA are continuing to carry out the October 2013 Court Order, which authorizes them to implement the 2013 RMPU. During the reporting period, the IEUA selected contractors to install monitoring wells and construct the San Sevaine Basin improvements. Construction of the San Sevaine Basin Improvements began in September 2017 and is expected to be completed in September 2018. In June 2017, a design consultant was chosen to design five of the chosen 2013 RMPU projects: CSI Basin, Wineville/Jurupa/RP3 Basins, Montclair Basins, Lower Day Basin, and Victoria Basin. Watermaster stakeholders chose to defer the CSI Basin project and the remaining 2013 RMPU projects for consideration in a future RMPU. During this reporting period, the 85 percent design plans and specifications were completed for the Wineville/Jurupa/RP3 Basins, Montclair Basins, Lower Day Basin, and Victoria Basin projects.

## Program Element 2: Develop and Implement a Comprehensive Recharge Program (Continued)

Additionally, Watermaster and the IEUA continued to develop a series of projects outside of the 2013 RMPU effort that will increase and/or facilitate stormwater and supplemental water recharge and have jointly funded these projects, including monitoring upgrades and habitat conservation. Watermaster's share of the cost of these projects was included in the budget adopted by Watermaster for fiscal year 2017/18.

The Recharge Improvements Project Committee met monthly on the progress of implementing the 2013 RMPU Projects and other recharge-related projects.

**Recharge for Dilution of Recycled Water.** In fiscal year 2009/10, Watermaster and the IEUA's recharge permit was amended to allow for existing underflow dilution and extended the period for calculating dilution from a running 60-month to a running 120-month period. Additionally, the IEUA has worked with the DDW to obtain approval to increase the allowable recycled water contribution (RWC) at wells to 50 percent. These permit amendments allow for increased recycled water recharge without having to increase the amount of imported and storm waters required for dilution. The IEUA projects its dilution requirements as part of its annual reporting to the DDW. Based on the latest Annual Report (May 2017), the IEUA projects that dilution requirements will be met through 2028 even if no imported water is available for dilution.

**Recharge Activities.** During this reporting period, ongoing recycled water recharge occurred in the Brooks, 7th Street, 8th Street, Turner, Ely, RP-3, Declez, Victoria, Hickory, and Banana Basins; stormwater was recharged at 18 recharge basins across all management zones of the Chino Basin; and imported water was recharged in 17 recharge basins, primarily in MZ-1. Watermaster and the IEUA recharged a total of 15,378 acre-feet of water: 4,043 acre-feet of stormwater, 5,689 acre-feet of recycled water, and 5,646 acre-feet of imported water.



Trenching for a Pipeline at San Sevaine Basin

**Balance of Recharge and Discharge in MZ-1**. The total amount of supplemental water recharged in MZ-1 since the Peace II Agreement through June 30, 2018 was approximately 88,711 acre-feet, which is about 17,211acre-feet more than the 71,500 acre-feet required by that date (annual requirement of 6,500 acre-feet). The amount of supplemental water recharged into MZ-1 during the reporting period was approximately 3,902 acre-feet.

## Program Element 3: Develop and Implement Water Supply Plan for the Impaired Areas of the Basin; and
## Program Element 5: Develop and Implement Regional Supplemental Water Program

As stated in the OBMP, "the goal of Program Elements 3 and 5 is to develop a regional, long range, cost-effective, equitable, water supply plan for producers in the Chino Basin that incorporates sound basin management." One element of the water supply plan is the development of a way to replace the decline in groundwater production to prevent significant amounts of degraded groundwater from discharging to the Santa Ana River and violating the Basin Plan. Replacing the decline in agricultural groundwater production will mitigate the reduction of the Safe Yield of the basin and allow for more flexibility in the basin's supplemental water supplies if the produced groundwater is treated. This is achieved through the operation of the Chino Basin Desalter facilities, which comprise a series of wells and treatment facilities in the southern Chino Basin that are designed to replace the decline in production of the agricultural groundwater producers and to treat and serve this groundwater to various Appropriative Pool members.

The Chino I Desalter Expansion and the Chino II Desalter facilities were completed in February 2006. As currently configured, the Chino I Desalter produces about 13,500 acre-feet of groundwater per year (12.1 million gallons per day [MGD]) at 15 wells (I-1 through I-15). This water is treated through air stripping (volatile organic compound [VOC] removal), ion exchange (nitrate removal), and/or reverse osmosis (for nitrate and TDS removal). The Chino II Desalter produces about 15,800 acre-feet of groundwater per

## Program Element 3: Develop and Implement Water Supply Plan for the Impaired Areas of the Basin; and
## Program Element 5: Develop and Implement Regional Supplemental Water Program (Continued)

year (14.1 MGD) at eight wells (II-1 through II-4 and II-6 through II-9). This water is treated through ion exchange and/or reverse osmosis. Development and planning continues between the CDA and Watermaster to expand the production and treatment capacity of the Chino Desalters by about 10,500 acre-feet per year (9.5 MGD). More than $77 million in grant funds have been secured toward this expansion.

The most recently completed expansion project included the construction of five wells for the new Chino Creek Well Field (CCWF): wells I-16, I-17, I-18, I-20, and I-21. These wells were constructed to meet the Hydraulic Control commitment associated with the maximum benefit (see the Program Element 7 update in this status report) and provide additional raw water to the Chino I Desalter. Production began at wells I-16 and I-17 in mid-2014 and at wells I-20 and I-21 in early 2016. Well 1-18 is not planned for operation by the CDA due to high concentrations of VOCs.

The current expansion project will add three additional desalter wells. Wells II-10, II-11, and II-12 will provide additional raw water to the Chino II Desalter and are required to meet the maximum-benefit commitment to produce a total of 40,000 acre-feet per year from the combined desalter well fields. These wells will also be utilized as part of the remediation action plan to clean up the South Archibald Plume (See the Program Element 6 update in this status report). The construction of wells II-10 and II-11 was completed in late-2015, equipping of the wells will be completed in July 2018, and production at the wells will commence soon after.

Property acquisition for well II-12 is anticipated to be completed by December 2018. Construction is expected to begin in mid-2019 and completed by 2020. The completion of a dedicated pipeline to convey groundwater from well II-12 along with wells II-10, II-11, and the existing I-11 is on hold until the land acquisition process is complete. The overall project is anticipated to be operational by early 2020 .

During this reporting period, the CDA continued with the equipping of wells II-10 and II-11 and the land acquisition process for Well II-12.

## Program Element 4: Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1

Because of the historical occurrence of pumping-induced land subsidence and ground fissuring in southwestern Chino Basin (Managed Area), the OBMP required the development and implementation of an Interim Management Plan (IMP) for MZ-1 that would:

- Minimize subsidence and fissuring in the short-term.
- Collect the information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring.
- Formulate a management plan to reduce to tolerable levels or abate future subsidence and fissuring.

From 2001-2005, Watermaster developed, coordinated, and conducted an IMP under the guidance of the MZ-1 Technical Committee. The investigation provided enough information for Watermaster to develop Guidance Criteria for the MZ-1 producers in the investigation area that, if followed, would minimize the potential for subsidence and fissuring during the completion of the MZ-1 Plan. The Guidance Criteria included a listing of Managed Wells and their owners subject to the criteria, a map of the so-called Managed Area, and an initial threshold water level (Guidance Level) of 245 feet below the top of the PA-7 well casing. The MZ-1 Summary Report and the Guidance Criteria were adopted by the Watermaster Board in May 2006. The Guidance Criteria formed the basis for the MZ-1 Plan, which was approved by Watermaster in October 2007. The Court approved the MZ-1 Plan in November 2007 and ordered its implementation. Watermaster has implemented the MZ-1 Plan since that time, including the ongoing Ground-Level Monitoring Program (GLMP) called for by the MZ-1 Plan (refer to the update in this report under Program Element 1).

The MZ-1 Plan states that if data from existing monitoring efforts in the so-called Areas of Subsidence Concern indicate the potential for adverse impacts due to subsidence, Watermaster will revise the MZ-1 Plan pursuant to the process outlined in Section 3 of the MZ-1 Plan. In early 2015, Watermaster prepared an update to the MZ-1 Plan, which included a name change to the *2015 Chino Basin Subsidence Management Plan* (SMP) and a *Work Plan to Develop the Subsidence Management Plan for the Northwest MZ-1 Area* (Work Plan) as an appendix. The SMP and the Work Plan were adopted through the Watermaster Pool process during July 2015.

## Program Element 4: Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1 (Continued)

The data, analysis, and reports generated through the implementation of the MZ-1 Plan, SMP, and Work Plan are reviewed and discussed by the Ground-Level Monitoring Committee (GLMC), which meets on a periodic basis throughout the year. The GLMC is open to all interested participants, including the Watermaster Parties and their consultants. During this reporting period, Watermaster undertook the following data analysis and reporting tasks:

- Prepared figures and tables for the *2017/18 Annual Report of the Ground-Level Monitoring Committee* report.
- For the *Work Plan to Develop a Subsidence Management Plan for the Northwest MZ-1 Area*:
    - Finalized the Detailed Technical Specifications for the Drilling and Construction of Two Dual-Nested Piezometers for the Pomona Extensometer Facility for the Pomona Extensometer Piezometers Construction Bid Package. The bid package was prepared by IEUA.
- Conducted one GLMC meeting on March 1, 2018 to review and discuss the Ground-Level Monitoring Program activities for fiscal year 2017/18 and the recommended scope and budget of the Ground-Level Monitoring Committee for fiscal year 2018/19.

## Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management

Program Elements 6 and 7 are necessary to address the water quality management problems that occur in the Chino Basin. During the development of the OBMP, it was identified that Watermaster did not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed, including the various contaminant plumes in the Chino Basin. With the Regional Board and other agencies, Watermaster has worked to address the following major point source contaminant plumes in the Chino Basin:

*South Archibald Plume*

In July 2005, the Regional Board prepared draft Cleanup and Abatement Orders (CAOs) for six parties who were tenants on the Ontario Airport with regard to the South Archibald TCE Plume. The draft CAOs required the parties to "submit a work plan and time schedule to further define the lateral and vertical extent of the TCE and related VOCs that are discharging, have been discharged, or threaten to be discharged from the site" and to "submit a detailed remedial action plan, including an implementation schedule, to cleanup or abate the effects of the TCE and related VOCs." Four of the six parties (Aerojet-General Corporation, The Boeing Company, General Electric, and Lockheed Martin) voluntarily formed a group known as ABGL to work jointly on a remedial investigation. Northrop Grumman declined to participate in the group. The US Air Force, in cooperation with the US Army Corps of Engineers, funded the installation of one of the four clusters of monitoring wells installed by the ABGL Parties.

In 2008, Regional Board staff conducted research pertaining to the likely source of the TCE contamination and identified discharges of wastewater that may have contained TCE to the RP-1 treatment plant and associated disposal areas to be a potential source. The Regional Board identified several industries, including some previously identified tenants of the Ontario Airport property, that likely used TCE solvents before and during the early-1970s, and discharged wastes to the Cities of Ontario and Upland's sewage systems and subsequently to the RP-1 treatment plant and disposal areas. In 2012, an additional Draft CAO was issued by the Regional Board jointly to the City of Ontario, City of Upland, and the IEUA as the previous and current operators of the RP-1 treatment plant and disposal area (collectively, the RP-1 Parties). In part, the draft CAOs require that RP-1 Parties "supply uninterrupted replacement water service […] to all residences south of Riverside Drive that are served by private domestic wells at which TCE has been detected at concentrations at or exceeding 5 µg/L […]" and to report this information to the Regional Board. In addition, the RP-1 Parties are to "prepare and submit [a] […] feasibility study" and "prepare, submit and implement the Remedial Action Plan" to mitigate the "effects of the TCE groundwater plume."

Under the Regional Board's oversight, the ABGL Parties and/or the RP-1 Parties conducted sampling at private residential wells and taps approximately every two years (2007-2008, 2009, 2011, 2013-2014) in the region where groundwater is potentially contaminated with TCE. By 2014, all private wells and/or taps in the region of the plume had been sampled at least once since 2007. Alternative water systems (tanks) have been installed at residences in the area where well water contains TCE at or above 80% of the MCL for TCE. Residents who declined tank systems are being provided bottled water. Watermaster also routinely samples for water quality at private wells in the area and uses data obtained from this monitoring to delineate the spatial extent of the plume. The most

## Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

recent characterization of the plume completed by Watermaster was in June 2017 for the *2016 State of the Basin* Report. During this reporting period Watermaster prepared a semi-annual status report on the South Archibald plume for Watermaster Parties in February.

In July 2015, the RP-1 Parties completed the Draft Feasibility Study Report for the South Archibald Plume (Feasibility Study). The Feasibility Study established cleanup objectives for both domestic water supply and plume remediation and evaluates alternatives to accomplish these objectives. In August 2015, a Draft Remedial Action Plan (RAP) was concurrently prepared by the RP-1 Parties to present the preferred plume remediation and domestic water supply alternatives. A public review period followed along with two community meetings to educate the public about the plume, the Feasibility Study, and the RAP, and to solicit comments on these reports. In November 2015, a revised Draft Feasibility Study, RAP, and Responses to Comments were completed to address input from the public, the ABGL, and others. In September 2016, the Regional Board issued the Final CAO R8-2016-0016 collectively to the RP-1 Parties and the ABGL Parties. The Final CAO was adopted by all parties in November 2016, thus approving the preferred plume remediation and domestic water supply alternatives identified in the RAP. The parties also reached a settlement agreement that aligns with the Final CAO and authorizes funding to initiate implementation of the plume remediation alternative.

The plume remediation alternative involves the use of existing and proposed CDA production wells and facilities. The RP-1 Parties reached a Joint Facility Development Agreement with the CDA for the implementation of a project designed to remediate the South Archibald Plume. The proposed project includes the operation of three new CDA desalter wells (II-10, II-11, and II-12) and a dedicated pipeline to convey produced groundwater from the three new wells and existing CDA well I-11 to the Desalter II treatment facility. As noted previously in this status report, the CDA has completed construction of two of the three wells, which will be operational during the next reporting period for the second half of 2018. The RP-1 Parties and the CDA have faced ongoing complications in their efforts to acquire the property for the third well, which is affecting the advancement of the remaining project. During this reporting period the RP-1 Parties petitioned the Regional Board for extension of imposed project deadlines in the Final CAO R8-2016-0016. The requested deadline extensions include: well II-12 design report completed by September 2019 construction completed by July 2020; dedicated pipeline design report for the remaining portion of the pipeline submitted by December 2018 and construction completed by April 2020; and the decarbonator modification design report submitted by July 2019 and construction completed by February 2020.

The domestic water supply alternative for those private residences affected by TCE groundwater contamination is a hybrid between the installation of tank systems for some residences, where water is delivered from the City of Ontario potable supply via truck deliveries, and the installation of a temporary pipeline to connect some residences to the City of Ontario potable water system. The Cities of Ontario and Upland have assumed responsibility for implementing the domestic water supply alternative. In February 2017, the Cities of Ontario and Upland submitted the Domestic Water Supply Work Plan to the Regional Board to outline the approach to provide water tank systems or connection to the City of Ontario municipal water supply system for affected residences currently receiving bottled water.

In December 2017, the Cities of Ontario and Upland submitted an Annual Groundwater Monitoring Report to the Regional Board summarizing monitoring conducted between September and November 2017. 42 samples were collected from 41 residential or agricultural locations located within or downgradient of the plume. Based on the results of this sampling event, no additional affected residences were identified for participation in the alternative water supply program. Currently, 37 residences are supplied water by tank systems. Multiple residences remain on bottled water supply and will be re-evaluated for the need for an alternative water supply offer in the next sampling event scheduled for Fall 2018 .

### *Chino Airport Plume*

In 1990, the Regional Board issued CAO No. 90-134 to the County of San Bernardino, Department of Airports (County) to address groundwater contamination originating from the Chino Airport. During 1991 to 1992, ten underground storage tanks and 310 containers of hazardous waste were removed, and 81 soil borings were drilled and sampled on the airport property. From 2003 to 2005, nine onsite monitoring wells were installed and used to collect groundwater quality samples. In 2007, the County conducted its first offsite monitoring effort, and in 2008, the Regional Board issued CAO No. R8-2008-0064, requiring the County to define the lateral and vertical extent of the plume and prepare a remedial action plan. From 2009 to 2012, Tetra Tech, the consultant to the County, conducted several off-site plume characterization studies to delineate the areal and vertical extent of the plume and constructed 33 offsite monitoring wells. From 2013 to early-2015, Tetra Tech conducted an extensive investigation of several areas identified for additional characterization of soil and groundwater contamination; and at the conclusion of the work, they constructed

## Program Element 6: Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region and Other Agencies to Improve Basin Management (Continued)

an additional 33 groundwater monitoring wells on and adjacent to the Airport property. In August 2016, the County completed a Draft Feasibility Study to identify remedial action objectives and evaluate remediation alternatives for mitigation. In January 2017, the Regional Board issued CAO R8-2017-0011, which requires the County to prepare a Final Feasibility Study that incorporates comments from the Regional Board and to prepare, submit, and implement a Remedial Action Plan. The County submitted a Final Feasibility Study for the Chino Airport on June 6, 2017, and it was approved by the Regional Board on June 7, 2017. The recommended remediation alternative is a groundwater pump-and-treat system to provide hydraulic containment and treatment of both the West Plume and the East Plume originating from the Chino Airport. The system consists of ten extraction wells that combined will produce approximately 900 gallons per minute of groundwater for onsite treatment using carbon adsorption. Included among the 10 wells is CDA well I-18, which is no longer planned for use by the CDA. Once treated, the preferred option is to discharge the treated groundwater to the CDA's Chino-I Desalter influent pipeline via a newly constructed pipeline. If this discharge option is not available at the time the system is constructed, the alternative options are to discharge the treated groundwater to either the local surface-water channels or wastewater treatment plants or to inject the treated groundwater back into the basin with six injection wells at the northeast corner of the Chino Airport.

On December 18, 2017 the County submitted the *Draft Interim Remedial Action Plan* for public review and comment. During this reporting period the County held a public workshop to receive public comments and answer questions on the proposed remediation alternative in January 2018. The public review period ended on February 18, 2018. In March 2018 the County published a *Chino Airport Community Involvement Plan* that describes the County's objectives, roles, and responsibilities for remediation, and the methods for public outreach. In April 2018 the following CEQA documents for the proposed Chino Airport remediation alternative were published: *Notice of Availability/Notice of Intent to Adopt a Mitigated Negative Declaration Chino Airport Groundwater Contamination Remedial Action Plan* and the *Initial Study Environmental Checklist Form*. The public review period for these documents ended on May 10, 2018.

The County conducts quarterly and/or annual monitoring events at all 75 of their monitoring wells constructed to date. The conclusions from this monitoring program can be found in reports posted on the Regional Board's GeoTracker website. Watermaster also routinely samples for water quality at private and monitoring wells in the area and uses this and other data obtained from its data collection programs to independently delineate the spatial extent of the plume. The most recent characterization of the plume completed by Watermaster was in June 2017 for the *2016 State of the Basin* Report. During this reporting period Watermaster prepared a semi-annual status report on the Chino Airport plume for Watermaster Parties in February. The County submitted to the Regional Board *the Semiannual Groundwater Monitoring Report Summer and Fall 2017 Chino Airport Groundwater Assessment, San Bernardino County, California.*

### *Other Water Quality Issues*

Watermaster continues to track monitoring programs and mitigation measures associated with other point sources in the Chino Basin, including: Alumax Aluminum Recycling, Alger Manufacturing Facility, the Former Crown Coach Facility, General Electric Test Cell and Flatiron, Former Kaiser Steel Mill, Milliken Landfill, Upland Landfill, and the Stringfellow National Priorities List sites. In June 2017 Watermaster prepared updated delineations of the extent of the VOC plumes for GE Test Cell, GE Flatiron, Milliken Landfill, and the so-called Pomona VOC plume as part of the *2016 Chino Basin State of the Basin Report* published on June 30, 2017. In the next reporting period Watermaster will prepare the annual status reports for the GE Test Cell, GE Flatiron, Milliken Landfill, Chino Institution for Men, and Stringfellow plume, and the former Kaiser Steel Mill site.

## Program Element 7: Develop and Implement a Salt Management Program

### *Maximum Benefit Salinity Management Plan*

In January 2004, the Regional Board amended the Basin Plan to incorporate an updated total dissolved solids (TDS) and nitrogen (N) management plan. The Basin Plan amendment includes both "antidegradation" and "maximum benefit" objectives for TDS and nitrate-N for the Chino-North and Cucamonga groundwater management zones (GMZs). The maximum benefit objectives allow for the reuse and recharge of recycled water and the recharge of imported water without mitigation; these activities are an integral part of the OBMP. The application of the maximum-benefit objectives is contingent on Watermaster and the IEUA's implementation of specific projects and requirements termed the maximum-benefit commitments. There are a total of nine commitments, and Watermaster and the IEUA report the status of compliance with each commitment to the Regional Board annually in April. During this

## Program Element 7: Develop and Implement a Salt Management Program (Continued)

reporting period, Watermaster prepared and submitted the *2017 Chino Basin Maximum Benefit Annual Report*. Specific details of the commitments and related activities are described below.

**Monitoring Programs.** Two of the maximum-benefit commitments are to implement surface and groundwater monitoring programs. On April 15, 2005, the Regional Board adopted resolution R8-2005-0064, approving Watermaster and the IEUA's surface and groundwater monitoring programs. These monitoring programs were conducted pursuant to the 2005 work plan until 2012, when the Basin Plan was amended to remove all references to the specific monitoring locations and sampling frequencies required for groundwater and surface water monitoring. The Basin Plan amendment allows for the monitoring programs to be modified over time on a go-forward basis, subject to the approval of the Executive Officer of the Regional Board. The Basin Plan amendment was approved by the Regional Board on February 12, 2012 and by the State Office of Administrative Law on December 6, 2012. This amendment was adopted based on demonstrations made by Watermaster and the IEUA, showing that the surface water monitoring program, as explicitly described in the Basin Plan, was not meaningfully adding to the body of evidence required to demonstrate Hydraulic Control. In the place of specific monitoring requirements, the Basin Plan required that Watermaster and the IEUA submit a new surface water monitoring program work plan by February 25, 2012 and a new groundwater monitoring program work plan by December 31, 2013. In February 2012, Watermaster and the IEUA submitted, and the Regional Board approved, a new surface water monitoring program that reduced the 2005 monitoring program from bi-weekly surface water quality measurements at 17 sites and direct discharge measurements at six sites to quarterly surface water quality sampling at two sites.

In December 2013, Watermaster and the IEUA submitted an updated *Maximum Benefit Monitoring Program Work Plan and Proposed Schedule for Achieving Hydraulic Control* to the Regional Board. The updated Work Plan states that Watermaster and the IEUA will recalibrate the Chino Basin groundwater model every five years and use the model to estimate groundwater discharge from the Chino-North GMZ to the Santa Ana River (i.e. annual underflow past the CCWF) and determine whether Hydraulic Control has been achieved. The new Maximum Benefit Monitoring Program Work Plan was adopted by the Regional Board in April 2014. Maximum benefit monitoring is incorporated as part of the groundwater level, groundwater quality, and surface water monitoring programs described in Program Element 1. During this reporting period, Watermaster continued implementing the monitoring programs (see Program Element 1 of this report for details).

**Hydraulic Control and Chino Desalters.** One of the main maximum-benefit commitments is to achieve and maintain "Hydraulic Control" of the Chino Basin through operation of the Chino Basin Desalters to protect downstream beneficial uses of the Santa Ana River. The Chino Basin Desalters are required to replace the diminishing agricultural production that previously prevented the outflow of high TDS and nitrate groundwater. Hydraulic Control is defined by the Basin Plan as the elimination of groundwater discharge from the Chino-North GMZ to the Santa Ana River or its reduction to a de minimus level. In October 2011, the Regional Board indicated that groundwater discharge from the Chino-North GMZ to the Prado Basin surface water management zone (Prado Basin) in an amount less than 1,000 acre-feet per year is considered de minimus. Watermaster and the IEUA have demonstrated, in Annual Reports to the Regional Board, that complete Hydraulic Control has been achieved at and east of Chino-I Desalter Well 5. The construction and operation of the CCWF (see Program Element 5), which began in 2010, is intended to achieve Hydraulic Control in the area west of Chino-I Desalter Well 5. In February 2016, the CCWF commenced full-scale operation with production at wells I-16, I-17, I-20, and I-21. The CCWF wells produced a total of about 1,665 acre-feet in 2016, which is more than the model-estimated production needed to achieve Hydraulic Control to the de minimus standard west of Chino-I Desalter Well 5. With this accomplishment, Watermaster has achieved full Hydraulic Control of the Chino Basin.



Santa Ana River

## Program Element 7: Develop and Implement a Salt Management Program (Continued)

Although full Hydraulic Control has been achieved, future agricultural groundwater production in the southern part of the basin is expected to continue to decline, necessitating future expansion of the desalters to sustain Hydraulic Control. In a letter dated January 23, 2014, the Regional Board required that by May 31, 2014, Watermaster and the IEUA submit a plan detailing how Hydraulic Control will be sustained in the future as agricultural production in the southern region of Chino-North continues to decrease—specifically, how the Chino Basin Desalters will achieve the required total groundwater production level of 40,000 acre-feet per year. On June 30, 2015 Watermaster and the IEUA submitted a final plan and schedule for the construction and operation of the three new desalter wells. These wells are under construction. During this reporting period, Watermaster coordinated with the CDA to track the progress of construction of the desalter expansion facilities. A full status report on the desalter expansion facilities is described in this status report under Program Element 3.

**Recycled Water Recharge.** The maximum benefit commitments require Watermaster and the IEUA to construct and operate expanded facilities for the recharge of storm and recycled waters and to report on the quality of the individual and combined sources of water used for recharge. Commitment number 7 requires that the use of recycled water for artificial recharge be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve five-year running-average concentrations of no more than the maximum-benefit objectives (420 mg/L for TDS and 5 mg/L for nitrate-nitrogen). This data is compiled and analyzed each year for reporting to the Regional Board. During this reporting period, Watermaster and the IEUA continued their monitoring programs to collect the data required for analysis and reporting to the Regional Board.

**Recycled Water Quality**. Commitment number 6 requires that recycled water quality be managed to ensure that the agency-wide, 12-month running average wastewater effluent quality does not exceed 550 mg/L and 8 mg/L for TDS and total inorganic nitrogen (TIN), respectively. Watermaster and the IEUA must submit a plan and schedule to the Regional Board for the implementation of measures to ensure long-term compliances with these limits when either the 12-month running-average IEUA agency-wide effluent TDS concentration exceeds 545 mg/L for three consecutive months, or the TIN concentration exceeds 8 mg/L in any one month. During 2015, a historical-high 12-month running-average IEUA agency-wide effluent TDS concentration of 534 mg/L was calculated for three consecutive months: June, July and August. This 12-month running-average IEUA agency-wide effluent TDS concentration of 534 mg/L was only 11 mg/L below the trigger. In Winter 2015, the increasing trend reversed, and by December 2016, the 12-month running-average IEUA agency-wide effluent TDS concentration decreased to 504 mg/L. Through analysis of water supply and wastewater data, Watermaster and the IEUA concluded that drought conditions have a meaningful impact on the short-term TDS concentration of the water supplies available to the IEUA agencies and that future droughts similar to the 2012-2016 period could lead to short term exceedances of the 12-month running-average IEUA agency-wide effluent TDS. For this reason, in October 2016, Watermaster and the IEUA petitioned the Regional Board to consider modifying the TDS compliance metric for recycled water to a longer-term averaging period. The Regional Board agreed that an evaluation of the compliance metric is warranted and directed Watermaster and the IEUA to develop a technical scope of work to support the adoption of a longer-term averaging period. The proposed technical scope of work to support a Basin Plan amendment to revise the recycled water compliance metric was submitted to the Regional Board for approval in May 2017, and after approval the work began in September 2017. During this reporting period, Watermaster and the IEUA continued implementing the scope of work, which included building a numerical fate-and-transport model to simulate future changes in TDS and nitrate concentrations in the Chino Basin under alternative salinity management plans. The technical work is scheduled to be completed in April 2019. The Basin Plan amendment is scheduled to be completed by December 2019.

**Ambient Water Quality.** Commitment number 9 requires that Watermaster and the IEUA recompute ambient TDS and nitrate concentrations for the Chino Basin and Cucamonga GMZs every three years. The recomputation of ambient water quality is performed for the entire Santa Ana River Watershed, and the technical work is contracted, managed, and directed by the Santa Ana Watershed Project Authority's Basin Monitoring Program Task Force. Watermaster and the IEUA have participated in each triennial, watershed-wide ambient water quality determination as members of the Task Force. The most recent recomputation, covering the 20-year period from 1993 to 2015, was completed in September 2017.

## Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program

Groundwater storage is critical to the Chino Basin stakeholders. The OBMP outlines Watermaster's commitments to investigate the technical and management implications of Local Storage Agreements, improve related policies and procedures, and then revisit all pending Local Storage Agreement applications.

## Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program (Continued)

The existing Watermaster/IEUA/MWDSC/Three Valleys Municipal Water District Dry-Year Yield (DYY) program continues to be implemented. By April 30, 2011, all DYY program construction projects and a full "put" and "take" cycle had been completed, leaving the DYY storage account with a zero balance. Another DYY cycle began in June 2017. During the reporting period 5,586 acre-feet of water was recharged through the DYY program.

### *Safe Yield Recalculation*

The Basin's Safe Yield was initially set by the Judgment at 140,000 acre-feet per year. The Safe Yield was based in on the hydrology for the period of 1965 through 1974. Pursuant to the Judgment, the Chino Basin Safe Yield is to be recalculated periodically but not for at least ten years following 1978. Pursuant to the OBMP Implementation Plan and Watermaster's Rules and Regulations, in year 2010/11 and every ten years thereafter, Watermaster is to recalculate the Safe Yield. The 2011 Safe Yield recalculation was to be based in part on the information obtained in the prior ten-year period.

In 2011, Watermaster authorized its staff to compile the necessary data and update the model of the basin and to recalculate the Safe Yield. The model calibration was completed in 2012, and the evaluation of Safe Yield began in 2013. During fiscal year 2014/15, the Watermaster Parties, pursuant to the Watermaster Board's direction, met intensively in a facilitated process, resulting in a majority consensus regarding the implementation of the recalculated Safe Yield, and drafted the 2015 Safe Yield Reset Agreement. At its September 24, 2015 meeting, the Board adopted Resolution 2015-06, endorsing the 2015 Safe Yield Reset Agreement, and directed Watermaster legal counsel to file the Agreement with the Court. Resolution 2015-06 was adopted by a majority vote with two of the nine Board members opposing the action. The agreement was filed with the Court on October 23, 2015 with a motion recommending that the Court reset the Safe Yield of the Chino Basin to 135,000 acre-feet per year. The hearing on this motion was originally scheduled for December 18, 2015. The Court continued the hearing and conducted it on September 23, 2016; the Court heard oral arguments from various parties and Watermaster legal counsel, requested further briefing from the interested parties, and scheduled a hearing in early 2017. On April 28, 2017, the Court issued a final order, resetting the Safe Yield to 135,000 acre-feet per year. By late June 2017, some parties had filed notices of appeal to the Court's order. During the reporting period the parties have continued to work together to resolve their legal challenges in adapting to the change in Safe Yield.

### *Groundwater Storage Management*

**Addendum to PEIR.** The OBMP storage management plan was temporarily revised in March 2017. The original OBMP storage management program consists of managing groundwater production, replenishment, recharge, and storage such that the total storage within the basin would range from a low of 5,300,000 acre-feet to a high of 5,800,000 acre-feet. The following storage-related definitions are included in the OBMP Implementation Plan:

- Operational Storage Requirement – The Operational Storage Requirement is the storage or volume in the Chino Basin that is necessary to maintain the Safe Yield. [Author's note: This is an average value with the storage oscillating around this value due to dry and wet periods in precipitation. The Operational Storage Requirement was estimated in the development of the OBMP to be about 5.3 million acre-feet. This storage value was set at the estimated storage in the basin in 1997.]
- Safe Storage – Safe Storage is an estimate of the maximum storage in the basin that will not cause significant water-quality and high-groundwater related problems. [Author's note: Safe storage was estimated in the development of the OBMP to be about 5.8 million acre-feet.]
- Safe Storage Capacity – Safe Storage Capacity is the difference between the Safe Storage and the Operational Storage Requirement. The allocation and use of storage space in excess of the Safe Storage Capacity will preemptively require mitigation; mitigation must be defined, and resources committed to mitigation prior to allocation and use.

Water occupying the Safe Storage Capacity includes Local Storage Account Water, Carryover Water, and water that was anticipated to be stored in future groundwater storage programs. This storage management program was evaluated in the OBMP programmatic environmental impact report (PEIR) in 2000.

Subsequent to the OBMP PEIR, Watermaster and the parties developed revisions to the OBMP based on: new monitoring and borehole data collected since 1998, an improved hydrogeologic conceptualization of the basin, new numerical models that have improved the understanding of basin hydrology since 2000, and the need to expand the Chino Basin Desalters (desalters) to the 40,000 acre-feet per year of groundwater production required in the OBMP Implementation Plan. These investigations included a

## Program Element 8: Develop and Implement a Groundwater Storage Management Program; and Program Element 9: Develop and Implement a Storage and Recovery Program (Continued)

recalculation of the total water in storage in the basin, based on the improved hydrogeologic understanding. The total storage in the Chino Basin for 2000 was estimated to be about 5,935,000 acre-feet.

The Peace II Agreement was negotiated by the parties to implement, among other things, the expansion of the desalters, the dedication of 400,000 acre-feet of groundwater in storage to desalter replenishment, and changes in the Judgment to implement the Peace II Agreement. However, there was no change to the storage management plan in the OBMP Implementation Plan even though the revised storage estimated for 2000 was greater than the Safe Storage and the implementation of the Peace II Agreement would result in 400,000 acre-feet of new controlled overdraft. The IEUA completed and subsequently adopted a supplemental environmental impact report (SEIR) for the Peace II Agreement in 2010.

There is a significant difference in what is known today regarding storage management and basin conditions compared to what was known in 2000 when the OBMP storage management plan was developed and evaluated in the PEIR. Watermaster and the IEUA proposed a temporary change in the Safe Storage Capacity, increasing it from 500,000 acre-feet to 600,000 acre-feet for the period July 1, 2017 through June 30, 2021. This temporary increase in Safe Storage Capacity was found to not cause MPI and/or loss of Hydraulic Control, and it will provide Watermaster and the IEUA time to develop a new storage management plan and agreements to implement it. The IEUA adopted an addendum to the 2000 PEIR, increasing the Safe Storage Capacity from 500,000 acre-feet to 600,000 acre-feet for the period July 1, 2017 through June 30, 2021. The addendum was approved by the IEUA Board of Directors on March 15, 2017.

**Storage Framework Investigation.** Watermaster staff, at the direction of the Watermaster Board, began an investigation to assess the groundwater basin response to the planned use of Managed Storage (storage space used by the Watermaster Parties that includes carryover, excess carryover, and local supplemental waters) and potential storage and recovery plans. In the prior reporting period, Watermaster updated its modeling tools and planning projections, and subsequently completed an assessment of potential MPI for the parties use of Managed Storage. In that work, it was determined that the Watermaster Parties' water use/pumping projections showed that the Managed Storage would likely use up to 700,000 acre-feet of storage space for Managed Storage and the use of that storage space would not result in MPI through 2050. In the current reporting period, Watermaster evaluated the use of storage space in the range of 700,000 acre-feet to 1,000,000 acre-feet. The results of this assessment were presented in three workshops in January, March and May. In the next reporting period Watermaster will prepare draft and final reports to document this work and conduct a final workshop.



**Randy Lee, P.E.**
Executive Manager of Operations / Assistant GM

**Peter Kavounas, P.E.**
General Manager

August 15, 2018

Regional Water Quality Control Board, Santa Ana Region
**Attention: Ms. Hope Smythe**
3737 Main Street, Suite 500
Riverside, California 92501-3348

**Subject: Chino Basin Recycled Water Groundwater Recharge Program: Quarterly Monitoring Report for April through June 2018**

Dear Ms. Smythe,

Inland Empire Utilities Agency and Chino Basin Watermaster hereby submit the *Quarterly Monitoring Report* for the second quarter of 2018 (2Q18), April 1 through June 30, 2018, for the *Chino Basin Recycled Water Groundwater Recharge Program*. This document is submitted pursuant to requirements in Order No. R8-2007-0039. All required monitoring and reporting for the quarter are presented in the attached report. During 2Q18, the Groundwater Recharge Program was in compliance with all monitoring and reporting requirements as specified in the Order.

Chino Basin Watermaster hereby certifies that, during the period of April 1 through June 30, 2018, there was no reported pumping for drinking water purposes in the buffer zones extending 500 feet laterally and 6 months underground travel time from each of the recharge sites using recycled water, namely 8th Street, Banana, Brooks, Declez, Ely, Hickory, RP3, San Sevaine, Turner, and Victoria Basins. In point of fact, there are no domestic or municipal production wells in the buffer zones of the aforementioned recharge sites.

**DECLARATION**

*I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments thereto; and that, based on my inquiry of the individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.*

Executed on the 15th day of August in the Cities of Chino and Rancho Cucamonga.

for Randy Lee, P.E.
*Executive Manager of Operations/*
*Assistant General Manager*

Peter Kavounas, P.E.
*General Manager*

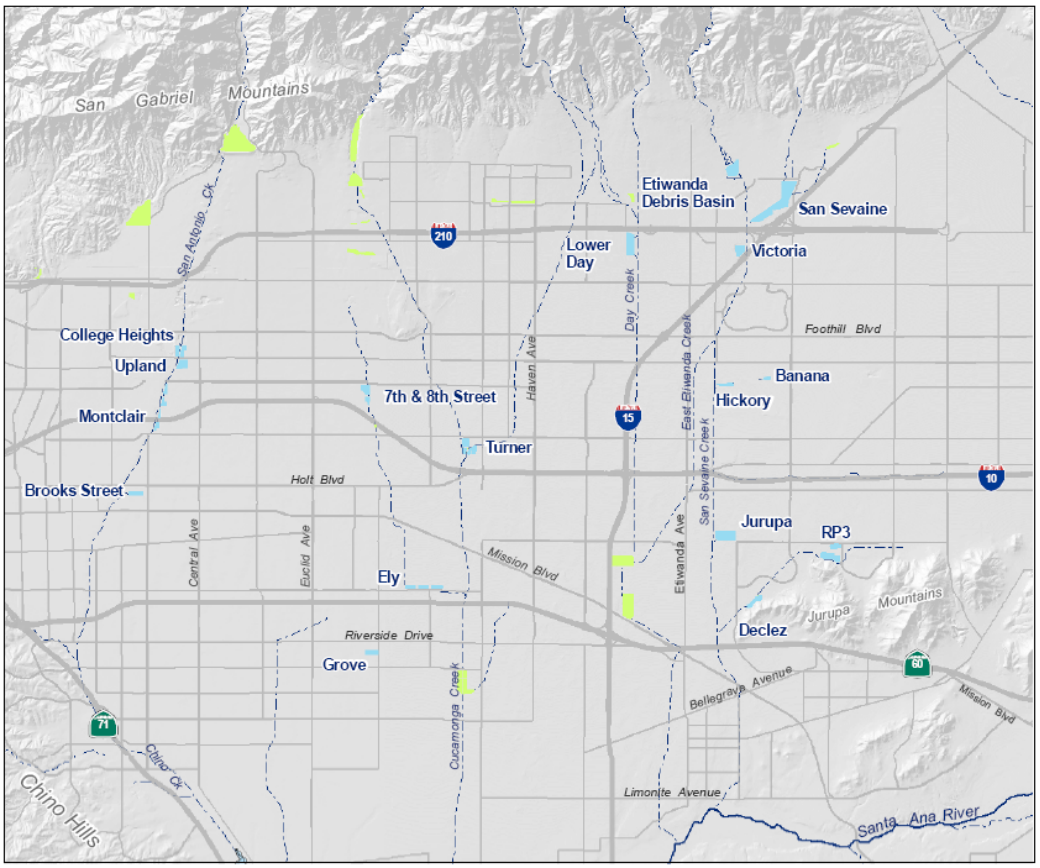
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# Chino Basin Recycled Water Groundwater Recharge Program

## Quarterly Monitoring Report

**April 1 through June 30, 2018**




*Prepared by:*

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

August 15, 2018

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# 1. Introduction

Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster (Watermaster), Chino Basin Water Conservation District, and San Bernardino County Flood Control District are partners in the implementation of the Chino Basin Recycled Water Groundwater Recharge Program. This is part of a comprehensive water supply program to enhance water supply reliability and improve the groundwater quality in local drinking water wells throughout the Chino Groundwater Basin by increasing the recharge of stormwater, imported water and recycled water. This program is an integral part of Watermaster's Optimum Basin Management Plan (OBMP).

## A. Order No. R8-2007-0039

On June 29, 2007, the Santa Ana Regional Water Quality Control Board (Regional Board) adopted Order No. R8-2007-0039 (Order) which prescribes the requirements for recycled water use for groundwater recharge in 13 recharge sites within the Chino-North Groundwater Management Zone. The locations of recharge basins in the Chino Basin Groundwater Recharge Program are shown in Figure 1-1.

As a provision of this Order, IEUA and Watermaster must also comply with Monitoring and Reporting Program No. R8-2007-0039 (MRP). The MRP includes the water quality monitoring requirements of the Chino Basin Recycled Water Groundwater Recharge Program and the requirement for the submittal of quarterly and annual reports. This document is the quarterly report for the second quarter of 2018 (2Q18).

The quarterly report includes the following elements as prescribed in the MRP:

- Monitoring results for recycled water (including lysimeter monitoring), diluent water, and groundwater.
- Recycled water and diluent water volumes recharged at each basin.
- Reporting of any non-compliance events due to water quality, including records of any operational problems, plant upset and equipment breakdowns or malfunctions, and any diversion(s) of off-specification recycled water and the location(s) of final disposal. All corrective or preventive action(s) taken.
- Certification that no groundwater has been pumped for domestic water supply use from the buffer zone that extends 500 feet and 6-months underground travel time from the recharge basin(s) where recycled water is applied.

## B. Order No. R8-2009-0057

On October 23, 2009, the Regional Board adopted Order No. R8-2009-0057, which amended the recharge permit (Order No. R8-2007-0039) by extending the previously 60-month averaging period to 120 months for determining a recharge site's recycled water contribution (RWC). The Order No. R8-2009-0057 also allowed a fraction of the groundwater underflow of the Chino Basin aquifers to be used as a source of diluent water when calculating the running average RWC.

## C. Revised Monitoring & Reporting Program No. R8-2007-0039

On October 27, 2010, the Regional Board revised Monitoring and Reporting Program No. R8-2007-0039 (MRP) based on requests for modifications from IEUA and approved by the State Water Resources Control Board – Division of Drinking Water (DDW, formerly California Department of Public Health). The following changes were made to the MRP:

1) Sampling Requirements A.3, A.4, and A.5 were modified by specifying that samples shall be collected on a representative day instead of the 10$^{th}$ day.

2) Groundwater Monitoring Program Requirement V.1. was modified by adding a sentence to the paragraph that allows IEUA to analyze the groundwater samples collected on a quarterly basis from non-active municipal drinking water wells for dissolved metals, instead of total recoverable metals.

3) Reporting Requirement VI.B.3.b. was modified and footnote No. 18 was added to reflect that IEUA uses groundwater monitoring information contained in the *State of the Basin* report prepared on a biennial basis by the Chino Basin Watermaster, amongst other sources, for the annual determination of the recycled water groundwater flow path.

### D. Title 22, Division 4, Chapter 3. Article 5.1 §60320.100

On June 18, 2014, the DDW adopted new regulations pertaining to Groundwater Replenishment Reuse Projects (GRRP), which can be found in Title 22 California Code of Regulations, Division 4, Chapter 3. Article 5.1 "Indirect Potable Reuse: Groundwater Replenishment - Surface Application" found in Sections §60320.100 through 60320.130. Pursuant to the new GRRP regulations, additional monitoring and reporting began in 3Q15.

### E. Outline of the Quarterly Report

Section 2 of this quarterly report discusses the water quality monitoring results for recycled water recharge (water recycling plant effluent, distribution system, basin surface water, and lysimeter data), diluent water, and groundwater. Section 3 provides an overview of recharge operations including the volume of diluent water and recycled water recharged. Section 4 describes any operational problems and preventive and/or corrective actions taken. Section 5 contains the certification of non-pumping in the 500-foot buffer zones around each basin. Section 6 is a brief overview of the Monte Vista Water District's (MVWD) Aquifer Storage and Recovery (ASR) project.

## 2. Monitoring Results

### A. Recycled Water: RP-1 and RP-4

The requirements for recycled water monitoring are described in the MRP. Tables 2-1 through 2-4 include all of the requisite 2Q18 data.

Recycled Water Specifications A.5 through A.9 in the Order are the narrative limits established in the permit. The corresponding monitoring data used to determine compliance with the Order are presented in Tables 2-1 and 2-2. This data is typically collected from samples of RP-1 and RP-4 effluent; however, recycled water compliance with the total nitrogen (TN) limit of 5 mg/L (Specification A.7) can also be met at the lysimeters (Table 2-5a) or at locations specified in alternative monitoring plans (Table 2-5b, and discussed in further detail in Section 2.B). During 2Q18, there were no exceedances of the TN limit.

Recycled Water Specifications A.1 through A.4 of the Order are numerical limits based on the EPA's primary maximum contaminant levels (MCLs), secondary MCLs, and Action Levels. Recycled Water Specification A.15 is a numerical limit for oil and grease. The corresponding monitoring data used to determine compliance with these specifications in the Order are presented in Table 2-3. Due to the volume of samples required for laboratory analyses, IEUA selected, and DDW approved, a sampling point along the recycled water distribution pipeline as the compliance point for the numerical limits. IEUA selected the turnout to NRG California South, LP (formerly Reliant Energy) as representative of the system blend of recycled water used for recharge.

In the Order, compliance for all constituents with MCLs or Action Levels is based on a 4-quarter running average (Recycled Water Specifications A.1 through A.4). Table 2-3 summarizes the 4-quarter running

average concentration data for each parameter from 3Q17 through 2Q18, and lists the corresponding limits for compliance.

There were no exceedances for the parameters analyzed during 2Q18, this includes the following categories: primary MCLs for inorganic chemicals, volatile organic compounds (VOCs), non-volatile synthetic organic chemicals (SOCs), radionuclides, and disinfection byproducts; action levels for lead and copper; secondary MCLs for required constituents; and oil and grease.

Although NRG turnout is a suitable sampling location for most constituents, it is not appropriate for Total Trihalomethanes (TTHMs), Total Haloacetic Acids (HAA5), and 1,2,3-Trichloropropane (1,2,3-TCP). Compliance samples for these compounds are taken from lysimeters or monitoring wells at basins actively receiving recycled water. At these locations, the samples better represent the compounds present in the recycled water prior to reaching the groundwater table, as the concentrations of these constituents change through the recharge process. Once a quarter, a representative sample is collected from a selected compliance lysimeter/monitoring well and analyzed for these compounds. For the 2Q18 sampling for these three compounds, IEUA chose the 25-foot below ground surface lysimeter at the Brooks Basin (BRK-LYS-25) as the compliance point. The Brooks Basin lysimeter was selected as the compliance point because the basin received consistent recycled water recharge and recycled water was present at the 25-foot depth based on electrical conductivity (EC) measurements.

For constituents with no specified limits, quarterly monitoring data are summarized in Table 2-4. All required constituents were analyzed in 2Q18.

Please note that there are several constituents highlighted in purple that are part of Attachment A in the draft State Water Resources Control Board – Division of Water Quality (DWQ) Policy for Water Quality Control for Recycled Water (RW Policy). The 2018 Science Advisory Panel presented their CEC monitoring recommendations in a report titled "Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water" that included:

- Removing five chemicals from the list of targeted chemistry monitoring requirements (17β-estradiol, caffeine, iopromide, N-N Diethyl-meta-toluamide (DEET), and triclosan);
- Adding four chemicals to the list of targeted chemistry monitoring requirements (1,4-dioxane, N-nitrosomorpholine (NMOR), iohexol, sulfamethoxazole)

The draft amendment to the RW Policy was released for public comment in May 9, 2018. Public comment letters were submitted by June 26, 2018. An adoption date for the amendment has not yet been announced.

### B. Recycled Water: Basin and Lysimeter Samples

Total organic carbon (TOC) and nitrogen species sampling and analyses are performed weekly or monthly at lysimeters at some basins when recycled water is being delivered, for the determination of compliance with Recycled Water Specifications A.7 and A.9 of the Order. EC is also measured and reported to assist in identifying the presence of recycled water at various depths in the vadose zone. Basin and lysimeter water quality results from 2Q18 are summarized in Table 2-5a. The table includes surface water data for Banana, Brooks, and Hickory Basin and lysimeter data at the 25-foot depth at Brooks Basin. Most compliance sampling for TOC and TN of the recycled water at each basin is analyzed using alternative monitoring plans (Section 2.C), and not lysimeter data. Currently, the only lysimeter monitoring data used to access TN and TOC compliance is the TN sampling at the Brooks Basin 25-foot lysimeter (BRK-LYS-25). This lysimeter is only sampled monthly due to slow travel times to the lysimeter. There were no exceedances of TN during 2Q18, at this compliance lysimeter.

## C. Recycled Water: Alternative Monitoring Plans for TOC and TN

As indicated in Recycled Water Compliance Determination B.5 and B.6 of the Order, alternative monitoring plans to the lysimeter-based compliance sampling for TOC and TN under Recycled Water Specifications A.7 and A.9 can be established upon development of a soil-aquifer treatment factor using recharge demonstration studies. The alternative monitoring plans can be determined in the basin Start-up Period Reports or First Year Operations Reports. The alternative TOC and TN monitoring plans approved by the Regional Board and DDW include alternative monitoring locations that include: sampling at a recycled water distribution turnout with the application of a correction factor; monitoring at one basin lysimeter; and/or monitoring at a basin monitoring well. The following are the alternative monitoring plans for each basin:

- Banana Basin: Sampling at the NRG turnout with a correction factor of 80 percent for TOC and 37 percent for TN (added to Table 2-5b in 2Q18 because alternative monitoring plan was located in the First Year Operations Report for Banana Basin prepared by WEI & IEUA in September 2007)
- Hickory Basin: Sampling at the NRG turnout with a correction factor of 81 percent for TOC and 27 percent for TN (added to Table 2-5b in 2Q18 because alternative monitoring plan was located in the First Year Operations Report for Hickory Basins prepared by WEI & IEUA in October 2007)
- Turner Basins 1 & 2: Sampling at the NRG turnout with a correction factor of 70 percent for TOC and 87 percent for TN
- Turner Basins 3 & 4: Sampling at the NRG turnout with a correction factor of 85 percent for TOC and 87 percent for TN
- Ely Basins: Sampling RP-1 recycled water with a correction factor of 76 percent for TOC and 52 percent for TN
- RP3 Basin: Sampling at the NRG turnout with a correction factor of 88 percent for TOC and 31 percent for TN
- 8$^{th}$ Street Basin: Sampling at the NRG turnout with a correction factor of 88 percent for TOC and 75 percent for TN
- San Sevaine 5 Basin: Sampling at the NRG turnout with a correction factor of 78 percent for TOC and 69 percent for TN (removed from Table 2-5b in 2Q18 because this site has not received recycled water since 2014)
- Victoria Basin: Sampling at the NRG turnout with a correction factor of 78 percent for TOC and 82 percent for TN
- Brooks Basin: Sampling at the 25-foot lysimeter is the compliance point for TN, and sampling at well BRK-1/1 is the compliance point for TOC

The TOC and TN values calculated based on the alternative monitoring locations and the application of these correction factors listed above are summarized in Table 2-5b. Some of these correction factors and locations for the compliance sampling have been modified since the basin's startup reports. These changes are described below.

In June 2015, the DDW issued a letter that approved the request for 50% RWC for most of the GWR basins, with the exception of RP3, San Sevaine 5, and Turner Basins. The letter stated that based on the data that was provided: "For most of the recharge basins, the data does show an increasing amount of EC and chloride in the mound monitoring wells over time, indicating that recycled water is reaching the mound. Corresponding TOC data from the mound monitoring wells also show a consistent TOC level of

less than 1.0 mg/L when recycled water is present; therefore, increasing the RWC limit to 50 percent for some basins is justified."

Starting 1Q17, the TOC reduction factor was amended to align with the DDW's evaluation and allowance for a 50% RWC at 8th Street Basin. Mound monitoring well data (2008-2016) was used to calculate percent reduction in place of the available lysimeter data used in the start-up period report.

During 2Q18, there were no exceedances of TOC and TN at the basins that have implemented alternative monitoring plans.

Table 2-6 is a compliance summary table for RWC, TOC average, and TN compliance. It includes the following: when the basin started receiving recycled water, when the startup period was completed, the RWC limit, the current RWC, the current TOC average limit (based on Recycled Water Specification A.10), the calculated monthly TOC averages, compliance with the TN limit, and recharged water monitoring plans for TOC and TN.

### D. Diluent Water

In addition to recycled water recharge, the two other water sources are imported water and stormwater / local runoff; these two types of water are considered diluent water. Imported water and stormwater / local runoff must be sampled quarterly in accordance with the DDW-approved Diluent Water Monitoring Plan.

Details on the methods used to measure daily diluent water flow and diluent water monitoring schedule can be found in the Diluent Water Monitoring Plan. The quarterly sampling schedule for stormwater and local runoff is presented in Table 4-2 of the plan. Stormwater is sampled during the rainy season (1$^{st}$ and 4$^{th}$ quarters) and local runoff is sampled during the dry season (2$^{nd}$ and 3$^{rd}$ quarters). Samples are collected at about half the locations during each seasonal quarter, alternating between even and odd years. Table 5-1 of the plan summarizes the sample type and reporting frequency for the parameters listed in Tables I, II, III, and IV of the Diluent Water Monitoring requirement III.3 of the MRP. For 2Q18, diluent water quality sampling of local runoff was conducted during the month of June 2018. Table 2-7a lists the results of the local runoff sampling and analyses.

State Water Project water was delivered as diluent water to multiple basins during 2Q18. Table 2-7b lists the results from Metropolitan Water District's general mineral and physical analysis of source water from Silverwood Lake for the calendar months that imported water deliveries occurred.

### E. Groundwater Monitoring Wells

Monitoring is conducted at groundwater monitoring wells quarterly and annually to evaluate groundwater quality conditions in the vicinity of the recharge basins utilizing recycled water. Groundwater monitoring results can be used to assess background conditions, time the arrival of recharge waters, and the impact that recharged water has on downgradient water supplies. The wells in the monitoring well networks for Hickory and Banana, Turner, 8$^{th}$ Street, Ely, Brooks, RP3, San Sevaine, Victoria, and Declez Basins are summarized in Table 2-8, and presented on Figures 2-1 through 2-7, respectively. Groundwater quality samples are collected and tested quarterly for all constituents listed in Table 1 of Section V in the MRP R8-2007-0039, and annually for constituents specified in the Phase II Findings of Fact, Attachment A in the permit (Bullet 27 in the Conditions Section). The groundwater constituents analyzed from the monitoring wells during quarterly monitoring are presented in Table 2-9a.

Any 2Q18 sample which exceeded primary or secondary MCLs are shown in the table in bold italic font. The DDW is notified within 48 hours of receiving the results for primary MCL exceedances or coliform presence at active municipal drinking water wells. Exceedances of primary MCLs and coliform presence at non-drinking water monitoring wells and all secondary MCL exceedances are not reported to the DDW but are reported in the quarterly reports. Of note are the analyses for the following wells and constituents:

Turbidity exceeding the secondary MCL of 5 NTU was observed in eight monitoring wells, namely: RP3-1/1, 8TH-1/1, 8TH-1/2, BRK-1/1, BRK-2/1, Ely MW1, and DCZ-1/1. The secondary MCL for color of 15 units was exceeded at 8TH-1/1, BRK-2/1, Ely MW1, and DCZ-1/1.

TDS and EC were higher than their secondary MCLs of 500 mg/L and 900 µmhos/cm, respectively, in ALCOA MW3 and Ely MW2. Southridge JHS and ALCOA MW1 exceeded the secondary MCL for TDS. The wells south of the Ely Basins and near the RP3 Basins are located in areas where the TDS and EC concentrations in groundwater are historically elevated. The distribution of TDS concentrations observed at wells in the Chino Basin is summarized in Watermaster's State of the Basin Reports.

Some monitoring wells at the RP3, 8th Street, Brooks, and Ely monitoring well networks have nitrate as nitrogen ($NO_3$-N) concentrations above the primary MCL of 10 mg/L. The $NO_3$-N levels range from 10 to 30 mg/L and are characteristic of groundwater quality in these areas of the Chino Basin. The distribution of $NO_3$-N concentrations observed at wells in the Chino Basin is summarized in Watermaster's State of the Basin Reports. No notifications were made to the DDW as these high $NO_3$-N concentrations are comparable to the ambient $NO_3$-N concentration in groundwater for each monitoring well's respective groundwater management zone within the Chino Basin.

The current State of the Basin Report, which is the "Chino Basin Optimum Basin Management Program 2016 State of the Basin Report" published in June 2017 was prepared by Wildermuth Environmental for the CBWM. The 2016 State of the Basin report can be downloaded from CBWM's website, www.cbwm.org.

The 2014 GRRP regulations require two downgradient monitoring wells to be monitored quarterly for Priority Pollutants, and that the wells are located (A) no less than two weeks but no more than six months of travel through the unsaturated zone affected by the project, and (B) at least 30 days upgradient of the nearest drinking water well be monitored quarterly for Priority Toxic Pollutants. The table below shows the monitoring wells that meet the (A) and (B) criteria specified above. The priority pollutants analysis results for these downgradient monitoring wells are summarized in Table 2-9b.

| Basins | Monitoring Well (A) | Monitoring Well (B) |
|---|---|---|
| 8th Street | 8TH-1/2 | 8TH-2/1 |
| Banana & Hickory | BH-1/2 | Reliant Energy – East Well |
| Brooks | BRK-1/1 | BRK-2/1 |
| Ely | Ely MW1 | Ely MW2 |
| RP3 | RP3-1/1 | Southridge JHS |
| Turner | T-1/2 | T-2/2 |
| Victoria & San Sevaine | SS-1/1 & VCT-1/1 | VCT-2/1 |
| Declez | DCZ-1/1 | DCZ-2 |

## 3. Recharge Operations

IEUA's GWR staff records the daily volumes of water routed to all basins. The 8th Street, Banana, Brooks, Declez, Ely, Hickory, RP3, Turner, and Victoria Basins received recycled water this quarter. Table 3-1 lists the volumes of recycled water and diluent water (local runoff, stormwater, and/or imported water) captured during 2Q18 at the basins that have initiated recharge using recycled water.

Recycled water deliveries were initiated at Declez Basin on December 23, 2015. DDW staff was contacted on June 23, 2016 informing them of IEUA's intent to extend the start-up period for Declez Basin for an additional four months beyond the initial 180-day period in order to gather more data. The

request to extend the start-up period was due to winter rain events that resulted in the lysimeter EC data showing significant influence for stormwater. Recycled water deliveries to the Declez Basin were stopped on September 8, 2016 after it was deemed that enough data was collected for the start-up period evaluation. The Declez Basin Start-Up Period Report was submitted to the RWQCB and DDW in May 2018.

An alternative monitoring plan is proposed for Declez Basin for the first year of monitoring. With travel time approximately 30 days to the 25-foot lysimeter, the proposed plan is to sample the surface water and 25-foot lysimeter (DCZ-LYS-25) for TOC, TN, and EC every other week with resumed delivery of recycled water. With confirmation of SAT performance during the initial year, lysimeter monitoring would be replaced with monitoring from the delivery pipeline and TOC and TN SAT correction factors applied to results. Pipeline monitoring would then occur weekly during active delivery.

Recycled water deliveries to Declez Basin were re-initiated on April 25, 2018. The sampling of the surface water and DCZ-LYS-25 was inadvertently not implemented during 2Q18. The biweekly monitoring for TOC, TN, and EC will start in August 2018 and will be reported in the 3Q18 report.

## 4. Operational Problems & Preventive or Corrective Actions

No operational problems were encountered this quarter, therefore no corrective actions were necessary for the following: Regional Water Recycling Facilities - RP-1 & RP-4 and recharge operations.

## 5. Certification of Non-Pumping in the Buffer Zones

Watermaster has certified that there was no reported pumping of groundwater in 2Q18 for domestic or municipal use from the buffer zones that extend 500 feet and 6 months underground travel time from the 8$^{th}$ Street, Banana, Brooks, Declez, Ely, Hickory, RP3, San Sevaine, Turner, and Victoria Basins. In fact, there are no domestic or municipal production wells within the buffer zones of these aforementioned recharge sites.

IEUA continues to work with the San Bernardino County Department of Environmental Health Services (SBCDEHS) to prevent the drilling and construction of new drinking water wells within the buffer zones. SBCDEHS has initiated control over production well permitting within the buffer zones of all recharge sites through the use of buffer zone maps that utilize the same land coordinate system (Township/Range/Section/40-acre Parcel) that is used in the permitting process. SBCDEHS reviews new well permit applications, in part, by checking the proposed location of a new drinking water well against recharge basin location maps and parcel lists, both provided by IEUA. The maps and lists show township/range/section parcels (40-acre parcels) that abut recharge basins and their 500-foot buffers.

If a proposed well falls within an abutting parcel, SBCDEHS will review the well location using maps of the basins and buffer zones. If the well falls too near the buffer zone boundary for SBCDEHS to determine the relationship of the proposed well location to the buffer boundary, SBCDEHS will defer to IEUA for a prompt field review of the proposed well location. The field review may include contacting and having the well applicant identify the exact location of the proposed well casing. To conduct a detailed field review, SBCDEHS will contact and provide the IEUA Groundwater Recharge Coordinator with a copy of the well permit application and a timeline for the completion of IEUA's review. Following the review, IEUA will notify SBCDEHS of its findings in writing. IEUA will also notify the DDW and the Regional Board of well permit applications that it recommends should be declined due to well locations determined to fall with a 500-foot buffer zone.

## 6. MVWD ASR Project

Reporting for the Monte Vista Water District (MVWD) Aquifer Storage and Recovery (ASR) project was allowed by the Regional Board to be included under IEUA/Watermaster Phase I Groundwater Recharge Order No. R8-2005-0033 and subsequent permit updates. In April 2007, MVWD, Watermaster, and IEUA entered into an agreement to report the MVWD ASR project groundwater injection/recovery volumes and TIN/TDS mass balance in the recharge program quarterly reports. Initial injection began in June 2007. In September 2017, MVWD restarted injection activities for the first time since September 2011. The injection activities continued through May 2018. Table 6-1 summarizes the monthly volumes and TIN/TDS of injected and recovered water. The table also includes the mass balance of TIN/TDS from the injection-recovery cycles.

Table 2-1a
Recycled Water Monitoring: RP-1 & RP-4 Effluent Water Quality for April 2018
(Recycled Water Quality Specifications A.5, A.7, A.8, & A.9)

| | RP-1 Effluent | | | | | | | | | | RP-4 Effluent | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC [7] | TDS [3] | Hardness | Coliform [1,2,4] | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC | TDS [3] | Hardness | Coliform [1,2,4] |
| Unit | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL |
| Limits | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 |
| 04/01/18 | 0.5 | 6.1 | 4.6 | 5.2 | 4.6 | 6.9 | 705 | 490 | 148 | <1 | 0.4 | 3.5 | 4.3 | 4.3 | 4.3 | 6.9 | 794 | 448 | 139 | <1 |
| 04/02/18 | 0.5 | 6.2 | 5.3 | 5.9 | 5.3 | 6.8 | 705 | | | 1 | 0.4 | 3.5 | 4.5 | | 4.5 | 7.0 | 799 | | | <1 |
| 04/03/18 | 0.5 | 6.3 | 4.6 | 5.2 | 4.6 | 6.9 | 711 | | | <1 | 0.5 | 3.9 | 4.8 | | 4.8 | 6.8 | 796 | | | <1 |
| 04/04/18 | 0.5 | 6.5 | 3.7 | 4.3 | 3.7 | 6.9 | 743 | | | <1 | 0.5 | 4.7 | 4.5 | | 4.5 | 6.7 | 790 | | | <1 |
| 04/05/18 | 0.5 | 5.8 | 3.9 | 4.5 | 3.9 | 7.0 | 759 | | | <1 | 0.4 | 3.7 | 5.0 | | 5.0 | 6.8 | 784 | | | <1 |
| 04/06/18 | 0.5 | 6.6 | | | | 7.0 | 752 | | | <1 | 0.4 | 4.3 | | | | 6.8 | 770 | | | <1 |
| 04/07/18 | 0.5 | 6.0 | | | | 7.0 | 745 | | | <1 | 0.4 | 4.8 | | | | 6.8 | 766 | | | <1 |
| 04/08/18 | 0.5 | 5.9 | 3.5 | 4.1 | 3.5 | 7.0 | 718 | 462 | | <1 | 0.4 | 3.6 | 4.0 | 4.0 | 4.0 | 6.8 | 957 | 466 | | <1 |
| 04/09/18 | 0.5 | 6.2 | 3.5 | 4.1 | 3.5 | 7.0 | 702 | | | <1 | 0.6 | 5.0 | 3.6 | | 3.6 | 6.8 | 783 | | | <1 |
| 04/10/18 | 0.5 | 5.8 | 3.4 | 4.0 | 3.4 | 7.0 | 735 | | | <1 | 0.5 | 3.7 | 4.2 | | 4.2 | 6.8 | 755 | | | <1 |
| 04/11/18 | 0.6 | 5.6 | 3.6 | 4.2 | 3.6 | 7.0 | 772 | | | <1 | 0.5 | 3.5 | 4.5 | | 4.5 | 6.8 | 759 | | | <1 |
| 04/12/18 | 0.5 | 5.6 | 4.3 | 4.9 | 4.3 | 7.0 | 762 | | | <1 | 0.5 | 3.3 | 5.1 | | 5.1 | 6.8 | 756 | | | <1 |
| 04/13/18 | 0.5 | 6.0 | | | | 7.0 | 741 | | | 1 | 0.5 | 4.5 | | | | 6.8 | 761 | | | <1 |
| 04/14/18 | 0.5 | 6.2 | | | | 7.1 | 752 | | | 1 | 0.5 | 4.1 | | | | 6.8 | 769 | | | 1 |
| 04/15/18 | 0.5 | 5.4 | 4.3 | 4.9 | 4.3 | 7.1 | 725 | 454 | | 1 | 0.5 | 3.5 | 4.6 | 4.6 | 4.6 | 6.8 | 773 | 428 | | <1 |
| 04/16/18 | 0.6 | 5.5 | 4.4 | 5.0 | 4.4 | 7.0 | 689 | | | <1 | 0.5 | 3.5 | 4.4 | | 4.4 | 6.8 | 784 | | | <1 |
| 04/17/18 | 0.5 | 6.0 | 4.4 | 5.0 | 4.4 | 6.9 | 672 | | | <1 | 0.6 | 3.8 | 4.6 | | 4.6 | 6.8 | 795 | | | <1 |
| 04/18/18 | 0.5 | 5.7 | 3.7 | 4.3 | 3.7 | 6.9 | 666 | | | 1 | 0.7 | 3.6 | 5.4 | | 5.4 | 6.7 | 760 | | | <1 |
| 04/19/18 | 0.5 | 5.4 | 4.4 | 5.0 | 4.4 | 7.0 | 666 | | | <1 | 0.8 | 4.2 | 7.6 | | 7.6 | 6.7 | 755 | | | <1 |
| 04/20/18 | 0.5 | 5.8 | | | | 6.9 | 680 | | | <1 | 0.9 | 4.9 | | | | 6.7 | 767 | | | <1 |
| 04/21/18 | 0.5 | 6.3 | | | | 6.9 | 685 | | | <1 | 1.0 | 4.7 | | | | 6.6 | 770 | | | <1 |
| 04/22/18 | 0.5 | 6.1 | 4.3 | 4.9 | 4.3 | 7.0 | 665 | 472 | | <1 | 1.0 | 4.4 | 3.5 | 4.2 | 3.5 | 6.6 | 776 | 450 | | <1 |
| 04/23/18 | 0.5 | 6.0 | 4.7 | 5.3 | 4.7 | 6.9 | 662 | | | <1 | 1.0 | 4.0 | 3.1 | | 3.1 | 6.7 | 688 | | | <1 |
| 04/24/18 | 0.6 | 6.2 | 4.9 | 5.5 | 4.9 | 6.9 | 680 | | | <1 | 1.0 | 5.3 | 3.5 | | 3.5 | 6.8 | 722 | | | <1 |
| 04/25/18 | 0.6 | 6.2 | 4.9 | 5.5 | 4.9 | 6.8 | 694 | | | <1 | 0.9 | 4.0 | 4.2 | | 4.2 | 6.8 | 720 | | | <1 |
| 04/26/18 | 0.7 | 6.7 | 4.3 | 4.9 | 4.3 | 6.9 | 668 | | | <1 | 0.8 | 3.5 | 4.7 | | 4.7 | 6.8 | 710 | | | <1 |
| 04/27/18 | 0.7 | 6.7 | | | | 6.9 | 681 | | | <1 | 0.8 | 4.5 | | | | 6.8 | 648 | | | <1 |
| 04/28/18 | 0.7 | 6.8 | | | | 6.9 | 704 | | | <1 | 0.8 | 4.2 | | | | 6.8 | 653 | | | <1 |
| 04/29/18 | 1.0 | 6.8 | 4.4 | 5.0 | 4.4 | 6.9 | 665 | 466 | | <1 | 0.8 | 3.7 | 4.0 | 4.0 | 4.0 | 6.9 | 655 | 426 | | <1 |
| 04/30/18 | 0.9 | 6.4 | 4.1 | 4.7 | 4.1 | 6.9 | 662 | | | <1 | 0.9 | 3.7 | 3.7 | | 3.7 | 6.9 | 728 | | | <1 |
| Avg | 0.6 | 6.1 | 4.2 | 4.8 | 4.2 | 6.9 | 706 | 469 | 148 | <1 | 0.7 | 4.1 | 4.4 | 4.2 | 4.4 | 6.8 | 758 | 444 | 139 | <1 |
| Min | 0.5 | 5.4 | 3.4 | 4.0 | 3.4 | 6.8 | 662 | 454 | 148 | <1 | 0.4 | 3.3 | 3.1 | 4.0 | 3.1 | 6.6 | 648 | 426 | 139 | <1 |
| Max | 1.0 | 6.8 | 5.3 | 5.9 | 5.3 | 7.1 | 772 | 490 | 148 | 1 | 1.0 | 5.3 | 7.6 | 4.6 | 7.6 | 7.0 | 957 | 466 | 139 | 1 |

Note: **Bolded characters signify an exceedance of a permit limitation**

Blank cells indicate that analysis was not run for a constituent on that particular date. The data presented meets/exceeds the frequency of analysis specified under the discharge permit for these facilities.

[1] Turbidity and coliform must meet water quality standards for disinfected tertiary treated recycled water, as specified in NPDES No. CA8000409, Order No. R8-2009-0021.

[2] Turbidity limits: 2 NTU average daily; 5 NTU no more than 5% of day; 10 NTU at any time. Coliform limits: 2.2 MPN/100mL 7-day median; 23 MPN/100mL in no more than 1 sample per month; 240 MPN/100mL at any time.

[3] TDS and TIN limits are based on the 12-month running average of the combined effluent from all plants, which are presented in Table 2-2.

[4] Monthly average for coliform is based on "non-detect" values equal to 2. Determination of "less than" is dependent on the number of "non-detect" occurrences more than half the days in the month.

[5] TOC shall not exceed 16 mg/L for more than two consecutive samples and an average of the last 4 sample results. TOC compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[6] TN compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[7] These values based on continuous monitoring data generated by the Supervisory Control and Data Acquisition (SCADA) system.

Table 2-1b
Recycled Water Monitoring: RP-1 & RP-4 Effluent Water Quality for May 2018
(Recycled Water Quality Specifications A.5, A.7, A.8, & A.9)

| | RP-1 Effluent | | | | | | | | | | RP-4 Effluent | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC [7] | TDS [3] | Hardness | Coliform [1,2,4] | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC | TDS [3] | Hardness | Coliform [1,2,4] |
| Unit | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL |
| Limits | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 |
| 05/01/18 | 0.9 | 6.3 | 4.4 | 4.4 | 4.4 | 6.8 | 680 | | | 1 | 0.8 | 3.8 | 4.4 | | 4.4 | 6.9 | 714 | | | <1 |
| 05/02/18 | 0.7 | 6.2 | 4.7 | 4.7 | 4.7 | 6.9 | 670 | | | <1 | 0.8 | 3.8 | 5.4 | | 5.4 | 6.8 | 728 | | | <1 |
| 05/03/18 | 0.7 | 6.0 | 4.7 | 4.7 | 4.7 | 6.8 | 690 | | | <1 | 0.7 | 4.0 | 5.7 | | 5.7 | 6.8 | 753 | | | <1 |
| 05/04/18 | 0.7 | 7.2 | | | | 6.7 | 699 | | | 1 | 0.7 | 5.1 | | | | 6.8 | 774 | | | <1 |
| 05/05/18 | 0.7 | 6.7 | | | | 6.8 | 694 | | | <1 | 0.7 | 5.4 | | | | 6.8 | 787 | | | 40 |
| 05/06/18 | 0.7 | 6.7 | 4.1 | 4.1 | 4.1 | 6.8 | 677 | 472 | 147 | <1 | 0.7 | 4.1 | 3.4 | 4.1 | 3.4 | 6.8 | 827 | 478 | 137 | <1 |
| 05/07/18 | 0.7 | 6.6 | 5.0 | 5.0 | 5.0 | 6.9 | 668 | | | <1 | 0.8 | 4.3 | 3.1 | | 3.1 | 6.8 | 814 | | | <1 |
| 05/08/18 | 0.7 | 6.4 | 4.8 | 4.8 | 4.8 | 6.9 | 691 | | | <1 | 0.7 | 4.5 | 3.8 | | 3.8 | 6.8 | 809 | | | <1 |
| 05/09/18 | 0.7 | 6.6 | 4.7 | 4.7 | 4.7 | 6.9 | 700 | | | 1 | 0.7 | 4.1 | 4.7 | | 4.7 | 6.9 | 793 | | | <1 |
| 05/10/18 | 0.7 | 6.5 | 4.6 | 4.6 | 4.6 | 6.9 | 697 | | | <1 | 0.6 | 4.8 | 5.0 | | 5.0 | 6.9 | 819 | | | <1 |
| 05/11/18 | 0.8 | 7.2 | | | | 6.9 | 687 | | | <1 | 0.5 | 5.0 | | | | 6.9 | 807 | | | <1 |
| 05/12/18 | 0.8 | 6.8 | | | | 7.0 | 688 | | | 1 | 0.5 | 4.6 | | | | 6.9 | 815 | | | <1 |
| 05/13/18 | 0.7 | 6.6 | 5.4 | 5.4 | 5.4 | 7.0 | 676 | 472 | | <1 | 0.5 | 4.0 | 4.3 | 4.3 | 4.3 | 6.9 | 824 | 474 | | <1 |
| 05/14/18 | 0.6 | 6.6 | 5.1 | 5.1 | 5.1 | 6.9 | 657 | | | 1 | 0.5 | 4.4 | 3.7 | | 3.7 | 6.9 | 829 | | | 155 |
| 05/15/18 | 0.6 | 6.9 | 4.3 | 4.3 | 4.3 | 6.9 | 697 | | | <1 | 0.5 | 4.1 | 3.8 | | 3.8 | 6.9 | 821 | | | <1 |
| 05/16/18 | 0.8 | 6.6 | 3.2 | 3.2 | 3.2 | 6.8 | 714 | | | <1 | 0.5 | 3.9 | 4.6 | | 4.6 | 6.9 | 822 | | | <1 |
| 05/17/18 | 0.9 | 5.9 | 3.0 | 3.0 | 3.0 | 6.8 | 748 | | | <1 | 0.4 | 3.6 | 4.4 | | 4.4 | 6.9 | 824 | | | <1 |
| 05/18/18 | 0.8 | 7.2 | | | | 6.9 | 716 | | | 1 | 0.4 | 5.0 | | | | 6.9 | 814 | | | <1 |
| 05/19/18 | 0.7 | 6.4 | | | | 6.9 | 707 | | | <1 | 0.4 | 4.6 | | | | 6.9 | 823 | | | <1 |
| 05/20/18 | 0.6 | 5.9 | 4.1 | 4.1 | 4.1 | 6.9 | 679 | 482 | | <1 | 0.4 | 3.9 | 3.1 | 3.8 | 3.1 | 6.8 | 809 | 488 | | <1 |
| 05/21/18 | 0.7 | 6.2 | 4.0 | 4.0 | 4.0 | 7.0 | 661 | | | <1 | 0.5 | 4.1 | 2.9 | | 2.9 | 6.8 | 784 | | | <1 |
| 05/22/18 | 0.7 | 6.3 | 3.4 | 3.4 | 3.4 | 7.0 | 682 | | | 2 | 0.5 | 3.9 | 3.7 | | 3.7 | 6.8 | 818 | | | <1 |
| 05/23/18 | 0.7 | 6.5 | 3.3 | 3.3 | 3.3 | 7.1 | 675 | | | <1 | 0.5 | 3.6 | 4.1 | | 4.1 | 6.8 | 817 | | | <1 |
| 05/24/18 | 0.7 | 6.3 | 3.3 | 3.3 | 3.3 | 7.1 | 686 | | | 2 | 0.5 | 4.8 | 4.6 | | 4.6 | 6.8 | 811 | | | <1 |
| 05/25/18 | 0.7 | 7.6 | | | | 7.0 | 705 | | | <1 | 0.5 | 5.2 | | | | 6.8 | 816 | | | <1 |
| 05/26/18 | 0.7 | 7.1 | | | | 7.1 | 706 | | | <1 | 0.5 | 5.2 | | | | 6.8 | 810 | | | <1 |
| 05/27/18 | 0.6 | 7.0 | | | | 7.1 | 685 | | | <1 | 0.5 | 5.3 | | | | 6.8 | 819 | | | <1 |
| 05/28/18 | 0.7 | 7.4 | 3.7 | 3.7 | 3.7 | 7.0 | 661 | | | <1 | 0.5 | 5.3 | 3.4 | | 3.4 | 6.8 | 822 | | | <1 |
| 05/29/18 | 0.8 | 6.5 | 3.7 | 3.7 | 3.7 | 7.0 | 713 | | | <1 | 0.5 | 3.9 | 3.0 | | 3.0 | 6.8 | 812 | | | <1 |
| 05/30/18 | 0.8 | 6.7 | 3.8 | 3.8 | 3.8 | 7.0 | 833 | 484 | | <1 | 0.5 | 3.3 | 3.3 | | 3.3 | 6.8 | 803 | 462 | | <1 |
| 05/31/18 | 0.8 | 6.2 | 3.4 | 3.4 | 3.4 | 6.9 | 860 | | | <1 | 0.5 | 3.8 | 4.2 | | 4.2 | 6.9 | 779 | | | <1 |
| Avg | 0.7 | 6.6 | 4.1 | 4.1 | 4.1 | 6.9 | 700 | 478 | 147 | <1 | 0.6 | 4.4 | 4.0 | 4.1 | 4.0 | 6.8 | 803 | 476 | 137 | <7 |
| Min | 0.6 | 5.9 | 3.0 | 3.0 | 3.0 | 6.7 | 657 | 472 | 147 | <1 | 0.4 | 3.3 | 2.9 | 3.8 | 2.9 | 6.8 | 714 | 462 | 137 | <1 |
| Max | 0.9 | 7.6 | 5.4 | 5.4 | 5.4 | 7.1 | 860 | 484 | 147 | 2 | 0.8 | 5.4 | 5.7 | 4.3 | 5.7 | 6.9 | 829 | 488 | 137 | 155 |

Note: **Bolded characters signify an exceedance of a permit limitation**

Blank cells indicate that analysis was not run for a constituent on that particular date. The data presented meets/exceeds the frequency of analysis specified under the discharge permit for these facilities.

[1] Turbidity and coliform must meet water quality standards for disinfected tertiary treated recycled water, as specified in NPDES No. CA8000409, Order No. R8-2009-0021.

[2] Turbidity limits: 2 NTU average daily; 5 NTU no more than 5% of day; 10 NTU at any time. Coliform limits: 2.2 MPN/100mL 7-day median; 23 MPN/100mL in no more than 1 sample per month; 240 MPN/100mL at any time.

[3] TDS and TIN limits are based on the 12-month running average of the combined effluent from all plants, which are presented in Table 2-2.

[4] Monthly average for coliform is based on "non-detect" values equal to 2. Determination of "less than" is dependent on the number of "non-detect" occurrences more than half the days in the month.

[5] TOC shall not exceed 16 mg/L for more than two consecutive samples and an average of the last 4 sample results. TOC compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[6] TN compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[7] These values based on continuous monitoring data generated by the Supervisory Control and Data Acquisition (SCADA) system.

Table 2-1c
Recycled Water Monitoring: RP-1 & RP-4 Effluent Water Quality for June 2018
(Recycled Water Quality Specifications A.5, A.7, A.8, & A.9)

| | RP-1 Effluent | | | | | | | | | | RP-4 Effluent | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC [7] | TDS [3] | Hardness | Coliform [1,2,4] | Turbidity [1,2,7] | TOC | $NO_3$-N | TN | TIN [3] | pH [7] | EC | TDS [3] | Hardness | Coliform [1,2,4] |
| Unit | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL | NTU | mg/L | mg/L | mg/L | mg/L | unit | µhmo/cm | mg/L | mg/L | mpn/100mL |
| Limits | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 | 2;5;10 | 16 [5] | | 5 [6] | | 6<pH<9 | | | | 2.2;23;240 |
| 06/01/18 | 0.8 | 6.5 | | | | 7.0 | 863 | | | <1 | 0.5 | 5.2 | | | | 6.8 | 798 | | | <1 |
| 06/02/18 | 0.8 | 6.4 | | | | 7.0 | 850 | | | <1 | 0.5 | 4.7 | | | | 6.8 | 796 | | | <1 |
| 06/03/18 | 0.8 | 5.8 | 3.8 | 3.8 | 3.8 | 7.0 | 839 | 474 | 145 | <1 | 0.5 | 3.8 | 3.2 | 3.8 | 3.2 | 6.8 | 792 | 472 | 128 | <1 |
| 06/04/18 | 0.9 | 6.7 | 3.7 | | 3.7 | 7.0 | 805 | | | <1 | 0.5 | 4.1 | 3.0 | | 3.0 | 6.8 | 812 | | | <1 |
| 06/05/18 | 0.9 | 5.9 | 3.5 | | 3.5 | 7.0 | 749 | | | <1 | 0.5 | 3.6 | 3.2 | | 3.2 | 6.9 | 778 | | | <1 |
| 06/06/18 | 0.9 | 5.9 | 3.3 | | 3.3 | 7.0 | 668 | | | <1 | 0.5 | 6.3 | 3.8 | | 3.8 | 6.8 | 767 | | | <1 |
| 06/07/18 | 0.9 | 9.5 | 3.3 | | 3.3 | 7.0 | 667 | | | <1 | 0.4 | 1.6 | 4.8 | | 4.8 | 6.8 | 813 | | | <1 |
| 06/08/18 | 0.9 | 6.9 | | | | 6.9 | 687 | | | <1 | 0.4 | 5.4 | | | | 6.8 | 806 | | | <1 |
| 06/09/18 | 0.8 | 6.0 | | | | 6.9 | 711 | | | <1 | 0.4 | 5.4 | | | | 6.8 | 802 | | | <1 |
| 06/10/18 | 0.7 | 6.6 | 3.7 | 3.7 | 3.7 | 6.9 | 695 | 502 | | <1 | 0.5 | 5.1 | 2.9 | 2.9 | 2.9 | 6.8 | 809 | 494 | | <1 |
| 06/11/18 | 0.7 | 5.6 | 3.8 | | 3.8 | 6.9 | 664 | | | <1 | 0.5 | 4.5 | 2.9 | | 2.9 | 6.8 | 791 | | | <1 |
| 06/12/18 | 0.7 | 5.8 | 3.5 | | 3.6 | 7.0 | 668 | | | <1 | 0.5 | 5.0 | 3.0 | | 3.0 | 6.8 | 786 | | | <1 |
| 06/13/18 | 0.7 | 6.3 | 2.7 | | 2.7 | 7.0 | 688 | | | <1 | 0.4 | 5.2 | 3.8 | | 3.8 | 6.8 | 780 | | | <1 |
| 06/14/18 | 0.8 | 6.0 | 2.7 | | 2.7 | 7.0 | 684 | | | <1 | 0.4 | 4.6 | 3.6 | | 3.6 | 6.8 | 774 | | | <1 |
| 06/15/18 | 0.8 | 5.7 | | | | 7.0 | 686 | | | <1 | 0.4 | 4.7 | | | | 6.8 | 768 | | | <1 |
| 06/16/18 | 0.7 | 5.9 | | | | 7.0 | 675 | | | <1 | 0.4 | 4.7 | | | | 6.8 | 737 | | | <1 |
| 06/17/18 | 0.7 | 5.8 | 4.3 | 4.3 | 4.3 | 7.0 | 656 | 470 | | <1 | 0.4 | 4.7 | 3.2 | 3.2 | 3.2 | 6.9 | 770 | 440 | | <1 |
| 06/18/18 | 0.8 | 6.7 | 4.6 | | 4.6 | 6.9 | 646 | | | <1 | 0.4 | 5.2 | 3.2 | | 3.2 | 6.9 | 757 | | | <1 |
| 06/19/18 | 0.8 | 6.8 | 4.3 | | 4.4 | 6.8 | 677 | | | <1 | 0.4 | 5.4 | 3.4 | | 3.5 | 6.8 | 747 | | | <1 |
| 06/20/18 | 1.0 | 6.8 | 4.1 | | 4.1 | 6.9 | 673 | | | <1 | 0.4 | 5.2 | 3.6 | | 3.6 | 6.8 | 737 | | | <1 |
| 06/21/18 | 1.0 | 6.3 | 4.8 | | 4.9 | 6.9 | 661 | | | <1 | 0.4 | 5.7 | 3.7 | | 3.8 | 6.8 | 736 | | | <1 |
| 06/22/18 | 1.0 | 6.6 | | | | 6.9 | 651 | | | <1 | 0.4 | 5.3 | | | | 6.8 | 737 | | | <1 |
| 06/23/18 | 1.0 | 6.9 | | | | 7.0 | 644 | | | <1 | 0.5 | 5.2 | | | | 6.8 | 740 | | | <1 |
| 06/24/18 | 1.0 | 6.7 | 5.6 | 5.7 | 5.7 | 6.9 | 638 | 458 | | <1 | 0.5 | 5.4 | 2.6 | 3.4 | 2.7 | 6.8 | 737 | 450 | | <1 |
| 06/25/18 | 0.9 | 6.4 | 6.0 | | 6.0 | 6.9 | 628 | | | <1 | 0.6 | 5.0 | 2.7 | | 2.7 | 6.8 | 743 | | | <1 |
| 06/26/18 | 0.9 | 6.7 | 5.0 | | 5.0 | 6.9 | 659 | | | <1 | 0.5 | 5.1 | 2.9 | | 2.9 | 6.8 | 770 | | | <1 |
| 06/27/18 | 1.0 | 6.7 | 4.6 | | 4.6 | 6.9 | 669 | | | <1 | 0.5 | 5.1 | 3.2 | | 3.2 | 6.8 | 778 | | | <1 |
| 06/28/18 | 1.0 | 6.1 | 5.0 | | 5.0 | 6.9 | 685 | | | <1 | 0.5 | 5.1 | 3.6 | | 3.6 | 6.8 | 760 | | | <1 |
| 06/29/18 | 0.9 | 6.6 | | | | 6.9 | 678 | | | <1 | 0.4 | 5.0 | | | | 6.8 | 755 | | | <1 |
| 06/30/18 | 0.9 | 6.3 | | | | 6.9 | 667 | | | <1 | 0.4 | 4.7 | | | | 6.8 | 765 | | | <1 |
| Avg | 0.9 | 6.4 | 4.1 | 4.4 | 4.1 | 6.9 | 694 | 476 | 145 | <1 | 0.5 | 4.9 | 3.3 | 3.3 | 3.3 | 6.8 | 771 | 464 | 128 | <1 |
| Min | 0.7 | 5.6 | 2.7 | 3.7 | 2.7 | 6.8 | 628 | 458 | 145 | <1 | 0.4 | 1.6 | 2.6 | 2.9 | 2.7 | 6.8 | 736 | 440 | 128 | <1 |
| Max | 1.0 | 9.5 | 6.0 | 5.7 | 6.0 | 7.0 | 863 | 502 | 145 | <1 | 0.6 | 6.3 | 4.8 | 3.8 | 4.8 | 6.9 | 813 | 494 | 128 | <1 |

Note: **Bolded characters signify an exceedance of a permit limitation**

Blank cells indicate that analysis was not run for a constituent on that particular date. The data presented meets/exceeds the frequency of analysis specified under the discharge permit for these facilities.

[1] Turbidity and coliform must meet water quality standards for disinfected tertiary treated recycled water, as specified in NPDES No. CA8000409, Order No. R8-2009-0021.

[2] Turbidity limits: 2 NTU average daily; 5 NTU no more than 5% of day; 10 NTU at any time. Coliform limits: 2.2 MPN/100mL 7-day median; 23 MPN/100mL in no more than 1 sample per month; 240 MPN/100mL at any time.

[3] TDS and TIN limits are based on the 12-month running average of the combined effluent from all plants, which are presented in Table 2-2.

[4] Monthly average for coliform is based on "non-detect" values equal to 2. Determination of "less than" is dependent on the number of "non-detect" occurrences more than half the days in the month.

[5] TOC shall not exceed 16 mg/L for more than two consecutive samples and an average of the last 4 sample results. TOC compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[6] TN compliance can be met at a point prior to reaching the regional groundwater table, including lysimeters.

[7] These values based on continuous monitoring data generated by the Supervisory Control and Data Acquisition (SCADA) system.

Table 2-2
Recycled Water Monitoring: Agency-Wide Flow-Weighted TIN & TDS (mg/L)
(Recycled Water Quality Specifications A.6)

| | TIN | | TDS | |
|---|---|---|---|---|
| Date | **Monthly** | **12-Mo. Run Avg.** | **Monthly** | **12-Mo. Run Avg.** |
| Jul-17 | 6.8 | 6.0 | 447 | 480 |
| Aug-17 | 6.0 | 6.0 | 446 | 476 |
| Sep-17 | 5.7 | 5.9 | 440 | 471 |
| Oct-17 | 6.1 | 6.0 | 428 | 466 |
| Nov-17 | 6.5 | 6.0 | 455 | 463 |
| Dec-17 | 6.8 | 6.0 | 444 | 459 |
| Jan-18 | 5.3 | 6.0 | 464 | 456 |
| Feb-18 | 5.3 | 5.9 | 488 | 456 |
| Mar-18 | 4.4 | 5.8 | 504 | 459 |
| Apr-18 | 5.0 | 5.8 | 485 | 460 |
| May-18 | 4.8 | 5.7 | 495 | 463 |
| Jun-18 | 4.7 | 5.6 | 490 | 465 |
| Avg | 5.6 | 5.9 | 465 | 465 |
| Min | 4.4 | 5.6 | 428 | 456 |
| Max | 6.8 | 6.0 | 504 | 480 |
| Limit | | 8.0 | | 550 |

Date source: IEUA NPDES monthly self-monitoring report (MRP No. R8-2009-0021).
Per the Regional Board, TDS is calculated using the flow-weighted averages based on discharged effluent flows and recycled water flows; TIN is calculated using the flow-weighted averages based on discharged effluent flows only.
The data reported above will supersede any information submitted for previous quarters. Agency-wide TIN & TDS were in compliance with permit limits at all times.

Table 2-3
Recycled Water Monitoring: Primary & Secondary Maximum Contaminant Levels
(Recycled Water Quality Specifications A.1, A.2, A.3, & A.15)

| Constituent | 3Q17 | 4Q17 | 1Q18 | 2Q18 | 4Q Run. Avg.[1] | Limit | Unit | Method |
|---|---|---|---|---|---|---|---|---|
| Inorganic Chemicals | | | | | | | | |
| Aluminum | 79 | 63 | 62 | 80 | 71 | 1000 | µg/L | EPA 200.8 |
| Antimony | <1 | <1 | <1 | <1 | <1 | 6 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | <2 | <2 | 10 | µg/L | EPA 200.8 |
| Asbestos | NA | <0.18 | <0.78 | <0.2 | <0.78 | 7 | MFL | EPA 100.2 |
| Barium | 11 | 9 | 7 | 12 | 10 | 1000 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 4 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | 5 | µg/L | EPA 200.8 |
| Chromium | 1.0 | 1.0 | 1.3 | 1.4 | 1.2 | 50 | µg/L | EPA 200.8 |
| Chromium VI [2] | 0.25 | 0.19 | 0.18 | 0.20 | 0.21 | 10 | µg/L | EPA 218.6 |
| Cyanide | <20 | <0.02 | <0.02 | <0.02 | <20 | 150 | µg/L | SM 4500-CN E |
| Fluoride | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 2 | mg/L | SM 4500-F C |
| Mercury | <0.05 | <0.5 | <0.5 | <0.5 | <0.39 | 2 | µg/L | EPA 245.2 |
| Nickel | 3 | 3 | 2 | 3 | 3 | 100 | µg/L | EPA 200.8 |
| Perchlorate | <4 | <4 | <4 | <4 | <4 | 6 | µg/L | EPA 314/331.0 |
| Selenium | <2 | <2 | <2 | <2 | <2 | 50 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | <1 | 2 | µg/L | EPA 200.8 |
| Volatile Organic Chemicals (VOCs) | | | | | | | | |
| Benzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1 | µg/L | EPA 524.2/624 |
| Carbon Tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2/624 |
| 1,2-Dichlorobenzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 600 | µg/L | EPA 524.2/624 |
| 1,4-Dichlorobenzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2/624 |
| 1,1-Dichloroethylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 6 | µg/L | EPA 524.2/624 |
| cis-1,2-Dichloroethylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 6 | µg/L | EPA 524.2/624 |
| trans-1,2-Dichloroethylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 10 | µg/L | EPA 524.2/624 |
| Dichloromethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| 1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2/624 |
| Ethylbenzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 300 | µg/L | EPA 524.2/624 |
| Monochlorobenzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 70 | µg/L | EPA 524.2/624 |
| Methyl-tert-butyl ether | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 13 | µg/L | EPA 524.2/624 |
| Styrene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 100 | µg/L | EPA 524.2/624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1 | µg/L | EPA 524.2/624 |
| Tetrachloroethylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| Toluene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 150 | µg/L | EPA 524.2/624 |
| 1,2,4-Trichlorobenzene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| 1,1,1-Trichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 200 | µg/L | EPA 524.2/624 |
| 1,1,2-Trichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| Trichloroethylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2/624 |
| Trichlorofluoromethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 150 | µg/L | EPA 524.2/624 |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1200 | µg/L | EPA 524.2/624 |
| Vinyl Chloride | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2/624 |
| m,p-Xylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1750 [3] | µg/L | EPA 524.2/624 |
| o-Xylene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | µg/L | EPA 524.2/624 |
| 1,2,3-Trichloropropane (added 7/17)[4] | <0.005 | 0.012 | 0.008 | <0.005 | 0.006 | 0.005 | µg/L | CASRL 524M-TCP |
| Non-Volatile Synthetic Organic Chemicals (SOCs) | | | | | | | | |
| Alachlor (Alanex) | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 2 | µg/L | EPA 505 |
| Atrazine | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 1 | µg/L | EPA 525.2 |
| Bentazon | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 18 | µg/L | EPA 515.4 |
| Benzo(a)pyrene | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.2 | µg/L | EPA 525.2 |
| Carbofuran | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 18 | µg/L | EPA 531.2 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | µg/L | EPA 505 |
| 2,4-D | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 70 | µg/L | EPA 515.4 |
| Dalapon | 6 | 5 | 7 | 6 | 6 | 200 | µg/L | EPA 515.4 |
| Dibromochloropropane | 0.023 | 0.04 | <0.01 | 0.04 | <0.01 | 0.2 | µg/L | EPA 504.1 |
| Di(2-ethylhexyl)adipate | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | 400 | µg/L | EPA 525.2 |
| Di(2-ethylhexyl)phthalate | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | 4 | µg/L | EPA 525.2 |
| Dinoseb | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 7 | µg/L | EPA 515.4 |
| Diquat | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | 20 | µg/L | EPA 549.2 |
| Endothall | <5 | <5 | <5 | <5 | <5 | 100 | µg/L | EPA 548.1 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 2 | µg/L | EPA 505 |

Table 2-3
Recycled Water Monitoring: Primary & Secondary Maximum Contaminant Levels
(Recycled Water Quality Specifications A.1, A.2, A.3, & A.15)

| Constituent | 3Q17 | 4Q17 | 1Q18 | 2Q18 | 4Q Run. Avg.[1] | Limit | Unit | Method |
|---|---|---|---|---|---|---|---|---|
| Ethylene Dibromide | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.05 | µg/L | EPA 504.1 |
| Glyphosate | <6 | <6 | <25 | <6 | <25 | 700 | µg/L | EPA 547 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | µg/L | EPA 505 |
| Heptachlor Epoxide | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | µg/L | EPA 505 |
| Hexachlorobenzene | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 1 | µg/L | EPA 525.2 |
| Hexachlorocyclopentadiene | 0.06 | <0.05 | <0.05 | <0.05 | <0.05 | 50 | µg/L | EPA 525.2 |
| Lindane | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.2 | µg/L | EPA 505 |
| Methoxychlor | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 30 | µg/L | EPA 505 |
| Molinate | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 20 | µg/L | EPA 525.2 |
| Oxamyl | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 50 | µg/L | EPA 531.2 |
| Pentachlorophenol | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | 1 | µg/L | EPA 515.4 |
| Picloram | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 500 | µg/L | EPA 515.4 |
| PCB 1016 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | 0.5 | µg/L | EPA 505 |
| PCB 1221 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1232 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1242 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1248 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1254 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1260 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| Simazine | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 4 | µg/L | EPA 525.2 |
| Thiobencarb | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 70 | µg/L | EPA 525.2 |
| Toxaphene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 3 | µg/L | EPA 505 |
| 2,3,7,8-TCDD (Dioxin) | <2.45 | <5 | <5 | <5.12 | <5 | 30 | pg/L | EPA 1613 |
| 2,4,5-TP (Silvex) | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 50 | µg/L | EPA 515.4 |
| Action Level Chemicals | | | | | | | | |
| Copper | 4.8 | 5.8 | 6.0 | 4.8 | 5.4 | 1300 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 15 | µg/L | EPA 200.8 |
| Radionuclides | | | | | | | | |
| Combined Radium-226 and Radium 228 | <0.34 | <0.39 | <0.39 | <0.17 | <0.44 | 5 | pCi/L | EPA 903.0 |
| Gross Alpha Particle Activity | <3 | <3 | <3 | <3 | <3 | 15 | pCi/L | EPA 900.0/SM7110C |
| Tritium | <326 | <398 | <347 | <271 | <577 | 20,000 | pCi/L | EPA 906 |
| Strontium-90 | <1.48 | <1.17 | <1.05 | <1.53 | <1.48 | 8 | pCi/L | EPA 905 |
| Gross Beta Particle Activity | 14 | 15 | 15 | 14 | 15 | 50 | pCi/L | EPA 900.0 |
| Uranium | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | 20 | pCi/L | EPA 200.8 |
| Secondary Maximum Contaminant Level Chemicals | | | | | | | | |
| Aluminum | 79 | 63 | 62 | 80 | 71 | 200 | µg/L | EPA 200.8 |
| Copper | 4.8 | 5.8 | 6.0 | 4.8 | 5.4 | 1000 | µg/L | EPA 200.8 |
| Corrosivity [5] | -0.5 (Non-Cor.) | -0.7 (Non-Cor.) | -0.3 (Non-Cor.) | -0.6 (Non-Cor.) | Non-Cor. | Non-Cor. | SI | SM 2330B |
| Foaming Agents (MBAS) [5] | <0.1 | <0.1 | 0.13 | <0.1 | <0.1 | 0.5 | mg/L | S5540C/EPA 425.1 |
| Iron [5] | 68 | NR | NR | NR | 46 | 300 | µg/L | EPA 200.7 |
| Manganese | 15 | 15 | 23 | 21 | 19 | 50 | µg/L | EPA 200.8 |
| Methyl-tert-butyl ether (MTBE) [5] | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| Odor--Threshold [5] | 2 | 2 | NA | 2 | 2 | 3 | TON | SM 2150B |
| Silver | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | 100 | µg/L | EPA 200.8 |
| Thiobencarb | <0.2 | <0.2 | <0.5 | <0.2 | <0.5 | 1 | µg/L | EPA 525.2 |
| Zinc | 31 | 31 | 30 | 32 | 31 | 5000 | µg/L | EPA 200.8 |
| Miscellaneous Regulated Constituents | | | | | | | | |
| Oil & Grease [6] | <1 | <1 | <1 | | <1 | 1 | mg/L | EPA 1664 |
| Disinfection Byproducts | | | | | | | | |
| Bromate | 1 | 1 | <1 | <1 | 1 | 10 | µg/L | EPA 300.1/317 |
| Chlorite | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 1 | mg/L | EPA 300.0 |
| | BRK-LYS-25 | BRK-LYS-25 | BH-1/2 | BRK-LYS-25 | <==TTHMs | | | |
| | BRK-LYS-25 | BRK-LYS-25 | BH-1/2 | BRK-LYS-25 | <==HAA5 | | | |
| | BRK-LYS-25 | BRK-LYS-25 | BH-1/2 | BRK-LYS-25 | <==1,2,3-TCP | | | |
| Alternative Compliance Point Data | 3Q17 | 4Q17 | 1Q18 | 2Q18 | | | | |
| Total Trihalomethanes (TTHMs) | <2 | <2 | 18 | <2 | <6 | 80 | µg/L | EPA 524.2/624 |
| Total Haloacetic Acids (HAA5) | <2 | <2 [7] | <2 | <2 | <2 | 60 | µg/L | S6251B |
| 1,2,3-Trichloropropane (added 7/17) [4] | <0.005 | <0.005 [7] | <0.005 | <0.005 | <0.005 | 0.005 | µg/L | CASRL 524M-TCP |

NR: Not required this quarter NA: Not Analyzed; Missed hold time for odor.

[1] 4-quarter running average is calculated based on ND values equal to half the detection limit. The reported 4-quarter running average value, if less than DL, will be based on highest DL found in the data set.

[2] As of September 11, 2017 the MCL for hexavalent chromium that was established in 2014 is no longer in effect; the State Board does plan on establishing a new MCL in the near future.

[3] The sum of m,p-Xylene and o-Xylene is used to calculate compliance for the Total Xylenes limit

[4] 1,2,3-Trichloropropane compliance is based on a 4-quarter running average of lysimeter samples collected prior to reaching the groundwater table

[5] 4-quarter running average is calculated based on the four most recent results. Monitoring is required annually. However, if monitoring takes place more frequently than required, those results will be reported.

[6] Oil & Grease compliance determination not based on 4-quarter running average

[7] Makeup sample collected on 2/6/18 for HAA5 and 1,2,3-TCP, for a quality control failure at the contract lab during 4Q17.

**Bold signifies an exceedance of a limit in the Order. Explained in further detail in the report text.**

Table 2-4
Recycled Water Monitoring: Remaining Priority Pollutants, EDCs & Pharmaceuticals, and Unregulated Chemicals
(Monitoring & Reporting Program)

| Constituent | 2Q18 | Unit | Method |
|---|---|---|---|
| **Metals** | | | |
| Chromium (III) [1] | 1.4 | µg/L | EPA 200.8 |
| **Volatile Organic Chemicals (VOCs)** | | | |
| Acrolein | NR | µg/L | EPA 624 |
| Acrylonitrile | NR | µg/L | EPA 624 |
| Bromoform | <0.5 | µg/L | EPA 524.2/624 |
| Chlorodibromomethane | 5.3 | µg/L | EPA 524.2/624 |
| Chloroethane | <0.5 | µg/L | EPA 524.2/624 |
| 2-Chloroethylvinylether | NR | µg/L | EPA 524.2/624 |
| Chloroform | 107 | µg/L | EPA 524.2/624 |
| Dichlorobromomethane | 24 | µg/L | EPA 524.2/624 |
| Methyl Bromide | <0.5 | µg/L | EPA 524.2/624 |
| Methyl Chloride | <0.5 | µg/L | EPA 524.2/624 |
| **Acid Extractibles** | | | |
| 2-Chlorophenol | NR | µg/L | EPA 625 |
| 2,4-Dichlorophenol | NR | µg/L | EPA 625 |
| 2,4-Dimethylphenol | NR | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | NR | µg/L | EPA 625 |
| 2,4-Dinitrophenol | NR | µg/L | EPA 625 |
| 2-Nitrophenol | NR | µg/L | EPA 625 |
| 4-Nitrophenol | NR | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | NR | µg/L | EPA 625 |
| Phenol | NR | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | NR | µg/L | EPA 625 |
| **Base/Neutral Extractibles** | | | |
| Acenaphthene | NR | µg/L | EPA 625 |
| Acenaphthylene | NR | µg/L | EPA 625 |
| Anthracene | NR | µg/L | EPA 625 |
| Benzidine | NR | µg/L | EPA 625 |
| Benzo(a)anthracene | NR | µg/L | EPA 625 |
| Benzo(b)fluoranthene | NR | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | NR | µg/L | EPA 625 |
| Benzo(k)fluoranthene | NR | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | NR | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | NR | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | NR | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | NR | µg/L | EPA 625 |
| Butyl benzyl phthalate | NR | µg/L | EPA 625 |
| 2-Chloronaphthalene | NR | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | NR | µg/L | EPA 625 |
| Chrysene | NR | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | NR | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | NR | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | NR | µg/L | EPA 625 |
| Diethyl phthalate | NR | µg/L | EPA 625 |
| Dimethyl phthalate | NR | µg/L | EPA 625 |
| Di-n-butyl phthalate | NR | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | NR | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | NR | µg/L | EPA 625 |
| Di-n-octyl phthalate | NR | µg/L | EPA 625 |
| Azobenzene | NR | µg/L | EPA 625 |
| Fluoranthene | NR | µg/L | EPA 625 |
| Fluorene | NR | µg/L | EPA 625 |
| Hexachlorobutadiene | NR | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | NR | µg/L | EPA 625 |
| Hexachloroethane | NR | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | NR | µg/L | EPA 625 |
| Isophorone | NR | µg/L | EPA 625 |
| Naphthalene | NR | µg/L | EPA 625 |
| Nitrobenzene | NR | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | NR | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | NR | µg/L | EPA 625 |
| Phenanthrene | NR | µg/L | EPA 625 |
| Pyrene | NR | µg/L | EPA 625 |

[1] Trivalent chromium is measured as total chromium

NR: Not Required (Annual Requirement)

| Constituent | 2Q18 | Unit | Method |
|---|---|---|---|
| **Pesticides** | | | |
| Aldrin | <0.01 | µg/L | EPA 505/608 |
| BHC, alpha isomer | <0.1 | µg/L | EPA 525/608 |
| BHC, beta isomer | <0.1 | µg/L | EPA 525/608 |
| BHC, delta isomer | <0.1 | µg/L | EPA 525/608 |
| 4,4'-DDT | <0.1 | µg/L | EPA 525/608 |
| 4,4'-DDE | <0.1 | µg/L | EPA 525/608 |
| 4,4'-DDD | <0.1 | µg/L | EPA 525/608 |
| Dieldrin | <0.01 | µg/L | EPA 505/608 |
| Endosulfan I | <0.1 | µg/L | EPA 525/608 |
| Endosulfan II | <0.1 | µg/L | EPA 525/608 |
| Endosulfan Sulfate | <0.1 | µg/L | EPA 525/608 |
| **Unregulated Chemicals** | | | |
| Endrin Aldehyde | <0.1 | µg/L | EPA 525/608 |
| Ethyl tertiary butyl ether | <0.5 | µg/L | EPA 524.2 |
| Tertiary amyl methyl ether | <0.5 | µg/L | EPA 524.2 |
| **Chemicals w/ State Notification Levels (NLs)** | | | |
| Boron | 0.3 | mg/L | EPA 200.7 |
| n-butylbenzene | <0.5 | µg/L | EPA 524.2 |
| sec-butylbenzene | <0.5 | µg/L | EPA 524.2 |
| tert-butylbenzene | <0.5 | µg/L | EPA 524.2 |
| Carbon disulfide | <0.5 | µg/L | EPA 524.2 |
| Chlorate | 380 | µg/L | EPA 300.0 |
| 2-Chlorotoluene | <0.5 | µg/L | EPA 524.2 |
| 4-Chlorotoluene | <0.5 | µg/L | EPA 524.2 |
| Diazinon | <0.1 | µg/L | EPA 525.2 |
| Dichlorodifluoromethane (Freon 12 | <0.5 | µg/L | EPA 524.2 |
| 1,4 - Dioxane | <1 | µg/L | EPA 522 |
| Ethylene glycol | <4 | mg/L | EPA 8015B |
| Formaldehyde | 46 | µg/L | EPA 556 |
| HMX | <0.4 | µg/L | EPA 8330B |
| Isopropylbenzene | <0.5 | µg/L | EPA 524.2 |
| Methyl isobutyl ketone (MIBK) | <2 | µg/L | EPA 524.2 |
| N-Nitrosodiethylamine (NDEA) | <2 | ng/L | EPA 521 |
| N-nitrosodimethylamine (NDMA) | 4.7 | ng/L | EPA 521 |
| Propachlor | <0.05 | µg/L | EPA 525.2 |
| N-propylbenzene | <0.5 | µg/L | EPA 524.2 |
| RDX | <0.4 | µg/L | EPA 8330B |
| Tertiary butyl alcohol | <2 | µg/L | EPA 524.2 |
| 1,2,4–trimethylbenzene | <0.5 | µg/L | EPA 524.2 |
| 1,3,5-trimethylbenzene | <0.5 | µg/L | EPA 524.2 |
| 2,4,6-Trinitrotoluene | <0.4 | µg/L | EPA 8330B |
| Vanadium | <5 | µg/L | EPA 200.8 |
| **Endocrine Disrupting Chemicals, Pharmaceuticals and Other Chemicals[2]** | | | |
| Acetominophen | <5 | ng/L | LC-MS-MS |
| Bis Phenol A (BPA) | <10 | ng/L | LC-MS-MS |
| Caffeine | <10 | ng/L | LC-MS-MS |
| Carbamazepine | 89 | ng/L | LC-MS-MS |
| DEET | 42 | ng/L | LC-MS-MS |
| Estradiol | <5 | ng/L | LC-MS-MS |
| Estrone | <5 | ng/L | LC-MS-MS |
| Ethinyl Estradiol - 17 alpha | <5 | ng/L | LC-MS-MS |
| Gemfibrozil | <5 | ng/L | LC-MS-MS |
| Iohexol | 17000 | ng/L | LC-MS-MS |
| Iopromide | 290 | ng/L | LC-MS-MS |
| N-Nitrosomorphline | 8.4 | ng/L | EPA 521 |
| Primidone | 130 | ng/L | LC-MS-MS |
| Progesterone | <5 | ng/L | LC-MS-MS |
| Sucralose | 60000 | ng/L | LC-MS-MS |
| Sulfamethoxazole | <5 | ng/L | LC-MS-MS |
| Testosterone | <5 | ng/L | LC-MS-MS |
| Triclosan | <10 | ng/L | LC-MS-MS |
| Trimethoprim | <5 | ng/L | LC-MS-MS |
| Warfarin | <5 | ng/L | LC-MS-MS |

Proposed RW Policy Amendment List for GW Recharge - Surface Application

Table 2-5a
Lysimeter and Surface Water Monitoring: TOC, Nitrogen Species, and EC

| Banana Basin | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | Depth, bgs | Date | TOC (Limit = 16 mg/L) | TN* (Limit = 5 mg/L) | TIN | $NO_3$-N | TKN+$NO_2$-N | $NO_2$-N | EC |
| Unit==> | feet | mm/dd/yy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | µmho/cm |
| BNA-LYS-00 | 0 | 04/06/18 | 6.17 | 4.9 | 3.4 | 3.4 | 1.5 | <0.01 | 716 |
| BNA-LYS-00 | 0 | 04/11/18 | 8.31 | 6.6 | 3.0 | 3.0 | 3.6 | <0.01 | 750 |
| BNA-LYS-00 | 0 | 04/16/18 | 8.09 | 6.7 | 3.3 | 3.3 | 3.4 | <0.01 | 777 |
| BNA-LYS-00 | 0 | 04/27/18 | 5.82 | 5.0 | 3.0 | 3.0 | 2.0 | <0.01 | 676 |
| BNA-LYS-00 | 0 | 05/04/18 | 5.99 | 4.9 | 3.8 | 3.8 | 1.1 | <0.01 | 754 |
| BNA-LYS-00 | 0 | 05/09/18 | 7.08 | 6.0 | 4.2 | 4.1 | 1.9 | <0.01 | 786 |
| BNA-LYS-00 | 0 | 05/18/18 | 6.75 | 4.5 | 2.9 | 2.9 | 1.6 | <0.01 | 811 |
| BNA-LYS-00 | 0 | 05/23/18 | 6.67 | 4.2 | 2.7 | 2.7 | 1.5 | <0.01 | 808 |
| BNA-LYS-00 | 0 | 06/01/18 | 7.11 | 4.1 | 2.1 | 2.0 | 2.1 | <0.01 | 788 |
| BNA-LYS-00 | 0 | 06/06/18 | 7.33 | 3.1 | 1.3 | 1.3 | 1.8 | <0.01 | 777 |
| BNA-LYS-00 | 0 | 06/14/18 | 6.25 | 2.8 | 2.1 | 2.0 | 0.8 | <0.01 | 775 |
| BNA-LYS-00 | 0 | 06/18/18 | 5.39 | 3.0 | 1.7 | 1.7 | 1.3 | <0.01 | 822 |
| BNA-LYS-00 | 0 | 06/27/18 | 6.39 | 3.2 | 2.4 | 2.4 | 0.8 | <0.01 | 756 |

| Brooks Basin | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | Depth, bgs | Date | TOC (Limit = 16 mg/L) | TN* (Limit = 5 mg/L) | TIN | $NO_3$-N | TKN+$NO_2$-N | $NO_2$-N | EC |
| Unit==> | feet | mm/dd/yy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | µmho/cm |
| BRK-LYS-00 | 0 | 04/25/18 | 5.26 | 4.5 | 2.9 | 2.8 | 1.7 | 0.05 | 536 |
| BRK-LYS-00 | 0 | 05/24/18 | 6.33 | 3.7 | 1.9 | 1.9 | 1.8 | <0.01 | 623 |
| BRK-LYS-00 | 0 | 06/20/18 | 5.48 | 2.7 | 1.5 | 1.4 | 1.3 | 0.10 | 712 |
| BRK-LYS-25** | 25 | 04/25/18 | 2.96 | <0.6 | <0.2 | <0.1 | <0.5 | <0.01 | 554 |
| BRK-LYS-25** | 25 | 05/24/18 | 3.08 | <0.6 | <0.2 | <0.1 | <0.5 | <0.01 | 602 |
| BRK-LYS-25** | 25 | 06/20/18 | 3.09 | <0.6 | <0.2 | <0.1 | <0.5 | 0.10 | 611 |

| Hickory East Basin | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | Depth, bgs | Date | TOC (Limit = 16 mg/L) | TN* | TIN | $NO_3$-N | TKN+$NO_2$-N | $NO_2$-N | EC |
| Unit==> | feet | mm/dd/yy | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | µmho/cm |
| HKYE-LYS-00 | 0 | 04/06/18 | 6.61 | 1.8 | 0.9 | 0.8 | 1.0 | <0.01 | 386 |
| HKYE-LYS-00 | 0 | 04/11/18 | 5.84 | 2.9 | 2.0 | 2.0 | 0.9 | <0.01 | 680 |
| HKYE-LYS-00 | 0 | 04/16/18 | 6.75 | 3.6 | 2.2 | 2.0 | 1.6 | <0.01 | 731 |
| HKYE-LYS-00 | 0 | 04/27/18 | 5.87 | 2.6 | 1.5 | 1.4 | 1.2 | 0.05 | 608 |
| HKYE-LYS-00 | 0 | 05/04/18 | 6.03 | 2.0 | 0.9 | 0.9 | 1.1 | <0.01 | 684 |
| HKYE-LYS-00 | 0 | 05/09/18 | 5.83 | 2.2 | 1.3 | 1.0 | 1.2 | 0.07 | 696 |
| HKYE-LYS-00 | 0 | 05/18/18 | 5.85 | 2.0 | 0.8 | 0.7 | 1.3 | 0.06 | 744 |
| HKYE-LYS-00 | 0 | 05/23/18 | 6.03 | 2.2 | 1.2 | 1.1 | 1.1 | 0.06 | 764 |
| HKYE-LYS-00 | 0 | 06/01/18 | 5.98 | 2.0 | 0.7 | 0.6 | 1.4 | <0.01 | 766 |
| HKYE-LYS-00 | 0 | 06/07/18 | 6.22 | 1.0 | <0.2 | <0.1 | 1.0 | <0.01 | 785 |
| HKYE-LYS-00 | 0 | 06/14/18 | 5.98 | 1.3 | 0.7 | 0.7 | 0.6 | <0.01 | 751 |
| HKYE-LYS-00 | 0 | 06/18/18 | 6.22 | 1.6 | 0.4 | 0.4 | 1.2 | <0.01 | 827 |
| HKYE-LYS-00 | 0 | 06/27/18 | 5.32 | 1.3 | 0.4 | 0.4 | 0.9 | <0.01 | 780 |

Blank cells indicate that analysis was not run for a constituent on that particular date and/or depth due to insufficient volume or data was invalidated after analysis.

* If TN limit of 5 mg/L is not met prior to the RW distribution system, TN compliance can be met at a point prior to reaching the regional groundwater, including lysimeters.

** Brooks Basin is part of an alternative monitoring plan; the Brooks Basin 25 foot bgs lysimeter is only used for compliance with TN. Compliance with TOC at Brooks Basin is measured at BRK-1/1 (see Table 2-5b)

Notes: Banana & Hickory Basins compliance point for TN is located at BH-1/2.

TOC & TN compliance is based on two consecutive sample results.

Table 2-5b
Alternative Monitoring Plans

| Banana Basin | | | | | |
|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | Banana | Banana | |
| mg/L==> | TOC | TN | TOC (80% reduction) | TN (47% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 1.02 | 3.2 | 3.0 |
| 04/10/18 | 5.21 | 4.4 | 1.04 | 2.3 | 2.8 |
| 04/17/18 | 5.56 | 5.9 | 1.11 | 3.1 | 2.7 |
| 04/24/18 | 5.51 | 5.0 | 1.10 | 2.7 | 2.9 |
| 05/01/18 | 5.23 | 4.9 | 1.05 | 2.6 | 2.6 |
| 05/08/18 | 6.31 | 5.0 | 1.26 | 2.7 | 2.6 |
| 05/15/18 | 5.68 | 5.1 | 1.14 | 2.7 | 2.7 |
| 05/22/18 | 5.36 | 4.4 | 1.07 | 2.3 | 2.5 |
| 05/30/18 | 6.74 | 4.7 | 1.35 | 2.5 | 2.4 |
| 06/05/18 | 5.79 | 4.4 | 1.16 | 2.3 | 2.4 |
| 06/12/18 | 5.66 | 4.4 | 1.13 | 2.3 | 2.3 |
| 06/19/18 | 5.47 | 4.7 | 1.09 | 2.5 | 2.5 |
| 06/26/18 | 5.18 | 3.6 | 1.04 | 1.9 | 2.2 |

| Hickory Basin | | | | | |
|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | Hickory | Hickory | |
| mg/L==> | TOC | TN | TOC (81% reduction) | TN (27% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 0.97 | 4.4 | 4.1 |
| 04/10/18 | 5.21 | 4.4 | 0.99 | 3.2 | 3.8 |
| 04/17/18 | 5.56 | 5.9 | 1.06 | 4.3 | 3.8 |
| 04/24/18 | 5.51 | 5.0 | 1.05 | 3.7 | 4.0 |
| 05/01/18 | 5.23 | 4.9 | 0.99 | 3.6 | 3.6 |
| 05/08/18 | 6.31 | 5.0 | 1.20 | 3.7 | 3.6 |
| 05/15/18 | 5.68 | 5.1 | 1.08 | 3.7 | 3.7 |
| 05/22/18 | 5.36 | 4.4 | 1.02 | 3.2 | 3.5 |
| 05/30/18 | 6.74 | 4.7 | 1.28 | 3.4 | 3.3 |
| 06/05/18 | 5.79 | 4.4 | 1.10 | 3.2 | 3.3 |
| 06/12/18 | 5.66 | 4.4 | 1.08 | 3.2 | 3.2 |
| 06/19/18 | 5.47 | 4.7 | 1.04 | 3.4 | 3.4 |
| 06/26/18 | 5.18 | 3.6 | 0.98 | 2.6 | 3.0 |

| Turner Basin | | | | | | |
|---|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | Turner 1 & 2 | Turner 3 & 4 | Turner 1 & 2 Turner 3 & 4 | |
| mg/L==> | TOC | TN | TOC (70% reduction) | TOC (85% reduction) | TN (87% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | 16 mg/L | | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 1.53 | 0.76 | 0.8 | 0.7 |
| 04/10/18 | 5.21 | 4.4 | 1.56 | 0.78 | 0.6 | 0.7 |
| 04/17/18 | 5.56 | 5.9 | 1.67 | 0.83 | 0.8 | 0.7 |
| 04/24/18 | 5.51 | 5.0 | 1.65 | 0.83 | 0.7 | 0.7 |
| 05/01/18 | 5.23 | 4.9 | 1.57 | 0.78 | 0.6 | 0.6 |
| 05/08/18 | 6.31 | 5.0 | 1.89 | 0.95 | 0.7 | 0.6 |
| 05/15/18 | 5.68 | 5.1 | 1.70 | 0.85 | 0.7 | 0.7 |
| 05/22/18 | 5.36 | 4.4 | 1.61 | 0.80 | 0.6 | 0.6 |
| 05/30/18 | 6.74 | 4.7 | 2.02 | 1.01 | 0.6 | 0.6 |
| 06/05/18 | 5.79 | 4.4 | 1.74 | 0.87 | 0.6 | 0.6 |
| 06/12/18 | 5.66 | 4.4 | 1.70 | 0.85 | 0.6 | 0.6 |
| 06/19/18 | 5.47 | 4.7 | 1.64 | 0.82 | 0.6 | 0.6 |
| 06/26/18 | 5.18 | 3.6 | 1.55 | 0.78 | 0.5 | 0.5 |

| Ely Basin | | | | | |
|---|---|---|---|---|---|
| Date | RP-1 RW | RP-1 RW | Ely 3 East | Ely 3 East | |
| mg/L==> | TOC | TN | TOC (76% reduction) | TN (52% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | | 5 mg/L |
| 04/02/18 | 6.13 | 5.2 | 1.47 | 2.5 | 2.3 |
| 04/09/18 | 5.94 | 4.1 | 1.43 | 2.0 | 2.2 |
| 04/16/18 | 5.35 | 5.3 | 1.28 | 2.5 | 2.3 |
| 04/23/18 | 6.14 | 5.3 | 1.47 | 2.5 | 2.5 |
| 04/30/18 | 6.85 | 5.3 | 1.64 | 2.5 | 2.5 |
| 05/07/18 | 6.73 | 5.1 | 1.62 | 2.4 | 2.5 |
| 05/14/18 | 6.55 | 6.1 | 1.57 | 2.9 | 2.7 |
| 05/21/18 | 5.88 | 5.0 | 1.41 | 2.4 | 2.7 |
| 05/31/18 | 6.66 | 5.0 | 1.60 | 2.4 | 2.4 |
| 06/04/18 | 5.80 | 5.0 | 1.39 | 2.4 | 2.4 |
| 06/11/18 | 6.62 | 4.5 | 1.59 | 2.2 | 2.3 |
| 06/18/18 | 5.84 | 4.3 | 1.40 | 2.1 | 2.1 |
| 06/25/18 | 6.74 | 6.5 | 1.62 | 3.1 | 2.6 |

*The recycled water blend of RP-1 & RP-4 effluent is sampled at the NRG Energy (formerly Reliant Energy) turnout point
Note: TOC & TN compliance is based on two consecutive sample results.

Table 2-5b
Alternative Monitoring Plans

| RP3 Basin | | | | | |
|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | RP3 | RP3 | |
| mg/L==> | TOC | TN | TOC (88% reduction) | TN (31% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 0.61 | 4.1 | 3.9 |
| 04/10/18 | 5.21 | 4.4 | 0.63 | 3.0 | 3.6 |
| 04/17/18 | 5.56 | 5.9 | 0.67 | 4.1 | 3.6 |
| 04/24/18 | 5.51 | 5.0 | 0.66 | 3.5 | 3.8 |
| 05/01/18 | 5.23 | 4.9 | 0.63 | 3.4 | 3.4 |
| 05/08/18 | 6.31 | 5.0 | 0.76 | 3.5 | 3.4 |
| 05/15/18 | 5.68 | 5.1 | 0.68 | 3.5 | 3.5 |
| 05/22/18 | 5.36 | 4.4 | 0.64 | 3.0 | 3.3 |
| 05/30/18 | 6.74 | 4.7 | 0.81 | 3.2 | 3.1 |
| 06/05/18 | 5.79 | 4.4 | 0.69 | 3.0 | 3.1 |
| 06/12/18 | 5.66 | 4.4 | 0.68 | 3.0 | 3.0 |
| 06/19/18 | 5.47 | 4.7 | 0.66 | 3.2 | 3.2 |
| 06/26/18 | 5.18 | 3.6 | 0.62 | 2.5 | 2.9 |

| 8th Street Basin | | | | | |
|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | 8th Street | 8th Street | |
| mg/L==> | TOC | TN | TOC (88% reduction)** | TN (75% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | 5 mg/L | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 0.61 | 1.5 | 1.4 |
| 04/10/18 | 5.21 | 4.4 | 0.63 | 1.1 | 1.3 |
| 04/17/18 | 5.56 | 5.9 | 0.67 | 1.5 | 1.3 |
| 04/24/18 | 5.51 | 5.0 | 0.66 | 1.3 | 1.4 |
| 05/01/18 | 5.23 | 4.9 | 0.63 | 1.2 | 1.2 |
| 05/08/18 | 6.31 | 5.0 | 0.76 | 1.3 | 1.2 |
| 05/15/18 | 5.68 | 5.1 | 0.68 | 1.3 | 1.3 |
| 05/22/18 | 5.36 | 4.4 | 0.64 | 1.1 | 1.2 |
| 05/30/18 | 6.74 | 4.7 | 0.81 | 1.2 | 1.1 |
| 06/05/18 | 5.79 | 4.4 | 0.69 | 1.1 | 1.1 |
| 06/12/18 | 5.66 | 4.4 | 0.68 | 1.1 | 1.1 |
| 06/19/18 | 5.47 | 4.7 | 0.66 | 1.2 | 1.2 |
| 06/26/18 | 5.18 | 3.6 | 0.62 | 0.9 | 1.0 |

| Victoria Basin | | | | | |
|---|---|---|---|---|---|
| Date | RW Blend* | RW Blend* | Victoria | Victoria | |
| mg/L==> | TOC | TN | TOC (78% reduction) | TN (82% reduction) | TN - 2 sample avg. |
| Limit ==> | | | 16 mg/L | 5 mg/L | 5 mg/L |
| 04/03/18 | 5.09 | 6.0 | 1.12 | 1.1 | 1.0 |
| 04/10/18 | 5.21 | 4.4 | 1.15 | 0.8 | 0.9 |
| 04/17/18 | 5.56 | 5.9 | 1.22 | 1.1 | 0.9 |
| 04/24/18 | 5.51 | 5.0 | 1.21 | 0.9 | 1.0 |
| 05/01/18 | 5.23 | 4.9 | 1.15 | 0.9 | 0.9 |
| 05/08/18 | 6.31 | 5.0 | 1.39 | 0.9 | 0.9 |
| 05/15/18 | 5.68 | 5.1 | 1.25 | 0.9 | 0.9 |
| 05/22/18 | 5.36 | 4.4 | 1.18 | 0.8 | 0.9 |
| 05/30/18 | 6.74 | 4.7 | 1.48 | 0.8 | 0.8 |
| 06/05/18 | 5.79 | 4.4 | 1.27 | 0.8 | 0.8 |
| 06/12/18 | 5.66 | 4.4 | 1.25 | 0.8 | 0.8 |
| 06/19/18 | 5.47 | 4.7 | 1.20 | 0.8 | 0.8 |
| 06/26/18 | 5.18 | 3.6 | 1.14 | 0.6 | 0.7 |

*The recycled water blend of RP-1 & RP-4 effluent is sampled at the NRG Energy (formerly Reliant Energy) turnout point

**Reduction factor amended to align with the DDW's evaluation and allowance for a 50% RWC at 8th Street Basin; using mound monitoring well data (2008-2016) to calculate percent reduction in place of the available lysimeter data used in the start-up period report.

Note: TOC & TN compliance is based on two consecutive sample results.

| Brooks Basin | | | | |
|---|---|---|---|---|
| Date | BRK-LYS-00 | BRK-LYS-00 | BRK-LYS-00 | BRK-LYS-00 |
| | TOC (mg/L) | TN (mg/L) | EC (µmhos/cm) | |
| 04/25/18 | 5.26 | 4.5 | 536 | |
| 05/24/18 | 6.33 | 3.7 | 623 | |
| 06/20/18 | 5.48 | 2.7 | 712 | |
| Date | BRK-LYS-25 | BRK-LYS-25 | | BRK-LYS-25 |
| | TOC (mg/L) | TN* (mg/L) | TN - 2 sample avg. | EC (µmhos/cm) |
| Limit==> | | | 5 mg/L | |
| 04/25/18 | 2.96 | <0.6 | <0.6 | 554 |
| 05/24/18 | 3.08 | <0.6 | <0.6 | 602 |
| 06/20/18 | 3.09 | <0.6 | <0.6 | 611 |
| Date | BRK-1/1 | BRK-1/1 | BRK-1/1 | BRK-1/1 |
| | TOC* (mg/L) | TN (mg/L) | EC (µmhos/cm) | Cl |
| Limit==> | 16 mg/L | | | |
| 04/25/18 | 0.26 | 0.7 | 551 | 75 |
| 05/29/18 | 0.42 | 0.8 | 637 | 68 |
| 06/20/18 | 0.52 | 0.8 | 587 | 64 |

*BRK-LYS-25 is the compliance point for TN and BRK-1/1 is the compliance point for TOC.

Table 2-6
RWC, TOC Average, and TN Compliance Summary

| Basin | SUP Start Date | SUP End Date | SUP Report Submittal | RWC Limit | Mos. in Operation (Jun 2018) | $RWC_{Avg}$ (June 2018) | $TOC_{Avg}$ Limit* (mg/L) | Apr 2018 $TOC_{Avg}$ (mg/L) | May 2018 $TOC_{Avg}$ (mg/L) | Jun 2018 $TOC_{Avg}$ (mg/L) | 2Q18 TN Limit Compliance | Recharged Water Monitoring Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8th Street | Sep-07 | Dec-10 | 05/23/11 | 50% | 130 | 22% | 2.3 | 0.6 | 0.7 | 0.7 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 88% and TN reduction of 75% |
| Banana | Jul-05 | Jan-06 | 10/27/06 | 50% | 156 | 36% | 1.4 | 2.8 | 2.6 | 2.4 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 80% and TN reduction of 47% |
| Brooks | Aug-08 | Dec-09 | 07/29/10 | 50% | 119 | 18% | 2.8 | 0.3 | 0.5 | NA | Met | **Alternative monitoring:** *Monthly* lysimeter monitoring at 0- and 25-feet bgs & BRK-1/1 for EC, TOC, TN. 25-foot lysimeter compliance point for TN and BRK-1/1 for TOC. *Monthly* BRK-1/1 analyzed for chloride to verify presence of RW. |
| Declez | Dec-15 | Sep-16 | TBD | TBD | 31 | 5% | 10.0 | - | - | - | Met | **Alternative monitoring:**<br>Initial year monitoring - *Every other week* lysimeter monitoring at 0- and 25-ft for EC, TOC, TN.<br>Future years - *Weekly* RW Blend with TOC reduction of 62% and TN reduction of 91% |
| Ely | RW initiated Sep-99 | NA | NA | 50% | 226 | 22% | 2.3 | 1.5 | 1.5 | 1.5 | Met | **Alternative monitoring:** *Weekly* RP-1 RW sample with TOC reduction of 76% and TN reduction of 52% |
| Hickory | Sep-05 | Feb-06 | 02/15/07 | 50% | 154 | 22% | 2.3 | 3.9 | 3.5 | 3.2 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 81% and TN reduction of 27% |
| RP3 | Jun-09 | Jun-10 | 12/15/10 | 50% | 109 | 18% | 2.8 | 0.6 | 0.7 | 0.7 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 76% and TN reduction of 31% |
| San Sevaine 5 | Jul-10 | Aug-11 | 02/08/12 | 27% | 96 | 6% | 8.3 | 1.2 | 1.3 | 1.2 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 78% and TN reduction of 69% |
| Turner 1&2 | Dec-06 | May-07 | 07/03/08 | 24% | 139 | 23% | 2.2 | 1.6 | 1.8 | 1.7 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 70%; TN reduction of 87% |
| Turner 3&4 | Dec-06 | May-07 | 07/03/08 | 45% | 139 | 23% | 2.2 | 0.8 | 0.9 | 0.8 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 85% ; TN reduction of 87% |
| Victoria | Sep-10 | Jul-11 | 02/08/12 | 50% | 94 | 30% | 1.7 | 1.2 | 1.3 | 1.2 | Met | **Alternative monitoring:** *Weekly* RW Blend with TOC reduction of 78% and TN reduction of 82% |

SUP - Start-Up Period NA - Not Analyzed

*$TOC_{Avg}$ limit is 0.5 mg/L divided by the $RWC_{Avg}$. Compliance is determined by checking that monthly $TOC_{Avg}$ does not exceed the $TOC_{Avg}$ limit. If the $TOC_{Avg}$ limit is exceeded, the monthly $TOC_{Avg}$ will be shown in bold font.

Table 2-7a
Diluent Water Monitoring*: Local

| Constituent | Cucamonga Creek @ Turner 1&2 06/07/18 | Deer Creek @ Turner 3&4 06/05/18 | West Cucamonga Creek @ 8th St Basin 06/05/18 | Max Level to Trigger Source Water Evaluation | Unit | Method |
|---|---|---|---|---|---|---|
| $NO_2$-N | <0.02 | <0.02 | <0.02 | 1 | mg/L | EPA 300.0 |
| $NO_3$-N | 0.1 | 0.1 | 1.8 | 10 | mg/L | EPA 300.0 |
| TDS | 546 | 334 | 376 | 1000 | mg/L | SM 2540C |
| Total Coliform | 50 | 1600 | 1600 | - | mpn/100ml | SM 9221B |
| Oil & Grease | <1 | <1 | 1 | - | mg/L | EPA 1664A |
| Inorganic Chemicals | | | | | | |
| Aluminum | 63 | 154 | 51 | 1000 | µg/L | EPA 200.7 |
| Antimony | 1 | <1 | <1 | 6 | µg/L | EPA 200.8 |
| Arsenic | 2 | <2 | <2 | 10 | µg/L | EPA 200.8 |
| Asbestos | <6.91 | <6.56 | <1.87 | 7 | MFL | EPA 100.2 |
| Barium | 37 | 37 | 37 | 1000 | µg/L | EPA 200.7 |
| Beryllium | <0.5 | <0.5 | <0.5 | 4 | µg/L | EPA 200.7 |
| Cadmium | <0.25 | <0.25 | <0.25 | 5 | µg/L | EPA 200.7 |
| Chromium | 0.9 | 0.5 | <0.5 | 50 | µg/L | EPA 200.7 |
| Chromium VI | 1.0 | 0.6 | 0.3 | 10 | µg/L | EPA 218.6 |
| Cyanide | <20 | <20 | <20 | 150 | µg/L | ASTM D7284 |
| Fluoride | 0.8 | 0.2 | 0.2 | 2 | mg/L | SM 4500-F C |
| Mercury | <0.5 | <0.5 | <0.5 | 2 | µg/L | EPA 245.2 |
| Nickel | 3 | 3 | 3 | 100 | µg/L | EPA 200.7 |
| Perchlorate | <4 | <4 | <4 | 6 | µg/L | EPA 314 |
| Selenium | <2 | <2 | <2 | 50 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | 2 | µg/L | EPA 200.8 |
| Volatile Organic Chemicals (VOCs) | | | | | | |
| Benzene | <0.5 | <0.5 | <0.5 | 1 | µg/L | EPA 524.2 |
| Carbon Tetrachloride | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2 |
| 1,2-Dichlorobenzene | <0.5 | <0.5 | <0.5 | 600 | µg/L | EPA 524.2 |
| 1,4-Dichlorobenzene | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2 |
| 1,1-Dichloroethylene | <0.5 | <0.5 | <0.5 | 6 | µg/L | EPA 524.2 |
| cis-1,2-Dichloroethylene | <0.5 | <0.5 | <0.5 | 6 | µg/L | EPA 524.2 |
| trans-1,2-Dichloroethylene | <0.5 | <0.5 | <0.5 | 10 | µg/L | EPA 524.2 |
| Dichloromethane | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| 1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2 |
| Ethylbenzene | <0.5 | <0.5 | <0.5 | 300 | µg/L | EPA 524.2 |
| Chlorobenzene | <0.5 | <0.5 | <0.5 | 70 | µg/L | EPA 524.2 |
| Methyl Tert-butyl ether (MTBE) | <0.5 | <0.5 | <0.5 | 13 | µg/L | EPA 524.2 |
| Styrene | <0.5 | <0.5 | <0.5 | 100 | µg/L | EPA 524.2 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | 1 | µg/L | EPA 524.2 |
| Tetrachloroethylene | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| Toluene | <0.5 | <0.5 | <0.5 | 150 | µg/L | EPA 524.2 |
| 1,2,4-Trichlorobenzene | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| 1,1,1-Trichloroethane | <0.5 | <0.5 | <0.5 | 200 | µg/L | EPA 524.2 |
| 1,1,2-Trichloroethane | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| Trichloroethylene | <0.5 | <0.5 | <0.5 | 5 | µg/L | EPA 524.2 |
| Trichlorofluoromethane | <0.5 | <0.5 | <0.5 | 150 | µg/L | EPA 524.2 |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane | <0.5 | <0.5 | <0.5 | 1200 | µg/L | EPA 524.2 |
| Vinyl Chloride | <0.5 | <0.5 | <0.5 | 0.5 | µg/L | EPA 524.2 |
| Total Xylenes | <1 | <1 | <1 | 1750 | µg/L | EPA 524.2 |
| 1,2,3-Trichloropropane | <0.005 | <0.005 | <0.005 | 0.005 | µg/L | CASRL 524M-TCP |
| Non-Volatile Synthetic Organic Chemicals (SOCs) | | | | | | |
| Alachlor (Alanex) | <0.1 | <0.1 | <0.1 | 2 | µg/L | EPA 505 |
| Atrazine | <0.05 | <0.05 | <0.05 | 1 | µg/L | EPA 525.2 |
| Bentazon | <0.5 | <0.5 | <0.5 | 18 | µg/L | EPA 515.4 |
| Benzo(a)pyrene | <0.02 | <0.02 | <0.02 | 0.2 | µg/L | EPA 525.2 |
| Carbofuran | <0.5 | <0.5 | <0.5 | 18 | µg/L | EPA 531.2 |
| Chlordane | <0.1 | <0.1 | <0.1 | 0.1 | µg/L | EPA 505 |
| 2,4-D | 0.6 | 0.5 | <0.1 | 70 | µg/L | EPA 515.4 |
| Dalapon | <1 | <1 | <1 | 200 | µg/L | EPA 515.4 |
| Dibromochloropropane | <0.01 | <0.01 | <0.01 | 0.2 | µg/L | EPA 504.1 |
| Di(2-ethylhexyl)adipate | <0.6 | <0.6 | <0.6 | 400 | µg/L | EPA 525.2 |
| Di(2-ethylhexyl)phthalate | <0.6 | <0.6 | <0.6 | 4 | µg/L | EPA 525.2 |
| Dinoseb | <0.2 | <0.2 | <0.2 | 7 | µg/L | EPA 515.4 |
| Diquat | <0.4 | <0.4 | <0.4 | 20 | µg/L | EPA 549.2 |
| Endothall | <5 | <5 | <5 | 100 | µg/L | EPA 548.1 |
| Endrin | <0.01 | <0.01 | <0.01 | 2 | µg/L | EPA 505 |
| Ethylene Dibromide | <0.01 | <0.01 | <0.01 | 0.05 | µg/L | EPA 504.1 |
| Glyphosate | 28 | 6 | <6 | 700 | µg/L | EPA 547 |
| Heptachlor | <0.01 | <0.01 | <0.01 | 0.01 | µg/L | EPA 505 |
| Heptachlor Epoxide | <0.01 | <0.01 | <0.01 | 0.01 | µg/L | EPA 505 |
| Hexachlorobenzene | <0.05 | <0.05 | <0.05 | 1 | µg/L | EPA 525.2 |
| Hexachlorocyclopentadiene | <0.05 | <0.05 | <0.05 | 50 | µg/L | EPA 525.2 |
| Lindane | <0.01 | <0.01 | <0.01 | 0.2 | µg/L | EPA 505 |

Table 2-7a
Diluent Water Monitoring*: Local

| Constituent | Cucamonga Creek @ Turner 1&2 06/07/18 | Deer Creek @ Turner 3&4 06/05/18 | West Cucamonga Creek @ 8th St Basin 06/05/18 | Max Level to Trigger Source Water Evaluation | Unit | Method |
|---|---|---|---|---|---|---|
| Methoxychlor | <0.05 | <0.05 | <0.05 | 30 | µg/L | EPA 505 |
| Molinate | <0.1 | <0.1 | <0.1 | 20 | µg/L | EPA 525.2 |
| Oxamyl | <0.5 | <0.5 | <0.5 | 50 | µg/L | EPA 531.2 |
| Pentachlorophenol | <0.04 | <0.04 | <0.04 | 1 | µg/L | EPA 515.4 |
| Picloram | <0.1 | <0.1 | <0.1 | 500 | µg/L | EPA 515.4 |
| PCB 1016 | <0.08 | <0.08 | <0.08 | 0.5 | µg/L | EPA 505 |
| PCB 1221 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1232 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1242 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1248 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1254 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| PCB 1260 | <0.1 | <0.1 | <0.1 | 0.5 | µg/L | EPA 505 |
| Simazine | <0.05 | <0.05 | <0.05 | 4 | µg/L | EPA 525.2 |
| Thiobencarb | <0.2 | <0.2 | <0.2 | 70 | µg/L | EPA 525.2 |
| Toxaphene | <0.5 | <0.5 | <0.5 | 3 | µg/L | EPA 505 |
| 2,3,7,8-TCDD (Dioxin) | <5.04 | <5.01 | <5.00 | 30 | pg/L | EPA 1613 |
| 2,4,5-TP (Silvex) | <0.2 | <0.2 | <0.2 | 50 | µg/L | EPA 515.4 |
| Disinfection Byproducts | | | | | | |
| Total Trihalomethanes (TTHMs) | <2 | <2 | <2 | 80 | µg/L | EPA 524.2/624 |
| Total Haloacetic Acids (HAA5) | 10 | 3 | 6 | 60 | µg/L | SM 6251B |
| Bromate | 9 | 2 | 10 | 10 | µg/L | EPA 300.1/317 |
| Chlorite | <0.01 | <0.01 | <0.01 | 1 | mg/L | EPA 300.0 |
| Action Level Chemicals | | | | | | |
| Copper | 37.2 | 16.1 | 8.7 | 1300 | µg/L | EPA 200.7 |
| Lead | <0.5 | <0.5 | <0.5 | 15 | µg/L | EPA 200.8 |
| Radionuclides | | | | | | |
| Combined Radium-226 & Radium 228 | <0.290 | <0.284 | <0.313 | 5 | pCi/L | EPA 903.0 |
| Gross Alpha Particle Activity | <3 | <3 | <3 | 15 | pCi/L | EPA 900.0/SM7110C |
| Tritium | <273 | <323 | <313 | 20,000 | pCi/L | EPA 906.0 |
| Strontium-90 | <1.27 | <1.27 | <1.29 | 8 | pCi/L | EPA 905.0 |
| Gross Beta Particle Activity | 10 | 5 | 6 | 50 | pCi/L | EPA 900.0 |
| Uranium | <1 | <1 | 3 | 20 | pCi/L | EPA 200.8 |
| Chemicals w/ State Notification Levels | | | | | | |
| Boron | 0.2 | 0.2 | 0.2 | - | mg/L | EPA 200.7 |
| n-butylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| sec-butylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| tert-butylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| Carbon disulfide | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| Chlorate | 610 | 140 | 1600 | - | µg/L | EPA 300.0 |
| 2-Chlorotoluene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| 4-Chlorotoluene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| Diazinon | <0.1 | <0.1 | <0.1 | - | µg/L | EPA 525.2 |
| Dichlorodifluoromethane (Freon 12) | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| 1,4 - Dioxane | <1 | <1 | <1 | - | µg/L | EPA 522 |
| Formaldehyde | 26 | 17 | <5 | - | µg/L | EPA 556 |
| HMX | <0.1 | <0.1 | <0.1 | - | µg/L | LC-MS-MS |
| Isopropylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| Methyl isobutyl ketone (MIBK) | <2 | <2 | <2 | - | µg/L | EPA 524.2 |
| N-Nitrosodiethylamine (NDEA) | <2 | <2 | 6 | - | ng/l | EPA 521 |
| N-nitrosodimethylamine (NDMA) | <2 | <2 | <2 | - | ng/l | EPA 521 |
| Propachlor | <0.05 | <0.05 | <0.05 | - | µg/L | EPA 525.2 |
| N-propylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| RDX | <0.1 | <0.1 | <0.1 | - | µg/L | LC-MS-MS |
| Tertiary butyl alcohol | <2 | <2 | <2 | - | µg/L | EPA 524.2 MOD |
| 1,2,3-Trichloropropane (1,2,3-TCP) | <0.005 | <0.005 | <0.005 | - | µg/L | CASRL 524M-TCP |
| 1,2,4 –trimethylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| 1,3,5-trimethylbenzene | <0.5 | <0.5 | <0.5 | - | µg/L | EPA 524.2 |
| 2,4,6-Trinitrotoluene | <0.1 | <0.1 | <0.1 | - | µg/L | LC-MS-MS |
| Vanadium | 28 | 10 | <1 | - | µg/L | EPA 200.8 |
| Secondary Maximum Contaminant Level Chemicals | | | | | | |
| Aluminum | 63 | 154 | 51 | - | µg/L | EPA 200.7 |
| Corrosivity | 1.9 | 2.1 | 0.4 | - | SI | SM 2330B |
| Foaming Agents (MBAS) | 0.2 | 0.2 | 0.1 | - | mg/L | SM 5540C/EPA 425.1 |
| Iron | 199 | <150 | <150 | - | µg/L | EPA 200.7 |
| Manganese | 5 | 9 | 7 | - | µg/L | EPA 200.7 |
| Odor--Threshold | 8 | 8 | 8 | - | TON | SM 2150B |
| Silver | <0.25 | <0.25 | <0.25 | - | µg/L | EPA 200.7 |
| Thiobencarb | <0.2 | <0.2 | <0.2 | - | µg/L | EPA 525.2 |
| Zinc | 11 | 19 | 22 | - | µg/L | EPA 200.7 |

* Diluent monitoring is monitored per the schedule identified in the CDPH-approved Diluent Water Monitoring Plan

**Bold signifies an exceedance of the maximum level to trigger a source water evaluation. Explained in further detail in the report text.**

Table 2-7b

Diluent Water Monitoring: State Water Project - Silverwood Lake

| Constituent | Jan-18 | Feb-18 | Mar-18 | Apr-18 | May-18 | Jun-18 | Jul-18 | Aug-18 | Sep-18 | Oct-18 | Nov-18 | Dec-18 | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Silica | 11.6 | | | | | 12.0 | | | | | | | mg/L |
| Calcium | 17 | | | | | 22 | | | | | | | mg/L |
| Magnesium | 9 | | | | | 10 | | | | | | | mg/L |
| Sodium | 34 | | | | | 48 | | | | | | | mg/L |
| Potassium | 2.2 | | | | | 2.4 | | | | | | | mg/L |
| Carbonate | 0 | | | | | 0 | | | | | | | mg/L |
| Bicarbonate | 93 | | | | | 85 | | | | | | | mg/L |
| Sulfate | 24 | | | | | 42 | | | | | | | mg/L |
| Chloride | 50 | | | | | 57 | | | | | | | mg/L |
| Nitrate | 2.6 | | | | | 1.4 | | | | | | | mg/L |
| Fluoride | <0.1 | | | | | <0.1 | | | | | | | mg/L |
| Total Dissolved Soilds | 197 | | | | | 236 | | | | | | | mg/L |
| Total Hardness as $CaCO_3$ | 74 | | | | | 99 | | | | | | | mg/L |
| Total Alkalinity as $CaCO_3$ | 76 | | | | | 70 | | | | | | | mg/L |
| Free Carbon Dioxide | 1.0 | | | | | 0.8 | | | | | | | mg/L |
| pH | 8.20 | | | | | 8.25 | | | | | | | unit |
| Specific Conductance | 340 | | | | | 414 | | | | | | | µmho/cm |
| Color | 10 | | | | | -- | | | | | | | CU |
| Turbidity | 0.7 | | | | | 1.1 | | | | | | | NTU |
| Temperature | 11 | | | | | 19 | | | | | | | °C |
| Bromide | 0.16 | | | | | 0.18 | | | | | | | mg/L |
| Total Organic Carbon | 3.97 | | | | | 4.02 | | | | | | | mg/L |

No Imported Water Delivery

No Imported Water Delivery

No Imported Water Delivery

No Imported Water Delivery

Table 2-8
Summary of Wells in Groundwater Monitoring Networks

| BASIN | CBWM_ID | OWNER/LOCAL NAME | SEPARATION DISTANCE (feet) | SCREENED INTERVAL(S) (feet bgs) | CASING DIAMETER (inches) | STATUS | TYPE |
|---|---|---|---|---|---|---|---|
| Hickory and Banana Basins | 600490 | Fontana Water Company - F7a*** | 3330 upgradient | 590-1000 | 18 | Active | Municipal |
| | 600660 | California Speedway - Infield Well | 2070 downgradient | NA | NA | Active | Industrial |
| | 3601365 | California Speedway 2 | 2780 downgradient | 451-455, 491-603, & 664-780 | 20 | Active | Industrial |
| | 3600371 | Reliant Energy - East Well | 4070 downgradient | 434-467, 500-513, 553-580, 593-652, & 825-847 | 20 | Active | Industrial |
| | 3602267 | City Of Ontario - 20 | 14500 downgradient | NA | 20 | Active | Municipal |
| | 601001 | Inland Empire Utilities Agency - BH-1/1 | 340 downgradient | 365-405 | 4 | Active | Monitoring |
| | 601002 | Inland Empire Utilities Agency - BH-1/2 | 340 downgradient | 435-475 | 4 | Active | Monitoring |
| Turner Basins | 3600010 | City Of Ontario - 25 | 2530 crossgradient | 370-903 | 20 | Inactive | Municipal |
| | 600453 | City Of Ontario - 29 | 2810 downgradient | 400-1095 | 18 | Active | Municipal |
| | 600585 | City of Ontario - 38* | 4600 crossgradient | 500-1010 | 16 | Active | Municipal |
| | 600997 | Inland Empire Utilities Agency - TRN-1/1 | 50 downgradient | 340-360 | 4 | Active | Monitoring |
| | 600998 | Inland Empire Utilities Agency - TRN-1/2 | 50 downgradient | 380-400 | 4 | Active | Monitoring |
| | 600999 | Inland Empire Utilities Agency - TRN-2/1 | 50 downgradient | 350-370 | 4 | Active | Monitoring |
| | 601000 | Inland Empire Utilities Agency - TRN-2/2 | 50 downgradient | 392-412 | 4 | Active | Monitoring |
| Declez Basin | 300208 | Jurupa Community Services District - 19 | 8900 downgradient | 230-390 | 18 | Active | Municipal |
| | 300207 | Jurupa Community Services District - 17 | 5240 downgradient | 259-290, & 300-400 | NA | Active | Municipal |
| | 300200 | Jurupa Community Services District - 13 | 5730 downgradient | 220-446 | 16-34 | Active | Municipal |
| | 300484 | Inland Empire Utilities Agency - DCZ-1 | 50 downgradient | 155-175 | 4 | Active | Monitoring |
| | -- | Inland Empire Utilities Agency - D-1/2 | 50 downgradient | 185-205 | 4 | NA | Monitoring |
| RP-3 Basins | 600492 | Fontana Water Company - F23a | 7900 upgradient | 450-740 | 18 | Active | Municipal |
| | 600477 | Inland Empire Utilities Agency - Southridge JHS | 5500 downgradient | NA | NA | Active | Monitoring |
| | 600848 | Alcoa - Offsite MW1 | 9480 downgradient | NA | NA | Active | Monitoring |
| | 600850 | Alcoa - Offsite MW3 | 4725 downgradient | NA | NA | Active | Monitoring |
| | 601040 | Inland Empire Utilities Agency - RP3-1/1 | 100 downgradient | 215-235 | 4 | Active | Monitoring |
| | 601041 | Inland Empire Utilities Agency - RP3-1/2 | 100 downgradient | 265-285 | 4 | Active | Monitoring |
| Jurupa Basin | Not currently planned for recharge | | | | | | |
| 7th & 8th Street Basins | 3601561 | San Antonio Water Company No. 12 | 740 downgradient | 379-480, 525-563, 578-609, & 634-679 | 16 | Inactive | Municipal |
| | 3601772 | City of Ontario No. 4 | 3429 downgradient | 526-910 | 16-20 | Inactive | Municipal |
| | -- | City of Ontario No. 51 | 3402 downgradient | Not Yet Constructed | NA | NA | Municipal |
| | 600493 | City of Ontario No. 35 | 9695 downgradient | 580-1020 | 18-36 | Active | Municipal |
| | 601036 | Inland Empire Utilities Agency - 8TH-1/1 | 150 downgradient | 495-535 | 4 | Active | Monitoring |
| | 601037 | Inland Empire Utilities Agency - 8TH-1/2 | 150 downgradient | 595-645 | 4 | Active | Monitoring |
| | 601038 | Inland Empire Utilities Agency - 8TH-2/1 | 2460 downgradient | 465-505 | 4 | Active | Monitoring |
| | 601039 | Inland Empire Utilities Agency - 8TH-2/2 | 2460 downgradient | 576-616 | 4 | Active | Monitoring |
| Brooks Basins | 1901719 | City of Pomona P-10 | 1983 downgradient | 295-784 | 20 | Active | Municipal |
| | 1901713 | City of Pomona P-04 | 2620 downgradient | 254-338, & 403-452 | NA | Inactive | Municipal |
| | 1904001 | City of Pomona P-34 | 2550 downgradient | 363-367,380-400, 419-427 | 20 | Active | Municipal |
| | 1903156 | City of Pomona P-30 | 2160 crossgradient | 565-875 | 20 | Inactive | Municipal |
| | 1903016 | City of Pomona P-2 | 3455 downgradient | NA | NA | Active | Municipal |
| | 1901725 | City of Pomona P-17 | 4500 downgradient | 454-536 | 20 | Inactive | Municipal |
| | 601050 | Inland Empire Utilities Agency - BRK-1/1 | 144 downgradient | 310-350 | 4 | Active | Monitoring |
| | 601051 | Inland Empire Utilities Agency - BRK-1/2 | 144 downgradient | 520-560 | 4 | Active | Monitoring |
| | 601048 | Inland Empire Utilities Agency - BRK-2/1 | 1305 downgradient | 320-360 | 4 | Active | Monitoring |
| | 601049 | Inland Empire Utilities Agency - BRK-2/2 | 1305 downgradient | 560-600 | 4 | Active | Monitoring |
| San Sevaine Basins | 600905 | Cucamonga Valley Water District No. 39 | 8300-13170 downgradient | 750-870, 940-960, 970-1060, & 1080-1130, | 20 | Active | Municipal |
| | 600905 | Cucamonga Valley Water District No. 39 | 8300-13170 downgradient | 750-870, 940-960, 970-1060, & 1080-1130, | 20 | Active | Municipal |
| | 601115 | Inland Empire Utilities Agency - SS-1/1 and 1/2 | ~39-116 downgradient | 640-680 | 4 | Active | Monitoring |
| | -- | Inland Empire Utilities Agency - SS-2/1 and 2/2 | ~39-116 downgradient | 650-690 | 4 | NA | Monitoring |
| | -- | Inland Empire Utilities Agency - SS-3/1 and 3/2 | ~750 downgradient | 650-690 | 4 | NA | Monitoring |
| | 600576 | Unitex IRR | ~ 1338 downgradient | NA | NA | NA | Private Irrigation |
| | 600462 | Unitex 91090 | ~1601 downgradient | NA | NA | Active | Private Domestic |
| | 600369 | Unitex CalDOT | ~ 2850 downgradient | 400-684 | NA | NA | Irrigation |
| Victoria Basin | 600905 | Cucamonga Valley Water District No. 39 | 4329 downgradient | 750-870, 940-960, 970-1060, & 1080-1130, | 20 | Active | Municipal |
| | 601033 | Cucamonga Valley Water District No. 43** | 8300 downgradient | 650-800 | 32-42 | Active | Municipal |
| | 601117 | Inland Empire Utilities Agency - VCT-1/1 and 1/2 | ~39-116 downgradient | 570-610 | 4 | Active | Monitoring |
| | -- | Inland Empire Utilities Agency - VCT-1/1 and 1/2 | ~ 2000 downgradient | 570-610 | 4 | Active | Monitoring |
| Ely Basin | 601003 | Ely Basin MW-1, Philadelphia Well (Casing 3) | 100 downgradient | 280 - 300 | 2 | Active | Monitoring |
| | 601004 | Ely Basin MW-2, Walnut Well (Casing 2) | 3050 downgradient | 290 - 310 | 4 | Active | Monitoring |
| | 3600975 | Riverside Drive Well (43840-CWW) | 6046 downgradient | NA | NA | Active | Private Irrigation |
| | 600134 | Bishop Of San Bernardino Corp. - DOM | 6500 downgradient | NA | NA | Active | Private Domestic |

**Notes:**

NA = Data not available
CBWM ID = Chino Basin Water Master well identification number
bgs = below ground surface
* = Ontario Well No. 38 replaced Ontario Well No. 19, which is inactive
** = Cucamonga Valley Water District No. 43 replaced CVWD Well Nos. 35 & 36, which are inactive.
*** = Fontana Water Company Well 7A replaced Fontana Water Company Well 37A (1Q18)

Table 2-9a
Groundwater Monitoring Well Results (Quarterly)

| | Sample Location | Date | TOC (mg/L) | Total Coliform (MPN/100mL) | pH | EC (µmho/cm) | Al (µg/L) | Color (units) | Cu (µg/L) | Corrosivity Index (SI) | Foaming Agents (mg/L) | Fe (µg/L) | Mn (µg/L) | MTBE (µg/L) | Odor Threshold (TON) | Ag (µg/L) | Thiobencarb (µg/L) | Turbidity (NTU) | Zn (µg/L) | TDS (mg/L) | Cl (mg/L) | Hardness (mg $CaCO_3$/L) | Na (mg/L) | $SO_4$ (mg/L) | Nitrogen, Total (mg/L) | $NO_2$-N (mg/L) | $NO_3$-N (mg/L) | Dissolved Oxygen (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Banana & Hickory | Fontana Water Co. - F7a | 04/16/18 | <0.10 | <1.1 | 7.7 | 389 | <25 | <3 | 1.3 | 0.3 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | 1 | 242 | 9 | 146 | 16 | 13 | 4.5 | 0.06 | 4.4 | 5.3 |
| | California Speedway - Infield Well | 06/21/18 | 0.23 | <1.1 | 7.7 | 584 | <25 | <3 | 5.6 | 0.2 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.4 | <1 | 382 | 42 | 256 | 24 | 57 | 7.8 | <0.02 | 7.8 | 4.1 |
| | California Speedway 2 | 06/06/18 | <0.10 | <1.1 | 7.9 | 463 | <25 | 5 | <0.5 | 0.5 | <0.05 | <15 | <1 | <0.5 | NA | <0.25 | <0.2 | <0.1 | <1 | 302 | 24 | 190 | 20 | 31 | 6.8 | 0.06 | 6.7 | 5.4 |
| | Reliant Energy - East Well | 5/30 & 6/7/2018 | <0.10 | <1.1 | 7.1 | 349 | <25 | <3 | <0.5 | -0.2 | <0.05 | <15 | <1 | <0.5 | 2 | <0.25 | <0.2 | 0.8 | <1 | 234 | 11 | 130 | 20 | 13 | 3.6 | <0.02 | 3.6 | 6.2 |
| | BH-1/2* | 04/24/18 | 0.33 | <1.1 | 8.0 | 613 | <25 | <3 | 1.0 | 0.6 | <0.05 | <15 | 1 | <0.5 | 1 | <0.25 | <0.2 | 0.8 | <1 | 468 | 91 | 258 | 27 | 44 | 2.4 | <0.02 | 2.4 | 7.5 |
| Turner | Ontario Well No. 25 | 04/18/18 | <0.10 | <1.1 | 7.7 | 410 | <25 | 5 | 0.7 | 0.3 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | <1 | 276 | 24 | 163 | 22 | 15 | 4.3 | 0.06 | 4.2 | 4.9 |
| | Ontario Well No. 29 | 06/28/18 | 0.40 | <1.1 | 7.9 | 344 | <25 | <3 | <0.5 | 0.1 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.3 | <1 | 226 | 9 | 127 | 22 | 12 | 1.6 | <0.02 | 1.6 | 4.3 |
| | Ontario Well No. 38 | 04/18/18 | 0.13 | <1.1 | 8.0 | 295 | <25 | <3 | 0.6 | 0.5 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | 2 | 202 | 5 | 115 | 18 | 8 | 1.5 | 0.06 | 1.4 | 4.6 |
| | T-1/2* | 04/23/18 | 0.68 | <1.1 | 7.6 | 521 | <25 | 5 | 1.6 | -0.3 | <0.05 | <15 | 2 | <0.5 | 2 | <0.25 | <0.2 | 1.2 | <1 | 366 | 91 | 184 | 43 | 11 | <0.6 | <0.02 | <0.1 | 1.2 |
| | T-2/1* | 05/31/18 | 0.78 | <1.1 | 7.4 | 325 | <25 | 5 | 0.6 | -0.5 | <0.05 | <15 | 1 | <0.5 | <1 | <0.25 | <0.2 | 3.7 | <1 | 230 | 39 | 98 | 38 | 27 | 1.2 | <0.02 | 1.2 | 1.6 |
| | T-2/2* | 04/23/18 | 0.86 | <1.1 | 7.7 | 418 | <25 | 5 | 1.4 | -0.1 | <0.05 | <15 | <1 | <0.5 | 2 | <0.25 | <0.2 | 0.5 | <1 | 298 | 70 | 144 | 35 | 19 | <0.6 | <0.02 | 0.2 | 2.5 |
| RP3 | Fontana Water Co. - F23a | 04/16/18 | 0.10 | <1.1 | 7.8 | 456 | <25 | <3 | 0.8 | 0.3 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | <1 | 276 | 21 | 164 | 18 | 23 | 8.5 | 0.05 | 8.4 | 6.1 |
| | Southridge JHS* | 04/24/18 | 0.26 | 2 | 7.3 | 861 | <25 | <3 | 3.2 | 0.3 | <0.05 | <15 | 2 | <0.5 | <1 | <0.25 | <0.2 | 0.6 | 4 | ***616*** | 88 | 338 | 55 | 73 | 15.8 | <0.02 | ***15.1*** | 5.8 |
| | Alcoa MW1* | 05/31/18 | 0.30 | <1.1 | 7.3 | 736 | <25 | 5 | <0.5 | 0.2 | <0.05 | <15 | <1 | <0.5 | 1 | <0.25 | <0.2 | 1.8 | <1 | ***560*** | 92 | 267 | 28 | 29 | 13.2 | <0.02 | ***13.2*** | 8.2 |
| | Alcoa MW3* | 05/31/18 | 0.32 | <1.1 | 6.9 | ***1110*** | <25 | <3 | 0.6 | 0.1 | <0.05 | <15 | <1 | <0.5 | 1 | <0.25 | <0.2 | 0.5 | <1 | ***856*** | 139 | 409 | 45 | 55 | 19.1 | <0.02 | ***19.1*** | 7.2 |
| | RP3-1/1* | 05/23/18 | <0.10 | <1.1 | 7.3 | 614 | <25 | 5 | 2.3 | -0.4 | <0.05 | <15 | 44 | <0.5 | 1 | <0.25 | <0.2 | ***8.2*** | <1 | 384 | 81 | 148 | 65 | 28 | 2.6 | <0.02 | 2.6 | 0.6 |
| 8th Street | Ontario Well No. 35 | 04/11/18 | <0.10 | <1.1 | 7.9 | 367 | <25 | <3 | 0.7 | 0.2 | <0.05 | <15 | <1 | <0.5 | 1 | <0.25 | <0.2 | 0.1 | <1 | 236 | 9 | 125 | 21 | 22 | 3.5 | <0.02 | 3.5 | 3.9 |
| | 8TH-1/1* | 04/26/18 | 0.27 | <1.1 | 7.7 | 342 | <25 | ***20*** | 0.6 | -0.1 | <0.05 | <15 | 4 | <0.5 | 2 | <0.25 | <0.2 | ***11.2*** | 1 | 292 | 34 | 178 | 10 | 28 | 1.5 | <0.02 | 1.5 | 6.0 |
| | 8TH-1/2* | 5/21 & 6/19/2018 | 0.35 | <1.1 | 7.5 | 407 | <25 | 15 | 0.6 | -0.3 | <0.05 | <15 | 9 | <0.5 | 2 | <0.25 | <0.2 | ***6.4*** | <1 | 308 | 51 | 155 | 15 | 16 | 1.3 | <0.02 | 1.3 | 6.3 |
| | 8TH-2/1* | 05/02/18 | <0.10 | <1.1 | 7.6 | 468 | <25 | 5 | 0.8 | 0.3 | <0.05 | <15 | <1 | <0.5 | NA | <0.25 | <0.2 | 0.2 | 2 | 306 | 18 | 202 | 13 | 16 | 9.2 | 0.05 | 9.1 | 8.3 |
| | 8TH-2/2* | 05/14/18 | 0.15 | <1.1 | 7.4 | 412 | <25 | 5 | 0.5 | -0.3 | <0.05 | <15 | 3 | <0.5 | 1 | <0.25 | <0.2 | 0.7 | 1 | 260 | 33 | 154 | 14 | 29 | 4.9 | <0.02 | 4.9 | 9.1 |
| Brooks | Pomona Well No. 10 | 04/10/18 | 0.17 | <1.1 | 8.2 | 587 | <25 | <3 | 1.6 | 0.7 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | 1 | 348 | 44 | 230 | 12 | 41 | 7.9 | <0.02 | 7.9 | 5.5 |
| | Pomona Well No. 34 | 04/10/18 | 0.18 | <1.1 | 7.8 | 598 | <25 | <3 | 0.8 | 0.7 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | 1 | 370 | 35 | 244 | 12 | 42 | 12.9 | <0.02 | ***12.9*** | 5.7 |
| | BRK-1/1* | 04/25/18 | 0.26 | <1.1 | 7.7 | 551 | <25 | 15 | 1.6 | 0.2 | <0.05 | <15 | 3 | <0.5 | 1 | <0.25 | <0.2 | ***13.5*** | 2 | 376 | 75 | 224 | 36 | 45 | 0.7 | <0.02 | 0.7 | 6.1 |
| | BRK-1/2* | 04/25/18 | 0.16 | <1.1 | 7.6 | 545 | <25 | 5 | 0.5 | 0.4 | <0.05 | <15 | <1 | <0.5 | 1 | <0.25 | <0.2 | 0.3 | 6 | 436 | 24 | 268 | 14 | 49 | 21.3 | 0.05 | ***21.2*** | 6.6 |
| | BRK-2/1* | 05/24/18 | 0.37 | 3 | 7.0 | 590 | <25 | ***25*** | 0.7 | 0.2 | <0.05 | 17 | 19 | <0.5 | <1 | <0.25 | <0.2 | ***49.0*** | <1 | 462 | 84 | 261 | 11 | 36 | 1.8 | <0.02 | 1.8 | 4.8 |
| | BRK-2/2* | 05/16/18 | <0.10 | 33 | 8.0 | 284 | <25 | <3 | 1.1 | 0.1 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 1.1 | <1 | 184 | 6 | 67 | 30 | 22 | 3.4 | <0.02 | 3.4 | 2.3 |
| Ely | Ely Basin MW1 Philadelphia St.* | 05/30/18 | 1.44 | <1.1 | 7.4 | 318 | <25 | ***25*** | <0.5 | -0.5 | <0.05 | <15 | 46 | <0.5 | 2 | <0.25 | <0.2 | ***26.1*** | <1 | 204 | 34 | 97 | 32 | 16 | <0.6 | <0.02 | <0.1 | 1.5 |
| | Ely Basin MW2 Walnut St.* | 05/24/18 | 0.81 | 980 | 7.3 | ***1190*** | <25 | 10 | 1.8 | 0.4 | <0.05 | <15 | 15 | <0.5 | <1 | <0.25 | <0.2 | 2.1 | 2 | ***874*** | 115 | 535 | 34 | 75 | 34.1 | <0.02 | ***34.1*** | 5.5 |
| | Riverside Well (43840-CWW)* | 04/09/18 | 0.22 | <1.1 | 7.6 | 589 | <25 | <3 | 1.0 | 0.4 | <0.05 | <15 | <1 | <0.5 | 1 | <0.25 | <0.2 | 0.2 | 36 | 360 | 31 | 226 | 20 | 34 | 10.8 | <0.02 | ***10.8*** | 5.3 |
| Victoria & San Sevaine | SS-1/1* | 04/19/18 | 0.11 | NA | 7.2 | 293 | <25 | 5 | 0.6 | -0.6 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 2.0 | 3 | 192 | 17 | 100 | 15 | 21 | 3.5 | 0.05 | 3.4 | 7.2 |
| | VCT-1/1* | 04/23/18 | 0.42 | <1.1 | 7.2 | 580 | <25 | 15 | 0.9 | 0.2 | <0.05 | <15 | 1 | <0.5 | 2 | <0.25 | <0.2 | 3.2 | 1 | 456 | 95 | 262 | 22 | 39 | 0.8 | <0.02 | 0.8 | 13.2 |
| | VCT-2/2* | 04/26/18 | 1.02 | 5 | 7.5 | 430 | <25 | <3 | 0.7 | 0.0 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.4 | 4 | 224 | 12 | 126 | 16 | 12 | 5.6 | 0.05 | 5.5 | 5.9 |
| | CVWD Well No. 39 | 04/16/18 | <0.10 | <1.1 | 7.5 | 305 | <25 | <3 | 1.4 | 0.0 | <0.05 | <15 | <1 | <0.5 | 2 | <0.25 | <0.2 | 0.2 | 7 | 180 | 6 | 96 | 21 | 11 | 2.4 | 0.06 | 2.3 | 5.3 |
| | CVWD Well No. 43 | 04/16/18 | <0.10 | <1.1 | 7.7 | 353 | <25 | 5 | 3.8 | 0.1 | <0.05 | <15 | <1 | <0.5 | 2 | <0.25 | <0.2 | 0.1 | <1 | 218 | 8 | 127 | 18 | 14 | 3.2 | 0.06 | 3.1 | 5.2 |
| | Unitex 91090 | 04/09/18 | 2.61 | <1.1 | 7.7 | 445 | <25 | <3 | <0.5 | 0.1 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.3 | 1 | 260 | 24 | 158 | 14 | 32 | 2.2 | <0.02 | 2.2 | 5.7 |
| Declez | JCSD Well No. 13 | 04/17/18 | 0.20 | <1.1 | 7.7 | 650 | <25 | 5 | 1.0 | 0.5 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.2 | <1 | 440 | 107 | 218 | 29 | 18 | 3.0 | <0.02 | 2.4 | 5.0 |
| | JCSD Well No. 19 | 04/17/18 | <0.10 | <1.1 | 8.0 | 383 | <25 | <3 | 0.9 | 0.2 | <0.05 | <15 | <1 | <0.5 | <1 | <0.25 | <0.2 | 0.1 | 3 | 238 | 13 | 126 | 24 | 15 | 4.5 | <0.02 | 4.5 | 8.5 |
| | DCZ-1/1* | 04/19/18 | <0.10 | NA | 7.4 | 550 | <25 | ***20*** | 1.3 | 0.1 | <0.05 | <15 | 21 | <0.5 | 2 | 0.32 | <0.2 | ***31.0*** | 7 | 328 | 57 | 184 | 27 | 36 | 1.7 | <0.02 | 1.7 | 2.7 |
| | DCZ-2* | 04/19/18 | 0.87 | 4 | 8.0 | 513 | <25 | 5 | 1.6 | 0.3 | <0.05 | <15 | 15 | <0.5 | 2 | <0.25 | <0.2 | 1.1 | 102 | 284 | 35 | 146 | 35 | 31 | 8.1 | 0.05 | 8.0 | 6.7 |
| | ***Primary Maximum Contaminant Level*** | | | | | | 1000 | | 1300 | | | | | 13 | | | 70 | | | | | | | | | 1 | 10 | |
| | ***Secondary Maximum Contaminant Level*** | | | | 6.5-8.5 | 900 | 200 | 15 | 1000 | | 0.5 | 300 | 50 | 5 | 3 | 100 | 1 | 5 | 5000 | 500 | 250 | | | 250 | | | | |

Blank cells indicate that analysis was not run for a constituent on that particular date. On certain dates, supplemental analysis was conducted on several monitoring wells. On those occasions, a full set of analysis was not necessary and only parameters of interest were analyzed.

* Total dissolved metals reported for these wells. The remaining wells report total recoverable metals values.

NA: Not analyzed

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | 8TH-1/1 | 8TH-1/2 | 8TH-2/1 | 8TH-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Metals | | | | | | |
| Antimony | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | µg/L | EPA 200.8 |
| Chromium | 0.8 | 1.9 | 1.7 | 2.2 | µg/L | EPA 200.8 |
| Copper | 0.6 | 0.6 | 0.8 | 0.5 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Mercury | <0.05 | <0.05 | <0.05 | <0.05 | µg/L | EPA 245.2 |
| Nickel | 28 | 166 | 2 | 23 | µg/L | EPA 200.8 |
| Selenium | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Zinc | 1 | <1 | 2 | 1 | µg/L | EPA 200.8 |
| EPA Priority Pollutants - Volatile Organics | | | | | | |
| 1,1,1-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 2-Chloroethyl vinyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Benzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromodichloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromoform | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromomethane | <1 | 2 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Carbon tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Chlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroform | 6 | 8 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| cis-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Dibromochloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Ethylbenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Methylene chloride | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Tetrachloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Toluene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| trans-1,2-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Trichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Trichlorofluoromethane | <2 | <2 | <2 | <2 | µg/L | EPA 524.2/EPA 624 |
| Vinyl chloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Acrolein | <1 | <1 | <1 | <1 | µg/L | EPA 624 |
| Acrylonitrile | <2 | <2 | <2 | <2 | µg/L | EPA 624 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | 8TH-1/1 | 8TH-1/2 | 8TH-2/1 | 8TH-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles | | | | | | |
| 1,2,4-Trichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dichlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2,4-Dimethylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dinitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Chloronaphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Chlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Nitrophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Nitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| Acenaphthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Acenaphthylene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Azobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)anthracene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(b)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Benzo(k)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-ethylhexyl)phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Butyl benzyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Chrysene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Diethyl phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Dimethyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-butyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-octyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluorene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobutadiene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Hexachloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Isophorone | <1 | <1 | <1 | <1 | µg/L | EPA 625 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | 8TH-1/1 | 8TH-1/2 | 8TH-2/1 | 8TH-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles (cont'd) | | | | | | |
| Naphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Nitrobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodimethylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pentachlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Phenanthrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Phenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| EPA Priority Pollutants - Pesticides | | | | | | |
| 4,4-DDD | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDE | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDT | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Alpha-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Beta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Delta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endosulfan I | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan II | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan Sulfate | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Gamma-BHC | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1016 | <0.08 | <0.08 | <0.08 | <0.08 | µg/L | EPA 505/EPA 608 |
| PCB-1221 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1232 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1242 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1248 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1254 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1260 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Toxaphene | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| EPA Priority Pollutants - Miscellaneous | | | | | | |
| Cyanide | <0.02 | <0.02 | <0.02 | <0.02 | mg/L | EPA OIA-1677 |
| 2,3,7,8-TCDD | ND | ND | ND | ND | µg/L | EPA 1613B |

ND = non-detect NA - not analyzed

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BRK-1/1 | BRK-1/2 | BRK-2/1 | BRK-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Metals | | | | | | |
| Antimony | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | 2 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | µg/L | EPA 200.8 |
| Chromium | 0.8 | 5.2 | 2.7 | 8.2 | µg/L | EPA 200.8 |
| Copper | 1.6 | 0.5 | 0.7 | 1.1 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Mercury | <0.05 | <0.05 | <0.05 | <0.05 | µg/L | EPA 245.2 |
| Nickel | 44 | 4 | 448 | 26 | µg/L | EPA 200.8 |
| Selenium | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Zinc | 2 | 6 | <1 | <1 | µg/L | EPA 200.8 |
| EPA Priority Pollutants - Volatile Organics | | | | | | |
| 1,1,1-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 2-Chloroethyl vinyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Benzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromodichloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromoform | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromomethane | <1 | <1 | 2 | 3 | µg/L | EPA 524.2/EPA 624 |
| Carbon tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Chlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroform | 3 | <1 | 3 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| cis-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Dibromochloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Ethylbenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Methylene chloride | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Tetrachloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Toluene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| trans-1,2-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Trichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Trichlorofluoromethane | <2 | <2 | <2 | <2 | µg/L | EPA 524.2/EPA 624 |
| Vinyl chloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Acrolein | <1 | <1 | <1 | <1 | µg/L | EPA 624 |
| Acrylonitrile | <2 | <2 | <2 | <2 | µg/L | EPA 624 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BRK-1/1 | BRK-1/2 | BRK-2/1 | BRK-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles | | | | | | |
| 1,2,4-Trichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dichlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2,4-Dimethylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dinitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Chloronaphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Chlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Nitrophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Nitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| Acenaphthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Acenaphthylene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Azobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)anthracene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(b)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Benzo(k)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-ethylhexyl)phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Butyl benzyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Chrysene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Diethyl phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Dimethyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-butyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-octyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluorene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobutadiene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Hexachloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Isophorone | <1 | <1 | <1 | <1 | µg/L | EPA 625 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BRK-1/1 | BRK-1/2 | BRK-2/1 | BRK-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles (cont'd) | | | | | | |
| Naphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Nitrobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodimethylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pentachlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Phenanthrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Phenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| EPA Priority Pollutants - Pesticides | | | | | | |
| 4,4-DDD | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDE | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDT | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Alpha-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Beta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Delta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endosulfan I | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan II | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan Sulfate | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Gamma-BHC | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1016 | <0.08 | <0.08 | <0.08 | <0.08 | µg/L | EPA 505/EPA 608 |
| PCB-1221 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1232 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1242 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1248 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1254 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1260 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Toxaphene | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Cyanide | <0.02 | <0.02 | <0.02 | <0.02 | mg/L | EPA OIA-1677 |
| 2,3,7,8-TCDD | ND | ND | ND | ND | µg/L | EPA 1613B |

ND = non-detect NA - not analyzed

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BH-1/2 | Ely Basin MW-1 | Ely Basin MW-2 | Reliant Energy - East Well | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Metals | | | | | | |
| Antimony | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | µg/L | EPA 200.8 |
| Chromium | 1.8 | <0.5 | 4.8 | 3.2 | µg/L | EPA 200.8 |
| Copper | 1.0 | <0.5 | 1.8 | <0.5 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Mercury | <0.05 | <0.05 | <0.05 | <0.05 | µg/L | EPA 245.2 |
| Nickel | 23 | 2 | 12 | 1 | µg/L | EPA 200.8 |
| Selenium | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Zinc | <1 | <1 | 2 | <1 | µg/L | EPA 200.8 |
| EPA Priority Pollutants - Volatile Organics | | | | | | |
| 1,1,1-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 2-Chloroethyl vinyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Benzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromodichloromethane | <1 | <1 | 1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromoform | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromomethane | <1 | 3 | 3 | <1 | µg/L | EPA 524.2/EPA 624 |
| Carbon tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Chlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroform | <1 | <1 | 5 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloromethane | <1 | <1 | 1 | <1 | µg/L | EPA 524.2/EPA 624 |
| cis-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Dibromochloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Ethylbenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Methylene chloride | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Tetrachloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Toluene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| trans-1,2-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Trichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Trichlorofluoromethane | <2 | <2 | <2 | <2 | µg/L | EPA 524.2/EPA 624 |
| Vinyl chloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Acrolein | <1 | <1 | <1 | <1 | µg/L | EPA 624 |
| Acrylonitrile | <2 | <2 | <2 | <2 | µg/L | EPA 624 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BH-1/2 | Ely Basin MW-1 | Ely Basin MW-2 | Reliant Energy - East Well | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles | | | | | | |
| 1,2,4-Trichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dichlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2,4-Dimethylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dinitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Chloronaphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Chlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Nitrophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Nitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| Acenaphthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Acenaphthylene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Azobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)anthracene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(b)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Benzo(k)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-ethylhexyl)phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Butyl benzyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Chrysene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Diethyl phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Dimethyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-butyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-octyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluorene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobutadiene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Hexachloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Isophorone | <1 | <1 | <1 | <1 | µg/L | EPA 625 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | BH-1/2 | Ely Basin MW-1 | Ely Basin MW-2 | Reliant Energy - East Well | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles (cont'd) | | | | | | |
| Naphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Nitrobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodimethylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pentachlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Phenanthrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Phenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| EPA Priority Pollutants - Pesticides | | | | | | |
| 4,4-DDD | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDE | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDT | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Alpha-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Beta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Delta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endosulfan I | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan II | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan Sulfate | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Gamma-BHC | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1016 | <0.08 | <0.08 | <0.08 | <0.08 | µg/L | EPA 505/EPA 608 |
| PCB-1221 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1232 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1242 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1248 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1254 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1260 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Toxaphene | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| EPA Priority Pollutants - Miscellaneous | | | | | | |
| Cyanide | <0.02 | <0.02 | <0.02 | <0.02 | mg/L | EPA OIA-1677 |
| 2,3,7,8-TCDD | ND | ND | ND | ND | µg/L | EPA 1613B |

ND = non-detect NA - not analyzed

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | RP3-1/1 | Southridge JHS | T-1/2 | T-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Metals | | | | | | |
| Antimony | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | µg/L | EPA 200.8 |
| Chromium | 0.8 | 3.4 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Copper | 2.3 | 3.2 | 1.6 | 1.4 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Mercury | <0.05 | <0.05 | <0.05 | <0.05 | µg/L | EPA 245.2 |
| Nickel | 89 | 5 | 15 | 4 | µg/L | EPA 200.8 |
| Selenium | <2 | 3 | <2 | <2 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Zinc | <1 | 4 | <1 | <1 | µg/L | EPA 200.8 |
| EPA Priority Pollutants - Volatile Organics | | | | | | |
| 1,1,1-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2-Trichloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 2-Chloroethyl vinyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Benzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromodichloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromoform | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromomethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Carbon tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Chlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroform | 7 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| cis-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Dibromochloromethane | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Ethylbenzene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Methylene chloride | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Tetrachloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Toluene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| trans-1,2-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Trichloroethene | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Trichlorofluoromethane | <2 | <2 | <2 | <2 | µg/L | EPA 524.2/EPA 624 |
| Vinyl chloride | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Acrolein | <1 | <1 | <1 | <1 | µg/L | EPA 624 |
| Acrylonitrile | <2 | <2 | <2 | <2 | µg/L | EPA 624 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | RP3-1/1 | Southridge JHS | T-1/2 | T-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles | | | | | | |
| 1,2,4-Trichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dichlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2,4-Dimethylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dinitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Chloronaphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Chlorophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Nitrophenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Nitrophenol | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| Acenaphthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Acenaphthylene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Azobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzidine | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)anthracene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(b)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Benzo(k)fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-ethylhexyl)phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Butyl benzyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Chrysene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Diethyl phthalate | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Dimethyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-butyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-octyl phthalate | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluoranthene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluorene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobutadiene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Hexachloroethane | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Isophorone | <1 | <1 | 2 | <1 | µg/L | EPA 625 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | RP3-1/1 | Southridge JHS | T-1/2 | T-2/2 | Unit | Method |
|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles (cont'd) | | | | | | |
| Naphthalene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Nitrobenzene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodimethylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pentachlorophenol | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Phenanthrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Phenol | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pyrene | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| EPA Priority Pollutants - Pesticides | | | | | | |
| 4,4-DDD | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDE | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDT | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Alpha-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Beta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Delta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endosulfan I | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan II | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan Sulfate | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Gamma-BHC | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1016 | <0.08 | <0.08 | <0.08 | <0.08 | µg/L | EPA 505/EPA 608 |
| PCB-1221 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1232 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1242 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1248 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1254 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1260 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Toxaphene | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| EPA Priority Pollutants - Miscellaneous | | | | | | |
| Cyanide | <0.02 | <0.02 | <0.02 | <0.02 | mg/L | EPA OIA-1677 |
| 2,3,7,8-TCDD | ND | ND | ND | ND | µg/L | EPA 1613B |

ND = non-detect NA - not analyzed

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | SS-1/1 | VCT-1/1 | VCT-2/2 | DCZ-1/1 | DCZ-2 | Unit | Method |
|---|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Metals | | | | | | | |
| Antimony | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Arsenic | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Beryllium | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Cadmium | <0.25 | <0.25 | <0.25 | <0.25 | <0.25 | µg/L | EPA 200.8 |
| Chromium | 0.9 | 1.5 | 2.0 | 1.2 | 3.1 | µg/L | EPA 200.8 |
| Copper | 0.6 | 0.9 | 0.7 | 1.3 | 1.6 | µg/L | EPA 200.8 |
| Lead | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 200.8 |
| Mercury | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | µg/L | EPA 245.2 |
| Nickel | 2 | 8 | 2 | 388 | 2 | µg/L | EPA 200.8 |
| Selenium | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 200.8 |
| Thallium | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 200.8 |
| Zinc | 3 | 1 | 4 | 7 | 102 | µg/L | EPA 200.8 |
| EPA Priority Pollutants - Volatile Organics | | | | | | | |
| 1,1,1-Trichloroethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2,2-Tetrachloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1,2-Trichloroethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,1-Dichloroethene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloroethane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,2-Dichloropropane | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| 2-Chloroethyl vinyl ether | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Benzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromodichloromethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromoform | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Bromomethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Carbon tetrachloride | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Chlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloroform | <1 | 6 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Chloromethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| cis-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Dibromochloromethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Ethylbenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Methylene chloride | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Tetrachloroethene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Toluene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| trans-1,2-Dichloroethene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| trans-1,3-Dichloropropene | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Trichloroethene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 524.2/EPA 624 |
| Trichlorofluoromethane | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 524.2/EPA 624 |
| Vinyl chloride | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | µg/L | EPA 524.2/EPA 624 |
| Acrolein | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 624 |
| Acrylonitrile | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 624 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | SS-1/1 | VCT-1/1 | VCT-2/2 | DCZ-1/1 | DCZ-2 | Unit | Method |
|---|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles | | | | | | | |
| 1,2,4-Trichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,2-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,3-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 1,4-Dichlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4,6-Trichlorophenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dichlorophenol | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2,4-Dimethylphenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,4-Dinitrophenol | <3 | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| 2,4-Dinitrotoluene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2,6-Dinitrotoluene | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Chloronaphthalene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Chlorophenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 2-Methyl-4,6-dinitrophenol | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| 2-Nitrophenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 3,3-Dichlorobenzidine | <5 | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| 4-Bromophenyl phenyl ether | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chloro-3-methylphenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Chlorophenyl phenyl ether | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| 4-Nitrophenol | <3 | <3 | <3 | <3 | <3 | µg/L | EPA 625 |
| Acenaphthene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Acenaphthylene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Anthracene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Azobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzidine | <5 | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)anthracene | <5 | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Benzo(a)pyrene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(b)fluoranthene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Benzo(g,h,i)perylene | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Benzo(k)fluoranthene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroethoxy)methane | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Bis(2-chloroethyl)ether | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-chloroisopropyl)ether | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Bis(2-ethylhexyl)phthalate | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Butyl benzyl phthalate | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Chrysene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Dibenzo(a,h)anthracene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Diethyl phthalate | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Dimethyl phthalate | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-butyl phthalate | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Di-n-octyl phthalate | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluoranthene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Fluorene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorobutadiene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Hexachlorocyclopentadiene | <5 | <5 | <5 | <5 | <5 | µg/L | EPA 625 |
| Hexachloroethane | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Indeno(1,2,3-cd)pyrene | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Isophorone | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |

Table 2-9b
Groundwater Monitoring Well Results - Priority Pollutants (Quarterly)

| Constituent | SS-1/1 | VCT-1/1 | VCT-2/2 | DCZ-1/1 | DCZ-2 | Unit | Method |
|---|---|---|---|---|---|---|---|
| EPA Priority Pollutants - Base/Neutral and Acid Extractibles (cont'd) | | | | | | | |
| Naphthalene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Nitrobenzene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodimethylamine | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitroso-di-n-propylamine | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| N-Nitrosodiphenylamine | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pentachlorophenol | <2 | <2 | <2 | <2 | <2 | µg/L | EPA 625 |
| Phenanthrene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Phenol | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| Pyrene | <1 | <1 | <1 | <1 | <1 | µg/L | EPA 625 |
| EPA Priority Pollutants - Pesticides | | | | | | | |
| 4,4-DDD | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDE | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| 4,4-DDT | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Aldrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Alpha-BHC | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Beta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Delta-BHC | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Dieldrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endosulfan I | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan II | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endosulfan Sulfate | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Endrin | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Endrin aldehyde | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 525.2/EPA 608 |
| Gamma-BHC | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Heptachlor epoxide | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | µg/L | EPA 505/EPA 608 |
| Chlordane | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1016 | <0.08 | <0.08 | <0.08 | <0.08 | <0.08 | µg/L | EPA 505/EPA 608 |
| PCB-1221 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1232 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1242 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1248 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1254 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| PCB-1260 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| Toxaphene | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | µg/L | EPA 505/EPA 608 |
| EPA Priority Pollutants - Miscellaneous | | | | | | | |
| Cyanide | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | mg/L | EPA OIA-1677 |
| 2,3,7,8-TCDD | ND | ND | ND | ND | ND | µg/L | EPA 1613B |

ND = non-detect NA - not analyzed

Table 3-1
Diluent & Recycled Water Recharge Volume (Acre-Feet)

| | Diluent Water | | | | | | | | | | | | | | | | | | | | | Recycled Water | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Imported Water | | | | | | | | | | Local Runoff / Storm Flow | | | | | | | | | | | | | | | | | | | | |
| Jul-17 | 0 | 0 | 94 | 0 | 0 | 527 | 246 | 567 | 220 | 235 | 105 | 0 | 0 | 7 | 37 | 0 | 5 | 0 | 13 | 0 | 1 | 0 | 228 | 0 | 34 | 168 | 225 | 0 | 156 | 140 |
| Aug-17 | 584 | 0 | 96 | 0 | 0 | 420 | 418 | 117 | 79 | 20 | 20 | 2 | 0 | 70 | 126 | 0 | 15 | 48 | 24 | 4 | 196 | 131 | 55 | 0 | 27 | 20 | 208 | 0 | 57 | 239 |
| Sep-17 | 287 | 134 | 3 | 20 | 0 | 263 | 200 | 151 | 0 | 130 | 5 | 2 | 1 | 6 | 0 | 10 | 15 | 0 | 18 | 0 | 131 | 161 | 169 | 0 | 216 | 119 | 223 | 0 | 122 | 167 |
| **3Q17 Total** | **871** | **134** | **192** | **20** | **0** | **1211** | **864** | **834** | **299** | **386** | **129** | **4** | **1** | **83** | **163** | **10** | **36** | **48** | **54** | **4** | **327** | **292** | **452** | **0** | **276** | **307** | **655** | **0** | **334** | **545** |
| Oct-17 | 218 | 126 | 0 | 0 | 9 | 160 | 171 | 525 | 0 | 156 | 51 | 2 | 1 | 6 | 48 | 10 | 4 | 0 | 4 | 0 | 217 | 252 | 104 | 0 | 91 | 178 | 301 | 0 | 248 | 45 |
| Nov-17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 0 | 0 | 3 | 0 | 3 | 6 | 0 | 15 | 0 | 0 | 7 | 0 | 102 | 470 | 154 | 0 | 37 | 172 | 289 | 0 | 149 | 41 |
| Dec-17 | 0 | 140 | 0 | 0 | 0 | 69 | 64 | 1121 | 0 | 4 | 3 | 2 | 1 | 6 | 0 | 8 | 1 | 0 | 2 | 0 | 215 | 256 | 124 | 0 | 222 | 107 | 409 | 0 | 158 | 100 |
| **4Q17 Total** | **218** | **266** | **0** | **0** | **9** | **230** | **234** | **1700** | **0** | **160** | **57** | **4** | **5** | **18** | **48** | **33** | **5** | **0** | **13** | **0** | **533** | **977** | **381** | **0** | **350** | **458** | **999** | **0** | **556** | **187** |
| Jan-18 | 0 | 95 | 5 | 0 | 0 | 40 | 63 | 906 | 0 | 36 | 121 | 115 | 28 | 136 | 255 | 85 | 92 | 104 | 153 | 57 | 100 | 128 | 96 | 0 | 31 | 86 | 226 | 0 | 26 | 7 |
| Feb-18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 | 11 | 9 | 48 | 91 | 16 | 19 | 21 | 94 | 9 | 82 | 209 | 107 | 0 | 184 | 136 | 233 | 0 | 13 | 34 |
| Mar-18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 142 | 60 | 43 | 223 | 266 | 59 | 103 | 127 | 315 | 40 | 9 | 89 | 13 | 0 | 0 | 17 | 104 | 0 | 54 | 25 |
| **1Q18 Total** | **0** | **95** | **5** | **0** | **0** | **40** | **63** | **906** | **0** | **36** | **348** | **186** | **80** | **408** | **611** | **160** | **214** | **253** | **562** | **106** | **191** | **426** | **216** | **0** | **215** | **239** | **563** | **0** | **94** | **66** |
| Apr-18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 2 | 18 | 19 | 10 | 30 | 0 | 10 | 3 | 0 | 180 | 38 | 58 | 161 | 193 | 295 | 0 | 180 | 0 |
| May-18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 3 | 30 | 0 | 0 | 9 | 4 | 40 | 0 | 7 | 169 | 89 | 307 | 313 | 139 | 253 | 0 | 172 | 0 |
| Jun-18 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 2 | 17 | 0 | 2 | 1 | 0 | 16 | 0 | 0 | 135 | 114 | 249 | 236 | 96 | 261 | 0 | 231 | 0 |
| **2Q18 Total** | **62** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **25** | **0** | **7** | **65** | **19** | **12** | **39** | **4** | **66** | **3** | **7** | **484** | **240** | **614** | **710** | **428** | **808** | **0** | **583** | **0** |

Table 6-1
MVWD ASR Project - TIN/TDS Mass Balance

| | ASR Well No. 4 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Injection | | | Recovery | | | Mass Balance | | |
| | Date | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Storage (AF) | TIN (kg) | TDS (kg) |
| 3Q17 | Jul-17 | 0.0 | <0.4 | 94 | 34 | 11.5 | 380 | (1,294) | (22,053) | (611,210) |
| | Aug-17 | 0.0 | <0.4 | 94 | 53 | 12.8 | 380 | (1,347) | (22,894) | (636,173) |
| | Sep-17 | 0.0 | <0.4 | 94 | 55 | 13.0 | 380 | (1,402) | (23,781) | (662,120) |
| 4Q17 | Oct-17 | 0.0 | <0.4 | 160 | 57 | 12.8 | 380 | (1,459) | (24,680) | (688,794) |
| | Nov-17 | 0.0 | <0.4 | 160 | 10 | 13.0 | 380 | (1,469) | (24,847) | (693,674) |
| | Dec-17 | 0.0 | <0.4 | 160 | 0 | 13.0 | 380 | (1,469) | (24,847) | (693,674) |
| 1Q18 | Jan-18 | 0.0 | 0.6 | 230 | 0 | 13.0 | 380 | (1,469) | (24,847) | (693,674) |
| | Feb-18 | 0.0 | 0.6 | 230 | 5 | 13.0 | 380 | (1,474) | (24,921) | (695,836) |
| | Mar-18 | 0.0 | 0.6 | 230 | 4 | 13.0 | 380 | (1,478) | (24,982) | (697,605) |
| 2Q18 | Apr-18 | 28.8 | 0.6 | 230 | 0 | 13.0 | 380 | (1,449) | (24,960) | (689,442) |
| | May-18 | 38.6 | 0.6 | 230 | 3 | 13.0 | 380 | (1,413) | (24,976) | (679,786) |
| | Jun-18 | 0.0 | 0.6 | 230 | 66 | 13.0 | 380 | (1,479) | (26,030) | (710,596) |

| | ASR Well No. 30 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Injection | | | Recovery | | | Mass Balance | | |
| | Date | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Storage (AF) | TIN (kg) | TDS (kg) |
| 3Q17 | Jul-17 | 0.0 | <0.4 | 94 | 0 | 18.0 | 320 | (193) | (25,850) | (293,714) |
| | Aug-17 | 0.0 | <0.4 | 94 | 5 | 19.0 | 320 | (198) | (25,971) | (295,759) |
| | Sep-17 | 44.5 | <0.4 | 94 | 4 | 12.0 | 320 | (157) | (26,003) | (292,043) |
| 4Q17 | Oct-17 | 139.2 | <0.4 | 160 | 0 | 12.0 | 320 | (18) | (25,935) | (264,567) |
| | Nov-17 | 135.7 | <0.4 | 160 | 0 | 12.0 | 320 | 118 | (25,868) | (237,782) |
| | Dec-17 | 139.7 | <0.4 | 160 | 0 | 12.0 | 320 | 258 | (25,799) | (210,208) |
| 1Q18 | Jan-18 | 138.1 | 0.6 | 230 | 0 | 12.0 | 320 | 396 | (25,697) | (171,015) |
| | Feb-18 | 124.5 | 0.6 | 230 | 0 | 12.0 | 320 | 520 | (25,610) | (135,830) |
| | Mar-18 | 142.6 | 0.6 | 230 | 0 | 12.0 | 320 | 662 | (25,504) | (95,383) |
| 2Q18 | Apr-18 | 99.5 | 0.6 | 230 | 61 | 12.0 | 320 | 701 | (26,334) | (91,228) |
| | May-18 | 102.8 | 0.6 | 230 | 27 | 12.0 | 320 | 777 | (26,656) | (72,694) |
| | Jun-18 | 0.0 | 0.6 | 230 | 244 | 12.0 | 320 | 533 | (30,271) | (169,089) |

| | ASR Well No. 32 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Injection | | | Recovery | | | Mass Balance | | |
| | Date | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Storage (AF) | TIN (kg) | TDS (kg) |
| 3Q17 | Jul-17 | 0.0 | <0.4 | 94 | 0 | 17.0 | 320 | (3,654) | (43,137) | (829,745) |
| | Aug-17 | 0.0 | <0.4 | 94 | 0 | 18.0 | 320 | (3,654) | (43,137) | (829,745) |
| | Sep-17 | 0.0 | <0.4 | 94 | 0 | 13.0 | 320 | (3,654) | (43,137) | (829,745) |
| 4Q17 | Oct-17 | 0.0 | <0.4 | 160 | 0 | 6.5 | 320 | (3,654) | (43,137) | (829,745) |
| | Nov-17 | 0.0 | <0.4 | 160 | 0 | 6.5 | 320 | (3,654) | (43,137) | (829,745) |
| | Dec-17 | 0.0 | <0.4 | 160 | 0 | 6.5 | 320 | (3,654) | (43,137) | (829,745) |
| 1Q18 | Jan-18 | 0.0 | 0.6 | 230 | 0 | 6.5 | 320 | (3,654) | (43,137) | (829,745) |
| | Feb-18 | 71.2 | 0.6 | 230 | 0 | 6.5 | 320 | (3,582) | (43,085) | (809,531) |
| | Mar-18 | 126.4 | 0.6 | 230 | 0 | 6.5 | 320 | (3,456) | (42,991) | (773,678) |
| 2Q18 | Apr-18 | 91.3 | 0.6 | 230 | 60 | 6.5 | 320 | (3,425) | (43,404) | (771,432) |
| | May-18 | 94.2 | 0.6 | 230 | 28 | 6.5 | 320 | (3,359) | (43,562) | (755,916) |
| | Jun-18 | 0.0 | 0.6 | 230 | 225 | 6.5 | 320 | (3,584) | (45,366) | (844,697) |

The injected water is WFA-treated water, which meets CCR Title 22 drinking water standards.

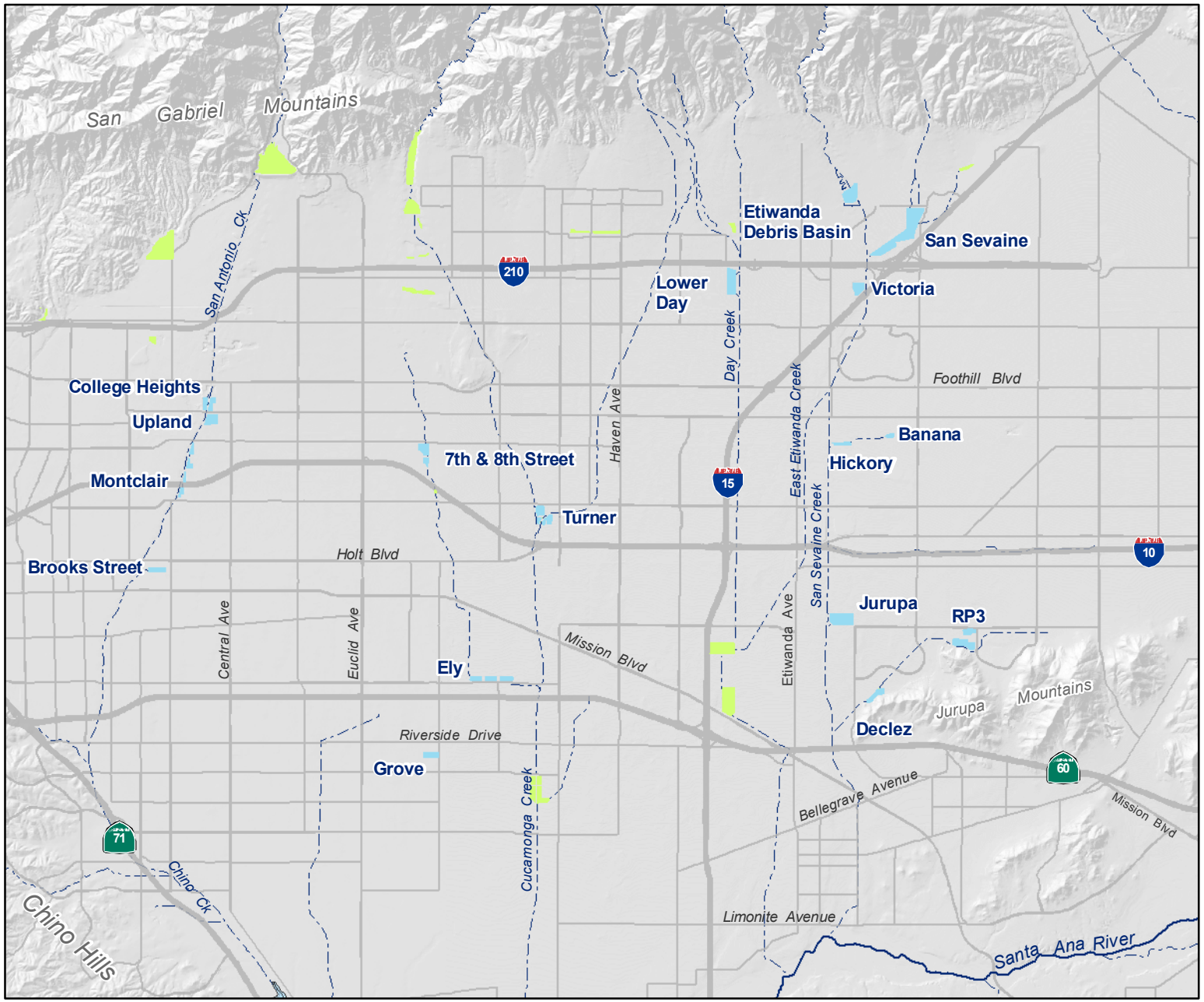
Cells shaded in grey reflect most recent lab values.

Table 6-1
MVWD ASR Project - TIN/TDS Mass Balance

| | ASR Well No. 33 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Injection | | | Recovery | | | Mass Balance | | |
| | Date | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Volume (AF) | TIN (mg/L) | TDS (mg/L) | Storage (AF) | TIN (kg) | TDS (kg) |
| 3Q17 | Jul-17 | 0.0 | <0.4 | 94 | 0 | 18.0 | 320 | (3,875) | (80,103) | (1,561,770) |
| | Aug-17 | 0.0 | <0.4 | 94 | 0 | 18.0 | 320 | (3,875) | (80,103) | (1,561,770) |
| | Sep-17 | 110.0 | <0.4 | 94 | 0 | 18.0 | 320 | (3,765) | (80,049) | (1,549,014) |
| 4Q17 | Oct-17 | 138.4 | <0.4 | 160 | 0 | 18.0 | 320 | (3,627) | (79,980) | (1,521,696) |
| | Nov-17 | 131.8 | <0.4 | 160 | 0 | 18.0 | 320 | (3,495) | (79,915) | (1,495,681) |
| | Dec-17 | 136.8 | <0.4 | 160 | 0 | 18.0 | 320 | (3,358) | (79,848) | (1,468,679) |
| 1Q18 | Jan-18 | 110.3 | 0.6 | 230 | 0 | 18.0 | 320 | (3,248) | (79,766) | (1,437,380) |
| | Feb-18 | 120.5 | 0.6 | 230 | 0 | 18.0 | 320 | (3,127) | (79,677) | (1,403,198) |
| | Mar-18 | 93.8 | 0.6 | 230 | 0 | 18.0 | 320 | (3,034) | (79,607) | (1,376,580) |
| 2Q18 | Apr-18 | 67.4 | 0.6 | 230 | 0 | 18.0 | 320 | (2,966) | (79,558) | (1,357,468) |
| | May-18 | 71.2 | 0.6 | 230 | 0 | 18.0 | 320 | (2,895) | (79,505) | (1,337,263) |
| | Jun-18 | 0.0 | 0.6 | 230 | 0 | 18.0 | 320 | (2,895) | (79,505) | (1,337,260) |

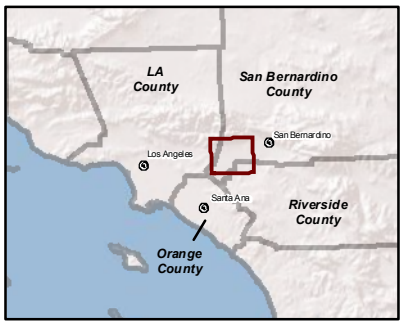
The injected water is WFA-treated water, which meets CCR Title 22 drinking water standards.
Cells shaded in grey reflect most recent lab values.

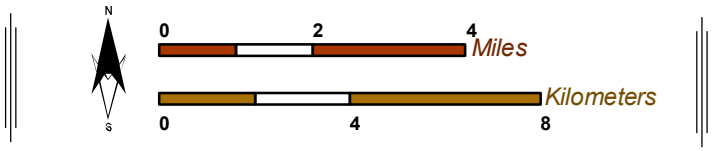
| | Total Project (All Wells) | | | |
|---|---|---|---|---|
| | | | Mass Balance | |
| | Date | | Storage (AF) | TIN (kg) | TDS (kg) |
| 3Q17 | Jul-17 | | (9,015) | (171,143) | (3,296,438) |
| | Aug-17 | | (9,074) | (172,105) | (3,323,446) |
| | Sep-17 | | (8,978) | (172,971) | (3,332,922) |
| 4Q17 | Oct-17 | | (8,757) | (173,732) | (3,304,802) |
| | Nov-17 | | (8,500) | (173,767) | (3,256,882) |
| | Dec-17 | | (8,224) | (173,631) | (3,202,306) |
| 1Q18 | Jan-18 | | (7,975) | (173,447) | (3,131,814) |
| | Feb-18 | | (7,664) | (173,292) | (3,044,395) |
| | Mar-18 | | (7,305) | (173,084) | (2,943,247) |
| 2Q18 | Apr-18 | | (7,139) | (174,256) | (2,909,569) |
| | May-18 | | (6,890) | (174,699) | (2,845,659) |
| | Jun-18 | | (7,425) | (181,171) | (3,061,642) |




## Main Map Features

- Recharge Basins in the Recycled Water Groundwater Recharge Program
- Non-Program Basins
- Rivers and Streams

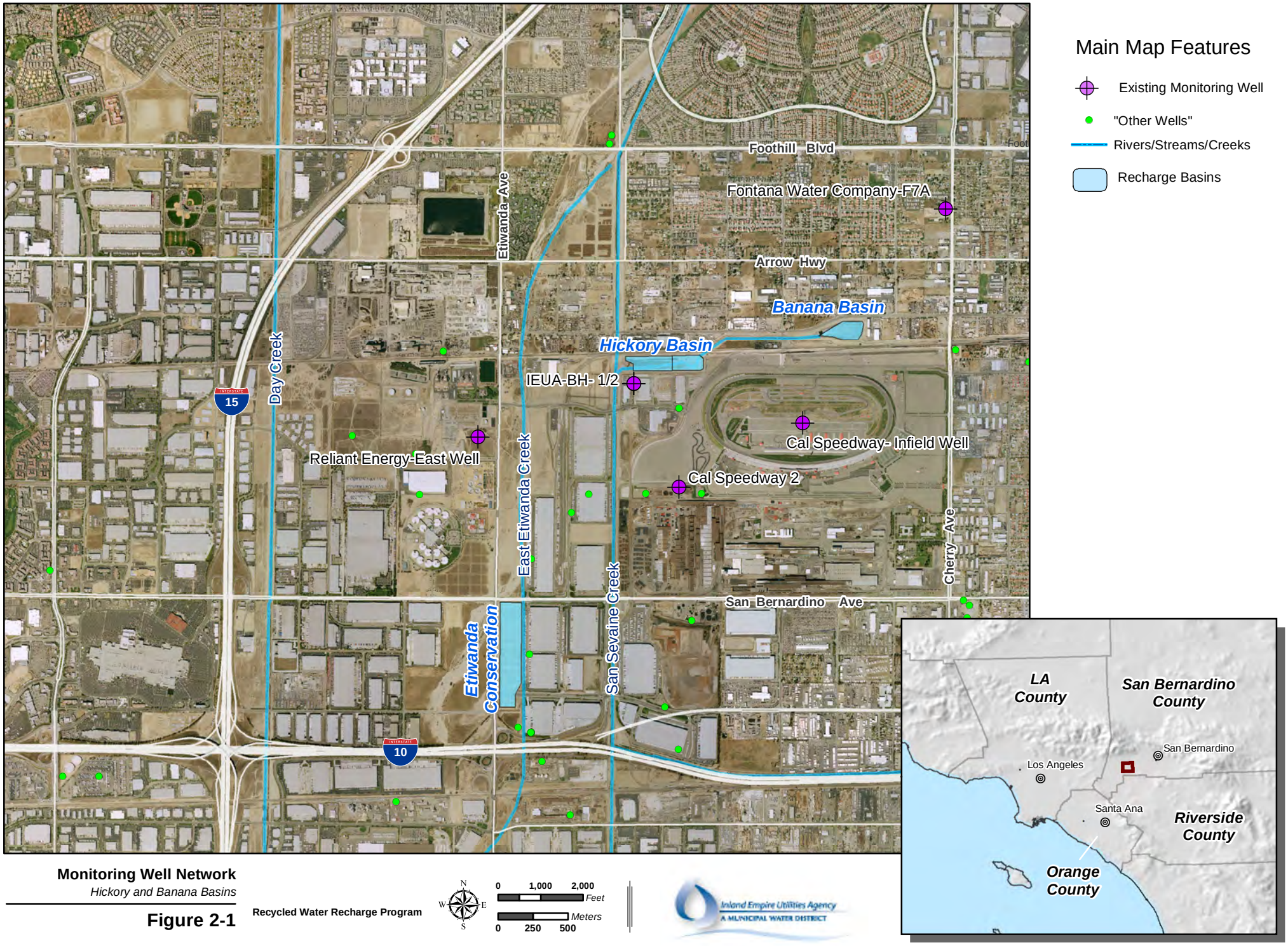



**Chino Basin Recycled Water Groundwater Recharge Program**

*Basin Locations*

**Figure 1-1**

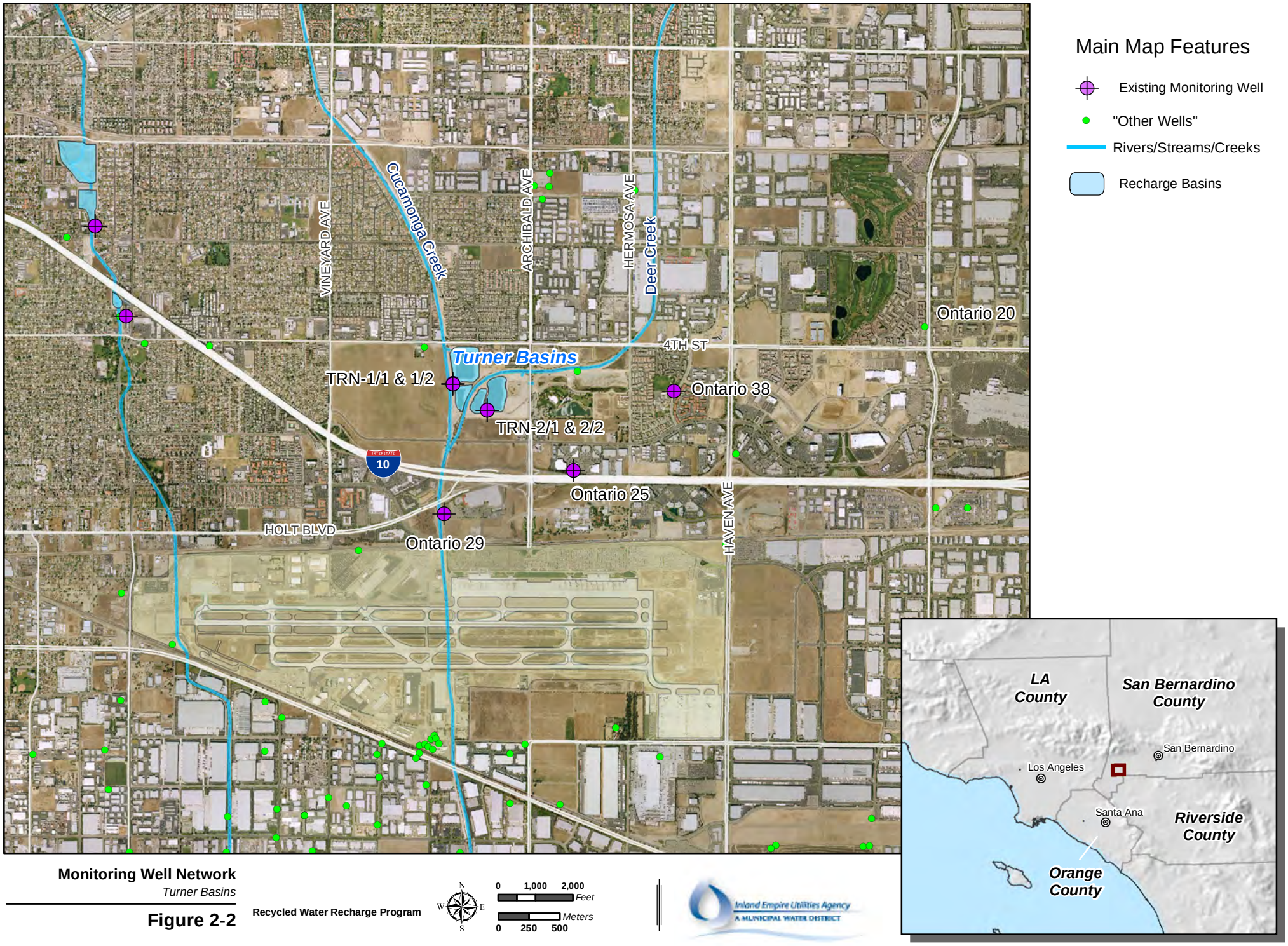



**Monitoring Well Network**

*Hickory and Banana Basins*

**Figure 2-1**

**Recycled Water Recharge Program**

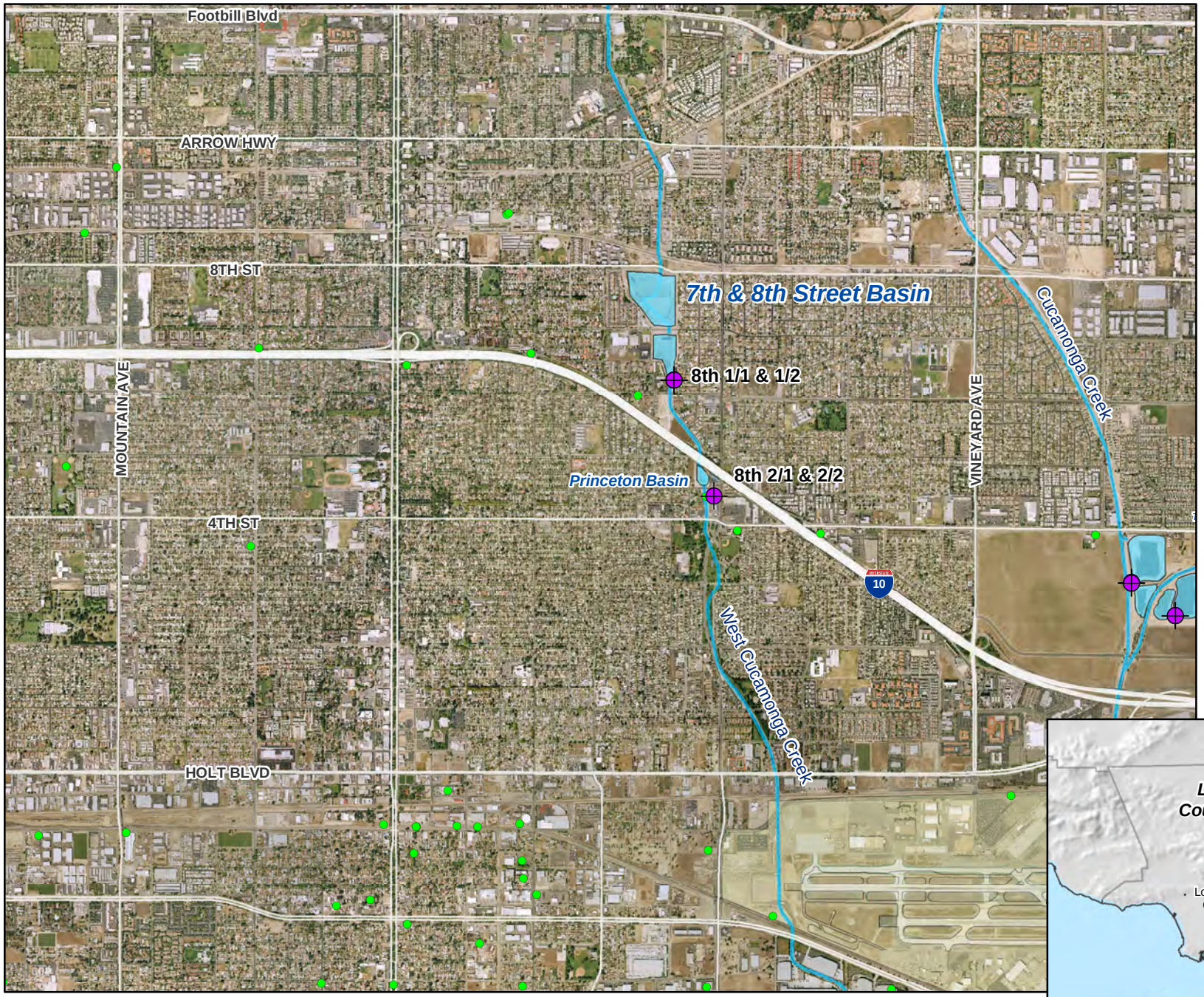



**Monitoring Well Network**

*Turner Basins*

**Figure 2-2**

**Recycled Water Recharge Program**




## Main Map Features

- Existing Monitoring Well
- "Other Wells"
- Rivers/Streams/Creeks
- Recharge Basins




**Monitoring Well Network**

*7th and 8th Street Basin*

**Figure 2-3**

**Recycled Water Recharge Program**

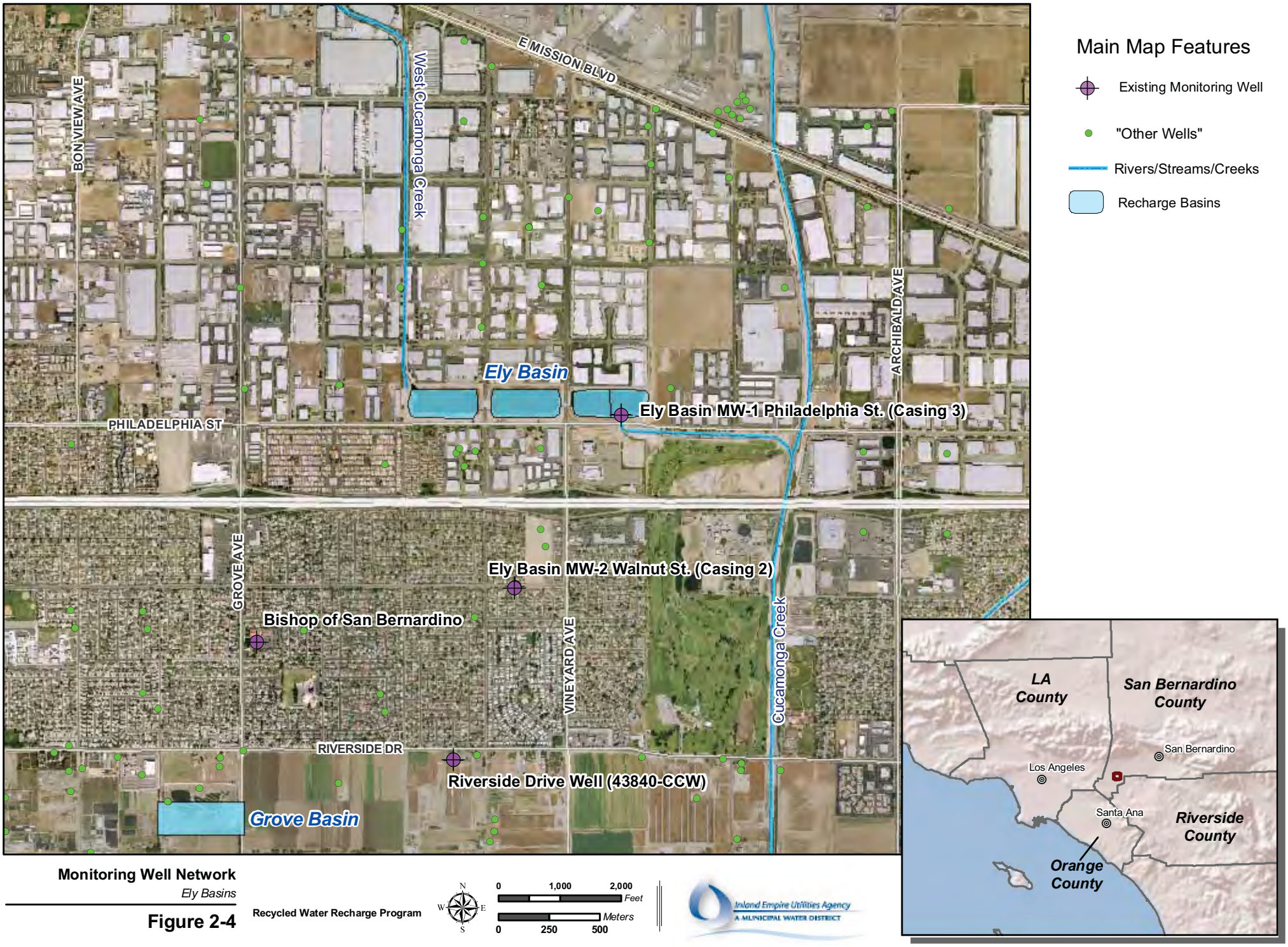
N W E S

0 1,000 2,000 Feet

0 250 500 Meters

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

20160203

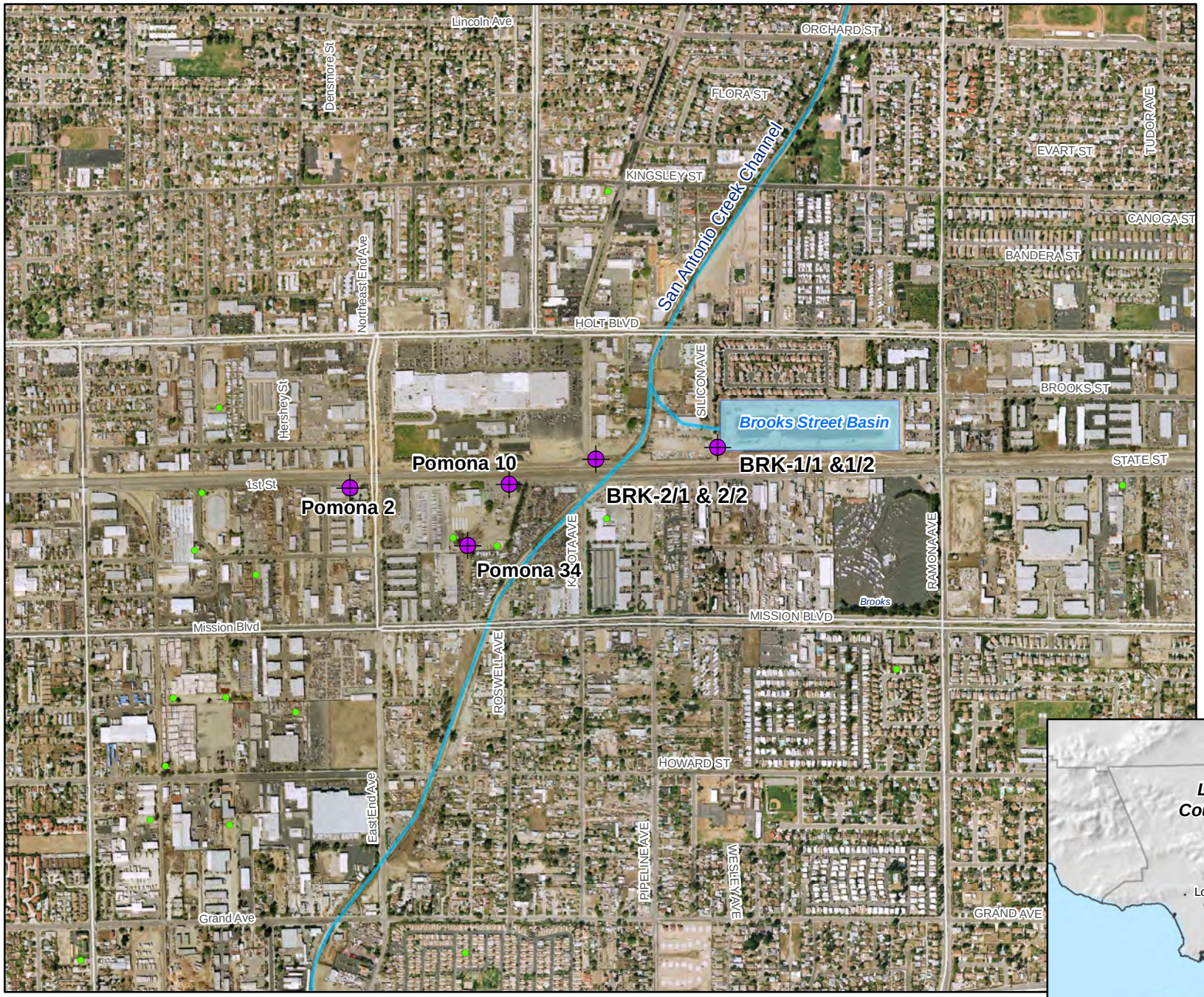



**Monitoring Well Network**

*Ely Basins*

**Figure 2-4**

**Recycled Water Recharge Program**




## Main Map Features

- Existing Monitoring Well
- "Other" Wells
- Rivers/Streams/Creeks
- Recharge Basins




**Monitoring Well Network**

*Brooks Street Basin*

**Figure 2-5**

**Recycled Water Recharge Program**

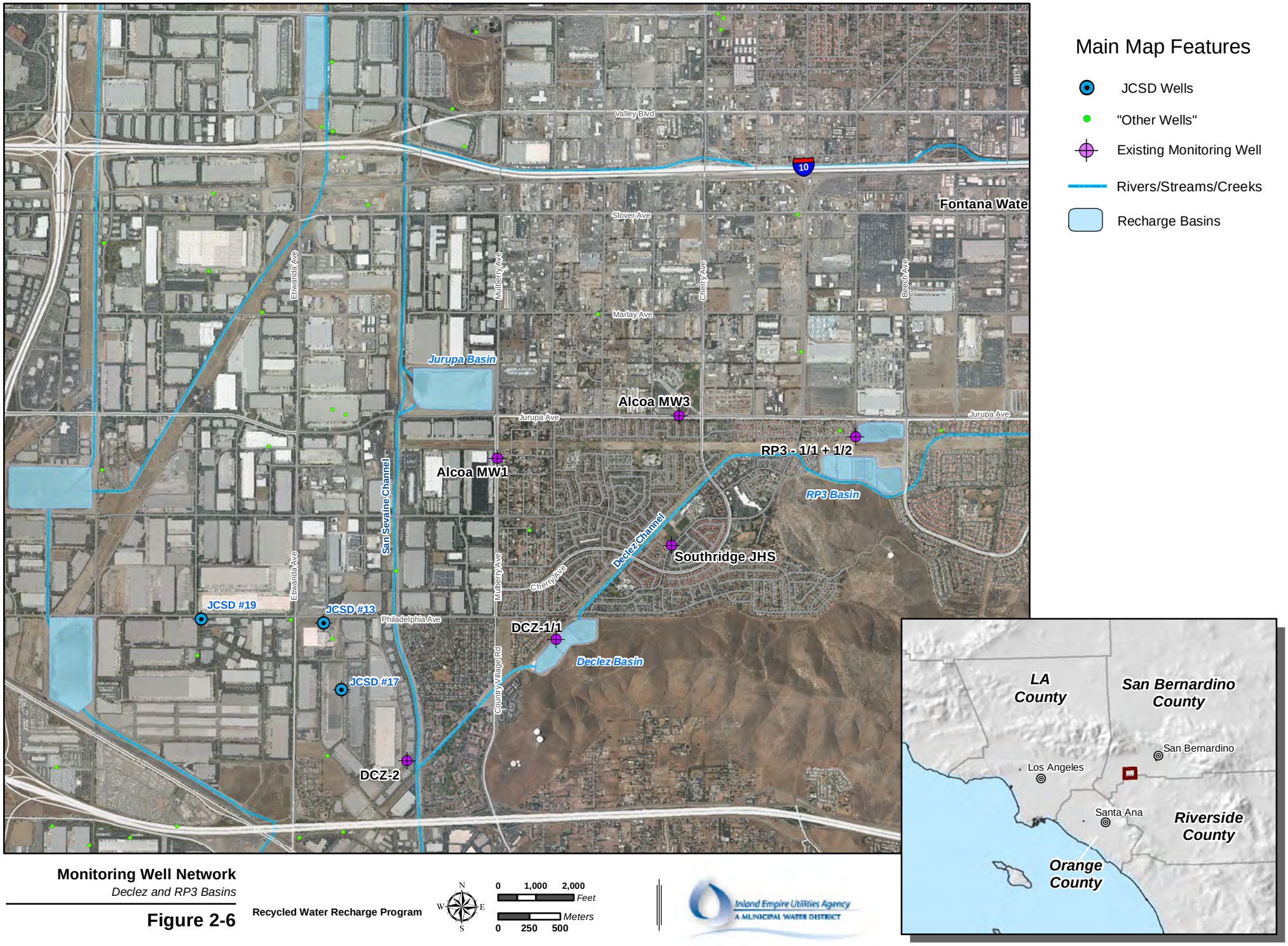
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A MUNICIPAL WATER DISTRICT

20160203

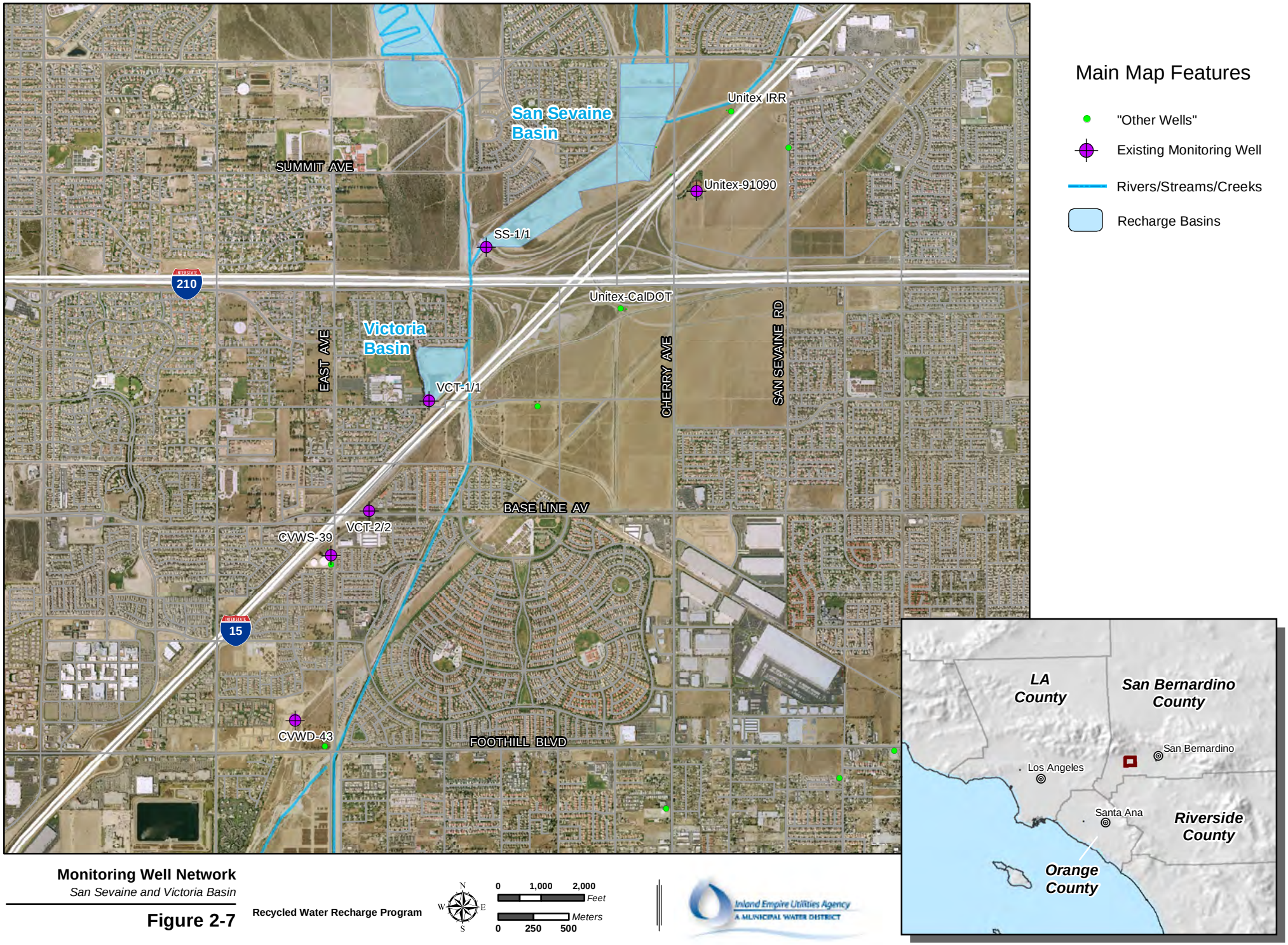



**Monitoring Well Network**

*Declez and RP3 Basins*

**Figure 2-6**

**Recycled Water Recharge Program**




**Monitoring Well Network**

*San Sevaine and Victoria Basin*

**Figure 2-7**

**Recycled Water Recharge Program**



MANAGEMENT OF THE

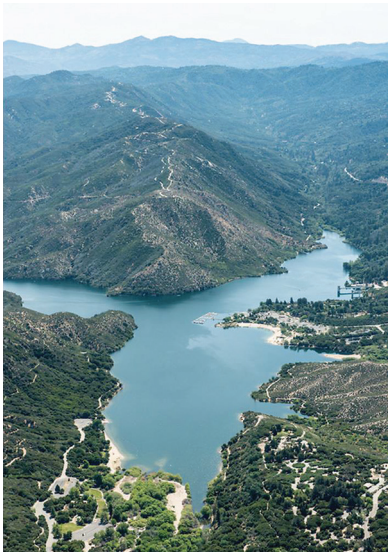
# CALIFORNIA STATE WATER PROJECT

BULLETIN 132-16 | JUNE 2017


EDMUND G. BROWN Jr.
*Governor, State of California*

JOHN LAIRD
*Secretary for Natural Resources*
*California Natural Resources Agency*

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## Publishing Information

Cover photo shows Silverwood Lake.

Photo provided by the Public Affairs Office Photography Unit.

Copies of this document are available for $25.00 per book and $5.00 per CD ROM from:

California Department of Water Resources
Attn: Publications Office
P.O. Box 942836
Sacramento, CA 94236-0001
(916) 653-1097

If you need this publication in alternate form, contact the Public Affairs Office, 1-800-272-8869.

Printed on recycled paper

## Bulletin 132-16

# Management of the California

# State Water Project

*Covers Calendar Year 2015 Activities*

***Published June 2017***

**Edmund G. Brown Jr.** *Governor*
*State of California*

**John Laird** *Secretary for Natural Resources*
*California Natural Resources Agency*

**William A. Croyle** *Acting Director*
*Department of Water Resources*

# Foreword

Bulletin 132-16, Management of the California State Water Project, continues the Bulletin 132 annual series begun in 1963. Bulletin 132-16 reports water supply planning, construction, financing, management, and operation activities of the State Water Project (SWP). Appendix B contains data and computations used to determine the SWP water contractors' Statements of Charges for 2017. Appendix B was previously printed and distributed to SWP water contractors to document and support calculation of contractors' annual charges.

The Bulletin discusses significant events and issues that affected SWP management and operations from January 1, 2015, through December 31, 2015.

Bulletin 132-16 also discusses water supply and delivery, Delta resources and environmental issues, local assistance programs, power resources, recreation, and financial analysis of the SWP.

Please note that the water delivery figures listed are accurate at the time of this publication, but small volumes of water may be reclassified over time pursuant to long-term water supply contract provisions. If your research requires more current data than were available at the time of publication, please consult the most recent edition of Bulletin 132, or contact Department of Water Resources staff in the State Water Project Analysis Office.



William A. Croyle
*Acting Director*

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**Appendix C** The California State Water Project Summary (discontinued)

**Appendix D** Costs of Recreation and Fish and Wildlife Enhancement (discontinued)

**Appendix E** Water Operations in the Sacramento-San Joaquin Delta (discontinued)

**Appendix F** San Joaquin Valley Post-Project Economic Impact (discontinued)

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# California Water Commission

The California Water Commission consists of nine members appointed by the Governor and confirmed by the Senate. Seven members are chosen for their expertise related to the control, storage, and beneficial use of water, and two are chosen for their knowledge of the environment. The commission advises the Director of the Department of Water Resources (DWR) on matters within DWR's jurisdiction, approves rules and regulations, and monitors and reports on the construction and operation of the State Water Project (SWP).

The roles and responsibilities of the California Water Commission are defined in the Water Code, Government Code, and Code of Civil Procedure.

The commission's SWP-specific responsibilities are to:

- conduct an annual review of the construction and operation of the SWP and report to DWR and the Legislature with any recommendations (Water Code Section 165);
- hold public hearings on all additional facilities proposed to be added to the SWP and name any new facilities (Water Code Sections 161.5 and 166); and
- adopt a resolution of necessity, and give each affected person a venue to be heard, before DWR may commence an eminent domain proceeding (Code of Civil Procedure Section 1245.210).

The California Water Commission's Executive Officer is Joseph Yun, and the Commission members at the time of publication are:

Carol Baker, Vice-Chair

Andrew Ball

Joseph Byrne

Daniel Curtin

Joe Del Bosque

Maria Herrera

Catherine Keig

David Orth

Armando Quintero, Chair

# Acronyms and Abbreviations

### *Symbols*

**µg/L** micrograms per liter
**µS/cm** microsiemens per centimeter

### *A*

**AB** Assembly Bill
**af** acre-feet/acre-foot
**AWMP** Agricultural Water Management Plan

### *B*

**Bay-Delta Estuary** San Francisco Bay/Sacramento-San Joaquin Delta Estuary
**Bay-Delta Plan** Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary
**BDCP** Bay Delta Conservation Plan
**BiOp** biological opinion

### *C*

**CAISO** California Independent System Operator
**California State Parks** California Department of Parks and Recreation
**C.A.S.T.** Catch A Special Thrill
**CDPH** California Department of Public Health
**CEQA** California Environmental Quality Act
**CESA** California Endangered Species Act
**CFR** Comprehensive Facility Review
**cfs** cubic feet per second
**CIMIS** California Irrigation Management Information System
**Corps** U.S. Army Corps of Engineers
**CVC** Cross Valley Canal
**CVP** Central Valley Project
**CWC** California Water Code

### *D*

**D-1641** State Water Resources Control Board, Water Right Decision 1641
**DCP** drought contingency plan
**DDA** Davis-Dolwig Act
**Delta** Sacramento-San Joaquin Delta Sacramento-San Joaquin Delta Estuary
**DFW** Department of Fish and Wildlife

**DO** dissolved oxygen
**DOE** Division of Engineering
**DSB** Dam Safety Branch
**DSC** Delta Stewardship Council
**DSM2** Delta Simulation Model 2
**DSOD** Division of Safety of Dams
**DSRB** Director's Safety Review Board
**DWR** Department of Water Resources

### *E*

**EC** electrical conductivity, specific conductance, or specific conductivity
**EIR** environmental impact report
**EIS** environmental impact statement
**EO** Executive Order
**EPA** U.S. Environmental Protection Agency
**ESA** federal Endangered Species Act

### *F*

**FERC** Federal Energy Regulatory Commission
**FRFH** Feather River Fish Hatchery
**FRP** Fish Restoration Program
**ft** feet

### *G*

**GHG** greenhouse gas
**GLC** Glorious Land Company

### *H*

**HEA** Habitat Expansion Agreement
**Hyatt-Thermalito** Hyatt Pumping-Generating Plant and Robie Thermalito Pumping-Generating Plant

### *I*

**IRWM** Integrated Regional Water Management

### *K*

**kV** kilovolt
**kWh** kilowatt hour

### *L*

**LADWP** Los Angeles Department of Water and Power
**LTMS** Long-Term Management Strategy

*M*

**m** meters
**maf** million acre-feet
**MCL** maximum contaminant level
**MeHg** methylmercury
**mg/L** milligrams per liter
**MIB** 2-methylisoborneol
**MIDS** Morrow Island Distribution System
**MME** Mercury Monitoring and Evaluation
**MRTU** Market Redesign and Technology Upgrade
**mS/cm** millisiemens per centimeter
**MW** megawatt
**MWh** megawatt hour
**MWQI** Municipal Water Quality Investigations
**MWQP** Municipal Water Quality Program
**MWT** McCormack-Williamson Tract

*N*

**NDOI** Net Delta Outflow Index
**NEPA** National Environmental Policy Act
**NERC** North American Electric Reliability Corporation
**NOAA Fisheries** National Marine Fisheries Service
**NVE** NV Energy

*O*

**O&M** Division of Operations and Maintenance
**OMP&R** operations, maintenance, power, and replacement
**OM&R** operations, maintenance, and replacement

*P*

**PAO** Public Affairs Office
**PFMA** Potential Failure Mode Analysis
**PFR** Periodic Facility Review
**PG&E** Pacific Gas & Electric Company
**PSP** proposal solicitation package

*Q*

**QSA** Quantification Settlement Agreement

*R*

**Reclamation** Bureau of Reclamation
**RETI** Renewable Energy Transmission Initiative
**RFWE** recreation and fish and wildlife enhancement

**RIMPR** Renewable Integration Market and Product Review
**RM** River Mile
**RST** rotary screw traps
**RWQCB** Regional Water Quality Control Board

### *S*

**Sacramento Valley 40-30-30 Index** Sacramento Valley Water Year Hydrologic Classification
**San Joaquin Valley 60-20-20 Index** San Joaquin Valley Water Year Hydrologic Classification
**SARMP** Settlement Agreement Recreation Management Plan
**SB** Senate Bill
**SBA** South Bay Aqueduct
**SCE** Southern California Edison
**SDIP** South Delta Improvements Program
**SJR** San Joaquin 4 Rivers
**SMPA** Suisun Marsh Preservation Agreement
**SMSCG** Suisun Marsh Salinity Control Gates
**SRR** Sacramento River Region
**SWP** State Water Project
**SWPAO** State Water Project Analysis Office
**SWRCB** State Water Resources Control Board

### *T*

**THg** total mercury
**TLR** Tulare Lake Region
**TUCP** temporary urgency change petition

### *U*

**USFWS** U.S. Fish and Wildlife Service

### *W*

**WQCP** water quality control plan

### *Y*

**Yuba Accord** Lower Yuba River Accord

# SWP Long-term Water Contractors

The State Water Project long-term water supply contractors are listed below, followed by shortened forms of their names that are used in Bulletin 132.

| | |
|---|---|
| Alameda County Flood Control and Water Conservation District, Zone 7 | Alameda-Zone 7 |
| Alameda County Water District | Alameda County |
| Antelope Valley-East Kern Water Agency | AVEK |
| Castaic Lake Water Agency | Castaic Lake |
| City of Yuba City | Yuba City |
| Coachella Valley Water District | Coachella |
| County of Butte | Butte |
| County of Kings | Kings |
| Crestline-Lake Arrowhead Water Agency | Crestline |
| Desert Water Agency | Desert |
| Dudley Ridge Water District | Dudley Ridge |
| Empire West Side Irrigation District | Empire |
| Kern County Water Agency | Kern |
| Littlerock Creek Irrigation District | Littlerock |
| The Metropolitan Water District of Southern California | Metropolitan |
| Mojave Water Agency | Mojave |
| Napa County Flood Control and Water Conservation District | Napa |
| Oak Flat Water District | Oak Flat |
| Palmdale Water District | Palmdale |
| Plumas County Flood Control and Water Conservation District | Plumas |
| San Bernardino Valley Municipal Water District | San Bernardino |
| San Gabriel Valley Municipal Water District | San Gabriel |
| San Gorgonio Pass Water Agency | San Gorgonio |
| San Luis Obispo County Flood Control and Water Conservation District | San Luis Obispo |
| Santa Barbara County Flood Control and Water Conservation District | Santa Barbara |
| Santa Clara Valley Water District | Santa Clara |
| Solano County Water Agency | Solano |
| Tulare Lake Basin Water Storage District | Tulare |
| Ventura County Watershed Protection District | Ventura |



# State Water Project Highlights

*The Cordelia Pumping Plant Forebay, part of the North Bay Aqueduct.*



The annual Bulletin 132 series began in 1963 and reported the first deliveries of water by the new State Water Project (SWP). Bulletin 132-16, *Management of the California State Water Project*, continues this series as the fifty-fourth edition. It reports on SWP planning, construction, finance, management, and operations during calendar year 2015. The SWP is operated and maintained by the California Department of Water Resources (DWR).

The SWP is one of the world's largest water, power, and conveyance systems. In the past decade it has conveyed an annual average of 2.9 million acre-feet (maf) of water. SWP facilities—pumping and power plants; reservoirs, lakes, and storage tanks; canals, tunnels, and pipelines—capture, store, and convey water to public water agencies and local water districts.

## Drought

In January 2014, the Governor declared a state of emergency due to severe drought conditions and directed State and local agencies to take all necessary actions to conserve water, enhance and protect water supplies, and reduce harmful effects of the drought. Subsequent proclamations and executive orders extended provisions and added new provisions. On November 13, 2015, the Governor issued Executive Order B-36-15, which requires the orders and provisions contained in the January 17, 2014 Proclamation; the April 25, 2014 Proclamation; and Executive Orders B-28-14 (December 22, 2014) and B-29-15 (April 1, 2015) to remain in full force and effect.

To address the effects of the historic drought in 2015, the Bureau of Reclamation (Reclamation), DWR, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Department of Fish and Wildlife, and State Water Resources Control Board (SWRCB) continued coordinated and extensive water operations and regulatory adjustments. The adjustments to existing water quality and federal Endangered Species Act requirements of SWRCB's Water Right Decision 1641 and the U.S. Fish and Wildlife Service and National Marine Fisheries Service biological opinions allowed the Central Valley Project (CVP) and SWP to support water deliveries and transfers and to maximize upstream water storage while minimizing adverse effects on listed fish species and protecting water quality.

DWR and Reclamation continued to work in close coordination with the fish and wildlife agencies and the SWRCB to produce and update a 2015 drought contingency plan for CVP and SWP operations.

During 2015, DWR and Reclamation submitted a number of temporary urgency change petitions to the SWRCB requesting modification of requirements to meet Water Right Decision 1641 objectives. The SWRCB issued orders allowing temporary changes to some of the water quality and flow objectives.

For more information about SWRCB drought-related actions, see Chapter 4, Water Quality.

### Emergency Drought Barrier

In 2015, in response to drought conditions, a temporary, emergency salinity/drought barrier was constructed in the Delta on West False River between Jersey and Bradford islands and just east of the confluence with the San Joaquin River. The purpose of the barrier was to limit the tidal push of saltwater from San Francisco Bay into the Central and South Delta, allowing Delta

water quality to be maintained and water in upstream reservoirs to be conserved. The barrier successfully allowed the SWP and the CVP to operate with reduced Sacramento River/Delta outflow, as approved by the SWRCB, while maintaining control of salinity in the Central Delta.

## SWP Allocations

DWR approved delivery of 0.42 maf on December 1, 2014, resulting in initial Table A amounts of 10 percent of SWP water contractor requests. On March 2, 2015, DWR increased the 2015 Table A amounts to 0.83 maf, for a final allocation of 20 percent.

## Water Supply Contract Extension Program

In May 2013, DWR and the SWP contractors began negotiations in a public forum to develop contract amendments to extend the term and change certain financial provisions of the water supply contracts. In June 2014, the negotiators for DWR and the SWP contractors reached a general agreement on principles for such an amendment. In 2015, DWR continued preparing a draft environmental impact report for the proposed contract extension amendment. For more information see Chapter 9, Water Contracts and Deliveries.

## Yearly Activities Summary

### 2015 Precipitation and Water Storage

#### *Precipitation and Mountain Snowpack in Water Year 2014–2015*

Water year 2014–2015 proved to be another dry year, the fourth consecutive year with less than average precipitation and mountain snowpack. The State received precipitation at 74 percent of average in water year 2014–2015 compared to 56 and 79 percent of average in water years 2013–2014 and 2012–2013, respectively. Though a below-average water year, the Northern Sierra 8-Station Precipitation Index had 37.2 inches of precipitation, which was 74 percent of average. The San Joaquin 5-Station Precipitation Index was 19 inches (47 percent of average), and the Tulare Basin 6-Station Precipitation Index was 13.6 inches (47 percent of average). The statewide mountain snowpack on April 1 was only 5 percent of average.

#### *River Runoff*

Statewide river runoff totaled 46 percent of average in the 2014–2015 water year. Runoff in the Sacramento River Region, the San Joaquin 4 Rivers, and the Tulare Lake Region was 51, 24, and 19 percent of average, respectively.

#### *Water Supply Indices*

The Sacramento Valley Water Year Hydrologic Classification and the San Joaquin Valley Water Year Hydrologic Classification were both "critical," based on observed data for water year 2014–2015.

#### *Water Year 2014–2015 Statewide Storage Totals*

Monthly storage totals for the major Sierra Nevada reservoirs began at 56 percent of average reservoir storage following a dry 2013–2014 water year. The percent of average storage dipped slightly in the fall and then rose through the winter, peaking at 71 percent of average at the end of February. During the next 5 months, storage dropped gradually to 54 percent of average in July where it remained through September.

#### *2015 Storage Totals in Major SWP Reservoirs*

End-of-year storage on December 31, 2015, in major SWP reservoirs and the State's share of joint-use reservoirs was 1.6 maf or 30 percent of maximum storage, compared to 2.3 maf or 43 percent of maximum storage

at the end of 2014. The average end-of-month total storage in major SWP reservoirs for 2015 was 2.2 maf.

## Diversions from the Delta

In 2015, the SWP diverted 837,421 acre-feet (af) at Banks Pumping Plant. There was no pumping for the Cross Valley Canal, and 8,380 af of CVP water was wheeled at Banks Pumping Plant by DWR during 2015.

Maximum daily Delta exports occurred on February 12 at 13,797 af. Combined SWP and CVP monthly Delta exports in 2015 varied from a high of 318,941 af in January to a low of 42,300 af in July. Delta exports totaled approximately 1.6 maf in 2015.

For more information, see Chapter 8, Water Supply.

## 2015 Water Supplies, Contracts, and Deliveries

### *2015 Water Deliveries*

In 2015, a total of 2,104,264 af of SWP and non-SWP water was delivered to 29 long-term SWP water contractors and 20 non-SWP agencies. The SWP portion totaled 1,336,889 af, and the non-SWP portion totaled 767,375 af.

The 1,336,889 af delivered to SWP water contractors was categorized as follows:

- 640,444 af of Table A water;
- 37,011 af of transfers and exchanges of Table A water;
- 3,000 af of Turn-Back or Multiyear Water Pool Program water;
- 131,990 af of carryover water;
- 690 af of Article 21 water;
- 347,852 af of water bank recovery;
- 128,871 af of delivery of backup water;
- 728 af of settlement water;
- 2 af of SWP water for parks and recreation;
- 12,025 af of 2013 Yuba Accord Dry Year Purchase Program water;
- 7,716 af of local water;
- 4,870 af of permit water; and
- 21,690 af of other non-SWP programs.

The 767,375 af portion delivered to 19 non-SWP agencies was categorized accordingly:

- 39,058 af of SWP contracted supply;
- 26,181 af of water bank recovery;
- 689,930 af of regulated delivery of local supply;
- 211 af for parks and recreation;
- 877 af for fish and wildlife;
- 10,455 af for Kern National Wildlife Refuge; and
- 663 af for annual contracts.

For more information, see Chapter 9, Water Contracts and Deliveries.

## Power Resources

SWP generation totaled 1,274,706 megawatt hours of energy in 2015. The SWP received a total of 2,780,640 megawatt hours of energy from other power resources and firm purchases under agreements and exchanges. There were no bilateral sales of energy in 2015. For detailed information, see Chapter 10, Power Resources.

The sidebar, State Water Project Power Generation and Consumption in 2015, summarizes amounts of power generated and consumed by the SWP.

### *Greenhouse Gas Management*

In 2015, DWR reported its pump load, sulfur hexafluoride emissions, and generation for 2014 to the California Air Resources Board. DWR's sulfur hexafluoride emissions were below the maximum allowable limit; however, because the allowable limit will be lower in future years, DWR is developing plans to reduce its sulfur hexafluoride emissions. DWR also reported its greenhouse

## State Water Project Power Generation and Consumption in 2015

| Power Generation and Consumption | Megawatt Hours |
|---|---|
| Energy generation by SWP facilities | 1,274,706 |
| Energy sources and firm purchases under agreements and exchanges | 2,780,640 |
| **Total Energy Available to the SWP** | 4,055,346 |
| Energy sales[a] | (566,888) |
| **Net SWP Power Consumption[b]** | 3,488,457 |

[a] Received under the Lodi Energy Center Power Sales Agreement as a purchase credit.
[b] Totals may not sum as expected due to rounding.

gas emissions for 2014 to The Climate Registry and submitted its fossil fuel report for 2014 to the Governor's Office.

For more information regarding DWR's management of greenhouse gas emissions, and its efforts to add renewable, greenhouse gas emission-free energy to the SWP's energy portfolio, see Chapter 10, Power Resources.

## Hydropower License Planning and Compliance

DWR holds three hydropower licenses and two conduit exemptions issued by the Federal Energy Regulatory Commission (FERC): Oroville Facilities, FERC Project No. 2100; South SWP Hydropower, FERC Project No. 2426; Pine Flat Transmission Line, FERC Project No. 2876; Alamo Powerplant Project, FERC Project No. 14579; and Mojave Siphon Powerplant Project, FERC Project No. 14580.

### *Oroville Facilities Relicensing*

On January 26, 2005, DWR filed an application with FERC requesting a new license for the Oroville Facilities (FERC Project No. 2100). The existing 50-year hydropower license expired January 31, 2007; FERC is issuing annual licenses under the same terms and conditions as the expired license until the new license is issued. Issuance of the new license has been delayed pending issuance of the National Marine Fisheries Service biological opinion.

For more information regarding events associated with Oroville Facilities relicensing in 2015, see Chapter 3, Environmental Programs; Chapter 6, Legislation and Litigation; Chapter 10, Power Resources; and Chapter 13, Recreation.

### *South SWP Hydropower*

In 2015, DWR initiated an extensive information gathering effort for the

pre-application document for the FERC relicensing of South SWP Hydropower. As a part of this effort, DWR mailed a notice and a questionnaire to agencies and potential stakeholders who may have an interest in the relicensing process. The questionnaire solicited information pertaining to the existing environment and potential effects of continued operation and maintenance of the South SWP Hydropower facilities. This information will be included in the pre-application document. The pre-application document and notice of intent for relicensing are due to FERC by January 31, 2017.

For more information about hydropower relicensing activities, see Chapter 10, Power Resources.

## Financial Analysis

In 2015, DWR continued to pay bondholders as scheduled. The SWP was financially viable and was indirectly paid for by the approximately 25 million water users served by the project. Direct payment was through the 29 long-term water contractors. In 2015, the SWP handled approximately $993 million in revenues and $993 million in expenses. The 2015 Income Statement for the State Water Project sidebar presents a summary of the year's revenues and expenses. For detailed information, see Chapter 14, Financial Analysis.

### 2015 Income Statement for the State Water Project

| **Revenues** | **Thousands of Dollars** |
|---|---|
| Water Contract Payments | 1,077,327 |
| Revenue Bond Cover Adjustments | (58,832) |
| Rate Management Adjustments | (40,470) |
| Other Revenues | 15,093 |
| **Total Operating Revenues** | **993,118** |
| **Expenses** | |
| Project Operations, Maintenance, Power, and Replacement | 637,202 |
| Deposits to Reserves | 53,047 |
| Water Bond Principal | 186,252 |
| Water Bond Interest | 116,616 |
| **Total Operating Expenses and Debt Service** | **993,118** |
| **Net System Revenues** | **0** |

## Engineering, Construction, and Real Estate

In 2015, engineering, construction, and real estate work to enhance, expand, repair, and protect the SWP and other facilities within the State continued. Significant projects included the Perris Dam remediation, the East Branch Extension Phase I Improvements and Phase II projects, Clifton Court Forebay radial gate repairs, the Emergency Drought Barriers Project, and the seismic retrofit of 23 bridges in the San Luis, San Joaquin, and Southern field divisions.

DWR worked on 65 construction contracts in various SWP construction divisions in 2015. Projects included pipeline repair, control system upgrades, fire systems modernization, equipment refurbishments and upgrades, seismic upgrades of bridges, maintenance facility improvements at dam and reservoir sites, and the addition of new pumping units and a reservoir.

DWR processed a net total of $7.02 million in payments in 2015 in support of right-of-way activities required for the construction, operation, and maintenance of the SWP. DWR also conducted real estate activities related to SWP acquisitions, temporary permits, property management, and appraisals.

For more information, see Chapter 12, Engineering, Construction, and Real Estate.

## Delta Resources and Environmental Issues

### *California WaterFix and California EcoRestore*

In April, DWR announced a new alternative that would replace the proposed Bay Delta Conservation Plan as the State's proposed project. The conveyance facility and habitat restoration measures proposed in the Bay Delta Conservation Plan would be separated into two distinct efforts—California WaterFix and California EcoRestore. Throughout the rest of the year, a number of regulatory processes were underway for California WaterFix.

### *Fish Restoration Program*

Pursuant to the U.S. Fish and Wildlife Service and National Marine Fisheries Service biological opinions and the Department of Fish and Wildlife Longfin Smelt incidental take permit, the Fish Restoration Program continued to make progress towards fulfilling its restoration requirements.

For more information about Delta resources and environmental issues, see Chapter 2, Delta Resources; Chapter 3, Environmental Programs; and Chapter 4, Water Quality Programs.

## Recreation

In 2015, SWP facilities supported an estimated 4.4 million recreation days of use, up 12.9 percent from the 3.9 million recorded in 2014. Most of the SWP recreation use was concentrated at the major reservoirs, with approximately 47 percent occurring in the Oroville Field Division and 38 percent occurring in the Southern Field Division. For more information, see Chapter 13, Recreation.

# SWP Security Measures

Security and protection of the SWP remain primary goals for DWR. SWP facilities are closely monitored, and DWR staff are vigilant in maintaining a secure environment. Security patrols of SWP facilities are frequent and ongoing, and plans are in place to address potential or actual acts of terrorism. Security system improvements continue in conjunction with Reclamation and other federal and State agencies.

# SWP Milestones through the Decades

## 50 Years Ago—1965

Construction began on Little Panoche Detention Dam and Reservoir.

Construction of Los Banos Detention Dam and Reservoir was completed.

Construction of the South Bay Aqueduct was completed in June and water deliveries began to Santa Clara County.

## 40 Years Ago—1975

An earthquake of magnitude 5.8 occurred in the Oroville area on August 1, 1975. A thorough earthquake safety investigation of the Oroville facilities was conducted, and the results were eventually published in Bulletin 203, "The August 1, 1975 Oroville Earthquake Investigations."

## 30 Years Ago—1985

Water deliveries to SWP long-term water contractors totaled 2,001,053 acre-feet, the largest amount delivered since the SWP began operating.

Construction of Alamo Powerplant was completed.

In March, a groundbreaking ceremony was held for the North Bay Aqueduct, Phase II.

## 20 Years Ago—1995

DWR relocated operational headquarters for the SWP from the Resources Building in downtown Sacramento to a renovated building north of downtown. The new Joint Operations Center would be shared with Reclamation, operators of the CVP, and the National Weather Service.

DWR began fishery studies on the lower Feather River to support the renewal of DWR's FERC license to operate the Oroville Facilities.

## 10 Years Ago—2005

On January 26, 2005, DWR submitted its application to FERC to renew the license for the Oroville Facilities.



# Chapter 1
# The State Water Project

*The California Aqueduct near Palmdale, California.*

This chapter primarily provides background on the State Water Project (SWP), including brief descriptions of SWP facilities, planning, construction, power operations, financing, contracting agencies, water deliveries, and the project's many uses and functions. It also provides a glimpse of California history, with a look at the processes and decisions that went into the creation of the largest state-built water project in the country.

Chapters 2 through 15 provide more detail on significant events and specific topics related to management of the SWP in calendar year 2015. At the end of the bulletin, Appendix B presents data and computations used to determine the SWP water contractors' Statements of Charges for 2017.

*Information in this chapter was contributed by the Division of Operations and Maintenance and the State Water Project Analysis Office.*

California's diverse geography contains both the highest and lowest elevations in the coterminous United States, with a resulting diversity of climate that ranges from desert to alpine to subtropical. In a typical year, some areas receive as little as 2 inches of rain, while others receive more than 100 inches. This diversity of geography and climate creates an intricate and constantly changing pattern of water supplies, which, in turn, creates enormous challenges in managing this vital resource.

## The State Water Project

Like present-day Californians, the earliest settlers faced the problem of how best to conserve, control, and deliver water. Remains of aqueducts, canals, and dams are still found near some of California's original missions. The first recorded aqueduct, built in 1770 to serve the San Diego mission, was 6 miles long. In the early twentieth century, several cities, including San Francisco and Los Angeles, built aqueducts to convey water from the Sierra Nevada to other parts of the State.

In 1951, after many years of discussion and study, the Legislature authorized construction of a water storage and supply system to capture and store rainfall and snowmelt runoff in Northern California and deliver it to areas of need throughout the State. Eight years later, the Legislature passed the Burns-Porter Act, which provided the mechanism for obtaining funds necessary to construct the initial State Water Project (SWP) facilities. In 1960, California voters approved issuance of $1.75 billion in general obligation bonds, as authorized in the act, thereby securing funds to build the SWP. In 1962, the first water was delivered through a portion of the South Bay Aqueduct to two long-term contracting agencies in Alameda County.

Today the SWP, built, operated, and managed by the Department of Water Resources (DWR), is the largest state-built, multipurpose, user-financed water project in the country. It was designed and built to deliver water, control flooding, generate power, provide recreational opportunities, and enhance habitat for fish and wildlife. SWP water irrigates about 750,000 acres of farmland, mainly in the southern San Joaquin Valley. Approximately 25 million of California's estimated 39 million residents benefit from SWP water.

## Precipitation and Runoff

The water stored and delivered by the SWP originates as rainfall and snowmelt runoff in Northern and Central California's watersheds, where most of the State's precipitation occurs. The precipitation, snowpack, and the rate and amount of snowmelt help determine how much water the SWP can deliver in any given year.

Since 1968, DWR has monitored and recorded annual precipitation and runoff for each water year, which begins on October 1 and ends on the following September 30.

## Water Delivery Facilities

The SWP depends on a complex system of dams, reservoirs, power plants, pumping plants, canals, and aqueducts to deliver water. Although initial water transportation facilities were essentially completed in 1973, other facilities have since been built, and still others are either under construction or are planned to be built, as needed.

The SWP facilities include 30 dams (29 of which impound water), 20 reservoirs, 29 pumping and generating plants, and approximately 700 miles of aqueducts and pipelines. Figure 1-1 shows the names and locations of primary water delivery facilities. For more information about existing long-term SWP water supply contracts and annual water deliveries, see Table 1-6 (at the end of this chapter) and Chapter 9, Water Contracts and Deliveries.

Changes have occurred since the long-term SWP water supply contracts were signed in the 1960s, including population growth, differences in local water use, local water conservation programs, conjunctive-use programs, and environmental issues. Demands for SWP water are expected to increase and change as California's population continues to grow and as the potentially serious effects of climate change impact the State's water resources.

## Project Design

Water from rainfall and snowmelt runoff is stored in SWP conservation facilities and delivered via SWP transportation facilities to water agencies and districts in the Upper Feather River, North Bay, South Bay, San Joaquin, Central Coastal, and Southern California areas.

Three small reservoirs—Antelope Lake, Lake Davis, and Frenchman Lake—are the northernmost SWP facilities. Situated on Feather River tributaries in Plumas County, these lakes are used primarily for recreation. They also provide water to the City of Portola and local agencies that have water rights agreements with DWR.

Downstream from these lakes lies Lake Oroville, which conserves water from the Feather River watershed. Created by Oroville Dam, the tallest earthfill dam in the Western Hemisphere, Lake Oroville is the project's largest storage facility with a capacity of approximately 3.5 million acre-feet (af).

Releases from Lake Oroville flow down the Feather River into the Sacramento River, which drains the northern portion of California's great Central Valley. The Sacramento River flows into the Sacramento-San Joaquin Delta, comprising 738,000 acres of land interlaced with channels that receive runoff from 40 percent of the State's land area. The SWP, federal Central Valley Project (CVP), and local agencies all divert water from the Delta.

From the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay Aqueduct, which was completed in 1988. Near Byron, in the southern Delta, the SWP diverts water into Clifton Court Forebay for delivery south of the Delta. Banks Pumping Plant lifts water from Clifton Court Forebay into the California Aqueduct, which flows to Bethany Reservoir. From Bethany Reservoir, the South Bay Pumping Plant lifts water into the South Bay Aqueduct to supply Alameda and Santa Clara counties. The South Bay Aqueduct provided initial deliveries in 1962 and has been fully operational since 1965.

Most of the water delivered to Bethany Reservoir from Banks Pumping Plant flows into the California Aqueduct. This 443-mile-long main aqueduct conveys water to the agricultural lands of the San Joaquin Valley and to the urban regions of Southern California.

The California Aqueduct winds along the west side of the San Joaquin Valley. It transports water to O'Neill Forebay, Gianelli Pumping-Generating Plant, and San Luis Reservoir. San Luis Reservoir has a storage capacity of more than 2 million af and is jointly owned by DWR and the Bureau of Reclamation (Reclamation). DWR's share of gross storage in the reservoir is 1,062,183 af. Generally, water is pumped into San Luis




**Figure 1-1** **Names and Locations of Primary Water Delivery Facilities, December 31, 2015**

Reservoir from late fall through early spring, where it is temporarily stored for release back to the California Aqueduct to meet summertime peaking demands of SWP and CVP water contractors.

SWP water not stored in San Luis Reservoir and water released from San Luis flows south through the San Luis Canal, a portion of the California Aqueduct jointly owned by DWR and Reclamation.

As the water flows through the San Joaquin Valley, numerous turnouts convey it to farmlands within the service areas of the SWP and CVP. Along its journey, this water is lifted more than 1,000 feet by four pumping plants—Dos Amigos, Buena Vista, Teerink, and Chrisman—before reaching the foot of the Tehachapi Mountains.

In the southern San Joaquin Valley, near Kettleman City, Phase I of the Coastal Branch Aqueduct serves agricultural areas west of the California Aqueduct. In August 1997, completion of Phase II extended the Coastal Branch Aqueduct to serve municipal and industrial water users in San Luis Obispo and Santa Barbara counties.

The remaining water conveyed by the California Aqueduct is delivered to Southern California, home to roughly two-thirds of California's population. Before it can be delivered, the water must first cross the Tehachapi Mountains. Fourteen 80,000-horsepower pumps at Edmonston Pumping Plant, situated at the foot of the mountains, raise the water 1,926 feet—the highest single lift of any pumping plant in the world. The water enters 8.5 miles of tunnels and siphons as it flows into Antelope Valley, where the California Aqueduct divides into two branches: the East Branch and the West Branch.

The East Branch carries water through Alamo Powerplant, Pearblossom Pumping Plant, and Mojave Siphon Powerplant into Silverwood Lake in the San Bernardino Mountains. From Silverwood Lake, water flows through the San Bernardino Tunnel to Devil Canyon Powerplant. Water continues down the East Branch through the Santa Ana Pipeline to Lake Perris, the southernmost SWP reservoir.

The East Branch Extension is a nearly 33-mile pipeline linking parts of service areas for San Bernardino Valley Municipal Water District and San Gorgonio Pass Water Agency to the California Aqueduct. The East Branch Extension, Phase I, carries water from Devil Canyon Powerplant Afterbay to Cherry Valley, bringing water to Yucaipa, Calimesa, Beaumont, Banning, and other communities. Phase II, when completed, will assist with this delivery.

Water in the West Branch flows through Oso Pumping Plant, Quail Lake, and then from the Peace Valley Pipeline through Warne Powerplant into Pyramid Lake in Los Angeles County. From there it flows through the Angeles Tunnel, Castaic Powerplant, Elderberry Forebay, and into Castaic Lake, terminus of the West Branch. Castaic Powerplant is operated by the Los Angeles Department of Water and Power.

The energy needed to operate the SWP, the largest single user of electrical power in California, comes from a combination of its own hydroelectric generating plants and power purchased from and exchanged with other utilities. The project's eight hydroelectric power plants, including four pumping-generating plants, produce enough electricity in a normal year to supply about two-thirds of the SWP's necessary operating power.

Tables 1-1 through 1-5, on the following pages, present statistical information about primary storage facilities, primary dams, pumping plants, power plants, and aqueducts.

## Future Planning and Construction

The planning, design, and construction of SWP facilities were based on studies and analyses that projected SWP water contractor annual water delivery needs. To meet these projected needs, water conservation reservoirs, storage facilities, and delivery facilities were planned to be constructed in stages as demands for water increased. Lake Oroville and San Luis Reservoir were the first SWP conservation reservoir facilities constructed. Additional facilities were scheduled to meet increased demands. It was anticipated that population growth in delivery service areas and water supply areas of origin would influence the final schedule for SWP facilities. Increasingly, issues such as escalating costs, environmental concerns, and increased non-SWP demand for limited water supplies have become important factors affecting the planning and construction of new facilities.

In response to changes in water management policy, DWR continues to reassess plans for additional facilities that will incorporate increased environmental safeguards, while also increasing SWP delivery yield. Developing these plans involves the time-consuming process of finding technically suitable projects and satisfying many complex and dynamic environmental procedures, laws, and regulations.

For more information about current SWP planning and construction, see Chapter 12, Engineering, Construction, and Real Estate. Information about prior construction activities can be found in previous issues of Bulletin 132.

**Table 1-1 Physical Characteristics of Primary Storage Facilities**

| Facility | Gross Capacity (acre-feet) | Surface Area (acres) | Shoreline (miles) |
|---|---|---|---|
| Antelope Lake | 22,600 | 930 | 15 |
| Frenchman Lake | 55,500 | 1,580 | 21 |
| Lake Davis | 84,400 | 4,030 | 32 |
| Lake Oroville | 3,537,600 | 15,810 | 167 |
| Thermalito Forebay | 11,800 | 630 | 10 |
| Thermalito Afterbay | 57,000 | 4,300 | 26 |
| Thermalito Diversion Pool | 13,400 | 320 | 10 |
| Clifton Court Forebay | 31,300 | 2,180 | 8 |
| Bethany Reservoir | 5,100 | 180 | 6 |
| Lake del Valle | 77,100 | 1,060 | 16 |
| San Luis Reservoir[a] | 2,027,800 | 12,520 | 65 |
| O'Neill Forebay[b] | 56,400 | 2,700 | 12 |
| Los Banos Reservoir | 34,600 | 620 | 12 |
| Little Panoche Reservoir | 5,600 | 190 | 6 |
| Quail Lake | 7,600 | 290 | 3 |
| Pyramid Lake | 171,200 | 1,300 | 21 |
| Elderberry Forebay | 32,500 | 500 | 7 |
| Castaic Lake | 323,700 | 2,240 | 29 |
| Silverwood Lake | 75,000 | 980 | 13 |
| Lake Perris | 131,500 | 2,320 | 10 |

[a] DWR's share of storage in San Luis Reservoir, jointly owned with Reclamation, is 1,062,183 af.
[b] DWR's share of storage in O'Neill Forebay is 29,500 af.

## Climate Change

Planners are also concerned about climate change and its potentially serious effects on water resources. Temperature increases may affect water demand and aquatic ecosystems. Projected increases in air temperature may lead to changes in the amount, timing, and form of precipitation—rain or snow; changes in the volume and timing of runoff; Delta water quality changes due to sea-level rise; and changes in the amount of irrigation water needed due to modified evapotranspiration rates.

The ability of the SWP and CVP to meet the water demands of their customers and the environment depends on the accumulation of mountain snowpack and subsequent spring and summer snowmelt runoff. A warming climate may reduce this natural water storage mechanism.

## Table 1-2 Physical Characteristics of Primary Dams

| Facility | Crest Elevation (feet) | Structural Height (feet) | Crest Length (feet) | Structural Volume (thousand cubic yards) |
|---|---|---|---|---|
| Antelope | 5,025 | 120 | 1,320 | 380 |
| Frenchman | 5,607 | 139 | 720 | 537 |
| Grizzly Valley | 5,785 | 132 | 800 | 253 |
| Oroville | 922 | 770 | 6,920 | 80,000 |
| Thermalito Diversion | 233 | 143 | 1,300 | 154 |
| Thermalito Forebay | 231 | 91 | 15,900 | 1,840 |
| Thermalito Afterbay | 142 | 39 | 42,000 | 5,020 |
| Clifton Court Forebay | 14 | 30 | 36,500 | 2,440 |
| Bethany | 250 | 121 | 3,940 | 1,400 |
| Del Valle | 773 | 235 | 880 | 4,150 |
| Sisk | 544 | 385 | 18,600 | 77,664 |
| O'Neill Forebay | 233 | 88 | 14,300 | 2,877 |
| Los Banos Detention | 384 | 167 | 1,370 | 2,100 |
| Little Panoche Detention | 676 | 152 | 1,440 | 1,210 |
| Pyramid | 2,606 | 400 | 1,090 | 6,860 |
| Elderberry Forebay | 1,550 | 200 | 1,990 | 6,000 |
| Castaic | 1,535 | 425 | 4,900 | 46,000 |
| Cedar Springs | 3,378 | 249 | 2,230 | 7,600 |
| Perris | 1,600 | 128 | 11,600 | 20,000 |
| Crafton Hills | 2,932 | 95 | 500 | 144 |

## Table 1-3 Pumping Plant Characteristics

| Facility | Number of Units | Normal Static Head (ft)[a] | Total Flow at Design Head (cfs)[a] | Total Motor Rating (hp)[a] |
|---|---|---|---|---|
| Robie Thermalito | 3 (p-g)[b] | 85-102 | 9,120 | 120,000 |
| Hyatt | 3 (p-g)[b] | 500-625 | 5,610 | 519,000 |
| Barker Slough | 9 | 95-120 | 228 | 4,800 |
| Cordelia | 11 | 138 | | |
| Banks | 11 | 236-252 | 10,670 | 333,000 |
| South Bay | 9 | 566 | 330 | 27,750 |
| Del Valle | 4 | 0-38 | 120 | 1,000 |
| Gianelli | 8 (p-g)[b] | 99-327 | 11,000 | 504,000 |
| Dos Amigos | 6 | 107-125 | 15,450 | 240,000 |
| Las Perillas | 6 | 55 | 461 | 4,050 |
| Badger Hill | 6 | 151 | 454 | 11,750 |
| Devil's Den[c] | 6 | 521 | 134 | 10,500 |
| Bluestone[c] | 6 | 484 | 134 | 10,500 |
| Polonio Pass[c] | 6 | 533 | 134 | 10,500 |
| Buena Vista[c] | 10 | 205 | 5,405 | 144,500 |
| Teerink[c] | 9 | 233 | 5,445 | 150,000 |
| Chrisman[c] | 9 | 518 | 4,995 | 330,000 |
| Edmonston[c] | 14 | 1,926 | 4,480 | 1,120,000 |
| Oso | 8 | 231 | 3,252 | 93,800 |
| Pearblossom | 9 | 540 | 2,575 | 203,200 |
| Greenspot | 4 | 382 | 50 | 3,900 |
| Crafton Hills | 3 | 613 | 40 | 4,000 |
| Cherry Valley | 2 | 130 | 75 | 300 |

[a] Feet=ft; cubic feet per second=cfs; horse power=hp.
[b] The term p-g indicates pumping-generating units.
[c] These plants have one unit in reserve.

## Table 1-4 Power Plant Characteristics, by Facility

| Hydroelectric Facility | Number of Units | Normal Static Head (ft)[a] | Total Flow at Design Head (cfs)[a] | Net Dependable Capacity (MW)[a] | Nameplate Capacity (MW)[a] |
|---|---|---|---|---|---|
| Thermalito Diversion Dam | 1 | 63-77 | 615 | 3 | 3 |
| Robie Thermalito | 4 (3 p-g)[b] | 85-102 | 17,400 | 114 | 114 |
| Hyatt | 6 (3 p-g)[b] | 410-676 | 16,950 | 645 | 645 |
| Gianelli (total) | 8 p-g[b] | 99-327 | 16,960 | 363 | 424 |
| Warne | 2 | 719-739 | 1,600 | 67 | 74 |
| Castaic[c] | 7 (6 p-g)[b] | 900-1,050 | 20,820 | 1,128 | 1,254 |
| Alamo | 1 | 115-141 | 1,740 | 15 | 17 |
| Mojave Siphon | 3 | 81-136 | 2,880 | 29 | 30 |
| Devil Canyon | 4 | 1,406 | 2,940 | 235 | 276 |

[a] Feet=ft; cubic feet per second=cfs; megawatts=MW.
[b] The term p-g indicates pumping-generating units.
[c] Castaic Pumping-Generating Plant is owned and operated by the Los Angeles Department of Water and Power.

## Table 1-5 Total Miles of Aqueducts

| Facility | Channel and Reservoir | Canal and Siphon | Pipeline and Discharge Line | Tunnel | Total |
|---|---|---|---|---|---|
| Grizzly Valley Pipeline | 0.0 | 0.0 | 6.0 | 0.0 | 6.0 |
| Thermalito Power Canal and Tail Channel | 1.5 | 1.9 | 0.0 | 0.0 | 3.4 |
| North Bay Aqueduct | 0.0 | 0.0 | 27.6 | 0.0 | 27.6 |
| South Bay Aqueduct (including Del Valle Branch) | 0.3 | 10.7 | 31.9 | 1.7 | 44.6 |
| *Subtotal* | *1.8* | *12.6* | *65.5* | *1.7* | *81.6* |
| California Aqueduct | | | | | |
| Clifton Court Forebay to O'Neill Forebay | 4.5 | 61.9 | 0.3 | 0.0 | 66.7 |
| O'Neill Forebay to Kettleman City | 4.1 | 101.4 | 0.2 | 0.0 | 105.7 |
| Kettleman City to Edmonston Pumping Plant | 0.0 | 120.1 | 0.9 | 0.0 | 121.0 |
| Edmonston Pumping Plant to Tehachapi Afterbay | 0.0 | 0.2 | 1.9 | 7.9 | 10.0 |
| Tehachapi Afterbay to Lake Perris | 4.0 | 97.8 | 34.3 | 3.9 | 140.0 |
| *Subtotal* | *12.6* | *381.4* | *37.6* | *11.8* | *443.4* |
| California Aqueduct Branches | | | | | |
| Coastal Branch | 0.0 | 14.1 | 98.7 | 2.7 | 115.5 |
| West Branch | 9.7 | 9.3 | 5.8 | 7.1 | 31.9 |
| East Branch Extension | | | | | |
| Devil Canyon Powerplant to Greenspot Pump Station | 0.0 | 0.0 | 16.2 | 0.0 | 16.2 |
| Greenspot Pump Station to Noble Creek Terminus | 0.0 | 0.0 | 16.4 | 0.0 | 16.4 |
| *Subtotal* | *9.7* | *23.4* | *137.1* | *9.8* | *180.0* |
| **Total** | **24.1** | **417.4** | **240.2** | **23.3** | **705.0** |

To address these concerns, DWR and Reclamation are coordinating with federal, State, and local agencies and nongovernmental organizations to provide qualitative and quantitative assessments of the potential risks and effects of climate change on California's water resources and update decision makers on climate change impacts, the ability of existing facilities to accommodate these impacts, and available mitigation measures.

In response to changes brought about by population growth, environmental concerns, climate change, and other factors, DWR continues to plan, design, and construct transportation and power-producing facilities for the SWP.

For more information on climate change, see Chapter 3, Environmental Programs.

## Methods of Financing

Project facilities have been constructed with several general types of financing: general obligation bonds and tideland oil revenues (under the Burns-Porter Act, which was approved by the Legislature in 1959, and the bond issue approved by voters in 1960); revenue bonds; and capital resources revenues. Repayment of these funds, and the operations, maintenance, power, and replacement costs associated with water supply, are paid by the 29 agencies and districts that have long-term contracts with DWR for the delivery of SWP water.

## Long-term Contracting Agencies

From 1963 through 1967, 32 agencies or districts signed long-term water supply contracts with DWR. However, in 1965, the City of West Covina was annexed to The Metropolitan Water District of Southern California, and in 1981, Hacienda Water District was assigned to Tulare Lake Basin Water Storage District. On January 1, 1992, Castaic Lake Water Agency assumed all rights and obligations granted to Devil's Den Water District in accordance with its long-term water supply contract. Therefore, only 29 agencies and districts have long-term contracts with DWR as of December 31, 2015.

The contracts initially provided for a combined maximum annual Table A amount of 4,230,000 af of water supply. As a result of contract amendments in the 1980s and the Monterey Amendment, the current combined maximum annual Table A amount by 2016 totals 4,172,786 af (see Appendix B, Table B-4 for details). The contracts are in effect for the longest of the following periods:

- the project repayment period, which extends to the year 2035;
- 75 years from the date of the contract; or
- the period ending with the latest maturity date of any bond used to finance the construction costs of project facilities.

Figure 1-2 shows the name and location of each contracting agency and district and lists the first year of SWP delivery service for each. Table 1-6 presents more detailed information about each contracting agency.

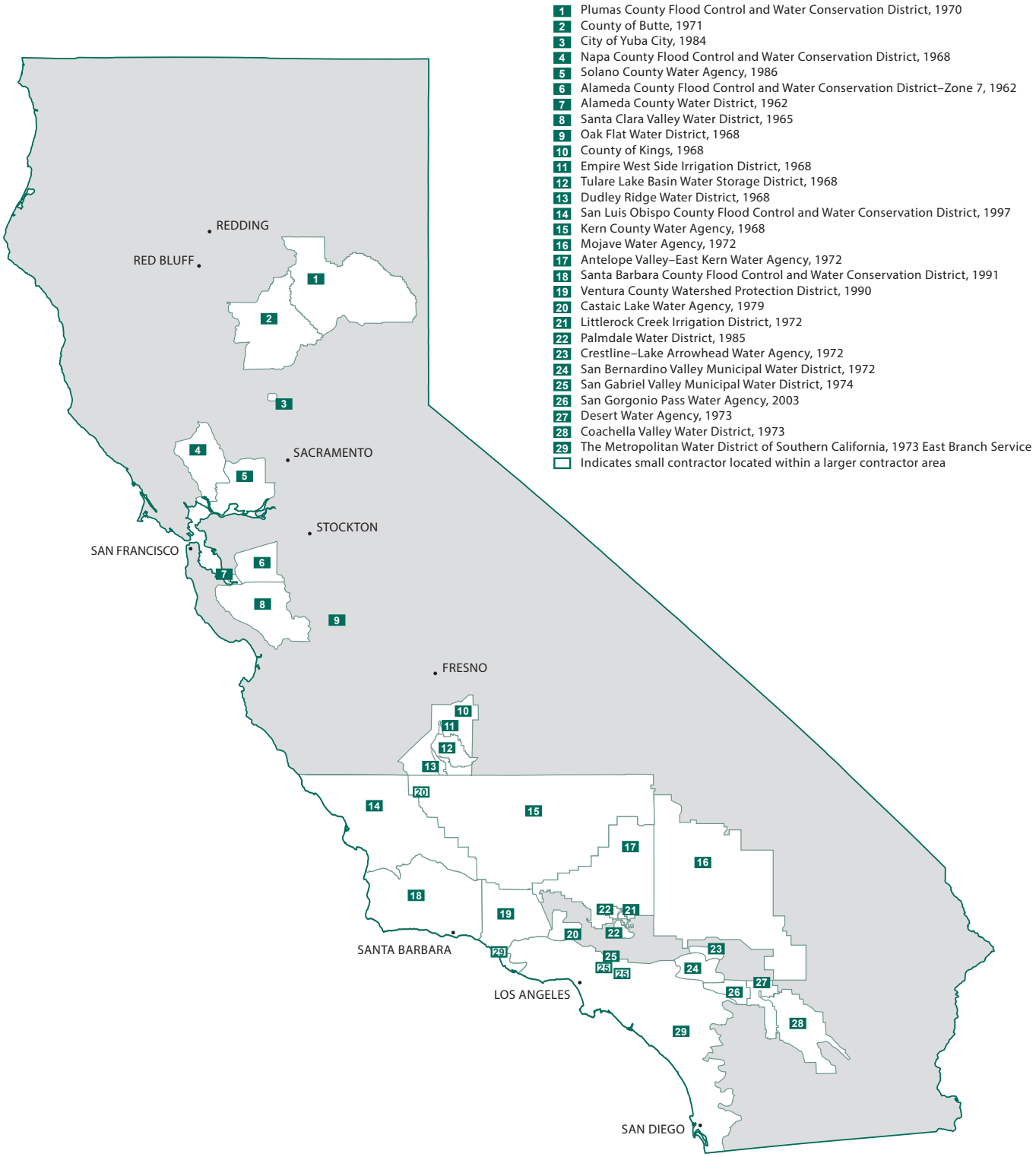



**Figure 1-2 Names, Locations, and First Year of Service of SWP Long-term Contracting Agencies, December 31, 2015**

## Table 1-6 Long-term Water Supply Contracting Agencies, by Area, as of December 31, 2015

| Contracting Agency | Cumulative Deliveries (acre-feet)[a] | Annual Table A (acre-feet) | Payments (in dollars)[h] | Gross Area (acres) | Assessed Valuation (in dollars)[b] | Estimated Population |
|---|---|---|---|---|---|---|
| **Upper Feather River Area** | | | | | | |
| City of Yuba City | 48,278 | 9,600 | 7,873,848 | 9,813 | 4,644,427,541 | 68,379 |
| County of Butte | 71,336 | 27,500 | 9,052,441 | 1,049,280 | 18,070,400,000 | 204,000 |
| Plumas County Flood Control and WCD | 12,682 | 2,600 | 2,446,628 | 1,676,056[c] | 2,060,744,342 | 21,200 |
| *Subtotal* | *132,296* | *39,700* | *19,372,917* | *2,735,149* | *24,775,571,883* | *293,579* |
| **North Bay Area** | | | | | | |
| Napa County Flood Control and WCD | 330,766 | 29,025 | 131,748,551 | 510,010 | 32,556,091,444 | 139,099 |
| Solano County Water Agency | 864,171 | 47,756 | 177,496,682 | 581,760 | 38,800,000 | 415,913 |
| *Subtotal* | *1,194,937* | *76,781* | *309,245,233* | *1,091,770* | *32,594,891,444* | *555,012* |
| **South Bay Area** | | | | | | |
| Alameda County Flood Control and WCD–Zone 7 | 1,627,505 | 80,619 | 343,053,094 | 275,900 | 49,415,658,709 | 238,600 |
| Alameda County Water District | 1,323,944 | 42,000 | 147,793,517 | 67,200 | 52,665,888,864 | 343,499 |
| Santa Clara Valley Water District | 4,228,293 | 100,000 | 442,718,304 | 835,098 | 357,340,668,642 | 1,889,638 |
| *Subtotal* | *7,179,742* | *222,619* | *933,564,915* | *1,178,198* | *459,422,216,215* | *2,471,737* |
| **San Joaquin Valley Area** | | | | | | |
| County of Kings | 160,675 | 9,305 | 11,237,460 | 893,300 | 9,125,193,927 | 149,942 |
| Castaic Lake Water Agency | 452,315 | 0 | | 8,700[e] | 4,532,936 | 0 |
| Dudley Ridge Water District | 2,403,862 | 45,350 | 103,582,401 | 37,600 | 54,549,134 | 36 |
| Empire West Side Irrigation District | 123,459 | 3,000 | 5,141,959 | 7,500 | [d] | 12 |
| Kern County Water Agency | 37,640,496 | 982,730 | 2,313,522,906 | 5,224,000 | 97,800,000,000 | 874,589 |
| Oak Flat Water District | 214,165 | 5,700 | 8,501,545 | 4,500 | [d] | 10 |
| Tulare Lake Basin Water Storage District | 4,940,659 | 87,471 | 198,766,489 | 189,519 | 194,000,000 | 23 |
| *Subtotal* | *45,935,631* | *1,133,556* | *2,640,752,760* | *6,365,119* | *107,178,275,997* | *1,024,612* |
| **Central Coastal Area** | | | | | | |
| San Luis Obispo County Flood Control and WCD | 82,005 | 25,000 | 104,992,994 | 2,122,240 | 45,457,307,011 | 279,083 |
| Santa Barbara County Flood Control and WCD | 384,956 | 45,486 | 707,417,165 | 193,391 | 29,732,075,614 | 373,719 |
| *Subtotal* | *466,961* | *70,486* | *812,410,159* | *2,315,631* | *75,189,382,625* | *652,802* |
| **Southern California Area** | | | | | | |
| Antelope Valley-East Kern Water Agency | 2,092,783 | 144,844 | 602,366,100 | 1,525,120 | 26,661,474,279 | 397,634 |
| Castaic Lake Water Agency | 1,070,977 | 95,200 | 392,719,453 | 124,800 | 36,211,395,525 | 274,000 |
| Coachella Valley Water District | 1,424,027 | 138,350 | 581,721,838 | 639,857 | 56,981,130,446 | 318,000 |
| Crestline-Lake Arrowhead Water Agency | 60,972 | 5,800 | 31,630,110 | 54,900 | 2,249,739,339 | 29,000 |
| Desert Water Agency | 1,282,170 | 55,750 | 335,592,519 | 209,760 | 9,131,393,000 | 72,000 |
| Littlerock Creek Irrigation District | 18,881 | 2,300 | 7,724,225 | 10,000 | 388,056,000 | 2,900 |
| The Metropolitan WD of Southern California | 36,677,626 | 1,911,500 | 11,950,174,613 | 3,315,238[f] | 2,435,000,264,069 | 18,800,000 |
| Mojave Water Agency | 411,813 | 85,800 | 337,983,933 | 3,136,000 | 30,898,552,936 | 469,000 |
| Palmdale Water District | 282,683 | 21,300 | 96,384,919 | 119,680 | 1,414,494,581 | 114,533 |
| San Bernardino Valley Municipal Water District | 983,488 | 102,600 | 725,351,822 | 225,577 | 42,950,247,633 | 661,546 |
| San Gabriel Valley Municipal Water District | 433,656 | 28,800 | 184,087,092 | 18,297 | 16,850,589,307 | 197,636 |
| San Gorgonio Pass Water Agency | 66,687 | 17,300 | 188,877,795 | 140,800 | 5,708,130,719 | 78,268 |
| Ventura County Watershed Protection District | 69,905 | 20,000 | 73,836,389 | 308,252 | 25,483,476,833 | 464,600 |
| *Subtotal* | *44,875,668* | *2,629,544* | *15,508,450,808* | *9,828,281* | *2,689,928,944,667* | *21,879,117* |
| **Total** | **99,785,235** | **4,172,686** | **20,223,796,792** | **23,514,148[g]** | **3,389,089,282,831** | **26,876,859** |

[a] All water delivered to long-term SWP water contractors, including carryover, Article 21, surplus, unscheduled, exchange, permit, purchased, local, and non-SWP water.
[b] Statutes of 1978, Chapter 1207, added Section 135 to the Revenue and Taxation Code, requiring assessment at 100 percent of full value for the 1981–1982 fiscal year and fiscal years thereafter.
[c] Total of all Plumas County Flood Control and Water Conservation District, including Last Chance Creek Water District.
[d] Assessed valuation not available on an agency area breakdown.
[e] Castaic Lake Water Agency (Southern California Area) includes land in the San Joaquin Valley Area formerly known as Devil's Den Water District.
[f] Total for Metropolitan, including Calleguas Municipal Water District, which is common to Metropolitan and Ventura County Watershed Protection District.
[g] Includes duplicate values. Some areas that are within two or more agencies are included in each agency's total.
[h] Includes all payments pursuant to the repayment provisions of the Water Supply Contracts. Transportation and Conservation Replacement Accounting System payments are also included in this table.
WD = Water District; WCD = Water Conservation District



# Chapter 2
# Delta Resources

*Waterways and wetlands of the Sacramento-San Joaquin Delta at Sherman Island.*

## Significant Events in 2015

In April, the Governor announced a major change for the project known as the Bay Delta Conservation Plan (BDCP). A new preferred alternative (Alternative 4A) proposed to construct water conveyance facilities through an initiative called California WaterFix.

In response to drought conditions, a temporary, emergency salinity/drought barrier was constructed in the Delta on West False River between Jersey and Bradford islands to limit saltwater intrusion into the Central and South Delta from San Francisco Bay.

The West Delta Program completed construction of the Sherman Island Whale's Mouth Wetland Restoration Project, a 650-acre wetland on the lower southwest side of Sherman Island.

*Information for this chapter was contributed by the FloodSAFE Environmental Stewardship and Statewide Resources Office, the Bay-Delta Office, and the Division of Flood Management.*

The Sacramento-San Joaquin Delta (Delta) is a unique environmental resource and a major source of water for millions of Californians. Since the 1950s, the Department of Water Resources (DWR) and other State and federal agencies have developed and implemented numerous programs to manage the Delta.

## Delta Water Management Programs

Future water deliveries to millions of Californians throughout the State will be affected by many factors, including two significant changes: Delta pumping restrictions and climate change. Ongoing planning activities and regulatory actions continue to influence DWR activities in the Delta. As a result of the efforts associated with the California Water Fix and California EcoRestore (these two programs replaced the Bay Delta Conservation Plan [BDCP]), and the Delta Stewardship Council's (DSC) *Delta Plan*, many of DWR's proposed projects were suspended as staff continued to work on the State Water Project (SWP) Delta Compliance Program.

## BDCP/California WaterFix

In April 2015, the Governor announced a major change for the project known as the BDCP. A new preferred alternative (Alternative 4A) to the BDCP would not complete BDCP as a Natural Community Conservation Plan, but instead construct water conveyance facilities through an initiative called California WaterFix. A parallel effort called California EcoRestore proposes to implement habitat restoration actions in the Delta. California WaterFix is being developed in compliance with the federal Endangered Species Act.

For more information regarding BDCP/California WaterFix, see Chapter 3, Environmental Programs.

## Emergency Drought Barrier

In 2015, in response to drought conditions, a temporary, emergency salinity/drought barrier was constructed in the Delta on West False River between Jersey and Bradford islands and just east of the confluence with the San Joaquin River. The barrier would limit saltwater intrusion into the Central and South Delta from San Francisco Bay, allowing Delta water quality to be maintained and water in upstream reservoirs to be conserved. The barrier, built with large rocks, measured approximately 750 feet long and 12 feet wide at the top. Installation started in May and was completed in June, and removal started in September and was completed in November. The barrier successfully allowed the SWP and CVP to operate with reduced Sacramento River/ Delta outflow, as approved by the SWRCB, while maintaining control of salinity in the Central Delta. A comprehensive efficacy report is being prepared by DWR and is planned to be completed by January 2017.

For more information see Chapter 4, Water Quality Programs, and Chapter 7, Water Supply Development & Reliability.

## Delta Plan

The *Delta Plan*, adopted by the DSC in May 2013 in compliance with the Delta Reform Act of 2009, is a comprehensive, long-term management plan for the Delta. It became effective with legally enforceable regulations in September 2013. (For more information, see the sidebar, Delta Stewardship Council.)

## Delta Stewardship Council

Created by the Legislature under the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act), the Delta Stewardship Council (DSC) is an independent agency of the State of California composed of members who represent different parts of the State and offer diverse expertise in fields such as agriculture, science, the environment, and public service. Of the seven members, four are appointed by the Governor, one each is appointed by the Senate and by the Assembly, and the seventh is the Chair of the Delta Protection Commission. The council is the successor to the California Bay-Delta Authority and assumes all of its administrative rights, abilities, obligations, and duties.

The *Delta Plan* was adopted by the DSC on May 16, 2013. It became effective with legally enforceable regulations on September 1, 2013. The *Delta Plan* is a comprehensive, long-term management plan for the Sacramento-San Joaquin Delta. It establishes a set of integrated policies, strategies, and actions to guide State and local agencies to help achieve the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. It will also guide protection and enhancement of the unique resources, culture, and values of the Delta as an evolving place (California Water Code Section 85054).

The Delta Reform Act specifies eight policy objectives that are "inherent" in the coequal goals (see California Water Code Section 85020). It also specifies a statewide policy to reduce reliance on the Delta in meeting the State's future water supply needs through improved regional water self-reliance (California Water Code Section 85021) and identifies specific subjects and strategies that must be included in the *Delta Plan* (see generally, California Water Code Sections 85301–85309).

The Delta Reform Act also established the Delta Science Program and Delta Independent Science Board (ISB) to provide the scientific support and oversight the DSC needs to make decisions based on sound science. The Delta Science Program replaces the CALFED Bay-Delta Program Science Program, and the Delta ISB replaces the CALFED Bay-Delta Program ISB.

The Delta Science Program will develop scientific information and synthesis on issues critical to managing the Bay-Delta system. That body of knowledge must be unbiased, relevant, authoritative, integrated across State and federal agencies, and communicated to Bay-Delta decision makers, agency managers, stakeholders, the scientific community, and the public. The *Delta Science Plan* released by the DSC in December 2013, provides a guide for organizing, conducting, and integrating science in the Delta. A Science Action Agenda will be a key component of implementing the *Delta Science Plan.*

The Delta ISB is a standing board of nationally and internationally prominent scientists with appropriate expertise to evaluate the broad range of scientific programs that support adaptive management of the Delta. The Delta ISB will provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic reviews of each of those programs. The overall objective of Delta ISB oversight is to ensure that the science supporting Bay-Delta programs, the application of that science, and the technical aspects of the Bay-Delta programs are optimally developed and implemented.

More information about the *Delta Plan* is available on the DSC's website.

## State Water Project Delta Compliance Program

The SWP and Central Valley Project (CVP) obtained take authorization for the federal Endangered Species Act and California Endangered Species Act listed fish species for coordinated operations in the Delta through a U.S. Fish and Wildlife Service biological opinion (BiOp) for Delta Smelt in December 2008, a Department of Fish and Wildlife incidental take permit for Longfin Smelt in February 2009, and a National Marine Fisheries Service (NOAA Fisheries) BiOp for salmon, steelhead, and Green Sturgeon in June 2009. Some of the requirements in these documents were implemented right away, while others needed development of studies and projects before being implemented.

In 2015, efforts continued under the SWP Delta Compliance Program to develop studies and construct projects to address regulatory requirements under the NOAA Fisheries and U.S. Fish and Wildlife Service BiOps and the Department of Fish and Wildlife incidental take permit.

### Predation, Release, and Efficiency Program

The predation, release, and efficiency program includes improving existing fish salvage release sites, developing additional fish salvage release sites, assessing predation reduction alternatives, continuing the associated predation study for Clifton Court Forebay, and evaluating the screening efficiency of the Skinner Fish Facility to comply with the requirements under the BiOps and incidental take permit. These requirements include:

- reducing prescreen loss of federal Endangered Species Act-protected salmon and steelhead in Clifton Court Forebay to no more than 40 percent (Prescreen loss is the loss of fish as they move across the forebay that results from predation by fish and birds.);
- reducing predation by 50 percent at the fish release sites;
- implementing fish release site studies to develop methods to reduce predation following release of salvaged fish; and
- identifying salvage deficiencies and recommending actions to improve salvage efficiency in order to meet a required efficiency goal of 75 percent for salmonids.

#### *Fish Science Building*

The addition of the Fish Science Building at the Skinner Fish Facility was essential to improve DWR's ability to conduct fish studies to meet regulatory requirements for operation of the SWP. The existing collection, handling, transport, and release building was too small and lacked the necessary equipment to hold and rear fish to carry out various studies and projects. The new building includes a small laboratory, fish rearing tanks, an office, and an area to store study gear and equipment. Construction of the Fish Science Building was initiated in 2013 and completed in 2014. It became fully operational in 2015, supporting numerous fishery studies related to the BiOps.

#### *Fish Salvage Release Sites*

The predation reduction strategy for the release sites includes designing and constructing the Curtis Landing fish release site with minimal in-water structure to reduce predation and improve survival of released salvaged fish. Two new fish release sites will be built on Sherman Island so that more time can be allowed between releases at each site. Coordinated interagency use will occur at a total of six release sites.

Construction of the major components of the Curtis Landing fish release site was

completed in 2014, and the facility became fully operational in 2015. Design of the two new Sherman Island sites was completed in 2014, all permits were obtained, and construction was initiated in fall 2015. A cost-sharing agreement with DWR's Delta Levees Program for these two sites was also implemented for the levee construction portion of this project.

### *Clifton Court Forebay Fishing Facility*

The predation reduction strategy for Clifton Court Forebay was to increase public fishing opportunities in the forebay, with the intention of reducing the number of predatory fish and the prescreen loss of federal Endangered Species Act-protected salmon and steelhead. This strategy involved constructing a fishing pier to provide improved access to anglers.

During 2014, changes were made to Conservation Measure 1 of the BDCP that conflicted with the fishing pier project and would have effectively prevented public access to the fishing pier. The project was indefinitely suspended, and DWR, in close coordination with NOAA Fisheries, analyzed other predator reduction alternatives in 2015 (as described in the Ad Hoc Studies section below).

The predator study continued in 2015. The study is designed to gather as much information as possible, pre- and post-installation of the proposed fishing facility, to document the behavior and population demographics of predatory fish and birds, as well as salmonid survival. Full-scale predator sampling and acoustic tagging, avian surveys, creel surveys, and releases of marked salmon were conducted. Pilot-level genetic analysis of predator stomach contents also continued in 2015.

### *Ad Hoc Studies*

Subsequent to the suspension of the fishing facility project, and as a result of numerous meetings with NOAA Fisheries and DWR's ongoing responsibility to reduce prescreen loss of listed fish species, DWR embarked on a study of more than 21 alternatives to reduce predation in the forebay. NOAA Fisheries identified six preferred alternatives and provided a ranking of these alternatives. In addition, NOAA Fisheries approved an extension for compliance with the BiOp requirement conditioned on DWR completing four interim measures to reduce predation in the forebay. DWR immediately initiated planning of the four interim measures:

- electrofishing the forebay;
- controlling aquatic weeds;
- establishing a fishing incentive program; and
- implementing operational changes to limit take.

DWR also initiated an in-depth study of various dredging proposals for the forebay that could contribute to the survival of listed fish species.

Additional information about CVP/SWP operations related to the BiOps can be found in Chapter 3, Environmental Programs.

### *Skinner Fish Facility*

The strategy for determining the screening efficiency of the Skinner Fish Facility includes evaluating:

- fish losses through primary louvers, secondary louvers, and holding tanks;
- hydraulics within the facility;
- relative abundance of predators within the primary louver channels; and
- fish behavior and movement patterns as they are entrained and guided through the facility.

During 2015, the technical team continued to evaluate and recommend revisions to the SWP and CVP fish loss equations used at the

respective facilities. Other efforts included construction and installation of new stainless steel fish transport and count buckets and initiation of a contract with the University of California, Davis, to conduct studies relative to Green Sturgeon behavior near structures similar to the louvers.

### Fish Screen Evaluations

Fish screens at Barker Slough Pumping Plant, Roaring River Slough Distribution System, and diversions around Sherman Island continued to be evaluated to comply with the requirements of the BiOps and the incidental take permit. The evaluations consisted of three components:

- fish screen cleanliness;
- fish screen hydraulics; and
- fish entrainment.

The evaluations were used to determine whether facility structural components are in sufficient condition to perform as designed; the effectiveness of fish screen cleaning practices; water approach velocities for various screen cleanliness conditions; and entrainment for various combinations of fish presence, pumping rates, times of day, and times of year.

During 2015, a number of evaluations were conducted for each facility. Final reports were prepared for the November 2013 through June 2014 evaluation period, and draft reports were prepared for the November 2014 through June 2015 evaluation period. In addition, some screens were repaired or replaced based on the results of these evaluations.

## Delta Knowledge Improvement Program

In response to Assembly Bill 1200 (Laird; Chapter 573, Statutes of 2005), which required DWR to provide a risk analysis of the Delta and Suisun Marsh and to develop a set of improvement strategies to manage those risks, DWR created the Delta Risk Management Strategy to look at the sustainability of the Delta and assess major risks to Delta resources from floods, seepage, subsidence, and earthquakes (see Bulletins 132-08 through 132-13).

During the course of the Delta Risk Management Strategy project, a number of information gaps and information quality issues were identified. The limited amount of quality information prompted the creation of the Delta Knowledge Improvement Program, as a means to actively fund specific studies to fill the data gaps identified in the Delta Risk Management Strategy.

In 2015, the Delta Knowledge Improvement Program focused on studies to improve State levee investment decisions in the Delta. These studies included:

- an ongoing economic study to assist the DSC in developing a comprehensive investment strategy for the Delta levees;
- a feasibility study to assist the Delta Protection Commission with making recommendations on how to implement a Delta Flood Risk Management Assessment District; and
- an investigation to determine how Delta levees on peat soils respond under seismic loading.

As part of an effort to update determination of the 100-year water levels in the Delta, the Delta Knowledge Improvement Program funded a data quality analysis of historical water levels reported by gauge stations in the Delta.

More information about the Delta Knowledge Improvement Program is available on DWR's website.

# North Delta Flood Control and Ecosystem Restoration Project

The North Delta Flood Control and Ecosystem Restoration Project will provide flood control improvements and ecosystem restoration in the North Delta. The project will implement important flood control improvements in the area of the North Delta where the Mokelumne River, Cosumnes River, Dry Creek, and Morrison Creek converge (see Figure 2-1). Flood flows in the area threaten levees, bridges, and roadways when levees on McCormack-Williamson Tract (MWT) are overtopped and a flood surge occurs. The proposed project will help regulate peak flood flows and prevent flood surges. It will also provide substantial aquatic and terrestrial habitat benefits.

The final North Delta Flood Control and Ecosystem Restoration Project environmental impact report was certified in November 2010 and recommended the implementation of a preferred alternative (Alternative 1-A for the Group I actions and the No Action Alternative for the Group II actions [for details see Bulletin 132-11]). The project will create tidal, subtidal, aquatic, and terrestrial habitats benefiting a number of special status species such as Sacramento Splittail and Chinook Salmon. The project, as proposed, will provide contiguous habitat and a riparian corridor from the downstream portion of the Cosumnes River Preserve to the Delta.

Two project elements are proposed for implementation: the MWT element combines North Delta flood surge reduction measures with the construction of habitat-friendly levees, floodplain restoration, and the creation of freshwater tidal habitat on MWT. The MWT property, purchased using a CALFED Bay-Delta Program grant, is currently owned and managed by The Nature Conservancy. (For background on the CALFED Bay-Delta Program, see Bulletins 132-95 through 132-11.) When completed, the MWT element will result in nearly 1,500 acres of tidal marsh and floodplain restoration. The Grizzly Slough element consists of breaching the Grizzly Slough and Bear Slough levees upstream of MWT to help attenuate peak flood flows and maximize nearly 500 acres of floodplain habitat on the DWR-owned property. These projects are consistent with the objectives put forth in the *California Water Action Plan*, the *Delta Plan*, and the California EcoRestore initiative.

## Project Status

The MWT project planning, permitting, and implementation was divided into two phases, due to the size and complexity of the multibenefit project. Phase A entails constructing a protective tower levee and resloping the landside levee to strengthen levees and minimize the effect of wave-wash erosion when the land receives flood water as designed. Phase B is proposed to include weir construction, levee breaching, and floodplain and tidal marsh restoration.

In 2015, the MWT Project Team completed studies, regulatory requirements (e.g., permits under Clean Water Act Sections 401 and 404 and a biological assessment), and planning work for Phase A. Construction is planned for 2017. Considerable progress was made on Phase B (real estate activities, permitting strategies, and updated hydrologic models), which is proposed to be implemented in 2018 and 2019. As part of Phase B, DWR is working with the California Natural Resources Agency/California EcoRestore to evaluate long-term ownership, management/monitoring options, and potential funding sources. Concurrent with MWT project work, a separate team under Reclamation District 348 (New Hope Reclamation District) is beginning the project design work for Grizzly Slough, including the real estate analyses and wetland delineation.

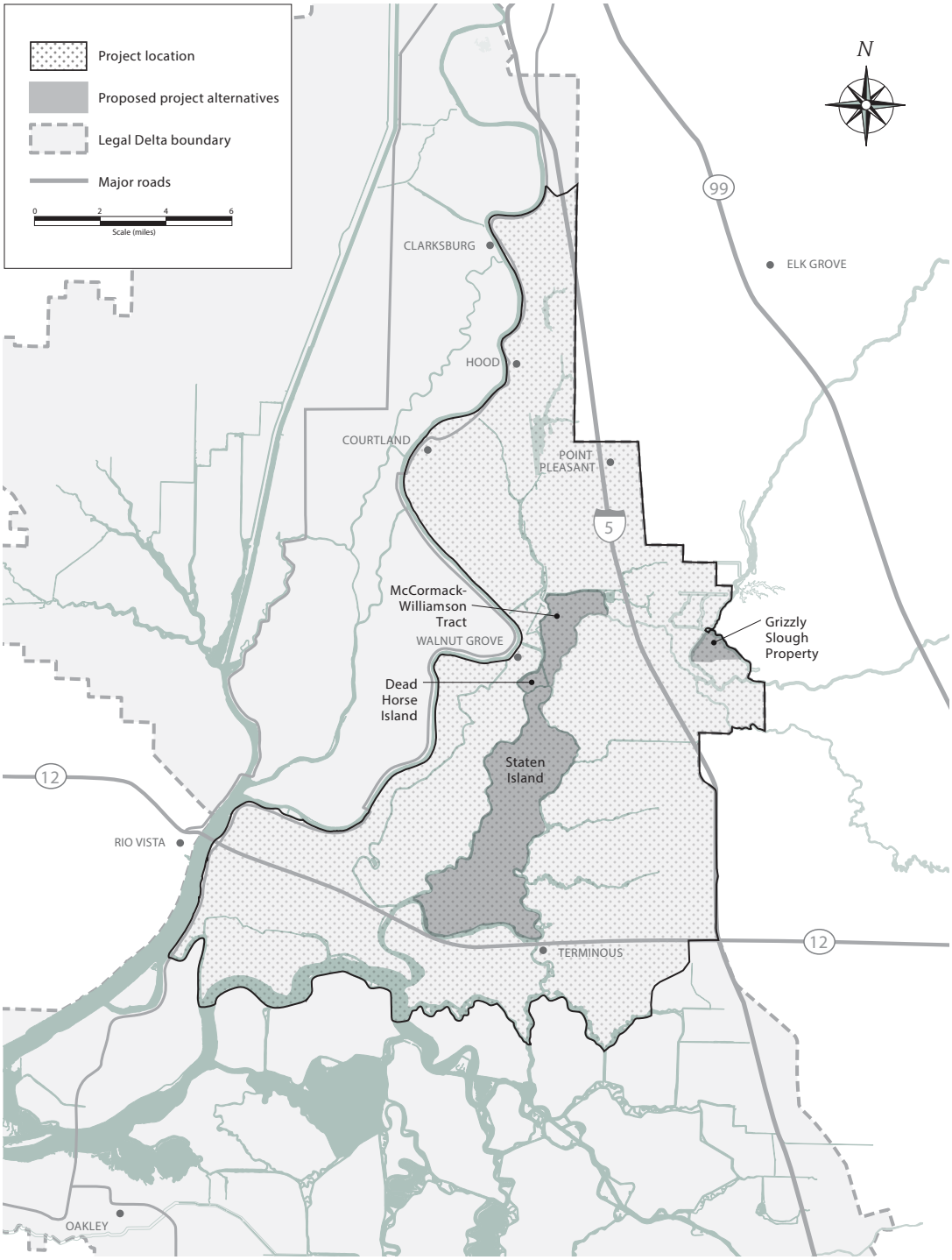



**Figure 2-1** **North Delta Flood Control and Ecosystem Restoration Project**

## South Delta Improvements Program

In 1999, the South Delta facilities became a key component of the CALFED Bay-Delta Program.

South Delta Improvements Program (SDIP) elements in the CALFED Bay-Delta Program record of decision included increasing diversions through Clifton Court Forebay (first to 8,500 cubic feet per second [cfs] and then to 10,300 cfs), dredging and installing operable tidal barriers in the South Delta, installing a fish barrier at the Head of Old River, and constructing the first phase of a new intake and fish screen in Clifton Court Forebay. SDIP is proposed to be implemented in two component stages.

DWR and the Bureau of Reclamation (Reclamation) identified the following SDIP project objectives and purposes:

- reducing movement of San Joaquin River watershed Central Valley fall-run and late fall-run juvenile Chinook Salmon into the South Delta via Old River (SDIP Stage 1);
- maintaining adequate water levels and water quality through improved circulation for agricultural diversions in the South Delta, downstream of the Head of Old River (SDIP Stage 1);
- increasing water deliveries and delivery reliability to SWP and CVP water contractors south of the Delta (SDIP Stage 2); and
- providing opportunities to convey water for fish and wildlife purposes by increasing the maximum permitted level of diversion through the existing intake gates at Clifton Court Forebay to 8,500 cfs (SDIP Stage 2).

The SDIP Stage 1 physical/structural component includes the following elements:

- constructing and operating a fish-control gate at the Head of Old River to reduce downstream movement of San Joaquin River watershed Central Valley fall-run and late fall-run juvenile Chinook Salmon into the South Delta via the Head of Old River;
- constructing and operating up to three flow-control structures (gates) at Middle River (near the confluence of Middle River with Victoria Canal); Grant Line Canal (near the confluence of Grant Line Canal and Old River); and Old River (just east of the Delta-Mendota Canal intake) to improve existing water levels and circulation patterns in South Delta water channels;
- dredging various channels in the South Delta, including Middle and Old rivers, to improve conveyance; and dredging areas surrounding agricultural diversions to improve their function; and
- extending up to 24 agricultural diversion intake facilities to improve their function.

The SDIP final environmental impact report/environmental impact statement (2006) determined the preferred alternative for SDIP Stage 1, which entails installation of permanent control gates to replace the temporary rock barriers currently installed and removed each year under the DWR South Delta Temporary Barriers Project. The preferred alternative also includes the elements of dredging and extending agricultural diversions.

### Preferred Plan

The preferred plan for SDIP is to construct the Stage 1 physical/structural component as soon as permits are obtained and defer the operational component until more is known about the project's potential effects on Delta Smelt and other protected fish species.

DWR deferred both the increase in diversions of up to 10,300 cfs and the associated new fish screens as components of the SDIP due to major funding issues and significant technical uncertainties associated with the design and construction of the new fish screens.

## Program Status

DWR and Reclamation continued to suspend most SDIP planning and permitting activities during 2015. Some activities were undertaken to address requirements of the 2009 NOAA Fisheries BiOp for the CVP and SWP Long-term Operations Criteria and Plan.

Discussions between DWR and NOAA Fisheries revealed NOAA Fisheries' concern for potential barrier hydraulic disturbances that could promote increased predation on juvenile salmon. DWR conducted a hydrodynamic study focusing on barrier design features to minimize these disturbances. A study report was submitted to NOAA Fisheries in April 2010, which identified several features that could be incorporated into the design.

NOAA Fisheries stated an interest in delaying further discussions on the SDIP until completion of an ongoing, multiyear South Delta Temporary Barriers Project predation study. The study is being conducted to satisfy requirements of the project's 2008 NOAA Fisheries BiOp and is examining the occurrence of predation associated with the project. The study's field data collection was completed in 2011, and data analysis is in progress. A final predation study report is expected in 2017. Data from the study will be useful in considering permanent barrier design options and operation strategies to minimize predation.

For additional information about SDIP, see Chapter 7, Water Supply Development and Reliability.

## Temporary Barriers Project Facilities

The South Delta Temporary Barriers Project is an ongoing project that installs up to four rock barriers in channels located in the southern portion of the Delta near the cities of Tracy and Lathrop in San Joaquin County. The barriers are usually installed during the irrigation season from April to November at four sites (see Figure 2-2), as follows:

(1) Head of Old River, in Old River where it splits from the San Joaquin River;
(2) Old River near Tracy, one-half mile east of the Jones Pumping Plant intake and about 8 miles northwest of Tracy;
(3) Middle River near Victoria Canal, just southeast of the confluence of Middle River, Trapper Slough, and North Canal; and
(4) Grant Line Canal, 420 feet east of the Tracy Boulevard Bridge.

The Old River near Tracy, Middle River near Victoria Canal, and Grant Line Canal rock barriers are designed to act as flow-control structures to improve water levels and circulation within the South Delta. The Head of Old River barrier is designed to improve migration conditions for Central Valley fall-run Chinook Salmon in the spring and fall. In the spring, the barrier blocks migratory movements of juvenile salmon into Old River from the San Joaquin River. In the fall, the barrier increases the volume of San Joaquin River flow passing downstream through the Port of Stockton and improves dissolved oxygen levels in the San Joaquin River. As a result, it improves the low dissolved oxygen sag that occurs near that area and aids upstream migration of adult salmon in the San Joaquin River basin.

In 2015, the three flow-control agricultural barriers at Middle River near Victoria Canal, Grant Line Canal, and Old River near Tracy were installed and operated as planned. Installation started in March, and the barriers were removed in November. Additionally,

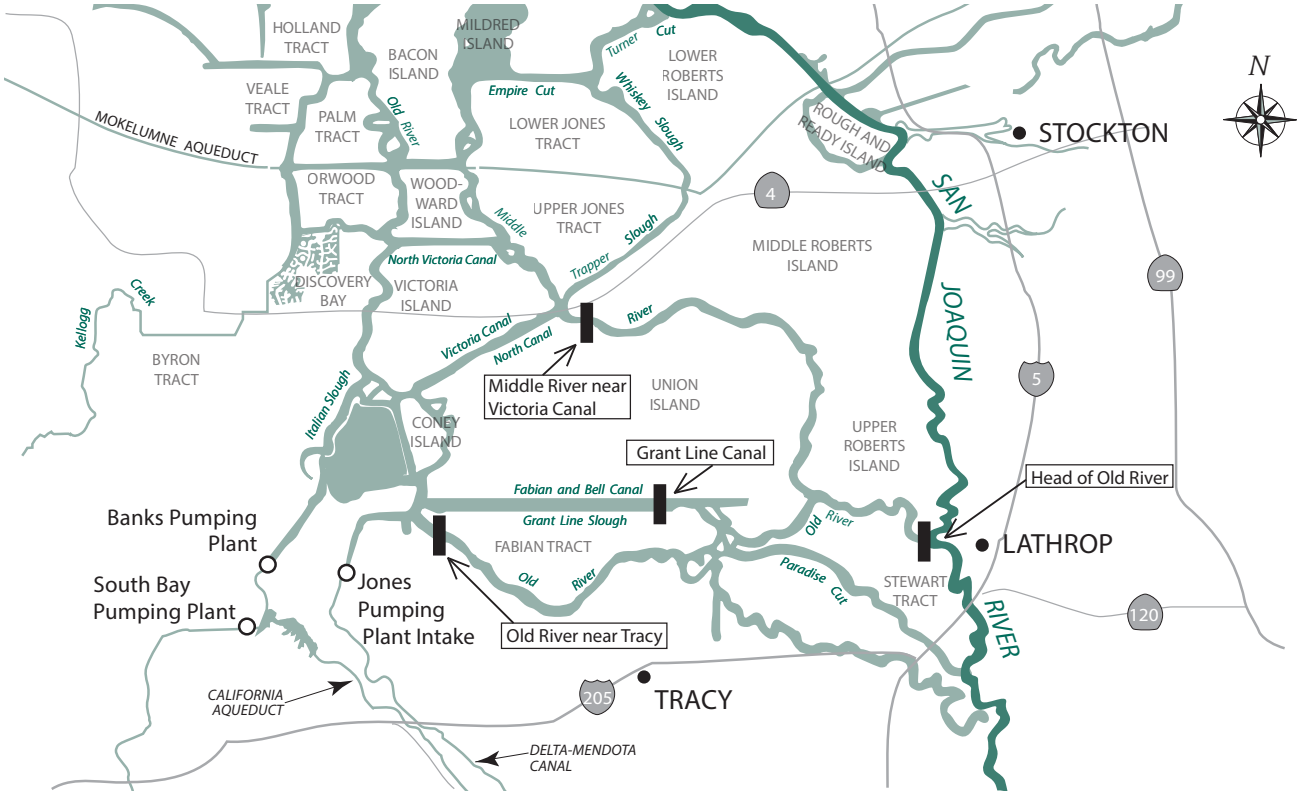



**Figure 2-2 Temporary Barrier Locations in the South Delta**

the option of raising the Middle River barrier by 1 foot to increase the water level and improve circulation was exercised on June 8, 2015.

The spring Head of Old River rock barrier was installed in 2015 with construction beginning in early March and full closure achieved by April 3. Eight culverts with slide gates remained in the open position for the duration of the installation. The barrier was breached on June 1, 2015, and it was completely removed by June 8, 2015.

In 2015, the Head of Old River Predator Manipulation Study was implemented to study predatory fish distribution and abundance in the San Joaquin River in the vicinity of the Head of Old River. The coordinated acoustic telemetry studies were conducted by Reclamation, NOAA Fisheries, and the U.S. Fish and Wildlife Service to track the movements of salmon smolts, steelhead, and predatory fish to determine the outmigrating salmon smolt survival in the Delta and to learn more about the predatory fish impact on the salmon population. In the Predator Manipulation Study, NOAA Fisheries used genetic analysis to determine predator diet and tested the hypothesis that salmon smolt survival can be improved in one reach of the San Joaquin River by removing and relocating predatory fish to another reach.

In 2015, the fall Head of Old River rock barrier was installed and operated from September 13 until November 12, when the barrier was breached. Removal was completed on November 18.

Data collected in 2015 are being analyzed, and the findings of the studies will be published in reports and peer-reviewed

journal articles by the respective agency for each individual study.

Information on the temporary barriers, including details about barrier operations, can be found on DWR's website.

## Delta Flood Control

Levees in the Delta protect valuable wildlife habitat, farms, homes, urban areas, recreational developments, highways, railroads, natural gas infrastructure, utility lines, a major aqueduct, and other public developments. Delta levees influence and protect critical water quality parameters in Delta waterways. Some levees also protect water quality for approximately 25 million Californians who receive a portion of their water from the Delta. The State Legislature recognized the importance of the Delta and enacted the Delta Flood Protection Act of 1988, declaring that ". . . the Delta is endowed with many invaluable and unique resources and that these resources are of major statewide significance" (California Water Code Sections 12300 et seq.).

Since 1988, the Delta Levees Program has provided more than $310 million in State-appropriated funds. These monies are combined with local cost-share funding to provide flood protection and environmental benefits in the Delta.

In Senate Bill 34 (Boatwright; Chapter 28, Statutes of 1988), the Legislature declared its intent to appropriate $6 million for local assistance under the Delta Levee Maintenance Subventions Program and $6 million for Delta Levees Special Flood Control Projects, including subsidence studies and monitoring on Bethel, Bradford, Jersey, Sherman, and Twitchell islands; Holland, Hotchkiss, and Webb tracts; and the towns of Thornton and Walnut Grove.

In 1996, Assembly Bill 360 (Hannigan; Chapter 601, Statutes of 1996) expanded the area covered by the Delta Levees Program to include the remainder of the legal Delta and northern Suisun Bay.

Additional funding sources for the Delta Levees Program include:

- Proposition 204 enacted in 1996 ($25 million);
- Proposition 13 enacted in 2000 ($30 million);
- Proposition 50 enacted in 2002 ($70 million);
- Proposition 84 enacted in 2006 ($275 million);
- Proposition 1E enacted in 2006; and
- Proposition 1 enacted in 2014.

### Delta Flood Emergency Preparedness, Response, and Recovery Program

The Delta Flood Emergency Preparedness, Response, and Recovery Program was initiated within the Division of Flood Management in response to the passing of the Disaster Preparedness and Flood Prevention Bond Act of 2006 (Proposition 1E). The program is designed to enhance emergency preparedness and enable DWR to better coordinate with its local partners to respond to and recover from a large-scale Delta flood emergency.

The *Delta Flood Emergency Management Plan* presents DWR's concept of operations for flood emergency response in the Delta. The plan describes the roles and responsibilities of DWR's emergency response organizations, including the Flood Operations Center, the Project Operations Center, and the Department Operations Center, and lists DWR's actions during flood emergency response. It also supports DWR's emergency preparedness efforts in the Delta and guides DWR management in making critical decisions during recovery.

A tabletop exercise was held in April 2015 in support of the Delta Flood Emergency Preparedness, Response, and Recovery Program. The exercise included staff from each of DWR's emergency response organizations.

For more information, visit DWR's website.

## Delta Levees Maintenance Subventions Program

The Delta Levees Maintenance Subventions Program (Subventions Program) is a cost-share program that provides technical and financial assistance to local levee-maintaining agencies in the Delta for the maintenance and rehabilitation of levees. The Subventions Program is authorized by California Water Code Sections 12980 through 12995 and is managed by DWR. The Central Valley Flood Protection Board reviews and approves DWR's recommendations and enters into agreements with local agencies to reimburse eligible costs for levee maintenance and rehabilitation.

The Subventions Program provides reimbursement funding to local levee-maintaining agencies for improving, maintaining, and enhancing nearly 700 miles of project and nonproject levees. Since its inception in 1973, the Subventions Program has provided more than $180 million of State funding to more than 70 islands in the Delta. In fiscal year 2015–2016, the program expects to reimburse approximately $8 million to local agencies for eligible levee maintenance and rehabilitation activities. (In fiscal year 2014–2015, the program reimbursed $8 million.) These activities help minimize the risk of Delta levee failure, which in turn protects the Delta's ecosystem, communities, and agriculture; State and private infrastructure; and the State's water supply.

## Delta Levees Special Flood Control Projects Program

The Delta Levees Special Flood Control Projects Program assists eligible local agencies in the Delta with flood protection and levee stability repairs. In 1990, the California Water Commission approved actions and priorities that serve as guides for DWR to determine the best use of appropriations to protect Delta islands. Long-term actions and priorities include:

- rehabilitating threatened levees through the beneficial reuse of dredged material;
- improving water supply reliability, levee integrity, and habitat enhancement by soliciting multibenefit projects through the projects solicitation process;
- upgrading levees to the standards included in Bulletin 192-82 (*Delta Levees Investigation*); and
- considering projects that will help achieve net long-term habitat improvement for fish and wildlife.

While DWR seeks cost sharing for all projects, the actual reimbursement depends on each local agency's ability to pay. In some cases, DWR may provide up to 100 percent of the cost. Districts receiving these funds are required to participate in a habitat improvement program to ensure net long-term habitat enhancement.

Levee restoration projects, habitat projects, and other special projects were conducted on various Delta islands and tracts in 2015–2016.

## Bulk Credit Program

In 2012, the Delta Levees Subventions Program and the Special Flood Control Projects Program established a model Bulk Credit Program allowing reclamation districts to more effectively meet habitat mitigation obligations.

Under the Bulk Credit Program, reclamation districts are able to utilize mitigation credits purchased in advance from an existing mitigation bank. These credits provide more biologically effective mitigation than past practices of establishing less formal, smaller mitigation sites, and are a much more efficient way of meeting mitigation obligations. The bulk purchase of credits from the mitigation bank is made at a substantial discount.

In 2015, the Bulk Credit Program continued to be the principal tool for participating reclamation districts to meet their habitat mitigation obligations resulting from Delta levee maintenance and improvement work. The program also continued planning for an 80-acre habitat mitigation site on Twitchell Island to support future mitigation obligations of the program. The mitigation site will be bordered by an 80-acre habitat enhancement site that will provide riparian forest and scrub shrub habitats.

### Reuse of Dredged Material for Delta Levees

As local sources of fill material for levee repair are depleted, new economical sources must be located. DWR has worked to find opportunities to reuse clean, dredged material in the Delta.

As part of this effort, a charter for the multiagency Delta Long-Term Management Strategy (LTMS) for the beneficial reuse of dredged material became effective in February 2007. The Delta LTMS is designed to improve operational efficiency and coordination of collective and individual agency decision-making responsibilities, resulting in approved dredging and dredged material management actions in the Delta, including the beneficial reuse of such material. Regular Delta LTMS meetings have included representatives from DWR, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Regional Water Quality Control Board, the Ports of Stockton and West Sacramento, and other interested parties.

Delta LTMS long-term goals include:

- developing a streamlined permitting process for dredging and dredged material reuse;
- developing a consolidated guidance document addressing sampling, tests, protocols, and methods for assessing sediment and dredged material characterization;
- developing a sediment management plan of methodologies for assessing and characterizing sediments and determining appropriate disposal options;
- developing a programmatic biological assessment for sensitive Delta species;
- drafting a programmatic environmental impact report/environmental impact statement for the Delta LTMS; and
- identifying and permitting additional sediment placement and beneficial reuse sites in the Delta.

The Delta LTMS program conducted a technical review of the program in July 2015 and concluded there was a need for continued effort. Progress has been slowed due to funding issues.

## West Delta Program

The West Delta Program is tasked with land management on Sherman and Twitchell islands to achieve DWR's goals and objectives, including understanding and managing methods that will mitigate subsidence. The West Delta Program objectives are supported by active research and application of land management activities used for subsidence reversal, carbon sequestration, and habitat development.

Since 2008, DWR has constructed approximately 1,700 acres of subsidence mitigation projects on Sherman and Twitchell islands and constructed approximately 6,000 lineal feet of "fish friendly" habitat setback levees. In 2015, the West Delta Program continued a partnership with the University of California, Berkeley, to collect greenhouse gas data on both newly constructed wetland sites, and typical Delta farmed crops such as corn and alfalfa, and irrigated pasture. Data collected since 2010 has shown that there is a net greenhouse gas benefit of approximately 10 metric tons of carbon dioxide equivalent by planting wetland crops on previously farmed Delta peatland soils.

Building upon subsidence mitigation work, DWR, in partnership with the Sherman Island Reclamation District, was awarded a $10.5 million grant from the California Department of Fish and Wildlife's fiscal year 2014–2015 Wetlands Restoration for Greenhouse Gas Reduction Program. The grant provided funding for another 2,200 acres of wetlands on Sherman Island; construction of the Sherman Island Whale's Mouth Wetland Restoration Project; and all planning, design, permitting, and construction for the Belly Wetland (see Figure 2-3). Matching funds from both DWR and the University of California, Berkeley, will provide for additional greenhouse gas monitoring throughout the Delta, resulting in a data set from a more robust variation of conditions.

In 2015, the West Delta Program completed construction of the Sherman Island Whale's Mouth Wetland Restoration Project, a 650-acre wetland on the lower southwest side of Sherman Island. Project features include more than 9 miles of berms needed to terrace the land into cells for appropriate water depth, approximately 23 water control

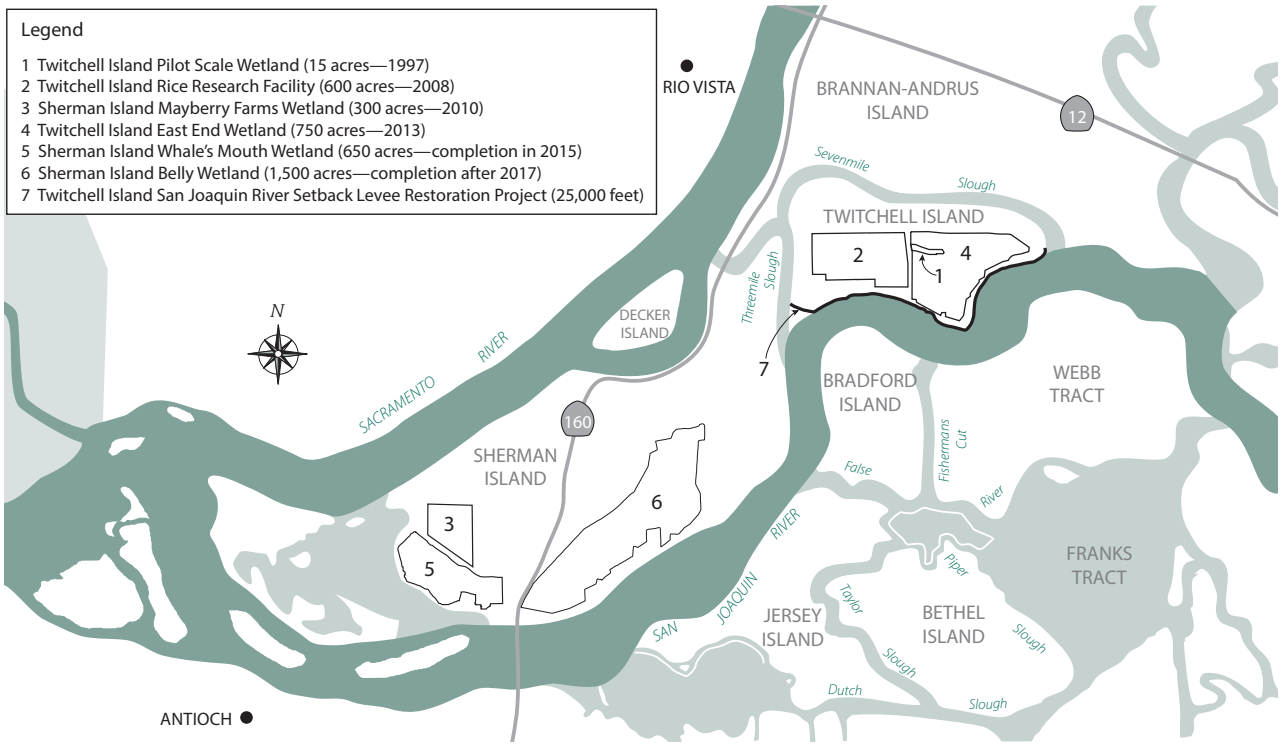



**Figure 2-3 Selected West Delta Program Projects**

structures, and approximately 75 acres of new upland habitat, including 13 acres that had been a scour pond created during the 1969 Sherman Island flood.

Continued efforts for 2015 included carbon protocol development, a multiagency effort to develop a draft greenhouse gas protocol that will allow for quantification of a project's net increase in carbon sequestration, which could be considered for adoption by the California Air Resources Board in late 2016 or early 2017.

The West Delta Program continued working with Twitchell Island Reclamation District to develop construction plans and environmental permits for the Twitchell Island San Joaquin River Setback Levee Restoration Project. This project will construct approximately 25,000 lineal feet of setback levee along the San Joaquin River, allowing for habitat features to be developed on the water side.



# Chapter 3
# Environmental Programs

*The restored Cookhouse Meadow in the Sierra Nevada.*

## Significant Events in 2015

In February, DWR received the Climate Leadership Award for Excellence in Greenhouse Gas Management (Goal Setting) for its work on the DWR *Greenhouse Gas Emissions Reduction Plan*. The award, given by the U.S. Environmental Protection Agency, the Association of Climate Change Officers, The Climate Registry, and the Center for Climate and Energy Solutions, is the highest national award given for greenhouse gas (GHG) management. DWR is the first public agency to be honored with the award.

In April, the Department of Water Resources (DWR) announced a new alternative that would replace the proposed Bay Delta Conservation Plan (BDCP) as the State's proposed project. The conveyance facility and habitat restoration measures proposed in the BDCP would be separated into two distinct efforts—California WaterFix and California EcoRestore.

*Information in this chapter was contributed by the Division of Environmental Services, the Division of Operations and Maintenance, the Division of Integrated Regional Water Management, and the State Water Project Analysis Office.*

The Department of Water Resources (DWR) has developed and implemented several programs to avoid, minimize, and/or offset adverse environmental impacts resulting from construction and operation of State Water Project (SWP) facilities. DWR has also established other environmental programs and partnered with other agencies to restore and enhance the natural environment.

## Operations for Species of Concern

A primary consideration in the operation of the SWP is avoiding, minimizing, and/or offsetting adverse impacts to species of concern, species listed as threatened or endangered by a State or federal agency, or species proposed for listing. The SWP is operated pursuant to biological opinions (BiOps) issued under the federal Endangered Species Act (ESA), and consistency determinations or incidental take permits issued under the California Endangered Species Act (CESA). A key to avoiding and minimizing adverse impacts to these species is maintaining flexibility in SWP operations. Operational responses can include Delta Cross Channel gate closure, export curtailments, changes in delivery schedules, increased reservoir releases, preferential use of certain facilities, or a combination of these actions.

Additional information can be found in Chapter 7, Water Supply Development and Reliability.

### San Joaquin River Restoration Program

The San Joaquin River Restoration Program is a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of the Merced River and to restore a self-sustaining Chinook Salmon (*Oncorhynchus tshawytscha*) fishery in the river, while reducing or avoiding adverse water supply impacts from restoration flows. The San Joaquin River Restoration Program worked through several challenges in 2015 related to water availability, levee stability, project implementation, and fish reintroduction.

Restoration flows continued to be hindered due to another critical water year in the San Joaquin River basin. The amount of water the San Joaquin River Restoration Program receives each year is based on the water year classification, and with water year 2014–2015 being one of the driest years on record, no restoration flows were released for a second consecutive year.

The San Joaquin River Restoration Program updated its Framework for Implementation that describes how the program will be implemented over the next 15 years. The framework seeks to sequence projects in a logical order to achieve program goals, based on realistic funding and resources, and includes schedules, budgets, and priorities of the five implementing agencies, including DWR. An initial milestone in the framework is to reconnect the San Joaquin River to the ocean by releasing 1,300 cubic feet per second restoration flows and by implementing channel and structural projects.

DWR continued to perform levee evaluations along the river and flood bypasses in the restoration area to ensure that the restoration flows will not significantly increase flood risk. Levee evaluations in 2015 focused on the Eastside Bypass where data show flows over 580 cubic feet per second would exceed criteria set by the U.S. Army Corps of Engineers (Corps) for levee

seepage and stability. DWR is developing plans to investigate this critical reach and develop alternatives to improve these levees to achieve the framework's restoration flow release goal of 1,300 cubic feet per second.

The framework identifies the Mendota Pool Bypass and Reach 2B Improvements Project as one of the first major structural improvement projects to be implemented. A public draft environmental impact statement (EIS)/environmental impact report (EIR) was released in June 2015 and is expected to be finalized in 2016.

Planning for the Reach 4B, Eastside Bypass and the Mariposa Bypass Channel and Structural Improvements Project also continued. A consensus-based alternative development process was initiated in 2015 with landowner and agency stakeholders to identify a preferred alternative for routing fish and flows through Reach 4B and the flood bypass area. DWR is the California Environmental Quality Act (CEQA) lead agency for the project and plans to implement flow and fish passage components of the project by 2019 to correspond with the framework schedule.

In April 2015, the Department of Fish and Wildlife (DFW) and the U.S. Fish and Wildlife Service (USFWS) released approximately 54,000 hatchery-produced juvenile spring-run Chinook Salmon into the San Joaquin River near its confluence with the Merced River. This release follows a similar release made in 2014 and contributes to the San Joaquin River Restoration Program's plan for long-term reintroduction of spring-run salmon to the San Joaquin River.

More information is available on the San Joaquin River Restoration Program's website.

## Lower Yuba River Accord

The Lower Yuba River Accord's purpose is to resolve instream flow issues and protect and enhance lower Yuba River fisheries and local water supply reliability. The Lower Yuba River Accord provides revenues for local flood control and water supply projects; water to enhance SWP and Central Valley Project (CVP) water supply reliability by offsetting Sacramento-San Joaquin Delta (Delta) export reductions for protection and restoration of Delta fisheries; and improvements in statewide water supply management, including dry year supplies for participating SWP and CVP contractors.

Water contracted by DWR under the Lower Yuba River Accord Water Purchase Agreement (Component 1 water) continues to be used to help offset Delta export reductions to benefit fish. In 2015, Yuba County Water Agency delivered 59,131 acre-feet of Component 1 water from surface releases, shared equally between DWR and the Bureau of Reclamation (Reclamation). This water was used to offset Delta pumping curtailments equally at Banks Pumping Plant and Jones Pumping Plant made pursuant to the BiOps on Delta Smelt and salmonids issued by the USFWS and the National Marine Fisheries Service (NOAA Fisheries) as modified by subsequent court orders. Under an agreement signed in 2012, DWR and Reclamation equally share Component 1 water made available from 2012 through 2015. Because 60,000 af of Component 1 water was due to be delivered in 2015, Yuba owes the remaining 869 af in a future year. In addition, Yuba County Water Agency provided 30,000 acre-feet of Component 4 groundwater substitution water through agreements with seven of its member units to enhance lower Yuba River flows. The water was then made available for transfer to many of the participating contractors through a letter agreement between DWR and Yuba County Water Agency.

For more information about the Lower Yuba River Accord, see Chapter 9, Water Contracts and Deliveries.

# Oroville Facilities

## Existing Federal Energy Regulatory Commission License Activities for 2015

### *Invasive Plant Management*

During 2015, DWR removed all the red sesbania (*Sesbania punicea*) along the Thermalito Power Canal, Thermalito Forebay, and Thermalito Diversion Pool as part of the annual maintenance that started in 2007. The Thermalito Power Canal, Thermalito Forebay, and Thermalito Diversion Pool are the upstream extent of the red sesbania population on the Feather River and are considered a high priority management area.

DWR also continued to partner with the Butte County Agricultural Commissioner to remove several invasive plants within areas of joint management. The Butte County Agricultural Commissioner treated several stands of red sesbania that are adjacent to the upstream extents managed by DWR, but are not on DWR property, and several locations of skeleton weed (*Chondrilla juncea*) near McCabe Creek and Ponderosa Reservoir.

### *Feather River Fish Hatchery*

**Fall-run Chinook Salmon.** A total of 7,075,242 juvenile fall-run Chinook Salmon were released into the Delta, Sacramento River, and San Francisco and San Pablo bays.

**Spring-run Chinook Salmon.** A total of 2,183,570 spring-run Chinook Salmon were released in the Feather River.

**Steelhead.** A total of 331,805 steelhead were planted in the Feather River at Boyd's Pump Boat Launch.

### *Lake Oroville and Thermalito Afterbay*

In October, 139,388 Chinook Salmon were planted in Lake Oroville.

Due to a surplus egg supply at the Feather River Fish Hatchery (FRFH), 17,200 steelhead were stocked in the Thermalito Afterbay.

For additional information about fish stocking in the SWP, see Chapter 13, Recreation.

Habitat improvement continued in 2015 in the fluctuation zone of the lake. Approximately 1,600 Christmas trees were recycled with the help of the Boy Scouts and the California Conservation Corps. The recycled trees were used to construct structures for juvenile fish habitat at the Spillway Boat Launch area, Loafer Creek, and Thermalito Afterbay.

### *Oroville Wildlife Area*

Monitoring and weed removal activities continued during 2015 at the wetland ponds that were constructed in 2011 in the Oroville Wildlife Area. These wetland ponds were created as a mitigation requirement in the 1995 Corps Clean Water Act Section 404 permit for a project that constructed two waterfowl brood ponds at Thermalito Afterbay. The wetland ponds project converted a 20-acre area of low-quality, disturbed, upland habitat into 10 acres of emergent wetland and 10 acres of riparian habitat. The waterfowl brood ponds were a requirement of the revised recreation plan that was part of the Federal Energy Regulatory Commission's September 22, 1994, order.

## Lake Oroville Elevation

A number of aspects of the Oroville Facilities can be affected by lake surface elevation including:

- habitat;
- flora and fauna of the lakeshore area and upstream tributaries;
- recreation;
- water quality;

- water temperature;
- shoreline and lakebed stability and erosion;
- flood storage capacity;
- power generation; and
- streamflow requirements (downstream of the lake).

The 2015 low point for the Lake Oroville reservoir surface elevation was reached on December 9 at 649.5 feet, and the annual high point of 764.1 feet was reached on April 17. The full pool elevation of Lake Oroville is approximately 900 feet.

## Federal Energy Regulatory Commission Relicensing Activities

### *USFWS Biological Opinion for the Oroville Facilities Relicensing*

Various conservation measures for the species identified in the USFWS 2007 BiOp for the Oroville Facilities relicensing project continued to be implemented on SWP lands. Monitoring associated with these measures includes an annual vernal pool survey (645 mapped vernal pools and/or features); protective measures for elderberry shrubs (*Sambucus* species, host plant for the valley elderberry longhorn beetle [*Desmocerus californicus dimorphus*]); and annual monitoring of nesting Bald Eagles (*Haliaeetus leucocephalus*) in the area (five currently active nests). In addition, habitat management activities within the Oroville Wildlife Area are coordinated through DFW. These activities include providing nest and forage habitat for waterfowl and upland bird species, monitoring and maintaining Thermalito Afterbay brood pond water surface elevations, and protecting and conserving Giant Garter Snake (*Thamnophis gigas*) habitat. An annual compliance report for 2015 was compiled by DWR and submitted to USFWS.

For more information about Oroville Facilities relicensing, see Chapter 10, Power Resources.

# Invasive Species

## Quagga and Zebra Mussel Monitoring and Assessment

The quagga mussel, *Dreissena rostriformis* (previously classified as *Dreissena rostriformis bugensis*), and the zebra mussel, *D. polymorpha*, are invasive freshwater mussels that pose a significant threat to the SWP. Both species attach to hard substrates, including other mussels, with strong byssal threads, forming dense colonies and causing significant biofouling impacts to raw water infrastructure by clogging small diameter piping and filters and encrusting trash racks and fish screens.

In early 2007, the quagga mussel was detected in the lower Colorado River and spread throughout connected water diversion systems (see Bulletin 132-08). The following year, the zebra mussel was detected in San Justo Reservoir in San Benito County, adding to the existing threat. In response, DWR formed the Aquatic Nuisance Species Program within the Division of Operations and Maintenance. The program includes applied studies, early detection monitoring, vector management, rapid response planning, long-term mussel management, and public outreach.

### *Applied Studies*

**Assessment of Habitat Suitability.** DWR's consultant (see Bulletin 132-11), examined the suitability of the SWP to support long-term populations of quagga and zebra mussels (dreissenids) if unintentionally introduced. Based on the results, SWP locations were classified into one of three groups: unable to support, potentially able to support, or able to support long-term populations of dreissenid mussels (see Bulletin 132-12). Understanding

where dreissenid mussels may survive in the SWP will be used to prioritize management efforts.

**Early Detection Monitoring.** DWR routinely monitors the California Aqueduct, SWP reservoirs, and the Delta for the presence of quagga and zebra mussels. DWR uses three different methods to monitor for mussels: zooplankton tows (with DNA analysis) for veligers (the free floating larval stage); settlement plates (see Bulletin 132-10); and bioboxes for adults (attached/settled stage).

In 2015, DWR and two collaborating water agencies, Santa Clara Valley Water District and The Metropolitan Water District of Southern California, collected veliger samples at 16 locations (see Bulletin 132-10). In addition, DWR staff are trained in quagga and zebra mussel identification and are instructed to look for mussels during regular field work and during routine facility maintenance activities. No mussels were detected in the SWP, the Delta, or other SWP source water during 2015.

## *Prevention and Response Planning*

To protect against and prepare for mussels in the SWP, the Aquatic Nuisance Species Program developed several planning documents to guide actions and identify vulnerabilities. The *Quagga and Zebra Mussel Vector Management Plan for the State Water Project* identifies potential mussel points-of-entry and vectors and outlines mechanisms to reduce the risk of introduction. The two primary vectors of mussels are downstream transport of planktonic veligers in natural and constructed waterways and overland transport of veligers and attached adults on watercraft. A critical component of the vector management plan is reducing the risk posed by watercraft. To accomplish this, DWR contracted with the California Department of Parks and Recreation and the Los Angeles County Department of Parks and Recreation to implement vessel inspection and outreach programs at San Luis State Recreation Area (San Luis Reservoir, O'Neill Forebay, and Los Banos Creek Reservoir) and Pyramid and Castaic lakes (see Bulletin 132-12).

At San Luis State Recreation Area, 11,349 vessels were inspected during 2015. Of those vessels, 328 failed the inspection due to the presence of wet equipment or standing water and were not allowed to launch. At Castaic Lake, 22,123 vessels were inspected, and 678 failed the inspection. At Pyramid Lake, 19,169 vessels were inspected, with 931 failures. No mussels were found during the inspections.

In December 2013, quagga mussels were discovered in Lake Piru, operated by United Water Conservation District, in Ventura County (see Bulletin 132-14). Lake Piru is in close proximity to Pyramid and Castaic lakes.

Sampling for veligers had been routinely conducted at Pyramid and Castaic lakes since 2008, and all samples had been negative. Due to the possibility that mussels were introduced in Pyramid and Castaic lakes from Lake Piru, monitoring efforts were immediately increased, additional settlement plates were deployed in 2013, and additional sampling for veligers was conducted during 2013, 2014, and 2015. All additional samples were negative for quagga mussels.

If mussels are detected in the SWP, the *Quagga and Zebra Mussel Rapid Response Plan for the State Water Project* outlines a course of action to confirm the sighting; delineate the population; implement containment and eradication measures; and notify State and federal partner agencies, the SWP water contractors, and any potentially impacted entities.

With uncontrolled watercraft access to and from infested bodies of water, such as the Colorado River, the SWP and the Delta remain vulnerable to mussel infestation.

Therefore, DWR has prepared a long-term mussel management plan that identifies facility vulnerabilities and outlines both short-term and long-term options to prevent or mitigate mussel biofouling impacts for all at-risk SWP facilities. The short-term control strategies are those that can be implemented within a few weeks to a few months time and may be temporary in nature, such as shutdowns for power washing and shell removal. The long-term control strategies have longer implementation times (6 months to multiple years) and are permanent in nature (alterations to infrastructure).

DWR's consultant assisted DWR with plan preparation (see Bulletin 132-14). As a follow-up to the management plan reports, the consultant will develop cost estimates for facility retrofit implementation.

## The Bay Delta Conservation Plan

The Bay Delta Conservation Plan (BDCP) was initiated in 2006 with the goal of providing a plan to restore and protect water supply, water quality, and Delta ecosystem health within a stable regulatory framework. The BDCP was being developed through collaboration, scientific analysis, policy review, and public input. Participants included state, federal, and local water agencies, state and federal fish and wildlife agencies, environmental organizations, agricultural organizations, and other interested parties. The BDCP would have served as a natural community conservation plan under the State's Natural Community Conservation Planning Act and a habitat conservation plan under Section 10 of the ESA, providing long-term take authorization for SWP and CVP operations under the CESA and ESA while providing for the conservation and management of species in the Delta. The draft BDCP and its associated environmental review documents were available for public review and comment from December 13, 2013 through July 29, 2014. In response to comments received during the public comment period, State and federal agencies decided to change the approach and would no longer pursue completion of the BDCP.

On April 30, 2015, DWR announced a new alternative that would replace the proposed BDCP as the State's proposed project. The conveyance facility and habitat restoration measures proposed in the BDCP would be separated into two distinct efforts—California WaterFix and California EcoRestore.

## California WaterFix and California EcoRestore

The California WaterFix will construct new Delta conveyance facilities in compliance with the ESA and CESA. The conveyance facilities would allow greater flexibility in water diversions and better balancing of the associated water quality and hydrodynamic benefits for fish, drinking water, agriculture, and other beneficial uses.

California EcoRestore was announced as an initiative to help coordinate and advance at least 30,000 acres of critical habitat restoration in the Delta over the next 4 years. California EcoRestore is unassociated with any habitat restoration that may be required as part of the construction and operation of the new Delta water conveyance (California Waterfix).

### Endangered Species Act Consultation Initiated

In early 2015, DWR and Reclamation initiated ESA Section 7 (informal) consultation with NOAA Fisheries and the USFWS and began to develop the biological assessment for construction and operation of California WaterFix. Species under the jurisdiction of the USFWS and NOAA Fisheries were confirmed by the agencies in May and July, respectively. DWR also engaged with DFW to begin the incidental take analysis for State-listed species, as required during the CESA

Section 2081(b) permitting process. The BiOp and 2081(b) permit are expected to be completed in 2016.

### Recirculated Draft Environmental Document Released

On July 10, 2015, DWR and Reclamation released the partially recirculated draft EIR/supplemental draft EIS for the BDCP/California WaterFix. The public comment period that began July 10, 2015, was originally scheduled to end August 31, 2015, but was extended to October 30, 2015. Public meetings were held in Sacramento on July 28 and in Walnut Grove on July 29.

The primary purposes of the partially recirculated draft EIR/supplemental draft EIS were to provide the public and interested agencies with updated environmental analysis to address certain revisions to the previously issued documents related to the BDCP and its draft EIR/EIS, to introduce new alternatives (Alternatives 4A, 2D, and 5A), and to address certain issues raised in comments received on the draft EIR/EIS. The partially recirculated draft EIR/supplemental draft EIS included evaluation of Alternative 4A, California WaterFix.

### Change Petition Submitted

On August 25, 2015, DWR and Reclamation submitted a petition for a change to the water rights necessary for the implementation of key components of California WaterFix. The petition requests the State Water Resources Control Board approval to add points of diversion and rediversion to the existing water right permits (and existing diversion authorization) held by the SWP and the CVP.

### Corps Permit Application Submitted

On August 26, 2015, DWR submitted a permit application to the Corps for California WaterFix. This application started a Corps environmental review process, which runs parallel to the environmental review process required by CEQA and National Environmental Policy Act. The Corps' process will consider whether to issue a permit for California WaterFix project activities, such as construction, that will occur in or affect waters of the United States, triggering the Corps' regulatory authority under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

### Final EIR/EIS

In late 2015, DWR began preparing the final BDCP/California WaterFix EIR/EIS, including updating analyses and modeling, drafting the executive summary, drafting the mitigation monitoring and reporting program, and responding to public comments. The final EIR/EIS is expected to be released in 2017.

## Biological Opinions Issued on CVP/SWP Operations

The NOAA Fisheries and USFWS have both issued BiOps on CVP and SWP operations that include reasonable and prudent alternatives to avoid jeopardy of federally listed species. Both the 2008 USFWS and 2009 NOAA Fisheries BiOps were challenged in federal court but were eventually upheld and are the basis for ESA compliance for the SWP and CVP. As required by the court order, Reclamation completed an EIS in November 2015. For more information about the federal litigation, see Chapter 6, Legislation and Litigation.

The remand process allowed DWR, DFW, Reclamation, USFWS, and NOAA Fisheries to undertake a collaborative adaptive management approach to interim operations under the existing BiOps.

The Collaborative Science and Adaptive Management Program was formed in May 2013 to produce information developed through a collaborative science process that

is directly relevant to management actions in the Delta and can be used to manage operations in a way that protects fish while providing for greater water supply reliability.

The Collaborative Science and Adaptive Management Program is comprised of a Policy Group and a Collaborative Adaptive Management Team. The Policy Group includes State and federal agency directors, regional directors, general managers of water agencies, and executive directors of nongovernmental organizations. The Collaborative Adaptive Management Team includes managers and scientists working under the direction of the Policy Group to facilitate collaborative science and adaptive management.

DWR, Reclamation, and the regulatory agencies have recently created multiple cooperative real-time management teams to provide a way to rapidly disseminate information, develop recommendations, and make decisions on fisheries-related issues to minimize adverse effects on listed species while meeting permit requirements and contractual obligations for water deliveries. These interagency teams meet regularly, up to weekly during critical periods, to review the latest available information on species status, environmental conditions, and

## Endangered Species and Biological Opinions

An endangered species is one in danger of extinction in all or a significant portion of its range; a threatened species is one likely to become endangered. The Endangered Species Act (ESA) and the California Endangered Species Act (CESA) are designed to protect threatened and endangered species by ensuring federal and State agencies adopt measures to protect the species during the design, construction, and operation of projects, or for other forms of agency action, and prohibit the unauthorized take of endangered species. Biological opinions and incidental take permits are issued to protect ESA- and CESA-listed species.

ESA Section 7 requires federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species or modify their critical habitat, otherwise formal consultation is required. Federal agencies must consult with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service (the wildlife agencies). As part of the consultation process, the wildlife agency issues a biological opinion which states the agency's determination of whether the action is likely to jeopardize a species or adversely modify critical habitat. If the wildlife agency determines an action will jeopardize or adversely modify, it will suggest reasonable and prudent alternatives that the "action agency" may take to avoid the likely jeopardy or adverse modification (Title 16, United States Code Sections 1531–1544 [1973]).

CESA is substantially similar to ESA in all aspects (California Fish and Game Code Sections 2050–2098 [1984]). Under CESA, an incidental take permit issued by the Department of Fish and Wildlife can allow for the take of State-listed species if specific criteria are met, including measures to minimize and mitigate the impacts of authorized take (California Code of Regulations, Title 14, Sections 783.0–783.8).

projected project operations and to develop recommendations for actions to protect listed species. A list of the interagency teams and their agency participants, descriptions of the teams, and the process for real-time decision making is in the EIS for the coordinated long-term operation of the CVP and SWP.

The Delta Science Program conducted the 2015 Long-term Operations Biological Opinions Annual Science Review in November. Background information, review materials, and the review report are available on the Delta Stewardship Council's website.

## Delta Operations for Delta Smelt and Longfin Smelt

The Smelt Working Group (an interagency team of experts on Delta Smelt and Longfin Smelt [*Spirinchus thaleichthys*] biology) meets regularly from December through June to assess the risk to Delta Smelt and Longfin Smelt from CVP and SWP export facilities. Based on near real-time technical information, such as fish distribution, salvage, and physical water conditions, the Smelt Working Group makes recommendations on export operations to the USFWS and DFW with the goal of reducing entrainment of the two species.

Recommendations are based on guidelines outlined in the 2008 USFWS BiOp and the 2009 DFW Longfin Smelt incidental take permit (see Bulletin 132-10).

During the 2014–2015 water year, the USFWS made no determinations that altered export operations. Several factors throughout the time period indicated that additional restrictions to pumping operations were not necessary to protect Delta Smelt or Longfin Smelt. These were: (1) low Delta Smelt salvage and no Longfin Smelt salvage at the export facilities, largely due to extremely low densities of both species in the system, and (2) severely restricted export levels to meet flow and water quality objectives during the critically dry conditions.

## Fish Restoration Program

Pursuant to the USFWS and NOAA Fisheries BiOps and the DFW Longfin Smelt incidental take permit (see Bulletin 132-11), the Fish Restoration Program (FRP) continued to make progress towards fulfilling its restoration requirements.

In 2015, the FRP continued its outreach efforts, primarily by sending out eNews updates and updating the website with new documents. The FRP website provides an overview of the program and serves as a publicly accessible repository for documents that are relevant to the program's efforts, including links to project-specific documents for each separate restoration project under the FRP. The website also provides a means by which the public can contact the program.

Interim land management of Prospect Island continued in 2015. A small levee repair was done in January after several small diameter pipes extending from Miner Slough to the land side of the levee were found conveying water and causing erosion damage. Vegetation on the crown and slopes of the Miner Slough levee along Prospect Island was cleared, using a combination of boom mowers and goat herds, to facilitate inspection and monitoring of the priority levee repair sites. Due to delays in obtaining permits, larger-scale levee repairs were not done in 2015. DWR continues to pursue obtaining the necessary permits to complete this work. After acquiring the southern portion of Prospect Island from the Port of West Sacramento in September, DWR had the California Conservation Corps clear vegetation from the Miner Slough levee. A portion of the levee was cleared in 2015; the remainder will be completed in 2016.

DWR's North Central Region Office continues to monitor the 20 groundwater wells and one surface water gauge installed on Prospect Island, and nine groundwater wells and three surface water gauges on Ryer Island. Groundwater and surface water levels are monitored to characterize the subsurface hydrogeological conditions to further evaluate the potential for seepage to occur on Ryer Island as a result of tidal restoration on Prospect Island.

The preferred alternative project description and conceptual restoration plan for Prospect Island habitat restoration was developed in 2014. Work on the administrative draft EIR continued in 2015. A public draft is scheduled to be released in 2016.

FRP monitoring activities in 2015 focused on the refinement of a standardized framework for tidal wetland monitoring in the Delta. The intent in using a common framework is to increase data comparability across projects and provide more power to detect effects of restoration. The FRP monitoring team revised the preliminary monitoring plan for the Prospect Island project to reflect the hypotheses and metrics included in the framework. Additionally, the team developed databases, and metadata standards that will be applied to all future monitoring.

DWR acquired the Port of West Sacramento's 140-acre portion of Decker Island. Restoration planning for Decker Island progressed with the development of goals and objectives, initial topography, and cultural resources, and the completion of vegetation surveys. Several conceptual designs were selected and evaluated; a single project design will be chosen in early 2016.

DWR purchased the 245-acre Property 322 in February 2013 for tidal habitat restoration. At the end of 2015, DWR was in escrow to purchase Property 329. The two properties are located on Bradmoor Island within the Suisun Marsh. Initial restoration planning includes alternatives to restore the whole island or only the portion already purchased.

The FRP continues efforts to acquire more restoration properties. In an effort to reach its BiOp restoration requirements, DWR is developing a process to solicit proposals for restoration projects in which private and nonprofit entities would acquire property and develop and implement tidal habitat restoration projects that meet DWR criteria. DWR began discussions with Reclamation to develop a joint, cost-shared process for soliciting proposals and awarding contracts. DWR expects to complete preparation of the full solicitation package to begin solicitation in 2016 and award contracts in late 2016.

## Decisions on Endangered Species

Table 3-1 lists fish species of concern found in the Delta. No status changes were made in 2015.

## Trends in Fish Abundance

Abundance indices for Longfin Smelt and Delta Smelt are based on DFW fall midwater trawl sampling conducted every year from September through December. Index calculations are based on average catch per trawl for 100 core index stations, which are partitioned into 14 geographic areas. The average monthly catch per tow in each area is multiplied by a weighting factor that is based on the estimated volume of water in each area. The resulting values are then summed over all areas and months to obtain the annual index. This fall abundance index serves as an indicator for adult Longfin and Delta Smelt populations over a relatively long period of time.

The abundance index for Longfin Smelt is shown on Figure 3-1. The index for 2015 declined from the previous year to the lowest value on record.

**Table 3-1 Special Status Delta Fish Species**

| Common Name | Scientific Name | Listing or Action | |
|---|---|---|---|
| | | ESA | CESA |
| Delta Smelt | *Hypomesus transpacificus* | threatened[a] (4/5/1993) | endangered (1/20/2010) |
| Longfin Smelt | *Spirinchus thaleichthys* | candidate[b] (4/2/2012) | threatened (4/9/2010) |
| Chinook Salmon (winter-run) | *Oncorhynchus tshawytscha* | endangered (2/3/1994) | endangered (9/22/1989) |
| Chinook Salmon (spring-run) | *Oncorhynchus tshawytscha* | threatened (11/15/1999) | threatened (2/5/1999) |
| Chinook Salmon (fall-/late fall-run) | *Oncorhynchus tshawytscha* | species of concern (4/15/2004) | none |
| Steelhead (Central Valley DPS) | *Oncorhynchus mykiss* | threatened (5/18/1998) | none |
| Green Sturgeon (Southern DPS) | *Acipenser medirostris* | threatened (6/6/2006) | none |
| Sacramento Splittail | *Pogonichthys macrolepidotus* | none | species of concern |
| Pacific Lamprey | *Entosphenus tridentata* | species of concern | none |
| River Lamprey | *Lampetra ayresii* | none | species of concern |

ESA = federal Endangered Species Act; CESA = California Endangered Species Act; DPS = distinct population segment

[a] In April 2010, the USFWS found that reclassification of Delta Smelt from threatened to endangered was warranted but precluded by other higher priority listing actions.

[b] On April 2, 2012, the USFWS found that listing the San Francisco Bay-Delta DPS as threatened or endangered was warranted but precluded by other higher priority listing actions and has added the San Francisco Bay-Delta DPS of Longfin Smelt to its list of candidate species.

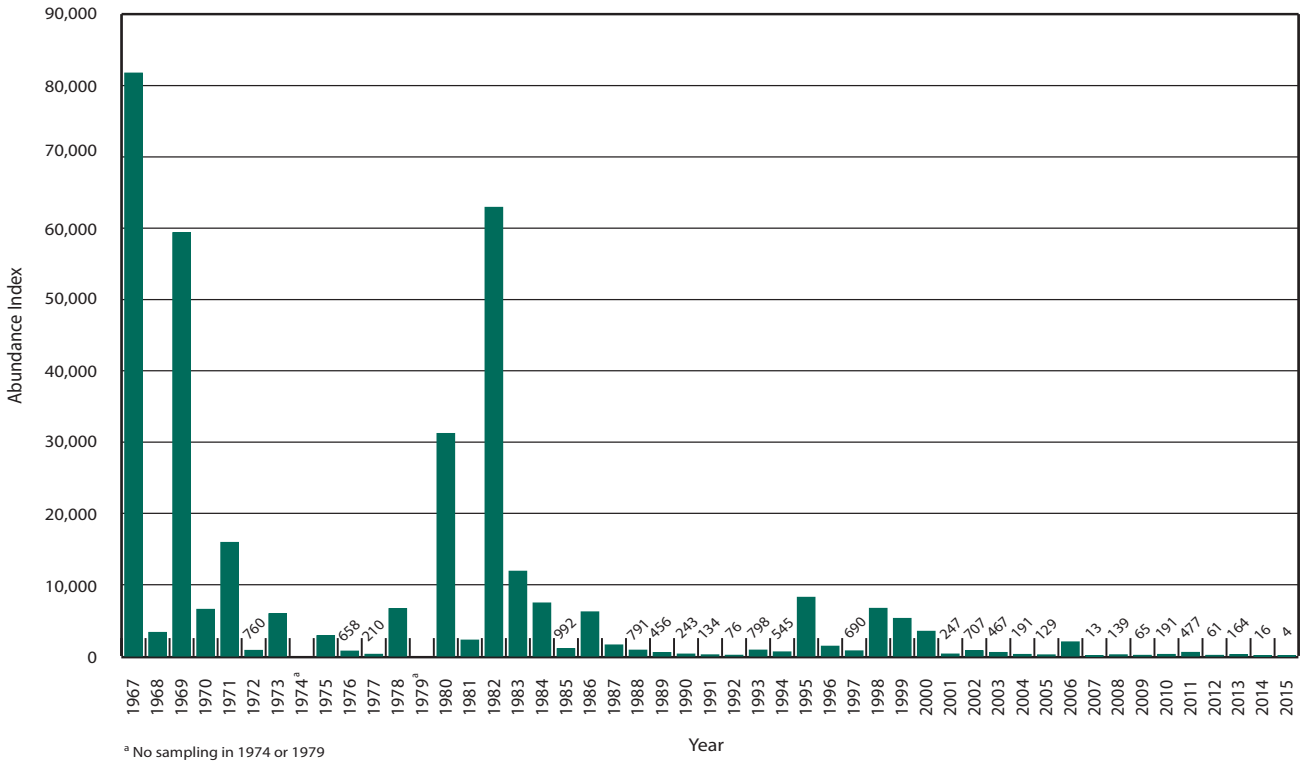



**Figure 3-1 Longfin Smelt Fall Midwater Trawl Abundance Index, 1967–2015**

Figure 3-2 shows the fall midwater trawl abundance index for Delta Smelt. In 2015, the index dropped to a value of 7, the lowest value observed since the inception of the survey.

Figure 3-3 shows estimates of returning adult winter-run Chinook Salmon from 1970 through 2015. These estimates, referred to as escapement estimates, are the number of adults that escape mortality and return to spawn. The Sacramento River winter-run Chinook Salmon escapement estimates are generated from the DFW carcass survey. DFW has been using the carcass survey data to generate escapement estimates since 2001, prior to which Red Bluff Diversion Dam counts were used. The estimated winter-run Chinook Salmon escapement for 2015 was 3,440, which was 14 percent higher than the 2014 escapement estimate.

Figure 3-4 shows estimates of returning adult spring-run Chinook Salmon from 1985 through 2015. Individual estimates are shown for the FRFH and the principal spring-run spawning streams: Battle Creek, Clear Creek, Mill Creek, Deer Creek, and Butte Creek. The escapement estimates are shown separately for each stream because the Feather River estimate is based on returns to the FRFH, where the genetic integrity of spring-run Chinook Salmon is uncertain. The estimated escapement for 2015 was 4,440 for the FRFH and 1,190 for the other streams combined. The 2015 escapement estimate was 1.2 times higher than the 2012 parent stock estimate for the FRFH, but 15.7 times lower than the 2012 parent stock estimate for naturally spawned fish in Battle, Clear, Mill, Deer, and Butte creeks.

Due to the lack of comprehensive monitoring programs, there are no reliable escapement estimates for wild Central Valley steelhead.

## Pelagic Organism Decline in the Upper San Francisco Estuary

By the early 2000s, long-term monitoring by the Interagency Ecological Program revealed marked declines in numerous pelagic (open water) fish species in the upper San Francisco Estuary (the Delta and Suisun Bay). This decline has collectively become known as pelagic organism decline.

Pelagic fish species in decline include Delta Smelt, Longfin Smelt, Striped Bass (*Morone saxatilis*), and Threadfin Shad (*Dorosoma petenense*). These declines resulted in significant management consequences, including limits on SWP and CVP pumping operations for the protection of Delta Smelt (listed as threatened under ESA and endangered under CESA) and Longfin Smelt (listed as threatened under CESA).

Since 2005, Interagency Ecological Program scientists have been coordinating studies investigating potential causes of pelagic organism decline. In 2010, an "ecosystem regime shift" conceptual model was put forward, hypothesizing that pelagic organism decline was caused by changes to multiple and interacting environmental variables, such as outflow, turbidity, and salinity, which led to fundamental changes to the Delta ecosystem. This conceptual model has served as a working hypothesis for continuing pelagic organism decline investigations since 2011. In early 2012, the Interagency Ecological Program formed the Management, Analysis, and Synthesis Team to synthesize scientific datasets with the goal of addressing pressing management information needs.

During 2015, the team conducted a synthesis on how recent drought conditions have influenced Delta fishes, including Delta Smelt and Longfin Smelt, and their habitats. The abundance of both species dropped

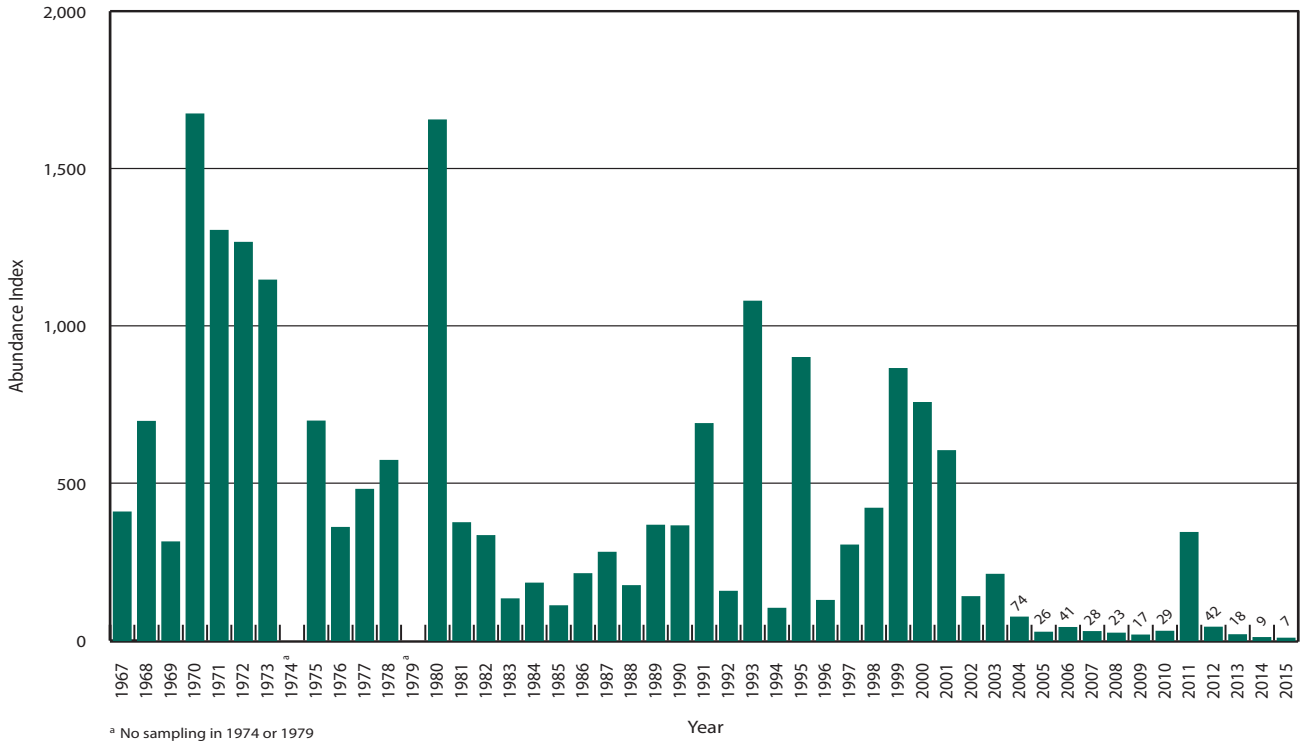



**Figure 3-2** **Delta Smelt Fall Midwater Trawl Abundance Index, 1967–2015**

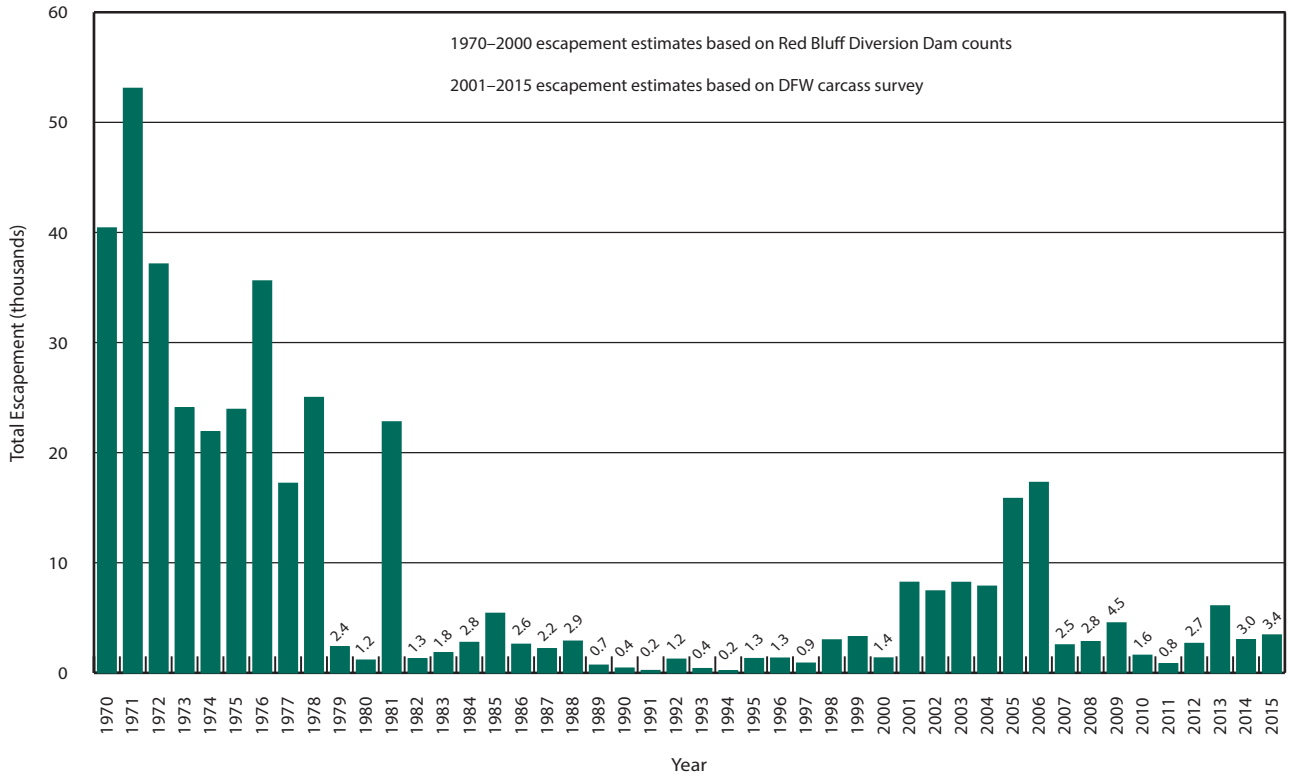
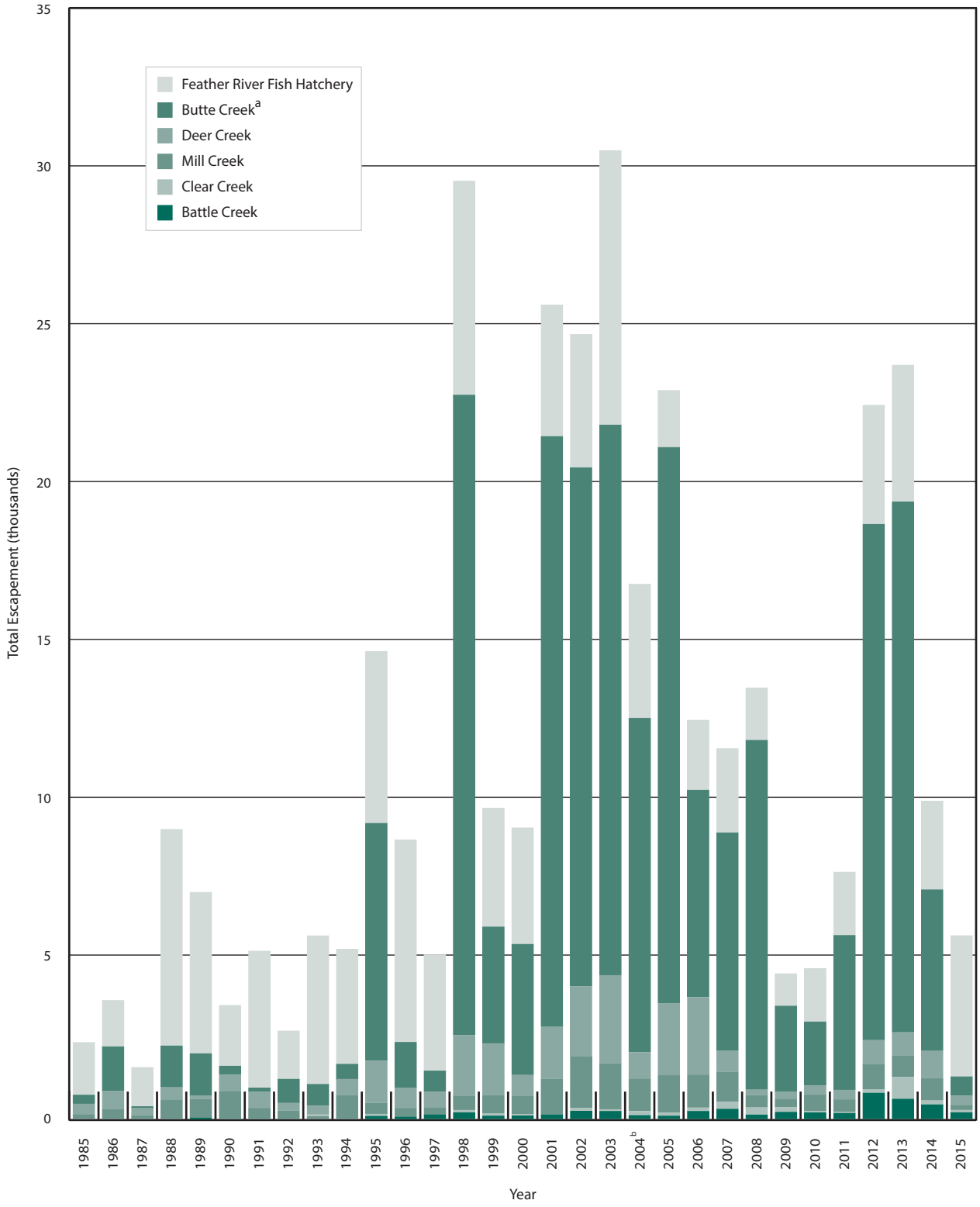



**Figure 3-3** **Estimated Total Adult Winter-run Chinook Salmon Escapement, 1970–2015**




[a] From 1985–2000, Butte Creek estimates were based on snorkel surveys.
From 2001–2015, Butte Creek estimates were based on carcass surveys.
[b] In 2004, the Feather River Fish Hatchery ladder was only open September 15–30 instead of the typical 30 days.

**Figure 3-4 Estimated Total Adult Spring-run Chinook Salmon Escapement, 1985–2015**

to record low levels during the current multiyear drought that extended into 2015. A manuscript detailing the Management, Analysis, and Synthesis Team's synthesis will be submitted to a peer-reviewed journal in 2016.

## Feather River Fish Studies

In the early 1990s, the Feather River fish studies were initiated to document and monitor fish populations in the lower Feather River. Early efforts focused on studies to identify flow requirements for Chinook Salmon and steelhead. The program has progressively expanded since the mid-1990s, first, to prepare for the Federal Energy Regulatory Commission relicensing of the Oroville Facilities and then to satisfy the 2004 NOAA Fisheries BiOp for the CVP and SWP long-term Operations Criteria and Plan. Recently, efforts have been made to satisfy the NOAA Fisheries BiOp with the Oroville Facilities license issuance in mind. Baseline information will be developed that satisfies current requirements and will directly benefit planning and implementation of license requirements. Field program elements have included operation of rotary screw traps (RSTs), acoustic and radio telemetry, salmon and steelhead spawning surveys, salmon escapement surveys, spring-run Chinook Salmon tagging, otolith thermal marking studies, snorkel and beach seining surveys, Green Sturgeon studies, steelhead acoustic tagging, and hatchery juvenile Chinook Salmon movement and survival studies.

The study area is generally divided into the low-flow channel, from the Fish Barrier Dam downstream to the Thermalito Afterbay Outlet, and the high-flow channel, from the Thermalito Afterbay Outlet downstream to the confluence with the Sacramento River at Verona (see Figure 3-5).

### Rotary Screw Traps

RSTs capture juvenile salmon and steelhead as they emigrate from the Feather River. Over the last 18 years, DWR has used RSTs as the primary method to assess the general abundance and timing of emigrating juvenile salmon and steelhead in the lower Feather River. In addition, large numbers of naturally produced (wild) salmon have been coded wire tagged to examine their return success. Although adult returns have been too small to evaluate, a 5-year tagging effort has led to estimates of fry survival through the upper reaches of the high-flow channel—the first time this has ever been achieved. This data will be presented in an upcoming report.

Emigration timing and travel times confirm that most wild juvenile Chinook Salmon move rapidly through the upper reaches of the lower Feather River as fry. However, little information exists regarding rearing behavior in the lower Feather River downstream of the town of Live Oak (see the Beach Seining section, later in the chapter). Additionally, trapping larger individuals that may be exhibiting alternative life-history strategies is difficult and not likely to be well documented without targeted trapping efforts (which are not currently employed).

In 2015, the RSTs fished throughout the majority of the emigration period, with salmon emigration observed from December through May, with the greatest abundance occurring in January and February. In 2015, trapping locations included both the low-flow and high-flow channels. Within the low-flow channel, approximately 19,500,000 juvenile salmon were estimated to have passed the RSTs. Within the high-flow channel, approximately 7,500,000 were estimated to have passed the Herringer Riffle trap at River Mile (RM) 46.

Although Chinook Salmon and steelhead were the primary targets of trapping efforts, records were kept on all fish species caught.

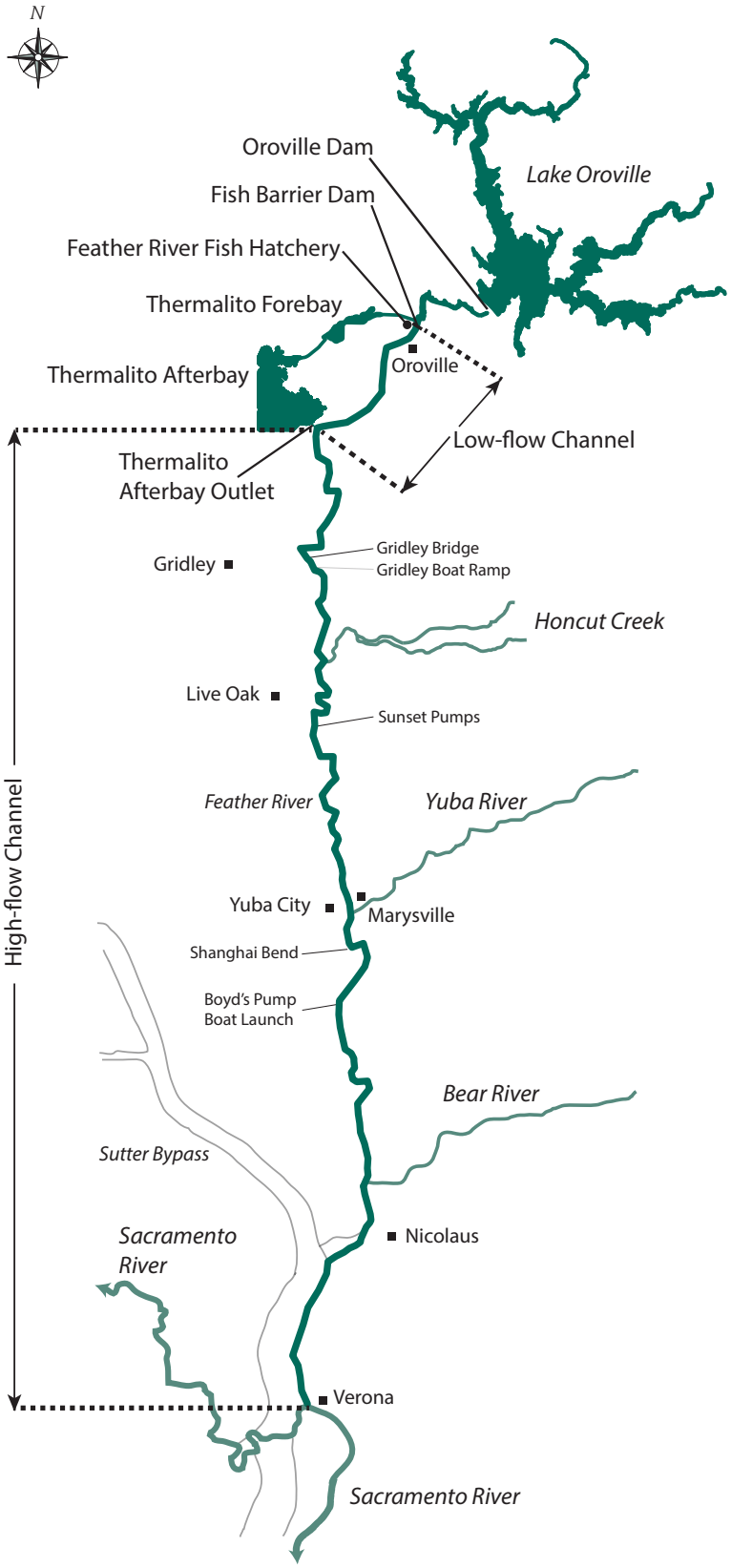



**Figure 3-5 The Lower Feather River**

Twenty-three species, including three races of Chinook Salmon (fall-run, spring-run, and late fall-run), were caught during the 2015 season. Chinook Salmon was the dominant species, comprising 95 percent of the catch. A total of 465,019 Chinook Salmon were caught in the RSTs with 319,221 (69 percent) of those captured in the low-flow channel and 145,798 (31 percent) caught in the high-flow channel.

## Acoustic Telemetry

Acoustic telemetry gathers baseline information on the migration and holding patterns of adult spring-run Chinook Salmon in the lower Feather River. In 2015, a telemetry study was conducted to collect additional data to better understand migration of prespawning adult Chinook Salmon.

Chinook Salmon with a spring-run life history enter freshwater in spring and hold in the river up to several months before spawning. In order to collect additional data to evaluate straying, migration patterns, and potential passage barriers for spring-run Chinook Salmon, adults were captured and tagged with acoustic tags.

Between April 28 and June 25, 2015, nine adult spring-run Chinook Salmon were captured at Shanghai Bend (downstream of the Yuba River confluence) using hook-and-line sampling and implanted with acoustic tags. These fish were monitored along the 67-mile stretch of river from the Fish Barrier Dam near the FRFH to the confluence with the Sacramento River at Verona. Twenty-six submersible hydrophone receivers positioned at various locations along this stretch picked up the signals from the implanted tags as fish passed the receivers. All salmon tagged at Shanghai Bend in 2015 swam to the upper reaches of the Feather River. Seven out of nine Chinook Salmon were observed to reach the uppermost extent near the FRFH (RM 67). Two fish demonstrated upstream movement to River Bend Park (RM 65.7) with no evidence of movement upstream of this point.

## Spawning Surveys

To better understand Feather River salmon and steelhead spawning distribution and response to restoration actions, redd surveys (a redd is a shallow depression in a streambed, excavated by a salmonid and containing deposited fish eggs) are performed to identify the location, timing, magnitude, and physical characteristics of natural spawning sites in the lower Feather River. The surveys are generally performed weekly, and, depending on the survey type, much of the available spawning area between the Fish Barrier Dam and Gridley Bridge is searched.

### *Salmon*

In June and July 2014, DWR implemented a project to strategically place 8,300 cubic yards of salmon and steelhead spawning gravel in the lower Feather River near the FRFH. The spawning gravel used was in the ideal size range for salmon and steelhead, and the project was designed to optimize depth, flow, and velocity for immediate use. In selected areas with significant armoring and large cobble, the riverbed was also scarified to increase permeability and to break up the armoring that had occurred over the past 50 years. Redd mapping and hydraulic modeling occurred before the project to document existing use and to inform the design of each new feature. Post-project redd mapping and modeling were performed to document use of the newly restored sites and to validate predictions.

In 2015, Chinook salmon redd surveys were conducted within the gravel augmentation project boundary to monitor the response to the restored areas. Redd surveys were also performed in the high-flow channel to record redds that could be dewatered when flows decrease in the fall.

Ground surveys for the 2015 Chinook Salmon redd survey began on September 16 and continued until December 4. The redd survey consisted of a total of 37 days over 13 survey weeks. The surveys were concentrated in lower, middle, and upper Auditorium Riffle as well as the section between upper Cottonwood Riffle and upper Moe's Side Channel. Hatchery Riffle and upper Hatchery Riffle (RM 66.6) were also sampled. The high-flow channel was surveyed four times in 2015. The first survey was conducted on October 15 and the last survey took place on December 3.

During the 13 weekly surveys, 2,023 redds were found within the spawning area between upper Hatchery Riffle and lower Auditorium Riffle (RM 66.4). This area included all of the newly restored spawning sites as well as Cottonwood Riffle and Moe's Side Channel. Since 2014, the restored areas continue to see significant spawning activity, indicating that the project was successful. Another 147 redds were discovered in the high-flow channel from the Thermalito Afterbay Outlet to the Gridley Bridge.

The week 4 survey (October 5, 6, 8, and 9) covering the area between upper Hatchery Riffle and lower Auditorium Riffle revealed the highest number of redds with 377. The second highest total was 350 redds for the survey conducted the week of October 19 in the same areas. The locations with the largest number of redds were the lower Auditorium Riffle area with 651 (32 percent) and Hatchery Riffle with 257 (13 percent). The average depth for all salmon redds was 0.45 meters (m) (1.48 feet [ft]), and the average water velocity was 0.46 m (1.51 ft) per second. The average redd length and width was 2.1 m (6.89 ft) by 1.4 m (4.59 ft), respectively.

### *Steelhead*

In 2015, a total of 56 steelhead redds were identified during 8 weekly surveys. Forty of the 56 redds (71 percent) were observed in Moe's Side Channel and Hatchery Side Channel, two side channels in the uppermost section (RM 66.5) of the lower Feather River. Steelhead redds were first observed on January 15, with newly constructed redds continuously observed through March 5. Fifty redds (89 percent) were observed between mid-January and mid-February.

The average depth for all recorded redds was 0.33 m (1.08 ft) with an average water velocity of 0.67 m (2.20 ft) per second. The average redd length and width was 1.17 m (3.84 ft) by 0.76 m (2.49 ft). Small gravel and pebbles were the dominant substrate types used by steelhead for redd construction, and overhead cover was present at 59 percent of observed redds. Instream cover was present at 55 percent of observed steelhead redds.

## Salmon Escapement Survey

The survey provides information crucial to monitoring, managing, and conserving Feather River salmon populations. The primary purpose of the salmon escapement survey is to evaluate the abundance of Chinook Salmon spawning in the lower Feather River. Other important objectives include: (1) understanding the distribution and success of spawning, (2) estimating the number of hatchery salmon spawning in the river, and (3) identifying trends in population and age structure.

The Chinook Salmon spawning escapement survey began September 8 and continued through December 23, 2015. The survey was conducted in the low-flow channel and the high-flow channel from the Table Mountain Bridge downstream to the Gridley Bridge. Due to the low numbers of returning fish in the high-flow channel, the data were pooled with the low-flow channel data to generate one estimate for the entire lower Feather River.

The carcass mark-recapture study resulted in a spawning population estimate of

18,069 adult Chinook Salmon for the lower Feather River. There were an estimated 2,497 grilse (2-year-old fish less than 65 centimeters in fork length). These estimates include both fall-run and spring-run Chinook Salmon since their spawning is currently not fully segregated on the Feather River.

Approximately 95.2 percent of the spawning population utilized the low-flow channel. Since 2000, the long-term average for the low-flow channel's spawning population is 82.8 percent. In the low-flow channel, survey section 8 (RM 66.5) had the highest carcass concentration followed by section 12 (RM 63.0). The highest concentrations of carcasses in the high-flow channel were found in sections 24 and 28 (RM 57 and 56, respectively).

## Feather River Fish Hatchery Spring-run Chinook Salmon Tagging

To better manage broodstock selection at the FRFH, a program was developed to mark spring-run Chinook Salmon entering the FRFH in the spring. The spring-run Chinook Salmon tagging program allows DFW to segregate the spawning of spring- and fall-run Chinook Salmon in the hatchery in the fall when the populations are mixed together in the fish ladder. The program also investigates potential differences in spawning distribution and timing of the early arriving spring-run Chinook Salmon in the river.

Early arriving spring-run Chinook Salmon entering the hatchery in May and June were marked with individually numbered Hallprint dart tags for identification. Once marked, the fish were released back into the river. During the hatchery spawning season, the tags enabled hatchery staff to distinguish the early arriving spring-run fish from the fall-run fish, allowing segregated spawning for each run. The tags also enabled the escapement survey crew to differentiate spring- and fall-run salmon, so that any potential differences in spawning success, distribution, or behavior of the two runs can be analyzed.

In 2015, 5,355 Central Valley spring-run Chinook Salmon were tagged at the FRFH. Tagging began on May 21 and ended on July 2. When spawning commenced in the fall, a total of 4,940 tagged fish were recaptured: 4,440 at the FRFH and 500 in the river escapement survey.

## Snorkel Surveys

From 1999 to 2001, DWR conducted snorkel surveys focused on juvenile steelhead, but included observations of other species and life stages. In 2010, DWR reinstituted the lower Feather River snorkeling surveys with the following objectives:

(1) determine the relative abundance and distribution of juvenile spring-run Chinook Salmon and steelhead prior to habitat improvements;
(2) identify habitat conditions (depth, substrate, velocity, and cover) where juvenile Chinook Salmon and steelhead occur; and
(3) identify potential sites for channel improvement and structural habitat restoration.

In 2015, the Feather River Program continued to collect data to determine the relative abundance and distribution of age-0 steelhead and salmon prior to habitat improvements. Nonsalmonid species were also identified and enumerated. The program also succeeded in quantifying habitat characteristics where juvenile steelhead and salmon occur as well as identifying other high-use areas of the low-flow channel that may benefit from habitat improvements.

Snorkel surveys were conducted during July, August, and September 2015 at 21 permanent sites, 12 in the low-flow

channel and 9 in the high-flow channel. Of the 116 Chinook Salmon identified during the snorkel surveys, 113 were adults. A total of 365 steelhead were identified and enumerated; 283 were considered to be juveniles (≤200 mm fork length).

## Beach Seining

DWR conducted beach seining surveys in the lower Feather River between January 1997 and August 2001 to document fish distribution. Since then, beach seining has occurred intermittently since 2008 to further document the distribution and condition of steelhead and salmon in both the low-flow and high-flow channels during the primary emigration and rearing period (roughly December through July).

Although targeted at steelhead and salmon, beach seining is useful to augment screw trapping for the purpose of documenting the distribution and relative abundance of all fish species found in the Feather River. In 2015, the objectives for beach seining included two relatively new components: capturing spring-run smolts released from the FRFH to augment survival study and emigration rate data collected via acoustic tagging, and collecting random samples of juvenile Chinook Salmon for an ongoing *Ceratonova shasta* study. This study is looking at the rate of infection and disease from the parasite *C. shasta* experienced by juvenile Chinook Salmon rearing or emigrating in the lower Feather River.

Beach seining surveys were conducted from April through August 2015. A total of 83 seine hauls and 6,076 individual fishes were sampled during the 2015 surveys. Native fishes dominated the beach seine catch and represented 88 percent of the overall catch. The most abundant groups captured were juvenile minnows (1,880), Sacramento Sucker (1,693), and juvenile Chinook Salmon (794). A total of 23 steelhead were captured by beach seine in 2015.

## Green Sturgeon Studies

The primary objective of the sturgeon study is to provide DWR with data to make long-term management decisions concerning future monitoring programs, operational changes to the facilities, and/or habitat enhancement within the lower Feather River. Specific studies focus on the following components of Green Sturgeon life-history in the lower Feather River:

- potential adult migration barriers;
- migration patterns;
- distribution and habitat preferences;
- annual abundance of adults; and
- identification of spawning grounds.

In 2015, 73 sonar surveys were completed from January 12 to December 23. The number of surveys conducted at six locations was as follows:

- Lower Shanghai (RM 24.7), 25;
- Upper Shanghai (RM 25.5), 1;
- Sunset Pumps (RM 38.5), 23;
- Lower McFarland (RM 52.0), 2;
- Big Hole (RM 57.9), 1; and
- Thermalito Afterbay Outlet (RM 59), 21.

A total of 29 sturgeon detections were made during the survey season. Since individuals are detected multiple times, analysis of the 29 detections suggests that at least 3 to 5 individuals were within the study area. Sturgeon at Shanghai accounted for 89 percent of the detections and were 1.5 to 1.9 m (4.9 to 6.2 ft) in length at depths of 1.1 m (3.6 ft) to 4.7 m (15.4 ft). The only sturgeon detected at Sunset Pumps rock dam was 1.5 m (4.9 ft) long at 1.1 m (3.6 ft) depth. The two other detections occurred at Upper Shanghai (1.4 m (4.6 ft) long; 1.2 m (3.9 ft) deep) and Lower McFarland (1.3 m (4.3 ft) long; 2.5 m (8.2 ft) deep). It

is not clear whether these were Green or White Sturgeon.

One adult Green Sturgeon was captured via angling and tagged on October 22 below Shanghai where it remained until it began outmigrating on December 23. One adult Green Sturgeon was visually identified repeatedly below Sunset Pumps between June 29 and August 1 at 1 to 2 m (3.3 to 6.6 ft) depth. A Green Sturgeon was also visually confirmed by multiple biologists at Lower McFarland (above the Sunset Pumps rock dam) on multiple occasions.

No egg or larval sampling occurred in 2015 since adults were not detected until after the spawning season was over.

### *Ceratonova shasta* Sampling

*Ceratonova* (previously known as *Ceratomyxa*) *shasta* is a parasite that infects freshwater salmonid fishes throughout tributaries of the Pacific coast of North America, including the Feather River. *C. shasta* has a complex life cycle involving an invertebrate polychaete worm host (*Manayunkia speciosa*) in addition to the salmon host. Infected worms release actinospores into the water that infect fish by attaching to the gills.

A high prevalence of severe *C. shasta* infection (68–83 percent) was observed in natural Feather River juvenile Chinook Salmon sampled in the high-flow channel between 2012–2014. Juveniles collected in the low-flow channel were far less likely to be infected (<10 percent prevalence of infection). In 2015, DWR partnered with the USFWS Coleman National Fish Health Laboratory to better understand the problem observed in the lower Feather River. The objectives of this study were to:

(1) compare prevalence and severity of infection by *C. shasta* and the myxozoan kidney parasite, *Parvicapsula minibicornis*, in natural Chinook Salmon juveniles in the low- and high-flow channel reaches of the Feather River from late January until outmigration ends in late spring;
(2) collect juvenile Chinook Salmon by beach seine in the lower Feather River below the confluence of the Yuba River during the prime infectivity period of March and April (the lower river sample may provide information on tributary input and prognosis of infections acquired up-river); and
(3) collect environmental DNA samples from the Feather River at several different locations to better determine the locations where actinospores are of highest density.

Results of the 2015 *C. shasta* sampling show both a high prevalence (58 percent) and disease severity in natural Chinook Salmon juveniles collected in the high-flow channel of the Feather River. Infection was detected as early as February when the water temperature was 11–12°C (51.8–53.6°F). These fish had concurrent infections by *P. minibicornis*. Salmon sampled from the low-flow channel of the Feather River and Lake Oroville showed little to no *C. shasta* infection. Infection data for natural Chinook Salmon and sentinel fish along with the *C. shasta* environmental DNA concentration in river water demonstrates a zone of high infectivity for both pathogens in the high-flow channel, from approximately the Thermalito Afterbay Outlet (RM 59) to at least the Herringer RST site (RM 45.8). Actinospore concentrations declined downstream of the Herringer site.

## Fish-related Mitigation Projects

In 1986, DWR and DFW signed the Delta Pumping Plant Fish Protection Agreement (Delta Fish Agreement) to annually provide funds to offset direct losses of Chinook Salmon, steelhead, and Striped Bass at

Banks Pumping Plant. The Delta Fish Agreement is commonly referred to as the Four Pumps Agreement because it was adopted as part of the mitigation for four additional pumps at Banks Pumping Plant. Direct losses are defined as losses of fish that occur from the time fish are drawn into Clifton Court Forebay until the surviving fish are returned to the Delta. In principle, DFW and DWR intended this agreement to offset direct losses of all fish caused by the diversion of water by the pumping plant starting in 1986. However, at that time, information on impacts and measures to offset those impacts was sufficient only to deal with Chinook Salmon, steelhead, and Striped Bass. The agreement allowed for addressing impacts on other fish species once impacts could be identified and measures could be developed that would offset such impacts.

The agreement formalized the Delta Pumping Plant Fish Advisory Committee consisting of representatives from interest groups concerned with fish resources affected by the SWP, including, but not limited to, representatives of the SWP water contractors, sport and commercial fishing groups, and environmental groups. DWR and DFW work with the Delta Pumping Plant Fish Advisory Committee to review the success of the agreement in offsetting the direct effects of diversions at Banks Pumping Plant.

To mitigate fish loss, mitigation projects are selected and funded by the Delta Fish Agreement. The agreement outlines how project proposals are reviewed and selected for funding and gives priority to mitigation measures for habitat restoration and other nonhatchery measures. Under the agreement, DWR calculates fish loss as prescribed in the agreement, and approved mitigation projects earn fish mitigation credits to satisfy the fish loss mitigation provisions in the agreement. Mitigation is on a fish-for-fish basis.

The agreement provides for two funding components. One component is the Annual Mitigation Account for compensating the annual fish loss. It has no expiration date. The second is a $15 million Lump Sum Account provided by DWR for additional projects to compensate for post-1986 fish loss.

Since 1986, DWR has spent $71 million on mitigation projects developed under the Delta Fish Agreement. Mitigation fund expenditures through December 31, 2015, were $57 million for the Annual Mitigation Account and $14 million for the $15 million Lump Sum Account. Funds approved but unexpended from each account were $7 million and $1 million, respectively. Funds for the Delta Fish Agreement's Lump Sum Account will be available for expenditure through December 31, 2016.

For more information, see DWR's website.

## Climate Change

Impacts on California under a changing climate include rising seas, longer, more frequent droughts, reduced snowpack, higher temperatures, and earlier snowmelt are already occurring and are projected to continue. These hydrologic changes will challenge current and future operation of the SWP.

California experienced a fourth consecutive year of drought in 2015. The extreme heat that accompanied this dry period was unprecedented. All four years ranked in the top 10 hottest years on record for the state, with 2014 being the hottest year ever recorded in California.

California's hydrology is a snowmelt-dominated system. Warmer temperatures are already shifting peak snowmelt runoff to earlier in the year. Projections show the trend of warming and earlier runoff will continue through the 21st century,

increasingly overlapping with winter storms and flood protection operations. Because flood control is a high priority for California's multipurpose reservoirs (like Lake Oroville) this shift in runoff timing will result in runoff being released to maintain flood protection storage space in reservoirs. Reduced late season runoff will result in less runoff captured for storage, increasing the potential for shortages when demand is high. Additionally, estimates of historical precipitation indicate that over time, there has been a trend toward more rain than snow in the total amount of precipitation in the Sierra Nevada. For more information, see *California Climate Science and Data*, published by DWR in June 2015 and available on DWR's website.

To address these challenges, DWR remains committed to contributing to statewide, national, and international efforts to mitigate the future impacts of climate change by reducing greenhouse gas (GHG) emissions from its activities and adapting to unavoidable climate change impacts. DWR's efforts throughout 2015 represent the continuation of its multipronged approach to addressing these issues by conducting research to better understand potential future impacts; monitoring and reporting GHG emissions; developing plans, strategies, and actions to improve the resiliency of DWR/SWP facilities and operations; reviewing and consulting with outside experts; and developing and managing climate data.

## Completed in 2015

### *Review and Consultation*

**DWR Climate Change Technical Advisory Group.** To improve the scientific basis for decisions and enhance the consistency of climate change approaches, DWR empaneled a Climate Change Technical Advisory Group. The group provides guidance on the scientific aspects of climate change, the impacts of climate change on water resources, the use and creation of planning approaches and analytical tools, and the development of adaptation responses.

The advisory group's work concluded with the release of the report, *Perspectives and Guidance for Climate Change Analysis* in August 2015. The group processes and outcomes were also presented at the American Geophysical Union 2015 Fall Meeting in a poster titled, "Producing Scientific and Strategic Guidance for California's Department of Water Resources: The Climate Change Technical Advisory Group."

Additional information on the Climate Change Technical Advisory Group can be found in previous editions of Bulletin 132, and Climate Change Technical Advisory Group materials and meeting notes can be found on DWR's climate change website.

### *Research*

**Climate Change Impacts on California Water Rights.** The project goal was to evaluate future nonproject water rights reliability in the Sacramento, Feather, and American river watersheds. The final report, published in 2015, gives projections of future water rights curtailments showing that water rights are likely to be curtailed much more frequently and for significantly longer durations in the future. Further, many more water rights holders will be affected by curtailment actions in the future. As curtailments last longer and become more common, more water users will have to access other supplies, such as groundwater or water transfers, or will have to fallow land or conserve water in other ways to meet their demands. The report also provides information about the amount of stored SWP and CVP water that is released each year in excess of the releases that would be necessary to meet SWP and CVP deliveries and how this amount of water is likely to change in the future. The report

is available on the University of California eScholarship website.

**Evaluation of Benefits of Meadow Restoration on Sierra Nevada Water Supply.** DWR provided funding to the U.S. Forest Service for a 5-year investigation of the hydrologic effects of meadow restoration and how restored meadows can contribute to improved system operation and ecosystem functioning.

In a natural, undegraded condition, mountain meadow communities have deep soils, dense herbaceous vegetation, and a naturally developed drainage pattern. Water infiltrates the soil, and shallow meandering channels then carry water downstream. Meadows typically remain fully saturated for most of each year and can store substantial quantities of groundwater in their soils, acting as natural reservoirs of water at high elevations. Slow release of water stored in meadow sediments can provide base flow to downstream drainages long after surface runoff has stopped for the season. In addition, the water storage capacity of meadows can buffer the rate of water runoff during snowmelt and reduce peak flows that cause flooding downstream. Degraded meadows that have been exposed to poor land-use practices drain rapidly into stream channels rather than across meadow surfaces.

The project culminated with the release of the final report, *Effects of Meadow Erosion and Restoration on Groundwater Storage and Baseflow in National Forests in the Sierra Nevada, California*. The report is available on the Sierra Nevada Meadows Data Clearinghouse website.

### *Data Development and Distribution*

**Formation of Regional Energy Intensity of Water Supplies Website.** As a follow up to the SWP water-energy intensity work completed in the *California Water Plan Update 2013*, an interactive website has been created. Regionally based energy intensity data is listed by source, including the SWP. SWP water-energy intensity is a measure of the amount of energy required to extract one unit of water from its origin on the Feather River or other tributary source water and convey it to a particular turnout point. Within California, the SWP water-energy intensity of water varies greatly depending on geography. Information about energy intensity and its associated GHG impacts is designed to help inform the public and SWP water contractors about the energy requirements of their SWP water supplies. Energy usage and GHG emissions information can support measures to reduce GHG emissions, as mandated by the State.

## Ongoing during 2015

### *Planning*

**Data Collection and Climate Services.** Since 2011, DWR has continued developing the Flood Emergency Response Information Exchange. Information in the exchange has been linked to the climate data in the California Climate Data Archive, and seasonal forecasting tools and a storms database have been developed. The exchange will also house a new server for providing depth-duration-frequency curves and annual extremes data sets that make up Bulletin 195 (*Rainfall Analysis for Drainage Design*) in a map-based format. Beta testing is currently underway in DWR's Hydrology and Flood Operations Office.

For observing data systems, DWR is continuing its partnership with the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration and Scripps Institution of Oceanography to deploy new monitoring equipment for extreme precipitation events. For this network, water vapor measurements, wind profilers, soil moisture sensors, and freezing-level radar are being deployed across the State. The data from this network are currently served through

the National Oceanic and Atmospheric Administration's Hydrometeorology Testbed website and the Center for Western Weather and Water Extremes website. Other observing opportunities include elements of the Forecast-Coordinated Operations program, the Forecast Informed Reservoir Operations Project at Lake Mendocino in the Russian River watershed, and the University of California, Merced/University of California, Berkeley, observing system in the American River and Feather River watersheds. A remote sensing monitoring effort using airborne LIDAR (light detection and ranging) measurements of the snowpack is continuing under a joint project between DWR, the California Cooperative Snow Survey Program, and the National Aeronautics and Space Administration's Jet Propulsion Laboratory. In the San Francisco Bay Area, new observations for precipitation will be part of the Advanced Quantitative Precipitation Information System, a regional project funded through the Integrated Water Resources Management Program.

## *Research*

**Reoperation of Water Supply and Flood Protection Systems.** The system reoperation study is being conducted in cooperation with stakeholders to identify strategies for reoperation of flood protection and water supply systems to improve water supply reliability, ecosystem protection, and flood management. In 2015, DWR completed assessments of reoperation of Shasta Lake, Lake Oroville, and Lake McClure, and integrated operation of the SWP and CVP, completing Phase 3 of the study.

Development of the system reoperation study is a multiphased effort that includes:

- Phase 1, Plan of Study (completed in 2011);
- Phase 2, Strategy Formulation and Refinement (completed in 2014);
- Phase 3, Preliminary Assessments of Strategies (completed in 2015); and
- Phase 4, Reconnaissance Level Assessments of Strategies (planned to be completed in 2016).

More information about this project can be found on the System Reoperation Program webpage on DWR's website.

## *Data Development and Curation*

**DWR Climate Change Basic Data Group.** DWR's Climate Change Basic Data group consists of representatives from the Division of Statewide Integrated Water Management, the Division of Flood Management, and DWR's regional offices. The project goals are to assess current climate data acquisition efforts at DWR; promote cooperation and coordination across programs; and strategize on issues of data storage, management, and dissemination. A partnership with the Western Regional Climate Center continued for coordinating statewide climate data collection, storage, and dissemination.

During 2015, the group began researching potential partnerships for assistance with managing in-house historical climate data. Future goals include digitizing historical climate data and providing access for academic research.

## *Policy*

**Development of Internal DWR Policies on Climate Change Mitigation, Analysis, and Adaptation.** In 2010, the DWR CEQA Climate Change Committee began a three-phase process to develop a comprehensive DWR Climate Action Plan that will contain internal policies to address climate change mitigation, effects analysis, and adaptation.

***Climate Action Plan Phase I.*** Completed in 2012, Climate Action Plan Phase I is the comprehensive DWR-wide *Greenhouse Gas Emissions Reduction Plan* that covers mitigation of GHG emissions. The plan lays

out steps to cut DWR's GHG emissions by 50 percent below 1990 levels by 2020 and 80 percent below 1990 levels by 2050.

In 2015, DWR's GHG emissions fell to their lowest levels since records have been kept (1988). The SWP produces more than 97 percent of DWR's GHG emissions. Since the implementation of the *Greenhouse Gas Emissions Reduction Plan* in 2012, DWR has realized a 30 percent reduction in overall GHG emissions.

***Climate Action Plan Phase II.*** Started in 2012, Phase II is a framework and data toolbox to guide analysis of the effects of climate change on DWR projects and activities. Phase II will ensure that all DWR projects meet standards for consistency, quality, and adequacy in climate change analysis for planning activities. This guidance may also provide assistance to local water managers. Phase II is expected to be completed in 2018.

***Climate Action Plan Phase III.*** Phase III of the Climate Action Plan evaluates the vulnerability of DWR facilities and operations to key climate change impacts and develops adaptation strategies to improve DWR's resiliency to climate change. The DWR Climate Change Vulnerability Assessment builds on studies of global, regional, and SWP-specific climate change impacts to evaluate, describe, and where possible, quantify DWR's vulnerabilities to expected changes in temperature, precipitation, and humidity. Specifically, this assessment looks at how changes in hydrology (precipitation, snowpack runoff, and flooding), extreme heat, wildfire, and sea-level rise will threaten DWR's infrastructure, maintenance activities, and operations. This comprehensive assessment is highly analytical using an array of geographic information system and modeling tools that goes beyond what any resource agency has previously employed for climate change vulnerability assessment. DWR-owned facilities and properties are considered, including those associated with the SWP, flood facilities, regional offices, and managed lands. It is intended that the climate change vulnerability assessment will serve as a foundation for the development of a climate change adaptation plan for impacted operations, infrastructure, and staff work. Together the climate change vulnerability assessment and climate change adaptation plan will help prioritize DWR's adaptation and resiliency efforts such as additional water storage projects, infrastructure improvements, enhanced maintenance and operation procedures, and improved habitat management. The vulnerability assessment portion of Phase III is expected to be completed in 2016, with the adaptation plan following in 2017.

## *Reporting*

**Emissions Reports to The Climate Registry.** DWR's emissions are primarily the result of electricity generation at DWR-owned power plants and power purchase transactions to provide power for operation of the SWP.

In May 2015, DWR reported its GHG emissions for the 2014 emission year to the California Air Resources Board pursuant to California mandatory GHG emissions reporting regulations (California Code of Regulations, Title 17, Sections 95100–95158). The report included energy generated and consumed by the SWP and sulfur hexafluoride emissions associated with the SWP's switchyard circuit breakers. The report did not include emissions from the Reid Gardner coal-fired power plant, which previously supplied DWR with up to 235 megawatts of power. (DWR's purchasing contract with Reid Gardner expired in 2013 and was not renewed in an effort to reduce GHG emissions from DWR activities.) In addition, to meet its compliance obligation for the Cap and Trade Program, DWR participated in GHG allowance auctions conducted by the California Air Resources Board.

## Environmental Document Review

Some environmental documents handled by the State Clearinghouse (a division in the Governor's Office of Planning and Research) concern proposed activities that could affect the SWP. Such documents are regularly reviewed to identify any public safety or liability issues arising from the proposed activities.

During 2015, the Division of Environmental Services, Environmental Document Review Section tracked documents related to development along the California Aqueduct, levee encroachment, dam safety issues, water transfers and other water supply issues, wastewater treatment, quarry development, solar and wind power facilities, and climate change issues. The number of environmental documents addressing significant climate change issues increased from 2, in 2010, to 26 in 2013 (after the CEQA guidelines were amended to address GHG emissions pursuant to Senate Bill 97 [Dutton; Chapter 185, Statutes of 2007]). However, in 2014, climate change issues began to be addressed in the general plan process, resulting in only 10 documents clearly dealing with climate change being processed that year. In 2015, 13 documents primarily related to climate change issues were processed.

DWR comments submitted through the CEQA and/or National Environmental Policy Act processes addressed a number of issues, including safety and water supply; encroachment on physical facilities; impacts to cross-drainage facilities; potential damage to SWP pipelines and aqueducts; wildlife issues, including migration, setbacks, and habitat conservation lands; DWR's status as a cooperating or responsible agency; development and operation of small-scale and utility-scale wind and solar projects; and jurisdictional dams.

In 2015, the Environmental Document Review Section screened 2,766 State Clearinghouse documents. After screening, 1,131 documents were referred for information, including notices of preparation and various final documents. Additionally, 129 formal referrals were made for negative declarations, notices of preparation, EIRs, and National Environmental Policy Act documents.

Seventy-six formal referrals plus one requested document were sent to the Division of Operations and Maintenance, and 17 referrals and two requested documents were sent to the State Water Project Analysis Office.

The total number of referrals and requests sent to the Division of Operations and Maintenance and the State Water Project Analysis Office remained the same as in 2014.

In 2015, formal referrals to all other DWR reviewers, including the Central Valley Flood Protection Board and the Division of Safety of Dams, decreased by about 25 percent from 2014. This decrease is relatively insignificant since the total number of referrals was small when compared to the total number of documents (41 were referred in 2014 and 31 in 2015). In addition, Central Valley Flood Protection Board referrals by the Environmental Document Review Section are made only if the State Clearinghouse does not directly assign an appropriate document to the board.



# Chapter 4
# Water Quality Programs

*An emergency drought barrier was built on West False River between Jersey and Bradford islands to block salt water from pushing into the central Delta from San Francisco Bay.*

## Significant Events in 2015

Due to a fourth year of drought conditions, an emergency drought barrier on West False River between Jersey and Bradford islands was erected in May in an effort to maintain good water quality in the central Sacramento-San Joaquin Delta.

Pyramid Lake in Los Angeles experienced a potentially harmful algal bloom in the summer. On June 26, the Department of Water Resources (DWR) issued a public advisory to avoid body contact with algal scum or visible blooms and to take precautions during recreation at the lake. The bloom subsided and the advisory was lifted on July 24.

In mid-October, mudflows clogged the East Branch Aqueduct and caused a shutdown of the normal aqueduct flows to Antelope Valley-East Kern Water Agency. DWR's Southern Field Division and contractors cleaned up and replaced parts of the aqueduct liner by early November.



*Information in this chapter was contributed by the Division of Environmental Services, the Division of Operations and Maintenance, and the State Water Project Analysis Office.*

The Department of Water Resources (DWR), Division of Operations and Maintenance currently maintains 16 automated water quality monitoring stations at key locations along the SWP. This network of automated stations continuously monitors a variety of water quality parameters throughout the system and provides real-time data to SWP water contractors. In addition, field grab samples collected weekly, monthly, quarterly, or annually from more than 30 SWP locations are routinely analyzed for a broad range of constituents at the State's Bryte Chemical Laboratory.

## Delta Water Quality

Maintaining adequate water quality to support multiple beneficial uses of water from the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) is of concern to DWR as well as other resource agencies. The State Water Resources Control Board (SWRCB) establishes water quality objectives to protect a variety of beneficial uses of water within the Bay-Delta. The objectives are contained within the water quality control plans (WQCPs) adopted by the SWRCB. Water quality objectives are also contained in Article 19 of the long-term SWP water supply contracts. In July 2014, the Drinking Water Program was transitioned from the California Department of Public Health (CDPH) to the SWRCB. The SWRCB is now the primary enforcement authority for federal and State safe drinking water acts and is responsible for the regulatory oversight of public water systems throughout the State.

The SWRCB adopted the current *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan) on December 13, 2006 (Resolution No. 2006-0098).

The SWRCB adopted Water Right Decision 1641 (D-1641) in December 1999 (amended March 15, 2000). D-1641 implements the objectives of the Bay-Delta Plan. D-1641 amends the water rights of a number of water rights holders—primarily those for the SWP and Central Valley Project (CVP)—to help achieve the Bay-Delta Plan objectives.

For additional background information about the SWRCB's activities and the Bay-Delta Plan, see the sidebar, State Water Resources Control Board, and Chapter 7, Water Supply Development and Reliability.

### 2015 Drought Conditions

In January 2014, the Governor declared a state of emergency due to severe drought conditions and directed State and local agencies to take all necessary actions to conserve water, enhance and protect water supplies, and reduce harmful effects of the drought. Subsequent proclamations and executive orders extended provisions and added new provisions. On November 13, 2015, the Governor issued Executive Order B-36-15, which requires the orders and provisions contained in the January 17, 2014 Proclamation; the April 25, 2014 Proclamation; and Executive Orders B-28-14 (December 22, 2014) and B-29-15 (April 1, 2015) to remain in full force and effect.

To address the effects of the historic drought in 2015, the Bureau of Reclamation (Reclamation), DWR, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NOAA Fisheries), Department of Fish and Wildlife (DFW), and SWRCB continued coordinated and extensive water operations and regulatory adjustments. The adjustments to existing water quality and federal Endangered Species Act requirements of D-1641 and the USFWS and NOAA Fisheries

## State Water Resources Control Board

The State Water Resources Control Board (SWRCB), established by the California Legislature in 1967, oversees water rights and protects water quality by setting and implementing statewide policy, administering appropriative water rights, coordinating with and supporting Regional Water Quality Control Board (RWQCB) efforts, and reviewing petitions that contest RWQCB actions. The five SWRCB members are appointed by the Governor and confirmed by the Senate. The SWRCB is responsible for four major programs.

Water quality: to preserve, protect, enhance, and restore water quality.

Water rights: to issue permits for water rights specifying amounts, conditions, and construction timetables for diversion and storage.

Financial assistance: to assist local agencies and individuals with pollution prevention or clean-up.

Enforcement: to enforce water rights and water quality laws and regulations.

Under their water quality authority, the SWRCB and RWQCBs adopt water quality control plans (WQCPs) for each of the planning basins in the State. The WQCPs contain water quality objectives for flow, salinity, dissolved oxygen levels, and other parameters necessary for the protection of various beneficial uses, such as municipal and industrial, agricultural, and fish and wildlife. The SWRCB implements these objectives in a number of ways, depending on the circumstances, including imposing conditions on water rights permits and licenses.

Current water quality objectives for the Sacramento-San Joaquin Delta and Suisun Marsh are contained in the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan), adopted December 13, 2006. The SWRCB is required to conduct periodic updates of the Bay-Delta Plan. As part of the update process, the SWRCB conducts proceedings to gather information, receive recommendations, consider public comments, and facilitate detailed discussions to evaluate new information relevant to potential changes to the water quality objectives. Recent issues of concern related to the WQCP include the ongoing drought, pelagic organism decline, special status fish species, Delta inflow, San Joaquin River flows, and southern Delta salinity.

Water Right Decision 1641 (D-1641), adopted by the SWRCB in December 1999 and amended in March 2000, implemented the objectives in the 1995 Bay-Delta Plan and continues to implement the objectives in the 2006 Bay-Delta Plan. D-1641 places terms and conditions on a number of water rights, primarily those for the State Water Project (SWP) and Central Valley Project (CVP). The Department of Water Resources and the Bureau of Reclamation operate the SWP and CVP in coordination to meet the terms in D-1641 and other applicable regulatory requirements relevant to each project.

biological opinions (BiOps) allowed the CVP and SWP to support water deliveries and transfers and to maximize upstream water storage while minimizing adverse effects on listed fish species and protecting water quality.

### *Emergency Drought Barrier*

Since early 2014, emergency drought barriers had been part of drought planning for CVP/SWP operations. If there was insufficient water in upstream reservoirs for release to minimize saline intrusion into the Sacramento-San Joaquin Delta Estuary (Delta), salinity intrusion could occur to the extent that interior portions of the Delta would exceed water quality objectives. Increased salinity in the Delta could compromise municipal and irrigation water supplies and have an adverse effect on the sensitive aquatic resources in the Delta. A 750-foot-wide barrier was installed in May 2015 on West False River between Jersey and Bradford islands near the confluence of the West False and San Joaquin rivers. The purpose of the barrier was to limit the tidal push of saltwater from San Francisco Bay into the Central Delta to protect Delta water quality and to minimize the amount of fresh water released from upstream reservoirs to repel the saltwater. Approximately 150,000 tons of rock were used to build the barrier. The barrier was removed by mid-November. To monitor effectiveness of the barrier, DWR installed 10 new monitoring stations to augment the existing network of monitoring stations in the Delta. DWR used emergency drought barriers to reduce salinity intrusion during the 1976–1977 drought.

For more information, see Chapter 2, Delta Resources, and Chapter 7, Water Supply Development and Reliability.

## SWRCB Drought Year Actions

As the State experienced one of the driest periods on record, the SWRCB took a number of drought-related actions pertaining to emergency rulemaking by issuing new or modifying existing orders; considering and/or approving temporary urgency change petitions (TUCPs) and water transfer requests; coordinating cooperative efforts with State and federal agencies; gathering information; and performing outreach, expanded monitoring, and field investigations.

On January 23, 2015, DWR and Reclamation filed a joint TUCP to temporarily change SWP and CVP water right permit and license conditions imposed pursuant to D-1641. On February 3, 2015, SWRCB issued an order approving parts of the TUCP, subject to conditions. Throughout the year, DWR and Reclamation submitted additional TUCPs and requests to modify the TUCP order, and SWRCB modified the order several times in response. Issues included Delta outflow requirements, export limits, Delta Cross Channel gate operations, Sacramento River and San Joaquin River flow requirements, western Delta agricultural salinity requirements, and adjusted operations to conserve water in upstream storage to ensure water supply.

DWR and Reclamation submitted the Drought Contingency Plan for the period January 15 through September 30, 2015, to SWRCB as required in SWRCB's TUCP order dated October 7, 2014, and water right order 2014-0029. The plan was developed in coordination with the fish and wildlife agencies and addressed projected water operations based on various hydrologic scenarios and potential adjustments to regulatory requirements. Proposed operations in the Drought Contingency Plan consider water quality, fish protection, and water supply. The Drought Contingency Plan serves as the framework to develop proposed modifications to D-1641 requirements during the drought. Reclamation and DWR will continue to work closely with the fish and wildlife agencies

to update the Drought Contingency Plan as necessary based on changing circumstances.

More information about the TUCP process is available on SWRCB's website.

### California WaterFix

In April 2015, DWR and Reclamation announced plans to split the proposed Bay Delta Conservation Plan into two separate efforts—one for water conveyance facilities and the other for habitat restoration. The water conveyance effort, identified as the California WaterFix, is Alternative 4a (the preferred alternative) of the Bay Delta Conservation Plan/California WaterFix partially recirculated draft environmental impact report/supplemental draft environmental impact statement released in July 2015. California WaterFix would construct new Delta conveyance facilities in compliance with the federal Endangered Species Act and California Endangered Species Act. The conveyance facilities would allow greater flexibility in water diversions and better balancing of the associated water quality and hydrodynamic benefits for fish, drinking water, agriculture, and other beneficial uses.

For additional information about California WaterFix, see Chapter 3, Environmental Programs and Chapter 7, Water Supply Development and Reliability.

## Water Quality Standards

Water quality objectives in the Bay-Delta Plan are categorized by the beneficial uses they are intended to protect, including municipal and industrial, agricultural, and fish and wildlife. DWR operators adjust upstream releases and Delta exports to meet D-1641 operational requirements for meeting water quality and flow standards.

### 2014–2015 Water Year Hydrologic Classifications

The Bay-Delta Plan contains water quality and flow standards that are conditioned by water year type and generally become less stringent in years with less precipitation. The water year classification system provides relative estimates of a basin's available water supply based on the amounts of rainfall and snowmelt runoff and rates of groundwater accretion. Water year types are classified as "wet," "above normal," "below normal," "dry," or "critical."

The Sacramento Valley Water Year Hydrologic Classification (Sacramento Valley 40-30-30 Index) forecast on May 1 of each year determines the water year type for the implementation of flow and water quality criteria contained in the Bay-Delta Plan.

The Sacramento Valley 40-30-30 Index and the San Joaquin Valley Water Year Hydrologic Classification (San Joaquin Valley 60-20-20 Index) were both critical, based on observed data for water year 2014–2015.

For a detailed discussion of water year 2014–2015, see Chapter 8, Water Supply.

### 2006 Bay-Delta Plan Review

California Water Code Section 13240 requires that the WQCP be periodically reviewed. Federal Clean Water Act Section 303(c) (33 U.S.C. Section 1313(c)) requires a triennial review of State water quality "standards," as defined in the act.

The WQCP review and amendment process consists of review of the Bay-Delta Plan to identify elements that may need amendment or new elements that may need to be added, staff preparation of any amendments or revision of the entire WQCP, and SWRCB adoption of some or all of the amendments or revisions. SWRCB information-gathering activities may affect the scope of the

WQCP review and may include a series of evidentiary hearings on critical issues concerning the Delta's ecology. The review includes both the review and update of water quality objectives (including flow objectives) and the program of implementation in the Bay-Delta Plan, as well as changes to water rights and water quality regulation consistent with the program of implementation.

The SWRCB is conducting the WQCP review in four phases:

- Phase 1 involves updating San Joaquin River flow and southern Delta water quality requirements.
- Phase 2 involves other comprehensive changes to the Bay-Delta Plan to protect beneficial uses not addressed in Phase 1 (e.g., objectives for Delta outflows, Sacramento River inflows, export constraints, Delta Cross Channel gate closure requirements, and Suisun Marsh protection).
- Phase 3 will involve changes to water rights and other measures to implement changes to the Bay-Delta Plan in Phases 1 and 2.
- Phase 4 involves developing and implementing flow criteria and flow objectives for priority Delta tributaries with a focus on the Sacramento River watershed.

The formal review and amendment process for the 2006 Bay-Delta Plan that began in October 2008 continued in 2015. Phase 1 began in 2009, Phase 2 began in 2012, and Phase 4 began in 2013.

## SWP Operations to Meet Water Quality Requirements

In 2015, DWR and Reclamation jointly operated the SWP and CVP in accordance with D-1641, which includes water quality, flow, and operational criteria for the SWP and CVP Delta operations. SWP and CVP operations were coordinated to meet the various objectives of the Bay-Delta Plan, Central Valley Project Improvement Act, and BiOps for listed species, as well as other regulatory requirements. Fish species currently listed under the Endangered Species Act and the California Endangered Species Act include the winter and spring runs of Chinook Salmon, Delta Smelt, steelhead, and Green Sturgeon.

Real-time monitoring of fish movement and conditions in the estuary aids daily water management and provides timely protection of targeted fish species from entrainment at the Delta pumping facilities.

The Bay-Delta Plan includes the requirement to monitor a number of stations within the Delta for specific water quality constituents. DWR conducts extensive monitoring in the Delta and the Suisun Marsh. Figure 4-1 shows water quality compliance and monitoring stations throughout the Delta specified in the Bay-Delta Plan.

In January 2015, the SWP and CVP submitted a TUCP to the SWRCB requesting modification of D-1641 requirements due to drought conditions. The SWRCB approved the TUCP and issued an order allowing temporary changes to some of the water quality and flow objectives. For additional information, see the 2015 Drought Conditions and SWRCB Drought Year Actions sections earlier in this chapter.

For a discussion of other environmental issues, see Chapter 3, Environmental Programs.

### Delta Cross Channel Gates

The Delta Cross Channel gates are operated in accordance with the Bay-Delta Plan/D-1641 and other regulatory requirements. In 2015, the gates were open for 178 days to allow fresher Sacramento River water to flow into interior Delta channels toward the SWP and CVP export

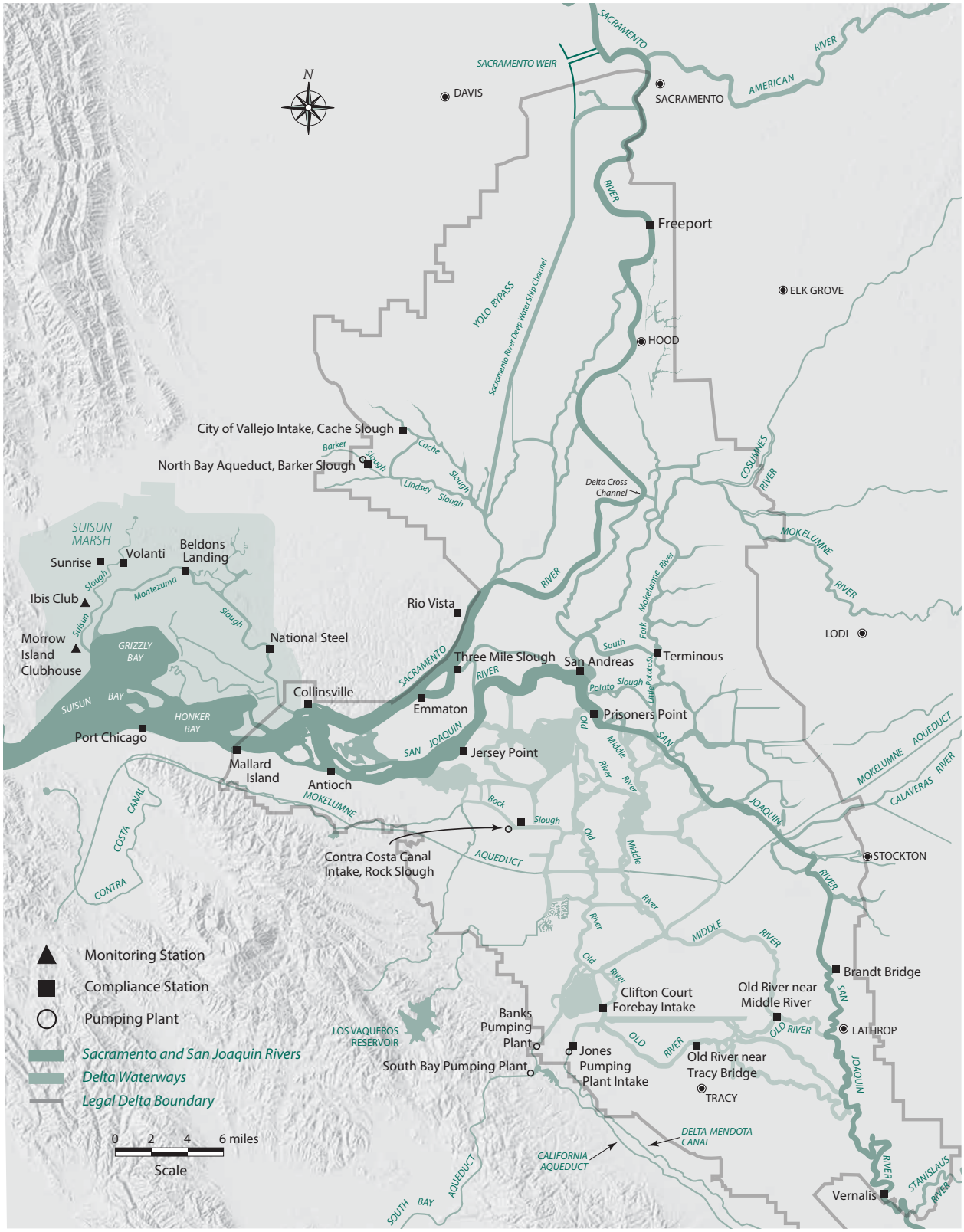



**Figure 4-1 D-1641 Water Quality Compliance and Monitoring Stations in the Sacramento-San Joaquin Delta**

facilities. Reclamation's standard operating procedures call for gate closure when flow on the Sacramento River at Freeport reaches between 20,000 cubic feet per second (cfs) and 25,000 cfs to reduce flooding potential on the Mokelumne River and to prevent scouring on the downstream side of the gate structure. D-1641 contains measures that require gate closure under certain conditions from November 1 through May 20 for fisheries protection as requested by the USFWS, NOAA Fisheries, and DFW. SWRCB's order for the 2015 TUCP allowed for opening the Delta Cross Channel Gates to reduce infiltration of high salinity water during the winter and spring. Under this TUCP order, the gates were opened from May 14 to May 18.

## Municipal and Industrial Objectives

The Bay-Delta Plan includes a year-round 250 milligrams per liter (mg/L) (maximum mean daily) chloride objective that is in effect at Delta export locations (Contra Costa Canal Pumping Plant No. 1, Clifton Court Forebay, Jones Pumping Plant, and Barker Slough). Chloride levels remained below the objective for all days in 2015.

An additional municipal and industrial water quality objective for chloride at the Contra Costa Canal Intake, near Rock Slough, specifies that the chloride level must be below 150 mg/L (maximum daily mean) for a minimum number of days during the year, dependent upon the water year forecast. For calendar year 2015, the objective of 155 days was met.

## Agricultural Salinity Objectives

The Bay-Delta Plan contains agricultural salinity objectives, which vary by location. The salinity objectives, recorded as electrical conductivity (EC), are based on both water year type and a 14-day running average during the irrigation season, from April to mid-August, at Emmaton, Jersey Point, Terminous, and San Andreas in the West and Central Delta. The agricultural salinity objectives at these Delta locations become less stringent under dryer conditions. The Terminous and San Andreas critical water year objectives were met for calendar year 2015. However, the Emmaton critical water year objective of 2.78 millisiemens per centimeter (mS/cm) was moved, under the SWRCB's TUCP order, to the Sacramento River at Three Mile Slough. The objective was not met at Jersey Point for 8 days and Three Mile Slough for 15 days for calendar year 2015.

In the South Delta, salinity may be influenced by San Joaquin River flows, in-Delta diversions, and SWP exports, and water circulation may be influenced by the annual placement of South Delta barriers. South Delta salinity objectives are based on a 30-day running average. The 1.0 mS/cm objective for the South Delta was met at Vernalis. The objective was not met at Old River near Tracy Road Bridge for 97 days, Old River near Middle River for 83 days, and San Joaquin River at Brandt Bridge for 39 days. The 0.7 mS/cm objective for the South Delta was met at Vernalis. The objective was not met at Old River near Tracy Road Bridge for 110 days, Old River near Middle River for 83 days, and San Joaquin River at Brandt Bridge for 82 days. The SWP and CVP share responsibility for meeting the agricultural EC objectives imposed at these South Delta compliance locations.

## Estuarine Habitat Protection Standard

The estuarine habitat protection standard incorporates modified X2 criteria (geographic isohaline) first established in the 1994 Delta Smelt BiOp. The upstream movement of 2 parts per thousand isohaline (2 parts per thousand of salt in the water), measured as 2.64 mS/cm at the surface, is maintained within a certain range of positions in the estuary by adequate Delta outflow. These positions (Collinsville, Chipps Island, Port

Chicago, or Martinez) are associated with an abundance of fish and biota.

The requirement for meeting X2 criteria at Collinsville applies to all days from February through June. The number of days per month when the daily average EC maximum (2.64 mS/cm) is in effect at Chipps Island or Port Chicago is conditioned by the previous month's Eight River Index. (The Eight River Index is the sum of the estimated unimpaired runoff from eight rivers—four in the Sacramento Valley [Sacramento River Region runoff] and four in the San Joaquin Valley [San Joaquin 4 Rivers runoff]. For more about runoff estimates, see Chapter 8, Water Supply.) This requirement may alternately be met with a maximum 14-day running average EC of 2.64 mS/cm or with specific Delta outflow, set as a 3-day average Net Delta Outflow Index (NDOI) of 7,100 cfs, 11,400 cfs, or 29,200 cfs, when the X2 position is at Collinsville, Chipps Island, or Port Chicago, respectively. As allowed by D-1641, the May and June X2 flow objective is reduced to a 14-day running average flow of 4,000 cfs when the best available estimate for the Sacramento River Index is less than 8.1 million acre-feet (af) at the 90 percent exceedance level. The Port Chicago standard becomes effective when the Port Chicago 14-day EC average, immediately prior to the first day of the month, is less than or equal to 2.64 mS/cm.

The Eight River Index for the months of January through May 2015, in million af, was 0.81, 2.23, 0.84, 0.77, and 0.83, respectively. The X2 habitat protection objective at Chipps Island was 1 day in February, 31 days in March, 1 day in April, and 0 days in May and June. The X2 habitat protection objective at Port Chicago was not in effect in 2015. Since the May estimate for the Sacramento River Index was 8.6 at the 90 percent exceedance level, the May and June NDOI objectives were reduced to 4,000 cfs on a 14-day running average. Starting February 3, 2015, the SWRCB TUCP order allowed for a relaxation of the X2 objectives, where an NDOI of 4,000 cfs objective temporarily replaced the X2 objectives for February, March, April, May, and June.

These objectives were met in calendar year 2015.

## Net Delta Outflow Index Standard

Delta outflow cannot be measured directly due to the tidal influence in the Delta. Instead, an approximation of Delta outflow is calculated using measured inflows, exports, and estimated Delta water use. The NDOI was introduced in the 1995 Bay-Delta Plan/D-1641 and remains the same in the 2006 Bay-Delta Plan. NDOI calculates Delta outflow using inflows of the Sacramento River, the Yolo Bypass system, the eastside stream system (consisting of the Mokelumne, Cosumnes, and Calaveras rivers), the Sacramento Regional Treatment Plant, and a measurement of San Joaquin River flow at Vernalis.

Excess outflow conditions, as defined by the Coordinated Operations Agreement, allow for greater flexibility in project operations.

Specific minimum monthly NDOI standards for the protection of fish and wildlife are based on water year type. The SWRCB TUCP order reduced the July NDOI objective from 4,000 cfs to 3,000 cfs. In 2015, the monthly mean NDOI was highest in February, averaging 15,835 cfs. The lowest monthly mean NDOI occurred in August with 3,030 cfs, which was above the objective of 3,000 cfs. All other monthly NDOI objectives were met in 2015.

## River Flow Standards

Water quality objectives include minimum flow requirements measured in the Sacramento River at Rio Vista. These flow standards, incorporated from the winter-run salmon BiOp, set flow requirements based on the Sacramento Valley water year

classification. Water year 2014–2015 was critical, requiring mean monthly flows of 3,000 cfs for September and October and 3,500 cfs for November and December. During these periods, the 7-day running average could not be more than 1,000 cfs below the monthly standard. The SWRCB TUCP order reduced the Rio Vista flow objective to a mean monthly flow of 2,500 cfs and a 7-day running average of 2,000 cfs for September, October, and November. The actual mean monthly flows were 2,954 cfs in September; 2,747 cfs in October; 2,676 cfs in November; and 7,524 cfs in December. The 7-day average Rio Vista flow was less than 2,000 cfs from November 27 to November 30.

Water quality objectives also specify minimum flow requirements measured in the San Joaquin River at Vernalis. These flow standards are based on the San Joaquin Valley 60-20-20 Index, which was critical for water year 2014–2015. If the X2 objective is required to be at or west of the Chipps Island location, critical year base Vernalis flows are set at 710 cfs in February; 710 cfs or 1,140 cfs from March to April 15; and 710 cfs or 1,140 cfs from May 15 to June. The base-flow objective is relaxed to 710 cfs when X2 is required to be east of Chipps Island.

A San Joaquin River spring pulse flow (a short-term increase in stream flow) is required from April 15 to May 15 at Vernalis. This spring pulse flow requirement varies based on the location of X2 during April. However, the CALFED Operations Group may vary the actual timing and duration of the pulse attraction flow based on real-time monitoring data. (For background on the CALFED Bay-Delta Program, see Bulletins 132-95 through 132-11.) The 2015 SWRCB TUCP order allowed the total volume of the pulse flow to be no less than 710 cfs at Vernalis during the pulse flow period from March 25 through April 25. It also reduced the average minimum flow rate to 300 cfs to the end of May, and then to 200 cfs to the end of June.

Additional information about San Joaquin River water quality can be found in Chapter 5, Local Assistance.

## Export Standards

Water quality objectives and D-1641 include an export limitation for the SWP and CVP. It limits Delta exports to a ratio of Delta inflow to combined water project exports and is expressed as a maximum export rate in percentage of Delta inflow.

The SWRCB TUCP order added an additional export limitation for those times when the obligations under D-1641 were not being met. Under these conditions, the maximum combined exports were 1,500 cfs.

The actual export amount is calculated using the 3-day average that combines the inflow rate for Clifton Court Forebay (excluding Byron Bethany Irrigation District diversions from Clifton Court Forebay) added to the Jones Pumping Plant diversion. The export-to-inflow ratio limit is reported as either a 3-day or 14-day running average. A 14-day running average of inflows is used unless storage withdrawals from upstream reservoirs are being made for export, in which case a 3-day average of inflows is used. For all water year types, the maximum combined export rate from February through June is 35 percent of Delta inflow. This rate may be relaxed in February during years with less precipitation to between 35 and 45 percent. From July through January, the export-to-inflow ratio rises to 65 percent.

The 2008 USFWS and the 2009 NOAA Fisheries BiOps typically control the export rate for most of the winter and spring. Under these conditions, the Delta can be pushed into excess conditions more often. Additional information about the BiOps can be found in Chapter 3, Environmental Programs.

During 2015, the Delta was in excess conditions from January 1 to January 14, and

February 7 to March 15, for a total of 51 days. Within this period, combined SWP and CVP exports averaged about 27 percent of Delta inflow, meeting the 65 percent limitation in January and also meeting the 35 percent limitation for February to March.

The Delta was in balanced conditions from January 15 to February 6, and March 16 to December 3, for a total of 314 days. Within this period, combined SWP and CVP exports averaged about 29 percent of Delta inflow, meeting both the 35 percent and 65 percent limitations.

## South Delta Temporary Barriers Project

The South Delta Temporary Barriers Project, initiated as a test project in 1991, was extended for 5 years in 1996, and extended again for 7 years in 2001. The project was created partially in response to a 1982 lawsuit filed by the South Delta Water Agency and consists of rock barriers across four South Delta channels.

These temporary seasonal barriers are designed to improve local water levels and circulation patterns, protect fishery resources, and improve water quality. They are placed across Middle River, Old River near Tracy, Grant Line Canal, and at the Head of Old River.

For more information about the temporary barriers, see Chapter 2, Delta Resources, and Chapter 3, Environmental Programs.

## Delta Mercury Control Program and Mercury Monitoring and Evaluation

DWR's Mercury Monitoring and Evaluation (MME) Section was established in 2012 in the Division of Environmental Services to ensure DWR meets its Delta Mercury Control Program regulatory compliance responsibilities for wetlands, open water, dredging, and educational outreach.

The Delta Mercury Control Program was adopted by the Central Valley RWQCB in 2010 to address mercury and methylmercury (MeHg) water quality impairments in the Delta. For more background information about the program, see Bulletin 132-14.

In 2015, continuing work included:

- completion of one tidal wetland control study and the initiation of a second study to characterize mercury dynamics in tidal wetlands;
- ongoing open water control studies to create mercury models for the Delta and Yolo Bypass;
- data collection from field and laboratory studies to provide information for the modeling work;
- development of brochures for the Mercury Exposure Reduction Program; and
- work on the Statewide Mercury Control Policy and Mercury Control Program for Reservoirs.

### Tidal Wetlands

The Yolo Bypass Wildlife Area tidal wetland study was completed in May 2015. Preliminary analysis of the data indicated that the tidal wetland was a sink for water as well as a sink for organic carbon and MeHg. The total mercury (THg) loads tended to show more seasonality with the tidal wetland being a small source of THg during the warmer months and a small sink during the cooler months.

The second wetland chosen for the tidal wetland studies was the Blacklock tidal wetland, located in the Suisun Marsh and owned by DWR. Sampling began in late spring 2015. To calculate loads and determine if the wetland was a net source or sink for THg or MeHg, two acoustic doppler

current profilers were installed in each of the two breaches to collect stage and velocity data for calculating flow. In October 2015, the acoustic doppler current profilers were removed due to biofouling and are expected to be redeployed in early 2016. The flow data were entered into the Hydstra database, where it was uploaded to DWR's Water Data Library. The study at Blacklock tidal wetland is expected to be completed in 2016.

In addition to flow data, the MME Section collected monthly samples using an autosampler. Composited water samples were analyzed for particulate and dissolved THg and MeHg, total suspended solids, total and dissolved organic carbon, and nutrients. Bryte Chemical Laboratory analyzed all samples except MeHg, which was analyzed by Moss Landing Marine Laboratories. The data collected during these events were entered by Bryte Chemical Laboratory into their Field and Laboratory Information Management System database, which was uploaded to DWR's Water Data Library.

A progress report was submitted to the Central Valley Regional Water Quality Control Board (RWQCB) in October 2015. The report included a preliminary analysis of the data collected at the Yolo Bypass Wildlife Area tidal wetland, plans for study of the Blacklock tidal wetland, and small changes in study design already approved by the RWQCB. The report is available on the Central Valley RWQCB's website.

## Open Water

In 2015, analytical data from the inlet/outlet sampling conducted during the miniflood event of December 2014 were reviewed. Preliminary results suggested that the Yolo Bypass was a net source for unfiltered THg as well as unfiltered and filtered MeHg and total suspended solids. Of the inlet sites, the Cache Creek Settling Basin was the highest contributor to THg loads, while the Knight's Landing Ridge Cut was the largest contributor to MeHg loads. Between the Toe Drain at Interstate 80 and the Toe Drain at Lisbon Weir, total MeHg loads increased by 40 percent. The source of this increase was unknown, and several hypotheses have been considered.

By the end of calendar year 2015, no flooding had occurred in the Yolo Bypass, therefore, no samples were collected for the inlet/outlet study of mass balances and partitioning between the solid and dissolved phases of mercury and MeHg in the Yolo Bypass. However, the U.S. Geological Survey and Moss Landing Marine Laboratories studies to provide data for the modeling effort continued. These studies are not dependent on flood flows for the analyses.

In 2015, the U.S. Geological Survey conducted sediment mesocosm experiments to quantify erosion characteristics associated with different land uses in the Yolo Bypass. Assessment of erosion characteristics was completed for 4 of the 10 land uses in the Yolo Bypass modeling grid. Land uses analyzed were wild rice, white rice, and disked and undisked seasonal wetlands. Preliminary results suggested that erosion characteristics varied between wetlands and rice fields. It is anticipated that assessment of erosion characteristics will be conducted on the remaining land uses in 2016.

In 2015, Moss Landing Marine Laboratories collected sediment cores from 2 of the 10 land uses used in the Yolo Bypass modeling grid (wild rice and undisked seasonal wetland) to analyze for fluxes of mercury and MeHg between sediment and overlying water. Moss Landing Marine Laboratories began a vegetation senescence study to examine the potential MeHg contribution of vegetation submerged by flood flows. It is anticipated that both sediment flux and vegetation senescence studies will continue in 2016. Bale chamber experiments were discontinued because pilot studies indicated this approach did not provide reliable erosion values.

As part of the Delta Mercury Control Program Phase 1 reporting requirements, DWR submitted a progress report in October 2015 to the Central Valley RWQCB documenting modeling progress and preliminary results associated with field and pilot studies. The report is available on the Central Valley RWQCB's website.

Modeling work and field/laboratory studies to collect data for the models will continue in 2016.

## Dredging

DWR is required to submit study workplans to the RWQCB to evaluate management practices to minimize increases in MeHg and mercury discharges from dredging and dredge material reuse.

As discussed in Bulletin 132-14, no dredging activity was identified during the Phase I period of the regulation. Therefore, DWR was not required to submit control study workplans for dredging. In 2015, the MME Section continued to provide mercury guidance to DWR staff for proposed projects involving dredging or spoils usage.

## Delta Mercury Exposure Reduction Program

Elevated concentrations of mercury in fish pose a human health threat. The objective of the Delta Mercury Exposure Reduction Program is to provide educational outreach to reduce human exposure to mercury from consumption of contaminated Delta fish. All entities regulated under the Delta Mercury Control Program are required to participate in a mercury exposure reduction program. DWR is providing up to $20,000 per year through 2019 of in-kind support for brochure and sign production, and associated costs.

Brochures are required for the Sacramento River/Northern Delta, the Central/Southern Delta, and the San Joaquin River regions. DWR's Public Affairs Office worked with the Office of State Publishing to translate fish consumption warning brochures into eight languages: Cambodian, Chinese, Hmong, Lao, Russian, Spanish, Tagalog, and Vietnamese. Brochure production and distribution at local educational outreach meetings will begin in 2016. It is also anticipated that sign production will begin in 2016.

## Statewide Mercury Control Policy and Mercury Control Program for Reservoirs

The SWRCB is developing a statewide mercury policy to control mercury in California's waters. It is anticipated that the policy and its regulations will be presented to the SWRCB for adoption in 2016.

In 2015, the MME Section continued to track developments associated with the Statewide Mercury Control Program for Reservoirs and attended all reservoir owner/operator meetings convened by the SWRCB.

Stakeholder meetings have focused on gathering information about individual reservoirs, determining what reservoir water quality improvement projects are already underway, and soliciting reservoir owner/operator feedback on reservoirs that might be suitable for pilot studies. In addition to attending meetings, the MME Section has provided written feedback on the technical and economic feasibility of the SWRCB's suggested management approaches to reducing MeHg in DWR reservoirs.

The MME Section also continued to collaborate with Reclamation, providing technical advice on the development of a reservoir mercury model.

# Special Studies and Biological Surveys

DWR conducts several special studies and biological surveys each year. This includes a special study in the Stockton Deep Water Ship Channel during the late summer and early fall to monitor the occurrence of low dissolved oxygen (DO) levels. Low DO levels potentially cause physiological stress to fish and block the migration of salmon into the San Joaquin River. DWR also conducts biological surveys of benthic organism density and diversity and of phytoplankton biomass and community composition in the Delta, Suisun Bay, and San Pablo Bay.

## Fall Dissolved Oxygen Study in the Stockton Deep Water Ship Channel

Historically, during the late summer and early fall, DO levels in the eastern and central portions of the Stockton Deep Water Ship Channel have dropped below both the 5.0 mg/L and 6.0 mg/L water quality objectives set by SWRCB and the RWQCB, respectively. These low DO levels are a result of several factors, including low San Joaquin River inflows, high water temperatures, high biochemical oxygen demand, reduced tidal circulation, and intermittent reverse flow conditions in the San Joaquin River at Stockton.

To help reduce the severity of these low DO conditions, DWR normally installs a temporary rock barrier across the Head of Old River during periods of projected low fall flows in the San Joaquin River.

In 2015, installation of the spring barrier began on March 16. Removal of the spring barrier was completed by June 8. Installation of the fall barrier began on September 3, and removal of the fall barrier was completed on November 18.

### *Methods*

In 2015, DO concentration monitoring in the Stockton Deep Water Ship Channel was conducted by boat on 12 monitoring runs, from June 15 to November 24. During each run, 14 sites were sampled at low-water slack tide from Prisoners Point in the Central Delta to the Stockton Turning Basin at the terminus of the ship channel. Because monitoring results differ within the channel, sampling stations were grouped into western, central, and eastern regions. The western region of the channel begins at Prisoners Point and ends at Columbia Cut. The central region of the channel begins one-half mile east of Columbia Cut and ends at Fourteen Mile Slough. Finally, the eastern region of the channel begins at Buckley Cove and ends at Rough and Ready Island. The turning basin is unique within the channel because it is east of the entry point of the San Joaquin River into the channel and isolated from down-channel flows.

### *Results*

During the period of this study, DO levels varied by season and exhibited similar ranges between regions within the channel excluding the turning basin. The overall study period range was 6.10 to 11.80 mg/L at the surface and 5.47 to 10.67 mg/L at the bottom. In the western portion of the channel, DO concentrations ranged from 6.70 to 10.60 mg/L at the surface and 6.66 to 10.67 mg/L at the bottom. In the central portion of the channel, DO concentrations were variable, ranging from 6.35 to 10.30 mg/L at the surface and 5.86 to 10.43 mg/L at the bottom. In the eastern portion of the channel, DO levels were similar to the other regions, ranging from 6.10 to 11.80 mg/L at the surface and 5.47 to 9.22 mg/L at the bottom. In 2015, bottom DO concentrations never fell below the objectives.

Higher San Joaquin River inflows, as well as the absence of intermittent reverse flows

near Stockton, coincided with improved DO conditions. Monitoring operations for the fall 2015 special study were suspended after November 24.

## Benthic Survey

The operation of the SWP can impact flow characteristics of the upper San Francisco Estuary and subsequently influence the density and distribution of benthic biota. Benthic biota are relatively long-lived and can respond to changes in physical factors within the estuary, such as fresh water inflows, salinity, and substrate composition. The benthic monitoring program documents changes in the composition, abundance, density, and distribution of the benthic biota within the estuary. Biological surveys conducted under the benthic monitoring program provide an indication of physical changes occurring within the upper estuary. In addition, benthic monitoring data are also used to detect and document the presence of newly introduced species within the upper estuary.

Benthic monitoring was conducted at 10 sampling sites distributed throughout the major habitat types within the estuary:

- Clifton Court Forebay Intake;
- San Joaquin River at Buckley Cove and at Twitchell Island;
- Old River opposite Rancho del Rio;
- Sacramento River below the Rio Vista Bridge and above Point Sacramento;
- Suisun Bay at Bulls Head Point;
- Grizzly Bay at Dolphin near Suisun Slough; and
- San Pablo Bay near Pinole Point and near the mouth of the Petaluma River.

Four bottom grab samples for benthic analysis and one sample for sediment analysis were collected monthly at each site during 2015. Samples were analyzed to identify organisms to the lowest possible identifiable taxon and to count all organisms collected.

DWR maintains a database of benthic organisms located within the upper estuary. The benthic database is dynamic and regularly undergoes peer review and update. When a new organism is identified at any of the sampling stations it is added to the database. In addition, the taxonomic names of organisms on the list are updated when sufficient evidence is produced to warrant such changes.

The benthic monitoring program collects a large number of organisms, but a relatively small number of species. A total of 198 species of benthic macrofauna were collected in 2015 at the 10 sampling sites. Of the 198 species, 10 represented 78.1 percent of all organisms collected:

- amphipods: *Ampelisca abdita*, *Corophium alienense*, and *Gammarus daiberi*;
- Asian clam: *Potamocorbula amurensis*;
- sabellid polychaetes: *Manayunkia speciosa* and *Laonome calida*;
- tubificid worms: *Limnodrilus hoffmeisteri*, *Varichaetadrilus angustipenis*, and *Aulodrilus pigueti*; and
- ostracod: *Cyprideis sp. A*.

Of the 10 dominant species, *Potamocorbula amurensis*, *Laonome calida*, and *Ampelisca abdita* represent macrofauna that inhabit a typically high saline environment and were found in San Pablo Bay, Suisun Bay, and Grizzly Bay. *Corophium alienense* tolerates a wider range of salinity. It was collected both in the higher saline western sites and the more brackish to fresh water eastern sites such as the San Joaquin River at Twitchell Island and the Sacramento River above Point Sacramento. The remaining six species, *Gammarus daiberi*, *Manayunkia speciosa*, *Limnodrilus hoffmeisteri*, *Varichaetadrilus angustipenis*, *Aulodrilus pigueti,* and *Cyprideis sp. A* are predominantly fresh water

species and were collected at sites east of Suisun Bay.

## Phytoplankton and Chlorophyll *a* Survey

Phytoplankton are small, free-floating or attached algae that can be tiny, single-celled organisms (less than 5 micrometers in diameter) or larger colonial organisms. Phytoplankton are an important source of food in the estuary for zooplankton, invertebrates, and some species of fish. Phytoplankton biomass is an indicator of the status of primary productivity in the estuary. Chlorophyll *a* is one of the main groups of pigments contained in the algal species that make up phytoplankton.

Monthly sampling of chlorophyll *a* concentrations and phytoplankton was conducted in 2015 by DWR's Bay-Delta Monitoring Branch at 13 stations throughout the upper San Francisco Estuary:

- Sacramento River at Greene's Landing/ Hood and above Point Sacramento;
- San Joaquin River at Vernalis, Buckley Cove, and Potato Point;
- Old River opposite Rancho del Rio;
- Disappointment Slough near Bishop Cut;
- Frank's Tract near Russo's Landing;
- Suisun Bay at Bulls Head Point near Martinez and off Middle Point near Nichols;
- Grizzly Bay at Dolphin near Suisun Slough; and
- San Pablo Bay near Pinole Point and near the mouth of the Petaluma River.

Chlorophyll *a* concentration was measured at the 13 monitoring stations to estimate overall phytoplankton biomass in the estuary. Phytoplankton samples were collected and analyzed separately to determine which species were present in the estuary.

Monthly chlorophyll *a* concentrations throughout much of the estuary were relatively low. Of the 155 samples taken in 2015, 94.8 percent (147 samples) had chlorophyll *a* levels below 10 micrograms per liter (µg/L). Chlorophyll *a* levels below 10 µg/L are considered limiting for zooplankton growth. Of the 8 samples with chlorophyll *a* concentrations above 10 µg/L, three were from the San Joaquin River at Vernalis in February, March, and June; two were from Franks Tract near Russo's Landing in April and December; two were from the San Joaquin River at Potato Point in April and December; and one was from Disappointment Slough near Bishop Cut in April. The mean chlorophyll *a* concentration for all samples in 2015 was 3.86 µg/L; the median value was 2.16 µg/L. In 2014, the mean and median were similar (3.41 µg/L and 2.03 µg/L, respectively). The maximum chlorophyll *a* concentration in 2015 was 94.09 µg/L, recorded in June on the San Joaquin River at Vernalis. It was much higher than the maximum in 2014 (34.18 µg/L). The minimum chlorophyll *a* concentration was 0.26 µg/L, recorded in January in Suisun Bay off Middle Point near Nichols.

Phytoplankton biomass and resulting chlorophyll *a* concentrations in some areas of the estuary may be influenced by extensive filtration of the water column by the introduced Asian clam, *Potamocorbula amurensis*. Well-established benthic populations of *P. amurensis* in Suisun and San Pablo bays are thought to have contributed to the low chlorophyll *a* concentrations (and increased water clarity) measured in these westerly bays since the mid-1980s.

In addition to monitoring for chlorophyll *a*, water samples were analyzed for pheophytin *a*.

Pheophytin *a* is a primary degradation product of chlorophyll *a*, and its relative concentration is useful for estimating the

general physiological state of phytoplankton populations. When phytoplankton are actively growing, the concentrations of pheophytin *a* are normally expected to be low in relation to chlorophyll *a*. The mean pheophytin *a* concentration for all samples in 2015 was 1.38 µg/L, and the median value was 1.02 µg/L. The maximum pheophytin *a* concentration was 12.78 µg/L, recorded on the San Joaquin River at Vernalis in June. The minimum pheophytin *a* concentration was 0.43 µg/L, recorded in San Pablo Bay near the mouth of the Petaluma River in February.

Cyanobacteria, cryptomonad flagellates, and green algae constituted 98.5 percent of the organisms collected in 2015. Cyanobacteria alone constituted 97.0 percent due to the presence of small-celled but numerically dominant genera such as *Chroococcus* and *Synechococcus*.

All organisms collected fell into these 11 categories (in order of abundance):

(1) cyanobacteria (class Cyanophyceae);
(2) centric diatoms (class Coscinodiscophyceae);
(3) pennate diatoms (classes Bacillariophyceae and Fragilariophyceae);
(4) cryptomonad flagellates (class Cryptophyceae);
(5) green algae (classes Chlorophyceae and Prasinophyceae);
(6) chrysophyte flagellates (class Chrysophyceae);
(7) euglenoid flagellates (class Euglenophyceae);
(8) dinoflagellates (class Dinophyceae);
(9) charophytes (class Klebsormidiophyceae);
(10) synurophyte flagellates (class Synurophyceae); and
(11) xanthophyte flagellates (class Xanthophyceae).

The 10 most common genera collected were:

(1) *Chroococcus* (cyanobacterium);
(2) *Synechococcus* (cyanobacterium);
(3) *Chlorella* (green alga);
(4) *Plagioselmis* (cryptomonad flagellate);
(5) *Aulacoseira* (centric diatom);
(6) *Cyclotella* (centric diatom);
(7) *Rhodomonas* (cryptomonad flagellate);
(8) *Thalassiosira* (centric diatom);
(9) *Monoraphidium* (green alga); and
(10) *Nitzschia* (pennate diatom).

The cyanobacterium genus *Chroococcus* dominated samples throughout the year, and cyanobacteria numbers overall were high compared to other phytoplankton. Overall numbers of all phytoplankton, however, were low compared with previous years. The low flows and long residence time associated with prolonged drought conditions likely contributed to the higher numbers of cyanobacteria seen in 2015, and cyanobacteria are likely to continue dominating the phytoplankton community during the drought.

## Activities Outside the Delta

Routine SWP water quality monitoring activities and special studies are conducted outside the Delta. The special studies are in response to increasingly stringent regulations facing water purveyors who rely on DWR to deliver high-quality raw water.

### Water Quality Monitoring in the SWP

DWR's Division of Operations and Maintenance monitors water quality throughout the SWP. This monitoring program has more than 30 sampling stations and analyzes more than 200 chemical, biological, and physical constituents. DWR operates monitoring stations at SWP storage and conveyance facilities located throughout the State, from the Feather

River watershed in the north to Lake Perris in the south. Conveyance facilities include the Oroville Facilities, California Aqueduct with the East and West Branches, North Bay Aqueduct, South Bay Aqueduct, Coastal Branch Aqueduct, and the San Luis Joint-Use Complex. DWR collects and analyzes samples monthly at most stations, although the frequency can vary from weekly to annually depending on location, time of year, or special events. DWR sends the water samples to its Bryte Chemical Laboratory in West Sacramento for analysis. Constituents analyzed include dissolved solids; nutrients; minerals such as chloride, sulfate, and sodium; trace metals; herbicides; pesticides; and organic substances.

DWR's water quality monitoring program also uses a network of 16 automated monitoring stations at key locations along the SWP. This network provides real-time data by continuously monitoring a variety of physicochemical parameters such as specific conductance (also referred to as specific conductivity or EC), turbidity (a measurement of suspended particles), pH (a measurement of how acidic or basic water is), $UV_{254}$ (254 nanometer ultraviolet absorbance; a measurement of dissolved organic carbon), and fluorometry (a measurement of algal biomass). SWP water contractors rely on this essential data to assess the quality of water delivered by the SWP.

The water quality monitoring program is an important operational component of the SWP. DWR uses the program's data to evaluate water quality changes in the SWP, short- and long-term trends, and impacts from emergencies such as spills and pipe ruptures. DWR also utilizes the data to influence operations and to determine the quality of drinking water as defined by the SWRCB's Division of Drinking Water. DWR periodically conducts special studies to investigate the impacts of specific incidents affecting SWP water quality. The special studies include non-SWP water turn-ins, floodwater inflows, hydrology, and Delta hydrodynamics. The Division of Operations and Maintenance posts a number of water quality reports on DWR's website.

During 2015, water quality was assessed monthly at eight SWP facilities and at the CVP's Delta-Mendota Canal. Table 4-1 provides mean concentrations for 27 water quality parameters.

EC is an important water quality measurement that estimates the amount of total dissolved salts in a water body. Examples of typical specific conductivity concentrations include a range of 30 to 1,500 microsiemens per centimeter (µS/cm) for potable water and over 50,000 µS/cm for sea water. Mean annual EC of SWP water was 104 µS/cm at Thermalito Afterbay; 385 µS/cm at the North Bay Aqueduct, Barker Slough Pumping Plant; and 776 µS/cm at the Delta-Mendota Canal. EC ranged from 558 to 716 µS/cm in the California Aqueduct.

Dissolved organic carbon measures the amount of organic matter in water. Monitoring of dissolved organic carbon is important to water treatment facility operators as dissolved organic carbon has the potential to facilitate the formation of trihalomethanes (potential toxins) during the chlorination process. Dissolved organic carbon was highest at the North Bay Aqueduct at 6.2 mg/L, while concentrations in the California Aqueduct ranged from 2.6 to 5.2 mg/L.

Turbidity monitoring is important because of the potential of increased turbidity to increase the cost of water treatment. The North Bay Aqueduct, Barker Slough Pumping Plant and Tehachapi Afterbay (Check 41) exhibited higher levels of turbidity (12 NTU [nephelometric turbidity units] and 15 NTU, respectively) compared with other locations, which had mean turbidity ranging from 1 to 4 NTU.

## Table 4-1 Mean Water Quality at Selected SWP Grab Sample[a] Locations in 2015

| Constituent | Units[b] | Reporting Limit | Thermalito Afterbay at Outlet | North Bay Aqueduct, Barker Slough Pumping Plant | Delta-Mendota Canal Upstream of McCabe Road | California Aqueduct | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Banks Pumping Plant | O'Neill Forebay Outlet (Check 13) | Kettleman City (Check 21) | Near Highway 119 (Check 29) | Tehachapi Afterbay (Check 41) | Devil Canyon Second Afterbay |
| Alkalinity | mg/L as $CaCO_3$ | 1 | 49 | 113 | 101 | 86 | 93 | 91 | 72 | 84 | 84 |
| Antimony | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | mg/L | 0.001 | <0.001 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.007 | 0.006 | 0.005 |
| Beryllium | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | mg/L | 0.1 | <0.1 | 0.2 | 0.3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 |
| Bromide | mg/L | 0.01 | <0.01 | 0.05 | 0.39 | 0.37 | 0.32 | 0.36 | 0.28 | 0.26 | 0.28 |
| Calcium | mg/L | 1 | 9 | 18 | 31 | 24 | 28 | 27 | 29 | 30 | 29 |
| Chloride | mg/L | 1 | 1 | 26 | 130 | 119 | 109 | 119 | 81 | 78 | 81 |
| Chromium | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 |
| Copper | mg/L | 0.001 | <0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.001 | <0.001 | 0.001 | 0.002 |
| Hardness | mg/L as $CaCO_3$ | 1 | 41 | 112 | 167 | 132 | 143 | 141 | 101 | 117 | 113 |
| Iron | mg/L | 0.005 | 0.008 | 0.029 | 0.007 | 0.015 | 0.009 | <0.005 | <0.005 | <0.005 | <0.005 |
| Lead | mg/L | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Magnesium | mg/L | 1 | 5 | 16 | 22 | 18 | 18 | 18 | 7 | 10 | 10 |
| Manganese | mg/L | 0.005 | <0.005 | 0.027 | <0.005 | 0.015 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite + Nitrate | mg/L as N | 0.01 | 0.01 | 0.12 | 0.78 | 0.33 | 0.49 | 0.26 | 0.90 | 0.81 | 0.42 |
| Organic Carbon, Dissolved | mg/L as C | 0.5 | NR | 6.2 | 5.5 | 5.2 | 5.2 | 5.0 | 2.6 | 2.8 | 3.0 |
| Organic Carbon, Total | mg/L as C | 0.5 | NR | 6.4 | 5.0 | 5.4 | 5.3 | 5.2 | 2.5 | 3.1 | 3.2 |
| Phosphate-Ortho | mg/L as P | 0.01 | <0.01 | 0.17 | 0.10 | 0.09 | 0.08 | 0.06 | <0.01 | 0.01 | <0.01 |
| Phosphorus, Total | mg/L | 0.01 | <0.01 | 0.28 | 0.15 | 0.13 | 0.13 | 0.11 | 0.05 | 0.14 | 0.03 |
| Selenium | mg/L | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 |
| Sodium | mg/L | 1 | 4 | 34 | 90 | 76 | 74 | 85 | 71 | 72 | 74 |
| Specific Conductance | µS/cm | 1 | 104 | 385 | 776 | 634 | 653 | 716 | 558 | 585 | 591 |
| Sulfate | mg/L | 1 | 2 | 22 | 68 | 42 | 52 | 67 | 58 | 72 | 72 |
| Total Dissolved Solids | mg/L | 1 | 63 | 223 | 429 | 359 | 364 | 399 | 322 | 355 | 335 |
| Turbidity | NTU | 1 | 2 | 12 | 4 | 4 | 4 | 4 | 4 | 15 | 1 |
| Zinc | mg/L | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |

[a] A grab sample is a single sample chosen to represent the conditions in a given matrix (usually natural water) at a specific location, depth, and time. All reported constituents are the annual mean of laboratory analytical values sampled monthly from January through December. The annual mean for a constituent may be based upon analytical results of 1 to 12 months. When one or more analytical results for a constituent are a "non-detect," the mean is calculated using "0" for the non-detect results.

[b] mg/L = milligrams per liter; µS/cm = microsiemens per centimeter; NTU = nephelometric turbidity unit; NR = No data recorded at this location.

Mean arsenic concentrations ranged from less than 0.001 mg/L at Thermalito Afterbay to 0.007 mg/L at Check 29. These surface water values fall below the 0.010 mg/L maximum contaminant level (MCL) for arsenic in drinking water. (The MCL is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on human health would occur.)

Bromide, another parameter that, when present in the water, has the potential to form trihalomethanes during water treatment. Bromide concentrations ranged from less than 0.01 mg/L at Thermalito Afterbay to 0.39 mg/L at the Delta-Mendota Canal.

In 2015, DWR sampled for pesticides, herbicides, and other organic compounds in March, June, and September at several SWP facilities and at the CVP's Delta-Mendota Canal (see Table 4-2). The concentrations of the detected herbicides ranged from 0.02 to 0.29 µg/L. No pesticides, herbicides, or other organic compounds were detected in March. In June, the herbicide metolachlor was detected at the Delta-Mendota Canal at a concentration of 0.29 µg/L and at Banks Pumping Plant at a concentration of 0.11 µg/L. The herbicides atrazine and simazine were also detected in June. In September, the detected herbicides were 2,4-D, atrazine, Dacthal (dimethyl tetrachloroterephthalate or DCPA), and simazine. The detected amounts of pesticides in 2015 were well below established MCLs.

DWR routinely monitors taste and odor compounds produced by algae. Chemical substances in water that are often associated with earthy, musty smelling or tasting water include geosmin and 2-methylisoborneol (MIB), which are produced in water bodies by cyanobacteria. Geosmin and MIB are natural by-products of algal chlorophyll production.

DWR's evaluation of a taste and odor event is based on microscopic examination of samples, and most importantly, the chemical analysis of MIB and geosmin. When sampling results indicate that concentrations of these compounds in SWP waters are increasing within the 10 nanograms per liter range, DWR responds by searching for the location of the source of the geosmin or MIB. To do this, water quality samples are collected and analyzed to ascertain the presence of possible algal sources. If an algal source is identified, DWR develops an aquatic herbicide application plan to control the specific algae that are associated with the elevated geosmin and/or MIB concentrations. In 2015, aquatic herbicide applications targeting taste- and odor-producing cyanobacteria occurred in the South Bay Aqueduct, Patterson Reservoir, Coastal Branch Aqueduct, and Castaic Lake.

Additional SWP water quality data are available on DWR's Water Data Library website.

## Non-SWP Turn-ins

Non-SWP water can be admitted to the California Aqueduct for conveyance and redistribution. Non-SWP water is considered to be any input to the SWP for conveyance that is not directly diverted from the Delta. According to California Water Code Section 1810, no agency may deny a transferor of water the use of a water conveyance facility which has unused capacity, for the period of time for which that capacity is available, if fair compensation is paid. Inputs to the California Aqueduct from these sources are called turn-ins.

Turn-in water may be used for local redistribution or transfer to other water contractors. Participants of an approved turn-in program can use available aqueduct capacity to move candidate waters from a point of availability to a point of need. Groundwater substitutions can also be

**Table 4-2 Pesticides, Herbicides, and Other Organic Substances Detected in the SWP in 2015**

| Sampling Location[a] | Sampling Station ID Number | Sample Date | Chemical Detected[b] | Concentration (µg/L)[c] |
|---|---|---|---|---|
| North Bay Aqueduct, Barker Slough Pumping Plant | KG000000 | 3/17/15 | None | — |
| | | 6/17/15 | None | — |
| | | 9/14/15 | None | — |
| Delta-Mendota Canal upstream of McCabe Road | DMC06716 | 6/16/15 | Atrazine | 0.03 |
| | | 6/16/15 | Metolachlor | 0.29 |
| | | 6/16/15 | Simazine | 0.02 |
| | | 9/15/15 | 2,4-D[d] | 0.2 |
| California Aqueduct at Banks Pumping Plant | KA000331 | 3/17/15 | None | — |
| | | 6/17/15 | Atrazine | 0.02 |
| | | 6/17/15 | Metolachlor | 0.11 |
| | | 6/17/15 | Simazine | 0.02 |
| | | 9/16/15 | 2,4-D | 0.2 |
| California Aqueduct at O'Neill Forebay Outlet (Check 13) | KA007089 | 6/16/15 | Simazine | 0.02 |
| | | 9/15/15 | 2,4-D | 0.1 |
| | | 9/15/15 | Atrazine | 0.02 |
| California Aqueduct near Kettleman City (Check 21) | KA017226 | 6/16/15 | Simazine | 0.02 |
| | | 9/15/15 | None | — |
| California Aqueduct near Highway 119 (Check 29) | KA024454 | 3/17/15 | None | — |
| | | 6/16/15 | Simazine | 0.02 |
| | | 9/14/15 | Dacthal (DCPA)[e] | 0.15 |
| California Aqueduct at Tehachapi Afterbay (Check 41) | KA030341 | 3/18/15 | None | — |
| | | 6/17/15 | None | — |
| | | 9/16/15 | Dacthal (DCPA) | 0.12 |
| | | 9/16/15 | Simazine | 0.02 |
| California Aqueduct at Devil Canyon Second Afterbay | KA041323 | 3/25/15 | None | — |
| | | 6/17/15 | Simazine | 0.02 |

[a] Water at these locations is normally sampled during March, June, and September; however, no samples were collected in March 2015 at Delta-Mendota Canal, O'Neill Forebay Outlet (Check 13), or California Aqueduct near Kettleman City (Check 21). No samples were collected at Devil Canyon Second Afterbay in September 2015.
[b] Only chemicals found in detectable amounts at the sampling stations are included in this table. Refer to the document entitled *Analytical Methods for Organic Chemicals* for a complete listing of all organic chemicals included in the laboratory analysis. The document is available on DWR's website.
[c] µg/L = micrograms per liter
[d] 2,4-D = 2,4-dichlorophenoxyacetic acid
[e] Dacthal (DCPA) = dimethyl tetrachloroterephthalate

made whereby surface water diversions are reduced by replacing that water with a like amount of groundwater. In this manner, more surface water is made available for transfer to other users. These voluntary water transfers aid in supplying water to areas experiencing shortages, usually during periods of drought or years with below-normal runoff.

Participants of turn-in programs include both SWP and non-SWP contractors that bank groundwater and routinely convey it into the California Aqueduct at various locations. Although most non-SWP turn-ins to the California Aqueduct originate as groundwater from Kern and Kings counties, other waters include excess surface flows or floodwaters typically from southern Sierra Nevada watersheds. Surface water turn-ins have included excess floodwaters from the Kings River redirected through the Mendota Pool and pumped into the California Aqueduct.

Certain conditions must be met before a turn-in proponent can be given approval to convey water into the California Aqueduct. In accordance with California Water Code Section 1810, water may be conveyed or transferred via any unused capacity of the California Aqueduct provided that the commingled water does not result in degradation of water quality. The transfer must also be made without unreasonably affecting fish, wildlife, or other instream beneficial uses.

DWR, therefore, established interim procedures and criteria to review turn-in proposals and determine their approval for acceptance into the California Aqueduct using a two-tiered approach. According to the policy, the proponent of any turn-in proposal shall demonstrate that the water is of consistent, predictable, and acceptable quality. Prospective turn-in entities are required to submit proposals describing their turn-ins, including information such as detailed water quality monitoring and analyses, source water description, identification of wells, inflow rates, and duration. Tier 1 programs have "no adverse impacts" based on historical water quality in the California Aqueduct. Tier 2 programs are those with constituent concentrations higher than historical California Aqueduct conditions and has the potential to cause adverse impacts. Tier 2 programs are referred to the State Water Contractor Facilitation Group for review. The facilitation group consists of DWR staff and representatives from each water contractor that chooses to participate. The group reviews Tier 2 proposals based on merits, impacts, mitigation, water quality monitoring, cost, benefits, and other issues. The group then provides recommendations to DWR regarding proposal approval. DWR considers all factors before making a decision on any turn-in proposal. Programs meeting Tier 1 criteria are approved by DWR without referral to the State Water Contractor Facilitation Group.

A total of 482,825 af of non-SWP turn-in water was admitted to the California Aqueduct during 2015. Most of it (94 percent) originated from groundwater pumping in the San Joaquin Field Division; the remainder came from pumping in the San Luis and Southern field divisions (see Table 4-3). Monitoring showed water quality in the California Aqueduct was affected, both positively and negatively, but the effects were sometimes inconsistent and depended on a variety of factors such as water quality parameter, upstream concentration, turn-in source, and relative flows.

Both the California Department of Public Health (CDPH) Title 22 parameters and a short list of constituents of concern, as determined via the DWR *Water Quality Policy and Implementation process for Acceptance of Non-Project Water into the State Water Project* (October 2012), are regularly monitored. Data are compared to MCLs. Since MCLs apply to drinking water and not surface water, they are used for turn-ins as a tangible goal for concentrations of constituents of concern in the aqueduct.

In the San Luis Field Division, 26,835 af of groundwater was pumped into the California Aqueduct from Westlands Water District. Sulfate and salinity consistently increased between upstream and downstream stations.

These parameters can cause taste and odor problems in drinking water but are not considered human health threats. No consistent increases or decreases were observed for arsenic, bromide, chromium, nitrate, or organic carbon. Manganese samples both upstream and downstream of turn-ins exceeded the secondary MCL of 0.05 mg/L; no other constituents of concern exceeded the MCL in California Aqueduct sampling.

In the San Joaquin Field Division, 454,385 af of groundwater was admitted to the aqueduct from Kern Water Bank Authority, Kern County Water Agency, Semitropic Water Storage District, Arvin-Edison Water Storage District, Wheeler Ridge-Maricopa Water Storage District, and West Kern Water District (see Table 4-3). These turn-ins comprised 44 percent of the total volume of water entering the aqueduct (turn-ins plus Check 21)—slightly less than the amount in 2014 (46 percent).

**Table 4-3 Turn-ins to the California Aqueduct in 2015**

| Groundwater Source | Amount (acre-feet) |
|---|---|
| Antelope Valley-East Kern Water Agency | 1,605 |
| Arvin-Edison Water Storage District | 70,200 |
| Cross Valley Canal | 89,886 |
| Kern Water Bank Canal | 155,394 |
| Semitropic Water Storage District | 109,580 |
| West Kern Water District | 2,103 |
| Westlands Water District | 26,835 |
| Wheeler Ridge-Maricopa Water Storage District | 27,222 |
| **Total** | **482,825** |

Arsenic, total chromium, and nitrate consistently increased in the aqueduct due to San Joaquin Field Division turn-ins. These are undesirable parameters in drinking water because of their potential threat to human health. Drinking water MCLs were exceeded once each for arsenic and chromium. Rising concentrations of constituents like arsenic and other co-occurring contaminants are a concern because they can accumulate in biosolids as a byproduct of drinking water production, potentially increasing disposal costs. Sulfate concentrations varied throughout the San Joaquin Field Division, with slightly more occurrences of increasing concentrations overall. This result is undesirable because sulfate can cause taste and odor problems in drinking water, however, it is not considered a human health threat.

Bromide and organic carbon decreased in the aqueduct downstream of the San Joaquin Field Division turn-ins. This provided a net benefit to SWP contractors because these parameters can increase both the cost of producing drinking water and the potential for creating harmful trihalomethanes during the treatment process.

Chloride and salinity also decreased downstream of the turn-ins, providing a benefit to aqueduct water quality as these parameters have the potential to cause taste and odor problems in drinking water. There are other benefits of lower concentrations of salt and salt-related parameters not necessarily associated with drinking water. Salinity in treated or reclaimed wastewater must meet regulatory limits upon discharge and can become a limiting factor for groundwater recharge. Salinity can also affect some crops, and it remains an ongoing concern for agricultural users of aqueduct water.

In the Southern Field Division, 1,605 af of groundwater was pumped into the aqueduct from Antelope Valley-East Kern Water Agency. This turn-in had very little influence on aqueduct water quality due to small relative inflows and good water quality.

## San Joaquin Valley Agricultural Water Quality Programs

There are a number of programs that conduct or support monitoring, research, training, or demonstration projects related to San Joaquin Valley agricultural water quality. For information about these programs, see Chapter 5, Local Assistance.

# Municipal Water Quality Program Branch

## Municipal Water Quality Investigations Program

The Municipal Water Quality Program (MWQP) Branch includes the Municipal Water Quality Investigations (MWQI) Program, which conducts water quality monitoring (both real time and discrete) in the Delta for municipal and industrial uses. The MWQI Program is the most comprehensive drinking water quality monitoring program in the Delta. Since its inception in 1983, information derived from this program has been supplied to the SWP water contractors and other agencies supplying drinking water taken from the Delta. This information is used extensively by federal, State, and local agencies and the public in water supply planning studies. Data from this program are used to identify longer-term trends in water quality changes in the Delta and the SWP. Monitoring data also help MWQI and other agencies develop research and mitigation measures to reduce drinking water contaminants in Delta waters. In collaboration with the Division of Operations and Maintenance, and through modeling, monitoring data derived from this program are used as an "early warning" system of changing conditions in source water, which can be used to provide advance notice to Delta water users of possible drinking water quality problems. Additionally, the MWQI Program provides technical water quality expertise to other units within DWR, local municipal water agencies, the SWRCB, and the RWQCBs. The program contributes water quality expertise while participating in regulatory, planning, and data sharing efforts.

## Real Time Data and Forecasting Comprehensive Program

The Real Time Data and Forecasting Comprehensive Program has become a central element of the MWQP. The goal of the program is to further develop the capability of real-time data collection and to forecast short- and long-term source drinking water quality conditions in the Delta and SWP. Within the MWQP, the Real Time Data and Forecasting Comprehensive Program entails the following elements:

- real-time water quality monitoring at key locations, providing stakeholders and interested parties with timely data;
- field operations that ensure proper operation of all automated sampling equipment;
- consistent modeling with continuous updates providing the best forecasts possible;
- quality assurance/quality control of the instruments and data; and
- centralized information management and dissemination.

The real-time monitoring network includes stations located at Banks Pumping Plant, Jones Pumping Plant, the Sacramento River at Hood, the San Joaquin River near Vernalis (McCune Station), and the Gianelli Pumping-Generating Plant at San Luis Reservoir.

## Quality Assurance/Quality Control Program

The Quality Assurance/Quality Control Program (Quality Assurance Program) was established in 1992 to ensure that data generated by DWR's environmental monitoring programs meet high quality standards and are scientifically defensible.

Monitoring programs are encouraged to follow standardized procedures including quality control measurements in their sampling protocols.

The Quality Assurance Program integrates planned quality control activities at all levels of environmental monitoring programs through standardized project design and organization; the establishment of data quality objectives; defined sampling, analysis, and quality control procedures; practices for data reduction and validation; guidelines for report preparation; and means to assess progress, feedback, and process improvement.

In 2015, the Quality Assurance Program worked closely with various environmental monitoring programs and provided technical support in the development and review of quality assurance project plans, field manuals, and standard operating procedures. The program also provided assistance with statistical analysis and review of data to ensure compliance with quality assurance objectives and with review of field and laboratory activities to ensure comparable and consistent sample handling and quality control procedures.

## Water Quality Special Studies

Special studies focus on specific aspects of source waters, contaminant loading, measurement methods and instrumentation, and climate and hydrology. They are conducted to:

- investigate the origins, fate, transport, and, in some cases, loads of current and emerging contaminants of concern;
- investigate seasonal patterns and trends of constituents and examine circulation patterns of contaminants;
- refine modeling assumptions; and
- assess the impacts of increasing urbanization on levels of water quality constituents of concern.

The following studies were in progress during 2015:

- Urban Sources and Loads Investigation of Lathrop, California;
- investigation of O'Neill Forebay water circulation;
- spectrofluorometer study;
- feasibility study for a portable water quality monitoring station;
- nutrient budget of the SWP;
- in-situ fluorometer measurements of dissolved organic matter;
- San Joaquin River watershed sanitary survey;
- fluoresence of dissolved organic matter proof of concept study;
- tidal marsh restoration literature review;
- Eastside Watershed Analysis Risk Management Framework and Yolo Delta Simulation Model 2 (DSM2) model monitoring;
- DSM2 nutrient monitoring study;
- Cache Slough Complex prerestoration baseline monitoring; and
- SWP limnology studies.

## Accomplishments for the 2014–2015 MWQI Work Plan

During 2015, the MWQI accomplished the following goals:

- continuous operation of five real-time water quality stations;
- continuous data dissemination of water quality reports;
- weekly distribution of short-term water quality forecasts;
- monthly distribution of volumetric, EC, and organic carbon source fingerprints;
- initialization of version 2 of the Field Station Real Time Monitoring Standard Operating Procedures; and
- production of several projects to develop data for historical conditions for the Delta and aqueduct models (DSM2 and DSM2 Aqueduct Extension Model of the SWP).

The special study reports and other MWQP publications can be found on DWR's website.

## Bryte Chemical Laboratory

Established in 1951, Bryte Chemical Laboratory is DWR's primary analytical laboratory. Its main function is to analyze drinking, surface, waste, and groundwater for the various water quality programs within DWR. Since 1990, the laboratory has been certified biennially by the SWRCB's Environmental Laboratory Accreditation Program to perform water quality analyses following U.S. Environmental Protection Agency or American Water Works Association procedures and analytical methods. This certification allows the laboratory to perform analyses that generate legally defensible data that can be used for regulatory or compliance purposes. The laboratory continues to perform the majority of chemical and other related analyses required to support DWR's water quality programs. Each year, thousands of water samples are routinely analyzed for inorganic and organic constituents such as standard minerals, cations, anions, nutrients, metals, chlorophyll, pesticides, herbicides, and volatile organic compounds.

In 2015, the laboratory upgraded its capability and capacity to detect and analyze anions (fluoride, chloride, bromide, nitrate, and sulfate) with the purchase of two ion chromatographs. The chromatographs are fully automated and computer-controlled electrochemical instruments that generate data that are highly stable, accurate, and reproducible. Each instrument's detection limit has been established at 1.0 part per million.

The laboratory has continued to manage a variety of analytical contracts with other State agencies and several outside laboratories in accordance with the master contract policy approved in fiscal year 1994–1995. These contracts are used to perform analyses that are beyond the capability and capacity of the laboratory, such as analyses of solids and fish tissues. The laboratory works in conjunction with the MWQP Quality Assurance Program to replace these contracts as they expire each fiscal year. On July 1, 2015, Weck Laboratories, Inc. was awarded the contract for water and solids analyses worth $1.5 million over 3 years.

Bryte Laboratory continues to be an active member of a group of laboratories called the California Association of Mutual Aid Laboratories Network headed by CDPH. The laboratory network's main objective is to voluntarily assist CDPH with analyzing chemical agents in water quality samples should a natural disaster or biochemical or chemical event occur in California. The assistance is only required should the analytical capacity of CDPH be exceeded or to confirm the presence or absence of chemical agents in water quality samples provided by CDPH. In 2007, Bryte Chemical Laboratory was classified as a Level II participating laboratory in the California Association of Mutual Aid Laboratories Network organization. Level II only allows the laboratory to receive samples that are prescreened and determined nonhazardous to laboratory personnel.

## Suisun Marsh Program Activities

Suisun Marsh consists of approximately 59,000 acres of tidal and managed brackish water wetlands and 30,000 acres of bays and sloughs. It is the largest contiguous brackish marsh remaining in the United States. Situated in southern Solano County, west of the Delta and north of Suisun Bay, the marsh encompasses more than 10 percent of California's remaining natural wetlands. The marsh is the resting and feeding ground for thousands of waterfowl and shorebirds migrating on the Pacific Flyway. It provides important habitat for more than 221 bird

species, 45 mammal species, 16 reptile and amphibian species, and more than 40 fish species.

DWR became involved in the Suisun Marsh in response to SWRCB Water Right Decision 1485, which required DWR and Reclamation to operate the SWP and CVP to meet salinity standards as specified in the SWRCB's 1978 *Water Quality Control Plan for the Delta and Suisun Marsh*, which established revised water quality objectives for flow and salinity in the Delta and Suisun Marsh. Water Right Decision 1485 also required DWR and Reclamation, in cooperation with other agencies, to develop a plan for Suisun Marsh that would ensure that the long-term standards for full protection of Suisun Marsh would be met. The 1984 *Plan of Protection for Suisun Marsh*, completed by DWR, included construction of a series of facilities to distribute lower-salinity water to managed wetlands and monitoring in relation to these facilities. Today, DWR operates and maintains these water management facilities, including the Roaring River Slough Distribution System, Morrow Island Distribution System (MIDS), Goodyear Slough Outfall, and the Suisun Marsh Salinity Control Gates (SMSCG). Figure 4-2 shows the water quality compliance and monitoring sampling locations and the water management facilities.

Through agreements and plans, DWR has been working in coordination with Reclamation, DFW, Suisun Resource Conservation District, USFWS, and other agencies, on habitat management, preservation, and restoration of the Suisun Marsh.

## Revised Suisun Marsh Preservation Agreement

In 1987, DWR, Reclamation, DFW, and the Suisun Resource Conservation District signed the *Suisun Marsh Preservation Agreement* (SMPA), a contractual framework for implementation of the *Plan of Protection for Suisun Marsh*. It required Reclamation and DWR to meet salinity standards as specified in the SWRCB's 1978 WQCP, set a timeline for implementing the *Plan of Protection for the Suisun Marsh*, and delineated monitoring and mitigation requirements. A revised SMPA and *Revised Mitigation and Monitoring Agreement* were signed in 2005 to include actions to meet channel water salinity standards consistent with D-1641 and to implement landowner-based management activities in lieu of the western marsh facilities proposed in the plan of protection.

The revised SMPA included the following actions: operate facilities to meet channel water salinity standards consistent with D-1641; implement a Water Manager Program; provide portable pumps; update Individual Ownership Adaptive Management Habitat Plans; establish a Drought Response Fund; and replace turnouts on the Roaring River Slough Distribution System. The monitoring agreement included monitoring for the Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*) and Ridgway's Rail (*Rallus obsoletus*; formerly known as the California Clapper Rail), fish, vegetation, and other biological monitoring.

### *SMPA 2015*

SMPA 2015 is the newest revision of the SMPA, which includes new provisions, including September SMSCG operation and the preservation agreement implementation funding. Preservation agreement implementation funds are provided by DWR and Reclamation to improve managed wetlands infrastructure for flooding and draining and joint-use facilities infrastructure.

## Facility Operations, Maintenance, and Related Activities

### *Morrow Island Distribution System*

MIDS is an interior ditch bordered by levees that was created to distribute water to managed wetlands on the western edge of Suisun Marsh. Water with relatively lower salinity is taken from Goodyear Slough in the west through water control structures that transport the water into MIDS. Water is then distributed to managed wetlands through private landowner water control structures along the ditch. Water not used by the landowners exits into Grizzly Bay through water control structures in the east (see Figure 4-2). Routine maintenance during 2015 included mowing, spraying, and levee road regrading and winterizing. Trees were trimmed and invasive trees were removed along 3 miles of the MIDS levee to reestablish access and to prepare for the ditch cleaning maintenance project in 2016.

**Fish Screen and Alternatives.** Based on previous study results, a fish screen

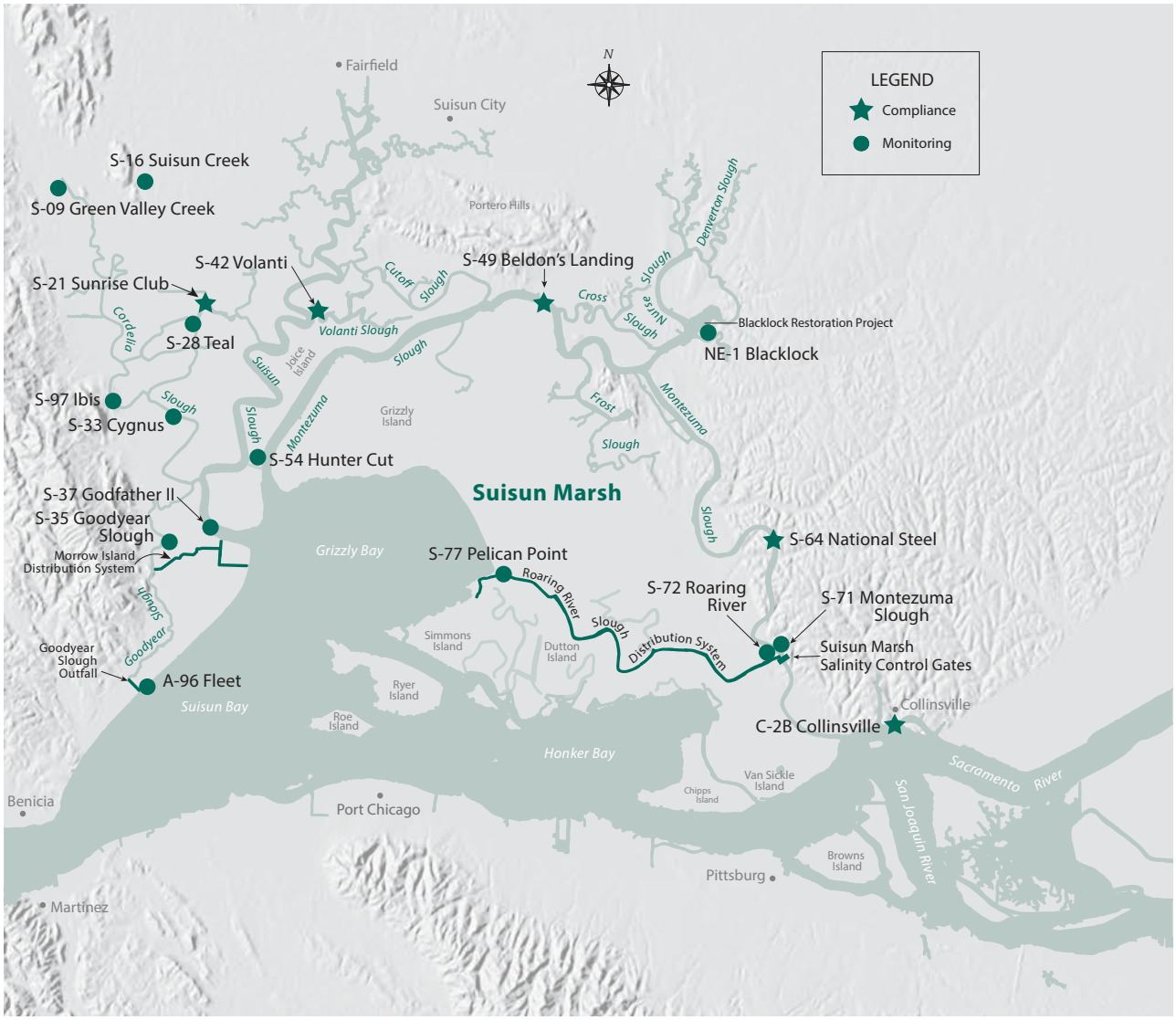



**Figure 4-2 Compliance and Monitoring Stations and Water Management Facilities in the Suisun Marsh**

at MIDS would likely have negligible benefits to sensitive fish populations (see Bulletin 132-07, Chapter 4, Water Quality). DWR and Reclamation are proposing to fulfill the outstanding terms and conditions of the USFWS 1997 BiOp for the MIDS maintenance project by acquiring and protecting, in perpetuity, aquatic habitat in Suisun Marsh. (For additional information about the BiOp, see Bulletin 132-08.) This proposal is ongoing.

**Longfin Smelt Incidental Take Permit.** On February 23, 2009, DFW issued an incidental take permit for the ongoing and long-term operation of existing SWP facilities in the Delta for the protection of Longfin Smelt. MIDS is included as one of these facilities.

To minimize the take of Longfin Smelt at the MIDS diversion, DFW specifies the average intake velocities each year to adequately protect these fish.

Also, as a requirement of the incidental take permit, DWR is developing a study to confirm that the aforementioned operation prevents or substantially reduces the entrainment of Longfin Smelt at MIDS.

**Morrow Lane Bridge Repair.** In July 2012, the Division of Engineering inspected the Morrow Lane Bridge over Goodyear Slough and found the bridge was severely deteriorated. As a result, access and maintenance of MIDS was suspended.

DWR worked with a landowner and consultant to determine how to proceed with bridge repairs. The landowner decided to address the deficiency in two phases. The first was a repair to extend the life of the bridge one to two years, and the second is a full replacement of the bridge (anticipated in 2017).

## *Suisun Marsh Salinity Control Gates*

The SMSCG are operated as needed to meet salinity standards. When they are not in operation, they are placed in an open position to minimize fish concerns related to predation and impedance. Installation or removal of the flashboards and operation of the gates vary depending on salinity conditions, fisheries agencies' requests for sensitive species concerns, or repairs.

**Status of SMSCG in 2014–2015.** The control season started September 2014, a month earlier than usual, due to salinity concerns. The flashboards were installed and the boat locks became operational on September 3, 2014. The SMSCG were tidally operated between September 3, 2014, and June 2, 2015, due to salinity concerns in the marsh. The boat lock was partially closed during the control season due to safety concerns. The gates were tidally operated from September 3 until October 6 to meet the 7-day running average EC of 17 mS/cm for the revised SMPA. Gate operations stopped on October 7 to allow the interior Delta to meet water quality standards. The gates began operating again on October 22 to bring salinity down for November standards. On November 19 there was an electrical control system failure. Gates were set to an open position while repairs were done. Operations resumed on December 4. On December 15, operations stopped for technical work and resumed on January 1, 2015. Operations continued until June 2, 2015. The flashboards were then removed, and the boat locks were set to the open position.

## *Other Facility Operation and Maintenance*

The Roaring River Slough Distribution System and Goodyear Slough Outfall are operated and maintained as needed to provide lower-salinity water to managed wetland properties. Roaring River Slough Distribution System 2015 maintenance

activities included levee mowing and spraying. Goodyear Slough Outfall 2015 maintenance activities included ditch cleaning and levee raising.

### *Water Quality and Compliance*

A deficiency period began in January 2014, which was triggered by a dry water year in 2013, followed by a critical water year in 2014. The deficiency period allows higher salinity conditions at the western marsh compliance stations (S-21 Sunrise Club and S-42 Volanti) from December through May. The deficiency period continued during 2015. Salinity levels in November 2014 at Beldon's Landing (S-49) exceeded the D-1641 standard of a progressive daily mean salinity of 15.5 mS/cm. The salinity standard of 11.0 mS/cm was exceeded for Collinsville (C-2) during May 2015. All other salinity levels for the 2014–2015 control season were below monthly standards for the compliance stations.

Details about salinity levels in the marsh are available in the monthly report entitled *Suisun Marsh Monitoring Program Channel Water Salinity Report* available on DWR's website.

## Blacklock Restoration Project

DWR received CALFED Ecosystem Restoration Program grant funds in 2001 to acquire the 70-acre Blacklock property in December 2003. DWR, in cooperation with Reclamation, DFW, USFWS, and Suisun Resource Conservation District, implemented the Blacklock Restoration Project (location shown on Figure 4-2). This project restored diked, managed wetlands to tidal wetlands. Although a natural breach in the levee occurred in July 2006, it was determined that the planned breach should still be constructed to allow for full tidal flow and optimum sediment transportation. The planned breach construction occurred on October 3 and 4, 2006.

The project goals and objectives are to:

- restore the area to a fully functioning, self-sustaining marsh ecosystem created through restoration of natural hydrologic, sedimentation, and biological processes;
- increase the area and contiguity of emergent wetlands providing habitat for tidal marsh species; and
- assist the recovery of at-risk species.

The final restoration plan for the project was published in June 2007.

In 2015, DWR continued implementing the 10-year monitoring program at the Blacklock site. Monitoring is performed in cooperation with State and federal agencies. There are 15 parameters being monitored, including sediment accretion, channel network evolution, vegetation development, water quality, methylmercury concentrations, and avian use.

In 2013, Wetlands and Water Resources, Inc. worked on the monitoring report for years one through five. The report is being finalized by DWR.

For more information about the Blacklock Restoration Project, visit the Suisun Marsh Program webpage on DWR's website.

## Suisun Marsh Habitat Management, Preservation, and Restoration Plan

The *Suisun Marsh Habitat Management, Preservation, and Restoration Plan*, referred to as the Suisun Marsh Plan, was developed by the Principal Agencies (or Principals), a group of agencies with primary responsibility for Suisun Marsh management. The Suisun Marsh Plan is intended to balance the benefits of tidal wetland restoration with other habitat uses in the marsh by evaluating alternatives that provide a politically acceptable change in marshwide land uses, such as Salt Marsh Harvest Mouse habitat, managed wetlands public use, and upland

habitat. It relies on the incorporation of existing science and information developed through adaptive management.

The principals include USFWS, Reclamation, DFW, DWR, NOAA Fisheries, and Suisun Resource Conservation District. The Principals have consulted with other participating agencies, such as the U.S. Army Corps of Engineers, the San Francisco Bay Conservation and Development Commission, the RWQCBs, and SWRCB, to develop this plan.

On April 21, 2014, Reclamation and USFWS signed the record of decision for the Suisun Marsh Plan. The principals will implement or approve activities in the marsh consistent with the plan over a 30-year period of implementation. The Suisun Marsh Plan is available on Reclamation's website.

## Suisun Marsh Expenditure History

Suisun Marsh expenditures and reimbursements administered by DWR for calendar years 1968 through 2015 are summarized in Table 4-4. From 1968 through December 31, 2015, DWR disbursed more than $162.1 million of SWP funds for planning, design, environmental documentation, construction, maintenance, monitoring, mitigation, and permit compliance in support of implementing the *Plan of Protection for the Suisun Marsh* through the SMPA and for meeting standards set by SWRCB. Reclamation has reimbursed DWR approximately $61.2 million (38 percent), and the State's General Fund has reimbursed approximately $9.5 million (5.9 percent). These figures do not include up-front payments made by Reclamation for staff and other direct costs, as well as approximately $5.7 million in Reclamation interest payments during 1988 and 1989.

Annual figures are reported in Table 4-4 for DWR's up-front payments, Reclamation's reimbursements, General Fund reimbursements, and DWR's cumulative expenditure balance.

## Table 4-4 Suisun Marsh Expenditures and Reimbursements Administered by DWR, Calendar Years 1968–2015 (in dollars)

| Year [1] | Reach 305 Costs [2] | General Fund Payment [3] | Adjustment for General Fund Payment[a] [4] | Reclamation Invoice Payment[d] [5] | Interest Payment Credited Back to Contractors [6] | Net SWP Costs [2] through [6] [7] | Recreation Costs[c] [8] | SWP Water Contractors' Costs [7] minus [8] [9] |
|---|---|---|---|---|---|---|---|---|
| 1968 | 10,571 | | | | | 10,571 | 359 | 10,212 |
| 1969 | 34,181 | | | | | 34,181 | 1,162 | 33,019 |
| 1970 | 23,343 | | | | | 23,343 | 794 | 22,549 |
| 1971 | 1,042 | | | | | 1,042 | 35 | 1,007 |
| 1972 | 47 | | | | | 47 | 2 | 45 |
| 1973 | 0 | | | | | 0 | 0 | 0 |
| 1974 | 0 | | | | | 0 | 0 | 0 |
| 1975 | 2,709 | | | | | 2,709 | 92 | 2,617 |
| 1976 | 32,960 | | | | | 32,960 | 1,121 | 31,839 |
| 1977 | 37,475 | | | | | 37,475 | 1,274 | 36,201 |
| 1978 | 350,831 | | | | | 350,831 | 11,928 | 338,903 |
| 1979 | 3,660,099 | | | | | 3,660,099 | 124,618 | 3,535,481 |
| 1980 | 5,005,759 | | | | | 5,005,759 | 170,772 | 4,834,987 |
| 1981 | 2,964,974 | | | | | 2,964,974 | 101,311 | 2,863,663 |
| 1982 | 2,955,705 | | | (2,500,000) | | 455,705 | 101,111 | 354,594 |
| 1983 | 2,754,094 | | | | | 2,754,094 | 93,643 | 2,660,451 |
| 1984 | 2,418,344 | | | | | 2,418,344 | 82,388 | 2,335,956 |
| 1985 | 2,332,773 | | | | | 2,332,773 | 79,432 | 2,253,341 |
| 1986 | 6,495,322 | | | | | 6,495,322 | 220,843 | 6,274,479 |
| 1987 | 13,600,701 | | | | | 13,600,701 | 462,424 | 13,138,277 |
| 1988 | 7,456,364 | | | (17,368,725)[b] | (2,039,752) | (11,952,113) | 253,516 | (12,205,629) |
| 1989 | 2,341,960 | (9,478,000) | 6,634,600 | (1,219,691)[b] | (283,857) | (2,004,988) | 79,643 | (2,084,631) |
| 1990 | 3,030,010 | | | (695,450) | | 2,334,560 | 101,460 | 2,233,100 |
| 1991 | 6,223,042 | | | (2,925,429) | | 3,297,613 | 210,454 | 3,087,159 |
| 1992 | 2,737,259 | | | (1,174,655) | | 1,562,604 | 91,951 | 1,470,653 |
| 1993 | 2,979,255 | | | (238,130) | | 2,741,125 | 99,897 | 2,641,228 |
| 1994 | 3,192,213 | | | (1,962,549) | | 1,229,664 | 107,281 | 1,122,383 |
| 1995 | 2,721,978 | | | (647,138) | | 2,074,840 | 91,218 | 1,983,622 |
| 1996 | 3,391,678 | | | (1,482,396) | | 1,909,282 | 113,244 | 1,796,038 |
| 1997 | 3,634,267 | | | (1,520,219) | | 2,114,048 | 121,132 | 1,992,916 |
| 1998 | 5,342,834 | | | (1,107,501) | | 4,235,333 | 177,132 | 4,058,201 |
| 1999 | 8,867,742 | | | (2,696,200) | | 6,171,542 | 301,424 | 5,870,118 |
| 2000 | 2,857,534 | | | (3,300,053) | | (442,519) | 98,146 | (540,665) |
| 2001 | 2,621,301 | | | (444,009) | | 2,177,292 | 89,431 | 2,087,861 |
| 2002 | 3,752,486 | | | (791,319) | | 2,961,167 | 124,387 | 2,836,780 |
| 2003 | 3,258,583 | | | (2,389,979) | | 868,604 | 107,566 | 761,038 |
| 2004 | 2,874,629 | | | (952,940) | | 1,921,689 | 94,885 | 1,826,804 |
| 2005 | 3,940,876 | | | (1,409,296) | | 2,531,580 | 130,049 | 2,401,531 |
| 2006 | 5,770,068 | | | (868,449) | | 4,901,619 | 192,622 | 4,708,997 |
| 2007 | 4,083,999 | | | (939,879) | | 3,144,120 | 135,910 | 3,008,210 |
| 2008 | 3,802,297 | | | (1,670,278) | | 2,132,019 | 126,064 | 2,005,973 |
| 2009 | 4,687,794 | | | (1,123,705) | | 3,564,089 | 154,699 | 3,409,391 |
| 2010 | 2,840,455 | | | (1,663,530) | | 1,176,925 | 93,735 | 1,083,190 |
| 2011 | 3,762,735 | | | (1,748,136) | | 2,014,599 | 124,170 | 1,890,428 |
| 2012 | 6,374,544 | | | (1,860,585) | | 4,513,959 | 210,360 | 4,303,600 |
| 2013 | 5,551,009 | | | | | 5,551,009 | 183,183 | 5,367,826 |
| 2014 | 4,974,994 | | | | | 4,974,994 | 164,175 | 4,810,819 |
| 2015 | 6,306,506 | | | (6,538,766) | | (232,260) | 182,515 | (414,776) |
| **Total** | **162,059,342** | **(9,478,000)** | **6,634,600** | **(61,239,007)** | **(2,323,609)** | **95,653,326** | **5,413,540** | **90,239,786** |

[a] Under Assembly Bill 1442, the General Fund paid 20 percent of the Suisun Marsh costs through June 1988, which totaled $9,478,000. This payment included $2,843,400, which represents 5.9 percent of the costs through June 1988 paid by the General Fund. This amount has reduced the costs billed to the SWP water contractors. The remaining $6,634,600 received from the General Fund represents DWR's recreation project purpose share of 14 percent.

[b] Excludes interest payments made by Reclamation.

[c] Allocation factors for capital recreation costs have changed from 14 percent to 3.4 percent, and operations and maintenance recreation costs from 14 percent to 3.3 percent.

[d] No payments were made by Reclamation in 2013 and 2014 due to disputed invoices. All disputed charges were resolved and paid in July 2015.



# Chapter 5
# Local Assistance

*California Irrigation Management Information System weather station buoy.*

## Significant Events in 2015

The program unit within the Department of Water Resources (DWR) that manages the California Irrigation Management Information System (CIMIS) conducted several outreach activities at farm shows and conferences to promote the use of CIMIS data to mitigate the impacts of drought. As a result, the CIMIS system received more data requests in 2015 than in any prior year.

DWR's Urban Water Use Efficiency Unit continued to review urban water management plans submitted for the 2010 cycle, and 242 reviews were finalized.

DWR's Water Use Efficiency Grant Program continued to manage approximately 170 grant agreements from previous proposal solicitations funded by Proposition 50.

DWR developed and released the application package for agricultural water management plan 2015 grants in October 2015. The grant program implements the Governor's Executive Order (EO) B-29-15, which directs DWR to prioritize grant funding for agricultural water management plans (AWMP) for midsized agricultural water suppliers.

*Information in this chapter was contributed by the Division of Statewide Integrated Water Management, the Division of Environmental Services, and the Division of Integrated Regional Water Management.*

The Department of Water Resources (DWR) manages the Davis-Grunsky Act program, water use efficiency, agricultural drainage, and Water Conservation Bond Law programs, and participates in several other programs that assist local agencies and benefit State Water Project (SWP) water contractors.

## Davis-Grunsky Act Program

The Davis-Grunsky Act, authorized in 1960 as part of the Burns-Porter Act, provides construction loans for local domestic water projects and agricultural water supply. It also provides grants for recreation and fish and wildlife enhancement. Additionally, loans and grants may be given to rehabilitate dams and reservoirs.

DWR's ongoing administration of Davis-Grunsky Act program loans and grants includes management and oversight of recreation projects and contracts. Administration costs are recovered from revenues generated by repayment of Davis-Grunsky Act loans. Recreation grant contracts are amended to reflect modification of DWR's fee oversight functions and actual construction of recreation facilities.

The Davis-Grunsky Act requires participating State agencies to operate and maintain the recreation projects, while DWR inspects the recreation facilities, monitors the recreation contracts, and maintains a list of the recreation projects.

## Water Use Efficiency

Activities of the Water Use and Efficiency Branch in the Division of Statewide Integrated Water Management include providing technical assistance to local agencies; managing water use efficiency financial assistance programs; managing the California Irrigation Management Information System (CIMIS); reviewing, tracking, and reporting on urban and agricultural water management plans; and promoting water recycling/desalination projects.

### California Irrigation Management Information System

CIMIS is a network of automated weather stations that collects weather data and transmits it to a central repository in Sacramento. After performing quality control and calculations, data are made available to the public for such diverse purposes as irrigation scheduling, resource planning, research, and modeling.

In 2015, DWR's CIMIS network collected data from 146 stations, with approximately 50 percent of the stations on the network belonging to local cooperators. The demand for CIMIS data has been increasing steadily since its establishment in 1982. The number of registered data users has grown from 661 in 1989, to more than 55,000 in 2015.

Approximately 2.5 million reports were generated from the database using the CIMIS website in 2015. An additional 6 million reports were also retrieved from the CIMIS File Transfer Protocol site and CIMIS web services. The ongoing drought mitigation efforts may have led to the high demand for CIMIS data. Users can register online, access archived data, download data files, and peruse content about the CIMIS program and other helpful information. A separate but concurrently operating database and web application is maintained for redundancy to protect the data.

CIMIS continued providing the spatially distributed reference evapotranspiration ($ET_0$) data, known as Spatial CIMIS, and expanded its user base through outreach activities. Spatial CIMIS is produced by coupling remotely sensed data from the National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite with point measurements from CIMIS stations to estimate $ET_0$ data at 2-kilometer grids.

In addition to increasing the number of its stations, CIMIS made significant improvements to data quality and availability in support of California Water Code (CWC) requirements pertaining to conservation, development, and utilization of State water resources and the Model Water Efficient Landscape Ordinance (California Code of Regulations, Title 23, Sections 490–494), which requires all water suppliers to increase water use efficiency. It also requires, among other things, the development of agricultural water management plans and a 20 percent reduction in urban water consumption by the year 2020.

In 2015, DWR conducted several outreach activities at farm shows and conferences to promote the use of CIMIS data to mitigate the impacts of drought. As a result, the CIMIS system received more data requests in 2015 than in any prior year. In anticipation of increased future demand, the CIMIS program is in the process of exploring new technologies and methods to efficiently address CIMIS demand. In one such effort to quantify evaporation from water surfaces, in January 2015 a buoy was deployed to collect data for accurately estimating the amount of evaporated water and developing methodologies to use on other water bodies. This information will be significant for the public in general and for water managers in particular.

## Recycling and Water Desalination

The goal of the Division of Statewide Integrated Water Management's Recycling and Water Desalination Section is to improve water management by promoting the increased use of nonconventional water sources—namely recycled water and desalinated brackish and ocean waters—through planning, technical, and financial assistance. As part of a balanced water portfolio, nonconventional water sources will help meet existing and future water supply and environmental needs. The section's mission consists of increasing safe and beneficial reuse of treated municipal wastewater, advancing energy-efficient treatment and desalination technologies, and encouraging economically and environmentally acceptable use of desalinated brackish and ocean waters.

A primary activity of this section is to manage the Water Desalination Grant Program, funded by voter-approved bond issues: Proposition 50 in 2002 and Proposition 1 in 2014. There have been three rounds of Proposition 50 funding for 51 projects (completed and ongoing), which were awarded $47.7 million for planning, construction, pilot studies, and research. All Proposition 50 funds have been obligated. Proposition 1 will provide $93.1 million in local assistance, for which the first round of funding is planned for 2017.

## Water Use Efficiency Grants and Loans Program

Proposition 50 has provided approximately $105 million for the Water Use Efficiency Grant Program since 2005. The grant program provided funds for implementation of all urban best management practices and agricultural efficient water management practices that would result in local, regional, and statewide benefits. The State benefits are water conservation, flow and timing, water quality, and energy efficiency, among others.

A competitive proposal solicitation package (PSP) was developed for all grant cycles, along with a comprehensive review and evaluation of the project proposals. The PSP defined project benefits, eligible projects, eligible applicants, funding caps, reporting, and other contract requirements.

In 2015, DWR's Water Use Efficiency Grant Program continued to manage close to 170 grant agreements from previous proposal solicitations funded by Proposition 50, pursuant to CWC Section 79550(g).

### *Proposition 1 CalConserve Water Use Efficiency Revolving Fund 2015 Loan Program*

The CalConserve Water Use Efficiency Revolving Fund is intended to be a sustainable funding source for water use efficiency projects. One of the purposes of this fund is to provide measurable reductions in urban per capita potable water use.

In late 2015, DWR developed and released the *CalConserve Water Use Efficiency Revolving Fund Proposition 1 Draft 2015 Loan Guidelines and Proposal Solicitation Package.*

This loan program implements CWC Section 79746, added by Proposition 1, that authorizes DWR to provide funding to assist water suppliers and regions to implement conservation programs and measures that are not locally cost effective. The CalConserve Water Use Efficiency Revolving Fund, established by legislation in 2014 (CWC Section 81000–81046), provides funding available to DWR for the purpose of water use efficiency projects. Assembly Bill 92 (Chapter 2, Statutes of 2015; CWC Section 81023 ) further defines that $10 million be established in the fund for water conservation and water use efficiency projects and programs to achieve urban water use targets. The loan program will provide local agencies with zero-interest loans of up to $3 million.

Of the $10 million in the CalConserve fund, $5 million will be for a pilot project for local agencies to provide water efficiency upgrades to eligible residents, and $5 million will be loaned to customers to finance the installation of onsite improvements to repair or replace, as necessary, cracked or leaking water pipes to conserve water. The final CalConserve guidelines and PSP are expected to be released in 2016.

### *Proposition 1 Agricultural Water Use Efficiency 2015 Grants Program*

This grant program implements CWC Section 79746, added by Proposition 1 that authorizes DWR to provide funding for agricultural water management planning and agricultural water use efficiency projects and programs developed pursuant to CWC Section 10800–10802.

DWR prepared and released the *Draft Agricultural Water Use Efficiency 2015 Grants Proposition 1 Guidelines and Proposal Solicitation Package* in August 2015.

The grant program funds agricultural water use efficiency projects that produce State benefits. Benefits to the State include: water savings, improved in-stream flow, improved water quality, increased energy conservation, reduction of greenhouse gas emissions, and increased local water supply reliability. Thirty million dollars of the $33 million of Proposition 1 funding allocated for agricultural water use efficiency grants in the Governor's budget are available through this PSP. The remaining $3 million are allocated to fund a joint request for proposal with the California Department of Food and Agriculture for a pilot project that will encourage partnerships between an agricultural water supplier and its growers to save water and reduce greenhouse gas emissions through on-farm and districts' conveyance water use efficiency improvements. A separate PSP and guidelines are being developed jointly

with the California Department of Food and Agriculture, and a draft is expected to be released in 2016.

The $30 million agricultural water use efficiency PSP gives priority to projects that are not locally cost-effective, employ a regional scope of activities, provide direct benefits to disadvantaged communities or economically distressed areas, produce multiple benefits, conserve energy and help the greenhouse gas emission reduction or carbon sequestration goals, and employ new or innovative technology or practices. Per the Governor's April 1, 2015, Executive Order (EO) B-29-15, priority in this solicitation will also be given to projects that implement agricultural water management plan (AWMP) actions for agricultural water suppliers serving 10,000 to 25,000 acres of irrigated land.

In accordance with legislative requirements, the draft PSP was posted on DWR's website in October 2015 to accept public comments. Three public workshops were conducted on November 3, 4, and 5, 2015, in Glendale, Sacramento, and Oroville, respectively.

The final Agricultural Water Use Efficiency PSP and guidelines are expected to be released in January 2016.

### *Agricultural Water Management Planning Grants*

DWR developed and released the application package for agricultural water management plan 2015 grants in October 2015. The grant program implements the Governor's EO B-29-15, which directs DWR to prioritize grant funding for AWMPs for midsized agricultural water suppliers (agricultural water suppliers that provide water to 10,000 to 25,000 irrigated acres of land). The grant program is a noncompetitive program to fund AWMPs that meet the requirements of the Governor's EO B-29-15, and to provide sufficient funds to prepare plans in order to meet the original intent of the CWC. One million dollars in grant funding was made available with a $50,000 cap for suppliers preparing new plans, a $10,000 cap for suppliers updating plans, and a $5,000 cap for suppliers who must already submit plans to the Bureau of Reclamation. Grant applications are accepted and reviewed for approval on a continuous basis until all available funding has been awarded, or by May 31, 2016, whichever occurs first.

### *Turf Replacement and High-Efficiency Toilet Rebate Programs*

In August 2015, DWR announced two rebate programs to help Californians further conserve water during the State's historic drought. The rebate programs are financed by the Proposition 1 water bond, approved by voters in 2014. The programs help carry out the Governor's April 1, 2015, EO B-29-15 on drought to further reduce water use in homes by replacing more than 10 million square feet of lawns and upgrading more than 60,000 water-wasting toilets. DWR oversees the rebate programs.

With $24 million in Proposition 1 funding, the turf replacement program will rebate $2 per square foot of turf replaced, up to $2,000 per household, through State or local turf replacement programs. Consumers are eligible to replace turf that is living or dead at the time of the rebate application. The turf rebate program is estimated to benefit more than 10,000 homes, with a focus on disadvantaged communities hardest hit by the drought. Twelve million dollars of the lawn removal funds is targeted for residents in disadvantaged communities with areas of depleted groundwater basins. The turf rebate program is monitored by DWR and administered by the Electric & Gas Industries Association. Approximately $1 million is targeted for lawn removal in institutional properties, such as schools, through an interagency agreement with the California Conservation Corps.

The $6 million toilet rebate program, also funded by Proposition 1, will help Californians replace approximately 60,000 inefficient toilets by offering a $100 customer rebate, per household, to replace them with high-efficiency toilets. Approximately $6 million is being used to fund the direct installation of high-efficiency toilets in disadvantaged communities through an interagency agreement with the Department of Community Services and Development.

## Agricultural Water Management Plans

The CWC requires all water suppliers to increase water use efficiency. Agricultural water suppliers are responsible for preparing, implementing, and updating AWMPs, measuring the volume of water delivered to customers, adopting a pricing structure, and implementing efficient water management practices. Agricultural water suppliers that fail to meet the specified water management planning requirements are not eligible for water grants or loans awarded or administered by the State.

The Agricultural Water Management Planning Act (CWC Section 10800, et seq.) requires an agricultural water supplier to prepare and adopt an AWMP on or before December 31, 2012, and to update its AWMP on December 31, 2015, and every 5 years thereafter. Updated AWMPs have to be submitted to DWR within 30 days of adoption.

"Agricultural water supplier" is defined as a publicly or privately owned water supplier that provides water to 10,000 or more irrigated acres, excluding acreage that receives recycled water. An agricultural water supplier is a supplier of or contractor for water that distributes or sells water for resale. Every water supplier that becomes an agricultural water supplier after December 31, 2012, and provides water to 25,000 or more irrigated acres, excluding recycled water, is responsible for preparing and adopting an AWMP within one year of becoming an agricultural water supplier. Agricultural water suppliers that provide water to less than 25,000 irrigated acres, excluding recycled water, are not required to adopt and implement AWMPs unless sufficient funding has specifically been provided for that purpose.

Agricultural water management and water use efficiency received major attention in the *California Water Action Plan Update 2013* as well as the Governor's EO B-29-15. Under the Emergency Services Act, and in response to the declared Drought Emergency, the Governor issued EO B-29-15, which required all midsized agricultural water suppliers to develop AWMPs. Under EO B-29-15, these agricultural water suppliers must develop AWMPs and shall include a detailed drought management plan and quantification of water supplies and demands for 2013, 2014, and 2015, to the extent data is available. These AWMPs must be submitted to DWR by July 1, 2016.

In 2015, DWR conducted workshops, targeted phone conferences, and Agricultural Stakeholder Committee public meetings as part of updating the AWMP guidebook and developing guidance related to the new agricultural water management requirements in EO B-29-15.

After updating and releasing *A Guidebook to Assist Agricultural Water Suppliers to Prepare a 2015 Agricultural Water Management Plan*, DWR conducted workshops statewide to provide technical assistance and help agricultural water suppliers effectively use the provided guidebook while preparing and implementing their AWMPs. DWR also employed a new web-based tool to make it easier for suppliers to submit AWMP data and tables in a format that will allow DWR to better track and analyze information. DWR continued to provide technical assistance and answer inquiries on the development and implementation of AWMPs.

DWR received AWMPs from 64 agricultural water suppliers for the 2012 submittal cycle. Those plans represent approximately 3.6 million acres, or roughly 44 percent, of the 8.13 million acres of irrigated lands estimated in the *California Water Plan Update 2013*. Some of the 2012 AWMPs were submitted as late as the summer of 2015 because the suppliers needed more time to develop and adopt their first AWMPs. Out of 54 agricultural water suppliers identified as having more than 25,000 acres of irrigated land that were required to submit plans, 44 agricultural water suppliers submitted plans, representing 81 percent compliance.

DWR expects to start receiving the 2015 AWMPs from the agricultural water suppliers after January 2016.

## Urban Water Management Plans

In accordance with the Urban Water Management Planning Act (CWC Section 10610 et seq.), California urban water suppliers are required to adopt and submit urban water management plans to DWR every 5 years on or before December 31 in years ending in five and zero.

CWC Section 10617 defines "urban water supplier" as a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. Assembly Bill 2067 (Chapter 463, Statutes of 2014) amended CWC Sections 10608.42, 10621, 10631, and 10632 to require each urban water supplier to submit its 2015 plan to DWR by July 1, 2016. In addition, the bill extended the date by which DWR is required to review the plans and report to the Legislature to July 1, 2017. Senate Bill 1036 (Chapter 285, Statues of 2014) and Senate Bill 1420 (Chapter 490, Statutes of 2014) amended CWC Sections 10631 and 10644 regarding voluntary reporting of energy intensity, electronic submittal, standardized forms, water loss, and estimating future water savings.

In 2015, DWR continued to review urban water management plans submitted for the 2010 cycle, and 242 reviews were finalized.

DWR also collected the information reported in urban water management plans into a database and provided reports on urban water use data to the Governor, legislators, the media, and interested members of the public. These reports were posted online.

### *20 Percent Urban Water Use Reduction by 2020*

The CWC directs DWR to be the lead agency in implementing a number of separate actions that would guide the State to a targeted reduction of 20 percent of urban water use by 2020. To implement these actions through a public process, DWR convened and continues to work with an Urban Stakeholder Committee to provide guidance and input.

Many of these actions required the development of methodologies, for use by urban water agencies, to calculate agency-level targets and progress toward meeting their water use reduction targets by 2020.

DWR is required to report to the Legislature by the end of 2016 and make recommendations on needed changes if the State is not on track to meet per capita targets. Data analysis is ongoing in preparation for this report.

## Integrated Regional Water Management Grant Program

The Integrated Regional Water Management (IRWM) Grant Program program provides funding for planning, disadvantaged community involvement, implementation, and companion grant programs that support sustainable groundwater planning and

water-energy programs and projects. The program is funded in part by Proposition 84.

### *Proposition 84*

In 2015, draft recommendations were made for the final round of Proposition 84 implementation grants. IRWM will award $231.6 million to 27 grant recipients for projects totaling more than $1 billion in improvements to water supply reliability projects.

## Agricultural Drainage Program

The Agricultural Drainage Program's mission is to seek in-valley solutions to surface and subsurface agricultural drainage water problems, particularly in the San Joaquin Valley, and to improve water quality in the San Joaquin River.

This program consists of several activities, including drainage monitoring and evaluation, drainage treatment, integrated on-farm drainage management, drainage reduction and reuse, environmental services, and the San Joaquin River Water Quality Improvement Program.

In 2015 the following activities were conducted:

- monitoring shallow groundwater levels and flows and collecting water quality data for drainage water from west side San Joaquin Valley tile drain sumps;
- measuring groundwater levels quarterly for approximately 200 wells in Kern County;
- preparing shallow groundwater and irrigation methods maps of drainage-impaired areas using drainage monitoring data in conjunction with land use and irrigation methods data;
- providing assistance for collecting groundwater, soil, and operational data for the integrated on-farm drainage management project at Red Rock Ranch in western Fresno County;
- collecting flow, electrical conductivity, and temperature data from several satellite-linked and web-accessible stations on the mainstem of the San Joaquin River for the Real-time Water Quality Monitoring Program;
- producing weekly forecasts of salinity and flow conditions on the San Joaquin River near Vernalis and other upstream stations using the San Joaquin River Input-Output Day model, and publishing them on DWR's website;
- testing the Watershed Analysis Risk Management Framework model (developed by the University of California, Merced, and the Bureau of Reclamation) and working with the Bureau of Reclamation to refine it for use to replace the current San Joaquin River Input-Output Day model;
- collaborating with the Central Valley Regional Water Quality Control Board and State Water Resources Control Board's initiative, the Central Valley Salinity Alternatives for Long-term Sustainability, by providing data, attending committee meetings, and reviewing program documents; and
- maintaining a DWR website that includes information on drainage programs and activities, salinity and shallow groundwater maps, grants, and links related to other agricultural drainage programs.

## San Joaquin River Water Quality Grant Program

The program provides funding to support projects that will result in direct, measurable water quality improvements to the San Joaquin River by reducing or eliminating discharges of subsurface agricultural drainage, a significant water quality concern for the San Joaquin River. The guidelines and PSP for the program were

released in November 2015. The amount of funding available was $36.6 million from Proposition 84. The due date for applications is March 4, 2016.

## Water Conservation Bond Laws

To help local agencies obtain financing for their water management programs, California voters have approved a number of bond laws authorizing DWR to provide grants and low-interest loans to fund project feasibility studies or construction activities. Recent bond laws are summarized below, with focus on funds administered by DWR.

- The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84; Public Resources Code Sections 75001–75130) authorized $1 billion to continue the IRWM Grant Program. Under this program, grants and construction loans are available with repayment periods of up to 20 years at reduced interest rates for most programs.
- The Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1; CWC Sections 79700–79798) authorized the appropriation of $510 million in IRWM funding for implementation and planning efforts. Funds for water use efficiency and desalination projects are also authorized.

Please see previous bulletins for historical authorizations.



# Chapter 6
# Legislation and Litigation

*Canada Geese at Lake Oroville.*

## Significant Events in 2015

Legislation related to drought response and planning; water management and infrastructure projects; urban water management plans; groundwater management; atmospheric rivers; and water supply, reliability, and flood control passed in 2015.

*Information for this chapter was provided by the Legislative Affairs Office and the Office of the Chief Counsel.*

The Department of Water Resources (DWR) monitors State and federal legislation that affects management of the State Water Project (SWP). Legislative bill tracking involves reviewing legislation at its introduction, evaluating amendments in State Assembly and Senate committee hearings, and monitoring its enactment into law. The DWR Assistant Director for Legislation monitors proposed legislation. The Office of the Chief Counsel tracks State and federal litigation that impacts management of the SWP. The DWR Chief Counsel also manages legal cases that involve SWP operations.

# Legislation

## State Legislation

### *AB 91 (Committee on Budget; Chapter 1, Budget Act of 2014)*

Assembly Bill (AB) 91, an amendment to the Budget Act of 2014, expedited General Fund, Proposition 1E bond fund, and Greenhouse Gas Reduction Fund monies for activities related to drought response and planning, as well as other water management and infrastructure projects.

### *AB 92 (Committee on Budget; Chapter 2, Budget Act of 2014)—Water: Drought*

This bill made changes to various provisions of law to address immediate actions associated with the State's drought conditions. Specifically, it granted new authorities to the State Water Resources Control Board (SWRCB), expedited drought response through exemption of certain actions from the California Environmental Quality Act (CEQA), and authorized funding for the removal of a salinity barrier installed in the Sacramento-San Joaquin Delta.

### *AB 149 (Chavez; Chapter 49, Statutes of 2015)—Urban water management plans*

AB 149 extends the date for urban water suppliers to submit their 2020 Urban Water Management Plans by 6 months, which allows DWR extra time to submit its consolidated report to the Legislature. This bill also allows for the most current census population data to be used in planning efforts.

### *AB 617 (Perea; Chapter 666, Statutes of 2015)—Groundwater*

This bill made various changes to the Sustainable Groundwater Management Act of 2014. Specifically, it created a pathway for compelling State agencies to comply with a groundwater plan, and it allowed for an extension to implement a groundwater sustainability plan if litigation had prevented implementation.

### *AB 1390 (Alejo; Chapter 672, Statutes of 2015)—Groundwater: comprehensive adjudication*

This bill establishes a special procedure for a comprehensive adjudication, defined as an action filed in superior court to determine the rights to extract groundwater in a basin. It authorizes the court to determine all rights to groundwater in a basin whether based on appropriation, overlying right, or other rights.

### *SB 13 (Pavley; Chapter 255, Statutes of 2015)—Groundwater*

Senate Bill (SB) 13 made technical changes to the Sustainable Groundwater Management Act of 2014 to improve groundwater management in California.

### *SB 208 (Lara; Chapter 675, Statutes of 2015)—Integrated regional water management plans: grants: advanced payment*

This bill established a requirement for DWR, within 60 days of receiving project information for projects that satisfy specified criteria, to provide advanced payment of 50 percent of the grant awards. It also requires that the advanced funds be handled as prescribed in the bill.

### *SB 226 (Pavley; Chapter 676, Statutes of 2015)—Sustainable Groundwater Management Act: adjudication*

SB 226 provides for expedited groundwater basin adjudication with the intent of encouraging early settlement and avoiding lengthy adjudication processes. The bill makes provisions to integrate and streamline the adjudication process for groundwater basins subject to the Sustainable Groundwater Management Act so that future adjudication furthers the objectives of the act.

### *SB 664 (Hertzberg; Chapter 681, Statutes of 2015)—Water: urban water management planning*

This bill establishes a requirement that an urban water supplier include within its plan, beginning January 1, 2020, a seismic risk assessment and mitigation plan to assess the vulnerability of each of the various facilities of a water system and mitigate those vulnerabilities. The bill authorizes an urban water supplier to comply with this requirement by submitting a copy of the most recently adopted local hazard mitigation plan or multihazard mitigation plan under specified federal law that addresses seismic risk.

### *SB 758 (Block; Chapter 682, Statutes of 2015)—Atmospheric Rivers: Research, Mitigation, and Climate Forecasting Program*

SB 758 established the Atmospheric Rivers: Research, Mitigation, and Climate Forecasting Program in DWR to, upon appropriation of special fund monies, research the causes and effects of atmospheric rivers; take actions to capture water generated by atmospheric rivers to increase the water supply and reliability of water resources in the State; and operate reservoirs in a manner that improves flood protection in the State.

## Federal Legislation

There was no significant federal legislation in 2015 affecting management of the SWP.

# Litigation

As of December 31, 2015, DWR was involved in, or closely monitored, a number of court cases and other actions related to the management of the SWP.

## Sacramento-San Joaquin Delta

### *Delta Smelt*

***Delta Smelt Consolidated Cases. San Luis & Delta-Mendota Water Authority v. Jewell* (9th Cir. 2014 747 F.3d 581).** Litigation stemming from a coalition of environmental groups' challenge to the 2005 biological opinion (BiOp) on Delta Smelt issued by the U.S. Fish and Wildlife Service (USFWS) continued. After judicial review, the 2005 BiOp was found to be unlawful, and USFWS was ordered to prepare a new one. On December 15, 2008, USFWS issued a new BiOp, which required sufficient quantities of fresh water be allowed to flow through the Delta to promote the survival and recovery of Delta Smelt. State and federal water contractors, along with DWR, challenged the BiOp in court alleging that the BiOp violated the National Environmental Policy Act (NEPA), the federal Endangered Species

Act (ESA), and the Administrative Procedure Act (APA.) (For details about this litigation prior to 2015, see Bulletin 132-15 and earlier bulletins.)

On May 12, 2014, DWR, along with State and federal water contractors, filed a petition for rehearing, arguing that the Ninth Circuit Court of Appeals decision did not apply the standard of review that has been established by the U.S. Supreme Court and Ninth Circuit precedent. DWR's petition for rehearing was denied on July 23, 2014. In September and October, State and federal water contractors filed petitions for writ of certiorari seeking review of the Ninth Circuit's decision by the U.S. Supreme Court. The Supreme Court did not rule on the petitions in 2014.

On January 12, 2015, without hearing oral arguments and without ruling on the merits of the case, the Supreme Court denied the petitions of the farmers and water districts seeking review of the March 2014 decision by the Ninth Circuit, thus upholding the 2008 BiOp.

## Salmon

***The Consolidated Salmon Cases* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1053).** *San Luis & Delta-Mendota Water Authority, et al. v. Gary F. Lock, as Secretary of the United States Department of Commerce, et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1053); *Stockton East Water District, et al. v. National Oceanic and Atmospheric Administration, et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1090); *State Water Contractors v. Gary F. Locke, Secretary, etc., et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1053); *Kern County Water Agency, et al. v. United States Department of Commerce, et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1520); *Oakdale Irrigation District, et al. v. United States Department of Commerce, et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1580); *The Metropolitan Water District of Southern California v. National Marine Fisheries Service, et al.* (U.S. Dist. Ct., Eastern Dist. Cal., No. 1:09-cv-1625).

Litigation stemming from a challenge to the 2004 BiOp issued by the National Marine Fisheries Service (NOAA Fisheries) continued. In August 2005, a coalition of environmental groups challenged the 2004 BiOp in federal district court. On April 16, 2008, the court held that the 2004 BiOp violated the ESA and APA and ordered NOAA Fisheries to prepare a new BiOp. NOAA Fisheries issued a new BiOp in June 2009. In September 2009, federal and State water contractors challenged the issuance and adoption of the BiOp on the grounds that the federal defendants failed to comply with NEPA, the ESA, and the APA. DWR joined the litigation in January 2010. (For earlier information about this litigation, see Bulletin 132-15 and prior bulletins.)

On December 22, 2014, a panel for the Ninth Circuit Court of Appeals issued its opinion, overturning in part and upholding in part the district court's ruling.

The panel held that the district court did not give NOAA Fisheries the substantial deference it was due under the APA. The panel found that the components of the BiOp invalidated by the district court were reasonable and supported by the record and therefore the panel upheld the BiOp in its entirety. Given that the U.S. Supreme Court denied review of the Delta Smelt case, parties did not file for Supreme Court review of the consolidated salmon cases.

## State Water Resources Control Board

***California Sportfishing Protection Alliance, et al. v. California State Water Resources Control Board, et al., California Department of Water Resources and United States Bureau of Reclamation, Real Parties in Interest* (Case No. RG15-780498).** The California Sportfishing Protection Alliance filed a petition for writ of mandate challenging the SWRCB's orders granting Temporary Urgency Change Petitions to DWR and the Bureau of Reclamation (Reclamation) in 2014 and 2015. DWR and Reclamation are named as

real parties in interest. On September 16, 2015, the California Sportfishing Protection Alliance filed a first amended complaint claiming that the SWRCB's orders violate the federal Clean Water Act, the Central Valley Basin Plan, and the Public Trust Doctrine. On October 21, the SWRCB filed a demurrer to dismiss the action. A hearing on the matter was set for December 14, 2015.

***California Water Impact Network, California Sportfishing Protection Alliance, and AquAlliance v. California State Water Resources Control Board and California Department of Water Resources* (Super. Ct. Sacramento County, No. 34-2010-80000653).** These conservation groups allege that permit approvals and enforcement failure by the SWRCB has allowed DWR to cause extensive damage to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary and the fish and wildlife that live there. The administrative record was prepared.

There was no new activity in this case in 2015.

## Bay Delta Conservation Plan

***Property Reserve, Inc. v. The Superior Court of San Joaquin County;* Department of Water Resources, real party in interest: *The Carolyn Nichols Revocable Living Trust v. The Superior Court of San Joaquin County;* Department of Water Resources, real party in interest (C067765) Coordinated Proceedings Special Title (Rule 3.550) (C067758, writ denied).** Twenty-four Delta property owners declined DWR's request to gain temporary entry onto their properties to perform environmental and geological surveys. DWR sought orders for temporary entry onto the respondents' properties under Code of Civil Procedure Section 1245.010 et seq. (More information about this litigation is available in Bulletin 132-14 and earlier bulletins.)

On March 13, 2014, the Third District Court of Appeal determined that the precondemnation entry order process was not sufficient to give DWR access to private properties to conduct the surveys. The court ruled that both the geotechnical studies and less disruptive environmental surveys would constitute takings, and therefore, DWR would need to bring condemnation actions to get the access it sought. By the end of 2014, an appeal had been filed with the Supreme Court of California, where briefing was completed in early 2015.

## Jones Tract

***Armando P. Vanni, et al. v. Rindge Land Reclamation District #2039* (Super. Ct. San Joaquin County, No. C072383, app. pending).** Three consolidated lawsuits alleging damages arising out of the levee breach on Upper Jones Tract in 2004 went to trial from August 22 to December 29, 2011.

In April 2012, the court entered judgment in favor of DWR. The court found that the plaintiffs failed to show a causal connection between the levee failure and SWP operations. The plaintiffs appealed.

On December 30, 2014, the Third District Court of Appeal rejected the plaintiffs' contention that the judgment was based on a factual premise not supported by evidence and affirmed the judgment. On January 21, 2015, the Supreme Court of California denied the Petition for Review.

## State Water Resources Control Board Hearing

SWRCB Water Right Decision 1641 contains a water quality objective requiring DWR to annually maintain 0.7 millimhos per centimeter electrical conductivity at three compliance points within the South Delta, from April 1 through August 31, beginning in 2005. In response to allegations that the water quality objective was not being met and would not be met, the SWRCB issued a cease and desist order, which was final on May 16, 2006, requiring DWR and Reclamation to take corrective actions to eliminate the threat of noncompliance.

After a period of negotiations, the SWRCB issued a final order in 2010, modifying its 2006 order, which extended the schedule to implement measures to meet the water quality objectives pending completion of the SWRCB's review and potential modification of the salinity objectives. The order also required DWR, along with Reclamation, to undertake studies to assess the feasibility of implementing various measures to meet the salinity objectives.

Through continued coordination with the Delta Watermaster, additional studies began in 2012 to determine the sources of this local salinity and to explore options for reducing those sources. Preliminary results of these studies indicated significant local sources of salinity. Coordination with the Delta Watermaster continued in 2015.

## Hydropower

### *Oroville Relicensing—Federal Energy Regulatory Commission Project No. 2100*

***Butte County et al. v. Department of Water Resources* (C071785, app. pending).** DWR is seeking renewal of the Federal Energy Regulatory Commission (FERC) license for its hydroelectric generation facilities at Oroville (Project No. 2100). DWR filed its relicensing application in 2005. The original 50-year FERC license expired on January 31, 2007. In February 2008, FERC authorized continued operation by issuing an annual license—under the same terms and conditions—that renews each year until FERC issues a new license. (Details of the license renewal negotiations and earlier litigation are described in previous bulletins.)

In January 2012, the court denied the petitioner's requests to set aside the EIR prepared by DWR and upheld the award to DWR of $675,087 in charges for the administrative record required to proceed with the suit. The court found that the EIR was legally adequate and noted that the record preparation complied with the California Environmental Quality Act (CEQA) and was reasonable and necessary. The petitioners, Butte and Plumas counties, appealed the judgment, and the appellate briefs were filed in 2013.

Oral argument on the appeal was pending through 2015.

## Other Cases

### *The Monterey Amendment*

***Central Delta Water Agency et al. v. California Department of Water Resources* (Super. Ct. Sacramento County, No. 34-2010-80000561) (Central Delta I); *Central Delta Water Agency et al. v. Kern County Water Agency et al., DWR et al., real parties in interest* (Super. Ct. Kern County, No. S-1500-CV-270965) (Central Delta II); *Rosedale-Rio Bravo Water Storage District and Buena Vista Water Storage District v. DWR* (Super. Ct. Kern County, No. S-1500-CV-270635-KCT) (Rosedale-Rio Bravo) (C098249, app. pending).** Legal challenges were brought against the 1995 Monterey Amendment and the EIR adopted by DWR in 2010. (The Monterey Amendment, litigation challenging the amendment and the first EIR, the settlement of that litigation, development of the second EIR (Monterey Plus EIR), and litigation prior to consolidation of the cases in Sacramento County Superior Court are described in earlier bulletins.)

After holding a hearing on the CEQA challenges in the remaining two cases, the trial court ruled that most of the EIR was adequate under CEQA, but that the EIR's discussion of the impacts on continued use and operation of the Kern Water Bank was insufficient. The court issued a decision in favor of the plaintiffs in the two cases finding that the EIR failed to analyze impacts associated with the use and operation of the Kern Water Bank, particularly as to potential groundwater and water quality impacts. On October 2, 2014, the court ordered DWR, as the remedy for the deficiency, to provide additional environmental analysis on the

future impacts of the continued use and operation of the Kern Water Bank and, upon completion of the EIR process, to determine whether to continue use and operation of the Kern Water Bank. On November 24, 2014, the court ordered DWR to set aside the certification of the Monterey Plus EIR and set a deadline of December 31, 2015, for DWR to correct deficiencies in and recertify the Monterey Plus EIR. In December 2014, one set of plaintiffs filed a notice of appeal with the court of appeal. The plaintiffs are appealing the lower court's final CEQA and validation decisions.

On August 10, 2015, the court granted DWR's request for an extension and set a new deadline of June 30, 2016, for completion of a revised Monterey Plus EIR.

## Construction Arbitration

***D.A. McCosker Construction Co., dba Independent Construction Company v. Department of Water Resources* (OAH/PWCA No. A-0021-2013).** This dispute arose out of the construction of Dyer Reservoir under a contract for $11 million. The work concluded in 2012, nearly 2 years behind schedule. In September 2013, the contractor brought a binding arbitration action seeking additional compensation in the amount of $12 million due to alleged defective specifications, differing site conditions, and owner-caused delay. DWR withheld over $1 million in liquidated damages for late completion. Limited discovery was conducted in 2014, and a mediation that took place in December 2014 was unsuccessful. The arbitration hearing is scheduled to commence in January 2016.

## Colorado River

***Quantification Settlement Agreement Cases* ((2015) 237 Cal.App.4th 72; (2014) 767 F.3d 781).** These nine claims (which have been coordinated into a single proceeding before the Sacramento County Superior Court) and federal litigation challenge the Quantification Settlement Agreement (QSA) and associated actions taken to implement the QSA—a collection of 38 agreements that resolve disputes among water users in Southern California regarding their rights to California's shrinking share of Colorado River water. (The QSA and earlier litigation activities are described in Bulletins 132-04 and 132-06 through 132-13.)

In State litigation, after the Sacramento County Superior Court issued a final judgment in July 2013 upholding the QSA's validity, another appeal was filed. In April 2015, the parties agreed to a settlement, and on May 26, 2015, the 3rd District Court of Appeal dismissed all remaining appeals.

On May 19, 2014, the Ninth Circuit Court of Appeals affirmed the judgment of the district court ruling that the Secretary of the Interior did not violate the NEPA or the Clean Air Act in approving the Colorado River Water Delivery Agreement. All remaining appeals were dismissed.

## Clean Water Act

***Catskill Mountains Chapter of Trout Unlimited, Inc., et al. v. United States Environmental Protection Agency, et al.* (N.Y.Dist.Ct., No. 7:08-CV-05606-KMK, app. pending).** A number of environmental groups, private entities, and governmental agencies controlling or utilizing water filed an action challenging the application of the Environmental Protection Agency's (EPA) Water Transfer Rule under the Clean Water Act (CWA). The CWA provides that the discharge of any pollutant by any person without a National Pollution Discharge Elimination System Permit is unlawful. (33 U.S.C. Section 1311(a)). The federal statute defines a discharge of a pollutant to mean any addition of any pollutant to navigable water from any point source. The EPA has applied the CWA provisions to transfers of water between navigable bodies of water and not to "water transfers."

According to the CWA, "water transfers" are "an activity that conveys or connects waters of the United States without subjecting the transferred water to intervening industrial, municipal, or commercial use."

On March 28, 2014, the court found the EPA Water Transfer Rule to be inconsistent with the CWA. The case has been appealed. As the outcome of the case will have a direct and material effect on the operations of the SWP, in June 2014, DWR filed a friend of the court brief (an amicus curiae brief) to advise the court of relevant information and arguments the court might wish to consider. Oral argument was scheduled for December 1, 2015.

***Oregon Natural Resources Council, Inc., et al. v. Bureau of Reclamation, et al.* (798 F.3d 933 (2015)).** The CWA prohibits discharge of any pollutant into navigable waters from any source. However, the CWA allows for the EPA to issue a permit authorizing the discharge of a pollutant in certain instances. If an activity conveys or connects waters of the United States without subjecting the transferred water to intervening industrial, municipal, or commercial use it is excluded from the permit requirement.

Oregon Natural Resources Council, Inc. filed suit against Reclamation alleging that Reclamation violated the CWA by discharging pollutants into the Klamath River from the Klamath Straights Drain without the necessary permit. After initiation of the suit, the EPA adopted a rule that provides an additional exemption from permitting under the CWA for an activity that moves water between two navigable waters without an intervening use. The court held that the rule was a valid regulation because it was a reasonable interpretation of the CWA. This ruling means that the water transfer activities by DWR in California (e.g., routing water through tunnels, channels, or natural streams and directing it to use for irrigation, municipal, or power purposes) are not subject to the permitting process under the national pollutant discharge elimination system program.

In June 2014, DWR filed a friend of the court brief (an amicus curiae brief) to advise the court of relevant information and arguments the court might wish to consider. Oral arguments for the appeal were heard on November 21, 2014.

On August 21, 2015, the Ninth Circuit Court of Appeals issued its determination that a permit is not required under the CWA for waters flowing from the Klamath Straits Drain into the Klamath River.

## Environmental Review Acts

The National Environmental Policy Act (NEPA) (Title 42 United States Code Sections 4321 et seq.) and the California Environmental Quality Act (CEQA) (California Public Resources Code Sections 21000 et seq.) require government agencies to document and consider environmental consequences of their actions in their decision-making processes. NEPA states that it is the goal of the federal government to use all practicable means consistent with other considerations of national policy to protect and enhance the quality of the environment. All federal agencies must prepare an environmental impact statement (EIS), including a discussion of mitigation measures and alternatives, for federal actions that could significantly affect environmental quality.

CEQA is patterned after NEPA. Under CEQA, State and local agencies are required to (1) disclose, through an environmental impact report (EIR), the significant impacts a proposed project would have on the environment, and (2) identify ways to reduce or avoid environmental damage.

CEQA applies to projects directly undertaken, funded, or approved by State or local agencies. NEPA applies to projects directly undertaken, funded, or approved by federal agencies. The Department of Water Resources (DWR) conducts many projects in cooperation with federal agencies. In these cases, both CEQA and NEPA must be followed.

NEPA requires that mitigation measures and alternatives be disclosed to the public in the EIS, but it does not generally require federal agencies to adopt such mitigation measures or alternatives. CEQA does impose substantive duties on all California government agencies approving projects with significant environmental impacts to adopt alternatives or mitigation measures that they find to be feasible to substantially lessen these impacts, unless there are overriding reasons they cannot. When a project is subject to both CEQA and NEPA, both laws encourage agencies to cooperate in planning the project and preparing joint environmental documents.

The environmental review process allows citizens to learn about a proposed project and its potential significant effects and to participate in the decision-making process by providing feedback on agency information. The review process requires agencies to:

- describe the proposed project and the purpose or need for it;
- identify the lead and cooperating agencies involved in the project;
- invite interested parties to participate in the process;
- determine the scope of study with input from responsible agencies and the public;
- prepare and distribute a draft EIS or EIR;
- respond to comments received on the draft;
- prepare the final EIS or EIR;
- make findings and adopt feasible alternatives or mitigation measures to avoid significant effects, if applicable;

## Environmental Review Acts

- adopt a monitoring plan to ensure compliance with mitigation measures; and
- prepare a list of permits required to implement the project if it is approved.

The scoping phase, which occurs early in the review process, is particularly important because it enables government agencies to identify issues and topics to be considered or addressed in the EIS or EIR.

Information gathered in the scoping phase helps agencies identify and evaluate reasonable alternatives, identify potential environmental impacts of the project, determine data and information needed, develop a work schedule, and allocate resources for preparing and distributing the draft environmental document for public review and comment.

NEPA requires a lead agency to involve the public during scoping, while CEQA does not. CEQA, however, does encourage public involvement, and agencies often opt to conduct activities that provide for wide public involvement. Members of the public may raise issues and identify additional alternatives, environmental effects, methods of assessment, and mitigation measures during the scoping phase and continue to participate in the review process for the draft environmental document. Thus, the CEQA process may lead to changes in a project through the development, consideration, and adoption of alternatives or enforceable mitigation measures to avoid or reduce any potential significant adverse effects on the environment.

If the project is approved, the lead agency publishes a document discussing all the factors considered in reaching its decision to proceed with the proposed action. It also discusses whether all practical means to avoid or minimize environmental harm have been adopted, and if not, the reasons they were not.



# Chapter 7
# Water Supply Development and Reliability

*Emergency drought barrier construction nears completion on the West False River in the Sacramento-San Joaquin Delta.*

## Significant Events in 2015

As the State continued to experience one of the driest periods on record, the State Water Resources Control Board (SWRCB) convened several workshops and approved a number of temporary urgency change petitions (TUCPs) from the Department of Water Resources (DWR) and the Bureau of Reclamation (Reclamation) to modify their water right permits for the State Water Project (SWP) and Central Valley Project (CVP).

In May, due to severe drought conditions, a temporary emergency drought barrier was installed on West False River between Jersey and Bradford islands to deter saltwater intrusion from the San Francisco Bay and to conserve water in upstream reservoirs needed to protect Delta water quality. The barrier was removed in November.

In July, *The State Water Project Final Delivery Reliability Report 2015* was released.

*Information in this chapter was contributed by the State Water Project Analysis Office, the Division of Integrated Regional Water Management, the Division of Statewide Integrated Water Management, and the Bay-Delta Office.*

The Department of Water Resources (DWR) works to improve the reliability of State Water Project (SWP) water supplies and the long-term water contract annual Table A water allocations delivered to SWP water contractors. DWR is engaged in planning activities to develop additional water supplies and storage capacity.

Developing new water supplies and storage projects that are economically, environmentally, and technically sound, while satisfying institutional requirements and political concerns, presents significant challenges. Many concerns center on possible adverse effects that additional storage and delivery facilities may have locally and on the Sacramento-San Joaquin Delta (Delta). In the SWP conveyance system, the Delta is the critical link between water supplies in the Sacramento Valley and deliveries to the rest of the Central Valley and Southern California.

DWR works with the State and federal governments, local agencies, and public interest stakeholder groups to ensure water supply reliability now and in the future. To meet SWP water contractors' needs for sufficient water supplies, DWR is engaged in planning, developing, and providing local assistance with the objective of augmenting future SWP water supplies.

## Supply Development and Reliability

Activities DWR is engaged in to augment future SWP supplies include:

- facilitating transfers between SWP long-term water contractors and other agencies, including Central Valley Project (CVP) contractors;
- funding studies on the Giant Garter Snake, a protected species known to inhabit rice growing regions of the Sacramento Valley, and on rice evapotranspiration, to better understand issues related to the transfer of water made available by crop idling;
- supporting the planning and implementation of local and regional conjunctive-use projects in the Sacramento Valley;
- constructing, operating, and maintaining groundwater and land subsidence monitoring networks to detect potential impacts caused by groundwater substitution transfers and other groundwater management activities in the Sacramento Valley;
- assisting with the development and implementation of restoration projects in the Feather River watershed to reduce sedimentation in Lake Oroville and preserve watershed storage capacity; and
- investigating and evaluating storage projects.

### Water Conveyance Through the SWP

DWR encourages and facilitates temporary transfers of water using SWP conveyance facilities for SWP water contractors and other agencies to help meet local, State, and environmental water supply needs. As a practical matter, SWP facilities are often needed to convey transfer water from the existing place of use to the place of use of the transferee. State law requires DWR to make unused SWP capacity available for transfers upon payment of fair compensation, provided that (1) no legal user of water will be injured; (2) there will be no unreasonable effect on fish, wildlife, or

other instream beneficial uses; and (3) there will be no unreasonable effect on the overall economy or the environment of the county from which the water is being transferred (California Water Code [CWC] Section 1810). Water transfers can involve transfers and exchanges among SWP water contractors, between SWP water contractors and non-SWP entities, or between two or more non-SWP entities.

### *Transfer and Exchange Evaluations*

An important element of any water transfer is to determine what quantity of water, if any, is transferable.

The transferability of water depends on many factors including the source of the water being transferred, what is being done to make water available, when the water can be made available, and the type of water right the existing user holds. Several CWC provisions authorize temporary transfers of water rights issued by the State Water Resources Control Board (SWRCB) (appropriative water rights issued after 1914) and placed conditions on the transfers to protect those not involved in them.

Short-term transfers, of less than one year, are authorized under CWC Sections 1725–1732. Long-term transfers, for periods greater than one year, are authorized by CWC Sections 1735–1737. Other CWC sections specify conditions under which water can be transferred and legal protections for those transferring water.

Transfers based on water rights obtained before 1914 are not under SWRCB jurisdiction but must comply with the requirements of the California Environmental Quality Act (CEQA) and possibly the National Environmental Policy Act (NEPA).

The CWC sections noted above contain provisions intended to protect other legal users of water and fish and wildlife from the possible adverse effects of a water transfer. These provisions reflect the concept that changes can be made to the authorized place and purpose of use or point of diversion of a water supply as long as there is no injury to others as a result of the change (the "no injury rule"). The no injury rule in State water law is intended to protect other legal users from the potential expansion of water use beyond what would have been consumed by the original users in the absence of the transfer. Hence, under the no injury rule, only "new water" is transferable (i.e., water added to the downstream water supply only as a result of the transfer). To protect other users, a transfer would not be authorized to the extent that it would reduce the amount or timing of water that would otherwise be available to downstream users, regardless of the water right priority of those users.

CWC Section 1810(d) requires DWR to consider potential impacts of a transfer on legal users, instream uses, and the economy of the area from which the water would be transferred. DWR must determine whether to allow the use of any unused available water conveyance capacity for a transfer under this section. DWR reviews each request to transfer water through SWP facilities to assure that only new water will be transferred. This requirement applies to transfers based on both pre-1914 and post-1914 water rights.

Transfer water is most commonly developed through one of four methods: surplus water release from storage facilities, substituting groundwater for transferred surface water, idling agricultural land, and undertaking conservation activities that develop new water. Because transfers may result in direct impacts and third-party impacts (impacts to parties not involved in the transfer), certain CWC provisions were enacted to limit potential impacts. For example, since additional groundwater pumping from a groundwater substitution project may

potentially affect other groundwater users in the area, CWC Section 1745.10 requires that the groundwater substitution project: (1) be consistent with a groundwater management plan adopted pursuant to State law for the affected area or (2) if a management plan has not been adopted, the transfer project proponent determines the transfer would not create or contribute to conditions of long-term overdraft in the affected groundwater basin.

Injury can also occur due to streamflow depletion induced by increased pumping from wells for groundwater substitution transfers. Consequently, to mitigate possible impacts from groundwater substitution transfers, DWR assesses a streamflow depletion factor, which represents an estimate of the potential effects of the additional groundwater pumping on the surface water system. Each type of transfer has its own set of potential impacts that must be evaluated to protect parties not involved in the transfer.

With the exception of short-term transfers under CWC Section 1725 et seq. (which provides for an expedited process for water rights issued by the SWRCB), water transfers are subject to compliance with CEQA and, possibly, NEPA. The CEQA/NEPA and SWRCB processes provide opportunities for public review and comment on water transfer proposals. The Governor's January 17, 2014, Drought Emergency Proclamation directed DWR and the SWRCB to expedite the review and approval of water transfer proposals and suspended the provisions of CEQA for actions taken by DWR related to transfers. The proclamation did not suspend CEQA for local agencies.

Staff in DWR's State Water Project Analysis Office, Division of Operations and Maintenance, Division of Integrated Regional Water Management, and the Office of the Chief Counsel evaluate proposed water transfers to determine whether the transfers will impact the SWP, other water users, the environment, or the area from which the water will be transferred.

## SWP Delivery Capability Report

*The State Water Project Final Delivery Capability Report 2015* was released in July 2015. The next update of this report is expected in March 2017.

Delivery capability depends on three factors:

(1) the availability of water at the source;
(2) the ability to convey water from the source to the desired point of delivery; and
(3) the level of demand.

To assist local agencies with assessing their overall water supply needs, and the amount of deliveries that they can expect from the SWP, the 2015 report and its appendices provide information on the annual SWP deliveries in the 10-year historical sequence preceding the publication date (2005–2014); the status of DWR activities in the Office of Water Use Efficiency; the results of a simulation model on the current (2015) level of development; and a range of future conditions (2035 level of development and climate change with varying regulations and facilities).

In order to provide a conservative estimate of water delivery capability for current conditions, no planned facility improvements to the SWP infrastructure were assumed, and the analysis of the ability to convey water from the source to the points of delivery assumes only current SWP facilities, regulations, and water rights permits existing in 2015. Lastly, the level of demand for SWP water assumed the maximum Table A delivery amount was requested and reflected current trends in demand from SWP water contractors.

Detailed information on the assumptions, data, and simulation results of existing and

future conditions for annual Table A water deliveries can be found in the final 2015 capability report available on DWR's website.

## SWP Future Water Supply Program

The Future Water Supply Program's goal is to improve and protect the water supply reliability of the SWP while protecting the environment and other legal users of water. The program consists of two main components; Sacramento Valley Groundwater (SVG) and Upper Feather River Watershed Management (UFRWM). The SVG component provides technical support for the Lower Yuba River Accord (Yuba Accord) and to monitor other groundwater and conjunctive-use projects and assess conditions of the Sacramento Valley Groundwater Basin that may affect SWP yield. The four primary objectives of the SVG are to: (1) collect, analyze, and report data to determine the effects of groundwater substitution transfers on the SWP; (2) analyze and report on groundwater substitution transfers that use SWP facilities; (3) monitor groundwater management planning and implementation activities that may affect SWP yield; and (4) develop and utilize analytical tools to support and enhance sustainable groundwater management in the Sacramento Valley.

The UFRWM component of the program evaluates the Feather River watershed above Lake Oroville with respect to watershed management and restoration actions being planned or implemented. These actions are intended to improve the ecological and hydrologic functions of watersheds, thus affecting base flow, improving flood attenuation, and reducing erosion and sedimentation. DWR continued collaborative efforts with local stakeholders in 2015 to implement and enhance monitoring activities for assessing the immediate and long-term hydrologic effects of these actions.

## SWP Water Rights Activities

### Water Right Permits

SWP operations are governed by the terms and conditions contained in DWR's water right permits and licenses along with other State and federal regulatory restrictions, including biological opinions (BiOps) for the protection of endangered species. DWR holds water right permits authorizing SWP operations at each of the SWP facilities, including the Oroville and Delta facilities (which include the North Bay Aqueduct), for water supply purposes. Each permit specifies the authorized quantities of direct diversion and diversion to storage, place of use, purpose of use, and time within which the permitted quantities must be put to beneficial use. A change in any of the terms and conditions contained in the water right permits and licenses, including a change in the place or purpose of use or point of diversion, requires SWRCB approval.

Diversion and use of SWP water throughout the SWP service area has increased since initial operations in the 1960s. However, due to a number of factors, including operational and regulatory constraints, water deliveries have not yet reached the maximum quantities anticipated for full development of the SWP.

#### *2015 Temporary Urgency Change Petition*

Water conditions continued to be critically dry in 2015. These conditions created severe challenges for the SWP and CVP to meet the regulatory objectives both within the Delta and in upstream areas. The SWRCB convened several workshops and approved a number of temporary urgency change petitions (TUCPs) received from DWR and the Bureau of Reclamation (Reclamation )to modify their water right permits for the SWP and CVP.

DWR estimated water balances, performed extensive water supply and salinity

modeling, coordinated with fish and wildlife agencies, and prepared drought contingency plans and operational forecasts, as required by the SWRCB.

On January 23, 2015, DWR and Reclamation filed a joint TUCP to temporarily change SWP and CVP water right permits and license conditions in SWRCB Water Right Decision 1641.

On February 3, 2015, SWRCB issued an order approving parts of the TUCP, subject to conditions. Throughout 2015, DWR and Reclamation submitted additional TUCPs and requests to modify the TUCP order, and SWRCB modified the order several times in response. Issues included Delta outflow requirements, export limits, Delta Cross Channel gate operations, Sacramento River and San Joaquin River flow requirements, western Delta agricultural salinity requirements, and adjusted operations to conserve water in upstream reservoirs.

### *Drought Contingency Plan*

SWRCB's Water Right Order 2014-0029, issued on September 24, 2014, and final TUCP order, dated October 7, 2014, required DWR and Reclamation to develop a drought contingency plan (DCP) for operations in the Delta and the associated project reservoirs in the event that water supplies remain inadequate to satisfy the projects' water right permits and license requirements and other uses. A DCP covering the beginning of water year 2014–2015 through January 15, 2015, was submitted to the SWRCB October 15, 2014. DWR and Reclamation submitted a DCP for the remainder of the 2014–2015 water year (January 15 through September 30, 2015) by January 15, 2015, as required by the 2014 water right and TUCP orders. The DCP included an interagency 2015 drought strategy describing the anticipated coordination, process, planning, and potential drought response actions for 2015.

The DCP was prepared by Reclamation and DWR, working with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NOAA Fisheries), and the Department of Fish and Wildlife. The DCP addressed projected water operations based on various hydrologic scenarios and potential adjustments to regulatory requirements. Reclamation and DWR continued to work closely with the fish and wildlife agencies to develop operational and contingency plans, as well as real-time coordinated operations and monitoring, in order to responsibly manage the State's limited water supplies. The DCP will be continually updated as necessary based on changing circumstances.

### *Emergency Drought Barrier*

In response to drought conditions in the State and potentially insufficient water supplies to repel salinity in the central and southern Sacramento-San Joaquin Delta, State and federal water and wildlife agencies, working together since 2014 as the Real-time Drought Operations Management Team, determined that installing an emergency drought barrier would help reduce tidally-driven saltwater intrusion into the Central and South Delta. DWR implemented the 2015 emergency drought barrier project constructing a temporary physical (rock) barrier across West False River to help protect Delta water quality and minimize the amount of water released from upstream reservoirs to repel salinity, allowing more water to be conserved in upstream areas. Ongoing coordination with regulatory agencies since 2014 and the Governor's April 1, 2015, Executive Order provided for an expedited permitting process.

Barrier installation started on May 5, 2015. The barrier was hydraulically closed May 28, and completed June 12, installation construction, including the installation of 10 new real-time water quality and flow monitoring stations, was completed July 2, 2015. Barrier removal

started on September 1, 2015, the barrier was breached on October 1, and barrier removal was completed on November 15, and demobilization was completed on November 16, 2015. Removal, including removal of the steel abutment structure, was slow-going and completed on the last day of permitted in-water work. Geologic explorations were also completed during removal thus allowing a future barrier to not require steel abutments. Levee improvements including buttress rock of steel sheet-pile cutoff walls remain in place.

Installation and operation of the 2015 emergency drought barrier successfully allowed the SWP and CVP to operate with reduced Sacramento River/Delta outflow while maintaining salinity control in the Central and South Delta. A comprehensive report is being drafted by DWR and is planned to be completed by March 2017.

### *Water Right Change Petition for California WaterFix*

In April 2015, DWR and Reclamation announced plans to split the proposed Bay Delta Conservation Plan (BDCP) into two separate efforts—one for water conveyance facilities and the other for habitat restoration. The water conveyance effort, identified as the California WaterFix, is Alternative 4a (the preferred alternative) of the BDCP/California WaterFix partially recirculated draft environmental impact report/supplemental draft environmental impact statement released in July 2015. California WaterFix would construct new Delta conveyance facilities consisting of three new water diversion intakes along the Sacramento River and two 30-mile long, 40-foot diameter tunnels to convey water to the existing SWP and CVP pumping facilities in the South Delta. The proposed conveyance facilities would allow greater flexibility in water diversions and better balancing of the associated water quality and hydrodynamic benefits for fish, drinking water, agriculture, and other beneficial uses.

On August 26, 2015, DWR and Reclamation submitted a joint petition to the SWRCB requesting changes in SWP and CVP water right permit conditions. The petition proposes adding points of diversion of water for the SWP and CVP associated with California WaterFix. In October, the SWRCB issued a public notice for the petition and the hearing for the petition. The hearing is scheduled to begin in April 2016 and is expected to be conducted in two parts.

For additional information about California WaterFix, see Chapter 3, Environmental Programs.

## Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary

The Delta and Suisun Marsh are located where California's two major river systems, the Sacramento and the San Joaquin, converge and flow westward to meet incoming seawater tides flowing through the San Francisco Bay. The watershed of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Estuary) is a critical source of water supply for much of California. The watershed is a source of drinking water for two-thirds of the State's population; it supplies some of the State's most productive agricultural areas; and it provides water for fish, wildlife, and other public trust uses of water within and upstream of the estuary.

Water originating in the Bay-Delta watershed is delivered to areas within the watershed and to areas south and west of the estuary. The largest water distribution systems that release stored water into the Delta and directly divert water from the Delta are the SWP, operated by DWR, and the

federal CVP, operated by Reclamation. Numerous other water storage and diversion projects also influence Bay-Delta Estuary inflows, outflows, water quality, and other hydrologic characteristics.

The SWRCB regulates both the quality of water in the Bay-Delta Estuary and the diversions and uses of water released into and diverted from the estuary for water supply. The SWRCB coordinates its regulatory authorities under State laws governing water quality and water rights, ensuring that water quality is protected for all beneficial uses when water is diverted from the estuary.

In 1999, the SWRCB adopted Water Right Decision 1641 (later modified by Order WR 2000-02) modifying the terms and conditions of a number of water right permits and licenses, primarily those for the SWP and CVP, to implement the objectives of the 1995 water quality control plan.

Under its authority to protect beneficial uses of water, the SWRCB adopted the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay-Delta Plan) on December 13, 2006 (Resolution No. 2006-0098). The Bay-Delta Plan contains objectives for flow, salinity, dissolved oxygen levels, and other parameters necessary for protection of various beneficial uses such as municipal and industrial, agricultural, and fish and wildlife. The SWRCB implements these objectives in part or in whole, depending on the circumstances, through conditions on water right permits and licenses.

## 2006 Bay-Delta Plan Review

CWC Section 13240 requires that the water quality control plan be periodically reviewed. Federal Clean Water Act Section 303(c) (33 U.S.C. Section 1313(c)) requires a triennial review of State water quality "standards," as defined in the act. Formal review of the 2006 Bay-Delta Plan began in October 2008.

The review and amendment process for the 2006 Bay-Delta Plan consists of:

- identifying elements that may need amendment or new elements that may need to be added;
- preparing any amendments to or revisions of the entire water quality control plan; and
- SWRCB's adoption of some or all of the amendments or revisions.

SWRCB information-gathering activities may affect the scope of the 2006 Bay-Delta Plan review and may include evidentiary hearings on critical issues concerning the Delta's ecology.

In 2015, SWRCB continued its review and update of the 2006 Bay-Delta Plan. The work consists of a four-phased process to develop and implement updates to the Bay-Delta Plan and flow objectives for priority tributaries to the Delta to protect beneficial uses in the Bay-Delta watershed. Phase 1 includes review and potential modification of the San Joaquin River flow objectives for the protection of fish and wildlife beneficial uses, the southern Delta water quality objectives for the protection of agricultural beneficial uses, and the program of implementation for those objectives. Phase 2, initiated in 2012, focuses on issues such as: (1) Delta flow objectives, (2) export/inflow objectives, (3) Delta Cross Channel gate closure objectives, (4) Suisun Marsh objectives, (5) potential new reverse flow objectives for Old and Middle rivers, (6) potential new flood plain habitat flow objectives, (7) potential changes to the monitoring and special studies program, and (8) other potential changes to the program of implementation. Phase 3 involves changes to water rights and other measures to implement changes to the Bay-Delta Plan from Phases 1 and 2. Phase 4 involves developing and implementing flow

objectives for priority Delta tributaries outside of the Bay-Delta Plan updates.

For more information about water quality objectives and compliance monitoring in the South Delta, see Chapter 4, Water Quality Programs.

### 2015 SWRCB Bay-Delta Proceedings

In 2015, SWRCB proceedings examined a number of issues in the Bay-Delta Estuary relating to water quality, conservation, availability, and rights, which have the potential to affect Delta water supply and reliability. The drought was the main issue of concern in 2015. The SWRCB proposed or adopted a number of emergency regulations related to the drought.

## Storage Program

DWR is the State lead agency for the Storage Program, which consists of surface storage studies and groundwater programs and projects. The Storage Program began under the CALFED Bay-Delta Program. (For background on the CALFED Bay-Delta Program, see Bulletins 132-95 through 132-11.)

The Storage Program is a comprehensive program with potential benefit for the SWP consisting of actions related to surface and groundwater storage. DWR's Division of Statewide Integrated Water Management and Division of Integrated Regional Water Management have been working with State and federal agencies to enhance storage and conjunctive-use programs that support local project development via loans and grants. The Storage Program is part of an ongoing evaluation of how storage, both groundwater conjunctive use and surface storage, can help meet California's urban, agricultural, and environmental water supply reliability, ecosystem restoration, and water quality needs.

### Surface Storage Investigations

Surface storage investigations are developing environmental documentation and feasibility studies for four of the five surface storage projects identified for further study in the CALFED record of decision. The four projects are discussed below.

#### *Los Vaqueros Reservoir Expansion Project*

Contra Costa Water District owns and operates the 160,000 acre-foot (af) Los Vaqueros Reservoir just southwest of the Sacramento-San Joaquin Delta. The Los Vaqueros Reservoir Expansion Project involves analysis of increasing reservoir storage up to 275,000 af.

The project objectives are: (1) to develop water supplies for environmental water management; (2) to increase water supply reliability within the San Francisco Bay Area; and (3) to the extent possible, improve the quality of water deliveries to municipal and industrial customers without impairing the project's ability to meet the first two objectives.

The Contra Costa Water District Board certified a final environmental impact report and approved an expansion from 100,000 af to 160,000 af in March 2010. The expansion was completed and dedicated in July 2012.

Contra Costa Water District and local, State, and federal partners continue to study the feasibility of a 275,000 af expansion alternative in the context of other Delta initiatives to improve Delta conveyance and Delta fisheries protection, including long-term programs being explored in California WaterFix and California EcoRestore.

#### *Shasta Lake Water Resources Investigation*

Reclamation, in coordination with other agencies, is studying the feasibility of expanding Shasta Dam and Lake,

primarily to promote increased survival of anadromous fish populations in the upper Sacramento River and to increase water supply reliability. An enlargement of Shasta Dam would inundate additional lands around the existing reservoir and affect a portion of the McCloud River. California Public Resources Code Section 5093.542(c), the Wild and Scenic Rivers Act, states that, "except for participation by the Department of Water Resources in studies involving the technical and economic feasibility of enlargement of Shasta Dam, no department or agency of the state shall assist or cooperate with, whether by loan, grant, license, or otherwise, any agency of the federal, state, or local government in the planning or construction of any dam, reservoir, diversion, or other water impoundment facility that could have an adverse effect on the free-flowing condition of the McCloud River, or on its wild trout fishery."

The State budget does not include funding for DWR to continue participating in this study. However, Reclamation's planning is ongoing.

In 2015, Reclamation completed the final feasibility study report and EIS for the Shasta Lake Water Resources Investigation.

### *North-of-the-Delta Offstream Storage Investigation*

DWR and Reclamation are working in partnership with local, State, and federal agencies to further study north-of-the-Delta offstream storage opportunities. The North-of-the-Delta Offstream Storage Investigation focuses on potential projects on the west side of the Sacramento Valley, including Sites Reservoir.

Storing water in offstream reservoirs during excess flow periods could provide opportunities to increase water storage in an environmentally sensitive manner. The stored water can then be made available to enhance water management flexibility in the Sacramento Valley and the Bay-Delta Estuary, reducing water diversions on the Sacramento River during critical fish migration periods, increasing the reliability of supplies for the Sacramento Valley and statewide, and providing storage and operational flexibility to support environmental enhancement actions and adapt to climate change.

DWR, Reclamation, and the Sites Project Joint Powers Authority continued to work on completing the draft feasibility study report and environmental documentation in 2015.

### *Upper San Joaquin River Basin Storage Investigation*

Reclamation, in coordination with other State and federal agencies, is evaluating opportunities for increased storage in the upper San Joaquin River watershed. The objectives of the Upper San Joaquin River Basin Storage Investigation are to: (1) increase water supply reliability and operational flexibility in the CVP's Friant Division, other San Joaquin Valley areas, and other regions, and (2) enhance water temperature and flow conditions in the San Joaquin River in support of San Joaquin River restoration efforts. Other opportunities include additional hydropower generation, reduction of flood damages, water quality improvements, and recreation site development.

In 2015, Reclamation continued working to complete the final feasibility study report and environmental impact statement. The feasibility report examines potential construction of a new dam and reservoir on the San Joaquin River. The environmental impact statement documents the potential environmental effects of alternatives to increased storage of water from the upper San Joaquin River watershed.

# Delta Conveyance Program

The Delta Conveyance Program previously consisted of projects proposed in the North and South Delta. As a result of the efforts associated with the BDCP and the Delta Stewardship Council's *Delta Plan*, many of these efforts were suspended as staff was redirected to work on the SWP Delta Compliance Program. The remaining projects are discussed briefly below; more detailed information about the Delta can be found in Chapter 2, Delta Resources.

## SWP Delta Compliance Program

The SWP obtained take authorization for federal and California Endangered Species Act listed species through the December 2008 USFWS BiOp for Delta Smelt; the February 2009 Department of Fish and Wildlife incidental take permit for Longfin Smelt; and the June 2009 NOAA Fisheries BiOp for salmon, steelhead, and Green Sturgeon. Many of the regulatory requirements require studies and projects, which are currently underway.

## North Delta

With the North Delta Flood Control and Ecosystem Restoration Project, solutions to improve flood management and the ecosystem are being considered, including setback levees, detention basins, dredging, and levee degradation for floodplain expansion. For more information about this project, see Chapter 2, Delta Resources.

## South Delta

Actions in the South Delta include monitoring and assessment of the South Delta Improvements Program (SDIP), implementing flood control and ecosystem improvements in the lower San Joaquin River, and continuation of DWR's Temporary Barriers Project.

SDIP is a two-stage project. Stage 1 proposes to reduce the movement of San Joaquin River watershed Central Valley fall-run and late fall-run juvenile Chinook Salmon into the South Delta via Old River and to maintain adequate water levels and water quality for agricultural diversions in the South Delta. Stage 2 would increase water deliveries and delivery reliability to SWP and CVP contractors south of the Delta and increase the maximum permitted level of diversion through the existing intake gates at Clifton Court Forebay.

DWR deferred both the increase in diversions and the associated new fish screens as components of the SDIP due to funding issues and technical uncertainties associated with the design and construction of the new fish screens.

The SDIP final environmental impact report/environmental impact statement (2006) evaluated alternatives and proposed continuing with SDIP Stage 1. This component involves constructing permanent operable gates and channel dredging in the South Delta. DWR is proposing installation of these permanent gates to replace temporary rock barriers currently installed and removed each year under DWR's Temporary Barriers Project.

Reclamation and DWR's 2008 biological assessment for the SWP and CVP Long-term Operations Criteria and Plan included operation of the SDIP permanent operable gates.

The USFWS BiOp, issued in December 2008, concluded that coordinated operations of the CVP and SWP would jeopardize Delta Smelt. The USFWS provided a reasonable and prudent alternative under which SDIP could move forward.

The NOAA Fisheries BiOp, issued in June 2009, concluded that CVP and SWP operations would jeopardize a number of

anadromous species, in particular Chinook Salmon. NOAA Fisheries provided no reasonable and prudent alternative for SDIP. DWR initiated discussion with NOAA Fisheries in late 2009 to establish what actions could lead to a reasonable and prudent alternative under which SDIP could move forward; however, NOAA Fisheries stated an interest in holding off on further discussion until completion of an on-going multiyear South Delta Temporary Barriers Project salmonid survival and predation study. The study field data collection has been completed, data analysis is in progress, and the final predation study report is expected in 2017. Data from the study will be useful in considering permanent barrier design options and operation strategies to minimize predation. Other than the on-going temporary barriers project Predation and Survival study, no work on Stage 1 of SDIP took place in 2015.

Any action regarding SDIP Stage 2 will require further study and public input. Stage 2 planning continued to be suspended in 2015.

For additional information about the South Delta Temporary Barriers Project, see Chapter 2, Delta Resources.

## Lower Yuba River Accord

The Lower Yuba River Accord's (Yuba Accord) purpose is to resolve instream flow issues and protect and enhance lower Yuba River fisheries and local water supply reliability. The Yuba Accord provides revenues for local flood control and water supply projects; water to enhance SWP and CVP water supply reliability by offsetting Delta export reductions for protection and restoration of Delta fisheries; and improvements in statewide water supply management, including dry year supplies for participating SWP and CVP contractors.

The Yuba Accord is based on three agreements, as follows:

- a water purchase agreement between DWR and Yuba County Water Agency (Yuba);
- conjunctive use agreements with Yuba member units; and
- a fisheries agreement.

Three amendments to the water purchase agreement were executed in 2009 and 2010 to address a technical refill accounting issue and groundwater substitution pricing issues.

DWR and Yuba executed Amendment 4 to the Water Purchase Agreement in 2012 to streamline the process for addressing groundwater substitution pricing issues. Conforming amendments were also executed to the participation agreements between DWR and 22 participating contractors in the Yuba Accord.

On December 5, 2014, DWR executed Amendment 5 between DWR and Yuba. The key new terms included: increased pricing for the four components of transfer water to be delivered by Yuba from 2016 through 2020; a $20 million deposit to be paid to Yuba to lock in the new pricing for 5 years, and that will be credited to surface water purchases; allowing for third-party sales by Yuba to nonparticipants in the program under certain circumstances; and continued annual negotiations of groundwater substitution pricing when available. All 22 participating contractors continued their participation from 2016 through 2020 by executing the conforming Amendment 5 to their participation agreements.

On January 8, 2015, DWR executed a Participation Agreement, Amendment 1, and Amendment 5 with two additional contractors, Mojave Water Agency and Santa Barbara County Flood Control and Water

Conservation District, increasing the number of participating contractors from 22 to 24.

Yuba released 59,131 af of Component 1 surface water in 2015 that was shared equally between the SWP and the CVP for project purposes to offset Delta export pumping reductions to benefit fish. Because 60,000 af of Component 1 water was due to be delivered in 2015, Yuba owes the remaining 869 af in a future year. In addition, Yuba provided 30,000 af of Component 4 groundwater substitution water to enhance lower Yuba River flows through agreements with seven of its Member Units. This Component 4 water was made available to many of the Participating Contractors through a letter agreement between DWR and Yuba executed on March 26, 2015, at an effective price of $665 per af.

The water purchase agreement transfers water to help offset Delta export reductions annually and provides dry-year transfer water for SWP and CVP contractors from surface and groundwater substitution sources.

For additional details about the Yuba Accord, see Chapter 9, Water Contracts and Deliveries.



# Chapter 8
# Water Supply

*There was no snow to measure when the April 1, 2015, manual snow survey was conducted at the Phillips snow course.*

## Significant Events in 2015

Water year 2014–2015 proved to be another dry year, the fourth consecutive year with less than average precipitation and mountain snowpack. The State received precipitation at 74 percent of average in water year 2014–2015 compared to 56 and 79 percent of average in water years 2013–2014 and 2012–2013, respectively. Though a below-average water year, the Northern Sierra 8-Station Precipitation Index had 37.2 inches of precipitation. Of this total, 22.8 inches fell during December and February. This accounted for 61 percent of the water year total. The statewide mountain snowpack on April 1 was only 5 percent of average.

Statewide river runoff totaled 46 percent of average in the 2014–2015 water year, which is well below average but 11 percent higher than the previous water year. The Feather River runoff totaled 45 percent of average. Water year runoff totals for the Sacramento River Region (SRR), San Joaquin 4 Rivers (SJR), and Tulare Lake Region (TLR) were well below average at 51, 24, and 19 percent of average, respectively.

The Sacramento Valley Water Year Hydrologic Classification (Sacramento Valley 40-30-30 Index) and the San Joaquin Valley Water Year Hydrologic Classification (San Joaquin Valley 60-20-20 Index) were both "critical," based on observed data for water year 2014–2015.

*Information in this chapter was contributed by the Division of Flood Management and the Division of Operations and Maintenance.*

The Department of Water Resources (DWR) monitors precipitation, estimates mountain snowpack, calculates river runoff, and operates storage facilities during each water year. The official California water year runs from October 1 through September 30.

## California's Hydrology

DWR divides California into 10 hydrologic regions. Each hydrologic region corresponds to the State's major water drainage basins. Annual precipitation, mountain snowpack, and runoff data are collected and analyzed for the hydrologic regions and used to determine water year type classifications and forecasts for the State's water supply outlook.

The State's precipitation is measured using three primary indices, the Northern Sierra 8-Station Precipitation Index, the San Joaquin 5-Station Precipitation Index, and the Tulare Basin 6-Station Precipitation Index. For more information, see the sidebar, Precipitation Estimates.

Runoff estimates are determined for the Sacramento River Region (SRR), the San Joaquin 4 Rivers (SJR), and the Tulare Lake Region (TLR). For more information, see the sidebar, Runoff Estimates.

The Eight River Index is used to determine the duration of fish and wildlife salinity and flow standards at Chipps Island or Port Chicago from February through June (see Chapter 4, Water Quality Programs). This index is the sum of the unimpaired runoff from the eight rivers in the SRR and SJR.

Two water supply indices, the Sacramento Valley Water Year Hydrologic Classification (Sacramento Valley 40-30-30 Index) and the San Joaquin Valley Water Year Hydrologic Classification (San Joaquin Valley 60-20-20 Index), are used to derive the water year classification for the Sacramento Valley and the San Joaquin Valley, respectively.

Water year classification is used by various water agencies to formulate water supply decisions. For more information, see the sidebar, Water Supply Indices.

DWR continually updates hydrologic data and information. If your research requires more current data than was available at the time of publication of this bulletin, please consult the most recent edition of Bulletin 120, and/or contact DWR staff in the Hydrology and Flood Operations Office.

## Water Year 2014–2015

### Precipitation

California experienced below average rainfall (74 percent of average) for the water year, and regionally, precipitation varied widely. Figure 8-1 presents water year precipitation for the various regions of the State.

Table 8-1 presents monthly precipitation totals for water year 2014–2015 at various gauges located throughout the State, listed north to south. Statewide, the wettest month, as measured by inches of precipitation, was December when most stations in the list received well above average precipitation. San Francisco measured nearly 290 percent of average.

December started with a strong precipitation event that resulted when a cut-off low drifted south offshore and entrained a pulse of tropical moisture. While not a traditional atmospheric river event, the high precipitation totals across the State reflected the high moisture content pushed into the State by the low. The warm temperatures that accompanied the storm also limited




**Figure 8-1 Statewide Precipitation by Hydrologic Region, 2014–2015 Water Year, as Percent of Average**

**Table 8-1 Monthly Precipitation Totals at Various Locations in California, Water Year[a] 2014–2015**

| | Monthly Precipitation (inches) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water Year 2014–2015 | | | | | | | | | | | | | Water Year 2015–2016 | | |
| | 2014 | | | 2015 | | | | | | | | | | | | |
| Station[b] | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | WY Total | Oct | Nov | Dec |
| Mount Shasta City | 4.83 | 1.86 | 12.83 | 0.48 | 10.16 | 1.27 | 1.48 | 1.76 | 0.23 | 1.50 | 0.00 | 0.23 | **36.63** | 0.59 | 1.44 | 7.46 |
| percent of average | *206* | *41* | *218* | *7* | *181* | *29* | *53* | *104* | *22* | *600* | *0* | *29* | ***101*** | *25* | *31* | *127* |
| Eureka Woodley Island | 4.74 | 3.89 | 9.81 | 1.36 | 5.04 | 3.11 | 2.56 | 0.01 | 0.08 | 0.15 | 0.39 | 0.27 | **31.41** | 1.18 | 4.88 | 14.66 |
| percent of average | *159* | *70* | *153* | *21* | *97* | *60* | *89* | *1* | *13* | *136* | *163* | *36* | ***82*** | *39* | *88* | *229* |
| Blue Canyon (DWR-2) | 3.62 | 7.23 | 17.01 | 0.11 | 9.63 | 1.26 | 4.78 | 1.49 | 1.13 | 0.04 | 0.00 | 0.11 | **46.41** | 1.80 | 5.67 | 16.57 |
| percent of average | *97* | *92* | *163* | *1* | *99* | *15* | *95* | *55* | *128* | *19* | *0* | *15* | ***74*** | *48* | *72* | *158* |
| Sacramento WB City | 0.53 | 1.25 | 8.60 | 0.00 | 2.28 | 0.22 | 1.85 | 0.07 | 0.07 | 0.00 | 0.00 | 0.04 | **14.91** | 0.44 | 1.35 | 1.83 |
| percent of average | *58* | *62* | *270* | *0* | *70* | *9* | *125* | *15* | *54* | *0* | *0* | *19* | ***83*** | *48* | *67* | *57* |
| San Francisco WB AP | 0.31 | 1.99 | 10.66 | 0.00 | 2.01 | 0.06 | 1.28 | 0.02 | 0.26 | 0.00 | 0.00 | 0.02 | **16.61** | 0.00 | 1.42 | 3.37 |
| percent of average | *29* | *84* | *287* | *0* | *61* | *2* | *90* | *5* | *173* | *0* | *0* | *11* | ***83*** | *0* | *60* | *91* |
| Yosemite Headquarters | 0.00 | 2.98 | 4.81 | 0.07 | 3.15 | 0.43 | 2.90 | 1.35 | 0.65 | 2.11 | 0.02 | 0.08 | **18.55** | 3.37 | 3.74 | 9.05 |
| percent of average | *0* | *71* | *73* | *1* | *50* | *9* | *90* | *96* | *114* | *754* | *10* | *13* | ***50*** | *196* | *89* | *138* |
| Fresno WB AP | 0.50 | 0.40 | 2.29 | 0.21 | 1.13 | 0.06 | 1.25 | 0.57 | 0.01 | 0.43 | 0.00 | 0.12 | **6.97** | 0.49 | 1.74 | 2.97 |
| percent of average | *104* | *36* | *130* | *10* | *54* | *3* | *116* | *204* | *14* | *0* | *0* | *80* | ***64*** | *102* | *157* | *169* |
| Grant Grove | 0.00 | 3.34 | 6.25 | 0.24 | 4.85 | 0.80 | 1.71 | 2.19 | 0.50 | 1.19 | 0.00 | [c] | **21.07** | 2.82 | 5.18 | 6.09 |
| percent of average | *0* | *65* | *80* | *3* | *67* | *11* | *40* | *187* | *179* | *1,983* | *0* | [c] | ***48*** | *144* | *100* | *78* |
| Los Angeles WSO AP | 0.24 | 0.42 | 4.04 | 1.25 | 0.27 | 0.49 | 0.11 | 0.43 | 0.01 | 0.35 | 0.00 | 1.81 | **9.42** | 0.10 | 0.06 | 1.08 |
| percent of average | *63* | *30* | *192* | *46* | *9* | *26* | *12* | *307* | *20* | *3,500* | *0* | *1,006* | ***74*** | *26* | *4* | *51* |
| San Diego NWS Lindbergh Field | 0.0 | 0.37 | 4.50 | 0.42 | 0.28 | 0.93 | 0.02 | 2.39 | 0.04 | 1.71 | 0.01 | 1.24 | **11.91** | 0.43 | 1.54 | 0.88 |
| percent of average | *0* | *33* | *236* | *20* | *15* | *58* | *3* | *1,138* | *57* | *8,550* | *11* | *689* | ***115*** | *102* | *136* | *46* |

[a] Water Year = October 1–September 30

[b] AP = Airport; NWS = National Weather Service; WB = Weather Bureau; WSO = Weather Service Office

[c] During September 2015, a fire prevented the measurement of precipitation at Grant Grove.

the amount of snowpack that accumulated during this event. The second week included a strong Pacific storm that brought more rain and more snow to the high country. This event was focused more on the northern half of the State and included high winds—more than 100 miles per hour in the Sierra Nevada. In contrast, January was extremely dry with only one of the ten selected stations receiving more than 25 percent of average precipitation.

Eureka Woodley Island on the north coast of California received 31.4 inches of precipitation for a water year total that was 82 percent of average. For the 2014–2015 water year, precipitation for the station was above normal for October, December, July, and August. Totals for October, December, and August were greater than 150 percent of average.

Blue Canyon experienced above normal precipitation for 2 months of water year 2014–2015. The station totals for the water year were 46.4 inches and 74 percent of average. The largest amount of precipitation and highest percent of normal for the water year occurred in December with 17.0 inches and 163 percent of average, respectively.

Areas of the Central Valley also received their largest amounts of precipitation in December. Precipitation totals were 8.6 inches (270 percent of average) for Sacramento and 2.3 inches (130 percent of average) for Fresno. For the water year, Sacramento received 83 percent of its annual

## Precipitation Estimates

### Northern Sierra 8-Station Precipitation Index (8SI)

In the northern Sierra Nevada, precipitation is indexed by averaging rain gauge totals at eight representative stations, creating what is known as the Northern Sierra 8-Station Precipitation Index. The index provides a representative sample of the major watersheds (upper Sacramento, Feather, Yuba, and American rivers) and serves as a wetness index for the Sacramento River hydrologic region.

The rain gauge stations are:

(1) Mount Shasta City
(2) Shasta Dam
(3) Mineral
(4) Quincy
(5) Brush Creek
(6) Sierraville Ranger Station
(7) Blue Canyon
(8) Pacific House

### San Joaquin 5-Station Precipitation Index (5SI)

In the central Sierra Nevada, precipitation is indexed by averaging rain gauge totals at five representative stations, creating what is known as the San Joaquin 5-Station Precipitation Index. The index provides a representative sample of the major watersheds (Stanislaus, Tuolumne, Merced, and San Joaquin rivers) and serves as a wetness index for the San Joaquin River hydrologic region.

The rain gauge stations are:

(1) Calaveras Big Trees
(2) Hetch Hetchy Reservoir
(3) Yosemite Headquarters
(4) North Fork Ranger Station
(5) Huntington Lake

### Tulare Basin 6-Station Precipitation Index (6SI)

In the southern Sierra Nevada, precipitation is indexed by averaging rain gauge totals at six representative stations, creating what is known as the Tulare Basin 6-Station Precipitation Index. The index provides a representative sample of the Kings, Kaweah, Tule, and Kern river watersheds.

The rain gauge stations are:

(1) Balch Power House
(2) Springville
(3) Giant Forest
(4) Pascoes
(5) Ash Mountain
(6) Isabella

precipitation average, while Fresno received 64 percent of its annual average.

In the San Joaquin and Tulare Lake watersheds, water year total precipitation was also well below average. The largest amounts of precipitation fell in these watersheds during the month of December, which is similar to what transpired in Northern California. Approximately one-fourth of the water year precipitation fell during December for Yosemite Headquarters and Grant Grove. Water year precipitation totals at those two sites were 50 and 48 percent of their respective annual averages.

Further south, Los Angeles was below average, totaling 74 percent of its annual average, whereas San Diego was above average totaling 115 percent of its annual average. San Diego received 4.5 inches of precipitation in December, which is 236 percent of the monthly average. San Diego received 2.4 inches of precipitation in May, which is 1,138 percent of the monthly average. Los Angeles received 4.0 inches of precipitation in December, which is 192 percent of the monthly average.

The monthly totals for the water year for the Northern Sierra 8-Station, the San Joaquin 5-Station, and the Tulare Basin 6-Station precipitation indices are presented in Table 8-2. Precipitation for the three indices totaled 37.2 inches (74 percent of average), 19.0 inches (47 percent of average), and 13.6 inches (47 percent of average), respectively.

For the Northern Sierra 8-Station Precipitation Index, December was wet, registering 15.2 inches, 181 percent of the monthly average. During the 3-month period of December through February, typically the wettest period in the Sierra Nevada, 23.1 inches of precipitation accumulated, which is 91 percent of the average (25.4 inches) for the index for those 3 months. January precipitation was only 3 percent of the monthly average.

For the San Joaquin 5-Station Precipitation Index, the total accumulated precipitation during December through February was 10.1 inches, which represents 53 percent of the water year total for the index and 49 percent of the average for those months for the index.

**Table 8-2 Regional Monthly Precipitation for Water Year 2014–2015**

| | | Northern Sierra 8-Station Precipitation Index | | San Joaquin 5-Station Precipitation Index | | Tulare Basin 6-Station Precipitation Index | |
|---|---|---|---|---|---|---|---|
| | Month | Precipitation (inches) | Percent of Monthly Average | Precipitation (inches) | Percent of Monthly Average | Precipitation (inches) | Percent of Monthly Average |
| 2014 | October | 3.70 | 123 | 0.10 | 5 | 0.80 | 67 |
| | November | 3.90 | 62 | 3.10 | 66 | 0.90 | 29 |
| | December | 15.20 | 181 | 5.90 | 95 | 4.70 | 107 |
| 2015 | January | 0.30 | 3 | 0.20 | 3 | 0.50 | 9 |
| | February | 7.60 | 95 | 4.00 | 58 | 3.20 | 62 |
| | March | 1.00 | 14 | 0.40 | 7 | 0.20 | 4 |
| | April | 2.30 | 59 | 2.30 | 64 | 1.00 | 38 |
| | May | 1.20 | 57 | 1.40 | 78 | 0.90 | 82 |
| | June | 0.80 | 80 | 0.30 | 50 | 0.50 | 125 |
| | July | 0.70 | 350 | 1.10 | 367 | 0.80 | 400 |
| | August | 0.10 | 33 | 0.00 | 0 | 0.00 | 0 |
| | September | 0.40 | 44 | 0.20 | 29 | 0.10 | 17 |
| **Total** | | **37.20** | **74** | **19.00** | **47** | **13.60** | **47** |

For the Tulare Basin 6-Station Precipitation Index, a total of 8.4 inches accumulated during December through February, which represents 62 percent of the water year total for the index and 56 percent of the average for those months for the index.

## Mountain Snowpack

Precipitation that fell during water year 2014–2015 consisted mostly of rain; snow accumulation was quite small, setting record lows throughout the State's mountainous regions. Monthly statewide snowpack for the water year is shown in Table 8-3. Snow water equivalents shown in the table were obtained from daily snow sensor reports corresponding to the first day of each month. The statewide average snow water equivalent reported for April 1 was 1.4 inches or 5 percent of average, lower than the previous record low snowpack of 25 percent in 1977 and 2014. April 1 is typically the average annual date of peak snow accumulation. In 2015, the mountain snowpack peaked during the second week of February at approximately 5.6 inches of snow water content or 19 percent of its April 1 average.

**Table 8-3 Statewide Mountain Snowpack for Water Year 2014–2015**

| | Date | Snow Water Equivalent (inches) | Percent of Average | Percent of April 1 Average[a] |
|---|---|---|---|---|
| 2014 | October 1 | 0.0 | 0 | 0 |
| | November 1 | 0.0 | 0 | 0 |
| | December 1 | 1.0 | 24 | 4 |
| 2015 | January 1 | 4.8 | 47 | 17 |
| | February 1 | 4.2 | 23 | 14 |
| | March 1 | 5.0 | 19 | 17 |
| | April 1 | 1.4 | 5 | 5 |
| | May 1 | 0.4 | 3 | 2 |
| | June 1 | 0.0 | 0 | 0 |
| | July 1 | 0.0 | 0 | 0 |
| | August 1 | 0.0 | 0 | 0 |
| | September 1 | 0.0 | 0 | 0 |

[a] April 1 is the average date of peak statewide mountain snowpack.
This table is based on snow pillow (a device for measuring mountain snowpack at automated reporting stations) data.

## River Runoff

Statewide river runoff totaled 46 percent of average in the 2014–2015 water year. The monthly runoff totals for the SRR, the SJR, the TLR, and the Feather River are shown in Table 8-4. As shown, the water year runoff totals for all of these areas were well below average, with the TLR the lowest at 19 percent of average.

**Table 8-4 Unimpaired Runoff for Water Year 2014–2015 (million acre-feet)**

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SRR runoff | 0.35 | 0.43 | 2.75 | 0.74 | 1.95 | 0.69 | 0.57 | 0.5 | 0.38 | 0.31 | 0.27 | 0.28 | 9.23 |
| percent of average | *68* | *49* | *161* | *29* | *78* | *24* | *24* | *22* | *31* | *53* | *66* | *69* | *51* |
| SJR runoff | 0.01 | 0.03 | 0.14 | 0.06 | 0.28 | 0.15 | 0.19 | 0.32 | 0.17 | 0.06 | 0.02 | 0.01 | 1.44 |
| percent of average | *21* | *21* | *57* | *13* | *61* | *24* | *23* | *23* | *15* | *13* | *17* | *20* | *24* |
| TLR runoff | 0.01 | 0.02 | 0.04 | 0.03 | 0.08 | 0.07 | 0.07 | 0.11 | 0.08 | 0.05 | 0.02 | 0.01 | 0.59 |
| percent of average | *25* | *30* | *36* | *17* | *41* | *26* | *18* | *15* | *13* | *16* | *16* | *16* | *19* |
| Feather River runoff | 0.05 | 0.09 | 0.59 | 0.18 | 0.44 | 0.16 | 0.12 | 0.1 | 0.08 | 0.07 | 0.07 | 0.06 | 2.02 |
| percent of average | *47* | *43* | *152* | *31* | *78* | *22* | *19* | *15* | *26* | *49* | *66* | *64* | *45* |
| Statewide runoff percent of average | *65* | *44* | *139* | *24* | *87* | *23* | *23* | *21* | *21* | *30* | *46* | *56* | *46* |

SRR: Sacramento River Region
Sacramento River above Bend Bridge, Feather River at Oroville, Yuba River near Smartville, American River below Folsom Lake

SJR: San Joaquin 4 Rivers
Stanislaus River below Goodwin Dam, Tuolumne River below La Grange, Merced River below Merced Falls, San Joaquin River below Millerton Lake

TLR: Tulare Lake Region
Kings River below Pine Flat Reservoir, Kaweah River below Terminus Reservoir, Tule River below Lake Success, Kern River below Lake Isabella

WY: Water Year (October 1–September 30)

## Runoff Estimates

Unimpaired runoff represents the natural water production in a river basin, unaltered by upstream diversions, storage, or export of water to or import of water from other basins.

**Sacramento River Region (SRR)**

The runoff estimate for the SRR is the sum of unimpaired flow in million acre-feet (maf) at the following gauging stations:

(1) Sacramento River above Bend Bridge
(2) Feather River at Oroville (inflow to Lake Oroville)
(3) Yuba River near Smartville
(4) American River below Folsom Lake

**San Joaquin 4 Rivers (SJR)**

The runoff estimate for the SJR is the sum of unimpaired flow in maf at the following gauging stations:

(1) Stanislaus River below Goodwin Dam (inflow to New Melones Reservoir)
(2) Tuolumne River below La Grange (inflow to New Don Pedro Reservoir)
(3) Merced River below Merced Falls (inflow to Lake McClure)
(4) San Joaquin River below Millerton Lake (inflow to Millerton Lake)

**Tulare Lake Region (TLR)**

The runoff estimate for the TLR is the sum of unimpaired flow in maf at the following gauging stations:

(1) Kings River below Pine Flat Reservoir
(2) Kaweah River below Terminus Reservoir
(3) Tule River below Lake Success
(4) Kern River below Lake Isabella

**Eight River Index**

The Eight River Index is the sum of the unimpaired runoff from the eight rivers in the SRR and the SJR.

From a water supply perspective, the most closely monitored period is April through July. By the end of July, the April–July runoff was 27, 19, and 15 percent of average, for the three respective regions.

## Water Supply Indices

The Sacramento Valley 40-30-30 Index and the San Joaquin Valley 60-20-20 Index were both "critical," based on observed data for water year 2014–2015.

For more information, see the sidebar, Water Supply Indices.

## Water Supply Indices

### Sacramento Valley 40-30-30 Index

State Water Resources Control Board, Water Right Decision 1641 (D-1641) defines the Sacramento Valley Water Year Hydrologic Classification (Sacramento Valley 40-30-30 Index), a water supply forecasting tool used to derive the water year type for the Sacramento Valley. The State Water Resources Control Board first introduced the Sacramento Valley 40-30-30 Index in the 1991 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan), and continued using it with the 1995 and 2006 Bay-Delta Plans. D-1641 implements portions of the 2006 Bay-Delta Plan with respect to the operation of the State Water Project and the Central Valley Project.

The Sacramento Valley 40-30-30 Index is used to determine the Sacramento Valley water year type for the purpose of implementing water quality objectives defined in D-1641. It also provides an estimate of the potential water supply originating in the basin from rainfall and snowmelt runoff, groundwater accretion, and reservoir carryover storage. The index incorporates seasonal differences in water contribution for the year and includes the prior year's conditions in order to establish a more reliable index of water availability. The 40-30-30 factors represent the percentage weight given to the following:

(1) 40%—the current year's April through July Sacramento Valley unimpaired runoff;

(2) 30%—the current year's October through March Sacramento Valley unimpaired runoff; and

(3) 30%—the previous year's index with a cap of 10 million acre-feet (to account for required flood control reservoir releases during wet years).

The water year type is determined by the index value on a scale specific to the Sacramento Valley (as defined in D-1641).

| Classification | Index (million acre-feet) |
|---|---|
| Wet | Equal to or greater than 9.2 |
| Above Normal | Greater than 7.8 and less than 9.2 |
| Below Normal | Equal to or less than 7.8 and greater than 6.5 |
| Dry | Equal to or less than 6.5 and greater than 5.4 |
| Critical | Equal to or less than 5.4 |

Water year type forecasts are made beginning in December. The Sacramento Valley 40-30-30 Index May 1 forecast (at the 50 percent exceedance level) determines the "official" water year type for implementing water quality and flow requirements contained in D-1641. The D-1641 objectives are conditioned by water year type and generally become less stringent during dryer years.

## Water Supply Indices

**San Joaquin Valley 60-20-20 Index**

D-1641 uses a similar method in the San Joaquin Valley Water Year Hydrologic Classification (San Joaquin Valley 60-20-20 Index) to determine the water year type for the San Joaquin Valley. The 60-20-20 factors represent the percentage weight given to the following:

(1) 60%—the current year's April through July San Joaquin Valley unimpaired runoff;

(2) 20%—the current year's October through March San Joaquin Valley unimpaired runoff; and

(3) 20%—the previous year's index with a cap of 4 million acre-feet (to account for required flood control reservoir releases during wet years).

The water year type is determined by the index value on a scale specific to the San Joaquin Valley (as defined in D-1641).

| Classification | Index (million acre-feet) |
|---|---|
| Wet | Equal to or greater than 3.8 |
| Above Normal | Greater than 3.1 and less than 3.8 |
| Below Normal | Equal to or less than 3.1 and greater than 2.5 |
| Dry | Equal to or less than 2.5 and greater than 2.1 |
| Critical | Equal to or less than 2.1 |

The San Joaquin Valley 60-20-20 Index May 1 forecast (at the 75 percent exceedance level) determines the "official" water year type for implementing D-1641 San Joaquin River Vernalis flow standards.

# Water Year 2015–2016 October through December Water Conditions

The last 3 months of calendar year 2015 mark the beginning of a new water year, 2015–2016. October was a warm, dry month.

Statewide, the average precipitation for October was 66 percent of average according to the Western Regional Climate Center. November was cool and dry with below normal precipitation. Statewide, November precipitation was 66 percent of average. December was cool and wet with 111 percent of average statewide precipitation. Preliminary records, reported in the National Weather Service Record Event Report, show that statewide there were 36 temperature records tied or broken and 7 precipitation records set for December. Of the 36 temperature records set, 16 were for new high maximum temperatures and 11 were for new low minimum temperatures.

At the end of December, water year runoff totals were 55 percent of average for the SRR, 73 percent of average for the SJR, and 49 percent of average for the TLR.

# Storage

## Statewide Storage

Monthly storage totals for the major Sierra Nevada reservoirs are shown in Table 8-5. Water year 2014–2015 began at 56 percent of average reservoir storage following a dry 2013–2014 water year. The percent of average storage dipped slightly in the fall and then rose through the winter, peaking at 71 percent of average at the end of February. During the next 5 months, storage dropped gradually to 54 percent of average in July where it remained through September.

## State Water Project Storage

The State Water Project (SWP) operates a complex system of dams, canals, and reservoirs to collect and store water for future deliveries. Lake Oroville is the first of two primary SWP conservation facilities. Lake Oroville inflow comes from tributaries of the Feather River.

San Luis Reservoir is the second primary SWP conservation facility. This Central California joint-use facility derives its inflow from pumping at the Gianelli Pumping-Generating Plant. San Luis is an off-stream storage reservoir. Most of the water is pumped into the reservoir from late fall to early spring. This water is temporarily

**Table 8-5 Monthly Reservoir Storage for Water Year 2014–2015 (thousand acre-feet)**

| Reservoir | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shasta | 1,109 | 1,048 | 1,867 | 2,001 | 2,613 | 2,689 | 2,662 | 2,404 | 2,198 | 1,990 | 1,789 | 1,603 |
| percent of average | *41* | *39* | *66* | *65* | *79* | *73* | *68* | *62* | *60* | *62* | *62* | *59* |
| Oroville | 954 | 910 | 1,347 | 1,444 | 1,736 | 1,794 | 1,782 | 1,565 | 1,395 | 1,162 | 1,072 | 1,057 |
| percent of average | *45* | *43* | *62* | *62* | *70* | *67* | *62* | *52* | *48* | *45* | *46* | *48* |
| Folsom | 305 | 278 | 430 | 448 | 564 | 572 | 576 | 535 | 438 | 286 | 195 | 174 |
| percent of average | *61* | *59* | *90* | *88* | *104* | *91* | *79* | *65* | *54* | *41* | *32* | *31* |
| San Luis | 394 | 489 | 820 | 1,103 | 1,293 | 1,354 | 1,273 | 1,090 | 813 | 523 | 410 | 398 |
| percent of average | *36* | *40* | *59* | *69* | *74* | *73* | *70* | *67* | *63* | *52* | *48* | *42* |
| Pardee | 161 | 171 | 168 | 166 | 178 | 176 | 179 | 179 | 175 | 171 | 163 | 140 |
| percent of average | *93* | *98* | *95* | *93* | *99* | *97* | *98* | *94* | *90* | *90* | *89* | *77* |
| New Melones | 513 | 513 | 547 | 563 | 606 | 553 | 491 | 453 | 401 | 344 | 295 | 268 |
| percent of average | *38* | *38* | *40* | *40* | *41* | *37* | *33* | *30* | *26* | *23* | *21* | *20* |
| Don Pedro | 756 | 756 | 794 | 827 | 872 | 893 | 843 | 826 | 756 | 694 | 651 | 644 |
| percent of average | *58* | *57* | *59* | *59* | *60* | *60* | *57* | *53* | *47* | *45* | *45* | *47* |
| Millerton | 175 | 175 | 180 | 186 | 195 | 205 | 192 | 177 | 179 | 179 | 158 | 193 |
| percent of average | *90* | *80* | *66* | *56* | *57* | *56* | *53* | *44* | *43* | *55* | *67* | *92* |
| Pine Flat | 113 | 119 | 130 | 132 | 160 | 185 | 211 | 265 | 266 | 156 | 126 | 119 |
| percent of average | *33* | *32* | *32* | *28* | *30* | *33* | *34* | *37* | *39* | *31* | *33* | *35* |
| Kaweah | 14 | 16 | 22 | 26 | 42 | 54 | 61 | 72 | 48 | 30 | 24 | 18 |
| percent of average | *129* | *122* | *143* | *126* | *173* | *133* | *80* | *60* | *45* | *58* | *124* | *144* |
| Success | 3 | 3 | 5 | 5 | 7 | 8 | 9 | 9 | 8 | 6 | 5 | 4 |
| percent of average | *36* | *36* | *37* | *31* | *30* | *25* | *20* | *16* | *15* | *18* | *24* | *25* |
| Isabella | 45 | 45 | 45 | 45 | 48 | 46 | 45 | 44 | 36 | 33 | 31 | 30 |
| percent of average | *28* | *29* | *28* | *26* | *26* | *23* | *19* | *15* | *12* | *12* | *14* | *16* |
| Statewide percent of average | *56* | *55* | *67* | *65* | *71* | *68* | *64* | *59* | *55* | *54* | *54* | *54* |

stored, then released into the California Aqueduct to meet SWP water contractor peaking demands in the summer months. The remaining SWP dams and reservoirs regulate the stored water supply with delivery patterns that are designed to fit local water demands.

## *2015 Storage Totals in Major SWP Reservoirs*

End-of-year storage on December 31, 2015, in major SWP reservoirs and the State's share of joint-use reservoirs was 1.6 million acre-feet (maf) or 30 percent of maximum storage, compared to 2.3 maf or 43 percent of maximum storage at the end of 2014. The average end-of-month total storage in major SWP reservoirs for 2015 was 2.2 maf.

## *Lake Oroville*

Lake Oroville has a maximum water storage capacity of 3,537,580 acre-feet (af). Runoff from the upper Feather River drainage is collected and stored in this reservoir and released to the Sacramento-San Joaquin Delta through Oroville Dam, Thermalito Diversion Dam, and Thermalito Afterbay.

**2015 Inflow.** Total Lake Oroville inflow for 2015 was 1,295,451 af, which was 35 percent of the average (3.69 maf) over the last 30 years. Maximum daily inflow occurred on February 9 at 55,407 af. Minimum daily inflow occurred on November 16 at 26 af. Peak monthly total inflow occurred in February at 329,201 af, 25 percent of the 2015 total. The highest total inflow in the last 30 years (1986–2015) was in 1995 at 8,996,242 af. The lowest total inflow for the same period was in 2015 at 1,295,451 af.

Figure 8-2 shows monthly Lake Oroville inflow for 2013, 2014, and 2015.

Figure 8-3 shows historical maximum and minimum cumulative Lake Oroville inflow and the current cumulative inflow for 2015.

**2015 Storage.** Minimum storage occurred on December 9 at 909,041 af, 26 percent of lake capacity. Maximum storage occurred on April 17 at 1,812,641 af, 51 percent of lake capacity. End-of-year Lake Oroville storage was 1,016,767 af. Figure 8-4 shows storage in Lake Oroville for 2014 and 2015.

## *2015 San Luis Reservoir Operations*

San Luis Reservoir is operated jointly by DWR and the Bureau of Reclamation pursuant to operating procedures adopted in June 1981. San Luis Reservoir has a normal operating capacity of 2,027,840 af. The SWP share of this capacity is 1,062,183 af.

San Luis Reservoir reached its maximum storage on March 16 at 1,382,623 af, 68 percent of its normal maximum operating capacity. At the beginning of 2015, San Luis Reservoir contained 820,209 af, 40 percent of its capacity. The SWP storage share was 535,326 af. The highest end-of-month SWP share of water storage occurred in March at 958,679 af. Figure 8-5 shows the SWP share of storage and total storage in San Luis Reservoir for 2014 and 2015.

## *2015 Lake del Valle Operations*

Lake del Valle, located off the South Bay Aqueduct, functions primarily as a storage facility for water delivery to Santa Clara and Alameda counties. At the beginning of 2015, Lake del Valle held 34,663 af, which was about 45 percent of its maximum capacity of 77,111 af. Its highest storage occurred on April 28 at 40,733 af. Its lowest storage occurred on December 21 at 26,161 af.

On December 31, storage in Lake del Valle was 26,181 af, 34 percent of its maximum capacity. There was 3,509 af of natural inflow into Lake del Valle, and 4,377 af of inflow from the South Bay Aqueduct. There were no releases to Arroyo Valle, and releases for 2015 to the South Bay Aqueduct from Lake del Valle totaled 13,353 af.

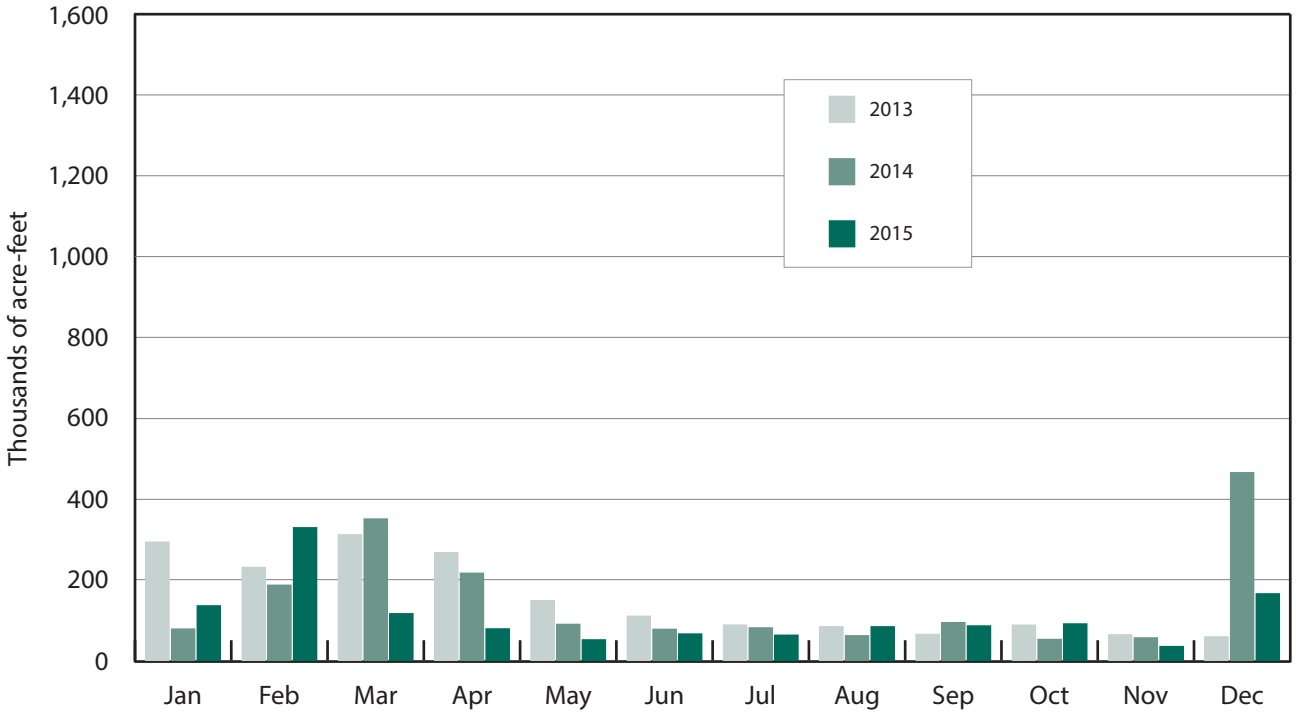



**Figure 8-2 Monthly Inflow into Lake Oroville from the Feather River, 2013–2015**

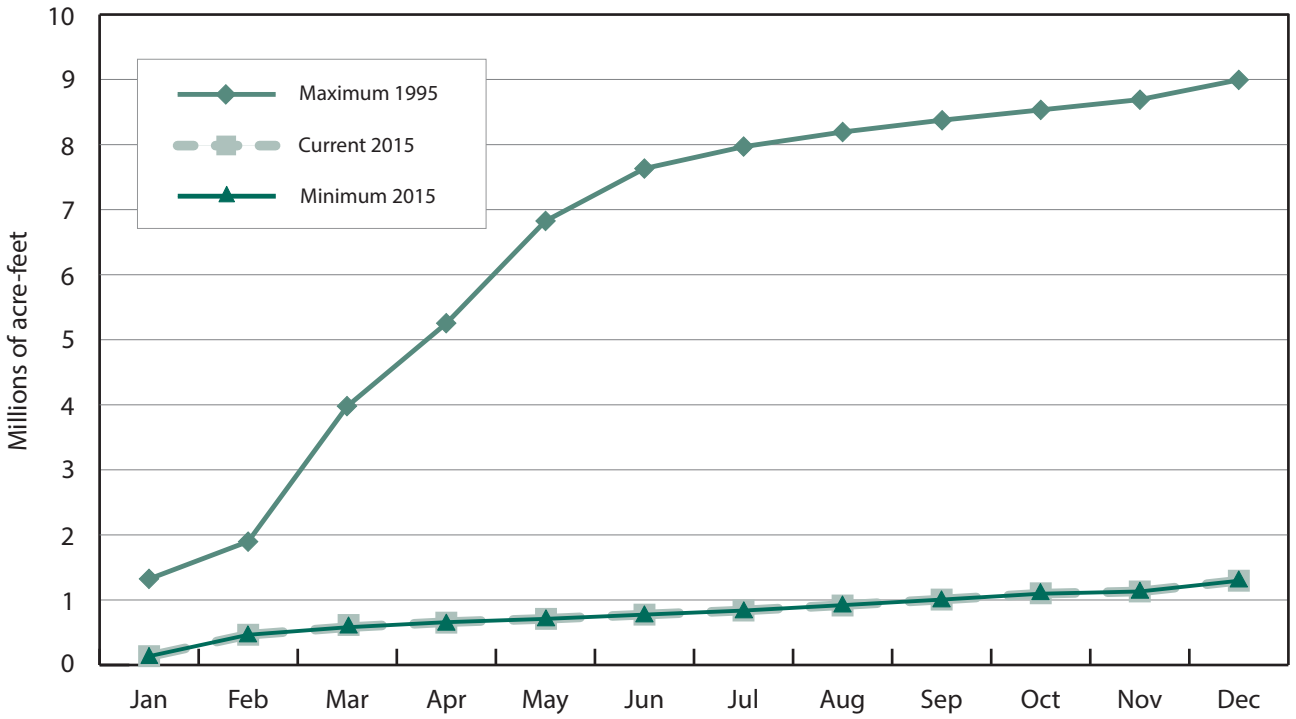



**Figure 8-3 Lake Oroville Cumulative Inflow over the Last 30 Years—Current and Historical Maximum and Minimum**

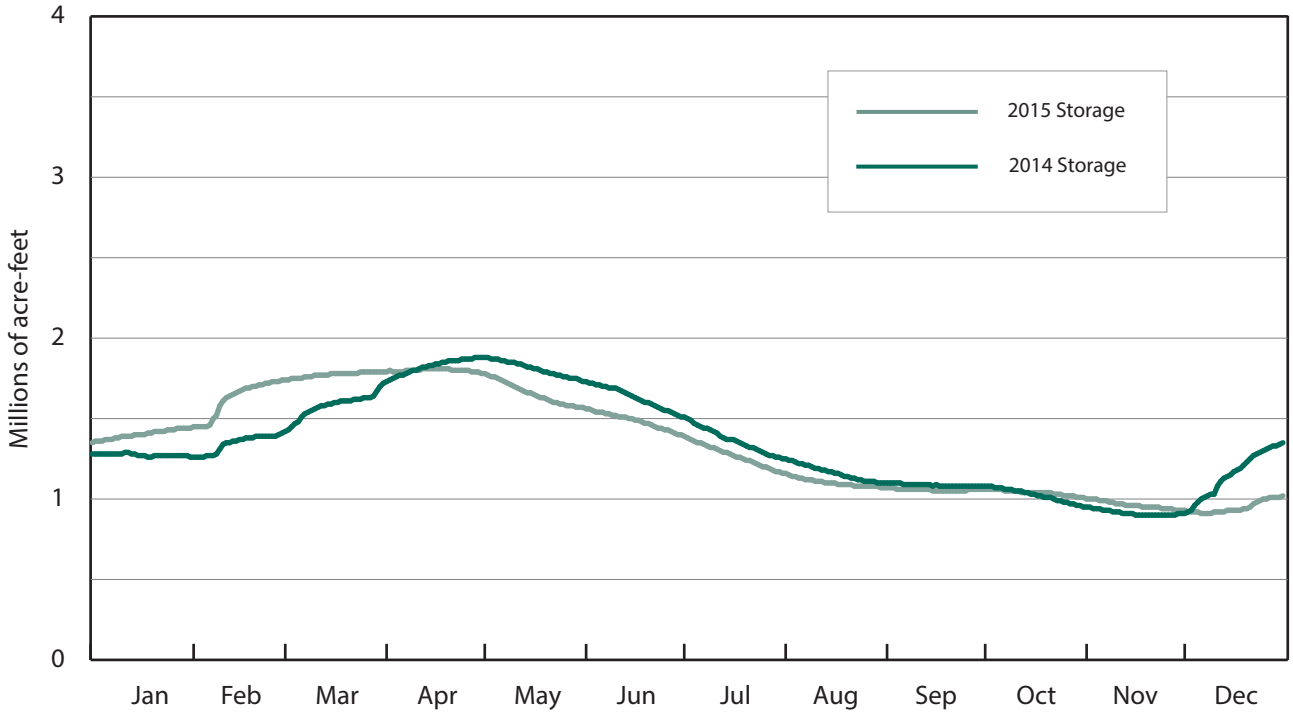



**Figure 8-4** **Storage in Lake Oroville, 2014 and 2015**

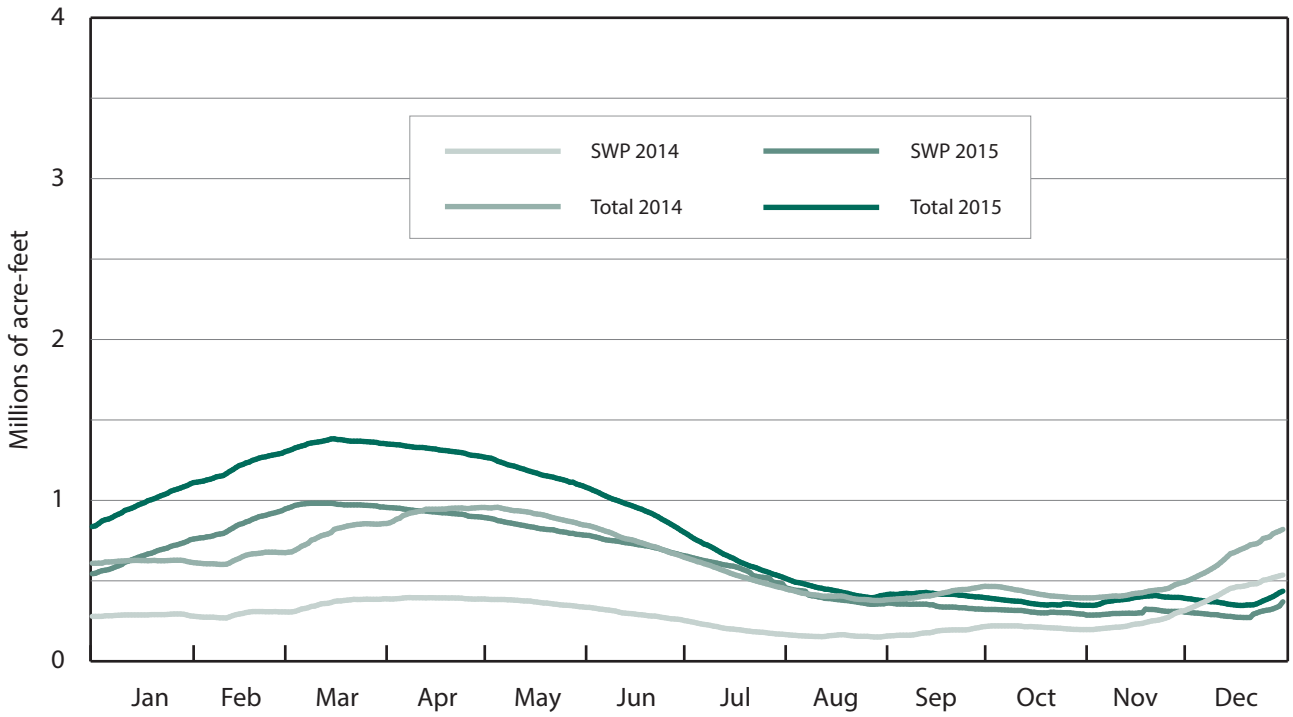



**Figure 8-5** **SWP Share of Storage and Total Storage in San Luis Reservoir, 2014 and 2015**

### *2015 Southern Reservoir Operations*

During normal operating conditions, DWR maintains its four southern reservoirs—Pyramid, Castaic, Silverwood, and Perris—at or near full operating capacity to ensure uninterrupted delivery of water to Southern California SWP water contractors.

At the beginning of 2015, these reservoirs held 406,879 af, which is 59 percent of their combined normal maximum operating capacity of 689,021 af. At the end of 2015, the reservoirs held 409,546 af, 59 percent of combined normal maximum operating capacity.

## Diversions from the Delta

The SWP diverts water from the Sacramento-San Joaquin Delta, through the Barker Slough and Banks pumping plants, for delivery to SWP water contractors' storage facilities. The SWP diverts water from Barker Slough Pumping Plant to the North Bay Aqueduct. Water is delivered from Banks Pumping Plant to the South Bay Area through the South Bay Aqueduct, and to the San Joaquin Valley, Central Coastal, and Southern California areas through the California Aqueduct. The Central Valley Project (CVP) diverts water to similar areas from the Delta through Jones Pumping Plant and Contra Costa Pumping Plant.

In 2015, the North Bay Aqueduct received 35,179 af of water from the Barker Slough Pumping Plant.

Figure 8-6 shows the amounts of water pumped each month for 2015 at Banks Pumping Plant, totaling 845,801 af. Of this amount, the SWP diverted 837,421 af. There was no pumping for the Cross Valley Canal, and 8,380 af was wheeled for the CVP. All CVP pumping at Banks Pumping Plant occurred in May and August.

The CVP diverted 688,723 af at Jones Pumping Plant and 71,621 af at Contra Costa Pumping Plant in 2015.

The combined Delta exports include all of these plants. Figure 8-7 shows the monthly amounts of water diverted from the Delta in 2015 by the SWP and CVP. Maximum daily Delta exports occurred on February 12 at 13,797 af. Combined SWP and CVP monthly Delta exports in 2015 varied from a low of 42,300 af in July, to a high of 318,941 af in January. Delta exports totaled approximately 1.6 maf in 2015.

Figure 8-8 shows monthly total amounts pumped at Dos Amigos Pumping Plant for 2015. Dos Amigos Pumping Plant diverts water from O'Neill Forebay to the California Aqueduct. Dos Amigos pumped the largest amount in July at 190,325 af.

Figure 8-9 shows the amount of water pumped each month in 2015 at Edmonston Pumping Plant. Water pumped through the Edmonston Pumping Plant for delivery to Southern California totaled 735,381 af.

Additional water supply information can be found on DWR's website.

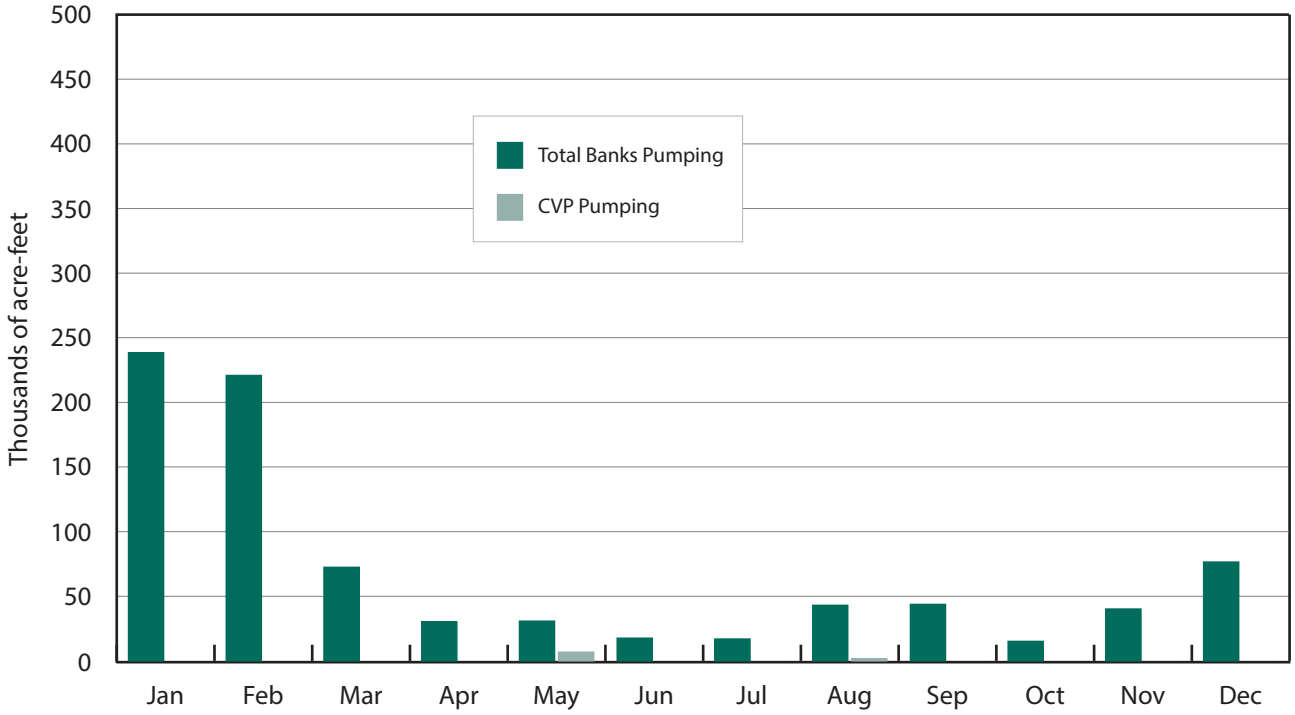



**Figure 8-6** **Water Pumped at Banks Pumping Plant, 2015**

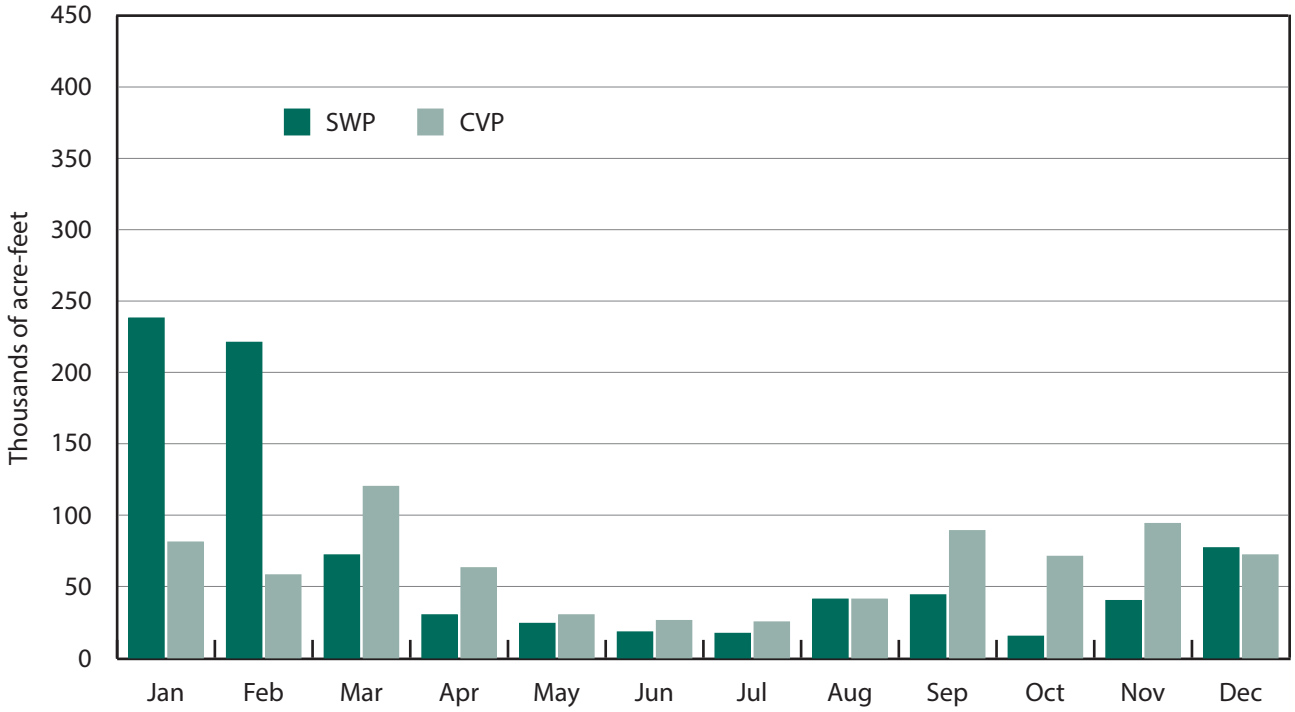



**Figure 8-7** **Sacramento-San Joaquin Delta Exports by State Water Project and Central Valley Project, 2015**

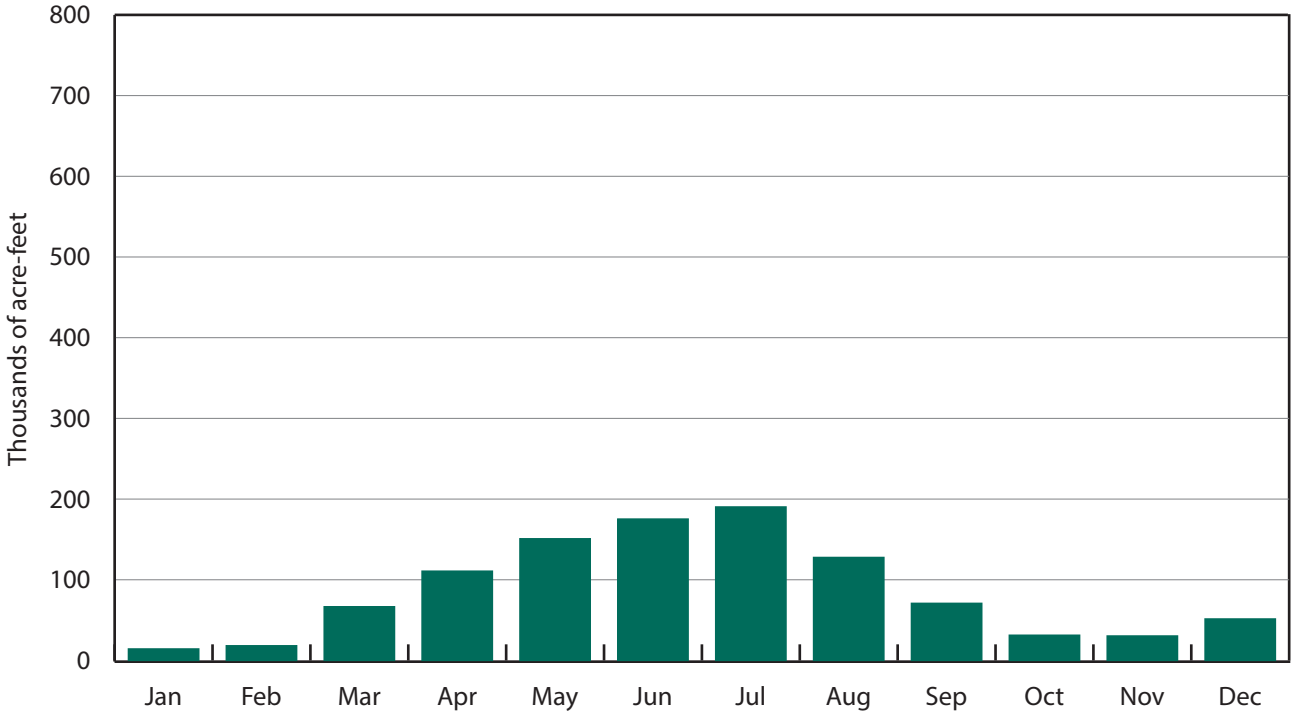



**Figure 8-8 Water Pumped at Dos Amigos Pumping Plant, 2015**

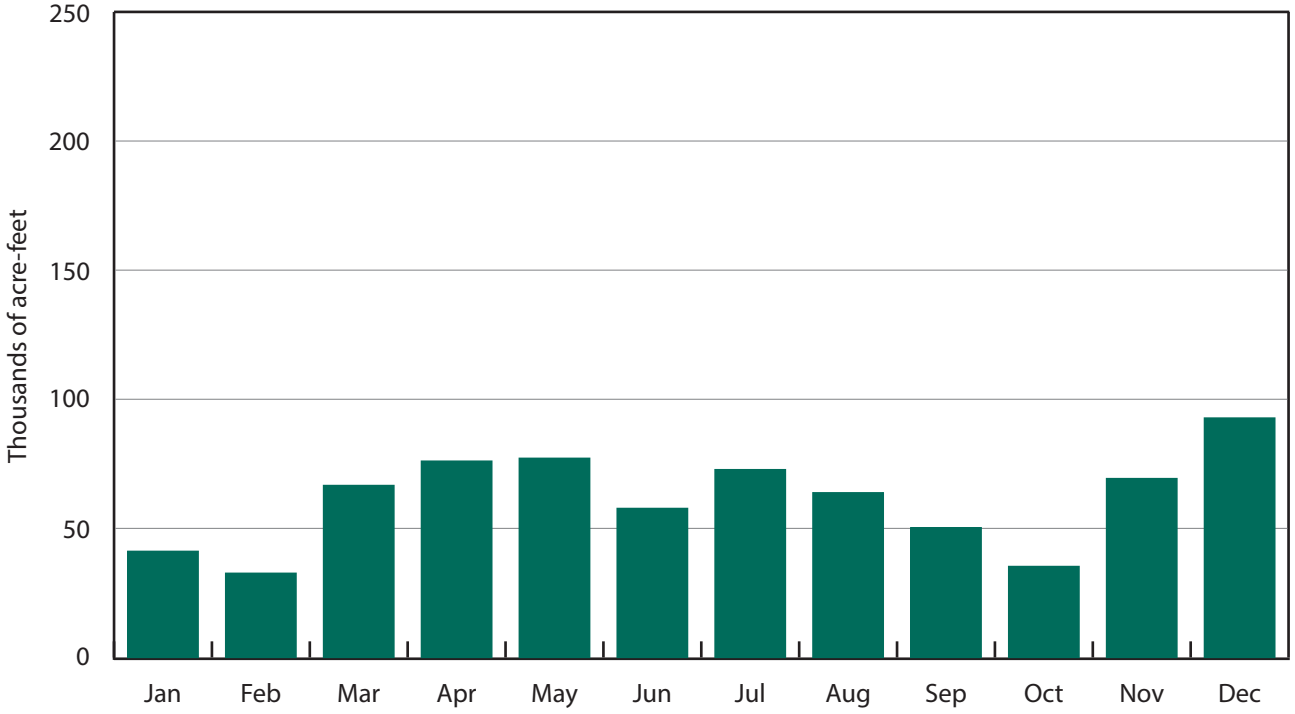



**Figure 8-9 Water Pumped at Edmonston Pumping Plant, 2015**



# Chapter 9
# Water Contracts and Deliveries

*Dyer Reservoir.*

## Significant Events in 2015

A total of 2,104,264 acre-feet (af) of State Water Project (SWP) and non-SWP water was delivered to 29 long-term SWP water contractors and 19 other agencies. The portion delivered to SWP water contractors was 1,336,889 af; the portion delivered to non-SWP agencies was 767,375 af.

The hydrologic conditions in the Sacramento and San Joaquin river watersheds were both classified as "critically dry." As a result, the Department of Water Resources (DWR) approved only 20 percent of the SWP water contractors' Table A allocation requests.

Eight SWP water contractors recovered approximately 347,852 af of water from water banks.

*Information for this chapter was provided by the State Water Project Analysis Office.*

Long-term water supply contracts between the Department of Water Resources (DWR) and 29 public agencies and local water districts provide for water service from the State Water Project (SWP) and are the basis for the SWP's construction and on-going operations. The State provides SWP financing, capital construction, improvements, and all operations and maintenance of SWP facilities, and the agencies and local districts have contractually agreed to repay all associated costs.

## Long-term Water Supply Contracts

The long-term water supply contracts also set forth the maximum amount of water a contractor may request each year from the SWP, and these water amounts are written within the contracts in a list format known as Table A. "Table A" or "Table A water" represents a portion or all of the annual Table A amount requested by SWP water contractors and approved for delivery by DWR based on hydrologic conditions, current reservoir storage, and combined requests from the SWP water contractors. Under certain water year conditions, DWR is not able to deliver the quantity of water requested by SWP water contractors. In those years, a proportional amount is allocated and delivered according to the long-term water supply contracts by prorating the amount in proportion to each SWP water contractor's annual Table A amount. Table A amounts may also be used as a factor to allocate other available water supplies to each contractor. Approved Table A amounts may also be referred to in this chapter as "approved amounts," "approved water," or "allocated water."

SWP water provided under the long-term water supply contracts include current year Table A amounts, transfer and exchange of Table A water, carryover water, Turn-Back Pools A and B water, Multiyear Water Pool Program water, and Article 21 water.

DWR enters into agreements with SWP water contractors and non-SWP agencies, which may be amended periodically, to convey SWP and non-SWP water through the California Aqueduct. Using SWP facilities, DWR conveys non-SWP water for various agencies according to the terms of water rights and water transfer and exchange agreements. DWR also enters into agreements to approve construction, operation, and maintenance of SWP facilities, including turnouts and turn-ins.

The State Water Project Analysis Office (SWPAO) uses a numbering system for contracts, amendments, and agreements executed by DWR. These numbers, referred to as SWPAO numbers, are designated in Chapter 9 text as "SWPAO #XXXXX" and are located in parentheses in descending order, after each contract, amendment, or agreement description. These numbers can be used as identifiers to contact DWR staff for more detailed information on a particular document.

### Contract Extension Negotiations

In May 2013, DWR and the SWP water contractors began negotiations in a public forum to develop contract amendments to extend the term and change certain financial provisions of the long-term water supply contracts. In June 2014, the negotiators for DWR and the SWP water contractors reached a general agreement on principles for such an amendment (the "Agreement in Principle").

## State Water Project Long-term Water Supply Contracts

The first long-term water supply contract was signed with The Metropolitan Water District of Southern California (Metropolitan) on November 4, 1960. The contract was negotiated by the Department of Water Resources (DWR) and Metropolitan according to terms of the contracting principles for water service contracts announced by the Governor on January 20, 1960.

The Metropolitan contract became the prototype for all long-term water supply contracts; by the end of 1967, 31 agencies had contracted for water. In addition, a long-term water supply contract was executed with the City of West Covina in December 1963, but it was terminated in August 1965, and the city's Table A amount was transferred to Metropolitan through an amendment to its long-term contract with DWR. Long-term contracts with Hacienda Water District and Devil's Den Water District were also terminated when those districts transferred their Table A amounts, through contract amendments, to Tulare Lake Basin Water Storage District (1981) and Castaic Lake Water Agency (1992), respectively. Today the State Water Project (SWP) has long-term water supply contracts with 29 SWP water contracting agencies. Those contracts have been amended periodically, and as needed, to incorporate mutually agreed upon modifications.

All water contracts signed in the 1960s included an estimated date for initial water deliveries and a schedule of the water delivery amount the SWP water contractor could expect annually (annual Table A amounts). That amount was designed to increase gradually until the maximum amount of annual Table A was reached. The total combined maximum annual Table A amount for all SWP water contracting agencies was initially 4,230,000 acre-feet (af), assuming full development of the SWP.

The contracts were executed for 75 years or until all bonds sold as part of the California Water Resources Development Bond Act were repaid, whichever period was longer. As a result of amendments to contracts in the 1990s, the current combined maximum annual Table A amount totals 4,172,786 af, and the contracts are in effect for the longest of the following periods: (1) the project repayment period, which extends to December 31, 2035; (2) 75 years from the date of the contract; or (3) the period ending with the latest maturity date of any bond used to finance the construction costs of project facilities.

Currently, the long-term water supply contracts remain in effect for whichever period is longest, the project repayment period, which extends to December 31, 2035, 75 years from the effective date of the contract, or until all bonds issued to finance construction costs of SWP facilities are repaid. Each SWP water contractor may elect to receive continued service under its long-term water supply contract contingent upon certain specified terms and conditions and other reasonable and equitable terms mutually agreed upon by DWR and the SWP water contractors.

The 75-year long-term water supply contract term results in the contracts having varying termination dates that range between

December 31, 2035, and December 31, 2042. Under the Agreement in Principle, each SWP water contractor that signs an amendment would extend its contract term to December 31, 2085.

Also under the Agreement in Principle, payment provisions for capital costs and certain other costs will be amended from an amortized basis to an annual "pay as you go" basis. The "pay as you go" provisions will provide revenues needed by DWR to operate the SWP in a fiscally sound manner. The long-term water supply contracts' current provisions authorizing DWR to charge the SWP water contractors annually for the full amount of required annual debt service and coverage on the bonds will continue in any extended long-term water supply contract.

The Agreement in Principle also provides for, among other things, the following:

- an increase in DWR's operating reserves—a mechanism for financing capital projects with interest from the SWP water contractors;
- the establishment of accounts to fund for certain State Water Resources Development System expenses not chargeable to the SWP water contractors; and
- the establishment of a finance committee consisting of DWR and contractor representatives to serve as a forum for discussions and to provide a channel for recommendations concerning SWP financial policies.

Before any long-term water supply contract amendment is adopted, DWR must accomplish the following as part of the contract amendment process: (1) complete an environmental review pursuant to the California Environmental Quality Act and (2) deliver a presentation in an informational hearing to the California Legislature. In 2015, DWR continued preparing a draft environmental impact report (EIR) for the proposed contract extension amendment.

# Amendments to Long-term SWP Water Supply Contracts

All of the original long-term water supply contracts signed by DWR and the 29 long-term SWP water contractors have been amended to incorporate mutually desired changes. Most amendments fall under the following general categories:

(1) permanent transfers of Table A amounts from one SWP water contractor to another;
(2) allocation of costs and benefits for the addition or enlargement of SWP facilities;
(3) purchase of excess capacity in the California Aqueduct; and
(4) provisions to implement Monterey Agreement principles.

## 2015 Amendments to Long-term SWP Water Supply Contracts

There were no amendments to the long-term water supply contracts in 2015.

## Monterey Amendments

The Monterey Amendments increased the reliability of existing water supplies and water management flexibility, providing more tools for the 29 long-term SWP water contractors to maximize use of existing facilities.

The Monterey Amendments included changes in allocation of Table A water, the transfer of Table A amounts and land, financial restructuring, and increased operational flexibility. The Monterey Amendments are discussed in detail in Bulletin 132-95, Chapter 1, Summary of Significant Events, available on the DWR website.

In 2015, DWR continued to operate the SWP according to the long-term water supply contracts, the Monterey Amendments, and the May 5, 2003, settlement agreement for the Planning and Conservation League v. DWR (1995) lawsuit. The May 2003 settlement agreement is discussed in detail in Bulletin 132-04, Chapter 9, Water Contracts and Deliveries, available on DWR's website. As required by the settlement agreement, the Monterey Plus EIR was prepared and eventually certified by DWR in 2010. The adequacy of the Monterey Plus EIR was challenged, and the court found that the Monterey Plus EIR complied with the California Environmental Quality Act in all respects except with regard to its discussion/analysis of the development, use, and operation of the Kern Water Bank. In November 2014, the court ordered DWR to correct the deficiencies in a revised Monterey Plus EIR and to recertify the revised Monterey Plus EIR by December 31, 2015. In July 2015, the court granted DWR's request for a 6-month extension, changing the deadline to June 30, 2016.

See Chapter 6, Legislation and Litigation, for the current status of the Monterey Amendment litigation.

# Miscellaneous Agreements with Long-term SWP Water Contractors

## 2015 Water Conveyance and Exchange Agreements

Water conveyance and exchange agreements that were executed or pending execution with SWP water contractors during 2015 are described below.

### *AVEK/Littlerock*

A letter agreement among DWR, AVEK, and Littlerock, dated December 29, 2015, and executed on December 31, 2015, approved the delivery of up to 460 acre-feet (af) of Littlerock's 2015 SWP Table A water to AVEK by December 31, 2015. In exchange, AVEK will return an equal amount, up to 460 af, of its future approved SWP Table A water to Littlerock by December 31, 2025. There will be no monetary payments between AVEK and Littlerock for this 1:1 exchange. During 2015, a total of 460 af was delivered to AVEK under this agreement. (SWPAO #15026)

### *Alameda County/Alameda-Zone 7/ Contra Costa*

A letter agreement among DWR, Alameda County, Alameda-Zone 7, and Contra Costa Water District (Contra Costa), dated December 18, 2015, was executed December 21, 2015. The agreement approved the exchange of up to 5,000 acre-feet (af) of SWP water supplies for an equal amount of Contra Costa's Central Valley Project (CVP) water supplies.

This CVP-SWP water exchange is to facilitate the return of up to 5,000 af of Alameda County's and Alameda-Zone 7's previously stored water in Kern County. Contra Costa can divert up to 5,000 af of SWP water supplies at its intakes for use in its service area before January 20, 2016. In exchange, the Bureau of Reclamation (Reclamation) will make available an equal amount, up to 5,000 af, of Contra Costa's CVP water supplies at Banks Pumping Plant for subsequent delivery by DWR to Alameda County and Alameda-Zone 7 turnouts located on the South Bay Aqueduct under Article 55 of Alameda County's and Alameda Zone 7's respective long-term water supply contracts with DWR. DWR filed a petition with the State Water Resources Control Board (SWRCB) and received a 1-year approval, effective January 20, 2015, for a temporary change in point of diversion to allow the diversion of SWP water at Contra Costa's intakes. Reclamation filed a separate petition and received a 1-year approval, effective September 28, 2015, for a change in point of diversion to allow the diversion

of CVP water at Banks Pumping Plant to complete the water exchange. In 2015, no water was moved under this agreement. (SWPAO #15025)

### *Santa Clara*

An agreement between DWR and Santa Clara, executed September 21, 2015, provides additional temporary points of delivery for the return of a portion of Santa Clara's previously stored SWP water supplies in the Semitropic Water Banking and Exchange Program. DWR and Santa Clara have previously entered into separate change in point of delivery agreements that allow for the storage and future return of Santa Clara's approved SWP water supplies under the Semitropic Water Banking and Exchange Program. Under the executed point of delivery agreements, Santa Clara's stored water can be returned to Santa Clara through the South Bay Aqueduct. This agreement allows for temporary additional points of delivery of a portion of Santa Clara's stored water in the Semitropic Water Banking and Exchange Program at O'Neill Forebay and/or San Luis Reservoir through December 31, 2017. Santa Clara's water delivered to San Luis Reservoir and/or O'Neill Forebay under this agreement will be used within the SWP place of use. (SWPAO #15017)

An agreement between DWR and Santa Clara Valley Water District (Santa Clara), executed September 21, 2015, allows for additional temporary points of delivery of a portion of Santa Clara's SWP water supplies at San Luis Reservoir and/or O'Neill Forebay through December 31, 2017. Santa Clara's water delivered to San Luis Reservoir and/or O'Neill Forebay under this agreement will be used within the SWP place of use. (SWPAO #15016)

### *Dudley Ridge/Westlands*

A change in point of delivery agreement among DWR, Dudley Ridge, and Westlands Water District (Westlands), executed August 4, 2015, approved the delivery of up to 850 af of Dudley Ridge's approved 2015 SWP Table A water to Westlands through August 31, 2015. This is to facilitate an exchange between Sandridge Partners and a landowner in Westlands' service area. The landowner acquired 850 af of water from Shafter-Wasco Irrigation District, a CVP Friant Division contractor. This water was made available to Sandridge Partners for use in Kern County. In exchange, an equivalent amount, up to 850 af, of Dudley Ridge's approved 2015 SWP Table A water was delivered to Westlands in Reach 7 of the California Aqueduct for use on lands in the Kings County portion of Westlands' service area, which is within the SWP place of use. In 2015, 850 af of Dudley Ridge's Table A water was delivered to Westlands under this agreement. (SWPAO #15015)

### *San Bernardino/Santa Clara*

A letter agreement among DWR, San Bernardino, and Santa Clara, dated July 16, 2015, and executed August 4, 2015, approved the delivery of up to 2,500 af of San Bernardino's approved 2015 SWP Table A water to Santa Clara by December 31, 2015. In exchange, Santa Clara will return up to 5,000 af, based on an exchange ratio of 1:2, of its future approved SWP water supplies. Santa Clara will return to San Bernardino up to 2,500 af by December 31, 2018, and up to 2,500 af by December 31, 2023. During 2015, a total of 2,500 af of San Bernardino's Table A water was delivered to Santa Clara under this agreement. (SWPAO #15014)

### *Tulare/San Luis Water District/Westlands*

A change in point of delivery agreement among DWR, Tulare, San Luis Water District (San Luis), and Westlands, executed August 4, 2015, approved the delivery of up to a total of 14,000 af of Tulare's approved SWP water supplies to Westlands and San Luis by April 30, 2016. This agreement facilitates delivery of Kings River pre-1914 water rights water from J.G. Boswell

Company, a landowner in Tulare, to Westlands' and San Luis' service areas. In exchange, up to 14,000 af of J.G. Boswell Company's Kings River pre-1914 water rights water will be delivered to Tulare for use in its service area. DWR filed a petition with the SWRCB and received a 1-year approval effective May 1, 2015, for consolidation of SWP and CVP places of use. During 2015, a total of 14,000 af of Tulare's Table A water was delivered to Westlands and San Luis, of which 10,500 af was delivered to Westlands and 3,500 af was delivered to San Luis under this agreement. (SWPAO #15013)

### *Kern/Westlands*

A change in point of delivery agreement among DWR, Kern, and Westlands, executed August 12, 2015, provided for a same landowner transfer by Paramount Farming Company that owns land in both Kern's and Westlands' service areas. This agreement approved the delivery of up to 3,000 af of Kern's approved 2015 and/or 2016 SWP Table A water to Westlands. In exchange, Kern will retain a like amount of Paramount Farming Company's CVP water previously stored in Kern's service area. DWR filed a petition with the SWRCB and received a 1-year approval order, effective May 1, 2015, for the consolidation of SWP and CVP places of use. During 2015, no water was delivered to Westlands under this agreement. (SWPAO #15012)

### *Kern*

A change in point of delivery agreement between DWR and Kern, executed July 9, 2015, approved the delivery of up to 16,705 af of Kern's approved 2015 and/or 2016 SWP Table A water at O'Neill Forebay to Reclamation for subsequent delivery by Reclamation to the San Joaquin River Exchange Contractors (Exchange Contractors) through April 30, 2016. This is to facilitate the return of Kern-Tulare Water District's (Kern-Tulare) and Delano-Earlimart Irrigation District's (Delano-Earlimart) previously stored CVP water supplies in Kern's service area. The return and delivery of Kern-Tulare's and Delano-Earlimart's previously stored water was accomplished through a series of exchanges. First, DWR made available up to 16,705 af of Kern's approved Table A water at O'Neill Forebay to Reclamation for subsequent delivery by Reclamation to the Exchange Contractors for use on lands outside the SWP place of use. In exchange, Kern will retain a like amount of Kern-Tulare's and Delano-Earlimart's previously stored water in Kern's service area. Kern-Tulare and Delano-Earlimart will in turn receive a like amount of San Joaquin River water, normally delivered to the Exchange Contractors, which will instead be released by Reclamation from Millerton Lake for delivery to Kern-Tulare and Delano-Earlimart. DWR filed a petition with the SWRCB on May 11, 2015, and received approval on May 22, 2015, for an additional exchange of water under SWRCB's April 27, 2015, order for approval of consolidation of SWP and CVP places of use. During 2015, a total of 16,705 af of Kern's Table A water was made available to Reclamation at O'Neill Forebay under this agreement. (SWPAO #15011)

### *AVEK/Kern*

A letter agreement among DWR, AVEK, and Kern, dated May 28, 2015, and executed October 20, 2015, approved the transfer of up to 861 af of approved AVEK's SWP water supplies to Kern on behalf of Tejon Ranch Company that farms in both AVEK's and Kern's service areas. During 2015, no water was delivered to Kern under this agreement. (SWPAO #15008)

### *Kern/Westlands*

A change in point of delivery agreement among DWR, Kern, and Westlands, executed August 12, 2015, provided for a same landowner transfer by Poso Creek Water Company that has farming operations in both Kern's and Westlands' service areas.

This agreement approved the delivery of up to 12,819 af of Kern's approved 2015 and/or 2016 SWP Table A water to Westlands. In exchange, Kern will retain a like amount of Poso Creek Water Company's CVP water previously stored in Kern's service area. DWR filed a petition with the SWRCB and received a 1-year approval order, effective May 1, 2015, for the consolidation of SWP and CVP places of use. During 2015, no water was delivered to Westlands under this agreement. (SWPAO #15007)

### *AVEK/Santa Barbara*

A letter agreement (SWPAO #15005) among DWR, AVEK, and Santa Barbara, dated March 26, 2015, and executed April 10, 2015, approved the delivery of up to 7,500 af of AVEK's approved SWP water supplies to Santa Barbara by December 31, 2015. In exchange, Santa Barbara will return up to 7,500 af, based on an even exchange ratio of 1:1, of its future approved SWP water supplies to AVEK by December 31, 2025. A subsequent amendment (SWPAO #15005-A), dated July 27, 2015, and executed August 31, 2015, allows storage of a portion of AVEK's SWP water supplies in San Luis Reservoir. The water supplies are identified as carryover water for later delivery to Santa Barbara by December 31, 2017. During 2015, 4,847 af of AVEK's Table A water was delivered to Santa Barbara under this agreement. (SWPAO #15005 and #15005-A)

### *AVEK/Santa Clara*

A letter agreement among DWR, AVEK, and Santa Clara, dated March 18, 2015, and executed April 23, 2015, approved the delivery of up to 15,000 af of AVEK's approved SWP water supplies to Santa Barbara by December 31, 2015. In exchange, Santa Clara will return up to 15,000 af, based on an even exchange ratio of 1:1, of its future approved SWP water supplies to AVEK by December 31, 2025. During 2015, a total of 7,500 af of AVEK's Table A water was delivered to Santa Clara under this agreement. (SWPAO #15004)

### *Tulare/Westlands*

A letter agreement among DWR, Tulare, and Westlands, dated March 5, 2015, and executed March 16, 2015, approved the transfer of up to 4,000 af of Tulare's 2015 SWP Table A water to Westlands on behalf of Westlake Farms Incorporated, which has farms in both Tulare's and Westlands' service areas. During 2015, no water was delivered to Westlands under this agreement. (SWPAO #15003)

### *Kern/Tulare*

A letter agreement among DWR, Kern, and Tulare, dated March 5, 2015, and executed April 24, 2015, approved the transfer of up to 10,000 af of Tulare's 2015 SWP Table A water to Kern on behalf of J.G. Boswell Company, which has farms in both Tulare's and Kern's service areas. During 2015, no water was delivered to Kern under this agreement. (SWPAO #15002)

### *AVEK/Littlerock*

A letter agreement among DWR, AVEK, and Littlerock, dated December 23, 2014, and executed September 3, 2015, approved the delivery of up to 115 af of Littlerock's 2014 SWP Table A water to AVEK. In exchange, AVEK will return an equal amount, up to 115 af, of its future approved SWP Table A water to Littlerock by December 31, 2024. There will be no monetary payments between AVEK and Littlerock for this 1:1 exchange. During 2015, no water was moved under this agreement. (SWPAO #14021)

### *Kern/Westlands*

A change in point of delivery agreement among DWR, Kern, and Westlands was executed February 24, 2015, to facilitate a water exchange between Harris Farms, LLC and Semitropic Water Storage District, a member unit of Kern. This agreement

approved the delivery of up to 4,627 af of Kern's approved 2014 and/or 2015 SWP Table A water to Westlands through April 30, 2015. In exchange, Kern will retain a like amount of Harris Farm, LLC's CVP water previously stored in Kern's service area. DWR filed a petition with the SWRCB on October 20, 2014, and received approval on October 24, 2014, for additional exchange of water under SWRCB's March 28, 2014, order for the approval of the consolidation of SWP and CVP places of use. An amendment (SWPAO #14020-A) dated July 9, 2015, and executed July 14, 2015, extends the term of the agreement to allow the delivery of up to 3,055 af of Kern's approved 2015 and/or 2016 Table A water to Westlands through April 30, 2016. DWR filed a petition with the SWRCB and received a 1-year approval order, effective May 1, 2015, for the consolidation of SWP and CVP places of use. During 2015, a total of 4,627 af of Kern's Table A water was delivered to Westlands under this agreement. (SWPAO #14020 and SWPAO #14020-A)

### *Kern*

An amendment between DWR and Kern, dated July 6, 2015, and executed July 15, 2015, approved the delivery of up to 5,182 af of Kern's Table A water to Westlands' service area outside of Kings County for 2015 and 2016. The original agreement (SWPAO #06013), executed April 26, 2007, allowed the return water to be delivered only in the Kings County portion of Westlands' service area, which is within the SWP place of use. DWR filed a petition with the SWRCB and received a 1-year approval order, effective May 1, 2015, for the consolidation of SWP and CVP places of use. During 2015, a total of 1,341 af of Kern's Table A water was delivered to Westlands under this agreement. (SWPAO #06013 and SWPAO #06013-D)

### *Kern/Metropolitan*

An amendment among DWR, Kern, and Metropolitan, executed August 31, 2015, approved the delivery of up to 20,000 af of Metropolitan's approved SWP water supplies to O'Neill Forebay by March 1, 2015, facilitating an exchange among the Exchange Contractors. Under this amendment, up to 20,000 af of Metropolitan's approved SWP water supplies would be made available at O'Neill Forebay and subsequently delivered by Reclamation to the Exchange Contractors. In exchange, Reclamation will deliver an equal amount of CVP water to Arvin-Edison Water Storage District (Arvin-Edison) on behalf of Metropolitan. DWR filed a petition with the SWRCB and received a 1-year approval order, effective May 1, 2014, for the consolidation of SWP and CVP places of use. The original long-term point of delivery agreement (SWPAO #01013), executed March 18, 2004, approved the delivery of a portion of Metropolitan's approved SWP water supplies for storage and later recovery from groundwater basins within Arvin-Edison through December 31, 2035. No water was moved under this amendment in 2015. (SWPAO #01013 and SWPAO #01013-A)

### *AVEK/Mojave*

An amendment (SWPAO #97003-B) among DWR, Mojave, and AVEK, executed April 30, 2015, approved an additional point of delivery of Mojave's approved SWP Table A water to AVEK's turnout in Reach 20A of the California Aqueduct. The 1997 agreement (SWPAO #97003) executed on November 13, 1997, and the amendment (SWPAO #97003-A) executed on January 12, 2012, approved the delivery of up to 1,800 af per year of Mojave's approved Table A water for use by a solar power generating plant operated by Luz Solar Partners, Ltd. III–VII. The amendment approved the delivery of up to 3,000 af of Mojave's approved Table A water in AVEK's groundwater basin as a

backup water supply to the solar plant in the event of an SWP outage through December 31, 2035. During 2015, a total of 1,023 af of Mojave's Table A water was delivered to AVEK under this agreement. (SWPAO #97003, SWPAO #97003-A, and SWPAO #97003-B)

## Water Conveyance and Exchange Agreements Prior to 2015

### *Palmdale/San Bernardino*

A letter agreement among DWR, Palmdale, and San Bernardino, dated August 1, 2014, and executed August 14, 2014, approved the delivery of up to 2,500 af of San Bernardino's approved SWP water supplies to Palmdale by December 31, 2014. In exchange, Palmdale will return up to 5,625 af, based on an unbalanced exchange ratio of 1:2.25, of its future SWP water supplies to San Bernardino by December 31, 2018. During 2015, a total of 500 af of Palmdale's Table A water was delivered to San Bernardino under this agreement. (SWPAO #14013)

### *Butte*

A letter agreement between DWR and Butte, dated July 7, 2014, and executed July 29, 2014, approved the conveyance of up to 3,000 af per year of non-SWP water to California Water Service Company, a member agency of Butte, through December 31, 2017. This non-SWP water is made available by Pacific Gas & Electric Company for DWR to convey to California Water Service Company's turnouts at the Thermalito Power Canal, under Article 55 of Butte's long-term water supply contract. During 2015, a total of 2,558 af of non-SWP water was conveyed under this agreement. (SWPAO #14011)

### *Dudley Ridge/Santa Clara*

A letter agreement among DWR, Dudley Ridge, and Santa Clara, dated June 28, 2013, and executed July 12, 2013, approved the conveyance of up to 3,100 af per year, minus Sacramento-San Joaquin Delta carriage water losses, on a 50/50 equal basis of non-SWP water to Dudley Ridge and Santa Clara through December 31, 2024. This non-SWP water is made available by Browns Valley Irrigation District. During 2015, 1,240 af was delivered to Dudley Ridge and 1,240 af was delivered to Santa Clara under this agreement. (SWPAO #13020)

### *Butte*

Three multiyear agreements (SWPAO #13013, SWPAO #13014, and SWPAO #13015) were executed in 2014 among DWR, Butte, and several participating SWP contractors. Butte's long-term water supply contract with DWR provides for Butte to have a maximum Table A amount of 27,500 af per year. Butte determined that 24,000 af per year of its Table A amount is not needed to meet its in-county demands for 2014 through 2021 and requested a transfer of up to 24,000 af per year of its Table A water to Palmdale, Dudley Ridge, and Kern. Up to 10,000 af of Butte's allocated Table A water is made available to transfer to Palmdale. Up to 14,000 af of Butte's allocated Table A water is shared on a percentage basis of 85.66 and 14.34 percent for transfer to Kern and Dudley Ridge, respectively. Butte also determined that the difference of 3,500 af per year (27,500 af minus 24,000 af) may not be fully utilized by Butte for its in-county needs and requested a transfer of a portion of the 3,500 af per year on a percentage basis to Palmdale, Dudley Ridge, and Kern when it becomes available (Butte's Additional Water). In 2015, Butte's allocated Table A water was transferred as follows.

**Butte/Kern.** A multiyear agreement among DWR, Butte, and Kern, executed August 5, 2014, approved the annual delivery of a portion of Butte's allocated Table A water plus a portion of Butte's Additional Water when it becomes available to four of Kern's member units (Belridge Water Storage District, Berrenda Mesa Water Storage District, Lost Hills Water District, and

Wheeler Ridge-Maricopa Water Storage District) in years 2014 through 2021. During 2015, a total of 1,554 af of Butte's Table A water was delivered to Kern under this agreement. (SWPAO #13015)

**Butte/Dudley Ridge.** A multiyear agreement among DWR, Butte, and Dudley Ridge, executed August 5, 2014, approved the annual delivery of a portion of Butte's allocated Table A water plus a portion of Butte's Additional Water when it becomes available to Dudley Ridge in years 2014 through 2021. During 2015, a total of 260 af of Butte's Table A water was delivered to Dudley Ridge under this agreement. (SWPAO #13014)

**Butte/Palmdale.** A multiyear agreement among DWR, Butte, and Palmdale, executed August 5, 2014, approved the annual delivery of a portion of Butte's allocated Table A water plus a portion of Butte's Additional Water when it becomes available to Palmdale in years 2014 through 2021. During 2015, a total of 1,296 af of Butte's Table A water was delivered to Palmdale under this agreement. (SWPAO #13013)

### *Dudley Ridge/Kern/Metropolitan*

A multiyear exchange and change in point of delivery agreement among DWR, Dudley Ridge, Kern, and Metropolitan, executed December 16, 2013, approved the delivery of up to 8,700 af of Dudley Ridge's approved SWP water supplies to Metropolitan by December 31, 2017. In exchange, Metropolitan will return up to 4,350 af, based on an unbalanced exchange ratio of 2:1, of its future approved SWP water supplies to Dudley Ridge by December 31, 2022. This agreement allows for the delivery of a portion of Dudley Ridge's approved SWP water supplies to either Metropolitan's service area and/or Kern's turnouts for storage in Rosedale-Rio Bravo Water District (Rosedale-Rio Bravo), a member unit of Kern, for later use by Metropolitan within its own service area. During 2015, a total of 452 af of Dudley Ridge's Table A water was delivered to Metropolitan under this agreement. (SWPAO #13012)

### *Coachella/Kern*

A multiyear change in point of delivery and conveyance agreement among DWR, Coachella, and Kern, executed July 30, 2013, approved the annual delivery of up to 16,500 af of water acquired by Coachella back to Coachella through December 31, 2035. Glorious Land Company (GLC) and Rosedale-Rio Bravo executed an agreement in 2005 to provide a water supply from Rosedale-Rio Bravo to GLC's development project in Riverside County. GLC was not yet ready to receive the water to which it was entitled under the 2005 Rosedale-Rio Bravo/GLC agreement. In 2012, GLC and Coachella executed an assignment agreement that allowed Coachella to annually acquire up to 16,500 af of Rosedale-Rio Bravo's water under the 2005 Rosedale-Rio Bravo/GLC Agreement (Assigned Water). This agreement allows for the delivery of the Assigned Water to Coachella by (1) a change in point of delivery of a portion of Rosedale-Rio Bravo's allocation of Kern's Table A water as an exchange for a like amount of Assigned Water and (2) conveyance of the Assigned Water to Coachella under Article 55 of Coachella's long-term water supply contract by direct pump-in of the water into the California Aqueduct. In 2015, a total of 9,500 af was delivered to Coachella under this agreement. (SWPAO #12023)

### *Dudley Ridge/Tulare*

A same landowner agreement among DWR, Dudley Ridge, and Tulare, executed September 7, 2012, approved multiyear transfers between Dudley Ridge and Tulare through December 31, 2035. This agreement allows for the delivery of up to 15,000 af per year of a portion of Dudley Ridge's and/or a portion of Tulare's approved Table A water for same landowner transfers to the other party without any expected return. During

2015, a total of 617 af of Tulare's Table A water was delivered to Dudley Ridge's turnouts. (SWPAO #12011)

### *Kern/Metropolitan/Santa Barbara*

A letter agreement among DWR, Kern, Metropolitan, and Santa Barbara, dated April 18, 2012, and executed June 28, 2012, approved the exchange of up to 1,500 af of Santa Barbara's approved SWP water supplies with Metropolitan's future SWP water supplies equal to one-half, less losses, of the total amount delivered to Metropolitan. Metropolitan will provide the return water to Santa Barbara by December 31, 2017. A separate change in point of delivery agreement (SWPAO #11022) among DWR, Kern, and Metropolitan, executed August 3, 2012, allowed for Santa Barbara's approved SWP water supplies to be delivered to Kern's turnouts for storage in Kern County, as described in Bulletin 132-13. During 2015, a total of 410 af of Metropolitan's Table A water was delivered to Santa Barbara. (SWPAO #11021)

### *AVEK/Palmdale*

A letter agreement among DWR, AVEK, and Palmdale, dated May 1, 2012, and executed November 13, 2012, approved the delivery of up to 10,000 af of Palmdale's 2011 SWP water supplies to AVEK. In exchange, AVEK will return 50 percent, up to 5,000 af, of its future SWP water supplies to Palmdale by December 31, 2021. During 2015, a total of 2,465 af of AVEK's water was delivered to Palmdale, of which 653 af was Article 56(c) carryover water and 1,812 af was Table A water. (SWPAO #11020)

### *Dudley Ridge/Kern*

A multiyear same landowner transfer agreement among DWR, Dudley Ridge, and Kern, executed June 13, 2011, provided for the delivery of a portion of Dudley Ridge's approved Table A water for same landowner transfers to Kern through December 31, 2020, without any expected return. During 2015, a total of 16,950 af of Dudley Ridge's water was delivered to Kern under this agreement. (SWPAO #10030)

### *Empire/Westlands*

A long-term change in place of use agreement among DWR, Empire, and Westlands, executed March 3, 2011, approved the annual delivery of up to 2,000 af of Empire's approved Table A water to Westlands through April 1, 2027. This transfer was made on behalf of two landowners, Brooks Farms and Newton Brothers Farms, that farm in both Empire's and Westlands' service areas. DWR filed a petition with the SWRCB and received approval for a temporary change in place of use. The SWRCB subsequently issued an order authorizing the long-term change in place of use on November 21, 2011. During 2015, a total of 262 af of Empire's Table A water was delivered to Westlands under this agreement. (SWPAO #10008)

### *Tulare/Westlands*

A long-term change in place of use agreement among DWR, Tulare, and Westlands, executed January 7, 2011, approved the annual delivery of up to 8,000 af of Tulare's approved Table A water to Westlands' turnouts through April 1, 2027. The transfer was made on behalf of two landowners, Hansen Ranches and Newton Brothers Farms, that farm in both Tulare's and Westlands' service areas. DWR filed a petition with the SWRCB and received approval for a temporary change in place of use. The SWRCB issued an order authorizing the long-term change in place of use on November 21, 2011. In 2015, a total of 1,742 af of Tulare's Table A water was delivered to Westlands. (SWPAO #10006)

### *Napa/Solano*

A long-term change in point of delivery agreement among DWR, Napa, and Solano, executed October 11, 2010, approved the conveyance of up to 500 af per year of

the City of Vallejo's non-SWP water from Solano's service area to Napa's turnouts located on the North Bay Aqueduct under Article 55 of Napa's long-term water supply contract. The City of Vallejo, a member agency of Solano, has water rights to this non-SWP water originating from Cache Slough and Lindsay Slough (tributaries of the Sacramento River). This agreement provides for the delivery of the City of Vallejo's non-SWP water through Reach 3B of the North Bay Aqueduct. This agreement is effective through December 31, 2035. During 2015, a total of 500 af of non-SWP water was conveyed under this agreement. (SWPAO #10005)

### *Crestline/San Bernardino*

A letter agreement (SWPAO #08063) among DWR, Crestline, and San Bernardino, dated December 17, 2008, and executed December 22, 2008, approved the delivery of up to 1,000 af of Crestline's approved SWP Table A water to San Bernardino by December 31, 2008. In exchange, San Bernardino returned an equal amount of its future approved Table A water to Crestline by December 31, 2011. There was no monetary payment between Crestline and San Bernardino for this 1:1 exchange. An amendment (SWPAO #08063-A) dated December 14, 2009, and executed February 16, 2010, among DWR, Crestline, and San Bernardino, extended the term for the delivery of San Bernardino's approved Table A water to Crestline to December 31, 2018. During 2015, a total of 850 af of San Bernardino's Table A water was delivered to Crestline under this agreement. (SWPAO #08063 and SWPAO #08063-A)

### *Castaic Lake/Kern*

A long-term agreement among DWR, Castaic Lake, and Kern, executed February 5, 2008, approves the annual conveyance of up to 11,000 af of non-SWP Kern River water from Buena Vista Water Storage District, a member unit of Kern, to Castaic Lake. The Kern River water was delivered to Castaic Lake either by a change in point of delivery of a portion of Kern's Table A water to Castaic Lake in exchange for a like amount of Buena Vista Water Storage District's water, or by direct pump-in to the California Aqueduct and conveyed to Castaic Lake under Article 55 of Castaic Lake's long-term water supply contract. During 2015, a total of 10,995 af was delivered to Castaic Lake under this agreement. (SWPAO #07008)

### *Mojave/Solano*

A letter agreement among DWR, Mojave, and Solano, dated December 7, 2007, and executed March 10, 2008, approved the delivery of up to 2,000 af of Solano's 2005 approved SWP water supplies to Mojave by December 31, 2005. In exchange, Mojave will return up to 1,000 af, based on an exchange ratio of 2:1, of its SWP water supplies to Solano by December 31, 2015. During 2015, a total of 1,000 af of Mojave's Table A water was delivered to Solano, thereby completing this agreement. (SWPAO #05019)

### *Kings/Westlands*

A long-term change in point of delivery agreement among DWR, Kings, and Westlands, executed March 24, 2004, provides for the delivery of up to 5,000 af of Kings' annual Table A water through Westlands' turnouts for use at Lemoore Naval Air Station. This agreement is effective through December 31, 2035. During 2015, a total of 190 af of Kings' Article 56(c) carryover water was delivered to Westlands' turnouts under this agreement. (SWPAO #04005)

### *Solano/Cities of Fairfield, Vacaville, and Benicia*

A settlement agreement among DWR, Solano, and the cities of Fairfield, Vacaville, and Benicia, which includes conveyance service by Solano, was executed on May 19, 2003. The agreement provides for delivery through December 31, 2035, of up to

31,620 af per year of settlement water to Solano for delivery through the North Bay Aqueduct to the three cities to help meet their current and future municipal and industrial water needs. During 2015, a total of 728 af of settlement water was delivered to Solano for conveyance to the three cities. (SWPAO #03017)

### *Kings/Tulare*

A long-term change in point of delivery agreement among DWR, Kings, and Tulare, executed March 10, 2006, provides for the delivery of up to 200 af of Kings' annual Table A water to Westlands' turnouts. The water is conveyed to GWF Energy LLC for use within Kings' service area. This agreement is effective through December 31, 2035. During 2015, a total of 22 af of Kings' Table A water was delivered to Westlands' turnouts. (SWPAO #02031)

### *Kern*

A long-term change in point of delivery agreement between DWR and Kern, executed June 8, 2000, approved the delivery of a portion of Kern's annual Table A water to Western Hills Water District (Western Hills). In exchange, Kern will receive a like amount of local water acquired by Western Hills in the Pioneer Groundwater Bank. The SWRCB approved Western Hills' service area to be included within the authorized SWP place of use on April 21, 2000. During 2015, a total 718 af of Kern's water was delivered to Western Hills, of which 133 af was Table A water and 585 af was Article 56(c) carryover water. (SWPAO #01001)

### *Napa/Solano*

A change in point of delivery agreement among DWR, Napa, and Solano, executed December 26, 2001, approved the delivery of up to 628 af of Napa's annual Table A water to the City of Vallejo's Water Treatment Plant in Solano's service area. This water is further conveyed to the city of American Canyon, a member agency of Napa. The agreement is effective through December 31, 2035. During 2015, a total of 66 af of Napa's Table A water was delivered to Solano's turnouts. (SWPAO #00029)

## Introduction of Local Water Agreement

### *AVEK*

An agreement between DWR and AVEK, executed April 7, 2015, approved the introduction and conveyance of up to 27,000 af of AVEK's local groundwater into the California Aqueduct within AVEK's service area. During 2015, AVEK introduced a total of 1,516 af of its local water into the California Aqueduct; DWR conveyed and delivered 1,516 af to AVEK's turnouts under this agreement. (SWPAO #14016)

## Turnout Agreements

### *Alameda-Zone 7*

On September 30, 2015, DWR executed an agreement with Alameda-Zone 7 for construction, operation and maintenance of the Olivina Turnout. The turnout, located at Station 37+50 of the South Bay Aqueduct's Del Valle Branch Pipeline, has a maximum design capacity of 0.7 cubic feet per second (cfs).

### *AVEK*

On June 24, 2015, DWR executed an agreement with AVEK for a temporary water diversion at Milepost 366.53 of the California Aqueduct's East Branch. Deliveries from this turnout, up to 100 af and not exceeding 4 cfs, were for agricultural purposes. The agreement expired on December 24, 2015.

On November 25, 2015, DWR executed an agreement with AVEK for operation and maintenance of the existing Quartz Hill Turnout. The turnout, located at Milepost 366.73 of the California Aqueduct's East Branch, has a maximum design capacity of 144 cfs.

### Byron Bethany Irrigation District

On August 25, 2015, DWR executed an agreement with Byron Bethany Irrigation District (Byron Bethany) and Musco Family Olive Company (Musco) for modification, operation and maintenance of the Musco Olive Turnout. Modifications included the installation of a magnetic flow meter and chart recorder on Musco property. The turnout, located at Milepost 12.47 of the California Aqueduct, has a maximum design capacity of 1 cfs.

### Kings

On November 20, 2015, DWR executed an agreement with Kings and Kettleman City Community Services District (Kettleman City) for construction, operation and maintenance of the Kettleman City Turnout. The turnout, located at Milepost 173.12 of the California Aqueduct, has a maximum design capacity of 2.67 cfs.

### Dudley Ridge/Kern

On August 6, 2015, DWR executed an amendment to the December 9, 2014, agreement with Dudley Ridge, Kern, Lost Hills Water District, Berrenda Mesa Water District, Semitropic Water Storage District, and Belridge Water Storage District for the 2014–2015 California Aqueduct Pump-Back Program. The amendment renamed the program from 2014–2015 California Aqueduct Pump-Back Program to 2014–2016 California Aqueduct Pump-Back Program and extended the termination date of the original agreement from April 30, 2015, to May 31, 2016.

### Kern

On July 20, 2015, DWR executed an amendment to the May 23, 1994, agreement with Kern and Buena Vista Water Storage District (Buena Vista) for construction, operation and maintenance of Buena Vista Turnout No. 7. The amendment specified the requirements for decommissioning the Buena Vista Turnout.

On July 20, 2015, DWR executed an agreement with Kern and Henry Miller Water District (Henry Miller) for operation and maintenance of Henry Miller Turnouts No. 1 and 2. Henry Miller Turnout No. 1, previously known as Buena Vista Turnout No. 3, is located at Milepost 243.09 of the California Aqueduct and has a design flow of 125 cfs. Henry Miller Turnout No. 2, previously known as Buena Vista Turnout No. 4, is located at Milepost 249.85 and has a design flow of 120 cfs.

## Activities Related to the Monterey Amendments

### Storage of Water Outside SWP Contractor Service Areas

Pursuant to Article 56(c) of the Monterey Amendments, seven SWP water contractors have separate agreements with DWR to convey approved water supplies outside their service areas for storage in existing and operational groundwater storage programs and for future recovery of water to use within their service areas. These change in point of delivery agreements are listed in Table 9-1. These agreements include provisions for conveyance to and from storage, and recovery methods by exchange and/or pump-in to the California Aqueduct. During 2015, a total of 239,100 af was recovered from storage.

### Turn-Back Water Pool Program

Pursuant to Article 56(d) of the Monterey Amendments, SWP water contractors who signed the Monterey Amendments are permitted to participate annually in the Turn-Back Water Pool Program. In 2015, SWP water contractors did not buy or sell water under Pool A or Pool B of the Turn-Back Water Pool Program due to their participation in the Multiyear Water Pool Program.

**Table 9-1 Storage of Water Outside SWP Contractor Service Areas in 2015 (acre-feet)[a]**

| Contractor | Contract Status | Storage Provider | To Storage (includes losses, if any) | From Storage | Return By |
|---|---|---|---|---|---|
| **Alameda-Zone 7** | | | | | |
| SWPAO #99018 | Continuing | Semitropic | 0 | 3,250 | 2035 |
| SWPAO #00037[b] | Continuing | Semitropic | 0 | 9,535 | 2035 |
| SWPAO #01035[b] | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #02010[b] | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #03008[b] | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #04017 | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #06010 | Continuing | Cawelo | 0 | 5,029 | 2035 |
| **Alameda County** | | | | | |
| SWPAO #99017 | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #00030 | Continuing | Semitropic | 0 | 7,691 | 2035 |
| SWPAO #07005 | Continuing | Semitropic | 0 | 8,521 | 2035 |
| SWPAO #10009 | Continuing | Semitropic | 0 | 0 | 2035 |
| **Castaic Lake** | | | | | |
| SWPAO #02015[b] | Continuing | Semitropic | 0 | 0 | 2022 |
| SWPAO #03060[b] | Continuing | Semitropic | 0 | 0 | 2024 |
| SWPAO #05016 | Continuing | Rosedale-Rio Bravo | 0 | 2,998 | 2035 |
| **Dudley Ridge** | | | | | |
| *SWP Water* | | | | | |
| SWPAO #08050 | Continuing | Kern Water Bank | 0 | 0 | 2035 |
| SWPAO #09002 | Continuing | Semitropic | 0 | 0 | 2035 |
| *Non-SWP Water* | | | | | |
| SWPAO #09040[b] | Continuing | Kern Water Bank | 0 | 14,460 | 2020 |
| SWPAO #03053 | Continuing | Cawelo | 0 | 2,000 | 2035 |
| **Metropolitan** | | | | | |
| SWPAO #95010 | Continuing | Semitropic | 0 | 57,084 | 2035 |
| SWPAO #01013[b] | Continuing | Arvin-Edison | 0 | 42,080 | 2035 |
| SWPAO #03019 | Continuing | Kern Delta | 0 | 31,977 | 2035 |
| SWPAO #03057 | Continuing | Mojave | 0 | 0 | 2015 |
| SWPAO #11011 | Continuing | Mojave | 0 | 8,580 | 2035 |
| SWPAO #11022 | Continuing | Rosedale-Rio Bravo | 0 | 410 | 2017 |
| **San Bernardino** | | | | | |
| SWPAO #11015 | Continuing | Kern Delta | 0 | 0 | 2035 |
| **Santa Clara** | | | | | |
| *SWP Water* | | | | | |
| SWPAO #99016 | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #00031 | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #06011 | Continuing | Semitropic | 0 | 37,312 | 2035 |
| SWPAO #10012 | Continuing | Semitropic | 0 | 0 | 2035 |
| *Non-SWP Water* | | | | | |
| SWPAO #06012[b] | Continuing | Semitropic | 0 | 8,173 | 2035 |
| SWPAO #10029 | Continuing | Semitropic | 0 | 0 | 2035 |
| SWPAO #11012 | Continuing | Semitropic | 0 | 0 | 2035 |
| **Total[c]** | | | **0** | **239,100** | |

[a] Storage amounts in this table may differ from the amounts in Table 9-8 due to water-type reclassification.
[b] Indicates amendments to agreement.
[c] Total acre-feet indicates all water recovered from various water banks. Some of the recovered water may be temporarily stored in SWP facilities. Amounts include losses, if any.

## Multiyear Water Pool Program

The 2015–2016 Multiyear Water Pool was initiated through a program letter sent to all SWP water contractors dated February 2, 2015. All SWP water contractors were permitted to participate in the program as either buyers or sellers in 2015 and/or 2016. The program allowed SWP water contractors to offer portions of their approved 2015 Table A water for sale in a water pool for use by interested SWP water contractors.

Based on Table A supply and demand, the pool water was allocated among the purchasing SWP water contractors into one of the two buyer pools. The "69 Percent Pool" consisted of water purchased by Metropolitan and Kern, which together take up 69.37 percent of the total SWP Table A amount. The remaining 30.63 percent of the SWP Table A amount was available for the other SWP water contractors to purchase in the "31 Percent Pool."

The Multiyear Water Pool Program participation occurred in June 2015, with 3,000 af purchased under this program. Multiyear Water Pool Program water was sold for $322.00 per af, for a Table A allocation of 20 percent on June 1, 2015. The 2015 Multiyear Water Pool Program closed on June 15, 2015.

Table 9-2 lists SWP water contractors that participated in the 2015 Multiyear Water Pool Program.

**Table 9-2 2015 Multiyear Water Pool Program (acre-feet)**

| Contractor | Sold | Purchased |
|---|---|---|
| Alameda County | | 51 |
| Alameda-Zone 7 | | 97 |
| AVEK | | 174 |
| Desert | | 67 |
| Dudley Ridge | | 55 |
| Kern-Agriculture | | 707 |
| Kings | | 11 |
| Metropolitan | | 1,374 |
| Napa | | 35 |
| Palmdale | | 26 |
| San Bernardino | | 123 |
| Santa Barbara | | 55 |
| Santa Clara | | 120 |
| Tulare | | 105 |
| Ventura | 3,000 | |
| **Total** | **3,000** | **3,000** |

## Article 21 Water Program

Pursuant to the Monterey Amendments, Article 21 water replaces surplus, wet weather, and Article 12(d) water. The Article 21 Water Program allows an SWP water contractor to take delivery of water over the approved and scheduled Table A amounts for the current year. Article 21 water is only available for delivery on a short-term basis as determined by DWR when water is still available after operational requirements for SWP water deliveries, water quality, and Sacramento-San Joaquin Delta (Delta) requirements are met. During 2015, 690 af of Article 21 water was delivered.

## Flexible Storage Program

Pursuant to Article 54 of the Monterey Amendments, the Flexible Storage Program provides the option to SWP water contractors participating in the repayment of the capital costs of Castaic Lake and Lake Perris to withdraw water in excess of approved deliveries. The program objective is to provide additional flexibility to benefit local water management activities. Participating SWP water contractors are given 5 years to replace withdrawn stored water with approved SWP or non-SWP water.

Flexible storage allows for withdrawal of up to 160,000 af at Castaic Lake and 65,000 af at Lake Perris. SWP water contractors participating in the Castaic Lake Flexible Storage Program include Metropolitan,

Ventura, and Castaic. These contractors are allowed to withdraw up to a maximum of 153,940 af, 1,377 af, and 4,683 af, respectively. Metropolitan is the only SWP water contractor allowed to withdraw water from Lake Perris, up to a maximum of 65,000 af.

In 2015, Metropolitan started with a balance of -218,940 af in flexible storage. Metropolitan did not withdraw flexible storage water, leaving them with an end-of-year balance of -218,940 af. Castaic started the year with a balance of -4,424 af in flexible storage. Castaic did not withdraw flexible storage water, but replaced 4,339 af of withdrawn storage water using their water bank recovery water, leaving them with an end-of-year balance of -85 af.

### *Extended Carryover Program*

Pursuant to Article 56 of the Monterey Amendments, SWP water contractors can elect to store SWP water outside of their service areas and carry it over to the following year for use within their service areas. Qualified SWP water contractors can request the carryover of Table A water for delivery in the following year to the extent that such deliveries do not adversely affect current or future project operations. Factors that influence how much extended carryover water can be delivered include operational constraints of project facilities, filling of SWP conservation storage facilities, flood control releases, and water quality restrictions.

If storage requests exceed the available storage capacity, the amount available is allocated among the SWP water contractors requesting storage in proportion to their annual Table A amount for that year.

Twenty SWP water contractors took delivery of Article 56(c) water in the amount of 131,990 af of previously approved Table A water carried over into 2015. A total of 265 af of SWP water contractors' carryover water was delivered to non-SWP contractors for a total of 132,255 af of water delivered.

## 2015 Water Transfers

Due to the critically dry hydrologic conditions in 2015, a number of SWP water contractors experienced significant water supply shortages. Nine SWP water contractors executed water transfer conveyance agreements with DWR and six non-SWP agencies on the Feather, Yuba, Sacramento, and American rivers, and within the Delta.

A total of 21,586 af of water was made available to the SWP buyers from a combination of reservoir releases and groundwater substitution. See Table 9-3 for a list of sellers that provided water for transfer in 2015. A total of 17,286 af of transfer water was delivered to the SWP buyers after conveyance losses, including Delta carriage water losses of 20 percent, except to Napa, which was assessed a zero percent carriage water loss. See Table 9-4 for a list of the SWP buyers and the quantities delivered.

## Lower Yuba River Accord

The Lower Yuba River Accord (Yuba Accord) was announced in 2005 to settle long-standing litigation over instream flows in the Yuba River in relation to fisheries. The purpose of the Yuba Accord is to resolve instream flow issues associated with the operation of the Yuba River Development Project in a way that protects and enhances lower Yuba River fisheries and local water supply reliability. The Yuba River Development Project provides revenues for local flood control and water supply projects, water to enhance SWP and CVP water supply reliability by offsetting Delta export reductions for the protection and restoration of Delta fisheries, and improvements in statewide water supply management, including dry year water

**Table 9-3 2015 Water Transfers Seller Activities (acre-feet)**

| Sellers | Buyers | SWPAO # | Transfer Action | Transfer Water Available |
|---|---|---|---|---|
| Garden Highway Mutual Water Company | Dudley Ridge | 15702 | Groundwater Substitution | 140 |
| | Kern | | | 241 |
| | Oak Flat | | | 17 |
| | Metropolitan | | | 468 |
| Sutter Extension Water District | Kern | 15704 | Groundwater Substitution | 510 |
| | Metropolitan | | | 990 |
| Plumas Mutual Water Company | Kern | 15724 | Groundwater Substitution | 591 |
| | Metropolitan | | | 1,149 |
| Sutter South Water District | Kern | 15725 | Reservoir Releases | 1,679 |
| | Kings | | | 29 |
| | Metropolitan | | | 3,269 |
| | Napa | | | 89 |
| | Palmdale | | | 66 |
| | Santa Barbara | | | 140 |
| | Santa Clara | | | 308 |
| Foresthill Public Utility District | Santa Clara | 15740 | Reservoir Releases | 1,900 |
| South Feather Water and Power Agency | Dudley Ridge | 15750 | Reservoir Releases | 154 |
| | Kings | | | 32 |
| | Kern | | | 3,333 |
| | Metropolitan | | | 6,481 |
| **Total** | | | | **21,586** |

**Table 9-4 2015 Water Transfers Buyer Activities (acre-feet)**

| Buyers | Water Available to Buyer | Carriage Water Losses[a] | Net Water Delivered |
|---|---|---|---|
| Dudley Ridge | 294 | 59 | 235 |
| Kern | 6,354 | 1,271 | 5,083 |
| Kings | 61 | 12 | 49 |
| Metropolitan | 12,357 | 2,472 | 9,885 |
| Napa | 89 | 0 | 89 |
| Oak Flat | 17 | 3 | 14 |
| Palmdale | 66 | 13 | 53 |
| Santa Barbara | 140 | 28 | 112 |
| Santa Clara | 2,208 | 442 | 1,766 |
| **Total[b]** | **21,586** | **4,300** | **17,286** |

[a] Carriage water losses of 20 percent were applied to all transfers except to Napa. Napa (located north of the Delta) was assigned with zero carriage water loss.
[b] Totals may not sum as expected due to rounding.

supplies for participating SWP and CVP water contractors.

## Agreements

The Yuba Accord is based on three sets of agreements: a water purchase agreement with DWR, that includes water to help offset Delta export reductions and dry year water for participating SWP and CVP water contractors; conjunctive use agreements with Yuba County Water Agency (Yuba) member units; and a fisheries agreement resolving minimum flows. The Yuba Accord provides for higher releases into the Yuba River to benefit Chinook Salmon and steelhead, transfer water to help offset Delta export reductions annually, and provide dry year transfer water for SWP and CVP water contractors from both surface and groundwater substitution sources.

The required agreements were executed in late 2007 and early 2008, and the SWRCB approved the Yuba Accord on March 25, 2008, setting the flow schedules for the river and authorizing accord-based water transfers through 2025. During that same period, DWR completed executing 22 agreements for dry year supplies for participating SWP and CVP water contractors under the accord.

## Amendments

In April 2009, two amendments to the Yuba Accord's water purchase agreement were executed. Amendment Number 1 resolved a technical issue related to refill accounting, and Amendment Number 2 addressed pricing issues for groundwater substitution water.

Amendment Number 3 was executed April 22, 2010, and addressed market pricing issues for groundwater substitution water.

On January 6, 2012, Amendment Number 4 was executed between DWR and Yuba, and between DWR and 22 participating contractors. Amendment Number 4 provides for annual negotiations of groundwater substitution water pricing, prioritizing SWP water contractors' Delta export transfer supplies, and optionally suspending certain accounting rules to permit all groundwater substitution water to be classified as Component 4 water.

Under Amendment Number 4, all accrued groundwater substitution water is payable even if it cannot be exported. The single exception is that DWR and Yuba Accord water contractors will not be required to pay for the portion (if any) of groundwater substitution component water that is released in accordance with the provisions of the Yuba Accord Fisheries Agreement, Section 5.1.8, Supplemental Flows for Groundwater Substitution Programs, unless it can be exported

On December 5, 2014, DWR executed Amendment Number 5 to the Yuba Accord Water Purchase Agreement with Yuba. The key new terms included: increased pricing for the four components of transfer water to be delivered by Yuba from 2016 through 2020; a $20 million deposit to be paid to Yuba to lock in the new pricing for 5 years and will be credited to surface water purchases; an allowance for third-party sales by Yuba to nonparticipants in the program under certain circumstances; and continued annual negotiations of groundwater substitution pricing when available. All 22 participating contractors agreed to continue their participation in the Yuba Accord from 2016 through 2020 by executing the conforming Amendment Number 5 to their participation agreements. On January 8, 2015, DWR executed a Participation Agreement, Amendment 1, and Amendment 5 with Mojave and Santa Barbara, increasing the number of participating contractors to from 22 to 24.

## Component 1 and Component 4 Water Deliveries

In 2015, Yuba delivered 59,131 af of Component 1 water from surface releases, shared equally between DWR and Reclamation. Because 60,000 af of Component 1 water was due to be delivered in 2015, Yuba owes the remaining 869 af in a future year. There were no water deliveries for Component 2 or Component 3 water.

A letter agreement was executed between DWR and Yuba on March 26, 2015. The agreement provided for 30,000 af of Component 4 groundwater substitution water at an effective price of $665 per af.

The 59,131 af of Component 1 water was used to offset Delta pumping curtailments equally at the Banks Pumping Plant and Jones Pumping Plant. The curtailments were made pursuant to the biological opinions on Delta Smelt and salmonids issued by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as modified by subsequent court orders. Yuba delivered 30,000 af of Component 4 groundwater substitutions water.

Component 4 water was shared 50 percent among 13 participating SWP water contractors, and 50 percent among CVP contractor members of the San Luis & Delta-Mendota Water Authority, a federal CVP water contractor. The 2015 transfers by Yuba pursuant to the 2007 DWR/ Yuba Water Purchase Agreement totaled 89,131 af. The 30,000 af of Component 4 water was used by the 14 State and federal participating contractors to help offset low water allocations.

### *Carriage Water Losses*

The 13 SWP water contractors shared the Yuba River water based on their relative requests for the various components in proportion to their Table A contract amounts. The SWP water contractors that purchased the water are responsible for applicable carriage water costs and conveyance charges based on Article 55 of their long-term water supply contracts. Carriage costs reduced actual deliveries of Yuba River water through Banks Pumping Plant and Jones Pumping for all participating contractors in 2015. The Yuba water for DWR and the SWP water contractors was exported through the Banks Pumping Plant, and the Yuba water for Reclamation and the San Luis & Delta-Mendota Water Authority was exported through the Jones Pumping Plant in 2015 with applicable carriage water costs.

Table 9-5 shows Lower Yuba River Accord Component 4 water deliveries.

# Agreements with Non-SWP Agencies

In addition to negotiating agreements with SWP water contractors to provide for specified water deliveries, DWR also enters into agreements with non-SWP agencies to provide water conveyance service.

## San Luis & Delta-Mendota Water Authority

An agreement among DWR, San Luis & Delta-Mendota Water Authority, Oakdale Irrigation District, and South San Joaquin Irrigation District was executed on September 29, 2015. DWR and San Luis & Delta-Mendota Water Authority purchased 23,000 af of pulse flow releases from Oakdale Irrigation District and South San Joaquin Irrigation District to benefit migratory fish on the Stanislaus River below Goodwin Dam during October and November 2015. The pulse flow releases provided water supply benefits in the Delta that were shared equally between the SWP and the CVP. DWR paid $500 per af for the pulse flow water. (SWPAO #15022)

**Table 9-5 Lower Yuba River Accord Component 4 Water Deliveries, 2015 (acre-feet)**

| Participating Contractor | Component 4 | Carriage Water Losses (20%) | Water Delivered |
|---|---|---|---|
| | [1] | [2] | [1] - [2] |
| **SWP Contractor** | | | |
| Alameda-Zone 7 | 345 | 69 | 276 |
| Coachella | 533 | 107 | 426 |
| Crestline | 2 | 1 | 1 |
| Dudley Ridge | 194 | 39 | 155 |
| Kern | 4,211 | 843 | 3,368 |
| Kings | 40 | 8 | 32 |
| Metropolitan | 8,192 | 1,639 | 6,553 |
| Napa[a] | 124 | 0 | 124 |
| Oak Flat | 24 | 5 | 19 |
| Palmdale | 91 | 19 | 72 |
| San Bernardino | 440 | 88 | 352 |
| Santa Clara | 429 | 86 | 343 |
| Tulare | 375 | 75 | 300 |
| *SWP Contractor Total* | *15,000* | *2,979* | *12,021* |
| **Non-SWP Contractor** | | | |
| San Luis & Delta-Mendota Water Authority | 15,000 | 5,250[b] | 9,750 |
| **Grand Total** | **30,000** | **8,229** | **21,771** |

[a] Carriage loss does not apply to Napa because these contractors are north of the Delta.
[b] San Luis & Delta-Mendota Water Authority's water was pumped through Jones Pumping Plant by Reclamation with deliveries reduced by 35 percent carriage water losses.

## Westlands Water District

An agreement between DWR and Westlands, executed June 29, 2015, allowed for the introduction of up to 30,000 af of Westlands' local groundwater within Westlands' service area in Reaches 4 through 7 of the California Aqueduct through October 30, 2015. During 2015, a total of 26,835 af of Westlands' water was pumped into the California Aqueduct under this agreement. (SWPAO #15019)

An amendment was executed February 10, 2015, to extend the term of an agreement between DWR and Westlands. The original agreement (SWPAO #14010) executed July 15, 2014, approved the introduction of up to 30,000 af of Westlands' local groundwater into the California Aqueduct, and provided for the conveyance and delivery by DWR to Westland's turnouts in Reaches 4 through 7 of the California Aqueduct through October 31, 2014. This amendment (SWPAO #14010-B) extends the term of the agreement to February 28, 2015. In 2015, Westlands introduced 4,297 af of local water into the California Aqueduct; DWR conveyed and delivered to Westlands a total of 3,641 af within the San Luis Canal portion (Reaches 4–7) of the California Aqueduct. Westlands made available, as mitigation to the SWP, 568 af for allocation to the SWP water contractors. (SWPAO #14010 and SWPAO #14010-B)

## Del Puerto Water District

An exchange agreement among DWR, Reclamation, Del Puerto Water District, and Oak Flat, executed May 14, 2014, approved the exchange of up to 2,000 af of Del Puerto Water District's CVP water supplies for an equivalent amount of Oak Flat's approved SWP water supplies through April 30, 2015. DWR will deliver up to 2,000 af of approved SWP water supplies to Del Puerto Water District using Oak Flat's turnouts in the California Aqueduct. In exchange, Reclamation will make an equivalent amount of Del Puerto Water District's CVP water supplies available to DWR at O'Neill Forebay. DWR filed a petition with the SWRCB, and received a 1-year approval order, effective May 1, 2014, for the consolidation of SWP and CVP places of use. During 2015, a total of 19 af was delivered to Oak Flat's turnouts under this agreement. (SWPAO #13022)

## Reclamation and Kern National Wildlife Refuge—U.S. Fish and Wildlife Service

A letter agreement sent by DWR on September 17, 2012, and accepted by Reclamation on September 21, 2012, provided for DWR to deliver up to 30,500 af of CVP water to the Kern National Wildlife Refuge from June 1, 2012, through September 30, 2028. Under this agreement, DWR conveys CVP water from the end of Reach 7 of the California Aqueduct to Buena Vista Water Storage District's turnouts in Reaches 10A and 12E. DWR conveyed a total of 10,455 af during 2015. (SWPAO #12309)

## Reclamation—Joint Point of Diversion

In 2012, DWR renewed the joint point of diversion agreement with Reclamation. Under this agreement, DWR makes excess SWP conveyance capacity available to Reclamation for the conveyance of water from the Delta at Banks Pumping Plant. This includes: (1) making up for curtailed water exports from Jones Pumping Plant associated with improving conditions for fish in the Delta; (2) replacing water exports foregone during maintenance and repair of CVP facilities between the Delta and O'Neill Forebay; and (3) conveying Reclamation's share of Component 1 water provided under the Yuba Accord. As part of the joint point of diversion agreement, the first 21,000 af conveyed through Banks Pumping Plant for July, August, and September of each year include a charge for the temporary barriers in the Delta. In 2015, DWR conveyed 8,380 af of water. (SWPAO #12300)

## Reclamation and San Joaquin Valley National Cemetery—U.S. Department of Veterans Affairs

A pending letter agreement among DWR, Reclamation, and the U.S. Department of Veterans Affairs provides for the conveyance of up to 850 af of CVP water to Reach 2B of the California Aqueduct for the U.S. Department of Veterans Affairs' San Joaquin Valley National Cemetery. DWR delivered a total of 210 af to the national cemetery through Reach 2B of the California Aqueduct in 2015 under this pending agreement. (SWPAO #10310)

## Reclamation and Byron Bethany Irrigation District—Musco Family Olive Company

A pending agreement among DWR, Byron Bethany, and Reclamation provides for the conveyance of up to 800 af of Byron Bethany's CVP water to repayment Reach 2A of the California Aqueduct for use by Musco Family Olive Company. DWR delivered a total of 453 af in 2015 under this pending agreement. (SWPAO #04300)

## Reclamation and Cross Valley Canal Contractors

Through eight, 3-party contracts, and the corresponding changes in points of delivery associated with Cross Valley Canal (CVC) contracts with Reclamation and CVC water contractors, DWR conveys CVP water for CVC water contractors. The following eight CVP water contractors are defined as CVC water contractors: the County of Fresno, County of Tulare, Hills Valley Irrigation District, Kern-Tulare Water District, Lower Tule River Irrigation District, Pixley Irrigation District, Rag Gulch Water District, and the Tri-Valley Water District.

During 2015, DWR did not convey any water for the CVC water contractors.

## Delta Settlement Agreements

DWR negotiated contracts with various Delta agencies to settle adverse impact claims by the agencies against DWR due to operation of the SWP. Water deliveries to these agencies in 2015 are reported in the sections covering deliveries to non-SWP agencies later in this chapter.

### *Byron Bethany Irrigation District*

Byron Bethany executed an agreement with DWR on May 28, 2003, that describes the nature and extent of Byron Bethany's right for the diversion of water from the Delta for agricultural, municipal, and industrial uses within the district. This agreement terminated a 1993 exchange agreement.

### *City of Antioch*

DWR and the City of Antioch executed an agreement on April 11, 1968, that requires DWR to reimburse the City of Antioch for decreases in usable San Joaquin River water availability caused by operation of the SWP. The agreement was amended October 29, 2013 to update boundaries and clarify measurement definitions. DWR reimburses the City of Antioch for the purchase of substitute water when the number of usable days, as defined by the contract, is below 208. Credits for the number of usable days above 208 in this same period accrue to offset the water-day deficiencies in future years.

In 2015, DWR determined that 45 usable days were available to the City of Antioch, and there were no credits to offset the deficiency of 163 days. DWR reimbursed the City of Antioch $1,386,287 for the purchase of substitute untreated water.

### *Contra Costa Water District*

DWR and Contra Costa Water District (Contra Costa) executed an agreement on April 21, 1967, that requires DWR to reimburse Contra Costa for decreases in availability of usable river water in Mallard Slough caused by operation of the SWP. DWR reimburses Contra Costa for the purchase of substitute water when the number of usable days, as defined by the contract, is below 142. Credits for the number of usable days above 142 in this same period accrue to offset the water-day deficiencies in future years.

In 2015, DWR determined that 10 usable days were available to Contra Costa, and there were no credits to offset the deficiency of 132 days. DWR reimbursed Contra Costa $337,499 for the purchase of substitute untreated water. The reimbursement included energy costs for pumping water into Los Vaqueros Reservoir for later release as substitute water.

### *East Contra Costa Irrigation District*

East Contra Costa Irrigation District (East Contra Costa) executed an agreement with DWR on January 7, 1981, that requires East Contra Costa to make payments to DWR for the assurance of adequate water supply and specific water quality from Delta channels. An agreement executed April 11, 1991, with DWR, East Contra Costa, and Contra Costa

allows for intake at Rock Slough on Contra Costa Canal by Contra Costa to treat water for municipal and industrial users within East Contra Costa's service area. It was amended February 7, 2000, to allow diversions under both contracts at the Rock Slough intake of the Contra Costa Canal and the Los Vaqueros Reservoir intake at Old River.

East Contra Costa paid DWR $38,145 for the assurance of adequate water supply and specific water quality in 2015.

### *North Delta Water Agency*

North Delta Water Agency's (North Delta) agreement with DWR, executed January 28, 1981, requires North Delta to make payments to DWR for the assurance of adequate water supply and specific water quality from Delta channels. An amendment signed on January 21, 1997, changed the monitoring station at Emmaton to Three Mile Slough and reduced North Delta's payments in lieu of assessments on land DWR owns within North Delta's jurisdiction. A memorandum of understanding was executed on May 26, 1998, to establish the joint position with respect to implementation of water quality objectives contained in the 1995 Bay-Delta water quality control plan.

An agreement executed on May 21, 2008, resolved a lawsuit regarding the Department of Fish and Wildlife's land within North Delta boundaries. The 2008 agreement expired May 4, 2011. DWR is negotiating with the Department of Fish and Wildlife and North Delta on a new agreement to replicate the functionality of the 2008 agreement.

North Delta paid DWR $368,711.96 for the assurance of adequate water supply and specific water quality in 2015.

In 2015, North Delta experienced a drought emergency as defined by the 1981 contract. DWR developed an expedited claims procedure and provided it to North Delta for its review.

### *South Delta Water Agency*

In September 1990, DWR completed negotiations for a long-term agreement with South Delta Water Agency and Reclamation. The parties agreed to proceed with the design, construction, and operation of certain barrier facilities in South Delta channels. These facilities resolved portions of the lawsuit that South Delta Water Agency filed in 1982 regarding the alleged effects of export pumping by the SWP and CVP on water levels, quality, and circulation in the South Delta.

DWR has installed and operated temporary barrier facilities in the South Delta to improve area conditions and collect data needed to design and operate permanent barrier facilities. Ongoing efforts are being made to improve water levels, circulation, and quality in South Delta channels. These efforts have included modifying and dredging around local diverters' intakes, conducting a series of computer modeling studies, and modifying barrier flap gate operations.

# Water Deliveries

## Table A Deliveries

Each year, by October 1, the SWP water contractors submit initial requests for Table A deliveries allocated to them for use in the subsequent calendar year. Initial Table A allocation amounts for the coming year are made by DWR in December. The Table A allocations are based on operations studies that assume 90 percent exceedance of historical water supply (where exceedance refers to the possibility that water supply in the coming year will be less than the historical average annual water supply), current reservoir storage, and total requests by the SWP water contractors. Forecasts for the year are updated as hydrologic conditions change. Table A amounts are

increased or decreased depending on both actual and projected hydrologic conditions, though decreases are rare as the 90 percent exceedance criterion is fairly conservative.

On October 1, 2014, SWP water contractors submitted initial requests for 2015 totaling 4.17 million acre-feet (maf).

DWR approved delivery of 0.42 maf on December 1, 2014, resulting in initial Table A amounts of 10 percent of SWP water contractor requests. DWR increased the 2015 Table A amounts to 0.83 maf, for a final allocation of 20 percent, on March 2, 2015.

Table 9-6 lists the changes in Table A amounts that were approved by DWR based on updated hydrologic conditions.

**Table 9-6 2015 Allocated Table A Amounts**

| Notice to SWP Contractors No. | Allocation Amount (maf) | Percentage of Requested Water |
|---|---|---|
| 14-10 | 0.42 | 10 |
| 15-01 | 0.63 | 15 |
| 15-03 | 0.83 | 20 |

## 2015 Water Deliveries

In 2015, a total of 2,104,264 af of SWP and non-SWP water was delivered to 29 long-term SWP water contractors and 19 non-SWP agencies. The SWP portion totaled 1,336,889 af, and the non-SWP portion totaled 767,375 af.

The 1,336,889 af delivered to SWP water contractors was categorized as follows:

- 640,444 af of Table A water;
- 37,011 af of transfers and exchanges of Table A water;
- 3,000 af of Turn-Back or Multiyear Water Pool Program water;
- 131,990 af of carryover water;
- 690 af of Article 21 water;
- 347 852 af of water bank recovery;
- 128 871 af of delivery of backup water;
- 728 af of settlement water;
- 2 af of SWP water for parks and recreation;
- 12,025 af of 2015 Yuba Accord Dry Year Purchase Program water;
- 7,716 af of local water;
- 4,870 af of permit water; and
- 21,690 af of other non-SWP programs.

The 767,375 af portion delivered to 19 non-SWP agencies was categorized accordingly:

- 39,058 af of SWP contracted supply;
- 26,181 af of water bank recovery;
- 689,930 af of regulated delivery of local supply;
- 211 af for parks and recreation;
- 877 af for fish and wildlife;
- 10,455 af for Kern National Wildlife Refuge; and
- 663 af for annual contracts.

Figure 9-1 shows amounts of water delivered to various locations during 2015.

Specific information about water deliveries made to SWP water contractors and other agencies during 2015, and historical deliveries from 1962 through 2015, is presented in the following four sections, each with a corresponding table located at the end of the chapter:

- Water Delivered to Long-term SWP Water Contractors in 2015, by Service Area (Table 9-7);
- Total Amounts of Water Delivered in 2015, by Month (Table 9-8);
- Total Amounts of Annual Table A Water and Water Conveyed, by Type, 1962–2015 (Table 9-9); and
- SWP Water Delivered by Category, 1962–2015 (Table 9-10).




**Figure 9-1 Water Delivered in 2015 and Delivery Locations of Long-term SWP Water Supply Contractors and Feather River Area Districts with Water Rights Agreements with DWR**

Please note that the water delivery figures listed are accurate at the time of this Bulletin 132 publication, but small volumes of water may be reclassified over time pursuant to long-term water supply contract provisions. If your research requires more current data than was available at the time of publication, please consult the most recent edition of Bulletin 132 and/or contact DWR staff in the State Water Project Analysis Office.

## 2015 Water Deliveries to Long-term SWP Water Contractors

Table 9-7 shows amounts delivered in 2015 by service area. The following information is arranged by column number.

### *Table A Water Delivered*

Columns 1 through 5 show a detailed breakdown of Table A water delivered for SWP water contractors in 2015.

### *Multiyear Water Pool Program*

Column 3 shows 3,000 af of Multiyear Water Pool Program water delivered to SWP water contractors in 2015.

### *Carryover Table A Water Delivered in 2015*

Column 4 shows a total of 132,255 af was carried over from previous years for delivery in 2015, which includes deliveries to non-SWP agencies.

The carryover program was designed to encourage the most effective and beneficial use of water and to avoid obligating the SWP water contractors to use or lose water by December 31 of each year. The SWP water contractors' long-term water supply contracts and amendments state the criteria for carrying over Table A water from one year to the next under Articles 12(e), 14(b), and 56(c).

### *Total Table A Water Delivered*

Column 5 shows all Table A water delivered in 2015—a total of 851,503 af.

### *Article 21*

Column 6 shows Article 21 water delivered to SWP water contractors. In 2015, 690 af of Article 21 water was delivered.

### *Other SWP Water*

Column 7 shows 728 af of other SWP water. Other SWP water consists of settlement water delivered to Solano.

### *Total SWP Water Delivered*

Column 8 shows a total of 852,921 af of SWP water was delivered in 2015. This includes total Table A water, Table A carryover water, Multiyear Water Pool Program water, and other SWP water consisting of settlement water.

### *Non-SWP Water Deliveries*

Columns 9, 10, and 11 include deliveries of non-SWP water to long-term water contractors. Column 9 shows delivery of 128,871 af of backup water, Column 10 shows 347,852 af of water bank recovery, and Column 11 shows 46,303 af of other non-SWP water. Other non-SWP water is local and permit water that an SWP water contractor has a water right to, or has purchased from, exchanged with, or transferred from non-SWP agencies.

### *Total Deliveries*

Column 12 shows total amounts of water delivered to SWP water contractors. In 2015, the SWP delivered 1,375,947 af of water to the 29 SWP water contractors.

## Water Delivered in 2015 by Month

During 2015, the SWP provided water service to 48 agencies, including 29 SWP water contractors. The amounts of water delivered by month to all agencies are listed in

Table 9-8 and are summarized below as SWP water and non-SWP water.

## SWP Water

SWP water, as defined in the long-term water supply contracts, includes current year Table A amounts, transfer and exchange of Table A water, carryover of Table A water, Turn-Back Pools A and B water, Multiyear Water Pool Program water, and Article 21 water. Detailed information concerning those conveyances for 2015 is found under the "Miscellaneous Agreements with Long-term SWP Water Contractors" section in this chapter's preceding pages or is listed below.

## Non-SWP Water

In 2015, DWR used SWP facilities to convey non-SWP water for various non-SWP agencies according to the terms of water rights and water transfer and exchange agreements. Detailed information concerning those deliveries is in this chapter's preceding pages or is listed below.

**Last Chance Creek Water District.** Under the water supply agreement between DWR and Last Chance Creek Water District, dated April 29, 2013, a total of 4,542 af was supplied from Frenchman Lake to Last Chance Creek Water District.

**Water Rights Water.** Water in this category is transported through SWP facilities to agencies with settlement agreements with DWR. Some water passes through SWP transportation facilities; some is stored in SWP reservoirs for release later. In 2015, the following water was delivered to the Feather River, North Bay, South Bay, Delta, and Southern California areas, as summarized below.

***Feather River Area.*** Seven non-SWP agencies received 664,207 af, under their water right settlement agreements, as follows:

- Garden Highway Mutual Water Company, 10,481 af;
- Joint Water Districts Board, 402,934 af;
- Oswald Water District, 1,501 af;
- Plumas Mutual Water Company, 7,882 af;
- Tudor Mutual Water Company, 2,622 af;
- Western Canal Water District, 238,781 af; and
- Valberde and Ramelli, 6 af.

DWR conveyed local water totaling 6,331 af through SWP facilities on behalf of two non-SWP agencies:

- South Feather Water and Power Agency (formerly Oroville-Wyandotte Irrigation District), 4,740 af; and
- Thermalito Water and Sewer District (formerly Thermalito Irrigation District), 1,591 af.

***North Bay Area.*** Deliveries in the North Bay area included 500 af of Vallejo permit water delivered to Napa, and 728 af of settlement water delivered pursuant to the May 19, 2003, *Settlement Agreement among DWR, Solano County Water Agency, and the Cities of Fairfield, Vacaville, and Benicia*.

***South Bay Area.*** In the South Bay area, a total of 7,690 af of local water was delivered to Alameda-Zone 7 and Alameda County. These two South Bay Aqueduct SWP water contractors hold water rights to runoff from the Lake del Valle watershed.

***Delta.*** In the Delta, 19,392 af of water was delivered to Byron Bethany pursuant to the May 28, 2003, *Agreement Between the Department of Water Resources of the State of California and the Byron-Bethany Irrigation District Regarding the Diversion of Water from the Delta*.

East Contra Costa Irrigation District diverted 18,982 af of water pursuant to the January 7,1981, *Contract Between the State of California Department of Water*

*Resources and the East Contra Costa Irrigation District for the Assurance of a Dependable Water Supply of Suitable Quality*.

***Southern California Area.*** In the Southern California area, 26 af of local runoff from the Houston Creek watershed was stored and delivered to Crestline under water rights held by DWR on Houston Creek. The authorized place of use is limited to the Crestline area.

## Annual Table A Water and Water Delivered Since 1962

Information about 2015 annual Table A water and water conveyed, by type, for the previous 50 years is contained in Table 9-9. The following discussion of conveyed Table A water is arranged according to column numbers.

### *Annual Table A Water*

Columns 1 through 7 of Table 9-9 show the amount of SWP water contractors' annual maximum Table A water by area for years 1962 through 2015 as specified in the Table A schedules of the long-term water supply contracts.

In some instances, Table A schedules—projections of each contractor's need for water to 2035—have been amended to meet the needs of individual contractors. The amounts of annual Table A water each SWP water contractor may request for years 1962 through 2035 can be found in Table B-4 of Appendix B in the back of this bulletin.

### *Water Delivered*

Columns 8 through 16 show water delivered or conveyed, including initial fill water and operational losses and storage changes.

**Table A Water.** Column 8 shows amounts of Table A water delivered each year from 1962 through 2015. In 2015, a total of 851,503 af of Table A water was delivered.

**Article 21 and Unscheduled Water.** Column 9 shows amounts of Article 21 water, as defined under SWP deliveries, and unscheduled water delivered from 1962 through 2015. Article 21 and unscheduled water are water in excess of that required to meet all demands for the year's Table A water and water to be stored in SWP reservoirs. In 2015, 690 af of Article 21 or unscheduled water was delivered.

**Other Water.** Column 10 includes amounts of water classified as other water delivered in 2015, including non-SWP water conveyed through SWP facilities and regulated delivery of local supply. In 2015, a total of 580,841 af of other water was delivered.

**Feather River Diversions.** Column 11 includes amounts of water from the Feather River delivered according to agreements with non-SWP agencies on the Feather River, including Last Chance Creek Water District. In 2015, a total of 670,538 af in this category was delivered to agencies in the Feather River area.

**Recreation and Fish and Wildlife Water.** Column 12 shows water conveyed for recreational use or to improve water quality for fish and wildlife. In 2015, a total of 692 af of SWP water was conveyed for this purpose.

**Initial Fill Water.** The quantities listed in Column 14 represent the amounts used to initially fill the aqueducts and reservoirs south of the Delta to maximum operating capacities. Initial filling began in 1962, with the filling of the South Bay Aqueduct, and was completed in 1979, when Lake Perris reached its maximum operating capacity of 127,000 af. In 1996 and 1997, the Coastal Aqueduct was initially filled.

**Operational Losses.** Column 15 includes the total amounts of water lost through evaporation and seepage, net storage changes in reservoirs south of the Delta, and amounts of inflow from local drainage areas,

including inflows into San Luis Canal and from the Kern River Intertie. Negative values are indicated for years when withdrawals and evaporation from reservoirs south of the Delta exceed the amounts of water added to the reservoirs.

## Historical Water Delivered

Table 9-10 shows SWP water delivered by category from 1962 to 2015.

## Table 9-7 Water Delivered to Long-term SWP Water Contractors in 2015, by Service Area (acre-feet)[a, b]

| Service Area and SWP Contractor | Table A Water Deliveries | | | | | SWP Water | | | Non-SWP Water | | | Total Water Delivered [12] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 Table A Not Transferred, Exchanged, or Stored [1] | 2015 Table A Transferred or Exchanged [2] | 2015 Multiyear Pool Program [3] | Carryover Water [4] | Total Table A [5] | 2015 Article 21 [6] | Other SWP Water [7] | Total SWP Water [8] | Delivery of Backup Water [9] | Water Bank Recovery [10] | Other Non-SWP Water [11] | |
| **Feather River** | | | | | | | | | | | | |
| Butte | 205 | 3,110 | - | - | 3,315 | - | - | 3,315 | - | - | 2,560 | 5,875 |
| Plumas | 730 | - | - | - | 730 | - | - | 730 | - | - | - | 730 |
| Yuba City | 2,400 | - | - | 604 | 3,004 | - | - | 3,004 | - | - | - | 3,004 |
| **North Bay** | | | | | | | | | | | | |
| Napa | 5,799 | 66 | 35 | 3,893 | 9,793 | 690 | - | 10,483 | - | - | 216 | 10,699 |
| Solano | 2,020 | - | - | 15,718 | 17,738 | - | 728 | 18,466 | - | - | 4,870 | 23,336 |
| **South Bay** | | | | | | | | | | | | |
| Alameda-Zone 7 | 4,686 | - | 97 | 3,307 | 8,090 | - | - | 8,090 | 6,264 | 15,454 | 6,197 | 36,005 |
| Alameda County | - | - | 51 | 2,233 | 2,284 | - | - | 2,284 | 8,763 | 10,180 | 1,769 | 22,996 |
| Santa Clara | - | - | 120 | 3,150 | 3,270 | - | - | 3,270 | 21,076 | 38,780 | 3,057 | 66,183 |
| **San Joaquin Valley** | | | | | | | | | | | | |
| Oak Flat | 698 | - | - | 348 | 1,046 | - | - | 1,046 | - | - | 31 | 1,077 |
| Kings | 676 | 22 | 11 | 335 | 1,044 | - | - | 1,044 | - | - | 185 | 1,229 |
| Dudley | 3,209 | 4,308 | 55 | 1,570 | 9,142 | - | - | 9,142 | 16,789 | - | 1,534 | 27,465 |
| Empire | 316 | 262 | - | 46 | 624 | - | - | 624 | - | - | - | 624 |
| Kern | 138,906 | 23,917 | 707 | 43,205 | 206,735 | - | - | 206,735 | 75,979 | 129,629 | 6,280 | 418,623 |
| Tulare | - | 16,359 | 105 | 571 | 17,035 | - | - | 17,035 | - | - | 301 | 17,336 |
| **Central Coastal** | | | | | | | | | | | | |
| San Luis Obispo | 3,446 | - | - | - | 3,446 | - | - | 3,446 | - | - | 27 | 3,473 |
| Santa Barbara | 5,047 | - | 55 | 1,055 | 6,157 | - | - | 6,157 | - | - | 282 | 6,439 |
| **Southern California** | | | | | | | | | | | | |
| AVEK | 7,583 | 12,437 | 174 | 5,154 | 25,348 | - | - | 25,348 | - | 1,516 | - | 26,864 |
| Castaic Lake | 11,075 | - | - | 4,121 | 15,196 | - | - | 15,196 | - | 11,243 | 2,750 | 29,189 |
| Coachella | 27,670 | - | - | - | 27,670 | - | - | 27,670 | - | 9,500 | 426 | 37,596 |
| Crestline | 154 | - | - | 247 | 401 | - | - | 401 | - | - | 28 | 429 |
| Desert | 11,150 | - | 67 | - | 11,217 | - | - | 11,217 | - | - | - | 11,217 |
| Littlerock | - | 460 | - | - | 460 | - | - | 460 | - | - | - | 460 |
| Metropolitan | 380,577 | 410 | 1,374 | 35,675 | 418,036 | - | - | 418,036 | - | 131,550 | 15,318 | 564,904 |
| Mojave | 5,936 | 10,603 | - | 1,871 | 18,410 | - | - | 18,410 | - | - | - | 18,410 |
| Palmdale | 3,667 | 500 | 26 | - | 4,193 | - | - | 4,193 | - | - | 120 | 4,313 |
| San Bernardino | 14,388 | 3,350 | 123 | 9,017 | 26,878 | - | - | 26,878 | - | - | 352 | 27,230 |
| San Gabriel | 5,760 | - | - | - | 5,760 | - | - | 5,760 | - | - | - | 5,760 |
| San Gorgonio | 3,346 | - | - | 135 | 3,481 | - | - | 3,481 | - | - | - | 3,481 |
| Ventura | 1,000 | - | - | - | 1,000 | - | - | 1,000 | - | - | - | 1,000 |
| **Total** | **640,444** | **75,804** | **3,000** | **132,255** | **851,503** | **690** | **728** | **852,921** | **128,871** | **347,852** | **46,303** | **1,375,947** |

[a] Please note that the water delivery figures listed are accurate at the time of this Bulletin 132 publication, but small volumes of water may be reclassified over time pursuant to long-term water supply contract provisions. If your research requires more current data than was available at the time of publication, please consult the most recent publication of Bulletin 132 and/or contact DWR staff in the State Water Project Analysis Office.

[b] This table includes SWP water that was delivered to non-SWP agencies.

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FEATHER RIVER AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| City of Yuba City | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 227 | 348 | 489 | 443 | 333 | 560 | 0 | 0 | 2,400 |
| Carryover Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 558 | 46 | 0 | 604 |
| Yuba Total | 0 | 0 | 0 | 0 | 227 | 348 | 489 | 443 | 333 | 1,118 | 46 | 0 | 3,004 |
| County of Butte | | | | | | | | | | | | | |
| Table A | 3 | 4 | 20 | 9 | 12 | 17 | 21 | 17 | 16 | 13 | 5 | 68 | 205 |
| Table A Transferred to Others* | 0 | 0 | 0 | 0 | 447 | 283 | 653 | 87 | 86 | 0 | 0 | 1,554 | 3,110 |
| Non-SWP Water | 135 | 117 | 155 | 184 | 179 | 248 | 345 | 398 | 327 | 219 | 175 | 76 | 2,558 |
| Butte Total (*excluded from total) | 138 | 121 | 175 | 193 | 191 | 265 | 366 | 415 | 343 | 232 | 180 | 144 | 2,763 |
| Recreation/Fish and Wildlife (SWP) | | | | | | | | | | | | | |
| Butte Recreation/Fish and Wildlife | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Butte Total | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Plumas County Flood Control and Water Conservation District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 65 | 139 | 161 | 161 | 143 | 61 | 0 | 0 | 730 |
| Plumas Total | 0 | 0 | 0 | 0 | 65 | 139 | 161 | 161 | 143 | 61 | 0 | 0 | 730 |
| *Non-SWP Agencies* | | | | | | | | | | | | | |
| Garden Highway Mutual Water Company | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 0 | 1,547 | 933 | 2,016 | 2,075 | 661 | 1,196 | 2,038 | 15 | 0 | 10,481 |
| Joint Water Districts Board | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 12,240 | 14,301 | 69,489 | 68,135 | 75,079 | 59,211 | 24,079 | 37,520 | 32,430 | 10,450 | 402,934 |
| Oswald Water District | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 0 | 133 | 176 | 286 | 286 | 269 | 194 | 157 | 0 | 0 | 1,501 |
| Plumas Mutual Water Company | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 318 | 1,270 | 1,404 | 1,745 | 205 | 1,864 | 535 | 541 | 0 | 0 | 7,882 |
| South Feather Water and Power Agency | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 42 | 152 | 482 | 647 | 676 | 714 | 726 | 688 | 455 | 133 | 25 | 4,740 |
| Thermalito Water and Sewer District | | | | | | | | | | | | | |
| Regulated delivery of local supply | 29 | 81 | 104 | 33 | 151 | 192 | 223 | 226 | 197 | 168 | 104 | 83 | 1,591 |
| Tudor Mutual Water Company | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 143 | 406 | 450 | 688 | 479 | 255 | 201 | 0 | 0 | 0 | 2,622 |
| Western Canal Water District | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 0 | 9,420 | 49,758 | 42,888 | 47,211 | 24,967 | 6,873 | 30,891 | 25,216 | 1,557 | 238,781 |
| Valberde and Ramelli | | | | | | | | | | | | | |
| Regulated delivery of local supply | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 456 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *SWP* | 3 | 4 | 20 | 9 | 304 | 505 | 671 | 622 | 492 | 1,192 | 51 | 68 | 3,941 |
| *Non-SWP* | 164 | 240 | 13,112 | 27,776 | 123,187 | 116,874 | 126,617 | 88,577 | 34,290 | 71,989 | 58,073 | 12,191 | 673,090 |
| ***Feather River Area Total*** | ***167*** | ***244*** | ***13,132*** | ***27,785*** | ***123,491*** | ***117,379*** | ***127,288*** | ***89,199*** | ***34,782*** | ***73,181*** | ***58,124*** | ***12,259*** | ***677,037*** |
| **NORTH BAY AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| Napa County Flood Control and Water Conservation District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 65 | 1,083 | 960 | 833 | 369 | 620 | 252 | 748 | 869 | 5,799 |
| Table A Transferred to Others* | 0 | 0 | 0 | 0 | 3 | 4 | 13 | 36 | 9 | 1 | 0 | 0 | 66 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 0 | 0 | 0 | 0 | 0 | 35 |
| Article 21 | 437 | 0 | 0 | 0 | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 690 |
| Carryover | 331 | 629 | 550 | 1,160 | 0 | 310 | 221 | 189 | 0 | 276 | 198 | 29 | 3,893 |
| Non-SWP Water Transferred from Others | 199 | 200 | 101 | 0 | 0 | 0 | 78 | 89 | 49 | 0 | 0 | 0 | 716 |
| Napa Total (*excluded from total) | 967 | 829 | 651 | 1,225 | 1,336 | 1,270 | 1,167 | 647 | 669 | 528 | 946 | 898 | 11,133 |
| Solano County Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 8 | 244 | 220 | 251 | 350 | 516 | 431 | 0 | 2,020 |
| Table A Transferred from Others | 0 | 0 | 0 | 0 | 3 | 4 | 363 | 386 | 309 | 1 | 0 | 0 | 1,066 |
| Carryover Water | 0 | 0 | 0 | 491 | 2,192 | 1,853 | 1,615 | 3,154 | 2,871 | 3,158 | 384 | 0 | 15,718 |
| Other SWP Water | 66 | 425 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 728 |
| Non-SWP Water | 81 | 247 | 893 | 1,614 | 0 | 0 | 0 | 0 | 0 | 0 | 1,500 | 35 | 4,370 |
| Non-SWP Water Transferred to Others* | 199 | 200 | 101 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 500 |
| Solano Total (*excluded from total) | 147 | 672 | 913 | 2,105 | 2,203 | 2,101 | 2,198 | 3,791 | 3,530 | 3,675 | 2,315 | 252 | 23,902 |
| *SWP* | 834 | 1,054 | 570 | 1,716 | 3,539 | 3,371 | 3,287 | 4,349 | 4,150 | 4,203 | 1,761 | 1,115 | 29,949 |
| *Non-SWP* | 280 | 447 | 994 | 1,614 | 0 | 0 | 78 | 89 | 49 | 0 | 1,500 | 35 | 5,086 |
| ***North Bay Area Total*** | ***1,114*** | ***1,501*** | ***1,564*** | ***3,330*** | ***3,539*** | ***3,371*** | ***3,365*** | ***4,438*** | ***4,199*** | ***4,203*** | ***3,261*** | ***1,150*** | ***35,035*** |
| **SOUTH BAY AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| Alameda County Flood Control and Water Conservation District, Zone 7 | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 43 | 360 | 518 | 0 | 1,510 | 1,276 | 647 | 294 | 38 | 4,686 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 97 | 0 | 0 | 0 | 0 | 97 |
| Carryover Water | 390 | 0 | 322 | 328 | 1,163 | 654 | 268 | 0 | 54 | 128 | 0 | 0 | 3,307 |
| Water Bank Recovery | 421 | 1,188 | 2,388 | 1,681 | 1,489 | 481 | 353 | 1,064 | 1,707 | 2,077 | 1,447 | 1,158 | 15,454 |
| Delivery of Backup Water | 710 | 0 | 0 | 1,158 | 671 | 2,247 | 1,478 | 0 | 0 | 0 | 0 | 0 | 6,264 |
| Non-SWP Water | 385 | 316 | 401 | 275 | 314 | 287 | 2,185 | 995 | 208 | 182 | 83 | 290 | 5,921 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 138 | 138 | 0 | 0 | 0 | 276 |
| Alameda-Zone 7 Total | 1,906 | 1,504 | 3,111 | 3,485 | 3,997 | 4,187 | 4,284 | 3,804 | 3,383 | 3,034 | 1,824 | 1,486 | 36,005 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alameda County Water District | | | | | | | | | | | | | |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 | 0 | 0 | 0 | 0 | 51 |
| Carryover Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,233 | 0 | 0 | 2,233 |
| Water Bank Recovery | 310 | 553 | 4 | 563 | 610 | 714 | 523 | 1,579 | 2,532 | 749 | 1,315 | 728 | 10,180 |
| Delivery of Backup Water | 355 | 0 | 0 | 691 | 1,990 | 1,076 | 1,867 | 1,586 | 612 | 0 | 0 | 586 | 8,763 |
| Non-SWP Water | 0 | 0 | 0 | 0 | 0 | 1,000 | 769 | 0 | 0 | 0 | 0 | 0 | 1,769 |
| Alameda County Total | 665 | 553 | 4 | 1,254 | 2,600 | 2,790 | 3,159 | 3,216 | 3,144 | 2,982 | 1,315 | 1,314 | 22,996 |
| Santa Clara Valley Water District | | | | | | | | | | | | | |
| Table A Transferred from Others | 0 | 0 | 0 | 0 | 0 | 2,500 | 2,500 | 3,750 | 1,250 | 0 | 0 | 0 | 10,000 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 0 | 0 | 0 | 0 | 120 |
| Carryover Water | 0 | 0 | 0 | 0 | 237 | 0 | 347 | 0 | 1,314 | 257 | 995 | 0 | 3,150 |
| Water Bank Recovery | 728 | 1,994 | 3,894 | 1,313 | 1,424 | 1,666 | 1,221 | 1,477 | 5,908 | 7,188 | 7,407 | 4,560 | 38,780 |
| Delivery of Backup Water | 3,005 | 1,062 | 0 | 2,274 | 6,605 | 2,046 | 5,942 | 0 | 142 | 0 | 0 | 0 | 21,076 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 1,277 | 1,698 | 82 | 0 | 0 | 0 | 3,057 |
| Santa Clara Total | 3,733 | 3,056 | 3,894 | 3,587 | 8,266 | 6,212 | 11,287 | 7,045 | 8,696 | 7,445 | 8,402 | 4,560 | 76,183 |
| *Non-SWP Agencies* | | | | | | | | | | | | | |
| Byron Bethany Irrigation District | | | | | | | | | | | | | |
| Regulated delivery of local supply | 133 | 480 | 2,552 | 3,318 | 3,942 | 4,233 | 343 | 907 | 1,793 | 1,386 | 184 | 121 | 19,392 |
| Contra Costa Water District | | | | | | | | | | | | | |
| Recreation/Fish and Wildlife (SWP) | | | | | | | | | | | | | |
| Lake del Valle | 2 | 0 | 6 | 4 | 5 | 6 | 0 | 0 | 10 | 8 | 2 | 0 | 43 |
| *SWP* | 392 | 0 | 328 | 375 | 1,765 | 3,678 | 3,115 | 5,528 | 3,904 | 3,273 | 1,291 | 38 | 23,687 |
| *Non-SWP* | 6,047 | 5,593 | 9,239 | 11,273 | 17,045 | 13,750 | 15,958 | 9,444 | 13,122 | 11,582 | 10,436 | 7,443 | 130,932 |
| ***South Bay Area Total*** | ***6,439*** | ***5,593*** | ***9,567*** | ***11,648*** | ***18,810*** | ***17,428*** | ***19,073*** | ***14,972*** | ***17,026*** | ***14,855*** | ***11,727*** | ***7,481*** | ***154,619*** |
| **SAN JOAQUIN VALLEY AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| County of Kings | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 446 | 129 | 101 | 0 | 0 | 0 | 0 | 0 | 676 |
| Table A Transferred to Others* | 1 | 1 | 0 | 0 | 0 | 6 | 5 | 6 | 2 | 1 | 0 | 0 | 22 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Carryover Water | 0 | 0 | 0 | 143 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 143 |
| Carryover Water Transferred to Others* | 0 | 10 | 82 | 0 | 0 | 98 | 0 | 0 | 0 | 2 | 0 | 0 | 192 |
| Non-SWP Water Transferred from Others | 55 | 55 | 0 | 0 | 0 | 0 | 14 | 0 | 16 | 45 | 0 | 0 | 185 |
| Kings Total (*excluded from total) | 55 | 55 | 0 | 143 | 446 | 140 | 115 | 0 | 16 | 45 | 0 | 0 | 1,015 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dudley Ridge Water District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 0 | 0 | 3,065 | 71 | 73 | 0 | 0 | 0 | 3,209 |
| Table A Transferred from Others | 0 | 0 | 0 | 0 | 617 | 0 | 87 | 2,087 | 86 | 0 | 0 | 0 | 2,877 |
| Table A Transferred to Others* | 0 | 0 | 0 | 0 | 0 | 0 | 2,100 | 1,756 | 0 | 0 | 0 | 452 | 4,308 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 18 | 19 | 0 | 0 | 0 | 55 |
| Carryover Water | 27 | 56 | 156 | 222 | 735 | 369 | 0 | 5 | 0 | 0 | 0 | 0 | 1,570 |
| Delivery of Backup Water | 0 | 0 | 0 | 0 | 0 | 2,845 | 0 | 0 | 0 | 0 | 0 | 0 | 2,845 |
| Delivery of Backup Water Transferred from Others | 0 | 0 | 0 | 8,200 | 0 | 0 | 0 | 5,744 | 0 | 0 | 0 | 0 | 13,944 |
| Non-SWP Water | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 1,281 | 115 | 51 | 1 | 29 | 50 | 1,527 |
| Dudley Ridge Total (*excluded from total) | 27 | 63 | 156 | 8,422 | 1,352 | 3,214 | 4,451 | 8,040 | 229 | 1 | 29 | 50 | 26,034 |
| Empire West Side Irrigation District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 0 | 72 | 73 | 171 | 0 | 0 | 0 | 0 | 316 |
| Table A Transferred to Others* | 0 | 0 | 120 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 262 |
| Carryover Water | 0 | 0 | 34 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| Empire Total (*excluded from total) | 0 | 0 | 34 | 12 | 0 | 72 | 73 | 171 | 0 | 0 | 0 | 0 | 362 |
| Kern County Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 7,728 | 0 | 56,034 | 74,854 | 0 | 0 | 290 | 0 | 0 | 138,906 |
| Table A Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 1,250 | 1,756 | 0 | 0 | 0 | 1,554 | 4,560 |
| Table A Transferred to Others* | 0 | 35 | 1,572 | 1,776 | 64 | 92 | 18,159 | 2,094 | 72 | 53 | 0 | 0 | 23,917 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 707 | 0 | 0 | 0 | 707 |
| Carryover Water | 0 | 0 | 0 | 0 | 38,563 | 4,569 | 0 | 0 | 0 | 0 | 0 | 0 | 43,132 |
| Carryover Water Transferred to Others* | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 26 | 73 |
| Water Bank Recovery | 4,593 | 12,145 | 20,391 | 21,992 | 20,796 | 12,180 | 1,952 | 10,003 | 10,535 | 12,632 | 0 | 2,410 | 129,629 |
| Delivery of Backup Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43,583 | 22,318 | 4,932 | 5,146 | 0 | 75,979 |
| Delivery of Backup Water Transferred to Others* | 0 | 0 | 0 | 8,200 | 0 | 0 | 0 | 5,744 | 0 | 0 | 0 | 0 | 13,944 |
| Non-SWP Water | 0 | 160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 160 |
| Non-SWP Wtaer Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 2,040 | 2,040 | 2,040 | 0 | 0 | 0 | 6,120 |
| Non-SWP Water Transferred to Others* | 0 | 2,750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,750 |
| Kern Total (*excluded from total) | 4,593 | 12,305 | 20,391 | 29,720 | 59,359 | 72,783 | 80,096 | 57,382 | 35,600 | 17,854 | 5,146 | 3,964 | 399,193 |
| Oak Flat Water District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 106 | 207 | 184 | 84 | 67 | 50 | 0 | 0 | 698 |
| Carryover Water | 1 | 26 | 46 | 132 | 101 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 348 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 6 | 3 | 4 | 0 | 0 | 31 |
| Oak Flat Total | 1 | 26 | 46 | 132 | 207 | 249 | 202 | 90 | 70 | 54 | 0 | 0 | 1,077 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tulare Lake Basin Water Storage District | | | | | | | | | | | | | |
| Table A Transferred to Others* | 60 | 0 | 1,600 | 82 | 617 | 0 | 10,500 | 1,750 | 1,750 | 0 | 0 | 0 | 16,359 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 105 | 0 | 0 | 0 | 0 | 0 | 0 | 105 |
| Carryover Water | 0 | 0 | 0 | 32 | 0 | 243 | 58 | 238 | 0 | 0 | 0 | 0 | 571 |
| Non-SWP | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Non-SWP Water Transferrred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 281 | 19 | 0 | 0 | 0 | 0 | 300 |
| Tulare Total (*excluded from total) | 0 | 0 | 0 | 32 | 1 | 348 | 339 | 257 | 0 | 0 | 0 | 0 | 977 |
| Recreation/Fish and Wildlife (SWP) | | | | | | | | | | | | | |
| Department of Parks and Recreation, Cattle | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Department of Fish & Wildlife, O'Neill | 51 | 32 | 21 | 49 | 19 | 39 | 66 | 33 | 42 | 36 | 18 | 75 | 481 |
| Department of Fish & Wildlife, Lateral 4 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 4 |
| Parks and Recreation, O'Neill | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 5 |
| Parks and Recreation, San Luis | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 5 |
| Recreation/Fish and Wildlife (SWP) Total | 53 | 33 | 21 | 51 | 20 | 41 | 67 | 35 | 42 | 38 | 19 | 76 | 496 |
| *Non-SWP Agencies* | | | | | | | | | | | | | |
| CVP Annual Contractors | | | | | | | | | | | | | |
| Musco Family Olive Company | 35 | 29 | 34 | 36 | 33 | 43 | 41 | 34 | 48 | 59 | 36 | 25 | 453 |
| San Joaquin Valley National Cemetery | 5 | 1 | 6 | 19 | 30 | 39 | 40 | 30 | 20 | 14 | 2 | 4 | 210 |
| San Luis Water District | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,750 | 1,750 | 0 | 0 | 0 | 3,500 |
| CVP Annual Contractors Total | 40 | 30 | 40 | 55 | 63 | 82 | 81 | 1,814 | 1,818 | 73 | 38 | 29 | 4,163 |
| Western Hills Water District | | | | | | | | | | | | | |
| Table A Point of Delivery from SWP | 0 | 35 | 0 | 67 | 64 | 92 | 108 | 94 | 72 | 53 | 0 | 0 | 585 |
| Carryover Point of Delivery from SWP | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 26 | 73 |
| Western Hills Total | 23 | 35 | 0 | 67 | 64 | 92 | 108 | 94 | 72 | 53 | 24 | 26 | 658 |
| Westlands Water District | | | | | | | | | | | | | |
| Table A Transferred from Others | 61 | 1 | 3,292 | 1,933 | 0 | 6 | 12,701 | 6 | 2 | 1 | 0 | 0 | 18,003 |
| Carryover Transferred from Others | 0 | 10 | 82 | 0 | 0 | 98 | 0 | 0 | 0 | 2 | 0 | 0 | 192 |
| Water Bank Recovery | 0 | 3,641 | 0 | 0 | 0 | 0 | 5,016 | 8,251 | 6,341 | 2,932 | 0 | 0 | 26,181 |
| Non-SWP Water Transferred to Others* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| Westlands Total (*excluded from total) | 61 | 3,652 | 3,374 | 1,933 | 0 | 104 | 17,717 | 8,257 | 6,343 | 2,935 | 0 | 0 | 44,376 |
| Bureau of Reclamation | | | | | | | | | | | | | |
| Non-SWP Water Transferred to Others* | 0 | 0 | 0 | 0 | 0 | 0 | 16,705 | 0 | 0 | 0 | 0 | 0 | 16,705 |
| Kern National Wildlife Refuge | 1,341 | 888 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,640 | 3,532 | 2,054 | 10,455 |
| Fish and Wildlife | 42 | 25 | 17 | 40 | 16 | 32 | 54 | 28 | 33 | 30 | 14 | 61 | 392 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parks and Recreation | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 6 |
| Reclamation Total (*excluded from total) | 1,383 | 913 | 19 | 41 | 16 | 32 | 54 | 30 | 33 | 2,671 | 3,546 | 2,115 | 10,853 |
| San Luis & Delta-Mendota Water Authority | | | | | | | | | | | | | |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,226 | 0 | 0 | 0 | 2,226 |
| San Luis & Delta-Mendota Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,226 | 0 | 0 | 0 | 2,226 |
| *SWP* | 165 | 161 | 3,631 | 10,320 | 40,652 | 62,018 | 92,566 | 6,315 | 2,818 | 434 | 43 | 1,656 | 220,779 |
| *Non-SWP* | 6,071 | 16,951 | 20,450 | 30,288 | 20,876 | 15,139 | 10,737 | 69,855 | 41,405 | 23,290 | 8,759 | 4,604 | 268,425 |
| ***San Joaquin Valley Area Total*** | ***6,236*** | ***17,112*** | ***24,081*** | ***40,608*** | ***61,528*** | ***77,157*** | ***103,303*** | ***76,170*** | ***44,223*** | ***23,724*** | ***8,802*** | ***6,260*** | ***489,204*** |
| **CENTRAL COASTAL AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| San Luis Obispo County Flood Control and Water Conservation District | | | | | | | | | | | | | |
| Table A | 154 | 177 | 308 | 292 | 288 | 354 | 346 | 437 | 444 | 338 | 35 | 273 | 3,446 |
| Non-SWP Water | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| San Luis Obispo Total | 154 | 204 | 308 | 292 | 288 | 354 | 346 | 437 | 444 | 338 | 35 | 273 | 3,473 |
| Santa Barbara County Flood Control and Water Conservation District | | | | | | | | | | | | | |
| Table A | 369 | 423 | 686 | 249 | 391 | 463 | 573 | 575 | 492 | 552 | 20 | 254 | 5,047 |
| Table A Transferred from Others | 346 | 383 | 721 | 1,165 | 1,071 | 778 | 534 | 113 | 49 | 0 | 39 | 0 | 5,199 |
| Pool Program Water | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 55 |
| Carryover Water | 85 | 123 | 145 | 113 | 15 | 10 | 16 | 24 | 102 | 265 | 38 | 119 | 1,055 |
| Non-SWP Water | 132 | 9 | 30 | 1 | 0 | 0 | 3 | 0 | 6 | 0 | 0 | 0 | 181 |
| Non-SWP Water Transferred from Others* | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 27 | 0 | 0 | 0 | 0 | 101 |
| Santa Barbara Total (*excluded from total) | 979 | 938 | 1,582 | 1,528 | 1,477 | 1,251 | 1,200 | 747 | 649 | 817 | 97 | 373 | 11,638 |
| *SWP* | 1,001 | 1,106 | 1,860 | 1,819 | 1,765 | 1,605 | 1,469 | 1,157 | 1,087 | 1,155 | 132 | 646 | 14,802 |
| *Non-SWP* | 132 | 36 | 30 | 1 | 0 | 0 | 77 | 27 | 6 | 0 | 0 | 0 | 309 |
| ***Central Coastal Area Total*** | ***1,133*** | ***1,142*** | ***1,890*** | ***1,820*** | ***1,765*** | ***1,605*** | ***1,546*** | ***1,184*** | ***1,093*** | ***1,155*** | ***132*** | ***646*** | ***15,111*** |
| **SOUTHERN CALIFORNIA AREA** | | | | | | | | | | | | | |
| *SWP Agencies* | | | | | | | | | | | | | |
| Antelope Valley-East Kern Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 373 | 0 | 476 | 0 | 1,352 | 578 | 1,394 | 1,612 | 1,017 | 281 | 500 | 7,583 |
| Table A Transferred from Others | 11 | 38 | 85 | 84 | 89 | 164 | 133 | 173 | 278 | 61 | 246 | 121 | 1,483 |
| Table A Tranferred to Others* | 346 | 383 | 721 | 938 | 888 | 3,278 | 3,034 | 2,613 | 197 | 0 | 39 | 0 | 12,437 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 0 | 0 | 0 | 0 | 0 | 174 |
| Carryover Water | 386 | 0 | 714 | 409 | 1,074 | 421 | 1,000 | 571 | 0 | 0 | 0 | 0 | 4,575 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)

| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carryover Water Transferred to Others* | 0 | 0 | 0 | 0 | 250 | 250 | 79 | 0 | 0 | 0 | 0 | 0 | 579 |
| Water Bank Recovery | 0 | 0 | 0 | 174 | 154 | 168 | 176 | 172 | 196 | 167 | 157 | 152 | 1,516 |
| AVEK Total (*excluded from total) | 397 | 411 | 799 | 1,143 | 1,317 | 2,105 | 2,061 | 2,310 | 2,086 | 1,245 | 684 | 773 | 15,331 |
| Castaic Lake Water Agency | | | | | | | | | | | | | |
| Table A | 224 | 0 | 0 | 815 | 613 | 1,675 | 1,177 | 153 | 767 | 2,295 | 1,843 | 1,513 | 11,075 |
| Carryover Water | 1,100 | 0 | 0 | 89 | 500 | 0 | 0 | 600 | 780 | 0 | 100 | 952 | 4,121 |
| Water Bank Recovery | 0 | 1,162 | 2,613 | 1,238 | 1,000 | 1,000 | 1,396 | 1,955 | 879 | 0 | 0 | 0 | 11,243 |
| Non-SWP Water Transferred from Others* | 0 | 2,750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,750 |
| Castaic Lake Total (*excluded from total) | 1,324 | 3,912 | 2,613 | 2,142 | 2,113 | 2,675 | 2,573 | 2,708 | 2,426 | 2,295 | 1,943 | 2,465 | 29,189 |
| Coachella Valley Water District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 4,852 | 5,086 | 6,424 | 6,916 | 4,392 | 0 | 0 | 0 | 27,670 |
| Water Bank Recovery | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 3,000 | 3,500 | 9,500 |
| Non-SWP Water Transferred from Others* | 0 | 0 | 0 | 0 | 0 | 0 | 142 | 142 | 142 | 0 | 0 | 0 | 426 |
| Coachella Total (*excluded from total) | 0 | 0 | 0 | 0 | 4,852 | 5,086 | 6,566 | 7,058 | 4,534 | 3,000 | 3,000 | 3,500 | 37,596 |
| Crestline-Lake Arrowhead Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 107 | 154 |
| Table A Transferred from Others* | 106 | 79 | 55 | 89 | 0 | 0 | 107 | 162 | 109 | 101 | 42 | 0 | 850 |
| Carryover Water | 0 | 0 | 0 | 0 | 130 | 117 | 0 | 0 | 0 | 0 | 0 | 0 | 247 |
| Non-SWP Water | 0 | 0 | 24 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 26 |
| Non-SWP Water Transferred from Others* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| Crestline Total (*excluded from total) | 106 | 79 | 79 | 89 | 130 | 117 | 109 | 162 | 109 | 103 | 89 | 107 | 1,279 |
| Desert Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 2,109 | 2,050 | 2,589 | 2,787 | 1,615 | 0 | 0 | 0 | 11,150 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 67 | 0 | 0 | 0 | 0 | 0 | 67 |
| Desert Total | 0 | 0 | 0 | 0 | 2,109 | 2,050 | 2,656 | 2,787 | 1,615 | 0 | 0 | 0 | 11,217 |
| Littlerock Creek Irrigation District | | | | | | | | | | | | | |
| Table A Transferred to Others* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 160 | 0 | 200 | 100 | 460 |
| Littlerock Total (*excluded from total) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 160 | 0 | 200 | 100 | 460 |
| The Metropolitan Water District of Southern California | | | | | | | | | | | | | |
| Table A | 0 | 31,623 | 50,744 | 51,492 | 34,487 | 36,104 | 16,838 | 27,142 | 13,560 | 24,883 | 28,240 | 65,464 | 380,577 |
| Table A Transferred from Others | 358 | 715 | 1,072 | 715 | 715 | 715 | 715 | 715 | 715 | 715 | 715 | 1,167 | 9,032 |
| Table A Transferred to Others* | 0 | 0 | 0 | 227 | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 410 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 1,374 | 0 | 0 | 0 | 0 | 0 | 1,374 |
| Carryover Water | 34,500 | 1,175 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35,675 |
| Water Bank Recovery | 9,471 | 9,562 | 9,688 | 6,741 | 5,454 | 4,524 | 5,078 | 7,875 | 16,632 | 16,786 | 18,797 | 20,942 | 131,550 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 10,949 | 2,185 | 2,184 | 0 | 0 | 0 | 15,318 |
| Metropolitan Total (*excluded from total) | 44,329 | 43,075 | 61,504 | 58,948 | 40,656 | 41,343 | 34,954 | 37,917 | 33,091 | 42,384 | 47,752 | 87,573 | 573,526 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mojave Water Agency | | | | | | | | | | | | | |
| Table A | 121 | 613 | 0 | 0 | 0 | 693 | 465 | 816 | 1,522 | 1,089 | 617 | 0 | 5,936 |
| Table A Transferred to Others* | 369 | 753 | 1,157 | 799 | 804 | 879 | 1,198 | 1,238 | 1,133 | 776 | 761 | 736 | 10,603 |
| Carryover | 0 | 0 | 561 | 481 | 404 | 0 | 0 | 0 | 0 | 0 | 0 | 425 | 1,871 |
| Mojave Total (*excluded from total) | 121 | 613 | 561 | 481 | 404 | 693 | 465 | 816 | 1,522 | 1,089 | 617 | 425 | 7,807 |
| Palmdale Water District | | | | | | | | | | | | | |
| Table A | 969 | 30 | 0 | 636 | 44 | 190 | 128 | 808 | 862 | 0 | 0 | 0 | 3,667 |
| Table A Transferred from Others | 0 | 0 | 0 | 0 | 447 | 283 | 566 | 0 | 148 | 0 | 0 | 0 | 1,444 |
| Table A Transferred to Others* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 0 | 0 | 500 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 26 |
| Carryover Transferred from Others | 0 | 0 | 0 | 0 | 250 | 250 | 79 | 0 | 0 | 0 | 0 | 0 | 579 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 73 | 0 | 0 | 0 | 120 |
| Palmdale Total | 969 | 30 | 0 | 636 | 741 | 723 | 799 | 855 | 1,083 | 0 | 0 | 0 | 5,836 |
| San Bernardino Valley Municipal Water District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 480 | 1,964 | 1,746 | 2,399 | 2,099 | 3,033 | 1,499 | 1,168 | 14,388 |
| Table A Transferred from Others* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 500 | 0 | 0 | 0 | 500 |
| Table A Transferred to Others* | 106 | 79 | 55 | 89 | 0 | 0 | 107 | 1,412 | 1,359 | 101 | 42 | 0 | 3,350 |
| Pool Program Water | 0 | 0 | 0 | 0 | 0 | 0 | 123 | 0 | 0 | 0 | 0 | 0 | 123 |
| Carryover Water | 19 | 9 | 818 | 1,181 | 1,133 | 689 | 1,972 | 1,496 | 1,700 | 0 | 0 | 0 | 9,017 |
| Non-SWP Water Transferred from Others | 0 | 0 | 0 | 0 | 0 | 0 | 150 | 158 | 44 | 0 | 0 | 0 | 352 |
| San Bernardino Total (*excluded from total) | 19 | 9 | 818 | 1,181 | 1,613 | 2,653 | 3,991 | 4,053 | 4,343 | 3,033 | 1,499 | 1,168 | 24,380 |
| San Gabriel Valley Municipal Water District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 2 | 5 | 0 | 1,457 | 1,898 | 1,864 | 534 | 0 | 0 | 5,760 |
| San Gabriel Total (*excluded from total) | 0 | 0 | 0 | 2 | 5 | 0 | 1,457 | 1,898 | 1,864 | 534 | 0 | 0 | 5,760 |
| San Gorgonio Pass Water Agency | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 549 | 530 | 390 | 371 | 376 | 370 | 141 | 196 | 423 | 3,346 |
| Carryover Water | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 85 | 0 | 135 |
| San Gorgonio Total (*excluded from total) | 0 | 0 | 0 | 549 | 580 | 390 | 371 | 376 | 370 | 141 | 281 | 423 | 3,481 |
| Ventura County Watershed Protection District | | | | | | | | | | | | | |
| Table A | 0 | 0 | 0 | 0 | 0 | 204 | 166 | 0 | 0 | 0 | 630 | 0 | 1,000 |
| Ventura Total | 0 | 0 | 0 | 0 | 0 | 204 | 166 | 0 | 0 | 0 | 630 | 0 | 1,000 |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)



| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Non-Swp Agencies* | | | | | | | | | | | | | |
| Recreation/Fish and Wildlife (SWP) | | | | | | | | | | | | | |
| Castaic Lagoon | 0 | 2 | 1 | 2 | 9 | 15 | 17 | 6 | 0 | 0 | 7 | 4 | 63 |
| Lake Perris—Parks and Recreation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 12 | 9 | 2 | 35 |
| Pyramid Lake | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 4 | 0 | 4 | 2 | 0 | 17 |
| Silverwood Lake | 1 | 1 | 2 | 3 | 2 | 3 | 5 | 4 | 5 | 3 | 3 | 4 | 36 |
| Recreation/Fish and Wildlife (SWP) Total | 2 | 4 | 4 | 6 | 12 | 20 | 22 | 26 | 5 | 19 | 21 | 10 | 151 |
| *SWP* | 37,796 | 34,659 | 54,053 | 57,024 | 47,924 | 52,367 | 38,297 | 48,432 | 32,898 | 33,888 | 34,562 | 71,850 | 543,750 |
| *Non-SWP* | 9,471 | 13,474 | 12,325 | 8,153 | 6,608 | 5,692 | 17,893 | 12,534 | 20,150 | 19,955 | 21,954 | 24,594 | 172,803 |
| ***Southern California Area Total*** | ***47,267*** | ***48,133*** | ***66,378*** | ***65,177*** | ***54,532*** | ***58,059*** | ***56,190*** | ***60,966*** | ***53,048*** | ***53,843*** | ***56,516*** | ***96,444*** | ***716,553*** |
| **SWP WATER** | | | | | | | | | | | | | |
| *SWP Long-term Water Supply Contracts* | | | | | | | | | | | | | |
| Table A | 1,840 | 33,243 | 51,758 | 62,356 | 46,106 | 109,193 | 112,859 | 48,778 | 32,477 | 36,271 | 34,886 | 70,677 | 640,444 |
| Transfer Table A and Exchanges | 821 | 1,215 | 1,933 | 2,053 | 2,942 | 4,444 | 6,255 | 9,142 | 3,444 | 878 | 1,042 | 2,842 | 37,011 |
| Pool Water | 47 | 0 | 0 | 0 | 0 | 116 | 1,817 | 294 | 726 | 0 | 0 | 0 | 3,000 |
| Carryover Water | 36,839 | 2,018 | 3,346 | 4,793 | 46,547 | 9,527 | 5,576 | 6,277 | 6,821 | 6,875 | 1,846 | 1,525 | 131,990 |
| *Subtotal* | *39,547* | *36,476* | *57,037* | *69,202* | *95,595* | *123,280* | *126,507* | *64,491* | *43,468* | *44,024* | *37,774* | *75,044* | *812,445* |
| *Other Water Supply Contracts* | | | | | | | | | | | | | |
| Article 21 | 437 | 0 | 0 | 0 | 253 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 690 |
| Settlement Water | 66 | 425 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 728 |
| Delivery of Backup Water | 4,070 | 1,062 | 0 | 12,323 | 9,266 | 8,214 | 9,287 | 50,913 | 23,072 | 4,932 | 5,146 | 586 | 128,871 |
| Water Bank Recovery | 15,523 | 26,604 | 38,978 | 33,702 | 30,927 | 20,733 | 10,699 | 24,125 | 38,389 | 42,599 | 32,123 | 33,450 | 347,852 |
| *Subtotal* | *20,096* | *28,091* | *38,998* | *46,025* | *40,446* | *28,947* | *19,986* | *75,038* | *61,461* | *47,531* | *37,269* | *34,253* | *478,141* |
| *Non-SWP Water Supply Contracts* | | | | | | | | | | | | | |
| Parks and Recreation | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| Dry Year Purchase Program | 0 | 0 | 0 | 0 | 0 | 0 | 4,108 | 4,036 | 3,873 | 8 | 0 | 0 | 12,025 |
| Local | 385 | 316 | 425 | 275 | 314 | 1,287 | 2,956 | 995 | 208 | 182 | 83 | 290 | 7,716 |
| Vallejo Permit | 280 | 447 | 994 | 1,614 | 0 | 0 | 0 | 0 | 0 | 0 | 1,500 | 35 | 4,870 |
| Other Non-SWP Programs | 322 | 3,125 | 185 | 185 | 180 | 248 | 12,544 | 3,026 | 1,282 | 263 | 204 | 126 | 21,690 |
| *Subtotal* | *987* | *3,888* | *1,604* | *2,074* | *494* | *1,536* | *19,608* | *8,058* | *5,363* | *453* | *1,787* | *451* | *46,303* |
| ***SWP Total*** | ***60,630*** | ***68,455*** | ***97,639*** | ***117,301*** | ***136,535*** | ***153,763*** | ***166,101*** | ***147,587*** | ***110,292*** | ***92,008*** | ***76,830*** | ***109,748*** | ***1,336,889*** |

## Table 9-8 Total Amounts of Water Delivered in 2015, by Month (acre-feet)

| Contracting Agency and Type of Service | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2015 Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NON-SWP WATER** | | | | | | | | | | | | | |
| *Non-SWP Agencies* | | | | | | | | | | | | | |
| SWP Contracted Supply Delivered to Non-SWP Agencies | 84 | 46 | 3,374 | 2,000 | 64 | 196 | 29,514 | 1,850 | 1,824 | 56 | 24 | 26 | 39,058 |
| Water Bank Recovery | 0 | 3,641 | 0 | 0 | 0 | 0 | 5,016 | 8,251 | 6,341 | 2,932 | 0 | 0 | 26,181 |
| Regulated delivery of local supply | 162 | 603 | 15,509 | 30,910 | 126,950 | 120,859 | 126,615 | 89,086 | 35,756 | 73,156 | 58,082 | 12,242 | 689,930 |
| Parks and Recreation | 6 | 4 | 12 | 12 | 18 | 28 | 22 | 30 | 15 | 29 | 24 | 11 | 211 |
| Fish and Wildlife | 93 | 58 | 38 | 90 | 35 | 71 | 121 | 61 | 75 | 67 | 32 | 136 | 877 |
| CVP/Reclamation | | | | | | | | | | | | | |
| Kern National Wildlife Refuge | 1,341 | 888 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,640 | 3,532 | 2,054 | 10,455 |
| Annual Contracts | 40 | 30 | 40 | 55 | 63 | 82 | 81 | 64 | 68 | 73 | 38 | 29 | 663 |
| ***Non-SWP Total*** | ***1,726*** | ***5,270*** | ***18,973*** | ***33,067*** | ***127,130*** | ***121,236*** | ***161,369*** | ***99,342*** | ***44,079*** | ***78,953*** | ***61,732*** | ***14,498*** | ***767,375*** |
| **Grand Total** | **62,356** | **73,725** | **116,612** | **150,368** | **263,665** | **274,999** | **327,470** | **246,929** | **154,371** | **170,961** | **138,562** | **124,246** | **2,104,264** |

## Table 9-9 Total Amounts of Annual Table A Water and Water Conveyed, by Type, 1962–2015 (acre-feet)

| Year | Annual Table A Amounts According to Long-term Water Supply Contracts | | | | | | | Water Conveyed | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Deliveries | | | | | | | | |
| | Upper Feather River Area [1] | North Bay Area [2] | South Bay Area [3] | San Joaquin Valley Area [4] | Central Coastal Area [5] | Southern California Area [6] | Total [7] | Table A Water [8] | Article 21, Surplus, and Unscheduled Water[a] [9] | Other Water[b] [10] | Feather River Diversions[c] [11] | Recreation/ Fish and Wildlife Water [12] | Subtotal [13] | Initial Fill Water [14] | Losses and Storage Changes[d] [15] | [16] |
| 1962 | - | - | - | - | - | - | - | - | - | 9,704 | 7,499 | - | 17,203 | 9 | 272 | 17,484 |
| 1963 | - | - | - | - | - | - | - | - | - | 13,212 | 16,049 | - | 29,261 | 71 | 185 | 29,517 |
| 1964 | - | - | - | - | - | - | - | - | - | 21,743 | 17,891 | - | 39,634 | 171 | 152 | 39,957 |
| 1965 | - | - | - | - | - | - | - | - | - | 35,985 | 27,425 | - | 63,410 | 93 | 729 | 64,232 |
| 1966 | - | - | - | - | - | - | - | - | - | 59,599 | 33,361 | - | 92,960 | - | 1,746 | 94,706 |
| 1967 | - | - | 11,538 | - | - | - | 11,538 | 11,354 | - | 45,225 | 24,639 | - | 81,218 | 8,328 | 4,212 | 93,758 |
| 1968 | 550 | - | 109,900 | 77,350 | - | 3,700 | 191,500 | 171,709 | 121,534 | 1,214 | 903,367 | - | 1,197,824 | 498,926 | 117,906 | 1,814,656 |
| 1969 | 620 | - | 98,700 | 163,075 | - | 5,000 | 267,395 | 193,020 | 72,397 | 8,692 | 832,454 | - | 1,106,563 | 510,614 | 72,196 | 1,689,373 |
| 1970 | 700 | - | 114,200 | 202,000 | - | 5,700 | 322,600 | 233,993 | 131,848 | 25,401 | 804,320 | - | 1,195,562 | 23,947 | 2,435 | 1,221,944 |
| 1971 | 890 | - | 116,200 | 251,800 | - | 6,700 | 375,590 | 357,340 | 294,581 | 35,438 | 825,886 | 8 | 1,513,253 | 7,853 | 5,812 | 1,526,918 |
| 1972 | 970 | - | 118,300 | 413,066 | - | 209,423 | 741,759 | 611,801 | 422,322 | 53,848 | 875,529 | 6,489 | 1,969,989 | 100,274 | 53,062 | 2,123,325 |
| 1973 | 1,100 | - | 120,400 | 383,652 | - | 481,100 | 986,252 | 692,888 | 294,916 | 29,540 | 851,285 | 1,155 | 1,869,784 | 204,638 | 53,798 | 2,128,220 |
| 1974 | 1,230 | - | 122,400 | 460,650 | - | 597,920 | 1,182,200 | 874,075 | 412,453 | 31,493 | 963,956 | 2,118 | 2,284,095 | 237,554 | 10,657 | 2,532,306 |
| 1975 | 1,610 | - | 124,500 | 545,809 | - | 714,950 | 1,386,869 | 1,223,990 | 620,685 | 46,995 | 924,696 | 3,377 | 2,819,743 | 103,352 | (94,606) | 2,828,489 |
| 1976 | 1,990 | - | 126,500 | 543,417 | - | 836,480 | 1,508,387 | 1,373,002 | 551,685 | 103,546 | 1,018,653 | 1,745 | 3,048,631 | 61,122 | (681,025) | 2,428,728 |
| 1977 | 2,420 | - | 128,600 | 581,400 | - | 954,901 | 1,667,321 | 573,896 | - | 410,991 | 624,497 | 1,111 | 1,610,495 | - | (131,151) | 1,479,344 |
| 1978 | 1,850 | - | 130,700 | 635,900 | - | 1,049,584 | 1,818,034 | 1,312,365 | 16,215 | 177,245 | 836,864 | 1,691 | 2,344,380 | 64,443 | 717,370 | 3,126,193 |
| 1979 | 2,130 | - | 132,700 | 702,685 | - | 1,190,573 | 2,028,088 | 1,404,292 | 646,830 | 431,693 | 933,067 | 1,766 | 3,417,648 | 12,302 | (83,430) | 3,346,520 |
| 1980 | 1,810 | 500 | 134,800 | 758,100 | 1,946 | 1,317,614 | 2,214,770 | 1,511,491 | 402,217 | 40,269 | 925,750 | 2,131 | 2,881,858 | - | (26,606) | 2,855,252 |
| 1981 | 1,940 | 650 | 137,000 | 818,000 | 2,813 | 1,432,065 | 2,392,468 | 1,889,125 | 908,428 | 283,310 | 993,785 | 4,688 | 4,079,336 | - | (802,263) | 3,277,073 |
| 1982 | 1,970 | 800 | 139,200 | 876,500 | 5,626 | 1,550,449 | 2,574,545 | 1,738,056 | 215,134 | 144,267 | 819,586 | 4,646 | 2,921,689 | - | 480,752 | 3,402,441 |
| 1983 | 2,000 | 950 | 141,400 | 867,118 | 8,439 | 1,681,257 | 2,701,164 | 1,184,119 | 13,019 | 172,030 | 633,778 | 7,849 | 2,010,795 | - | (90,997) | 1,919,798 |
| 1984 | 3,630 | 1,100 | 143,600 | 979,211 | 12,698 | 1,744,098 | 2,884,337 | 1,587,593 | 262,917 | 366,273 | 891,128 | 7,040 | 3,114,951 | - | (140,182) | 2,974,769 |
| 1985 | 3,760 | 1,250 | 145,800 | 1,019,049 | 21,138 | 1,864,849 | 3,055,846 | 1,912,765 | 301,844 | 474,417 | 924,049 | 4,033 | 3,617,108 | - | 92,885 | 3,709,993 |
| 1986 | 4,190 | 1,400 | 148,100 | 1,091,946 | 28,210 | 1,983,890 | 3,257,736 | 2,007,906 | 24,350 | 177,176 | 843,040 | 3,865 | 3,056,337 | - | 284,380 | 3,340,717 |
| 1987 | 4,620 | 1,550 | 150,300 | 1,188,500 | 35,204 | 2,103,941 | 3,484,115 | 2,113,915 | 114,907 | 375,810 | 882,301 | 7,672 | 3,494,605 | - | (390,413) | 3,104,192 |
| 1988 | 5,060 | 15,471 | 152,500 | 1,246,100 | 43,722 | 2,225,482 | 3,688,335 | 2,376,373 | - | 520,375 | 884,877 | 4,889 | 3,786,514 | - | (92,850) | 3,693,664 |
| 1989 | 5,500 | 24,615 | 156,700 | 1,290,400 | 56,342 | 2,424,633 | 3,958,190 | 2,853,747 | - | 474,559 | 830,500 | 8,135 | 4,166,941 | - | 447,917 | 4,614,858 |
| 1990 | 6,040 | 28,190 | 160,900 | 1,313,450 | 70,486 | 2,500,600 | 4,079,666 | 2,582,151 | 90 | 424,697 | 875,099 | 9,262 | 3,891,299 | - | (528,869) | 3,362,430 |
| 1991 | 11,880 | 29,590 | 166,400 | 1,338,011 | 70,486 | 2,510,200 | 4,126,567 | 549,113 | 3,521 | 543,582 | 565,395 | 4,879 | 1,666,490 | - | 167,435 | 1,833,925 |

## Table 9-9 Total Amounts of Annual Table A Water and Water Conveyed, by Type, 1962–2015 (acre-feet)

| Year | Annual Table A Amounts According to Long-term Water Supply Contracts | | | | | | | Water Conveyed | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Deliveries | | | | | | | | |
| | Upper Feather River Area [1] | North Bay Area [2] | South Bay Area [3] | San Joaquin Valley Area [4] | Central Coastal Area [5] | Southern California Area [6] | Total [7] | Table A Water [8] | Article 21, Surplus, and Unscheduled Water[a] [9] | Other Water[b] [10] | Feather River Diversions[c] [11] | Recreation/ Fish and Wildlife Water [12] | Subtotal [13] | Initial Fill Water [14] | Losses and Storage Changes[d] [15] | **Total** [16] |
| 1992 | 11,920 | 32,010 | 171,900 | 1,342,300 | 70,486 | 2,510,200 | 4,138,816 | 1,410,799 | 1,156 | 166,992 | 613,978 | 2,605 | 2,195,530 | - | (63,541) | 2,131,989 |
| 1993 | 11,960 | 34,620 | 177,400 | 1,342,300 | 70,486 | 2,510,200 | 4,146,966 | 2,313,236 | - | 256,853 | 822,589 | 2,609 | 3,395,287 | - | 726,123 | 4,121,410 |
| 1994 | 12,000 | 37,215 | 182,000 | 1,342,300 | 70,486 | 2,510,200 | 4,154,201 | 1,749,351 | 112,625 | 236,739 | 874,018 | 8,200 | 2,980,933 | - | (295,405) | 2,685,528 |
| 1995 | 12,050 | 44,030 | 184,000 | 1,342,300 | 70,486 | 2,510,200 | 4,163,066 | 1,967,093 | 64,330 | 85,560 | 860,077 | 2,575 | 2,979,635 | - | 69,536 | 3,049,171 |
| 1996 | 12,100 | 48,225 | 186,000 | 1,301,630 | 70,486 | 2,492,900 | 4,111,341 | 2,514,824 | 28,647 | 252,346 | 1,005,148 | 3,907 | 3,804,872 | 86 | 491,550 | 4,296,508 |
| 1997 | 12,150 | 49,315 | 188,000 | 1,297,300 | 45,201 | 2,492,900 | 4,084,866 | 2,260,383 | 21,432 | 322,000 | 993,211 | 4,146 | 3,601,172 | 527 | (11,806) | 3,589,893 |
| 1998 | 12,200 | 50,420 | 188,000 | 1,272,300 | 45,201 | 2,517,900 | 4,086,021 | 1,726,519 | 20,288 | 127,405 | 872,738 | 2,108 | 2,749,058 | - | (132,491) | 2,616,567 |
| 1999 | 13,940 | 55,020 | 188,000 | 1,272,300 | 70,486 | 2,519,900 | 4,119,646 | 2,738,903 | 158,070 | 85,312 | 1,108,672 | 4,324 | 4,095,281 | - | (189,525) | 3,905,756 |
| 2000 | 14,000 | 55,945 | 210,000 | 1,205,300 | 70,486 | 2,565,900 | 4,121,631 | 3,172,407 | 308,785 | 353,584 | 1,085,886 | 4,096 | 4,924,758 | - | (20,103) | 4,904,655 |
| 2001 | 14,670 | 66,561 | 220,000 | 1,185,519 | 70,486 | 2,566,900 | 4,124,136 | 1,579,291 | 48,145 | 632,403 | 1,077,997 | 2,942 | 3,340,778 | - | 159,983 | 3,500,761 |
| 2002 | 14,730 | 67,396 | 220,000 | 1,182,519 | 70,486 | 2,569,900 | 4,125,031 | 2,634,672 | 43,115 | 311,976 | 1,131,880 | 3,712 | 4,125,355 | - | 80,709 | 4,206,064 |
| 2003 | 14,790 | 68,231 | 220,400 | 1,182,119 | 70,486 | 2,570,900 | 4,126,926 | 2,975,817 | 59,828 | 160,087 | 1,006,995 | 2,862 | 4,205,589 | - | 459,377 | 4,664,966 |
| 2004 | 13,100 | 69,056 | 222,619 | 1,170,000 | 70,486 | 2,581,800 | 4,127,061 | 2,644,787 | 218,496 | 403,542 | 1,171,835 | 2,887 | 4,441,547 | - | 108,840 | 4,550,387 |
| 2005 | 10,800 | 69,481 | 222,619 | 1,170,000 | 70,486 | 2,582,300 | 4,125,686 | 2,827,256 | 731,083 | 92,858 | 1,074,706 | 1,515 | 4,727,418 | - | 529,347 | 5,256,765 |
| 2006 | 11,124 | 69,856 | 222,619 | 1,170,000 | 70,486 | 2,582,800 | 4,126,885 | 2,973,349 | 621,339 | 143,774 | 1,094,944 | 3,628 | 4,837,034 | - | (119,981) | 4,717,053 |
| 2007 | 11,520 | 70,231 | 222,619 | 1,170,000 | 70,486 | 2,584,450 | 4,129,306 | 2,180,751 | 309,973 | 598,789 | 1,193,237 | 2,581 | 4,285,331 | - | (524,851) | 3,760,480 |
| 2008 | 39,120 | 70,606 | 222,619 | 1,170,000 | 70,486 | 2,593,100 | 4,165,931 | 1,244,240 | 2,729 | 769,517 | 1,087,669 | 2,778 | 3,106,933 | - | (758,813) | 2,348,120 |
| 2009 | 39,190 | 70,981 | 222,619 | 1,170,000 | 70,486 | 2,593,100 | 4,166,376 | 1,385,266 | 6,032 | 709,885 | 1,125,147 | 2,047 | 3,228,377 | - | (31,319) | 3,197,058 |
| 2010 | 13,491 | 76,531 | 222,619 | 1,140,000 | 70,486 | 2,623,100 | 4,146,227 | 2,010,672 | 7,505 | 790,602 | 978,172 | 1,167 | 3,788,118 | - | 461,751 | 4,249,869 |
| 2011 | 14,388 | 76,581 | 222,619 | 1,140,000 | 70,486 | 2,623,100 | 4,147,174 | 2,847,572 | 420,691 | 388,632 | 1,028,542 | 1,593 | 4,687,030 | - | 358,354 | 5,045,384 |
| 2012 | 39,420 | 76,631 | 222,619 | 1,140,000 | 70,486 | 2,623,100 | 4,172,256 | 2,593,699 | - | 367,609 | 1,047,832 | 1,609 | 4,010,749 | - | (537,209) | 3,473,540 |
| 2013 | 39,510 | 76,681 | 222,619 | 1,140,000 | 70,486 | 2,623,100 | 4,172,396 | 1,623,212 | - | 579,512 | 1,166,635 | 1,641 | 3,371,000 | - | (256,889) | 3,114,111 |
| 2014 | 39,600 | 76,731 | 222,619 | 1,136,556 | 70,486 | 2,626,544 | 4,172,536 | 476,033 | 1,444 | 697,050 | 839,792 | 677 | 2,014,996 | - | (222,460) | 1,792,536 |
| 2015 | 39,700 | 76,781 | 222,619 | 1,133,556 | 70,486 | 2,629,544 | 4,172,686 | 851,503 | 690 | 580,841 | 670,538 | 692 | 2,104,264 | - | (419,759) | 1,684,505 |
| **Total** | **535,933** | **1,595,201** | **8,238,466** | **46,865,488** | **1,998,204** | **90,999,147** | **150,232,439** | **82,041,714** | **9,018,296** | **14,652,197** | **44,522,964** | **155,450** | **150,390,621** | **1,834,310** | **(687,073)** | **151,537,858** |

[a] Values include amounts of deliveries to short-term contractors (Mustang Water District, 1970–1972; Tracy Golf and Country Club, 1974, 1979, and 1980; Green Valley Water District, 1974, 1975, 1978, 1979, 1980, and 1985; and Granite Construction Company, 1980).
[b] Includes amounts of SWP and non-SWP water conveyed for SWP and non-SWP water contractors.
[c] Includes amounts of water diverted under various water rights agreements.
[d] Amounts reflect net effect of (1) operational losses from SWP transportation facilities; (2) changes in reservoir storage south of the Delta; (3) storable local inflows to SWP reservoirs; (4) side inflow to San Luis Canal; and (5) inflow into the California Aqueduct from the Kern River Intertie.

## Table 9-10 SWP Water Delivered by Category, 1962–2015 (acre-feet)

| Year | Table A Water | | | Article 21/Unscheduled | | Other SWP Water Deliveries | | | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|
| | Municipal and Industrial | Agricultural | Total Table A[a] | Municipal and Industrial | Agricultural | Other Water[b] | Feather River Diversions[c] | Fish & Wildlife/ Recreation Water | |
| 1962 | 0 | 0 | 0 | 0 | 0 | 9,704 | 7,499 | 0 | 17,203 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 13,212 | 16,049 | 0 | 29,261 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 21,743 | 17,891 | 0 | 39,634 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 35,985 | 27,425 | 0 | 63,410 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 59,599 | 33,361 | 0 | 92,960 |
| 1967 | 5,563 | 5,791 | 11,354 | 0 | 0 | 45,225 | 24,639 | 0 | 81,218 |
| 1968 | 86,541 | 85,168 | 171,709 | 10,000 | 111,534 | 1,214 | 903,367 | 0 | 1,197,824 |
| 1969 | 63,956 | 129,064 | 193,020 | 0 | 72,397 | 8,692 | 832,454 | 0 | 1,106,563 |
| 1970 | 83,415 | 150,578 | 233,993 | 0 | 131,848 | 25,401 | 804,320 | 0 | 1,195,562 |
| 1971 | 93,776 | 263,564 | 357,340 | 0 | 294,581 | 35,438 | 825,886 | 8 | 1,513,253 |
| 1972 | 186,796 | 425,005 | 611,801 | 0 | 422,322 | 53,848 | 875,529 | 6,489 | 1,969,989 |
| 1973 | 297,497 | 395,391 | 692,888 | 0 | 294,916 | 29,540 | 851,285 | 1,155 | 1,869,784 |
| 1974 | 423,982 | 450,093 | 874,075 | 0 | 412,453 | 31,493 | 963,956 | 2,118 | 2,284,095 |
| 1975 | 670,492 | 553,498 | 1,223,990 | 356 | 620,329 | 46,995 | 924,696 | 3,377 | 2,819,743 |
| 1976 | 631,876 | 741,126 | 1,373,002 | 4,147 | 547,538 | 103,546 | 1,018,653 | 1,745 | 3,048,631 |
| 1977 | 354,930 | 218,966 | 573,896 | 0 | 0 | 410,991 | 624,497 | 1,111 | 1,610,495 |
| 1978 | 782,625 | 529,740 | 1,312,365 | 0 | 16,215 | 177,245 | 836,864 | 1,691 | 2,344,380 |
| 1979 | 692,888 | 711,404 | 1,404,292 | 0 | 646,830 | 431,693 | 933,067 | 1,766 | 3,417,648 |
| 1980 | 726,545 | 784,946 | 1,511,491 | 52,200 | 350,017 | 40,269 | 925,750 | 2,131 | 2,881,858 |
| 1981 | 1,053,273 | 835,852 | 1,889,125 | 18,920 | 889,508 | 283,310 | 993,785 | 4,688 | 4,079,336 |
| 1982 | 916,014 | 822,042 | 1,738,056 | 140 | 214,994 | 144,267 | 819,586 | 4,646 | 2,921,689 |
| 1983 | 482,749 | 701,370 | 1,184,119 | 0 | 13,019 | 172,030 | 633,778 | 7,849 | 2,010,795 |
| 1984 | 725,799 | 861,794 | 1,587,593 | 3,663 | 259,254 | 366,273 | 891,128 | 7,040 | 3,114,951 |
| 1985 | 983,341 | 929,424 | 1,912,765 | 9,638 | 292,206 | 474,417 | 924,049 | 4,033 | 3,617,108 |
| 1986 | 998,611 | 1,009,295 | 2,007,906 | 2,595 | 21,755 | 177,176 | 843,040 | 3,865 | 3,056,337 |
| 1987 | 1,079,983 | 1,033,932 | 2,113,915 | 6,949 | 107,958 | 375,810 | 882,301 | 7,672 | 3,494,605 |
| 1988 | 1,308,071 | 1,068,302 | 2,376,373 | 0 | 0 | 520,375 | 884,877 | 4,889 | 3,786,514 |
| 1989 | 1,602,543 | 1,251,204 | 2,853,747 | 0 | 0 | 474,559 | 830,500 | 8,135 | 4,166,941 |
| 1990 | 1,876,072 | 706,079 | 2,582,151 | 0 | 90 | 424,697 | 875,099 | 9,262 | 3,891,299 |
| 1991 | 536,669 | 12,444 | 549,113 | 3,521 | 0 | 543,582 | 565,395 | 4,879 | 1,666,490 |
| 1992 | 955,687 | 455,112 | 1,410,799 | 1,156 | 0 | 166,992 | 613,978 | 2,605 | 2,195,530 |
| 1993 | 1,069,258 | 1,243,978 | 2,313,236 | 0 | 0 | 256,853 | 822,589 | 2,609 | 3,395,287 |
| 1994 | 1,134,992 | 614,359 | 1,749,351 | 48,150 | 64,475 | 236,739 | 874,018 | 8,200 | 2,980,933 |
| 1995 | 801,570 | 1,165,523 | 1,967,093 | 17,984 | 46,346 | 85,560 | 860,077 | 2,575 | 2,979,635 |
| 1996 | 1,143,638 | 1,371,186 | 2,514,824 | 12,091 | 16,556 | 252,346 | 1,005,148 | 3,907 | 3,804,872 |
| 1997 | 1,220,200 | 1,040,183 | 2,260,383 | 2,814 | 18,618 | 322,000 | 993,211 | 4,146 | 3,601,172 |
| 1998 | 865,795 | 860,724 | 1,726,519 | 9,982 | 10,306 | 127,405 | 872,738 | 2,108 | 2,749,058 |
| 1999 | 1,405,311 | 1,333,592 | 2,738,903 | 61,191 | 96,879 | 85,312 | 1,108,672 | 4,324 | 4,095,281 |
| 2000 | 1,949,922 | 1,222,485 | 3,172,407 | 170,302 | 138,483 | 353,584 | 1,085,886 | 4,096 | 4,924,758 |

## Table 9-10 SWP Water Delivered by Category, 1962–2015 (acre-feet)

| | Table A Water | | | Article 21/Unscheduled | | Other SWP Water Deliveries | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Municipal and Industrial | Agricultural | Total Table A[a] | Municipal and Industrial | Agricultural | Other Water[b] | Feather River Diversions[c] | Fish & Wildlife/ Recreation Water | **Total Deliveries** |
| 2001 | 1,171,421 | 407,870 | 1,579,291 | 14,971 | 33,174 | 632,403 | 1,077,997 | 2,942 | 3,340,778 |
| 2002 | 1,918,094 | 716,578 | 2,634,672 | 15,478 | 27,637 | 311,976 | 1,131,880 | 3,712 | 4,125,355 |
| 2003 | 2,188,647 | 787,170 | 2,975,817 | 23,019 | 36,809 | 160,087 | 1,006,995 | 2,862 | 4,205,589 |
| 2004 | 2,001,278 | 643,509 | 2,644,787 | 103,890 | 114,606 | 403,542 | 1,171,835 | 2,887 | 4,441,547 |
| 2005 | 1,923,222 | 904,034 | 2,827,256 | 186,787 | 544,296 | 92,858 | 1,074,706 | 1,515 | 4,727,418 |
| 2006 | 1,973,662 | 999,687 | 2,973,349 | 293,358 | 327,981 | 143,774 | 1,094,944 | 3,628 | 4,837,034 |
| 2007 | 1,670,711 | 510,040 | 2,180,751 | 185,825 | 124,148 | 598,789 | 1,193,237 | 2,581 | 4,285,331 |
| 2008 | 1,024,147 | 224,012 | 1,248,159 | 2,729 | 0 | 769,517 | 1,087,669 | 2,778 | 3,110,852 |
| 2009 | 1,036,273 | 348,993 | 1,385,266 | 6,032 | 0 | 709,885 | 1,125,147 | 2,047 | 3,228,377 |
| 2010 | 1,503,908 | 506,764 | 2,010,672 | 7,158 | 347 | 790,602 | 978,172 | 1,167 | 3,788,118 |
| 2011 | 1,871,986 | 975,586 | 2,847,572 | 207,307 | 213,384 | 388,632 | 1,028,542 | 1,593 | 4,687,030 |
| 2012 | 1,879,350 | 714,349 | 2,593,699 | 0 | 0 | 367,609 | 1,047,832 | 1,609 | 4,010,749 |
| 2013 | 1,195,815 | 424,608 | 1,620,423 | 0 | 0 | 582,301 | 1,166,635 | 1,641 | 3,371,000 |
| 2014 | 406,314 | 69,719 | 476,033 | 1,444 | 0 | 697,050 | 839,792 | 677 | 2,014,996 |
| 2015 | 623,088 | 228,415 | 851,503 | 690 | 0 | 580,841 | 670,538 | 692 | 2,104,264 |
| **Total** | **49,602,774** | **32,438,940** | **82,041,714** | **1,485,579** | **7,532,717** | **14,652,197** | **44,522,964** | **155,450** | **150,390,621** |

[a] Includes Table A, Table A transfers, Table A exchanges, Carryover, and Pool Water.
[b] Includes water conveyed for SWP and non-SWP water contractors.
[c] Includes amounts of water diverted according to various water rights agreements.



# Chapter 10
# Power Resources

*Power lines near Victor Valley in the Mojave Desert.*

## Significant Events in 2015

Energy used at the 29 State Water Project (SWP) pumping and generating plants totaled 3.49 million megawatt hours (MWh). To meet SWP energy needs, the Department of Water Resources (DWR) purchased 2.59 million MWh of energy at a cost of $81.33 million. This included: (1) 1.95 million MWh of WSPP short-term energy from four marketers (referred to as bilaterals) and two renewable-energy electric utilities at a combined cost of $64.75 million; and (2) 0.64 million MWh of long-term energy at a cost of $16.58 million. Additional energy-associated costs totaled $117.87 million.

Pursuant to WSPP bilateral trades, transactions made under the Lodi Energy Center Power Sales Agreement, transactions under the California Independent System Operator (CAISO), and revenues from other long-term contracts, DWR received a total of $83.35 million.

On November 5, 2015, DWR executed a power purchase agreement with sPower to provide solar power from the Solverde 1 Solar Facility, a solar photovoltaic renewable energy generation facility.

*Information for this chapter was provided by the State Water Project Analysis Office, the SWP Power and Risk Office, the Hydropower License Planning and Compliance Office, and the SWP Operations Control Office.*

Long-term State Water Project (SWP) water contractors depend on the SWP to obtain economical sources of power in order to deliver affordable water. Consequently, the Department of Water Resources (DWR) administers a comprehensive power resources program. Key elements of the program include studies of power resources for future needs, acquisition of long-term power resources and transmission services, short-term purchases or sales of power, and the strategic operation of generation and pumping facilities.

## Power Resources Program

The goals of the SWP power resources program are to:

- obtain reliable, environmentally sensitive, and competitively priced power resources and transmission services sufficient to operate the SWP;
- develop and manage power resources to minimize the cost of water deliveries to SWP water contractors;
- meet responsibilities and criteria of the Western Electricity Coordinating Council (WECC); and
- conform to regulations of the Federal Energy Regulatory Commission (FERC).

To achieve these goals, DWR constructed its own power facilities. Additionally, DWR enters into long-term contracts and short-term arrangements with other electric utilities and with the California Independent System Operator (CAISO) for transmission access and for power purchases and sales. DWR's generators and pumps provide a mix of regulation, spinning, and nonspinning reserves to the CAISO's ancillary services market. DWR's power resources program also takes advantage of SWP water storage and conveyance capacities, which cost-effectively control pump loads and generation.

### Major Electric Utility Industry Developments

In 2015, CAISO continued to address the impact of increasing renewable energy generation and the need for greater ramping capability to maintain grid reliability.

In April 2015, CAISO and PacifiCorp entered into a memorandum of understanding to explore the feasibility, costs, and benefits of PacifiCorp joining CAISO as a Participating Transmission Owner. In October 2015, the Governor signed Senate Bill 350, the Clean Energy and Pollution Reduction Act of 2015, which requires that the amount of electricity generated and sold to retail customers per year from eligible renewable energy resources be increased to 50 percent by 2030 and for CAISO to study the impacts of becoming a regional grid operator.

Throughout 2015, CAISO continued to work on governance of and enhancements to the Energy Imbalance Market (EIM), which allows other balancing area authorities to participate in CAISO's real-time market. The purpose of the EIM is to provide market efficiency by allowing other regions to share resources that are intended to be more economic. At the end of 2015, PacifiCorp, Puget Sound Energy, Arizona Public Service, and Portland General Electric had committed to CAISO EIM participation. The participation of these regional utilities with resources in California, Oregon, Washington, Utah, Wyoming, Idaho, Nevada, and Arizona

expanded the pool of generating resources bidding energy into the CAISO real-time market.

On April 29, 2015, FERC waived CAISO's requirement to reinstate convergence bidding at interties due to CAISO's findings related to potential market inefficiencies that could allow market gaming opportunities.

In June 2015, Peak Reliability completed its separation from WECC. Peak Reliability was formed as an independent company to perform the reliability coordinator services previously performed by WECC.

In July 2015, CAISO kicked off its stakeholder initiative on the Flexible Resource Adequacy Criteria and Must-Offer Obligation (Phase 2) as a continuation to the flexible capacity stakeholder process that was initiated in January 2012. Phase 2 is meant to enhance the Phase 1 processes, including flexible capacity from external resources through interties and from storage resources. It also kicked off its Reliability Services Initiative (Phase 2) to enhance resource adequacy provisions such as substitution of forced outages and Local Regulatory Authority interaction and process alignment.

In order to comply with the interregional planning requirements established by FERC Order 1000, the four planning regions—CAISO, ColumbiaGrid, Northern Tier Transmission Group, and WestConnect—agreed to hold at least one coordination meeting a year to inform stakeholders about each region's current planning activities and coordination efforts. During 2015, significant events included the completion of required regional planning processes by the four regional entities and ongoing dialog among the planning regions to develop a process for coordinating transmission planning information.

On October 23, 2015, CAISO released an issue paper to evaluate whether revisions to its existing Transmission Access Charge rate structure are appropriate when adding a new large utility with a load service territory (e.g., PacifiCorp) to the CAISO's existing Balancing Authority Area, creating an expanded Balancing Authority Area footprint. This initiative's focus is on high-voltage transmission rate recovery only. The various alternatives presented in the issue paper are meant to initiate discussion of potential Transmission Access Charge structures for consideration as alternatives to the existing structure.

Also in 2015, CAISO, along with the California Energy Commission and California Public Utilities Commission, introduced the Renewable Energy Transmission Initiative 2.0 to facilitate electric transmission coordination and planning as the State looks to increase to a 50 percent renewable portfolio standard.

## DWR Participation in Electric Utility Industry Activities

DWR continued to participate in CAISO's stakeholder processes to help ensure that tariff and business practice manuals are compatible with SWP operations. DWR's participation in CAISO stakeholder processes focused on the following primary elements in 2015:

- Market Initiatives Roadmap;
- Stakeholder Initiatives Catalog;
- Intertie Convergence Bidding;
- 2-Tier Real-time Bid Cost Recovery;
- Energy Storage and Distributed Energy Resources, Phase 1;
- Grid Management Charge rate structure for 2016;
- Pay for Performance;
- Bidding Rules Enhancements FERC Order 809;
- Load Granularity Refinements;
- Barriers to demand response;
- FERC Order 764 compliance;

- Commitment Cost Enhancements, Phases 2 and 3;
- Pricing Enhancements;
- Flexible Ramping Product;
- EIM Enhancements;
- Generator Interconnection Process Enhancements;
- Reactive Power Requirements;
- Transmission planning;
- FERC Order 1000 compliance, Phase 2;
- Local capacity procurement for 2016 requirements;
- Annual Resource Adequacy processes including the Path 26 allocation, import allocation, and net qualifying capacity; and
- Flexible Capacity Procurement process for 2017—Capacity Procurement Mechanism tariff language.

In addition, DWR participated in the California Energy Commission's planning processes by submitting a demand forecast to the commission.

Besides CAISO and the California Energy Commission stakeholder processes, DWR participated in FERC proceedings to help ensure that various market requirements or cost allocation mechanisms were appropriately structured. This included the following major processes and litigations (with FERC docket numbers given in parenthesis, if applicable):

- CAISO's Multi-stage Generation enhancements (ER14-93, ER14-1004, ER15-1875);
- CAISO's Demand Response Report (ER06-615);
- CAISO's EIM (ER13-1372, ER14-1729, EL15-53, ER15-1196, ER15-1919);
- CAISO's Amendment to Participating Load Agreement (ER15-1805);
- CAISO's Two-tier Real-time Bid Cost Recovery (ER06-615);
- CAISO's Commitment Cost Enhancements (ER15-15);
- CAISO's Convergence Bidding at Interties (ER14-480, ER15-1451);
- CAISO's Order 1000 Compliance (ER13-1470);
- Pacific Gas & Electric Company's (PG&E) TO17 proposal to increase transmission revenue requirement rates for retail and wholesale customers of CAISO (ER15-2294);
- San Diego Gas & Electric's TO4—Cycle 3 proposal to increase transmission revenue requirement rates for retail and wholesale customers of CAISO (ER16-445);
- Southern California Edison's (SCE) fourth annual update to its approved formula rate (ER11-3697);
- SCE's proposed annual update to its Transmission Revenue Balancing Account (ER16-175) and Reliability Services tariff (ER16-174);
- San Diego Gas & Electric's proposed annual update to its Transmission Revenue Balancing Account Adjustment and Transmission Access Charge Balancing Account Adjustment (ER16-550);
- PG&E's proposed annual update to its Transmission Revenue Balancing Account (ER16-42);
- TransCanyon's initial transmission owner tariff, which includes a formula rate designed to calculate annual transmission revenue requirement (ER15-1682);
- NextEra Energy Transmission West's initial transmission owner tariff, which includes a formula rate designed to calculate annual transmission revenue requirement (ER15-2239); and
- PG&E's notice of termination of the Comprehensive Agreement between PG&E and the State of California Department of Water Resources State Water Project (Comprehensive Agreement) (ER15-223) and PG&E's filing of new load and generator interconnection agreements with DWR (ER15-227).

In April 2015, DWR submitted a motion to intervene in Cases No. 15-1057 and 15-1241 (consolidated) before the U.S. Court of Appeals for the District of Columbia Circuit, which were petitioned by the Transmission Agency of Northern California, Modesto Irrigation District, the City of Santa Clara, and the City of Redding. The petitioners are seeking to appeal FERC orders (EL14-44 and ER15-223) relating to a complaint versus PG&E, alleging a breach of PG&E's contractual obligations to them under the operating agreement for the California-Oregon Intertie resulting from the loss of DWR participation in PG&E's Pacific AC Intertie remedial action schemes with termination of the Comprehensive Agreement. Briefs will be due beginning in February 2016.

## Bulk Electric System Reliability Standards

### *Background*

The Energy Policy Act of 2005 assigned FERC the responsibility for bulk electric system reliability and required the creation of an Electric Reliability Organization. The North American Electric Reliability Corporation (NERC) was named the Electric Reliability Organization by FERC in July 2006 and was tasked with establishing reliability standards for the bulk electric system. Compliance with NERC reliability standards is mandatory.

WECC was named by NERC and approved by FERC as the regional entity responsible for enforcing a reliable bulk electric system in the Western Interconnection, which includes both western Canada and the western United States. WECC oversees implementation of standards and validation of compliance, including assessment of penalties and/or sanctions. Details of the NERC standards and the attributes of the compliance program appear in Bulletin 132-11.

### *NERC Reliability Compliance—Internal Compliance Program Improvements*

In March 2015, DWR executed a settlement agreement with WECC regarding possible violations of NERC's reliability standards. As a result of this settlement agreement, DWR improved its internal compliance program (ICP) to foster a culture of partnership with WECC by committing to:

- encourage communication and collaboration with WECC;
- provide all relevant information, as well as mitigating factors, when making self-reports to WECC if DWR discovers possible violations of NERC reliability standards;
- respond timely to WECC data requests, and promptly escalate unresolved issues to higher-level employees;
- ensure knowledgeable staff is readily available to respond to WECC by assigning properly trained owners to each applicable NERC standard and instituting advanced internal deadlines to reduce the need for extension requests.

Additionally, to ensure that DWR is adhering to NERC's reliability standards and DWR's own internal procedures, DWR modified existing policies and processes to incorporate annual internal spot-check/audits on 20 percent of applicable NERC reliability standards and on DWR's internal procedures that relate to compliance.

Pursuant to its ICP, DWR's Compliance and Regulatory Office conducted an internal audit of DWR's compliance to its nine existing ICP policies and associated processes and twelve NERC reliability standards, which is 20 percent of the standards applicable to DWR. DWR used the audit results to improve and strengthen the ICP.

In 2015, NERC implemented its Risk-Based Compliance Monitoring and Enforcement Program to replace its previous

zero-tolerance program. Under this new program, entities that have effective internal controls and low reliability risks may receive fewer audits from NERC and WECC, reduced audit scope, and reduced penalties for noncompliance.

NERC also continued to help the industry transition to Version 5 of the Critical Infrastructure Protection Reliability Standards (CIP Version 5) to further mitigate cyber risks to the bulk power system. In response, DWR developed its CIP Version 5 transition plan to ensure that DWR is in compliance by the implementation date.

In compliance with the requirements of the reliability standards, DWR also submitted its annual self-certification to WECC in February 2015. This was done to certify DWR's compliance with the requirements of a WECC-determined subset of standards or to provide a violation report supported by a mitigation plan to resolve outstanding items. Violations can lead to financial penalties or reduced operating flexibility.

In addition, NERC annually creates a 3-year plan to address reliability standards development and revision. DWR's Division of Operations and Maintenance monitors this plan to ensure compliance with standards as they change.

## Greenhouse Gas Management

In 2015, DWR reported its pump load, sulfur hexafluoride emissions, and generation for 2014 to the California Air Resources Board. DWR's sulfur hexafluoride emissions were below the maximum allowable limit; however, because the allowable limit will be lower in future years, DWR is developing plans to reduce its sulfur hexafluoride emissions. DWR also reported its greenhouse gas (GHG) emissions for 2014 to The Climate Registry and submitted its fossil fuel report for 2014 to the Governor's Office.

To meet its contractual obligation for the Lodi Energy Center's cap and trade compliance cost, DWR continued participating in allowance auctions conducted jointly by the California Air Resources Board and Québec's Ministry of Sustainable Development, Environment and the Fight against Climate Change.

## Hydropower License Planning and Compliance

DWR holds three hydropower licenses and two conduit exemptions issued by FERC: Oroville Facilities, FERC Project No. 2100; South SWP Hydropower, FERC Project No. 2426 (P-2426); Pine Flat Transmission Line, FERC Project No. 2876; Alamo Powerplant Project, FERC Project No. 14579; and Mojave Siphon Powerplant Project, FERC Project No. 14580. FERC licenses and conduit exemptions may contain terms and conditions related to operations, maintenance, engineering, dam safety, security, environmental and cultural resources, recreation, and public safety. FERC also conducts safety, security, and environmental inspections, and DWR is required to comply with all findings of the inspections. Compliance with FERC requirements is an important function of DWR organizations since FERC has the authority to levy fines for noncompliance. FERC also considers the record of compliance when considering the term of license renewals.

### *Oroville Facilities Relicensing*

On January 26, 2005, DWR filed an application with FERC requesting a new license for the Oroville Facilities. (More detailed information about the relicensing process is available in previous editions of Bulletin 132.) The existing 50-year license expired January 31, 2007; FERC is issuing annual licenses under the same terms and conditions as the expired license until the new license is issued. Issuance of the new

license has been delayed pending issuance of the National Marine Fisheries Service (NOAA Fisheries) biological opinion.

DWR certified the final environmental impact report on July 22, 2008. One month later, Butte and Plumas counties filed a lawsuit challenging the adequacy of the environmental impact report. The case was heard in January 2012, and the court ruled in DWR's favor. (More detailed information about the original lawsuit is available in previous editions of Bulletin 132). However, Butte and Plumas counties filed an appeal of the decision on August 6, 2012. Opening and responding briefs were filed on February 14, 2013, and June, 24, 2013, respectively. In addition, *State Water Contractors Inc., et al.* filed a respondent's brief on June 10, 2013, and Butte and Plumas counties filed an appellant's reply brief on July 31, 2013. In 2014 and 2015, the parties filed supplemental briefs in response to the court's request. A trial date to hear arguments has not yet been set.

The Habitat Expansion Agreement (HEA) submitted by DWR and PG&E to NOAA Fisheries for Central Valley salmon and steelhead in 2010 required preparation of a Habitat Expansion Plan (completed in 2010 with NOAA Fisheries consultation initiated in 2012) and annual reporting of activities undertaken to implement the HEA. On January 9, 2014, NOAA Fisheries provided DWR and PG&E with a letter explaining the bases for its determination that the measures contained in the Habitat Expansion Plan would not fulfill the fish enhancement goals of the HEA. On August 24, 2015, DWR submitted an annual report describing the activities of the previous 12 months toward implementing the HEA.

### *South SWP Hydropower*

In 2015, DWR initiated an extensive information gathering effort for the pre-application document for the FERC relicensing of South SWP Hydropower. As a part of this effort, on July 8, 2015, DWR mailed a notice and a questionnaire to agencies and potential stakeholders who may have an interest in the relicensing process. The questionnaire solicited information pertaining to the existing environment and potential effects of continued operation and maintenance of the South SWP Hydropower facilities. This information will be included in the pre-application document. The pre-application document and notice of intent for relicensing are due to FERC by January 31, 2017.

On December 11, 2015, FERC issued an order approving DWR's request to permanently close Hardluck Campground and remove it as a requirement of the South SWP Hydropower license. Hardluck Campground has been closed to public use periodically since 2001, and to all camping use since 2008, to protect habitat for the Arroyo Toad (*Anaxyrus californicus*), which is listed as endangered under the federal Endangered Species Act. In the order, FERC also required DWR to file a demand analysis report by April 30, 2016, clearly specifying whether or not there is sufficient demand to replace Hardluck Campground with a similar camping facility.

## Existing SWP Power Facilities

Figure 10-1 shows the names, locations, and nameplate capacities of DWR's primary power facilities.

### *Hydroelectric*

Hydroelectric generation provides the largest share of SWP power resources. The combined Hyatt Pumping-Generating Plant and Robie Thermalito Pumping-Generating Plant (Hyatt-Thermalito) generate about 2.2 billion kilowatt hours (kWh) of energy in a median water year, while the 3 megawatts (MW) from the Thermalito Diversion Dam Powerplant adds another 24 million kWh per year.




*CVP* = Central Valley Project
*KRCD* = Kings River Conservation District
*LADWP* = Los Angeles Department of Water and Power
*MWD* = The Metropolitan Water District of Southern California
*NCPA* = Northern California Power Agency

**Figure 10-1 Names, Locations, and Nameplate Capacities of Primary Long-term Power Facilities**

Generation at California Aqueduct recovery plants—Alamo, Devil Canyon, Gianelli, Mojave Siphon, and Warne—varies with the amount of water conveyed. These five plants generate about one-sixth of the total energy used by the SWP.

### *Renewables*

Dominion's RE Camelot solar photovoltaic project near Mojave, California in southeastern Kern County began full commercial operation December 23, 2014, and began delivering renewable, GHG emission-free energy to the CAISO grid to meet a portion of the energy needs for operation of SWP pump loads. The facility's single-axis photovoltaic panels directionally track the sun's movement to maximize the panels' efficiency. The 45 MW plant is expected to deliver approximately 124,000 MWh of annual generation.

SunPower will design, build, operate, and maintain a 9.5 MW single-axis solar photovoltaic facility adjacent to the Pearblossom Pumping Plant. This solar facility is expected to begin commercial operation in December 2016. DWR will receive all of the energy and associated renewable credits from the facility. The plant is expected to deliver approximately 27,400 MWh of annual generation.

Solverde 1, a solar photovoltaic renewable energy generation facility, is expected to commence commercial operation on December 31, 2016. The 85 MW plant is expected to deliver approximately 230,000 MWh of annual generation.

## DWR Power Planning Activities

DWR does long-term power planning for the SWP through periodic development of an Integrated Resource Plan (IRP). The IRP concludes with plans for long-term and mid-term power procurements necessary to provide power to operate the SWP and ensure rate stability through energy market disruptions. IRP 2013 will be succeeded by IRP 2016; development of the new IRP began in the fall of 2015. IRP 2016 will look at current and future SWP operational scenarios and the corresponding power portfolio needs and uncertainties. Findings and recommendations of previous plans will be updated based on current market developments and constraints.

DWR had completed a power planning study in 2011 of the economic viability of a second unit at the Alamo Powerplant, which would be a qualified renewable small hydroelectric facility. The project was shown to provide substantial energy and GHG reduction benefits to DWR. Following the power planning study, DWR initiated a design study in 2012 to determine whether a surge chamber would be required and to finalize the project cost estimates. A project implementation decision will be made following completion of the design and cost studies.

In May 2012, DWR's California Environmental Quality Act Climate Change Committee oversaw the completion of DWR's Climate Action Plan (CAP) Phase I: GHG Emissions Reduction Plan that established DWR's overall GHG emissions strategy. CAP Phase I assesses GHG emissions from on-going activities, sets goals for GHG reductions that will exceed State GHG mandates, and presents plans for how emissions reductions will be achieved. It memorialized the previously approved SWP Renewable Energy Procurement Plan, which had been completed in February 2010, as the method to achieve the SWP's CAP Phase I emission reduction goals. DWR initiated renewable energy procurements in late 2012 and 2013 in accordance with the CAP Phase I and Renewable Energy Procurement Plan.

In 2015, DWR procured GHG compliance instruments to meet its compliance and contractual obligations under the Cap

and Trade Program administered by the California Air Resources Board.

## Contractual Resource Arrangements

Through joint development, DWR obtains a significant amount of capacity and energy for SWP operations from other utilities throughout California and the Southwest. However, with the implementation of the CAISO Market Redesign and Technology Upgrade (MRTU) in April 2009, and implementation of CAISO's power markets that provide access to affordable day-ahead and real-time energy, DWR is less reliant on marketers and other utilities to meet its net energy needs.

### *Joint Developments*

In 1966, DWR entered into a contract with the Los Angeles Department of Water and Power (LADWP) for joint development of the West Branch of the California Aqueduct. LADWP constructed and operates Castaic Powerplant, which is a pumped-storage facility connected to the LADWP transmission system at the Sylmar Substation. DWR receives capacity and energy at the Sylmar Substation based on weekly water schedules through the West Branch.

Gianelli Pumping-Generating Plant is a joint-use facility owned and operated by DWR and the Bureau of Reclamation. DWR's share is 222 MW, and the Bureau of Reclamation's share is 202 MW.

### *Long-term Purchase Agreements*

In 1979, DWR entered into a contract with Kings River Conservation District to receive the output of the 165 MW hydroelectric Pine Flat Powerplant. The power plant supplies the SWP with about 400 million kWh of energy in median water years.

DWR also contracts for the energy output of five hydroelectric plants totaling 30 MW owned and operated by The Metropolitan Water District of Southern California (Metropolitan).

In May 2010, DWR entered into an agreement with the Northern California Power Agency (NCPA) and various public agencies to finance, construct, operate, and maintain the Lodi Energy Center—a 280 MW natural gas combined cycle combustion turbine generation facility that NCPA would own and operate, and from which DWR would receive 33.5 percent of the output. The facility achieved its commercial operation date on November 27, 2012.

In an effort to add "green" generating resources to the SWP's energy portfolio, DWR entered into a renewable Power Purchase Agreement with Alameda Municipal Power that started in 2012. The contract provides certified renewable energy, with 28.3 MW from an existing geothermal project and 5.3 MW from landfill gas energy. Under this agreement, DWR receives an estimated 183,000 MWh of annual generation. The geothermal plants are owned and operated by NCPA and are located at The Geysers geothermal field in Middletown, California. The landfill gas energy under the new contract will come from the Republic Services Ox Mountain Landfill gas-to-energy plant in Half Moon Bay, California. The plant is owned and operated by a subsidiary of Ameresco, Inc. Landfill gas is created when organic waste decomposes, producing methane—the primary ingredient in natural gas and a GHG. The contract with Alameda Municipal Power helps DWR meet its goal of reducing emissions by 50 percent below 1990 levels by 2020. The agreement term is October 15, 2012, through December 31, 2016.

On March 13, 2014, DWR executed a consent and amendment agreement with RE Columbia and RE Camelot transferring the RE Columbia generation facility to RE Camelot. Under a 20-year power purchase

agreement through 2034, the 45 MW plant is expected to deliver approximately 124,000 MW of annual generation.

On October 5, 2015, a 20-year power purchase agreement, with an optional 10-year extension, was executed between DWR and SunPower Corporation to provide solar photovoltaic renewable energy to the SWP. The solar facility will be located adjacent to the SWP Pearblossom pumping facility.

On November 5, 2015, DWR executed a 20-year power purchase agreement, through 2036, with Solverde 1 for solar photovoltaic renewable energy.

On December 16, 2015, DWR executed a WSPP agreement with Metropolitan for the purchase of 51.4 MW of capacity and renewable energy credits bundled with energy. The contract provides certified renewable energy from five small hydro plants, owned and operated by Metropolitan. Under this agreement, DWR will receive an estimated 54,574 MWh of annual energy and renewable energy credits. The agreement term is January 1, 2016, through December 31, 2020.

The renewable energy procured under these agreements will further increase the amount of renewable and zero GHG emission energy used by the SWP and will help DWR meet its 2020 GHG emission reduction goals.

### *Short-term Purchase Agreements*

DWR typically transacts with member utilities and energy marketers of the WSPP. In 2015, these transactions included energy and capacity to meet the requirements of resource adequacy, which is a planning and procurement process to ensure adequate resources.

In addition to transactions under the WSPP master agreement, DWR can purchase surplus energy from Metropolitan's Colorado River Aqueduct system according to the terms of the 1988 coordination agreement between DWR and Metropolitan. This agreement also provides for monthly surplus firm and economy energy sales from DWR to Metropolitan and energy exchanges between DWR and Metropolitan.

## Load Management

DWR operates its pumps through an extensive computerized network. This control system, coupled with the operating flexibility of DWR's pumping and generating plants provided by storage reservoirs, allows DWR to maximize pumping during off-peak periods when power costs are lower—usually at night—and maximize power generation during on-peak periods when power costs are higher. By taking advantage of this scheduling flexibility, when not restricted by operating requirements, SWP pump load and generation are optimized to reduce the net cost of power needed for SWP water deliveries.

### *Demand Response*

DWR is the largest single supplier of demand response in the CAISO market via a participating load agreement under which DWR bids SWP load to be curtailed by CAISO when the price of energy in the CAISO market reaches DWR's bid price. Due to DWR's water delivery priority, these bids are normally restricted to contingency events.

## Contractual Transmission Agreements

DWR has contracts with CAISO, PG&E, and SCE for both transmission interconnections and network transmission service for SWP power resources and pumping loads.

The Comprehensive Agreement—a bilateral transmission agreement with PG&E, entered into in 1983, that covered transmission service, interconnection service, and other services—expired on December 31, 2014.

With the termination of the Comprehensive Agreement, all transmission service for DWR facilities in Northern and Central California transitioned to open-access transmission service under the CAISO tariff. For continuation of interconnection service, DWR entered into a successor load interconnection agreement, generation interconnection agreements, and transmission facilities agreements, effective January 1, 2015. The interconnection services for Pine Flat Powerplant are managed under a separate letter agreement with PG&E that does not expire until 2029. The letter agreement was revised, effective January 1, 2015, to remove references to the Comprehensive Agreement and other outdated provisions for consistency with current accepted practices. The DWR/PG&E Midway-Wheeler Ridge Transmission System agreement was revised in November 2015 to remove references to the Comprehensive Agreement and to reflect that transmission service is provided under CAISO.

With the termination of the Comprehensive Agreement on December 31, 2014, DWR's historic participation in PG&E's remedial action system, which allowed PG&E to shed DWR load under certain conditions, was also terminated. Under the new load interconnection agreement, DWR agreed to continue using the remedial action system equipment for an interim period at a limited group of facilities to provide load shed only in the event of a triple line outage of the California-Oregon Intertie 500 kV transmission lines. DWR load shed in this scenario supports the Southern Island Load Tripping plan and is in exchange for PG&E covering underfrequency load shedding requirements associated with SWP load under the WECC coordinated plan.

In Southern California, DWR receives transmission service for SWP loads and resources through CAISO, and DWR has interconnection agreements with SCE. Additionally, DWR has wholesale distribution service agreements with SCE for service over SCE's distribution system from the CAISO interchange points to SWP loads and resources.

In 2015, DWR and SCE continued coordination on the engineering, design, and construction of the new interconnection facilities for Citrus Pump Station, located in San Bernardino County, which is expected to begin start-up in late 2016 and achieve commercial operation in early 2017. In addition, DWR and SCE entered into negotiations for a new distribution service agreement to cover Citrus Pump Station service over SCE's distribution network.

## SWP Power Operations in 2015

Tables 10-1 through 10-4, at the end of the chapter, present historical information about SWP power operations for calendar year 2015, including energy consumed, generated, purchased, and sold. Note that in some instances, these tables may not sum as expected due to rounding.

### Energy Consumed

In 2015, energy used for SWP operations at the 29 SWP pumping and generating plants totaled 3.49 million MWh. According to the terms and conditions of various water conveyance contracts and exchange agreements, some water belonging to the Central Valley Project is pumped through Banks and Dos Amigos pumping plants and Gianelli Pumping-Generating Plant. The Bureau of Reclamation furnishes additional energy for this purpose.

Table 10-1 shows the amount of energy used each month at SWP pumping and power generating plants to operate the SWP in 2015.

## Energy Generated and Purchased

Table 10-2 shows the amounts of energy generated at SWP facilities in 2015, as well as energy purchased for SWP operations.

### *Hydroelectric and Natural Gas*

The Hyatt-Thermalito power complex in Oroville generated 589,395 MWh of energy in 2015.

Energy generated at SWP aqueduct recovery plants—Gianelli, Alamo, Mojave Siphon, Devil Canyon, and Warne—totaled 685,311 MWh.

The SWP received generation from the Lodi Energy Center. SWP's 33.5 percent share of the Lodi Energy Center's energy output for 2015 was 566,888 MWh.

## Contractual Resource Arrangements in 2015

SWP power operations rely on contractual arrangements as well as SWP facilities. These contractual arrangements include joint development projects and energy purchases.

### *Joint Developments*

Through the *West Branch Cooperative Development Agreement* with LADWP, DWR receives energy based on the amount of water scheduled through the West Branch. In 2015, LADWP provided 424,024 MWh for DWR's share of energy generated at Castaic Powerplant.

DWR's share of Gianelli Pumping-Generating Plant used 156,027 MWh and generated 115,210 MWh of energy in 2015.

### *Purchases and Costs*

Table 10-3 shows the amounts of energy, transmission, and other services purchased in 2015. Amounts include contractual short-term and long-term energy trades and associated transactions of energy, transmission, capacity, and ancillary services with CAISO, and miscellaneous energy-related costs.

DWR transacted 2.59 million MWh of energy at a cost of $81.33 million. Other SWP-related costs include $4.98 million for transmission service outside CAISO and $112.90 million for operation, maintenance, and miscellaneous CAISO charges, among other things. Key costs associated with the latter amount are (1) $4.35 million for debt service and $3.84 million for operations and maintenance, both related to Pine Flat Powerplant; (2) $9.42 million for debt service and $7.93 million for capital improvement, management, operations, and maintenance, all connected to the Lodi Energy Center Project. The $4.98 million for transmission service outside CAISO includes $0.42 million for PG&E; $2.72 million for SCE; and a total of $1.84 million related to LADWP and NCPA.

**Long-term Purchase Agreements.** According to terms of the Kings River Conservation District contract, DWR receives the total output of the 165 MW Pine Flat Powerplant. In 2015, the power plant provided 20,951 MWh of energy to the SWP at an energy component cost of $159,227.

Under the Metropolitan Small Hydro contract, DWR purchased 56,452 MWh of energy in 2015 from three small hydroelectric power plants on the Metropolitan system at a cost of $3.23 million.

Also, under the Lodi Energy Center Power Sales Agreement with NCPA, DWR received a purchase credit of $21.31 million based on 566,888 MWh generated at the Lodi Energy Center plant during 2015 and conveyed to the CAISO power grid. This amount is shown in Table 10-4.

Lastly, under renewable energy long-term contracts with Alameda Municipal Power

and RE Camelot, LLC, DWR received a total of 310,544 MWh at a cost of $13.11 million.

**Short-term Energy Purchase Agreements.** Existing resources and long-term power and transmission contracts ensure that the SWP has enough power to meet long-term needs.

When SWP power requirements exceed resources during daily operations, short-term purchases make up the difference. In 2015, the SWP purchased 1.64 million MWh of short-term energy under the WSPP agreement from four WSPP marketers at a cost of $51.64 million. These purchases are reflected in Table 10-3.

## Contractual Sales of Excess Power

In 2015, DWR received $83.35 million in energy revenues. This includes (1) $46.33 million connected to bilateral trades and $14.90 million for ancillary service transactions, both made through CAISO; (2) $11,563 in short-term sales; and (3) $22.10 million associated with long-term contracts. This third item includes, among other things, $21.31 million related to the Lodi Energy Center Power Sales Agreement with NCPA. It also includes $134,221 for CAISO pass-through costs collected from the U.S. Department of Energy, Western Area Power Administration, in accordance with a contract executed June 27, 2012, with DWR for CAISO scheduling coordinator services. Under the terms of this contract, DWR acts as a scheduling coordinator for the joint-use facilities of the San Luis Unit and certain DWR pumping facilities occasionally used to pump federal water. See Table 10-4 for information about energy and other services sold and revenue received.

# Forecasting Power Operations

Each year, after reviewing the SWP water contractors' water delivery requests and the construction schedule for future facilities, DWR forecasts the associated energy consumption and generation through 2035. Short-term power requirements, based on actual water supply and reservoir storage levels, are determined for the current and two ensuing years of operation. Long-term operational studies for the remaining years are based on median-year water supply conditions and optimal reservoir storage levels. The forecast also includes losses in reservoirs and aqueducts, recreation water, and water to replace storage in reservoirs south of the Delta.

Actual SWP power requirements may vary significantly from the forecast amounts. Those variations are due to the amount of water available and delivered in a given year. For example, dry conditions in Northern California could result in a reduction in the amount of water available for delivery and for generation. If full deliveries could not be made, less power would be used. Power requirements could also decrease during a wet year because of the availability of local water in the San Joaquin Valley or Southern California.

Conversely, power requirements could exceed the amount originally forecast if actual water deliveries are greater than the amounts estimated. For example, if additional pumping is needed to refill reservoirs south of the Delta after an unexpectedly dry year, more power would be used.

## Table 10-1 Energy Used at Pumping Plants and Power Plants in 2015, by Month (megawatt-hours)

| Pumping Plants and Power Plants | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hyatt-Thermalito Power Complex (station service) | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 7 | 1 | 4 | 3 | 19 |
| North Bay Interim Pumping Plant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cordelia Pumping Plant | 557 | 658 | 476 | 832 | 1,022 | 1,131 | 1,063 | 930 | 892 | 809 | 856 | 477 | 9,703 |
| Barker Slough Pumping Plant | 211 | 277 | 295 | 613 | 655 | 609 | 590 | 816 | 769 | 783 | 613 | 218 | 6,448 |
| South Bay Pumping Plant | 5,021 | 4,370 | 5,384 | 10,276 | 9,468 | 10,129 | 11,990 | 9,352 | 8,026 | 8,508 | 5,088 | 4,427 | 92,040 |
| Del Valle Pumping Plant | 13 | 12 | 13 | 358 | 11 | 6 | 6 | 8 | 8 | 6 | 12 | 14 | 466 |
| Banks Pumping Plant | 67,278 | 62,038 | 20,462 | 8,825 | 6,878 | 5,344 | 5,148 | 11,999 | 12,672 | 4,610 | 11,583 | 21,898 | 238,736 |
| Gianelli Pumping-Generating Plant (SWP share) | 64,313 | 56,311 | 15,397 | 154 | 75 | 113 | 0 | 1,254 | 1,373 | 1,018 | 3,913 | 12,106 | 156,027 |
| Dos Amigos Pumping Plant (SWP share) | 2,430 | 2,851 | 6,587 | 10,279 | 16,298 | 18,058 | 16,480 | 14,833 | 9,953 | 4,562 | 4,446 | 6,249 | 113,025 |
| Buena Vista Pumping Plant | 7,621 | 6,231 | 15,944 | 20,309 | 21,729 | 18,363 | 20,830 | 17,557 | 13,434 | 8,863 | 15,187 | 19,941 | 186,010 |
| Teerink Pumping Plant | 11,595 | 9,140 | 18,162 | 21,936 | 22,471 | 17,433 | 21,169 | 18,337 | 14,325 | 10,084 | 19,443 | 25,417 | 209,511 |
| Chrisman Pumping Plant | 25,216 | 20,529 | 40,627 | 48,356 | 49,354 | 37,416 | 46,646 | 40,476 | 31,839 | 22,490 | 43,178 | 57,135 | 463,260 |
| Edmonston Pumping Plant | 91,921 | 73,110 | 147,984 | 170,375 | 172,799 | 129,098 | 162,107 | 138,994 | 112,720 | 79,246 | 155,691 | 209,056 | 1,643,101 |
| Alamo Powerplant (station service) | 0 | 5 | 21 | 12 | 27 | 33 | 27 | 22 | 29 | 51 | 25 | 10 | 263 |
| Pearblossom Pumping Plant | 7,988 | 12,449 | 20,585 | 18,547 | 13,170 | 9,900 | 11,491 | 13,588 | 11,544 | 3,406 | 15,075 | 26,322 | 164,065 |
| Pine Flat Powerplant (station service)[a] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mojave Siphon Powerplant (station service) | 64 | 42 | 28 | 36 | 47 | 63 | 56 | 50 | 48 | 83 | 42 | 13 | 571 |
| Devil Canyon Powerplant (station service) | 320 | 200 | 27 | 93 | 69 | 116 | 96 | 10 | 30 | 139 | 49 | 3 | 1,151 |
| Oso Pumping Plant | 7,656 | 3,653 | 8,830 | 12,605 | 15,261 | 11,068 | 14,360 | 10,394 | 8,092 | 7,996 | 12,464 | 14,200 | 126,580 |
| Warne Powerplant (station service) | 454 | 333 | 377 | 143 | 102 | 213 | 145 | 431 | 444 | 231 | 292 | 174 | 3,338 |
| Las Perillas Pumping Plant | 183 | 311 | 462 | 649 | 1,088 | 1,291 | 1,500 | 1,291 | 587 | 311 | 34 | 100 | 7,808 |
| Badger Hill Pumping Plant | 463 | 799 | 1,193 | 1,702 | 2,733 | 3,143 | 3,657 | 3,138 | 1,462 | 800 | 70 | 243 | 19,403 |
| Devil's Den Pumping Plant | 807 | 825 | 1,331 | 1,291 | 1,239 | 1,146 | 1,099 | 846 | 767 | 855 | 115 | 481 | 10,800 |
| Bluestone Pumping Plant | 755 | 771 | 1,239 | 1,204 | 1,154 | 1,059 | 1,023 | 793 | 716 | 799 | 103 | 450 | 10,064 |
| Polonio Pass Pumping Plant | 819 | 832 | 1,340 | 1,306 | 1,257 | 1,159 | 1,117 | 859 | 779 | 870 | 99 | 486 | 10,923 |
| Greenspot Pump Station | 61 | 54 | 161 | 711 | 710 | 752 | 692 | 672 | 762 | 607 | 661 | 731 | 6,573 |
| Crafton Hills Pump Station | 23 | 18 | 147 | 959 | 931 | 942 | 871 | 859 | 919 | 712 | 864 | 967 | 8,211 |
| Cherry Valley Pump Station | 10 | 9 | 11 | 44 | 46 | 41 | 33 | 41 | 42 | 23 | 23 | 38 | 361 |
| **Total Energy Required for the SWP[b]** | **295,781** | **255,828** | **307,081** | **331,615** | **338,593** | **268,625** | **322,197** | **287,549** | **232,239** | **157,863** | **289,930** | **401,156** | **3,488,457** |

[a] Pine Flat station service energy provided by CAISO under MRTU operation.
[b] Totals may not sum as expected due to rounding.

## Table 10-2 Energy Generated and Purchased in 2015, by Month (megawatt-hours)

| Sources of Energy | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SWP Energy Sources** | | | | | | | | | | | | | |
| Hyatt-Thermalito Power Complex | 13,484 | 18,462 | 28,638 | 42,712 | 128,601 | 112,477 | 138,838 | 56,546 | 3,285 | 10,702 | 15,216 | 20,433 | 589,395 |
| Gianelli Pumping-Generating Plant (SWP share) | 0 | 140 | 4,997 | 12,868 | 22,571 | 24,813 | 22,998 | 12,190 | 3,952 | 4,283 | 1,522 | 4,875 | 115,210 |
| Alamo Powerplant | 0 | 0 | 2,841 | 3,221 | 2,303 | 1,918 | 1,813 | 2,266 | 2,196 | 444 | 2,668 | 4,145 | 23,814 |
| Mojave Siphon Powerplant | 595 | 1,006 | 2,077 | 1,980 | 1,151 | 822 | 1,038 | 1,209 | 871 | 133 | 1,559 | 2,875 | 15,316 |
| Devil Canyon Powerplant | 11,234 | 22,183 | 38,545 | 28,338 | 19,953 | 15,441 | 18,048 | 20,395 | 19,535 | 13,235 | 24,514 | 35,589 | 267,009 |
| Warne Powerplant | 15,635 | 6,352 | 19,155 | 26,795 | 31,194 | 23,833 | 30,597 | 20,364 | 16,289 | 17,314 | 25,775 | 30,658 | 263,962 |
| *Subtotal* | *40,949* | *48,142* | *96,253* | *115,914* | *205,773* | *179,304* | *213,332* | *112,970* | *46,127* | *46,112* | *71,254* | *98,575* | *1,274,706* |
| **Energy Sources from Long-term Agreements** | | | | | | | | | | | | | |
| Castaic Powerplant | 24,578 | 10,577 | 31,398 | 44,164 | 51,865 | 33,277 | 50,201 | 33,729 | 26,004 | 26,051 | 41,787 | 50,392 | 424,024 |
| Metropolitan Small Hydro Generation | 3,392 | 5,566 | 7,497 | 4,958 | 3,360 | 3,685 | 2,845 | 2,899 | 2,072 | 3,030 | 7,840 | 9,306 | 56,452 |
| Pine Flat Powerplant (Kings River Conservation District) | 0 | 0 | 0 | 0 | 0 | 5,106 | 14,332 | 1,513 | 0 | 0 | 0 | 0 | 20,951 |
| Energy to Metropolitan for CRA[a] Pumping | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Energy from Metropolitan for CRA[a] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lodi Energy Center | 65,666 | 50,786 | 61,809 | 60,716 | 30,507 | 47,662 | 34,800 | 45,984 | 44,089 | 55,521 | 25,202 | 44,146 | 566,888 |
| **Purchases** | | | | | | | | | | | | | |
| Purchases (Firm and WSPP Contracts) | 161,110 | 142,560 | 166,314 | 155,997 | 176,954 | 158,103 | 168,796 | 168,398 | 161,316 | 157,389 | 167,033 | 161,974 | 1,945,944 |
| CAISO Energy[b] | 65,752 | 48,982 | 5,620 | 10,581 | (99,359) | (110,851) | (127,311) | (31,960) | (3,280) | (74,720) | 2,015 | 80,910 | (233,619) |
| *Subtotal* | *320,498* | *258,472* | *272,638* | *276,416* | *163,327* | *136,983* | *143,664* | *220,563* | *230,201* | *167,272* | *243,878* | *346,727* | *2,780,640* |
| Total Resources | 361,447 | 306,614 | 368,890 | 392,331 | 369,100 | 316,287 | 356,997 | 333,533 | 276,328 | 213,384 | 315,132 | 445,302 | 4,055,346 |
| Less Energy Sales[c] | (65,666) | (50,786) | (61,809) | (60,716) | (30,507) | (47,662) | (34,800) | (45,984) | (44,089) | (55,521) | (25,202) | (44,146) | (566,888) |
| **Total Energy Provided to the SWP[e]** | **295,781** | **255,828** | **307,081** | **331,615** | **338,593** | **268,625** | **322,197** | **287,549** | **232,239** | **157,863** | **289,930** | **401,156** | **3,488,457** |

[a] Contractual Resource Arrangement.
[b] Energy provided by CAISO for balancing the total SWP loads and resources.
[c] Received under the Lodi Energy Center Power Sales Agreement as a purchase credit.
[d] Totals may not sum as expected due to rounding.

## Table 10-3 Energy, Transmission, and Related Costs in 2015

| Category | Energy Trades (MWh) | Energy Cost (in dollars) | Transmission Cost Outside CAISO (in dollars) | Other Energy-Related Costs (in dollars) | Total Cost (in dollars) |
|---|---|---|---|---|---|
| CAISO–Bilateral Trades | | 76 | | | 76 |
| CAISO–Other[a] | | | | 87,158,894 | 87,158,894 |
| Energy Marketers–Bilaterals (WSPP) | 1,635,400 | 51,641,839 | | 178,750 | 51,820,589 |
| Long-term Contracts[b] | 644,289[c] | 16,581,104 | 4,975,682 | 25,560,816 | 47,117,603 |
| Renewable Energy[d] | 310,544 | 13,111,691 | | | 13,111,691 |
| **Total** | **2,590,233** | **81,334,710** | **4,975,682** | **112,898,460** | **199,208,853** |

[a] Transmission, capacity, imbalance energy, etc.
[b] California Power Exchange, Kings River Conservation District, Los Angeles Department of Water and Power, The Metropolitan Water District of Southern California, NV Energy, Northern California Power Agency, Pacific Gas & Electric Company, and Southern California Edison.
[c] Includes 566,888 MWh generated at the Lodi Energy Center.
[d] Alameda Municipal Power and RE Camelot LLC.

## Table 10-4 Energy and Energy-related Revenue in 2015 per Contract Agreements

| Category | Energy (MWh) | Energy Revenues (in dollars) | Other Energy-related Revenue (in dollars) | Total Sales (in dollars) |
|---|---|---|---|---|
| CAISO–Bilateral Trades | | 46,332,363 | | 46,332,363 |
| CAISO–Other[a] | | | 14,901,675 | 14,901,675 |
| Energy Marketers–Bilaterals (WSPP) | | | 11,563 | 11,563 |
| Long-term Contracts[b] | 566,888 | 21,311,419 | 789,368 | 22,100,787 |
| **Total** | **566,888** | **67,643,782** | **15,702,606** | **83,346,388** |

[a] Transmission, capacity, imbalance energy, etc.
[b] Los Angeles Department of Water and Power, Northern California Power Agency, Western Area Power Administration, and the City of Santa Clara.



# Chapter 11
# Facilities Maintenance

*Many features along the California Aqueduct were inspected in 2015.*

## Significant Events in 2015

Potential Failure Mode Analyses (PFMAs) were conducted for Bidwell Bar Canyon Saddle, Parish Camp Saddle, Thermalito Diversion, Thermalito Forebay, and Thermalito Afterbay dams in January.

Sisk and O'Neill dams had Comprehensive Facility Review (CFR) inspections by the Bureau of Reclamation (Reclamation) in March 2015.

At the Castaic Dam outlet works, valves on the high intake tower were refurbished.

Reclamation inspected the spillway and intake structures at Little Panoche Detention Dam.

In June, Thermalito Afterbay Outlet Gate No. 3 was returned to service.

Oroville Dam Flood Control Outlet Gates No. 7 and No. 8 seal refurbishment was completed. This completed the refurbishment effort for all eight flood control outlet gates

Hyatt Penstock No. 1 was dewatered and inspected.

*Information for this chapter was provided by the Division of Operations and Maintenance, the Division of Safety of Dams, the Division of Integrated Regional Water Management, and the State Water Project Analysis Office.*

The Department of Water Resources (DWR), through the Division of Operations and Maintenance (O&M), monitors all State Water Project (SWP) facilities to ensure safety and reliability. DWR is required, by federal and State law, to contract periodically with independent consultants to review the safety of SWP dams and power facilities.

## Inspecting and Maintaining Project Dams

DWR conducts several types of inspections on SWP facilities to ensure that each dam is safe for continued operation. The Dam Safety Branch (DSB), Division of Safety of Dams (DSOD), Federal Energy Regulatory Commission (FERC), and the Bureau of Reclamation conduct various inspections and safety analyses to ensure the safety of SWP dams.

O&M staff, through the DSB and field divisions, inspect, collect, and analyze data for all SWP dams and appurtenant structures. DSB also conducts performance and instrumentation analyses and prepares annual reports that are distributed to the field divisions for scheduling and maintenance. The reports are also sent to FERC and to DSOD for their review.

In accordance with Division 3 of the California Water Code, DSOD has regulatory authority over dams owned and operated by DWR.

DSOD is responsible for overseeing all design modifications and construction activities on jurisdictional SWP dams. In accordance with the California Code of Regulations (Title 23, Division 2, Chapter 1, Article 5), DSOD participates in the Director's Safety Review Board (DSRB) events and presents their findings to the DSRB.

Additionally, DSOD engineers inspect SWP dams annually, on a fiscal year basis, to ensure they remain safe, are performing as intended, and are not developing problems. These annual inspections also include in-depth instrumentation review of dam surveillance data. DSOD engineers and geologists evaluate proposed modifications to existing dams, as well as designs for any proposed new jurisdictional dams. DSOD also oversees construction activities to ensure work is performed in accordance with approved plans and specifications.

FERC inspects all FERC-licensed SWP facilities annually. These inspections include a review of significant events, instrumentation data, and the visual appearance of each dam, penstock, or power plant. Under FERC's requirements, consulting engineers and geologists are retained to evaluate SWP dam facilities every 5 years.

DWR contracts periodically with independent consultants to review the safety of SWP dams and power facilities, except for Pearblossom Spill Basin. Pearblossom Spill Basin Dam was originally designed to be used during misoperation at the Pearblossom Pumping Plant; the spill basin was never fully completed and has never been used.

### Routine Inspections

During 2015, DSOD along with O&M staff conducted routine periodic inspections for all of the dams in the SWP. These inspections included Antelope, Frenchman, Grizzly Valley, Oroville, Bidwell Canyon Saddle, Parish Camp Saddle, Thermalito Diversion, Thermalito Forebay, Thermalito Afterbay, and Feather River Fish Barrier dams in the Oroville Field Division; Bethany, Clifton Court Forebay, Del Valle, Dyer, and Patterson dams in the Delta Field Division; and Castaic, Crafton Hills, Crafton Hills Reservoir Enlargement, Pyramid, Quail, Cedar Springs,

Devil Canyon Second Afterbay, and Perris dams in the Southern Field Division. Table 11-1 shows SWP dam inspections conducted in 2015.

## Joint-use Facility Inspection

The four dams in the San Luis Field Division (Sisk Dam, O'Neill Dam, Los Banos Detention Dam, and Little Panoche Detention Dam) are used jointly with the Bureau of Reclamation (Reclamation) and are not under DSOD jurisdiction.

Every 6 years, Reclamation conducts a Comprehensive Facility Review (CFR) of these joint-use facility dams. The CFRs for Sisk Dam, O'Neill Dam, Los Banos Detention Dam, and Little Panoche Detention Dam occurred in 2015.

Periodic Facility Reviews (PFRs) are also conducted by Reclamation every 6 years using an alternate schedule spaced between the CFRs. PFRs were conducted for the joint-use facilities in 2012. A joint annual inspection of the facilities with Reclamation, DSB, and San Luis Field Division was conducted in March 2015.

## Independent Reviews

### *Director's Safety Review Board*

Under California Water Code, Section 6056, DWR is required to retain a consulting board to review: (1) the adequacy of the design of any dam or reservoir DWR proposes to construct; and (2) the safety of the completed construction, including the terms and conditions for the Certificate of Approval. In accordance with this California Water Code requirement, DWR formed the DSRB.

The DSRB is a board of three independent consultants that meet at least once every 5 years to review the operational performance of DWR-owned dams and more frequently when consulting on new dams. The DSRB independently reviews and assesses safety conditions of SWP dams.

DSRB consultants are selected based on their knowledge of geotechnical, structural, and civil engineering, including their experience evaluating dam performance. Their independent assessments include the review of dam performance during earthquakes, evaluation of instrumentation data, inspection of each dam, and evaluation of studies performed by DWR. The DSRB then prepares reports on each dam, approving dams as safe for continued operation and making recommendations. Based on DSRB recommendations, DWR prepares action plans. No DSRB inspections occurred on the SWP in 2015.

## FERC Reviews

FERC conducts dam safety inspections in conjunction with O&M on an annual basis for SWP dams under its jurisdiction. Every 5 years, a FERC Part 12D inspection is also conducted. The last Part 12D inspections occurred in 2014. SWP dams under FERC jurisdiction are reviewed under FERC-defined northern section, Project 2100 (P-2100) and southern section, Project 2426 (P-2426). P-2100 consists of dams associated with Oroville Field Division facilities, and P-2426 dams are associated with Pyramid, Quail, Cedar Springs, and Devil Canyon Second Afterbay facilities.

As a supplement to the FERC Part 12D safety inspection, FERC's Dam Safety Performance Monitoring Program requires that a Potential Failure Mode Analysis (PFMA) be performed for FERC-licensed dams. The PFMA involves document review and site visits to develop a comprehensive list of potential failure modes at each dam. From the FERC review process, two documents are generated: the FERC Part 12D Safety Inspection Report and the PFMA Report. FERC-licensed facilities are also inspected annually by DSB and FERC's Dam Safety engineer.

## Table 11-1 State Water Project Dam Inspections in 2015

| Field Division | Facility | Type of Inspection | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Operations & Maintenance-Dam Safety Branch | Division of Safety of Dams | Federal Energy Regulatory Commission | Bureau of Reclamation Annual Inspection | Bureau of Reclamation 6-Year Comprehensive Facility Review | Director's Safety Review Board | Part 12D 5-Year Review |
| **Oroville** | | | | | | | | |
| | Antelope Dam | X | X | - | - | | - | - |
| | Frenchman Dam | X | X | - | - | | - | - |
| | Grizzly Valley Dam | X | X | - | - | | - | - |
| | Oroville Dam | X | X | X | - | | - | - |
| | Bidwell Canyon Saddle Dam | X | X | X | - | | - | - |
| | Parish Camp Saddle Dam | X | X | X | - | | - | - |
| | Thermalito Diversion Dam | X | X | X | - | | - | - |
| | Thermalito Forebay Dam | X | X | X | - | | - | - |
| | Thermalito Afterbay Dam | X | X | X | - | | - | - |
| | Feather River Fish Barrier Dam | X | X | X | - | | - | - |
| **Delta** | | | | | | | | |
| | Bethany Dams | X | X | - | - | | - | - |
| | Clifton Court Forebay Dam | X | X | - | - | | - | - |
| | Del Valle Dam | X | X | - | - | | - | - |
| | Dyer Reservoir | X | X | - | - | | - | - |
| | Patterson Dam | X | X | - | - | | - | - |
| **San Luis** | | | | | | | | |
| | Little Panoche Detention Dam | X | - | - | X | X | - | - |
| | Los Banos Detention Dam | X | - | - | X | X | - | - |
| | O'Neill Forebay Dam | X | - | - | X | X | - | - |
| | Sisk Dam | X | - | - | X | X | - | - |
| **Southern** | | | | | | | | |
| | *West Branch* | | | | | | | |
| | Castaic Dam | X | X | - | - | | - | - |
| | Pyramid Dam | X | X | X | - | | - | - |
| | Quail Canal and Dam | X | - | X | - | | - | - |
| | *East Branch* | | | | | | | |
| | Cedar Springs Dam | X | X | X | - | | - | - |
| | Devil Canyon Second Afterbay Dam | X | X | X | - | | - | - |
| | Perris Dam | X | X | - | - | | - | - |
| | Crafton Hills Dam | X | X | - | - | | - | - |
| | Crafton Hills Reservoir Enlargement Dam | X | X | - | - | | - | - |

### Supporting Technical Information

The Supporting Technical Information Document is a separate report that summarizes SWP project elements and details that do not change significantly over time. The document is updated as required but is not generated as part of any of the dam safety inspections.

## Arroyo Pasajero Program

The Arroyo Pasajero and its tributaries drain approximately 530 square miles of the Diablo Range of the coastal mountains west of the California Aqueduct in Fresno County. Its downstream juncture with the San Luis Canal segment of the California Aqueduct, between Highway 198 and Avenal Cutoff Road, poses a particularly difficult operational and maintenance problem for the SWP. Reclamation designed and constructed the San Luis Canal segment of the California Aqueduct, while DWR operates and maintains it, with all costs shared 45 percent and 55 percent, respectively.

During periods of heavy rainfall, high flows in the Arroyo Pasajero and its tributaries transport heavy sediment loads eroded from the Arroyo Pasajero watershed. Over a vast amount of time, sediment transported by arroyo floods formed a 450-square-mile alluvial fan extending from its apex at the eastern margin of Pleasant Valley (Anticline Ridge) to the San Joaquin Valley trough. The California Aqueduct traverses the arroyo's alluvial fan and forms a barrier to arroyo flood flows. Flood control facilities, designed to accommodate Arroyo Pasajero floodwater, include the West Side Detention Basin (designed to store floodwater and sediment west of the California Aqueduct), an evacuation culvert to release floodwater east of the California Aqueduct, and drain inlets to release floodwater into the California Aqueduct.

Since the floods of 1969, when nearly all of the detention basin's planned 50-year sediment storage capacity was filled by deposition, DWR and Reclamation have worked to mitigate the effects of heavy flooding and the diminished storage capacity of the detention basin. In 1980, asbestos discovered in The Metropolitan Water District of Southern California's water supply was traced to runoff from the Arroyo Pasajero and other Diablo Range streams. This discovery, in conjunction with the high cost of removing sediment from the California Aqueduct, led DWR to adjust operating procedures to minimize runoff entering the California Aqueduct. The volume of runoff and sediment transported by the Arroyo Pasajero is roughly 400 percent greater than was originally estimated during the design of the detention basin in the mid-1960s.

### DWR and DWR/Reclamation Alternative Long-term Solution

Construction to restore the storage capacity of the West Side Detention Basin started in August 2004, and many of the designed improvements were completed by the summer of 2005. These improvements restored the storage capacity to the detention basin and added control over releases of floodwater into the California Aqueduct and onto private farmland. The intended 50-year level of protection was achieved by raising levees, adding a control structure equipped with an inflatable rubber dam, installing flood gates, and acquiring flood easements. As of 2015, the basin's flood control features continued to function as expected.

Rating curve updates for the three aqueduct flood water inlet control structures (the evacuation culvert, flood gates, and rubber dam) were completed. Near the end of the year, construction was initiated on staff gages to allow field crews to better estimate aqueduct inflows.

In 2009, DWR signed the certificate of acceptance for the deeds for easements and lands acquired via litigation. The deeds were recorded, and the process to transfer the rights to Reclamation, as required by the joint-use agreement, was initiated. Work to address the transfer documents continued in 2015.

The West Side Detention Basin is an area of interest in the U.S. Environmental Protection Agency (EPA) Atlas Mine Area Operable Unit Record of Decision issued by the EPA in 1991. Five-year reviews of the Atlas Mine Area Operable Unit began in 2001 and have continued every 5 years since. In fall 2010, as a part of the upcoming 2011 review cycle, DWR toured the basin with representatives from the EPA and inspected all of the basin flood control features as well as soil berms, gates, locks, and signs used to deter soil disturbing activities. The EPA released its Five-Year Review Report in August 2011. The report contained various recommendations for DWR to take into consideration while operating the basin. As of 2015, DWR continued its standard operating procedures within the basin to comply with the EPA's Comprehensive Environmental Response Compensation and Liability Act (Superfund law).

## Related Activities

In September 2011, the California Department of Transportation (Caltrans) informed DWR that it had funding through final design on the proposed bridge project at Lassen Avenue (State Route 269) over Arroyo Pasajero. DWR provided comments on the current project study report in October 2011, which focused on flood control and the ongoing operations and maintenance needs of DWR's field division staff to properly maintain the channel. Throughout 2015, Caltrans continued to advance the California Environmental Quality Act/National Environmental Policy Act process and design of the project.

## Cantua Creek Stream Group

Planning for a restoration project similar to the West Side Detention Basin restoration project began in 2006 for the Cantua Creek Stream Group detention basins. The project goal is to improve aqueduct flood protection and water quality between Mileposts 128.48 and 141.57.

A feasibility-level study for the Cantua Creek Stream Group Improvements Project, completed in April 2011, identified actions such as raising embankments, making modifications to structures, and acquiring flood easements to provide a 50-year level of protection for the California Aqueduct. Improving water quality in the aqueduct was a significant goal of the study, since currently, several of the existing drain inlets are not gated, and sediment-laden floodwater flows directly into the aqueduct with little detention and decanting. Increasing flood storage and detention of this floodwater prior to releasing it into the California Aqueduct would provide a significant benefit to water quality in the aqueduct.

In 2015, environmental and real estate processes continued to move forward, which resulted in minor changes to the design plans. The project is planned for construction in the late summer and fall of 2016.

Rating curve updates for four aqueduct flood water inlet control structures (Cantua Creek drain inlet at Harlan Avenue, Cantua Creek flume near Mt. Whitney Avenue, Salt Creek weir near Mt. Whitney Avenue, and the Salt Creek drain inlet at Laguna Avenue) were updated. Near the end of 2015, construction began on a series of staff gauges that would allow field crews to better estimate aqueduct inflows.

# Repairs, Modifications, and Inspections

DWR continually monitors all SWP facilities and performs repairs, modifications, and inspections as necessary to ensure safe, reliable water delivery.

## Inspections

Condition Assessment Program inspections are scheduled annually, biennially, or every 5 years. Future inspections will aim to identify trends in maintenance and aging of the SWP.

In 2015, Condition Assessment Program inspections were performed on 31 different reaches of the SWP along more than 258 miles of canals. To aid in maintenance efforts, check structures, control buildings, compound grounds, roads, culverts, drain inlets, overchutes, turn-ins, turnouts, and utility crossings along the canal were inspected and rated.

### *Oroville Field Division*

In the Oroville Field Division, four features along 2 miles of the Thermalito Power Canal were inspected.

Refurbishment efforts continued at Thermalito Powerplant from the damage that occurred during a fire in November 2012.

In June 2015, Thermalito Afterbay Outlet Gate No. 3 was returned to service.

### *Delta Field Division*

In the Delta Field Division, features along 54 miles of the California Aqueduct were inspected. One hundred eighty-one California Aqueduct features were inspected, spanning 5 repayment reaches and 15 aqueduct pools.

The installation of the Clifton Court Forebay intake structure radial Gate No. 2 telemetry equipment was completed on February 19, 2015. The special condition placed on operation of the gate on July 31, 2014, was removed.

### *San Luis Field Division*

In the San Luis Field Division, features along 60 miles of the California Aqueduct were inspected. Two hundred thirty-three California Aqueduct features were inspected, spanning 3 repayment reaches and 6 aqueduct pools.

### *San Joaquin Field Division*

In the San Joaquin Field Division, features along 44 miles of the California Aqueduct were inspected. One hundred thirty-two California Aqueduct features were inspected, spanning 5 repayment reaches and 11 aqueduct pools.

### *Southern Field Division*

In the Southern Field Division, features along 98 miles of the West and East branches of the California Aqueduct were inspected, including Gorman Creek, Beartrap Road culverts in Tejon Ranch, and gauging stations for Castaic Lake inflow. Four hundred twelve California Aqueduct features were inspected, spanning 18 repayment reaches and 34 aqueduct pools.

At the Castaic Dam outlet works, valves on the high intake tower were refurbished. The refurbishment took place from April through August, 2015, and involved the top seven of the nine tiers of valves in the high intake tower. The refurbishment work occurred while the water surface elevation at Castaic Lake was low due to the drought. The water surface elevation reached approximately 100 feet below the normal operating level.

Perris Dam's emergency bulkhead bolts were exercised in the presence of DSOD. The Perris Dam seismic remediation of dam embankment project (Specification No. 14-03) began in September 2014 and continued in 2015.

This work was implemented to upgrade the seismic safety of Perris Dam. The outlet tower and penstock are on a 10-year inspection cycle.

## Other Inspections

In addition to the conveyance facilities, 65 bridges, along with 89 roofs of SWP buildings, were inspected as part of a regularly scheduled maintenance program. SWP access roads are routinely inspected by staff in each field division as they traverse the hundreds of miles of paved and unpaved roadways daily. Staff reports of distressed and problematic areas result in road repair projects.

## Outages for Maintenance and Repair of Facilities

Table 11-2 presents information, arranged chronologically, about significant scheduled and unscheduled outages at SWP pumping and power plants in 2015. The table includes information about incidents resulting in outages of 14 days or more.

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 1 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| January | Banks Pumping Plant | 5 | January 1 to February 4 for lower guide bearing inspection and repair; continued from December 3, 2014 |
| | Banks Pumping Plant | 11 | January 21 to March 1 for loss of synchronization |
| | Barker Slough Pumping Plant | 7 | January 1 to December 31 for excessive vibration |
| | Cordelia Pumping Plant | 3 | January 1 to June 16 for motor pump refurbishment |
| | South Bay Pumping Plant | 3 | January 1 to December 31 for motor pump coupling and alignment |
| | South Bay Pumping Plant | 6 | January 1 to December 31 for vibration testing and balancing; continued from June 2, 2014 |
| | South Bay Pumping Plant | 7 | January 1 to December 31 for excessive vibration |
| | South Bay Pumping Plant | 10 | January 1 to March 27 for cooling water failure |
| | Hyatt Powerplant | 1 | January 1 to July 14 for river valve operation due to water temperature requirements |
| | Hyatt Powerplant | 2 | January 1 to February 26 for river valve operation due to water temperature requirements |
| | Robie Thermalito Pumping-Generating Plant | 1 | January 1 to December 31 for fire damage; continued from November 22, 2012 |
| | Robie Thermalito Pumping-Generating Plant | 2 | January 1 to December 31 for fire damage; continued from November 22, 2012 |
| | Robie Thermalito Pumping-Generating Plant | 3 | January 1 to December 31 for fire damage; continued from November 22, 2012 |
| | Robie Thermalito Pumping-Generating Plant | 4 | January 1 to December 31 for fire damage; continued from November 22, 2012 |
| | Alamo Powerplant | 1 | January 1 to March 5 for Condition Assessment Program inspection, current transformer replacement, and relay upgrade; continued from October 13, 2014 |
| | Oso Pumping Plant | 3 | January 1 to December 31 to refurbish, overhaul, and rewind discharge valve; continued from December 4, 2013 |
| | Oso Pumping Plant | 4 | January 1 to December 31 to refurbish, overhaul, and rewind, discharge valve; continued from December 4, 2013 |
| | Pearblossom Pumping Plant | 1 | January 5 to February 6 for annual Condition Assessment Program inspection |
| | Buena Vista Pumping Plant | 6 | January 2 to May 6 for stator rewind, motor refurbishment, and discharge valve repairs |
| | Edmonston Pumping Plant | 2 | January 2 to April 3 for discharge valve repairs |
| | Edmonston Pumping Plant | 4 | January 2 to April 3 for discharge valve repairs |
| | Edmonston Pumping Plant | 6 | January 2 to April 3 for discharge valve repairs |

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 2 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| | Edmonston Pumping Plant | 8 | January 2 to April 3 for discharge valve repairs |
| | Edmonston Pumping Plant | 10 | January 2 to April 3 for discharge valve repairs |
| | Edmonston Pumping Plant | 12 | January 2 to April 3 for discharge valve repairs |
| | Edmonston Pumping Plant | 14 | January 2 to April 3 for discharge valve repairs |
| | Dos Amigos Pumping Plant | 1 | January 1 to February 6 for field breaker replacement; continued from June 21, 2014 |
| | Giannelli Pumping-Generating Plant | 1 | January 1 to June 18 for generator refurbishment; continued from September 13, 2012 |
| | Giannelli Pumping-Generating Plant | 2 | January 1 to June 9 for butterfly valve installation; continued from October 24, 2014 |
| | Pine Flat Powerplant | 1 | January 1 to February 28 for annual maintenance |
| | Pine Flat Powerplant | 2 | January 1 to February 28 for annual maintenance |
| | Pine Flat Powerplant | 3 | January 1 to February 28 for annual maintenance |
| February | Barker Slough Pumping Plant | 1 | February 16 to March 20 because of an incomplete start |
| | South Bay Pumping Plant | 5 | February 12 to March 30 to repair bearing cooling water leak |
| | Hyatt Powerplant | 3 | February 23 to April 6 for transmission line #2 protective line relay replacement |
| | Hyatt Powerplant | 4 | February 23 to March 30 for transmission line #2 protective line relay replacement |
| | Hyatt Powerplant | 5 | February 26 to March 14 for penstock #2 runner inspection |
| | Hyatt Powerplant | 6 | February 26 to March 14 for penstock #2 runner inspection |
| | Badger Hill Pumping Plant | 1 | February 13 to April 25 for discharge line #1 recoat and flow meter installation |
| | Badger Hill Pumping Plant | 2 | February 13 to April 25 for discharge line #1 recoat and flow meter installation |
| | Badger Hill Pumping Plant | 3 | February 13 to April 25 for discharge line #1 recoat and flow meter installation |
| | Badger Hill Pumping Plant | 4 | February 13 to April 25 for discharge line #1 recoat and flow meter installation |
| | Dos Amigos Pumping Plant | 3 | February 9 to February 24 for Condition Assessment Program inspection and exciter preventative maintenance |
| March | Banks Pumping Plant | 9 | March 2 to July 23 for Condition Assessment Program inspection and preventative maintenance |
| | Hyatt Powerplant | 2 | March 17 to April 4 for penstock #1 for Unit 3 runner inspection and repair |

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 3 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| | Chrisman Pumping Plant | 8 | March 19 to April 9 brakes failed to release |
| | Teerink Pumping Plant | 8 | March 2 to March 23 for replacement of motor bus |
| | Dos Amigos Pumping Plant | 2 | March 9 to November 13 for discharge line inspection |
| | Giannelli Pumping-Generating Plant | 3 | March 3 to March 23 for scroll case inspection |
| | Giannelli Pumping-Generating Plant | 3 | March 23 to May 7 for excessive noise in turbine pit and loss of nose cone |
| April | Banks Pumping Plant | 8 | April 30 to May 17 for upstream seat position indicator oil leak |
| | Hyatt Powerplant | 5 | April 6 to May 19 for Oroville-Thermalito transmission line #3 protective line relay replacement |
| | Hyatt Powerplant | 6 | April 6 to May 15 for Oroville-Thermalito transmission line #3 protective line relay replacement |
| | Mojave Siphon Powerplant | 3 | April 13 to May 1 for annual Condition Assessment Program inspection |
| May | Barker Slough Pumping Plant | 6 | May 21 to June 19 for ground fault |
| | Mojave Siphon Powerplant | 2 | May 7 to May 27 for annual Condition Assessment Program inspection |
| | Oso Pumping Plant | 5 | May 29 to July 14 discharge valve failed to open |
| | Giannelli Pumping-Generating Plant | 3 | May 7 to December 31 for penstock #2 out of service |
| | Giannelli Pumping-Generating Plant | 4 | May 7 to August 25 for penstock #2 out of service |
| June | Devil Canyon Powerplant | 2 | June 8 to October 1 for annual Condition Assessment Program inspection and relay replacement |
| | Mojave Siphon Powerplant | 1 | June 1 to June 19 for annual Condition Assessment Program inspection |
| | Oso Pumping Plant | 6 | June 29 to July 14 for discharge valve refurbishment |
| | Badger Hill Pumping Plant | 6 | June 10 to October 6 for valve malfunction |
| | Chrisman Pumping Plant | 4 | June 8 to October 20 for Condition Assessment Program inspection and suction elbow inspection |
| | Chrisman Pumping Plant | 7 | June 1 to July 7 for Condition Assessment Program inspection, motor brake repair, and replacement of backfill piping |
| | Pine Flat Powerplant | 1 | June 2 to June 17 for penstock #1 work |
| | Pine Flat Powerplant | 2 | June 2 to June 17 for penstock #1 work |
| July | Banks Pumping Plant | 1 | July 27 to August 11 for relay and instrumentation calibration |
| | Banks Pumping Plant | 5 | July 24 to August 20 for motor pole replacement |

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 4 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| | Cordelia Pumping Plant | 3 | July 21 to August 5 for excessive vibration |
| | Cordelia Pumping Plant | 4 | July 20 to August 6 for excessive vibration |
| | Buena Vista Pumping Plant | 7 | July 22 to August 21 for KYB transformer problem |
| | Buena Vista Pumping Plant | 8 | July 22 to August 10 for KYB transformer problem |
| | Buena Vista Pumping Plant | 9 | July 22 to August 10 for KYB transformer problem |
| | Buena Vista Pumping Plant | 10 | July 22 to August 10 for KYB transformer problem |
| | Chrisman Pumping Plant | 5 | July 8 to October 10 for Condition Assessment Program inspection and discharge line #2 dewatering |
| | Teerink Pumping Plant | 3 | July 13 to August 8 for KYA transformer secondary bus links removal |
| | Teerink Pumping Plant | 4 | July 13 to August 8 for KYA transformer secondary bus links removal |
| August | Banks Pumping Plant | 10 | August 3 to September 5 for Condition Assessment Program inspection, preventative maintenance, and Doble testing |
| | South Bay Pumping Plant | 13 | August 27 to September 11 for excitation trouble |
| | Hyatt Powerplant | 1 | August 14 to December 31 for river valve operation due to water temperature requirements |
| | Hyatt Powerplant | 2 | August 14 to December 31 for river valve operation due to water temperature requirements |
| | Hyatt Powerplant | 4 | August 31 to December 31 for low lake level |
| | Hyatt Powerplant | 6 | August 24 to December 31 for low lake level |
| | Crafton Hills Pump Station | 3 | August 14 to September 12 breaker 146 tripped |
| | Pearblossom Pumping Plant | 7 | August 9 to September 11 discharge valve failed to open |
| | Chrisman Pumping Plant | 1 | August 16 to October 20 for 64F field ground trip |
| | Chrisman Pumping Plant | 3 | August 18 to September 10 for pump packing box excessive leakage |
| | Teerink Pumping Plant | 6 | August 17 to September 21 for discharge valve compressor and hydraulic system work |
| | Pine Flat Powerplant | 1 | August 13 to December 31 for lack of water |
| | Pine Flat Powerplant | 2 | August 13 to December 31 for lack of water |
| | Pine Flat Powerplant | 3 | August 13 to December 31 for lack of water |
| September | Giannelli Pumping-Generating Plant | 5 | September 2 to September 19 for exciter preventative maintenance and K5A transformer replacement |
| | Giannelli Pumping-Generating Plant | 6 | September 2 to September 19 for exciter preventative maintenance and K5A transformer replacement |

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 5 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| October | Devil Canyon Powerplant | 1 | October 5 to October 23 for penstock #1 drain and pipe inspection |
| | Devil Canyon Powerplant | 2 | October 5 to October 22 for penstock #1 drain and pipe inspection |
| | Devil Canyon Powerplant | 3 | October 26 to November 20 for annual Condition Assessment Program inspection and governor and cooling water system preventative maintenance |
| | Badger Hill Pumping Plant | 1 | October 30 to November 19 for annual coastal outage |
| | Badger Hill Pumping Plant | 2 | October 30 to November 19 for annual coastal outage |
| | Badger Hill Pumping Plant | 3 | October 30 to November 19 for annual coastal outage |
| | Badger Hill Pumping Plant | 4 | October 30 to December 3 for annual coastal outage |
| | Badger Hill Pumping Plant | 5 | October 30 to November 19 for annual coastal outage |
| | Badger Hill Pumping Plant | 6 | October 30 to November 19 for annual coastal outage |
| | Bluestone Pumping Plant | 1 | October 31 to November 22 for annual coastal outage |
| | Bluestone Pumping Plant | 2 | October 31 to November 22 for annual coastal outage |
| | Bluestone Pumping Plant | 3 | October 31 to November 22 for annual coastal outage |
| | Bluestone Pumping Plant | 4 | October 31 to November 22 for annual coastal outage |
| | Bluestone Pumping Plant | 5 | October 31 to November 21 for annual coastal outage |
| | Bluestone Pumping Plant | 6 | October 31 to November 21 for annual coastal outage |
| | Devils Den Pumping Plant | 1 | October 31 to November 21 for annual coastal outage |
| | Devils Den Pumping Plant | 2 | October 31 to November 21 for annual coastal outage |
| | Devils Den Pumping Plant | 3 | October 31 to November 21 for annual coastal outage |
| | Devils Den Pumping Plant | 4 | October 31 to November 21 for annual coastal outage |
| | Devils Den Pumping Plant | 5 | October 31 to November 20 for annual coastal outage |
| | Devils Den Pumping Plant | 6 | October 31 to November 21 for annual coastal outage |
| | Las Perillas Pumping Plant | 1 | October 30 to November 19 for annual coastal outage |
| | Las Perillas Pumping Plant | 2 | October 30 to November 19 for annual coastal outage |
| | Las Perillas Pumping Plant | 3 | October 30 to November 19 for annual coastal outage |
| | Las Perillas Pumping Plant | 4 | October 30 to November 19 for annual coastal outage |
| | Las Perillas Pumping Plant | 5 | October 30 to November 19 for annual coastal outage |
| | Las Perillas Pumping Plant | 6 | October 30 to November 19 for annual coastal outage |
| | Polonio Pass Pumping Plant | 1 | October 31 to November 22 for annual coastal outage |
| | Polonio Pass Pumping Plant | 2 | October 31 to November 22 for annual coastal outage |

**Table 11-2 Outages for Maintenance and Repair of Facilities in 2015, by Month** 6 of 6

| Month | Facility | Unit | Outage Description |
|---|---|---|---|
| | Polonio Pass Pumping Plant | 3 | October 31 to November 22 for annual coastal outage |
| | Polonio Pass Pumping Plant | 4 | October 31 to November 22 for annual coastal outage |
| | Polonio Pass Pumping Plant | 5 | October 31 to November 24 for annual coastal outage |
| | Polonio Pass Pumping Plant | 6 | October 31 to November 22 for annual coastal outage |
| | Teerink Pumping Plant | 1 | October 12 to November 4 to investigate and repair KYA transformer oil leak |
| | Teerink Pumping Plant | 2 | October 12 to October 28 to investigate and repair KYA transformer oil leak |
| | Teerink Pumping Plant | 3 | October 12 to October 27 to investigate and repair KYA transformer oil leak |
| | Teerink Pumping Plant | 9 | October 19 to November 5 to repair suction drain valve |
| November | Banks Pumping Plant | 2 | November 20 to December 11 for overvoltage relay trip |
| | Banks Pumping Plant | 3 | November 16 to December 16 for 59x neutral overvoltage 86m motor lock out |
| | Banks Pumping Plant | 6 | November 9 to November 24 for relay and instrumentation calibration |
| | Banks Pumping Plant | 10 | November 30 to December 15 for headworks gate #5 control and power feed refurbishment |
| | Banks Pumping Plant | 11 | November 30 to December 15 for headworks gate #5 control and power feed refurbishment |
| | South Bay Pumping Plant | 12 | November 17 to December 7 for incomplete start sequence |
| | Hyatt Powerplant | 3 | November 16 to December 12 for runner band drain leak |
| | Devil Canyon Powerplant | 4 | November 30 to December 22 for annual Condition Assessment Program inspection |
| | Teerink Pumping Plant | 7 | November 9 to November 24 to replace pump packing and equalize vent lines |
| | Dos Amigos Pumping Plant | 5 | November 17 to December 29 to replace vane control oil |
| December | Pearblossom Pumping Plant | 6 | December 14 to December 31 for hydraulic oil loss |
| | Pearblossom Pumping Plant | 7 | December 14 to December 31 for head cover bolt failure |
| | Badger Hill Pumping Plant | 3 | December 2 to December 31 for shaft seal leak |



# Chapter 12
# Engineering, Construction, and Real Estate

*Cement deep soil mixing at Perris Dam.*

## Significant Events in 2015

In 2015, engineering, construction, and real estate continued to work to enhance, expand, repair, and protect the State Water Project (SWP) and other facilities within the State. Significant projects included Perris Dam remediation, the East Branch Extension Phase I improvements and Phase II projects, Clifton Court Forebay radial gate repairs, the emergency drought barrier project, and the seismic retrofit of 23 bridges in the San Luis, San Joaquin, and Southern field divisions.

*Information for this chapter was provided by the Division of Engineering.*

Initial construction of the State Water Project (SWP) facilities began in 1957 with the relocation of the Western Pacific Railroad facilities and Highway 70 near the City of Oroville to accommodate the SWP Oroville Facilities. Oroville Dam was constructed between 1961 and 1967. Construction of the South Bay Aqueduct (SBA) facilities started in 1960, and the first SWP water was delivered through the SBA in 1962 to serve Alameda County.

In 1963, work began on the California Aqueduct, and by 1968, the SWP was delivering water to long-term SWP water contractors in the San Joaquin Valley. By 1973, with the completion of Edmonston Pumping Plant at the foot of the Tehachapi Mountains and other East Branch conveyance facilities, the SWP was delivering water to Lake Perris at the southernmost point in Riverside County.

Other water deliveries took place as follows:

- 1968—the first SWP water was delivered through the first phase facilities of the North Bay Aqueduct and through the first phase facilities of the Coastal Branch;
- 1974—the first SWP water was delivered through the West Branch facilities to Los Angeles County;
- 1988—SWP water was delivered through the second phase facilities of the North Bay Aqueduct to Solano County; and
- 1997—SWP water was delivered through the second phase facilities of the Coastal Branch Aqueduct to San Luis Obispo and Santa Barbara counties.

Prior to the completion of the initial facilities in 1973, work began on the Upper Feather River facilities to supply local water, recreation, and fish enhancement. Power plants, additional pumping units, and turbine-generators that had previously been deferred were built to ensure water quality and fish enhancement in the Delta.

From 1974 through 2015, design and construction activities included repairing concrete lining failures or potential failures of the canal system and concrete pipeline sections, replacing equipment components of existing facilities, enlarging or extending aqueduct reaches, refurbishing pump-turbine units, and adding pumps and motors to existing facilities. Specific projects included constructing the Devil Canyon Second Afterbay, constructing Phase II of the Coastal Branch, extending the SWP through the East Branch Extension to the San Gorgonio Pass service area in San Bernardino and Riverside counties with enlargements and expansions in later years, SBA enlargement, Perris Dam seismic remediation, and activities related to habitat restoration and water conveyance options in the Delta.

## Design Activities

In 2015, work to enhance, expand, repair, and protect SWP water delivery facilities continued. Engineering activities supported more efficient water deliveries within the confines of legal and environmental constraints and power availability. Significant projects included the Sisk Dam seismic reevaluation, North Bay Aqueduct alternate intake study, and Perris Dam emergency release facility design. Table 12-1 (at the end of the chapter) provides a list of completed and ongoing design work that was undertaken in 2015.

The Department of Water Resources' (DWR), Division of Engineering (DOE) continued

to design projects for development into the construction phase, including awarding construction contracts. DOE worked with many DWR divisions and offices, as well as local, State, and federal agencies. DOE prepared preliminary designs and estimates; developed and administered construction contract documents and carried out construction projects; and conducted special studies of dams, canal embankments, and other SWP facilities.

Study and design activities continued from previous reporting periods, or initiated in 2015, included the following:

- Oroville, Thermalito Afterbay, and Thermalito Forebay dams radial gate nondestructive examination of tendons—study;
- Lake Oroville reservoir rim inspection—study;
- Oroville Field Division roofing replacement—design;
- Thermalito Afterbay Dam, well replacement, phase II—design;
- Hyatt Powerplant, Thermalito Diversion Dam Powerplant, and Oroville Operations and Maintenance Center fire systems modernization—design;
- North Bay Aqueduct alternate intake—study;
- Clifton Court Forebay Dam stratigraphic model of foundation—study;
- Delta Field Division—Byron Road Bridge replacement—design;
- Delta Field Division embankment and liner repair (Milepost 62)—design;
- Sisk Dam seismic reevaluation—study;
- San Joaquin Field Division bridge hinge retrofits—design;
- Castaic Dam left abutment analysis—study;
- Castaic Dam tower nonlinear structural analysis—study; and
- Perris Dam emergency release facility—design and environmental documents.

In 2015, DOE staff completed the following projects:

- Oroville, Thermalito, and Pyramid dams radial gate structural reevaluation—design;
- Bidwell Canyon stage III boat ramp extension—design;
- Oroville Dam river outlet modification—design;
- Oroville Dam radial gates seal replacement—design;
- Oroville Field Division roofing replacement—design;
- Oroville Field Division fire systems modernization—design review;
- Hyatt and Thermalito power plants fire detection system—design;
- Thermalito Powerplant bypass gate reliability—design;
- Montezuma Slough Control Facility roofing replacement—design;
- Sherman and Twitchell islands new fish screens at existing siphons at 5 sites—final design;
- Del Valle Dam right abutment fault, phase 2 investigation—study;
- Delta Field Division canal repairs (Reaches 1 and 2A)—design;
- San Luis Field Division canal liner and embankment repair—design;
- Devil's Den, Bluestone, and Polonio Pass pumping plants insulated flange repair and vault construction—design;
- Los Robles Bridge—seismic analysis;
- East Branch Enlargement, Phase II—preliminary design and environmental documents; and
- Mojave Division replacement of standby emergency generators—design.

## California WaterFix

In 2008, the Delta Habitat Conservation and Conveyance Program was established to conduct activities related to assessing

potential habitat restoration and water conveyance options in the Delta for the Bay/Delta Conservation Plan. On April 30, 2015, State and federal agencies announced a new sub-alternative, Alternative 4A, to replace Alternative 4 (the proposed Bay Delta Conservation Plan) as the State's proposed project. Alternative 4A reflects the State's proposal to separate the conveyance facility and habitat restoration measures into two separate efforts: California WaterFix (Alternative 4A) and California EcoRestore.

In 2015, activities related to California WaterFix included the following:

- completing the phase 1 of system impact studies for Pacific Gas & Electric Company, Sacramento Municipal Utility District, and Western Area Power Administration regarding potential impacts to their systems to provide transmission service to the California Waterfix project;
- preparing a conceptual engineering report for the Dual Conveyance Facility Modified/Pipeline/Tunnel Option—Clifton Court Forebay Pumping Plant;
- completing initial draft design phase studies for the Clifton Court Pumping Plant;
- completing transmission system modeling for Western Area Power Administration for system impact study purposes;
- completing a draft agreement and exhibits to establish the Design and Construction Enterprise to support collaboration in the design and construction of California WaterFix; and
- completing phase 2 of system impact study for Sacramento Municipal Utility District.

More information can be found in Chapter 3, Environmental Programs, or on the California WaterFix and California EcoRestore websites.

## Construction Activities

DWR divides the California Aqueduct into the following construction divisions: North San Joaquin, San Luis, South San Joaquin, Tehachapi, Mojave, and Santa Ana divisions of the so-called "main line," and the West and Coastal branches.

DOE worked on 65 construction contracts in various SWP construction divisions in 2015. Projects included pipeline repair, control system upgrades, fire systems modernization, equipment refurbishments and upgrades, seismic upgrades of bridges, maintenance facility improvements at dam and reservoir sites, and the addition of new pumping units and a reservoir. Table 12-2 (at the end of the chapter) provides a list of completed and ongoing construction contracts undertaken in 2015. Resolution of contract claims may extend the actual contract closeout beyond the completion or acceptance date.

Since the inception of the SWP, environmental issues have increased in magnitude with the enactment of numerous federal and State laws. DWR has complied with these laws by seeking appropriate permits, preparing environmental compliance documents, and incorporating environmental requirements and conditions into the design and execution of construction projects. Environmental scientists work with design engineers to produce projects that meet SWP objectives while having the least impact possible on the environment.

Construction contract specifications and plans are reviewed and modified with the environmental compliance requirements and sensitive resource protection needs in mind. Ongoing construction activities are monitored to ensure compliance with requirements outlined in environmental permits for each contract.

## SWP—General

### *SWP Supervisory Control and Data Acquisition System*

A contract (Specification No. 08-12) to replace portions of the aging SWP supervisory control and data acquisition system began in May 2009. This contract furnishes and installs 176 controller assemblies for the replacement of remote terminal units located throughout the SWP and furnishes 16 controller assemblies for Devil Canyon Powerplant and DWR's development lab at the Joint Operations Center. The controller assemblies were built from components furnished by the contractor (programmable logic controllers, sequence-of-event recorders, fiber patch panels, modems, and other equipment). Work was completed in October 2015. Acceptance is expected in July 2016.

### *California Aqueduct Copper Communications Cable and Voice and Data Equipment*

Work began on approximately 450 miles of California Aqueduct copper communications cable and voice data equipment monitoring, testing, and repair in March 2014 (Specification No. 13-17). The project includes providing monitoring, testing, leak detection, and routine and nonroutine cable repairs. Work is scheduled to be completed in March 2016. Acceptance is expected in May 2016.

## Oroville Division

### *Robie Thermalito Pumping-Generating Plant*

Initial cleanup of the Robie Thermalito Pumping-Generating Plant (Specification No. 13-16) began in October 2013. The work involves cleaning and repairing all fire-impacted equipment; installing new roll-up doors; procedure testing essential systems; and installing a new heating, ventilation, and air-conditioning system. Work also includes repairing spalled concrete, the roof, and skylights; cleaning electrical components in the switchyard; and other cleanup as deemed necessary by the engineer. Work is scheduled to be completed in May 2016. Acceptance is expected in July 2016.

### *Bidwell Bar Bridge*

The Bidwell Bar Bridge access road repair (Specification No. 14-10) began in September 2014. Work included reinforcing embankment material. Work was completed in January 2015 and accepted in November 2015.

### *Oroville Dam River Outlet Diversion Tunnel No. 2*

Baffle ring installation work (Specification No. 15-11) began in December 2015. This project includes furnishing and installing two water-filled tunnel plugs, providing support work for fixed cone valve replacement, and installing 12 DWR-furnished baffle ring segments at the Oroville Dam River Outlet Diversion Tunnel No. 2. Work is scheduled to be completed in April 2016. Acceptance is expected in June 2016.

### *Bidwell Canyon Boat Ramp*

The stage III boat ramp extension (Specification No. 15-13) began in December 2015. Work includes a concrete paved boat ramp, earthwork, compacted backfill, reinforced concrete, rock slope protection, erosion control, and drill and bond dowels. Work is scheduled to be completed in January 2016. Acceptance is expected in May 2016.

### *Hyatt Powerplant Fire System Modernization Project*

The goals of the fire system modernization project are to increase safety and property protection, while reducing business interruptions and environmental impacts. The project to furnish and install the new

fire detection and evacuation system project (Specification No. 15-06) began in October 2015.

Work includes:

- upgrading transformer, generator, high voltage tunnel, and Area Control Center communication room fire suppression systems;
- replacing Hyatt's oil purification/storage room and high voltage cable oil room carbon dioxide suppression system with a high pressure water mist system;
- installing water sprinkler and clean agent suppression at specific locations within Hyatt and the Area Control Center to meet probable maximum loss criteria;
- providing modifications within the plant and the dam core block that allow a safe outlet for staff during an emergency event and providing additional communications systems throughout the plant; and
- networking all fire detection and suppression systems at all facilities to remote workstations capable of monitoring and controlling the new and existing systems.

DWR assisted the contractor with the design work and are assisting the contractor during the construction phase of the project. Work is scheduled to be completed in June 2017. Acceptance is expected in July 2017.

## *Hyatt Powerplant Diversion Tunnel No. 2*

Emergency repairs (Specification No. 14-07) began in March 2014 involving furnishing, installing, and commissioning video surveillance and telecommunications equipment; refurbishing the existing hydraulic system; and furnishing, installing, and commissioning new hydraulic system components for actuation.

Additional work included:

- furnishing and installing hydraulics and electronic controls to allow backup operation of the 72-inch spherical valve plug from Elevation 252 inside the Hyatt Powerplant;
- furnishing and installing an emergency actuation system for the 72-inch spherical valves;
- removing two 54-inch fixed cone valves for refurbishment and reinstalling them; and
- constructing other appurtenances and hydraulic structures as required.

Work was completed in July 2014 and accepted in September 2015.

## *Feather River Fish Hatchery*

Repair of the raw water supply pipeline (Specification No. 14-01) began in April 2014. Work included removing and providing surface preparation of the delaminated lining area inside the existing 60-inch diameter steel pipe. Surface preparation and removal and replacement of mortar at various pipe joints was also completed for a 54-inch reinforced concrete pipe.

Additional work included:

- removing existing pipe access structures and concrete slabs;
- removing and salvaging existing combination air release valves, stand pipes, and valves;
- constructing two new manholes and concrete encasements;
- installing two new pipe access structures with hatch covers, ladders, and extension safety posts; and
- removing and replacing manhole lid gratings.

The work was completed in September 2014 and accepted in February 2015.

### *Feather River Spawning Gravel Supplementation*

A project (Specification No. 14-04) to enhance fish habitat began in May 2014 and consisted of three parts:

(1) importing 13,300 cubic yards of gravel and stockpiling it adjacent to the fish hatchery;
(2) clearing, grading, shaping, and maintaining an earth access ramp from the stockpile location down to the Feather River; and
(3) constructing an access road in the river channel and placing 8,300 cubic yards of the stockpiled gravel in the river channel to construct riffles, berms, and channels.

This work was completed in September 2014 and accepted in February 2015.

## South Bay Aqueduct

### *SBA Enlargement and Improvement*

The SBA Enlargement and Improvement projects restored the first 16.38 miles of the SBA to the 300 cubic feet per second (cfs) design flow and increased the design capacity by up to 130 cfs. This work enlarged the South Bay Pumping Plant to accommodate four additional 45 cfs units, constructed a third discharge line, constructed Dyer Reservoir, enlarged the canal, and modified associated structures. Projects are described below.

**Canal Modifications.** Various modifications were performed along Dyer Canal, Livermore Canal, Alameda Canal, and Del Valle Pipeline under a contract that began in October 2010 (Specification No. 09-16). Work included raising the canal lining, canal embankment, and operating roads; removing, modifying, installing, and constructing various structures, including overchutes, inlets, pipes, bridges, trash racks, siphons, check structures, water-level measurement systems, radial gates, motors, control systems, flowmeters, and valves; and raising/refurbishing Patterson Reservoir. Work was completed in June 2015. Acceptance is expected in February 2016.

**South Bay Pumping Plant.** The following contracts for the SBA Enlargement project at South Bay Pumping Plant continued throughout 2015.

Specification No. 04-05: furnishing 45 cfs pump and motor units for Unit Nos. 10 through 13 and one spare pump and motor. Work began in November 2004. In February 2015, DWR and the contractor agreed to terms for closing out the contract. Acceptance is expected in January 2016.

Specification No. 04-20: furnishing valves, actuators, and hydraulic power units. Work began in May 2005. The equipment was furnished in June 2007. Repairs to the butterfly valves were added to this contract by change order. Work was completed in October 2015, and acceptance is expected in January 2016.

Specification No. 06-04: enlarging pumping plant initial facilities. Work began in August 2006 and was completed in October 2011. Acceptance is expected in January 2016.

Specification No. 07-18: complete pumping plant enlargement. Work began in December 2007. Added work included repairs to a water system pipeline adjacent to Banks Pumping Plant. Work was completed in April 2014. Acceptance is expected in January 2016.

**Del Valle Dam.** The following contracts for Del Valle Dam continued in 2015.

Specification No. 12-14: bulkhead installation and removal. Work began in October 2012. Original contract work included labor, materials, and construction equipment;

hauling construction equipment for installation and removal of a DWR-furnished bulkhead gate; repairing cracks inside the flood control outlet works tunnel; applying coatings to the bulkhead gate and flood control outlet works tunnel slide gates; painting station markings on the inside of the Del Valle spillway tunnel; and installing a metal walkway.

In addition to the original contract work, additional tasks were performed under change order. These tasks included:

- urgent repair of leaks on the SBA Pipeline at Mileposts 38.90, 33.83, and 35.34;
- Thermalito Powerplant recovery efforts;
- Clifton Court Forebay gate repair;
- open channel flowmeter installation at Dyer Reservoir;
- Del Valle floodgate repair;
- Hyatt Powerplant clean-up; and
- furnishing WEKO-SEALs (internal joint seals).

Work was completed in April 2014. Acceptance is expected in July 2016.

Specification No. 14-17: repair leaks inside tier valve intake structure, conservation outlet works tunnel and access tunnel, Del Valle Branch Pipeline, and gate chamber access tunnel. Work began in October 2014. The contractor repaired damaged coatings of valves and steel pipe, installed pressure transducer conduits on the exterior of the tier valve intake structure, installed a remotely monitored weir for seepage measurement, and painted station markings on the inside of the tier valve intake structure and the conservation outlet works access tunnel. Work was completed in April 2015 and accepted in October 2015.

## North San Joaquin Division

### *Skinner Fish Science Building*

The Delta Fish Survival Improvements Program (Specification No. 12-15) began in December 2012. Work consisted of construction of a cold-formed steel frame building with restroom, office space, and break room facilities. The project included demolishing the following existing items:

- asphalt concrete paving;
- concrete and reinforcing steel;
- concrete curb and gutter;
- chain-link fencing;
- traffic gates;
- metal beam guardrail; and
- cathodic protection.

Work was completed in October 2014. Acceptance is expected in January 2016.

### *Clifton Court Forebay Dam*

On July 8, 2013, radial Gate No. 2 at the Clifton Court Forebay Dam intake structure failed catastrophically. With an advance directive under a contract that began in October 2012 (Specification No. 12-14), a contractor retrieved the gate from the reservoir and made immediate minor repairs to radial Gates No. 1, 3, 4, and 5 to minimize the potential for failure of additional gates. DOE issued and awarded Specification No. 13-15 in July 2013 to repair and reinstall Gate No. 2 and to identify and correct conditions to a level of acceptable operational risk on the four remaining gates. The contract also included removing, cleaning, and repairing five loading gates. Work was completed in February 2015 and accepted in July 2015.

### *Skinner Fish Facility*

**Fish Count and Transport Buckets.** Work began in June 2014 to furnish fish count and transport buckets (Specification No. 14-08) for the Skinner Fish Facility. Work was

completed in June 2015, and acceptance is expected in February 2016.

**Emergency Repair of Louvers.** On September 18, 2014, six louver supports in Bay 5 at the Skinner Fish Facility failed catastrophically. With an advance directive under a contract that began in October 2012 (Specification No. 12-18), a contractor recovered the broken louvers and performed a dive inspection and damage assessment. A contract (Specification No. 14-20) began in November 2014 to temporarily replace the failed aluminum frames in Bay 5 with steel ones, fabricate and install new louvers, perform additional condition assessment dive inspections of Bays 1 through 5, and make necessary temporary repairs based on conditions. In addition, the louver washing system was upgraded with new pumps, valves, and controls, and the flow meters were replaced. Work was completed in May 2015 and accepted in September 2015.

### *Curtis Landing Fish Release Site*

Work for this project (Specification No. 14-02) began in March 2014. It involved two tasks related to the Curtis Landing fish release site. The first included selective demolition of the existing fish release system piping, support framing and piles, electrical system, and other miscellaneous facilities, and relocation of passive integrated transponder antennas, a submersible pump, and articulated mats. The second task included construction of a concrete slab, wall, and foundation; construction of a steel platform with metal grating, piping, valves, flowmeter, and submersible pump; construction of the structural steel framework to support the piping; and electrical work for the fish screen pump, lights, and gates. Work was completed in May 2015. Acceptance is expected in February 2016.

## San Luis Division

### *Canal Milepost 86.69 to Milepost 138.29*

Turnout structure modifications (Specification No. 15-03) began in November 2015. Work includes installation of guide steel and thermoplastic polyolefin single-ply roofing at five locations, and head panel modification. The project is scheduled to be completed in March 2016. Acceptance is expected in July 2016.

### *Delta and San Luis Field Divisions—Roads and Parking Areas*

Work began in July 2013 (Specification No. 13-06) to seal and pave roads and parking areas in Alameda, Contra Costa, Stanislaus, Santa Clara, Merced, Kings, and Fresno counties. Work was completed in January 2014 and accepted in February 2015.

## Tehachapi Division

### *Edmonston Pumping Plant*

A contract to replace pump Units W2, W4, W6, and W8 (Specification No. 02-10) began in June 2003. Work was completed in March 2011. Delivery of additional spare parts was added later to the contract through a change order. Delivery and acceptance were completed in November 2015. Work consisted of:

- designing, fabricating, and testing a four-stage pump model and a single-stage pump model, and furnishing a pump model test program report;
- designing, manufacturing, delivering, storing, and installing four pumps to replace existing pumps;
- furnishing spare parts, auxiliary equipment, tools, and templates;
- applying coatings;
- providing liaison services; and
- furnishing additional spare parts requested via change order.

### *Chrisman and Devil's Den Pumping Plants*

Site improvements (Specification No. 12-12) began in December 2012. The work included:

- repairing and coating water discharge pipe sleeve couplings and expansion joints;
- constructing temporary scaffolds with containment structures for sandblasting and cleaning the joints;
- removing sandblast dust and debris; and
- removing and replacing 160 feet of 12-inch diameter steel pipe.

Work was completed in February 2015 and accepted in December 2015.

### *Antelope Valley-East Kern Water Agency Turnout*

Construction of the Antelope Valley-East Kern turnout (Specification No. 13-11) began in August 2013. The work involved excavation, constructing a temporary coffer dam, erosion control, installing steel pipe and fittings, concrete work, miscellaneous metal work, a trash rack, and backfilling. The contractor performed demolition of the concrete liner and existing drainage ditch and removal of an existing asphalt concrete road. Work was completed in August 2014 and accepted in May 2015.

## Mojave Division

### *Canal Milepost 335.80*

The emergency canal lining repair project (Specification No. 15-16) began in October 2015. Work includes dewatering, removal of the concrete liner and unsuitable material, backfill, and concrete and joint sealant repair. Work is expected to be completed in January 2016. Acceptance is expected in June 2016.

### *Canal Milepost 342.65*

Repair at Milepost 342.65 (Specification No. 13-10) began in July 2013. The work included dewatering of Pool 52, removal and repair of concrete panels, concrete repair and cleaning, replacement of bolt anchors and ladders, and repair of the access road. Work was completed in January 2014 and accepted in January 2015.

### *Pearblossom Pumping Plant*

A contract to construct a new 20,000 square-foot Pearblossom Administration Building near Pearblossom Pumping Plant began in February 2011 (Specification No. 10-23). The new building, which received notification of Leadership in Energy and Environmental Design platinum certification in May 2015, is occupied by Southern Field Division staff and Lancaster Project Headquarters personnel. Work was completed in February 2013. Acceptance is expected in April 2016.

## Santa Ana Division

### *East Branch Extension Phase I Improvements*

#### Crafton Hills Reservoir Enlargement.

A construction contract (Specification No. 11-12) to increase the reservoir's operating storage from 85 acre-feet to approximately 225 acre-feet began in December 2011. The work included an earthen embankment dam with rock slope protection, access roads, grouting, a seepage collection system, geotechnical instrumentation, and mechanical aerators. The reservoir was filled in September 2014. Work was completed in June 2014 and accepted in March 2015.

### *East Branch Extension Phase II*

Phase II of the East Branch Extension will complete the planned capacity increase for the East Branch Extension. Phase II will allow San Gorgonio Pass Water Agency to receive its maximum annual Table A water and allow the San Bernardino Valley Municipal Water District to increase its distribution system capacity to its Redlands and Yucaipa Valley service areas. Principal Phase II features include approximately

6 miles of new 72-inch and 66-inch diameter pipe, a new reservoir (Citrus Reservoir), a new 160 cfs pump station (Citrus Pump Station), expansion of the existing Crafton Hills Pump Station, and installation of an additional pump at Cherry Valley Pump Station.

**Citrus Reservoir.** Construction of Citrus Reservoir (Specification No. 12-02) began in June 2012. The work to construct the reservoir included selective demolition, excavation, compacted soil liner, hydraulic asphalt concrete, inlet works, and environmental protection. Work was completed in February 2014 and accepted in February 2015.

**Mentone Pipeline.** Construction of Mentone Pipeline (Specification No. 12-03) began in July 2012. The work includes installation of approximately 2 miles of 72-inch buried steel pipe from Foothill Pump Station to Citrus Reservoir and approximately 3.5 miles of 66-inch buried steel pipe from Citrus Pump Station to Crafton Hills Pump Station. Work is scheduled to be completed in June 2015. Acceptance is expected in December 2016.

**Valves.** Manufacturing, testing, and delivery of three energy dissipating valve assemblies (including electric actuators) for Citrus Reservoir (Specification No. 10-10) began in September 2010. The valves were delivered to the site in October 2012. Spare parts and special tools were included in the contract work. Work was completed in March 2013. Acceptance is expected in July 2017.

Manufacturing, testing, and delivery of 14 ANSI (American National Standards Institute) butterfly valve assemblies with actuators for Citrus Pump Station, Crafton Hills Pump Station, and Cherry Valley Pump Station (Specification No. 10-16) began in January 2011. Spare parts and special tools were included in the contract work. Work was completed in July 2013. Acceptance is expected in July 2017.

Manufacturing, testing, and delivery of 12 AWWA (American Water Works Association) butterfly valve assemblies with actuators for Crafton Hills Pump Station, Cherry Valley Pump Station, and Mentone Pipeline (Specification No. 10-17) began in February 2011. Spare parts and special tools were included in the contract work. Work was completed in mid-2013. Acceptance is expected in July 2017.

Manufacturing, testing, and delivering 12 ANSI ball valve assemblies with actuators and 4 actuators for Citrus Pump Station, Crafton Hills Pump Station, and Cherry Valley Pump Station (Specification No. 10-18) began in January 2011. The valves were delivered to the site in October 2012. Spare parts and special tools were included in the contract work. Acceptance is expected in July 2017.

**Transformers.** Transformers, accessories, tools, and spare parts were manufactured, tested, and delivered for Citrus Pump Station under a contract (Specification No. 10-20) that began in March 2011. The equipment was delivered to the completion contractor in December 2015. Acceptance is expected in July 2017.

**5 kilovolt Switchgear.** Work includes manufacturing, factory testing, and commissioning equipment (Specification No. 13-12) for a prefabricated control building and associated equipment, accessories, tools, special tools, and spare parts. Also included are 5 kilovolt (kV), 4,000 amperes (A) switchgear motor breaker cubicle assemblies; 5 kV, 4000 A main and tie breaker switchgear cubicle assemblies; 5 kV, 4,000 A station service breaker switchgear cubicle assemblies; and 5 kV-class surge protection equipment in the main incoming bus compartments. Fabrication began in June 2014 and is scheduled to be completed in October 2016. Acceptance is expected in June 2017.

### *Crafton Hills and Citrus Pump Stations*

Construction on the Crafton Hills Pump Station expansion and Citrus Pump Station initial work (Specification No. 12-10) began in October 2012. Work included construction of a prestressed concrete forebay water tank and pump station buildings; earthwork, shoring, and demolition; installation of a hydraulic asphalt concrete liner, steel pipe and appurtenances, DWR-furnished materials, and equipment; application of coatings; and testing. Work was completed in October 2014. Acceptance is expected in July 2016.

### *Citrus, Crafton Hills, and Cherry Valley Pump Stations*

Work to provide pumps, motors, variable frequency drives, and excitation system equipment, and associated hardware, for the pump stations (Specification No. 13-01) began in June 2013. Units were delivered in December 2015. Acceptance is expected in July 2017.

## West Branch

### *Oso Pumping Plant*

Work to construct a 14,400 square-foot civil maintenance and mobile equipment building at Oso Pumping Plant (Specification No. 07-22) began in December 2007. Work was completed in July 2012. Acceptance is expected in October 2016.

### *Perris Dam*

The seismic remediation of Perris Dam (Specification No. 14-03) began in August 2014. The work involves construction of a new compacted berm; extension of the existing blanket drain; construction of a new drain line, a new toe drain, and a relief well system; cement deep soil mixing treatment of the alluvium beneath the footprint of the compacted berm; road work; and other related work. The rock material for the project is being produced on-site by using blasting methods and a rock processing plant. The work is scheduled to be completed in November 2017. Acceptance is expected in March 2018.

**Oak Valley (Perris Dam).** Mitigation work for the Perris Dam seismic remediation project (Specification No. 15-01) began in June 2015. The work involves:

- excavation, grading, and revegetation of a new channel and floodplain system;
- protection of native trees and vegetation;
- monitoring well destruction;
- earthwork, including excavation, transport, stockpile, and placement of fill and rock structures for grade control;
- installing biotechnical structures;
- installing erosion control devices;
- installing a hog exclusion fence and gate; and
- planting, seeding, irrigating, and plant establishment.

The work is scheduled to be completed in January 2017. Acceptance is expected in April 2017.

## Coastal Branch

### *Kern and San Luis Obispo Counties*

The cathodic protection rehabilitation project in Kern and San Luis Obispo counties (Specification No. 13-13) began in September 2013. Work included removing encasement at insulating coupling flanges and installing new insulating sleeve couplings inside new cast-in-place vaults. A portion of the work was completed in January 2014 and accepted in September 2014. The remaining work was completed under Specification No. 15-05. Acceptance is expected in July 2016.

### *Devil's Den, Bluestone, and Polonio Pass Pumping Plants*

Work on cathodic protection rehabilitation and installation of insulated sleeve

couplings (Specification No. 15-05) began in September 2015 and was completed in December 2015. The project is expected to be accepted in July 2016.

## Construction Activities in Multiple Divisions

### *Temporary Rock Barriers 2013, 2014, and 2015*

Two tasks related to the South Delta Temporary Barriers Project (Specification No. 12-18) began in January 2013. The first task included the removal of temporary rock barriers and appurtenances at Middle River, Old River, and Grant Line Canal. Additional work included temporary pumping facilities, dredging in the South Delta, removing of aquatic weeds in Clifton Court Forebay, installing of stone protection in the South Delta, and structural maintenance and repair at the Curtis Landing and Horseshoe Bend release facilities. The second task included furnishing, installing, and removing a nonphysical barrier at the head of Georgiana Slough and at the east side of the Sacramento River (immediately downstream of the Walnut Grove Bridge). Work was completed in December 2015. Acceptance is expected in March 2016.

### *West False River*

The temporary rock barrier for the drought emergency (Specification No. 15-04) began in April 2015. Work included construction of a rock barrier at West False River, which included installing embankment rock to form the embankments of the barrier, aggregate base materials, and whalers and attachments between the king pipe piles and sheet piles. The contractor also installed DWR-furnished materials such as warning signs and buoys, ball floats, and lights. Work was completed in June 2015 and was accepted in September 2015.

### *West False River and Rio Vista Storage Area*

The work (Specification No. 15-08) at West False River began in August 2015 and consists of removal of the drought barrier, including:

- removing of embankment rock and transporting the rock to the Rio Vista storage area;
- removing of warning signs, warning buoys, ball floats, and lights;
- cutting and removal of steel sheet; and
- applying seeding and erosion control methods.

The work at the Rio Vista storage area includes:

- demolition of selected existing features;
- clearing and grubbing, including tree removal, grading, imported backfill, and geotextile fabric;
- installing corrugated metal pipe, aggregate base, hot mix asphalt, pavement markings and signs, woven wire fence and gates, metal beam guardrail, bollards, and applying seeding and erosion control methods,
- installing a hot-tap water connection, piping, valves, backflow device, water meter, and appurtenances.

Work is scheduled to be completed in January 2016. Acceptance is expected in March 2016.

### *San Luis, San Joaquin, and Southern Field Divisions*

The seismic retrofit of bridges addressed existing seismic deficiencies in 23 bridges (9 DWR and 14 Reclamation) located in the San Luis, San Joaquin, and Southern field divisions. There are 22 structures that carry local streets and roads over the California Aqueduct, and one that supports the aqueduct operational road over a local

county road. The work included constructing of shear keys at bridge piers and abutments, replacing some existing reinforced concrete bridge deck, installing hot mix asphalt pavement and dikes, and installing metal beam guard railing. The seismic retrofit was required to prevent potential collapse during an earthquake, and deck replacement work is required due to deterioration of the concrete decks from heavy truck traffic.

**Phase I.** Work on the Duncan Road Bridge, Goss Road (Goodwin Drive) Bridge, Maple Avenue Bridge, Mesquite Street Bridge, and the Ranchero Road Bridge in the Southern Field Division (Specification No. 14-09) began in August 2014. The bridge decks were replaced at the Maple Avenue and the Ranchero Road bridges. Work was completed in September 2015. Acceptance is expected in August 2016.

**Phase II.** Work on the Butts Road Bridge, McCabe Road Bridge, and Mervel Avenue Bridge in the San Luis Field Division (Specification No. 14-14) began in September 2014. Work was completed in February 2015 and accepted in April 2015.

**Phase III.** Work on the 15 bridges located in Fresno, Kings, and Kern counties in the San Luis and San Joaquin field divisions (Specification No. 14-13) began in September 2014. Work was completed in March 2015 and accepted in April 2015.

### *Edmonston, Chrisman, Teerink, and Buena Vista Pumping Plants*

Work at these pumping plants involved the following contracts.

Specification No. 11-10: furnish and install 230 kV SF6 power circuit breakers. Work began in March 2012, was completed in March 2015, and accepted in November 2015.

Specification No. 13-09: replace 57 annunciator panels and the associated hardware for the equipment at the pumping plants. Work began in November 2013, was completed in February 2015, and accepted in August 2015.

Specification No. 11-04: replace the septic tanks, sewage piping, and pumps. Work began in April 2012, was completed in August 2014, and accepted in February 2015.

### *San Joaquin Field Division*

Replacement of the existing standby engine generators with new liquefied petroleum gas and diesel standby engine generators (Specification No. 14-19) began at 21 check sites and 8 pumping plant sites in the San Joaquin Field Division in May 2015. Work also includes installing new fuel tanks, transfer switches, and load banks to support operation of the new standby engine generators. The sites include all of the Coastal Branch pumping plants and check sites; all check sites from Check 22 to 39 on the California Aqueduct; and Teerink, Buena Vista, and Edmonston pumping plants. Work is estimated to be completed in October 2016. Acceptance is expected in November 2016.

### *Badger Hill Pipeline*

Work began in the San Joaquin and Southern field divisions (Specification No. 13-14) in November 2013. Work included removing and replacing the existing lining in manifolds and pipeline, constructing a flow metering vault, removing and replacing a joint at Check 66, and removing and reinstalling pipe spool pieces. Because of emergency work in Specification No. 15-16, work under this contract (Specification No. 13-14) is suspended through October 2016. Work is scheduled to be completed in June 2017. Acceptance is expected in June 2017.

### *Southern Field Division—Seal and Pave Roads and Parking Areas*

This project (Specification No. 14-05) began in July 2014 and covered areas in Los Angeles and San Bernardino counties.

The work included:

- traffic stripes and pavement markings;
- pavement repairs;
- hot mix asphalt paving and overlays;
- earthwork including excavation and compacted backfill;
- wheelstops; and
- miscellaneous metalwork.

The work was completed in September 2015. Acceptance is expected in March 2016.

## Real Estate Activities

DWR processed a net total of $7.02 million in payments in 2015 in support of right-of-way activities required for the construction, operation, and maintenance of the SWP. This amount represents direct payments made for the cost of real property rights, damages, temporary entry permits, licenses, leases, and relocation expenses.

DWR conducted the following real estate activities from January 1 through December 31, 2015.

### SWP Acquisitions

Activities related to SWP acquisitions were as follows:

- recorded two easements and secured one encroachment permit for the 2009 National Marine Fisheries Service biological opinion for the Sherman Island Little Baja and Manzo Ranch fish release sites project;
- secured two agreements with East Bay Regional Park District and the Department of Fish and Wildlife for use of the Bureau of Reclamation fish release site for the 2009 National Marine Fisheries Service biological opinion for the Sherman Island Little Baja and Manzo Ranch fish release sites project;
- processed three payments to the Delta Ferry Authority for costs related to boat repair for the emergency drought barrier project;
- secured two encroachment permits with the city of Tracy for the South Delta salinity study;
- processed six permits for the California Irrigation Management Information System;
- secured one encroachment permit with the city of Rio Vista for the Delta Flood Emergency Preparedness, Response, and Recovery Program;
- recorded one grant deed for DWR Parcel No. SGP-85 as required for the East Branch Extension Phase I Improvements, mitigation project;
- recorded three permanent easement deeds and one Director's quitclaim deed as required for the East Branch Extension Phase II Improvements Project;
- retrieved condemnation deposit monies from the State Treasurer for the East Branch Extension and SBA, Dyer Reservoir Project;
- secured one damage agreement, one lease agreement, one easement deed, and one encroachment permit as required for the 2015 emergency drought barrier project;
- processed two license and hold harmless agreements as required for the emergency drought barrier project;
- processed payment for a landowner claim for damages as related to the emergency drought barrier project;
- secured a damage agreement with the delta ferry authority for the emergency drought barrier project;
- processed agreement for access as required for the Division of

Environmental Services, Interagency Ecology Program, delta compliance monitoring;
- completed property exchange with the Port of West Sacramento for the Decker Island and Prospect Island habitat restoration projects;
- secured the right-of-way contract for spoil site as required for the Milepost 62 canal embankment repair project;
- secured one special use permit and two access agreements as required for the Division of Operation and Maintenance (O&M) earthquake engineering project;
- secured one encroachment permit as required for the San Joaquin Fish Hatchery access and trail project;
- secured one right-of-way contract and one utility modification agreement as required for the SBA Improvement and Enlargement Project; and
- processed three payments for water monitoring compliance related to the Suisun Marsh water monitoring project.

## Temporary Entry Permits

In 2015, DWR obtained 28 temporary entry permits including:

- Bay Delta Office—South Delta salinity study, 1;
- Cantua Creek Stream Group Improvements Project,1;
- Del Valle fault survey project, 2;
- East Porterville emergency well project, 1;
- emergency drought barrier project—water information monitoring station, 1;
- emergency drought barrier project—boundary survey, 1;
- FloodSAFE Environmental Stewardship and Statewide Resources Office Delta ecosystem enhancement—levees project, 1;
- Fish Restoration Program, 1;
- Fish Restoration Program—Decker Island land management project, 2;
- Fish Restoration Program—flood systems repair project, 1;
- Perris Dam Remediation—Oak Valley mitigation project, 1;
- North Central Region Office, O&M delta operation project, 1;
- O&M—Coastal Branch maintenance, 1;
- O&M—earthquake engineering permits, 1;
- Prospect Island Restoration Project, 1;
- San Joaquin River Restoration Program, 1;
- SBA—erosion repair project, 2;
- Suisun Marsh compliance program, 1;
- South Delta Temporary Barriers Project, 2;
- Division of Environmental Services—water quality monitoring stations, 1;
- Yolo Bypass habitat restoration, 4; and
- Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project, 1.

## SWP Property Management

Property management activities during 2015 were as follows:

- managed leasing activities of SWP nonoperating properties, which produced $728,662;
- processed 44 encroachment permit applications and executed 22;
- collected fees of $217,390.50 for review and inspection costs related to encroachment permit applications; and
- coordinated review of 21 tentative tract map developments within 1 mile of the California Aqueduct.

## SWP Appraisals

In 2015, 54 percent of total appraisal assignments (27 of 50) completed by

DWR were exclusively for the SWP. These assignments included the following:

- East Branch Extension Phase I, Crafton Hills Reservoir enlargement project—completed two appraisals and three appraisal reviews;
- Cantua Creek Stream Group Improvements Project—completed five appraisals;
- Fish Restoration Program—completed four appraisals, one agricultural lease rate, and one review;
- West Sacramento Corporation Yard Agreement—completed two appraisals;
- Perris Dam seismic remediation—completed one appraisal review;
- Decker Island acquisition project—completed one appraisal;
- SWP property management—reviewed one appraisal and completed one appraisal and one license rate;
- Dutch Slough Tidal Marsh Restoration Project—completed two appraisals;
- North Bay Aqueduct—completed one review; and
- Winter Island acquisition, tidal habitat restoration—completed one appraisal.

In addition, two Architectural Revolving Fund accounts were established at the Department of General Services to finance appraisals for the Fish Restoration Program and the Perris Dam Emergency Release Facility Project.

## Table 12-1 Design Activities, 2015

| Construction Division and Facility | Design Activity | Date Design Began | Design Actual/ Estimated Completion Date |
|---|---|---|---|
| **Oroville Division** | | | |
| Oroville, Thermalito Afterbay, and Thermalito Forebay dams | Radial gate nondestructive examination of tendons study | July 2015 | December 2017 |
| Lake Oroville | Reservoir rim inspection study | November 2015 | June 2016 |
| Bidwell Canyon | Stage III boat ramp extension | June 2015 | August 2015 |
| Oroville Dam | River outlet modification | December 2013 | December 2015 |
| | Radial gates seals replacement | July 2011 | March 2015 |
| Oroville Field Division | Fire systems modernization (design review) | September 2014 | October 2015 |
| | Roofing replacement | May 2015 | November 2015 |
| Hyatt and Thermalito power plants | Fire detection system | March 2013 | June 2015 |
| Thermalito Powerplant | Bypass gate reliability | October 2013 | November 2015 |
| Thermalito Afterbay Dam | Well replacement, phase II, | June 2013 | January 2016 |
| Hyatt Powerplant, Thermalito Diversion Dam Powerplant, and Oroville Operations & Maintenance Center | Fire systems modernization | August 2013 | October 2015 |
| **Suisun Marsh Facilities** | | | |
| Montezuma Slough Control Facility | Roofing replacement | April 2014 | May 2015 |
| **Delta Facilities** | | | |
| Georgiana Slough | Salmon protection technology (preliminary design) | October 2015 | December 2015 |
| Sherman and Twitchell islands | New fish screens at existing siphons—5 sites | July 2014 | June 2015 |
| Middle River, Old River, Grant Line Canal | Temporary rock barrier | July 2015 | October 2015 |
| **North Bay Aqueduct** | | | |
| North Bay Aqueduct | Alternate intake study | October 2008 | June 2016 |
| **South Bay Aqueduct** | | | |
| Del Valle Dam | Right abutment fault phase 2 investigation study | May 2015 | September 2015 |
| **North San Joaquin Division** | | | |
| Clifton Court Forebay Dam | Stratigraphic model of foundation study | July 2014 | July 2015 |
| Delta Field Division | Byron Road bridge replacement | January 2014 | July 2016 |
| | Canal repairs (Reaches 1 and 2A) | February 2015 | May 2015 |
| | Embankment and liner repair (Milepost 62) | July 2015 | January 2016 |
| **San Luis Division** | | | |
| Sisk Dam | Seismic reevaluation | July 2007 | September 2016 |
| San Luis Field Division | Canal liner and embankment repair | February 2013 | May 2015 |
| **South San Joaquin Division** | | | |
| San Joaquin Field Division | Bridge hinge retrofit | July 2015 | January 2016 |

**Table 12-1 Design Activities, 2015** *(continued)*

| Construction Division and Facility | Design Activity | Date Design Began | Design Actual/ Estimated Completion Date |
|---|---|---|---|
| **Coastal Branch** | | | |
| Devil's Den, Bluestone, Polonio Pass pumping plants | Insulated flange repair and vault construction | December 2014 | March 2015 |
| **West Branch** | | | |
| Castaic Dam | Left abutment analysis study | November 2015 | December 2017 |
| | Tower nonlinear structural analysis study | January 2015 | February 2016 |
| Los Robles Bridge (not part of seismic program) | Seismic analysis | August 2005 | June 2015 |
| **East Branch** | | | |
| Southern Field Division | Pools 47–49 canal repair and restoration design | October 2015 | November 2015 |
| **East Branch Enlargement** | | | |
| East Branch Enlargement Phase II | Preliminary design and environmental documents | March 2007 | June 2015 |
| **Mojave Division** | | | |
| Various Sites | Replace standby emergency generators at 19 check sites, 8 pumping plants, and 2 special locations | April 2012 | May 2015 |
| **Santa Ana Division** | | | |
| Perris Dam | Emergency release facility preliminary design and environmental documents | October 2006 | July 2017 |
| **Miscellaneous** | | | |
| Oroville, Thermalito, Pyramid dams | Radial gate structural reevaluation | July 2011 | March 2015 |

## Table 12-2 Construction Activities, 2015



| Construction Division and Facility | Construction Contract (Specification Number) | Starting Date (Notice to Begin Work) | Acceptance Date (expected or actual) | Estimated Total Contract Costs (in thousands of dollars) |
|---|---|---|---|---|
| **State Water Project—General** | | | | |
| SWP Supervisory Control and Data Acquisition System | Replace remote terminal units (08-12) | May 2009 | July 2016 | 12,112 |
| California Aqueduct | Copper communications cable and voice and data equipment—monitoring, testing, and repair (13-17) | March 2014 | May 2016 | 877 |
| **Oroville Division** | | | | |
| Robie Thermalito Pumping-Generating Plant | Initial cleanup and restoration—clean and repair fire-impacted equipment (13-16) | October 2013 | July 2016 | 1,218 |
| Bidwell Bar Bridge | Repair access road erosion (14-10) | September 2014 | November 2015 | 433 |
| Oroville Dam Outlet Diversion Tunnel No. 2 | Baffle ring installation (15-11) | December 2015 | June 2016 | 2,621 |
| Bidwell Canyon Boat Ramp | Stage III boat ramp extension (15-13) | December 2015 | May 2016 | 319 |
| Hyatt Powerplant | Fire systems modernization (15-06) | October 2015 | July 2017 | 15,000 |
| Hyatt Powerplant Diversion Tunnel No. 2 | Emergency repair—video surveillance and telecommunications equipment, refurbish existing/furnish new hydraulic system components (14-07) | March 2014 | September 2015 | 5,404 |
| Feather River Fish Hatchery | Water supply pipeline repair—remove and provide surface prep to existing steel pipe and associated structures (14-01) | April 2014 | February 2015 | 356 |
| Feather River Spawning Gravel Supplementation | Spawning gravel supplementation for fish habitat enhancement (14-04) | May 2014 | February 2015 | 851 |
| **South Bay Aqueduct** | | | | |
| South Bay Aqueduct Enlargement and Improvement | | | | |
| Dyer Canal, Livermore Canal, Alameda Canal, and Del Valle Pipeline | Perform canal modifications (09-16) | October 2010 | February 2016 | 29,468 |
| South Bay Pumping Plant | Furnish four 45 cfs pump and motor units and one spare pump and motor (04-05) | November 2004 | January 2016 | 5,530 |
| | Furnish valves, actuators, and hydraulic power unit (04-20) | May 2005 | January 2016 | 2,039 |
| | Construct pumping plant enlargement—initial facilities (06-04) | August 2006 | January 2016 | 16,424 |
| | Enlarge pumping plant (07-18) | December 2007 | January 2016 | 24,436 |
| Del Valle Dam | Bulkhead installation and removal (12-14) | October 2012 | July 2016 | 76,658 |
| | Tier valve intake repairs (14-17) | October 2014 | October 2015 | 1,348 |
| **North San Joaquin Division** | | | | |
| Skinner Fish Science Building | Delta Fish Survival Improvements Program (12-15) | December 2012 | January 2016 | 6,104 |
| Clifton Court Forebay Dam | Emergency radial gate repairs (12-14) [Remaining work will finish under 13-15] | October 2012/ July 2013 | July 2015 | 1,241 |

## Table 12-2 Construction Activities, 2015



| Construction Division and Facility | Construction Contract (Specification Number) | Starting Date (Notice to Begin Work) | Acceptance Date (expected or actual) | Estimated Total Contract Costs (in thousands of dollars) |
|---|---|---|---|---|
| **North San Joaquin Division** (continued) | | | | |
| Skinner Fish Facility | Fish count and transport buckets (14-08) | June 2014 | February 2016 | 177 |
| | Emergency louver repair (12-18) [Remaining work will finish under 14-20] | October 2012/ November 2014 | September 2015 | 1,230 |
| Curtis Landing Fish Release Site | Site improvements (14-02) | March 2014 | February 2016 | 1,179 |
| **San Luis Division** | | | | |
| Mileposts 86.69–138.29 | Turnout structure modifications at 15 locations (15-03) | November 2015 | July 2016 | 714 |
| Various counties | Seal and pave roads and parking areas (13-06) | July 2013 | February 2015 | 9,251 |
| **Tehachapi Division** | | | | |
| Edmonston Pumping Plant | Replace pumps, Units W2, W4, W6, and W8 (02-10) | June 2003 | November 2015 | 36,916 |
| Chrisman and Devil's Den pumping plants | Site improvements (12-12) | December 2012 | December 2015 | 3,530 |
| Antelope Valley-East Kern Water Agency Turnout | Construct turnout (13-11) | August 2013 | May 2015 | 969 |
| **Mojave Division** | | | | |
| Milepost 335.80 | Emergency canal lining repair (15-16) | October 2015 | June 2016 | 1,052 |
| Milepost 342.65 | Pool 52 repair (13-10) | July 2013 | January 2015 | 1,333 |
| Pearblossom Pumping Plant | Construct new administration building (10-23) | February 2011 | April 2016 | 13,243 |
| **Santa Ana Division** | | | | |
| East Branch Extension Phase I Improvements | | | | |
| Crafton Hills Reservoir Enlargement | Increase operating storage of the reservoir (11-12) | December 2011 | March 2015 | 10,890 |
| East Branch Extension Phase II | | | | |
| Citrus Reservoir | Construct new reservoir (12-02) | June 2012 | February 2015 | 19,310 |
| Mentone Pipeline | Construct 5.5 miles of pipeline (12-03) | July 2012 | December 2016 | 42,729 |
| Valves | Manufacture, test, and deliver 3 energy dissipating valves for Citrus Reservoir (10-10) | September 2010 | July 2017 | 626 |
| | Manufacture, test, and deliver 14 ANSI butterfly valves for Citrus, Crafton Hills, and Cherry Valley pump stations (10-16) | January 2011 | July 2017 | 1,320 |
| | Manufacture, test, and deliver 12 AWWA butterfly valves for Crafton Hills and Cherry Valley pump stations and Mentone Pipeline (10-17) | February 2011 | July 2017 | 550 |
| | Manufacture, test, and deliver 12 ANSI ball valves for Citrus, Crafton Hills, and Cherry Valley pump stations (10-18) | January 2011 | July 2017 | 3,300 |

## Table 12-2 Construction Activities, 2015



| Construction Division and Facility | Construction Contract (Specification Number) | Starting Date (Notice to Begin Work) | Acceptance Date (expected or actual) | Estimated Total Contract Costs (in thousands of dollars) |
|---|---|---|---|---|
| **Santa Ana Division** (continued) | | | | |
| Transformers | Manufacture, test, and deliver transformers and accessories for Citrus Pump Station (10-20) | March 2011 | July 2017 | 793 |
| 5 kV switchgear | Manufacture, factory test, and commission equipment (13-12) | June 2014 | June 2017 | 5,001 |
| Crafton Hills and Citrus pump stations | Pump station expansion and initial construction (12-10) | October 2012 | July 2016 | 25,566 |
| Citrus, Crafton Hills, and Cherry Valley pump stations | Furnish equipment and hardware (13-01) | June 2013 | July 2017 | 2,144 |
| **West Branch** | | | | |
| Oso Pumping Plant | Construct civil maintenance and mobile equipment building (07-22) | December 2007 | October 2016 | 4,048 |
| Perris Dam | Seismic remediation of dam embankment (14-03) | August 2014 | March 2018 | 75,539 |
| Oak Valley—Perris Dam | Mitigation for Perris Dam seismic remediation impacts (15-01) | June 2015 | April 2017 | 2,357 |
| **Coastal Branch** | | | | |
| Kern and San Luis Obispo counties | Cathodic protection rehabilitation (13-13) [Remaining work will finish under 15-05] | September 2013 | September 2014 | 552 |
| Devil's Den, Bluestone, and Polonio Pass pumping plants | Cathodic protection rehabilitation (15-05) | September 2015 | July 2016 | 180 |
| **Multiple Divisions** | | | | |
| Temporary rock barriers, 2013, 2014, and 2015 | Installation and removal at various Delta locations (12-18) | January 2013 | March 2016 | 11,834 |
| West False River | Emergency drought barrier installation (15-04) | April 2015 | September 2015 | 13,800 |
| West False River and Rio Vista Storage Area | Emergency drought barrier removal and various work in storage area (15-08) | August 2015 | March 2016 | 14,618 |
| San Luis, San Joaquin, and Southern field divisions | Phase I seismic retrofit of bridges (14-09) | August 2014 | August 2016 | 433 |
| | Phase II seismic retrofit of bridges (14-14) | September 2014 | April 2015 | 2,794 |
| | Phase III seismic retrofit of bridges (14-13) | September 2014 | April 2015 | 2,306 |
| Edmonston, Chrisman, Teerink, and Buena Vista pumping plants | Furnish and install circuit breakers (11-10) | March 2012 | November 2015 | 2,306 |
| | Replace annunciator panels and hardware (13-09) | November 2013 | August 2015 | 809 |
| | Replace septic tanks, sewage piping, and pumps (11-04) | April 2012 | February 2015 | 1,634 |
| San Joaquin Field Division | Replace standby engine generators (14-19) | May 2015 | November 2016 | 5,000 |
| Badger Hill Pipeline | Pipeline repair (13-14) | November 2013 | June 2017 | 3,325 |
| Southern Field Division | Seal and pave roads and parking areas (14-05) | July 2014 | March 2016 | 2,715 |



# Chapter 13
# Recreation

*Low water at Lake Oroville during the fourth year of drought.*

## Significant Events in 2015

The fourth year of drought in California continued to negatively impact recreation at many State Water Project (SWP) facilities. Two Catch A Special Thrill (C.A.S.T.) for Kids events and the popular Apple Festival at Silverwood Lake were cancelled in Southern California due of the lack of water.

Despite low water levels, several reservoir draw-downs, and the start of the Perris Dam remediation project, Lake Perris remained open, and the campgrounds remained full throughout the summer. Other regional reservoirs were closed mid-summer due to low water levels.

The Department of Water Resources (DWR), along with the California Department of Parks and Recreation (California State Parks), the California Conservation Corps, and the California Department of Forestry and Fire Protection, held a third annual C.A.S.T. for Kids event at Brannan Island State Recreation Area in the Delta.

DWR supported the 2015 Independence Day celebration and fireworks show on Lake Oroville, which included a "Red, White, and You" party at the upper overlook parking lot at the south end of Oroville Dam. More than 5,000 participants attended the event, and an estimated 10,000 people watched the enhanced fireworks show, the largest in many years.

*Information for this chapter was provided by the Division of Integrated Regional Water Management, the Public Affairs Office, the Division of Environmental Services, the Division of Operations and Maintenance, and the State Water Project Analysis Office.*

The State Water Project (SWP) is a multipurpose project that provides recreational benefits to millions of Californians. In addition to providing water supply, flood control, and habitat for fish and wildlife, the SWP offers extensive and varied recreational opportunities—tours, sightseeing, fishing, hunting, picnicking, camping, boating, water skiing, bicycling, hiking, and swimming. Under the Davis-Dolwig Act (DDA), these recreational opportunities, as well as fish and wildlife enhancements, are not allocable as water and power costs to the SWP water contractors. The DDA, together with the Burns-Porter Act, provide financing for SWP recreational facilities and fish and wildlife enhancement projects, declaring that these projects benefit all the people of California and should be paid for by all Californians. The Department of Water Resources (DWR) coordinates with the California Department of Parks and Recreation (California State Parks) and the Department of Fish and Wildlife (DFW) to assure that the recreation and fish and wildlife enhancement potential at SWP facilities is fully realized.

## Recreation Areas

The SWP has 37 developed recreation areas, or sites, throughout California, including 18 developed fishing access sites. Figure 13-1 shows the name and location of each area.

## Recreation Use

Since the SWP began delivering water in 1962, more than 243 million recreation days have been recorded at SWP recreation facilities. A recreation day is defined as one individual user visiting a recreation site along the SWP within all or part of a 1-day period.

In 2015, SWP facilities supported an estimated 4.4 million recreation days of use, up 12.9 percent from the 3.9 million recorded in 2014. Most of the SWP recreation use was concentrated at the major reservoirs, with approximately 47 percent occurring in the Oroville Field Division and 38 percent occurring in the Southern Field Division.

California experienced a fourth year of significant drought in 2015, negatively impacting recreation throughout the SWP. The major reservoirs in the Southern Field Division were especially hard hit, with both low water levels and cancelled events. Silverwood Lake's popular annual Apple Festival was cancelled due to a lack of apples on the trees of the historic apple orchard. But despite the low water levels and draw-downs during dam repairs, recreation at Lake Perris remained steady throughout the year while other regional reservoirs, such as Diamond Valley Lake, were closed to recreation by mid-summer due to low water levels.

SWP facilities around the Oroville Field Division received 9 percent more recreational use than those around the Southern Field Division, the opposite of previous years when the southern reservoirs have typically received more recreational use. This may have been due to the unusually low drawn-down water levels experienced at two major southern SWP reservoirs—Castaic Lake and Lake Perris.

Visitation at DWR's three SWP educational visitors centers, in recreation days, totaled approximately 356,500. This included:

- 95,900 at Lake Oroville Visitors Center;
- 134,700 at Romero Overlook Visitors Center, San Luis Reservoir; and
- 125,900 at Vista del Lago Visitors Center, Pyramid Lake.




**Figure 13-1 Names and Locations of SWP Recreation Areas**

Overall, recreation usage of more than 4.4 million recreation days at the SWP reservoirs listed in Table 13-1 contributed significantly to the total day-use visitors reported at the 280 units of the California State Park System.

# Facilities

## Planning

### *Lake Oroville State Recreation Area*

In 2015, DWR and California State Parks planned a number of future improvements. One of these was the addition of three new floating campsites designed to accommodate users with disabilities. The new campsites are expected to be available for public use in 2017.

California State Parks plans to install 10 new shade ramadas at the South Thermalito Forebay day-use area. Additionally, installation of 1,300 feet of Class 1 trail and four shade ramadas with concrete picnic tables for visitors with disabilities are planned on the Brad Freeman Trail near North Thermalito Forebay. These improvements will enhance the visitors' experience; they will now have the opportunity to use a picnic site that can be reached by trail or by water.

California State Parks also plans to extend the existing Wyk Island Trail, a trail in the Bidwell Canyon Recreation Area designed for visitors with disabilities, by an additional 2,700 feet. And in the Spillway Recreation Area, there are plans to update the parking lot striping to accommodate users with disabilities.

DWR and California State Parks staff are also in the process of updating and improving the Lake Oroville State Recreation Area Trail Map.

### *San Luis Reservoir State Recreation Area*

The California State Parks Planning, Research and Support Section, along with local district superintendents, develops plans for future park needs and addresses issues such as removing overgrowth and improving visitor access and staff accommodations. The following planned improvements are scheduled to begin in either late 2015 or 2016, depending on funding:

- seal cracks and slurry campground roads at San Luis Creek;
- install a recirculation pump at the Basalt Water Treatment Plant; and
- replace a 30-year-old employee housing trailer.

## New Facilities

### *Lake Oroville State Recreation Area*

A DWR project to extend the Bidwell Canyon Stage 3 Boat Ramp 106 feet farther into Lake Oroville was completed in December 2015. The boat ramp extension project will now allow boat launching and retrieval on a three-lane concrete ramp down to lake elevation 665 feet (235 feet below full pool). Construction crews took advantage of near-record-low lake levels to extend the ramp to elevation 660 feet, which is 16 feet deeper into the lake than the ramp reached after initial construction in 2008–2009. Plans are to eventually extend the ramp to elevation 640 feet as lake levels allow.

The boat ramp project improves safe access to Lake Oroville for emergency responders and law enforcement, marina operators, the public, and California State Parks and DWR operations and maintenance staff during drought conditions. Aquatic habitat and cultural resource mitigation projects were also initiated in compliance with terms of the project's permit.

## Table 13-1 Estimated Recreation Days in 2015, by Field Division and Facility

| Field Division and Facility | Recreation Days (rounded) | |
|---|---|---|
| **Oroville Field Division** | | |
| Frenchman Lake | 21,000 | e |
| Antelope Lake | 35,000 | e |
| Lake Davis | 45,000 | e |
| Lake Oroville, Thermalito Diversion Pool, and Thermalito Forebay | 1,162,000 | e(2) |
| Thermalito Afterbay and Oroville Wildlife Area | 332,000 | e(2) |
| Feather River Fish Hatchery | 226,700 | e(2) |
| Lake Oroville Visitors Center | 95,900 | e(2) |
| ***Subtotal*** | ***1,917,600*** | |
| **Delta Field Division** | | |
| Lake del Valle | 535,500 | |
| Bethany Reservoir | 2,800 | e(1) |
| Fishing Access Site: | | |
| Niels Hansen | 200 | e(1) |
| California Aqueduct: | | |
| Walk-in Fishing | 200 | e(1) |
| Bikeway | 100 | e(1) |
| White Slough Wildlife Area | 13,000 | e(1) |
| ***Subtotal*** | ***551,800*** | |
| **San Luis Field Division** | | |
| San Luis Reservoir SRA: San Luis Reservoir, O'Neill Forebay, and Los Banos Reservoir | 275,300 | |
| Romero Overlook Visitors Center | 134,700 | |
| ***Subtotal*** | ***410,000*** | |
| **San Joaquin Field Division** | | |
| Fishing Access Sites: Kettleman City, Lost Hills, Buttonwillow, and California Aqueduct Walk-in Fishing | 21,800 | e(1) |
| ***Subtotal*** | 21,800 | |
| **Southern Field Division** | | |
| Silverwood Lake | 335,300 | |
| Lake Perris | 535,900 | |
| Vista del Lago Visitors Center | 125,900 | |
| Pyramid Lake | 161,300 | |
| Castaic Lake and Castaic Lagoon | 370,200 | |
| Fishing Access Sites: | | |
| Quail Lake | 1,700 | e(1) |
| Longview Road | 100 | e(1) |
| California Aqueduct: | | |
| Walk-in Fishing | 2,500 | e(1) |
| Bikeway | 4,700 | e(1) |
| ***Subtotal*** | ***1,537,600*** | |
| **Total for Recreational Sites** | **4,082,300** | |
| **Total for Visitors Centers** | **356,500** | |
| **Grand Total** | **4,438,800** | |

Note: These values are provided by facility operators and numerous other sources and vary in their degree of accuracy. Recreation days are based on counts, except those marked "e," which are based on partial data. Locations marked "e(1)" are not regularly monitored and are only visually monitored. It is likely that these areas are used significantly more than what is represented in this table, but it is difficult to ascertain a realistic annual use. Rows marked "e(2)" are estimates for locations at Lake Oroville State Recreation Area and Oroville Wildlife Area using trends in preliminary data between years 2014 and 2015. Official attendance data will be published in a March 2017 Technical Information Record, which will be submitted to FERC as part of the 2017 Biennial Record consistent with FERC Order 2100-054 requirements.

## Improvements to Facilities

### *Lake Oroville State Recreation Area*

The Bidwell Canyon Stage 3 Boat Ramp parking lot striping was redesigned to provide safer vehicle and boat-trailer parking and improve traffic flow. Additionally, the California State Parks Division of Boating and Waterways funded a new boarding float for the boat ramp.

DWR continued to work on wildfire fuel load reduction within the Loafer Creek Recreation Area, Lime Saddle Recreation Area, and the Saddle Dam area. The work involves the removal and thinning of trees, shrubs, and grasses to create a shaded fuel break.

DWR improved the swim beach at the Monument Hill Boat Ramp and Day Use Area at Thermalito Afterbay with the addition of 350 tons of sand. A chain-link fence separating the parking lot from the beach was removed to provide easier access to the beach, and picnic tables were moved to enhance access to them. The parking lot striping was also redesigned and wheel stops were added to improve traffic flow and enhance safety.

California State Parks staff rebuilt the bridge at North Thermalito Forebay near the swim beach. They also rebuilt Bidwell Canyon Bridge #1, widening it to accommodate emergency equipment and bringing the railings up to date.

California State Parks also installed a new puncheon on the Roy Rogers Trail.

### *Lake del Valle State Recreation Area*

In 2015, a total of 23 work orders were handled at Lake del Valle State Recreation Area by the East Bay Regional Park District. These included:

- replacing flooring in the camp and marina stores;
- grading the hiking trails around the facilities;
- replacing two manhole concrete collars in the campgrounds;
- repairing irrigation lines and leaking water lines to the kiosk;
- repairing a broken isolation valve for the womens' restroom in Westside Building No. 1;
- performing emergency tree work in Campsite 101 and throughout the park as a result of the drought, which has killed many of the trees that were planted when the reservoir was built; and
- installing rock around the culvert of the campground.

### *Silverwood Lake State Recreation Area*

During 2015, California State Parks completed a project at Cleghorn Day Use Area, which included walkways to picnic tables and to the lake and a new pathway. These facilities were designed and built to accommodate visitors with disablilties.

A project was started in the New Mesa Campground with an emphasis on making the facilities accessible for visitors with disabilities. This included 28 comfort stations, 3 campsites, and several parking spaces. A new fish-cleaning station was also built in the boat lot.

### *Lake Perris State Recreation Area*

California State Parks and DWR made a number of improvements to the Lake Perris State Recreation Area facilities, including:

- crack-sealing and repaving 2 miles of park roads;
- updating kiosks with new carpentry;
- initiating a new contract that added large trash cans and eliminated 1,200 smaller cans. The large cans are less likely to be affected by wind or animals, keeping the park cleaner;

- towing out several sunken boats, removing hazards to vessel navigation;
- adding 20,000 tons of sand to the swim beaches;
- replacing several navigational buoys; and
- converting an old beach snack bar into a new group picnic site.

## Recreation Activities

The SWP, with its many reservoirs and hundreds of miles of aqueducts, offers Californians extensive and varied recreational opportunities. From Antelope Lake in Northern California to Lake Perris in Southern California, the SWP includes facilities for anglers, boaters, campers, hikers, cyclists, and many others. While DWR manages the routing of water through the aqueducts and reservoirs, the recreational facilities are operated variously by federal, State, and local agencies and, in many cases, their private concessionaires. Visitors to SWP recreation facilities can swim, water ski, picnic, and enjoy many other recreational activities. See Figure 13-2 for the various types of recreation available along the SWP.

### Lake Oroville State Recreation Area

DWR, California State Parks, and other agencies sponsored a number of activities at Lake Oroville State Recreation Area in 2015.

DWR and California State Parks helped support, through a contract with the Oroville Chamber of Commerce, the annual Oroville Salmon Festival. This one-day fall event was held at the Feather River Fish Hatchery, downtown Oroville, and the Feather River Nature Center. It was attended by an estimated 22,000 participants.

A Native Ways Celebration, attended by 400 visitors, was held by California State Parks at the Lake Oroville Visitors Center.

California State Parks hosted Bidwell Bar Days at Bidwell Canyon Day Use Area's historic Toll House. The event treats park visitors to a day in the life of the old west.

Kiwanis hosted a "Hooked on Fishing, Not on Drugs" free kids' fishing day at Bedrock Park in the spring with support from DWR staff. Approximately 1,000 people attended the half-day event.

An estimated 22,000 visitors attended the annual 24 Hours of Gold Bicycle Race, which was held on the Lake Oroville trail system and based out of the Loafer Creek Campground.

California State Parks hosted the annual Frontier Christmas at the Lake Oroville Visitors Center. Visitors learned how to make pioneer crafts and pan for gold.

DWR, California State Parks, and the California Department of Forestry and Fire Protection hosted a C.A.S.T. (Catch A Special Thrill) for Kids fishing event for children with special needs. The event, which treated the children to a day of fishing on the lake, had a reported attendance of 135 people including 39 children, experienced fishermen, and volunteers.

### Lake del Valle State Recreation Area

The East Bay Regional Park District sponsored or co-sponsored the following activities at the Lake del Valle State Recreation Area in 2015:

- two Aquatic Adventure Camps, co-sponsored by DWR and the Richmond Police Athletic League, that served 82 children;
- Coastal Cleanup 2015, where 201 volunteers cleaned up the Lake del Valle shoreline by contributing 706 hours removing 1,000 pounds of trash and 3 large bags of recyclable materials;
- 31 Regional in Nature programs led by naturalists serving 348 individuals, and 52 other nature programs serving 571 individuals;

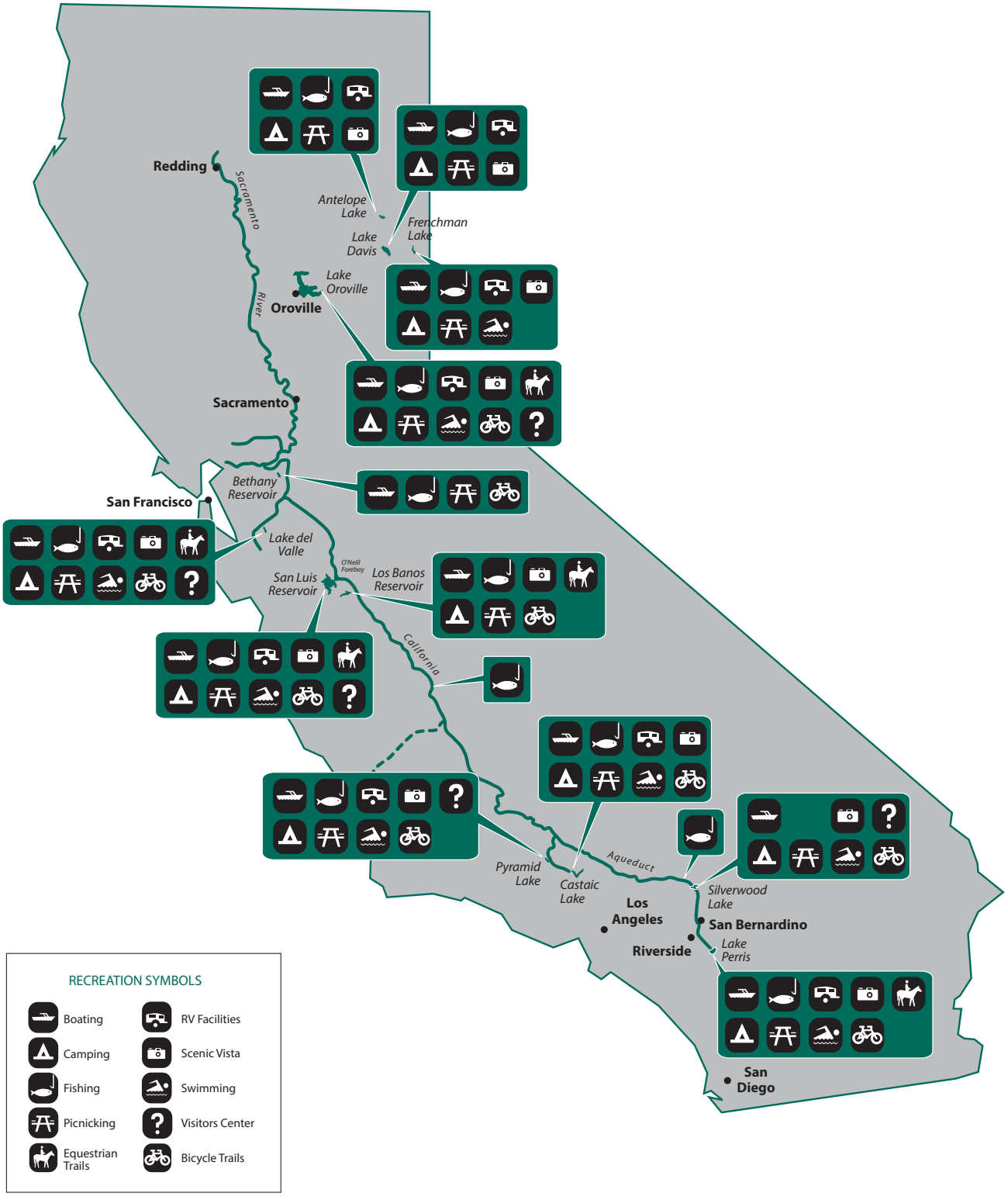



**Figure 13-2** **Types of Recreation along the SWP**

- 16 campfire programs, which served 1,934 attendees;
- 15 boat tours of Lake del Valle serving 571 attendees; and
- 119 Community Outreach Overnight Programs serving eight Youth Employment Programs, co-sponsored by the YMCA and other local agencies.

## San Luis Reservoir State Recreation Area

California State Parks sponsored the "Path of the Padres," hike funded by the Four Rivers Association. During March and April, 700 hikers were exposed to wildflowers, geology, cultural and historical areas, and Native American sites along a 35-mile trail. (As early as 1805, the Mission Padres and accompanying soldiers rested at Los Banos del Padre Arroyo, now known as Los Banos Creek.) Water conservation and the reservoir systems at Los Banos and San Luis reservoirs were discussed on a boat ride to the trailhead.

California State Park employees from San Luis Reservoir State Recreation Area set up interpretative booths and displays and provided the public with information and pamphlets at several local fairs in addition to the California State Fair. In 2015, park employees volunteered at the Merced County Fair and the River Dance Farms Fair, promoting aquatic safety and providing additional water conservation information.

DWR and its partners, including California State Parks, the California Department of Forestry and Fire Protection, the San Joaquin River Exchange Contractors Water Authority, the San Luis & Delta-Mendota Water Authority, and the Bureau of Reclamation, hosted special-needs children at a C.A.S.T. for Kids fishing event at O'Neill Forebay. Fourteen local children were treated to a day of fishing with five of the area's top Delta tournament fishermen.

California State Parks hosted the Central Valley's first Junior Lifeguard Program at San Luis Creek on O'Neill Forebay. The 3-week program provided training, activities, and education for the 16 young people that participated. The Junior Lifeguard Program provides children ages 9 to 14 with entry-level training to become a lifeguard. It promotes aquatic safety and awareness in addition to teaching skills to remain safe while performing aquatic rescues.

## Castaic Lake State Recreation Area

The County of Los Angeles Department of Parks and Recreation sponsored the following activities at Castaic Lake State Recreation Area in 2015:

- 12 "Splash in the Water" events with 875 children ages 7 to 14 who learned about water safety, kayaking, canoeing, standup paddleboarding, and sailing;
- three moonlight kayak classes in which 65 participants ages eight and older learned about the environment at Castaic Lake, the SWP, water safety, and boating safety;
- 52 standup paddleboarding classes to a total of 200 participants;
- two Junior Lifeguard Program sessions, with co-sponsorship from Teague Custom Marine, for a total of 409 participants ages 9 to 17 who learned lifeguarding, first aid, CPR, and water safety skills;
- 11 sessions of FamCamp (formerly Aquatic Adventure Camp) for 576 participants ages 17 and under, which taught boating safety, camping, and team-building principles;
- 64 drop-in kayak clinics provided to 450 participants ages 8 and up; and
- a new program offering early evening paddle sports demonstration activities open to all ages at no charge from May through September, with a total of 450 participants.

## Silverwood Lake State Recreation Area

In 2015, California State Parks sponsored the following activities at Silverwood Lake State Recreation Area:

- Bald Eagle Barge Tours for 600 park visitors on Saturdays and Sundays from January through March, where monthly eagle counts were taken;
- an Adopt-a-School program serving 125 children;
- a Coastal Cleanup Day with 75 volunteers who cleaned up the lake shoreline;
- Earth Day with approximately 100 volunteers who helped park employees install a drip irrigation line in the apple orchard and install a new ramada;
- Veterans Appreciation Day, co-sponsored by the Mojave River Natural History Association, which included a raffle and barbecue and was attended by approximately 200 participants;
- three CAPS Program days (Creative Before and After School Programs for Success, San Bernardino City Unified School District), which served 300 children per day and consisted of lake tours, nature hikes, and making animal tracks;
- 13 Campfire Programs on various park topics, hosted by California State Parks from Memorial Day through Labor Day, which were attended by an estimated 125 visitors per program throughout the summer;
- a group of church volunteers from Victorville cleared brush and repaired and painted various facilities in the Baranca Group Camp; and
- a C.A.S.T. for Kids fishing event, which paired 40 special-needs children with 30 experienced bass fishermen for a day of fishing on the lake, co-hosted by DWR.

## Lake Perris State Recreation Area

California State Parks and other agencies sponsored a number of activities at Lake Perris State Recreation Area in 2015, which included the following:

- 300 children attended outdoor education activities, including geocaching; and
- DFW helped children raise fish, which were later released into the lake.

# Oroville Recreation Plan

The Oroville Facilities, including Lake Oroville State Recreation Area, Oroville Wildlife Area, and adjacent DWR facilities, are operated in conformance with the 1993 Amended Recreation Plan that was approved by the Federal Energy Regulatory Commission (FERC) in its 1994 Order 2100-054. In 2006, DWR and its Settlement Agreement signatories submitted the Settlement Agreement Recreation Management Plan (SARMP, March 2006) for FERC approval. The approved SARMP will be implemented when the new hydropower license is issued by FERC, currently expected sometime in 2017 or later.

Additional recreation improvements identified and proposed in the SARMP are anticipated to be constructed after the new FERC license is issued. The new license terms and conditions are expected to be consistent with the proposed SARMP. In the meantime, DWR, California State Parks, and DFW—Davis-Dolwig Act (DDA) collaborating partners—continue to operate the Oroville Facilities recreation facilities consistent with the existing FERC license (renewed annually) and its associated 1993 Amended Recreation Plan.

## Fish Plantings

In 2015, DFW planted 534,300 fish in SWP reservoirs (see Table 13-2). This was 40.3 percent less fish than the 895,500 planted in 2014 and is the lowest number of fish planted in 10 years. The 4-year average for fish planted from 2012 through 2015 was 714,200. Thermalito Afterbay received 56.4 percent more steelhead trout than it received in 2014, the only SWP location to have more fish planted in 2015 than in the previous year.

## SWP Deliveries for Recreation

DWR has an agreement with California State Parks to provide onshore recreation water at several SWP facilities in an amount prorated to the yearly SWP Table A allocation. Per the 20 percent SWP Table A allocation for 2015, maximum diversion amounts under the onshore recreation agreement were allocated at 20 percent, or a total of 1,356 acre-feet (af), as follows: 550 af at San Luis Reservoir; 80 af at Lake del Valle; 466 af at Castaic Lake and Castaic Lagoon; 250 af at Lake Perris; and 10 af at Bethany Reservoir. Actual deliveries under the agreement totaled 151 af, as follows: 10 af at San Luis Reservoir; 43 af at Lake del Valle; 63 af at Castaic Lake and Castaic Lagoon; 35 af at Lake Perris; and 0 af at Bethany Reservoir. Additional SWP recreation deliveries included 36 af at Silverwood Lake and 17 af at Pyramid Lake. Details about these deliveries are provided in Chapter 9, Water Contracts and Deliveries.

## Recreation Financing

Prior to 2001, DWR reported capital costs allocated to fish and wildlife enhancement and recreation in Bulletin 132, Appendix D, *Costs of Recreation and Fish and Wildlife Enhancement*. With the passage of Senate Bill (SB) 1191 in October 2001, this report was no longer mandated by the Legislature. DWR initially began reporting recreation capital cost information in this bulletin for fiscal year 2000–2001.

The approach to financing recreation and fish and wildlife enhancement (RFWE) in connection with the SWP is provided in the DDA (California Water Code [CWC] Sections 11900–11925) and the Burns-Porter Act (CWC Section 12937). Additionally, as early as 1953, financing for RFWE was addressed in CWC Sections 233, 345, 346, 12581, and 12582. These statutes declare that recreation at the SWP is a benefit to all the people of California and that the associated costs should be borne by all Californians. While this intent is cited in the DDA, no specific appropriation or funding source was defined. Consequently, Assembly Bill (AB) 12 in 1966; SB 1268 in 1970; and the Environmental Water Act—AB 1441 and AB 1442—in 1989 were all enacted to provide the necessary State funding for this SWP purpose. The DDA does, however, explicitly preclude DWR from including RFWE costs in the SWP charges for water and power billed to the public water agencies contracting for SWP water supply.

The Legislature has intermittently appropriated monies to meet State obligations to fund RFWE at the SWP. AB 12 appropriated $5 million per year to DWR from $90 million in tidelands oil and gas revenues. By the early 1980s, DWR had expended the entire $90 million toward funding SWP RFWE obligations. SB 1268 appropriated $55 million to California State Parks and $5 million to DFW specifically for their responsibilities under the DDA at SWP facilities. Finally, AB 1442 appropriated $172 million to reimburse DWR for SWP RFWE costs incurred over the previous 12 years as an offset to DWR's California Water Fund repayment, and an additional $30 million for SWP RFWE through 1994.

In 2012, the DDA was amended to continuously appropriate $10 million per

**Table 13-2 Fish Planted by the Department of Fish and Wildlife in 2015 (thousands)[a]**

| Location and Size | Eagle Lake Trout | Brook Trout | Rainbow Trout | Chinook Salmon | Steelhead Trout | Kokanee Salmon | Total for Lake |
|---|---|---|---|---|---|---|---|
| **Antelope Lake** | | | | | | | |
| Subcatchable | 10.1 | | | | | | |
| Catchable | | 7.3 | 9.5 | | | | 26.9 |
| **Lake Davis** | | | | | | | |
| Fingerling | 99.2 | | | | | | 99.2 |
| **Frenchman Lake** | | | | | | | |
| Subcatchable | 119.9 | | | | | | 119.9 |
| **Lake Oroville** | | | | | | | |
| Catchable | | | | 139.4 | | | 139.4 |
| **Thermalito Afterbay** | | | | | | | |
| Yearling | | | | | 17.2 | | 17.2 |
| **Lake del Valle** | | | | | | | |
| Catchable | | | 14.0 | | | | 14.0 |
| **Los Banos Reservoir** | | | | | | | |
| Catchable | | | 11.8 | | | | 11.8 |
| **Pyramid Lake** | | | | | | | |
| Catchable | | | 19.4 | | | | 19.4 |
| **Castaic Lake** | | | | | | | |
| Catchable | | | 53.2 | | | | 53.2 |
| **Silverwood Lake** | | | | | | | |
| Catchable | | | 13.7 | | | | |
| Super Catchable | | | 12.1 | | | | 25.8 |
| **Lake Perris** | | | | | | | |
| Catchable | | | 7.5 | | | | 7.5 |
| **Total** | **229.2** | **7.3** | **141.2** | **139.4** | **17.2** | **0.0** | **534.3** |

[a] Information provided by DFW, using the following size classes: yearling = a maximum of 20.0 fish per pound; fingerling = 16.1 fish per pound or smaller; subcatchable = between 16.0 and 6.1 fish per pound; catchable = between 6.0 and 1.0 fish per pound; supercatchable = larger than 1.0 fish per pound and up to 0.34 fish per pound; and trophy = 0.33 fish per pound or larger (or greater than 2.99 pounds per fish).

year to DWR. The funding was sourced from the Harbors and Watercraft Revolving Fund that is funded by fuel taxes at marinas statewide; this continuous SWP RFWE funding is essentially a user-funded source. Of the $10 million, $2.5 million per year is for past unreimbursed SWP RFWE costs incurred by DWR through December 31, 2011, and the remaining $7.5 million per year is primarily intended to fund DWR's ongoing annual joint SWP RFWE costs that are generated through DWR's statutory mandate to allocate SWP costs to their respective purposes, including RFWE. These joint costs are those for facilities such as dams, which were constructed to provide multiple benefits such as flood control, water supply, power generation, and RFWE. DWR is required to determine and allocate shares of such facilities to all of the respective purposes. Moreover, the DDA prohibits SWP RFWE purpose costs from being included in charges for water and power to SWP customers, so

the 2012 amendment filled a long-standing shortfall in SWP RFWE funding.

The 2012 DDA amendment was the result of several years of close, cooperative solution development that involved the Natural Resources Agency, the Department of Finance, the Legislative Analyst's Office, legislative staff, DWR, and many of DWR's long-term SWP water contractors.

As another part of the cooperative solution to the long-standing DDA funding difficulties, DWR reexamined the joint RFWE allocation for SWP transportation facilities located south of Dos Amigos Pumping Plant, and beginning January 1, 2013, made revisions to the RFWE allocations described in Table 2 of Appendix B (located at the end of this bulletin).

## Capital Cost Allocations

Table 13-3 shows capital costs allocated to RFWE and overall costs of lands acquired for recreation development through 2015. Total capital costs increased by $11,750,775 over those reported in Bulletin 132-15 due to an increase of $11,342,303 in 2015, and an upward adjustment of $408,472 in years prior to 2015. The increase in 2015 included $10,904,126 in joint costs and $438,177 in specific costs. These costs are budgeted by DWR from funds available for financing project construction costs. Recreation and enhancement costs not reported in this table are budgeted by several State departments and are financed by appropriations from a variety of funds.

## Table 13-3 Recreation and Enhancement Capital Costs of the State Water Project (in dollars)

| Facility | Joint Costs Allocated to Recreation and Enhancement | | | Specific Costs Allocated to Recreation and Enhancement | | | Total |
|---|---|---|---|---|---|---|---|
| | 1952–2014 Updated | 2015 | Subtotal | 1952–2014 Updated | 2015 | Subtotal | |
| Frenchman Dam and Lake (78.5%)[a] | | | | | | | |
| California Water Resources Development Bond Fund | 102,997 | 0 | 102,997 | 3,379 | 0 | 3,379 | 106,376 |
| All Other Funds | 2,719,924 | 0 | 2,719,924 | 49,950 | 0 | 49,950 | 2,769,874 |
| Antelope Dam and Lake (100%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 1,033,261 | 0 | 1,033,261 | 3,167 | 0 | 3,167 | 1,036,428 |
| All Other Funds | 4,626,085 | 0 | 4,626,085 | 201,137 | 0 | 201,137 | 4,827,222 |
| Grizzly Valley Dam and Lake Davis (99.0%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 4,003,092 | 0 | 4,003,092 | 204,475 | 0 | 204,475 | 4,207,567 |
| All Other Funds | 4,170,913 | 20,285 | 4,191,198 | 554,246 | 0 | 554,246 | 4,745,444 |
| Other Feather River Projects (100%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 0 | 0 | 0 | 9 | 0 | 9 | 9 |
| All Other Funds | 746,174 | 0 | 746,174 | 9,921 | 0 | 9,921 | 756,095 |
| Delta Facilities (3.4%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| All Other Funds | 14,124,573 | 426,759 | 14,551,332 | 0 | 0 | 0 | 14,551,332 |
| San Luis Dam and Reservoir, O'Neill Forebay, and Los Banos Reservoir (3.4%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 988,910 | 0 | 988,910 | 395,284 | 0 | 395,284 | 1,384,194 |
| All Other Funds | 4,944,927 | (214,958) | 4,729,969 | 867,243 | 0 | 867,243 | 5,597,212 |
| California Aqueduct, Delta to Dos Amigos Pumping Plant (3.4%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 4,467,667 | 0 | 4,467,667 | 422,681 | 0 | 422,681 | 4,890,348 |
| All Other Funds | 5,826,611 | 362,778 | 6,189,389 | (91,879) | 0 | (91,879) | 6,097,510 |
| Oroville Division (2.9%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 5,725,216 | 0 | 5,725,216 | 7,809,509 | 0 | 7,809,509 | 13,534,725 |
| All Other Funds | 6,932,453 | 138,281 | 7,070,734 | 6,021,441 | 313,940 | 6,335,381 | 13,406,115 |
| Del Valle Dam and Lake del Valle (48.0%)[a] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 10,546,762 | 0 | 10,546,762 | 519,425 | 0 | 519,425 | 11,066,187 |
| All Other Funds | 4,382,165 | 9,353 | 4,391,518 | (32,202) | 0 | (32,202) | 4,359,316 |
| California Aqueduct, Dos Amigos Pumping Plant to Termini (0.4%–32.3%)[a, b] | | | | | | | 0 |
| California Water Resources Development Bond Fund | 48,382,162 | 0 | 48,382,162 | 3,880,547 | 0 | 3,880,547 | 52,262,709 |
| All Other Funds | 98,473,493 | 10,161,628 | 108,635,121 | 6,942,795 | 124,237 | 7,067,032 | 115,702,153 |
| **Total** | **222,197,385** | **10,904,126** | **233,101,511** | **27,761,128** | **438,177** | **28,199,305** | **261,300,816** |

[a] Percentages are the share of joint costs.

[b] Specific costs for Dos Amigos Pumping Plant to Termini include $2,905,649 for Castaic Dam and Lake, $795,130 for Cedar Springs Dam and Silverwood Lake, $6,348,741 for Perris Dam and Lake Perris, and $898,059 for the California Aqueduct.



# Chapter 14
# Financial Analysis

*Pyramid Lake and Dam.*

## Significant Events in 2015

On September 2, the Department of Water Resources (DWR) delivered $109.275 million of Water System Revenue Bonds, Series AU. The proceeds were presold on August 25 to refinance commercial paper and pay bond financing costs.

*Information for this chapter was provided by the State Water Project Analysis Office in conjunction with the Division of Fiscal Services.*

This chapter presents both a summary and a detailed explanation of the State Water Project's (SWP) current financial analysis, capital costs and requirements, revenues and expenses, and bond activities for years 2015 through 2025.

The Department of Water Resources (DWR) performs a financial analysis annually to ensure the SWP financing program will have sufficient funds to meet construction obligations; project operation, maintenance, power, and replacement costs; and debt service payments for bonds expended for construction. The results of the current financial analysis, dated December 31, 2015, are presented in Tables 14-1 and 14-2, located at the end of this chapter. (Please note that, in some instances, the tables and text figures in this chapter may not sum as expected due to rounding.)

Future contingencies may change the financial analysis, some of which include:

- alterations in schedules of currently planned construction for future facilities;
- changes in economic conditions, including changes in interest rates and in SWP water contractor Table A amounts due to changes in amounts of water needed, conserved, or reclaimed;
- development of additional sources of water not foreseen at this time;
- deviations from the assumptions regarding actual rates of price escalations for future construction from those currently assumed for cost estimates;
- increases in capital costs related to additional conservation facilities; and
- outcome of lawsuits now pending before the courts.

## Capital Requirements and Financing

In conducting the current financial analysis, DWR projected future construction costs through the year 2025 including reimbursement of $123 million interim financing for prior expenditures will total $1.16 billion. Special capital requirements for revenue bond financing of these construction costs are projected at $87 million for a total capital requirement of $1.25 billion. This projection includes construction and financing costs for the following significant SWP projects planned for completion by 2025:

- Perris Dam remediation;
- Phase II enlargement of the East Branch of the California Aqueduct;
- Phase II of the East Branch Extension; and
- a new intake to the North Bay Aqueduct.

Most of these capital requirements will be financed from the projected sale of $1.2 billion of revenue bonds. SWP water contractors will directly be paying $2.6 million. The remaining $45 million of the total capital requirement of $1.25 billion will be financed from capital resources revenues and the transfer of excess revenues not needed for operation costs or debt service.

The analysis of capital requirements and financing presented in Table 14-1 does not include the costs and financing of all facilities needed to develop the remaining yield necessary to meet the

total 4.2 million acre-foot contractual commitment to long-term SWP water contractors. Table 14-1 also excludes the costs of associated facilities financed and constructed by local interests or State agencies other than DWR. Those facilities are essential for realizing full benefits from the SWP and include on-shore recreational developments at SWP facilities and local distribution facilities.

The allocation of capital expenditures for various SWP purposes is detailed in Table 14-3.

## Capital Requirements

Lines 1 through 20 in Table 14-1 show actual and projected SWP capital requirements through 2025. Estimates of future capital expenditures include allowances for construction cost escalation of 5 percent per year from 2016 through 2025. Right-of-way costs are escalated at 4 percent per year from 2016 through 2025. Capital expenditures for the SWP also include requirements other than those for construction, such as disbursements made as part of the Davis-Grunsky Act Program (Line 16) and special capital requirements under revenue bond financing (Line 17). DWR will decide whether to construct facilities only after examining alternatives and completing environmental documentation and other review processes.

*Line 1, Initial Project Facilities*, includes only those facilities completed in the initial construction program, which concluded December 31, 1973 (see Bulletin 132-74, Chapter 2). Additional costs after 1973, and estimated costs of remaining work on the initial SWP facilities, are not included.

*Line 2, North Bay Aqueduct*, consists of the costs for Phase II, improvements, and the Alternate Intake Project. Operational in May 1988, Phase II connected with the Phase I facilities, which were completed in 1968 (Phase I costs are included in the initial project facilities discussed in Line 1). Phase II included costs for pipelines, pumping plants, and a small reservoir necessary to divert water from the western Delta to Napa and Solano counties for urban use. The improvements consist of replacing the existing tank with two 5-million gallon tanks. Construction of the new tanks began in 2007 and was completed in 2010. The Alternate Intake Project includes a new point of diversion along the Sacramento River or its tributaries, a new pumping plant, an in-line storage tank, and an underground pipeline connection to the existing North Bay Aqueduct. The project is expected to be completed in 2025.

*Line 3, Delta and Suisun Marsh Facilities*, shows historical costs that include planning for general Delta facilities and the previously planned peripheral canal and overland water delivery facilities for the western Delta. Also included are historical planning costs for Suisun Marsh as well as construction costs for the Suisun Marsh Salinity Control Gates and an access road. The projected amounts include projected planning costs plus projected costs for fish screens at Sherman and Twitchell islands.

*Line 4, Final Four Units at Banks Pumping Plant*, includes costs of the final four 1,067 cubic feet per second units, which became operational in spring 1992.

*Line 5, Coastal Branch Aqueduct*, includes all costs for the planning, design, and construction of Phase II of the Coastal Branch of the California Aqueduct. Phase II construction began in October 1993 and was completed in 1997. Water deliveries from Phase II facilities began in July 1997.

*Line 6, West Branch Aqueduct*, shows costs for all facilities on the West Branch except Warne Powerplant. Those costs are included in Line 11.

## Table 14-3 Allocation of Capital Expenditures (in thousands of dollars)

| Facilities and Construction Divisions | Expenditures Incurred Through 2015 | Future Expenditures | Total | Preliminary Allocation Among Project Purposes | | | |
|---|---|---|---|---|---|---|---|
| | | | | Water Supply and Power Generation | Flood Control[a] | Recreation and Fish and Wildlife Enhancement | Other[b] |
| **Project Construction Expenditures** | | | | | | | |
| Upper Feather Division | 20,233 | 0 | 20,233 | 1,784 | 0 | 18,449 | 0 |
| Oroville Division (excludes Small Hydro) | 830,317 | 262,830 | 1,093,148 | 994,501 | 71,690 | 26,957 | 0 |
| Delta Facilities Division | 458,926 | 294,769 | 753,695 | 721,752 | 0 | 31,944 | 0 |
| North Bay Aqueduct | 120,069 | 2,630 | 122,700 | 122,700 | 0 | 0 | 0 |
| South Bay Aqueduct | 404,053 | 8,530 | 412,582 | 388,856 | 8,301 | 15,425 | 0 |
| California Aqueduct | | | | | | | |
| North San Joaquin Division | 316,349 | 39,412 | 355,761 | 343,438 | 0 | 12,323 | 0 |
| San Luis Division | 321,709 | 53,115 | 374,824 | 360,318 | 0 | 14,506 | 0 |
| South San Joaquin Division | 342,796 | 35,212 | 378,008 | 360,162 | 0 | 17,845 | 0 |
| Tehachapi Division | 383,022 | 24,997 | 408,019 | 387,132 | 0 | 20,888 | 0 |
| Mojave Division (excludes Small Hydro) | 378,774 | 13,148 | 391,922 | 351,837 | 0 | 40,084 | 0 |
| Santa Ana Division | 357,309 | 93,367 | 450,676 | 378,915 | 0 | 71,761 | 0 |
| West Branch | 568,778 | 25,436 | 594,214 | 559,912 | 0 | 34,302 | 0 |
| Coastal Branch | 499,549 | 12,253 | 511,802 | 511,802 | 0 | 0 | 0 |
| *Subtotal, California Aqueduct* | *3,168,285* | *296,940* | *3,465,225* | *3,253,516* | *0* | *211,709* | *0* |
| Other Project Facilities | | | | | | | |
| Small Hydroelectric Power | | | | | | | |
| Generating Facilities | 100,066 | 0 | 100,066 | 100,066 | 0 | 0 | 0 |
| Off-Aqueduct Power | | | | | | | |
| Generating Facilities | 491,574 | 110,600 | 602,174 | 602,174 | 0 | 0 | 0 |
| East Branch Enlargement | 462,031 | 0 | 462,031 | 462,031 | 0 | 0 | 0 |
| East Branch Extension | 360,775 | 49,804 | 410,580 | 410,580 | 0 | 0 | 0 |
| Coastal Power Allocation | 30,708 | 0 | 30,708 | 30,708 | 0 | 0 | 0 |
| Agricultural Drainage Facilities | 86,471 | 18,566 | 105,037 | 0 | 0 | 0 | 105,037 |
| Planning and Pre-operations | 76,542 | 30,000 | 106,542 | 106,542 | 0 | 0 | 0 |
| Unassigned/Miscellaneous | 54,685 | (33,435) | 21,250 | 0 | 0 | 0 | 21,250 |
| *Subtotal, Project Construction Expenditures* | *6,664,737* | *1,041,235* | *7,705,971* | *7,195,210* | *79,990* | *304,484* | *126,287* |
| **Other Capital Requirements** | | | | | | | |
| Davis-Grunsky Act Program | 130,000 | 0 | 130,000 | 0 | 0 | 0 | 130,000 |
| **Total Capital Expenditures** | **6,794,737** | **1,041,235** | **7,835,971** | **7,195,210** | **79,990** | **304,484** | **256,287** |

[a] Reflects DWR's allocation to this purpose irrespective of federal payments.
[b] Includes costs currently unassigned to purpose, planning costs of deleted features of project facilities, initial costs of inventoried items, and costs assigned to the Davis-Grunsky Act Program.

*Line 7, East Branch Enlargement*, includes expenditures for Phases I and II of the East Branch Enlargement. Phase I included the enlargement share of power plant costs at Mojave Siphon and Devil Canyon. (The remaining power plant costs are included in Line 11.) East Branch Enlargement costs for Phase I, by facility, are presented in Table 14-4. Costs for Alamo Powerplant consist of expenditures for Unit 1 facilities allocated to enlargement.

Work on the draft environmental impact report, mapping, and conceptual design for Phase II of the enlargement began in March 2007 and ceased in 2013 at the request of the participating contractors. Project costs include raising the canal embankment and concrete lining, constructing additional siphon barrels, adding bays to check structures, constructing Unit 2 at Alamo Powerplant, and adding two pump/motor units and a discharge line at Pearblossom Pumping Plant. Construction of Unit 2 at Alamo Powerplant is expected to be completed in 2023, all other Phase II construction has been postponed indefinitely.

All costs in Line 7 are allocated to and repaid by the seven Southern California contractors participating in the East Branch Enlargement.

*Line 8, East Branch Improvements*, shows all aqueduct costs on the East Branch not allocated to the enlargement project. Those costs include improvements constructed concurrently with the enlargement work, the reconstruction of the San Bernardino Tunnel Intake, and the construction of the Tehachapi East Afterbay. Costs for power plant construction at Alamo, Mojave Siphon, and Devil Canyon are not included in this line.

*Line 9, East Branch Extension*, shows expenditures for Phases I and II of the extension of the East Branch of the California Aqueduct. The East Branch Extension extends the California Aqueduct east from the Devil Canyon Powerplant to a terminus at Noble Creek near Beaumont in Riverside County. The extension provides water service to the San Gorgonio Pass Water Agency and the San Bernardino Valley Municipal Water District. Construction of Phase I began in February 1999 and was completed in 2003. Phase I improvements include enlargement of the Crafton Hills Reservoir and construction of the Yucaipa Connector Pipeline. Construction of this phase was completed in 2014. Phase II will increase the pumping capacity to 100 percent of design capacity. Construction of Phase II began in 2012 and is scheduled to be completed in 2017. All costs in Line 9 will be allocated to and repaid by the two participating contractors.

*Line 10, South Bay Aqueduct Improvements and Enlargement*, shows expenditures for providing additional capacity required to meet increases in water demands for the service area of Alameda County Flood Control and Water Conservation District, Zone 7, and increasing the existing capacity of the SBA to its original design capacity. Construction began in 2006, and overall project work was completed in 2014.

*Line 11, Power Generation and Transmission Facilities*, does not include the East Branch Enlargement share of costs for Alamo, Mojave Siphon, and Devil Canyon powerplants shown in Line 7 of Table 14-1. The capital costs for facilities included in Line 11 are shown in Table 14-5.

*Line 12, Additional Conservation Facilities*, shows projected costs to plan and study additional conservation facilities. Specific planning activities and projected spending amounts for 2016 through 2025 are shown in Table 14-6. Expenditures for these items are being reviewed. Construction costs of additional conservation facilities are not included in the financial analysis.

Line 12 does not include the Bay Delta Conservation Plan costs. DWR's share of the

**Table 14-4 East Branch Enlargement Phase I Capital Costs by Facility**

| Facility | Amount (in millions of dollars) |
|---|---|
| Aqueduct and Siphons | 128.1 |
| Pearblossom Pumping Plant | 70.1 |
| Alamo Powerplant | 5.0 |
| Mojave Siphon Powerplant | 47.3 |
| Devil Canyon Powerplant and Second Afterbay | 202.9 |
| **Total** | **453.4** |

**Table 14-5 Estimated Capital Costs for Power Generation and Transmission Facilities**

| Power Plants and Transmission Lines | Amount (in millions of dollars) |
|---|---|
| **Power Plants** | |
| Reid Gardner, Unit 4 | 314.2 |
| Bottle Rock | 120.9 |
| South Geysers | 49.6 |
| Devil Canyon | 36.8 |
| Warne | 84.5 |
| Alamo | 44.9 |
| Mojave Siphon | 41.1 |
| Hyatt | 46.2 |
| Robie Thermalito | 113.5 |
| *Subtotal* | *851.6* |
| **Transmission Lines** | |
| Midway–Wheeler Ridge | 10.7 |
| Geysers–Lakeville | 6.9 |
| *Subtotal* | *17.6* |
| **Total** | **869.2** |

**Table 14-6 Estimated Future Costs for Planning Additional Conservation Facilities**

| Activity | Amount (in millions of dollars) |
|---|---|
| SWP Future Water Supply | 30.0 |
| Other Planning Costs | 0.0 |
| **Total** | **30.0** |

Bay Delta Conservation Plan expenditures for preliminary planning and environmental impact report preparation are currently financed by participating contractors.

*Line 13, Agricultural Drainage Facilities*, includes projected costs of the Agricultural Drainage Program. The activities in this program are monitoring, evaluating, reducing, and treating drainage, as well as investigating treatment and reuse of drainage water.

DWR assumes that future costs of the drainage program will be financed by revenue transfers (Line 37).

*Line 14, Other Costs*, includes items such as general design and construction costs, costs of completing operation and maintenance facilities, and costs of other completion activities for the initial facilities of the California Aqueduct. Portions of those costs ultimately will be allocated to California Aqueduct units described in the preceding paragraphs.

*Line 15, Total Project Construction Expenditures*, is the total of Lines 1 through 14.

*Line 16, Davis-Grunsky Act Program Costs*, shows costs of the Davis-Grunsky Act Program, a financial assistance program to provide grants and loans to public agencies for constructing local water projects.

As of December 31, 2015, DWR had disbursed $130 million (including $8.5 million for administration) in grants and loans to local agencies throughout the State.

*Line 17, Special Capital Requirements Under Revenue Bond Financing*, presents special capital requirements at the time revenue bonds are sold. The financial analysis assumes that proceeds from any future revenue bonds will be used to pay for bond discounts, bond issuance costs, and debt service reserve requirements.

Information about the application of proceeds to these special requirements for actual and assumed revenue bond sales is presented in Table 14-7.

*Line 18, Total Capital Requirements*, is the total of Lines 15, 16, and 17.

*Line 19, Power Facilities Capital Requirements*, shows the total capital requirements for power facilities included in Line 18.

*Line 20, Water Facilities Capital Requirements*, shows the total capital requirements for water facilities included in Line 18.

## Capital Financing

The SWP was constructed using three general types of financing: Burns-Porter Act, revenue bonds, and capital resources. Lines 21 through 37 of Table 14-1 present specific information about these financing sources.

### *Burns-Porter Act*

Burns-Porter Act financing is derived from the sale of California Water Resources Development Bonds (general obligation bonds) and State tideland oil revenues deposited in the California Water Fund as authorized by the Burns-Porter Act (California Water Code Sections 12930–12944), approved by voters in November 1960. The Burns-Porter Act authorized an issuance of $1.75 billion of general obligation State bonds, which are repaid by revenues received according to the water supply contracts. Of that authorization, $130 million was reserved specifically for the Davis-Grunsky Act Program.

Proceeds from the sale of general obligation bonds were deposited in the California Water Resources Development Bond Fund—Bond Proceeds Account, from which monies were

## Table 14-7 Application of Revenue Bond Proceeds (in millions of dollars)

| Bond Series[a] | Construction Expenditures | Other Capital Requirements | | | | | Total Principal Amount of Bonds |
|---|---|---|---|---|---|---|---|
| | | Reimbursement of General Fund | Capitalized Interest | Capitalized Operating Costs | Bond Financing and Refunding Costs[b] | Subtotal | |
| Oroville | 218.0 | 2.6 | 19.9 | 1.5 | 3.0 | 27.0 | 245.0 |
| Devil Canyon-Castaic | 126.4 | 0.0 | 10.0 | 0.7 | 2.1 | 12.8 | 139.2 |
| Pyramid Series A | 74.0 | 0.0 | 19.2 | 1.0 | 1.6 | 21.8 | 95.8 |
| Reid Gardner Series B | 146.1 | 0.0 | 41.9 | 0.0 | 12.0 | 53.9 | 200.0 |
| Reid Gardner Series C | 91.1 | 0.0 | 17.9 | 7.9 | 8.1 | 33.9 | 125.0 |
| Small Hydro-South Geysers Series D | 49.6 | 0.0 | 19.9 | 0.0 | 5.5 | 25.4 | 75.0 |
| Bottle Rock Series E | 96.9 | 0.0 | 22.0 | 3.7 | 2.4 | 28.1 | 125.0 |
| Alamo-South Geysers Series F | 59.1 | 0.0 | 14.2 | 0.0 | 1.7 | 15.9 | 75.0 |
| Reid Gardner Series G | 1.6 | 0.0 | 0.0 | 0.0 | 237.9 | 237.9 | 239.5 |
| Power Facilities Series H | 22.2 | 0.0 | 0.0 | 0.0 | 184.5 | 184.5 | 206.7 |
| East Branch Enlargement Series A | 108.3 | 0.0 | 12.6 | 0.0 | 11.1 | 23.7 | 132.0 |
| Water System Facilities Series B | 97.4 | 0.0 | 0.0 | 0.0 | 2.6 | 2.6 | 100.0 |
| Water System Facilities Series C | 0.6 | 0.0 | 0.0 | 0.0 | 8.4 | 8.4 | 9.0 |
| Water System Facilities Series D | 95.9 | 0.0 | 2.9 | 0.0 | 1.2 | 4.1 | 100.0 |
| Water System Facilities Series E | 0.4 | 0.0 | 0.0 | 0.0 | 8.6 | 8.6 | 9.0 |
| Water System Facilities Series F | 0.0 | 0.0 | 0.0 | 0.0 | 160.0 | 160.0 | 160.0 |
| Water System Facilities Series G | 86.8 | 0.0 | 4.6 | 0.0 | 8.6 | 13.2 | 100.0 |
| Water System Facilities Series H | 85.5 | 0.0 | 5.7 | 0.0 | 8.8 | 14.5 | 100.0 |
| Water System Facilities Series I | 158.9 | 0.0 | 5.8 | 0.0 | 15.3 | 21.1 | 180.0 |
| Water System Facilities Series J | 0.0 | 0.0 | 0.0 | 0.0 | 649.8 | 649.8 | 649.8 |
| Water System Facilities Series K | 88.6 | 0.0 | 3.1 | 0.0 | 8.3 | 11.4 | 100.0 |
| Water System Facilities Series L | 0.0 | 0.0 | 0.0 | 0.0 | 537.8 | 537.8 | 537.8 |
| Water System Facilities Series M | 166.3 | 0.0 | 9.9 | 0.0 | 13.8 | 23.7 | 190.0 |
| Water System Facilities Series N | 137.4 | 0.0 | 6.0 | 0.0 | 8.6 | 14.6 | 152.0 |
| Water System Facilities Series O | 156.5 | 0.0 | 8.4 | 0.0 | 170.1 | 178.5 | 335.0 |
| Water System Facilities Series P | 141.6 | 0.0 | 5.2 | 0.0 | 13.2 | 18.4 | 160.0 |
| Water System Facilities Series Q | 135.0 | 0.0 | 8.0 | 0.0 | 123.6 | 131.6 | 266.6 |
| Water System Facilities Series R | 0.0 | 0.0 | 0.0 | 0.0 | 20.7 | 20.7 | 20.7 |
| Water System Facilities Series S | 78.2 | 0.0 | 5.8 | 0.0 | 116.2 | 122.0 | 200.2 |
| Water System Facilities Series T | 0.0 | 0.0 | 0.0 | 0.0 | 135.7 | 135.7 | 135.7 |
| Water System Facilities Series U | 98.7 | 0.0 | 5.3 | 0.0 | 103.2 | 108.5 | 207.2 |
| Water System Facilities Series V | 0.0 | 0.0 | 0.0 | 0.0 | 20.6 | 20.6 | 20.6 |
| Water System Facilities Series W | 41.0 | 0.0 | 1.3 | 0.0 | 218.7 | 220.0 | 261.0 |
| Water System Facilities Series X | 0.0 | 0.0 | 0.0 | 0.0 | 160.2 | 160.2 | 160.2 |
| Water System Facilities Series Y | 0.0 | 0.0 | 0.0 | 0.0 | 329.9 | 329.9 | 329.9 |
| Water System Facilities Series Z | 0.0 | 0.0 | 0.0 | 0.0 | 170.7 | 170.7 | 170.7 |
| Water System Facilities Series AA | 0.0 | 0.0 | 0.0 | 0.0 | 108.7 | 108.7 | 108.7 |
| Water System Facilities Series AB | 92.2 | 0.0 | 3.9 | 0.0 | 93.6 | 97.5 | 189.7 |
| Water System Facilities Series AC | 13.7 | 0.0 | 0.6 | 0.0 | 257.7 | 258.3 | 272.0 |
| Water System Facilities Series AD | 12.4 | 0.0 | 0.9 | 0.0 | 99.1 | 100.0 | 112.4 |
| Water System Facilities Series AE | 383.9 | 0.0 | 9.5 | 0.0 | 239.5 | 249.0 | 632.9 |
| Water System Facilities Series AF | 33.4 | 0.0 | 1.3 | 0.0 | 253.1 | 254.4 | 287.7 |
| Water System Facilities Series AG | 9.9 | 0.0 | 0.4 | 0.0 | 158.8 | 159.2 | 169.1 |
| Water System Facilities Series AH | 71.7 | 0.0 | 3.6 | 0.0 | 22.3 | 26.0 | 97.7 |
| Water System Facilities Series AI | 0.0 | 0.0 | 0.0 | 0.0 | 92.3 | 92.3 | 92.3 |

**Table 14-7 Application of Revenue Bond Proceeds (in millions of dollars)** *(continued)*

| Bond Series[a] | Construction Expenditures | Other Capital Requirements | | | | | Total Principal Amount of Bonds |
|---|---|---|---|---|---|---|---|
| | | Reimbursement of General Fund | Capitalized Interest | Capitalized Operating Costs | Bond Financing and Refunding Costs[b] | Subtotal | |
| Water System Facilities Series AJ | 69.3 | 0.0 | 3.7 | 0.0 | 143.9 | 147.6 | 216.9 |
| Water System Facilities Series AK | 32.0 | 0.0 | 0.9 | 0.0 | 3.4 | 4.3 | 36.3 |
| Water System Facilities Series AL | 0.0 | 0.0 | 0.0 | 0.0 | 105.9 | 105.9 | 105.9 |
| Water System Facilities Series AM | 0.0 | 0.0 | 0.0 | 0.0 | 184.0 | 184.0 | 184.0 |
| Water System Facilities Series AN | 44.8 | 0.0 | 0.3 | 0.0 | 4.4 | 4.7 | 49.5 |
| Water System Facilities Series AO | 0.0 | 0.0 | 0.0 | 0.0 | 317.5 | 317.5 | 317.5 |
| Water System Facilities Series AP | 47.7 | 0.0 | 1.2 | 0.0 | (3.5) | (2.4) | 45.3 |
| Water System Facilities Series AQ | 122.6 | 0.0 | 7.2 | 0.0 | (9.6) | (2.4) | 120.2 |
| Water System Facilities Series AR | 168.1 | 0.0 | 5.4 | 0.0 | (12.1) | (6.7) | 161.4 |
| Water System Facilities Series AS | 0.0 | 0.0 | 0.0 | 0.0 | 645.8 | 645.8 | 645.8 |
| Water System Facilities Series AT | 139.5 | 0.0 | 5.9 | 0.0 | 3.9 | 9.8 | 149.2 |
| Water System Facilities Series AU | 104.6 | 0.0 | 3.4 | 0.0 | 1.3 | 4.7 | 109.3 |
| *Subtotal* | *3,907.9* | *2.6* | *297.9* | *14.8* | *6,194.4* | *6,509.7* | *10,417.5*[c] |
| Future East Branch Enlargement Bonds | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Future East Branch Extension Bonds | 34.9 | 0.0 | 1.9 | 0.0 | 2.5 | 4.4 | 39.3 |
| Future SBA Enlargement Bonds | 4.7 | 0.0 | 0.2 | 0.0 | 0.2 | 0.4 | 5.0 |
| Future Water System Facilities Bonds | 1,073.0 | 0.0 | 36.0 | 0.0 | 45.9 | 81.9 | 1,154.9 |
| **Total** | **5,020.5** | **2.6** | **336.0** | **14.8** | **6,243.0** | **6,596.3** | **11,616.8** |

[a] Actual bond issue for all except future East Branch Enlargement, future East Branch Extension, future South Bay Aqueduct Improvements and Enlargement, and future Water System Facilities bonds.
[b] Bond financing and refunding costs include funds applied to debt service reserve requirements.
[c] Includes $5,911.2 million of refunded principal, leaving a net principal obligation of $4,506.4 million.

expended only for the construction of SWP facilities and for the Davis-Grunsky Act Program. Approximately 24 percent of the expenditures through 2015 for construction and the Davis-Grunsky Act Program were financed with general obligation bonds.

Monies deposited in the California Water Fund were appropriated for purposes outlined in the Burns-Porter Act. Such deposits were derived from a portion of the State tideland oil revenues, in accordance with a continuing authorization. The California Water Fund was used to finance $508 million, or approximately 7 percent, of the construction expenditures through 2015.

## Revenue Bonds

Revenue bond financing is derived from the sale of revenue bonds as authorized by the Central Valley Project Act (California Water Code Sections 11100–11925). DWR's authority to issue revenue bonds was confirmed by a decision of the California Supreme Court in 1963 (*Warne v. Harkness*, 60 Cal. 2d 579).

Proceeds from the sale of revenue bonds are deposited in the Central Valley Water Project Construction Fund, from which money is expended only for purposes specified in the resolution authorizing each bond sale. Those purposes, in addition to paying construction, planning, and right-of-way costs, may include funding the Debt Service Reserve Account, paying interest on bonds, and paying water system operating expenses during a specified period.

As of December 31, 2015, DWR had sold $10.4 billion of revenue bonds. That amount includes $5.9 billion of refunded bonds, leaving a total principal obligation of $4.5 billion.

### *Capital Resources*

Capital resources financing is derived from payments and appropriations (including a portion of the State tideland oil revenues) authorized by a variety of special contracts, cost-sharing agreements, and legislative actions concerning the SWP, plus accrued interest on these funds. Capital resources revenues are deposited in the Central Valley Water Project Construction Fund and may be expended for interest on general obligation bonds and costs of constructing SWP facilities.

According to DWR's financial management policy, the capital resources revenues are used first to cover any general obligation bond debt service that exceeds available revenues.

## Capital Financing Sources

Capital financing sources include power revenue bonds, East Branch Enlargement bonds, East Branch Extension bonds, SBA Enlargement bonds, water system facilities bonds, initial project facilities bonds, bond proceeds from the Davis-Grunsky Act Program, California Water Fund monies, and capital resources revenues.

*Line 21, Power Facilities Revenue Bonds through Series H*, includes the proceeds applied from power revenue bonds for Oroville, Devil Canyon, Castaic, Warne, Reid Gardner, Bottle Rock, Alamo, South Geysers, and small hydro projects.

No future power revenue bond sales are projected for this financial analysis.

*Line 22, East Branch Enlargement, Current Bonds*, shows that $482 million of Water System Revenue Bond proceeds has been applied to the East Branch Enlargement project through December 31, 2015. Of this total, $424 million was used for construction expenditures and $58 million was used for bond discounts, interest costs, and debt service reserve requirements.

*Line 23, East Branch Enlargement, Future Bonds*, shows no projected bond sales for this financial analysis.

*Line 24, East Branch Extension, Current Bonds*, shows that $383 million of Water System Revenue Bond proceeds has been spent through December 31, 2015.

*Line 25, East Branch Extension, Future Bonds*, shows DWR's estimate of $39 million of additional bonds required to complete construction of the East Branch Extension and to pay for bond discounts, capitalized interest, and debt service reserve requirements.

*Line 26, South Bay Aqueduct Enlargement, Current Bonds*, shows that $219 million of Water System Revenue Bond proceeds had been spent through December 31, 2015.

*Line 27, South Bay Aqueduct Enlargement, Future Bonds*, shows DWR's estimate of $5 million of additional bonds required to complete construction of the SBA Enlargement and to pay for bond discounts, capitalized interest, and debt service reserve requirements.

*Line 28, Water System Facilities, Current Bonds*, shows that through December 31, 2015, $2.2 billion of proceeds from Water System Revenue Bonds, Series A through Series AU, was applied to SWP projects other than the East Branch Enlargement, the East Branch Extension, and the SBA Enlargement. Of this total, $2.0 billion was used to pay for construction expenditures and $0.2 billion was used to pay for bond discounts, capitalized interest, and debt service reserve requirements.

*Line 29, Water System Facilities, Future Bonds*, shows that $1.2 billion of future water revenue bonds is needed to provide $1.1 billion for construction of SWP water system facilities and $0.1 billion for bond discounts, interest costs, and debt service reserve requirements.

*Line 30, Subtotal, Water System Revenue Bonds*, is the total of Lines 22 through 29.

*Line 31, Initial Project Facilities Bond Proceeds*, shows the amount of general obligation bonds sold to provide financing costs for initial SWP facilities and for costs of planning certain additional conservation facilities.

Financing initial facilities from general obligation bonds was completed in mid-1972 and totaled $1.444 billion—$1.750 billion Burns-Porter Act authorization less $130 million reserved for the Davis-Grunsky Act Program and $176 million "offset" for additional conservation facilities. (The Burns-Porter Act provides that to the extent California Water Fund monies are expended, an equal amount of general obligation bonds are reserved [offset] for financing the construction of additional conservation facilities in certain watersheds.)

In mid-1972, the reservation of offset bonds was effectively limited to $176 million, the total amount of California Water Fund monies expended up to that time. By mid-1972, all general obligation bonds authorized by the Burns-Porter Act had been offset, reserved for the Davis-Grunsky Act Program, or used for SWP construction.

Approximately $8.5 million of the offset bonds was used to finance planning studies of the Middle Fork Eel River Development. This financial analysis is not based on the use of any offset bond proceeds to meet capital requirements. If, at some time, the State constructs an additional conservation facility, as specified in California Water Code Section 12938, the remaining offset bonds could be sold.

*Line 32, Davis-Grunsky Act Program Bond Proceeds*, shows, for simplification, the entire $130 million of capital expenditures authorized for the Davis-Grunsky Act Program, according to the Burns-Porter Act, as being funded by proceeds from the sale of general obligation bonds. In fact, $102 million originated from bond proceeds while $28 million from the California Water Fund was used for the program in lieu of bond proceeds prior to 1969. Since the final offset in 1994, DWR has accumulated $44.6 million in capital costs through fiscal year 2006–2007.

*Line 33, Application of California Water Fund Monies*, shows the amount of SWP costs financed under the Burns-Porter Act. The act provides that any available money in the California Water Fund must be used for construction in lieu of proceeds from the sale of general obligation bonds.

When the Burns-Porter Act became effective in late 1960, approximately $97 million had been accumulated in the fund. That balance, plus subsequent appropriations, interest earnings, and other miscellaneous income to the fund through December 31, 2015, was used to finance a total of $508 million of SWP costs.

*Line 34, Interim Financing*, shows the net annual amounts of funds flowing into and out of the Water Revenue Commercial Paper Notes program. This program was established in March 1993 to provide an ongoing source of interim financing for water system projects prior to permanent financing from the sale of long-term revenue bonds. DWR has authority to issue up to $150 million of Water Revenue Commercial Paper Notes. A positive number indicates money borrowed from the program to finance construction costs. A negative number indicates money repaid to the program. The financial analysis assumes that all funds borrowed from the program will be repaid before the end of the analysis period.

*Line 35, Direct Pay*, shows the revenues received directly from the contractors rather than financing through bonds for certain SWP project construction expenditures. At this time, the North Bay Aqueduct Alternate Intake is funded this way.

*Line 36, Application of Capital Resources Revenues to Construction*, presents the Capital Resources Revenues applied for capital expenditures.

*Line 37, Revenue Transfers Applied*, shows monies assumed to be transferred to the California Water Fund, according to provisions of the Burns-Porter Act, and subsequently reappropriated to construction (see Line 40 of Table 14-2). Projected amounts for the years 2016 through 2025 include funds to finance expenditures for agricultural drainage facilities, as indicated in Line 13 of Table 14-1, and expenditures for additional conservation facilities, as indicated in Line 12.

*Line 38, Subtotal, Other Capital Financing*, is the total of Lines 31 through 37.

*Line 39, Total Financing of Capital Requirements*, totals Lines 21, 30, and 38.

# Annual Revenues and Expenditures

After financial analysis of SWP operations, DWR concluded that projected payments by contractors and other revenues will be adequate to pay annual operations, maintenance, power, and replacement (OMP&R) costs and meet all repayment obligations on funds used to finance SWP construction and other authorized costs during the period 2016 through 2025. Data on annual revenues and expenditures are presented in Table 14-2. A detailed discussion of each line item follows.

## Project Revenues

Project revenues primarily consist of SWP water contractor payments required under their individual long-term water supply contracts. Those revenues are deposited in two funds: the Central Valley Water Project Revenue Fund, where all revenues pledged to revenue bonds are placed, and the California Water Resources Development Bond Fund—Systems Revenue Account, where all other SWP operating revenues are placed. Use of those funds is limited to paying operating costs and debt service; except that revenues in excess of those costs may be deposited to a reserve for future SWP construction, since the California Water Fund has been repaid (see Line 39).

*Line 1, Capital Resources Revenues*, includes the following:

- federal payments for SWP capital expenditures;
- appropriations for capital costs allocated to recreation;
- appropriations for SWP capital expenditures prior to passage of the Burns-Porter Act and according to Senate Bill 261 (1968);
- payments from Los Angeles Department of Water and Power for Castaic power development;
- advances from contractors for construction of requested work;
- investment earnings on the Capital Resources Account; and
- investment earnings on unexpended revenue bond proceeds.

Historically, appropriations for capital costs allocated to recreation and fish and wildlife enhancement amounted to $5 million per year and were appropriated by the California Legislature from the State tideland oil revenues. There have been no appropriations from this fund since 1985.

Legislation enacted in 1989 offset a portion of the amount owed to the SWP by the State for costs allocated to recreation and fish and wildlife enhancement against the amount the SWP owed to the California Water Fund (see Line 39). Since the final offset in 1994, DWR has accumulated $68.3 million in capital costs through December 31, 2015.

In 2012, the Davis-Dolwig Act was amended to appropriate $10 million per fiscal year from the Harbors and Watercraft Revolving Fund to cover a portion of the OMP&R and capital costs allocated to recreation and fish and wildlife enhancement. Starting in fiscal year 2012–2013, $7.5 million is being appropriated for on-going OMP&R and capital costs and $2.5 million is being appropriated to reimburse for past unreimbursed OMP&R and capital costs.

*Lines 2 through 12, Water Contractor Payments*, show amounts of the separate elements of water contractor payments.

Amounts in Line 4 also include revenues sufficient to cover costs associated with sales of excess power. Appendix B of this bulletin presents a detailed explanation of payments identified in Lines 2 through 12.

OMP&R costs are repaid as they are incurred as part of the Transportation Charge; therefore, no interest charges are included. Construction costs included in the Transportation Charge, and all construction and annual OMP&R costs included in the Delta Water Charge, are to be repaid with interest at the Project Interest Rate.

The Project Interest Rate, as defined in Article 1(r) of the standard provisions of the long-term water supply contracts, is the weighted average of the rates paid on certain securities issued and loans obtained to finance SWP facilities.

According to the original water supply contract provisions, the basis for determining the Project Interest Rate was the weighted average of rates paid on general obligation bond sales only. In 1969, after Oroville Revenue Bonds were issued, the contracts were amended to expand the basis to include rates on all other securities sold and loans obtained thereafter for financing SWP facilities, including revenue bonds (see Bulletin 132-70, page 28).

However, not all proceeds from the sale of revenue bonds are melded into the calculation of the Project Interest Rate. Only those proceeds applied to construction costs (the only application of general obligation bonds permitted by law) and those consumed by the bond discount (a component of the total interest cost of a revenue bond issue) are included in the calculation (see Table 14-8).

Calculations for determining the Project Interest Rate do not include proceeds from the sale of revenue bonds for Off-Aqueduct Power facilities, the East Branch Enlargement facilities, SBA, or water system facilities defined in the Water Revenue Bond Amendment. Table 14-9 lists all bond sales by date and presents basic information used in the calculation of the Project Interest Rate.

Information about contractor water charges in Appendix B, which can be found in the back of this bulletin, is based on known conditions and substantiates DWR's determination of 2017 water charges to be billed on July 1, 2016. However, information about significant differences between the sum of future charges included in Lines 2 through 12 of Table 14-2 and the substantiation of 2016 charges included in Appendix B are as follows.

- Future capital costs in Appendix B are based on the prevailing prices as of December 31, 2015. Those costs presented in the financial analysis include allowances for price escalation.
- Pre-2016 charges in Appendix B represent charges as they should have been, according to currently known conditions. Pre-2016 charges included in Table 14-2 are those actually paid as part of previously determined bills.
- Charges in Appendix B are unadjusted for past overpayments or underpayments. Charges included in Table 14-2 for 2016 and thereafter have been adjusted for any apparent overpayments or underpayments of pre-2016 charges.

## Table 14-8 Revenue Bond Proceeds Affecting Project Interest Rate (in millions of dollars)

| Project | Proceeds Included in Project Interest Rate | | | | Total Principal Amount of Bonds | Percentage of Total Amount Included in Calculating Project Interest Rate [4] / [5] |
|---|---|---|---|---|---|---|
| | Applied to Construction Costs | Less Portion of Proceeds Derived from Interest Earnings Prior to Delivery of Bonds | Plus Bond Financing and Refunding Costs | Subtotal, Proceeds Included in Calculating Project Interest Rate [1] - [2] + [3] | | |
| | [1] | [2] | [3] | [4] | [5] | [6] |
| Devil Canyon-Castaic Project Revenue Bonds | 125.3 | 1.5 | 1.4 | 125.2 | 139.2 | 90 |
| Pyramid Project Revenue Bonds (Series A) | 71.2 | 0.5 | 1.1 | 71.8 | 95.8 | 75 |
| Alamo Project Bond Anticipation Note | 16.8 | 0.1 | 0.3 | 17.0 | 24.4 | 70 |
| Small Hydro Project I Revenue Bonds (Series D) | 25.4 | 0.2 | 1.5 | 26.7 | 37.5 | 71 |
| Alamo Project Revenue Bonds (Series F) | 38.9 | 0.3 | 0.7 | 39.3 | 50.0 | 79 |
| Power Facilities Revenue Bonds (Series H) | | | | | | |
| Pyramid Project | 5.0 | 0.0 | 0.1 | 5.1 | 5.1 | 100 |
| Alamo Project | 1.7 | 0.0 | 0.0 | 1.7 | 1.7 | 100 |
| Small Hydro Project I | 25.2[a] | 0.2 | 0.4 | 25.4 | 35.6 | 71 |
| Water System Revenue Bonds (Series J) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 75.9[b] | 75.9 | 99.2[b] | 77 |
| Alamo Project | 0.0 | 0.0 | 45.6[b] | 45.6 | 57.1[b] | 80 |
| Small Hydro Project I | 0.0 | 0.0 | 27.8[b] | 27.8 | 38.8[b] | 72 |
| Water System Revenue Bonds (Series L) | | | | | | |
| Small Hydro Project I | 0.0 | 0.0 | 1.5[b] | 1.5 | 2.1[b] | 71 |
| Water System Revenue Bonds (Series Q) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 3.0[b] | 3.0 | 3.9[b] | 77 |
| Alamo Project | 0.0 | 0.0 | 4.8[b] | 4.8 | 6.0[b] | 80 |
| Water System Revenue Bonds (Series S) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 8.0[b] | 8.0 | 10.4[b] | 77 |
| Alamo Project | 0.0 | 0.0 | 7.6[b] | 7.6 | 9.5[b] | 80 |
| Water System Revenue Bonds (Series U) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 2.4[b] | 2.4 | 3.2[b] | 75 |
| Alamo Project | 0.0 | 0.0 | 3.2[b] | 3.2 | 4.0[b] | 80 |
| Water System Revenue Bonds (Series W) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 27.7[b] | 27.7 | 36.0[b] | 77 |
| Alamo Project | 0.0 | 0.0 | 11.8[b] | 11.8 | 14.7[b] | 80 |
| Small Hydro Project (construction) | 3.4 | 0.0 | 0.0 | 3.4 | 3.7 | 92 |
| Small Hydro Project (refunding) | 0.0 | 0.0 | 16.3[b] | 16.3 | 22.7[b] | 72 |
| Water System Revenue Bonds (Series X) | | | | | | |
| Pyramid Project | 0.0 | 0.0 | 8.5[b] | 8.5 | 11.0[b] | 77 |
| Alamo Project (Series H refunding) | 0.0 | 0.0 | 0.3[b] | 0.3 | 0.3[b] | 100 |
| Alamo Project (Series F refunding) | 0.0 | 0.0 | 3.9[b] | 3.9 | 4.9[b] | 79 |
| Small Hydro Project | 0.0 | 0.0 | 4.6[b] | 4.6 | 6.4[b] | 72 |

[a] Amount consists of 71 percent of proceeds deposited in escrow to refund portion of Series D bonds ($35.1 million plus deposits to construction account [$0.3 million]).
[b] Represents amount of principal used to refund portions of prior bond issues.

**Table 14-9 Actual Bond Sales and Project Interest Rates, by Date of Sale**

| Bond Sales | Date of Sale | Delivery Date | Dollar-Years[a] (thousands) | Interest Cost (thousands) | Issue Interest Rate[b] (percent) | Project Interest Rate[c] (percent) |
|---|---|---|---|---|---|---|
| $ 50,000,000 Bond Anticipation Notes | 11/21/63 | 11/21/63 | 26,944 | 531 | 1.971 | 1.971 |
| $100,000,000 Series A Water Bonds | 2/18/64 | 2/18/64 | 3,402,000 | 119,750 | 3.520 | 3.508 |
| $ 50,000,000 Series B Water Bonds | 5/5/64 | 5/5/64 | 1,726,000 | 60,986 | 3.533 | 3.516 |
| $100,000,000 Series C Water Bonds | 10/7/64 | 10/7/64 | 3,452,000 | 123,764 | 3.585 | 3.544 |
| $100,000,000 Series D Water Bonds | 2/16/65 | 2/16/65 | 3,497,900 | 122,403 | 3.499 | 3.531 |
| $100,000,000 Series E Water Bonds | 11/23/65 | 11/23/65 | 3,497,900 | 130,029 | 3.717 | 3.573 |
| $100,000,000 Series F Water Bonds | 6/8/66 | 6/8/66 | 3,497,900 | 137,359 | 3.927 | 3.638 |
| $100,000,000 Series G Water Bonds | 11/22/66 | 11/22/66 | 3,497,900 | 143,788 | 4.111 | 3.711 |
| $100,000,000 Series H Water Bonds | 3/21/67 | 3/21/67 | 3,497,900 | 129,261 | 3.695 | 3.709 |
| $100,000,000 Series J Water Bonds | 7/18/67 | 7/18/67 | 3,497,900 | 143,199 | 4.094 | 3.754 |
| $100,000,000 Series K Water Bonds | 11/14/67 | 11/14/67 | 3,497,900 | 163,887 | 4.685 | 3.853 |
| $150,000,000 Revenue Bonds, Oroville Division, Series A | 4/3/68 | 4/3/68 | 5,228,700 | 270,289 | 5.169 | |
| $100,000,000 Series L Water Bonds | 7/11/68 | 7/11/68 | 3,497,900 | 166,918 | 4.772 | 3.941 |
| $100,000,000 Series M Water Bonds | 10/22/68 | 10/22/68 | 3,497,900 | 169,989 | 4.860 | 4.021 |
| $ 94,995,000 Revenue Bonds, Oroville Division, Series B | 4/1/69 | 4/1/69 | 3,423,460 | 195,902 | 5.722 | |
| $ 46,761,000 Cumulative 1970 General Fund Borrowing, repaid 7/10/70 | - | | 4,938 | 346 | 7.007 | |
| $200,000,000 Series N and P Bond Anticipation Notes | 6/16/70 | 6/16/70 | 200,000 | 11,660 | 5.830 | 4.030 |
| $100,000,000 Series N Water Bonds | 2/2/71 | 2/2/71 | 3,447,900 | 190,292 | 5.519 | 4.148 |
| $100,000,000 Series Q Bond Anticipation Notes | 3/10/71 | 3/10/71 | 100,000 | 2,349 | 2.349 | 4.143 |
| $100,000,000 Series P Water Bonds | 4/21/71 | 4/21/71 | 3,397,900 | 193,377 | 5.691 | 4.255 |
| $150,000,000 Series Q and R Water Bonds | 11/9/71 | 11/9/71 | 5,171,850 | 265,734 | 5.138 | 4.342 |
| $ 40,000,000 Series S Water Bonds | 3/28/72 | 3/28/72 | 1,399,160 | 76,509 | 5.468 | 4.371 |
| $139,165,000 Devil Canyon-Castaic Revenue Bonds | 8/8/72 | 8/8/72 | 4,776,204 | 258,839 | 5.419 | 4.457 |
| $ 10,000,000 Series T Water Bonds | 3/20/73 | 3/20/73 | 185,265 | 9,491 | 5.123 | 4.459 |
| $ 10,000,000 Series U Water Bonds | 1/13/76 | 1/13/76 | 158,750 | 8,731 | 5.500 | 4.462 |
| $ 10,000,000 Series V Water Bonds | 11/15/77 | 11/15/77 | 158,750 | 7,573 | 4.770 | 4.462 |
| $ 95,800,000 Pyramid Hydroelectric Revenue Bonds | 10/23/79 | 10/23/79 | 2,260,072 | 172,495 | 7.632 | 4.584 |
| $150,000,000 Reid Gardner Project, Series A Bond Anticipation Notes | 7/1/81 | 7/1/81 | 347,906 | 29,572 | 8.500 | |
| $ 75,600,000 Bottle Rock Project, Bond Anticipation Notes | 12/1/81 | 12/1/81 | 264,600 | 25,137 | 9.500 | |
| $ 24,400,000 Alamo Project, Bond Anticipation Notes | 12/1/81 | 12/1/81 | 24,266 | 2,305 | 9.499 | 4.589 |
| $200,000,000 Reid Gardner Project, Series B Revenue Bonds | 7/7/82 | 7/7/82 | 4,623,137 | 553,793 | 11.979 | |
| $125,000,000 Reid Gardner Project, Series C Revenue Bonds | 11/16/82 | 11/16/82 | 2,720,045 | 255,744 | 9.402 | |
| $ 37,500,000 Small Hydro Project I, Series D Revenue Bonds | 11/16/82 | 11/16/82 | 837,769 | 84,587 | 10.097 | 4.666 |
| $ 37,500,000 South Geysers Project, Series D Revenue Bonds | 11/16/82 | 11/16/82 | 930,325 | 90,021 | 9.676 | |
| $125,000,000 Bottle Rock Project, Series E Revenue Bonds | 4/27/83 | 4/27/83 | 2,624,805 | 225,102 | 8.576 | |
| $ 50,000,000 Alamo Project, Series F Revenue Bonds | 4/27/83 | 4/27/83 | 1,190,763 | 100,836 | 8.468 | 4.727 |
| $ 25,000,000 South Geysers Project, Series F Revenue Bonds | 4/27/83 | 4/27/83 | 608,550 | 52,578 | 8.640 | |
| $239,505,000 Reid Gardner Project, Series G Revenue Bonds | 3/15/85 | 3/15/85 | 4,524,136 | 425,840 | 9.413 | |
| $206,690,000 Power Facilities Series H Revenue Bonds | 6/20/86 | 6/20/86 | 4,430,520 | 347,745 | 7.849 | 4.713 |
| $132,000,000 East Branch Enlarg., Series A Water System Revenue Bonds | 7/15/86 | 7/15/86 | 3,427,165 | 254,915 | 7.438 | |
| $100,000,000 Series B Water System Revenue Bonds | 5/5/87 | 5/5/87 | 2,564,012 | 194,817 | 7.598 | |
| $ 9,000,000 Series C Water System Revenue Bonds | 12/1/87 | 12/1/87 | 324,000 | 31,995 | 9.875 | |
| $100,000,000 Series D Water System Revenue Bonds | 6/14/88 | 6/14/88 | 2,640,510 | 201,253 | 7.622 | |
| $ 9,000,000 Series E Water System Revenue Bonds | 11/29/88 | 12/5/88 | 324,000 | 31,995 | 9.875 | |
| $160,030,000 Series F Water System Revenue Bonds | 3/15/89 | 4/20/89 | 2,779,838 | 189,261 | 6.808 | |
| $100,000,000 Series G Water System Revenue Bonds | 3/6/90 | 3/6/90 | 2,434,175 | 172,277 | 7.077 | |
| $100,000,000 Series H Water System Revenue Bonds | 1/10/91 | 1/10/91 | 2,459,172 | 168,857 | 6.866 | |

## Table 14-9 Actual Bond Sales and Project Interest Rates, by Date of Sale

| Bond Sales | Date of Sale | Delivery Date | Dollar-Years[a] (thousands) | Interest Cost (thousands) | Issue Interest Rate[b] (percent) | Project Interest Rate[c] (percent) |
|---|---|---|---|---|---|---|
| $180,000,000 Series I Water System Revenue Bonds | 5/14/91 | 5/14/91 | 4,366,680 | 294,090 | 6.735 | |
| $649,835,000 Series J Water System Revenue Bonds | 1/16/92 | 1/28/92 | 12,422,222 | 745,198 | 5.999 | |
| $100,000,000 Series K Water System Revenue Bonds | 5/12/92 | 6/4/92 | 2,366,783 | 147,064 | 6.214 | |
| $ 9,000,000 Series W Water Bonds | 8/19/92 | 8/19/92 | 95,250 | 6,172 | 6.480 | 4.621 |
| $537,830,000 Series L Water System Revenue Bonds | 5/19/93 | 6/2/93 | 11,414,859 | 640,518 | 5.611 | 4.620 |
| $ 2,000,000 Series X Water Bonds | 9/1/93 | 9/1/93 | 26,000 | 1,247 | 4.796 | 4.621 |
| $ 1,400,000 Series Y Water Bonds | 11/30/94 | 11/30/94 | 19,483 | 1,249 | 6.411 | |
| $190,000,000 Series M Water System Revenue Bonds | 12/9/93 | 12/21/93 | 3,911,846 | 194,981 | 4.984 | |
| $152,000,000 Series N Water System Revenue Bonds | 3/3/95 | 3/14/95 | 2,241,606 | 122,658 | 5.472 | |
| $335,000,000 Series O Water System Revenue Bonds | 12/5/95 | 12/20/95 | 7,528,890 | 375,667 | 4.990 | |
| $160,000,000 Series P Water System Revenue Bonds | 5/7/96 | 5/22/96 | 3,553,823 | 204,524 | 5.755 | |
| $266,630,000 Series Q Water System Revenue Bonds | 11/5/96 | 12/4/96 | 5,481,815 | 299,846 | 5.470 | 4.620 |
| $ 20,700,000 Series R Water System Revenue Bonds | 3/10/97 | 3/12/97 | 564,125 | 36,627 | 6.493 | |
| $200,205,000 Series S Water System Revenue Bonds | 7/30/97 | 8/13/97 | 4,093,110 | 203,755 | 4.978 | 4.615 |
| $135,665,000 Series T Water System Revenue Bonds | 7/30/97 | 3/4/98 | 1,310,620 | 66,942 | 5.108 | |
| $207,180,000 Series U Water System Revenue Bonds | 11/19/98 | 12/1/98 | 4,032,075 | 200,758 | 4.979 | |
| $ 20,580,000 Series V Water System Revenue Bonds | 11/19/98 | 12/1/98 | 525,100 | 32,819 | 6.250 | |
| $260,995,000 Series W Water System Revenue Bonds | 5/1/01 | 5/17/01 | 3,659,312 | 195,822 | 5.351 | 4.613 |
| $160,225,000 Series X Water System Revenue Bonds | 5/1/02 | 6/4/02 | 2,732,785 | 139,109 | 5.090 | 4.610 |
| $329,885,000 Series Y Water System Revenue Bonds | 7/25/02 | 3/5/03 | 4,422,973 | 222,654 | 5.034 | |
| $170,655,000 Series Z Water System Revenue Bonds | 10/1/02 | 10/16/02 | 1,706,132 | 75,696 | 4.437 | |
| $108,705,000 Series AA Water System Revenue Bonds | 10/4/02 | 3/5/03 | 2,114,341 | 104,220 | 4.929 | |
| $189,625,000 Series AB Water System Revenue Bonds | 3/9/04 | 3/18/04 | 4,344,942 | 173,788 | 4.000 | |
| $272,070,000 Series AC Water System Revenue Bonds | 12/15/04 | 1/6/05 | 4,479,436 | 209,150 | 4.669 | |
| $112,390,000 Series AD Water System Revenue Bonds | 6/14/05 | 7/7/05 | 1,827,449 | 90,461 | 4.950 | 4.608 |
| $632,890,000 Series AE Water System Revenue Bonds | 4/23/08 | 5/1/08 | 8,884,000 | 436,216 | 4.910 | |
| $287,735,000 Series AF Water System Revenue Bonds | 3/11/09 | 3/19/09 | 2,980,895 | 431,199 | 14.465 | |
| $169,115,000 Series AG Water System Revenue Bonds | 11/17/09 | 12/2/09 | 2,907,605 | 311,889 | 10.727 | |
| $ 97,675,000 Series AH Water System Revenue Bonds | 10/27/10 | 11/9/10 | 1,432,014 | 72,176 | 5.040 | 4.610 |
| $ 92,275,000 Series AI Water System Revenue Bonds | 10/27/10 | 9/7/11 | 698,716 | 34,936 | 5.000 | |
| $216,930,000 Series AJ Water System Revenue Bonds | 10/6/11 | 10/13/11 | 2,080,429 | 100,663 | 4.839 | |
| $ 36,370,000 Series AK Water System Revenue Bonds | 2/28/12 | 3/13/12 | 495,566 | 23,466 | 4.735 | |
| $105,875,000 Series AL Water System Revenue Bonds | 2/28/12 | 9/5/12 | 739,447 | 36,972 | 5.000 | |
| $183,960,000 Series AM Water System Revenue Bonds | 2/28/12 | 3/5/13 | 1,440,539 | 72,027 | 5.000 | |
| $ 49,525,000 Series AN Water System Revenue Bonds | 9/19/12 | 9/27/12 | 646,489 | 31,783 | 4.916 | |
| $317,505,000 Series AO Water System Revenue Bonds | 9/19/12 | 9/27/12 | 2,830,185 | 71,219 | 2.516 | |
| $45,340,000 Series AP Water System Revenue Bonds | 3/12/13 | 3/26/13 | 621,111 | 25,008 | 4.026 | |
| $120,205,000 Series AQ Water System Revenue Bonds | 5/21/13 | 6/18/13 | 2,120,496 | 85,993 | 4.055 | |
| $161,445,000 Series AR Water System Revenue Bonds | 2/25/14 | 3/6/14 | 2,126,626 | 91,827 | 4.318 | |
| $645,795,000 Series AS Water System Revenue Bonds | 9/30/14 | 10/30/14 | 7,285,936 | 363,246 | 4.986 | |
| $149,245,000 Series AT Water System Revenue Bonds[d] | 10/29/14 | 11/6/14 | 2,784,834 | 83,541 | 3.000 | |
| $109,275,000 Series AU Water System Revenue Bonds[d] | 8/25/15 | 9/2/15 | 1,946,180 | 40,285 | 2.070 | |
| **Total** | | | **241,343,414** | **13,811,541** | | |
| **Portion allocated to Project Interest Rate** | | | **63,903,487** | **2,945,789** | **4.610** | **4.610** |

[a] A unit equivalent to one dollar of principal amount outstanding for one year.

[b] The total interest rate (without regard to discounts paid or to premiums received) divided by the total dollar-years, expressed as a percent.

[c] Cumulative interest costs divided by cumulative dollar-years, expressed as a percent. (Excluding Oroville Division bonds and revenue bonds for Off-Aqueduct Power Facilities, East Branch Enlargement Facilities, East Branch Extension Facilities, Water System Facilities as defined in the Water Revenue Bond Amendment, Coastal Extension Facilities, or South Bay Aqueduct Enlargement Facilities.)

[d] Variable rate issue. Assumed an interest rate. Actual interest cost and rate will vary.

- Charges in Appendix B for East Branch Enlargement costs include the amounts for debt service and 25 percent cover for the East Branch Enlargement share of the Series A through Series AU bonds. Charges in Table 14-2 apply to Series A through Series AU bonds and also include amounts of the debt service and cover for assumed future bonds.
- The water revenue bond surcharge in Appendix B applies only to the Series B through Series AU bonds. Surcharge values included in Table 14-2 apply to Series B through Series AU bonds and to assumed future issues required to finance SWP construction costs included in Table 14-1.

*Line 13, Subtotal, Water Contractor Payments*, is the total of Lines 2 through 12.

*Line 14, Revenue Bond Cover Adjustments*, represents the credit to contractors resulting from the cover of 25 percent of the annual debt service for Power Facilities Revenue Bonds and Water System Revenue Bonds. Cover is collected as required by the bond resolutions to provide security to the bondholders. If not needed to meet annual bond service, the cover is credited to the contractors in the following year. The annual charges for the following cost components include an amount for bond cover:

- minimum OMP&R component of the Transportation Charge for Off-Aqueduct Power Facilities;
- Water System Revenue Bond Surcharge;
- capital cost component of the Transportation Charge for East Branch Enlargement Facilities;
- capital cost component of the Transportation Charge for Coastal Branch Extension Facilities;
- capital cost component of the Transportation Charge for East Branch Extension Facilities;
- capital cost component of the Transportation Charge for Tehachapi Afterbay; and
- capital cost component of the Transportation Charge for SBA Enlargement.

*Line 15, Rate Management Adjustments*, shows the projected amount of revenue reductions allocated to contractors after repayment of the California Water Fund (see Line 39). Under provisions of the Monterey Amendment, the reduction amount allocated to agricultural contractors is deposited into a trust fund to stabilize payments in water-short years. The urban contractor allocation is applied as a direct reduction in charges.

*Line 16, Federal Payments for Project Operating Costs*, shows federal payments made in accordance with the December 31, 1961, agreement between California and the United States providing for DWR to operate and maintain the San Luis Joint-Use Facilities. According to the January 12, 1972, supplement to the agreement, the Bureau of Reclamation (Reclamation) initially paid 45 percent of operations, maintenance, and replacement (OM&R) costs for those activities. (The percentage does not apply to power costs; Reclamation and DWR each provide their own power to pump water through the joint facilities.)

The percentage paid by Reclamation is periodically reviewed by Reclamation and DWR. A review of the percentage paid by Reclamation was completed in 1987 and resulted in a federal share of 44.09 percent. During the most recent review concluded in August 2015, DWR agreed to reevaluate Reclamation's percentage every five years based on the preceding five years of actual operating expenditures. Operating expenditures for calendar years 2006 through 2010 were reviewed, and the percentage paid by Reclamation for calendar years 2011 through 2015 was retroactively reduced to 39.72 percent. The amounts in

Line 16 are based on the assumption that the federal share will continue at this level for calendar years 2016 through 2025. However, it is anticipated that the percentage paid by Reclamation for calendar years 2016–2020 will be revised once all expenditures through 2015 are known and a new percentage can be determined.

*Line 17, Appropriations for Operating Costs Allocated to Recreation*, shows appropriations made under the Davis-Dolwig Act. In passing the Davis-Dolwig Act, the California Legislature declared its intent that, except for funds provided according to Assembly Bill 12 (1966), DWR's budget will include appropriations of monies from the General Fund necessary for enhancement of fish and wildlife and recreation in connection with State water projects.

Annual OMP&R costs allocated to recreation and fish and wildlife enhancement are to be paid by annual appropriations from the General Fund. Through fiscal year 1982–1983, these appropriations totaled $16.7 million. No additional appropriations have been made from this fund since fiscal year 1982–1983.

Legislation enacted in 1989 offset a portion of the amount owed to the SWP by the State for costs allocated to recreation and to fish and wildlife enhancement against the amount the SWP owed to the California Water Fund (see line 39). Since the final offset in 1994, DWR has accumulated $201.3 million in OMP&R costs through December 31, 2015.

In 2012, the Davis-Dolwig Act was amended to appropriate $10 million per fiscal year from the Harbors and Watercraft Revolving Fund to cover a portion of the OMP&R and capital costs allocated to recreation and fish and wildlife enhancement. Starting in fiscal year 2012–2013, $7.5 million is being appropriated for ongoing OM&R and capital recreation and fish and wildlife enhancement costs and $2.5 million is being appropriated to reimburse DWR for past unreimbursed OMP&R and capital costs.

*Line 18, Davis-Grunsky Loan Repayments*, shows the repayments by local agencies of $76.3 million of loans disbursed as of December 31, 2015. Repayment on any future loans was assumed to be beyond the period covered by the financial analysis.

*Line 19, Revenue Bond Proceeds*, includes bond proceeds classified as special reserves according to the description of revenue bond financing in Line 17 of Table 14-1. Those proceeds, used for capitalized OMP&R costs, revenue bond debt service, and debt service reserves, are not classified as revenue but are included in this line to simplify the financial presentation.

*Line 20, Interest Earnings on Operating Revenues*, includes interest earnings on unexpended proceeds from the sale of general obligation bonds, interest on operating reserves, and other short-term investment earnings on SWP revenues.

*Line 21, Oroville-Thermalito Payments*, shows payments from Pacific Gas & Electric Company, Southern California Edison, and San Diego Gas & Electric Company for power generation at the Oroville facilities. Those utilities purchased all power generation from Hyatt and Thermalito powerplants before April 1, 1983, in accordance with a power sale contract dated November 29, 1967. The historic amount includes the amounts of final settlement of payments made according to the contract.

*Line 22, Miscellaneous Revenues*, includes all other operating revenues not included in Lines 2 through 21.

*Line 23, Subtotal, Other Revenues*, is the total of Lines 16 through 22.

*Line 24, Total Operating Revenues*, is the total of Lines 13, 14, 15, and 23.

*Line 25, Total Operating Revenues and Capital Resources Revenues*, is the total of Lines 1 and 24.

## Project Expenses

Project expenses include the following:

- operations, maintenance, and power costs;
- deposits to replacement reserves;
- deposits to special reserves;
- capital resources expenditures; and
- debt service.

Revenue bond proceeds earmarked for debt service during construction and the first year's operating expenses are deposited in the Central Valley Water Project Construction Fund and disbursed in accordance with resolutions authorizing the issuance of such bonds.

Water contractor revenues associated with operating costs and debt service attributable to projects financed by revenue bonds are deposited in the Central Valley Water Project Revenue Fund for appropriate disbursement. All other operating revenues are deposited in the California Water Resources Development Bond Fund—Systems Revenue Account and are disbursed in accordance with the following four priorities of use, as specified in the Burns-Porter Act:

- SWP OMP&R costs;
- general obligation bond debt service;
- repayment of expenditures from the California Water Fund; and
- deposits to a reserve for future SWP construction.

Project expenses are presented in Lines 26 through 36 of Table 14-2.

*Line 26, Project Operations, Maintenance, Power, and Replacement Costs*, shows the OMP&R portion of the historical and projected costs presented in Table 14-10.

Table 14-10 and Line 26 of Table 14-2 also include the amounts of the operations and maintenance costs for the federal share of joint facilities and those OMP&R costs allocated to recreation, which are intended to be offset by revenues listed in Lines 16 and 17.

Allowances for cost escalations are included in OMP&R costs through 2015. Allowances for additional long-term price escalations in the future are not included in these estimates, because changes in OMP&R costs do not substantially affect the overall results of the financial analysis. (For the most part, changes in OMP&R costs cause direct offsetting changes in operating revenues.)

Power costs make up the largest component of annual operating expenses for the SWP. Assumptions about future power sources and costs are discussed in Chapter 10, Power Resources. Line 26 also includes costs associated with power transactions that result in the sale of power not required for the delivery of water.

*Line 27, Deposits to Replacement Reserves*, shows funds set aside as required by contract for replacing existing SWP facilities. By December 31, 2015, a net deposit (which includes returned deposits) of $98.2 million had been made. $91.7 million had been spent for replacement costs. The balance of the replacement reserve as of that date was $27.9 million.

*Line 28, Deposits to Special Reserves Under Revenue Bond Financing*, includes two significant components: special reserve deposits related to revenue bonds and capital resources revenue carryover from prior years used for construction in the current year. Special reserve deposits are the

## Table 14-10 Operations, Maintenance, Power, and Replacement Costs, by Facility, Composition, and Purpose (in thousands of dollars)

| | Calendar Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Feature** | **1962–2013** | **2014** | **2015** | **1962–2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2026–2035** | **TOTAL** |
| **Project Facility** | | | | | | | | | | | | | | | | |
| Feather River facilities | 1,464,425 | 75,962 | 72,083 | 1,612,344 | 68,758 | 72,303 | 74,145 | 74,173 | 73,439 | 74,680 | 74,727 | 75,713 | 76,303 | 76,910 | 820,979 | 3,174,474 |
| North Bay Aqueduct | 97,420 | 8,029 | 7,497 | 113,242 | 7,575 | 9,008 | 8,450 | 8,200 | 8,134 | 8,237 | 8,246 | 8,335 | 8,391 | 8,453 | 89,353 | 285,624 |
| Delta facilities | 854,355 | 45,592 | 69,934 | 969,938 | 84,261 | 56,230 | 81,170 | 73,212 | 64,420 | 65,509 | 65,550 | 66,415 | 66,932 | 67,465 | 720,153 | 2,381,255 |
| Suisun Marsh | 56,369 | 5,332 | (1,351) | 60,592 | 6,902 | 7,840 | 7,737 | 7,418 | 7,345 | 7,469 | 7,474 | 7,572 | 7,631 | 7,692 | 82,108 | 217,780 |
| South Bay Aqueduct | 352,673 | 20,683 | 23,306 | 396,876 | 27,927 | 26,014 | 23,414 | 25,844 | 25,671 | 25,967 | 25,998 | 26,260 | 26,432 | 26,621 | 280,678 | 937,702 |
| California Aqueduct | | | | | | | | | | | | | | | | |
| Delta to Edmonston | 4,136,074 | 172,549 | 184,120 | 4,488,083 | 223,945 | 253,302 | 251,170 | 252,199 | 244,199 | 250,933 | 251,857 | 249,744 | 248,518 | 250,013 | 2,643,890 | 9,607,854 |
| Edmonston to Perris | 3,676,007 | 191,195 | 199,349 | 4,066,286 | 219,805 | 254,406 | 254,215 | 253,211 | 258,657 | 257,409 | 260,645 | 261,400 | 259,147 | 263,876 | 2,730,290 | 9,339,347 |
| West Branch | 99,600 | 36,574 | 30,095 | 169,478 | 40,566 | 38,198 | 29,533 | 34,775 | 34,418 | 35,197 | 35,215 | 35,790 | 36,014 | 36,715 | 392,028 | 917,927 |
| Coastal Branch | 305,976 | 19,748 | 23,781 | 349,875 | 19,344 | 19,956 | 20,575 | 21,399 | 21,271 | 21,467 | 21,497 | 21,685 | 21,816 | 21,963 | 230,301 | 791,149 |
| East Branch Enlargement | 115,043 | 9,594 | 10,555 | 135,554 | 9,063 | 10,298 | 10,031 | 9,935 | 9,739 | 9,806 | 9,715 | 9,746 | 9,724 | 9,705 | 98,036 | 331,352 |
| East Branch Extension | 40,188 | 5,035 | 4,337 | 49,859 | 4,124 | 6,036 | 5,105 | 5,182 | 5,144 | 5,198 | 5,205 | 5,254 | 5,288 | 5,325 | 56,004 | 157,724 |
| Off-Aqueduct power-generating facilities | 1,587,556 | 2,265 | 111 | 1,589,933 | 110 | 110 | 111 | 111 | 112 | 112 | 113 | 113 | 114 | 115 | 1,177 | 1,592,231 |
| Recreation, planning, and CVP negotiations | 7,934 | 724 | 572 | 9,230 | 690 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 7,200 | 23,600 |
| Water quality monitoring | 412,293 | 12,683 | 12,683 | 437,659 | 12,683 | 12,683 | 12,683 | 12,683 | 11,379 | 11,379 | 11,379 | 11,379 | 11,379 | 11,379 | 113,790 | 670,455 |
| Davis-Grunsky Act Program | 5,727 | 237 | 131 | 6,094 | 268 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 288 | 2,880 | 11,834 |
| *Subtotal* | *13,211,639* | *606,202* | *637,202* | *14,455,044* | *726,021* | *767,392* | *779,347* | *779,350* | *764,936* | *774,371* | *778,629* | *780,414* | *778,697* | *787,240* | *8,268,867* | *30,440,308* |
| Payments to/credits from PG&E under Comprehensive Agreement | (59,848) | 0 | 0 | (59,848) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59,848) |
| **Total OMP&R Costs** | **13,151,791** | **606,202** | **637,202** | **14,395,196** | **726,021** | **767,392** | **779,347** | **779,350** | **764,936** | **774,371** | **778,629** | **780,414** | **778,697** | **787,240** | **8,268,867** | **30,380,460** |
| **Composition** | | | | | | | | | | | | | | | | |
| Salaries and expenses of headquarters personnel | 3,539,945 | 232,190 | 146,112 | 4,013,267 | 187,201 | 195,724 | 205,311 | 199,691 | 192,952 | 195,141 | 200,045 | 197,428 | 199,145 | 205,635 | 2,202,869 | 8,194,409 |
| Salaries and expenses of field personnel | 5,274,295 | 214,141 | 153,393 | 5,546,810 | 196,530 | 205,478 | 215,543 | 209,643 | 202,568 | 204,866 | 210,015 | 207,267 | 209,069 | 215,883 | 2,312,651 | 9,936,323 |
| Pumping power | | | | | | | | | | | | | | | | |
| Used by pumping plants | 3,580,952 | 162,408 | 345,497 | 4,088,857 | 381,437 | 411,543 | 396,535 | 394,939 | 392,884 | 397,947 | 392,158 | 400,649 | 395,535 | 390,546 | 3,963,991 | 12,007,021 |
| Produced by generation plants | (663,871) | (5,079) | (8,188) | (677,139) | (39,534) | (45,740) | (38,430) | (25,311) | (23,857) | (23,972) | (23,979) | (25,320) | (25,443) | (25,216) | (214,591) | (1,188,532) |
| Off-Aqueduct power-generating facilities requirement | 1,587,556 | 2,265 | 111 | 1,589,933 | 110 | 110 | 111 | 111 | 112 | 112 | 113 | 113 | 114 | 115 | 1,177 | 1,592,231 |
| Oroville-Thermalito insurance premiums | 13,813 | 277 | 277 | 14,367 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 277 | 2,770 | 19,907 |
| Less portion of costs incurred during construction | (121,051) | - | 0 | (121,051) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (121,051) |
| Payments to/credits from PG&E under Comprehensive Agreement | (59,848) | - | 0 | (59,848) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59,848) |
| **Total OMP&R Costs** | **13,151,791** | **606,202** | **637,202** | **14,395,196** | **726,021** | **767,392** | **779,347** | **779,350** | **764,936** | **774,371** | **778,629** | **780,414** | **778,697** | **787,240** | **8,268,867** | **30,380,460** |
| **Project Purpose** | | | | | | | | | | | | | | | | |
| Water supply and power generation | 12,750,049 | 579,374 | 611,516 | 13,940,939 | 699,937 | 741,158 | 753,076 | 753,079 | 738,665 | 748,100 | 752,358 | 754,143 | 752,426 | 760,969 | 8,006,155 | 29,401,003 |
| Recreation and fish and wildlife enhancement | 258,435 | 17,572 | 16,775 | 292,783 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 16,775 | 167,754 | 628,291 |
| Flood control | 10,005 | 900 | 732 | 11,637 | 732 | 732 | 732 | 732 | 732 | 732 | 732 | 732 | 732 | 732 | 7,324 | 26,285 |
| Miscellaneous purposes | | | | | | | | | | | | | | | | |
| Federal share: San Luis and Delta facilities | 157,052 | 6,558 | 6,639 | 170,249 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 6,598 | 65,984 | 302,217 |
| Other (Davis-Grunsky, drainage, City of Los Angeles) | 36,098 | 1,799 | 1,539 | 39,436 | 1,978 | 2,128 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 21,650 | 82,512 |
| Payments to/credits from PG&E under Comprehensive Agreement | (59,848) | 0 | 0 | (59,848) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59,848) |
| **Total OMP&R Costs** | **13,151,791** | **606,202** | **637,202** | **14,395,196** | **726,021** | **767,392** | **779,347** | **779,350** | **764,936** | **774,371** | **778,629** | **780,414** | **778,697** | **787,240** | **8,268,867** | **30,380,460** |

net of several income and expenditure items. Income items related to revenue bonds are:

- proceeds set aside to pay bond interest during construction (capitalized interest);
- proceeds set aside for first year operating costs (capitalized operations and maintenance);
- water contractor payments or bond proceeds set aside for debt service reserves;
- water contractor payments for revenue bond cover requirements; and
- deposits to and withdrawals from operating reserves to meet day-to-day cash flow requirements.

The 1952–2015 column also includes advances to DWR's revolving fund for working funds to purchase mobile equipment and to meet day-to-day operating expenses.

The expenditure items related to revenue bonds include:

- debt service cover payments returned to contractors;
- debt service reserve interest payments returned to contractors;
- surplus account funds returned to contractors or applied to meet expenses;
- total capitalized interest paid out; and
- total capitalized operations and maintenance paid out.

Special reserves, reduced over time as reserved amounts, are used for their respective purposes. The amount indicated each year in Line 28 reflects the change from the previous year. A negative number indicates a withdrawal of special reserves to meet expenses, while a positive number indicates a deposit.

*Line 29, Capital Resources Expenditures*, includes the amount of capital resources revenues applied to construction that is shown in Line 36 of Table 14-1. In Table 14-2, these expenditures are funded out of withdrawals from the reserves in Line 28 and do not affect net revenues shown in Line 38.

*Lines 30 and 31, Payment of Debt Service on Bonds Sold through December 31, 2015*, show the total principal and interest payments, respectively, on bonds sold to date. Table 14-11, at the end of this chapter, summarizes payments on general obligation bonds (Series A through Y water bonds), power revenue bonds by project, and water system revenue bonds (Series A through AU).

*Lines 32 and 33, Payments on Projected Future Water Bonds*, include the projected annual bond debt service amounts for future water revenue bonds included on Lines 23, 25, 27, and 29 of Table 14-1 for the East Branch Enlargement, East Branch Extension, SBA Enlargement, and other water system facilities. Assumptions about the bond debt service on these future bonds are that interest costs for the water revenue bonds average 3.15 percent; and that bonds are to be repaid by the end of the project repayment period (2035) or sooner, with maturities commencing in the year following the date of sale and with equal annual bond debt service for the principal repayment period.

*Lines 34 and 35, Total Payments of Bond Debt Service*, show the total of principal payments indicated on Lines 30 and 32, and the total of interest repayments indicated on Lines 31 and 33.

*Line 36, Subtotal, Bond Debt Service*, is the total of Lines 34 and 35.

*Line 37, Total Operating Expenses and Bond Debt Service*, is the total of Lines 26, 27, 28, 29, and 36.

*Line 38, Net System Revenues*, shows the annual amounts of revenues remaining after the payment of operating costs and bond debt service costs.

*Line 39, California Water Fund Repayment*, shows the total amount of repayments made to the California Water Fund to reimburse the fund for monies expended for construction of the State Water Resources Development System.

Repayment of the California Water Fund was completed in 1998. The $508 million includes the $306 million of repayments shown in Line 39 and the $202 million of reimbursement that was credited to the SWP as offsets for recreation and fish and wildlife enhancement expenditures.

*Line 40, Revenues Used for Capital Expenditures*, includes the amounts required annually for financing scheduled capital expenditures. Revenues not needed for operating costs or bond debt services are available for financing SWP capital expenditures.

## Future Costs of Water Service

Estimates of future water costs are useful to contractors for short-range and long-range planning of water needs, operations, and budgets. Unit water charges shown in Table 14-12 represent estimated costs of water delivery by service area for calendar years 2017 and 2022. The unit rates include costs of existing and future SWP facilities accounted for in Table 14-1 and Table 14-7. The unit water charges are based on the assumption that in 2017 and 2022, the SWP will be able to deliver the entire amount of water requested by each contractor. The unit water charges included in Table 14-12 are listed both as 2017 dollars and as escalated rates reflecting assumed future inflation of 7.5 percent in 2016 and 4.5 percent from 2017 through 2022.

**Table 14-12 Estimated Unit Water Charges for 2017 and 2022, by Service Area (in dollars per acre-foot)**

| Service Area and Charge | 2017 (in 2017 dollars) | 2022 (in 2022 dollars) |
|---|---|---|
| **Feather River Area** | | |
| Capital; Operations, Maintenance, and Replacement (OM&R) | **481** | **486** |
| **North Bay Area** | | |
| Capital; OM&R | 459 | 507 |
| Power | 31 | 31 |
| **Total** | **490** | **538** |
| **South Bay Area** | | |
| Capital; OM&R | 390 | 449 |
| Power | 53 | 61 |
| **Total** | **443** | **510** |
| **Coastal Area** | | |
| Capital; OM&R | 1,116 | 1,202 |
| Power | 125 | 182 |
| **Total** | **1,241** | **1,384** |
| **San Joaquin Area** | | |
| Capital; OM&R | 193 | 219 |
| Power | 28 | 32 |
| **Total** | **221** | **251** |
| **Southern California Area** | | |
| Capital; OM&R | 399 | 426 |
| Power | 162 | 188 |
| **Total** | **561** | **614** |

## Table 14-1 Capital Requirements and Financing, December 31, 2015 (in thousands of dollars)

| | Calendar Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Line Number/Item** | **1952–2013** | **2014** | **2015** | **1952–2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** | **2016–2025** | **1952–2025** |
| **CAPITAL REQUIREMENTS** | | | | | | | | | | | | | | | | |
| 1. Initial Project Facilities | 2,202,316 | 0 | 0 | 2,202,316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,202,316 |
| 2. North Bay Aqueduct | 112,782 | 1,800 | 1,272 | 115,853 | 1,566 | 1,064 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,630 | 118,484 |
| 3. Delta and Suisun Marsh Facilities | 296,335 | 12,734 | 12,773 | 321,842 | 71,404 | 82,759 | 109,564 | 31,043 | 0 | 0 | 0 | 0 | 0 | 0 | 294,769 | 616,611 |
| 4. Final Four Units at Banks Pumping Plant | 43,673 | 0 | 0 | 43,673 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43,673 |
| 5. Coastal Branch Aqueduct | 511,561 | 2,639 | 2,085 | 516,284 | 2,614 | 1,027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,641 | 519,925 |
| 6. West Branch Aqueduct | 210,981 | 3,135 | 5,130 | 219,247 | 5,191 | 4,461 | 5,475 | 5,708 | 0 | 0 | 0 | 0 | 0 | 0 | 20,835 | 240,082 |
| 7. East Branch Enlargement | 461,828 | 147 | 57 | 462,031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 462,031 |
| 8. East Branch Improvements | 409,139 | 15,970 | 36,915 | 462,024 | 44,030 | 30,085 | 21,797 | 16,609 | 0 | 0 | 0 | 0 | 0 | 0 | 112,522 | 574,546 |
| 9. East Branch Extension | 261,137 | 64,242 | 35,397 | 360,775 | 28,327 | 14,018 | 4,801 | 2,659 | 0 | 0 | 0 | 0 | 0 | 0 | 49,804 | 410,580 |
| 10. South Bay Aqueduct Improvements and Enlargement | 255,709 | 4,223 | 8,248 | 268,179 | 4,546 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,546 | 272,725 |
| 11. Power Generation and Transmission Facilities | 833,086 | 24,693 | 11,435 | 869,214 | 32,679 | 42,218 | 35,236 | 468 | 0 | 0 | 0 | 0 | 0 | 0 | 110,600 | 979,814 |
| 12. Additional Conservation Facilities | 164,459 | 2,545 | 3,100 | 170,103 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 | 30,000 | 200,103 |
| 13. Agricultural Drainage Facilities | 83,501 | 1,562 | 1,409 | 86,471 | 1,710 | 1,840 | 1,877 | 1,877 | 1,877 | 1,877 | 1,877 | 1,877 | 1,877 | 1,877 | 18,566 | 105,037 |
| 14. Other Costs | 468,590 | 62,890 | 38,851 | 570,331 | 109,684 | 101,593 | 118,490 | 63,556 | 0 | 0 | 0 | 0 | 0 | 0 | 393,322 | 963,653 |
| **15. Total Project Construction Expenditures** | **6,315,096** | **196,578** | **156,671** | **6,668,344** | **304,750** | **282,065** | **300,239** | **124,919** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **1,041,235** | **7,709,579** |
| 16. Davis-Grunsky Act Program Costs | 130,000 | 0 | 0 | 130,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 |
| 17. Special Capital Requirements Under Revenue Bond Financing | 575,262 | 3,091 | 4,654 | 583,007 | 26,863 | 23,888 | 25,549 | 10,384 | 0 | 0 | 0 | 0 | 0 | 0 | 86,683 | 669,690 |
| **18. Total Capital Requirements** | **7,020,358** | **199,668** | **161,325** | **7,381,351** | **331,612** | **305,953** | **325,788** | **135,303** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **1,127,918** | **8,509,269** |
| 19. Power Facilities Capital Requirements | 833,086 | 24,693 | 11,435 | 869,214 | 32,679 | 42,218 | 35,236 | 468 | 0 | 0 | 0 | 0 | 0 | 0 | 110,600 | 979,814 |
| 20. Water Facilities Capital Requirements | 6,187,272 | 174,975 | 149,890 | 6,512,137 | 298,934 | 263,735 | 290,552 | 134,835 | 4,877 | 4,877 | 4,877 | 4,877 | 4,877 | 4,877 | 1,017,318 | 7,529,455 |
| **FINANCING OF CAPITAL REQUIREMENTS** | | | | | | | | | | | | | | | | |
| **Power Facilities Revenue Bond Proceeds** | | | | | | | | | | | | | | | | |
| 21. Power Facilities Revenue Bonds through Series H | 1,162,458 | 0 | 0 | 1,162,458 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,162,458 |
| **Water System Revenue Bond Proceeds** | | | | | | | | | | | | | | | | |
| 22. East Branch Enlargement, Current Bonds | 473,451 | 8,330 | 155 | 481,936 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 481,936 |
| 23. East Branch Enlargement, Future Bonds | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24. East Branch Extension, Current Bonds | 339,545 | 43,200 | 0 | 382,745 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 382,745 |
| 25. East Branch Extension, Future Bonds | 0 | 0 | 0 | 0 | 16,008 | 15,231 | 5,216 | 2,889 | 0 | 0 | 0 | 0 | 0 | 0 | 39,344 | 39,344 |
| 26. South Bay Aqueduct Enlargement, Current Bonds | 201,283 | 13,725 | 4,035 | 219,043 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 219,043 |
| 27. South Bay Aqueduct Enlargement, Future Bonds | 0 | 0 | 0 | 0 | 5,024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,024 | 5,024 |
| 28. Water System Facilities, Current Bonds | 2,080,602 | 44,020 | 105,085 | 2,229,707 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,229,707 |
| 29. Water System Facilities, Future Bonds | 0 | 0 | 0 | 0 | 427,665 | 285,158 | 316,072 | 127,914 | 377 | 377 | 377 | 377 | 377 | 377 | 1,159,070 | 1,159,070 |
| *30. Subtotal, Water System Revenue Bonds* | 3,094,882 | 109,275 | 109,275 | 3,313,432 | *448,697* | *300,389* | *321,288* | *130,803* | *377* | *377* | *377* | *377* | *377* | *377* | *1,203,438* | *4,516,870* |
| **Other Capital Financing** | | | | | | | | | | | | | | | | |
| 31. Initial Project Facilities Bond Proceeds | 1,452,452 | 0 | 0 | 1,452,452 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,452,452 |
| 32. Davis-Grunsky Act Program Bond Proceeds | 130,000 | 0 | 0 | 130,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 |
| 33. Application of CA Water Fund Monies (Tideland Oil Revenues) | 508,056 | 0 | 0 | 508,056 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 508,056 |
| 34. Interim Financing | (8,922) | 85,340 | 46,733 | 123,151 | (123,151) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (123,151) | 0 |
| 35. Direct Pay | 6,173 | 554 | 817 | 7,544 | 1,566 | 1,064 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,630 | 10,174 |
| 36. Application of Capital Resources Revenues to Construction | 566,269 | 0 | 0 | 566,269 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 566,269 |
| 37. Revenue Transfers Applied | 108,990 | 4,500 | 4,500 | 117,990 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 45,000 | 162,990 |
| *38. Subtotal, Other Capital Financing* | 2,763,018 | 90,393 | 52,050 | 2,905,462 | *(117,085)* | *5,564* | *4,500* | *4,500* | *4,500* | *4,500* | *4,500* | *4,500* | *4,500* | *4,500* | *(75,521)* | *2,829,941* |
| **39. Total Financing of Capital Requirements** | **7,020,358** | **199,668** | **161,325** | **7,381,351** | **331,612** | **305,953** | **325,788** | **135,303** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **4,877** | **1,127,918** | **8,509,269** |

## Table 14-2 State Water Project Revenues and Expenditures, December 31, 2015 (in thousands of dollars)

| Line Number/Item | Calendar Year | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1952–2013 | 2014 | 2015 | 1952–2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2016–2025 | 1952–2025 |
| **PROJECT REVENUES** | | | | | | | | | | | | | | | | |
| 1. Capital Resources Revenues | 814,701 | 0 | 0 | 814,701 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 814,701 |
| **Water Contractor Payments** | | | | | | | | | | | | | | | | |
| 2. Transportation Capital | 4,806,248 | 174,004 | 179,247 | 5,159,499 | 183,654 | 186,410 | 184,076 | 180,496 | 175,012 | 164,485 | 156,378 | 153,721 | 151,417 | 150,183 | 1,685,833 | 6,845,332 |
| 3. Transportation Minimum | 4,222,988 | 260,281 | 252,612 | 4,735,881 | 278,271 | 305,796 | 300,415 | 297,930 | 298,626 | 301,612 | 304,629 | 307,675 | 310,752 | 313,859 | 3,019,564 | 7,755,445 |
| 4. Transportation Variable | 5,821,618 | 194,999 | 233,088 | 6,249,705 | 247,904 | 278,462 | 280,896 | 297,191 | 302,806 | 302,652 | 309,589 | 304,411 | 299,791 | 305,353 | 2,929,054 | 9,178,760 |
| 5. Off-Aqueduct Power Facilities | 2,928,593 | 34,699 | 21,207 | 2,984,499 | 4,649 | 4,300 | 3,300 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 13,649 | 2,998,147 |
| 6. Delta Water Charge | 3,181,442 | 183,479 | 249,669 | 3,614,591 | 298,433 | 287,567 | 287,567 | 287,567 | 287,567 | 287,567 | 287,567 | 287,567 | 287,567 | 287,567 | 2,886,533 | 6,501,124 |
| 7. East Branch Enlargement | 935,307 | 41,209 | 46,672 | 1,023,188 | 45,970 | 48,457 | 47,405 | 47,495 | 46,633 | 47,443 | 46,011 | 39,512 | 40,993 | 45,294 | 455,214 | 1,478,403 |
| 8. East Branch Extension | 156,925 | 17,742 | 18,304 | 192,971 | 34,188 | 38,102 | 36,520 | 37,587 | 38,036 | 38,114 | 37,884 | 37,662 | 37,889 | 37,735 | 373,718 | 566,689 |
| 9. Coastal Extension | 51,468 | 4,137 | 4,605 | 60,210 | 4,594 | 4,347 | 3,345 | 2,534 | 3,531 | 3,656 | 4,531 | 3,406 | 3,406 | 2,764 | 36,113 | 96,322 |
| 10. South Bay Aqueduct Improvements and Enlargement | 67,124 | 16,156 | 19,949 | 103,228 | 20,637 | 19,635 | 19,458 | 19,413 | 19,303 | 19,249 | 19,248 | 19,471 | 19,471 | 19,299 | 195,184 | 298,413 |
| 11. Tehachapi East Afterbay | 33,533 | 5,310 | 6,771 | 45,613 | 6,815 | 6,319 | 6,159 | 6,168 | 6,157 | 6,145 | 6,148 | 6,218 | 6,226 | 6,115 | 62,471 | 108,084 |
| 12. Water Revenue Bond Surcharge | 686,471 | 47,157 | 45,204 | 778,831 | 81,446 | 85,949 | 87,340 | 95,587 | 92,371 | 92,401 | 89,294 | 90,278 | 88,099 | 83,429 | 886,192 | 1,665,023 |
| *13. Subtotal, Water Contractor Payments* | *22,891,717* | 979,172 | 1,077,327 | 24,948,217 | *1,206,561* | *1,265,342* | *1,256,482* | *1,272,167* | *1,270,241* | *1,263,525* | *1,261,477* | *1,250,121* | *1,245,811* | *1,251,798* | *12,543,525* | *37,491,742* |
| 14. Revenue Bond Cover Adjustments | (960,097) | (47,600) | (57,444) | (1,065,141) | (58,350) | (58,819) | (53,659) | (54,991) | (53,769) | (53,013) | (52,773) | (49,428) | (48,495) | (46,595) | (529,893) | (1,595,035) |
| 15. Rate Management Adjustments | (461,621) | (40,470) | (40,470) | (542,562) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (40,470) | (404,705) | (947,266) |
| **Other Revenues** | | | | | | | | | | | | | | | | |
| 16. Federal Payments for Project Operating Costs | 389,191 | 19,061 | 8,175 | 416,426 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 18,000 | 180,000 | 596,426 |
| 17. Appropriations for Operating Costs Allocated to Recreation | 26,342 | 11,182 | 5,071 | 42,596 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 100,000 | 142,596 |
| 18. Davis-Grunsky Loan Repayments | 73,657 | 1,236 | 1,359 | 76,252 | 1,367 | 1,206 | 1,013 | 967 | 897 | 890 | 890 | 875 | 796 | 733,209 | 742,109 | 818,361 |
| 19. Revenue Bond Proceeds | 652,977 | 0 | 0 | 652,977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 652,977 |
| 20. Interest Earnings on Operating Revenues | 576,594 | 269 | 487 | 577,350 | 380 | 380 | 380 | 380 | 380 | 510 | 510 | 510 | 510 | 510 | 4,450 | 581,800 |
| 21. Oroville-Thermalito Payments | 249,279 | 0 | 0 | 249,279 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 249,279 |
| 22. Miscellaneous Revenues | 184,264 | 0 | 0 | 184,264 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 184,264 |
| *23. Subtotal, Other Revenues* | *2,152,304* | 31,748 | 15,093 | 2,199,144 | *29,747* | *29,586* | *29,393* | *29,347* | *29,277* | *29,400* | *29,400* | *29,385* | *29,306* | *761,719* | *1,026,559* | *3,225,704* |
| **24. Total Operating Revenues** | **23,622,303** | **922,849** | **994,506** | **25,539,658** | **1,137,487** | **1,195,639** | **1,191,745** | **1,206,052** | **1,205,279** | **1,199,442** | **1,197,633** | **1,189,607** | **1,186,151** | **1,926,451** | **12,635,486** | **38,175,144** |
| **25. Total Operating Revenues and Capital Resources Revenues** | **24,437,004** | **922,849** | **994,506** | **26,354,359** | **1,137,487** | **1,195,639** | **1,191,745** | **1,206,052** | **1,205,279** | **1,199,442** | **1,197,633** | **1,189,607** | **1,186,151** | **1,926,451** | **12,635,486** | **38,989,845** |
| **PROJECT EXPENSES** | | | | | | | | | | | | | | | | |
| 26. Project Operations, Maintenance, Power, and Replacement Costs | 13,151,791 | 606,202 | 637,202 | 14,395,196 | 726,021 | 767,392 | 779,347 | 779,350 | 764,936 | 774,371 | 778,629 | 780,414 | 778,697 | 787,240 | 7,716,398 | 22,111,593 |
| 27. Deposits to Replacement Reserves | 86,794 | 9,826 | 1,607 | 98,227 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 98,227 |
| 28. Deposits to Special Reserves Under Revenue Bond Financing | 817,248 | 23,270 | 48,329 | 888,847 | 82,867 | 102,740 | 97,709 | 90,652 | 98,524 | 97,202 | 98,192 | 110,972 | 115,062 | 853,978 | 1,747,898 | 2,636,745 |
| 29. Capital Resources Expenditures | 686,932 | 0 | 0 | 686,932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 686,932 |
| **Payments of Bond Debt Service** | | | | | | | | | | | | | | | | |
| 30. Principal Repayments on Bonds Sold Through December 31, 2015 (Current Bonds) | 3,152,186 | 173,566 | 186,252 | 3,512,004 | 188,275 | 181,650 | 157,172 | 159,649 | 161,356 | 154,900 | 154,511 | 138,790 | 140,138 | 138,625 | 1,575,066 | 5,087,070 |
| 31. Interest on Bonds Sold Through December 31, 2015 (Current Bonds) | 6,127,298 | 105,485 | 116,616 | 3,442,368 | 113,070 | 106,932 | 98,474 | 92,659 | 86,188 | 78,660 | 71,961 | 65,055 | 57,839 | 52,153 | 822,991 | 4,265,359 |
| 32. Future Water Bond Principal Repayments | 0 | 0 | 0 | 0 | 9,435 | 16,866 | 30,112 | 45,700 | 53,616 | 55,390 | 57,224 | 59,121 | 61,083 | 63,111 | 451,658 | 451,658 |
| 33. Future Water Bond Interest Payments | 0 | 0 | 0 | 6,232,783 | 13,319 | 15,559 | 24,431 | 33,542 | 36,159 | 34,418 | 32,616 | 30,755 | 28,832 | 26,844 | 276,475 | 6,509,258 |
| **34. Total Principal** | **3,152,186** | **173,566** | **186,252** | **3,512,004** | **197,710** | **198,516** | **187,284** | **205,349** | **214,972** | **210,290** | **211,735** | **197,911** | **201,221** | **201,736** | **2,026,724** | **5,538,728** |
| **35. Total Interest** | **6,127,298** | **105,485** | **116,616** | **9,675,151** | **126,389** | **122,491** | **122,905** | **126,201** | **122,347** | **113,078** | **104,577** | **95,810** | **86,671** | **78,997** | **1,099,466** | **10,774,617** |
| *36. Subtotal, Bond Debt Service* | *9,279,484* | *279,051* | *302,868* | *13,187,155* | *324,099* | *321,007* | *310,189* | *331,550* | *337,319* | *323,368* | *316,312* | *293,721* | *287,892* | *280,733* | *3,126,190* | *16,313,345* |
| **NET REVENUES** | | | | | | | | | | | | | | | | |
| **37. Total Operating Expenses and Bond Debt Service** | **24,022,249** | **918,349** | **990,006** | **29,256,356** | **1,132,987** | **1,191,139** | **1,187,245** | **1,201,552** | **1,200,779** | **1,194,942** | **1,193,133** | **1,185,107** | **1,181,651** | **1,921,951** | **12,590,486** | **41,846,842** |
| 38. Net System Revenues | 414,755 | 4,500 | 4,500 | (2,901,997) | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 45,000 | (2,856,997) |
| **Application of Net System Revenues** | 0 | 0 | 0 | | | | | | | | | | | | | |
| 39. California Water Fund Repayment | 305,765 | 0 | 0 | 305,765 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 305,765 |
| 40. Revenues Used for Capital Expenditures | 108,990 | 4,500 | 4,500 | 117,990 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 45,000 | 162,990 |

## Table 14-11 Annual Debt Service on Bonds Sold through December 31, 2015 (in thousands of dollars)

| Calendar Year | Series A through Y Water Bonds | | Oroville Revenue Bonds[a] | | Pyramid Project Revenue Bonds[b] | | Alamo Project Revenue Bonds[b] | | Small Hydro Project Revenue Bonds[b] | | Water System Facilities Water System Revenue Bonds[c] | | *Subtotal* | | Devil Canyon-Castaic Project Revenue Bonds | | Reid Gardner Project Revenue Bonds[b,c] | | South Geysers Project Revenue Bonds[b] | | Bottle Rock Project Revenue Bonds[b] | | East Branch Enlargement Project Water System Revenue Bonds[c] | | Coastal Extension Facilities Water System Revenue Bonds | | East Branch Extension Facilities Water System Revenue Bonds[c] | | South Bay Enlargement Facilities Water System Revenue Bonds[c] | | Tehachapi East Afterbay Facilities Water System Revenue Bonds[c] | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | *Principal* | *Interest* | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest |
| 1964 | 0 | 3,333 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *3,333* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,333 |
| 1965 | 0 | 11,114 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *11,114* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11,114 |
| 1966 | 0 | 18,764 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *18,764* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18,764 |
| 1967 | 0 | 26,911 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *26,911* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26,911 |
| 1968 | 0 | 37,761 | 0 | 3,876 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *41,637* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41,637 |
| 1969 | 0 | 47,460 | 0 | 10,448 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *57,908* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57,908 |
| 1970 | 0 | 53,290 | 0 | 13,145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *66,435* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66,435 |
| 1971 | 0 | 63,035 | 0 | 13,145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *0* | *76,180* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 76,180 |
| 1972 | 0 | 69,149 | 1,260 | 13,112 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *1,260* | *82,261* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,260 | 82,261 |
| 1973 | 1,200 | 69,347 | 1,330 | 13,042 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *2,530* | *82,389* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,530 | 90,097 |
| 1974 | 3,000 | 69,533 | 1,400 | 12,969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *4,400* | *82,502* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,400 | 90,210 |
| 1975 | 5,000 | 69,366 | 1,475 | 12,893 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *6,475* | *82,259* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,475 | 89,967 |
| 1976 | 7,000 | 69,657 | 1,555 | 12,811 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *8,555* | *82,468* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,555 | 90,176 |
| 1977 | 10,200 | 69,298 | 1,635 | 12,727 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *11,835* | *82,025* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11,835 | 89,733 |
| 1978 | 12,700 | 69,286 | 5,775 | 12,537 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *18,475* | *81,823* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18,475 | 89,531 |
| 1979 | 13,650 | 68,660 | 11,585 | 12,275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | *25,235* | *80,935* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,235 | 88,643 |
| 1980 | 16,050 | 67,941 | 3,265 | 11,739 | 0 | 7,900 | 0 | 0 | 0 | 0 | 0 | 0 | *19,315* | *87,580* | 0 | 7,708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19,315 | 95,288 |
| 1981 | 18,050 | 67,078 | 4,885 | 11,444 | 0 | 7,292 | 0 | 0 | 0 | 0 | 0 | 0 | *22,935* | *85,814* | 0 | 7,708 | 0 | 5,312 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22,935 | 98,834 |
| 1982 | 19,250 | 66,130 | 17,920 | 10,968 | 0 | 7,292 | 0 | 0 | 0 | 0 | 0 | 0 | *37,170* | *84,390* | 0 | 7,708 | 0 | 14,347 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37,170 | 106,445 |
| 1983 | 20,520 | 65,111 | 21,110 | 10,147 | 0 | 7,292 | 0 | 2,449 | 0 | 3,727 | 0 | 0 | *41,630* | *88,726* | 900 | 7,708 | 0 | 35,719 | 0 | 4,777 | 0 | 6,017 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42,530 | 142,947 |
| 1984 | 21,785 | 64,036 | 10,005 | 9,013 | 640 | 7,292 | 0 | 4,198 | 0 | 3,727 | 0 | 0 | *32,430* | *88,266* | 955 | 7,647 | 0 | 35,719 | 0 | 5,647 | 0 | 10,315 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33,385 | 147,594 |
| 1985 | 22,555 | 62,892 | 12,700 | 8,628 | 675 | 7,238 | 0 | 4,198 | 0 | 3,727 | 0 | 0 | *35,930* | *86,683* | 1,010 | 7,583 | 9,425 | 27,209 | 0 | 5,647 | 0 | 10,315 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46,365 | 137,437 |
| 1986 | 23,830 | 61,705 | 11,435 | 7,859 | 715 | 7,377 | 0 | 4,263 | 0 | 3,537 | 0 | 0 | *35,980* | *84,741* | 1,070 | 7,515 | 3,805 | 32,882 | 0 | 5,516 | 1,240 | 10,315 | 0 | 4,021 | 0 | 0 | 0 | 0 | 0 | 0 | 42,095 | 144,990 |
| 1987 | 25,495 | 60,452 | 11,715 | 7,188 | 790 | 7,513 | 265 | 4,329 | 0 | 3,348 | 0 | 4,952 | *38,265* | *87,782* | 1,135 | 7,442 | 4,860 | 32,605 | 0 | 5,386 | 1,305 | 10,253 | 0 | 9,651 | 0 | 0 | 0 | 0 | 0 | 0 | 45,565 | 153,119 |
| 1988 | 26,770 | 59,120 | 6,685 | 6,664 | 830 | 7,447 | 280 | 4,314 | 345 | 3,348 | 710 | 11,037 | *35,620* | *91,930* | 1,205 | 7,366 | 5,065 | 32,295 | 580 | 5,521 | 1,390 | 10,849 | 995 | 9,875 | 0 | 0 | 0 | 0 | 0 | 0 | 44,855 | 157,836 |
| 1989 | 28,145 | 57,790 | 33,705 | 5,513 | 875 | 7,378 | 295 | 4,298 | 365 | 3,328 | 1,148 | 14,373 | *64,533* | *92,680* | 1,275 | 7,284 | 7,820 | 27,557 | 709 | 5,646 | 1,565 | 11,592 | 1,078 | 10,104 | 0 | 0 | 0 | 0 | 0 | 0 | 76,980 | 154,863 |
| 1990 | 29,385 | 56,436 | 10,385 | 4,301 | 930 | 7,305 | 320 | 4,279 | 405 | 3,304 | 1,227 | 19,555 | *42,652* | *95,180* | 1,355 | 7,198 | 6,675 | 29,781 | 761 | 5,596 | 1,678 | 11,491 | 1,134 | 10,048 | 0 | 0 | 0 | 0 | 0 | 0 | 54,255 | 159,294 |
| 1991 | 30,365 | 55,034 | 12,055 | 3,922 | 980 | 7,227 | 335 | 4,257 | 430 | 3,276 | 2,129 | 27,569 | *46,294* | *101,285* | 1,435 | 7,107 | 7,170 | 29,302 | 818 | 5,535 | 1,791 | 11,376 | 1,197 | 16,856 | 0 | 0 | 0 | 0 | 0 | 0 | 58,705 | 171,461 |
| 1992 | 31,745 | 54,193 | 14,135 | 2,985 | 2,395 | 5,308 | 1,260 | 3,086 | 960 | 2,553 | 5,108 | 28,412 | *55,603* | *96,537* | 1,520 | 7,010 | 8,950 | 27,188 | 1,934 | 4,136 | 4,575 | 7,942 | 2,583 | 22,241 | 0 | 0 | 0 | 0 | 0 | 0 | 75,165 | 165,054 |
| 1993 | 33,390 | 52,670 | 13,755 | 2,237 | 1,525 | 5,688 | 755 | 3,300 | 445 | 2,640 | 4,576 | 29,965 | *54,446* | *96,500* | 1,610 | 6,907 | 8,820 | 26,953 | 901 | 4,256 | 3,264 | 8,385 | 3,040 | 21,428 | 0 | 0 | 0 | 0 | 0 | 0 | 72,081 | 164,429 |
| 1994 | 35,075 | 51,231 | 35,225 | 934 | 1,580 | 5,634 | 780 | 3,274 | 695 | 2,569 | 5,910 | 38,223 | *79,265* | *101,865* | 1,705 | 6,799 | 77,105 | 26,273 | 1,588 | 4,072 | 3,374 | 8,270 | 4,567 | 20,752 | 0 | 0 | 0 | 0 | 0 | 0 | 167,604 | 168,031 |
| 1995 | 36,280 | 49,703 | 0 | 0 | 1,635 | 5,570 | 805 | 3,242 | 745 | 2,536 | 8,064 | 37,879 | *47,529* | *98,930* | 1,810 | 6,684 | 5,420 | 19,230 | 1,695 | 4,004 | 3,521 | 8,133 | 4,979 | 20,499 | 0 | 0 | 0 | 0 | 0 | 0 | 64,954 | 157,480 |
| 1996 | 37,520 | 48,024 | 0 | 0 | 2,320 | 5,486 | 1,055 | 3,203 | 3,135 | 2,464 | 10,459 | 58,171 | *54,489* | *117,348* | 1,920 | 6,561 | 49,465 | 18,130 | 3,043 | 3,908 | 3,682 | 7,974 | 4,771 | 23,240 | 0 | 0 | 0 | 0 | 0 | 0 | 117,370 | 177,161 |
| 1997 | 37,215 | 46,365 | 0 | 0 | 1,695 | 5,274 | 875 | 3,073 | 585 | 2,283 | 14,375 | 67,909 | *54,745* | *124,904* | 2,035 | 6,432 | 7,515 | 15,255 | 1,825 | 3,696 | 3,861 | 7,741 | 6,300 | 23,702 | 0 | 1,981 | 0 | 76 | 0 | 0 | 76,281 | 183,787 |
| 1998 | 37,295 | 44,736 | 0 | 0 | 1,770 | 5,237 | 910 | 3,059 | 625 | 2,258 | 16,755 | 68,584 | *57,355* | *123,874* | 2,155 | 6,295 | 5,045 | 16,144 | 1,935 | 3,637 | 4,030 | 7,509 | 6,760 | 23,966 | 0 | 1,829 | 0 | 229 | 0 | 0 | 77,280 | 183,483 |
| 1999 | 38,220 | 43,132 | 0 | 0 | 1,845 | 5,141 | 960 | 3,004 | 680 | 2,229 | 18,701 | 68,086 | *60,406* | *121,592* | 2,285 | 6,160 | 9,310 | 11,660 | 2,081 | 3,549 | 4,240 | 7,319 | 7,518 | 25,032 | 0 | 1,808 | 65 | 2,930 | 0 | 0 | 85,905 | 180,050 |
| 2000 | 39,510 | 41,469 | 0 | 0 | 1,925 | 5,045 | 1,010 | 2,955 | 610 | 2,197 | 19,536 | 66,900 | *62,591* | *118,566* | 2,420 | 6,040 | 9,870 | 11,194 | 1,950 | 3,448 | 4,470 | 7,097 | 8,974 | 24,651 | 0 | 1,808 | 915 | 2,928 | 0 | 0 | 91,190 | 175,732 |
| 2001 | 40,600 | 39,751 | 0 | 0 | 2,250 | 4,949 | 1,155 | 2,902 | 780 | 2,272 | 20,945 | 66,417 | *65,730* | *116,291* | 2,565 | 5,912 | 10,365 | 10,758 | 2,045 | 3,344 | 4,720 | 6,855 | 9,425 | 24,188 | 0 | 2,131 | 950 | 2,889 | 0 | 0 | 95,800 | 172,368 |
| 2002 | 41,740 | 37,984 | 0 | 0 | 2,460 | 4,619 | 1,280 | 2,758 | 950 | 2,192 | 23,918 | 63,126 | *70,348* | *110,679* | 2,720 | 5,773 | 11,185 | 10,010 | 2,225 | 3,074 | 5,265 | 6,323 | 9,817 | 23,099 | 335 | 2,311 | 1,245 | 3,481 | 0 | 0 | 103,140 | 164,750 |
| 2003 | 43,590 | 36,159 | 0 | 0 | 2,500 | 4,429 | 1,315 | 2,671 | 940 | 2,110 | 23,441 | 60,465 | *71,786* | *105,834* | 2,885 | 5,626 | 2,135 | 9,313 | 2,335 | 2,889 | 5,445 | 5,938 | 9,988 | 18,479 | 245 | 2,310 | 1,105 | 4,278 | 0 | 0 | 95,924 | 154,667 |
| 2004 | 45,730 | 34,244 | 0 | 0 | 2,500 | 4,291 | 1,330 | 2,598 | 970 | 2,059 | 26,396 | 58,988 | *76,926* | *102,180* | 3,055 | 5,470 | 2,210 | 9,214 | 2,425 | 2,758 | 5,610 | 5,633 | 9,883 | 20,583 | 220 | 2,298 | 2,045 | 4,747 | 0 | 91 | 0 | 55 | 102,374 | 153,029 |
| 2005 | 46,985 | 32,242 | 0 | 0 | 2,727 | 4,097 | 1,461 | 2,487 | 1,327 | 1,987 | 23,064 | 58,061 | *75,564* | *98,874* | 3,240 | 5,305 | 8,825 | 9,112 | 2,759 | 2,598 | 5,959 | 5,289 | 3,669 | 20,046 | 305 | 2,163 | 2,124 | 5,345 | 0 | 435 | 0 | 171 | 102,445 | 149,338 |
| 2006 | 48,275 | 30,186 | 0 | 0 | 2,868 | 3,985 | 1,527 | 2,437 | 1,371 | 1,924 | 28,901 | 59,149 | *82,942* | *97,681* | 3,435 | 5,130 | 9,340 | 8,617 | 2,920 | 2,453 | 6,326 | 4,958 | 11,627 | 20,182 | 240 | 2,235 | 2,222 | 5,731 | 82 | 669 | 0 | 287 | 119,134 | 147,942 |
| 2007 | 49,765 | 28,060 | 0 | 0 | 3,023 | 3,817 | 1,622 | 2,346 | 1,451 | 1,846 | 30,267 | 58,239 | *86,128* | *94,308* | 3,640 | 4,945 | 9,835 | 8,079 | 3,101 | 2,278 | 6,731 | 4,578 | 12,229 | 19,664 | 1,015 | 2,225 | 2,305 | 5,825 | 239 | 698 | 75 | 306 | 125,298 | 142,906 |
| 2008 | 51,755 | 25,871 | 0 | 0 | 2,794 | 3,525 | 1,618 | 2,147 | 1,161 | 1,763 | 25,352 | 60,365 | *82,680* | *93,671* | 3,860 | 4,749 | 23,689 | 8,084 | 2,765 | 2,037 | 5,637 | 4,096 | 10,602 | 18,753 | 179 | 2,167 | 51 | 7,036 | 247 | 2,926 | 80 | 1,961 | 129,790 | 145,480 |
| 2009 | 54,095 | 23,583 | 0 | 0 | 2,947 | 3,391 | 1,743 | 2,042 | 1,168 | 1,699 | 33,484 | 62,154 | *93,437* | *92,869* | 4,090 | 4,540 | 25,475 | 5,581 | 2,908 | 1,915 | 5,981 | 3,787 | 12,289 | 18,007 | 200 | 1,943 | 2,629 | 7,580 | 2,604 | 5,354 | 1,843 | 3,160 | 151,456 | 144,736 |
| 2010 | 55,785 | 21,206 | 0 | 0 | 3,525 | 3,249 | 2,078 | 2,000 | 1,399 | 1,610 | 31,016 | 61,546 | *93,803* | *89,611* | 4,335 | 4,319 | 33,201 | 5,547 | 3,221 | 1,750 | 6,611 | 3,440 | 12,644 | 17,746 | 2,790 | 2,059 | 2,803 | 7,780 | 3,334 | 6,045 | 1,911 | 3,094 | 164,653 | 141,391 |
| 2011 | 57,275 | 18,749 | 0 | 0 | 2,599 | 2,795 | 1,465 | 1,749 | 1,045 | 1,335 | 40,105 | 60,528 | *102,489* | *85,156* | 4,595 | 4,085 | 33,105 | 4,344 | 2,917 | 1,510 | 6,366 | 3,066 | 14,115 | 15,805 | 1,237 | 1,802 | 2,826 | 7,869 | 3,782 | 7,343 | 1,992 | 3,062 | 173,424 | 134,042 |
| 2012 | 58,615 | 16,199 | 0 | 0 | 2,761 | 2,591 | 1,574 | 1,597 | 1,060 | 1,311 | 43,169 | 56,206 | *107,179* | *77,904* | 4,875 | 3,837 | 35,031 | 2,558 | 3,116 | 1,273 | 6,845 | 2,499 | 14,853 | 15,051 | 1,294 | 1,721 | 2,955 | 7,925 | 4,527 | 8,294 | 2,094 | 2,948 | 182,769 | 124,010 |
| 2013 | 60,455 | 13,650 | 0 | 0 | 4,214 | 2,385 | 2,601 | 1,471 | 2,191 | 1,242 | 48,284 | 54,025 | *117,745* | *72,773* | 5,165 | 3,574 | 8,657 | 860 | 4,825 | 1,049 | 10,997 | 2,034 | 13,816 | 11,445 | 1,482 | 1,381 | 4,605 | 10,946 | 5,737 | 8,684 | 2,200 | 2,880 | 175,229 | 115,626 |
| 2014 | 57,985 | 11,222 | 0 | 0 | 4,831 | 2,099 | 3,107 | 1,279 | 2,405 | 1,113 | 56,254 | 48,659 | *124,582* | *64,372* | 5,475 | 3,303 | 260 | 425 | 4,164 | 773 | 8,619 | 1,436 | 15,082 | 11,743 | 2,106 | 1,203 | 4,835 | 13,210 | 6,147 | 7,085 | 2,296 | 1,935 | 173,566 | 105,485 |
| **2015** | **53,775** | **8,806** | **0** | **0** | **5,272** | **1,899** | **3,126** | **1,170** | **2,741** | **992** | **71,571** | **58,855** | ***136,485*** | ***71,722*** | **5,805** | **3,015** | **860** | **444** | **3,795** | **563** | **2,556** | **994** | **14,691** | **12,209** | **2,492** | **1,192** | **9,249** | **15,166** | **7,503** | **8,620** | **2,816** | **2,612** | **186,252** | **116,537** |
| 2016 | 46,215 | 6,588 | 0 | 0 | 5,671 | 1,657 | 3,211 | 1,031 | 3,084 | 860 | 74,865 | 58,066 | *133,046* | *68,202* | 6,150 | 2,710 | 1,070 | 398 | 2,215 | 384 | 2,961 | 871 | 19,939 | 11,495 | 2,518 | 1,157 | 9,659 | 14,761 | 7,798 | 8,406 | 2,919 | 2,510 | 188,275 | 110,894 |
| 2017 | 38,145 | 4,652 | 0 | 0 | 6,445 | 1,379 | 3,654 | 877 | 3,246 | 705 | 76,134 | 54,970 | *127,624* | *62,583* | 6,520 | 2,388 | 1,234 | 340 | 1,510 | 275 | 3,668 | 718 | 18,743 | 10,664 | 2,400 | 1,077 | 10,089 | 14,331 | 7,240 | 8,121 | 2,622 | 2,396 | 181,650 | 102,893 |

**Table 14-11 Annual Debt Service on Bonds Sold through December 31, 2015 (in thousands of dollars)** *(continued)*

| Calendar Year | Series A through Y Water Bonds | | Oroville Revenue Bonds[a] | | Pyramid Project Revenue Bonds[b] | | Alamo Project Revenue Bonds[b] | | Small Hydro Project Revenue Bonds[b] | | Water System Facilities Water System Revenue Bonds[c] | | *Subtotal* | | Devil Canyon-Castaic Project Revenue Bonds | | Reid Gardner Project Revenue Bonds[b,c] | | South Geysers Project Revenue Bonds[b] | | Bottle Rock Project Revenue Bonds[b] | | East Branch Enlargement Project Water System Revenue Bonds[c] | | Coastal Extension Facilities Water System Revenue Bonds | | East Branch Extension Facilities Water System Revenue Bonds[c] | | South Bay Enlargement Facilities Water System Revenue Bonds[c] | | Tehachapi East Afterbay Facilities Water System Revenue Bonds[c] | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | *Principal* | *Interest* | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest | Principal | Interest |
| 2018 | 25,435 | 3,011 | 0 | 0 | 4,844 | 1,078 | 2,842 | 716 | 2,516 | 541 | 67,940 | 51,263 | *103,577* | *56,609* | 6,910 | 2,045 | 104 | 273 | 707 | 210 | 1,228 | 542 | 19,271 | 9,805 | 1,680 | 996 | 10,431 | 13,902 | 7,418 | 7,782 | 2,616 | 2,271 | 153,942 | 94,435 |
| 2019 | 16,975 | 1,804 | 0 | 0 | 4,504 | 882 | 2,736 | 607 | 2,184 | 430 | 76,730 | 49,289 | *103,129* | *53,012* | 7,325 | 1,682 | 109 | 269 | 746 | 189 | 1,243 | 500 | 21,446 | 9,053 | 1,094 | 933 | 10,787 | 13,467 | 7,659 | 7,505 | 2,721 | 2,172 | 156,259 | 88,782 |
| 2020 | 17,405 | 956 | 0 | 0 | 5,518 | 681 | 3,327 | 491 | 2,797 | 322 | 72,194 | 46,649 | *101,241* | *49,099* | 7,765 | 1,298 | 113 | 263 | 873 | 163 | 1,455 | 453 | 22,383 | 8,147 | 1,926 | 898 | 11,287 | 12,952 | 7,912 | 7,165 | 2,841 | 2,043 | 157,796 | 82,481 |
| 2021 | 8,595 | 318 | 0 | 0 | 2,636 | 446 | 1,680 | 354 | 1,150 | 197 | 77,163 | 43,060 | *91,224* | *44,375* | 8,230 | 890 | 957 | 258 | 927 | 131 | 2,248 | 396 | 22,459 | 7,153 | 2,090 | 834 | 11,801 | 12,415 | 8,258 | 6,774 | 2,971 | 1,905 | 151,165 | 75,131 |
| 2022 | 1,885 | 60 | 0 | 0 | 5,241 | 339 | 4,962 | 289 | 1,204 | 145 | 74,424 | 39,818 | *87,716* | *40,651* | 8,725 | 458 | 1,003 | 211 | 853 | 95 | 2,194 | 298 | 23,097 | 6,138 | 2,852 | 773 | 12,376 | 11,853 | 8,653 | 6,382 | 3,117 | 1,760 | 150,586 | 68,619 |
| 2023 | 85 | 7 | 0 | 0 | 1,024 | 96 | 550 | 55 | 635 | 90 | 81,068 | 36,652 | *83,362* | *36,900* | 0 | 0 | 554 | 161 | 555 | 59 | 1,881 | 196 | 20,738 | 5,086 | 2,052 | 673 | 12,954 | 11,258 | 9,243 | 5,968 | 3,326 | 1,607 | 134,665 | 61,908 |
| 2024 | 35 | 3 | 0 | 0 | 661 | 50 | 380 | 31 | 427 | 60 | 82,261 | 32,235 | *83,764* | *32,379* | 0 | 0 | 346 | 133 | 441 | 32 | 1,498 | 93 | 20,830 | 4,107 | 2,135 | 589 | 13,596 | 10,622 | 9,707 | 5,503 | 3,496 | 1,442 | 135,813 | 54,900 |
| 2025 | 0 | 0 | 0 | 0 | 149 | 23 | 106 | 16 | 170 | 41 | 78,190 | 29,255 | *78,615* | *29,335* | 0 | 0 | 137 | 116 | 62 | 10 | 61 | 9 | 25,671 | 3,136 | 1,709 | 502 | 14,248 | 9,974 | 10,006 | 5,068 | 3,571 | 1,279 | 134,080 | 49,429 |
| 2026 | 0 | 0 | 0 | 0 | 153 | 18 | 110 | 13 | 178 | 33 | 75,479 | 25,110 | *75,920* | *25,174* | 0 | 0 | 244 | 109 | 64 | 8 | 63 | 7 | 9,320 | 1,865 | 1,787 | 426 | 14,439 | 9,296 | 11,451 | 4,561 | 4,333 | 1,100 | 117,621 | 42,546 |
| 2027 | 0 | 0 | 0 | 0 | 397 | 13 | 283 | 9 | 263 | 25 | 86,420 | 21,602 | *87,363* | *21,649* | 0 | 0 | 314 | 97 | 166 | 6 | 162 | 5 | 8,632 | 1,424 | 1,782 | 346 | 18,217 | 8,577 | 12,523 | 3,998 | 4,860 | 886 | 134,019 | 36,988 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 139 | 14 | 70,829 | 17,687 | *70,968* | *17,701* | 0 | 0 | 421 | 81 | 0 | 0 | 0 | 0 | 8,909 | 1,015 | 2,725 | 280 | 23,802 | 7,671 | 14,054 | 3,379 | 5,612 | 645 | 126,491 | 30,772 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 148 | 7 | 80,035 | 13,762 | *80,183* | *13,769* | 0 | 0 | 439 | 60 | 0 | 0 | 0 | 0 | 7,328 | 594 | 2,881 | 144 | 24,836 | 6,490 | 14,712 | 2,674 | 5,880 | 364 | 136,259 | 24,095 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51,250 | 10,467 | *51,250* | *10,467* | 0 | 0 | 103 | 38 | 0 | 0 | 0 | 0 | 1,315 | 257 | 0 | 0 | 19,490 | 5,260 | 7,788 | 1,980 | 324 | 77 | 80,270 | 18,079 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52,530 | 9,236 | *52,530* | *9,236* | 0 | 0 | 110 | 33 | 0 | 0 | 0 | 0 | 1,335 | 231 | 0 | 0 | 20,280 | 4,469 | 8,160 | 1,649 | 335 | 68 | 82,750 | 15,686 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54,605 | 7,173 | *54,605* | *7,173* | 0 | 0 | 120 | 27 | 0 | 0 | 0 | 0 | 1,395 | 174 | 0 | 0 | 21,105 | 3,645 | 8,530 | 1,269 | 350 | 53 | 86,105 | 12,341 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56,315 | 5,466 | *56,315* | *5,466* | 0 | 0 | 125 | 21 | 0 | 0 | 0 | 0 | 1,435 | 132 | 0 | 0 | 21,960 | 2,788 | 6,480 | 886 | 365 | 41 | 86,680 | 9,334 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58,070 | 3,706 | *58,070* | *3,706* | 0 | 0 | 130 | 14 | 0 | 0 | 0 | 0 | 1,480 | 90 | 0 | 0 | 22,855 | 1,896 | 6,770 | 604 | 380 | 28 | 89,685 | 6,338 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59,880 | 1,885 | *59,880* | *1,885* | 0 | 0 | 140 | 7 | 0 | 0 | 0 | 0 | 1,525 | 45 | 0 | 0 | 23,790 | 967 | 7,060 | 309 | 390 | 14 | 92,785 | 3,227 |
| **Total** | **1,582,400** | **2,386,523** | **244,995** | **246,522** | **107,639** | **195,719** | **60,748** | **100,924** | **49,125** | **81,976** | **2,041,247** | **1,985,749** | ***4,086,154*** | ***4,997,413*** | **139,165** | **283,872** | **448,266** | **570,610** | **74,460** | **115,803** | **156,316** | **227,907** | **485,877** | **613,677** | **43,771** | **46,195** | **370,931** | **292,566** | **215,624** | **146,226** | **68,336** | **45,132** | **6,088,900** | **7,339,401** |

[a] Principal and interest schedule adjusted to reflect early redemption of bonds.
[b] Allocated portions of Power Facilities Revenue Bonds and Water System Revenue Bonds.
[c] Interest includes a minimum fee for Water System Revenue Bonds Series AB.




# Chapter 15
# SWP Education and Information

*Visitors at the California State Fair learn water conservation and drought-tolerant landscaping tips at the Department of Water Resources' outdoor exhibit.*

## Significant Events in 2015

On April 1, immediately following the Department of Water Resources' (DWR) fourth manual snow survey of the winter, which found bare ground and historically low water content, the Governor issued Executive Order B-29-15. The order mandated water restrictions statewide and directed DWR, along with other State agencies, to work with cities and counties to implement statewide water saving programs. The order also streamlined the government review process for major drought-related water infrastructure projects and water transfers.

On April 30, the Governor's Office announced a dual approach to improving water conveyance and ecosystem health in the Sacramento-San Joaquin Delta through two projects, California WaterFix and California EcoRestore.

*Save Our Water*, a partnership between DWR and the Association of California Water Agencies (ACWA), launched the *Let it Go* and the *Turn it Off* campaigns in the summer, and the *Fix it for Good* campaign in the fall. These campaigns featured billboard, radio, Internet, theater, and outdoor advertisements urging continued water conservation efforts.

*Information for this chapter was provided by the Public Affairs Office.*

The Department of Water Resources' (DWR) Public Affairs Office (PAO) produces and distributes news and program information describing California's water resources and DWR's mission, programs, and activities. PAO disseminates information by way of news releases, interviews, Internet posts, and both printed and electronic publications. Other avenues include artwork, films, graphics, exhibits, press conferences, photography, public meetings, social media, and special events.

## News Topics

Selected highlights below provide examples of PAO's 2015 outreach efforts and news media responses related to DWR's water policy, programs, and activities.

### Drought

In 2015, PAO observed an increase in public and media interest regarding California water supply and drought-related activities. To address the various interests, PAO increased its public outreach efforts related to the drought.

#### *Executive Order B-29-15*

On April 1, prompted by a fourth consecutive year of drought, the Governor issued Executive Order B-29-15, directing the first-ever statewide, mandatory water use reductions. Key provisions in the order included:

- ordering the State Water Resources Control Board to impose restrictions to achieve a 25 percent reduction in potable urban water usage through February 28, 2016;
- directing DWR to lead a statewide initiative, in partnership with local agencies, to collectively replace 50 million square feet of lawns and ornamental turf with drought-tolerant landscapes; and
- directing the California Energy Commission to implement a statewide appliance rebate program to provide monetary incentives for the replacement of inefficient household devices.

**Model Water Efficient Landscape Ordinance.** On July 15, the California Water Commission approved the updated Model Water Efficient Landscape Ordinance after DWR was directed in the Governor's April 1 Executive Order to revise the existing model landscape ordinance through expedited regulation. DWR developed the revised ordinance, held public workshops on the revisions, and conducted a 15-day public comment period.

The revised ordinance is expected to reduce a new home's water use by 12,000 gallons a year, or 20 percent. Water use on new commercial landscapes will be cut by approximately 35 percent. The ordinance took effect in December 2015.

**Turf and Toilet Rebate Programs.** On August 12, DWR announced two new rebate programs, financed by Proposition 1, which enabled DWR to carry out the Governor's April 1 Executive Order to further reduce water use in homes. DWR oversaw the two rebate programs: one that provided a $100 consumer rebate to replace one inefficient toilet per household; and one that provided up to $2 per square foot to remove lawns and replace them with water-efficient landscaping.

#### *Emergency Drought Barrier*

On February 12, DWR staff organized an informational meeting in Clarksburg about preparations for emergency drought barriers in Delta channels. The overview of the proposal was followed by a question-and-answer period. Several print, television, and radio outlets attended.

In May, installation of the emergency temporary rock barrier began. The barrier was installed on West False River to deter saltwater intrusion from the San Francisco Bay and to conserve water in upstream reservoirs that would be needed for the Delta to protect water quality. Barrier dismantling was completed in November. Project updates were delivered to the public and media via news releases, website updates, and social media.

For more information about the Emergency Drought Barrier, see Chapter 4, Water Quality Programs and Chapter 7, Water Supply Development and Reliability.

### *Save Our Water*

On June 30, *Save Our Water*, a 13-year partnership between DWR and the Association of California Water Agencies, launched a summer campaign with the messages of *Let It Go* and *Turn it Off*, encouraging Californians to continue to conserve water by allowing grass to turn brown and by turning off sprinklers.

The fall campaign, *Fix It for Good,* urged Californians to make permanent changes to save water such as drought-resistant landscapes, water-efficient appliances, and fixture replacements.

The two campaigns included social media messaging, billboards, radio spots, direct mail, theater ads, and outdoor media.

## Snow Surveys

Beginning in late December or early January, DWR conducts five monthly snow surveys to obtain an estimate of snow water content. Data collected in the snow surveys are used to estimate spring and summer snowmelt runoff. The melting snowpack provides much of the State's irrigation and drinking water as demand peaks during the summer months.

In 2015, due to the severity of the drought and lack of snow, DWR conducted only four media-oriented snow surveys in the Sierra Nevada, with the final April 1 survey reporting a record-low measurement at the Phillips Station survey site near Lake Tahoe.

Statewide snowpack water content on April 1 was just 5 percent of the historical average for the date. In 2014, water content was 33 percent of average, and 47 percent of average in 2013.

Media interest was high for all manual snow surveys. PAO distributed news releases on the snow survey findings, historical data, and video and photo links. PAO spoke to many media outlets about the severity of the drought and California's water supply and shared snow survey results on DWR's main website and on social media.

## State Water Project Allocations

On December 1, 2014, DWR announced an initial allocation of 10 percent for the 29 State Water Project (SWP) water contractors that collectively serve more than 25 million Californians and about 750,000 acres of irrigated farmland. On January 15, 2015, DWR announced an increase in the allocation to 15 percent. With the help of mid-December and early February storms, SWP allocations increased to 20 percent on March 2.

The 2014 final allocation of 5 percent was the lowest allocation in SWP history. The final SWP allocation in 2013 was 35 percent of the SWP water contractor requests. In 2012, the first year of the ongoing drought, the final allocation was 65 percent.

## Bay Delta Conservation Plan/ California WaterFix

California WaterFix is a collaborative effort by State and federal agencies to improve California's aging water delivery system.

On April 30, the Governor's Office announced a plan to fix the SWP's aging infrastructure and restore the Delta's ecosystem by splitting the multifaceted Bay Delta Conservation Plan project into two different efforts, California WaterFix and California EcoRestore.

On July, 9, the partially recirculated draft environmental impact report/supplemental draft environmental impact statement for the Bay Delta Conservation Plan/California WaterFix was released. The public comment period that began July 10 was scheduled to end August 31, but was extended an additional 60 days to October 30.

Additional information can be found in Chapter 3, Environmental Programs.

## Solverde I Solar Facility

On December 15, DWR announced a new 20-year power purchase agreement to provide solar power to the SWP from the Solverde I Solar Facility. The facility will be located in Lancaster, and is expected to be fully operational by December 2016. The facility is part of DWR's long-term effort to reduce greenhouse gas emissions.

## SWP Publications

PAO creates and maintains approximately 40 brochures describing the SWP, its mission, and its facilities. The brochures are periodically updated and distributed statewide to educate the public about the SWP.

Brochures distributed to stakeholders, the public, and DWR's Visitors Centers during 2015 included updated versions of the *SWP Visitors Centers* and *History of California Water Development*. Spanish translations were completed for the *Easy Ways to Save Water* brochure and *The Water Cycle* handout. A new *Water Safe for Life with Albert & Einstein Along the California State Water Project* brochure in Spanish was created.

### *E-News*

Each weekday, PAO compiles and electronically distributes news articles, blogs, and commentaries on water-related issues to more than 5,000 subscribers. These news clips inform DWR staff of water issues relevant to DWR and its programs.

Topics highlighted in the weekday news clips include water supply, water quality, drought, watersheds and programs, and agencies and people.

### *Spotlight Stories and Social Media*

On DWR's main website and on DWR's Facebook page, many Spotlight Stories were featured in 2015. Subjects included how California coped with the fourth year of drought, how green power energizes the SWP, snow surveys, emergency groundwater wells, and the salmon passage project at Knights Landing.

DWR increased Facebook and Twitter messaging in 2015. PAO posted four to five messages per week on Facebook and Twitter about various DWR projects, updates, and activities of interest to the public and DWR employees. In 2015, DWR's Facebook followers increased to 5,577.

### *DWR Magazine*

Published three times a year, this news magazine features articles describing DWR programs, staff, and activities.

In 2015, articles covered how Californians were mandated to save water, the Emergency Drought Barrier installation in the Delta, the Clifton Court Forebay predation study, how the Division of Environmental Services monitors turbidity in the Delta, and the installation of a weather buoy at Folsom Lake to study evaporation.

## DWR Tours Program

The DWR tours program regularly attracts foreign and domestic tour groups. The SWP and its water supply mission is the major attraction.

Strong interest in SWP operations among foreign and domestic organizations continued in 2015 as California's historic drought intensified. The DWR tours program arranged visits by academics and water managers from Asia, Europe, the Middle East, and the Americas, who were all interested in how DWR was managing the State's water resources during an extended dry period.

Teachers and students from high school through law school visited DWR as they sought information about the SWP and the drought. The schools included: the University of California, Davis; Humboldt State University; McGeorge School of Law, University of the Pacific; the Urban School of San Francisco; and schools from the Tuolumne County school system.

As a basic component of DWR's Training Program, tours to the Sacramento–San Joaquin Delta and to Oroville Dam and Lake Oroville were provided for recently hired DWR employees.

During 2015, foreign agencies sending visitors to DWR and the SWP included: the Environmental Protection Association and the Ministry of Agriculture and Rural Community Cooperation of South Korea; the Ministries of Energy, Water, and Agriculture from Afghanistan; Taiwan's Ministry of Economic Affairs and Water Resources Agency; the Shanxi Grand Water Network of China; and Singapore's Public Utilities Board, among others.

In 2015, several visits were highlighted among foreign and domestic tour groups.

- The Ministry of Environment, Republic of Korea, sent a delegation seeking information about how DWR and other agencies in California cooperate to protect sources of drinking water.
- Representatives of the Environment Agency-Abu Dhabi visited DWR to compare how environmental programs are designed and implemented, with a focus on groundwater resources management.
- The World Food Center sponsored a visit to Oroville Dam for water experts from private and public sectors who had met at the University of California, Davis to discuss food security from a global perspective.
- The Northern California World Trade Center brought water managers from Afghanistan and Pakistan to DWR to discuss climate change impacts and the drought's effect on SWP hydroelectric power operations.

Figure 15-1 shows the SWP visitors center locations.

## Community Relations and Recreational Safety

In 2015, PAO staff continued to educate the public about the drought, water conservation, and the *Save Our Water* program through DWR's award-winning, water-efficient gardens and exhibits at the California State Fair, which ran from July 10 through July 26.

PAO staff also provided exhibits at the following events:

- San Francisco Flower & Garden Show;
- International Sportsmen's Exposition, Sacramento;
- Healthy Kids Day, Oroville;
- Sacramento Area Creeks Council Creek Week Event;

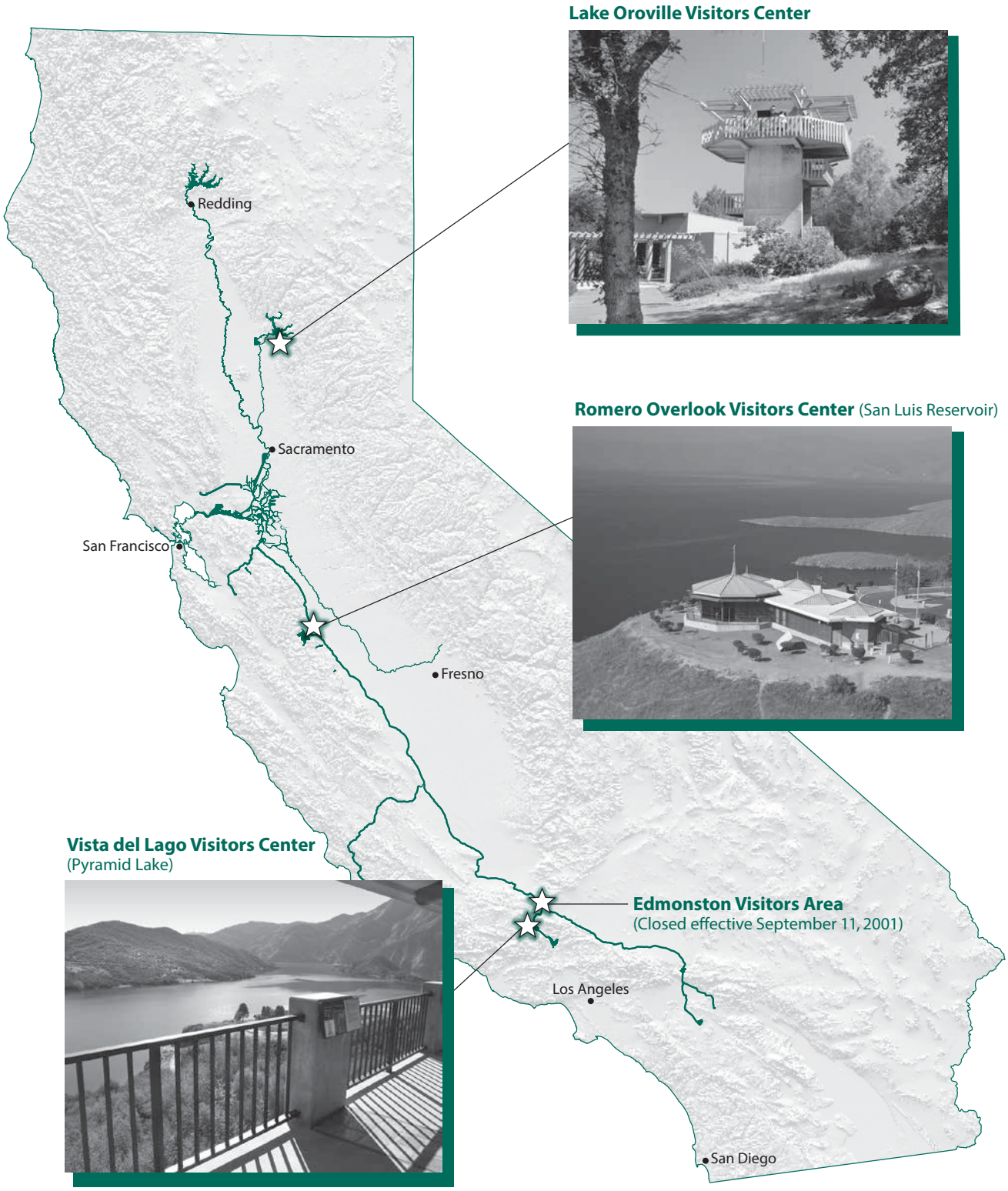



**Figure 15-1** **Visitors Centers on the SWP**

- Feather Fiesta Days, Oroville;
- YMCA Kids Adventure Day, Oroville;
- Sacramento Earth Day;
- World Ag Expo,Tulare;
- CalSTRS Earth Day, West Sacramento;
- CalEPA Earth Day, Sacramento;
- Walk on the Wildside, Sacramento;
- Hooked on Fishing, Not on Drugs, Oroville;
- California State Fair, Sacramento;
- Big Fresno Fair;
- 6th Annual Sacramento Banana Festival;
- Department of Social Services Emergency Preparedness Fair 2015, Sacramento;
- Office of Emergency Services National Preparedness Month, California Day of Preparedness, Sacramento;
- 48th Annual Native American Day, California State Capitol, Sacramento;
- Oroville Salmon Festival; and
- Grape, Raisin & Nut Expo, Fresno.

DWR also co-sponsors and coordinates "Catch A Special Thrill" (C.A.S.T.) fishing events for children with special needs. During 2015, C.A.S.T. events were held at Lake Oroville, Brannan Island State Recreation Area near Rio Vista, O'Neill Forebay at San Luis State Recreation Area, and Silverwood Lake.

DWR continued its partnerships with communities to offer nine Aquatic Adventure Camps throughout the summer months, teaching water safety to young people. In 2015, the camps utilized SWP facilities at Lake del Valle and Castaic Lake.

## SWP Recreation Outreach Program

The goal of the SWP recreation outreach program is to educate the public about the many recreational opportunities available at SWP facilities. PAO staff attends community events; State and county fairs; State and federally sponsored events; and forms partnerships with State, federal, and community groups.

### *SWP Recreation Outreach Events*

DWR, the California Department of Parks and Recreation, and several partner agencies co-sponsored or attended the following recreation outreach events in 2015:

- International Sportsmen's Exposition, Sacramento;
- Jack Splash Club/Oroville YMCA Fit-N-Fun Day;
- Feather Fiesta Days, Oroville;
- Healthy Kids Day, Oroville;
- Hooked on Fishing, Not on Drugs, Oroville; and
- Oroville Salmon Festival.

The Jack Splash Club was created by PAO as a way to interest and educate kids and their families in the Oroville area about safe water recreation. The Oroville YMCA helps manage the club because of its water safety programs, fitness programs, and community standing.

# School Education Program

The School Education Program's goal is to provide students and educators with a statewide perspective on water issues such as conservation, conveyance systems, and the water cycle. PAO staff develops and promotes high-quality materials, providing them free of charge to schools, educators, and water districts. Program achievements for 2015 are described below.

## Public Events and Outreach

In 2015, PAO staff provided displays of DWR's interactive children's exhibits and other educational materials at the:

- 48th Annual Native American Day, California State Capitol, Sacramento;
- Sacramento Area Creeks Council Creek Week Event;
- Water Conservation Presentation, St. Philomene School, Sacramento;

- CalEPA Earth Day, Sacramento; and
- State Scientist Day, Sacramento.

PAO staff organized a team of DWR judges from multiple divisions and provided a special award at the Sacramento Regional Science and Engineering Fair in Sacramento.

PAO staff also assisted at the *Save Our Water* booths at two events in Sacramento: the Office of Emergency Services National Preparedness Month, California Day of Preparedness; and the California State Fair.

## Publications and Materials

Curriculum materials and children's videos were provided to California teachers and water agencies through the *Water Facts & Fun* online catalog and order form and during promotional events. During 2015, the following materials were purchased or reprinted:

- 1,500 *Teacher's Guide for Hands-on Water Activities* booklets;
- 5,000 *Water & Me* color and activity booklets; and
- 5,000 hamburger activity sheets.

## Collaboration and Partnerships

DWR's School Education Program seeks to partner with other entities with similar interests and goals to pool resources in educating California's youth on the importance of water resources. During 2015, PAO staff participated in the following collaborative activities/meetings:

- DWR's Water Education Committee meeting;
- Project Water Education for Teachers (WET) Advisory Committee, the California Environmental Education Interagency Network Committee;
- Creek Week Planning Committee and the Kids' Art Contest Winner Selection Subcommittee; and
- Caring for Our Watersheds contest, sponsored by Agrium Inc. and the Center for Land-Based Learning.

Additional collaborative efforts included PAO staff working with the following:

- California Department of Education's California Regional Environmental Education Community network;
- California Environmental Education Foundation;
- California Project WET program;
- Floodplain and Delta Ecology Institute for teachers, co-sponsored with the San Joaquin County Office of Education;
- Floodplain and Riparian Ecology Institute for teachers, co-sponsored with California State University, Chico;
- Central Valley Floodplain Ecology Institute for Educators, co-sponsored with the SAM Academy and the Central Valley Science Project, California State University, Fresno; and
- Delta Studies Institute for teachers, co-sponsored with the San Joaquin County Office of Education.

# Glossary

This glossary contains terms used in the text of Bulletin 132-16 as well as additional terms related to water resources.

## *A*

**abundance** The number of organisms of a particular kind in a population. (See also, abundance index.)

**abundance index** (fisheries) A relative measure of the weight or number of fish in a stock, a segment of the stock (e.g. the spawners), or an area. Often available in time series, the information is collected through scientific surveys or inferred from fishery data.

**acre-foot** The volume of water that would cover one acre to a depth of one foot; equal to 43,560 cubic feet or 325,851 gallons.

**adaptive management** The process of improving management effectiveness by learning from the results of carefully designed decisions or experiments.

**adipose fin** A small fleshy fin with no rays on the topside of a fish located between the fin on the back and the tail fin.

**afterbay** A storage reservoir downstream of a power plant or large reservoir that regulates fluctuating discharges from a spillway, hydroelectric power plant, or a pumping plant.

**agricultural drainage** (1) The process of directing excess water away from root zones by natural or artificial means, such as by using a system of drains placed below ground surface level (also called subsurface drainage); (2) the water drained away from irrigated farmland.

**alluvium** Unconsolidated soil strata deposited over time by flowing water.

**amphipod** A small crustacean with a flat (laterally compressed) body belonging to the group Amphipoda, found in both marine and freshwater environments.

**anadromous** Fish that live the majority of their life cycle in the sea and return to freshwater streams to spawn.

**anion** An atom or a molecule in which the total number of electrons is greater than the total number of protons, giving it a net negative electrical charge.

**aquifer** A geologic formation that stores water underground (called groundwater), especially one that yields significant quantities of water to wells or springs.

**arid** Describes a climate or region in which precipitation is so deficient in quantity or occurs so infrequently that intensive agricultural production is not possible without irrigation.

**artificial recharge** The addition of surface water to a groundwater basin by human activity, such as putting surface water into spreading basins.

**atmospheric river** A short-lived, narrow stream of high-velocity wind that carries large amounts of water vapor from tropical oceans to mid-latitude land areas resulting in large amounts of precipitation in those areas.

**average annual runoff** The average value of annual runoff volume calculated for a selected period of record, at a specified location, such as a dam or stream gauge.

**average year water demand** Demand for water under average hydrologic conditions for a defined level of development.

## *B*

**balanced water conditions** These exist when upstream reservoir storage releases, plus other inflows, approximately equal the water supply needed to (1) satisfy Sacramento Valley and Sacramento-San Joaquin Delta in-basin needs, including Delta water quality requirements, and (2) meet export needs. DWR and the Bureau of Reclamation jointly decide when balanced or excess water conditions exist.

**beach seine** A rectangular net with poles attached to the ends that is held vertically in the water and dragged through the water a short distance to capture fish.

**beneficial use** Water quality beneficial use categories for water are designated by State law. Beneficial uses of the waters of the State that may be protected against water quality degradation include, but are not limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

**benthic organisms** Aquatic animals without backbones that dwell on or in the bottom sediments of fresh or salt water.

**biological assessment** A document prepared as part of the Endangered Species Act, Section 7 process to determine whether a proposed major

construction activity under the authority of a federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.

**biological opinion** A scientific assessment issued by the U.S. Fish and Wildlife Service or National Marine Fisheries Service, required by the Endangered Species Act for listed species. Determines the likelihood of a federal action to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

**biota** Living organisms of a region, as in a stream or other body of water.

**brackish water** Water containing dissolved minerals in amounts that exceed normally acceptable standards for municipal, domestic, and irrigation uses. Considerably less saline than seawater.

**bromide** A salt which naturally occurs in small quantities in seawater; a compound of bromine.

**Burns-Porter Act** (California Water Code Section 12930 et seq.) Formally known as the California Water Resources Development Bond Act, this act passed the Legislature in 1959 and was approved by voters in 1960. It provided initial funding of $1.75 billion in general obligation bonds and authorized construction of the State Water Project facilities.

**bypass** As part of a flood management system, a natural overflow area or channel that allows excessive floodwaters to flow or be diverted from a main river channel to prevent water from overflowing the main river channel.

## C

**CALFED Bay-Delta Program** (CALFED) A federal and State multiagency program established by the 1994 Bay-Delta Accord. CALFED's mission was to develop and implement a long-term comprehensive plan that would restore ecological health and improve water management in the Bay-Delta system. In 2010, all functions and responsibilities of CALFED were assumed by the Delta Stewardship Council.

**California Data Exchange Center** (CDEC) CDEC installs, maintains, and operates an extensive hydrologic data collection network including automatic snow reporting gauges for the DWR Cooperative Snow Surveys Program and precipitation and river stage sensors for flood forecasting. CDEC provides a centralized location to store and process real-time hydrologic information gathered cooperatively throughout the State.

**California Irrigation Management Information System** (CIMIS) A network of automated weather stations that are owned and operated cooperatively between DWR and local agencies. The stations are installed in

most of the agricultural and urban areas of the State and provide farm and large landscape irrigation managers and researchers with "real-time" weather data to estimate crop and landscape evapotranspiration rates and make irrigation management decisions.

**California Water Resources Simulation Model** (CALSIM) A computer model that simulates operations of SWP and Central Valley Project water delivery systems. CALSIM II is a planning tool that was jointly developed by DWR and the Bureau of Reclamation. The model's inputs include hydrologic data for specified study planning years, water demands, infrastructure and regulatory change, and other factors. Outputs include deliveries to water contractors, river flows, reservoir changes, Delta hydrologic parameters, and other data.

**cation** An atom or a molecule in which the total number of protons is greater than the total number of electrons, giving it a net positive electrical charge.

**Central Valley Project deliveries** The volume of water imported to a given area through the Central Valley Project.

**ciliates** Single-celled organisms, characterized by the presence of many hair-like structures called cilia used for locomotion and for feeding.

**climate change** Any significant change in the measures of climate lasting for an extended period of time. This includes major changes in temperature, precipitation, or wind patterns, among other things, that occur over several decades or longer.

**coded wire tag** A small piece of stainless steel wire injected into the snout of juvenile salmon and steelhead. Each tag is etched with a binary code that identifies a fish release group.

**conjunctive use** Application of surface water and groundwater to meet the demand for a beneficial use. Coordinated and planned management of both surface water and groundwater resources to maximize the efficient use of the resources; that is, the planned and managed operation of a groundwater basin and a surface water storage system combined through a coordinated conveyance infrastructure. Water is stored in the groundwater basin for later planned use by intentionally recharging the basin during years of above-average surface water supply.

**conservation facilities** Reservoir facilities that store water and make it available for later use.

**consultation** The process required of a federal agency under Section 7 of the Endangered Species Act when any activity authorized, carried out, or conducted by that agency may affect a listed species or designated critical

habitat; consultation is with the U.S. Fish and Wildlife Service or National Marine Fisheries Service and may be either informal or formal.

**conveyance** Provides for the movement of water and includes the use of natural watercourses and constructed facilities including open channels, pipelines, diversions, fish screens, distribution systems, and pump lifts.

**conveyance facilities** Canals, pipelines, pump lifts, ditches, etc., used to move water from one area to another.

**cryptomonad** A single-celled, photosynthetic organism with two flagella that inhabits both marine and freshwater environments.

**cyanobacteria** Photosynthetic, nitrogen-fixing, colonial bacteria found in a wide variety of terrestrial and aquatic habitats, often referred to as "blue-green algae."

## *D*

**Davis-Grunsky Act** Authorized in 1960 as part of the Burns-Porter Act, this act provides construction loans for local domestic water projects and agricultural water conservation projects.

**Delta outflow** Freshwater outflow from the Sacramento-San Joaquin Delta to protect the beneficial uses within the Delta from the incursion of saline water.

**Delta outflow index** A calculated approximation of the seaward freshwater outflow as it passes Chipps Island near Pittsburg, beyond the confluence of the Sacramento and San Joaquin rivers.

**desalting** A process to reduce the salt concentration of seawater or brackish water.

**diatom** Microscopic marine or freshwater colonial algae that have cell walls made out of silica.

**dinoflagellate** A small, single-celled organism with flagella and an internal skeleton of cellulose-like plates found in both marine and freshwater environments and best known as causers of harmful algal blooms.

**discount rate** The interest rate used to calculate the present value of future benefits and future costs or to convert benefits and costs to a common time basis.

**dissolved organic compounds** Carbon-based substances dissolved in water.

**dissolved oxygen** The amount of oxygen dissolved in water or wastewater, usually expressed in milligrams per liter, parts per million, or percent of saturation.

**distinct population segment** A subdivision of a species that is treated as a species for purposes of listing under the Endangered Species Act. The smallest division of a taxonomic species that can be protected under the Endangered Species Act.

**drainage area** The area of land from which water drains into a river; for example, the Sacramento River Basin, in which all land area drains into the Sacramento River. Also called a watershed, drainage basin, or river basin.

**drought preparedness** The magnitude and probability of economic, social, or environmental consequences that would occur as a result of a sustained drought under a given study plan.

**drought condition** Hydrologic conditions during a defined period, greater than one dry year, when precipitation and runoff are much less than average.

**drought year supply** The average annual supply of a water development system during a defined drought period.

**Delta Simulation Model 2** (DSM2) A hydrodynamic and water quality simulation model used to simulate water flow and quality conditions in the Sacramento-San Joaquin Delta. The model is frequently used to evaluate potential changes in Delta conditions (salinity, flow, and water level) associated with changes in flow patterns in the Delta.

## *E*

**ecosystem restoration** The activity of improving the condition of natural landscapes and biotic communities.

**effluent** Wastewater or other liquid, treated or in its natural state, flowing from a treatment plant or process.

**electrical conductivity** The measure of the ability of water to conduct an electrical current, the magnitude of which depends on the dissolved mineral content of the water.

**endangered species** An animal or plant species in danger of extinction throughout all or a significant portion of its range.

**entrainment** The unintended diversion of fish (or other aquatic organisms) into an unsafe passage route. The incidental trapping of any life stage of fish within waterways or structures that carry water being diverted for use

elsewhere. Fish are considered "entrained" when they enter a diversion point, which for the SWP is Clifton Court Forebay.

**environmental impact report** A report done to analyze project or program impacts on a variety of resources under the California Environmental Quality Act.

**environmental impact statement** A report done to analyze project or program impacts on a variety of resources under the National Environmental Policy Act.

**environmental water** The water for wetlands, for the instream flow in a major river or the Bay-Delta, or for a designated wild and scenic river.

**escapement** The portion of an anadromous fish population that escapes commercial and recreational fisheries and reaches its freshwater spawning grounds.

**estuary** A semi-closed coastal body of water where the lower course of a river enters the sea, influenced by tidal action where the tide meets the river flow, resulting in brackish water.

**evapotranspiration** The amount of water transpired by plants, retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (See also, reference evapotranspiration.)

**excess water conditions** Periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceeds Sacramento Valley in-basin uses plus exports. DWR and the Bureau of Reclamation jointly decide when balanced or excess water conditions exist. During excess water conditions, sufficient water is available to meet all beneficial needs, and the SWP and Central Valley Project are not required to supplement the supply with water from reservoir storage.

**export** An amount of water transported from one source or location to another.

## *F*

**firm yield** The maximum annual supply of a water development project under drought conditions, for some specified level of demand.

**flagellates** Organisms with one or more whip-like structures called flagella, which are used for locomotion or feeding.

**floodplain** A strip of relatively level land bordering a stream or river that is often inundated during times of high water.

**forages** Food for animals, especially crops grown to feed horses, cattle, and other livestock.

**forebay** A reservoir at the intake of a pumping plant or power plant to stabilize water levels; also a storage basin for regulating water for percolation into groundwater basins.

**fork length** A measurement used frequently for fish length when the tail has a fork shape; projected straight distance between the tip of the snout and the fork of the tail.

**freeboard** The height of the physical top of a levee above a specified water surface elevation. This serves as a factor of safety for containing water in the stream or reservoir without overtopping the levee or dam.

**fry** Young, recently hatched fish that are able to swim and catch their own food.

## *G*

**greenhouse gas emissions** Also referred to as carbon intensity or carbon footprint, greenhouse gases trap heat in the atmosphere and contribute to climate change. They include carbon dioxide, methane, nitrous oxide, and fluorinated gases.

**grilse** A term that generally refers to young adult salmonids of a certain length and age. Grilse are often 55–65 centimeters (22–26 inches) in length. They are assumed to be two years old, and adults are assumed to be age three and older.

**groundwater** Water located beneath the land surface that fills the pore spaces of the alluvium, soil, or rock formation in which it is situated. It excludes soil moisture, which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

**groundwater bank** Groundwater banking refers to the practice of recharging specific amounts of water in a groundwater basin during wet or above-average years, which can later be withdrawn and used by the depositing entity.

**groundwater basin** An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.

**groundwater recharge** The natural or intentional infiltration of surface water into the zone of saturation of an aquifer (i.e., into groundwater).

**groundwater storage capacity** The volume of void space that can be occupied by water in a given volume of a formation, aquifer, or groundwater basin.

**groundwater table** The upper surface of the zone of saturation in an unconfined aquifer.

## *H*

**habitat** The place or environment where a plant or animal naturally lives and grows with a group of particular environmental conditions.

**habitat conservation plan** A plan that outlines ways of maintaining, enhancing, and protecting a given habitat type needed to protect species; it usually includes measures to minimize impacts, and may include provisions for permanently protecting land, restoring habitat, and relocating plants or animals to another area. Required before a federal Endangered Species Act incidental take permit may be issued.

**halophyte** A plant capable of growing in salty soil.

**haptophyte** A kind of unicellular marine phytoplankton typically covered in tiny scales or plates composed of carbohydrates and calcium deposits.

**hydraulic barrier** (1) A barrier created by injecting fresh water to control seawater intrusion in an aquifer, or created by water injection to control migration of contaminants in an aquifer. (2) A barrier developed in the estuary (the Delta) by release of fresh water from upstream reservoirs to prevent intrusion of seawater into the body of fresh water.

**hydrologic balance** An accounting of all water inflow to, water outflow from, and changes in water storage within a hydrologic unit over a specified period of time.

**hydrologic basin** Where, conceptually, any drop of water that falls in the basin will flow to a stream or groundwater basin within it. It is a larger set of which a subset is the groundwater basin that can be within a hydrologic basin. DWR's hydrologic regions are collections of the larger hydrologic basins.

**hydrologic region** DWR divides California into 10 hydrologic regions, corresponding to the state's major water drainage basins: North Coast, San Francisco Bay, Central Coast, South Coast, Sacramento River, San Joaquin River, Tulare Lake, North Lahontan, South Lahontan, and Colorado River.

**hydrology** The science dealing with the occurrence, circulation, distribution, and properties of the waters of the earth and its atmosphere.

## I

**in-lieu recharge** The practice of providing surplus surface water to historic groundwater users, thereby leaving groundwater in storage for later use.

**ion exchange** Processes of purification, separation, and decontamination of aqueous and other ion-containing solutions with solid ion exchangers (such as sodium carbonate used for water softening).

**instream use** Use of water within its natural watercourse as specified in an agreement, water rights permit, etc. For example, the use of water for navigation, recreation, fish and wildlife, aesthetics, and scenic enjoyment.

**integrated regional water management** A comprehensive approach for determining the appropriate mix of demand and supply management options to provide long-term, reliable water supply at the lowest reasonable cost and with the highest possible benefits to customers, economic development, environmental quality, and other social objectives.

**invertebrate** An animal that lacks a backbone.

## J

**joint points of diversion** The ability of the SWP to use Jones Pumping Plant as a point of diversion and the Central Valley Project to use Banks Pumping Plant as a point of diversion. The SWP and Central Valley Project may use one another's diversion facilities under certain conditions.

**joint powers agreement** An agreement entered into by two or more public agencies that allows them to jointly exercise any power common to the contracting parties. This is defined in Chapter 5 (commencing with Section 6500) of Division 7 of Title 1 of the California Government Code.

**joint-use facilities** Those portions of the SWP that serve both SWP and Central Valley Project functions, and in which both State and federal agencies participate in the construction and use; specifically, the San Luis complex and Reaches 3, 4, 5, 6, and 7 of the California Aqueduct.

**jurisdictional dam** Artificial barriers, together with appurtenant works, which are 25 feet or more in height or have an impounding capacity of 50 acre-feet or more, which are regulated by the DWR Division of Safety of Dams.

## K

**kathablepharid** A specific type of cryptomonad.

## *L*

**land subsidence** The lowering of the natural land surface in response to: earth movements; the lowering of fluid pressure or groundwater level; consolidation of underlying soils; removal of underlying supporting materials by mining (e.g., oil and gas extraction); compaction caused by wetting; or oxidation of organic matter in soils (e.g., peat soil being converted to gas).

**legal Delta** The legal geographical boundaries of the Sacramento-San Joaquin Delta, as established by the Delta Protection Act of 1959, and as defined in California Water Code Section 12220.

**listed species** A species, subspecies, or distinct population segment that has been added to the federal list of endangered and threatened wildlife and plants. The term also applies to a species or subspecies added to the California list of endangered or threatened plants and animals.

## *M*

**maximum contaminant level** The highest drinking water contaminant concentration allowed under federal and State Safe Drinking Water Act regulations.

**mitigation** (1) An action or set of actions designed to avoid, minimize, reduce, eliminate, or compensate for adverse environmental impacts due to an agency activity or program. (2) Reduction of human activities that affect global climate change, including strategies to reduce greenhouse gas emissions.

**Monterey Agreement** An agreement executed in December 1994 among DWR and the SWP water contractors to address fundamental contract issues by amending the long-term water supply contracts.

**Monterey Amendments** Amendments to the long-term water supply contracts for the SWP entered into by DWR and most (27 of 29) of the SWP water contractors in 1995 and 1996 as implementation of the terms of the Monterey Agreement.

**multipurpose project** A project, usually a reservoir, designed to serve more than one purpose, whose costs are normally allocated among the different functions it provides. For example, a project that provides water supply, flood control, and generates hydroelectricity.

## *N*

**natural community conservation planning** (NCCP) A process that promotes multispecies and multihabitat management and conservation through cooperative efforts among public agencies, private landowners, and other interests within a plan area. It provides a framework for minimizing impacts on plant communities and wildlife from proposed development projects.

**natural recharge** Natural replenishment of an aquifer generally from snowmelt and runoff through seepage from the surface.

**net groundwater** The amount of groundwater extraction in excess of deep percolation.

**nonreimbursable costs** The part of project costs allocated to general statewide or national beneficial purposes and funded from general revenues, rather than by water users.

**normalized demand** The process of adjusting actual water use in a given year to account for unusual events such as dry weather conditions, government price support programs for agriculture, rationing programs, or other unusual conditions.

## *O*

**operational yield** An optimal amount of groundwater that should be withdrawn from an aquifer system or a groundwater basin each year. It is a dynamic quantity that must be determined from a set of alternative groundwater management decisions subject to goals, objectives, and constraints of the management plan.

**Operations Criteria and Plan** (OCAP) (1) The document titled, "Long-Term Central Valley Project Operations Criteria and Plan," that serves as a baseline description of the facilities and operating environment of the Central Valley Project and the SWP and identifies factors influencing the physical and institutional conditions and decision-making processes under which the projects currently operate. Regulatory and legal requirements are explained and alternative operating models and strategies described. (2) The document titled, "Central Valley Project Operations Criteria and Plan" (CVP-OCAP, 2004), that describes the laws, regulations, and other criteria applicable to operations of the Central Valley Project that were in effect from 1991 through 2003.

**Operations Criteria and Plan biological opinion** (1) The document titled, "Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and the State Water Project" (NOAA Fisheries, 2009).

(2) The December 15, 2008, memorandum from the U.S. Fish and Wildlife Service to the Bureau of Reclamation that comprises the U.S. Fish and Wildlife Service biological opinion on the coordinated operations of the Central Valley Project and the SWP.

**ostracod** A type of bivalve (with a hinged, two-part shell) crustacean, mostly microscopic to small in size, found in aquatic and marine habitats occurring as benthic or planktonic organisms.

**otolith** Ear bone of a fish. Otoliths often show seasonal or annual rings that can be used to determine age.

**outflow** The amount of applied water and conveyance water leaving the service area. Also conveyance outflow.

## *P*

**parr** The developmental life stage of salmon and trout when the young have developed parr marks (vertical bars or spots on the sides of the fish) and are actively feeding in fresh water.

**pelagic** Inhabiting the water column as opposed to being associated with the bottom; generally occurring anywhere from the water's surface down to, but not including, the bottom.

**pelagic fish** Fish that live in open water, often near the surface.

**perched groundwater** Groundwater supported by a zone of material of low permeability located above an underlying main body of groundwater.

**perennial yield** The maximum quantity of water that can be annually withdrawn from a groundwater basin over a long period of time without developing an overdraft condition.

**permeability** The capability of soil or other geologic formations to transmit water.

**phytoplankton** Minute plants, such as algae, that live suspended in bodies of water and drift with the current.

**precipitation** A deposit on the earth of hail, rain, mist, sleet, or snow. It is the common process by which atmospheric water becomes surface or subsurface water.

**project yield** The water supply attributed to all features of a project, including integrated operation.

**proposal solicitation package** (PSP) As part of the formal solicitation for grant applications, a PSP provides detailed instructions on the mechanics of submitting proposals and specific information on submittal requirements.

**public trust doctrine** A legal doctrine recognizing public rights in the beds, banks, and waters of navigable waterways, and the State's power and duty to exercise continued supervision over them as trustee for the benefit of the people.

**pump lift** (1) The vertical distance that a pump will raise water. (2) The distance between the groundwater table and the overlying land surface.

**pumped storage project** A hydroelectric power plant and reservoir system using an arrangement whereby water released for generating energy during peak load periods is stored and pumped back into the upper reservoir, usually during periods of reduced power demand.

**pumping-generating plant** A plant that can either pump water or generate electricity, depending on the direction of water flow.

**punch list** A list of tasks or "to-do" items necessary for the completion of a construction project.

## *Q*

**Quantification Settlement Agreement** A complex package of agreements that defines the rights to a portion of Colorado River water for four water agencies in Southern California, provides for water transfers, and establishes a Joint Powers Authority to oversee restoration of the Salton Sea. The *Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement* was signed in October 2003 by Coachella Valley Water District, Imperial Irrigation District, The Metropolitan Water District of Southern California, the San Diego County Water Authority, and the federal government.

## *R*

**radial gates** Gates used to control the flow of water into or from a reservoir, canal, or pipeline, or through a channel. Each gate can close under its own weight and is operated independently by remote control.

**radio-telemetry** Automatic measurement and transmission of data from remote sources via radio to a receiving station for recording and analysis.

**rate structure** Designates the rate basis for cost recovery (e.g., flat, uniform, tiered, etc.). Block/tiered rates are assumed to provide cost signals to

consumers. Costs can include capital, operation and maintenance, financing, environmental compliance (documentation, permitting, and mitigation), etc.

**raw water** Water found in the environment, such as rainwater, surface water (e.g., lakes, streams, and the ocean), or groundwater, that has not been treated. Most water is considered raw until it is treated for consumption or used for agriculture or industry.

**reach** On the California Aqueduct, a specific segment of the canal, identified by a number, which is the smallest unit of the SWP identified in water supply contracts for cost allocation and repayment purposes.

**rearing** Refers to the amount of time that juvenile fish spend feeding in nursery areas of rivers, lakes, streams, and estuaries before migration.

**reasonable and prudent alternatives** Alternative actions that can be implemented in a manner consistent with the intended purpose and scope of a project, are economically and technologically feasible, and would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

**recharge** Water added to an aquifer or the process of adding water to an aquifer. Groundwater recharge occurs either naturally as the net gain from precipitation or artificially as the result of human influence.

**recharge basin** A surface facility constructed to infiltrate surface water into a groundwater basin.

**recreation** Water-dependent recreation activities that are consumptive (e.g., parks), flat-water (e.g., boating), or flow-based (e.g., whitewater rafting).

**recycled water** (1) The application of treated water/reclaimed water to meet a beneficial use, supplanting a potable or potentially potable supply. (2) Treated municipal, industrial, or agricultural wastewater to produce water that can be reused.

**redd** A shallow nest of fish eggs covered with gravel in a streambed.

**reference evapotranspiration** ($ET_o$) The evapotranspiration rate from an extended surface of 3 to 6 inch (8 to 15 centimeter) tall green grass cover of uniform height, actively growing, completely shading the ground, and not short on water.

**reliability planning** Water reliability management planning is done by comparing the costs of taking actions to maintain or increase reliability to the costs of accepting less reliability. On this basis, accepting the costs of the adverse effects of less than 100 percent reliability could be a legitimate planning decision. Providing full water supply to meet 100 percent of

projected future water demand is not the planning goal, rather, the goal is to find the justified level of reliability.

**reoperation** See system reoperation.

**repayment reach** California Aqueduct reaches are delineated for the purpose of making project repayment as equitable as possible. The reaches are generally numbered consecutively from the Delta, with Reach 1 being first. Repayment reaches vary greatly in length. (See also, reach.)

**required instream flow** The amount of water required for instream use by agreement, water rights permit, or State/federal acts.

**reused water** The application of previously used water to meet a beneficial use, whether treated or not prior to the subsequent use. (See also, recycled water.)

**return flow** The portion of withdrawn water not consumed by evapotranspiration or system losses which returns to its source or to another body of water.

**reverse osmosis** A method to remove salts and other constituents from water by forcing water through membranes.

**riparian area** The area of land adjacent to a stream, lake, or wetland with vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas. Riparian areas provide important fish and wildlife habitat.

**riparian (water) right** A right to use surface water derived from the fact that the land in question abuts the banks of a stream or other water source (lake or pond). These rights are senior to most appropriative water rights.

**riprap** A layer of large uncoursed stones, broken rock, boulders, or precast blocks placed in random fashion on the upstream and downstream faces of embankment dams, stream banks, on a reservoir shore, on the sides of a channel, or other land surfaces to protect them from erosion caused by current, wind, wave, and/or ice action. Very large riprap is sometimes referred to as "armoring."

**run (of fish)** A group of fish of the same species whose upstream spawning migration timing is associated with the seasons, e.g., fall, spring, summer, and winter runs. Members of a run may interbreed with fish of another run.

**runoff** The volume of surface flow from an area during a specified period. Natural runoff is the portion of precipitation that runs off the land and makes up the natural flow in rivers. Incidental runoff is the portion of precipitation that would have been used by natural vegetation but now contributes to

runoff. This is a result of roads, paved areas, building roofs, land drainage systems, fields developed for irrigation, and other changes in land use.

## *S*

**sabellid polychaete** A segmented marine worm that lives in a tube that it builds.

**saline intrusion** The movement of salt water into a body of fresh water. It can occur in either surface water or groundwater bodies.

**salinity** Generally, the concentration of mineral salts dissolved in water. Salinity may be expressed in terms of a concentration, weight (total dissolved solids), electrical conductivity, or osmotic pressure. When describing salinity influenced by seawater, salinity often refers to the concentration of chlorides in the water. (See also, total dissolved solids.)

**salmonid** A fish species belonging to the salmon family, including salmon and trout.

**salt-water barrier** A physical facility or method of operation designed to prevent the intrusion of salt water into a body of fresh water.

**salvage (fish)** At the SWP and Central Valley Project fish protective facilities, fish are removed from export water, transported, and released away from the influence of the water diversion facilities.

**sediment** Soil or mineral material transported by water and deposited in streams or other bodies of water.

**seepage** The gradual movement of water into, through, or from a porous medium. Also, the infiltration of water into the soil from canals, ditches, laterals, watercourses, reservoirs, storage facilities, or other bodies of water, or from a field.

**service area** The geographic area served by a water agency.

**smolt** A juvenile salmonid fish that has assumed the silvery color of the adult and, while migrating toward the ocean, is undergoing physiological changes that will allow it to live in salt water.

**snowpack** The annual accumulation of snow in mountain areas.

**soluble minerals** Naturally occurring substances capable of being dissolved.

**special status species** Plants or animals legally protected under either the federal or California Endangered Species Act or the California Fish and Game Code; those species not currently protected by statute but considered to be rare or endangered under the California Environmental Quality Act; and species considered by the scientific community to be sufficiently rare to qualify for legal protection (e.g., candidate species for listing as threatened or endangered, species of concern to the Department of Fish and Wildlife or U.S. Fish and Wildlife Service, or rare plants identified by the California Native Plant Society).

**species of concern** An informal term referring to a species that might be in need of conservation action.

**spillway** The section of a dam designed to permit water to pass over its crest; a weir or channel taking overflow from the dam. The spillway serves as a safety channel to prevent erosion or overtopping of the dam.

**sprinkler irrigation** A method of irrigation in which the water is sprayed, or sprinkled, through the air to the ground surface.

**stakeholder** Individuals or groups who can affect or be affected by an organization's activities; individuals or groups with an interest or "stake" in what happens as a result of a decision or action.

**State Water Project deliveries** The volume of water imported to a given area through the State Water Project.

**statewide water management systems** These include physical facilities (more than 1,200 State, federal, and local reservoirs, as well as canals, treatment plants, and levees), which make up the backbone of water management in California; and statewide water management programs, which include water-quality standards, monitoring programs, economic incentives, water-pricing policies, and statewide water-efficiency programs such as appliance standards, labeling, and education.

**strategic plan** The long-term goals of an organization or program and an outline of how the goals will be achieved (e.g., adopting specific strategies, approaches, and methodologies).

**stocking** Releasing hatchery-raised fish into a water body for the purposes of supplementing existing populations or creating new ones for fishing (also referred to as "planting").

**streamflow** The rate of water flow past a specified point in a channel.

**subsidence** See land subsidence.

**surface storage** Surface storage uses reservoirs to collect water for later release and use.

**surface supply** Water supply obtained from streams, rivers, lakes, and reservoirs.

**system reoperation** Changes to existing water system operations and management procedures for existing reservoirs and conveyance facilities to increase their water-related benefits.

## *T*

**temporary urgency change petition** A formal request to the State Water Resources Control Board for conditional, temporary changes to the terms and conditions of a water right. Temporary urgency change orders issued by the State Water Resources Control Board allow water right holders to temporarily deviate from the terms of their existing water right.

**threatened species** An animal or plant species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

**tidal wetlands** The margins of an estuary that are periodically inundated by tides; includes all habitats within the elevation range between the lowest and highest tides: intertidal mudflats, regularly inundated tidal marsh plains, tidal channels within the marsh, and infrequently inundated wetland-upland transition zones at the edge of the upland.

**total capital cost** The total monetary cost of options required for "turnkey" implementation, including environmental and third-party impact mitigation, storage, conveyance, energy, capitalized operations and maintenance, administrative costs, planning costs, legal costs, and engineering costs.

**total dissolved solids** The quantity of the residual minerals dissolved in water that remain after evaporation of a solution.

**transpiration** An essential physiological process in which plant tissues give off water vapor into the atmosphere.

**tributary** A stream that flows into a larger stream or other body of water.

**tubificid worm** An aquatic worm with a small, thin, segmented body.

**turbidity** A measure of the cloudiness of water caused by the presence of suspended particles in the water that attenuate or reduce light penetration. Turbidity in natural waters may be composed of organic and/or inorganic constituents and may have direct implications to drinking water treatment.

**turnout** The point at which water is diverted from a main channel or water delivery facility to a distributing facility; a structure through which a water contractor takes delivery of water.

## *U*

**unimpaired flow** The flow past a specified point on a natural stream that is unaffected by stream diversion, storage, import, export, return flow, or change in use caused by modifications in land use.

**unimpaired runoff** A representation of the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds.

**Urban Water Management Planning Act** Sections 10610 through 10657 of the California Water Code. The act requires urban water suppliers to prepare urban water management plans that describe and evaluate sources of water supplies, efficient uses of water, demand management measures, implementation strategies and schedules, and other relevant information and programs within their water service areas. Urban water suppliers (Section 10617) are either publicly or privately owned and provide water for municipal purposes, either directly or indirectly, to more than 3,000 customers or supply more than 3,000 acre-feet of water annually.

**urban water use** The use of water for urban purposes, including residential, commercial, industrial, recreation, energy production, military, and institutional classes. The term is applied in the sense that it is a kind of use rather than a place of use.

**urban water use efficiency** Methods or technologies resulting in the same beneficial residential, commercial, industrial, and institutional uses with less water or increased beneficial uses from existing water quantities.

## *V*

**vernal pools** A type of wetland that occurs in shallow foothill and valley depressions. Water remains in pools and swales until it evaporates, usually within a few days to a few months, mainly in late winter and spring.

**volatile organic compound** (VOC) A man-made organic compound that readily vaporizes in the atmosphere. These compounds are often highly mobile in the groundwater system and are generally associated with industrial activities.

## *W*

**wastewater** Domestic or municipal sewage or effluent from an industrial process.

**water demand** The desired quantity of water that would be used if the water were available and if a number of other factors, such as price, did not change. Demand is not static.

**water exchange** Typically, water delivered by one water user to another water user; the receiving water user will return the water at a specified time or when the conditions of the parties' agreement are met. (See also, water transfer.)

**water quality** Description of the chemical, physical, and biological characteristics of water, usually with regard to its suitability for a particular purpose or use.

**water quality objectives** Specific, legally enforced levels of water quality desired for identified uses including drinking, recreation, fish production or propagation of other aquatic life, agriculture, industry, and urban use.

**water recycling** The process of treating wastewater, rendering it suitable for beneficial use.

**water right** In water law, the right of a user to use water from a water source (e.g., a river, stream, pond, or source of groundwater).

**water service reliability** The degree to which a water service system can successfully manage water shortages.

**water supply exports** The amount of water that a region transfers to another to meet needs.

**water table** See groundwater table.

**water transfer** A temporary or long-term change in the point of diversion, place of use, or purpose of use due to a transfer or exchange of water or water rights. A more general definition is that water transfers are a voluntary change in the way water is usually distributed among water users in response to water scarcity.

**water year** A continuous 12-month period for which hydrologic records are compiled and summarized. Different agencies may use different calendar periods for their water years. For DWR, a water year is October 1 through September 30.

**watershed** The land area from which water drains into a stream, river, or reservoir. Also called drainage area, drainage basin, or river basin.

**watershed management** The process of evaluating, planning, managing, restoring, and organizing land and other resource use within an area that has a single common drainage point.

**weir** (1) Any structure across a watercourse used to control, raise, or measure flows. (2) A barrier constructed to catch upstream migrating adult fish.

**wetlands** Lands including swamps, marshes, bogs, and similar areas such as wet meadows, river overflows, mud flats, and natural ponds. An area characterized by periodic inundation or saturation, certain types of soils, and vegetation adapted for life in saturated soil conditions.

**Wild and Scenic River systems** State and federally designated river systems under the 1968 national Wild and Scenic Rivers Act and the 1972 California Wild and Scenic Rivers Act. Seventeen rivers in California, including many forks and tributaries, are designated wild, scenic, or recreational.

**wheel** As applied to water and power, to provide the use of one agency's conveyance facilities for the purpose of transporting another agency's supply.

## *X*

**X2** Delta outflow interaction with tides determines the location of the X2 isohaline salinity gradient. X2 is the location in the Bay-Delta where the tidally averaged bottom salinity is 2 parts per thousand. It is expressed as the distance in kilometers from the Golden Gate Bridge. X2 is used as a primary indicator in managing Delta outflow.

## *Z*

**zooplankton** Small aquatic animals that are suspended or swimming in water.

# Bulletin 132-16

# Appendix B

# Data and Computations Used to Determine 2017 Water Charges

Appendix B, Data and Computations Used to Determine 2017 Water Charges, was previously printed and distributed under an August 2016 cover letter from Pedro Villalobos, Acting Chief of SWPAO, to State Water Project water contractors to document and support DWR's calculation of the contractors' annual charges. Appendix B appears on the following pages as it was published in August 2016. However, Table B-7 was not published in the August 2016 version of Appendix B because the data were not available at the time of publication. Table B-7 now appears in its entirety on page B-78.

# Appendix B
# Data and Computations
# Used to Determine 2017 Water Charges

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# SWP Water Contractors

The State Water Project water supply contractors are listed below, followed by shortened forms of their names that are used in Bulletin 132.

| | |
|---|---|
| Alameda County Flood Control and Water Conservation District, Zone 7 | Alameda-Zone 7 |
| Alameda County Water District | Alameda County |
| Antelope Valley-East Kern Water Agency | AVEK |
| Castaic Lake Water Agency | Castaic Lake |
| City of Yuba City | Yuba City |
| Coachella Valley Water District | Coachella |
| County of Butte | Butte |
| County of Kings | Kings |
| Crestline-Lake Arrowhead Water Agency | Crestline |
| Desert Water Agency | Desert |
| Dudley Ridge Water District | Dudley Ridge |
| Empire West Side Irrigation District | Empire |
| Kern County Water Agency | Kern |
| Littlerock Creek Irrigation District | Littlerock |
| The Metropolitan Water District of Southern California | Metropolitan |
| Mojave Water Agency | Mojave |
| Napa County Flood Control and Water Conservation District | Napa |
| Oak Flat Water District | Oak Flat |
| Palmdale Water District | Palmdale |
| Plumas County Flood Control and Water Conservation District | Plumas |
| San Bernardino Valley Municipal Water District | San Bernardino |
| San Gabriel Valley Municipal Water District | San Gabriel |
| San Gorgonio Pass Water Agency | San Gorgonio |
| San Luis Obispo County Flood Control and Water Conservation District | San Luis Obispo |
| Santa Barbara County Flood Control and Water Conservation District | Santa Barbara |
| Santa Clara Valley Water District | Santa Clara |
| Solano County Water Agency | Solano |
| Tulare Lake Basin Water Storage District | Tulare |
| Ventura County Watershed Protection District | Ventura |

# Appendix B
# Data and Computations
# Used to Determine 2017 Water Charges

The Department of Water Resources (DWR) annually furnishes Statements of Charges to the 29 State Water Project (SWP) water supply contractors. Article 29(e) of the *Standard Provisions for Water Supply Contract*, approved August 3, 1962, describes those statements:

> "All such statements shall be accompanied by the latest revised copies of the document amendatory to Article 22 and of Tables B, C, D, E, F, and G of this contract, together with such other data and computations used by the State in determining the amounts of the above charges as the State deems appropriate."

To comply with Article 29(e), DWR performs an annual comprehensive review and redetermination of all water supply and financial aspects of the SWP for the entire project repayment period. This annual redetermination is performed in accordance with Article 22(f) and Article 28 of the water supply contracts, which concern the Delta Water Rate and annual transportation charges, respectively.

Appendix B includes data used to document the redetermination of water charges to be paid by contractors during calendar year 2017. The information is based on established data about the SWP, both known and projected, as of June 2016; however, small volumes of water may be reclassified over time pursuant to water supply contract provisions. If research requires more current data than was available at the time of production of Bulletin 132, please contact the State Water Project Analysis Office. Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

The computational procedures and interrelationships between tabulations in this appendix are outlined on *Figures B-1* and *B-2*. All tables referenced on Figures B-1 and B-2 follow this text.

## Types of Water Charges

Charges to SWP water supply contractors include the costs of facilities for the conservation and development of a water supply and the conveyance of such supply to SWP service areas. These facilities are classified as "Project Conservation Facilities" and "Project Transportation Facilities" in the *Standard Provisions for Water Supply Contract*. Names of the main facilities in each classification follow.

Project Conservation Facilities

- Frenchman Dam and Lake
- Grizzly Valley Dam and Lake Davis
- Antelope Dam and Lake
- Oroville Dam and Lake Oroville
- Oroville power facilities
- Delta facilities
- Suisun Marsh facilities
- Yolo Bypass
- A portion of the California Aqueduct from the Delta to Dos Amigos Pumping Plant

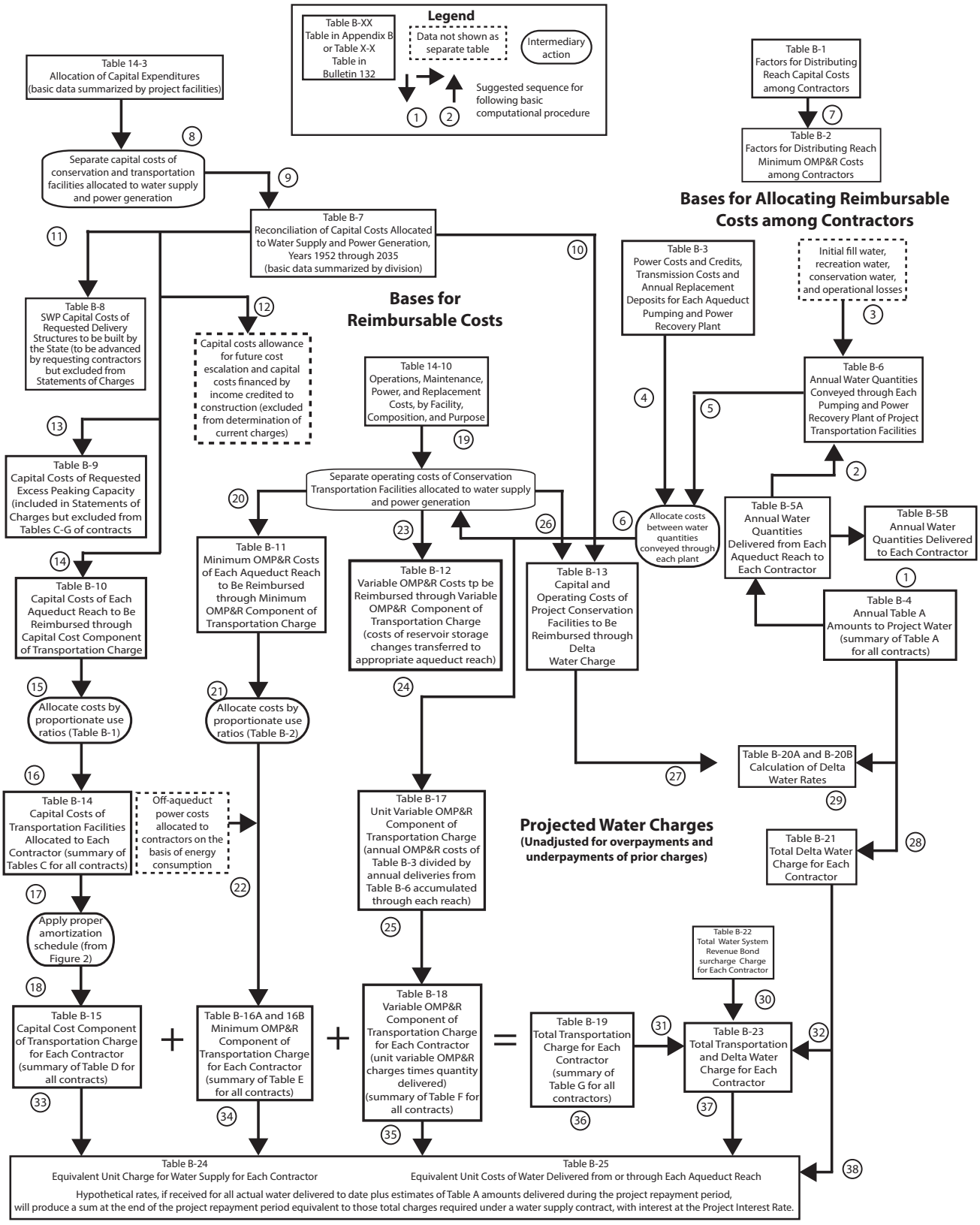



**Figure B-1 Relationships of Data Used to Substantiate Statements of Charges**

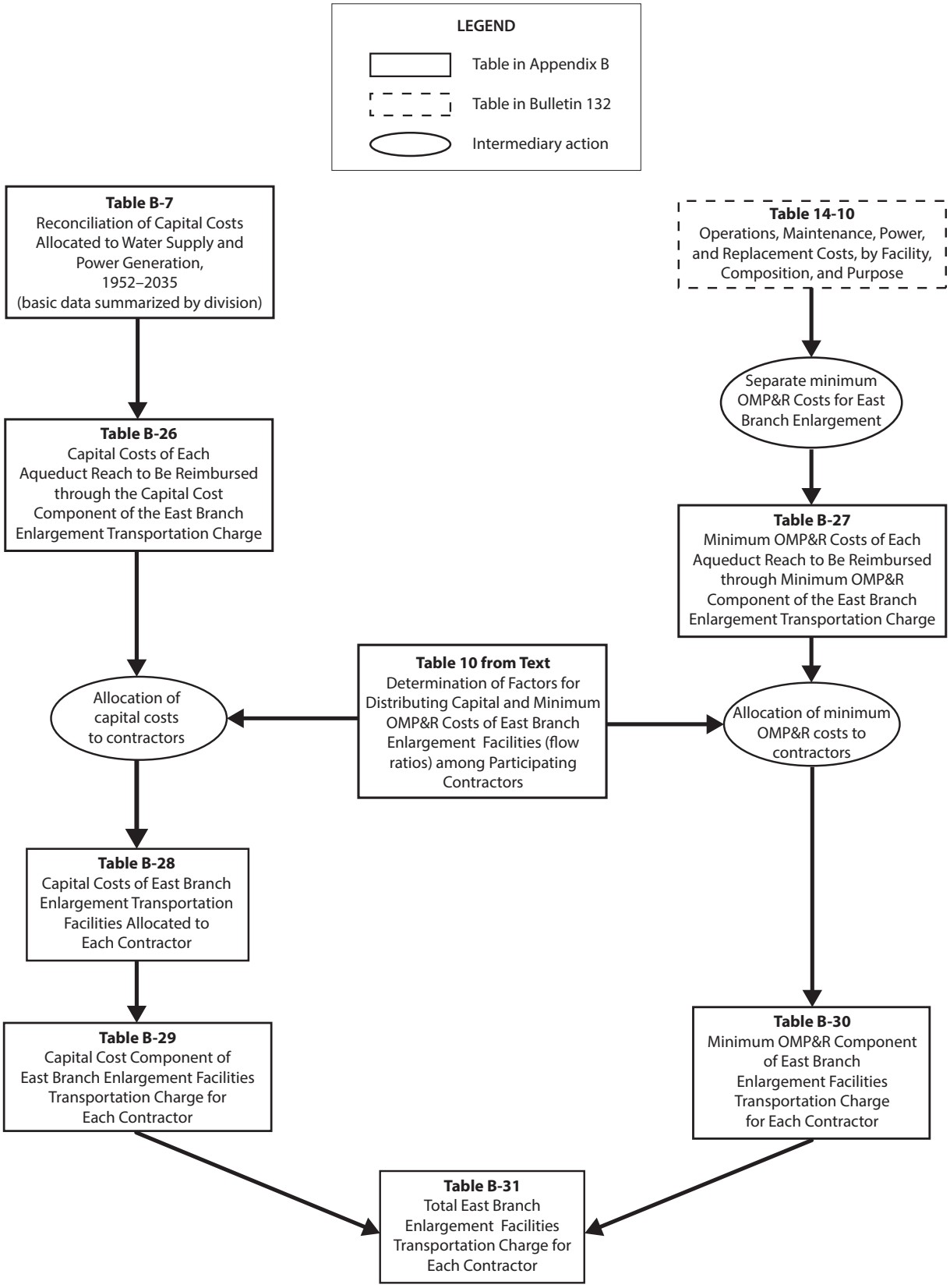



**Figure B-2 Relationships of Data Used to Substantiate East Branch Enlargement Charges**

- Sisk Dam, San Luis Reservoir, and Gianelli Pumping-Generating Plant

Project Transportation Facilities

- Grizzly Valley Pipeline
- North Bay Aqueduct
- South Bay Aqueduct, including Del Valle Dam and Lake del Valle
- the remainder of the California Aqueduct from the Delta to Dos Amigos Pumping Plant and all facilities south, including dams and lakes in Southern California
- Off-Aqueduct Power Facilities (Reid Gardner Unit No. 4, Bottlerock Powerplant, and South Geysers Powerplant)

The standard provisions provide for a Delta Water Charge and a Transportation Charge for project water.

The Delta Water Charge is a unit charge applied to each acre-foot of SWP water the contractors are to receive, in accordance with their contracts. The unit charge, if applied to each acre-foot of all such allocations for the remainder of the project repayment period, is calculated to result in repayment of all outstanding reimbursable costs of the Project Conservation Facilities, with appropriate interest, by the end of the repayment period (2035).

The Transportation Charge is for use of facilities to transport water to the vicinity of each contractor's turnout(s). Generally, the annual charge represents each contractor's proportionate share of the reimbursable capital costs and operating costs of the Project Transportation Facilities.

Each contractor's allocated share of those reimbursable capital costs is amortized for repayment to the State, and certain variations are allowed in the amortization methods. Contractors' shares of reimbursable operating costs are repaid in the year such costs are incurred by the State.

The East Branch Enlargement Transportation Charge is paid by the seven Southern California contractors participating in the enlargement. San Bernardino Valley Municipal Water District advanced funds to pay the district's allocated capital costs for the East Branch Enlargement. The remaining six contractors pay an allocated share of the debt service on revenue bonds sold to finance the enlargement. Each contractor will also pay an allocated share of the minimum operation, maintenance, power, and replacement (OMP&R) costs of the East Branch Enlargement.

Transportation charges for the Coastal Branch Extension, East Branch Extension, and South Bay Enlargement are being repaid by contractors in their respective service areas.

Transportation charges for the Tehachapi Afterbay are repaid by those contractors using electrical power for delivery of their Table A water downstream of the Tehachapi Afterbay.

## Composition and Timing of Water Charges

As shown on *Figure B-3*, the Delta Water Charge and the Transportation Charge consist of the following three components:

(1) conservation and transportation capital cost components, which will return to the State all reimbursable capital costs;
(2) conservation and transportation minimum OMP&R components, which will return to the State all reimbursable operating costs that do not depend on or vary with quantities of water actually delivered to the contractors; and
(3) a transportation variable OMP&R component, which will return to

**Delta Water Charge**

*Capital Cost Component*

1. Planning, design, right-of-way, and construction costs of Conservation Facilities
2. Operations and maintenance (O&M) costs for newly constructed Conservation Facilities prior to initial operations
3. Activation costs for newly constructed Conservation Facilities
4. Power costs allocated to initial filling of San Luis Reservoir
5. Capitalized O&M costs (major repair work and so forth) for Conservation Facilities
6. Program costs (portion) to mitigate impacts on current Delta fishery population due to State Water Project (SWP) pumping prior to 1986 (Department of Water Resources-Department of Fish and Game agreement)

*Minimum Operations, Maintenance, Power, and Replacement (OMP&R) Component*

1. Direct O&M costs of Conservation Facilities
2. General O&M costs allocated to Conservation Facilities
   a. Contractor Accounting Office (portion)
   b. Financial and contract administration (portion)
   c. Water rights
   d. Power planning for SWP facilities (portion)
3. Replacement deposits for SWP control centers (portion)
4. Credits for a portion of Hyatt-Thermalito power generation
5. Power costs and credits related to pumping water to San Luis Reservoir for project operations (storage changes)
6. Value of power used and generated by Gianelli Pumping-Generating Plant
7. Program costs (portion) to offset annual fish losses resulting from pumping at Banks Pumping Plant (Department of Water Resources-Department of Fish and Game agreement)

**Transportation Charge**

*Capital Cost Component*

1. Planning, design, right-of-way, and construction costs of Transportation Facilities
2. Operations and maintenance (O&M) costs for newly constructed Transportation Facilities prior to initial operation
3. Activation costs for newly constructed Transportation Facilities
4. Power costs allocated to initial filling of Southern California reservoirs
5. Capitalized O&M costs (e.g., major repair work) for Transportation Facilities
6. Program costs (portion) to mitigate impacts on current Delta fishery population due to SWP pumping prior to 1986 (Department of Water Resources-Department of Fish and Game agreement)

*Minimum OMP&R Component*

1. Direct O&M costs of Transportation Facilities
   a. Headquarters and field divisions (portion)
   b. Insurance and Federal Energy Regulatory Commission (FERC) costs (portion)
2. General O&M costs related to Transportation Facilities
   a. Contractor Accounting Office (portion)
   b. Financial and contract administration (portion)
   c. Power planning for SWP facilities (portion)
3. Power costs and credits related to pumping water to Southern California reservoirs for project operations (storage changes)
4. Power costs for pumping water to replenish losses from Transportation Facilities (downstream costs)
5. Other power costs
   a. Station service at Transportation Facility power and pumping plants
   b. Certain transmission service costs (transmission access charges, downstream costs, etc.)
6. Replacement deposits for SWP control centers (portion)
7. Off-Aqueduct Power Facility costs—bond service, bond cover costs (25 percent of bond service), bond reserves, transmission service costs, fuel costs, taxes, and O&M—less power sales allocated to Off-Aqueduct Power Facilities
8. Program costs (portion to offset annual fish losses resulting from pumping at Banks Pumping Plant (Department of Water Resources-Department of Fish and Game agreement)

*Variable OMP&R Component*

1. Power purchase costs
   a. Capacity
   b. Energy
   c. Pine Flat Powerplant bond service, O&M, and transmission costs allocated to aqueduct pumping plants
2. Alamo, Devil Canyon, Warne, and Castaic power generation credited at the power plant reach and charged to aqueduct pumping plants
3. Hyatt-Thermalito Diversion Dam Powerplant generation charged to aqueduct pumping plants (credits for this generation are reflected in the Delta Water Rate)
4. Replacement deposits for equipment at pumping plants and power plants
5. Credits from sale of excess SWP system power
6. Program costs (portion) to offset annual fish losses resulting from pumping at Banks Pumping Plant (Department of Water Resources-Department of Fish and Game agreement)

Note: Excludes costs recovered under the East Branch Enlargement Transportation Charge.

**Figure B-3 Composition of Delta Water Charge and Transportation Charge**

the State all reimbursable operating costs that depend on and vary with quantities of water actually delivered to the contractors.

The formula for computing the Delta Water Rate, Article 22(f) of the *Standard Provisions for Water Supply Contract*, was designed to ensure that all adjustments for prior overpayments or underpayments of the Delta Water Charge are accounted for in a redetermination of the rate. Since the redetermined rate applies to all future allocations, such adjustments are amortized during the remainder of the project repayment period. This appendix includes a redetermination of the Delta Water Rate for 2017.

Article 28 of the standard provisions stipulates that Transportation Charges be redetermined each year. The tables in Appendix B include the numerical data used in this redetermination. Transportation Charges for prior years through 2016, included in those tables, are the redetermined amounts and do not equal the amounts actually paid by contractors.

As provided under the Water System Revenue Bond Amendment to the water supply contracts, differences between actual payments under the Transportation capital cost component and amounts computed in this redetermination are accumulated with interest and amortized during the remaining years of the contract repayment period. All computations for adjustments are included in the attachments accompanying each contractor's Statement of Charges and are reflected in revised copies of Table C through Table G of the contract, which are also furnished to each SWP contractor in its annual Statement of Charges.

These redeterminations exclude four charges associated with water service other than the Delta Water Charge and the Transportation Charge. The excluded charges (and the manner in which they are treated in this appendix) are outlined below.

(1) Advances of funds pursuant to Article 24(d) of the standard provisions for excess capacity constructed by the State at the request of contractors.
(2) Advances of funds pursuant to Article 10(d) of the standard provisions for delivery structures (turnouts) constructed by the State at the request of contractors. Partial information concerning actual and projected capital costs of such delivery structures is included in this appendix. Statements concerning these costs and data are furnished to the appropriate contractors at various times and are not part of the annual statements.
(3) Payments for sale and service of surplus water to entities other than contractors, pursuant to Article 21 of the standard provisions, are also excluded. Those payments are generally based on the unit rates shown in Table B-25. Net revenues resulting from noncontractor service are applied as indicated on page 24 of Bulletin 132-71.
(4) Payments under the Devil Canyon-Castaic contract for costs of the Devil Canyon-Castaic facilities allocable to power generation. Charges billed as a result of the contract are billed separately from those billed as a result of the water supply contract. Information about the treatment of such charges in relation to redetermined Transportation Charges is included in special attachments to the bills of the six participating contractors.

Time and method of payment for corresponding components of the Delta Water Charge and the Transportation Charge are as follows:

(1) The capital cost components of the Delta Water Charge and the

Transportation Charge are paid in two semiannual installments, due January 1 and July 1 of each year, based on statements furnished by the State on or before July 1 of the preceding year.

(2) The minimum OMP&R components of the Delta Water Charge and the Transportation Charge are paid in 12 equal installments due the first of each month and based on statements furnished by the State on or before July 1 of the preceding year.

(3) The variable OMP&R component of the Transportation Charge is paid in varying monthly amounts and is due the fifteenth day of the second month following actual water delivery. The charges are projected based on a unit charge per acre-foot established on or before July 1 of the preceding year. Those unit charges may be revised during the year to reflect current power costs and revenues. The unit charges are applied to actual monthly delivery quantities as determined by the State on or before the fifteenth day of the month following actual water delivery.

# Bases for Allocating Reimbursable Costs among Contractors

This section describes procedures for allocating reimbursable costs of Project Transportation Facilities among contractors (see upper right portion of Figure B-1). Those costs do not include annual costs of Off-Aqueduct Power Facilities, which are explained in the "Project Water Charges" section.

## Capital and Minimum OMP&R Costs

*Figure B-4* includes information about the repayment reaches that form the basis for allocating reimbursable costs of the Project Transportation Facilities among contractors. Allocations of reimbursable capital costs and minimum OMP&R costs of each reach are based on the proportionate maximum use of that reach by respective contractors under planned conditions of full development.

The derivation of ratios that represent the proportionate maximum use of each aqueduct reach by the respective contractors was first reported in Bulletin 132-70. The ratios in Bulletin 132-70 were subsequently revised for the North Bay Aqueduct, the South Bay Aqueduct, the California Aqueduct from the Delta to Castaic Lake, and the Coastal Branch.

All the revisions reported in previous bulletins regarding the derivation of ratios that represent the proportionate maximum use of each aqueduct reach by the respective contractors were last reported in Tables B-1 and B-2 of Bulletin 132-91. Under Article 53 of the Monterey Amendment, agricultural contractors may sell up to 130,000 acre-feet of aqueduct capacity to municipal and industrial contractors. The first permanent transfer occurred in 1998. Currently, 114,000 acre-feet of the allowable capacity has been transferred. *Table 1* shows the permanent capacity transfers that have taken place since the Monterey Amendment was implemented in 1995.

*Table B-1* presents the reach ratios currently applicable to reimbursable capital costs. These reach ratios do not reflect the permanent capacity transfers.

*Table B-2* presents corresponding ratios for allocating 2016 and after reimbursable minimum OMP&R costs among contractors. Requested excess capacity is omitted when deriving ratios applicable to capital costs because the capital costs for the excess capacity are paid on an incremental-cost basis and not a proportionate-use basis. However, requested excess capacity is accounted for in the ratios applicable to minimum OMP&R costs.

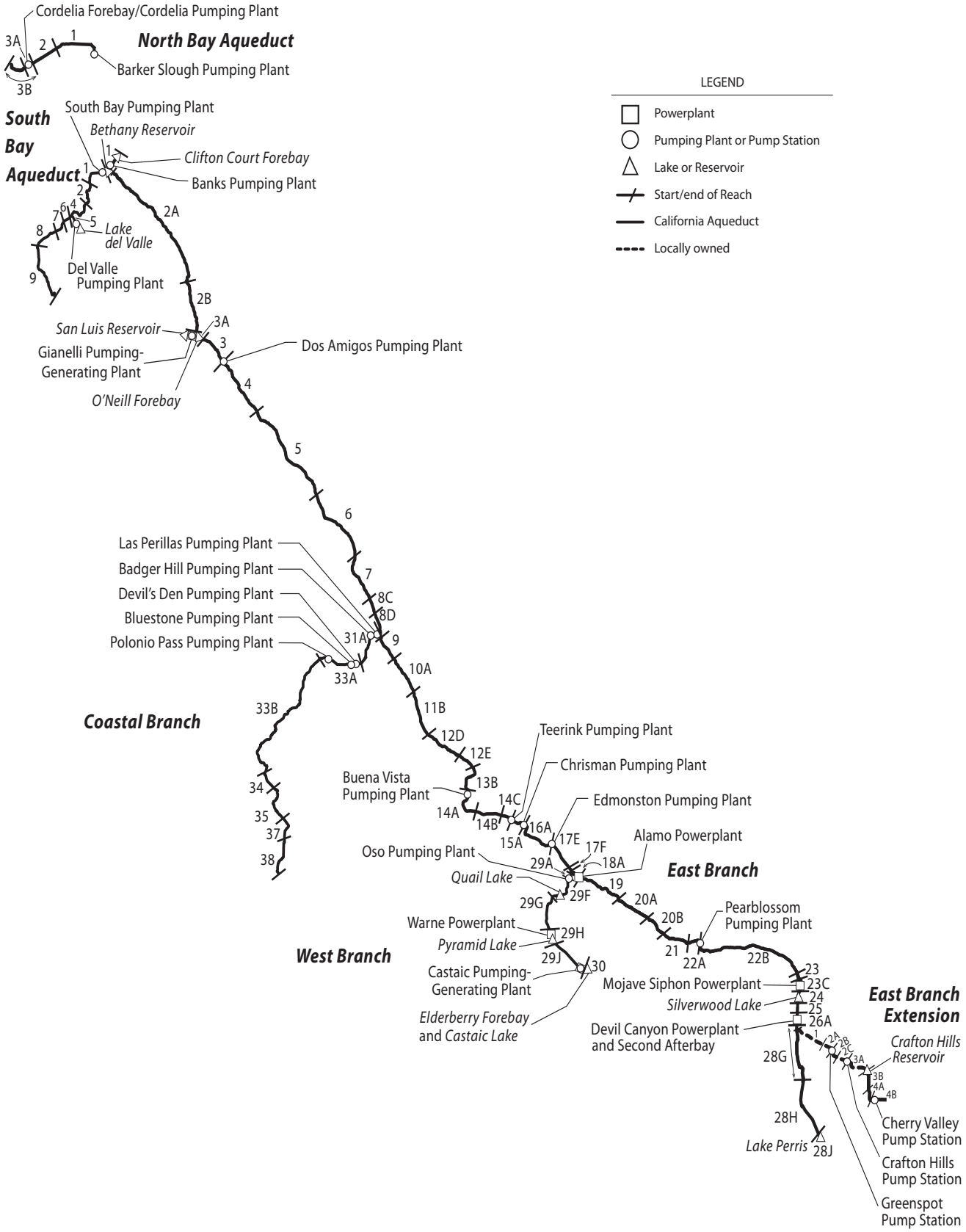



**Figure B-4 Repayment Reaches and Descriptions**

***North Bay Aqueduct***

| | |
|---|---|
| 1 | Barker Slough through Fairfield/Vacaville Turnout |
| 2 | Fairfield/Vacaville Turnout to Cordelia Forebay |
| 3A | Cordelia Forebay through Benicia and Vallejo Turnouts |
| 3B | Cordelia Forebay through Napa Turnout Reservoir |

***South Bay Aqueduct***

| | |
|---|---|
| 1 | Bethany Reservoir through Altamont Turnout |
| 2 | Altamont Turnout through Patterson Reservoir |
| 4 | Patterson Reservoir to Del Valle Junction |
| 5 | Del Valle Junction through Lake del Valle |
| 6 | Del Valle Junction through South Livermore Turnout |
| 7 | South Livermore Turnout through Vallecitos Turnout |
| 8 | Vallecitos Turnout through Alameda-Bayside No. 1 Turnout |
| 9 | Alameda-Bayside No. 1 Turnout through Santa Clara Terminal Facilities |

***California Aqueduct***

***North San Joaquin Division***

| | |
|---|---|
| 1 | Delta through Bethany Reservoir |
| 2A | Bethany Reservoir to Orestimba Creek |
| 2B | Orestimba Creek to O'Neill Forebay |

***San Luis Division***

| | |
|---|---|
| 3A | Sisk Dam, San Luis Reservoir, and Gianelli Pumping-Generating Plant |
| 3 | O'Neill Forebay to Dos Amigos Pumping Plant |
| 4 | Dos Amigos Pumping Plant to Panoche Creek |
| 5 | Panoche Creek to Five Points |
| 6 | Five Points to Arroyo Pasajero |
| 7 | Arroyo Pasajero to Kettleman City |

***South San Joaquin Division***

| | |
|---|---|
| 8C | Kettleman City through Milham Avenue |
| 8D | Milham Avenue through Avenal Gap |
| 9 | Avenal Gap through Twisselman Road |
| 10A | Twisselman Road through Lost Hills |
| 11B | Lost Hills to 7th Standard Road |
| 12D | 7th Standard Road through Elk Hills Road |
| 12E | Elk Hills Road through Tupman Road |
| 13B | Tupman Road to Buena Vista Pumping Plant |
| 14A | Buena Vista Pumping Plant through Santiago Creek |
| 14B | Santiago Creek through Old River Road |
| 14C | Old River Road to Teerink Pumping Plant |
| 15A | Teerink Pumping Plant to Chrisman Pumping Plant |
| 16A | Chrisman Pumping Plant to Edmonston Pumping Plant |

***Coastal Branch, California Aqueduct***

| | |
|---|---|
| 31A | Avenal Gap to Devil's Den Pumping Plant |
| 33A | Devil 's Den Pumping Plant through Tank 1 |
| 33B | Tank 1 through Chorro Valley Turnout |
| 34 | Chorro Valley Turnout through Lopez Turnout |
| 35 | Lopez Turnout through Guadalupe Turnout |
| 37 | Guadalupe Turnout to SPRR crossing near Casmalia |
| 38 | SPRR crossing near Casmalia through terminous at Tank 5 (Outlet Vault) |

***Tehachapi Division***

| | |
|---|---|
| 17E | Edmonston Pumping Plant to Porter Tunnel |
| 17F | Porter Tunnel to Junction, West Branch |

***Mojave Division***

| | |
|---|---|
| 18A | Junction, West Branch through Alamo Powerplant |
| 19 | Alamo Powerplant to Fairmont |
| 19C | Buttes Junction through Buttes Reservoir |
| 20A | Fairmont through 70th Street West |
| 20B | 70th Street West to Palmdale |
| 21 | Palmdale to Littlerock Creek |
| 22A | Littlerock Creek to Pearblossom Pumping Plant |
| 22B | Pearblossom Pumping Plant to West Fork Mojave River |
| 23 | West Fork Mojave River to Silverwood Lake (excluding Mojave Siphon Powerplant) |
| 23C | Mojave Siphon Powerplant |
| 24 | Cedar Springs Dam and Silverwood Lake |

***Santa Ana Division***

| | |
|---|---|
| 25 | Silverwood Lake to South Portal, San Bernardino Tunnel |
| 26A | South Portal, San Bernardino Tunnel through Devil Canyon Powerplant and Second Afterbay |
| 28G | Devil Canyon Powerplant and Second Afterbay to Barton Road |
| 28H | Barton Road to Lake Perris |
| 28J | Perris Dam and Lake Perris |

***East Branch Extension***

| | |
|---|---|
| 1 | Devil Canyon Powerplant to Junction, Foothill Pipeline near Cone Camp Road |
| 2A | Junction, Foothill Pipeline near Cone Camp Road to Greenspot Pump Station |
| 2B | Greenspot Pump Station to Morton Canyon Valve Vault |
| 2C | Morton Canyon Valve Vault to Crafton Hills Pump Station |
| 3A | Crafton Hills Pump Station to Carter Street Valve Vault |
| 3B | Carter Street Valve Vault to Garden Air Creek, South of San Bernardino/Riverside County Line |
| 4A | Garden Air Creek to Cherry Valley Pump Station |
| 4B | Cherry Valley Pump Station to Terminus at Noble Creek |

***West Branch, California Aqueduct***

| | |
|---|---|
| 29A | Junction, California Aqueduct through Oso Pumping Plant |
| 29F | Oso Pumping Plant through Quail Embankment |
| 29G | Quail Embankment through Warne Powerplant |
| 29H | Pyramid Dam and Lake |
| 29J | Pyramid Lake through Castaic Powerplant |
| 30 | Castaic Dam and Lake |

## Variable OMP&R Costs

Article 26(a) includes provisions to ensure that the variable OMP&R component of the Transportation Charge will result in a return to the State of those costs that depend on and vary with the amount of SWP water deliveries. (The minimum OMP&R component results in a return of those operating costs that do not vary with deliveries.) Under Article 26(a) all such costs for a reach for a given year will be allocated among contractors in proportion to the actual annual use of that reach by the respective contractors.

*Table B-3* summarizes the total power costs, credits, and transmission costs for each aqueduct pumping and power recovery plant. Variable costs are the following:

- Costs of capacity and energy used exclusive of associated power transmission and station service charges (transmission and station service costs that are independent and vary with power usage are classified as minimum OMP&R costs).
- Credits for capacity and energy produced at aqueduct power recovery plants (treated as negative costs).
- Payments for replacement of major plant machinery components having economic lives shorter than the project repayment period. (In 1997, DWR discontinued charging for a sinking fund for replacements. Replacement costs, for 1999 and thereafter, are to be paid on an annual basis as the costs are incurred.)
- Beginning in 2005, a portion of transmission expenditures that will depend on and vary with water and power usage. These costs will be included as part of the variable component.

Table B-3 excludes plant capacity and energy costs associated with surplus and unscheduled water service after May 1, 1973. Prior to that date, surplus water service was charged the same unit variable OMP&R component as allocated water service. An amendment to the water supply contracts in 1973 significantly changed the rate structure for surplus water service. Capacity and energy costs for pumping surplus and unscheduled water were allocated directly to those SWP contractors receiving surplus and unscheduled water service. A contract amendment in 1991 again revised the rate structure to provide for payment of costs through a melded power rate. These revisions to charges for surplus and unscheduled water are effective from the date of the amendments and are not applied to past charges.

An interruptible water program was established in 1994. This program, later renamed as the Article 21 program, is based on individual annual contracts; costs for Article 21 water actually delivered are included in Table B-3.

## Water Conveyance

Tables B-4, B-5A, B-5A-Adj, B-5B, and B-6 present water conveyance quantities that form the basis for allocating costs.

*Table B-4* presents the schedules of annual allocations as set forth in Table A and Article 6(a) of each water supply contract.

*Table B-5A* shows amounts of actual and projected allocated water quantities delivered from each aqueduct reach to each contractor. Projected deliveries for years 2016 through 2035 are based on contractors' requests for future water deliveries. The quantities included in Table B-5A also include nonproject water delivered to contractors, surplus water deliveries prior to May 1, 1973, and actual Article 21 water deliveries in 1994 and thereafter.

**Table 1 Summary of Permanent Aqueduct Capacity Transfers**

| Contractor | | Capacity Transfer | | |
|---|---|---|---|---|
| Seller | Buyer | Amount (acre-feet) | Effective Year | Transfer Description |
| **Transfers under Monterey Amendment** | | | | |
| Kern | Mojave | 25,000 | 1998 | Purchased capacity upstream of Reach 31A |
| Kern | Castaic Lake | 41,000 | 2000 | Purchased capacity upstream of Reach 16A |
| Kern | Palmdale | 4,000 | 2000 | Purchased capacity upstream of Reach 11B |
| Kern | Alameda-Zone 7 | 7,000 | 2000 | Purchased capacity upstream of Reach 10A |
| Kern | Alameda-Zone 7 | 15,000 | 2000 | Purchased capacity upstream of Reach 10A |
| Kern | Alameda-Zone 7 | 10,000 | 2001 | Purchased capacity upstream of Reach 11B |
| Kern | Solano | 5,756 | 2001 | Purchased capacity upstream of Reach 11B and Reach 31A |
| Kern | Napa | 4,025 | 2001 | Purchased capacity upstream of Reach 11B and Reach 31A |
| Kern | Alameda-Zone 7 | 2,219 | 2004 | Purchased capacity upstream of Reach 11B |
| *Subtotal under Article 53* | | *114,000* | | |
| **Transfers outside of Monterey Amendment** | | | | |
| Tulare | Dudley Ridge | 3,973 | 2002 | Purchased capacity upstream of Reach 8D |
| Tulare | AVEK | 3,000 | 2002 | Purchased capacity upstream of Reach 8D |
| Tulare | Alameda-Zone 7 | 400 | 2003 | Purchased capacity upstream of Reach 8D |
| Tulare | Kings | 5,000 | 2004 | Purchased capacity upstream of Reach 8D |
| Tulare | Coachella | 9,900 | 2004 | Purchased capacity upstream of Reach 8D |
| Metropolitan | Coachella | 88,100 | 2005 | Purchased capacity upstream of Reach 28J |
| Metropolitan | Desert | 11,900 | 2005 | Purchased capacity upstream of Reach 28J |
| Tulare | Kings | 305 | 2006 | Purchased capacity upstream of Reach 31A |
| Tulare | Desert | 1,750 | 2010 | Purchased capacity upstream of Reach 17F |
| Tulare | Coachella | 5,250 | 2010 | Purchased capacity upstream of Reach 17F |
| Kern | Desert | 4,000 | 2010 | Purchased capacity upstream of Reach 17F and Reach 31A |
| Kern | Coachella | 12,000 | 2010 | Purchased capacity upstream of Reach 17F and Reach 31A |
| Dudley Ridge | Mojave | 7,000 | 2010 | Purchased capacity upstream of Reach 8D |
| Dudley Ridge | AVEK | 1,993 | 2014 | Purchased capacity upstream of Reach 8D |
| Tulare | AVEK | 1,451 | 2014 | Purchased capacity upstream of Reach 8D |
| Dudley Ridge | Mojave | 3,000 | 2015 | Purchased capacity upstream of Reach 8D |
| *Subtotal outside of Article 53* | | *159,022* | | |

*Table B-5A-Adj* presents a summary of accounting adjustments that result from water deliveries not originating from the Sacramento-San Joaquin Delta. The methodologies used to calculate various components are based on cumulative charges from the Delta through facilities conveying water to a specific repayment reach. When water is introduced to the SWP downstream of the Delta, contractors require an adjustment, or credit, for those facilities not used to convey the water.

*Table B-5B* presents a summary of actual and projected annual allocated water quantities for each contractor. The quantities also include amounts of nonproject water and surplus water delivered prior to May 1, 1973, and actual deliveries of Article 21 water in 1994 and thereafter.

*Table B-6* summarizes the annual allocated water quantities conveyed or to be conveyed through each aqueduct pumping plant or power plant for each of the following functions:

- *Deliveries–Water Supply.* Water made available to contractors at down-aqueduct delivery structures, including certain hypothetical quantities to facilitate cost allocations, for those years when deliveries are made from net annual storage withdrawals. The net annual amounts of storage withdrawals are hypothetically added to the actual amounts conveyed from the Delta to the reservoirs, since deliveries made from storage withdrawals bear the same variable OMP&R costs per acre-foot as they would if the deliveries were actually conveyed from the Delta in that year. The hypothetical increases in the deliveries made from reservoir storage withdrawals are offset by equal credits to the minimum OMP&R costs of the respective reservoirs. Thus, the variable OMP&R components per acre-foot (Table B-17) may be applied to the total annual quantities delivered either from aqueduct reservoir storage or from the Delta.
- *Initial Fill Water.* Water required for initial filling of down-aqueduct reaches and reservoirs or for repayment of pre-consolidation water used during construction.
- *Deliveries–Recreation.* Water delivered to down-aqueduct recreation developments or used for fish and wildlife enhancement.
- *Operational Losses.* Water lost through evaporation and seepage from all down-aqueduct reaches.
- *Reservoir Storage Changes.* Water placed in down-aqueduct reservoir storage after initial filling of the reservoirs, including projected net annual storage accretions (positive values) and withdrawals (negative values) for all down-aqueduct reservoirs of the Project Transportation Facilities.

Variable OMP&R costs (Table B-12) that are allocable to storage accretions are assigned to the minimum OMP&R costs of the respective reservoirs. With the exception of Banks Pumping Plant, "Reservoir Storage Changes" also includes SWP water placed into Southern California groundwater storage from 1978 through 1982 (as positive amounts); and water withdrawn from storage and delivered to contractors in 1979, 1982, 1987, 1988, and 1989 (as negative amounts). At Banks Pumping Plant, groundwater additions and withdrawals are included in "Conservation Water."

Table B-6 also summarizes the following two amounts under the heading *Conservation Water* (Column 25):

(1) Net annual water amounts stored and projected to be stored in San Luis Reservoir.
(2) Water lost and projected to be lost through evaporation and seepage from San Luis Reservoir and from the water conservation portion of the California Aqueduct.

"Conservation Water" includes initial fill water, operational losses, and net annual storage changes associated with San Luis Reservoir and the portion of the California Aqueduct that is allocated to conservation. The same allocation procedure outlined previously for Transportation Facilities also applies to water delivered from storage in Conservation Facilities, except that the hypothetical cost increases are added to the variable OMP&R cost to be reimbursed through the Transportation Charge and deducted from the minimum OMP&R costs to be reimbursed through the Delta Water Charge.

San Luis Reservoir is operated to conserve water for future delivery to downstream

contractors. To account for costs associated with reservoir storage, the power and replacement costs of Banks Pumping Plant (a joint Transportation-Conservation Facility) that are allocated to the conveyance of annual conservation water quantities are transferred to the capital costs of San Luis Reservoir (during initial fill) or to the minimum OMP&R costs of San Luis Reservoir (following initial fill).

In years of net storage withdrawal from San Luis Reservoir, a portion of the minimum OMP&R cost of the reservoir is transferred to the variable OMP&R cost of Banks Pumping Plant. That transfer is equal to the variable OMP&R cost per acre-foot of delivery through Banks Pumping Plant for that year, multiplied by the acre-feet of deliveries derived from San Luis Reservoir storage for that year. Table B-6 also includes amounts of nonproject water and surplus water delivered prior to May 1, 1973, and actual deliveries of Article 21 water in 1994 and thereafter.

## Bases for Reimbursable Costs

This section describes the methods used to derive the costs allocated by the procedures outlined in the preceding section. A diagram of the cost derivation process is shown in the upper-left quadrant of Figure B-1.

First, the capital and minimum OMP&R costs of all SWP facilities are allocated among the various project purposes in accordance with the allocation percentages in *Table 2*. Those percentages may be subject to revision in the future.

The redeterminations in this appendix involve only the SWP costs that are allocated to water supply and power generation.

### Capital Costs

Capital costs used in the redeterminations in this appendix reflect prices prevailing on December 31, 2015; future cost escalation will be reflected in subsequent bulletins.

*Table B-7* presents a reconciliation of estimated total capital costs of each Project Conservation Facility and each Project Transportation Facility. This table shows the relationship of Project Conservation and Transportation costs allocated to contractors (Tables B-8, B-9, B-10, and B-13) to the total SWP capital costs projected by DWR.

*Table B-8* shows costs incurred and projected to be incurred by the State in connection with each contractor's turnouts. Costs incurred by the State for both State-constructed and contractor-constructed delivery structures are paid directly by the contractors for which the structures are built. The State incurs design review and construction inspection costs in connection with contractor-constructed turnouts.

*Table B-9* lists costs and payments for excess capacity built into SWP Transportation Facilities in accordance with amendments to contracts with The Metropolitan Water District of Southern California (Metropolitan), San Gabriel Valley Municipal Water District, and Antelope Valley-East Kern Water Agency, including the following:

- additional costs incurred by the State for requested excess capacity;
- advances by SWP contractors of funds for such costs; and
- credits for advances in excess of costs which were applied to respective contractors' installments of the capital cost component of the Transportation Charge in 1981.

Under Amendment 2 of Metropolitan's contract, 809 cubic feet per second of excess capacity was originally constructed in reaches of the West Branch at Metropolitan's request. That capacity was reclassified as basic capacity of SWP Transportation

**Table 2 Project Purpose Cost Allocation Factors (percentages)[a]**

| PROJECT FACILITIES | Water Supply and Power Generation | | All Other Purposes (Nonreimbursable) | |
|---|---|---|---|---|
| | Capital Costs | Minimum OMP&R Costs | Capital Costs | Minimum OMP&R Costs |
| **Project Conservation Facilities** | | | | |
| Frenchman Dam and Lake | 21.5 | 0.0 | 78.5 | 100.0 |
| Antelope Dam and Lake | 0.0 | 0.0 | 100.0 | 100.0 |
| Grizzly Valley Dam and Lake Davis | 1.0 | 1.8 | 99.0 | 98.2 |
| Oroville Division[b] | 97.1 | 99.5 | 2.9 | 0.5 |
| California Aqueduct, Delta to Dos Amigos Pumping Plant | 96.6 | 96.7 | 3.4 | 3.3 |
| Delta Facilities | | | | |
| Peripheral Canal Related | 86.0 | 86.0 | 14.0 | 14.0 |
| Remaining of Delta Facilities | 96.6 | 96.7 | 3.4 | 3.3 |
| **Transportation Facilities** | | | | |
| Grizzly Valley Pipeline | 100.0 | 100.0 | 0.0 | 0.0 |
| North Bay Aqueduct | 100.0 | 100.0 | 0.0 | 0.0 |
| South Bay Aqueduct | | | | |
| Del Valle Dam and Lake del Valle | 25.2 | 22.0 | 74.8[c] | 78.0[d] |
| Remainder of South Bay Aqueduct | 100.0 | 100.0 | 0.0 | 0.0 |
| California Aqueduct | | | | |
| Delta to Dos Amigos Pumping Plant | 96.6 | 96.6 | 3.4 | 3.4 |
| Dos Amigos Pumping Plant to termini (excluding Coastal Branch)[e,f] | 94.3 / 99.6 | 96.9 / 99.6 | 5.7 / 0.4 | 3.1 / 0.4 |
| Aqueduct and Plants[e,f] | 94.3 / 99.6 | 96.9 / 99.6 | 5.7 / 0.4 | 3.1 / 0.4 |
| Pyramid Dam and Lake[e,f] | 94.3 / 96.1 | 96.9 / 96.1 | 5.7 / 3.9 | 3.1 / 3.9 |
| Castaic Dam and Lake[e,f] | 94.3 / 91.1 | 96.9 / 91.1 | 5.7 / 8.9 | 3.1 / 8.9 |
| Silverwood Dam and Lake[e,f] | 94.3 / 85.3 | 96.9 / 85.3 | 5.7 / 14.7 | 3.1 / 14.7 |
| Perris Dam and Lake[e,f] | 94.3 / 67.7 | 96.9 / 67.7 | 5.7 / 32.3 | 3.1 / 32.3 |
| Coastal Branch | 100.0 | 100.0 | 0.0 | 0.0 |

[a] Percentages indicated apply to the majority of the facilities with minor exceptions.
[b] Percentages indicated are applicable to the remaining costs of division after excluding costs allocated to flood control that are reimbursed by the federal government (22 percent of capital costs) and excluding specific power costs of Hyatt and Thermalito powerplants and switchyards.
[c] Percentage indicated consists of 48.0 percent of costs allocated to recreation and 26.8 percent to flood control.
[d] Percentage indicated consists of 44.9 percent of costs allocated to recreation and 33.1 percent to flood control.
[e] Percentage indicated is used for 2012 and previous years.
[f] Percentage indicated is used for 2013 and forward.

Facilities under Amendment 7. Metropolitan paid $16.3 million as a prepayment of the capital cost component of the Transportation Charge in lieu of advancing funds for the original requested capacity.

Amendment 5 to Metropolitan's contract requires that additional costs for modifications to the Santa Ana Pipeline (required for enlargement of Lake Perris) will be allocated to Metropolitan and returned to the State through payments of the Transportation Charge. The additional costs to be repaid through Metropolitan's capital cost component for the aqueduct reach from Devil Canyon Powerplant to Barton Road total about $6.7 million (see Bulletin 132-72, page 98).

*Table B-10* presents the actual and projected annual capital costs of each aqueduct reach that will eventually be returned to the

State, with interest, through contractors' payments of the capital cost component of the Transportation Charge and payment of debt service under the Devil Canyon-Castaic contracts.

## Annual Operating Costs

Annual operating costs allocable to water supply and power generation are returned to the State through the minimum OMP&R components of the Delta Water Charge and the Transportation Charge and through a portion of the revenues from energy sales. All reimbursable operating costs of Conservation Facilities are included in the minimum OMP&R component of the Delta Water Charge.

## Transportation and Devil Canyon-Castaic Contract Costs

*Table B-11* shows the amounts of the actual and projected costs to be reimbursed through payments of the minimum OMP&R component of the Transportation Charge and allocated operating costs under the Devil Canyon-Castaic contract. The table includes the following seven types of operating costs incurred annually that do not vary with water quantities delivered to the contractors:

(1) all direct labor charges for field operation and maintenance personnel, including associated indirect costs;
(2) a distributed share of general operating costs that cannot be identified solely with one facility or aqueduct reach;
(3) all of electric power transmission and station service costs up to 2004, and electric power transmission and station service costs for 2005 and after that do not vary with power usage allocable to aqueduct pumping and recovery plants;
(4) all costs for equipment, materials, and supplies;
(5) portions of the power and replacement costs of all pumping plants and power plants that are up-aqueduct from Devil Canyon Powerplant and Castaic Powerplant and that are allocable to the annual conveyance of water lost to evaporation and seepage from respective aqueduct reaches or placed into storage in respective reservoirs of the project transportation facilities (after initial fill);
(6) credits, which offset those costs in (5) above, for deliveries drawn from reservoir storage; and
(7) escalation of certain projected operating costs at 1 percent per year for 2019–2035.

*Table B-12* shows the portions of variable OMP&R costs in Table B-3 that are allocable to the water supply delivery quantities included in Table B-6 and reimbursed through payments of the variable OMP&R component of the Transportation Charge.

To derive Table B-12 costs, the following adjustments are made to Table B-3 costs.

(1) Part of the variable OMP&R costs of each plant is allocated to recreation. The allocation to recreation is in proportion to the quantity of water conveyed through each plant each year for delivery to on-shore recreational developments. That portion of variable plant costs attributable to the initial fill of aqueduct reaches is allocated to the joint capital costs of respective down-aqueduct reaches and reservoirs.
(2) That portion of costs attributable to evaporation and seepage is allocated to the joint minimum OMP&R costs of respective down-aqueduct reaches and reservoirs.
(3) Adjustments are made for additions or withdrawals from storage in aqueduct reservoirs. In years when water is added to storage in aqueduct reservoirs, the cost of conveying this water into storage is charged to the minimum OMP&R costs of the corresponding reservoir. In years when storage in aqueduct reservoirs is decreased for the purpose of making deliveries, a credit

is applied to the minimum OMP&R costs of the reservoir from which the storage is released. This credit is equal to the number of acre-feet of storage reduction times the variable OMP&R unit rate for the year the storage is released. The unit rate is equal to the variable OMP&R unit rate for the year the water is taken from storage.

(4) That portion of costs attributable to pumping water to replace evaporation and seepage losses and for additions or withdrawals from storage in San Luis Reservoir is charged to the minimum OMP&R component of the Delta Water Rate.

The remaining costs are allocated to transportation water supply and repaid by the contractors.

### Conservation Capital and Operating Costs

*Table B-13* is a summary of actual and projected capital and operating costs of the initial Project Conservation Facilities. These costs are reimbursed through payments by contractors under the Delta Water Charge, Oroville power sales, and Gianelli Pumping-Generating Plant credits. Table B-13 also shows credits applied to the reimbursable capital costs of the initial Project Conservation Facilities in accordance with negotiated settlements concerning incurred planning costs for the period from 1952 through 1978.

## Project Water Charges

This section describes the redetermination of past and projected components of the Transportation Charge for annual revision of Tables C through G of each water supply contract. This section also describes the derivation of the unit Delta Water Rates and the Water System Revenue Bond Surcharge.

A summary of equivalent unit charges for each acre-foot of allocated water service is also included for each contractor and each aqueduct reach. A diagram of all calculations may be found on the lower half of Figure B-1.

### Transportation Charges

The accumulation of allocated costs of each aqueduct reach to each contractor is the basis for the Transportation Charge components.

*Table B-14* summarizes each contractor's share of the capital costs of the aqueduct reaches presented in Table B-10. Those amounts are determined by applying proportionate-use ratios set forth in Table B-1 to the costs in Table B-10. The resulting allocated costs are set forth in Table C of the respective water supply contracts.

Prepayments of the capital cost component, required under Metropolitan's Amendment 7, are included as negative capital costs in Table B-14 and Table C of Metropolitan's Statement of Charges. Solano County Water Agency, Empire West Side Irrigation District, and Castaic Lake Water Agency also prepaid capital costs (see Table B-14 footnotes). Table B-14 includes costs of the East Branch Extension to provide water service to San Bernardino Valley Municipal Water District (San Bernardino) and San Gorgonio Pass Water Agency (San Gorgonio).

Both Table B-14 and Table C of the six contractors for project water service below Devil Canyon Powerplant and Castaic Powerplant include the capital costs reimbursable under the Devil Canyon-Castaic contract.

*Table B-15* summarizes capital cost components of the Transportation Charge for each contractor for each year of the project repayment period. By the year 2035, the capital cost components shown in

Table B-15 will recover the costs shown in Table B-14, with interest at the Project Interest Rate of 4.610 percent per annum and based on the amortization schedules included in *Table 3*.

Those estimated components, subsequently adjusted for prior overpayments or underpayments, are included in Table D of the water supply contracts. Costs of excess capacity are billed separately and are not included in Table B-15.

Table B-15 includes the debt service payments due from the six contractors down-aqueduct from Devil Canyon Powerplant and Castaic Powerplant, in accordance with terms of the Devil Canyon-Castaic contract.

*Table B-16A* summarizes the minimum OMP&R components of the Transportation Charge for each year of the project repayment period. Those estimated components, subsequently adjusted for prior overpayments or underpayments, are included in Table E of the respective water supply contracts.

The total amounts included in Table B-16A are determined by applying the proportionate-use ratios in Table B-2 to the reach costs in Table B-11.

Table B-16A excludes Off-Aqueduct Power Facility charges, which are included separately in Table B-16B. Both Table B-16A and Table E include the operating costs payable under the Devil Canyon-Castaic contract for the six contractors down-aqueduct from Devil Canyon Powerplant and Castaic Powerplant.

As part of operating agreements with DWR, Kern County Water Agency was billed from 1963 through 1987 for any additional operating costs caused by early installation of units in Las Perillas and Badger Hill pumping plants by Berrenda Mesa Water

**Table 3 Criteria for Amortizing Capital Costs of Transportation Facilities**

| Contractor | Year of Initial Payment[a] |
|---|---|
| Alameda County Flood Control and Water Conservation District, Zone 7 | 1963[b] |
| Alameda County Water District | 1963 |
| Antelope Valley-East Kern Water Agency | 1963 |
| Castaic Lake Water Agency | 1964 |
| City of Yuba City | [c] |
| Coachella Valley Water District | 1964 |
| County of Butte | [c] |
| County of Kings | 1968 |
| Crestline-Lake Arrowhead Water Agency | 1964 |
| Desert Water Agency | 1963[d] |
| Dudley Ridge Water District | 1968[e] |
| Empire West Side Irrigation District | 1968[e] |
| Kern County Water Agency | |
| Agricultural Use | 1968[e] |
| Municipal and Industrial Use | 1968[e] |
| Littlerock Creek Irrigation District | 1964 |
| The Metropolitan Water District of Southern California | 1963 |
| Mojave Water Agency | 1964 |
| Napa County Flood Control and Water Conservation District | 1966 |
| Oak Flat Water District | 1968 |
| Palmdale Water District | 1964 |
| Plumas County Flood Control and Water Conservation District | 1970 |
| San Bernadino Valley Municipal Water District | 1963 |
| San Gabriel Valley Municipal Water District | 1963[d] |
| San Gorgonio Pass Water Agency | 1963[d] |
| San Luis Obispo County Flood Control and Water Conservation District | 1964[f] |
| Santa Barbara County Flood Control and Water Conservation District | 1964 |
| Santa Clara Valley Water District | 1963 |
| Solano County Water Agency | 1973 |
| Tulare Lake Basin Water Storage District | 1968[e] |
| Ventura County Watershed Protection District | 1964 |

[a] Allocated capital costs of transportation facilities amortized in equal annual installments unless otherwise noted.
[b] Principal payments on each annual capital cost prior to 1971 delayed until calendar year 1972, except payments for 1963.
[c] For City of Yuba City and County of Butte, payments for Delta Water Charge only.
[d] Payment deferred for 1963 and added to 1964 payment with accrued interest.
[e] For Dudley Ridge Water District, Empire West Side Irrigation District, Kern County Water Agency (agricultural use), Oak Flat Water District, and Tulare Lake Basin Water Storage District, according to Article 45 of the contracts for supply of agricultural water, capital costs of transportation facilities allocated to agricultural water supply are amortized by using an equivalent unit rate per acre-foot applied to the annual allocations (Table B-4) through the project repayment period.
[f] For San Luis Obispo and Santa Barbara, all principal and interest payments for costs of the Coastal Stub were deferred until 1976.

Storage District (see Bulletin 132-71, page 7). Under those agreements, a portion of minimum OMP&R costs of Reach 31A were assigned directly to Kern, as shown in *Table 4*, with the remaining reach costs allocated by application of the proportionate-use ratios. DWR purchased the last unit, Unit No. 6, at Las Perillas and Badger Hill pumping plants in early 1997 to provide pumping capacity for deliveries to Coastal Area contractors, which began in 1997.

**Table 4 Minimum OMP&R Costs of Reach 31A Assigned Directly to Kern County Water Agency (in dollars)**

| Year | Direct Charges |
|---|---|
| 1969 | 46,511 |
| 1970 | 46,302 |
| 1971 | 140,074 |
| 1972 | 95,017 |
| 1973 | 72,454 |
| 1974 | 100,692 |
| 1975 | 127,456 |
| 1976 | 138,504 |
| 1977 | 120,753 |
| 1978 | 157,652 |
| 1979 | 121,231 |
| 1980 | 150,728 |
| 1981 | 75,866 |
| 1982 | 82,805 |
| 1983 | 90,007 |
| 1984 | 107,468 |
| 1985 | 159,406 |
| 1986 | 137,241 |
| 1987 | 127,073 |
| 1988 | 130,924 |
| 1989 | 128,468 |
| 1990 | 138,234 |
| 1991 | 139,527 |
| 1992 | 185,370 |
| 1993 | 219,334 |
| 1994 | 364,196 |
| 1995 | 272,341 |
| 1996 | 322,123 |
| **Total** | **3,997,767** |

As a result of the Monterey Amendment, the costs related to this settlement are to be allocated among all SWP contractors in proportion to their maximum Table A amounts. As costs are incurred, related charges will be included in the contractors' annual Statements of Charges as part of the minimum. Between 2002 and 2010, the Monterey Amendment litigation costs recovered from SWP contractors were $15.8 million.

*Table B-16B* summarizes annual Off-Aqueduct Power Facility charges allocated to each water contractor, adjusted for prior overpayments or underpayments. Those charges are to repay all Off-Aqueduct Power costs, including bond service, deposits for reserves, operation and maintenance costs, fuel costs, taxes, and insurance.

Adopted October 1, 1979, the General Bond Resolution requires that sufficient revenues be collected each year to repay all of those costs. In addition, an amount totaling 25 percent of the annual bond service is collected each year to ensure that sufficient funds are available to cover all annual costs. Any revenues collected and not needed during the year are refunded to the contractors in the next year.

*Table 5* summarizes Off-Aqueduct Power Facility charges and credits related to deliveries for 2015. The ongoing Reid Gardner Powerplant closure costs related to the Reid Gardner Powerplant contract expiration in 2013 are tracked independently from annual Reid Gardner operating costs.

*Table 6* shows projected Off-Aqueduct Power Facility charges and an amount equal to 25 percent of annual bond service for 2016 through 2035. Defeasance of Off-Aqueduct Power facilities bonds occurred in June 2016, so no debt service charges are included in

**Table 5 Summary of 2015 Off-Aqueduct Power Facility Charges and Credits (in dollars)**

| | |
|---|---|
| **Charges by Item** | |
| Reid Gardner Powerplant | 1,630,586 |
| Reid Gardner Closure Costs | 11,957,444 |
| Bottle Rock Powerplant | 4,546,719 |
| South Geysers Powerplant | 5,447,854 |
| *Subtotal* | *23,582,603* |
| **Credits by Item** | |
| Transmission Services | (72,647) |
| **Net Total Charge** | **23,509,956** |

**Table 6 Projected Charges for Off-Aqueduct Power Facilities (in dollars)**

| Year | Total Annual Cost | 25 Percent Bond Cover |
|---|---|---|
| 2016 | 4,648,897 | 206,321 |
| **2017** | **4,300,000** | **-** |
| 2018 | 3,300,000 | - |
| 2019 | 200,000 | - |
| 2020 | 200,000 | - |
| 2021 | 200,000 | - |
| 2022 | 200,000 | - |
| 2023 | 200,000 | - |
| 2024 | 200,000 | - |
| 2025 | 200,000 | - |
| 2026 | 200,000 | - |
| 2027 | 200,000 | - |
| 2028 | 200,000 | - |
| 2029 | 200,000 | - |
| 2030 | 200,000 | - |
| 2031 | 200,000 | - |
| 2032 | 200,000 | - |
| 2033 | 200,000 | - |
| 2034 | 200,000 | - |
| 2035 | 200,000 | - |

future years. Additionally, Reid Gardner, Unit 4 Powerplant remediation costs are projected for 2016, 2017, and 2018 and then only minor operating costs are projected post-2018.

Annual Off-Aqueduct Power Facility charges are allocated among contractors in proportion to the electrical energy required to pump allocated water for the year. The initial allocation for the Statements of Charges is based on estimates of energy to pump requested allocated water deliveries, based on a 60-percent allocation.

An interim adjustment in the allocation of Off-Aqueduct Power costs may be made in May of each year, based on updated cost estimates and April revisions in water delivery schedules. An additional adjustment is made the following year based on actual water deliveries and actual costs for the year.

The energy required to pump each contractor's water is calculated using the kilowatt-hour per acre-foot factors shown in *Table 7* for the pumping plants upstream from the delivery turnouts. The amounts shown include transmission losses.

*Table B-17* presents a summary of actual and projected total variable OMP&R costs for each acre-foot conveyed through each aqueduct pumping plant and power plant for each year of the project. Following are provisions for calculating the variable OMP&R component of the Transportation Charge:

- An annual charge per acre-foot of projected water deliveries to all contractors served from or through each reach is determined so the projected variable OMP&R costs to be incurred for each reach will be returned to the State.

**Table 7 Kilowatt-Hour per Acre-Foot Factors for Allocating Off-Aqueduct Power Facility Costs**

| | kWh per acre-foot[a] | |
|---|---|---|
| **Pumping Plant** | At Plant | Cumulative from Delta |
| Barker Slough | 223 | 223 |
| Cordelia-Benicia | 434 | 657 |
| Cordelia-Vallejo | 178 | 401 |
| Cordelia-Napa | 563 | 786 |
| Banks (Delta) | 296 | 296 |
| South Bay (including Del Valle) | 869 | 1,165 |
| Dos Amigos | 138 | 434 |
| Buena Vista | 242 | 676 |
| Teerink | 295 | 971 |
| Chrisman | 639 | 1,610 |
| Edmonston | 2,236 | 3,846 |
| Pearblossom | 703 | 4,549 |
| Greenspot | 871 | 5,420 |
| Crafton Hills | 1,087 | 6,507 |
| Cherry Valley | 224 | 6,731 |
| Oso | 280 | 4,126 |
| Las Perillas | 77 | 511 |
| Badger Hill | 200 | 711 |
| Devil's Den | 705 | 1,416 |
| Bluestone | 705 | 2,121 |
| Polonio Pass | 705 | 2,826 |

[a] Includes transmission losses.

- The total annual variable OMP&R component for any contractor for a given reach is obtained by multiplying the unit charge associated with that reach by the quantity of water actually delivered from or through the reach to the contractor.

The data summarized in Table B-17 are derived by dividing the costs shown in Table B-3 by the water quantities shown in Table B-6. However, certain costs included in Table B-3 for extra peaking service, which would otherwise constitute variable OMP&R costs, are assigned directly to contractors requesting this type of service (see Bulletin 132-71, page 21, and Water Service Contractors Council Memo No. 593, July 10, 1970). Those costs are excluded from the unit charges shown in Table B-17. Peaking charges based on additional capacity ceased in 1983. Since 1984, costs are based on power market energy rates. The amounts of extra peaking charges for additional power costs are shown in *Tables 8 and 9*.

Unit rates shown in Table B-17 constitute the rates for the pumping plants and power plants listed. The cumulative rates constitute the total rates, cumulative from the Sacramento-San Joaquin Delta, and are applicable to deliveries from or downstream of the pumping plants and power plants. Extra peaking service costs are excluded.

*Table B-18* shows the variable OMP&R components of the Transportation Charge for each contractor for each year of the project repayment period. Table B-18 is developed from the costs per acre-foot included in Table B-17 and the delivery quantities for each contractor from each reach as indicated in Table B-5A and Table B-5A-Adj, plus any costs for extra peaking service. Those estimated components, subsequently adjusted for prior overpayments or underpayments, are included in Table F of the respective water supply contracts.

*Table B-19* summarizes the annual Transportation Charges for each contractor (the sum of the corresponding amounts included in Tables B-15, B-16A, B-16B, and B-18). Those estimated payments, subsequently adjusted for prior overpayments or underpayments, are set forth in Table G of the respective water supply contracts.

In accordance with provisions of the Devil Canyon-Castaic contract, Table B-19 and Table G include amounts of debt service and operating cost payments due from the six contractors located down-aqueduct from Devil Canyon and Castaic powerplants.

## Delta Water Charges

*Table B-20A* presents the calculation of the Delta Water Rate for the initial Conservation Facilities applicable in 2017 in accordance with the amended Article 22(e) and 22(g) of all 29 water supply contracts. The Delta Water Rate was calculated at a Project Interest Rate of 4.610 percent, based on Conservation Facility costs shown in Table B-13. That Delta Water Rate is used to compute projected Delta Water Charges under Article 53(i) for the contractors who have executed the Monterey Amendment. Included in Table B-20A is the Delta Water Rate for the two contractors who have not executed the Monterey Amendment: Plumas County Flood Control and Water Conservation District and Empire West Side Irrigation District.

*Table B-20B* shows each component of the 2017 Delta Water Rate from Table B-20A.

*Table B-21* summarizes the annual Delta Water Charge for each contractor. The projected charges in Table B-21 are developed by multiplying the total rate per acre-foot, as shown in Table B-20A, by the amount of allocated water for each contractor, as shown in Table B-4.

The projected Delta Water Charges from 2016–2035 include the assumption of escalation of projected operating costs at 1.0 percent per year for 2019–2035.

## Water System Revenue Bond Surcharge

*Table B-22* summarizes the Water System Revenue Bond (WSRB) Surcharge to the Delta Water Charge and the transportation capital cost component for each contractor. The surcharge shown in Table B-22 includes the financing costs of the WSRB Surcharge, Series B through Series AT. This surcharge is levied according to an amendment to the water supply contracts, which was signed by all of the water supply contractors.

## Total Water Charges

*Table B-23* summarizes the total annual charges to each contractor (the sum of the Transportation Charge in Table B-19, the Delta Water Charge in Table B-21, and the WSRB Surcharge in Table B-22). The charges do not reflect past payments by contractors and are unadjusted for prior overpayments or underpayments.

## Equivalent Total Water Charges

*Table B-24* presents the Transportation Charge and Delta Water Charge in terms of the equivalent unit charge for each acre-foot of allocated water now projected for delivery to the respective contractors.

These equivalent charges would provide the same principal sum at the end of the project repayment period as annual payments to be made as part of the Delta Water Charge and Transportation Charge, plus interest at the Project Interest Rate, if applied to each acre-foot of allocated water delivered to date; all surplus water delivered prior to May 1, 1973; all Article 21 water deliveries in 1994 and thereafter; and all allocated water now projected to be delivered during the remainder of the project repayment period (Table B-5B).

The equivalent unit Delta Water Charges included in Table B-24 are greater than those presented in Table B-20A because current projections of allocated water service are less for most contractors than the amounts shown in Table A.

## Equivalent Water Costs by Reach

*Table B-25* presents a summary of the equivalent unit transportation cost of conveying allocated water through respective aqueduct reaches of the Project Transportation Facilities.

Those unit costs provide the basis of charges assessed for extra service (such

## Table 8 Extra Peaking Charges for Additional Power, by Pumping Plant (in dollars)

| Year | Cordelia Napa | Cordelia Solano | Barker Slough | South Bay | Banks | Dos Amigos | Las Perillas and Badger Hill | Buena Vista | Teerink | Chrisman | Edmonston | Pearblossom | Oso | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | 0 | 0 | 0 | 0 | 0 | 10,579 | 24,700 | 0 | 0 | 0 | 0 | 0 | 0 | 35,279 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 6,016 | 0 | 0 | 0 | 0 | 0 | 0 | 6,016 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 7,140 | 0 | 0 | 0 | 0 | 0 | 0 | 7,140 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 494 | 6,397 | 0 | 0 | 0 | 0 | 0 | 0 | 6,891 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 1,981 | 0 | 0 | 0 | 0 | 0 | 0 | 1,981 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 45,145 | 3,680 | 0 | 0 | 0 | 0 | 0 | 0 | 48,825 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 3,306 | 0 | 0 | 0 | 0 | 0 | 0 | 3,306 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 12,126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,126 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 89,339 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 89,339 |
| 1983 | 0 | 0 | 0 | 35 | 7,594 | 3,534 | 152 | 0 | 0 | 0 | 0 | 0 | 0 | 11,315 |
| 1984 | 0 | 0 | 0 | 2,096 | 84,396 | 38,607 | 7,203 | 11,173 | 3,823 | 3,593 | 0 | 0 | 0 | 150,891 |
| 1985 | 0 | 0 | 0 | 1,480 | 19,612 | 8,841 | 763 | 4,488 | 4,412 | 8,929 | 28,353 | 0 | 0 | 76,878 |
| 1986 | 0 | 0 | 0 | 0 | 1,864 | 863 | 0 | 291 | 354 | 766 | 2,683 | 0 | 0 | 6,821 |
| 1987 | 0 | 0 | 0 | 604 | 17,129 | 7,838 | 835 | 2,295 | 1,806 | 3,460 | 11,058 | 0 | 0 | 45,025 |
| 1988 | 639 | 39 | 287 | 894 | 43,475 | 20,082 | 2,213 | 5,792 | 4,367 | 8,272 | 25,886 | 0 | 0 | 111,946 |
| 1989 | 2,491 | 566 | 1,483 | 70 | 40,251 | 18,642 | 1,935 | 3,401 | 1,531 | 2,058 | 3,793 | 0 | 0 | 76,221 |
| 1990 | 45 | 0 | 18 | 343 | 19,524 | 9,044 | 0 | 150 | 145 | 314 | 643 | 0 | 0 | 30,226 |
| 1991 | 903 | 0 | 281 | 0 | 21 | 8 | 0 | 15 | 17 | 39 | 139 | 41 | 0 | 1,464 |
| 1992 | 208 | 117 | 203 | 0 | 7,070 | 2,502 | 0 | 182 | 190 | 435 | 0 | 0 | 0 | 10,907 |
| 1993 | 0 | 681 | 889 | 4,483 | 123,080 | 54,741 | 0 | 8,898 | 5,458 | 10,900 | 35,068 | 11,139 | 0 | 255,337 |
| 1994 | 0 | 366 | 393 | 679 | 6,566 | 2,795 | 454 | 1,083 | 155 | 357 | 1,121 | 0 | 132 | 14,101 |
| 1995 | 0 | 0 | 0 | 1,717 | 24,464 | 9,422 | 27 | 1,865 | 3,475 | 782 | 1,104 | 400 | 0 | 43,256 |
| 1996 | 4 | 0 | 1 | 1,983 | 10,031 | 4,976 | 0 | 391 | 432 | 1,015 | 3,404 | 1,160 | 0 | 23,397 |
| 1997 | 0 | 1,780 | 2,152 | 3,107 | 337,357 | 165,774 | 1,753 | 34,604 | 12,296 | 15,910 | 21,028 | 0 | 0 | 595,761 |
| 1998 | 0 | 0 | 0 | 20,966 | 235,693 | 106,251 | 2,354 | 697 | 848 | 1,836 | 6,426 | 0 | 0 | 375,071 |
| 1999 | 0 | 0 | 0 | 0 | 63,196 | 26,235 | 0 | 3,394 | 4,136 | 8,959 | 31,350 | 7,740 | 0 | 145,010 |
| 2000–2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **4,290** | **3,549** | **5,707** | **38,457** | **1,041,323** | **637,838** | **70,909** | **78,719** | **43,445** | **67,625** | **172,056** | **20,480** | **132** | **2,184,530** |

## Table 9 Extra Peaking Charges for Additional Power, by Contractor (in dollars)

| Year | Napa | Solano | Alameda-Zone 7 | Alameda County | Santa Clara | Dudley Ridge | Empire | Kern | Kings | Oak Flat | Tulare | AVEK | Castaic Lake | Coachella | Desert | Littlerock | Palmdale | San Gabriel | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35,269 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35,279 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,016 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,140 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,891 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,891 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,981 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 2,035 | 0 | 44,484 | 42 | 0 | 0 | 2,264 | 0 | 0 | 0 | 0 | 0 | 0 | 48,825 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,821 | 0 | 0 | 0 | 0 | 485 | 0 | 0 | 0 | 0 | 0 | 3,306 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11,951 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 0 | 0 | 12,126 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 2,173 | 0 | 80,945 | 0 | 0 | 0 | 4,671 | 1,128 | 0 | 0 | 0 | 0 | 422 | 89,339 |
| 1983 | 0 | 0 | 0 | 0 | 48 | 9,511 | 0 | 0 | 1,365 | 0 | 0 | 0 | 391 | 0 | 0 | 0 | 0 | 0 | 11,315 |
| 1984 | 0 | 0 | 0 | 0 | 2,874 | 0 | 0 | 144,021 | 281 | 809 | 0 | 0 | 2,906 | 0 | 0 | 0 | 0 | 0 | 150,891 |
| 1985 | 0 | 0 | 0 | 2,029 | 0 | 0 | 64 | 25,664 | 0 | 98 | 0 | 48,767 | 256 | 0 | 0 | 0 | 0 | 0 | 76,878 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 2,194 | 4,614 | 0 | 0 | 0 | 0 | 0 | 0 | 6,821 |
| 1987 | 0 | 0 | 229 | 0 | 599 | 313 | 84 | 24,141 | 0 | 95 | 0 | 18,207 | 545 | 0 | 0 | 812 | 0 | 0 | 45,025 |
| 1988 | 892 | 73 | 665 | 561 | 0 | 1,853 | 1,404 | 58,905 | 0 | 72 | 2,368 | 44,526 | 627 | 0 | 0 | 0 | 0 | 0 | 111,946 |
| 1989 | 3,478 | 1,062 | 96 | 0 | 0 | 13 | 403 | 55,085 | 0 | 239 | 8,278 | 0 | 1,043 | 0 | 0 | 1,035 | 5,489 | 0 | 76,221 |
| 1990 | 63 | 0 | 470 | 0 | 0 | 0 | 0 | 28,587 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 81 | 1,025 | 0 | 30,226 |
| 1991 | 1,184 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 280 | 0 | 0 | 1,464 |
| 1992 | 271 | 257 | 0 | 0 | 0 | 0 | 49 | 10,109 | 221 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,907 |
| 1993 | 0 | 1,570 | 6,122 | 0 | 0 | 0 | 3,757 | 97,812 | 504 | 0 | 74,577 | 0 | 0 | 24,983 | 41,156 | 0 | 4,856 | 0 | 255,337 |
| 1994 | 0 | 759 | 896 | 0 | 0 | 0 | 7 | 9,933 | 0 | 0 | 0 | 0 | 2,450 | 0 | 0 | 56 | 0 | 0 | 14,101 |
| 1995 | 0 | 0 | 2,353 | 0 | 0 | 10,197 | 0 | 28,085 | 310 | 0 | 0 | 0 | 27 | 0 | 0 | 0 | 2,284 | 0 | 43,256 |
| 1996 | 5 | 0 | 81 | 2,612 | 0 | 334 | 205 | 4,552 | 969 | 0 | 7,809 | 0 | 0 | 0 | 0 | 0 | 3,598 | 3,232 | 23,397 |
| 1997 | 0 | 3,932 | 3,999 | 0 | 0 | 6,190 | 0 | 546,733 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 34,867 | 0 | 595,761 |
| 1998 | 0 | 0 | 19,666 | 8,442 | 0 | 22,631 | 1 | 312,626 | 0 | 651 | 0 | 0 | 0 | 0 | 0 | 0 | 11,054 | 0 | 375,071 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 76,425 | 0 | 0 | 6,922 | 0 | 0 | 0 | 0 | 0 | 11,576 | 50,087 | 145,010 |
| 2000–2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **5,893** | **7,653** | **34,577** | **13,644** | **3,521** | **55,250** | **5,974** | **1,620,176** | **3,692** | **2,017** | **102,158** | **123,049** | **9,858** | **24,983** | **41,156** | **2,439** | **74,749** | **53,741** | **2,184,530** |

as delivery of allocations down-aqueduct from a contractor's turnout) and for wheeling service to entities other than the SWP contractors.

The cumulative unit conveyance costs indicated for reaches in Table B-25 do not necessarily equal the equivalent unit Transportation Charges to contractors served from such reaches. The unit charges in Table B-24 account for the rate of water demand buildup and cost allocation factors of the individual contractors; however, the unit costs included in Table B-25 reflect the effect of melding the respective buildups and allocation criteria of all contractors whose allocations are conveyed through a given reach. Table B-25 also includes surplus water delivered prior to May 1, 1973, and Article 21 water deliveries in 1994 and thereafter.

## East Branch Enlargement Charges

*Table B-26* reflects DWR's projection of annual capital costs of the East Branch Enlargement for each aqueduct reach. These projections will be redetermined in future bulletins to include the following:

- a reallocation of costs of constructing the present East Branch facilities between Alamo Powerplant and Silverwood Lake;
- a reallocation of costs of Silverwood Lake to reflect additional use as a result of East Branch Enlargement operation;
- a reallocation of costs of San Bernardino Tunnel to reflect redistribution of flow capacities necessary for the East Branch Enlargement facilities; and
- actual enlargement construction costs.

These costs will be recovered with interest from the seven Southern California SWP contractors participating in the enlargement, in accordance with their amended water supply contracts (see *Table 10*).

*Table B-27* lists the projected minimum OMP&R costs for each reach of the enlargement to be repaid by the seven East Branch Enlargement participating contractors. Currently, this table includes only minimum OMP&R costs attributable to the East Branch Enlargement. In accordance with Article 49(e)(1), the contractors participating in the East Branch Enlargement will also share in the remaining minimum OMP&R costs of the affected reaches, in accordance with a formula developed by DWR in consultation with the affected contractors.

*Table B-28* shows each participating contractor's share of the estimated capital costs of the East Branch Enlargement shown in Table B-26.

*Table B-29* shows the amounts of the annual capital cost components of the East Branch Enlargement Transportation Charge for each participating contractor. This component consists of each contractor's allocated share of debt service on bonds sold to finance the enlargement.

*Table B-30* shows the minimum OMP&R components of the East Branch Enlargement Transportation Charge for each participating contractor for each year of the project repayment period. The amounts shown in Table B-30 will recover the minimum OMP&R costs shown in Table B-27.

*Table B-31* shows the annual East Branch Enlargement Transportation charges for each participating contractor (the sum of the corresponding amounts included in Tables B-29 and B-30).

## East Branch Extension Charges

The East Branch Extension charges recover associated costs for East Branch Extension facilities beginning at Devil Canyon Powerplant Afterbay and extending to the terminus at Noble Creek in the vicinity of Beaumont, Riverside County. These costs, separated into 3 phases: Phase 1 Original, Phase 1 Improvements, and Phase 2, will be recovered from two contractors—San Bernardino and San Gorgonio—in

## Table 10 Determination of Factors for Distributing Capital and Minimum OMP&R Costs of East Branch Enlargement Facilities among Participating Contractors

| Reach Number | Description |
|---|---|
| 18A | Junction, West Branch, California Aqueduct through Alamo Powerplant |
| 19 | Alamo Powerplant to Fairmont |
| 20A | Fairmont through 70th Street West |
| 20B | 70th Street West to Palmdale |
| 21 | Palmdale to Littlerock Creek |
| 22A | Littlerock Creek to Pearblossom Pumping Plant |
| 22B | Pearblossom Pumping Plant to West Fork Mojave River |
| 23B | West Fork Mojave River to Silverwood Lake (excluding Mojave Siphon Powerplant facilities) |
| 23C | Mojave Siphon Powerplant facilities |
| 24 | Cedar Springs Dam and Silverwood Lake |
| 25 | Silverwood Lake to South Portal, San Bernardino Tunnel |
| 26A | South Portal, San Bernardino Tunnel through Devil Canyon Powerplant |
| 26B | Devil Canyon Powerplant Bypass |

**Share of Enlargement Capacity (cubic feet per second)**

| Reach Number | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino | Metropolitan | Total |
|---|---|---|---|---|---|---|---|---|
| 18A | | 151 | 13 | 136 | 6 | | 1,200 | 1,506 |
| 19 | | 151 | 13 | 136 | 6 | | 1,200 | 1,506 |
| 20A | 35 | 151 | 13 | 136 | 6 | | 1,200 | 1,541 |
| 20B | 35 | 151 | 13 | 136 | 6 | | 1,200 | 1,541 |
| 21 | 35 | 151 | 13 | 136 | | | 1,200 | 1,535 |
| 22A | 35 | 151 | 13 | 136 | | | 1,200 | 1,535 |
| 22B | | 151 | 13 | 136 | | | 1,200 | 1,500 |
| 23B | | 184 | 67 | 212 | | | 1,200 | 1,663 |
| 23C | | 184 | 67 | | | | 1,200 | 1,451 |
| 24 | | 190 | 78 | | | | 1,200 | 1,468 |
| 25 | | 193 | 83 | | | 63 | 1,200 | 1,539 |
| 26A | | 193 | 83 | | | 63 | 1,200 | 1,539 |
| 26B | | | | | | | 300 | 300 |

**Factors for Distributing Capital and Minimum OMP&R Costs of East Branch Enlargement Facilities (flow ratios)**

| Reach Number | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino | Metropolitan | Total |
|---|---|---|---|---|---|---|---|---|
| 18A | 0.00000000 | 0.10026560 | 0.00863214 | 0.09030544 | 0.00398406 | 0.00000000 | 0.79681276 | 1.00000000 |
| 19 | 0.00000000 | 0.10026560 | 0.00863214 | 0.09030544 | 0.00398406 | 0.00000000 | 0.79681276 | 1.00000000 |
| 20A | 0.02271252 | 0.09798832 | 0.00843608 | 0.08825438 | 0.00389358 | 0.00000000 | 0.77871512 | 1.00000000 |
| 20B | 0.02271252 | 0.09798832 | 0.00843608 | 0.08825438 | 0.00389358 | 0.00000000 | 0.77871512 | 1.00000000 |
| 21 | 0.02280130 | 0.09837134 | 0.00846906 | 0.08859935 | 0.00000000 | 0.00000000 | 0.78175895 | 1.00000000 |
| 22A | 0.02280130 | 0.09837134 | 0.00846906 | 0.08859935 | 0.00000000 | 0.00000000 | 0.78175895 | 1.00000000 |
| 22B | 0.00000000 | 0.10066667 | 0.00866667 | 0.09066667 | 0.00000000 | 0.00000000 | 0.79999999 | 1.00000000 |
| 23B | 0.00000000 | 0.11064342 | 0.04028863 | 0.12748046 | 0.00000000 | 0.00000000 | 0.72158749 | 1.00000000 |
| 23C | 0.00000000 | 0.12680910 | 0.04617505 | 0.00000000 | 0.00000000 | 0.00000000 | 0.82701585 | 1.00000000 |
| 24 | 0.00000000 | 0.12942779 | 0.05313351 | 0.00000000 | 0.00000000 | 0.00000000 | 0.81743870 | 1.00000000 |
| 25 | 0.00000000 | 0.12540611 | 0.05393112 | 0.00000000 | 0.00000000 | 0.04093567 | 0.77972710 | 1.00000000 |
| 26A | 0.00000000 | 0.12540611 | 0.05393112 | 0.00000000 | 0.00000000 | 0.04093567 | 0.77972710 | 1.00000000 |
| 26B | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 | 0.00000000 | 1.00000000 | 1.00000000 |

accordance with their amended water supply contracts. The factors for distributing minimum costs are shown in *Table 11*. *Table 12* shows the capital factors and the corresponding debt service for each of the phases in 2017.

**Table 11 Factors for Distributing Minimum OMP&R Costs of the East Branch Extension Facilities**

| Reach Number | Reach Description | San Bernardino | San Gorgonio | Total |
|---|---|---|---|---|
| 1 | Devil Canyon Powerplant to Junction, Foothill Pipeline near Cone Camp Road | 0.557330 | 0.442670 | 1.000000 |
| 2A | Junction Foothill Pipeline near Cone Camp Road to Greenspot Pump Station | 0.557330 | 0.442670 | 1.000000 |
| 2B | Greenspot Pump Station to Morton Canyon Valve Vault | 0.777778 | 0.222222 | 1.000000 |
| 2C | Morton Canyon Valve Vault to Crafton Hills Pump Station | 0.777778 | 0.222222 | 1.000000 |
| 3A | Crafton Hills Pump Station to Carter Street Valve Vault | 0.557330 | 0.442670 | 1.000000 |
| 3B | Carter Street Valve Vault to Garden Air Creek, South of San Bernardino County Line | 0.557330 | 0.442670 | 1.000000 |
| 4A | Garden Air Creek to Cherry Valley Pump Station | | 1.000000 | 1.000000 |
| 4B | Cherry Valley Pump Station to Terminus at Noble Creek | | 1.000000 | 1.000000 |

**Table 12 East Branch Extension Facilities Debt Service for 2017**

| Contractor | Share of Participation (percent) | Total Debt Service Charge (in dollars) |
|---|---|---|
| **Phase 1 Original** | | |
| San Bernardino | 45.8417 | **5,062,124** |
| San Gorgonio | 54.1583 | **5,980,495** |
| *Subtotal* | *100.0000* | ***11,042,619*** |
| **Phase 1 Improvements** | | |
| San Bernardino | 63.3410 | **3,684,787** |
| San Gorgonio | 36.6590 | **2,132,594** |
| *Subtotal* | *100.0000* | ***5,817,381*** |
| **Phase 2** | | |
| San Bernardino | 64.4210 | **8,803,483** |
| San Gorgonio | 35.5790 | **4,862,065** |
| *Subtotal* | *100.0000* | ***13,665,548*** |
| **Total** | | **30,525,548** |

# Short-term Agreements

DWR and the water supply contractors execute short-term agreements that affect the contractors' charges.

## Municipal Water Quality Investigations

DWR executed a 5-year agreement in 1997 with 16 municipal and industrial contractors, who agreed to pay for allocated shares of DWR's Municipal Water Quality Investigations costs. Additional amendments were executed in 2002, 2006, 2008, 2010, and 2014 to extend the program. The Municipal Water Quality Investigations charges under this agreement are included in the transportation minimum OMP&R components shown in Table B-16A.

## Feasibility Study

Nine contractors executed a short-term agreement (1997 and 1998) to participate in the feasibility study for the American Basin conjunctive-use program. Feasibility study costs are included in Table B-16A.

## Delta Programs

Contractors have agreed to participate in several Delta improvement programs that started in 2007 and that will possibly extend into the future.

The first agreement pertains to the Bay Delta Conservation Plan (BDCP) agreed to in the Memorandum of Agreement (MOA) for Supplemental Funding for Certain Ecosystem Actions and Support for Implementation of Near-Term Water Supply, Water Quality, Ecosystem, and Levee Actions. The BDCP comprises two elements: fishery costs and consultation costs. These costs were added to the contractors' transportation minimum component for bill years 2007 through 2012.

The second agreement pertains to the non-BDCP costs of the MOA, comprising the Delta Vision and pelagic organism decline research costs. These costs were added to the contractors' conservation minimum component for bill years 2007 and 2008.

The third set of agreements pertains to the Delta Habitat Conservation and Conveyance Program (DHCCP). The agreements are between DWR and 20 participating SWP contractors to provide 50 percent of the funding for the preliminary planning phase of an improved Delta water conveyance facility. (The remaining 50 percent is provided by the Bureau of Reclamation.) This program will assess potential habitat restoration and water conveyance options in the Delta. For bill years 2008 through 2011, nearly $70 million in charges associated with the DHCCP were billed directly to the 20 participating SWP contractors as a separate line item in the Statements of Charges and are not reflected in the tables in this appendix.

A fourth set of agreements pertains to both DHCCP and BDCP. For bill years 2012 and 2013, an Agreement for Supplemental Funding for the Costs of Environmental Analysis, Planning and Design of Delta Conservation Measures, Including Delta Conveyance Options, was executed in 2012 between DWR and 16 participating SWP contractors to provide 50 percent of the project funding. In 2012, $22 million was billed and in 2013, $28 million was billed directly to the 16 participating contractors as a separate line item in the Statements of Charges.

During 2013, SWP water supply contractors agreed to participate in the 2013 San Joaquin River Flow Augmentation Program. The costs of the $4 million program were recovered in the 2014 Statements of Charges.

## TABLE B-1 Factors for Distributing Reach Capital Costs Among Contractors[a]



| Reach No. | Reach Description | NORTH BAY AREA | | SOUTH BAY AREA | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Napa | Solano | Alameda-Zone 7 | Alameda County | Santa Clara | Future Contractor South Bay | |
| | **NORTH BAY AQUEDUCT** | | | | | | | |
| 1 | Barker Slough through Fairfield/Vacaville Turnout | 0.29667896 | 0.70332104 | | | | | 1.00000000 |
| 2 | Fairfield/Vacaville Turnout to Cordelia Forebay | 0.38414552 | 0.61585448 | | | | | 1.00000000 |
| 3A | Cordelia Forebay through Benicia and Vallejo Turnouts | | 1.00000000 | | | | | 1.00000000 |
| 3B | Cordelia Forebay through Napa Turnout Reservoir | 1.00000000 | | | | | | 1.00000000 |
| | **SOUTH BAY AQUEDUCT** | | | | | | | |
| 1 | Bethany Reservoir through Altamont Turnout | | | 0.22599612 | 0.20663021 | 0.49237700 | 0.07499667 | 1.00000000 |
| 2 | Altamont Turnout through Patterson Reservoir | | | 0.22599658 | 0.20663059 | 0.49237783 | 0.07499500 | 1.00000000 |
| 4 | Patterson Reservoir to Del Valle Junction | | | 0.19504795 | 0.21450017 | 0.51113249 | 0.07931939 | 1.00000000 |
| 5 | Del Valle Junction through Lake del Valle | | | 0.14436367 | 0.12972254 | 0.33715573 | 0.38875806 | 1.00000000 |
| 6 | Del Valle Junction through South Livermore Turnout | | | 0.14599918 | 0.21144710 | 0.50574745 | 0.13680627 | 1.00000000 |
| 7 | South Livermore Turnout through Vallecitos Turnout | | | | 0.25176680 | 0.60218448 | 0.14604872 | 1.00000000 |
| 8 | Vallecitos Turnout through Alameda-Bayside Turnout | | | | 0.27934645 | 0.72065355 | | 1.00000000 |
| 9 | Alameda-Bayside Turnout through Santa Clara Terminal Facilities | | | | | 1.00000000 | | 1.00000000 |
| | **CALIFORNIA AQUEDUCT** | | | | | | | |
| 1 | Delta through Bethany Reservoir | | | 0.00954737 | 0.00872917 | 0.02080118 | 0.00342507 | N/A |

| Reach No. | Reach Description | CENTRAL COASTAL AREA | | SOUTHERN CALIFORNIA AREA | | | | |
|---|---|---|---|---|---|---|---|---|
| | | San Luis Obispo | Santa Barbara | AVEK | Castaic Lake | Coachella | Crestline | Desert |
| | **CALIFORNIA AQUEDUCT** | | | | | | | |
| 1 | Delta through Bethany Reservoir | 0.00533010 | 0.00983337 | 0.02939084 | 0.01285827 | 0.00528315 | 0.00133612 | 0.00871300 |
| 2A | Bethany Reservoir to Orestimba Creek | 0.00557213 | 0.01027988 | 0.03072531 | 0.01343201 | 0.00552068 | 0.00139620 | 0.00910474 |
| 2B | Orestimba Creek to O'Neill Forebay | 0.00557824 | 0.01029119 | 0.03075915 | 0.01345351 | 0.00552831 | 0.00139814 | 0.00911733 |
| 3 | O'Neill Forebay to Dos Amigos Pumping Plant | 0.00557719 | 0.01028923 | 0.03075332 | 0.01345294 | 0.00552772 | 0.00139798 | 0.00911637 |
| 4 | Dos Amigos Pumping Plant to Panoche Creek | 0.00557607 | 0.01028717 | 0.03074719 | 0.01345233 | 0.00552710 | 0.00139784 | 0.00911536 |
| 5 | Panoche Creek to Five Points | 0.00557467 | 0.01028462 | 0.03073954 | 0.01345157 | 0.00552633 | 0.00139763 | 0.00911409 |
| 6 | Five Points to Arroyo Pasajero | 0.00557257 | 0.01028074 | 0.03072799 | 0.01345042 | 0.00552517 | 0.00139733 | 0.00911216 |
| 7 | Arroyo Pasajero to Kettleman City | 0.00557189 | 0.01027949 | 0.03072428 | 0.01345006 | 0.00552480 | 0.00139723 | 0.00911154 |
| 8C | Kettleman City through Milham Avenue | 0.00557103 | 0.01027792 | 0.03071961 | 0.01344960 | 0.00552432 | 0.00139712 | 0.00911076 |
| 8D | Milham Avenue through Avenal Gap | 0.00568611 | 0.01049020 | 0.03135418 | 0.01373353 | 0.00563986 | 0.00142632 | 0.00930130 |
| 9 | Avenal Gap through Twisselman Road | | | 0.03426625 | 0.01356094 | 0.00616886 | 0.00156011 | 0.01017373 |
| 10A | Twisselman Road through Lost Hills | | | 0.03481391 | 0.01377767 | 0.00626946 | 0.00158556 | 0.01033963 |
| 11B | Lost Hills to 7th Standard Road | | | 0.03835043 | 0.01517717 | 0.00691699 | 0.00174933 | 0.01140749 |
| 12D | 7th Standard Road through Elk Hills Road | | | 0.04031661 | 0.01595523 | 0.00727790 | 0.00184059 | 0.01200265 |
| 12E | Elk Hills Road through Tupman Road | | | 0.04037074 | 0.01597665 | 0.00728878 | 0.00184332 | 0.01202059 |
| 13B | Tupman Road to Buena Vista Pumping Plant | | | 0.04379882 | 0.01733322 | 0.00791595 | 0.00200194 | 0.01305492 |
| 14A | Buena Vista Pumping Plant through Santiago Creek | | | 0.04599268 | 0.01820137 | 0.00831952 | 0.00210399 | 0.01372049 |
| 14B | Santiago Creek through Old River Road | | | 0.04682530 | 0.01853084 | 0.00847388 | 0.00214303 | 0.01397505 |
| 14C | Old River Road to Wheeler Ridge Pumping Plant | | | 0.04825217 | 0.01909545 | 0.00873768 | 0.00220973 | 0.01441013 |
| 15A | Wheeler Ridge Pumping Plant to Chrisman Pumping Plant | | | 0.04905609 | 0.01941356 | 0.00888679 | 0.00224744 | 0.01465600 |
| 16A | Chrisman Pumping Plant to Edmonston Pumping Plant | | | 0.05089794 | 0.02014241 | 0.00922722 | 0.00233351 | 0.01521742 |
| 17E | Edmonston Pumping Plant to Porter Tunnel | | | 0.05329388 | 0.02109050 | 0.00967107 | 0.00244575 | 0.01594937 |
| 17F | Porter Tunnel to Junction, West Branch, California Aqueduct | | | 0.05340725 | 0.02113537 | 0.00969176 | 0.00245098 | 0.01598349 |
| 18A | Junction, West Branch, California Aqueduct through Alamo Powerplant | | | 0.13238112 | | 0.02399391 | 0.00606795 | 0.03957043 |
| 19 | Alamo Powerplant to Fairmont | | | 0.13237766 | | 0.02399451 | 0.00606811 | 0.03957141 |
| 19C | Buttes Junction through Buttes Reservoir | | | 1.00000000 | | | | |
| 20A | Fairmont through 70th Street West | | | 0.06847931 | | 0.02576425 | 0.00651573 | 0.04249001 |
| 20B | 70th Street West to Palmdale | | | 0.02276024 | | 0.02702917 | 0.00683555 | 0.04457607 |
| 21 | Palmdale to Littlerock Creek | | | 0.02318952 | | 0.02754716 | 0.00696651 | 0.04543034 |
| 22A | Littlerock Creek to Pearblossom Pumping Plant | | | 0.01181870 | | 0.02794143 | 0.00706621 | 0.04608043 |
| 22B | Pearblossom Pumping Plant to West Fork Mojave River | | | | | 0.02827552 | 0.00715074 | 0.04663153 |
| 23 | West Fork Mojave River to Silverwood Lake | | | | | 0.00324449 | 0.00818122 | 0.00535117 |
| 24 | Cedar Springs Dam and Silverwood Lake | | | | | 0.01024605 | 0.01251569 | 0.01690478 |
| 25 | Silverwood Lake to South Portal San Bernardino Tunnel | | | | | | | |
| 26A | South Portal, San Bernardino Tunnel through Devil Canyon Powerplant | | | | | | | |
| 28G | Devil Canyon Powerplant to Barton Road | | | | | | | |
| 28H | Barton Road to Lake Perris | | | | | | | |
| 28J | Perris Dam and Lake Perris | | | | | | | |
| 29A | Junction, West Branch, California Aqueduct through Oso Pumping Plant | | | | 0.03544337 | | | |
| 29F | Oso Pumping Plant through Quail Embankment | | | | 0.03544339 | | | |
| 29G | Quail Embankment through Warne Powerplant | | | | 0.03544339 | | | |
| 29H | Pyramid Dam and Lake | | | | 0.02817144 | | | |
| 29J | Pyramid Lake through Castaic Powerplant | | | | 0.03544338 | | | |
| 30 | Castaic Dam and Lake | | | | 0.02927284 | | | |
| 31A | Avenal Gap to Devil's Den Pumping Plant | 0.10560301 | 0.19482503 | | 0.07364766 | | | |
| 33A | Devil's Den Pumping Plant through Tank 1 | 0.10101221 | 0.89898779 | | | | | |
| 33B | Tank 1 through Chorro Valley Turnout | 0.09912818 | 0.90087182 | | | | | |
| 34 | Chorro Valley Turnout through Lopez Turnout | 0.05479573 | 0.94520427 | | | | | |
| 35 | Lopez Turnout through Guadalupe Turnout | | 1.00000000 | | | | | |

[a] Proportionate use factors do not reflect permanent water transfers as a result of the Monterey Amendment and after.

## TABLE B-1 Factors for Distributing Reach Capital Costs Among Contractors[a]



| Reach No. | SAN JOAQUIN VALLEY AREA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | |
| | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare |
| | **CALIFORNIA AQUEDUCT** | | | | | | | |
| 1 | 0.01707770 | 0.00088678 | 0.00254693 | 0.02741768 | 0.30629913 | 0.00090695 | 0.00167121 | 0.03504975 |
| 2A | 0.01781031 | 0.00092482 | 0.00266258 | 0.02864263 | 0.31945188 | 0.00094747 | 0.00174288 | 0.03655331 |
| 2B | 0.01785838 | 0.00092731 | 0.00266550 | 0.02868743 | 0.32030556 | 0.00094896 | | 0.03665201 |
| 3 | 0.01786337 | 0.00092757 | 0.00266499 | 0.02868589 | 0.32039254 | 0.00094892 | | 0.03666225 |
| 4 | 0.01786863 | 0.00092785 | 0.00266446 | 0.02868428 | 0.32048398 | 0.00094886 | | 0.03667303 |
| 5 | 0.01787517 | 0.00092819 | 0.00266380 | 0.02868227 | 0.32059816 | 0.00094879 | | 0.03668649 |
| 6 | 0.01788508 | 0.00092870 | 0.00266279 | 0.02867923 | 0.32077093 | 0.00094868 | | 0.03670685 |
| 7 | 0.01788826 | 0.00092887 | 0.00266246 | 0.02867825 | 0.32082633 | 0.00094864 | | 0.03671338 |
| 8C | 0.01789228 | 0.00092909 | 0.00266205 | 0.02867702 | 0.32089625 | 0.00094859 | | 0.03672162 |
| 8D | 0.01828779 | | 0.00271703 | 0.02928147 | 0.32798200 | | | 0.01820857 |
| 9 | | | | 0.03204523 | 0.32739538 | | | |
| 10A | | | | 0.03257442 | 0.31658608 | | | |
| 11B | | | | 0.03597398 | 0.24684668 | | | |
| 12D | | | | 0.03787171 | 0.20804762 | | | |
| 12E | | | | 0.03793198 | 0.20695175 | | | |
| 13B | | | | 0.01458796 | 0.16600071 | | | |
| 14A | | | | 0.00620338 | 0.13319181 | | | |
| 14B | | | | 0.00632023 | 0.11741558 | | | |
| 14C | | | | 0.00651962 | 0.09039633 | | | |
| 15A | | | | 0.00663252 | 0.07516317 | | | |
| 16A | | | | 0.00688973 | 0.04028829 | | | |
| 17E | | | | 0.00212516 | | | | |
| 31A | | | 0.05046240 | | 0.57546190 | | | |

| Reach No. | SOUTHERN CALIFORNIA AREA (continued) | | | | | | | | California Aqueduct Total |
|---|---|---|---|---|---|---|---|---|---|
| | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel | San Gorgonio | Metropolitan | Ventura | |
| | **CALIFORNIA AQUEDUCT** | | | | | | | | |
| 1 | 0.00049180 | 0.01101147 | 0.00369131 | 0.02362857 | 0.00650354 | 0.00398392 | 0.43929350 | 0.00429212 | 1.00000000 |
| 2A | 0.00051413 | 0.01151136 | 0.00385891 | 0.02469101 | 0.00679699 | 0.00416304 | 0.45921072 | 0.00448701 | 1.00000000 |
| 2B | 0.00051469 | 0.01152409 | 0.00386317 | 0.02472511 | 0.00680570 | 0.00416880 | 0.45973548 | 0.00449194 | 1.00000000 |
| 3 | 0.00051461 | 0.01152193 | 0.00386244 | 0.02472246 | 0.00680478 | 0.00416835 | 0.45965407 | 0.00449108 | 1.00000000 |
| 4 | 0.00051451 | 0.01151965 | 0.00386167 | 0.02471968 | 0.00680380 | 0.00416787 | 0.45956848 | 0.00449019 | 1.00000000 |
| 5 | 0.00051440 | 0.01151681 | 0.00386070 | 0.02471620 | 0.00680259 | 0.00416730 | 0.45946161 | 0.00448907 | 1.00000000 |
| 6 | 0.00051419 | 0.01151251 | 0.00385926 | 0.02471095 | 0.00680076 | 0.00416640 | 0.45929991 | 0.00448738 | 1.00000000 |
| 7 | 0.00051413 | 0.01151113 | 0.00385879 | 0.02470927 | 0.00680016 | 0.00416612 | 0.45924807 | 0.00448685 | 1.00000000 |
| 8C | 0.00051405 | 0.01150938 | 0.00385821 | 0.02470716 | 0.00679941 | 0.00416576 | 0.45918261 | 0.00448616 | 1.00000000 |
| 8D | 0.00052466 | 0.01174718 | 0.00393793 | 0.02522383 | 0.00694100 | 0.00425288 | 0.46868533 | 0.00457883 | 1.00000000 |
| 9 | 0.00057339 | 0.01283841 | 0.00430367 | 0.02758959 | 0.00758975 | 0.00465175 | 0.51227887 | 0.00500407 | 1.00000000 |
| 10A | 0.00058254 | 0.01304366 | 0.00437246 | 0.02803943 | 0.00771262 | 0.00472760 | 0.52049091 | 0.00508405 | 1.00000000 |
| 11B | 0.00064171 | 0.01436906 | 0.00481665 | 0.03093503 | 0.00850448 | 0.00521581 | 0.57349473 | 0.00560046 | 1.00000000 |
| 12D | 0.00067463 | 0.01510596 | 0.00506361 | 0.03254889 | 0.00894541 | 0.00548790 | 0.60297374 | 0.00588755 | 1.00000000 |
| 12E | 0.00067553 | 0.01512626 | 0.00507040 | 0.03259749 | 0.00895830 | 0.00549608 | 0.60379667 | 0.00589546 | 1.00000000 |
| 13B | 0.00073290 | 0.01641098 | 0.00550099 | 0.03540212 | 0.00972547 | 0.00596896 | 0.65516902 | 0.00639604 | 1.00000000 |
| 14A | 0.00076961 | 0.01723325 | 0.00577656 | 0.03720681 | 0.01021819 | 0.00627322 | 0.68807273 | 0.00671639 | 1.00000000 |
| 14B | 0.00078354 | 0.01754538 | 0.00588113 | 0.03789703 | 0.01040613 | 0.00638960 | 0.70057530 | 0.00683798 | 1.00000000 |
| 14C | 0.00080743 | 0.01808019 | 0.00606036 | 0.03907670 | 0.01072763 | 0.00658850 | 0.72199174 | 0.00704634 | 1.00000000 |
| 15A | 0.00082089 | 0.01838154 | 0.00616135 | 0.03974336 | 0.01090913 | 0.00670088 | 0.73406357 | 0.00716371 | 1.00000000 |
| 16A | 0.00085171 | 0.01907194 | 0.00639271 | 0.04126559 | 0.01132404 | 0.00695754 | 0.76170731 | 0.00743264 | 1.00000000 |
| 17E | 0.00089182 | 0.01997003 | 0.00669365 | 0.04325018 | 0.01186455 | 0.00729213 | 0.79767940 | 0.00778251 | 1.00000000 |
| 17F | 0.00089372 | 0.02001251 | 0.00670788 | 0.04334270 | 0.01188988 | 0.00730773 | 0.79937767 | 0.00779906 | 1.00000000 |
| 18A | 0.00221525 | 0.04960424 | 0.01662680 | 0.10730448 | 0.02944860 | 0.01809192 | 0.57469530 | | 1.00000000 |
| 19 | 0.00221522 | 0.04960300 | 0.01662640 | 0.10730707 | 0.02944876 | 0.01809230 | 0.57469556 | | 1.00000000 |
| 19C | | | | | | | | | 1.00000000 |
| 20A | 0.00237800 | 0.05324853 | 0.01784830 | 0.11522152 | 0.03161798 | 0.01942666 | 0.61700971 | | 1.00000000 |
| 20B | 0.00249470 | 0.05586076 | 0.01872390 | 0.12087843 | 0.03316986 | 0.02038045 | 0.64729087 | | 1.00000000 |
| 21 | 0.00254199 | 0.05692053 | | 0.12319480 | 0.03380324 | 0.02077093 | 0.65963498 | | 1.00000000 |
| 22A | | 0.05773082 | | 0.12495766 | 0.03428605 | 0.02106816 | 0.66905054 | | 1.00000000 |
| 22B | | 0.05842136 | | 0.12645207 | 0.03469614 | 0.02132008 | 0.67705256 | | 1.00000000 |
| 23 | | | | 0.14467451 | 0.03969010 | 0.02439237 | 0.77446614 | | 1.00000000 |
| 24 | | | | 0.22243002 | 0.04339444 | 0.02843498 | 0.66607404 | | 1.00000000 |
| 25 | | | | 0.14947726 | 0.03997502 | 0.02520426 | 0.78534346 | | 1.00000000 |
| 26A | | | | 0.14947726 | 0.03997502 | 0.02520426 | 0.78534346 | | 1.00000000 |
| 28G | | | | 0.05126137 | | | 0.94873863 | | 1.00000000 |
| 28H | | | | | | | 1.00000000 | | 1.00000000 |
| 28J | | | | | | | 1.00000000 | | 1.00000000 |
| 29A | | | | | | | 0.95147783 | 0.01307880 | 1.00000000 |
| 29F | | | | | | | 0.95147785 | 0.01307876 | 1.00000000 |
| 29G | | | | | | | 0.95147785 | 0.01307876 | 1.00000000 |
| 29H | | | | | | | 0.96278381 | 0.00904475 | 1.00000000 |
| 29J | | | | | | | 0.95147787 | 0.01307875 | 1.00000000 |
| 30 | | | | | | | 0.96212388 | 0.00860328 | 1.00000000 |
| 31A | | | | | | | | | 1.00000000 |
| 33A | | | | | | | | | 1.00000000 |
| 33B | | | | | | | | | 1.00000000 |
| 34 | | | | | | | | | 1.00000000 |
| 35 | | | | | | | | | 1.00000000 |

[a] Proportionate use factors do not reflect permanent water transfers as a result of the Monterey Amendment and after.

## TABLE B-2 Factors for Distributing Reach Minimum OMP&R Costs Among Contractors[a]



| Reach No. | Reach Description | NORTH BAY AREA | | SOUTH BAY AREA | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Napa | Solano | Alameda-Zone 7 | Alameda County | Santa Clara | Future Contractor South Bay | |
| | **NORTH BAY AQUEDUCT** | | | | | | | |
| 1 | Barker Slough through Fairfield/Vacaville Turnout | 0.29251728 | 0.70748272 | | | | | 1.00000000 |
| 2 | Fairfield/Vacaville Turnout to Cordelia Forebay | 0.42000793 | 0.57999207 | | | | | 1.00000000 |
| 3A | Cordelia Forebay through Benicia and Vallejo Turnouts | | 1.00000000 | | | | | 1.00000000 |
| 3B | Cordelia Forebay through Napa Turnout Reservoir | 1.00000000 | | | | | | 1.00000000 |
| | **SOUTH BAY AQUEDUCT** | | | | | | | |
| 1 | Bethany Reservoir through Altamont Turnout | | | 0.33980110 | 0.19515838 | 0.46504052 | 0.00000000 | 1.00000000 |
| 2 | Altamont Turnout through Patterson Reservoir | | | 0.33978741 | 0.19516252 | 0.46505007 | 0.00000000 | 1.00000000 |
| 4 | Patterson Reservoir to Del Valle Junction | | | 0.31610985 | 0.20216089 | 0.48172926 | 0.00000000 | 1.00000000 |
| 5 | Del Valle Junction through Lake del Valle | | | 0.53312173 | 0.12972254 | 0.33715573 | 0.00000000 | 1.00000000 |
| 6 | Del Valle Junction through South Livermore Turnout | | | 0.32478705 | 0.19906896 | 0.47614399 | 0.00000000 | 1.00000000 |
| 7 | South Livermore Turnout through Vallecitos Turnout | | | 0.14604872 | 0.25176680 | 0.60218448 | 0.00000000 | 1.00000000 |
| 8 | Vallecitos Turnout through Alameda-Bayside Turnout | | | | 0.27934645 | 0.72065355 | | 1.00000000 |
| 9 | Alameda-Bayside Turnout through Santa Clara Terminal Facilities | | | | | 1.00000000 | | 1.00000000 |
| | **CALIFORNIA AQUEDUCT** | | | | | | | |
| 1 | Delta through Bethany Reservoir | | | | 0.00870518 | 0.02074403 | | N/A |

| Reach No. | Reach Description | CENTRAL COASTAL AREA | | SOUTHERN CALIFORNIA AREA | | | | |
|---|---|---|---|---|---|---|---|---|
| | | San Luis Obispo | Santa Barbara | AVEK | Castaic Lake | Coachella | Crestline | Desert |
| | **CALIFORNIA AQUEDUCT** | | | | | | | |
| 1 | Delta through Bethany Reservoir | 0.00531721 | 0.00980965 | 0.03130358 | 0.02543338 | 0.03261213 | 0.00133220 | 0.01285646 |
| 2A | Bethany Reservoir to Orestimba Creek | 0.00556969 | 0.01027545 | 0.03278434 | 0.02659653 | 0.03414259 | 0.00139484 | 0.01346045 |
| 2B | Orestimba Creek to O'Neill Forebay | 0.00557578 | 0.01028673 | 0.03282389 | 0.02665383 | 0.03419149 | 0.00139677 | 0.01347932 |
| 3 | O'Neill Forebay to Dos Amigos Pumping Plant | 0.00557472 | 0.01028476 | 0.03281870 | 0.02665705 | 0.03418834 | 0.00139663 | 0.01347795 |
| 4 | Dos Amigos Pumping Plant to Panoche Creek | 0.00557360 | 0.01028270 | 0.03281323 | 0.02666041 | 0.03418504 | 0.00139648 | 0.01347652 |
| 5 | Panoche Creek to Five Points | 0.00557222 | 0.01028014 | 0.03280640 | 0.02666463 | 0.03418091 | 0.00139630 | 0.01347474 |
| 6 | Five Points to Arroyo Pasajero | 0.00557012 | 0.01027626 | 0.03279609 | 0.02667100 | 0.03417466 | 0.00139599 | 0.01347205 |
| 7 | Arroyo Pasajero to Kettleman City | 0.00556944 | 0.01027501 | 0.03279278 | 0.02667304 | 0.03417265 | 0.00139589 | 0.01347118 |
| 8C | Kettleman City through Milham Avenue | 0.00551362 | 0.01017203 | 0.03245613 | 0.02634257 | 0.03380450 | 0.00138102 | 0.01332696 |
| 8D | Milham Avenue through Avenal Gap | 0.00562578 | 0.01037893 | 0.03311929 | 0.02690184 | 0.03450165 | 0.00140943 | 0.01360147 |
| 9 | Avenal Gap through Twisselman Road | | | 0.03490917 | 0.02761987 | 0.03509927 | 0.00151717 | 0.01432230 |
| 10A | Twisselman Road through Lost Hills | | | 0.03544917 | 0.02807208 | 0.03564408 | 0.00154110 | 0.01454684 |
| 11B | Lost Hills to 7th Standard Road | | | 0.03880671 | 0.03085710 | 0.03902944 | 0.00168938 | 0.01593968 |
| 12D | 7th Standard Road through Elk Hills Road | | | 0.04066779 | 0.03241328 | 0.04090687 | 0.00177180 | 0.01671325 |
| 12E | Elk Hills Road through Tupman Road | | | 0.04071899 | 0.03246787 | 0.04095940 | 0.00177429 | 0.01673594 |
| 13B | Tupman Road to Buena Vista Pumping Plant | | | 0.04402054 | 0.03519674 | 0.04428760 | 0.00191991 | 0.01810442 |
| 14A | Buena Vista Pumping Plant through Santiago Creek | | | 0.04611560 | 0.03675967 | 0.04640153 | 0.00201279 | 0.01897599 |
| 14B | Santiago Creek through Old River Road | | | 0.04676624 | 0.03303687 | 0.04706094 | 0.00204236 | 0.01925135 |
| 14C | Old River Road to Wheeler Ridge Pumping Plant | | | 0.04794869 | 0.03181987 | 0.04825630 | 0.00209534 | 0.01974685 |
| 15A | Wheeler Ridge Pumping Plant to Chrisman Pumping Plant | | | 0.04864100 | 0.03227919 | 0.04895597 | 0.00212631 | 0.02003668 |
| 16A | Chrisman Pumping Plant to Edmonston Pumping Plant | | | 0.05024161 | 0.03334119 | 0.05057226 | 0.00219758 | 0.02070455 |
| 17E | Edmonston Pumping Plant to Porter Tunnel | | | 0.05223186 | 0.03466168 | 0.05258256 | 0.00228636 | 0.02153594 |
| 17F | Porter Tunnel to Junction, West Branch, California Aqueduct | | | 0.05233552 | 0.03473046 | 0.05268698 | 0.00229092 | 0.02157880 |
| 18A | Junction, West Branch, California Aqueduct through Alamo Powerplant | | | 0.13774725 | | 0.11306511 | 0.00603056 | 0.05137695 |
| 19 | Alamo Powerplant to Fairmont | | | 0.13774370 | | 0.11306344 | 0.00603069 | 0.05137766 |
| 19C | Buttes Junction through Buttes Reservoir | | | 1.00000000 | | | | |
| 20A | Fairmont through 70th Street West | | | 0.06855702 | | 0.12212506 | 0.00651522 | 0.05550243 |
| 20B | 70th Street West to Palmdale | | | 0.02284441 | | 0.12811683 | 0.00683511 | 0.05822670 |
| 21 | Palmdale to Littlerock Creek | | | 0.02327543 | | 0.13055246 | 0.00696606 | 0.05933989 |
| 22A | Littlerock Creek to Pearblossom Pumping Plant | | | 0.01190663 | | 0.13241285 | 0.00706574 | 0.06018798 |
| 22B | Pearblossom Pumping Plant to West Fork Mojave River | | | 0.00195128 | | 0.13374659 | 0.00713697 | 0.06079440 |
| 23 | West Fork Mojave River to Silverwood Lake | | | | | 0.12416451 | 0.00818135 | 0.02168414 |
| 24 | Cedar Springs Dam and Silverwood Lake | | | | | 0.02651510 | 0.01251569 | 0.01910229 |
| 25 | Silverwood Lake to South Portal San Bernardino Tunnel | | | | | 0.09751351 | | 0.01317145 |
| 26A | South Portal, San Bernardino Tunnel through Devil Canyon Powerplant | | | | | 0.12013473 | | 0.01622697 |
| 28G | Devil Canyon Powerplant to Barton Road | | | | | 0.30672992 | | 0.04143095 |
| 28H | Barton Road to Lake Perris | | | | | 0.32330286 | | 0.04366951 |
| 28J | Perris Dam and Lake Perris | | | | | 0.32330202 | | 0.04366970 |
| 29A | Junction, West Branch, California Aqueduct through Oso Pumping Plant | | | 0.00296720 | 0.05726734 | | | |
| 29F | Oso Pumping Plant through Quail Embankment | | | 0.00296796 | 0.05726649 | | | |
| 29G | Quail Embankment through Warne Powerplant | | | | 0.05742327 | | | |
| 29H | Pyramid Dam and Lake | | | | 0.03349572 | | | |
| 29J | Pyramid Lake through Castaic Powerplant | | | | 0.05740996 | | | |
| 30 | Castaic Dam and Lake | | | | 0.03248607 | | | |
| 31A | Avenal Gap to Devil's Den Pumping Plant | 0.10542164 | 0.19449108 | | 0.07351496 | 0.05400251 | | 0.01800084 |
| 33A | Devil's Den Pumping Plant through Tank 1 | 0.10101221 | 0.89898779 | | | | | |
| 33B | Tank 1 through Chorro Valley Turnout | 0.10101221 | 0.89898779 | | | | | |
| 34 | Chorro Valley Turnout through Lopez Turnout | 0.05271277 | 0.94728723 | | | | | |
| 35 | Lopez Turnout through Guadalupe Turnout | | 1.00000000 | | | | | |

[a] Proportionate use factors apply to 2017 and reflect permanent capacity water transfers that have been signed as of February 1, 2016.

## TABLE B-2 Factors for Distributing Reach Minimum OMP&R Costs Among Contractors[a]



| Reach No. | SAN JOAQUIN VALLEY AREA | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Alameda-Zone 7 | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Kern | | Kings | Oak Flat | Tulare |
| | | | | | | | Municipal and Industrial | Agricultural | | | |
| | **CALIFORNIA AQUEDUCT** | | | | | | | | | | |
| 1 | 0.00101482 | 0.00145895 | 0.02319903 | 0.01467673 | 0.00088461 | 0.00254076 | 0.02734568 | 0.27096833 | 0.00247145 | 0.00166714 | 0.02580275 |
| 2A | 0.00106145 | 0.00152591 | 0.00868253 | 0.01533481 | 0.00092428 | 0.00266141 | 0.02862314 | 0.28310687 | 0.00258398 | 0.00174185 | 0.02695973 |
| 2B | 0.00106360 | 0.00152905 | 0.00869823 | 0.01537617 | 0.00092676 | 0.00266432 | 0.02866783 | 0.28387747 | 0.00258988 | | 0.02703241 |
| 3 | 0.00106370 | 0.00152920 | 0.00869838 | 0.01538045 | 0.00092702 | 0.00266381 | 0.02866629 | 0.28395878 | 0.00259028 | | 0.02703994 |
| 4 | 0.00106379 | 0.00152934 | 0.00869854 | 0.01538495 | 0.00092729 | 0.00266328 | 0.02866467 | 0.28404425 | 0.00259071 | | 0.02704786 |
| 5 | 0.00106390 | 0.00152952 | 0.00869876 | 0.01539058 | 0.00092763 | 0.00266262 | 0.02866263 | 0.28415100 | 0.00259125 | | 0.02705775 |
| 6 | 0.00106409 | 0.00152980 | 0.00869909 | 0.01539909 | 0.00092815 | 0.00266161 | 0.02865956 | 0.28431251 | 0.00259206 | | 0.02707272 |
| 7 | 0.00106415 | 0.00152990 | 0.00869920 | 0.01540183 | 0.00092832 | 0.00266127 | 0.02865857 | 0.28436430 | 0.00259232 | | 0.02707752 |
| 8C | 0.00105126 | 0.00151129 | 0.00859813 | 0.01519240 | 0.00091570 | 0.00263462 | 0.02834154 | 0.28048179 | 0.00255949 | | 0.02670939 |
| 8D | 0.00107347 | 0.00154326 | 0.00877817 | 0.01552187 | | 0.00268820 | 0.02892910 | 0.28657021 | 0.00165698 | | 0.00825002 |
| 9 | 0.00079148 | 0.00109219 | 0.00779740 | | | | 0.03115978 | 0.29020213 | | | |
| 10A | 0.00080441 | 0.00110983 | 0.00792269 | | | | 0.03165722 | 0.27906723 | | | |
| 11B | 0.00064433 | 0.00094350 | 0.00351417 | | | | 0.03473359 | 0.21569759 | | | |
| 12D | | | | | | | 0.03644652 | 0.18305822 | | | |
| 12E | | | | | | | 0.03650093 | 0.18194750 | | | |
| 13B | | | | | | | 0.01398402 | 0.14058058 | | | |
| 14A | | | | | | | 0.00593078 | 0.10814827 | | | |
| 14B | | | | | | | 0.00602009 | 0.09952426 | | | |
| 14C | | | | | | | 0.00617876 | 0.07848396 | | | |
| 15A | | | | | | | 0.00627144 | 0.06500426 | | | |
| 16A | | | | | | | 0.00648410 | 0.03392037 | | | |
| 17E | | | | | | | 0.00198506 | | | | |
| 31A | 0.00628695 | 0.00977801 | 0.02617705 | | | 0.05037550 | | 0.36716813 | 0.00176551 | | |

| Reach No. | SOUTHERN CALIFORNIA AREA (continued) | | | | | | | | California Aqueduct Total |
|---|---|---|---|---|---|---|---|---|---|
| | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel | San Gorgonio | Metroplitan | Ventura | |
| | **CALIFORNIA AQUEDUCT** | | | | | | | | |
| 1 | 0.00049038 | 0.02116470 | 0.00458381 | 0.02355980 | 0.00648455 | 0.00397230 | 0.41532271 | 0.00427768 | 1.00000000 |
| 2A | 0.00051367 | 0.02214484 | 0.00480091 | 0.02466751 | 0.00679050 | 0.00415906 | 0.43501287 | 0.00448079 | 1.00000000 |
| 2B | 0.00051423 | 0.02218483 | 0.00480654 | 0.02470151 | 0.00679919 | 0.00416478 | 0.43550968 | 0.00448571 | 1.00000000 |
| 3 | 0.00051414 | 0.02218522 | 0.00480573 | 0.02469885 | 0.00679827 | 0.00416433 | 0.43543260 | 0.00448486 | 1.00000000 |
| 4 | 0.00051405 | 0.02218564 | 0.00480489 | 0.02469606 | 0.00679730 | 0.00416387 | 0.43535156 | 0.00448397 | 1.00000000 |
| 5 | 0.00051393 | 0.02218616 | 0.00480382 | 0.02469256 | 0.00679607 | 0.00416328 | 0.43525035 | 0.00448285 | 1.00000000 |
| 6 | 0.00051372 | 0.02218693 | 0.00480221 | 0.02468729 | 0.00679422 | 0.00416240 | 0.43509723 | 0.00448115 | 1.00000000 |
| 7 | 0.00051366 | 0.02218719 | 0.00480171 | 0.02468559 | 0.00679362 | 0.00416212 | 0.43504813 | 0.00448061 | 1.00000000 |
| 8C | 0.00050851 | 0.02192962 | 0.00475278 | 0.02442260 | 0.00672277 | 0.00411777 | 0.44211780 | 0.00443571 | 1.00000000 |
| 8D | 0.00051885 | 0.02238875 | 0.00484976 | 0.02492516 | 0.00686055 | 0.00420251 | 0.45117880 | 0.00452595 | 1.00000000 |
| 9 | 0.00055796 | 0.02061192 | 0.00521674 | 0.02683029 | 0.00738240 | 0.00452372 | 0.48549902 | 0.00486719 | 1.00000000 |
| 10A | 0.00056659 | 0.02092935 | 0.00529783 | 0.02725335 | 0.00749802 | 0.00459505 | 0.49310270 | 0.00494246 | 1.00000000 |
| 11B | 0.00062024 | 0.02290463 | 0.00580164 | 0.02987521 | 0.00821533 | 0.00503710 | 0.54027985 | 0.00541051 | 1.00000000 |
| 12D | 0.00064998 | 0.02399884 | 0.00599767 | 0.03133251 | 0.00861365 | 0.00528280 | 0.56647688 | 0.00566994 | 1.00000000 |
| 12E | 0.00065079 | 0.02402828 | 0.00600523 | 0.03137638 | 0.00862529 | 0.00529020 | 0.56724183 | 0.00567708 | 1.00000000 |
| 13B | 0.00070354 | 0.02597118 | 0.00649222 | 0.03395142 | 0.00933012 | 0.00572435 | 0.61359604 | 0.00613732 | 1.00000000 |
| 14A | 0.00073704 | 0.02720257 | 0.00680126 | 0.03559402 | 0.00977890 | 0.00600130 | 0.64311092 | 0.00642936 | 1.00000000 |
| 14B | 0.00074743 | 0.02758281 | 0.00689726 | 0.03611670 | 0.00992049 | 0.00608943 | 0.65242374 | 0.00652003 | 1.00000000 |
| 14C | 0.00076634 | 0.02827615 | 0.00707171 | 0.03705347 | 0.01017549 | 0.00624735 | 0.66919487 | 0.00668485 | 1.00000000 |
| 15A | 0.00077741 | 0.02868221 | 0.00717384 | 0.03760115 | 0.01032464 | 0.00633968 | 0.67900489 | 0.00678133 | 1.00000000 |
| 16A | 0.00080298 | 0.02962205 | 0.00740997 | 0.03886148 | 0.01066844 | 0.00655218 | 0.70161679 | 0.00700445 | 1.00000000 |
| 17E | 0.00083480 | 0.03079028 | 0.00770356 | 0.04043105 | 0.01109636 | 0.00681681 | 0.72976182 | 0.00728186 | 1.00000000 |
| 17F | 0.00083646 | 0.03085132 | 0.00771884 | 0.04051162 | 0.01111844 | 0.00683040 | 0.73121394 | 0.00729630 | 1.00000000 |
| 18A | 0.00220155 | 0.04929713 | 0.01652427 | 0.10664131 | 0.02926634 | 0.01798005 | 0.46986948 | | 1.00000000 |
| 19 | 0.00220151 | 0.04929585 | 0.01652388 | 0.10664396 | 0.02926656 | 0.01798044 | 0.46987231 | | 1.00000000 |
| 19C | | | | | | | | | 1.00000000 |
| 20A | 0.00237787 | 0.05324421 | 0.01784728 | 0.11521174 | 0.03161525 | 0.01942494 | 0.50757898 | | 1.00000000 |
| 20B | 0.00249455 | 0.05585607 | 0.01872278 | 0.12086783 | 0.03316690 | 0.02037859 | 0.53249023 | | 1.00000000 |
| 21 | 0.00254183 | 0.05691567 | | 0.12318381 | 0.03380017 | 0.02076901 | 0.54265567 | | 1.00000000 |
| 22A | | 0.05772584 | | 0.12494639 | 0.03428290 | 0.02106619 | 0.55040548 | | 1.00000000 |
| 22B | | 0.05830722 | | 0.12620561 | 0.03462835 | 0.02127845 | 0.55595113 | | 1.00000000 |
| 23 | | | | 0.14467451 | 0.03969010 | 0.02439237 | 0.63721302 | | 1.00000000 |
| 24 | | | | 0.22243002 | 0.04339445 | 0.02843498 | 0.64760747 | | 1.00000000 |
| 25 | | | | 0.11825184 | 0.03722720 | 0.01993915 | 0.71389685 | | 1.00000000 |
| 26A | | | | 0.14947726 | 0.03997501 | 0.02520426 | 0.64898177 | | 1.00000000 |
| 28G | | | | 0.05126136 | | | 0.60057777 | | 1.00000000 |
| 28H | | | | | | | 0.63302763 | | 1.00000000 |
| 28J | | | | | | | 0.63302828 | | 1.00000000 |
| 29A | | | | | | | 0.92702291 | 0.01274255 | 1.00000000 |
| 29F | | | | | | | 0.92702302 | 0.01274253 | 1.00000000 |
| 29G | | | | | | | 0.92979606 | 0.01278067 | 1.00000000 |
| 29H | | | | | | | 0.95753173 | 0.00897255 | 1.00000000 |
| 29J | | | | | | | 0.92980918 | 0.01278086 | 1.00000000 |
| 30 | | | | | | | 0.95895422 | 0.00855971 | 1.00000000 |
| 31A | | 0.09301782 | | | | | | | 1.00000000 |
| 33A | | | | | | | | | 1.00000000 |
| 33B | | | | | | | | | 1.00000000 |
| 34 | | | | | | | | | 1.00000000 |
| 35 | | | | | | | | | 1.00000000 |

[a] Proportionate use factors apply to 2017 and reflect permanent capacity water transfers that have been signed as of February 1, 2016.

## TABLE B-3 Power Costs and Credits, Transmission Costs and Annual Replacement Deposits for Each Aqueduct Pumping and Power Recovery Plant[a] (in dollars)



| | NORTH BAY AQUEDUCT | | | SOUTH BAY AQUEDUCT | CALIFORNIA AQUEDUCT | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 1 | Reach 3A | Reach 3B | Reach 1[c] | Reach 1 | Reach 4 | Reach 14A | Reach 15A |
| Calendar Year | Barker Slough Pumping Plant | Cordelia Pumping Plant Solano | Cordelia Pumping Plant Napa[b] | South Bay and Del Valle Pumping Plants | Banks Pumping Plant | Dos Amigos Pumping Plant | Buena Vista Pumping Plant | Teerink Pumping Plant |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 36,771 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 55,654 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 73,240 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 137,665 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 186,064 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 216,515 | 15,453 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 6,989 | 336,671 | 452,630 | 202,947 | 0 | 0 |
| 1969 | 0 | 0 | 8,551 | 257,579 | 293,741 | 135,425 | 0 | 0 |
| 1970 | 0 | 0 | 13,598 | 396,358 | 346,215 | 211,197 | 1 | 0 |
| 1971 | 0 | 0 | 10,609 | 381,662 | 574,015 | 225,188 | 115,801 | 2,564 |
| 1972 | 0 | 0 | 14,434 | 598,702 | 933,292 | 492,633 | 198,914 | 68,304 |
| 1973 | 0 | 0 | 14,449 | 493,490 | 688,030 | 381,232 | 263,468 | 236,623 |
| 1974 | 0 | 0 | 17,473 | 565,575 | 783,562 | 447,772 | 315,939 | 324,966 |
| 1975 | 0 | 0 | 14,779 | 349,758 | 1,341,019 | 518,322 | 508,060 | 552,952 |
| 1976 | 0 | 0 | 20,856 | 571,361 | 1,638,453 | 641,115 | 712,947 | 713,875 |
| 1977 | 0 | 0 | 22,635 | 512,996 | 1,013,307 | 277,439 | 265,169 | 300,985 |
| 1978 | 0 | 0 | 21,692 | 586,355 | 2,339,502 | 560,759 | 689,236 | 616,104 |
| 1979 | 0 | 0 | 16,237 | 605,136 | 3,554,256 | 1,008,564 | 776,016 | 749,188 |
| 1980 | 0 | 0 | 19,945 | 523,369 | 2,083,336 | 1,129,152 | 1,051,629 | 1,047,495 |
| 1981 | 0 | 0 | 23,842 | 567,692 | 3,952,931 | 1,939,189 | 1,336,867 | 1,319,739 |
| 1982 | 0 | 0 | 12,157 | 605,780 | 3,082,031 | 1,363,705 | 1,200,226 | 1,213,660 |
| 1983 | 0 | 0 | 2,342 | 82,222 | 1,001,612 | 396,086 | 450,801 | 432,165 |
| 1984 | 0 | 0 | 4,822 | 271,543 | 1,856,959 | 976,773 | 823,681 | 770,618 |
| 1985 | 0 | 0 | 10,188 | 451,020 | 3,186,029 | 1,621,418 | 1,409,980 | 1,411,621 |
| 1986 | 0 | 0 | 15,501 | 807,984 | 6,601,752 | 2,627,407 | 2,405,224 | 2,432,322 |
| 1987 | 0 | 0 | 27,223 | 886,956 | 5,820,699 | 2,555,341 | 2,295,575 | 2,286,066 |
| 1988 | 17,813 | 0 | 24,020 | 909,300 | 6,365,669 | 2,648,986 | 2,628,985 | 2,636,224 |
| 1989 | 29,819 | 43,846 | 26,519 | 1,161,160 | 9,964,956 | 4,002,409 | 4,130,033 | 4,159,440 |
| 1990 | 52,210 | 67,109 | 40,775 | 1,834,626 | 10,554,762 | 4,541,508 | 5,855,196 | 6,099,412 |
| 1991 | 10,429 | 10,118 | 5,252 | 378,966 | 1,994,449 | 510,781 | 944,445 | 1,077,662 |
| 1992 | 13,319 | 13,070 | 9,406 | 311,251 | 3,385,375 | 1,235,571 | 1,366,433 | 1,441,966 |
| 1993 | (11,941) | (8,753) | (5,392) | (158,214) | 537,591 | 348,409 | (127,617) | (104,923) |
| 1994 | 46,791 | 39,624 | 29,189 | 799,624 | 6,013,464 | 2,450,174 | 2,778,971 | 2,823,137 |
| 1995 | 20,014 | 20,620 | 11,791 | 247,645 | 4,066,595 | 1,532,502 | 952,304 | 877,047 |
| 1996 | 57,320 | 47,288 | 23,483 | 619,160 | 8,385,766 | 4,056,188 | 2,565,655 | 2,378,677 |
| 1997 | 67,416 | 52,935 | 21,955 | 986,312 | 7,010,228 | 2,870,194 | 2,637,433 | 2,469,147 |
| 1998 | (11,427) | (10,141) | (4,879) | (133,721) | 204,374 | (365,361) | (319,014) | (295,861) |
| 1999 | 34,881 | 25,288 | 11,623 | 507,549 | 6,333,906 | 2,421,869 | 1,691,167 | 1,446,775 |
| 2000 | 61,251 | 42,605 | 15,645 | 744,601 | 8,192,499 | 3,183,058 | 3,047,566 | 3,216,888 |
| 2001 | 376,166 | 250,964 | 214,751 | 4,262,186 | 27,678,243 | 10,726,077 | 15,061,255 | 15,960,123 |
| 2002 | 192,540 | 104,564 | 61,470 | 2,036,126 | 17,666,689 | 7,284,182 | 8,870,415 | 9,554,380 |
| 2003 | 198,411 | 118,387 | 97,762 | 2,591,352 | 24,686,904 | 9,172,710 | 10,694,766 | 11,529,669 |
| 2004 | 262,243 | 139,241 | 107,251 | 2,420,894 | 22,910,295 | 9,450,923 | 12,600,249 | 13,757,895 |
| 2005 | 291,101 | 147,895 | 149,083 | 2,791,021 | 33,776,092 | 12,750,371 | 11,843,712 | 12,615,882 |
| 2006 | 240,451 | 116,406 | 147,541 | 2,551,235 | 24,153,833 | 10,464,755 | 11,470,441 | 12,268,716 |
| 2007 | 461,136 | 228,029 | 257,116 | 4,809,380 | 23,665,366 | 11,668,533 | 17,485,162 | 18,965,848 |
| 2008 | 430,277 | 195,656 | 307,555 | 3,425,973 | 14,703,503 | 6,671,984 | 11,660,910 | 13,395,079 |
| 2009 | 221,684 | 103,270 | 164,922 | 2,501,591 | 13,814,314 | 4,320,317 | 7,109,228 | 7,916,544 |
| 2010 | 265,329 | 112,283 | 219,613 | 2,505,829 | 27,497,962 | 9,982,984 | 11,243,647 | 11,839,241 |
| 2011 | 276,011 | 116,076 | 232,697 | 3,365,611 | 40,410,387 | 15,518,386 | 14,818,528 | 15,530,918 |
| 2012 | 277,025 | 123,844 | 193,629 | 3,787,397 | 24,413,047 | 12,628,000 | 14,645,228 | 14,989,804 |
| 2013 | 446,094 | 208,054 | 331,870 | 5,281,604 | 23,461,974 | 9,732,824 | 13,373,155 | 13,792,322 |
| 2014 | 388,724 | 184,702 | 476,187 | 4,476,996 | 18,433,560 | 4,771,903 | 8,576,932 | 8,930,574 |
| 2015 | 390,734 | 239,088 | 361,235 | 5,307,739 | 16,574,599 | 6,150,419 | 10,562,911 | 11,933,700 |
| 2016 | 548,601 | 306,673 | 375,675 | 5,200,567 | 46,688,708 | 12,352,893 | 17,512,117 | 18,458,474 |
| **2017** | **629,471** | **178,375** | **600,736** | **4,905,065** | **43,881,122** | **16,473,139** | **20,872,813** | **21,522,503** |
| 2018 | 640,090 | 181,385 | 610,872 | 5,125,759 | 43,055,561 | 16,700,175 | 20,380,145 | 20,966,695 |
| 2019 | 573,263 | 193,348 | 545,427 | 5,366,543 | 48,107,976 | 17,843,553 | 21,049,535 | 21,580,257 |
| 2020 | 585,727 | 197,552 | 557,286 | 5,504,796 | 35,329,763 | 18,243,993 | 21,535,259 | 22,079,893 |
| 2021 | 576,541 | 194,453 | 548,545 | 5,418,457 | 42,469,703 | 17,957,848 | 21,197,493 | 21,733,584 |
| 2022 | 583,831 | 196,912 | 555,481 | 5,486,975 | 39,111,067 | 18,184,930 | 21,465,542 | 22,008,412 |
| 2023 | 580,757 | 195,876 | 552,557 | 5,458,084 | 38,905,132 | 18,089,180 | 21,352,517 | 21,892,529 |
| 2024 | 583,026 | 196,641 | 554,715 | 5,479,405 | 38,709,904 | 18,159,841 | 21,435,927 | 21,978,048 |
| 2025 | 586,434 | 197,790 | 557,958 | 5,511,439 | 32,358,922 | 18,266,008 | 21,561,246 | 22,106,537 |
| 2026 | 575,597 | 194,135 | 547,647 | 5,409,587 | 45,700,739 | 17,928,449 | 21,162,791 | 21,698,004 |
| 2027 | 579,719 | 195,525 | 551,569 | 5,448,325 | 38,835,570 | 18,056,836 | 21,314,339 | 21,853,385 |
| 2028 | 581,960 | 196,281 | 553,701 | 5,469,393 | 38,985,740 | 18,126,659 | 21,396,758 | 21,937,889 |
| 2029 | 583,836 | 196,914 | 555,486 | 5,487,022 | 38,763,714 | 18,185,085 | 21,465,724 | 22,008,599 |
| 2030 | 586,041 | 197,658 | 557,584 | 5,507,748 | 33,212,248 | 18,253,774 | 21,546,806 | 22,091,731 |
| 2031 | 586,184 | 197,706 | 557,720 | 5,509,084 | 36,334,412 | 18,258,201 | 21,552,031 | 22,097,089 |
| 2032 | 576,048 | 194,287 | 548,076 | 5,413,825 | 47,759,974 | 17,942,496 | 21,179,371 | 21,715,004 |
| 2033 | 588,371 | 198,444 | 559,801 | 5,529,646 | 27,502,911 | 18,326,349 | 21,632,473 | 22,179,565 |
| 2034 | 579,894 | 195,585 | 551,736 | 5,449,977 | 42,288,305 | 18,062,309 | 21,320,799 | 21,860,009 |
| 2035 | 576,408 | 194,409 | 548,419 | 5,417,210 | 46,863,598 | 17,953,715 | 21,192,614 | 21,728,582 |
| **TOTAL** | **16,807,621** | **6,732,017** | **14,821,381** | **178,980,220** | **1,273,280,293** | **541,807,754** | **645,113,929** | **669,182,323** |

[a] Starting with 2005, transmission costs that vary and depend on power usage are included, therefore recovered through the variable component.

[b] Power costs for the period 1968 through 1987 are for an interim facility.

[c] The costs of Del Valle Pumping Plant are combined with those of South Bay Pumping Plant to simplify the cost allocations.

## TABLE B-3 Power Costs and Credits, Transmission Costs and Annual Replacement Deposits for Each Aqueduct Pumping and Power Recovery Plant[a] (in dollars)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 16A | Reach 17E | Reach 18A | Reach 22B | Reach 23 | Reach 26A | Reach 2B (EBX) | Reach 3A (EBX) |
| Calendar Year | Chrisman Pumping Plant | Edmonston Pumping Plant | Alamo Pumping Plant | Pearblossom Pumping Plant | Mojave Siphon Powerplant | Devil Canyon Powerplant | Greenspot Pump Station | Crafton Hills Pump Station |
| | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 142,902 | 542,625 | 0 | 3,468 | 0 | (3,024) | 0 | 0 |
| 1973 | 387,198 | 1,548,428 | 0 | 202,289 | 0 | (461,268) | 0 | 0 |
| 1974 | 564,464 | 2,164,223 | 0 | 324,993 | 0 | (546,156) | 0 | 0 |
| 1975 | 1,095,331 | 4,010,395 | 0 | 575,061 | 0 | (1,095,523) | 0 | 0 |
| 1976 | 1,506,985 | 5,443,936 | 0 | 889,544 | 0 | (1,566,056) | 0 | 0 |
| 1977 | 652,643 | 2,345,033 | 0 | 315,128 | 0 | (1,222,866) | 0 | 0 |
| 1978 | 1,132,296 | 4,180,131 | 0 | 1,508,115 | 0 | (3,085,094) | 0 | 0 |
| 1979 | 1,526,850 | 5,475,688 | 0 | 1,838,687 | 0 | (3,466,481) | 0 | 0 |
| 1980 | 2,102,439 | 7,028,235 | 0 | 1,762,063 | 0 | (3,318,152) | 0 | 0 |
| 1981 | 2,838,773 | 9,351,931 | 0 | 2,296,771 | 0 | (3,842,971) | 0 | 0 |
| 1982 | 2,424,920 | 8,352,207 | 0 | 1,498,620 | 0 | (2,736,072) | 0 | 0 |
| 1983 | 793,915 | 2,375,225 | 0 | 397,766 | 0 | (5,478,830) | 0 | 0 |
| 1984 | 1,479,784 | 4,585,198 | 0 | 624,213 | 0 | (7,350,989) | 0 | 0 |
| 1985 | 2,812,461 | 9,365,591 | 0 | 1,226,515 | 0 | (10,748,103) | 0 | 0 |
| 1986 | 4,999,949 | 16,956,023 | (1,013,756) | 2,359,599 | 0 | (11,484,996) | 0 | 0 |
| 1987 | 4,586,919 | 15,121,886 | (1,064,827) | 1,907,854 | 0 | (11,151,140) | 0 | 0 |
| 1988 | 5,284,130 | 17,342,811 | (744,374) | 2,375,784 | 0 | (14,495,967) | 0 | 0 |
| 1989 | 8,772,733 | 29,455,330 | (789,392) | 4,235,981 | 0 | (18,688,631) | 0 | 0 |
| 1990 | 13,814,150 | 49,027,449 | (841,172) | 6,559,548 | 0 | (21,045,321) | 0 | 0 |
| 1991 | 2,535,180 | 9,033,684 | (269,625) | 996,352 | 0 | (4,884,013) | 0 | 0 |
| 1992 | 2,907,026 | 9,754,469 | (975,679) | 1,225,121 | 0 | (9,782,946) | 0 | 0 |
| 1993 | (598,008) | (2,721,158) | (58,116) | (260,035) | 0 | (7,502,549) | 0 | 0 |
| 1994 | 5,941,789 | 20,657,617 | (60,125) | 2,644,592 | 0 | (11,998,949) | 0 | 0 |
| 1995 | 1,752,212 | 5,829,425 | (1,324,810) | 1,106,460 | 0 | (9,742,248) | 0 | 0 |
| 1996 | 5,050,986 | 17,658,964 | (2,955,178) | 2,833,791 | (979,429) | (12,358,465) | 0 | 0 |
| 1997 | 5,545,919 | 19,859,875 | (2,572,220) | 3,156,995 | (1,748,195) | (13,830,356) | 0 | 0 |
| 1998 | (664,843) | (2,312,472) | (2,016,390) | (443,482) | (1,253,110) | (10,108,555) | 0 | 0 |
| 1999 | 3,616,732 | 13,967,075 | (2,980,122) | 1,837,476 | (2,587,958) | (15,232,207) | 0 | 0 |
| 2000 | 7,255,331 | 26,090,314 | (5,123,988) | 3,817,684 | (4,402,610) | (25,758,437) | 0 | 0 |
| 2001 | 35,512,637 | 129,642,109 | (3,383,762) | 18,930,997 | (3,714,425) | (20,062,834) | 0 | 0 |
| 2002 | 21,173,346 | 77,461,814 | (5,057,760) | 10,849,297 | (5,371,837) | (25,292,454) | 0 | 0 |
| 2003 | 25,596,032 | 94,010,922 | (3,408,979) | 14,573,122 | (6,565,620) | (27,777,638) | 0 | 0 |
| 2004 | 30,537,142 | 112,157,127 | (6,431,864) | 17,022,676 | (7,858,117) | (32,044,505) | 78,555 | 68,914 |
| 2005 | 27,845,084 | 97,798,938 | (5,880,165) | 17,454,941 | (6,454,740) | (28,818,797) | 69,542 | 48,909 |
| 2006 | 26,820,813 | 84,626,897 | (4,091,143) | 15,795,475 | (6,391,206) | (34,897,387) | 135,205 | 148,128 |
| 2007 | 41,386,558 | 138,617,059 | (3,029,048) | 19,242,314 | (5,896,486) | (28,814,592) | 248,626 | 256,313 |
| 2008 | 26,255,003 | 82,159,793 | (3,426,928) | 10,827,189 | (3,300,797) | (16,968,293) | 242,648 | 326,570 |
| 2009 | 16,500,988 | 75,435,159 | (3,266,008) | 9,230,210 | (2,288,833) | (13,842,660) | 360,373 | 391,267 |
| 2010 | 26,190,014 | 95,975,151 | (5,115,083) | 16,897,664 | (5,653,201) | (24,769,829) | 313,542 | 431,062 |
| 2011 | 33,960,779 | 118,907,531 | (6,536,645) | 23,388,410 | (7,792,422) | (32,285,174) | 372,501 | 500,578 |
| 2012 | 33,052,074 | 115,573,786 | (2,492,869) | 17,437,731 | (8,905,115) | (23,525,846) | 451,850 | 551,794 |
| 2013 | 30,134,416 | 106,092,103 | (2,081,221) | 12,343,413 | (4,915,165) | (14,305,918) | 487,724 | 570,697 |
| 2014 | 19,618,567 | 67,887,838 | (1,786,122) | 7,162,418 | (1,465,644) | (5,391,598) | 316,015 | 438,715 |
| 2015 | 26,453,951 | 94,140,819 | (2,289,717) | 9,195,351 | (2,103,231) | (6,675,218) | 342,464 | 457,405 |
| 2016 | 41,795,991 | 152,354,540 | (10,274,609) | 26,431,248 | (11,357,647) | (22,454,991) | 377,640 | 462,567 |
| **2017** | **49,135,597** | **180,049,497** | **(11,603,405)** | **24,467,615** | **(14,419,970)** | **(20,822,068)** | **476,840** | **595,092** |
| 2018 | 47,830,901 | 175,144,689 | (12,072,573) | 25,989,343 | (15,093,100) | (21,811,146) | 484,175 | 604,246 |
| 2019 | 49,160,563 | 179,855,764 | (9,666,198) | 22,778,616 | (12,708,216) | (18,407,632) | 510,297 | 636,847 |
| 2020 | 50,300,020 | 184,028,818 | (9,695,490) | 23,350,642 | (12,750,129) | (18,407,632) | 521,393 | 650,693 |
| 2021 | 49,511,097 | 181,142,449 | (9,695,490) | 22,984,402 | (12,750,129) | (18,407,632) | 513,215 | 640,488 |
| 2022 | 50,137,180 | 183,433,052 | (9,695,490) | 23,275,047 | (12,750,129) | (18,407,632) | 519,705 | 648,587 |
| 2023 | 49,873,188 | 182,467,206 | (11,056,463) | 23,152,495 | (12,750,128) | (18,407,632) | 516,968 | 645,172 |
| 2024 | 50,068,008 | 183,179,974 | (11,056,463) | 23,242,935 | (12,750,128) | (18,407,632) | 518,988 | 647,692 |
| 2025 | 50,360,718 | 184,250,888 | (11,056,463) | 23,378,819 | (12,750,129) | (18,407,632) | 522,022 | 651,478 |
| 2026 | 49,430,042 | 180,845,898 | (11,056,463) | 22,946,774 | (12,750,129) | (18,407,632) | 512,375 | 639,439 |
| 2027 | 49,784,015 | 182,140,951 | (11,056,463) | 23,111,098 | (12,750,129) | (18,407,632) | 516,044 | 644,018 |
| 2028 | 49,976,522 | 182,845,264 | (11,056,463) | 23,200,465 | (12,750,128) | (18,407,632) | 518,039 | 646,508 |
| 2029 | 50,137,606 | 183,434,609 | (11,056,463) | 23,275,244 | (12,750,128) | (18,407,632) | 519,709 | 648,592 |
| 2030 | 50,326,988 | 184,127,485 | (11,056,463) | 23,363,161 | (12,750,128) | (18,407,632) | 521,672 | 651,042 |
| 2031 | 50,339,194 | 184,172,141 | (11,056,463) | 23,368,827 | (12,750,129) | (18,407,632) | 521,799 | 651,200 |
| 2032 | 49,468,770 | 180,987,588 | (11,056,463) | 22,964,753 | (12,750,129) | (18,407,632) | 512,776 | 639,940 |
| 2033 | 50,527,082 | 184,859,553 | (11,056,463) | 23,456,050 | (12,750,129) | (18,407,632) | 523,746 | 653,631 |
| 2034 | 49,799,104 | 182,196,159 | (11,056,463) | 23,118,103 | (12,750,128) | (18,407,632) | 516,200 | 644,213 |
| 2035 | 49,499,702 | 181,100,757 | (11,056,463) | 22,979,112 | (12,750,128) | (18,407,632) | 513,097 | 640,340 |
| **TOTAL** | **1,498,760,858** | **5,415,594,465** | **(297,504,362)** | **739,002,909** | **(347,229,131)** | **(956,477,057)** | **13,555,745** | **16,832,139** |

[a] Starting with 2005, transmission costs that vary and depend on power usage are included, therefore recovered through the variable component.

## TABLE B-3 Power Costs and Credits, Transmission Costs and Annual Replacement Deposits for Each Aqueduct Pumping and Power Recovery Plant[a] (in dollars)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Reach 4B (EBX) | Reach 29A | Reach 29G | Reach 29J | Reach 31A | Reach 33A | |
| Calendar Year | Cherry Valley Pump Station | Oso Pumping Plant | Warne Powerplant | Castaic Powerplant | Las Perillas and Badger Hill Pumping Plants | Devil's Den, Bluestone, and Polonio Pass Pumping Plants | Grand Total |
| | [17] | [18] | [19] | [20] | [21] | [22] | [23] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 36,771 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 55,654 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 73,240 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 137,665 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 186,064 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 231,968 |
| 1968 | 0 | 0 | 0 | 0 | 118,676 | 0 | 1,117,913 |
| 1969 | 0 | 0 | 0 | 0 | 78,350 | 0 | 773,646 |
| 1970 | 0 | 0 | 0 | 0 | 136,429 | 0 | 1,103,798 |
| 1971 | 0 | 0 | 0 | 0 | 166,296 | 0 | 1,476,135 |
| 1972 | 0 | 79,315 | 0 | (211,144) | 212,938 | 0 | 3,073,359 |
| 1973 | 0 | 122,787 | 0 | (1,057,564) | 114,897 | 0 | 2,934,059 |
| 1974 | 0 | 157,511 | 0 | (1,547,884) | 111,442 | 0 | 3,683,880 |
| 1975 | 0 | 314,636 | 0 | (2,455,461) | 88,451 | 0 | 5,817,780 |
| 1976 | 0 | 326,967 | 0 | (2,827,557) | 139,279 | 0 | 8,211,705 |
| 1977 | 0 | 75,335 | 0 | (3,734,462) | 63,079 | 0 | 886,421 |
| 1978 | 0 | 89,383 | 0 | (1,542,479) | 176,153 | 0 | 7,272,153 |
| 1979 | 0 | 102,584 | 0 | (2,776,030) | 188,881 | 0 | 9,599,576 |
| 1980 | 0 | 236,768 | 0 | (3,415,486) | 168,458 | 0 | 10,419,251 |
| 1981 | 0 | 444,280 | 0 | (2,834,322) | 169,177 | 0 | 17,563,899 |
| 1982 | 0 | 539,245 | (783,626) | (3,463,971) | 168,390 | 0 | 13,477,272 |
| 1983 | 0 | 214,069 | (1,488,439) | (6,649,718) | 17,920 | 0 | (7,452,864) |
| 1984 | 0 | 484,239 | (4,088,209) | (4,710,802) | 112,679 | 0 | (4,159,491) |
| 1985 | 0 | 874,069 | (5,930,176) | (15,698,638) | 146,843 | 0 | (9,861,182) |
| 1986 | 0 | 1,269,590 | (5,579,301) | (11,072,448) | 297,886 | 0 | 11,622,736 |
| 1987 | 0 | 1,355,533 | (6,445,265) | (11,726,458) | 245,082 | 0 | 6,701,444 |
| 1988 | 0 | 1,515,349 | (7,457,050) | (13,026,992) | 214,519 | 0 | 6,239,207 |
| 1989 | 0 | 2,156,915 | (8,822,367) | (15,535,849) | 282,180 | 0 | 24,585,082 |
| 1990 | 0 | 2,913,030 | (11,225,401) | (20,510,539) | 416,832 | 0 | 48,154,174 |
| 1991 | 0 | 576,721 | (3,882,595) | (6,579,194) | 3,610 | 0 | 2,462,222 |
| 1992 | 0 | 829,862 | (6,369,339) | (10,976,538) | 101,665 | 0 | (5,509,968) |
| 1993 | 0 | 70,836 | (4,665,393) | (9,531,404) | (111,306) | 0 | (24,907,973) |
| 1994 | 0 | 1,503,796 | (7,249,239) | (13,126,331) | 206,086 | (1,127) | 13,499,083 |
| 1995 | 0 | 247,869 | (1,934,202) | (4,049,615) | 243,434 | 0 | (142,957) |
| 1996 | 0 | 895,929 | (4,248,531) | (8,457,232) | 296,170 | 0 | 15,870,542 |
| 1997 | 0 | 902,690 | (4,824,488) | (8,776,260) | 298,483 | 208,816 | 14,336,879 |
| 1998 | 0 | (67,399) | (1,811,154) | (4,644,120) | (55,491) | (92,902) | (24,405,948) |
| 1999 | 0 | 731,865 | (5,831,573) | (9,811,777) | 166,036 | 234,077 | (3,417,317) |
| 2000 | 0 | 1,317,745 | (10,161,472) | (17,729,381) | 230,343 | 381,037 | (5,579,322) |
| 2001 | 0 | 6,502,346 | (7,918,467) | (13,370,061) | 1,076,567 | 2,170,015 | 219,914,887 |
| 2002 | 0 | 4,246,409 | (11,349,183) | (19,513,997) | 547,531 | 1,344,783 | 94,808,314 |
| 2003 | 0 | 4,642,103 | (10,436,535) | (17,134,431) | 637,936 | 1,538,955 | 134,765,827 |
| 2004 | 7,290 | 5,682,375 | (12,281,228) | (21,354,179) | 675,724 | 1,804,179 | 149,713,081 |
| 2005 | 2,544 | 3,705,184 | (7,106,531) | (13,339,416) | 858,232 | 1,749,845 | 162,298,726 |
| 2006 | 18,268 | 2,749,517 | (7,208,025) | (12,042,760) | 864,560 | 1,537,230 | 129,478,951 |
| 2007 | 11,163 | 7,582,778 | (11,444,524) | (21,845,299) | 1,341,242 | 2,345,146 | 217,541,819 |
| 2008 | 7,432 | 4,769,303 | (7,762,363) | (14,997,326) | 1,166,751 | 1,732,340 | 131,822,259 |
| 2009 | 7,529 | 4,624,245 | (6,997,502) | (15,725,766) | 710,827 | 1,018,536 | 102,310,234 |
| 2010 | 19,507 | 3,835,825 | (6,643,531) | (11,641,405) | 939,644 | 1,507,260 | 155,953,509 |
| 2011 | 33,172 | 3,575,446 | (5,996,974) | (10,892,193) | 1,151,811 | 2,176,571 | 210,832,007 |
| 2012 | 49,815 | 5,698,695 | (8,863,057) | (15,797,149) | 1,075,414 | 2,072,310 | 187,437,409 |
| 2013 | 69,151 | 6,825,113 | (9,189,037) | (15,851,695) | 1,457,638 | 2,088,482 | 180,353,599 |
| 2014 | 51,910 | 4,813,249 | (4,376,621) | (7,912,327) | 1,670,311 | 2,535,765 | 129,802,055 |
| 2015 | 15,029 | 7,309,133 | (6,599,051) | (11,183,098) | 1,682,907 | 1,993,346 | 164,260,516 |
| 2016 | 83,645 | 6,112,414 | (6,516,031) | (10,450,501) | 1,120,409 | 2,867,075 | 271,995,458 |
| **2017** | **96,640** | **9,954,440** | **(10,351,627)** | **(17,281,090)** | **1,128,424** | **3,682,158** | **304,171,367** |
| 2018 | 96,927 | 8,737,353 | (9,038,124) | (14,991,580) | 1,151,349 | 3,762,171 | 298,455,313 |
| 2019 | 100,892 | 9,717,418 | (9,454,247) | (15,262,028) | 822,547 | 5,415,626 | 318,760,151 |
| 2020 | 101,794 | 9,928,701 | (9,466,665) | (15,262,028) | 841,590 | 5,543,717 | 313,719,693 |
| 2021 | 100,198 | 9,772,976 | (9,465,833) | (15,262,028) | 828,390 | 5,456,768 | 315,465,495 |
| 2022 | 101,465 | 9,896,558 | (9,465,188) | (15,262,028) | 838,865 | 5,525,770 | 316,388,912 |
| 2023 | 100,931 | 9,844,449 | (9,442,478) | (15,262,028) | 834,448 | 5,496,675 | 313,039,435 |
| 2024 | 101,325 | 9,882,904 | (9,455,444) | (15,262,028) | 837,708 | 5,518,147 | 314,163,493 |
| 2025 | 101,917 | 9,940,682 | (9,454,612) | (15,262,028) | 842,605 | 5,550,407 | 309,815,006 |
| 2026 | 100,034 | 9,756,976 | (9,465,833) | (15,262,028) | 827,034 | 5,447,834 | 316,781,270 |
| 2027 | 100,750 | 9,826,847 | (9,465,833) | (15,262,028) | 832,956 | 5,486,847 | 312,336,709 |
| 2028 | 101,140 | 9,864,846 | (9,443,310) | (15,262,028) | 836,177 | 5,508,064 | 313,825,845 |
| 2029 | 101,466 | 9,896,642 | (9,444,196) | (15,262,028) | 838,872 | 5,525,817 | 314,704,490 |
| 2030 | 101,849 | 9,934,024 | (9,454,612) | (15,262,028) | 842,041 | 5,546,690 | 310,437,679 |
| 2031 | 101,874 | 9,936,434 | (9,454,612) | (15,262,028) | 842,245 | 5,548,035 | 313,643,312 |
| 2032 | 100,112 | 9,764,621 | (9,466,665) | (15,262,028) | 827,682 | 5,452,103 | 319,104,509 |
| 2033 | 102,254 | 9,973,521 | (9,465,188) | (15,262,028) | 845,389 | 5,568,742 | 306,086,088 |
| 2034 | 100,781 | 9,829,825 | (9,442,478) | (15,262,028) | 833,209 | 5,488,510 | 315,915,989 |
| 2035 | 100,175 | 9,770,727 | (9,444,196) | (15,262,028) | 828,199 | 5,455,512 | 318,442,129 |
| **TOTAL** | **2,288,978** | **289,185,598** | **(413,627,621)** | **(743,258,405)** | **38,671,103** | **132,191,333** | **8,734,712,092** |

[a] Starting with 2005, transmission costs that vary and depend on power usage are included, therefore recovered through the variable component.

# Tables B-4 through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-4 Maximum Contractual Table A Amounts (acre-feet)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA[a] | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa[b] | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 507 | 5,248 | 5,783 | 11,538 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 6,900 | 15,000 | 88,000 | 109,900 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 8,200 | 15,500 | 75,000 | 98,700 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 10,000 | 16,200 | 88,000 | 114,200 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 11,200 | 17,000 | 88,000 | 116,200 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 12,400 | 17,900 | 88,000 | 118,300 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 13,600 | 18,800 | 88,000 | 120,400 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 14,800 | 19,600 | 88,000 | 122,400 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 16,000 | 20,500 | 88,000 | 124,500 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 17,200 | 21,300 | 88,000 | 126,500 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 18,400 | 22,200 | 88,000 | 128,600 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 19,600 | 23,100 | 88,000 | 130,700 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 20,800 | 23,900 | 88,000 | 132,700 | 0 | 0 | 0 |
| 1980 | 0 | 500 | 500 | 22,000 | 24,800 | 88,000 | 134,800 | 1,000 | 946 | 1,946 |
| 1981 | 0 | 650 | 650 | 23,000 | 26,000 | 88,000 | 137,000 | 1,000 | 1,813 | 2,813 |
| 1982 | 0 | 800 | 800 | 24,000 | 27,200 | 88,000 | 139,200 | 2,000 | 3,626 | 5,626 |
| 1983 | 0 | 950 | 950 | 25,000 | 28,400 | 88,000 | 141,400 | 3,000 | 5,439 | 8,439 |
| 1984 | 0 | 1,100 | 1,100 | 26,000 | 29,600 | 88,000 | 143,600 | 4,500 | 8,198 | 12,698 |
| 1985 | 0 | 1,250 | 1,250 | 27,000 | 30,800 | 88,000 | 145,800 | 7,500 | 13,638 | 21,138 |
| 1986 | 0 | 1,400 | 1,400 | 28,000 | 32,100 | 88,000 | 148,100 | 10,000 | 18,210 | 28,210 |
| 1987 | 0 | 1,550 | 1,550 | 29,000 | 33,300 | 88,000 | 150,300 | 12,500 | 22,704 | 35,204 |
| 1988 | 5,745 | 9,726 | 15,471 | 30,000 | 34,500 | 88,000 | 152,500 | 15,500 | 28,222 | 43,722 |
| 1989 | 6,195 | 18,420 | 24,615 | 31,000 | 35,700 | 90,000 | 156,700 | 20,000 | 36,342 | 56,342 |
| 1990 | 6,940 | 21,250 | 28,190 | 32,000 | 36,900 | 92,000 | 160,900 | 25,000 | 45,486 | 70,486 |
| 1991 | 7,290 | 22,300 | 29,590 | 34,000 | 38,400 | 94,000 | 166,400 | 25,000 | 45,486 | 70,486 |
| 1992 | 7,840 | 24,170 | 32,010 | 36,000 | 39,900 | 96,000 | 171,900 | 25,000 | 45,486 | 70,486 |
| 1993 | 8,490 | 26,130 | 34,620 | 38,000 | 41,400 | 98,000 | 177,400 | 25,000 | 45,486 | 70,486 |
| 1994 | 9,135 | 28,080 | 37,215 | 40,000 | 42,000 | 100,000 | 182,000 | 25,000 | 45,486 | 70,486 |
| 1995 | 9,780 | 34,250 | 44,030 | 42,000 | 42,000 | 100,000 | 184,000 | 25,000 | 45,486 | 70,486 |
| 1996 | 10,425 | 37,800 | 48,225 | 44,000 | 42,000 | 100,000 | 186,000 | 25,000 | 45,486 | 70,486 |
| 1997 | 11,065 | 38,250 | 49,315 | 46,000 | 42,000 | 100,000 | 188,000 | 6,215 | 38,986 | 45,201 |
| 1998 | 11,710 | 38,710 | 50,420 | 46,000 | 42,000 | 100,000 | 188,000 | 6,215 | 38,986 | 45,201 |
| 1999 | 15,850 | 39,170 | 55,020 | 46,000 | 42,000 | 100,000 | 188,000 | 25,000 | 45,486 | 70,486 |
| 2000 | 16,325 | 39,620 | 55,945 | 68,000 | 42,000 | 100,000 | 210,000 | 25,000 | 45,486 | 70,486 |
| 2001 | 20,725 | 45,836 | 66,561 | 78,000 | 42,000 | 100,000 | 220,000 | 25,000 | 45,486 | 70,486 |
| 2002 | 21,100 | 46,296 | 67,396 | 78,000 | 42,000 | 100,000 | 220,000 | 25,000 | 45,486 | 70,486 |
| 2003 | 21,475 | 46,756 | 68,231 | 78,400 | 42,000 | 100,000 | 220,400 | 25,000 | 45,486 | 70,486 |
| 2004 | 21,850 | 47,206 | 69,056 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2005 | 22,225 | 47,256 | 69,481 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2006 | 22,550 | 47,306 | 69,856 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2007 | 22,875 | 47,356 | 70,231 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2008 | 23,200 | 47,406 | 70,606 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2009 | 23,525 | 47,456 | 70,981 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2010 | 29,025 | 47,506 | 76,531 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2011 | 29,025 | 47,556 | 76,581 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2012 | 29,025 | 47,606 | 76,631 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2013 | 29,025 | 47,656 | 76,681 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2014 | 29,025 | 47,706 | 76,731 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2015 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2016 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| **2017** | **29,025** | **47,756** | **76,781** | **80,619** | **42,000** | **100,000** | **222,619** | **25,000** | **45,486** | **70,486** |
| 2018 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2019 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2020 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2021 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2022 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2023 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2024 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2025 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2026 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2027 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2028 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2029 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2030 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2031 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2032 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2033 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2034 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| 2035 | 29,025 | 47,756 | 76,781 | 80,619 | 42,000 | 100,000 | 222,619 | 25,000 | 45,486 | 70,486 |
| **TOTAL** | **1,080,965** | **2,049,856** | **3,130,821** | **3,720,815** | **2,459,248** | **6,510,783** | **12,690,846** | **1,189,430** | **2,218,494** | **3,407,924** |

[a] Table A amounts for the South Bay Area were supplied by non-project water for the period June 1962 through November 1967. Actual delivery quantities of project water are shown for 1967.

[b] Napa's Table A quantities exclude amounts during the period 1968 through 1987 that were supplied by non-project water.

## TABLE B-4 Maximum Contractual Table A Amounts (acre-feet)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Kern | | | | | | |
| | Dudley Ridge | Empire | Municipal and Industrial | Agricultural | Total | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 14,300 | 1,000 | 0 | 46,600 | 46,600 | 900 | 2,300 | 12,250 | 77,350 |
| 1969 | 14,325 | 3,000 | 0 | 95,700 | 95,700 | 1,200 | 2,500 | 46,350 | 163,075 |
| 1970 | 15,700 | 3,000 | 28,700 | 116,400 | 145,100 | 1,300 | 2,600 | 34,300 | 202,000 |
| 1971 | 17,900 | 3,000 | 35,700 | 154,600 | 190,300 | 1,300 | 2,800 | 36,500 | 251,800 |
| 1972 | 20,000 | 3,000 | 39,200 | 231,500 | 270,700 | 1,400 | 5,366 | 112,600 | 413,066 |
| 1973 | 22,000 | 3,000 | 43,500 | 267,000 | 310,500 | 1,500 | 3,100 | 43,552 | 383,652 |
| 1974 | 33,390 | 3,000 | 48,000 | 299,000 | 347,000 | 1,500 | 3,471 | 72,289 | 460,650 |
| 1975 | 40,555 | 3,000 | 52,700 | 358,120 | 410,820 | 1,600 | 3,576 | 86,258 | 545,809 |
| 1976 | 30,921 | 3,000 | 56,100 | 386,050 | 442,150 | 1,600 | 4,039 | 61,707 | 543,417 |
| 1977 | 30,400 | 3,000 | 60,600 | 423,000 | 483,600 | 1,700 | 3,700 | 59,000 | 581,400 |
| 1978 | 32,500 | 0 | 64,100 | 470,200 | 534,300 | 1,900 | 3,900 | 63,300 | 635,900 |
| 1979 | 38,544 | 3,000 | 67,600 | 516,300 | 583,900 | 2,000 | 4,000 | 71,241 | 702,685 |
| 1980 | 41,000 | 3,000 | 71,100 | 563,400 | 634,500 | 2,200 | 5,700 | 71,700 | 758,100 |
| 1981 | 41,000 | 3,000 | 74,800 | 616,600 | 691,400 | 2,300 | 4,300 | 76,000 | 818,000 |
| 1982 | 41,000 | 3,000 | 79,600 | 665,700 | 745,300 | 2,500 | 4,500 | 80,200 | 876,500 |
| 1983 | 42,900 | 3,000 | 83,500 | 721,600 | 805,100 | 2,800 | 3,770 | 9,548 | 867,118 |
| 1984 | 45,100 | 3,000 | 103,600 | 757,000 | 860,600 | 3,100 | 4,800 | 62,611 | 979,211 |
| 1985 | 47,200 | 3,000 | 108,900 | 806,100 | 915,000 | 3,400 | 4,900 | 45,549 | 1,019,049 |
| 1986 | 49,300 | 3,000 | 113,400 | 820,246 | 933,646 | 3,700 | 5,100 | 97,200 | 1,091,946 |
| 1987 | 51,400 | 3,000 | 119,100 | 904,400 | 1,023,500 | 4,000 | 5,200 | 101,400 | 1,188,500 |
| 1988 | 53,500 | 3,000 | 123,900 | 950,700 | 1,074,600 | 4,000 | 5,400 | 105,600 | 1,246,100 |
| 1989 | 55,600 | 3,000 | 128,200 | 984,100 | 1,112,300 | 4,000 | 5,600 | 109,900 | 1,290,400 |
| 1990 | 28,850 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,313,450 |
| 1991 | 53,411 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,338,011 |
| 1992 | 57,700 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,342,300 |
| 1993 | 57,700 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,342,300 |
| 1994 | 57,700 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,342,300 |
| 1995 | 57,700 | 3,000 | 134,600 | 1,018,800 | 1,153,400 | 4,000 | 5,700 | 118,500 | 1,342,300 |
| 1996 | 53,370 | 3,000 | 134,600 | 982,460 | 1,117,060 | 4,000 | 5,700 | 118,500 | 1,301,630 |
| 1997 | 53,370 | 3,000 | 134,600 | 978,130 | 1,112,730 | 4,000 | 5,700 | 118,500 | 1,297,300 |
| 1998 | 53,370 | 3,000 | 134,600 | 953,130 | 1,087,730 | 4,000 | 5,700 | 118,500 | 1,272,300 |
| 1999 | 53,370 | 3,000 | 134,600 | 953,130 | 1,087,730 | 4,000 | 5,700 | 118,500 | 1,272,300 |
| 2000 | 53,370 | 3,000 | 134,600 | 886,130 | 1,020,730 | 4,000 | 5,700 | 118,500 | 1,205,300 |
| 2001 | 53,370 | 3,000 | 134,600 | 866,349 | 1,000,949 | 4,000 | 5,700 | 118,500 | 1,185,519 |
| 2002 | 57,343 | 3,000 | 134,600 | 866,349 | 1,000,949 | 4,000 | 5,700 | 111,527 | 1,182,519 |
| 2003 | 57,343 | 3,000 | 134,600 | 866,349 | 1,000,949 | 4,000 | 5,700 | 111,127 | 1,182,119 |
| 2004 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,000 | 5,700 | 96,227 | 1,170,000 |
| 2005 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,000 | 5,700 | 96,227 | 1,170,000 |
| 2006 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,305 | 5,700 | 95,922 | 1,170,000 |
| 2007 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,305 | 5,700 | 95,922 | 1,170,000 |
| 2008 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,305 | 5,700 | 95,922 | 1,170,000 |
| 2009 | 57,343 | 3,000 | 134,600 | 864,130 | 998,730 | 9,305 | 5,700 | 95,922 | 1,170,000 |
| 2010 | 50,343 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 88,922 | 1,140,000 |
| 2011 | 50,343 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 88,922 | 1,140,000 |
| 2012 | 50,343 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 88,922 | 1,140,000 |
| 2013 | 50,343 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 88,922 | 1,140,000 |
| 2014 | 48,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,136,556 |
| 2015 | 45,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,133,556 |
| 2016 | 45,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,133,556 |
| **2017** | **45,350** | **3,000** | **134,600** | **848,130** | **982,730** | **9,305** | **5,700** | **87,471** | **1,133,556** |
| 2018 | 45,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,133,556 |
| 2019 | 45,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,133,556 |
| 2020 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2021 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2022 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2023 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2024 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2025 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2026 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2027 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2028 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2029 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2030 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2031 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2032 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2033 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2034 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| 2035 | 41,350 | 3,000 | 134,600 | 848,130 | 982,730 | 9,305 | 5,700 | 87,471 | 1,129,556 |
| **TOTAL** | **3,008,632** | **199,000** | **7,693,900** | **51,855,303** | **59,549,203** | **403,050** | **352,822** | **5,959,901** | **69,472,608** |

**TABLE B-4 Maximum Contractual Table A Amounts (acre-feet)**



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 3,700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 5,700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 6,700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 20,000 | 8,936 | 5,200 | 526 | 8,000 | 170 | 8,400 | 1,620 | 1,677 | 122 |
| 1973 | 25,000 | 12,400 | 5,800 | 870 | 9,000 | 290 | 10,700 | 2,940 | 48,000 | 11,500 |
| 1974 | 30,000 | 15,400 | 6,400 | 1,160 | 10,000 | 400 | 13,100 | 4,260 | 50,000 | 12,300 |
| 1975 | 35,000 | 18,200 | 7,000 | 1,450 | 11,000 | 520 | 15,400 | 5,580 | 52,500 | 13,100 |
| 1976 | 44,000 | 21,200 | 7,600 | 1,740 | 12,000 | 640 | 17,800 | 6,900 | 55,000 | 14,000 |
| 1977 | 50,000 | 24,100 | 8,421 | 2,030 | 13,000 | 730 | 20,200 | 8,220 | 57,500 | 14,800 |
| 1978 | 57,000 | 24,762 | 9,242 | 2,320 | 14,000 | 920 | 0 | 9,340 | 60,000 | 15,700 |
| 1979 | 63,000 | 28,000 | 10,063 | 2,610 | 15,000 | 1,040 | 24,900 | 10,260 | 62,500 | 16,600 |
| 1980 | 69,200 | 30,400 | 10,884 | 2,900 | 17,000 | 1,150 | 27,200 | 11,180 | 65,500 | 17,400 |
| 1981 | 75,000 | 32,800 | 12,105 | 3,190 | 19,000 | 1,270 | 23,100 | 11,700 | 68,500 | 18,300 |
| 1982 | 81,300 | 34,800 | 13,326 | 3,480 | 21,000 | 1,380 | 22,843 | 12,320 | 71,500 | 19,100 |
| 1983 | 87,700 | 37,300 | 14,547 | 3,770 | 23,000 | 1,500 | 34,300 | 12,940 | 74,500 | 19,900 |
| 1984 | 35,000 | 39,600 | 15,768 | 4,060 | 25,000 | 1,610 | 36,700 | 13,560 | 78,000 | 20,700 |
| 1985 | 40,000 | 41,800 | 16,989 | 4,350 | 27,000 | 1,730 | 39,000 | 14,180 | 81,500 | 21,800 |
| 1986 | 42,000 | 43,600 | 18,210 | 4,640 | 29,000 | 1,840 | 41,400 | 14,800 | 85,000 | 23,200 |
| 1987 | 44,000 | 45,600 | 19,431 | 4,930 | 31,500 | 1,960 | 43,700 | 15,420 | 89,000 | 24,600 |
| 1988 | 46,000 | 48,000 | 20,652 | 5,220 | 34,000 | 2,070 | 46,000 | 16,040 | 93,000 | 26,000 |
| 1989 | 125,700 | 50,100 | 21,873 | 5,510 | 36,500 | 2,190 | 48,500 | 16,660 | 97,000 | 27,400 |
| 1990 | 132,100 | 52,000 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 101,500 | 28,800 |
| 1991 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1992 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1993 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1994 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1995 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1996 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1997 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 50,800 | 17,300 | 102,600 | 28,800 |
| 1998 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 17,300 | 102,600 | 28,800 |
| 1999 | 138,400 | 54,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 17,300 | 102,600 | 28,800 |
| 2000 | 138,400 | 95,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2001 | 138,400 | 95,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2002 | 141,400 | 95,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2003 | 141,400 | 95,200 | 23,100 | 5,800 | 38,100 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2004 | 141,400 | 95,200 | 33,000 | 5,800 | 38,100 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2005 | 141,400 | 95,200 | 121,100 | 5,800 | 50,000 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2006 | 141,400 | 95,200 | 121,100 | 5,800 | 50,000 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2007 | 141,400 | 95,200 | 121,100 | 5,800 | 50,000 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2008 | 141,400 | 95,200 | 121,100 | 5,800 | 50,000 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2009 | 141,400 | 95,200 | 121,100 | 5,800 | 50,000 | 2,300 | 75,800 | 21,300 | 102,600 | 28,800 |
| 2010 | 141,400 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 82,800 | 21,300 | 102,600 | 28,800 |
| 2011 | 141,400 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 82,800 | 21,300 | 102,600 | 28,800 |
| 2012 | 141,400 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 82,800 | 21,300 | 102,600 | 28,800 |
| 2013 | 141,400 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 82,800 | 21,300 | 102,600 | 28,800 |
| 2014 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 82,800 | 21,300 | 102,600 | 28,800 |
| 2015 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 85,800 | 21,300 | 102,600 | 28,800 |
| 2016 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 85,800 | 21,300 | 102,600 | 28,800 |
| **2017** | **144,844** | **95,200** | **138,350** | **5,800** | **55,750** | **2,300** | **85,800** | **21,300** | **102,600** | **28,800** |
| 2018 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 85,800 | 21,300 | 102,600 | 28,800 |
| 2019 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 85,800 | 21,300 | 102,600 | 28,800 |
| 2020 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2021 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2022 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2023 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2024 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2025 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2026 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2027 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2028 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2029 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2030 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2031 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2032 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2033 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2034 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| 2035 | 144,844 | 95,200 | 138,350 | 5,800 | 55,750 | 2,300 | 89,800 | 21,300 | 102,600 | 28,800 |
| **TOTAL** | **7,507,768** | **4,545,098** | **4,782,511** | **321,556** | **2,626,000** | **127,210** | **4,069,043** | **1,127,720** | **5,909,177** | **1,641,322** |

## TABLE B-4 Maximum Contractual Table A Amounts (acre-feet)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11,538 |
| 1968 | 0 | 0 | 0 | 3,700 | 0 | 300 | 250 | 550 | 0 | 191,500 |
| 1969 | 0 | 0 | 0 | 5,000 | 0 | 350 | 270 | 620 | 0 | 267,395 |
| 1970 | 0 | 0 | 0 | 5,700 | 0 | 400 | 300 | 700 | 0 | 322,600 |
| 1971 | 0 | 0 | 0 | 6,700 | 0 | 450 | 440 | 890 | 0 | 375,590 |
| 1972 | 0 | 154,772 | 0 | 209,423 | 0 | 500 | 470 | 970 | 0 | 741,759 |
| 1973 | 0 | 354,600 | 0 | 481,100 | 0 | 600 | 500 | 1,100 | 0 | 986,252 |
| 1974 | 0 | 454,900 | 0 | 597,920 | 0 | 700 | 530 | 1,230 | 0 | 1,182,200 |
| 1975 | 0 | 555,200 | 0 | 714,950 | 0 | 1,050 | 560 | 1,610 | 0 | 1,386,869 |
| 1976 | 0 | 655,600 | 0 | 836,480 | 0 | 1,400 | 590 | 1,990 | 0 | 1,508,387 |
| 1977 | 0 | 755,900 | 0 | 954,901 | 0 | 1,800 | 620 | 2,420 | 0 | 1,667,321 |
| 1978 | 0 | 856,300 | 0 | 1,049,584 | 0 | 1,200 | 650 | 1,850 | 0 | 1,818,034 |
| 1979 | 0 | 956,600 | 0 | 1,190,573 | 0 | 1,450 | 680 | 2,130 | 0 | 2,028,088 |
| 1980 | 6,800 | 1,057,000 | 1,000 | 1,317,614 | 0 | 1,100 | 710 | 1,810 | 0 | 2,214,770 |
| 1981 | 7,800 | 1,157,300 | 2,000 | 1,432,065 | 0 | 1,200 | 740 | 1,940 | 0 | 2,392,468 |
| 1982 | 8,800 | 1,257,600 | 3,000 | 1,550,449 | 0 | 1,200 | 770 | 1,970 | 0 | 2,574,545 |
| 1983 | 9,800 | 1,358,000 | 4,000 | 1,681,257 | 0 | 1,200 | 800 | 2,000 | 0 | 2,701,164 |
| 1984 | 10,800 | 1,458,300 | 5,000 | 1,744,098 | 1,600 | 1,200 | 830 | 3,630 | 0 | 2,884,337 |
| 1985 | 11,800 | 1,558,700 | 6,000 | 1,864,849 | 1,700 | 1,200 | 860 | 3,760 | 0 | 3,055,846 |
| 1986 | 12,900 | 1,659,300 | 8,000 | 1,983,890 | 2,100 | 1,200 | 890 | 4,190 | 0 | 3,257,736 |
| 1987 | 14,000 | 1,759,800 | 10,000 | 2,103,941 | 2,500 | 1,200 | 920 | 4,620 | 0 | 3,484,115 |
| 1988 | 15,100 | 1,860,400 | 13,000 | 2,225,482 | 2,900 | 1,200 | 960 | 5,060 | 0 | 3,688,335 |
| 1989 | 16,200 | 1,961,000 | 16,000 | 2,424,633 | 3,300 | 1,200 | 1,000 | 5,500 | 0 | 3,958,190 |
| 1990 | 17,300 | 2,011,500 | 20,000 | 2,500,600 | 3,800 | 1,200 | 1,040 | 6,040 | 0 | 4,079,666 |
| 1991 | 17,300 | 2,011,500 | 20,000 | 2,510,200 | 9,600 | 1,200 | 1,080 | 11,880 | 0 | 4,126,567 |
| 1992 | 17,300 | 2,011,500 | 20,000 | 2,510,200 | 9,600 | 1,200 | 1,120 | 11,920 | 0 | 4,138,816 |
| 1993 | 17,300 | 2,011,500 | 20,000 | 2,510,200 | 9,600 | 1,200 | 1,160 | 11,960 | 0 | 4,146,966 |
| 1994 | 17,300 | 2,011,500 | 20,000 | 2,510,200 | 9,600 | 1,200 | 1,200 | 12,000 | 0 | 4,154,201 |
| 1995 | 17,300 | 2,011,500 | 20,000 | 2,510,200 | 9,600 | 1,200 | 1,250 | 12,050 | 0 | 4,163,066 |
| 1996 | 0 | 2,011,500 | 20,000 | 2,492,900 | 9,600 | 1,200 | 1,300 | 12,100 | 0 | 4,111,341 |
| 1997 | 0 | 2,011,500 | 20,000 | 2,492,900 | 9,600 | 1,200 | 1,350 | 12,150 | 0 | 4,084,866 |
| 1998 | 0 | 2,011,500 | 20,000 | 2,517,900 | 9,600 | 1,200 | 1,400 | 12,200 | 0 | 4,086,021 |
| 1999 | 2,000 | 2,011,500 | 20,000 | 2,519,900 | 9,600 | 2,890 | 1,450 | 13,940 | 0 | 4,119,646 |
| 2000 | 3,000 | 2,011,500 | 20,000 | 2,565,900 | 9,600 | 2,890 | 1,510 | 14,000 | 0 | 4,121,631 |
| 2001 | 4,000 | 2,011,500 | 20,000 | 2,566,900 | 9,600 | 3,500 | 1,570 | 14,670 | 0 | 4,124,136 |
| 2002 | 4,000 | 2,011,500 | 20,000 | 2,569,900 | 9,600 | 3,500 | 1,630 | 14,730 | 0 | 4,125,031 |
| 2003 | 5,000 | 2,011,500 | 20,000 | 2,570,900 | 9,600 | 3,500 | 1,690 | 14,790 | 0 | 4,126,926 |
| 2004 | 6,000 | 2,011,500 | 20,000 | 2,581,800 | 9,600 | 3,500 | 0 | 13,100 | 0 | 4,127,061 |
| 2005 | 6,500 | 1,911,500 | 20,000 | 2,582,300 | 9,600 | 1,200 | 0 | 10,800 | 0 | 4,125,686 |
| 2006 | 7,000 | 1,911,500 | 20,000 | 2,582,800 | 9,600 | 1,200 | 324 | 11,124 | 0 | 4,126,885 |
| 2007 | 8,650 | 1,911,500 | 20,000 | 2,584,450 | 9,600 | 1,200 | 720 | 11,520 | 0 | 4,129,306 |
| 2008 | 17,300 | 1,911,500 | 20,000 | 2,593,100 | 9,600 | 27,500 | 2,020 | 39,120 | 0 | 4,165,931 |
| 2009 | 17,300 | 1,911,500 | 20,000 | 2,593,100 | 9,600 | 27,500 | 2,090 | 39,190 | 0 | 4,166,376 |
| 2010 | 17,300 | 1,911,500 | 20,000 | 2,623,100 | 9,600 | 1,731 | 2,160 | 13,491 | 0 | 4,146,227 |
| 2011 | 17,300 | 1,911,500 | 20,000 | 2,623,100 | 9,600 | 2,548 | 2,240 | 14,388 | 0 | 4,147,174 |
| 2012 | 17,300 | 1,911,500 | 20,000 | 2,623,100 | 9,600 | 27,500 | 2,320 | 39,420 | 0 | 4,172,256 |
| 2013 | 17,300 | 1,911,500 | 20,000 | 2,623,100 | 9,600 | 27,500 | 2,410 | 39,510 | 0 | 4,172,396 |
| 2014 | 17,300 | 1,911,500 | 20,000 | 2,626,544 | 9,600 | 27,500 | 2,500 | 39,600 | 0 | 4,172,536 |
| 2015 | 17,300 | 1,911,500 | 20,000 | 2,629,544 | 9,600 | 27,500 | 2,600 | 39,700 | 0 | 4,172,686 |
| 2016 | 17,300 | 1,911,500 | 20,000 | 2,629,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| **2017** | **17,300** | **1,911,500** | **20,000** | **2,629,544** | **9,600** | **27,500** | **2,700** | **39,800** | **0** | **4,172,786** |
| 2018 | 17,300 | 1,911,500 | 20,000 | 2,629,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2019 | 17,300 | 1,911,500 | 20,000 | 2,629,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2020 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2021 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2022 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2023 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2024 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2025 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2026 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2027 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2028 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2029 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2030 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2031 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2032 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2033 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2034 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| 2035 | 17,300 | 1,911,500 | 20,000 | 2,633,544 | 9,600 | 27,500 | 2,700 | 39,800 | 0 | 4,172,786 |
| **TOTAL** | **748,350** | **109,260,272** | **988,000** | **143,654,027** | **449,900** | **775,559** | **106,474** | **1,331,933** | **0** | **233,688,159** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | UPPER FEATHER AREA | | | NORTH BAY AQUEDUCT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Reach 1 | Reach 3A | | Reach 3A-T | | Reach 3B | | |
| Calendar Year | Butte | Grizzly Valley Pipeline Plumas | Yuba City | Solano | Napa | Solano | Napa | Solano | Napa[a] | Solano | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,214 | 0 | 1,214 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,687 | 0 | 2,687 |
| 1970 | 0 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 3,618 | 0 | 3,618 |
| 1971 | 192 | 64 | 0 | 0 | 0 | 0 | 0 | 0 | 2,521 | 0 | 2,521 |
| 1972 | 186 | 505 | 0 | 0 | 0 | 0 | 0 | 0 | 3,647 | 0 | 3,647 |
| 1973 | 53 | 679 | 0 | 0 | 0 | 0 | 0 | 0 | 3,792 | 0 | 3,792 |
| 1974 | 127 | 648 | 0 | 0 | 0 | 0 | 0 | 0 | 4,870 | 0 | 4,870 |
| 1975 | 253 | 405 | 0 | 0 | 0 | 0 | 0 | 0 | 6,840 | 0 | 6,840 |
| 1976 | 527 | 382 | 0 | 0 | 0 | 0 | 0 | 0 | 7,122 | 0 | 7,122 |
| 1977 | 706 | 303 | 0 | 0 | 0 | 0 | 0 | 0 | 8,226 | 0 | 8,226 |
| 1978 | 579 | 278 | 0 | 0 | 0 | 0 | 0 | 0 | 6,034 | 0 | 6,034 |
| 1979 | 302 | 329 | 0 | 0 | 0 | 0 | 0 | 0 | 6,561 | 0 | 6,561 |
| 1980 | 267 | 295 | 0 | 0 | 0 | 0 | 0 | 0 | 6,707 | 0 | 6,707 |
| 1981 | 221 | 355 | 0 | 0 | 0 | 0 | 0 | 0 | 9,001 | 0 | 9,001 |
| 1982 | 334 | 305 | 0 | 0 | 0 | 0 | 0 | 0 | 1,213 | 0 | 1,213 |
| 1983 | 325 | 262 | 0 | 0 | 0 | 0 | 0 | 0 | 2,287 | 0 | 2,287 |
| 1984 | 177 | 272 | 108 | 0 | 0 | 0 | 0 | 0 | 2,923 | 0 | 2,923 |
| 1985 | 308 | 254 | 62 | 0 | 0 | 0 | 0 | 0 | 4,039 | 0 | 4,039 |
| 1986 | 313 | 317 | 328 | 1,400 | 0 | 0 | 0 | 0 | 3,519 | 0 | 4,919 |
| 1987 | 459 | 452 | 88 | 1,550 | 0 | 0 | 0 | 0 | 7,693 | 0 | 9,243 |
| 1988 | 385 | 523 | 303 | 1 | 0 | 9,725 | 0 | 0 | 5,392 | 0 | 15,118 |
| 1989 | 300 | 486 | 403 | 10 | 0 | 17,246 | 0 | 0 | 6,195 | 0 | 23,451 |
| 1990 | 380 | 548 | 494 | 3,275 | 0 | 15,856 | 0 | 0 | 6,940 | 0 | 26,071 |
| 1991 | 328 | 420 | 265 | 3,117 | 0 | 3,855 | 0 | 0 | 1,380 | 0 | 8,352 |
| 1992 | 117 | 485 | 642 | 5,553 | 0 | 9,220 | 0 | 0 | 4,001 | 0 | 18,774 |
| 1993 | 256 | 444 | 746 | 14,709 | 0 | 14,471 | 0 | 0 | 5,286 | 0 | 34,466 |
| 1994 | 329 | 492 | 1,035 | 10,343 | 0 | 14,913 | 0 | 0 | 6,792 | 0 | 32,048 |
| 1995 | 203 | 308 | 910 | 5,452 | 0 | 15,893 | 0 | 0 | 5,182 | 0 | 26,527 |
| 1996 | 257 | 360 | 820 | 12,930 | 0 | 17,069 | 0 | 0 | 4,893 | 0 | 34,892 |
| 1997 | 185 | 231 | 1,005 | 16,029 | 0 | 17,501 | 0 | 0 | 4,341 | 0 | 37,871 |
| 1998 | 527 | 0 | 1,054 | 11,562 | 0 | 18,204 | 0 | 0 | 5,359 | 0 | 35,125 |
| 1999 | 286 | 0 | 1,096 | 15,191 | 0 | 19,562 | 0 | 0 | 5,304 | 0 | 40,057 |
| 2000 | 586 | 0 | 901 | 15,490 | 0 | 11,290 | 0 | 10,235 | 4,958 | 0 | 41,973 |
| 2001 | 513 | 0 | 1,065 | 14,849 | 0 | 11,377 | 0 | 8,360 | 9,345 | 0 | 43,931 |
| 2002 | 419 | 0 | 1,181 | 18,841 | 0 | 11,130 | 0 | 8,589 | 6,875 | 0 | 45,435 |
| 2003 | 551 | 0 | 1,324 | 17,260 | 0 | 9,682 | 9 | 7,009 | 7,637 | 0 | 41,597 |
| 2004 | 1,440 | 0 | 1,434 | 20,951 | 0 | 10,691 | 135 | 10,860 | 7,999 | 500 | 51,136 |
| 2005 | 527 | 0 | 1,894 | 18,290 | 0 | 10,585 | 160 | 8,444 | 7,509 | 500 | 45,488 |
| 2006 | 468 | 0 | 5,342 | 16,573 | 0 | 10,865 | 208 | 7,578 | 7,581 | 500 | 43,305 |
| 2007 | 956 | 0 | 2,327 | 19,187 | 0 | 12,301 | 180 | 15,312 | 10,777 | 500 | 58,257 |
| 2008 | 451 | 243 | 1,923 | 21,436 | 15 | 11,410 | 37 | 7,974 | 13,240 | 500 | 54,612 |
| 2009 | 581 | 200 | 2,114 | 15,004 | 0 | 8,651 | 27 | 6,795 | 10,877 | 500 | 41,854 |
| 2010 | 807 | 243 | 2,331 | 17,598 | 0 | 8,231 | 70 | 4,487 | 12,347 | 500 | 43,233 |
| 2011 | 1,092 | 98 | 2,297 | 15,202 | 0 | 7,761 | 39 | 5,032 | 11,275 | 0 | 39,309 |
| 2012 | 1,374 | 79 | 2,695 | 16,508 | 0 | 8,298 | 47 | 4,541 | 9,860 | 0 | 39,254 |
| 2013 | 908 | 366 | 4,850 | 16,525 | 0 | 10,082 | 60 | 9,262 | 12,478 | 0 | 48,407 |
| 2014 | 1,617 | 251 | 4,237 | 7,354 | 0 | 6,856 | 41 | 5,469 | 14,123 | 0 | 33,843 |
| 2015 | 2,763 | 730 | 3,004 | 8,581 | 0 | 6,538 | 66 | 8,717 | 11,133 | 0 | 35,035 |
| 2016 | 3,141 | 625 | 3,649 | 13,708 | 1 | 9,317 | 16 | 8,701 | 13,231 | 500 | 45,474 |
| **2017** | **270** | **730** | **5,760** | **20,762** | **0** | **6,708** | **0** | **1,185** | **17,415** | **0** | **46,070** |
| 2018 | 270 | 730 | 5,760 | 20,762 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,070 |
| 2019 | 270 | 730 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2020 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2021 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2022 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2023 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2024 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2025 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2026 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2027 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2028 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2029 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2030 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2031 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2032 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2033 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2034 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| 2035 | 270 | 1,619 | 5,760 | 20,761 | 0 | 6,708 | 0 | 1,185 | 17,415 | 0 | 46,069 |
| **TOTAL** | **32,206** | **41,401** | **161,367** | **768,940** | **16** | **466,032** | **1,095** | **159,880** | **657,709** | **4,000** | **2,057,672** |

[a] For the period 1968 through 1987, deliveries were non-project water pumped through an interim facility.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | SOUTH BAY AQUEDUCT[b] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Reach 1 | | Reach 2 | Reach 4 | Reach 5 | | Reach 6 | Reach 7 | Reach 8 | Reach 9 | |
| Calendar Year | Alameda-Zone 7 | Alameda County | Alameda-Zone 7 | Alameda-Zone 7 | Alameda-Zone 7 | Alameda County | Alameda-Zone 7 | Alameda County | Alameda County | Santa Clara | Total |
| | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] | [21] | [22] |
| 1962 | 141 | 8,412 | 353 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,906 |
| 1963 | 814 | 10,914 | 917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,645 |
| 1964 | 248 | 19,238 | 1,425 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,911 |
| 1965 | 637 | 15,280 | 1,830 | 138 | 0 | 0 | 0 | 1,127 | 0 | 15,014 | 34,026 |
| 1966 | 2,475 | 0 | 2,537 | 499 | 0 | 0 | 0 | 14,864 | 0 | 34,538 | 54,913 |
| 1967 | 1,527 | 0 | 2,391 | 862 | 0 | 0 | 0 | 12,882 | 0 | 39,101 | 56,763 |
| 1968 | 1,608 | 0 | 3,799 | 721 | 5 | 0 | 0 | 24,817 | 0 | 70,105 | 101,055 |
| 1969 | 1,165 | 0 | 3,459 | 1,851 | 160 | 0 | 0 | 813 | 0 | 62,264 | 69,712 |
| 1970 | 1,345 | 0 | 4,558 | 3,182 | 164 | 0 | 0 | 0 | 0 | 80,311 | 89,560 |
| 1971 | 546 | 0 | 1,908 | 2,403 | 160 | 0 | 0 | 5,961 | 0 | 87,606 | 98,584 |
| 1972 | 1,066 | 0 | 4,605 | 2,041 | 2,777 | 1,489 | 0 | 26,182 | 0 | 100,266 | 138,426 |
| 1973 | 430 | 0 | 1,123 | 1,193 | 229 | 0 | 0 | 2,521 | 0 | 88,582 | 94,078 |
| 1974 | 177 | 0 | 0 | 975 | 162 | 0 | 0 | 0 | 4 | 88,000 | 89,318 |
| 1975 | 137 | 0 | 1,783 | 1,864 | 120 | 0 | 714 | 393 | 593 | 88,000 | 93,604 |
| 1976 | 265 | 0 | 7,204 | 3,384 | 817 | 0 | 5,461 | 13,774 | 7,526 | 88,000 | 126,431 |
| 1977 | 210 | 0 | 4,491 | 2,213 | 524 | 0 | 5,206 | 11,284 | 7,556 | 76,220 | 107,704 |
| 1978 | 422 | 0 | 2,426 | 3,754 | 2,034 | 0 | 2,348 | 854 | 5,009 | 95,727 | 112,574 |
| 1979 | 197 | 0 | 4,283 | 5,567 | 3,937 | 0 | 5,341 | 3,430 | 7,444 | 91,991 | 122,190 |
| 1980 | 77 | 0 | 3,883 | 6,686 | 0 | 1,508 | 6,144 | 2,824 | 6,702 | 88,000 | 115,824 |
| 1981 | 1,250 | 0 | 4,648 | 5,273 | 1,157 | 5,752 | 7,262 | 7,595 | 8,570 | 88,000 | 129,507 |
| 1982 | 473 | 0 | 3,043 | 4,406 | 630 | 0 | 4,571 | 1,776 | 4,540 | 88,000 | 107,439 |
| 1983 | 179 | 0 | 2,712 | 1,714 | 50 | 0 | 111 | 0 | 3,157 | 86,733 | 94,656 |
| 1984 | 165 | 0 | 4,219 | 2,219 | 55 | 0 | 126 | 0 | 3,338 | 88,000 | 98,122 |
| 1985 | 213 | 0 | 5,199 | 2,060 | 63 | 0 | 7,537 | 11,203 | 7,813 | 88,000 | 122,088 |
| 1986 | 200 | 0 | 6,052 | 2,062 | 212 | 0 | 2,083 | 5,311 | 7,068 | 88,000 | 110,988 |
| 1987 | 218 | 0 | 7,538 | 2,372 | 285 | 0 | 12,993 | 15,488 | 9,902 | 88,000 | 136,796 |
| 1988 | 222 | 0 | 8,302 | 4,681 | 189 | 0 | 12,436 | 24,259 | 9,205 | 87,961 | 147,255 |
| 1989 | 222 | 0 | 8,051 | 6,562 | 418 | 0 | 10,974 | 17,340 | 8,702 | 90,000 | 142,269 |
| 1990 | 256 | 0 | 8,160 | 8,347 | 593 | 0 | 15,678 | 22,149 | 9,554 | 91,800 | 156,537 |
| 1991 | 162 | 0 | 3,676 | 3,269 | 359 | 0 | 1,945 | 9,155 | 3,493 | 28,200 | 50,259 |
| 1992 | 217 | 0 | 5,177 | 2,188 | 154 | 0 | 6,933 | 12,621 | 6,532 | 42,839 | 76,661 |
| 1993 | 190 | 0 | 5,843 | 8,430 | 5,964 | 1,650 | 13,208 | 1,792 | 6,829 | 62,065 | 105,971 |
| 1994 | 132 | 0 | 4,482 | 5,427 | 822 | 0 | 9,679 | 3,379 | 19,532 | 57,115 | 100,568 |
| 1995 | 278 | 0 | 6,236 | 7,195 | 955 | 0 | 15,427 | 21 | 17,772 | 28,756 | 76,640 |
| 1996 | 277 | 0 | 6,151 | 5,119 | 388 | 0 | 6,968 | 1,871 | 11,591 | 44,850 | 77,215 |
| 1997 | 138 | 0 | 6,647 | 6,501 | 1,582 | 1,323 | 12,654 | 1,876 | 10,864 | 60,601 | 102,186 |
| 1998 | 106 | 0 | 3,748 | 2,493 | 1,277 | 0 | 8,347 | 3,817 | 11,478 | 39,610 | 70,876 |
| 1999 | 148 | 0 | 5,048 | 8,227 | 1,444 | 0 | 13,133 | 5,326 | 16,226 | 52,945 | 102,497 |
| 2000 | 110 | 0 | 7,464 | 9,761 | 946 | 0 | 16,396 | 4,498 | 18,100 | 78,258 | 135,533 |
| 2001 | 105 | 0 | 7,822 | 4,879 | 3,010 | 0 | 13,593 | 0 | 18,004 | 47,922 | 95,335 |
| 2002 | 93 | 0 | 7,758 | 11,619 | 2,446 | 0 | 17,058 | 5,112 | 20,616 | 58,875 | 123,577 |
| 2003 | 108 | 0 | 7,916 | 11,348 | 2,887 | 0 | 16,684 | 5,037 | 12,753 | 75,981 | 132,714 |
| 2004 | 72 | 0 | 11,754 | 9,737 | 3,763 | 0 | 21,260 | 4,968 | 14,916 | 59,458 | 125,928 |
| 2005 | 1,430 | 0 | 11,520 | 10,100 | 1,826 | 0 | 16,597 | 4,139 | 10,160 | 52,364 | 108,136 |
| 2006 | 830 | 0 | 11,546 | 4,097 | 2,123 | 0 | 19,870 | 2,708 | 12,924 | 64,174 | 118,272 |
| 2007 | 179 | 0 | 10,066 | 2,563 | 3,107 | 0 | 23,205 | 8,255 | 15,107 | 71,690 | 134,172 |
| 2008 | 238 | 0 | 11,424 | 2,206 | 1,899 | 0 | 25,363 | 4,421 | 18,481 | 52,530 | 116,562 |
| 2009 | 211 | 0 | 7,054 | 5,437 | 1,987 | 0 | 16,398 | 2,551 | 16,945 | 66,364 | 116,947 |
| 2010 | 160 | 0 | 7,788 | 7,528 | 1,824 | 0 | 17,043 | 330 | 15,241 | 45,888 | 95,802 |
| 2011 | 1,541 | 0 | 6,282 | 6,887 | 2,173 | 0 | 20,098 | 7 | 15,203 | 60,761 | 112,952 |
| 2012 | 262 | 0 | 7,598 | 9,987 | 2,972 | 0 | 14,112 | 0 | 13,331 | 63,794 | 112,056 |
| 2013 | 237 | 0 | 11,253 | 9,998 | 3,171 | 0 | 20,197 | 31 | 23,609 | 78,623 | 147,119 |
| 2014 | 206 | 0 | 7,517 | 4,321 | 975 | 0 | 15,469 | 8,989 | 13,669 | 39,970 | 91,116 |
| 2015 | 182 | 0 | 6,136 | 3,640 | 4,594 | 0 | 15,532 | 6,389 | 14,838 | 65,773 | 117,084 |
| 2016 | 228 | 0 | 5,926 | 9,121 | 3,264 | 0 | 19,026 | 1,221 | 4,085 | 67,652 | 110,523 |
| **2017** | **0** | **0** | **9,340** | **8,520** | **1,660** | **0** | **28,851** | **0** | **11,112** | **60,000** | **119,483** |
| 2018 | 0 | 0 | 5,580 | 4,910 | 1,660 | 0 | 36,221 | 0 | 11,304 | 62,502 | 122,177 |
| 2019 | 0 | 0 | 5,800 | 4,910 | 1,660 | 0 | 36,001 | 0 | 11,784 | 60,000 | 120,155 |
| 2020 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2021 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2022 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2023 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2024 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2025 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2026 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2027 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2028 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2029 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2030 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2031 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2032 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2033 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2034 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| 2035 | 0 | 0 | 6,010 | 4,910 | 1,660 | 0 | 35,791 | 0 | 12,264 | 60,000 | 120,635 |
| **TOTAL** | **24,725** | **53,844** | **421,611** | **346,007** | **102,193** | **11,722** | **1,168,909** | **325,361** | **699,406** | **4,687,779** | **7,841,557** |

[b] For the period June 1962 through November 1967, deliveries were supplied by non-project water.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NORTH SAN JOAQUIN DIVISION | | | | | | SAN LUIS DIVISION | | | | | |
| | Reach 1 | Reach 2A | | | | | Reach 3 | | Reach 3A | | | |
| Calendar Year | Kern (Agricultural) | Alameda-Zone 7 | Kern (Agricultural) | Oak Flat[c] | Santa Clara | Tulare | Dudley Ridge | Metropolitan | Alameda-Zone 7 | Alameda County | AVEK | Castaic Lake |
| | [23] | [24] | [25] | [26] | [27] | [28] | [29] | [30] | [31] | [32] | [33] | [34] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 3,084 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 3,016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 5,911 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 7,212 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 8,166 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 3,214 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 3,471 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 3,576 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 4,112 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 1,472 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 3,906 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 6,149 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 5,700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 4,300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 3,838 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 3,822 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 5,700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 5,433 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 5,107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 5,625 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 4,412 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 6,091 | 0 | 300 | 602 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 2,922 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 141 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 2,239 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 2,858 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 3,071 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 5,169 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 4,904 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 5,238 | 0 | 0 | 0 | 11,100 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 4,401 | 0 | 0 | 0 | (11,100) | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 4,871 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 4,508 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 638 | 3,592 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 773 | 4,885 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 7 | 917 | 4,266 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 38 | 786 | 4,629 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 299 | 1,046 | 4,194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 321 | 1,103 | 4,242 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 320 | 1,031 | 3,567 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 8,885 | 56 | 1,744 | 1,985 | 0 | 0 | 0 | 0 | 0 | 0 | 5,873 | 0 |
| 2009 | 0 | 0 | 1,169 | 1,993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,300 |
| 2010 | 0 | 0 | 1,124 | 2,906 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 1,112 | 2,715 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 1,258 | 3,208 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 1,156 | 2,820 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 609 | 1,520 | 0 | 0 | 0 | 0 | 5,808 | 7,408 | 0 | 0 |
| 2015 | 0 | 0 | 658 | 1,077 | 0 | 0 | 0 | 0 | 2,360 | 6,032 | 0 | 0 |
| 2016 | 0 | 0 | 1,167 | 3,051 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,940 |
| **2017** | **0** | **0** | **1,300** | **3,420** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 1,300 | 3,420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **8,885** | **1,041** | **40,991** | **259,269** | **200** | **300** | **602** | **0** | **8,168** | **13,440** | **5,873** | **9,240** |

[c] Includes 425 af of 1988 advance allocation and 141 af of 1992 advance allocation.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION (continued) | | | | | | | | | | | |
| | Reach 3A (continued) | | | | | | | Reach 4 | | | | |
| | | Kern | | | | | | | | Kern | | |
| Calendar Year | Dudley Ridge | Municipal and Industrial | Agricultural | Metropolitan | Santa Barbara | Santa Clara | Tulare | Castaic Lake | Dudley Ridge | Municipal and Industrial | Agricultural | Tulare |
| | [35] | [36] | [37] | [38] | [39] | [40] | [41] | [42] | [43] | [44] | [45] | [46] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,898 | 0 | 12,647 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,500 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14,446 | 0 | 3,500 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,125 | 4,162 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,300 |
| 2000 | 0 | 3,320 | 68,960 | 0 | 0 | 0 | 0 | 0 | 0 | 1,517 | 878 | 0 |
| 2001 | 0 | 0 | 140,242 | 0 | 0 | 30,000 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 6,000 | 62,024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 151,044 | 29,596 | 0 | 0 | 0 | 0 | 0 | 0 | 1,351 | 0 |
| 2004 | 0 | 0 | 44,877 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 109,712 | 50,000 | 0 | 8,804 | 277 | 0 | 0 | 0 | 7,000 | 0 |
| 2006 | 0 | 0 | 19,575 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 71,567 | 116,272 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 94,562 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,721 | 0 |
| 2009 | 0 | 0 | 164,653 | 52,933 | 0 | 9,999 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 0 | 0 | 35,896 | 120,274 | 0 | 9,993 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 78,324 | 2,548 | 1,825 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 6,068 | 0 | 23,401 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 64,524 | 0 | 0 | 6,000 | 0 | 6,000 | 0 | 0 | 0 | 0 |
| 2014 | 16,789 | 0 | 104,689 | 15,000 | 0 | 27,476 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 14,460 | 0 | 105,537 | 0 | 0 | 17,115 | 0 | 0 | 0 | 0 | 3,278 | 8,166 |
| 2016 | 1,350 | 0 | 13,769 | 31,386 | 0 | 6,000 | 0 | 0 | 0 | 0 | 1,047 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **38,667** | **80,887** | **1,319,737** | **377,513** | **2,548** | **117,212** | **277** | **6,000** | **16,344** | **2,642** | **44,584** | **10,966** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION (continued) | | | | | | | | SOUTH SAN JOAQUIN DIVISION | | | |
| | Reach 5 | | | | | | | | Reach 6 | | | |
| | | | | Kern | | | | | | Kern | | |
| Calendar Year | Castaic Lake | Dudley Ridge | Empire | Municipal and Industrial | Agricultural | Metropolitan | Oak Flat | Tulare | Empire | Municipal and Industrial | Agricultural | Kings |
| | [47] | [48] | [49] | [50] | [51] | [52] | [53] | [54] | [55] | [56] | [57] | [58] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,550 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 18,831 | 0 | 0 | 0 | 0 | 0 | 8,260 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 10,823 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 5,095 | 27,200 | 0 | 0 | 28,200 | 0 | 2,000 | 1,624 | 0 | 0 | 31,200 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 21,776 | 0 | 0 | 0 | 0 | 0 | 3,932 | 0 |
| 1996 | 0 | 0 | 0 | 1,125 | 81,507 | 0 | 0 | 4,000 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 9,080 | 154,940 | 0 | 0 | 3,500 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,400 | 33,340 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 21,500 | 0 | 8,000 | 0 | 0 | 33,776 | 0 |
| 2000 | 0 | 0 | 0 | 8,130 | 57,647 | 0 | 0 | 0 | 0 | 1,457 | 35,847 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,457 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,900 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,850 | 0 | 0 | 0 | 3,250 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,000 | 0 | 0 | 0 | 6,954 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 | 0 | 0 | 2,659 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,600 | 0 | 0 | 0 | 3,119 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,355 | 0 | 0 | 0 | 2,159 |
| 2009 | 0 | 0 | 870 | 0 | 0 | 0 | 0 | 1,490 | 0 | 0 | 0 | 1,779 |
| 2010 | 0 | 0 | 431 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,477 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 400 | 0 | 0 | 2,964 |
| 2012 | 0 | 0 | 449 | 0 | 0 | 0 | 0 | 2,800 | 514 | 0 | 0 | 2,706 |
| 2013 | 0 | 0 | 692 | 0 | 8,393 | 0 | 0 | 5,350 | 280 | 0 | 0 | 2,666 |
| 2014 | 0 | 0 | 303 | 0 | 0 | 0 | 0 | 661 | 38 | 0 | 0 | 1,109 |
| 2015 | 0 | 0 | 142 | 0 | 1,349 | 0 | 0 | 7,576 | 120 | 0 | 0 | 391 |
| 2016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 0 | 0 | 0 | 4,484 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **3,120** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,120 |
| **TOTAL** | **5,095** | **38,023** | **2,887** | **18,335** | **372,643** | **21,500** | **2,000** | **58,913** | **1,352** | **21,857** | **146,355** | **95,997** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | | |
| | Reach 6 (continued) | | Reach 7 | | | | | | | Reach 8C | | |
| | | | | | Kern | | | | | | | Kern |
| Calendar Year | Metropolitan | Tulare | Castaic Lake | Dudley Ridge | Municipal and Industrial | Agricultural | Kings | Metropolitan | Tulare | Dudley Ridge | Empire | Municipal and Industrial) |
| | [59] | [60] | [61] | [62] | [63] | [64] | [65] | [66] | [67] | [68] | [69] | [70] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,978 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,942 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,990 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,795 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,000 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 738 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 454 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,739 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 894 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,859 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 361 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,197 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,170 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,525 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,475 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 5,262 | 0 | 0 | 0 | 2,391 | 3,000 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,279 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 221 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 280 | 1,354 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 18,157 | 10,043 | 0 | 0 | 0 | 0 | 2,741 | 0 |
| 1994 | 0 | 0 | 2,100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,666 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 10,875 | 20,595 | 0 | 0 | 0 | 0 | 1,631 | 989 |
| 1996 | 0 | 0 | 0 | 0 | 3,424 | 69,704 | 0 | 0 | 0 | 95 | 1,868 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 27,079 | 32,463 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 3,000 | 0 | 200 | 3,998 | 62,081 | 0 | 0 | 0 | 90 | 542 | 0 |
| 1999 | 11,000 | 23,000 | 0 | 0 | 7,923 | 19,500 | 0 | 500 | 4,470 | 86 | 3,176 | 0 |
| 2000 | 0 | 3,000 | 1,200 | 0 | 0 | 45,137 | 0 | 20,000 | 20,500 | 166 | 1,799 | 0 |
| 2001 | 0 | 600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 1,360 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,067 | 0 | 1,405 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15,103 | 0 | 1,436 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,562 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 6,904 | 0 | 4,000 | 0 | 3,834 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 2,500 | 0 | 6,000 | 0 | 3,282 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 16,214 | 0 | 0 | 2,545 | 0 | 2,084 | 0 |
| 2008 | 0 | 0 | 0 | 400 | 0 | 1,998 | 1,330 | 0 | 1,500 | 0 | 947 | 0 |
| 2009 | 0 | 2,100 | 0 | 1,400 | 0 | 0 | 0 | 0 | 600 | 0 | 164 | 0 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,850 | 0 | 2,828 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,500 | 0 | 1,515 | 0 |
| 2012 | 0 | 500 | 0 | 0 | 0 | 0 | 2,000 | 0 | 0 | 0 | 1,279 | 0 |
| 2013 | 0 | 1,159 | 0 | 500 | 0 | 0 | 0 | 0 | 1,121 | 0 | 595 | 0 |
| 2014 | 0 | 275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 175 | 0 |
| 2015 | 0 | 0 | 0 | 850 | 0 | 0 | 0 | 0 | 0 | 0 | 362 | 0 |
| 2016 | 0 | 213 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,822 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1,800** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 | 0 |
| **TOTAL** | **11,000** | **33,847** | **3,300** | **3,350** | **71,456** | **282,997** | **12,734** | **20,500** | **74,256** | **3,122** | **132,300** | **989** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | | |
| | Reach 8C (continued) | | | Reach 8D | | | | | | Reach 9 | | |
| | Kern | | | | Kern | | | | | | Kern | |
| Calendar Year | Agricultural | Kings | Tulare | Dudley Ridge | Municipal and Industrial | Agricultural | Kings | San Luis Obispo | Tulare | Dudley Ridge | Municipal and Industrial | Agricultural |
| | [71] | [72] | [73] | [74] | [75] | [76] | [77] | [78] | [79] | [80] | [81] | [82] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 900 | 25,100 | 26,360 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30,951 |
| 1969 | 0 | 100 | 7,081 | 31,375 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24,489 |
| 1970 | 0 | 0 | 0 | 40,407 | 0 | 0 | 0 | 0 | 3,408 | 0 | 0 | 46,114 |
| 1971 | 0 | 3,700 | 80,906 | 41,053 | 0 | 0 | 0 | 0 | 41,579 | 0 | 0 | 58,356 |
| 1972 | 0 | 1,400 | 144,843 | 42,443 | 0 | 0 | 0 | 0 | 113,550 | 0 | 0 | 75,464 |
| 1973 | 0 | 1,500 | 26,317 | 22,057 | 0 | 1,500 | 0 | 0 | 24,147 | 0 | 0 | 54,583 |
| 1974 | 0 | 1,500 | 32,603 | 33,390 | 0 | 0 | 0 | 0 | 39,686 | 0 | 0 | 63,814 |
| 1975 | 0 | 1,600 | 41,536 | 40,555 | 0 | 0 | 0 | 0 | 44,722 | 0 | 0 | 50,021 |
| 1976 | 0 | 1,600 | 26,595 | 41,421 | 0 | 0 | 0 | 0 | 32,216 | 0 | 0 | 53,465 |
| 1977 | 0 | 1,530 | 12,984 | 11,153 | 0 | 0 | 0 | 0 | 5,097 | 0 | 0 | 24,668 |
| 1978 | 0 | 2,070 | 3,934 | 51,747 | 0 | 0 | 0 | 0 | 8,119 | 0 | 0 | 72,231 |
| 1979 | 0 | 2,000 | 74,758 | 38,544 | 0 | 0 | 0 | 0 | 80,363 | 0 | 0 | 74,524 |
| 1980 | 0 | 2,200 | 35,140 | 41,000 | 0 | 0 | 0 | 0 | 40,304 | 0 | 0 | 79,946 |
| 1981 | 0 | 2,300 | 50,888 | 41,000 | 0 | 0 | 0 | 0 | 32,550 | 0 | 0 | 76,508 |
| 1982 | 0 | 1,536 | 4,405 | 41,000 | 0 | 0 | 214 | 0 | 14,146 | 0 | 0 | 76,877 |
| 1983 | 0 | 3,550 | 1,001 | 42,900 | 0 | 0 | 0 | 0 | 5 | 0 | 2,217 | 84,573 |
| 1984 | 0 | 3,100 | 3,677 | 45,100 | 0 | 0 | 0 | 0 | 2,066 | 0 | 4,100 | 85,732 |
| 1985 | 0 | 3,400 | 68,638 | 46,251 | 0 | 0 | 0 | 0 | 41,153 | 0 | 0 | 67,696 |
| 1986 | 0 | 3,700 | 40,017 | 50,249 | 0 | 0 | 0 | 0 | 39,338 | 0 | 0 | 79,943 |
| 1987 | 0 | 4,000 | 30,359 | 46,288 | 0 | 0 | 0 | 0 | 62,725 | 0 | 0 | 97,732 |
| 1988 | 0 | 4,000 | 46,281 | 47,994 | 0 | 0 | 0 | 0 | 48,035 | 0 | 1,100 | 83,858 |
| 1989 | 0 | 4,000 | 63,703 | 52,158 | 0 | 0 | 0 | 0 | 63,947 | 0 | 0 | 91,134 |
| 1990 | 0 | 2,000 | 23,504 | 36,296 | 0 | 161 | 0 | 0 | 32,066 | 0 | 0 | 83,108 |
| 1991 | 0 | 0 | 1,697 | 927 | 0 | 0 | 0 | 0 | 483 | 0 | 13,683 | 601 |
| 1992 | 0 | 1,806 | 15,982 | 12,667 | 0 | 0 | 0 | 0 | 30,746 | 0 | 28 | 40,183 |
| 1993 | 0 | 4,000 | 57,112 | 23,221 | 0 | 0 | 0 | 0 | 65,732 | 197 | 5,945 | 53,597 |
| 1994 | 0 | 2,116 | 21,510 | 28,793 | 0 | 1,726 | 0 | 0 | 40,852 | 0 | 0 | 44,994 |
| 1995 | 10,527 | 4,000 | 40,934 | 45,240 | 2,959 | 27,270 | 0 | 0 | 57,435 | 0 | 0 | 64,076 |
| 1996 | 1,500 | 4,000 | 84,130 | 52,722 | 0 | 1,455 | 0 | 100 | 148,745 | 0 | 2,236 | 89,291 |
| 1997 | 1,500 | 0 | 9,467 | 57,496 | 0 | 0 | 0 | 100 | 9,402 | 4,900 | 0 | 72,013 |
| 1998 | 1,000 | 15 | 8,956 | 49,435 | 0 | 20,000 | 0 | 0 | 8,721 | 0 | 0 | 57,530 |
| 1999 | 400 | 4,000 | 90,334 | 58,290 | 0 | 9,000 | 0 | 0 | 162,631 | 0 | 0 | 72,734 |
| 2000 | 400 | 3,600 | 63,842 | 57,920 | 0 | 0 | 0 | 0 | 113,952 | 0 | 0 | 73,562 |
| 2001 | 0 | 1,560 | 23,300 | 40,155 | 0 | 6,089 | 0 | 0 | 58,369 | 0 | 0 | 54,198 |
| 2002 | 0 | 2,854 | 34,009 | 48,179 | 0 | 7,522 | 0 | 0 | 47,426 | 0 | 0 | 60,957 |
| 2003 | 0 | 3,692 | 25,317 | 45,732 | 0 | 8,350 | 0 | 0 | 61,521 | 0 | 0 | 54,724 |
| 2004 | 0 | 5,803 | 30,546 | 45,823 | 0 | 4,979 | 0 | 0 | 55,625 | 0 | 0 | 54,330 |
| 2005 | 0 | 4,057 | 42,450 | 58,627 | 0 | 0 | 1,891 | 0 | 92,552 | 0 | 0 | 53,206 |
| 2006 | 0 | 1,105 | 34,367 | 61,410 | 0 | 0 | 3,266 | 0 | 64,840 | 0 | 0 | 56,909 |
| 2007 | 0 | 657 | 31,305 | 39,974 | 0 | 7,740 | 1,921 | 0 | 49,633 | 0 | 0 | 66,018 |
| 2008 | 0 | 240 | 14,146 | 18,974 | 0 | 21,242 | 107 | 0 | 16,903 | 0 | 0 | 63,315 |
| 2009 | 0 | 1,612 | 13,522 | 12,037 | 0 | 19,684 | 0 | 0 | 16,794 | 5,500 | 0 | 64,007 |
| 2010 | 0 | 26 | 14,005 | 17,346 | 0 | 14,094 | 1,900 | 0 | 40,609 | 0 | 0 | 76,357 |
| 2011 | 0 | 2,160 | 23,814 | 22,427 | 0 | 65 | 1,194 | 0 | 30,827 | 292 | 0 | 78,177 |
| 2012 | 0 | 2,699 | 25,847 | 17,122 | 0 | 2,168 | 0 | 0 | 56,570 | 3,400 | 0 | 69,395 |
| 2013 | 0 | 1,029 | 16,490 | 19,605 | 0 | 4,239 | 950 | 0 | 24,241 | 1,941 | 0 | 82,005 |
| 2014 | 0 | 81 | 2,880 | 12,960 | 0 | 3,554 | 66 | 0 | 5,118 | 1,000 | 0 | 67,754 |
| 2015 | 0 | 838 | 977 | 9,473 | 0 | 2,000 | 0 | 0 | 617 | 1,250 | 0 | 64,809 |
| 2016 | 0 | 1,195 | 20,313 | 23,196 | 0 | 140 | 1,209 | 0 | 33,781 | 3,400 | 0 | 67,468 |
| **2017** | **0** | **912** | **20,993** | **18,368** | **0** | **0** | **1,368** | **0** | **31,490** | **0** | **0** | **61,816** |
| 2018 | 0 | 912 | 20,993 | 23,575 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2019 | 0 | 912 | 20,993 | 20,571 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2020 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2021 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2022 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2023 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2024 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2025 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2026 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2027 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2028 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2029 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2030 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2031 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2032 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2033 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2034 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| 2035 | 0 | 912 | 20,993 | 20,692 | 0 | 0 | 1,368 | 0 | 31,490 | 0 | 0 | 61,816 |
| **TOTAL** | **15,327** | **122,159** | **1,990,389** | **2,184,078** | **2,959** | **162,978** | **38,710** | **200** | **2,661,657** | **21,880** | **29,309** | **4,312,501** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | | |
| | Reach 9 | Reach 10A | | | | | | | | | | Reach 11B |
| | | | | | | Kern | | | | | | |
| Calendar Year | Tulare | Alameda-Zone 7 | Alameda County | Castaic Lake | Dudley Ridge | Municipal and Industrial | Agricultural | Metropolitan | San Bernardino | Santa Clara | Tulare | Castaic Lake |
| | [83] | [84] | [85] | [86] | [87] | [88] | [89] | [90] | [91] | [92] | [93] | [94] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,842 | 0 |
| 1970 | 1,855 | 0 | 0 | 0 | 0 | 0 | 158 | 0 | 0 | 0 | 4,315 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 9,973 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 5,876 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 22,948 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 10,019 | 22,719 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 2,791 | 72,121 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 74 | 50,444 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 201 | 34,451 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 161,889 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 285 | 153,245 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 3,780 | 131,836 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 341 | 133,500 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 4,700 | 164,832 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 146,493 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 6,910 | 150,302 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 6,495 | 153,473 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 5,065 | 198,099 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 900 | 226,521 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 9,529 | 212,495 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 21,038 | 251,979 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 25,189 | 47,472 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 1,142 | 6,820 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 3,685 | 89,390 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 775 | 233,862 | 44,496 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 5,227 | 126,792 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 366 | 229,448 | 50,000 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 6,200 | 0 | 0 | 6,666 | 199,854 | 95,000 | 0 | 45,000 | 0 | 0 |
| 1997 | 0 | 0 | 10,000 | 0 | 900 | 3,577 | 157,385 | 125,000 | 0 | 35,000 | 0 | 0 |
| 1998 | 0 | 1,970 | 3,780 | 0 | 0 | 2,603 | 163,587 | 39,500 | 0 | 23,800 | 0 | 0 |
| 1999 | 0 | 22,910 | 16,100 | 0 | 0 | 1,657 | 190,787 | 75,850 | 0 | 30,000 | 0 | 0 |
| 2000 | 0 | 23,940 | 13,380 | 0 | 0 | 7,672 | 283,208 | 0 | 0 | 23,730 | 0 | 0 |
| 2001 | 0 | 5,000 | 0 | 0 | 0 | 160 | 98,175 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 14,287 | 2,083 | 24,000 | 0 | 145 | 171,498 | 0 | 0 | 3,311 | 0 | 0 |
| 2003 | 0 | 6,500 | 18,800 | 0 | 0 | 217 | 174,674 | 70,940 | 0 | 33,000 | 0 | 0 |
| 2004 | 0 | 5,740 | 8,000 | 32,522 | 0 | 65,751 | 117,286 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 28,422 | 0 | 0 | 146 | 232,519 | 31,210 | 0 | 55,448 | 0 | 0 |
| 2006 | 0 | 5,740 | 27,447 | 0 | 5,000 | 0 | 237,623 | 0 | 0 | 64,036 | 0 | 0 |
| 2007 | 0 | 717 | 1,029 | 0 | 3,000 | 0 | 203,794 | 0 | 0 | 3,692 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 2,800 | 1,702 | 103,176 | 0 | 0 | 4,306 | 0 | 0 |
| 2009 | 2,330 | 0 | 0 | 0 | 2,000 | 690 | 95,798 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 0 | 3,000 | 7,000 | 0 | 2,000 | 14 | 102,773 | 74,000 | 0 | 51,990 | 800 | 0 |
| 2011 | 2,000 | 3,414 | 16,020 | 0 | 2,908 | 26 | 137,476 | 149,012 | 0 | 65,770 | 500 | 0 |
| 2012 | 2,000 | 0 | 7,500 | 0 | 1,660 | 29 | 201,876 | 45,000 | 2,868 | 0 | 0 | 5,500 |
| 2013 | 0 | 0 | 0 | 0 | 2,500 | 2,057 | 116,190 | 0 | 0 | 0 | 0 | 5,500 |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 40,332 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 3,751 | 49,953 | 0 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 10,491 | 15,875 | 0 | 0 | 0 | 120,982 | 0 | 0 | 15,987 | 0 | 0 |
| **2017** | **0** | **0** | **14,088** | **0** | **0** | **0** | **141,830** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 13,896 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 13,416 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 12,936 | 0 | 0 | 0 | 140,140 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **8,185** | **103,709** | **430,012** | **56,522** | **22,768** | **205,375** | **8,900,434** | **800,008** | **2,868** | **455,070** | **8,457** | **11,000** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | |
| | Reach 11B (continued) | | | | Reach 12D | | Reach 12E | | | | |
| | | Kern | | | Kern | | | | | | Kern |
| Calendar Year | Dudley Ridge | Municipal and Industrial | Agricultural | Tulare | Municipal and Industrial | Agricultural | Alameda-Zone 7 | Alameda County | Castaic Lake | Dudley Ridge | Municipal and Industrial |
| | [95] | [96] | [97] | [98] | [99] | [100] | [101] | [102] | [103] | [104] | [105] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 24,776 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 64,682 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 72,279 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 63,773 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 72,358 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 67,544 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 87,476 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,651 |
| 1975 | 0 | 0 | 85,675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 85,067 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37,519 |
| 1977 | 0 | 3,981 | 29,603 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,280 |
| 1978 | 0 | 0 | 88,753 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47,133 |
| 1979 | 0 | 484 | 108,379 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50,740 |
| 1980 | 0 | 3,112 | 103,207 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32,039 |
| 1981 | 0 | 494 | 104,395 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59,917 |
| 1982 | 0 | 798 | 99,081 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36,139 |
| 1983 | 0 | 2,069 | 94,117 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 2,349 | 124,819 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63,941 |
| 1985 | 0 | 10,666 | 118,646 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69,839 |
| 1986 | 0 | 8,673 | 124,836 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62,109 |
| 1987 | 0 | 13,074 | 111,877 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 95,297 |
| 1988 | 0 | 13,509 | 114,031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 86,390 |
| 1989 | 0 | 9,986 | 127,058 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83,965 |
| 1990 | 0 | 9,319 | 104,107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 82,164 |
| 1991 | 0 | 6,099 | 118 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,842 |
| 1992 | 0 | 7,419 | 35,093 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47,181 |
| 1993 | 0 | 2,696 | 72,645 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 84,822 |
| 1994 | 0 | 3,506 | 71,202 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66,188 |
| 1995 | 0 | 1,154 | 97,072 | 0 | 0 | 0 | 0 | 0 | 0 | 1,000 | 107,130 |
| 1996 | 0 | 1,185 | 96,250 | 0 | 0 | 0 | 0 | 0 | 0 | 4,131 | 89,257 |
| 1997 | 0 | 1,111 | 104,823 | 0 | 0 | 0 | 0 | 0 | 0 | 8,012 | 32,061 |
| 1998 | 0 | 1,311 | 72,646 | 0 | 0 | 0 | 0 | 0 | 0 | 5,925 | 28,258 |
| 1999 | 0 | 2,127 | 92,262 | 0 | 0 | 0 | 0 | 0 | 0 | 1,321 | 110,161 |
| 2000 | 1,500 | 3,793 | 89,622 | 0 | 21 | 0 | 0 | 0 | 0 | 953 | 11,772 |
| 2001 | 0 | 636 | 73,105 | 0 | 41 | 0 | 0 | 0 | 0 | 0 | 385 |
| 2002 | 0 | 1,457 | 91,123 | 0 | 760 | 6 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 1,379 | 87,174 | 0 | 2,431 | 152 | 0 | 0 | 0 | 0 | 39,479 |
| 2004 | 0 | 1,299 | 97,722 | 0 | 3,419 | 768 | 0 | 0 | 0 | 1,600 | 52,303 |
| 2005 | 0 | 824 | 93,554 | 0 | 2,841 | 644 | 3,419 | 1,878 | 20,000 | 1,154 | 43,835 |
| 2006 | 0 | 0 | 98,417 | 0 | 2,513 | 1,556 | 10,000 | 0 | 20,000 | 0 | 82,207 |
| 2007 | 0 | 4,030 | 94,334 | 0 | 2,164 | 2,284 | 0 | 0 | 8,200 | 0 | 1,179 |
| 2008 | 0 | 263 | 93,417 | 0 | 1,514 | 3,000 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 300 | 127 | 96,776 | 0 | 564 | 4,274 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 5,350 | 381 | 92,220 | 974 | 1,904 | 2,206 | 10,000 | 0 | 25,844 | 0 | 4,851 |
| 2011 | 0 | 1,160 | 105,682 | 3,500 | 973 | 65 | 10,000 | 1,960 | 0 | 0 | 26,249 |
| 2012 | 2,000 | 1,019 | 94,519 | 0 | 3,128 | 939 | 20,308 | 0 | 6,416 | 200 | 19,423 |
| 2013 | 2,500 | 1,167 | 110,418 | 0 | 3,473 | 1,531 | 0 | 0 | 0 | 0 | 26,652 |
| 2014 | 9,786 | 0 | 87,728 | 0 | 0 | 5,225 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 8,200 | 4,553 | 84,300 | 0 | 985 | 3,486 | 0 | 0 | 0 | 0 | 280 |
| 2016 | 3,000 | 6,000 | 80,865 | 0 | 0 | 2,297 | 8,000 | 0 | 0 | 0 | 54,367 |
| **2017** | **0** | **7,500** | **59,915** | **0** | **3,900** | **0** | **0** | **0** | **0** | **0** | **54,167** |
| 2018 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2019 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2020 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2021 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2022 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2023 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2024 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2025 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2026 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2027 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2028 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2029 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2030 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2031 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2032 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2033 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2034 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| 2035 | 0 | 7,500 | 59,915 | 0 | 3,900 | 0 | 0 | 0 | 0 | 0 | 54,167 |
| **TOTAL** | **32,636** | **275,710** | **5,428,011** | **4,474** | **100,831** | **28,433** | **61,727** | **3,838** | **80,460** | **24,296** | **2,796,178** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | |
| | Reach 12E (continued) | | | | Reach 13B | | | | | | |
| | Kern | | | | | | | Kern | | | |
| Calendar Year | Agricultural | Metropolitan | San Bernardino | Santa Clara | Alameda-Zone 7 | Alameda County | Dudley Ridge | Municipal and Industrial | Agricultural | Metropolitan | Palmdale |
| | [106] | [107] | [108] | [109] | [110] | [111] | [112] | [113] | [114] | [115] | [116] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 9,279 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,891 | 0 | 0 |
| 1971 | 28,056 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 62,342 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17,388 | 0 | 0 |
| 1973 | 13,082 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,297 | 0 | 0 |
| 1974 | 4,248 | 0 | 0 | 0 | 0 | 0 | 0 | 8,038 | 4,246 | 0 | 0 |
| 1975 | 10,787 | 0 | 0 | 0 | 0 | 0 | 0 | 8,538 | 7,059 | 0 | 0 |
| 1976 | 20,555 | 0 | 0 | 0 | 0 | 0 | 0 | 5,626 | 8,855 | 0 | 0 |
| 1977 | 1,737 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,024 | 0 | 0 |
| 1978 | 15,011 | 0 | 0 | 0 | 0 | 0 | 0 | 21,773 | 7,601 | 0 | 0 |
| 1979 | 61,567 | 0 | 0 | 0 | 0 | 0 | 0 | 5,663 | 17,766 | 0 | 0 |
| 1980 | 22,252 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22,515 | 0 | 0 |
| 1981 | 58,470 | 0 | 0 | 0 | 0 | 0 | 0 | 7,844 | 14,037 | 0 | 0 |
| 1982 | 75,587 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,553 | 0 | 0 |
| 1983 | 10,950 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,491 | 0 | 0 |
| 1984 | 39,929 | 0 | 0 | 0 | 0 | 0 | 0 | 12,117 | 26,178 | 0 | 0 |
| 1985 | 84,117 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67,711 | 0 | 0 |
| 1986 | 51,540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66,551 | 0 | 0 |
| 1987 | 86,223 | 0 | 0 | 0 | 0 | 0 | 0 | 5,609 | 40,374 | 0 | 0 |
| 1988 | 123,249 | 0 | 0 | 0 | 0 | 0 | 0 | 9,298 | 47,167 | 0 | 0 |
| 1989 | 146,544 | 0 | 0 | 0 | 0 | 0 | 0 | 5,504 | 57,114 | 0 | 0 |
| 1990 | 38,973 | 0 | 0 | 0 | 0 | 0 | 0 | 7,645 | 20,423 | 0 | 0 |
| 1991 | 303 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 57,048 | 0 | 0 | 0 | 0 | 0 | 0 | 789 | 17,449 | 0 | 0 |
| 1993 | 285,554 | 5,504 | 0 | 0 | 0 | 0 | 0 | 12,798 | 88,157 | 0 | 0 |
| 1994 | 77,839 | 0 | 0 | 0 | 0 | 0 | 0 | 2,494 | 33,148 | 0 | 0 |
| 1995 | 181,097 | 0 | 0 | 0 | 0 | 0 | 0 | 8,751 | 110,685 | 0 | 0 |
| 1996 | 134,138 | 0 | 0 | 0 | 0 | 0 | 0 | 28,063 | 64,849 | 0 | 0 |
| 1997 | 128,329 | 1,486 | 0 | 0 | 0 | 0 | 0 | 43,803 | 49,312 | 0 | 0 |
| 1998 | 88,998 | 24,234 | 0 | 0 | 0 | 0 | 0 | 29,444 | 40,085 | 5,500 | 0 |
| 1999 | 255,343 | 62,162 | 0 | 0 | 0 | 0 | 0 | 12,969 | 92,998 | 0 | 0 |
| 2000 | 156,215 | 149,731 | 0 | 0 | 0 | 0 | 0 | 0 | 102,202 | 0 | 0 |
| 2001 | 51,076 | 0 | 0 | 0 | 0 | 0 | 1,733 | 0 | 33,925 | 0 | 0 |
| 2002 | 135,335 | 0 | 0 | 0 | 0 | 0 | 736 | 0 | 71,444 | 0 | 0 |
| 2003 | 112,056 | 45,989 | 0 | 0 | 0 | 0 | 350 | 2,396 | 124,582 | 1,865 | 0 |
| 2004 | 95,893 | 0 | 0 | 0 | 0 | 0 | 1,657 | 1,922 | 73,801 | 0 | 0 |
| 2005 | 340,281 | 15,384 | 0 | 2,619 | 2,321 | 0 | 14,540 | 21,781 | 269,631 | 192 | 0 |
| 2006 | 296,230 | 5,065 | 0 | 0 | 0 | 0 | 5,670 | 11,787 | 196,116 | 0 | 0 |
| 2007 | 87,764 | 0 | 0 | 0 | 0 | 0 | 2,161 | 0 | 72,240 | 0 | 0 |
| 2008 | 58,983 | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 9,785 | 0 | 0 |
| 2009 | 82,434 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,060 | 0 | 0 |
| 2010 | 72,809 | 134,855 | 0 | 0 | 0 | 0 | 304 | 0 | 63,966 | 22,000 | 0 |
| 2011 | 313,619 | 109,787 | 8,066 | 706 | 2,331 | 3,420 | 34,733 | 4,896 | 273,275 | 25,845 | 7,000 |
| 2012 | 102,054 | 92,803 | 19,066 | 0 | 0 | 0 | 0 | 448 | 70,805 | 1,950 | 2,500 |
| 2013 | 60,295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14,189 | 0 | 0 |
| 2014 | 500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,246 | 0 | 0 |
| 2015 | 2,750 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 481 | 0 | 0 |
| 2016 | 58,676 | 18,000 | 0 | 0 | 0 | 0 | 0 | 0 | 19,000 | 0 | 0 |
| **2017** | **64,394** | **68,964** | **0** | **0** | **0** | **0** | **12,000** | **0** | **22,200** | **0** | **0** |
| 2018 | 66,084 | 127,949 | 0 | 0 | 0 | 0 | 6,793 | 0 | 22,200 | 0 | 0 |
| 2019 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,793 | 0 | 22,200 | 0 | 0 |
| 2020 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2021 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2022 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2023 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2024 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2025 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2026 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2027 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2028 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2029 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2030 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2031 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2032 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2033 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2034 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| 2035 | 66,084 | 178,205 | 0 | 0 | 0 | 0 | 6,672 | 0 | 22,200 | 0 | 0 |
| **TOTAL** | **5,454,023** | **3,891,398** | **27,132** | **3,325** | **4,652** | **3,420** | **194,222** | **280,196** | **2,801,472** | **57,352** | **9,500** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | | |
| | Reach 13B (continued) | | Reach 14A | | Reach 14B | | Reach 14C | | | Reach 15A | | Reach 16A |
| | | | Kern | | Kern | | Kern | | | Kern | | |
| Calendar Year | Santa Clara | Tulare | Municipal and Industrial | Agricultural | Municipal and Industrial | Agricultural | Municipal and Industrial | Agricultural | Metropolitan | Municipal and Industrial | Agricultural | AVEK |
| | [117] | [118] | [119] | [120] | [121] | [122] | [123] | [124] | [125] | [126] | [127] | [128] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 23,844 | 0 | 49,929 | 0 | 24,187 | 0 | 0 | 3,552 | 0 |
| 1972 | 0 | 0 | 0 | 26,621 | 0 | 77,034 | 0 | 35,016 | 0 | 0 | 6,064 | 0 |
| 1973 | 0 | 0 | 0 | 15,328 | 0 | 47,040 | 0 | 19,043 | 0 | 0 | 19,916 | 0 |
| 1974 | 0 | 0 | 0 | 7,794 | 0 | 32,356 | 0 | 12,601 | 0 | 0 | 18,000 | 0 |
| 1975 | 0 | 0 | 0 | 10,306 | 0 | 27,736 | 0 | 12,783 | 0 | 0 | 35,420 | 0 |
| 1976 | 0 | 0 | 0 | 268 | 0 | 35,296 | 0 | 9,005 | 0 | 0 | 39,551 | 0 |
| 1977 | 0 | 0 | 0 | 8,299 | 0 | 13,539 | 0 | 3,757 | 0 | 0 | 6,158 | 0 |
| 1978 | 0 | 0 | 0 | 34,029 | 0 | 72,351 | 0 | 24,542 | 0 | 0 | 31,148 | 0 |
| 1979 | 0 | 0 | 3,012 | 27,356 | 0 | 59,413 | 0 | 22,372 | 0 | 0 | 38,602 | 0 |
| 1980 | 0 | 0 | 4,312 | 16,876 | 0 | 40,513 | 0 | 19,953 | 0 | 0 | 37,817 | 0 |
| 1981 | 0 | 0 | 4,511 | 13,007 | 8 | 42,753 | 7 | 18,729 | 0 | 0 | 39,033 | 0 |
| 1982 | 0 | 0 | 3,735 | 24,240 | 184 | 57,739 | 0 | 26,479 | 0 | 0 | 47,782 | 0 |
| 1983 | 0 | 0 | 1,168 | 20,302 | 0 | 57,922 | 0 | 26,613 | 0 | 0 | 37,426 | 0 |
| 1984 | 0 | 0 | 137 | 35,369 | 10 | 79,179 | 2 | 34,996 | 0 | 0 | 49,848 | 0 |
| 1985 | 0 | 0 | 206 | 33,103 | 0 | 72,855 | 0 | 31,758 | 0 | 0 | 44,078 | 0 |
| 1986 | 0 | 0 | 180 | 26,384 | 0 | 70,864 | 0 | 34,566 | 0 | 0 | 42,461 | 0 |
| 1987 | 0 | 0 | 610 | 30,098 | 9 | 67,710 | 10 | 31,019 | 0 | 0 | 34,748 | 0 |
| 1988 | 0 | 0 | 622 | 32,778 | 19 | 75,968 | 1 | 37,165 | 0 | 16 | 41,978 | 0 |
| 1989 | 0 | 0 | 721 | 29,292 | 7 | 82,201 | 5 | 37,800 | 0 | 2 | 43,239 | 0 |
| 1990 | 0 | 0 | 673 | 26,800 | 13 | 81,076 | 9 | 34,174 | 0 | 6 | 36,347 | 0 |
| 1991 | 0 | 0 | 768 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,000 |
| 1992 | 0 | 0 | 673 | 16,238 | 464 | 41,143 | 0 | 18,084 | 0 | 0 | 24,243 | 0 |
| 1993 | 0 | 0 | 629 | 17,832 | 0 | 62,493 | 0 | 28,103 | 0 | 0 | 27,997 | 0 |
| 1994 | 0 | 0 | 2,513 | 16,760 | 3,000 | 54,011 | 1,000 | 22,624 | 0 | 0 | 29,511 | 0 |
| 1995 | 0 | 3,500 | 3 | 21,234 | 0 | 67,391 | 0 | 31,285 | 0 | 0 | 26,134 | 0 |
| 1996 | 0 | 0 | 0 | 26,978 | 0 | 85,936 | 0 | 38,879 | 0 | 0 | 36,186 | 0 |
| 1997 | 0 | 0 | 0 | 23,035 | 0 | 79,790 | 0 | 33,512 | 0 | 0 | 36,281 | 0 |
| 1998 | 0 | 0 | 0 | 15,706 | 0 | 58,132 | 0 | 23,097 | 0 | 0 | 28,712 | 0 |
| 1999 | 0 | 0 | 0 | 21,153 | 0 | 67,576 | 0 | 31,489 | 0 | 0 | 36,801 | 0 |
| 2000 | 0 | 0 | 0 | 19,264 | 0 | 70,585 | 0 | 33,716 | 0 | 0 | 40,063 | 0 |
| 2001 | 0 | 0 | 0 | 12,452 | 0 | 49,602 | 0 | 23,557 | 0 | 0 | 31,192 | 0 |
| 2002 | 0 | 0 | 0 | 11,161 | 0 | 52,762 | 0 | 27,138 | 0 | 0 | 41,552 | 0 |
| 2003 | 0 | 0 | 0 | 13,685 | 0 | 44,576 | 0 | 24,783 | 12,911 | 0 | 36,602 | 0 |
| 2004 | 0 | 0 | 0 | 13,030 | 0 | 52,012 | 0 | 30,313 | 0 | 0 | 40,184 | 0 |
| 2005 | 9,014 | 0 | 0 | 15,663 | 0 | 56,739 | 0 | 21,979 | 0 | 0 | 39,870 | 0 |
| 2006 | 0 | 0 | 0 | 17,779 | 0 | 65,142 | 1,413 | 20,193 | 5,440 | 0 | 46,244 | 0 |
| 2007 | 0 | 0 | 0 | 21,435 | 0 | 67,955 | 0 | 24,947 | 1,881 | 0 | 47,390 | 0 |
| 2008 | 2,324 | 0 | 0 | 20,087 | 0 | 63,497 | 0 | 27,847 | 0 | 0 | 33,029 | 0 |
| 2009 | 0 | 0 | 0 | 22,281 | 0 | 60,726 | 0 | 27,185 | 0 | 0 | 26,007 | 0 |
| 2010 | 0 | 10,000 | 0 | 21,964 | 0 | 58,110 | 0 | 25,477 | 29,818 | 0 | 22,045 | 0 |
| 2011 | 0 | 0 | 0 | 24,131 | 0 | 61,859 | 0 | 27,061 | 27,326 | 0 | 42,158 | 0 |
| 2012 | 0 | 8,000 | 0 | 25,982 | 0 | 64,489 | 0 | 23,446 | 31,703 | 0 | 27,920 | 0 |
| 2013 | 0 | 0 | 0 | 29,414 | 0 | 62,137 | 0 | 25,004 | 6,592 | 0 | 28,147 | 0 |
| 2014 | 0 | 0 | 0 | 28,172 | 0 | 50,337 | 0 | 20,992 | 0 | 0 | 10,784 | 0 |
| 2015 | 0 | 0 | 0 | 25,886 | 0 | 48,996 | 0 | 17,267 | 0 | 0 | 10,202 | 0 |
| 2016 | 0 | 0 | 0 | 24,106 | 0 | 50,210 | 0 | 22,403 | 11 | 0 | 22,924 | 0 |
| **2017** | **0** | **0** | **0** | **17,000** | **0** | **42,800** | **0** | **20,500** | **0** | **0** | **25,800** | **0** |
| 2018 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2019 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2020 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2021 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2022 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2023 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2024 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2025 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2026 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2027 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2028 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2029 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2030 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2031 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2032 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2033 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2034 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| 2035 | 0 | 0 | 0 | 17,000 | 0 | 42,800 | 0 | 20,500 | 0 | 0 | 25,800 | 0 |
| **TOTAL** | **11,338** | **21,500** | **24,473** | **1,270,522** | **3,714** | **3,452,883** | **2,447** | **1,536,439** | **115,682** | **24** | **1,935,546** | **2,000** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | TEHACHAPI DIVISION | MOJAVE DIVISION | | | | | | | | |
| | Reach 16A (continued) | | Reach 17E | Reach 18A | Reach 19 | | Reach 20A | | | Reach 20B | | |
| | Kern | | Kern | | | | | | | | | |
| Calendar Year | Municipal and Industrial | Agricultural | (Municipal and Industrial) | AVEK | AVEK | Mojave | AVEK | Mojave | Palmdale | AVEK | Littlerock | Palmdale |
| | [129] | [130] | [131] | [132] | [133] | [134] | [135] | [136] | [137] | [138] | [139] | [140] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 4,768 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 1,961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 3,000 | 1,564 | 0 | 0 | 1,223 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 3,200 | 9,867 | 0 | 0 | 7,622 | 0 | 420 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 3,500 | 11,667 | 0 | 3,808 | 23,063 | 0 | 471 | 0 | 0 | 416 | 0 | 0 |
| 1977 | 3,420 | 685 | 0 | 1,231 | 8,927 | 0 | 773 | 0 | 0 | 271 | 0 | 0 |
| 1978 | 7,989 | 1,655 | 0 | 1,321 | 36,333 | 0 | 5,549 | 0 | 0 | 934 | 0 | 0 |
| 1979 | 2,813 | 15,808 | 0 | 2,098 | 49,910 | 0 | 7,555 | 0 | 0 | 930 | 0 | 0 |
| 1980 | 2,700 | 16,145 | 0 | 2,610 | 61,534 | 0 | 7,605 | 0 | 0 | 655 | 0 | 0 |
| 1981 | 2,636 | 18,156 | 0 | 2,340 | 65,690 | 0 | 10,333 | 0 | 0 | 966 | 0 | 0 |
| 1982 | 1,921 | 16,577 | 0 | 1,669 | 41,127 | 0 | 7,313 | 0 | 0 | 8 | 0 | 0 |
| 1983 | 1,400 | 17,907 | 0 | 43 | 26,377 | 0 | 6,253 | 0 | 0 | 20 | 0 | 0 |
| 1984 | 1,338 | 24,246 | 0 | 90 | 22,462 | 0 | 9,558 | 0 | 0 | 2 | 0 | 0 |
| 1985 | 1,309 | 16,820 | 0 | 8 | 23,440 | 0 | 11,613 | 0 | 1,510 | 217 | 0 | 32 |
| 1986 | 1,213 | 15,559 | 0 | 8 | 16,898 | 0 | 13,808 | 0 | 3,041 | 0 | 0 | 45 |
| 1987 | 1,665 | 10,170 | 0 | 0 | 15,958 | 0 | 15,493 | 0 | 2,389 | 151 | 0 | 1,624 |
| 1988 | 1,925 | 8,987 | 0 | 0 | 13,471 | 0 | 17,117 | 0 | 366 | 281 | 0 | 1,261 |
| 1989 | 2,668 | 8,649 | 0 | 0 | 18,007 | 0 | 23,481 | 0 | 381 | 112 | 0 | 7,848 |
| 1990 | 2,819 | 8,608 | 0 | 0 | 17,281 | 0 | 25,843 | 0 | 282 | 84 | 0 | 8,292 |
| 1991 | 2,588 | 343 | 0 | 0 | 728 | 0 | 4,282 | 1,391 | 84 | 131 | 0 | 3,830 |
| 1992 | 2,087 | 8,275 | 0 | 0 | 7,238 | 0 | 18,518 | 1,310 | 185 | 650 | 0 | 3,850 |
| 1993 | 2,494 | 9,167 | 0 | 0 | 13,340 | 0 | 23,662 | 1,514 | 164 | 996 | 0 | 7,597 |
| 1994 | 3,011 | 13,877 | 0 | 0 | 19,122 | 0 | 25,250 | 1,399 | 299 | 124 | 0 | 8,119 |
| 1995 | 3,188 | 15,042 | 0 | 0 | 20,222 | 0 | 22,385 | 1,227 | 328 | 0 | 0 | 6,633 |
| 1996 | 2,573 | 18,142 | 0 | 0 | 23,919 | 0 | 26,979 | 1,316 | 354 | 0 | 0 | 11,080 |
| 1997 | 3,997 | 17,048 | 0 | 0 | 28,834 | 64 | 27,999 | 1,272 | 313 | 0 | 0 | 11,548 |
| 1998 | 3,751 | 17,032 | 0 | 0 | 22,466 | 1,345 | 25,985 | 0 | 195 | 0 | 0 | 8,557 |
| 1999 | 3,316 | 24,071 | 0 | 0 | 30,944 | 1,439 | 32,409 | 0 | 377 | 36 | 0 | 12,901 |
| 2000 | 3,015 | 20,919 | 0 | 0 | 34,786 | 1,361 | 37,819 | 0 | 0 | 80 | 0 | 9,060 |
| 2001 | 1,894 | 13,476 | 0 | 0 | 24,370 | 1,385 | 33,216 | 0 | 0 | 282 | 0 | 10,427 |
| 2002 | 4,227 | 14,520 | 0 | 0 | 14,297 | 1,370 | 36,311 | 0 | 0 | 1,662 | 0 | 18,496 |
| 2003 | 1,168 | 16,799 | 0 | 0 | 12,145 | 1,285 | 39,532 | 0 | 0 | 2,289 | 0 | 11,547 |
| 2004 | 2,239 | 19,714 | 0 | 0 | 11,201 | 1,223 | 40,408 | 0 | 0 | 1,774 | 0 | 12,139 |
| 2005 | 167 | 18,353 | 0 | 11 | 11,804 | 1,051 | 41,496 | 0 | 0 | 1,336 | 0 | 11,678 |
| 2006 | 279 | 22,570 | 0 | 0 | 18,438 | 1,021 | 53,878 | 0 | 0 | 1,415 | 0 | 12,487 |
| 2007 | 204 | 26,229 | 0 | 0 | 22,916 | 1,176 | 47,639 | 0 | 0 | 1,349 | 0 | 19,609 |
| 2008 | 3,834 | 18,426 | 0 | 0 | 9,096 | 1,238 | 33,919 | 0 | 0 | 792 | 25 | 14,255 |
| 2009 | 1,531 | 19,517 | 0 | 0 | 5,717 | 1,345 | 35,402 | 0 | 0 | 366 | 42 | 15,339 |
| 2010 | 1,033 | 19,829 | 0 | 0 | 10,825 | 1,181 | 43,122 | 0 | 0 | 643 | 0 | 10,969 |
| 2011 | 3,808 | 17,957 | 0 | 0 | 55,707 | 2,184 | 35,543 | 0 | 0 | 507 | 0 | 9,881 |
| 2012 | 3,453 | 19,842 | 0 | 0 | 41,053 | 1,306 | 33,390 | 0 | 0 | 901 | 0 | 16,397 |
| 2013 | 148 | 21,311 | 4 | 16 | 13,414 | 1,095 | 33,507 | 0 | 0 | 693 | 0 | 10,567 |
| 2014 | 0 | 18,673 | 1 | 0 | 621 | 41 | 15,761 | 1,004 | 0 | 744 | 0 | 8,406 |
| 2015 | 2,407 | 16,214 | 0 | 0 | 0 | 0 | 12,447 | 1,023 | 0 | 447 | 0 | 5,836 |
| 2016 | 4,689 | 15,997 | 0 | 0 | 24,485 | 0 | 54,086 | 1,042 | 160 | 2,438 | 0 | 13,945 |
| **2017** | **7,083** | **14,733** | **0** | **3,444** | **14,369** | **863** | **63,565** | **0** | **0** | **2,270** | **0** | **19,543** |
| 2018 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 63,565 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2019 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2020 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2021 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2022 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2023 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2024 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2025 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2026 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2027 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2028 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2029 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2030 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2031 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2032 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2033 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2034 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| 2035 | 7,083 | 14,733 | 0 | 3,444 | 14,369 | 863 | 61,499 | 0 | 0 | 2,270 | 0 | 19,543 |
| **TOTAL** | **241,194** | **933,069** | **5** | **80,689** | **1,200,022** | **37,507** | **2,170,743** | **12,498** | **10,428** | **67,832** | **67** | **675,572** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | | | | | | | | | |
| | Reach 21 | | | Reach 22A | | Reach 22B | | | | | Reach 23 | Reach 24 |
| | AVEK | Littlerock | Palmdale | AVEK | Littlerock | AVEK[d] | Coachella[e] | Desert[e] | Metropolitan[e] | Mojave | Mojave | Crestline |
| | [141] | [142] | [143] | [144] | [145] | [146] | [147] | [148] | [149] | [150] | [151] | [152] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 338 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 0 | 464 |
| 1973 | 0 | 290 | 0 | 0 | 0 | 0 | 5,800 | 9,000 | (14,800) | 0 | 0 | 389 |
| 1974 | 0 | 400 | 0 | 0 | 0 | 0 | 6,400 | 10,000 | (16,400) | 0 | 14 | 627 |
| 1975 | 0 | 520 | 0 | 0 | 0 | 0 | 7,000 | 11,000 | (18,000) | 0 | 0 | 825 |
| 1976 | 0 | 589 | 0 | 0 | 0 | 0 | 7,600 | 12,000 | (19,600) | 0 | 0 | 1,002 |
| 1977 | 0 | 111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 58 | 1,109 |
| 1978 | 0 | 208 | 0 | 0 | 0 | 0 | 10,084 | 15,300 | (25,384) | 0 | 0 | 1,209 |
| 1979 | 0 | 133 | 0 | 0 | 0 | 0 | 10,063 | 15,000 | (25,063) | 4,000 | 0 | 1,260 |
| 1980 | 0 | 191 | 0 | 3 | 0 | 0 | 10,884 | 17,000 | (27,884) | 4,000 | 0 | 1,239 |
| 1981 | 0 | 1,270 | 0 | 46 | 0 | 0 | 12,105 | 19,000 | (31,105) | 4,000 | 0 | 1,485 |
| 1982 | 0 | 0 | 0 | 174 | 0 | 0 | 13,326 | 21,000 | (34,326) | 10,500 | 0 | 1,238 |
| 1983 | 0 | 38 | 0 | 268 | 0 | 0 | 14,547 | 23,000 | (37,547) | 0 | 0 | 911 |
| 1984 | 0 | 1 | 0 | 550 | 0 | 0 | 15,768 | 25,000 | (40,768) | 0 | 0 | 1,128 |
| 1985 | 0 | 0 | 16 | 1,786 | 0 | 0 | 16,989 | 27,000 | (43,989) | 0 | 0 | 1,422 |
| 1986 | 0 | 163 | 10 | 1,735 | 0 | 0 | 18,210 | 29,000 | (47,210) | 0 | 0 | 1,506 |
| 1987 | 0 | 1,080 | 1,366 | 2,273 | 5 | 214 | 19,431 | 31,500 | (50,931) | 17 | 0 | 1,849 |
| 1988 | 0 | 419 | 143 | 3,210 | 0 | 0 | 20,652 | 34,000 | (54,652) | 9 | 0 | 2,006 |
| 1989 | 0 | 971 | 780 | 3,591 | 0 | 89 | 21,873 | 36,500 | (58,373) | 0 | 200 | 2,170 |
| 1990 | 0 | 1,747 | 34 | 3,988 | 0 | 10 | 23,100 | 38,100 | (61,200) | 0 | 0 | 1,827 |
| 1991 | 0 | 522 | 0 | 2,427 | 0 | 0 | 6,930 | 11,430 | (18,360) | 0 | 0 | 849 |
| 1992 | 0 | 251 | 0 | 3,859 | 0 | 0 | 10,427 | 17,197 | (27,624) | 42 | 0 | 519 |
| 1993 | 0 | 734 | 0 | 5,098 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 439 |
| 1994 | 0 | 1,098 | 0 | 4,657 | 0 | 0 | 0 | 0 | 0 | 14,634 | 0 | 785 |
| 1995 | 0 | 480 | 0 | 4,679 | 0 | 0 | 0 | 0 | 0 | 7,495 | 0 | 409 |
| 1996 | 0 | 494 | 0 | 5,458 | 0 | 0 | 0 | 0 | 0 | 6,111 | 0 | 485 |
| 1997 | 0 | 444 | 0 | 5,549 | 0 | 0 | 0 | 0 | 0 | 9,038 | 0 | 651 |
| 1998 | 0 | 404 | 0 | 4,468 | 0 | 0 | 0 | 0 | 0 | 2,580 | 0 | 187 |
| 1999 | 0 | 342 | 0 | 5,684 | 0 | 0 | 0 | 0 | 0 | 6,705 | 0 | 1,132 |
| 2000 | 5,002 | 0 | 0 | 5,890 | 0 | 0 | 0 | 0 | 0 | 10,019 | 0 | 1,194 |
| 2001 | 0 | 0 | 0 | 4,989 | 0 | 0 | 0 | 0 | 0 | 3,048 | 0 | 1,057 |
| 2002 | 0 | 0 | 0 | 5,404 | 0 | 497 | 0 | 0 | 0 | 2,976 | 0 | 2,189 |
| 2003 | 0 | 0 | 0 | 6,063 | 0 | 0 | 0 | 0 | 7,625 | 13,150 | 0 | 1,563 |
| 2004 | 0 | 0 | 23 | 6,095 | 0 | 253 | 0 | 0 | 0 | 11,953 | 0 | 2,006 |
| 2005 | 0 | 0 | 34 | 5,184 | 0 | 0 | 0 | 0 | 5,942 | 12,169 | 0 | 807 |
| 2006 | 0 | 0 | 5 | 6,653 | 0 | 0 | 0 | 0 | 0 | 32,993 | 0 | 641 |
| 2007 | 0 | 0 | 25 | 7,711 | 0 | 588 | 0 | 0 | 0 | 27,684 | 0 | 1,768 |
| 2008 | 0 | 0 | 0 | 4,756 | 0 | 0 | 0 | 0 | 0 | 20,479 | 0 | 848 |
| 2009 | 0 | 0 | 0 | 4,185 | 0 | 0 | 0 | 0 | 0 | 20,214 | 0 | 894 |
| 2010 | 0 | 0 | 0 | 3,899 | 0 | 0 | 0 | 0 | 0 | 27,640 | 0 | 357 |
| 2011 | 0 | 0 | 0 | 2,289 | 0 | 0 | 0 | 0 | 30,907 | 2,915 | 0 | 474 |
| 2012 | 0 | 0 | 0 | 2,328 | 0 | 0 | 0 | 0 | 12,025 | 9,938 | 0 | 624 |
| 2013 | 0 | 0 | 0 | 3,227 | 0 | 118 | 0 | 0 | 0 | 5,888 | 0 | 1,368 |
| 2014 | 0 | 0 | 0 | 1,318 | 0 | 88 | 0 | 0 | 0 | 2,536 | 0 | 1,233 |
| 2015 | 0 | 0 | 0 | 1,298 | 0 | 116 | 0 | 0 | 0 | 7,807 | 0 | 1,253 |
| 2016 | 0 | 0 | 0 | 5,113 | 0 | 92 | 0 | 0 | 0 | 10,817 | 0 | 2,019 |
| **2017** | **0** | **0** | **0** | **4,538** | **0** | **100** | **0** | **0** | **0** | **33,065** | **0** | **3,880** |
| 2018 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 33,065 | 0 | 3,480 |
| 2019 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2020 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2021 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2022 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2023 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2024 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2025 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2026 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2027 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2028 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2029 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2030 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2031 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2032 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2033 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2034 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| 2035 | 0 | 0 | 0 | 4,538 | 0 | 100 | 0 | 0 | 0 | 35,515 | 0 | 3,480 |
| **TOTAL** | **5,002** | **13,238** | **2,436** | **222,127** | **5** | **3,965** | **251,189** | **402,027** | **(596,717)** | **961,319** | **272** | **115,937** |

[d] 1988 advance allocation.

[e] In accordance with the exchange agreement between the noted agencies, Metropolitan assumed responsibility for payment of variable OMP&R costs on the exchange water in reaches beyond Reach 22B, and Desert and Coachella for such costs from the Delta through Reach 22B. The adjustment in deliveries in Reach 22B provides for compliance with provisions for the repayment of costs under the agreement. In 1993 and after, the exchange takes place in Reach 26A.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | SANTA ANA DIVISION | | | | | | | |
| | Reach 24 (continued) | | | Reach 26A | | | | | Reach 28G | Reach 28H | |
| | Metropolitan[e] | Mojave | San Bernardino | Coachella[e] | Desert[e] | Metropolitan[e] | San Bernardino[f] | San Gabriel | Metropolitan | Coachella | Desert |
| | [153] | [154] | [155] | [156] | [157] | [158] | [159] | [160] | [161] | [162] | [163] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 1,275 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 444 | 32,426 | 0 | 18,942 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 84,981 | 16,605 | 612 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 169,960 | 13,865 | 5,450 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 215,312 | 12,273 | 6,071 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 64,823 | 24,833 | 8,996 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 297,708 | 4,055 | 7,771 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 260,903 | 18 | 290 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 300,345 | 0 | 1,085 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 395,678 | 16,021 | 3,619 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 214,566 | 8,409 | 12,599 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 175,288 | 5,994 | 734 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 122,311 | 5,556 | 7,656 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 147,599 | 7,390 | 5,028 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 215,265 | 6,421 | 9,454 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 175,012 | 18,751 | 10,630 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 247,101 | 21,386 | 8,948 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 326,217 | 20,782 | 12,839 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 399,387 | 18,831 | 16,649 | 0 | 0 | 0 |
| 1991 | 0 | 2,032 | 0 | 0 | 0 | 107,182 | 3,661 | 5,399 | 0 | 0 | 0 |
| 1992 | 0 | 9,334 | 0 | 0 | 0 | 219,524 | 3,358 | 7,908 | 0 | 0 | 0 |
| 1993 | 0 | 10,000 | 0 | 23,100 | 38,100 | 98,291 | 4,361 | 14,397 | 0 | 0 | 0 |
| 1994 | 0 | 819 | 0 | 14,102 | 23,257 | 192,979 | 9,135 | 15,230 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 23,100 | 38,100 | 107,299 | 696 | 12,922 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 62,219 | 102,622 | 73,438 | 6,064 | 15,989 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 58,100 | 53,100 | 157,215 | 9,654 | 18,175 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 78,100 | 58,100 | 36,770 | 1,878 | 9,310 | 0 | 6,582 | 7,708 |
| 1999 | 0 | 0 | 0 | 50,480 | 58,100 | 139,752 | 12,874 | 21,729 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 42,323 | 58,234 | 326,647 | 0 | 15,140 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 9,100 | 15,010 | 284,007 | 0 | 2,360 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 16,755 | 27,640 | 301,700 | 26,399 | 24,851 | 0 | 0 | 0 |
| 2003 | 17,249 | 0 | 0 | 14,443 | 23,819 | 464,719 | 5,000 | 21,934 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 15,465 | 21,190 | 428,316 | 40,000 | 12,541 | 0 | 0 | 0 |
| 2005 | 14,058 | 341 | 0 | 34,356 | 49,089 | 361,976 | 15,834 | 13,984 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 121,100 | 50,000 | 404,594 | 20,000 | 16,284 | 0 | 0 | 0 |
| 2007 | 0 | 17,249 | 710 | 66,007 | 27,253 | 370,971 | 10,022 | 4,024 | 0 | 7,221 | 2,981 |
| 2008 | 0 | 3,679 | 411 | 40,171 | 24,643 | 210,520 | 187 | 7,212 | 0 | 6,620 | 1,785 |
| 2009 | 0 | 7,488 | 149 | 45,074 | 17,872 | 138,216 | 0 | 11,520 | 0 | 948 | 391 |
| 2010 | 0 | 9,331 | 26 | 53,866 | 18,398 | 463,654 | 20,008 | 19,180 | 0 | 30,415 | 12,257 |
| 2011 | 14,141 | 0 | 31 | 84,566 | 34,076 | 610,454 | 368 | 23,591 | 0 | 5,713 | 2,303 |
| 2012 | 2,994 | 0 | 0 | 98,793 | 33,806 | 362,047 | 50,723 | 22,058 | 0 | 16,575 | 8,266 |
| 2013 | 0 | 500 | 0 | 33,551 | 17,611 | 234,576 | 1,120 | 9,252 | 0 | 28,232 | 3,180 |
| 2014 | 0 | 0 | 202 | 9,966 | 3,049 | 95,402 | 1,345 | 1,200 | 0 | 1,103 | 0 |
| 2015 | 0 | 0 | 0 | 26,600 | 67 | 110,774 | 2,100 | 5,760 | 0 | 10,996 | 9,611 |
| 2016 | 0 | 0 | 101 | 82,742 | 34,016 | 475,102 | 1,024 | 16,088 | 0 | 9,768 | 0 |
| **2017** | **0** | **6,000** | **0** | **83,010** | **33,450** | **327,544** | **0** | **17,280** | **0** | **0** | **0** |
| 2018 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2019 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2020 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2021 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2022 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2023 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2024 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2025 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2026 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2027 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2028 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2029 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2030 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2031 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2032 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2033 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2034 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| 2035 | 0 | 6,000 | 0 | 83,010 | 33,450 | 320,607 | 0 | 17,280 | 0 | 0 | 0 |
| **TOTAL** | **48,442** | **174,773** | **1,630** | **2,681,269** | **1,462,702** | **16,687,495** | **480,702** | **794,789** | **18,942** | **124,173** | **48,482** |

[e] In accordance with the exchange agreement between the noted agencies, Metropolitan assumed responsibility for payment of variable OMP&R costs on the exchange water in reaches beyond Reach 22B, and Desert and Coachella for such costs from the Delta through Reach 22B. The adjustment in deliveries in Reach 22B provides for compliance with provisions for the repayment of costs under the agreement. In 1993 and after, the exchange takes place in Reach 26A.

[f] Includes 1,650 acre-feet recaptured from groundwater storage in 1982, 10,000 acre-feet in 1987, and 8,749 acre-feet in 1988. This water was stored under DWR's Ground Water Demonstration Program.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SANTA ANA DIVISION (continued) | | | | | | | | | | |
| | Reach 28H (continued) | Reach 28J | | | Reach EBX1 | | | Reach EBX2C | Reach EBX3A | Reach EBX4B-G | Reach EBX4B |
| Calendar Year | Metropolitan | Coachella | Desert | Metropolitan | Coachella | Metropolitan | San Bernardino | San Bernardino | San Bernardino | San Gorgonio | San Gorgonio |
| | [164] | [165] | [166] | [167] | [168] | [169] | [170] | [171] | [172] | [173] | [174] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 251 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 55 | 0 | 0 | 2,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 43 | 0 | 0 | 2,442 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 48 | 0 | 0 | 64,054 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 1,290 | 0 | 0 | 94,353 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 3,013 | 0 | 0 | 91,532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 4,365 | 0 | 0 | 149,405 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 3,961 | 0 | 0 | 155,629 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 6,645 | 0 | 0 | 41,616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 109,743 | 0 | 0 | 5,672 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 182,781 | 0 | 0 | 6,538 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 131,439 | 0 | 0 | 30,071 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 144,743 | 0 | 0 | 26,315 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 199,641 | 0 | 0 | 22,209 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 247,430 | 0 | 0 | 51,462 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 257,796 | 0 | 0 | 36,060 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 38,832 | 0 | 0 | 5,958 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 85,341 | 0 | 0 | 12,223 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 61,841 | 0 | 0 | 4,588 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 134,262 | 0 | 0 | 4,725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 117,762 | 0 | 0 | 21,099 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 144,906 | 0 | 0 | 12,418 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 107,853 | 0 | 0 | 47,777 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 77,473 | 1,027 | 4,839 | 50,411 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 206,689 | 0 | 0 | 8,163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 379,713 | 0 | 0 | 7,864 | 0 | 5,466 | 18,399 | 0 | 0 | 0 | 0 |
| 2001 | 260,984 | 0 | 0 | 33,414 | 0 | 0 | 26,488 | 0 | 0 | 0 | 0 |
| 2002 | 340,635 | 0 | 0 | 41,552 | 0 | 1,427 | 37,069 | 0 | 0 | 0 | 0 |
| 2003 | 246,485 | 0 | 0 | 50,776 | 0 | 74,496 | 16,703 | 1,793 | 2,617 | 0 | 116 |
| 2004 | 357,995 | 0 | 0 | 20,437 | 0 | 120,338 | 13,229 | 1,430 | 2,371 | 0 | 841 |
| 2005 | 242,245 | 0 | 0 | 114,499 | 8,163 | 153,700 | 12,715 | 966 | 2,035 | 0 | 692 |
| 2006 | 342,734 | 0 | 0 | 32,242 | 0 | 147,432 | 11,832 | 885 | 2,614 | 3,471 | 807 |
| 2007 | 271,874 | 0 | 0 | 48,923 | 0 | 94,208 | 38,151 | 3,130 | 5,103 | 3,758 | 177 |
| 2008 | 175,460 | 0 | 0 | 10,432 | 0 | 16,745 | 25,038 | 686 | 8,823 | 3,863 | 1,042 |
| 2009 | 126,265 | 0 | 0 | 5,849 | 0 | 18,314 | 25,041 | 4,090 | 10,066 | 4,499 | 1,898 |
| 2010 | 129,145 | 1,311 | 528 | 65,439 | 0 | 0 | 19,190 | 617 | 9,538 | 2,555 | 5,685 |
| 2011 | 213,215 | 0 | 0 | 51,638 | 0 | 0 | 19,578 | 699 | 9,384 | 1,213 | 9,290 |
| 2012 | 86,266 | 2,219 | 3,029 | 36,875 | 0 | 0 | 27,534 | 3,177 | 9,604 | 0 | 11,010 |
| 2013 | 45,039 | 4,756 | 0 | 40,494 | 0 | 0 | 19,850 | 3,034 | 8,081 | 0 | 9,445 |
| 2014 | 0 | 1,801 | 0 | 998 | 0 | 0 | 4,610 | 375 | 4,424 | 0 | 5,044 |
| 2015 | 25,883 | 0 | 1,539 | 977 | 0 | 0 | 15,970 | 382 | 5,928 | 0 | 3,481 |
| 2016 | 38,920 | 0 | 0 | 58,779 | 0 | 0 | 51,322 | 278 | 1,953 | 0 | 8,335 |
| **2017** | **138,069** | **0** | **0** | **0** | **0** | **0** | **61,160** | **0** | **0** | **2,200** | **8,180** |
| 2018 | 71,220 | 0 | 0 | 0 | 0 | 0 | 59,058 | 0 | 0 | 2,300 | 8,080 |
| 2019 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,400 | 7,980 |
| 2020 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2021 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2022 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2023 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2024 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2025 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2026 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2027 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2028 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2029 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2030 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2031 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2032 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2033 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2034 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| 2035 | 71,220 | 0 | 0 | 0 | 0 | 0 | 61,560 | 0 | 0 | 2,500 | 7,880 |
| **TOTAL** | **6,970,839** | **11,114** | **9,935** | **1,568,159** | **8,163** | **632,126** | **1,549,457** | **21,542** | **82,541** | **66,259** | **208,183** |

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | WEST BRANCH | | | | | | | | | |
| | Reach 29F | Reach 29H | | Reach 30 | | | | | | |
| Calendar Year | AVEK | Castaic Lake | Ventura | Castaic Lake | Coachella | Desert | Metropolitan[g] | San Bernardino | Santa Barbara | Ventura |
| | [175] | [176] | [177] | [178] | [179] | [180] | [181] | [182] | [183] | [184] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 53 | 0 | 0 | 0 | 0 | 0 | 71,938 | 0 | 0 | 0 |
| 1973 | 20 | 0 | 0 | 0 | 0 | 0 | 155,297 | 0 | 0 | 0 |
| 1974 | 36 | 0 | 0 | 0 | 0 | 0 | 209,136 | 0 | 0 | 0 |
| 1975 | 26 | 0 | 0 | 0 | 0 | 0 | 374,280 | 0 | 0 | 0 |
| 1976 | 24 | 0 | 0 | 0 | 0 | 0 | 420,684 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 122,447 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 171,139 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 7 | 0 | 0 | 145,591 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 1,210 | 0 | 0 | 164,721 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 5,761 | 0 | 0 | 277,503 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 9,516 | 0 | 0 | 351,362 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 9,476 | 0 | 0 | 157,519 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 11,477 | 0 | 0 | 260,624 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 12,401 | 0 | 0 | 390,696 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 13,928 | 0 | 0 | 379,275 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 16,167 | 0 | 0 | 417,285 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 18,904 | 0 | 0 | 488,265 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 21,719 | 0 | 0 | 589,962 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 4,836 | 22,139 | 0 | 0 | 764,380 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 988 | 3,846 | 0 | 0 | 257,835 | 0 | 1,240 | 0 |
| 1992 | 0 | 0 | 0 | 14,812 | 0 | 0 | 420,849 | 0 | 0 | 0 |
| 1993 | 6 | 0 | 0 | 13,787 | 0 | 0 | 437,470 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 14,919 | 0 | 0 | 475,900 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 17,747 | 0 | 0 | 139,882 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 18,448 | 0 | 0 | 267,618 | 0 | 0 | 0 |
| 1997 | 11 | 0 | 0 | 22,842 | 10,240 | 16,890 | 271,379 | 0 | 0 | 1,850 |
| 1998 | 7 | 0 | 0 | 19,782 | 0 | 0 | 187,277 | 0 | 0 | 1,850 |
| 1999 | 0 | 0 | 0 | 28,813 | 0 | 0 | 327,001 | 0 | 0 | 1,850 |
| 2000 | 0 | 0 | 2,200 | 31,085 | 0 | 0 | 632,991 | 0 | 0 | 1,850 |
| 2001 | 0 | 0 | 0 | 30,701 | 0 | 0 | 444,764 | 0 | 0 | 1,850 |
| 2002 | 0 | 0 | 3,148 | 42,080 | 0 | 0 | 723,605 | 8,601 | 0 | 1,850 |
| 2003 | 0 | 6,768 | 3,150 | 44,967 | 0 | 0 | 678,964 | 0 | 0 | 1,850 |
| 2004 | 0 | 0 | 4,047 | 47,463 | 0 | 0 | 797,294 | 0 | 0 | 1,203 |
| 2005 | 0 | 0 | 0 | 36,747 | 0 | 0 | 538,839 | 0 | 0 | 1,665 |
| 2006 | 0 | 0 | 0 | 40,017 | 0 | 0 | 574,679 | 0 | 0 | 1,850 |
| 2007 | 0 | 0 | 1,890 | 45,919 | 0 | 0 | 711,831 | 0 | 0 | 1,110 |
| 2008 | 0 | 0 | 1,980 | 42,878 | 0 | 0 | 485,156 | 0 | 0 | 1,818 |
| 2009 | 0 | 0 | 3,150 | 38,784 | 0 | 0 | 589,294 | 0 | 0 | 741 |
| 2010 | 0 | 0 | 3,150 | 31,288 | 0 | 0 | 376,877 | 0 | 0 | 925 |
| 2011 | 0 | 0 | 2,520 | 31,445 | 0 | 0 | 375,921 | 0 | 0 | 1,480 |
| 2012 | 24 | 0 | 3,150 | 36,153 | 0 | 0 | 553,244 | 0 | 0 | 1,203 |
| 2013 | 47 | 0 | 2,242 | 44,126 | 0 | 0 | 565,849 | 0 | 0 | 648 |
| 2014 | 0 | 0 | 0 | 29,448 | 0 | 0 | 275,992 | 0 | 0 | 93 |
| 2015 | 0 | 0 | 630 | 29,189 | 0 | 0 | 435,892 | 0 | 0 | 370 |
| 2016 | 0 | 0 | 1,890 | 30,061 | 0 | 0 | 467,816 | 0 | 0 | 1,110 |
| **2017** | **0** | **0** | **1,890** | **55,120** | **0** | **0** | **597,323** | **0** | **0** | **1,110** |
| 2018 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2019 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2020 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2021 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2022 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2023 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2024 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2025 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2026 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2027 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2028 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2029 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2030 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2031 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2032 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2033 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2034 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| 2035 | 0 | 0 | 1,890 | 55,120 | 0 | 0 | 576,868 | 0 | 0 | 1,110 |
| **TOTAL** | **254** | **6,768** | **74,881** | **1,977,332** | **10,240** | **16,890** | **28,907,270** | **8,601** | **1,240** | **48,256** |

[g] Deliveries exclude 6,171 acre-feet of 1982 exchange water.

## TABLE B-5A Annual Water Quantities Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | COASTAL BRANCH | | | | | | | | | |
| | Reach 31A | | | | | | Reach 33A | | | |
| | | | | Kern | | | | | | |
| Calendar Year | AVEK | Castaic Lake | Dudley Ridge | Municipal and Industrial | Agricultural | Kings | San Luis Obispo | Santa Barbara | Total | GRAND TOTAL |
| | [185] | [186] | [187] | [188] | [189] | [190] | [191] | [192] | [193] | [194] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,906 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,645 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,911 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34,026 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54,913 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56,763 |
| 1968 | 0 | 7,382 | 0 | 0 | 71,657 | 0 | 0 | 0 | 192,188 | 294,457 |
| 1969 | 0 | 9,970 | 0 | 0 | 52,094 | 0 | 0 | 0 | 195,705 | 268,104 |
| 1970 | 0 | 11,739 | 0 | 0 | 71,910 | 0 | 0 | 0 | 276,211 | 369,459 |
| 1971 | 0 | 12,490 | 0 | 0 | 98,481 | 0 | 0 | 0 | 553,081 | 654,442 |
| 1972 | 0 | 13,905 | 0 | 0 | 107,850 | 0 | 0 | 0 | 895,006 | 1,037,770 |
| 1973 | 0 | 9,418 | 0 | 0 | 69,227 | 0 | 0 | 0 | 638,930 | 737,532 |
| 1974 | 0 | 9,700 | 0 | 0 | 68,474 | 0 | 0 | 0 | 783,984 | 878,947 |
| 1975 | 0 | 10,700 | 0 | 0 | 74,516 | 0 | 0 | 0 | 1,129,728 | 1,230,830 |
| 1976 | 0 | 11,700 | 0 | 0 | 78,358 | 0 | 0 | 0 | 1,245,662 | 1,380,124 |
| 1977 | 0 | 5,075 | 0 | 0 | 35,504 | 0 | 0 | 0 | 465,442 | 582,381 |
| 1978 | 0 | 11,362 | 0 | 0 | 81,242 | 0 | 0 | 0 | 1,339,268 | 1,458,733 |
| 1979 | 0 | 19,138 | 0 | 0 | 104,017 | 0 | 0 | 0 | 1,537,075 | 1,666,457 |
| 1980 | 0 | 13,882 | 0 | 0 | 97,497 | 0 | 0 | 0 | 1,413,363 | 1,536,456 |
| 1981 | 0 | 12,700 | 0 | 0 | 97,054 | 0 | 0 | 0 | 1,779,479 | 1,918,563 |
| 1982 | 0 | 12,700 | 0 | 0 | 83,076 | 0 | 0 | 0 | 1,641,571 | 1,750,862 |
| 1983 | 0 | 12,659 | 0 | 0 | 87,859 | 0 | 0 | 0 | 1,089,626 | 1,187,156 |
| 1984 | 0 | 12,741 | 0 | 0 | 119,098 | 0 | 0 | 0 | 1,489,814 | 1,591,416 |
| 1985 | 0 | 12,099 | 0 | 0 | 110,124 | 0 | 0 | 0 | 1,863,544 | 1,990,295 |
| 1986 | 0 | 13,301 | 0 | 0 | 118,298 | 0 | 0 | 0 | 1,882,290 | 1,999,155 |
| 1987 | 0 | 11,821 | 0 | 0 | 116,259 | 0 | 0 | 0 | 1,984,570 | 2,131,608 |
| 1988 | 0 | 11,534 | 0 | 0 | 109,435 | 0 | 0 | 0 | 2,221,538 | 2,385,122 |
| 1989 | 0 | 14,645 | 0 | 0 | 102,156 | 0 | 0 | 0 | 2,686,838 | 2,853,747 |
| 1990 | 0 | 6,440 | 0 | 0 | 103,362 | 0 | 0 | 0 | 2,398,121 | 2,582,151 |
| 1991 | 0 | 716 | 0 | 0 | 780 | 0 | 0 | 0 | 489,489 | 549,113 |
| 1992 | 0 | 5,887 | 0 | 0 | 73,748 | 0 | 0 | 0 | 1,374,775 | 1,471,454 |
| 1993 | 0 | 4,157 | 0 | 0 | 90,764 | 0 | 0 | 0 | 2,173,352 | 2,315,235 |
| 1994 | 0 | 9,422 | 0 | 200 | 77,536 | 0 | 0 | 0 | 1,727,504 | 1,861,976 |
| 1995 | 0 | 9,486 | 0 | 0 | 85,050 | 0 | 0 | 0 | 1,926,835 | 2,031,423 |
| 1996 | 0 | 14,052 | 0 | 0 | 100,578 | 0 | 0 | 0 | 2,429,928 | 2,543,472 |
| 1997 | 0 | 4,870 | 0 | 0 | 97,020 | 0 | 1,099 | 7,439 | 2,263,966 | 2,405,444 |
| 1998 | 0 | 311 | 0 | 0 | 86,879 | 0 | 3,592 | 18,618 | 1,657,381 | 1,764,963 |
| 1999 | 0 | 4,086 | 0 | 0 | 92,095 | 0 | 3,743 | 20,137 | 2,755,025 | 2,898,961 |
| 2000 | 0 | 8,395 | 0 | 0 | 85,215 | 0 | 3,962 | 22,741 | 3,390,079 | 3,569,072 |
| 2001 | 0 | 1,238 | 0 | 0 | 63,448 | 0 | 4,283 | 18,946 | 2,034,350 | 2,175,194 |
| 2002 | 0 | 2,737 | 0 | 0 | 65,055 | 0 | 4,355 | 27,636 | 2,738,943 | 2,909,555 |
| 2003 | 0 | 4,001 | 0 | 0 | 65,691 | 0 | 4,453 | 26,968 | 3,151,625 | 3,327,811 |
| 2004 | 0 | 3,776 | 0 | 0 | 66,498 | 0 | 4,165 | 29,705 | 3,050,652 | 3,230,590 |
| 2005 | 0 | 2,709 | 4,684 | 0 | 68,190 | 0 | 4,251 | 23,344 | 3,597,829 | 3,753,874 |
| 2006 | 0 | 2,735 | 0 | 0 | 85,214 | 0 | 4,209 | 23,275 | 3,526,551 | 3,693,938 |
| 2007 | 0 | 6,071 | 0 | 0 | 93,954 | 49 | 3,776 | 27,740 | 3,088,763 | 3,284,475 |
| 2008 | 0 | 0 | 0 | 17,059 | 68,385 | 0 | 3,402 | 18,393 | 1,978,428 | 2,152,219 |
| 2009 | 0 | 1 | 0 | 0 | 83,255 | 0 | 3,801 | 15,452 | 2,065,868 | 2,227,564 |
| 2010 | 0 | 768 | 2,967 | 0 | 81,047 | 276 | 3,757 | 17,775 | 2,690,242 | 2,832,658 |
| 2011 | 0 | 1,746 | 200 | 0 | 86,594 | 238 | 3,819 | 21,050 | 3,513,232 | 3,668,980 |
| 2012 | 33,511 | 2,404 | 0 | 0 | 50,050 | 0 | 3,944 | 19,474 | 2,726,325 | 2,881,783 |
| 2013 | 0 | 6,128 | 0 | 0 | 82,887 | 0 | 3,681 | 18,018 | 2,023,225 | 2,224,875 |
| 2014 | 0 | 0 | 0 | 0 | 74,406 | 0 | 3,206 | 16,757 | 1,111,222 | 1,242,286 |
| 2015 | 0 | 0 | 7,500 | 0 | 71,616 | 0 | 3,473 | 11,638 | 1,339,751 | 1,498,367 |
| 2016 | 1,489 | 2,000 | 0 | 0 | 70,395 | 186 | 4,032 | 25,097 | 2,271,712 | 2,435,124 |
| **2017** | **0** | **2,000** | **0** | **0** | **52,810** | **183** | **13,056** | **27,292** | **2,294,775** | **2,467,088** |
| 2018 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,125 | 27,292 | 2,256,894 | 2,431,901 |
| 2019 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,161 | 27,292 | 2,306,588 | 2,479,572 |
| 2020 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2021 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2022 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2023 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2024 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2025 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2026 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2027 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2028 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2029 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2030 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2031 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2032 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2033 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2034 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| 2035 | 0 | 2,000 | 0 | 0 | 52,810 | 183 | 13,237 | 27,292 | 2,306,184 | 2,480,537 |
| **TOTAL** | **35,000** | **402,797** | **15,351** | **17,259** | **5,027,288** | **4,226** | **326,137** | **928,751** | **134,557,287** | **144,691,490** |

# Tables B-5A-Adj through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-5A-Adj Annual Water Quantity Adjustments to Water Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION | | | | | | | | | | | | |
| | Reach 1 | Reach 3A | | | | | | | | | | | |
| Calendar Year | Santa Clara | Alameda-Zone 7 | Alameda County | AVEK | Castaic Lake | Crestline | Dudley Ridge | Kern (Agricultural) | Kings | Metropolitan | Mojave | Palmdale | San Bernardino |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (11,135) | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (11,487) | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (9,332) | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (18,428) | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (866) | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | (576) | (20,082) | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (20,239) | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (9,867) | 0 | 0 | 0 | 0 | 0 |
| 2008 | (8,885) | 0 | 0 | 0 | 0 | 0 | 0 | (99,439) | 0 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 0 | (5,926) | (38) | (1) | (28) | (88,699) | 0 | (815) | (5) | (15) | (21) |
| 2010 | 0 | 0 | 0 | 0 | (3,300) | | 0 | (87,370) | 0 | (177,476) | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56,909) | 0 | (106,423) | 0 | (2,548) | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | (6,068) | (60,762) | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (11,846) | 0 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 0 | (32) | (34) | (5) | (36) | (114,007) | (2) | (789) | (6) | (14) | (23) |
| 2015 | 0 | (6,264) | (8,763) | 0 | 0 | 0 | (16,796) | (76,139) | 0 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | (1,208) | 0 | 0 | 0 | (503) | (57,875) | 0 | 0 | 0 | 0 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **(8,885)** | **(6,264)** | **(9,971)** | **(5,958)** | **(3,372)** | **(6)** | **(24,007)** | **(754,482)** | **(2)** | **(285,503)** | **(11)** | **(2,577)** | **(44)** |

## TABLE B-5A-Adj Annual Water Quantity Adjustments to Water Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION (continued) | | | | | | | | | SOUTH SAN JOAQUIN DIVISION | | | |
| | Reach 3A (continued) | | | | | | | Reach 4 | | Reach 7 | | REACH 10A | |
| Calendar Year | San Gabriel | San Gorgonio | San Luis Obispo | Santa Barbara | Santa Clara | Tulare | Ventura | Kern (Agricultural) | Tulare | Kern (Agricultural) | Tulare | Alameda-Zone 7 | Alameda County |
| | [14] | [15] | [16] | [17] | [18] | [19] | [20] | [21] | [22] | [23] | [24] | [25] | [26] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (12,806) | 0 | (24,167) | (2,981) | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (25,164) | (1,807) | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | (4,000) | 0 | | (6,020) | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | (20,000) | (277) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | (53,573) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (5,000) |
| 2008 | 0 | 0 | 0 | 0 | (3,681) | 0 | 0 | 0 | 0 | 0 | 0 | (7,000) | (10,000) |
| 2009 | (4) | (4) | (2) | (19) | (1,000) | (49) | (1) | 0 | 0 | 0 | 0 | 0 | (3,083) |
| 2010 | 0 | 0 | 0 | 0 | (44,668) | (17,551) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | (51,404) | (11,096) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | (9,366) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | (6,054) | 0 | 0 | 0 | 0 | 0 | (4,000) | (4,000) |
| 2014 | (6) | (13) | (134) | (926) | 0 | (8) | 0 | 0 | 0 | 0 | 0 | (8,074) | (13,652) |
| 2015 | 0 | 0 | (27) | (181) | (21,076) | 0 | 0 | 0 | 0 | 0 | 0 | (11,185) | (14,115) |
| 2016 | 0 | 0 | 0 | 0 | (6,706) | 0 | 0 | 0 | 0 | 0 | 0 | (324) | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **(10)** | **(17)** | **(163)** | **(1,126)** | **(202,108)** | **(48,401)** | **(1)** | **(12,806)** | **(6,020)** | **(24,167)** | **(28,145)** | **(32,390)** | **(49,850)** |

## TABLE B-5A-Adj Annual Water Quantity Adjustments to Water Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | | | |
| | Reach 10A (continued) | | | | | | | Reach 12E | | | | | |
| Calendar Year | Castaic Lake | Coachella | Desert | Kern (Agricultural) | Metropolitan | San Bernardino | Santa Clara | Alameda-Zone 7 | AVEK | Castaic Lake | Coachella | Desert | Kern (Agricultural) |
| | [27] | [28] | [29] | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | (1,813) | (31,500) | 0 | (30,000) | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (14,638) |
| 2003 | 0 | 0 | 0 | 0 | (10,000) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (5,170) |
| 2004 | 0 | 0 | 0 | (3) | (93,555) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | | (12,469) | (93,986) | 0 | (20,000) | 0 | | (11,000) | 0 | | (16,618) |
| 2008 | 0 | 0 | (4,864) | 0 | (99,024) | 0 | (10,000) | 0 | (8,393) | (11,000) | (3,000) | (3,486) | (103,683) |
| 2009 | (4,950) | 0 | 0 | (7,733) | (65,499) | 0 | (27,319) | 0 | (6,393) | (11,000) | (3,000) | 0 | (105,145) |
| 2010 | | | 0 | (56) | 0 | | 0 | 0 | 0 | (2,750) | (8,393) | 0 | (43,833) |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (14,223) |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | (17,000) | 0 | 0 | 0 | (4,000) | 0 | (12,815) |
| 2013 | 0 | 0 | 0 | (24,626) | (37,544) | 0 | (27,308) | 0 | 0 | 0 | (16,500) | 0 | (34,355) |
| 2014 | (4,951) | 0 | 0 | (7,476) | (30,049) | (694) | (29,134) | (5,901) | 0 | (13,824) | (5,000) | 0 | (90,996) |
| 2015 | 0 | 0 | 0 | (20,190) | (32,517) | 0 | (40,572) | (5,029) | 0 | (13,993) | (9,500) | 0 | (56,927) |
| 2016 | 0 | 0 | 0 | (626) | (12,440) | 0 | (1,122) | 0 | 0 | 0 | 0 | 0 | (36,893) |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **(9,901)** | **0** | **(4,864)** | **(74,992)** | **(506,114)** | **(694)** | **(202,455)** | **(10,930)** | **(14,786)** | **(63,567)** | **(49,393)** | **(3,486)** | **(535,296)** |

## TABLE B-5A-Adj Annual Water Quantity Adjustments to Water Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | | |
| | Reach 12E (continued) | | | Reach 13B | | | | | | | |
| Calendar Year | Metropolitan | San Bernardino | Santa Clara | Alameda-Zone 7 | Alameda County | Dudley Ridge | Kern (Agricultural) | Metropolitan | Palmdale | San Bernardino | Santa Clara |
| | [40] | [41] | [42] | [43] | [44] | [45] | [46] | [47] | [48] | [49] | [50] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | (20,800) | 0 | 0 | 0 | 0 | 0 | (132,228) | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | (22,161) | 0 | 0 | 0 | 0 |
| 2003 | (5,073) | 0 | 0 | 0 | 0 | 0 | (15,316) | (24,523) | 0 | 0 | 0 |
| 2004 | (17,765) | 0 | 0 | 0 | 0 | 0 | (43,985) | (4,813) | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | (5,000) | 0 | 0 | 0 | 0 | 0 | (257,750) | 0 | (4,926) | 0 | 0 |
| 2008 | (8,402) | 0 | 0 | 0 | 0 | 0 | (228,579) | (25,721) | 0 | 0 | 0 |
| 2009 | (14,516) | 0 | (6,134) | 0 | 0 | 0 | (186,044) | 0 | 0 | 0 | 0 |
| 2010 | (52,413) | 0 | 0 | 0 | 0 | | (59,451) | 0 | 0 | 0 | 0 |
| 2011 | (23,419) | 0 | 0 | 0 | 0 | 0 | (29,041) | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | (6,068) | (103,364) | 0 | 0 | 0 | 0 |
| 2013 | (31,478) | (1,500) | 0 | 0 | 0 | 0 | (160,286) | (1,033) | 0 | 0 | (17,692) |
| 2014 | (9,882) | (400) | 0 | (931) | (1,088) | (16,789) | (161,077) | (17,184) | 0 | (3,906) | (5,253) |
| 2015 | (6,899) | 0 | (288) | (1,600) | (2,097) | (14,460) | (112,781) | (21,934) | 0 | 0 | (4,625) |
| 2016 | 0 | 0 | 0 | 0 | 0 | (1,350) | (26,683) | 0 | 0 | 0 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **(195,647)** | **(1,900)** | **(6,422)** | **(2,531)** | **(3,185)** | **(38,667)** | **(1,538,746)** | **(95,208)** | **(4,926)** | **(3,906)** | **(27,570)** |

## TABLE B-5A-Adj Annual Water Quantity Adjustments to Water Delivered from Each Aqueduct Reach to Each Contractor (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | MOJAVE DIVISION | | | | SANTA ANA DIVISION | |
| | Reach 14B | Reach 14C | | Reach 15A | Reach 16A | Reach 19 | Reach 22A | Reach 22B | | Reach 24 | Reach EBX2C | |
| Calendar Year | Kern (Agricultural) | Kern (Agricultural) | Metropolitan | Kern (Agricultural) | Kern (Agricultural) | AVEK | AVEK | AVEK | Metropolitan | Metropolitan | San Bernardino | GRAND TOTAL |
| | [51] | [52] | [53] | [54] | [55] | [56] | [57] | [58] | [59] | [60] | [61] | [62] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (51,089) |
| 2001 | (396) | (242) | 0 | 0 | 0 | 0 | 0 | (152) | 0 | 0 | 0 | (255,589) |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (46,131) |
| 2003 | 0 | 0 | (12,380) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (90,890) |
| 2004 | 0 | 0 | (25,512) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (844) | (197,363) |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (7) | (40,942) |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (2) | (73,814) |
| 2007 | 0 | 0 | (24,225) | 0 | 0 | 0 | 0 | 0 | (8,751) | (17,249) | 0 | (486,841) |
| 2008 | 0 | 0 | (37,602) | 0 | 0 | 0 | 0 | 0 | (4,816) | (3,679) | (6) | (681,260) |
| 2009 | (1,706) | (5,168) | (54,948) | (2,788) | (444) | 0 | 0 | 0 | 0 | (7,488) | (11) | (609,996) |
| 2010 | (1,867) | (4,761) | (32,758) | (2,913) | 0 | 0 | 0 | 0 | 0 | (2,891) | 0 | (542,451) |
| 2011 | 0 | 0 | (16,065) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (311,128) |
| 2012 | (73) | (862) | (10,010) | (405) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (230,793) |
| 2013 | (264) | (4,691) | (33,205) | (406) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (416,788) |
| 2014 | (6,898) | (10,773) | (47,358) | (5,962) | 0 | 0 | (1,046) | 0 | 0 | 0 | 0 | (614,333) |
| 2015 | (10,554) | (11,108) | (70,200) | (5,560) | 0 | 0 | (1,516) | 0 | 0 | 0 | 0 | (596,896) |
| 2016 | (4,452) | (4,073) | (29,819) | (2,115) | 0 | 0 | (539) | 0 | 0 | 0 | 0 | (186,728) |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **(26,210)** | **(41,678)** | **(394,082)** | **(20,149)** | **(444)** | **0** | **(3,101)** | **(152)** | **(13,567)** | **(31,307)** | **(870)** | **(5,433,032)** |

# Tables B-5B through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-5B Annual Water Quantities Delivered to Each Contractor (acre-feet)



| | NORTH BAY AREA | | | SOUTH BAY AREA[a] | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | Napa[b] | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1962 | 0 | 0 | 0 | 494 | 8,412 | 0 | 8,906 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 1,731 | 10,914 | 0 | 12,645 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 1,673 | 19,238 | 0 | 20,911 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 2,605 | 16,407 | 15,014 | 34,026 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 5,511 | 14,864 | 34,538 | 54,913 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 4,780 | 12,882 | 39,101 | 56,763 | 0 | 0 | 0 |
| 1968 | 1,214 | 0 | 1,214 | 6,133 | 24,817 | 70,105 | 101,055 | 0 | 0 | 0 |
| 1969 | 2,687 | 0 | 2,687 | 6,635 | 813 | 62,264 | 69,712 | 0 | 0 | 0 |
| 1970 | 3,618 | 0 | 3,618 | 9,249 | 0 | 80,311 | 89,560 | 0 | 0 | 0 |
| 1971 | 2,521 | 0 | 2,521 | 5,017 | 5,961 | 87,606 | 98,584 | 0 | 0 | 0 |
| 1972 | 3,647 | 0 | 3,647 | 10,489 | 27,671 | 100,266 | 138,426 | 0 | 0 | 0 |
| 1973 | 3,792 | 0 | 3,792 | 2,975 | 2,521 | 88,582 | 94,078 | 0 | 0 | 0 |
| 1974 | 4,870 | 0 | 4,870 | 1,314 | 4 | 88,000 | 89,318 | 0 | 0 | 0 |
| 1975 | 6,840 | 0 | 6,840 | 4,618 | 986 | 88,000 | 93,604 | 0 | 0 | 0 |
| 1976 | 7,122 | 0 | 7,122 | 17,131 | 21,300 | 88,000 | 126,431 | 0 | 0 | 0 |
| 1977 | 8,226 | 0 | 8,226 | 12,644 | 18,840 | 76,220 | 107,704 | 0 | 0 | 0 |
| 1978 | 6,034 | 0 | 6,034 | 10,984 | 5,863 | 95,727 | 112,574 | 0 | 0 | 0 |
| 1979 | 6,561 | 0 | 6,561 | 19,325 | 10,874 | 91,991 | 122,190 | 0 | 0 | 0 |
| 1980 | 6,707 | 0 | 6,707 | 16,790 | 11,034 | 88,000 | 115,824 | 0 | 0 | 0 |
| 1981 | 9,001 | 0 | 9,001 | 19,590 | 21,917 | 88,000 | 129,507 | 0 | 0 | 0 |
| 1982 | 1,213 | 0 | 1,213 | 13,123 | 6,316 | 88,000 | 107,439 | 0 | 0 | 0 |
| 1983 | 2,287 | 0 | 2,287 | 4,766 | 3,157 | 86,733 | 94,656 | 0 | 0 | 0 |
| 1984 | 2,923 | 0 | 2,923 | 6,784 | 3,338 | 88,000 | 98,122 | 0 | 0 | 0 |
| 1985 | 4,039 | 0 | 4,039 | 15,072 | 19,016 | 88,000 | 122,088 | 0 | 0 | 0 |
| 1986 | 3,519 | 1,400 | 4,919 | 10,609 | 12,379 | 88,000 | 110,988 | 0 | 0 | 0 |
| 1987 | 7,693 | 1,550 | 9,243 | 23,406 | 25,390 | 88,000 | 136,796 | 0 | 0 | 0 |
| 1988 | 5,392 | 9,726 | 15,118 | 25,830 | 33,464 | 87,961 | 147,255 | 0 | 0 | 0 |
| 1989 | 6,195 | 17,256 | 23,451 | 26,227 | 26,042 | 90,000 | 142,269 | 0 | 0 | 0 |
| 1990 | 6,940 | 19,131 | 26,071 | 33,034 | 31,703 | 92,000 | 156,737 | 0 | 0 | 0 |
| 1991 | 1,380 | 6,972 | 8,352 | 9,411 | 12,648 | 28,200 | 50,259 | 0 | 1,240 | 1,240 |
| 1992 | 4,001 | 14,773 | 18,774 | 14,669 | 19,153 | 42,839 | 76,661 | 0 | 0 | 0 |
| 1993 | 5,286 | 29,180 | 34,466 | 33,635 | 10,271 | 62,065 | 105,971 | 0 | 0 | 0 |
| 1994 | 6,792 | 25,256 | 32,048 | 20,542 | 22,911 | 57,115 | 100,568 | 0 | 0 | 0 |
| 1995 | 5,182 | 21,345 | 26,527 | 30,091 | 17,793 | 28,756 | 76,640 | 0 | 0 | 0 |
| 1996 | 4,893 | 29,999 | 34,892 | 18,903 | 19,662 | 89,850 | 128,415 | 100 | 0 | 100 |
| 1997 | 4,341 | 33,530 | 37,871 | 27,522 | 24,063 | 95,601 | 147,186 | 1,199 | 7,439 | 8,638 |
| 1998 | 5,359 | 29,766 | 35,125 | 17,941 | 19,075 | 63,410 | 100,426 | 3,592 | 18,618 | 22,210 |
| 1999 | 5,304 | 34,753 | 40,057 | 50,910 | 37,652 | 82,945 | 171,507 | 3,743 | 20,137 | 23,880 |
| 2000 | 4,958 | 37,015 | 41,973 | 58,617 | 35,978 | 101,988 | 196,583 | 3,962 | 22,741 | 26,703 |
| 2001 | 9,345 | 34,586 | 43,931 | 34,409 | 18,004 | 77,922 | 130,335 | 4,283 | 18,946 | 23,229 |
| 2002 | 6,875 | 38,560 | 45,435 | 53,261 | 27,811 | 62,186 | 143,258 | 4,355 | 27,636 | 31,991 |
| 2003 | 7,646 | 33,951 | 41,597 | 45,450 | 36,590 | 108,981 | 191,021 | 4,453 | 26,968 | 31,421 |
| 2004 | 8,134 | 43,002 | 51,136 | 52,364 | 27,884 | 59,458 | 139,706 | 4,165 | 29,705 | 33,870 |
| 2005 | 7,669 | 37,819 | 45,488 | 47,512 | 44,599 | 128,249 | 220,360 | 4,251 | 23,344 | 27,595 |
| 2006 | 7,789 | 35,516 | 43,305 | 54,527 | 43,079 | 128,210 | 225,816 | 4,209 | 23,275 | 27,484 |
| 2007 | 10,957 | 47,300 | 58,257 | 40,157 | 24,391 | 75,382 | 139,930 | 3,776 | 27,740 | 31,516 |
| 2008 | 13,292 | 41,320 | 54,612 | 41,186 | 22,902 | 59,160 | 123,248 | 3,402 | 18,393 | 21,795 |
| 2009 | 10,904 | 30,950 | 41,854 | 31,087 | 19,496 | 76,363 | 126,946 | 3,801 | 15,452 | 19,253 |
| 2010 | 12,417 | 30,816 | 43,233 | 47,343 | 22,571 | 107,871 | 177,785 | 3,757 | 17,775 | 21,532 |
| 2011 | 11,314 | 27,995 | 39,309 | 52,726 | 36,610 | 129,062 | 218,398 | 3,819 | 23,598 | 27,417 |
| 2012 | 9,907 | 29,347 | 39,254 | 55,239 | 20,831 | 63,794 | 139,864 | 3,944 | 19,474 | 23,418 |
| 2013 | 12,538 | 35,869 | 48,407 | 44,856 | 23,640 | 84,623 | 153,119 | 3,681 | 18,018 | 21,699 |
| 2014 | 14,164 | 19,679 | 33,843 | 34,296 | 30,066 | 67,446 | 131,808 | 3,206 | 16,757 | 19,963 |
| 2015 | 11,199 | 23,836 | 35,035 | 32,444 | 27,259 | 82,888 | 142,591 | 3,473 | 11,638 | 15,111 |
| 2016 | 13,248 | 32,226 | 45,474 | 56,056 | 21,181 | 89,639 | 166,876 | 4,032 | 25,097 | 29,129 |
| **2017** | **17,415** | **28,655** | **46,070** | **48,371** | **25,200** | **60,000** | **133,571** | **13,056** | **27,292** | **40,348** |
| 2018 | 17,415 | 28,655 | 46,070 | 48,371 | 25,200 | 62,502 | 136,073 | 13,125 | 27,292 | 40,417 |
| 2019 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,161 | 27,292 | 40,453 |
| 2020 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2021 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2022 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2023 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2024 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2025 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2026 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2027 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2028 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2029 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2030 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2031 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2032 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2033 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2034 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| 2035 | 17,415 | 28,654 | 46,069 | 48,371 | 25,200 | 60,000 | 133,571 | 13,237 | 27,292 | 40,529 |
| **TOTAL** | **658,820** | **1,398,852** | **2,057,672** | **2,242,742** | **1,541,043** | **5,274,924** | **9,058,709** | **326,337** | **932,539** | **1,258,876** |

[a] For the period June 1962 through November 1967, deliveries were supplied by non-project water.

[b] For the period 1968 through 1987, deliveries are non-project water pumped through an interim facility.

## TABLE B-5B Annual Water Quantities Delivered to Each Contractor (acre-feet)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Kern | | | | | | |
| | Dudley Ridge | Empire | Municipal and Industrial | Agricultural | Total | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 26,360 | 1,978 | 0 | 127,384 | 127,384 | 900 | 3,084 | 25,100 | 184,806 |
| 1969 | 31,375 | 56 | 0 | 141,265 | 141,265 | 100 | 3,016 | 9,923 | 185,735 |
| 1970 | 40,407 | 3,942 | 0 | 204,634 | 204,634 | 0 | 5,911 | 9,578 | 264,472 |
| 1971 | 41,053 | 5,990 | 0 | 360,151 | 360,151 | 3,700 | 7,212 | 122,485 | 540,591 |
| 1972 | 42,443 | 5,795 | 0 | 490,781 | 490,781 | 1,400 | 8,166 | 258,393 | 806,978 |
| 1973 | 22,057 | 3,000 | 0 | 341,469 | 341,469 | 1,500 | 3,214 | 50,464 | 421,704 |
| 1974 | 33,390 | 3,000 | 23,708 | 323,292 | 347,000 | 1,500 | 3,471 | 72,289 | 460,650 |
| 1975 | 40,555 | 3,000 | 14,529 | 396,291 | 410,820 | 1,600 | 3,576 | 86,258 | 545,809 |
| 1976 | 41,421 | 3,000 | 46,719 | 392,531 | 439,250 | 1,600 | 4,112 | 58,811 | 548,194 |
| 1977 | 11,153 | 738 | 27,882 | 163,425 | 191,307 | 1,530 | 1,472 | 18,081 | 224,281 |
| 1978 | 51,747 | 454 | 76,895 | 590,452 | 667,347 | 2,070 | 3,906 | 12,053 | 737,577 |
| 1979 | 38,544 | 1,739 | 62,997 | 683,049 | 746,046 | 2,000 | 6,149 | 155,121 | 949,599 |
| 1980 | 41,000 | 894 | 45,943 | 588,557 | 634,500 | 2,200 | 5,700 | 75,444 | 759,738 |
| 1981 | 41,000 | 5,859 | 75,758 | 615,642 | 691,400 | 2,300 | 4,300 | 83,438 | 828,297 |
| 1982 | 41,000 | 361 | 47,477 | 697,823 | 745,300 | 1,750 | 3,838 | 18,551 | 810,800 |
| 1983 | 42,900 | 0 | 6,854 | 587,653 | 594,507 | 3,550 | 3,822 | 1,006 | 645,785 |
| 1984 | 45,100 | 0 | 90,904 | 769,696 | 860,600 | 3,100 | 5,700 | 5,743 | 920,243 |
| 1985 | 46,251 | 5,197 | 88,515 | 800,381 | 888,896 | 3,400 | 5,433 | 109,791 | 1,058,968 |
| 1986 | 50,249 | 1,170 | 77,240 | 829,101 | 906,341 | 3,700 | 5,107 | 79,355 | 1,045,922 |
| 1987 | 46,288 | 2,525 | 117,174 | 852,731 | 969,905 | 4,000 | 5,625 | 93,084 | 1,121,427 |
| 1988 | 47,994 | 3,475 | 122,409 | 887,111 | 1,009,520 | 4,000 | 4,412 | 95,866 | 1,165,267 |
| 1989 | 57,049 | 3,000 | 123,896 | 1,022,166 | 1,146,062 | 4,000 | 6,091 | 127,950 | 1,344,152 |
| 1990 | 36,296 | 1,279 | 127,837 | 584,611 | 712,448 | 2,000 | 2,922 | 57,070 | 812,015 |
| 1991 | 927 | 221 | 33,122 | 8,965 | 42,087 | 0 | 141 | 2,180 | 45,556 |
| 1992 | 23,770 | 1,354 | 62,326 | 420,894 | 483,220 | 1,806 | 2,239 | 46,728 | 559,117 |
| 1993 | 50,618 | 2,741 | 128,316 | 1,039,614 | 1,167,930 | 4,000 | 4,858 | 124,468 | 1,354,615 |
| 1994 | 28,793 | 1,666 | 87,139 | 570,020 | 657,159 | 2,116 | 3,071 | 62,362 | 755,167 |
| 1995 | 60,686 | 1,631 | 135,415 | 1,016,114 | 1,151,529 | 4,000 | 5,169 | 101,869 | 1,324,884 |
| 1996 | 56,948 | 1,868 | 135,654 | 1,049,409 | 1,185,063 | 4,000 | 4,904 | 236,875 | 1,489,658 |
| 1997 | 71,308 | 0 | 120,708 | 987,451 | 1,108,159 | 0 | 5,238 | 22,369 | 1,207,074 |
| 1998 | 55,650 | 542 | 89,765 | 768,825 | 858,590 | 15 | 4,401 | 20,677 | 939,875 |
| 1999 | 59,697 | 3,176 | 138,153 | 1,039,985 | 1,178,138 | 4,000 | 4,871 | 289,735 | 1,539,617 |
| 2000 | 60,539 | 1,799 | 40,697 | 1,183,440 | 1,224,137 | 3,600 | 4,508 | 201,294 | 1,495,877 |
| 2001 | 41,902 | 1,360 | 3,116 | 651,175 | 654,291 | 1,560 | 3,592 | 84,726 | 787,431 |
| 2002 | 48,915 | 1,405 | 12,589 | 812,870 | 825,459 | 2,854 | 4,885 | 96,502 | 980,020 |
| 2003 | 46,082 | 1,436 | 47,070 | 917,160 | 964,230 | 3,692 | 4,266 | 105,841 | 1,125,547 |
| 2004 | 49,080 | 3,562 | 126,933 | 712,193 | 839,126 | 9,053 | 4,629 | 90,021 | 995,471 |
| 2005 | 79,005 | 3,834 | 69,594 | 1,328,387 | 1,397,981 | 19,806 | 4,194 | 140,279 | 1,645,099 |
| 2006 | 72,080 | 3,282 | 98,199 | 1,164,671 | 1,262,870 | 9,530 | 4,242 | 108,207 | 1,460,211 |
| 2007 | 45,135 | 2,084 | 79,144 | 949,601 | 1,028,745 | 5,746 | 3,567 | 87,083 | 1,172,360 |
| 2008 | 22,174 | 947 | 24,572 | 702,099 | 726,671 | 3,836 | 1,985 | 33,904 | 789,517 |
| 2009 | 21,237 | 1,034 | 2,912 | 779,826 | 782,738 | 3,391 | 1,993 | 36,836 | 847,229 |
| 2010 | 27,967 | 3,259 | 8,183 | 689,917 | 698,100 | 4,679 | 2,906 | 70,238 | 807,149 |
| 2011 | 60,560 | 1,915 | 37,112 | 1,169,231 | 1,206,343 | 6,556 | 2,715 | 63,141 | 1,341,230 |
| 2012 | 30,450 | 2,242 | 27,500 | 778,144 | 805,644 | 7,405 | 3,208 | 95,717 | 944,666 |
| 2013 | 27,046 | 1,567 | 33,501 | 711,840 | 745,341 | 4,645 | 2,820 | 48,361 | 829,780 |
| 2014 | 40,535 | 516 | 1 | 516,001 | 516,002 | 1,256 | 1,520 | 8,934 | 568,763 |
| 2015 | 41,733 | 624 | 11,976 | 508,782 | 520,758 | 1,229 | 1,077 | 17,336 | 582,757 |
| 2016 | 30,946 | 1,822 | 65,056 | 571,446 | 636,502 | 7,074 | 3,051 | 54,507 | 733,902 |
| **2017** | **30,368** | **1,800** | **72,650** | **525,098** | **597,748** | **5,583** | **3,420** | **52,483** | **691,402** |
| 2018 | 30,368 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 691,402 |
| 2019 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2020 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2021 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2022 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2023 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2024 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2025 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2026 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2027 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2028 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2029 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2030 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2031 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2032 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2033 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2034 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| 2035 | 27,364 | 1,800 | 72,650 | 525,098 | 597,748 | 5,583 | 3,420 | 52,483 | 688,398 |
| **TOTAL** | **2,595,339** | **136,539** | **4,175,840** | **43,475,118** | **47,650,958** | **273,826** | **261,269** | **4,873,221** | **55,791,152** |

## TABLE B-5B Annual Water Quantities Delivered to Each Contractor (acre-feet)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake[c] | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 7,382 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 9,970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 11,739 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 12,490 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 53 | 13,905 | 0 | 464 | 0 | 338 | 55 | 0 | 1,275 | 0 |
| 1973 | 20 | 9,418 | 5,800 | 389 | 9,000 | 290 | 0 | 0 | 32,426 | 0 |
| 1974 | 1,259 | 9,700 | 6,400 | 627 | 10,000 | 400 | 14 | 0 | 16,605 | 612 |
| 1975 | 8,068 | 10,700 | 7,000 | 825 | 11,000 | 520 | 0 | 0 | 13,865 | 5,450 |
| 1976 | 27,782 | 11,700 | 7,600 | 1,002 | 12,000 | 589 | 0 | 0 | 12,273 | 6,071 |
| 1977 | 11,202 | 5,075 | 0 | 1,109 | 0 | 111 | 80 | 0 | 24,833 | 8,996 |
| 1978 | 44,137 | 11,362 | 10,084 | 1,209 | 15,300 | 208 | 0 | 0 | 4,055 | 7,771 |
| 1979 | 60,493 | 19,145 | 10,063 | 1,260 | 15,000 | 133 | 4,000 | 0 | 18 | 290 |
| 1980 | 72,407 | 15,092 | 10,884 | 1,239 | 17,000 | 191 | 4,000 | 0 | 0 | 1,085 |
| 1981 | 79,375 | 18,461 | 12,105 | 1,485 | 19,000 | 1,270 | 4,000 | 0 | 16,021 | 3,619 |
| 1982 | 50,291 | 22,216 | 13,326 | 1,238 | 21,000 | 0 | 10,500 | 0 | 8,409 | 12,599 |
| 1983 | 32,961 | 22,135 | 14,547 | 911 | 23,000 | 38 | 0 | 0 | 5,994 | 734 |
| 1984 | 32,662 | 24,218 | 15,768 | 1,128 | 25,000 | 1 | 0 | 0 | 5,556 | 7,656 |
| 1985 | 37,064 | 24,500 | 16,989 | 1,422 | 27,000 | 0 | 0 | 1,558 | 7,390 | 5,028 |
| 1986 | 32,449 | 27,229 | 18,210 | 1,506 | 29,000 | 163 | 0 | 3,096 | 6,421 | 9,454 |
| 1987 | 34,089 | 27,988 | 19,431 | 1,849 | 31,500 | 1,085 | 17 | 5,379 | 18,751 | 10,630 |
| 1988 | 34,079 | 30,438 | 20,652 | 2,006 | 34,000 | 419 | 9 | 1,770 | 21,386 | 8,948 |
| 1989 | 45,280 | 36,364 | 21,873 | 2,170 | 36,500 | 971 | 200 | 9,009 | 20,782 | 12,839 |
| 1990 | 47,206 | 28,579 | 23,100 | 1,827 | 38,100 | 1,747 | 0 | 8,608 | 18,831 | 16,649 |
| 1991 | 9,568 | 4,562 | 6,930 | 849 | 11,430 | 522 | 3,423 | 3,914 | 3,661 | 5,399 |
| 1992 | 30,265 | 20,699 | 10,427 | 519 | 17,197 | 251 | 10,686 | 4,035 | 3,358 | 7,908 |
| 1993 | 43,102 | 23,039 | 23,100 | 439 | 38,100 | 734 | 11,514 | 7,761 | 4,361 | 14,397 |
| 1994 | 49,153 | 26,441 | 14,102 | 785 | 23,257 | 1,098 | 16,852 | 8,418 | 9,135 | 15,230 |
| 1995 | 47,286 | 27,233 | 23,100 | 409 | 38,100 | 480 | 8,722 | 6,961 | 696 | 12,922 |
| 1996 | 56,356 | 32,500 | 62,219 | 485 | 102,622 | 494 | 7,427 | 11,434 | 6,064 | 15,989 |
| 1997 | 62,393 | 27,712 | 68,340 | 651 | 69,990 | 444 | 10,374 | 11,861 | 9,654 | 18,175 |
| 1998 | 52,926 | 20,093 | 85,709 | 187 | 70,647 | 404 | 3,925 | 8,752 | 1,878 | 9,310 |
| 1999 | 69,073 | 32,899 | 50,480 | 1,132 | 58,100 | 342 | 8,144 | 13,278 | 12,874 | 21,729 |
| 2000 | 83,577 | 40,680 | 42,323 | 1,194 | 58,234 | 0 | 11,380 | 9,060 | 18,399 | 15,140 |
| 2001 | 62,857 | 31,939 | 9,100 | 1,057 | 15,010 | 0 | 4,433 | 10,427 | 26,488 | 2,360 |
| 2002 | 58,171 | 68,817 | 16,755 | 2,189 | 27,640 | 0 | 4,346 | 18,496 | 72,069 | 24,851 |
| 2003 | 60,029 | 55,736 | 14,443 | 1,563 | 23,819 | 0 | 14,435 | 11,547 | 26,113 | 21,934 |
| 2004 | 59,731 | 83,761 | 15,465 | 2,006 | 21,190 | 0 | 13,176 | 12,162 | 57,030 | 12,541 |
| 2005 | 59,831 | 59,456 | 42,519 | 807 | 49,089 | 0 | 13,561 | 11,712 | 31,550 | 13,984 |
| 2006 | 80,384 | 62,752 | 121,100 | 641 | 50,000 | 0 | 34,014 | 12,492 | 35,331 | 16,284 |
| 2007 | 80,203 | 60,190 | 73,228 | 1,768 | 30,234 | 0 | 46,109 | 19,634 | 57,116 | 4,024 |
| 2008 | 54,436 | 42,878 | 46,791 | 848 | 26,428 | 25 | 25,396 | 14,255 | 35,145 | 7,212 |
| 2009 | 45,670 | 42,085 | 46,022 | 894 | 18,263 | 42 | 29,047 | 15,339 | 39,346 | 11,520 |
| 2010 | 58,489 | 57,900 | 85,592 | 357 | 31,183 | 0 | 38,152 | 10,969 | 49,379 | 19,180 |
| 2011 | 94,046 | 33,191 | 90,279 | 474 | 36,379 | 0 | 5,099 | 16,881 | 38,126 | 23,591 |
| 2012 | 111,207 | 50,473 | 117,587 | 624 | 45,101 | 0 | 11,244 | 18,897 | 112,972 | 22,058 |
| 2013 | 51,022 | 61,754 | 66,539 | 1,368 | 20,791 | 0 | 7,483 | 10,567 | 32,085 | 9,252 |
| 2014 | 18,532 | 29,448 | 12,870 | 1,233 | 3,049 | 0 | 3,581 | 8,406 | 10,956 | 1,200 |
| 2015 | 14,308 | 29,189 | 37,596 | 1,253 | 11,217 | 0 | 8,830 | 5,836 | 24,380 | 5,760 |
| 2016 | 87,703 | 38,001 | 92,510 | 2,019 | 34,016 | 0 | 11,859 | 14,105 | 54,678 | 16,088 |
| **2017** | **88,286** | **57,120** | **83,010** | **3,880** | **33,450** | **0** | **39,928** | **19,543** | **61,160** | **17,280** |
| 2018 | 88,286 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 39,928 | 19,543 | 59,058 | 17,280 |
| 2019 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2020 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2021 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2022 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2023 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2024 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2025 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2026 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2027 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2028 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2029 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2030 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2031 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2032 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2033 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2034 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| 2035 | 86,220 | 57,120 | 83,010 | 3,480 | 33,450 | 0 | 42,378 | 19,543 | 61,560 | 17,280 |
| **TOTAL** | **3,793,507** | **2,558,514** | **3,086,148** | **115,937** | **1,940,036** | **13,310** | **1,186,369** | **697,936** | **2,174,473** | **794,789** |

[c] Devil's Den Water District merged with Castaic Lake Water Agency effective January 1, 1992.

## TABLE B-5B Annual Water Quantities Delivered to Each Contractor (acre-feet)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | GRAND TOTAL |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,906 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,645 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,911 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34,026 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54,913 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56,763 |
| 1968 | 0 | 0 | 0 | 7,382 | 0 | 0 | 0 | 0 | 0 | 294,457 |
| 1969 | 0 | 0 | 0 | 9,970 | 0 | 0 | 0 | 0 | 0 | 268,104 |
| 1970 | 0 | 0 | 0 | 11,739 | 0 | 0 | 70 | 70 | 0 | 369,459 |
| 1971 | 0 | 0 | 0 | 12,490 | 0 | 192 | 64 | 256 | 0 | 654,442 |
| 1972 | 0 | 71,938 | 0 | 88,028 | 0 | 186 | 505 | 691 | 0 | 1,037,770 |
| 1973 | 0 | 159,883 | 0 | 217,226 | 0 | 53 | 679 | 732 | 0 | 737,532 |
| 1974 | 0 | 277,717 | 0 | 323,334 | 0 | 127 | 648 | 775 | 0 | 878,947 |
| 1975 | 0 | 526,491 | 0 | 583,919 | 0 | 253 | 405 | 658 | 0 | 1,230,830 |
| 1976 | 0 | 618,451 | 0 | 697,468 | 0 | 527 | 382 | 909 | 0 | 1,380,124 |
| 1977 | 0 | 189,755 | 0 | 241,161 | 0 | 706 | 303 | 1,009 | 0 | 582,381 |
| 1978 | 0 | 507,565 | 0 | 601,691 | 0 | 579 | 278 | 857 | 0 | 1,458,733 |
| 1979 | 0 | 477,074 | 0 | 587,476 | 0 | 302 | 329 | 631 | 0 | 1,666,457 |
| 1980 | 0 | 531,727 | 0 | 653,625 | 0 | 267 | 295 | 562 | 0 | 1,536,456 |
| 1981 | 0 | 795,846 | 0 | 951,182 | 0 | 221 | 355 | 576 | 0 | 1,918,563 |
| 1982 | 0 | 691,192 | 0 | 830,771 | 0 | 334 | 305 | 639 | 0 | 1,750,862 |
| 1983 | 0 | 343,521 | 0 | 443,841 | 0 | 325 | 262 | 587 | 0 | 1,187,156 |
| 1984 | 0 | 457,582 | 0 | 569,571 | 108 | 177 | 272 | 557 | 0 | 1,591,416 |
| 1985 | 0 | 683,625 | 0 | 804,576 | 62 | 308 | 254 | 624 | 0 | 1,990,295 |
| 1986 | 0 | 708,840 | 0 | 836,368 | 328 | 313 | 317 | 958 | 0 | 1,999,155 |
| 1987 | 0 | 712,424 | 0 | 863,143 | 88 | 459 | 452 | 999 | 0 | 2,131,608 |
| 1988 | 0 | 902,564 | 0 | 1,056,271 | 303 | 385 | 523 | 1,211 | 0 | 2,385,122 |
| 1989 | 0 | 1,156,698 | 0 | 1,342,686 | 403 | 300 | 486 | 1,189 | 0 | 2,853,747 |
| 1990 | 0 | 1,396,423 | 4,836 | 1,585,906 | 494 | 380 | 548 | 1,422 | 0 | 2,582,151 |
| 1991 | 0 | 391,447 | 988 | 442,693 | 265 | 328 | 420 | 1,013 | 0 | 549,113 |
| 1992 | 0 | 710,313 | 0 | 815,658 | 642 | 117 | 485 | 1,244 | 0 | 1,471,454 |
| 1993 | 0 | 652,190 | 0 | 818,737 | 746 | 256 | 444 | 1,446 | 0 | 2,315,235 |
| 1994 | 0 | 807,866 | 0 | 972,337 | 1,035 | 329 | 492 | 1,856 | 0 | 1,861,976 |
| 1995 | 0 | 436,042 | 0 | 601,951 | 910 | 203 | 308 | 1,421 | 0 | 2,031,423 |
| 1996 | 0 | 593,380 | 0 | 888,970 | 820 | 257 | 360 | 1,437 | 0 | 2,543,472 |
| 1997 | 0 | 721,810 | 1,850 | 1,003,254 | 1,005 | 185 | 231 | 1,421 | 0 | 2,405,444 |
| 1998 | 0 | 410,065 | 1,850 | 665,746 | 1,054 | 527 | 0 | 1,581 | 0 | 1,764,963 |
| 1999 | 0 | 852,617 | 1,850 | 1,122,518 | 1,096 | 286 | 0 | 1,382 | 0 | 2,898,961 |
| 2000 | 0 | 1,522,412 | 4,050 | 1,806,449 | 901 | 586 | 0 | 1,487 | 0 | 3,569,072 |
| 2001 | 0 | 1,023,169 | 1,850 | 1,188,690 | 1,065 | 513 | 0 | 1,578 | 0 | 2,175,194 |
| 2002 | 0 | 1,408,919 | 4,998 | 1,707,251 | 1,181 | 419 | 0 | 1,600 | 0 | 2,909,555 |
| 2003 | 116 | 1,701,615 | 5,000 | 1,936,350 | 1,324 | 551 | 0 | 1,875 | 0 | 3,327,811 |
| 2004 | 841 | 1,724,380 | 5,250 | 2,007,533 | 1,434 | 1,440 | 0 | 2,874 | 0 | 3,230,590 |
| 2005 | 692 | 1,528,045 | 1,665 | 1,812,911 | 1,894 | 527 | 0 | 2,421 | 0 | 3,753,874 |
| 2006 | 4,278 | 1,512,186 | 1,850 | 1,931,312 | 5,342 | 468 | 0 | 5,810 | 0 | 3,693,938 |
| 2007 | 3,935 | 1,499,688 | 3,000 | 1,879,129 | 2,327 | 956 | 0 | 3,283 | 0 | 3,284,475 |
| 2008 | 4,905 | 898,313 | 3,798 | 1,160,430 | 1,923 | 451 | 243 | 2,617 | 0 | 2,152,219 |
| 2009 | 6,397 | 930,871 | 3,891 | 1,189,387 | 2,114 | 581 | 200 | 2,895 | 0 | 2,227,564 |
| 2010 | 8,240 | 1,416,062 | 4,075 | 1,779,578 | 2,331 | 807 | 243 | 3,381 | 0 | 2,832,658 |
| 2011 | 10,503 | 1,686,570 | 4,000 | 2,039,139 | 2,297 | 1,092 | 98 | 3,487 | 0 | 3,668,980 |
| 2012 | 11,010 | 1,224,907 | 4,353 | 1,730,433 | 2,695 | 1,374 | 79 | 4,148 | 0 | 2,881,783 |
| 2013 | 9,445 | 892,550 | 2,890 | 1,165,746 | 4,850 | 908 | 366 | 6,124 | 0 | 2,224,875 |
| 2014 | 5,044 | 387,392 | 93 | 481,804 | 4,237 | 1,617 | 251 | 6,105 | 0 | 1,242,286 |
| 2015 | 3,481 | 573,526 | 1,000 | 716,376 | 3,004 | 2,763 | 730 | 6,497 | 0 | 1,498,367 |
| 2016 | 8,335 | 1,090,014 | 3,000 | 1,452,328 | 3,649 | 3,141 | 625 | 7,415 | 0 | 2,435,124 |
| **2017** | **10,380** | **1,131,900** | **3,000** | **1,548,937** | **5,760** | **270** | **730** | **6,760** | **0** | **2,467,088** |
| 2018 | 10,380 | 1,096,644 | 3,000 | 1,511,179 | 5,760 | 270 | 730 | 6,760 | 0 | 2,431,901 |
| 2019 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 730 | 6,760 | 0 | 2,479,572 |
| 2020 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2021 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2022 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2023 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2024 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2025 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2026 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2027 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2028 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2029 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2030 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2031 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2032 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2033 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2034 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| 2035 | 10,380 | 1,146,900 | 3,000 | 1,564,321 | 5,760 | 270 | 1,619 | 7,649 | 0 | 2,480,537 |
| **TOTAL** | **274,442** | **59,531,509** | **123,137** | **76,290,107** | **161,367** | **32,206** | **41,401** | **234,974** | **0** | **144,691,490** |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | NORTH BAY AQUEDUCT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Barker Slough Pumping Plant | | | | Cordelia Pumping Plant Solano | | | | Cordelia Pumping Plant Napa | | | |
| Calendar Year | Initial Fill Water | Operational Losses | Water Supply Delivery | Total | Initial Fill Water | Operational Losses | Water Supply Delivery | Total | Initial Fill Water | Operational Losses | Water Supply Delivery[a] | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | (10) | 1,214 | 1,228 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2,687 | 2,689 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 3,618 | 3,636 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2,521 | 2,525 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (10) | 3,647 | 3,637 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3,792 | 3,793 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 4,870 | 4,880 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 6,840 | 6,850 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7,122 | 7,126 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8,226 | 8,228 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (6) | 6,034 | 6,028 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6,561 | 6,562 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (3) | 6,707 | 6,704 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 9,001 | 9,009 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (8) | 1,213 | 1,205 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (12) | 2,287 | 2,275 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (15) | 2,923 | 2,908 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 4,039 | 4,052 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (4) | 3,519 | 3,515 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7,693 | 7,693 |
| 1988 | 1 | 283 | 15,118 | 15,402 | 0 | 0 | 9,725 | 9,725 | 1 | (1) | 5,392 | 5,392 |
| 1989 | 0 | 758 | 23,451 | 24,209 | 0 | 0 | 17,246 | 17,246 | 0 | (4) | 6,195 | 6,191 |
| 1990 | 0 | 3 | 26,071 | 26,074 | 0 | (634) | 15,856 | 15,222 | 0 | 3 | 6,940 | 6,943 |
| 1991 | 0 | 667 | 8,352 | 9,019 | 0 | 124 | 3,855 | 3,979 | 0 | 198 | 1,380 | 1,578 |
| 1992 | 0 | 1,643 | 18,774 | 20,417 | 0 | 0 | 9,220 | 9,220 | 0 | 0 | 4,001 | 4,001 |
| 1993 | 0 | 1,153 | 34,466 | 35,619 | 0 | 0 | 14,471 | 14,471 | 0 | 0 | 5,286 | 5,286 |
| 1994 | 0 | 780 | 32,048 | 32,828 | 0 | (6) | 14,913 | 14,907 | 0 | 0 | 6,792 | 6,792 |
| 1995 | 0 | 908 | 26,527 | 27,435 | 0 | 0 | 15,893 | 15,893 | 0 | 0 | 5,182 | 5,182 |
| 1996 | 0 | 1,354 | 34,892 | 36,246 | 0 | 0 | 17,069 | 17,069 | 0 | 0 | 4,893 | 4,893 |
| 1997 | 0 | 1,422 | 37,871 | 39,293 | 0 | 0 | 17,501 | 17,501 | 0 | 0 | 4,341 | 4,341 |
| 1998 | 0 | 1,343 | 35,125 | 36,468 | 0 | 0 | 18,204 | 18,204 | 0 | 0 | 5,359 | 5,359 |
| 1999 | 0 | 2,522 | 40,057 | 42,579 | 0 | 0 | 19,562 | 19,562 | 0 | 0 | 5,304 | 5,304 |
| 2000 | 0 | 1,853 | 41,973 | 43,826 | 0 | 4 | 21,525 | 21,529 | 0 | 180 | 4,958 | 5,138 |
| 2001 | 0 | 1,760 | 43,931 | 45,691 | 0 | 0 | 19,737 | 19,737 | 0 | 0 | 9,345 | 9,345 |
| 2002 | 0 | 496 | 45,435 | 45,931 | 0 | 0 | 19,719 | 19,719 | 0 | 0 | 6,875 | 6,875 |
| 2003 | 0 | 3,991 | 41,597 | 45,588 | 0 | 0 | 16,700 | 16,700 | 0 | 0 | 7,637 | 7,637 |
| 2004 | 0 | 2,181 | 51,136 | 53,317 | 0 | 0 | 21,686 | 21,686 | 0 | 0 | 8,499 | 8,499 |
| 2005 | 0 | 935 | 45,488 | 46,423 | 0 | 0 | 19,189 | 19,189 | 0 | 0 | 8,009 | 8,009 |
| 2006 | 0 | 1,005 | 43,305 | 44,310 | 0 | 0 | 18,651 | 18,651 | 0 | 0 | 8,081 | 8,081 |
| 2007 | 0 | 1,189 | 58,257 | 59,446 | 0 | 0 | 27,793 | 27,793 | 0 | 0 | 11,277 | 11,277 |
| 2008 | 0 | 845 | 54,612 | 55,457 | 0 | 0 | 19,436 | 19,436 | 0 | 255 | 13,740 | 13,995 |
| 2009 | 0 | 537 | 41,854 | 42,391 | 0 | 0 | 15,473 | 15,473 | 0 | 130 | 11,377 | 11,507 |
| 2010 | 0 | 809 | 43,233 | 44,042 | 0 | 0 | 12,788 | 12,788 | 0 | 254 | 12,847 | 13,101 |
| 2011 | 0 | 803 | 39,309 | 40,112 | 0 | 0 | 12,832 | 12,832 | 0 | 213 | 11,275 | 11,488 |
| 2012 | 0 | 686 | 39,254 | 39,940 | 0 | 0 | 12,886 | 12,886 | 0 | 196 | 9,860 | 10,056 |
| 2013 | 0 | 1,150 | 48,407 | 49,557 | 0 | 0 | 19,404 | 19,404 | 0 | 350 | 12,478 | 12,828 |
| 2014 | 0 | 2,597 | 33,843 | 36,440 | 0 | 0 | 12,366 | 12,366 | 0 | 970 | 14,123 | 15,093 |
| 2015 | 0 | 144 | 35,035 | 35,179 | 0 | 0 | 15,321 | 15,321 | 0 | 76 | 11,133 | 11,209 |
| 2016 | 0 | 51 | 45,474 | 45,525 | 0 | 0 | 18,035 | 18,035 | 0 | 5 | 13,731 | 13,736 |
| **2017** | **0** | **51** | **46,070** | **46,121** | **0** | **0** | **7,893** | **7,893** | **0** | **5** | **17,415** | **17,420** |
| 2018 | 0 | 51 | 46,070 | 46,121 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2019 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2020 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2021 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2022 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2023 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2024 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2025 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2026 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2027 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2028 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2029 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2030 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2031 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2032 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2033 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2034 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |
| 2035 | 0 | 51 | 46,069 | 46,120 | 0 | 0 | 7,893 | 7,893 | 0 | 5 | 17,415 | 17,420 |

[a] For the period 1968 through 1987, deliveries are non-SWP water pumped through an interim facility.

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | SOUTH BAY AQUEDUCT | | | | | | CALIFORNIA AQUEDUCT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | NORTH SAN JOAQUIN DIVISION | | | | | | | |
| | South Bay Pumping Plant | | | | | | Banks Pumping Plant | | | | | | | |
| | | | | Deliveries | | | Transportation Water | | | | | | | |
| | | | | | | | | | | Deliveries | | | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply[b] | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Conservation Water | Total |
| | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] | [21] | [22] | [23] | [24] | [25] | [26] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 9 | 272 | 0 | 8,906 | 0 | 9,187 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 71 | 185 | 0 | 12,645 | 0 | 12,901 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 171 | 152 | 0 | 20,911 | 0 | 21,234 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 93 | 729 | 0 | 34,026 | 0 | 34,848 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 1,746 | 0 | 54,913 | 0 | 56,659 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 1,677 | 0 | 56,763 | 0 | 58,440 | 5,746 | 1,183 | 0 | 11,538 | 0 | 18,467 | 2,957 | 21,424 |
| 1968 | 0 | 1,847 | 0 | 101,055 | 0 | 102,902 | 11,079 | 74,464 | 0 | 293,243 | 0 | 378,786 | 531,275 | 910,061 |
| 1969 | 3,449 | 2,668 | 0 | 69,712 | 0 | 75,829 | 7,336 | 44,287 | 0 | 265,417 | 0 | 317,040 | 531,185 | 848,225 |
| 1970 | 16,279 | 1,086 | (5,355) | 89,560 | 0 | 101,570 | 23,947 | 20,767 | (5,355) | 365,771 | 0 | 405,130 | (12,995) | 392,135 |
| 1971 | 0 | 1,815 | 8,854 | 98,584 | 0 | 109,253 | 23,207 | (10,754) | 8,854 | 651,665 | 8 | 672,980 | 7,708 | 680,688 |
| 1972 | 0 | 3,557 | 2,273 | 138,426 | 0 | 144,256 | 145,066 | 9,057 | (4,285) | 1,033,432 | 6,489 | 1,189,759 | 48,300 | 1,238,059 |
| 1973 | 0 | (33) | (1,510) | 94,078 | 0 | 92,535 | 214,941 | (4,951) | 2,902 | 733,008 | 1,155 | 947,055 | 55,846 | 1,002,901 |
| 1974 | 0 | 1,287 | (10,056) | 89,318 | 0 | 80,549 | 247,894 | (11,526) | (32,510) | 873,302 | 2,118 | 1,079,278 | 54,683 | 1,133,961 |
| 1975 | 0 | 320 | 8,550 | 93,604 | 0 | 102,474 | 110,149 | (8,092) | 16,101 | 1,223,332 | 3,377 | 1,344,867 | (102,625) | 1,242,242 |
| 1976 | 0 | 2,431 | 1,391 | 126,431 | 141 | 130,394 | 67,834 | 5,443 | (244,124) | 1,372,093 | 1,745 | 1,202,991 | (442,348) | 760,643 |
| 1977 | 0 | 2,866 | 2,685 | 107,704 | 112 | 113,367 | 0 | 39,897 | (157,543) | 573,146 | 1,111 | 456,611 | (13,507) | 443,104 |
| 1978 | 0 | 2,165 | (11,249) | 112,574 | 126 | 103,616 | 67,457 | (36,898) | 35,129 | 1,451,842 | 1,177 | 1,518,707 | 752,075 | 2,270,782 |
| 1979 | 0 | 2,401 | 1,069 | 122,190 | 89 | 125,749 | 17,397 | 60,958 | (32,307) | 1,659,265 | 1,398 | 1,706,711 | (112,053) | 1,594,658 |
| 1980 | 0 | 1,758 | (6,563) | 115,824 | 123 | 111,142 | 3,159 | 58,484 | (275,538) | 1,529,187 | 2,131 | 1,317,423 | 186,601 | 1,504,024 |
| 1981 | 0 | 2,627 | 13,742 | 129,507 | 121 | 145,997 | 46,060 | 85,350 | 40,536 | 1,908,986 | 4,974 | 2,085,906 | (931,878) | 1,154,028 |
| 1982 | 0 | 2,344 | (23,928) | 107,439 | 129 | 85,984 | 5,979 | 61,556 | 99,897 | 1,743,145 | 4,646 | 1,915,223 | 347,983 | 2,263,206 |
| 1983 | 0 | 2,151 | (22,886) | 94,656 | 132 | 74,053 | 6,071 | 47,022 | (310,477) | 1,184,282 | 7,853 | 934,751 | 835,771 | 1,770,522 |
| 1984 | 0 | 2,088 | 8,442 | 98,122 | 158 | 108,810 | 38,649 | 97,143 | (108,548) | 1,587,936 | 5,874 | 1,621,054 | 21,875 | 1,642,929 |
| 1985 | 0 | 2,817 | (1,607) | 122,088 | 152 | 123,450 | 0 | 110,469 | 137,783 | 1,985,632 | 5,452 | 2,239,336 | (110,569) | 2,128,767 |
| 1986 | 0 | 2,299 | (1,850) | 110,988 | 130 | 111,567 | 0 | 90,799 | 20,177 | 1,993,278 | 3,865 | 2,108,119 | 200,298 | 2,308,417 |
| 1987 | 0 | 2,625 | (584) | 136,796 | 137 | 138,974 | 0 | 91,427 | (23,116) | 2,121,366 | 7,672 | 2,197,349 | (458,725) | 1,738,624 |
| 1988 | 0 | 2,884 | (698) | 147,255 | 142 | 149,583 | 0 | 107,249 | (35,484) | 2,368,793 | 4,889 | 2,445,447 | (303,583) | 2,141,864 |
| 1989 | 0 | 2,673 | 3,296 | 142,269 | 152 | 148,390 | 0 | 117,603 | (38,058) | 2,829,107 | 8,135 | 2,916,787 | 421,131 | 3,337,918 |
| 1990 | 0 | 894 | 1,982 | 156,537 | 168 | 159,581 | 0 | 99,059 | (290,965) | 2,554,658 | 9,262 | 2,372,014 | (374,027) | 1,997,987 |
| 1991 | 0 | 2,637 | (4,532) | 50,259 | 150 | 48,514 | 0 | 80,106 | (79,038) | 539,748 | 4,879 | 545,695 | 554,904 | 1,100,599 |
| 1992 | 0 | 2,881 | 756 | 76,661 | 147 | 80,445 | 0 | 91,391 | (218,170) | 1,451,436 | 2,605 | 1,327,262 | 61,343 | 1,388,605 |
| 1993 | 0 | 1,940 | (20,051) | 105,971 | 143 | 88,003 | 0 | 149,372 | (273,789) | 2,279,323 | 2,609 | 2,157,515 | 849,249 | 3,006,764 |
| 1994 | 0 | 1,981 | 1,714 | 100,568 | 168 | 104,431 | 0 | 148,712 | (120,985) | 1,828,072 | 3,803 | 1,859,602 | (324,640) | 1,534,962 |
| 1995 | 0 | 1,188 | (12,333) | 76,640 | 146 | 65,641 | 0 | 173,074 | (397,605) | 2,003,475 | 2,575 | 1,781,519 | 293,159 | 2,074,678 |
| 1996 | 0 | 981 | (1,990) | 77,215 | 150 | 76,356 | 0 | 123,502 | 78,123 | 2,507,143 | 3,902 | 2,712,670 | 288,576 | 3,001,246 |
| 1997 | 0 | 1,575 | 5,016 | 102,186 | 155 | 108,932 | 527 | 135,106 | (98,334) | 2,366,152 | 2,594 | 2,406,045 | (50,000) | 2,356,045 |
| 1998 | 0 | 1,551 | 3,595 | 70,876 | 114 | 76,136 | 0 | 91,319 | (346,039) | 1,728,257 | 2,107 | 1,475,644 | 120,886 | 1,596,530 |
| 1999 | 0 | 2,166 | 12,313 | 100,497 | 139 | 115,115 | 0 | 135,809 | (17,569) | 2,855,522 | 4,301 | 2,978,063 | (307,839) | 2,670,224 |
| 2000 | 0 | 2,346 | (20,958) | 135,533 | 145 | 117,066 | 0 | 115,895 | (13,232) | 3,474,523 | 5,182 | 3,582,368 | (15,487) | 3,566,881 |
| 2001 | 0 | 2,784 | 1,301 | 95,335 | 196 | 99,616 | 0 | 222,144 | (17,529) | 1,874,096 | 1,978 | 2,080,689 | 86,928 | 2,167,617 |
| 2002 | 0 | 2,534 | (13,938) | 123,577 | 146 | 112,319 | 0 | 225,032 | 36,404 | 2,816,389 | 4,672 | 3,082,497 | (151,719) | 2,930,778 |
| 2003 | 0 | 2,920 | (1,399) | 132,714 | 131 | 134,366 | 0 | 329,699 | (49,580) | 3,193,449 | 11,362 | 3,484,930 | 225,348 | 3,710,278 |
| 2004 | 0 | 2,982 | (7,240) | 125,928 | 150 | 121,820 | 0 | 83,788 | (4,079) | 2,979,217 | 1,337 | 3,060,263 | 103,811 | 3,164,074 |
| 2005 | 0 | 2,823 | (3,565) | 108,136 | 154 | 107,548 | 0 | 151,931 | (163,243) | 3,665,023 | 1,270 | 3,654,981 | 535,754 | 4,190,735 |
| 2006 | 0 | 2,989 | (9,645) | 118,272 | 169 | 111,785 | 0 | 67,040 | (129,767) | 3,571,009 | 1,208 | 3,509,490 | 43,481 | 3,552,971 |
| 2007 | 0 | 2,840 | 14,928 | 134,172 | 146 | 152,086 | 0 | 73,956 | 133,124 | 2,736,094 | 830 | 2,944,004 | (398,297) | 2,545,707 |
| 2008 | 0 | 2,215 | 880 | 116,562 | 166 | 119,823 | 0 | 130,066 | (3,350) | 1,413,730 | 1,082 | 1,541,528 | (397,949) | 1,143,579 |
| 2009 | 0 | 1,999 | (1,134) | 116,947 | 108 | 117,920 | 0 | 111,805 | (1,860) | 1,572,819 | 2,023 | 1,684,787 | 928,666 | 2,613,453 |
| 2010 | 0 | 1,717 | 3,436 | 95,802 | 117 | 101,072 | 0 | 203,757 | 51,667 | 2,243,593 | 1,163 | 2,500,180 | 37,606 | 2,537,786 |
| 2011 | 0 | 1,534 | (2,332) | 112,952 | 122 | 112,276 | 0 | 314,282 | (21,148) | 3,315,056 | 1,588 | 3,609,778 | 165,312 | 3,775,090 |
| 2012 | 0 | 2,025 | 5,931 | 112,056 | 150 | 120,162 | 0 | 143,580 | 20,504 | 2,607,588 | 1,606 | 2,773,278 | (473,745) | 2,299,533 |
| 2013 | 0 | 2,753 | (5,596) | 147,119 | 137 | 144,413 | 0 | 173,145 | (6,654) | 1,753,556 | 1,641 | 1,921,688 | (123,957) | 1,797,731 |
| 2014 | 0 | 3,285 | 4,951 | 91,116 | 46 | 99,398 | 0 | 114,127 | 36,033 | 588,005 | 650 | 738,815 | 301,102 | 1,039,917 |
| 2015 | 0 | 2,727 | (8,482) | 117,084 | 43 | 111,372 | 0 | 109,951 | (7,686) | 859,939 | 690 | 962,894 | (140,538) | 822,356 |
| 2016 | 0 | 2,686 | 9,000 | 110,523 | 400 | 122,609 | 0 | 120,595 | 97,393 | 2,195,507 | 8,660 | 2,422,155 | 76,703 | 2,498,858 |
| **2017** | **0** | **2,401** | **0** | **119,483** | **400** | **122,284** | **0** | **121,618** | **83,000** | **2,414,258** | **8,660** | **2,627,536** | **225,962** | **2,853,498** |
| 2018 | 0 | 2,308 | 0 | 122,177 | 400 | 124,885 | 0 | 121,576 | 38,000 | 2,379,071 | 8,660 | 2,547,307 | 129,783 | 2,677,090 |
| 2019 | 0 | 3,351 | 0 | 120,155 | 400 | 123,906 | 0 | 128,613 | 50,179 | 2,426,743 | 8,660 | 2,614,195 | 77,224 | 2,691,419 |
| 2020 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,690 | (366) | 2,426,819 | 8,660 | 2,563,803 | (8,687) | 2,555,116 |
| 2021 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,769 | 10,725 | 2,426,819 | 8,660 | 2,574,973 | (1,095) | 2,573,878 |
| 2022 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,846 | (3,483) | 2,426,819 | 8,660 | 2,560,842 | (185,907) | 2,374,935 |
| 2023 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,818 | (18,971) | 2,426,819 | 8,660 | 2,545,326 | 115,791 | 2,661,117 |
| 2024 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,625 | 11,289 | 2,426,819 | 8,660 | 2,575,393 | 79,858 | 2,655,251 |
| 2025 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 130,380 | (12,518) | 2,426,819 | 8,660 | 2,553,341 | (247,205) | 2,306,136 |
| 2026 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,700 | 24,308 | 2,426,819 | 8,660 | 2,588,487 | 246,850 | 2,835,337 |
| 2027 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,692 | (17,799) | 2,426,819 | 8,660 | 2,546,372 | (12,304) | 2,534,068 |
| 2028 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,783 | 12,291 | 2,426,819 | 8,660 | 2,576,553 | 15,430 | 2,591,983 |
| 2029 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,671 | (9,046) | 2,426,819 | 8,660 | 2,555,104 | (10,778) | 2,544,326 |
| 2030 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,777 | 20,756 | 2,426,819 | 8,660 | 2,585,012 | 124,586 | 2,709,598 |
| 2031 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,134 | (97,726) | 2,426,819 | 8,660 | 2,465,887 | (259,831) | 2,206,056 |
| 2032 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 128,005 | 84,999 | 2,426,819 | 8,660 | 2,648,483 | 138,527 | 2,787,010 |
| 2033 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 127,876 | (94,652) | 2,426,819 | 8,660 | 2,468,703 | (184,372) | 2,284,331 |
| 2034 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 127,725 | 69,593 | 2,426,819 | 8,660 | 2,632,797 | 120,375 | 2,753,172 |
| 2035 | 0 | 3,351 | 0 | 120,635 | 400 | 124,386 | 0 | 127,379 | (242,659) | 2,426,819 | 8,660 | 2,320,199 | (587,531) | 1,732,668 |

[b] For the period June 1962 through November 1967, deliveries were supplied by non-SWP water.

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION | | | | | | SOUTH SAN JOAQUIN DIVSION | | | | | |
| | Dos Amigos Pumping Plant | | | | | | Buena Vista Pumping Plant | | | | | |
| | | | | Deliveries | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [27] | [28] | [29] | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 11,079 | 25,126 | 0 | 189,104 | 0 | 225,309 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 3,887 | 9,922 | 0 | 192,689 | 0 | 206,498 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 7,668 | 1,901 | 0 | 270,300 | 0 | 279,869 | 4,779 | 1,012 | 0 | 3 | 0 | 5,794 |
| 1971 | 23,207 | (12,030) | 0 | 545,869 | 0 | 557,046 | 7,853 | 8,399 | 0 | 101,512 | 0 | 117,764 |
| 1972 | 145,066 | (6,635) | (6,558) | 886,840 | 6,481 | 1,025,194 | 100,274 | 20,044 | (6,558) | 223,626 | 6,481 | 343,867 |
| 1973 | 214,941 | (6,778) | 1,329 | 635,716 | 1,147 | 846,355 | 204,638 | 35,695 | 1,329 | 311,096 | 1,147 | 553,905 |
| 1974 | 247,894 | (16,765) | (15,295) | 780,513 | 2,108 | 998,455 | 237,554 | 19,672 | (15,295) | 388,949 | 2,108 | 632,988 |
| 1975 | 110,149 | (12,144) | (693) | 1,126,152 | 3,358 | 1,226,822 | 103,352 | 26,342 | (693) | 672,531 | 3,358 | 804,890 |
| 1976 | 67,834 | (456) | (152,171) | 1,241,550 | 1,581 | 1,158,338 | 61,122 | 29,428 | (152,171) | 785,055 | 1,581 | 725,015 |
| 1977 | 0 | 26,359 | (116,219) | 463,970 | 737 | 374,847 | 0 | 25,173 | (116,219) | 271,944 | 560 | 181,458 |
| 1978 | 67,457 | 1,905 | 79,308 | 1,335,362 | 680 | 1,484,712 | 65,027 | 17,751 | 121,904 | 762,043 | 674 | 967,399 |
| 1979 | 17,397 | 33,884 | (51,299) | 1,530,926 | 685 | 1,531,593 | 12,302 | 46,157 | (51,299) | 737,714 | 502 | 745,376 |
| 1980 | 3,159 | 34,391 | (272,825) | 1,407,663 | 1,514 | 1,173,902 | 0 | 49,025 | (134,009) | 778,059 | 1,262 | 694,337 |
| 1981 | 46,060 | 36,962 | 23,359 | 1,775,179 | 4,348 | 1,885,908 | 0 | 38,942 | 23,359 | 1,077,322 | 4,112 | 1,143,735 |
| 1982 | 5,979 | 57,146 | 116,086 | 1,631,868 | 4,205 | 1,815,284 | 0 | 29,059 | 117,174 | 990,863 | 4,045 | 1,141,141 |
| 1983 | 6,071 | 63,583 | (101,155) | 1,085,804 | 7,475 | 1,061,778 | 0 | 40,205 | (101,155) | 593,920 | 7,291 | 540,261 |
| 1984 | 38,649 | 109,263 | (112,744) | 1,484,114 | 5,391 | 1,524,673 | 0 | 38,487 | (114,984) | 781,955 | 5,244 | 710,702 |
| 1985 | 0 | 86,772 | 138,898 | 1,858,111 | 4,936 | 2,088,717 | 0 | 42,838 | 139,689 | 992,606 | 4,804 | 1,179,937 |
| 1986 | 0 | 51,963 | 19,989 | 1,877,183 | 3,426 | 1,952,561 | 0 | 36,751 | 37,546 | 1,014,294 | 3,285 | 1,091,876 |
| 1987 | 0 | 64,827 | (25,707) | 1,978,945 | 7,121 | 2,025,186 | 0 | 30,495 | (25,522) | 1,027,361 | 6,937 | 1,039,271 |
| 1988 | 0 | 72,679 | (34,592) | 2,217,126 | 4,490 | 2,259,703 | 0 | 38,804 | (29,747) | 1,244,196 | 4,360 | 1,257,613 |
| 1989 | 0 | 90,090 | (29,411) | 2,679,845 | 7,652 | 2,748,176 | 0 | 29,594 | (60,826) | 1,532,625 | 7,490 | 1,508,883 |
| 1990 | 0 | 115,074 | (11,323) | 2,394,999 | 8,922 | 2,507,672 | 0 | 46,865 | (15,092) | 1,769,991 | 8,879 | 1,810,643 |
| 1991 | 0 | 92,227 | 9,325 | 489,348 | 4,605 | 595,505 | 0 | 39,274 | 96,506 | 446,916 | 4,560 | 587,256 |
| 1992 | 0 | 118,796 | (225,603) | 1,372,536 | 2,079 | 1,267,808 | 0 | 28,138 | (98,271) | 920,978 | 1,995 | 852,840 |
| 1993 | 0 | 136,432 | (220,537) | 2,170,494 | 1,864 | 2,088,253 | 0 | 14,186 | (128,363) | 908,200 | 1,676 | 795,699 |
| 1994 | 0 | 152,414 | (78,957) | 1,724,433 | 3,098 | 1,800,988 | 0 | 35,083 | (88,211) | 1,107,122 | 2,918 | 1,056,912 |
| 1995 | 0 | 137,937 | (12,473) | 1,921,666 | 1,711 | 2,048,841 | 0 | 33,963 | (16,431) | 706,742 | 1,669 | 725,943 |
| 1996 | 0 | 45,591 | 14,927 | 2,425,024 | 2,998 | 2,488,540 | 0 | 31,304 | 15,438 | 988,612 | 2,928 | 1,038,282 |
| 1997 | 527 | 107,033 | (66,814) | 2,247,628 | 2,090 | 2,290,464 | 0 | 42,670 | 40,852 | 1,054,461 | 2,076 | 1,140,059 |
| 1998 | 0 | 95,185 | (338,076) | 1,664,080 | 1,589 | 1,422,778 | 0 | 41,910 | (106,487) | 753,731 | 1,585 | 690,739 |
| 1999 | 0 | 95,262 | (2,778) | 2,750,154 | 3,285 | 2,845,923 | 0 | 48,502 | (2,807) | 1,131,826 | 3,279 | 1,180,800 |
| 2000 | 0 | 134,231 | 7,726 | 3,273,337 | 4,222 | 3,419,516 | 0 | 37,514 | 7,726 | 1,814,685 | 4,216 | 1,864,141 |
| 2001 | 0 | 150,830 | (18,830) | 1,615,776 | 1,218 | 1,748,994 | 0 | 31,361 | (18,830) | 1,318,835 | 1,211 | 1,332,577 |
| 2002 | 0 | 92,905 | 50,342 | 2,628,462 | 3,968 | 2,775,677 | 0 | 41,565 | 50,342 | 1,831,874 | 3,961 | 1,927,742 |
| 2003 | 0 | 85,360 | (48,181) | 2,893,333 | 10,656 | 2,941,168 | 0 | 43,352 | (48,181) | 1,909,192 | 10,645 | 1,915,008 |
| 2004 | 0 | 25,865 | 3,161 | 2,807,825 | 652 | 2,837,503 | 0 | 41,551 | 3,161 | 2,102,371 | 649 | 2,147,732 |
| 2005 | 0 | 62,569 | (159,678) | 3,423,490 | 581 | 3,326,962 | 0 | 35,019 | (159,678) | 1,846,180 | 559 | 1,722,080 |
| 2006 | 0 | (12,341) | (120,122) | 3,501,308 | 504 | 3,369,349 | 0 | 30,271 | (120,122) | 2,077,130 | 504 | 1,987,783 |
| 2007 | 0 | 47,736 | 118,196 | 2,419,032 | 312 | 2,585,276 | 0 | 43,400 | 118,196 | 2,002,793 | 305 | 2,164,694 |
| 2008 | 0 | 103,375 | (4,230) | 1,296,068 | 361 | 1,395,574 | 0 | 39,056 | (4,230) | 1,275,174 | 327 | 1,310,327 |
| 2009 | 0 | 76,206 | (726) | 1,318,452 | 1,367 | 1,395,299 | 0 | 32,900 | (726) | 1,217,847 | 1,295 | 1,251,316 |
| 2010 | 0 | 76,447 | 48,231 | 2,307,963 | 636 | 2,433,277 | 0 | 43,377 | 48,231 | 1,505,105 | 603 | 1,597,316 |
| 2011 | 0 | 66,937 | (18,816) | 3,343,960 | 870 | 3,392,951 | 0 | 39,914 | (18,816) | 1,820,268 | 742 | 1,842,108 |
| 2012 | 0 | 113,586 | 14,573 | 2,537,793 | 942 | 2,666,894 | 0 | 95,029 | 14,573 | 1,672,197 | 938 | 1,782,737 |
| 2013 | 0 | 174,857 | (1,058) | 1,549,837 | 836 | 1,724,472 | 0 | 105,771 | (1,058) | 1,275,717 | 795 | 1,381,225 |
| 2014 | 0 | 105,741 | 31,082 | 433,625 | 214 | 570,662 | 0 | 72,181 | 31,082 | 523,726 | 172 | 627,161 |
| 2015 | 0 | 103,380 | 796 | 724,862 | 155 | 829,193 | 0 | 46,903 | 796 | 738,410 | 151 | 786,260 |
| 2016 | 0 | 63,199 | 88,393 | 2,088,613 | 7,210 | 2,247,415 | 0 | 33,737 | 88,393 | 1,492,844 | 7,010 | 1,621,984 |
| **2017** | **0** | **64,552** | **83,000** | **2,290,055** | **7,210** | **2,444,817** | **0** | **35,090** | **83,000** | **1,605,889** | **7,010** | **1,730,989** |
| 2018 | 0 | 64,990 | 38,000 | 2,252,174 | 7,210 | 2,362,374 | 0 | 35,528 | 38,000 | 1,509,146 | 7,010 | 1,589,684 |
| 2019 | 0 | 70,564 | 50,179 | 2,301,868 | 7,210 | 2,429,821 | 0 | 41,102 | 50,179 | 1,512,032 | 7,010 | 1,610,323 |
| 2020 | 0 | 70,628 | (366) | 2,301,464 | 7,210 | 2,378,936 | 0 | 41,166 | (366) | 1,512,032 | 7,010 | 1,559,842 |
| 2021 | 0 | 70,711 | 10,725 | 2,301,464 | 7,210 | 2,390,110 | 0 | 41,249 | 10,725 | 1,512,032 | 7,010 | 1,571,016 |
| 2022 | 0 | 70,705 | (3,483) | 2,301,464 | 7,210 | 2,375,896 | 0 | 41,243 | (3,483) | 1,512,032 | 7,010 | 1,556,802 |
| 2023 | 0 | 70,696 | (18,971) | 2,301,464 | 7,210 | 2,360,399 | 0 | 41,234 | (18,971) | 1,512,032 | 7,010 | 1,541,305 |
| 2024 | 0 | 70,575 | 11,289 | 2,301,464 | 7,210 | 2,390,538 | 0 | 41,113 | 11,289 | 1,512,032 | 7,010 | 1,571,444 |
| 2025 | 0 | 70,638 | (12,518) | 2,301,464 | 7,210 | 2,366,794 | 0 | 41,176 | (12,518) | 1,512,032 | 7,010 | 1,547,700 |
| 2026 | 0 | 70,650 | 24,308 | 2,301,464 | 7,210 | 2,403,632 | 0 | 41,188 | 24,308 | 1,512,032 | 7,010 | 1,584,538 |
| 2027 | 0 | 70,563 | (17,799) | 2,301,464 | 7,210 | 2,361,438 | 0 | 41,101 | (17,799) | 1,512,032 | 7,010 | 1,542,344 |
| 2028 | 0 | 70,703 | 12,291 | 2,301,464 | 7,210 | 2,391,668 | 0 | 41,241 | 12,291 | 1,512,032 | 7,010 | 1,572,574 |
| 2029 | 0 | 70,630 | (9,046) | 2,301,464 | 7,210 | 2,370,258 | 0 | 41,168 | (9,046) | 1,512,032 | 7,010 | 1,551,164 |
| 2030 | 0 | 70,694 | 20,756 | 2,301,464 | 7,210 | 2,400,124 | 0 | 41,232 | 20,756 | 1,512,032 | 7,010 | 1,581,030 |
| 2031 | 0 | 70,566 | (97,726) | 2,301,464 | 7,210 | 2,281,514 | 0 | 41,104 | (97,726) | 1,512,032 | 7,010 | 1,462,420 |
| 2032 | 0 | 70,168 | 84,999 | 2,301,464 | 7,210 | 2,463,841 | 0 | 40,706 | 84,999 | 1,512,032 | 7,010 | 1,644,747 |
| 2033 | 0 | 70,373 | (94,652) | 2,301,464 | 7,210 | 2,284,395 | 0 | 40,911 | (94,652) | 1,512,032 | 7,010 | 1,465,301 |
| 2034 | 0 | 69,865 | 69,593 | 2,301,464 | 7,210 | 2,448,132 | 0 | 40,403 | 69,593 | 1,512,032 | 7,010 | 1,629,038 |
| 2035 | 0 | 69,205 | (242,659) | 2,301,464 | 7,210 | 2,135,220 | 0 | 39,743 | (242,659) | 1,512,032 | 7,010 | 1,316,126 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVSION (continued) | | | | | | | | | | | |
| | Teerink Pumping Plant | | | | | | Chrisman Pumping Plant | | | | | |
| | | | | Deliveries | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [39] | [40] | [41] | [42] | [43] | [44] | [45] | [46] | [47] | [48] | [49] | [50] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 198 | 2 | 0 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 7,533 | (112) | 0 | 3,552 | 0 | 10,973 | 7,366 | (159) | 0 | 0 | 0 | 7,207 |
| 1972 | 100,274 | 12,765 | (6,558) | 84,955 | 6,481 | 197,917 | 100,274 | 13,160 | (6,558) | 78,891 | 6,481 | 192,248 |
| 1973 | 204,638 | 21,543 | 1,329 | 229,685 | 1,147 | 458,342 | 204,638 | 32,414 | 1,329 | 209,769 | 1,147 | 449,297 |
| 1974 | 237,554 | 11,843 | (15,295) | 336,198 | 2,108 | 572,408 | 237,554 | 17,655 | (15,295) | 318,198 | 2,108 | 560,220 |
| 1975 | 103,352 | 19,763 | (693) | 621,706 | 3,358 | 747,486 | 103,352 | 25,326 | (693) | 586,286 | 3,358 | 717,629 |
| 1976 | 61,122 | 18,552 | (152,171) | 740,486 | 1,581 | 669,570 | 61,122 | 21,468 | (152,171) | 700,935 | 1,581 | 632,935 |
| 1977 | 0 | 16,415 | (116,219) | 246,349 | 560 | 147,105 | 0 | 15,698 | (116,219) | 240,191 | 560 | 140,230 |
| 1978 | 65,027 | 28,820 | 121,904 | 631,121 | 674 | 847,546 | 65,027 | 26,705 | 121,904 | 599,973 | 674 | 814,283 |
| 1979 | 12,302 | 50,663 | (51,299) | 625,561 | 502 | 637,729 | 12,302 | 50,580 | (51,299) | 586,959 | 502 | 599,044 |
| 1980 | 0 | 48,825 | (134,009) | 696,405 | 1,262 | 612,483 | 0 | 58,085 | (134,009) | 658,588 | 1,262 | 583,926 |
| 1981 | 0 | 51,600 | 23,359 | 998,307 | 4,112 | 1,077,378 | 0 | 48,844 | 23,359 | 959,274 | 4,112 | 1,035,589 |
| 1982 | 0 | 44,353 | 117,332 | 878,486 | 4,045 | 1,044,216 | 0 | 33,541 | 117,277 | 830,704 | 4,045 | 985,567 |
| 1983 | 0 | 43,961 | (101,155) | 487,915 | 7,291 | 438,012 | 0 | 34,698 | (101,155) | 450,489 | 7,291 | 391,323 |
| 1984 | 0 | 45,999 | (115,088) | 632,262 | 5,244 | 568,417 | 0 | 33,132 | (115,092) | 582,414 | 5,244 | 505,698 |
| 1985 | 0 | 50,106 | 139,973 | 854,684 | 4,804 | 1,049,567 | 0 | 54,831 | 139,954 | 810,606 | 4,804 | 1,010,195 |
| 1986 | 0 | 38,747 | 37,546 | 882,300 | 3,285 | 961,878 | 0 | 41,421 | 37,546 | 839,839 | 3,285 | 922,091 |
| 1987 | 0 | 47,815 | (25,522) | 897,905 | 6,937 | 927,135 | 0 | 33,195 | (25,522) | 863,157 | 6,937 | 877,767 |
| 1988 | 0 | 53,815 | (29,747) | 1,097,643 | 4,360 | 1,126,071 | 0 | 39,775 | (29,747) | 1,055,649 | 4,360 | 1,070,037 |
| 1989 | 0 | 49,088 | (60,826) | 1,382,599 | 7,490 | 1,378,351 | 0 | 42,307 | (60,826) | 1,339,358 | 7,490 | 1,328,329 |
| 1990 | 0 | 66,868 | (15,092) | 1,627,246 | 8,879 | 1,687,901 | 0 | 56,663 | (15,092) | 1,590,893 | 8,879 | 1,641,343 |
| 1991 | 0 | 40,564 | 105,176 | 446,148 | 4,560 | 596,448 | 0 | 34,016 | 105,176 | 446,148 | 4,560 | 589,900 |
| 1992 | 0 | 31,820 | (92,123) | 844,376 | 1,995 | 786,068 | 0 | 34,477 | (92,123) | 820,133 | 1,995 | 764,482 |
| 1993 | 0 | 27,158 | (127,738) | 799,143 | 1,676 | 700,239 | 0 | 28,614 | (127,738) | 771,146 | 1,676 | 673,698 |
| 1994 | 0 | 50,802 | (88,211) | 1,007,214 | 2,918 | 972,723 | 0 | 57,203 | (88,211) | 977,703 | 2,918 | 949,613 |
| 1995 | 0 | 48,705 | (16,431) | 586,829 | 1,669 | 620,772 | 0 | 36,309 | (16,431) | 560,695 | 1,669 | 582,242 |
| 1996 | 0 | 58,437 | 15,438 | 836,819 | 2,928 | 913,622 | 0 | 43,710 | 15,438 | 800,633 | 2,928 | 862,709 |
| 1997 | 0 | 73,656 | 40,852 | 918,124 | 2,076 | 1,034,708 | 0 | 62,275 | 40,852 | 881,843 | 2,076 | 987,046 |
| 1998 | 0 | 61,137 | (106,487) | 656,796 | 1,585 | 613,031 | 0 | 47,523 | (106,487) | 628,084 | 1,585 | 570,705 |
| 1999 | 0 | 77,334 | (2,807) | 1,011,608 | 3,279 | 1,089,414 | 0 | 55,514 | (2,807) | 974,807 | 3,279 | 1,030,793 |
| 2000 | 0 | 87,084 | 7,726 | 1,691,120 | 4,216 | 1,790,146 | 0 | 49,690 | 7,726 | 1,651,057 | 4,216 | 1,712,689 |
| 2001 | 0 | 71,588 | (18,830) | 1,233,862 | 1,211 | 1,287,831 | 0 | 54,742 | (18,830) | 1,202,670 | 1,211 | 1,239,793 |
| 2002 | 0 | 108,309 | 50,342 | 1,740,813 | 3,961 | 1,903,425 | 0 | 69,443 | 50,342 | 1,699,261 | 3,961 | 1,823,007 |
| 2003 | 0 | 106,973 | (48,181) | 1,825,617 | 10,645 | 1,895,054 | 0 | 57,291 | (48,181) | 1,789,015 | 10,645 | 1,808,770 |
| 2004 | 0 | 122,559 | 3,161 | 2,032,528 | 649 | 2,158,897 | 0 | 60,847 | 3,161 | 1,992,344 | 649 | 2,057,001 |
| 2005 | 0 | 99,523 | (159,678) | 1,751,799 | 559 | 1,692,203 | 0 | 53,502 | (159,678) | 1,711,929 | 559 | 1,606,312 |
| 2006 | 0 | 128,022 | (120,122) | 1,967,163 | 504 | 1,975,567 | 0 | 46,463 | (120,122) | 1,920,919 | 504 | 1,847,764 |
| 2007 | 0 | 139,502 | 118,196 | 1,910,800 | 305 | 2,168,803 | 0 | 59,454 | 118,196 | 1,863,410 | 305 | 2,041,365 |
| 2008 | 0 | 97,209 | (4,230) | 1,201,345 | 327 | 1,294,651 | 0 | 51,709 | (4,230) | 1,168,316 | 327 | 1,216,122 |
| 2009 | 0 | 88,574 | (726) | 1,169,477 | 1,295 | 1,258,620 | 0 | 43,229 | (726) | 1,146,258 | 1,295 | 1,190,056 |
| 2010 | 0 | 92,345 | 48,231 | 1,409,122 | 603 | 1,550,301 | 0 | 59,808 | 48,231 | 1,389,990 | 603 | 1,498,632 |
| 2011 | 0 | 114,286 | (18,816) | 1,695,956 | 742 | 1,792,168 | 0 | 67,210 | (18,816) | 1,653,798 | 742 | 1,702,934 |
| 2012 | 0 | 114,502 | 14,573 | 1,537,522 | 938 | 1,667,535 | 0 | 70,999 | 14,573 | 1,510,007 | 938 | 1,596,517 |
| 2013 | 0 | 116,975 | (1,058) | 1,190,730 | 795 | 1,307,442 | 0 | 69,572 | (1,058) | 1,162,989 | 795 | 1,232,298 |
| 2014 | 0 | 70,655 | 31,082 | 489,254 | 172 | 591,163 | 0 | 52,458 | 31,082 | 484,432 | 172 | 568,144 |
| 2015 | 0 | 67,819 | 796 | 738,123 | 151 | 806,889 | 0 | 56,466 | 796 | 733,481 | 151 | 790,894 |
| 2016 | 0 | 30,107 | 88,393 | 1,434,458 | 7,010 | 1,559,968 | 0 | 29,857 | 88,393 | 1,413,649 | 7,010 | 1,538,909 |
| **2017** | **0** | **31,460** | **83,000** | **1,525,589** | **7,010** | **1,647,059** | **0** | **31,210** | **83,000** | **1,499,789** | **7,010** | **1,621,009** |
| 2018 | 0 | 31,898 | 38,000 | 1,428,846 | 7,010 | 1,505,754 | 0 | 31,648 | 38,000 | 1,403,046 | 7,010 | 1,479,704 |
| 2019 | 0 | 37,472 | 50,179 | 1,431,732 | 7,010 | 1,526,393 | 0 | 37,222 | 50,179 | 1,405,932 | 7,010 | 1,500,343 |
| 2020 | 0 | 37,536 | (366) | 1,431,732 | 7,010 | 1,475,912 | 0 | 37,286 | (366) | 1,405,932 | 7,010 | 1,449,862 |
| 2021 | 0 | 37,619 | 10,725 | 1,431,732 | 7,010 | 1,487,086 | 0 | 37,369 | 10,725 | 1,405,932 | 7,010 | 1,461,036 |
| 2022 | 0 | 37,613 | (3,483) | 1,431,732 | 7,010 | 1,472,872 | 0 | 37,363 | (3,483) | 1,405,932 | 7,010 | 1,446,822 |
| 2023 | 0 | 37,604 | (18,971) | 1,431,732 | 7,010 | 1,457,375 | 0 | 37,354 | (18,971) | 1,405,932 | 7,010 | 1,431,325 |
| 2024 | 0 | 37,483 | 11,289 | 1,431,732 | 7,010 | 1,487,514 | 0 | 37,233 | 11,289 | 1,405,932 | 7,010 | 1,461,464 |
| 2025 | 0 | 37,546 | (12,518) | 1,431,732 | 7,010 | 1,463,770 | 0 | 37,296 | (12,518) | 1,405,932 | 7,010 | 1,437,720 |
| 2026 | 0 | 37,558 | 24,308 | 1,431,732 | 7,010 | 1,500,608 | 0 | 37,308 | 24,308 | 1,405,932 | 7,010 | 1,474,558 |
| 2027 | 0 | 37,471 | (17,799) | 1,431,732 | 7,010 | 1,458,414 | 0 | 37,221 | (17,799) | 1,405,932 | 7,010 | 1,432,364 |
| 2028 | 0 | 37,611 | 12,291 | 1,431,732 | 7,010 | 1,488,644 | 0 | 37,361 | 12,291 | 1,405,932 | 7,010 | 1,462,594 |
| 2029 | 0 | 37,538 | (9,046) | 1,431,732 | 7,010 | 1,467,234 | 0 | 37,288 | (9,046) | 1,405,932 | 7,010 | 1,441,184 |
| 2030 | 0 | 37,602 | 20,756 | 1,431,732 | 7,010 | 1,497,100 | 0 | 37,352 | 20,756 | 1,405,932 | 7,010 | 1,471,050 |
| 2031 | 0 | 37,474 | (97,726) | 1,431,732 | 7,010 | 1,378,490 | 0 | 37,224 | (97,726) | 1,405,932 | 7,010 | 1,352,440 |
| 2032 | 0 | 37,076 | 84,999 | 1,431,732 | 7,010 | 1,560,817 | 0 | 36,826 | 84,999 | 1,405,932 | 7,010 | 1,534,767 |
| 2033 | 0 | 37,281 | (94,652) | 1,431,732 | 7,010 | 1,381,371 | 0 | 37,031 | (94,652) | 1,405,932 | 7,010 | 1,355,321 |
| 2034 | 0 | 36,773 | 69,593 | 1,431,732 | 7,010 | 1,545,108 | 0 | 36,523 | 69,593 | 1,405,932 | 7,010 | 1,519,058 |
| 2035 | 0 | 36,113 | (242,659) | 1,431,732 | 7,010 | 1,232,196 | 0 | 35,863 | (242,659) | 1,405,932 | 7,010 | 1,206,146 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEHACHAPI DIVSION | | | | | | MOJAVE DIVISION | | | | | |
| | Edmonston Pumping Plant | | | | | | Alamo Pumping Plant | | | | | |
| | | | | Deliveries | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [51] | [52] | [53] | [54] | [55] | [56] | [57] | [58] | [59] | [60] | [61] | [62] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 5,446 | 8 | 0 | 0 | 0 | 5,454 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 100,274 | 16,067 | (6,558) | 74,123 | 6,481 | 190,387 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 204,638 | 34,051 | 1,329 | 207,808 | 1,147 | 448,973 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 237,554 | 18,181 | (15,295) | 313,634 | 2,108 | 556,182 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 103,352 | 20,183 | (693) | 573,219 | 3,358 | 699,419 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 61,122 | 21,096 | (152,171) | 685,768 | 1,581 | 617,396 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 18,424 | (116,219) | 236,086 | 560 | 138,851 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 65,027 | 20,887 | 121,904 | 590,329 | 674 | 798,821 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 12,302 | 46,332 | (51,299) | 568,338 | 502 | 576,175 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 52,967 | (134,009) | 639,743 | 1,262 | 559,963 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 40,602 | 23,359 | 938,482 | 4,112 | 1,006,555 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 37,244 | 117,296 | 812,206 | 4,045 | 970,791 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 40,690 | (101,155) | 431,182 | 7,291 | 378,008 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 42,112 | (115,214) | 556,830 | 5,244 | 488,972 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 45,265 | 139,988 | 792,477 | 4,804 | 982,534 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 36,918 | 37,546 | 823,067 | 3,285 | 900,816 | 0 | 14,735 | 12,258 | 429,864 | 1,508 | 458,365 |
| 1987 | 0 | 29,580 | (25,522) | 851,322 | 6,937 | 862,317 | 0 | 11,665 | (15,270) | 417,870 | 1,239 | 415,504 |
| 1988 | 0 | 42,017 | (29,747) | 1,044,737 | 4,360 | 1,061,367 | 0 | 21,696 | 1,101 | 537,568 | 971 | 561,336 |
| 1989 | 0 | 32,270 | (60,826) | 1,328,041 | 7,490 | 1,306,975 | 0 | 4,686 | (20,363) | 716,360 | 1,407 | 702,090 |
| 1990 | 0 | 42,198 | (15,092) | 1,579,466 | 8,879 | 1,615,451 | 0 | 8,898 | (5,916) | 788,111 | 1,388 | 792,481 |
| 1991 | 0 | 33,999 | 105,176 | 441,217 | 4,560 | 584,952 | 0 | 17,908 | 34,422 | 177,308 | 394 | 230,032 |
| 1992 | 0 | 23,121 | (92,123) | 809,771 | 1,995 | 742,764 | 0 | 14,873 | (17,115) | 374,110 | 423 | 372,291 |
| 1993 | 0 | 11,946 | (127,738) | 759,485 | 1,676 | 645,369 | 0 | 9,304 | (3,455) | 308,222 | 443 | 314,514 |
| 1994 | 0 | 40,808 | (88,211) | 960,815 | 2,918 | 916,330 | 0 | 21,837 | 3,395 | 469,996 | 430 | 495,658 |
| 1995 | 0 | 36,001 | (16,431) | 542,465 | 1,669 | 563,704 | 0 | 14,139 | (30,761) | 384,836 | 427 | 368,641 |
| 1996 | 0 | 37,357 | 15,438 | 779,918 | 2,928 | 835,641 | 0 | 7,247 | (11,410) | 493,852 | 565 | 490,254 |
| 1997 | 0 | 51,475 | 40,852 | 860,798 | 2,076 | 955,201 | 0 | 20,725 | 38,960 | 537,586 | 507 | 597,778 |
| 1998 | 0 | 48,601 | (106,487) | 607,301 | 1,585 | 551,000 | 0 | 21,456 | 16,361 | 398,385 | 363 | 436,565 |
| 1999 | 0 | 52,726 | (2,807) | 947,420 | 3,279 | 1,000,618 | 0 | 26,644 | (8,486) | 589,756 | 396 | 608,310 |
| 2000 | 0 | 43,072 | 7,726 | 1,627,123 | 4,216 | 1,682,137 | 0 | 8,983 | (10,472) | 958,997 | 449 | 957,957 |
| 2001 | 0 | 39,544 | (18,830) | 1,187,300 | 1,211 | 1,209,225 | 0 | 14,526 | 3,478 | 709,985 | 452 | 728,441 |
| 2002 | 0 | 60,037 | 50,342 | 1,680,514 | 3,961 | 1,794,854 | 0 | 15,190 | 8,398 | 901,230 | 490 | 925,308 |
| 2003 | 0 | 53,320 | (48,181) | 1,771,048 | 10,645 | 1,786,832 | 0 | 13,676 | (20,787) | 1,035,349 | 355 | 1,028,593 |
| 2004 | 0 | 57,962 | 3,161 | 1,970,391 | 649 | 2,032,163 | 0 | 15,581 | 17,207 | 1,120,384 | 171 | 1,153,343 |
| 2005 | 0 | 40,949 | (159,678) | 1,693,409 | 559 | 1,575,239 | 0 | 2,561 | (50,014) | 1,116,158 | 84 | 1,068,789 |
| 2006 | 0 | 52,291 | (120,122) | 1,898,070 | 504 | 1,830,743 | 0 | 13,170 | 8,653 | 1,281,524 | 98 | 1,303,445 |
| 2007 | 0 | 65,423 | 118,196 | 1,836,977 | 305 | 2,020,901 | 0 | 17,957 | (5,091) | 1,076,227 | 103 | 1,089,196 |
| 2008 | 0 | 50,959 | (4,230) | 1,146,056 | 327 | 1,193,112 | 0 | 14,592 | 5,383 | 614,224 | 80 | 634,279 |
| 2009 | 0 | 59,186 | (726) | 1,125,654 | 1,295 | 1,185,409 | 0 | 25,599 | (5,619) | 493,685 | 1,100 | 514,765 |
| 2010 | 0 | 61,816 | 48,231 | 1,369,128 | 603 | 1,479,778 | 0 | 33,660 | 6,964 | 956,888 | 363 | 997,875 |
| 2011 | 0 | 64,370 | (18,816) | 1,632,033 | 742 | 1,678,329 | 0 | 34,783 | (1,405) | 1,220,667 | 500 | 1,254,545 |
| 2012 | 0 | 65,684 | 14,573 | 1,486,712 | 938 | 1,567,907 | 0 | 22,523 | (229) | 892,938 | 550 | 915,782 |
| 2013 | 0 | 69,789 | (1,058) | 1,141,530 | 795 | 1,211,056 | 0 | 20,563 | 3,278 | 528,614 | 501 | 552,956 |
| 2014 | 0 | 43,179 | 31,082 | 465,759 | 172 | 540,192 | 0 | 16,120 | 41,923 | 160,225 | 81 | 218,349 |
| 2015 | 0 | 43,312 | 796 | 714,860 | 151 | 759,119 | 0 | 10,834 | (7,803) | 248,779 | 71 | 251,881 |
| 2016 | 0 | 28,307 | 88,393 | 1,392,963 | 7,010 | 1,516,673 | 0 | 17,263 | 6,393 | 892,086 | 1,630 | 917,372 |
| **2017** | **0** | **29,660** | **83,000** | **1,477,973** | **7,010** | **1,597,643** | **0** | **17,245** | **10,000** | **822,530** | **1,630** | **851,405** |
| 2018 | 0 | 30,098 | 38,000 | 1,381,230 | 7,010 | 1,456,338 | 0 | 18,043 | 38,000 | 746,242 | 1,630 | 803,915 |
| 2019 | 0 | 35,672 | 50,179 | 1,384,116 | 7,010 | 1,476,977 | 0 | 20,924 | 31,508 | 749,128 | 1,630 | 803,190 |
| 2020 | 0 | 35,736 | (366) | 1,384,116 | 7,010 | 1,426,496 | 0 | 20,947 | (3,398) | 749,128 | 1,630 | 768,307 |
| 2021 | 0 | 35,819 | 10,725 | 1,384,116 | 7,010 | 1,437,670 | 0 | 20,946 | (1,117) | 749,128 | 1,630 | 770,587 |
| 2022 | 0 | 35,813 | (3,483) | 1,384,116 | 7,010 | 1,423,456 | 0 | 20,940 | (3,434) | 749,128 | 1,630 | 768,264 |
| 2023 | 0 | 35,804 | (18,971) | 1,384,116 | 7,010 | 1,407,959 | 0 | 20,939 | (18,638) | 749,128 | 1,630 | 753,059 |
| 2024 | 0 | 35,683 | 11,289 | 1,384,116 | 7,010 | 1,438,098 | 0 | 20,881 | 21,309 | 749,128 | 1,630 | 792,948 |
| 2025 | 0 | 35,746 | (12,518) | 1,384,116 | 7,010 | 1,414,354 | 0 | 20,965 | (11,624) | 749,128 | 1,630 | 760,099 |
| 2026 | 0 | 35,758 | 24,308 | 1,384,116 | 7,010 | 1,451,192 | 0 | 20,930 | 13,030 | 749,128 | 1,630 | 784,718 |
| 2027 | 0 | 35,671 | (17,799) | 1,384,116 | 7,010 | 1,408,998 | 0 | 20,861 | (6,161) | 749,128 | 1,630 | 765,458 |
| 2028 | 0 | 35,811 | 12,291 | 1,384,116 | 7,010 | 1,439,228 | 0 | 20,961 | 4,006 | 749,128 | 1,630 | 775,725 |
| 2029 | 0 | 35,738 | (9,046) | 1,384,116 | 7,010 | 1,417,818 | 0 | 20,955 | (913) | 749,128 | 1,630 | 770,800 |
| 2030 | 0 | 35,802 | 20,756 | 1,384,116 | 7,010 | 1,447,684 | 0 | 20,930 | 8,528 | 749,128 | 1,630 | 780,216 |
| 2031 | 0 | 35,674 | (97,726) | 1,384,116 | 7,010 | 1,329,074 | 0 | 20,956 | (31,057) | 749,128 | 1,630 | 740,657 |
| 2032 | 0 | 35,276 | 84,999 | 1,384,116 | 7,010 | 1,511,401 | 0 | 20,865 | 43,953 | 749,128 | 1,630 | 815,576 |
| 2033 | 0 | 35,481 | (94,652) | 1,384,116 | 7,010 | 1,331,955 | 0 | 20,854 | (37,929) | 749,128 | 1,630 | 733,683 |
| 2034 | 0 | 34,973 | 69,593 | 1,384,116 | 7,010 | 1,495,692 | 0 | 20,769 | 28,588 | 749,128 | 1,630 | 800,115 |
| 2035 | 0 | 34,313 | (242,659) | 1,384,116 | 7,010 | 1,182,780 | 0 | 20,892 | (49,219) | 749,128 | 1,630 | 722,431 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | | | | | | | | | |
| | Pearblossom Pumping Plant | | | | | | Mojave Siphon Powerplant | | | | | |
| | | | | Deliveries | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [63] | [64] | [65] | [66] | [67] | [68] | [69] | [70] | [71] | [72] | [73] | [74] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 21 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 35,243 | 5,282 | (153) | 1,794 | 0 | 42,166 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 80,177 | 21,522 | (2,700) | 52,201 | 72 | 151,272 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 76,694 | 10,847 | (11,149) | 102,839 | 44 | 179,275 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 10,000 | 2,364 | (8,397) | 190,351 | 70 | 194,388 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 4,168 | 7,040 | (16,055) | 236,713 | 152 | 232,018 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 11,398 | (17,534) | 102,326 | 580 | 96,770 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 19,922 | 5,696 | 69,130 | 374,845 | 498 | 470,091 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 12,302 | 6,836 | (32,518) | 362,114 | 502 | 349,236 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 16,200 | 6,159 | 401,214 | 781 | 424,354 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 4,992 | (36,278) | 574,573 | 933 | 544,220 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 5,251 | 55,232 | 401,037 | 1,919 | 463,439 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 11,745 | (26,847) | 231,188 | 1,180 | 217,266 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 18,228 | 23,230 | 252,066 | 1,494 | 295,018 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 25,292 | (2,815) | 350,758 | 1,076 | 374,311 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 30,876 | 12,258 | 394,156 | 1,508 | 438,798 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 27,552 | (15,270) | 377,531 | 1,239 | 391,052 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 32,209 | 1,101 | 501,300 | 971 | 535,581 | 0 | 1,977 | 1,101 | 501,291 | 971 | 505,340 |
| 1989 | 0 | 31,500 | (20,363) | 661,189 | 1,407 | 673,733 | 0 | 29,110 | (20,363) | 661,100 | 1,407 | 671,254 |
| 1990 | 0 | 32,672 | (5,916) | 730,560 | 1,388 | 758,704 | 0 | 23,692 | (5,916) | 730,550 | 1,388 | 749,714 |
| 1991 | 0 | 15,209 | 34,774 | 163,913 | 394 | 214,290 | 0 | (543) | 34,774 | 163,913 | 394 | 198,538 |
| 1992 | 0 | 13,989 | (17,451) | 338,249 | 423 | 335,210 | 0 | (13,193) | (17,451) | 338,207 | 423 | 307,986 |
| 1993 | 0 | 9,779 | (3,455) | 255,117 | 443 | 261,884 | 0 | (11,922) | (3,455) | 255,117 | 443 | 240,183 |
| 1994 | 0 | 150 | 3,395 | 409,928 | 430 | 413,903 | 0 | 1,601 | 3,395 | 395,294 | 430 | 400,720 |
| 1995 | 0 | 6,820 | (29,282) | 328,882 | 427 | 306,847 | 0 | 10,458 | (29,282) | 321,387 | 427 | 302,990 |
| 1996 | 0 | 9,514 | (11,410) | 424,252 | 565 | 422,921 | 0 | (5,577) | (11,410) | 418,141 | 565 | 401,719 |
| 1997 | 0 | (1,124) | 38,960 | 461,563 | 507 | 499,906 | 0 | 5,171 | 38,960 | 452,525 | 507 | 497,163 |
| 1998 | 0 | (2,087) | 16,361 | 334,965 | 363 | 349,602 | 0 | 11,496 | 16,361 | 332,385 | 363 | 360,605 |
| 1999 | 0 | (1,154) | (8,486) | 505,624 | 396 | 496,380 | 0 | 11,065 | (8,486) | 498,919 | 396 | 501,894 |
| 2000 | 0 | (23,296) | (10,472) | 864,999 | 449 | 831,680 | 0 | 4,896 | (10,472) | 854,980 | 449 | 849,853 |
| 2001 | 0 | (9,304) | 3,478 | 635,316 | 452 | 629,942 | 0 | 7,403 | 3,478 | 632,420 | 452 | 643,753 |
| 2002 | 0 | 3,810 | 8,398 | 823,690 | 490 | 836,388 | 0 | 9,300 | 8,398 | 820,217 | 490 | 838,405 |
| 2003 | 0 | 2,814 | (20,787) | 962,488 | 355 | 944,870 | 0 | (6,586) | (20,787) | 941,713 | 355 | 914,695 |
| 2004 | 0 | (15,558) | 17,207 | 1,047,521 | 171 | 1,049,341 | 0 | 5,034 | 17,207 | 1,035,315 | 171 | 1,057,727 |
| 2005 | 0 | (18,967) | (50,014) | 1,043,564 | 84 | 974,667 | 0 | 827 | (50,014) | 1,025,453 | 84 | 976,350 |
| 2006 | 0 | (21,986) | 8,653 | 1,187,627 | 98 | 1,174,392 | 0 | (845) | 8,653 | 1,154,634 | 98 | 1,162,540 |
| 2007 | 0 | (13,055) | (5,091) | 975,802 | 103 | 957,759 | 0 | 3,060 | (5,091) | 956,281 | 103 | 954,353 |
| 2008 | 0 | 723 | 5,383 | 550,143 | 80 | 556,329 | 0 | 8,380 | 5,383 | 534,480 | 80 | 548,323 |
| 2009 | 0 | 3,807 | (5,619) | 431,289 | 1,100 | 430,577 | 0 | 10,520 | (5,619) | 411,075 | 1,100 | 417,076 |
| 2010 | 0 | 3,489 | 6,964 | 886,249 | 363 | 897,065 | 0 | 11,912 | 6,964 | 858,609 | 363 | 877,848 |
| 2011 | 0 | 7,953 | (1,405) | 1,114,556 | 500 | 1,121,604 | 0 | 13,506 | (1,405) | 1,080,734 | 500 | 1,093,335 |
| 2012 | 0 | 3,499 | (229) | 797,563 | 550 | 801,383 | 0 | 3,492 | (229) | 775,600 | 550 | 779,413 |
| 2013 | 0 | 6,273 | 3,278 | 466,095 | 501 | 476,147 | 0 | 12,172 | 3,278 | 460,089 | 501 | 476,040 |
| 2014 | 0 | 11,143 | 41,923 | 133,376 | 81 | 186,523 | 0 | 13,671 | 41,923 | 130,752 | 81 | 186,427 |
| 2015 | 0 | 7,067 | (7,803) | 229,244 | 71 | 228,579 | 0 | 9,953 | (7,803) | 221,321 | 71 | 223,542 |
| 2016 | 0 | 11,913 | 6,393 | 791,356 | 1,430 | 811,092 | 0 | 8,443 | 6,393 | 780,447 | 1,430 | 796,713 |
| **2017** | **0** | **11,895** | **10,000** | **713,938** | **1,430** | **737,263** | **0** | **8,425** | **10,000** | **680,773** | **1,430** | **700,628** |
| 2018 | 0 | 12,693 | 38,000 | 637,650 | 1,430 | 689,773 | 0 | 9,223 | 38,000 | 604,485 | 1,430 | 653,138 |
| 2019 | 0 | 15,574 | 31,508 | 642,602 | 1,430 | 691,114 | 0 | 12,104 | 31,508 | 606,987 | 1,430 | 652,029 |
| 2020 | 0 | 15,597 | (3,398) | 642,602 | 1,430 | 656,231 | 0 | 12,127 | (3,398) | 606,987 | 1,430 | 617,146 |
| 2021 | 0 | 15,596 | (1,117) | 642,602 | 1,430 | 658,511 | 0 | 12,126 | (1,117) | 606,987 | 1,430 | 619,426 |
| 2022 | 0 | 15,590 | (3,434) | 642,602 | 1,430 | 656,188 | 0 | 12,120 | (3,434) | 606,987 | 1,430 | 617,103 |
| 2023 | 0 | 15,589 | (18,638) | 642,602 | 1,430 | 640,983 | 0 | 12,119 | (18,638) | 606,987 | 1,430 | 601,898 |
| 2024 | 0 | 15,531 | 21,309 | 642,602 | 1,430 | 680,872 | 0 | 12,061 | 21,309 | 606,987 | 1,430 | 641,787 |
| 2025 | 0 | 15,615 | (11,624) | 642,602 | 1,430 | 648,023 | 0 | 12,145 | (11,624) | 606,987 | 1,430 | 608,938 |
| 2026 | 0 | 15,580 | 13,030 | 642,602 | 1,430 | 672,642 | 0 | 12,110 | 13,030 | 606,987 | 1,430 | 633,557 |
| 2027 | 0 | 15,511 | (6,161) | 642,602 | 1,430 | 653,382 | 0 | 12,041 | (6,161) | 606,987 | 1,430 | 614,297 |
| 2028 | 0 | 15,611 | 4,006 | 642,602 | 1,430 | 663,649 | 0 | 12,141 | 4,006 | 606,987 | 1,430 | 624,564 |
| 2029 | 0 | 15,605 | (913) | 642,602 | 1,430 | 658,724 | 0 | 12,135 | (913) | 606,987 | 1,430 | 619,639 |
| 2030 | 0 | 15,580 | 8,528 | 642,602 | 1,430 | 668,140 | 0 | 12,110 | 8,528 | 606,987 | 1,430 | 629,055 |
| 2031 | 0 | 15,606 | (31,057) | 642,602 | 1,430 | 628,581 | 0 | 12,136 | (31,057) | 606,987 | 1,430 | 589,496 |
| 2032 | 0 | 15,515 | 43,953 | 642,602 | 1,430 | 703,500 | 0 | 12,045 | 43,953 | 606,987 | 1,430 | 664,415 |
| 2033 | 0 | 15,504 | (37,929) | 642,602 | 1,430 | 621,607 | 0 | 12,034 | (37,929) | 606,987 | 1,430 | 582,522 |
| 2034 | 0 | 15,419 | 28,588 | 642,602 | 1,430 | 688,039 | 0 | 11,949 | 28,588 | 606,987 | 1,430 | 648,954 |
| 2035 | 0 | 15,542 | (49,219) | 642,602 | 1,430 | 610,355 | 0 | 12,072 | (49,219) | 606,987 | 1,430 | 571,270 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SANTA ANA DIVISION | | | | | | | | | |
| | Devil Canyon Powerplant | | | | | | Greenspot Pump Station | | | |
| | | | | Deliveries | | | | | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Water Supply Delivery | Total |
| | [75] | [76] | [77] | [78] | [79] | [80] | [81] | [82] | [83] | [84] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 37 | 0 | 0 | 1,275 | 0 | 1,312 | 0 | 0 | 0 | 0 |
| 1973 | 40,848 | 14,745 | 0 | 51,812 | 0 | 107,405 | 0 | 0 | 0 | 0 |
| 1974 | 74,666 | 8,367 | (4,925) | 102,198 | 0 | 180,306 | 0 | 0 | 0 | 0 |
| 1975 | 10,000 | 1,995 | (6,719) | 189,526 | 0 | 194,802 | 0 | 0 | 0 | 0 |
| 1976 | 4,168 | 5,180 | (9,182) | 235,711 | 23 | 235,900 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 8,082 | (5,235) | 101,137 | 469 | 104,453 | 0 | 0 | 0 | 0 |
| 1978 | 14,820 | 3,754 | 21,686 | 373,636 | 481 | 414,377 | 0 | 0 | 0 | 0 |
| 1979 | 12,302 | 5,620 | (27,107) | 356,854 | 485 | 348,154 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 9,468 | 12,714 | 395,975 | 742 | 418,899 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 8,401 | (23,448) | 569,088 | 807 | 554,848 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 6,012 | 44,469 | 399,799 | 1,798 | 452,078 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 8,597 | 5,188 | 230,277 | 1,078 | 245,140 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 12,861 | (850) | 250,938 | 1,414 | 264,363 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 14,325 | (8,791) | 349,336 | 956 | 355,826 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 9,486 | 8,339 | 392,650 | 1,378 | 411,853 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 7,923 | (11,335) | 375,451 | 1,118 | 373,157 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 11,090 | 2,238 | 499,285 | 861 | 513,474 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 13,116 | (5,487) | 658,730 | 1,301 | 667,660 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 13,439 | (4,622) | 728,723 | 1,281 | 738,821 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 10,836 | 18,308 | 161,032 | 340 | 190,516 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 9,157 | (9,084) | 328,354 | 371 | 328,798 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 5,602 | 5,593 | 244,678 | 364 | 256,237 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 10,915 | (11,045) | 393,690 | 357 | 393,917 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 11,268 | 2,331 | 320,978 | 358 | 334,935 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 9,496 | 13,015 | 417,656 | 494 | 440,661 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 8,087 | (19,685) | 451,874 | 416 | 440,692 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 6,700 | 16,643 | 332,198 | 310 | 355,851 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 9,784 | (4,177) | 497,787 | 341 | 503,735 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 7,407 | (11,040) | 853,786 | 375 | 850,528 | 0 | 0 | | 0 |
| 2001 | 0 | 9,324 | 8,183 | 631,363 | 374 | 649,244 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 10,315 | 9,682 | 818,028 | 413 | 838,438 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 9,198 | (18,298) | 922,901 | 260 | 914,061 | 0 | 0 | 4,526 | 4,526 |
| 2004 | 0 | 11,166 | 15,150 | 1,033,309 | 85 | 1,059,710 | 0 | 0 | 3,798 | 3,798 |
| 2005 | 0 | 4,500 | (63,441) | 1,010,247 | 0 | 951,306 | 0 | 0 | 3,686 | 3,686 |
| 2006 | 0 | 8,208 | 7,571 | 1,153,993 | 0 | 1,169,772 | 0 | 0 | 7,775 | 7,775 |
| 2007 | 0 | 8,216 | (5,872) | 953,803 | 0 | 956,147 | 0 | 0 | 12,168 | 12,168 |
| 2008 | 0 | 10,599 | 7,759 | 533,221 | 0 | 551,579 | 0 | 0 | 14,408 | 14,408 |
| 2009 | 0 | 10,035 | (5,600) | 410,032 | 1,025 | 415,492 | 0 | 0 | 20,542 | 20,542 |
| 2010 | 0 | 6,275 | 5,344 | 851,786 | 307 | 863,712 | 0 | 0 | 18,395 | 18,395 |
| 2011 | 0 | 7,359 | 2,371 | 1,066,088 | 417 | 1,076,235 | 0 | 0 | 20,586 | 20,586 |
| 2012 | 0 | (1,942) | (2,225) | 771,982 | 459 | 768,274 | 0 | 0 | 23,791 | 23,791 |
| 2013 | 0 | 3,306 | 3,042 | 458,221 | 416 | 464,985 | 0 | 0 | 20,560 | 20,560 |
| 2014 | 0 | 9,919 | 42,495 | 129,317 | 27 | 181,758 | 0 | 0 | 9,843 | 9,843 |
| 2015 | 0 | 8,923 | (4,305) | 220,068 | 35 | 224,721 | 0 | 0 | 9,791 | 9,791 |
| 2016 | 0 | 5,241 | 393 | 778,327 | 1,250 | 785,211 | 0 | 0 | 10,566 | 10,566 |
| **2017** | **0** | **5,544** | **10,000** | **670,893** | **1,250** | **687,687** | **0** | **0** | **10,380** | **10,380** |
| 2018 | 0 | 6,465 | 38,000 | 595,005 | 1,250 | 640,720 | 0 | 0 | 10,380 | 10,380 |
| 2019 | 0 | 8,492 | 17,408 | 597,507 | 1,250 | 624,657 | 0 | 0 | 10,380 | 10,380 |
| 2020 | 0 | 8,483 | (17,305) | 597,507 | 1,250 | 589,935 | 0 | 0 | 10,380 | 10,380 |
| 2021 | 0 | 8,486 | (398) | 597,507 | 1,250 | 606,845 | 0 | 0 | 10,380 | 10,380 |
| 2022 | 0 | 8,486 | 13,735 | 597,507 | 1,250 | 620,978 | 0 | 0 | 10,380 | 10,380 |
| 2023 | 0 | 8,482 | (8,417) | 597,507 | 1,250 | 598,822 | 0 | 0 | 10,380 | 10,380 |
| 2024 | 0 | 8,462 | 689 | 597,507 | 1,250 | 607,908 | 0 | 0 | 10,380 | 10,380 |
| 2025 | 0 | 8,489 | 4,591 | 597,507 | 1,250 | 611,837 | 0 | 0 | 10,380 | 10,380 |
| 2026 | 0 | 8,475 | (3,819) | 597,507 | 1,250 | 603,413 | 0 | 0 | 10,380 | 10,380 |
| 2027 | 0 | 8,479 | 745 | 597,507 | 1,250 | 607,981 | 0 | 0 | 10,380 | 10,380 |
| 2028 | 0 | 8,481 | (5,355) | 597,507 | 1,250 | 601,883 | 0 | 0 | 10,380 | 10,380 |
| 2029 | 0 | 8,481 | 2,909 | 597,507 | 1,250 | 610,147 | 0 | 0 | 10,380 | 10,380 |
| 2030 | 0 | 8,480 | 296 | 597,507 | 1,250 | 607,533 | 0 | 0 | 10,380 | 10,380 |
| 2031 | 0 | 8,475 | (1,976) | 597,507 | 1,250 | 605,256 | 0 | 0 | 10,380 | 10,380 |
| 2032 | 0 | 8,449 | 18,821 | 597,507 | 1,250 | 626,027 | 0 | 0 | 10,380 | 10,380 |
| 2033 | 0 | 8,449 | (23,419) | 597,507 | 1,250 | 583,787 | 0 | 0 | 10,380 | 10,380 |
| 2034 | 0 | 8,443 | 21,651 | 597,507 | 1,250 | 628,851 | 0 | 0 | 10,380 | 10,380 |
| 2035 | 0 | 8,451 | (31,434) | 597,507 | 1,250 | 575,774 | 0 | 0 | 10,380 | 10,380 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SANTA ANA DIVISION (continued) | | | | | | | | WEST BRANCH | | | | | |
| | Crafton Hills Pump Station | | | | Cherry Valley Pump Station | | | | Oso Pumping Plant | | | | | |
| | | | | | | | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Water Supply Delivery | Total | Initial Fill Water | Operational Losses | Water Supply Delivery | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [85] | [86] | [87] | [88] | [89] | [90] | [91] | [92] | [93] | [94] | [95] | [96] | [97] | [98] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,444 | 133 | 0 | 0 | 0 | 2,577 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63,883 | 6,557 | (6,405) | 71,991 | 6,481 | 142,507 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124,461 | 16,995 | 4,029 | 155,317 | 1,075 | 301,877 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 160,860 | 12,702 | (4,146) | 209,172 | 2,064 | 380,652 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 93,352 | 23,008 | 7,704 | 374,306 | 3,288 | 501,658 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56,954 | 15,845 | (136,116) | 420,708 | 1,429 | 358,820 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,407 | (98,685) | 122,447 | (20) | 28,149 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45,105 | 9,061 | 52,774 | 171,139 | 176 | 278,255 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,355 | (18,781) | 145,598 | 0 | 152,172 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24,576 | (140,168) | 165,931 | 481 | 50,820 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15,254 | 59,637 | 283,264 | 3,179 | 361,334 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23,824 | 61,685 | 360,878 | 2,126 | 448,513 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23,601 | (74,308) | 166,995 | 6,111 | 122,399 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,461 | (138,146) | 272,101 | 3,750 | 150,166 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28,257 | 142,219 | 403,097 | 3,728 | 577,301 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22,387 | 25,288 | 393,203 | 1,777 | 442,655 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18,164 | (10,252) | 433,452 | 5,698 | 447,062 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20,461 | (30,848) | 507,169 | 3,389 | 500,171 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27,914 | (40,463) | 611,681 | 6,083 | 605,215 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33,666 | (9,176) | 791,355 | 7,491 | 823,336 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16,460 | 70,754 | 263,909 | 4,166 | 355,289 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,238 | (75,008) | 435,661 | 1,572 | 370,463 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,674 | (124,283) | 451,263 | 1,233 | 330,887 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18,688 | (91,606) | 490,819 | 2,488 | 420,389 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21,775 | 14,330 | 157,629 | 1,242 | 194,976 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30,121 | 26,848 | 286,066 | 2,363 | 345,398 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30,468 | 1,892 | 323,212 | 1,569 | 357,141 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26,851 | (122,848) | 208,916 | 1,222 | 114,141 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25,690 | 5,679 | 357,664 | 2,883 | 391,916 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33,658 | 18,198 | 668,126 | 3,767 | 723,749 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24,551 | (22,308) | 477,315 | 759 | 480,317 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44,692 | 41,944 | 779,284 | 3,471 | 869,391 |
| 2003 | 0 | 0 | 2,733 | 2,733 | 0 | 0 | 116 | 116 | 0 | 39,495 | (27,394) | 735,699 | 10,290 | 758,090 |
| 2004 | 0 | 0 | 3,212 | 3,212 | 0 | 0 | 841 | 841 | 0 | 41,947 | (14,046) | 850,007 | 478 | 878,386 |
| 2005 | 0 | 0 | 2,727 | 2,727 | 0 | 0 | 692 | 692 | 0 | 38,154 | (109,664) | 577,251 | 475 | 506,216 |
| 2006 | 0 | 0 | 6,892 | 6,892 | 0 | 0 | 807 | 807 | 0 | 38,534 | (128,775) | 616,546 | 406 | 526,711 |
| 2007 | 0 | 0 | 9,038 | 9,038 | 0 | 0 | 177 | 177 | 0 | 46,921 | 123,287 | 760,750 | 202 | 931,160 |
| 2008 | 0 | 0 | 13,728 | 13,728 | 0 | 0 | 1,042 | 1,042 | 0 | 36,204 | (9,613) | 531,832 | 247 | 558,670 |
| 2009 | 0 | 0 | 16,463 | 16,463 | 0 | 0 | 1,898 | 1,898 | 0 | 33,295 | 4,893 | 631,969 | 195 | 670,352 |
| 2010 | 0 | 0 | 17,778 | 17,778 | 0 | 0 | 5,685 | 5,685 | 0 | 27,788 | 41,267 | 412,240 | 240 | 481,535 |
| 2011 | 0 | 0 | 19,887 | 19,887 | 0 | 0 | 9,290 | 9,290 | 0 | 29,227 | (17,411) | 411,366 | 242 | 423,424 |
| 2012 | 0 | 0 | 20,614 | 20,614 | 0 | 0 | 11,010 | 11,010 | 0 | 42,913 | 14,802 | 593,774 | 388 | 651,877 |
| 2013 | 0 | 0 | 17,526 | 17,526 | 0 | 0 | 9,445 | 9,445 | 0 | 49,029 | (4,336) | 612,912 | 294 | 657,899 |
| 2014 | 0 | 0 | 9,468 | 9,468 | 0 | 0 | 5,044 | 5,044 | 0 | 27,005 | (10,841) | 305,533 | 91 | 321,788 |
| 2015 | 0 | 0 | 9,409 | 9,409 | 0 | 0 | 3,481 | 3,481 | 0 | 32,430 | 8,599 | 466,081 | 80 | 507,190 |
| 2016 | 0 | 0 | 10,288 | 10,288 | 0 | 0 | 8,335 | 8,335 | 0 | 10,994 | 82,000 | 500,877 | 5,380 | 599,251 |
| **2017** | **0** | **0** | **10,380** | **10,380** | **0** | **0** | **8,180** | **8,180** | **0** | **12,365** | **73,000** | **655,443** | **5,380** | **746,188** |
| 2018 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 8,080 | 8,080 | 0 | 12,005 | 0 | 634,988 | 5,380 | 652,373 |
| 2019 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,980 | 7,980 | 0 | 14,698 | 18,671 | 634,988 | 5,380 | 673,737 |
| 2020 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,739 | 3,032 | 634,988 | 5,380 | 658,139 |
| 2021 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,823 | 11,842 | 634,988 | 5,380 | 667,033 |
| 2022 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,823 | (49) | 634,988 | 5,380 | 655,142 |
| 2023 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,815 | (333) | 634,988 | 5,380 | 654,850 |
| 2024 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,752 | (10,020) | 634,988 | 5,380 | 645,100 |
| 2025 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,731 | (894) | 634,988 | 5,380 | 654,205 |
| 2026 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,778 | 11,278 | 634,988 | 5,380 | 666,424 |
| 2027 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,760 | (11,638) | 634,988 | 5,380 | 643,490 |
| 2028 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,800 | 8,285 | 634,988 | 5,380 | 663,453 |
| 2029 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,733 | (8,133) | 634,988 | 5,380 | 646,968 |
| 2030 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,822 | 12,228 | 634,988 | 5,380 | 667,418 |
| 2031 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,668 | (66,669) | 634,988 | 5,380 | 588,367 |
| 2032 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,361 | 41,046 | 634,988 | 5,380 | 695,775 |
| 2033 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,577 | (56,723) | 634,988 | 5,380 | 598,222 |
| 2034 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 14,154 | 41,005 | 634,988 | 5,380 | 695,527 |
| 2035 | 0 | 0 | 10,380 | 10,380 | 0 | 0 | 7,880 | 7,880 | 0 | 13,371 | (193,440) | 634,988 | 5,380 | 460,299 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WEST BRANCH (continued) | | | | | | | | | | | |
| | Warne Powerplant | | | | | | Castaic Powerplant | | | | | |
| | | | | Deliveries | | | | | | Deliveries | | |
| Calendar Year | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total | Initial Fill Water | Operational Losses | Reservoir Storage Changes | Water Supply | Recreation | Total |
| | [99] | [100] | [101] | [102] | [103] | [104] | [105] | [106] | [107] | [108] | [109] | [110] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 57,364 | 1,788 | (6,162) | 71,938 | 6,481 | 131,409 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 37,198 | 6,430 | 4,542 | 155,297 | 1,075 | 204,542 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 82,364 | 1,772 | (950) | 209,136 | 541 | 292,863 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 90,460 | 5,002 | (1,534) | 374,280 | 1,563 | 469,771 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 55,990 | (7,695) | (132,036) | 420,684 | 1,429 | 338,372 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (1,485) | (102,532) | 122,447 | (20) | 18,410 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 45,105 | (2,264) | 129,523 | 171,139 | 176 | 343,679 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (2,339) | (20,400) | 145,598 | 0 | 122,859 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 991 | (118,026) | 165,931 | 481 | 49,377 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (44,416) | 47,244 | 283,264 | 2,704 | 288,796 |
| 1982 | 0 | 24,468 | 61,169 | 360,878 | 2,126 | 448,641 | 0 | (60,135) | 59,069 | 360,878 | 1,187 | 360,999 |
| 1983 | 0 | 20,780 | (74,308) | 166,995 | 6,111 | 119,578 | 0 | (33,418) | (46,904) | 166,995 | 2,618 | 89,291 |
| 1984 | 0 | 13,572 | (139,219) | 275,212 | 2,208 | 151,773 | 0 | (29,618) | (139,545) | 275,212 | 2,201 | 108,250 |
| 1985 | 0 | 29,286 | 141,492 | 403,097 | 874 | 574,749 | 0 | (4,622) | 135,007 | 403,097 | 844 | 534,326 |
| 1986 | 0 | 21,579 | 25,288 | 393,203 | 1,777 | 441,847 | 0 | (6,664) | 21,520 | 393,203 | 623 | 408,682 |
| 1987 | 0 | 20,885 | (10,252) | 433,452 | 5,698 | 449,783 | 0 | (519) | (6,241) | 433,452 | 2,734 | 429,426 |
| 1988 | 0 | 23,253 | (31,453) | 507,169 | 3,389 | 502,358 | 0 | 12,650 | (28,498) | 507,169 | 1,359 | 492,680 |
| 1989 | 0 | 27,131 | (40,463) | 611,681 | 6,083 | 604,432 | 0 | 634 | (40,154) | 611,681 | 3,161 | 575,322 |
| 1990 | 0 | 34,208 | (9,176) | 791,355 | 7,491 | 823,878 | 0 | (14,012) | (15,101) | 786,519 | 3,419 | 760,825 |
| 1991 | 0 | 16,908 | 70,754 | 263,909 | 4,166 | 355,737 | 0 | (871) | 89,637 | 262,921 | 2,283 | 353,970 |
| 1992 | 0 | 9,638 | (75,008) | 435,661 | 1,572 | 371,863 | 0 | (609) | (71,795) | 435,661 | 1,543 | 364,800 |
| 1993 | 0 | 1,922 | (124,283) | 451,257 | 1,233 | 330,129 | 0 | 21,959 | (77,428) | 451,257 | 1,211 | 396,999 |
| 1994 | 0 | 23,151 | (91,606) | 490,819 | 2,488 | 424,852 | 0 | 5,205 | (95,738) | 490,819 | 2,465 | 402,751 |
| 1995 | 0 | 15,860 | 14,330 | 157,629 | 1,242 | 189,061 | 0 | 20,400 | 75,863 | 157,629 | 1,223 | 255,115 |
| 1996 | 0 | 21,191 | 26,848 | 286,066 | 2,363 | 336,468 | 0 | (5,621) | 19,088 | 286,066 | 2,362 | 301,895 |
| 1997 | 0 | 23,437 | 1,892 | 323,201 | 1,569 | 350,099 | 0 | 11,119 | (1,802) | 323,201 | 1,566 | 334,084 |
| 1998 | 0 | 26,864 | (122,848) | 208,909 | 1,222 | 114,147 | 0 | 24,544 | (57,726) | 208,909 | 1,222 | 176,949 |
| 1999 | 0 | 21,822 | 8,120 | 357,664 | 2,883 | 390,489 | 0 | (3,670) | 6,280 | 357,664 | 2,865 | 363,139 |
| 2000 | 0 | 27,237 | 18,198 | 668,126 | 3,767 | 717,328 | 0 | (19,645) | 9,320 | 665,926 | 1,556 | 657,157 |
| 2001 | 0 | 17,404 | (22,308) | 477,315 | 759 | 473,170 | 0 | (5,949) | (16,588) | 477,315 | 746 | 455,524 |
| 2002 | 0 | 35,058 | 41,944 | 779,284 | 3,471 | 859,757 | 0 | 10,071 | 35,623 | 776,136 | 305 | 822,135 |
| 2003 | 0 | 28,167 | (27,394) | 735,699 | 10,290 | 746,762 | 0 | 9,075 | (17,034) | 725,781 | 356 | 718,178 |
| 2004 | 0 | 31,034 | (14,046) | 850,007 | 478 | 867,473 | 0 | 9,120 | (11,440) | 845,960 | 456 | 844,096 |
| 2005 | 0 | 29,111 | (109,664) | 577,251 | 475 | 497,173 | 0 | 21,155 | (61,490) | 577,251 | 472 | 537,388 |
| 2006 | 0 | 23,453 | (128,775) | 616,546 | 406 | 511,630 | 0 | 4,173 | (121,607) | 616,546 | 396 | 499,508 |
| 2007 | 0 | 29,978 | 123,287 | 760,750 | 202 | 914,217 | 0 | (1,664) | 117,880 | 758,860 | 196 | 875,272 |
| 2008 | 0 | 36,744 | (9,613) | 531,832 | 247 | 559,210 | 0 | 498 | (14,279) | 529,852 | 211 | 516,282 |
| 2009 | 0 | 30,564 | 4,893 | 631,969 | 195 | 667,621 | 0 | (2,825) | 9,194 | 628,819 | 164 | 635,352 |
| 2010 | 0 | 26,930 | 41,267 | 412,240 | 240 | 480,677 | 0 | (4,135) | 40,284 | 409,090 | 207 | 445,446 |
| 2011 | 0 | 29,363 | (17,411) | 411,366 | 242 | 423,560 | 0 | (9,084) | (22,531) | 408,846 | 221 | 377,452 |
| 2012 | 0 | 28,769 | 14,802 | 593,750 | 388 | 637,709 | 0 | 10,210 | 16,335 | 590,600 | 375 | 617,520 |
| 2013 | 0 | 30,918 | (4,336) | 612,865 | 294 | 639,741 | 0 | 13,114 | (3,811) | 610,623 | 196 | 620,122 |
| 2014 | 0 | 17,555 | (10,841) | 305,533 | 91 | 312,338 | 0 | 4,742 | (11,327) | 305,533 | 47 | 298,995 |
| 2015 | 0 | 22,165 | 8,599 | 466,081 | 80 | 496,925 | 0 | 4,268 | 9,481 | 465,451 | 63 | 479,263 |
| 2016 | 0 | 9,084 | 82,000 | 500,877 | 5,380 | 597,341 | 0 | 4,700 | 82,000 | 498,987 | 2,330 | 588,017 |
| **2017** | **0** | **10,455** | **73,000** | **655,443** | **5,380** | **744,278** | **0** | **6,575** | **73,000** | **653,553** | **2,330** | **735,458** |
| 2018 | 0 | 10,095 | 0 | 634,988 | 5,380 | 650,463 | 0 | 6,377 | 0 | 633,098 | 2,330 | 641,805 |
| 2019 | 0 | 12,788 | 18,671 | 634,988 | 5,380 | 671,827 | 0 | 6,503 | 18,671 | 633,098 | 2,330 | 660,602 |
| 2020 | 0 | 12,829 | 3,032 | 634,988 | 5,380 | 656,229 | 0 | 6,544 | 3,032 | 633,098 | 2,330 | 645,004 |
| 2021 | 0 | 12,913 | 11,842 | 634,988 | 5,380 | 665,123 | 0 | 6,628 | 11,842 | 633,098 | 2,330 | 653,898 |
| 2022 | 0 | 12,913 | (49) | 634,988 | 5,380 | 653,232 | 0 | 6,628 | (49) | 633,098 | 2,330 | 642,007 |
| 2023 | 0 | 12,905 | (333) | 634,988 | 5,380 | 652,940 | 0 | 6,620 | (333) | 633,098 | 2,330 | 641,715 |
| 2024 | 0 | 12,842 | (10,020) | 634,988 | 5,380 | 643,190 | 0 | 6,557 | (10,020) | 633,098 | 2,330 | 631,965 |
| 2025 | 0 | 12,821 | (894) | 634,988 | 5,380 | 652,295 | 0 | 6,536 | (894) | 633,098 | 2,330 | 641,070 |
| 2026 | 0 | 12,868 | 11,278 | 634,988 | 5,380 | 664,514 | 0 | 6,583 | 11,278 | 633,098 | 2,330 | 653,289 |
| 2027 | 0 | 12,850 | (11,638) | 634,988 | 5,380 | 641,580 | 0 | 6,565 | (11,638) | 633,098 | 2,330 | 630,355 |
| 2028 | 0 | 12,890 | 8,285 | 634,988 | 5,380 | 661,543 | 0 | 6,605 | 8,285 | 633,098 | 2,330 | 650,318 |
| 2029 | 0 | 12,823 | (8,133) | 634,988 | 5,380 | 645,058 | 0 | 6,538 | (8,133) | 633,098 | 2,330 | 633,833 |
| 2030 | 0 | 12,912 | 12,228 | 634,988 | 5,380 | 665,508 | 0 | 6,627 | 12,228 | 633,098 | 2,330 | 654,283 |
| 2031 | 0 | 12,758 | (66,669) | 634,988 | 5,380 | 586,457 | 0 | 6,473 | (66,669) | 633,098 | 2,330 | 575,232 |
| 2032 | 0 | 12,451 | 41,046 | 634,988 | 5,380 | 693,865 | 0 | 6,166 | 41,046 | 633,098 | 2,330 | 682,640 |
| 2033 | 0 | 12,667 | (56,723) | 634,988 | 5,380 | 596,312 | 0 | 6,382 | (56,723) | 633,098 | 2,330 | 585,087 |
| 2034 | 0 | 12,244 | 41,005 | 634,988 | 5,380 | 693,617 | 0 | 5,959 | 41,005 | 633,098 | 2,330 | 682,392 |
| 2035 | 0 | 11,461 | (193,440) | 634,988 | 5,380 | 458,389 | 0 | 5,176 | (193,440) | 633,098 | 2,330 | 447,164 |

## TABLE B-6 Annual Water Quantities Conveyed through Each Pumping and Power Recovery Plant of Project Transportation Facilities (acre-feet)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) — COASTAL BRANCH — Las Perillas and Badger Hill Pumping Plants — Initial Fill Water | Operational Losses | Water Supply Delivery | Total | Devil's Den, Bluestone, and Polonio Pass Pumping Plants — Initial Fill Water | Operational Losses | Water Supply Delivery | Total |
|---|---|---|---|---|---|---|---|---|
| | [111] | [112] | [113] | [114] | [115] | [116] | [117] | [118] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 210 | 873 | 79,039 | 80,122 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 1,042 | 62,064 | 63,106 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 638 | 83,649 | 84,287 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 3,455 | 110,971 | 114,426 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 1,745 | 121,755 | 123,500 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 5,479 | 78,645 | 84,124 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 7,344 | 78,174 | 85,518 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 5,819 | 85,216 | 91,035 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 6,562 | 90,058 | 96,620 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 5,777 | 40,579 | 46,356 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 9,085 | 92,604 | 101,689 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 10,896 | 123,155 | 134,051 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 9,449 | 111,379 | 120,828 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 13,232 | 109,754 | 122,986 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 7,984 | 95,776 | 103,760 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 5,710 | 100,518 | 106,228 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 5,740 | 126,387 | 132,127 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 7,563 | 120,823 | 128,386 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 8,719 | 131,599 | 140,318 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 11,363 | 128,080 | 139,443 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 12,831 | 120,969 | 133,800 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 11,454 | 116,801 | 128,255 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 13,022 | 109,802 | 122,824 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 5,802 | 1,496 | 7,298 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 7,893 | 79,635 | 87,528 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 9,282 | 94,921 | 104,203 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 8,515 | 87,158 | 95,673 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 6,986 | 94,536 | 101,522 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 9,663 | 114,630 | 124,293 | 0 | 0 | 0 | 0 |
| 1997 | 527 | 8,343 | 110,428 | 119,298 | 527 | 0 | 8,538 | 9,065 |
| 1998 | 0 | 8,415 | 109,400 | 117,815 | 0 | 0 | 22,210 | 22,210 |
| 1999 | 0 | 2,453 | 120,061 | 122,514 | 0 | 303 | 23,880 | 24,183 |
| 2000 | 0 | (429) | 120,313 | 119,884 | 0 | 0 | 26,703 | 26,703 |
| 2001 | 0 | (742) | 87,915 | 87,173 | 0 | 0 | 23,229 | 23,229 |
| 2002 | 0 | 638 | 99,783 | 100,421 | 0 | (151) | 31,991 | 31,840 |
| 2003 | 0 | 161 | 101,113 | 101,274 | 0 | 284 | 31,421 | 31,705 |
| 2004 | 0 | 492 | 104,144 | 104,636 | 0 | 480 | 33,870 | 34,350 |
| 2005 | 0 | 1,484 | 103,178 | 104,662 | 0 | 573 | 27,595 | 28,168 |
| 2006 | 0 | 1,994 | 115,433 | 117,427 | 0 | 2,034 | 27,484 | 29,518 |
| 2007 | 0 | 3,355 | 131,590 | 134,945 | 0 | 293 | 31,516 | 31,809 |
| 2008 | 0 | 3,696 | 107,239 | 110,935 | 0 | (30) | 21,795 | 21,765 |
| 2009 | 0 | 2,242 | 102,509 | 104,751 | 0 | (3,078) | 19,253 | 16,175 |
| 2010 | 0 | 4,050 | 106,590 | 110,640 | 0 | 272 | 21,532 | 21,804 |
| 2011 | 0 | 3,994 | 113,647 | 117,641 | 0 | 533 | 24,869 | 25,402 |
| 2012 | 0 | 7,411 | 109,383 | 116,794 | 0 | 589 | 23,418 | 24,007 |
| 2013 | 0 | 7,637 | 110,714 | 118,351 | 0 | 295 | 21,699 | 21,994 |
| 2014 | 0 | 6,636 | 94,369 | 101,005 | 0 | 4,018 | 19,963 | 23,981 |
| 2015 | 0 | 5,458 | 94,227 | 99,685 | 0 | 378 | 15,111 | 15,489 |
| 2016 | 0 | 802 | 103,199 | 104,001 | 0 | 212 | 29,129 | 29,341 |
| **2017** | **0** | **802** | **95,341** | **96,143** | **0** | **212** | **40,348** | **40,560** |
| 2018 | 0 | 802 | 95,410 | 96,212 | 0 | 212 | 40,417 | 40,629 |
| 2019 | 0 | 802 | 95,446 | 96,248 | 0 | 212 | 40,453 | 40,665 |
| 2020 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2021 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2022 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2023 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2024 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2025 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2026 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2027 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2028 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2029 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2030 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2031 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2032 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2033 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2034 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |
| 2035 | 0 | 802 | 95,522 | 96,324 | 0 | 212 | 40,529 | 40,741 |

**TABLE B-7 Reconciliation of Capital Costs Allocated to Water Supply and Power Generation (in thousands of dollars)**

| Item | Project Costs Allocated to Water Supply and Power Generation | | | | | | | Capital Costs Allocated to Other Purposes | Total State Water Project Capital Cost |
|---|---|---|---|---|---|---|---|---|---|
| | Miscellaneous Income Credited to Construction[a] | Allowance for Future Price Escalation[b] | Costs of Construction of Delivery Structures[c] | Costs of Requested Excess Capacity and Future Enlargement[d] | Capital Cost Component of Delta Water Charge[e] | Capital Cost Component of Transportation Water Charge[f] | Water Supply and Power Total | | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| **CONSERVATION FACILITIES** | | | | | | | | | |
| Upper Feather Division | | | | | | | | | |
| Frenchman Dam and Lake | 180 | 0 | 0 | 0 | 602 | 0 | 782 | 2,876 | 3,658 |
| Grizzly Valley Dam and Lake Davis | 65 | 0 | 0 | 0 | 55 | 0 | 120 | 8,953 | 9,073 |
| Antelope Dam and Lake | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5,864 | 5,865 |
| Abbey Bridge Dam and Reservoir | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 520 | 520 |
| Dixie Refuge Dam and Reservoir | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 236 | 236 |
| ***Total, Upper Feather Division*** | ***246*** | ***0*** | ***0*** | ***0*** | ***657*** | ***0*** | ***903*** | ***18,449*** | ***19,352*** |
| Oroville Division | | | | | | | | | |
| Multipurpose Facilities | 3,152 | 0 | 0 | 0 | 776,437 | 0 | 779,589 | 99,522 | 879,111 |
| Specific Power Facilities | 230 | 0 | 0 | 0 | 214,682 | 0 | 214,912 | (876) | 214,037 |
| ***Total, Oroville Division*** | ***3,382*** | ***0*** | ***0*** | ***0*** | ***991,119*** | ***0*** | ***994,501*** | ***98,646*** | ***1,093,148*** |
| California Aqueduct | | | | | | | | | |
| North San Joaquin Division | 1,210 | 0 | 0 | 0 | 105,794 | 0 | 107,004 | 3,820 | 110,824 |
| San Luis Division | 13,152 | 0 | 0 | 0 | 162,632 | 0 | 175,784 | 5,701 | 181,484 |
| ***Total, California Aqueduct*** | ***14,362*** | ***0*** | ***0*** | ***0*** | ***268,426*** | ***0*** | ***282,788*** | ***9,521*** | ***292,309*** |
| Delta Facilities | 314,899 | 0 | 0 | 0 | 649,755 | 0 | 687,066 | 31,944 | 719,009 |
| Planning and Preoperation | 5,302 | 0 | 0 | 0 | 101,240 | 0 | 106,542 | 0 | 106,542 |
| **TOTAL, CONSERVATION FACILITIES** | **338,191** | **0** | **0** | **0** | **2,011,197** | **0** | **2,071,800** | **158,560** | **2,230,360** |
| **TRANSPORTATION FACILITIES** | | | | | | | | | |
| Upper Feather Division | | | | | | | | | |
| Grizzly Valley Pipeline | 0 | 0 | 315 | 0 | 0 | 567 | 881 | 0 | 881 |
| North Bay Aqueduct | 266 | 0 | 676 | 0 | 0 | 121,758 | 122,700 | 0 | 122,700 |
| South Bay Aqueduct | 1,791 | 0 | 3,655 | 0 | 0 | 383,410 | 388,856 | 23,726 | 412,582 |
| California Aqueduct | | | | | | | | | |
| North San Joaquin Division | 2,462 | 0 | 108 | 0 | 0 | 233,864 | 236,434 | 8,503 | 244,936 |
| San Luis Division | 9,201 | 0 | 0 | 0 | 0 | 175,334 | 184,535 | 8,805 | 193,340 |
| South San Joaquin Division | 386 | 0 | 4,800 | 13,152 | 0 | 341,825 | 360,162 | 17,845 | 378,008 |
| Tehachapi Division | 27 | 0 | 0 | 5,230 | 0 | 381,875 | 387,132 | 20,888 | 408,019 |
| Mojave Division | 918 | 0 | 2,153 | 0 | 0 | 348,766 | 351,837 | 40,084 | 391,922 |
| Santa Ana Division | 1,184 | 0 | 6,060 | 5,331 | 0 | 366,341 | 378,915 | 71,761 | 450,676 |
| West Branch | 37,592 | 0 | 455 | 37 | 0 | 521,827 | 559,912 | 34,302 | 594,214 |
| Coastal Branch | (279) | 0 | 216 | 0 | 0 | 511,864 | 511,802 | 0 | 511,802 |
| ***Total, California Aqueduct*** | ***51,491*** | ***0*** | ***13,792*** | ***23,750*** | ***0*** | ***2,881,695*** | ***2,970,729*** | ***202,188*** | ***3,172,917*** |
| **TOTAL, TRANSPORTATION FACILITIES** | **53,548** | **0** | **18,438** | **23,750** | **0** | **3,387,430** | **3,483,166** | **225,914** | **3,709,080** |
| East Branch Enlargement | 0 | 0 | 0 | 0 | 0 | 462,031 | 462,031 | 0 | 462,031 |
| East Branch Extension | 0 | 0 | 0 | 0 | 0 | 410,580 | 410,580 | 0 | 410,580 |
| Coastal Power Allocation | 0 | 0 | 0 | 0 | 0 | 30,708 | 30,708 | 0 | 30,708 |
| San Joaquin Drainage Facilities | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 105,037 | 105,037 |
| Off-Aqueduct Power Generation Facilities | 0 | 0 | 0 | 0 | 0 | 602,174 | 602,174 | 0 | 602,174 |
| Small Hydro Power Generation Facilities | 0 | 0 | 0 | 0 | 14,095 | 85,971 | 100,066 | 0 | 100,066 |
| Land Purchase—Kern Water Bank | 0 | 0 | 0 | 0 | 34,686 | 0 | 34,686 | 0 | 34,686 |
| Unassigned/Miscellaneous | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21,250 | 21,250 |
| Davis-Grunsky | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130,000 | 130,000 |
| **TOTAL THROUGH 2025** | **391,739** | **0** | **18,438** | **23,750** | **2,059,978** | **4,978,894** | **7,195,210** | **640,761** | **7,835,971** |

[a] Miscellaneous project receipts that are applied for accounting purposes to reduce the capital costs of the particular facilities.
[b] These allowances are included for planning the future financial program, but not for determining current water charges.
[c] See Table B-8.
[d] See Table B-9.
[e] See Table B-13.
[f] See Table B-10. Mojave Division total reduced by $85,971,000 for costs included in "Small Hydro Power Generation Facilities" line.

**TABLE B-8 SWP Capital Costs of Requested Delivery Structures (in dollars)**

| Project Service Area and Water Supply Contractors | Calendar Year Capital Costs[a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1952-2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] |
| FEATHER RIVER AREA | | | | | | | |
| County of Butte | 261,979 | 0 | 0 | 0 | 0 | 0 | 261,979 |
| Plumas County Flood Control and Water Conservation District | 8,723 | 0 | 0 | 0 | 0 | 0 | 8,723 |
| Thermalito Irrigation District[b] | 43,939 | 0 | 0 | 0 | 0 | 0 | 43,939 |
| *Subtotal* | *314,641* | *0* | *0* | *0* | *0* | *0* | *314,641* |
| NORTH BAY AREA | | | | | | | |
| Napa County Flood Control and Water Conservation District | 13,590 | 0 | 0 | 0 | 0 | 0 | 13,590 |
| Solano County Water Agency | 662,113 | 0 | 0 | 0 | 0 | 0 | 662,113 |
| *Subtotal* | *675,703* | *0* | *0* | *0* | *0* | *0* | *675,703* |
| SOUTH BAY AREA | | | | | | | |
| Alameda County Flood Control and Water Conservation District, Zone 7 | 1,882,673 | 5,216 | 23,461 | 13,000 | 0 | 0 | 1,924,350 |
| Alameda County Water District | 630,576 | 0 | | 0 | 0 | 0 | 630,576 |
| Santa Clara Valley Water District | 21,500 | 1,215 | 10,816 | 0 | 0 | 0 | 33,531 |
| San Francisco Water Department[b] | 1,066,680 | 0 | 0 | 0 | 0 | 0 | 1,066,680 |
| *Subtotal* | *3,601,429* | *6,431* | *34,277* | *13,000* | *0* | *0* | *3,655,137* |
| CENTRAL COASTAL AREA | | | | | | | |
| San Luis Obispo County Flood Control and Water Conservation District | 26,204 | 204 | 15,010 | 20,000 | 0 | 0 | 61,418 |
| Santa Barbara County Flood Control and Water Conservation District | 67,058 | 0 | 0 | 0 | 0 | 0 | 67,058 |
| *Subtotal* | *93,262* | *204* | *15,010* | *20,000* | *0* | *0* | *128,476* |
| SAN JOAQUIN VALLEY AREA | | | | | | | |
| Castaic Lake Water Agency | 82,567 | 0 | 0 | 0 | 0 | 0 | 82,567 |
| County of Kings | 17,210 | 16,731 | 1,450 | 10,000 | 30,000 | 0 | 75,391 |
| Dudley Ridge Water District[c] | 304,541 | 19,171 | 2,235 | 15,000 | 15,000 | 0 | 355,947 |
| Empire West Side Irrigation District | 6,358 | 0 | 0 | 0 | 0 | 0 | 6,358 |
| Green Valley Water District[b] | 5,292 | 0 | 0 | 0 | 0 | 0 | 5,292 |
| Kern County Water Agency | 3,990,419 | 22,998 | 15,999 | 20,000 | 35,000 | 0 | 4,084,416 |
| Oak Flat Water District | 97,643 | 0 | 0 | 0 | 0 | 0 | 97,643 |
| Tracy Golf and Country Club[b] | 6,932 | 0 | 0 | 0 | 0 | 0 | 6,932 |
| Tulare Lake Basin Water Storage District | 277,483 | 0 | 0 | 0 | 0 | 0 | 277,483 |
| Veterans Administration Cemetery[b] | 3,342 | 0 | 0 | 0 | 0 | 0 | 3,342 |
| *Subtotal* | *4,791,787* | *58,900* | *19,684* | *45,000* | *80,000* | *0* | *4,995,371* |
| SOUTHERN CALIFORNIA AREA | | | | | | | |
| Antelope Valley-East Kern Water Agency | 1,095,918 | 118,410 | 289,003 | 120,000 | 100,000 | 0 | 1,723,331 |
| Castaic Lake Water Agency | 375,593 | 0 | 0 | 0 | 0 | 0 | 375,593 |
| Coachella Valley Water District | 14,206 | 0 | 0 | 0 | 0 | 0 | 14,206 |
| Crestline-Lake Arrowhead Water Agency | 25,298 | 0 | 0 | 0 | 0 | 0 | 25,298 |
| Desert Water Agency | 23,438 | 0 | 0 | 0 | 0 | 0 | 23,438 |
| Littlerock Creek Irrigation District | 23,732 | 0 | 0 | 0 | 0 | 0 | 23,732 |
| Mojave Water Agency | 309,042 | 12 | 0 | 0 | 0 | 0 | 309,054 |
| Palmdale Water District | 34,173 | 0 | 0 | 0 | 0 | 0 | 34,173 |
| San Bernardino Valley Municipal Water District | 960,685 | 0 | 0 | 0 | 0 | 0 | 960,685 |
| San Gabriel Valley Municipal Water District | 131,052 | 0 | 0 | 0 | 0 | 0 | 131,052 |
| San Gorgonio Pass Water Agency | 119,654 | 3,063 | 2,768 | 10,000 | 15,000 | 0 | 150,485 |
| The Metropolitan Water District of Southern California | 4,817,609 | 1 | 0 | 0 | 0 | 0 | 4,817,610 |
| Ventura County Flood Control District | 79,699 | 0 | 0 | 0 | 0 | 0 | 79,699 |
| *Subtotal* | *8,010,099* | *121,486* | *291,771* | *130,000* | *115,000* | *0* | *8,668,356* |
| TOTAL | 17,486,921 | 187,021 | 360,742 | 208,000 | 195,000 | 0 | 18,437,684 |

[a] Approximate only, not to be construed as invoice amounts.

[b] Not a SWP water supply contractor.

[c] 2014 and the majority of 2015 costs were from proposed reverse flow program; to be split among Dudley Ridge, Kern, and four Kern member units.

**Table B-9 Capital Costs of Requested Excess Peaking Capacity (in dollars unless otherwise indicated)** Sheet 1 of 2

| Calendar Year | Total Advance Payments and Credits for Excess Capacity | Total Incremental Costs for Excess Capacity | Overpayment (+) or Underpayment (-)[a] | Annual Surplus Money Investment Fund Interest Rate[b] | | Net Over- or Underpayment With Interest[c] |
|---|---|---|---|---|---|---|
| | | | | January–June | July–December | |
| | [1] | [2] | [3] | [4] | [5] | [6] |
| | | | **THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA** | | | |
| 1965 | 0 | 158,000 | (158,000) | 3.968% | 4.184% | (163,412) |
| 1966 | 8,056,000 | 435,800 | 7,620,200 | 4.540% | 5.057% | 7,701,103 |
| 1967 | 9,094,963 | 1,878,270 | 7,216,693 | 4.815% | 4.744% | 15,524,533 |
| 1968 | 1,523,252 | 2,887,351 | (1,364,099) | 5.330% | 5.540% | 14,959,187 |
| 1969 | 8,310,651 | 3,059,310 | 5,251,341 | 5.946% | 6.389% | 21,369,973 |
| 1970 | 3,426,736 | 2,397,102 | 1,029,634 | 7.071% | 7.125% | 23,986,083 |
| 1971 | 1,086,045 | 1,146,648 | (60,603) | 5.154% | 5.580% | 25,238,017 |
| 1972 | (4,244,807) | 487,394 | (4,732,201) | 4.477% | 4.977% | 21,532,965 |
| 1973 | (15,913,829) | 25,041 | (15,938,870) | 6.023% | 8.717% | 6,014,116 |
| 1974 | 0 | 37,775 | (37,775) | 9.222% | 10.351% | 6,576,393 |
| 1975 | 0 | 2,085 | (2,085) | 7.089% | 6.791% | 7,038,515 |
| 1976 | 0 | 0 | 0 | 6.048% | 6.021% | 7,469,662 |
| 1977 | 0 | 0 | 0 | 5.788% | 6.182% | 7,923,403 |
| 1978 | 0 | 0 | 0 | 7.171% | 8.096% | 8,539,736 |
| 1979 | 0 | 0 | 0 | 8.979% | 9.671% | 9,354,605 |
| 1980 | 0 | 0 | 0 | 11.500% | 11.500% | 10,461,314 |
| **Total** | **11,339,011** | **12,514,776** | **(1,175,765)** | **—** | **—** | **10,461,314** |
| | | | **SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT** | | | |
| 1967 | 0 | 25,730 | (25,730) | 4.815% | 4.744% | (26,611) |
| 1968 | 184,422 | 44,053 | 140,369 | 5.330% | 5.540% | 117,587 |
| 1969 | 49,052 | 38,075 | 10,977 | 5.946% | 6.389% | 136,751 |
| 1970 | 44,911 | 17,959 | 26,952 | 7.071% | 7.125% | 175,186 |
| 1971 | 61,588 | 5,900 | 55,688 | 5.154% | 5.580% | 242,927 |
| 1972 | (20,263) | 6,835 | (27,098) | 4.477% | 4.977% | 226,230 |
| 1973 | (180,465) | 0 | (180,465) | 6.023% | 8.717% | 49,198 |
| 1974 | 0 | 0 | 0 | 9.222% | 10.351% | 54,130 |
| 1975 | 0 | 0 | 0 | 7.089% | 6.791% | 57,952 |
| 1976 | 0 | 0 | 0 | 6.048% | 6.021% | 61,501 |
| 1977 | 0 | 0 | 0 | 5.788% | 6.182% | 65,237 |
| 1978 | 0 | 0 | 0 | 7.171% | 8.096% | 70,312 |
| 1979 | 0 | 0 | 0 | 8.979% | 9.671% | 77,021 |
| 1980 | 0 | 0 | 0 | 11.500% | 11.500% | 86,133 |
| **Total** | **139,245** | **138,552** | **693** | **—** | **—** | **86,133** |
| | | | **ANTELOPE VALLEY-EAST KERN WATER AGENCY** | | | |
| 1968 | 85,495 | 1,645 | 83,850 | 5.330% | 5.540% | 86,962 |
| 1969 | 52,625 | 6,326 | 46,299 | 5.946% | 6.389% | 140,964 |
| 1970 | 101,648 | 15,076 | 86,572 | 7.071% | 7.125% | 243,222 |
| 1971 | 34,062 | 11,748 | 22,314 | 5.154% | 5.580% | 279,673 |
| 1972 | (12,794) | 2,018 | (14,812) | 4.477% | 4.977% | 277,552 |
| 1973 | (205,354) | 308 | (205,662) | 6.023% | 8.717% | 77,288 |
| 1974 | 0 | 96 | (96) | 9.222% | 10.351% | 84,933 |
| 1975 | 0 | 0 | 0 | 7.089% | 6.791% | 90,929 |
| 1976 | 0 | 190 | (190) | 6.048% | 6.021% | 96,300 |
| 1977 | 0 | 0 | 0 | 5.788% | 6.182% | 102,150 |
| 1978 | 0 | 0 | 0 | 7.171% | 8.096% | 110,096 |
| 1979 | 0 | 0 | 0 | 8.979% | 9.671% | 120,601 |
| 1980 | 0 | 0 | 0 | 11.500% | 11.500% | 134,869 |
| **Total** | **55,682** | **37,407** | **18,275** | **—** | **—** | **134,869** |

[a] Overpayment or underpayment for each calendar year—column [1] minus column [2].

[b] Interest rates shown are annual rates. Interest is credited daily at applicable rates on funds deposited in the State's Surplus Money Investment Fund.

[c] Amounts shown are end-of-year balances. Interest on overpayments is credited at applicable Surplus Money Investment Fund interest rates shown in columns [4] and [5]. Interest on underpayments is charged at the 1980 Project Interest Rate of 4.584 percent.

## Table B-9 Capital Costs of Requested Excess Peaking Capacity (in dollars)



| Reach Number | ANNUAL REQUIRED ADVANCE OF FUNDS — Incremental Costs and Advance Payments by Calendar Year | | | | | | | | | | | | | Reach Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1981 | |
| | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] |
| **THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA** | | | | | | | | | | | | | | |
| *Incremental Costs* | | | | | | | | | | | | | | |
| 8C | | 1,000 | 1,000 | | | | | | | | | | | 2,000 |
| 8D | | 43,500 | 43,500 | | | | | | | | | | | 87,000 |
| 9 | | 27,000 | 27,000 | 13,500 | | | | | | | | | | 67,500 |
| 10A | | 29,700 | 29,700 | 14,800 | | | | | | | | | | 74,200 |
| 11B | 10,100 | 18,300 | 18,300 | 9,200 | | | | | | | | | | 55,900 |
| 12D | 1,800 | | 19,300 | 25,800 | 12,900 | | | | | | | | | 59,800 |
| 12E | 1,800 | | 12,400 | 18,800 | 10,800 | | | | | | | | | 43,800 |
| 13B | | | 12,600 | 37,800 | 31,600 | | | | | | | | | 82,000 |
| 14A | 2,500 | 500 | 11,100 | 80,216 | 107,504 | 124,069 | 37,519 | 6,413 | 381 | 87 | | | | 370,289 |
| 14B | 1,200 | 1,800 | | 19,100 | 19,100 | 12,800 | | | | | | | | 54,000 |
| 14C | 1,800 | 900 | | 13,500 | 13,500 | 9,000 | | | | | | | | 38,700 |
| 15A | 700 | | 14,000 | 66,947 | 133,357 | 128,099 | 54,821 | 5,327 | 946 | 2,076 | | | | 406,273 |
| 16A | 700 | | 18,900 | 137,894 | 182,000 | 211,608 | 133,927 | 26,203 | 5,767 | 6,156 | | | | 723,155 |
| 17E | | 51,500 | 444,600 | 537,247 | 860,024 | 998,985 | 699,281 | 193,286 | 17,947 | 29,456 | 2,085 | | | 3,834,411 |
| 17F | 109,100 | 261,600 | 261,600 | 261,600 | 261,600 | 239,500 | | | | | | | | 1,395,000 |
| 25 | | | 964,270 | 1,650,947 | 1,426,925 | 673,041 | 221,100 | 256,165 | | | | | | 5,192,448 |
| 28J | | 304,612 | 13,706 | 296,668 | 65,966 | 230,169 | 1,209,586 | 2,017,134 | 235,900 | 4,900 | | | | 4,378,641 |
| Total | 129,700 | 740,412 | 1,891,976 | 3,184,019 | 3,125,276 | 2,627,271 | 2,356,234 | 2,504,528 | 260,941 | 42,675 | 2,085 | | | 16,865,117 |
| *Current Adjustments* | | | | | | | | | | | | | | |
| 8C through 25 | 1. Advance Payments Applied to Incremental Costs Amendment 2[d] | | | | | | | | | | | | | |
| | 0 | 8,056,000 | 9,094,963 | 1,523,252 | 8,310,651 | 3,426,736 | 1,086,045 | (4,244,807) | (14,381,396) | | | | (356,668) | 12,514,776 |
| | 2. Interest Credits-Amendment 2[e] | | | | | | | | | | | | | |
| | | | | | | | | | (1,532,433) | | | | (10,104,646) | (11,637,079) |
| 28J | | | | | | | | | | | | | | |
| | 3. Advance Payments Applied to Incremental Costs Amendment 5[f] | | | | | | | | | | | | | |
| | 0 | 1,240,000 | 1,483,180 | 2,469,325 | (927,035) | 1,729,160 | 3,215,258 | 2,967,475 | 1,690,000 | (9,488,722) | | | | 4,378,641 |
| | 4. Interest Credits-Amendment 5[g] | | | | | | | | | | | | | |
| | | | | | | | | | | (2,721,803) | | | | (2,721,803) |
| | 5. Net Required Advance of Funds | | | | | | | | | | | | [h] | |
| | 0 | 9,296,000 | 10,578,143 | 3,992,577 | 7,383,616 | 5,155,896 | 4,301,303 | (1,277,332) | (14,233,829) | (12,210,525) | | | (10,461,314) | 2,524,535 |
| **SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT** | | | | | | | | | | | | | | |
| *Incremental Costs* | | | | | | | | | | | | | | |
| 25 | | | 25,730 | 44,053 | 38,075 | 17,959 | 5,900 | 6,835 | | | | | | 138,552 |
| Total Unadjusted Incremental Costs for Past Payments | | | | | | | | | | | | | | |
| | | | 25,730 | 44,053 | 38,075 | 17,959 | 5,900 | 6,835 | | | | | | 138,552 |
| *Current Adjustments* | | | | | | | | | | | | | | |
| | 1. Advance Payments Applied to Incremental Costs[d] | | | | | | | | | | | | | |
| | | | 0 | 184,422 | 49,052 | 44,911 | 61,588 | (20,263) | (174,133) | | | | (7,025) | 138,552 |
| | 2. Interest Credit | | | | | | | | | | | | [h] | |
| | | | | | | | | | (6,332) | | | | (79,108) | (85,440) |
| | 3. Net Required Advance of Funds | | | | | | | | | | | | | |
| | | | 0 | 184,422 | 49,052 | 44,911 | 61,588 | (20,263) | (180,465) | | | | (86,133) | 53,112 |
| **ANTELOPE VALLEY-EAST KERN WATER AGENCY** | | | | | | | | | | | | | | |
| *Incremental Costs* | | | | | | | | | | | | | | |
| 29A | | | | 1,645 | 6,326 | 13,376 | 10,048 | 2,018 | 308 | 96 | | 190 | | 34,007 |
| 29F | | | | | | 1,700 | 1,700 | | | | | | | 3,400 |
| Total Unadjusted Incremental Costs for Past Payments | | | | | | | | | | | | | | |
| | | | | 1,645 | 6,326 | 15,076 | 11,748 | 2,018 | 308 | 96 | | 190 | | 37,407 |
| *Current Adjustments* | | | | | | | | | | | | | | |
| | 1. Advance Payments Applied to Incremental Costs[d] | | | | | | | | | | | | | |
| | | | | 85,495 | 52,625 | 101,648 | 34,062 | (12,794) | (189,120) | 0 | | 0 | (34,509) | 37,407 |
| | 2. Interest Credit | | | | | | | | | | | | | |
| | | | | | | | | | (16,234) | | | | (100,360) | (116,594) |
| | 3. Net Required Advance of Funds | | | | | | | | | | | | [h] | |
| | | | | 85,495 | 52,625 | 101,648 | 34,062 | (12,794) | (205,354) | 0 | | 0 | (134,869) | (79,187) |

[d] Actual payments are shown for 1965 through 1976 with 1981 adjusted to reflect overpayments and underpayments without interest for prior years.

[e] Interest for overpayments and underpayments under provisions of Amendment 2 of the contract.

[f] Actual payments are shown for 1965 through 1973 with 1974 adjusted to reflect overpayments and underpayments without interest for prior years.

[g] Interest for overpayments and underpayments under provisions of Amendment 5 of the contract.

[h] Amounts in excess of incremental costs, under the provisions of the contract, reduce the Transportation Charge capital cost component of the agency's Statement of Charges for January 1981.

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | UPPER FEATHER DIVISION | NORTH BAY AQUEDUCT | | | | | SOUTH BAY AQUEDUCT | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 1 | Reach 2 | Reach 3A | Reach 3B | Total | Reach 1 | Reach 2 | Reach 4 | Reach 5 |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1952 | 0 | 0 | 0 | 0 | 0 | 0 | 97 | 34 | 30 | 57 |
| 1953 | 0 | 0 | 0 | 0 | 0 | 0 | 477 | 166 | 144 | 297 |
| 1954 | 0 | 0 | 0 | 0 | 0 | 0 | 1,466 | 508 | 437 | 959 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 1,944 | 674 | 560 | 1,266 |
| 1956 | 0 | 0 | 0 | 0 | 0 | 0 | 18,789 | 6,515 | 5,090 | 12,545 |
| 1957 | 0 | 13,290 | 3,391 | 0 | 9,953 | 26,634 | 45,090 | 15,639 | 12,285 | 33,218 |
| 1958 | 2 | 19,202 | 5,011 | 0 | 25,798 | 50,011 | 195,985 | 80,961 | 7,714 | 21,930 |
| 1959 | 14 | 7,517 | 2,118 | 0 | 17,653 | 27,288 | 496,140 | 148,516 | 24,945 | 17,118 |
| 1960 | 28 | 8,797 | 4,292 | 0 | 4,838 | 17,927 | 1,130,378 | 67,351 | 71,779 | 68,028 |
| 1961 | 10 | 1,551 | 10,318 | 0 | 2,526 | 14,395 | 3,273,247 | 180,596 | 307,885 | 74,398 |
| 1962 | 32 | 217 | (1,751) | 0 | 414 | (1,120) | 1,548,884 | 203,535 | 695,446 | 35,102 |
| 1963 | 51 | 2,510 | (1,063) | 0 | 983 | 2,430 | 480,716 | 69,182 | 2,284,291 | 206,587 |
| 1964 | 7,791 | 39,879 | 12,046 | 0 | 21,934 | 73,859 | 2,549,118 | 15,903 | 181,900 | 264,410 |
| 1965 | 3,139 | 72,793 | 17,900 | 0 | 170,361 | 261,054 | 807,505 | 153,454 | 85,425 | 447,830 |
| 1966 | (48) | 59,615 | 12,972 | 0 | 438,949 | 511,536 | 898,074 | 149,529 | 142,096 | 1,690,200 |
| 1967 | 47 | 47,257 | 11,597 | 0 | 1,551,023 | 1,609,877 | 607,614 | 50,423 | 293,304 | 3,496,284 |
| 1968 | 51,573 | 70,586 | 19,560 | 0 | 831,158 | 921,304 | 965,119 | 19,543 | 89,300 | 2,931,101 |
| 1969 | 234,232 | 63,650 | 23,628 | 0 | 46,428 | 133,706 | 455,173 | 9,618 | 3,860 | 896,727 |
| 1970 | 16,227 | 59,090 | 42,733 | 0 | 9,415 | 111,238 | 52,481 | 3,380 | 10,517 | 154,358 |
| 1971 | 27,204 | 20,819 | 31,516 | 0 | 8,480 | 60,815 | 24,505 | 4,645 | 5,035 | 20,395 |
| 1972 | 9 | 15,538 | 12,952 | 0 | 10,058 | 38,548 | 26,918 | 825 | 2,945 | 26,090 |
| 1973 | 25 | 18,488 | 29,018 | 0 | 39,878 | 87,384 | 24,468 | 4,010 | 6,016 | 12,708 |
| 1974 | 45 | 67,352 | 29,978 | 0 | 134,332 | 231,662 | 17,108 | 1,192 | 1,765 | 65,587 |
| 1975 | 21 | 62,855 | 73,112 | 0 | 45,091 | 181,058 | 57,619 | 561 | 1,165 | 7,291 |
| 1976 | 51 | 52,419 | 75,611 | 218 | 13,168 | 141,416 | 104,242 | 2,846 | 8,915 | 12,701 |
| 1977 | 28 | 53,274 | 65,662 | 2,240 | 23,138 | 144,314 | 176,062 | 3,625 | 3,225 | 16,158 |
| 1978 | 38 | 61,936 | 57,158 | 2,955 | 28,987 | 151,036 | 264,581 | 4,494 | 3,668 | 14,028 |
| 1979 | 23 | 316,620 | 91,367 | 3,953 | 62,240 | 474,180 | 111,106 | 17,151 | 8,515 | 31,725 |
| 1980 | 26 | 422,804 | 111,600 | 19,910 | 96,125 | 650,439 | 368,942 | 17,708 | 8,249 | 38,045 |
| 1981 | 34 | 430,992 | 147,295 | (10,752) | 43,157 | 610,692 | (145,428) | 3,600 | 6,533 | 12,448 |
| 1982 | 11 | 934,812 | 357,720 | (7,165) | 134,408 | 1,419,775 | (44,778) | 18,971 | 7,451 | 37,824 |
| 1983 | 19 | 1,091,091 | 1,076,627 | 2,628 | 517,615 | 2,687,961 | 429,225 | 73,925 | 38,185 | 72,415 |
| 1984 | 26 | 1,875,968 | 2,317,661 | 3,290 | 1,068,363 | 5,265,282 | 506,951 | 36,354 | 9,610 | 92,846 |
| 1985 | 29 | 2,248,491 | 7,849,886 | 27,815 | 3,416,370 | 13,542,562 | 34,103 | 2,822 | 5,034 | 27,138 |
| 1986 | 31 | 16,420,238 | 10,020,277 | 1,309,599 | 1,819,349 | 29,569,463 | 85,732 | 14,715 | 17,144 | 13,982 |
| 1987 | 32 | 11,873,826 | 7,214,307 | 1,628,932 | 1,670,596 | 22,387,661 | 126,377 | 15,693 | 27,881 | 32,931 |
| 1988 | 55 | 3,287,756 | 1,648,431 | 1,015,971 | 686,821 | 6,638,979 | 290,505 | 36,744 | 51,786 | 25,078 |
| 1989 | 44 | 1,056,583 | 950,985 | 224,567 | 374,886 | 2,607,021 | 130,609 | 16,848 | 35,518 | 12,582 |
| 1990 | 63 | 493,522 | 537,881 | 145,694 | 71,938 | 1,249,035 | 275,732 | 32,387 | 99,251 | 40,263 |
| 1991 | 54 | 76,599 | 17,130 | 24,846 | 70,542 | 189,117 | 1,153,109 | 26,900 | 53,613 | 21,889 |
| 1992 | 42 | 56,492 | 6,525 | 18,333 | 37,778 | 119,128 | 401,906 | 53,036 | 61,799 | 51,386 |
| 1993 | 30 | 104,317 | 24,579 | 40,129 | 82,032 | 251,057 | 313,476 | 55,679 | 79,149 | 39,293 |
| 1994 | 14 | 68,065 | 13,463 | 27,107 | 45,909 | 154,544 | (211,712) | 29,017 | 362,585 | 36,350 |
| 1995 | 3 | 26,002 | 5,920 | 7,337 | 20,617 | 59,876 | 265,751 | 42,516 | 48,189 | 21,436 |
| 1996 | 0 | 14,790 | 3,334 | 6,614 | 14,606 | 39,344 | 139,573 | 13,049 | 25,751 | 10,677 |
| 1997 | 3 | 67,264 | 35,545 | 38,585 | (13,571) | 127,823 | 203,476 | 31,135 | 36,986 | 16,906 |
| 1998 | 7 | 15,410 | 6,392 | 6,797 | 10,396 | 38,995 | 67,974 | 6,120 | 14,731 | 4,616 |
| 1999 | 2 | 71,950 | 35,515 | 33,879 | 32,613 | 173,957 | 162,161 | 25,329 | 35,716 | 24,347 |
| 2000 | 24 | 29,992 | 8,327 | 11,710 | 4,156 | 54,185 | 100,654 | 15,688 | 24,144 | 19,652 |
| 2001 | 20 | 10,597 | 3,904 | 3,892 | 1,954 | 20,347 | 436,756 | 4,272 | 118,836 | 4,207 |
| 2002 | 14 | 27,018 | 18,971 | 15,254 | 4,614 | 65,857 | 3,068,535 | 5,648 | 329,244 | 64,425 |
| 2003 | 0 | 14,733 | 9,243 | 4,658 | 46,313 | 74,947 | 4,465,569 | 200,125 | 199,457 | 360,387 |
| 2004 | 0 | 23,929 | 2,214 | 2,341 | 145,290 | 173,774 | 1,257,335 | 120,340 | 131,702 | 99,547 |
| 2005 | 0 | 89,369 | 216 | 9 | 33,947 | 123,541 | 1,224,486 | 119,298 | 260,893 | (81) |
| 2006 | 5 | 28,222 | 237 | 90 | 879,428 | 907,978 | 1,234,636 | 68,374 | 259,542 | 523 |
| 2007 | 0 | 61,330 | 1 | 0 | 3,219,041 | 3,280,372 | 3,406,319 | 15,183 | 70,776 | 1,884 |
| 2008 | 4 | 75,107 | 6,065 | 5,318 | 7,878,424 | 7,964,914 | 6,248,064 | 35,890 | 169,891 | 5,098 |
| 2009 | 13 | 26,653 | 348 | 0 | 1,188,748 | 1,215,749 | 10,200,692 | 1,397,392 | 1,835,005 | 1,984 |
| 2010 | 0 | 4,735 | (10) | (1) | 395,362 | 400,086 | 7,061,416 | 104,212 | 468,330 | 14,866,013 |
| 2011 | 1 | 57,126 | 34 | 0 | 175,933 | 233,093 | 10,255,066 | 1,863,345 | 4,089,231 | 3,416,729 |
| 2012 | 0 | 585,216 | 3 | 15,163 | 311,585 | 911,967 | 7,800,110 | 1,379,855 | 3,102,674 | 104,555 |
| 2013 | 0 | 870,300 | 27 | 67,533 | 394,181 | 1,332,041 | 2,392,878 | 1,228,777 | 1,071,752 | 328,413 |
| 2014 | 0 | 781,566 | 3 | 109,243 | 355,488 | 1,246,300 | (122,873) | (1,111,982) | (319,804) | 127,441 |
| 2015 | 0 | 263,623 | 2 | 81,486 | 109,403 | 454,515 | 1,779,537 | 117,701 | 716,517 | 127,700 |
| 2016 | 0 | 93,968 | 4,506 | 50,292 | 32,460 | 181,226 | 200,594 | 156,508 | 198,553 | 46,005 |
| **2017** | **0** | **35,812** | **572** | **25,101** | **10,195** | **71,680** | **35,832** | **131** | **176** | **23,884** |
| 2018 | 0 | 198,951 | 105,367 | 96,168 | 20,797 | 421,283 | 1,548,287 | 49,862 | 67,616 | 454,214 |
| 2019 | 0 | 211,487 | 6,469 | 5,779 | 1,230 | 224,965 | 26,427 | 128,462 | 9,207 | 230,235 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **341,149** | **45,261,962** | **33,176,697** | **5,067,519** | **28,905,904** | **112,412,082** | **81,508,910** | **7,666,506** | **18,087,160** | **31,474,364** |

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | SOUTH BAY AQUEDUCT (continued) | | | | | CALIFORNIA AQUEDUCT NORTH SAN JOAQUIN DIVISION | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Reach 6 | Reach 7 | Reach 8 | Reach 9 | Total | Reach 1 | Reach 2A | Reach 2B | Subtotal |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1952 | 8 | 66 | 72 | 132 | 496 | 4,012 | 3,279 | 1,499 | 8,790 |
| 1953 | 38 | 327 | 336 | 640 | 2,425 | 10,559 | 8,589 | 3,964 | 23,112 |
| 1954 | 123 | 1,005 | 1,003 | 1,954 | 7,455 | 13,796 | 11,163 | 5,179 | 30,138 |
| 1955 | 160 | 1,293 | 1,149 | 2,454 | 9,500 | 7,370 | 5,952 | 2,760 | 16,082 |
| 1956 | 1,559 | 11,959 | 11,043 | 28,372 | 95,872 | 9,880 | 5,020 | 2,398 | 17,298 |
| 1957 | 3,659 | 28,675 | 27,385 | 563,114 | 729,065 | 11,953 | 5,456 | 2,612 | 20,021 |
| 1958 | 2,243 | 17,872 | 17,385 | 560,904 | 904,994 | 18,585 | 17,191 | 7,994 | 43,770 |
| 1959 | 357 | 3,200 | 3,568 | 149,874 | 843,718 | 123,170 | 100,306 | 45,510 | 268,986 |
| 1960 | 1,102 | 2,944 | 4,498 | 359,749 | 1,705,829 | 191,408 | 102,136 | 48,968 | 342,512 |
| 1961 | 4,726 | 18,325 | 22,765 | (1,367) | 3,880,575 | 153,765 | 195,947 | 42,843 | 392,555 |
| 1962 | 17,295 | 160,939 | 178,242 | 209,042 | 3,048,485 | 612,258 | 491,225 | 168,218 | 1,271,701 |
| 1963 | 265,414 | 1,250,386 | 939,832 | 129,902 | 5,626,310 | 1,993,284 | 1,525,734 | 684,095 | 4,203,113 |
| 1964 | 100,603 | 1,716,371 | 2,327,770 | 2,947,522 | 10,103,597 | 4,674,280 | 2,369,858 | 700,074 | 7,744,212 |
| 1965 | 42,345 | 368,476 | 637,266 | 1,921,844 | 4,464,145 | 5,877,189 | 6,873,699 | 2,975,719 | 15,726,607 |
| 1966 | 17,663 | 34,915 | 140,350 | 777,887 | 3,850,714 | 8,553,362 | 14,112,820 | 5,677,099 | 28,343,281 |
| 1967 | (41,567) | 137,856 | 147,183 | 379,764 | 5,070,861 | 9,678,607 | 10,672,113 | 6,646,739 | 26,997,459 |
| 1968 | 84,553 | 2,130 | 68,057 | 253,152 | 4,412,955 | 6,392,664 | 891,681 | 1,303,186 | 8,587,531 |
| 1969 | 4,279 | 11,572 | 162,300 | 32,000 | 1,575,529 | 3,542,767 | 792,259 | 443,924 | 4,778,950 |
| 1970 | 2,487 | 6,820 | 20,086 | (15,718) | 234,411 | 2,236,607 | 149,692 | 115,578 | 2,501,877 |
| 1971 | 4,350 | 6,923 | 17,750 | 39,084 | 122,687 | 98,138 | 215,512 | 69,410 | 383,060 |
| 1972 | 1,084 | 203 | 4,800 | 32,199 | 95,064 | 159,608 | 43,721 | 7,744 | 211,073 |
| 1973 | 288 | 989 | 7,449 | 9,693 | 65,621 | 105,581 | 25,496 | 22,418 | 153,495 |
| 1974 | 527 | 6,020 | 30,628 | 11,433 | 134,260 | 177,700 | 16,627 | 45,707 | 240,034 |
| 1975 | 126 | 679 | 1,086 | 3,464 | 71,991 | 239,144 | 14,680 | 169,676 | 423,500 |
| 1976 | 701 | 3,529 | 8,362 | 26,186 | 167,482 | 641,860 | 45,533 | 65,943 | 753,336 |
| 1977 | 270 | 1,310 | 8,651 | 24,938 | 234,239 | 274,381 | 20,283 | 22,568 | 317,232 |
| 1978 | 231 | 1,204 | 1,631 | 17,123 | 306,960 | 801,265 | 36,221 | 9,714 | 847,200 |
| 1979 | 1,367 | 1,721 | 2,134 | 7,322 | 181,041 | 1,051,792 | 59,695 | 26,106 | 1,137,593 |
| 1980 | 1,321 | 1,718 | 2,182 | 7,102 | 445,267 | 4,173,603 | 96,760 | 38,789 | 4,309,152 |
| 1981 | 308 | 1,462 | 1,398 | 5,077 | (114,602) | (502,921) | 1,487,516 | 38,451 | 1,023,046 |
| 1982 | 716 | 1,561 | 1,746 | 6,074 | 29,565 | 700,738 | 46,501 | 22,308 | 769,547 |
| 1983 | 407 | 5,721 | 8,143 | 23,367 | 651,388 | 706,104 | 84,435 | 211,619 | 1,002,158 |
| 1984 | 269 | 1,853 | 1,667 | 13,301 | 662,851 | 1,559,539 | 41,352 | 48,478 | 1,649,369 |
| 1985 | 402 | 1,657 | 2,129 | 6,750 | 80,035 | 677,955 | 24,812 | 19,404 | 722,171 |
| 1986 | 1,119 | 2,744 | 3,313 | 12,234 | 150,983 | 398,788 | 63,830 | 35,420 | 498,038 |
| 1987 | 1,496 | 3,081 | 3,560 | 21,842 | 232,861 | 799,672 | 88,945 | 41,659 | 930,276 |
| 1988 | 5,706 | 6,689 | 7,603 | 33,728 | 457,839 | 2,898,156 | (128,051) | (56,448) | 2,713,657 |
| 1989 | 2,641 | 3,878 | 4,755 | 14,489 | 221,320 | 6,898,872 | 346,589 | 173,993 | 7,419,454 |
| 1990 | 5,092 | 19,899 | 36,584 | 87,796 | 597,004 | 13,483,785 | 112,002 | 2,446,232 | 16,042,019 |
| 1991 | 1,942 | 5,059 | 7,357 | 31,682 | 1,301,551 | 13,914,632 | 133,121 | 114,981 | 14,162,734 |
| 1992 | 1,184 | 2,042 | 2,250 | 35,464 | 609,067 | 6,260,482 | 241,456 | 239,437 | 6,741,375 |
| 1993 | 3,618 | 6,028 | 8,873 | 42,200 | 548,316 | 2,542,869 | 257,330 | 200,072 | 3,000,271 |
| 1994 | 2,897 | 4,781 | 5,346 | 89,991 | 319,255 | 1,145,666 | 148,396 | 88,357 | 1,382,419 |
| 1995 | 11,556 | 3,635 | 14,769 | 24,750 | 432,602 | 1,462,211 | 217,940 | 131,995 | 1,812,146 |
| 1996 | 3,092 | 2,271 | 2,699 | 12,522 | 209,634 | 874,227 | 74,153 | 41,215 | 989,595 |
| 1997 | 1,454 | 4,141 | 3,655 | 20,589 | 318,342 | 2,064,446 | 146,851 | 84,303 | 2,295,600 |
| 1998 | 363 | 1,134 | (6,005) | 5,776 | 94,709 | 729,475 | 33,695 | 16,670 | 779,840 |
| 1999 | 1,533 | 3,304 | 12,727 | 31,634 | 296,751 | 2,208,776 | 88,951 | 90,639 | 2,388,366 |
| 2000 | 2,406 | 4,944 | 5,331 | 10,755 | 183,575 | (706,517) | 57,503 | 40,185 | (608,829) |
| 2001 | 91,721 | 68,849 | 404,226 | 1,190,653 | 2,319,521 | 371,407 | 91,792 | 8,926 | 472,124 |
| 2002 | 229,409 | 453,259 | 1,107,580 | 2,977,939 | 8,236,039 | 833,187 | 44,543 | 22,639 | 900,369 |
| 2003 | 67,216 | 509,964 | 477,926 | 1,409,228 | 7,689,872 | 228,767 | 22,779 | 13,565 | 265,112 |
| 2004 | 3,193 | 3,100 | 39,326 | 3,276,907 | 4,931,451 | 892,456 | 15,333 | 77,640 | 985,430 |
| 2005 | 5,341 | 5,271 | 4,848 | 731,512 | 2,351,567 | 294,112 | 40,135 | 98,505 | 432,751 |
| 2006 | 1,286 | 1,342 | 1,352 | 15,393 | 1,582,447 | 422,511 | 15,048 | 177,980 | 615,539 |
| 2007 | 7,470 | 7,471 | 7,471 | 10,731 | 3,527,304 | 490,384 | 58,152 | 121,987 | 670,522 |
| 2008 | 8,415 | 8,730 | 8,932 | 12,419 | 6,497,439 | 1,202,812 | 39,742 | 85,604 | 1,328,158 |
| 2009 | 3,054 | 3,271 | 3,369 | 4,804 | 13,449,571 | 555,295 | 41,137 | 30,031 | 626,464 |
| 2010 | 734 | 731 | 730 | 1,045 | 22,503,210 | 181,448 | 8,328 | 2,386 | 192,162 |
| 2011 | 6,514 | 7,668 | 6,484 | 9,188 | 19,654,224 | 813,697 | 51,659 | 3,983 | 869,339 |
| 2012 | 51,903 | 117,364 | 68,876 | 393,352 | 13,018,689 | 1,570,134 | 226,476 | 75,111 | 1,871,721 |
| 2013 | 130,731 | 137,199 | 384,922 | 875,282 | 6,549,953 | 6,957,464 | 800,204 | 237,566 | 7,995,234 |
| 2014 | 102,374 | 121,005 | 107,609 | 207,301 | (888,929) | 5,789,004 | 3,238,636 | 167,361 | 9,195,000 |
| 2015 | 26,053 | 37,802 | 38,192 | 62,844 | 2,906,347 | 5,857,589 | 930,778 | 373,501 | 7,161,867 |
| 2016 | 6,311 | 6,525 | 6,425 | 10,060 | 630,981 | 5,621,086 | 575,134 | 2,899,639 | 9,095,859 |
| **2017** | **32** | **40** | **45** | **51** | **60,191** | **7,104,765** | **733,943** | **137,201** | **7,975,909** |
| 2018 | 12,083 | 15,083 | 17,126 | 19,946 | 2,184,217 | 5,304,235 | 1,466,819 | 14,184 | 6,785,238 |
| 2019 | 1,203 | 1,430 | 1,281 | 3,124 | 401,369 | 2,570,357 | 756,964 | 9,902 | 3,337,223 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **1,320,557** | **5,391,413** | **7,609,582** | **20,221,567** | **173,280,058** | **157,006,252** | **51,633,575** | **27,943,116** | **236,582,942** |

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION | | | | | | SOUTH SAN JOAQUIN DIVISION | | | |
| | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Subtotal | Reach 8C | Reach 8D | Reach 9 | Reach 10A |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1952 | 2,492 | 3,549 | 3,987 | 1,010 | 1,390 | 12,428 | 13 | 727 | 1,109 | 695 |
| 1953 | 6,999 | 10,144 | 10,986 | 2,834 | 3,869 | 34,832 | 45 | 2,671 | 4,185 | 2,569 |
| 1954 | 8,704 | 12,545 | 13,693 | 3,520 | 4,766 | 43,228 | 50 | 2,719 | 4,026 | 2,821 |
| 1955 | 4,273 | 6,055 | 6,813 | 1,728 | 2,325 | 21,194 | 19 | 888 | 1,100 | 1,097 |
| 1956 | 3,295 | 5,600 | 5,857 | 1,445 | 3,556 | 19,753 | 98 | 3,850 | 4,376 | 4,428 |
| 1957 | 3,543 | 6,115 | 6,357 | 1,565 | 3,998 | 21,578 | 234 | 10,604 | 13,209 | 13,269 |
| 1958 | 11,927 | 19,393 | 22,037 | 5,509 | 7,512 | 66,378 | 375 | 19,033 | 25,073 | 25,086 |
| 1959 | 21,979 | 37,358 | 39,689 | 9,813 | 19,679 | 128,518 | 436 | 20,578 | 25,697 | 25,787 |
| 1960 | 207,025 | 45,419 | 41,044 | 12,074 | 37,633 | 343,195 | 1,673 | 44,565 | 25,290 | 47,492 |
| 1961 | 184,443 | 292,639 | 170,559 | 38,338 | 70,068 | 756,047 | 3,949 | 75,726 | 30,852 | 68,505 |
| 1962 | 495,836 | 549,984 | 252,698 | 22,397 | 26,967 | 1,347,882 | 6,131 | 159,481 | 62,375 | 57,705 |
| 1963 | 2,772,189 | 2,034,351 | 2,498,712 | 66,353 | 30,647 | 7,402,252 | 5,861 | 161,252 | 81,343 | 52,585 |
| 1964 | 4,348,311 | 4,932,301 | 1,053,227 | 161,422 | 251,461 | 10,746,722 | 4,014 | 90,622 | 117,907 | 124,014 |
| 1965 | 3,860,997 | 5,688,252 | 2,869,931 | 1,072,111 | 667,768 | 14,159,059 | 15,049 | 491,042 | 564,036 | 622,257 |
| 1966 | 2,312,372 | 8,527,843 | 5,765,798 | 4,230,221 | 7,708,334 | 28,544,568 | 201,274 | 5,197,322 | 2,539,278 | 2,800,056 |
| 1967 | (44,527) | 2,062,305 | 6,942,522 | 222,885 | 6,675,398 | 15,858,583 | 212,285 | 4,982,844 | 3,363,650 | 3,652,342 |
| 1968 | 119,884 | 395,689 | 973,956 | 179,917 | 461,031 | 2,130,477 | 64,234 | 611,192 | 940,074 | 1,025,969 |
| 1969 | (6,065) | 126,946 | 98,492 | 107,486 | 160,668 | 487,527 | 58,960 | 116,146 | 85,130 | 145,111 |
| 1970 | 32,387 | (20,243) | 105,385 | (827,457) | 1,215,966 | 506,038 | 23,011 | 106,810 | 84,116 | 74,366 |
| 1971 | 99,945 | 230,624 | 305,227 | 26,995 | 341,010 | 1,003,801 | 8,813 | 33,099 | 23,088 | 15,595 |
| 1972 | 15,990 | 90,852 | 17,053 | 14,621 | 281,343 | 419,859 | 10,818 | 13,349 | 16,603 | 19,736 |
| 1973 | 6,753 | 103,707 | 41,549 | 13,810 | 41,427 | 207,246 | 5,145 | 11,089 | 13,249 | 14,283 |
| 1974 | 6,618 | 117,165 | 55,978 | 16,199 | 71,796 | 267,756 | 5,434 | 24,433 | 16,567 | 22,111 |
| 1975 | 18,921 | 107,275 | 23,671 | 8,797 | 152,574 | 311,238 | 5,424 | 15,960 | 12,966 | 15,865 |
| 1976 | 17,485 | 79,554 | 13,041 | 5,138 | 41,687 | 156,905 | 19,931 | 76,280 | 62,164 | 76,202 |
| 1977 | 35,707 | 84,669 | 9,412 | 4,028 | 9,655 | 143,471 | 21,096 | 70,005 | 97,952 | 75,628 |
| 1978 | 8,539 | 428,395 | 7,006 | 3,536 | 6,994 | 454,470 | 7,584 | 40,453 | 17,395 | 48,754 |
| 1979 | (35,394) | 543,225 | 19,463 | 9,485 | (242,253) | 294,526 | 10,474 | 6,181 | 6,227 | 241 |
| 1980 | 66,622 | 3,450,695 | 191,307 | 75,209 | 185,384 | 3,969,217 | 2,158 | 17,492 | 17,706 | 18,165 |
| 1981 | 28,491 | (2,244,127) | (44,017) | (15,456) | 918,984 | (1,356,125) | 1,151 | 9,642 | 9,541 | 10,309 |
| 1982 | 100,629 | (1,616,569) | 20,184 | 10,359 | 3,525,738 | 2,040,341 | 2,469 | 8,283 | 6,956 | 8,237 |
| 1983 | 75,639 | 33,881 | 11,785 | 6,638 | 1,811,638 | 1,939,581 | 7,955 | 13,782 | 11,090 | 14,488 |
| 1984 | 31,748 | 87,083 | 26,712 | 12,754 | 3,053,662 | 3,211,959 | 26,489 | 9,959 | 6,268 | 7,533 |
| 1985 | 53,251 | 56,732 | 13,685 | 6,934 | 582,910 | 713,512 | 7,220 | 9,762 | 7,688 | 9,215 |
| 1986 | 73,979 | 201,509 | 50,668 | 19,223 | 1,282,469 | 1,627,848 | 8,902 | 25,011 | 20,503 | 22,335 |
| 1987 | (7,829) | 116,268 | 40,009 | 15,946 | 518,349 | 682,743 | 12,744 | 18,927 | 56,042 | 16,704 |
| 1988 | (149,385) | 224,154 | (406,398) | (137,353) | 923,622 | 454,640 | 9,833 | (119,741) | (60,639) | (159,357) |
| 1989 | 39,652 | 594,894 | 232,852 | 80,090 | 575,855 | 1,523,343 | 5,279 | 91,501 | 278,061 | 70,153 |
| 1990 | 39,270 | 259,895 | 79,589 | 29,606 | 461,219 | 869,579 | 5,814 | 41,345 | 2,016,434 | 34,841 |
| 1991 | 4,916,134 | 397,959 | 98,847 | 35,860 | 511,519 | 5,960,319 | 4,588 | 43,140 | 41,348 | 36,888 |
| 1992 | (757,001) | 545,729 | 211,854 | 74,544 | 396,398 | 471,524 | 3,546 | 103,695 | 109,225 | 103,321 |
| 1993 | 110,233 | 724,929 | 186,271 | 70,815 | 720,283 | 1,812,531 | 15,016 | 101,634 | 90,929 | 90,291 |
| 1994 | 1,151,976 | 288,018 | 63,862 | 27,812 | 710,770 | 2,242,438 | 6,770 | 42,455 | 40,696 | 65,737 |
| 1995 | 285,776 | 441,479 | 130,761 | 58,640 | 1,914,186 | 2,830,842 | 12,548 | 49,963 | 43,251 | 435,909 |
| 1996 | 31,942 | (110,471) | 34,529 | 12,219 | 588,712 | 556,931 | 6,444 | 29,863 | 27,050 | 253,433 |
| 1997 | 73,224 | 513,793 | (277,781) | 42,881 | 5,016,215 | 5,368,332 | 11,497 | 49,111 | 43,799 | 73,458 |
| 1998 | 19,692 | 304,115 | 34,319 | 16,542 | 2,819,556 | 3,194,224 | 2,562 | 11,115 | 8,955 | 14,618 |
| 1999 | 18,187 | 158,902 | 100,061 | 41,691 | 1,901,382 | 2,220,222 | 5,706 | 25,179 | 23,510 | 47,359 |
| 2000 | 101,618 | 373,699 | 78,036 | 36,186 | 1,139,073 | 1,728,613 | 3,922 | 23,591 | 29,281 | 43,459 |
| 2001 | (10,513) | (47,112) | 519,031 | (3,546) | 61,595 | 519,455 | 2,280 | 17,030 | 21,196 | 42,731 |
| 2002 | 12,237 | 24,434 | 6,079,343 | 3,454 | (1,812,639) | 4,306,829 | 3,627 | 44,010 | 20,221 | 87,805 |
| 2003 | 8,864 | 79,647 | (5,377,004) | 7,923 | 6,118,421 | 837,852 | 2,130 | 18,793 | 16,716 | 22,946 |
| 2004 | (16,126) | (14,365) | (50,563) | (2,487) | 147,468 | 63,927 | 22,520 | 5,980 | 3,879 | 5,493 |
| 2005 | 261 | 11,360 | 129,470 | 3,529 | 2,533,886 | 2,678,506 | 26,301 | 11,593 | 6,323 | 7,316 |
| 2006 | 1,421 | 27,658 | (10,639) | 1,444 | (28,549) | (8,664) | 6,106 | 2,942 | 1,621 | 1,872 |
| 2007 | 2 | 87,855 | 39,476 | 7,718 | 34,608 | 169,659 | 13,352 | 21,920 | 11,909 | 13,807 |
| 2008 | 14,780 | 16,097 | 46,719 | 13,920 | 2,107,019 | 2,198,535 | 9,017 | 13,020 | 7,277 | 8,919 |
| 2009 | 934 | 216,920 | 45,727 | 5,164 | (43,789) | 224,956 | 2,380 | 16,160 | 8,894 | 10,504 |
| 2010 | (16) | 1,560,454 | 130,995 | 655 | (355,859) | 1,336,229 | (1) | 1,824 | 989 | 1,148 |
| 2011 | 7,073 | 644,241 | 481,776 | 1,325 | 78,355 | 1,212,771 | 3 | 6,385 | 1,768 | 14,006 |
| 2012 | 44,540 | 213,896 | 2,999 | 29,658 | 170,358 | 461,451 | 1,139 | 114,545 | 36,447 | 73,710 |
| 2013 | 810,117 | 299,508 | 906,259 | 120,865 | 215,316 | 2,352,064 | 42,393 | 383,194 | 323,185 | 342,033 |
| 2014 | 843,003 | 317,107 | 461,093 | 67,178 | 207,794 | 1,896,174 | 20,475 | 181,707 | 136,459 | 158,996 |
| 2015 | (624,058) | 145,421 | 228,663 | 15,444 | 153,006 | (81,523) | 45,988 | 140,973 | 95,175 | 122,837 |
| 2016 | 248,879 | 3,350,250 | 2,784,418 | 121,708 | 551,346 | 7,056,601 | 91,311 | 422,628 | 209,782 | 402,801 |
| **2017** | **176,001** | **7,197,061** | **1,946,640** | **184,593** | **2,340,382** | **11,844,677** | **82,770** | **327,598** | **1,167,528** | **424,335** |
| 2018 | 78,295 | 5,800,148 | 1,375,418 | 133,210 | 188,747 | 7,575,818 | 0 | 7,328 | 0 | 616,221 |
| 2019 | 42,007 | 2,101,728 | 540,675 | 28,007 | 23,656 | 2,736,073 | 577 | 7,405 | 4,801 | 319,380 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **22,462,178** | **53,356,588** | **32,531,774** | **6,676,682** | **60,306,313** | **175,333,534** | **1,227,412** | **14,739,666** | **13,140,902** | **12,928,526** |

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Reach 11B | Reach 12D | Reach 12E | Reach 13B | Reach 14A | Reach 14B | Reach 14C | Reach 15A | Reach 16A | Subtotal |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1952 | 1,279 | 1,980 | 995 | 1,663 | 794 | 212 | 212 | 1,911 | 4,440 | 16,030 |
| 1953 | 4,790 | 7,480 | 3,745 | 6,236 | 2,599 | 733 | 741 | 7,016 | 16,513 | 59,323 |
| 1954 | 4,855 | 7,565 | 3,792 | 6,319 | 2,880 | 810 | 817 | 7,073 | 16,601 | 60,328 |
| 1955 | 1,557 | 2,404 | 1,211 | 2,025 | 1,183 | 325 | 327 | 2,253 | 5,223 | 19,612 |
| 1956 | 6,223 | 9,233 | 4,737 | 8,054 | 7,026 | 1,638 | 1,584 | 9,939 | 21,754 | 82,940 |
| 1957 | 18,772 | 29,082 | 14,615 | 24,411 | 15,651 | 3,834 | 3,864 | 26,871 | 62,657 | 237,073 |
| 1958 | 48,191 | 78,564 | 39,087 | 61,715 | 33,726 | 12,330 | 11,813 | 49,499 | 133,083 | 537,575 |
| 1959 | 67,246 | 107,781 | 53,836 | 86,478 | 64,824 | 22,102 | 21,828 | 70,838 | 205,748 | 773,179 |
| 1960 | 66,317 | 77,936 | 39,867 | 63,517 | 84,363 | 23,260 | 22,305 | 73,305 | 204,788 | 774,678 |
| 1961 | 46,073 | 88,274 | 51,457 | 28,015 | 242,753 | 91,290 | 65,565 | 150,205 | 206,305 | 1,148,969 |
| 1962 | 56,056 | 69,189 | 44,851 | 49,179 | 208,180 | 61,489 | 47,608 | 133,653 | 171,396 | 1,127,293 |
| 1963 | 91,914 | 173,985 | 86,405 | 67,733 | 425,626 | 104,436 | 77,970 | 102,072 | 481,941 | 1,913,123 |
| 1964 | 333,621 | 291,013 | 174,469 | 86,271 | 1,093,795 | 684,005 | 485,033 | 571,173 | 1,778,952 | 5,834,889 |
| 1965 | 1,053,029 | 1,524,848 | 1,044,851 | 196,487 | 3,385,205 | 1,655,024 | 1,436,258 | 476,830 | 1,268,176 | 13,733,092 |
| 1966 | 3,709,779 | 673,429 | 466,228 | 418,141 | 4,916,319 | 974,862 | 724,354 | 1,829,852 | 2,896,274 | 27,347,168 |
| 1967 | 4,636,627 | 1,881,333 | 1,244,265 | 1,238,428 | 2,788,299 | 525,653 | 400,183 | 1,721,304 | 3,442,021 | 30,089,234 |
| 1968 | 1,323,302 | 4,726,074 | 3,145,775 | 8,343,706 | 10,210,266 | 1,330,361 | 1,405,117 | 7,522,015 | 7,578,498 | 48,226,583 |
| 1969 | 229,185 | 706,272 | 529,080 | 3,704,065 | 15,112,041 | 1,223,457 | 1,134,395 | 9,523,012 | 13,136,056 | 45,702,910 |
| 1970 | 85,151 | 70,725 | 72,798 | 320,797 | 11,031,255 | 987,213 | 738,955 | 8,836,897 | 13,890,751 | 36,322,845 |
| 1971 | 45,006 | 43,988 | 42,624 | 339,078 | 2,925,191 | 193,255 | 36,514 | 3,275,227 | 7,903,937 | 14,885,415 |
| 1972 | 32,657 | 43,939 | 24,748 | 81,937 | 1,388,348 | 101,784 | 20,165 | 1,003,380 | 3,025,555 | 5,783,019 |
| 1973 | 16,448 | 9,980 | 16,320 | 25,090 | 680,834 | 19,584 | 13,469 | 798,805 | 1,472,313 | 3,096,609 |
| 1974 | 14,951 | 19,555 | 32,240 | 29,582 | 524,504 | 30,735 | 16,333 | 778,696 | 1,031,843 | 2,546,984 |
| 1975 | 13,479 | 10,793 | 13,678 | 25,827 | 269,197 | 25,164 | 21,048 | 370,265 | 489,545 | 1,289,211 |
| 1976 | 54,217 | 37,464 | 59,842 | 105,332 | 507,519 | 59,753 | 42,776 | 434,574 | 618,049 | 2,154,103 |
| 1977 | 52,919 | 22,826 | 54,444 | 81,293 | 301,515 | 49,972 | 30,152 | 235,514 | 580,209 | 1,673,525 |
| 1978 | 16,469 | (2,816) | 27,331 | 43,126 | 348,674 | (653) | 1,500 | 297,817 | 582,775 | 1,428,409 |
| 1979 | 6,906 | 13,401 | 14,229 | 25,411 | 293,786 | 9,846 | 7,856 | 245,590 | 542,554 | 1,182,702 |
| 1980 | 18,813 | 15,608 | 27,498 | 34,190 | 1,676,267 | 29,169 | 23,023 | 1,719,775 | 3,772,498 | 7,372,362 |
| 1981 | 14,885 | 26,473 | 20,972 | 25,515 | (1,076,221) | 27,551 | 33,674 | (1,142,721) | (2,527,211) | (4,566,440) |
| 1982 | 6,608 | 7,680 | 8,346 | 16,339 | (745,914) | 9,886 | 29,393 | (804,147) | (1,850,736) | (3,296,600) |
| 1983 | 9,792 | 14,174 | 13,050 | 35,872 | 419,650 | 17,389 | 24,933 | 115,983 | 166,232 | 864,390 |
| 1984 | 27,613 | 87,907 | 49,271 | 22,732 | 54,590 | 75,453 | 63,060 | 63,537 | 119,387 | 613,799 |
| 1985 | 6,949 | 5,263 | 8,013 | 8,875 | (49,408) | 9,523 | 5,867 | 54,782 | 82,117 | 165,866 |
| 1986 | 16,664 | 16,014 | 25,031 | 20,483 | 140,642 | 25,960 | 13,913 | 154,089 | 186,348 | 675,895 |
| 1987 | 13,512 | 12,369 | 20,023 | 15,435 | 101,453 | 20,411 | 8,581 | 227,047 | 194,936 | 718,184 |
| 1988 | (73,648) | (151,040) | (51,401) | (120,104) | 161,077 | (75,276) | (75,307) | 144,369 | 262,334 | (308,900) |
| 1989 | 65,216 | 63,382 | 120,925 | 73,037 | 2,778,880 | 119,559 | 36,660 | 2,952,046 | 5,955,356 | 12,610,055 |
| 1990 | 29,230 | 27,269 | 49,082 | 34,048 | 715,031 | 44,187 | 14,537 | 440,017 | 640,283 | 4,092,118 |
| 1991 | 32,195 | 30,146 | 55,119 | 34,144 | 423,235 | 50,345 | 12,116 | 353,596 | 774,129 | 1,890,989 |
| 1992 | 99,765 | 98,178 | 192,455 | 97,638 | 991,603 | 185,311 | 9,210 | 387,615 | 731,512 | 3,113,074 |
| 1993 | 70,131 | 63,247 | 118,440 | 80,530 | 687,462 | 109,792 | 38,960 | 942,211 | 857,038 | 3,265,681 |
| 1994 | 29,221 | 26,997 | 50,234 | 35,154 | 400,534 | 44,481 | 17,426 | 324,942 | 853,328 | 1,937,975 |
| 1995 | 32,487 | 25,516 | 49,885 | 41,733 | 524,524 | 48,740 | 29,125 | 450,952 | 628,941 | 2,373,574 |
| 1996 | 19,489 | 15,020 | 30,202 | 29,333 | 403,125 | 26,945 | 16,405 | 253,622 | 388,064 | 1,498,995 |
| 1997 | 30,890 | 25,368 | 48,767 | 40,900 | 451,910 | 47,815 | 29,878 | 809,848 | 481,458 | 2,144,699 |
| 1998 | 7,107 | 5,773 | 10,697 | 9,676 | 288,667 | 10,799 | 6,819 | 119,562 | 440,746 | 937,096 |
| 1999 | 17,022 | 13,362 | 34,410 | 31,539 | 260,623 | 24,634 | 14,826 | 264,538 | 361,516 | 1,124,225 |
| 2000 | 21,186 | 32,480 | 40,180 | 25,119 | 168,825 | 15,243 | 11,006 | 151,512 | 372,997 | 938,802 |
| 2001 | 14,471 | 22,325 | 34,995 | 8,027 | 71,645 | 4,537 | 3,988 | 66,918 | 167,694 | 477,837 |
| 2002 | 19,626 | 7,157 | 78,600 | 47,505 | 276,160 | 22,632 | 34,980 | 164,596 | 286,748 | 1,093,668 |
| 2003 | 9,280 | 8,935 | 18,115 | 15,308 | 136,433 | 6,671 | 9,686 | 110,492 | 159,978 | 535,484 |
| 2004 | 3,291 | 4,188 | 7,001 | 5,787 | 52,563 | 5,588 | 1,490 | 50,520 | 322,068 | 490,368 |
| 2005 | 6,332 | 12,579 | 6,307 | 6,354 | 21,617 | 12,567 | 44 | 9,079 | 43,887 | 170,299 |
| 2006 | 1,680 | 3,146 | 1,618 | 1,736 | 5,936 | 3,109 | 108 | 2,695 | 11,294 | 43,863 |
| 2007 | 11,909 | 23,818 | 11,909 | 11,910 | 40,392 | 23,818 | 1 | 16,745 | 82,675 | 284,166 |
| 2008 | 6,999 | 12,960 | 8,044 | 8,187 | 35,363 | 13,537 | 568 | 22,711 | 63,596 | 210,197 |
| 2009 | 8,926 | 16,976 | 9,236 | 9,565 | 35,656 | 17,158 | 450 | 18,753 | 67,633 | 222,291 |
| 2010 | 985 | 1,985 | 990 | 981 | 3,325 | 1,988 | (7) | 1,362 | 6,865 | 22,435 |
| 2011 | 1,782 | 3,513 | 1,767 | 1,796 | 40,475 | 3,504 | 26 | 13,750 | 134,357 | 223,131 |
| 2012 | 33,065 | 62,348 | 34,901 | 34,973 | 393,561 | 64,937 | 3,511 | 494,940 | 686,555 | 2,034,633 |
| 2013 | 196,084 | 263,911 | 240,567 | 240,749 | 1,246,859 | 349,608 | 127,458 | 1,544,197 | 1,678,853 | 6,979,091 |
| 2014 | 98,155 | 149,649 | 112,143 | 112,254 | 867,288 | 175,751 | 46,203 | 632,842 | 1,189,256 | 3,881,178 |
| 2015 | 80,659 | 97,498 | 100,853 | 108,237 | 819,453 | 119,113 | 58,327 | 664,725 | 820,322 | 3,274,158 |
| 2016 | 137,263 | 691,256 | 300,700 | 653,250 | 1,148,537 | 518,366 | 113,544 | 869,378 | 1,591,803 | 7,150,619 |
| **2017** | **88,172** | **1,159,310** | **123,762** | **480,491** | **921,558** | **377,241** | **90,109** | **758,082** | **1,653,348** | **7,654,304** |
| 2018 | 0 | 5,400,095 | 0 | 0 | 3,430,464 | 0 | 0 | 1,851,138 | 3,709,585 | 15,014,831 |
| 2019 | 3,265 | 1,905 | 9,543 | 10,021 | 2,039,503 | 5,576 | 2,466 | 1,010,033 | 1,977,319 | 5,391,794 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **13,254,091** | **19,131,038** | **9,329,769** | **17,819,236** | **77,229,696** | **10,786,090** | **7,625,800** | **54,841,716** | **89,313,065** | **341,367,007** |

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TEHACHAPI DIVISION | | | MOJAVE DIVISION | | | | | | |
| | Reach 17E | Reach 17F | Subtotal | Reach 18A | Reach 19 | Reach 19C | Reach 20A | Reach 20B | Reach 21 | Reach 22A |
| | [40] | [41] | [42] | [43] | [44] | [45] | [46] | [47] | [48] | [49] |
| 1952 | 9,703 | 4,072 | 13,775 | 4,090 | 1,520 | 0 | 2,561 | 892 | 5,788 | 35 |
| 1953 | 31,337 | 13,284 | 44,621 | 12,610 | 4,685 | 0 | 7,246 | 3,402 | 17,846 | 71 |
| 1954 | 46,243 | 20,010 | 66,253 | 16,642 | 6,184 | 0 | 9,506 | 4,548 | 23,558 | 369 |
| 1955 | 25,880 | 11,362 | 37,242 | 5,612 | 2,086 | 0 | 2,529 | 2,213 | 7,947 | 178 |
| 1956 | 47,487 | 17,609 | 65,096 | 6,038 | 2,244 | 0 | 2,440 | 2,655 | 8,542 | 216 |
| 1957 | 119,673 | 49,130 | 168,803 | 22,348 | 8,304 | 0 | 9,035 | 9,826 | 31,616 | 800 |
| 1958 | 164,056 | 72,091 | 236,147 | 37,917 | 14,166 | 123 | 15,391 | 16,752 | 53,569 | 1,397 |
| 1959 | 151,389 | 57,883 | 209,272 | 38,620 | 23,450 | 1,102 | 23,605 | 18,604 | 56,724 | 1,844 |
| 1960 | 203,222 | 45,323 | 248,545 | 21,356 | 26,093 | 5,318 | 40,523 | 37,179 | 43,893 | 11,029 |
| 1961 | 387,819 | 85,558 | 473,377 | 35,664 | 32,281 | 2,262 | 34,918 | 37,102 | 21,532 | 14,517 |
| 1962 | 353,119 | 82,610 | 435,729 | 68,508 | 266,284 | 1,841 | 10,323 | 10,730 | 8,197 | 4,186 |
| 1963 | 1,191,633 | 124,757 | 1,316,390 | 37,379 | 435,881 | 4,137 | 39,706 | 40,865 | 26,670 | 17,081 |
| 1964 | 1,866,000 | 775,005 | 2,641,005 | 95,693 | 706,369 | 8,564 | 43,342 | 71,116 | 33,912 | 22,793 |
| 1965 | 2,574,824 | 2,284,869 | 4,859,693 | 121,060 | 716,092 | 9,156 | 108,519 | 343,506 | 91,095 | 65,689 |
| 1966 | 5,537,412 | 9,323,517 | 14,860,929 | 366,116 | 1,644,699 | 13,373 | 159,282 | 1,311,628 | 160,388 | 178,538 |
| 1967 | 26,239,390 | 12,398,708 | 38,638,098 | 1,312,022 | 903,880 | 24,103 | 645,078 | 1,718,942 | 498,257 | 367,961 |
| 1968 | 33,363,479 | 7,416,464 | 40,779,943 | 136,804 | 7,109,653 | 71,388 | 1,889,601 | 2,291,691 | 1,141,929 | 1,145,768 |
| 1969 | 40,368,425 | 6,883,206 | 47,251,631 | 213,805 | 2,465,641 | 7,423 | 5,939,151 | 5,626,284 | 2,358,737 | 1,515,147 |
| 1970 | 35,446,706 | 6,786,231 | 42,232,937 | 2,211,077 | 1,210,665 | 6,217 | 3,652,478 | 5,304,372 | 3,232,911 | 2,081,810 |
| 1971 | 20,141,395 | 6,835,303 | 26,976,698 | 1,496,843 | 284,738 | 6,994 | 1,074,759 | 1,091,123 | 825,070 | 432,464 |
| 1972 | 10,002,935 | 34,791 | 10,037,726 | 129,417 | 409,903 | 3,620 | 471,963 | 635,507 | 484,772 | 324,865 |
| 1973 | 3,090,140 | 36,207 | 3,126,347 | 23,931 | 75,638 | 2,539 | 88,416 | 83,840 | 63,774 | 36,179 |
| 1974 | 4,798,348 | 152,494 | 4,950,842 | 28,399 | 205,581 | 2,703 | 138,673 | 118,639 | 103,545 | 54,198 |
| 1975 | 2,144,178 | 411,404 | 2,555,582 | 44,774 | 70,652 | 5,066 | 68,157 | 169,294 | 167,240 | 19,453 |
| 1976 | 1,124,357 | 174,629 | 1,298,986 | 121,043 | 84,593 | 6,786 | 59,967 | 102,909 | 44,896 | 24,732 |
| 1977 | 655,047 | 31,512 | 686,559 | 261,400 | 133,767 | 7,521 | 117,878 | 120,160 | 71,389 | 49,445 |
| 1978 | 1,900,843 | 27,956 | 1,928,799 | 553,014 | 57,150 | 5,872 | 51,615 | 68,838 | 32,855 | 18,183 |
| 1979 | 2,099,385 | 61,381 | 2,160,766 | 626,615 | 339,536 | 10,831 | 37,085 | 36,225 | 18,948 | 10,675 |
| 1980 | 17,433,610 | 6,046 | 17,439,656 | 1,130,429 | 1,073,430 | 3,604 | 308,188 | 284,545 | 133,526 | 121,171 |
| 1981 | (3,848,206) | 6,908 | (3,841,298) | 1,218,824 | 845,702 | 4,498 | 48,625 | 32,214 | 13,223 | 6,466 |
| 1982 | 11,370,112 | 6,054 | 11,376,166 | 6,968,683 | 746,900 | 3,920 | 33,869 | 77,988 | 13,158 | 14,459 |
| 1983 | 8,862,914 | 8,269 | 8,871,183 | 10,909,386 | 64,660 | 2,596 | 40,793 | 58,714 | 25,900 | 10,363 |
| 1984 | 3,227,937 | 31,701 | 3,259,638 | 8,340,371 | 309,491 | 3,124 | 17,505 | 35,378 | 845,423 | 6,052 |
| 1985 | 1,926,289 | 10,460 | 1,936,749 | 5,264,156 | 227,986 | 3,885 | 68,422 | (232,549) | (481,017) | 1,945,477 |
| 1986 | 1,381,955 | 33,788 | 1,415,743 | 2,049,111 | 2,069,663 | 4,261 | 2,331,707 | (2,046,222) | (1,334,975) | 3,260,280 |
| 1987 | 671,183 | 13,807 | 684,990 | 1,347,722 | (6,453) | 4,684 | 562,540 | (344,829) | 55,519 | 64,264 |
| 1988 | 1,408,760 | (49,734) | 1,359,026 | 847,954 | (104,961) | 13,409 | (159,892) | (147,290) | (70,564) | 351,489 |
| 1989 | 504,715 | 64,660 | 569,375 | 376,980 | 207,150 | 50,953 | 31,173 | 60,657 | 30,217 | 534,658 |
| 1990 | 783,219 | 25,218 | 808,437 | 202,065 | (402,573) | 61,192 | (637,062) | (403,413) | (635,623) | (97,841) |
| 1991 | 691,578 | 33,405 | 724,983 | 273,021 | 22,218 | 81,545 | (188,732) | (18,809) | (147,369) | (17,234) |
| 1992 | 741,986 | 24,369 | 766,355 | 620,962 | 384,568 | 86,644 | 225,398 | 338,098 | (263,897) | 75,210 |
| 1993 | 1,223,402 | 35,370 | 1,258,772 | 1,131,166 | 248,287 | 72,746 | 110,869 | 180,598 | 133,941 | 49,144 |
| 1994 | 806,213 | 16,681 | 822,894 | 998,126 | 164,096 | 60,147 | 51,340 | 114,273 | 65,260 | 26,546 |
| 1995 | 1,538,497 | 19,443 | 1,557,940 | 390,433 | 157,481 | 45,990 | 92,925 | 121,499 | 66,503 | 30,918 |
| 1996 | 2,571,039 | 10,797 | 2,581,836 | 91,593 | 69,281 | 22,188 | 35,656 | 48,699 | 44,953 | 17,787 |
| 1997 | 1,009,249 | 18,265 | 1,027,514 | 135,402 | 92,607 | 13,590 | 65,433 | 39,973 | 55,881 | 27,865 |
| 1998 | 925,574 | 6,843 | 932,417 | 47,486 | 36,170 | 4,164 | 29,900 | 27,626 | 20,285 | 12,816 |
| 1999 | 662,144 | 12,166 | 674,310 | 113,232 | 49,150 | 5,329 | 171,935 | 58,392 | 37,660 | 17,874 |
| 2000 | 408,352 | 14,333 | 422,685 | 120,267 | 90,145 | 936 | 83,478 | 75,230 | 44,857 | 20,181 |
| 2001 | 266,815 | 10,891 | 277,706 | 65,580 | 186,973 | 2,223 | 343,775 | 121,907 | 77,799 | 54,526 |
| 2002 | 247,986 | 9,586 | 257,572 | 35,787 | (139,334) | 1,374 | (111,675) | (82,663) | (7,369) | (43,431) |
| 2003 | 189,022 | 12,339 | 201,361 | 84,434 | (19,049) | 0 | (11,367) | (7,564) | (3,238) | (3,009) |
| 2004 | 372,622 | 4,637 | 377,259 | 19,723 | 17,430 | 0 | 18,763 | 12,619 | 13,744 | 5,414 |
| 2005 | 2,264,602 | 6,587 | 2,271,188 | 27,020 | 18,910 | 0 | 25,134 | 18,874 | 25,074 | 6,335 |
| 2006 | 5,855,349 | 2,353 | 5,857,702 | 7,062 | 4,978 | 0 | 6,373 | 4,511 | 5,983 | 1,500 |
| 2007 | 3,829,554 | 11,915 | 3,841,469 | 49,382 | 35,729 | 0 | 47,637 | 35,725 | 47,634 | 11,908 |
| 2008 | 640,715 | 7,591 | 648,306 | 20,474 | 19,644 | 0 | 28,901 | 19,526 | 25,456 | 6,477 |
| 2009 | 9,987,899 | 10,348 | 9,998,247 | 23,685 | 25,891 | 0 | 33,870 | 24,745 | 32,909 | 8,241 |
| 2010 | 11,126,864 | 940 | 11,127,803 | 25,049 | 2,960 | 0 | 3,965 | 2,992 | 3,992 | 997 |
| 2011 | 4,980,685 | 1,943 | 4,982,629 | 4,594 | 5,331 | 0 | 7,045 | 5,220 | 6,951 | 1,739 |
| 2012 | 875,243 | 32,877 | 908,120 | 95,936 | 114,523 | 0 | 152,679 | 114,484 | 152,651 | 38,158 |
| 2013 | 704,335 | 156,471 | 860,806 | 234,199 | 314,887 | 0 | 419,827 | 314,845 | 419,785 | 104,949 |
| 2014 | 3,010,683 | 79,990 | 3,090,674 | 1,077,259 | 203,219 | 0 | 270,945 | 203,188 | 270,922 | 67,726 |
| 2015 | 9,052,794 | 37,215 | 9,090,009 | 678,421 | 91,309 | 0 | 1,520,944 | 91,309 | 121,745 | 30,436 |
| 2016 | 5,005,509 | 48,665 | 5,054,174 | 80,972 | 52,468 | 0 | 70,385 | 52,503 | 69,933 | 17,494 |
| **2017** | **6,799,918** | **4,198** | **6,804,116** | **168,157** | **268,272** | **0** | **357,696** | **268,272** | **357,696** | **89,424** |
| 2018 | 7,163,698 | 0 | 7,163,698 | 184,711 | 325,905 | 0 | 558,224 | 335,969 | 427,179 | 109,904 |
| 2019 | 5,975,009 | 0 | 5,975,009 | 231,728 | 15,093 | 0 | 130,055 | 24,038 | 13,581 | 6,159 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **326,734,248** | **55,004,762** | **381,739,010** | **53,740,340** | **25,131,870** | **759,941** | **21,940,993** | **19,200,113** | **10,350,885** | **13,392,516** |

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | | SANTA ANA DIVISION | | | | | |
| | Reach 22B | Reach 23 | Reach 24 | Subtotal | Reach 25 | Reach 26A | Reach 28G[a] | Reach 28H | Reach 28J | Subtotal |
| | [50] | [51] | [52] | [53] | [54] | [55] | [56] | [57] | [58] | [59] |
| 1952 | 2,013 | 2,074 | 2,413 | 21,386 | 3,334 | 5,599 | 4,785 | 4,055 | 3,020 | 20,793 |
| 1953 | 5,752 | 6,886 | 7,438 | 65,936 | 10,275 | 17,264 | 15,580 | 11,511 | 9,476 | 64,106 |
| 1954 | 8,560 | 7,849 | 9,820 | 87,036 | 13,566 | 22,790 | 18,015 | 18,100 | 12,160 | 84,631 |
| 1955 | 2,754 | 2,725 | 3,313 | 29,357 | 4,575 | 7,687 | 6,052 | 6,081 | 4,151 | 28,546 |
| 1956 | 2,905 | 2,961 | 3,561 | 31,562 | 4,917 | 8,264 | 6,496 | 6,525 | 4,480 | 30,682 |
| 1957 | 10,757 | 10,962 | 13,177 | 116,825 | 18,205 | 30,586 | 24,044 | 24,156 | 16,585 | 113,576 |
| 1958 | 18,717 | 18,578 | 22,627 | 199,237 | 31,001 | 52,019 | 40,844 | 41,033 | 28,470 | 193,367 |
| 1959 | 25,421 | 20,372 | 45,646 | 255,388 | 39,325 | 58,137 | 45,746 | 45,946 | 44,331 | 233,485 |
| 1960 | 136,751 | 17,152 | 109,816 | 449,110 | 65,655 | 93,700 | 59,102 | 58,548 | 118,969 | 395,974 |
| 1961 | 215,859 | 9,546 | 373,473 | 777,154 | 26,979 | 56,734 | 32,226 | 34,382 | 674,787 | 825,108 |
| 1962 | 164,168 | 4,336 | 279,421 | 817,994 | 9,964 | 36,235 | 21,383 | 20,530 | 47,484 | 135,596 |
| 1963 | 237,695 | 7,228 | 358,503 | 1,205,145 | 31,013 | 112,271 | 43,884 | 41,698 | 1,506,440 | 1,735,306 |
| 1964 | 262,996 | 6,863 | 244,003 | 1,495,651 | 69,669 | 202,642 | 89,710 | 45,762 | 98,569 | 506,352 |
| 1965 | 827,655 | 11,836 | 621,566 | 2,916,174 | 279,237 | 206,356 | 96,956 | 76,899 | 146,095 | 805,543 |
| 1966 | 1,746,245 | 31,078 | 1,018,628 | 6,629,975 | 415,066 | 364,004 | 170,878 | 308,756 | 589,107 | 1,847,811 |
| 1967 | 3,146,128 | 62,135 | 2,331,106 | 11,009,612 | 3,184,296 | 638,539 | 233,968 | 283,126 | 987,832 | 5,327,761 |
| 1968 | 4,588,850 | 102,207 | 2,600,293 | 21,078,184 | 8,264,126 | 1,268,194 | 871,337 | 266,295 | 780,587 | 11,450,539 |
| 1969 | 7,750,478 | 260,659 | 11,131,406 | 37,268,731 | 6,807,783 | 1,768,456 | 1,117,873 | 1,444,654 | 756,442 | 11,895,208 |
| 1970 | 23,451,612 | 1,240,798 | 16,885,193 | 59,277,133 | 2,169,051 | 7,229,429 | 1,843,621 | 1,013,468 | 2,829,523 | 15,085,092 |
| 1971 | 16,772,680 | 1,922,115 | 5,385,721 | 29,292,507 | 1,135,248 | 9,811,736 | 16,095,702 | 6,401,303 | 12,111,623 | 45,555,612 |
| 1972 | 3,788,894 | 48,049 | 788,479 | 7,085,469 | 1,095,740 | 5,528,987 | 1,537,880 | 11,960,791 | 21,542,747 | 41,666,145 |
| 1973 | 1,623,274 | 24,333 | 4,225,877 | 6,247,801 | 136,994 | 1,810,729 | 209,664 | 247,769 | 3,673,344 | 6,078,500 |
| 1974 | 5,699,605 | 130,567 | 766,562 | 7,248,472 | 68,180 | 1,922,999 | 162,178 | 101,638 | 1,980,991 | 4,235,986 |
| 1975 | 4,793,580 | 19,467 | 373,783 | 5,731,466 | 166,653 | 3,787,797 | 157,365 | 124,399 | 1,626,274 | 5,862,488 |
| 1976 | 3,103,916 | 84,188 | 204,705 | 3,837,735 | 475,176 | 1,494,750 | 178,287 | 118,748 | 1,497,465 | 3,764,426 |
| 1977 | 1,654,122 | 60,112 | 232,230 | 2,708,024 | 76,255 | 776,085 | 127,106 | 89,036 | 323,091 | 1,391,573 |
| 1978 | 677,448 | 36,484 | 210,198 | 1,711,657 | 57,463 | 131,076 | 147,112 | 153,867 | 347,482 | 837,000 |
| 1979 | 560,506 | 10,634 | 103,615 | 1,754,670 | 29,960 | 80,482 | 29,723 | 19,225 | 225,947 | 385,337 |
| 1980 | 2,239,224 | 60,229 | 559,963 | 5,914,309 | 31,462 | 181,638 | 137,833 | 154,821 | 1,077,900 | 1,583,654 |
| 1981 | (774,614) | 138,917 | 203,941 | 1,737,796 | 5,864 | 69,031 | 28,815 | 22,654 | 61,349 | 187,713 |
| 1982 | 432,274 | 346,905 | 79,819 | 8,717,975 | 9,224 | 159,280 | 16,069 | 58,900 | 55,841 | 299,314 |
| 1983 | 451,428 | 2,029,405 | 58,989 | 13,652,234 | 4,304 | 528,764 | 18,213 | 89,581 | (264,804) | 376,058 |
| 1984 | (83,811) | 1,290,740 | 34,764 | 10,799,037 | 3,850 | 270,455 | 14,462 | 12,259 | 49,547 | 350,573 |
| 1985 | 608,583 | 966,160 | 51,634 | 8,422,737 | 5,555 | 62,571 | 17,816 | 11,481 | 54,070 | 151,493 |
| 1986 | 1,097,122 | 230,510 | 51,994 | 7,713,451 | 9,927 | 114,561 | 31,564 | 25,037 | 86,794 | 267,883 |
| 1987 | 3,631,282 | 146,850 | 91,223 | 5,552,802 | 4,908 | 27,208 | 17,141 | 8,005 | 45,528 | 102,790 |
| 1988 | 552,546 | 558,557 | 197,761 | 2,039,009 | 7,358 | 161,957 | 41,892 | 21,113 | 90,784 | 323,104 |
| 1989 | 4,161,037 | 1,496,776 | 433,072 | 7,382,673 | 8,092 | (2,297,399) | 28,708 | 12,619 | 51,556 | (2,196,424) |
| 1990 | 8,794,258 | 1,394,698 | 344,367 | 8,620,068 | 176,854 | (1,657,576) | 27,478 | 12,817 | 55,408 | (1,385,019) |
| 1991 | 7,985,326 | 3,624,824 | 139,105 | 11,753,895 | 202,286 | (1,316,160) | 142,139 | 15,524 | 62,794 | (893,417) |
| 1992 | 4,849,560 | 8,364,426 | 127,829 | 14,808,798 | 333,934 | (1,878,502) | 34,185 | 13,422 | 69,479 | (1,427,482) |
| 1993 | 2,094,764 | 15,390,366 | 159,211 | 19,571,092 | 1,506,787 | 3,979,221 | 44,300 | 27,047 | 162,854 | 5,720,209 |
| 1994 | 933,021 | 8,082,401 | 81,869 | 10,577,079 | 2,104,588 | 2,493,097 | 16,351 | 11,673 | 54,581 | 4,680,290 |
| 1995 | 1,096,953 | 5,924,175 | 123,653 | 8,050,530 | 3,310,564 | 500,791 | 35,402 | 28,202 | 164,254 | 4,039,213 |
| 1996 | 1,736,686 | 2,181,669 | 96,339 | 4,344,851 | 19,019,751 | (100,474) | 76,723 | 73,629 | 344,747 | 19,414,376 |
| 1997 | 809,666 | (342,563) | 102,390 | 1,000,244 | 7,645,602 | (662,524) | 50,662 | 20,720 | 268,293 | 7,322,753 |
| 1998 | 273,139 | 3,392,776 | 36,135 | 3,880,497 | 993,619 | 1,613,505 | 10,268 | 8,970 | 479,138 | 3,105,500 |
| 1999 | 1,006,721 | 2,208,657 | 123,472 | 3,792,421 | 224,119 | 843,638 | 84,683 | 45,293 | 324,223 | 1,521,955 |
| 2000 | 724,837 | 1,251,684 | 83,871 | 2,495,486 | 129,156 | 1,285,637 | 64,095 | 41,331 | 114,224 | 1,634,443 |
| 2001 | 550,843 | 342,964 | 26,780 | 1,773,369 | 73,031 | 447,282 | 20,193 | 13,635 | 88,656 | 642,797 |
| 2002 | 270,386 | 269,139 | 71,793 | 264,008 | 54,815 | 1,753,554 | 53,787 | 12,619 | 196,949 | 2,071,724 |
| 2003 | 382,025 | 146,659 | 30,255 | 599,147 | 86,731 | 350,997 | 1,096,665 | 2,482,179 | 179,466 | 4,196,038 |
| 2004 | 262,810 | 48,570 | 12,285 | 411,358 | 13,577 | 275,709 | 1,736,308 | 856,587 | 24,559 | 2,906,739 |
| 2005 | 62,967 | 104,838 | 144,149 | 433,303 | 16,962 | 120,279 | 2,049,655 | 410,021 | 270,894 | 2,867,810 |
| 2006 | 15,163 | 294,318 | 577,859 | 917,747 | 21,932 | 16,665 | 2,302,259 | 406,071 | 2,544,382 | 5,291,309 |
| 2007 | 151,063 | 919,040 | 69,935 | 1,368,052 | 12,905 | 55,918 | (246) | 1,099,958 | 3,664,344 | 4,832,879 |
| 2008 | 346,638 | 3,113,899 | 2,019,852 | 5,600,869 | 2,481 | 82,555 | 835,530 | 899,508 | 682,829 | 2,502,902 |
| 2009 | 940,452 | 448,164 | 1,834,401 | 3,372,357 | 2,972 | 260,999 | 4,202,648 | 976,867 | 2,819,145 | 8,262,631 |
| 2010 | 2,207,142 | 26,737 | 1,373,264 | 3,647,098 | (3) | 119,968 | 43,408 | 930,165 | 3,865,738 | 4,959,276 |
| 2011 | 5,924,635 | 6,288 | 99,900 | 6,061,703 | 11 | 35,412 | 1,173,995 | 577 | 1,955,691 | 3,165,686 |
| 2012 | 10,149,651 | 95,175 | 28,760 | 10,942,016 | 8,715 | 477,006 | 2,750,751 | 214,702 | 2,760,048 | 6,211,222 |
| 2013 | 6,331,413 | 334,524 | 74,035 | 8,548,463 | 36,624 | 1,113,282 | 3,313,512 | 1,342,565 | 6,139,955 | 11,945,937 |
| 2014 | 2,576,361 | 184,199 | 28,491 | 4,882,309 | 15,952 | 2,420,588 | 79,084 | 64,672 | 3,933,527 | 6,513,824 |
| 2015 | 1,890,516 | 120,714 | 15,294 | 4,560,688 | 10,156 | 3,069,709 | 19,721 | 20,406 | 20,412,533 | 23,532,526 |
| 2016 | 506,452 | 1,575,567 | 12,648 | 2,438,422 | 11,340 | 1,799,535 | 11,667 | 22,681 | 31,053,422 | 32,898,645 |
| **2017** | **1,071,939** | **1,841,209** | **74,052** | **4,496,717** | **766,417** | **3,852,864** | **86,466** | **735,050** | **19,327,280** | **24,768,077** |
| 2018 | 2,038,964 | 550,950 | 142,540 | 4,674,346 | 534,182 | 5,059,005 | 160,274 | 2,465,034 | 12,885,912 | 21,104,407 |
| 2019 | 966,163 | 103,569 | 48,307 | 1,538,693 | 0 | 2,764,690 | 0 | 5,772,375 | 6,059,228 | 14,596,293 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **160,544,927** | **73,426,880** | **58,218,575** | **436,707,041** | **62,096,311** | **65,978,283** | **44,261,992** | **42,409,069** | **174,260,587** | **389,006,243** |

[a] Includes excess capacity costs (not shown in Table B-9) allocated to Metropolitan in the following years and repaid under Article 24(c) of its contract: 1970 - $362,000; 1971 - $6,198,000; 1972 - $139,000.

## TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | WEST BRANCH | | | | | | | COASTAL BRANCH | | |
| | Reach 29A | Reach 29F | Reach 29G | Reach 29H | Reach 29J | Reach 30 | Subtotal | Reach 31A | Reach 33A | Reach 33B |
| | [60] | [61] | [62] | [63] | [64] | [65] | [66] | [67] | [68] | [69] |
| 1952 | 2,924 | 136 | 175 | 459 | 553 | 1,408 | 5,655 | 0 | 0 | 0 |
| 1953 | 9,093 | 344 | 237 | 1,754 | 1,683 | 4,346 | 17,457 | 0 | 0 | 0 |
| 1954 | 7,389 | 1,201 | 2,229 | 2,350 | 4,162 | 5,743 | 23,074 | 0 | 0 | 0 |
| 1955 | 1,019 | 585 | 1,086 | 1,147 | 2,029 | 1,943 | 7,809 | 0 | 0 | 0 |
| 1956 | 490 | 698 | 1,297 | 1,366 | 2,420 | 2,077 | 8,348 | 0 | 0 | 0 |
| 1957 | 1,809 | 2,583 | 4,792 | 5,057 | 8,952 | 7,684 | 30,877 | 0 | 0 | 0 |
| 1958 | 3,256 | 4,516 | 8,714 | 8,878 | 15,847 | 13,931 | 55,142 | 0 | 0 | 0 |
| 1959 | 7,953 | 9,150 | 19,414 | 18,243 | 35,583 | 44,384 | 134,727 | 28,046 | 49,114 | 0 |
| 1960 | 21,753 | 14,990 | 34,447 | 29,764 | 69,752 | 84,703 | 255,409 | 34,404 | 70,450 | 0 |
| 1961 | 22,442 | 12,775 | 21,559 | 20,086 | 39,761 | 123,330 | 239,953 | 13,801 | 17,868 | 0 |
| 1962 | 40,237 | 28,729 | 86,938 | 58,215 | 108,962 | 348,366 | 671,447 | 10,121 | 7,798 | 0 |
| 1963 | 91,959 | 69,162 | 163,347 | 110,015 | 211,592 | 521,491 | 1,167,566 | 20,470 | 14,299 | 0 |
| 1964 | 150,670 | 66,420 | 207,977 | 143,340 | 291,404 | 1,372,464 | 2,232,275 | 315,418 | 26,963 | 0 |
| 1965 | 361,811 | 77,914 | 403,115 | 127,430 | 589,638 | 3,383,950 | 4,943,858 | 747,023 | 36,178 | 0 |
| 1966 | 489,512 | 203,497 | 1,233,640 | 348,918 | 3,231,797 | 9,364,753 | 14,872,117 | 2,258,915 | 35,864 | 0 |
| 1967 | 1,589,715 | 882,096 | 1,117,243 | 891,607 | 31,088,491 | 17,618,827 | 53,187,979 | 6,310,419 | 38,331 | 0 |
| 1968 | 3,899,363 | 300,921 | 396,190 | 1,104,832 | 36,157,768 | 15,736,691 | 57,595,765 | 2,707,580 | 30,784 | 0 |
| 1969 | 6,592,580 | 336,480 | 693,348 | 1,184,454 | 9,655,871 | 16,228,175 | 34,690,908 | 423,797 | 26,549 | 0 |
| 1970 | 7,986,733 | 6,089,401 | 2,624,747 | 3,002,968 | 8,463,475 | 22,330,328 | 50,497,652 | 269,194 | 24,368 | 0 |
| 1971 | 4,247,037 | 3,768,699 | 1,120,231 | 8,244,651 | 5,844,024 | 16,890,503 | 40,115,145 | 164,446 | 32,230 | 0 |
| 1972 | 1,871,831 | 426,932 | 985,512 | 18,787,722 | (23,015,734) | 3,818,001 | 2,874,264 | 131,332 | 17,601 | 0 |
| 1973 | 775,824 | 168,064 | 399,856 | 9,408,706 | 1,821,206 | 13,426,222 | 25,999,878 | 182,493 | 16,154 | 0 |
| 1974 | 560,657 | 168,878 | 169,717 | 3,901,261 | (3,454,239) | 2,988,318 | 4,334,592 | 190,866 | 18,799 | 0 |
| 1975 | 353,670 | 421,176 | 925,693 | 664,113 | 609,891 | 1,808,235 | 4,782,778 | 64,582 | 36,012 | 0 |
| 1976 | 396,809 | 650,417 | 1,274,484 | 706,244 | 650,209 | 1,253,067 | 4,931,230 | 198,266 | 68,898 | 0 |
| 1977 | 390,637 | 3,018,637 | 2,152,961 | 196,012 | 1,135,148 | 345,023 | 7,238,418 | 918,473 | 81,305 | 0 |
| 1978 | 1,427,190 | 2,219,135 | 6,694,615 | 57,817 | 149,932 | 763,445 | 11,312,134 | 52,994 | 83,300 | 0 |
| 1979 | 940,013 | 2,168,382 | 19,813,742 | 597,858 | 331,313 | 282,145 | 24,133,453 | 38,182 | 108,951 | 0 |
| 1980 | 1,276,793 | 4,108,143 | 24,537,814 | 550,337 | 204,751 | 2,055,206 | 32,733,044 | 189,070 | 376,036 | 0 |
| 1981 | (711,751) | 2,699,873 | 19,806,531 | 94,944 | 28,852 | 275,460 | 22,193,909 | 19,897 | (157,537) | 0 |
| 1982 | (465,217) | 351,251 | 17,964,617 | 215,678 | 42,587 | 351,376 | 18,460,292 | (16,381) | (96,449) | 0 |
| 1983 | 100,394 | 180,971 | 6,751,649 | 220,029 | 24,295 | 566,545 | 7,843,883 | 85,496 | 67,106 | 0 |
| 1984 | 71,759 | 68,930 | 2,870,259 | 335,942 | 17,285 | 1,118,954 | 4,483,129 | 28,568 | 54,074 | 0 |
| 1985 | 142,244 | 25,386 | 2,126,670 | 102,366 | 21,971 | 284,243 | 2,702,880 | 36,834 | 54,314 | 0 |
| 1986 | 133,914 | 62,294 | 274,660 | 141,894 | 36,149 | 213,353 | 862,264 | 82,358 | 223,134 | 0 |
| 1987 | 13,936 | 453,949 | 711,773 | 192,511 | 27,931 | 158,313 | 1,558,413 | 53,817 | 1,061,939 | 0 |
| 1988 | 427,544 | 118,010 | 1,660,959 | 203,130 | 95,930 | 222,068 | 2,727,641 | 183,853 | 1,141,272 | 0 |
| 1989 | 207,067 | 430,662 | 584,186 | 241,811 | 97,472 | 148,674 | 1,709,872 | 84,678 | 893,765 | 0 |
| 1990 | 197,428 | 355,480 | 386,882 | 813,211 | 54,269 | 119,438 | 1,926,708 | 133,868 | 1,100,167 | 0 |
| 1991 | 219,321 | 344,386 | 453,336 | 1,132,520 | 55,176 | 229,315 | 2,434,054 | 164,610 | 1,635,283 | 0 |
| 1992 | 541,026 | 295,312 | 464,421 | 4,402,524 | 47,182 | 206,495 | 5,956,960 | 183,240 | 1,220,510 | 1,495,646 |
| 1993 | 464,987 | 320,182 | 643,189 | 3,361,457 | 74,198 | 296,349 | 5,160,362 | 344,928 | 5,274,657 | 5,052,431 |
| 1994 | 203,666 | 231,527 | 362,717 | 306,148 | 33,758 | 168,426 | 1,306,242 | 282,150 | 15,905,886 | 21,341,196 |
| 1995 | 344,358 | 392,647 | 536,253 | 468,656 | 34,007 | 304,983 | 2,080,904 | 1,196,326 | 45,172,271 | 62,947,362 |
| 1996 | 150,901 | 161,394 | 427,223 | 203,201 | 15,357 | 98,522 | 1,056,598 | 948,730 | 42,987,442 | 54,300,990 |
| 1997 | 298,002 | 71,310 | 432,940 | 276,180 | 50,095 | 233,956 | 1,362,483 | 562,583 | 11,209,633 | 13,893,576 |
| 1998 | 346,973 | 21,003 | 2,028,979 | 181,951 | 49,377 | 67,874 | 2,696,157 | 248,671 | 2,355,322 | 4,159,441 |
| 1999 | 296,520 | 37,641 | 1,080,682 | 125,373 | 51,213 | 118,013 | 1,709,442 | 288,236 | 2,906,010 | 4,398,935 |
| 2000 | 212,174 | 33,747 | 238,676 | 116,588 | 13,241 | 187,926 | 802,352 | 132,435 | 228,901 | 2,965,936 |
| 2001 | 43,281 | 6,448 | 104,127 | 110,850 | 10,737 | 23,847 | 299,290 | 103,281 | (7,057) | 568,968 |
| 2002 | 171,190 | 30,767 | 252,912 | 60,146 | 7,881 | 62,684 | 585,581 | 98,021 | 147,827 | 105,972 |
| 2003 | 50,519 | 9,141 | 103,160 | 57,712 | 51,000 | 34,282 | 305,814 | 42,075 | 43,753 | 31,706 |
| 2004 | 47,768 | 6,780 | 27,718 | 107,695 | 215,925 | 16,535 | 422,421 | 26,667 | 13,644 | 21,479 |
| 2005 | 273,482 | 12,706 | 54,409 | 6,642 | 52,413 | 594,136 | 993,789 | 29,337 | (261,476) | 38,618 |
| 2006 | 660,664 | 3,017 | 115,825 | 1,557 | 2,299,565 | 164,739 | 3,245,367 | 7,046 | 6,303 | 37,583 |
| 2007 | 107,460 | 23,817 | 1,958,512 | 269,569 | 347 | 31,047 | 2,390,752 | 37,460 | 32,702 | 42,774 |
| 2008 | 2,090,139 | 13,683 | 103,704 | 1,001,788 | 2,089 | 60,186 | 3,271,589 | 41,227 | 34,997 | 10,865 |
| 2009 | 1,931,429 | 16,719 | 22,988 | 1,463,563 | 631 | 47,211 | 3,482,539 | 19,458 | 17,409 | 2,357 |
| 2010 | 864,340 | 1,994 | 24,691 | 231,970 | (12) | 17,025 | 1,140,007 | 633,621 | 3,158 | 0 |
| 2011 | 426,185 | 3,483 | 3,892 | 40,732 | 41 | 3,525 | 477,858 | 894,066 | 39,656 | 0 |
| 2012 | 615,441 | 76,325 | 91,531 | 55,362 | 18,910 | 79,163 | 936,732 | 337,039 | 271,933 | 0 |
| 2013 | 182,443 | 231,925 | 230,217 | 172,032 | 51,955 | 257,967 | 1,126,538 | 840,207 | 1,113,962 | 0 |
| 2014 | 300,223 | 264,332 | 332,855 | 96,090 | 39,531 | 1,677,183 | 2,710,215 | 1,315,805 | 1,321,585 | 0 |
| 2015 | 154,771 | 112,785 | 1,070,833 | 48,982 | 27,813 | 3,377,755 | 4,792,939 | 812,625 | 1,255,677 | 0 |
| 2016 | 196,852 | 1,706,010 | 159,211 | 375,351 | 28,519 | 3,124,623 | 5,590,566 | 3,953,756 | 1,735,542 | 0 |
| **2017** | **176,526** | **990,494** | **1,336,936** | **1,820,869** | **98,586** | **2,221,794** | **6,645,205** | **1,946,582** | **880,140** | **0** |
| 2018 | 330,428 | 205,949 | 586,965 | 867,556 | 104,196 | 4,476,833 | 6,571,927 | 1,241,221 | 1,242,580 | 0 |
| 2019 | 330,330 | 16,841 | 2,114,192 | 593,692 | 17,879 | 3,555,614 | 6,628,548 | 624,445 | 624,445 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **45,669,886** | **35,609,232** | **133,596,398** | **70,693,877** | **78,154,592** | **156,021,191** | **519,745,176** | **33,318,730** | **142,972,331** | **171,415,834** |

**TABLE B-10 Capital Costs of Each Aqueduct Reach to be Reimbursed through Capital Cost Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|
| | COASTAL BRANCH (continued) | | | | | | |
| | Reach 34 | Reach 35 | Reach 37 | Reach 38 | Subtotal | Total | |
| | [70] | [71] | [72] | [73] | [74] | [75] | [76] |
| 1952 | 0 | 0 | 0 | 0 | 0 | 98,857 | 99,353 |
| 1953 | 0 | 0 | 0 | 0 | 0 | 309,387 | 311,812 |
| 1954 | 0 | 0 | 0 | 0 | 0 | 394,688 | 402,143 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 159,842 | 169,342 |
| 1956 | 0 | 0 | 0 | 0 | 0 | 255,679 | 351,551 |
| 1957 | 0 | 0 | 0 | 0 | 0 | 708,753 | 1,464,452 |
| 1958 | 0 | 0 | 0 | 0 | 0 | 1,331,616 | 2,286,623 |
| 1959 | 7,441 | 8,236 | 0 | 0 | 92,837 | 2,096,392 | 2,967,412 |
| 1960 | 8,507 | 14,265 | 0 | 0 | 127,626 | 2,937,049 | 4,660,833 |
| 1961 | 1,501 | 3,931 | 0 | 0 | 37,101 | 4,650,264 | 8,545,244 |
| 1962 | 524 | 1,689 | 0 | 0 | 20,132 | 5,827,774 | 8,875,171 |
| 1963 | 880 | 2,943 | 0 | 0 | 38,592 | 18,981,487 | 24,610,278 |
| 1964 | 1,687 | 5,639 | 0 | 0 | 349,707 | 31,550,813 | 41,736,060 |
| 1965 | 2,118 | 7,060 | 0 | 0 | 792,379 | 57,936,405 | 62,664,743 |
| 1966 | 1,736 | 5,764 | 0 | 0 | 2,302,279 | 124,748,128 | 129,110,330 |
| 1967 | 1,891 | 6,213 | 0 | 0 | 6,356,854 | 187,465,580 | 194,146,365 |
| 1968 | 1,324 | 4,369 | 0 | 0 | 2,744,057 | 192,593,079 | 197,978,911 |
| 1969 | 907 | 2,905 | 0 | 0 | 454,158 | 182,530,023 | 184,473,490 |
| 1970 | 851 | 2,787 | 0 | 0 | 297,200 | 206,720,774 | 207,082,650 |
| 1971 | 1,315 | 3,804 | 0 | 0 | 201,795 | 158,414,033 | 158,624,739 |
| 1972 | 522 | 1,660 | 0 | 0 | 151,115 | 68,228,670 | 68,362,291 |
| 1973 | 542 | 1,758 | 0 | 0 | 200,947 | 45,110,823 | 45,263,853 |
| 1974 | 463 | 1,405 | 0 | 0 | 211,533 | 24,036,199 | 24,402,166 |
| 1975 | 2,255 | 6,656 | 0 | 0 | 109,505 | 21,065,768 | 21,318,838 |
| 1976 | 5,088 | 14,988 | 0 | 0 | 287,240 | 17,183,961 | 17,492,910 |
| 1977 | 1,834 | 5,387 | 0 | 0 | 1,006,999 | 15,165,801 | 15,544,382 |
| 1978 | 1,302 | 3,852 | 0 | 0 | 141,448 | 18,661,117 | 19,119,151 |
| 1979 | 1,505 | 4,433 | 0 | 0 | 153,071 | 31,202,118 | 31,857,362 |
| 1980 | 1,152 | 3,449 | 0 | 0 | 569,707 | 73,891,101 | 74,986,833 |
| 1981 | 1,427 | 4,261 | 0 | 0 | (131,952) | 15,246,649 | 15,742,773 |
| 1982 | 588 | 1,787 | 0 | 0 | (110,455) | 38,256,580 | 39,705,931 |
| 1983 | 794 | 2,398 | 0 | 0 | 155,794 | 34,705,281 | 38,044,649 |
| 1984 | 986 | 2,959 | 0 | 0 | 86,587 | 24,454,091 | 30,382,250 |
| 1985 | 2,111 | 6,263 | 0 | 0 | 99,522 | 14,914,930 | 28,537,556 |
| 1986 | 17,458 | 51,279 | 0 | 0 | 374,229 | 13,435,351 | 43,155,828 |
| 1987 | 92,506 | 272,968 | 0 | 0 | 1,481,230 | 11,711,428 | 34,331,982 |
| 1988 | 99,456 | 293,612 | 0 | 0 | 1,718,193 | 11,026,370 | 18,123,243 |
| 1989 | 77,283 | 228,038 | 0 | 0 | 1,283,764 | 30,302,112 | 33,130,497 |
| 1990 | 103,785 | 277,889 | 0 | 0 | 1,615,709 | 32,589,619 | 34,435,721 |
| 1991 | 123,603 | 363,889 | 0 | 0 | 2,287,385 | 38,320,942 | 39,811,664 |
| 1992 | 566,230 | 240,553 | 102,051 | 74,162 | 3,882,392 | 34,312,996 | 35,041,233 |
| 1993 | 1,345,211 | 688,935 | 268,937 | 358,367 | 13,333,466 | 53,122,384 | 53,921,787 |
| 1994 | 8,915,445 | 2,363,238 | 678,753 | 1,315,559 | 50,802,227 | 73,751,564 | 74,225,377 |
| 1995 | 23,975,738 | 20,849,939 | 7,029,108 | 7,117,197 | 168,287,941 | 191,033,090 | 191,525,571 |
| 1996 | 26,475,298 | 18,790,572 | 7,213,823 | 6,616,310 | 157,333,165 | 187,776,347 | 188,025,325 |
| 1997 | 10,456,863 | 4,149,105 | 545,378 | 798,606 | 41,615,744 | 62,137,369 | 62,583,537 |
| 1998 | 3,368,320 | 952,615 | 192,567 | 280,779 | 11,557,715 | 27,083,446 | 27,217,157 |
| 1999 | 2,616,574 | 356,318 | 36,680 | 51,648 | 10,654,402 | 24,085,343 | 24,556,053 |
| 2000 | 2,746,120 | 17,830 | 0 | 0 | 6,091,222 | 13,504,773 | 13,742,557 |
| 2001 | 3,960 | (1,112) | 0 | 0 | 668,039 | 5,130,617 | 7,470,505 |
| 2002 | 77,266 | 13,119 | 0 | 0 | 442,204 | 9,921,954 | 18,223,863 |
| 2003 | 25,734 | 6,272 | 0 | 0 | 149,540 | 7,090,347 | 14,855,165 |
| 2004 | 3,142 | 1,942 | 0 | 0 | 66,873 | 5,724,375 | 10,829,600 |
| 2005 | 526 | 327 | 0 | 0 | (192,669) | 9,654,977 | 12,130,085 |
| 2006 | 4 | 18,012 | 0 | 0 | 68,949 | 16,031,812 | 18,522,243 |
| 2007 | 0 | 152 | 0 | 0 | 113,088 | 13,670,587 | 20,478,263 |
| 2008 | 24 | 14,163 | 0 | 0 | 101,277 | 15,861,831 | 30,324,188 |
| 2009 | 43 | 44,176 | 0 | 0 | 83,443 | 26,272,929 | 40,938,263 |
| 2010 | (1) | (1,210) | 0 | 0 | 635,568 | 23,060,578 | 45,963,874 |
| 2011 | 4 | 4,284 | 0 | 0 | 938,010 | 17,931,126 | 37,818,444 |
| 2012 | 96 | 1,455 | 0 | 0 | 610,523 | 23,976,419 | 37,907,075 |
| 2013 | 209 | 1,590 | 0 | 0 | 1,955,967 | 41,764,102 | 49,646,096 |
| 2014 | 114 | 1,113 | 0 | 0 | 2,638,616 | 34,807,990 | 35,165,362 |
| 2015 | 1,286 | 0 | 0 | 0 | 2,069,588 | 54,400,252 | 57,761,115 |
| 2016 | 3,878 | 0 | 0 | 0 | 5,693,176 | 74,978,062 | 75,790,269 |
| **2017** | **104** | **0** | **0** | **0** | **2,826,826** | **73,015,831** | **73,147,702** |
| 2018 | 0 | 0 | 0 | 0 | 2,483,801 | 71,374,066 | 73,979,566 |
| 2019 | 0 | 0 | 0 | 0 | 1,248,890 | 41,452,523 | 42,078,857 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **81,147,529** | **50,131,923** | **16,067,297** | **16,612,628** | **511,666,272** | **2,992,147,224** | **3,278,180,514** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | UPPER FEATHER DIVISION | NORTH BAY AQUEDUCT | | | | | SOUTH BAY AQUEDUCT | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Reach 1 | Reach 2 | Reach 3A | Reach 3B | Total | Reach 1 | Reach 2 | Reach 4 | Reach 5 |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 37,396 | 5,522 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 147,719 | 20,639 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 149,750 | 15,574 | 19,405 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 259,939 | 45,718 | 46,485 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 270,890 | 23,799 | 63,921 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 438,050 | 32,798 | 108,127 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 130 | 130 | 410,919 | 44,277 | 66,973 | 706 |
| 1969 | 0 | 0 | 0 | 0 | 80,875 | 80,875 | 487,377 | 48,339 | 75,644 | 706 |
| 1970 | 0 | 0 | 0 | 0 | 94,872 | 94,872 | 381,734 | 44,852 | 64,833 | 71,376 |
| 1971 | 54 | 0 | 0 | 0 | 45,579 | 45,579 | 357,850 | 25,666 | 50,344 | 38,735 |
| 1972 | 40 | 0 | 0 | 0 | 37,895 | 37,895 | 347,941 | 30,606 | 56,800 | 100,106 |
| 1973 | 1 | 0 | 0 | 0 | 32,993 | 32,993 | 386,897 | 36,172 | 58,288 | 28,810 |
| 1974 | 143 | 0 | 0 | 0 | 46,498 | 46,498 | 456,381 | 57,081 | 83,120 | 61,623 |
| 1975 | 1,069 | 0 | 0 | 0 | 37,707 | 37,707 | 624,989 | 46,111 | 81,361 | 36,682 |
| 1976 | 139 | 0 | 0 | 0 | 60,786 | 60,786 | 614,362 | 47,862 | 123,838 | 91,096 |
| 1977 | 892 | 0 | 0 | 0 | 78,400 | 78,400 | 511,065 | 48,926 | 104,280 | 102,083 |
| 1978 | 39 | 0 | 0 | 0 | 56,318 | 56,318 | 671,195 | 125,224 | 176,855 | 50,289 |
| 1979 | 3,235 | 0 | 0 | 0 | 73,852 | 73,852 | 650,826 | 76,849 | 212,826 | 91,380 |
| 1980 | 416 | 0 | 0 | 0 | 81,769 | 81,769 | 1,128,840 | 212,974 | 242,118 | 110,786 |
| 1981 | 3,847 | 0 | 0 | 0 | 101,340 | 101,340 | 884,763 | 130,126 | 167,118 | 204,772 |
| 1982 | 11,075 | 0 | 0 | 0 | 191,987 | 191,987 | 1,156,605 | 141,718 | 249,447 | 96,020 |
| 1983 | 1,928 | 0 | 0 | 0 | 80,215 | 80,215 | 1,258,144 | 84,360 | 373,875 | 152,255 |
| 1984 | 3,765 | 0 | 0 | 0 | 139,121 | 139,121 | 1,998,984 | 113,797 | 340,344 | 34,461 |
| 1985 | 2,888 | 0 | 0 | 0 | 259,515 | 259,515 | 2,044,121 | 207,478 | 427,930 | 247,308 |
| 1986 | 2,787 | 0 | 0 | 0 | 229,508 | 229,508 | 1,834,838 | 285,908 | 305,149 | 159,054 |
| 1987 | 2,388 | 0 | 0 | 0 | 310,683 | 310,683 | 2,118,974 | 163,714 | 400,547 | 283,067 |
| 1988 | 545 | 0 | (94) | 0 | 330,156 | 330,062 | 2,068,655 | 186,275 | 299,934 | 370,212 |
| 1989 | 1,800 | 473,408 | 178,069 | 237,480 | 373,427 | 1,262,384 | 2,164,688 | 163,481 | 320,734 | 497,038 |
| 1990 | 788 | 556,610 | 244,897 | 123,144 | 427,257 | 1,351,908 | 2,233,036 | 251,434 | 355,022 | 571,415 |
| 1991 | 3,654 | 651,307 | 302,327 | 205,516 | 428,470 | 1,587,620 | 1,806,699 | 152,509 | 95,745 | 93,986 |
| 1992 | 647 | 443,912 | 189,330 | 265,462 | 280,505 | 1,179,209 | 2,064,907 | 405,932 | 409,435 | 363,964 |
| 1993 | 3,630 | 435,240 | 294,416 | 213,267 | 289,206 | 1,232,129 | 3,925,050 | 621,712 | 480,832 | 399,558 |
| 1994 | 2,279 | 430,112 | 198,322 | 206,594 | 365,646 | 1,200,674 | 4,673,275 | 302,115 | 404,709 | 408,066 |
| 1995 | 2,906 | 428,313 | 282,898 | 151,703 | 295,326 | 1,158,240 | 3,849,620 | 316,905 | 566,447 | 330,706 |
| 1996 | 8,007 | 796,526 | 272,743 | 240,106 | 260,001 | 1,569,376 | 3,526,989 | 254,075 | 664,485 | 493,300 |
| 1997 | 7,449 | 504,476 | 210,763 | 213,211 | 315,374 | 1,243,824 | 3,010,809 | 189,269 | 591,540 | 230,371 |
| 1998 | 798 | 404,834 | 227,562 | 204,821 | 251,154 | 1,088,371 | 2,965,219 | 426,872 | 532,042 | 303,263 |
| 1999 | 416 | 678,159 | 332,340 | 298,066 | 289,895 | 1,598,459 | 3,748,823 | 478,982 | 437,660 | 463,868 |
| 2000 | 505 | 919,679 | 254,626 | 657,967 | 414,264 | 2,246,536 | 3,810,111 | 541,675 | 440,808 | 550,541 |
| 2001 | 314 | 1,072,446 | 231,959 | 455,772 | 181,372 | 1,941,549 | 2,907,483 | 272,673 | 289,919 | 390,950 |
| 2002 | 3,627 | 1,586,250 | 415,744 | 410,985 | 398,645 | 2,811,624 | 3,853,092 | 341,500 | 466,141 | 537,905 |
| 2003 | 393 | 1,776,863 | 546,644 | 567,701 | 354,209 | 3,245,417 | 2,347,693 | 365,741 | 575,370 | 963,068 |
| 2004 | 455 | 1,601,564 | 636,208 | 738,083 | 818,164 | 3,794,019 | 3,338,897 | 510,169 | 746,539 | 698,050 |
| 2005 | 452 | 1,059,791 | 322,691 | 767,313 | 412,453 | 2,562,248 | 3,309,594 | 262,581 | 427,595 | 807,600 |
| 2006 | 3,899 | 780,037 | 229,313 | 602,270 | 430,027 | 2,041,646 | 3,469,851 | 376,927 | 752,147 | 587,680 |
| 2007 | (8) | 1,081,328 | 233,393 | 467,032 | 275,816 | 2,057,569 | 5,012,579 | 690,060 | 587,379 | 789,216 |
| 2008 | 3,578 | 822,561 | 218,282 | 524,737 | 600,368 | 2,165,948 | 5,191,152 | 674,547 | 739,593 | 920,312 |
| 2009 | 88 | 1,224,100 | 274,814 | 618,045 | 550,745 | 2,667,705 | 3,988,958 | 671,161 | 701,725 | 1,354,606 |
| 2010 | 25 | 2,676,286 | 112,906 | 1,103,248 | 276,198 | 4,168,638 | 4,462,007 | 579,469 | 803,235 | 718,991 |
| 2011 | 63 | 2,637,729 | 584,885 | 1,237,150 | 415,201 | 4,874,964 | 5,107,370 | 830,971 | 858,788 | 501,594 |
| 2012 | (24) | 2,606,317 | 143,492 | 1,448,182 | 1,123,880 | 5,321,871 | 5,277,809 | 1,107,820 | 742,533 | 830,281 |
| 2013 | 277 | 3,312,169 | 133,031 | 474,666 | 369,782 | 4,289,649 | 6,079,677 | 1,205,562 | 650,830 | 1,099,343 |
| 2014 | 111 | 4,104,427 | 176,973 | 616,666 | 552,426 | 5,450,493 | 7,418,110 | 632,701 | 641,034 | 1,318,890 |
| 2015 | 114 | 2,893,292 | 252,069 | 1,230,053 | 1,088,021 | 5,463,435 | 8,540,606 | 662,653 | 630,093 | 857,266 |
| 2016 | 111 | 3,735,827 | 207,056 | 1,055,657 | 1,082,388 | 6,080,928 | 9,530,570 | 717,679 | 725,386 | 1,768,833 |
| **2017** | **111** | **4,362,459** | **252,147** | **1,291,807** | **1,325,272** | **7,231,685** | **10,293,334** | **816,292** | **809,586** | **1,489,355** |
| 2018 | 111 | 3,967,043 | 250,623 | 1,287,429 | 1,321,939 | 6,827,034 | 12,717,965 | 805,363 | 798,630 | 1,590,106 |
| 2019 | 112 | 4,061,994 | 238,975 | 1,223,747 | 1,255,632 | 6,780,348 | 10,955,763 | 787,576 | 785,646 | 1,632,259 |
| 2020 | 113 | 4,102,614 | 241,365 | 1,235,985 | 1,268,188 | 6,848,152 | 11,065,320 | 795,451 | 793,503 | 1,648,582 |
| 2021 | 114 | 4,143,640 | 243,778 | 1,248,345 | 1,280,870 | 6,916,633 | 11,175,973 | 803,406 | 801,438 | 1,665,068 |
| 2022 | 116 | 4,185,076 | 246,216 | 1,260,828 | 1,293,679 | 6,985,799 | 11,287,733 | 811,440 | 809,452 | 1,681,718 |
| 2023 | 117 | 4,226,927 | 248,678 | 1,273,437 | 1,306,615 | 7,055,657 | 11,400,611 | 819,554 | 817,546 | 1,698,535 |
| 2024 | 118 | 4,269,196 | 251,165 | 1,286,171 | 1,319,682 | 7,126,214 | 11,514,617 | 827,750 | 825,722 | 1,715,521 |
| 2025 | 119 | 4,311,888 | 253,677 | 1,299,033 | 1,332,878 | 7,197,476 | 11,629,763 | 836,027 | 833,979 | 1,732,676 |
| 2026 | 120 | 4,355,007 | 256,213 | 1,312,023 | 1,346,207 | 7,269,450 | 11,746,060 | 844,388 | 842,319 | 1,750,003 |
| 2027 | 122 | 4,398,557 | 258,776 | 1,325,143 | 1,359,669 | 7,342,145 | 11,863,521 | 852,832 | 850,742 | 1,767,503 |
| 2028 | 123 | 4,442,543 | 261,363 | 1,338,395 | 1,373,266 | 7,415,567 | 11,982,156 | 861,360 | 859,250 | 1,785,178 |
| 2029 | 124 | 4,486,968 | 263,977 | 1,351,779 | 1,386,999 | 7,489,723 | 12,101,978 | 869,973 | 867,842 | 1,803,030 |
| 2030 | 125 | 4,531,838 | 266,617 | 1,365,296 | 1,400,869 | 7,564,620 | 12,222,998 | 878,673 | 876,520 | 1,821,060 |
| 2031 | 126 | 4,577,156 | 269,283 | 1,378,949 | 1,414,877 | 7,640,265 | 12,345,228 | 887,460 | 885,286 | 1,839,270 |
| 2032 | 128 | 4,622,928 | 271,976 | 1,392,739 | 1,429,026 | 7,716,669 | 12,468,680 | 896,335 | 894,138 | 1,857,663 |
| 2033 | 129 | 4,669,157 | 274,696 | 1,406,666 | 1,443,316 | 7,793,835 | 12,593,367 | 905,298 | 903,080 | 1,876,240 |
| 2034 | 130 | 4,715,849 | 277,442 | 1,420,733 | 1,457,749 | 7,871,773 | 12,719,300 | 914,351 | 912,111 | 1,895,002 |
| 2035 | 132 | 4,763,007 | 280,217 | 1,434,940 | 1,472,327 | 7,950,491 | 12,846,493 | 923,494 | 921,232 | 1,913,952 |
| **TOTAL** | **83,894** | **122,887,411** | **12,614,845** | **40,468,342** | **41,079,478** | **217,050,075** | **364,244,738** | **32,446,563** | **35,925,348** | **54,344,909** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**

Sheet 2 of 9

| Calendar Year | SOUTH BAY AQUEDUCT (continued) | | | | | CALIFORNIA AQUEDUCT | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | NORTH SAN JOAQUIN DIVISION | | | |
| | Reach 6 | Reach 7 | Reach 8 | Reach 9 | Total | Reach 1 | Reach 2A | Reach 2B | Subtotal |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 42,918 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 168,358 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 184,729 | 0 | 0 | 0 | 0 |
| 1965 | 2,634 | 6,490 | 4,704 | 12,904 | 378,874 | 0 | 0 | 0 | 0 |
| 1966 | 4,707 | 10,328 | 9,233 | 25,519 | 408,397 | 0 | 0 | 0 | 0 |
| 1967 | 2,712 | 7,659 | 10,812 | 34,347 | 634,505 | 0 | 0 | 0 | 0 |
| 1968 | 3,109 | 7,960 | 10,166 | 40,372 | 584,482 | 1,001,998 | 228,359 | 103,116 | 1,333,473 |
| 1969 | 3,944 | 5,975 | 8,795 | 38,566 | 669,346 | 933,116 | 301,596 | 188,194 | 1,422,906 |
| 1970 | 2,464 | (1,991) | 6,870 | 28,210 | 598,348 | 971,602 | 306,198 | 151,539 | 1,429,339 |
| 1971 | 3,116 | 9,394 | 9,895 | 31,068 | 526,068 | 1,103,021 | 254,786 | 113,694 | 1,471,501 |
| 1972 | 5,125 | 10,247 | 12,054 | 44,699 | 607,578 | 1,107,855 | 230,906 | 110,109 | 1,448,870 |
| 1973 | 4,178 | 7,500 | 4,890 | 43,816 | 570,551 | 1,150,864 | 221,445 | 100,221 | 1,472,530 |
| 1974 | 7,812 | 7,564 | 5,523 | 48,054 | 727,158 | 1,272,034 | 231,383 | 117,156 | 1,620,573 |
| 1975 | 18,120 | 14,683 | 18,325 | 68,377 | 908,648 | 1,434,736 | 455,110 | 201,075 | 2,090,921 |
| 1976 | 10,873 | 5,557 | 19,920 | 49,921 | 963,429 | 1,519,801 | 217,348 | 453,400 | 2,190,549 |
| 1977 | (240) | 2,228 | 8,391 | 89,579 | 866,312 | 1,913,643 | 292,380 | 196,564 | 2,402,587 |
| 1978 | (1,404) | 16,766 | (5,313) | 104,078 | 1,137,690 | 1,860,456 | 306,503 | 188,214 | 2,355,173 |
| 1979 | 1,269 | 29,294 | 7,351 | 106,835 | 1,176,630 | 1,848,109 | 231,339 | 145,205 | 2,224,653 |
| 1980 | 3,621 | 24,270 | 17,404 | 110,852 | 1,850,865 | 2,365,292 | 472,660 | 247,608 | 3,085,560 |
| 1981 | 4,038 | 20,109 | 17,586 | 98,143 | 1,526,655 | 2,649,730 | 435,226 | 154,191 | 3,239,147 |
| 1982 | 2,236 | 22,870 | 21,919 | 202,590 | 1,893,405 | 3,192,710 | 599,793 | 244,664 | 4,037,167 |
| 1983 | (2,047) | 48,781 | 45,573 | 216,434 | 2,177,375 | 4,244,937 | 802,908 | 273,081 | 5,320,926 |
| 1984 | 4,449 | 44,017 | 23,563 | 455,054 | 3,014,669 | 4,373,157 | 808,917 | 290,728 | 5,472,802 |
| 1985 | 13,097 | 74,565 | 57,920 | 238,067 | 3,310,486 | 4,717,323 | 629,825 | 189,199 | 5,536,347 |
| 1986 | 11,614 | 31,084 | 46,864 | 363,350 | 3,037,861 | 5,217,491 | 929,919 | 359,365 | 6,506,775 |
| 1987 | 15,273 | 25,182 | 37,949 | 416,375 | 3,461,081 | 5,292,200 | 958,927 | 362,065 | 6,613,192 |
| 1988 | 30,207 | 41,047 | 49,156 | 335,408 | 3,380,894 | 5,329,317 | 822,300 | 360,336 | 6,511,953 |
| 1989 | 9,740 | 54,881 | 114,203 | 179,323 | 3,504,088 | 5,753,966 | 851,745 | 907,609 | 7,513,320 |
| 1990 | 31,161 | 69,416 | 119,309 | 247,781 | 3,878,574 | 6,788,986 | 1,066,314 | 883,822 | 8,739,122 |
| 1991 | 22,434 | (18,690) | 99,577 | 262,052 | 2,514,312 | 6,796,247 | 1,067,078 | 585,008 | 8,448,333 |
| 1992 | 26,787 | 332,012 | 98,670 | 186,640 | 3,888,347 | 9,415,121 | 1,419,603 | 673,833 | 11,508,557 |
| 1993 | 24,845 | 181,592 | 94,169 | 316,045 | 6,043,803 | 10,274,070 | 1,371,074 | 900,996 | 12,546,140 |
| 1994 | 28,383 | 90,791 | 80,942 | 416,061 | 6,404,342 | 8,451,199 | 1,325,511 | 802,217 | 10,578,927 |
| 1995 | 29,298 | 64,012 | 80,278 | 373,657 | 5,610,923 | 10,406,784 | 2,386,507 | 959,685 | 13,752,976 |
| 1996 | (1,020) | 60,610 | 11,672 | 312,097 | 5,322,208 | 10,246,985 | 2,604,651 | 628,177 | 13,479,813 |
| 1997 | 18,428 | 95,321 | 15,691 | 335,566 | 4,486,995 | 10,429,338 | 1,098,381 | 2,084,859 | 13,612,578 |
| 1998 | 26,323 | 54,255 | 611,290 | 658,090 | 5,577,354 | 11,409,135 | 1,449,411 | 5,364,368 | 18,222,914 |
| 1999 | 50,555 | 36,519 | 430,229 | 2,035,938 | 7,682,573 | 11,604,989 | 1,444,270 | 1,338,751 | 14,388,009 |
| 2000 | 135,659 | 87,477 | 185,352 | 640,387 | 6,392,010 | 12,608,781 | 893,969 | 641,868 | 14,144,617 |
| 2001 | 112,959 | 188,988 | 197,681 | 1,047,994 | 5,408,647 | 17,552,867 | 1,388,491 | 756,266 | 19,697,624 |
| 2002 | 143,673 | 171,046 | 500,788 | 2,780,034 | 8,794,180 | 14,389,040 | 859,538 | 618,090 | 15,866,667 |
| 2003 | 77,999 | 97,782 | 247,719 | 987,204 | 5,662,577 | 16,518,162 | 1,742,623 | 753,303 | 19,014,088 |
| 2004 | 156,564 | 179,006 | 205,095 | 453,634 | 6,287,953 | 13,885,710 | 1,209,768 | 678,337 | 15,773,814 |
| 2005 | 143,052 | 202,176 | 135,131 | 223,699 | 5,511,428 | 12,444,177 | 1,941,010 | 872,985 | 15,258,172 |
| 2006 | 143,824 | 119,903 | 73,947 | 376,646 | 5,900,924 | 13,714,452 | 1,912,078 | 1,248,347 | 16,874,876 |
| 2007 | 78,501 | 115,030 | 67,507 | 242,111 | 7,582,385 | 11,969,643 | 1,699,879 | 626,384 | 14,295,906 |
| 2008 | 170,307 | 155,609 | 232,191 | 234,883 | 8,318,594 | 15,507,243 | 1,444,449 | 802,326 | 17,754,019 |
| 2009 | 84,133 | 140,725 | 113,617 | 616,936 | 7,671,860 | 13,690,186 | 1,056,971 | 855,488 | 15,602,646 |
| 2010 | 52,534 | 575,109 | 24,031 | 454,850 | 7,670,226 | 12,753,967 | 2,062,618 | 1,416,588 | 16,233,173 |
| 2011 | 82,590 | 77,284 | 58,732 | 472,947 | 7,990,276 | 16,652,633 | 2,812,144 | 1,444,687 | 20,909,465 |
| 2012 | 55,686 | 132,731 | 61,561 | 2,492,483 | 10,700,905 | 15,602,498 | 1,324,371 | 1,308,624 | 18,235,493 |
| 2013 | 81,564 | 174,382 | 98,067 | 1,165,316 | 10,554,741 | 16,956,601 | 1,840,446 | 2,477,620 | 21,274,667 |
| 2014 | 188,016 | 171,874 | 58,769 | 2,061,674 | 12,491,067 | 23,790,397 | 2,788,820 | 2,015,701 | 28,594,917 |
| 2015 | 122,039 | 194,215 | 143,600 | 3,152,008 | 14,302,479 | 24,926,649 | 1,648,818 | 1,919,733 | 28,495,200 |
| 2016 | 173,138 | 203,619 | 310,919 | 8,834,445 | 22,264,589 | 28,278,887 | 2,443,227 | 1,938,195 | 32,660,309 |
| **2017** | **193,705** | **227,668** | **268,877** | **6,059,026** | **20,157,843** | **33,554,425** | **2,708,001** | **2,152,716** | **38,415,142** |
| 2018 | 192,563 | 226,178 | 94,593 | 1,443,966 | 17,869,364 | 34,141,292 | 2,664,637 | 2,113,969 | 38,919,898 |
| 2019 | 188,334 | 221,346 | 227,044 | 5,500,271 | 20,298,239 | 32,311,450 | 2,631,341 | 2,088,976 | 37,031,767 |
| 2020 | 190,217 | 223,560 | 229,315 | 5,555,273 | 20,501,221 | 32,634,564 | 2,657,655 | 2,109,866 | 37,402,085 |
| 2021 | 192,119 | 225,795 | 231,608 | 5,610,826 | 20,706,233 | 32,960,910 | 2,684,231 | 2,130,965 | 37,776,106 |
| 2022 | 194,040 | 228,053 | 233,924 | 5,666,934 | 20,913,294 | 33,290,519 | 2,711,074 | 2,152,274 | 38,153,867 |
| 2023 | 195,981 | 230,334 | 236,263 | 5,723,604 | 21,122,428 | 33,623,424 | 2,738,184 | 2,173,797 | 38,535,405 |
| 2024 | 197,940 | 232,637 | 238,626 | 5,780,840 | 21,333,653 | 33,959,658 | 2,765,566 | 2,195,535 | 38,920,759 |
| 2025 | 199,920 | 234,964 | 241,012 | 5,838,648 | 21,546,989 | 34,299,255 | 2,793,222 | 2,217,491 | 39,309,968 |
| 2026 | 201,919 | 237,313 | 243,422 | 5,897,034 | 21,762,458 | 34,642,248 | 2,821,154 | 2,239,665 | 39,703,067 |
| 2027 | 203,938 | 239,686 | 245,857 | 5,956,005 | 21,980,084 | 34,988,670 | 2,849,366 | 2,262,062 | 40,100,098 |
| 2028 | 205,978 | 242,083 | 248,315 | 6,015,565 | 22,199,885 | 35,338,557 | 2,877,859 | 2,284,683 | 40,501,099 |
| 2029 | 208,037 | 244,504 | 250,798 | 6,075,721 | 22,421,883 | 35,691,942 | 2,906,638 | 2,307,530 | 40,906,110 |
| 2030 | 210,118 | 246,949 | 253,306 | 6,136,478 | 22,646,102 | 36,048,862 | 2,935,704 | 2,330,605 | 41,315,171 |
| 2031 | 212,219 | 249,419 | 255,839 | 6,197,843 | 22,872,564 | 36,409,350 | 2,965,061 | 2,353,911 | 41,728,322 |
| 2032 | 214,341 | 251,913 | 258,398 | 6,259,821 | 23,101,289 | 36,773,444 | 2,994,712 | 2,377,450 | 42,145,606 |
| 2033 | 216,485 | 254,432 | 260,982 | 6,322,419 | 23,332,303 | 37,141,178 | 3,024,659 | 2,401,225 | 42,567,062 |
| 2034 | 218,649 | 256,976 | 263,591 | 6,385,643 | 23,565,623 | 37,512,590 | 3,054,906 | 2,425,237 | 42,992,733 |
| 2035 | 220,836 | 259,546 | 266,227 | 6,449,500 | 23,801,280 | 37,887,716 | 3,085,455 | 2,449,489 | 43,422,660 |
| **TOTAL** | **6,277,420** | **9,012,610** | **9,468,283** | **143,638,535** | **655,358,406** | **1,099,528,159** | **108,761,018** | **82,821,035** | **1,291,110,213** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SAN LUIS DIVISION | | | | | | SOUTH SAN JOAQUIN DIVISION | | | |
| | Reach 3 | Reach 4 | Reach 5 | Reach 6 | Reach 7 | Subtotal | Reach 8C | Reach 8D | Reach 9 | Reach 10A |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 120,038 | 428,308 | 130,105 | 44,591 | 104,033 | 827,075 | 0 | 0 | 0 | 0 |
| 1969 | 90,033 | 460,907 | 184,467 | 35,696 | 235,322 | 1,006,425 | 22,013 | 134,760 | 86,103 | 83,706 |
| 1970 | 89,547 | 484,300 | 226,002 | 66,070 | 192,582 | 1,058,501 | 26,207 | 156,981 | 128,273 | 118,046 |
| 1971 | 99,917 | 541,574 | 175,592 | 64,193 | 158,170 | 1,039,446 | 32,312 | 190,753 | 118,372 | 129,811 |
| 1972 | 116,708 | 647,979 | 174,519 | 73,670 | 154,783 | 1,167,659 | 35,031 | 187,242 | 130,396 | 117,625 |
| 1973 | 116,791 | 611,705 | 158,145 | 58,344 | 153,955 | 1,098,940 | 51,150 | 225,747 | 127,530 | 117,706 |
| 1974 | 120,309 | 671,455 | 150,835 | 63,905 | 150,230 | 1,156,734 | 34,752 | 199,127 | 131,298 | 141,658 |
| 1975 | 133,593 | 839,285 | 178,974 | 81,478 | 157,586 | 1,390,916 | 78,523 | 250,377 | 159,006 | 207,908 |
| 1976 | 54,938 | 883,956 | 220,832 | 90,305 | 174,835 | 1,424,866 | 39,348 | 133,933 | 123,424 | 139,134 |
| 1977 | 73,331 | 1,114,465 | 270,734 | 98,132 | 196,311 | 1,752,973 | 38,086 | 121,348 | 178,078 | 194,086 |
| 1978 | 45,867 | 898,992 | 203,261 | 106,938 | 203,079 | 1,458,137 | 45,552 | 178,805 | 129,928 | 168,634 |
| 1979 | 223,973 | 842,508 | 144,055 | 99,670 | 180,734 | 1,490,940 | 69,973 | 150,679 | 129,756 | 175,107 |
| 1980 | 243,507 | 1,176,463 | 222,942 | 127,625 | 281,860 | 2,052,397 | 57,726 | 274,848 | 185,155 | 284,207 |
| 1981 | 265,766 | 1,065,358 | 193,048 | 90,533 | 1,612,157 | 3,226,862 | 80,121 | 198,256 | 144,187 | 199,927 |
| 1982 | 279,250 | 1,241,285 | 209,371 | 114,421 | 1,433,180 | 3,277,507 | 59,424 | 269,086 | 233,494 | 264,947 |
| 1983 | 214,468 | 1,949,017 | 339,809 | 131,377 | 2,143,678 | 4,778,349 | 49,448 | 383,476 | 223,078 | 308,801 |
| 1984 | 241,273 | 2,233,969 | 335,166 | 163,858 | 2,111,386 | 5,085,652 | 42,062 | 458,489 | 300,924 | 396,448 |
| 1985 | 322,068 | 2,882,583 | 360,431 | 176,577 | 1,603,532 | 5,345,191 | 58,820 | 495,500 | 213,368 | 298,337 |
| 1986 | 416,027 | 2,996,792 | 472,551 | 252,188 | 601,250 | 4,738,808 | 90,730 | 478,786 | 596,800 | 422,493 |
| 1987 | 362,738 | 3,104,592 | 424,107 | 236,349 | 439,232 | 4,567,018 | 113,962 | 412,042 | 446,067 | 488,226 |
| 1988 | 365,209 | 2,954,186 | 456,864 | 231,754 | 639,242 | 4,647,255 | 96,728 | 379,073 | 417,991 | 532,489 |
| 1989 | 263,171 | 3,182,472 | 393,589 | 332,986 | 633,419 | 4,805,637 | 83,282 | 389,698 | 400,853 | 733,030 |
| 1990 | 397,353 | 4,011,110 | 579,073 | 464,639 | 729,132 | 6,181,307 | 111,019 | 436,849 | 515,611 | 651,465 |
| 1991 | 256,473 | 4,388,184 | 543,760 | 728,156 | 765,765 | 6,682,338 | 104,414 | 496,794 | 465,940 | 716,328 |
| 1992 | 302,021 | 3,792,401 | 795,587 | 363,134 | 815,590 | 6,068,733 | 118,315 | 511,982 | 417,871 | 574,145 |
| 1993 | 439,725 | 4,337,616 | 1,008,394 | 551,849 | 734,796 | 7,072,380 | 230,338 | 745,885 | 490,159 | 723,450 |
| 1994 | 282,579 | 4,376,461 | 816,129 | 396,768 | 492,860 | 6,364,797 | 125,398 | 602,404 | 572,557 | 703,493 |
| 1995 | 107,995 | 5,026,076 | 1,066,971 | 440,006 | 1,356,668 | 7,997,716 | 185,681 | 657,282 | 432,072 | 881,902 |
| 1996 | 1,003,229 | 4,738,221 | 931,944 | 683,323 | 1,034,376 | 8,391,093 | 112,062 | 416,294 | 472,350 | 984,784 |
| 1997 | 859,665 | 5,761,996 | 924,289 | 254,934 | 646,209 | 8,447,093 | 128,190 | 449,316 | 728,436 | 1,864,113 |
| 1998 | 690,845 | 5,520,206 | 1,242,589 | 534,931 | 654,538 | 8,643,109 | 115,748 | 457,845 | 429,433 | 1,011,284 |
| 1999 | 601,726 | 5,793,961 | 1,220,810 | 540,364 | 679,483 | 8,836,344 | 107,647 | 426,289 | 440,869 | 1,161,363 |
| 2000 | 708,169 | 5,826,574 | 1,028,776 | 525,073 | 871,710 | 8,960,301 | 103,853 | 463,578 | 509,758 | 919,469 |
| 2001 | (581,175) | 7,166,334 | 850,243 | 372,180 | 677,562 | 8,485,144 | 58,377 | 554,983 | 604,713 | 872,227 |
| 2002 | 1,074,504 | 5,158,919 | 663,420 | 249,525 | 731,359 | 7,877,727 | 54,621 | 729,627 | 416,211 | 1,308,245 |
| 2003 | 1,034,027 | 6,035,460 | 744,338 | 301,781 | 617,433 | 8,733,040 | 62,401 | 676,858 | 646,001 | 819,171 |
| 2004 | 619,278 | 6,865,921 | 679,631 | 337,749 | 578,358 | 9,080,937 | 35,363 | 474,032 | 334,335 | 604,690 |
| 2005 | 553,163 | 5,984,035 | 984,716 | 401,930 | 799,290 | 8,723,134 | 28,347 | 403,804 | 296,577 | 898,100 |
| 2006 | (88,420) | 6,126,305 | 1,583,392 | 632,718 | 896,513 | 9,150,507 | 46,470 | 530,528 | 789,865 | 480,754 |
| 2007 | 1,134,200 | 7,672,694 | 1,960,080 | 686,349 | 933,964 | 12,387,287 | 242,446 | 855,398 | 535,678 | 632,751 |
| 2008 | 881,252 | 10,607,394 | 2,142,634 | 658,371 | 963,220 | 15,252,871 | 71,530 | 455,135 | 657,221 | 942,082 |
| 2009 | 959,839 | 8,156,620 | 1,219,003 | 505,401 | 1,137,623 | 11,978,486 | 36,452 | 762,901 | 473,869 | 926,070 |
| 2010 | 957,367 | 9,472,901 | 1,599,039 | 567,698 | 1,308,120 | 13,905,125 | 67,258 | 743,999 | 550,142 | 726,994 |
| 2011 | 1,230,248 | 7,617,811 | 2,856,384 | 601,015 | 1,659,616 | 13,965,074 | 12,993 | 601,287 | 796,103 | 1,165,011 |
| 2012 | 1,670,712 | 10,840,403 | 2,393,275 | 635,916 | 1,228,086 | 16,768,391 | 36,160 | 661,338 | 806,876 | 813,710 |
| 2013 | 1,848,948 | 11,472,141 | 2,834,618 | 1,348,079 | 3,254,456 | 20,758,242 | 39,807 | 620,550 | 617,626 | 1,023,482 |
| 2014 | 1,375,711 | 11,781,292 | 2,598,056 | 802,158 | 1,318,030 | 17,875,247 | 3,986 | 1,146,644 | 254,127 | 1,985,121 |
| 2015 | 1,168,352 | 11,861,195 | 2,413,481 | 855,789 | 2,062,856 | 18,361,672 | 6,335 | 563,501 | 261,272 | 1,452,032 |
| 2016 | 1,461,189 | 11,986,860 | 2,294,822 | 801,782 | 1,522,865 | 18,067,518 | 7,371 | 825,578 | 229,499 | 1,677,228 |
| **2017** | **1,635,143** | **13,031,123** | **2,630,456** | **888,853** | **1,675,133** | **19,860,708** | **8,022** | **906,224** | **249,215** | **1,845,746** |
| 2018 | 1,604,223 | 13,844,970 | 2,907,437 | 874,374 | 1,645,927 | 20,876,931 | 7,686 | 900,240 | 247,841 | 1,832,879 |
| 2019 | 1,582,520 | 13,083,861 | 2,637,014 | 863,553 | 1,630,788 | 19,797,736 | 7,770 | 886,121 | 244,607 | 1,803,137 |
| 2020 | 1,598,345 | 13,214,699 | 2,663,384 | 872,189 | 1,647,096 | 19,995,713 | 7,847 | 894,982 | 247,053 | 1,821,168 |
| 2021 | 1,614,329 | 13,346,846 | 2,690,018 | 880,910 | 1,663,567 | 20,195,670 | 7,926 | 903,932 | 249,524 | 1,839,380 |
| 2022 | 1,630,472 | 13,480,315 | 2,716,918 | 889,720 | 1,680,202 | 20,397,627 | 8,005 | 912,971 | 252,019 | 1,857,774 |
| 2023 | 1,646,777 | 13,615,118 | 2,744,088 | 898,617 | 1,697,004 | 20,601,604 | 8,085 | 922,101 | 254,539 | 1,876,352 |
| 2024 | 1,663,245 | 13,751,269 | 2,771,528 | 907,603 | 1,713,974 | 20,807,619 | 8,166 | 931,322 | 257,084 | 1,895,115 |
| 2025 | 1,679,877 | 13,888,782 | 2,799,244 | 916,679 | 1,731,114 | 21,015,696 | 8,248 | 940,635 | 259,655 | 1,914,066 |
| 2026 | 1,696,676 | 14,027,670 | 2,827,236 | 925,846 | 1,748,425 | 21,225,853 | 8,330 | 950,041 | 262,252 | 1,933,207 |
| 2027 | 1,713,643 | 14,167,946 | 2,855,508 | 935,104 | 1,765,910 | 21,438,111 | 8,414 | 959,542 | 264,874 | 1,952,539 |
| 2028 | 1,730,779 | 14,309,626 | 2,884,064 | 944,455 | 1,783,569 | 21,652,493 | 8,498 | 969,137 | 267,523 | 1,972,064 |
| 2029 | 1,748,087 | 14,452,722 | 2,912,904 | 953,900 | 1,801,404 | 21,869,017 | 8,583 | 978,829 | 270,198 | 1,991,785 |
| 2030 | 1,765,568 | 14,597,249 | 2,942,033 | 963,439 | 1,819,418 | 22,087,707 | 8,668 | 988,617 | 272,900 | 2,011,703 |
| 2031 | 1,783,223 | 14,743,222 | 2,971,454 | 973,073 | 1,837,613 | 22,308,585 | 8,755 | 998,503 | 275,629 | 2,031,820 |
| 2032 | 1,801,056 | 14,890,654 | 3,001,168 | 982,804 | 1,855,989 | 22,531,671 | 8,843 | 1,008,488 | 278,386 | 2,052,138 |
| 2033 | 1,819,066 | 15,039,560 | 3,031,180 | 992,632 | 1,874,549 | 22,756,987 | 8,931 | 1,018,573 | 281,169 | 2,072,659 |
| 2034 | 1,837,257 | 15,189,956 | 3,061,492 | 1,002,558 | 1,893,294 | 22,984,557 | 9,020 | 1,028,759 | 283,981 | 2,093,386 |
| 2035 | 1,855,629 | 15,341,856 | 3,092,107 | 1,012,584 | 1,912,227 | 23,214,403 | 9,111 | 1,039,046 | 286,821 | 2,114,320 |
| **TOTAL** | **57,613,411** | **491,608,686** | **97,740,084** | **35,661,171** | **75,408,238** | **758,031,590** | **3,616,739** | **40,077,752** | **23,354,523** | **68,953,026** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SOUTH SAN JOAQUIN DIVISION (continued) | | | | | | | | | |
| | Reach 11B | Reach 12D | Reach 12E | Reach 13B | Reach 14A | Reach 14B | Reach 14C | Reach 15A | Reach 16A | Subtotal |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 59,077 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 385,659 |
| 1970 | 85,758 | 94,171 | 123,374 | 152,424 | 0 | 0 | 0 | 0 | 0 | 885,234 |
| 1971 | 80,282 | 95,075 | 91,389 | 167,142 | 691,791 | 151,979 | 111,623 | 529,723 | 10,291 | 2,400,543 |
| 1972 | 84,287 | 98,647 | 115,592 | 146,096 | 877,535 | 124,831 | 101,479 | 609,058 | 1,106,884 | 3,734,703 |
| 1973 | 92,257 | 74,238 | 114,843 | 221,385 | 961,855 | 120,106 | 99,429 | 692,748 | 1,243,941 | 4,142,935 |
| 1974 | 98,103 | 74,914 | 193,523 | 141,540 | 898,272 | 143,866 | 115,649 | 853,098 | 1,343,972 | 4,369,772 |
| 1975 | 124,105 | 61,799 | 117,194 | 108,154 | 1,156,757 | 180,614 | 119,889 | 988,045 | 1,537,862 | 5,090,233 |
| 1976 | 69,715 | 33,655 | 147,908 | 134,063 | 1,124,051 | 177,086 | 114,133 | 1,037,799 | 1,727,428 | 5,001,677 |
| 1977 | 108,644 | 91,547 | 175,039 | 137,975 | 1,397,006 | 203,837 | 119,467 | 1,339,196 | 1,961,081 | 6,065,390 |
| 1978 | 106,702 | 72,585 | 170,578 | 151,120 | 1,254,043 | 139,662 | 132,224 | 1,265,813 | 1,922,950 | 5,738,596 |
| 1979 | 85,942 | 56,331 | 174,147 | 150,029 | 1,490,461 | 201,935 | 260,981 | 1,216,126 | 1,798,566 | 5,960,033 |
| 1980 | 120,896 | 123,120 | 167,249 | 164,749 | 1,988,619 | 189,132 | 238,607 | 1,437,614 | 2,231,456 | 7,463,378 |
| 1981 | 76,965 | 33,322 | 113,202 | 171,669 | 1,741,488 | 163,934 | 161,182 | 1,799,832 | 2,762,773 | 7,646,858 |
| 1982 | 158,178 | 142,631 | 224,170 | 224,051 | 1,793,867 | 195,086 | 15,768 | 1,933,859 | 2,961,383 | 8,475,944 |
| 1983 | 136,350 | 124,724 | 203,733 | 217,324 | 2,421,794 | 199,708 | 181,879 | 2,550,842 | 4,302,165 | 11,303,322 |
| 1984 | 163,331 | 108,212 | 188,724 | 245,764 | 3,312,127 | 329,490 | 204,332 | 3,215,901 | 5,077,824 | 14,043,628 |
| 1985 | 198,368 | 154,995 | 194,327 | 360,308 | 3,463,178 | 237,127 | 180,068 | 3,427,049 | 5,683,454 | 14,964,899 |
| 1986 | 248,170 | 242,660 | 346,410 | 349,369 | 3,781,427 | 320,984 | 360,156 | 3,574,451 | 5,780,666 | 16,593,102 |
| 1987 | 334,059 | 325,697 | 469,378 | 322,824 | 3,731,912 | 463,757 | 238,813 | 4,080,465 | 5,636,043 | 17,063,245 |
| 1988 | 290,881 | 220,658 | 374,653 | 318,253 | 3,451,893 | 411,110 | 313,806 | 3,746,920 | 5,150,238 | 15,704,693 |
| 1989 | 268,025 | 207,487 | 595,433 | 380,883 | 3,512,884 | 333,996 | 220,978 | 3,751,081 | 5,458,633 | 16,336,263 |
| 1990 | 363,652 | 225,171 | 480,738 | 677,729 | 4,021,727 | 439,953 | 212,851 | 4,381,643 | 6,440,643 | 18,959,051 |
| 1991 | 328,683 | 269,873 | 371,312 | 433,313 | 4,309,082 | 424,704 | 273,169 | 4,566,702 | 5,805,189 | 18,565,503 |
| 1992 | 334,579 | 270,768 | 409,314 | 423,717 | 4,734,368 | 729,211 | 571,412 | 4,270,793 | 6,471,964 | 19,838,439 |
| 1993 | 413,722 | 278,375 | 496,851 | 594,201 | 5,182,830 | 664,063 | 423,780 | 5,266,124 | 7,583,165 | 23,092,943 |
| 1994 | 346,600 | 239,873 | 482,301 | 445,909 | 4,012,614 | 414,899 | 254,393 | 3,727,019 | 7,142,378 | 19,069,838 |
| 1995 | 405,045 | 242,253 | 622,654 | 507,102 | 4,607,154 | 309,283 | 315,905 | 3,973,757 | 6,540,575 | 19,680,665 |
| 1996 | 367,570 | 238,622 | 519,560 | 604,736 | 4,892,967 | 214,773 | 187,784 | 4,331,630 | 7,065,052 | 20,408,184 |
| 1997 | 309,696 | 254,080 | 516,115 | 429,771 | 5,094,202 | 261,221 | 275,610 | 4,011,366 | 7,387,904 | 21,710,020 |
| 1998 | 295,927 | 170,556 | 384,226 | 484,072 | 4,752,549 | 309,440 | 248,178 | 4,694,822 | 7,530,927 | 20,885,007 |
| 1999 | 395,036 | 195,417 | 423,158 | 542,097 | 5,103,420 | 342,515 | 221,942 | 4,894,215 | 8,835,442 | 23,089,410 |
| 2000 | 404,362 | 327,150 | 648,418 | 562,412 | 5,945,146 | 344,498 | 142,466 | 5,359,955 | 12,461,593 | 28,192,658 |
| 2001 | 416,395 | 897,047 | 522,093 | 661,972 | 4,692,342 | (139,041) | (98,322) | 6,011,908 | 15,791,557 | 30,846,252 |
| 2002 | 380,417 | 296,724 | 958,343 | 860,305 | 5,941,368 | 31,540 | 251,192 | 5,589,160 | 11,451,910 | 28,269,664 |
| 2003 | 340,029 | 236,373 | 691,470 | 614,014 | 6,164,414 | (137,592) | 18,098 | 6,989,790 | 11,502,383 | 28,623,409 |
| 2004 | 245,166 | 176,282 | 624,735 | 585,768 | 7,239,478 | (138,773) | (165,021) | 8,910,178 | 14,633,593 | 33,559,826 |
| 2005 | 211,328 | 118,730 | 849,764 | 466,735 | 6,234,813 | (183,109) | (192,435) | 5,882,666 | 13,847,844 | 28,863,166 |
| 2006 | 188,866 | 52,813 | 762,428 | 499,485 | 5,083,876 | (181,776) | (182,478) | 8,375,589 | 13,735,578 | 30,181,999 |
| 2007 | 258,809 | 292,673 | 551,452 | 551,241 | 6,675,167 | (434,035) | (342,673) | 10,901,936 | 8,478,396 | 29,199,239 |
| 2008 | 426,215 | 237,474 | 422,241 | 719,977 | 11,073,392 | (266,060) | (206,483) | 13,007,213 | 10,907,808 | 38,447,745 |
| 2009 | 410,501 | 210,761 | 617,913 | 547,520 | 7,830,639 | 581,148 | (49,310) | 8,769,515 | 13,408,814 | 34,526,793 |
| 2010 | 447,372 | 114,405 | 424,310 | 704,712 | 7,799,349 | (173,823) | (67,392) | 6,623,155 | 9,524,487 | 27,484,968 |
| 2011 | 623,899 | 313,489 | 875,232 | 1,586,259 | 8,809,103 | (231,506) | (41,917) | 6,239,408 | 15,913,157 | 36,662,518 |
| 2012 | 793,290 | 280,317 | 1,047,947 | 3,225,501 | 11,205,763 | 394,747 | 450,640 | 8,830,991 | 12,805,126 | 41,352,406 |
| 2013 | 488,570 | 459,096 | 908,878 | 835,436 | 11,814,134 | 279,726 | 167,099 | 9,575,603 | 14,554,021 | 41,384,028 |
| 2014 | 114,415 | 75,228 | 565,140 | 336,771 | 15,188,195 | 208,189 | 330,856 | 10,418,109 | 16,031,466 | 46,658,246 |
| 2015 | 688,341 | 296,151 | 641,512 | 859,451 | 11,133,640 | 119,822 | 218,661 | 11,945,683 | 16,392,990 | 44,579,392 |
| 2016 | 374,197 | 149,056 | 571,929 | 538,637 | 14,105,103 | 254,358 | 381,822 | 9,905,215 | 12,398,885 | 41,418,878 |
| **2017** | **408,959** | **159,814** | **626,765** | **590,364** | **15,989,459** | **276,070** | **415,050** | **12,107,122** | **13,767,055** | **47,349,865** |
| 2018 | 408,411 | 160,495 | 625,264 | 586,516 | 14,871,228 | 274,403 | 418,217 | 11,625,419 | 14,947,487 | 46,906,086 |
| 2019 | 401,161 | 158,019 | 614,066 | 577,558 | 15,138,483 | 270,960 | 409,080 | 11,324,711 | 13,841,520 | 45,677,193 |
| 2020 | 405,172 | 159,600 | 620,207 | 583,333 | 15,289,867 | 273,670 | 413,171 | 11,437,958 | 13,979,936 | 46,133,964 |
| 2021 | 409,224 | 161,196 | 626,409 | 589,166 | 15,442,766 | 276,406 | 417,302 | 11,552,338 | 14,119,735 | 46,595,304 |
| 2022 | 413,316 | 162,807 | 632,673 | 595,058 | 15,597,194 | 279,170 | 421,475 | 11,667,861 | 14,260,932 | 47,061,255 |
| 2023 | 417,450 | 164,436 | 639,000 | 601,009 | 15,753,166 | 281,962 | 425,690 | 11,784,540 | 14,403,542 | 47,531,872 |
| 2024 | 421,624 | 166,080 | 645,390 | 607,019 | 15,910,697 | 284,782 | 429,947 | 11,902,385 | 14,547,577 | 48,007,188 |
| 2025 | 425,840 | 167,741 | 651,844 | 613,089 | 16,069,804 | 287,630 | 434,247 | 12,021,409 | 14,693,053 | 48,487,261 |
| 2026 | 430,099 | 169,418 | 658,362 | 619,220 | 16,230,502 | 290,506 | 438,589 | 12,141,623 | 14,839,983 | 48,972,132 |
| 2027 | 434,400 | 171,112 | 664,946 | 625,412 | 16,392,807 | 293,411 | 442,975 | 12,263,039 | 14,988,383 | 49,461,854 |
| 2028 | 438,744 | 172,823 | 671,595 | 631,666 | 16,556,735 | 296,345 | 447,405 | 12,385,670 | 15,138,267 | 49,956,472 |
| 2029 | 443,131 | 174,552 | 678,311 | 637,983 | 16,722,303 | 299,308 | 451,879 | 12,509,526 | 15,289,650 | 50,456,038 |
| 2030 | 447,562 | 176,297 | 685,094 | 644,363 | 16,889,526 | 302,301 | 456,398 | 12,634,622 | 15,442,546 | 50,960,597 |
| 2031 | 452,038 | 178,060 | 691,945 | 650,806 | 17,058,421 | 305,325 | 460,962 | 12,760,968 | 15,596,972 | 51,470,204 |
| 2032 | 456,558 | 179,841 | 698,865 | 657,314 | 17,229,005 | 308,378 | 465,571 | 12,888,577 | 15,752,941 | 51,984,905 |
| 2033 | 461,124 | 181,639 | 705,853 | 663,888 | 17,401,295 | 311,462 | 470,227 | 13,017,463 | 15,910,471 | 52,504,754 |
| 2034 | 465,735 | 183,456 | 712,912 | 670,526 | 17,575,308 | 314,576 | 474,929 | 13,147,638 | 16,069,576 | 53,029,802 |
| 2035 | 470,393 | 185,290 | 720,041 | 677,232 | 17,751,061 | 317,722 | 479,678 | 13,279,114 | 16,230,271 | 53,560,100 |
| **TOTAL** | **21,573,719** | **12,587,901** | **33,260,440** | **35,385,486** | **542,567,425** | **14,271,002** | **15,263,082** | **457,955,749** | **636,160,355** | **1,905,027,200** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TEHACHAPI DIVISION | | | MOJAVE DIVISION | | | | | |
| | Reach 17E | Reach 17F | Subtotal | Reach 18A | Reach 19 | Reach 20A | Reach 20B | Reach 21 | Reach 22A |
| | [40] | [41] | [42] | [43] | [44] | [45] | [46] | [47] | [48] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 3,471 | 0 | 3,471 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 1,424,782 | 28,127 | 1,452,909 | 36,699 | 135,675 | 130,711 | 120,271 | 75,768 | 80,436 |
| 1973 | 1,777,260 | 49,949 | 1,827,209 | 36,207 | 146,739 | 161,838 | 148,631 | 60,641 | 66,539 |
| 1974 | 2,298,091 | 16,259 | 2,314,350 | 30,525 | 90,404 | 115,571 | 88,200 | 65,007 | 77,667 |
| 1975 | 2,403,430 | 35,193 | 2,438,623 | 40,588 | 122,584 | 137,684 | 118,898 | 135,462 | 77,825 |
| 1976 | 2,776,194 | 126,653 | 2,902,847 | 118,610 | 201,215 | 182,927 | 151,555 | 106,314 | 131,007 |
| 1977 | 3,845,464 | 83,936 | 3,929,400 | 93,565 | 226,906 | 180,884 | 112,589 | 98,757 | 86,279 |
| 1978 | 2,954,313 | 42,637 | 2,996,950 | 91,815 | 200,759 | 215,673 | 120,584 | 109,271 | 71,763 |
| 1979 | 3,539,402 | 45,997 | 3,585,399 | 99,670 | 307,386 | 261,205 | 194,104 | 203,078 | 121,586 |
| 1980 | 4,749,245 | 54,806 | 4,804,051 | 116,487 | 446,175 | 290,719 | 237,250 | 156,794 | 117,274 |
| 1981 | 5,485,957 | 64,886 | 5,550,843 | 316,590 | 585,003 | 325,112 | 292,081 | 181,062 | 119,602 |
| 1982 | 6,349,080 | 55,997 | 6,405,077 | 447,739 | 638,615 | 275,763 | 330,502 | 186,109 | 125,429 |
| 1983 | 14,153,033 | 96,397 | 14,249,430 | 345,229 | 564,698 | 368,139 | 326,767 | 219,943 | 140,523 |
| 1984 | 18,448,383 | 77,201 | 18,525,584 | 267,497 | 563,588 | 413,443 | 329,933 | 266,919 | 146,866 |
| 1985 | 18,134,698 | 137,928 | 18,272,626 | 298,932 | 475,028 | 450,444 | 388,327 | 799,514 | 125,780 |
| 1986 | 19,297,129 | 109,938 | 19,407,067 | 703,413 | 350,906 | 347,690 | 315,566 | 242,158 | 178,847 |
| 1987 | 17,398,908 | 98,355 | 17,497,263 | 1,261,056 | 558,996 | 818,475 | 357,971 | 298,190 | 236,263 |
| 1988 | 17,697,838 | 138,405 | 17,836,243 | 1,242,139 | 560,911 | 585,014 | 400,005 | 331,099 | 149,876 |
| 1989 | 17,641,151 | 88,488 | 17,729,639 | 1,049,615 | 283,065 | 366,590 | 345,614 | 194,047 | 138,825 |
| 1990 | 19,995,760 | 99,868 | 20,095,628 | 1,298,537 | 229,083 | 469,502 | 202,412 | 273,748 | 49,174 |
| 1991 | 19,903,346 | 131,558 | 20,034,904 | 1,432,360 | 665,443 | 1,025,089 | 516,257 | 478,555 | 231,223 |
| 1992 | 18,194,788 | 279,610 | 18,474,398 | 1,167,898 | 738,238 | 666,181 | 696,623 | 585,072 | 168,251 |
| 1993 | 19,051,939 | 199,640 | 19,251,579 | 1,868,745 | 606,763 | 1,232,409 | 818,675 | 509,309 | 207,818 |
| 1994 | 17,354,702 | 204,963 | 17,559,665 | 1,699,479 | 763,493 | 1,145,700 | 957,350 | 873,215 | 241,679 |
| 1995 | 19,360,033 | 191,516 | 19,551,549 | 1,284,146 | 614,314 | 1,941,939 | 2,411,412 | 355,198 | 179,930 |
| 1996 | 19,041,451 | 237,846 | 19,279,297 | 1,163,708 | 576,674 | 1,335,804 | 1,713,145 | 790,618 | 136,397 |
| 1997 | 19,724,881 | 176,120 | 19,901,001 | 1,330,450 | 730,628 | 1,401,562 | 2,043,179 | 640,177 | 189,241 |
| 1998 | 23,227,152 | 182,754 | 23,409,906 | 1,513,656 | 309,052 | 7,568,901 | 508,030 | 297,621 | 115,100 |
| 1999 | 19,935,886 | 160,568 | 20,096,454 | 3,153,935 | 732,113 | 5,398,788 | 1,667,027 | 1,395,062 | 188,629 |
| 2000 | 23,226,081 | 243,938 | 23,470,019 | 1,868,145 | 727,509 | 1,371,226 | 1,426,706 | 967,602 | 162,166 |
| 2001 | 24,048,075 | 618,800 | 24,666,875 | 2,441,832 | 2,559,238 | 1,850,191 | 1,534,046 | 1,075,394 | 479,665 |
| 2002 | 20,727,872 | 472,355 | 21,200,227 | 1,398,680 | 800,777 | 757,179 | 584,201 | 1,156,428 | 282,340 |
| 2003 | 20,832,780 | 283,162 | 21,115,942 | 3,732,995 | 677,629 | 710,160 | 624,723 | 469,296 | 279,974 |
| 2004 | 26,586,558 | 245,747 | 26,832,306 | 1,821,260 | 1,373,456 | 1,320,755 | 1,043,387 | 1,053,643 | 412,752 |
| 2005 | 16,373,205 | 1,498,514 | 17,871,718 | 2,840,486 | 1,501,877 | 1,540,619 | 879,549 | 677,058 | 353,179 |
| 2006 | 14,670,515 | 266,057 | 14,936,572 | 4,449,702 | 1,303,886 | 1,193,604 | 2,914,336 | 958,902 | 754,968 |
| 2007 | 15,871,071 | 347,913 | 16,218,984 | 5,893,334 | 1,629,072 | 1,794,553 | 1,821,245 | 829,221 | 654,462 |
| 2008 | 23,109,411 | 319,178 | 23,428,589 | 2,246,772 | 1,362,637 | 1,251,216 | 824,345 | 497,380 | 704,285 |
| 2009 | 23,067,138 | 155,874 | 23,223,012 | 2,530,319 | 1,537,178 | 1,338,895 | 1,165,997 | 776,728 | 537,958 |
| 2010 | 14,067,369 | 265,687 | 14,333,057 | 3,393,552 | 1,619,063 | 2,625,090 | 1,740,261 | 792,598 | 701,196 |
| 2011 | 18,685,334 | 142,015 | 18,827,348 | 2,549,346 | 1,775,618 | 2,319,037 | 2,218,994 | 625,535 | 580,615 |
| 2012 | 21,008,891 | 220,193 | 21,229,084 | 5,054,306 | 1,462,607 | 1,601,347 | 2,700,410 | 1,804,711 | 652,283 |
| 2013 | 33,828,004 | 265,732 | 34,093,736 | 5,868,227 | 1,678,553 | 1,304,759 | 3,052,637 | 1,415,631 | 532,979 |
| 2014 | 38,296,710 | 224,743 | 38,521,453 | 4,001,952 | 2,661,670 | 1,379,980 | 2,971,265 | 630,562 | 764,712 |
| 2015 | 27,088,951 | 146,355 | 27,235,307 | 4,684,007 | 2,079,809 | 2,850,085 | 865,084 | 2,594,986 | 1,107,739 |
| 2016 | 30,834,000 | 205,974 | 31,039,974 | 4,836,958 | 2,668,672 | 2,348,147 | 1,168,168 | 1,077,924 | 659,698 |
| **2017** | **33,129,641** | **214,074** | **33,343,715** | **5,034,328** | **2,733,060** | **2,406,053** | **1,182,929** | **1,097,364** | **664,663** |
| 2018 | 31,305,908 | 2,271,125 | 33,577,033 | 5,146,068 | 2,688,430 | 2,362,006 | 1,170,629 | 1,077,279 | 653,903 |
| 2019 | 32,074,081 | 906,028 | 32,980,109 | 5,055,843 | 2,723,688 | 2,395,790 | 1,185,648 | 1,095,031 | 666,015 |
| 2020 | 32,394,822 | 915,088 | 33,309,910 | 5,106,401 | 2,750,925 | 2,419,747 | 1,197,504 | 1,105,981 | 672,676 |
| 2021 | 32,718,770 | 924,239 | 33,643,009 | 5,157,465 | 2,778,434 | 2,443,945 | 1,209,479 | 1,117,041 | 679,402 |
| 2022 | 33,045,958 | 933,482 | 33,979,440 | 5,209,040 | 2,806,218 | 2,468,384 | 1,221,574 | 1,128,211 | 686,196 |
| 2023 | 33,376,418 | 942,816 | 34,319,234 | 5,261,130 | 2,834,281 | 2,493,068 | 1,233,790 | 1,139,493 | 693,058 |
| 2024 | 33,710,182 | 952,245 | 34,662,427 | 5,313,741 | 2,862,623 | 2,517,999 | 1,246,128 | 1,150,888 | 699,989 |
| 2025 | 34,047,284 | 961,767 | 35,009,051 | 5,366,879 | 2,891,250 | 2,543,179 | 1,258,589 | 1,162,397 | 706,989 |
| 2026 | 34,387,757 | 971,385 | 35,359,142 | 5,420,548 | 2,920,162 | 2,568,611 | 1,271,175 | 1,174,021 | 714,059 |
| 2027 | 34,731,634 | 981,099 | 35,712,733 | 5,474,753 | 2,949,364 | 2,594,297 | 1,283,886 | 1,185,761 | 721,199 |
| 2028 | 35,078,950 | 990,909 | 36,069,859 | 5,529,501 | 2,978,857 | 2,620,240 | 1,296,725 | 1,197,619 | 728,411 |
| 2029 | 35,429,740 | 1,000,819 | 36,430,559 | 5,584,796 | 3,008,646 | 2,646,442 | 1,309,693 | 1,209,595 | 735,695 |
| 2030 | 35,784,037 | 1,010,827 | 36,794,864 | 5,640,644 | 3,038,732 | 2,672,907 | 1,322,789 | 1,221,691 | 743,052 |
| 2031 | 36,141,878 | 1,020,935 | 37,162,813 | 5,697,050 | 3,069,120 | 2,699,636 | 1,336,017 | 1,233,908 | 750,483 |
| 2032 | 36,503,297 | 1,031,144 | 37,534,441 | 5,754,020 | 3,099,811 | 2,726,632 | 1,349,378 | 1,246,247 | 757,988 |
| 2033 | 36,868,330 | 1,041,456 | 37,909,786 | 5,811,561 | 3,130,809 | 2,753,898 | 1,362,871 | 1,258,710 | 765,568 |
| 2034 | 37,237,013 | 1,051,870 | 38,288,883 | 5,869,676 | 3,162,117 | 2,781,437 | 1,376,500 | 1,271,297 | 773,223 |
| 2035 | 37,609,383 | 1,062,389 | 38,671,772 | 5,928,373 | 3,193,738 | 2,809,252 | 1,390,265 | 1,284,010 | 780,956 |
| **TOTAL** | **1,404,064,815** | **28,321,529** | **1,432,386,343** | **185,482,981** | **95,463,973** | **104,294,125** | **67,653,882** | **49,688,848** | **27,114,325** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | | SANTA ANA DIVISION | | | | | |
| | Reach 22B | Reach 23 | Reach 24 | Subtotal | Reach 25 | Reach 26A | Reach 28G | Reach 28H | Reach 28J | Subtotal |
| | [49] | [50] | [51] | [52] | [53] | [54] | [55] | [56] | [57] | [58] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 1,036,831 | 51,520 | 362,153 | 2,030,064 | 26 | 578 | 109 | 30 | 0 | 743 |
| 1973 | 1,283,816 | 65,475 | 353,262 | 2,323,148 | 20,541 | 679,328 | 136,352 | 79 | 0 | 836,300 |
| 1974 | 1,477,946 | 96,340 | 334,302 | 2,375,962 | 24,380 | 799,400 | 155,262 | 34,693 | 854,637 | 1,868,372 |
| 1975 | 1,630,554 | 111,141 | 419,450 | 2,794,186 | 29,337 | 885,021 | 110,729 | 69,082 | 723,814 | 1,817,983 |
| 1976 | 1,598,071 | 107,787 | 304,638 | 2,902,124 | 51,356 | 1,103,139 | 138,575 | 100,400 | 635,853 | 2,029,323 |
| 1977 | 1,882,080 | 71,228 | 48,359 | 2,800,647 | 62,584 | 1,412,740 | 127,543 | 92,647 | 825,880 | 2,521,394 |
| 1978 | 2,211,965 | 72,179 | 637,401 | 3,731,410 | 67,186 | 1,159,950 | 166,919 | 68,363 | 835,082 | 2,297,500 |
| 1979 | 2,104,832 | 76,960 | 202,566 | 3,571,387 | 84,462 | 1,235,189 | 142,586 | 92,812 | 265,525 | 1,820,574 |
| 1980 | 2,670,387 | 147,009 | 688,605 | 4,870,700 | 72,651 | 1,532,535 | 158,340 | 129,897 | 1,120,131 | 3,013,554 |
| 1981 | 3,030,407 | 134,895 | 47,750 | 5,032,502 | 35,662 | 1,575,444 | 160,053 | 111,722 | 333,550 | 2,216,431 |
| 1982 | 3,248,883 | 299,712 | 623,755 | 6,176,507 | 26,852 | 1,822,250 | 205,350 | 135,463 | 1,518,759 | 3,708,674 |
| 1983 | 3,899,769 | 223,626 | 384,292 | 6,472,986 | 19,017 | 1,663,599 | 244,720 | 124,651 | 412,806 | 2,464,793 |
| 1984 | 4,783,997 | 59,337 | 1,104,149 | 7,935,729 | 11,319 | 2,325,661 | 240,496 | 190,924 | 769,068 | 3,537,468 |
| 1985 | 5,330,501 | 261,135 | 811,346 | 8,941,007 | 17,764 | 2,707,662 | 451,600 | 182,242 | 871,492 | 4,230,760 |
| 1986 | 6,190,812 | 156,053 | 515,945 | 9,001,390 | 31,012 | 2,768,728 | 439,048 | 256,526 | 982,332 | 4,477,646 |
| 1987 | 5,731,239 | 151,796 | 732,607 | 10,146,593 | 19,362 | 2,847,390 | 278,094 | 218,717 | 1,118,529 | 4,482,092 |
| 1988 | 6,910,472 | 253,833 | 970,052 | 11,403,401 | 36,576 | 3,087,873 | 271,868 | 200,811 | 1,176,659 | 4,773,787 |
| 1989 | 5,963,386 | 349,544 | 1,242,144 | 9,932,830 | 30,881 | 3,190,809 | 230,953 | 281,861 | 1,130,035 | 4,864,539 |
| 1990 | 6,905,442 | 436,785 | 1,891,053 | 11,755,736 | 25,518 | 3,330,913 | 437,812 | 308,144 | 1,538,449 | 5,640,836 |
| 1991 | 7,488,366 | 263,723 | 1,561,051 | 13,662,067 | 32,172 | 3,847,589 | 843,388 | 632,912 | 1,630,321 | 6,986,382 |
| 1992 | 7,076,997 | 317,042 | 622,116 | 12,038,418 | 55,819 | 4,043,878 | 281,864 | 5,636,464 | 1,102,519 | 11,120,544 |
| 1993 | 7,765,751 | 359,632 | 1,708,915 | 15,078,017 | 72,464 | 5,638,325 | 382,195 | 570,563 | 994,721 | 7,658,268 |
| 1994 | 7,691,548 | 1,220,795 | 1,245,936 | 15,839,195 | 105,373 | 5,139,991 | 617,136 | 415,603 | 1,022,412 | 7,300,515 |
| 1995 | 6,994,639 | 842,041 | 746,371 | 15,369,990 | 96,781 | 4,357,648 | 1,308,828 | 704,154 | 894,338 | 7,361,749 |
| 1996 | 8,590,347 | 889,842 | (78,782) | 15,117,753 | 156,395 | 4,051,744 | 1,001,063 | 1,041,697 | 1,316,493 | 7,567,392 |
| 1997 | 8,138,580 | 1,586,227 | 3,355,446 | 19,415,490 | 177,217 | 4,585,198 | 493,841 | 949,188 | 953,590 | 7,159,034 |
| 1998 | 8,887,728 | 1,924,868 | 1,134,837 | 22,259,793 | 142,703 | 4,856,225 | 379,997 | 991,426 | (67,444) | 6,302,907 |
| 1999 | 9,516,356 | 2,034,226 | 1,222,891 | 25,309,026 | 190,302 | 6,039,135 | 503,433 | 1,970,921 | 1,084,943 | 9,788,735 |
| 2000 | 9,556,103 | 1,711,058 | 1,516,573 | 19,307,088 | 353,556 | 4,201,190 | 842,570 | 1,003,213 | 1,120,734 | 7,521,262 |
| 2001 | 7,652,968 | 1,891,843 | 12,799 | 19,497,975 | 296,461 | 2,417,502 | 1,667,660 | 810,577 | 5,739,153 | 10,931,354 |
| 2002 | 11,246,808 | 1,693,570 | 934,841 | 18,854,823 | 509,111 | 3,398,149 | 1,250,266 | 422,611 | 2,236,460 | 7,816,597 |
| 2003 | 13,351,358 | 2,095,918 | (453,629) | 21,488,425 | 368,521 | 3,728,906 | 545,107 | 375,520 | 1,281,666 | 6,299,722 |
| 2004 | 10,504,893 | 2,128,188 | 1,088,145 | 20,746,480 | 427,774 | 5,436,548 | 1,238,040 | 439,722 | 3,569,898 | 11,111,982 |
| 2005 | 7,608,361 | 2,414,926 | 2,241,009 | 20,057,064 | 452,675 | 5,608,440 | 1,518,256 | 683,607 | (1,905,129) | 6,357,849 |
| 2006 | 10,098,886 | 1,919,091 | 568,759 | 24,162,134 | 293,908 | 5,197,631 | 634,186 | 316,935 | 5,184,271 | 11,626,932 |
| 2007 | 10,008,621 | 2,951,769 | 651,749 | 26,234,026 | 229,797 | 8,066,110 | 822,916 | 704,840 | 3,274,316 | 13,097,980 |
| 2008 | 14,593,176 | 2,387,828 | 994,755 | 24,862,395 | 307,325 | 6,579,986 | 801,539 | 772,346 | 4,546,566 | 13,007,763 |
| 2009 | 12,215,276 | 3,461,716 | 1,505,075 | 25,069,142 | 504,670 | 7,181,446 | 623,720 | 672,441 | 2,745,997 | 11,728,274 |
| 2010 | 12,778,606 | 3,245,549 | 2,773,872 | 29,669,788 | 610,161 | 6,555,228 | 475,716 | 424,243 | 3,582,180 | 11,647,528 |
| 2011 | 13,501,681 | 4,111,682 | 3,061,369 | 30,743,878 | 435,864 | 5,580,016 | 878,382 | 567,478 | 4,853,781 | 12,315,520 |
| 2012 | 13,565,808 | 2,841,988 | 4,693,221 | 34,376,682 | 245,876 | 6,395,064 | 1,704,208 | 545,922 | 3,968,805 | 12,859,875 |
| 2013 | 14,711,098 | 3,546,462 | 3,640,725 | 35,751,072 | 444,336 | 7,997,122 | 850,408 | 723,742 | 2,262,056 | 12,277,664 |
| 2014 | 18,266,063 | 4,407,799 | 2,923,227 | 38,007,231 | 321,796 | 9,265,546 | 1,195,014 | 337,187 | 9,656,256 | 20,775,799 |
| 2015 | 19,470,668 | 4,574,534 | 2,788,399 | 41,015,311 | 179,011 | 12,000,606 | 829,035 | 500,506 | 2,185,546 | 15,694,705 |
| 2016 | 20,250,606 | 5,018,044 | 5,000,473 | 43,028,690 | 257,560 | 10,805,264 | 1,051,274 | 435,754 | 3,179,339 | 15,729,191 |
| **2017** | **23,685,221** | **5,213,511** | **4,171,880** | **46,189,009** | **639,846** | **12,255,029** | **1,207,113** | **493,890** | **5,152,073** | **19,747,951** |
| 2018 | 21,849,024 | 5,203,282 | 4,850,130 | 45,000,751 | 1,082,537 | 12,189,352 | 1,176,700 | 483,869 | 10,242,983 | 25,175,441 |
| 2019 | 22,147,567 | 5,196,395 | 4,720,903 | 45,186,880 | 666,581 | 11,867,380 | 1,156,479 | 475,883 | 6,253,380 | 20,419,703 |
| 2020 | 22,369,042 | 5,248,359 | 4,768,112 | 45,638,747 | 673,247 | 11,986,054 | 1,168,044 | 480,642 | 6,315,913 | 20,623,900 |
| 2021 | 22,592,733 | 5,300,842 | 4,815,793 | 46,095,134 | 679,979 | 12,105,915 | 1,179,724 | 485,448 | 6,379,073 | 20,830,139 |
| 2022 | 22,818,660 | 5,353,851 | 4,863,951 | 46,556,085 | 686,779 | 12,226,974 | 1,191,522 | 490,303 | 6,442,863 | 21,038,441 |
| 2023 | 23,046,847 | 5,407,389 | 4,912,590 | 47,021,646 | 693,647 | 12,349,243 | 1,203,437 | 495,206 | 6,507,292 | 21,248,825 |
| 2024 | 23,277,315 | 5,461,463 | 4,961,716 | 47,491,862 | 700,583 | 12,472,736 | 1,215,471 | 500,158 | 6,572,365 | 21,461,313 |
| 2025 | 23,510,088 | 5,516,078 | 5,011,333 | 47,966,782 | 707,589 | 12,597,463 | 1,227,626 | 505,159 | 6,638,089 | 21,675,926 |
| 2026 | 23,745,189 | 5,571,239 | 5,061,447 | 48,446,451 | 714,665 | 12,723,438 | 1,239,902 | 510,211 | 6,704,469 | 21,892,685 |
| 2027 | 23,982,641 | 5,626,951 | 5,112,061 | 48,930,913 | 721,812 | 12,850,672 | 1,252,301 | 515,313 | 6,771,514 | 22,111,612 |
| 2028 | 24,222,468 | 5,683,221 | 5,163,182 | 49,420,224 | 729,030 | 12,979,179 | 1,264,824 | 520,466 | 6,839,229 | 22,332,728 |
| 2029 | 24,464,692 | 5,740,053 | 5,214,814 | 49,914,426 | 736,320 | 13,108,971 | 1,277,473 | 525,671 | 6,907,622 | 22,556,057 |
| 2030 | 24,709,339 | 5,797,453 | 5,266,962 | 50,413,569 | 743,683 | 13,240,061 | 1,290,247 | 530,928 | 6,976,698 | 22,781,617 |
| 2031 | 24,956,433 | 5,855,428 | 5,319,631 | 50,917,706 | 751,120 | 13,372,461 | 1,303,150 | 536,237 | 7,046,465 | 23,009,433 |
| 2032 | 25,205,997 | 5,913,982 | 5,372,828 | 51,426,883 | 758,631 | 13,506,186 | 1,316,181 | 541,599 | 7,116,929 | 23,239,526 |
| 2033 | 25,458,057 | 5,973,122 | 5,426,556 | 51,941,152 | 766,218 | 13,641,248 | 1,329,343 | 547,015 | 7,188,099 | 23,471,923 |
| 2034 | 25,712,637 | 6,032,853 | 5,480,821 | 52,460,561 | 773,880 | 13,777,660 | 1,342,636 | 552,485 | 7,259,980 | 23,706,641 |
| 2035 | 25,969,764 | 6,093,182 | 5,535,630 | 52,985,170 | 781,619 | 13,915,437 | 1,356,063 | 558,010 | 7,332,579 | 23,943,708 |
| **TOTAL** | **813,146,397** | **169,155,370** | **153,164,312** | **1,665,164,213** | **21,941,881** | **430,268,154** | **50,534,687** | **34,997,130** | **212,174,006** | **749,915,859** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SANTA ANA DIVISION - EAST BRANCH EXTENSION | | | | | | | | | |
| | Reach 1 | Reach 2A | Reach 2B | Reach 2C | Reach 2D | Reach 3A | Reach 3B | Reach 4A | Reach 4B | Subtotal |
| | [59] | [60] | [61] | [62] | [63] | [64] | [65] | [66] | [67] | [68] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 1,022 | 84,351 | 375,153 | 2,329 | 0 | 627,038 | 360 | 93,305 | 33,614 | 1,217,171 |
| 2004 | 10,740 | 40,841 | 509,089 | 2,340 | 0 | 276,019 | 337 | 13,434 | 71,444 | 924,242 |
| 2005 | 9,849 | 15,079 | 526,273 | 4,153 | 0 | 496,547 | 9,036 | 27,330 | 216,418 | 1,304,685 |
| 2006 | 10,208 | 10,233 | 535,408 | 9,252 | 57,222 | 398,825 | 1,267 | 14,835 | 70,564 | 1,107,813 |
| 2007 | 27,119 | 9,819 | 657,783 | 5,082 | 124,796 | 616,238 | 58,536 | 39,166 | 138,296 | 1,676,836 |
| 2008 | 76,886 | 34,526 | 847,770 | 1,323 | 208,729 | 1,316,836 | 92,649 | 76,305 | 230,399 | 2,885,423 |
| 2009 | 79,262 | 17,694 | 995,567 | 911 | 220,884 | 1,004,939 | 24,654 | 139,677 | 229,081 | 2,712,670 |
| 2010 | 53,803 | 3,532 | 812,550 | 15,916 | 256,844 | 1,263,890 | 9,501 | 165,322 | 356,984 | 2,938,342 |
| 2011 | 21,463 | 5,389 | 701,037 | 4,454 | 111,270 | 1,082,991 | 11,005 | 75,379 | 543,209 | 2,556,199 |
| 2012 | 5,714 | 15,628 | 750,672 | 15,710 | 167,228 | 1,591,638 | 26,683 | 18,408 | 198,024 | 2,789,705 |
| 2013 | 1,099 | 6,045 | 597,222 | 183,482 | 221,805 | 1,498,333 | 4,349 | 6,272 | 178,225 | 2,696,832 |
| 2014 | 8,302 | 9,525 | 802,623 | 105,209 | 149,466 | 1,825,021 | 3,996 | 2,447 | 326,592 | 3,233,181 |
| 2015 | (140) | 7,978 | 826,907 | 11,362 | 79,024 | 1,485,418 | 106,157 | 19,865 | 379,551 | 2,916,122 |
| 2016 | 4,281 | 7,921 | 572,391 | 59,259 | 159,773 | 1,712,220 | 53,936 | 11,272 | 475,688 | 3,056,741 |
| **2017** | **6,044** | **9,264** | **1,119,425** | **83,575** | **175,960** | **2,514,708** | **79,694** | **15,890** | **616,004** | **4,620,564** |
| 2018 | 5,402 | 9,395 | 800,458 | 74,736 | 160,201 | 2,095,036 | 70,794 | 14,206 | 574,233 | 3,804,461 |
| 2019 | 5,295 | 8,949 | 839,065 | 73,248 | 166,964 | 2,128,394 | 68,823 | 13,927 | 560,861 | 3,865,526 |
| 2020 | 5,348 | 9,038 | 847,456 | 73,981 | 168,634 | 2,149,678 | 69,511 | 14,067 | 566,470 | 3,904,183 |
| 2021 | 5,401 | 9,129 | 855,931 | 74,721 | 170,320 | 2,171,175 | 70,206 | 14,207 | 572,135 | 3,943,225 |
| 2022 | 5,455 | 9,220 | 864,490 | 75,468 | 172,024 | 2,192,887 | 70,908 | 14,349 | 577,856 | 3,982,657 |
| 2023 | 5,510 | 9,312 | 873,135 | 76,222 | 173,744 | 2,214,816 | 71,617 | 14,493 | 583,635 | 4,022,484 |
| 2024 | 5,565 | 9,405 | 881,866 | 76,985 | 175,481 | 2,236,964 | 72,333 | 14,638 | 589,471 | 4,062,708 |
| 2025 | 5,621 | 9,499 | 890,685 | 77,754 | 177,236 | 2,259,333 | 73,057 | 14,784 | 595,366 | 4,103,335 |
| 2026 | 5,677 | 9,594 | 899,592 | 78,532 | 179,009 | 2,281,927 | 73,787 | 14,932 | 601,319 | 4,144,369 |
| 2027 | 5,733 | 9,690 | 908,588 | 79,317 | 180,799 | 2,304,746 | 74,525 | 15,081 | 607,333 | 4,185,812 |
| 2028 | 5,791 | 9,787 | 917,673 | 80,111 | 182,607 | 2,327,793 | 75,270 | 15,232 | 613,406 | 4,227,670 |
| 2029 | 5,849 | 9,885 | 926,850 | 80,912 | 184,433 | 2,351,071 | 76,023 | 15,384 | 619,540 | 4,269,947 |
| 2030 | 5,907 | 9,984 | 936,119 | 81,721 | 186,277 | 2,374,582 | 76,783 | 15,538 | 625,735 | 4,312,646 |
| 2031 | 5,966 | 10,084 | 945,480 | 82,538 | 188,140 | 2,398,328 | 77,551 | 15,694 | 631,993 | 4,355,774 |
| 2032 | 6,026 | 10,185 | 954,935 | 83,363 | 190,021 | 2,422,311 | 78,327 | 15,851 | 638,313 | 4,399,332 |
| 2033 | 6,086 | 10,286 | 964,484 | 84,197 | 191,921 | 2,446,534 | 79,110 | 16,009 | 644,696 | 4,443,323 |
| 2034 | 6,147 | 10,389 | 974,129 | 85,039 | 193,841 | 2,471,000 | 79,901 | 16,169 | 651,143 | 4,487,758 |
| 2035 | 6,209 | 10,493 | 983,870 | 85,889 | 195,779 | 2,495,710 | 80,700 | 16,331 | 657,654 | 4,532,635 |
| **TOTAL** | **418,640** | **452,148** | **26,894,676** | **1,929,091** | **5,170,432** | **59,032,947** | **1,821,385** | **989,798** | **14,975,252** | **111,684,370** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | |
|---|---|---|---|---|---|---|---|
| | WEST BRANCH | | | | | | |
| | Reach 29A | Reach 29F | Reach 29G | Reach 29H | Reach 29J | Reach 30 | Subtotal |
| | [69] | [70] | [71] | [72] | [73] | [74] | [75] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 719,255 | 159,249 | 199,145 | 234,196 | 88,198 | 420,789 | 1,820,832 |
| 1973 | 779,949 | 339,363 | 122,664 | 264,850 | 119,743 | 621,431 | 2,248,000 |
| 1974 | 883,312 | 158,366 | 112,458 | 350,160 | (4,525) | 723,949 | 2,223,720 |
| 1975 | 1,049,990 | 176,676 | 194,724 | 801,457 | 75,870 | 841,991 | 3,140,708 |
| 1976 | 1,220,429 | 215,588 | 202,591 | 624,614 | 98,268 | (650,944) | 1,710,546 |
| 1977 | 1,268,813 | 116,939 | 218,129 | 684,679 | 184 | 634,581 | 2,923,325 |
| 1978 | 1,174,708 | 342,479 | 267,308 | 415,641 | 17,764 | 3,088,954 | 5,306,854 |
| 1979 | 1,366,942 | 285,575 | 284,188 | 972,584 | 29,850 | 958,068 | 3,897,207 |
| 1980 | 1,698,215 | 224,472 | 455,619 | 874,259 | 288,303 | 222,549 | 3,763,417 |
| 1981 | 1,783,405 | 123,264 | 615,047 | 2,305,110 | 8,794 | 1,093,897 | 5,929,517 |
| 1982 | 1,919,979 | 190,500 | 702,265 | 2,208,264 | 414,230 | 978,624 | 6,413,862 |
| 1983 | 2,739,814 | 149,333 | 888,475 | 745,939 | 579,882 | 3,698,681 | 8,802,124 |
| 1984 | 3,463,038 | 81,260 | 2,358,495 | 537,207 | 719,282 | 755,136 | 7,914,418 |
| 1985 | 3,866,946 | 295,836 | 3,047,591 | 975,729 | 614,735 | 1,753,355 | 10,554,192 |
| 1986 | 3,791,427 | 457,604 | 2,893,171 | 1,480,015 | 1,032,216 | 1,338,657 | 10,993,090 |
| 1987 | 3,423,494 | 213,106 | 2,933,342 | 944,604 | 459,398 | 1,406,519 | 9,380,463 |
| 1988 | 3,447,403 | 255,113 | 3,017,463 | 883,714 | 446,468 | 1,452,589 | 9,502,750 |
| 1989 | 4,025,641 | 405,583 | 2,738,143 | 1,398,165 | 865,738 | 1,505,029 | 10,938,299 |
| 1990 | 4,088,481 | 383,655 | 3,232,445 | 3,153,869 | 777,713 | 847,500 | 12,483,663 |
| 1991 | 3,862,056 | 304,143 | 3,550,063 | 639,527 | 763,037 | 1,191,090 | 10,309,916 |
| 1992 | 4,286,050 | 327,802 | 3,892,480 | 1,014,551 | 872,953 | 2,259,032 | 12,652,868 |
| 1993 | 3,969,075 | 343,304 | 4,515,385 | 1,670,952 | 852,208 | 1,157,876 | 12,508,800 |
| 1994 | 3,649,861 | 293,376 | 3,359,381 | 1,879,417 | 872,624 | 1,674,576 | 11,729,235 |
| 1995 | 4,137,046 | 883,315 | 4,750,275 | 1,588,080 | 754,904 | (421,879) | 11,691,741 |
| 1996 | 4,511,858 | 966,044 | 3,593,671 | 4,208,195 | 877,111 | 1,574,098 | 15,730,977 |
| 1997 | 4,543,506 | 1,030,809 | 2,429,066 | 3,755,901 | 1,597,361 | 1,521,491 | 14,878,134 |
| 1998 | 4,871,761 | 464,376 | 3,473,405 | 2,398,630 | 1,996,114 | 1,291,185 | 14,495,471 |
| 1999 | 4,859,457 | 4,249,651 | 4,989,423 | 1,764,943 | 1,005,565 | 1,911,025 | 18,780,064 |
| 2000 | 5,444,691 | 774,398 | 4,265,267 | 2,284,579 | 170,222 | 1,536,126 | 14,475,283 |
| 2001 | 5,907,227 | 1,543,146 | 5,135,332 | 4,420,653 | 240,595 | (980,772) | 16,266,181 |
| 2002 | 5,322,904 | 1,489,898 | 4,065,555 | 4,477,490 | (53,068) | 3,471,144 | 18,773,924 |
| 2003 | 4,454,348 | 1,314,746 | 3,721,548 | 3,350,981 | (628,046) | 951,438 | 13,165,016 |
| 2004 | 8,912,025 | 1,374,456 | 3,481,196 | 5,116,356 | (616,073) | 1,506,926 | 19,774,885 |
| 2005 | 5,758,956 | 2,597,096 | 7,383,506 | (596,347) | 2,649,206 | (1,245,748) | 16,546,669 |
| 2006 | 6,911,944 | 2,288,053 | 5,092,673 | 3,553,035 | (573,856) | (4,269,390) | 13,002,460 |
| 2007 | 5,696,261 | 2,717,724 | 10,411,695 | 7,817,696 | 358,723 | 12,030,517 | 39,032,616 |
| 2008 | 8,251,259 | 826,055 | 16,167,768 | 7,403,865 | (108,940) | 423,365 | 32,963,372 |
| 2009 | 7,845,579 | 885,234 | 8,628,704 | 5,631,532 | 242,713 | 2,819,511 | 26,053,273 |
| 2010 | 10,044,990 | 794,487 | 8,884,396 | 6,261,330 | 434,116 | 5,354,068 | 31,773,387 |
| 2011 | 6,957,766 | 937,807 | 9,611,877 | 8,050,024 | 49,269 | (254,496) | 25,352,248 |
| 2012 | 7,469,442 | 2,896,857 | 9,420,124 | 6,177,066 | 109,979 | 6,527,159 | 32,600,628 |
| 2013 | 8,908,504 | 3,791,701 | 12,367,640 | 7,266,853 | 406,492 | 3,722,179 | 36,463,369 |
| 2014 | 10,960,305 | 3,105,173 | 7,417,392 | 7,330,754 | 402,036 | 5,457,532 | 34,673,193 |
| 2015 | 9,389,581 | 3,629,618 | 7,617,836 | 8,728,237 | 299,124 | 6,391,330 | 36,055,726 |
| 2016 | 10,649,346 | 1,895,719 | 7,304,887 | 6,884,574 | 665,334 | 20,974,332 | 48,374,192 |
| **2017** | **11,876,289** | **2,505,391** | **8,186,404** | **8,075,808** | **1,253,010** | **20,467,653** | **52,364,555** |
| 2018 | 14,541,621 | 2,537,998 | 8,277,639 | 7,785,870 | 748,013 | 10,080,445 | 43,971,586 |
| 2019 | 12,479,309 | 2,336,166 | 8,002,207 | 7,657,905 | 897,674 | 17,345,885 | 48,719,146 |
| 2020 | 12,604,103 | 2,359,528 | 8,082,229 | 7,734,484 | 906,650 | 17,519,344 | 49,206,338 |
| 2021 | 12,730,144 | 2,383,123 | 8,163,051 | 7,811,829 | 915,717 | 17,694,537 | 49,698,401 |
| 2022 | 12,857,445 | 2,406,954 | 8,244,682 | 7,889,947 | 924,874 | 17,871,483 | 50,195,385 |
| 2023 | 12,986,019 | 2,431,024 | 8,327,128 | 7,968,846 | 934,123 | 18,050,197 | 50,697,337 |
| 2024 | 13,115,880 | 2,455,334 | 8,410,400 | 8,048,535 | 943,464 | 18,230,699 | 51,204,312 |
| 2025 | 13,247,038 | 2,479,887 | 8,494,504 | 8,129,020 | 952,899 | 18,413,006 | 51,716,354 |
| 2026 | 13,379,509 | 2,504,686 | 8,579,449 | 8,210,310 | 962,428 | 18,597,136 | 52,233,518 |
| 2027 | 13,513,304 | 2,529,733 | 8,665,243 | 8,292,413 | 972,052 | 18,783,108 | 52,755,853 |
| 2028 | 13,648,437 | 2,555,031 | 8,751,896 | 8,375,338 | 981,772 | 18,970,939 | 53,283,413 |
| 2029 | 13,784,921 | 2,580,581 | 8,839,415 | 8,459,091 | 991,590 | 19,160,648 | 53,816,246 |
| 2030 | 13,922,771 | 2,606,387 | 8,927,809 | 8,543,682 | 1,001,506 | 19,352,255 | 54,354,410 |
| 2031 | 14,061,998 | 2,632,450 | 9,017,087 | 8,629,119 | 1,011,521 | 19,545,777 | 54,897,952 |
| 2032 | 14,202,618 | 2,658,775 | 9,107,258 | 8,715,410 | 1,021,636 | 19,741,235 | 55,446,932 |
| 2033 | 14,344,644 | 2,685,363 | 9,198,330 | 8,802,564 | 1,031,853 | 19,938,647 | 56,001,401 |
| 2034 | 14,488,091 | 2,712,216 | 9,290,314 | 8,890,590 | 1,042,171 | 20,138,034 | 56,561,416 |
| 2035 | 14,632,972 | 2,739,339 | 9,383,217 | 8,979,495 | 1,052,593 | 20,339,414 | 57,127,030 |
| **TOTAL** | **466,704,151** | **94,398,916** | **353,962,071** | **289,934,187** | **38,817,361** | **448,505,513** | **1,692,322,199** |

**TABLE B-11 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of Transportation Charge (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|---|
| | COASTAL BRANCH | | | | | | Total | |
| | Reach 31A[a] | Reach 33A | Reach 33B | Reach 34 | Reach 35 | Subtotal | | |
| | [76] | [77] | [78] | [79] | [80] | [81] | [82] | [83] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42,918 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 168,358 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 184,729 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 378,874 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 408,397 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 634,505 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 2,160,548 | 2,745,160 |
| 1969 | 509,728 | 0 | 0 | 0 | 0 | 509,728 | 3,324,718 | 4,074,939 |
| 1970 | 609,988 | 0 | 0 | 0 | 0 | 609,988 | 3,983,062 | 4,676,282 |
| 1971 | 699,052 | 0 | 0 | 0 | 0 | 699,052 | 5,614,013 | 6,185,714 |
| 1972 | 697,576 | 0 | 0 | 0 | 0 | 697,576 | 12,353,356 | 12,998,869 |
| 1973 | 641,626 | 0 | 0 | 0 | 0 | 641,626 | 14,590,688 | 15,194,233 |
| 1974 | 669,279 | 0 | 0 | 0 | 0 | 669,279 | 16,598,762 | 17,372,561 |
| 1975 | 806,429 | 0 | 0 | 0 | 0 | 806,429 | 19,569,999 | 20,517,423 |
| 1976 | 840,927 | 0 | 0 | 0 | 0 | 840,927 | 19,002,859 | 20,027,213 |
| 1977 | 872,169 | 0 | 0 | 0 | 0 | 872,169 | 23,267,885 | 24,213,489 |
| 1978 | 934,119 | 0 | 0 | 0 | 0 | 934,119 | 24,818,739 | 26,012,786 |
| 1979 | 871,688 | 0 | 0 | 0 | 0 | 871,688 | 23,421,881 | 24,675,598 |
| 1980 | 1,047,396 | 4,790 | 0 | 30 | 75 | 1,052,291 | 30,105,348 | 32,038,398 |
| 1981 | 1,037,469 | 4,790 | 0 | 30 | 75 | 1,042,364 | 33,884,524 | 35,516,366 |
| 1982 | 1,015,555 | 4,790 | 0 | 30 | 75 | 1,020,450 | 39,515,188 | 41,611,655 |
| 1983 | 1,146,269 | 4,957 | 0 | 30 | 77 | 1,151,333 | 54,543,263 | 56,802,781 |
| 1984 | 1,427,192 | 5,051 | 0 | 31 | 78 | 1,432,352 | 63,947,633 | 67,105,188 |
| 1985 | 1,849,827 | 5,051 | 0 | 31 | 78 | 1,854,987 | 69,700,009 | 73,272,898 |
| 1986 | 1,714,723 | 5,051 | 0 | 31 | 78 | 1,719,883 | 73,437,761 | 76,707,917 |
| 1987 | 1,689,141 | 4,324 | 0 | 26 | 67 | 1,693,558 | 71,443,424 | 75,217,576 |
| 1988 | 1,964,428 | 4,509 | 0 | 28 | 70 | 1,969,035 | 72,349,117 | 76,060,618 |
| 1989 | 1,768,942 | 4,509 | 0 | 28 | 70 | 1,773,549 | 73,894,076 | 78,662,348 |
| 1990 | 2,274,772 | 0 | 0 | 0 | 0 | 2,274,772 | 86,130,115 | 91,361,385 |
| 1991 | 2,187,841 | 0 | 0 | 0 | 0 | 2,187,841 | 86,877,284 | 90,982,870 |
| 1992 | 2,465,364 | 0 | 0 | 0 | 0 | 2,465,364 | 94,167,321 | 99,235,524 |
| 1993 | 2,811,441 | 0 | 0 | 0 | 0 | 2,811,441 | 100,019,568 | 107,299,130 |
| 1994 | 3,894,639 | 0 | 0 | 0 | 0 | 3,894,639 | 92,336,811 | 99,944,106 |
| 1995 | 3,481,049 | 0 | 0 | 0 | 0 | 3,481,049 | 98,887,435 | 105,659,504 |
| 1996 | 5,144,684 | 0 | 0 | 0 | 0 | 5,144,684 | 105,119,193 | 112,018,784 |
| 1997 | 2,523,741 | (33) | 0 | 0 | 0 | 2,523,708 | 107,647,058 | 113,385,326 |
| 1998 | 4,302,712 | 1,878,365 | 1,386 | 160,400 | 88,026 | 6,430,889 | 120,649,996 | 127,316,519 |
| 1999 | 4,235,897 | 1,957,943 | 16,646 | 184,325 | 87,373 | 6,482,183 | 126,770,225 | 136,051,673 |
| 2000 | 2,879,118 | 2,533,780 | 20,786 | 253,538 | 109,328 | 5,796,549 | 121,867,778 | 130,506,829 |
| 2001 | 3,113,568 | 2,233,156 | 14,426 | 151,374 | 57,878 | 5,570,402 | 135,961,807 | 143,312,316 |
| 2002 | 3,174,177 | 2,686,500 | 49,511 | 189,458 | 81,857 | 6,181,502 | 124,841,131 | 136,450,562 |
| 2003 | 3,333,348 | 2,780,287 | 44,211 | 200,986 | 85,015 | 6,443,847 | 126,100,659 | 135,009,046 |
| 2004 | 3,535,885 | 2,673,103 | 69,895 | 240,426 | 109,830 | 6,629,139 | 144,433,611 | 154,516,038 |
| 2005 | 3,837,238 | 2,979,942 | 120,379 | 292,354 | 137,878 | 7,367,791 | 122,350,247 | 130,424,375 |
| 2006 | 2,514,944 | 3,182,628 | 56,543 | 154,568 | 71,756 | 5,980,438 | 127,023,731 | 134,970,200 |
| 2007 | 3,215,040 | 2,947,240 | 24,929 | 13,664 | 18,235 | 6,219,107 | 158,361,980 | 168,001,926 |
| 2008 | 5,595,179 | 4,234,972 | 10,299 | 5,521 | 8,567 | 9,854,537 | 178,456,714 | 188,944,834 |
| 2009 | 5,184,588 | 3,721,283 | 20,503 | 8,770 | 8,182 | 8,943,325 | 159,837,620 | 170,177,273 |
| 2010 | 6,475,063 | 6,418,684 | 77,603 | 19,136 | 23,139 | 13,013,624 | 160,998,991 | 172,837,881 |
| 2011 | 6,183,012 | 5,772,017 | 39,858 | 13,760 | 15,156 | 12,023,804 | 173,356,054 | 186,221,357 |
| 2012 | 5,316,241 | 6,435,779 | 24,816 | 11,514 | 10,418 | 11,798,768 | 192,011,031 | 208,033,783 |
| 2013 | 5,960,212 | 7,983,102 | 54,228 | 26,376 | 22,921 | 14,046,838 | 218,746,448 | 233,591,114 |
| 2014 | 7,958,084 | 4,183,688 | 15,209 | 7,392 | 15,843 | 12,180,216 | 240,519,484 | 258,461,154 |
| 2015 | 10,129,075 | 6,792,122 | (1,296) | 7,644 | 22,043 | 16,949,588 | 231,303,023 | 251,069,052 |
| 2016 | 8,777,026 | 5,934,430 | 0 | 0 | 0 | 14,711,456 | 248,086,949 | 276,432,577 |
| **2017** | **8,129,107** | **6,229,226** | **0** | **0** | **0** | **14,358,333** | **276,249,842** | **303,639,481** |
| 2018 | 8,989,556 | 6,235,823 | 0 | 0 | 0 | 15,225,379 | 273,457,566 | 298,154,075 |
| 2019 | 8,718,215 | 6,194,491 | 0 | 0 | 0 | 14,912,706 | 268,590,766 | 295,669,465 |
| 2020 | 8,805,397 | 6,256,436 | 0 | 0 | 0 | 15,061,833 | 271,276,673 | 298,626,159 |
| 2021 | 8,893,451 | 6,319,001 | 0 | 0 | 0 | 15,212,452 | 273,989,440 | 301,612,420 |
| 2022 | 8,982,386 | 6,382,191 | 0 | 0 | 0 | 15,364,577 | 276,729,334 | 304,628,543 |
| 2023 | 9,072,210 | 6,446,012 | 0 | 0 | 0 | 15,518,222 | 279,496,629 | 307,674,831 |
| 2024 | 9,162,932 | 6,510,473 | 0 | 0 | 0 | 15,673,405 | 282,291,593 | 310,751,578 |
| 2025 | 9,254,561 | 6,575,577 | 0 | 0 | 0 | 15,830,138 | 285,114,511 | 313,859,095 |
| 2026 | 9,347,107 | 6,641,333 | 0 | 0 | 0 | 15,988,440 | 287,965,657 | 316,997,685 |
| 2027 | 9,440,578 | 6,707,746 | 0 | 0 | 0 | 16,148,324 | 290,845,310 | 320,167,661 |
| 2028 | 9,534,984 | 6,774,824 | 0 | 0 | 0 | 16,309,808 | 293,753,766 | 323,369,341 |
| 2029 | 9,630,333 | 6,842,572 | 0 | 0 | 0 | 16,472,905 | 296,691,305 | 326,603,035 |
| 2030 | 9,726,637 | 6,910,998 | 0 | 0 | 0 | 16,637,635 | 299,658,216 | 329,869,063 |
| 2031 | 9,823,903 | 6,980,108 | 0 | 0 | 0 | 16,804,011 | 302,654,800 | 333,167,755 |
| 2032 | 9,922,142 | 7,049,909 | 0 | 0 | 0 | 16,972,051 | 305,681,347 | 336,499,433 |
| 2033 | 10,021,364 | 7,120,408 | 0 | 0 | 0 | 17,141,772 | 308,738,160 | 339,864,427 |
| 2034 | 10,121,577 | 7,191,612 | 0 | 0 | 0 | 17,313,189 | 311,825,540 | 343,263,066 |
| 2035 | 10,222,793 | 7,263,528 | 0 | 0 | 0 | 17,486,321 | 314,943,799 | 346,695,702 |
| **TOTAL** | **321,116,692** | **204,009,076** | **659,930** | **1,941,500** | **974,187** | **528,701,385** | **10,134,343,371** | **11,006,835,745** |

[a] Includes certain costs to be assigned directly to Kern County Water Agency. Refer to Appendix B text discussion of Table B-16A under "Project Water Charges."

# Tables B-12 through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-12 Variable OMP&R Costs to be Reimbursed through Variable OMP&R Component of Transportation Charge[a] (in dollars)



| | NORTH BAY AQUEDUCT | | | | SOUTH BAY AQUEDUCT | CALIFORNIA AQUEDUCT | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 1 | Reach 3A | Reach 3B | | Reach 1 | Reach 1 | Reach 4 | Reach 14A |
| Calendar Year | Barker Slough Pumping Plant | Cordelia Pumping Plant (Solano ) | Cordelia Pumping Plant (Napa)[b] | Total | South Bay and Del Valle Pumping Plants[c] | Banks Pumping Plant | Dos Amigos Pumping Plant | Buena Vista Pumping Plant |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1962 | 0 | 0 | 0 | 0 | 36,970 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 57,711 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 74,134 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 142,609 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 192,605 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 223,117 | 13,881 | 0 | 0 |
| 1968 | 0 | 0 | 6,989 | 6,989 | 336,671 | 452,630 | 202,947 | 0 |
| 1969 | 0 | 0 | 8,551 | 8,551 | 257,579 | 293,741 | 135,425 | 0 |
| 1970 | 0 | 0 | 13,598 | 13,598 | 396,358 | 346,215 | 211,197 | 1 |
| 1971 | 0 | 0 | 10,609 | 10,609 | 381,662 | 574,015 | 225,188 | 115,801 |
| 1972 | 0 | 0 | 14,434 | 14,434 | 598,702 | 933,292 | 502,196 | 198,914 |
| 1973 | 0 | 0 | 14,449 | 14,449 | 493,490 | 688,030 | 381,232 | 263,468 |
| 1974 | 0 | 0 | 17,473 | 17,473 | 565,575 | 783,562 | 447,772 | 315,939 |
| 1975 | 0 | 0 | 14,779 | 14,779 | 349,758 | 1,341,019 | 518,816 | 508,060 |
| 1976 | 0 | 0 | 20,856 | 20,856 | 571,361 | 1,638,453 | 641,115 | 712,947 |
| 1977 | 0 | 0 | 22,635 | 22,635 | 512,996 | 1,013,307 | 284,828 | 267,467 |
| 1978 | 0 | 0 | 21,692 | 21,692 | 586,355 | 2,339,502 | 607,042 | 689,236 |
| 1979 | 0 | 0 | 16,237 | 16,237 | 605,136 | 3,554,256 | 1,008,564 | 776,016 |
| 1980 | 0 | 0 | 19,945 | 19,945 | 523,369 | 2,083,336 | 1,129,152 | 1,051,629 |
| 1981 | 0 | 0 | 23,842 | 23,842 | 567,692 | 3,952,931 | 1,939,189 | 1,336,867 |
| 1982 | 0 | 0 | 12,157 | 12,157 | 605,780 | 3,082,031 | 1,363,705 | 1,200,226 |
| 1983 | 0 | 0 | 2,342 | 2,342 | 82,222 | 1,001,612 | 396,086 | 450,801 |
| 1984 | 0 | 0 | 4,822 | 4,822 | 271,543 | 1,856,959 | 976,773 | 823,681 |
| 1985 | 0 | 0 | 10,188 | 10,188 | 451,020 | 3,186,029 | 1,621,418 | 1,409,980 |
| 1986 | 0 | 0 | 15,501 | 15,501 | 814,111 | 6,595,625 | 2,627,407 | 2,405,224 |
| 1987 | 0 | 0 | 27,223 | 27,223 | 888,558 | 5,740,403 | 2,518,308 | 2,231,491 |
| 1988 | 17,813 | 0 | 24,020 | 41,833 | 911,176 | 6,276,214 | 2,610,048 | 2,560,122 |
| 1989 | 29,819 | 43,846 | 26,519 | 100,184 | 1,163,619 | 9,847,706 | 3,953,735 | 4,042,211 |
| 1990 | 52,210 | 67,109 | 40,775 | 160,094 | 1,834,626 | 10,460,533 | 4,498,260 | 5,779,750 |
| 1991 | 10,429 | 10,118 | 5,252 | 25,799 | 420,688 | 1,882,952 | 491,071 | 904,541 |
| 1992 | 13,319 | 13,070 | 9,406 | 35,795 | 339,021 | 3,129,419 | 1,147,502 | 1,221,282 |
| 1993 | (11,941) | (8,753) | (5,392) | (26,086) | (150,856) | 497,455 | 326,100 | (108,089) |
| 1994 | 46,791 | 39,624 | 29,189 | 115,604 | 801,374 | 5,677,009 | 2,305,603 | 2,523,572 |
| 1995 | 20,014 | 20,620 | 11,791 | 52,425 | 302,558 | 3,805,713 | 1,451,578 | 815,572 |
| 1996 | 57,320 | 47,288 | 23,483 | 128,091 | 718,807 | 8,192,821 | 4,009,531 | 2,493,264 |
| 1997 | 67,416 | 52,935 | 21,955 | 142,306 | 1,038,568 | 6,900,694 | 2,845,506 | 2,589,077 |
| 1998 | (11,427) | (10,141) | (4,879) | (26,447) | (130,734) | 185,756 | (336,341) | (263,072) |
| 1999 | 31,419 | 25,288 | 11,623 | 68,330 | 408,566 | 6,753,244 | 2,307,304 | 1,581,950 |
| 2000 | 58,046 | 42,597 | 15,125 | 115,767 | 904,390 | 7,961,599 | 3,043,655 | 2,952,780 |
| 2001 | 359,270 | 250,964 | 214,751 | 824,984 | 4,079,017 | 23,842,925 | 9,743,418 | 14,600,626 |
| 2002 | 190,349 | 104,564 | 61,470 | 356,383 | 2,324,926 | 17,025,395 | 6,894,112 | 8,423,370 |
| 2003 | 180,192 | 118,387 | 97,762 | 396,341 | 2,568,880 | 21,142,127 | 8,873,082 | 10,393,189 |
| 2004 | 250,597 | 139,241 | 107,251 | 497,090 | 2,554,982 | 21,514,887 | 9,305,543 | 12,252,400 |
| 2005 | 285,238 | 147,895 | 149,083 | 582,216 | 2,835,209 | 28,306,243 | 12,456,894 | 11,506,677 |
| 2006 | 234,970 | 116,406 | 147,445 | 498,821 | 2,764,840 | 23,330,330 | 10,474,002 | 11,242,457 |
| 2007 | 451,874 | 228,029 | 257,003 | 936,906 | 4,242,890 | 25,193,715 | 10,890,726 | 16,129,285 |
| 2008 | 423,721 | 195,656 | 301,951 | 921,328 | 3,332,734 | 17,276,071 | 6,116,442 | 11,199,859 |
| 2009 | 218,859 | 103,270 | 163,048 | 485,178 | 2,487,492 | 9,192,019 | 4,049,968 | 6,861,490 |
| 2010 | 260,455 | 112,283 | 215,355 | 588,094 | 2,375,172 | 24,513,390 | 9,468,531 | 10,594,566 |
| 2011 | 270,486 | 116,076 | 228,382 | 614,944 | 3,410,523 | 35,599,947 | 15,173,838 | 14,431,218 |
| 2012 | 272,391 | 123,844 | 189,952 | 586,187 | 3,538,975 | 27,319,377 | 12,014,879 | 13,731,449 |
| 2013 | 435,741 | 208,054 | 322,814 | 966,610 | 5,453,846 | 22,827,935 | 8,721,713 | 12,308,957 |
| 2014 | 361,021 | 184,702 | 445,584 | 991,306 | 4,103,966 | 11,268,486 | 3,525,274 | 6,999,090 |
| 2015 | 389,135 | 239,088 | 358,785 | 987,009 | 5,749,403 | 16,835,825 | 5,310,736 | 9,802,435 |
| 2016 | 547,986 | 306,673 | 375,538 | 1,230,197 | 4,687,929 | 41,020,893 | 11,480,039 | 16,117,828 |
| **2017** | **628,775** | **178,375** | **600,564** | **1,407,714** | **4,792,711** | **37,126,485** | **15,430,355** | **19,364,318** |
| 2018 | 639,382 | 181,385 | 610,697 | 1,431,464 | 5,014,612 | 38,262,530 | 15,921,145 | 19,347,628 |
| 2019 | 572,629 | 193,348 | 545,270 | 1,311,247 | 5,204,082 | 43,377,004 | 16,903,922 | 19,764,712 |
| 2020 | 585,079 | 197,552 | 557,126 | 1,339,757 | 5,338,793 | 33,555,792 | 17,649,863 | 20,875,192 |
| 2021 | 575,903 | 194,453 | 548,388 | 1,318,744 | 5,255,057 | 40,043,189 | 17,291,815 | 20,401,630 |
| 2022 | 583,185 | 196,912 | 555,322 | 1,335,419 | 5,321,509 | 39,965,507 | 17,615,233 | 20,848,243 |
| 2023 | 580,115 | 195,876 | 552,398 | 1,328,389 | 5,293,489 | 35,479,730 | 17,637,525 | 20,946,983 |
| 2024 | 582,381 | 196,641 | 554,556 | 1,333,578 | 5,314,167 | 35,379,680 | 17,483,186 | 20,625,493 |
| 2025 | 585,786 | 197,790 | 557,798 | 1,341,374 | 5,345,235 | 34,052,305 | 17,761,816 | 21,064,350 |
| 2026 | 574,960 | 194,135 | 547,490 | 1,316,585 | 5,246,455 | 39,116,134 | 17,166,388 | 20,194,415 |
| 2027 | 579,078 | 195,525 | 551,411 | 1,326,014 | 5,284,025 | 37,191,938 | 17,598,242 | 20,895,444 |
| 2028 | 581,316 | 196,281 | 553,542 | 1,331,139 | 5,304,457 | 36,501,526 | 17,442,995 | 20,573,011 |
| 2029 | 583,190 | 196,914 | 555,327 | 1,335,431 | 5,321,555 | 36,973,453 | 17,657,284 | 20,924,197 |
| 2030 | 585,393 | 197,658 | 557,424 | 1,340,475 | 5,341,656 | 29,746,152 | 17,503,430 | 20,606,478 |
| 2031 | 585,536 | 197,706 | 557,560 | 1,340,802 | 5,342,951 | 39,970,446 | 18,417,854 | 22,283,175 |
| 2032 | 575,411 | 194,287 | 547,919 | 1,317,617 | 5,250,565 | 41,587,512 | 16,760,014 | 19,470,403 |
| 2033 | 587,720 | 198,444 | 559,640 | 1,345,804 | 5,362,893 | 29,218,439 | 18,463,283 | 22,322,370 |
| 2034 | 579,253 | 195,585 | 551,578 | 1,326,416 | 5,285,627 | 37,275,572 | 16,980,193 | 19,789,428 |
| 2035 | 575,771 | 194,409 | 548,262 | 1,318,442 | 5,253,848 | 65,638,351 | 19,351,556 | 24,347,145 |
| **TOTAL** | **16,654,377** | **6,732,010** | **14,755,636** | **38,142,023** | **175,533,359** | **1,209,713,251** | **521,927,209** | **623,090,218** |

[a] Excludes extra peaking costs assigned directly to contractors. Refer to Appendix B text discussion of Table B-17 under "Project Water Charges."

[b] Costs for the period 1968 through 1987 are for an interim facility.

[c] The relatively minor costs of Del Valle Pumping Plant have been combined with those of South Bay Pumping Plant to simplify the allocation procedures.

## TABLE B-12 Variable OMP&R Costs to be Reimbursed through Variable OMP&R Component of Transportation Charge[a] (in dollars)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Reach 15A | Reach 16A | Reach 17E | Reach 18A | Reach 22B | Reach 23 | Reach 24 |
| Calendar Year | Wheeler Ridge Pumping Plant | Chrisman Pumping Plant | Edmonston Pumping Plant | Alamo Pumping Plant | Pearblossom Pumping Plant | Mojave Siphon Powerplant | Silverwood Lake[d] |
| | [9] | [10] | [11] | [12] | [13] | [14] | [15] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 2,564 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 68,304 | 142,902 | 542,625 | 0 | 3,468 | 0 | 0 |
| 1973 | 236,623 | 387,198 | 1,548,428 | 0 | 202,289 | 0 | 0 |
| 1974 | 324,966 | 564,464 | 2,164,223 | 0 | 324,993 | 0 | 0 |
| 1975 | 552,952 | 1,095,331 | 4,010,395 | 0 | 575,061 | 0 | 0 |
| 1976 | 713,875 | 1,506,985 | 5,443,936 | 0 | 889,544 | 0 | 0 |
| 1977 | 303,107 | 657,108 | 2,360,624 | 0 | 315,128 | 0 | 0 |
| 1978 | 616,104 | 1,132,296 | 4,180,131 | 0 | 1,508,115 | 0 | 0 |
| 1979 | 749,188 | 1,526,850 | 5,475,688 | 0 | 1,838,687 | 0 | 0 |
| 1980 | 1,047,495 | 2,102,439 | 7,028,235 | 0 | 1,762,063 | 0 | 0 |
| 1981 | 1,319,739 | 2,838,773 | 9,351,931 | 0 | 2,296,771 | 0 | 0 |
| 1982 | 1,213,660 | 2,424,920 | 8,352,207 | 0 | 1,498,620 | 0 | 0 |
| 1983 | 432,165 | 793,915 | 2,375,225 | 0 | 397,766 | 0 | 0 |
| 1984 | 770,618 | 1,479,784 | 4,585,198 | 0 | 624,213 | 0 | 0 |
| 1985 | 1,411,621 | 2,812,461 | 9,365,591 | 0 | 1,226,515 | 0 | 0 |
| 1986 | 2,432,322 | 4,999,949 | 16,956,023 | (1,013,756) | 2,359,599 | 0 | 0 |
| 1987 | 2,213,047 | 4,434,510 | 14,612,448 | (1,017,868) | 1,814,728 | 0 | 243,983 |
| 1988 | 2,557,952 | 5,120,998 | 16,801,811 | (742,800) | 2,370,395 | 0 | 37,927 |
| 1989 | 4,061,396 | 8,559,270 | 28,732,499 | (788,139) | 4,228,697 | 0 | 50,884 |
| 1990 | 6,013,924 | 13,616,111 | 48,319,508 | (832,947) | 6,490,357 | 0 | 187,259 |
| 1991 | 1,032,050 | 2,427,880 | 8,647,065 | (269,625) | 996,352 | 0 | 0 |
| 1992 | 1,274,895 | 2,560,253 | 8,575,989 | (916,154) | 1,142,454 | 0 | 317,172 |
| 1993 | (86,676) | (490,235) | (2,223,221) | (55,346) | (245,059) | 0 | (79,954) |
| 1994 | 2,537,943 | 5,323,430 | 18,470,003 | (59,356) | 2,605,813 | 0 | 0 |
| 1995 | 725,389 | 1,435,098 | 4,738,967 | (1,187,312) | 972,086 | 0 | 777,343 |
| 1996 | 2,299,388 | 4,875,010 | 17,027,386 | (2,788,262) | 2,647,473 | (914,092) | 1,053,254 |
| 1997 | 2,417,154 | 5,424,334 | 19,413,834 | (2,488,338) | 3,037,087 | (1,680,469) | 0 |
| 1998 | (236,322) | (524,933) | (1,809,182) | (1,969,187) | (431,135) | (1,217,950) | (149,186) |
| 1999 | 1,288,328 | 3,316,481 | 12,854,526 | (2,851,993) | 1,861,548 | (2,533,429) | 71,918 |
| 2000 | 3,028,152 | 6,960,756 | 25,109,200 | (5,070,499) | 3,912,220 | (4,371,978) | 0 |
| 2001 | 14,956,504 | 33,675,515 | 124,395,398 | (3,276,174) | 18,951,103 | (3,621,886) | 932,664 |
| 2002 | 8,731,681 | 19,721,183 | 72,470,283 | (4,919,131) | 10,667,925 | (5,247,076) | 95,264 |
| 2003 | 10,813,824 | 24,634,501 | 90,645,034 | (3,362,477) | 14,524,405 | (6,610,346) | 231,993 |
| 2004 | 12,865,130 | 29,371,203 | 107,981,335 | (6,248,061) | 16,993,228 | (7,691,613) | 0 |
| 2005 | 11,769,639 | 26,675,193 | 94,388,290 | (5,791,742) | 17,552,651 | (6,359,950) | 0 |
| 2006 | 11,416,278 | 26,012,299 | 81,782,430 | (4,022,339) | 15,973,485 | (6,347,742) | 0 |
| 2007 | 16,657,505 | 37,657,877 | 125,592,420 | (2,976,651) | 19,486,841 | (5,872,118) | 0 |
| 2008 | 12,257,369 | 24,863,347 | 77,772,541 | (3,305,736) | 10,660,557 | (3,203,162) | 320,480 |
| 2009 | 7,289,924 | 15,752,135 | 70,995,351 | (3,096,612) | 9,125,041 | (2,225,065) | 2,053 |
| 2010 | 10,761,094 | 24,291,392 | 88,798,635 | (4,904,985) | 16,693,927 | (5,529,305) | 0 |
| 2011 | 14,469,169 | 32,456,256 | 113,763,699 | (6,340,454) | 23,162,701 | (7,675,700) | 496,252 |
| 2012 | 13,819,789 | 31,232,852 | 109,484,761 | (2,424,628) | 17,308,629 | (8,836,129) | 0 |
| 2013 | 12,514,624 | 28,331,949 | 99,615,990 | (1,989,602) | 12,082,796 | (4,750,469) | 0 |
| 2014 | 7,210,625 | 16,315,446 | 57,032,086 | (1,305,981) | 5,099,627 | (1,023,443) | 136,848 |
| 2015 | 10,787,103 | 24,240,558 | 87,565,766 | (2,190,585) | 8,908,201 | (2,008,918) | 821,286 |
| 2016 | 16,973,365 | 38,393,993 | 139,927,484 | (9,991,405) | 25,788,106 | (11,125,765) | 0 |
| **2017** | **19,935,226** | **45,461,208** | **166,563,053** | **(11,209,881)** | **23,693,526** | **(14,011,324)** | **0** |
| 2018 | 19,895,799 | 45,352,959 | 166,111,918 | (11,206,485) | 24,025,447 | (13,968,798) | 0 |
| 2019 | 20,241,933 | 46,067,072 | 168,547,811 | (9,015,575) | 21,179,696 | (11,830,336) | 0 |
| 2020 | 21,418,953 | 48,775,958 | 178,561,476 | (9,453,465) | 22,865,682 | (12,540,246) | 0 |
| 2021 | 20,924,592 | 47,643,751 | 174,394,793 | (9,425,494) | 22,429,121 | (12,494,087) | 0 |
| 2022 | 21,393,677 | 48,720,206 | 178,363,520 | (9,453,994) | 22,793,150 | (12,541,120) | 0 |
| 2023 | 21,507,323 | 48,988,393 | 179,377,226 | (10,998,748) | 23,210,974 | (12,857,929) | 0 |
| 2024 | 21,153,868 | 48,165,548 | 176,303,933 | (10,445,459) | 21,936,512 | (12,058,770) | 0 |
| 2025 | 21,622,684 | 49,247,242 | 180,311,720 | (10,896,878) | 23,183,245 | (12,709,278) | 0 |
| 2026 | 20,702,093 | 47,129,565 | 172,486,963 | (10,555,010) | 21,921,978 | (12,215,416) | 0 |
| 2027 | 21,453,573 | 48,865,330 | 178,924,459 | (10,820,588) | 22,729,793 | (12,598,405) | 0 |
| 2028 | 21,099,187 | 48,040,394 | 175,843,616 | (10,677,374) | 22,464,684 | (12,391,303) | 0 |
| 2029 | 21,476,067 | 48,911,218 | 179,074,308 | (10,745,597) | 22,705,592 | (12,489,792) | 0 |
| 2030 | 21,127,138 | 48,099,196 | 176,042,422 | (10,615,914) | 22,470,162 | (12,302,838) | 0 |
| 2031 | 22,950,554 | 52,330,221 | 191,799,409 | (11,182,917) | 23,890,087 | (13,128,439) | 0 |
| 2032 | 19,919,098 | 45,316,147 | 165,745,435 | (10,155,652) | 20,976,825 | (11,648,085) | 0 |
| 2033 | 22,988,171 | 52,413,887 | 192,098,881 | (11,289,216) | 24,248,287 | (13,285,614) | 0 |
| 2034 | 20,255,979 | 46,090,507 | 168,604,645 | (10,351,894) | 21,591,420 | (11,925,594) | 0 |
| 2035 | 25,247,206 | 57,698,832 | 211,928,216 | (11,465,048) | 24,193,172 | (13,547,293) | 0 |
| **TOTAL** | **639,928,669** | **1,444,447,670** | **5,226,306,601** | **(288,163,334)** | **722,714,424** | **(339,391,272)** | **5,547,442** |

[a] Excludes extra peaking costs assigned directly to contractors. Refer to Appendix B text discussion of Table B-17 under "Project Water Charges."

[d] These values represent a proportionate allocation of the total variable OMP&R costs of pumping and recovery plants (Table B-3) associated with net annual withdrawals from storage for Project Transportation Facilities. The allocation is determined annually by applying the following ratio, calculated from the data shown in Table B-6: "Reservoir Storage Changes" (withdrawals, as a positive value) conveyed through each plant, divided by "Total" annual quantity conveyed through each plant, in acre-feet. The costs so determined are accumulated for all upstream plants for each year, for each respective reservoir.

## TABLE B-12 Variable OMP&R Costs to be Reimbursed through Variable OMP&R Component of Transportation Charge[a] (in dollars)



| | CALIFORNIA AQUEDUCT (continued) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Reach 26A | Reach 2B (EBX) | Reach 3A (EBX) | Reach 4B (EBX) | Reach 28J | Reach 29A | Reach 29G |
| Calendar Year | Devil Canyon Powerplant | Greenspot Pump Station | Crafton Hills Pump Station | Cherry Valley Pump Station | Lake Perris[d] | Oso Pumping Plant | Warne Powerplant |
| | [16] | [17] | [18] | [19] | [20] | [21] | [22] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | (3,024) | 0 | 0 | 0 | 0 | 79,315 | 0 |
| 1973 | (461,268) | 0 | 0 | 0 | 0 | 122,787 | 0 |
| 1974 | (546,156) | 0 | 0 | 0 | 0 | 157,511 | 0 |
| 1975 | (1,095,523) | 0 | 0 | 0 | 0 | 314,636 | 0 |
| 1976 | (1,566,056) | 0 | 0 | 0 | 0 | 326,967 | 0 |
| 1977 | (1,222,866) | 0 | 0 | 0 | 0 | 75,335 | 0 |
| 1978 | (3,085,094) | 0 | 0 | 0 | 0 | 89,383 | 0 |
| 1979 | (3,466,481) | 0 | 0 | 0 | 0 | 102,584 | 0 |
| 1980 | (3,318,152) | 0 | 0 | 0 | 0 | 236,768 | 0 |
| 1981 | (3,842,971) | 0 | 0 | 0 | 0 | 444,280 | 0 |
| 1982 | (2,736,072) | 0 | 0 | 0 | 0 | 539,245 | (783,626) |
| 1983 | (5,478,830) | 0 | 0 | 0 | 0 | 214,069 | (1,488,439) |
| 1984 | (7,350,989) | 0 | 0 | 0 | 0 | 484,239 | (4,088,209) |
| 1985 | (10,748,103) | 0 | 0 | 0 | 0 | 874,069 | (5,930,176) |
| 1986 | (11,484,996) | 0 | 0 | 0 | 0 | 1,269,590 | (5,579,301) |
| 1987 | (10,814,483) | 0 | 0 | 0 | 53,242 | 1,323,472 | (6,292,822) |
| 1988 | (14,495,967) | 0 | 0 | 0 | 0 | 1,421,372 | (6,994,588) |
| 1989 | (18,688,631) | 0 | 0 | 0 | 0 | 2,046,005 | (8,368,716) |
| 1990 | (20,911,839) | 0 | 0 | 0 | 147,163 | 2,857,442 | (11,011,193) |
| 1991 | (4,884,013) | 0 | 0 | 0 | 0 | 535,456 | (3,604,791) |
| 1992 | (9,513,281) | 0 | 0 | 0 | (61,233) | 686,984 | (5,272,726) |
| 1993 | (7,502,549) | 0 | 0 | 0 | 0 | 51,327 | (3,380,473) |
| 1994 | (11,815,745) | 0 | 0 | 0 | 80,824 | 1,210,469 | (5,835,219) |
| 1995 | (9,742,248) | 0 | 0 | 0 | 0 | 151,109 | (1,179,155) |
| 1996 | (12,358,465) | 0 | 0 | 0 | 0 | 895,929 | (4,248,531) |
| 1997 | (13,293,791) | 0 | 0 | 0 | 111,776 | 897,657 | (4,797,589) |
| 1998 | (10,108,555) | 0 | 0 | 0 | 0 | (27,767) | (746,113) |
| 1999 | (14,952,833) | 0 | 0 | 0 | (44,587) | 655,690 | (5,341,364) |
| 2000 | (25,522,757) | 0 | 0 | 0 | (107,824) | 1,221,657 | (9,464,490) |
| 2001 | (19,510,278) | 0 | 0 | 0 | 0 | 6,159,709 | (7,614,510) |
| 2002 | (24,676,763) | 0 | 0 | 0 | 0 | 3,806,290 | (10,286,903) |
| 2003 | (27,490,216) | 0 | 0 | 0 | 1,149,448 | 4,337,168 | (9,899,070) |
| 2004 | (31,246,167) | 78,555 | 68,914 | 7,290 | 0 | 5,408,386 | (11,835,098) |
| 2005 | (28,682,474) | 69,542 | 48,909 | 2,544 | 5,151,512 | 3,422,443 | (6,683,632) |
| 2006 | (34,389,659) | 135,205 | 148,128 | 18,268 | 0 | 2,545,881 | (6,870,988) |
| 2007 | (28,529,045) | 248,626 | 256,313 | 11,163 | 589,895 | 6,194,316 | (9,522,236) |
| 2008 | (16,403,544) | 242,648 | 326,570 | 7,432 | 0 | 4,418,292 | (7,184,125) |
| 2009 | (13,474,182) | 360,373 | 391,267 | 7,529 | 418,484 | 4,329,384 | (6,578,744) |
| 2010 | (24,427,811) | 313,542 | 431,062 | 19,507 | 0 | 3,283,833 | (5,697,650) |
| 2011 | (31,980,782) | 372,501 | 500,578 | 33,172 | 0 | 3,283,372 | (5,505,320) |
| 2012 | (23,571,258) | 451,850 | 551,794 | 49,815 | 231,470 | 5,192,037 | (8,230,796) |
| 2013 | (14,097,814) | 487,724 | 570,697 | 69,151 | 0 | 6,312,913 | (8,740,718) |
| 2014 | (3,836,008) | 316,015 | 438,715 | 51,910 | 0 | 4,400,056 | (4,122,547) |
| 2015 | (6,409,125) | 342,464 | 457,405 | 15,029 | 882,882 | 6,702,841 | (6,176,657) |
| 2016 | (22,258,127) | 377,640 | 462,567 | 83,645 | 0 | 5,108,990 | (5,463,764) |
| **2017** | **(20,313,572)** | **476,840** | **595,092** | **96,640** | **0** | **8,743,866** | **(9,116,085)** |
| 2018 | (20,254,933) | 484,175 | 604,246 | 96,927 | 0 | 8,504,512 | (8,823,100) |
| 2019 | (17,607,565) | 510,297 | 636,847 | 100,892 | 0 | 9,158,535 | (8,935,832) |
| 2020 | (18,643,900) | 521,393 | 650,693 | 101,794 | 0 | 9,579,444 | (9,160,245) |
| 2021 | (18,124,379) | 513,215 | 640,488 | 100,198 | 0 | 9,303,472 | (9,036,961) |
| 2022 | (17,711,882) | 519,705 | 648,587 | 101,465 | 0 | 9,592,112 | (9,200,836) |
| 2023 | (18,367,209) | 516,968 | 645,172 | 100,931 | 0 | 9,545,861 | (9,182,866) |
| 2024 | (18,092,687) | 518,988 | 647,692 | 101,325 | 0 | 9,727,989 | (9,334,868) |
| 2025 | (17,976,502) | 522,022 | 651,478 | 101,917 | 0 | 9,648,679 | (9,203,758) |
| 2026 | (18,227,464) | 512,375 | 639,439 | 100,034 | 0 | 9,296,728 | (9,045,243) |
| 2027 | (18,090,514) | 516,044 | 644,018 | 100,750 | 0 | 9,697,011 | (9,368,575) |
| 2028 | (18,273,799) | 518,039 | 646,508 | 101,140 | 0 | 9,441,602 | (9,064,246) |
| 2029 | (18,026,294) | 519,709 | 648,592 | 101,466 | 0 | 9,713,384 | (9,296,763) |
| 2030 | (18,103,854) | 521,672 | 651,042 | 101,849 | 0 | 9,451,327 | (9,021,026) |
| 2031 | (18,171,962) | 521,799 | 651,200 | 101,874 | 0 | 10,723,777 | (10,237,008) |
| 2032 | (17,569,033) | 512,776 | 639,940 | 100,112 | 0 | 8,911,526 | (8,663,384) |
| 2033 | (18,840,243) | 523,746 | 653,631 | 102,254 | 0 | 10,586,482 | (10,079,087) |
| 2034 | (17,490,135) | 516,200 | 644,213 | 100,781 | 0 | 8,974,232 | (8,644,339) |
| 2035 | (19,102,441) | 513,097 | 640,340 | 100,175 | 0 | 13,478,835 | (13,082,668) |
| **TOTAL** | **(940,983,359)** | **13,555,745** | **16,832,139** | **2,288,978** | **8,603,053** | **278,242,868** | **(393,317,169)** |

[a] Excludes extra peaking costs assigned directly to contractors. Refer to Appendix B text discussion of Table B-17 under "Project Water Charges."

[d] These values represent a proportionate allocation of the total variable OMP&R costs of pumping and recovery plants (Table B-3) associated with net annual withdrawals from storage for Project Transportation Facilities. The allocation is determined annually by applying the following ratio, calculated from the data shown in Table B-6: "Reservoir Storage Changes" (withdrawals, as a positive value) conveyed through each plant, divided by "Total" annual quantity conveyed through each plant, in acre-feet. The costs so determined are accumulated for all upstream plants for each year, for each respective reservoir.

## TABLE B-12 Variable OMP&R Costs to be Reimbursed through Variable OMP&R Component of Transportation Charge[a] (in dollars)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Reach 29H | Reach 29J | Reach 30 | Reach 31A | Reach 33A | | |
| | Pyramid Lake[d] | Castaic Powerplant | Castaic Lake[d] | Las Perillas and Badger Hill Pumping Plants | Devil's Den, Bluestone, and Polonio Pass Pumping Plants | Total | Grand Total |
| | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 36,970 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 57,711 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 74,134 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 142,609 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 192,605 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 13,881 | 236,998 |
| 1968 | 0 | 0 | 0 | 118,676 | 0 | 774,253 | 1,117,913 |
| 1969 | 0 | 0 | 0 | 78,350 | 0 | 507,516 | 773,646 |
| 1970 | 0 | 0 | 0 | 136,429 | 0 | 693,842 | 1,103,798 |
| 1971 | 0 | 0 | 0 | 166,296 | 0 | 1,083,864 | 1,476,135 |
| 1972 | 0 | (211,144) | 0 | 237,638 | 0 | 2,494,486 | 3,107,622 |
| 1973 | 0 | (1,057,564) | 0 | 120,913 | 0 | 2,432,136 | 2,940,075 |
| 1974 | 0 | (1,547,884) | 0 | 118,582 | 0 | 3,107,972 | 3,691,020 |
| 1975 | 0 | (2,455,461) | 0 | 94,848 | 0 | 5,460,134 | 5,824,671 |
| 1976 | 0 | (2,827,557) | 0 | 141,260 | 0 | 7,621,469 | 8,213,686 |
| 1977 | 0 | (3,734,462) | 0 | 71,311 | 0 | 390,887 | 926,518 |
| 1978 | 0 | (1,542,479) | 0 | 179,925 | 0 | 6,714,161 | 7,322,208 |
| 1979 | 0 | (2,773,323) | 0 | 192,126 | 0 | 8,984,155 | 9,605,528 |
| 1980 | 0 | (3,408,863) | 0 | 168,458 | 0 | 9,882,560 | 10,425,874 |
| 1981 | 0 | (2,834,322) | 0 | 169,177 | 0 | 16,972,365 | 17,563,899 |
| 1982 | 0 | (3,463,971) | 0 | 168,390 | 0 | 12,859,335 | 13,477,272 |
| 1983 | 0 | (6,649,626) | 0 | 17,920 | 0 | (7,537,336) | (7,452,772) |
| 1984 | 0 | (4,710,802) | 0 | 112,679 | 0 | (4,435,856) | (4,159,491) |
| 1985 | 0 | (15,698,638) | 0 | 146,843 | 0 | (10,322,390) | (9,861,182) |
| 1986 | 0 | (11,072,448) | 0 | 297,886 | 0 | 10,793,124 | 11,622,736 |
| 1987 | 80,822 | (11,557,616) | (43,085) | 245,082 | 0 | 5,785,662 | 6,701,444 |
| 1988 | 54,038 | (12,295,001) | (210,845) | 214,519 | 0 | 5,286,197 | 6,239,206 |
| 1989 | 84,370 | (14,812,039) | 89,852 | 282,180 | 0 | 23,321,280 | 24,585,082 |
| 1990 | 0 | (20,116,741) | 245,034 | 416,832 | 0 | 46,159,454 | 48,154,174 |
| 1991 | 432,382 | (6,579,194) | 0 | 3,610 | 0 | 2,015,735 | 2,462,222 |
| 1992 | 29,879 | (9,167,653) | (1,141,229) | 101,665 | 0 | (5,884,783) | (5,509,967) |
| 1993 | (675,438) | (7,895,978) | (2,751,590) | (111,306) | 0 | (24,731,032) | (24,907,974) |
| 1994 | 0 | (10,565,940) | (81,262) | 206,086 | 0 | 12,583,232 | 13,500,210 |
| 1995 | 544,099 | (4,049,615) | 0 | 243,434 | 0 | (497,940) | (142,957) |
| 1996 | 0 | (8,457,232) | 0 | 296,170 | 0 | 15,023,644 | 15,870,542 |
| 1997 | 0 | (8,727,328) | (897) | 298,483 | 208,816 | 13,156,005 | 14,336,879 |
| 1998 | (965,988) | (3,360,851) | (2,139,549) | (55,491) | (92,902) | (24,248,768) | (24,405,949) |
| 1999 | 0 | (9,672,802) | 0 | 160,203 | 228,670 | (4,317,144) | (3,840,249) |
| 2000 | 0 | (17,958,033) | 0 | 231,125 | 381,037 | (7,693,401) | (6,673,244) |
| 2001 | 1,003,254 | (13,495,346) | 2,423,551 | 1,085,730 | 2,170,015 | 206,422,217 | 211,326,218 |
| 2002 | 0 | (18,455,025) | 0 | 544,053 | 1,351,161 | 86,145,817 | 88,827,127 |
| 2003 | 833,189 | (16,903,355) | 963,682 | 636,921 | 1,525,163 | 126,438,262 | 129,403,483 |
| 2004 | 222,030 | (21,110,644) | 685,288 | 672,555 | 1,779,029 | 141,074,190 | 144,126,262 |
| 2005 | 4,755,989 | (12,763,664) | 4,548,906 | 846,063 | 1,714,250 | 162,934,283 | 166,351,708 |
| 2006 | 528,663 | (11,822,176) | 6,064,195 | 848,860 | 1,423,676 | 128,491,254 | 131,754,915 |
| 2007 | 0 | (19,017,327) | 0 | 1,306,516 | 2,313,454 | 196,611,274 | 201,791,070 |
| 2008 | 0 | (14,961,833) | 1,320,512 | 1,127,445 | 1,732,916 | 124,584,081 | 128,838,144 |
| 2009 | 407,982 | (15,564,065) | 0 | 695,135 | 1,212,175 | 90,151,641 | 93,124,311 |
| 2010 | 0 | (10,738,810) | 0 | 903,993 | 1,484,471 | 140,259,384 | 143,222,649 |
| 2011 | 0 | (11,102,175) | 1,992,972 | 1,112,160 | 2,128,325 | 196,371,729 | 200,397,197 |
| 2012 | 186,883 | (15,133,885) | 0 | 1,008,578 | 2,019,551 | 176,407,019 | 180,532,182 |
| 2013 | 77,188 | (15,520,329) | 462,842 | 1,362,201 | 2,054,765 | 162,702,513 | 169,122,969 |
| 2014 | 0 | (7,773,330) | 2,168,085 | 1,559,450 | 2,105,230 | 100,565,634 | 105,660,906 |
| 2015 | 188,915 | (10,877,597) | 0 | 1,585,077 | 1,925,495 | 148,709,137 | 155,445,549 |
| 2016 | 0 | (8,868,220) | 0 | 1,111,769 | 2,846,359 | 241,985,397 | 247,903,523 |
| **2017** | **0** | **(15,356,565)** | **0** | **1,119,011** | **3,662,912** | **272,261,105** | **278,461,530** |
| 2018 | 0 | (14,788,198) | 0 | 1,141,752 | 3,742,540 | 274,450,064 | 280,896,140 |
| 2019 | 0 | (14,626,597) | 0 | 815,693 | 5,387,393 | 290,675,902 | 297,191,231 |
| 2020 | 0 | (14,980,309) | 0 | 834,583 | 5,514,870 | 296,127,528 | 302,806,078 |
| 2021 | 0 | (14,776,554) | 0 | 821,493 | 5,428,373 | 296,078,655 | 302,652,456 |
| 2022 | 0 | (15,050,240) | 0 | 831,881 | 5,497,016 | 302,932,230 | 309,589,158 |
| 2023 | 0 | (15,057,088) | 0 | 827,500 | 5,468,072 | 297,788,818 | 304,410,696 |
| 2024 | 0 | (15,289,390) | 0 | 830,733 | 5,489,433 | 293,143,206 | 299,790,951 |
| 2025 | 0 | (15,072,238) | 0 | 835,589 | 5,521,525 | 298,665,918 | 305,352,527 |
| 2026 | 0 | (14,790,329) | 0 | 820,148 | 5,419,486 | 290,672,284 | 297,235,324 |
| 2027 | 0 | (15,328,441) | 0 | 826,021 | 5,458,296 | 298,694,396 | 305,304,435 |
| 2028 | 0 | (14,857,899) | 0 | 829,215 | 5,479,402 | 293,716,698 | 300,352,294 |
| 2029 | 0 | (15,244,330) | 0 | 831,887 | 5,497,063 | 299,231,444 | 305,888,430 |
| 2030 | 0 | (14,767,859) | 0 | 835,030 | 5,517,827 | 287,862,234 | 294,544,365 |
| 2031 | 0 | (16,797,326) | 0 | 835,232 | 5,519,165 | 320,477,141 | 327,160,894 |
| 2032 | 0 | (14,154,400) | 0 | 820,791 | 5,423,732 | 283,993,757 | 290,561,939 |
| 2033 | 0 | (16,514,398) | 0 | 838,350 | 5,539,764 | 309,988,987 | 316,697,684 |
| 2034 | 0 | (14,159,544) | 0 | 826,272 | 5,459,950 | 284,537,886 | 291,149,929 |
| 2035 | 0 | (21,608,089) | 0 | 821,303 | 5,427,124 | 370,579,813 | 377,152,103 |
| **TOTAL** | **7,788,259** | **(726,532,142)** | **14,596,461** | **38,019,290** | **130,965,597** | **8,216,180,598** | **8,429,855,980** |

[a] Excludes extra peaking costs assigned directly to contractors. Refer to Appendix B text discussion of Table B-17 under "Project Water Charges."

[d] These values represent a proportionate allocation of the total variable OMP&R costs of pumping and recovery plants (Table B-3) associated with net annual withdrawals from storage for Project Transportation Facilities. The allocation is determined annually by applying the following ratio, calculated from the data shown in Table B-6: "Reservoir Storage Changes" (withdrawals, as a positive value) conveyed through each plant, divided by "Total" annual quantity conveyed through each plant, in acre-feet. The costs so determined are accumulated for all upstream plants for each year, for each respective reservoir.

## TABLE B-13 Capital and Operating Costs of Project Conservation Facilities to be Reimbursed through Delta Water Charge (in dollars)

| Calendar Year | Initial Project Conservation Facilities (Portions of Upper Feather Lakes, Oroville-Thermalito, and California Aqueduct Facilities) | | | | | Planning and Pre-operating Costs[a,f] | Total |
|---|---|---|---|---|---|---|---|
| | | | | Application of Oroville Power Revenues to: | | | |
| | Capital Costs[a] | Capital Cost Credits[b] | Operating Costs[c] | Capital Costs[d] | Operating Costs[e] | | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] |
| 1952 | 171,322 | 0 | 0 | 0 | 0 | 0 | 171,322 |
| 1953 | 312,190 | 0 | 0 | 0 | 0 | 0 | 312,190 |
| 1954 | 308,624 | 0 | 0 | 0 | 0 | 0 | 308,624 |
| 1955 | 194,645 | 0 | 0 | 0 | 0 | 0 | 194,645 |
| 1956 | 1,357,077 | 0 | 0 | 0 | 0 | 0 | 1,357,077 |
| 1957 | 6,210,709 | 0 | 0 | 0 | 0 | 0 | 6,210,709 |
| 1958 | 9,510,916 | 0 | 0 | 0 | 0 | 0 | 9,510,916 |
| 1959 | 11,390,586 | 0 | 0 | 0 | 0 | 0 | 11,390,586 |
| 1960 | 14,463,274 | (4,850,000) | 0 | 0 | 0 | 0 | 9,613,274 |
| 1961 | 18,729,965 | (431,527) | 0 | 0 | 0 | 0 | 18,298,438 |
| 1962 | 9,099,967 | (479,280) | 0 | 0 | 0 | 0 | 8,620,687 |
| 1963 | 73,098,107 | (478,743) | (14,000) | 0 | 0 | 0 | 72,605,364 |
| 1964 | 62,629,003 | (751,330) | (14,000) | 0 | 0 | 107,780 | 61,971,453 |
| 1965 | 71,048,877 | (763,541) | (14,000) | 0 | 0 | 551,850 | 70,823,186 |
| 1966 | 125,376,541 | (748,649) | (14,000) | 0 | 0 | 1,081,023 | 125,694,915 |
| 1967 | 94,481,603 | (812,145) | (13,446) | 0 | 0 | 1,189,212 | 94,845,224 |
| 1968 | 39,986,145 | (431,574) | 1,303,821 | (951,000) | 0 | 793,399 | 40,700,791 |
| 1969 | 5,367,865 | (259,015) | 2,890,772 | (11,007,000) | 0 | 601,867 | (2,405,511) |
| 1970 | 4,208,411 | (203,733) | 4,818,634 | (14,650,000) | (1,500,000) | 516,659 | (6,810,029) |
| 1971 | 3,956,703 | (193,631) | 6,026,480 | (14,650,000) | (1,500,000) | 408,754 | (5,951,694) |
| 1972 | 4,662,255 | (196,361) | 5,393,011 | (14,650,000) | (1,500,000) | 287,374 | (6,003,721) |
| 1973 | 4,090,078 | (136,997) | 6,135,774 | (14,650,000) | (1,500,000) | 203,384 | (5,857,761) |
| 1974 | 6,852,718 | (137,503) | 6,944,723 | (17,950,000) | (1,500,000) | 201,907 | (5,588,155) |
| 1975 | 8,343,833 | (234,567) | 7,697,390 | (14,650,000) | (1,500,000) | 146,188 | (197,156) |
| 1976 | 6,189,618 | (204,944) | 7,067,037 | (14,650,000) | (1,500,000) | 205,234 | (2,893,055) |
| 1977 | 21,554,452 | (150,214) | 10,547,977 | (14,650,000) | (1,500,000) | 857,419 | 16,659,634 |
| 1978 | 8,031,393 | (64,566) | 12,851,158 | (14,650,000) | (1,500,000) | 2,131,286 | 6,799,271 |
| 1979 | 9,751,861 | 0 | 9,547,014 | (14,650,000) | (1,500,000) | 2,131,884 | 5,280,759 |
| 1980 | 11,345,574 | 0 | 13,258,298 | (14,650,000) | (1,500,000) | 3,638,851 | 12,092,723 |
| 1981 | 11,921,267 | 0 | 10,326,538 | (14,650,000) | (1,500,000) | 4,597,474 | 10,695,279 |
| 1982 | 17,479,059 | 0 | 16,154,872 | (14,650,000) | (1,500,000) | 4,594,682 | 22,078,613 |
| 1983 | 12,763,378 | 0 | 22,251,331 | (34,705,000) | (8,735,000) | 3,751,993 | (4,673,298) |
| 1984 | 9,367,268 | 0 | 22,700,224 | (14,650,000) | (10,348,000) | 2,979,126 | 10,048,618 |
| 1985 | 12,538,173 | 0 | 23,462,283 | (14,650,000) | (8,198,000) | 2,069,024 | 15,221,480 |
| 1986 | 21,586,488 | 0 | 26,479,379 | (14,650,000) | (9,107,000) | 1,602,419 | 25,911,286 |
| 1987 | 32,734,633 | 0 | 23,479,839 | (14,650,000) | (9,451,000) | 1,762,179 | 33,875,651 |
| 1988 | 33,028,679 | 0 | 25,832,491 | (14,650,000) | (8,677,000) | 1,808,899 | 37,343,069 |
| 1989 | 11,075,132 | 0 | 28,442,946 | (14,650,000) | (8,102,000) | 2,678,007 | 19,444,085 |
| 1990 | 28,764,328 | 0 | 37,430,776 | (14,650,000) | (8,498,000) | 1,436,712 | 44,483,816 |
| 1991 | 37,462,303 | 0 | 76,586,450 | (14,650,000) | (9,487,000) | 1,727,664 | 91,639,417 |
| 1992 | 29,169,134 | 0 | 32,280,229 | (14,650,000) | (8,526,000) | 1,707,822 | 39,981,185 |
| 1993 | 22,366,873 | 0 | 36,884,103 | (14,650,000) | (8,768,000) | 1,708,490 | 37,541,465 |
| 1994 | 14,709,626 | 0 | 41,193,693 | (14,650,000) | (7,484,000) | 2,134,392 | 35,903,711 |
| 1995 | 15,120,856 | 0 | 46,162,374 | (14,650,000) | (4,976,939) | 2,042,481 | 43,698,773 |
| 1996 | 11,001,852 | 0 | 50,885,567 | (14,650,000) | (5,503,289) | 2,448,692 | 44,182,822 |
| 1997 | 15,278,251 | 0 | 51,788,497 | (14,650,000) | (5,740,515) | 1,699,730 | 48,375,963 |
| 1998 | 3,864,189 | 0 | 54,726,293 | (14,650,000) | (8,155,000) | 1,193,198 | 36,978,680 |
| 1999 | 7,773,761 | 0 | 56,065,583 | (14,650,000) | (9,198,000) | 9,686 | 40,001,030 |
| 2000 | 10,847,131 | 0 | 56,064,265 | (14,688,338) | (10,297,482) | 13,491 | 41,939,067 |
| 2001 | 10,948,086 | 0 | 75,987,138 | (16,223,803) | (14,328,482) | 23,866 | 56,406,805 |
| 2002 | 20,389,719 | 0 | 67,977,990 | (19,498,891) | (20,826,560) | 24,426 | 48,066,683 |
| 2003 | 23,658,616 | 0 | 77,725,364 | (20,605,664) | (29,982,088) | 9,833 | 50,806,061 |
| 2004 | 21,653,508 | 0 | 91,157,572 | (17,530,688) | (35,845,422) | 7,548 | 59,442,518 |
| 2005 | 6,610,322 | 0 | 104,208,826 | (15,354,462) | (22,004,805) | 0 | 73,459,881 |
| 2006 | 11,469,917 | 0 | 102,783,234 | (15,210,585) | (21,005,765) | 0 | 78,036,801 |
| 2007 | 8,510,649 | 0 | 87,611,433 | (14,734,855) | (17,033,961) | 0 | 64,353,266 |
| 2008 | 7,244,557 | 0 | 105,494,597 | (14,968,129) | (19,570,602) | 0 | 78,200,423 |
| 2009 | 7,627,891 | 0 | 114,930,514 | (15,959,419) | (20,921,647) | 0 | 85,677,339 |
| 2010 | 8,249,943 | 0 | 120,615,283 | (15,958,194) | (20,222,025) | 0 | 92,685,006 |
| 2011 | 13,237,900 | 0 | 127,458,663 | (15,958,715) | (19,207,013) | 0 | 105,530,835 |
| 2012 | 28,034,954 | 0 | 127,406,898 | (16,032,565) | (22,105,563) | 0 | 117,303,723 |
| 2013 | 101,193,467 | 0 | 138,602,948 | (16,034,532) | (20,414,514) | 0 | 203,347,368 |
| 2014 | 83,349,581 | 0 | 144,423,857 | (15,852,875) | (18,597,043) | 0 | 193,323,520 |
| 2015 | 46,909,960 | 0 | 150,760,902 | (20,661,827) | (17,587,782) | 0 | 159,421,254 |
| 2016 | 160,315,285 | 0 | 202,484,836 | (21,519,913) | (20,121,015) | 0 | 321,159,193 |
| **2017** | **177,833,499** | **0** | **187,535,249** | **(28,737,811)** | **(16,550,456)** | **0** | **320,080,481** |
| 2018 | 210,234,997 | 0 | 209,698,316 | (34,576,196) | (17,126,441) | 0 | 368,230,676 |
| 2019 | 71,350,118 | 0 | 202,426,320 | (40,187,479) | (18,111,964) | 0 | 215,476,995 |
| 2020 | 410,311 | 0 | 183,379,919 | (41,724,651) | (18,293,083) | 0 | 123,772,496 |
| 2021 | 410,311 | 0 | 190,009,280 | (41,608,625) | (18,476,014) | 0 | 130,334,952 |
| 2022 | 410,311 | 0 | 184,452,023 | (41,601,966) | (18,660,774) | 0 | 124,599,594 |
| 2023 | 410,311 | 0 | 188,511,116 | (41,598,416) | (18,847,382) | 0 | 128,475,629 |
| 2024 | 410,311 | 0 | 188,374,663 | (41,488,814) | (19,035,856) | 0 | 128,260,304 |
| 2025 | 410,311 | 0 | 188,623,044 | (41,714,406) | (19,226,214) | 0 | 128,092,735 |
| 2026 | 410,311 | 0 | 200,266,613 | (41,594,621) | (19,418,477) | 0 | 139,663,826 |
| 2027 | 410,311 | 0 | 196,225,917 | (41,592,930) | (19,612,661) | 0 | 135,430,637 |
| 2028 | 410,311 | 0 | 198,611,781 | (41,603,649) | (19,808,788) | 0 | 137,609,655 |
| 2029 | 410,311 | 0 | 197,392,503 | (41,484,751) | (20,006,876) | 0 | 136,311,187 |
| 2030 | 410,311 | 0 | 200,235,302 | (48,071,435) | (20,206,945) | 0 | 132,367,233 |
| 2031 | 410,311 | 0 | 204,309,821 | (48,075,845) | (20,409,014) | 0 | 136,235,273 |
| 2032 | 410,311 | 0 | 216,410,486 | (48,077,501) | (20,613,104) | 0 | 148,130,192 |
| 2033 | 410,311 | 0 | 202,454,284 | (48,072,951) | (20,819,235) | 0 | 133,972,409 |
| 2034 | 410,311 | 0 | 214,692,110 | (48,077,813) | (21,027,428) | 0 | 145,997,180 |
| 2035 | 410,311 | 0 | 219,422,844 | (48,066,466) | (21,237,702) | 0 | 150,528,987 |
| **TOTAL** | **2,016,964,636** | **(11,528,320)** | **6,446,272,022** | **(1,569,562,781)** | **(876,014,926)** | **57,085,905** | **6,063,216,536** |

[a] Reimbursed through the capital cost component of the Delta Water Charge.

[b] Negotiated settlements as to the magnitude of SWP planning costs from 1952 through 1978.

[c] Reimbursed through the minimum OMP&R component of the Delta Water Charge. Credits for Gianelli power generation are reflected in these net costs.

[d] Revenues credited through the capital cost component of the Delta Water Charge.

[e] Revenues credited through the minimum OMP&R component of the Delta Water Charge.

[f] Under amendments of Articles 22(e) and 22(g), planning and pre-operating costs of additional Project Conservation Facilities incurred through the previous year reflected in the Delta Water Charge.

# Tables B-14 through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-14 Capital Costs of Transportation Facilities Allocated to Each Contractor (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano[a] | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1952 | 0 | 0 | 0 | 83 | 114 | 410 | 608 | 122 | 224 | 346 |
| 1953 | 0 | 0 | 0 | 323 | 479 | 1,808 | 2,610 | 336 | 620 | 956 |
| 1954 | 0 | 0 | 0 | 819 | 1,306 | 5,150 | 7,275 | 421 | 777 | 1,199 |
| 1955 | 0 | 0 | 0 | 977 | 1,570 | 6,297 | 8,844 | 211 | 390 | 601 |
| 1956 | 0 | 0 | 0 | 8,844 | 14,459 | 63,816 | 87,120 | 227 | 418 | 645 |
| 1957 | 15,199 | 11,436 | 26,634 | 21,564 | 35,240 | 649,596 | 706,401 | 291 | 536 | 827 |
| 1958 | 33,420 | 16,591 | 50,011 | 67,764 | 71,717 | 733,414 | 872,896 | 720 | 1,328 | 2,048 |
| 1959 | 20,697 | 6,591 | 27,288 | 154,255 | 143,730 | 493,050 | 791,035 | 10,636 | 69,139 | 79,775 |
| 1960 | 9,097 | 8,830 | 17,927 | 296,492 | 275,610 | 1,018,661 | 1,590,763 | 15,255 | 99,794 | 115,048 |
| 1961 | 6,950 | 7,445 | 14,395 | 853,506 | 802,675 | 1,914,709 | 3,570,890 | 10,163 | 36,681 | 46,843 |
| 1962 | (194) | (926) | (1,120) | 545,123 | 615,141 | 1,686,041 | 2,846,306 | 17,281 | 39,570 | 56,851 |
| 1963 | 1,319 | 1,111 | 2,430 | 657,426 | 1,281,271 | 3,243,838 | 5,182,534 | 68,821 | 140,841 | 209,662 |
| 1964 | 38,393 | 35,466 | 73,859 | 712,650 | 1,747,783 | 7,251,800 | 9,712,233 | 138,614 | 282,003 | 420,617 |
| 1965 | 198,833 | 62,221 | 261,054 | 360,779 | 606,025 | 3,414,457 | 4,381,262 | 250,706 | 497,152 | 747,859 |
| 1966 | 461,619 | 49,917 | 511,536 | 592,714 | 592,598 | 2,245,215 | 3,430,528 | 587,951 | 1,117,486 | 1,705,437 |
| 1967 | 1,569,498 | 40,379 | 1,609,877 | 796,995 | 803,951 | 2,401,862 | 4,002,808 | 936,412 | 1,762,694 | 2,699,106 |
| 1968 | 859,613 | 61,691 | 921,304 | 736,470 | 696,075 | 1,997,924 | 3,430,469 | 351,131 | 675,220 | 1,026,351 |
| 1969 | 74,388 | 59,318 | 133,706 | 269,698 | 293,275 | 764,950 | 1,327,923 | 76,966 | 164,583 | 241,550 |
| 1970 | 43,361 | 67,877 | 111,238 | 58,676 | 61,200 | 135,569 | 255,445 | 47,891 | 109,224 | 157,115 |
| 1971 | 26,763 | 34,052 | 60,815 | 12,086 | 18,227 | 84,089 | 114,402 | 28,638 | 80,715 | 109,353 |
| 1972 | 19,643 | 18,905 | 38,548 | 12,293 | 12,763 | 63,610 | 88,666 | 19,289 | 50,230 | 69,519 |
| 1973 | 56,510 | 30,874 | 87,384 | 10,494 | 12,136 | 39,380 | 62,010 | 23,010 | 56,178 | 79,189 |
| 1974 | 165,830 | 65,832 | 231,662 | 15,722 | 24,402 | 73,119 | 113,243 | 25,037 | 61,383 | 86,420 |
| 1975 | 91,824 | 89,234 | 181,058 | 16,730 | 15,806 | 41,394 | 73,930 | 14,740 | 61,416 | 76,156 |
| 1976 | 57,765 | 83,651 | 141,416 | 34,004 | 34,663 | 109,610 | 178,277 | 33,638 | 130,440 | 164,078 |
| 1977 | 64,167 | 80,147 | 144,314 | 46,229 | 45,115 | 133,375 | 224,720 | 108,324 | 264,720 | 373,044 |
| 1978 | 69,319 | 81,717 | 151,036 | 71,234 | 66,008 | 174,898 | 312,140 | 21,415 | 103,822 | 125,237 |
| 1979 | 191,273 | 282,907 | 474,180 | 45,468 | 42,943 | 110,665 | 199,077 | 22,941 | 125,669 | 148,610 |
| 1980 | 264,433 | 386,006 | 650,439 | 134,522 | 124,352 | 304,614 | 563,488 | 103,258 | 462,895 | 566,153 |
| 1981 | 227,606 | 383,086 | 610,692 | (33,738) | (29,856) | (65,637) | (129,231) | (15,416) | (135,240) | (150,656) |
| 1982 | 549,164 | 870,611 | 1,419,775 | 7,876 | 8,321 | 27,065 | 43,262 | 4,102 | (58,882) | (54,780) |
| 1983 | 1,254,900 | 1,433,061 | 2,687,961 | 138,413 | 131,515 | 339,246 | 609,175 | 32,196 | 110,287 | 142,483 |
| 1984 | 2,547,878 | 2,750,040 | 5,297,918 | 152,992 | 140,971 | 351,921 | 645,884 | 35,448 | 107,723 | 143,171 |
| 1985 | 7,143,123 | 6,443,613 | 13,586,736 | 19,776 | 19,245 | 53,491 | 92,512 | 17,424 | 78,896 | 96,319 |
| 1986 | 10,565,937 | 16,926,630 | 27,492,567 | 32,034 | 31,581 | 88,070 | 151,684 | 44,135 | 306,452 | 350,588 |
| 1987 | 7,979,832 | 12,599,507 | 20,579,339 | 50,153 | 48,675 | 138,959 | 237,787 | 126,995 | 1,342,116 | 1,469,110 |
| 1988 | 2,312,909 | 4,343,513 | 6,656,422 | 116,181 | 112,294 | 302,461 | 530,935 | 156,473 | 1,479,545 | 1,636,018 |
| 1989 | 1,224,538 | 1,553,352 | 2,777,890 | 108,320 | 102,804 | 260,092 | 471,217 | 152,173 | 1,210,940 | 1,363,112 |
| 1990 | 443,002 | 824,055 | 1,267,057 | 224,283 | 224,188 | 625,213 | 1,073,684 | 222,208 | 1,559,457 | 1,781,665 |
| 1991 | 99,848 | 89,269 | 189,117 | 413,426 | 383,368 | 946,246 | 1,743,040 | 298,398 | 2,184,088 | 2,482,487 |
| 1992 | 57,045 | 62,083 | 119,128 | 182,231 | 169,968 | 442,055 | 794,255 | 361,210 | 3,504,755 | 3,865,965 |
| 1993 | 122,423 | 128,634 | 251,057 | 129,344 | 125,312 | 342,416 | 597,071 | 1,170,649 | 11,997,953 | 13,168,602 |
| 1994 | 71,274 | 83,270 | 154,544 | 46,042 | 58,050 | 229,649 | 333,741 | 4,260,734 | 46,401,596 | 50,662,331 |
| 1995 | 30,605 | 29,271 | 59,876 | 97,808 | 97,063 | 257,484 | 452,355 | 12,268,787 | 155,255,850 | 167,524,637 |
| 1996 | 20,275 | 19,069 | 39,344 | 49,854 | 48,056 | 127,493 | 225,403 | 11,284,548 | 145,409,410 | 156,693,959 |
| 1997 | 20,039 | 107,784 | 127,823 | 82,598 | 78,996 | 209,517 | 371,111 | 3,184,506 | 38,158,718 | 41,343,224 |
| 1998 | 17,423 | 21,572 | 38,995 | 27,302 | 24,121 | 63,057 | 114,480 | 883,110 | 10,563,359 | 11,446,469 |
| 1999 | 67,602 | 106,355 | 173,957 | 74,165 | 73,552 | 208,296 | 356,013 | 928,738 | 9,596,058 | 10,524,796 |
| 2000 | 16,252 | 37,932 | 54,185 | 27,445 | 28,844 | 80,346 | 136,635 | 488,160 | 5,529,102 | 6,017,261 |
| 2001 | 6,598 | 13,750 | 20,347 | 140,394 | 270,055 | 1,856,845 | 2,267,294 | 72,358 | 539,206 | 611,564 |
| 2002 | 19,917 | 45,940 | 65,857 | 809,721 | 1,193,494 | 5,886,086 | 7,889,301 | 69,122 | 387,295 | 456,418 |
| 2003 | 54,235 | 20,712 | 74,947 | 1,157,357 | 1,331,716 | 4,620,228 | 7,109,301 | 19,610 | 118,117 | 137,728 |
| 2004 | 153,240 | 20,534 | 173,774 | 360,395 | 346,065 | 4,106,509 | 4,812,969 | 12,286 | 52,406 | 64,692 |
| 2005 | 60,543 | 62,997 | 123,541 | 358,153 | 339,995 | 1,541,971 | 2,240,119 | (1,979) | (161,490) | (163,469) |
| 2006 | 887,892 | 20,086 | 907,978 | 349,395 | 329,656 | 801,023 | 1,480,075 | 8,438 | 65,059 | 73,497 |
| 2007 | 3,237,236 | 43,135 | 3,280,372 | 793,095 | 732,240 | 1,756,072 | 3,281,407 | 16,262 | 84,170 | 100,432 |
| 2008 | 7,903,036 | 61,877 | 7,964,914 | 1,466,734 | 1,352,530 | 3,236,019 | 6,055,283 | 28,452 | 99,415 | 127,867 |
| 2009 | 1,196,789 | 18,960 | 1,215,749 | 2,985,071 | 2,797,639 | 6,671,528 | 12,454,237 | 8,765 | 74,482 | 83,248 |
| 2010 | 396,763 | 3,323 | 400,086 | 3,858,703 | 3,511,676 | 8,785,887 | 16,156,266 | 75,721 | 140,736 | 216,456 |
| 2011 | 192,894 | 40,199 | 233,092 | 4,038,282 | 3,836,620 | 9,247,635 | 17,122,537 | 109,867 | 235,239 | 345,106 |
| 2012 | 485,208 | 426,760 | 911,967 | 2,717,470 | 2,649,415 | 6,713,706 | 12,080,591 | 76,346 | 336,174 | 412,520 |
| 2013 | 652,391 | 679,649 | 1,332,041 | 1,160,446 | 1,251,281 | 3,887,891 | 6,299,619 | 259,660 | 1,274,653 | 1,534,313 |
| 2014 | 587,364 | 658,937 | 1,246,300 | (252,836) | (174,519) | (198,598) | (625,953) | 334,011 | 1,559,222 | 1,893,233 |
| 2015 | 187,616 | 266,900 | 454,515 | 646,687 | 639,112 | 1,591,599 | 2,877,399 | 251,818 | 1,360,495 | 1,612,313 |
| 2016 | 62,069 | 119,157 | 181,226 | 180,661 | 176,185 | 431,563 | 788,409 | 684,646 | 2,503,167 | 3,187,813 |
| **2017** | **21,039** | **50,641** | **71,680** | **79,446** | **72,615** | **173,761** | **325,823** | **405,557** | **1,375,509** | **1,781,066** |
| 2018 | 120,298 | 300,985 | 421,283 | 492,341 | 461,089 | 1,132,409 | 2,085,840 | 335,399 | 1,504,273 | 1,839,672 |
| 2019 | 66,459 | 158,506 | 224,965 | 94,754 | 87,256 | 217,578 | 399,587 | 162,294 | 744,413 | 906,707 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **55,402,981** | **53,407,027** | **108,810,008** | **29,916,717** | **31,521,823** | **96,650,476** | **158,089,015** | **41,747,654** | **453,290,872** | **495,038,526** |

Note: Allocated capital costs as a result of permanent water transfers under the Monterey Amendment are not reflected in this table.

[a] Costs from Table B-10 allocated to Solano County Water Agency are reduced herein by $2,102,700 in 1986 and $1,823,500 in 1987 under provisions of Amendment 10 to its water supply contract.

## TABLE B-14 Capital Costs of Transportation Facilities Allocated to Each Contractor (in dollars)



| | SAN JOAQUIN VALLEY AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | | |
| Calendar Year | Dudley Ridge | Empire[b] | Future Contractor San Joaquin Valley | Municipal and Industrial | Municipal and Industrial[c] | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] |
| 1952 | 389 | 20 | 58 | 938 | 119 | 9,129 | 20 | 12 | 785 | 11,470 |
| 1953 | 1,076 | 53 | 161 | 2,887 | 345 | 27,383 | 55 | 33 | 2,157 | 34,150 |
| 1954 | 1,350 | 68 | 201 | 3,373 | 417 | 32,369 | 69 | 43 | 2,718 | 40,608 |
| 1955 | 677 | 34 | 101 | 1,497 | 197 | 14,721 | 35 | 23 | 1,371 | 18,656 |
| 1956 | 726 | 34 | 108 | 2,702 | 273 | 24,255 | 35 | 25 | 1,416 | 29,575 |
| 1957 | 932 | 38 | 139 | 6,048 | 494 | 49,932 | 39 | 29 | 1,707 | 59,359 |
| 1958 | 2,308 | 102 | 344 | 14,374 | 1,153 | 119,049 | 104 | 61 | 4,368 | 141,862 |
| 1959 | 7,384 | 364 | 2,517 | 26,218 | 2,597 | 253,891 | 372 | 381 | 14,757 | 308,481 |
| 1960 | 12,940 | 630 | 3,666 | 34,054 | 4,155 | 352,166 | 644 | 498 | 25,696 | 434,448 |
| 1961 | 21,848 | 1,063 | 3,954 | 51,407 | 6,500 | 538,707 | 1,087 | 598 | 43,377 | 668,542 |
| 1962 | 49,320 | 2,410 | 7,867 | 94,933 | 13,834 | 1,017,146 | 2,465 | 1,879 | 98,141 | 1,287,996 |
| 1963 | 208,757 | 10,687 | 32,172 | 364,014 | 55,715 | 3,934,636 | 10,932 | 5,990 | 425,330 | 5,048,232 |
| 1964 | 328,286 | 16,961 | 64,890 | 600,152 | 88,904 | 6,636,279 | 17,350 | 11,942 | 672,013 | 8,436,776 |
| 1965 | 538,215 | 27,481 | 117,996 | 1,098,999 | 152,930 | 11,999,892 | 28,116 | 21,802 | 1,095,126 | 15,080,557 |
| 1966 | 1,107,757 | 52,586 | 279,172 | 2,218,832 | 339,222 | 24,857,487 | 53,789 | 38,891 | 2,173,090 | 31,120,826 |
| 1967 | 852,537 | 39,537 | 445,562 | 2,012,744 | 286,990 | 23,629,026 | 40,444 | 34,775 | 1,653,429 | 28,995,045 |
| 1968 | 198,739 | 9,739 | 166,267 | 1,104,132 | 70,086 | 11,544,942 | 9,962 | 12,238 | 396,075 | 13,512,180 |
| 1969 | 94,436 | 4,793 | 35,473 | 616,516 | 27,216 | 6,416,147 | 4,903 | 7,302 | 191,574 | 7,398,361 |
| 1970 | 54,344 | 2,720 | 21,686 | 414,659 | 15,520 | 4,145,046 | 2,782 | 3,999 | 109,470 | 4,770,226 |
| 1971 | 25,462 | 1,291 | 12,094 | 190,552 | 7,114 | 1,622,274 | 1,320 | 540 | 51,618 | 1,912,264 |
| 1972 | 11,589 | 589 | 8,354 | 82,886 | 3,409 | 723,623 | 602 | 343 | 23,526 | 854,921 |
| 1973 | 6,657 | 335 | 10,201 | 39,973 | 1,980 | 458,527 | 343 | 221 | 13,448 | 531,685 |
| 1974 | 9,478 | 469 | 11,044 | 45,420 | 2,766 | 483,866 | 479 | 326 | 18,979 | 572,828 |
| 1975 | 13,329 | 677 | 5,246 | 36,467 | 3,710 | 382,743 | 692 | 425 | 27,048 | 470,338 |
| 1976 | 17,506 | 837 | 12,615 | 53,085 | 5,621 | 654,026 | 856 | 1,152 | 34,455 | 780,152 |
| 1977 | 9,672 | 436 | 47,790 | 36,478 | 3,753 | 886,672 | 446 | 494 | 18,497 | 1,004,236 |
| 1978 | 23,499 | (30,406) | 6,178 | 54,219 | 6,579 | 575,169 | 1,209 | 1,402 | 47,446 | 685,296 |
| 1979 | 25,051 | 1,295 | 5,664 | 53,866 | 6,610 | 559,746 | 1,325 | 1,862 | 51,293 | 706,711 |
| 1980 | 144,980 | (4,617) | 31,160 | 321,890 | 38,126 | 3,211,810 | 7,682 | 7,144 | 297,215 | 4,055,391 |
| 1981 | (5,427) | (15,464) | 200 | (44,773) | (1,223) | (385,275) | (296) | 1,752 | (11,324) | (461,830) |
| 1982 | 49,916 | 2,584 | 6,600 | 83,283 | 13,142 | 654,692 | 2,638 | 1,252 | 102,287 | 916,395 |
| 1983 | 52,429 | (35,295) | 12,125 | 110,465 | 13,872 | 1,073,500 | 2,769 | 1,327 | 107,337 | 1,338,529 |
| 1984 | 86,345 | 4,474 | 14,303 | 154,799 | 22,764 | 1,617,225 | 4,572 | 2,678 | 177,020 | 2,084,180 |
| 1985 | 25,435 | 1,311 | 5,649 | 47,055 | 6,766 | 484,485 | 1,341 | 1,176 | 52,013 | 625,231 |
| 1986 | 38,309 | (41,067) | 9,862 | 71,661 | 10,320 | 796,097 | 2,009 | 778 | 78,142 | 966,110 |
| 1987 | 28,769 | 1,476 | 7,004 | 55,537 | 7,969 | 616,845 | 1,509 | 1,491 | 58,679 | 779,279 |
| 1988 | 52,329 | 2,831 | 17,078 | 70,572 | 12,049 | 909,046 | 2,894 | 4,620 | 109,713 | 1,181,132 |
| 1989 | 156,099 | 8,019 | 27,551 | 352,103 | 42,943 | 3,834,481 | 8,201 | 12,134 | 318,604 | 4,760,133 |
| 1990 | 292,361 | 15,142 | 50,360 | 553,394 | 87,199 | 6,094,021 | 15,487 | 22,729 | 599,233 | 7,729,927 |
| 1991 | 349,413 | 18,103 | 60,419 | 580,572 | 91,765 | 6,447,565 | 18,515 | 23,486 | 716,292 | 8,306,130 |
| 1992 | 125,891 | 6,439 | 28,019 | 241,559 | 34,559 | 2,711,639 | 6,585 | 10,883 | 256,370 | 3,421,943 |
| 1993 | 86,113 | 4,375 | 30,245 | 174,630 | 23,840 | 2,059,168 | 4,474 | 4,698 | 174,772 | 2,562,314 |
| 1994 | 64,762 | 3,323 | 23,894 | 124,518 | 17,633 | 1,488,418 | 3,398 | 2,173 | 132,095 | 1,860,213 |
| 1995 | 82,969 | (1,000) | 72,734 | 167,698 | 24,390 | 2,472,332 | 4,355 | 2,824 | 169,318 | 2,995,621 |
| 1996 | 27,611 | (61,913) | 51,990 | 68,870 | 8,812 | 1,233,548 | 1,437 | 1,590 | 56,092 | 1,388,037 |
| 1997 | 136,503 | 7,041 | 48,721 | 241,400 | 36,417 | 2,951,687 | 7,195 | 3,706 | 279,205 | 3,711,875 |
| 1998 | 70,737 | (121,004) | 23,083 | 122,934 | 18,622 | 1,474,568 | 3,742 | 1,278 | 144,963 | 1,738,923 |
| 1999 | 81,197 | 4,192 | 26,645 | 142,983 | 21,661 | 1,715,933 | 4,285 | 3,846 | 166,160 | 2,166,903 |
| 2000 | 21,089 | 1,073 | 9,822 | 45,704 | 6,013 | 547,927 | 1,096 | (1,081) | 42,826 | 674,466 |
| 2001 | 17,776 | 907 | 7,862 | 36,078 | 5,062 | 432,671 | 927 | 781 | 36,153 | 538,217 |
| 2002 | 93,258 | 4,801 | 18,852 | 163,537 | 25,021 | 1,835,443 | 4,909 | 1,470 | 190,549 | 2,337,839 |
| 2003 | 19,993 | 1,020 | 5,083 | 37,987 | 5,481 | 435,030 | 1,038 | 422 | 40,670 | 546,724 |
| 2004 | 18,558 | 958 | 4,113 | 34,437 | 4,911 | 374,948 | 980 | 1,518 | 37,972 | 478,394 |
| 2005 | 56,091 | 2,902 | 9,832 | 96,815 | 14,744 | 1,025,877 | 2,964 | 561 | 114,896 | 1,324,682 |
| 2006 | 10,670 | 551 | 1,947 | 30,110 | 2,812 | 197,248 | 564 | 732 | 21,841 | 266,475 |
| 2007 | 15,261 | 772 | 4,166 | 36,509 | 4,188 | 324,461 | 789 | 921 | 30,898 | 417,965 |
| 2008 | 62,504 | 3,233 | 11,391 | 104,213 | 16,434 | 1,151,588 | 3,304 | 2,079 | 128,030 | 1,482,775 |
| 2009 | 15,109 | 769 | 3,235 | 48,489 | 4,097 | 304,508 | 787 | 1,000 | 30,698 | 408,693 |
| 2010 | 27,193 | 1,410 | 36,031 | 67,633 | 7,112 | 848,012 | 1,443 | 318 | 55,776 | 1,044,927 |
| 2011 | 36,679 | 1,899 | 50,586 | 71,555 | 9,664 | 1,181,799 | 1,941 | 1,450 | 75,156 | 1,430,729 |
| 2012 | 42,554 | 2,101 | 23,353 | 90,014 | 11,882 | 1,139,946 | 2,149 | 3,019 | 85,122 | 1,400,140 |
| 2013 | 187,114 | 9,352 | 70,303 | 385,659 | 53,496 | 4,595,517 | 9,566 | 13,022 | 376,622 | 5,700,651 |
| 2014 | 197,108 | 10,063 | 95,812 | 366,806 | 53,569 | 4,666,940 | 10,296 | 15,319 | 401,027 | 5,816,940 |
| 2015 | 125,234 | 6,369 | 59,687 | 255,647 | 34,305 | 3,039,981 | 6,515 | 11,411 | 254,302 | 3,793,452 |
| 2016 | 293,506 | 14,839 | 243,283 | 581,580 | 80,635 | 8,356,946 | 15,177 | 10,396 | 594,215 | 10,190,577 |
| **2017** | **356,036** | **18,176** | **151,308** | **721,033** | **101,790** | **8,587,766** | **18,586** | **13,153** | **724,387** | **10,692,236** |
| 2018 | 252,480 | 13,103 | 100,292 | 704,291 | 69,157 | 7,237,570 | 13,402 | 11,421 | 518,040 | 8,919,758 |
| 2019 | 106,594 | 5,528 | 47,411 | 228,132 | 29,558 | 2,777,252 | 5,654 | 5,615 | 218,628 | 3,424,371 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **7,525,810** | **43,617** | **2,803,531** | **17,008,802** | **2,179,765** | **192,472,065** | **385,351** | **352,381** | **15,160,907** | **237,932,229** |

[b] Costs from Table B-10 allocated to Empire West Side Irrigation District are reduced herein by $31,588 in 1978; $12,129 in 1980; $15,173 in 1981; $38,004 in 1983; $43,033 in 1986; $5,261 in 1995; $63,318 in 1996; and $124,667 in 1998 in accordance with letters of agreement with the district.

[c] Costs related to maximum annual Table A of 15,000 acre-feet under Amendment 18 of the water supply contract with Kern County Water Agency.

## TABLE B-14 Capital Costs of Transportation Facilities Allocated to Each Contractor (in dollars)



| | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | AVEK | Castaic Lake[d] | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] | [30] |
| 1952 | 3,158 | 1,042 | 850 | 254 | 1,402 | 70 | 1,695 | 418 | 6,079 | 1,550 |
| 1953 | 10,026 | 3,327 | 2,668 | 799 | 4,401 | 222 | 5,318 | 1,328 | 19,058 | 4,852 |
| 1954 | 12,742 | 4,193 | 3,465 | 1,031 | 5,714 | 285 | 6,908 | 1,691 | 24,608 | 6,290 |
| 1955 | 5,411 | 1,881 | 1,374 | 401 | 2,267 | 115 | 2,756 | 715 | 9,229 | 2,377 |
| 1956 | 9,775 | 3,590 | 2,196 | 612 | 3,622 | 191 | 4,449 | 1,267 | 13,138 | 3,438 |
| 1957 | 26,306 | 9,255 | 6,343 | 1,816 | 10,461 | 540 | 12,767 | 3,450 | 40,646 | 10,534 |
| 1958 | 49,204 | 17,599 | 11,581 | 3,290 | 19,099 | 991 | 23,360 | 6,414 | 72,708 | 18,898 |
| 1959 | 70,247 | 29,740 | 15,869 | 4,616 | 26,171 | 1,347 | 31,759 | 9,030 | 98,596 | 25,519 |
| 1960 | 84,552 | 38,760 | 22,068 | 6,797 | 36,395 | 1,547 | 43,260 | 10,772 | 147,170 | 37,469 |
| 1961 | 126,542 | 54,262 | 34,613 | 12,530 | 57,086 | 2,245 | 63,709 | 16,437 | 236,164 | 57,707 |
| 1962 | 198,558 | 85,352 | 43,719 | 13,861 | 72,102 | 3,344 | 84,709 | 24,943 | 253,435 | 64,330 |
| 1963 | 580,138 | 255,252 | 116,797 | 33,149 | 192,624 | 9,828 | 234,926 | 73,256 | 610,277 | 160,624 |
| 1964 | 1,094,365 | 501,858 | 209,462 | 55,445 | 345,446 | 18,442 | 429,605 | 137,769 | 1,026,066 | 276,118 |
| 1965 | 1,908,076 | 947,523 | 385,533 | 103,757 | 635,825 | 32,819 | 786,986 | 244,587 | 1,913,090 | 512,862 |
| 1966 | 3,960,302 | 2,150,972 | 812,655 | 215,858 | 1,340,235 | 69,325 | 1,664,584 | 517,269 | 3,943,586 | 1,062,417 |
| 1967 | 4,976,538 | 4,100,531 | 1,077,422 | 296,069 | 1,776,892 | 88,301 | 2,182,240 | 653,250 | 5,821,681 | 1,550,239 |
| 1968 | 5,924,474 | 3,998,942 | 1,350,742 | 368,156 | 2,227,646 | 107,350 | 2,738,009 | 783,940 | 7,982,824 | 2,122,940 |
| 1969 | 5,822,708 | 3,079,426 | 1,690,259 | 539,851 | 2,787,631 | 121,303 | 3,256,507 | 865,455 | 10,898,185 | 2,769,647 |
| 1970 | 5,032,959 | 3,277,778 | 2,050,788 | 695,345 | 3,382,251 | 106,381 | 3,872,367 | 736,775 | 13,795,809 | 3,457,109 |
| 1971 | 2,577,507 | 2,146,954 | 1,071,523 | 338,581 | 1,767,179 | 48,337 | 2,087,223 | 347,057 | 8,137,053 | 1,987,120 |
| 1972 | 973,436 | 283,257 | 331,759 | 92,079 | 547,138 | 19,134 | 668,550 | 134,360 | 2,691,137 | 697,957 |
| 1973 | 354,407 | 914,303 | 158,579 | 82,223 | 261,557 | 6,304 | 238,094 | 46,102 | 1,760,570 | 403,582 |
| 1974 | 451,450 | 280,861 | 259,175 | 74,113 | 427,433 | 8,143 | 518,453 | 59,145 | 1,617,394 | 425,927 |
| 1975 | 253,438 | 246,492 | 193,632 | 52,821 | 319,337 | 4,954 | 392,110 | 33,995 | 1,533,664 | 407,913 |
| 1976 | 237,539 | 255,238 | 136,751 | 37,235 | 225,529 | 4,245 | 277,807 | 31,002 | 962,280 | 255,901 |
| 1977 | 199,554 | 371,469 | 91,384 | 25,858 | 150,711 | 3,757 | 183,609 | 26,834 | 591,445 | 155,537 |
| 1978 | 302,111 | 470,176 | 78,573 | 22,226 | 129,584 | 5,233 | 157,815 | 38,654 | 428,989 | 111,769 |
| 1979 | 357,678 | 938,985 | 81,807 | 21,795 | 134,915 | 5,965 | 166,931 | 44,410 | 403,569 | 108,408 |
| 1980 | 1,867,517 | 1,777,294 | 423,755 | 113,166 | 698,855 | 32,435 | 864,104 | 240,899 | 2,040,757 | 548,085 |
| 1981 | (158,728) | 610,795 | (47,102) | (8,865) | (77,678) | (2,576) | (102,568) | (19,588) | (143,875) | (43,557) |
| 1982 | 1,557,934 | 861,928 | 298,770 | 78,903 | 492,728 | 26,237 | 613,587 | 196,672 | 1,421,407 | 388,261 |
| 1983 | 2,062,512 | 521,349 | 396,033 | 115,678 | 653,134 | 34,699 | 803,945 | 259,939 | 2,126,313 | 581,672 |
| 1984 | 1,518,361 | 295,783 | 297,559 | 85,097 | 490,731 | 27,272 | 606,124 | 188,562 | 1,546,628 | 423,408 |
| 1985 | 896,226 | 158,810 | 217,115 | 62,532 | 358,064 | 13,104 | 441,299 | 107,533 | 1,116,949 | 305,291 |
| 1986 | 841,555 | 104,860 | 221,194 | 58,152 | 364,790 | 9,038 | 454,702 | 93,309 | 1,048,625 | 286,302 |
| 1987 | 333,052 | 105,625 | 166,099 | 43,992 | 273,928 | 5,566 | 340,485 | 40,716 | 783,725 | 213,202 |
| 1988 | 259,234 | 174,155 | 65,831 | 22,723 | 108,570 | 3,384 | 128,339 | 26,743 | 429,498 | 113,644 |
| 1989 | 1,045,999 | 434,394 | 323,138 | 97,036 | 532,920 | 16,777 | 649,616 | 125,344 | 1,375,722 | 372,048 |
| 1990 | 678,053 | 374,313 | 332,566 | 97,789 | 548,468 | 7,335 | 672,344 | 67,179 | 1,509,745 | 409,710 |
| 1991 | 831,687 | 401,961 | 367,196 | 120,925 | 605,579 | 11,966 | 733,443 | 92,625 | 1,979,364 | 540,210 |
| 1992 | 633,272 | 356,952 | 270,826 | 131,328 | 446,647 | 9,556 | 501,634 | 76,760 | 2,093,387 | 573,386 |
| 1993 | 634,283 | 332,089 | 222,347 | 171,095 | 366,700 | 10,194 | 353,470 | 73,955 | 3,848,084 | 1,046,752 |
| 1994 | 467,409 | 165,607 | 132,599 | 93,839 | 218,685 | 7,255 | 218,494 | 53,209 | 2,347,599 | 637,733 |
| 1995 | 459,990 | 293,308 | 132,690 | 78,390 | 218,835 | 7,436 | 232,377 | 54,544 | 1,960,100 | 530,656 |
| 1996 | 299,764 | 206,742 | 110,520 | 44,965 | 182,270 | 4,885 | 211,872 | 35,808 | 4,024,655 | 972,829 |
| 1997 | 438,898 | 249,699 | 103,382 | 24,640 | 170,497 | 7,397 | 214,534 | 54,452 | 2,892,626 | 397,103 |
| 1998 | 234,379 | 202,650 | 62,492 | 41,136 | 103,063 | 3,989 | 106,009 | 29,551 | 3,683,353 | 303,255 |
| 1999 | 268,224 | 175,939 | 89,312 | 40,069 | 147,294 | 4,812 | 167,592 | 35,399 | 5,733,587 | 235,054 |
| 2000 | 139,035 | 77,889 | 54,795 | 23,903 | 90,369 | 2,665 | 103,194 | 19,150 | 14,346,200 | 171,107 |
| 2001 | 130,754 | 44,790 | 50,816 | 15,641 | 83,805 | 2,989 | 102,254 | 20,949 | 20,292,396 | 96,254 |
| 2002 | 199,807 | 121,849 | 40,293 | 12,884 | 66,452 | 3,001 | 80,478 | 22,664 | 9,868,237 | 133,675 |
| 2003 | 76,592 | 42,072 | 24,945 | 7,688 | 41,140 | 1,245 | 50,028 | 9,409 | 4,043,119 | 54,302 |
| 2004 | 81,688 | 46,992 | 23,476 | 6,416 | 38,716 | 1,445 | 48,028 | 10,585 | 2,163,304 | 42,507 |
| 2005 | 232,323 | 126,137 | 47,108 | 14,116 | 77,691 | 4,011 | 93,862 | 29,628 | 1,028,935 | 71,539 |
| 2006 | 334,422 | 246,722 | 68,325 | 25,180 | 112,684 | 5,626 | 126,956 | 42,114 | 2,038,034 | 113,701 |
| 2007 | 258,891 | 182,329 | 57,769 | 22,068 | 95,272 | 4,567 | 111,771 | 33,367 | 2,135,050 | 108,623 |
| 2008 | 159,067 | 175,464 | 70,874 | 60,890 | 116,900 | 2,792 | 83,144 | 20,471 | 3,370,729 | 263,890 |
| 2009 | 578,474 | 339,864 | 153,763 | 60,390 | 253,597 | 9,843 | 275,836 | 73,253 | 4,780,827 | 271,769 |
| 2010 | 644,944 | 340,818 | 193,760 | 62,827 | 319,555 | 10,812 | 371,109 | 81,075 | 5,464,239 | 285,839 |
| 2011 | 341,198 | 219,298 | 230,791 | 59,404 | 380,618 | 5,744 | 474,843 | 42,979 | 7,766,883 | 287,950 |
| 2012 | 257,613 | 144,365 | 343,375 | 87,824 | 566,289 | 5,062 | 708,509 | 35,082 | 12,009,741 | 445,112 |
| 2013 | 789,946 | 377,704 | 348,815 | 91,411 | 575,262 | 15,285 | 718,195 | 106,713 | 34,509,949 | 488,498 |
| 2014 | 875,295 | 463,394 | 248,206 | 64,409 | 409,340 | 15,980 | 512,246 | 114,774 | 30,956,904 | 409,695 |
| 2015 | 1,055,137 | 551,459 | 271,019 | 69,580 | 446,961 | 19,980 | 559,583 | 147,636 | 17,918,289 | 460,622 |
| 2016 | 1,101,272 | 914,143 | 222,597 | 68,017 | 367,107 | 18,773 | 450,948 | 139,570 | 19,706,337 | 402,587 |
| **2017** | **1,389,544** | **888,769** | **309,506** | **92,561** | **510,436** | **25,013** | **627,849** | **180,911** | **11,336,624** | **632,965** |
| 2018 | 1,617,566 | 899,351 | 381,231 | 101,882 | 628,723 | 29,364 | 782,971 | 212,246 | 5,711,566 | 715,887 |
| 2019 | 801,107 | 562,532 | 175,859 | 45,716 | 290,025 | 13,645 | 362,326 | 102,152 | 2,934,515 | 331,647 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **61,837,496** | **39,039,211** | **17,745,231** | **5,605,967** | **29,265,674** | **1,109,320** | **34,992,037** | **8,128,664** | **319,238,576** | **31,322,248** |

[d] Costs from Table B-10 allocated to Castaic Lake Water Agency are reduced herein by $14,088 in1978 in accordance with a letter of agreement with the agency.

## TABLE B-14 Capital Costs of Transportation Facilities Allocated to Each Contractor (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan[e] | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] | [40] |
| 1952 | 962 | 69,020 | 370 | 86,871 | 0 | 0 | 0 | 0 | 59 | 99,353 |
| 1953 | 3,011 | 217,634 | 1,187 | 273,833 | 0 | 0 | 0 | 0 | 264 | 311,812 |
| 1954 | 3,904 | 279,967 | 1,496 | 352,294 | 0 | 0 | 0 | 0 | 766 | 402,143 |
| 1955 | 1,474 | 111,602 | 670 | 140,272 | 0 | 0 | 0 | 0 | 969 | 169,342 |
| 1956 | 2,127 | 179,335 | 1,299 | 225,040 | 0 | 0 | 0 | 0 | 9,172 | 351,551 |
| 1957 | 6,526 | 516,050 | 3,367 | 648,059 | 0 | 0 | 0 | 0 | 23,172 | 1,464,452 |
| 1958 | 11,701 | 945,684 | 6,390 | 1,186,917 | 0 | 0 | 2 | 2 | 32,888 | 2,286,623 |
| 1959 | 15,815 | 1,364,298 | 9,894 | 1,702,901 | 0 | 0 | 14 | 14 | 57,918 | 2,967,412 |
| 1960 | 23,307 | 1,914,521 | 12,798 | 2,379,418 | 0 | 0 | 28 | 28 | 123,202 | 4,660,833 |
| 1961 | 36,153 | 3,212,125 | 18,770 | 3,928,343 | 0 | 0 | 10 | 10 | 316,220 | 8,545,244 |
| 1962 | 40,012 | 3,543,471 | 29,069 | 4,456,905 | 0 | 0 | 32 | 32 | 228,202 | 8,875,171 |
| 1963 | 99,266 | 11,185,928 | 86,807 | 13,638,873 | 0 | 0 | 51 | 51 | 528,496 | 24,610,278 |
| 1964 | 170,012 | 18,065,455 | 164,709 | 22,494,750 | 0 | 0 | 7,791 | 7,791 | 590,034 | 41,736,060 |
| 1965 | 316,082 | 33,763,577 | 307,475 | 41,858,192 | 0 | 0 | 3,139 | 3,139 | 332,680 | 62,664,743 |
| 1966 | 654,194 | 74,485,027 | 681,898 | 91,558,323 | 0 | 0 | (48) | (48) | 783,728 | 129,110,330 |
| 1967 | 958,406 | 130,599,417 | 1,279,076 | 155,360,062 | 0 | 0 | 47 | 47 | 1,479,421 | 194,146,365 |
| 1968 | 1,314,841 | 147,502,290 | 1,360,687 | 177,782,842 | 0 | 0 | 51,573 | 51,573 | 1,254,192 | 197,978,911 |
| 1969 | 1,726,891 | 140,096,646 | 1,085,026 | 174,739,535 | 0 | 0 | 234,232 | 234,232 | 398,183 | 184,473,490 |
| 1970 | 2,160,122 | 161,983,078 | 1,147,609 | 201,698,371 | 0 | 0 | 16,227 | 16,227 | 74,028 | 207,082,650 |
| 1971 | 1,237,573 | 133,903,316 | 738,822 | 156,388,246 | 0 | 0 | 27,204 | 27,204 | 12,457 | 158,624,739 |
| 1972 | 434,507 | 43,931,880 | 66,878 | 50,872,072 | 0 | 0 | 9 | 9 | 13,182 | 51,936,917 |
| 1973 | 256,711 | 39,723,010 | 290,020 | 44,495,462 | 0 | 0 | 25 | 25 | 8,099 | 45,263,853 |
| 1974 | 264,349 | 18,896,593 | 86,362 | 23,369,399 | 0 | 0 | 45 | 45 | 28,570 | 24,402,166 |
| 1975 | 253,838 | 16,732,939 | 83,975 | 20,509,109 | 0 | 0 | 21 | 21 | 8,226 | 21,318,838 |
| 1976 | 158,850 | 13,545,451 | 84,623 | 16,212,450 | 0 | 0 | 51 | 51 | 16,486 | 17,492,910 |
| 1977 | 96,517 | 11,769,352 | 110,833 | 13,776,859 | 0 | 0 | 28 | 28 | 21,181 | 15,544,382 |
| 1978 | 69,152 | 15,781,696 | 174,876 | 17,770,853 | 0 | 0 | 38 | 38 | 28,876 | 19,073,475 |
| 1979 | 66,847 | 27,627,424 | 343,361 | 30,302,093 | 0 | 0 | 23 | 23 | 26,668 | 31,857,362 |
| 1980 | 337,811 | 59,493,774 | 641,586 | 69,080,039 | 0 | 0 | 26 | 26 | 59,169 | 74,974,704 |
| 1981 | (26,356) | 15,661,179 | 224,257 | 15,865,338 | 0 | 0 | 34 | 34 | (6,746) | 15,727,602 |
| 1982 | 238,792 | 30,873,857 | 316,107 | 37,365,183 | 0 | 0 | 11 | 11 | 16,086 | 39,705,931 |
| 1983 | 357,812 | 25,056,047 | 187,121 | 33,156,253 | 0 | 0 | 19 | 19 | 72,225 | 38,006,645 |
| 1984 | 260,327 | 16,317,441 | 103,160 | 22,160,455 | 0 | 0 | 26 | 26 | 83,252 | 30,414,886 |
| 1985 | 187,699 | 10,243,779 | 56,162 | 14,164,564 | 0 | 0 | 29 | 29 | 16,338 | 28,581,730 |
| 1986 | 176,057 | 8,365,310 | 34,777 | 12,058,671 | 0 | 0 | 31 | 31 | 16,248 | 41,035,899 |
| 1987 | 131,163 | 6,955,356 | 36,142 | 9,429,050 | 0 | 0 | 32 | 32 | 29,062 | 32,523,660 |
| 1988 | 70,260 | 6,626,545 | 57,117 | 8,086,041 | 0 | 0 | 55 | 55 | 50,083 | 18,140,686 |
| 1989 | 227,772 | 18,531,680 | 153,200 | 23,885,645 | 0 | 0 | 44 | 44 | 43,324 | 33,301,366 |
| 1990 | 251,185 | 17,430,869 | 125,376 | 22,504,929 | 0 | 0 | 63 | 63 | 96,419 | 34,453,743 |
| 1991 | 331,235 | 20,792,168 | 132,558 | 26,940,915 | 0 | 0 | 54 | 54 | 149,922 | 39,811,664 |
| 1992 | 351,492 | 21,196,762 | 116,999 | 26,758,999 | 0 | 0 | 42 | 42 | 80,900 | 35,041,233 |
| 1993 | 646,980 | 29,471,748 | 105,693 | 37,283,389 | 0 | 0 | 30 | 30 | 59,324 | 53,921,787 |
| 1994 | 394,936 | 16,392,019 | 50,941 | 21,180,326 | 0 | 0 | 14 | 14 | 34,208 | 74,225,377 |
| 1995 | 331,286 | 16,078,395 | 72,214 | 20,450,221 | 0 | 0 | 3 | 3 | 42,395 | 191,525,108 |
| 1996 | 1,079,629 | 23,237,696 | 49,282 | 30,460,917 | 0 | 0 | 0 | 0 | 21,388 | 188,829,048 |
| 1997 | 1,914,804 | 13,530,777 | 72,335 | 20,071,144 | 0 | 0 | 3 | 3 | 34,976 | 65,660,155 |
| 1998 | 3,219,136 | 11,284,364 | 65,745 | 19,339,120 | 0 | 0 | 7 | 7 | 11,234 | 32,689,229 |
| 1999 | 5,888,075 | 9,063,618 | 54,504 | 21,903,479 | 0 | 0 | 2 | 2 | 34,616 | 35,159,766 |
| 2000 | 16,301,847 | 5,393,221 | 24,010 | 36,747,384 | 0 | 0 | 24 | 24 | 16,912 | 43,646,866 |
| 2001 | 23,613,431 | 2,988,800 | 13,047 | 47,455,926 | 0 | 0 | 20 | 20 | 68,013 | 50,961,381 |
| 2002 | 11,150,014 | 5,787,234 | 39,607 | 27,526,196 | 0 | 0 | 14 | 14 | 382,151 | 38,657,775 |
| 2003 | 4,505,927 | 5,783,732 | 13,689 | 14,653,890 | 0 | 0 | 0 | 0 | 590,294 | 23,112,883 |
| 2004 | 2,291,776 | 4,555,521 | 15,942 | 9,326,396 | 0 | 0 | 0 | 0 | 156,414 | 15,012,639 |
| 2005 | 816,407 | 7,322,277 | 42,941 | 9,906,976 | 0 | 0 | 0 | 0 | 123,949 | 13,555,798 |
| 2006 | 1,805,626 | 13,867,322 | 90,203 | 18,876,917 | 0 | 0 | 5 | 5 | 120,330 | 21,725,278 |
| 2007 | 2,116,022 | 11,723,751 | 65,425 | 16,914,905 | 0 | 0 | 0 | 0 | 266,740 | 24,261,822 |
| 2008 | 2,807,622 | 11,885,796 | 60,480 | 19,078,119 | 0 | 0 | 4 | 4 | 493,279 | 35,202,241 |
| 2009 | 4,253,381 | 22,122,930 | 122,402 | 33,296,331 | 0 | 0 | 13 | 13 | 1,018,936 | 48,477,206 |
| 2010 | 5,295,528 | 18,062,434 | 107,473 | 31,240,413 | 0 | 0 | 0 | 0 | 6,354,657 | 55,412,806 |
| 2011 | 8,034,523 | 12,729,103 | 55,589 | 30,628,923 | 0 | 0 | 1 | 1 | 2,566,271 | 52,326,660 |
| 2012 | 12,375,165 | 17,420,517 | 42,735 | 44,441,389 | 0 | 0 | 0 | 0 | 1,004,833 | 60,251,441 |
| 2013 | 38,758,009 | 28,351,615 | 110,781 | 105,242,183 | 0 | 0 | 0 | 0 | 546,046 | 120,654,854 |
| 2014 | 35,045,545 | 21,851,724 | 126,201 | 91,093,714 | 0 | 0 | 0 | 0 | (16,925) | 99,407,310 |
| 2015 | 19,455,197 | 43,016,163 | 170,596 | 84,142,221 | 0 | 0 | 0 | 0 | 277,912 | 93,157,813 |
| 2016 | 10,342,761 | 55,738,581 | 214,717 | 89,687,410 | 0 | 0 | 0 | 0 | 81,484 | 104,116,919 |
| **2017** | **5,405,291** | **52,601,147** | **258,270** | **74,258,886** | **0** | **0** | **0** | **0** | **36,341** | **87,166,031** |
| 2018 | 2,178,612 | 51,649,959 | 280,428 | 65,189,785 | 0 | 0 | 0 | 0 | 323,822 | 78,780,160 |
| 2019 | 1,151,501 | 32,720,720 | 179,164 | 39,670,908 | 0 | 0 | 0 | 0 | 111,029 | 44,737,568 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **234,457,429** | **1,854,122,716** | **12,867,325** | **2,649,731,894** | **0** | **0** | **341,149** | **341,149** | **21,864,249** | **3,671,807,072** |

[e] Costs from Table B-10 allocated to The Metropolitan Water District of Southern California are reduced herein by $16,425,374 in 1972 under provisions of Amendment 7 to its water supply contract.

## TABLE B-15 Capital Cost Component of Transportation Charge for Each Contractor (in dollars)[a,b,c]



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 153,778 | 105,673 | 364,827 | 624,278 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 216,203 | 170,929 | 530,036 | 917,168 | 6,696 | 21,667 | 28,363 |
| 1965 | 0 | 0 | 0 | 284,369 | 259,943 | 899,371 | 1,443,684 | 13,756 | 36,029 | 49,785 |
| 1966 | 18,063 | 0 | 18,063 | 320,384 | 290,808 | 1,073,270 | 1,684,462 | 26,524 | 61,349 | 87,873 |
| 1967 | 41,574 | 0 | 41,574 | 391,262 | 320,989 | 1,187,619 | 1,899,870 | 56,469 | 118,263 | 174,731 |
| 1968 | 121,509 | 0 | 121,509 | 507,987 | 361,935 | 1,309,946 | 2,179,868 | 104,160 | 208,037 | 312,197 |
| 1969 | 165,289 | 0 | 165,289 | 610,320 | 397,386 | 1,411,701 | 2,419,407 | 122,043 | 242,426 | 364,469 |
| 1970 | 169,077 | 0 | 169,077 | 644,726 | 412,322 | 1,450,660 | 2,507,708 | 125,963 | 250,808 | 376,771 |
| 1971 | 171,286 | 0 | 171,286 | 651,690 | 415,439 | 1,457,564 | 2,524,693 | 128,402 | 256,371 | 384,773 |
| 1972 | 172,649 | 0 | 172,649 | 653,292 | 416,368 | 1,461,847 | 2,531,506 | 129,861 | 260,482 | 390,343 |
| 1973 | 173,649 | 31,366 | 205,015 | 654,759 | 417,018 | 1,465,086 | 2,536,863 | 130,843 | 263,040 | 393,883 |
| 1974 | 176,527 | 32,938 | 209,466 | 655,864 | 417,636 | 1,467,092 | 2,540,591 | 132,015 | 265,901 | 397,916 |
| 1975 | 184,973 | 36,291 | 221,264 | 658,384 | 418,879 | 1,470,816 | 2,548,078 | 133,290 | 269,028 | 402,318 |
| 1976 | 189,650 | 40,836 | 230,485 | 659,811 | 419,684 | 1,472,924 | 2,552,418 | 134,041 | 272,155 | 406,196 |
| 1977 | 192,592 | 45,096 | 237,688 | 662,613 | 421,449 | 1,478,507 | 2,562,568 | 135,754 | 278,799 | 414,553 |
| 1978 | 195,860 | 49,178 | 245,038 | 666,364 | 423,747 | 1,485,299 | 2,575,410 | 141,271 | 292,281 | 433,552 |
| 1979 | 199,390 | 53,340 | 252,730 | 671,832 | 427,108 | 1,494,207 | 2,593,148 | 142,362 | 297,569 | 439,930 |
| 1980 | 209,132 | 67,748 | 276,880 | 675,794 | 429,296 | 1,499,843 | 2,604,932 | 143,530 | 303,969 | 447,499 |
| 1981 | 222,599 | 87,408 | 310,007 | 686,138 | 435,629 | 1,515,357 | 2,637,124 | 148,789 | 327,544 | 476,333 |
| 1982 | 234,191 | 106,918 | 341,110 | 684,198 | 434,108 | 1,512,014 | 2,630,321 | 148,004 | 320,657 | 468,660 |
| 1983 | 262,160 | 151,259 | 413,419 | 685,644 | 434,532 | 1,513,393 | 2,633,568 | 148,213 | 317,658 | 465,870 |
| 1984 | 326,072 | 224,245 | 550,317 | 696,867 | 441,230 | 1,530,671 | 2,668,768 | 149,853 | 323,275 | 473,127 |
| 1985 | 455,836 | 364,305 | 820,141 | 709,462 | 448,410 | 1,548,594 | 2,706,466 | 151,658 | 328,761 | 480,419 |
| 1986 | 819,636 | 692,479 | 1,512,115 | 711,533 | 449,390 | 1,551,318 | 2,712,242 | 152,545 | 332,779 | 485,324 |
| 1987 | 1,360,688 | 1,559,243 | 2,919,931 | 714,293 | 451,007 | 1,555,828 | 2,721,129 | 154,805 | 348,472 | 503,277 |
| 1988 | 1,771,651 | 2,208,121 | 3,979,772 | 718,680 | 453,514 | 1,562,985 | 2,735,179 | 161,346 | 417,591 | 578,937 |
| 1989 | 1,891,484 | 2,433,160 | 4,324,645 | 727,688 | 459,332 | 1,578,655 | 2,765,675 | 169,453 | 494,247 | 663,699 |
| 1990 | 1,955,330 | 2,514,151 | 4,469,481 | 735,864 | 464,692 | 1,592,216 | 2,792,772 | 177,387 | 557,384 | 734,771 |
| 1991 | 1,978,582 | 2,557,403 | 4,535,985 | 752,972 | 476,459 | 1,625,032 | 2,854,463 | 189,050 | 639,235 | 828,285 |
| 1992 | 1,983,860 | 2,562,121 | 4,545,981 | 783,571 | 496,722 | 1,675,047 | 2,955,340 | 204,822 | 754,678 | 959,500 |
| 1993 | 1,986,897 | 2,565,427 | 4,552,324 | 797,930 | 505,773 | 1,698,585 | 3,002,289 | 224,056 | 941,300 | 1,165,356 |
| 1994 | 1,993,467 | 2,572,330 | 4,565,797 | 808,361 | 512,498 | 1,716,961 | 3,037,820 | 286,878 | 1,585,162 | 1,872,040 |
| 1995 | 1,997,323 | 2,576,836 | 4,574,159 | 812,837 | 515,639 | 1,729,387 | 3,057,862 | 517,412 | 4,095,799 | 4,613,211 |
| 1996 | 1,998,994 | 2,578,433 | 4,577,427 | 820,741 | 520,936 | 1,743,439 | 3,085,117 | 1,187,010 | 12,569,247 | 13,756,257 |
| 1997 | 2,000,110 | 2,579,484 | 4,579,594 | 824,791 | 523,583 | 1,750,461 | 3,098,835 | 1,808,545 | 20,578,178 | 22,386,724 |
| 1998 | 2,001,225 | 2,585,478 | 4,586,703 | 831,521 | 527,976 | 1,762,113 | 3,121,611 | 1,985,644 | 22,700,288 | 24,685,933 |
| 1999 | 2,002,204 | 2,586,690 | 4,588,893 | 833,750 | 529,331 | 1,765,656 | 3,128,737 | 2,035,260 | 23,293,767 | 25,329,027 |
| 2000 | 2,006,043 | 2,592,730 | 4,598,773 | 995,060 | 533,508 | 1,777,485 | 3,306,054 | 2,088,005 | 23,838,744 | 25,926,748 |
| 2001 | 2,326,959 | 2,783,054 | 5,110,013 | 1,129,600 | 535,165 | 1,782,101 | 3,446,866 | 2,116,046 | 24,156,352 | 26,272,398 |
| 2002 | 2,327,398 | 2,783,894 | 5,111,292 | 1,144,002 | 550,866 | 1,890,059 | 3,584,927 | 2,120,253 | 24,187,702 | 26,307,955 |
| 2003 | 2,328,742 | 2,786,703 | 5,115,446 | 1,229,165 | 621,150 | 2,236,683 | 4,086,998 | 2,124,324 | 24,210,510 | 26,334,833 |
| 2004 | 2,332,426 | 2,787,997 | 5,120,423 | 1,363,189 | 700,643 | 2,512,474 | 4,576,306 | 2,125,494 | 24,217,560 | 26,343,054 |
| 2005 | 2,342,974 | 2,789,335 | 5,132,309 | 1,399,982 | 721,599 | 2,761,150 | 4,882,731 | 2,126,238 | 24,220,734 | 26,346,972 |
| 2006 | 2,347,226 | 2,793,568 | 5,140,793 | 1,435,499 | 742,505 | 2,855,962 | 5,033,966 | 2,126,116 | 24,210,804 | 26,336,921 |
| 2007 | 2,410,261 | 2,794,938 | 5,205,199 | 1,470,671 | 763,106 | 2,906,021 | 5,139,797 | 2,126,644 | 24,214,870 | 26,341,514 |
| 2008 | 2,644,076 | 2,797,935 | 5,442,011 | 1,551,173 | 809,662 | 3,017,673 | 5,378,509 | 2,127,678 | 24,220,221 | 26,347,899 |
| 2009 | 3,225,451 | 2,802,260 | 6,027,711 | 1,702,818 | 897,252 | 3,227,237 | 5,827,307 | 2,129,520 | 24,226,659 | 26,356,180 |
| 2010 | 3,315,236 | 2,803,627 | 6,118,864 | 2,019,588 | 1,082,010 | 3,667,829 | 6,769,428 | 2,130,099 | 24,231,578 | 26,361,677 |
| 2011 | 3,345,630 | 2,803,872 | 6,149,502 | 2,738,611 | 1,318,824 | 4,260,316 | 8,317,751 | 2,135,205 | 24,241,069 | 26,376,274 |
| 2012 | 3,360,757 | 2,806,902 | 6,167,659 | 3,260,311 | 1,583,400 | 4,898,039 | 9,741,750 | 2,142,782 | 24,257,291 | 26,400,073 |
| 2013 | 3,399,861 | 2,839,745 | 6,239,606 | 3,399,722 | 1,664,856 | 5,007,406 | 10,071,984 | 2,148,174 | 24,281,035 | 26,429,210 |
| 2014 | 3,453,831 | 2,893,117 | 6,346,948 | 3,474,962 | 1,690,277 | 5,123,939 | 10,289,178 | 2,160,295 | 24,351,739 | 26,512,034 |
| 2015 | 3,503,780 | 2,946,007 | 6,449,786 | 3,374,007 | 1,588,262 | 4,739,810 | 9,702,079 | 2,178,117 | 24,453,526 | 26,631,643 |
| 2016 | 3,499,646 | 2,967,809 | 6,467,456 | 3,418,675 | 1,606,440 | 4,688,045 | 9,713,161 | 2,184,672 | 24,532,606 | 26,717,277 |
| **2017** | **3,478,545** | **2,977,737** | **6,456,281** | **3,368,386** | **1,590,219** | **4,607,890** | **9,566,495** | **2,208,974** | **24,674,025** | **26,882,999** |
| 2018 | 3,389,707 | 2,982,082 | 6,371,789 | 3,259,558 | 1,555,230 | 4,499,815 | 9,314,603 | 2,194,548 | 24,697,077 | 26,891,625 |
| 2019 | 3,351,709 | 3,008,822 | 6,360,531 | 3,232,855 | 1,559,047 | 4,494,501 | 9,286,403 | 2,205,229 | 24,790,797 | 26,996,026 |
| 2020 | 3,354,166 | 3,024,110 | 6,378,276 | 3,216,641 | 1,551,851 | 4,474,845 | 9,243,337 | 2,215,707 | 24,848,456 | 27,064,162 |
| 2021 | 3,351,634 | 3,024,110 | 6,375,744 | 3,209,443 | 1,548,734 | 4,467,940 | 9,226,118 | 2,213,268 | 24,842,893 | 27,056,161 |
| 2022 | 3,350,074 | 3,024,110 | 6,374,184 | 3,208,067 | 1,547,806 | 4,463,657 | 9,219,531 | 2,211,809 | 24,838,782 | 27,050,591 |
| 2023 | 3,348,931 | 2,990,578 | 6,339,508 | 3,206,658 | 1,547,156 | 4,460,418 | 9,214,232 | 2,210,827 | 24,836,224 | 27,047,051 |
| 2024 | 3,345,650 | 2,988,944 | 6,334,594 | 3,205,596 | 1,546,538 | 4,458,412 | 9,210,546 | 2,209,655 | 24,833,363 | 27,043,018 |
| 2025 | 3,336,035 | 2,985,367 | 6,321,402 | 3,203,260 | 1,545,295 | 4,454,688 | 9,203,243 | 2,208,380 | 24,830,237 | 27,038,616 |
| 2026 | 3,330,691 | 2,980,613 | 6,311,304 | 3,201,786 | 1,544,490 | 4,452,580 | 9,198,856 | 2,207,629 | 24,827,109 | 27,034,738 |
| 2027 | 3,327,320 | 2,976,178 | 6,303,498 | 3,198,799 | 1,542,725 | 4,446,998 | 9,188,521 | 2,205,916 | 24,820,465 | 27,026,381 |
| 2028 | 3,323,580 | 2,971,919 | 6,295,499 | 3,194,790 | 1,540,427 | 4,440,205 | 9,175,421 | 2,200,399 | 24,806,983 | 27,007,382 |
| 2029 | 3,319,543 | 2,967,551 | 6,287,094 | 3,188,792 | 1,537,065 | 4,431,297 | 9,157,155 | 2,199,308 | 24,801,695 | 27,001,004 |
| 2030 | 3,308,386 | 2,952,089 | 6,260,475 | 3,184,596 | 1,534,878 | 4,425,661 | 9,145,135 | 2,198,140 | 24,795,295 | 26,993,435 |
| 2031 | 3,292,970 | 2,931,023 | 6,223,992 | 3,173,113 | 1,528,545 | 4,410,147 | 9,111,805 | 2,192,881 | 24,771,720 | 26,964,601 |
| 2032 | 3,279,673 | 2,910,078 | 6,189,751 | 3,175,629 | 1,530,065 | 4,413,490 | 9,119,185 | 2,193,666 | 24,778,608 | 26,972,274 |
| 2033 | 3,247,613 | 2,862,627 | 6,110,240 | 3,174,388 | 1,529,642 | 4,412,111 | 9,116,141 | 2,193,457 | 24,781,606 | 26,975,063 |
| 2034 | 3,174,517 | 2,786,011 | 5,960,527 | 3,161,965 | 1,522,944 | 4,394,834 | 9,079,742 | 2,191,817 | 24,775,989 | 26,967,807 |
| 2035 | 3,026,373 | 2,639,709 | 5,666,082 | 3,148,119 | 1,515,764 | 4,376,910 | 9,040,793 | 2,190,012 | 24,770,503 | 26,960,515 |
| **TOTAL** | **140,730,943** | **137,619,435** | **278,350,378** | **120,095,749** | **62,335,315** | **195,846,955** | **378,278,019** | **89,948,990** | **977,799,023** | **1,067,748,013** |

[a] Unadjusted for prior overpayments or underpayments of charges.

[b] Determined at the current Project Interest Rate of 4.610 percent per annum.

[c] Reflects the transfers of permanent aqueduct capacity among contractors.

## TABLE B-15 Capital Cost Component of Transportation Charge for Each Contractor (in dollars) [a,b,c]



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | | |
| | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Municipal and Industrial[d] | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 2,725 | 0 | 0 | 0 | 0 | 0 | 0 | 2,725 |
| 1965 | 0 | 0 | 6,029 | 64,284 | 9,284 | 0 | 0 | 0 | 0 | 79,598 |
| 1966 | 0 | 0 | 12,039 | 120,256 | 17,073 | 0 | 0 | 0 | 0 | 149,368 |
| 1967 | 0 | 0 | 26,257 | 233,262 | 34,350 | 0 | 0 | 0 | 0 | 293,869 |
| 1968 | 80,541 | 1,907 | 48,950 | 335,771 | 48,966 | 437,900 | 9,407 | 4,950 | 67,937 | 1,036,329 |
| 1969 | 80,682 | 5,720 | 57,418 | 392,005 | 52,536 | 899,308 | 10,158 | 5,380 | 257,051 | 1,760,257 |
| 1970 | 88,426 | 5,720 | 59,224 | 423,404 | 53,922 | 1,093,828 | 10,446 | 5,595 | 190,223 | 1,930,788 |
| 1971 | 100,817 | 5,720 | 60,329 | 444,522 | 54,712 | 1,452,791 | 10,612 | 6,026 | 202,424 | 2,337,953 |
| 1972 | 112,644 | 5,720 | 60,945 | 454,227 | 55,075 | 2,175,428 | 10,694 | 11,548 | 624,464 | 3,510,744 |
| 1973 | 123,909 | 5,720 | 61,370 | 458,449 | 55,248 | 2,509,025 | 10,736 | 6,672 | 241,533 | 3,472,662 |
| 1974 | 188,060 | 5,720 | 61,890 | 460,485 | 55,349 | 2,809,736 | 10,770 | 7,470 | 400,905 | 4,000,384 |
| 1975 | 228,415 | 5,720 | 62,452 | 462,798 | 55,490 | 3,365,290 | 10,812 | 7,696 | 478,375 | 4,677,048 |
| 1976 | 174,154 | 5,720 | 62,720 | 464,655 | 55,679 | 3,627,755 | 10,853 | 8,692 | 342,219 | 4,752,446 |
| 1977 | 171,219 | 5,720 | 63,362 | 467,359 | 55,965 | 3,974,977 | 10,914 | 7,963 | 327,206 | 5,084,685 |
| 1978 | 183,047 | 0 | 65,796 | 469,216 | 56,156 | 4,418,522 | 11,019 | 8,393 | 351,053 | 5,563,203 |
| 1979 | 217,088 | 5,720 | 66,111 | 471,978 | 56,491 | 4,851,732 | 11,086 | 8,608 | 395,093 | 6,083,907 |
| 1980 | 230,921 | 5,720 | 66,399 | 474,721 | 56,828 | 5,294,333 | 11,157 | 12,267 | 397,638 | 6,549,984 |
| 1981 | 230,921 | 5,720 | 67,986 | 491,115 | 58,770 | 5,794,252 | 11,565 | 9,254 | 421,486 | 7,091,069 |
| 1982 | 230,921 | 5,720 | 67,996 | 488,835 | 58,707 | 6,255,660 | 11,552 | 9,685 | 444,778 | 7,573,855 |
| 1983 | 241,622 | 5,720 | 68,332 | 493,076 | 59,377 | 6,780,957 | 11,685 | 8,113 | 52,952 | 7,721,835 |
| 1984 | 254,013 | 5,720 | 68,950 | 498,702 | 60,083 | 7,117,422 | 11,834 | 10,330 | 347,232 | 8,374,286 |
| 1985 | 265,841 | 5,720 | 69,678 | 506,586 | 61,243 | 7,578,817 | 12,069 | 10,545 | 252,609 | 8,763,109 |
| 1986 | 277,668 | 5,720 | 69,966 | 508,983 | 61,587 | 7,701,383 | 12,141 | 10,976 | 539,058 | 9,187,482 |
| 1987 | 289,496 | 5,720 | 70,471 | 512,652 | 62,116 | 8,502,556 | 12,251 | 11,191 | 562,351 | 10,028,804 |
| 1988 | 301,324 | 5,720 | 70,832 | 515,513 | 62,526 | 8,937,644 | 12,334 | 11,621 | 585,643 | 10,503,156 |
| 1989 | 313,151 | 5,720 | 71,717 | 519,169 | 63,150 | 9,251,501 | 12,501 | 12,052 | 609,490 | 10,858,451 |
| 1990 | 162,490 | 5,720 | 73,153 | 537,527 | 65,389 | 9,577,588 | 12,936 | 12,267 | 657,185 | 11,104,256 |
| 1991 | 300,822 | 5,720 | 75,796 | 566,573 | 69,966 | 9,577,588 | 13,762 | 12,267 | 657,185 | 11,279,680 |
| 1992 | 324,979 | 5,720 | 78,990 | 597,260 | 74,817 | 9,577,588 | 14,756 | 12,267 | 657,185 | 11,343,562 |
| 1993 | 324,979 | 5,720 | 80,482 | 610,123 | 76,657 | 9,577,588 | 15,124 | 12,267 | 657,185 | 11,360,125 |
| 1994 | 324,979 | 5,720 | 82,105 | 619,494 | 77,936 | 9,577,588 | 15,397 | 12,267 | 657,185 | 11,372,671 |
| 1995 | 324,979 | 5,720 | 83,398 | 626,231 | 78,890 | 9,577,588 | 15,608 | 12,267 | 657,185 | 11,381,866 |
| 1996 | 300,592 | 5,720 | 87,367 | 635,384 | 80,221 | 9,248,813 | 15,961 | 12,267 | 657,185 | 11,043,511 |
| 1997 | 300,592 | 5,720 | 90,231 | 639,177 | 80,707 | 9,181,391 | 16,133 | 12,267 | 657,185 | 10,983,402 |
| 1998 | 300,591 | 5,720 | 92,940 | 652,602 | 82,732 | 8,928,998 | 16,588 | 12,267 | 657,185 | 10,749,624 |
| 1999 | 300,591 | 5,720 | 94,237 | 659,509 | 83,778 | 8,928,998 | 16,823 | 12,267 | 657,185 | 10,759,109 |
| 2000 | 300,591 | 5,720 | 95,750 | 667,629 | 85,008 | 8,282,917 | 17,096 | 12,267 | 657,185 | 10,124,164 |
| 2001 | 300,591 | 5,720 | 96,315 | 670,255 | 85,354 | 8,147,788 | 17,172 | 12,267 | 657,185 | 9,992,646 |
| 2002 | 323,398 | 5,720 | 96,772 | 672,352 | 85,648 | 8,147,788 | 17,237 | 12,267 | 617,226 | 9,978,407 |
| 2003 | 323,398 | 5,720 | 97,882 | 681,983 | 87,121 | 8,147,788 | 17,536 | 12,267 | 614,946 | 9,988,641 |
| 2004 | 323,398 | 5,720 | 98,185 | 684,250 | 87,449 | 8,135,401 | 46,093 | 12,267 | 530,040 | 9,922,803 |
| 2005 | 323,398 | 5,720 | 98,434 | 686,336 | 87,746 | 8,135,401 | 46,156 | 12,267 | 530,040 | 9,925,497 |
| 2006 | 323,398 | 5,720 | 99,039 | 692,288 | 88,653 | 8,135,401 | 48,078 | 12,267 | 528,303 | 9,933,147 |
| 2007 | 323,398 | 5,720 | 99,161 | 694,170 | 88,828 | 8,135,401 | 48,114 | 12,267 | 528,303 | 9,935,362 |
| 2008 | 323,398 | 5,720 | 99,425 | 696,491 | 89,095 | 8,135,401 | 48,169 | 12,267 | 528,303 | 9,938,269 |
| 2009 | 323,398 | 5,720 | 100,163 | 703,240 | 90,159 | 8,135,401 | 48,387 | 12,267 | 528,303 | 9,947,038 |
| 2010 | 283,973 | 5,720 | 100,377 | 706,442 | 90,429 | 7,958,283 | 48,442 | 12,267 | 488,415 | 9,694,348 |
| 2011 | 283,973 | 5,720 | 102,807 | 711,003 | 90,909 | 7,958,283 | 48,614 | 12,267 | 488,415 | 9,701,991 |
| 2012 | 283,973 | 5,720 | 106,295 | 715,938 | 91,575 | 7,958,283 | 48,857 | 12,267 | 488,415 | 9,711,323 |
| 2013 | 283,973 | 5,720 | 107,944 | 722,296 | 92,415 | 7,958,283 | 49,051 | 12,267 | 488,415 | 9,720,364 |
| 2014 | 272,748 | 5,720 | 110,315 | 750,243 | 96,291 | 7,958,283 | 49,852 | 12,267 | 480,147 | 9,735,866 |
| 2015 | 255,852 | 5,720 | 114,147 | 713,283 | 90,997 | 7,958,283 | 50,793 | 12,267 | 480,147 | 9,681,489 |
| 2016 | 255,852 | 5,720 | 112,718 | 676,928 | 85,841 | 7,958,283 | 51,403 | 12,267 | 480,147 | 9,639,159 |
| **2017** | **280,240** | **5,720** | **117,775** | **610,003** | **74,953** | **8,344,206** | **53,159** | **12,267** | **480,147** | **9,978,471** |
| 2018 | 280,240 | 5,720 | 107,494 | 566,636 | 68,686 | 8,344,206 | 45,559 | 12,267 | 480,147 | 9,910,956 |
| 2019 | 280,240 | 5,720 | 107,567 | 570,383 | 71,006 | 8,344,206 | 46,137 | 12,267 | 480,147 | 9,917,673 |
| 2020 | 257,710 | 5,720 | 109,966 | 559,222 | 72,243 | 8,344,206 | 46,449 | 12,267 | 480,147 | 9,887,930 |
| 2021 | 257,710 | 5,720 | 108,862 | 538,104 | 71,452 | 8,344,206 | 46,283 | 12,267 | 480,147 | 9,864,751 |
| 2022 | 257,710 | 5,720 | 108,246 | 528,399 | 71,090 | 8,344,206 | 46,201 | 12,267 | 480,147 | 9,853,986 |
| 2023 | 257,710 | 5,720 | 107,821 | 524,178 | 70,916 | 8,344,206 | 46,158 | 12,267 | 480,147 | 9,849,123 |
| 2024 | 257,710 | 5,720 | 107,301 | 522,142 | 70,815 | 8,344,206 | 46,124 | 12,267 | 480,147 | 9,846,432 |
| 2025 | 257,710 | 5,720 | 106,739 | 519,828 | 70,675 | 8,344,206 | 46,083 | 12,267 | 480,147 | 9,843,374 |
| 2026 | 257,710 | 5,720 | 106,471 | 517,971 | 70,486 | 8,344,206 | 46,042 | 12,267 | 480,147 | 9,841,020 |
| 2027 | 257,710 | 5,720 | 105,829 | 515,268 | 70,199 | 8,344,206 | 45,980 | 12,267 | 480,147 | 9,837,326 |
| 2028 | 257,710 | 5,720 | 103,395 | 513,410 | 70,008 | 8,344,206 | 45,875 | 12,267 | 480,147 | 9,832,738 |
| 2029 | 257,710 | 5,720 | 103,080 | 510,648 | 69,673 | 8,344,206 | 45,809 | 12,267 | 480,147 | 9,829,260 |
| 2030 | 257,710 | 5,720 | 102,792 | 507,905 | 69,336 | 8,344,206 | 45,738 | 12,267 | 480,147 | 9,825,821 |
| 2031 | 257,710 | 5,720 | 101,205 | 491,511 | 67,395 | 8,344,206 | 45,329 | 12,267 | 480,147 | 9,805,490 |
| 2032 | 257,710 | 5,720 | 101,195 | 493,791 | 67,457 | 8,344,206 | 45,342 | 12,267 | 480,147 | 9,807,835 |
| 2033 | 257,710 | 5,720 | 100,858 | 489,550 | 66,788 | 8,344,206 | 45,210 | 12,267 | 480,147 | 9,802,455 |
| 2034 | 257,710 | 5,720 | 100,241 | 483,924 | 66,081 | 8,344,206 | 45,061 | 12,267 | 480,147 | 9,795,357 |
| 2035 | 257,710 | 5,720 | 99,513 | 476,040 | 64,922 | 8,344,206 | 44,825 | 12,267 | 480,147 | 9,785,349 |
| **TOTAL** | **17,423,264** | **379,427** | **6,050,720** | **38,659,946** | **4,929,478** | **494,371,127** | **1,978,096** | **759,309** | **32,900,298** | **597,451,665** |

[a] Unadjusted for prior overpayments or underpayments of charges.

[b] Determined at the current Project Interest Rate of 4.610 percent per annum.

[c] Reflects the transfers of permanent aqueduct capacity among contractors.

[d] Charges under Amendment No. 18 of the water supply contract with Kern County Water Agency.

## TABLE B-15 Capital Cost Component of Transportation Charge for Each Contractor (in dollars) [a,b,c]



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] | [30] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 34,411 | 0 | 0 | 0 | 726 | 0 | 0 | 0 | 51,729 | 0 |
| 1964 | 64,494 | 27,447 | 19,542 | 4,370 | 38,211 | 1,143 | 30,324 | 8,205 | 82,811 | 34,987 |
| 1965 | 121,484 | 53,007 | 34,348 | 7,194 | 42,701 | 2,082 | 53,730 | 15,222 | 135,069 | 35,344 |
| 1966 | 221,012 | 101,264 | 62,476 | 12,478 | 76,886 | 3,753 | 96,944 | 27,679 | 232,502 | 61,465 |
| 1967 | 427,622 | 210,814 | 121,269 | 23,472 | 148,839 | 7,284 | 188,141 | 54,023 | 433,350 | 115,574 |
| 1968 | 689,327 | 420,406 | 206,952 | 38,551 | 245,877 | 11,781 | 311,846 | 87,293 | 729,849 | 194,527 |
| 1969 | 1,003,797 | 624,866 | 318,583 | 57,301 | 368,426 | 17,249 | 468,342 | 127,219 | 1,136,415 | 302,649 |
| 1970 | 1,312,832 | 782,035 | 451,031 | 84,796 | 520,243 | 23,427 | 651,828 | 171,297 | 1,691,461 | 443,708 |
| 1971 | 1,581,850 | 949,590 | 595,102 | 120,210 | 700,914 | 28,845 | 864,650 | 208,821 | 2,394,083 | 619,778 |
| 1972 | 1,720,363 | 1,060,176 | 671,098 | 137,454 | 795,465 | 31,306 | 980,825 | 226,497 | 2,808,504 | 720,983 |
| 1973 | 1,772,377 | 1,075,176 | 696,065 | 142,143 | 825,044 | 32,281 | 1,018,759 | 233,340 | 2,945,564 | 756,530 |
| 1974 | 1,791,355 | 1,122,258 | 707,278 | 146,331 | 839,031 | 32,602 | 1,032,858 | 235,688 | 3,035,230 | 777,084 |
| 1975 | 1,815,881 | 1,137,517 | 724,295 | 150,105 | 861,611 | 33,017 | 1,062,188 | 238,700 | 3,117,604 | 798,777 |
| 1976 | 1,829,760 | 1,150,522 | 736,112 | 152,796 | 878,290 | 33,269 | 1,083,591 | 240,431 | 3,195,714 | 819,552 |
| 1977 | 1,842,615 | 1,164,117 | 744,718 | 154,692 | 890,124 | 33,485 | 1,099,294 | 242,010 | 3,244,723 | 832,585 |
| 1978 | 1,853,320 | 1,183,798 | 750,463 | 156,009 | 898,031 | 33,676 | 1,110,253 | 243,377 | 3,274,845 | 840,506 |
| 1979 | 1,869,355 | 1,208,488 | 756,140 | 157,141 | 904,987 | 33,943 | 1,120,086 | 245,346 | 3,296,693 | 846,199 |
| 1980 | 1,888,324 | 1,257,072 | 762,012 | 158,251 | 912,220 | 34,247 | 1,130,426 | 247,607 | 3,317,247 | 851,720 |
| 1981 | 1,987,339 | 1,348,448 | 796,384 | 164,015 | 950,529 | 35,899 | 1,180,521 | 259,877 | 3,421,183 | 879,634 |
| 1982 | 1,978,809 | 1,380,348 | 789,720 | 163,563 | 945,667 | 35,768 | 1,174,972 | 258,879 | 3,413,856 | 877,416 |
| 1983 | 2,061,590 | 1,425,149 | 809,319 | 167,582 | 971,692 | 37,104 | 1,209,272 | 268,895 | 3,486,248 | 897,190 |
| 1984 | 2,171,231 | 1,452,273 | 834,564 | 173,473 | 1,006,034 | 38,871 | 1,249,189 | 282,134 | 3,594,542 | 926,815 |
| 1985 | 2,251,676 | 1,468,130 | 851,720 | 177,807 | 1,031,452 | 40,260 | 1,282,056 | 291,738 | 3,673,311 | 948,379 |
| 1986 | 2,299,323 | 1,477,004 | 863,875 | 180,992 | 1,049,921 | 40,927 | 1,314,961 | 297,214 | 3,730,198 | 963,927 |
| 1987 | 2,344,046 | 1,483,175 | 876,261 | 183,970 | 1,068,826 | 41,390 | 1,331,125 | 301,992 | 3,783,895 | 978,588 |
| 1988 | 2,362,143 | 1,489,362 | 885,509 | 186,235 | 1,083,080 | 41,677 | 1,350,100 | 304,089 | 3,824,257 | 989,568 |
| 1989 | 2,376,030 | 1,498,925 | 889,631 | 187,412 | 1,088,857 | 41,852 | 1,357,872 | 305,475 | 3,846,509 | 995,456 |
| 1990 | 2,432,706 | 1,522,133 | 912,986 | 192,472 | 1,118,024 | 42,727 | 1,395,024 | 312,010 | 3,918,238 | 1,014,854 |
| 1991 | 2,469,661 | 1,541,780 | 932,659 | 197,604 | 1,147,282 | 43,112 | 1,431,131 | 315,536 | 3,997,480 | 1,036,359 |
| 1992 | 2,514,880 | 1,563,026 | 953,475 | 203,996 | 1,179,589 | 43,744 | 1,470,418 | 320,432 | 4,102,102 | 1,064,912 |
| 1993 | 2,549,874 | 1,582,033 | 969,784 | 210,989 | 1,203,773 | 44,253 | 1,497,825 | 324,519 | 4,213,571 | 1,095,444 |
| 1994 | 2,585,113 | 1,599,855 | 983,985 | 220,171 | 1,223,934 | 44,800 | 1,517,631 | 328,488 | 4,420,076 | 1,151,617 |
| 1995 | 2,611,217 | 1,608,815 | 992,587 | 225,248 | 1,236,069 | 45,193 | 1,529,979 | 331,367 | 4,547,097 | 1,186,123 |
| 1996 | 2,637,094 | 1,624,823 | 1,001,843 | 229,526 | 1,248,440 | 45,599 | 1,543,405 | 334,344 | 4,654,074 | 1,215,084 |
| 1997 | 2,654,359 | 1,636,210 | 1,010,118 | 232,003 | 1,258,944 | 45,868 | 1,555,881 | 336,316 | 4,875,746 | 1,268,666 |
| 1998 | 2,679,335 | 1,650,097 | 1,017,568 | 233,373 | 1,268,786 | 46,279 | 2,081,362 | 339,344 | 5,036,613 | 1,290,750 |
| 1999 | 2,692,811 | 1,661,482 | 1,022,130 | 235,684 | 1,274,800 | 46,503 | 2,088,636 | 341,005 | 5,243,553 | 1,307,788 |
| 2000 | 2,708,447 | 2,815,439 | 1,028,194 | 237,960 | 1,283,376 | 46,776 | 2,099,391 | 405,580 | 5,569,174 | 1,321,137 |
| 2001 | 2,716,761 | 2,821,380 | 1,032,076 | 239,333 | 1,288,723 | 46,930 | 2,106,233 | 406,784 | 6,393,264 | 1,330,966 |
| 2002 | 2,741,763 | 2,824,673 | 1,035,440 | 240,242 | 1,293,682 | 47,103 | 2,112,683 | 408,058 | 7,573,077 | 1,336,562 |
| 2003 | 2,753,701 | 2,833,188 | 1,038,552 | 241,001 | 1,297,752 | 47,280 | 2,118,334 | 409,493 | 8,154,205 | 1,344,434 |
| 2004 | 2,758,437 | 2,836,411 | 1,096,866 | 241,460 | 1,300,295 | 47,354 | 2,121,831 | 410,112 | 8,395,547 | 1,347,676 |
| 2005 | 2,763,549 | 2,840,340 | 6,717,581 | 241,849 | 2,061,704 | 47,442 | 2,125,380 | 410,828 | 8,526,549 | 1,350,250 |
| 2006 | 2,778,221 | 2,851,092 | 6,786,588 | 242,717 | 2,075,530 | 47,688 | 2,133,081 | 412,875 | 8,589,816 | 1,354,649 |
| 2007 | 2,800,019 | 2,876,703 | 6,915,867 | 244,290 | 2,099,752 | 48,040 | 2,145,806 | 416,072 | 8,717,179 | 1,361,754 |
| 2008 | 2,817,158 | 2,895,362 | 7,040,664 | 245,693 | 2,122,376 | 48,330 | 2,156,268 | 418,587 | 8,852,927 | 1,368,660 |
| 2009 | 2,827,654 | 2,911,185 | 7,132,465 | 249,637 | 2,141,770 | 48,511 | 2,162,362 | 419,994 | 9,071,215 | 1,385,750 |
| 2010 | 2,867,627 | 2,947,603 | 7,519,118 | 253,625 | 2,242,177 | 49,161 | 2,228,748 | 425,861 | 9,386,944 | 1,403,698 |
| 2011 | 2,913,247 | 2,983,881 | 7,693,412 | 257,862 | 2,286,106 | 49,890 | 2,263,565 | 432,482 | 9,755,432 | 1,422,974 |
| 2012 | 2,938,447 | 3,005,275 | 7,841,203 | 261,958 | 2,330,453 | 50,287 | 2,300,972 | 435,994 | 10,291,040 | 1,442,831 |
| 2013 | 2,924,175 | 3,018,765 | 8,028,589 | 268,161 | 2,378,543 | 50,644 | 2,353,421 | 438,747 | 11,087,568 | 1,461,168 |
| 2014 | 2,973,143 | 3,017,174 | 8,346,432 | 270,415 | 2,452,635 | 50,609 | 2,376,814 | 438,251 | 13,557,310 | 1,488,388 |
| 2015 | 2,983,474 | 3,028,432 | 8,500,428 | 272,390 | 2,485,341 | 50,860 | 2,410,975 | 439,905 | 15,811,105 | 1,504,844 |
| 2016 | 2,967,766 | 3,029,346 | 9,035,847 | 272,444 | 2,559,493 | 50,722 | 2,415,101 | 439,012 | 17,088,653 | 1,514,070 |
| **2017** | **2,850,660** | **2,981,887** | **9,720,258** | **266,840** | **2,615,322** | **48,679** | **2,355,978** | **422,887** | **18,449,195** | **1,491,859** |
| 2018 | 2,705,915 | 2,785,180 | 10,110,795 | 259,353 | 2,621,898 | 46,233 | 2,271,998 | 401,990 | 19,082,579 | 1,464,824 |
| 2019 | 2,533,951 | 2,585,253 | 10,315,539 | 249,280 | 2,592,603 | 43,267 | 2,167,586 | 376,514 | 19,162,432 | 1,417,670 |
| 2020 | 2,298,625 | 2,422,203 | 10,219,641 | 225,841 | 2,470,114 | 38,299 | 2,044,434 | 336,090 | 18,867,722 | 1,306,034 |
| 2021 | 2,029,608 | 2,175,124 | 9,547,418 | 190,427 | 2,218,104 | 32,881 | 1,791,485 | 292,700 | 18,165,100 | 1,129,963 |
| 2022 | 1,891,095 | 2,015,589 | 8,639,479 | 173,183 | 2,011,178 | 30,419 | 1,655,048 | 271,850 | 17,750,679 | 1,028,759 |
| 2023 | 1,839,081 | 2,007,864 | 7,935,719 | 168,493 | 1,889,910 | 29,445 | 1,609,651 | 263,813 | 17,613,619 | 993,212 |
| 2024 | 1,820,103 | 1,948,990 | 7,819,152 | 164,306 | 1,861,692 | 29,124 | 1,593,116 | 261,002 | 17,523,953 | 972,657 |
| 2025 | 1,795,577 | 1,931,126 | 7,703,898 | 160,531 | 1,825,843 | 28,709 | 1,561,345 | 257,426 | 17,441,579 | 950,965 |
| 2026 | 1,781,698 | 1,912,878 | 7,600,029 | 157,841 | 1,796,730 | 28,457 | 1,538,629 | 255,407 | 17,363,469 | 930,190 |
| 2027 | 1,768,843 | 1,894,367 | 7,523,677 | 155,945 | 1,775,745 | 28,241 | 1,522,190 | 253,595 | 17,314,460 | 917,157 |
| 2028 | 1,758,138 | 1,866,531 | 7,486,460 | 154,628 | 1,763,587 | 28,049 | 1,511,329 | 252,078 | 17,284,338 | 909,235 |
| 2029 | 1,742,103 | 1,828,217 | 7,454,130 | 153,496 | 1,753,031 | 27,783 | 1,500,944 | 249,866 | 17,262,490 | 903,543 |
| 2030 | 1,723,134 | 1,751,004 | 7,427,543 | 152,386 | 1,743,000 | 27,479 | 1,490,044 | 247,352 | 17,241,936 | 898,022 |
| 2031 | 1,624,119 | 1,607,951 | 7,288,932 | 146,622 | 1,690,611 | 25,827 | 1,428,048 | 233,189 | 17,138,000 | 870,108 |
| 2032 | 1,632,648 | 1,556,445 | 7,301,735 | 147,074 | 1,696,302 | 25,958 | 1,439,276 | 234,822 | 17,145,327 | 872,326 |
| 2033 | 1,549,867 | 1,483,894 | 7,220,204 | 143,055 | 1,661,911 | 24,622 | 1,401,865 | 224,156 | 17,072,935 | 852,552 |
| 2034 | 1,440,226 | 1,441,658 | 7,107,648 | 137,163 | 1,615,776 | 22,855 | 1,353,787 | 210,167 | 16,964,642 | 822,927 |
| 2035 | 1,359,782 | 1,419,936 | 7,023,722 | 132,829 | 1,581,340 | 21,466 | 1,320,104 | 200,270 | 16,885,872 | 801,363 |
| **TOTAL** | **151,878,176** | **129,693,969** | **277,986,903** | **13,089,737** | **102,187,729** | **2,610,634** | **109,053,264** | **21,120,220** | **615,457,274** | **72,413,715** |

[a] Unadjusted for prior overpayments or underpayments of charges.

[b] Determined at the current Project Interest Rate of 4.610 percent per annum.

[c] Reflects the transfers of permanent aqueduct capacity among contractors.

## TABLE B-15 Capital Cost Component of Transportation Charge for Each Contractor (in dollars) [a,b,c]



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] | [40] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 690,812 | 0 | 777,678 | 0 | 0 | 0 | 0 | 0 | 1,401,957 |
| 1964 | 21,735 | 1,260,513 | 9,378 | 1,603,161 | 0 | 0 | 0 | 0 | 0 | 2,551,416 |
| 1965 | 21,866 | 2,180,589 | 17,766 | 2,720,401 | 0 | 0 | 405 | 405 | 0 | 4,293,872 |
| 1966 | 37,964 | 3,900,172 | 33,426 | 4,868,023 | 0 | 0 | 565 | 565 | 0 | 6,808,355 |
| 1967 | 71,283 | 7,693,703 | 68,155 | 9,563,529 | 0 | 0 | 562 | 562 | 0 | 11,974,135 |
| 1968 | 120,094 | 14,345,147 | 133,299 | 17,534,951 | 0 | 0 | 564 | 564 | 0 | 21,185,417 |
| 1969 | 187,059 | 21,857,456 | 202,599 | 26,671,961 | 0 | 0 | 3,191 | 3,191 | 0 | 31,384,573 |
| 1970 | 275,010 | 28,992,595 | 257,859 | 35,658,122 | 0 | 0 | 15,121 | 15,121 | 0 | 40,657,587 |
| 1971 | 385,025 | 37,242,413 | 316,307 | 46,007,589 | 0 | 0 | 15,947 | 15,947 | 0 | 51,442,241 |
| 1972 | 448,055 | 44,062,125 | 353,935 | 54,016,785 | 0 | 0 | 17,332 | 17,332 | 0 | 60,639,360 |
| 1973 | 470,185 | 46,299,581 | 357,342 | 56,624,384 | 0 | 0 | 17,333 | 17,333 | 0 | 63,250,141 |
| 1974 | 483,259 | 48,322,678 | 372,112 | 58,897,764 | 0 | 0 | 17,334 | 17,334 | 0 | 66,063,456 |
| 1975 | 496,722 | 49,285,084 | 376,511 | 60,098,012 | 0 | 0 | 17,337 | 17,337 | 0 | 67,964,056 |
| 1976 | 509,650 | 50,137,295 | 380,788 | 61,147,768 | 0 | 0 | 17,338 | 17,338 | 0 | 69,106,652 |
| 1977 | 517,741 | 50,827,166 | 385,097 | 61,978,368 | 0 | 0 | 17,340 | 17,340 | 0 | 70,295,202 |
| 1978 | 522,656 | 51,426,581 | 390,742 | 62,684,258 | 0 | 0 | 17,342 | 17,342 | 0 | 71,518,803 |
| 1979 | 526,178 | 52,230,344 | 399,649 | 63,594,548 | 0 | 0 | 17,344 | 17,344 | 0 | 72,981,607 |
| 1980 | 529,583 | 53,637,412 | 417,136 | 65,143,257 | 0 | 0 | 17,345 | 17,345 | 0 | 75,039,897 |
| 1981 | 546,787 | 56,667,437 | 449,812 | 68,687,865 | 0 | 0 | 17,346 | 17,346 | 0 | 79,219,744 |
| 1982 | 545,445 | 57,465,063 | 461,234 | 69,490,738 | 0 | 0 | 17,348 | 17,348 | 0 | 80,522,031 |
| 1983 | 557,607 | 59,037,472 | 477,333 | 71,406,454 | 0 | 0 | 17,348 | 17,348 | 0 | 82,658,494 |
| 1984 | 575,830 | 60,313,580 | 486,863 | 73,105,397 | 0 | 0 | 17,349 | 17,349 | 0 | 85,189,245 |
| 1985 | 589,089 | 61,144,629 | 492,117 | 74,242,363 | 0 | 0 | 17,351 | 17,351 | 0 | 87,029,847 |
| 1986 | 598,648 | 61,666,346 | 494,977 | 74,978,314 | 0 | 0 | 17,352 | 17,352 | 0 | 88,892,829 |
| 1987 | 607,664 | 62,094,710 | 496,758 | 75,592,400 | 0 | 0 | 17,354 | 17,354 | 0 | 91,782,895 |
| 1988 | 614,418 | 62,452,912 | 498,619 | 76,081,971 | 0 | 0 | 17,355 | 17,355 | 0 | 93,896,370 |
| 1989 | 618,059 | 62,796,236 | 501,579 | 76,503,893 | 0 | 0 | 17,358 | 17,358 | 0 | 95,133,721 |
| 1990 | 629,934 | 63,762,459 | 509,566 | 77,763,133 | 0 | 0 | 17,360 | 17,360 | 0 | 96,881,773 |
| 1991 | 643,118 | 64,677,355 | 516,147 | 78,949,225 | 0 | 0 | 17,364 | 17,364 | 0 | 98,465,001 |
| 1992 | 660,626 | 65,776,353 | 523,154 | 80,376,707 | 0 | 0 | 17,367 | 17,367 | 0 | 100,198,457 |
| 1993 | 679,343 | 66,905,041 | 529,383 | 81,805,833 | 0 | 0 | 17,369 | 17,369 | 0 | 101,903,296 |
| 1994 | 714,062 | 68,486,622 | 535,055 | 83,811,409 | 0 | 0 | 17,370 | 17,370 | 0 | 104,677,108 |
| 1995 | 735,431 | 69,373,540 | 537,812 | 84,960,477 | 0 | 0 | 17,371 | 17,371 | 0 | 108,604,946 |
| 1996 | 753,512 | 70,251,056 | 541,753 | 86,080,553 | 0 | 0 | 17,371 | 17,371 | 0 | 118,560,235 |
| 1997 | 812,976 | 71,530,953 | 544,467 | 87,762,508 | 0 | 0 | 17,371 | 17,371 | 0 | 128,828,435 |
| 1998 | 919,464 | 72,283,436 | 548,490 | 89,394,898 | 0 | 0 | 0 | 0 | 0 | 132,538,767 |
| 1999 | 1,100,324 | 72,917,423 | 552,184 | 90,484,323 | 0 | 0 | 0 | 0 | 0 | 134,290,088 |
| 2000 | 1,434,718 | 73,432,162 | 555,279 | 92,937,633 | 0 | 0 | 0 | 0 | 0 | 136,893,371 |
| 2001 | 2,371,146 | 73,741,965 | 556,658 | 95,052,218 | 0 | 0 | 0 | 0 | 0 | 139,874,141 |
| 2002 | 3,744,046 | 73,915,736 | 557,417 | 97,830,482 | 0 | 0 | 0 | 0 | 0 | 142,813,063 |
| 2003 | 4,400,656 | 74,256,539 | 559,749 | 99,454,884 | 0 | 0 | 17,375 | 17,375 | 0 | 144,998,177 |
| 2004 | 4,669,624 | 74,601,782 | 560,566 | 100,387,963 | 0 | 0 | 17,375 | 17,375 | 0 | 146,367,926 |
| 2005 | 4,808,406 | 68,499,909 | 561,532 | 100,955,319 | 0 | 0 | 17,375 | 17,375 | 0 | 147,260,204 |
| 2006 | 4,858,605 | 68,876,841 | 564,172 | 101,571,876 | 0 | 0 | 17,375 | 17,375 | 0 | 148,034,078 |
| 2007 | 4,971,445 | 69,605,880 | 569,809 | 102,772,616 | 0 | 0 | 17,376 | 17,376 | 0 | 149,411,864 |
| 2008 | 5,105,983 | 70,216,830 | 573,969 | 103,862,808 | 0 | 0 | 17,376 | 17,376 | 0 | 150,986,872 |
| 2009 | 5,287,804 | 70,888,202 | 577,886 | 105,104,435 | 0 | 0 | 17,376 | 17,376 | 0 | 153,280,047 |
| 2010 | 5,568,700 | 72,114,491 | 585,969 | 107,593,722 | 0 | 0 | 17,377 | 17,377 | 0 | 156,555,416 |
| 2011 | 5,925,811 | 73,158,377 | 593,217 | 109,736,254 | 0 | 0 | 17,377 | 17,377 | 0 | 160,299,150 |
| 2012 | 6,479,876 | 73,890,701 | 597,050 | 111,866,087 | 0 | 0 | 17,377 | 17,377 | 0 | 163,904,268 |
| 2013 | 7,345,791 | 74,247,332 | 600,069 | 114,202,974 | 0 | 0 | 17,377 | 17,377 | 0 | 166,681,514 |
| 2014 | 10,149,401 | 75,383,564 | 598,719 | 121,102,854 | 0 | 0 | 17,377 | 17,377 | 0 | 174,004,257 |
| 2015 | 12,751,368 | 75,926,270 | 599,731 | 126,765,122 | 0 | 0 | 16,972 | 16,972 | 0 | 179,247,093 |
| 2016 | 14,228,188 | 76,902,197 | 597,162 | 131,100,001 | 0 | 0 | 16,813 | 16,813 | 0 | 183,653,866 |
| **2017** | **15,014,357** | **76,711,532** | **579,446** | **133,508,901** | **0** | **0** | **16,815** | **16,815** | **0** | **186,409,962** |
| 2018 | 15,408,912 | 73,875,413 | 535,487 | 131,570,578 | 0 | 0 | 16,813 | 16,813 | 0 | 184,076,364 |
| 2019 | 15,527,486 | 70,459,540 | 490,069 | 127,921,189 | 0 | 0 | 14,186 | 14,186 | 0 | 180,496,008 |
| 2020 | 15,541,691 | 66,214,749 | 450,703 | 122,436,148 | 0 | 0 | 2,257 | 2,257 | 0 | 175,012,111 |
| 2021 | 15,431,676 | 58,564,422 | 392,255 | 111,961,163 | 0 | 0 | 1,430 | 1,430 | 0 | 164,485,366 |
| 2022 | 15,368,646 | 52,689,028 | 354,627 | 103,879,581 | 0 | 0 | 45 | 45 | 0 | 156,377,917 |
| 2023 | 15,346,517 | 51,222,055 | 351,221 | 101,270,601 | 0 | 0 | 44 | 44 | 0 | 153,720,559 |
| 2024 | 15,333,442 | 49,318,542 | 336,450 | 98,982,530 | 0 | 0 | 43 | 43 | 0 | 151,417,163 |
| 2025 | 15,319,979 | 48,467,642 | 332,052 | 97,776,673 | 0 | 0 | 41 | 41 | 0 | 150,183,349 |
| 2026 | 15,307,051 | 47,719,918 | 327,775 | 96,720,072 | 0 | 0 | 39 | 39 | 0 | 149,106,029 |
| 2027 | 15,298,961 | 47,106,942 | 323,465 | 95,883,587 | 0 | 0 | 37 | 37 | 0 | 148,239,350 |
| 2028 | 15,294,045 | 46,543,253 | 317,820 | 95,169,491 | 0 | 0 | 35 | 35 | 0 | 147,480,566 |
| 2029 | 15,290,523 | 45,769,741 | 308,914 | 94,244,780 | 0 | 0 | 34 | 34 | 0 | 146,519,325 |
| 2030 | 15,287,119 | 44,386,187 | 291,427 | 92,666,629 | 0 | 0 | 32 | 32 | 0 | 144,891,527 |
| 2031 | 15,269,914 | 41,474,480 | 258,751 | 89,056,551 | 0 | 0 | 31 | 31 | 0 | 141,162,469 |
| 2032 | 15,271,256 | 40,669,887 | 247,329 | 88,240,386 | 0 | 0 | 29 | 29 | 0 | 140,329,460 |
| 2033 | 15,259,095 | 39,167,775 | 231,230 | 86,293,161 | 0 | 0 | 29 | 29 | 0 | 138,297,090 |
| 2034 | 15,240,871 | 37,990,772 | 221,700 | 84,570,192 | 0 | 0 | 28 | 28 | 0 | 136,373,653 |
| 2035 | 15,227,613 | 37,235,511 | 216,446 | 83,426,253 | 0 | 0 | 26 | 26 | 0 | 134,879,019 |
| **TOTAL** | **413,667,125** | **4,009,240,460** | **30,545,529** | **5,948,944,734** | **0** | **0** | **781,795** | **781,795** | **0** | **8,271,554,604** |

[a] Unadjusted for prior overpayments or underpayments of charges.

[b] Determined at the current Project Interest Rate of 4.610 percent per annum.

[c] Reflects the transfers of permanent aqueduct capacity among contractors.

## TABLE B-16A Minimum OMP&R Component of Transportation Charge for Each Contractor (in dollars)



| | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 9,699 | 8,868 | 21,132 | 39,699 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 38,048 | 34,788 | 82,896 | 155,732 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 41,148 | 38,323 | 91,320 | 170,791 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 78,529 | 75,616 | 195,793 | 349,937 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 79,753 | 78,779 | 218,543 | 377,076 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 127,896 | 123,667 | 335,224 | 586,787 | 0 | 0 | 0 |
| 1968 | 130 | 0 | 130 | 126,058 | 120,563 | 333,506 | 580,128 | 11,800 | 21,770 | 33,571 |
| 1969 | 80,875 | 0 | 80,875 | 145,411 | 138,050 | 372,585 | 656,046 | 63,113 | 116,435 | 179,548 |
| 1970 | 94,872 | 0 | 94,872 | 128,993 | 120,245 | 320,664 | 569,902 | 74,187 | 136,867 | 211,054 |
| 1971 | 45,579 | 0 | 45,579 | 113,071 | 108,346 | 296,004 | 517,421 | 74,011 | 136,541 | 210,552 |
| 1972 | 37,895 | 0 | 37,895 | 122,407 | 117,483 | 334,366 | 574,256 | 79,196 | 146,107 | 225,303 |
| 1973 | 32,993 | 0 | 32,993 | 122,738 | 116,785 | 325,726 | 565,250 | 75,714 | 139,683 | 215,398 |
| 1974 | 46,498 | 0 | 46,498 | 154,435 | 146,929 | 403,080 | 704,444 | 76,530 | 141,189 | 217,719 |
| 1975 | 37,707 | 0 | 37,707 | 189,175 | 182,087 | 513,823 | 885,086 | 92,605 | 170,845 | 263,450 |
| 1976 | 60,786 | 0 | 60,786 | 203,064 | 193,435 | 524,813 | 921,312 | 94,935 | 175,144 | 270,079 |
| 1977 | 78,400 | 0 | 78,400 | 179,869 | 169,065 | 500,101 | 849,035 | 102,945 | 189,922 | 292,867 |
| 1978 | 56,318 | 0 | 56,318 | 239,301 | 228,855 | 647,828 | 1,115,984 | 104,060 | 191,978 | 296,038 |
| 1979 | 73,852 | 0 | 73,852 | 236,986 | 232,105 | 666,742 | 1,135,833 | 100,748 | 185,868 | 286,617 |
| 1980 | 81,769 | 0 | 81,769 | 389,575 | 372,185 | 1,010,830 | 1,772,591 | 126,328 | 233,105 | 359,433 |
| 1981 | 101,340 | 0 | 101,340 | 317,408 | 302,272 | 834,257 | 1,453,937 | 140,208 | 258,712 | 398,920 |
| 1982 | 191,987 | 0 | 191,987 | 386,742 | 369,633 | 1,098,844 | 1,855,219 | 142,045 | 262,101 | 404,146 |
| 1983 | 80,215 | 0 | 80,215 | 438,536 | 428,973 | 1,269,373 | 2,136,882 | 171,001 | 315,523 | 486,524 |
| 1984 | 106,485 | 0 | 106,485 | 591,243 | 565,721 | 1,817,629 | 2,974,593 | 201,768 | 372,284 | 574,052 |
| 1985 | 215,341 | 0 | 215,341 | 674,975 | 655,490 | 1,840,211 | 3,170,677 | 242,935 | 448,233 | 691,167 |
| 1986 | 203,704 | 0 | 203,704 | 613,273 | 583,077 | 1,784,056 | 2,980,407 | 233,000 | 429,904 | 662,905 |
| 1987 | 295,505 | 0 | 295,505 | 687,629 | 652,468 | 2,000,817 | 3,340,914 | 230,484 | 463,838 | 694,322 |
| 1988 | 312,677 | (58) | 312,619 | 676,847 | 655,274 | 1,910,092 | 3,242,213 | 258,807 | 561,030 | 819,837 |
| 1989 | 403,330 | 688,185 | 1,091,515 | 716,831 | 712,354 | 1,897,149 | 3,326,335 | 244,772 | 668,476 | 913,248 |
| 1990 | 658,942 | 674,944 | 1,333,886 | 782,589 | 780,305 | 2,129,966 | 3,692,860 | 310,222 | 677,025 | 987,247 |
| 1991 | 726,717 | 860,903 | 1,587,620 | 543,178 | 524,741 | 1,520,569 | 2,588,488 | 302,369 | 673,858 | 976,227 |
| 1992 | 483,580 | 712,313 | 1,195,893 | 796,058 | 855,050 | 2,253,496 | 3,904,605 | 346,220 | 736,477 | 1,082,698 |
| 1993 | 524,000 | 708,129 | 1,232,129 | 1,280,736 | 1,261,431 | 3,338,742 | 5,880,908 | 386,060 | 734,138 | 1,120,197 |
| 1994 | 573,814 | 658,274 | 1,232,087 | 1,368,665 | 1,312,746 | 3,560,310 | 6,241,720 | 481,022 | 888,287 | 1,369,309 |
| 1995 | 539,407 | 660,770 | 1,200,177 | 1,232,272 | 1,187,201 | 3,216,470 | 5,635,943 | 477,929 | 881,323 | 1,359,251 |
| 1996 | 604,992 | 1,011,298 | 1,616,291 | 1,185,220 | 1,124,968 | 3,007,330 | 5,317,518 | 649,161 | 1,197,179 | 1,846,340 |
| 1997 | 563,579 | 741,881 | 1,305,460 | 1,029,670 | 968,999 | 2,667,649 | 4,666,319 | 406,652 | 749,805 | 1,156,456 |
| 1998 | 461,844 | 661,193 | 1,123,037 | 1,064,729 | 1,174,897 | 3,502,733 | 5,742,360 | 810,087 | 3,051,492 | 3,861,579 |
| 1999 | 613,368 | 1,006,577 | 1,619,945 | 1,243,942 | 1,285,417 | 5,135,770 | 7,665,129 | 795,894 | 3,101,531 | 3,897,425 |
| 2000 | 776,103 | 1,493,609 | 2,269,711 | 2,174,750 | 1,295,722 | 3,754,532 | 7,225,004 | 699,691 | 3,083,826 | 3,783,517 |
| 2001 | 652,140 | 1,445,102 | 2,097,242 | 4,194,623 | 1,038,221 | 3,544,696 | 8,777,541 | 723,561 | 2,906,335 | 3,629,896 |
| 2002 | 1,096,986 | 1,871,521 | 2,968,508 | 8,256,339 | 1,356,061 | 6,055,048 | 15,667,449 | 754,997 | 3,285,166 | 4,040,162 |
| 2003 | 1,168,961 | 2,247,939 | 3,416,900 | 4,901,800 | 1,057,277 | 3,547,979 | 9,507,055 | 803,488 | 3,440,321 | 4,243,809 |
| 2004 | 1,618,577 | 2,346,399 | 3,964,976 | 2,574,419 | 1,276,805 | 3,528,181 | 7,379,405 | 799,124 | 3,354,234 | 4,153,358 |
| 2005 | 916,728 | 1,796,605 | 2,713,333 | 2,391,493 | 1,129,780 | 2,947,359 | 6,468,631 | 848,861 | 3,682,079 | 4,530,940 |
| 2006 | 812,275 | 1,380,452 | 2,192,726 | 2,477,902 | 1,202,787 | 3,264,177 | 6,944,866 | 746,326 | 3,622,713 | 4,369,039 |
| 2007 | 775,905 | 1,515,458 | 2,291,363 | 3,221,595 | 1,566,980 | 4,002,251 | 8,790,826 | 827,306 | 3,589,163 | 4,416,469 |
| 2008 | 1,050,425 | 1,422,880 | 2,473,305 | 3,612,846 | 1,759,443 | 4,466,561 | 9,838,849 | 1,244,006 | 5,312,308 | 6,556,314 |
| 2009 | 1,115,900 | 1,788,056 | 2,903,956 | 3,253,083 | 1,473,809 | 4,173,538 | 8,900,430 | 1,084,857 | 4,523,409 | 5,608,266 |
| 2010 | 1,195,038 | 3,197,517 | 4,392,555 | 3,126,472 | 1,533,124 | 4,225,704 | 8,885,300 | 1,409,671 | 6,238,142 | 7,647,813 |
| 2011 | 1,570,749 | 3,658,432 | 5,229,181 | 3,492,661 | 1,682,351 | 4,499,335 | 9,674,347 | 1,449,813 | 6,570,102 | 8,019,915 |
| 2012 | 2,061,367 | 3,553,096 | 5,614,463 | 3,694,169 | 1,762,925 | 6,720,575 | 12,177,668 | 1,442,182 | 7,247,007 | 8,689,189 |
| 2013 | 1,501,285 | 3,057,899 | 4,559,183 | 4,171,803 | 1,964,594 | 5,883,634 | 12,020,031 | 1,692,848 | 8,805,697 | 10,498,545 |
| 2014 | 1,957,135 | 3,821,415 | 5,778,550 | 4,792,166 | 2,217,121 | 7,385,893 | 14,395,180 | 1,545,326 | 5,832,100 | 7,377,427 |
| 2015 | 2,180,263 | 3,637,209 | 5,817,472 | 4,976,881 | 2,401,565 | 8,907,256 | 16,285,702 | 2,033,662 | 8,591,988 | 10,625,650 |
| 2016 | 2,401,212 | 4,031,064 | 6,432,276 | 5,924,931 | 2,836,344 | 15,660,540 | 24,421,815 | 1,829,566 | 7,603,778 | 9,433,344 |
| **2017** | **2,843,708** | **4,731,067** | **7,574,775** | **6,214,664** | **3,020,017** | **13,312,757** | **22,547,439** | **1,826,540** | **7,808,421** | **9,634,961** |
| 2018 | 2,732,122 | 4,458,491 | 7,190,613 | 7,131,577 | 3,459,298 | 9,737,687 | 20,328,562 | 1,927,131 | 7,998,678 | 9,925,809 |
| 2019 | 2,683,869 | 4,448,088 | 7,131,958 | 6,483,143 | 3,133,761 | 13,026,721 | 22,643,626 | 1,878,195 | 7,878,943 | 9,757,138 |
| 2020 | 2,687,352 | 4,454,141 | 7,141,493 | 6,483,089 | 3,131,305 | 13,076,526 | 22,690,920 | 1,876,862 | 7,921,134 | 9,797,995 |
| 2021 | 2,714,225 | 4,498,682 | 7,212,907 | 6,547,920 | 3,162,618 | 13,207,291 | 22,917,829 | 1,895,630 | 8,000,345 | 9,895,976 |
| 2022 | 2,741,368 | 4,543,668 | 7,285,036 | 6,613,398 | 3,194,244 | 13,339,364 | 23,147,006 | 1,914,587 | 8,080,349 | 9,994,936 |
| 2023 | 2,768,781 | 4,589,105 | 7,357,886 | 6,679,533 | 3,226,186 | 13,472,758 | 23,378,477 | 1,933,733 | 8,161,152 | 10,094,884 |
| 2024 | 2,796,469 | 4,634,996 | 7,431,465 | 6,746,328 | 3,258,448 | 13,607,486 | 23,612,262 | 1,953,070 | 8,242,764 | 10,195,834 |
| 2025 | 2,824,433 | 4,681,347 | 7,505,780 | 6,813,791 | 3,291,033 | 13,743,560 | 23,848,384 | 1,972,601 | 8,325,191 | 10,297,791 |
| 2026 | 2,852,678 | 4,728,159 | 7,580,837 | 6,881,929 | 3,323,943 | 13,880,995 | 24,086,867 | 1,992,327 | 8,408,443 | 10,400,770 |
| 2027 | 2,881,205 | 4,775,441 | 7,656,646 | 6,950,749 | 3,357,182 | 14,019,806 | 24,327,737 | 2,012,250 | 8,492,527 | 10,504,777 |
| 2028 | 2,910,017 | 4,823,196 | 7,733,213 | 7,020,256 | 3,390,754 | 14,160,004 | 24,571,015 | 2,032,372 | 8,577,453 | 10,609,825 |
| 2029 | 2,939,117 | 4,871,428 | 7,810,545 | 7,090,459 | 3,424,662 | 14,301,604 | 24,816,724 | 2,052,696 | 8,663,227 | 10,715,923 |
| 2030 | 2,968,509 | 4,920,142 | 7,888,651 | 7,161,363 | 3,458,908 | 14,444,620 | 25,064,892 | 2,073,223 | 8,749,860 | 10,823,083 |
| 2031 | 2,998,193 | 4,969,343 | 7,967,536 | 7,232,977 | 3,493,498 | 14,589,067 | 25,315,542 | 2,093,955 | 8,837,358 | 10,931,314 |
| 2032 | 3,028,175 | 5,019,037 | 8,047,213 | 7,305,307 | 3,528,432 | 14,734,957 | 25,568,696 | 2,114,895 | 8,925,732 | 11,040,627 |
| 2033 | 3,058,457 | 5,069,227 | 8,127,684 | 7,378,360 | 3,563,717 | 14,882,307 | 25,824,384 | 2,136,044 | 9,014,989 | 11,151,033 |
| 2034 | 3,089,041 | 5,119,919 | 8,208,961 | 7,452,143 | 3,599,354 | 15,031,129 | 26,082,625 | 2,157,404 | 9,105,139 | 11,262,543 |
| 2035 | 3,119,932 | 5,171,118 | 8,291,050 | 7,526,664 | 3,635,347 | 15,181,441 | 26,343,452 | 2,178,978 | 9,196,190 | 11,375,168 |
| **TOTAL** | **85,877,201** | **141,155,658** | **227,032,859** | **217,308,286** | **109,214,807** | **406,297,782** | **732,820,875** | **65,864,583** | **266,532,935** | **332,397,518** |

## TABLE B-16A Minimum OMP&R Component of Transportation Charge for Each Contractor (in dollars)



| | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| Calendar Year | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 37,806 | 1,963 | 5,639 | 60,701 | 678,086 | 2,008 | 2,073 | 77,591 | 865,867 |
| 1969 | 45,479 | 2,235 | 30,158 | 80,554 | 1,197,126 | 2,286 | 2,085 | 90,773 | 1,450,698 |
| 1970 | 46,969 | 2,292 | 35,450 | 96,673 | 1,381,493 | 2,344 | 2,158 | 93,408 | 1,660,786 |
| 1971 | 47,997 | 2,314 | 35,366 | 106,654 | 1,643,163 | 2,366 | 2,288 | 94,874 | 1,935,021 |
| 1972 | 49,866 | 2,414 | 37,844 | 122,313 | 1,729,169 | 2,469 | 2,254 | 98,777 | 2,045,106 |
| 1973 | 50,006 | 2,385 | 36,180 | 125,553 | 1,719,873 | 2,440 | 2,310 | 98,330 | 2,037,076 |
| 1974 | 52,818 | 2,556 | 36,570 | 135,661 | 1,823,065 | 2,614 | 2,529 | 104,609 | 2,160,424 |
| 1975 | 66,963 | 3,243 | 44,251 | 162,738 | 2,235,242 | 3,317 | 3,191 | 132,663 | 2,651,608 |
| 1976 | 66,504 | 3,328 | 45,364 | 159,303 | 2,215,999 | 3,404 | 2,919 | 133,940 | 2,630,761 |
| 1977 | 75,595 | 3,812 | 49,192 | 189,661 | 2,522,290 | 3,898 | 3,708 | 152,838 | 3,000,994 |
| 1978 | 70,688 | 3,503 | 49,725 | 174,897 | 2,427,163 | 3,583 | 3,644 | 141,672 | 2,874,875 |
| 1979 | 68,879 | 3,436 | 48,142 | 173,677 | 2,378,315 | 3,514 | 3,492 | 138,493 | 2,817,948 |
| 1980 | 95,898 | 4,722 | 59,551 | 235,741 | 3,146,570 | 4,830 | 4,777 | 191,582 | 3,743,671 |
| 1981 | 118,448 | 5,965 | 66,183 | 266,353 | 3,440,557 | 6,099 | 5,187 | 239,323 | 4,148,116 |
| 1982 | 134,083 | 6,711 | 67,061 | 311,879 | 3,848,922 | 6,862 | 6,382 | 270,061 | 4,651,960 |
| 1983 | 184,902 | 9,242 | 80,869 | 426,485 | 5,030,031 | 9,450 | 8,494 | 372,182 | 6,121,656 |
| 1984 | 194,228 | 9,656 | 95,555 | 471,854 | 5,636,134 | 9,874 | 8,719 | 389,892 | 6,815,912 |
| 1985 | 200,694 | 9,957 | 115,227 | 486,162 | 6,042,593 | 10,182 | 8,982 | 402,457 | 7,276,254 |
| 1986 | 207,028 | 10,302 | 110,479 | 530,803 | 6,372,710 | 10,536 | 10,341 | 415,776 | 7,667,975 |
| 1987 | 205,002 | 10,259 | 109,401 | 533,451 | 6,378,437 | 10,493 | 10,517 | 412,889 | 7,670,450 |
| 1988 | 203,711 | 10,223 | 122,903 | 516,432 | 6,388,497 | 10,455 | 10,341 | 410,868 | 7,673,430 |
| 1989 | 224,049 | 11,269 | 116,197 | 564,169 | 6,747,046 | 11,526 | 11,102 | 452,406 | 8,137,763 |
| 1990 | 271,051 | 13,666 | 148,238 | 664,040 | 8,111,616 | 13,976 | 13,206 | 547,974 | 9,783,767 |
| 1991 | 275,748 | 13,854 | 144,486 | 662,755 | 8,111,610 | 14,168 | 13,218 | 556,474 | 9,792,313 |
| 1992 | 317,889 | 16,027 | 162,466 | 764,224 | 9,115,453 | 16,393 | 18,209 | 642,672 | 11,053,333 |
| 1993 | 359,879 | 17,989 | 184,477 | 831,662 | 10,372,245 | 18,399 | 19,560 | 724,397 | 12,528,608 |
| 1994 | 309,084 | 15,486 | 224,254 | 738,619 | 9,789,833 | 15,839 | 16,434 | 622,879 | 11,732,427 |
| 1995 | 395,441 | 19,918 | 220,899 | 898,339 | 11,190,121 | 20,373 | 21,551 | 799,070 | 13,565,713 |
| 1996 | 362,623 | 19,968 | 301,835 | 902,162 | 11,872,821 | 20,424 | 21,664 | 796,711 | 14,298,209 |
| 1997 | 366,476 | 20,154 | 186,450 | 942,987 | 10,558,144 | 20,613 | 19,344 | 806,084 | 12,920,252 |
| 1998 | 453,033 | 24,560 | 288,906 | 1,098,213 | 12,207,920 | 25,122 | 21,594 | 995,194 | 15,114,543 |
| 1999 | 384,169 | 21,168 | 275,698 | 980,700 | 11,106,789 | 21,650 | 21,913 | 844,306 | 13,656,391 |
| 2000 | 384,501 | 21,145 | 206,873 | 1,022,780 | 9,948,383 | 21,647 | 22,809 | 844,101 | 12,472,238 |
| 2001 | 463,902 | 25,523 | 231,686 | 1,212,212 | 11,269,413 | 26,115 | 31,799 | 1,018,751 | 14,279,401 |
| 2002 | 426,218 | 21,572 | 223,769 | 1,080,829 | 10,227,644 | 22,080 | 25,646 | 813,667 | 12,841,425 |
| 2003 | 494,764 | 25,202 | 242,079 | 1,178,001 | 11,268,644 | 25,794 | 30,740 | 944,674 | 14,209,898 |
| 2004 | 442,087 | 22,638 | 244,299 | 1,124,271 | 10,636,853 | 61,698 | 25,463 | 731,719 | 13,289,028 |
| 2005 | 427,271 | 21,928 | 257,146 | 1,013,649 | 10,307,500 | 59,685 | 24,396 | 708,154 | 12,819,729 |
| 2006 | 463,217 | 23,692 | 195,878 | 1,106,863 | 10,300,213 | 71,531 | 26,336 | 763,664 | 12,951,394 |
| 2007 | 525,633 | 26,655 | 234,501 | 1,266,196 | 11,655,504 | 82,238 | 27,088 | 861,943 | 14,679,758 |
| 2008 | 624,293 | 32,182 | 369,287 | 1,523,401 | 15,043,805 | 101,213 | 32,491 | 1,034,422 | 18,761,093 |
| 2009 | 513,758 | 26,120 | 335,108 | 1,262,679 | 12,702,505 | 83,728 | 26,737 | 843,841 | 15,794,477 |
| 2010 | 498,092 | 28,934 | 407,061 | 1,310,281 | 13,109,586 | 93,958 | 27,637 | 864,438 | 16,339,987 |
| 2011 | 601,955 | 35,251 | 403,956 | 1,641,598 | 15,521,232 | 111,512 | 39,520 | 1,050,483 | 19,405,507 |
| 2012 | 569,774 | 33,277 | 360,992 | 1,608,982 | 15,233,911 | 103,899 | 31,071 | 992,497 | 18,934,404 |
| 2013 | 653,998 | 38,322 | 411,882 | 1,721,174 | 16,708,527 | 118,623 | 31,522 | 1,141,754 | 20,825,802 |
| 2014 | 696,810 | 42,085 | 524,826 | 1,852,808 | 19,005,950 | 133,537 | 44,538 | 1,237,039 | 23,537,592 |
| 2015 | 650,067 | 42,399 | 633,520 | 1,822,700 | 19,505,682 | 137,273 | 44,441 | 1,241,357 | 24,077,439 |
| 2016 | 705,783 | 45,833 | 576,016 | 1,917,094 | 20,072,047 | 144,917 | 51,401 | 1,343,708 | 24,856,799 |
| **2017** | **886,889** | **52,608** | **563,050** | **2,159,937** | **23,304,069** | **162,833** | **60,657** | **1,541,962** | **28,732,004** |
| 2018 | 909,779 | 53,993 | 610,358 | 2,199,336 | 23,925,685 | 168,212 | 61,560 | 1,582,318 | 29,511,241 |
| 2019 | 865,205 | 51,319 | 588,973 | 2,108,322 | 22,959,340 | 160,241 | 58,451 | 1,504,222 | 28,296,073 |
| 2020 | 803,538 | 51,833 | 594,863 | 2,065,290 | 23,184,412 | 161,844 | 59,036 | 1,519,265 | 28,440,079 |
| 2021 | 811,573 | 52,351 | 600,812 | 2,085,943 | 23,416,256 | 163,463 | 59,626 | 1,534,457 | 28,724,481 |
| 2022 | 819,689 | 52,874 | 606,820 | 2,106,802 | 23,650,419 | 165,097 | 60,222 | 1,549,802 | 29,011,725 |
| 2023 | 827,886 | 53,403 | 612,888 | 2,127,870 | 23,886,923 | 166,748 | 60,824 | 1,565,300 | 29,301,843 |
| 2024 | 836,165 | 53,937 | 619,017 | 2,149,149 | 24,125,792 | 168,416 | 61,433 | 1,580,953 | 29,594,861 |
| 2025 | 844,526 | 54,477 | 625,207 | 2,170,640 | 24,367,050 | 170,100 | 62,047 | 1,596,762 | 29,890,810 |
| 2026 | 852,972 | 55,021 | 631,459 | 2,192,347 | 24,610,721 | 171,801 | 62,668 | 1,612,730 | 30,189,718 |
| 2027 | 861,501 | 55,571 | 637,774 | 2,214,270 | 24,856,828 | 173,519 | 63,294 | 1,628,857 | 30,491,615 |
| 2028 | 870,116 | 56,127 | 644,152 | 2,236,413 | 25,105,396 | 175,254 | 63,927 | 1,645,146 | 30,796,532 |
| 2029 | 878,818 | 56,688 | 650,593 | 2,258,777 | 25,356,450 | 177,007 | 64,566 | 1,661,597 | 31,104,497 |
| 2030 | 887,606 | 57,255 | 657,099 | 2,281,365 | 25,610,014 | 178,777 | 65,212 | 1,678,213 | 31,415,541 |
| 2031 | 896,482 | 57,828 | 663,670 | 2,304,178 | 25,866,115 | 180,564 | 65,864 | 1,694,995 | 31,729,697 |
| 2032 | 905,447 | 58,406 | 670,307 | 2,327,220 | 26,124,776 | 182,370 | 66,523 | 1,711,945 | 32,046,994 |
| 2033 | 914,501 | 58,990 | 677,010 | 2,350,492 | 26,386,024 | 184,194 | 67,188 | 1,729,065 | 32,367,464 |
| 2034 | 923,646 | 59,580 | 683,780 | 2,373,997 | 26,649,884 | 186,036 | 67,860 | 1,746,356 | 32,691,139 |
| 2035 | 932,883 | 60,176 | 690,618 | 2,397,737 | 26,916,383 | 187,896 | 68,539 | 1,763,819 | 33,018,050 |
| **TOTAL** | **31,614,347** | **1,869,777** | **21,422,347** | **80,191,021** | **880,238,970** | **4,995,326** | **2,047,316** | **59,535,138** | **1,081,914,242** |

## TABLE B-16A Minimum OMP&R Component of Transportation Charge for Each Contractor (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 65,074 | 28,085 | 11,697 | 2,958 | 19,291 | 1,089 | 24,380 | 8,173 | 52,315 | 14,399 |
| 1969 | 86,339 | 70,342 | 15,522 | 3,925 | 25,598 | 1,445 | 32,348 | 10,844 | 69,419 | 19,106 |
| 1970 | 107,807 | 84,577 | 19,392 | 4,904 | 31,981 | 1,804 | 40,391 | 13,540 | 86,727 | 23,865 |
| 1971 | 178,820 | 105,979 | 32,228 | 8,150 | 53,151 | 2,992 | 66,999 | 22,459 | 144,136 | 39,636 |
| 1972 | 363,555 | 202,625 | 106,740 | 30,967 | 176,037 | 6,601 | 213,032 | 48,102 | 548,123 | 144,113 |
| 1973 | 404,661 | 222,765 | 121,341 | 34,674 | 200,116 | 7,346 | 243,320 | 53,975 | 724,535 | 190,156 |
| 1974 | 434,868 | 235,528 | 130,627 | 37,062 | 215,432 | 7,677 | 262,735 | 56,383 | 786,107 | 207,019 |
| 1975 | 504,791 | 289,501 | 151,031 | 43,176 | 249,082 | 9,082 | 303,108 | 65,580 | 905,424 | 238,842 |
| 1976 | 559,013 | 262,420 | 160,686 | 44,454 | 265,004 | 10,030 | 325,512 | 73,253 | 964,524 | 256,570 |
| 1977 | 675,504 | 335,749 | 184,813 | 47,743 | 304,792 | 11,890 | 381,161 | 87,355 | 1,069,446 | 289,793 |
| 1978 | 600,343 | 376,946 | 187,028 | 54,156 | 308,449 | 10,711 | 373,192 | 78,304 | 1,148,279 | 300,751 |
| 1979 | 661,123 | 349,072 | 196,264 | 52,211 | 323,677 | 12,124 | 401,469 | 87,126 | 1,125,452 | 302,508 |
| 1980 | 858,039 | 415,571 | 253,090 | 71,921 | 417,398 | 15,435 | 508,379 | 112,853 | 1,518,405 | 401,223 |
| 1981 | 1,001,503 | 511,087 | 284,970 | 73,534 | 469,970 | 18,046 | 588,024 | 131,992 | 1,548,350 | 420,523 |
| 1982 | 1,128,643 | 557,494 | 320,938 | 89,560 | 529,292 | 20,193 | 649,204 | 148,012 | 1,870,559 | 497,871 |
| 1983 | 1,744,932 | 832,687 | 450,049 | 119,275 | 742,218 | 30,643 | 922,072 | 225,793 | 2,373,149 | 639,682 |
| 1984 | 2,105,780 | 943,524 | 548,784 | 150,179 | 905,055 | 36,810 | 1,112,196 | 271,187 | 3,018,294 | 803,394 |
| 1985 | 2,157,936 | 1,055,744 | 584,697 | 157,841 | 964,282 | 38,972 | 1,191,309 | 277,250 | 3,230,403 | 860,780 |
| 1986 | 2,311,841 | 1,102,466 | 618,750 | 162,748 | 1,020,438 | 40,051 | 1,268,806 | 295,987 | 3,318,638 | 893,069 |
| 1987 | 2,366,343 | 1,032,918 | 628,222 | 167,262 | 1,036,061 | 41,773 | 1,283,836 | 307,844 | 3,400,838 | 913,933 |
| 1988 | 2,303,274 | 1,042,113 | 649,276 | 175,694 | 1,070,784 | 40,604 | 1,321,553 | 298,438 | 3,587,873 | 960,968 |
| 1989 | 2,280,051 | 1,088,176 | 613,266 | 169,993 | 1,011,401 | 39,501 | 1,240,888 | 292,775 | 3,499,964 | 932,519 |
| 1990 | 2,636,186 | 1,275,150 | 708,829 | 201,242 | 1,169,006 | 45,472 | 1,424,445 | 336,069 | 4,084,211 | 1,078,392 |
| 1991 | 2,737,441 | 1,454,172 | 763,989 | 210,644 | 1,259,974 | 48,936 | 1,546,583 | 358,165 | 4,348,900 | 1,150,633 |
| 1992 | 2,781,586 | 1,579,025 | 750,248 | 198,232 | 1,237,307 | 49,829 | 1,538,733 | 362,844 | 4,131,745 | 1,115,632 |
| 1993 | 3,109,819 | 1,689,775 | 850,589 | 234,719 | 1,402,796 | 56,125 | 1,722,415 | 411,539 | 5,023,595 | 1,338,111 |
| 1994 | 2,825,193 | 1,608,731 | 794,991 | 225,121 | 1,311,100 | 51,259 | 1,634,886 | 376,180 | 4,794,820 | 1,267,565 |
| 1995 | 3,121,440 | 1,720,649 | 848,101 | 231,718 | 1,398,686 | 58,749 | 1,766,297 | 444,998 | 4,828,432 | 1,272,345 |
| 1996 | 3,093,678 | 1,966,634 | 862,720 | 228,008 | 1,422,789 | 56,813 | 1,817,427 | 423,444 | 4,707,473 | 1,256,549 |
| 1997 | 3,250,394 | 1,810,292 | 918,428 | 281,067 | 1,514,687 | 59,547 | 1,853,224 | 446,127 | 5,705,741 | 1,477,757 |
| 1998 | 3,876,512 | 2,050,254 | 1,070,517 | 299,639 | 1,765,491 | 73,835 | 3,207,848 | 561,246 | 6,076,375 | 1,634,942 |
| 1999 | 3,832,428 | 2,108,765 | 1,114,208 | 311,154 | 1,837,547 | 75,908 | 3,226,793 | 549,879 | 6,454,799 | 1,738,148 |
| 2000 | 3,751,246 | 3,379,197 | 1,035,809 | 291,749 | 1,708,257 | 68,397 | 3,000,267 | 594,476 | 5,876,829 | 1,572,232 |
| 2001 | 4,466,081 | 3,774,256 | 1,111,995 | 298,109 | 1,833,891 | 80,995 | 3,288,756 | 701,008 | 5,755,346 | 1,555,635 |
| 2002 | 3,640,169 | 3,495,749 | 1,017,609 | 282,351 | 1,678,240 | 62,563 | 2,999,670 | 549,516 | 5,628,787 | 1,510,425 |
| 2003 | 4,067,238 | 3,392,425 | 1,123,332 | 298,423 | 1,852,588 | 68,045 | 3,294,976 | 608,585 | 6,599,063 | 1,603,957 |
| 2004 | 4,444,794 | 4,031,985 | 1,441,819 | 322,933 | 1,908,894 | 76,792 | 3,426,109 | 676,844 | 7,222,338 | 1,765,213 |
| 2005 | 3,834,679 | 3,548,174 | 5,894,144 | 289,387 | 2,247,118 | 66,837 | 2,910,013 | 581,713 | 6,801,965 | 1,600,286 |
| 2006 | 4,065,824 | 3,227,620 | 8,392,469 | 307,024 | 2,802,655 | 74,378 | 3,141,641 | 637,731 | 6,978,778 | 1,684,736 |
| 2007 | 4,471,736 | 4,386,577 | 8,615,852 | 327,740 | 2,896,056 | 78,587 | 3,332,816 | 681,107 | 8,081,288 | 1,888,501 |
| 2008 | 4,911,498 | 5,273,310 | 9,668,253 | 370,220 | 3,280,149 | 81,753 | 4,093,082 | 744,040 | 9,279,740 | 2,026,829 |
| 2009 | 4,558,861 | 4,472,820 | 8,662,536 | 354,650 | 2,989,534 | 77,841 | 3,711,164 | 690,315 | 9,013,489 | 1,982,918 |
| 2010 | 4,115,793 | 4,274,406 | 9,273,129 | 361,341 | 3,189,762 | 72,678 | 3,754,171 | 616,601 | 8,959,609 | 1,965,077 |
| 2011 | 4,893,499 | 4,719,132 | 10,754,286 | 411,789 | 3,649,302 | 85,936 | 4,334,281 | 763,864 | 9,476,615 | 2,161,740 |
| 2012 | 5,430,973 | 5,140,657 | 11,269,605 | 454,099 | 3,921,703 | 97,044 | 4,567,961 | 833,318 | 10,748,233 | 2,361,046 |
| 2013 | 6,357,752 | 6,022,293 | 11,902,152 | 494,208 | 4,304,584 | 112,050 | 5,208,547 | 972,884 | 11,657,319 | 2,650,790 |
| 2014 | 7,028,850 | 6,479,531 | 15,524,841 | 535,726 | 5,070,762 | 117,698 | 5,910,720 | 1,051,263 | 12,813,247 | 2,905,423 |
| 2015 | 6,461,842 | 6,187,954 | 13,210,682 | 526,089 | 4,718,493 | 110,485 | 6,003,266 | 939,078 | 12,769,014 | 2,967,880 |
| 2016 | 6,665,253 | 6,622,669 | 13,548,757 | 559,666 | 4,797,842 | 110,205 | 5,948,960 | 972,859 | 13,208,699 | 3,044,195 |
| **2017** | **7,326,448** | **7,241,233** | **15,586,762** | **604,061** | **5,389,838** | **121,174** | **6,485,731** | **1,067,965** | **15,183,059** | **3,352,754** |
| 2018 | 7,386,436 | 7,121,668 | 17,116,462 | 601,304 | 5,548,725 | 121,837 | 6,491,195 | 1,075,409 | 14,669,678 | 3,340,459 |
| 2019 | 7,188,648 | 7,059,452 | 15,571,501 | 593,880 | 5,297,923 | 118,916 | 6,366,347 | 1,047,859 | 14,491,216 | 3,278,261 |
| 2020 | 7,138,824 | 7,049,900 | 15,722,023 | 594,930 | 5,348,787 | 120,020 | 6,528,586 | 1,040,437 | 14,549,600 | 3,309,948 |
| 2021 | 7,210,212 | 7,120,399 | 15,879,243 | 600,879 | 5,402,275 | 121,220 | 6,593,872 | 1,050,841 | 14,695,097 | 3,343,048 |
| 2022 | 7,282,314 | 7,191,603 | 16,038,036 | 606,888 | 5,456,297 | 122,433 | 6,659,810 | 1,061,350 | 14,842,048 | 3,376,478 |
| 2023 | 7,355,137 | 7,263,519 | 16,198,417 | 612,957 | 5,510,860 | 123,657 | 6,726,409 | 1,071,963 | 14,990,468 | 3,410,243 |
| 2024 | 7,428,688 | 7,336,154 | 16,360,400 | 619,086 | 5,565,969 | 124,893 | 6,793,673 | 1,082,683 | 15,140,372 | 3,444,345 |
| 2025 | 7,502,976 | 7,409,516 | 16,524,005 | 625,277 | 5,621,629 | 126,142 | 6,861,609 | 1,093,510 | 15,291,776 | 3,478,789 |
| 2026 | 7,578,005 | 7,483,611 | 16,689,245 | 631,530 | 5,677,845 | 127,404 | 6,930,225 | 1,104,445 | 15,444,695 | 3,513,577 |
| 2027 | 7,653,785 | 7,558,447 | 16,856,137 | 637,845 | 5,734,623 | 128,678 | 6,999,528 | 1,115,489 | 15,599,141 | 3,548,712 |
| 2028 | 7,730,323 | 7,634,032 | 17,024,698 | 644,224 | 5,791,970 | 129,965 | 7,069,523 | 1,126,644 | 15,755,132 | 3,584,200 |
| 2029 | 7,807,626 | 7,710,372 | 17,194,946 | 650,666 | 5,849,889 | 131,264 | 7,140,218 | 1,137,911 | 15,912,684 | 3,620,042 |
| 2030 | 7,885,703 | 7,787,476 | 17,366,895 | 657,173 | 5,908,388 | 132,577 | 7,211,620 | 1,149,290 | 16,071,811 | 3,656,242 |
| 2031 | 7,964,560 | 7,865,350 | 17,540,564 | 663,745 | 5,967,472 | 133,903 | 7,283,737 | 1,160,783 | 16,232,529 | 3,692,804 |
| 2032 | 8,044,205 | 7,944,004 | 17,715,969 | 670,382 | 6,027,147 | 135,242 | 7,356,574 | 1,172,391 | 16,394,854 | 3,729,733 |
| 2033 | 8,124,647 | 8,023,444 | 17,893,129 | 677,086 | 6,087,418 | 136,594 | 7,430,140 | 1,184,114 | 16,558,802 | 3,767,030 |
| 2034 | 8,205,894 | 8,103,678 | 18,072,060 | 683,857 | 6,148,292 | 137,960 | 7,504,441 | 1,195,956 | 16,724,391 | 3,804,700 |
| 2035 | 8,287,953 | 8,184,715 | 18,252,781 | 690,695 | 6,209,775 | 139,340 | 7,579,486 | 1,207,915 | 16,891,635 | 3,842,747 |
| **TOTAL** | **282,433,389** | **249,926,145** | **467,002,575** | **22,675,901** | **186,053,845** | **4,856,795** | **233,431,685** | **40,999,874** | **531,456,400** | **125,021,788** |

## TABLE B-16A Minimum OMP&R Component of Transportation Charge for Each Contractor (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,219 | 42,918 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,626 | 168,358 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13,938 | 184,729 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28,937 | 378,874 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31,321 | 408,397 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47,718 | 634,505 |
| 1968 | 8,821 | 972,734 | 9,504 | 1,218,520 | 0 | 0 | 0 | 0 | 46,945 | 2,745,160 |
| 1969 | 11,704 | 1,295,607 | 12,610 | 1,654,810 | 0 | 0 | 0 | 0 | 52,963 | 4,074,939 |
| 1970 | 14,623 | 1,624,569 | 15,746 | 2,069,923 | 0 | 0 | 0 | 0 | 69,744 | 4,676,282 |
| 1971 | 24,302 | 2,716,584 | 26,118 | 3,421,555 | 0 | 0 | 54 | 54 | 55,532 | 6,185,714 |
| 1972 | 89,131 | 8,038,463 | 68,369 | 10,035,857 | 0 | 0 | 40 | 40 | 80,412 | 12,998,869 |
| 1973 | 117,779 | 9,890,316 | 78,313 | 12,289,296 | 0 | 0 | 1 | 1 | 54,219 | 15,194,233 |
| 1974 | 128,169 | 11,581,491 | 83,453 | 14,166,551 | 0 | 0 | 143 | 143 | 76,783 | 17,372,561 |
| 1975 | 147,899 | 13,584,548 | 101,893 | 16,593,957 | 0 | 0 | 1,069 | 1,069 | 84,547 | 20,517,423 |
| 1976 | 158,664 | 12,862,489 | 94,799 | 16,037,419 | 0 | 0 | 139 | 139 | 106,717 | 20,027,213 |
| 1977 | 178,774 | 16,203,699 | 121,966 | 19,892,683 | 0 | 0 | 892 | 892 | 98,618 | 24,213,489 |
| 1978 | 186,384 | 17,811,770 | 132,435 | 21,568,747 | 0 | 0 | 39 | 39 | 100,786 | 26,012,786 |
| 1979 | 186,688 | 16,414,289 | 126,756 | 20,238,761 | 0 | 0 | 3,235 | 3,235 | 119,352 | 24,675,598 |
| 1980 | 248,399 | 20,926,898 | 154,096 | 25,901,706 | 0 | 0 | 416 | 416 | 178,812 | 32,038,398 |
| 1981 | 259,244 | 23,731,024 | 186,592 | 29,224,860 | 0 | 0 | 3,847 | 3,847 | 185,347 | 35,516,366 |
| 1982 | 307,955 | 27,994,510 | 209,141 | 34,323,374 | 0 | 0 | 11,075 | 11,075 | 173,894 | 41,611,655 |
| 1983 | 394,524 | 38,953,367 | 326,258 | 47,754,649 | 0 | 0 | 1,928 | 1,928 | 220,926 | 56,802,781 |
| 1984 | 496,808 | 45,597,671 | 382,104 | 56,371,786 | 0 | 0 | 3,765 | 3,765 | 225,959 | 67,072,552 |
| 1985 | 531,765 | 50,064,444 | 416,652 | 61,532,075 | 0 | 0 | 2,888 | 2,888 | 340,322 | 73,228,724 |
| 1986 | 551,066 | 52,858,915 | 442,334 | 64,885,109 | 0 | 0 | 2,787 | 2,787 | 279,227 | 76,682,113 |
| 1987 | 564,352 | 50,737,631 | 411,276 | 62,892,287 | 0 | 0 | 2,388 | 2,388 | 345,116 | 75,240,981 |
| 1988 | 593,787 | 51,262,231 | 406,248 | 63,712,844 | 0 | 0 | 545 | 545 | 365,207 | 76,126,695 |
| 1989 | 576,852 | 52,638,942 | 431,020 | 64,815,349 | 0 | 0 | 1,800 | 1,800 | 422,329 | 78,708,338 |
| 1990 | 667,687 | 61,053,824 | 494,721 | 75,175,234 | 0 | 0 | 788 | 788 | 474,284 | 91,448,066 |
| 1991 | 711,803 | 60,874,529 | 470,139 | 75,935,908 | 0 | 0 | 3,654 | 3,654 | 214,683 | 91,098,893 |
| 1992 | 688,558 | 67,460,598 | 502,131 | 82,396,469 | 0 | 0 | 647 | 647 | 443,676 | 100,077,320 |
| 1993 | 828,208 | 68,749,547 | 538,751 | 85,955,990 | 0 | 0 | 3,630 | 3,630 | 599,571 | 107,321,034 |
| 1994 | 783,691 | 63,898,029 | 473,897 | 80,045,461 | 0 | 0 | 2,279 | 2,279 | 609,966 | 101,233,250 |
| 1995 | 785,191 | 68,079,888 | 523,512 | 85,080,005 | 0 | 0 | 2,906 | 2,906 | 534,971 | 107,378,966 |
| 1996 | 773,653 | 72,757,439 | 561,100 | 89,927,727 | 0 | 0 | 8,007 | 8,007 | 571,857 | 113,585,948 |
| 1997 | 917,372 | 75,655,465 | 564,455 | 94,454,555 | 0 | 0 | 7,449 | 7,449 | 428,638 | 114,939,131 |
| 1998 | 1,000,558 | 80,540,695 | 608,294 | 102,766,204 | 0 | 0 | 0 | 0 | 465,095 | 129,072,817 |
| 1999 | 1,066,898 | 86,320,578 | 637,626 | 109,274,730 | 0 | 0 | (0) | (0) | 584,116 | 136,697,736 |
| 2000 | 964,354 | 82,432,338 | 635,349 | 105,310,501 | 0 | 0 | 0 | 0 | 0 | 131,060,971 |
| 2001 | 949,248 | 93,016,285 | 709,327 | 117,540,934 | 0 | 0 | 0 | 0 | 0 | 146,325,014 |
| 2002 | 922,151 | 85,415,139 | 657,493 | 107,859,863 | 0 | 0 | (0) | (0) | 0 | 143,377,406 |
| 2003 | 1,514,514 | 82,358,489 | 621,310 | 107,402,945 | 0 | 0 | 3,425 | 3,425 | 0 | 138,784,032 |
| 2004 | 1,435,507 | 99,527,399 | 761,599 | 127,042,226 | 0 | 0 | 3,455 | 3,455 | 0 | 155,832,448 |
| 2005 | 1,587,021 | 74,184,438 | 652,293 | 104,198,067 | 0 | 0 | 3,452 | 3,452 | 0 | 130,734,153 |
| 2006 | 1,447,103 | 76,147,507 | 598,995 | 109,506,460 | 0 | 0 | 3,904 | 3,904 | 0 | 135,968,390 |
| 2007 | 1,833,598 | 105,091,465 | 863,260 | 142,548,583 | 0 | 0 | 3,517 | 3,517 | 0 | 172,730,516 |
| 2008 | 2,482,168 | 113,274,967 | 979,577 | 156,465,586 | 0 | 0 | 5,036 | 5,036 | 0 | 194,100,185 |
| 2009 | 2,373,282 | 99,895,425 | 829,566 | 139,612,401 | 0 | 0 | 844 | 844 | 0 | 172,820,374 |
| 2010 | 2,583,425 | 97,926,307 | 786,760 | 137,879,060 | 0 | 0 | 1,071 | 1,071 | 0 | 175,145,786 |
| 2011 | 2,646,540 | 105,598,030 | 850,140 | 150,345,154 | 0 | 0 | 2,754 | 2,754 | 0 | 192,676,858 |
| 2012 | 2,628,237 | 118,229,648 | 954,152 | 166,636,677 | 0 | 0 | 1,093 | 1,093 | 0 | 212,053,494 |
| 2013 | 2,727,617 | 133,540,862 | 1,129,336 | 187,080,395 | 0 | 0 | 289 | 289 | 0 | 234,984,245 |
| 2014 | 3,192,991 | 147,378,197 | 1,183,103 | 209,192,353 | 0 | 0 | 116 | 116 | 0 | 260,281,218 |
| 2015 | 3,161,234 | 137,650,749 | 1,098,502 | 195,805,269 | 0 | 0 | 117 | 117 | 0 | 252,611,649 |
| 2016 | 3,351,786 | 153,073,428 | 1,222,188 | 213,126,509 | 0 | 0 | 111 | 111 | 0 | 278,270,854 |
| **2017** | **4,179,183** | **169,408,883** | **1,359,420** | **237,306,511** | **0** | **0** | **111** | **111** | **0** | **305,795,800** |
| 2018 | 3,862,368 | 164,820,220 | 1,303,117 | 233,458,878 | 0 | 0 | 111 | 111 | 0 | 300,415,214 |
| 2019 | 3,834,722 | 163,944,264 | 1,307,857 | 230,100,847 | 0 | 0 | 112 | 112 | 0 | 297,929,753 |
| 2020 | 3,858,482 | 163,973,812 | 1,320,210 | 230,555,559 | 0 | 0 | 113 | 113 | 0 | 298,626,159 |
| 2021 | 3,897,067 | 165,613,549 | 1,333,412 | 232,861,114 | 0 | 0 | 114 | 114 | 0 | 301,612,420 |
| 2022 | 3,936,037 | 167,269,685 | 1,346,746 | 235,189,724 | 0 | 0 | 116 | 116 | 0 | 304,628,543 |
| 2023 | 3,975,398 | 168,942,382 | 1,360,213 | 237,541,623 | 0 | 0 | 117 | 117 | 0 | 307,674,831 |
| 2024 | 4,015,152 | 170,631,805 | 1,373,815 | 239,917,037 | 0 | 0 | 118 | 118 | 0 | 310,751,578 |
| 2025 | 4,055,303 | 172,338,124 | 1,387,554 | 242,316,210 | 0 | 0 | 119 | 119 | 0 | 313,859,095 |
| 2026 | 4,095,856 | 174,061,506 | 1,401,429 | 244,739,373 | 0 | 0 | 120 | 120 | 0 | 316,997,685 |
| 2027 | 4,136,815 | 175,802,119 | 1,415,443 | 247,186,763 | 0 | 0 | 122 | 122 | 0 | 320,167,661 |
| 2028 | 4,178,183 | 177,560,142 | 1,429,598 | 249,658,633 | 0 | 0 | 123 | 123 | 0 | 323,369,341 |
| 2029 | 4,219,965 | 179,335,745 | 1,443,894 | 252,155,221 | 0 | 0 | 124 | 124 | 0 | 326,603,035 |
| 2030 | 4,262,164 | 181,129,101 | 1,458,333 | 254,676,771 | 0 | 0 | 125 | 125 | 0 | 329,869,063 |
| 2031 | 4,304,787 | 182,940,392 | 1,472,916 | 257,223,541 | 0 | 0 | 126 | 126 | 0 | 333,167,755 |
| 2032 | 4,347,835 | 184,769,795 | 1,487,645 | 259,795,775 | 0 | 0 | 128 | 128 | 0 | 336,499,433 |
| 2033 | 4,391,312 | 186,617,494 | 1,502,522 | 262,393,733 | 0 | 0 | 129 | 129 | 0 | 339,864,427 |
| 2034 | 4,435,226 | 188,483,668 | 1,517,547 | 265,017,668 | 0 | 0 | 130 | 130 | 0 | 343,263,066 |
| 2035 | 4,479,578 | 190,368,506 | 1,532,722 | 267,667,848 | 0 | 0 | 132 | 132 | 0 | 346,695,702 |
| **TOTAL** | **128,267,516** | **6,365,904,649** | **50,899,654** | **8,688,930,217** | **0** | **0** | **97,884** | **97,884** | **8,748,370** | **11,071,941,965** |

## TABLE B-16B Minimum OMP&R Component of Transportation Charge for Each Contractor for Off-Aqueduct Power Facilities[a,b] (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 10,070 | 0 | 10,070 | 47,473 | 31,446 | 863,937 | 942,856 | 0 | 0 | 0 |
| 1984 | 29,957 | 0 | 29,957 | 157,280 | 77,388 | 2,040,188 | 2,274,856 | 0 | 0 | 0 |
| 1985 | 54,709 | 0 | 54,709 | 458,427 | 582,679 | 2,696,450 | 3,737,556 | 0 | 0 | 0 |
| 1986 | 45,887 | 0 | 45,887 | 312,938 | 365,147 | 2,595,765 | 3,273,850 | 0 | 0 | 0 |
| 1987 | 90,385 | 0 | 90,385 | 622,029 | 674,111 | 2,306,079 | 3,602,219 | 0 | 0 | 0 |
| 1988 | 115,970 | 114,196 | 230,166 | 616,865 | 804,606 | 2,116,236 | 3,537,707 | 0 | 0 | 0 |
| 1989 | 64,584 | 138,240 | 202,824 | 407,353 | 396,069 | 1,389,347 | 2,192,769 | 0 | 0 | 0 |
| 1990 | 77,126 | 138,805 | 215,931 | 535,269 | 514,372 | 1,490,250 | 2,539,891 | 0 | 0 | 0 |
| 1991 | 35,178 | 245,181 | 280,359 | 355,578 | 477,883 | 1,065,488 | 1,898,949 | 0 | 165,930 | 165,930 |
| 1992 | 74,573 | 230,716 | 305,289 | 405,244 | 529,119 | 1,183,466 | 2,117,829 | 0 | 0 | 0 |
| 1993 | 89,214 | 247,977 | 337,191 | 841,383 | 256,930 | 1,552,562 | 2,650,875 | 0 | 0 | 0 |
| 1994 | 111,942 | 229,598 | 341,540 | 501,812 | 559,683 | 1,395,238 | 2,456,733 | 0 | 0 | 0 |
| 1995 | 96,842 | 235,605 | 332,447 | 833,227 | 492,578 | 796,524 | 2,122,329 | 0 | 0 | 0 |
| 1996 | 63,698 | 205,414 | 269,112 | 367,297 | 304,845 | 1,189,291 | 1,861,433 | 711 | 105 | 816 |
| 1997 | 48,518 | 193,255 | 241,773 | 455,751 | 294,951 | 1,220,497 | 1,971,199 | 44,788 | 298,986 | 343,774 |
| 1998 | 82,317 | 251,217 | 333,534 | 380,321 | 380,282 | 1,103,662 | 1,864,265 | 198,376 | 1,028,220 | 1,226,596 |
| 1999 | 58,017 | 195,562 | 253,579 | 559,900 | 446,655 | 1,039,572 | 2,046,127 | 147,204 | 791,946 | 939,150 |
| 2000 | 28,759 | 128,393 | 157,152 | 374,808 | 237,138 | 748,820 | 1,360,766 | 82,628 | 474,268 | 556,896 |
| 2001 | 81,666 | 157,196 | 238,862 | 396,340 | 233,205 | 673,431 | 1,302,976 | 134,574 | 595,294 | 729,868 |
| 2002 | 40,236 | 127,750 | 167,986 | 383,365 | 229,280 | 519,819 | 1,132,464 | 91,639 | 583,933 | 675,572 |
| 2003 | 37,618 | 92,735 | 130,353 | 301,657 | 180,804 | 643,729 | 1,126,190 | 78,771 | 477,048 | 555,819 |
| 2004 | 50,289 | 128,180 | 178,469 | 447,802 | 210,093 | 546,342 | 1,204,237 | 92,836 | 662,110 | 754,946 |
| 2005 | 53,455 | 149,328 | 202,783 | 452,896 | 265,252 | 772,420 | 1,490,568 | 106,901 | 587,036 | 693,937 |
| 2006 | 59,239 | 127,708 | 186,947 | 476,295 | 277,304 | 798,098 | 1,551,697 | 109,498 | 605,502 | 715,000 |
| 2007 | 82,724 | 182,954 | 265,678 | 445,250 | 246,862 | 740,211 | 1,432,323 | 103,331 | 759,114 | 862,445 |
| 2008 | 200,185 | 304,502 | 504,687 | 861,568 | 428,737 | 1,074,975 | 2,365,280 | 184,501 | 997,507 | 1,182,008 |
| 2009 | 167,186 | 237,569 | 404,755 | 708,409 | 418,456 | 1,279,442 | 2,406,307 | 209,684 | 853,143 | 1,062,827 |
| 2010 | 186,503 | 221,486 | 407,989 | 876,092 | 407,548 | 1,266,270 | 2,549,910 | 203,422 | 963,122 | 1,166,544 |
| 2011 | 121,673 | 145,499 | 267,172 | 685,604 | 372,699 | 1,174,038 | 2,232,341 | 147,645 | 829,034 | 976,679 |
| 2012 | 130,199 | 185,005 | 315,204 | 830,163 | 319,227 | 1,135,648 | 2,285,038 | 186,059 | 920,215 | 1,106,274 |
| 2013 | 114,869 | 172,310 | 287,179 | 609,808 | 327,688 | 1,046,787 | 1,984,283 | 121,826 | 607,752 | 729,578 |
| 2014 | 97,013 | 94,810 | 191,823 | 317,446 | 235,476 | 541,866 | 1,094,788 | 83,501 | 442,785 | 526,286 |
| 2015 | 35,945 | 49,630 | 85,575 | 146,118 | 96,412 | 319,724 | 562,254 | 39,698 | 160,291 | 199,989 |
| 2016 | 5,130 | 8,834 | 13,964 | 30,254 | 16,590 | 62,636 | 109,480 | 5,556 | 32,260 | 37,816 |
| **2017** | **4,296** | **7,981** | **12,277** | **26,609** | **17,407** | **58,184** | **102,200** | **5,251** | **25,656** | **30,907** |
| 2018 | 6,766 | 4,598 | 11,364 | 27,855 | 9,491 | 35,993 | 73,339 | 18,335 | 38,125 | 56,459 |
| 2019 | 408 | 277 | 685 | 1,680 | 583 | 2,084 | 4,347 | 1,109 | 2,299 | 3,408 |
| 2020 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2021 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2022 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2023 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2024 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2025 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2026 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2027 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2028 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2029 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2030 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2031 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2032 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2033 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2034 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| 2035 | 408 | 277 | 685 | 1,680 | 593 | 2,084 | 4,357 | 1,115 | 2,299 | 3,414 |
| **TOTAL** | **2,659,675** | **4,956,947** | **7,616,622** | **16,285,044** | **11,728,488** | **39,518,409** | **67,531,941** | **2,415,685** | **12,938,468** | **15,354,153** |

[a] 1983 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include both debt service and bond cover.

[b] 2009 through 2017 charges include Reid Gardner separation costs that are allocated to contractors based on theoretical energy use over the facility service life, 1983–2013.

## TABLE B-16B Minimum OMP&R Component of Transportation Charge for Each Contractor for Off-Aqueduct Power Facilities[a,b] (in dollars)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Kern | | | | | |
| | Dudley Ridge | Empire | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 159,191 | 0 | 34,366 | 2,964,185 | 13,174 | 9,673 | 3,733 | 3,184,322 |
| 1984 | 389,518 | 0 | 816,103 | 9,095,509 | 26,774 | 33,576 | 49,601 | 10,411,081 |
| 1985 | 527,952 | 59,322 | 1,053,957 | 11,978,046 | 38,810 | 42,297 | 1,253,257 | 14,953,641 |
| 1986 | 552,172 | 12,858 | 885,988 | 11,788,714 | 40,659 | 38,275 | 872,008 | 14,190,674 |
| 1987 | 450,941 | 24,936 | 1,192,388 | 10,448,063 | 39,134 | 37,538 | 911,938 | 13,104,938 |
| 1988 | 425,261 | 31,146 | 1,130,988 | 9,910,050 | 35,851 | 26,779 | 850,225 | 12,410,300 |
| 1989 | 331,852 | 17,226 | 607,908 | 7,400,983 | 22,959 | 24,306 | 754,007 | 9,159,241 |
| 1990 | 219,381 | 7,731 | 428,482 | 5,216,562 | 12,089 | 12,046 | 344,943 | 6,241,234 |
| 1991 | 13,048 | 3,111 | 570,942 | 146,276 | 0 | 1,354 | 30,685 | 765,416 |
| 1992 | 244,630 | 13,395 | 706,155 | 5,788,599 | 18,587 | 15,716 | 480,903 | 7,267,985 |
| 1993 | 471,706 | 25,543 | 1,202,455 | 11,405,212 | 37,276 | 36,803 | 1,159,908 | 14,338,903 |
| 1994 | 262,029 | 15,161 | 901,463 | 6,786,208 | 19,257 | 19,061 | 567,521 | 8,570,700 |
| 1995 | 626,214 | 16,830 | 1,486,494 | 12,489,555 | 41,275 | 36,377 | 1,051,178 | 15,747,923 |
| 1996 | 407,919 | 13,446 | 1,226,968 | 9,219,091 | 28,668 | 24,001 | 1,691,135 | 12,611,228 |
| 1997 | 423,144 | (6) | 794,476 | 7,471,645 | (31) | 22,025 | 137,304 | 8,848,557 |
| 1998 | 471,993 | 4,597 | 837,228 | 8,366,817 | 127 | 25,458 | 175,371 | 9,881,591 |
| 1999 | 360,554 | 19,182 | 874,948 | 7,723,883 | 24,159 | 20,065 | 1,749,925 | 10,772,716 |
| 2000 | 193,895 | 5,762 | 392,659 | 4,215,772 | 11,530 | 9,847 | 667,127 | 5,496,592 |
| 2001 | 200,485 | 6,563 | 113,854 | 2,948,087 | 7,528 | 11,821 | 287,409 | 3,575,747 |
| 2002 | 153,306 | 4,540 | 308,554 | 2,797,916 | 9,223 | 10,767 | 299,940 | 3,584,246 |
| 2003 | 125,188 | 3,901 | 301,142 | 2,626,386 | 10,030 | 7,904 | 287,531 | 3,362,082 |
| 2004 | 168,005 | 12,193 | 457,106 | 2,914,113 | 30,989 | 10,807 | 278,204 | 3,871,417 |
| 2005 | 315,142 | 14,807 | 358,007 | 5,609,958 | 76,490 | 11,047 | 540,681 | 6,926,132 |
| 2006 | 287,977 | 13,112 | 401,503 | 5,488,668 | 38,075 | 11,559 | 432,313 | 6,673,207 |
| 2007 | 189,684 | 8,758 | 242,253 | 3,662,405 | 24,280 | 10,224 | 365,975 | 4,503,579 |
| 2008 | 184,682 | 7,887 | 381,864 | 3,930,067 | 31,949 | 11,276 | 282,379 | 4,830,104 |
| 2009 | 181,200 | 8,817 | 63,082 | 4,518,839 | 28,827 | 11,595 | 314,621 | 5,126,981 |
| 2010 | 250,194 | 27,117 | 96,128 | 5,774,210 | 40,474 | 16,580 | 488,098 | 6,692,801 |
| 2011 | 362,592 | 11,506 | 290,168 | 7,797,111 | 39,939 | 11,233 | 338,448 | 8,850,997 |
| 2012 | 139,042 | 16,387 | 281,108 | 5,881,018 | 53,747 | 16,121 | 654,940 | 7,042,363 |
| 2013 | 174,617 | 9,247 | 247,481 | 4,100,710 | 25,730 | 11,818 | 300,486 | 4,870,089 |
| 2014 | 121,811 | 4,353 | 114,780 | 2,211,296 | 10,098 | 7,131 | 151,394 | 2,620,863 |
| 2015 | 60,603 | 2,503 | 94,999 | 1,282,664 | 5,431 | 3,379 | 99,348 | 1,548,927 |
| 2016 | 14,208 | 647 | 27,049 | 300,454 | 1,691 | 884 | 26,996 | 371,929 |
| **2017** | **14,491** | **621** | **26,002** | **306,323** | **1,421** | **882** | **27,495** | **377,235** |
| 2018 | 6,515 | 386 | 19,703 | 144,810 | 1,223 | 500 | 11,259 | 184,397 |
| 2019 | 354 | 23 | 1,188 | 8,734 | 74 | 30 | 679 | 11,082 |
| 2020 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2021 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2022 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2023 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2024 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2025 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2026 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2027 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2028 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2029 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2030 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2031 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2032 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2033 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2034 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| 2035 | 354 | 23 | 1,188 | 8,733 | 74 | 30 | 679 | 11,081 |
| **TOTAL** | **9,487,160** | **423,981** | **18,988,951** | **204,858,668** | **848,696** | **601,238** | **17,949,829** | **253,158,524** |

[a] 1983 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include both debt service and bond cover.

[b] 2009 through 2017 charges include Reid Gardner separation costs that are allocated to contractors based on theoretical energy use over the facility service life, 1983–2013.

**TABLE B-16B Minimum OMP&R Component of Transportation Charge for Each Contractor for Off-Aqueduct Power Facilities[a,b] (in dollars)**



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [19] | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 1,083,881 | 411,247 | 565,798 | 35,432 | 894,572 | 1,250 | 0 | 0 | 233,134 | 28,548 |
| 1984 | 2,499,848 | 1,122,640 | 1,427,428 | 102,114 | 2,263,172 | 77 | 0 | 0 | 502,967 | 693,074 |
| 1985 | 3,749,257 | 1,572,025 | 2,032,672 | 170,137 | 3,230,451 | 0 | 0 | 157,601 | 884,188 | 601,583 |
| 1986 | 3,159,857 | 1,694,487 | 2,097,408 | 173,460 | 3,340,188 | 15,873 | 0 | 301,486 | 739,563 | 1,088,901 |
| 1987 | 3,167,759 | 1,694,698 | 1,991,841 | 190,149 | 3,230,424 | 95,994 | 1,786 | 258,719 | 1,951,799 | 1,091,691 |
| 1988 | 2,688,113 | 1,776,471 | 1,940,156 | 187,156 | 3,194,137 | 30,395 | 846 | 126,639 | 2,000,664 | 839,774 |
| 1989 | 2,357,669 | 1,348,806 | 1,326,863 | 132,076 | 2,218,516 | 50,948 | 13,206 | 493,424 | 1,257,332 | 792,087 |
| 1990 | 2,528,625 | 1,335,341 | 1,463,452 | 115,746 | 2,413,745 | 110,678 | 0 | 545,342 | 1,192,997 | 1,054,762 |
| 1991 | 1,048,414 | 531,160 | 1,022,405 | 125,256 | 1,686,304 | 65,111 | 473,291 | 488,207 | 540,119 | 796,531 |
| 1992 | 2,760,199 | 1,548,472 | 1,124,775 | 55,985 | 1,855,065 | 22,891 | 1,130,876 | 367,996 | 362,232 | 853,047 |
| 1993 | 3,559,487 | 1,332,392 | 2,256,338 | 29,498 | 3,721,492 | 60,615 | 1,101,799 | 640,919 | 425,969 | 1,406,255 |
| 1994 | 3,963,982 | 1,450,328 | 1,345,145 | 74,879 | 2,218,411 | 88,549 | 1,371,116 | 678,876 | 871,358 | 1,452,741 |
| 1995 | 4,324,009 | 1,901,361 | 2,498,462 | 44,237 | 4,120,837 | 43,892 | 881,146 | 636,541 | 75,278 | 1,397,623 |
| 1996 | 3,572,856 | 1,507,542 | 4,652,945 | 77,384 | 7,674,388 | 31,691 | 760,763 | 723,670 | 458,246 | 1,201,941 |
| 1997 | 3,411,379 | 1,468,949 | 4,294,703 | 42,135 | 4,319,206 | 24,319 | 891,191 | 648,652 | 625,340 | 1,175,556 |
| 1998 | 3,977,988 | 1,599,394 | 7,554,910 | 16,624 | 6,174,031 | 30,365 | 508,248 | 657,806 | 166,952 | 827,650 |
| 1999 | 3,696,973 | 1,694,851 | 3,195,685 | 71,662 | 3,678,076 | 18,305 | 501,486 | 710,674 | 815,001 | 1,375,575 |
| 2000 | 2,372,130 | 994,396 | 1,420,806 | 40,083 | 1,954,947 | 0 | 374,972 | 257,146 | 617,664 | 508,258 |
| 2001 | 2,680,895 | 1,418,179 | 460,256 | 53,460 | 759,169 | 0 | 213,385 | 445,872 | 1,339,699 | 119,363 |
| 2002 | 1,668,457 | 1,384,832 | 567,521 | 74,145 | 936,215 | 0 | 140,035 | 529,674 | 2,414,011 | 841,746 |
| 2003 | 1,445,146 | 1,353,956 | 411,258 | 44,506 | 678,236 | 0 | 405,376 | 277,984 | 780,631 | 624,561 |
| 2004 | 1,813,317 | 1,677,090 | 554,874 | 71,974 | 760,283 | 0 | 465,965 | 368,929 | 2,072,770 | 449,963 |
| 2005 | 2,047,638 | 1,443,555 | 1,721,141 | 32,667 | 1,987,091 | 0 | 542,366 | 400,828 | 1,568,493 | 566,063 |
| 2006 | 2,845,985 | 1,617,750 | 5,071,235 | 26,843 | 2,093,821 | 0 | 1,417,777 | 442,278 | 1,533,665 | 681,916 |
| 2007 | 2,990,954 | 1,864,667 | 3,225,680 | 77,880 | 1,331,802 | 0 | 2,023,088 | 710,515 | 2,639,102 | 177,256 |
| 2008 | 3,547,772 | 3,303,503 | 4,059,802 | 74,029 | 2,237,582 | 1,845 | 2,200,333 | 1,052,126 | 3,410,480 | 629,597 |
| 2009 | 3,350,539 | 3,010,931 | 4,067,070 | 79,671 | 1,633,327 | 3,263 | 2,559,670 | 1,152,062 | 3,948,007 | 1,025,723 |
| 2010 | 4,321,133 | 2,663,067 | 7,385,867 | 31,714 | 2,730,993 | 177 | 3,304,241 | 810,142 | 4,668,858 | 1,673,291 |
| 2011 | 4,952,954 | 1,811,301 | 5,605,548 | 13,018 | 2,290,872 | 407 | 309,065 | 551,068 | 2,185,513 | 1,468,910 |
| 2012 | 5,401,397 | 2,619,529 | 8,864,502 | 48,852 | 3,451,280 | 495 | 848,848 | 1,072,349 | 7,388,666 | 1,677,958 |
| 2013 | 2,563,236 | 2,266,914 | 3,520,765 | 77,123 | 1,425,559 | 3,270 | 475,946 | 512,798 | 1,986,377 | 591,150 |
| 2014 | 1,148,978 | 1,191,895 | 1,021,712 | 56,389 | 644,953 | 3,804 | 273,011 | 348,413 | 787,781 | 231,637 |
| 2015 | 563,666 | 564,243 | 859,445 | 26,404 | 488,140 | 2,405 | 213,055 | 137,848 | 587,116 | 195,205 |
| 2016 | 181,611 | 93,466 | 187,451 | 4,645 | 127,772 | 704 | 39,240 | 31,322 | 114,853 | 48,299 |
| **2017** | **155,616** | **90,283** | **145,329** | **4,087** | **122,748** | **825** | **40,344** | **27,869** | **91,387** | **44,030** |
| 2018 | 167,877 | 113,121 | 186,658 | 7,825 | 75,216 | 0 | 89,483 | 37,154 | 132,799 | 38,856 |
| 2019 | 9,888 | 6,823 | 11,258 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,349 | 2,343 |
| 2020 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2021 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2022 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2023 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2024 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2025 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2026 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2027 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2028 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2029 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2030 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2031 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2032 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2033 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2034 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| 2035 | 9,887 | 6,822 | 11,257 | 472 | 4,536 | 0 | 5,729 | 2,241 | 8,348 | 2,343 |
| **TOTAL** | **95,937,680** | **53,588,816** | **90,319,270** | **2,497,268** | **82,040,134** | **708,148** | **23,669,341** | **16,641,019** | **51,512,926** | **28,310,957** |

[a] 1983 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include both debt service and bond cover.

[b] 2009 through 2017 charges include Reid Gardner separation costs that are allocated to contractors based on theoretical energy use over the facility service life, 1983–2013.

## TABLE B-16B Minimum OMP&R Component of Transportation Charge for Each Contractor for Off-Aqueduct Power Facilities[a,b] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | Total State Water Project[c] |
| | [29] | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 12,791,358 | 0 | 16,045,220 | 0 | 0 | 0 | 0 | 20,182,468 |
| 1984 | 0 | 39,229,567 | 0 | 47,840,887 | 0 | 0 | 0 | 0 | 60,556,781 |
| 1985 | 0 | 77,446,523 | 0 | 89,844,437 | 0 | 0 | 0 | 0 | 108,590,343 |
| 1986 | 0 | 77,581,287 | 0 | 90,192,510 | 0 | 0 | 0 | 0 | 107,702,921 |
| 1987 | 0 | 68,939,195 | 0 | 82,614,055 | 0 | 0 | 0 | 0 | 99,411,597 |
| 1988 | 0 | 79,936,309 | 0 | 92,720,660 | 0 | 0 | 0 | 0 | 108,898,833 |
| 1989 | 0 | 68,311,546 | 0 | 78,302,473 | 0 | 0 | 0 | 0 | 89,857,307 |
| 1990 | 0 | 83,964,409 | 277,885 | 95,002,982 | 0 | 0 | 0 | 0 | 104,000,038 |
| 1991 | 0 | 54,214,229 | 132,209 | 61,123,236 | 0 | 0 | 0 | 0 | 64,233,890 |
| 1992 | 0 | 72,401,054 | 0 | 82,482,592 | 0 | 0 | 0 | 0 | 92,173,695 |
| 1993 | 0 | 55,312,615 | 0 | 69,847,379 | 0 | 0 | 0 | 0 | 87,174,348 |
| 1994 | 0 | 72,838,621 | 0 | 86,354,006 | 0 | 0 | 0 | 0 | 97,722,979 |
| 1995 | 0 | 40,862,813 | 0 | 56,786,199 | 0 | 0 | 0 | 0 | 74,988,898 |
| 1996 | 0 | 36,536,259 | 401 | 57,198,086 | 0 | 0 | 0 | 0 | 71,940,675 |
| 1997 | 0 | 37,121,379 | 108,559 | 54,131,368 | 0 | 0 | 0 | 0 | 65,536,671 |
| 1998 | 0 | 30,341,609 | 149,170 | 52,004,747 | 0 | 0 | 0 | 0 | 65,310,733 |
| 1999 | 0 | 42,257,580 | 106,226 | 58,122,094 | 0 | 0 | 0 | 0 | 72,133,666 |
| 2000 | 0 | 43,977,877 | 123,318 | 52,641,597 | 0 | 0 | 0 | 0 | 60,213,003 |
| 2001 | 0 | 49,405,276 | 84,868 | 56,980,422 | 0 | 0 | 0 | 0 | 62,827,875 |
| 2002 | 0 | 45,412,974 | 153,549 | 54,123,159 | 0 | 0 | 0 | 0 | 59,683,427 |
| 2003 | 3,303 | 41,917,356 | 129,134 | 48,071,447 | 0 | 0 | 0 | 0 | 53,245,891 |
| 2004 | 44,648 | 58,676,035 | 170,851 | 67,126,699 | 0 | 0 | 0 | 0 | 73,135,768 |
| 2005 | 41,448 | 56,220,579 | 61,131 | 66,633,000 | 0 | 0 | 0 | 0 | 75,946,420 |
| 2006 | 265,078 | 60,701,335 | 70,268 | 76,767,951 | 0 | 0 | 0 | 0 | 85,894,802 |
| 2007 | 248,328 | 61,354,857 | 119,861 | 76,763,990 | 0 | 0 | 0 | 0 | 83,828,015 |
| 2008 | 616,986 | 72,144,765 | 300,729 | 93,579,549 | 0 | 0 | 0 | 0 | 102,461,628 |
| 2009 | 819,589 | 71,530,603 | 313,357 | 93,493,812 | 0 | 0 | 0 | 0 | 102,494,682 |
| 2010 | 1,048,807 | 88,263,837 | 322,003 | 117,224,130 | 0 | 0 | 0 | 0 | 128,041,374 |
| 2011 | 954,501 | 80,381,761 | 225,564 | 100,750,482 | 0 | 0 | 0 | 0 | 113,077,671 |
| 2012 | 1,225,982 | 78,031,475 | 299,385 | 110,930,718 | 0 | 0 | 0 | 0 | 121,679,597 |
| 2013 | 679,437 | 49,351,291 | 144,019 | 63,597,885 | 0 | 0 | 0 | 0 | 71,469,014 |
| 2014 | 284,110 | 24,242,063 | 30,070 | 30,264,816 | 0 | 0 | 0 | 0 | 34,698,576 |
| 2015 | 92,664 | 15,050,985 | 28,825 | 18,810,001 | 0 | 0 | 0 | 0 | 21,206,746 |
| 2016 | 17,610 | 3,261,543 | 7,192 | 4,115,708 | 0 | 0 | 0 | 0 | 4,648,897 |
| **2017** | **11,267** | **3,037,319** | **6,277** | **3,777,381** | **0** | **0** | **0** | **0** | **4,300,000** |
| 2018 | 34,282 | 2,085,052 | 6,119 | 2,974,441 | 0 | 0 | 0 | 0 | 3,300,000 |
| 2019 | 2,067 | 126,403 | 369 | 180,477 | 0 | 0 | 0 | 0 | 200,000 |
| 2020 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2021 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2022 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2023 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2024 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2025 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2026 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2027 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2028 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2029 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2030 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2031 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2032 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2033 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2034 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| 2035 | 2,066 | 126,393 | 369 | 180,462 | 0 | 0 | 0 | 0 | 200,000 |
| **TOTAL** | **6,423,164** | **1,857,282,022** | **3,377,242** | **2,312,307,988** | **0** | **0** | **0** | **0** | **2,655,969,229** |

[a] 1983 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include both debt service and bond cover.

[b] 2009 through 2017 charges include Reid Gardner separation costs that are allocated to contractors based on theoretical energy use over the facility service life, 1983–2013.

[c] Costs allocated to contractors in 1989 through 2002 are reduced by credits for Off-Aqueduct Power Facility costs allocated to the pumping of non-SWP water.

## TABLE B-17 Unit Variable OMP&R Component of Transportation Charge (in dollars per acre-foot)



| | NORTH BAY AQUEDUCT | | | | | | SOUTH BAY AQUEDUCT | | CALIFORNIA AQUEDUCT | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Reach 1 Barker Slough Pumping Plant | | Reach 3A Cordelia Pumping Plant Solano | | Reach 3B Cordelia Pumping Plant Napa[a] | | Reach 1 South Bay and Del Valle Pumping Plants[b] | | Reach 1 Banks Pumping Plant | |
| Calendar Year | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 4.1511341 | 4.1511341 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 4.5639383 | 4.5639383 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5452154 | 3.5452154 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 4.1911773 | 4.1911773 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5074573 | 3.5074573 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 3.9306767 | 4.1752198 | 0.2445431 | 0.2445431 |
| 1968 | 0 | 0 | 0 | 0 | 5.7570017 | 5.7570017 | 3.3315620 | 4.8750942 | 1.5435322 | 1.5435322 |
| 1969 | 0 | 0 | 0 | 0 | 3.1823595 | 3.1823595 | 3.6949019 | 4.8016170 | 1.1067151 | 1.1067151 |
| 1970 | 0 | 0 | 0 | 0 | 3.7584301 | 3.7584301 | 4.4256141 | 5.3721490 | 0.9465349 | 0.9465349 |
| 1971 | 0 | 0 | 0 | 0 | 4.2082507 | 4.2082507 | 3.8714396 | 4.7522833 | 0.8808437 | 0.8808437 |
| 1972 | 0 | 0 | 0 | 0 | 3.9577735 | 3.9577735 | 4.3250690 | 5.2281686 | 0.9030996 | 0.9030996 |
| 1973 | 0 | 0 | 0 | 0 | 3.8103903 | 3.8103903 | 5.2455409 | 6.1841801 | 0.9386391 | 0.9386391 |
| 1974 | 0 | 0 | 0 | 0 | 3.5878850 | 3.5878850 | 6.3321503 | 7.2293909 | 0.8972406 | 0.8972406 |
| 1975 | 0 | 0 | 0 | 0 | 2.1606725 | 2.1606725 | 3.7365711 | 4.8327731 | 1.0962020 | 1.0962020 |
| 1976 | 0 | 0 | 0 | 0 | 2.9283909 | 2.9283909 | 4.5191527 | 5.7132795 | 1.1941268 | 1.1941268 |
| 1977 | 0 | 0 | 0 | 0 | 2.7516411 | 2.7516411 | 4.7630172 | 6.5309908 | 1.7679736 | 1.7679736 |
| 1978 | 0 | 0 | 0 | 0 | 3.5949619 | 3.5949619 | 5.2086183 | 6.8200210 | 1.6114026 | 1.6114026 |
| 1979 | 0 | 0 | 0 | 0 | 2.4747752 | 2.4747752 | 4.9524184 | 7.0944849 | 2.1420665 | 2.1420665 |
| 1980 | 0 | 0 | 0 | 0 | 2.9737588 | 2.9737588 | 4.5186576 | 5.8810391 | 1.3623815 | 1.3623815 |
| 1981 | 0 | 0 | 0 | 0 | 2.6488168 | 2.6488168 | 4.3834851 | 6.4541818 | 2.0706967 | 2.0706967 |
| 1982 | 0 | 0 | 0 | 0 | 10.0222589 | 10.0222589 | 5.6383622 | 7.4005197 | 1.7621575 | 1.7621575 |
| 1983 | 0 | 0 | 0 | 0 | 1.0240490 | 1.0240490 | 0.8686401 | 1.7143948 | 0.8457546 | 0.8457546 |
| 1984 | 0 | 0 | 0 | 0 | 1.6496750 | 1.6496750 | 2.7674018 | 3.9368186 | 1.1694168 | 1.1694168 |
| 1985 | 0 | 0 | 0 | 0 | 2.5224065 | 2.5224065 | 3.6942206 | 5.2987621 | 1.6045415 | 1.6045415 |
| 1986 | 0 | 0 | 0 | 0 | 4.4049446 | 4.4049446 | 7.2799222 | 10.5919298 | 3.3120077 | 3.3120077 |
| 1987 | 0 | 0 | 0 | 0 | 3.5386715 | 3.5386715 | 6.4837861 | 9.2276309 | 2.7438448 | 2.7438448 |
| 1988 | 1.1782643 | 1.1782643 | 0 | 1.1782643 | 4.4547478 | 5.6330121 | 6.1750026 | 8.8623074 | 2.6873049 | 2.6873049 |
| 1989 | 1.2715449 | 1.2715449 | 2.5423866 | 3.8139316 | 4.2807103 | 5.5522552 | 8.1617218 | 11.6840191 | 3.5222973 | 3.5222973 |
| 1990 | 2.0026083 | 2.0026083 | 4.2324041 | 6.2350124 | 5.8753602 | 7.8779685 | 11.7200790 | 15.8516543 | 4.1315753 | 4.1315753 |
| 1991 | 1.2486830 | 1.2486830 | 2.6246433 | 3.8733263 | 3.8057971 | 5.0544801 | 7.5402615 | 11.2354099 | 3.6951485 | 3.6951485 |
| 1992 | 0.7094386 | 0.7094386 | 1.4175705 | 2.1270091 | 2.3509123 | 3.0603509 | 4.0600958 | 6.3925272 | 2.3324315 | 2.3324315 |
| 1993 | -0.3464574 | -0.3464574 | -0.6048649 | -0.9513223 | -1.0200530 | -1.3665104 | -1.4929934 | -1.2571378 | 0.2358556 | 0.2358556 |
| 1994 | 1.4600287 | 1.4600287 | 2.6570107 | 4.1170394 | 4.2975560 | 5.7575847 | 7.9510779 | 11.2405895 | 3.2895116 | 3.2895116 |
| 1995 | 0.7544766 | 0.7544766 | 1.2974265 | 2.0519031 | 2.2753763 | 3.0298529 | 3.2312761 | 5.2610469 | 2.0297708 | 2.0297708 |
| 1996 | 1.6427835 | 1.6427835 | 2.7704025 | 4.4131859 | 4.7993051 | 6.4420886 | 8.0186492 | 11.3633990 | 3.3447498 | 3.3447498 |
| 1997 | 1.7801484 | 1.7801484 | 3.0246843 | 4.8048327 | 5.0575904 | 6.8377388 | 9.6521246 | 12.6148370 | 2.9627125 | 2.9627125 |
| 1998 | -0.3253238 | -0.3253238 | -0.5570754 | -0.8823992 | -0.9104311 | -1.2357549 | -1.8866894 | -1.7684350 | 0.1182544 | 0.1182544 |
| 1999 | 0.7843563 | 0.7843563 | 1.2927037 | 2.0770600 | 2.1913971 | 2.9757534 | 3.9861234 | 6.3557474 | 2.3696240 | 2.3696240 |
| 2000 | 1.3829278 | 1.3829278 | 1.9789654 | 3.3618932 | 3.0505466 | 4.4334744 | 6.3152141 | 8.6279347 | 2.3127206 | 2.3127206 |
| 2001 | 8.1780479 | 8.1780479 | 12.7154051 | 20.8934529 | 22.9802761 | 31.1583239 | 42.7861432 | 55.6945641 | 12.9084209 | 12.9084209 |
| 2002 | 4.1894843 | 4.1894843 | 5.3026984 | 9.4921827 | 8.9411156 | 13.1306000 | 18.1280636 | 24.2060285 | 6.0779649 | 6.0779649 |
| 2003 | 4.3318595 | 4.3318595 | 7.0890449 | 11.4209044 | 12.8010554 | 17.1329149 | 19.2856231 | 26.0104983 | 6.7248752 | 6.7248752 |
| 2004 | 4.9006056 | 4.9006056 | 6.4207890 | 11.3213946 | 12.6192952 | 17.5199009 | 19.8710473 | 27.1446743 | 7.2736270 | 7.2736270 |
| 2005 | 6.2706237 | 6.2706237 | 7.7072771 | 13.9779008 | 18.6144338 | 24.8850574 | 25.9514011 | 34.0659018 | 8.1145007 | 8.1145007 |
| 2006 | 5.4259377 | 5.4259377 | 6.2412600 | 11.6671976 | 18.2458557 | 23.6717934 | 22.8226972 | 29.6194124 | 6.7967153 | 6.7967153 |
| 2007 | 7.7565590 | 7.7565590 | 8.2045346 | 15.9610936 | 22.7900532 | 30.5466123 | 31.6227665 | 40.8504831 | 9.2277166 | 9.2277166 |
| 2008 | 7.7587563 | 7.7587563 | 10.0666989 | 17.8254552 | 21.9760357 | 29.7347920 | 28.5919449 | 40.9578318 | 12.3658869 | 12.3658869 |
| 2009 | 5.2291150 | 5.2291150 | 6.6742086 | 11.9033236 | 14.3314002 | 19.5605152 | 21.2131796 | 27.0988402 | 5.8856607 | 5.8856607 |
| 2010 | 6.0244466 | 6.0244466 | 8.7803566 | 14.8048032 | 16.7630949 | 22.7875415 | 24.7925097 | 35.7184619 | 10.9259523 | 10.9259523 |
| 2011 | 6.8810183 | 6.8810183 | 9.0458323 | 15.9268506 | 20.2556452 | 27.1366636 | 29.9707962 | 40.8032460 | 10.8324498 | 10.8324498 |
| 2012 | 6.9391963 | 6.9391963 | 9.6107660 | 16.5499622 | 19.2648925 | 26.2040888 | 31.5821999 | 42.0741970 | 10.4919971 | 10.4919971 |
| 2013 | 9.0016171 | 9.0016171 | 10.7222346 | 19.7238517 | 25.8706892 | 34.8723063 | 36.5729919 | 49.6652267 | 13.0922348 | 13.0922348 |
| 2014 | 10.6675197 | 10.6675197 | 14.9362696 | 25.6037893 | 31.5502018 | 42.2177215 | 45.0411127 | 64.6008573 | 19.5597446 | 19.5597446 |
| 2015 | 11.1070333 | 11.1070333 | 15.6052627 | 26.7122960 | 32.2272002 | 43.3342335 | 47.6577519 | 67.6344777 | 19.9767258 | 19.9767258 |
| 2016 | 12.0505437 | 12.0505437 | 17.0043249 | 29.0548686 | 27.3496651 | 39.4002088 | 42.4158667 | 61.0998848 | 18.6840181 | 18.6840181 |
| **2017** | **13.6482513** | **13.6482513** | **22.5991385** | **36.2473898** | **34.4854191** | **48.1336704** | **40.1120752** | **55.4900856** | **15.3780104** | **15.3780104** |
| 2018 | 13.8784935 | 13.8784935 | 22.9804890 | 36.8589826 | 35.0672790 | 48.9457725 | 41.0438323 | 57.1268034 | 16.0829711 | 16.0829711 |
| 2019 | 12.4298135 | 12.4298135 | 24.4961358 | 36.9259494 | 31.3103904 | 43.7402039 | 43.3114054 | 61.1859824 | 17.8745769 | 17.8745769 |
| 2020 | 12.7000651 | 12.7000651 | 25.0287597 | 37.7288247 | 31.9911596 | 44.6912246 | 44.2557523 | 58.0828204 | 13.8270681 | 13.8270681 |
| 2021 | 12.5008890 | 12.5008890 | 24.6361333 | 37.1370223 | 31.4893800 | 43.9902690 | 43.5616307 | 60.0619089 | 16.5002782 | 16.5002782 |
| 2022 | 12.6589549 | 12.6589549 | 24.9476752 | 37.6066301 | 31.8875431 | 44.5464980 | 44.1124805 | 60.5807489 | 16.4682684 | 16.4682684 |
| 2023 | 12.5923027 | 12.5923027 | 24.8164196 | 37.4087223 | 31.7196900 | 44.3119927 | 43.8802116 | 58.5000618 | 14.6198502 | 14.6198502 |
| 2024 | 12.6415004 | 12.6415004 | 24.9133409 | 37.5548414 | 31.8435706 | 44.4850710 | 44.0516216 | 58.6302448 | 14.5786233 | 14.5786233 |
| 2025 | 12.7153946 | 12.7153946 | 25.0589130 | 37.7743076 | 32.0297359 | 44.7451306 | 44.3091586 | 58.3408211 | 14.0316625 | 14.0316625 |
| 2026 | 12.4804206 | 12.4804206 | 24.5958444 | 37.0762651 | 31.4378301 | 43.9182507 | 43.4903205 | 59.6085946 | 16.1182741 | 16.1182741 |
| 2027 | 12.5697962 | 12.5697962 | 24.7719498 | 37.3417460 | 31.6629736 | 44.2327698 | 43.8017542 | 59.1271401 | 15.3253859 | 15.3253859 |
| 2028 | 12.6183868 | 12.6183868 | 24.8677309 | 37.4861177 | 31.7853617 | 44.4037485 | 43.9711302 | 59.0120236 | 15.0408934 | 15.0408934 |
| 2029 | 12.6590633 | 12.6590633 | 24.9479285 | 37.6069919 | 31.8878301 | 44.5468934 | 44.1128584 | 59.3482150 | 15.2353566 | 15.2353566 |
| 2030 | 12.7068734 | 12.7068734 | 25.0421893 | 37.7490627 | 32.0082664 | 44.7151397 | 44.2794848 | 56.5367451 | 12.2572603 | 12.2572603 |
| 2031 | 12.7099740 | 12.7099740 | 25.0482706 | 37.7582446 | 32.0160735 | 44.7260475 | 44.2902256 | 60.7605292 | 16.4703036 | 16.4703036 |
| 2032 | 12.4901995 | 12.4901995 | 24.6151020 | 37.1053015 | 31.4624570 | 43.9526564 | 43.5243918 | 60.6610271 | 17.1366353 | 17.1366353 |
| 2033 | 12.7573938 | 12.7573938 | 25.1417712 | 37.8991650 | 32.1355339 | 44.8929276 | 44.4555336 | 56.4953435 | 12.0398099 | 12.0398099 |
| 2034 | 12.5735906 | 12.5735906 | 24.7795515 | 37.3531421 | 31.6725603 | 44.2461509 | 43.8150355 | 59.1748840 | 15.3598486 | 15.3598486 |
| 2035 | 12.4980052 | 12.4980052 | 24.6305587 | 37.1285639 | 31.4821470 | 43.9801522 | 43.5516055 | 70.5986786 | 27.0470731 | 27.0470731 |

[a] For the period 1968 through 1987, rates are for an interim facility.

[b] The relatively minor costs of Del Valle Pumping Plant have been combined with those of South Bay Pumping Plant to simplify the allocation procedure.

## TABLE B-17 Unit Variable OMP&R Component of Transportation Charge (in dollars per acre-foot)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Reach 4 Dos Amigos Pumping Plant | | Reach 14A Buena Vista Pumping Plant | | Reach 15A Teerink Pumping Plant | | Reach 16A Chrisman Pumping Plant | | Reach 17E Edmonston Pumping Plant | |
| | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 1.0732031 | 2.6167353 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0.7028165 | 1.8095316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0.7813430 | 1.7278778 | 0.3333333 | 2.0612111 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0.4125312 | 1.2933749 | 1.1407617 | 2.4341366 | 0.7218469 | 3.1559834 | 0 | 0 | 0 | 0 |
| 1972 | 0.5662758 | 1.4693754 | 0.8894941 | 2.3588694 | 0.8040021 | 3.1628715 | 1.8113853 | 4.9742569 | 7.3206022 | 12.2948591 |
| 1973 | 0.5996892 | 1.5383283 | 0.8469026 | 2.3852309 | 1.0302066 | 3.4154375 | 1.8458304 | 5.2612679 | 7.4512435 | 12.7125113 |
| 1974 | 0.5736894 | 1.4709300 | 0.8122890 | 2.2832190 | 0.9665911 | 3.2498101 | 1.7739395 | 5.0237496 | 6.9004732 | 11.9242227 |
| 1975 | 0.4606980 | 1.5569000 | 0.7554447 | 2.3123448 | 0.8894108 | 3.2017555 | 1.8682537 | 5.0700092 | 6.9962702 | 12.0662794 |
| 1976 | 0.5163828 | 1.7105095 | 0.9081491 | 2.6186586 | 0.9640628 | 3.5827214 | 2.1499640 | 5.7326854 | 7.9384515 | 13.6711369 |
| 1977 | 0.6138931 | 2.3818668 | 0.9835371 | 3.3654038 | 1.2303967 | 4.5958005 | 2.7357728 | 7.3315733 | 9.9990004 | 17.3305737 |
| 1978 | 0.4545898 | 2.0659925 | 0.9044582 | 2.9704506 | 0.9762058 | 3.9466564 | 1.8872449 | 5.8339014 | 7.0810192 | 12.9149206 |
| 1979 | 0.6587934 | 2.8008600 | 1.0519199 | 3.8527798 | 1.1976258 | 5.0504056 | 2.6012890 | 7.6516946 | 9.6345625 | 17.2862572 |
| 1980 | 0.8021465 | 2.1645280 | 1.3516057 | 3.5161337 | 1.5041463 | 5.0202800 | 3.1923433 | 8.2126233 | 10.9860288 | 19.1986521 |
| 1981 | 1.0923907 | 3.1630874 | 1.2409168 | 4.4040042 | 1.3219771 | 5.7259813 | 2.9592932 | 8.6852745 | 9.9649551 | 18.6502296 |
| 1982 | 0.8326785 | 2.5948359 | 1.2041660 | 3.7990019 | 1.3723736 | 5.1713756 | 2.8986491 | 8.0700247 | 10.2096358 | 18.2796606 |
| 1983 | 0.3647859 | 1.2105406 | 0.7590265 | 1.9695670 | 0.8857383 | 2.8553053 | 1.7623405 | 4.6176458 | 5.5086367 | 10.1262825 |
| 1984 | 0.6581523 | 1.8275691 | 1.0533611 | 2.8809302 | 1.2188270 | 4.0997572 | 2.5407768 | 6.6405340 | 8.2344665 | 14.8750006 |
| 1985 | 0.8726163 | 2.4771579 | 1.4204831 | 3.8976409 | 1.6516291 | 5.5492701 | 3.4695783 | 9.0188484 | 11.8181234 | 20.8369718 |
| 1986 | 1.3996542 | 4.7116618 | 2.3713282 | 7.0829901 | 2.7567970 | 9.8397871 | 5.9534613 | 15.7932484 | 20.6010240 | 36.3942724 |
| 1987 | 1.2912643 | 4.0351091 | 2.2344385 | 6.2695476 | 2.5459999 | 8.8155474 | 5.3141190 | 14.1296664 | 17.7628277 | 31.8924941 |
| 1988 | 1.1947837 | 3.8820886 | 2.1129991 | 5.9950877 | 2.4017135 | 8.3968012 | 5.0055748 | 13.4023759 | 16.6001692 | 30.0025452 |
| 1989 | 1.4935226 | 5.0158199 | 2.6947446 | 7.7105645 | 3.0084211 | 10.7189856 | 6.5499538 | 17.2689394 | 22.1795336 | 39.4484730 |
| 1990 | 1.8962463 | 6.0278216 | 3.3080372 | 9.3358588 | 3.7483036 | 13.0841624 | 8.6832678 | 21.7674302 | 31.0405219 | 52.8079521 |
| 1991 | 1.0437991 | 4.7389476 | 2.1132495 | 6.8521971 | 2.4154810 | 9.2676780 | 5.6823745 | 14.9500525 | 20.4744695 | 35.4245220 |
| 1992 | 0.9002103 | 3.2326417 | 1.4836761 | 4.7163178 | 1.7077297 | 6.4240475 | 3.5445788 | 9.9686263 | 12.0459599 | 22.0145862 |
| 1993 | 0.1605206 | 0.3963762 | -0.1405164 | 0.2558598 | -0.1312944 | 0.1245654 | -0.7754796 | -0.6509143 | -3.5828989 | -4.2338132 |
| 1994 | 1.4208578 | 4.7103693 | 2.5100856 | 7.2204549 | 2.8029168 | 10.0233717 | 6.0772944 | 16.1006661 | 21.5000984 | 37.6007645 |
| 1995 | 0.7974861 | 2.8272569 | 1.3474564 | 4.1747133 | 1.4945529 | 5.6692662 | 3.1250716 | 8.7943378 | 10.7461772 | 19.5405149 |
| 1996 | 1.6726383 | 5.0173881 | 2.5952092 | 7.6125973 | 2.8425227 | 10.4551200 | 6.3087407 | 16.7638607 | 22.6420778 | 39.4059385 |
| 1997 | 1.2769880 | 4.2397005 | 2.5012144 | 6.7409148 | 2.6893394 | 9.4302542 | 6.2890095 | 15.7192637 | 23.0714697 | 38.7907334 |
| 1998 | -0.2195574 | -0.1013030 | -0.4232465 | -0.5245494 | -0.4504610 | -0.9750105 | -1.0585256 | -2.0335361 | -3.8077856 | -5.8413217 |
| 1999 | 0.8412976 | 3.2109216 | 1.4071463 | 4.6180679 | 1.2831855 | 5.9012534 | 3.4289262 | 9.3301795 | 13.6776471 | 23.0078267 |
| 2000 | 0.9329791 | 3.2456997 | 1.6371180 | 4.8828178 | 1.8023858 | 6.6852036 | 4.2443196 | 10.9295232 | 15.5370734 | 26.4665966 |
| 2001 | 6.1327071 | 19.0411280 | 11.3023513 | 30.3434793 | 12.3930201 | 42.7364994 | 28.6439963 | 71.3804957 | 107.2108863 | 178.5913820 |
| 2002 | 2.6241510 | 8.7021160 | 4.6014508 | 13.3035668 | 5.0195661 | 18.3231329 | 11.6145173 | 29.9376502 | 43.1568537 | 73.0945038 |
| 2003 | 3.1186670 | 9.8435422 | 5.5847004 | 15.4282425 | 6.0839458 | 21.5121883 | 14.1509765 | 35.6631648 | 52.6129029 | 88.2760677 |
| 2004 | 3.3308086 | 10.6044356 | 5.8670943 | 16.4715299 | 6.3736662 | 22.8451961 | 14.8467033 | 37.6918994 | 55.1954462 | 92.8873456 |
| 2005 | 3.8324365 | 11.9469372 | 6.8775620 | 18.8244992 | 7.4553008 | 26.2798000 | 17.3347915 | 43.6145915 | 62.0851423 | 105.6997338 |
| 2006 | 3.1056782 | 9.9023935 | 5.7702305 | 15.6726240 | 6.2099396 | 21.8825636 | 14.5146252 | 36.3971888 | 46.2231736 | 82.6203624 |
| 2007 | 4.5130560 | 13.7407726 | 8.0770771 | 21.8178497 | 8.7444274 | 30.5622771 | 20.2730047 | 50.8352818 | 68.5883222 | 119.4236041 |
| 2008 | 4.7806627 | 17.1465496 | 8.8992367 | 26.0457863 | 10.3464784 | 36.3922647 | 21.5891194 | 57.9813841 | 68.8617605 | 126.8431446 |
| 2009 | 3.0950474 | 8.9807080 | 5.6803844 | 14.6610924 | 6.2868178 | 20.9479102 | 13.8621915 | 34.8101017 | 63.6310725 | 98.4411742 |
| 2010 | 4.1025490 | 15.0285013 | 7.0390876 | 22.0675889 | 7.6367372 | 29.7043261 | 17.4759473 | 47.1802734 | 64.8578039 | 112.0380773 |
| 2011 | 4.5736663 | 15.4061160 | 8.0443320 | 23.4504480 | 8.6659945 | 32.1164425 | 19.9425101 | 52.0589526 | 70.8487617 | 122.9077144 |
| 2012 | 4.7414022 | 15.2333993 | 8.2301173 | 23.4635165 | 9.0103751 | 32.4738916 | 20.7355174 | 53.2094090 | 73.8288314 | 127.0382404 |
| 2013 | 5.6432914 | 18.7355262 | 9.6815642 | 28.4170904 | 10.5484550 | 38.9655454 | 24.4524881 | 63.4180334 | 87.5980614 | 151.0160948 |
| 2014 | 8.3591575 | 27.9189021 | 13.6747187 | 41.5936208 | 15.1053722 | 56.6989930 | 34.5276323 | 91.2266253 | 125.6600845 | 216.8867098 |
| 2015 | 7.4153962 | 27.3921220 | 13.4330537 | 40.8251758 | 14.7882390 | 55.6134148 | 33.4446627 | 89.0580774 | 124.0000930 | 213.0581704 |
| 2016 | 5.4964895 | 24.1805076 | 10.7967261 | 34.9772337 | 11.8325979 | 46.8098315 | 27.1594948 | 73.9693264 | 100.4531234 | 174.4224497 |
| **2017** | **6.7379845** | **22.1159949** | **12.0583164** | **34.1743113** | **13.0672326** | **47.2415438** | **30.3117361** | **77.5532799** | **112.6969523** | **190.2502323** |
| 2018 | 7.0692342 | 23.1522052 | 12.8202492 | 35.9724544 | 13.9243827 | 49.8968371 | 32.3246413 | 82.2214784 | 120.2637636 | 202.4852421 |
| 2019 | 7.3435669 | 25.2181438 | 13.0716229 | 38.2897667 | 14.1380739 | 52.4278406 | 32.7662161 | 85.1940567 | 121.7728942 | 206.9669510 |
| 2020 | 7.6689718 | 21.4960399 | 13.8060515 | 35.3020914 | 14.9601690 | 50.2622604 | 34.6929708 | 84.9552312 | 129.0075948 | 213.9628260 |
| 2021 | 7.5133981 | 24.0136763 | 13.4928562 | 37.5065325 | 14.6148804 | 52.1214129 | 33.8876640 | 86.0090769 | 125.9972379 | 212.0063148 |
| 2022 | 7.6539251 | 24.1221935 | 13.7882287 | 37.9104222 | 14.9425150 | 52.8529372 | 34.6533160 | 87.5062532 | 128.8645747 | 216.3708279 |
| 2023 | 7.6636111 | 22.2834614 | 13.8535313 | 36.1369926 | 15.0218914 | 51.1588840 | 34.8440697 | 86.0029537 | 129.5969599 | 215.5999135 |
| 2024 | 7.5965498 | 22.1751731 | 13.6409105 | 35.8160836 | 14.7750193 | 50.5911029 | 34.2588035 | 84.8499064 | 127.3765585 | 212.2264648 |
| 2025 | 7.7176163 | 21.7492788 | 13.9311533 | 35.6804321 | 15.1024662 | 50.7828984 | 35.0281821 | 85.8110805 | 130.2721158 | 216.0831962 |
| 2026 | 7.4588993 | 23.5771734 | 13.3558116 | 36.9329850 | 14.4594751 | 51.3924601 | 33.5219381 | 84.9143982 | 124.6188637 | 209.5332619 |
| 2027 | 7.6465425 | 22.9719284 | 13.8194456 | 36.7913740 | 14.9843494 | 51.7757234 | 34.7565388 | 86.5322623 | 129.2698435 | 215.8021058 |
| 2028 | 7.5790867 | 22.6199801 | 13.6062010 | 36.2261811 | 14.7368269 | 50.9630080 | 34.1697846 | 85.1327927 | 127.0439875 | 212.1767801 |
| 2029 | 7.6721964 | 22.9075531 | 13.8384620 | 36.7460150 | 15.0000607 | 51.7460757 | 34.7891775 | 86.5352532 | 129.3781071 | 215.9133603 |
| 2030 | 7.6053462 | 19.8626065 | 13.6283347 | 33.4909412 | 14.7563496 | 48.2472908 | 34.2116094 | 82.4589002 | 127.1876218 | 209.6465220 |
| 2031 | 8.0026688 | 24.4729724 | 14.7372376 | 39.2102100 | 16.0299233 | 55.2401333 | 37.2210183 | 92.4611516 | 138.5717733 | 231.0329249 |
| 2032 | 7.2823271 | 24.4189624 | 12.8769780 | 37.2959404 | 13.9125881 | 51.2085285 | 32.2321043 | 83.4406328 | 119.7482257 | 203.1888585 |
| 2033 | 8.0224081 | 20.0622180 | 14.7631599 | 34.8253779 | 16.0561971 | 50.8815750 | 37.2805276 | 88.1621027 | 138.7881370 | 226.9502396 |
| 2034 | 7.3779964 | 22.7378449 | 13.0879691 | 35.8258140 | 14.1478842 | 49.9736982 | 32.7828852 | 82.7565834 | 121.8139557 | 204.5705391 |
| 2035 | 8.4083678 | 35.4554408 | 16.1022683 | 51.5577092 | 17.6340306 | 69.1917398 | 41.0395607 | 110.2313005 | 153.1144904 | 263.3457909 |

**TABLE B-17 Unit Variable OMP&R Component of Transportation Charge (in dollars per acre-foot)** Sheet 3 of 5

| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 18A Alamo Powerplant | | Reach 22B Pearblossom Pumping Plant | | Reach 23 Mojave Siphon Powerplant | | Reach 26A Devil Canyon Powerplant | |
| | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate |
| | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 1.9331104 | 14.2279695 | 0 | 0 | -2.3717647 | 11.8562048 |
| 1973 | 0 | 0 | 3.8751940 | 16.5877053 | 0 | 0 | -8.9027252 | 7.6849801 |
| 1974 | 0 | 0 | 3.1602116 | 15.0844343 | 0 | 0 | -5.3440968 | 9.7403376 |
| 1975 | 0 | 0 | 3.0210558 | 15.0873353 | 0 | 0 | -5.7803309 | 9.3070043 |
| 1976 | 0 | 0 | 3.7579009 | 17.4290378 | 0 | 0 | -6.6439666 | 10.7850713 |
| 1977 | 0 | 0 | 3.0796474 | 20.4102211 | 0 | 0 | -12.0911833 | 8.3190378 |
| 1978 | 0 | 0 | 4.0233030 | 16.9382236 | 0 | 0 | -8.2569506 | 8.6812730 |
| 1979 | 0 | 0 | 5.0776468 | 22.3639040 | 0 | 0 | -9.7140035 | 12.6499005 |
| 1980 | 0 | 0 | 4.3918283 | 23.5904804 | 0 | 0 | -8.3797007 | 15.2107797 |
| 1981 | 0 | 0 | 3.9973528 | 22.6475824 | 0 | 0 | -6.7528590 | 15.8947235 |
| 1982 | 0 | 0 | 3.6829998 | 21.9626604 | 0 | 0 | -6.9238898 | 15.0387706 |
| 1983 | 0 | 0 | 1.7205305 | 11.8468130 | 0 | 0 | -23.7923457 | -11.9455328 |
| 1984 | 0 | 0 | 2.4763871 | 17.3513877 | 0 | 0 | -29.2940447 | -11.9426570 |
| 1985 | 0 | 0 | 3.4967556 | 24.3337274 | 0 | 0 | -30.7672356 | -6.4335082 |
| 1986 | -2.3583180 | 34.0359544 | 5.9864597 | 40.0224141 | 0 | 0 | -29.2499580 | 10.7724561 |
| 1987 | -2.5482255 | 29.3442686 | 5.0535029 | 34.3977715 | 0 | 0 | -29.7006534 | 4.6971181 |
| 1988 | -1.3847067 | 28.6178385 | 4.7392460 | 33.3570844 | 0 | 0 | -29.0334518 | 4.3236326 |
| 1989 | -1.1019487 | 38.3465243 | 6.4066114 | 44.7531357 | 0 | 0 | -28.3706997 | 16.3824360 |
| 1990 | -1.0673268 | 51.7406253 | 8.9787944 | 60.7194197 | 0 | 0 | -28.8797266 | 31.8396931 |
| 1991 | -1.5206590 | 33.9038630 | 6.0785417 | 39.9824047 | 0 | 0 | -30.3294563 | 9.6529484 |
| 1992 | -2.6080003 | 19.4065859 | 3.6219501 | 23.0285360 | 0 | 0 | -29.7938993 | -6.7653633 |
| 1993 | -0.1885524 | -4.4223656 | -1.0192774 | -5.4416430 | 0 | 0 | -30.6629489 | -36.1045919 |
| 1994 | -0.1279266 | 37.4728379 | 6.4513573 | 43.9241952 | 0 | 0 | -30.4781656 | 13.4460296 |
| 1995 | -3.4425314 | 16.0979836 | 3.3643070 | 19.4622905 | 0 | 0 | -30.3517624 | -10.8894719 |
| 1996 | -5.9839345 | 33.4220040 | 6.6794995 | 40.1015035 | -2.3423415 | 37.7591620 | -29.5900574 | 8.1691046 |
| 1997 | -4.7847600 | 34.0059734 | 6.8397922 | 40.8457656 | -3.8632009 | 36.9825646 | -30.6066647 | 6.3758999 |
| 1998 | -5.0614104 | -10.9027321 | -1.3239652 | -12.2266973 | -3.7700558 | -15.9967531 | -30.4293072 | -46.4260603 |
| 1999 | -4.8990186 | 18.1088081 | 3.7378677 | 21.8466757 | -5.1563836 | 16.6902921 | -30.2385322 | -13.5482400 |
| 2000 | -5.3488706 | 21.1177260 | 4.5812734 | 25.6989994 | -5.1804371 | 20.5185623 | -30.2852311 | -9.7666688 |
| 2001 | -4.6452108 | 173.9461712 | 30.0519705 | 203.9981416 | -5.7699537 | 198.2281879 | -30.9018397 | 167.3263483 |
| 2002 | -5.4660286 | 67.6284752 | 12.9716035 | 80.6000788 | -6.4072101 | 74.1928686 | -30.1661590 | 44.0267096 |
| 2003 | -3.3142156 | 84.9618520 | 15.4235840 | 100.3854360 | -7.1779336 | 93.2075024 | -30.3892607 | 62.8182418 |
| 2004 | -5.5767140 | 87.3106316 | 16.2223264 | 103.5329580 | -7.4292488 | 96.1037093 | -30.2389380 | 65.8647713 |
| 2005 | -5.5017080 | 100.1980258 | 17.9086202 | 118.1066460 | -6.6110924 | 111.4955536 | -30.2939296 | 81.2016240 |
| 2006 | -3.1387155 | 79.4816469 | 13.4499174 | 92.9315643 | -5.4976224 | 87.4339418 | -29.8005787 | 57.6333631 |
| 2007 | -2.7809944 | 116.6426096 | 20.0909768 | 136.7335865 | -6.1785168 | 130.5550697 | -30.0961198 | 100.4589500 |
| 2008 | -5.4028716 | 121.4402730 | 19.4618461 | 140.9021191 | -6.0198040 | 134.8823151 | -30.7631237 | 104.1191914 |
| 2009 | -6.3446584 | 92.0965158 | 21.4368911 | 113.5334069 | -5.4878092 | 108.0455978 | -33.3163094 | 74.7292884 |
| 2010 | -5.1259757 | 106.9121016 | 18.8366105 | 125.7487121 | -6.4398404 | 119.3088717 | -28.6783430 | 90.6305287 |
| 2011 | -5.2103711 | 117.6973433 | 20.8526451 | 138.5499884 | -7.1272044 | 131.4227840 | -29.9982569 | 101.4245272 |
| 2012 | -2.7221204 | 124.3161200 | 21.7626077 | 146.0787277 | -11.4254128 | 134.6533149 | -30.6216868 | 104.0316281 |
| 2013 | -3.7638094 | 147.2522854 | 25.9234628 | 173.1757482 | -10.3251093 | 162.8506389 | -30.7664075 | 132.0842314 |
| 2014 | -8.1801225 | 208.7065873 | 38.3996499 | 247.1062372 | -7.8617556 | 239.2444816 | -29.6636049 | 209.5808766 |
| 2015 | -9.0904712 | 203.9676992 | 40.2283289 | 244.1960281 | -9.4086610 | 234.7873672 | -29.7044693 | 205.0828979 |
| 2016 | -11.2000464 | 163.2224033 | 32.5872380 | 195.8096412 | -14.2556316 | 181.5540097 | -28.5973974 | 152.9566123 |
| **2017** | **-13.6285375** | **176.6216947** | **33.1870920** | **209.8087867** | **-20.5814926** | **189.2272941** | **-30.2784086** | **158.9488855** |
| 2018 | -15.0172257 | 187.4680164 | 37.6781100 | 225.1461264 | -23.1085927 | 202.0375337 | -34.0416188 | 167.9959149 |
| 2019 | -12.0347589 | 194.9321921 | 32.9592745 | 227.8914665 | -19.4902619 | 208.4012046 | -29.4683835 | 178.9328211 |
| 2020 | -12.6192915 | 201.3435345 | 35.5829609 | 236.9264954 | -20.6598260 | 216.2666694 | -31.2028139 | 185.0638555 |
| 2021 | -12.5819538 | 199.4243610 | 34.9035961 | 234.3279571 | -20.5837808 | 213.7441764 | -30.3333339 | 183.4108425 |
| 2022 | -12.6199978 | 203.7508301 | 35.4700894 | 239.2209195 | -20.6612656 | 218.5596538 | -29.6429696 | 188.9166842 |
| 2023 | -14.6820674 | 200.9178461 | 36.1202949 | 237.0381410 | -21.1832038 | 215.8549372 | -30.7397390 | 185.1151982 |
| 2024 | -13.9434906 | 198.2829742 | 34.1370111 | 232.4199853 | -19.8666037 | 212.5533816 | -30.2802924 | 182.2730892 |
| 2025 | -14.5460828 | 201.5371134 | 36.0771439 | 237.6142573 | -20.9383041 | 216.6759532 | -30.0858431 | 186.5901101 |
| 2026 | -14.0897278 | 195.4435341 | 34.1143937 | 229.5579278 | -20.1246754 | 209.4332523 | -30.5058592 | 178.9273932 |
| 2027 | -14.4442451 | 201.3578607 | 35.3714948 | 236.7293554 | -20.7556426 | 215.9737128 | -30.2766567 | 185.6970561 |
| 2028 | -14.2530704 | 197.9237098 | 34.9589391 | 232.8826489 | -20.4144459 | 212.4682030 | -30.5834057 | 181.8847973 |
| 2029 | -14.3441399 | 201.5692204 | 35.3338333 | 236.9030537 | -20.5767035 | 216.3263502 | -30.1691756 | 186.1571746 |
| 2030 | -14.1710283 | 195.4754937 | 34.9674634 | 230.4429571 | -20.2687015 | 210.1742556 | -30.2989829 | 179.8752727 |
| 2031 | -14.9279127 | 216.1050123 | 37.1771132 | 253.2821255 | -21.6288643 | 231.6532611 | -30.4129691 | 201.2402921 |
| 2032 | -13.5566311 | 189.6322273 | 32.6435721 | 222.2757995 | -19.1900078 | 203.0857917 | -29.4038947 | 173.6818970 |
| 2033 | -15.0698094 | 211.8804302 | 37.7345332 | 249.6149634 | -21.8878068 | 227.7271566 | -31.5314181 | 196.1957385 |
| 2034 | -13.8185923 | 190.7519467 | 33.5999892 | 224.3519360 | -19.6471984 | 204.7047376 | -29.2718498 | 175.4328878 |
| 2035 | -15.3045246 | 248.0412664 | 37.6487651 | 285.6900314 | -22.3189175 | 263.3711139 | -31.9702383 | 231.4008756 |

## TABLE B-17 Unit Variable OMP&R Component of Transportation Charge (in dollars per acre-foot)



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 2B (EBX) Greenspot Pump Station | | Reach 3A (EBX) Crafton Hills Pump Station | | Reach 4B (EBX) Cherry Valley Pump Station | | Reach 29A Oso Pumping Plant | |
| | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate |
| | [29] | [30] | [31] | [32] | [33] | [34] | [35] | [36] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 1.1017349 | 13.3965941 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7905574 | 13.5030687 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7530214 | 12.6772442 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0.8405850 | 12.9068644 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7771828 | 14.4483197 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6152458 | 17.9458194 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5222831 | 13.4372037 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7045701 | 17.9908273 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 1.4269064 | 20.6255585 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5684309 | 20.2186605 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 1.4942585 | 19.7739190 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 1.2818887 | 11.4081712 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 1.7796296 | 16.6546302 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 2.1683838 | 23.0053556 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 3.2288411 | 39.6231134 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 3.1272967 | 35.0197908 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 2.9878581 | 32.9904032 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5262089 | 42.9746819 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 3.6810660 | 56.4890182 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 2.1853025 | 37.6098245 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 1.9048343 | 23.9194204 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1569728 | -4.0768404 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 3.0638504 | 40.6646149 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5724835 | 21.1129984 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 3.1318961 | 42.5378346 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 2.7928728 | 41.5836062 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | -0.3226129 | -6.1639346 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 1.8332567 | 24.8410833 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 1.8284824 | 28.2950790 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 13.5376135 | 192.1289954 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 4.8843428 | 77.9788467 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 6.1233062 | 94.3993738 |
| 2004 | 20.6831806 | 86.5479519 | 21.4551370 | 108.0030889 | 8.6683948 | 116.6714837 | 6.4696629 | 99.3570085 |
| 2005 | 18.8666468 | 100.0682708 | 17.9350642 | 118.0033350 | 3.6760116 | 121.6793465 | 7.3193726 | 113.0191064 |
| 2006 | 17.3897441 | 75.0231072 | 21.4927481 | 96.5158553 | 22.6369517 | 119.1528070 | 5.2194188 | 87.8397812 |
| 2007 | 20.4327334 | 120.8916834 | 28.3594988 | 149.2511821 | 63.0683616 | 212.3195437 | 8.1423808 | 127.5659848 |
| 2008 | 16.8411646 | 120.9603561 | 23.7886276 | 144.7489837 | 7.1321689 | 151.8811526 | 8.5368878 | 135.3800324 |
| 2009 | 17.5432149 | 92.2725032 | 23.7664326 | 116.0389358 | 3.9665543 | 120.0054901 | 6.8975698 | 105.3387440 |
| 2010 | 17.0449437 | 107.6754724 | 24.2469592 | 131.9224316 | 3.4313175 | 135.3537491 | 7.9658290 | 120.0039063 |
| 2011 | 18.0948625 | 119.5193897 | 25.1711299 | 144.6905196 | 3.5706900 | 148.2612096 | 8.4441273 | 131.3518416 |
| 2012 | 18.9924808 | 123.0241089 | 26.7679364 | 149.7920452 | 4.5245631 | 154.3166083 | 8.7667646 | 135.8050050 |
| 2013 | 23.7219961 | 155.8062275 | 32.5629060 | 188.3691335 | 7.3214018 | 195.6905353 | 10.3732537 | 161.3893485 |
| 2014 | 32.1056030 | 241.6864796 | 46.3366508 | 288.0231304 | 10.2913997 | 298.3145301 | 14.9556969 | 231.8424066 |
| 2015 | 34.9774528 | 240.0603506 | 48.6136114 | 288.6739621 | 4.3175352 | 292.9914972 | 14.4085461 | 227.4667165 |
| 2016 | 35.7410562 | 188.6976685 | 44.9618002 | 233.6594687 | 10.0353929 | 243.6948616 | 10.2000898 | 184.6225395 |
| **2017** | **45.9383430** | **204.8872284** | **57.3306358** | **262.2178643** | **11.8141809** | **274.0320452** | **13.3403914** | **203.5906237** |
| 2018 | 46.6449904 | 214.6409053 | 58.2125241 | 272.8534294 | 11.9959158 | 284.8493452 | 13.3931861 | 215.8784282 |
| 2019 | 49.1615607 | 228.0943818 | 61.3532755 | 289.4476573 | 12.6431078 | 302.0907651 | 14.4231622 | 221.3901131 |
| 2020 | 50.2305395 | 235.2943950 | 62.6871869 | 297.9815819 | 12.9180203 | 310.8996022 | 15.0860244 | 229.0488504 |
| 2021 | 49.4426782 | 232.8535207 | 61.7040462 | 294.5575669 | 12.7154822 | 307.2730492 | 14.6514131 | 226.6577278 |
| 2022 | 50.0679191 | 238.9846033 | 62.4842967 | 301.4689000 | 12.8762690 | 314.3451690 | 15.1059740 | 231.4768019 |
| 2023 | 49.8042389 | 234.9194371 | 62.1552987 | 297.0747358 | 12.8085025 | 309.8832383 | 15.0331358 | 230.6330494 |
| 2024 | 49.9988439 | 232.2719331 | 62.3980732 | 294.6700063 | 12.8585025 | 307.5285089 | 15.3199566 | 227.5464214 |
| 2025 | 50.2911368 | 236.8812469 | 62.7628131 | 299.6440600 | 12.9336294 | 312.5776895 | 15.1950566 | 231.2782528 |
| 2026 | 49.3617534 | 228.2891465 | 61.6029865 | 289.8921331 | 12.6946701 | 302.5868031 | 14.6407933 | 224.1740551 |
| 2027 | 49.7152216 | 235.4122777 | 62.0441233 | 297.4564010 | 12.7855330 | 310.2419340 | 15.2711728 | 231.0732786 |
| 2028 | 49.9074181 | 231.7922154 | 62.2840077 | 294.0762231 | 12.8350254 | 306.9112485 | 14.8689448 | 227.0457249 |
| 2029 | 50.0683044 | 236.2254790 | 62.4847784 | 298.7102574 | 12.8763959 | 311.5866533 | 15.2969575 | 231.2103178 |
| 2030 | 50.2574181 | 230.1326908 | 62.7208093 | 292.8535001 | 12.9250000 | 305.7785001 | 14.8842614 | 224.5307834 |
| 2031 | 50.2696532 | 251.5099453 | 62.7360308 | 314.2459761 | 12.9281726 | 327.1741487 | 16.8881565 | 247.9210814 |
| 2032 | 49.4003854 | 223.0822824 | 61.6512524 | 284.7335348 | 12.7045685 | 297.4381033 | 14.0341648 | 217.2230232 |
| 2033 | 50.4572254 | 246.6529639 | 62.9702312 | 309.6231951 | 12.9763959 | 322.5995911 | 16.6719395 | 243.6221792 |
| 2034 | 49.7302505 | 225.1631383 | 62.0629094 | 287.2260477 | 12.7894670 | 300.0155147 | 14.1329165 | 218.7034555 |
| 2035 | 49.4313102 | 280.8321858 | 61.6897881 | 342.5219739 | 12.7125635 | 355.2345373 | 21.2269134 | 284.5727043 |

**TABLE B-17 Unit Variable OMP&R Component of Transportation Charge (in dollars per acre-foot)** Sheet 5 of 5

| | CALIFORNIA AQUEDUCT (continued) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 29G Warne Powerplant | | Reach 29J Castaic Powerplant | | Reach 31A Las Perillas and Badger Hill Pumping Plants | | Reach 33A Devil's Den, Bluestone, and Polonio Pass Pumping Plants | |
| Calendar Year | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate | Unit Rate | Cumulative Unit Rate |
| | [37] | [38] | [39] | [40] | [41] | [42] | [43] | [44] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 1.5014866 | 4.1182219 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 1.2624066 | 3.0719381 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 1.6309699 | 3.3588477 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 1.4985537 | 2.7919286 | 0 | 0 |
| 1972 | 0 | 0 | -2.9350830 | 10.4615111 | 1.9517720 | 3.4211474 | 0 | 0 |
| 1973 | 0 | 0 | -6.8099448 | 6.6931239 | 1.5374531 | 3.0757814 | 0 | 0 |
| 1974 | 0 | 0 | -7.4013274 | 5.2759168 | 1.5168982 | 2.9878282 | 0 | 0 |
| 1975 | 0 | 0 | -6.5604921 | 6.3463723 | 1.1130304 | 2.6699305 | 0 | 0 |
| 1976 | 0 | 0 | -6.7213324 | 7.7269873 | 1.5685447 | 3.2790543 | 0 | 0 |
| 1977 | 0 | 0 | -30.4985994 | -12.5527800 | 1.7573375 | 4.1392043 | 0 | 0 |
| 1978 | 0 | 0 | -9.0130187 | 4.4241850 | 1.9429506 | 4.0089431 | 0 | 0 |
| 1979 | 0 | 0 | -19.0478097 | -1.0569824 | 1.5600341 | 4.3608941 | 0 | 0 |
| 1980 | 0 | 0 | -20.5438586 | 0.0816999 | 1.5124754 | 3.6770034 | 0 | 0 |
| 1981 | 0 | 0 | -10.0059379 | 10.2127225 | 1.5414199 | 4.7045073 | 0 | 0 |
| 1982 | -2.1714430 | 17.6024760 | -9.5987314 | 8.0037446 | 1.7581649 | 4.3530008 | 0 | 0 |
| 1983 | -8.9130752 | 2.4950960 | -39.8193120 | -37.3242160 | 0.1782765 | 1.3888171 | 0 | 0 |
| 1984 | -15.0246012 | 1.6300290 | -17.3126964 | -15.6826674 | 0.8546712 | 2.6822403 | 0 | 0 |
| 1985 | -14.7115359 | 8.2938197 | -38.9450629 | -30.6512432 | 1.2014351 | 3.6785929 | 0 | 0 |
| 1986 | -14.1893653 | 25.4337481 | -28.1596224 | -2.7258742 | 2.2635886 | 6.9752505 | 0 | 0 |
| 1987 | -14.8696165 | 20.1501743 | -27.0536484 | -6.9034741 | 1.9135072 | 5.9486162 | 0 | 0 |
| 1988 | -14.7032843 | 18.2871189 | -25.6857024 | -7.3985835 | 1.7733386 | 5.6554272 | 0 | 0 |
| 1989 | -14.4231503 | 28.5515316 | -25.3986130 | 3.1529186 | 2.4159040 | 7.4317239 | 0 | 0 |
| 1990 | -14.1850383 | 42.3039798 | -26.0776142 | 16.2263657 | 3.7962150 | 9.8240367 | 0 | 0 |
| 1991 | -14.7118704 | 22.8979541 | -25.0234633 | -2.1255092 | 2.4131016 | 7.1520492 | 0 | 0 |
| 1992 | -14.6199430 | 9.2994774 | -25.1951357 | -15.8956583 | 1.2766372 | 4.5092789 | 0 | 0 |
| 1993 | -10.3386607 | -14.4155011 | -21.1218973 | -35.5373984 | -1.1726172 | -0.7762411 | 0 | 0 |
| 1994 | -14.7696788 | 25.8949361 | -26.7437304 | -0.8487943 | 2.3645104 | 7.0748798 | 0 | 0 |
| 1995 | -12.2705974 | 8.8424010 | -25.6907993 | -16.8483983 | 2.5750402 | 5.4022971 | 0 | 0 |
| 1996 | -14.8515762 | 27.6862584 | -29.5639188 | -1.8776604 | 2.5837041 | 7.6010922 | 0 | 0 |
| 1997 | -14.9272063 | 26.6563999 | -27.1541858 | -0.4977859 | 2.7029648 | 6.9426653 | 24.4572499 | 31.3999152 |
| 1998 | -8.6695834 | -14.8335180 | -22.2303491 | -37.0638671 | -0.5072304 | -0.6085333 | -4.1828906 | -4.7914239 |
| 1999 | -14.9340263 | 9.9070570 | -27.0443818 | -17.1373248 | 1.3343489 | 4.5452705 | 9.5757906 | 14.1210611 |
| 2000 | -14.1657261 | 14.1293529 | -26.9670096 | -12.8376567 | 1.9210288 | 5.1667286 | 14.2694428 | 19.4361713 |
| 2001 | -16.7349304 | 175.3940651 | -29.2914159 | 146.1026492 | 12.3497747 | 31.3909026 | 93.4183473 | 124.8092500 |
| 2002 | -13.2004543 | 64.7783923 | -23.7780808 | 41.0003115 | 5.4523570 | 14.1544730 | 42.2356453 | 56.3901183 |
| 2003 | -13.9757172 | 80.4236566 | -23.8496317 | 56.5740249 | 6.2991021 | 16.1426443 | 48.5395958 | 64.6822401 |
| 2004 | -14.1574758 | 85.1995327 | -25.2967499 | 59.9027828 | 6.4579354 | 17.0623710 | 52.5252011 | 69.5875721 |
| 2005 | -14.2938796 | 98.7252268 | -24.7472457 | 73.9779811 | 8.2000327 | 20.1469699 | 62.1217478 | 82.2687176 |
| 2006 | -14.0865037 | 73.7532775 | -23.8861273 | 49.8671502 | 7.3537028 | 17.2560963 | 51.8001830 | 69.0562794 |
| 2007 | -12.5169061 | 115.0490788 | -25.0603889 | 89.9886899 | 9.9286839 | 23.6694565 | 73.4057069 | 97.0751634 |
| 2008 | -13.8809446 | 121.4990878 | -29.0198140 | 92.4792738 | 10.5133875 | 27.6599371 | 79.5098036 | 107.1697407 |
| 2009 | -10.4812488 | 94.8574952 | -24.7512646 | 70.1062306 | 6.7812125 | 15.7619205 | 62.9603277 | 78.7222483 |
| 2010 | -13.8211960 | 106.1827104 | -26.2504816 | 79.9322288 | 8.4810305 | 23.5095318 | 68.9425325 | 92.4520643 |
| 2011 | -14.1584994 | 117.1933422 | -28.7386599 | 88.4546823 | 9.7860943 | 25.1922104 | 85.5814464 | 110.7736567 |
| 2012 | -13.8982775 | 121.9067275 | -25.6245942 | 96.2821334 | 9.2206114 | 24.4540107 | 86.2392613 | 110.6932719 |
| 2013 | -14.3636831 | 147.0256653 | -25.5768325 | 121.4488329 | 12.3037862 | 31.0393124 | 94.6940145 | 125.7333269 |
| 2014 | -14.0124517 | 217.8299550 | -26.4213846 | 191.4085704 | 16.5250256 | 44.4439277 | 105.4565722 | 149.9004999 |
| 2015 | -13.2774506 | 214.1892659 | -23.3700144 | 190.8192516 | 16.8218942 | 44.2140162 | 127.4233757 | 171.6373919 |
| 2016 | -10.9083940 | 173.7141455 | -17.7724471 | 155.9416984 | 10.7730599 | 34.9535675 | 97.7156539 | 132.6692213 |
| **2017** | **-13.9082802** | **189.6823434** | **-23.4970454** | **166.1852981** | **11.7369335** | **33.8529284** | **90.7829882** | **124.6359166** |
| 2018 | -13.8949087 | 201.9835195 | -23.3584656 | 178.6250539 | 11.9667921 | 35.1189973 | 92.5981688 | 127.7171661 |
| 2019 | -14.0724428 | 207.3176703 | -23.1032119 | 184.2144584 | 8.5461204 | 33.7642643 | 133.1765892 | 166.9408535 |
| 2020 | -14.4258559 | 214.6229945 | -23.6619122 | 190.9610823 | 8.7370749 | 30.2331148 | 136.0721877 | 166.3053025 |
| 2021 | -14.2317030 | 212.4260248 | -23.3400745 | 189.0859504 | 8.6000374 | 32.6137137 | 133.9379986 | 166.5517123 |
| 2022 | -14.4897801 | 216.9870218 | -23.7723701 | 193.2146517 | 8.7087849 | 32.8309784 | 135.6316733 | 168.4626517 |
| 2023 | -14.4614789 | 216.1715705 | -23.7831872 | 192.3883833 | 8.6629293 | 30.9463906 | 134.9175278 | 165.8639184 |
| 2024 | -14.7008567 | 212.8455648 | -24.1501159 | 188.6954489 | 8.6967734 | 30.8719465 | 135.4445644 | 166.3165109 |
| 2025 | -14.4943806 | 216.7838722 | -23.8071162 | 192.9767560 | 8.7476122 | 30.4968910 | 136.2363958 | 166.7332868 |
| 2026 | -14.2447458 | 209.9293093 | -23.3618322 | 186.5674771 | 8.5859599 | 32.1631333 | 133.7187109 | 165.8818442 |
| 2027 | -14.7539403 | 216.3193384 | -24.2117981 | 192.1075402 | 8.6474399 | 31.6193683 | 134.6762966 | 166.2956649 |
| 2028 | -14.2746730 | 212.7710519 | -23.4685615 | 189.3024904 | 8.6808791 | 31.3008592 | 135.1970742 | 166.4979334 |
| 2029 | -14.6408478 | 216.5694700 | -24.0789419 | 192.4905280 | 8.7088576 | 31.6164107 | 135.6328269 | 167.2492376 |
| 2030 | -14.2066091 | 210.3241743 | -23.3263404 | 186.9978339 | 8.7417570 | 28.6043635 | 136.1451609 | 164.7495244 |
| 2031 | -16.1215775 | 231.7995039 | -26.5319523 | 205.2675516 | 8.7438748 | 33.2168472 | 136.1781743 | 169.3950216 |
| 2032 | -13.6433816 | 203.5796416 | -22.3573597 | 181.2222819 | 8.5926872 | 33.0116496 | 133.8234948 | 166.8351443 |
| 2033 | -15.8728786 | 227.7493005 | -26.0850574 | 201.6642431 | 8.7765147 | 28.8387327 | 136.6864338 | 165.5251665 |
| 2034 | -13.6133890 | 205.0900666 | -22.3654849 | 182.7245817 | 8.6500664 | 31.3879114 | 134.7171154 | 166.1050268 |
| 2035 | -20.6030162 | 263.9696881 | -34.1307171 | 229.8389710 | 8.5980545 | 44.0534953 | 133.9071697 | 177.9606650 |

# Tables B-18 through B-31

Note: Where applicable, the projected data values shown in this appendix are shaded and the bill year data are in **bold** type.

## TABLE B-18 Variable OMP&R Component of Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 2,051 | 34,919 | 0 | 36,970 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 7,900 | 49,811 | 0 | 57,711 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 5,931 | 68,203 | 0 | 74,134 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 10,918 | 68,765 | 62,926 | 142,609 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 19,330 | 52,135 | 121,141 | 192,606 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 19,958 | 53,785 | 163,255 | 236,998 | 0 | 0 | 0 |
| 1968 | 6,989 | 0 | 6,989 | 29,899 | 120,985 | 341,768 | 492,652 | 0 | 0 | 0 |
| 1969 | 8,551 | 0 | 8,551 | 31,859 | 3,904 | 298,968 | 334,731 | 0 | 0 | 0 |
| 1970 | 13,598 | 0 | 13,598 | 49,687 | 0 | 431,443 | 481,130 | 0 | 0 | 0 |
| 1971 | 10,609 | 0 | 10,609 | 23,842 | 28,328 | 416,329 | 468,499 | 0 | 0 | 0 |
| 1972 | 14,434 | 0 | 14,434 | 54,838 | 144,669 | 524,208 | 723,715 | 0 | 0 | 0 |
| 1973 | 14,449 | 0 | 14,449 | 18,398 | 15,590 | 547,807 | 581,795 | 0 | 0 | 0 |
| 1974 | 17,473 | 0 | 17,473 | 9,499 | 29 | 636,186 | 645,714 | 0 | 0 | 0 |
| 1975 | 14,779 | 0 | 14,779 | 22,318 | 4,765 | 425,284 | 452,367 | 0 | 0 | 0 |
| 1976 | 20,856 | 0 | 20,856 | 97,874 | 121,693 | 502,769 | 722,336 | 0 | 0 | 0 |
| 1977 | 22,635 | 0 | 22,635 | 82,578 | 123,044 | 497,792 | 703,414 | 0 | 0 | 0 |
| 1978 | 21,692 | 0 | 21,692 | 74,911 | 39,986 | 652,860 | 767,757 | 0 | 0 | 0 |
| 1979 | 16,237 | 0 | 16,237 | 137,101 | 77,145 | 652,629 | 866,875 | 0 | 0 | 0 |
| 1980 | 19,945 | 0 | 19,945 | 98,743 | 64,891 | 517,531 | 681,165 | 0 | 0 | 0 |
| 1981 | 23,842 | 0 | 23,842 | 126,437 | 141,456 | 567,968 | 835,861 | 0 | 0 | 0 |
| 1982 | 12,157 | 0 | 12,157 | 97,117 | 46,742 | 651,246 | 795,105 | 0 | 0 | 0 |
| 1983 | 2,342 | 0 | 2,342 | 8,171 | 5,412 | 148,743 | 162,326 | 0 | 0 | 0 |
| 1984 | 4,822 | 0 | 4,822 | 26,707 | 13,141 | 349,314 | 389,162 | 0 | 0 | 0 |
| 1985 | 10,188 | 0 | 10,188 | 79,863 | 102,790 | 466,291 | 648,944 | 0 | 0 | 0 |
| 1986 | 15,501 | 0 | 15,501 | 112,370 | 131,118 | 932,090 | 1,175,578 | 0 | 0 | 0 |
| 1987 | 27,223 | 0 | 27,223 | 216,211 | 234,290 | 812,631 | 1,263,132 | 0 | 0 | 0 |
| 1988 | 31,265 | 11,533 | 42,798 | 229,578 | 297,129 | 779,537 | 1,306,244 | 0 | 0 | 0 |
| 1989 | 37,874 | 66,850 | 104,724 | 306,533 | 304,275 | 1,051,562 | 1,662,370 | 0 | 0 | 0 |
| 1990 | 54,736 | 105,421 | 160,157 | 524,114 | 502,545 | 1,456,008 | 2,482,667 | 0 | 0 | 0 |
| 1991 | 8,159 | 18,824 | 26,983 | 105,736 | 142,105 | 316,839 | 564,680 | 0 | (2,636) | (2,636) |
| 1992 | 12,515 | 23,808 | 36,323 | 93,772 | 122,436 | 273,849 | 490,057 | 0 | 0 | 0 |
| 1993 | (7,223) | (17,293) | (24,516) | (36,162) | (12,912) | (78,024) | (127,098) | 0 | 0 | 0 |
| 1994 | 39,106 | 77,257 | 116,363 | 231,800 | 257,533 | 642,006 | 1,131,339 | 0 | 0 | 0 |
| 1995 | 15,701 | 36,724 | 52,425 | 160,663 | 93,610 | 151,287 | 405,560 | 0 | 0 | 0 |
| 1996 | 31,526 | 96,570 | 128,096 | 214,883 | 186,694 | 735,431 | 1,137,008 | 502 | 0 | 502 |
| 1997 | 29,683 | 116,555 | 146,238 | 351,185 | 219,799 | 912,861 | 1,483,845 | 34,932 | 233,584 | 268,516 |
| 1998 | (6,622) | (19,825) | (26,447) | (8,777) | (18,989) | (72,459) | (100,225) | (17,211) | (89,207) | (106,418) |
| 1999 | 15,783 | 52,547 | 68,330 | 251,523 | 188,675 | 432,833 | 873,031 | 52,855 | 284,356 | 337,211 |
| 2000 | 21,981 | 93,786 | 115,767 | 376,893 | 238,402 | 752,225 | 1,367,520 | 77,006 | 441,998 | 519,004 |
| 2001 | 291,175 | 533,810 | 824,984 | 1,698,720 | 1,002,725 | 2,485,014 | 5,186,458 | 534,558 | 2,364,636 | 2,899,194 |
| 2002 | 90,273 | 266,110 | 356,383 | 1,067,733 | 640,899 | 1,453,943 | 3,162,575 | 245,579 | 1,558,397 | 1,803,976 |
| 2003 | 130,947 | 265,394 | 396,341 | 1,076,957 | 647,785 | 2,301,141 | 4,025,883 | 288,030 | 1,744,351 | 2,032,381 |
| 2004 | 141,670 | 355,420 | 497,090 | 1,325,708 | 624,580 | 1,613,968 | 3,564,256 | 289,832 | 2,067,099 | 2,356,931 |
| 2005 | 189,098 | 393,118 | 582,216 | 1,483,817 | 849,101 | 2,494,389 | 4,827,307 | 349,724 | 1,920,481 | 2,270,205 |
| 2006 | 181,883 | 316,938 | 498,821 | 1,297,386 | 734,802 | 2,170,785 | 4,202,973 | 290,658 | 1,607,285 | 1,897,943 |
| 2007 | 332,074 | 604,832 | 936,906 | 1,610,876 | 899,784 | 2,704,487 | 5,215,147 | 366,556 | 2,692,865 | 3,059,421 |
| 2008 | 394,616 | 526,713 | 921,328 | 1,565,262 | 766,551 | 1,938,341 | 4,270,154 | 364,591 | 1,971,173 | 2,335,765 |
| 2009 | 213,081 | 272,097 | 485,178 | 842,422 | 500,631 | 1,550,921 | 2,893,974 | 299,212 | 1,216,304 | 1,515,516 |
| 2010 | 282,394 | 305,699 | 588,094 | 1,422,050 | 661,372 | 2,041,523 | 4,124,944 | 347,342 | 1,643,335 | 1,990,678 |
| 2011 | 306,587 | 308,357 | 614,944 | 1,751,514 | 950,308 | 2,966,321 | 5,668,143 | 423,045 | 2,359,387 | 2,782,431 |
| 2012 | 259,150 | 327,037 | 586,187 | 1,779,054 | 675,142 | 2,425,114 | 4,879,309 | 436,574 | 2,155,641 | 2,592,215 |
| 2013 | 436,320 | 530,290 | 966,610 | 2,152,841 | 1,099,144 | 3,140,284 | 6,392,269 | 462,824 | 2,265,463 | 2,728,287 |
| 2014 | 597,291 | 394,016 | 991,306 | 1,537,793 | 1,197,100 | 2,159,473 | 4,894,366 | 477,960 | 2,493,770 | 2,971,730 |
| 2015 | 484,203 | 502,806 | 987,009 | 1,468,763 | 937,040 | 3,123,464 | 5,529,267 | 595,557 | 1,993,900 | 2,589,457 |
| 2016 | 521,798 | 708,400 | 1,230,198 | 2,734,504 | 685,491 | 4,479,782 | 7,899,777 | 534,922 | 3,329,599 | 3,864,522 |
| **2017** | **838,248** | **569,466** | **1,407,714** | **2,684,111** | **928,176** | **3,329,405** | **6,941,692** | **1,627,247** | **3,401,563** | **5,028,810** |
| 2018 | 852,391 | 579,073 | 1,431,464 | 2,763,281 | 967,484 | 3,570,539 | 7,301,305 | 1,676,288 | 3,485,657 | 5,161,945 |
| 2019 | 761,736 | 549,512 | 1,311,248 | 2,959,627 | 1,059,342 | 3,671,159 | 7,690,128 | 2,197,109 | 4,556,150 | 6,753,258 |
| 2020 | 778,298 | 561,460 | 1,339,757 | 2,809,524 | 990,400 | 3,484,969 | 7,284,894 | 2,201,383 | 4,538,804 | 6,740,188 |
| 2021 | 766,091 | 552,653 | 1,318,744 | 2,905,255 | 1,047,240 | 3,603,715 | 7,556,209 | 2,204,645 | 4,545,529 | 6,750,174 |
| 2022 | 775,777 | 559,642 | 1,335,419 | 2,930,351 | 1,055,007 | 3,634,845 | 7,620,203 | 2,229,940 | 4,597,683 | 6,827,623 |
| 2023 | 771,693 | 556,696 | 1,328,389 | 2,829,706 | 1,005,704 | 3,510,004 | 7,345,414 | 2,195,541 | 4,526,758 | 6,722,299 |
| 2024 | 774,708 | 558,871 | 1,333,578 | 2,836,004 | 1,005,899 | 3,517,815 | 7,359,718 | 2,201,532 | 4,539,110 | 6,740,642 |
| 2025 | 779,236 | 562,137 | 1,341,373 | 2,822,004 | 996,841 | 3,500,449 | 7,319,294 | 2,207,049 | 4,550,485 | 6,757,533 |
| 2026 | 764,836 | 551,749 | 1,316,585 | 2,883,327 | 1,036,034 | 3,576,516 | 7,495,877 | 2,195,778 | 4,527,247 | 6,723,025 |
| 2027 | 770,314 | 555,700 | 1,326,014 | 2,860,039 | 1,022,300 | 3,547,628 | 7,429,967 | 2,201,256 | 4,538,541 | 6,739,797 |
| 2028 | 773,291 | 557,848 | 1,331,140 | 2,854,471 | 1,016,336 | 3,540,721 | 7,411,528 | 2,203,933 | 4,544,062 | 6,747,995 |
| 2029 | 775,784 | 559,647 | 1,335,431 | 2,870,733 | 1,024,179 | 3,560,893 | 7,455,804 | 2,213,878 | 4,564,566 | 6,778,444 |
| 2030 | 778,714 | 561,761 | 1,340,475 | 2,734,739 | 950,309 | 3,392,205 | 7,077,253 | 2,180,789 | 4,496,344 | 6,677,133 |
| 2031 | 778,904 | 561,898 | 1,340,802 | 2,939,048 | 1,061,750 | 3,645,632 | 7,646,429 | 2,242,282 | 4,623,129 | 6,865,411 |
| 2032 | 765,436 | 552,181 | 1,317,617 | 2,934,235 | 1,059,831 | 3,639,662 | 7,633,727 | 2,208,397 | 4,553,265 | 6,761,662 |
| 2033 | 781,810 | 563,994 | 1,345,805 | 2,732,736 | 952,384 | 3,389,721 | 7,074,841 | 2,191,057 | 4,517,513 | 6,708,569 |
| 2034 | 770,547 | 555,869 | 1,326,415 | 2,862,348 | 1,019,858 | 3,550,493 | 7,432,699 | 2,198,732 | 4,533,338 | 6,732,071 |
| 2035 | 765,914 | 552,527 | 1,318,441 | 3,414,929 | 1,324,474 | 4,235,921 | 8,975,323 | 2,355,665 | 4,856,902 | 7,212,568 |
| **TOTAL** | **20,259,093** | **17,896,476** | **38,155,569** | **83,708,117** | **36,664,899** | **125,026,373** | **245,399,389** | **47,387,549** | **118,748,429** | **166,135,978** |

[a] B-18 includes Extra Peaking Charges for additional power shown in Table 9.

## TABLE B-18 Variable OMP&R Component of Transportation Charge for Each Contractor[a] (in dollars)



| | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| Calendar Year | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 68,977 | 5,176 | 0 | 0 | 440,922 | 2,355 | 4,760 | 65,680 | 587,870 |
| 1969 | 56,774 | 101 | 0 | 0 | 321,387 | 181 | 3,338 | 17,956 | 399,737 |
| 1970 | 69,818 | 6,811 | 0 | 0 | 470,867 | 0 | 5,595 | 16,550 | 569,641 |
| 1971 | 53,097 | 7,747 | 0 | 0 | 769,054 | 4,785 | 6,353 | 158,419 | 999,455 |
| 1972 | 62,365 | 8,515 | 0 | 0 | 1,151,788 | 2,057 | 7,375 | 379,686 | 1,611,786 |
| 1973 | 33,931 | 4,615 | 0 | 0 | 770,121 | 2,307 | 3,017 | 77,630 | 891,621 |
| 1974 | 49,114 | 4,413 | 0 | 46,752 | 677,660 | 2,206 | 3,114 | 106,332 | 889,591 |
| 1975 | 63,140 | 4,671 | 0 | 34,580 | 848,249 | 2,491 | 3,920 | 134,295 | 1,091,346 |
| 1976 | 70,851 | 5,132 | 0 | 94,653 | 966,820 | 2,737 | 4,910 | 100,597 | 1,245,701 |
| 1977 | 26,565 | 1,758 | 0 | 84,875 | 498,624 | 3,644 | 2,602 | 43,067 | 661,135 |
| 1978 | 108,944 | 938 | 0 | 190,675 | 1,616,975 | 4,319 | 6,294 | 24,901 | 1,953,046 |
| 1979 | 107,956 | 4,871 | 0 | 194,048 | 2,371,175 | 5,602 | 13,172 | 434,472 | 3,131,297 |
| 1980 | 88,746 | 1,935 | 0 | 121,603 | 1,731,588 | 4,762 | 7,766 | 163,301 | 2,119,701 |
| 1981 | 129,687 | 18,533 | 0 | 263,077 | 2,398,339 | 7,275 | 8,904 | 263,922 | 3,089,737 |
| 1982 | 108,561 | 937 | 0 | 145,246 | 2,375,404 | 4,541 | 6,763 | 48,137 | 2,689,589 |
| 1983 | 61,443 | 0 | 0 | 13,954 | 929,183 | 5,662 | 3,232 | 1,218 | 1,014,692 |
| 1984 | 82,423 | 0 | 0 | 216,437 | 1,996,259 | 5,946 | 7,475 | 10,496 | 2,319,036 |
| 1985 | 114,571 | 12,938 | 0 | 242,645 | 2,567,184 | 8,422 | 8,815 | 271,970 | 3,226,545 |
| 1986 | 236,756 | 5,513 | 0 | 377,798 | 4,876,960 | 17,433 | 16,927 | 376,088 | 5,907,475 |
| 1987 | 187,090 | 10,273 | 0 | 504,168 | 4,230,949 | 16,140 | 15,529 | 375,604 | 5,339,753 |
| 1988 | 188,170 | 14,894 | 0 | 524,965 | 4,250,194 | 15,528 | 11,928 | 374,528 | 5,380,207 |
| 1989 | 285,261 | 15,450 | 0 | 681,238 | 6,158,648 | 20,063 | 21,693 | 649,604 | 7,831,957 |
| 1990 | 218,786 | 7,710 | 0 | 845,877 | 4,778,185 | 12,056 | 12,072 | 344,008 | 6,218,694 |
| 1991 | 4,393 | 1,047 | 0 | 185,013 | 47,869 | 0 | 521 | 10,331 | 249,174 |
| 1992 | 76,840 | 4,426 | 0 | 227,332 | 1,699,824 | 6,059 | 5,222 | 151,055 | 2,170,758 |
| 1993 | 20,064 | 4,843 | 0 | 78,585 | 340,588 | 2,090 | 1,467 | 123,913 | 571,550 |
| 1994 | 135,626 | 7,854 | 0 | 471,316 | 3,417,815 | 9,967 | 10,102 | 293,748 | 4,346,428 |
| 1995 | 181,772 | 4,611 | 0 | 409,656 | 3,437,735 | 11,619 | 10,492 | 288,010 | 4,343,895 |
| 1996 | 286,064 | 9,577 | 0 | 715,404 | 6,328,965 | 21,039 | 16,403 | 1,196,303 | 8,573,755 |
| 1997 | 308,515 | 0 | 0 | 650,416 | 5,627,735 | 0 | 15,559 | 94,838 | 6,697,063 |
| 1998 | 16,993 | (54) | 0 | (16,341) | 91,651 | (2) | 1,171 | (2,095) | 91,324 |
| 1999 | 191,682 | 10,198 | 0 | 463,890 | 3,954,090 | 12,844 | 11,542 | 937,238 | 5,581,485 |
| 2000 | 196,491 | 5,839 | 0 | 152,159 | 4,295,523 | 11,685 | 10,426 | 643,664 | 5,315,788 |
| 2001 | 797,861 | 25,896 | 0 | 158,463 | 12,010,806 | 29,704 | 46,367 | 1,134,128 | 14,203,225 |
| 2002 | 425,664 | 12,226 | 0 | 183,569 | 8,013,780 | 24,836 | 29,691 | 839,772 | 9,529,537 |
| 2003 | 453,610 | 14,135 | 0 | 493,493 | 9,967,016 | 36,342 | 28,688 | 1,041,850 | 12,035,136 |
| 2004 | 520,466 | 37,773 | 0 | 1,406,702 | 8,942,325 | 96,002 | 33,670 | 861,689 | 11,898,625 |
| 2005 | 977,603 | 45,805 | 0 | 836,724 | 17,643,647 | 236,621 | 34,032 | 1,672,595 | 21,447,026 |
| 2006 | 713,765 | 32,500 | 0 | 987,951 | 13,704,881 | 94,370 | 28,832 | 1,071,508 | 16,633,806 |
| 2007 | 620,190 | 28,636 | 0 | 772,081 | 12,112,916 | 79,441 | 32,915 | 1,196,588 | 14,842,766 |
| 2008 | 380,208 | 16,238 | 0 | 757,234 | 7,707,593 | 65,774 | 24,546 | 581,337 | 9,532,929 |
| 2009 | 190,558 | 9,286 | 0 | 65,697 | 5,114,787 | 30,454 | 11,730 | 330,525 | 5,753,036 |
| 2010 | 445,465 | 48,978 | 0 | 156,191 | 9,867,515 | 72,659 | 31,751 | 863,810 | 11,486,369 |
| 2011 | 934,952 | 29,503 | 0 | 711,326 | 19,844,714 | 103,332 | 29,410 | 852,561 | 22,505,797 |
| 2012 | 278,984 | 34,153 | 0 | 550,050 | 11,928,370 | 112,803 | 33,658 | 1,359,827 | 14,297,847 |
| 2013 | 506,721 | 29,359 | 0 | 634,801 | 12,216,148 | 87,027 | 36,920 | 826,808 | 14,337,783 |
| 2014 | 521,916 | 14,406 | 0 | 217 | 7,059,386 | 35,027 | 29,731 | 249,271 | 7,909,955 |
| 2015 | 430,474 | 17,093 | 0 | 476,478 | 8,963,183 | 33,665 | 21,515 | 474,870 | 10,417,277 |
| 2016 | 698,828 | 44,057 | 0 | 1,806,547 | 13,822,645 | 173,057 | 57,005 | 1,318,007 | 17,920,145 |
| **2017** | **671,619** | **39,809** | **0** | **1,999,389** | **14,657,412** | **125,621** | **52,593** | **1,160,714** | **18,707,157** |
| 2018 | 703,086 | 41,674 | 0 | 2,100,395 | 15,369,698 | 131,449 | 55,004 | 1,215,097 | 19,616,403 |
| 2019 | 690,069 | 45,393 | 0 | 2,256,908 | 16,319,058 | 142,357 | 61,131 | 1,323,524 | 20,838,439 |
| 2020 | 588,218 | 38,693 | 0 | 2,011,169 | 14,524,702 | 121,611 | 47,289 | 1,128,177 | 18,459,857 |
| 2021 | 657,110 | 43,225 | 0 | 2,183,707 | 15,775,968 | 135,642 | 56,431 | 1,260,310 | 20,112,393 |
| 2022 | 660,080 | 43,420 | 0 | 2,201,427 | 15,898,762 | 136,268 | 56,321 | 1,266,005 | 20,262,282 |
| 2023 | 609,765 | 40,110 | 0 | 2,070,219 | 14,944,731 | 125,994 | 50,000 | 1,169,503 | 19,010,322 |
| 2024 | 606,801 | 39,915 | 0 | 2,054,951 | 14,845,423 | 125,396 | 49,859 | 1,163,820 | 18,886,165 |
| 2025 | 595,147 | 39,149 | 0 | 2,033,835 | 14,683,993 | 123,027 | 47,988 | 1,141,467 | 18,664,606 |
| 2026 | 645,166 | 42,439 | 0 | 2,147,333 | 15,517,842 | 133,203 | 55,125 | 1,237,401 | 19,778,508 |
| 2027 | 628,604 | 41,349 | 0 | 2,119,108 | 15,298,518 | 129,835 | 52,413 | 1,205,636 | 19,475,463 |
| 2028 | 618,973 | 40,716 | 0 | 2,086,120 | 15,071,120 | 127,876 | 51,440 | 1,187,164 | 19,183,409 |
| 2029 | 626,842 | 41,234 | 0 | 2,114,909 | 15,271,341 | 129,487 | 52,105 | 1,202,257 | 19,438,174 |
| 2030 | 543,520 | 35,753 | 0 | 1,886,388 | 13,630,492 | 112,493 | 41,920 | 1,042,449 | 17,293,014 |
| 2031 | 669,678 | 44,051 | 0 | 2,259,522 | 16,280,932 | 138,233 | 56,328 | 1,284,415 | 20,733,160 |
| 2032 | 668,200 | 43,954 | 0 | 2,192,088 | 15,861,420 | 137,904 | 58,607 | 1,281,580 | 20,243,753 |
| 2033 | 548,983 | 36,112 | 0 | 1,939,872 | 13,971,626 | 113,613 | 41,176 | 1,052,925 | 17,704,307 |
| 2034 | 622,198 | 40,928 | 0 | 2,077,017 | 15,024,721 | 128,528 | 52,531 | 1,193,350 | 19,139,274 |
| 2035 | 970,203 | 63,820 | 0 | 3,105,475 | 22,325,795 | 199,521 | 92,501 | 1,860,808 | 28,618,123 |
| **TOTAL** | **25,112,995** | **1,433,058** | **0** | **58,757,374** | **550,631,592** | **4,054,982** | **1,809,682** | **46,227,215** | **688,026,898** |

[a] B-18 includes Extra Peaking Charges for additional power shown in Table 9.

## TABLE B-18 Variable OMP&R Component of Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 30,401 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 30,627 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 39,430 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 34,871 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 780 | 47,571 | 0 | 12,785 | 0 | 4,496 | 1,515 | 0 | 32,107 | 0 |
| 1973 | 286 | 28,968 | 102,812 | 6,896 | 159,536 | 3,855 | 0 | 0 | 301,444 | 0 |
| 1974 | 15,558 | 28,982 | 100,955 | 9,890 | 157,742 | 4,932 | 221 | 0 | 177,173 | 5,961 |
| 1975 | 99,186 | 28,568 | 108,253 | 12,758 | 170,111 | 6,391 | 0 | 0 | 136,066 | 50,723 |
| 1976 | 385,090 | 38,365 | 135,276 | 17,835 | 213,594 | 8,164 | 0 | 0 | 139,354 | 65,476 |
| 1977 | 199,166 | 21,006 | 0 | 23,598 | 0 | 1,974 | 1,702 | 0 | 239,663 | 74,838 |
| 1978 | 581,729 | 45,550 | 174,116 | 20,875 | 264,178 | 2,731 | 0 | 0 | 37,043 | 67,462 |
| 1979 | 1,058,904 | 83,940 | 228,437 | 28,603 | 340,510 | 2,328 | 90,803 | 0 | 236 | 3,668 |
| 1980 | 1,390,117 | 51,143 | 256,759 | 29,229 | 401,038 | 3,667 | 94,362 | 0 | 0 | 16,504 |
| 1981 | 1,480,362 | 118,583 | 274,149 | 33,632 | 430,304 | 23,861 | 90,590 | 0 | 254,649 | 57,523 |
| 1982 | 923,973 | 132,575 | 292,674 | 27,190 | 461,216 | 0 | 230,608 | 0 | 126,461 | 189,895 |
| 1983 | 333,772 | (335,712) | 172,336 | 10,792 | 272,477 | 385 | 0 | 0 | (71,602) | (8,768) |
| 1984 | 485,847 | (142,910) | 273,597 | 19,572 | 433,785 | 15 | 0 | 0 | (66,353) | (91,433) |
| 1985 | 821,069 | (335,343) | 413,406 | 34,603 | 657,011 | 0 | 0 | 32,464 | (47,544) | (32,348) |
| 1986 | 1,109,047 | 54,812 | 728,808 | 60,274 | 1,160,650 | 5,548 | 0 | 105,375 | 69,170 | 101,843 |
| 1987 | 1,019,605 | (40,745) | 668,383 | 63,601 | 1,083,530 | 32,651 | 585 | 157,843 | 88,076 | 49,930 |
| 1988 | 1,019,793 | (74,006) | 688,891 | 66,914 | 1,134,141 | 11,991 | 300 | 50,654 | 92,465 | 38,688 |
| 1989 | 1,736,901 | 178,359 | 978,885 | 97,114 | 1,633,489 | 38,269 | 8,951 | 350,953 | 340,460 | 210,334 |
| 1990 | 2,442,558 | 422,502 | 1,402,619 | 110,934 | 2,313,410 | 90,472 | 0 | 446,408 | 599,573 | 530,099 |
| 1991 | 286,485 | (3,054) | 277,078 | 33,945 | 456,999 | 17,978 | 128,405 | 132,700 | 35,339 | 52,116 |
| 1992 | 587,340 | (208,900) | 240,119 | 11,952 | 396,022 | 4,871 | 241,338 | 78,306 | (22,718) | (53,500) |
| 1993 | (190,611) | (491,161) | (809,033) | (2,389) | (1,334,429) | (3,246) | (61,112) | (29,466) | (157,452) | (519,798) |
| 1994 | 1,841,902 | 66,338 | 189,616 | 34,480 | 312,714 | 41,201 | 731,185 | 315,446 | 122,829 | 204,783 |
| 1995 | 761,209 | (247,735) | (251,547) | 7,960 | (414,889) | 7,727 | 165,622 | 114,342 | (7,579) | (140,714) |
| 1996 | 1,883,530 | 72,171 | 508,274 | 18,313 | 838,330 | 16,510 | 289,044 | 385,745 | 49,537 | 133,848 |
| 1997 | 2,121,818 | 22,440 | 365,342 | 24,076 | 330,153 | 15,099 | 414,596 | 438,212 | 61,553 | 115,882 |
| 1998 | (577,005) | (733,387) | (3,979,131) | (2,991) | (3,279,862) | (4,405) | (46,209) | (84,367) | (87,188) | (432,227) |
| 1999 | 1,250,830 | (475,206) | (683,915) | 18,893 | (787,153) | 6,193 | 172,541 | 252,025 | (174,420) | (244,303) |
| 2000 | 1,764,956 | (351,789) | (413,355) | 24,499 | (568,752) | 0 | 286,220 | 191,327 | (179,697) | (147,867) |
| 2001 | 10,902,727 | 4,524,359 | 1,522,670 | 209,527 | 2,511,568 | 0 | 862,702 | 1,813,737 | 4,432,140 | 394,890 |
| 2002 | 3,940,463 | 1,972,885 | 737,668 | 162,408 | 1,216,898 | 0 | 332,517 | 1,250,856 | 3,146,931 | 1,094,108 |
| 2003 | 5,100,175 | 3,152,858 | 907,284 | 145,683 | 1,496,268 | 0 | 1,429,244 | 981,055 | 1,640,373 | 1,377,855 |
| 2004 | 5,219,256 | 3,252,471 | 1,018,599 | 192,784 | 1,395,675 | 0 | 1,344,310 | 1,061,872 | 3,812,708 | 826,010 |
| 2005 | 5,994,948 | 3,011,986 | 3,452,612 | 89,977 | 3,986,107 | 0 | 1,580,568 | 1,173,519 | 2,654,327 | 1,135,524 |
| 2006 | 6,389,053 | 2,240,777 | 6,979,400 | 56,045 | 2,881,668 | 0 | 3,147,242 | 992,885 | 2,153,123 | 938,502 |
| 2007 | 9,366,901 | 4,237,414 | 7,356,408 | 230,821 | 3,037,276 | 0 | 6,174,449 | 2,222,474 | 6,072,123 | 404,247 |
| 2008 | 5,826,218 | 3,776,714 | 4,820,401 | 114,380 | 2,608,488 | 3,036 | 3,532,110 | 1,731,131 | 4,041,217 | 750,908 |
| 2009 | 4,113,756 | 2,594,973 | 3,412,249 | 96,587 | 1,364,781 | 3,868 | 3,227,850 | 1,412,580 | 3,431,699 | 860,858 |
| 2010 | 6,253,182 | 2,829,987 | 7,631,114 | 42,593 | 2,826,132 | 0 | 4,715,229 | 1,172,719 | 4,880,349 | 1,738,294 |
| 2011 | 11,068,964 | 2,825,443 | 9,156,505 | 62,294 | 3,689,723 | 0 | 660,924 | 1,243,209 | 3,592,673 | 2,392,706 |
| 2012 | 10,478,619 | 3,721,197 | 12,171,833 | 84,024 | 4,691,930 | 0 | 1,614,087 | 2,076,495 | 10,304,783 | 2,294,730 |
| 2013 | 7,516,830 | 5,764,719 | 8,479,616 | 222,780 | 2,746,163 | 0 | 1,262,325 | 1,556,015 | 4,736,630 | 1,222,043 |
| 2014 | 3,652,197 | 5,111,757 | 2,557,711 | 294,891 | 639,012 | 0 | 844,642 | 1,754,114 | 2,521,184 | 251,380 |
| 2015 | 2,613,821 | 5,186,525 | 7,450,071 | 294,189 | 2,300,415 | 0 | 2,115,097 | 1,190,355 | 5,508,810 | 1,181,277 |
| 2016 | 14,039,123 | 4,868,654 | 14,150,016 | 366,558 | 5,202,972 | 0 | 2,288,151 | 2,302,252 | 8,533,799 | 2,460,766 |
| **2017** | **15,596,542** | **9,227,839** | **13,194,347** | **734,202** | **5,316,840** | **0** | **8,225,116** | **3,451,718** | **9,721,314** | **2,746,637** |
| 2018 | 16,554,569 | 9,916,051 | 13,945,341 | 703,091 | 5,619,463 | 0 | 8,818,467 | 3,663,687 | 9,921,503 | 2,902,969 |
| 2019 | 16,810,350 | 10,221,429 | 14,853,213 | 725,236 | 5,985,303 | 0 | 9,512,199 | 3,809,560 | 11,015,104 | 3,091,959 |
| 2020 | 17,363,398 | 10,586,241 | 15,362,151 | 752,608 | 6,190,386 | 0 | 9,885,804 | 3,934,857 | 11,392,531 | 3,197,903 |
| 2021 | 17,197,859 | 10,487,645 | 15,224,934 | 743,830 | 6,135,093 | 0 | 9,776,726 | 3,897,350 | 11,290,771 | 3,169,339 |
| 2022 | 17,570,944 | 10,715,654 | 15,681,974 | 760,588 | 6,319,263 | 0 | 9,983,126 | 3,981,902 | 11,629,711 | 3,264,480 |
| 2023 | 17,326,749 | 10,666,340 | 15,366,413 | 751,175 | 6,192,103 | 0 | 9,886,931 | 3,926,537 | 11,395,692 | 3,198,791 |
| 2024 | 17,099,372 | 10,462,637 | 15,130,489 | 739,686 | 6,097,035 | 0 | 9,700,834 | 3,875,044 | 11,220,731 | 3,149,679 |
| 2025 | 17,380,138 | 10,697,873 | 15,488,845 | 754,032 | 6,241,439 | 0 | 9,912,853 | 3,938,640 | 11,486,487 | 3,224,277 |
| 2026 | 16,854,553 | 10,347,926 | 14,852,763 | 728,828 | 5,985,121 | 0 | 9,578,017 | 3,819,553 | 11,014,770 | 3,091,865 |
| 2027 | 17,364,612 | 10,652,206 | 15,414,713 | 751,589 | 6,211,567 | 0 | 9,877,057 | 3,935,137 | 11,431,511 | 3,208,845 |
| 2028 | 17,068,478 | 10,496,955 | 15,098,257 | 739,389 | 6,084,046 | 0 | 9,716,445 | 3,868,023 | 11,196,828 | 3,142,969 |
| 2029 | 17,382,832 | 10,673,311 | 15,452,907 | 752,816 | 6,226,957 | 0 | 9,885,524 | 3,939,267 | 11,459,836 | 3,216,796 |
| 2030 | 16,857,394 | 10,364,529 | 14,931,446 | 731,406 | 6,016,828 | 0 | 9,613,923 | 3,820,178 | 11,073,122 | 3,108,245 |
| 2031 | 18,636,292 | 11,380,781 | 16,704,957 | 806,153 | 6,731,488 | 0 | 10,571,733 | 4,223,340 | 12,388,352 | 3,477,432 |
| 2032 | 16,353,355 | 10,054,995 | 14,417,334 | 706,739 | 5,809,659 | 0 | 9,276,292 | 3,705,983 | 10,691,858 | 3,001,223 |
| 2033 | 18,272,104 | 11,173,411 | 16,286,208 | 792,491 | 6,562,747 | 0 | 10,414,291 | 4,140,779 | 12,077,810 | 3,390,262 |
| 2034 | 16,449,993 | 10,134,555 | 14,562,684 | 712,372 | 5,868,230 | 0 | 9,360,706 | 3,727,865 | 10,799,649 | 3,031,480 |
| 2035 | 21,389,883 | 12,756,831 | 19,208,587 | 916,531 | 7,740,359 | 0 | 11,940,568 | 4,847,470 | 14,245,038 | 3,998,607 |
| **TOTAL** | **466,839,844** | **258,227,181** | **385,425,525** | **17,824,136** | **167,164,862** | **350,562** | **223,909,326** | **101,380,125** | **289,004,132** | **80,236,472** |

[a] B-18 includes Extra Peaking Charges for additional power shown in Table 9.

## TABLE B-18 Variable OMP&R Component of Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36,970 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57,711 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 74,134 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 142,609 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 192,606 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 236,998 |
| 1968 | 0 | 0 | 0 | 30,401 | 0 | 0 | 0 | 0 | 0 | 1,117,912 |
| 1969 | 0 | 0 | 0 | 30,627 | 0 | 0 | 0 | 0 | 0 | 773,646 |
| 1970 | 0 | 0 | 0 | 39,430 | 0 | 0 | 0 | 0 | 0 | 1,103,799 |
| 1971 | 0 | 0 | 0 | 34,871 | 0 | 0 | 0 | 0 | 0 | 1,513,434 |
| 1972 | 0 | 848,011 | 0 | 947,266 | 0 | 0 | 0 | 0 | 0 | 3,297,202 |
| 1973 | 0 | 1,083,328 | 0 | 1,687,126 | 0 | 0 | 0 | 0 | 0 | 3,174,991 |
| 1974 | 0 | 1,872,297 | 0 | 2,373,712 | 0 | 0 | 0 | 0 | 0 | 3,926,489 |
| 1975 | 0 | 3,887,152 | 0 | 4,499,209 | 0 | 0 | 0 | 0 | 0 | 6,057,701 |
| 1976 | 0 | 5,485,263 | 0 | 6,488,418 | 0 | 0 | 0 | 0 | 0 | 8,477,311 |
| 1977 | 0 | (796,686) | 0 | (234,739) | 0 | 0 | 0 | 0 | 0 | 1,152,444 |
| 1978 | 0 | 3,696,428 | 0 | 4,890,112 | 0 | 0 | 0 | 0 | 0 | 7,632,606 |
| 1979 | 0 | 4,021,960 | 0 | 5,859,389 | 0 | 0 | 0 | 0 | 0 | 9,873,798 |
| 1980 | 0 | 5,362,245 | 0 | 7,605,064 | 0 | 0 | 0 | 0 | 0 | 10,425,875 |
| 1981 | 0 | 10,862,932 | 0 | 13,626,585 | 0 | 0 | 0 | 0 | 0 | 17,576,025 |
| 1982 | 0 | 7,685,168 | 0 | 10,069,760 | 0 | 0 | 0 | 0 | 0 | 13,566,611 |
| 1983 | 0 | (8,994,497) | 0 | (8,620,817) | 0 | 0 | 0 | 0 | 0 | (7,441,457) |
| 1984 | 0 | (7,633,741) | 0 | (6,721,621) | 0 | 0 | 0 | 0 | 0 | (4,008,601) |
| 1985 | 0 | (15,739,366) | 0 | (14,196,048) | 0 | 0 | 0 | 0 | 0 | (10,310,371) |
| 1986 | 0 | 1,135,478 | 0 | 4,531,005 | 0 | 0 | 0 | 0 | 0 | 11,629,559 |
| 1987 | 0 | (3,007,097) | 0 | 116,362 | 0 | 0 | 0 | 0 | 0 | 6,746,470 |
| 1988 | 0 | (3,407,929) | 0 | (378,098) | 0 | 0 | 0 | 0 | 0 | 6,351,151 |
| 1989 | 0 | 9,488,536 | 0 | 15,062,251 | 0 | 0 | 0 | 0 | 0 | 24,661,302 |
| 1990 | 0 | 30,759,725 | 204,582 | 39,322,882 | 0 | 0 | 0 | 0 | 0 | 48,184,400 |
| 1991 | 0 | 184,870 | 22,623 | 1,625,484 | 0 | 0 | 0 | 0 | 0 | 2,463,685 |
| 1992 | 0 | (9,471,028) | 0 | (8,196,198) | 0 | 0 | 0 | 0 | 0 | (5,499,060) |
| 1993 | 0 | (21,473,875) | 0 | (25,072,572) | 0 | 0 | 0 | 0 | 0 | (24,652,636) |
| 1994 | 0 | 4,059,683 | 0 | 7,920,177 | 0 | 0 | 0 | 0 | 0 | 13,514,307 |
| 1995 | 0 | (4,895,977) | 0 | (4,901,581) | 0 | 0 | 0 | 0 | 0 | (99,701) |
| 1996 | 0 | 1,859,275 | 0 | 6,054,577 | 0 | 0 | 0 | 0 | 0 | 15,893,938 |
| 1997 | 0 | 2,428,729 | (921) | 6,336,979 | 0 | 0 | 0 | 0 | 0 | 14,932,641 |
| 1998 | 0 | (14,593,773) | (68,568) | (23,889,113) | 0 | 0 | 0 | 0 | 0 | (24,030,879) |
| 1999 | 0 | (9,859,076) | (31,704) | (10,555,295) | 0 | 0 | 0 | 0 | 0 | (3,695,239) |
| 2000 | 0 | (14,604,199) | 7,335 | (13,991,323) | 0 | 0 | 0 | 0 | 0 | (6,673,244) |
| 2001 | 0 | 160,767,744 | 270,290 | 188,212,355 | 0 | 0 | 0 | 0 | 0 | 211,326,217 |
| 2002 | 0 | 59,840,151 | 279,773 | 73,974,657 | 0 | 0 | 0 | 0 | 0 | 88,827,129 |
| 2003 | 7,287 | 94,317,664 | 357,996 | 110,913,742 | 0 | 0 | 0 | 0 | 0 | 129,403,482 |
| 2004 | 98,121 | 107,170,690 | 416,866 | 125,809,361 | 0 | 0 | 0 | 0 | 0 | 144,126,263 |
| 2005 | 84,202 | 113,938,011 | 123,173 | 137,224,954 | 0 | 0 | 0 | 0 | 0 | 166,351,708 |
| 2006 | 431,163 | 82,219,262 | 92,254 | 108,521,373 | 0 | 0 | 0 | 0 | 0 | 131,754,915 |
| 2007 | 598,467 | 137,718,921 | 317,330 | 177,736,829 | 0 | 0 | 0 | 0 | 0 | 201,791,069 |
| 2008 | 717,425 | 83,447,245 | 408,696 | 111,777,969 | 0 | 0 | 0 | 0 | 0 | 128,838,145 |
| 2009 | 749,806 | 60,856,856 | 350,744 | 82,476,606 | 0 | 0 | 0 | 0 | 0 | 93,124,310 |
| 2010 | 1,106,548 | 91,428,005 | 408,413 | 125,032,565 | 0 | 0 | 0 | 0 | 0 | 143,222,650 |
| 2011 | 1,552,856 | 132,154,342 | 426,240 | 168,825,881 | 0 | 0 | 0 | 0 | 0 | 200,397,197 |
| 2012 | 1,699,026 | 108,540,066 | 499,834 | 158,176,624 | 0 | 0 | 0 | 0 | 0 | 180,532,182 |
| 2013 | 1,848,297 | 108,934,271 | 408,330 | 144,698,019 | 0 | 0 | 0 | 0 | 0 | 169,122,969 |
| 2014 | 1,504,444 | 69,744,415 | 17,801 | 88,893,548 | 0 | 0 | 0 | 0 | 0 | 105,660,905 |
| 2015 | 1,019,903 | 106,856,531 | 205,542 | 135,922,538 | 0 | 0 | 0 | 0 | 0 | 155,445,548 |
| 2016 | 2,031,197 | 160,243,981 | 501,415 | 216,988,883 | 0 | 0 | 0 | 0 | 0 | 247,903,525 |
| **2017** | **2,818,461** | **174,800,176** | **542,965** | **246,376,157** | **0** | **0** | **0** | **0** | **0** | **278,461,529** |
| 2018 | 2,929,146 | 171,830,714 | 580,023 | 247,385,024 | 0 | 0 | 0 | 0 | 0 | 280,896,140 |
| 2019 | 3,105,359 | 180,872,136 | 596,308 | 260,598,157 | 0 | 0 | 0 | 0 | 0 | 297,191,230 |
| 2020 | 3,194,843 | 186,503,055 | 617,604 | 268,981,380 | 0 | 0 | 0 | 0 | 0 | 302,806,076 |
| 2021 | 3,157,706 | 185,222,311 | 611,371 | 266,914,935 | 0 | 0 | 0 | 0 | 0 | 302,652,455 |
| 2022 | 3,230,712 | 189,780,703 | 624,574 | 273,543,630 | 0 | 0 | 0 | 0 | 0 | 309,589,158 |
| 2023 | 3,184,567 | 187,486,859 | 622,115 | 270,004,272 | 0 | 0 | 0 | 0 | 0 | 304,410,696 |
| 2024 | 3,160,000 | 184,223,611 | 611,730 | 265,470,848 | 0 | 0 | 0 | 0 | 0 | 299,790,950 |
| 2025 | 3,212,222 | 188,308,989 | 623,926 | 271,269,720 | 0 | 0 | 0 | 0 | 0 | 305,352,527 |
| 2026 | 3,109,114 | 181,934,961 | 603,856 | 261,921,328 | 0 | 0 | 0 | 0 | 0 | 297,235,324 |
| 2027 | 3,188,347 | 187,675,525 | 622,083 | 270,333,191 | 0 | 0 | 0 | 0 | 0 | 305,304,433 |
| 2028 | 3,153,651 | 184,500,917 | 612,263 | 265,678,222 | 0 | 0 | 0 | 0 | 0 | 300,352,293 |
| 2029 | 3,202,078 | 188,065,274 | 622,981 | 270,880,579 | 0 | 0 | 0 | 0 | 0 | 305,888,432 |
| 2030 | 3,141,668 | 181,892,671 | 605,080 | 262,156,490 | 0 | 0 | 0 | 0 | 0 | 294,544,365 |
| 2031 | 3,363,747 | 201,624,868 | 665,948 | 290,575,092 | 0 | 0 | 0 | 0 | 0 | 327,160,893 |
| 2032 | 3,055,646 | 176,946,173 | 585,922 | 254,605,180 | 0 | 0 | 0 | 0 | 0 | 290,561,938 |
| 2033 | 3,316,143 | 196,783,624 | 654,293 | 283,864,163 | 0 | 0 | 0 | 0 | 0 | 316,697,685 |
| 2034 | 3,082,187 | 178,199,304 | 590,445 | 256,519,470 | 0 | 0 | 0 | 0 | 0 | 291,149,929 |
| 2035 | 3,655,553 | 229,574,195 | 754,024 | 331,027,647 | 0 | 0 | 0 | 0 | 0 | 377,152,102 |
| **TOTAL** | **73,709,893** | **5,214,648,057** | **16,965,556** | **7,295,685,673** | **0** | **0** | **0** | **0** | **0** | **8,433,403,508** |

[a] B-18 includes Extra Peaking Charges for additional power shown in Table 9.

## TABLE B-19 Total Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 11,750 | 43,787 | 21,132 | 76,669 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 199,726 | 190,272 | 447,723 | 837,721 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 263,282 | 277,455 | 621,356 | 1,162,093 | 6,696 | 21,667 | 28,363 |
| 1965 | 0 | 0 | 0 | 373,816 | 404,324 | 1,158,090 | 1,936,230 | 13,756 | 36,029 | 49,785 |
| 1966 | 18,063 | 0 | 18,063 | 419,468 | 421,723 | 1,412,954 | 2,254,144 | 26,524 | 61,349 | 87,873 |
| 1967 | 41,574 | 0 | 41,574 | 539,115 | 498,441 | 1,686,098 | 2,723,655 | 56,469 | 118,263 | 174,731 |
| 1968 | 128,628 | 0 | 128,628 | 663,944 | 603,483 | 1,985,220 | 3,252,647 | 115,961 | 229,807 | 345,768 |
| 1969 | 254,715 | 0 | 254,715 | 787,590 | 539,340 | 2,083,253 | 3,410,184 | 185,156 | 358,861 | 544,017 |
| 1970 | 277,547 | 0 | 277,547 | 823,406 | 532,567 | 2,202,767 | 3,558,740 | 200,150 | 387,675 | 587,825 |
| 1971 | 227,474 | 0 | 227,474 | 788,603 | 552,113 | 2,169,897 | 3,510,613 | 202,413 | 392,912 | 595,325 |
| 1972 | 224,978 | 0 | 224,978 | 830,536 | 678,520 | 2,320,421 | 3,829,477 | 209,057 | 406,589 | 615,646 |
| 1973 | 221,091 | 31,366 | 252,457 | 795,896 | 549,393 | 2,338,620 | 3,683,908 | 206,557 | 402,724 | 609,281 |
| 1974 | 240,498 | 32,938 | 273,437 | 819,798 | 564,593 | 2,506,358 | 3,890,749 | 208,545 | 407,090 | 615,635 |
| 1975 | 237,459 | 36,291 | 273,750 | 869,877 | 605,731 | 2,409,923 | 3,885,531 | 225,895 | 439,873 | 665,768 |
| 1976 | 271,292 | 40,836 | 312,127 | 960,749 | 734,812 | 2,500,506 | 4,196,066 | 228,976 | 447,299 | 676,275 |
| 1977 | 293,627 | 45,096 | 338,723 | 925,060 | 713,558 | 2,476,399 | 4,115,017 | 238,699 | 468,721 | 707,420 |
| 1978 | 273,870 | 49,178 | 323,048 | 980,577 | 692,587 | 2,785,987 | 4,459,151 | 245,331 | 484,259 | 729,590 |
| 1979 | 289,479 | 53,340 | 342,819 | 1,045,919 | 736,358 | 2,813,578 | 4,595,856 | 243,110 | 483,437 | 726,547 |
| 1980 | 310,846 | 67,748 | 378,594 | 1,164,112 | 866,372 | 3,028,204 | 5,058,688 | 269,858 | 537,074 | 806,932 |
| 1981 | 347,781 | 87,408 | 435,189 | 1,129,983 | 879,357 | 2,917,582 | 4,926,922 | 288,997 | 586,257 | 875,254 |
| 1982 | 438,335 | 106,918 | 545,254 | 1,168,058 | 850,483 | 3,262,104 | 5,280,645 | 290,049 | 582,757 | 872,806 |
| 1983 | 354,787 | 151,259 | 506,046 | 1,179,824 | 900,363 | 3,795,446 | 5,875,633 | 319,214 | 633,181 | 952,395 |
| 1984 | 467,336 | 224,245 | 691,581 | 1,472,097 | 1,097,480 | 5,737,801 | 8,307,379 | 351,620 | 695,559 | 1,047,179 |
| 1985 | 736,074 | 364,305 | 1,100,379 | 1,922,727 | 1,789,369 | 6,551,546 | 10,263,642 | 394,593 | 776,994 | 1,171,586 |
| 1986 | 1,084,728 | 692,479 | 1,777,207 | 1,750,114 | 1,528,732 | 6,863,230 | 10,142,076 | 385,545 | 762,684 | 1,148,229 |
| 1987 | 1,773,801 | 1,559,243 | 3,333,044 | 2,240,162 | 2,011,876 | 6,675,355 | 10,927,393 | 385,289 | 812,310 | 1,197,599 |
| 1988 | 2,231,563 | 2,333,792 | 4,565,355 | 2,241,970 | 2,210,523 | 6,368,850 | 10,821,343 | 420,153 | 978,621 | 1,398,774 |
| 1989 | 2,397,272 | 3,326,436 | 5,723,708 | 2,158,405 | 1,872,030 | 5,916,714 | 9,947,149 | 414,224 | 1,162,723 | 1,576,947 |
| 1990 | 2,746,135 | 3,433,320 | 6,179,455 | 2,577,836 | 2,261,914 | 6,668,440 | 11,508,190 | 487,609 | 1,234,409 | 1,722,018 |
| 1991 | 2,748,636 | 3,682,311 | 6,430,947 | 1,757,464 | 1,621,188 | 4,527,928 | 7,906,580 | 491,419 | 1,476,387 | 1,967,806 |
| 1992 | 2,554,528 | 3,528,958 | 6,083,486 | 2,078,645 | 2,003,328 | 5,385,858 | 9,467,831 | 551,042 | 1,491,156 | 2,042,198 |
| 1993 | 2,592,888 | 3,504,240 | 6,097,128 | 2,883,887 | 2,011,222 | 6,511,865 | 11,406,974 | 610,115 | 1,675,438 | 2,285,553 |
| 1994 | 2,718,329 | 3,537,459 | 6,255,788 | 2,910,638 | 2,642,460 | 7,314,515 | 12,867,612 | 767,900 | 2,473,449 | 3,241,348 |
| 1995 | 2,649,273 | 3,509,935 | 6,159,208 | 3,038,999 | 2,289,027 | 5,893,667 | 11,221,693 | 995,341 | 4,977,122 | 5,972,462 |
| 1996 | 2,699,210 | 3,891,715 | 6,590,926 | 2,588,141 | 2,137,443 | 6,675,492 | 11,401,075 | 1,837,384 | 13,766,531 | 15,603,915 |
| 1997 | 2,641,891 | 3,631,175 | 6,273,066 | 2,661,398 | 2,007,332 | 6,551,469 | 11,220,199 | 2,294,917 | 21,860,553 | 24,155,470 |
| 1998 | 2,538,764 | 3,478,062 | 6,016,827 | 2,267,794 | 2,064,166 | 6,296,050 | 10,628,010 | 2,976,896 | 26,690,793 | 29,667,689 |
| 1999 | 2,689,372 | 3,841,375 | 6,530,748 | 2,889,115 | 2,450,078 | 8,373,830 | 13,713,024 | 3,031,213 | 27,471,599 | 30,502,813 |
| 2000 | 2,832,886 | 4,308,518 | 7,141,404 | 3,921,511 | 2,304,770 | 7,033,063 | 13,259,343 | 2,947,330 | 27,838,836 | 30,786,166 |
| 2001 | 3,351,939 | 4,919,162 | 8,271,101 | 7,419,283 | 2,809,316 | 8,485,242 | 18,713,841 | 3,508,739 | 30,022,618 | 33,531,357 |
| 2002 | 3,554,893 | 5,049,275 | 8,604,169 | 10,851,439 | 2,777,107 | 9,918,869 | 23,547,414 | 3,212,467 | 29,615,198 | 32,827,666 |
| 2003 | 3,666,268 | 5,392,771 | 9,059,039 | 7,509,579 | 2,507,016 | 8,729,531 | 18,746,126 | 3,294,613 | 29,872,229 | 33,166,842 |
| 2004 | 4,142,962 | 5,617,996 | 9,760,958 | 5,711,118 | 2,812,121 | 8,200,965 | 16,724,205 | 3,307,286 | 30,301,003 | 33,608,289 |
| 2005 | 3,502,255 | 5,128,386 | 8,630,641 | 5,728,188 | 2,965,732 | 8,975,318 | 17,669,237 | 3,431,724 | 30,410,329 | 33,842,054 |
| 2006 | 3,400,622 | 4,618,665 | 8,019,287 | 5,687,082 | 2,957,398 | 9,089,022 | 17,733,502 | 3,272,598 | 30,046,304 | 33,318,902 |
| 2007 | 3,600,964 | 5,098,183 | 8,699,147 | 6,748,392 | 3,476,732 | 10,352,970 | 20,578,093 | 3,423,837 | 31,256,011 | 34,679,848 |
| 2008 | 4,289,301 | 5,052,031 | 9,341,332 | 7,590,849 | 3,764,393 | 10,497,550 | 21,852,792 | 3,920,777 | 32,501,210 | 36,421,986 |
| 2009 | 4,721,617 | 5,099,982 | 9,821,599 | 6,506,732 | 3,290,149 | 10,231,137 | 20,028,018 | 3,723,273 | 30,819,516 | 34,542,789 |
| 2010 | 4,979,172 | 6,528,330 | 11,507,502 | 7,444,202 | 3,684,053 | 11,201,327 | 22,329,582 | 4,090,534 | 33,076,178 | 37,166,712 |
| 2011 | 5,344,639 | 6,916,161 | 12,260,800 | 8,668,390 | 4,324,182 | 12,900,011 | 25,892,583 | 4,155,708 | 33,999,591 | 38,155,300 |
| 2012 | 5,811,473 | 6,872,040 | 12,683,513 | 9,563,697 | 4,340,693 | 15,179,375 | 29,083,765 | 4,207,597 | 34,580,154 | 38,787,751 |
| 2013 | 5,452,335 | 6,600,244 | 12,052,578 | 10,334,175 | 5,056,283 | 15,078,110 | 30,468,567 | 4,425,673 | 35,959,947 | 40,385,620 |
| 2014 | 6,105,270 | 7,203,358 | 13,308,628 | 10,122,366 | 5,339,975 | 15,211,171 | 30,673,512 | 4,267,082 | 33,120,394 | 37,387,477 |
| 2015 | 6,204,190 | 7,135,651 | 13,339,842 | 9,965,769 | 5,023,279 | 17,090,255 | 32,079,302 | 4,847,034 | 35,199,705 | 40,046,739 |
| 2016 | 6,427,786 | 7,716,107 | 14,143,893 | 12,108,365 | 5,144,865 | 24,891,003 | 42,144,233 | 4,554,716 | 35,498,243 | 40,052,959 |
| **2017** | **7,164,797** | **8,286,250** | **15,451,047** | **12,293,770** | **5,555,819** | **21,308,236** | **39,157,826** | **5,668,011** | **35,909,666** | **41,577,677** |
| 2018 | 6,980,985 | 8,024,245 | 15,005,230 | 13,182,271 | 5,991,503 | 17,844,035 | 37,017,809 | 5,816,301 | 36,219,536 | 42,035,838 |
| 2019 | 6,797,722 | 8,006,700 | 14,804,422 | 12,677,305 | 5,752,733 | 21,194,465 | 39,624,503 | 6,281,641 | 37,228,189 | 43,509,830 |
| 2020 | 6,820,224 | 8,039,988 | 14,860,211 | 12,510,934 | 5,674,150 | 21,038,424 | 39,223,508 | 6,295,067 | 37,310,693 | 43,605,760 |
| 2021 | 6,832,358 | 8,075,723 | 14,908,081 | 12,664,297 | 5,759,185 | 21,281,030 | 39,704,513 | 6,314,658 | 37,391,067 | 43,705,725 |
| 2022 | 6,867,627 | 8,127,697 | 14,995,324 | 12,753,497 | 5,797,650 | 21,439,950 | 39,991,097 | 6,357,451 | 37,519,113 | 43,876,564 |
| 2023 | 6,889,813 | 8,136,656 | 15,026,469 | 12,717,577 | 5,779,639 | 21,445,263 | 39,942,479 | 6,341,215 | 37,526,433 | 43,867,648 |
| 2024 | 6,917,235 | 8,183,088 | 15,100,323 | 12,789,607 | 5,811,479 | 21,585,797 | 40,186,882 | 6,365,372 | 37,617,536 | 43,982,908 |
| 2025 | 6,940,113 | 8,229,127 | 15,169,240 | 12,840,735 | 5,833,762 | 21,700,782 | 40,375,278 | 6,389,144 | 37,708,211 | 44,097,355 |
| 2026 | 6,948,614 | 8,260,798 | 15,209,412 | 12,968,723 | 5,905,060 | 21,912,175 | 40,785,958 | 6,396,849 | 37,765,098 | 44,161,947 |
| 2027 | 6,979,246 | 8,307,596 | 15,286,843 | 13,011,266 | 5,922,801 | 22,016,516 | 40,950,583 | 6,420,536 | 37,853,833 | 44,274,369 |
| 2028 | 7,007,296 | 8,353,241 | 15,360,537 | 13,071,196 | 5,948,110 | 22,143,014 | 41,162,321 | 6,437,820 | 37,930,797 | 44,368,616 |
| 2029 | 7,034,852 | 8,398,903 | 15,433,755 | 13,151,663 | 5,986,499 | 22,295,878 | 41,434,040 | 6,466,997 | 38,031,788 | 44,498,785 |
| 2030 | 7,056,017 | 8,434,269 | 15,490,286 | 13,082,378 | 5,944,689 | 22,264,570 | 41,291,636 | 6,453,267 | 38,043,798 | 44,497,065 |
| 2031 | 7,070,475 | 8,462,540 | 15,533,015 | 13,346,817 | 6,084,385 | 22,646,930 | 42,078,132 | 6,530,233 | 38,234,506 | 44,764,739 |
| 2032 | 7,073,692 | 8,481,574 | 15,555,266 | 13,416,850 | 6,118,922 | 22,790,193 | 42,325,965 | 6,518,073 | 38,259,903 | 44,777,976 |
| 2033 | 7,088,288 | 8,496,126 | 15,584,414 | 13,287,164 | 6,046,336 | 22,686,223 | 42,019,723 | 6,521,673 | 38,316,408 | 44,838,080 |
| 2034 | 7,034,513 | 8,462,076 | 15,496,589 | 13,478,137 | 6,142,748 | 22,978,539 | 42,599,424 | 6,549,069 | 38,416,766 | 44,965,835 |
| 2035 | 6,912,628 | 8,363,631 | 15,276,259 | 14,091,392 | 6,476,178 | 23,796,355 | 44,363,925 | 6,725,771 | 38,825,895 | 45,551,666 |
| **TOTAL** | **249,526,913** | **301,628,515** | **551,155,428** | **437,397,196** | **219,943,510** | **766,689,519** | **1,424,030,225** | **205,616,808** | **1,376,018,854** | **1,581,635,662** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; 2016 and after includes both bond debt service and bond cover.

## TABLE B-19 Total Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 2,725 | 0 | 0 | 0 | 0 | 0 | 2,725 |
| 1965 | 0 | 0 | 6,029 | 73,569 | 0 | 0 | 0 | 0 | 79,598 |
| 1966 | 0 | 0 | 12,039 | 137,330 | 0 | 0 | 0 | 0 | 149,368 |
| 1967 | 0 | 0 | 26,257 | 267,611 | 0 | 0 | 0 | 0 | 293,869 |
| 1968 | 187,324 | 9,046 | 54,588 | 445,439 | 1,556,908 | 13,770 | 11,783 | 211,208 | 2,490,065 |
| 1969 | 182,935 | 8,056 | 87,576 | 525,094 | 2,417,821 | 12,625 | 10,803 | 365,780 | 3,610,691 |
| 1970 | 205,213 | 14,823 | 94,675 | 573,998 | 2,946,188 | 12,790 | 13,348 | 300,181 | 4,161,215 |
| 1971 | 201,911 | 15,781 | 95,695 | 605,889 | 3,865,008 | 17,763 | 14,667 | 455,717 | 5,272,430 |
| 1972 | 224,875 | 16,649 | 98,788 | 631,615 | 5,056,385 | 15,220 | 21,177 | 1,102,927 | 7,167,636 |
| 1973 | 207,846 | 12,720 | 97,550 | 639,250 | 4,999,018 | 15,483 | 11,999 | 417,493 | 6,401,359 |
| 1974 | 289,992 | 12,689 | 98,460 | 698,247 | 5,310,461 | 15,590 | 13,113 | 611,846 | 7,050,399 |
| 1975 | 358,518 | 13,634 | 106,703 | 715,606 | 6,448,781 | 16,620 | 14,807 | 745,333 | 8,420,001 |
| 1976 | 311,509 | 14,180 | 108,084 | 774,291 | 6,810,574 | 16,993 | 16,521 | 576,756 | 8,628,908 |
| 1977 | 273,379 | 11,290 | 112,554 | 797,859 | 6,995,891 | 18,457 | 14,273 | 523,111 | 8,746,814 |
| 1978 | 362,679 | 4,441 | 115,521 | 890,945 | 8,462,660 | 18,921 | 18,331 | 517,626 | 10,391,124 |
| 1979 | 393,923 | 14,027 | 114,253 | 896,194 | 9,601,223 | 20,202 | 25,272 | 968,058 | 12,033,151 |
| 1980 | 415,565 | 12,377 | 125,950 | 888,893 | 10,172,491 | 20,749 | 24,810 | 752,521 | 12,413,356 |
| 1981 | 479,056 | 30,218 | 134,169 | 1,079,315 | 11,633,148 | 24,939 | 23,345 | 924,731 | 14,328,922 |
| 1982 | 473,565 | 13,368 | 135,057 | 1,004,667 | 12,479,986 | 22,955 | 22,830 | 762,976 | 14,915,404 |
| 1983 | 647,158 | 14,962 | 149,202 | 1,027,258 | 15,704,356 | 39,971 | 29,512 | 430,085 | 18,042,505 |
| 1984 | 920,182 | 15,376 | 164,505 | 2,063,179 | 23,845,324 | 54,427 | 60,100 | 797,221 | 27,920,315 |
| 1985 | 1,109,058 | 87,937 | 184,905 | 2,350,593 | 28,166,640 | 69,483 | 70,639 | 2,180,293 | 34,219,549 |
| 1986 | 1,273,624 | 34,393 | 180,445 | 2,365,159 | 30,739,767 | 80,769 | 76,519 | 2,202,930 | 36,953,606 |
| 1987 | 1,132,529 | 51,188 | 179,872 | 2,804,776 | 29,560,005 | 78,018 | 74,775 | 2,262,782 | 36,143,945 |
| 1988 | 1,118,466 | 61,983 | 193,735 | 2,750,424 | 29,486,385 | 74,168 | 60,669 | 2,221,264 | 35,967,093 |
| 1989 | 1,154,313 | 49,665 | 187,913 | 2,435,635 | 29,558,178 | 67,048 | 69,153 | 2,465,507 | 35,987,412 |
| 1990 | 871,708 | 34,827 | 221,392 | 2,541,316 | 27,683,951 | 51,058 | 49,591 | 1,894,110 | 33,347,951 |
| 1991 | 594,011 | 23,732 | 220,282 | 2,055,250 | 17,883,343 | 27,930 | 27,360 | 1,254,675 | 22,086,583 |
| 1992 | 964,338 | 39,568 | 241,455 | 2,369,788 | 26,181,464 | 55,795 | 51,414 | 1,931,815 | 31,835,638 |
| 1993 | 1,176,628 | 54,095 | 264,959 | 2,799,482 | 31,695,633 | 72,889 | 70,097 | 2,665,403 | 38,799,186 |
| 1994 | 1,031,718 | 44,221 | 306,359 | 2,808,829 | 29,571,444 | 60,460 | 57,864 | 2,141,333 | 36,022,227 |
| 1995 | 1,528,406 | 47,079 | 304,297 | 3,499,611 | 36,694,999 | 88,875 | 80,687 | 2,795,443 | 45,039,398 |
| 1996 | 1,357,198 | 48,711 | 389,203 | 3,560,139 | 36,669,690 | 86,092 | 74,335 | 4,341,334 | 46,526,702 |
| 1997 | 1,398,727 | 25,868 | 276,681 | 3,107,763 | 32,838,915 | 36,715 | 69,195 | 1,695,411 | 39,449,275 |
| 1998 | 1,242,611 | 34,823 | 381,847 | 2,654,434 | 29,595,386 | 41,835 | 60,491 | 1,825,655 | 35,837,081 |
| 1999 | 1,236,996 | 56,268 | 369,935 | 3,062,825 | 31,713,760 | 75,476 | 65,787 | 4,188,654 | 40,769,701 |
| 2000 | 1,075,478 | 38,466 | 302,623 | 2,320,236 | 26,742,595 | 61,957 | 55,348 | 2,812,077 | 33,408,781 |
| 2001 | 1,762,840 | 63,702 | 328,001 | 2,240,137 | 34,376,094 | 80,519 | 102,254 | 3,097,473 | 42,051,019 |
| 2002 | 1,328,586 | 44,059 | 320,541 | 2,330,952 | 29,187,128 | 73,376 | 78,371 | 2,570,604 | 35,933,615 |
| 2003 | 1,396,960 | 48,958 | 339,961 | 2,741,740 | 32,009,834 | 89,703 | 79,599 | 2,889,002 | 39,595,757 |
| 2004 | 1,453,956 | 78,324 | 342,484 | 3,759,777 | 30,628,692 | 234,783 | 82,207 | 2,401,651 | 38,981,874 |
| 2005 | 2,043,413 | 88,260 | 355,581 | 2,982,461 | 41,696,506 | 418,952 | 81,742 | 3,451,470 | 51,118,385 |
| 2006 | 1,788,356 | 75,024 | 294,916 | 3,277,258 | 37,629,163 | 252,054 | 78,994 | 2,795,788 | 46,191,553 |
| 2007 | 1,658,905 | 69,769 | 333,662 | 3,063,528 | 35,566,226 | 234,073 | 82,494 | 2,952,809 | 43,961,465 |
| 2008 | 1,512,581 | 62,027 | 468,712 | 3,448,084 | 34,816,866 | 247,105 | 80,580 | 2,426,440 | 43,062,395 |
| 2009 | 1,208,915 | 49,943 | 435,271 | 2,184,856 | 30,471,532 | 191,396 | 62,330 | 2,017,290 | 36,621,533 |
| 2010 | 1,477,724 | 110,749 | 507,438 | 2,359,472 | 36,709,593 | 255,532 | 88,235 | 2,704,762 | 44,213,506 |
| 2011 | 2,183,472 | 81,979 | 506,763 | 3,445,004 | 51,121,340 | 303,397 | 92,431 | 2,729,907 | 60,464,292 |
| 2012 | 1,271,774 | 89,538 | 467,287 | 3,247,652 | 41,001,582 | 319,307 | 93,117 | 3,495,679 | 49,985,937 |
| 2013 | 1,619,309 | 82,647 | 519,826 | 3,418,166 | 40,983,668 | 280,430 | 92,527 | 2,757,464 | 49,754,038 |
| 2014 | 1,613,285 | 66,564 | 635,140 | 2,814,339 | 36,234,915 | 228,514 | 93,666 | 2,117,851 | 43,804,275 |
| 2015 | 1,396,995 | 67,715 | 747,667 | 3,198,458 | 37,709,812 | 227,162 | 81,602 | 2,295,722 | 45,725,132 |
| 2016 | 1,674,671 | 96,257 | 688,733 | 4,513,460 | 42,153,429 | 371,068 | 121,557 | 3,168,858 | 52,788,032 |
| **2017** | **1,853,238** | **98,757** | **680,826** | **4,870,285** | **46,612,010** | **343,034** | **126,399** | **3,210,317** | **57,794,867** |
| 2018 | 1,899,620 | 101,773 | 717,852 | 4,954,757 | 47,784,400 | 346,443 | 129,331 | 3,288,821 | 59,222,997 |
| 2019 | 1,835,868 | 102,455 | 696,540 | 5,007,807 | 47,631,337 | 348,808 | 131,879 | 3,308,572 | 59,063,267 |
| 2020 | 1,649,819 | 96,269 | 704,830 | 4,709,112 | 46,062,052 | 329,978 | 118,621 | 3,128,267 | 56,798,948 |
| 2021 | 1,726,747 | 101,319 | 709,674 | 4,880,394 | 47,545,163 | 345,461 | 128,354 | 3,275,593 | 58,712,706 |
| 2022 | 1,737,833 | 102,038 | 715,066 | 4,908,906 | 47,902,119 | 347,640 | 128,841 | 3,296,633 | 59,139,075 |
| 2023 | 1,695,714 | 99,257 | 720,709 | 4,794,371 | 47,184,594 | 338,974 | 123,122 | 3,215,629 | 58,172,369 |
| 2024 | 1,701,030 | 99,596 | 726,318 | 4,798,246 | 47,324,154 | 340,009 | 123,589 | 3,225,598 | 58,338,540 |
| 2025 | 1,697,738 | 99,369 | 731,946 | 4,796,166 | 47,403,982 | 339,283 | 122,333 | 3,219,056 | 58,409,872 |
| 2026 | 1,756,201 | 103,203 | 737,931 | 4,929,325 | 48,481,502 | 351,119 | 130,089 | 3,330,957 | 59,820,327 |
| 2027 | 1,748,169 | 102,664 | 743,603 | 4,920,034 | 48,508,285 | 349,408 | 128,004 | 3,315,319 | 59,815,486 |
| 2028 | 1,747,154 | 102,586 | 747,547 | 4,907,139 | 48,529,455 | 349,079 | 127,664 | 3,313,136 | 59,823,760 |
| 2029 | 1,763,724 | 103,665 | 753,674 | 4,955,195 | 48,980,730 | 352,376 | 128,968 | 3,344,681 | 60,383,012 |
| 2030 | 1,689,190 | 98,751 | 759,891 | 4,746,182 | 47,593,445 | 337,081 | 119,429 | 3,201,489 | 58,545,458 |
| 2031 | 1,824,224 | 107,623 | 764,875 | 5,123,794 | 50,499,986 | 364,200 | 134,490 | 3,460,236 | 62,279,428 |
| 2032 | 1,831,711 | 108,104 | 771,502 | 5,081,745 | 50,339,135 | 365,690 | 137,427 | 3,474,352 | 62,109,665 |
| 2033 | 1,721,548 | 100,846 | 777,868 | 4,847,890 | 48,710,589 | 343,091 | 120,661 | 3,262,816 | 59,885,308 |
| 2034 | 1,803,908 | 106,252 | 784,021 | 5,002,208 | 50,027,543 | 359,699 | 132,688 | 3,420,532 | 61,636,850 |
| 2035 | 2,161,149 | 129,739 | 790,130 | 6,045,362 | 57,595,117 | 432,316 | 173,337 | 4,105,453 | 71,432,604 |
| **TOTAL** | **83,637,766** | **4,106,242** | **27,473,067** | **201,526,770** | **2,130,100,357** | **11,877,101** | **5,217,546** | **156,612,481** | **2,620,551,329** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; 2016 and after includes both bond debt service and bond cover.

## TABLE B-19 Total Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 34,411 | 0 | 0 | 0 | 726 | 0 | 0 | 0 | 51,729 | 0 |
| 1964 | 64,494 | 27,447 | 19,542 | 4,370 | 38,211 | 1,143 | 30,324 | 8,205 | 82,811 | 34,987 |
| 1965 | 121,484 | 53,007 | 34,348 | 7,194 | 42,701 | 2,082 | 53,730 | 15,222 | 135,069 | 35,344 |
| 1966 | 221,012 | 101,264 | 62,476 | 12,478 | 76,886 | 3,753 | 96,944 | 27,679 | 232,502 | 61,465 |
| 1967 | 427,622 | 210,814 | 121,269 | 23,472 | 148,839 | 7,284 | 188,141 | 54,023 | 433,350 | 115,574 |
| 1968 | 754,401 | 478,892 | 218,649 | 41,509 | 265,168 | 12,870 | 336,227 | 95,466 | 782,163 | 208,927 |
| 1969 | 1,090,136 | 725,835 | 334,105 | 61,226 | 394,024 | 18,693 | 500,689 | 138,063 | 1,205,834 | 321,755 |
| 1970 | 1,420,639 | 906,043 | 470,423 | 89,700 | 552,223 | 25,231 | 692,219 | 184,837 | 1,778,187 | 467,573 |
| 1971 | 1,760,670 | 1,090,440 | 627,331 | 128,360 | 754,065 | 31,837 | 931,649 | 231,280 | 2,538,219 | 659,414 |
| 1972 | 2,084,699 | 1,310,372 | 777,838 | 181,206 | 971,501 | 42,404 | 1,195,372 | 274,599 | 3,388,734 | 865,095 |
| 1973 | 2,177,324 | 1,326,909 | 920,218 | 183,713 | 1,184,696 | 43,482 | 1,262,078 | 287,315 | 3,971,543 | 946,686 |
| 1974 | 2,241,780 | 1,386,769 | 938,860 | 193,283 | 1,212,205 | 45,212 | 1,295,813 | 292,071 | 3,998,510 | 990,064 |
| 1975 | 2,419,858 | 1,455,585 | 983,580 | 206,040 | 1,280,804 | 48,490 | 1,365,296 | 304,281 | 4,159,094 | 1,088,341 |
| 1976 | 2,773,862 | 1,451,307 | 1,032,075 | 215,084 | 1,356,888 | 51,463 | 1,409,102 | 313,685 | 4,299,592 | 1,141,598 |
| 1977 | 2,717,286 | 1,520,872 | 929,532 | 226,032 | 1,194,916 | 47,348 | 1,482,157 | 329,365 | 4,553,831 | 1,197,216 |
| 1978 | 3,035,392 | 1,606,294 | 1,111,606 | 231,040 | 1,470,658 | 47,118 | 1,483,445 | 321,681 | 4,460,167 | 1,208,720 |
| 1979 | 3,589,381 | 1,641,500 | 1,180,841 | 237,955 | 1,569,175 | 48,396 | 1,612,358 | 332,472 | 4,422,382 | 1,152,375 |
| 1980 | 4,136,480 | 1,723,785 | 1,271,861 | 259,401 | 1,730,656 | 53,348 | 1,733,166 | 360,461 | 4,835,652 | 1,269,447 |
| 1981 | 4,469,204 | 1,978,119 | 1,355,504 | 271,181 | 1,850,802 | 77,806 | 1,859,135 | 391,869 | 5,224,182 | 1,357,680 |
| 1982 | 4,031,426 | 2,070,417 | 1,403,332 | 280,313 | 1,936,175 | 55,961 | 2,054,784 | 406,891 | 5,410,876 | 1,565,182 |
| 1983 | 5,224,176 | 2,333,372 | 1,997,502 | 333,081 | 2,880,959 | 69,381 | 2,131,344 | 494,688 | 6,020,929 | 1,556,652 |
| 1984 | 7,262,706 | 3,375,527 | 3,084,372 | 445,339 | 4,608,046 | 75,773 | 2,361,384 | 553,321 | 7,049,449 | 2,331,849 |
| 1985 | 8,979,937 | 3,760,557 | 3,882,496 | 540,388 | 5,883,196 | 79,232 | 2,473,365 | 759,052 | 7,740,359 | 2,378,394 |
| 1986 | 8,880,068 | 4,328,769 | 4,308,841 | 577,474 | 6,571,197 | 102,400 | 2,583,767 | 1,000,062 | 7,857,569 | 3,047,741 |
| 1987 | 8,897,753 | 4,170,045 | 4,164,707 | 604,982 | 6,418,841 | 211,809 | 2,617,332 | 1,026,398 | 9,224,608 | 3,034,142 |
| 1988 | 8,373,323 | 4,233,940 | 4,163,832 | 615,999 | 6,482,143 | 124,667 | 2,672,799 | 779,820 | 9,505,259 | 2,828,998 |
| 1989 | 8,750,651 | 4,114,266 | 3,808,646 | 586,595 | 5,952,262 | 170,570 | 2,620,917 | 1,442,627 | 8,944,266 | 2,930,395 |
| 1990 | 10,040,074 | 4,555,126 | 4,487,886 | 620,394 | 7,014,185 | 289,349 | 2,819,468 | 1,639,830 | 9,795,019 | 3,678,107 |
| 1991 | 6,542,001 | 3,524,058 | 2,996,131 | 567,450 | 4,550,559 | 175,137 | 3,579,410 | 1,294,608 | 8,921,839 | 3,035,638 |
| 1992 | 8,644,005 | 4,481,624 | 3,068,616 | 470,165 | 4,667,984 | 121,335 | 4,381,364 | 1,129,578 | 8,573,361 | 2,980,091 |
| 1993 | 9,028,570 | 4,113,039 | 3,267,678 | 472,817 | 4,993,632 | 157,747 | 4,260,927 | 1,347,511 | 9,505,683 | 3,320,012 |
| 1994 | 11,216,190 | 4,725,251 | 3,313,737 | 554,651 | 5,066,159 | 225,809 | 5,254,817 | 1,698,990 | 10,209,083 | 4,076,706 |
| 1995 | 10,817,875 | 4,983,090 | 4,087,603 | 509,163 | 6,340,703 | 155,561 | 4,343,044 | 1,527,248 | 9,443,228 | 3,715,377 |
| 1996 | 11,187,158 | 5,171,170 | 7,025,782 | 553,232 | 11,183,947 | 150,612 | 4,410,639 | 1,867,203 | 9,869,329 | 3,807,422 |
| 1997 | 11,437,950 | 4,937,891 | 6,588,591 | 579,281 | 7,422,990 | 144,833 | 4,714,892 | 1,869,307 | 11,268,380 | 4,037,862 |
| 1998 | 9,956,830 | 4,566,358 | 5,663,864 | 546,645 | 5,928,447 | 146,074 | 5,751,249 | 1,474,029 | 11,192,751 | 3,321,115 |
| 1999 | 11,473,042 | 4,989,892 | 4,648,108 | 637,393 | 6,003,270 | 146,909 | 5,989,455 | 1,853,582 | 12,338,933 | 4,177,208 |
| 2000 | 10,596,779 | 6,837,243 | 3,071,454 | 594,291 | 4,377,827 | 115,173 | 5,760,850 | 1,448,529 | 11,883,970 | 3,253,760 |
| 2001 | 20,766,464 | 12,538,175 | 4,126,996 | 800,429 | 6,393,351 | 127,925 | 6,471,076 | 3,367,401 | 17,920,450 | 3,400,854 |
| 2002 | 11,990,852 | 9,678,139 | 3,358,238 | 759,146 | 5,125,035 | 109,667 | 5,584,904 | 2,738,104 | 18,762,806 | 4,782,841 |
| 2003 | 13,366,259 | 10,732,427 | 3,480,426 | 729,614 | 5,324,844 | 115,325 | 7,247,931 | 2,277,117 | 17,174,271 | 4,950,808 |
| 2004 | 14,235,804 | 11,797,957 | 4,112,158 | 829,151 | 5,365,147 | 124,146 | 7,358,215 | 2,517,757 | 21,503,364 | 4,388,862 |
| 2005 | 14,640,814 | 10,844,055 | 17,785,478 | 653,880 | 10,282,020 | 114,279 | 7,158,326 | 2,566,888 | 19,551,335 | 4,652,123 |
| 2006 | 16,079,083 | 9,937,239 | 27,229,693 | 632,629 | 9,853,675 | 122,066 | 9,839,741 | 2,485,769 | 19,255,382 | 4,659,802 |
| 2007 | 19,629,610 | 13,365,361 | 26,113,808 | 880,732 | 9,364,886 | 126,627 | 13,676,159 | 4,030,167 | 25,509,692 | 3,831,758 |
| 2008 | 17,102,645 | 15,248,889 | 25,589,120 | 804,323 | 10,248,596 | 134,964 | 11,981,793 | 3,945,884 | 25,584,364 | 4,775,994 |
| 2009 | 14,850,810 | 12,989,909 | 23,274,321 | 780,545 | 8,129,412 | 133,483 | 11,661,046 | 3,674,951 | 25,464,410 | 5,255,249 |
| 2010 | 17,557,736 | 12,715,063 | 31,809,228 | 689,273 | 10,989,064 | 122,016 | 14,002,388 | 3,025,322 | 27,895,761 | 6,780,360 |
| 2011 | 23,828,664 | 12,339,758 | 33,209,751 | 744,963 | 11,916,002 | 136,233 | 7,567,835 | 2,990,623 | 25,010,233 | 7,446,330 |
| 2012 | 24,249,437 | 14,486,658 | 40,147,143 | 848,933 | 14,395,366 | 147,826 | 9,331,869 | 4,418,156 | 38,732,722 | 7,776,565 |
| 2013 | 19,361,992 | 17,072,691 | 31,931,123 | 1,062,272 | 10,854,849 | 165,964 | 9,300,239 | 3,480,443 | 29,467,894 | 5,925,151 |
| 2014 | 14,803,167 | 15,800,357 | 27,450,696 | 1,157,421 | 8,807,362 | 172,112 | 9,405,188 | 3,592,040 | 29,679,522 | 4,876,828 |
| 2015 | 12,622,803 | 14,967,155 | 30,020,626 | 1,119,071 | 9,992,389 | 163,750 | 10,742,393 | 2,707,186 | 34,676,045 | 5,849,206 |
| 2016 | 23,853,753 | 14,614,135 | 36,922,072 | 1,203,313 | 12,688,080 | 161,631 | 10,691,452 | 3,745,445 | 38,946,003 | 7,067,330 |
| **2017** | **25,929,265** | **19,541,243** | **38,646,697** | **1,609,190** | **13,444,748** | **170,678** | **17,107,169** | **4,970,439** | **43,444,955** | **7,635,280** |
| 2018 | 26,814,797 | 19,936,021 | 41,359,255 | 1,571,573 | 13,865,303 | 168,070 | 17,671,142 | 5,178,240 | 43,806,559 | 7,747,109 |
| 2019 | 26,542,837 | 19,872,957 | 40,751,511 | 1,568,868 | 13,880,366 | 162,183 | 18,051,861 | 5,236,173 | 44,677,101 | 7,790,234 |
| 2020 | 26,810,734 | 20,065,166 | 41,315,071 | 1,573,851 | 14,013,823 | 158,319 | 18,464,553 | 5,313,625 | 44,818,202 | 7,816,229 |
| 2021 | 26,447,565 | 19,789,990 | 40,662,853 | 1,535,608 | 13,760,007 | 154,101 | 18,167,811 | 5,243,132 | 44,159,316 | 7,644,693 |
| 2022 | 26,754,239 | 19,929,667 | 40,370,746 | 1,541,130 | 13,791,274 | 152,852 | 18,303,713 | 5,317,343 | 44,230,786 | 7,672,061 |
| 2023 | 26,530,854 | 19,944,545 | 39,511,805 | 1,533,097 | 13,597,410 | 153,102 | 18,228,720 | 5,264,555 | 44,008,127 | 7,604,589 |
| 2024 | 26,358,050 | 19,754,604 | 39,321,298 | 1,523,550 | 13,529,232 | 154,017 | 18,093,351 | 5,220,970 | 43,893,405 | 7,569,025 |
| 2025 | 26,688,577 | 20,045,336 | 39,728,004 | 1,540,313 | 13,693,447 | 154,851 | 18,341,536 | 5,291,817 | 44,228,190 | 7,656,374 |
| 2026 | 26,224,143 | 19,751,236 | 39,153,293 | 1,518,671 | 13,464,233 | 155,861 | 18,052,600 | 5,181,646 | 43,831,283 | 7,537,975 |
| 2027 | 26,797,127 | 20,111,842 | 39,805,783 | 1,545,850 | 13,726,471 | 156,918 | 18,404,503 | 5,306,462 | 44,353,460 | 7,677,058 |
| 2028 | 26,566,826 | 20,004,339 | 39,620,672 | 1,538,713 | 13,644,139 | 158,014 | 18,303,026 | 5,248,986 | 44,244,647 | 7,638,747 |
| 2029 | 26,942,448 | 20,218,722 | 40,113,239 | 1,557,449 | 13,834,414 | 159,047 | 18,532,415 | 5,329,284 | 44,643,357 | 7,742,724 |
| 2030 | 26,476,118 | 19,909,830 | 39,737,141 | 1,541,437 | 13,672,752 | 160,056 | 18,321,315 | 5,219,060 | 44,395,216 | 7,664,852 |
| 2031 | 28,234,858 | 20,860,904 | 41,545,709 | 1,616,992 | 14,394,107 | 159,730 | 19,289,246 | 5,619,553 | 45,767,229 | 8,042,688 |
| 2032 | 26,040,096 | 19,562,267 | 39,446,295 | 1,524,666 | 13,537,644 | 161,200 | 18,077,871 | 5,115,435 | 44,240,387 | 7,605,625 |
| 2033 | 27,956,506 | 20,687,571 | 41,410,798 | 1,613,103 | 14,316,613 | 161,216 | 19,252,025 | 5,551,291 | 45,717,895 | 8,012,187 |
| 2034 | 26,106,000 | 19,686,713 | 39,753,649 | 1,533,865 | 13,636,835 | 160,815 | 18,224,663 | 5,136,229 | 44,497,029 | 7,661,451 |
| 2035 | 31,047,505 | 22,368,305 | 44,496,347 | 1,740,528 | 15,536,010 | 160,805 | 20,845,886 | 6,257,896 | 48,030,892 | 8,645,060 |
| **TOTAL** | **997,089,089** | **691,436,112** | **1,220,734,273** | **56,087,043** | **537,446,570** | **8,526,139** | **590,063,616** | **180,141,239** | **1,487,430,732** | **305,982,932** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; 2016 and after includes both bond debt service and bond cover.

## TABLE B-19 Total Transportation Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,219 | 79,888 |
| 1963 | 0 | 690,812 | 0 | 777,678 | 0 | 0 | 0 | 0 | 12,626 | 1,628,026 |
| 1964 | 21,735 | 1,260,513 | 9,378 | 1,603,161 | 0 | 0 | 0 | 0 | 13,938 | 2,810,279 |
| 1965 | 21,866 | 2,180,589 | 17,766 | 2,720,401 | 0 | 0 | 405 | 405 | 28,937 | 4,815,355 |
| 1966 | 37,964 | 3,900,172 | 33,426 | 4,868,023 | 0 | 0 | 565 | 565 | 31,321 | 7,409,358 |
| 1967 | 71,283 | 7,693,703 | 68,155 | 9,563,529 | 0 | 0 | 562 | 562 | 47,718 | 12,845,638 |
| 1968 | 128,915 | 15,317,881 | 142,803 | 18,783,872 | 0 | 0 | 564 | 564 | 46,945 | 25,048,489 |
| 1969 | 198,764 | 23,153,064 | 215,209 | 28,357,398 | 0 | 0 | 3,191 | 3,191 | 52,963 | 36,233,158 |
| 1970 | 289,633 | 30,617,164 | 273,605 | 37,767,476 | 0 | 0 | 15,121 | 15,121 | 69,744 | 46,437,668 |
| 1971 | 409,327 | 39,958,997 | 342,425 | 49,464,015 | 0 | 0 | 16,001 | 16,001 | 55,532 | 59,141,390 |
| 1972 | 537,186 | 52,948,599 | 422,304 | 64,999,909 | 0 | 0 | 17,372 | 17,372 | 80,412 | 76,935,430 |
| 1973 | 587,963 | 57,273,225 | 435,655 | 70,600,806 | 0 | 0 | 17,334 | 17,334 | 54,219 | 81,619,365 |
| 1974 | 611,428 | 61,776,466 | 455,565 | 75,438,027 | 0 | 0 | 17,477 | 17,477 | 76,783 | 87,362,507 |
| 1975 | 644,621 | 66,756,784 | 478,403 | 81,191,178 | 0 | 0 | 18,406 | 18,406 | 84,547 | 94,539,180 |
| 1976 | 668,315 | 68,485,047 | 475,587 | 83,673,605 | 0 | 0 | 17,477 | 17,477 | 106,717 | 97,611,176 |
| 1977 | 696,515 | 66,234,179 | 507,063 | 81,636,312 | 0 | 0 | 18,232 | 18,232 | 98,618 | 95,661,135 |
| 1978 | 709,040 | 72,934,779 | 523,177 | 89,143,116 | 0 | 0 | 17,381 | 17,381 | 100,786 | 105,164,195 |
| 1979 | 712,866 | 72,666,594 | 526,405 | 89,692,699 | 0 | 0 | 20,579 | 20,579 | 119,352 | 107,531,003 |
| 1980 | 777,981 | 79,926,555 | 571,232 | 98,650,027 | 0 | 0 | 17,761 | 17,761 | 178,812 | 117,504,170 |
| 1981 | 806,031 | 91,261,394 | 636,404 | 111,539,309 | 0 | 0 | 21,193 | 21,193 | 185,347 | 132,312,136 |
| 1982 | 853,400 | 93,144,741 | 670,375 | 113,883,872 | 0 | 0 | 28,423 | 28,423 | 173,894 | 135,700,297 |
| 1983 | 952,131 | 101,787,700 | 803,591 | 126,585,506 | 0 | 0 | 19,276 | 19,276 | 220,926 | 152,202,286 |
| 1984 | 1,072,639 | 137,507,077 | 868,967 | 170,596,449 | 0 | 0 | 21,114 | 21,114 | 225,959 | 208,809,977 |
| 1985 | 1,120,854 | 172,916,230 | 908,769 | 211,422,827 | 0 | 0 | 20,239 | 20,239 | 340,322 | 258,538,543 |
| 1986 | 1,149,714 | 193,242,026 | 937,311 | 234,586,938 | 0 | 0 | 20,139 | 20,139 | 279,227 | 284,907,422 |
| 1987 | 1,172,015 | 178,764,439 | 908,034 | 221,215,104 | 0 | 0 | 19,742 | 19,742 | 345,116 | 273,181,943 |
| 1988 | 1,208,206 | 190,243,523 | 904,868 | 232,137,377 | 0 | 0 | 17,900 | 17,900 | 365,207 | 285,273,049 |
| 1989 | 1,194,911 | 193,235,261 | 932,599 | 234,683,966 | 0 | 0 | 19,158 | 19,158 | 422,329 | 288,360,668 |
| 1990 | 1,297,621 | 239,540,417 | 1,486,755 | 287,264,231 | 0 | 0 | 18,148 | 18,148 | 474,284 | 340,514,277 |
| 1991 | 1,354,921 | 179,950,983 | 1,141,118 | 217,633,853 | 0 | 0 | 21,018 | 21,018 | 214,683 | 256,261,469 |
| 1992 | 1,349,184 | 196,166,977 | 1,025,285 | 237,059,570 | 0 | 0 | 18,014 | 18,014 | 443,676 | 286,950,412 |
| 1993 | 1,507,550 | 169,493,328 | 1,068,135 | 212,536,630 | 0 | 0 | 20,999 | 20,999 | 599,571 | 271,746,042 |
| 1994 | 1,497,753 | 209,282,955 | 1,008,952 | 258,131,053 | 0 | 0 | 19,649 | 19,649 | 609,966 | 317,147,644 |
| 1995 | 1,520,622 | 173,420,265 | 1,061,324 | 221,925,100 | 0 | 0 | 20,277 | 20,277 | 534,971 | 290,873,109 |
| 1996 | 1,527,165 | 181,404,029 | 1,103,254 | 239,260,943 | 0 | 0 | 25,378 | 25,378 | 571,857 | 319,980,796 |
| 1997 | 1,730,348 | 186,736,527 | 1,216,560 | 242,685,410 | 0 | 0 | 24,820 | 24,820 | 428,638 | 324,236,878 |
| 1998 | 1,920,021 | 168,571,967 | 1,237,386 | 220,276,736 | 0 | 0 | 0 | 0 | 465,095 | 302,891,438 |
| 1999 | 2,167,221 | 191,636,505 | 1,264,332 | 247,325,851 | 0 | 0 | (0) | (0) | 584,116 | 339,426,251 |
| 2000 | 2,399,072 | 185,238,178 | 1,321,281 | 236,898,408 | 0 | 0 | 0 | 0 | 0 | 321,494,102 |
| 2001 | 3,320,394 | 376,931,270 | 1,621,143 | 457,785,929 | 0 | 0 | 0 | 0 | 0 | 560,353,246 |
| 2002 | 4,666,197 | 264,584,000 | 1,648,232 | 333,788,162 | 0 | 0 | (0) | (0) | 0 | 434,701,025 |
| 2003 | 5,925,760 | 292,850,048 | 1,668,190 | 365,843,019 | 0 | 0 | 20,800 | 20,800 | 0 | 466,431,583 |
| 2004 | 6,247,900 | 339,975,906 | 1,909,882 | 420,366,249 | 0 | 0 | 20,830 | 20,830 | 0 | 519,462,405 |
| 2005 | 6,521,078 | 312,842,936 | 1,398,129 | 409,011,340 | 0 | 0 | 20,827 | 20,827 | 0 | 520,292,484 |
| 2006 | 7,001,949 | 287,944,945 | 1,325,689 | 396,367,660 | 0 | 0 | 21,280 | 21,280 | 0 | 501,652,185 |
| 2007 | 7,651,837 | 373,771,122 | 1,870,260 | 499,822,019 | 0 | 0 | 20,893 | 20,893 | 0 | 607,761,465 |
| 2008 | 8,922,562 | 339,083,808 | 2,262,970 | 465,685,913 | 0 | 0 | 22,412 | 22,412 | 0 | 576,386,830 |
| 2009 | 9,230,481 | 303,171,086 | 2,071,553 | 420,687,254 | 0 | 0 | 18,220 | 18,220 | 0 | 521,719,413 |
| 2010 | 10,307,480 | 349,732,641 | 2,103,145 | 487,729,477 | 0 | 0 | 18,448 | 18,448 | 0 | 602,965,226 |
| 2011 | 11,079,708 | 391,292,510 | 2,095,161 | 529,657,771 | 0 | 0 | 20,131 | 20,131 | 0 | 666,450,876 |
| 2012 | 12,033,121 | 378,691,890 | 2,350,421 | 547,610,106 | 0 | 0 | 18,470 | 18,470 | 0 | 678,169,541 |
| 2013 | 12,601,142 | 366,073,756 | 2,281,754 | 509,579,273 | 0 | 0 | 17,666 | 17,666 | 0 | 642,257,742 |
| 2014 | 15,130,946 | 316,748,240 | 1,829,693 | 449,453,571 | 0 | 0 | 17,493 | 17,493 | 0 | 574,644,956 |
| 2015 | 17,025,170 | 335,484,534 | 1,932,601 | 477,302,931 | 0 | 0 | 17,089 | 17,089 | 0 | 608,511,035 |
| 2016 | 19,628,780 | 393,481,149 | 2,327,958 | 565,331,101 | 0 | 0 | 16,924 | 16,924 | 0 | 714,477,142 |
| **2017** | **22,023,268** | **423,957,910** | **2,488,108** | **620,968,950** | **0** | **0** | **16,926** | **16,926** | **0** | **774,967,291** |
| 2018 | 22,234,708 | 412,611,400 | 2,424,745 | 615,388,921 | 0 | 0 | 16,924 | 16,924 | 0 | 768,687,718 |
| 2019 | 22,469,633 | 415,402,342 | 2,394,604 | 618,800,671 | 0 | 0 | 14,298 | 14,298 | 0 | 775,816,992 |
| 2020 | 22,597,082 | 416,818,009 | 2,388,886 | 622,153,549 | 0 | 0 | 2,370 | 2,370 | 0 | 776,644,346 |
| 2021 | 22,488,515 | 409,526,676 | 2,337,407 | 611,917,673 | 0 | 0 | 1,544 | 1,544 | 0 | 768,950,242 |
| 2022 | 22,537,462 | 409,865,808 | 2,326,316 | 612,793,397 | 0 | 0 | 161 | 161 | 0 | 770,795,617 |
| 2023 | 22,508,548 | 407,777,688 | 2,333,919 | 608,996,959 | 0 | 0 | 161 | 161 | 0 | 766,006,085 |
| 2024 | 22,510,660 | 404,300,351 | 2,322,365 | 604,550,877 | 0 | 0 | 161 | 161 | 0 | 762,159,692 |
| 2025 | 22,589,571 | 409,241,148 | 2,343,900 | 611,543,065 | 0 | 0 | 160 | 160 | 0 | 769,594,970 |
| 2026 | 22,514,088 | 403,842,777 | 2,333,429 | 603,561,235 | 0 | 0 | 159 | 159 | 0 | 763,539,038 |
| 2027 | 22,626,189 | 410,710,980 | 2,361,360 | 613,584,004 | 0 | 0 | 159 | 159 | 0 | 773,911,444 |
| 2028 | 22,627,945 | 408,730,704 | 2,360,050 | 610,686,808 | 0 | 0 | 158 | 158 | 0 | 771,402,201 |
| 2029 | 22,714,632 | 413,297,152 | 2,376,158 | 617,461,042 | 0 | 0 | 158 | 158 | 0 | 779,210,792 |
| 2030 | 22,693,017 | 407,534,351 | 2,355,209 | 609,680,352 | 0 | 0 | 157 | 157 | 0 | 769,504,955 |
| 2031 | 22,940,514 | 426,166,133 | 2,397,984 | 637,035,646 | 0 | 0 | 157 | 157 | 0 | 801,691,117 |
| 2032 | 22,676,804 | 402,512,248 | 2,321,266 | 602,821,803 | 0 | 0 | 157 | 157 | 0 | 767,590,831 |
| 2033 | 22,968,616 | 422,695,285 | 2,388,414 | 632,731,519 | 0 | 0 | 158 | 158 | 0 | 795,059,202 |
| 2034 | 22,760,350 | 404,800,136 | 2,330,060 | 606,287,793 | 0 | 0 | 158 | 158 | 0 | 770,986,648 |
| 2035 | 23,364,810 | 457,304,605 | 2,503,561 | 682,302,210 | 0 | 0 | 158 | 158 | 0 | 858,926,822 |
| **TOTAL** | **622,067,698** | **17,447,075,188** | **101,787,982** | **24,245,868,612** | **0** | **0** | **879,679** | **879,679** | **8,748,370** | **30,432,869,305** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; 2016 and after includes both bond debt service and bond cover.

## TABLE B-20A Calculation of Delta Water Rates

**Calculation in Accordance with Article 53(i) of the Monterey Amendment**
**(Values in millions of dollars [$] or millions of acre-feet [af] discounted to 2016 at 4.610 percent per annum)**

| Procedure | Capital Cost Component | | Minimum Operation, Maintenance, Power and Replacement Component[a] | | Total Delta Water Rate | |
|---|---|---|---|---|---|---|
| | [1] | | [2] | | [3] | |
| **Commencing in 2017** | | | | | | |
| Total Costs of "Initial" Project Conservation Facilities to be Reimbursed and Project Water Table A Amounts During the Project Repayment Period | $8,606.93[b] | 466.11 af | $7,723.93[c] | 466.11 af | $16,330.86 | 466.11 af |
| Less, Project Power Revenues to be Realized During the Project Repayment Period | ($4,267.49) | | ($3,926.98) | | ($8,194.47) | |
| Less, Delta Water Charges Paid and Project Water Table A Amounts, Prior to 2017 | ($3,229.25)[d] | (414.04) af | ($1,320.64) | (414.04) af | ($4,549.89) | (414.04) af |
| TOTAL | $1,110.19 | 52.07 af | $2,476.31 | 52.07 af | $3,586.50 | 52.07 af |
| Rate Applicable in 2017 | $21.32 per acre-foot | | $47.56 per acre-foot | | $68.88 per acre-foot | |

**Calculation Under Original Provisions, without the Monterey Amendment**
**(for Plumas and Empire)**

| Procedure | Capital Cost Component | | Minimum Operation, Maintenance, Power and Replacement Component[a] | | Total Delta Water Rate | |
|---|---|---|---|---|---|---|
| | [4] | | [5] | | [6] | |
| **Commencing in 2017** | | | | | | |
| Total Costs of "Initial" Project Conservation Facilities to be Reimbursed and Project Water Table A Amounts during the Project Repayment Period | $8,587.90[b] | 466.11 af | $7,690.03[c] | 466.11 af | $16,277.93 | 466.11 af |
| Less, Project Power Revenues to be Realized During the Project Repayment Period | ($4,267.49) | | ($3,926.98) | | ($8,194.47) | |
| Less, Delta Water Charges Paid and Project Water Table A Amounts, Prior to 2017 | ($3,229.25)[d] | (414.04) af | ($1,320.64) | (414.04) af | ($4,549.89) | (414.04) af |
| TOTAL | $1,091.15 | 52.07 af | $2,442.42 | 52.07 af | $3,533.57 | 52.07 af |
| Rate Applicable in 2017 | $20.95 per acre-foot | | $46.91 per acre-foot | | $67.86 per acre-foot | |

[a] Considering that all operating costs of Project Conservation Facilities will not vary with annual amounts of Project water delivered, and therefore are properly classified as "Minimum" OMP&R Costs. OMP&R costs exclude amounts for Conservation Replacement Accounting System.

[b] Including net credits of $4,850,000 for settlements as to the magnitude of Project Capital costs incurred prior to December 31, 1960, and net credits of $6,678,320 for settlement as to the magnitude of Project Capital costs incurred during the 1961 through 1978 period.

[c] Includes conservation power costs and credits at San Luis Reservoir.

[d] Applying all Delta Water Charges paid prior to 1970 to reimburse Capital costs (the charge was not divided into components until 1970).

**TABLE B-20B Delta Water Rates by Facility (in dollars per acre-foot)**

| Item | Capital Cost Component | Minimum Operation, Maintenance, Power and Replacement Component | Total Delta Water Rate |
|---|---|---|---|
| | [1] | [2] | [3] |
| **Initial Conservation Facilities** | | | |
| Oroville Division | | | |
| Water Supply and Power Costs[a] | 97.42 | 65.90 | 163.32 |
| Less, Oroville Power Revenues | -59.66 | -25.36 | -85.02 |
| *Subtotal* | *37.76* | *40.54* | *78.30* |
| Delta Facilities[b] | 31.70 | 50.83 | 82.53 |
| California Aqueduct portion | | | |
| Reach1 | 5.95 | 11.95 | 17.90 |
| Reach 2A | 3.41 | 1.43 | 4.83 |
| Reach 2B | 1.72 | 1.00 | 2.73 |
| Reach 3 | 1.21 | 0.52 | 1.73 |
| *Subtotal* | *12.29* | *14.90* | *27.19* |
| San Luis Facilities | 18.65 | 16.05 | 34.70 |
| Planning and Preoperating Costs through 2015 | 4.87 | 0.00 | 4.87 |
| 45,000 af Relinquished Costs | 0.37 | 0.65 | 1.02 |
| Less, Capital Cost Credits | -2.35 | 0.00 | -2.35 |
| Less, Delta Water Charges paid prior to 2017 | -81.95 | -75.42 | -157.37 |
| Rate Applicable in 2017 | 21.32 | 47.56 | 68.88 |

[a] Includes revenue received from non-SWP contractors.

[b] Includes: 1. Delta Facility planning costs; 2. Delta Studies costs; and 3. Suisun Marsh Facilities Costs.

## TABLE B-21 Total Delta Water Charge for Each Contractor (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 14,000 | 50,050 | 177,100 | 241,150 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 19,156 | 29,701 | 193,245 | 242,102 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 30,324 | 44,096 | 215,483 | 289,903 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 80,908 | 107,730 | 585,200 | 773,838 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 57,320 | 123,080 | 637,120 | 817,520 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 99,668 | 143,877 | 707,328 | 950,873 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 120,880 | 167,099 | 782,167 | 1,070,146 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 137,684 | 182,339 | 818,664 | 1,138,687 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 146,204 | 187,324 | 804,123 | 1,137,651 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 168,489 | 208,652 | 862,036 | 1,239,177 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 172,931 | 208,645 | 827,062 | 1,208,638 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 206,378 | 243,231 | 926,594 | 1,376,203 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 237,771 | 273,208 | 1,005,955 | 1,516,934 | 0 | 0 | 0 |
| 1980 | 0 | 18,325 | 18,325 | 272,717 | 307,426 | 1,090,867 | 1,671,010 | 12,396 | 3,479 | 15,875 |
| 1981 | 0 | 25,440 | 25,440 | 415,564 | 469,768 | 1,589,984 | 2,475,316 | 18,068 | 10,414 | 28,482 |
| 1982 | 0 | 34,917 | 34,917 | 457,988 | 519,053 | 1,679,289 | 2,656,330 | 38,166 | 99,788 | 137,954 |
| 1983 | 0 | 12,035 | 12,035 | 316,703 | 359,775 | 1,114,795 | 1,791,273 | 38,004 | 68,902 | 106,906 |
| 1984 | 0 | 22,453 | 22,453 | 334,587 | 380,914 | 1,132,448 | 1,847,949 | 57,909 | 105,498 | 163,407 |
| 1985 | 0 | 22,001 | 22,001 | 381,970 | 435,728 | 1,244,939 | 2,062,637 | 106,103 | 192,937 | 299,040 |
| 1986 | 35,358 | 21,767 | 57,125 | 423,378 | 485,372 | 1,330,615 | 2,239,365 | 151,206 | 275,347 | 426,553 |
| 1987 | 0 | 22,984 | 22,984 | 430,024 | 493,786 | 1,304,900 | 2,228,710 | 185,355 | 336,664 | 522,019 |
| 1988 | 88,878 | 150,466 | 239,344 | 464,114 | 533,731 | 1,361,400 | 2,359,245 | 239,792 | 436,607 | 676,399 |
| 1989 | 102,688 | 305,328 | 408,016 | 513,853 | 591,760 | 1,491,833 | 2,597,446 | 331,518 | 602,402 | 933,920 |
| 1990 | 112,723 | 355,132 | 467,855 | 534,787 | 616,676 | 1,537,512 | 2,688,975 | 417,802 | 760,166 | 1,177,968 |
| 1991 | 129,296 | 395,515 | 524,811 | 603,028 | 681,067 | 1,667,194 | 2,951,289 | 443,403 | 806,745 | 1,250,148 |
| 1992 | 158,879 | 489,808 | 648,687 | 729,545 | 808,579 | 1,945,453 | 3,483,577 | 506,628 | 921,780 | 1,428,408 |
| 1993 | 172,457 | 530,778 | 703,235 | 771,894 | 840,958 | 1,990,673 | 3,603,525 | 507,825 | 923,957 | 1,431,782 |
| 1994 | 177,824 | 546,610 | 724,434 | 778,647 | 817,579 | 1,946,615 | 3,542,841 | 486,654 | 885,437 | 1,372,091 |
| 1995 | 203,738 | 713,497 | 917,235 | 874,946 | 874,946 | 2,083,205 | 3,833,097 | 520,801 | 947,567 | 1,468,368 |
| 1996 | 213,506 | 774,152 | 987,658 | 901,129 | 860,168 | 2,048,020 | 3,809,317 | 512,005 | 931,562 | 1,443,567 |
| 1997 | 250,558 | 866,141 | 1,116,699 | 1,041,633 | 951,056 | 2,264,420 | 4,257,109 | 566,105 | 1,029,994 | 1,596,099 |
| 1998 | 266,952 | 882,469 | 1,149,421 | 1,048,658 | 957,470 | 2,279,691 | 4,285,819 | 141,683 | 888,760 | 1,030,443 |
| 1999 | 290,688 | 923,459 | 1,214,147 | 1,084,480 | 990,178 | 2,357,566 | 4,432,224 | 589,391 | 1,072,362 | 1,661,753 |
| 2000 | 390,936 | 948,784 | 1,339,720 | 1,628,402 | 1,005,778 | 2,394,709 | 5,028,889 | 598,677 | 1,089,257 | 1,687,934 |
| 2001 | 496,412 | 1,097,880 | 1,594,292 | 1,868,283 | 1,005,998 | 2,395,234 | 5,269,515 | 598,809 | 1,089,496 | 1,688,305 |
| 2002 | 512,928 | 1,125,429 | 1,638,357 | 1,896,134 | 1,020,996 | 2,430,942 | 5,348,072 | 607,736 | 1,105,738 | 1,713,474 |
| 2003 | 511,059 | 1,112,692 | 1,623,751 | 1,856,232 | 999,510 | 2,379,785 | 5,235,527 | 594,946 | 1,082,469 | 1,677,415 |
| 2004 | 569,615 | 1,230,627 | 1,800,242 | 2,033,406 | 1,094,911 | 2,606,931 | 5,735,248 | 651,732 | 1,185,788 | 1,837,520 |
| 2005 | 573,729 | 1,219,893 | 1,793,622 | 2,081,144 | 1,084,212 | 2,581,456 | 5,746,812 | 645,364 | 1,174,201 | 1,819,565 |
| 2006 | 606,343 | 1,272,001 | 1,878,344 | 2,167,748 | 1,129,330 | 2,688,880 | 5,985,958 | 672,220 | 1,223,064 | 1,895,284 |
| 2007 | 623,728 | 1,291,247 | 1,914,975 | 2,198,222 | 1,145,206 | 2,726,679 | 6,070,107 | 681,671 | 1,240,257 | 1,921,928 |
| 2008 | 647,091 | 1,322,240 | 1,969,331 | 2,248,610 | 1,171,457 | 2,789,182 | 6,209,249 | 697,295 | 1,268,688 | 1,965,983 |
| 2009 | 717,087 | 1,446,549 | 2,163,636 | 2,457,420 | 1,280,240 | 3,048,190 | 6,785,850 | 762,047 | 1,386,499 | 2,148,546 |
| 2010 | 1,105,529 | 1,809,450 | 2,914,979 | 3,070,686 | 1,599,732 | 3,808,886 | 8,479,304 | 952,222 | 1,732,510 | 2,684,732 |
| 2011 | 1,216,921 | 1,993,865 | 3,210,786 | 3,380,086 | 1,760,920 | 4,192,667 | 9,333,673 | 1,048,166 | 1,907,076 | 2,955,242 |
| 2012 | 1,270,523 | 2,083,876 | 3,354,399 | 3,528,968 | 1,838,483 | 4,377,339 | 9,744,790 | 1,094,335 | 1,991,077 | 3,085,412 |
| 2013 | 1,344,704 | 2,207,862 | 3,552,566 | 3,735,010 | 1,945,825 | 4,632,915 | 10,313,750 | 1,158,229 | 2,107,328 | 3,265,557 |
| 2014 | 1,276,099 | 2,097,420 | 3,373,519 | 3,544,457 | 1,846,552 | 4,396,552 | 9,787,561 | 1,099,138 | 1,999,815 | 3,098,953 |
| 2015 | 1,736,721 | 2,857,498 | 4,594,219 | 4,823,867 | 2,513,086 | 5,983,536 | 13,320,489 | 1,495,884 | 2,721,671 | 4,217,555 |
| 2016 | 2,075,875 | 3,415,521 | 5,491,396 | 5,765,891 | 3,003,850 | 7,152,025 | 15,921,766 | 1,788,006 | 3,253,170 | 5,041,176 |
| **2017** | **1,999,142** | **3,289,270** | **5,288,412** | **5,552,760** | **2,892,816** | **6,887,657** | **15,333,233** | **1,721,914** | **3,132,919** | **4,854,833** |
| 2018 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2019 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2020 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2021 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2022 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2023 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2024 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2025 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2026 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2027 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2028 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2029 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2030 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2031 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2032 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2033 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2034 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| 2035 | 1,999,142 | 3,289,270 | 5,288,412 | 5,552,760 | 2,892,816 | 6,887,657 | 15,333,233 | 1,721,914 | 3,132,919 | 4,854,833 |
| **TOTAL** | **55,862,543** | **98,142,241** | **154,004,784** | **167,658,364** | **95,354,612** | **233,454,887** | **496,467,863** | **53,733,657** | **98,383,933** | **152,117,590** |

## TABLE B-21 Total Delta Water Charge for Each Contractor (in dollars)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 40,695 | 10,469 | 0 | 0 | 165,522 | 3,177 | 8,073 | 98,608 | 326,544 |
| 1969 | 61,267 | 3,281 | 0 | 0 | 337,686 | 4,200 | 8,805 | 102,478 | 517,717 |
| 1970 | 104,405 | 19,950 | 0 | 0 | 964,915 | 8,645 | 17,290 | 228,095 | 1,343,300 |
| 1971 | 129,596 | 21,720 | 0 | 0 | 1,377,772 | 9,412 | 20,272 | 264,260 | 1,823,032 |
| 1972 | 160,756 | 24,113 | 0 | 0 | 2,175,835 | 11,253 | 43,131 | 905,057 | 3,320,145 |
| 1973 | 195,541 | 26,664 | 0 | 386,638 | 2,373,167 | 13,333 | 27,553 | 373,307 | 3,396,203 |
| 1974 | 224,202 | 27,909 | 0 | 446,545 | 2,781,595 | 13,954 | 29,770 | 445,138 | 3,969,113 |
| 1975 | 329,688 | 27,413 | 0 | 481,560 | 3,041,048 | 14,620 | 33,702 | 827,591 | 4,755,622 |
| 1976 | 414,245 | 29,388 | 0 | 549,549 | 3,931,785 | 15,673 | 35,966 | 877,151 | 5,853,757 |
| 1977 | 312,532 | 28,195 | 0 | 569,545 | 4,071,218 | 15,977 | 40,289 | 626,210 | 5,663,966 |
| 1978 | 342,208 | 31,588 | 0 | 674,939 | 4,950,959 | 20,006 | 41,065 | 666,516 | 6,727,281 |
| 1979 | 395,523 | 34,294 | 0 | 772,757 | 5,901,986 | 22,863 | 45,725 | 771,613 | 7,944,761 |
| 1980 | 555,341 | 37,679 | 0 | 881,371 | 6,984,026 | 27,272 | 70,658 | 933,481 | 9,489,828 |
| 1981 | 740,789 | 54,204 | 0 | 1,351,487 | 11,140,730 | 41,556 | 77,692 | 1,373,168 | 14,779,626 |
| 1982 | 782,396 | 57,248 | 0 | 1,518,993 | 12,703,436 | 47,707 | 85,873 | 1,530,443 | 16,726,096 |
| 1983 | 543,462 | 38,004 | 0 | 1,057,789 | 9,141,315 | 35,471 | 58,273 | 78,506 | 10,952,820 |
| 1984 | 580,379 | 13,572 | 0 | 1,333,200 | 9,741,623 | 39,893 | 61,770 | 756,132 | 12,526,569 |
| 1985 | 667,740 | 42,441 | 0 | 1,540,611 | 11,403,920 | 48,100 | 69,320 | 644,383 | 14,416,515 |
| 1986 | 745,447 | 45,362 | 0 | 1,714,679 | 12,925,113 | 55,946 | 77,115 | 1,469,725 | 17,033,387 |
| 1987 | 762,180 | 44,485 | 0 | 1,766,065 | 13,410,817 | 59,314 | 77,108 | 1,503,601 | 17,623,570 |
| 1988 | 827,669 | 46,411 | 0 | 1,916,790 | 14,707,763 | 61,882 | 83,540 | 1,633,680 | 19,277,735 |
| 1989 | 921,621 | 49,728 | 0 | 2,125,033 | 16,312,361 | 66,304 | 92,825 | 1,821,693 | 21,389,565 |
| 1990 | 964,288 | 50,136 | 0 | 1,998,766 | 17,276,959 | 66,848 | 95,259 | 1,980,383 | 22,432,639 |
| 1991 | 1,023,374 | 53,208 | 0 | 2,121,239 | 18,335,590 | 70,944 | 101,096 | 2,101,729 | 23,807,180 |
| 1992 | 1,169,299 | 60,795 | 0 | 2,727,688 | 20,646,125 | 81,061 | 115,511 | 2,401,419 | 27,201,898 |
| 1993 | 1,172,060 | 60,939 | 0 | 2,734,129 | 20,694,874 | 81,252 | 115,784 | 2,407,089 | 27,266,127 |
| 1994 | 1,123,198 | 58,398 | 0 | 2,156,809 | 20,295,455 | 77,865 | 110,957 | 2,306,739 | 26,129,421 |
| 1995 | 1,202,009 | 62,497 | 0 | 2,803,995 | 21,223,694 | 83,328 | 118,743 | 2,468,598 | 27,962,864 |
| 1996 | 534,818 | 69,191 | 0 | 2,756,635 | 19,492,814 | 81,921 | 102,219 | 2,426,904 | 25,464,502 |
| 1997 | 1,208,521 | 67,162 | 0 | 3,047,908 | 22,148,973 | 90,576 | 129,072 | 2,683,338 | 29,375,550 |
| 1998 | 1,216,671 | 77,807 | 0 | 2,726,511 | 22,070,376 | 91,188 | 129,942 | 2,820,148 | 29,132,643 |
| 1999 | 1,258,233 | 69,974 | 0 | 2,819,648 | 22,824,299 | 94,303 | 134,381 | 2,793,715 | 29,994,553 |
| 2000 | 1,278,056 | 70,943 | 0 | 3,223,279 | 21,220,235 | 95,788 | 136,498 | 2,837,730 | 28,862,529 |
| 2001 | 1,278,336 | 71,058 | 0 | 2,864,700 | 21,110,372 | 95,809 | 136,528 | 2,838,352 | 28,395,155 |
| 2002 | 1,393,975 | 72,121 | 0 | 3,272,056 | 21,060,431 | 97,237 | 138,564 | 2,711,156 | 28,745,540 |
| 2003 | 1,364,640 | 70,550 | 0 | 3,203,191 | 20,617,243 | 95,192 | 135,648 | 2,654,103 | 28,140,567 |
| 2004 | 1,494,892 | 77,810 | 0 | 3,508,929 | 22,585,122 | 104,277 | 148,595 | 2,897,005 | 30,816,630 |
| 2005 | 1,480,284 | 77,153 | 0 | 3,474,640 | 22,307,136 | 232,331 | 147,143 | 2,739,621 | 30,458,308 |
| 2006 | 1,541,884 | 80,380 | 0 | 3,619,232 | 23,235,418 | 242,000 | 153,266 | 2,587,428 | 31,459,608 |
| 2007 | 1,563,559 | 81,479 | 0 | 3,670,110 | 23,562,051 | 253,717 | 155,421 | 2,615,486 | 31,901,823 |
| 2008 | 1,599,401 | 83,191 | 0 | 3,754,239 | 24,102,160 | 259,533 | 158,984 | 2,675,439 | 32,632,947 |
| 2009 | 1,747,923 | 90,846 | 0 | 4,102,863 | 26,340,321 | 283,634 | 173,747 | 2,923,885 | 35,663,219 |
| 2010 | 1,917,507 | 113,466 | 0 | 5,126,760 | 32,304,300 | 354,417 | 217,107 | 3,386,937 | 43,420,494 |
| 2011 | 2,110,714 | 123,965 | 0 | 5,643,329 | 35,559,263 | 390,127 | 238,982 | 3,728,203 | 47,794,583 |
| 2012 | 2,203,684 | 129,358 | 0 | 5,891,899 | 37,125,531 | 407,312 | 249,508 | 3,892,417 | 49,899,709 |
| 2013 | 2,332,348 | 136,898 | 0 | 6,235,904 | 39,293,142 | 431,093 | 264,076 | 4,119,681 | 52,813,142 |
| 2014 | 2,125,733 | 129,639 | 0 | 5,917,760 | 37,288,481 | 409,099 | 250,603 | 3,845,708 | 49,967,023 |
| 2015 | 2,713,534 | 176,957 | 0 | 8,053,840 | 50,748,164 | 556,768 | 341,062 | 5,233,858 | 67,824,183 |
| 2016 | 3,243,443 | 211,761 | 0 | 9,626,626 | 60,658,473 | 665,496 | 407,666 | 6,255,949 | 81,069,414 |
| **2017** | **3,123,553** | **203,580** | **0** | **9,270,786** | **58,416,281** | **640,896** | **392,596** | **6,024,702** | **78,072,394** |
| 2018 | 3,123,553 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 78,072,394 |
| 2019 | 3,123,553 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 78,072,394 |
| 2020 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2021 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2022 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2023 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2024 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2025 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2026 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2027 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2028 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2029 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2030 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2031 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2032 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2033 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2034 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| 2035 | 2,848,046 | 203,580 | 0 | 9,270,786 | 58,416,281 | 640,896 | 392,596 | 6,024,702 | 77,796,887 |
| **TOTAL** | **107,039,461** | **7,009,820** | **0** | **302,315,170** | **1,984,580,933** | **18,606,698** | **13,171,501** | **214,733,194** | **2,647,456,777** |

## TABLE B-21 Total Delta Water Charge for Each Contractor (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 13,060 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 17,804 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 37,905 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 48,508 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 160,756 | 74,751 | 41,797 | 4,662 | 64,303 | 1,367 | 67,518 | 13,021 | 369,739 | 85,202 |
| 1973 | 222,207 | 107,163 | 51,552 | 7,279 | 79,994 | 2,577 | 95,104 | 26,131 | 54,908 | 14,338 |
| 1974 | 279,090 | 143,266 | 59,539 | 10,791 | 93,030 | 3,721 | 121,869 | 39,631 | 465,150 | 114,427 |
| 1975 | 319,822 | 166,307 | 63,964 | 13,250 | 100,515 | 4,752 | 140,722 | 50,989 | 479,733 | 119,705 |
| 1976 | 431,018 | 207,673 | 74,449 | 17,045 | 117,550 | 6,269 | 174,366 | 67,591 | 538,772 | 137,142 |
| 1977 | 469,922 | 226,502 | 79,144 | 19,079 | 122,180 | 6,861 | 189,848 | 77,255 | 540,410 | 139,097 |
| 1978 | 600,180 | 274,819 | 97,313 | 24,428 | 147,413 | 9,687 | 236,913 | 98,345 | 631,768 | 165,313 |
| 1979 | 720,173 | 320,077 | 115,033 | 29,836 | 171,470 | 11,889 | 284,640 | 117,285 | 714,457 | 189,760 |
| 1980 | 857,818 | 376,845 | 134,920 | 35,949 | 210,736 | 14,256 | 337,177 | 138,590 | 811,952 | 215,694 |
| 1981 | 1,355,100 | 592,631 | 218,713 | 57,637 | 343,292 | 22,946 | 534,813 | 211,396 | 1,237,658 | 330,644 |
| 1982 | 1,551,434 | 664,082 | 254,298 | 66,408 | 400,739 | 26,335 | 313,057 | 235,100 | 1,341,923 | 364,482 |
| 1983 | 1,110,994 | 472,521 | 184,283 | 47,759 | 291,367 | 19,002 | 434,517 | 163,925 | 943,775 | 252,096 |
| 1984 | 450,405 | 509,602 | 202,914 | 52,247 | 321,718 | 20,719 | 472,282 | 174,500 | 1,003,760 | 266,383 |
| 1985 | 565,881 | 591,346 | 240,344 | 61,540 | 381,970 | 24,474 | 551,734 | 200,605 | 1,152,983 | 308,405 |
| 1986 | 635,066 | 659,259 | 275,347 | 70,160 | 438,498 | 27,822 | 625,994 | 223,785 | 1,285,253 | 350,799 |
| 1987 | 652,450 | 676,176 | 288,131 | 73,104 | 467,095 | 29,064 | 648,002 | 228,654 | 1,319,729 | 364,779 |
| 1988 | 711,641 | 742,582 | 319,496 | 80,756 | 525,996 | 32,024 | 711,641 | 248,146 | 1,438,752 | 402,232 |
| 1989 | 2,083,593 | 830,453 | 362,565 | 91,333 | 605,021 | 36,301 | 803,932 | 276,155 | 1,607,864 | 454,180 |
| 1990 | 2,207,667 | 869,029 | 386,049 | 96,930 | 636,731 | 38,438 | 848,974 | 289,119 | 1,696,277 | 481,308 |
| 1991 | 2,454,678 | 961,298 | 409,704 | 102,869 | 675,746 | 40,793 | 900,994 | 306,835 | 1,819,725 | 510,800 |
| 1992 | 2,804,695 | 1,098,371 | 468,125 | 117,538 | 772,102 | 46,610 | 1,029,469 | 350,587 | 2,079,203 | 583,636 |
| 1993 | 2,811,318 | 1,100,964 | 469,230 | 117,815 | 773,925 | 46,720 | 1,031,900 | 351,415 | 2,084,113 | 585,014 |
| 1994 | 2,694,116 | 1,055,065 | 449,668 | 112,905 | 741,661 | 44,772 | 988,880 | 336,766 | 1,997,227 | 560,625 |
| 1995 | 2,883,156 | 1,129,097 | 481,220 | 120,826 | 793,702 | 47,914 | 1,058,269 | 360,394 | 2,137,369 | 599,963 |
| 1996 | 2,834,460 | 1,110,027 | 473,093 | 118,785 | 780,296 | 47,104 | 1,040,394 | 354,307 | 2,101,269 | 589,830 |
| 1997 | 3,133,957 | 1,227,316 | 523,081 | 131,336 | 862,744 | 52,082 | 1,150,325 | 391,745 | 2,323,295 | 652,153 |
| 1998 | 3,155,093 | 1,235,593 | 526,609 | 132,222 | 868,562 | 52,433 | 1,728,006 | 394,387 | 2,338,963 | 656,551 |
| 1999 | 3,262,870 | 1,277,800 | 544,598 | 136,739 | 898,233 | 54,224 | 1,787,034 | 407,859 | 2,418,863 | 678,979 |
| 2000 | 3,314,278 | 2,279,763 | 553,178 | 138,893 | 912,384 | 55,078 | 1,815,190 | 510,073 | 2,456,972 | 689,676 |
| 2001 | 3,315,004 | 2,280,263 | 553,299 | 138,924 | 912,584 | 55,090 | 1,815,587 | 510,185 | 2,457,510 | 689,827 |
| 2002 | 3,437,351 | 2,314,256 | 561,548 | 140,995 | 926,188 | 55,912 | 1,842,654 | 517,791 | 2,494,146 | 700,112 |
| 2003 | 3,365,016 | 2,265,555 | 549,731 | 138,028 | 906,698 | 54,735 | 1,803,877 | 506,894 | 2,441,659 | 685,379 |
| 2004 | 3,686,201 | 2,481,798 | 602,201 | 151,202 | 993,241 | 59,960 | 1,976,053 | 555,277 | 2,674,711 | 750,797 |
| 2005 | 3,650,179 | 2,457,547 | 596,316 | 149,725 | 983,535 | 59,374 | 1,956,744 | 549,850 | 2,648,574 | 743,459 |
| 2006 | 3,802,076 | 2,559,814 | 3,256,234 | 155,955 | 1,344,440 | 61,844 | 2,038,171 | 572,732 | 2,758,791 | 774,397 |
| 2007 | 3,855,524 | 2,595,798 | 3,302,008 | 158,148 | 1,363,339 | 62,714 | 2,066,822 | 580,783 | 2,797,573 | 785,284 |
| 2008 | 3,943,904 | 2,655,301 | 3,377,700 | 161,772 | 1,394,591 | 64,151 | 2,114,200 | 594,096 | 2,861,701 | 803,284 |
| 2009 | 4,310,140 | 2,901,877 | 3,691,358 | 176,795 | 1,524,095 | 70,109 | 2,310,528 | 649,264 | 3,127,443 | 877,878 |
| 2010 | 5,385,764 | 3,626,059 | 5,269,593 | 220,916 | 2,123,453 | 87,605 | 3,153,757 | 811,293 | 3,907,916 | 1,096,959 |
| 2011 | 5,928,431 | 3,991,418 | 5,800,554 | 243,174 | 2,337,412 | 96,432 | 3,471,528 | 893,038 | 4,301,676 | 1,207,488 |
| 2012 | 6,189,558 | 4,167,227 | 6,056,050 | 253,886 | 2,440,367 | 100,679 | 3,624,437 | 932,373 | 4,491,150 | 1,260,674 |
| 2013 | 6,550,942 | 4,410,535 | 6,409,638 | 268,709 | 2,582,850 | 106,557 | 3,836,054 | 986,811 | 4,753,371 | 1,334,279 |
| 2014 | 6,368,143 | 4,185,518 | 6,082,630 | 255,000 | 2,451,078 | 101,120 | 3,640,346 | 936,466 | 4,510,863 | 1,266,208 |
| 2015 | 8,666,793 | 5,696,327 | 8,278,222 | 347,045 | 3,335,822 | 137,621 | 5,133,874 | 1,274,493 | 6,139,108 | 1,723,258 |
| 2016 | 10,359,280 | 6,808,728 | 9,894,827 | 414,817 | 3,987,255 | 164,497 | 6,136,437 | 1,523,381 | 7,337,978 | 2,059,784 |
| **2017** | **9,976,357** | **6,557,049** | **9,529,073** | **399,484** | **3,839,869** | **158,416** | **5,909,610** | **1,467,071** | **7,066,735** | **1,983,645** |
| 2018 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 5,909,610 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2019 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 5,909,610 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2020 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2021 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2022 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2023 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2024 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2025 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2026 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2027 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2028 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2029 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2030 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2031 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2032 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2033 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2034 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| 2035 | 9,976,357 | 6,557,049 | 9,529,073 | 399,484 | 3,839,869 | 158,416 | 6,185,116 | 1,467,071 | 7,066,735 | 1,983,645 |
| **TOTAL** | **317,098,927** | **201,079,607** | **253,682,653** | **13,055,408** | **116,163,432** | **5,174,538** | **183,735,319** | **46,913,667** | **233,363,997** | **65,311,535** |

## TABLE B-21 Total Delta Water Charge for Each Contractor (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | South Bay Area Future Contractor | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | | |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 241,150 |
| 1968 | 0 | 0 | 0 | 13,060 | 0 | 1,050 | 875 | 1,925 | 0 | 583,631 |
| 1969 | 0 | 0 | 0 | 17,804 | 0 | 1,225 | 929 | 2,154 | 0 | 827,578 |
| 1970 | 0 | 0 | 0 | 37,905 | 0 | 3,848 | 1,995 | 5,843 | 0 | 2,160,886 |
| 1971 | 0 | 0 | 0 | 48,508 | 0 | 4,546 | 3,186 | 7,732 | 0 | 2,696,792 |
| 1972 | 0 | 2,043,211 | 0 | 2,926,327 | 0 | 4,929 | 3,778 | 8,707 | 0 | 7,206,052 |
| 1973 | 0 | 2,317,893 | 0 | 2,979,146 | 0 | 7,059 | 4,444 | 11,503 | 0 | 7,456,998 |
| 1974 | 0 | 4,231,933 | 0 | 5,562,447 | 0 | 8,336 | 4,931 | 13,267 | 0 | 10,683,514 |
| 1975 | 0 | 5,073,286 | 0 | 6,533,045 | 0 | 9,416 | 5,117 | 14,533 | 0 | 12,440,851 |
| 1976 | 0 | 6,422,167 | 0 | 8,194,042 | 0 | 7,004 | 5,780 | 12,784 | 0 | 15,299,760 |
| 1977 | 0 | 7,104,278 | 0 | 8,974,576 | 0 | 16,917 | 5,827 | 22,744 | 0 | 15,869,924 |
| 1978 | 0 | 9,016,389 | 0 | 11,302,568 | 0 | 12,635 | 6,844 | 19,479 | 0 | 19,425,531 |
| 1979 | 0 | 10,935,192 | 0 | 13,609,812 | 0 | 16,575 | 7,773 | 24,348 | 0 | 23,095,855 |
| 1980 | 84,294 | 13,102,796 | 12,396 | 16,333,423 | 0 | 19,834 | 8,801 | 28,635 | 0 | 27,557,096 |
| 1981 | 140,930 | 20,910,099 | 36,136 | 25,991,995 | 0 | 21,682 | 13,370 | 35,052 | 0 | 43,335,911 |
| 1982 | 167,929 | 23,998,560 | 57,248 | 29,441,595 | 0 | 16,117 | 14,694 | 30,811 | 0 | 49,027,703 |
| 1983 | 124,148 | 17,203,307 | 50,672 | 21,298,366 | 0 | 15,202 | 10,134 | 25,336 | 0 | 34,186,736 |
| 1984 | 138,982 | 18,766,458 | 64,344 | 22,444,314 | 20,590 | 15,442 | 10,681 | 46,713 | 0 | 37,051,405 |
| 1985 | 166,935 | 22,050,974 | 84,882 | 26,382,073 | 24,050 | 16,976 | 12,166 | 53,192 | 0 | 43,235,458 |
| 1986 | 195,056 | 25,089,658 | 120,965 | 29,997,662 | 31,753 | 18,145 | 13,457 | 63,355 | 0 | 49,817,447 |
| 1987 | 207,598 | 26,095,043 | 148,284 | 31,198,109 | 37,071 | 17,794 | 13,642 | 68,507 | 0 | 51,663,899 |
| 1988 | 233,604 | 28,781,238 | 201,116 | 34,429,224 | 46,722 | 18,565 | 14,852 | 80,139 | 0 | 57,062,086 |
| 1989 | 268,530 | 32,505,376 | 265,215 | 40,190,518 | 61,184 | 19,891 | 16,576 | 97,651 | 0 | 65,617,116 |
| 1990 | 289,119 | 33,616,369 | 334,242 | 41,790,252 | 63,506 | 20,055 | 17,381 | 100,942 | 0 | 68,658,631 |
| 1991 | 306,835 | 35,676,185 | 354,722 | 44,521,184 | 170,267 | 21,283 | 19,155 | 210,705 | 0 | 73,265,317 |
| 1992 | 350,587 | 40,763,329 | 405,303 | 50,869,555 | 194,545 | 24,318 | 22,697 | 241,560 | 0 | 83,873,685 |
| 1993 | 351,415 | 40,859,579 | 406,260 | 50,989,668 | 195,005 | 24,376 | 23,563 | 242,944 | 0 | 84,237,281 |
| 1994 | 336,766 | 39,156,173 | 389,323 | 48,863,947 | 186,875 | 23,360 | 23,360 | 233,595 | 0 | 80,866,329 |
| 1995 | 360,394 | 41,903,674 | 416,641 | 52,292,619 | 199,987 | 24,999 | 26,040 | 251,026 | 0 | 86,725,209 |
| 1996 | 0 | 41,195,923 | 409,604 | 51,055,092 | 196,610 | 24,576 | 26,624 | 247,810 | 0 | 83,007,946 |
| 1997 | 0 | 45,548,810 | 447,746 | 56,444,590 | 214,918 | 27,173 | 30,223 | 272,314 | 0 | 93,062,361 |
| 1998 | 0 | 45,855,992 | 450,529 | 57,394,940 | 107,459 | 27,356 | 31,537 | 166,352 | 0 | 93,159,618 |
| 1999 | 47,152 | 47,422,430 | 466,491 | 59,403,272 | 226,327 | 28,291 | 33,820 | 288,438 | 0 | 96,994,387 |
| 2000 | 71,841 | 48,169,576 | 478,942 | 61,445,844 | 229,892 | 69,207 | 35,708 | 334,807 | 0 | 98,699,723 |
| 2001 | 95,809 | 48,180,135 | 479,047 | 61,483,264 | 229,942 | 83,833 | 37,187 | 350,962 | 0 | 98,781,493 |
| 2002 | 97,237 | 48,898,394 | 486,188 | 62,472,772 | 233,371 | 85,083 | 39,185 | 357,639 | 0 | 100,275,854 |
| 2003 | 118,989 | 47,869,376 | 475,957 | 61,181,894 | 228,460 | 83,293 | 39,743 | 351,496 | 0 | 98,210,650 |
| 2004 | 156,416 | 52,438,419 | 521,386 | 67,047,662 | 250,266 | 92,048 | 0 | 342,314 | 0 | 107,579,616 |
| 2005 | 167,795 | 51,925,988 | 516,291 | 66,405,377 | 247,820 | 717,290 | 0 | 965,110 | 0 | 107,188,794 |
| 2006 | 188,222 | 51,397,939 | 537,776 | 69,448,391 | 258,133 | 32,606 | 8,699 | 299,438 | 0 | 110,967,023 |
| 2007 | 204,501 | 52,120,469 | 545,336 | 70,438,299 | 268,738 | 33,950 | 19,600 | 322,288 | 0 | 112,569,420 |
| 2008 | 482,528 | 53,315,217 | 557,837 | 72,326,282 | 274,736 | 794,785 | 56,138 | 1,125,659 | 0 | 116,229,451 |
| 2009 | 527,337 | 58,266,144 | 609,638 | 79,042,606 | 292,626 | 844,842 | 63,417 | 1,200,885 | 0 | 127,004,742 |
| 2010 | 658,937 | 72,806,845 | 761,778 | 99,910,875 | 365,653 | 1,054,033 | 81,825 | 1,501,511 | 0 | 158,911,895 |
| 2011 | 725,331 | 80,142,822 | 838,533 | 109,977,837 | 414,001 | 1,185,940 | 92,561 | 1,692,502 | 0 | 174,964,623 |
| 2012 | 757,280 | 83,672,846 | 875,468 | 114,821,995 | 424,826 | 1,216,951 | 100,037 | 1,741,814 | 0 | 182,648,119 |
| 2013 | 801,494 | 88,558,170 | 926,583 | 121,525,993 | 444,760 | 1,274,052 | 109,975 | 1,828,787 | 0 | 193,299,795 |
| 2014 | 760,603 | 84,040,101 | 879,310 | 115,477,386 | 431,273 | 1,235,416 | 108,033 | 1,774,722 | 0 | 183,479,164 |
| 2015 | 1,035,151 | 114,375,290 | 1,196,707 | 157,339,711 | 574,420 | 1,645,472 | 153,363 | 2,373,255 | 0 | 249,669,412 |
| 2016 | 1,237,301 | 136,710,965 | 1,430,405 | 188,065,655 | 686,595 | 1,966,807 | 190,584 | 2,843,986 | 0 | 298,433,393 |
| **2017** | **1,191,565** | **131,657,554** | **1,377,531** | **181,113,959** | **703,970** | **2,016,581** | **183,222** | **2,903,773** | **0** | **287,566,604** |
| 2018 | 1,191,565 | 131,657,554 | 1,377,531 | 181,113,959 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,604 |
| 2019 | 1,191,565 | 131,657,554 | 1,377,531 | 181,113,959 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,604 |
| 2020 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2021 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2022 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2023 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2024 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2025 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2026 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2027 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2028 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2029 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2030 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2031 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2032 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2033 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2034 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| 2035 | 1,191,565 | 131,657,554 | 1,377,531 | 181,389,465 | 703,970 | 2,016,581 | 183,222 | 2,903,773 | 0 | 287,566,603 |
| **TOTAL** | **34,496,781** | **4,362,028,544** | **43,412,390** | **5,875,516,798** | **21,207,811** | **51,249,622** | **5,051,525** | **77,508,958** | **0** | **9,403,072,770** |

## TABLE B-22 Water System Revenue Bond Surcharge for Each Contractor[a] (in dollars)



| | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis Obispo | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 29,131 | 40,505 | 69,636 | 25,436 | 30,176 | 100,035 | 155,647 | 13,126 | 24,392 | 37,518 |
| 1989 | 48,804 | 69,621 | 118,425 | 43,343 | 51,681 | 170,303 | 265,327 | 26,828 | 49,634 | 76,462 |
| 1990 | 41,166 | 60,482 | 101,648 | 38,407 | 51,185 | 149,440 | 239,032 | 27,956 | 51,795 | 79,751 |
| 1991 | 63,389 | 92,401 | 155,790 | 62,470 | 81,991 | 235,712 | 380,173 | 44,887 | 83,709 | 128,596 |
| 1992 | 84,320 | 126,227 | 210,547 | 89,247 | 115,208 | 325,629 | 530,084 | 61,137 | 113,925 | 175,062 |
| 1993 | 90,152 | 137,473 | 227,625 | 98,432 | 125,174 | 347,457 | 571,063 | 67,725 | 126,662 | 194,387 |
| 1994 | 91,785 | 141,222 | 233,007 | 102,021 | 126,216 | 352,415 | 580,652 | 81,420 | 159,156 | 240,576 |
| 1995 | 108,311 | 181,787 | 290,098 | 126,001 | 149,377 | 416,956 | 692,334 | 131,675 | 270,726 | 402,401 |
| 1996 | 132,305 | 232,343 | 364,648 | 158,514 | 180,787 | 505,042 | 844,343 | 242,654 | 534,449 | 777,103 |
| 1997 | 135,556 | 237,492 | 373,048 | 171,263 | 187,162 | 522,127 | 880,552 | 141,810 | 846,617 | 988,427 |
| 1998 | 130,346 | 228,366 | 358,712 | 164,682 | 179,971 | 502,065 | 846,718 | 136,361 | 814,087 | 950,448 |
| 1999 | 182,507 | 316,416 | 498,923 | 227,072 | 248,031 | 691,830 | 1,166,933 | 188,835 | 1,124,110 | 1,312,945 |
| 2000 | 238,571 | 364,418 | 602,989 | 260,766 | 284,875 | 794,730 | 1,340,371 | 218,359 | 1,364,019 | 1,582,378 |
| 2001 | 234,773 | 358,616 | 593,389 | 561,965 | 280,341 | 782,078 | 1,624,384 | 214,883 | 1,342,304 | 1,557,187 |
| 2002 | 257,520 | 391,851 | 649,371 | 610,230 | 288,977 | 806,174 | 1,705,381 | 221,503 | 1,383,661 | 1,605,164 |
| 2003 | 268,151 | 408,027 | 676,178 | 635,422 | 300,907 | 839,455 | 1,775,784 | 230,647 | 1,440,782 | 1,671,429 |
| 2004 | 268,425 | 408,444 | 676,869 | 636,070 | 301,214 | 840,312 | 1,777,596 | 230,883 | 1,442,252 | 1,673,135 |
| 2005 | 253,413 | 385,602 | 639,015 | 610,756 | 284,369 | 793,318 | 1,688,443 | 217,970 | 1,361,594 | 1,579,564 |
| 2006 | 274,219 | 417,261 | 691,480 | 660,900 | 307,716 | 858,451 | 1,827,067 | 235,866 | 1,473,385 | 1,709,251 |
| 2007 | 177,891 | 270,066 | 447,957 | 441,730 | 197,505 | 550,975 | 1,190,210 | 152,478 | 975,872 | 1,128,350 |
| 2008 | 254,590 | 386,862 | 641,452 | 773,686 | 288,283 | 803,089 | 1,865,058 | 223,659 | 1,369,892 | 1,593,551 |
| 2009 | 285,324 | 434,158 | 719,482 | 687,665 | 320,178 | 893,215 | 1,901,058 | 245,418 | 1,533,052 | 1,778,470 |
| 2010 | 273,015 | 415,428 | 688,443 | 657,998 | 306,365 | 854,681 | 1,819,044 | 234,831 | 1,466,914 | 1,701,745 |
| 2011 | 294,866 | 448,677 | 743,543 | 710,662 | 330,884 | 923,085 | 1,964,631 | 253,625 | 1,584,318 | 1,837,943 |
| 2012 | 383,092 | 455,983 | 839,075 | 753,264 | 330,355 | 933,048 | 2,016,667 | 229,311 | 1,456,050 | 1,685,361 |
| 2013 | 416,223 | 495,679 | 911,902 | 820,192 | 360,039 | 1,013,496 | 2,193,727 | 249,613 | 1,583,700 | 1,833,313 |
| 2014 | 454,438 | 541,511 | 995,949 | 894,353 | 392,064 | 1,103,675 | 2,390,092 | 271,760 | 1,722,805 | 1,994,565 |
| 2015 | 436,482 | 520,709 | 957,191 | 854,027 | 375,378 | 1,053,325 | 2,282,730 | 260,767 | 1,649,215 | 1,909,982 |
| 2016 | 785,679 | 940,036 | 1,725,715 | 1,537,135 | 675,549 | 1,890,817 | 4,103,501 | 469,895 | 2,967,716 | 3,437,611 |
| **2017** | **825,082** | **988,823** | **1,813,905** | **1,735,420** | **711,139** | **1,988,098** | **4,434,657** | **494,547** | **3,122,046** | **3,616,593** |
| 2018 | 838,436 | 1,004,827 | 1,843,263 | 1,763,508 | 722,649 | 2,020,276 | 4,506,433 | 502,551 | 3,172,578 | 3,675,129 |
| 2019 | 917,602 | 1,099,704 | 2,017,306 | 1,930,020 | 790,882 | 2,211,032 | 4,931,934 | 550,003 | 3,472,134 | 4,022,137 |
| 2020 | 886,730 | 1,062,706 | 1,949,436 | 1,865,087 | 764,274 | 2,136,644 | 4,766,005 | 531,498 | 3,355,318 | 3,886,816 |
| 2021 | 887,015 | 1,063,047 | 1,950,062 | 1,865,685 | 764,519 | 2,137,330 | 4,767,534 | 531,669 | 3,356,395 | 3,888,064 |
| 2022 | 857,192 | 1,027,305 | 1,884,497 | 1,802,957 | 738,814 | 2,065,469 | 4,607,240 | 513,793 | 3,243,546 | 3,757,339 |
| 2023 | 866,635 | 1,038,623 | 1,905,258 | 1,822,820 | 746,954 | 2,088,224 | 4,657,998 | 519,454 | 3,279,280 | 3,798,734 |
| 2024 | 845,721 | 1,013,558 | 1,859,279 | 1,778,831 | 728,928 | 2,037,829 | 4,545,588 | 506,918 | 3,200,143 | 3,707,061 |
| 2025 | 800,892 | 959,833 | 1,760,725 | 1,684,541 | 690,290 | 1,929,811 | 4,304,642 | 480,048 | 3,030,515 | 3,510,563 |
| 2026 | 758,624 | 909,176 | 1,667,800 | 1,595,637 | 653,859 | 1,827,962 | 4,077,458 | 454,713 | 2,870,574 | 3,325,287 |
| 2027 | 805,047 | 964,812 | 1,769,859 | 1,693,280 | 693,871 | 1,939,823 | 4,326,974 | 482,538 | 3,046,236 | 3,528,774 |
| 2028 | 683,762 | 819,457 | 1,503,219 | 1,438,177 | 589,335 | 1,647,576 | 3,675,088 | 409,841 | 2,587,301 | 2,997,142 |
| 2029 | 716,316 | 858,472 | 1,574,788 | 1,506,649 | 617,393 | 1,726,018 | 3,850,060 | 429,354 | 2,710,484 | 3,139,838 |
| 2030 | 518,342 | 621,209 | 1,139,551 | 1,090,244 | 446,759 | 1,248,984 | 2,785,987 | 310,690 | 1,961,366 | 2,272,056 |
| 2031 | 518,648 | 621,575 | 1,140,223 | 1,090,887 | 447,023 | 1,249,721 | 2,787,631 | 310,873 | 1,962,522 | 2,273,395 |
| 2032 | 518,720 | 621,662 | 1,140,382 | 1,091,039 | 447,085 | 1,249,895 | 2,788,019 | 310,916 | 1,962,796 | 2,273,712 |
| 2033 | 518,742 | 621,688 | 1,140,430 | 1,091,085 | 447,104 | 1,249,948 | 2,788,137 | 310,929 | 1,962,878 | 2,273,807 |
| 2034 | 518,710 | 621,650 | 1,140,360 | 1,091,019 | 447,077 | 1,249,871 | 2,787,967 | 310,910 | 1,962,758 | 2,273,668 |
| 2035 | 518,639 | 621,565 | 1,140,204 | 1,090,869 | 447,016 | 1,249,700 | 2,787,585 | 310,868 | 1,962,490 | 2,273,358 |
| **TOTAL** | **20,495,299** | **26,047,355** | **46,542,654** | **42,441,464** | **19,046,929** | **53,307,146** | **114,795,539** | **13,597,995** | **82,538,153** | **96,136,148** |

[a] 1988 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include bond cover.

## TABLE B-22 Water System Revenue Bond Surcharge for Each Contractor[a] (in dollars)



| | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| Calendar Year | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 33,986 | 1,657 | 0 | 67,288 | 726,501 | 2,228 | 2,851 | 66,748 | 901,259 |
| 1989 | 59,273 | 2,785 | 0 | 116,689 | 1,251,452 | 3,733 | 4,927 | 116,736 | 1,555,595 |
| 1990 | 53,349 | 2,419 | 0 | 287,811 | 947,351 | 3,248 | 4,367 | 109,118 | 1,407,663 |
| 1991 | 82,252 | 3,731 | 0 | 359,380 | 1,564,983 | 5,035 | 6,771 | 168,217 | 2,190,369 |
| 1992 | 112,566 | 5,127 | 0 | 452,691 | 2,153,423 | 6,927 | 9,285 | 230,217 | 2,970,236 |
| 1993 | 119,670 | 5,459 | 0 | 272,449 | 2,491,672 | 7,381 | 9,894 | 244,813 | 3,151,338 |
| 1994 | 118,265 | 5,379 | 0 | 244,671 | 2,485,820 | 7,300 | 9,766 | 241,933 | 3,113,134 |
| 1995 | 139,226 | 6,340 | 0 | 317,885 | 2,894,181 | 8,599 | 11,490 | 284,798 | 3,662,519 |
| 1996 | 169,333 | 7,703 | 0 | 354,341 | 2,722,240 | 10,461 | 13,978 | 346,367 | 3,624,423 |
| 1997 | 165,364 | 7,980 | 0 | 366,285 | 2,673,847 | 10,826 | 14,465 | 357,986 | 3,596,753 |
| 1998 | 159,011 | 7,672 | 0 | 352,211 | 2,571,110 | 10,410 | 13,909 | 344,232 | 3,458,555 |
| 1999 | 218,784 | 10,373 | 0 | 485,897 | 3,371,115 | 14,376 | 19,166 | 476,017 | 4,595,728 |
| 2000 | 251,339 | 11,735 | 0 | 557,296 | 3,620,348 | 16,500 | 21,990 | 546,406 | 5,025,614 |
| 2001 | 247,338 | 11,547 | 0 | 548,424 | 3,461,158 | 16,238 | 21,640 | 537,707 | 4,844,052 |
| 2002 | 273,542 | 11,904 | 0 | 565,321 | 3,496,023 | 16,737 | 22,306 | 521,659 | 4,907,492 |
| 2003 | 284,834 | 12,395 | 0 | 588,659 | 3,640,346 | 17,428 | 23,227 | 543,193 | 5,110,082 |
| 2004 | 285,125 | 12,408 | 0 | 589,259 | 3,644,059 | 17,446 | 23,251 | 543,748 | 5,115,296 |
| 2005 | 269,179 | 11,714 | 0 | 556,305 | 3,431,851 | 39,485 | 21,951 | 488,483 | 4,818,968 |
| 2006 | 291,279 | 12,676 | 0 | 601,979 | 3,713,614 | 42,726 | 23,753 | 528,589 | 5,214,616 |
| 2007 | 187,144 | 8,113 | 0 | 383,463 | 2,314,841 | 34,088 | 15,230 | 285,915 | 3,228,794 |
| 2008 | 271,383 | 11,832 | 0 | 563,171 | 3,478,837 | 41,080 | 22,094 | 445,805 | 4,834,202 |
| 2009 | 303,076 | 13,189 | 0 | 626,357 | 3,864,004 | 46,037 | 24,715 | 497,108 | 5,374,486 |
| 2010 | 257,209 | 12,620 | 0 | 599,335 | 3,631,924 | 44,051 | 23,648 | 440,950 | 5,009,737 |
| 2011 | 277,794 | 13,630 | 0 | 647,304 | 3,922,606 | 47,577 | 25,542 | 476,242 | 5,410,695 |
| 2012 | 271,192 | 12,709 | 0 | 666,489 | 5,450,478 | 40,125 | 23,964 | 510,822 | 6,975,779 |
| 2013 | 286,050 | 13,814 | 0 | 724,170 | 5,680,875 | 43,592 | 26,041 | 521,112 | 7,295,654 |
| 2014 | 302,692 | 15,056 | 0 | 790,204 | 6,189,586 | 47,573 | 28,404 | 561,312 | 7,934,827 |
| 2015 | 278,438 | 14,506 | 0 | 758,484 | 5,949,402 | 45,814 | 27,366 | 540,099 | 7,614,109 |
| 2016 | 503,415 | 26,336 | 0 | 1,371,356 | 10,760,127 | 83,031 | 49,670 | 977,911 | 13,771,846 |
| **2017** | **531,373** | **27,824** | **0** | **1,443,220** | **11,382,800** | **88,473** | **52,401** | **1,042,586** | **14,568,677** |
| 2018 | 539,973 | 28,274 | 0 | 1,466,579 | 11,567,035 | 89,905 | 53,249 | 1,059,461 | 14,804,476 |
| 2019 | 590,958 | 30,944 | 0 | 1,605,054 | 12,659,202 | 98,394 | 58,277 | 1,159,496 | 16,202,325 |
| 2020 | 571,076 | 29,903 | 0 | 1,551,054 | 12,233,297 | 95,084 | 56,316 | 1,120,486 | 15,657,216 |
| 2021 | 571,259 | 29,913 | 0 | 1,551,552 | 12,237,224 | 95,114 | 56,334 | 1,120,845 | 15,662,241 |
| 2022 | 552,052 | 28,907 | 0 | 1,499,386 | 11,825,784 | 91,916 | 54,440 | 1,083,160 | 15,135,645 |
| 2023 | 558,134 | 29,225 | 0 | 1,515,904 | 11,956,067 | 92,929 | 55,040 | 1,095,093 | 15,302,392 |
| 2024 | 544,665 | 28,520 | 0 | 1,479,321 | 11,667,535 | 90,686 | 53,712 | 1,068,666 | 14,933,105 |
| 2025 | 515,794 | 27,008 | 0 | 1,400,908 | 11,049,082 | 85,879 | 50,865 | 1,012,020 | 14,141,556 |
| 2026 | 488,572 | 25,583 | 0 | 1,326,973 | 10,465,948 | 81,347 | 48,180 | 958,609 | 13,395,212 |
| 2027 | 518,470 | 27,148 | 0 | 1,408,175 | 11,106,401 | 86,325 | 51,129 | 1,017,270 | 14,214,918 |
| 2028 | 440,359 | 23,058 | 0 | 1,196,025 | 9,433,152 | 73,319 | 43,426 | 864,012 | 12,073,351 |
| 2029 | 461,325 | 24,156 | 0 | 1,252,968 | 9,882,268 | 76,810 | 45,493 | 905,148 | 12,648,168 |
| 2030 | 333,825 | 17,480 | 0 | 906,675 | 7,151,026 | 55,581 | 32,920 | 654,985 | 9,152,492 |
| 2031 | 334,022 | 17,490 | 0 | 907,210 | 7,155,243 | 55,614 | 32,939 | 655,371 | 9,157,889 |
| 2032 | 334,068 | 17,493 | 0 | 907,337 | 7,156,241 | 55,622 | 32,944 | 655,462 | 9,159,167 |
| 2033 | 334,082 | 17,493 | 0 | 907,375 | 7,156,541 | 55,624 | 32,945 | 655,490 | 9,159,550 |
| 2034 | 334,062 | 17,492 | 0 | 907,319 | 7,156,104 | 55,621 | 32,943 | 655,450 | 9,158,991 |
| 2035 | 334,016 | 17,490 | 0 | 907,195 | 7,155,125 | 55,613 | 32,939 | 655,360 | 9,157,738 |
| **TOTAL** | **15,160,193** | **758,210** | **0** | **38,955,404** | **292,499,849** | **2,209,908** | **1,422,153** | **29,393,213** | **380,398,930** |

[a] 1988 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include bond cover.

## TABLE B-22 Water System Revenue Bond Surcharge for Each Contractor[a] (in dollars)



| | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Calendar Year | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 64,266 | 57,111 | 27,032 | 7,656 | 44,492 | 2,154 | 55,996 | 16,240 | 151,182 | 39,907 |
| 1989 | 205,668 | 98,720 | 46,993 | 13,263 | 78,104 | 3,763 | 97,138 | 27,981 | 259,860 | 69,104 |
| 1990 | 185,010 | 87,808 | 42,449 | 11,905 | 69,970 | 3,385 | 87,327 | 24,956 | 231,650 | 61,851 |
| 1991 | 296,854 | 140,371 | 65,947 | 18,548 | 108,704 | 5,236 | 135,623 | 38,641 | 363,310 | 96,172 |
| 1992 | 402,015 | 234,421 | 89,358 | 25,192 | 147,297 | 7,053 | 183,813 | 52,160 | 491,537 | 130,372 |
| 1993 | 424,871 | 247,076 | 93,981 | 26,566 | 154,919 | 7,437 | 193,361 | 55,045 | 517,379 | 137,298 |
| 1994 | 424,023 | 247,222 | 94,502 | 26,865 | 155,776 | 7,431 | 194,191 | 54,968 | 525,394 | 139,422 |
| 1995 | 500,084 | 290,998 | 111,730 | 31,822 | 184,170 | 8,769 | 229,530 | 64,852 | 623,848 | 165,593 |
| 1996 | 606,388 | 353,132 | 135,428 | 38,634 | 223,237 | 10,640 | 278,178 | 78,696 | 760,333 | 201,821 |
| 1997 | 626,151 | 362,776 | 139,565 | 39,802 | 230,058 | 10,972 | 286,779 | 81,146 | 808,482 | 207,472 |
| 1998 | 602,091 | 348,838 | 134,202 | 38,273 | 221,218 | 10,550 | 275,761 | 78,028 | 777,418 | 199,501 |
| 1999 | 826,108 | 479,470 | 184,524 | 52,650 | 304,166 | 14,475 | 642,815 | 107,060 | 1,041,566 | 277,200 |
| 2000 | 940,325 | 1,150,965 | 210,453 | 60,212 | 346,906 | 16,486 | 736,157 | 121,898 | 1,191,538 | 316,860 |
| 2001 | 925,355 | 1,132,642 | 207,102 | 59,254 | 341,384 | 16,224 | 724,438 | 135,581 | 1,172,568 | 311,816 |
| 2002 | 974,814 | 1,167,539 | 213,483 | 61,079 | 351,902 | 16,724 | 746,758 | 139,071 | 1,208,696 | 321,423 |
| 2003 | 1,015,056 | 1,215,738 | 222,296 | 63,601 | 366,429 | 17,415 | 777,586 | 144,812 | 1,258,593 | 334,692 |
| 2004 | 1,016,092 | 1,216,978 | 222,523 | 63,666 | 366,803 | 17,432 | 778,379 | 144,960 | 1,259,877 | 335,033 |
| 2005 | 959,268 | 1,148,920 | 210,078 | 60,105 | 346,290 | 16,457 | 734,849 | 136,853 | 1,189,420 | 316,297 |
| 2006 | 1,038,026 | 1,243,248 | 1,213,645 | 65,040 | 501,286 | 17,809 | 795,182 | 148,089 | 1,287,074 | 342,266 |
| 2007 | 666,215 | 820,799 | 1,036,396 | 41,723 | 354,543 | 11,413 | 520,847 | 95,550 | 825,932 | 219,727 |
| 2008 | 999,433 | 1,167,531 | 1,157,440 | 61,924 | 478,719 | 17,175 | 757,686 | 144,009 | 1,367,672 | 325,069 |
| 2009 | 1,080,062 | 1,293,596 | 1,262,793 | 67,674 | 521,586 | 18,529 | 827,383 | 154,087 | 1,339,196 | 356,126 |
| 2010 | 1,033,467 | 1,237,788 | 1,283,384 | 64,754 | 524,108 | 17,731 | 824,481 | 147,438 | 1,281,421 | 340,762 |
| 2011 | 1,116,181 | 1,336,855 | 1,386,101 | 69,937 | 566,054 | 19,149 | 890,469 | 159,239 | 1,383,979 | 368,035 |
| 2012 | 1,090,934 | 915,850 | 1,073,158 | 67,263 | 523,945 | 18,453 | 731,452 | 154,732 | 1,323,822 | 351,925 |
| 2013 | 1,186,869 | 996,745 | 1,172,413 | 73,154 | 570,092 | 20,052 | 795,549 | 168,130 | 1,438,513 | 382,372 |
| 2014 | 1,345,233 | 1,085,473 | 1,276,763 | 79,660 | 621,395 | 21,838 | 866,523 | 183,142 | 1,568,301 | 416,868 |
| 2015 | 1,288,246 | 1,039,717 | 1,228,651 | 76,255 | 595,985 | 20,924 | 868,542 | 175,577 | 1,500,551 | 398,955 |
| 2016 | 2,323,705 | 1,873,178 | 2,223,587 | 137,172 | 1,074,426 | 37,709 | 1,565,138 | 316,644 | 2,698,764 | 717,704 |
| **2017** | **2,441,561** | **1,968,931** | **2,487,883** | **144,061** | **1,130,096** | **39,617** | **1,645,505** | **332,754** | **2,834,899** | **753,972** |
| 2018 | 2,481,079 | 2,000,799 | 2,528,150 | 146,393 | 1,148,387 | 40,258 | 1,672,138 | 338,140 | 2,880,783 | 766,175 |
| 2019 | 2,715,344 | 2,189,716 | 2,766,860 | 160,215 | 1,256,818 | 44,059 | 1,830,022 | 370,067 | 3,152,788 | 838,518 |
| 2020 | 2,623,989 | 2,116,045 | 2,673,772 | 154,825 | 1,214,534 | 42,577 | 1,768,453 | 357,617 | 3,046,716 | 810,307 |
| 2021 | 2,624,831 | 2,116,724 | 2,674,630 | 154,875 | 1,214,924 | 42,591 | 1,769,021 | 357,731 | 3,047,694 | 810,567 |
| 2022 | 2,536,579 | 2,045,556 | 2,584,704 | 149,667 | 1,174,076 | 41,159 | 1,709,543 | 345,704 | 2,945,225 | 783,314 |
| 2023 | 2,564,524 | 2,068,091 | 2,613,179 | 151,316 | 1,187,011 | 41,612 | 1,728,377 | 349,512 | 2,977,672 | 791,944 |
| 2024 | 2,502,635 | 2,018,183 | 2,550,116 | 147,665 | 1,158,365 | 40,608 | 1,686,667 | 341,078 | 2,905,813 | 772,832 |
| 2025 | 2,369,980 | 1,911,206 | 2,414,944 | 139,837 | 1,096,964 | 38,456 | 1,597,262 | 322,998 | 2,751,786 | 731,867 |
| 2026 | 2,244,900 | 1,810,339 | 2,287,491 | 132,457 | 1,039,070 | 36,426 | 1,512,964 | 305,952 | 2,606,556 | 693,242 |
| 2027 | 2,382,275 | 1,921,121 | 2,427,472 | 140,563 | 1,102,655 | 38,655 | 1,605,549 | 324,674 | 2,766,061 | 735,664 |
| 2028 | 2,023,370 | 1,631,692 | 2,061,758 | 119,386 | 936,533 | 32,831 | 1,363,663 | 275,760 | 2,349,337 | 624,832 |
| 2029 | 2,119,703 | 1,709,378 | 2,159,919 | 125,070 | 981,122 | 34,395 | 1,428,587 | 288,889 | 2,461,190 | 654,580 |
| 2030 | 1,533,864 | 1,236,943 | 1,562,965 | 90,504 | 709,961 | 24,889 | 1,033,757 | 209,046 | 1,780,971 | 473,668 |
| 2031 | 1,534,768 | 1,237,673 | 1,563,886 | 90,557 | 710,380 | 24,903 | 1,034,367 | 209,170 | 1,782,021 | 473,948 |
| 2032 | 1,534,982 | 1,237,845 | 1,564,105 | 90,570 | 710,479 | 24,907 | 1,034,511 | 209,199 | 1,782,270 | 474,014 |
| 2033 | 1,535,047 | 1,237,897 | 1,564,170 | 90,573 | 710,509 | 24,908 | 1,034,554 | 209,208 | 1,782,345 | 474,034 |
| 2034 | 1,534,953 | 1,237,821 | 1,564,075 | 90,568 | 710,465 | 24,906 | 1,034,491 | 209,195 | 1,782,236 | 474,005 |
| 2035 | 1,534,743 | 1,237,652 | 1,563,861 | 90,555 | 710,368 | 24,903 | 1,034,350 | 209,166 | 1,781,992 | 473,940 |
| **TOTAL** | **65,001,937** | **55,925,117** | **58,379,917** | **3,913,306** | **29,276,681** | **1,076,045** | **44,125,712** | **8,915,445** | **77,266,231** | **20,493,066** |

[a] 1988 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include bond cover.

## TABLE B-22 Water System Revenue Bond Surcharge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 24,019 | 2,642,354 | 18,118 | 3,150,527 | 1,336 | 552 | 853 | 2,741 | 0 | 4,317,328 |
| 1989 | 42,040 | 4,587,641 | 34,565 | 5,564,840 | 0 | 918 | 1,454 | 2,372 | 0 | 7,583,021 |
| 1990 | 38,023 | 4,037,980 | 34,994 | 4,917,308 | 2,535 | 800 | 1,283 | 4,618 | 0 | 6,750,020 |
| 1991 | 59,122 | 6,259,893 | 54,115 | 7,642,536 | 9,945 | 1,243 | 2,027 | 13,215 | 0 | 10,510,679 |
| 1992 | 80,131 | 8,435,312 | 72,892 | 10,351,553 | 13,671 | 1,710 | 2,806 | 18,187 | 0 | 14,255,669 |
| 1993 | 84,371 | 8,885,273 | 76,858 | 10,904,435 | 14,608 | 1,827 | 3,026 | 19,461 | 0 | 15,068,309 |
| 1994 | 85,698 | 8,926,755 | 76,794 | 10,959,041 | 14,409 | 1,801 | 3,070 | 19,280 | 0 | 15,145,690 |
| 1995 | 101,792 | 10,539,430 | 90,436 | 12,943,054 | 16,958 | 2,119 | 3,705 | 22,782 | 0 | 18,013,188 |
| 1996 | 124,074 | 12,810,359 | 109,783 | 15,730,703 | 20,640 | 2,579 | 4,620 | 27,839 | 0 | 21,369,059 |
| 1997 | 28,259 | 13,168,230 | 112,960 | 16,102,652 | 21,382 | 2,674 | 4,872 | 28,928 | 0 | 21,970,360 |
| 1998 | 27,174 | 12,662,268 | 108,619 | 15,483,941 | 20,562 | 2,571 | 4,685 | 27,818 | 0 | 21,126,192 |
| 1999 | 53,545 | 17,454,651 | 149,123 | 21,587,353 | 28,348 | 3,543 | 6,765 | 38,656 | 0 | 29,200,538 |
| 2000 | 70,117 | 19,805,800 | 168,259 | 25,135,976 | 32,271 | 9,794 | 7,996 | 50,061 | 0 | 33,737,389 |
| 2001 | 69,001 | 19,490,499 | 165,580 | 24,751,444 | 31,757 | 9,638 | 7,869 | 49,264 | 0 | 33,419,720 |
| 2002 | 71,126 | 20,091,004 | 170,682 | 25,534,301 | 32,736 | 9,935 | 8,112 | 50,783 | 0 | 34,452,492 |
| 2003 | 74,063 | 20,920,403 | 177,728 | 26,588,412 | 34,087 | 10,345 | 8,446 | 52,878 | 0 | 35,874,763 |
| 2004 | 74,138 | 20,941,743 | 177,910 | 26,615,534 | 34,121 | 10,356 | 8,456 | 52,933 | 0 | 35,911,363 |
| 2005 | 69,992 | 19,770,593 | 167,960 | 25,127,082 | 32,213 | 9,776 | 7,983 | 49,972 | 0 | 33,903,044 |
| 2006 | 75,738 | 20,330,228 | 181,750 | 27,239,381 | 34,858 | 10,579 | 8,638 | 54,075 | 0 | 36,735,870 |
| 2007 | 45,192 | 12,752,863 | 116,415 | 17,507,615 | 22,362 | 7,007 | 5,579 | 34,948 | 0 | 23,537,874 |
| 2008 | 250,631 | 19,303,204 | 173,561 | 26,204,054 | 32,180 | 9,751 | 7,973 | 49,904 | 0 | 35,188,221 |
| 2009 | 78,805 | 21,153,536 | 189,110 | 28,342,483 | 36,270 | 11,008 | 8,988 | 56,266 | 0 | 38,172,245 |
| 2010 | 75,405 | 20,240,944 | 180,952 | 27,252,635 | 34,705 | 10,532 | 8,600 | 53,837 | 0 | 36,525,441 |
| 2011 | 81,440 | 21,860,932 | 195,434 | 29,433,805 | 37,482 | 11,375 | 9,289 | 58,146 | 0 | 39,448,763 |
| 2012 | 215,055 | 22,686,017 | 191,051 | 29,343,657 | 35,313 | 101,156 | 12,344 | 148,813 | 0 | 41,009,352 |
| 2013 | 233,662 | 23,602,562 | 207,636 | 30,847,749 | 38,359 | 109,882 | 13,628 | 161,869 | 0 | 43,244,214 |
| 2014 | 254,740 | 25,718,327 | 226,122 | 33,664,385 | 41,861 | 119,916 | 15,370 | 177,147 | 0 | 47,156,965 |
| 2015 | 243,775 | 24,614,514 | 216,476 | 32,268,168 | 40,374 | 115,656 | 15,317 | 171,347 | 0 | 45,203,527 |
| 2016 | 438,500 | 44,298,522 | 389,777 | 58,094,826 | 73,332 | 210,067 | 28,720 | 312,119 | 0 | 81,445,618 |
| **2017** | **460,639** | **46,536,525** | **409,305** | **61,185,748** | **77,392** | **221,697** | **30,266** | **329,355** | **0** | **85,948,935** |
| 2018 | 468,095 | 47,289,738 | 415,930 | 62,176,065 | 78,645 | 225,285 | 30,756 | 334,686 | 0 | 87,340,052 |
| 2019 | 512,292 | 51,754,865 | 455,202 | 68,046,766 | 86,070 | 246,557 | 33,660 | 366,287 | 0 | 95,586,755 |
| 2020 | 495,057 | 50,013,628 | 439,887 | 65,757,407 | 83,175 | 238,262 | 32,527 | 353,964 | 0 | 92,370,844 |
| 2021 | 495,216 | 50,029,689 | 440,029 | 65,778,522 | 83,201 | 238,338 | 32,538 | 354,077 | 0 | 92,400,500 |
| 2022 | 478,566 | 48,347,582 | 425,234 | 63,566,909 | 80,404 | 230,325 | 31,444 | 342,173 | 0 | 89,293,803 |
| 2023 | 483,838 | 48,880,225 | 429,919 | 64,267,220 | 81,290 | 232,862 | 31,790 | 345,942 | 0 | 90,277,544 |
| 2024 | 472,162 | 47,700,612 | 419,544 | 62,716,280 | 79,328 | 227,243 | 31,023 | 337,594 | 0 | 88,098,907 |
| 2025 | 447,134 | 45,172,179 | 397,305 | 59,391,918 | 75,123 | 215,197 | 29,379 | 319,699 | 0 | 83,429,103 |
| 2026 | 423,536 | 42,788,138 | 376,337 | 56,257,408 | 71,158 | 203,840 | 27,828 | 302,826 | 0 | 79,025,991 |
| 2027 | 449,454 | 45,406,514 | 399,366 | 59,700,023 | 75,513 | 216,314 | 29,531 | 321,358 | 0 | 83,861,906 |
| 2028 | 381,741 | 38,565,743 | 339,199 | 50,705,845 | 64,136 | 183,725 | 25,082 | 272,943 | 0 | 71,227,588 |
| 2029 | 399,915 | 40,401,867 | 355,349 | 53,119,964 | 67,190 | 192,472 | 26,276 | 285,938 | 0 | 74,618,756 |
| 2030 | 289,388 | 29,235,680 | 257,138 | 38,438,774 | 48,620 | 139,277 | 19,014 | 206,911 | 0 | 53,995,771 |
| 2031 | 289,558 | 29,252,920 | 257,290 | 38,461,441 | 48,649 | 139,359 | 19,025 | 207,033 | 0 | 54,027,612 |
| 2032 | 289,599 | 29,257,000 | 257,326 | 38,466,807 | 48,655 | 139,378 | 19,028 | 207,061 | 0 | 54,035,148 |
| 2033 | 289,611 | 29,258,229 | 257,336 | 38,468,421 | 48,658 | 139,384 | 19,029 | 207,071 | 0 | 54,037,416 |
| 2034 | 289,593 | 29,256,438 | 257,321 | 38,466,067 | 48,655 | 139,376 | 19,028 | 207,059 | 0 | 54,034,112 |
| 2035 | 289,554 | 29,252,441 | 257,285 | 38,460,810 | 48,648 | 139,357 | 19,025 | 207,030 | 0 | 54,026,725 |
| **TOTAL** | **10,874,576** | **1,266,391,850** | **11,081,962** | **1,652,721,845** | **2,083,185** | **4,507,358** | **728,723** | **7,319,266** | **0** | **2,297,914,382** |

[a] 1988 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include bond cover.

## TABLE B-23 Total Transportation and Delta Water Charge for Each Contractor[a] (in dollars)



| Calendar Year | NORTH BAY AREA | | | SOUTH BAY AREA | | | | CENTRAL COASTAL AREA | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Napa | Solano | Total | Alameda-Zone 7 | Alameda County | Santa Clara | Total | San Luis | Santa Barbara | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 11,750 | 43,787 | 21,132 | 76,669 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 199,726 | 190,272 | 447,723 | 837,721 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 263,282 | 277,455 | 621,356 | 1,162,093 | 6,696 | 21,667 | 28,363 |
| 1965 | 0 | 0 | 0 | 373,816 | 404,324 | 1,158,090 | 1,936,230 | 13,756 | 36,029 | 49,785 |
| 1966 | 18,063 | 0 | 18,063 | 419,468 | 421,723 | 1,412,954 | 2,254,144 | 26,524 | 61,349 | 87,873 |
| 1967 | 41,574 | 0 | 41,574 | 553,115 | 548,491 | 1,863,198 | 2,964,805 | 56,469 | 118,263 | 174,731 |
| 1968 | 128,628 | 0 | 128,628 | 683,100 | 633,184 | 2,178,465 | 3,494,749 | 115,961 | 229,807 | 345,768 |
| 1969 | 254,715 | 0 | 254,715 | 817,914 | 583,436 | 2,298,736 | 3,700,087 | 185,156 | 358,861 | 544,017 |
| 1970 | 277,547 | 0 | 277,547 | 904,314 | 640,297 | 2,787,967 | 4,332,578 | 200,150 | 387,675 | 587,825 |
| 1971 | 227,474 | 0 | 227,474 | 845,923 | 675,193 | 2,807,017 | 4,328,133 | 202,413 | 392,912 | 595,325 |
| 1972 | 224,978 | 0 | 224,978 | 930,204 | 822,397 | 3,027,749 | 4,780,350 | 209,057 | 406,589 | 615,646 |
| 1973 | 221,091 | 31,366 | 252,457 | 916,776 | 716,492 | 3,120,787 | 4,754,054 | 206,557 | 402,724 | 609,281 |
| 1974 | 240,498 | 32,938 | 273,437 | 957,482 | 746,932 | 3,325,022 | 5,029,436 | 208,545 | 407,090 | 615,635 |
| 1975 | 237,459 | 36,291 | 273,750 | 1,016,081 | 793,055 | 3,214,046 | 5,023,182 | 225,895 | 439,873 | 665,768 |
| 1976 | 271,292 | 40,836 | 312,127 | 1,129,238 | 943,464 | 3,362,542 | 5,435,243 | 228,976 | 447,299 | 676,275 |
| 1977 | 293,627 | 45,096 | 338,723 | 1,097,991 | 922,203 | 3,303,461 | 5,323,655 | 238,699 | 468,721 | 707,420 |
| 1978 | 273,870 | 49,178 | 323,048 | 1,186,955 | 935,818 | 3,712,581 | 5,835,354 | 245,331 | 484,259 | 729,590 |
| 1979 | 289,479 | 53,340 | 342,819 | 1,283,690 | 1,009,566 | 3,819,533 | 6,112,790 | 243,110 | 483,437 | 726,547 |
| 1980 | 310,846 | 86,073 | 396,919 | 1,436,829 | 1,173,798 | 4,119,071 | 6,729,698 | 282,254 | 540,553 | 822,807 |
| 1981 | 347,781 | 112,848 | 460,629 | 1,545,547 | 1,349,125 | 4,507,566 | 7,402,238 | 307,065 | 596,671 | 903,736 |
| 1982 | 438,335 | 141,835 | 580,171 | 1,626,046 | 1,369,536 | 4,941,393 | 7,936,975 | 328,215 | 682,545 | 1,010,760 |
| 1983 | 354,787 | 163,294 | 518,081 | 1,496,527 | 1,260,138 | 4,910,241 | 7,666,906 | 357,218 | 702,083 | 1,059,301 |
| 1984 | 467,336 | 246,698 | 714,034 | 1,806,684 | 1,478,394 | 6,870,249 | 10,155,328 | 409,529 | 801,057 | 1,210,586 |
| 1985 | 736,074 | 386,306 | 1,122,380 | 2,304,697 | 2,225,097 | 7,796,485 | 12,326,279 | 500,696 | 969,931 | 1,470,626 |
| 1986 | 1,120,086 | 714,246 | 1,834,332 | 2,173,492 | 2,014,104 | 8,193,845 | 12,381,441 | 536,751 | 1,038,031 | 1,574,782 |
| 1987 | 1,773,801 | 1,582,227 | 3,356,028 | 2,670,186 | 2,505,662 | 7,980,255 | 13,156,103 | 570,644 | 1,148,974 | 1,719,618 |
| 1988 | 2,349,572 | 2,524,763 | 4,874,335 | 2,731,520 | 2,774,430 | 7,830,285 | 13,336,235 | 673,071 | 1,439,620 | 2,112,691 |
| 1989 | 2,548,764 | 3,701,385 | 6,250,149 | 2,715,601 | 2,515,471 | 7,578,850 | 12,809,922 | 772,570 | 1,814,759 | 2,587,329 |
| 1990 | 2,900,024 | 3,848,934 | 6,748,958 | 3,151,030 | 2,929,775 | 8,355,392 | 14,436,197 | 933,367 | 2,046,370 | 2,979,737 |
| 1991 | 2,941,321 | 4,170,227 | 7,111,548 | 2,422,962 | 2,384,246 | 6,430,834 | 11,238,042 | 979,709 | 2,366,841 | 3,346,550 |
| 1992 | 2,797,727 | 4,144,993 | 6,942,720 | 2,897,437 | 2,927,115 | 7,656,940 | 13,481,492 | 1,118,807 | 2,526,861 | 3,645,668 |
| 1993 | 2,855,497 | 4,172,491 | 7,027,988 | 3,754,213 | 2,977,354 | 8,849,995 | 15,581,562 | 1,185,665 | 2,726,057 | 3,911,722 |
| 1994 | 2,987,938 | 4,225,291 | 7,213,229 | 3,791,306 | 3,586,255 | 9,613,545 | 16,991,105 | 1,335,974 | 3,518,042 | 4,854,015 |
| 1995 | 2,961,322 | 4,405,219 | 7,366,541 | 4,039,946 | 3,313,350 | 8,393,828 | 15,747,124 | 1,647,817 | 6,195,415 | 7,843,231 |
| 1996 | 3,045,021 | 4,898,210 | 7,943,232 | 3,647,784 | 3,178,398 | 9,228,554 | 16,054,735 | 2,592,043 | 15,232,542 | 17,824,585 |
| 1997 | 3,028,005 | 4,734,808 | 7,762,813 | 3,874,294 | 3,145,550 | 9,338,016 | 16,357,860 | 3,002,832 | 23,737,164 | 26,739,996 |
| 1998 | 2,936,062 | 4,588,897 | 7,524,960 | 3,481,134 | 3,201,607 | 9,077,806 | 15,760,547 | 3,254,940 | 28,393,640 | 31,648,580 |
| 1999 | 3,162,567 | 5,081,250 | 8,243,818 | 4,200,667 | 3,688,287 | 11,423,226 | 19,312,181 | 3,809,439 | 29,668,071 | 33,477,511 |
| 2000 | 3,462,393 | 5,621,720 | 9,084,113 | 5,810,679 | 3,595,423 | 10,222,502 | 19,628,603 | 3,764,366 | 30,292,112 | 34,056,478 |
| 2001 | 4,083,124 | 6,375,658 | 10,458,782 | 9,849,531 | 4,095,655 | 11,662,554 | 25,607,740 | 4,322,431 | 32,454,418 | 36,776,849 |
| 2002 | 4,325,341 | 6,566,555 | 10,891,897 | 13,357,803 | 4,087,080 | 13,155,985 | 30,600,867 | 4,041,706 | 32,104,597 | 36,146,304 |
| 2003 | 4,445,478 | 6,913,490 | 11,358,968 | 10,001,233 | 3,807,433 | 11,948,771 | 25,757,437 | 4,120,206 | 32,395,480 | 36,515,686 |
| 2004 | 4,981,002 | 7,257,067 | 12,238,069 | 8,380,594 | 4,208,246 | 11,648,208 | 24,237,049 | 4,189,901 | 32,929,043 | 37,118,944 |
| 2005 | 4,329,397 | 6,733,881 | 11,063,278 | 8,420,088 | 4,334,313 | 12,350,092 | 25,104,492 | 4,295,058 | 32,946,124 | 37,241,183 |
| 2006 | 4,281,184 | 6,307,927 | 10,589,111 | 8,515,730 | 4,394,444 | 12,636,353 | 25,546,527 | 4,180,684 | 32,742,753 | 36,923,437 |
| 2007 | 4,402,583 | 6,659,496 | 11,062,079 | 9,388,344 | 4,819,443 | 13,630,624 | 27,838,410 | 4,257,986 | 33,472,140 | 37,730,126 |
| 2008 | 5,190,982 | 6,761,133 | 11,952,115 | 10,613,145 | 5,224,133 | 14,089,821 | 29,927,099 | 4,841,731 | 35,139,790 | 39,981,520 |
| 2009 | 5,724,028 | 6,980,689 | 12,704,717 | 9,651,817 | 4,890,567 | 14,172,542 | 28,714,926 | 4,730,738 | 33,739,067 | 38,469,805 |
| 2010 | 6,357,716 | 8,753,208 | 15,110,924 | 11,172,886 | 5,590,150 | 15,864,894 | 32,627,930 | 5,277,587 | 36,275,602 | 41,553,189 |
| 2011 | 6,856,426 | 9,358,703 | 16,215,129 | 12,759,138 | 6,415,986 | 18,015,763 | 37,190,887 | 5,457,499 | 37,490,985 | 42,948,485 |
| 2012 | 7,465,088 | 9,411,899 | 16,876,987 | 13,845,929 | 6,509,531 | 20,489,762 | 40,845,222 | 5,531,243 | 38,027,281 | 43,558,524 |
| 2013 | 7,213,262 | 9,303,785 | 16,517,046 | 14,889,377 | 7,362,147 | 20,724,521 | 42,976,044 | 5,833,515 | 39,650,975 | 45,484,490 |
| 2014 | 7,835,807 | 9,842,289 | 17,678,096 | 14,561,176 | 7,578,591 | 20,711,398 | 42,851,165 | 5,637,980 | 36,843,014 | 42,480,995 |
| 2015 | 8,377,393 | 10,513,858 | 18,891,252 | 15,643,663 | 7,911,743 | 24,127,116 | 47,682,521 | 6,603,685 | 39,570,591 | 46,174,276 |
| 2016 | 9,289,340 | 12,071,664 | 21,361,004 | 19,411,391 | 8,824,264 | 33,933,845 | 62,169,500 | 6,812,617 | 41,719,129 | 48,531,746 |
| **2017** | **9,989,021** | **12,564,343** | **22,553,364** | **19,581,950** | **9,159,774** | **30,183,991** | **58,925,716** | **7,884,472** | **42,164,631** | **50,049,103** |
| 2018 | 9,818,563 | 12,318,342 | 22,136,905 | 20,498,539 | 9,606,968 | 26,751,968 | 56,857,475 | 8,040,766 | 42,525,033 | 50,565,800 |
| 2019 | 9,714,466 | 12,395,674 | 22,110,140 | 20,160,085 | 9,436,431 | 30,293,154 | 59,889,670 | 8,553,558 | 43,833,242 | 52,386,800 |
| 2020 | 9,706,096 | 12,391,964 | 22,098,059 | 19,928,781 | 9,331,240 | 30,062,725 | 59,322,746 | 8,548,479 | 43,798,930 | 52,347,409 |
| 2021 | 9,718,515 | 12,428,040 | 22,146,555 | 20,082,742 | 9,416,520 | 30,306,017 | 59,805,280 | 8,568,241 | 43,880,381 | 52,448,622 |
| 2022 | 9,723,961 | 12,444,272 | 22,168,233 | 20,109,214 | 9,429,280 | 30,393,076 | 59,931,570 | 8,593,158 | 43,895,578 | 52,488,736 |
| 2023 | 9,755,590 | 12,464,549 | 22,220,139 | 20,093,157 | 9,419,409 | 30,421,144 | 59,933,710 | 8,582,583 | 43,938,632 | 52,521,215 |
| 2024 | 9,762,098 | 12,485,916 | 22,248,014 | 20,121,198 | 9,433,223 | 30,511,283 | 60,065,703 | 8,594,204 | 43,950,598 | 52,544,802 |
| 2025 | 9,740,147 | 12,478,230 | 22,218,377 | 20,078,036 | 9,416,868 | 30,518,250 | 60,013,153 | 8,591,106 | 43,871,645 | 52,462,751 |
| 2026 | 9,706,380 | 12,459,244 | 22,165,624 | 20,117,120 | 9,451,735 | 30,627,794 | 60,196,649 | 8,573,476 | 43,768,591 | 52,342,067 |
| 2027 | 9,783,435 | 12,561,678 | 22,345,114 | 20,257,306 | 9,509,488 | 30,843,996 | 60,610,790 | 8,624,988 | 44,032,988 | 52,657,976 |
| 2028 | 9,690,200 | 12,461,968 | 22,152,168 | 20,062,133 | 9,430,261 | 30,678,247 | 60,170,642 | 8,569,575 | 43,651,017 | 52,220,591 |
| 2029 | 9,750,310 | 12,546,645 | 22,296,955 | 20,211,072 | 9,496,708 | 30,909,553 | 60,617,333 | 8,618,265 | 43,875,191 | 52,493,456 |
| 2030 | 9,573,501 | 12,344,748 | 21,918,249 | 19,725,382 | 9,284,264 | 30,401,211 | 59,410,856 | 8,485,871 | 43,138,083 | 51,623,954 |
| 2031 | 9,588,265 | 12,373,385 | 21,961,650 | 19,990,464 | 9,424,224 | 30,784,308 | 60,198,996 | 8,563,020 | 43,329,947 | 51,892,967 |
| 2032 | 9,591,554 | 12,392,506 | 21,984,060 | 20,060,649 | 9,458,823 | 30,927,745 | 60,447,217 | 8,550,903 | 43,355,618 | 51,906,521 |
| 2033 | 9,606,172 | 12,407,084 | 22,013,256 | 19,931,009 | 9,386,256 | 30,823,828 | 60,141,093 | 8,554,516 | 43,412,205 | 51,966,720 |
| 2034 | 9,552,365 | 12,372,996 | 21,925,361 | 20,121,916 | 9,482,641 | 31,116,067 | 60,720,624 | 8,581,893 | 43,512,443 | 52,094,336 |
| 2035 | 9,430,409 | 12,274,466 | 21,704,875 | 20,735,021 | 9,816,010 | 31,933,712 | 62,484,743 | 8,758,553 | 43,921,304 | 52,679,857 |
| **TOTAL** | **325,884,755** | **425,818,111** | **751,702,866** | **647,497,024** | **334,345,051** | **1,053,451,552** | **2,035,293,627** | **272,948,460** | **1,556,940,940** | **1,829,889,400** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; capital charges for 2016 and after include both bond debt service and bond cover.

## TABLE B-23 Total Transportation and Delta Water Charge for Each Contractor[a] (in dollars)



| Calendar Year | SAN JOAQUIN VALLEY AREA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Kern | | | | | |
| | Dudley Ridge | Empire | Future Contractor San Joaquin Valley | Municipal and Industrial | Agricultural | Kings | Oak Flat | Tulare | Total |
| | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 2,725 | 0 | 0 | 0 | 0 | 0 | 2,725 |
| 1965 | 0 | 0 | 6,029 | 73,569 | 0 | 0 | 0 | 0 | 79,598 |
| 1966 | 0 | 0 | 12,039 | 137,330 | 0 | 0 | 0 | 0 | 149,368 |
| 1967 | 0 | 0 | 26,257 | 267,611 | 0 | 0 | 0 | 0 | 293,869 |
| 1968 | 228,019 | 19,515 | 54,588 | 445,439 | 1,722,430 | 16,947 | 19,856 | 309,816 | 2,816,609 |
| 1969 | 244,202 | 11,337 | 87,576 | 525,094 | 2,755,507 | 16,825 | 19,608 | 468,258 | 4,128,408 |
| 1970 | 309,618 | 34,773 | 94,675 | 573,998 | 3,911,103 | 21,435 | 30,638 | 528,276 | 5,504,515 |
| 1971 | 331,507 | 37,501 | 95,695 | 605,889 | 5,242,780 | 27,175 | 34,939 | 719,977 | 7,095,462 |
| 1972 | 385,631 | 40,762 | 98,788 | 631,615 | 7,232,220 | 26,473 | 64,308 | 2,007,984 | 10,487,781 |
| 1973 | 403,387 | 39,384 | 97,550 | 1,025,888 | 7,372,185 | 28,816 | 39,552 | 790,800 | 9,797,562 |
| 1974 | 514,194 | 40,598 | 98,460 | 1,144,792 | 8,092,056 | 29,544 | 42,883 | 1,056,984 | 11,019,512 |
| 1975 | 688,206 | 41,047 | 106,703 | 1,197,166 | 9,489,829 | 31,240 | 48,509 | 1,572,924 | 13,175,623 |
| 1976 | 725,754 | 43,568 | 108,084 | 1,323,840 | 10,742,359 | 32,666 | 52,487 | 1,453,907 | 14,482,665 |
| 1977 | 585,911 | 39,485 | 112,554 | 1,367,404 | 11,067,109 | 34,434 | 54,562 | 1,149,321 | 14,410,780 |
| 1978 | 704,887 | 36,029 | 115,521 | 1,565,884 | 13,413,619 | 38,927 | 59,396 | 1,184,142 | 17,118,405 |
| 1979 | 789,446 | 48,321 | 114,253 | 1,668,951 | 15,503,209 | 43,065 | 70,997 | 1,739,671 | 19,977,912 |
| 1980 | 970,906 | 50,056 | 125,950 | 1,770,264 | 17,156,517 | 48,021 | 95,468 | 1,686,002 | 21,903,184 |
| 1981 | 1,219,845 | 84,422 | 134,169 | 2,430,802 | 22,773,878 | 66,495 | 101,037 | 2,297,899 | 29,108,548 |
| 1982 | 1,255,961 | 70,616 | 135,057 | 2,523,660 | 25,183,422 | 70,662 | 108,703 | 2,293,419 | 31,641,500 |
| 1983 | 1,190,620 | 52,966 | 149,202 | 2,085,047 | 24,845,671 | 75,442 | 87,785 | 508,591 | 28,995,325 |
| 1984 | 1,500,561 | 28,948 | 164,505 | 3,396,379 | 33,586,947 | 94,320 | 121,870 | 1,553,353 | 40,446,884 |
| 1985 | 1,776,798 | 130,378 | 184,905 | 3,891,204 | 39,570,560 | 117,583 | 139,959 | 2,824,676 | 48,636,064 |
| 1986 | 2,019,071 | 79,755 | 180,445 | 4,079,838 | 43,664,880 | 136,715 | 153,634 | 3,672,655 | 53,986,993 |
| 1987 | 1,894,709 | 95,673 | 179,872 | 4,570,841 | 42,970,822 | 137,332 | 151,883 | 3,766,383 | 53,767,515 |
| 1988 | 1,980,121 | 110,051 | 193,735 | 4,734,502 | 44,920,649 | 138,278 | 147,060 | 3,921,692 | 56,146,087 |
| 1989 | 2,135,207 | 102,178 | 187,913 | 4,677,357 | 47,121,991 | 137,085 | 166,905 | 4,403,936 | 58,932,572 |
| 1990 | 1,889,345 | 87,382 | 221,392 | 4,827,893 | 45,908,261 | 121,154 | 149,217 | 3,983,611 | 57,188,253 |
| 1991 | 1,699,637 | 80,671 | 220,282 | 4,535,869 | 37,783,916 | 103,909 | 135,227 | 3,524,621 | 48,084,132 |
| 1992 | 2,246,203 | 105,490 | 241,455 | 5,550,167 | 48,981,012 | 143,783 | 176,210 | 4,563,451 | 62,007,772 |
| 1993 | 2,468,358 | 120,493 | 264,959 | 5,806,060 | 54,882,179 | 161,522 | 195,775 | 5,317,305 | 69,216,651 |
| 1994 | 2,273,181 | 107,998 | 306,359 | 5,210,309 | 52,352,719 | 145,625 | 178,587 | 4,690,005 | 65,264,782 |
| 1995 | 2,869,641 | 115,916 | 304,297 | 6,621,491 | 60,812,874 | 180,802 | 210,920 | 5,548,839 | 76,664,781 |
| 1996 | 2,061,349 | 125,605 | 389,203 | 6,671,115 | 58,884,744 | 178,474 | 190,532 | 7,114,605 | 75,615,627 |
| 1997 | 2,772,612 | 101,010 | 276,681 | 6,521,956 | 57,661,735 | 138,117 | 212,732 | 4,736,735 | 72,421,578 |
| 1998 | 2,618,293 | 120,302 | 381,847 | 5,733,156 | 54,236,872 | 143,433 | 204,342 | 4,990,035 | 68,428,279 |
| 1999 | 2,714,013 | 136,615 | 369,935 | 6,368,370 | 57,909,174 | 184,155 | 219,334 | 7,458,386 | 75,359,982 |
| 2000 | 2,604,873 | 121,144 | 302,623 | 6,100,811 | 51,583,178 | 174,245 | 213,836 | 6,196,213 | 67,296,924 |
| 2001 | 3,288,514 | 146,307 | 328,001 | 5,653,261 | 58,947,624 | 192,566 | 260,422 | 6,473,532 | 75,290,226 |
| 2002 | 2,996,103 | 128,084 | 320,541 | 6,168,329 | 53,743,582 | 187,350 | 239,241 | 5,803,419 | 69,586,647 |
| 2003 | 3,046,434 | 131,903 | 339,961 | 6,533,590 | 56,267,423 | 202,323 | 238,474 | 6,086,298 | 72,846,406 |
| 2004 | 3,233,973 | 168,542 | 342,484 | 7,857,965 | 56,857,873 | 356,506 | 254,053 | 5,842,404 | 74,913,800 |
| 2005 | 3,792,876 | 177,127 | 355,581 | 7,013,406 | 67,435,493 | 690,768 | 250,836 | 6,679,574 | 86,395,661 |
| 2006 | 3,621,519 | 168,080 | 294,916 | 7,498,469 | 64,578,195 | 536,780 | 256,013 | 5,911,805 | 82,865,777 |
| 2007 | 3,409,608 | 159,361 | 333,662 | 7,117,101 | 61,443,118 | 521,878 | 253,145 | 5,854,210 | 79,092,082 |
| 2008 | 3,383,365 | 157,050 | 468,712 | 7,765,494 | 62,397,863 | 547,718 | 261,658 | 5,547,684 | 80,529,544 |
| 2009 | 3,259,914 | 153,978 | 435,271 | 6,914,076 | 60,675,857 | 521,067 | 260,792 | 5,438,283 | 77,659,238 |
| 2010 | 3,652,440 | 236,835 | 507,438 | 8,085,567 | 72,645,817 | 654,000 | 328,990 | 6,532,649 | 92,643,737 |
| 2011 | 4,571,980 | 219,574 | 506,763 | 9,735,637 | 90,603,209 | 741,101 | 356,955 | 6,934,352 | 113,669,570 |
| 2012 | 3,746,650 | 231,605 | 467,287 | 9,806,040 | 83,577,591 | 766,744 | 366,589 | 7,898,918 | 106,861,425 |
| 2013 | 4,237,707 | 233,359 | 519,826 | 10,378,240 | 85,957,685 | 755,115 | 382,644 | 7,398,257 | 109,862,834 |
| 2014 | 4,041,710 | 211,259 | 635,140 | 9,522,303 | 79,712,982 | 685,186 | 372,673 | 6,524,871 | 101,706,125 |
| 2015 | 4,388,967 | 259,178 | 747,667 | 12,010,782 | 94,407,378 | 829,744 | 450,030 | 8,069,679 | 121,163,424 |
| 2016 | 5,421,529 | 334,354 | 688,733 | 15,511,442 | 113,572,029 | 1,119,595 | 578,893 | 10,402,718 | 147,629,292 |
| **2017** | **5,508,164** | **330,161** | **680,826** | **15,584,291** | **116,411,091** | **1,072,403** | **571,396** | **10,277,605** | **150,435,938** |
| 2018 | 5,563,146 | 333,627 | 717,852 | 15,692,122 | 117,767,716 | 1,077,244 | 575,176 | 10,372,984 | 152,099,867 |
| 2019 | 5,550,379 | 336,979 | 696,540 | 15,883,647 | 118,706,820 | 1,088,098 | 582,752 | 10,492,770 | 153,337,986 |
| 2020 | 5,068,941 | 329,752 | 704,830 | 15,530,952 | 116,711,630 | 1,065,958 | 567,533 | 10,273,455 | 150,253,051 |
| 2021 | 5,146,052 | 334,812 | 709,674 | 15,702,732 | 118,198,668 | 1,081,471 | 577,284 | 10,421,140 | 152,171,834 |
| 2022 | 5,137,931 | 334,525 | 715,066 | 15,679,078 | 118,144,184 | 1,080,452 | 575,877 | 10,404,495 | 152,071,607 |
| 2023 | 5,101,894 | 332,062 | 720,709 | 15,581,061 | 117,556,942 | 1,072,799 | 570,758 | 10,335,424 | 151,271,648 |
| 2024 | 5,093,741 | 331,696 | 726,318 | 15,548,353 | 117,407,970 | 1,071,591 | 569,897 | 10,318,966 | 151,068,532 |
| 2025 | 5,061,578 | 329,957 | 731,946 | 15,467,860 | 116,869,345 | 1,066,058 | 565,794 | 10,255,778 | 150,348,315 |
| 2026 | 5,092,819 | 332,366 | 737,931 | 15,527,084 | 117,363,731 | 1,073,362 | 570,865 | 10,314,268 | 151,012,426 |
| 2027 | 5,114,685 | 333,392 | 743,603 | 15,598,995 | 118,030,967 | 1,076,629 | 571,729 | 10,357,291 | 151,827,291 |
| 2028 | 5,035,559 | 329,224 | 747,547 | 15,373,950 | 116,378,888 | 1,063,294 | 563,686 | 10,201,850 | 149,693,998 |
| 2029 | 5,073,095 | 331,401 | 753,674 | 15,478,949 | 117,279,279 | 1,070,082 | 567,057 | 10,274,531 | 150,828,067 |
| 2030 | 4,871,061 | 319,811 | 759,891 | 14,923,643 | 113,160,752 | 1,033,558 | 544,945 | 9,881,176 | 145,494,837 |
| 2031 | 5,006,292 | 328,693 | 764,875 | 15,301,790 | 116,071,510 | 1,060,710 | 560,025 | 10,140,309 | 149,234,204 |
| 2032 | 5,013,825 | 329,177 | 771,502 | 15,259,868 | 115,911,657 | 1,062,208 | 562,967 | 10,154,516 | 149,065,719 |
| 2033 | 4,903,676 | 321,919 | 777,868 | 15,026,051 | 114,283,411 | 1,039,611 | 546,202 | 9,943,008 | 146,841,745 |
| 2034 | 4,986,016 | 327,324 | 784,021 | 15,180,313 | 115,599,928 | 1,056,216 | 558,227 | 10,100,684 | 148,592,728 |
| 2035 | 5,343,211 | 350,809 | 790,130 | 16,223,343 | 123,166,523 | 1,128,825 | 598,872 | 10,785,515 | 158,387,229 |
| **TOTAL** | **205,837,420** | **11,874,272** | **27,473,067** | **542,797,344** | **4,407,181,139** | **32,693,707** | **19,811,200** | **400,738,888** | **5,648,407,036** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; capital charges for 2016 and after include both bond debt service and bond cover.

## TABLE B-23 Total Transportation and Delta Water Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AVEK | Castaic Lake | Coachella | Crestline | Desert | Littlerock | Mojave | Palmdale | San Bernardino | San Gabriel |
| | [20] | [21] | [22] | [23] | [24] | [25] | [26] | [27] | [28] | [29] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 34,411 | 0 | 0 | 0 | 726 | 0 | 0 | 0 | 51,729 | 0 |
| 1964 | 64,494 | 27,447 | 19,542 | 4,370 | 38,211 | 1,143 | 30,324 | 8,205 | 82,811 | 34,987 |
| 1965 | 121,484 | 53,007 | 34,348 | 7,194 | 42,701 | 2,082 | 53,730 | 15,222 | 135,069 | 35,344 |
| 1966 | 221,012 | 101,264 | 62,476 | 12,478 | 76,886 | 3,753 | 96,944 | 27,679 | 232,502 | 61,465 |
| 1967 | 427,622 | 210,814 | 121,269 | 23,472 | 148,839 | 7,284 | 188,141 | 54,023 | 433,350 | 115,574 |
| 1968 | 754,401 | 491,952 | 218,649 | 41,509 | 265,168 | 12,870 | 336,227 | 95,466 | 782,163 | 208,927 |
| 1969 | 1,090,136 | 743,639 | 334,105 | 61,226 | 394,024 | 18,693 | 500,689 | 138,063 | 1,205,834 | 321,755 |
| 1970 | 1,420,639 | 943,948 | 470,423 | 89,700 | 552,223 | 25,231 | 692,219 | 184,837 | 1,778,187 | 467,573 |
| 1971 | 1,760,670 | 1,138,948 | 627,331 | 128,360 | 754,065 | 31,837 | 931,649 | 231,280 | 2,538,219 | 659,414 |
| 1972 | 2,245,455 | 1,385,123 | 819,635 | 185,868 | 1,035,804 | 43,771 | 1,262,890 | 287,620 | 3,758,473 | 950,297 |
| 1973 | 2,399,531 | 1,434,072 | 971,770 | 190,992 | 1,264,690 | 46,059 | 1,357,182 | 313,446 | 4,026,451 | 961,024 |
| 1974 | 2,520,870 | 1,530,035 | 998,399 | 204,074 | 1,305,235 | 48,933 | 1,417,682 | 331,702 | 4,463,660 | 1,104,491 |
| 1975 | 2,739,680 | 1,621,892 | 1,047,544 | 219,290 | 1,381,319 | 53,242 | 1,506,018 | 355,270 | 4,638,827 | 1,208,046 |
| 1976 | 3,204,880 | 1,658,980 | 1,106,524 | 232,129 | 1,474,438 | 57,732 | 1,583,468 | 381,276 | 4,838,364 | 1,278,740 |
| 1977 | 3,187,208 | 1,747,374 | 1,008,676 | 245,111 | 1,317,096 | 54,209 | 1,672,005 | 406,620 | 5,094,241 | 1,336,313 |
| 1978 | 3,635,572 | 1,881,113 | 1,208,919 | 255,468 | 1,618,071 | 56,805 | 1,720,358 | 420,026 | 5,091,935 | 1,374,033 |
| 1979 | 4,309,554 | 1,961,577 | 1,295,874 | 267,791 | 1,740,645 | 60,285 | 1,896,998 | 449,757 | 5,136,839 | 1,342,135 |
| 1980 | 4,994,298 | 2,100,630 | 1,406,781 | 295,350 | 1,941,392 | 67,604 | 2,070,343 | 499,051 | 5,647,604 | 1,485,141 |
| 1981 | 5,824,304 | 2,570,750 | 1,574,217 | 328,818 | 2,194,094 | 100,752 | 2,393,948 | 603,265 | 6,461,840 | 1,688,324 |
| 1982 | 5,582,860 | 2,734,499 | 1,657,630 | 346,721 | 2,336,914 | 82,296 | 2,367,841 | 641,991 | 6,752,799 | 1,929,664 |
| 1983 | 6,335,170 | 2,805,893 | 2,181,785 | 380,840 | 3,172,326 | 88,383 | 2,565,861 | 658,613 | 6,964,704 | 1,808,748 |
| 1984 | 7,713,111 | 3,885,129 | 3,287,286 | 497,586 | 4,929,764 | 96,492 | 2,833,666 | 727,821 | 8,053,209 | 2,598,232 |
| 1985 | 9,545,818 | 4,351,903 | 4,122,840 | 601,928 | 6,265,166 | 103,706 | 3,025,099 | 959,657 | 8,893,342 | 2,686,799 |
| 1986 | 9,515,134 | 4,988,028 | 4,584,188 | 647,634 | 7,009,695 | 130,222 | 3,209,761 | 1,223,847 | 9,142,822 | 3,398,540 |
| 1987 | 9,550,203 | 4,846,221 | 4,452,838 | 678,086 | 6,885,936 | 240,873 | 3,265,334 | 1,255,052 | 10,544,337 | 3,398,921 |
| 1988 | 9,149,230 | 5,033,633 | 4,510,360 | 704,411 | 7,052,631 | 158,845 | 3,440,436 | 1,044,206 | 11,095,193 | 3,271,137 |
| 1989 | 11,039,912 | 5,043,439 | 4,218,204 | 691,191 | 6,635,387 | 210,634 | 3,521,987 | 1,746,763 | 10,811,990 | 3,453,679 |
| 1990 | 12,432,751 | 5,511,963 | 4,916,384 | 729,229 | 7,720,886 | 331,172 | 3,755,769 | 1,953,905 | 11,722,946 | 4,221,266 |
| 1991 | 9,293,533 | 4,625,727 | 3,471,782 | 688,867 | 5,335,009 | 221,166 | 4,616,027 | 1,640,084 | 11,104,874 | 3,642,610 |
| 1992 | 11,850,715 | 5,814,416 | 3,626,099 | 612,895 | 5,587,383 | 174,998 | 5,594,646 | 1,532,325 | 11,144,101 | 3,694,099 |
| 1993 | 12,264,759 | 5,461,079 | 3,830,889 | 617,198 | 5,922,476 | 211,904 | 5,486,188 | 1,753,971 | 12,107,175 | 4,042,324 |
| 1994 | 14,334,329 | 6,027,538 | 3,857,907 | 694,421 | 5,963,596 | 278,012 | 6,437,888 | 2,090,724 | 12,731,704 | 4,776,753 |
| 1995 | 14,201,115 | 6,403,185 | 4,680,553 | 661,811 | 7,318,575 | 212,244 | 5,630,843 | 1,952,494 | 12,204,445 | 4,480,933 |
| 1996 | 14,628,006 | 6,634,329 | 7,634,303 | 710,651 | 12,187,480 | 208,356 | 5,729,211 | 2,300,206 | 12,730,931 | 4,599,073 |
| 1997 | 15,198,058 | 6,527,983 | 7,251,237 | 750,419 | 8,515,792 | 207,887 | 6,151,996 | 2,342,198 | 14,400,157 | 4,897,487 |
| 1998 | 13,714,014 | 6,150,789 | 6,324,675 | 717,140 | 7,018,227 | 209,057 | 7,755,016 | 1,946,444 | 14,309,132 | 4,177,167 |
| 1999 | 15,562,020 | 6,747,162 | 5,377,230 | 826,782 | 7,205,669 | 215,608 | 8,419,304 | 2,368,501 | 15,799,362 | 5,133,387 |
| 2000 | 14,851,382 | 10,267,971 | 3,835,085 | 793,396 | 5,637,117 | 186,737 | 8,312,197 | 2,080,500 | 15,532,480 | 4,260,296 |
| 2001 | 25,006,823 | 15,951,080 | 4,887,397 | 998,607 | 7,647,319 | 199,239 | 9,011,101 | 4,013,167 | 21,550,528 | 4,402,497 |
| 2002 | 16,403,017 | 13,159,934 | 4,133,269 | 961,220 | 6,403,125 | 182,303 | 8,174,316 | 3,394,966 | 22,465,648 | 5,804,376 |
| 2003 | 17,746,331 | 14,213,720 | 4,252,453 | 931,243 | 6,597,971 | 187,475 | 9,829,394 | 2,928,823 | 20,874,523 | 5,970,879 |
| 2004 | 18,938,097 | 15,496,733 | 4,936,882 | 1,044,019 | 6,725,191 | 201,538 | 10,112,647 | 3,217,994 | 25,437,952 | 5,474,692 |
| 2005 | 19,250,261 | 14,450,522 | 18,591,872 | 863,710 | 11,611,845 | 190,110 | 9,849,919 | 3,253,591 | 23,389,329 | 5,711,879 |
| 2006 | 20,919,185 | 13,740,301 | 31,699,572 | 853,624 | 11,699,401 | 201,719 | 12,673,094 | 3,206,590 | 23,301,247 | 5,776,465 |
| 2007 | 24,151,349 | 16,781,958 | 30,452,212 | 1,080,603 | 11,082,768 | 200,754 | 16,263,828 | 4,706,500 | 29,133,197 | 4,836,769 |
| 2008 | 22,045,982 | 19,071,721 | 30,124,260 | 1,028,019 | 12,121,906 | 216,290 | 14,853,679 | 4,683,989 | 29,813,737 | 5,904,347 |
| 2009 | 20,241,012 | 17,185,382 | 28,228,472 | 1,025,014 | 10,175,093 | 222,121 | 14,798,957 | 4,478,302 | 29,931,049 | 6,489,253 |
| 2010 | 23,976,967 | 17,578,910 | 38,362,205 | 974,943 | 13,636,625 | 227,352 | 17,980,626 | 3,984,053 | 33,085,098 | 8,218,081 |
| 2011 | 30,873,276 | 17,668,031 | 40,396,406 | 1,058,074 | 14,819,468 | 251,814 | 11,929,832 | 4,042,900 | 30,695,888 | 9,021,853 |
| 2012 | 31,529,929 | 19,569,735 | 47,276,351 | 1,170,082 | 17,359,678 | 266,958 | 13,687,758 | 5,505,261 | 44,547,694 | 9,389,164 |
| 2013 | 27,099,803 | 22,479,971 | 39,513,174 | 1,404,135 | 14,007,791 | 292,573 | 13,931,842 | 4,635,384 | 35,659,778 | 7,641,802 |
| 2014 | 22,516,543 | 21,071,348 | 34,810,089 | 1,492,081 | 11,879,835 | 295,070 | 13,912,057 | 4,711,648 | 35,758,686 | 6,559,904 |
| 2015 | 22,577,842 | 21,703,199 | 39,527,499 | 1,542,371 | 13,924,196 | 322,295 | 16,744,809 | 4,157,256 | 42,315,704 | 7,971,419 |
| 2016 | 36,536,738 | 23,296,041 | 49,040,486 | 1,755,302 | 17,749,761 | 363,837 | 18,393,027 | 5,585,470 | 48,982,745 | 9,844,818 |
| **2017** | **38,347,183** | **28,067,223** | **50,663,653** | **2,152,735** | **18,414,713** | **368,711** | **24,662,284** | **6,770,264** | **53,346,589** | **10,372,897** |
| 2018 | 39,272,233 | 28,493,869 | 53,416,478 | 2,117,450 | 18,853,559 | 366,744 | 25,252,890 | 6,983,451 | 53,754,077 | 10,496,929 |
| 2019 | 39,234,538 | 28,619,722 | 53,047,444 | 2,128,567 | 18,977,053 | 364,658 | 25,791,493 | 7,073,311 | 54,896,624 | 10,612,397 |
| 2020 | 39,411,080 | 28,738,260 | 53,517,916 | 2,128,160 | 19,068,226 | 359,312 | 26,418,122 | 7,138,313 | 54,931,653 | 10,610,181 |
| 2021 | 39,048,753 | 28,463,763 | 52,866,556 | 2,089,967 | 18,814,800 | 355,108 | 26,121,948 | 7,067,934 | 54,273,745 | 10,438,905 |
| 2022 | 39,267,175 | 28,532,272 | 52,484,523 | 2,090,281 | 18,805,219 | 352,427 | 26,198,372 | 7,130,118 | 54,242,746 | 10,439,020 |
| 2023 | 39,071,735 | 28,569,685 | 51,654,057 | 2,083,897 | 18,624,290 | 353,130 | 26,142,213 | 7,081,138 | 54,052,534 | 10,380,178 |
| 2024 | 38,837,042 | 28,329,836 | 51,400,487 | 2,070,699 | 18,527,466 | 353,041 | 25,965,134 | 7,029,119 | 53,865,953 | 10,325,502 |
| 2025 | 39,034,914 | 28,513,591 | 51,672,021 | 2,079,634 | 18,630,280 | 351,723 | 26,123,914 | 7,081,886 | 54,046,711 | 10,371,886 |
| 2026 | 38,445,400 | 28,118,624 | 50,969,857 | 2,050,612 | 18,343,172 | 350,703 | 25,750,680 | 6,954,669 | 53,504,574 | 10,214,862 |
| 2027 | 39,155,759 | 28,590,012 | 51,762,328 | 2,085,897 | 18,668,995 | 353,989 | 26,195,168 | 7,098,207 | 54,186,256 | 10,396,367 |
| 2028 | 38,566,553 | 28,193,080 | 51,211,503 | 2,057,583 | 18,420,541 | 349,261 | 25,851,805 | 6,991,817 | 53,660,719 | 10,247,224 |
| 2029 | 39,038,508 | 28,485,149 | 51,802,231 | 2,082,003 | 18,655,405 | 351,858 | 26,146,118 | 7,085,244 | 54,171,282 | 10,380,949 |
| 2030 | 37,986,339 | 27,703,822 | 50,829,179 | 2,031,425 | 18,222,582 | 343,361 | 25,540,188 | 6,895,177 | 53,242,922 | 10,122,165 |
| 2031 | 39,745,983 | 28,655,626 | 52,638,668 | 2,107,033 | 18,944,356 | 343,049 | 26,508,729 | 7,295,794 | 54,615,985 | 10,500,281 |
| 2032 | 37,551,435 | 27,357,161 | 50,539,473 | 2,014,720 | 18,087,992 | 344,523 | 25,297,498 | 6,791,705 | 53,089,392 | 10,063,284 |
| 2033 | 39,467,910 | 28,482,517 | 52,504,041 | 2,103,160 | 18,866,991 | 344,540 | 26,471,695 | 7,227,570 | 54,566,975 | 10,469,866 |
| 2034 | 37,617,310 | 27,481,583 | 50,846,797 | 2,023,917 | 18,187,169 | 344,137 | 25,444,270 | 6,812,495 | 53,346,000 | 10,119,101 |
| 2035 | 42,558,605 | 30,163,006 | 55,589,281 | 2,230,567 | 20,086,247 | 344,124 | 28,065,352 | 7,934,133 | 56,879,619 | 11,102,645 |
| **TOTAL** | **1,379,189,953** | **948,440,836** | **1,532,796,843** | **73,055,757** | **682,886,683** | **14,776,722** | **817,924,647** | **235,970,351** | **1,798,060,960** | **391,787,533** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; capital charges for 2016 and after include both bond debt service and bond cover.

## TABLE B-23 Total Transportation and Delta Water Charge for Each Contractor[a] (in dollars)



| Calendar Year | SOUTHERN CALIFORNIA AREA (continued) | | | | FEATHER RIVER AREA | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | San Gorgonio | Metropolitan | Ventura | Total | Yuba City | Butte | Plumas | Total | South Bay Area Future Contractor | Grand Total |
| | [30] | [31] | [32] | [33] | [34] | [35] | [36] | [37] | [38] | [39] |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,219 | 79,888 |
| 1963 | 0 | 690,812 | 0 | 777,678 | 0 | 0 | 0 | 0 | 12,626 | 1,628,026 |
| 1964 | 21,735 | 1,260,513 | 9,378 | 1,603,161 | 0 | 0 | 0 | 0 | 13,938 | 2,810,279 |
| 1965 | 21,866 | 2,180,589 | 17,766 | 2,720,401 | 0 | 0 | 405 | 405 | 28,937 | 4,815,355 |
| 1966 | 37,964 | 3,900,172 | 33,426 | 4,868,023 | 0 | 0 | 565 | 565 | 31,321 | 7,409,358 |
| 1967 | 71,283 | 7,693,703 | 68,155 | 9,563,529 | 0 | 0 | 562 | 562 | 47,718 | 13,086,788 |
| 1968 | 128,915 | 15,317,881 | 142,803 | 18,796,932 | 0 | 1,050 | 1,439 | 2,489 | 46,945 | 25,632,120 |
| 1969 | 198,764 | 23,153,064 | 215,209 | 28,375,202 | 0 | 1,225 | 4,120 | 5,345 | 52,963 | 37,060,736 |
| 1970 | 289,633 | 30,617,164 | 273,605 | 37,805,381 | 0 | 3,848 | 17,116 | 20,964 | 69,744 | 48,598,554 |
| 1971 | 409,327 | 39,958,997 | 342,425 | 49,512,523 | 0 | 4,546 | 19,187 | 23,733 | 55,532 | 61,838,182 |
| 1972 | 537,186 | 54,991,810 | 422,304 | 67,926,236 | 0 | 4,929 | 21,150 | 26,079 | 80,412 | 84,141,482 |
| 1973 | 587,963 | 59,591,118 | 435,655 | 73,579,952 | 0 | 7,059 | 21,778 | 28,837 | 54,219 | 89,076,363 |
| 1974 | 611,428 | 66,008,399 | 455,565 | 81,000,474 | 0 | 8,336 | 22,408 | 30,744 | 76,783 | 98,046,021 |
| 1975 | 644,621 | 71,830,070 | 478,403 | 87,724,223 | 0 | 9,416 | 23,523 | 32,939 | 84,547 | 106,980,031 |
| 1976 | 668,315 | 74,907,214 | 475,587 | 91,867,647 | 0 | 7,004 | 23,257 | 30,261 | 106,717 | 112,910,936 |
| 1977 | 696,515 | 73,338,457 | 507,063 | 90,610,888 | 0 | 16,917 | 24,059 | 40,976 | 98,618 | 111,531,059 |
| 1978 | 709,040 | 81,951,168 | 523,177 | 100,445,684 | 0 | 12,635 | 24,225 | 36,860 | 100,786 | 124,589,726 |
| 1979 | 712,866 | 83,601,786 | 526,405 | 103,302,511 | 0 | 16,575 | 28,352 | 44,927 | 119,352 | 130,626,858 |
| 1980 | 862,275 | 93,029,351 | 583,628 | 114,983,450 | 0 | 19,834 | 26,562 | 46,396 | 178,812 | 145,061,266 |
| 1981 | 946,961 | 112,171,493 | 672,540 | 137,531,304 | 0 | 21,682 | 34,563 | 56,245 | 185,347 | 175,648,047 |
| 1982 | 1,021,329 | 117,143,301 | 727,623 | 143,325,467 | 0 | 16,117 | 43,117 | 59,234 | 173,894 | 184,728,000 |
| 1983 | 1,076,279 | 118,991,007 | 854,263 | 147,883,872 | 0 | 15,202 | 29,410 | 44,612 | 220,926 | 186,389,022 |
| 1984 | 1,211,621 | 156,273,535 | 933,311 | 193,040,763 | 20,590 | 15,442 | 31,795 | 67,827 | 225,959 | 245,861,382 |
| 1985 | 1,287,789 | 194,967,204 | 993,651 | 237,804,900 | 24,050 | 16,976 | 32,405 | 73,431 | 340,322 | 301,774,001 |
| 1986 | 1,344,770 | 218,331,684 | 1,058,276 | 264,584,600 | 31,753 | 18,145 | 33,596 | 83,494 | 279,227 | 334,724,869 |
| 1987 | 1,379,613 | 204,859,482 | 1,056,318 | 252,413,213 | 37,071 | 17,794 | 33,384 | 88,249 | 345,116 | 324,845,842 |
| 1988 | 1,465,829 | 221,667,115 | 1,124,102 | 269,717,128 | 48,058 | 19,117 | 33,605 | 100,780 | 365,207 | 346,652,463 |
| 1989 | 1,505,481 | 230,328,278 | 1,232,379 | 280,439,324 | 61,184 | 20,809 | 37,188 | 119,181 | 422,329 | 361,560,805 |
| 1990 | 1,624,763 | 277,194,766 | 1,855,991 | 333,971,791 | 66,041 | 20,855 | 36,812 | 123,708 | 474,284 | 415,922,928 |
| 1991 | 1,720,878 | 221,887,061 | 1,549,955 | 269,797,573 | 180,212 | 22,526 | 42,200 | 244,938 | 214,683 | 340,037,465 |
| 1992 | 1,779,902 | 245,365,618 | 1,503,480 | 298,280,678 | 208,216 | 26,028 | 43,517 | 277,761 | 443,676 | 385,079,766 |
| 1993 | 1,943,336 | 219,238,180 | 1,551,253 | 274,430,733 | 209,613 | 26,203 | 47,588 | 283,404 | 599,571 | 371,051,632 |
| 1994 | 1,920,217 | 257,365,883 | 1,475,069 | 317,954,041 | 201,284 | 25,161 | 46,079 | 272,524 | 609,966 | 413,159,663 |
| 1995 | 1,982,808 | 225,863,369 | 1,568,401 | 287,160,773 | 216,945 | 27,118 | 50,022 | 294,085 | 534,971 | 395,611,506 |
| 1996 | 1,651,239 | 235,410,311 | 1,622,641 | 306,046,738 | 217,250 | 27,155 | 56,622 | 301,027 | 571,857 | 424,357,801 |
| 1997 | 1,758,607 | 245,453,567 | 1,777,266 | 315,232,652 | 236,300 | 29,847 | 59,915 | 326,062 | 428,638 | 439,269,599 |
| 1998 | 1,947,195 | 227,090,227 | 1,796,534 | 293,155,617 | 128,021 | 29,927 | 36,222 | 194,170 | 465,095 | 417,177,248 |
| 1999 | 2,267,918 | 256,513,586 | 1,879,946 | 328,316,476 | 254,675 | 31,834 | 40,585 | 327,094 | 584,116 | 465,621,176 |
| 2000 | 2,541,030 | 253,213,554 | 1,968,482 | 323,480,228 | 262,163 | 79,001 | 43,704 | 384,868 | 0 | 453,931,214 |
| 2001 | 3,485,204 | 444,601,904 | 2,265,770 | 544,020,637 | 261,699 | 93,471 | 45,056 | 400,226 | 0 | 692,554,459 |
| 2002 | 4,834,560 | 333,573,398 | 2,305,102 | 421,795,235 | 266,107 | 95,018 | 47,297 | 408,422 | 0 | 569,429,371 |
| 2003 | 6,118,812 | 361,639,827 | 2,321,875 | 453,613,325 | 262,547 | 93,638 | 68,989 | 425,174 | 0 | 600,516,996 |
| 2004 | 6,478,454 | 413,356,068 | 2,609,178 | 514,029,445 | 284,387 | 102,404 | 29,286 | 416,077 | 0 | 662,953,384 |
| 2005 | 6,758,865 | 384,539,517 | 2,082,380 | 500,543,799 | 280,033 | 727,066 | 28,810 | 1,035,909 | 0 | 661,384,322 |
| 2006 | 7,265,909 | 359,673,112 | 2,045,215 | 493,055,432 | 292,991 | 43,185 | 38,617 | 374,793 | 0 | 649,355,078 |
| 2007 | 7,901,530 | 438,644,454 | 2,532,011 | 587,767,933 | 291,100 | 40,957 | 46,072 | 378,129 | 0 | 743,868,759 |
| 2008 | 9,655,721 | 411,702,229 | 2,994,368 | 564,216,249 | 306,916 | 804,536 | 86,523 | 1,197,975 | 0 | 727,804,502 |
| 2009 | 9,836,623 | 382,590,766 | 2,870,301 | 528,072,343 | 328,896 | 855,850 | 90,625 | 1,275,371 | 0 | 686,896,400 |
| 2010 | 11,041,822 | 442,780,430 | 3,045,875 | 614,892,987 | 400,358 | 1,064,565 | 108,873 | 1,573,796 | 0 | 798,402,562 |
| 2011 | 11,886,479 | 493,296,264 | 3,129,128 | 669,069,413 | 451,483 | 1,197,315 | 121,981 | 1,770,779 | 0 | 880,864,262 |
| 2012 | 13,005,456 | 485,050,753 | 3,416,940 | 691,775,758 | 460,139 | 1,318,107 | 130,851 | 1,909,097 | 0 | 901,827,012 |
| 2013 | 13,636,298 | 478,234,488 | 3,415,973 | 661,953,015 | 483,119 | 1,383,934 | 141,269 | 2,008,322 | 0 | 878,801,751 |
| 2014 | 16,146,289 | 426,506,668 | 2,935,125 | 598,595,342 | 473,134 | 1,355,332 | 140,896 | 1,969,362 | 0 | 805,281,085 |
| 2015 | 18,304,096 | 474,474,338 | 3,345,784 | 666,910,810 | 614,794 | 1,761,128 | 185,769 | 2,561,691 | 0 | 903,383,974 |
| 2016 | 21,304,581 | 574,490,636 | 4,148,140 | 811,491,582 | 759,927 | 2,176,874 | 236,228 | 3,173,029 | 0 | 1,094,356,153 |
| **2017** | **23,675,472** | **602,151,989** | **4,274,944** | **863,268,657** | **781,362** | **2,238,278** | **230,414** | **3,250,054** | **0** | **1,148,482,830** |
| 2018 | 23,894,368 | 591,558,692 | 4,218,206 | 858,678,945 | 782,615 | 2,241,866 | 230,902 | 3,255,383 | 0 | 1,143,594,374 |
| 2019 | 24,173,490 | 598,814,761 | 4,227,337 | 867,961,396 | 790,040 | 2,263,138 | 231,180 | 3,284,358 | 0 | 1,158,970,351 |
| 2020 | 24,283,704 | 598,489,191 | 4,206,304 | 869,300,421 | 787,145 | 2,254,843 | 218,119 | 3,260,107 | 0 | 1,156,581,793 |
| 2021 | 24,175,296 | 591,213,919 | 4,154,967 | 859,085,660 | 787,171 | 2,254,919 | 217,304 | 3,259,394 | 0 | 1,148,917,345 |
| 2022 | 24,207,593 | 589,870,944 | 4,129,081 | 857,749,771 | 784,374 | 2,246,906 | 214,827 | 3,246,107 | 0 | 1,147,656,023 |
| 2023 | 24,183,951 | 588,315,467 | 4,141,369 | 854,653,644 | 785,260 | 2,249,443 | 215,173 | 3,249,876 | 0 | 1,143,850,232 |
| 2024 | 24,174,387 | 583,658,517 | 4,119,440 | 848,656,622 | 783,298 | 2,243,824 | 214,406 | 3,241,528 | 0 | 1,137,825,202 |
| 2025 | 24,228,270 | 586,070,881 | 4,118,736 | 852,324,448 | 779,093 | 2,231,778 | 212,761 | 3,223,632 | 0 | 1,140,590,676 |
| 2026 | 24,129,189 | 578,288,469 | 4,087,297 | 841,208,108 | 775,128 | 2,220,421 | 211,209 | 3,206,758 | 0 | 1,130,131,632 |
| 2027 | 24,267,208 | 587,775,048 | 4,138,257 | 854,673,492 | 779,483 | 2,232,895 | 212,912 | 3,225,290 | 0 | 1,145,339,953 |
| 2028 | 24,201,251 | 578,954,001 | 4,076,780 | 842,782,118 | 768,106 | 2,200,306 | 208,462 | 3,176,874 | 0 | 1,130,196,392 |
| 2029 | 24,306,112 | 585,356,573 | 4,109,038 | 851,970,471 | 771,160 | 2,209,053 | 209,656 | 3,189,869 | 0 | 1,141,396,151 |
| 2030 | 24,173,970 | 568,427,585 | 3,989,878 | 829,508,591 | 752,590 | 2,155,858 | 202,393 | 3,110,841 | 0 | 1,111,067,329 |
| 2031 | 24,421,637 | 587,076,607 | 4,032,805 | 856,886,552 | 752,619 | 2,155,940 | 202,404 | 3,110,963 | 0 | 1,143,285,332 |
| 2032 | 24,157,968 | 563,426,802 | 3,956,123 | 822,678,075 | 752,625 | 2,155,959 | 202,407 | 3,110,991 | 0 | 1,109,192,582 |
| 2033 | 24,449,792 | 583,611,068 | 4,023,281 | 852,589,405 | 752,628 | 2,155,965 | 202,409 | 3,111,002 | 0 | 1,136,663,221 |
| 2034 | 24,241,508 | 565,714,128 | 3,964,912 | 826,143,325 | 752,625 | 2,155,957 | 202,408 | 3,110,990 | 0 | 1,112,587,363 |
| 2035 | 24,845,929 | 618,214,600 | 4,138,377 | 902,152,485 | 752,618 | 2,155,938 | 202,405 | 3,110,961 | 0 | 1,200,520,150 |
| **TOTAL** | **667,439,055** | **23,075,495,582** | **156,282,334** | **31,774,107,255** | **23,290,996** | **55,756,980** | **6,659,927** | **85,707,903** | **8,748,370** | **42,133,856,457** |

[a] Capital charges repaid through bond debt service prior to 2015 exclude bond cover; capital charges for 2016 and after include both bond debt service and bond cover.

**TABLE B-24 Equivalent Unit Charge for Water Supply for Each Contractor[a] (in dollars per acre-foot)**

| Project Service Area and Water Supply Contractor | Transportation Charge | | | | | Delta Water Charge | Water System Revenue Bond Surcharge | Total Equivalent Unit Charge |
|---|---|---|---|---|---|---|---|---|
| | Capital Cost Component | Minimum OMP&R Component | Off-Aqueduct Component | Variable OMP&R Component | Total | | | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| FEATHER RIVER AREA | | | | | | | | |
| Yuba City | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 143.05 | 14.13 | 157.19 |
| Butte | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 648.89 | 53.76 | 702.65 |
| Plumas | 38.63 | 4.25 | 0.00 | 0.00 | 42.88 | 76.71 | 10.23 | 129.82 |
| Feather River Area | 9.14 | 1.01 | 0.00 | 0.00 | 10.15 | 241.67 | 22.16 | 273.98 |
| NORTH BAY AREA | | | | | | | | |
| Napa | 176.99 | 81.24 | 4.83 | 16.10 | 279.16 | 44.32 | 17.27 | 340.75 |
| Solano | 104.84 | 71.09 | 5.30 | 9.19 | 190.42 | 50.34 | 13.73 | 254.48 |
| North Bay Area | 131.70 | 74.87 | 5.12 | 11.76 | 223.45 | 48.10 | 15.05 | 286.59 |
| SOUTH BAY AREA | | | | | | | | |
| Alameda-Zone 7 | 51.47 | 63.24 | 9.11 | 21.74 | 145.56 | 46.21 | 10.14 | 201.91 |
| Alameda County | 30.64 | 36.94 | 7.44 | 12.59 | 87.61 | 31.85 | 5.14 | 124.60 |
| Santa Clara | 25.00 | 29.81 | 6.60 | 11.28 | 72.69 | 20.73 | 3.50 | 96.92 |
| South Bay Area | 30.29 | 36.49 | 7.15 | 13.22 | 87.16 | 26.75 | 4.86 | 118.77 |
| SAN JOAQUIN VALLEY AREA | | | | | | | | |
| Kings | 6.41 | 9.77 | 3.80 | 8.35 | 28.33 | 37.75 | 4.08 | 70.16 |
| Dudley Ridge | 5.55 | 6.04 | 3.34 | 4.91 | 19.85 | 21.02 | 2.28 | 43.15 |
| Empire | 2.34 | 5.68 | 2.54 | 4.62 | 15.18 | 23.82 | 1.88 | 40.89 |
| Kern | 10.15 | 11.88 | 5.10 | 6.92 | 34.05 | 26.40 | 3.01 | 63.46 |
| Oak Flat | 2.28 | 3.24 | 2.04 | 3.13 | 10.68 | 22.52 | 1.90 | 35.10 |
| Tulare | 5.75 | 6.18 | 3.26 | 4.80 | 20.00 | 22.11 | 2.35 | 44.46 |
| San Joaquin Valley Area | 9.37 | 10.92 | 4.79 | 6.57 | 31.66 | 25.70 | 2.90 | 60.25 |
| CENTRAL COASTAL AREA | | | | | | | | |
| San Luis Obispo | 420.93 | 278.36 | 13.49 | 125.80 | 838.58 | 208.55 | 51.41 | 1,098.54 |
| Santa Barbara | 1,157.58 | 282.60 | 21.01 | 103.68 | 1,564.87 | 108.89 | 83.20 | 1,756.95 |
| Central Coastal Area | 994.91 | 281.66 | 19.35 | 108.56 | 1,404.49 | 130.89 | 76.18 | 1,611.56 |
| SOUTHERN CALIFORNIA AREA | | | | | | | | |
| AVEK | 58.07 | 59.18 | 33.14 | 68.91 | 219.29 | 56.27 | 10.19 | 285.75 |
| Castaic Lake | 62.35 | 65.94 | 25.86 | 46.35 | 200.50 | 49.59 | 13.13 | 263.22 |
| Coachella | 82.48 | 102.72 | 44.23 | 78.02 | 307.47 | 54.06 | 12.43 | 373.95 |
| Crestline | 161.81 | 157.16 | 34.80 | 83.20 | 436.97 | 82.65 | 21.27 | 540.88 |
| Desert | 53.64 | 58.60 | 52.95 | 44.50 | 209.69 | 33.78 | 7.68 | 251.15 |
| Littlerock | 132.81 | 134.85 | 41.08 | 24.18 | 332.91 | 124.78 | 22.35 | 480.04 |
| Mojave | 194.59 | 229.86 | 34.07 | 141.67 | 600.19 | 160.19 | 36.19 | 796.57 |
| Palmdale | 60.35 | 64.96 | 39.58 | 104.87 | 269.76 | 65.78 | 10.86 | 346.40 |
| San Bernardino | 299.74 | 221.43 | 31.41 | 79.80 | 632.39 | 96.72 | 26.56 | 755.67 |
| San Gabriel | 124.91 | 123.44 | 48.37 | 49.97 | 346.69 | 60.70 | 15.92 | 423.31 |
| San Gorgonio | 1,797.80 | 648.83 | 36.49 | 245.46 | 2,728.58 | 166.70 | 46.31 | 2,941.59 |
| Metropolitan | 92.08 | 80.66 | 39.75 | 43.05 | 255.54 | 50.07 | 12.27 | 317.88 |
| Ventura | 527.45 | 466.48 | 39.01 | 101.02 | 1,133.96 | 318.72 | 77.72 | 1,530.39 |
| Southern California Area | 97.26 | 85.56 | 39.30 | 48.17 | 270.30 | 52.86 | 12.79 | 335.95 |
| ALL AREAS | 56.09 | 48.40 | 20.61 | 26.34 | 151.45 | 38.92 | 7.97 | 198.33 |

[a] Hypothetical charges, which, if assessed on all Table A water delivered to date, all surplus water delivered prior to May 1, 1973, and all Table A water estimated to be delivered during the remainder of the project repayment period (Table B-5B), would provide a sum at the end of the period financially equivalent to all Transportation Charge and Delta Water Charge payments required under a water supply contract, considering interest at the Project Interest Rate, 4.610 percent per annum.

## TABLE B-25 Equivalent Unit Transportation Costs of Water Delivered from or through Each Aqueduct Reach[a] (in dollars per acre-foot)

| Aqueduct Reach | Unit Cost of Reach[b] | | | | | | Cumulative Unit Costs from the Delta | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Capital Costs | Water System Revenue Bond Surcharge[c] | Minimum OMP&R | Off-Aqueduct Costs | Variable OMP&R | Total | Capital Costs | Water System Revenue Bond Surcharge[c] | Minimum OMP&R | Off-Aqueduct Costs | Variable OMP&R | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] |
| **NBA** | | | | | | | | | | | | |
| 1 | 45.48 | 16.25 | 17.65 | 2.49 | 1.43 | 83.30 | 45.48 | 16.25 | 17.65 | 2.49 | 1.43 | 83.30 |
| 2 | 48.41 | 17.30 | 7.71 | 0.00 | 0.00 | 73.42 | 93.89 | 33.55 | 25.36 | 2.49 | 1.43 | 156.72 |
| 3A | 8.63 | 3.08 | 15.34 | 5.35 | 2.32 | 34.72 | 102.52 | 36.63 | 40.70 | 7.84 | 3.75 | 191.44 |
| 3B | 55.50 | 19.83 | 34.68 | 3.78 | 5.15 | 118.94 | 149.39 | 53.38 | 60.04 | 6.27 | 6.58 | 275.66 |
| **SBA** | | | | | | | | | | | | |
| 1 | 7.95 | 2.84 | 20.69 | 5.62 | 5.37 | 42.47 | 10.17 | 3.63 | 24.76 | 8.35 | 7.88 | 54.79 |
| 2 | 0.75 | 0.27 | 2.34 | 0.00 | 0.00 | 3.36 | 10.92 | 3.90 | 27.10 | 8.35 | 7.88 | 58.15 |
| 4 | 2.50 | 0.89 | 3.99 | 0.00 | 0.00 | 7.38 | 13.42 | 4.79 | 31.09 | 8.35 | 7.88 | 65.53 |
| 5 | 5.25 | 1.88 | 3.13 | 0.00 | 0.00 | 10.26 | 18.67 | 6.67 | 34.22 | 8.35 | 7.88 | 75.79 |
| 6 | 0.30 | 0.11 | 0.33 | 0.00 | 0.00 | 0.74 | 18.97 | 6.78 | 34.55 | 8.35 | 7.88 | 76.53 |
| 7 | 2.33 | 0.83 | 0.60 | 0.00 | 0.00 | 3.76 | 21.30 | 7.61 | 35.15 | 8.35 | 7.88 | 80.29 |
| 8 | 3.16 | 1.13 | 1.00 | 0.00 | 0.00 | 5.29 | 24.46 | 8.74 | 36.15 | 8.35 | 7.88 | 85.58 |
| 9 | 6.52 | 2.33 | 3.76 | 0.00 | 0.00 | 12.61 | 30.98 | 11.07 | 39.91 | 8.35 | 7.88 | 98.19 |
| **CA** | | | | | | | | | | | | |
| 1 | 2.22 | 0.79 | 4.07 | 2.73 | 2.51 | 12.32 | 2.22 | 0.79 | 4.07 | 2.73 | 2.51 | 12.32 |
| 2A | 1.41 | 0.50 | 0.80 | 0.00 | 0.00 | 2.71 | 3.63 | 1.29 | 4.87 | 2.73 | 2.51 | 15.03 |
| 2B | 0.72 | 0.26 | 0.40 | 0.00 | 0.00 | 1.38 | 4.35 | 1.55 | 5.27 | 2.73 | 2.51 | 16.41 |
| 3 | 0.63 | 0.23 | 0.30 | 0.00 | 0.00 | 1.16 | 4.98 | 1.78 | 5.57 | 2.73 | 2.51 | 17.57 |
| 4 | 1.01 | 0.36 | 2.02 | 1.30 | 1.13 | 5.82 | 5.99 | 2.14 | 7.59 | 4.03 | 3.64 | 23.39 |
| 5 | 0.77 | 0.28 | 0.40 | 0.00 | 0.00 | 1.45 | 6.76 | 2.42 | 7.99 | 4.03 | 3.64 | 24.84 |
| 6 | 0.20 | 0.07 | 0.20 | 0.00 | 0.00 | 0.47 | 6.96 | 2.49 | 8.19 | 4.03 | 3.64 | 25.31 |
| 7 | 1.16 | 0.41 | 0.49 | 0.00 | 0.00 | 2.06 | 8.12 | 2.90 | 8.68 | 4.03 | 3.64 | 27.37 |
| 8C | 0.02 | 0.01 | 0.09 | 0.00 | 0.00 | 0.12 | 8.14 | 2.91 | 8.77 | 4.03 | 3.64 | 27.49 |
| 8D | 0.44 | 0.16 | 0.39 | 0.00 | 0.00 | 0.99 | 8.58 | 3.07 | 9.16 | 4.03 | 3.64 | 28.48 |
| 9 | 0.37 | 0.13 | 0.36 | 0.00 | 0.00 | 0.86 | 8.95 | 3.20 | 9.52 | 4.03 | 3.64 | 29.34 |
| 10A | 0.40 | 0.14 | 0.47 | 0.00 | 0.00 | 1.01 | 9.35 | 3.34 | 9.99 | 4.03 | 3.64 | 30.35 |
| 11B | 0.58 | 0.21 | 0.30 | 0.00 | 0.00 | 1.09 | 9.93 | 3.55 | 10.29 | 4.03 | 3.64 | 31.44 |
| 12D | 0.55 | 0.20 | 0.27 | 0.00 | 0.00 | 1.02 | 10.48 | 3.75 | 10.56 | 4.03 | 3.64 | 32.46 |
| 12E | 0.39 | 0.14 | 0.46 | 0.00 | 0.00 | 0.99 | 10.87 | 3.89 | 11.02 | 4.03 | 3.64 | 33.45 |
| 13B | 0.83 | 0.30 | 0.53 | 0.00 | 0.00 | 1.66 | 11.70 | 4.19 | 11.55 | 4.03 | 3.64 | 35.11 |
| 14A | 3.20 | 1.14 | 4.09 | 2.32 | 2.14 | 12.89 | 14.90 | 5.33 | 15.64 | 6.35 | 5.78 | 48.00 |
| 14B | 0.50 | 0.18 | 0.50 | 0.00 | 0.00 | 1.18 | 15.40 | 5.51 | 16.14 | 6.35 | 5.78 | 49.18 |
| 14C | 0.42 | 0.15 | 0.37 | 0.00 | 0.00 | 0.94 | 15.82 | 5.66 | 16.51 | 6.35 | 5.78 | 50.12 |
| 15A | 2.37 | 0.85 | 4.26 | 2.83 | 2.32 | 12.63 | 18.19 | 6.51 | 20.77 | 9.18 | 8.10 | 62.75 |
| 16A | 3.93 | 1.40 | 6.59 | 6.14 | 5.42 | 23.48 | 22.12 | 7.91 | 27.36 | 15.32 | 13.52 | 86.23 |
| 17E | 13.26 | 4.74 | 18.52 | 21.49 | 20.00 | 78.01 | 35.38 | 12.65 | 45.88 | 36.81 | 33.52 | 164.24 |
| 17F | 3.44 | 1.23 | 0.23 | 0.00 | 0.00 | 4.90 | 38.82 | 13.88 | 46.11 | 36.81 | 33.52 | 169.14 |
| 18A | 3.09 | 1.10 | 2.22 | 0.00 | -2.10 | 4.31 | 41.91 | 14.98 | 48.33 | 36.81 | 31.42 | 173.45 |
| 19 | 2.28 | 0.81 | 1.35 | 0.00 | 0.00 | 4.44 | 44.19 | 15.79 | 49.68 | 36.81 | 31.42 | 177.89 |
| 19C | 2.48 | 0.89 | 0.00 | 0.00 | 0.00 | 3.37 | 46.67 | 16.68 | 49.68 | 36.81 | 31.42 | 181.26 |
| 20A | 1.81 | 0.65 | 2.22 | 0.00 | 0.00 | 4.68 | 48.48 | 17.33 | 51.90 | 36.81 | 31.42 | 185.94 |
| 20B | 2.20 | 0.79 | 1.46 | 0.00 | 0.00 | 4.45 | 50.68 | 18.12 | 53.36 | 0.00 | 31.42 | 153.58 |
| 21 | 1.11 | 0.40 | 1.02 | 0.00 | 0.00 | 2.53 | 51.79 | 18.52 | 54.38 | 0.00 | 31.42 | 156.11 |
| 22A | 1.16 | 0.41 | 0.53 | 0.00 | 0.00 | 2.10 | 52.95 | 18.93 | 54.91 | 0.00 | 31.42 | 158.21 |
| 22B | 11.36 | 4.06 | 14.34 | 6.67 | 6.59 | 43.02 | 64.31 | 22.99 | 69.25 | 6.67 | 38.01 | 201.23 |
| 23 | 3.12 | 1.12 | 0.99 | 0.00 | -2.68 | 2.55 | 67.43 | 24.11 | 70.24 | 6.67 | 35.33 | 203.78 |
| 24 | 6.06 | 2.17 | 2.78 | 0.00 | 0.00 | 11.01 | 73.49 | 26.28 | 73.02 | 6.67 | 35.33 | 214.79 |
| 25 | 4.42 | 1.58 | 0.16 | 0.00 | 0.00 | 6.16 | 77.91 | 27.86 | 73.18 | 6.67 | 35.33 | 220.95 |
| 26A | 4.83 | 1.73 | 9.29 | 0.00 | -18.28 | (2.43) | 82.74 | 29.59 | 82.47 | 6.67 | 17.05 | 218.52 |
| 28G | 8.99 | 3.21 | 3.51 | 0.00 | 0.00 | 15.71 | 91.73 | 32.80 | 85.98 | 6.67 | 17.05 | 234.23 |
| 28H | 8.65 | 3.09 | 3.68 | 0.00 | 0.00 | 15.42 | 100.38 | 35.89 | 89.66 | 6.67 | 17.05 | 249.65 |
| 28J | 97.04 | 34.68 | 51.22 | 0.00 | 0.00 | 182.94 | 197.42 | 70.57 | 140.88 | 6.67 | 17.05 | 432.59 |
| **EBX** | | | | | | | | | | | | |
| 1 | N/A | 0.00 | 0.18 | 0.00 | 0.00 | 0.18 | N/A | 29.59 | 82.65 | 6.67 | 17.05 | 135.96 |
| 2A | N/A | 0.00 | 1.46 | 0.00 | 0.00 | 1.46 | N/A | 29.59 | 84.12 | 6.67 | 17.05 | 137.43 |
| 2B | N/A | 0.00 | 65.87 | 7.80 | 30.51 | 104.19 | N/A | 29.59 | 149.99 | 14.47 | 47.56 | 241.62 |
| 2C | N/A | 0.00 | 4.02 | 0.00 | 0.00 | 4.02 | N/A | 29.59 | 154.01 | 14.47 | 47.56 | 245.63 |
| 2D | N/A | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | N/A | 29.59 | 154.01 | 14.47 | 47.56 | 245.63 |
| 2E | N/A | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | N/A | 29.59 | 154.01 | 14.47 | 47.56 | 245.63 |
| 3A | N/A | 0.00 | 142.50 | 9.35 | 41.01 | 192.86 | N/A | 29.59 | 296.51 | 23.82 | 88.57 | 438.49 |
| 3B | N/A | 0.00 | 6.32 | 0.00 | 0.00 | 6.32 | N/A | 29.59 | 302.82 | 23.82 | 88.57 | 444.81 |
| 4A | N/A | 0.00 | 5.22 | 0.00 | 0.00 | 5.22 | N/A | 29.59 | 308.04 | 23.82 | 88.57 | 450.03 |
| 4B | N/A | 0.00 | 70.38 | 1.21 | 10.12 | 81.71 | N/A | 29.59 | 378.43 | 25.03 | 98.69 | 531.74 |
| **WB** | | | | | | | | | | | | |
| 29A | 4.50 | 1.61 | 10.64 | 2.75 | 2.35 | 21.85 | 43.32 | 15.49 | 56.75 | 39.56 | 35.87 | 190.99 |
| 29F | 3.28 | 1.17 | 1.28 | 0.00 | 0.00 | 5.73 | 46.60 | 16.66 | 58.03 | 39.56 | 35.87 | 196.72 |
| 29G | 10.91 | 3.90 | 6.05 | 0.00 | -8.45 | 12.41 | 57.51 | 20.56 | 64.08 | 39.56 | 27.42 | 209.13 |
| 29H | 6.79 | 2.43 | 5.73 | 0.00 | 0.00 | 14.95 | 64.30 | 22.99 | 69.81 | 39.56 | 27.42 | 224.08 |
| 29J | 11.39 | 4.07 | 1.65 | 0.00 | -15.81 | 1.30 | 75.69 | 27.06 | 71.46 | 39.56 | 11.61 | 225.38 |
| 30 | 18.27 | 6.53 | 5.15 | 0.00 | 0.00 | 29.95 | 93.96 | 33.59 | 76.61 | 39.56 | 11.61 | 255.33 |
| **CB** | | | | | | | | | | | | |
| 31A | 8.26 | 2.95 | 24.28 | 2.11 | 2.02 | 39.62 | 16.84 | 6.02 | 33.44 | 6.14 | 5.66 | 68.10 |
| 33A | 308.82 | 110.36 | 45.80 | 14.62 | 26.41 | 506.01 | 325.66 | 116.38 | 79.24 | 20.76 | 32.07 | 574.11 |
| 34 | 220.64 | 78.85 | 1.28 | 0.00 | 0.00 | 300.77 | 546.30 | 195.23 | 80.52 | 20.76 | 32.07 | 874.88 |
| 35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 546.30 | 195.23 | 80.52 | 20.76 | 32.07 | 874.88 |

[a] Representative of transportation unit costs only; does not include a unit cost of conservation. The Delta Water Rate should be added to these values in order to approximate unit costs at canalside. Includes surplus water prior to May 1, 1973.

[b] Hypothetical charges which, if assessed on all Table A water delivered to date, all surplus water delivered prior to May 1, 1973, and all Table A water estimated to be delivered during the remainder of the project repayment period (Table B-5B), would provide a sum at the end of the period financially equivalent to all Transportation Charges required under the water supply contract considering interest rate at the Project Interest Rate of 4.610 percent per annum.

[c] The Water System Revenue Bond (WSRB) Surcharge equivalent unit rate is calculated by multiplying Column 1 by the ratio of the 2017 WSRB surcharge to the sum of the Transportation Capital and the Capital component of the Delta Water Charge.

**TABLE B-26 Capital Costs of Each Aqueduct Reach to be Reimbursed through the Capital Cost Component of the East Branch Enlargement Transportation Charge Phase 1 and Phase 2 (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT<br>MOJAVE DIVISION<br>Reach 18A | Reach 19 | Reach 20A | Reach 20B | Reach 21 | Reach 22A | Reach 22B | Reach 23B |
|---|---|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1952 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1953 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1954 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1956 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1957 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1958 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1959 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 117,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 200,000 | 0 | 0 | 0 | 0 | 0 | 0 | 74,000 |
| 1981 | 135,000 | 0 | 0 | 0 | 0 | 0 | 0 | 385,000 |
| 1982 | 1,503,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1,586,000 |
| 1983 | 2,260,000 | 0 | 0 | 0 | 0 | 0 | 0 | 2,965,000 |
| 1984 | 735,000 | 0 | 0 | 0 | 0 | 0 | 796,000 | 1,380,000 |
| 1985 | 93,000 | 435,000 | 75,000 | 544,000 | 859,000 | 703,000 | 970,000 | 146,000 |
| 1986 | 784,000 | 4,477,000 | 3,144,000 | 2,234,000 | 1,569,000 | 1,203,000 | 1,808,000 | 34,000 |
| 1987 | 11,000 | 951,000 | 1,076,000 | 666,000 | 399,000 | 47,000 | 16,421,000 | 43,000 |
| 1988 | 1,000 | 125,000 | 1,681,000 | 1,730,000 | 2,024,000 | 40,000 | 13,326,000 | 70,000 |
| 1989 | 0 | 206,000 | 2,089,000 | 2,174,000 | 2,510,000 | 61,000 | 11,242,000 | 229,000 |
| 1990 | 1,000 | 577,000 | 903,000 | 735,000 | 928,000 | 194,000 | 20,131,000 | 887,000 |
| 1991 | 1,000 | 280,000 | 413,000 | 333,000 | 422,000 | 93,000 | 20,702,000 | 1,215,000 |
| 1992 | 0 | 40,000 | 41,000 | 39,000 | 35,000 | 13,000 | 9,599,000 | 3,719,000 |
| 1993 | 0 | 19,000 | 16,000 | 19,000 | 12,000 | 6,000 | 2,319,000 | 19,654,000 |
| 1994 | 0 | 2,000 | 3,000 | 2,000 | 4,000 | 3,000 | 803,000 | 3,173,000 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 223,000 | 1,465,000 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 6,014,000 | 478,000 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 404,000 | 1,327,000 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 4,366 | 0 | 22,095 | 37,971 | 0 | 67,871 | 0 |
| 2007 | 0 | 34,564 | 0 | 174,915 | 300,601 | 0 | 537,312 | 0 |
| 2008 | 0 | 67,077 | 0 | 339,450 | 583,367 | 0 | 1,042,743 | 0 |
| 2009 | 0 | 90,089 | 0 | 455,906 | 783,502 | 0 | 1,400,476 | 0 |
| 2010 | 0 | 21,120 | 0 | 106,881 | 183,682 | 0 | 328,324 | 0 |
| 2011 | 0 | 16,403 | 0 | 83,011 | 142,660 | 0 | 254,998 | 0 |
| 2012 | 0 | 26,143 | 0 | 132,299 | 227,364 | 0 | 406,404 | 0 |
| 2013 | 0 | 690 | 0 | 3,492 | 6,002 | 0 | 10,728 | 0 |
| 2014 | 0 | 4,290 | 0 | 21,708 | 37,307 | 0 | 66,685 | 0 |
| 2015 | 0 | 3,519 | 0 | 17,808 | 30,604 | 0 | 54,704 | 0 |
| 2016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **5,841,000** | **7,380,261** | **9,441,000** | **9,833,565** | **11,095,061** | **2,363,000** | **108,928,245** | **38,830,000** |

**TABLE B-26 Capital Costs of Each Aqueduct Reach to be Reimbursed through the Capital Cost Component of the East Branch Enlargement Transportation Charge Phase 1 and Phase 2 (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | SANTA ANA DIVISION | | | | |
| | Reach 23C | Reach 24 | Total | Reach 25 | Reach 26A | Reach 26B | Total | |
| | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] |
| 1952 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1953 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1954 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1955 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1956 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1957 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1958 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1959 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1965 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1966 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1967 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1968 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1969 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 117,000 | 0 | 0 | 0 | 0 | 117,000 |
| 1980 | 0 | 0 | 274,000 | 0 | 0 | 0 | 0 | 274,000 |
| 1981 | 0 | 0 | 520,000 | 0 | 0 | 0 | 0 | 520,000 |
| 1982 | 0 | 0 | 3,089,000 | 0 | 0 | 0 | 0 | 3,089,000 |
| 1983 | 0 | 0 | 5,225,000 | 0 | 0 | 0 | 0 | 5,225,000 |
| 1984 | 0 | 0 | 2,911,000 | 0 | 0 | 0 | 0 | 2,911,000 |
| 1985 | 0 | 0 | 3,825,000 | 0 | 528,000 | 89,000 | 617,000 | 4,442,000 |
| 1986 | 25,000 | 0 | 15,278,000 | 0 | 1,926,000 | 154,000 | 2,080,000 | 17,358,000 |
| 1987 | 178,000 | 0 | 19,792,000 | 0 | 3,699,000 | 437,000 | 4,136,000 | 23,928,000 |
| 1988 | 632,000 | 0 | 19,629,000 | 0 | 5,667,000 | 3,329,000 | 8,996,000 | 28,625,000 |
| 1989 | 1,130,000 | 0 | 19,641,000 | 0 | 40,879,000 | 1,650,000 | 42,529,000 | 62,170,000 |
| 1990 | 2,066,000 | 0 | 26,422,000 | 0 | 29,853,000 | 1,650,000 | 31,503,000 | 57,925,000 |
| 1991 | 4,980,000 | 0 | 28,439,000 | 0 | 26,027,000 | 999,000 | 27,026,000 | 55,465,000 |
| 1992 | 11,920,000 | 0 | 25,406,000 | 0 | 15,317,000 | 299,000 | 15,616,000 | 41,022,000 |
| 1993 | 16,303,000 | 0 | 38,348,000 | 0 | 4,878,000 | 0 | 4,878,000 | 43,226,000 |
| 1994 | 7,081,000 | 0 | 11,071,000 | 0 | 3,151,000 | 0 | 3,151,000 | 14,222,000 |
| 1995 | 5,350,000 | 0 | 7,038,000 | 0 | 2,137,000 | 0 | 2,137,000 | 9,175,000 |
| 1996 | 1,706,000 | 0 | 8,198,000 | 0 | 9,181,000 | 0 | 9,181,000 | 17,379,000 |
| 1997 | 1,905,000 | 0 | 3,636,000 | 0 | 175,000 | 0 | 175,000 | 3,811,000 |
| 1998 | 28,000 | 0 | 28,000 | 0 | 0 | 0 | 0 | 28,000 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 132,302 | 0 | 0 | 0 | 0 | 132,302 |
| 2007 | 0 | 0 | 1,047,392 | 0 | 0 | 0 | 0 | 1,047,392 |
| 2008 | 0 | 0 | 2,032,638 | 0 | 0 | 0 | 0 | 2,032,638 |
| 2009 | 0 | 0 | 2,729,973 | 0 | 0 | 0 | 0 | 2,729,973 |
| 2010 | 0 | 0 | 640,008 | 0 | 0 | 0 | 0 | 640,008 |
| 2011 | 0 | 0 | 497,072 | 0 | 0 | 0 | 0 | 497,072 |
| 2012 | 0 | 0 | 792,210 | 0 | 0 | 0 | 0 | 792,210 |
| 2013 | 0 | 0 | 20,913 | 0 | 0 | 0 | 0 | 20,913 |
| 2014 | 0 | 0 | 129,990 | 0 | 0 | 0 | 0 | 129,990 |
| 2015 | 0 | 0 | 106,635 | 0 | 0 | 0 | 0 | 106,635 |
| 2016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **53,304,000** | **0** | **247,016,132** | **0** | **143,418,000** | **8,607,000** | **152,025,000** | **399,041,132** |

**TABLE B-27 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of the East Branch Enlargement Transportation Charge Phase 1 and Phase 2 (in dollars)**

Sheet 1 of 2

| Calendar Year | CALIFORNIA AQUEDUCT MOJAVE DIVISION | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Reach 18A | Reach 19 | Reach 20A | Reach 20B | Reach 21 | Reach 22A | Reach 22B | Reach 23B |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 1,048,625 | 0 |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 953,814 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 1,171,411 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 1,110,038 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 1,213,002 | 0 |
| 1999 | 1,229 | 517 | 646 | 409 | 383 | 169 | 668,466 | 0 |
| 2000 | 4,452 | 1,875 | 2,340 | 1,484 | 1,386 | 614 | 1,315,186 | 0 |
| 2001 | 347 | 146 | 183 | 116 | 108 | 48 | 1,028,420 | 0 |
| 2002 | 1,639 | 690 | 861 | 546 | 510 | 226 | 1,533,612 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 1,817,744 | 0 |
| 2004 | 2,132 | 27,868 | 18,579 | 18,731 | 10,355 | 8,528 | 1,476,962 | 0 |
| 2005 | 1,243 | 16,250 | 10,833 | 10,922 | 6,038 | 4,973 | 1,028,465 | 0 |
| 2006 | 3,279 | 42,860 | 28,573 | 28,807 | 15,926 | 13,116 | 1,463,487 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 1,408,475 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 2,053,641 | 0 |
| 2009 | (4) | (46) | (31) | (31) | (17) | (14) | 1,718,899 | 0 |
| 2010 | (1) | (8) | (5) | (5) | (3) | (2) | 1,798,266 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 1,900,038 | 0 |
| 2012 | 4 | 54 | 36 | 36 | 20 | 17 | 1,909,193 | 0 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 2,014,115 | 0 |
| 2014 | 231 | 3,023 | 2,015 | 2,032 | 1,123 | 925 | 2,508,755 | 0 |
| 2015 | (697) | (9,108) | (6,072) | (6,122) | (3,385) | (2,787) | 2,693,324 | 0 |
| 2016 | 0 | 0 | 0 | 0 | 0 | 0 | 2,666,145 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **3,136,517** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 2,883,358 | 0 |
| **TOTAL** | **13,855** | **84,122** | **57,959** | **56,926** | **32,445** | **25,812** | **91,537,043** | **0** |

**TABLE B-27 Minimum OMP&R Costs of Each Aqueduct Reach to be Reimbursed through Minimum OMP&R Component of the East Branch Enlargement Transportation Charge Phase 1 and Phase 2 (in dollars)**



| Calendar Year | CALIFORNIA AQUEDUCT (continued) | | | | | | | GRAND TOTAL |
|---|---|---|---|---|---|---|---|---|
| | MOJAVE DIVISION (continued) | | | SANTA ANA DIVISION | | | | |
| | Reach 23C | Reach 24 | Subtotal | Reach 25 | Reach 26A[a] | Reach 26B | Subtotal | |
| | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 1,048,625 | 0 | 1,713,260 | 0 | 1,713,260 | 2,761,885 |
| 1995 | 0 | 0 | 953,814 | 0 | 1,452,549 | 0 | 1,452,549 | 2,406,363 |
| 1996 | 0 | 0 | 1,171,411 | 0 | 1,350,581 | 0 | 1,350,581 | 2,521,992 |
| 1997 | 679,826 | 0 | 1,789,864 | 0 | 1,528,509 | 0 | 1,528,509 | 3,318,373 |
| 1998 | 825,038 | 0 | 2,038,040 | 0 | 1,619,068 | 0 | 1,619,068 | 3,657,108 |
| 1999 | 382,178 | 0 | 1,053,997 | 0 | 956,229 | 0 | 956,229 | 2,010,227 |
| 2000 | 735,389 | 0 | 2,062,727 | 0 | 1,408,811 | 0 | 1,408,811 | 3,471,538 |
| 2001 | 812,038 | 0 | 1,841,406 | 0 | 789,894 | 0 | 789,894 | 2,631,301 |
| 2002 | 727,219 | 0 | 2,265,303 | 0 | 1,132,447 | 0 | 1,132,447 | 3,397,751 |
| 2003 | 899,528 | 0 | 2,717,272 | 0 | 1,235,686 | 0 | 1,235,686 | 3,952,958 |
| 2004 | 913,368 | 0 | 2,476,523 | 0 | 1,808,950 | 0 | 1,808,950 | 4,285,473 |
| 2005 | 1,036,431 | 0 | 2,115,156 | 0 | 1,850,269 | 0 | 1,850,269 | 3,965,425 |
| 2006 | 835,977 | 0 | 2,432,025 | 0 | 1,758,916 | 0 | 1,758,916 | 4,190,941 |
| 2007 | 1,305,526 | 0 | 2,714,001 | 0 | 2,794,987 | 0 | 2,794,987 | 5,508,988 |
| 2008 | 1,056,104 | 0 | 3,109,745 | 0 | 2,701,841 | 0 | 2,701,841 | 5,811,585 |
| 2009 | 1,531,068 | 0 | 3,249,824 | 0 | 2,834,596 | 0 | 2,834,596 | 6,084,420 |
| 2010 | 1,435,460 | 0 | 3,233,702 | 0 | 2,409,559 | 0 | 2,409,559 | 5,643,261 |
| 2011 | 1,818,536 | 0 | 3,718,574 | 0 | 2,106,592 | 0 | 2,106,592 | 5,825,166 |
| 2012 | 1,256,975 | 0 | 3,166,335 | 0 | 2,334,826 | 0 | 2,334,826 | 5,501,161 |
| 2013 | 1,525,748 | 0 | 3,539,862 | 0 | 2,789,110 | 0 | 2,789,110 | 6,328,972 |
| 2014 | 1,896,137 | 0 | 4,414,241 | 0 | 3,283,738 | 0 | 3,283,738 | 7,697,979 |
| 2015 | 1,968,399 | 0 | 4,633,551 | 0 | 4,447,708 | 0 | 4,447,708 | 9,081,260 |
| 2016 | 2,158,924 | 0 | 4,825,069 | 0 | 3,922,002 | 0 | 3,922,002 | 8,747,071 |
| **2017** | **2,243,028** | **0** | **5,379,545** | **0** | **4,497,056** | **0** | **4,497,056** | **9,876,601** |
| 2018 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2019 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2020 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2021 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2022 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2023 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2024 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2025 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2026 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2027 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2028 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2029 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2030 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2031 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2032 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2033 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2034 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| 2035 | 2,238,620 | 0 | 5,121,978 | 0 | 4,681,660 | 0 | 4,681,660 | 9,803,638 |
| **TOTAL** | **66,338,056** | **0** | **158,146,217** | **0** | **136,997,065** | **0** | **136,997,065** | **295,143,283** |

[a] Units 3 and 4 at Devil Canyon Powerplant were operational in 1993.

**TABLE B-28 Capital Costs of East Branch Enlargement Transportation Facilities Allocated to Each Contractor Phase 1 and Phase 2 (in dollars)**

| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino | Metropolitan | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 11,731 | 1,010 | 10,566 | 466 | 0 | 93,227 | 117,000 |
| 1980 | 0 | 28,241 | 4,708 | 27,495 | 797 | 0 | 212,759 | 274,000 |
| 1981 | 0 | 56,134 | 16,676 | 61,271 | 538 | 0 | 385,381 | 520,000 |
| 1982 | 0 | 326,180 | 76,872 | 337,913 | 5,988 | 0 | 2,342,047 | 3,089,000 |
| 1983 | 0 | 554,658 | 138,964 | 582,070 | 9,004 | 0 | 3,940,304 | 5,225,000 |
| 1984 | 0 | 306,514 | 68,842 | 314,468 | 2,928 | 0 | 2,218,248 | 2,911,000 |
| 1985 | 49,675 | 447,266 | 65,773 | 347,262 | 4,514 | 21,614 | 3,505,896 | 4,442,000 |
| 1986 | 185,353 | 1,757,633 | 236,324 | 1,363,586 | 41,900 | 78,842 | 13,694,362 | 17,358,000 |
| 1987 | 49,735 | 2,455,279 | 378,535 | 1,774,447 | 10,615 | 151,421 | 19,107,968 | 23,928,000 |
| 1988 | 124,534 | 2,689,959 | 500,466 | 1,712,431 | 13,783 | 231,982 | 23,351,845 | 28,625,000 |
| 1989 | 155,446 | 7,118,094 | 2,423,000 | 1,671,088 | 17,419 | 1,673,409 | 49,111,544 | 62,170,000 |
| 1990 | 62,786 | 6,459,229 | 1,943,918 | 2,234,452 | 8,680 | 1,222,053 | 45,993,882 | 57,925,000 |
| 1991 | 28,686 | 6,265,822 | 1,875,066 | 2,168,712 | 4,024 | 1,065,433 | 44,057,257 | 55,465,000 |
| 1992 | 2,911 | 4,826,764 | 1,610,921 | 1,359,335 | 471 | 627,012 | 32,594,586 | 41,022,000 |
| 1993 | 1,205 | 5,094,237 | 1,828,410 | 2,722,156 | 212 | 199,684 | 33,380,096 | 43,226,000 |
| 1994 | 273 | 1,726,376 | 631,816 | 478,543 | 27 | 128,988 | 11,255,977 | 14,222,000 |
| 1995 | 0 | 1,130,963 | 423,243 | 206,978 | 0 | 87,480 | 7,326,336 | 9,175,000 |
| 1996 | 0 | 2,025,987 | 645,296 | 606,205 | 0 | 375,830 | 13,725,682 | 17,379,000 |
| 1997 | 0 | 451,011 | 154,366 | 205,796 | 0 | 7,164 | 2,992,663 | 3,811,000 |
| 1998 | 0 | 3,551 | 1,293 | 0 | 0 | 0 | 23,156 | 28,000 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 1,368 | 13,170 | 1,134 | 11,862 | 103 | 0 | 104,665 | 132,302 |
| 2007 | 10,827 | 104,265 | 8,976 | 93,908 | 819 | 0 | 828,597 | 1,047,392 |
| 2008 | 21,011 | 202,344 | 17,420 | 182,243 | 1,589 | 0 | 1,608,031 | 2,032,638 |
| 2009 | 28,220 | 271,762 | 23,397 | 244,765 | 2,134 | 0 | 2,159,695 | 2,729,973 |
| 2010 | 6,616 | 63,711 | 5,485 | 57,382 | 500 | 0 | 506,314 | 640,008 |
| 2011 | 5,138 | 49,482 | 4,260 | 44,567 | 389 | 0 | 393,236 | 497,072 |
| 2012 | 8,189 | 78,862 | 6,789 | 71,028 | 619 | 0 | 626,723 | 792,210 |
| 2013 | 216 | 2,082 | 179 | 1,875 | 16 | 0 | 16,545 | 20,913 |
| 2014 | 1,344 | 12,940 | 1,114 | 11,655 | 102 | 0 | 102,835 | 129,990 |
| 2015 | 1,102 | 10,615 | 914 | 9,561 | 83 | 0 | 84,360 | 106,635 |
| 2016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2017** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| 2018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **744,635** | **44,544,862** | **13,095,167** | **18,913,620** | **127,720** | **5,870,912** | **315,744,217** | **399,041,133** |

**TABLE B-29 Capital Cost Component of East Branch Enlargement Facilities Transportation Charge for Each Contractor[a] [b] (in dollars)**

| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino[c] | Metropolitan | Total |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 18,266 | 1,209,293 | 360,156 | 502,810 | 3,356 | 0 | 8,552,529 | 10,646,410 |
| 1989 | 19,176 | 1,269,524 | 378,094 | 527,854 | 3,523 | 0 | 8,978,504 | 11,176,675 |
| 1990 | 19,186 | 1,270,244 | 378,308 | 528,153 | 3,525 | 0 | 8,983,597 | 11,183,013 |
| 1991 | 19,187 | 1,270,261 | 378,314 | 528,160 | 3,525 | 0 | 8,983,717 | 11,183,164 |
| 1992 | 38,420 | 2,543,616 | 757,549 | 1,057,606 | 7,059 | 0 | 17,989,315 | 22,393,565 |
| 1993 | 40,029 | 2,650,139 | 789,274 | 1,101,897 | 7,354 | 0 | 18,742,682 | 23,331,375 |
| 1994 | 39,705 | 2,628,706 | 782,890 | 1,092,986 | 7,295 | 0 | 18,591,099 | 23,142,681 |
| 1995 | 39,632 | 2,623,828 | 781,438 | 1,090,958 | 7,281 | 0 | 18,556,603 | 23,099,740 |
| 1996 | 39,825 | 2,636,667 | 785,261 | 1,096,296 | 7,317 | 0 | 18,647,406 | 23,212,772 |
| 1997 | 41,743 | 2,763,629 | 823,074 | 1,149,085 | 7,669 | 0 | 19,545,322 | 24,330,522 |
| 1998 | 42,642 | 2,823,126 | 840,793 | 1,173,823 | 7,834 | 0 | 19,966,108 | 24,854,326 |
| 1999 | 44,738 | 2,961,887 | 882,120 | 1,231,519 | 8,219 | 0 | 20,947,475 | 26,075,958 |
| 2000 | 49,031 | 3,246,109 | 966,768 | 1,349,695 | 9,008 | 0 | 22,957,586 | 28,578,197 |
| 2001 | 49,048 | 3,247,263 | 967,111 | 1,350,175 | 9,011 | 0 | 22,965,748 | 28,588,356 |
| 2002 | 47,894 | 3,170,848 | 944,353 | 1,318,402 | 8,799 | 0 | 22,425,318 | 27,915,614 |
| 2003 | 40,765 | 2,698,871 | 803,787 | 1,122,160 | 7,489 | 0 | 19,087,337 | 23,760,409 |
| 2004 | 44,199 | 2,926,222 | 871,498 | 1,216,690 | 8,120 | 0 | 20,695,237 | 25,761,966 |
| 2005 | 33,144 | 2,194,299 | 653,514 | 912,364 | 6,089 | 0 | 15,518,826 | 19,318,236 |
| 2006 | 46,979 | 3,110,276 | 926,313 | 1,293,217 | 8,631 | 0 | 21,996,926 | 27,382,342 |
| 2007 | 45,289 | 2,998,370 | 892,985 | 1,246,688 | 8,321 | 0 | 21,205,488 | 26,397,141 |
| 2008 | 42,491 | 2,813,118 | 837,813 | 1,169,662 | 7,806 | 0 | 19,895,328 | 24,766,218 |
| 2009 | 43,670 | 2,891,182 | 861,062 | 1,202,121 | 8,023 | 0 | 20,447,424 | 25,453,482 |
| 2010 | 44,839 | 2,968,619 | 884,125 | 1,234,318 | 8,238 | 0 | 20,995,084 | 26,135,223 |
| 2011 | 43,190 | 2,859,419 | 851,602 | 1,188,914 | 7,935 | 0 | 20,222,785 | 25,173,845 |
| 2012 | 43,704 | 2,893,449 | 861,737 | 1,203,063 | 8,029 | 0 | 20,463,459 | 25,473,441 |
| 2013 | 37,663 | 2,493,469 | 742,614 | 1,036,756 | 6,919 | 0 | 17,634,660 | 21,952,081 |
| 2014 | 39,838 | 2,637,482 | 785,504 | 1,096,635 | 7,319 | 0 | 18,653,166 | 23,219,944 |
| 2015 | 44,619 | 2,954,015 | 879,775 | 1,228,246 | 8,197 | 0 | 20,891,796 | 26,006,648 |
| 2016 | 64,929 | 4,224,099 | 1,261,425 | 1,741,435 | 11,665 | 0 | 29,840,781 | 37,144,334 |
| **2017** | **67,986** | **4,387,080** | **1,309,263** | **1,809,965** | **12,137** | **0** | **30,994,029** | **38,580,460** |
| 2018 | 66,053 | 4,276,637 | 1,277,292 | 1,761,594 | 11,810 | 0 | 30,208,216 | 37,601,602 |
| 2019 | 66,388 | 4,286,916 | 1,280,236 | 1,765,768 | 11,843 | 0 | 30,280,398 | 37,691,549 |
| 2020 | 65,281 | 4,187,156 | 1,248,498 | 1,730,188 | 11,610 | 0 | 29,586,664 | 36,829,397 |
| 2021 | 66,335 | 4,280,656 | 1,278,006 | 1,764,317 | 11,834 | 0 | 30,238,485 | 37,639,633 |
| 2022 | 63,896 | 4,117,742 | 1,229,299 | 1,697,168 | 11,386 | 0 | 29,087,515 | 36,207,006 |
| 2023 | 52,917 | 3,377,916 | 1,007,245 | 1,394,955 | 9,369 | 0 | 23,866,311 | 29,708,713 |
| 2024 | 55,213 | 3,546,728 | 1,058,288 | 1,463,195 | 9,818 | 0 | 25,056,506 | 31,189,748 |
| 2025 | 63,019 | 4,034,693 | 1,202,714 | 1,667,993 | 11,196 | 0 | 28,510,862 | 35,490,477 |
| 2026 | 26,140 | 1,589,925 | 472,729 | 657,847 | 4,449 | 0 | 11,234,016 | 13,985,106 |
| 2027 | 26,537 | 1,618,059 | 481,352 | 668,776 | 4,522 | 0 | 11,431,404 | 14,230,650 |
| 2028 | 18,266 | 1,051,912 | 310,301 | 441,048 | 3,001 | 0 | 7,443,195 | 9,267,723 |
| 2029 | 18,775 | 1,104,420 | 326,949 | 460,179 | 3,125 | 0 | 7,809,305 | 9,722,753 |
| 2030 | 20,307 | 195,564 | 16,836 | 176,137 | 1,536 | 0 | 1,554,155 | 1,964,535 |
| 2031 | 20,236 | 194,875 | 16,778 | 175,516 | 1,530 | 0 | 1,548,678 | 1,957,613 |
| 2032 | 20,276 | 195,266 | 16,811 | 175,869 | 1,534 | 0 | 1,551,790 | 1,961,546 |
| 2033 | 20,251 | 195,026 | 16,790 | 175,652 | 1,531 | 0 | 1,549,876 | 1,959,126 |
| 2034 | 20,283 | 195,325 | 16,816 | 175,921 | 1,534 | 0 | 1,552,251 | 1,962,130 |
| 2035 | 20,293 | 195,420 | 16,825 | 176,008 | 1,535 | 0 | 1,553,008 | 1,963,089 |
| **TOTAL** | **1,942,293** | **120,009,346** | **35,512,285** | **50,329,784** | **338,856** | **0** | **849,437,970** | **1,057,570,534** |

[a] 1988 through 2015 charges are debt service only and do not include bond cover; 2016 charges and after include both debt service and bond cover.

[b] East Branch Enlargement Phase 2 debt service schedule starts in 2016, and this table is the sum of East Branch Enlargement Phase 1 and Phase 2 capital charges for each contractor.

[c] Under Article 49(d)(4)(A) of its contract, San Bernardino Valley Municipal Water District elected to pay a portion of its allocated costs of East Branch Enlargement in advance rather than to participate in payment of Water System Revenue Bonds. This election was made via a letter of agreement signed June 1, 1987. As of June 1999, $6,347,938 has been received from the San Bernardino Valley Municipal Water District.

**TABLE B-30 Minimum OMP&R Component of East Branch Enlargement Facilities Transportation Charge for Each Contractor (in dollars)**

| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino | Metropolitan | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 320,415 | 101,486 | 95,075 | 0 | 70,133 | 2,174,776 | 2,761,885 |
| 1995 | 0 | 278,176 | 86,604 | 86,479 | 0 | 59,461 | 1,895,643 | 2,406,363 |
| 1996 | 0 | 287,293 | 82,991 | 106,208 | 0 | 55,287 | 1,990,213 | 2,521,992 |
| 1997 | 0 | 389,636 | 123,446 | 100,643 | 0 | 62,571 | 2,642,077 | 3,318,373 |
| 1998 | 0 | 429,772 | 135,927 | 109,979 | 0 | 66,278 | 2,915,152 | 3,657,108 |
| 1999 | 37 | 236,006 | 75,040 | 60,907 | 11 | 39,144 | 1,599,082 | 2,010,227 |
| 2000 | 132 | 403,529 | 121,437 | 120,330 | 40 | 57,671 | 2,768,399 | 3,471,538 |
| 2001 | 10 | 305,653 | 89,017 | 93,328 | 3 | 32,335 | 2,110,955 | 2,631,301 |
| 2002 | 49 | 389,061 | 107,983 | 139,447 | 15 | 46,357 | 2,714,839 | 3,397,751 |
| 2003 | 0 | 452,017 | 123,931 | 164,809 | 0 | 50,584 | 3,161,617 | 3,952,958 |
| 2004 | 1,278 | 499,879 | 153,267 | 141,586 | 265 | 74,051 | 3,415,147 | 4,285,473 |
| 2005 | 745 | 471,965 | 156,985 | 97,723 | 154 | 75,742 | 3,162,111 | 3,965,425 |
| 2006 | 1,965 | 487,018 | 147,273 | 144,493 | 407 | 72,002 | 3,337,783 | 4,190,941 |
| 2007 | 0 | 657,848 | 223,226 | 127,702 | 0 | 114,415 | 4,385,797 | 5,508,988 |
| 2008 | 0 | 679,484 | 212,277 | 186,197 | 0 | 110,602 | 4,623,025 | 5,811,585 |
| 2009 | (2) | 722,651 | 238,466 | 155,834 | 0 | 116,036 | 4,851,435 | 6,084,420 |
| 2010 | 0 | 665,226 | 211,817 | 163,041 | 0 | 98,637 | 4,504,540 | 5,643,261 |
| 2011 | 0 | 686,057 | 214,049 | 172,270 | 0 | 86,235 | 4,666,555 | 5,825,166 |
| 2012 | 2 | 644,406 | 200,508 | 173,115 | 1 | 95,578 | 4,387,551 | 5,501,161 |
| 2013 | 0 | 746,004 | 238,327 | 182,613 | 0 | 114,174 | 5,047,854 | 6,328,972 |
| 2014 | 139 | 905,721 | 286,472 | 228,293 | 29 | 134,422 | 6,142,903 | 7,697,979 |
| 2015 | (418) | 1,075,723 | 353,863 | 241,686 | (87) | 182,070 | 7,228,423 | 9,081,260 |
| 2016 | 0 | 1,034,006 | 334,313 | 241,730 | 0 | 160,550 | 6,976,472 | 8,747,071 |
| **2017** | **0** | **1,164,137** | **373,286** | **284,378** | **0** | **184,090** | **7,870,710** | **9,876,601** |
| 2018 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2019 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2020 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2021 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2022 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2023 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2024 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2025 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2026 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2027 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2028 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2029 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2030 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2031 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2032 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2033 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2034 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| 2035 | 0 | 1,161,244 | 380,845 | 261,424 | 0 | 191,647 | 7,808,478 | 9,803,638 |
| **TOTAL** | **3,937** | **34,834,075** | **11,247,201** | **8,323,498** | **838** | **5,608,071** | **235,125,663** | **295,143,283** |

**TABLE B-31 Total East Branch Enlargement Facilities Transportation Charge for Each Contractor (in dollars)**

| Calendar Year | SOUTHERN CALIFORNIA AREA | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | AVEK | Coachella | Desert | Mojave | Palmdale | San Bernardino | Metropolitan | |
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 18,266 | 1,209,293 | 360,156 | 502,810 | 3,356 | 0 | 8,552,529 | 10,646,410 |
| 1989 | 19,176 | 1,269,524 | 378,094 | 527,854 | 3,523 | 0 | 8,978,504 | 11,176,675 |
| 1990 | 19,186 | 1,270,244 | 378,308 | 528,153 | 3,525 | 0 | 8,983,597 | 11,183,013 |
| 1991 | 19,187 | 1,270,261 | 378,314 | 528,160 | 3,525 | 0 | 8,983,717 | 11,183,164 |
| 1992 | 38,420 | 2,543,616 | 757,549 | 1,057,606 | 7,059 | 0 | 17,989,315 | 22,393,565 |
| 1993 | 40,029 | 2,650,139 | 789,274 | 1,101,897 | 7,354 | 0 | 18,742,682 | 23,331,375 |
| 1994 | 39,705 | 2,949,121 | 884,376 | 1,188,061 | 7,295 | 70,133 | 20,765,875 | 25,904,566 |
| 1995 | 39,632 | 2,902,004 | 868,042 | 1,177,437 | 7,281 | 59,461 | 20,452,246 | 25,506,103 |
| 1996 | 39,825 | 2,923,960 | 868,252 | 1,202,504 | 7,317 | 55,287 | 20,637,619 | 25,734,764 |
| 1997 | 41,743 | 3,153,265 | 946,520 | 1,249,728 | 7,669 | 62,571 | 22,187,399 | 27,648,895 |
| 1998 | 42,642 | 3,252,898 | 976,720 | 1,283,802 | 7,834 | 66,278 | 22,881,260 | 28,511,434 |
| 1999 | 44,775 | 3,197,893 | 957,160 | 1,292,426 | 8,230 | 39,144 | 22,546,557 | 28,086,185 |
| 2000 | 49,163 | 3,649,638 | 1,088,205 | 1,470,025 | 9,048 | 57,671 | 25,725,985 | 32,049,735 |
| 2001 | 49,058 | 3,552,916 | 1,056,128 | 1,443,503 | 9,014 | 32,335 | 25,076,703 | 31,219,657 |
| 2002 | 47,943 | 3,559,909 | 1,052,336 | 1,457,849 | 8,814 | 46,357 | 25,140,157 | 31,313,365 |
| 2003 | 40,765 | 3,150,888 | 927,718 | 1,286,969 | 7,489 | 50,584 | 22,248,954 | 27,713,367 |
| 2004 | 45,477 | 3,426,101 | 1,024,765 | 1,358,276 | 8,385 | 74,051 | 24,110,384 | 30,047,439 |
| 2005 | 33,889 | 2,666,264 | 810,499 | 1,010,087 | 6,243 | 75,742 | 18,680,937 | 23,283,661 |
| 2006 | 48,944 | 3,597,294 | 1,073,586 | 1,437,710 | 9,038 | 72,002 | 25,334,709 | 31,573,283 |
| 2007 | 45,289 | 3,656,218 | 1,116,211 | 1,374,390 | 8,321 | 114,415 | 25,591,285 | 31,906,129 |
| 2008 | 42,491 | 3,492,602 | 1,050,090 | 1,355,859 | 7,806 | 110,602 | 24,518,353 | 30,577,803 |
| 2009 | 43,668 | 3,613,833 | 1,099,528 | 1,357,955 | 8,023 | 116,036 | 25,298,859 | 31,537,902 |
| 2010 | 44,839 | 3,633,845 | 1,095,942 | 1,397,359 | 8,238 | 98,637 | 25,499,624 | 31,778,484 |
| 2011 | 43,190 | 3,545,476 | 1,065,651 | 1,361,184 | 7,935 | 86,235 | 24,889,340 | 30,999,011 |
| 2012 | 43,706 | 3,537,855 | 1,062,245 | 1,376,178 | 8,030 | 95,578 | 24,851,010 | 30,974,602 |
| 2013 | 37,663 | 3,239,473 | 980,941 | 1,219,369 | 6,919 | 114,174 | 22,682,514 | 28,281,053 |
| 2014 | 39,977 | 3,543,203 | 1,071,976 | 1,324,928 | 7,348 | 134,422 | 24,796,069 | 30,917,923 |
| 2015 | 44,201 | 4,029,738 | 1,233,638 | 1,469,932 | 8,110 | 182,070 | 28,120,219 | 35,087,908 |
| 2016 | 64,929 | 5,258,105 | 1,595,738 | 1,983,165 | 11,665 | 160,550 | 36,817,253 | 45,891,405 |
| **2017** | **67,986** | **5,551,217** | **1,682,549** | **2,094,343** | **12,137** | **184,090** | **38,864,739** | **48,457,061** |
| 2018 | 66,053 | 5,437,881 | 1,658,137 | 2,023,018 | 11,810 | 191,647 | 38,016,694 | 47,405,240 |
| 2019 | 66,388 | 5,448,160 | 1,661,081 | 2,027,192 | 11,843 | 191,647 | 38,088,876 | 47,495,187 |
| 2020 | 65,281 | 5,348,400 | 1,629,343 | 1,991,612 | 11,610 | 191,647 | 37,395,142 | 46,633,035 |
| 2021 | 66,335 | 5,441,900 | 1,658,851 | 2,025,741 | 11,834 | 191,647 | 38,046,963 | 47,443,271 |
| 2022 | 63,896 | 5,278,986 | 1,610,144 | 1,958,592 | 11,386 | 191,647 | 36,895,993 | 46,010,644 |
| 2023 | 52,917 | 4,539,160 | 1,388,090 | 1,656,379 | 9,369 | 191,647 | 31,674,789 | 39,512,351 |
| 2024 | 55,213 | 4,707,972 | 1,439,133 | 1,724,619 | 9,818 | 191,647 | 32,864,984 | 40,993,386 |
| 2025 | 63,019 | 5,195,937 | 1,583,559 | 1,929,417 | 11,196 | 191,647 | 36,319,340 | 45,294,115 |
| 2026 | 26,140 | 2,751,169 | 853,574 | 919,271 | 4,449 | 191,647 | 19,042,494 | 23,788,744 |
| 2027 | 26,537 | 2,779,303 | 862,197 | 930,200 | 4,522 | 191,647 | 19,239,882 | 24,034,288 |
| 2028 | 18,266 | 2,213,156 | 691,146 | 702,472 | 3,001 | 191,647 | 15,251,673 | 19,071,361 |
| 2029 | 18,775 | 2,265,664 | 707,794 | 721,603 | 3,125 | 191,647 | 15,617,783 | 19,526,391 |
| 2030 | 20,307 | 1,356,808 | 397,681 | 437,561 | 1,536 | 191,647 | 9,362,633 | 11,768,173 |
| 2031 | 20,236 | 1,356,119 | 397,623 | 436,940 | 1,530 | 191,647 | 9,357,156 | 11,761,251 |
| 2032 | 20,276 | 1,356,510 | 397,656 | 437,293 | 1,534 | 191,647 | 9,360,268 | 11,765,184 |
| 2033 | 20,251 | 1,356,270 | 397,635 | 437,076 | 1,531 | 191,647 | 9,358,354 | 11,762,764 |
| 2034 | 20,283 | 1,356,569 | 397,661 | 437,345 | 1,534 | 191,647 | 9,360,729 | 11,765,768 |
| 2035 | 20,293 | 1,356,664 | 397,670 | 437,432 | 1,535 | 191,647 | 9,361,486 | 11,766,727 |
| **TOTAL** | **1,946,230** | **154,843,421** | **46,759,486** | **58,653,282** | **339,694** | **5,608,071** | **1,084,563,633** | **1,352,713,817** |

## CONVERSION FACTORS

| Quantity | To convert from customary unit | To metric units | Multiply customary unit by | To convert to customary unit, multiply metric unit by |
|---|---|---|---|---|
| Length | inches (in) | millimeters (mm)● | 25.4 | 0.03937 |
| | inches (in) | centimeters (cm) | 2.54 | 0.3937 |
| | feet (ft) | meters (m) | 0.3048 | 3.2808 |
| | miles (mi) | kilometers (km) | 1.6093 | 0.62139 |
| Area | square inches ($in^2$) | square millimeters ($mm^2$) | 645.16 | 0.00155 |
| | square feet ($ft^2$) | square meters ($m^2$) | 0.092903 | 10.764 |
| | acres (ac) | hectares (ha) | 0.40469 | 2.4710 |
| | square miles ($mi^2$) | square kilometers ($km^2$) | 2.590 | 0.3861 |
| Volume | gallons (gal) | liters (L) | 3.7854 | 0.26417 |
| | million gallons ($10^6$ gal) | megaliters (ML) | 3.7854 | 0.26417 |
| | cubic feet ($ft^3$) | cubic meters ($m^3$) | 0.028317 | 35.315 |
| | cubic yards ($yd^3$) | cubic meters ($m^3$) | 0.76455 | 1.308 |
| | acre-feet (af) | thousand cubic meters ($m^3 \times 10^3$) | 1.2335 | 0.8107 |
| | acre-feet (af) | hectare-meters (ha - m)■ | 0.1234 | 8.107 |
| | thousand acre-feet (taf) | million cubic meters ($m^3 \times 10^6$) | 1.2335 | 0.8107 |
| | thousand acre-feet (taf) | hectare-meters (ha - m)■ | 123.35 | 0.008107 |
| | million acre-feet (maf) | billion cubic meters ($m^3 \times 10^9$)◆ | 1.2335 | 0.8107 |
| | million acre-feet (maf) | cubic kilometers ($km^3$) | 1.2335 | 0.8107 |
| Flow | cubic feet per second ($ft^3/s$) | cubic meters per second ($m^3/s$) | 0.028317 | 35.315 |
| | gallons per minute (gal/min) | liters per minute (L/min) | 3.7854 | 0.26417 |
| | gallons per day (gal/day) | liters per day (L/day) | 3.7854 | 0.26417 |
| | million gallons per day (mgd) | megaliters per day (ML/day) | 3.7854 | 0.26417 |
| | acre-feet per day (af/day) | thousand cubic meters per day ($m^3 \times 10^3$/day) | 1.2335 | 0.8107 |
| Mass | pounds (lb) | kilograms (kg) | 0.45359 | 2.2046 |
| | tons (short, 2,000 lb) | megagrams (Mg) | 0.90718 | 1.1023 |
| Velocity | feet per second (ft/s) | meters per second (m/s) | 0.3048 | 3.2808 |
| Power | horsepower (hp) | kilowatts (kW) | 0.746 | 1.3405 |
| Pressure | pounds per square inch (psi) | kilopascals (kPa) | 6.8948 | 0.14505 |
| | feet head of water | kilopascals (kPa) | 2.989 | 0.32456 |
| Specific capacity | gallons per minute per foot of drawdown | liters per minute per meter of drawdown | 12.419 | 0.08052 |
| Concentration | parts per million (ppm) | milligrams per liter (mg/L) | 1.0 | 1.0 |
| Electrical conductivity | micromhos per centimeter (µmhos/cm) | microsiemens per centimeter (µS/cm) | 1.0 | 1.0 |
| Temperature | degrees Fahrenheit (°F) | degrees Celsius (°C) | (°F - 32)/1.8 | (1.8 x °C) + 32 |

● When using "dual units," inches are normally converted to millimeters (rather than centimeters).

■ Not used often in metric countries, but is offered as a conceptual equivalent of customary western U.S. practice (a standard depth of water over a given area of land).

◆ ASTM Manual E380 discourages the use of billion cubic meters since that magnitude is represented by giga (a thousand million) in other countries. It is shown here for potential use for quantifying large reservoir volumes (similar to million acre-feet).

### OTHER COMMON CONVERSION FACTORS

1 cubic foot=7.48 gallons=62.4 pounds of water
1 cubic foot per second (cfs)=450 gallons per minute (gpm)
1 cfs=646,320 gallons per day=1.98 af a day
1 acre-foot=approximately 325,851 gallons=43,560 cubic feet
1 million gallons=3.07 acre-feet
1 million gallons per day (mgd)=1,120 af a year

STATE OF CALIFORNIA
CALIFORNIA NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
1416 Ninth Street, P.O. Box 942836
Sacramento, CA 94236-0001

# Initial State Water Project Allocation Set at 15 Percent

Published: Nov 30, 2017



Initial State Water Project Allocation Set at 15 Percent

SACRAMENTO – The Department of Water Resources (DWR) today announced an initial water allocation of 15 percent for most State Water Project (SWP) contractors for the 2018 calendar year. That allocation will likely change depending on rain and snowfall received this winter.

“It’s hard to know what mother nature will have in store for us this year, but it’s safe to say California is in a better place than we were during the recent drought,”said DWR Director Grant Davis. “Planning for the year and providing more accurate early estimates for water managers so they can better plan for the year is just one of the many reasons the state needs to improve our forecasting ability.”

percent of its 2.4 million AF capacity and 148 percent of its average for this date. Lake Oroville however, currently holds 59 percent of its historical average this time of year. Water was released beginning in spring to provide adequate flood protection during reconstruction of the main spillway.

Last year, the Department's initial allocation was 20 percent. By the end of Water Year 2017, allocations reached 85 percent due to the abundant rainfall during the year. During the recent drought, the initial allocation was as low as 5 percent in 2014.

Nearly all areas served by the SWP have sources of water other than the allocation, among them streams, groundwater, and local reservoirs. DWR is hopeful that today's SWP allocation, made before the wettest months, will increase as storms bring rain and snow to the state.

Historical December 1 Allocations:

2017: 20 percent

2016: 10 percent

2015: 10 percent

2014: 5 percent

2013: 30 percent

2012: 60 percent

2011: 25 percent

2010: 5 percent

2009: 15 percent

2008: 25 percent

2007: 60 percent

DWR's California Data Exchange Center website shows current water conditions at the state's largest reservoirs and weather stations.

Reservoirs: http://cdec.water.ca.gov/reservoir.html

Precipitation: http://cdec.water.ca.gov/snow_rain.html

#####

Every Californian should take steps to conserve water. Find out how at SaveOurWater.com.

Contact: Doug Carlson, Information Officer – (916) 335- 2299, Doug.Carlson@water.ca.gov |Maggie Macias, Information Officer – (916) 653- 8743 ,Maggie.Macias@water.ca.gov

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Department of Water Resources

**Karla Nemeth**

Visit Director Profile Page



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# Memorandum

Date: March 18, 2018

**To:** 1. Erik Reyes, Chief
Central Valley Modeling Section
2. Tara Smith, Chief
Modeling Support Branch

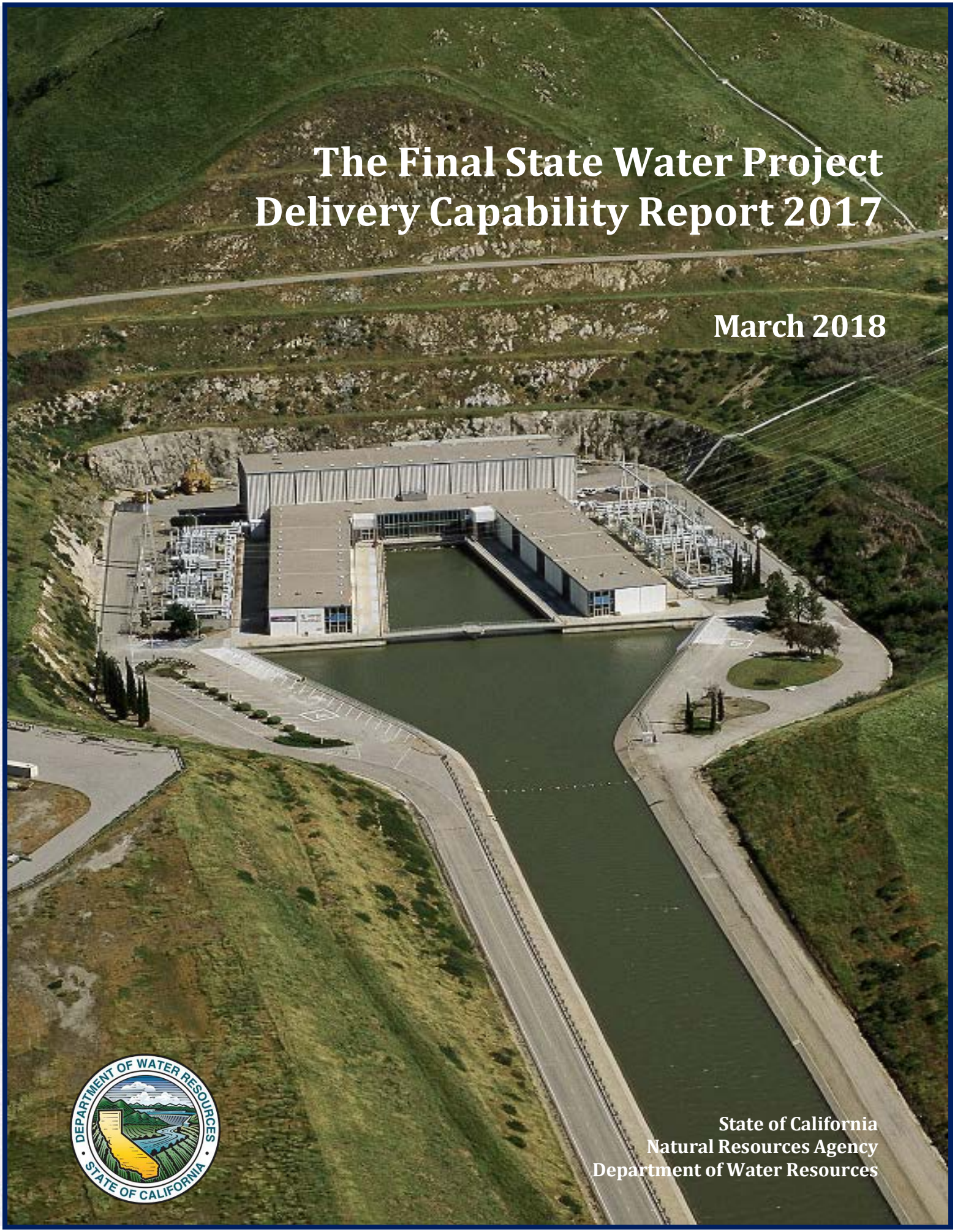
**From:** Sina Darabzand
Senior Engineer Water Resources
Central Valley Modeling Section

Nazrul Islam
Senior Engineer Water Resources
Central Valley Modeling Section

**Subject:** The Final State Water Project Delivery Capability Report 2017

The attached report, "The Final State Water Project Delivery Capability Report 2017" (Final DCR 2017), is submitted for your review and approval to print multiple copies for public distribution in compliance with the requirements of Attachment B to the Monterey Plus Settlement Agreement of May 2003.
No comments were received during the public comment period that ended January 19th, 2018, and except for minor changes in formatting and the cover photo, the report contains the same material as was presented in "The State Water Project Draft Delivery Capability Report 2017", December 15th, 2017.

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# The Final State Water Project Delivery Capability Report 2017

March 2018

State of California
Natural Resources Agency
Department of Water Resources

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State of California
**Edmund G. Brown Jr., Governor**

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# List of Acronyms

ANN (Artificial Neural Network)
BDCP (Bay Delta Conservation Plan)
BiOps (Biological Opinions)
CEQA (California Environmental Quality Act)
CESA (California Endangered Species Act)
CDFW (California Department of Fish and Wildlife)
CVP (Central Valley Project)
CY (Calendar Year)
D-1641 (State Water Board's Water Right Decision 1641 (D-1641), issued in December 1999 and updated in March 2000)
DKIP (Delta Knowledge Improvement Program)
DLIS (Delta Levees Investment Strategy)
DO (Dissolved oxygen)
DRMS (Delta Risk Management Strategy)
DSM2 (Delta Simulation Model 2)
E/I (Delta Exports to Inflow ratio)
EcoRestore (Governor Brown's Delta habitat restoration plan)
EIR (Environmental Impact Report)
EIS (Environmental Impact Statement)
ESA (Endangered Species Act)
FCWCD (Flood Control and Water Conservation District)
HCP (Habitat Conservation Plan)
ID (Irrigation District)
KCWA (Kern County Water Agency)
M&I (Municipal and Industrial)
MWDSC (Metropolitan Water District of Southern California)
NCCP (Natural Community Conservation Plan)
NEPA (National Environmental Policy Act)
NMFS (National Marine Fisheries Service)
NOD (Notice of Determination)
OAL (The State Office of Administrative Law)
ROD (Record of Decision)
RPA (Reasonable and Prudent Alternative)
SED (Substitute Environmental Document)
SWC (State Water Contractors)
SWP (State Water Project)
SWPAO (State Water Project Analysis Office)
SWRCB (State Water Resources Control Board)
USBR (United States Bureau of Reclamation)
USFWS (United States Fish and Wildlife Service)
UWMP (Urban Water Management Plan)
WaterFix (The water transfer component of the Bay Delta Conservation Plan)
WD (Water District)
WSD (Water Storage District)
WSI-DI (Water Supply Index vs. Demand Index Relationship)
WQCP (Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta)
WY (Water Year)
X2 (The distance in kilometers from Golden Gate, where salinity concentration in the Delta is 2 parts per thousand

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# Summary

This report is intended for public information about the key factors affecting the operation of the State Water Project (SWP) system in California, its long-term reliability as a source of water for beneficial use, and an estimate of its current delivery capability.

Water provided by the SWP is a major component of the water supplies available to many SWP Contractors. State Water Contractors (SWC) consists of 29 legal entities that include cities, counties, urban water agencies, and agricultural irrigation districts. SWC's local/regional water users have long term contracts with the California Department of Water Resources (DWR) for all, or a portion of their water supply needs. Thus, the reliability of water from the SWP system is an important component in the water supply planning of its recipients, and ultimately affects the amount of water available for beneficial use in California.

The availability of these water supplies may be highly variable. A sequence of relatively wet water years[1] may be followed by a varying sequence of dry or critically dry years. Having good and reliable estimates on how much water each water user under contract with DWR will receive in a given year—whether it be a wet water year, a critical year, or somewhere in between—gives Contractors a better sense of the degree to which they may need to implement increased conservation measures, or plan for new additional, or back up sources of water to meet their needs.

The geography of California, and infrastructure of water transfer from the source areas, located in the Sierra Mountain Range, to areas of demand for water makes the Sacramento-San Joaquin Delta, a key feature of the SWP's ability to deliver water to its agricultural and urban Contractors in the North Bay, the South Bay, California Central Valley, and Southern California. All but five of the 29 SWP Contractors receive water deliveries by diversions from the Delta. These water diversions are pumped by either the Harvey O. Banks or Barker Slough pumping plants.

DWR, and the United States Bureau of Reclamation (USBR), the managing entities of the two statewide systems of water transfer in California, face numerous challenges in the operation of their diversion facilities in the Delta, and are regulated by several state and federal agencies to maintain, and enhance the Delta's long-term sustainability.

Maintaining suitable quality of water flowing in the channels of the Delta for the numerous in-basin beneficial uses, and the protection of endangered and threatened fish species, are important factors of concern for the operators of the Delta export diversion facilities. Ongoing regulatory restrictions, such as those aimed at protecting the estuary's resident and migratory fish species are major challenges to a reliable, and at the same time, sustainable water delivery capability of both, SWP and the CVP systems.

Complications induced by climate change also pose the threat of increased variability in floods and droughts, and the projected sea level rise, caused by the increase in

[1] Water years start on October 1 and end on September 30 of the next year. It is the time period where precipitation totals are measured

average temperature, complicate efforts to manage salinity levels in the channels below tide level. This could result in more frequent water quality degradation in the Delta channels.

Among the other challenges are continued subsidence of Delta islands, many of which are already below sea level, maintained by relatively unstable levee system, and the related threat of a catastrophic levee failure as water pressure increases on fragile levees.

The analyses in this report, factor in all of the current regulations governing SWP and CVP operations in the Delta and upstream, and assumptions about water uses upstream in the Sacramento River and San Joaquin River watersheds.

Analyses were conducted that considered the amounts of water that SWP Contractors use, and the amounts of water they choose to hold for use in a subsequent year.

Many of the same specific assumptions on SWP operations described in the *State Water Project Delivery Capability Report 2015* remain the same in this update for 2017. Most notably, the effects on the timing and the amount of SWP and CVP Delta diversions, by operating the system to meet the constraints spelled out in the 2008 and 2009 federal biological opinions (BiOps). Hence, the differences between the 2015 and 2017 reports can be attributed primarily to inputs on operating assumptions that result in a realistic simulation study, with the least amount of foresight on the historical hydrology (October 1921-September 2003) used in the simulation.

SWP Delta exports have decreased since 2005, although the bulk of the change occurred by 2009 as the federal BiOps went into effect, restricting operations of the CVP and SWP diversion pumps. The most salient findings in this report are as follows:

- Under existing conditions, the average annual delivery of Table A water estimated for this 2017 Report is 2,571 taf/year, 21 taf more than the 2,550 taf/year estimated for the 2015 Report.

- The likelihood of existing-condition SWP Article 21 deliveries (supplemental deliveries to Table A water) being greater than 20 taf/year has decreased by 2% relative to the likelihood presented in the 2015 Report.

# Section 1
## Reasons to Assess SWP Water Delivery Capability

Two major factors underscore the importance of assessing the SWP's water delivery capability: the effects of population growth on California's balance of water supply and demand, and State legislations intended to help maintain a reliable water supply.

### Population Growth, Land Use, and Water Supply

California's population has grown rapidly in recent years, with resulting changes in land use. This growth is expected to continue. From 1990 to 2005, California's population increased from about 29.8 million to about 36 million. Based on this trend, California's population has been projected to be more than 40.8 million by 2020. The "current trends" scenario depicted in the *California Water Plan 2013* for year-2050 conditions, based on the California Department of Finance's projections of 2010 U.S. Census data, assumes a population of nearly 51 million—a 75% increase in the 1990 population.

The amount of water available in California can vary greatly from year to year. Some areas may receive 2 inches of rain a year, while others are deluged with 100 inches or more. As land uses have changed, population centers have emerged in many locations without sufficient local water supplies. Thus, Californians have always been faced with the problem of how best to conserve, control, and move water from areas of abundant water to areas of water need and use.

### Legislation on Ensuring a Reliable Water Supply

The laws described below impose specific requirements on both urban and agricultural water suppliers. These laws increase the importance of SWP water delivery capability estimates to local and regional water purveyors.

#### Urban Water Management Planning Act

The Urban Water Management Planning Act was enacted in 1983 (California Water Code, Sections 10610–10656). As amended, this law requires all public urban water purveyors to adopt urban water management plans (UWMPs) every 5 years and submit those plans to DWR. DWR reviews submitted plans to report to the legislature on the status of submitted plans and for the purposes of grant eligibility requirements.

UWMPs must include an estimate of water supply and demand for a 20-year planning horizon and three water-year types, normal, single dry year and multi dry years. SWP Contractors use SWP delivery capability to estimate their long-term water supply needs from other sources available to them.

DWR publishes a guidebook to assist water suppliers prepare their urban water management plans. Guidance documents are available at http://www.water.ca.gov/urbanwatermanagement.

The municipalities and water districts that have adopted 2010 UWMPs and submitted them to DWR are listed at https://wuedata.water.ca.gov/uwmp_plans.asp.

## Water Conservation Act

The Water Conservation Act of 2009 (Senate Bill X7.7, Steinberg), enacted in November 2009, includes requirements for urban and agricultural suppliers. Water suppliers report on compliance with these requirements in either the urban or agricultural water management plans. DWR reviews plans for consistency with Water Conservation Act requirements.

This law sets goals for the State of California to reduce average statewide per capita urban water use by 10% by the end of 2015, and 20% by the end of 2020. Urban (M&I) water suppliers in their 2010 UWMPs, calculated baseline water-use and set targets for 2015 and 2020. Data submitted by participating local/regional suppliers on water use reduction target compliance, show a cumulative reduction in statewide M&I water production of more than 22% during the 22-month period of June 2015 through March 2017. DWR is required to report to the Legislature on progress toward meeting the State's goal of 20% reduction by 2020.

In addition, as part of the Water Conservation Act, agricultural water suppliers with 25,000 acres or more of irrigated land were required to prepare and adopt agricultural water management plans and submit the plans to DWR by the end of 2012 and then once every five years beginning in 2015. The Act also required suppliers to measure volumetrically water deliveries to farms and base the price of water sales at least in part on the volume of water delivered. Water suppliers were required to report on water measurement and water pricing in the water management plans.

In June 2015, DWR released a guidebook for developing agricultural water management plans:
http://www.water.ca.gov/wateruseefficiency/sb7/docs/2015/Approved%20Final%202015%20AWMP%20Guidebook%20June%202015.pdf

Water agencies filing agricultural water management plans are listed on a Web page maintained by DWR's Water Use and Efficiency Branch:
http://www.water.ca.gov/wateruseefficiency/sb7/docs/2014/032315_2012_AWMPs_Received_12March2015.pdf

# Section 2
## Regulatory Restrictions on SWP Delta Exports

Multiple needs converge in the Delta: the need to protect a fragile ecosystem, to support Delta recreation and farming, and to provide water for agricultural and urban needs throughout much of California. Various regulatory requirements are placed on the SWP's Delta operations to protect special-status species such as delta smelt and spring- and winter-run Chinook salmon. As a result, as described below, restrictions on SWP operations imposed by State and federal fish and wildlife agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year.

### Biological Opinions on Effects of Coordinated SWP and CVP Operations

Several fish species listed under the federal Endangered Species Act (ESA) as threatened or endangered are found in the Delta. These protected species' health and the viability of their populations are impacted by various factors, including SWP and CVP operations, nonnative species, predation, Delta salinity, water quality and contaminants, sediment supply, physical alterations to the Delta, land subsidence, pelagic organism decline, methylmercury and selenium, invasive aquatic vegetation, low dissolved oxygen (DO) levels and illegal harvest.

Because of the decline of these species, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have issued several Biological Opinions (BiOps) since the 1990s on the effects of coordinated SWP/CVP operations on several listed species. (USFWS Biological Opinion for Delta smelt protection and NMFS Biological Opinion for salmonids, green sturgeon, and Southern Resident killer whales.)

These BiOps affect the SWP's water delivery reliability for two reasons. Most notably, they include terms that restrict SWP exports in the Delta to specific amounts at certain times under certain conditions. In addition, the BiOps' requirements are predicated on physical and biological conditions that occur daily while DWR's water supply models are based on monthly data.

The first BiOp on the effects of SWP (and CVP) operations were issued in February 1993 (NMFS BiOp on effects of project operations on winter-run Chinook salmon) and March 1995 (USFWS BiOp on project effects on delta smelt and splittail). Among other things, the BiOps contained requirements for Delta inflow, Delta outflow, and export pumping restrictions in order to protect listed species. These requirements imposed substantial constraints on Delta water supply operations. Many were incorporated into the 1995 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta*[2] (1995 WQCP), as described in the "Water Quality Objectives" section, below.

[2] The SWRCB is currently updating the WQCP

The terms of the USFWS and NMFS BiOps have become increasingly restrictive over the years. In 2004 the USBR sought a new BiOp from USFWS regarding the operation of the Central Valley Project (CVP) and the State Water Project (SWP) (collectively, Projects). USFWS issued the opinion in 2005, finding that the proposed coordinated operations of the Projects were not likely to jeopardize the continued existence of the delta smelt or result in the destruction or adverse modification of its critical habitat. After judicial review, the 2005 BiOp was vacated and USFWS was ordered to prepare a new one. USFWS found that the proposed operations of the Project would result in jeopardy to the delta smelt and in December 2008 issued a Jeopardy BiOp which included a Reasonable and Prudent Alternative (RPA) with more protective export restrictions and other actions intended to protect the delta smelt.

Similarly, in 2004 NMFS issued a BiOp on the effects of the coordinated operation of the Projects on salmonids, green sturgeon, and Southern Resident killer whales and found that the proposed operations of the Projects were not likely to jeopardize the continued existence of the listed species or result in the destruction or adverse modification of their critical habitat. After judicial review, the 2004 BiOp was also vacated and NMFS was ordered to prepare a new one. In June 2009, NMFS issued a Jeopardy BiOp covering effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. Like the 2008 smelt BiOp, the salmon BiOp included an RPA with more protective export restrictions and other actions intended to protect listed species.

The USFWS BiOp includes requirements on operations in all but 2 months of the year. The BiOp calls for “adaptively managed” (adjusted as necessary based on the results of monitoring) flow restrictions in the Delta intended to protect delta smelt at various life stages. USFWS determines the required target flow with the reductions accomplished primarily by reducing SWP and CVP exports. Because this flow restriction is determined based on fish location and decisions by USFWS staff, predicting the flow restriction and corresponding effects on export pumping with any great certainty poses a challenge. The USFWS BiOp also includes an additional salinity requirement in the Delta for September and October in wet and above-normal water years, calling for increased releases from SWP and CVP reservoirs to reduce salinity. Among other provisions included in the NMFS BiOp, limits on total Delta exports have been established for the months of April and May. These limits are mandated for all but extremely wet years.

The 2008 and 2009 BiOps were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third consecutive dry year. NMFS calculated that implementing its BiOp would reduce SWP and CVP Delta exports by a combined 5% to 7%, but DWR’s initial estimates showed an impact on exports closer to 10% in average years, combined with the effects of pumping restrictions imposed by the BiOps to protect delta smelt and other species. The operational rules specified in the 2008 and 2009 BiOps continue to be legally required and are the rules used in the analyses presented in this report. It should be noted that in late 2016 USBR and DWR requested reinitiating consultation with NMFS and USFWS on the Coordinated Long-term Operations of the CVP and SWP due to new information and science on declining listed fish species populations. During this reinitiated consultation, the CVP and SWP will continue to operate pursuant to the existing USFWS (2008) and NMFS (2009) Biological Opinion requirements. The

consultation process formally began in 2017 with a kick-off meeting and regular meetings with DWR, regulatory agencies, and stakeholders. A project management plan was developed and scoping notices are anticipated in 2018.

In 2008-2009 and periodically through the drought and for changed circumstances in 2017, CDFW issued consistency determinations under Section 2080.1 of the California Fish and Game Code. The consistency determinations stated that the USFWS and the NMFS BiOps would be consistent with the California Endangered Species Act (CESA). Thus, CDFW allowed incidental take of species listed under both the federal ESA and CESA to occur during SWP and CVP operations without requiring DWR or the USBR to obtain a separate State-issued permit.[3]

These BiOps affect the SWP's water delivery capability by requiring constraints on the total SWP and CVP exports from the Delta. These constraints include terms that restrict total Delta exports to specific amounts at certain times under certain conditions. A complicating factor in the methodology used in this report, however, is that the BiOps' requirements are predicated on physical and biological conditions that occur daily in the Delta, while DWR's water supply models are based on monthly average data. This requires the application of the artificial neural network (ANN) methodology to long-term planning studies. The DWR ANN constructs a response function for the monthly average water supply regime that is most likely to minimize instances of violation of the conditions of the BiOps and other regulatory constraints for exports from the Delta. The DWR ANN is trained on the average daily results of several 16-year simulations by DWR's Delta Simulation Model 2 (DSM2) that simulates the hydrodynamic conditions in the Delta channels at a 15-minute time resolution.

## Delta Inflows

Delta inflows vary considerably from season to season, and from year to year. For example, in an above-normal year, nearly 85% of the total Delta inflow comes from the Sacramento River, more than 10% comes from the San Joaquin River, and the rest comes from the three eastside streams (the Mokelumne, Cosumnes, and Calaveras Rivers).

The type of water year is also an important factor affecting the volume of Delta inflows. When hydrology is analyzed, water years are designated by DWR as "wet" (W), "above normal" (AN), "below normal" (BN), "dry" (D), or "critical" (C). All other factors (such as upstream level of development) being equal, much less water will flow into the Delta during a dry or critical water year (that is, during a drought) than during a wet or above-normal water year. Fluctuations in inflows are a substantial overall concern for the Delta, and a specific concern for the SWP; such fluctuations affect Delta water quality and fish habitat, which in turn trigger regulatory requirements that constrain SWP Delta pumping.

[3] However, CDFW stated in an October 2017 response letter to DWR that according to the evidence, the USFWS memorandum (2017 Memorandum), authorizing a change to the required location of X2 in September and October of Wet Years, would not be consistent with the California Endangered Species Act (CESA) requirements

Delta inflows will also vary by time of year as the amount of precipitation varies by season. About 80% of annual precipitation occurs between November and March, and very little rain typically falls from June through September. Upstream reservoirs regulate this variability by reducing flood flows during the rainy season, and storing water to be released later in the year to meet regulatory requirements and water demands.

## Water Quality Objectives

Because the Delta is an estuary, salinity is a particular concern. In the 1995 WQCP, the State Water Board set water quality objectives to protect beneficial uses of water in the Delta and Suisun Bay. The objectives must be met by the SWP and federal CVP as specified in the water right permits issued to DWR and the USBR. Those objectives—minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity levels—are enforced through the provisions of the State Water Board's Water Right Decision 1641 (D-1641), issued in December 1999 and updated in March 2000, which implemented the 1995 WQCP.

DWR and the USBR must monitor the effects of diversions and SWP and CVP operations to ensure compliance with existing water quality standards.

Among the objectives established in the 1995 WQCP and D-1641 are the "X2" objectives. X2 is defined as the distance in kilometers from Golden Gate, where salinity concentration in the Delta is 2 parts per thousand. The location of X2 is used as a surrogate measure of Delta ecosystem health.

For the X2 objective to be achieved, the X2 position must remain downstream of Collinsville in the Delta for the entire 5-month period, and downstream of other specific locations in the Delta on a certain number of days each month from February through June. This means that Delta outflow, which among other factors controls the location of X2 must be at certain specified levels at certain times. This can limit the amount of water the SWP may pump at those times at its Harvey O. Banks Pumping Plant in the Delta.

Because of the relationship between seawater intrusion and interior Delta water quality, meeting the X2 objective can also improve water quality at Delta drinking water intakes; however, meeting the X2 objectives can require a relatively large volume of water for outflow during dry months that follow months with large storms.

The 1995 WQCP and D-1641 also established an export/inflow (E/I) ratio. The E/I ratio is designed to provide protection for the fish and wildlife beneficial uses in the Bay Delta estuary. The E/I ratio limits the fraction of Delta inflows that are exported. When other restrictions are not controlling, Delta exports are limited to 35% of total Delta inflow from February through June and 65% of inflow from July through January.

The State Water Board is updating the WQCP. Phase 1 of the WQCP update focuses on flows on the San Joaquin River and salinity objectives in the South Delta. Phase 2 focuses on new inflow requirements for the Sacramento River, its tributaries, and eastside tributaries to the Delta (the Mokelumne, Calaveras and Cosumnes rivers); new and modified Delta outflow requirements; new requirements for cold water habitat; new and modified interior Delta flow requirements; recommendations for

complementary ecosystem protection actions that others should take; and adaptive management, monitoring, evaluation, special study, and reporting provisions. A primary focus of the WQCP update is on additional flows for the beneficial use of fish and wildlife. Based on the environmental documentation that has been produced up to this date by the State Water Board, it is likely that the implementation of these flow requirements will affect SWP contractor deliveries. The State Water Board issued its Substitute Environmental Document (SED), which is the equivalent of CEQA analysis, on Phase 1 in 2016 and expects to issue its SED on Phase 2 in 2018. After these documents are finalized, the proposed changes will have to be adopted through an order of the State Water Board.

# Section 3

## Ongoing Environmental and Policy Planning Efforts

It is hard to overstate the Delta's importance to California's economy and natural heritage. The Delta supplies a large share of the water used in the state. California would not be the same without that water — hundreds of billions of dollars of economic activity depend upon it. Southern California, with half of the state's population, gets almost a quarter of its average water supply from the Delta; Kern County, which produces nearly $3 billion annually in grapes, almonds, pistachios, milk, citrus, and carrots, depends on the Delta for about a fifth of its irrigation supply; the west side of the San Joaquin Valley also produces billions of dollars' worth of food and depends on the Delta for about three-quarters of its irrigation supply; and the San Francisco Bay Area, including the innovation hub of Silicon Valley, takes about half of its water supply from the Delta and its tributaries.

At the same time, the hundreds of miles of river channels that crisscross the Delta's farmed islands provide a migratory pathway for Chinook salmon, which support an important West Coast fishing industry. Other native fish species depend upon the complex mix of fresh and salt water in the Delta estuary. Multiple stressors have impaired the ecological functions of the Delta, and concerns have been growing over the ability to balance the many needs of both people and the ecosystem.

In order to respond to these concerns, considerable effort by government agencies and California water community as a whole has been spent during the past several decades to study ways that the problems in the Delta can be addressed, and the more recent attention to the effects of climate change has helped the water community to realize the urgency of addressing these problems. The essential part of all these efforts has been to find a comprehensive solution that brings various, sometimes competing, interests together in a coordinated and concerted set of actions. The Delta Plan and the Bay Delta Conservation Plan (BDCP)/California WaterFix are two large-scale planning efforts that are in development. Once implemented, both efforts, could affect SWP water delivery capability in different ways, and at different scales.

### Delta Plan

After years of concern about the Delta amid rising water demand and habitat degradation, the Delta Stewardship Council was created in legislation to achieve State-mandated coequal goals for the Delta. As specified in Section 85054 of the California Water Code:

"Coequal goals" means the two goals of providing more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The final Delta Plan was adopted by the Council on May 16, 2013. The Delta Plan contains a set of 14 regulatory policies as well as 73 recommendations, which are non-regulatory but identify actions essential to achieving the coequal goals. The State

Office of Administrative Law (OAL) approved the 14 regulations to implement the Delta Plan, which became effective with legally-enforceable regulations on September 1, 2013.

The Council is required to review the Delta Plan at least every five years. To be responsive to changing circumstances and in accordance with commitments made in the 2013 Plan, the Council amended the Delta Plan twice in 2016, and work on several other amendments are underway.

The Delta Plan as adopted in 2013 called for completion of the Bay Delta Conservation Plan (BDCP). Pursuant to the Delta Reform Act of 2009, the BDCP, if it met all other requirements of law, was to be automatically incorporated into the Delta Plan. The Delta Plan also provided that if the BDCP were not approved by Jan. 1, 2016, the Council would consider amending the Delta Plan to promote options for new conveyance and storage projects and how they could be operated.

To fulfill the Delta Plan's directives, the Council this year directed staff to develop a proposed amendment to the Delta Plan regarding Delta conveyance, water storage, and the operation of both.

## Bay Delta Conservation Plan (BDCP)/California WaterFix

In 2006, state and federal agencies started pursuing an ambitious and comprehensive conservation plan under Section 10 of the Endangered Species Act (ESA) and California's Natural Community Conservation Planning Act. The approach included new water conveyance facilities and sought to improve reliability of water delivery and contribute to the recovery of listed species under a single regulatory package. A draft Bay Delta Conservation Plan (BDCP) and draft EIR/EIS were released for a public comment period that began in December 2013 and closed in July 2014. While the draft EIR/EIS was out for public review several significant changes were announced by the Brown Administration and its federal partners.

Based on these project changes and in consideration of comments received on the draft EIR/EIS, state and federal agencies announced in April 2015 a change in their approach to seeking a permit for a project to improve, protect, and maintain ecosystem health, water quality, and water supplies so that the SWP and CVP are capable of reliably delivering water within a stable regulatory framework. Rather than pursue the project as a Habitat Conservation Plan (HCP), under Section 10 of the ESA, and a Natural Community Conservation Plan (NCCP), under the state's Natural Community Conservation Planning Act, the state and federal agencies chose to study additional alternatives to achieve the dual goals through implementation of new water conveyance facilities that would be built in compliance with Section 7 of the ESA and Section 2081(b) of the California ESA.

Based on this change in the permitting approach and other design modifications, DWR and the USBR released a joint Partially Recirculated Draft EIR/Supplemental Draft EIS on the Bay Delta Conservation Plan/California WaterFix for public review and comment from July 2015 through October 2015. The draft document included analysis of three new sub-alternatives as well as additional analysis and refinement of portions of the previous draft environmental document. The additional sub-alternatives do not include an HCP/NCCP, as was proposed as part of the alternatives analyzed in the

previously circulated documents. Instead, the alternative implementation strategy allows for other state and federal programs to address the long-term conservation efforts for species recovery in programs separate from the project.

The new sub-alternatives, including the new preferred alternative known as California WaterFix (sub-alternative 4A), focus on the conveyance facility improvements necessary for the SWP and CVP to address more immediate water supply reliability needs in conjunction with ecosystem improvements to significantly reduce reverse flows and fish species impacts associated with the existing south Delta intakes.

In December of 2016, DWR and the USBR publicly released a Final EIR/EIS. The Final EIR/EIS describes the alternatives, discusses potential environmental impacts, and identifies mitigation measures that would help avoid or minimize impacts. It also provides responses to all substantive comments received on the 2013 Draft Environmental Impact Report/Environmental Impact Statement and 2015 Partially Recirculated Draft Environmental Impact Report /Supplemental Draft Environmental Impact Statement. In July 2017, DWR released a Notice of Determination and certified the Final EIR under the California Environmental Quality Act. The USBR has not issued a ROD under the National Environmental Protection Act (NEPA) as of the date of this report.

## Biological Opinions for CA WaterFix

Moving forward with the alternative implementation strategy (described above), in January 2016, DWR and the USBR released a draft Biological Assessment, which included a species-by-species analysis and proposed mitigation to offset and avoid potential project impacts. In August 2016, DWR and the USBR submitted a revised Biological Assessment to USFWS and NMFS to initiate formal consultation and under Section 7 of the ESA and begin the process of obtaining incidental take authorization for federally-listed species. Remaining consistent with the change in approach, in October 2016, DWR submitted a 2081 (b) application to CDFW to address incidental take of state-listed species for California ESA compliance. The incidental take analysis included in the 2081(b) application analyzes potential project impacts and provides mitigation necessary to ensure project impacts are fully mitigated. In January 2017, NMFS, USFWS, and CDFW submitted draft CA WaterFix Biological Opinion and 2081(b) mitigation analyses to the Delta Science Program's Aquatic Science Peer Review Panel. During this time, DWR and USBR assisted and coordinated with NMFS, USFW, CDFW working towards the completion of the CA WaterFix Biological Opinions and 2081(b) document. In June 2017, NMFS and USFWS Service released their final Biological Opinions. In July 2017, CDFW issued the incidental take permit (20181(b) document).

## EcoRestore

In addition to the new Section 7 permitting approach, and preferred alternative California WaterFix, Governor Brown announced the creation of the California EcoRestore program in April 2015, committing to restore more than 30,000 acres of Delta habitat, which will be implemented on an accelerated timeline independent of the proposed water conveyance facilities. This comprehensive suite of habitat restoration actions under the California EcoRestore program includes specific targets for

floodplain, tidal and sub-tidal, managed wetlands, and fish passage improvements to benefit native fish species and a commitment to adaptive management. A subset of the program's targets includes breaking ground on efforts complying with the restoration required by the 2008 and 2009 Biological Opinions for Long Term Operations of the SWP and CVP.

# Section 4

## State Water Project Historical Deliveries (2007-2016)

Section 4 and Section 6 present the State Water Project Historical Deliveries from 2007-2016 (Calendar year). Section 4, this section, focuses on the annual minimum, maximum, and average total contractor combined deliveries during this 10 year (2007-2016) period. Section 6 of this report includes tables listing annual historical deliveries by various water classifications for each SWP Contractor for 2007–2016.

Contractor deliveries are presented as four different delivery types - Table A delivery, an Article 21 delivery, a carryover delivery, or a turnback delivery. These delivery types are briefly described below.

"Table A" Water is an exhibit to the SWP's water supply contracts. The maximum Table A amount is the basis for apportioning water supply and costs to the SWP contractors. Once the total amount of water to be delivered is determined for the year, all available water is allocated in proportion to each contractor's annual maximum SWP Table A amount.

Article 21 Water (it is described in Article 21 of the water contracts) is water that SWP contractors may receive on a short-term basis in addition to their Table A water, if they request it. Article 21 water is used by many SWP contractors to help meet demands when allocations are less than 100%. The availability and delivery of Article 21 water cannot interfere with normal SWP operations.

Carryover Water is SWP water that is allocated to an SWP contractor and approved for delivery to that contractor in a given year, but not used by the end of the year. This water is exported from the Delta by the Banks Pumping Plant, but instead of being delivered to the contractor, it is stored in the SWP's share of San Luis Reservoir, when space is available, for the contractor to use in the following year.

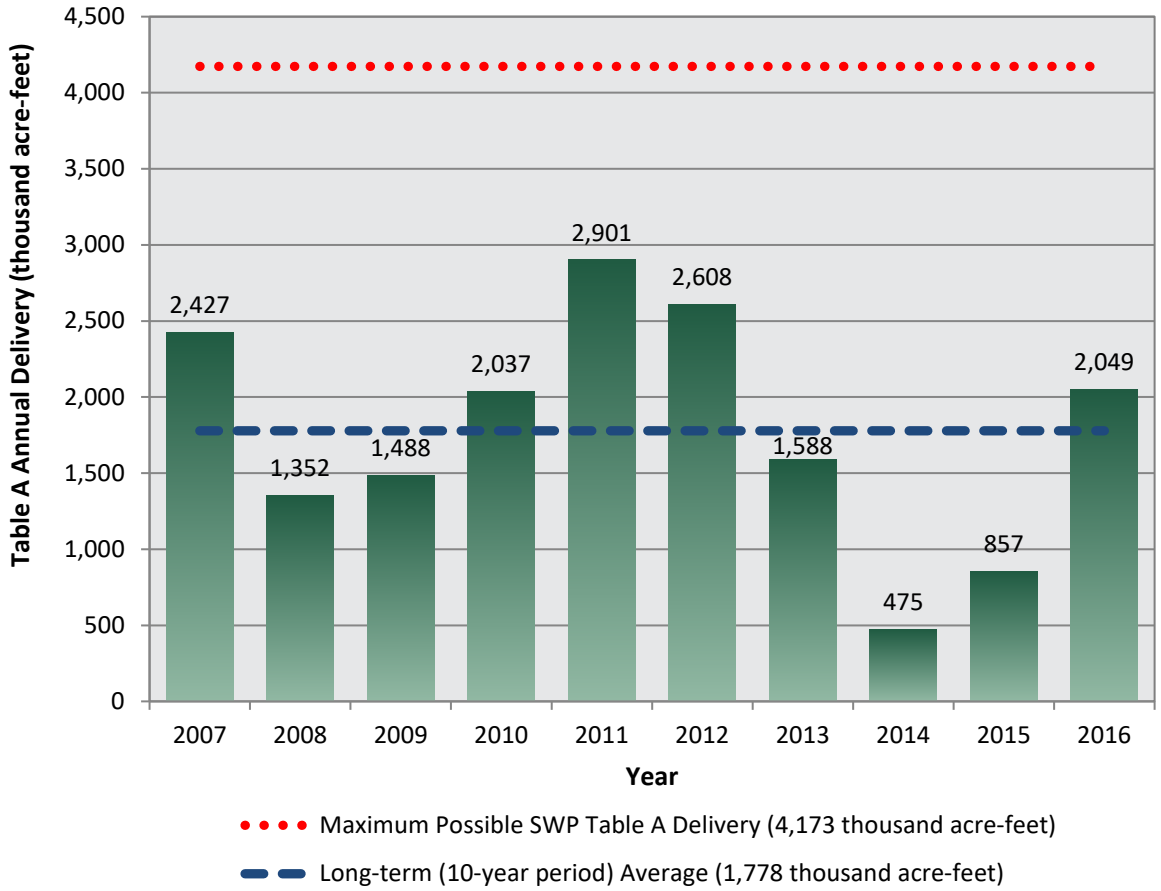
Turnback Pool Water SWP contractors may offer a portion of their Table A water that has been allocated in the current year and exceeds their needs to a "turnback pool," where another contractor may purchase it. Contractors that sell their extra Table A water in a turnback pool receive payments from contractors that buy this water.

Table 4-1 lists the maximum annual SWP Table A water delivery amounts for SWP Contractors. Figure 4-1 shows that deliveries of SWP Table A water for 2007–2016 range from an annual minimum of 475 taf to a maximum of 2,901 taf, with an average of 1 ,778 taf. Historical deliveries of SWP Table A water over this 10-year period are less than the maximum of 4,173 taf/year.

Total historical SWP deliveries, including Table A, Article 21, turnback pool, and carryover water, range from 3,353 to 477 taf/ year, with an average of 1,872 taf/year for the period of 2007–2016 (Figure 4-2).

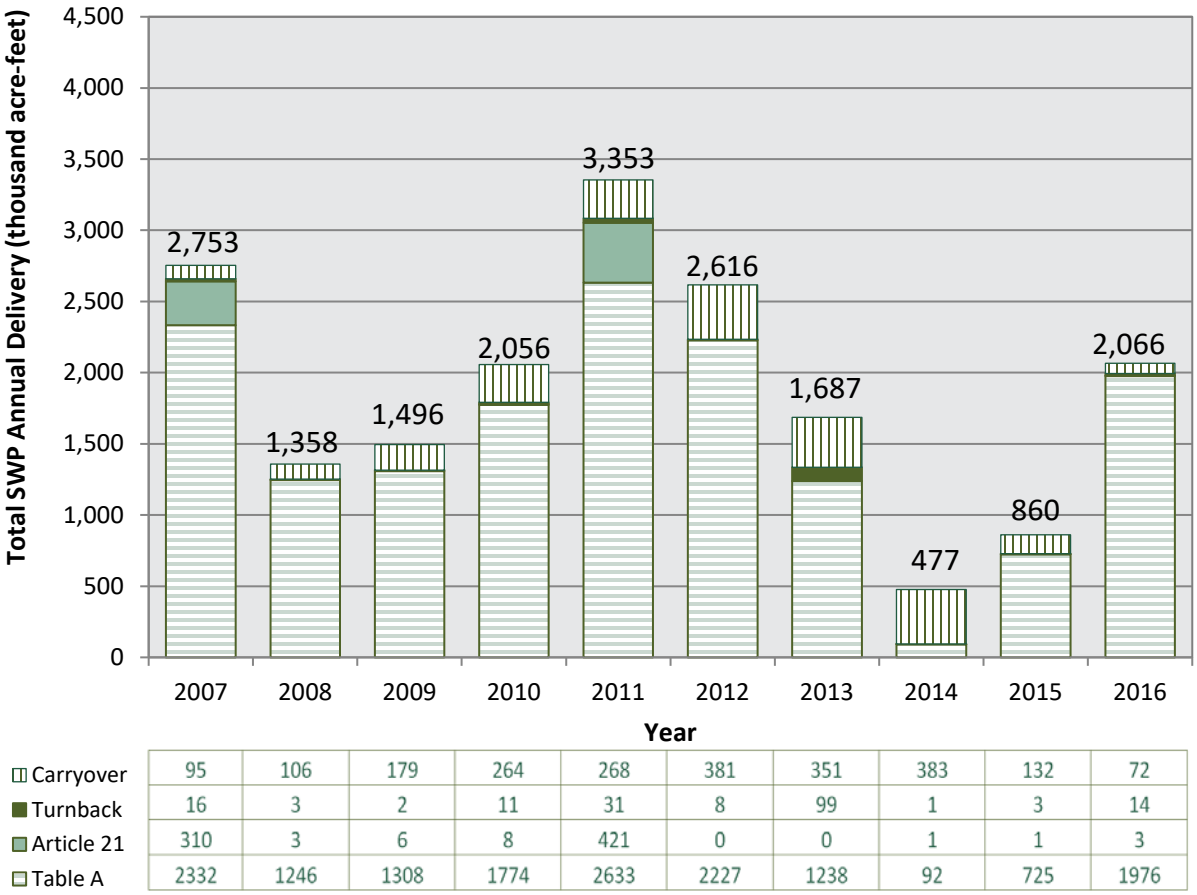
| Table 4-1. Maximum Annual SWP Table A Water Delivery Amounts for SWP Contractors | |
|---|---|
| Contractor | Maximum Table A Delivery Amounts (acre-feet) |
| Feather River Area Contractors | |
| Butte County | 27,500 |
| Yuba City | 9,600 |
| Plumas County Flood Control and Water Conservation District | 2,700 |
| Subtotal | 39,800 |
| North Bay Area Contractors | |
| Napa County Flood Control and Water Conservation District | 29,025 |
| Solano County Water Agency | 47,756 |
| Subtotal | 76,781 |
| South Bay Area Contractors | |
| Alameda County Flood Control and Water Conservation District, Zone 7 | 80,619 |
| Alameda County Water District | 42,000 |
| Santa Clara Valley Water District | 100,000 |
| Subtotal | 222,619 |
| San Joaquin Valley Area Contractors | |
| Dudley Ridge Water District | 45,350 |
| Empire West Side Irrigation District | 3,000 |
| Kern County Water Agency | 982,730 |
| Kings County | 9,305 |
| Oak Flat Water District | 5,700 |
| Tulare Lake Basin Water Storage District | 87,471 |
| Subtotal | 1,133,556 |
| Central Coastal Area Contractors | |
| San Luis Obispo County Flood Control and Water Conservation District | 25,000 |
| Santa Barbara County Flood Control and Water Conservation District | 45,486 |
| Subtotal | 70,486 |
| Southern California Area Contractors | |
| Antelope Valley–East Kern Water Agency | 144,844 |
| Castaic Lake Water Agency | 95,200 |
| Coachella Valley Water District | 138,350 |
| Crestline–Lake Arrowhead Water Agency | 5,800 |
| Desert Water Agency | 55,750 |
| Littlerock Creek Irrigation District | 2,300 |
| Metropolitan Water District of Southern California | 1,911,500 |
| Mojave Water Agency | 85,800 |
| Palmdale Water District | 21,300 |
| San Bernardino Valley Municipal Water District | 102,600 |
| San Gabriel Valley Municipal Water District | 28,800 |
| San Gorgonio Pass Water Agency | 17,300 |
| Ventura County Watershed Protection District | 20,000 |
| Subtotal | 2,629,544 |
| TOTAL TABLE A AMOUNTS | 4,172,786 |

Source: California State Water Project Bulletin 132.




Note: The differences in historical deliveries from those reported in the DCR 2015 are due to the State Water Project Analysis Office (SWPAO) reclassification of the various components of water delivered to the SWP Contractors.

Figure 4-1. Historical Deliveries of SWP Table A Water, 2007–2016




| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Carryover | 95 | 106 | 179 | 264 | 268 | 381 | 351 | 383 | 132 | 72 |
| Turnback | 16 | 3 | 2 | 11 | 31 | 8 | 99 | 1 | 3 | 14 |
| Article 21 | 310 | 3 | 6 | 8 | 421 | 0 | 0 | 1 | 1 | 3 |
| Table A | 2332 | 1246 | 1308 | 1774 | 2633 | 2227 | 1238 | 92 | 725 | 1976 |

Note: The differences in historical deliveries from the State Water Project Delivery Capability Report 2015 are due to reclassification of the various components of water delivered to SWP Contractors

Figure 4-2. Total Historical SWP Deliveries, 2007–2016 (by Delivery Type)

# Section 5
## Existing SWP Water Delivery Capability (2017)

This Section presents estimates of the SWP's existing (2017) water delivery capability (Water Year). The estimates are presented below, alongside the results obtained from the 2015 Report. Like this 2017 Report, the 2015 Report incorporated the requirements of BiOps issued by USFWS and NMFS in December 2008 and June 2009, respectively, on the effects of coordinated operations of the SWP and CVP. These BiOps are discussed in detail in Section 2, "Regulatory Restrictions on SWP Delta Exports."

The discussions of SWP water delivery capability in this Section presents the results of DWR's updated modeling of the SWP's water delivery capability. A tabular summary of the modeling results is presented in the Technical Addendum of this report, which is available online at http://baydeltaoffice.water.ca.gov/. The Technical Addendum also contains annual delivery probability curves (i.e., exceedance plots) to graphically show the estimated percentage of years in which a given annual delivery is equaled or exceeded.

### Hydrologic Sequence

SWP delivery amounts are estimated in this 2017 Report for existing conditions using computer modeling[3] that incorporates the historic range of hydrologic conditions (i.e., precipitation and runoff) that occurred from water years 1922 through 2003. The historic hydrologic conditions are adjusted to account for land-use changes (i.e., the current level of development) and upstream flow regulations that characterize 2017, and current sea levels reflecting sea level rise. By using this 82-year historical flow record, the delivery estimates modeled for existing conditions reflect a reasonable range of potential hydrologic conditions from wet years to critically dry years.

### Water Year Type Definition

The Sacramento valley 40-30-30 index is used to define the water year type. The Sacramento valley index, previously referred to as the "4 River Index" or "4 Basin Index," is the sum of the unimpaired runoff of four rivers: the Sacramento River above Bend Bridge near Red Bluff, Feather River inflow to Lake Oroville Reservoir, Yuba River at Smartville, and American River inflow to Folsom Lake. The five water year types used in the Sacramento River Index are as follows:

[3] CalSim II was used to perform the modeling simulations.
http://baydeltaoffice.water.ca.gov/modeling/hydrology/WRIMS2/index.cfm

| Table 5-1. Water year types used in the Sacramento River Index | |
|---|---|
| Sacramento River Index | Water Year Type |
| 1 | Wet |
| 2 | Above Normal |
| 3 | Below Normal |
| 4 | Dry |
| 5 | Critical |

## Existing Demand for Delta Water

Demand levels for the SWP water users in this report are derived from historical data and information from the SWP Contractors themselves. The amount of water that the SWP contractors request each year is related to:

- The magnitude (maximum contracted amount),
- The extent of water conservation measures, in place,
- Local weather patterns, and
- Water costs.

The existing level of development (i.e., the level of water use in the source areas from which the water supply originates) is based on recent land uses, and is assumed to be representative of existing conditions for the purposes of this 2017 Report.

### SWP Table A Water Demands

The current combined maximum Table A amount is 4,173 taf/year. See Table 4-1 in Section 4, “State Water Project Historical Delivery Capability (2007-2016). Of the combined maximum Table A amount, 4,133 taf/year is the SWP’s maximum Table A water available for delivery from the Delta.

The estimated demands by SWP Contractors for deliveries of Table A water from the Delta under existing conditions is assumed to be the maximum SWP Table A delivery amount for the 2017 Report (Table 5-2). Estimated demands for SWP Table A water is 1 taf/year higher than the 2015 Report since the maximum Table A demand amount for some SWP Contractors has changed in Table 4-1 according to the California State Water Project Bulletin 132. Due to the fact that SWP Contractors have been requesting the full amount in recent years, the 2015, and the 2017 Reports more accurately reflect the trend in demand.

| Table 5-2. Comparison of Estimated Average, Maximum, and Minimum Demands for SWP Table A Water, Excluding Butte County and Yuba City (Existing Conditions, in taf/year) | | |
|---|---|---|
| | 2015 Report | 2017 Report |
| Average | 4,132 | 4,133 |
| Maximum | 4,132 | 4,133 |
| Minimum | 4,132 | 4,133 |

## SWP Article 21 Water Demands

Under Article 21 of the SWP's long-term water supply contracts, Contractors may receive additional water deliveries only under the following specific conditions:

- Such deliveries do not interfere with SWP Table A allocations and SWP operations;
- Excess water is available in the Delta;
- Capacity is not being used for SWP purposes or scheduled SWP deliveries; and
- Contractors can use the SWP Article 21 water directly or can store it in their own system (i.e., the water cannot be stored in the SWP system).

The demand for SWP Article 21 water by SWP Contractors is assumed to vary depending on the month and weather conditions (i.e., amounts of precipitation and runoff). To illustrate how demand varies and for the purposes of this discussion of SWP Article 21 water demands, a Kern wet year is defined as a year when the annual Kern River flow is projected to be greater than 1,500 taf. There are nine Kern wet years in the simulation period of 1922 – 2003 (1941, 1952, 1969, 1978, 1980, 1983, 1986, 1995, and 1998). Kern River inflows are important because they are a major component of the local water supply for Kern County Water Agency (KCWA), which is the second largest SWP Contractor and possesses significant local groundwater recharge capability. During Kern wet years, KCWA uses more Kern River flows to recharge its groundwater storage and reduce its demand for Article 21 water.

As shown in Figure 5-1, existing demands for SWP Article 21 water estimated for this 2017 update of the DCR are assumed to be high during the spring and late fall in Kern non-wet years (214 taf/month) because most of the irrigation districts in this service area cannot rely as heavily on the Kern River flows to recharge their groundwater basins. Demand for Article 21 water is also high during the winter months of December through March in all year types (202 taf in Kern wet years and 414 taf in Kern non-wet years). Demands are assumed to be very low (2 taf/month) from April through November of Kern wet years (because high Kern River flows provide groundwater recharge water) and from July through October of Kern dry years.

These demand patterns for SWP Article 21 water are identical to what were used in the 2015 update of the DCR, for existing conditions.

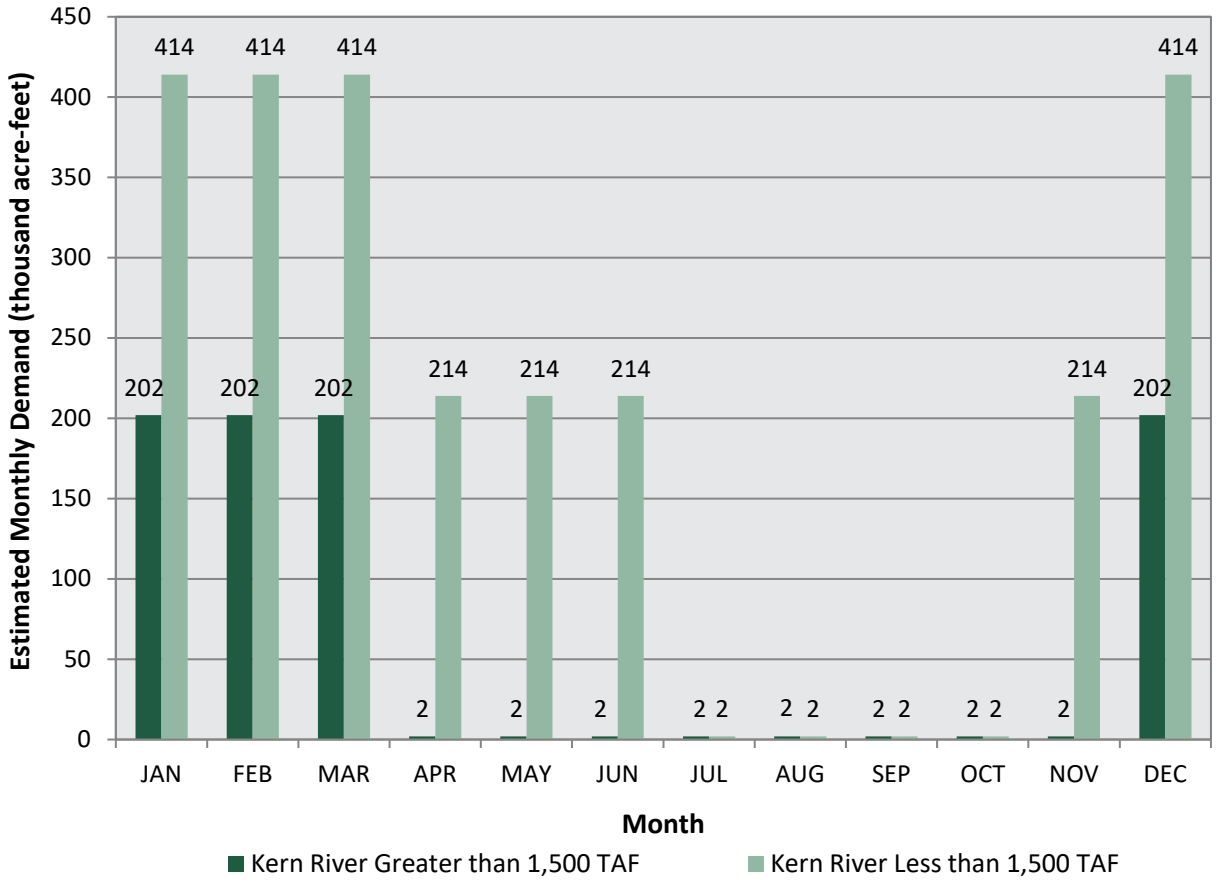
## Estimates of SWP Table A Water Deliveries

Table 5-3 presents the annual average, maximum, and minimum estimates of SWP Table A deliveries from the Delta for existing conditions, as calculated for the 2015 and 2017 Reports. The average Table A deliveries increased in the 2017 Report mostly due to 30 taf/year demand reduction for the Placer County water agency in the North of Delta. The demand reduction resulted in higher inflow into the Delta, therefore, more water became available for SWP Table A deliveries (Table 5-3).

**Table 5-3. Comparison of Estimated Average, Maximum, and Minimum Deliveries of SWP Table A Water, Excluding Butte County and Yuba City (Existing Conditions, in taf/year)**

| | 2015 Report | 2017 Report |
|---|---|---|
| Average | 2,550 | 2,571 |
| Maximum | 4,055 | 4,098 |
| Minimum | 454 | 336 |

Assumptions about Table A and Article 21 water demands, along with operations for carryover water, have been updated in the model based on discussions with State Water Contractors staff and DWR's Operations and Control Office.




Note: Values shown are the maximum amount that can be delivered monthly. However, the actual capability of SWP water Contractors to take this amount of SWP Article 21 water is not the sum of these maximum monthly values.

Figure 5-1. SWP Article 21 Demands during Non–Kern Wet Years and Kern Wet Years (Existing Conditions)

Figure 5-2 presents the estimated likelihood of delivery of a given amount of SWP Table A water under the existing conditions scenario, as estimated for both the 2015 and 2017 Reports. This figure shows a 77% likelihood (74% with the 2015 Report) that more than 2,000 taf/year of Table A water will be delivered under the current estimates. The distribution of the delivery ranges has also changed since the 2015 Report. Figure 5-2 shows a shift of Table A deliveries from 500-1,000 taf/year range to 2,000-3000 taf/year range in comparison to the 2015 Report due to the demand decrease in the North of Delta and Water Supply Index – Delivery Index[4] (WSI-DI) curve in the study.

[4] WSI-DI relates forecasted water supplies to deliverable "demand," and then use deliverable "demand" to assign subsequent delivery levels to estimate the water available for delivery and carryover storage.

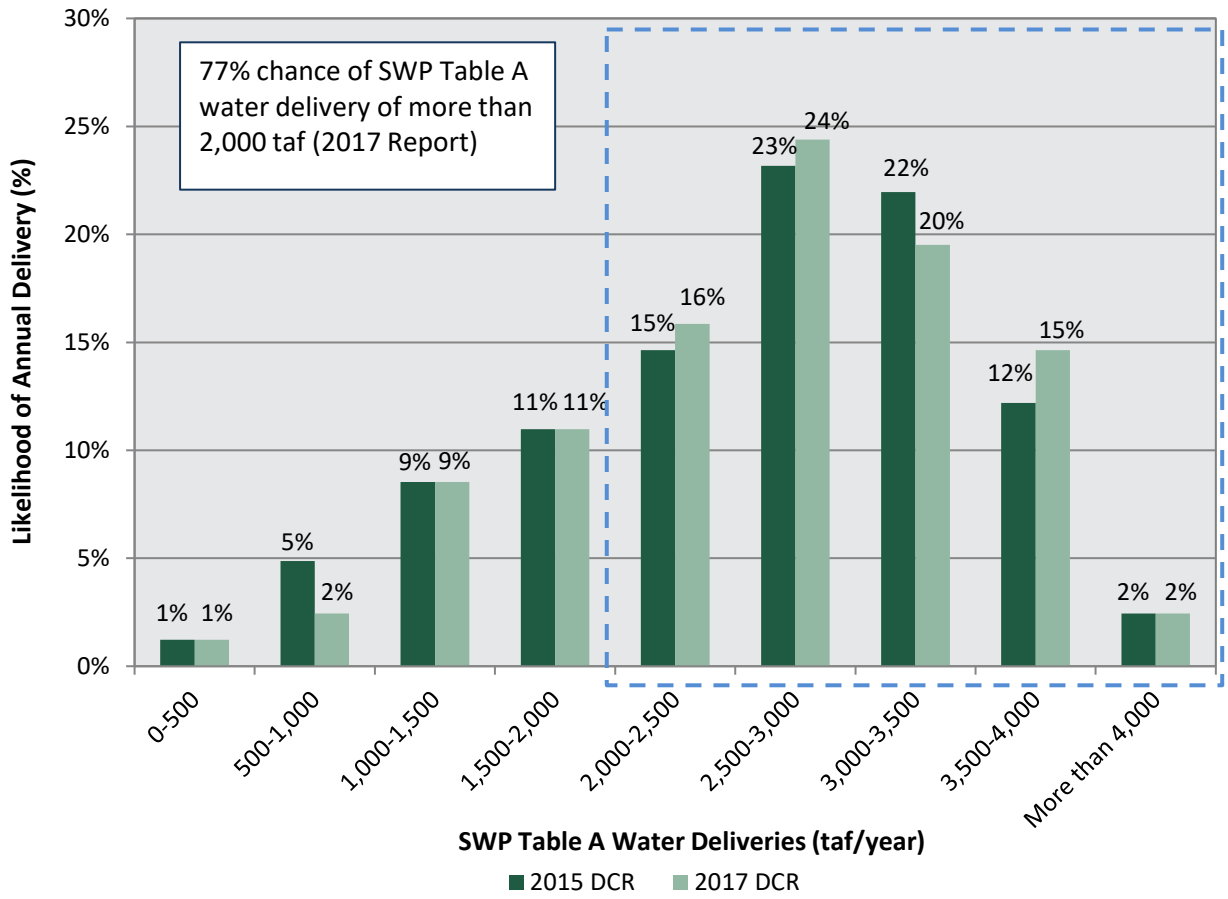



Figure 5-2. Estimated Likelihood of SWP Table A Water Deliveries, by Increments of 500 taf (Excluding Butte County and Yuba City)

## Wet-Year Deliveries of SWP Table A Water

Table 5-4 and Figure 5-3 present estimates of SWP Table A water deliveries under existing conditions during possible wet conditions and compares them with corresponding delivery estimates calculated for the 2015 Report. Wet periods for 2017 are analyzed using historical precipitation and runoff patterns from 1922–2003 as a reference, while accounting for existing 2017 conditions (e.g., land use, water infrastructure). For reference, the wettest single year on the 1992-2003 record was 1983.

The results of modeling existing conditions over historical wet years indicate that SWP Table A water deliveries during wet periods can be estimated to range between yearly averages of 4,098 to 3,163 taf.

Table 5-4 shows that the 2017 deliveries of SWP Table A water stayed relatively the same in wet periods in comparison to the 2015 Report.

Table 5-4. Estimated Average and Wet-Period Deliveries of SWP Table A Water, Excluding Butte County and Yuba City (Existing Conditions, in taf/year), and Percent of Maximum SWP Table A Amount, 4,133 taf/year

| | Long-term Average (1921–2003) | | Single Wet Year (1983) | | Wet Periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 Years (1982–1983) | | 4 Years (1980–1983) | | 6 Years (1978–1983) | | 10 Years (1978–1987) | |
| 2015 Report | 2,550 | 62% | 4,055 | 98% | 3,946 | 95% | 3,558 | 86% | 3,414 | 83% | 3,123 | 76% |
| 2017 Report | 2,571 | 62% | 4,098 | 99% | 3,967 | 96% | 3,569 | 86% | 3,433 | 83% | 3,163 | 77% |

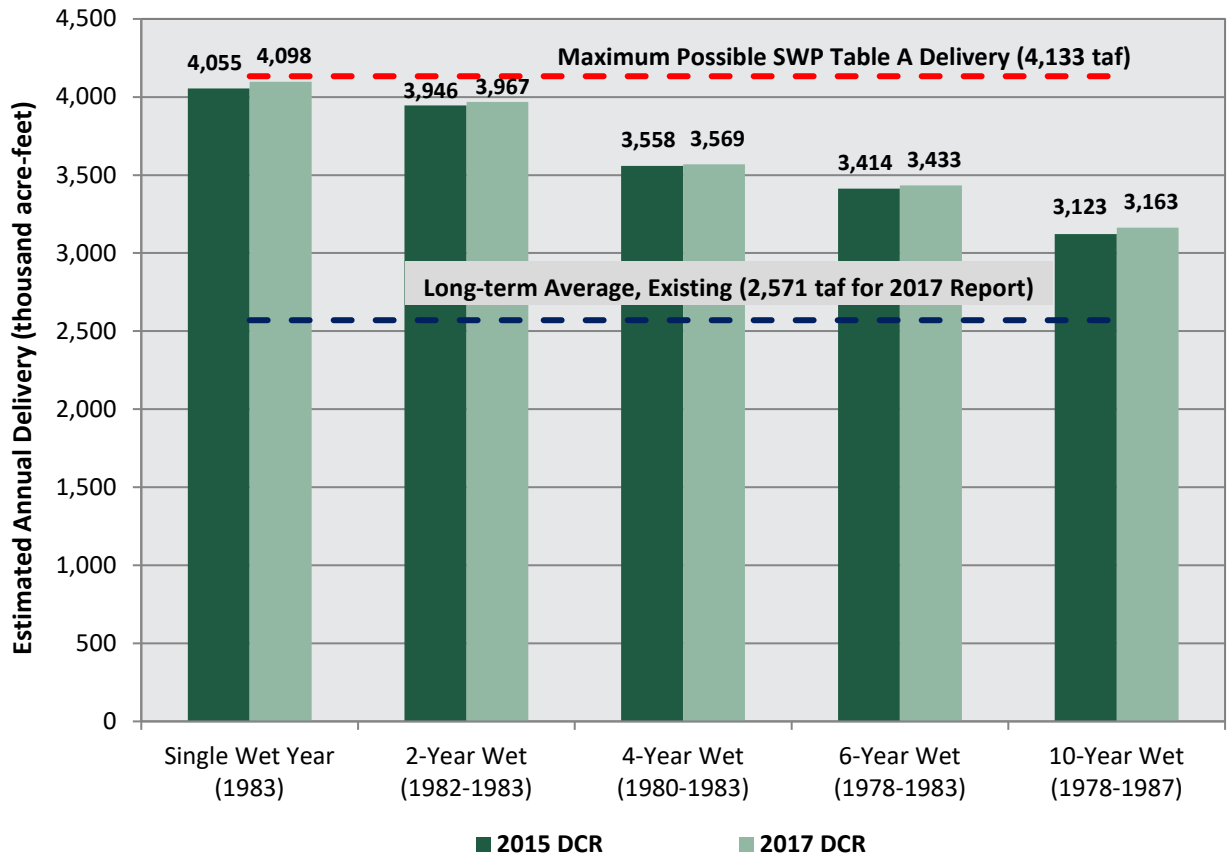



Figure 5-3. Estimated Wet-Period SWP Table A Water Deliveries (Excluding Butte County and Yuba City)

## Dry-Year Deliveries of SWP Table A Water

Table 5-5 and Figure 5-4 display estimates of existing-conditions deliveries of SWP Table A water during possible drought conditions and compares them with the corresponding delivery estimates calculated for the 2015 Report. Droughts are analyzed using the historical drought-period precipitation and runoff patterns from 1922 through 2003 as a reference, although existing 2015 conditions (e.g., land use, water infrastructure) are also accounted for in the modeling. For reference, the worst multiyear drought on the 1922-2003 record was the 1929–1934 drought, although the brief drought of 1976–1977 was more intensely dry.

The results of modeling existing conditions under historical drought scenarios indicate

that SWP Table A water deliveries during dry years can be estimated to range between yearly averages of 336 and 1,408 taf.

On average, the dry-period deliveries of Table A water are higher in this 2017 Report than in the 2015 Report due to the demand decrease in the North of Delta and WSI-DI curve in the study. Table 5-5 indicates that the Table A deliveries for the single dry year (1977) has decreased, but the two-year drought (1976-1977) has increased. WSI-DI along with the model allocation logic allowed more water delivery in water year 1976, but less water delivery in water year 1977.

**Table 5-5. Estimated Average and Dry-Period Deliveries of SWP Table A Water, Excluding Butte County and Yuba City (Existing Conditions, in taf/year), and Percent of Maximum SWP Table A Amount, 4,133**

| | Long-term Average (1921–2003) | | Single Dry Year (1977) | | Dry Periods | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2-Year Drought (1976–1977) | | 4-Year Drought (1931–1934) | | 6-Year Drought (1987–1992) | | 6-Year Drought (1929–1934) | |
| 2015 Report | 2,550 | 62% | 454 | 11% | 1,165 | 28% | 1,356 | 33% | 1,182 | 29% | 1,349 | 33% |
| 2017 Report | 2,571 | 62% | 336 | 8% | 1,206 | 29% | 1,397 | 34% | 1,203 | 29% | 1,408 | 34% |

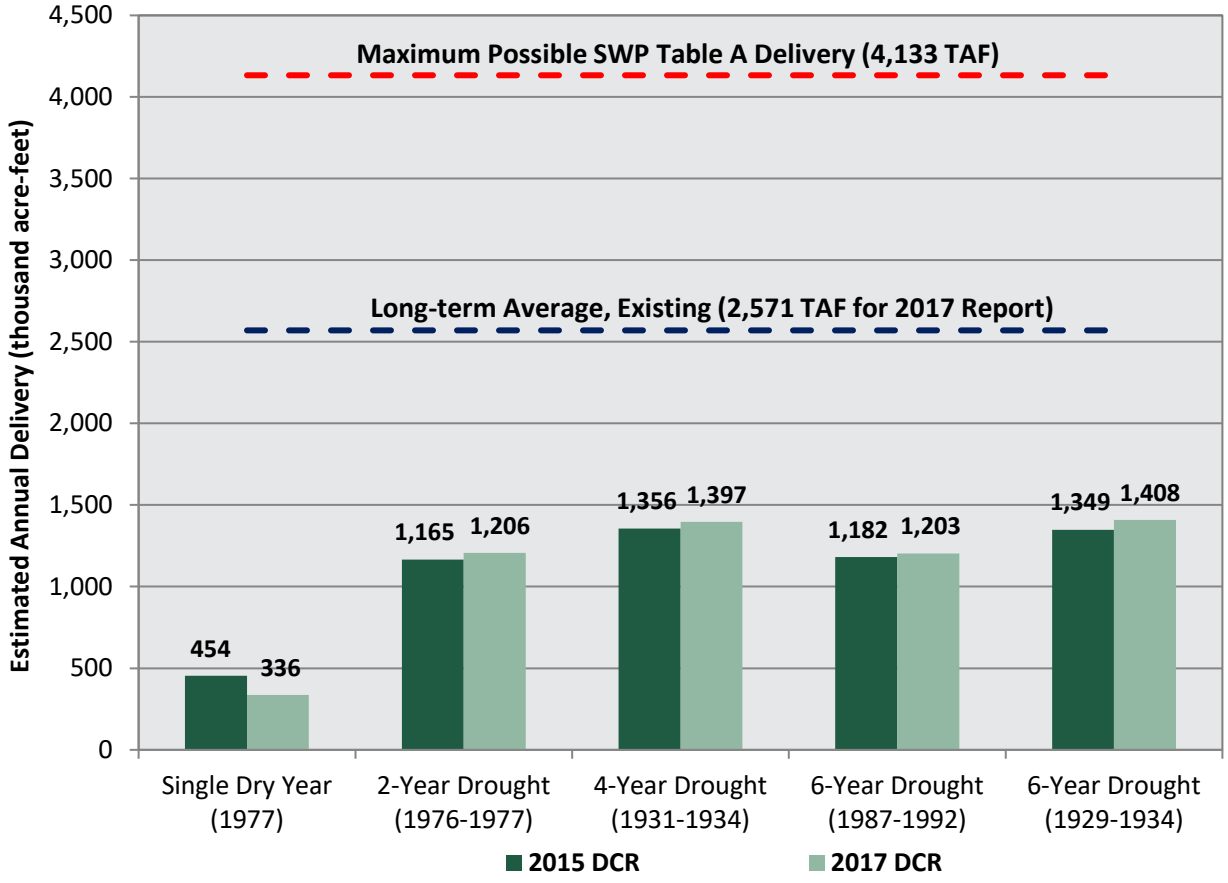



Figure 5-4. Estimated Dry-Period SWP Table A Water Deliveries (Excluding Butte County and Yuba City)

## Estimates of SWP Article 21 Water Deliveries

SWP water delivery is a combination of deliveries of Table A water and Article 21 water. Some SWP Contractors store Article 21 water locally when extra water and capacity are available beyond that needed by normal SWP operations. Deliveries of SWP Article 21 water vary not only by year, but also by month. The estimated range of monthly deliveries of SWP Article 21 water is displayed in Figure 5-5. In May through October, essentially no Article 21 water is estimated to be delivered. In the late fall and winter (November through April), maximum monthly deliveries range from 84 to 340 taf/month.

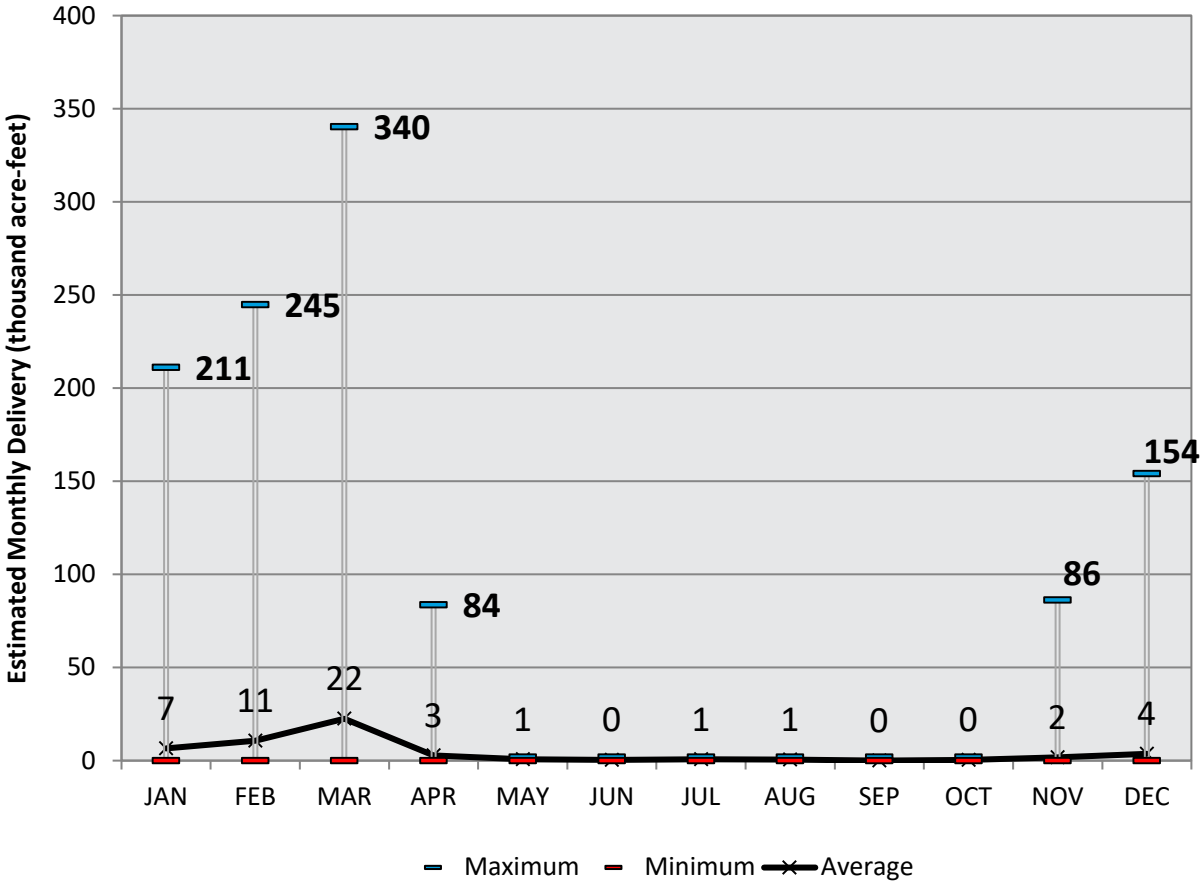



Figure 5-5. Estimated Range of Monthly Deliveries of SWP Article 21 Water (Existing Conditions)

The estimated likelihood that a given amount of SWP Article 21 water will be delivered is presented in Figure 5-6.

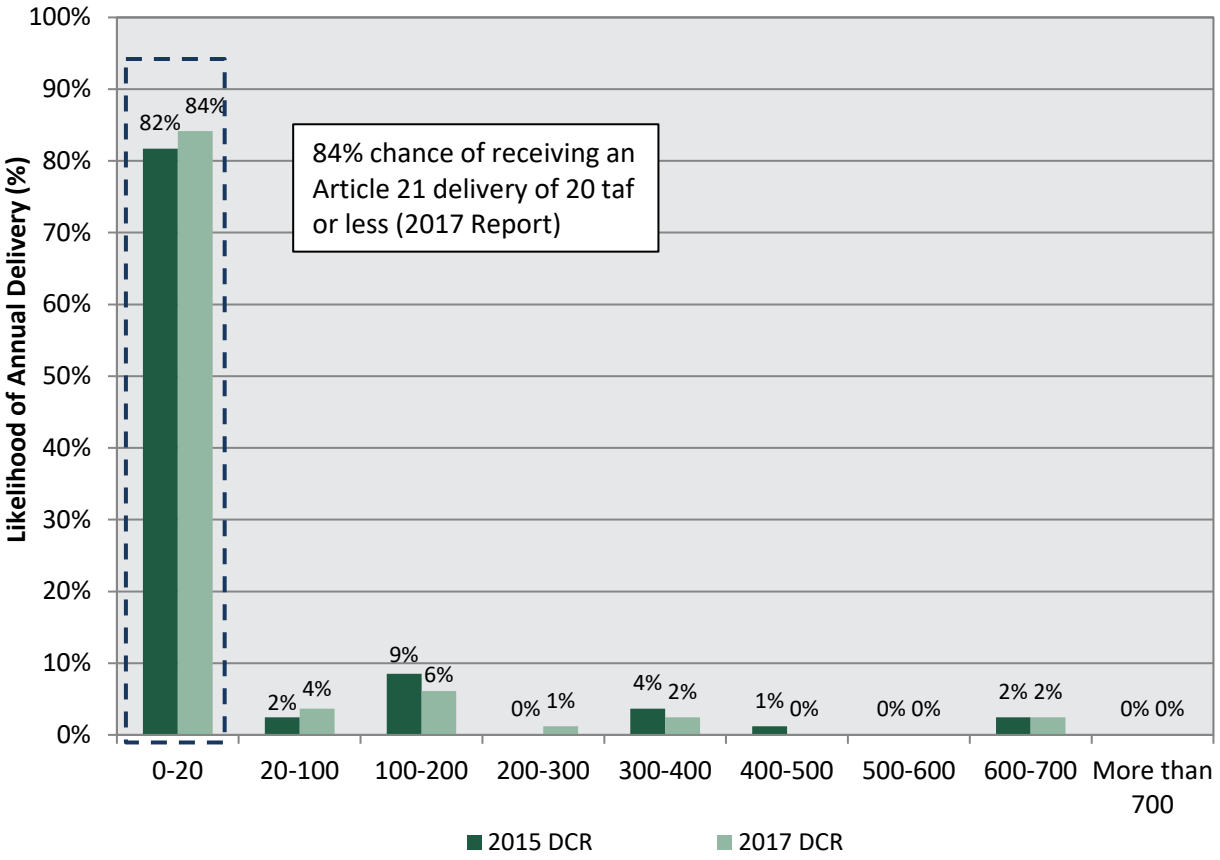



Figure 5-6. Estimated Likelihood of Annual Deliveries of SWP Article 21 Water (Existing Conditions)

## Wet-Year Deliveries of SWP Article 21 Water

Table 5-6 shows the estimates of deliveries of SWP Article 21 water during wet periods under existing conditions. Estimated deliveries in wet years are approximately 1.7 to 5.5 times larger than the average existing-conditions delivery of SWP Article 21 water.

In general, the wet-period Article 21 deliveries in this 2017 Report are lower than in the 2015 Report.

**Table 5-6. Estimated Average and Wet-Period Deliveries of SWP Article 21 Water (Existing Conditions, in taf/year)**

| | Long-term Average (1921–2003) | Single Wet Year (1983) | Wet Periods | | | |
|---|---|---|---|---|---|---|
| | | | 2 Years (1982–1983) | 4 Years (1980–1983) | 6 Years (1978–1983) | 10 Years (1978–1987) |
| 2015 Report | 56 | 316 | 204 | 134 | 93 | 134 |
| 2017 Report | 50 | 273 | 183 | 123 | 86 | 123 |

## Dry-Year Deliveries of SWP Article 21 Water

Although deliveries of SWP Article 21 water are smaller during dry years than during wet ones, opportunities exist to deliver SWP Article 21 water during multiyear drought periods. As modeled, deliveries in dry years are often small (less than 5 taf); however, longer drought periods can include several years that support Article 21 deliveries. Annual average Article 21 estimates for drought periods of 4 and 6 years vary greatly and can approach a significant fraction of the long-term average annual estimate, as shown in Table 5-7.

**Table 5-7. Estimated Average and Dry-Period Deliveries of SWP Article 21 Water (Existing Conditions, in taf/year)**

| | Long-term Average (1921–2003) | Single Dry Year (1977) | Wet Periods | | | |
|---|---|---|---|---|---|---|
| | | | 2-Year Drought (1976–1977) | 4-Year Drought (1931–1934) | 6-Year Drought (1987–1992) | 6-Year Drought (1929–1934) |
| 2015 Report | 56 | 8 | 12 | 41 | 13 | 31 |
| 2017 Report | 50 | 8 | 14 | 16 | 13 | 15 |

# Section 6

## Historical SWP Delivery Tables for 2007–2016

The State Water Project (SWP) contracts define several types of SWP water available for delivery to its Contractors under specific circumstances: Table A water, Article 21 water, turnback pool water, and carryover water. Many SWP Contractors frequently use Article 21, turnback pool, and carryover water to increase or decrease the amount of water available to them under SWP Table A.

Tables 6-1 through 6-10 list annual historical deliveries by SWP water type for each Contractor for 2007 through 2016. Similar delivery tables are presented for years 2005–2014 in the *State Water Project Delivery Capability Report 2015.* Any differences in values presented in this 2017 report and those in the 2015 report are due to reclassification of deliveries since the production of the 2015 report.

| Table 6–1. Historical State Water Project Deliveries, Calendar Year 2007 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 720 | - | - | - | 720 |
| | Plumas County FCWCD | - | - | - | - | - |
| | Yuba City | 2,327 | - | - | - | 2,327 |
| | **Subtotal** | **3,047** | **-** | **-** | **-** | **3,047** |
| North Bay Area | Napa County FCWCD | 6,362 | 3,597 | 998 | - | 10,957 |
| | Solano County WA | 14,892 | 8,217 | 1,822 | - | 24,931 |
| | **Subtotal** | **21,254** | **11,814** | **2,820** | **-** | **35,888** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 32,972 | 912 | 2,895 | 378 | 37,157 |
| | Alameda County WD | 16,541 | 550 | 2,103 | 197 | 19,391 |
| | Santa Clara Valley WD | 38,812 | 4,840 | 8,161 | 469 | 52,282 |
| | **Subtotal** | **88,325** | **6,302** | **13,159** | **1,044** | **108,830** |
| San Joaquin Valley Area | Dudley Ridge WD | 28,457 | 8,953 | 2,000 | 269 | 39,679 |
| | Empire West Side ID | 397 | 1,172 | 515 | - | 2,084 |
| | Kern County WA | 592,423 | 99,861 | 19,645 | 4,683 | 716,612 |
| | Kings County | 4,924 | 474 | 305 | 43 | 5,746 |
| | Oak Flat WD | 3,420 | 41 | 69 | 27 | 3,557 |
| | Tulare Lake Basin WSD | 57,272 | 12,902 | 16,459 | 450 | 87,083 |
| | **Subtotal** | **686,893** | **123,403** | **38,993** | **5,472** | **854,761** |
| Central Coastal Area | San Luis Obispo County FCWCD | 3,752 | 24 | - | - | 3,776 |
| | Santa Barbara County FCWCD | 24,760 | 1,070 | 1,390 | - | 27,220 |
| | **Subtotal** | **28,512** | **1,094** | **1,390** | **-** | **30,996** |
| Southern California Area | Antelope Valley–East Kern WA | 74,459 | - | 4,364 | - | 78,823 |
| | Castaic Lake WA | 44,974 | - | 4,216 | - | 49,190 |
| | Coachella Valley WD | 72,660 | - | - | 568 | 73,228 |
| | Crestline–Lake Arrowhead WA | 1,768 | - | - | - | 1,768 |
| | Desert WA | 30,000 | - | - | 234 | 30,234 |
| | Littlerock Creek ID | 1,380 | - | - | - | 1,380 |
| | Metropolitan WD of Southern California | 1,146,900 | 166,517 | 28,098 | 8,962 | 1,350,477 |
| | Mojave WA | 45,372 | - | 737 | - | 46,109 |
| | Palmdale WD | 12,780 | 843 | 985 | 100 | 14,708 |
| | San Bernardino Valley MWD | 57,116 | - | - | - | 57,116 |
| | San Gabriel Valley MWD | 10,000 | - | - | - | 10,000 |
| | San Gorgonio Pass WA | 3,935 | - | - | - | 3,935 |
| | Ventura County WPD | 3,000 | - | - | - | 3,000 |
| | **Subtotal** | **1,504,344** | **167,360** | **38,400** | **9,864** | **1,719,968** |
| **TOTAL SWP DELIVERIES** | | **2,332,375** | **309,973** | **94,762** | **16,380** | **2,753,490** |

| Table 6–2. Historical State Water Project Deliveries, Calendar Year 2008 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 9,436 | - | - | - | 9,436 |
| | Plumas County FCWCD | 243 | - | - | - | 243 |
| | Yuba City | 1,923 | - | - | - | 1,923 |
| | **Subtotal** | **11,602** | **-** | **-** | **-** | **11,602** |
| North Bay Area | Napa County FCWCD | 3,636 | 1,219 | 7,363 | 21 | 12,239 |
| | Solano County WA | 10,436 | 1,510 | 12,389 | - | 24,335 |
| | **Subtotal** | **14,072** | **2,729** | **19,752** | **21** | **36,574** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 13,634 | - | 15,399 | - | 29,033 |
| | Alameda County WD | 4,206 | - | 8,659 | 37 | 12,902 |
| | Santa Clara Valley WD | 11,133 | - | 21,188 | 88 | 32,409 |
| | **Subtotal** | **28,973** | **-** | **45,246** | **125** | **74,344** |
| San Joaquin Valley Area | Dudley Ridge WD | 12,260 | - | 5,949 | 51 | 18,260 |
| | Empire West Side ID | - | - | 915 | - | 915 |
| | Kern County WA | 275,555 | - | 2,896 | 883 | 279,334 |
| | Kings County | 3,187 | - | 541 | 8 | 3,736 |
| | Oak Flat WD | 1,929 | - | - | 5 | 1,934 |
| | Tulare Lake Basin WSD | 32,302 | - | 281 | 85 | 32,668 |
| | **Subtotal** | **325,233** | **-** | **10,582** | **1,032** | **336,847** |
| Central Coastal Area | San Luis Obispo County FCWCD | 8,512 | - | - | - | 8,512 |
| | Santa Barbara County FCWCD | 11,311 | - | 2,532 | 40 | 13,883 |
| | **Subtotal** | **19,823** | **-** | **2,532** | **40** | **22,395** |
| Southern California Area | Antelope Valley–East Kern WA | 31,082 | - | 10,381 | 125 | 41,588 |
| | Castaic Lake WA | 18,710 | - | 12,146 | - | 30,856 |
| | Coachella Valley WD | 42,385 | - | - | 107 | 42,492 |
| | Crestline–Lake Arrowhead WA | 1,159 | - | 689 | - | 1,848 |
| | Desert WA | 17,500 | - | - | 44 | 17,544 |
| | Littlerock Creek ID | 805 | - | - | - | 805 |
| | Metropolitan WD of Southern California | 658,304 | - | - | 1,689 | 659,993 |
| | Mojave WA | 26,288 | - | 108 | - | 26,396 |
| | Palmdale WD | 4,226 | - | - | 19 | 4,245 |
| | San Bernardino Valley MWD | 26,562 | - | 4,444 | - | 31,006 |
| | San Gabriel Valley MWD | 10,080 | - | - | - | 10,080 |
| | San Gorgonio Pass WA | 5,419 | - | 300 | - | 5,719 |
| | Ventura County WPD | 3,798 | - | - | - | 3,798 |
| | **Subtotal** | **846,318** | | **28,068** | **1,984** | **876,370** |
| **TOTAL SWP DELIVERIES** | | **1,246,021** | **2,729** | **106,180** | **3,202** | **1,358,132** |

| Table 6–3. Historical State Water Project Deliveries, Calendar Year 2009 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 10,206 | - | - | - | 10,206 |
| | Plumas County FCWCD | 200 | - | - | - | 200 |
| | Yuba City | 2,114 | - | - | - | 2,114 |
| | **Subtotal** | **12,520** | **-** | **-** | **-** | **12,520** |
| North Bay Area | Napa County FCWCD | 2,723 | 1,588 | 4,475 | 13 | 8,799 |
| | Solano County WA | 7,118 | 4,444 | 3,123 | - | 14,685 |
| | **Subtotal** | **9,841** | **6,032** | **7,598** | **13** | **23,484** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 11,746 | - | 14,583 | - | 26,329 |
| | Alameda County WD | 5,911 | - | 10,494 | 8 | 16,413 |
| | Santa Clara Valley WD | 9,188 | - | 23,867 | 54 | 33,109 |
| | **Subtotal** | **26,845** | **-** | **48,944** | **62** | **75,851** |
| San Joaquin Valley Area | Dudley Ridge WD | 13,185 | - | 7,810 | 32 | 21,027 |
| | Empire West Side ID | 1,034 | - | - | - | 1,034 |
| | Kern County WA | 325,426 | - | 56,367 | 544 | 382,337 |
| | Kings County | 3,153 | - | 70 | 5 | 3,228 |
| | Oak Flat WD | 1,825 | - | 66 | 3 | 1,894 |
| | Tulare Lake Basin WSD | 35,160 | - | 1,271 | 52 | 36,483 |
| | **Subtotal** | **379,783** | **-** | **65,584** | **636** | **446,003** |
| Central Coastal Area | San Luis Obispo County FCWCD | 9,723 | - | - | - | 9,723 |
| | Santa Barbara County FCWCD | 4,961 | - | 4,523 | 25 | 9,509 |
| | **Subtotal** | **14,684** | **-** | **4,523** | **25** | **19,232** |
| Southern California Area | Antelope Valley–East Kern WA | 13,499 | - | 18,408 | 77 | 31,984 |
| | Castaic Lake WA | 14,858 | - | 9,529 | 52 | 24,439 |
| | Coachella Valley WD | 40,845 | - | - | 66 | 40,911 |
| | Crestline–Lake Arrowhead WA | 1,000 | - | 893 | - | 1,893 |
| | Desert WA | 16,865 | - | - | 27 | 16,892 |
| | Littlerock Creek ID | 920 | - | - | - | 920 |
| | Metropolitan WD of Southern California | 696,817 | - | 10,721 | 1,042 | 708,580 |
| | Mojave WA | 30,300 | - | 242 | - | 30,542 |
| | Palmdale WD | 2,470 | - | 3,229 | - | 5,699 |
| | San Bernardino Valley MWD | 26,085 | - | 9,348 | - | 35,433 |
| | San Gabriel Valley MWD | 11,516 | - | - | - | 11,516 |
| | San Gorgonio Pass WA | 5,312 | - | 480 | - | 5,792 |
| | Ventura County WPD | 3,890 | - | - | - | 3,890 |
| | **Subtotal** | **864,377** | **-** | **52,850** | **1,264** | **918,491** |
| **TOTAL SWP DELIVERIES** | | **1,308,050** | **6,032** | **179,499** | **2,000** | **1,495,581** |

| Table 6–4. Historical State Water Project Deliveries, Calendar Year 2010 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 807 | - | - | - | 807 |
| | Plumas County FCWCD | 243 | - | - | - | 243 |
| | Yuba City | 2,331 | - | - | - | 2,331 |
| | **Subtotal** | **3,381** | **-** | **-** | **-** | **3,381** |
| North Bay Area | Napa County FCWCD | 7,275 | 2,207 | 2,845 | 90 | 12,417 |
| | Solano County WA | 13,793 | 5,298 | 3,661 | - | 22,752 |
| | **Subtotal** | **21,068** | **7,505** | **6,506** | **90** | **35,169** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 28,694 | - | 13,104 | 249 | 42,047 |
| | Alameda County WD | 11,668 | - | 10,889 | 14 | 22,571 |
| | Santa Clara Valley WD | 37,850 | - | 22,471 | 34 | 60,355 |
| | **Subtotal** | **78,212** | **-** | **46,464** | **297** | **124,973** |
| San Joaquin Valley Area | Dudley Ridge WD | 19,650 | - | 9,750 | 156 | 29,556 |
| | Empire West Side ID | 380 | - | 166 | - | 546 |
| | Kern County WA | 411,821 | - | 55,419 | 3,044 | 470,284 |
| | Kings County | 4,094 | - | 522 | 29 | 4,645 |
| | Oak Flat WD | 2,412 | - | 455 | 18 | 2,885 |
| | Tulare Lake Basin WSD | 39,835 | - | 3,199 | 275 | 43,309 |
| | **Subtotal** | **478,192** | **-** | **69,511** | **3,522** | **551,225** |
| Central Coastal Area | San Luis Obispo County FCWCD | 3,480 | - | 277 | - | 3,757 |
| | Santa Barbara County FCWCD | 8,640 | - | 8,995 | 140 | 17,775 |
| | **Subtotal** | **12,120** | **-** | **9,272** | **140** | **21,532** |
| Southern California Area | Antelope Valley–East Kern WA | 35,312 | - | 20,813 | 438 | 56,563 |
| | Castaic Lake WA | 37,054 | - | 14,501 | 295 | 51,850 |
| | Coachella Valley WD | 69,175 | - | 7,595 | 429 | 77,199 |
| | Crestline–Lake Arrowhead WA | 1,357 | - | - | - | 1,357 |
| | Desert WA | 27,875 | - | 3,135 | 173 | 31,183 |
| | Littlerock Creek ID | 1,150 | - | - | - | 1,150 |
| | Metropolitan WD of Southern California | 900,210 | - | 67,783 | 5,922 | 973,915 |
| | Mojave WA | 41,132 | - | 20 | - | 41,152 |
| | Palmdale WD | 5,585 | - | 5,325 | 59 | 10,969 |
| | San Bernardino Valley MWD | 38,133 | - | 11,273 | - | 49,406 |
| | San Gabriel Valley MWD | 14,400 | - | - | - | 14,400 |
| | San Gorgonio Pass WA | 5,226 | - | 1,608 | 6 | 6,840 |
| | Ventura County WPD | 4,075 | - | - | - | 4,075 |
| | **Subtotal** | **1,180,684** | **-** | **132,053** | **7,322** | **1,320,059** |
| **TOTAL SWP DELIVERIES** | | **1,773,657** | **7,505** | **263,806** | **11,371** | **2,056,339** |

| Table 6–5. Historical State Water Project Deliveries, Calendar Year 2011 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 1,092 | - | - | - | 1,092 |
| | Plumas County FCWCD | 98 | - | - | - | 98 |
| | Yuba City | 2,297 | - | - | - | 2,297 |
| | **Subtotal** | **3,487** | **-** | **-** | **-** | **3,487** |
| North Bay Area | Napa County FCWCD | 9,426 | - | 1,388 | - | 10,814 |
| | Solano County WA | 9,620 | 14,739 | - | - | 24,359 |
| | **Subtotal** | **19,046** | **14,739** | **1,388** | **-** | **35,173** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 39,066 | - | 11,675 | 1,319 | 52,060 |
| | Alameda County WD | 24,813 | 1,959 | 9,332 | 506 | 36,610 |
| | Santa Clara Valley WD | 64,538 | 970 | 20,491 | - | 85,999 |
| | **Subtotal** | **128,417** | **2,929** | **41,498** | **1,825** | **174,669** |
| San Joaquin Valley Area | Dudley Ridge WD | 40,141 | 11,666 | 5,524 | 823 | 58,154 |
| | Empire West Side ID | 1,626 | 138 | 151 | - | 1,915 |
| | Kern County WA | 753,707 | 194,119 | 119,773 | 16,068 | 1,083,667 |
| | Kings County | 5,294 | 552 | 558 | 152 | 6,556 |
| | Oak Flat WD | 2,644 | - | 71 | - | 2,715 |
| | Tulare Lake Basin WSD | 39,056 | 6,909 | 4,626 | 1,454 | 52,045 |
| | **Subtotal** | **842,468** | **213,384** | **130,703** | **18,497** | **1,205,052** |
| Central Coastal Area | San Luis Obispo County FCWCD | 3,340 | - | 479 | - | 3,819 |
| | Santa Barbara County FCWCD | 29,132 | - | 9,318 | - | 38,450 |
| | **Subtotal** | **32,472** | **-** | **9,797** | **-** | **42,269** |
| Southern California Area | Antelope Valley–East Kern WA | 77,549 | 7,629 | 5,888 | - | 91,066 |
| | Castaic Lake WA | 34,067 | 400 | 9,332 | - | 43,799 |
| | Coachella Valley WD | 88,017 | - | - | 2,262 | 90,279 |
| | Crestline–Lake Arrowhead WA | 423 | - | 51 | - | 474 |
| | Desert WA | 36,139 | - | - | 240 | 36,379 |
| | Littlerock Creek ID | - | - | - | - | - |
| | Metropolitan WD of Southern California | 1,286,935 | 181,610 | 55,540 | 8,237 | 1,532,322 |
| | Mojave WA | 4,831 | - | 268 | - | 5,099 |
| | Palmdale WD | 12,294 | - | 5,019 | - | 17,313 |
| | San Bernardino Valley MWD | 30,916 | - | 7,210 | - | 38,126 |
| | San Gabriel Valley MWD | 23,040 | - | - | - | 23,040 |
| | San Gorgonio Pass WA | 8,884 | - | 1,619 | - | 10,503 |
| | Ventura County WPD | 4,000 | - | - | - | 4,000 |
| | **Subtotal** | **1,607,095** | **189,639** | **84,927** | **10,739** | **1,892,400** |
| **TOTAL SWP DELIVERIES** | | **2,632,985** | **420,691** | **268,313** | **31,061** | **3,353,050** |

| Table 6–6. Historical State Water Project Deliveries, Calendar Year 2012 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 17,875 | - | - | - | 17,875 |
| | Plumas County FCWCD | 79 | - | - | - | 79 |
| | Yuba City | 2,695 | - | - | - | 2,695 |
| | **Subtotal** | **20,649** | **-** | **-** | **-** | **20,649** |
| North Bay Area | Napa County FCWCD | 5,065 | - | 4,278 | 64 | 9,407 |
| | Solano County WA | 11,673 | - | 9,641 | - | 21,314 |
| | **Subtotal** | **16,738** | **-** | **13,919** | **64** | **30,721** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 32,301 | - | 20,357 | 179 | 52,837 |
| | Alameda County WD | 11,951 | - | 8,787 | 93 | 20,831 |
| | Santa Clara Valley WD | 34,612 | - | 11,462 | 222 | 46,296 |
| | **Subtotal** | **78,864** | **-** | **40,606** | **494** | **119,964** |
| San Joaquin Valley Area | Dudley Ridge WD | 17,694 | - | - | 112 | 17,806 |
| | Empire West Side ID | 1,468 | - | 774 | - | 2,242 |
| | Kern County WA | 560,969 | - | 32,477 | 2,180 | 595,626 |
| | Kings County | 5,337 | - | 2,001 | 21 | 7,359 |
| | Oak Flat WD | 2,596 | - | 612 | - | 3,208 |
| | Tulare Lake Basin WSD | 53,630 | - | 32,081 | 197 | 85,908 |
| | **Subtotal** | **641,694** | **-** | **67,945** | **2,510** | **712,149** |
| Central Coastal Area | San Luis Obispo County FCWCD | 3,111 | - | 833 | - | 3,944 |
| | Santa Barbara County FCWCD | 20,874 | - | 43 | - | 20,917 |
| | **Subtotal** | **23,985** | **-** | **876** | **-** | **24,861** |
| Southern California Area | Antelope Valley–East Kern WA | 80,694 | - | 32,854 | - | 113,548 |
| | Castaic Lake WA | 42,707 | - | 11,350 | - | 54,057 |
| | Coachella Valley WD | 89,928 | - | 22,663 | 307 | 112,898 |
| | Crestline–Lake Arrowhead WA | 624 | - | - | - | 624 |
| | Desert WA | 36,238 | - | 8,461 | 124 | 44,823 |
| | Littlerock Creek ID | - | - | - | - | - |
| | Metropolitan WD of Southern California | 1,086,084 | - | 118,172 | 4,241 | 1,208,497 |
| | Mojave WA | 4,672 | - | 6,572 | - | 11,244 |
| | Palmdale WD | 9,959 | - | 4,736 | - | 14,695 |
| | San Bernardino Valley MWD | 65,102 | - | 47,870 | - | 112,972 |
| | San Gabriel Valley MWD | 18,720 | - | - | - | 18,720 |
| | San Gorgonio Pass WA | 5,968 | - | 4,956 | - | 10,924 |
| | Ventura County WPD | 4,353 | - | - | - | 4,353 |
| | **Subtotal** | **1,445,049** | **-** | **257,634** | **4,672** | **1,707,355** |
| **TOTAL SWP DELIVERIES** | | **2,226,979** | **-** | **380,980** | **7,740** | **2,615,699** |

| Table 6–7. Historical State Water Project Deliveries, Calendar Year 2013 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 9,233 | - | - | - | 9,233 |
| | Plumas County FCWCD | 366 | - | - | - | 366 |
| | Yuba City | 3,360 | - | 1,490 | - | 4,850 |
| | **Subtotal** | **12,959** | **-** | **1,490** | **-** | **14,449** |
| North Bay Area | Napa County FCWCD | 2,963 | - | 9,075 | - | 12,038 |
| | Solano County WA | 5,355 | - | 17,805 | - | 23,160 |
| | **Subtotal** | **8,318** | **-** | **26,880** | **-** | **35,198** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 14,059 | - | 21,042 | 2,596 | 37,697 |
| | Alameda County WD | 4,241 | - | 15,349 | 50 | 19,640 |
| | Santa Clara Valley WD | 9,353 | - | 16,261 | 10,749 | 36,363 |
| | **Subtotal** | **27,653** | **-** | **52,652** | **13,395** | **93,700** |
| San Joaquin Valley Area | Dudley Ridge WD | 6,113 | - | 9,951 | 5,412 | 21,476 |
| | Empire West Side ID | 1,004 | - | 482 | 16 | 1,502 |
| | Kern County WA | 314,466 | - | 73,303 | 37,005 | 424,774 |
| | Kings County | 2,851 | - | 591 | 1,000 | 4,442 |
| | Oak Flat WD | 583 | - | 2,200 | 7 | 2,790 |
| | Tulare Lake Basin WSD | 27,803 | - | 4,169 | 8,400 | 40,372 |
| | **Subtotal** | **352,820** | **-** | **90,696** | **51,840** | **495,356** |
| Central Coastal Area | San Luis Obispo County FCWCD | 1,178 | - | 2,503 | - | 3,681 |
| | Santa Barbara County FCWCD | 3,252 | - | 12,233 | - | 15,485 |
| | **Subtotal** | **4,430** | **-** | **14,736** | **-** | **19,166** |
| Southern California Area | Antelope Valley–East Kern WA | 37,628 | - | 13,386 | - | 51,014 |
| | Castaic Lake WA | 33,320 | - | 28,434 | - | 61,754 |
| | Coachella Valley WD | 48,423 | - | - | 164 | 48,587 |
| | Crestline–Lake Arrowhead WA | 1,368 | - | 2,000 | - | 3,368 |
| | Desert WA | 19,513 | - | - | 66 | 19,579 |
| | Littlerock Creek ID | - | - | - | - | - |
| | Metropolitan WD of Southern California | 619,863 | - | 106,288 | 32,267 | 758,418 |
| | Mojave WA | 25,294 | - | 2,852 | - | 28,146 |
| | Palmdale WD | 4,559 | - | 3,122 | - | 7,681 |
| | San Bernardino Valley MWD | 26,159 | - | 4,426 | - | 30,585 |
| | San Gabriel Valley MWD | 10,080 | - | - | - | 10,080 |
| | San Gorgonio Pass WA | 2,339 | - | 3,729 | 1,000 | 7,068 |
| | Ventura County WPD | 2,890 | - | - | - | 2,890 |
| | **Subtotal** | **831,436** | **-** | **164,237** | **33,497** | **1,029,170** |
| **TOTAL SWP DELIVERIES** | | **1,237,616** | **-** | **350,691** | **98,732** | **1,687,039** |

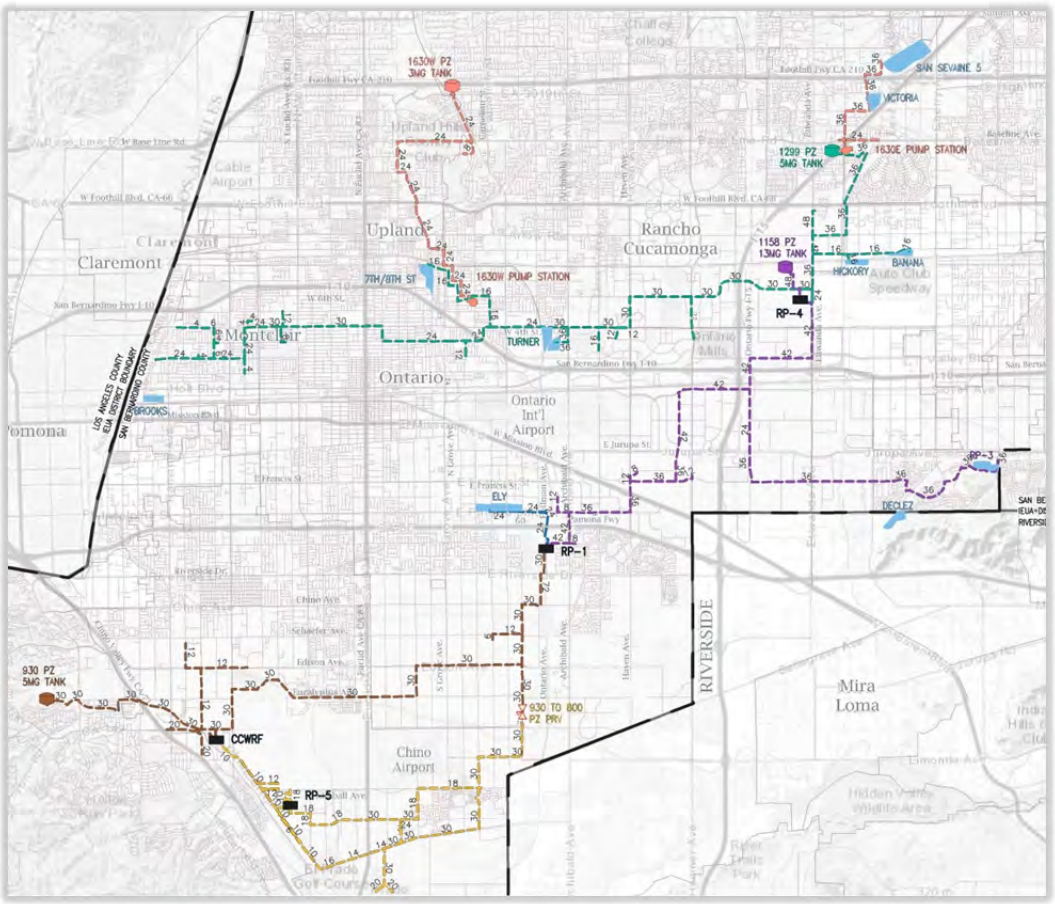
| Table 6–8. Historical State Water Project Deliveries, Calendar Year 2014 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 2,596 | - | - | - | 2,596 |
| | Plumas County FCWCD | 251 | - | - | - | 251 |
| | Yuba City | 96 | - | 4,085 | - | 4,181 |
| | **Subtotal** | **2,943** | **-** | **4,085** | **-** | **7,028** |
| North Bay Area | Napa County FCWCD | 41 | 1,444 | 9,731 | - | 11,216 |
| | Solano County WA | 450 | - | 9,493 | - | 9,943 |
| | **Subtotal** | **491** | **1,444** | **19,224** | **-** | **21,159** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 1,367 | - | 17,646 | - | 19,013 |
| | Alameda County WD | - | - | 10,326 | - | 10,326 |
| | Santa Clara Valley WD | - | - | 12,339 | 79 | 12,418 |
| | **Subtotal** | **1,367** | **-** | **40,311** | **79** | **41,757** |
| San Joaquin Valley Area | Dudley Ridge WD | 1,783 | - | 15,783 | 40 | 17,606 |
| | Empire West Side ID | 104 | - | 349 | - | 453 |
| | Kern County WA | 1,393 | - | 24,717 | 520 | 26,630 |
| | Kings County | 112 | - | 360 | - | 472 |
| | Oak Flat WD | - | - | 983 | - | 983 |
| | Tulare Lake Basin WSD | 3,942 | - | 3,181 | - | 7,123 |
| | **Subtotal** | **7,334** | **-** | **45,373** | **560** | **53,267** |
| Central Coastal Area | San Luis Obispo County FCWCD | 379 | - | 2,693 | - | 3,072 |
| | Santa Barbara County FCWCD | 289 | - | 10,533 | - | 10,822 |
| | **Subtotal** | **668** | **-** | **13,226** | **-** | **13,894** |
| Southern California Area | Antelope Valley–East Kern WA | 2,152 | - | 12,345 | 111 | 14,608 |
| | Castaic Lake WA | 451 | - | 7,743 | - | 8,194 |
| | Coachella Valley WD | 6,918 | - | - | - | 6,918 |
| | Crestline–Lake Arrowhead WA | 83 | - | 645 | - | 728 |
| | Desert WA | 2,788 | - | - | - | 2,788 |
| | Littlerock Creek ID | 106 | - | - | - | 106 |
| | Metropolitan WD of Southern California | 59,900 | - | 223,358 | - | 283,258 |
| | Mojave WA | 3,347 | - | 2,228 | - | 5,575 |
| | Palmdale WD | 1,005 | - | 3,670 | - | 4,675 |
| | San Bernardino Valley MWD | - | - | 6,320 | - | 6,320 |
| | San Gabriel Valley MWD | 1,434 | - | - | - | 1,434 |
| | San Gorgonio Pass WA | 603 | - | 4,572 | - | 5,175 |
| | Ventura County WPD | 93 | - | - | - | 93 |
| | **Subtotal** | **78,880** | **-** | **260,881** | **111** | **339,872** |
| **TOTAL SWP DELIVERIES** | | **91,683** | **1,444** | **383,100** | **750** | **476,977** |

| Table 6–9. Historical State Water Project Deliveries, Calendar Year 2015 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 3,315 | - | - | - | 3,315 |
| | Plumas County FCWCD | 285 | - | - | - | 285 |
| | Yuba City | 2,400 | - | 604 | - | 3,004 |
| | **Subtotal** | **6,000** | **-** | **604** | **-** | **6,604** |
| North Bay Area | Napa County FCWCD | 5,365 | 690 | 3,896 | 35 | 9,986 |
| | Solano County WA | 2,020 | - | 15,718 | - | 17,738 |
| | **Subtotal** | **7,385** | **690** | **19,614** | **35** | **27,724** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 4,686 | - | 3,295 | 97 | 8,078 |
| | Alameda County WD | - | - | 2,233 | 51 | 2,284 |
| | Santa Clara Valley WD | - | - | 2,858 | 120 | 2,978 |
| | **Subtotal** | **4,686** | **-** | **8,386** | **268** | **13,340** |
| San Joaquin Valley Area | Dudley Ridge WD | 7,414 | - | 1,570 | 55 | 9,039 |
| | Empire West Side ID | 578 | - | 46 | - | 624 |
| | Kern County WA | 173,581 | - | 43,265 | 707 | 217,553 |
| | Kings County | 698 | - | 333 | 11 | 1,042 |
| | Oak Flat WD | 696 | - | 348 | - | 1,044 |
| | Tulare Lake Basin WSD | 16,359 | - | 571 | 105 | 17,035 |
| | **Subtotal** | **199,326** | **-** | **46,133** | **878** | **246,337** |
| Central Coastal Area | San Luis Obispo County FCWCD | 3,411 | - | - | - | 3,411 |
| | Santa Barbara County FCWCD | 4,973 | - | 1,089 | 55 | 6,117 |
| | **Subtotal** | **8,384** | **-** | **1,089** | **55** | **9,528** |
| Southern California Area | Antelope Valley–East Kern WA | 21,810 | - | 5,154 | 174 | 27,138 |
| | Castaic Lake WA | 11,068 | - | 4,121 | - | 15,189 |
| | Coachella Valley WD | 27,670 | - | - | - | 27,670 |
| | Crestline–Lake Arrowhead WA | 154 | - | 247 | - | 401 |
| | Desert WA | 11,150 | - | - | 67 | 11,217 |
| | Littlerock Creek ID | 460 | - | - | - | 460 |
| | Metropolitan WD of Southern California | 379,706 | - | 35,675 | 1,374 | 416,755 |
| | Mojave WA | 16,538 | - | 1,871 | - | 18,409 |
| | Palmdale WD | 2,420 | - | - | 26 | 2,446 |
| | San Bernardino Valley MWD | 17,737 | - | 9,012 | 123 | 26,872 |
| | San Gabriel Valley MWD | 5,759 | - | - | - | 5,759 |
| | San Gorgonio Pass WA | 3,343 | - | 135 | - | 3,478 |
| | Ventura County WPD | 1,000 | - | - | - | 1,000 |
| | **Subtotal** | **498,815** | **-** | **56,215** | **-** | **556,794** |
| **TOTAL SWP DELIVERIES** | | **724,596** | **690** | **132,041** | **3,000** | **860,327** |

| Table 6–10. Historical State Water Project Deliveries, Calendar Year 2016 | | | | | | |
|---|---|---|---|---|---|---|
| Contractor Location | SWP Contractor | SWP Water Type Delivered (acre–feet) | | | | Total SWP Deliveries (acre–feet) |
| | | Table A | Article 21 | Carryover | Turnback | |
| Feather River Area | Butte County | 15,634 | - | - | - | 15,634 |
| | Plumas County FCWCD | 387 | - | - | - | 387 |
| | Yuba City | 1,229 | - | - | - | 1,229 |
| | **Subtotal** | **17,250** | **-** | **-** | **-** | **17,250** |
| North Bay Area | Napa County FCWCD | 13,138 | 3,319 | - | 295 | 16,752 |
| | Solano County WA | 12,595 | - | 4,130 | - | 16,725 |
| | **Subtotal** | **25,733** | **3,319** | **4,130** | **295** | **33,477** |
| South Bay Area | Alameda County FCWCD, Zone 7 | 41,987 | - | 8,450 | 819 | 51,256 |
| | Alameda County WD | 14,280 | - | 8,400 | - | 22,680 |
| | Santa Clara Valley WD | 40,214 | - | 32,863 | - | 73,077 |
| | **Subtotal** | **96,481** | **-** | **49,713** | **819** | **147,013** |
| San Joaquin Valley Area | Dudley Ridge WD | 17,372 | - | 1,656 | 461 | 19,489 |
| | Empire West Side ID | 1,800 | - | 22 | - | 1,822 |
| | Kern County WA | 458,759 | - | - | 3,533 | 462,292 |
| | Kings County | 2,466 | - | 1,095 | 95 | 3,656 |
| | Oak Flat WD | 832 | - | 1,023 | - | 1,855 |
| | Tulare Lake Basin WSD | 41,126 | - | 1,135 | 126 | 42,387 |
| | **Subtotal** | **522,355** | **-** | **4,931** | **4,215** | **531,501** |
| Central Coastal Area | San Luis Obispo County FCWCD | 4,199 | - | - | - | 4,199 |
| | Santa Barbara County FCWCD | 12,003 | - | 917 | - | 12,920 |
| | **Subtotal** | **16,202** | **-** | **917** | **-** | **17,119** |
| Southern California Area | Antelope Valley–East Kern WA | 56,148 | - | 6,054 | 1,471 | 63,673 |
| | Castaic Lake WA | 31,147 | - | 2,241 | - | 33,388 |
| | Coachella Valley WD | 52,922 | - | - | - | 52,922 |
| | Crestline–Lake Arrowhead WA | 1,873 | - | - | - | 1,873 |
| | Desert WA | 21,327 | - | - | 566 | 21,893 |
| | Littlerock Creek ID | 1,380 | - | - | - | 1,380 |
| | Metropolitan WD of Southern California | 1,006,900 | - | - | 6,871 | 1,013,771 |
| | Mojave WA | 32,045 | - | 1,170 | - | 33,215 |
| | Palmdale WD | 7,805 | - | - | - | 7,805 |
| | San Bernardino Valley MWD | 57,815 | - | 2,348 | - | 60,163 |
| | San Gabriel Valley MWD | 17,280 | - | - | - | 17,280 |
| | San Gorgonio Pass WA | 8,683 | - | 933 | - | 9,616 |
| | Ventura County WPD | 3,000 | - | - | - | 3,000 |
| | **Subtotal** | **1,298,325** | **-** | **12,746** | **8,908** | **1,319,979** |
| **TOTAL SWP DELIVERIES** | | **1,976,346** | **3,319** | **72,437** | **14,237** | **2,066,339** |

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

# RECYCLED WATER PROGRAM STRATEGY




## *Inland Empire Utilities Agency*

**October 2015**

Stantec

# Recycled Water Program Strategy

Facility Master Planning Study




Prepared for:
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October 28, 2015

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"*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*", December 2013

# Abbreviations

| | |
|---|---|
| AF | Acre-Feet |
| AFM | Acre-Feet per Month |
| AFY | Acre-Feet per Year |
| BPS | Booster Pump Station |
| CBWCD | Chino Basin Water Conservation District |
| CBWM | Chino Basin Water Master |
| CCWRF | Carbon Canyon Wastewater Reclamation Facility |
| CIP | Capital Improvement Plan |
| CVWD | Cucamonga Valley Water District |
| EPS | Extend Period Simulation |
| ft | feet |
| fps | feet per second |
| FWC | Fontana Water Company |
| gpm | gallons per minute |
| GWR | Groundwater Recharge |
| HGL | Hydraulic Grade Line |
| Hp | Horsepower |
| HWL | High Water Level |
| IEUA | Inland Empire Utilities Agency or “Agency” |
| IW | Imported MWD Water |
| LF | Linear feet |
| LR | Local Runoff |
| MG | Million Gallons |
| MGD | Million Gallons per Day |
| MVWD | Monte Vista Water District |
| MWD | Metropolitan Water District |
| PRV | Pressure Reducing Valve |
| psi | pounds per square inch |
| RMPU | Recharge Master Plan Update |
| RP | Regional Recycling Plant |
| RW | Recycled Water |
| RWC | Recycled Water Contribution |
| RWIP | Recycled Water Implementation Plan |
| RWPS | Recycled Water Program Strategy |
| SARBF | Santa Ana River Base Flow |
| SB | San Bernardino |
| SBCFCD | San Bernardino County Flood Control District |
| TDH | Total Dynamic Head |
| TYCIP | Ten Year Capital Improvement Plan |
| VFD | Variable Frequency Drive |
| WW | Wastewater |
| WFMP | Wastewater Facilities Master Plan |

# Executive Summary

The Agency and its member agencies have developed a successful regional Recycled Water Program (RW Program) for both direct use and GWR. In 2000, the region identified that recycled water use was a critical component in drought-proofing and maintaining its economic growth. With imported water rates increasing and long-term imported supply reliability in decline, the region committed to aggressively and proactively develop local water supplies to offset these impacts. This set the path for the development of a regional recycled water distribution system and a Recycled Water Implementation Plan.

As the Program continues to advance, it is important to reevaluate capital improvement needs as changes in the region's water resource priorities occur. The purpose of the RWPS was to update the 2005 Recycled Water Implementation Plan and the 2007 Recycled Water Three Year Business Plan. The primary objective of the RWPS was to update supply and demand forecasts and to help identify improvements to maximize the use of recycled water throughout the year. This approach is consistent with prior commitments of the region by:

- Maximize the beneficial use of recycled water to enhance local water resource availability and reduce reliance on imported water, and
- Continuing the development of the Regional Recycled Water infrastructure to achieve delivery of 50,000 AF/year of recycled water by 2025.

The RW Program is operated based on the following priorities for recycled water deliveries:

1) Regional discharge obligations (Santa Ana Judgment, environmental obligations, etc.),
2) Member agency direct use demands
3) Regional GWR

In addition to meeting the direct use demands, the RWPS also investigated the impacts of increasing deliveries to the GWR basins. This approach raised the priority for GWR to 9 months out of the year between March through November. The RWPS evaluated the need for additional GWR basins, beyond what was committed through the CBWM 2013 RMPU to identify if and when any new basins will be needed. The 9-month operational recharge period was selected for delivery of recycled water to the GWR basins to avoid conflicts with the capture of storm water during the winter months.

This approach is also consistent with the current multi-party agreement between SBCFCD, CBWM, CBWCD and IEUA.

The planning period of the RWPS was through 2035, with a focus on the first ten years, through 2025. Through this planning period, modeling was performed for a variety of demand conditions, including changes in direct use and GWR. The first step in determining the best approach for maximizing the beneficial use of recycled water was to identify what the remaining supply (reuse supply) would be after direct use demands and the SARBF at Prado discharge obligation have been met. This is the quantity of recycled water available for GWR or another reuse strategy. Modeling was performed on a range of available reuse supply, which could be from reduced outdoor irrigation and increased direct use efficiency or if an external supply is provided into the region. To achieve a greater annual yield from the RW Program, GWR was maximized to utilize the reuse supply when available. This modeling approach was necessary to determine if and when new facilities will be needed to maximize the beneficial use of all available reuse supply.

The RWPS will be reevaluated at a minimum once every five years, but additional studies will be performed in the coming years to identify and present changes needed to accommodate any potential shift in recycled water use.

The projects recommended by the RWPS address improvements necessary to achieve the goal of maximizing beneficial use of RW throughout the year. The majority of the projects proposed focus on relieving existing capacity constraints in order to meet the demand (direct and GWR) forecast, or increasing the ability to deliver reuse supply for GWR.

## ES.1 - Projected Recycled Water Demands and Supplies

The analyses and facility recommendations for the RWPS are based on the RW demands and wastewater supplies provided by the Agency and their member agencies as shown in Table ES.1. The estimated reuse supply is defined as the amount of recycled water effluent available to be used for the SARBF Discharge Obligation, direct use demands, and GWR as also shown in Table ES.1. The total annual GWR projection for the basins is based on a 9-month operating period between March through November. It should be noted that the SARBF Discharge Obligation and RW direct use demands are based on a 12-month annual total as opposed to the 9-month annual total for GWR.

**Table ES.1 Summary of Recycled Water Use and Supplies**

| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
|---|---|---|---|---|---|
| | AFY | | | | |
| RW Reuse Supply[1] | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 |
| SARBF Discharge Obligation[2] | 17,000 | 17,000 | 17,000 | 17,000 | 17,000 |
| Direct Use Demand Forecast | 24,655 | 30,757 | 36,507 | 40,320 | 43,019 |
| Available GWR Supply[3] | 20,289 | 18,555 | 18,406 | 20,194 | 22,311 |
| RWPS GWR Basin Deliveries[4] | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Remaining Reuse Supply | 4,194 | 4,578 | 5,379 | 6,487 | 7,440 |

[1] Total RW Reuse Supply does not include any wastewater treatment losses generated at the Regional Recycling Plants.

[2] Minimum discharge required by SAR obligation is 16,850 AFY. For purposes of the RWPS, discharge obligation was assumed to be 17,000 AFY.

[3] Total supply available for GWR is the remaining supply after direct use demands and the SARBF discharge obligation are met. The supply shown is a 12-month total annual supply.

[4] Based on a 9-month operating GWR basin program between March through November. Deliveries are limited by available reuse supply after the SARBF Discharge Obligation and direct use demands are met.

As shown in Table ES.1, the total annual GWR basin deliveries are less than the total annual available supply to the GWR basins. This is due to the GWR basin deliveries assumed to be for only a 9-month annual recharge operation. Supplies are available for all 12-months. If the GWR operation were to be extended for the entire 12-months, then the remaining reuse supply would be able to be delivered to the basins for recharge.

## ES.2 - Summary of Remaining Reuse Supply and GWR Basin Capacity

Table ES.2 is provided below to illustrate the amount of reuse supply available to the groundwater basins for recharge as compared with the basins' recharge capacity for the existing and 2013 RMPU basins. The table illustrates that the amount of reuse supply that can be recharged in the basins is limited by the available supply and duration of recharge operations throughout the year. The capacity of the basins may be greater and total GWR may be higher if additional supply were available, or if direct use demands were less. Therefore, an analysis was performed to determine the appropriate facilities to accommodate potential increase in supplies or changes in direct use demands, both annually and seasonally. The seasonal analysis was performed to determine basin capacities on a monthly basis to verify if additional basins are required beyond those identified in the RMPU.

The seasonal, or monthly, analysis approach provided the opportunity to determine if additional facilities or potential GWR basins would need to be added to recharge any additional supply that may become available both during the peak summer direct use demand periods as well in the lower demand spring and fall periods. As described in Chapter 7, the analysis identifies if additional GWR basins or distribution facilities are needed to deliver additional reuse supply. Appropriately identifying and sizing these system conveyance improvements was the goal of the RWPS.

**Table ES.2 Summary of Remaining Reuse Supply and GWR Basin Capacity**

| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
|---|---|---|---|---|---|
| | AFY | | | | |
| Available Supply to GWR[1] | 20,289 | 18,555 | 18,406 | 20,194 | 22,311 |
| RWPS GWR Basin Deliveries[2] | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| GWR Basin Capacity[3] | 25,600 | 37,300 | 37,300 | 37,300 | 37,300 |

[1] Quantity of reuse supply available for recharge to the basins after the SARBF discharge obligation and direct use demands are met. Values per Table ES.1.

[2] Per RWPS, based on a 9-month operating GWR basin program between March through November. Deliveries limited by available reuse supply. Values per Table ES.1.

[3] Range of potential annual deliveries to the existing and 2013 RMPU GWR basins only, based on operating time of GWR program and basin capacity estimated at 9-months per year. Values assume all basins operating at average annual infiltration without reuse supply limitations for duration specified. Constraints or limitations of the underlying groundwater basin are not the RWPS scope.

## ES.3 - Potential GWR Basin Implementation

The proposed RW implementation strategy is consistent with the Agency's goal to increase GWR to utilize all of the remaining reuse supply once demands for the direct uses and SARBF at Prado Obligation are met. The strategy analyzed by this RWPS has a 20-year planning horizon to Year 2035, which was analyzed and planned in 5-year increments. The RWPS identified if and when additional GWR basins should be connected to the RW system. The RWPS evaluated the capacity of the conveyance facilities to maximize delivery of available reuse supply to the basins.

The Agency operates 11 existing GWR basins that are currently connected to the RW system (i.e., currently receiving RW for GWR). The Agency operates several other GWR basins that are currently configured to only accept storm water, local runoff, and/or imported MWD water. This RPWS investigates the potential for each of these GWR basins to be connected to the RW system and acceptable to receiving RW.

Table ES.3 provides a list of all GWR basins that could be added to the RW Program. Figure ES-1 identifies the location of each of these GWR basins within the RW Program.
Identfying basin constraints or infiltration limitations due to the underlying groundwater basin was this RWPS scope. The RWPS evaluated the RW conveyance facilities and improvements to deliver the potential reuse supply to GWR, not evaluate basin performance. Additional studies may be recommended to determine basin performance.

ETIWANDA DEBRIS
SAN SEVAINE (1–3)
SAN SEVAINE 5
LOWER DAY
VICTORIA
VICTORIA (INCREASE)
1630W PZ 3MG TANK
1299 PZ 5MG TANK
1630E PUMP STATION
COLLEGE HEIGHTS EAST
COLLEGE HEIGHTS WEST
UPLAND
MONTCLAIR (1–3)
1158 PZ 13MG TANK
HICKORY
BANANA
1630W PUMP STATION
RP–4
TURNER
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
BROOKS
JURUPA
RP–3 (NEW CELL)
WINEVILLE
ELY
RP–1
GROVE
DECLEZ
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY
930 PZ 5MG TANK
CCWRF
930 TO 800 PZ PRV
RP–5
RIVERSIDE

Claremont Hills Wilderness Park
Foothill Fwy CA-210
Chaffey College
Summit Ave.
Rialto Municipal Airport
CA-30
W Base Line Rd.
San Dimas
La Verne
Cable Airport
W Foothill Blvd. CA-66
Upland
Rancho Cucamonga
Fontana
Rialto
Brackett Field Airport
Claremont
Auto Club Speedway
W 6th St.
Montclair
Ontario
Ontario Mills
San Bernardino Fwy I-10
Valley Blvd
Slover Ave
Bloomington
W Holt Ave
Pomona
W Mission Blvd
Ontario Int'l Airport
E Jurupa St.
E Francis St.
Pomona Fwy
Riverside Dr.
Chino Airport
Kimball Ave.
Jurupa Hills Regional Park
Riverside Cement Company
Mira Loma
Indian Hills Golf Club
Hidden Valley Wildlife Area
River Trails Park
Riverside Municipal Airport
Jurupa Ave
Central Ave
Limonite Ave
Mission Blvd
Santa Ana River Wilderness Area

**LEGEND:**

- Existing Basins
- Year 2020 Basins
- Year 2025 Basins
- Year 2030 Basins
- Year 2035 Basins
- 800 PZ (Existing)
- 930 PZ (Existing)
- 1050 PZ (Existing)
- 1158 PZ (Existing)
- 1299 PZ (Existing)
- 1630 PZ (Existing)
- Storage Tank
- Pump Station
- PRV
- Regional Recycling Plant

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Prepared For:
Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Potential GWR Basin Implementation Strategy

FIGURE ES-1

**Table ES.3 Potential GWR Basins to Receive Recycled Water**

| Basin/Site | Basin Status | Size (acres) | Storage Volume (AF) |
|---|---|---|---|
| Lower Day | RW Connection[1] | 15.0 | 179 |
| Etiwanda Debris | RW Connection[1] | 14.6 | 73 |
| San Sevaine (1-3) | RW Connection[1] | 21.4 | 99 |
| Victoria (Increase) | N/A[3] | 17.4 | 237 |
| Lower San Sevaine | New[2] | 23.0 | 230 |
| Wineville | New[2] | 30.0 | 240 |
| RP-3 (New Cell) | New[2] | 3.5 | 35 |
| Vulcan | New[2] | 30.0 | 450 |
| College Heights East | RW Connection[1] | 6.2 | 112 |
| College Heights West | RW Connection[1] | 5.8 | 110 |
| Grove | RW Connection[1] | 10.0 | 114 |
| Jurupa | RW Connection[1] | 17.0 | 249 |
| Montclair (1-3) | RW Connection[1] | 22.5 | 518 |
| Montclair 4 | RW Connection[1] | 5.8 | 139 |
| Upland | RW Connection[1] | 16.6 | 392 |
| | **Total** | **238.8** | **3,177** |

[1] "RW Connection" implies that the basin is currently operating as part of the GWR program for storm water/local runoff and imported water. These basins will require modifications and facilities to connect to the RW system.

[2] "New" is a new basin that is currently not in the GWR program.

[3] Existing Basin and no RW improvements will be required. Existing RW turnout structure is adequate for the proposed basin improvements.

For purposes of this RWPS, the GWR basins identified in Table ES.3 were prioritized to determine the schedule of which GWR basins to implement for each of the planning years to Year 2035. Based on the ranking criteria and corresponding priority, Table ES.4 identifies the recommended implementation schedule for new GWR basins.

**Table ES.4 Potential GWR Basins**
**RWPS Implementation Strategy and Flows**

| Planning Year | Basin/Site | Monthly Flows (AF per Month) | Daily Demand[1] (MGD) | Flow Rate[2] (gpm) |
|---|---|---|---|---|
| Year 2020 | RP-3 (New Cell) | 1,366 | 0.8 | 1,111 |
| | Victoria (increase) | 212 | 5.5 | 7,639 |
| | San Sevaine (1-3) | 1,508 | 3.1 | 4,306 |
| Year 2025 | Wineville | 117 | 2.8 | 3,889 |
| | Lower Day | 340 | 5.0 | 6,944 |
| | Etiwanda Debris | 263 | 1.7 | 2,361 |
| Year 2030 | Montclair (1-3) | 1,107 | 4.0 | 5,556 |
| | College Heights East | 302 | 2.6 | 3,611 |
| | College Heights West | 155 | 2.5 | 3,472 |
| Year 2035 | Upland | 370 | 6.8 | 9,444 |
| | Jurupa | 233 | 8.9 | 12,361 |
| | Grove | 75 | 2.7 | 3,750 |

[1] Daily demand is based on the basin storage volume divided by 14 days for a 14-day fill period.
[2] The flow rate for each basin is based on the daily demand for a 12-hour per day operation, with the fill period occurring during the day outside the peak irrigation direct use demand period.

## ES.4 - Summary of System Facilities Analysis

Hydraulic model analyses were performed for several demand and operational scenarios as described in Chapters 6 and 7 of the RWPS.

A total of five (5) demand and operational scenarios were analyzed as described below.

**Table ES.5 Description of Hydraulic Analysis Scenarios**

| Scenario | Description |
|---|---|
| Direct Use Demands | Maximum Day Direct Use Demands anticipated during the Summer |
| Base GWR Basin Implementation | Assumes all GWR Basins listed in Table ES.3 are converted and connected to the RW system and that the Agency meets the SARBF at Prado Obligation from their RW effluent. |
| Sensitivity Analysis – Scenario A – Base GWR Basin Implementation with 10,000 AFY External Supply | Assumes all GWR Basins listed in Table ES.3 are converted and connected to the RW and that the Agency obtains an external supply of approximately 10,000 AFY to supplement the SARBF at Prado Obligation. |
| Sensitivity Analysis – Scenario B – Existing/2013 | Assumes only existing GWR basins and committed 2013 RMPU Basins are connected to the RW system and that the Agency |

**Table ES.5 Description of Hydraulic Analysis Scenarios**

| Scenario | Description |
|---|---|
| RMPU Basins (No External Supply) | meets the SARBF at Prado Obligation from their RW effluent. |
| Sensitivity Analysis – Scenario C – Existing/ 2013 RMPU Basins with 5,000 AFY External Supply | Assumes only existing GWR basins and committed 2013 RMPU Basins are connected to the RW system and that the Agency obtains an external supply of approximately 5,000 AFY to supplement the Southern Area supply deficit. |

## ES.5 – Summary of Scenario and Project Cost Analysis

A comparison of the total estimated project costs was performed for each scenario. The Base GWR Basin implementation project recommendations were then compared with the project improvements recommended for Scenarios A, B, and C.

Table ES.5 on the following page shows the cost summary analysis that was performed. The overall project costs for each Scenario are listed along with the corresponding total annual GWR benefit.

Based on the total project costs for the different operational conditions, Scenario B of the Sensitivity Analysis herein will provide the Agency the lowest total capital improvement costs. This scenario assumes that the Agency will continue to meet SARBF at Prado Obligation from their RW effluent.

## Table ES.5 Summary of Scenario Improvements Project Costs Analysis

| Year | Previous Costs | Direct Use (DU) Only Improvements Costs | DU Improvements Cumulative Costs | Annual DU Demands (AFY) | Spring/Fall DU plus GWR Improvement Costs | Summer DU plus GWR Improvement Costs | GWR plus DU Improvements Cumulative Costs | Total Annual Recharge (AFY) | Total Cumulative Costs | Total Annual Demand (AFY) |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASE GWR IMPLEMENTATION PROJECT IMPROVEMENTS (SEE CHAPTER 6) – All GWR Basins with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Exist | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 7,250,000 | $ - | $ 7,250,000 | 13,977 | $ 13,470,000 | 44,734 |
| 2025 | $ 13,470,000 | $ 6,280,000 | $ 12,500,000 | 36,507 | $ 6,060,000 | $ 11,690,000 | $ 25,000,000 | 13,027 | $ 37,500,000 | 49,534 |
| 2030 | $ 37,500,000 | $ 34,300,000 | $ 46,800,000 | 40,320 | $ 39,000,000 | $ - | $ 64,000,000 | 13,707 | $ 110,800,000 | 54,027 |
| 2035 | $110,800,000 | $ 12,520,000 | $ 59,320,000 | 43,019 | $ 16,030,000 | $ - | $ 80,030,000 | **14,871** | **$139,350,000** | 57,890 |
| **SCENARIO A - PROJECT IMPROVEMENTS – All GWR Basins plus External Supply** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $ 20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 4,130,000 | $ - | $ 24,130,000 | 21,427 | $ 30,350,000 | 52,184 |
| 2025 | $ 30,350,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ 6,060,000 | $ - | $ 30,190,000 | 19,797 | $ 41,530,000 | 56,304 |
| 2030 | $ 41,530,000 | $ 41,550,000 | $ 52,890,000 | 40,320 | $ 71,730,000 | $ 7,610,000 | $ 109,530,000 | 19,422 | $ 162,420,000 | 59,742 |
| 2035 | $ 62,420,000 | $ 3,460,000 | $ 56,350,000 | 43,019 | $ 16,030,000 | $ - | $ 125,560,000 | **19,906** | **$181,910,000** | 62,925 |
| **SCENARIO B - PROJECT IMPROVEMENTS – Existing/RMPU Basins with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 6,860,000 | $ - | $ 6,860,000 | 13,977 | $ 13,080,000 | 44,734 |
| 2025 | $ 13,080,000 | $ 17,970,000 | $ 24,190,000 | 36,507 | $ - | $ - | $ 6,860,000 | 13,027 | $ 31,050,000 | 49,534 |
| 2030 | $ 31,050,000 | $ 34,300,000 | $ 58,490,000 | 40,320 | $ - | $ - | $ 6,860,000 | 13,707 | $ 65,350,000 | 54,027 |
| 2035 | $ 65,350,000 | $ 12,520,000 | $ 71,010,000 | 43,019 | $ - | $ - | $ 6,860,000 | **14,871** | **$ 77,870,000** | 57,890 |
| **SCENARIO C - PROJECT IMPROVEMENTS – Existing/RMPU Basins plus External Supply** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 17,982 | $ 20,000,000 | 42,637 |
| 2020 | $20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 3,740,000 | $ - | $ 23,740,000 | 15,702 | $ 9,960,000 | 46,459 |
| 2025 | $29,960,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ - | $ - | $ 23,740,000 | 14,458 | $ 35,080,000 | 50,965 |
| 2030 | $35,080,000 | $ 41,110,000 | $ 52,450,000 | 40,320 | $ 33,310,000 | $ 7,610,000 | $ 64,660,000 | 15,834 | $117,110,000 | 56,154 |
| 2035 | $117,110,000 | $ 3,460,000 | $ 55,910,000 | 43,019 | $ - | $ - | $ 64,660,000 | **17,242** | **$120,570,000** | 60,261 |

## ES.6 – Summary of Project Recommendations for the RWPS

Based on the sensitivity analysis performed and comparison of project costs and benefits for each scenario, the proposed projects recommended by the RWPS are those identified in Scenario B.

Based on the overall goals of the RWPS, this recommendation will allow the Agency to meet the projected direct use demand forecast and maximize the available reuse supply to the GWR basins in the most cost effective manner. While there are plans to recommend additional GWR basins in the long-term, the basins that have prior commitment have adequate capacity for the available reuse supply forecast. This provides the opportunity to reevaluate the RW Program after performance metrics are obtained from prior project commitments. Additional GWR basins and other reuse methods will be evaluated as changes in direct use demand occur, of if more reuse supply is identified. This could either be from reduced direct use demands caused by changes in landscape irrigation or if an external supply is provided into the Region.

Additionally, it should be noted that the basins included for Existing/RMPU scenarios will have the ability to recharge the total available reuse supply. Therefore, the cost of GWR is much less than the program required for implementing all of the GWR basins included in the Base scenario.

However, other considerations should be given to utilizing only the Existing/2013 RMPU GWR basins:

- Using only the Existing/RMPU GWR basins limits basins to be down for maintenance, leaving no operational redundancy or flexibility for under-performing basins.
- If reductions in the direct use demand projections occur, the additional reuse supply that would become available would be limited to the capacity of the existing/2013 RMPU GWR basins. The need to evaluate other basins and reuse opportunities may be required as changes in direct use demands occur.
- If the Agency decides to secure an additional external supply source greater than 5,000 AFY, additional basins may need to be considered for connection to the RW system.

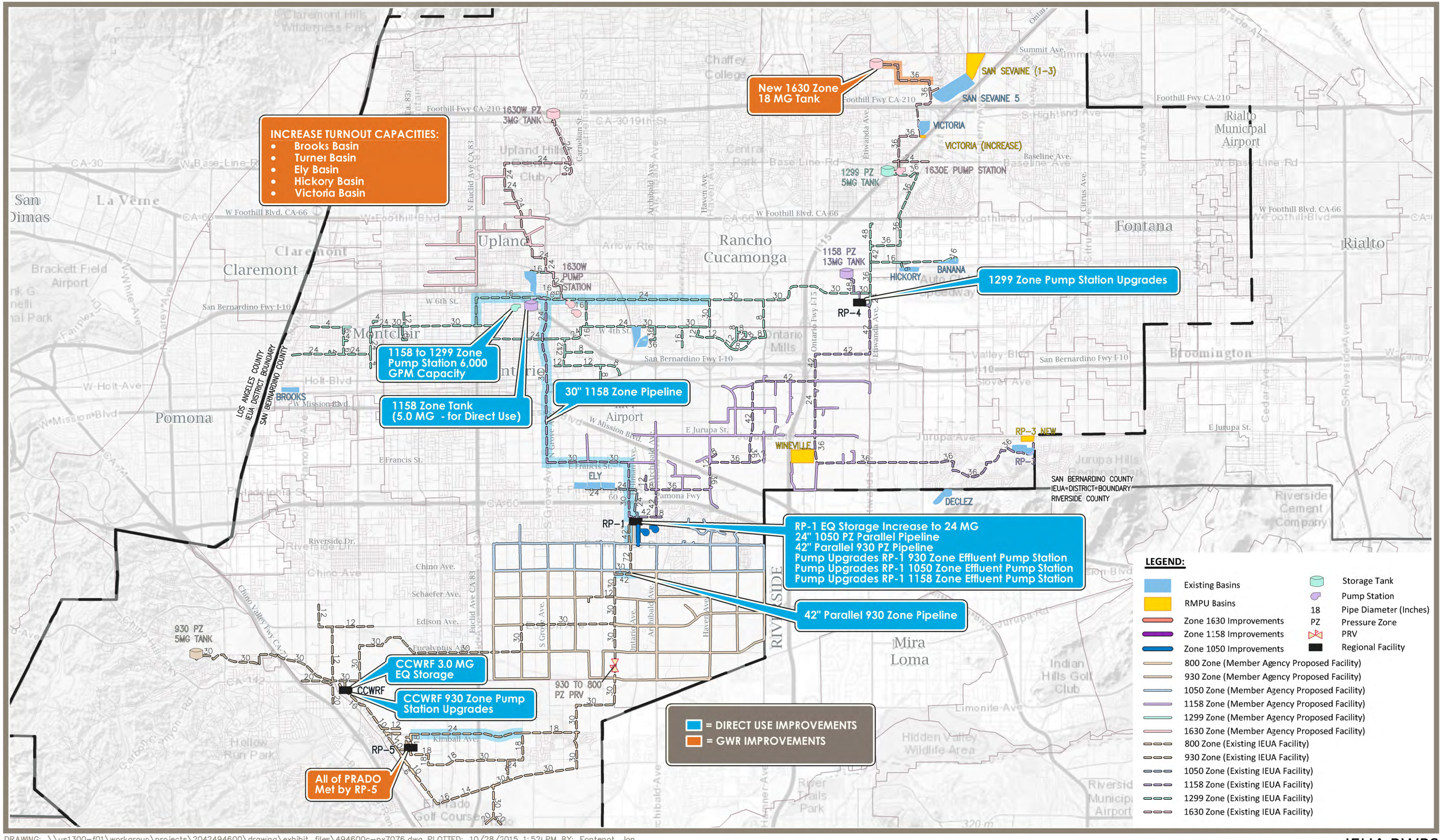
Table ES.6 identifies the comprehensive list of projects and corresponding project costs for each planning year. Since the improvements recommended are to either meet direct use demands or maximize GWR to the basins, a description of the demand condition that triggers the need for the project as well as the type of deficiency that the project is intended to mitigate has been included. Figure ES-2 shows the locations of the recommended improvements.

Project costs and total CIP costs are based on 2015 dollars and do not include cost escalations.

These recommendations and analyses herein should be reevaluated at least every five (5) years or as planning policies and demand projections change from those described.

## Table ES.6 Recommended RWPS Projects

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | Unit Cost | Total Const. Cost | Cont. / Admin./ Eng. | Total Estimated Project Cost | Cumulative CIP Costs | GWR Program Improvement | Direct Use Improvement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 LS | $ 500,000 | $ 500,000 | $ 225,000 | $ 730,000 | $ 730,000 | $ 730,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6,715 LF | $ 495 | $ 3,323,925 | $ 1,495,766 | $ 4,820,000 | $ 5,550,000 | $ 4,820,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 LS | $ 900,000 | $ 900,000 | $ 405,000 | $ 1,310,000 | $ 6,860,000 | $ 1,310,000 | $ - |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12,620 LF | $ 340 | $ 4,290,800 | $ 1,930,860 | $ 6,220,000 | $ 13,080,000 | $ - | $ 6,220,000 |
| | | | | | | | **Year 2020 Improvement Costs** | **$13,080,000** | **$ 13,080,000** | **$ 6,860,000** | **$ 6,220,000** |
| 2025 | Max Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 LS | $ - | $ - | $ - | $ - | $ 13,080,000 | $ - | $ - |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, to serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15,289 LF | $ 225 | $ 3,440,025 | $ 1,548,011 | $ 4,990,000 | $ 18,070,000 | $ - | $ 4,990,000 |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13,600 LF | $ 340 | $ 4,624,000 | $ 2,080,800 | $ 6,700,000 | $ 24,770,000 | $ - | $ 6,700,000 |
| 2025 | Max Summer Direct Use | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 42-inch 930 PZ Parallel Pipeline | 2,300 LF | $ 860 | $ 1,978,000 | $ 890,100 | $ 2,870,000 | $ 27,640,000 | $ - | $ 2,870,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-4 1158 PZ PS Capacity Upgrades | 1 LS | $ 950,000 | $ 950,000 | $ 427,500 | $ 1,380,000 | $ 29,020,000 | $ - | $ 1,380,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 PZ PS Capacity Upgrades | 1 LS | $ 800,000 | $ 800,000 | $ 360,000 | $ 1,160,000 | $ 30,180,000 | $ - | $ 1,160,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | CCWRF PS Capacity Upgrades | 1 LS | $ 600,000 | $ 600,000 | $ 270,000 | $ 870,000 | $ 31,050,000 | $ - | $ 870,000 |
| | | | | | | | **Year 2025 Improvement Costs** | **$ 17,970,000** | **$ 31,050,000** | **$ -** | **$ 17,970,000** |
| 2030 | Max Summer Direct Use | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Ave. | 1,680 LF | $ 590 | $ 991,200 | $ 446,040 | $ 1,440,000 | $ 32,490,000 | $ - | $ 1,440,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31,800 LF | $ 420 | $ 13,356,000 | $ 6,010,200 | $ 19,370,000 | $ 51,860,000 | $ - | $ 19,370,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 MG | $ 1.50 | $ 7,500,000 | $ 3,375,000 | $ 10,880,000 | $ 62,740,000 | $ - | $ 10,880,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 LS | $1,800,000 | $ 1,800,000 | $ 810,000 | $ 2,610,000 | $ 65,350,000 | $ - | $ 2,610,000 |
| | | | | | | | **Year 2030 Improvement Costs** | **$ 34,300,000** | **$ 65,350,000** | **$ -** | **$ 34,300,000** |
| 2035 | Max Summer Direct Use | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 MG | $ 1.75 | $ 5,250,000 | $ 2,362,500 | $ 7,610,000 | $ 72,960,000 | $ - | $ 7,610,000 |
| 2035 | Max Summer Direct Use | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 74,410,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2,000 LF | $ 340 | $ 680,000 | $ 306,000 | $ 990,000 | $ 75,400,000 | $ - | $ 990,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 76,850,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 LS | $ 700,000 | $ 700,000 | $ 315,000 | $ 1,020,000 | $ 77,870,000 | $ - | $ 1,020,000 |
| | | | | | | | **Year 2035 Improvement Costs** | **$ 12,520,000** | **$ 77,870,000** | **$ -** | **$ 12,520,000** |
| | | | | | | | **Total Program Improvement Costs** | **$ 77,870,000** | | **$ 6,860,000** | **$ 71,010,000** |




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Prepared For:
Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

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# IEUA RWPS
## Recommended Recycled Water System Improvements

FIGURE ES-2

# 1.0 INTRODUCTION

The purpose of this document is to update Direct Use demand projections and changes to the Agency's GWR program contained in the 2005 Recycled Water Implementation Plan. The Agency has also requested that the RWPS investigate operational changes to the RW conveyance system as a result of increasing reuse of the RW supply availability to the GWR.

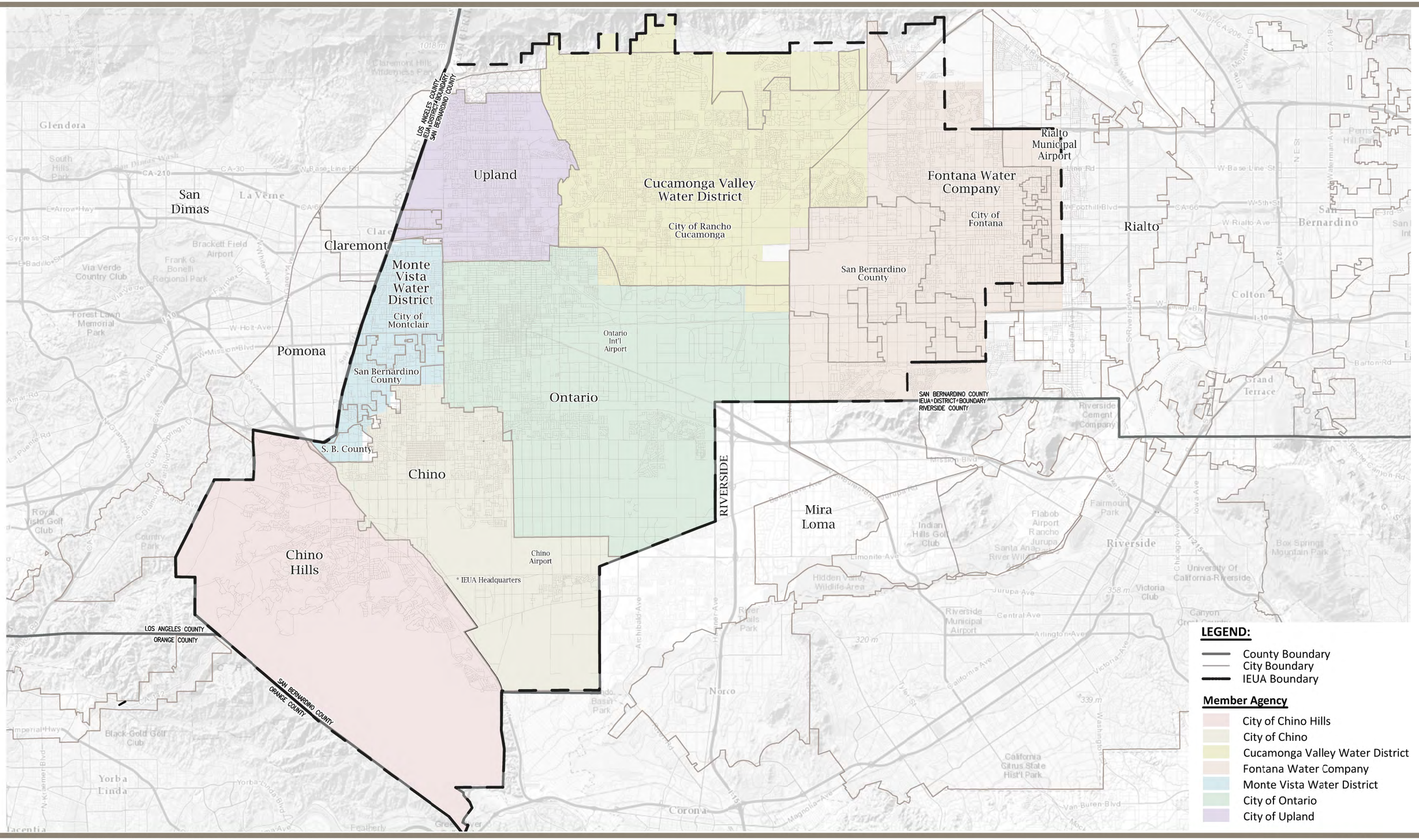
Although this RWPS does not change the priority of reuse supply (SARBF Obligation is first, direct use demands are second, and GWR is third), it does define a delivery strategy in order to maximize all of the reuse supply available to the GWR basins. Reuse supply to the GWR basins is defined to be a 9-month operation between the months of March and November. The remaining winter months of December, January and February are defined as the wet winter months and no reuse supply is planned for basin recharge during this time to allow for maximum storm water capture.

This RWPS is intended to analyze the reuse demands and supplies over the next 20 years to Year 2035, with implementation strategies for every 5 year incremental period.

## 1.1 STUDY AREA

The Agency's service area encompasses approximately 242 square miles in the western end of the San Bernardino County. As shown in Figure 1-1, the service area is generally bordered by the San Gabriel Mountains to the north, Riverside County line to the southeast, County of Los Angeles to the northwest, County of Orange to the southwest, City of Chino Hills to the west, and Jurupa Mountains to the east.

As a regional wastewater treatment agency, the Agency provides sewage utility services to the seven contracting agencies under the Chino Basin Regional Sewage Service Contract. All the wastewater collected is treated at the Agency's regional wastewater recycling plants (RP's). The regional wastewater recycling plants provide recycled water supply to the Agency's RW program.




**LEGEND:**

- County Boundary
- City Boundary
- IEUA Boundary

**Member Agency**

- City of Chino Hills
- City of Chino
- Cucamonga Valley Water District
- Fontana Water Company
- Monte Vista Water District
- City of Ontario
- City of Upland

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GRAPHIC SCALE
0 6,000' 12,000' 24,000'
( IN FEET ) 1 inch = 12,000'

# IEUA RWPS
# IEUA Service Area

FIGURE 1-1

### 1.1.1 Member Agencies

The Agency's wholesales disinfected tertiary RW to its seven (7) member agencies. With the exception of Reliant Energy, located in the City of Rancho Cucamonga, the majority of the current RW users are located in the Agency's Southern Service Area. The following are the IEUA's member agencies:

- City of Chino
- City of Chino Hills
- Cucamonga Valley Water District
- Fontana Water Company
- Monte Vista Water District
- City of Ontario
- City of Upland

### 1.1.2 Current Groundwater Recharge

IEUA, Chino Basin Watermaster (CBWM), Chino Basin Water Conservation District (CBWCD), and the San Bernadino County Flood Control District (SBCFCD) are partners in the operation of the Chino Basin RW Groundwater Recharge Program. This recharge program is part of a comprehensive program to enhance water supply reliability and to improve groundwater quality throughout Agency's service area. The GWR program includes capturing and recharge of storm water, imported water, and RW.

The Agency operates several GWR basin sites as shown Table 1-1.

Historical GWR was evaluated for the twelve months prior to the time of the RWPS. Based on the Agency's GWR Quarterly Reports, between April 2013 and March 2104, approximately 16,373 AF of water was recharged in the Chino Basin. This includes 13,237 AF of RW, 2,780 AF of storm water and local runoff, and 356 AF of imported water. It should be noted that this historical reuse supply to GWR occurred over a twelve (12) month period due to the dry winter season and that the basins did not need to remain available for storm water capture.

**Table 1.1 IEUA Existing Groundwater Recharge Basins and Supply Source**

| Basin/Site | Supply Source | | |
|---|---|---|---|
| | SW/LR | IW | RW |
| 7th/8th Street | ✓ | ✓ | ✓ |
| Banana | ✓ | ✓ | ✓ |
| Brooks | ✓ | ✓ | ✓ |
| College Heights | ✓ | ✓ | |
| Declez | ✓ | ✓ | ✓ |
| Ely (1-3) | ✓ | ✓ | ✓ |
| Etiwanda Debris | ✓ | ✓ | |
| Grove | ✓ | | |
| Hickory | ✓ | ✓ | ✓ |
| Lower Day | ✓ | ✓ | |
| Montclair (1-4) | ✓ | ✓ | |
| RP-3 (1,3,4) | ✓ | ✓ | ✓ |
| RP-3 2 | ✓ | ✓ | |
| San Sevaine 5 | ✓ | ✓ | ✓ |
| San Sevaine (1-4) | ✓ | ✓ | |
| Turner (1-4) | ✓ | ✓ | ✓ |
| Upland | ✓ | ✓ | |
| Victoria | ✓ | ✓ | ✓ |

SW = Storm Water
LR = Local Runoff
IW = Imported MWD Water
RW = Recycled Water

# 2.0 RECYCLED WATER DEMANDS

This section provides the existing and projected RW direct use demands, as reported by each of the IEUA member agencies. Direct use demands were provided according to pressure zone as well as by member agency for each of the 5-year planning period increments.

## 2.1 DIRECT USE DEMANDS

The direct use demands include uses for irrigation of golf courses, landscaping, parks, school yards, agricultural uses, commercial car washes and laundries, industrial cooling towers, process water, and other miscellaneous construction and dust control uses.

Table 2.1 shows the existing and projected direct use demands. For purposes of the RWPS, the demands provided by the Agency for the Year 2015 are assumed to be existing demand conditions. The direct use demands were collected by the Agency from each of their member agencies.

**Table 2.1 Existing and Projected Direct Use Demands by Member Agency**

| Member Agency | Demand Year (AFY) | | | | | |
|---|---|---|---|---|---|---|
| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 | Ultimate[1] |
| Chino | 8,915 | 9,935 | 8,523 | 6,844 | 6,257 | 6,210 |
| Chino Hills | 2,001 | 2,600 | 3,000 | 3,400 | 3,800 | 4,004 |
| CVWD | 1,651 | 1,540 | 1,770 | 2,000 | 2,000 | 2,000 |
| MVWD | 339 | 600 | 725 | 850 | 1,000 | 1,220 |
| Ontario | 8,427 | 10,323 | 15,705 | 18,440 | 21,176 | 26,645 |
| Upland | 868 | 800 | 800 | 800 | 800 | 800 |
| Fontana | 0 | 2,500 | 3,500 | 5,500 | 5,500 | 8,350 |
| *Other Usage*: | | | | | | |
| San Bernardino County | 1,611 | 1,611 | 1,611 | 1,611 | 1,611 | 1,611 |
| IEUA | 843 | 848 | 873 | 875 | 875 | 875 |
| **Total Direct Use Demand** | **24,655** | **30,757** | **36,507** | **40,320** | **43,019** | **51,715** |

[1] Ultimate demands are shown for reference only. This RWPS has a 20-year planning horizon to Year 2035.

[2] The direct use demand projections were provided by member agencies

Table 2.2 shows the direct use demand projections by pressure zone.

**Table 2.2 Existing and Projected Direct Use Demands by Pressure Zone**

| Pressure Zone | Demand Year (AFY) | | | | | |
|---|---|---|---|---|---|---|
| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 | Ultimate[1] |
| 800 Zone | 8,884 | 9,696 | 7,728 | 6,207 | 5,374 | 4,667 |
| 930 Zone | 7,684 | 9,895 | 13,137 | 14,873 | 16,996 | 20,693 |
| 1050 Zone | 1,262 | 966 | 2,337 | 3,335 | 4,327 | 5,926 |
| 1158 Zone | 2,106 | 4,467 | 5,994 | 6,500 | 6,771 | 7,609 |
| 1299 Zone | 3,158 | 4,173 | 5,531 | 5,905 | 6,051 | 6,470 |
| 1630 Zone | 1,561 | 1,560 | 1,780 | 3,500 | 3,500 | 6,350 |
| **Total Direct Use Demand** | **24,655** | **30,757** | **36,507** | **40,320** | **43,019** | **51,715** |

[1] Ultimate demands are shown for reference only. This RWPS has a 20-year planning horizon to Year 2035.

[2] The direct use demand projections are the member agency projections that were provided to IEUA.

## 2.2 EXISTING GWR BASIN DEMANDS

As described in Chapter 1, the Agency operates several GWR recharge basins. Not all of the basins are permitted, or have connections to receive reuse supply. The existing GWR basins that currently receive RW are listed in Table 2.3.

**Table 2.3 Existing GWR Basins Recycled Water Annual Demands**

| Basin/Site | Existing Annual Recharge[1] (AF) | Percent of Total Recycled Water Recharge |
|---|---|---|
| 7th/8th Street | 1,930 | 15% |
| Banana | 727 | 5% |
| Brooks | 1,697 | 13% |
| Ely (1-3) | 3,199 | 24% |
| Hickory | 1,221 | 9% |
| RP-3 | 2,022 | 15% |
| San Sevaine 5 | 328 | 2% |
| Turner (1-4) | 1,070 | 8% |
| Victoria | 1,043 | 8% |
| **Total** | **13,237** | **100%** |

[1] Based on IEUA GWR Quarterly Reports , between April 2013 and March 2104,

It should be noted that RW recharge to the existing GWR basins shown in Table 2.3 occurred over 12 months of the reporting period, including December, January, and February. The strategy proposed for this study for future planning conditions assumes these months are wet weather months and no RW is used for recharge to allow the basins to fully capture the potential storm water and local runoff. However, during dry conditions when no potential storm water capture is anticipated, the Agency will be able to deliver RW to the GWR basins during these months.

# 3.0 RECYCLED WATER SYSTEM AND SUPPLY

This section provides a description of the reuse supply and existing distribution facilities for the RW Program operated by the Agency. Distribution facilities include items such as pipelines, reservoirs, booster pump stations, and pressure regulating valves that are used to deliver RW.

## 3.1 RECYCLED WATER SUPPLY

The Agency's reuse supply is generated from tertiary treated wastewater effluent meeting Title 22 unrestricted use standards from their regional wastewater recycling plants. The Agency recently prepared a Wastewater Facilities Master Plan (WFMP) that developed wastewater flow projections and addressed facility improvements. Descriptions of the facilities herein are based on the current published information, and do not necessarily reflect the latest facility updates and planning from the WFMP. Wastewater flow projections were obtained using information provided in the WFMP.

### 3.1.1 Recycled Water Supply Projections

Coordination was provided with the WFMP to obtain the latest wastewater flow projections to each of the regional wastewater recycling plants (RP's). This information is provided in Table 3.1 and will be used as the reuse supply projections available to the RW Program.

**Table 3.1 Recycled Water Supply Projections**

| Facility | Year 2015 | Year 2020 | Year 2025[1] | Year 2030 | Year 2035[1] | Ultimate |
|---|---|---|---|---|---|---|
| | MGD | | | | | |
| RP-5 | 6.5 | 10.2 | 13.1 | 15.9 | 18.4 | 25.3 |
| CCWRF | 6.9 | 6.9 | 7.0 | 7.1 | 7.3 | 7.9 |
| RP-1 | 30.4 | 30.4 | 31.3 | 32.2 | 33.1 | 36.3 |
| RP-4 | 11.5 | 11.7 | 12.9 | 14.0 | 14.7 | 18.4 |
| **Total Recycled Water Supply, MGD** | **55.3** | **59.2** | **64.2** | **69.2** | **73.5** | **87.9** |
| Total Recycled Water Supply, AFY | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 | 98,460 |

[1] The Recycled Water Supply projections for the years 2025 and 2035 are estimated based on a linear interpolation from the Year 2020, Year 2030, and Year 2040 projections provided by the WFMP.

## 3.2 REGIONAL RECYCLING PLANTS AND EFFLUENT PUMP STATIONS

A brief description of the existing regional recycling plants and RW supply facilities is provided in the following sections. The regional water recycling plants are graphically shown on Figure 3-1.

### 3.2.1 RP-1

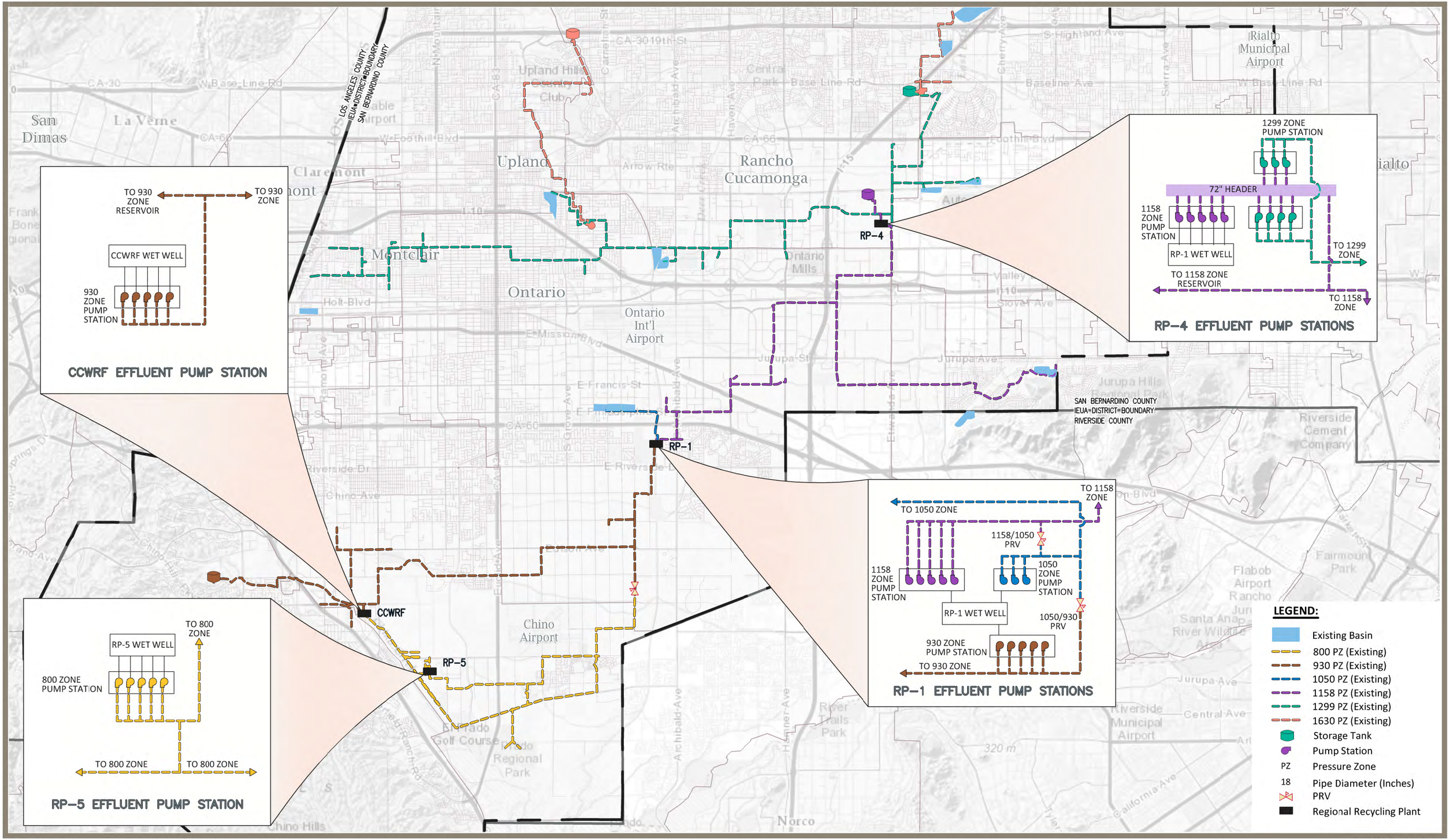
Regional Water Recycling Plant No. 1 (RP-1) is located in the City of Ontario near the intersection of State Highway 60 and Archibald Avenue. This facility was originally commissioned in1948 and has undergone several expansions to increase the design wastewater treatment capacity to the current 44.0 MGD and biosolids treatment capacity equivalent to a wastewater flow rate of 60.0 MGD. This facility serves the Cities of Ontario, Rancho Cucamonga, Upland, Montclair, Fontana, and an unincorporated area of San Bernardino County.

RP-1 includes several treatment processes that contribute to providing a quality recycle water pursuant to the State of California Title 22 regulations. The major treatment processes include preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, tertiary treatment, and biosolids treatment. Nitrified and de-nitrified secondary effluent flows by gravity to tertiary treatment containing a network of filters designed to remove in excess of 99% of the remaining total solids.

Before the filtered reclaimed wastewater (tertiary effluent and therefore, recycled water) can be used for irrigation and GWR purposes and/or be discharged to any other body of surface water, it must be disinfected to comply with the State of California Title 22 bacteriological water quality regulations.

Upon being disinfected, the RW flows by gravity from the chlorine contact tanks to the RW pumping stations at RP-1. From these pumping facilities, the water is pumped into the RW distribution system.

There are three (3) sets of RW effluent pump stations that pump from RP-1 and supply three different pressure zones; the 930, 1050, and 1158 Pressure Zones.




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GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Regional Recycling Plants and Effluent Pump Stations
## FIGURE 3-1

#### 3.2.1.1 RP-1 930 Zone Effluent Pump Station

The existing RP-1 930 Zone Effluent Pump Station includes 3 small identically sized pumps and 2 large identically sized pumps. Each pump is equipped with VFD driven motors. The pumps are staged on and off to maintain an operator adjustable set point pressure in the 930 Zone.

Supply from RP-1 into the 930 Zone has separate control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the 930 Zone Effluent Pump Station pumps are first in the control sequence and the 1050/930 PRV is last. During wet weather low demand periods, the 1050/930 PRV is first in the control sequence, and the 930 Zone pumps are turned on when the 1050/930 PRV cannot maintain pressure.

#### 3.2.1.2 RP-1 1050 Zone Effluent Pump Station

The existing RP-1 1050 Zone Effluent Pump Station includes 3 identically sized pumps. Each pump is equipped with VFD driven 350 Hp motors. The pumps are staged on and off to maintain an operator adjustable set point pressure in the 1050 Zone.

Supply from RP-1 into the 1050 Zone has two control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the 1050 Zone Effluent Pump Station pumps are first in the control sequence and the 1158/1050 PRV is last. During wet weather low demand periods, the 1158/1050 PRV is first in the control sequence, and the 1050 Zone pumps are turned on when the 1158/1050 PRV cannot maintain pressure.

#### 3.2.1.3 RP-1 1158 Zone Effluent Pump Station

The existing RP-1 1158 Zone Effluent Pump station includes 4 identical pumps. Each pump is equipped with VFD driven 400 Hp motor. The pumps are controlled by the 1158 Zone Reservoir water level.

The 1158 Zone Effluent Pump Station is the third supply priority to the 1158 Zone after the RP-4 1158 Zone Pump Station and 1158 Zone Reservoir.

Table 3.2 shows the pump characteristics for the three RP-1 Effluent Pump Stations.

**Table 3.2 Existing RP-1 Effluent Supply Pump Stations**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-1 930 Zone Effluent Pump Station | 930 | 3 Pumps @ 2,790 gpm<br>2 Pumps @ 9,330 gpm<br>Total Capacity = 27,030 gpm | Pressure in 930 Zone (VFD pumps) |
| RP-1 1050 Zone Effluent Pump Station | 1050 | 3 Pumps @ 3,750 gpm<br>Total Capacity = 11,250 gpm | Pressure in 1050 Zone (VFD pumps) |
| RP-1 1158 Zone Effluent Pump Station | 1158 | 4 Pumps @ 2,780 gpm<br>Total Capacity = 11,120 gpm | 1158 Zone Reservoir Level |

### 3.2.2 RP-4

Located in the City of Rancho Cucamonga, the Regional Water Recycling Plant No. 4 (RP-4) has been in operation and producing RW since 1997. RP-4 treats an average flow of 10 MGD. The RP-4 facility has been recently expanded to a capacity of 14 MGD.

RP-4 includes several treatment processes that contribute to providing quality RW pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the RW flows by gravity from the chlorine contact tanks into a common channel and wet well, where it can be discharged to the plant storage pond or pumped into the RW distribution system.

When the demand for utility water or RW is less than the amount of water being produced, the excess RW is discharged to the storage pond and the filter backwash water is sent to RP-1.

#### 3.2.2.1 RP-4 1158 Zone Effluent Pump Station

The existing RP-4 1158 Zone Effluent Pump station includes 2 large pumps and 3 small pumps. Each pump is equipped with VFD driven motor. The pumps are controlled by maintaining the RP-4 wet well level at 13-ft.

The 1158 Zone Effluent Pump Station is the first supply priority to the 1158 Zone.

Table 3.3 shows the pump characteristics for the RP-4 1158 Zone Effluent Pump Station.

**Table 3.3 Existing RP-4 Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-4 1158 Zone Effluent Pump Station | 1158 | 2 Pumps @ 7,200 gpm<br>3 Pumps @ 2,700 gpm<br>Total Capacity = 22,500 gpm | RP-4 Wet Well (13-ft) |

### 3.2.3 RP-5

Regional Water Recycling Plant No. 5 (RP-5), located immediately east of the Agency's Administrative Headquarters in the City of Chino, began operation in March 2004. The first phase of RP-5 was designed to treat 15 million gallons of wastewater per day. Ultimately, RP-5 will treat 60 million gallons of wastewater per day and process 68 MGD of solids combined from RP-5 and the Agency's Carbon Canyon Waste Recycling Facility (CCWRF).

RP-5 includes several treatment processes that contribute to providing quality RW pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the RW flows by gravity from the chlorine contact tanks into a common channel, where it can be discharged to a creek by gravity and also pumped to the 800 Pressure Zone RW distribution system.

#### 3.2.3.1 RP-5 800 Zone Effluent Pump Station

The existing RP-5 800 Zone Effluent Pump station includes 5 pumps of equal size. Two of the pumps are equipped with VFDs and all five pumps have 150 Hp motors. The pumps are controlled by maintaining the RP-5 wet well level at 13 feet.

Supply from RP-5 into the 800 Zone has different control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods the 800 Zone Effluent Pump Station pumps are first in the control sequence and the 930/800 PRV is last. During wet weather low demand periods, the 930/800 PRV is first in the control sequence, and the 800 Zone pumps start when the 930/800 PRV cannot maintain pressure. The 800 Zone Effluent Pump Station will start when the pressure falls below 100 psi.

Table 3.4 shows the pump characteristics for the RP-5 800 Zone Effluent Pump Station.

**Table 3.4 Existing RP-5 Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-5 800 Zone Effluent Pump Station | 800 | 5 Pumps @ 1,925 gpm<br>Total Capacity = 9,625 gpm | Operator defined Wet Well level, and system pressure |

### 3.2.4 CCWRF

CCWRF is located in the City of Chino, and has been in operation since May 1992. This facility serves the cities of Chino, Chino Hills, Montclair, and Upland. Liquids are treated at CCWRF, while the solids removed from the waste flow are treated at RP-2. CCWRF treats an annual average flow of 9.5 MGD.

CCWRF includes several treatment processes that contribute to providing quality recycle water pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the RW flows by gravity from the chlorine contact tanks to the RW pumping station at CCWRF. From those pumping facilities, the water is pumped into the RW distribution system 930 Pressure Zone.

#### 3.2.4.1 CCWRF 930 Zone Effluent Pump Station

The existing CCWRF 930 Zone Effluent Pump station includes 5 pumps of equal size. Two of the pumps are equipped with VFD's motors and all five pumps have 150 Hp motors. The pumps are controlled by maintaining the CCWRF wet level at 13 feet.

Supply from CCWRF into the 930 Zone has different control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the CCWRF 930 Zone Effluent Pump Station pumps are first in the control sequence, the RP-1 930 Zone Pump Station is second, and the 1050/930 PRV is last. During wet weather low demand periods, the priority sequence is reversed: the 1050/930 PRV is first in the control sequence, the RP-1 930 Zone Pump Station is second, and the CCWRF 930 Zone pumps are last priority.

Table 3.5 shows the pump characteristics for the CCWRF 930 Zone Effluent Pump Station.

**Table 3.5 Existing CCWRF Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| CCWRF 930 Zone Effluent Pump Station | 930 | 5 Pumps @ 2,585 gpm<br>Total Capacity = 12,925 gpm | Operator defined Wet Well level, and 930 Zone Reservoir level |

## 3.3 EXISTING DISTRIBUTION SYSTEM FACILITIES

The treated wastewater effluent from the regional wastewater recycling plants deliver the reuse supply to the member agencies and customers via six pressures zones, several hundred miles of pipelines, three booster pump stations, three storage reservoirs, and four pressure regulating stations. These facilities are shown in Figure 3-2.

### 3.3.1 Pressure Zones

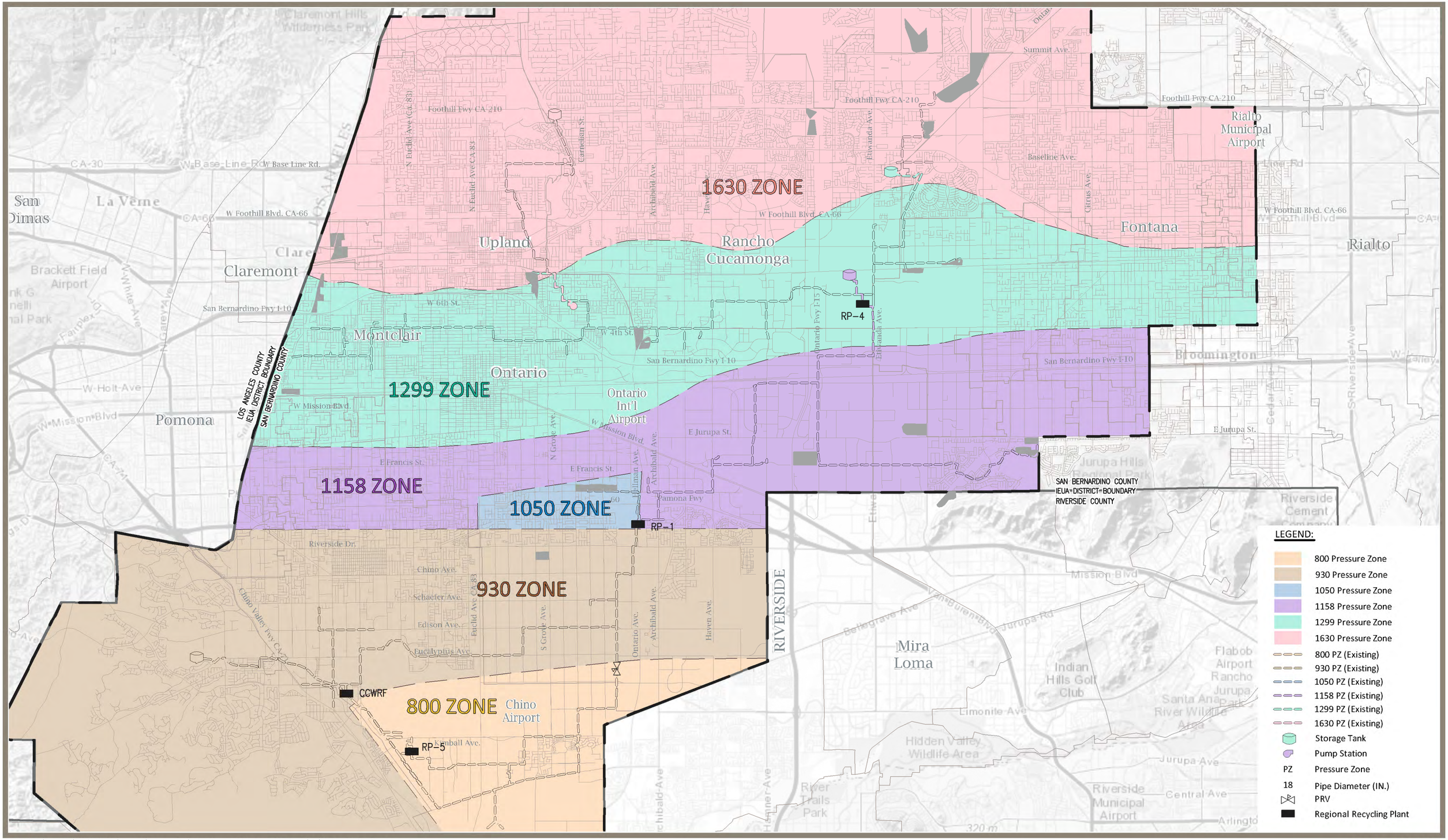
Six (6) pressure zones are utilized to deliver the reuse supply to the Agency's customers with the appropriate service pressures as shown below. These pressure zones are listed in Table 3.6 and illustrated in Figure 3-2. The pressure zones are established based on the following set of design criteria:

- Minimum regional service pressure = 50 psi
- Maximum regional system pressure = 150 psi
- Minimum Basin service pressure = 25 psi (assumes losses through metering/inlet control structure facility are accounted for)

The regional system pressures listed above are used to establish the pressure zones for the RW Program. Localized pressures near reservoirs, regulating valves, and pump stations may vary from those listed.

**Table 3.6 Pressure Zone Characteristics**

| Pressure Zone/HGL | Minimum Service Elevation | Maximum Service Elevation | RP Supply |
|---|---|---|---|
| 800 | 510-ft | 660-ft | RP-5, RP-1 |
| 930 | 600-ft | 778-ft | CCWRF, RP-1 |
| 1050 | 746-ft | 843-ft | RP-1 |
| 1158 | 813-ft | 1,042-ft | RP-1, RP-4 |
| 1299 | 971-ft | 1,183-ft | RP-4 |
| 1630 (East & West) | 1,283-ft | 1,465-ft | RP-4 |




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GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Existing Recycled Water Pressure Zones

FIGURE 3-2

### 3.3.2 Storage Tanks

There are four (4) existing storage tank sites to provide operational storage for the RW system. The storage tanks provide equalization storage for the RW system beyond the delivery capacities of the supply sources due to peak demand characteristics. These tanks and their characteristics are provided in Table 3.7.

**Table 3.7 Existing Storage Tanks**

| Storage Tank/ Pressure Zone | HWL | Capacity |
|---|---|---|
| 930 Reservoir | 930-ft | 5.0 MG |
| 1158 Reservoir | 1158-ft | 2 tanks – 4.0 MG each (8.0 MG Total) |
| 1299 Reservoir | 1299-ft | 3.5 MG |
| 1630 West Reservoir | 1630-ft | 3.0 MG |

### 3.3.3 Booster Pump Stations

In addition to the effluent pump stations supplying the RW distribution system from the four RP's, there are three (3) booster pump stations used to boost water from one pressure zone to a higher pressure zone. These booster pump stations are described in Table 3.8.

**Table 3.8 Existing Booster Pump Stations**

| Booster Pump Station | From Pressure Zone | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|---|
| 1299 Pump Station | 1158 | 1299 | 7 Pumps @ 4,600 gpm | 1299 Reservoir Level |
| 1630 East Pump Station | 1299 | 1630E | 2 Pumps @ 3,000 gpm<br>1 Pumps @ 1,500 gpm<br>2 Pumps @ 750 gpm | Pressure (VFDs) - 150 psi set point |
| 1630 West Pump Station | 1299 | 1630W | 3 Pumps @ 2,000 gpm | 1630 W Reservoir Level |

### 3.3.4 Pressure Reducing Stations

There are three (3) pressure reducing stations that allow RW to flow from a higher pressure zone down to a lower pressure zone. These pressure reducing stations are equipped with a PRV designed to open and supplement the lower pressure zone with RW when the downstream system pressure drops below a defined set point. Table 3.5 identifies the characteristics for each pressure reducing station.

**Table 3.5 Existing Pressure Reducing Stations**

| Pressure Reducing Station | Location | Description | Downstream Pressure Setting[1] |
|---|---|---|---|
| 1630 West PRV to 1299 Zone | 1630 West Pump Station | Functions as Pressure Reducing, Manual Operation, Currently Normally Closed | n/a |
| 1158 PRV to 1050 Zone | RP-1 Effluent Pump Station | Functions as Pressure Sustaining and Reducing | 115-118 psi |
| 1050 PRV to 930 Zone[2] | RP-1 Effluent Pump Station | Functions as Pressure Sustaining and Reducing | 55-65 psi |
| 930 PRV to 800 Zone | Carpenter & Eucalyptus Ave | Pressure Reducing Only – No Electronic Controls | 55 psi |

[1] Pressure settings are subject to change periodically depending on demand conditions or system operation requirements, and actual settings in the field may be different from reported herein.

[2] As described in Section 3.2.1 for the RP-1 930 Zone Effluent Pump Station, the 1050/930 PRV is last in the control sequence during dry weather peak demand periods, but is first in the control sequence during wet weather low demand periods. The 1050/930 PRV is modulated by the operator.

1630W PZ
3MG TANK
1630W PUMP STATION
7TH/8TH ST
TURNER
BROOKS
ELY
RP-1
RP-3
RP-4
RP-5
CCWRF
930 PZ
5MG TANK
930 TO 800
PZ PRV
1299 PZ
5MG TANK
1630E PUMP STATION
SAN SEVAINE 5
VICTORIA
1158 PZ
13MG TANK
HICKORY
BANANA
DECLEZ
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY
RIVERSIDE

**LEGEND:**

- Existing Basin
- 800 PZ (Existing)
- 930 PZ (Existing)
- 1050 PZ (Existing)
- 1158 PZ (Existing)
- 1299 PZ (Existing)
- 1630 (Existing)
- Storage Tank
- Pump Station
- PZ Pressure Zone
- 18 Pipe Diameter (Inches)
- PRV
- Regional Recycling Plant

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A MUNICIPAL WATER DISTRICT

GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Existing Recycled Water System Conveyance Facilities

FIGURE 3-3

# 4.0 IMPLEMENTATION OF PROPOSED GWR BASINS

This section describes the proposed implementation strategy associated with the RWPS goal to increase GWR by maximizing RW recharge to the basins. The strategy proposed has a 20-year planning horizon, which is analyzed and planned in 5-year increments to Year 2035. The following will describe the process of selecting when GWR basins are to be connected to the RW system.

## 4.1 PROPOSED GWR BASINS

Section 2.2 in this report identified the existing GWR basins that are currently connected to the RW system and receive RW for recharge. The Agency operates several other basins that are currently configured only to recharge storm water, local runoff, and/or imported water. The new RW program assumes that each of these basins will be connected to the RW system and receive RW recharge. In Table 4.1, each basin is given a label based on its status. A label of "RW Connection" status implies that the basin is currently operating as part of the GWR program for storm water/local runoff and imported water, and will require modifications and facilities to connect to the RW system to receive RW for recharge.

In addition to the existing basins that will be connected to the RW system, several other sites have been identified by the Agency as new basins that could come online in the future. These GWR basins are at various stages of planning and permitting. Some of these new basins are at existing basin sites where basin capacities will be expanded by adding new cells.

Table 4.1 provides a list of available GWR basins, with corresponding performance criteria that could be added to the RW GWR program. Figure 4-1 is a map identifying the location of each of these GWR basins.

**Table 4.1 Proposed GWR Basins to Receive Recycled Water**

| Basin/Site | Basin Status | Size (acres) | Storage Volume (AF) |
|---|---|---|---|
| Lower Day | RW Connection[1] | 15.0 | 179 |
| Etiwanda Debris | RW Connection[1] | 14.6 | 73 |
| San Sevaine (1-3) | RW Connection[1] | 21.4 | 99 |
| Victoria (Increase) | N/A[3] | 17.4 | 237 |
| Lower San Sevaine | New[2] | 23.0 | 230 |
| Wineville | New[2] | 30.0 | 240 |
| RP-3 (New Cell) | New[2] | 3.5 | 35 |
| Vulcan | New[2] | 30.0 | 450 |
| College Heights East | RW Connection[1] | 6.2 | 112 |
| College Heights West | RW Connection[1] | 5.8 | 110 |
| Grove | RW Connection[1] | 10.0 | 114 |
| Jurupa | RW Connection[1] | 17.0 | 249 |
| Montclair (1-3) | RW Connection[1] | 22.5 | 518 |
| Montclair 4 | RW Connection[1] | 5.8 | 139 |
| Upland | RW Connection[1] | 16.6 | 392 |
| | **Total** | **238.8** | **3,177** |

[1] "RW Connection" implies that the basin is currently operating as part of the GWR program for storm water/local runoff and imported water, These basins will require modifications and facilities to connect to the recycled water system to receive RW recharge.

[2] "New" is a new basin that is currently not in the GWR program.

[3] Existing Basin and no RW improvements will be required. Existing RW turnout structure is adequate for the proposed basin improvements.

ETIWANDA DEBRIS

SAN SEVAINE (1–3)

SAN SEVAINE 5

LOWER DAY

VICTORIA

VICTORIA (INCREASE)

COLLEGE HEIGHTS EAST

COLLEGE HEIGHTS WEST

UPLAND

MONTCLAIR (1–3)

HICKORY

BANANA

TURNER

BROOKS

JURUPA

RP-3 NEW

WINEVILLE

ELY

DEMEZ

GROVE

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing RW GWR Basin
- Proposed RW GWR Basin
- 800 PZ (Existing)
- 930 PZ (Existing)
- 1050 PZ (Existing)
- 1158 PZ (Existing)
- 1299 PZ (Existing)
- 1630 PZ (Existing)
- Storage Tank
- Pump Station
- PRV
- Regional Facility
- * Denotes Existing Operational Basins Proposed to be Connected to Recycled Water System for Recycled Water Recharge

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GRAPHIC SCALE
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( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Existing and Proposed Recycled Water GWR Basins

FIGURE 4-1

## 4.2 GWR BASIN IMPLEMENTATION

The strategy for implementing the proposed GWR basins listed in Table 4.1 is based on the basins coming online in the next 20 years, with a subset of GWR basins coming online every 5 years. The general overall goal of the strategy is to implement basins in the early phases that will maximize infiltration while minimizing facility improvements and permitting requirements.

Identifying GWR basins in each 5-year increment was performed by rating the basins against a set of criteria. A benefit score, or weighting factor, was then determined for each basin based on the criteria below. The following sub-sections briefly describe the evaluation criteria and methodology used for this analysis.

The proposed criteria, definitions and weighting factors for evaluating each of the GWR basins in the RWPS are provided in Section 4.2.1 below.

The evaluation criteria described below are grouped into two major categories, as they will either have impacts related to infrastructure costs, or readiness to proceed due to scheduling constraints and implementation ability.

### 4.2.1 Evaluation Criteria

The criteria used to determine which basins will come online in each 5-year period during the next 20 years were based on the criteria described below.

Costs Related Criteria

- *Pressure Zone Demand Distribution* – consideration is given to how the basins will be implemented over the next 20 years based on the geographic location within each pressure zone, and how many basins are supplied by the same pressure zone. This criterion groups the basins for each 5-year increment to evenly spread out the basin demands within each pressure zone and spread the demands over multiple basins, if possible, in order to limit the amount of new infrastructure required during the same planning year. Based on the hydraulic evaluations, the pressure zones in the eastern portion of the system have more available capacity than do those in the western portion of the system. Basins are ranked on a scale of 1 to 10 points, where points are assigned to the pressure zone service area where each basin is located. With 10 points given to basins located within pressure zones with the most available capacity. The weighting factor assigned to each pressure zone are as follows:

| Pressure Zone Service Area | Weighting Factor |
|---|---|
| 1050 | 1 pt |
| 1158 | 5 pts |
| 1299 West Area | 1 pt |
| 1299 East Area | 5 pts |
| 1630 West | 1 pt |
| 1630 East | 10 pts |

The table above does include 800 and 930 Pressure Zones since these pressure zones do not include a recharge basin.

- *Infiltration Rate* – the average infiltration rate for each basin was utilized in determining the total GWR demand for the pressure zones. The basins were ranked from 1 to 15 depending on the basin's infiltration rate, in acre-feet per month (AFM). The higher the infiltration rate, the higher the ranking and corresponding weight assigned. The weighting factor assigned to each basin based on its infiltration rate are as follows:

| GWR Basin | Average Infiltration Rate (AFM) | Weighting Factor |
|---|---|---|
| Grove | 75 | 1 |
| Lower San Sevaine | 90 | 2 |
| Montclair 4 | 95 | 3 |
| Wineville | 117 | 4 |
| College Heights West | 155 | 5 |
| Vulcan Pit | 171 | 6 |
| Victoria (increase) | 212 | 7 |
| Jurupa | 233 | 8 |
| Etiwanda Debris | 263 | 9 |
| College Heights East | 302 | 10 |
| Lower Day | 340 | 11 |
| Upland | 370 | 12 |
| Montclair (1-3) | 1,107 | 13 |
| RP-3 (New Cell) | 1,366 | 14 |
| San Sevaine (1-3) | 1,508 | 15 |

- *Basin Fill Rate* – basin fill rate was established by a 14-day fill rate for each basin in order to allow the basins a complete fill cycle in the spring and fall seasons to maximize the recharge capabilities of the GWR program. The fill rate was determined by the basin storage volume divided by 14 days. Basin fill rates are listed in Table 4.4. Similar to infiltration rate, the basins are ranked from 1 to 15 depending on the basins fill rate. Basin having the highest required fill rate ranked with the lowest weight. This implies that a basin requiring a higher flow rate will have the most impact to the existing system and will require increased costs for system upgrades and improvements.

| GWR Basin | 14-Day Fill Rate (MGD) | Weighting Factor |
|---|---|---|
| Jurupa | 8.9 | 1 |
| Upland | 6.8 | 2 |
| Victoria (increase) | 5.5 | 3 |
| Lower San Sevaine | 5.4 | 4 |
| Grove | 5.3 | 5 |
| Lower Day | 5 | 6 |
| Montclair (1-3) | 4 | 7 |
| Montclair 4 | 3.3 | 8 |
| San Sevaine (1-3) | 3.1 | 9 |
| Wineville | 2.8 | 10 |
| College Heights East | 2.6 | 11 |
| College Heights West | 2.5 | 12 |
| Vulcan Pit | 2.1 | 13 |
| Etiwanda Debris | 1.7 | 14 |
| RP-3 (New Cell) | 0.8 | 15 |

- *Vicinity to Existing RW System* – this criterion weights each basin based on its location relative to existing RW system facilities. For example, a basin that is immediately adjacent to an existing transmission main would have a higher weight to come online sooner than a basin that is further away, as it would require additional pipelines to receive RW. The weighting factor assigned to each basin based on its location to existing RW facilities are as follows:

| Vicinity to Existing RW System | Criteria Points |
|---|---|
| Greater than 1 ½ Miles from RW System | 1 pt |
| Within 1 ½ Miles from RW System | 5 pts |
| Immediately Adjacent to RW System | 10 pts |

Schedule Related Criteria

- *Basin Status* – as shown in Table 1.1, some basins are existing basins but are equipped or permitted to only recharge storm water, local runoff, and/or imported water. These basins are identified as "RW Connection", since they will only require the modifications necessary for them to be connected to the RW system. All other basins are being assigned as "New" and will have a higher weighting factor due to increased costs associated with basin improvements. The weighting factor assigned to each basin based on its connection status is as follows:

| Basin Status | Weighting Factor |
|---|---|
| RW Connection | 10 pts |
| New | 1 pt |

- *Permitted* – basins are weighted based on whether or not they are already permitted. Some existing basins may not be permitted for RW recharge. Basins already permitted were assigned a higher weight than those not, as it may be easier to commence RW recharge. The weighting factor assigned to each basin based on its permit status is as follows:

| Permit Status | Weighting Factor |
|---|---|
| No | 1 pt |
| Yes | 10 pts |

- *Property Ownership* – consideration is given to the property ownership for each basin. The different property owners may have different requirements in place for allowing the Agency to recharge the basin with RW. Basins located on property owned by IEUA or SBCFCD were given higher weight because of current agreements already in place for RW recharge. The weighting factors assigned to each basin based on the property owner are as follows:

| Property Owner | Weighting Factor |
|---|---|
| IEUA | 10 pts |
| SBCFCD | 8 pts |
| CBWCD | 6 pts |
| Upland | 4 pts |
| Calmat | 2 pts |

- *Planned Basin in RMPU* – some of the basins have already been planned and committed through the 2013 CBWM RMPU. Basins identified in the 2013 CBWM RMPU will receive a higher weight. The weighting factor assigned to each basin based on 2013 RMPU status is as follows:

| Planned in RMPU | Weighting Factor |
|---|---|
| No | 1 pt |
| Yes | 10 pts |

- *Production Wells* – some basins have potable production wells nearby for the recovery of groundwater. Basins that have production wells within a 500-ft radius and/or less than a 6-month travel time were given a lower weight due to increased permitting requirements. The weighting factor assigned to each basin based on the location of existing or planned production wells is as follows:

| Production Wells | Weighting Factor |
|---|---|
| No Existing Wells | 10 pts |
| Existing Wells | 1 pt |

### 4.2.2 Proposed Basin Implementation Strategy

For Years 2020, 2025, 2030, 2035, and Ultimate analysis scenarios, it was assumed that three (3) basins would come online in each 5-year planning period. This provided for an even and balanced distribution of RW to GWR basins while maintaining the goal to maximize the amount of GWR in the near-term with minimal investment.

The evaluation criteria and corresponding weighting factors described in Section 4.2.1 were used to prioritize which of the basins are to be implemented within each 5-year planning period.

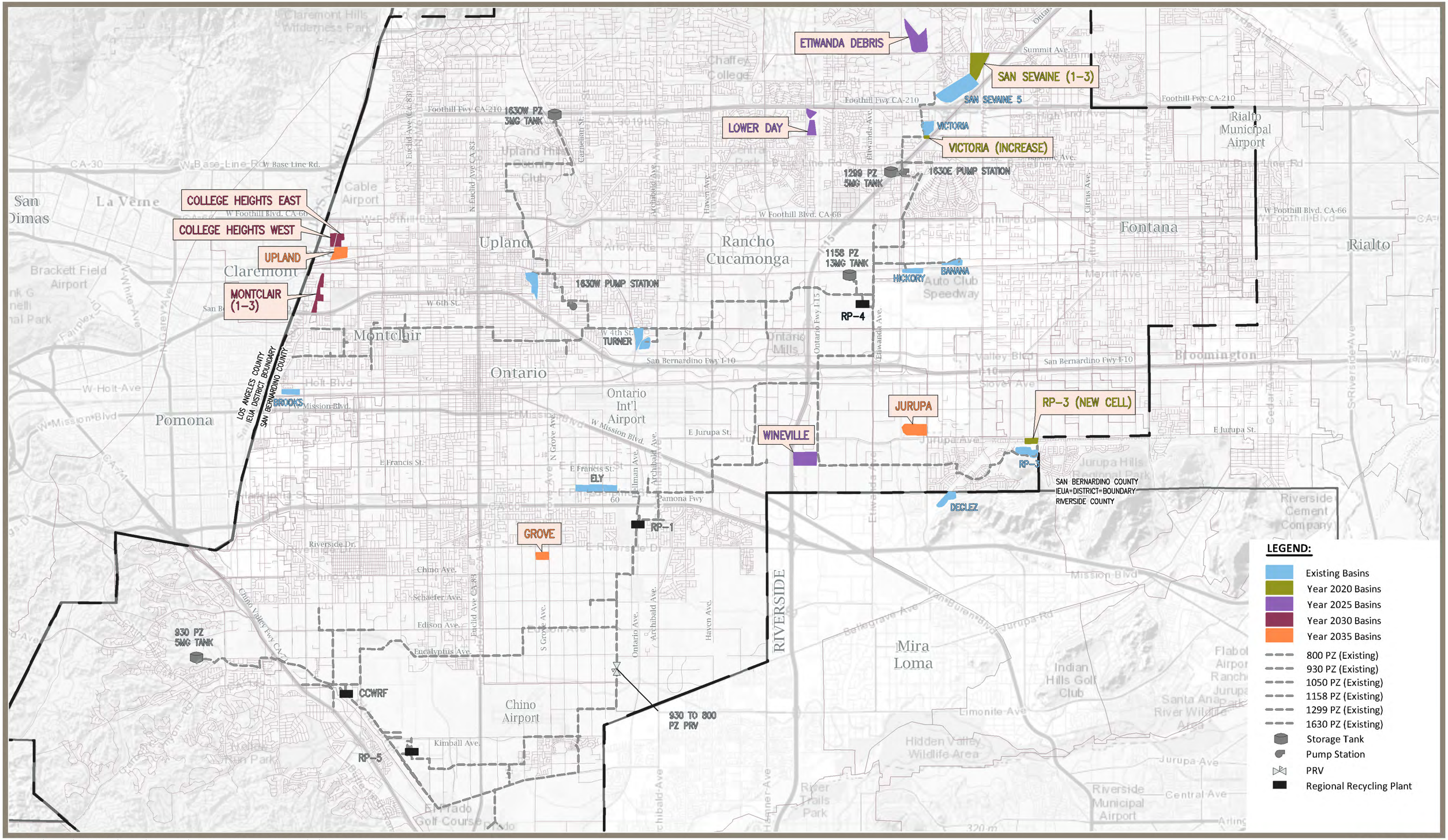
It should be noted that the priority order in which the basins were grouped and implemented also included consideration for total GWR demand. The implementation order of the GWR basins was modified as necessary to balance the GWR demand as evenly as possibly throughout the entire 20 year RWPS planning horizon.

The proposed GWR Basin implementation schedule is shown in Table 4.2. Basins with the highest points were identified and ranked as the highest priority, or first to implement. The GWR basins shown for Year 2020 and 2025 are located in pressure zones near existing infrastructure that has sufficient capacity to supply the additional GWR demand without significant improvement costs. It should also be noted that majority of these GWR basins are already permitted and acceptable to receive RW.

The GWR Basin implementation schedule is illustrated in Figure 4-2.

## Table 4.2 Proposed GWR Basin Implementation Priority Ranking

| Planning Year | Basin | Costs Related Criteria | | | | Schedule Related Criteria | | | | | Total Points | Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pressure Zone | Ave. Infilt. Rate | 14-Day Fill Rate | Vicinity to Existing RW System | Basin Status | Permit Status | Property Owner | Planned Basin in RMPU | Prod. Well | | |
| Year 2020 | RP-3 (New Cell) | 1 | 14 | 15 | 10 | 1 | 10 | 10 | 10 | 10 | **81** | **1** |
| | Victoria (increase) | 10 | 7 | 3 | 10 | 10 | 10 | 8 | 10 | 10 | **78** | **2** |
| | San Sevaine (1-3) | 10 | 15 | 9 | 10 | 10 | 10 | 8 | 10 | 1 | **83** | **3** |
| Year 2025 | Wineville | 10 | 4 | 10 | 5 | 1 | 10 | 10 | 10 | 10 | **70** | **4** |
| | Lower Day | 10 | 2 | 4 | 10 | 1 | 10 | 8 | 10 | 10 | **65** | **5** |
| | Etiwanda Debris | 10 | 9 | 14 | 5 | 10 | 1 | 8 | 1 | 1 | **59** | **6** |
| Year 2030 | Montclair (1-3) | 5 | 13 | 7 | 5 | 10 | 1 | 6 | 1 | 1 | **49** | **7** |
| | College Heights East | 1 | 10 | 11 | 1 | 10 | 10 | 6 | 1 | 10 | **60** | **8** |
| | College Heights West | 1 | 5 | 12 | 1 | 10 | 10 | 6 | 1 | 10 | **56** | **9** |
| Year 2035 | Upland | 10 | 11 | 6 | 1 | 10 | 1 | 8 | 1 | 1 | **49** | **10** |
| | Jurupa | 1 | 8 | 1 | 5 | 10 | 10 | 8 | 1 | 10 | **54** | **11** |
| | Grove | 1 | 1 | 5 | 1 | 10 | 10 | 8 | 1 | 10 | **47** | **12** |
| Ultimate[1] | Vulcan Pit | 1 | 12 | 2 | 1 | 1 | 1 | 4 | 1 | 1 | **24** | **13** |
| | Lower San Sevaine | 5 | 6 | 13 | 1 | 10 | 10 | 2 | 10 | 10 | **67** | **14** |
| | Montclair 4 | 1 | 3 | 8 | 5 | 10 | 1 | 6 | 1 | 1 | **36** | **15** |




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GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## GWR Basin Implementation Strategy

FIGURE 4-2

# 5.0 MASS BALANCE ANALYSIS

The following is a brief description of the approach taken in performing the mass balance of the reuse supply and direct use demands to determine the amount of reuse supply that will be available for GWR recharge into the existing and proposed GWR basins.

## 5.1 EXISTING AND PROJECTED ANNUAL DEMANDS

The annual demand projections provided by the Agency were subtotaled by member agency and by pressure zone, and provided for existing demand conditions through Year 2035 demand conditions, in 5-year increments. These annual demands are used as the basis for the direct use demand projections for the study.

**Table 5.1 Summary of Supplies and Demands**

| | Planning Year | | | | |
|---|---|---|---|---|---|
| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | *AFY* | | | | |
| Total Supplies | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 |
| Direct Use Demands | 24,655 | 30,757 | 36,507 | 40,320 | 43,019 |
| **Surplus[1]** | **37,289** | **35,555** | **35,406** | **37,194** | **39,311** |

[1] The Surplus shown in this table is a gross annual surplus total and does not consider monthly supply deficits due to maximum month or peak direct use demand periods.

### 5.1.1 Monthly Demands

Direct use demands for existing Year 2013 conditions were obtained from the Agency's monthly customer billing data. (The Agency recharge billings were separated from the direct use billing). This information was used to establish the existing direct use demands for each month, subtotaled by pressure zone.

Future demands for each member agency was provided by the Agency for each planning period. The monthly demand patterns from the 2013 billing information were extrapolated to the future annual demand projections for each 5-year increment to obtain future monthly direct use demand projections. The demand projections assume that existing agricultural irrigation will be reduced as development increases over time. These monthly demand estimates are used to analyze the spring (average demands) and summer (maximum demands) analysis scenarios for each 5-year planning period.

#### 5.1.1.1 Santa Ana River Base Flow (SARBF) at Prado Obligation

In addition to the current direct use demands, the Agency maintains an annual base flow obligation to the Santa Ana River at Prado Dam. The Agency typically meets the SARBF at Prado Obligation through effluent discharge from each of the RPs.

The SARBF at Prado obligation is an annual demand ranging from 14,000 AF to 17,000 AF. Due to other flows to the Santa Ana River and water quality credits, 14,000 AFY, or approximately 12.5 MGD, is used in the RWPS for facility sizing purposes. Approximately 2.0 MGD of the 12.5 MGD can be delivered from RP-5 through the 800 Pressure Zone. The remaining demand is met by discharging directly into the nearby creek from either RP-5 and CCWRF or RP-1. This study assumes that the SARBF at Prado Obligation is met by RP-5 and CCWRF first, as it is the Agency's desire to keep as much RW at RP-1 as possibly for GWR. Therefore, RP-1 was assumed to be supplementary supply as necessary for meeting the SARBF at Prado obligation.

The supply priority assumed in the RWPS was to first meet the SARBF at Prado Obligation than direct use demands. Based on historical data, the SARBF at Prado Obligation demand is assumed to be approximately 40% of the total annual obligation during the winter months of December, January, and February to be in compliance with the obligation agreement. For the purposes of the RWPS, the SARBF at Prado demand obligation was limited to 40% of the annual obligation even if there was additional reuse supply available for contribution. Meeting the SARBF at Prado obligation during the winter months is advantageous due to the reduced direct use demands, but there are limitations per the obligation agreement. The minimum flow rate to SARBF at Prado Obligation in any one month is 3.5 MGD, or approximately 5.4 CFS on average. This constraint is primarily due to the RP's ability to turndown de-chlorination facilities.

#### 5.1.1.2 Existing and Projected Wastewater Supply

The wastewater flow projections were provided by the Agency from the WFMP project, and shown in Table 3.1. These flows were provided for existing conditions through Year 2035 conditions, in 5-year increments. The monthly wastewater supply is assumed to be constant for each month in each year of the planning study.

#### 5.1.1.3 Southern and Northern Service Areas

As shown in Table 5.2, the supplies and demands were divided into two services areas; the Southern and Northern Service Areas. The service areas are grouped by the pressure zones that are primarily supplied by the regional recycling plants. Table 4.3 shows the service areas that are assumed for the mass balance analysis.

**Table 5.2 Southern and Northern Service Areas**

| Service Area | Supply from Regional Recycling Plant | Pressure Zones Served |
|---|---|---|
| Southern Area | RP-5<br>CCWRF | 800<br>930 |
| Northern Service Area | RP-1 [1]<br>RP-4 [2] | 1050<br>1158<br>1299<br>1630E<br>1630W |

[1] RP-1 is the only facility that can supply both the Southern and Northern Service Areas via the 930 PZ Effluent Pump Station, 1050 PZ Effluent Pump Station, and the 1158 PZ Effluent Pump Station. For the mass balance analysis, RP-1 is assumed to supply only the Northern Service Area for the calculations and tables presented herein.

[2] RP-4 supplies directly to the 1158 PZ. Other Booster Pump Stations are required to supply the higher pressure zones.

### 5.1.2 GWR Basin Demand Assumptions

For the existing direct use demands scenario, the existing GWR Basins were assigned a GWR demand which corresponds to its 14-day fill rate. The average daily base flow rate for each basin was assumed to be the basin volume divided by 14 days. Each basin's flow rate is listed in Table 5.3.

The reuse supply delivered to the GWR Basins was assumed to flow daily for a 12-hour period outside the normal peak irrigation period during the night; therefore, the instantaneous flow rate is twice the daily average flow rate. Reducing daily operation of the GWR basins to 12-hours during the day was done due to low availability of reuse supply during the night time hours. During the night time hours, the wastewater flows are low and reuse supply from each RP is limited. Additionally, the peak irrigation demands occur during the night which utilizes much of the reuse supply available during this period. Typically, more reuse supply is available from each RP during the day, outside the peak irrigation demand period.

This operational strategy to deliver GWR during a 12-hour day time period allows the Agency to increase the GWR priority and maximize the available reuse supply. Distribution facilities and

basin turnout capacities will need to be sized accordingly to accommodate these higher flow rates.

The 14-day fill cycle repeats every 6-week period for each basin when possible. Some of the basins with large storage volumes and reduced infiltration rates required additional time between filling cycles. For the analysis in section 5.1.3, the GWR basin demands are limited by the supply of RW from the regional recycling plants.

It should be noted that all of the existing and proposed basins are located in the Northern Service Area.

**Table 5.3 Proposed GWR Basins Recycled Water Demands**

| Basin/Site | Daily Demand[1] (MGD) | Flow Rate[2] (gpm) |
|---|---|---|
| 7th/8th Street | 5.3 | 7,361 |
| Banana | 1.0 | 1,389 |
| Brooks | 5.5 | 7,639 |
| Ely (1-3) | 4.9 | 6,806 |
| Hickory | 3.7 | 5,139 |
| RP-3/Declez | 4.3 | 5,972 |
| San Sevaine 5 | 17.4 | 24,167 |
| Turner (1-4) | 10.2 | 14,167 |
| Victoria | 3.7 | 5,139 |
| Wineville | 2.8 | 3,889 |
| Victoria (increase) | 5.5 | 7,639 |
| San Sevaine (1-3) | 3.1 | 4,306 |
| RP-3 (New Cell) | 0.8 | 1,111 |
| Lower Day | 5.0 | 6,944 |
| Etiwanda Debris | 1.7 | 2,361 |
| Montclair (1-3) | 4.0 | 5,556 |
| College Heights East | 2.6 | 3,611 |
| College Heights West | 2.5 | 3,472 |
| Upland | 6.8 | 9,444 |
| Jurupa | 8.9 | 12,361 |
| Grove | 2.7 | 3,750 |
| Vulcan Pit | 2.1 | 2,917 |
| Lower San Sevaine | 5.4 | 7,500 |
| Montclair 4 | 3.3 | 4,583 |
| **Total** | **113.2** | |

[1] Daily demand is based on the basin storage volume divided by 14 days for a 14-day fill period.

[2] The flow rate for each basin is based on a 12-hour per day operation, with the fill period occurring during the day outside the peak irrigation direct use demand period.

### 5.1.3 Supply versus Demands Analysis

For each 5-year demand scenario, a monthly supply versus direct use demands analysis was performed for the Southern and Northern Service Areas, which were defined previously in Section 5.1.1.3. The monthly direct use demand projections were compared with the monthly wastewater supply flow projections. It was assumed that the wastewater flows were constant for each month throughout the year. The difference between the wastewater supply and direct use demands plus the SARBF at Prado Obligation yields the supply or reuse supply available to the GWR program for each month.

Table 5.4 shows the supply and demand analysis, with the available supply to recharge the GWR basins by month for each planning year. This table assumes a 9-month GWR operation, where the monthly GWR is limited by the wastewater supply from the regional recycling plants.

**Table 5.4 Supply versus Demands Mass Balance**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| **Southern Service Area** | | | | | |
| Southern Area RW Supply (RP-5, CCWRF) | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Total to SARBF at Prado Obligation[1] | 4,497 | 5,428 | 6,513 | 8,168 | 9,446 |
| Southern Area Supply Surplus/(Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| **Northern Service Area** | | | | | |
| Northern Area RW Supply (RP-1, RP-4) | 46,934 | 47,158 | 49,454 | 51,750 | 53,543 |
| Northern Area Direct Use Demands | 8,087 | 11,166 | 15,642 | 19,240 | 20,650 |
| Supplemental Supply to Southern Area | 6,056 | 5,865 | 4,919 | 3,484 | 3,028 |
| Total to SARBF at Prado from North[2] | 9,502 | 8,571 | 7,487 | 5,832 | 4,554 |
| Northern Area Supply Surplus/(Deficit) | 23,289 | 21,556 | 21,406 | 23,194 | 25,311 |
| **GWR 9-Month Operation RW Availability[3]** | **16,095** | **13,977** | **13,027** | **13,707** | **14,871** |
| 3-Month Un-Used Winter Surplus | 7,194 | 7,579 | 8,379 | 9,487 | 10,440 |

[1] The Total to SARBF at Prado Obligation from the South is calculated based on the monthly mass balance analysis, and assumes a base flow of 2.6 MG per month, plus the sum of any additional available for each month.

[2] The Total to SARB at Prado Obligation from the North is calculated based on the monthly mass balance analysis, and assumes a base flow of 0.9 MG per month, plus additional flows needed to meet the 14,000 AFY requirement and limit the 3-month winter period to 40% of the annual flow.

[3] The GWR 9-Month Operation RW Availability shown is calculated based on the monthly mass balance and surplus analysis for the 9-month GWR operation period.

A summary of the mass balance analysis and total reuse supply available for the GWR program, listed for each service area by planning horizon, is provided in Table 5.5.

**Table 5.5 Summary of Mass Balance**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Southern Service Area Supply/(Deficit)[1] | - | - | - | - | - |
| Northern Service Area Supply/(Deficit)[2] | 23,289 | 21,556 | 21,406 | 23,194 | 25,311 |
| GWR 9-Month Operation RW Availability | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Un-Used Winter Months RW Surplus[3] | 7,194 | 7,579 | 8,379 | 9,487 | 10,440 |

[1] Southern Service Area has a deficit that is supplemented from the surplus from RP-1 of the Northern Service Area.

[2] The Northern Service Area surplus shown accounts for the supplemental supply delivered to the Southern Service Area via RP-1. This surplus is available to GWR program.

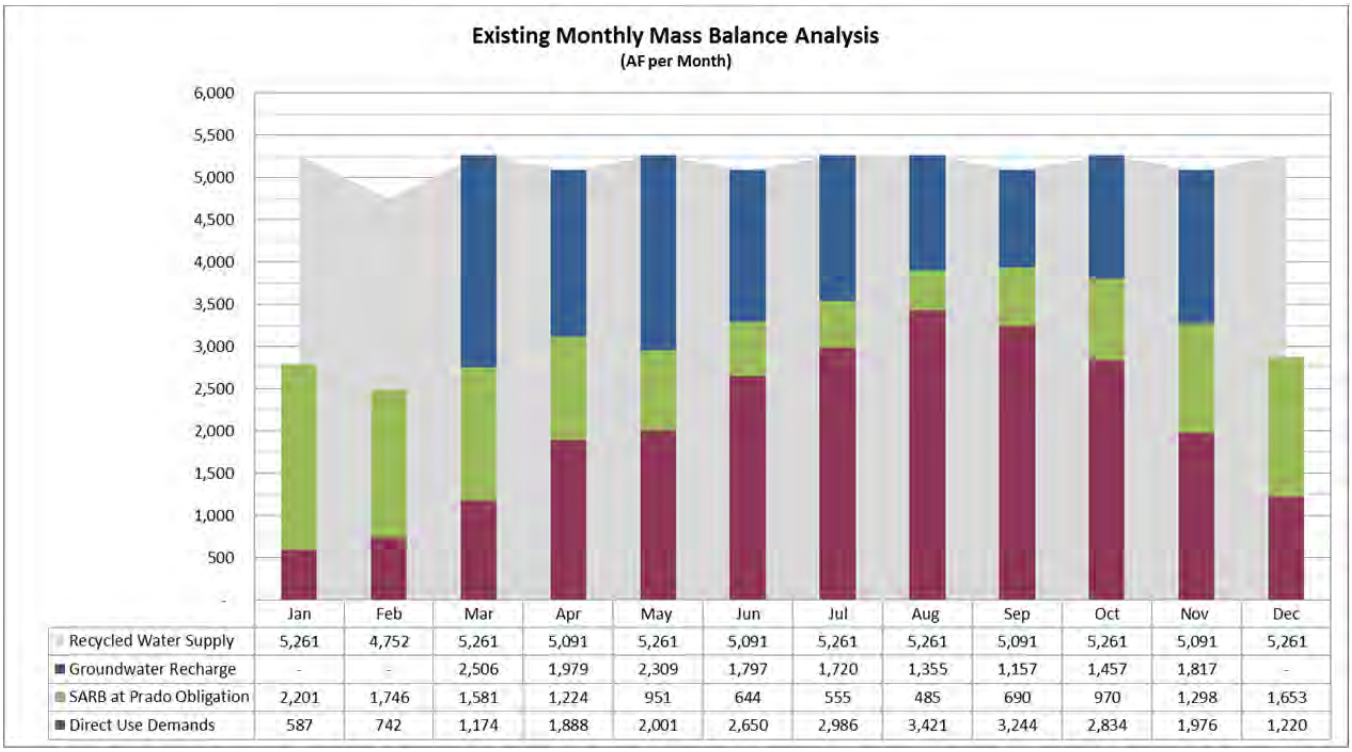
[3] The Un-Used Winter Months RW Surplus could be utilized in dry years for GWR if no storm water or local runoff water needs are to be captured.

Tables 5.6 through 5.10 on the following pages and Figures 5-1 through 5-5 illustrate the relationship of the mass balance shown in Tables 5.4 and 5.5 on a monthly basis for the RW Program as a whole. The monthly mass balance assumes a 9-month GWR operation. However, it should be noted that the un-used surplus RW during the winter months could be utilized during dry years while no storm water or local runoff is to be captured.

## Table 5.6 Existing Monthly Mass Balance Analysis

| EXISTING | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 15,010 |
| Southern Area Direct Use Demands | 3.2 | 6.0 | 8.2 | 14.4 | 12.6 | 18.7 | 20.5 | 23.3 | 25.4 | 21.3 | 15.1 | 8.9 | 14.8 | 16,568 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 7.5 | 4.8 | 2.6 | - | - | - | - | - | - | - | - | 1.9 | 3.4 | 1,557 |
| Total to SARBF at Prado from Southern Area | 10.2 | 7.4 | 5.2 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 4.5 | 4.0 | 4,497 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | (3.6) | (1.8) | (7.9) | (9.7) | (12.5) | (14.7) | (10.6) | (4.3) | 0.0 | (9.0) | (6055.6) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 46,934 |
| Northern Area Direct Use Demands | 2.9 | 2.7 | 4.2 | 6.1 | 8.5 | 10.1 | 10.9 | 12.7 | 9.8 | 8.5 | 6.4 | 3.9 | 7.2 | 8,087 |
| Supplemental Supply to Southern Area | - | - | - | 3.6 | 1.8 | 7.9 | 9.7 | 12.5 | 14.7 | 10.6 | 4.3 | - | 9.0 | 6,056 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 12.1 | 12.0 | 10.5 | 9.8 | 6.5 | 3.5 | 2.3 | 1.6 | 4.0 | 6.7 | 10.6 | 12.0 | 7.6 | 8,522 |
| Total to SARBF at Prado from North Area | 13.0 | 12.9 | 11.4 | 10.7 | 7.4 | 4.4 | 3.2 | 2.5 | 4.9 | 7.6 | 11.5 | 12.9 | 8.5 | 9,502 |
| Northern Area Supply Surplus/(Deficit) | 26.0 | 26.4 | 26.3 | 21.5 | 24.3 | 19.5 | 18.1 | 14.2 | 12.6 | 15.3 | 19.7 | 25.1 | 20.7 | 23,289 |
| Total SARBF at Prado Obligation | 23.1 | 20.3 | 16.6 | 13.3 | 10.0 | 7.0 | 5.8 | 5.1 | 7.5 | 10.2 | 14.1 | 17.4 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **26.3** | **21.5** | **24.3** | **19.5** | **18.1** | **14.2** | **12.6** | **15.3** | **19.7** | **-** | **19.1** | **16,095** |

Figure 5-1 EXISTING Monthly Mass Balance Analysis

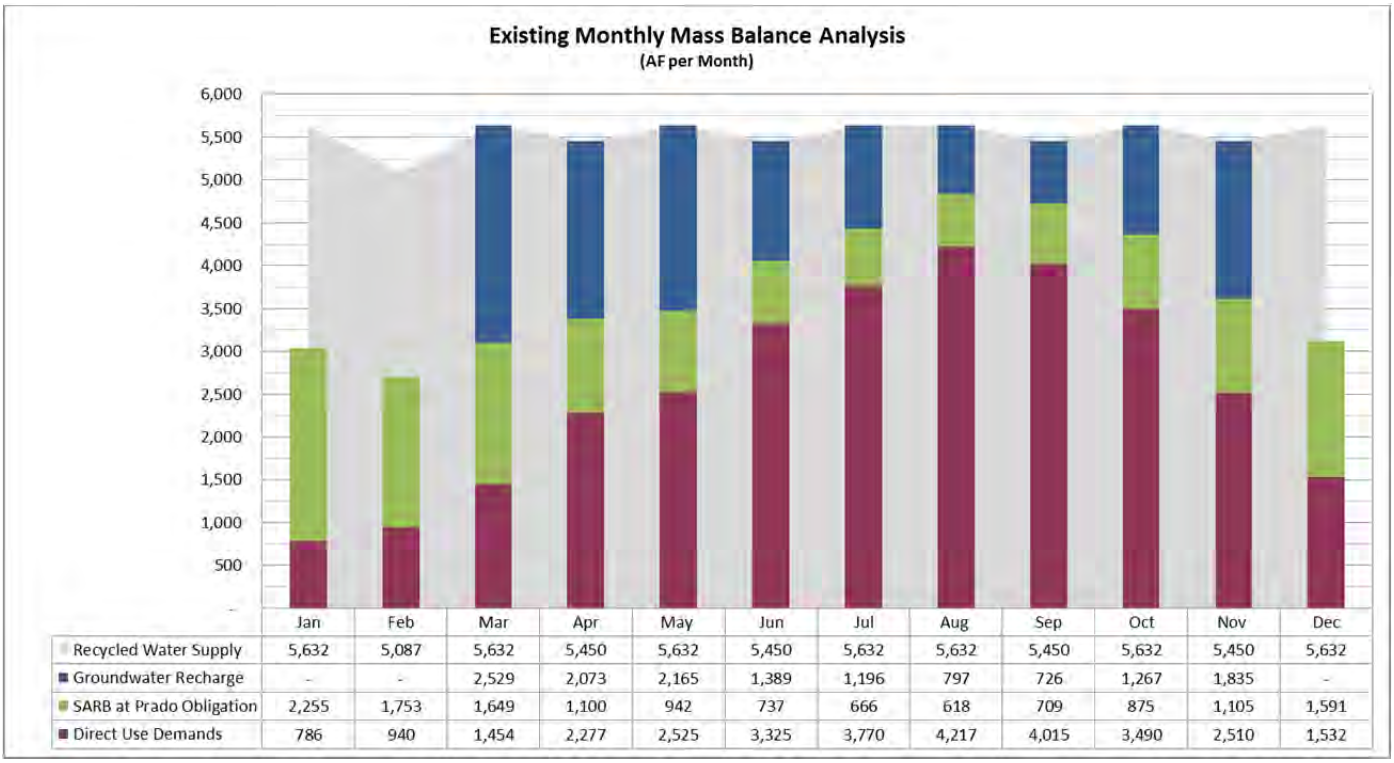



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 5,261 | 4,752 | 5,261 | 5,091 | 5,261 | 5,091 | 5,261 | 5,261 | 5,091 | 5,261 | 5,091 | 5,261 |
| Groundwater Recharge | - | - | 2,506 | 1,979 | 2,309 | 1,797 | 1,720 | 1,355 | 1,157 | 1,457 | 1,817 | - |
| SARB at Prado Obligation | 2,201 | 1,746 | 1,581 | 1,224 | 951 | 644 | 555 | 485 | 690 | 970 | 1,298 | 1,653 |
| Direct Use Demands | 587 | 742 | 1,174 | 1,888 | 2,001 | 2,650 | 2,986 | 3,421 | 3,244 | 2,834 | 1,976 | 1,220 |

## Table 5.7 YEAR 2020 Monthly Mass Balance Analysis

| Year 2020 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 19,154 |
| Southern Area Direct Use Demands | 3.8 | 7.0 | 9.6 | 16.7 | 15.0 | 22.1 | 24.4 | 27.6 | 30.0 | 25.1 | 18.0 | 10.6 | 17.5 | 19,591 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 10.7 | 7.5 | 4.8 | - | - | - | - | - | - | - | - | 3.8 | 5.4 | 2,488 |
| Total to SARBF at Prado from Southern Area | 13.3 | 10.1 | 7.5 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 6.5 | 4.9 | 5,428 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | (2.2) | (0.5) | (7.7) | (10.0) | (13.1) | (15.5) | (10.6) | (3.5) | 0.0 | (8.9) | (5865.2) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 47,158 |
| Northern Area Direct Use Demands | 4.5 | 4.0 | 5.6 | 8.1 | 11.6 | 14.0 | 15.2 | 16.8 | 13.6 | 11.6 | 9.3 | 5.5 | 10.0 | 11,166 |
| Supplemental Supply to Southern Area | - | - | - | 2.2 | 0.5 | 7.7 | 10.0 | 13.1 | 15.5 | 10.6 | 3.5 | - | 8.9 | 5,865 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 9.5 | 9.4 | 9.0 | 8.5 | 6.4 | 4.5 | 3.5 | 3.0 | 4.2 | 5.7 | 8.5 | 9.4 | 6.8 | 7,591 |
| Total to SARBF at Prado from North Area | 10.4 | 10.3 | 9.9 | 9.3 | 7.3 | 5.4 | 4.4 | 3.9 | 5.1 | 6.6 | 9.4 | 10.3 | 7.7 | 8,571 |
| Northern Area Supply Surplus/(Deficit) | 27.2 | 27.9 | 26.6 | 22.5 | 22.8 | 15.1 | 12.6 | 8.4 | 7.9 | 13.3 | 19.9 | 26.4 | 19.2 | 21,556 |
| Total SARBF at Prado Obligation | 23.7 | 20.4 | 17.3 | 12.0 | 9.9 | 8.0 | 7.0 | 6.5 | 7.7 | 9.2 | 12.0 | 16.7 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | - | - | **26.6** | **22.5** | **22.8** | **15.1** | **12.6** | **8.4** | **7.9** | **13.3** | **19.9** | - | **16.6** | **13,977** |

Figure 5-2 YEAR 2020 Monthly Mass Balance Analysis

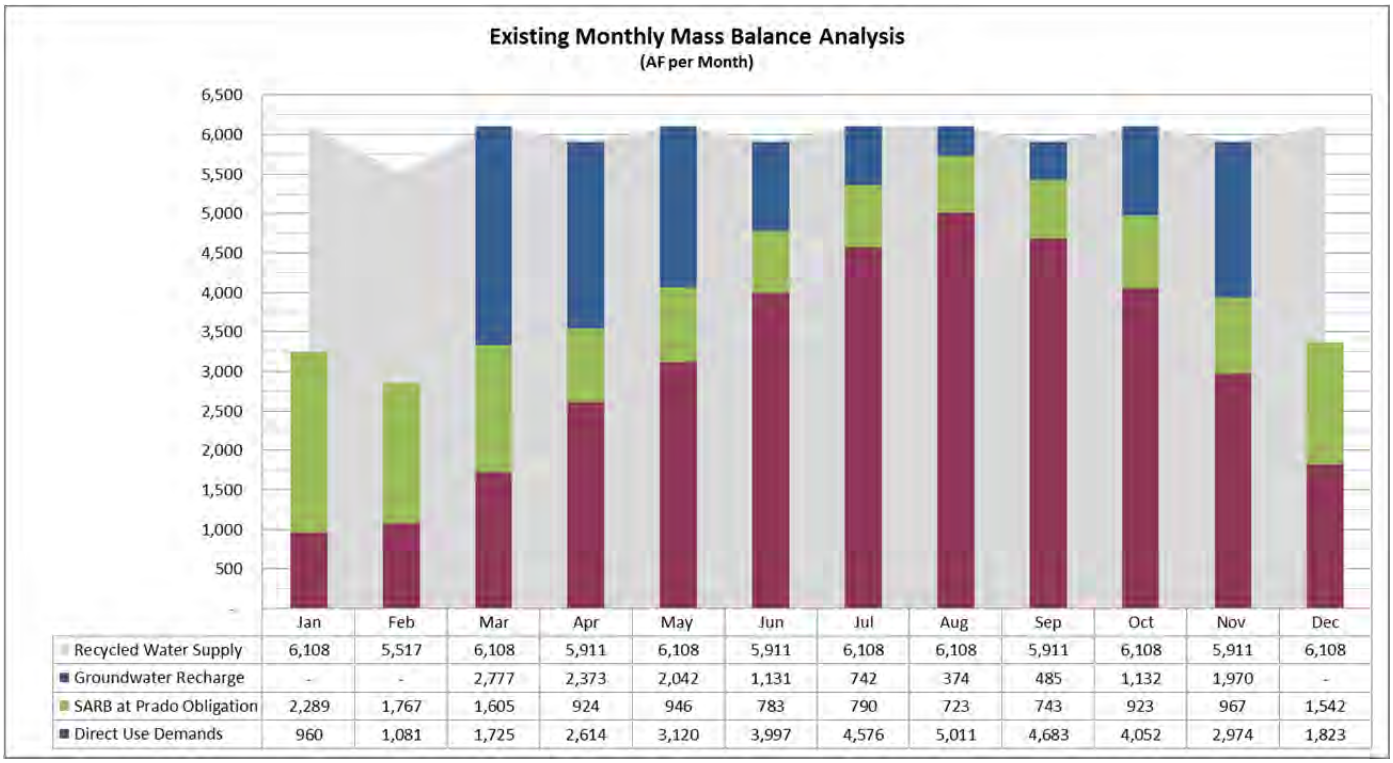



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 5,632 | 5,087 | 5,632 | 5,450 | 5,632 | 5,450 | 5,632 | 5,632 | 5,450 | 5,632 | 5,450 | 5,632 |
| Groundwater Recharge | - | - | 2,529 | 2,073 | 2,165 | 1,389 | 1,196 | 797 | 726 | 1,267 | 1,835 | - |
| SARB at Prado Obligation | 2,255 | 1,753 | 1,649 | 1,100 | 942 | 737 | 666 | 618 | 709 | 875 | 1,105 | 1,591 |
| Direct Use Demands | 786 | 940 | 1,454 | 2,277 | 2,525 | 3,325 | 3,770 | 4,217 | 4,015 | 3,490 | 2,510 | 1,532 |

## Table 5.8 YEAR 2025 Monthly Mass Balance Analysis

| Year 2025 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 22,459 |
| Southern Area Direct Use Demands | 3.9 | 7.2 | 10.3 | 16.7 | 16.4 | 23.6 | 26.8 | 29.5 | 31.6 | 26.4 | 19.6 | 11.6 | 18.6 | 20,865 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 13.6 | 10.3 | 7.2 | 0.7 | 1.0 | - | - | - | - | - | - | 5.8 | 7.6 | 3,572 |
| Total to SARBF at Prado from Southern Area | 16.2 | 12.9 | 9.8 | 3.4 | 3.7 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 8.4 | 5.8 | 6,513 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (6.2) | (9.3) | (12.1) | (14.2) | (9.0) | (2.2) | 0.0 | (7.6) | (4918.8) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 49,454 |
| Northern Area Direct Use Demands | 6.2 | 5.4 | 7.9 | 11.7 | 16.4 | 19.8 | 21.3 | 23.1 | 19.2 | 16.2 | 12.7 | 7.5 | 14.0 | 15,642 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 6.2 | 9.3 | 12.1 | 14.2 | 9.0 | 2.2 | - | 7.6 | 4,919 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 7.0 | 6.8 | 6.2 | 5.8 | 5.4 | 5.0 | 4.8 | 4.1 | 4.6 | 6.2 | 7.0 | 6.9 | 5.8 | 6,507 |
| Total to SARBF at Prado from North Area | 7.9 | 7.7 | 7.1 | 6.7 | 6.3 | 5.9 | 5.7 | 5.0 | 5.4 | 7.1 | 7.9 | 7.8 | 6.7 | 7,487 |
| Northern Area Supply Surplus/(Deficit) | 30.0 | 31.1 | 29.2 | 25.8 | 21.5 | 12.3 | 7.8 | 3.9 | 5.3 | 11.9 | 21.4 | 28.8 | 19.1 | 21,406 |
| Total SARBF at Prado Obligation | 24.1 | 20.6 | 16.9 | 10.0 | 9.9 | 8.5 | 8.3 | 7.6 | 8.1 | 9.7 | 10.5 | 16.2 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **29.2** | **25.8** | **21.5** | **12.3** | **7.8** | **3.9** | **5.3** | **11.9** | **21.4** | **-** | **15.4** | **13,027** |

Figure 5-3 YEAR 2025 Monthly Mass Balance Analysis

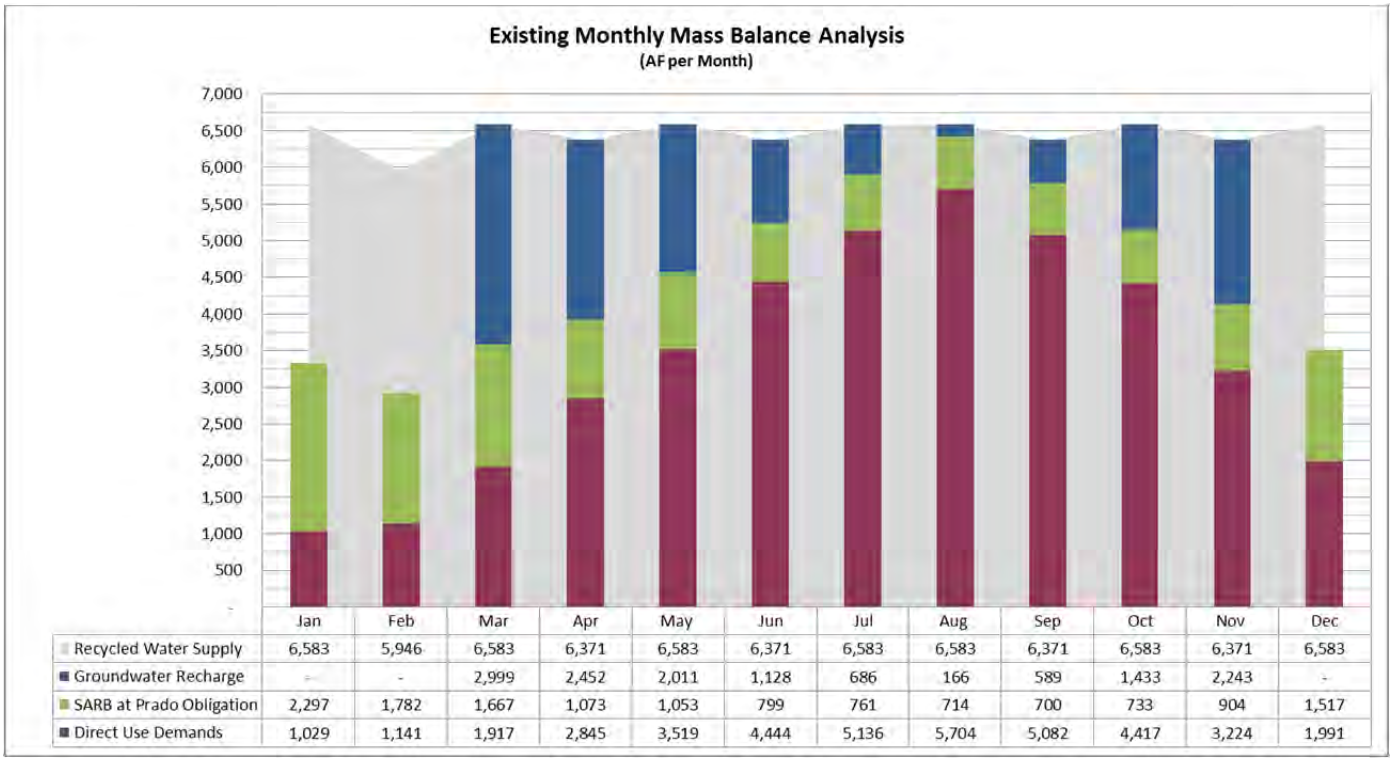



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,108 | 5,517 | 6,108 | 5,911 | 6,108 | 5,911 | 6,108 | 6,108 | 5,911 | 6,108 | 5,911 | 6,108 |
| Groundwater Recharge | - | - | 2,777 | 2,373 | 2,042 | 1,131 | 742 | 374 | 485 | 1,132 | 1,970 | - |
| SARB at Prado Obligation | 2,289 | 1,767 | 1,605 | 924 | 946 | 783 | 790 | 723 | 743 | 923 | 967 | 1,542 |
| Direct Use Demands | 960 | 1,081 | 1,725 | 2,614 | 3,120 | 3,997 | 4,576 | 5,011 | 4,683 | 4,052 | 2,974 | 1,823 |

## Table 5.9 YEAR 2030 Monthly Mass Balance Analysis

| Year 2030 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 25,763 |
| Southern Area Direct Use Demands | 3.8 | 7.1 | 10.4 | 16.2 | 16.8 | 23.9 | 27.5 | 30.0 | 31.8 | 26.4 | 20.1 | 11.9 | 18.8 | 21,080 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 16.6 | 13.3 | 10.0 | 4.2 | 3.6 | - | - | - | - | - | 0.3 | 8.4 | 10.4 | 5,228 |
| Total to SARBF at Prado from Southern Area | 19.2 | 15.9 | 12.6 | 6.8 | 6.2 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.9 | 11.1 | 7.3 | 8,168 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (3.6) | (7.1) | (9.6) | (11.4) | (6.1) | 0.0 | 0.0 | (5.4) | (3484.5) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 51,750 |
| Northern Area Direct Use Demands | 7.0 | 6.2 | 9.8 | 14.7 | 20.2 | 24.3 | 26.5 | 30.0 | 23.4 | 20.0 | 15.0 | 9.0 | 17.2 | 19,240 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 3.6 | 7.1 | 9.6 | 11.4 | 6.1 | - | - | 5.4 | 3,484 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 4.1 | 4.0 | 4.0 | 4.0 | 4.0 | 5.2 | 4.5 | 4.0 | 4.1 | 4.2 | 6.0 | 4.0 | 4.3 | 4,852 |
| Total to SARBF at Prado from North Area | 4.9 | 4.8 | 4.9 | 4.9 | 4.9 | 6.1 | 5.4 | 4.9 | 5.0 | 5.1 | 6.9 | 4.9 | 5.2 | 5,832 |
| Northern Area Supply Surplus/(Deficit) | 34.2 | 35.2 | 31.5 | 26.6 | 21.1 | 12.3 | 7.2 | 1.7 | 6.4 | 15.1 | 24.4 | 32.3 | 20.7 | 23,194 |
| Total SARBF at Prado Obligation | 24.1 | 20.7 | 17.5 | 11.7 | 11.1 | 8.7 | 8.0 | 7.5 | 7.6 | 7.7 | 9.8 | 15.9 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **31.5** | **26.6** | **21.1** | **12.3** | **7.2** | **1.7** | **6.4** | **15.1** | **24.4** | **-** | **16.3** | **13,707** |

Figure 5-4 YEAR 2030 Monthly Mass Balance Analysis

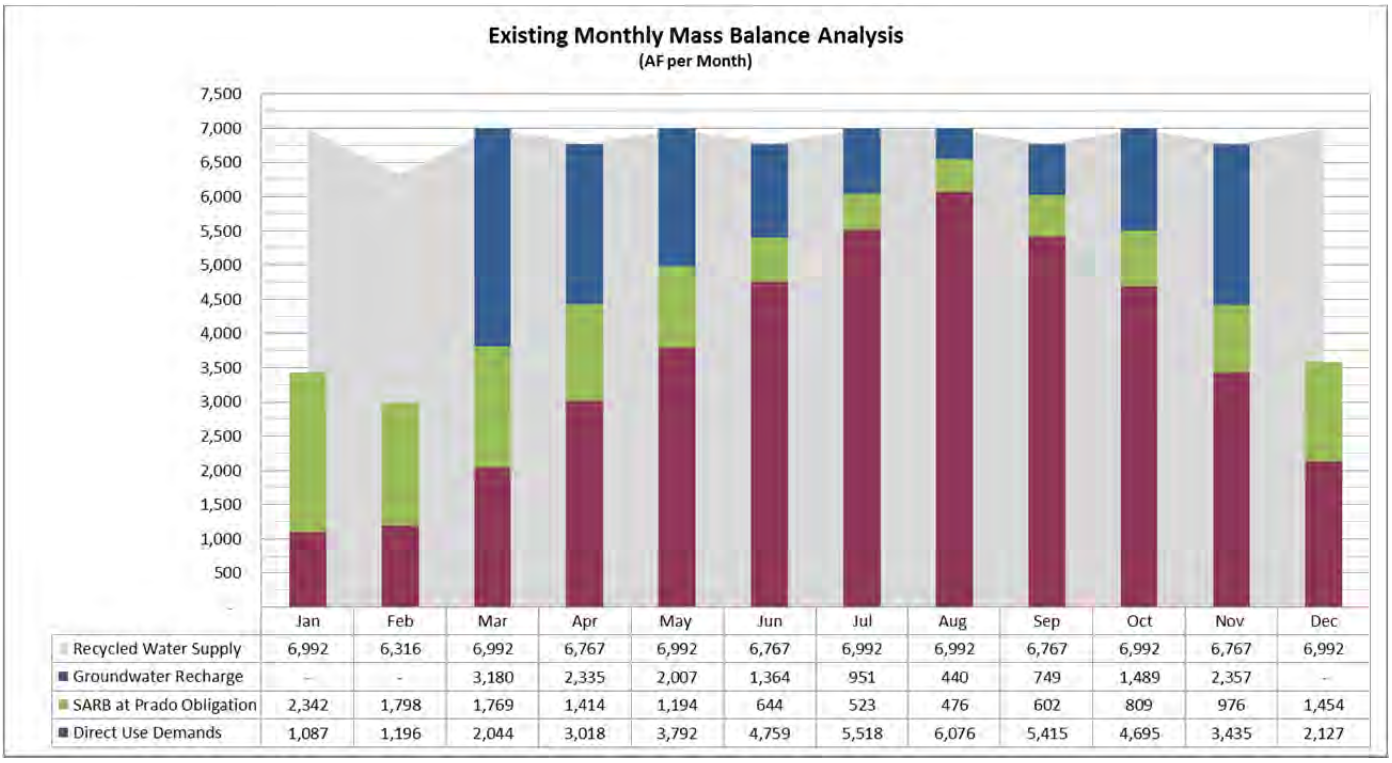



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,583 | 5,946 | 6,583 | 6,371 | 6,583 | 6,371 | 6,583 | 6,583 | 6,371 | 6,583 | 6,371 | 6,583 |
| Groundwater Recharge | - | - | 2,999 | 2,452 | 2,011 | 1,128 | 686 | 166 | 589 | 1,433 | 2,243 | - |
| SARB at Prado Obligation | 2,297 | 1,782 | 1,667 | 1,073 | 1,053 | 799 | 761 | 714 | 700 | 733 | 904 | 1,517 |
| Direct Use Demands | 1,029 | 1,141 | 1,917 | 2,845 | 3,519 | 4,444 | 5,136 | 5,704 | 5,082 | 4,417 | 3,224 | 1,991 |

## Table 5.10 YEAR 2035 Monthly Mass Balance Analysis

| Year 2035 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 28,788 |
| Southern Area Direct Use Demands | 4.0 | 7.4 | 11.0 | 16.7 | 18.0 | 25.4 | 29.5 | 31.9 | 33.6 | 27.9 | 21.5 | 12.8 | 20.0 | 22,369 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 19.1 | 15.7 | 12.1 | 6.4 | 5.0 | - | - | - | - | - | 1.6 | 10.3 | 12.4 | 6,506 |
| Total to SARBF at Prado from Southern Area | 21.7 | 18.3 | 14.7 | 9.0 | 7.7 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 4.2 | 12.9 | 8.5 | 9,446 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (2.3) | (6.5) | (8.8) | (10.5) | (4.8) | 0.0 | 0.0 | (4.7) | (3028.3) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 53,543 |
| Northern Area Direct Use Demands | 7.5 | 6.5 | 10.5 | 16.1 | 21.8 | 26.3 | 28.5 | 32.0 | 25.3 | 21.5 | 15.8 | 9.5 | 18.4 | 20,650 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 2.3 | 6.5 | 8.8 | 10.5 | 4.8 | - | - | 4.7 | 3,028 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 2.0 | 1.8 | 3.0 | 5.5 | 4.0 | 3.5 | 2.0 | 1.5 | 3.0 | 5.0 | 5.5 | 1.5 | 3.2 | 3,574 |
| Total to SARBF at Prado from North Area | 2.9 | 2.6 | 3.9 | 6.4 | 4.9 | 4.4 | 2.9 | 2.4 | 3.9 | 5.9 | 6.4 | 2.4 | 4.1 | 4,554 |
| Northern Area Supply Surplus/(Deficit) | 37.5 | 38.7 | 33.4 | 25.4 | 21.1 | 14.8 | 10.0 | 4.6 | 8.1 | 15.7 | 25.6 | 35.9 | 22.6 | 25,311 |
| Total SARBF at Prado Obligation | 24.6 | 20.9 | 18.6 | 15.4 | 12.5 | 7.0 | 5.5 | 5.0 | 6.5 | 8.5 | 10.6 | 15.3 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **33.4** | **25.4** | **21.1** | **14.8** | **10.0** | **4.6** | **8.1** | **15.7** | **25.6** | **-** | **17.6** | **14,871** |

Figure 5-5 YEAR 2035 Monthly Mass Balance Analysis




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,992 | 6,316 | 6,992 | 6,767 | 6,992 | 6,767 | 6,992 | 6,992 | 6,767 | 6,992 | 6,767 | 6,992 |
| Groundwater Recharge | - | - | 3,180 | 2,335 | 2,007 | 1,364 | 951 | 440 | 749 | 1,489 | 2,357 | - |
| SARB at Prado Obligation | 2,342 | 1,798 | 1,769 | 1,414 | 1,194 | 644 | 523 | 476 | 602 | 809 | 976 | 1,454 |
| Direct Use Demands | 1,087 | 1,196 | 2,044 | 3,018 | 3,792 | 4,759 | 5,518 | 6,076 | 5,415 | 4,695 | 3,435 | 2,127 |

### 5.1.4 Additional Supply Needed to Supplement Southern Area

This section evaluates the annual volume of additional reuse supply required to eliminate the need for the Northern Service Area to supplement the Southern Service Area. As shown in Table 5.2, the Southern Service Area (supplied by RP-5 and CCWRF) cannot meet all of the direct use demands and SARBF at Prado Obligation during the higher demand periods, particularly during the summer months.

The volume of water available to the GWR could be increased if additional external supply is provided to supplement the Southern Service Area. Alternatively, the Southern Service Area deficit could also be eliminated if either a change in direct use demand occurs from increased irrigation efficiency or a non-potable water source is connected into the RW system. For the purposes of the RWPS, the additional supply could be from either of these or other sources. This analysis will only identify the quantity of supply needed to eliminate the Southern Service Area deficit.

Table 5.11 is provided to identify the additional supply for each planning year that would be required for the Southern Service Area.

**Table 5.11 Additional Supply Needs to the Southern Service Area**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Southern Service Area RW Supply | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Service Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Southern Service Area Min. Base Flow to SARBF at Prado[1] | 2,940 | 2,940 | 2,940 | 2,940 | 2,940 |
| Additional Supply Available to SARBF at Prado[2] | 1,557 | 2,488 | 3,572 | 5,228 | 6,506 |
| Total to SARBF at Prado from Southern Area | 4,497 | 5,428 | 6,513 | 8,168 | 9,446 |
| Southern Area Supply /(Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| **Total Additional External Supply Needed for Southern Service Area** | **6,056** | **5,865** | **4,919** | **3,484** | **3,028** |

[1] Southern Service Area Min. Base Flow to SARBF at Prado Obligation is the base flow each month from RP-5 and CCWRF, and is assumed to be approximately 2.6 MGD, or 2,940 AFY.

[2] Additional Supply Available to SARBF at Prado Obligation is based on the monthly mass balance analysis, and is the amount of available water from RP-5 and CCWRF after the direct use demands and Min. Base Flow to SARBF at Prado Obligation are used. This supply is typically only available during the winter or low direct use demand months.

As shown in Table 5.11, approximately 5,000 AFY of additional supply would be needed to supplement the 800 and/or 930 Pressure Zones. With the growth anticipated in the 930 Pressure Zone, it would be recommended to connect an external supply into the 930 Pressure Zone. The additional supply could then be pressure reduced through the existing 930/800 PRV if supplemental supply to the 800 Pressure Zone if needed without additional pumping facilities.

### 5.1.5 Supply Needs to Maximize GWR

This section investigates the maximum potential of GWR assuming additional RW supplies would be acquired. Similar to Section 5.1.4, the supply could either be from an external RW intertie, such as the one currently being studied with Western Riverside County Regional Wastewater Authority, reductions in direct use demands or other non-potable supply connected to the RW system.

The GWR maximum potential was previously investigated in a separate study for the Agency and addressed in the Technical Memorandum, dated December 13, 2013, entitled "Recycled Water System Hydraulic Analysis for the Enhanced GWR Program." The Technical Memorandum assumed that supply was unlimited and identified system improvements needed to deliver the maximum RW to the GWR facilities. The GWR flows from the December 2013 TM established GWR basin demands based on the 14-day fill period cycle throughout the 9-month operation period, as described in Section 4.2.1. The analysis assumed no RW system supply limitations or constraints on the capacity or performance of the GWR basins.

In order for the GWR program to operate in this fashion, additional supplies would need to be acquired. Table 5.12 shows the volume of additional supply that would be needed for each planning year.

**Table 5.12 External Supply Needs to Maximize GWR**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Year 2015 | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Maximum 9-Month GWR Program[1] | 33,776 | 33,776 | 33,776 | 33,776 | 33,776 |
| Proposed RWPS 9-Month GWR Program[2] | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| GWR Program Difference | 17,681 | 19,799 | 20,749 | 20,069 | 18,905 |
| **Total External Supply Needed for Maximum GWR** | **17,681** | **19,799** | **20,749** | **20,069** | **18,905** |

[1] The Maximum 9-Month GWR Program is the total estimated maximum recycled water recharge potential as identified in the Technical Memorandum, dated December 13, 2013, entitled "*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*". This Maximum GWR Program assumes no limitations as to recycled water supply or groundwater basin capacity.

[2] The Proposed 9-Month GWR Program flows are based on the net available recycled water supply as shown in Table 5.4 herein.

# 6.0 IMPLEMENTATION OF GWR BASINS HYDRAULIC ANALYSIS

This section provides a brief description of the hydraulic model analysis performed based on the monthly mass balance analysis. The GWR goals for the hydraulic model analysis were previously presented in Section 5.1.2, Table 5.3.

## 6.1 HYDRAULIC MODEL ANALYSIS

The Agency's hydraulic model of the RW system was created using InfoWater modeling software. The Agency's existing model was updated and the revised version was utilized for the RWPS hydraulic analysis. The computer model was analyzed as a 24-hour extended period simulation for average day and maximum day direct use demand conditions. The average day demand condition was assumed to be the spring and fall months of March, April, May and November. The maximum day demand condition was assumed to be the maximum month demands between the months of June and October.

SARBF at Prado Obligation was accounted for in the computer model analysis by subtracting this demand from the net available reuse supply, after direct use demands were met. The remaining reuse supply available after direct use demands and SARBF at Prado Obligation are met is available for GWR.

Table 6.1 shows the demand conditions used for the hydraulic model analysis. The average demands (AD) for the direct use, Prado, and GWR shown in the table are the AD for the months of March, April, May and November. The maximum demand conditions (MD) are the maximum day direct use demand conditions. The values for SARBF at Prado Obligation and GWR are based on the average monthly demand between June through October.

**Table 6.1 Summary of Demands Used for Hydraulic Analysis**

| | Existing | | Year 2020 | | Year 2025 | | Year 2030 | | Year 2035 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AD | MD | AD | MD | AD | MD | AD | MD | AD | MD |
| | MGD | | | | | | | | | |
| Recycled Water Supply | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| Direct Use Demands[1] | 22.0 | 36.0 | 27.5 | 44.4 | 32.6 | 52.7 | 36.0 | 60.0 | 38.4 | 63.9 |
| SARBF at Prado Obligation[2] | 12.5 | 5.1 | 12.5 | 6.5 | 12.5 | 7.6 | 12.5 | 7.5 | 12.5 | 5.0 |
| **GWR Available Flows[3]** | **20.8** | **14.2** | **19.2** | **8.3** | **19.1** | **3.9** | **20.7** | **1.7** | **22.6** | **4.6** |
| Total Demand | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |

[1] The Direct Use Demands for the "AD" condition are the average demands for the spring/fall months of March, April, May, and November. The "MD" condition demands are the maximum month's demands between June and October.
[2] The SARBF at Prado Obligation demands are the average demands for the appropriate demand period described in Footnote 1 above.
[3] The GWR Available Flows are the average monthly flow available for the appropriate demand period described in Footnote 1 above.

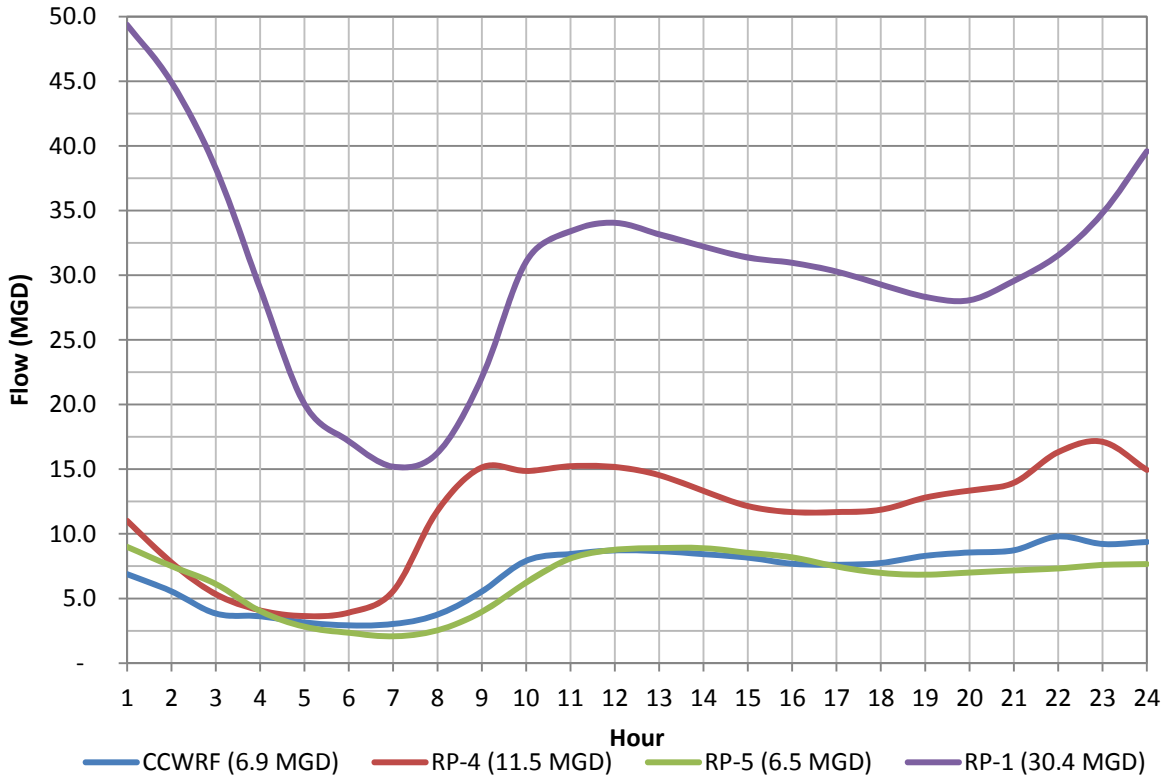
### 6.1.1 Summary of Model Analysis Assumptions

The flows to the GWR basins are based on the basin volumes and fill periods during the year to include only the spring, summer, and fall months where direct use demands are added with the GWR demands. (No GWR is assumed during the wet winter months.) For modeling purposes, system performance is analyzed with average day demands and maximum day direct use demands plus GWR flows as shown in Table 6.1. Average day demand conditions are assumed to be approximately the spring and fall months. Maximum day demands occur the summer months, in particular August and September. Appendix B provides the information regarding the basins volumes and infiltration data, as well as which basins will be supplied by RW.

The following assumptions are made for this study:

- Supply to the system was modeled to be from only the existing Regional Wastewater Recycling Plants.
- The effluent from each of the Regional Wastewater Recycling Plants was assumed to be available to the effluent pump stations based on the wastewater 24-hour diurnal pattern that was provided by the Agency in their calibrated hydraulic model.

**Figure 6-1 Wastewater Supply 24-Hour Diurnal Pattern**




Note: Existing daily flows are shown in the Legend for Figure 5-1.

- GWR fill rates are based on the basin storage volumes, areas, and infiltration rates, and filled in 14-days, and repeated every 6 weeks for the 9-month operation period. Additionally:
    - No RWC limitations (only for purposes of this study to determine maximum capacity limitations of the RW system)
    - No operational constraints (i.e., permits, agreements, land acquisitions, mounding, etc.)
- The SARBF at Prado Obligation demands were assumed to be met directly from the Regional Wastewater Recycling Plants, and therefore, not included as demand nodes in the model. The available supply from the treatment plants were reduced accordingly in the model analyses. The exception to this is the minimum 2.6 MGD demand to Prado from the 800 Pressure Zone.

- Imported water would be made available if there are RWC issues; however, this study assumes the recharge volume is met 100% by RW.

#### 6.1.1.1 Model Analysis Criteria

The following criteria were used to evaluate facility performance and to determine any deficiencies in the conveyance system:

- Minimum regional service pressure = 50 psi (at demand nodes)
- Minimum Basin service pressure = 25 psi
- Maximum pipeline velocity = 7 fps

## 6.2 DIRECT USE DEMANDS ANALYSIS AND IMPROVEMENTS

The hydraulic model analysis first investigated the RW system's ability to meet the projected direct use demands, without any flow to the GWR basins. This analysis is intended to produce a set of recommendations that are directly related to meeting maximum day direct use demands as shown in Tables 2.2 and 6.1. Only the summer maximum day demand conditions were analyzed in this analysis.

### 6.2.1 Existing Direct Use Demands Analysis

The existing demands condition model analysis did not show any deficiencies that required recommended improvements.

### 6.2.2 Year 2020 Direct Use Demands Analysis

The Year 2020 direct use demands analysis showed two areas that are considered to be deficient. The first is the 800 Zone pipeline in Bickmore Avenue that experiences high velocities and limits the flow out of RP-5 into the 800 Zone distribution system. A new 24-inch pipeline is recommended in Kimball Avenue from the RP-5 Recycled Water Effluent Pump Station to approximately Rincon Meadows Avenue, approximately 12,620 lf. An alignment study is recommended prior to final design to verify alignment in Kimball Avenue is feasible. The second improvement area is the RP-1 1158 Zone Recycled Water Effluent Pump Station. This pump station operates too far to the right on their pump curves for the operation conditions resulting in lower pressures than desired. Therefore, it is recommended to replace two of the pumps with large capacity pumps.

### 6.2.3 Year 2025 Direct Use Demands Analysis

The Year 2025 analysis showed deficiencies in the 1299 Zone, 930 Zone and in several RW effluent pump station facilities. The 930 Zone supply facilities from the RP-1 930 Pump Station and CCWRF Effluent Pump Station could not meet the summer maximum day demands. These pump stations should be upgraded. The CCWRF Effluent Pump Station is recommended to have two pumps replaced with larger capacity pumps to increase the station output to 13,000 gpm. The RP-1 930 Zone Pump Station is recommended to have one of the smaller pumps replaced with a larger capacity pump to match the existing large capacity pumps.

Pump upgrades are also recommended for the RP-4 1158 Zone Pump Station to increase station capacity by replacing three pumps with the larger 7,200 gpm capacity pumps and adding one pump as a standby pump.

The 30-inch 930 Zone pipeline between RP-1 and Riverside Drive should be paralleled with a 42-inch pipeline to alleviate high velocities and low pressures in the 930 Zone.

The 1299 Zone showed deficiencies and low service pressures in the western portion of the zone. To alleviate these concerns, a parallel pipeline system is recommended. A new 24-inch and 16-inch pipeline is recommended in 6$^{th}$ Street from Haven Avenue to Euclid Avenue, approximately 28,900 lf.

### 6.2.4 Year 2030 Direct Use Demands Analysis

The 1158 Zone and 1299 Zone in the western portion of the service areas were shown to be deficient with high velocities and low service pressures, in addition to the supply facilities inability to adequately meet the demands during the demand period. To mitigate these issues, it is recommended that a new 1158 Zone Storage Tank, 4.0 MG, be installed as shown in Figure 6-2.

Figure 6-2 Proposed 1158 Storage Tank Site




In addition to the storage tank, a new 30-inch 1158 Zone pipeline from RP-1 to the storage tank is required to be routed along East Francis Street and Grove Avenue to the tank site. A new 1299 Zone Pump Station will pump from the storage tank into the 1299 Zone pipeline in 6th Street.

### 6.2.5 Year 2035 Direct Use Demands Analysis

The Year 2035 analysis and recommendations are primarily due to the growth associated with development in the 930 Zone and 1050 Zone service areas.

To meet the 930 Zone summer demands requires additional upgrades to the RP-1 930 Zone Effluent Pump Station and CCWRF Effluent Pump Station. The RP-1 930 Zone Effluent Pump Station requires two pumps to be replaced with larger capacity pumps, assumed to be the same as the existing large capacity pumps with 9,330 gpm capacity. The CCWRF Effluent Pump Station requires the addition one pump with the same capacity as the existing large capacity pumps.

Additionally, the CCWRF facility will require an additional 3.0 MG of equalization storage to meet the flows required from the facility during low effluent flow periods.

To mitigate low pressures and high velocities in the 1050 Zone, it is recommended to upgrade the RP-1 1050 Zone Effluent Pump Station. Two of the pumps should be replaced with larger capacity pumps for a station capacity of 16,000 gpm. The 1050 Zone pipeline from RP-1 to Riverside Drive should have a 24-inch parallel pipeline installed, approximately 2,000 lf.

See Figures 6-3, 6-4, 6-5, and 6-6 for illustrations of the recommended improvements to meet the direct use demands.

**PROPOSED IMPROVEMENT**

- 24" Pipeline in Kimball Ave. – 800 PZ 12,620 LF
- RP-1 1158 Effluent Pump Station – Replace With 2 Large Pumps

1630W PZ 3MG TANK

1630W PUMP STATION

1630E PUMP STATION

1299 PZ 3MG TANK

1158 PZ 13MG TANK

930 PZ 5MG TANK

SAN SEVAINE 5

VICTORIA

BANANA

HICKORY

BROOKS

ELY

DECLEZ

RP-1

RP-3

RP-4

RP-5

CCWRF

24" PIPELINE

930 TO 800 PZ PRV

UPGRADES TO RP-1 1158 ZONE EFFLUENT PUMP STATION

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

Foothill Fwy CA-210
W Foothill Blvd. CA-66
San Bernardino Fwy I-10
Pomona Fwy
W Base Line Rd.
Baseline Ave.
Summit Ave.
W 6th St.
W 4th St.
W Holt Blvd
W Mission Blvd.
E Jurupa St.
E Francis St.
Riverside Dr.
Chino Ave.
Schaefer Ave.
Edison Ave.
Eucalyptus Ave.
Kimball Ave.
Limonite Ave.
Mission Blvd
Jurupa Ave.
Slover Ave.
Valley Blvd
Merrill Ave.
Foothill Blvd

Upland
Claremont
Montclair
Ontario
Rancho Cucamonga
Fontana
Rialto
Pomona
San Dimas
La Verne
Chino
Chino Hills
Bloomington
Mira Loma
RIVERSIDE

Ontario Int'l Airport
Chino Airport
Rialto Municipal Airport
Brackett Field Airport
Cable Airport
Auto Club Speedway
Ontario Mills
Chaffey College
Indian Hills Golf Club
Hidden Valley Wildlife Area
River Trails Park
Riverside Municipal Airport
Riverside Cement Company
Los Serranos Golf Course
Los Serranos Country Club

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 800 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2020 - Direct Use Demands Only

FIGURE 6-3

PROPOSED IMPROVEMENT

- 24" / 16" Pipeline in 6th St – 1299 PZ – 28,900 LF
- RP-4 1158 PZ Effluent Pump Station – Replace 3 Pumps W\ Larger 7,200 GPM, ADD 1 Pump Standby
- 42" Parallel Pipeline RP-1 TO Riverside Dr. – 2,300 LF
- Increase EQ Storage at RP-1 to 24 MG
- RP-1 930 PZ Effluent Pump Station – Replace 1 Pump W/ 9,330 GPM
- CCCWRF 930 PZ Effluent Pump Station – Replace 2 Pumps W/ Larger Capacity, Increase to 13,000 GPM PS Capacity

1630W PZ 3MG TANK
1630W PUMP STATION
24"/16" PIPELINE 1299 ZONE
1299 PZ 5MG TANK
1630E PUMP STATION
SAN SEVAINE 5
VICTORIA
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
PUMP UPGRADES TO RP-4 1158 ZONE PS
BROOKS
WINEVILLE
RP-3
ELY
DECLEZ
INCREASE EQ. STORAGE AT RP-1 TO 24 MG
PARALLEL 42" PIPELINE 930 ZONE
RP-1
PUMP UPGRADES TO RP-1 930 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
PUMP UPGRADES @ CCWRF 930 ZONE PS
930 TO 800 PZ PRV
RP-5
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 930 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2025 - Direct Use Demands Only
## FIGURE 6-4

PROPOSED IMPROVEMENT

- 42" Parrallel 930 PZ Pipeline in Chino Ave. – 1,700 LF
- 30" Pipeline 1158 PZ From RP-1 to 1158 PZ Tank – 31,800 LF
- 1158 PZ Storage Tank – 4.0 MG
- 1158 to 1299 Booster Pump Station – 4 Pumps, 75 HP

1630W PZ 3MG TANK

1630W PUMP STATION

PROPOSED 1158 TO 1299 PUMP STATION

PROPOSED 1158 ZONE 4.0 MG TANK

30" 1158 ZONE PIPELINE

42" PARALLEL

930 PZ 5MG TANK

CCWRF

930 TO 800 PZ PRV

RP-1

RP-3

RP-3 NEW

RP-4

RP-5

1158 PZ 13MG TANK

1299 PZ 5MG TANK

1630E PUMP STATION

SAN SEVAINE 5

VICTORIA

BANANA

HICKORY

WINEVILLE

ELY

DEGLEZ

BROOKS

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 1158 Improvements
- Zone 930 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2030 - Direct Use Demands Only
## FIGURE 6-5

PROPOSED IMPROVEMENT

- 24" Parallel Pipeline 1050 PZ from RP-1 to Riverside Dr. – 2,000 LF
- RP-1 930 PZ Effluent Pump Station – Replace 2 Pumps W/ 9,330 GPM Pumps
- RP-1 1050 PZ Effluent Pump Station – Replace 2 Pumps W/ Larger Capacity for Station Capacity of 16,000 GPM
- CCWRF 930 PZ Effluent Pump Station Add 1 Pump
- 3.0 MG EQ Storage Tank at CCWRF

24" 1050 PZ PARALLEL PIPELINE
PUMP UPGRADES RP-1 930 ZONE EFFLUENT PUMP STATION
PUMP UPGRADES RP-1 1050 ZONE EFFLUENT PUMP STATION

3.0 MG EQ STORAGE
CCWRF PS UPGRADES

LEGEND:

- Existing Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2035 - Direct Use Demands Only

FIGURE 6-6

# 6.3 GWR IMPLEMENTATION ANALYSIS AND IMPROVEMENTS

## 6.3.1 Existing GWR Conditions and Improvements

Existing GWR demands were considered to be those for the Year 2015. The demands shown in Table 6.1 were applied to the model nodes and an EPS model was run. For both average and maximum demand, the results of the model show that no system improvements are needed other than to increase turnout capacities at some of the basins. The turnout capacity upgrades are required since the GWR Implementation program of the proposed 9-month period while flowing 12-hour daily operations results in recharging more reuse supply in a shorter period of time than under current operations. The following basin turnout capacity upgrades are proposed as shown in Table 6.2.

**Table 6.2 GWR Implementation Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Capacity (cfs) | Proposed Turnout Capacity (cfs) |
|---|---|---|
| Ely (1-3) | 6.00 | 6.2 |
| Hickory | 4.00 | 4.6 |
| Turner | 8.00 | 9.3 |
| Victoria | 8.00 | 10.5 |

## 6.3.2 Year 2020 GWR Implementation Analysis and Improvements

### 6.3.2.1 Year 2020 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The hydraulic model analysis scenario analyzed the system for a GWR Basin demand of 20.8 MGD, including the RP-3 (New Cell), San Sevaine (1-3), and Victoria (increase) basins scheduled to come on line for this planning year.

The analysis showed that increased flow is required to the Northern Service Area to meet the increased direct use demands and demands to the GWR basins. More flow from the RP-1 effluent pump stations was required by the RP-1 1158 Pump Station. In order to increase the flow through this pump station without exceeding the capacity of the RP-1 supply, the 930 PS Pump Station flow rate was required to be limited.

To limit the flow from the RP-1 930 Pump Station, the flow through the 930/800 PRV could be reduced. This reduction in flow could take place if more effluent from RP-5 could be pumped to meet demands in the 800 PZ. The 18-inch pipeline in Bickmore is a restriction in the 800 PZ as it has velocities that exceed 7 fps, even under existing demand conditions. Therefore, a new 24-inch pipeline in Kimball Avenue, from RP-5 to connect to the existing 18-inch pipeline at Millcreek, is proposed.

To meet the needs of the GWR Basins in the 1630E PZ while avoiding low suction pressure concerns at the 1630E Booster Pump Station and depleting the 1299 Storage Tank, the proposed 18 MG 1630E Storage Tank is required. Therefore, it is recommended to install the 36-inch pipeline from the existing 1630E pipeline north of Baseline Road to the new 1630E Storage Tank. The proposed 18 MG 1630E Storage Tank is an existing tank build for the Lloyd W. Michael Water Treatment Plant by the CVWD. This tank will be converted to the Agency's RW system and 1630E pressure zone.

Before adding any proposed improvements, the pressures to the 7th/8th Street Basins were low and even negative at some hours of the day. The suction line to the basins is 16-inch and is undersized to allow the full basin recharge demand as shown in Table 4.4 plus provide suction pressure for both pumps at the 1630 West Recycled Water Pump Station to operate. The fill rate to the 7th/8th Street Basins should be limited to approximately 1.1 MGD, or 1,500 gpm. When the 7th/8th Street Basins are filling, the 1630 West Recycled Water Pump Station should be limited to one pump in operation.

#### 6.3.2.2 Year 2020 GWR plus Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 14.2 MGD from the 20.8 MGD during the average demand conditions for Year 2020.

No other deficiencies were recognized in the model analysis for the maximum day Year 2020 demand conditions.

For the Year 2020 analysis, one existing pump station is proposed to require upgrades, RP-1 1158 Zone Effluent Pump Station. The current design capacity and proposed pump station capacity is shown below. Other Year 2020 facility improvements are shown in Figure 6-7.

| Pump Station | Current Design Capacity | Year 2020 Proposed Design Capacity | Pump Upgrade |
|---|---|---|---|
| RP-1 1158 Zone Effluent Pump Station | 11,100 gpm | 12,700 gpm | Replace 2 Pumps with Larger Capacity Pumps |

PROPOSED IMPROVEMENT

- Conversion of 18 MG 1630E Storage Tank
- 36" 1630E Pipeline to 1630E Tank – 6,715 LF
- RP-1 1158 PS Upgrades – Replace Zone Pumps W/ Larger Capacity Pumps
- 24" 800 PZ Pipeline in Kimball Ave. – 12,620 LF

NEW 1630 ZONE 18 MG TANK

SAN SEVAINE (1-3)

SAN SEVAINE 5

VICTORIA

VICTORIA (INCREASE)

1630E PUMP STATION

1299 PZ 5MG TANK

1630W PZ 3MG TANK

1630W PUMP STATION

1158 PZ 13MG TANK

HICKORY

BANANA

RP-4

RP-3 NEW

RP-3

DECLEZ

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

UPGRADES TO RP-1
1158 ZONE EFFLUENT
PUMP STATION

RP-1

ELY

BROOKS

930 PZ 5MG TANK

CCWRF

24" PIPELINE

RP-5

930 TO 800 PZ PRV

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

Foothill Fwy CA-210
W Foothill Blvd. CA-66
W Base Line Rd.
San Bernardino Fwy I-10
W 6th St.
W 4th St.
Summit Ave.
Baseline Ave.
E Jurupa St.
Jurupa Ave
E Francis St.
Pomona Fwy
W Mission Blvd.
Holt Blvd
Riverside Dr.
Chino Ave.
Schaefer Ave.
Edison Ave.
Eucalyptus Ave
Kimball Ave.
Limonite Ave
Valley Blvd
Slover Ave
Merrill Ave
Ontario Fwy I-15
Haven Ave
Archibald Ave
Euclid Ave CA-83
Carnelian St.
Etiwanda Ave
Citrus Ave.
N Grove Ave
S Grove Ave.
Cable Airport
Brackett Field Airport
Fairplex
Chino Airport
Ontario Int'l Airport
Rialto Municipal Airport
Riverside Cement Company
Auto Club Speedway
Ontario Mills
Hidden Valley Wildlife Area
River Trails Park
Indian Hills Golf Club
Jurupa Hills Regional Park
Riverside Municipal Airport
El Prado Golf Course
Chaffey College
Upland Hills Country Club

San Dimas
La Verne
Claremont
Montclair
Ontario
Pomona
Upland
Rancho Cucamonga
Fontana
Rialto
Bloomington
Mira Loma
RIVERSIDE

LEGEND:

- Existing Basins
- Year 2025 Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 800 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2020 - Base GWR Implementation

FIGURE 6-7

### 6.3.3 Year 2025 GWR Implementation Analysis and Improvements

#### 6.3.3.1 Year 2025 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2025 model analysis scenario analyzed the system for a GWR Basin demand of 19.2 MGD, including the addition of the following basins: Wineville, Lower Day, and Etiwanda Debris basins, which are scheduled to come on line for this planning year.

Due to the increased direct use demands, the RP-1 diurnal supply pattern is not able to meet the demands during the peak irrigation period. The supply pattern from the RP-1 facility will be required to flow more evenly throughout the day. This is proposed to be accomplished by increased equalization storage upstream of the RP-1 effluent pump stations. The existing 6.0 MG equalization storage should be increased to 13.0 MG.

In addition, a 16-inch pipeline is required from the existing 36-inch 1630E pipeline to the proposed Etiwanda Debris Basin.

#### 6.3.3.2 Year 2025 Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 12.6 MGD from the 19.2 MGD during the average demand conditions for Year 2025.

To meet the maximum day demands in the Southern Service Area, the RP-1 930 Zone Effluent Pump Station capacity should be increased. Also, the existing 30-inch diameter pipeline from the 930 Zone Effluent Pump Station to the existing 930 Zone pipeline in Riverside Drive experiences velocities up 8 fps. A parallel 42-inch diameter pipeline is recommended.

The CCWRF 930 Zone Effluent Pump Station is modeled to utilize all five of the existing pumps with each operating on the far right side of the pump curve. Therefore, for reliability it is recommended to add two new pumps of equal size to the existing pumps or replace a minimum of two pumps with larger capacity pumps.

The demand increase in the Northern Service Area requires additional capacity to the RP-4 1158 Zone Effluent Pump Station. It is recommended that two pumps be replaced with larger capacity pumps at this station.

The pressures in the west portion of the 1299 Zone do not meet the minimum pressure criteria and the 24-inch transmission main experiences high velocities. Therefore, a 16-inch diameter pipeline is proposed from the existing 30-inch along 6th Street to the existing 30-inch transmission main at Euclid Avenue. (See Figure 6-8)

For the Year 2025 analysis, three existing pump stations are proposed to require upgrades; CCRWF 930 Zone Effluent Pump Station, RP-1 930 Zone Effluent Pump Station, and RP-4 1158 Zone

Effluent Pump Station. The current design capacity and proposed pump station capacity is shown below. Other Year 2025 facility improvements are shown in Figure 6-8.

| Pump Station | Current Design Capacity | Year 2025 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| RP-4 1158 Zone Effluent Pump Station | 22,500 gpm | 29,100 gpm | Replace 3 pumps and add 1 pump with larger capacity |
| RP-1 930 Zone Effluent Pump Station | 27,030 gpm | 30,700 gpm | Replace 1 pump with larger capacity |
| CCWRF 930 Zone Effluent Pump Station | 10,340 gpm | 13,000 gpm | Replace 2 pumps with larger capacity |

PROPOSED IMPROVEMENT

- 24" Pipeline to Lower Day – 10,520 LF
- 16" 1630E Pipeline – 2,670 LF
- 16" Parallel 1299 PZ Pipeline – 15,289 LF
- 24" Parallel 1299 PZ Pipeline – 13,600 LF
- 42" 930 PZ Parallel Pipeline – 2,300 LF
- 16" Pipeline to Wineville Basin – 1,200 LF
- RP-4 1158 PZ Pump Station Capacity Upgrades – Replace 3 Pumps W/ 7,200 GPM
- RP-1 930 PZ Pump Station Capacity Upgrades – Replace 1 Pump W/ 9,330 GPM
- CCWRF Pump Station Capacity Upgrades – Replace 2 Pumps Larger Capacity
- Increase EQ Storage at RP-1 to 24 MG

ETIWANDA DEBRIS
16" PIPELINE
SAN SEVAINE (1-3)
SAN SEVAINE 5
VICTORIA
VICTORIA (INCREASE)
LOWER DAY
24" PIPELINE
1299 PZ 5MG TANK
1630E PUMP STATION
1630W PZ 3MG TANK
1630W PUMP STATION
24" / 16" PIPELINE 1299 ZONE
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
PUMP UPGRADES TO RP-4 1158 ZONE PS
BROOKS
ELY
WINEVILLE
16" PIPELINE
RP-3
DECLEZ
INCREASE EQ. STORAGE AT RP-1 TO 24 MG
PARALLEL 42" PIPELINE 930 ZONE
RP-1
PUMP UPGRADES TO RP-1 930 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
PUMP UPGRADES @ CCWRF 930 ZONE PS
930 TO 800 PZ PRV
RP-5
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

LEGEND:

- Existing Basins
- Year 2025 Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 930 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2025 - Base GWR Implementation
## FIGURE 6-8

### 6.3.4 Year 2030 GWR Implementation Analysis and Improvements

#### 6.3.4.1 Year 2030 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2030 model analysis scenario analyzed the system for a GWR Basin demand of 20.7 MGD, including the addition of the following basins: Montclair (1-3), College Heights East, and College Heights West basins, which are scheduled to come on line for this planning year.

The additional College Heights East and West basins are located in the 1630W PZ and there are currently no pipelines to convey RW from the existing infrastructure to the basins. Approximately 19,600 lf of 36-inch new pipeline in Foothill Boulevard is required to serve these basins.

The Montclair basin is in the 1299 PZ and will require approximately 7,800 lf of new 30-inch diameter pipeline.

The 1630W PZ is deficient in supply capacity for this GWR condition as well. The hydraulic analysis indicates additional capacity is needed at the 1299 to 1630W Booster Pump Station. Due to space constraints at this facility, it is assumed existing pumps will be replaced with larger capacity pumps.

#### 6.3.4.2 Year 2030 GWR plus Maximum Direct Use Demand Conditions (Summer)

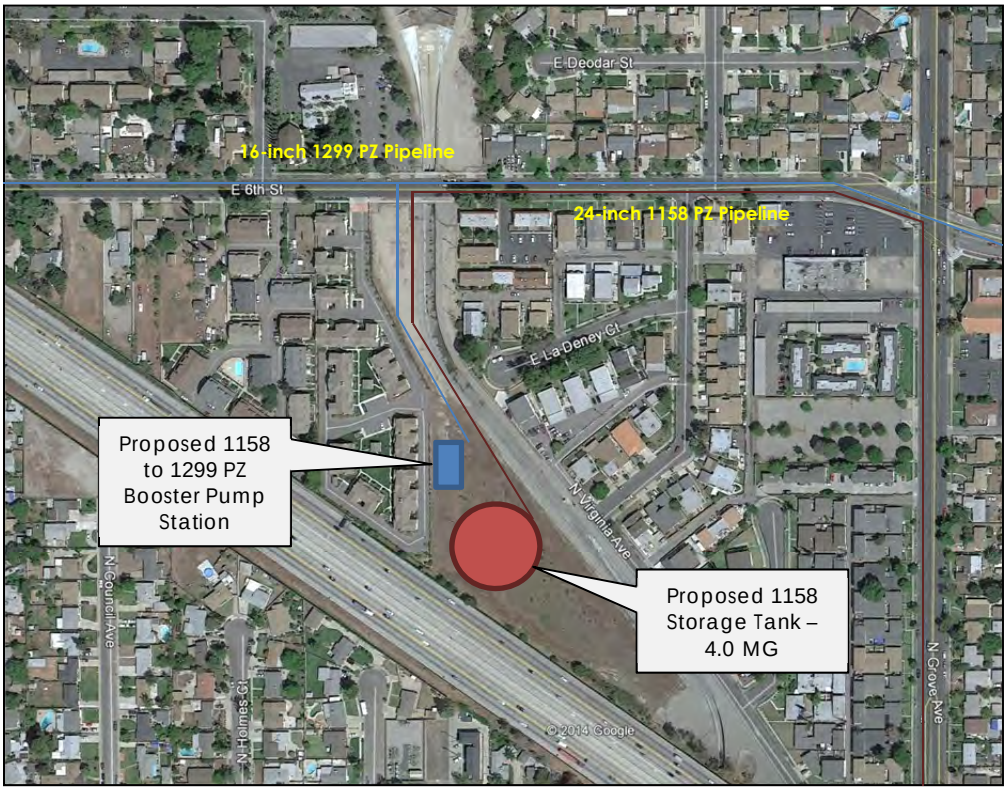
The same GWR Basins were analyzed as was for the Year 2030 Average Demand Conditions; however, due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 1.7 MGD from the 20.7 MGD during the average demand conditions for Year 2030.

Due to the increased direct use demands, the 1158 PZ and 1299 PZ are deficient. Velocities in the pipelines exceed 7 fps and the effluent pumps from the RP-1 and RP-4 facilities cannot meet the demands.

In order to mitigate the deficiencies in the 1158 PZ and 1299 PZ, a new 1158 PZ Storage Tank, and a new 1158 to 1299 Booster Pump Station are proposed.

The 1158 Storage Tank is proposed to be 4.0 MG and located in the City of Upland, between 6$^{th}$ Street and the 10-Fwy within the SBCFCD property along the existing flood control channel south of the 7$^{th}$/8$^{th}$ Street Basins. (See Figure 6-9)

Figure 6-9 Proposed 1158 Storage Tank Site




The proposed 1158 PZ pipeline would be routed from the RP-1 1158 Pump Station northerly to Francis Street, and then westerly along Francis Street to Grove Avenue. The pipeline would then be routed northerly along Grove Avenue to 6th Street, and then westerly along 6th Street to the 1158 Storage Tank site.

A new 1158 to 1299 Booster Pump Station is proposed to be located at the 1158 Storage Tank Site. The pump station will boost pressure in the westerly end of the 1299 PZ during peak demand and GWR basin fill periods. The pump station is assumed to have four (4) pumps of equal size, each with 75 Hp motors with VFD's.

Other Year 2030 facility improvements are shown in Figure 6-10.

PROPOSED IMPROVEMENT

- 36" 1630W Pipeline in Foothill Blvd – 19,600 LF
- 30" 1299 PZ Pipeline to Montclair Basins – 7,840 LF
- 1630W Pump Station Capacity Upgrades – Replace Pumps W/ Larger Capacity
- 15 MG 1630W Storage Tank
- 42" Parallel Pipeline in Chino Ave. – 930 PZ – 1,600 LF
- 30" 1158 PZ Pipeline RP-1 to 1158 PZ Tank – 31,800 LF
- 4.0 MG 1158 PZ Storage Tank
- New 1158 to 1299 Booster Pump Station – 4 Pumps, 75 HP

1630 ZONE 15 MG TANK
1630W PZ 3MG TANK
36" PIPELINE
COLLEGE HEIGHTS EAST
COLLEGE HEIGHTS WEST
MONTCLAIR (1-3)
30" PIPELINE
PUMP UPGRADES 1299 TO 1630 PUMP STATION
1630W PUMP STATION
PROPOSED 1158 TO 1299 PUMP STATION
PROPOSED 1158 ZONE 4.0 MG TANK
30" 1158 ZONE PIPELINE
BROOKS
ELY
RP-1
42" PARALLEL
930 PZ 5MG TANK
CCWRF
930 TO 800 PZ PRV
RP-5
ETIWANDA DEBRIS
SAN SEVAINE (1-3)
SAN SEVAINE 5
LOWER DAY
VICTORIA
VICTORIA (INCREASE)
1299 PZ 5MG TANK
1630E PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
WINEVILLE
RP-3 NEW
RP-3
DEGLEZ
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

LEGEND:

- Existing Basins
- Year 2030 Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 1158 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2030 - Base GWR Implementation
## FIGURE 6-10

For the Year 2030 analysis, in addition to the new 1158 to 1299 Zone RW Pump Station, two existing pump stations are proposed to require upgrades: the 1630 West RW Pump Station and the 1630 East RW Pump Station. The current design capacity and proposed pump station capacity is shown below.

| Pump Station | Current Design Capacity | Year 2030 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| 1630 West RW Pump Station | 6,000 gpm | 6,350 gpm | Replace 3 pumps with larger capacity |
| 1630 East RW Pump Station | 8,250 gpm | 9,140 gpm | 1 New Pump |

### 6.3.5 Year 2035 GWR Implementation Analysis and Improvements

#### 6.3.5.1 Year 2035 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2035 model analysis scenario analyzed the system for a GWR Basin demand of 22.6 MGD, including the addition of the following basins: Upland, Jurupa, and Grove basins which are scheduled to come on line for this planning year.

The addition of the Upland Basin in the 1630W PZ will be supplied from the 36-inch pipeline in Foothill Boulevard that was constructed for the two College Heights Basins.

The Jurupa Basin will require a new 30-inch pipeline from the existing 36-inch Wineville Pipeline in Francis Street and the SBCFCD channel. This pipeline is proposed to be routed northerly along the SBCFCD channel to the Jurupa Basin.

In addition to the pipeline to the Jurupa Basin, the existing 1158 PZ is deficient and creates low pressures in the easterly end of the zone when applying the GWR Basin demands. To mitigate this condition, approximately 5,366-lf of 36-inch pipeline is proposed in Etiwanda Avenue from Valley Boulevard to Jurupa Street. A 30-inch pipeline is proposed in Jurupa Street from Etiwanda Avenue to the 30-inch Jurupa Basin pipeline. A 20-inch pipeline is proposed in Jurupa Street from Etiwanda Avenue westerly to the existing 20-inch pipeline. (See Figure 6-11)

The Grove Basin is within the 1050 PZ and is assumed to come online after the proposed New Model Colony streets and pipelines are installed. It is assumed that the New Model Colony will construct 24-inch and 20-inch pipelines in Riverside Drive. A 12-inch pipeline is required in Grove Avenue between Riverside Drive and Chino Avenue.

#### 6.3.5.2 Year 2035 GWR plus Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed for this condition as for the Year 2035 Average demand conditions. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 4.6 MGD from the 22.6 MGD during the average demand conditions for Year 2035.

The RP-1 930 Pump Station was not able to meet demands for the direct use peak demand periods. Therefore, two (2) pumps are proposed to be replaced with larger capacity pumps, each to be equal to the largest existing pump.

The pipeline from the RP-1 1050 Pump Station to Riverside Drive is deficient. A parallel 24-inch 1050 PZ pipeline is recommended.

For the Year 2035 analysis, two existing pump stations are proposed to require upgrades, the RP-1 930 Zone Effluent Pump Station and the RP-1 1050 Zone Effluent Pump Station. The current design capacity and proposed pump station capacities are shown below. Other Year 2035 facility improvements are shown in Figure 6-11.

| Pump Station | Current Design Capacity | Year 2035 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| RP-1 930 Zone Effluent Pump Station | 27,030 gpm | 39,000 gpm | Replace 2 pumps with larger capacity |
| RP-1 1050 Zone Effluent Pump Station | 11,250 gpm | 15,879 gpm | Replace 2 pumps with larger capacity |

### 6.3.6 Year 2035 Additional External Supply Analysis

A model scenario was analyzed assuming an external supply source is provided to the 930 PZ, and to be supplied to the existing 30-inch pipeline just north of the existing 930 PZ to 800 PZ PRV's location. The average day demand analysis assumes an external supply of 15,000 AFY, which equates to approximately 13 MGD. In order for the system to operate, it was necessary to control the supply source by the 930 West Reservoir water level. Approximately 7.7 MGD was able to be supplied into the system. This supply resulted in the CCWRF supply to the 930 PZ reduced to less than 1 MGD. No other system facility improvements were required.

The maximum day analysis shows that approximately 11 MGD can be provided by the supply source, and is also required to be controlled by the 930 West Reservoir water level. Approximately 3.8 MGD was supplied by the CCWRF. The RP-1 930 Zone Effluent Pump Station pump capacity improvements for Year 2035 could be eliminated. No other changes to improvement recommendations are required.

PROPOSED IMPROVEMENT

- 12" to Grove Basin – 1,000 LF
- 36" Pipeline in 1158 PZ 19,600 LF
- 30" Pipeline in Jurupa Street to Jurupa Basin – 5,400 LF
- 20" Pipeline in Jurupa Street – 1,300 LF
- 3 MG EQ Storage at CCWRF
- CCWRF Pump Station Capacity Upgrades – Add 1 Pump
- 24" 1050 PZ Parallel Pipeline – 2,000 LF
- RP-1 930 Pump Station Capacity Upgrades – Replace 2 pumps at 9,300 GPM
- RP-1 1050 Pump Station Capacity Upgrades – Replace 2 pumps W/ Larger Capacity

ETIWANDA DEBRIS
SAN SEVAINE (1-3)
SAN SEVAINE 5
VICTORIA
VICTORIA (INCREASE)
LOWER DAY
1630W PZ 3MG TANK
1630 ZONE 15 MG TANK
1299 PZ 5MG TANK
1630E PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
COLLEGE HEIGHTS EAST
COLLEGE HEIGHTS WEST
UPLAND
MONTCLAIR (1-3)
1630W PUMP STATION
36" PIPELINE
30" PIPELINE
20" PIPELINE
JURUPA
WINEVILLE
RP-3 NEW
RP-3
DECLEZ
ELY
RP-1
12" PIPELINE
GROVE
24" 1050 PZ PARALLEL PIPELINE
PUMP UPGRADES RP-1 930 ZONE EFFLUENT PUMP STATION
PUMP UPGRADES RP-1 1050 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
CCWRF 3 MG EQ STORAGE
CCWRF 930 ZONE PUMP STATION UPGRADES
RP-5
ALL OF PRADO OBLIGATION MET BY RP-5
930 TO 800 PZ PRV
BROOKS
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

LEGEND:

- Existing Basins
- Year 2035 Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2035 - Base GWR Implementation
## FIGURE 6-11

# 7.0 PROGRAM SENSITIVITY ANALYSIS

Section 6 analyzed the RW system assuming the GWR program will include all potential basins listed and implemented as shown in Table 4.2. This section analyzes various operational scenarios to understand the needs and impacts on the RW system by determining the number of groundwater basins to be connected to the RW program as changes in reuse supply occur. The minimum number of basins included in the analysis includes only the existing basins and those committed in the 2013 RMPU. Additionally, an analysis was conducted to estimate when additional RMPU basins would be appropriate to come on line.

## 7.1 SENSITIVITY ANALYSIS SCENARIOS

In addition to the GWR implementation analyses discussed in Section 6, three (3) additional sensitivity analysis scenarios were analyzed to understand the limitations on the RW system and recharge capacities, as described below:

**Scenario A – All GWR Basins with Approximately 10,000 AFY of External Supply**

This scenario assumes all of the GWR basins are able to be recharged with RW as shown in Tables 4.2 and 5.3 in the previous sections. However, rather than the Agency meeting their entire SARBF at Prado Obligation directly from treated effluent, the SARBF at Prado Obligation is met by a portion of an external supply. The source of this external supply is unknown at this time, but it is assumed to be able to replace the Agency's current Obligation met directly from RP-5, CCWRF, and RP-1. The external supply is assumed to be approximately 10,000 AFY.

**Scenario B – Existing and 2013 RMPU Basins (No External Supply)**

This scenario assumes that the number of GWR basins to be converted and receive reuse supply for recharge is limited to the current 2013 RMPU. The analysis assumes all of the existing basins will remain operational plus the following RMPU basins:

- RP-3 (New Cell)
- Victoria (Increase)
- San Sevaine (1-3)

Also, under this scenario, the Agency will continue to fulfill the SARBF at Prado Obligation directly from the treated effluent as is done for current operations.

**Scenario C – Existing and 2013 RMPU Basins with Approximately 5,000 AFY of External Supply**

This scenario assumes that the number of GWR basins to be converted and receive reuse supply for recharge is limited to the 2013 RMPU. The analysis assumes all of the existing basins will remain operational plus the following RMPU basins:

- RP-3 New Cell
- Victoria (Increase)
- San Sevaine (1-3)

However, rather than the Agency meeting their entire SARBF at Prado Obligation directly from treated effluent, the SARBF at Prado Obligation is met by a portion of an external supply. The source of this external supply is currently unknown, but it is assumed will reduce the Southern Area supply deficit shown in Table 5.11.

## 7.2 SENSITIVITY ANALYSIS - MASS BALANCE

Scenarios A and C as described above assume an external supply will be able to eliminate the Southern Area supply deficit and meet portions of the Agency's SARBF at Prado Obligation. Therefore, a mass balance analyzing the proposed direct use demands versus the new supply availability was performed that removed a portion of the Prado Obligation annual demand in accordance with the amount of external supply.

A summary of the Scenario A annual supply availability to the GWR program is provided in Table 7.1.

## Table 7.1 Sensitivity Analysis Supply versus Demands Mass Balance – Scenario A

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| **Southern Service Area** | | | | | |
| Southern Area RW Supply (RP-5, CCWRF) | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| External Supply | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Southern Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Total to SARBF at Prado Obligation[1] | 14,000 | 14,000 | 14,000 | 14,000 | 14,000 |
| Southern Area Annual Months of (Deficit)[2] | (5,595) | (4,482) | (3,193) | (1,643) | (1,193) |
| Southern Area Annual Months of Surplus[3] | - | - | 757 | 2,269 | 3,548 |
| **Northern Service Area** | | | | | |
| Northern Area RW Supply (RP-1, RP-4) | 46,934 | 47,158 | 49,454 | 51,750 | 53,543 |
| Northern Area Direct Use Demands | 8,087 | 11,166 | 15,642 | 19,240 | 20,650 |
| Supplemental Supply to Southern Area [2] | (5,595) | (4,482) | (3,193) | (1,643) | (1,193) |
| Surplus Available from the Southern Area[3] | - | - | 757 | 2,269 | 3,548 |
| Total to SARBF at Prado from North[1] | - | - | - | - | - |
| Northern Area Supply Surplus/(Deficit) | 33,252 | 31,510 | 31,380 | 33,168 | 35,248 |
| **Scenario A GWR 9-Month Operation RW Availability[4]** | **23,645** | **21,528** | **20,579** | **21,261** | **22,428** |
| 3-Month Un-Used Winter Surplus | 9,575 | 9,942 | 10,718 | 11,801 | 12,741 |

[1] The SARBF at Prado Obligation is assumed to be met by the surplus available from RP-5 and CCWRF plus the external supply source. The entire 10,000 AFY external supply is assumed to be used in the Southern Service Area and no supply is available SARBF at Prado Obligation is from RP-1. 14,000 AFY is assumed to conservatively increase the available GWR potential for purposes of analysis of the RW system facilities.

[2] The monthly mass balance shows a deficit due to no seasonal storage availability and the maximum demand months in the summer exceeding the supplies even with the additional 10,000 AFY external supply. The 10,000 AFY external supply was assumed to be a constant supply for each month with an average of 8.9 MGD entering the Southern Service Area. The deficit during the maximum demand months in the summer is assumed to be made up from the Northern Service Area.

[3] The remaining months outside the summer maximum demand months show a surplus, which are assumed to be available to the Northern Service Area.

[4] The GWR 9-Month Operation RW Availability shown is calculated based on the monthly mass balance and surplus analysis for the 9-month GWR operating period.

The monthly mass balance and large amount of surplus supply that is un-used during the winter months indicates that an external supply received during these winter months is not beneficial to the GWR program or to meet maximum day direct use demand periods.

The reuse supply availability to GWR shows an overall net increase assuming Scenario A conditions. This is shown in Table 7.2.

### Table 7.2 Comparison of Recycled Water Supply Availability – Scenario A

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Scenario A GWR 9-Month Operation RW Availability (10,000 AFY External Supply) – | 23,645 | 21,528 | 20,579 | 21,261 | 22,428 |
| GWR 9-Month Operation RW Availability – *Without* External Supply | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Scenario A Difference in GWR Availability | 7,550 | 7,551 | 7,552 | 7,554 | 7,557 |

A summary of the Scenario C annual supply (additional 5,000 AFY) availability to the GWR program is provided in Table 7.3.

### Table 7.3 Sensitivity Analysis Supply versus Demands Mass Balance – Scenario C

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| **Southern Service Area** | | | | | |
| Southern Area RW Supply (RP-5, CCWRF) | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| External Supply | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| Southern Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Total to SARBF at Prado Obligation[1] | 14,000 | 14,000 | 14,000 | 14,000 | 14,000 |
| Southern Area Annual Months of (Deficit)[2] | (10,595) | (9,482) | (7,432) | (4,692) | (3,607) |
| Southern Area Annual Months of Surplus[3] | - | - | - | 350 | 962 |
| **Northern Service Area** | | | | | |
| Northern Area RW Supply (RP-1, RP-4) | 46,934 | 47,158 | 49,454 | 51,750 | 53,543 |
| Northern Area Direct Use Demands | 8,087 | 11,166 | 15,642 | 19,240 | 20,650 |
| Supplemental Supply to Southern Area [2] | (10,595) | (9,482) | (7,432) | (4,692) | (3,607) |
| Surplus Available from the Southern Area[3] | - | - | - | 350 | 962 |
| Total to SARBF at Prado from North[1] | - | - | - | - | - |
| Northern Area Supply Surplus/(Deficit) | 28,252 | 26,510 | 26,380 | 28,168 | 30,248 |
| **Scenario C GWR 9-Month Operation RW Availability[4]** | **19,878** | **17,761** | **16,812** | **17,494** | **18,661** |
| 3-Month Un-Used Winter Surplus | 8,342 | 8,709 | 9,485 | 10,568 | 11,508 |

[1] The SARBF at Prado Obligation is assumed to be met by the surplus available from RP-5 and CCWRF plus the external supply source. The entire 5,000 AFY external supply is assumed to be used in the Southern Service Area and no supply is available SARBF at Prado Obligation is from RP-1. 14,000 AFY is assumed to conservatively increase the available GWR potential for purposes of analysis of the RW system facilities.

[2] The monthly mass balance shows a deficit due to no seasonal storage availability and the maximum demand summer months exceeding the supplies even with the additional 10,000 AFY external supply. The 5,000 AFY external supply was assumed to be a constant supply for each month with an average of 4.5 MGD entering the Southern Service Area. The deficit during the maximum demand months in the summer is assumed to be made up from the Northern Service Area.

[3] The remaining months outside the summer maximum demand months show a surplus, which are assumed to be available to the Northern Service Area.

[4] The GWR 9-Month Operation RW Availability shown is calculated based on the monthly mass balance and surplus analysis for the 9-month GWR operating period.

Table 7.4 shows the net increase in RW basin recharge availability based on Scenario C assumptions.

**Table 7.4 Comparison of Recycled Water Supply Availability – Scenario C**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Scenario C GWR 9-Month Operation RW Availability – with 5,000 AFY External Supply | 19,878 | 17,761 | 16,812 | 17,494 | 18,661 |
| GWR 9-Month Operation RW Availability – *Without* External Supply | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Scenario C Difference in GWR Availability | 3,783 | 3,784 | 3,785 | 3,787 | 3,790 |

## 7.3 SENSITIVITY ANALYSIS - HYDRAULIC DEMANDS

The demands used for the sensitivity analysis used the same direct use demands described in Section 6. However, the model was updated with increased flows to the groundwater basins. The scenarios that include additional supply, assume that the supply will be used to meet the SARBF at Prado Obligation and therefore, increases the reuse supply available to the groundwater basins.

**Table 7.5 Sensitivity Analysis Demands Used for Hydraulic Analysis – Scenario A**

| | Existing | | Year 2020 | | Year 2025 | | Year 2030 | | Year 2035 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AD | MD | AD | MD | AD | MD | AD | MD | AD | MD |
| | MGD | | | | | | | | | |
| Reuse Supply | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| Direct Use Demands[1] | 22.0 | 36.0 | 27.5 | 44.4 | 32.6 | 52.7 | 36.0 | 60.0 | 38.4 | 63.9 |
| SABRF at Prado Obligation[2] | 3.6 | 2.6 | 3.6 | 2.6 | 3.6 | 2.6 | 3.6 | 2.6 | 3.6 | 2.6 |
| **Sensitivity Analysis GWR Available Flows[3]** | **29.7** | **16.7** | **28.1** | **12.2** | **28.0** | **8.9** | **29.6** | **6.6** | **31.5** | **7.0** |
| Total Reuse Supply Used | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| **Base Analysis GWR Available Flows [4]** | **20.8** | **14.2** | **19.2** | **8.3** | **19.1** | **3.9** | **20.7** | **1.7** | **22.6** | **4.6** |
| Net Increase to GWR | 8.9 | 2.5 | 8.9 | 3.9 | 8.9 | 5.0 | 8.9 | 4.9 | 8.9 | 2.4 |

[1] The Direct Use Demands for the "AD" condition are the average daily demands for the spring/fall months of March, April, May, and November. The "MD" condition demands are the maximum month's demands between June and October.

[2] The SARBF at Prado Obligation demands for this sensitivity analysis are assumed to be met from the Southern Service Area RP effluent and external supply source. The Southern Service Area will meet approximately 4,000 AFY of the total obligation.

[3] The GWR Available Flows are the average monthly flow available for the appropriate demand period described in Footnote 1 above. The Sensitivity Analysis for GWR available flows assumes the additional supply will meet a portion of the Prado Obligation demand.

[4] See Table 6.1. The Base Analysis for GWR Available Flows assumes with additional supply if provided.

**Table 7.6 Sensitivity Analysis Demands Used for Hydraulic Analysis – Scenario C**

| | Existing | | Year 2020 | | Year 2025 | | Year 2030 | | Year 2035 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AD | MD | AD | MD | AD | MD | AD | MD | AD | MD |
| | MGD | | | | | | | | | |
| Reuse Supply | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| Direct Use Demands | 22.0 | 36.0 | 27.5 | 44.4 | 32.6 | 52.7 | 36.0 | 60.0 | 38.4 | 63.9 |
| SABRF at Prado Obligation[2] | 8.0 | 3.5 | 8.0 | 3.5 | 8.0 | 3.5 | 8.0 | 3.5 | 8.0 | 3.5 |
| **Sensitivity Analysis GWR Available Flows[1]** | **25.3** | **15.8** | **23.7** | **11.3** | **23.6** | **8.0** | **25.2** | **5.7** | **27.1** | **6.1** |
| Total Reuse Supply Used | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| **Base Analysis GWR Available Flows [2]** | **20.8** | **14.2** | **19.2** | **8.3** | **19.1** | **3.9** | **20.7** | **1.7** | **22.6** | **4.6** |
| Net Increase to GWR | 4.5 | 1.6 | 4.5 | 3.0 | 4.5 | 4.1 | 4.5 | 4.0 | 4.5 | 1.5 |

[1] The GWR Available Flows are the average monthly flow available for the appropriate demand period described in Footnote 1 above. The Sensitivity Analysis GWR Available Flows assumes an external supply will meet the Prado Obligation demand.

[2] See Table 6.1. The Base Analysis GWR Available Flows assumes only RW Effluent supply with no external supply.

# 7.4 SENSITIVITY ANALYSIS - HYDRAULIC MODEL ANALYSIS

This Section summarizes the results of the computer model analyses conducted for the three (3) sensitivity analyses to the Year 2035. The following is a brief description of the analysis and resulting improvements proposed.

## 7.4.1 Scenario A – Hydraulic Analysis with All Basins and 10,000 AFY Additional Supply

This scenario assumes that the Agency will obtain an external supply source to meet a portion of the SRBF at Prado Obligation and that all proposed GWR basins will be implemented for RW recharge as described in Section 7.1. The recommended improvements for this scenario are summarized in Table 7.6. The sections below describe in detail improvements needed for each 5-year planning period.

### 7.4.1.1 Scenario A - Existing Conditions Analysis

As a result of the increased flow to the GWR program, some of the basins would require upgrades to their turnout and delivery structures to accommodate the higher flow rates. The following is a preliminary list of the basins that are proposed to require upgrades along with capacity requirements.

**Table 7.4 Scenario A Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Capacity (cfs) | Proposed Turnout Capacity (cfs) |
|---|---|---|
| Brooks[1] | 12.00 | 14 |
| Ely (1-3) | 6.00 | 12 |
| Hickory | 4.00 | 8 |
| San Sevaine (5)[1] | 24.00 | 29 |
| Turner | 8.00 | 12 |
| Victoria | 8.00 | 12 |

[1] Additional basin requiring upgrades beyond those identified in the based GWR Implementation analysis.

Other system improvements were required for this scenario and have been summarized in Table 7.6.

### 7.4.1.2 Scenario A - Year 2020 Analysis

The Year 2020 analysis showed upgrades to the 1630 East Recycled Water Pump Station and a parallel 16-inch 1299 Zone pipeline are required. These improvements are summarized in Table 7.6.

#### 7.4.1.3 Scenario A - Year 2025 Analysis

The Year 2025 analysis showed that no additional facility improvements are required than those already proposed to meet direct use and GWR demands per Section 6.

#### 7.4.1.4 Scenario A - Year 2030 Analysis

Significant system facility improvements are required to meet the Year 2030 conditions. A new 30-inch 1158 Zone pipeline is proposed from RP-5 to the 30-inch 1158 Zone pipeline previously proposed for the direct use demands analysis. This will require a new 1158 Pump Station at RP-5. This scenario also requires capacity upgrades at the 1299 Zone Pump Station at RP-4 and increased equalization storage at RP-4 of approximately 1.6 MG. These improvements are summarized in Table 7.6.

#### 7.4.1.5 Scenario A - Year 2035 Analysis

The Year 2035 analysis shows that no additional facility improvements are required other than those already proposed to meet direct use and GWR demands per Section 6.

See Figure 7-1 for the proposed facilities related to Scenario A through Year 2035.

### 7.4.2 Scenario B – Hydraulic Analysis with Existing/2013 RMPU Basins (No Additional Supply)

This scenario assumes that the Agency will continue to meet SARBF at Prado Obligation and that the proposed basins to be implemented for RW recharge are only the 2013 RMPU basins as described in Section 7.1. The recommended improvements for this scenario are summarized in Table 7.7. The sections below describe in detail the improvements needed for each 5-year planning period.

#### 7.4.2.1 Scenario B - Existing Conditions Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6.

#### 7.4.2.2 Scenario B - Year 2020 Analysis

The Year 2020 analysis shows no additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6.

#### 7.4.2.3 Scenario B - Year 2025 Analysis

The Year 2025 analysis shows no additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6.

#### 7.4.2.4 Scenario B - Year 2030 Analysis

The Year 2030 analysis shows upgrades to increase the capacity of the proposed 1158 Zone Storage Tank from 4.0 MG to 5.0 MG. These improvements are summarized in Table 7.7.

#### 7.4.2.5 Scenario B - Year 2035 Analysis

The Year 2025 analysis shows no additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6.

See Figure 7-2 for an illustration of the proposed facilities related to Scenario B for Year 2020 through Year 2035.

### 7.4.3 Scenario C – Hydraulic Analysis with Existing/ 2013 RMPU Basins and 5,000 AFY of Additional Supply

This scenario assumes that the Agency will obtain an external supply source to meet a portion of the SARBF at Prado Obligation and that the proposed GWR basins to be implemented for RW recharge are only the RMPU basins as described in Section 7.1. The recommended improvements for this scenario are summarized in Table 7.8. The sections below describe in detail the improvements needed for each 5-year planning period.

#### 7.4.3.1 Scenario C - Existing Conditions Analysis

As a result of the increased flow to the GWR program, some of the basins would require upgrades to the turnout and delivery structures to accommodate the higher flow rates. The following is a preliminary list of the basins that are proposed to require upgrades along with capacity requirements. It should be noted that the turnout capacities shown in Table 7.5 are the same as those required for Scenario A conditions per Table 7.4.

**Table 7.5 Scenario C Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Flow Capacity (cfs) | Proposed Flow/Turnout Capacity (cfs) |
|---|---|---|
| Brooks[1] | 12.00 | 14 |
| Ely (1-3) | 6.00 | 12 |
| Hickory | 4.00 | 8 |
| San Sevaine (5)[1] | 24.00 | 29 |
| Turner | 8.00 | 12 |
| Victoria | 8.00 | 12 |

[1] Additional basin requiring upgrades beyond those identified in the based GWR Implementation analysis.

Other system improvements were required for this existing condition demands and basin flow scenario. The system improvements that were proposed and related to the Year 2020 base GWR Implementation analysis are required earlier in the planning horizon for this Existing Conditions scenario. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

### 7.4.3.2 Scenario C - Year 2020 Analysis

The Year 2020 analysis shows that in addition to the facilities proposed for the base GWR Implementation analysis, upgrades to the 1630 East Recycled Water Pump Station and a parallel 16-inch 1299 Zone pipeline are required. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

### 7.4.3.3 Scenario C - Year 2025 Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6. However, since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

### 7.4.3.4 Scenario C - Year 2030 Analysis

Significant system facility improvements are required to meet the Year 2030 conditions for this scenario. A new 30-inch 1158 Zone pipeline is proposed from RP-5 to the 30-inch 1158 Zone pipeline previously proposed for the direct use demands analysis. This will require a new 1158 Pump Station at RP-5. This scenario also requires capacity upgrades at the 1299 Zone Pump Station at RP-4 and increased equalization storage at RP-4 of approximately 1.6 MG. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

#### 7.4.3.5 Scenario C - Year 2035 Analysis

Since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. No additional facilities other those required for the base GWR Implementation program in Section 6 are proposed. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

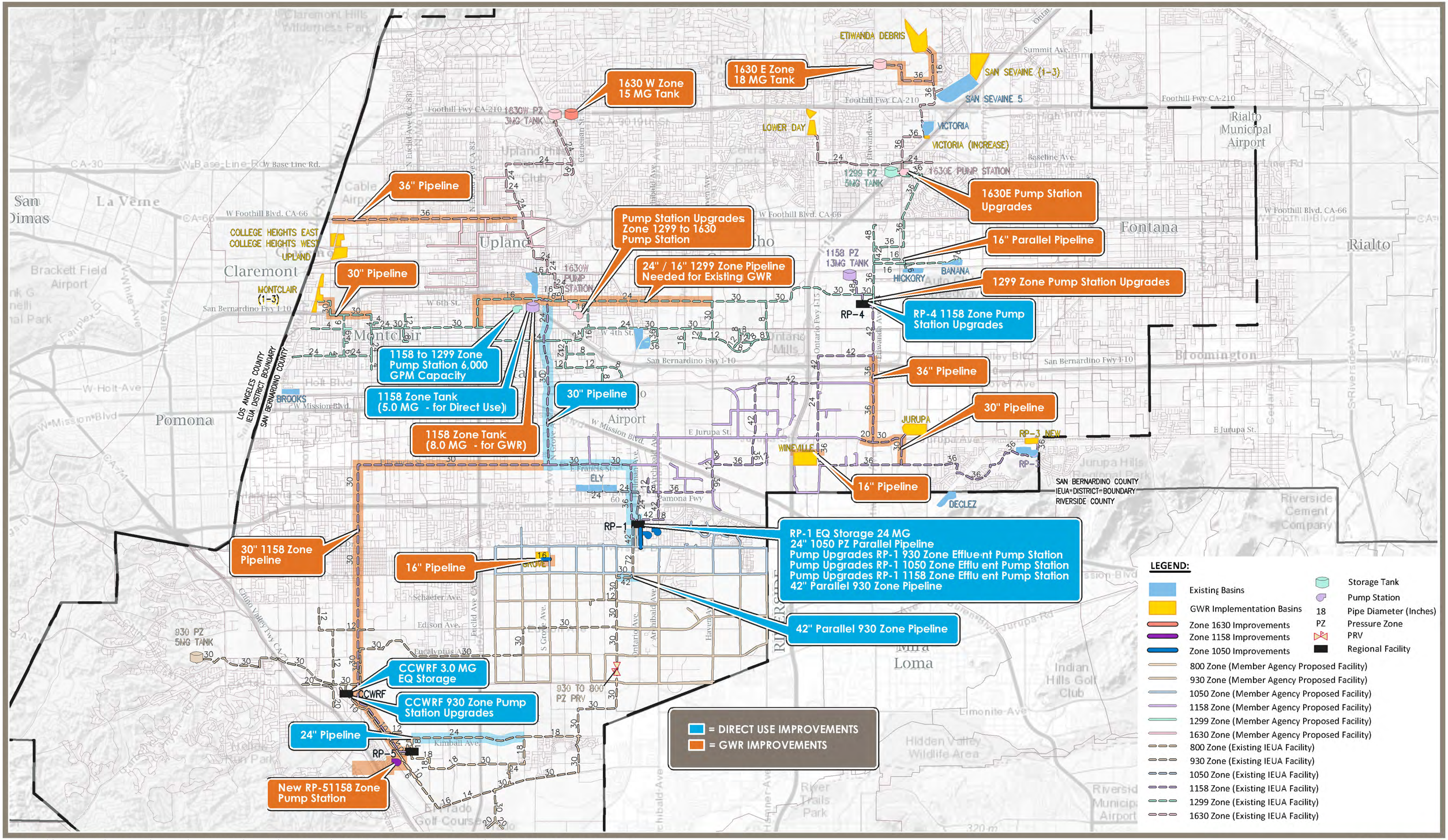
See Figure 7-3 for an illustration of the proposed facilities related to Scenario C for Year 2020 through Year 2035.

## Table 7.6 Scenario A Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| Exist | GWR in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| Exist | GWR in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| Exist | GWR in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| Exist | GWR Increase Flow | Turnout Capacities undersized at Brooks, Ely, Hickory, Turner, Victoria | Increase Basin turnout capacities | 1 | LS |
| 2020 | GWR to Wineville Basin | System expansion to serve GWR Basin | 16-inch Pipeline to Wineville Basin | 1200 | lf |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2020 | GWR Increase to 1630E PZ | Capacity in 1630 E PZ | 1630E Pump Station Upgrades | 1 | LS |
| 2020 | GWR increase to Upper Zones | Pump capacity exceeded | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2020 | GWR to Banana | Pipe capacity exceeded from Etiwanda to Hickory turnout | 16-inch Parallel 1299 PZ Pipeline | 3000 | lf |
| 2025 | GWR to Lower Day Basin | System expansion to serve GWR Basin | 24-inch Pipeline to Lower Day | 10520 | lf |
| 2025 | GWR to Etiwanda Debris Basin | System expansion to serve GWR Basin | 16-inch 1630E Pipeline | 2670 | lf |
| 2025 | Max Summer Direct Use & GWR | Supply Deficiency in RP-1 | 24 MG EQ Storage | 1 | LS |
| 2025 | Max Summer DU | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 42-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR to College Heights Basin | System expansion to serve GWR Basin | 36-inch 1630W Pipeline in Foothill Blvd | 19600 | lf |
| 2030 | GWR to Montclair Basin | System expansion to serve GWR Basin | 30-inch 1299 PZ Pipeline to Montclair Basins | 7840 | lf |
| 2030 | GWR to 1630W PZ | System expansion to serve GWR Basin | 1630W Booster Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR to 1630W PZ | System operations for 1630W PZ and reduce impacts to 1299 PZ | 15 MG 1630W Storage Tank | 15 | MG |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP-5 1158PZ Pump Station | 1 | LS |

## Table 7.6 Scenario A Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-6 | 30-inch 1158PZ Pipeline from RP-5 | 48500 | lf |
| 2030 | GWR to 1630E PZ | Increased flow to 1630E PZ, deficient capacity in 1299 PS | Capacity Upgrades to 1299PS at RP-4 | 1 | LS |
| 2030 | Max Summer Direct Use & GWR | Supply Deficiency in RP-4 | 1.6 MG EQ Storage at RP-4 | 1.6 | MG |
| 2030 | Max Summer Direct Use & GWR | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2030 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 1158 PZ Storage Tank | 8 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2035 | GWR to Grove Basin | System expansion to serve GWR Basin | 12-inch to Grove Basin | 1000 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 36-inch Pipeline in 1158 PZ | 19600 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 30-inch Pipeline in Jurupa Street to Jurupa Basin | 5400 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 20-inch Pipeline in Jurupa Street | 1300 | lf |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |




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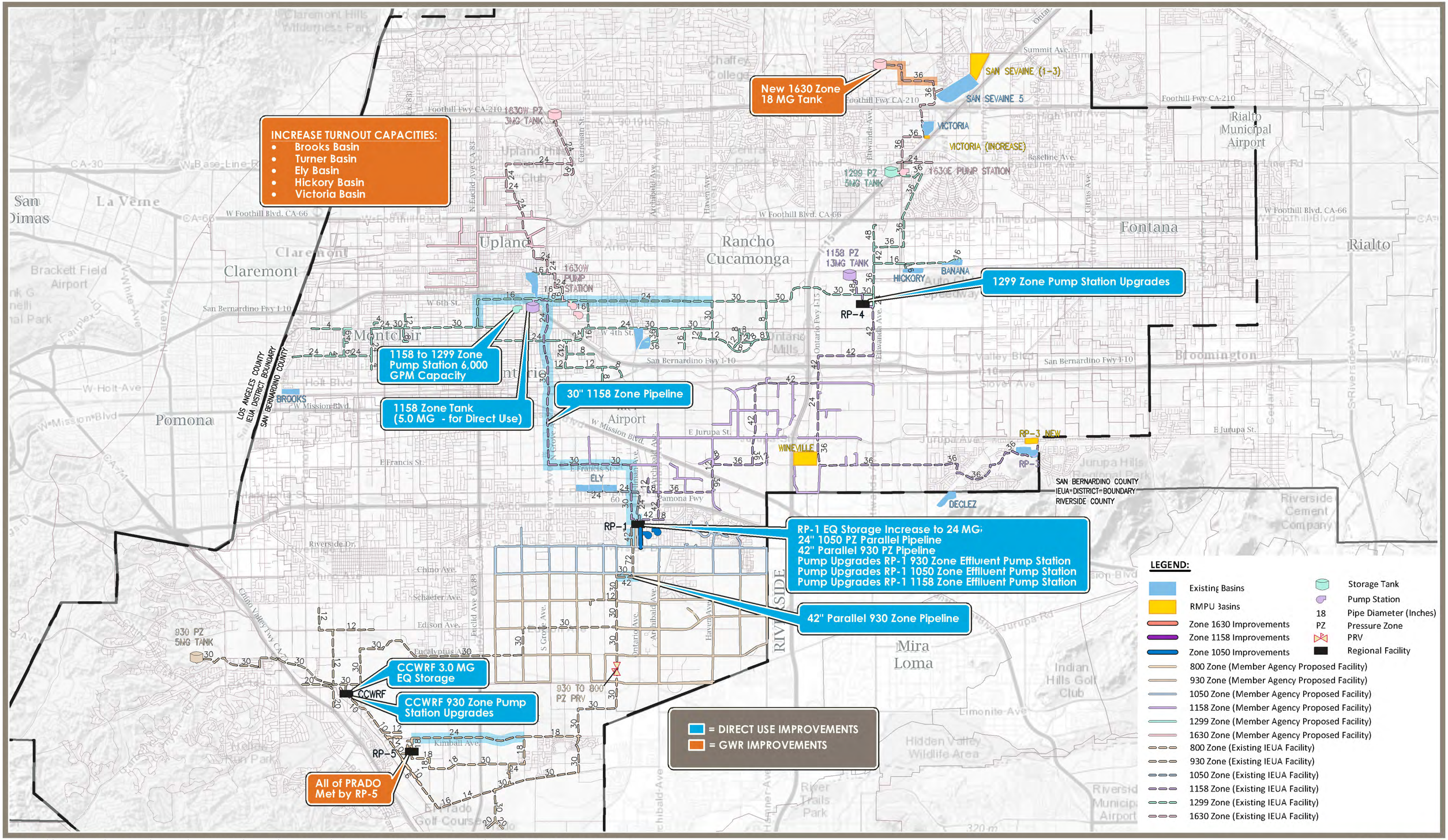

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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario A
## FIGURE 7-1

## Table 7.7 Scenario B Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2025 | Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 | LS |
| 2025 | Summer DU & GWR | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| 2025 | Summer DU & GWR | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| 2025 | Summer DU & GWR | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 42-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2035 | Max Summer DU | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2035 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |




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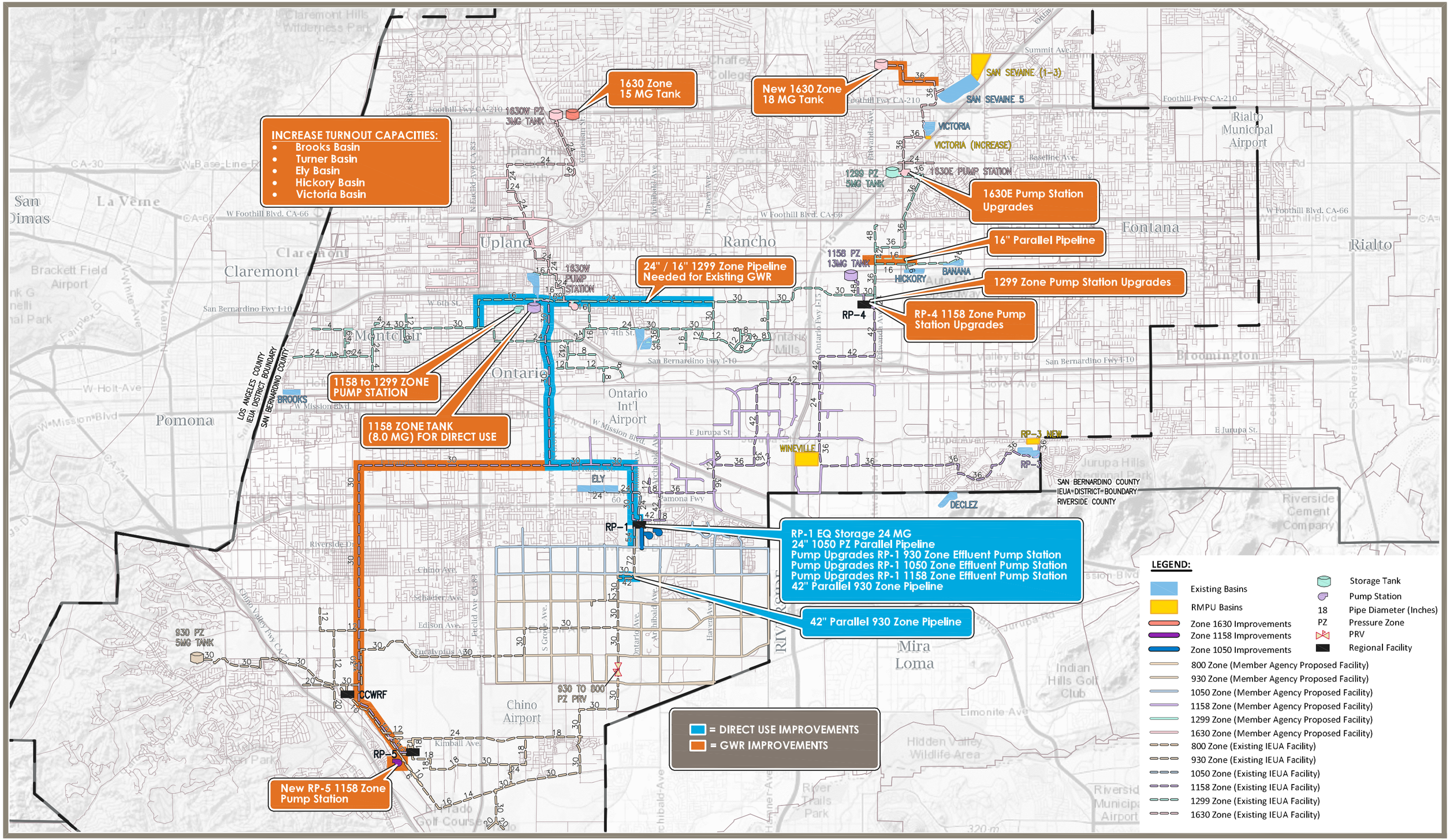
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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario B
## FIGURE 7-2

## Table 7.8 Scenario C Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| Exist | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| Exist | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| Exist | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| Exist | GWR Increase Flow | Turnout Capacities undersized at Brooks, Ely, Hickory, Turner, Victoria | Increase Basin turnout capacities | 1 | LS |
| 2020 | Average Direct Use | Ex. 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2020 | GWR Increase to 1630E PZ | Capacity in 1630 E PZ | 1630E Pump Station Upgrades | 1 | LS |
| 2020 | GWR increase to Upper Zones | Pump capacity exceeded | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2020 | GWR to Banana | Pipe capacity exceeded from Etiwanda to Hickory turnout | 16-inch Parallel 1299 PZ Pipeline | 3000 | lf |
| 2025 | Summer DU & GWR | Supply Deficiency in RP-1 | 24 MG EQ Storage | 1 | LS |
| 2025 | Max Summer DU | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 42-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP5 1158PZ Pump Station | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | 30-inch 1158PZ Pipeline from RP5 | 48500 | lf |
| 2030 | GWR to 1630E PZ | Increased flow to 1630E PZ, deficient capacity in 1299 PS | Capacity Upgrades to 1299PS at RP-4 | 1 | LS |
| 2030 | Summer DU & GWR | Supply Deficiency in RP-4 | 1.6 MG EQ Storage at RP-4 | 1.6 | MG |
| 2030 | Summer DU & GWR | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2030 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 8.0 MG 1158 PZ Storage Tank | 8 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP-5 1158PZ Pump Station | 1 | LS |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |




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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario C
## FIGURE 7-3

## 7.5 SENSITIVITY ANALYSIS - PROJECT COST EVALUATIONS

A comparison of total estimated project costs was performed to analyze and develop an overall recommendation for an implementation strategy. The GWR project recommendations described in Section 6 were compared with the project improvements recommended for the sensitivity analysis scenarios A, B, and C as shown in Tables 7.6, 7.7, and 7.8.

Table 7.9 on the following page shows the capital cost summary analysis that was performed. The overall projects' capital costs for each of the implementation scenarios are listed with the total estimated annual reuse supply recharge benefit for that scenario.

Based on the total project capital costs for the different operational conditions, Scenario B of the Sensitivity Analysis herein shows the lowest total project capital costs. It also shows to be the lowest cost per annual acre-feet of RW recharge to the basins. This scenario assumes that the Agency will continue to meet SARBF at Prado Obligation as it currently does from the effluent supply from RP-5, CCRWF and RP-1.

Additionally, it should be noted that the basins assumed for Existing/RMPU scenarios will have the ability to recharge the total annual reuse supply available for GWR. Therefore, the cost to recharge per annual acre-feet of RW is much less than the Base GWR program required for implementing all of the GWR proposed basins.

However, other considerations should be given if only the Existing and 2013 RMPU GWR basins are connected to the RW system:

- Using only the Existing/RMPU basins limit the ability to take a basin down for maintenance. This leaves no operational redundancy or flexibility for under-performing basins or those needed to be taken out of service.

- If actual direct use demands do not meet the projections assumed in the RWPS, the additional reuse supply that would become available for GWR could be limited based on the capacity of the existing/2013 RMPU basins. The theoretical monthly recharge capacity for the Existing/2013 RMPU basins is approximately 4,100 AF per month. Depending on quantity and availability of the additional supply, there could be a need to evaluate adding additional GWR basins or investigating other reuse opportunities to maximize the available reuse supply.

Based on the overall goals of the RWPS to meet the projected direct use demands and to maximize the remaining reuse supply for GWR to the basins, Scenario B of the Sensitivity Analysis is recommended. Based on the total project capital costs for the different operational conditions, Scenario B will also provide the Agency the lowest total capital improvement costs.

## Table 7.9 Sensitivity Analysis Project Costs Analysis

| Year | Previous Costs | Direct Use (DU) Only Improvements Costs | DU Improvements Cumulative Costs | Annual DU Demands (AFY) | Spring/Fall DU plus GWR Improvement Costs | Summer DU plus GWR Improvement Costs | GWR plus DU Improvements Cumulative Costs | Total Annual Recharge (AFY) | Total Cumulative Costs | Total Annual Demand (AFY) |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE GWR PROJECT IMPROVEMENTS (SEE CHAPTER 6) – All GWR Implementation Basins (No External Supply)** | | | | | | | | | | |
| Exist | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 7,250,000 | $ - | $ 7,250,000 | 13,977 | $ 13,470,000 | 44,734 |
| 2025 | $ 13,470,000 | $ 6,280,000 | $ 12,500,000 | 36,507 | $ 6,060,000 | $ 11,690,000 | $ 25,000,000 | 13,027 | $ 37,500,000 | 49,534 |
| 2030 | $ 37,500,000 | $ 34,300,000 | $ 46,800,000 | 40,320 | $ 39,000,000 | $ - | $ 64,000,000 | 13,707 | $ 110,800,000 | 54,027 |
| 2035 | $110,800,000 | $ 12,520,000 | $ 59,320,000 | 43,019 | $ 16,030,000 | $ - | $ 80,030,000 | **14,871** | **$139,350,000** | 57,890 |
| **SCENARIO A - PROJECT IMPROVEMENTS – All GWR Implementation Basins plus 10,000 AFY External Supply** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $ 20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 4,130,000 | $ - | $ 24,130,000 | 21,427 | $ 30,350,000 | 52,184 |
| 2025 | $ 30,350,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ 6,060,000 | $ - | $ 30,190,000 | 19,797 | $ 41,530,000 | 56,304 |
| 2030 | $ 41,530,000 | $ 41,550,000 | $ 52,890,000 | 40,320 | $ 71,730,000 | $ 7,610,000 | $ 109,530,000 | 19,422 | $ 162,420,000 | 59,742 |
| 2035 | $ 62,420,000 | $ 3,460,000 | $ 56,350,000 | 43,019 | $ 16,030,000 | $ - | $ 125,560,000 | **19,906** | **$181,910,000** | 62,925 |
| **SCENARIO B - PROJECT IMPROVEMENTS – Existing/2013 RMPU Basins (No External Supply)** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 6,860,000 | $ - | $ 6,860,000 | 13,977 | $ 13,080,000 | 44,734 |
| 2025 | $ 13,080,000 | $ 17,970,000 | $ 24,190,000 | 36,507 | $ - | $ - | $ 6,860,000 | 13,027 | $ 31,050,000 | 49,534 |
| 2030 | $ 31,050,000 | $ 34,300,000 | $ 58,490,000 | 40,320 | $ - | $ - | $ 6,860,000 | 13,707 | $ 65,350,000 | 54,027 |
| 2035 | $ 65,350,000 | $ 12,520,000 | $ 71,010,000 | 43,019 | $ - | $ - | $ 6,860,000 | **14,871** | **$ 77,870,000** | 57,890 |
| **SCENARIO C - PROJECT IMPROVEMENTS – Existing/2013 RMPU Basins plus 5,000 AFY External Supply** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 17,982 | $ 20,000,000 | 42,637 |
| 2020 | $20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 3,740,000 | $ - | $ 23,740,000 | 15,702 | $ 9,960,000 | 46,459 |
| 2025 | $29,960,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ - | $ - | $ 23,740,000 | 14,458 | $ 35,080,000 | 50,965 |
| 2030 | $35,080,000 | $ 41,110,000 | $ 52,450,000 | 40,320 | $ 33,310,000 | $ 7,610,000 | $ 64,660,000 | 15,834 | $117,110,000 | 56,154 |
| 2035 | $117,110,000 | $ 3,460,000 | $ 55,910,000 | 43,019 | $ - | $ - | $ 64,660,000 | **17,242** | **$120,570,000** | 60,261 |

# 8.0 RWPS RECOMMENDED PROJECTS

This section provides a list of the recommended projects to meet the Agency's projected direct use demands while maximizing the use of the available reuse supply. The list of recommended projects is based on the Sensitivity Analysis Scenario B described in the previous section. Also, based on the project improvement costs, the total cost of water is determined for the proposed GWR Implementation Strategy proposed herein.

## 8.1 PROPOSED PROJECTS

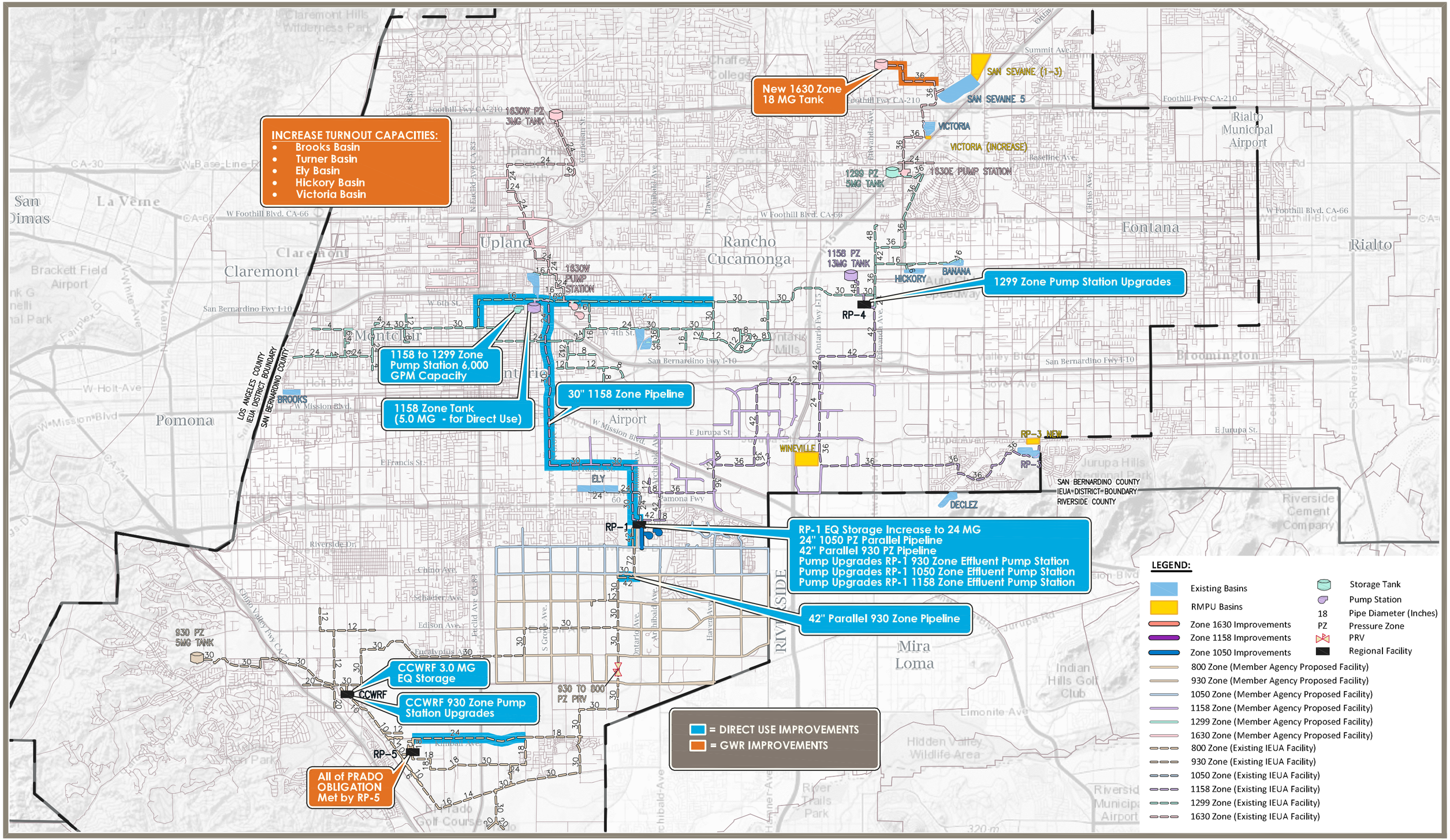
Table 8.1 provides a comprehensive list of projects and project costs identified for each planning year. Since the proposed improvements recommended are required to either meet direct use demands or GWR purposes, the table includes a description of the demand condition that triggers the need for the project, as well the type of deficiency the project is intended to mitigate.

Project costs and total CIP cost projects are based on 2015 dollars and do not include cost escalations for future expenditures.

The location of the RWPS recommended facility improvements are shown in Figure 8-1.

## Table 8.1 Recommended RWPS Projects

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | Unit Cost | Total Const. Cost | Cont. / Admin./ Eng. | Total Estimated Project Cost | Cumulative CIP Costs | GWR Program Improvement | Direct Use Improvement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 LS | $ 500,000 | $ 500,000 | $ 225,000 | $ 730,000 | $ 730,000 | $ 730,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 lf | $ 495 | $ 3,323,925 | $ 1,495,766 | $ 4,820,000 | $ 5,550,000 | $ 4,820,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 LS | $ 900,000 | $ 900,000 | $ 405,000 | $ 1,310,000 | $ 6,860,000 | $ 1,310,000 | $ - |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 lf | $ 340 | $ 4,290,800 | $ 1,930,860 | $ 6,220,000 | $ 13,080,000 | $ - | $ 6,220,000 |
| | | | | | | **Year 2020 Improvement Costs** | | **$13,080,000** | **$ 13,080,000** | **$ 6,860,000** | **$ 6,220,000** |
| 2025 | Max Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 LS | $ - | $ - | $ - | $ - | $ 13,080,000 | $ - | $ - |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, to serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 lf | $ 225 | $ 3,440,025 | $ 1,548,011 | $ 4,990,000 | $ 18,070,000 | $ - | $ 4,990,000 |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 lf | $ 340 | $ 4,624,000 | $ 2,080,800 | $ 6,700,000 | $ 24,770,000 | $ - | $ 6,700,000 |
| 2025 | Max Summer Direct Use | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 42-inch 930 PZ Parallel Pipeline | 2300 lf | $ 860 | $ 1,978,000 | $ 890,100 | $ 2,870,000 | $ 27,640,000 | $ - | $ 2,870,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-4 1158 PZ PS Capacity Upgrades | 1 LS | $ 950,000 | $ 950,000 | $ 427,500 | $ 1,380,000 | $ 29,020,000 | $ - | $ 1,380,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 PZ PS Capacity Upgrades | 1 LS | $ 800,000 | $ 800,000 | $ 360,000 | $ 1,160,000 | $ 30,180,000 | $ - | $ 1,160,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | CCWRF PS Capacity Upgrades | 1 LS | $ 600,000 | $ 600,000 | $ 270,000 | $ 870,000 | $ 31,050,000 | $ - | $ 870,000 |
| | | | | | | **Year 2025 Improvement Costs** | | **$ 17,970,000** | **$ 31,050,000** | **$ -** | **$ 17,970,000** |
| 2030 | Max Summer Direct Use | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Ave. | 1680 lf | $ 590 | $ 991,200 | $ 446,040 | $ 1,440,000 | $ 32,490,000 | $ - | $ 1,440,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 lf | $ 420 | $ 13,356,000 | $ 6,010,200 | $ 19,370,000 | $ 51,860,000 | $ - | $ 19,370,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 MG | $ 1.50 | $ 7,500,000 | $ 3,375,000 | $ 10,880,000 | $ 62,740,000 | $ - | $ 10,880,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 LS | $1,800,000 | $ 1,800,000 | $ 810,000 | $ 2,610,000 | $ 65,350,000 | $ - | $ 2,610,000 |
| | | | | | | **Year 2030 Improvement Costs** | | **$ 34,300,000** | **$ 65,350,000** | **$ -** | **$ 34,300,000** |
| 2035 | Max Summer Direct Use | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 MG | $ 1.75 | $ 5,250,000 | $ 2,362,500 | $ 7,610,000 | $ 72,960,000 | $ - | $ 7,610,000 |
| 2035 | Max Summer Direct Use | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 74,410,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 lf | $ 340 | $ 680,000 | $ 306,000 | $ 990,000 | $ 75,400,000 | $ - | $ 990,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 76,850,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 LS | $ 700,000 | $ 700,000 | $ 315,000 | $ 1,020,000 | $ 77,870,000 | $ - | $ 1,020,000 |
| | | | | | | **Year 2035 Improvement Costs** | | **$ 12,520,000** | **$ 77,870,000** | **$ -** | **$ 12,520,000** |
| | | | | | | **Total Program Improvement Costs** | | **$ 77,870,000** | | **$ 6,860,000** | **$ 71,010,000** |




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# IEUA RWPS
## Recommended Recycled Water System Improvements

FIGURE 8-1

## 8.2 SUMMARY OF RECOMMENDED PROJECT COSTS

Table 8.3 summarizes the project costs estimated for each planning year horizon based on the recommended improvements.

**Table 8.3 Total Project Cost Summary**

| Planning Year | Construction Costs | Contingency/ Admin/Eng.[1] | Total Project Costs |
|---|---|---|---|
| Year 2020 | $ 9,014,725 | $ 4,056,626 | $ 13,080,000 |
| Year 2025 | $ 12,392,025 | $ 5,576,411 | $ 17,970,000 |
| Year 2030 | $ 23,647,200 | $ 10,641,240 | $ 34,300,000 |
| Year 2035 | $ 8,630,000 | $ 3,883,500 | $ 12,520,000 |
| **Total Capital Improvements** | **$ 71,010,000** | | **$ 77,870,000** |

[1] The Contingency/Administration/Engineering costs associated with each of the improvement construction costs is assumed to be 45% of the estimated construction costs.

# 9.0 OPERATIONAL CONTROL STRATEGY

This section provides a description of a proposed general RW program operational control strategy. The general control philosophy provided below can be used as a guidance document to allow the RW program to operate effectively throughout the various seasonal supply and demand fluctuations experience by the RW system. A general control philosophy is provided for each of the 5-year planning periods for the winter, spring/fall, and summer direct use demands and GWR conditions.

## 9.1 WINTER DEMAND CONDITIONS

The winter demand conditions are considered to be the months of December, January, and February.

In general, for each of the planning years, during the winter demand months the RW system will be operated to meet only the direct use demands and the SARBF at Prado Obligation demand. No GWR will occur during these months, as noted previously in this report. If weather conditions are acceptable for GWR during these months, the RW program can be operated to deliver GWR to the basins as determined by the operator.

To maximize the GWR during non-winter months of the year, reuse supply should be used as much as possible to meet the SARBF at Prado Obligation demands as allowed by agreement. For purposes of this study, a maximum of 40% of the annual SARBF at Prado Obligation demand should be met during the winter months.

Winter program operational strategy will be the same for each of the planning years, Year 2020, Year 2025, Year 2030, and Year 2035. The surplus supply from RP-5 will be used as the first priority to meet the SARBF at Prado Obligation during the winter months. The 930 PZ demands will be met by RP-1 930 PS as the first priority and RP-4 will provide primary reuse supply to the upper RW pressure zones.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.

## 9.2 SPRING/FALL DEMAND CONDITIONS

The spring/fall demand conditions include the months of March, April, May, and November.

In general for each of the planning years, the SARBF at Prado Obligation will be met first and then the direct use demands. Based on the mass balance analysis approximately 35% of the total annual SARBF at Prado Obligation will be met during the Spring/Fall months.

The surplus supply from RP-5 and CCWRF should be the first priority to meet the SARBF at Prado Obligation demands. RP-1 should be last priority to maximize reuse supply available to the GWR basins.

The surplus from the RP-1 and RP-4 facilities, after meeting the direct use demands, should be used to supply RW for GWR.

Due to the low reuse supply availability during the night from reduced wastewater flows and the peak direct use demand period, limited reuse supply will be available for GWR. This typically occurs during a 12 hour nighttime period from 9 pm to 9 am. Therefore, GWR flows to the basin should be met during the 12-hour period outside of peak direct use demands.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.

## 9.3 SUMMER DEMAND CONDITIONS

The summer demand conditions are considered to be the months between June and October.

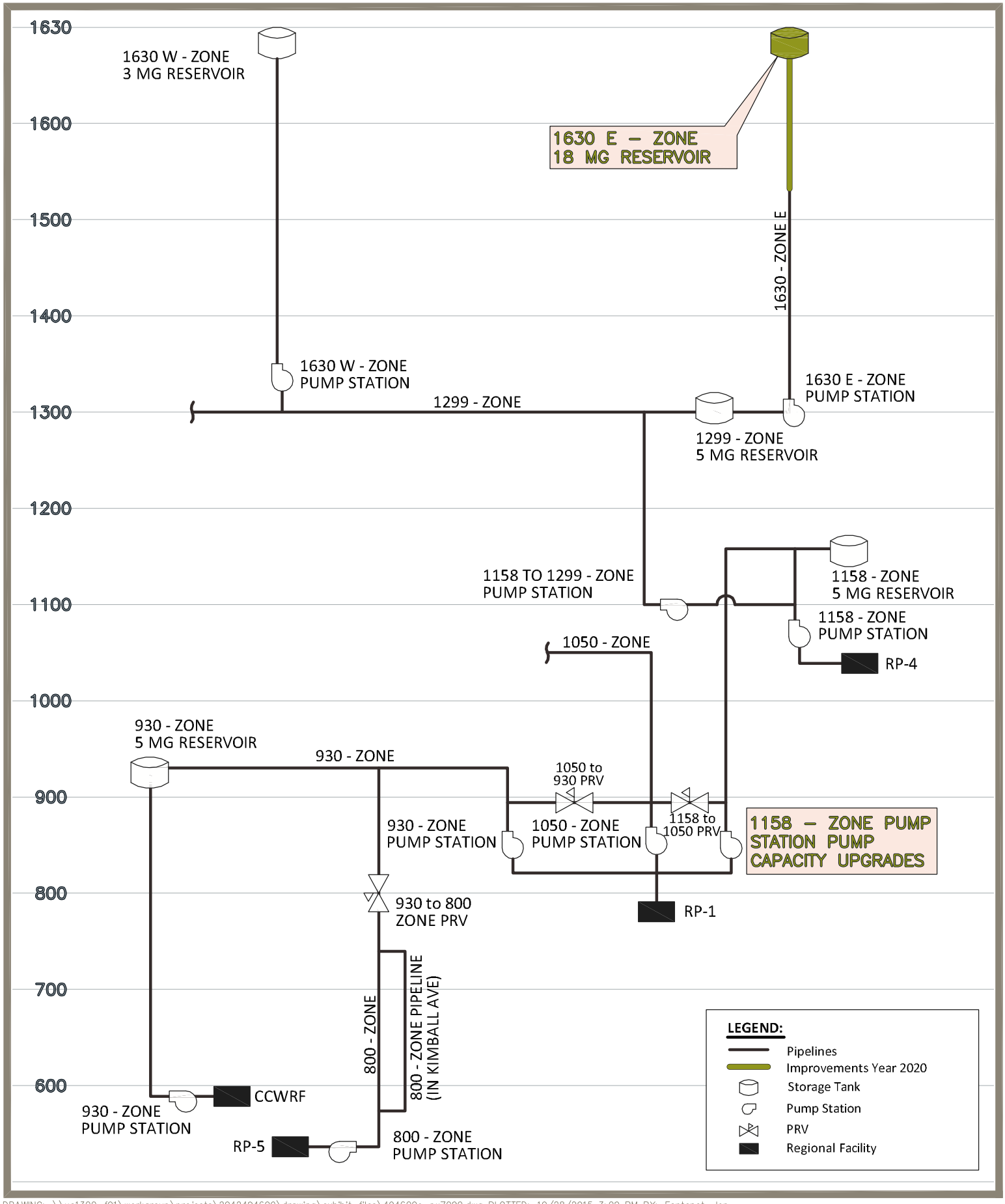
For each of the planning years, the direct use demands will be met first. For purposes of this study, approximately 25% of the total annual SARBF at Prado Obligation demand should be met during the summer months.

The surplus supply from the Southern Service Area from RP-5 and CCWRF will be the first priority to meet the SARBF at Prado Obligation demands up to only 24%. The minimum flow to SARBF at Prado Obligation is 3.5 MGD.

The surplus from the RP-1 and RP-4 facilities, after meeting the direct use demand needs and supplementing the SARBF at Prado Obligation, is used to supply GWR to the existing and proposed groundwater basins. Due to the increase in direct use demands during the summer months, the GWR flows are reduced so that the reuse supply available from the treatment facilities is not exceeded.

Due to the low flow periods during the night from the wastewater supply, and the peak direct use demands during this same period, the GWR flows to the basin are met during a 12-hour period during the day.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.




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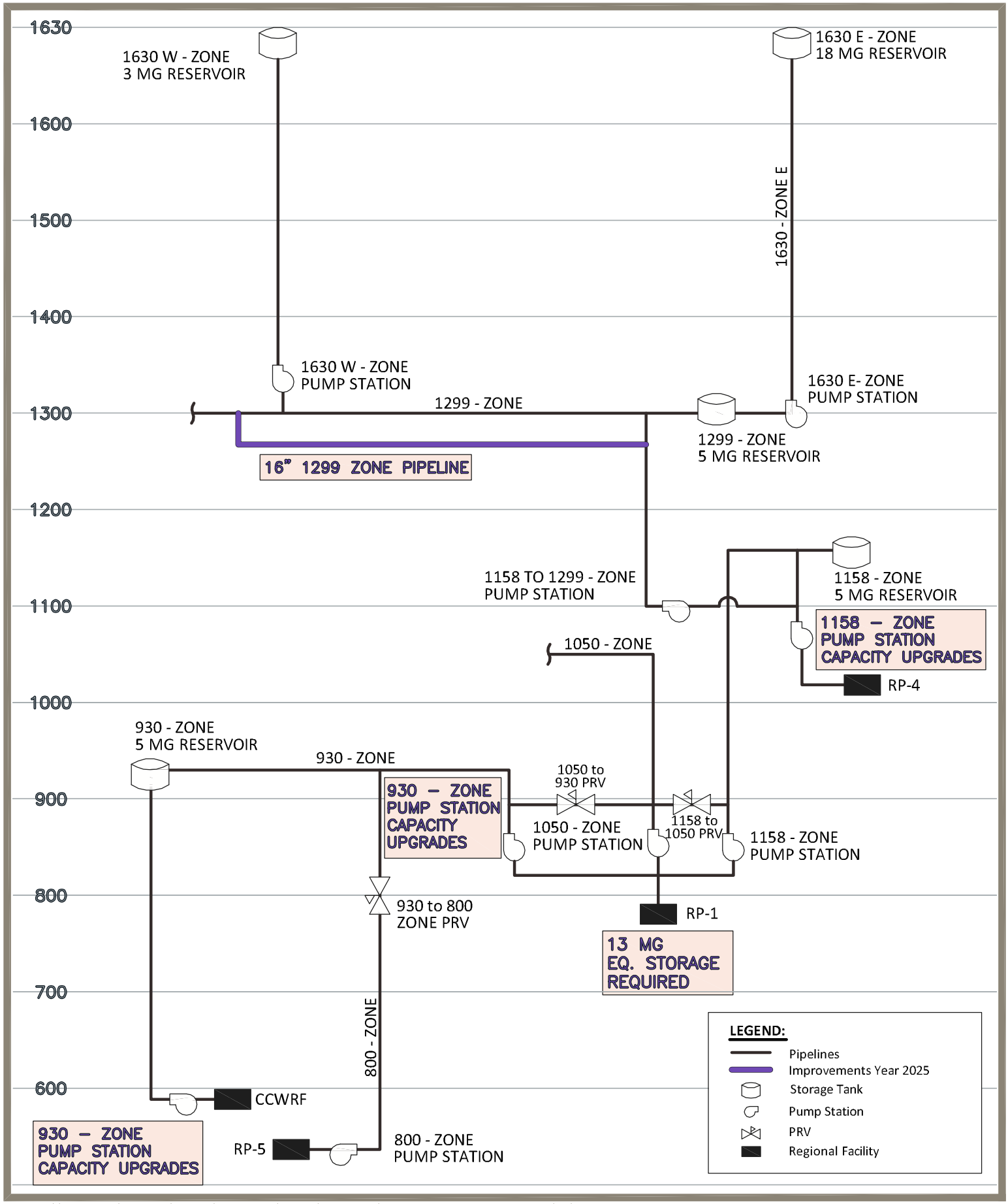
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# IEUA RWPS
## Year 2020 System Profile

FIGURE 9-1




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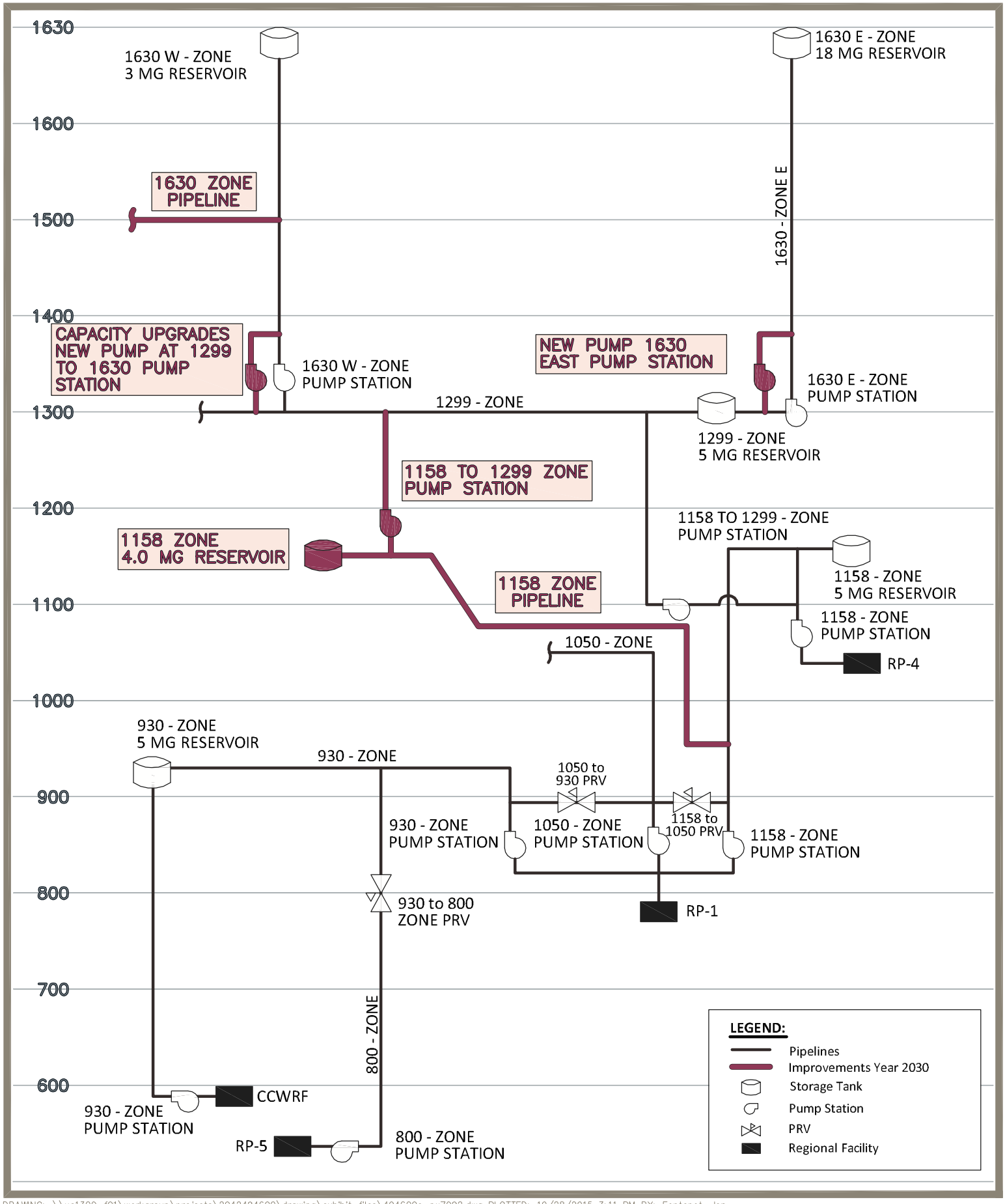
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# IEUA RWPS
# Year 2025 System Profile

FIGURE 9-2




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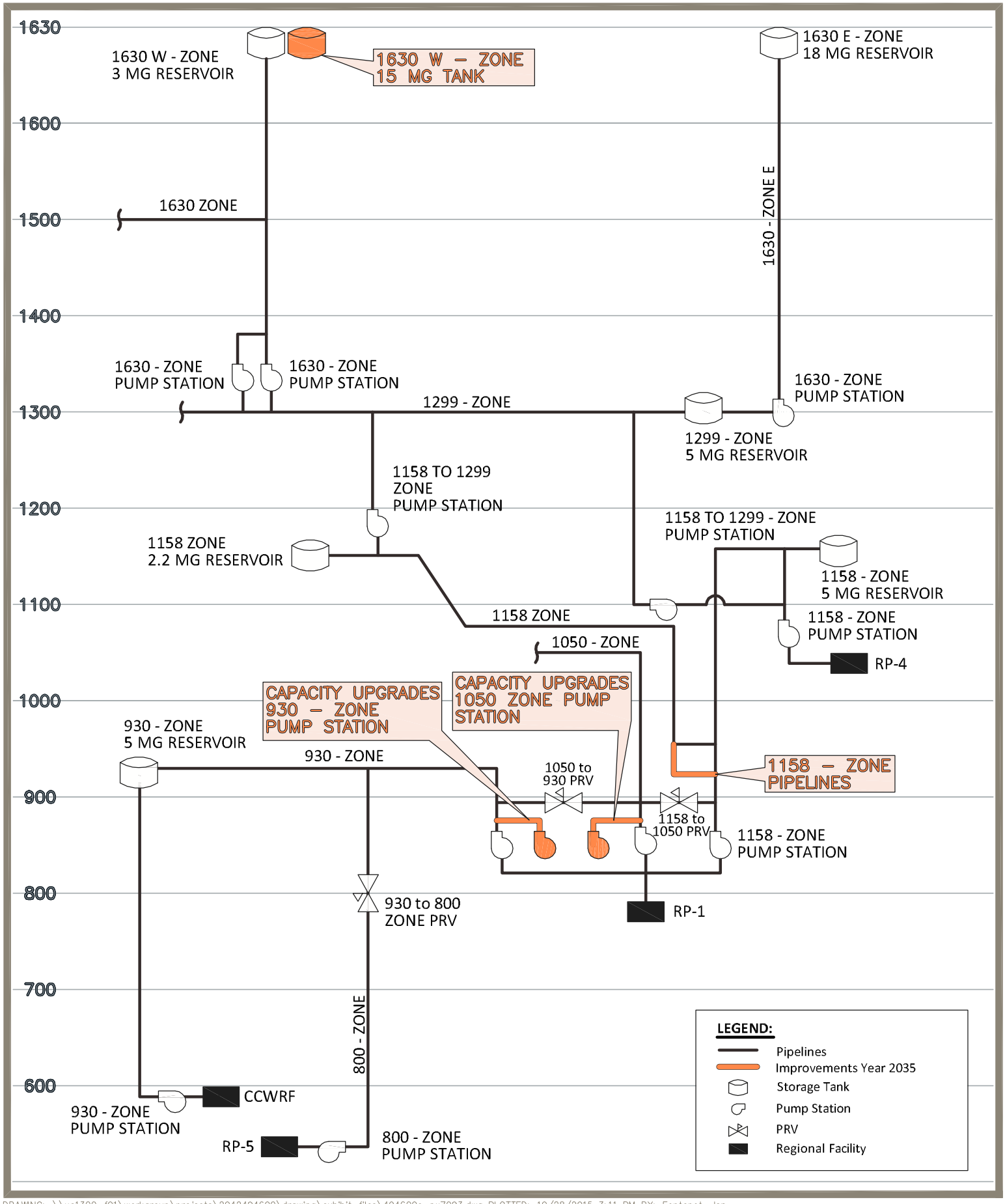
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# IEUA RWPS
## Year 2030 System Profile

FIGURE 9-3




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# IEUA RWPS
# Year 2035 System Profile

FIGURE 9-4

# Appendix A

"*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*", December 2013

ARCADIS Design & Consultancy for natural and built assets

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

wfa
Water Facilities Authority

# 2015
# URBAN WATER MANAGEMENT PLAN

FINAL

June 2016

# 2015 URBAN WATER MANAGEMENT PLAN

## FINAL

## FINAL




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June 2016

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H IEUA 2014 Wastewater Facilities Master Plan

I Regional Alliance SB X7-7 Calculations

J MWD Demand Model Projections

K IEUA Drought Plan

L Retail Agency Drought Plans

M WFA Contingency Operations Plan

N Land Use Based Demand Model Development Tech Memo

O Water Loss Audit

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 20x2020 | 20 percent reduction in urban water use by year 2020 |
| Act | Urban Water Management Planning Act |
| AF | Acre-Feet |
| AFY | Acre-Feet per Year |
| AWE | Alliance for Water Efficiency |
| AWWA | American Water Works Association |
| BMP | Best Management Practice |
| CARL | Current Annual Real Losses |
| CBFIP | Chino Basin Facilities Improvement Program |
| CBWCD | Chino Basin Water Conservation District |
| CBWM | Chino Basin Watermaster |
| CCWRF | Carbon Canyon Water Recycling Facility |
| CDA | Chino Basin Desalter Authority |
| CDP | Climate Disclosure Project |
| CFS | Cubic Feet per Second |
| Chino Basin | Chino Groundwater Basin |
| CII | Commercial/Industrial/Institutional |
| COPC | Constituents of Potential Concern |
| CRA | Colorado River Aqueduct |
| CUP | Conjunctive Use Program |
| CUWCC | California Urban Water Conservation Council |
| CVWD | Cucamonga Valley Water District |
| DDW | Division of Drinking Water |
| DMM | Demand Management Measure |
| DVL | Diamond Valley Lake |
| DWR | Department of Water Resources |
| DYY | Dry Year Yield |
| FTE | Full Time Employee |
| FWC | Fontana Water Company |
| FY | Fiscal Year |
| GIS | Geographic Information Systems |
| GPCD | Gallons per Capita per Day |
| GPF | Gallons per Flush |
| GPM | Gallons per Minute |
| GHG | Greenhouse Gas |
| Handbook | Climate Change Handbook for Regional Water Planning |
| HECW | High Efficiency Clothes Washer |
| HEN | High Efficiency Sprinkler Nozzle |

| | |
|---|---|
| HET | High Efficiency Toilet |
| HEU | High Efficiency Urinal |
| IEBL | Inland Empire Brine Line |
| IELA | Inland Empire Landscape Alliance |
| IEUA | Inland Empire Utilities Agency |
| ILI | Infrastructure Leakage Index |
| IPCC | Intergovernmental Panel on Climate Change |
| IRP | Integrated Water Resource Plan |
| IWA | International Water Association |
| JPA | Joint Powers Authority |
| kWh | Kilowatt Hour |
| LEAP | Landscape Evaluation and Audit Program |
| LID | Low Impact Development |
| LRP | Local Resources Program |
| LUD | Land Use Unit Demands |
| MEU | Meter Equivalent Unit |
| M&I | Municipal and Industrial |
| MAF | Million Acre-Feet |
| MCL | Maximum Contaminant Level |
| MWD | Metropolitan Water District of Southern California |
| MNWD | Moulton Niguel Water District |
| MG | Million Gallon |
| MGD | Million Gallons per Day |
| MOU | Memorandum of Understanding Regarding Urban Water Conservation |
| MWELO | Model Water Efficiency Landscape Ordinance |
| MVWD | Monte Vista Water District |
| NIMS | National Incident Management System |
| NPDES | National Pollution Discharge Elimination System |
| NTC | National Theatre for Children |
| NL | Notification Level |
| NO. | Number |
| NRDC | Natural Resources Defense Council |
| NRWS | Non-reclaimable Wastewater System |
| OBMP | Chino Basin Optimum Basin Management Program |
| OCSD | Orange County Sanitation District |
| OSY | Operating Safe Yield |
| Plan | Water Quality Control Plan |
| PSI | Pounds per Square Inch |
| RO | Reverse Osmosis |
| RP-1 | Regional Water Recycling Plant #1 |

| | |
|---|---|
| RP-2 | Regional Water Recycling Plant #2 |
| RP-4 | Regional Water Recycling Plant #4 |
| RP-5 | Regional Water Recycling Plant #5 |
| RTP-SCAB | Regional Transport Plan of Southern California Association of Governments |
| RTS | Readiness-to-Serve |
| RWIP | Recycled Water Implementation Plan |
| RWPS | Recycled Water Program Strategy |
| RWRP | Regional Water Recycling Plant |
| SANDAG | San Diego Association of Governments |
| SARWQCB | Santa Ana Regional Water Quality Control Board |
| SAWCO | San Antonio Water Company |
| SAWPA | Santa Ana Watershed Project Authority |
| SB | Senate Bill |
| SBCFCD | San Bernardino County Flood Control District |
| SB X7-7 | Senate Bill 7 as part of the Seventh Extraordinary Session |
| SCAB | South Coast Air Basin |
| SCAG | Southern California Association of Governments |
| STT | Shows that Teach |
| SWP | State Water Project |
| SWRCB | California State Water Resources Control Board |
| TDS | Total Dissolved Solids |
| TYCIP | Ten Year Capital Improvement Plan |
| UARL | Unavoidable Annual Real Losses |
| ULFT | Ultra-Low Flow Toilets |
| USBR | United States Bureau of Reclamation |
| UWMP | Urban Water Management Plan |
| VOC | Volatile Organic Compound |
| WBIC | Weather Based Irrigation Controller |
| WEWAC | Water Education Water Awareness Committee |
| WFA | Water Facilities Authority |
| WSAP | Water Supply Allocation Plan |
| WSDM | Water Surplus and Drought Management |
| WUE | Water Use Efficiency |

# 1 INTRODUCTION

The Inland Empire Utilities Agency (IEUA) is a wholesale supplier of imported water from Metropolitan Water District of Southern California (MWD) and a regional wastewater treatment agency. IEUA is focused on providing four key services: 1) treating wastewater; 2) developing recycled water, local water resources, and water use efficiency programs that will reduce the region's dependence on imported water supplies and drought-proof the service area; 3) converting biosolids and waste products into a high-quality compost made from recycled materials; and 4) generating electrical energy from renewable sources. Since its formation in 1950 as an agency to supply supplemental imported water from MWD, IEUA has expanded to become a major provider of recycled water, a supplier of biosolids/compost materials, as well as continuing its leading role in water quality management and environmental protection in the Inland Empire.

IEUA provides wholesale imported water to seven retail agencies including, the Cities of Chino, Chino Hills, Ontario, and Upland, Cucamonga Valley Water District (CVWD) in the City of Rancho Cucamonga, Fontana Water Company (FWC) in the City of Fontana, and Monte Vista Water District (MVWD) in the City of Montclair. IEUA purchases only untreated imported water from MWD. Two of IEUA's retail water agencies (FWC and CVWD) provide their own treatment. Five of IEUA's retail water agencies purchase treated water from the Water Facilities Authority (WFA). WFA purchases untreated imported water from IEUA, treats and delivers the water to the cities of Chino, Chino Hills, Ontario, Upland, and MVWD. IEUA also provides wastewater services to seven contracting agencies under the Chino Basin Regional Sewage Service Contract including, the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Upland, and CVWD. IEUA and WFA's service area boundaries are illustrated in Figure 1-1 and the relationship between MWD, IEUA, WFA, and their retail agencies are shown in Figure 1-2.

Between 2013 and 2016, IEUA collaborated with its retail agencies to develop an Integrated Water Resources Plan (IRP) and a regional Water Use Efficiency Business Plan update. These two foundational planning documents together with IEUA's 2015 Recycled Water Program Strategy and 2015 Energy Management Plan, lay out the region's plan for ensuring reliable, cost-effective, and environmentally responsible water supplies for the next 25 years. It is IEUA's goal to capture these previous efforts and to incorporate the new regional vision into this 2015 Urban Water Management Plan (UWMP).

In line with IEUA's goals towards regional resiliency and sustainability, this 2015 UWMP includes an evaluation of the water energy intensity of IEUA's operations and an assessment of climate change vulnerability impacts on the region's supply portfolio. The water resources management strategies detailed in this 2015 UWMP illustrate that despite past periods of extraordinary growth and prolonged drought, the region is well positioned to ensure adequate water supplies, reduce dependence on imported supplies and increase drought resilient water sources, while addressing water quality management challenges. This 2015 Regional UWMP is reflective of IEUA's holistic water resources management strategies to prepare for future uncertainty and to ensure sufficient water resources for the region.

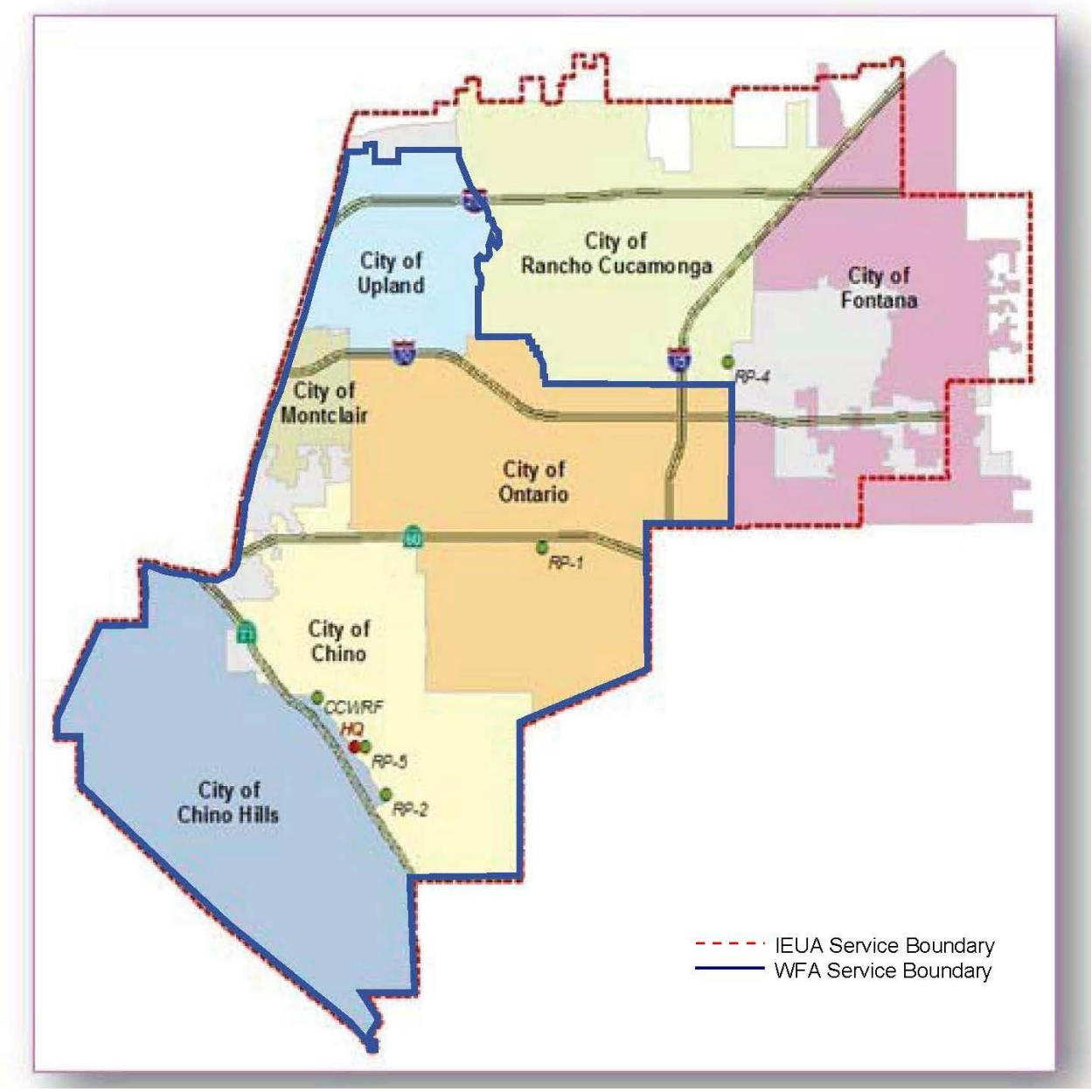



**Figure 1-1: IEUA and WFA's Service Area Boundaries**

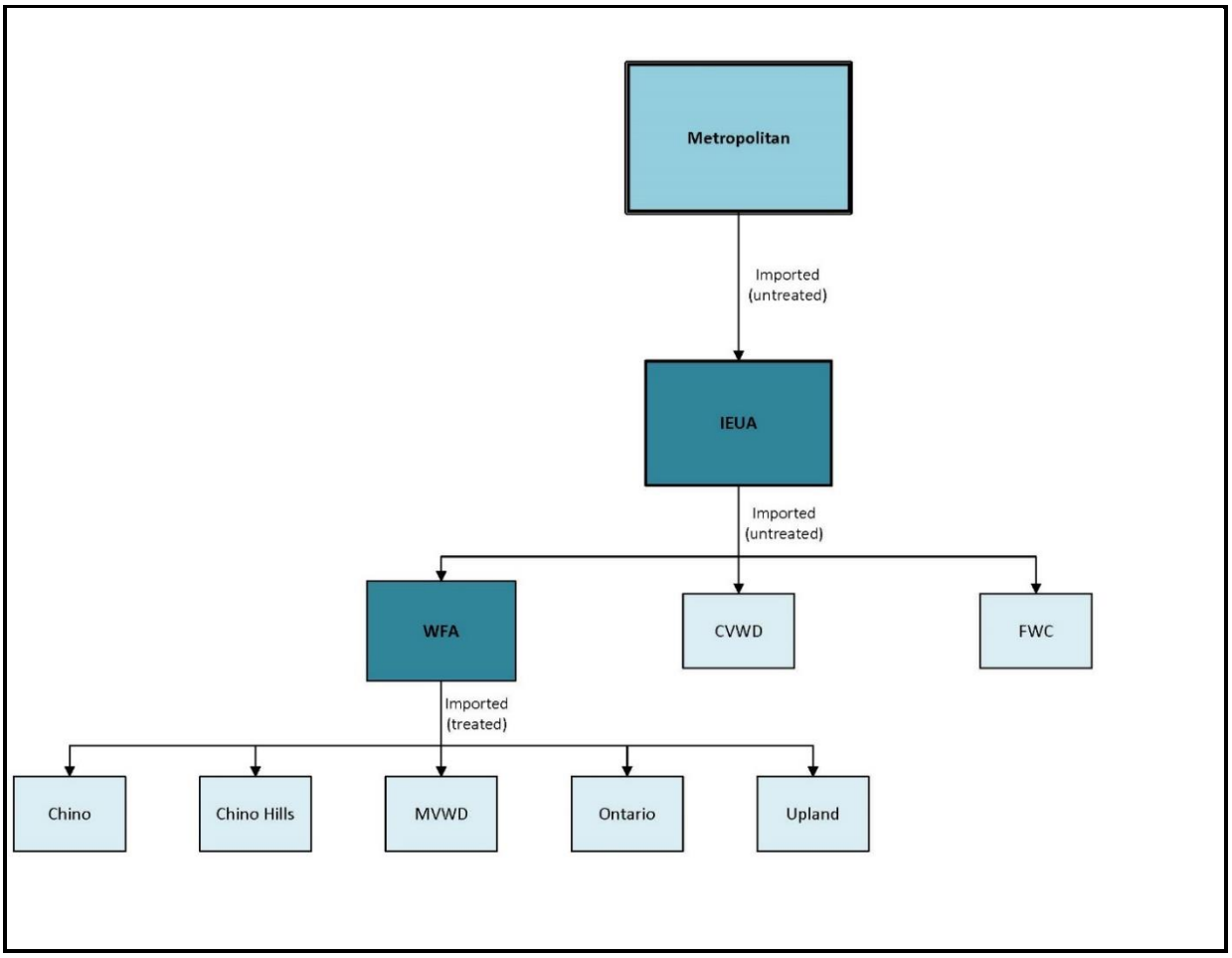



**Figure 1-2: Relationship between MWD, IEUA, WFA, and Their Retail Agencies**

## 1.1 Urban Water Management Plan Requirements

This 2015 Regional UWMP has been prepared consistent with the State of California Water Code Sections 10610 through 10656, known as the Urban Water Management Planning Act (Act). Originally enacted in 1983, the Act requires every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an UWMP with the California Department of Water Resources (DWR) every five years in the years ending in zero and five. The 2015 UWMP updates are due to DWR by July 1, 2016.

A UWMP must provide water supply planning for a 20-year planning period in five-year increments and identifies water supplies needed to meet existing and future demands. It must include an assessment of supply reliability under three hydrologic conditions: a normal year, a single-dry year, and multiple-dry years and includes a discussion of:

- Plan Preparation

- System Description
- System Water Use
- System Supplies
- Water Supply Reliability Assessment
- Water Shortage Contingency Planning
- Demand Management Measures
- Plan Adoption and Implementation

Since the original Act's passage in 1983, several amendments have been made. A significant change in 2010 was the passage of the Water Conservation Act of 2009 also known as Senate Bill (SB) 7 as part of the Seventh Extraordinary Session (SB X7-7) stemmed from Governor Schwarzenegger's goal to achieve a 20 percent statewide reduction in urban per capita water use by 2020 (20x2020). SB X7-7 requires each urban retail water supplier to develop urban water use targets to achieve the 20 percent reduction goal by 2020 and an interim ten percent goal by 2015. Wholesale water suppliers are not required to establish reduction targets but are required to include an assessment of present and proposed future measures, programs, and policies that would help their region achieve the reduction.

The most recent amendment made to the UWMP requirements is set forth by SB 1420 approved on September 19, 2014. SB 1420 - Distribution System Water Losses requires water purveyors who own a water distribution system to quantify distribution system losses for the most recent 12-month period available based on the water system balance methodology developed by the American Water Works Association (AWWA).

## 1.2 IEUA and WFA 2015 UWMP Preparation

This 2015 Regional UWMP is an update of IEUA and WFA's 2010 UWMPs. In previous years, IEUA and WFA prepared separate UWMP documents where WFA's UWMP was a companion document to the IEUA UWMP. WFA is a wholesale supplier of imported water (State Water Project water) purchased from MWD via IEUA. WFA provides services to five retail agencies that are encompassed within IEUA's service area, including the cities of Chino, Chino Hills, Ontario, and Upland, and MVWD. Because of this overlap, IEUA and WFA prepared a synergistic planning document i.e. one UWMP that is inclusive of IEUA and WFA that represents a regional perspective.

While this 2015 Regional UWMP provides water demand, water supply, and supply reliability assessment for the entire IEUA region consistent with IEUA's IRP, all requirements of the California Water Code for each of IEUA's member agencies will be met through each retail agency's individual 2015 UWMP. Additionally, IEUA formed a regional alliance consisting of all of its retail agencies to comply with SB X7-7 goals. Table 1-1 identifies this as a regional UWMP prepared collaboratively by IEUA and WFA. Table 1-2 indicates that IEUA and WFA are wholesale suppliers.

**Table 1-1: Plan Identification**

| Plan Identification | | | |
|---|---|---|---|
| **Select Only One** | **Type of Plan** | | **Name of RUWMP or Regional Alliance** |
| ☐ | **Individual UWMP** | | |
| | ☐ | Water Supplier is also a member of a RUWMP | |
| | ☐ | Water Supplier is also a member of a Regional Alliance | |
| ☑ | **Regional Urban Water Management Plan (RUWMP)** | | IEUA |
| NOTES: This UWMP covers the Inland Empire Utilities Agency (IEUA) and the Water Facilities Authority (WFA) | | | |

**Table 1-2: Agency Information**

| Agency Identification | |
|---|---|
| Type of Agency | |
| ☑ | Agency is a wholesaler |
| ☐ | Agency is a retailer |
| Fiscal or Calendar Year | |
| ☐ | UWMP Tables Are in Calendar Years |
| ☑ | UWMP Tables Are in Fiscal Years |
| If Using Fiscal Years Provide Month and Date that the Fiscal Year Begins (mm/dd) | |
| *07/01* | |
| Units of Measure Used in UWMP | |
| Unit | AF |
| NOTES: This agency identification table applies to both IEUA and the WFA. | |

## 1.3 2015 UWMP Organization

The content presented in this UWMP correspond to the outline of the Act, specifically Article 2, Contents of Plans, which correspond to the California Water Code Sections 10631, 10632, and 10633. The organization of the report slightly differs from the DWR UWMP Guidebook's organization in order to reflect the unique characteristics of IEUA's and WFA's systems as well as to be as consistent as possible with IEUA's IRP and Water Use Efficiency Business Plan. This UWMP is organized as follows:

- Section 1 – Introduction
- Section 2 – Water Demands
- Section 3 – Water Sources and Supply Reliability
- Section 4 – Water Use Efficiency Program
- Section 5 – Water Shortage Contingency Plan
- Section 6 – Recycled Water
- Section 7 – Future Water Supply Projects and Programs
- Section 8 – Climate Change Vulnerability Assessment
- Section 9 – Voluntary Reporting of Energy Intensity
- Section 10 – UWMP Adoption Process

The UWMP Checklist has been completed, which identifies the location of the Act requirements in this UWMP and is included in Appendix A.

## 1.4 IEUA System Description

IEUA was formed as a municipal water district by popular vote of its residents in June 1950 to become a member agency of the MWD for the purpose of importing water to its retail agencies. IEUA has significantly expanded its water and wastewater utility services since 1950 to also include wastewater treatment, recycled water production and distribution, co-composting of green waste and municipal biosolids, desalination of brackish water, and disposal of non-reclaimable industrial wastewater and brine.

IEUA is governed by a five-member Board of Directors. Each Director is publicly elected for a four year term and represents one of the five divisions:

- Division 1 – Upland, Montclair, portion of Ontario, and portion of Rancho Cucamonga.
- Division 2 – Ontario, portion of Chino, and portion of Fontana.
- Division 3 – Chino and Chino Hills
- Division 4 – Fontana, portion of Rialto, and portion of Bloomington.
- Division 5 – Rancho Cucamonga and portion of Fontana.

Current Board members are:

- Terry Catlin – President, Division 1 (Upland/Montclair)
- Michael Camacho – Vice President, Division 5 (Rancho Cucamonga)
- Steven J. Elie – Secretary/Treasurer, Division 3 (Chino/Chino Hills)
- Gene Koopman – Director, Division 2 (Ontario)
- Jasmin A. Hall – Director, Division 4 (Fontana)

IEUA owns and operates four regional water recycling plants in its service area: Regional Water Recycling Plant Number (No.) 1, Regional Water Recycling Plant No. 4, Regional Water Recycling Plant No. 5, and the Carbon Canyon Water Recycling Facility. IEUA's regional recycled water plants produce disinfected, tertiary treated recycled water in compliance with California's Title 22 regulations. Wastewater is collected with regional wastewater interceptors and two non-reclaimable wastewater pipeline systems. Biosolids produced at the water recycling plants are handled by three facilities: Regional Water Recycling Plant No. 1 Solids Handling Facility, Regional Water Recycling Plant No. 2 Solids Handling Facility, and the Inland Empire Regional Composting Facility. Regional Water Recycling Plant No. 5 can also handle solids and is leased to a private enterprise for biogas energy production from food or dairy waste. IEUA owns and operates sewer lines and recycled water pipelines. The recycled water systems include pump stations, reservoirs, and pressure regulating stations to serve numerous pressure zones.

IEUA also operates groundwater recharge facilities in cooperation with the Chino Basin Watermaster (CBWM), San Bernardino County Flood Control District (SBCFCD), and the Chino Basin Water Conservation District. The Chino I Desalter is managed by IEUA under an agreement with the Chino Basin Desalter Authority (CDA).

### 1.4.1 IEUA Service Area

IEUA provides a number of services for the southwestern section of San Bernardino County in the Santa Ana River Watershed. The IEUA service area overlies almost entirely the Chino Groundwater Basin (Chino Basin). The 242-square mile service area encompasses the Chino Basin that consists of a relatively flat alluvial valley from east to west and slopes from north to south at a one to two percent grade. Valley elevation ranges from about 2,000 feet above sea level in the foothills below the San Gabriel Mountains to about 500 feet near Prado Dam.

IEUA's service area population has grown quickly in the past decade and is expected to increase in the future. The region's growth underlies the need for careful water resources planning and management to ensure adequate water supplies and address water quality management problems.

### 1.4.2 IEUA Member Agencies

The IEUA service area consists of the cities of Chino, Chino Hills, Montclair, Upland, Ontario, Rancho Cucamonga, and Fontana, and unincorporated areas within San Bernardino County. There are eight

retail water agencies within IEUA's service area (Table 1-3 and 1-4). Two of IEUA's retail water agencies, (FWC and CVWD) purchase untreated water directly from IEUA and provide their own treatment. Five of IEUA's retail water agencies purchase treated water from WFA. WFA purchases untreated imported water from IEUA, treats and delivers the water to the cities of Chino, Chino Hills, Ontario, Upland, and MVWD. San Antonio Water Company (SAWCO) wholesales surface water from San Antonio Creek and potable groundwater to Upland, Ontario, and irrigation customers.

IEUA also provides wastewater services to seven agencies including, the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Upland, and CVWD in the city of Rancho Cucamonga.

**Table 1-3: IEUA's Retail Member Agencies**

| Agency | Description |
|---|---|
| City of Chino | The City of Chino serves water to a population of approximately 74,000 in the city and some unincorporated areas in San Bernardino County. |
| City of Chino Hills | The City of Chino Hills provides water to a population of approximately 77,600 in the City within its 46 square mile service area that also includes small portions of Chino and Pomona. |
| Cucamonga Valley Water District | CVWD is a retail agency that provides water to approximately 200,460 residents within a 47 square mile area comprised mainly of the City of Rancho Cucamonga. CVWD also provides water to small portions of the cities of Upland, Ontario, Fontana and unincorporated areas of San Bernardino County. |
| Fontana Water Company | Fontana Water Company is a retail investor-owned utility company that provides water to approximately 215,500 residents mainly in the City of Fontana, and also serves portions of the cities of Rancho Cucamonga and Rialto, outside the IEUA service area. |
| Monte Vista Water District | MVWD is a county water district founded in 1927 that provides retail water services to a population of approximately 54,200 in the City of Montclair, portions of the City of Chino, and unincorporated areas of San Bernardino County between Chino, Ontario, and Pomona. MVWD is also a wholesale water supplier to the City of Chino Hills, providing up to 21 MGD of water. |
| City of Ontario | The City of Ontario supplies water to a population of approximately 168,780 in the city and some unincorporated areas of San Bernardino County. The City of Ontario also serves a small portion of the City of Rancho Cucamonga. |
| San Antonio Water Company | San Antonio Water Company is a mutual water company that supplies water to approximately 3,150 residents in the unincorporated area of the City of Upland. |
| City of Upland | The City of Upland encompasses 15 square miles and serves water to approximately 75,790 people. |

**Table 1-4: Water Supplier Information Exchange**

| **Wholesale: Water Supplier Information Exchange** | |
|---|---|
| ☐ | Supplier has informed more than 10 other water suppliers of water supplies available in accordance with CWC 10631. Completion of the table below is optional. If not completed include a list of the water suppliers that were informed. |
| | **Provide page number for location of the list.** |
| ☑ | Supplier has informed 10 or fewer other water suppliers of water supplies available in accordance with CWC 10631. |
| City of Chino | |
| City of Chino Hills | |
| Cucamonga Valley Water District | |
| Fontana Water Company | |
| Monte Vista Water District | |
| City of Ontario | |
| San Antonio Water Company | |
| City of Upland | |
| NOTES: | |

### 1.4.3 IEUA Climate

IEUA is located within the South Coast Air Basin (SCAB) that encompasses all of Orange County and the urban areas of Los Angeles, San Bernardino, and Riverside counties. The SCAB climate is characterized as “Mediterranean” climate with a semi-arid environment with mild winters, warm summers, and moderate rainfall.

### 1.4.4 IEUA Population and Demographics

The IEUA IRP based on the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) projects a population of 856,168 in 2015 for IEUA’s service area with a growth rate of approximately 1.3 percent per year to reach a population of 1,125,203 in 2040.

**Table 1-5: IEUA Population – Current and Projected**

| Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| | 856,168 | 896,533 | 955,569 | 1,009,349 | 1,067,946 | 1,125,203 |
| NOTES: Total population for IEUA service area from IEUA IRP (Appendix D) based on 2012 SCAG RTP including unincorporated area population. | | | | | | |

The IEUA IRP also provided demographics data for the IEUA service area based on 2012 SCAG RTP (Table 1-6). IEUA's service is expected to see an increase in new housing developments and more dense developments within existing communities. Urban employment is also projected to increase.

**Table 1-6: IEUA Demographics – Current and Projected Occupied Housing Units**

| Demographics - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Occupied Housing Units | 246,784 | 262,894 | 279,209 | 295,545 | 311,860 | 329,707 |
| Single Family Units | 170,447 | 178,394 | 187,488 | 197,642 | 207,794 | 218,366 |
| Multi-Family Units | 76,337 | 84,500 | 91,721 | 97,903 | 104,066 | 111,422 |
| NOTES: For IEUA service area from IEUA IRP (Appendix D) based on 2012 SCAG RTP including unincorporated area population. | | | | | | |

## 1.5 WFA System Description

WFA owns and operates the Agua de Lejos Treatment Plant, a conventional surface water treatment facility that treats and disinfects imported water supplies, primarily State Water Project (SWP) water that is purchased from MWD through IEUA. This plant is located in Upland on a sixteen acre site. The plant began operating in 1988 and has a treatment capacity of 81 million gallons per day (MGD). Historical flows through the treatment plant range from 30 to 40 MGD during the peak summer months and can be as low as 12 MGD during winter months.

WFA is guided by a five-member Board of Directors. Each retail agency of WFA appoints, by Resolution of its governing body, one member of its governing body to act as its representative on the Board.

### 1.5.1 WFA Service Area

WFA's service area covers approximately 135 square miles within the upper Santa Ana River watershed. WFA provides services to five retail agencies that are encompassed within IEUA's service area. The service area is located within the boundary of the Chino Basin at the western portion of San Bernardino County as shown on Figure 1-1. This area is an alluvial valley that is relatively flat from east to west and slopes along a north-south grade. The service area is bounded to the north by the San Gabriel Mountains and on the west by the Chino Hills. The principle drainage within the Chino Basin is the Santa Ana River.

### 1.5.2 WFA Member Agencies

WFA provides services to five retail water agencies that are encompassed within IEUA's service area, including the cities of Chino, Chino Hills, Ontario, and Upland, and MVWD as previously listed in Table 1-3.

### 1.5.3 WFA Climate

The WFA service area has the same climatic characteristics as described in Section 1.4.3.

### 1.5.4 WFA Population and Demographics

The population for WFA is projected to increase at the same rate as IEUA's service area. Table 1-7 shows WFA's service area population projections in five-year increments to 2040. The 2015 population shown in Table 1-7 reflects the sum of WFA member agencies estimate based on methods described in Section 4.4.1. In 2015, WFA's population represents 52.6 percent of IEUA's service area population. This percentage was applied to IEUA's population from 2020 to 2040 to obtain WFA's population estimates for those years.

**Table 1-7: WFA Population – Current and Projected**

| Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| | 450,041 | 471,259 | 502,291 | 530,560 | 561,361 | 591,458 |
| NOTES: 2015 population is the sum of 2015 population reported by each of WFA's five retail agencies (estimated using various methods) representing 52.6 percent of IEUA's service area population estimated by 2012 SCAG RTP. Projections assume 52.6 percent for all future years. | | | | | | |

## 1.6 Regional Water Agency Coordination

There are many agencies involved in water management within the Chino Basin. IEUA is working, in cooperation with each of these agencies, to achieve water supply reliability, water quality and watershed management goals for the Santa Ana River Watershed and the Inland Empire.

### 1.6.1 Metropolitan Water District of Southern California

IEUA is a member agency of MWD. MWD is a public agency that provides supplemental imported water from the northern California SWP and the Colorado River Aqueduct (CRA) to 26 member agencies located in the coastal plains of Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura Counties. Nearly 90 percent of the population within these counties, about 19 million people, resides within MWD's 5,200 square mile service area.

As a water wholesaler, MWD has no retail customers. It distributes treated and untreated imported water from the CRA and SWP to its member agencies. MWD provides an average of 50 percent of the municipal, industrial and agricultural water used within its service area. The remaining 50 percent comes from local groundwater, local surface water, recycling, and from the City of Los Angeles' Owen's Valley Aqueduct in the eastern Sierra Nevada.

MWD prepares its own UWMP and IEUA's Regional 2015 UWMP was developed with information provided from MWD's 2015 UWMP (MWD, 2015 Draft UWMP, March 2016). MWD currently provides financial support for local water projects and water conservation projects implemented by its member agencies that increase the reliability of water supplies to the region.

MWD sponsors the Local Resources Program (LRP), established in June 1998, to encourage member agencies to develop and use recycled water and recover groundwater to reduce dependence on imported water supplies. IEUA currently receives financial contributions from MWD from the following programs:

- LRP – MWD made significant improvements to the LRP in October 2014 such as providing three incentive payment structures to choose from: sliding scale incentives up to $340 per AF over 25 years, sliding sale incentives up to $475 per AF over 15 years, or fixed incentives up to $305 per AF over 25 years. MWD funds local projects that seek to identify the best way to meet the region's water needs and provide the greatest return on investment.
- Conservation Credits Program – MWD pays the lesser of one-half the program cost or the equivalent of $195 per AF of water saved through conservation. A variation of this policy provides funding for programs that document water savings.

MWD also provides financial and technical assistance to its member agencies for implementing the water conservation measures, known as Best Management Practices (BMP), contained in the California Urban Water Conservation Council (CUWCC) Best Management Practices Memorandum of Understanding. IEUA currently receives financial contribution from MWD for the following conservation programs:

- Residential SoCal Water Smart Program - MWD sponsors a region-wide program that offers single family residents rebates for high efficiency toilets (HET) and washers, weather based irrigation controllers (WBIC), rotating nozzles, and synthetic turf.

- Enhanced Conservation Program - The Enhanced Conservation Program provides funding directly to MWD member agencies to encourage new and creative approaches to implement urban water conservation.
- California Friendly Landscape Irrigation Efficiency Training - MWD offers classroom and online training to professional landscapers and the residential community.
- Community Partnering Program - MWD provides co-sponsorships to support water-related and education community projects, programs, and events.
- Innovative Conservation Program - The Innovative Conservation Program provides funding for research and development of new and creative ways to conserve water. The participants include public agencies, individuals and organizations.
- California Friendly Model Homes for New Construction - MWD offers financial incentives to builders who incorporate California Friendly features into new southern California homes, which include appliances and irrigation devices.
- Public Sector Program Phase I - MWD provided up-front funding to increase water use efficiency at public facilities through indoor/outdoor water audits, enhanced device incentives, and recycled water hook-ups. Phase II is currently suspended.
- Water Savings Performance Program – MWD provides incentives for customized water process and irrigation system improvements for both large landscape water use efficiency and industrial process improvements.
- Pilot Turf Removal Program - Modeled after IEUA's Water Wise Landscape Rebate Program, this program is currently suspended due to the State economic crisis. May in the future provide $1 per square foot of turf removed for residential and commercial, industrial, and institutional (CII) customers to assist them in reducing outdoor irrigation.

### 1.6.2 Santa Ana Watershed Project Authority

The Santa Ana River Watershed faces enormous challenges as it strives to adapt to changing conditions, many of which are at an unprecedented scale in its modern history. Santa Ana Watershed Project Authority (SAWPA) acts as the Regional Water Management Group and its Mission is to facilitate communication, identify emerging opportunities, develop regional plans, secure funding, implement programs, build projects, and operate and maintain facilities.

IEUA is a member of SAWPA formed in 1972. SAWPA is a Joint Powers Authority (JPA) that coordinates regional planning within the Santa Ana River Watershed to address water quality and supply improvements. SAWPA is comprised of the five major water supply and wastewater management agencies within the Santa Ana Watershed including: IEUA, Eastern Municipal Water District, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District.

Since the early 1970's, SAWPA has played a key role in developing and updating the Regional Basin Plan for the California Regional Water Quality Control Board. SAWPA conducts water-related

investigations and planning studies, and builds facilities needed for regional water supply and water quality remediation.

The “One Water One Watershed” (OWOW) is the Santa Ana River Watershed’s integrated regional water management (IRWM) plan. This plan reflects a collaborative planning process that addresses all aspects of water resources throughout the region and watershed. It includes planning of future water demands and supplies over a 20-year time horizon within the watershed as a hydrologic and interconnected system. The plan represents collaboration across jurisdictions, and political boundaries involving multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. The plan reflects a new suite of innovative approaches that instead of relying solely on continued imported water deliveries to meet growing water demands in the region, is leading with a water demand reduction strategy.

### 1.6.3 Chino Basin Watermaster

IEUA is a member of the CBWM Board of Directors. CBWM was established in 1978 by a judgment entered by the Superior Court of California. The judgment requires that the CBWM develop a management plan for the Chino Groundwater Basin that meets water quality and quantity objectives for the region.

In 1998, CBWM developed an integrated set of water management goals and actions for the Chino Basin known as the Optimum Basin Management Program (OBMP) that describes nine program elements to meet the water quality and local production objectives in the Chino Groundwater Basin (See Section 3.3.2 – Management of the Chino Groundwater Basin). The OBMP encourages the increased use of local supplies to help “drought proof” the Chino Basin.

In July 2000, CBWM adopted the “Peace Agreement” that ended over 15 years of litigation within the Chino Basin. The Peace Agreement outlined the schedule and actions for implementing the OBMP. In December 2007, CBWM adopted the “Peace II Agreement” that redefined the future programs and actions required to implement the OBMP, based on the nine years of experience and accomplishments in implementing the OBMP. Between 2009 and 2010, CBWM updated the Groundwater Recharge Master Plan in response to changes in demand, recharge capacity, safe yield, and other factors. CBWM was required to prepare an update of the Groundwater Recharge Master Plan for the Chino Basin by July 2010 consistent with the Peace II Agreement and court deadline. The updated Groundwater Recharge Master Plan includes an assessment of safe yield changes and a revised safe yield projection as well as identified opportunities for enhanced stormwater, recycled water, and imported water recharge (including low impact development (LID), new recharge projects and integrated stormwater and supplement water facilities).

### 1.6.4 Chino Basin Water Conservation District

The Chino Basin Water Conservation District (CBWCD) was established in 1949 to protect and replenish the Chino Groundwater Basin with rainfall and stormwater runoff from the San Gabriel Mountains. CBWCD uses an extensive system of percolation ponds and spreading grounds to augment the natural

capacity of the region to capture runoff for recharge. CBWCD also promotes water conservation through public education programs. IEUA works closely with the CBWCD. Figure 1-3 is a map of the CBWCD service area.

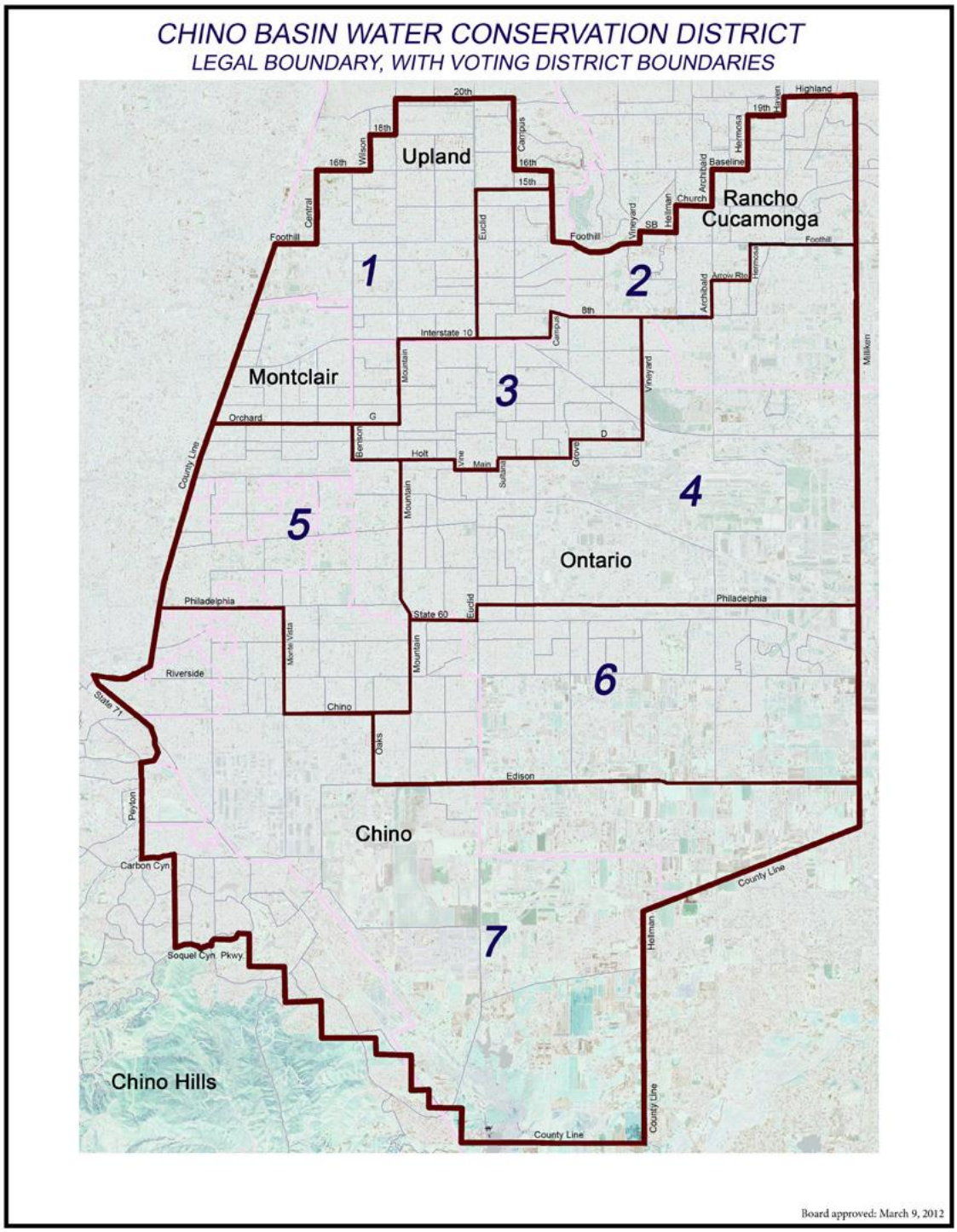



**Figure 1-3: Chino Basin Water Conservation District Boundaries**

### 1.6.5 Santa Ana Regional Water Quality Control Board

The Santa Ana Regional Water Quality Control Board (SARWQCB) is responsible for the development and enforcement of water quality objectives to meet the requirements of the Federal Clean Water Act, California Porter-Cologne Act, and the National Pollution Discharge Elimination System (NPDES).

In 1975, the SARWQCB completed the Water Quality Control Plan (Plan) for the upper portion of the Santa Ana Watershed. The plan outlined specific water quality management actions to address water quality and salt build up, in the form of total dissolved solids (TDS) within the Chino Groundwater Basin. These included the construction of a large well field and desalters in the lower part of the Chino Basin to extract and treat poor quality water, and construction of a pipeline to export brine from the upper Basin to the Orange County Sanitation District (OCSD) Plant 1.

The brine line, previously known as the Santa Ana River Interceptor or SARI line and now known as the Inland Empire Brine Line (IEBL) was built and has been in operation since 1975. The 2000 OBMP by CBWM has been developed to meet the requirements of the 1975 Plan.

### 1.6.6 Chino Basin Desalter Authority

The CDA is a JPA consisting of the cities of Chino, Chino Hills, Norco and Ontario, the Jurupa Community Services District, the Santa Ana River Water Company, Western Municipal Water District, and IEUA. The CDA treats brackish groundwater from the lower Chino Basin with the Chino I and II Desalter facilities along with distribution of drinking water to retail agencies. IEUA operates and maintains the Chino I Desalter while Jurupa Community Services District operates and maintains the Chino II Desalter. These desalter facilities consist of groundwater wells and associated raw water pipelines, treatment facilities, pumps, and water distribution pipelines. Treatment processes include ion exchange and reverse osmosis (RO). Each of the eight retail water entities have agreements to purchase desalted water.

### 1.6.7 San Bernardino County Flood Control District

The SBCFCD is partnering with IEUA, CBWM and CBWCD in implementation of the Chino Basin Groundwater Recharge Master Plan. The implementation is known as Chino Basin Facilities Improvement Program (CBFIP). The CBFIP includes modifications to several SBCFCD basins and flood control channels including the installation of five rubber dams and three drop inlet diversion structures to divert imported, storm and recycled water to 18 groundwater recharge sites.

# 2 WATER DEMANDS

Since the 2010 UWMP update, IEUA's retail agencies have been actively engaged in efforts to comply with SB X7-7 that requires all California retail urban water suppliers serving more than 3,000 acre-feet per year (AFY) or 3,000 service connections to achieve a 20 percent water demand reduction from a historical baseline by 2020. Meeting this target is critical to ensure that agencies are eligible to receive future state water grants and loans. The effort to reduce water use in the IEUA region has also expanded in response to one of the most severe droughts in California's recorded history that was solidified by Governor Brown's Emergency Drought Mandate issued in April 2015. The IEUA Regional Alliance, that comprises all of IEUA's retail agencies, has already met the SB X7-7's 20 percent reduction in urban water use in FY 2014-15.

## 2.1 Overview

### 2.1.1 Water Use Trends

Since the 1990s, approximately 90 percent of the region's water demands have come from urban municipal and industrial (M&I) users with the remaining 10 percent coming from agricultural users. Overall urban water demand since 1995 has increased by approximately 20 percent, despite a regional growth of 30 percent (approximately 200,000 more residents). This is indicative of new water use behaviors, such as efficient irrigation and the use of more efficient indoor fixtures, which prolong the availability of current regional water supplies into the future.

The 2010 UWMP projected total urban demand by the year 2015 to be approximately 272,000 AFY. However, actual demands have grown more slowly, increasing by only 3,000 AF over the past five years from approximately 197,000 AFY in FY2010-11 to 200,000 AFY in FY2014-15. This is due in part to delayed growth as a result of the economic recession, as well as changes in plumbing codes, implementation of water use efficiency programs, and responses to current water supply challenges such as the drought that California has been experiencing since 2012.

The impact of plumbing code changes and the implementation of water use efficiency programs was quantified in the recent 2015 Wastewater Facilities Master Plan flow monitoring. IEUA monitoring of new versus older residential developments showed that urban usage patterns have decreased from a regional indoor flow average of 55 GPCD down to 37 GPCD in new developments. This is consistent with new development trends throughout California (Codes and Standards Research Report: California's Residential Indoor Water Use. May 2015).

These findings suggest that future developments will require less water than in the past, reducing the previous projected regional need for additional water supplies. This shift has significant implications for future wastewater and recycled water planning. Regional treatment plants may not need to be expanded for hydraulic capacity as quickly as previously thought (potentially saving regional capital); however, treatment plants will have to be expanded to treat increased wastewater strength (because there will be

greater concentrations of solids), and future available recycled water supplies may be lower than projected.

### 2.1.2 IEUA IRP and 2015 Regional UWMP Demand Projections

To prepare the region for uncertain climate patterns and to ensure sufficient water resources and adequate infrastructure capacity, IEUA in collaboration with its member agencies developed the comprehensive Integrated Water Resources Plan (IEUA IRP) in 2014-2016. The two key goals of the IEUA IRP are to integrate and update water resources planning documents in a focused, holistic manner, and to develop an implementation strategy that will improve near-term and long-term water resources management for the region. The IEUA IRP evaluates new growth, development, and water demand patterns within the service area and conducts an assessment of water needs and supply source vulnerabilities under climate change.

The IEUA IRP provides aggregated water demand projections for the IEUA region based on an econometric demand forecasting model through 2040. The econometric model incorporates various influences that impact urban water demand such as population, employment, economics, weather, and conservation activities (both passive and active). Regional demographic forecasts are based on the SCAG 2012 Regional Transportation Plan.

To support its planning efforts, IEUA also undertook a land-use based demand model project to augment its IRP process and to ensure consistency with retail member agency demand projections through 2040. The primary objective was to develop a land use based water demand model that disaggregates regional data to the retail member agency level for IEUA's UWMP. The demand projections can be used by IEUA and retail member agencies for any system or supply planning purpose that requires detailed demand estimates and projections, such as conservation savings analyses.

Because the land use based demand projections do not include active conservation as the econometric model did, these estimates should be considered an upper end of future water needs. The land use based model projection of approximately 278,000 AF at 2040 is four percent higher than the high range IRP projection of 266,557 AF in 2040 (Figure 2-1). When savings from current conservation programs and more efficient developments, such as seen in new developments in Chino and Ontario, are factored in, the higher estimates from the land use model are well within the expected range of future demands. Since both models used different methodologies and the resulting projections are within the error range of each other, there is strong confidence in the projection and the models have, in effect, validated both methodologies.

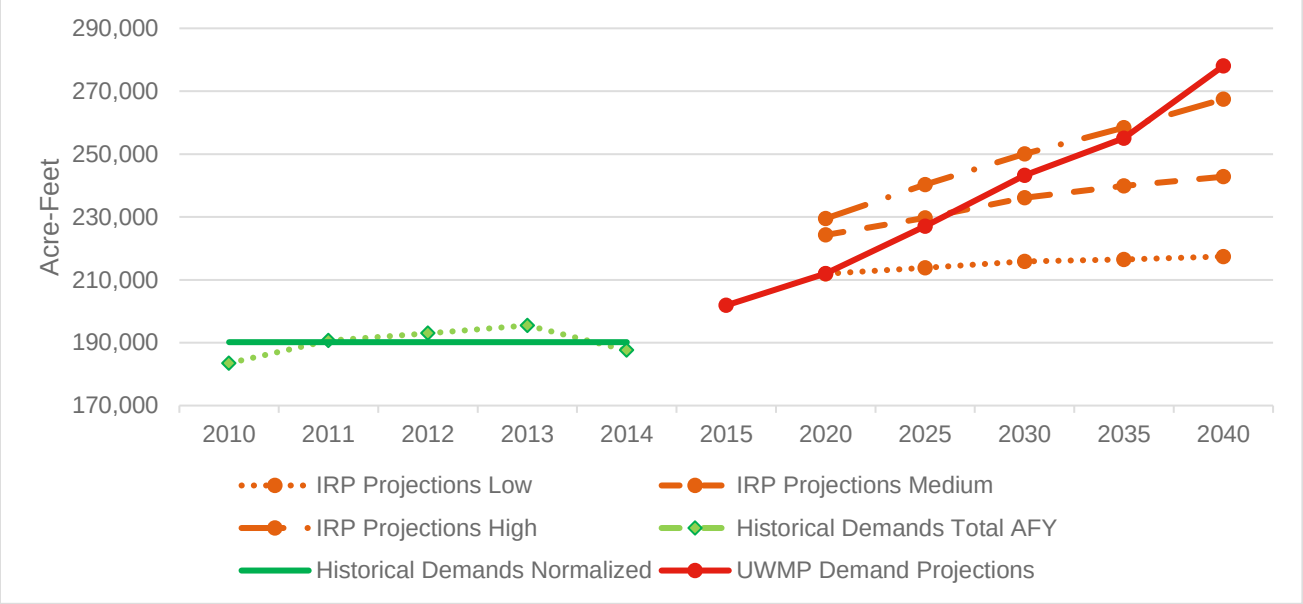



**Figure 2-1: Demand Projection Comparison between IEUA IRP and 2015 UWMP Projections**

The retail agency level demand projections provided by the land use based model can be used by IEUA and retail agencies for any system or supply planning purpose that requires detailed demand estimates and projections, such as conservation savings analyses. IEUA will be using the retail agency level demand projections for the next phase (Phase 2: Implementation and Capital Improvement Program) of its IRP process to develop detailed project level analyses.

## 2.2 Demand Projection Methodology

The methodology used to create the land use based demand model and identify demand projections relied on developing a land use database within a geographic information system (GIS), and determining land use unit demands (LUD). LUDs measure water use on a per acre basis. These water use factors were generated for each IEUA member agency using their billing data and existing land use acreage inventory. The land use projections relied on the use of approved general plans and specifically the land use element and map for vacant lands identified for future development. Adjustment factors were incorporated into the demand model to account for unbilled water, intensification of buildings and uses as land values increase, climate change impacts, and passive conservation savings. The demand model provided demand projections for each member agency separately and for the total IEUA service area in five-year increments to 2040. A detailed description can be found in the Land Use Based Demand Model Development Technical Memorandum (2016).

### 2.2.1 Land Use Trends

When IEUA was formed in 1950 land use within the service area was primarily field crops, citrus, and vineyards and total urban area land use was less than eight percent. Since 1950, urban areas have expanded significantly and replaced many agricultural uses in the northern and central portions of the Chino Basin. Total urban areas comprised 56 percent of the service area in 2015 with agricultural land uses making up about two percent; in addition, there are large areas of open space such as Chino Hills State Park in the service area. The conversion of agricultural land to urban developments is anticipated to continue for land use within the Chino Basin, based on the general plans.

Table 2-1, from the Demand Model development report, presents a summary of acreages of existing and planned land uses within the service area. The future land uses were calculated based on the general plans for each city in the service area using city spheres of influence as boundaries to prevent overlap. Residential land use is expected to have the largest growth projected at 31 percent, industrial land use is projected to grow at 20 percent, while vacant land will decrease 98 percent and agriculture use will decrease by 96 percent. Agricultural lands not identified for urban uses in the respective general plans will remain as agricultural lands.

**Table 2-1: Land Use Projection by Acreage**

| | Acreage Inventory by Year | | | | | |
|---|---|---|---|---|---|---|
| Land Use (du/ac) | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 9,089 | 9,504 | 10,155 | 10,282 | 10,115 | 11,522 |
| Residential Low (3 - 7) | 26,329 | 27,090 | 28,463 | 29,691 | 30,804 | 32,593 |
| Residential Medium (8 - 14) | 3,067 | 3,500 | 3,959 | 4,425 | 4,663 | 5,915 |
| Residential High (15 - 24) | 2,349 | 2,678 | 3,131 | 3,263 | 3,300 | 3,427 |
| Residential Very High (25+) | 231 | 256 | 283 | 408 | 466 | 646 |
| Commercial | 6,838 | 6,925 | 7,180 | 7,994 | 8,456 | 9,221 |
| Industrial | 16,974 | 18,587 | 19,856 | 20,141 | 20,306 | 20,420 |
| Public/Institutional | 2,979 | 2,990 | 3,066 | 3,095 | 3,289 | 3,334 |
| Parks, Schools, Irrigation | 5,629 | 5,687 | 5,657 | 5,890 | 5,963 | 6,154 |
| Agriculture | 2,026 | 1,534 | 1,175 | 630 | 376 | 68 |
| Unique Water Users | 863 | 863 | 852 | 852 | 852 | 852 |
| Non-Irrigated | 34,438 | 34,410 | 35,668 | 35,833 | 35,904 | 36,085 |
| Vacant | 19,724 | 16,512 | 11,090 | 8,032 | 6,042 | 298 |
| **Total** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** |

The greatest acreage increase by 2040 is the largest land use category of low density residential, with an increase of 6,264 acres. The majority of this new low density residential use is attributed to new growth areas in Ontario's New Model Colony and Chino's The Preserve. These lands are currently agricultural lands, but as shown in Table 2-1, agricultural lands designated for future urban uses will decline over time as they are developed.

Medium, high, and very high density residential lands are anticipated to increase at a greater rate (percentage) than very low and low density residential lands. The changes in acreage from 2015 to 2040 listed in Table 2-1 are shown as percent changes in Table 2-2.

Very high density residential lands will increase by 180 percent from 231 acres in 2015 to 646 acres in 2040. This large percentage increase is due to the current low inventory of this category and the significant increase in acres planned for by each city in its general plan. As land values increase, densities tend to increase. The general plans reflect the unique characteristics and policies of each community which are reflected in the water demand projections.

**Table 2-2: Changes in Acreage from 2015 to 2040**

| Land Use (du/ac) | Percent Change |
|---|---|
| Residential Very Low (1 - 2) | 27 |
| Residential Low (3 - 7) | 24 |
| Residential Medium (8 - 14) | 93 |
| Residential High (15 - 24) | 46 |
| Residential Very High (25+) | 180 |
| Commercial | 35 |
| Industrial | 20 |
| Public/Institutional | 12 |
| Parks, Schools, Irrigation | 9 |
| Agriculture | -97 |
| Non-irrigated | 5 |
| Vacant | -98 |

### 2.2.2 Demand Factors

The land use based model accounts for water demand changes over time due to three factors – climate change, intensification, and conservation.

- **Climate Change** – DWR identified that climate change would impact the region by increasing the surface temperature by 5.5 to 10.4 degrees Fahrenheit by the end of the century; increasing frequency, magnitude, and duration of heat waves; and causing longer, drier and more frequent periods of droughts. The land use based model assumed climate change will increase demand by 3.2 percent by 2040.
- **Intensification** - The IEUA service area is still rebounding from the Great Recession and market conditions for the region are noted by economists to be strong with higher employment and higher occupancy rates anticipated. As the region develops, some communities are reaching build out, which is a bit of a misnomer as lands are continually evolving over time, resulting in an "up not out" land use pattern shift. In addition, land values are increasing and are anticipated to increase over the 25 year planning horizon which contributes to higher densities and higher use of existing buildings or lands. All of these conditions result in an intensification of land uses and thus higher water demands on a per acre basis.
- **Conservation** – Conservation savings associated with plumbing code changes and water use efficiency programs were determined in IEUA's 2015 Wastewater Facilities Master Plan. Flow monitoring of older residential developments compared with new home development indicated a reduction of indoor flows from an average of 55 GPCD to 37 GPCD. The land use based model assumed the proportional share of this indoor reduction on total 2040 residential demands to be approximately 2.8 percent.

## 2.3 Regional Water Demands

Regional water demands represent the total demand of all agencies within IEUA's service area over the planning horizon. Total regional demand includes imported water, which is provided by IEUA and WFA, recycled water, groundwater and local surface water. These demands are broken down by retail agency in section 2.3.1 and customer sector in 2.3.2.

### 2.3.1 Demands by Retail Agency

Table 2-3 and Figure 2-2 presents the water demands for the IEUA service area for existing normalized 2015, and projected years 2020, 2025, 2030, 2035, and 2040.

**Table 2-3: IEUA Total Water Demands by Retail Agency (AF)**

| IEUA Retail Agency Demands – Projected | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| City of Chino | 15,744 | 17,135 | 18,579 | 19,951 | 20,844 | 23,271 |
| City of Chino Hills | 16,592 | 18,066 | 19,029 | 20,171 | 20,397 | 22,642 |
| Cucamonga Valley Water District | 50,986 | 54,170 | 57,150 | 58,200 | 59,677 | 60,930 |
| Fontana Water Company | 42,132 | 42,835 | 47,590 | 52,332 | 57,400 | 58,512 |
| Monte Vista Water District | 10,312 | 11,085 | 11,316 | 11,612 | 11,904 | 12,180 |
| City of Ontario | 41,796 | 44,093 | 48,209 | 55,402 | 58,665 | 73,938 |
| San Antonio Water Company | 1,493 | 1,510 | 1,597 | 1,617 | 1,919 | 2,267 |
| City of Upland | 20,647 | 21,694 | 22,453 | 23,447 | 23,915 | 24,277 |
| **Total** | **199,702** | **210,588** | **225,923** | **242,732** | **254,721** | **278,017** |
| NOTES: Water demands for 2015 reflect normalized production demands (including system losses), not actual. The simplified normalization methodology used averaged five years of actual demands to smooth annual fluctuations (FY2010-11 to FY2014-15). 2020 to 2040 projections are from land use based model excluding recycled water for agriculture. | | | | | | |

The above demand values were developed in a land use based model and reviewed by IEUA and its retail agencies. These values represent total demand from each agency that are met through several different supply sources. IEUA's demand data from Table 2-6 and Table 2-7 are incorporated into Table 2-3 above and represent the imported water demands of these eight retail agencies. Recycled water demand for agriculture use is not included in Table 2-3 because it was excluded from the land use based projections.

On Figure 2-2, total IEUA demands are shown using the shaded area and values read from the right vertical axis. The individual member agency demands are shown using different lines and values are reads from the left vertical axis.

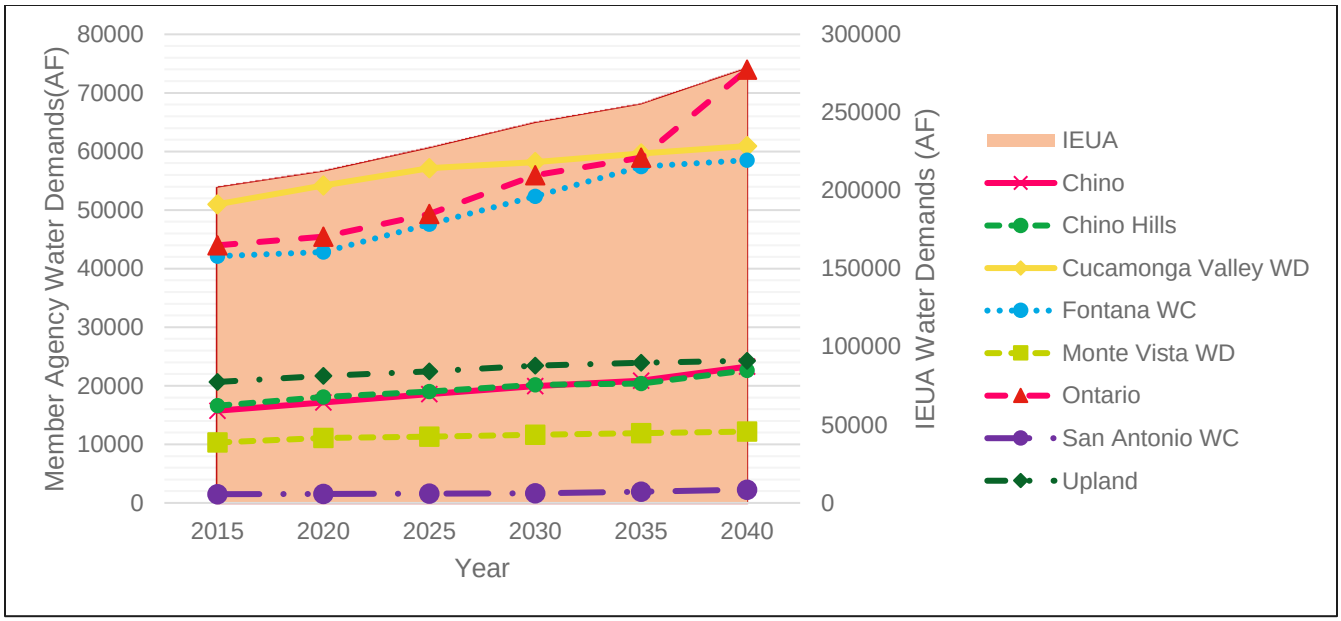



**Figure 2-2: Demand Projection by Member Agency**

As shown on Figure 2-2, total water demands increase gradually between 2015 and 2035 with a slightly steeper curve between 2035 and 2040. The steeper curve in later years is primarily attributed to the large amounts of residential land uses to be developed in Ontario's New Model Colony. Development of this land is anticipated to be at the outer end of the study planning horizon.

### 2.3.2 Demands by Sector

The IEUA regional demands by customer sector are shown in Table 2-4 for the 25-year planning window. This information is from the land use based demand model created for IEUA and its retail agencies, and explained in greater detail above in Section 2.2. Water demands for 2015 presented in Table 2-4 reflect normalized water demands, not actual. The simplified normalization methodology used averaged five years of actual demands to smooth annual fluctuations.

Table 2-5 presents the percentage of total demand for each water use sector or land use designation; this table demonstrates that the largest percent of total demand from the region is residential at about 63 percent. Although agriculture is less than one percent of total demand, it goes from 97 AF to 0 AF over the projected period because these are agricultural lands with a general plan designation for future urban use. Most agricultural lands currently are on individual private wells and, therefore, are not included in the water demands in Table 2-4.

**Table 2-4: IEUA Total Water Demands by Customer Sector (AF)**

| IEUA | Total Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Residential Very Low (<1 - 2) | 15,761 | 16,753 | 18,097 | 18,557 | 18,778 | 21,303 |
| Residential Low (3 - 7) | 73,060 | 75,949 | 80,499 | 84,647 | 88,824 | 94,202 |
| Residential Medium (8 - 14) | 16,012 | 18,376 | 20,967 | 24,117 | 25,806 | 33,264 |
| Residential High (15 - 24) | 18,611 | 21,212 | 25,739 | 27,062 | 27,752 | 28,827 |
| Residential Very High (25+) | 2,634 | 2,904 | 3,300 | 5,105 | 6,009 | 8,292 |
| Commercial | 19,607 | 19,922 | 20,885 | 24,281 | 27,068 | 29,455 |
| Industrial | 6,974 | 7,601 | 8,143 | 8,318 | 8,436 | 8,529 |
| Public/Institutional | 7,285 | 7,354 | 7,627 | 7,746 | 8,138 | 8,257 |
| Parks, Schools, Irrigation | 32,890 | 33,607 | 33,756 | 35,988 | 36,975 | 38,926 |
| Agriculture | 97 | 95 | 70 | 30 | 14 | 0 |
| Unique Water Users | 6,771 | 6,815 | 6,840 | 6,881 | 6,921 | 6,962 |
| **Total** | **199,702** | **210,588** | **225,923** | **242,732** | **254,721** | **278,017** |

NOTE: Water demands for 2015 reflect normalized production demands (including system losses), not actual. The simplified normalization methodology used averaged five years of actual demands to smooth annual fluctuations (FY2010-11 to FY2014-15). 2020 to 2040 projections are from land use based model excluding recycled water for agriculture.

**Table 2-5: IEUA Total Water Demands as Percentages by Customer Sector**

| IEUA | Total Water Demands (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Residential Very Low (<1 - 2) | 8% | 8% | 8% | 8% | 7% | 8% |
| Residential Low (3 - 7) | 37% | 36% | 36% | 35% | 35% | 34% |
| Residential Medium (8 - 14) | 8% | 9% | 9% | 10% | 10% | 12% |
| Residential High (15 - 24) | 9% | 10% | 11% | 11% | 11% | 10% |
| Residential Very High (25+) | 1% | 1% | 1% | 2% | 2% | 3% |
| Commercial | 10% | 9% | 9% | 10% | 11% | 11% |
| Industrial | 3% | 4% | 4% | 3% | 3% | 3% |
| Public/Institutional | 4% | 3% | 3% | 3% | 3% | 3% |
| Parks, Schools, Irrigation | 16% | 16% | 15% | 15% | 15% | 14% |
| Agriculture | 0% | 0% | 0% | 0% | 0% | 0% |
| Unique Water Users | 3% | 3% | 3% | 3% | 3% | 3% |
| **Total** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

## 2.4 IEUA's Water Demands

As a wholesaler, IEUA delivers untreated imported water (State Water Project water) that is purchased from the MWD to WFA, CVWD, and FWC. In FY 2014-2015, IEUA delivered 58,906 AFY of untreated imported supply. Approximately 47 percent of IEUA's imported water demand is from WFA.

**Table 2-6: IEUA Demands for Potable and Raw Water - Actual (AF)**

| Wholesale: Demands for Potable and Raw Water – Actual | | | |
|---|---|---|---|
| Use Type | 2015 Actual | | |
| | Additional Description | Level of Treatment When Delivered | Volume |
| Sales to other agencies | | Raw Water | 58,906 |
| | | **Total** | **58,906** |
| NOTES: Actual FY 2014/15 from IEUA Annual Water Use Report/Database | | | |

### 2.4.1 IEUA's 25 Year Demand Projections

A key component of the 2015 Regional UWMP is to provide insight into the future water demand outlook of the region in addition to IEUA's service area. In FY 2014-15, total water demand for the region (excluding recycled water for agriculture) was 199,702 AFY. Demand is met through a diverse portfolio of groundwater, purchased imported water from MWD, local surface water and recycled water are described in Chapter 3. IEUA, as the regional wholesaler, is responsible for the purchase of imported water supplies.

Table 2-7 below, identifies IEUA's imported water supply to retail member agencies. This amount is IEUA's purchase order for SWP imported water with member agencies. In FY 2015, imported water met 26 percent of total demand. IEUA's retail agencies, and the region as a whole, will aim to decrease their reliance on imported water by pursuing a variety of water use efficiency and conservation strategies (refer to Chapter 3 and 4). Per capita water use is developed in Section 4.4. IEUA will meet demand shortfalls by a diverse portfolio of local supply sources supplemented with imported water from MWD which projects 100 percent reliability (MWD, 2015 UWMP).

**Table 2-7: IEUA Demands for Potable and Raw Water - Projected (AF)**

| Wholesale: Demands for Potable and Raw Water – Projected | | | | | | |
|---|---|---|---|---|---|---|
| Use Type | Additional Description | Projected Water Use | | | | |
| | | 2020 | 2025 | 2030 | 2035 | 2040 |
| Sales to other agencies | | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| **Total** | | **69,752** | **69,752** | **69,752** | **69,752** | **69,752** |
| NOTES: From IEUA IRP baseline projections for imported water. | | | | | | |

## 2.4.2 IEUA's Total Water Demand Projections

The total demand on IEUA for raw, potable, and recycled water is listed below in Table 2-8. Use of recycled water is projected to increase within IEUA's service area. Currently, IEUA meets about a third of total water demands within the region, this number is projected to increase to 50 percent of total demands within the service area by 2040. For additional details on IEUA's Recycled Water Program, please refer to Chapter 6 – Recycled Water.

**Table 2-8: IEUA Total Water Demands (AF)**

| Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Potable and Raw Water | 58,906 | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| Recycled Water Demand | 33,419 | 44,734 | 49,534 | 54,027 | 57,890 | 67,969 |
| **Total** | **92,325** | **114,486** | **119,286** | **123,779** | **127,642** | **137,721** |
| NOTES: 2015 values are FY 2014-15 actuals. Raw imported water projections are from IEUA IRP baseline projection and recycled water projections are derived from IEUA's RWPS (Table 5.4). | | | | | | |

## 2.4.3 IEUA's Sales to Other Agencies

IEUA wholesales untreated imported water to WFA, CVWD, and FWC as shown previously in Figure 1-2.

## 2.5 WFA's Water Demands

WFA purchases raw imported water form MWD through IEUA for treatment at its Agua De Lejos Treatment Plant. The water is then sold to five retail agencies, also within IEUA's service area, to meet potable water demands. For FY 2014-15, WFA's total demand from its retail agencies was 27,606 AFY.

**Table 2-9: WFA Demands for Potable and Raw Water - Actual (AF)**

| Wholesale: Demands for Potable and Raw Water – Actual | | | |
|---|---|---|---|
| Use Type | 2015 Actual | | |
| | Additional Description | Level of Treatment When Delivered | Volume |
| Sales to other agencies | | Potable Water | 27,606 |
| | | **Total** | **27,606** |
| NOTES: IEUA's imported water sales to WFA was 47 percent of its total imported water sales in FY 2014-15. | | | |

### 2.5.1 WFA's 25 Year Demand Projections

A key component of the 2015 UWMP is to provide insight into the region's and WFA's future water demand outlook. Water demand on WFA for FY 2014-15 is 27,606 AFY while the total demand of the five retail agencies WFA serves is 105,091 AFY. Total demand encompasses all supply sources including groundwater, imported water from MWD, local surface water and recycled water. WFA provides potable imported water for its retail agencies. Table 2-10 is a projection of total demand of WFA's five retail agencies for the next 25 years.

**Table 2-10: Total Water Demands for WFA's Retail Agencies (AF)**

| WFA Retail Agency Demands – Projected | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| City of Chino | 15,744 | 17,135 | 18,579 | 19,951 | 20,844 | 23,271 |
| City of Chino Hills | 16,592 | 18,066 | 19,029 | 20,171 | 20,397 | 22,642 |
| Monte Vista Water District | 10,312 | 11,085 | 11,316 | 11,612 | 11,904 | 12,180 |
| City of Ontario | 41,796 | 44,093 | 48,209 | 55,402 | 58,665 | 73,938 |
| City of Upland | 20,647 | 21,694 | 22,453 | 23,447 | 23,915 | 24,277 |
| **Total** | **105,091** | **112,073** | **119,586** | **130,583** | **135,725** | **156,308** |
| Note: From Land Use Based Demand Model Development (Technical Memorandum, Arcadis, May 2016) | | | | | | |

The demand values in Table 2-10 were developed for IEUA, WFA, and its retail agencies in a land use based model as explained above. These values represent total demand for the five retail agencies of WFA, which are also a part of the total demand for IEUA. Demand is met through a diversified supply portfolio for which WFA provides potable water. Recycled water demand for agriculture use is not included in Table 2-10 because it was excluded from the land use based projections.

WFA's projected demands for imported water from IEUA are broken out in Table 2-11 below. In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. A similar proportion is assumed for 2020 to 2040 i.e. the projected WFA demands shown in Table 2-11 are expected to remain 47 percent of IEUA's SWP imported water purchases as shown in Table 2-7.

**Table 2-11: WFA Demands for Potable and Raw Water – Projected (AF)**

| Wholesale: Demands for Potable and Raw Water - Projected | | | | | | |
|---|---|---|---|---|---|---|
| Use Type | Additional Description | Projected Water Use | | | | |
| | | 2020 | 2025 | 2030 | 2035 | 2040 |
| Sales to other agencies | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| **Total** | | **32,783** | **32,783** | **32,783** | **32,783** | **32,783** |
| NOTES: IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assumption is 47 percent for all future years. | | | | | | |

As the wholesale supplier, WFA works in collaboration with its retail agencies as well as IEUA, its wholesaler, to develop demand projections for imported water.

### 2.5.2 WFA's Total Water Demand Projections

Table 2-11 above, represents WFA's projected water use for potable and raw water from 2020 through 2040. WFA's imported water purchases comprise 47 percent of IEUA's total imported water purchases of approximately 69,752 AFY. Table 2-12 below, presents the WFA's total water demand with the 2015 value representing actual demand and projected values representing 47 percent of IEUA's total imported water purchases through 2040.Recycled water is used within WFA's service area but is provided directly by IEUA; for this reason, recycled water use demands are included in Table 2-8 but not Table 2-12.

**Table 2-12: WFA Total Water Demands (AF)**

| Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Potable and Raw Water | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| Recycled Water | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **27,606** | **32,783** | **32,783** | **32,783** | **32,783** | **32,783** |
| NOTES: 2015 value represents actual demand for FY 2014-15. Projected values assume WFA's demands represent 47 percent of IEUA's imported water demand. | | | | | | |

### 2.5.3 WFA's Sales to Other Agencies

WFA wholesales treated imported water to five retail water agencies including: cities of Chino, Chino Hills, Ontario, and Upland, and MVWD.

### 2.5.4 Non-Revenue Water for WFA

Non-revenue water is defined by the International Water Association (IWA) as the difference between distribution systems input volume (i.e. production) and billed authorized consumption. Non-revenue water consists of three components: unbilled authorized consumption (e.g. hydrant flushing, firefighting, and blow-off water from well start-ups), real losses (e.g. leakage in mains and service lines, and storage tank

overflows), and apparent losses (unauthorized consumption, customer metering inaccuracies and systematic data handling errors).

A water loss audit must be conducted for any water system that owns and operates potable water distribution pipelines. **IEUA is exempt from this requirement because owned and operated distribution pipelines do not deliver potable water; WFA owns and operates 4.55 miles of a potable distribution pipeline** with six customer meter connections and one inactive meter connection and so must conduct a water loss audit. The WFA system does not include hydrants for flushing or

*WFA owns and operates 4.55 miles of potable distribution pipelines, therefore must conduct a water loss audit for this 2015 UWMP.*

*IEUA does not own or operate any potable distribution system, therefore is exempt.*

firefighting as is typical for retail suppliers. Further, for the WFA, non-revenue water also includes utility water consumption or losses used in the treatment process, domestic purposes, and landscape irrigation, activities of which are prior to production supplies entering the distribution pipeline.

#### 2.5.4.1 AWWA Water Audit Methodology

AWWA Water Audit consists of five data categories: 1) Water Supplied 2) Authorized Consumption 3) Water Losses 4) System Data and 5) Cost Data. Data was compiled from questionnaires, invoices, meter test results, and discussion with WFA. Each data value has a corresponding validation score that evaluates WFA's internal processes associated with that data entry. The scoring scale is 1-10 with 10 representing best practice.

The *Water Supplied* section represents the volume of treated water WFA delivered from purchased imported raw water. Validation scores for each supply source correspond to meter accuracy and how often the meters are calibrated. If the calibration results of supply meters were provided, a weighted average of errors was calculated for master meter adjustment. This adjustment factor was applied to reported supply volumes for meters that were found to register either over or under the true volume. Validity scores for meter adjustment are based on how often the meter is read and what method is used.

The *Authorized Consumption* section breaks down consumption of the volume of Water Supplied. Billed metered water is billed and delivered to customers and makes up the majority of an agency's consumption. Unbilled metered water is typically per policy and not present within the WFA system. Unbilled unmetered water is authorized use that is neither billed nor metered which typically includes activities such as flushing of water mains, which is limited to a single sample collection flushing site for the WFA since there are no hydrants. The AWWA Water Audit recommends using the default value of 1.25 percent to represent this use, as calculating an accurate volume is often tedious due to the many different components involved and it represents a small portion of overall use. For each consumption type listed

above the associated validation score reflects utility policy for customer accounts, frequency of meter testing and replacement, computer-based billing and transition to electronic metering systems.

*Water Losses* are defined as the difference between the volume of water supplied and the volume of authorized consumption. Water losses are further broken down into apparent and real losses. Apparent losses include unauthorized consumption, customer meter inaccuracies and systematic data handling errors. Default percentages were provided for the Audit by AWWA for unauthorized consumption and systematic data handling error as this data is not often available. The corresponding default validation score assigned is 5 out of 10. A discrete validation score was included for customer meter inaccuracies to represent quality of meter testing records, testing procedures for meter accuracy, meter replacement cycles, and inclusion of new meter technology.

*System Data* includes information about WFA's physical distribution system and customer accounts. The information included is: length of mains, number of active and inactive service connections, and the average operating pressure of the system. The number of service connections is automatically divided by the length of mains to find the service connection density of the system. The calculated service connection density determines which performance indicators best represent a water system's real loss performance. The validity scores in this section relate to the water system's policies and procedures for calculating and documenting the required system data, quality of records kept, integration with an electronic database including GIS and SCADA, and how often this data is verified.

The final section is *Cost Data* and contains three important financial values related to system operation, customer cost and water production. The total annual cost of operating the water system, customer retail unit cost and the variable production cost per AF are included. The customer retail unit value is applied to the apparent losses to determine lost revenue, while the variable production cost is typically applied to real losses. In water systems with scarce water supplies, a case can be made for real losses to be valued at the retail rate, as this volume of water could be sold to additional customers if it were not lost. Validity scores for these items consider how often audits of the financial data and supporting documents are compiled and if third-party accounting professionals are part of the process.

Calculations based on the entered and limited data produce a series of results that quantify the volume and financial impacts of water loss and allow a comparison of WFA's water loss performance with that of other water systems who have also performed water loss audits using the same AWWA methodology that is primarily designed for retail suppliers. WFA's Data Validity Score was 76 out of 100, with a total calculated water loss volume of 266.60 AFY. The Non-Revenue Water volume represents 1.0 percent of the total treated water supplied by WFA, compared to the total raw water supplies to the WFA and also includes utility water consumption or losses used in the treatment process, domestic purposes, and landscape irrigation, activities of which are prior to production supplies entering the distribution pipeline. The value of non-revenue water is calculated to be $172,290 per year.

Apparent losses make up most of the WFA's total water loss at 52 percent; most of this was developed from default percentages provided by the AWWA Water Audit. Based on this information, WFA can improve its water loss assessment by taking a closer look at apparent losses and developing a strategy to better quantify and validate this data in the future. The overall Water Audit score can also be improved by meeting the standards AWWA has developed for each data point through clear procedures and reliable data, subject to the applicability of the AWWA Water Audit Methodology to that of the WFA system.

The result of the AWWA Water Audit completed for WFA as required by the 2015 UWMP is summarized in Table 2-13. The water loss summary was calculated over a one-year period from available data (FY 2014-15) and the methodology explained above.

**Table 2-13: Water Loss Audit Summary for WFA (AF)**

| Wholesale: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss |
| 07/2014 | 266.60 |
| NOTES: WFA's AWWA water loss audit | |

# 3 WATER SOURCES AND SUPPLY RELIABILITY

## 3.1 Overview

A diverse portfolio of water supply sources have been developed within IEUA's service area. The region relies on groundwater from the Chino Basin and other basins (Cucamonga, Rialto, Lytle Creek, Colton, and the Six Basins groundwater basins), local surface water from creeks originating in the San Gabriel Mountains, recycled water produced locally, and imported water from SWP via MWD.

The IEUA IRP established a baseline water supply scenario for the IEUA's service area up to 2040. Table 3-1 provides the current and projected baseline regional water supply from each source. About 31,720 AF is expected to be added to the supplies within next ten years in the IEUA IRP baseline forecast. Groundwater from the Chino Basin is expected to increase from 90,538 AF in 2015 (39 percent of the region's total supply) to 97,666 AF by 2020 and constant through 2040 (37 percent of the region's total supply). In an effort to expand recycled water production, the recycled water supply in the region is projected to increase from 16,050 AF (7 percent of the region's total supply) in 2015 to 28,957 AF (11 percent of the region's total supply) by 2040. Recycled water used for groundwater replenishment is also projected to increase from 14,500 AF in 2015 to 16,900 AF by 2020 and 18,700 AF by 2025. Imported water, used to supplement regional local supplies, is projected to increase to 69,752 AF by 2020 through to 2040. The Regional UWMP supply type (Table 3-1) below for Chino Basin Groundwater includes a combination of the IEUA IRP baseline supply types of Chino Basin Groundwater (91,266 AF) and new Stormwater (6,400 AF), post 2015. Current active and passive water savings is embedded in the current water demand forecast and is estimated to be 1,000 AFY through 2040.

**Table 3-1: Current and Projected Regional Baseline Urban Water Supply Sources (AF)**

| Baseline Supply Forecast | | | | | | |
|---|---|---|---|---|---|---|
| **Supply Type** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Imported Water | 65,000 | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| Chino Basin Groundwater | 90,538 | 97,666 | 97,666 | 97,666 | 97,666 | 97,666 |
| Other Groundwater | 22,098 | 22,098 | 22,098 | 22,098 | 22,098 | 22,098 |
| Surface Water | 11,651 | 11,651 | 11,651 | 11,651 | 11,651 | 11,651 |
| Recycled Water | 16,050 | 24,936 | 28,957 | 28,957 | 28,957 | 28,957 |
| Groundwater Replenishment Recycled Water | 14,500 | 16,900 | 18,700 | 18,700 | 18,700 | 18,700 |
| Chino Basin Desalter | 15,000 | 17,733 | 17,733 | 17,733 | 17,733 | 17,733 |
| Water Use Efficiency | 1,975 | 9,788 | 11,984 | 17,257 | 22,570 | 27,802 |
| **Total** | **236,812** | **270,524** | **278,541** | **283,814** | **289,127** | **294,359** |
| NOTES: From IEUA IRP's baseline supply forecast to 2040 (Appendix E) excluding recycled water for agriculture. Chino Basin Groundwater includes stormwater recharge beginning in 2020. 2015 and 2020 annual WUE from IEUA 2015 WUE Business Plan. 2025-2040 WUE projections based on 10 percent demand reduction by 2040 as per IRP Phase I Goal. | | | | | | |

Table 3-2 shows the projected supply by source for each of IEUA's retail agencies.

**Table 3-2: IEUA Retail Agencies Projected Water Supply (AF)**

| Wholesale: Water Supplies — Projected | | | | | |
|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply | | | |
| | | 2020 | 2025 | 2030 | 2035 |
| | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| **City of Chino** | | | | | |
| Imported Water | WFA | 5,353 | 5,353 | 5,353 | 5,353 |
| Groundwater | Chino Wells | 10,251 | 11,656 | 13,061 | 14,466 |
| Desalinated Water | CDA | 5,000 | 5,000 | 5,000 | 5,000 |
| Recycled Water | IEUA | 8,107 | 7,864 | 7,621 | 7,379 |
| **City of Chino Hills** | | | | | |
| Groundwater | Chino Hills Well | 4,000 | 4,000 | 4,000 | 4,000 |
| Desalinated Water | CDA | 4,200 | 4,200 | 4,200 | 4,200 |
| Recycled Water | IEUA | 1,850 | 1,850 | 1,850 | 1,850 |
| Imported Water | WFA | 14,069 | 14,069 | 14,069 | 14,069 |
| Imported Water | MVWD | 8,577 | 8,577 | 8,577 | 8,577 |
| **Cucamonga Valley Water District** | | | | | |
| Groundwater | Chino Basin | 12,755 | 13,687 | 13,859 | 19,282 |
| Groundwater | Cucamonga Basin | 10,000 | 10,000 | 10,000 | 10,000 |
| Surface Water | Cucamonga Canyon | 1,000 | 1,000 | 1,000 | 1,000 |
| Surface Water | Deer Canyon | 140 | 140 | 140 | 140 |
| Surface Water | Day/East Canyon | 3,400 | 3,400 | 3,400 | 3,400 |
| Imported Water | (Tier I) | 28,369 | 28,369 | 28,369 | 28,369 |
| Imported Water | (Tier II) | 3,236 | 4,704 | 6,932 | 1,509 |
| Recycled Water | | 1,600 | 1,800 | 2,000 | 2,000 |
| **Fontana Water Company** | | | | | |
| Imported Water | IEUA | 10,000 | 10,000 | 12,000 | 12,000 |
| Imported Water | SBVMWD | 2,000 | 2,000 | 2,000 | 2,000 |
| Groundwater | Chino Basin | 10,038 | 11,666 | 12,153 | 14,341 |
| Groundwater | Rialto-Colton Basin | 2,520 | 2,520 | 2,520 | 2,520 |
| Groundwater | Lytle Basin | 9,400 | 9,400 | 9,400 | 9,400 |
| Groundwater | No Man's Land Basin | 4,000 | 4,000 | 4,000 | 4,000 |
| Surface water | Lytle Creek | 5,700 | 5,700 | 5,700 | 5,700 |
| Recycled Water | | 1,000 | 1,500 | 2,000 | 2,500 |

| Wholesale: Water Supplies — Projected | | | | | |
|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply | | | |
| | | 2020 | 2025 | 2030 | 2035 |
| | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| **Monte Vista Water District** | | | | | |
| Groundwater | Chino Basin | 30,260 | 30,260 | 30,260 | 30,260 |
| Imported Water | WFA | 21,776 | 21,776 | 21,776 | 21,776 |
| Imported Water | SAWCO | 800 | 800 | 800 | 800 |
| Recycled Water | IEUA | 1,350 | 1,350 | 1,350 | 1,350 |
| **City of Ontario** | | | | | |
| Groundwater | Chino Basin | 11,782 | 13,465 | 16,234 | 21,627 |
| Imported Water | WFA | 10,000 | 11,000 | 13,000 | 15,000 |
| Desalinated Water | CDA | 8,533 | 8,533 | 8,533 | 8,533 |
| Purchased Water | SAWCO | 765 | 765 | 765 | 765 |
| Recycled Water | IEUA | 8,289 | 9,947 | 12,434 | 15,545 |
| **City of Upland** | | | | | |
| Groundwater | Chino Basin | 7,327 | 7,327 | 7,327 | 7,327 |
| Groundwater | Six Basins | 4,975 | 4,975 | 4,975 | 4,975 |
| Groundwater | Cucamonga Basin | 5,103 | 5,103 | 5,103 | 5,103 |
| Surface Water | SAWCO | 1,780 | 1,780 | 1,780 | 1,780 |
| Recycled Water | WFA | 5,098 | 5,098 | 5,098 | 5,098 |
| Imported Water | | 660 | 710 | 800 | 800 |
| | **Total** | **285,063** | **295,344** | **309,439** | **323,794** |

NOTES: Project supply numbers from 2015 UWMP for each individual retail agency. CVWD's projected Chino Basin Groundwater and Imported Tier II/Chino Basin Replenishment Water is subject to change pending Chino Basin "Safe Yield Reset."

## 3.2 Chino Basin Groundwater

The Chino Basin is one of the largest groundwater basins in southern California containing approximately 5 million acre-feet (MAF) of water with an unused storage capacity of approximately 1 MAF for a total potential of 6 MAF.

Groundwater from the Chino Basin accounts for approximately 40 percent of the total water used in IEUA's service area. The Chino groundwater basin is managed by CBWM. IEUA and WFA do not provide groundwater directly to their retail agencies.

Approximately 5 percent of Chino Basin is located in Los Angeles County, 15 percent in Riverside County, and 80 percent in San Bernardino County. Chino Basin is bounded by Cucamonga Basin and the San Gabriel Mountains to the north, the Temescal Basin to the south, Chino Hills and Puente Hills to the

southwest, San Jose Hills, Pomona, and Claremont basins on the northwest, and the Rialto/Colton Basins on the east. IEUA's service area overlies approximately 70 percent of Chino Basin.

San Bernardino County Superior Court created the CBWM in 1978 as a solution to lawsuits over historical water right allocations. CBWM is responsible for managing Chino Basin in accordance with the 2000 Peace Agreement, 2007 Peace II Agreement, and the OBMP. CBWM is governed by three stakeholder groups, called Pools. The three Pools consist of:

- **Overlying Agricultural Pool:** representing dairymen, farmers, and the State of California
- **Overlying Non-Agricultural Pool:** representing area industries
- **Appropriative Pool:** representing local cities, public water districts, and private water companies

Although groundwater is an important local supply, the water quality in the lower Chino Basin area has been impacted by historical agricultural uses and now has high levels of nitrates and TDS. There are also some areas that exceed standards for perchlorate and volatile organic compounds (VOC). This lower quality of water requires additional treatment, and/or blending with higher quality imported water before it can be used as a potable supply. CBWM works in partnership with municipalities, IEUA, and the Santa Ana Regional Water Quality Control Board to address these water quality problems and to manage the groundwater basin sustainably.

Chino Basin is hydrologically subdivided into five groundwater zones or systems, referred to as management zones. Each management zone has a unique hydrology, and actions within one zone have little or no impact on adjacent zones. Management zones are used to characterize the groundwater level, storage, production, and water quality conditions. Throughout these management zones, there are 19 existing spreading basins that have the capability of recharging stormwater, recycled water, and/or imported water into the Chino Basin. A description of each of the management zones is listed below.

- **Management Zone 1:** This zone is bounded on the southwest by Chino and Puente Hills, on the northwest by the San Jose fault that separates the Chino Basin from the Pomona and Claremont Heights Basins, on the north by an unnamed non-echelon fault system, and on the east by a line that stretches from the southernmost edge of the Red Hill fault to Prado Dam. Groundwater generally flows south with some localized flows to the west in response to groundwater production.
- **Management Zone 2:** This zone is bounded on the west by Management Zone 1, on the north by the Red Hill fault, on the northeast by a segment of the Rialto-Colton fault, and on the east by a segment of Barrier J. Groundwater generally flows in a southwesterly direction in the northern half of the zone and then due south in the southern half of the zone.
- **Management Zone 3:** This zone is bounded on the west by Management Zone 2, on the northeast by the Rialto Colton fault, and on the southeast by the Bloomington divide. Groundwater generally flows in a southwesterly direction.
- **Management Zone 4:** This zone is bounded on the west by Management Zone 3, on the north by the Jurupa Hills, on the southeast by the Pedley Hills, and on the south by Management Zone 5. Groundwater flows west.
- **Management Zone 5:** This zone is bounded on the north and west by Management Zones 3 and 4, on the east by the Riverside Narrows, and on the south by the La Sierra area and Temescal Basin

(Chino Basin Watermaster, Chino Basin Optimum Basin Management Program 2014 State of the Basin Report, June 2015).

A map of Chino Basin and its management zones is displayed on Figure 3-1.

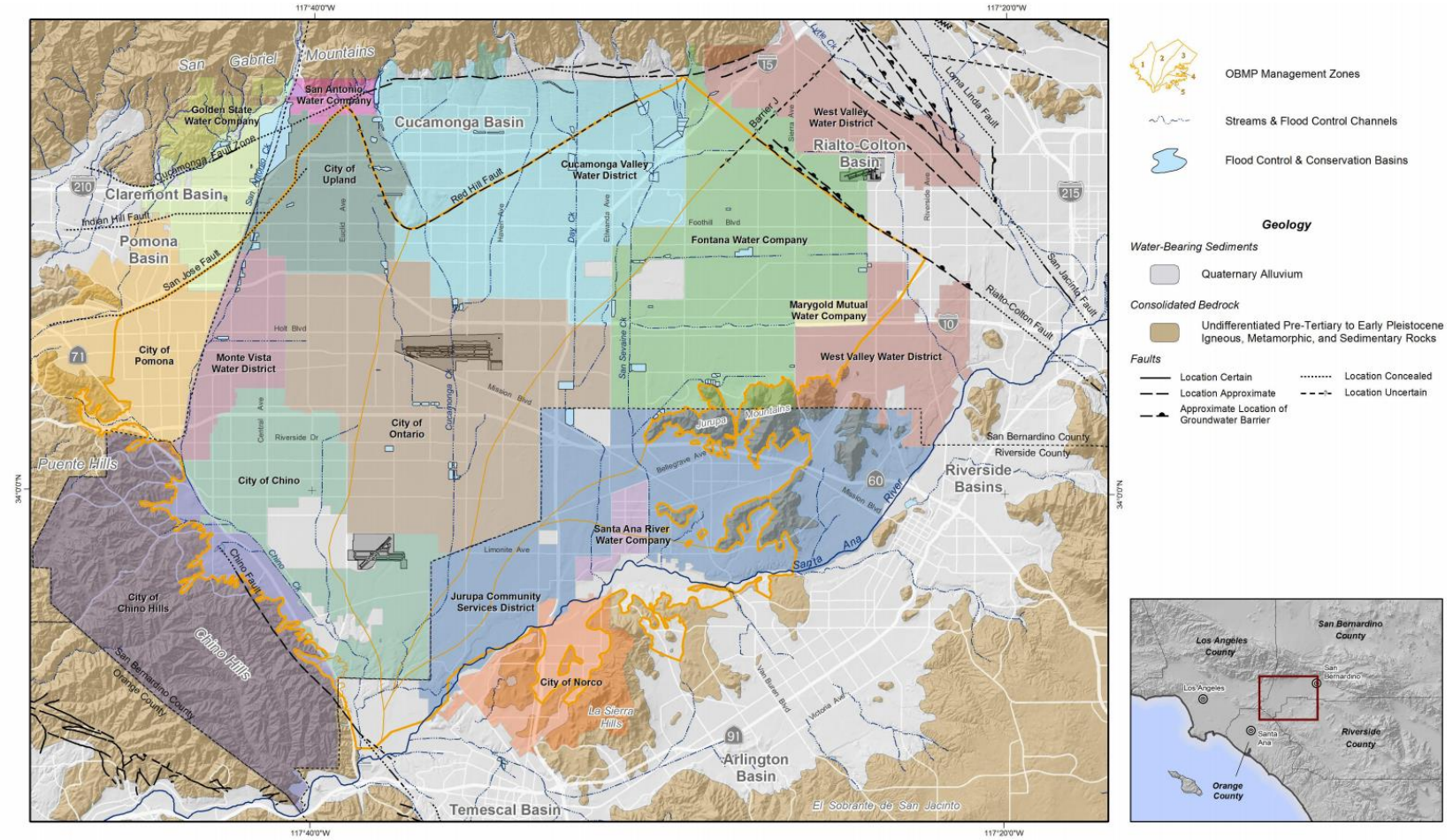



**Figure 3-1: Chino Groundwater Basin**

### 3.2.1 Baseline Supply

The court judgment allocates groundwater rights by establishing an annual pumping "safe yield" for each Pool. The Operating Safe Yield (OSY) is the annual amount of groundwater that can be pumped from the Chino Basin by the Pool parties free of replenishment obligations. For planning purposes, controlled overdraft for the Appropriative Pool was not included. Annual groundwater production in excess of the OSY is allowed by the adjudication, provided that the pumped water is replaced and recharged back into the groundwater basin.

The baseline amount for groundwater production between 2015 and 2020 is assumed to be 90,538 AFY, based on historical production. This amount of groundwater pumping includes recharge from natural rainfall and stormwater capture. It does not include recharge from recycled water.

The baseline amount for groundwater production between 2020 and 2040 is assumed to be 91,266 AFY, which is IEUA's retail agencies share of the forecasted OSY for this period and increased stormwater recharge. This baseline amount does not include future stormwater recharge or recycled water for groundwater recharge.

## 3.3 Stormwater

Stormwater is water that originates during rainfall and snow melt. IEUA and WFA do not provide stormwater directly to their retail agencies.

In the IEUA region, stormwater comes primarily from surface water runoff from rain and snow originating in the San Gabriel Mountains and moving down through the Santa Ana watershed. In undeveloped areas, the soil absorbs much of the runoff and helps retain the water within the groundwater basin. However, developed areas with a significant amount of hardscape tend to concentrate and accumulate runoff in large quantities in a relatively short amount of time. Stormwater runs off roofs, through streets, and into regional storm drains, where these flows are largely diverted into the region's flood control channels.

The Chino Basin has six major flood control channels spread throughout the region. These channels collect and manage the stormwater generated within the watershed. Major flood control channels that convey stormwater within IEUA's service area include:

- San Sevaine Creek
- Day Creek
- Deer Creek
- Cucamonga Creek
- West Cucamonga Creek
- San Antonio Creek

Located adjacent to the channels are detention basins that are operated regionally under a multiple-use agreement for both flood control and groundwater recharge operations. IEUA, CBWM, and other

agencies work closely with the San Bernardino Flood Control District to maximize the amount of stormwater that can be captured and recharged into the Chino Groundwater Basin. These channels also carry dry weather runoff from excessive outdoor irrigation. Stormwater percolates to groundwater and is not utilized directly as a supply type, but is counted in the volume of annual groundwater supply.

Runoff that is not captured by detention basins ultimately flows to the Santa Ana River. While there are efforts by agencies further downstream to capture these flows, large amounts of water discharge into the ocean during storm events.

## 3.4 Recycled Water

IEUA has produced and distributed high quality recycled water since 1972 when the Agency expanded its services to include regional wastewater treatment. While IEUA serves recycled water for both indirect use (outdoor irrigation, industrial processing) and groundwater recharge, WFA does not.

Currently, IEUA owns and operates five regional recycled water plants that produce disinfected and filtered tertiary treated recycled water in compliance with California's Title 22 regulations. These five water reclamation plants are: Regional Plant No. 1 (RP-1), Regional Plant No. 2 (RP-2), Regional Plant No. 4 (RP-4), Regional Plant No. 5 (RP-5), and the Carbon Canyon Water Reclamation Facility (CCWRF).

IEUA's five regional water reclamation plants produced approximately 60,200 AF of recycled water during FY 2014-15. Wastewater projections from the Wastewater Facilities Master Plan as documented in the IEUA IRP shows that the regional recycled water supply forecast is expected to increase to approximately 83,000 AFY by 2040. IEUA has a 17,000 AFY dedicated to discharge obligation of recycled water to the Santa Ana River as shown in Table 3-3.The remaining supply would be available for local use and groundwater recharge.

**Table 3-3: Projected Regional Recycled Water Supply (AF)**

| Year | 2015 | 2020 | 2030 | 2040 |
|---|---|---|---|---|
| Recycled Water Supply | 60,200 | 64,300 | 75,100 | 82,900 |
| Note: From IEUA IRP Table 3-4 (2035 projection is not provided). | | | | |

More information about recycled water usage in IEUA's region can be found in Section 6.

## 3.5 Chino Basin Desalter

The Chino Basin Desalters provide a local source of potable water supply for the region through treatment of unusable groundwater. The Desalters also provide hydraulic control of the lower Chino

Groundwater Basin. These facilities are critical to the continued use of recycled water in the region as well as the improvement of groundwater quality and yield in the Chino Basin.

IEUA and WFA do not provide desalted water directly to their retail agencies. IEUA operates one of the facilities (Chino I Desalter) under contract to the CDA.

The CDA was formed to manage the production, treatment, and distribution of highly treated potable water to cities and water agencies throughout the Chino Basin. A Joint Exercise of Powers Agency, the CDA was formed by the Jurupa Community Services District; Santa Ana River Water Company; Western Municipal Water District; the Cities of Chino, Chino Hills, Norco, and Ontario; and IEUA to treat brackish groundwater extracted from the lower portion of the Chino Basin. Brackish water is water that has more salt (about 1000 ppm of TDS) than fresh water, but not as high as seawater (about 35,000 ppm of TDS).

The Chino I Desalter was constructed in 2000 through a Joint Participation Agreement among five agencies: SAWPA, Western Municipal Water District, Orange County Water District, MWD, and IEUA. The Chino II Desalter was constructed in 2007 and provides a supplemental supply to the Cities of Chino, Chino Hills, and Ontario located within IEUA's service area as well as to the Jurupa Community Services District, City of Norco and the Santa Ana River Water Company located outside of IEUA's service area. The treatment processes at the Chino I and Chino II Desalters include RO and Ion-Exchange for the removal of nitrate and TDS. The treatment processes at Chino I Desalter also includes air stripping for the removal of VOCs.

These facilities serve three purposes. First, they convert unusable groundwater into a reliable potable water supply for the region and are part of a long-term pollution cleanup strategy for the Chino Basin. Second, they provide hydraulic control over the lower Chino Basin, which prevents the migration of poor quality water into the Santa Ana River as well as downstream impacts on groundwater basins in Orange County. Third, they maintain and enhance groundwater yield for the Chino Basin.

Currently, the Chino I and Chino II Desalters produces approximately 25,000 AFY of treated groundwater combined, with plans to expand treat capacity to 35,200 AFY by 2017. IEUA retail member agencies who receive water from the Desalter facilities as part of their water supply portfolios include the cities of Chino, Chino Hills, and Ontario.

## 3.6 Local Surface Water

Several of the retail agencies within the northern part of IEUA's service area have long standing legal rights to divert and treat water supplies from local surface sources in the Santa Ana River watershed. These sources include San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several smaller surface streams.

IEUA and WFA do not provide local surface water directly to their retail agencies.

Production from surface supplies varies dramatically depending on climate conditions. However, when available, local surface water is an extremely valuable resource as it is essentially "free," with the only cost to retail agencies being the operation of necessary facilities to capture, treat and distribute this water. This is due in part to the high quality of local surface water. Nevertheless, surface water is treated to state and federal drinking water quality standards before it can be served for public use.

## 3.7 Non-Chino Groundwater

Local groundwater supplies from basins other than the Chino Basin represent a significant supplemental source of water for the retail water agencies within IEUA's service area. These basins include Cucamonga, Rialto, Lytle Creek, Colton, and the Six Basins groundwater basins. The Six Basins are comprised of the Ganesha, Live Oak, Pomona, Lower Claremont Heights, Upper Claremont heights, and Canyon Basin.

IEUA's retail agencies that use groundwater from all or some of these basins include the City of Upland, CVWD, FWC, and SAWCO. IEUA and WFA do not provide groundwater directly to their retail agencies.

## 3.8 Imported Water

IEUA was originally formed in 1950 to act as a municipal wholesale water district in order to provide regional municipalities with imported water purchased from MWD as a supplemental source of water. Tables 3-4 and 3-5 respectively show the current and projected amount of water supplies that IEUA will have available to supply to its retail agencies.

**Table 3-4: IEUA Wholesale Imported Water Supplies - Actual (AF)**

| Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| | | Actual Volume | Water Quality | Total Right or Safe Yield |
| Purchased or Imported Water | | 58,906 | Raw Water | |
| **Total** | | **58,906** | | **0** |
| NOTES: Imported water from Actual FY 2014-15 IEUA Water Use Report/Database. | | | | |

**Table 3-5: IEUA Wholesale Imported Water Supplies – Projected (AF)**

| Wholesale: Water Supplies — Projected | | | | | | |
|---|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply | | | | |
| | | 2020 | 2025 | 2030 | 2035 | 2040 |
| | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| Purchased or Imported Water | | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| **Total** | | **69,752** | **69,752** | **69,752** | **69,752** | **69,752** |
| NOTES: IEUA IRP Baseline Supply Projection | | | | | | |

WFA treats and sells imported water wholesale to its five member retail agencies, which are a subset of IEUA. This treated imported water supply supplements the member agencies' local water supplies. Tables 3-6 and 3-7 respectively show the current and projected amount of raw water supplies that WFA will have available to supply to its member agencies, respectively.

**Table 3-6: WFA Wholesale Water Supplies - Actual (AF)**

| Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| | | Actual Volume | Water Quality | Total Right or Safe Yield |
| Purchased or Imported Water | | 27,606 | Potable Water | |
| **Total** | | **27,606** | | **0** |
| NOTES: FY 2014-15 IEUA sales to WFA | | | | |

**Table 3-7: WFA Wholesale Water Supplies – Projected (AF)**

| Wholesale: Water Supplies — Projected | | | | | | |
|---|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply | | | | |
| | | 2020 | 2025 | 2030 | 2035 | 2040 |
| | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| Purchased or Imported Water | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| **Total** | | **32,783** | **32,783** | **32,783** | **32,783** | **32,783** |
| NOTES: Assume 47 percent of IEUA's imported supply is for WFA for all future years (same proportion as in FY 2014-15 actual). | | | | | | |

MWD is a contractor for SWP water, which imports water from northern California; and also imports water from the Colorado River via MWD's CRA system. Hydrology and environmental regulations are major factors that play into the reliability of imported water supplies from MWD. This dependency can lead to high variability in the annual amount of water available to the southern California region. In 2013-2014, SWP was only able to supply 5 percent of its contract allocation in the midst of the current drought.

IEUA only receives and allocates SWP water from MWD. This is due to water quality concerns in the Chino Basin and regional board regulations that preclude the use of CRA water with its higher salinity levels. Imported water purchased from MWD is limited by a purchase order agreement that allows IEUA to purchase up to 93,283 AFY at its lowest (Tier 1) rate. Of this amount, IEUA's wholesales 69,752 AFY to WFA, CVWD, and FWC. As part of IEUA's purchase order agreement with MWD, the agreement includes an annual minimum purchase commitment of 39,835 AFY, which is consistent with the minimum operational needs of the following water treatment facilities.

There are four water treatment plants in the IEUA service area that treat imported water purchased from MWD. These facilities are:

- WFA's Agua de Lejos Treatment Plant (81 MGD capacity)
- FWC's Sandhill Surface Water Treatment Plant (29 MGD capacity)
- CVWD's Lloyd W. Michael Water Treatment Plant (60 MGD capacity)
- CVWD's Royer Nesbit Water Treatment Plant (11 MGD capacity)

Each of these three agencies is allocated an annual portion of IEUA's purchase order volume (shown below). The allocations do not confer a contractual right to MWD imported water but are used to determine the price paid for the water. Purchases in excess of the Tier 1 allocation are assessed by IEUA at MWD's higher Tier 2 rate.

- WFA - 31,384 AFY
- CVWD - 28,368 AFY
- FWC - 10,000 AFY
- IEUA/CBWM – 23,531 AFY

The amount available to IEUA and/or CBWM is used only for groundwater recharge.

### 3.8.1 Metropolitan Water District's 2015 UWMP

MWD's 2015 UWMP reports its water reliability and identifies projected supplies to meet long-term demand within its service area. MWD's 2015 UWMP indicates that MWD has supply capabilities that would be sufficient to meet expected demands from 2020 through 2040 under average condition (average of 1922 to 2012 hydrology), the single-dry year condition (1977 hydrology), and the multiple-dry year condition (1990 to 1992 hydrologies). MWD's supply capabilities are evaluated using the following assumptions:

- CRA supplies include supplies that would result from existing and committed programs and from implementation of the Quantification Settlement Agreement (QSA) and related agreements. The QSA facilitates the transfer of water from agricultural agencies to urban uses. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.2 MAF on an as-needed basis.
- SWP supplies are estimated based on DWR's 2015 SWP Delivery Capability Report (July 2015) which accounted for restrictions on SWP and Central Valley Project operations in accordance with the biological opinions of the U.S. Fish and Wildlife Service (December 15, 2008) and National Marine Fisheries Service (June 4, 2009). The delivery estimates for SWP for 2020 conditions are 51 percent of Table A amounts under long-term average condition and12 percent under single-dry year condition, equivalent to 976 thousand AF and 257 thousand AF for MWD, respectively.
- Storage is a major component of MWD's dry-year resource management strategy. MWD has developed a large regional storage portfolio that includes both dry-year and emergency storage capacity. Storage programs capture surplus water in normal and wet hydrologic conditions for use in dry years where augments water supplies are needed to meet demands.

MWD's 2015 UWMP documents MWD's comprehensive plans for stages of actions it would undertake to address up to a 50 percent reduction in its water supplies and a catastrophic interruption in water supplies. MWD's 2015 UWMP describes MWD's investments in water use efficiency measures to help the region achieve the 20 percent urban water use reduction by 2020 (MWD, 2015 UWMP, June 2016).

### 3.8.2 IEUA Imported Water Rates

As MWD has adjusted their rates over time, IEUA has done the same. The IEUA's Board of Directors most recently established rates for the delivery of imported water supplies on May 20, 2015. Effective

January 1, 2016, IEUA's rates listed in Table 3-8 for the 2016 calendar year (IEUA, Resolution NO. 2015-5-10, May 2015).

**Table 3-8: IEUA Rates Adopted for 2016 Calendar Year**

| Rate Type | Amount |
|---|---|
| Tier 1 Full Service Untreated | $ 609 per AF |
| Tier 2 Full Service Untreated | $ 743 per AF |
| WSAP Penalty | 2 X Tier 1 (100%-115%)<br>4 X Tier 2 (115% or greater)<br>Imposed by MWD |
| Capacity Charge | $ 10,900 per cfs |

## 3.9 Supply Reliability

The available supplies to meet projected water demands for IEUA's service area were analyzed to assess the region's ability to satisfy demands during three scenarios: a normal water year, single-dry year, and multiple-dry years. This section presents the supply-demand balance for the various drought scenarios for the 25-year planning period 2015 to 2040. It is expected that the region will be able to meet 100 percent of its dry year demand under each scenario as shown in Tables 3-9, 3-10, and 3-11.

### 3.9.1 Supply Challenges

Supply reliability can be impacted by water quality and climate change. Some sources are more vulnerable to seasonal or climatic shortage than others. The supply challenges for each of the region's water sources are discussed in this section.

#### 3.9.1.1 Chino Basin Groundwater

Chino Basin groundwater is impacted by climate change given that supplies are dependent on rainfall and supplemental sources for recharge as well as the ability of soil to absorb water during period of rainfall. Warmer temperatures and drought increase the dryness of soil, resulting in less absorption and an increase of water runoff instead of percolation through the soil. However, Chino Basin groundwater supplies are not impacted by climate once the water is stored in the groundwater basin (IEUA, Integrated Water Resources Plan, 2016).

The OBMP characterizes constituents of potential concern (COPC) in the Chino Basin. CBWM routinely collects groundwater quality data from well owners and determines any exceedances of Primary or

Secondary, federal or state, Maximum Contaminant Levels (MCL), or State Notification Levels (NL). COPCs in the Chino Basin include:

- Constituents associated with salt and nutrient management. These constituents are primarily TDS and nitrate.
- Constituents that exceeded their primary MCL in twenty or more wells from the time period of July 2009 to June 2014. These constituents include nitrate, perchlorate, total chromium, hexavalent chromium, arsenic, trichloroethene, tetrachloroethene, *cis*-1,2-dichloroethene, 1,1-dichloroethene, and 1,1-dichloroethane.
- Constituents where the California DDW is in current development of an MCL that may impact future beneficial use of groundwater such as 1,2,3-trichloropropane.

#### 3.9.1.2 Stormwater

Stormwater is affected by temperature due to soils drying out through evaporation of moisture caused by warmer temperatures. This results in increased water runoff as water is unable to penetrate into dry soil. However, once water is in the soil column, the ground retains this moisture until the soil is saturated which helps to replenish groundwater supplies.

Other challenges that stormwater supplies face include:

- Dependence on annual rainfall and snow melt.
- Reductions in natural infiltration into the groundwater basin due to channelization, new development, hardscape, increased outdoor water efficiency, and open space conversion.
- Construction of additional stormwater recharge facilities in a highly urbanized area where land may not be available or not available in the right places to capture and recharge significant volumes of water.
- Compliance with Municipal Separate Storm Sewer System Permit LID stormwater retention/recharge requirements for new and existing development and quantification of corresponding water supply benefits.

#### 3.9.1.3 Recycled Water

Recycled water holds the greatest potential as a source of reliable supply in the Chino Basin and in the southern California region as a whole. Recycled water is the most climate resilient water supply available to the region as wastewater flows were shown not to be impacted by climate under climate simulations according to the 2015 IEUA IRP as all supplies are generated are from indoor water use. However, the amount of wastewater available in the future may change from trends towards more efficient indoor water use.

Other supply challenges recycled water faces include increasingly strict regulatory and environmental issues for construction and operation of recycled water systems and the high amount of energy consumption required in recycled water treatment. Recycled water requires the highest level of treatment to meet Title 22 water recycling requirements. All IEUA water recycling treatment plants produce recycled

water suitable for full body contact recreation and generally meet the more stringent aquatic habitat criteria (IEUA, Integrated Resources Plan, 2016).

#### 3.9.1.4 Chino Basin Desalter

Water supply from the Chino Basin Desalter facilities is not affected by climate change as the quantity of water produced is dependent upon the capacity of the desalter facility and is not supply limited. Supply challenges that face the Chino Basin Desalters include:

- The outstanding obligation for groundwater replenishment obligation to the Chino Basin of 152,900 AF through the duration of the Peace Agreement.
- High energy needs and costs of the expanded treatment of brackish water and brine disposal.

#### 3.9.1.5 Surface Water

Surface water supplies are highly impacted by climate due to their dependence on precipitation and snow melt. Temperature is also a factor in the reliability of surface water supplies. Higher temperatures result in increased evaporation of soil moisture, reducing the soil's ability to absorb and hold water during rainfall. Therefore, surface water supplies are highly variable from a yearly basis.

Surface water from local sources that originate in the San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several other smaller surface streams is generally of high quality, as these creeks are fed by snowmelt and other precipitation in the San Gabriel Mountains. Surface water sources are treated prior to introduction to the potable water supply in order to insure bacteriological quality and compliance with state and federal drinking water quality standards.

#### 3.9.1.6 Other Groundwater

Climate effects on non-Chino Basin groundwater is expected to be similar to those identified for the Chino Basin. Supply challenges that non-Chino Basin groundwater faces are also similar to those for the Chino Basin which includes reduced natural infiltration, safe yield operating constraints, and water quality issues (IEUA, Integrated Water Resources Plan, 2016).

#### 3.9.1.7 Imported Water

Changing climate patterns are expected to shift precipitation patterns and affect water supply. Unpredictable weather patterns will make water supply planning more challenging. The areas of concern for California include a reduction in Sierra Nevada Mountain snowpack, increased intensity and frequency of extreme weather events, and rising sea levels causing increased risk of Delta levee failure, seawater intrusion of coastal groundwater basins, and potential cutbacks on SWP. The major impact in California is that without additional surface storage, the earlier and heavier runoff (rather than snowpack retaining water in storage in the mountains), will result in more water being lost to the oceans. A heavy emphases on storage is needed in the State of California.

MWD is responsible for providing high quality potable water throughout its service area. Over 300,000 water quality tests are performed per year on MWD's water to test for regulated contaminants and additional contaminants of concern to ensure the safety of its waters.

The key water quality issues for SWP waters are disinfection byproduct precursors, in particular, total organic carbon and bromide. Disinfection byproducts result from total organic carbon and bromide in the source water reacting with disinfectants at the water treatment plant. MWD has resolved these treatment restrictions by using ozone disinfection at its treatment plants. All of MWD's treatment plants currently have ozone treatment facilities.

Arsenic is also of concern in some groundwater storage/transfer programs that MWD participates in. Groundwater inflows into the California Aqueduct are managed to comply with water quality regulations and protect downstream water quality while meeting supply targets. Additionally, nutrient levels in SWP system are relatively high, leading to the potential for algal related taste and odor issues that can affect water management strategies. MWD is engaged in efforts to protect the quality of SWP water from potential increases in nutrient loading from wastewater treatment plants (MWD, 2015 UWMP, June 2016).

### 3.9.2 Regional Water Supply Reliability Assessment

This section looks at the reliability of all urban water supplies within the IEUA service area. The total demand in the region is met through local groundwater, local surface water, recycled water, and supplemental imported water. This supply reliability assessment examines the reliability of urban water supplies served by IEUA (recycled water and imported water) as well as supplies served by other agencies within the IEUA's service area (groundwater and surface water). It does not include recycled water for agricultural uses. The analysis in this section examines the water supply reliability of IEUA's service area for normal (2010 hydrology), single-dry (2013 hydrology) and multiple-dry scenarios (2014 to 2015 hydrologies) for the UWMP. The region is projected to be able to meet all demands between 2015 and 2040 under all the UWMP dry year scenarios through the diverse local supply sources supplemented with imported water from MWD which projects 100 percent reliability (MWD, 2015 UWMP, June 2016).

#### 3.9.2.1 Regional Normal Year Reliability

During periods of normal (average) levels of rainfall, total regional demand is not projected to deviate from the regional demand projected by the land use based model described in Section 2. A comparison between the urban supply and demand for projected years between 2015 and 2040 is shown in Table 3-9 recycled water for agriculture is not included in this assessment. The projected available urban supply will meet projected urban demand due to diversified supply and conservation measures. Based on IEUA IRP baseline supply projections, there are sufficient supplies to meet normal year demands and single dry year demands (Table 3-10). However, a multiple dry year scenario a local supply gap of 283 AF is projected for 2040 (Table 3-11). This supply gap presents an opportunity for the region to develop supplemental supplies. IEUA and retail agencies plan to close the supply gap through utilizing local supplemental supply opportunities and securing additional imported water as needed to accommodate for the variability in supply from SWP. IEUA and retail agencies are in the process of developing local supply strategies to meet the demand in 2040 as part of IEUA's IRP Phase 2. IEUA's IRP Phase 2 will include the disaggregation of the regional demand and supply to the local retail level and provide detailed project level analysis.

**Table 3-9: Regional Normal Year Supply and Demand Comparison (AF)**

| IEUA's Service Area : Normal Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Regional baseline supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,359 |
| Supplemental Supply Opportunities | - | - | - | - | 0 | 283 |
| Demand totals | 199,702 | 210,588 | 225,923 | 242,732 | 254,721 | 278,017 |
| **Difference** | **37,110** | **59,936** | **52,618** | **41,082** | **34,406** | **16,622** |
| NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc. not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Supply numbers from IEUA IRP's baseline supplies plus supplemental supply opportunities (excluding recycled water for agriculture). Demand numbers also excludes recycled water for agriculture. Demand numbers from land use based model projection excluding demand for recycled water for agriculture. | | | | | | |

### 3.9.2.2 Regional Single-Dry Year Reliability

A single-dry year is defined as a single year of no to minimal rainfall within a period that average precipitation is expected to occur. The IEUA IRP considers 2013 to represent the single dry year hydrologic conditions and forecasts a regional demand increase of 3.74 percent by 2040 for a single-dry year due to above normal temperature and reduced wet periods (IEUA IRP Appendix E). Demand increase for prior years are interpolated (0.62 percent in 2015 to 3.74 percent in 2040). A comparison between the supply and the demand in a single dry year is shown in Table 3-10. Based on IEUA IRP baseline supply projections, there are sufficient supplies to meet single dry year demands. However, a multiple-dry year scenario a local supply gap of 283 AF is projected for 2040 (Table 3-11). This supply gap in supply presents an opportunity for the region to develop supplemental supplies. IEUA and retail agencies plan to close these gaps through utilizing local supplemental supply opportunities and securing additional imported water as needed to accommodate for the variability in supply from SWP system. IEUA and retail agencies are also in the process of developing local supply strategies to meet the demand in 2040 as part of IEUA IRP Phase 2. IEUA IRP Phase 2 will include the disaggregation of the regional demand and supply to the local retail level and provide detailed project level analysis.

**Table 3-10: Regional Single Dry Year Supply and Demand Comparison (AF)**

| IEUA's Service Area: Single Dry Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Regional baseline supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,359 |
| Supplemental Supply Opportunities | - | - | - | - | - | 283 |
| Demand totals | 200,947 | 213,213 | 230,148 | 248,784 | 262,660 | 288,415 |
| **Difference** | **35,865** | **57,311** | **48,393** | **35,030** | **26,467** | **6,228** |

NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc., not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Single dry year demands are normal year demand increased by 3.74 percent in 2040, prior year demands are interpolated. Supply numbers are IEUA IRP baseline numbers plus supplemental supply opportunities in 2035 and 2040.

### 3.9.2.3 Regional Multiple-Dry Year Reliability

Multiple-dry years are defined as three or more years with minimal rainfall within a period of average precipitation. The IEUA IRP forecasts a regional demand increase of 5.98 percent by 2040 for a multiple-dry year due to extended periods of above normal temperature and reduced wet periods (IEUA IRP Appendix E). The analysis in Table 3-11 shows that the region is capable of meeting all demands in multiple-dry year scenarios with an average demand increase of 5.98 percent by 2040 through diversified supplies, conservation measures, and purchases of supplemental imported water. Based on IEUA IRP baseline supply projections, a local supply gap of 283 AF is projected for 2040. However, the gap will be closed through utilizing local supplemental supply opportunities and securing additional imported water as needed to accommodate for the variability in supply from SWP system. In addition to MWD's ability to supply supplemental imported water, through the IRP, IEUA includes an evaluation of strategies that increase investments in local resources supplies, storage, and demand management to offset any potential shortfalls due to climate change through 2040. Detailed analysis of specific projects and corresponding water supply benefits are scheduled to occur through 2017 to develop a regional supply buffer for the IEUA service area. IEUA and its retail member agencies will revise this water supply forecast after completion of the next phase of the IRP scheduled for completion by 2017.

**Table 3-11: Regional Multiple Dry Years Supply and Demand Comparison (AF)**

| IEUA's Service Area: Multiple Dry Years Supply and Demand Comparison | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| First year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,359 |
| | Supplemental Supply Opportunities | - | - | - | - | - | 283 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | **Difference** | **35,119** | **55,738** | **45,863** | **31,405** | **21,712** | **0** |
| Second year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,359 |
| | Supplemental Supply Opportunities | - | - | - | - | - | 283 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | **Difference** | **35,119** | **55,738** | **45,863** | **31,405** | **21,712** | **0** |
| Third year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,359 |
| | Supplemental Supply Opportunities | - | - | - | - | - | 283 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | **Difference** | **35,119** | **55,738** | **45,863** | **31,405** | **21,712** | **0** |

NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc. not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Multiple dry year demands are normal year demand increased by 5.98 percent in 2040, prior year demands are interpolated. Supply numbers are IEUA IRP baseline numbers plus local supplemental supply opportunities to close any supply gaps in 2035 and 2040.

### 3.9.3 WFA Water Supply Reliability Assessment

This section focuses on the reliability of imported water supply that WFA purchases from IEUA. IEUA is projecting a 100 percent reliability of its imported water supply based on MWD's 2015 UWMP findings that its imported supply will be able to meet 100 percent of its 26 member agencies in normal year, single-dry year, and multiple-dry year scenarios through 2040. Therefore, it is implied that WFA's imported water supply is also 100 percent reliable in all three hydrologic scenarios. Since WFA's supply comes from IEUA, the demand and supply numbers presented in this section is a subset of those shown in Section 3.9.3.

#### 3.9.3.1 WFA Normal Year Reliability

WFA has entitlements to receive imported water from MWD through a connection from MWD. Although pipeline and connection capacity rights do not guarantee the availability of water, they do guarantee the ability to convey water when it is available in the MWD distribution system. All imported water supplies are assumed available to WFA from existing water transmission facilities.

WFA's imported water demand is assumed to be a constant 47 percent of IEUA demand through 2040 based on the 2015 data. Table 3-12 shows the supply/demand balance for WFA in a normal year scenario.

**Table 3-12: WFA Normal Year Imported Water Supply and Demand Comparison (AF)**

| WFA Wholesale: Normal Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Supply totals | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| Demand totals | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| **Difference** | **0** | **0** | **0** | **0** | **0** | **0** |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. | | | | | | |

#### 3.9.3.2 WFA Single-Dry Year Reliability

A demand increase of 3.74 percent by 2040 is forecasted for a single-dry year scenario (IEUA IRP Appendix E). A comparison between supply and demand in a single-dry year scenario is shown in Table 3-13.

**Table 3-13: WFA Single Dry Year Imported Water Supply and Demand Comparison (AF)**

| WFA Wholesale: Single Dry Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Supply totals | 27,778 | 33,192 | 33,396 | 33,601 | 33,805 | 34,010 |
| Demand totals | 27,778 | 33,192 | 33,396 | 33,601 | 33,805 | 34,010 |
| **Difference** | **0** | **0** | **0** | **0** | **0** | **0** |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. Increase of 3.74 percent by 2040, interpolate for prior years. | | | | | | |

### 3.9.3.3 WFA Multiple-Dry Year Reliability

Based on MWD and IEUA's 100 percent reliability projection, WFA projects it will be capable of meeting all customers' demands potable water in multiple-dry years with an average demand increase of 5.98 percent by 2040 as shown in Table 3-14.

**Table 3-14: WFA Multiple Dry Year Imported Water Supply and Demand Comparison (AF)**

| WFA Wholesale: Multiple Dry Years Supply and Demand Comparison | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| First year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | **Difference** | **0** | **0** | **0** | **0** | **0** | **0** |
| Second year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | **Difference** | **0** | **0** | **0** | **0** | **0** | **0** |
| Third year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | **Difference** | **0** | **0** | **0** | **0** | **0** | **0** |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. Increase of 5.98 percent by 2040, interpolate for prior years. | | | | | | | |

# 4 WATER USE EFFICIENCY PROGRAM

## 4.1 Overview

Over the last five years, the State of California, specifically the southern California region, has reached a critical point in water supply reliability with the convergence of several key factors that include unseasonably low rainfall, critically dry conditions, drought, economic recession, and significant population increases. As a result of these conditions, water use efficiency has become a statewide priority, and most State and local leaders recognize it as a vital component in meeting current and future water supply needs and reliability.

IEUA and retail member agencies have recognized the need for developing programs that protect existing water resources so that adequate water supplies will be available for sustainability and future growth. The development of reliable local resources has been critical to maintaining current and future water supplies. The need for regional water supply diversification and an increase in local water resources is the primary force ensuring the reliability of IEUA, WFA, and their retail agencies' water sources.

As the regional wholesale supplier of imported water for the area, IEUA has assumed the role of coordinating the region's activities and programs to reduce demand. IEUA has worked closely with IEUA's retail agencies (five of which are WFA's retail members) to facilitate the installation of thousands of water saving technologies and devices as well as the implementation of public outreach and education programs throughout the region. IEUA retail agencies, whose direct contact with retail customers is crucial to the implementation of water use efficiency measures, have co-funded these efforts with IEUA and taken a proactive approach in educating and working with their customers to conserve water.

In light of these circumstances, IEUA and their retail agencies' commitment to conservation has increased over the past 15 years as demonstrated through financial investments, policies, authorization of a broad range of water use efficiency (WUE) and conservation programs, expansion of the regional recycled water program, support for legislation, and local ordinance implementation.

*IEUA provides wholesale supplier assistance programs to all retail water agencies in the region inclusive of WFA's retail agencies.*

Despite this considerable progress, the future still presents uncertainties and significant challenges in maintaining regional water supply reliability. The continued development of new and expanded local resources is vital to sustaining current and future water sources.

IEUA through its retail agencies, currently serve a population of approximately 856,168 residents with an anticipated growth rate of approximately 30 percent over the next 25 years. Conservation and the efficient

use of water is the most cost-effective source of water supply and essential to meeting our regions demand, today and for years to come.

## 4.2 Commitment to Conservation

WUE programs are a significant part of IEUA's Water Resources Program and, in light of that, IEUA recognized early on that WUE would play a fundamental role in sustaining and meeting future water supply needs.

In September 1991, IEUA became one of the first water agencies to sign the California Urban Water Conservation Council (CUWCC)'s Memorandum of Understanding Regarding Urban Water Conservation (MOU), accepting and supporting to implement a prescribed set of urban water conservation BMPs. As one of the original signatories to the MOU in 1991, IEUA's highest conservation priority has been to ensure that good-faith efforts are made on behalf of the retail agencies in implementing BMPs, locally.

Over the last 25 years, IEUA has been and will continue to be committed to developing and implementing many core regional conservation programs that have been designed on the foundation of BMPs, and these programs continue to serve as a key component in the overall regional water resource management portfolio.

Moving forward, IEUA will continue to implement active and code-based BMP related activities using strategies identified in the 2015 Regional Water Use Efficiency Business Plan (Regional WUE Business Plan). IEUA's 2015 WUE Business Plan focuses not on water conservation with its short-term focus on current emergency conditions but instead on approaches that will provide prolonged savings to achieve WUE, a sustained reduction in water use, by creating a new resource value for water in the eyes of the end user. The Regional WUE Business Plan proposes a strategy to seek out inefficient water use customers, educating them about WUE goal attainment, and providing a "road map" to accomplish this. IEUA and its eight retail member agencies, of which five members are inclusive of the WFA, have agreed to implement parallel programs that have complementary approaches. The strategies identified seek to leverage assets through regional funding opportunities, inter-agency partnerships, and grants in order to provide a greater return on the region's investment in WUE and conservation and maintain financially sustainable conservation programs.

### 4.2.1 Core Water Use Efficiency Strategies for the IEUA Region

***Regional Goals***

- Achieve and maintain compliance with other water use efficiency laws and regulations
- Achieve a reduction in per-capita water use by 20 percent by 2020, as called for by SB X7-7
- Guide regional water use efficiency programs
- Relieve drought and environmental impacts on regional water supply
- Increase water use efficiency, eliminate waste, and improve water supply reliability

- Contribute to other regional water resource management goals through the identification and integration of common interests such as groundwater recharge and recycled water.

***Regional Principles***

There are five key elements to the WUE strategy within the IEUA region:

- **Promote Water Resource Management**. Manage effective WUE programs at a regional level using sound business decision-making practices to develop and implement strategies to meet water use efficiency targets and stretch limited water resources.
- **Develop and Implement Regional Programs.** Take advantage of economies of scale and stretch the limited regional WUE budget by implementing programs on a regional basis. It is recognized that some programs may only be implemented at the individual agency level, such as budget-based tiered rate structures and WUE ordinances.
- **Build IEUA Retail Agency Cooperation.** Foster the cooperation, collaboration, and active participation of all IEUA retail agencies for the successful development and implementation of WUE programs. It is recognized that successful development and implementation of regional WUE programs requires retail agency cooperation in obtaining accurate water demand data, by customer class, in a timely manner, and promotion of cost-effective programs to customers.
- **Develop Incentive-Based Programs.** Develop effective incentive programs that encourage participation, provide public benefit, and achieve quantifiable water savings.
- **Public Recognition**. Provide recognition to customers who have implemented measures resulting in extraordinary water use efficiency achievements.

## 4.3 Legislative and Regulatory Requirements

As can be expected in a state with ongoing water resource issues, California's governing entities have issued a number of regulatory requirements and policies over the past decade.

Some of the regulations and policies have successfully driven down California's per capita water usage and increased the manufacturing standards for a number of major water consuming products utilized across all markets. Other regulations are aimed at achieving a higher level of water conservation during times of severe drought through temporary water use cutbacks and associated reporting.

Table 4-1 below is a summary of the current state regulations and information about the designated implementer for each regulation.

**Table 4-1: WUE Legislative and Regulatory Requirements**

| Regulatory Statute | Requirements | Agency or Regional Implementation | Approach |
|---|---|---|---|
| **Assembly Bill 1420** | Mandatory BMP Compliance. | Implemented by Agencies & IEUA | Lines up with actions taken to meet CUWCC BMP compliance – sunsets July 1, 2016 |
| **20x2020 (SB X7-7)** | Reduce per capita water use by 10% by 2015. AND Reduce per capita water use by 20% by 2020. | Implemented by the Regional Alliance | By implementing active water use efficiency programs and policy Initiatives the Regional Alliance are projected to be on track to meet per capita water reduction goals. |
| **Governor's Executive Order and Emergency Regulation** | Mandatory statewide reduction of 25% of residential per capita water use. Each agency assigned local target of 4 – 36%. | Implemented by retail each Agency | Implement active WUE programs, enforce mandatory watering days and eliminate water waste. All agencies are at, or near, compliance. |
| **AB1881 - Model Water Efficiency Landscape Ordinance (MWELO)** | ETo Allowances Residential 0.55 Commercial 0.45 | Implemented locally by city and/or county | Agencies need to educate customers and developers about ordinance requirements |
| **Assembly Bill 715** | Requires any toilet or urinal sold or installed in California cannot have a flush rating exceeding 1.28 and 0.125 respectively | Manufacturers, distributors, retailers, plumbers and customers must all adhere to new standards | Supply chain removes non-conforming fixtures from marketplace and supplies only efficient and conforming fixtures |
| **Senate Bill 407** | Requires existing buildings comply with 1992 standards | Implemented locally by city and county | Difficult to enforce. Could be added to current criteria for change of ownership inspections and reporting |
| **CalGreen** | 20% reduction of water use prescriptively designated Irrigation controllers shall be weather- or soil moisture-based | Implemented locally by city and county | Difficult to enforce. Could be added to current criteria for change of ownership inspections and reporting |
| **Senate Bill 555** | Requires water agencies to submit annual water loss reports | Implemented by Agencies | Agencies compile data and submit report to DWR |

| Regulatory Statute | Requirements | Agency or Regional Implementation | Approach |
|---|---|---|---|
| **Assembly Bill 1** | City or county cannot fine customers for failure to water | Local agencies to follow requirements of the bill | Agencies need to communicate requirements with cities and counties |
| **Assembly Bill 349** | HOAs cannot prohibit installation of artificial turf and allows for turf removal and installation of low water use plants | Local agencies to follow requirements of the bill | Agencies need to work with HOA's and community groups to educate about the bill |

## 4.4 SB X7-7 Requirements

IEUA, as an urban wholesale water supplier, is not required to develop a baseline or set reduction targets to achieve a 20 percent reduction in GPCD by 2020 as written under SB X7-7. However, as the statute does require urban retail water suppliers to comply, IEUA takes the position of preparing a regional approach establishing a baseline and setting targets based on regional demands and in support of its seven retail agencies that must comply. All retail agencies within IEUA's service area have agreed to the formation of a regional alliance, and will continue to cooperatively participate in developing WUE programs and meeting water conservation goals.

As a wholesale water supplier, IEUA is required to provide an assessment of its present and proposed future WUE measures, programs, and policies that will help its retail water suppliers achieve their water reduction goals.

IEUA and its retail members have developed core strategies to meet compliance requirements through a collaborative process that focuses on aligning activities with established regional water use efficiency principles and goals.

### 4.4.1 Historical Demand, Selected Baseline, and 20x2020 Targets

In the 2010 UWMP, the baseline and water use targets for the IEUA regional alliance were calculated using an aggregate of individual agency water use and population information to calculate one baseline GPCD for the whole IEUA region. To do this, IEUA analyzed historical retail demand data from 1995 to 2010 and selected a 10-year baseline period (1999 to 2008). The aggregate of individual agency water use and population information for the same period were used to calculate the regional alliance's baseline GPCD and water use targets for 2015 and 2020. The targets set in the 20x2020 Water Conservation Plan do not include recycled water use. Thus, recycled water use was subtracted from historical recycled water production to get retail demands for non-recycled supplies. Using historical population over the same time period, the following formula was applied to calculate GPCD. The 2015 interim target and the 2020 target was a 10 and 20 percent reduction from the baseline GPCD, respectively.

*Non-Recycled Demand (AF) x 325,851 gallons / population / 365 days*

The GPCD baselines and targets found using the regional aggregate approach are summarized in Table 4-2.

**Table 4-2**: **IEUA Regional Alliance GPCD Baseline and Targets (2010 Aggregate Approach)**

| Regulatory Statute | Baseline | 2015 Target (10% Reduction) | 2015 Actual | 2020 Target (20% Reduction) |
|---|---|---|---|---|
| **GPCD** | 251 | 226 | 160 | 201 |
| Note: Baseline GPCD was based upon average annual water sales years 1999 to 2008. | | | | |

In 2015, an alternative approach to calculating the regional water use targets was carried out to compare findings. For this method, each water supplier in the regional alliance first calculates its individual target in its retail UWMP as if it were complying individually. Then, the individual targets are weighted by each supplier's population and averaged over all members in the alliance to determine the regional water use target. The GPCD baselines and targets found using the population weighted average approach are summarized in Table 4-3 and shown individually in Table 4-4. In 2015, each retail water supplier revised their baseline per capita water use calculations which resulted in an updated per capita water use targets.

The 2015 population for the sum of IEUA's retail member agencies within the regional alliance is 866,027 which includes IEUA's total service area as well as boundaries outside of the service area. Most of IEUA's member agencies used the Department of Finance population data. However, one agency used the persons-per-connection method, one used the DWR population tool, and one used the "other" method. The sum of the member agencies 2015 population estimate yields a regional population of 866,027. This is the 2015 population number used to determine the regional alliance's 2015 gallons per capita per day (GPCD).

**Table 4-3**: **IEUA Regional Alliance Summary of Baseline Period, Baselines, and Target GPCDs**

| **Baselines and Targets Summary** *Regional Alliance Only* | | | | | |
|---|---|---|---|---|---|
| Baseline Period | Start Year | End Year | Average Baseline GPCD* | 2015 Interim Target GPCD | Confirmed 2020 Target GPCD |
| 10-15 year | 1995 – 1999 | 2004 – 2008 | 243 | 218 | 194 |
| 5 Year | 2003 – 2005 | 2007 - 2009 | 227 | | |
| NOTES: Baselines and targets were determined by calculating the weighted average for each category, taken from the verification forms for each retail agency within the Regional Alliance. | | | | | |

**Table 4-4**: **Regional Alliance Compliance by Retail Agency**

| Agency | 2015 Service Area Population | Baseline GPCD (5 Yrs) | Baseline GPCD (10-15 Yrs) | 2015 Target GPCD | 2015 Actual GPCD | 2020 Target GPCD | Selected Compliance Method (1 or 3) |
|---|---|---|---|---|---|---|---|
| Chino | 73,683 | 238 | 237 | 213 | 157 | 189 | 1 |
| Chino Hills | 77,596 | 202 | 217 | 195 | 162 | 173 | 1 |
| CVWD | 200,466 | 284 | 291 | 262 | 180 | 233 | 1 |
| Fontana | 215,520 | 204 | 216 | 194 | 138 | 173 | 1 |
| MVWD | 54,198 | 193 | 205 | 184 | 99 | 164 | 1 |
| Ontario | 168,777 | 189 | 235 | 207 | 152 | 188 | 1 |
| Upland | 75,787 | 262 | 271 | 244 | 233 | 217 | 1 |
| **IEUA region** | **866,027** | **227** | **243** | **218** | **160** | **194** | |

## 4.4.2 2015 Compliance

In this 2015 Regional UWMP, the region must demonstrate compliance with its 2015 water use interim compliance target indicating whether or not the Regional Alliance is on track to meet the 2020 water use target. Table 4-5 provides the regional urban water use targets for the IEUA region as well as the actual 2015 GPCD. The actual 2015 water use in the region is 160 GPCD, approximately 27 percent lower than the 2015 target of 218 GPCD which is indicative of the collective efforts of IEUA and retail agencies to reduce water use in the region.

**Table 4-5: IEUA Regional Alliance's 2015 Compliance**

| **2015 Compliance** *Regional Alliance Only* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | **Optional Adjustments to 2015 GPCD** *From Methodology 8* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? Y/N |
| | | Extraordinary Events | Economic Adjustment | Weather Normalization | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 160 | 218 | - | - | - | 0 | 160 | 160 | Yes |
| NOTES: Actual 2015 GPCD and 2015 target was determined by calculating the weighted average for each category, taken from the verification forms for each retail agency within the Retail Alliance. | | | | | | | | |

IEUA's service area exceeds the 2015 reduction goal and also expects to exceed the SB X7-7 goal for the 2020 target. This will be accomplished through regional and local actions using:

1. **Water Use Efficiency (WUE) Active Programs** – offering customers a portfolio of programs including cost-effective indoor and outdoor water efficiency measures.
2. **WUE Passive Policy Initiatives –** including building codes and landscape ordinances.
3. **Recycled Water Use** – reducing demand for potable water by increasing recycled water supply.

Table 4-6 shows the anticipated GPCD reduction from the WUE activities and recycled water supply in 2015 and 2020 as modeled in IEUA's 2015 Water Use Efficiency Business Plan Update:

**Table 4-6: Impact of WUE Activities and Recycled Water Supply**

| | 2015 GPCD | 2020 GPCD |
|---|---|---|
| Projected GPCD reduction from WUE Active and Passive Activities | 3 | 6 – 11* |
| Projected GPCD reduction from Recycled Water Supply | 21 | 35 |
| TOTAL Projected GPCD Reduction | 24 | 41 – 46* |
| 10 Year Baseline GPCD | **243** | |
| Regional GPCD Target | 218 | 194 |
| Regional GPCD Projected Achievement** | 160 | 169 – 174* |

*Range represents GPCD reduction with and without Budget-based Water Rate implementation.
** 2015 GPCD numbers are reported actuals

## 4.5 Projected Water Savings

Table 4-7 depicts the projected annual water savings from active WUE activities projected for the five-year implementation period FY2015-16 to FY2019-20. However, as presented in Chapter 3, Table 3-1 (Current and Projected Regional Baseline Urban Water Supply Sources), savings from WUE programs are recognized as a water supply source and projected to offset water demands from 9,788 AF in 2020 to 27,802 AF in 2040. This is equivalent to a 10 percent reduction in 2040 demand from Table 2-3 as recommended through IEUA's IRP Phase I.

**Table 4-7: Projected Annual Water Savings**

| Projected Annual Water Savings | |
|---|---|
| Fiscal Year | Annual Water Savings (AF) |
| 2015/16 | 1,975 |
| 2016/17 | 3,083 |
| 2017/18 | 9,206 |
| 2018/19 | 9,502 |
| 2019/20 | 9,788 |

### 4.5.1 Water Savings by Sector

Table 4-8 below depicts the water savings by sector. 84 percent of the projected savings will be realized from the single family sector predominately through landscape measures. Savings from the programs targeted residential landscape and dedicated irrigation customers together represent nearly 99 percent of the total savings projected for FY2015-16 to FY2019-20 within IEUA's service area.

**Table 4-8: Water Savings by Sector**

| Sector | Lifetime Water Savings (AF) | Percent of Total Water Savings |
|---|---|---|
| Single Family | 124,389 | 84% |
| Multi-family | 103 | 0.07% |
| Commercial | 835 | 0.55% |
| Irrigation | 22,717 | 14.8% |
| **Total** | **148,044** | |

### 4.5.2 Passive versus Active Savings Assumptions

Some of the most significant and cost-effective water savings in California have come from state or national updates to plumbing and building codes. These changes are referred to as "passive" savings, simply because they require no active program efforts for local water agencies. The Alliance for Water Efficiency's (AWE) Tracking Tool calculates the passive savings from activities including:

- Residential and commercial HETs
- Single family and multi-family high efficiency clothes washers (HECW)

Table 4-9 shows the estimated passive and active water savings to be achieved through the five-year plan outlined in the 2015 Water Use Efficiency Business Plan.

**Table 4-9: Estimated Passive and Active Water Savings**

| Water Savings Category | Five-Year Savings (AF) | Total Lifetime Savings (AF) |
|---|---|---|
| Passive Water Savings | 3,150 | 146,933 |
| Active Water Savings | 33,554 | 147,836 |
| **Total** | **36,704** | **294,769** |

Over the last five years, IEUA and its regional retail member agencies have developed a strong partnership and a coordinated approach to water use efficiency and conservation management measures that reduce water use. This partnership will continue into the future as presented in the 2009 Short-Term Regional Water Use Efficiency Business Plan, the 2010 long-term Regional Water Use Efficiency Plan and the most recently completed 2015 Regional Water Use Efficiency Business Plan Update. The eight retail agencies, along with IEUA, have developed a strong collaborative working relationship and accomplished the following as a result of the planning process:

- Agreement on a regional strategy to focus on landscape water use efficiency as well as a portfolio of regional programs;
- Completion of a documented plan that provides the implementation steps necessary to launch the programs as well as clearly defined roles/responsibilities between IEUA and the retail members; and,
- Commitment from IEUA to administer the regional programs with retail members responsible for marketing, outreach, and possible augmentation of programs within their individual service areas.

## 4.6 Water Use Efficiency Programming (2010-2015)

It is necessary to understand past achieved conservation when determining remaining conservation potential. Data from the region's locally administered programs, as well as MWD's regional rebate programs was collected from IEUA's fiscal year (FY) reports 2002 through 2015. The data was entered into the AWE Tracking Tool and is summarized in the Table 4-10.

The total lifetime water savings for all of the measures is estimated at 89,161 AF. Toilets, HETs and ultra-low flow toilets (ULFT), have provided the most significant savings at 49,347 AF over the life of measures. This represents over 55 percent of the total water savings. Smart controllers provide savings of 8,581 AF

representing over 9 percent of total savings. Over half of the smart controller savings came from central irrigation control system rebates through MWD's Public Agency Program.

**Table 4-10**: **Lifetime Savings by Measure for Past Achieved Conservation**

| Measure | Lifetime Savings (AF) | Percent of Total Savings |
|---|---|---|
| High Efficiency and ULF Toilets (all markets) | 49,347 | 55.35% |
| Smart Controllers (all markets) | 8,581 | 9.62% |
| High Efficiency Clothes Washers (all markets) | 6,669 | 7.48% |
| High Efficiency Nozzles (all markets) | 5,966 | 6.69% |
| Fontana USD Retrofits | 4,170 | 4.68% |
| Ultra Low Volume Urinals | 4,155 | 4.66% |
| Residential Landscape Retrofits | 4,104 | 4.60% |
| Turf Removal (all markets) | 2,911 | 3.26% |
| Landscape Evaluations | 1,855 | 2.08% |
| Water Brooms | 416 | 0.47% |
| Pre-rinse Spray Valves | 379 | 0.43% |
| X-ray Film Processors | 304 | 0.34% |
| Cooling Tower Controllers | 142 | 0.16% |
| Laminar Flow Restrictors | 105 | 0.12% |
| Pool Cover | 28 | 0.03% |
| Large Rotatory Nozzles | 22 | 0.02% |
| Air-Cooled Ice Machines | 5 | 0.01% |
| Rain Barrels | 2 | 0.00% |
| **Total** | **89,161** | |

### 4.6.1 Past Program Activity – Estimated Savings FY2010 – 2015

When evaluating past performance, it is also important to view activity and performance in the most recent years. This allows for better identification of trends and assessment of a given program's ability to deliver results.

Table 4-11 provides a summary of the savings by program for the last five fiscal years, FY2010-11 to FY2014-15. The total lifetime water savings is estimated at 30,856 AF. These savings are nearly double what was projected in the 2010 Water Use Efficiency Business Plan with estimated savings of 16,055 AF.

**Table 4-11: Savings by Program - Last Five Fiscal Years (FY 2010-11 to FY 2014-15)**

| Measure | Lifetime Savings (AF) | Percent of Total Savings |
|---|---|---|
| High Efficiency Toilets (all markets) | 8,413 | 27.3% |
| FreeSprinklerNozzles.com | 5,679 | 18.4% |
| Fontana USD Retrofits | 4,170 | 13.5% |
| Residential Landscape Retrofits | 4,105 | 13.3% |
| High Efficiency Clothes Washers | 2,826 | 9.2% |
| Turf Removal (all markets) | 2,059 | 6.7% |
| Smart Controllers (all markets) | 1,973 | 6.4% |
| High Efficiency Nozzle Rebates (all markets) | 983 | 3.2% |
| Ultra Low Volume Urinals | 775 | 2.5% |
| Landscape Evaluations | 674 | 2.2% |
| Laminar Flow Restrictors | 105 | 0.3% |
| Cooling Tower Conductivity Controllers | 71 | 0.2% |
| Air-Cooled Ice Machines | 5 | 0.0% |
| Rain Barrels | 2 | 0.0% |
| **Total** | **30,856** | |

As with previous years, toilets still represented the most significant savings (27.27 percent), however, the locally administered programs, FreeSprinkerNozzles.com, Fontana USD Retrofits, and Residential Landscape Retrofits represented over 45 percent of combined savings. Each of these programs provided landscape and irrigation measures and was implemented through voucher and direct install delivery mechanisms versus the standard rebate-style program.

In the last two years, savings from turf removal increased significantly (over 300 percent) due to the increased incentive available through MWD's Regional Rebate Program.

### 4.6.2 Indoor Passive Water Savings and Saturation

Water agencies have promoted indoor water use efficiency since the early 1990's. Indoor water use efficiency has focused on upgrading high water use fixtures such as toilets, showerheads, and clothes washers. Examples of common programs are rebates to upgrade fixtures and direct installation programs (active conservation). In addition, water agencies have supported upgrading plumbing codes that require high efficiency fixtures (passive conservation). Both passive and active conservation has contributed to saturation of indoor measures. For future program planning it is important to understand the saturation and thereby the remaining potential.

*Single Family Homes: Saturation of High Efficiency Toilets and Clothes Washers*

Table 4-12 shows the current saturation of HETs and clothes washers in single family residences. "Efficient" toilets are defined as ULFT or better (saturation includes anything 1.6 gallons per flush (gpf) or better). Recent active programs have focused on HETs (1.28 gpf) and current programs focus on "premium" fixtures (1 gpf or less).

For toilets, the saturation rate is a significant 79 percent. Of the inventory of 390,324 fixtures in IEUA's service area, there are approximately 83,383 non-efficient toilets remaining.

For HECWs, the saturation rate in single family homes is 53 percent. There are an estimated 161,925 clothes washers in the Region's single family residential sector. Of the inventory of fixtures in the IEUA service area, there are approximately 75,000 non-efficient clothes washers remaining. "Efficient" clothes washers have a water factor of 8 or better, which includes all residential front loaders and the most efficient of the newer top loaders.

**Table 4-12: Single Family Market Potential: Saturation of Efficient Toilets and Clothes Washers**

| Single Family | Toilets | Clothes Washers |
|---|---|---|
| Total Devices | 390,324 | 161,925 |
| Remaining (Non Efficient) Devices | 83,383 | 75,932 |
| Devices Actively Retrofitted | 18,940 | 15,359 |
| Devices Passively Retrofitted | 288,001 | 70,633 |
| Saturation | 79% | 53% |
| **Total Water Savings Potential** | **3,544 AFY** | **8,163 AFY** |

*Multi-family Homes: Saturation of High efficiency Toilets and Clothes Washers*

Table 4-13 shows the saturation in the multi-family sector. HET saturation is even higher at nearly 100 percent and saturation of HECWs is 44 percent. One reason for the high saturation rate for toilets is that the IEUA and its regional partners have been extremely aggressive implementing direct install programs for more than a decade.

**Table 4-13**: **Multi-Family Market Potential: Saturation of Efficient Toilets and Clothes Washers**

| Multi-Family | Toilets | Clothes Washers |
|---|---|---|
| **Total Devices** | 117,559 | 29,771 |
| **Remaining (Non Efficient) Devices** | Very few | 16,785 |
| **Devices Actively Retrofitted** | 31,534 | Not categorized |
| **Devices Passively Retrofitted** | 94,956 | 12,987 |
| **Saturation** | Near 100% | 44% |
| **Total Water Savings Potential** | **NA** | **1,804 AFY** |

**Remaining Potential for Toilets**

Due to the high saturation rate of residential toilets as well as current code, it is recommended that the region no longer offer programs for toilet replacements.

**Remaining Potential for Clothes Washers**

There is still some market for HECWs. Future programs should offer incentives for the highest efficiency models because many customers are already choosing efficient models without incentives.

## 4.7 Wholesale Supplier Assistance Programs

### 4.7.1 FY 2010-11 to FY 2014-15 Conservation Programs

From FY 2010-11 to FY 2014-15, IEUA and its retail member agencies developed strategies and actions that exceeded the water use efficiency goals set forth in the 2010 Regional Water Use Efficiency Business Plan. Over the 5-year period, the regional program performance exceeded the water savings goal by 200 percent with half of the funding estimated to be spent in order to achieve the savings goals outlined in the 2010 Regional Water Use Efficiency Business Plan. The cornerstone of IEUA's efforts over the last five years has been the development and implementation of programs that meet and exceed the SB X7-7, Assembly Bill 1420 - mandatory implementation of Demand Management Measures (DMM), the Governor's Executive Order, statewide mandatory water use reductions, and emergency drought regulations.

IEUA works collaboratively with its retail agencies to facilitate programs and services that provide education, and distributes and installs high efficiency water saving activities throughout the region.

Each year, staff prepares a comprehensive annual report that captures all of the implemented activities from the past fiscal year. The annual report tracks the progress that has been made against the goals and objectives, identified in IEUA's long-term Water Use Efficiency Plan, and provides the retail agencies with

service area specific data. All Annual Water Use Efficiency Programs Reports are posted on IEUA's website for public access.

Creating public value means to develop and implement programs that will capture the public's interest and sustain local water supplies at a reasonable cost. This ambitious goal calls for a new vision for conservation that includes a transformation in the way the public values water and embraces efficiency within individual residences, businesses, institutions, and landscapes. Achieving this vision requires a long-term coordinated effort on the part of IEUA, its retail member agencies, and other stakeholders.

Water efficiency programs connect directly to communities, necessitating citizen involvement. The programs empower water customers to manage their own use and water bills. Water efficiency programs stimulate economic growth through driving manufacturers to produce more water efficient technology innovation in product design and through the distribution of those products utilizing a variety of retail and wholesale networks. Increasing water efficiency can preempt the need for new energy-intensive water supply development while also reducing greenhouse gases (GHG).

Despite considerable progress, the region still faces water supply uncertainties and significant challenges to maintain regional reliability. Water conservation strategies have visibly changed over the past five years as a result of state and local policies that require increased water conservation and improved efficiency, technological improvements that increase water savings potential, and advancements in methods of communication that provide new opportunities to engage and educate the public. These changes create a new foundation for future water conservation efforts. The preservation of local water resources is essential to regional sustainability and is the cornerstone in shaping current and future regional water efficiency strategies.

Water use efficiency and conservation are key fundamentals of IEUA's long-term water resource management strategy. They are essential to IEUA's mission in providing regional water supply reliability and in demonstrating good stewardship of both local and imported water supplies. The objective of the water use efficiency program is to reduce the region's need for more expensive water sources and maximize the efficient use of existing supplies.

The current and future suite of water use efficiency programs focuses on increased efforts in landscape management and reducing outdoor water use. Programs are designed to positively impact long-term behavior regarding efficient use of water. Those activities include education through landscape management training workshops, rebates for residential and commercial customers, a voucher program for free high efficiency sprinkler nozzles, landscape evaluations, and landscape retrofits which incorporate hardware and climate appropriate plant recommendations that are consistent with landscape ordinances. This is combined with the ability to initiate a comprehensive marketing, education, and outreach program which includes the combined efforts of IEUA and its retail agencies.

IEUA's strategy and priorities have been realigned to maintain sustained demand reductions and exceed per capita water use reductions of 10 percent by 2015 and 20 percent by 2020. Regional planning for the next 25 years is dependent upon the savings goals for IEUA retail agencies. IEUA recognizes that its regional strategy does not, by itself, assist its retail agencies in achieving their own legislatively mandated water use reduction goals. IEUA is, thus, further committed to assisting its retail members in achieving their individual water use reduction goals through regional programs and technical assistance.

#### 4.7.1.1 Wholesale Agency Support

IEUA provides financial assistance to each of the local retail agencies in an effort to support local WUE implementation efforts. Specifically, IEUA provides an annual grant of $2,000 to each agency for a BMP related program or project. In addition, IEUA covers dues costs for memberships in the AWE and the CUWCC on behalf of the retail members and conducts annual technical workshops that provide retail members with information related to specific water use efficiency initiatives, programs, BMP implementation and compliance with new statutory requirements.

This is part of IEUA's commitment to the DMMs (Wholesaler Assistance Programs) which requires a wholesaler to provide financial and/or technical assistance to their local retail member agencies to implement DMMs.

Over the past five years, member retail agencies have used their grant monies for a variety of conservation related activities that include purchasing materials for public outreach and education, magnetic conservation signage for vehicles, special events, Children's Environmental Educational Festivals, and expansion of school education programs.

IEUA has an annual average WUE budget of approximately $900,000 that is dedicated to supporting the local retail members in implementing WUE and conservation related programs.

#### 4.7.1.2 Residential Programs and Accomplishments

Between 2010 and 2015, IEUA and its retail members continued implementing a variety of WUE and conservation programs and products that have led to significant accomplishments in demand reduction and sustained water savings. These programs have consisted of incentives for homeowners and businesses, landscape efficiency and educational programs. Most of these programs have been very successful and others were introduced as pilots.

The following is a list of activities and programs that were accomplished by IEUA and its retail members from 2010 to 2015:

- ***MWD So Cal Water$mart Residential Rebate Program*** IEUA's foundational WUE rebate program for residential customers provides incentives for HETs, washing machines, sprinkler nozzles, weather-based irrigation controllers, and rain barrels. IEUA and its retail members dedicate funding specifically for enhancing MWD's base rate rebate amounts to attract higher customer participation.
- ***Multi-Family Toilet Installation Program*** Beginning in October 2006, IEUA and retail members launched a DWR grant funded toilet installation program to perform 22,500 retrofits throughout the service area. The program completed in May 2013. Since program inception, there has been a total of 22,500 ultra-low flush and HETs installed region-wide through this program.
- ***IEUA Water Softener Rebate Program*** On September 15, 2008, IEUA launched its Water Softener Removal Rebate Program. This project is the third phase of the Agency's Salinity Reduction Program that is addressing the impacts of automatic water softeners on IEUA's recycled water. The goal of this project is to demonstrate the transferability of a financial incentive "rebate" for the removal of residential self-regenerating water softeners within the service area of the IEUA. Since program inception, 650 water softeners have been removed and $419,238.42 in incentives has been paid to

program participants. The removal of these devices will save approximately 12.368 AFY in addition to the removal of more than 150.15 tons of salt.

#### 4.7.1.3 Commercial, Industrial, Institutional Programs and Accomplishments

IEUA's service area hosts a diverse range of CII activities, including numerous service industries (such as hotels and restaurants), manufacturing, agriculture and health care, and a large number of schools and colleges. Each of these sectors present unique opportunities to reduce water consumption. Although commercial accounts comprise only 5 percent of the total number of accounts in the IEUA area, they use approximately 17 percent of the overall water demand.

During 2010 to 2015, in cooperation with local retail agencies and MWD, IEUA increased its efforts in the CII sector through MWD's SoCalWater$mart Program and Save-A-Buck Program, offering an array of water saving technologies and through augmenting supplemental funding for those rebates. These rebate devices include HETs, urinals, and washing machines, cooling tower conductivity controllers, pressurized water brooms, pre-rinse spray nozzles, weather-based irrigation controllers, and high efficiency sprinkler nozzles. This program provides an important financial incentive to make it cost-effective for business and industry to participate in programs that reduce water use. For the local retail water agencies, this program helps them meet their DMM obligations under the CII DMM.

The following is a list of activities and programs that were accomplished by IEUA and its retail agencies from 2010 to 2015:

- ***MWD SoCalWaterSmart.com CII Rebate Program*** IEUA's foundational WUE rebate program for commercial, industrial and institutional customers provides incentives for a menu of devices that include plumbing fixtures, landscaping devices, and some industry specific technologies.
- ***Fontana Unified School Retrofit Program*** This joint venture project was a partnership between FWC and IEUA. FWC appropriated $210,613 in funding for conservation for the Fontana Unified School District. IEUA provided administrative oversight and management for that included the installation of HETs, high efficiency urinals (HEU), WBICs, and high efficiency sprinkler nozzles (HEN) throughout the entire school district over a three year period.
- ***MWD CII Save-A-Buck Program*** This is IEUA's foundational conservation rebate program for commercial, industrial and institutional sectors. Approximately 45,212 devices were processed for rebates over the course of the program with an estimated water savings of 2,916 AF per year and lifetime water savings of 14,134 AF. The program ended in 2012.

#### 4.7.1.4 Landscape Programs and Accomplishments

The semi-arid climate of southern California, with only 15 inches of average annual rainfall, combined with the lush landscaping aesthetic that predominates in the region, creates a significant water demand for irrigation of outdoor landscaping. The IEUA service area reflects this demand, where outdoor water use is estimated to be nearly 70 percent of total demand across all sectors.

During 2010 to 2015, irrigation technology continued to advance and has increasingly contributed to WUE in water agencies throughout California. Outdoor irrigation is the single largest water use for residential property owners and most commercial property owners. In California, landscape irrigation is about 60

percent of overall water use. For the local retail water agencies, the landscape programs help them meet their CUWCC MOU obligations under the Landscape BMP.

The following is a list of activities and programs that were accomplished by IEUA and its retail agencies over the last five years:

- ***Weather-Based Irrigation Controller Rebate*** Launched in January 2006, this program has provided incentives for up to $300 per controller through MWD and a grant from DWR. Since program inception until FY 2014-15, there have been 549 rebates issued with an estimated annual water savings of 179 AF and savings of 1,822 AF over the life of the devices.
- ***Residential Landscape Transformation Program*** Launched on October 1, 2012, the Landscape Transformation Program offered residential participants a turnkey approach to turf removal. Participants were provided with contractor services that included landscape design, selection of climate appropriate plants from a variety of plant palettes, removal of living turf, installation of weed barriers and plants, and conversion of overhead sprinklers to drip irrigation. This program allowed customers to convert between 500 and 1,000 square feet of their landscaping for a nominal co-pay of $0.30 per square foot.
- ***IEUA Regional Residential Landscape Retrofit Program*** Initially launched in April 2011, this program provides outdoor irrigation evaluations and upgrades existing controllers and sprinkler nozzles with high efficiency landscape devices for residential customers who irrigated area is a quarter acre for larger and who have been identified as high water users within the top 10 percent of the participating retail water providers' customer base.
- ***FreeSprinklerNozzles.com Voucher Program*** Initially launched in April 2011, this online program enables residents and CII customers within IEUA's service area, regardless of water provider, to obtain a voucher for free Precision™ Series irrigation spray nozzles through a web-based portal. These nozzles are proven to provide up to a 20 percent water savings per head (1,300 gallons annually) without adjusting controllers or irrigation run times. Since program inception, a total of 5,827 vouchers have been redeemed representing 221,421 nozzles through local authorized distributors throughout IEUA's service area. The total estimated water savings from the installed devices represents 1,109 AFY.
- ***Landscape Evaluation and Audit Program (LEAP)*** The LEAP Program, administered by the Chino Basin Water Conservation District in partnership with IEUA and retail members, provides landscape and irrigation evaluations for residential, commercial, institutional and industrial customers. This program was launched in 2007 through a grant from DWR and is available region-wide and offered annually.

## 4.8 Public Education and Outreach

### 4.8.1 Education and Outreach Programs Accomplishments

Developed over the last 15 years and in cooperation with its local retail agencies, IEUA participates in and offers an array of regional educational outreach activities

These programs all help to provide support to the local retail members to help them meet their DMM requirements (School Education and Public Information).

The following is a list of programs and activities implemented over the last five years and that will continue to be foundational elements of IEUA's regional programs over the next five years (FY2015-16 to FY 2019-20).

- **National Theatre for Children Program** National Theatre for Children (NTC) delivers a package of live theatre, student curriculum and teacher guides to elementary schools throughout the region.
- **Shows That Teach** Shows That Teach (STT*)* provides educational and motivational school assembly programs that focus on water education.
- **Garden in Every School® Program** Grants are awarded to elementary schools within IEUA's service area for the establishment of a water-wise gardens. In addition, a blog is available for educators, parents, and community members to follow the development of the gardens, acquire gardening tips, curriculum tips and water savings tips at ieuagies.blogspost.com.
- **Water Discovery Field Trip Program** Free educational field trips are provided at the Chino Creek Wetlands and Educational Park to promote the public understanding of the value of natural treatment wetlands, the creation of habitat for endangered/sensitive species and environmental stewardship. A busing mini-grant is offered to schools within the state of California to take part in the field trip program, partially funded by the California Department of Parks and Recreation.
- ***Regional Water Conservation Outreach Campaign*** IEUA provides conservation and drought outreach messaging to the community by monthly ads including, water softener removal rebate ads, "No Drugs Down the Drain" ads, water saving tips, etc. In addition, IEUA staff implemented a 12 week drought campaign in local movie theaters featuring 15 second drought and water conservation ads. The ads were run annually on all screens at theaters in Ontario, Rancho Cucamonga, and Chino Hills.
- ***IEUA Regional Landscape Training Workshops*** In this series of IEUA sponsored courses; residential landscapers learn the latest ways to reduce water usage through workshops. The courses cover information on the basics of efficient irrigation systems, the benefits of properly watering and fertilizing landscaping, landscape design techniques and plant identification. Courses are held throughout IEUA's service area with participants attending workshops held by CVWD, MVWD, FWC, and the cities of Chino, Chino Hills, Ontario and Upland.
- ***Community Outreach*** IEUA annually participates in the following community outreach activities in coordination with its retail member agencies:
    - San Bernardino County Water Conference
    - Landscape and Water Conservation Fair
    - City of Chino Hills Day at the LA County Fair
    - City of Chino Day at the LA County Fair
    - CVWD's Earth Day

  - Earth Day at the Chino Creek Wetlands and Educational Park
  - Chino Valley YMCA Healthy Kids Day
  - Compost Awareness Week

- ***IEUA's Social Media Outreach*** On September 16, 2014, IEUA launched its Twitter channel- @IEUAwater. IEUA continues to offer updates via Facebook and Twitter, an educational blog as well as a Chino Creek Park blog in order to outreach and provide up-to-the-minute information on events, news, education programs, drought updates, and conservation tips and facts, including "Water Tip Wednesdays." The blogs are attached to IEUA's Facebook page and website for outreach messaging as well.
- ***IEUA's Regional "Water is Life" Student Art/Poster Contest*** IEUA hosts its annual "Water is Life" student art/poster contests for grades K-12. The theme "Water is Life" is used to help students express their creativity while focusing on the importance of water. IEUA typically receives over 1,000 entries annually. The top three winners from each category (K-5; 6-8; 9-12) are sent to MWD to be entered into their regional contest.
- ***Inland Empire Landscape Alliance (IELA)*** The IELA was established as a voluntary collaborative working group in which landscaping policies are reviewed and implementation regionally. The IELA provides a unified voice in recommending landscaping related policies within the Chino Basin, ensuring that landscaping ordinances meet or exceed new standards laid out in AB1881 (Water Model Efficient Landscape Ordinance), identify needs and share information that will support all city and agency landscape efficiency and water conservation development programs, while providing access to funding opportunities including federal, state and local grants that support this effort
- ***IELA - The California Friendly® Water Wise Landscape Manual*** was completed, printed, and distributed throughout the service area in March 2011. The initial printing of 1000 copies was so popular that an additional 1000 copies were printed a month later. To date, 2,500 copies have been distributed to residents by cities at their planning counters, Home Depot parking lot plant sales, Earth Day events and various garden workshops hosted by member agencies. At distribution events, many residents requested information about low water use landscapes in fire and erosion prone areas. As there was still time and funding available due to reduced printing costs for the California Friendly® Water Wise Landscape Manual, a complementary Water-Wise Fire Resistant Landscaping for Erosion Prone Areas guide was created, printed, and approximately 500 have been distributed to date.
- ***MWD Solar Cup*** The annual Solar Cup competition is held each year in May at MWD's Lake Skinner reservoir in the Temecula Valley. High school students from surrounding areas designed, built, equipped and raced solar-powered boats. This competition encourages well-thought out boat design, high speed and endurance, which require participants to use an alternative power source in a real world application. IEUA co-sponsors three local highs school teams annually.
- ***Water Saving Garden Friendly*** The program was developed by Eastern Municipal Water District, IEUA, San Bernardino Valley Municipal Water District and Western Municipal Water District. The program has expanded to other parts of California and as far as Texas. The program makes it easy to spot outdoor water efficient irrigation products, plants and landscape material by looking for the bright

and colorful Water Saving Garden Friendly sticker. The program is a public-private partnership open to all landscape retailers. Events take place in the spring and fall at various locations throughout the region. A partnership between Home Depot and the agencies has proved to be successful with the increasing number of returning and new customers attending the events. The events take place at Home Depot locations throughout the IEUA service area, including Rancho Cucamonga, North and South Upland, Chino and Fontana.

- ***IEUA Regional Water Use Efficiency Business Plan (5 Year Plan)*** An extension of the IEUA "Interim" Plan, the long-term business plan provides more in-depth research and technical analysis on past, present and potential future programs. The plan includes detailed sector analyses based on end-use data, a regional saturation evaluation based on implemented WUE programs, identification of active and passive water savings within the region, cost-benefit analyses for existing and potential WUE programs, and potential water savings opportunities. The purpose of the long term plan is to develop a blueprint to help IEUA and its retail members comprehensively plan for and implement future water use efficiency activities and programs over a five year period.
- ***Water Education Water Awareness Committee (WEWAC)*** Since 1989, the Water Education - Water Awareness Committee promotes the importance of water conservation in southern California through coordination and participation in community outreach projects and providing grant funded opportunities for local educators. Projects include hosting booths at local resource and educational fairs, conducting water education workshops at local primary and secondary schools, offering grant opportunities to educators, and sponsoring an annual water conservation video contest. IEUA participates with 12 other water agencies in San Bernardino County and Los Angeles County.
- ***Regional Water and Landscape Fair*** Held annually in October, the fair is a community awareness partnering event with the Chino Basin Water Conservation District, IEUA and its retail agencies created to educate the public on the importance of using water efficiently. Over 1,000 people usually attend the event where money saving devices, tips and rebate information is provided.

## 4.9 Water Use Efficiency Programming (2015-2020)

With major challenges ahead, IEUA recognizes that a sound, fact-based plan is needed as a tool to guide water use efficiency program implementation over the upcoming years. IEUA, working in tandem with the eight agencies, created a Regional Water Use Efficiency Partnership Workgroup and initiated an eight-step process that resulted in the creation of a Regional WUE Business Plan (see Appendix F).

The Regional Water Use Efficiency Business Plan includes the following information:

- Water reduction goals and regulatory compliance.
- Market condition and potential.
- A strategy for reaching water savings goals.
- Recommended programs with budgets, water savings, costs, marketing and operational details.
- A program implementation plan and schedule.

- A system for tracking and reporting performance over time.

### 4.9.1 Selected Programs

The selected programs, with their heavy emphasis on landscape opportunities, will integrate the following elements:

- **High Efficiency Nozzle Installations (FreeSprinklerNozzle.com Voucher Program)** – Retrofitting pop-up spray heads with high efficiency rotary nozzles is a low cost measure and delivers high water savings. The saturation rate of high efficiency nozzles is extremely low, and the sheer volume of spray heads offers a prime market opportunity.
- **Smart Controllers in Combination with High Efficiency Nozzle Installations for Larger Landscape Sites** – Smart controllers are cost-effective for sites with large landscape areas. By combining controllers with high efficiency nozzles, significant and cost-effective water savings can be achieved.
- **Residential Pressure Regulator Rebate Pilot Program** – A properly installed regulating valve at the main line into a residential property can reduce water flowing into irrigation systems and indoor fixtures to 60 pounds per square inch (psi) or below. This Pilot Program has created customer awareness of pressure regulators and proper pressure. It will also provide more information to IEUA and its regional partners on the importance and effectiveness of pressure regulation within their service area.
- **Turf Removal** – Although turf removal delivers extremely high water savings in most retrofit projects, it is not yet deemed cost-effective for IEUA to fund a turf removal “direct” incentive program at this time, unless substantially funded through outside sources. By offering a low interest financing option customers would not be required to pay for up-front costs and should be able to realize substantial water savings. As a result, IEUA will be driving a market transformation—away from high water use turf and towards regional plants with low precipitation rates and minimal irrigation needs.
- **Water Budgets** – A “water budget” is the calculated amount of water a customer would require over a particular time period (usually a month, billing cycle, or year) based on the lot size and local weather conditions. A Water Budget Program will educate customers about their water consumption patterns as compared to their budget. The savvy customer will be armed with a tool to better understand their usage and then independently make modifications to reduce their water use. The program is extremely cost effective because the educated customer makes the changes on their own thereby transforming the market.
- **Customer Engagement Technology and Data Analytics Program** - OmniEarth is a new technology that combines physical characteristics of parcels collected through aerial/satellite imagery (e.g. size, land cover type) with customer information (e.g. current and historical water usage) to create water budgets for each customer. The program compares water budgets with actual usage to identify customers who are exceeding their water budget and have the most room for efficiency. This information is then consolidated and presented in layered maps and easy to understand graphs.

- **Landscape Evaluations** – Comprehensive landscape evaluations provide customer education and information on landscape and irrigation system upgrades specific to each individual site. Intended to drive customers to make improvements in their landscape irrigation efficiency, the evaluations direct customers to SoCalWater$mart, Save-A-Buck or other customer incentives, as applicable.
- **MWD's SoCalWater$mart and Save-A-Buck Programs** – These programs are slated to continue until at least 2018, providing IEUA and its retail agencies with continued outside funding and program administration. Moving forward, IEUA will add additional funding to landscape water use efficiency products to provide increased customer response.
- **Education and Outreach Programs** – IEUA will continue to provide regional educational and outreach programs. Current regional education and outreach programs include the following:
    - National Theatre for Children
    - Garden in Every School
    - Residential Landscape Training Workshops
    - Water Wise Landscape Contest
    - Annual Water Fair
    - WEWAC
    - Regional Water Use Efficiency Outreach
    - No Water Waste Ordinance

On an annual basis, IEUA and its retail agencies will review the effectiveness and desirability of regional educational and outreach programs. Budget priority will be given to programs that assist retail agencies in meeting state mandates.

**Table 4-14: Selected Programs and Reasoning**

| Program | Reasoning | Support Actions |
|---|---|---|
| • Budget-Based Water Rates | - Sends strong price signal<br>- Drives over-allocation customers to consider changes<br>- Proven effective at reducing water demand | - Member agency education<br>- Rate evalution and implementation support through SAWPA grant |
| • Customer Engagement Software | - Customer-preferred communication method<br>- Allows retailers to send messaging & program links to over-allocation users<br>- Proven effective elsewhere for reducing demand | - Link new media and WUE programs with targeted customers |

| Program | Reasoning | Support Actions |
|---|---|---|
| • Landscape Evaluations | - Links customer with programs<br>- Provides one-on-one customer education<br>- Starts relationship with customer | - Use water budget data to identify customers<br>- Provide more visual report<br>- Implement automated and consisent follow up<br>- Provide more cost/benefit information<br>- Modernize data collection and reporting |
| • Residential Landscape Retrofit Program | - Target large water use<br>- Site visit verifies there will be savings<br>- Professional installation and programming of controller | - Provide electronic follow up with customer to ensure sustained savings |
| • Residential Smart Controller Upgrade Program | - Offering to smaller customer provides bigger pool of potential customers<br>- Site vistis verifies there will be savings<br>- Education workshop ensures customer can program and maintain controller and therefore sustain savings | - Use water budget and potential savings to show return on investment<br>- Consider customer co-pay option to lower costs |
| • FreeSprinklerNozzles.com Program | - Cost effective<br>- Targets large water use<br>- Hugely scalable<br>- Gateway measure | - Target largest users and over-allocation users to maximize savings and MWD funding<br>- Market more aggressively |
| • SoCal Water$mart Regional Rebate Program | - MWD funding<br>- MWD administration<br>- Ease of implementation | - Continue to add dollars to priority measures<br>- Market locally |
| • High Efficiency Nozzle Direct Installation Program | - Removes financial barrier of entry<br>- Ensures quality installation<br>- Hugh potential and scalability | - Implement aggressive marketing campaign<br>- Hire additional contractors<br>- Offer multiple nozzle manufacturers |

## 4.10 Value of Conservation

Between FY2010-11 and FY2014-15, IEUA and the regional retail water agencies have developed a strong partnership and a coordinated approach to conservation management measures that reduce water

use. Conservation has multiple benefits, one of which is the value of conservation to the region's ratepayers. Conservation also saves money to the ratepayer.

The eight retail agencies, along with IEUA, developed a strong working accord and accomplished the following as a result of the regional WUE planning process:

- Agreement on a regional strategy to focus on landscape WUE as well as a portfolio of regional programs;
- Completion of a documented plan that provides the implementation steps necessary to launch the programs as well as clearly defined roles/responsibilities between IEUA and the retail agencies; and,
- Commitment from IEUA to administer the regional programs with retail agencies responsible for implementing and possibly augmenting programs within their individual service areas.

Many retail agencies may need to develop an individual plan for their own agency in order to understand their specific compliance requirements and to address the local needs of their respective service areas.

Overall, there are multiple benefits of water use efficiency and conservation:

- Ratepayers save money on their water utility bills;
- Reduced urban runoff from improved irrigation efficiency;
- Avoidance of purchasing additional expensive imported water; and
- Environmental benefits

Another regional benefit for maintaining strong support for conservation is the reduced dependence on imported water. The Bay-Delta is the single most important link in California's water supply system. Two major water supply projects, SWP and the Central Valley Project convey water to more than 22 million Californians and 7 million acres of farmland. The IEUA service area receives a significant portion of its supply (about 30 percent) from SWP via MWD. Local water supply projects such as conservation help limit the amount of imported water for water supply, thus enhancing Bay-Delta environmental protection. Conservation also helps increase irrigation efficiency which reduces runoff.

### 4.10.1 Funding Goal

Currently, the IEUA regional conservation budget is approximately $2.2 million annually - $1.1 million of IEUA funding which leverage another $1.1 million of outside funding. These revenues are collected with the support and cooperation of the local retail water agencies. The source of IEUA revenues for the regional conservation budget is the Meter Equivalent Unit (MEU) which replaced the former imported water surcharge and the retail meter revenues.

These local funds are augmented with funding from our partner agencies such as MWD, DWR, and USBR to expand the grant funding to $1.1 million, annually. While having decreased substantially over the last several years, approximately $3 of outside funding continues to be secured for each $1 of IEUA regional revenues. Availability of outside funding to augment regional funds has steadily decreased since the economic decline.

The IEUA will continue to work on the development of new innovative conservation programs over the next twenty years. However, the foundation for future conservation programs will be built upon historical achievements, prior successful programs, available funding, evolving technologies, market transformation, and a coordinated effort on the part of IEUA, its retail agencies, and other stakeholders. The planned programs and activities for 2015 to 2020 outlined in IEUA's 2015 Regional Water Use Efficiency Business Plan.

### 4.10.2 Regional Educational and Outreach Programs

In addition to the nine selected active programs, IEUA and its regional partners will continue to provide regional educational and outreach programs. Current regional education and outreach programs include the following:

- **National Theatre for Children Program** NTC delivers a package of live theatre, student curriculum and teacher guides to elementary schools throughout the region.
- **Shows That Teach** STT provides educational and motivational school assembly programs that focus on water education.
- **Regional Landscape Training Workshops** In this series of regional sponsored courses; residential landscapers learn the latest ways to reduce water usage through workshops. The courses cover information on the basics of efficient irrigation systems, the benefits of properly watering and fertilizing landscaping, landscape design techniques and plant identification.
- **Garden in Every School® Program** Grants are awarded to elementary schools within IEUA's service area for the establishment of a water-wise gardens. In addition, a blog is available for educators, parents, and community members to follow the development of the gardens, acquire gardening tips, curriculum tips and water savings tips at ieuagies.blogspost.com.
- **Water Discovery Field Trip Program** Free educational field trips are provided at the Chino Creek Wetlands and Educational Park to promote the public understanding of the value of natural treatment wetlands, the creation of habitat for endangered/sensitive species and environmental stewardship. A busing mini-grant is offered to schools within the state of California to take part in the field trip program, partially funded by the California Department of Parks and Recreation.
- **IEUA Water Softener Rebate Program** The IEUA Water Softener Rebate Program is part of the third phase of the IEUA's Salinity Reduction Program that is addressing the impacts of automatic water softeners on IEUA's recycled water. The goal of this project is to demonstrate the transferability of a financial incentive "rebate" for the removal of residential self-regenerating water softeners within the service area of IEUA.
- **Water Saving Garden Friendly** The Water Saving Garden Friendly program was founded in 2011 to provide local communities with conservation-based educational opportunities, as well as information and access to climate-appropriate plants. Through partnerships with sponsors like Home Depot, Scotts Miracle Grow and others, the program hosts events, workshops, and other educational and "do-it-yourself" opportunities for local residents to learn about and enjoy sustainable landscaping. The

Garden Friendly program is a public-private partnership that welcomes the participation of all members of the public as well as interested landscape retailers.

### 4.10.3 Implementation Schedule and Activities per Year

Table 4-15 displays the projected annual activity for each measure. Toilets are being phased out in FY2015-16. As of October 2015, MWD only provides rebates for premium efficiency fixtures at a much discounted incentive. The model includes toilet activity prior to the change. Turf removal was not modeled after FY2015-16. It is likely that MWD will lower the current turf removal incentive and impose caps. If the regional partners chose to offer turf removal incentives more than likely they would have to fund the program themselves.

**Table 4-15: Annual Activities by Measure**

| Activity Name | Measure Metric | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|---|
| | Sites Evaluated | 200 | 150 | 150 | 150 | 150 |
| Cooling Tower Controller Rebates | Cooling Tower Controllers | 10 | 10 | 10 | 10 | 10 |
| FreeSprinklerNozzles.com | HE Nozzles | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| High Efficiency Clothes Washer Rebate | HE Clothes Washers | 500 | 500 | 500 | 500 | 500 |
| HE Nozzle Direct Install | HE Nozzles | -- | 30,000 | 30,000 | 30,000 | 30,000 |
| High Efficiency Nozzle Rebate (all markets) | HE Nozzles | 10,750 | 11,000 | 11,000 | 11,000 | 11,000 |
| High Efficiency Toilet Rebates (all markets) | HE Toilets | 2,600 | 0 | 0 | 0 | 0 |
| Premium Efficiency Toilet Rebate (MF) | HE Toilets | 750 | 0 | 0 | 0 | 0 |
| Rain Barrels | Rain Barrels | 50 | 50 | 50 | 50 | 50 |
| Residential Landscape Retrofit | Turf Removed (sites) | 200 | 250 | 250 | 250 | 250 |

| Activity Name | Measure Metric | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|---|
| Residential Smart Controller Upgrade | Smart Controllers | 0 | 500 | 500 | 500 | 500 |
| Smart Controller Rebate (SF) | Smart Controllers | 50 | 50 | 50 | 50 | 50 |
| Smart Controller Rebate (CII) | Smart Controllers | 100 | 50 | 50 | 50 | 50 |
| Technology Customer Engagement Software | Customer Accounts | 0 | 131,376 | 131,376 | 131,376 | 131,376 |
| Turf Removal Rebate (CII ) | Turf Removed (SF) | 11.5 M | -- | -- | -- | -- |
| Turf Removal Rebate (SF) | Turf Removed (SF) | 1.5 M | -- | -- | -- | -- |
| Ultra Low Volume Urinals | ULV Urinals | 5 | -- | -- | -- | -- |
| Budget-Based Water Rates (2 Agencies) | Customer Accounts | -- | -- | 52,551 | -- | -- |

## 4.11 Water Conservation Program Coordination and Funding Sources

IEUA's Water Use Efficiency Program consists of one full time employee (FTE), one FTE at 50 percent, and two interns. The source of IEUA's revenues for the regional conservation budget is collected through a $4 per imported AF surcharge and a $0.04 RTS charge which results in an approximately $350,000 in annual revenue, excluding labor.

In FY 2016-17, the method of revenue collection for water use efficiency and conservation will be converted to a MEU charge which will replace the AF surcharge and RTS charge. An MEU is defined as the number of active water accounts of each meter served by an IEUA Local Retail Agency. IEUA has committed to dedicate $1,120,000 annually to Wholesale Assistance Programs which are defined as IEUA's regional water use efficiency and conservation programming portfolio. IEUA's water use efficiency program funding is heavily leveraged by external funding through the DWR, the USBR, the MWD and inter-agency partnering programs.

IEUA prepares annual regional water use efficiency program budgets with line items dedicated to specific water use efficiency activities. The projected annual budget for each year of the five-year planning period is shown in Table 4-16. The budget amounts reflect the financial commitment of IEUA only and are exclusive of MWD or other external financial contributions. The budgets presented below do not align exactly with actual costs because the figures are based upon estimated WUE programming activity that vary depending upon program participation rates.

**Table 4-16**: **IEUA Annual Water Use Efficiency Budget**

| Program Year | Annual Budget ($/Year) |
|---|---|
| FY 2015/16 | $1,928,800 |
| FY 2016/17 | $1,120,000 |
| FY 2017/18 | $1,120,000 |
| FY 2018/19 | $1,120,000 |
| FY 2019/20 | $1,120,000 |
| **Total** | **$6,408,800** |

**Budget includes IEUA regional program costs exclusive of outside funding.*
**Budget includes $300,000 per year for education and outreach programs.*

Funding sources for the implementation of projects and programs to achieve the regional water use reduction goals is a combination of IEUA revenues leveraged with external funding from the DWR, the USBR, the MWD Water District and inter-agency partnering programs.

The 2010 UWMP adopted a funding strategy for the regional agencies that would have a minimal impact on each member agency's budget, yet would provide an equitable flow of funding for the regional conservation programs. Since 2010, the number of individual revenue sources has decreased due to drought and the economy. Below is a description of each of the funding sources:

The source of IEUA's revenues for the regional conservation budget has been collected through a $4 per imported AF surcharge and a $0.04 Readiness-to-Serve (RTS) charge which generates on average, revenues of approximately $350,000 annually, excluding labor.

In FY 2016-17, the method of revenue collection for water use efficiency and conservation will be converted to a MEU charge which will replace the AF surcharge and RTS charge. An MEU is defined as the number of active water accounts of each meter served by an IEUA Local Retail Agency. IEUA has committed to dedicate $1,120,000 annually to Wholesale Assistance Programs which are defined as IEUA's regional water use efficiency and conservation programming portfolio. IEUA's WUE program funding is heavily leveraged by external funding

Figure 4-1 provides an example of local revenues and the ability to substantially leverage those funds with outside funding. Over the last five years, the regional conservation programs budget has fluctuated between $700,000 to over $4,000,000 for WUE program implementation. However, whenever possible IEUA leverages these funds with external funding. IEUA's five-year annual water conservation budget is projected to be $1.1 million of local funding and $1.1 million of leveraged funding for a total maximum annual budget of $3 million.

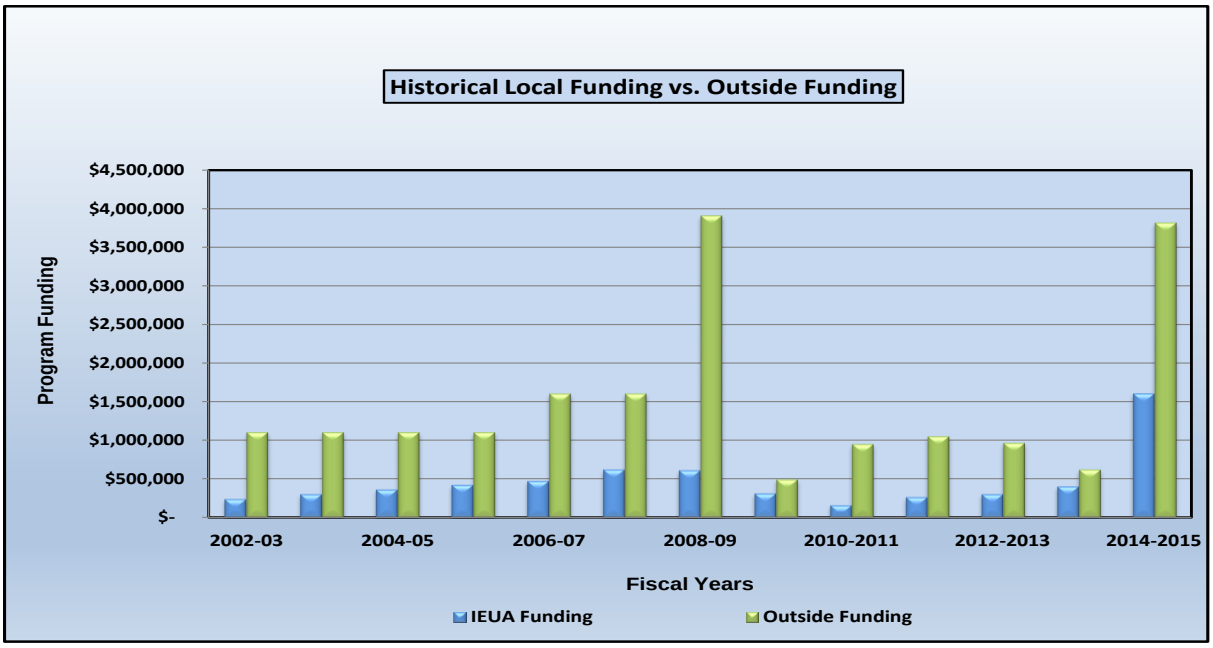



**Figure 4-1: Historical Local Funding versus Outside Funding**

## 4.12 Utility Operations

Previous sections of this UWMP describe IEUA's core WUE programs in detail. The goal of Section 4.15 is to provide additional information to satisfy the requirements set forth in DWR's 2015 UWMP Guidebook. For this 2015 UWMP, the reporting requirements for DMM has been significantly modified and streamlined in 2014 by Assembly Bill 2067. For a wholesale agency such as IEUA and WFA, the requirements changed from having 14 specific measures (following CUWCC BMPs) to six more general requirements pertaining to utility operations, including metering, public education and outreach, water conservation program coordination and staffing support, asset management, wholesale supplier assistance programs, and other DMMs as described in the following sections.

### 4.12.1 Metering

IEUA does not have any direct connections to potable customers. All imported water supplied to the area through IEUA is delivered through a direct connection from MWD.

*WFA is fully metered. Its meter replacement program is part of its capital replacement projects forecasted and budgeted through the normal annual budget process.*

WFA is fully metered. Capital replacement projects are forecasted and budgeted through the normal annual budget process. These are funded by WFA's member agencies based on four different criteria on how the equipment service life is utilized in the treatment plant process or if it is part of a member agency owned turnout. Routine preventative maintenance is conducted on a regular basis and repairs are made upon certain equipment failure or when signs of fatigue are evident. WFA owned meters are maintained by WFA staff supplemented by third party evaluations.

### 4.12.2 Asset Management

IEUA does not own or operate a potable water distribution system therefore this section is not applicable to IEUA.

*WFA owns and operates 4.55 miles of potable distribution system. Routine preventative maintenance is conducted on a regular basis. Repairs are made upon signs of fatigue.*

WFA's capital improvement projects may be developed when treatment plant enhancements are identified that provides for greater operational flexibility, productivity, service life extension, and are funded by WFA's member agencies based on their percent ownership or entitlement of the treatment plant, through the normal annual budget process. Capital replacement projects are forecasted and budgeted through the normal annual budget process. These are funded by WFA's member agencies based on four different criteria on how the equipment service life is utilized in the treatment plant process or if it is part of a member agency owned turnout. Routine preventative maintenance is conducted on a regular basis and repairs are made upon certain equipment failure or signs of fatigue are evident.

# 5 WATER SHORTAGE CONTINGENCY PLAN

## 5.1 Overview

Recent water supply challenges throughout the Southwest and the State of California have resulted in the development of a number of policy actions that water agencies would implement in the event of a water shortage. In southern California, the development of such policies has occurred at both the wholesale and retail level. This section describes how new and existing policies that MWD and IEUA have in place to respond would address supply shortages.

## 5.2 IEUA Drought Plan

IEUA's Drought Plan is consistent with and contributes to the existing IEUA imported water policies and programs. Principles of IEUA's Drought Plan encourage development and full use of local water resources, such as recycled water and conservation measures. The IEUA Drought Plan also addresses MWD's Chino Basin Groundwater Storage Dry Year Yield (DYY) program and the need for best management of DYY program "shift" obligations concurrent with MWD Water Supply Allocation Plan (WSAP) reductions of imported water supplies to IEUA.

IEUA's Drought Plan was developed for the purpose of implementing MWD's WSAP in a manner that is fair and equitable to IEUA's member agencies. IEUA's Drought Plan is an extension of MWD's WSAP. For example, if IEUA is not imposed a penalty from MWD, then IEUA would also not impose a penalty on its member agencies (IEUA, Inland Empire Utilities Agency Drought Plan, April 2009). Table 5-1 displays the actions that IEUA and its member agencies will take locally.

**Table 5-1: IEUA and Member Agency Staged Actions**

| Surplus Stage | | Shortage Stages | | | |
|---|---|---|---|---|---|
| Surplus | IEUA & Retail Agency General Actions | Shortage | | | |
| | | 1 | 2 | 3 | 4 |
| | Increase Imported Firm Deliveries | | | | |
| | Maximize Replenishment Activities | | | | |
| | Conservation Programs | | | | |
| | Public Information and Outreach Campaign | | | | |
| | Maximize Stormwater Storage | | | | |
| | Increase Groundwater Pumping | | | | |
| | Water Use Restrictions in Effect* | | | | |
| | Landscape Irrigation Restrictions* | | | | |
| | Dust Control w/ Recycled Water Only | | | | |
| | Landscape Irrigation w/ Recycled Water Only* | | | | |
| | Water Bill Surcharge/Fine* | | | | |
| | Potable Water Use Curtailments* | | | | |
| | Meter Flow Restricting Device* | | | | |

*Local agencies maintain their own water use restrictions and other actions in event of a drought declaration.

### 5.2.1 MWD Water Surplus and Drought Management Plan

MWD has taken the lead in drought planning for the southern California region. MWD's Board of Directors adopted the Water Surplus and Drought Management (WSDM) Plan in 1998 to address surplus and shortage operating strategies. The WSDM plan reflects anticipated responses based on the water supplies available to MWD.

Surplus stages occur when net annual deliveries can be made to water storage programs. Under the WSDM Plan, there are four surplus management stages that provide a framework for actions to take for surplus supplies. Deliveries in Diamond Valley Lake (DVL) and in SWP terminal reservoirs continue through each surplus stage provided there is available storage capacity. Withdrawals from DVL for regulatory purposes or to meet seasonal demands may occur in any stage.

The WSDM Plan distinguishes between Shortages, Severe Shortages, and Extreme Shortages. The differences between each term is listed below.

- Shortage: MWD can meet full-service demands and partially meet or fully meet interruptible demands using stored water or water transfers as necessary.
- Severe Shortage: MWD can meet full-service demands only by using stored water, transfers, and possibly calling for extraordinary conservation.
- Extreme Shortage: MWD must allocate available supply to full-service customers.

There are six shortage management stages to guide resource management activities. These stages are defined by shortfalls in imported supply and water balances in MWD's storage programs. When MWD must make net withdrawals from storage to meet demands, it is considered to be in a shortage condition. Figure 5-1 gives a summary of actions under each surplus and shortage stages when an allocation plan is necessary to enforce mandatory cutbacks. The goal of the WSDM plan is to avoid Stage 6, an extreme shortage (MWD, 2015 Draft UWMP, March 2016).

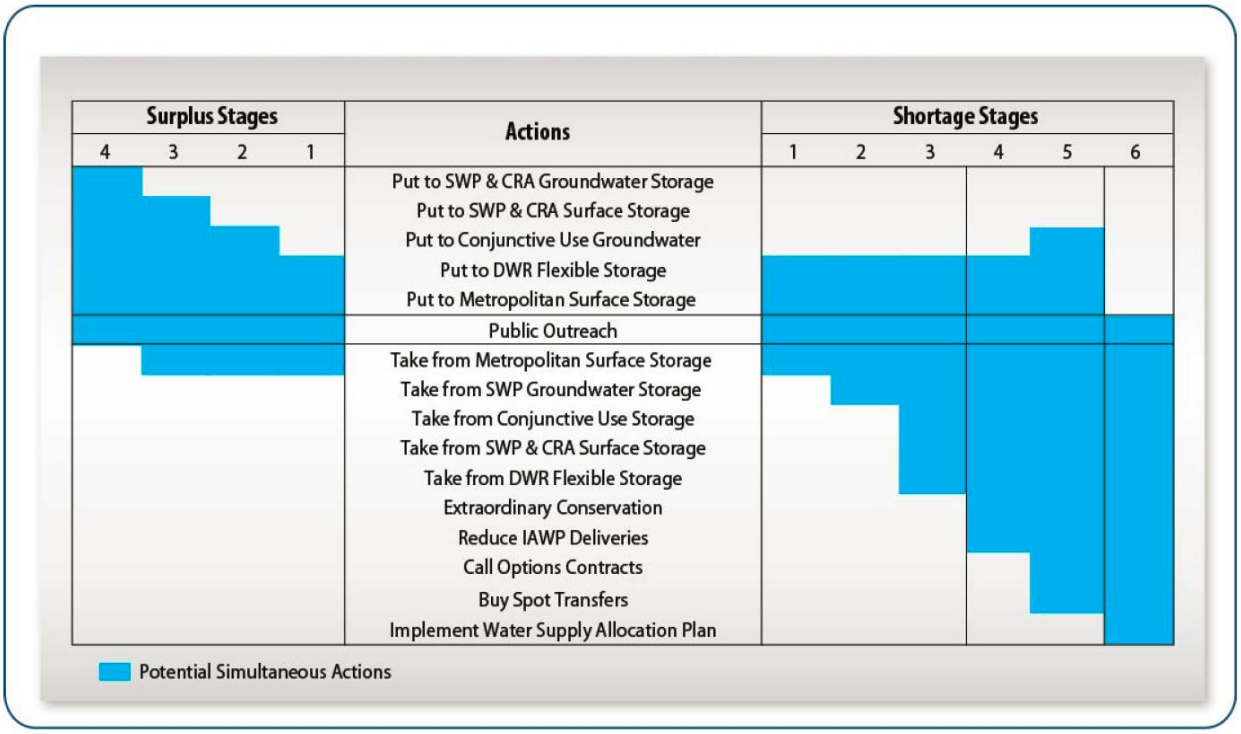



**Figure 5-1: Resource Stages, Anticipated Actions, and Supply Declarations**

### 5.2.2 MWD Water Supply Allocation Plan

MWD's Board of Directors adopted the WSAP in February 2008 in anticipation of possible water supply shortages. The WSAP provides guidance for allocating limited water supplies to member agencies should the need arise.

MWD's WSAP was developed in consideration of the principles and guidelines in MWD's 1999 WSDM Plan. The WSAP's formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level for shortages of MWD supplies of up to 50 percent. The formula takes into account the impact on retail customers and the economy, growth and population, changes in supply conditions, investments in local resources, demand hardening aspects of non-potable recycled water use, implementation of conservation savings program, participation in MWD's interruptible programs, and investments in facilities.

In order to implement the WSAP, the MWD Board makes a determination on the level of the regional shortage, based on specific criteria, annually in April. The allocations, if deemed necessary, go into effect in July of the same year and remain in effect for a 12-month period. The schedule is made at the discretion of the Board (MWD, 2015 Draft UWMP, March 2016).

## 5.3 IEUA Emergency Drought Ordinances

IEUA's retail agencies have adopted ordinances that address urban water shortage requirements. In 2009, IEUA performed an inventory of drought related ordinances that are currently part of the municipal code or administrative code of the cities and agencies in the IEUA service area. The results of the survey are summarized in Table 5-2. The ordinances will generally come into force upon a formal declaration of drought or water shortage conditions by one or more entities such as the DWR and MWD.

If a drought is declared, financial impacts to the local retail water agencies will vary from one agency to another. As a wholesale water agency, IEUA is simply a "pass-through" wholesaler so loss of revenue has no significant impacts except possibly the conservation programs which receive a portion of funding through a surcharge on each AF of imported water sold.

The ordinances vary with different actions based upon the severity of the drought conditions. The definition of drought and water shortage stages used by Cities of Chino, Chino Hills and Ontario and the MVWD are presented in Table 5-3. Table 5-4 provides a summary of local agency drought ordinances, in the categories of prohibitions and restrictions, conservation actions, and the enforcement mechanisms available to each agency.

**Table 5-2: Water Shortage Contingency Plan Checklist by Agency**

| | IEUA Member Agency | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Emergency Drought or Water Shortage Ordinances** | **Chino** | **Chino Hills** | **MVWD** | **Ontario** | **CVWD** | **FWC** | **SAWCO** | **Upland** |
| Catastrophic Interruption Plan | √ | √ | √ | √ | √ | √ | √ | √ |
| Consumption Reduction Methods | √ | √ | √ | √ | √ | √ | √ | √ |
| Contingency Plan | √ | √ | √ | √ | √ | √ | √ | √ |
| Emergency Fund | √ | | √ | √ | √ | √ | √ | √ |
| Mandatory Prohibition | √ | √ | √ | √ | √ | √ | √ | √ |
| Ordinance/Resolution | √ | √ | √ | √ | √ | √ | √ | √ |
| Penalties | √ | √ | √ | √ | √ | √ | | √ |
| Rationing Allocation Method | √ | √ | √ | √ | √ | √ | | √ |
| Reduction Measuring Mechanism | √ | √ | √ | √ | √ | √ | √ | √ |

**Table 5-3: Drought Stage Definitions by Agency**

| Drought Stage | Agency | | | |
|---|---|---|---|---|
| | **Chino** | **Chino Hills** | **MVWD** | **Ontario** |
| **1** | Water supplies are anticipated to be reduced by up to 10% | Customers are requested to voluntarily limit water usage to the amount necessary for health, safety, business, and irrigation | Customers are required to follow water use efficiency best practices at all times. | Water conservation goals are not being met by voluntary water conservation measures or water supplies are likely to be reduced by up to 10% |
| **2** | Water supplies are reduced by approximately 10% to 20% | Water supplies are anticipated to be reduced by up to 10% | Existing or near-term water supply shortage conditions that require a 10% to 25% demand reduction. | Water supply reduction of 10% to 20% |
| **3** | Water supplies are reduced by approximately 20% or more | Water supplies are anticipated to be reduced by more than 10% and up to 25% | Existing or near-term water supply shortage conditions that require a 25% to 40% demand reduction. | Water supply reduction greater than 20% |
| **4** | No definition | Water supplies are anticipated to be reduced by more than 25% due to catastrophic events | Emergency circumstances that require a 40% or higher demand reduction. | Emergency water shortage cause by a catastrophic event such as a major earthquake, large-scale fire, or other "Act of God" |
| Note: Drought stages for FWC, SAWCO, CVWD, and the City of Upland are not listed numerically and are thus not included in this table. | | | | |

**Table 5-4: Local Agency Drought Ordinances**

| *Prohibitions and Restrictions during Drought* | By Drought Stage as Defined in Table 5-3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Chino** | **Chino Hills** | **MVWD** | **Ontario** | **CVWD** | **FWC** | **SAWCO** | **Upland** |
| Washing of vehicles without shut-off nozzle | 1 | 2 | 1 | 1 | X | X | X | X |
| Washing of sidewalks and all other hard surfaces | 1 | 2 | 1 | 1 | X | X | X | X |
| Water runoff into gutters from excessive or mismanaged irrigation | 1 | 2 | 1 | 1 | X | X | X | X |
| Non-recycling fountains/lakes/ponds restrictions | 1 | 2 | 1 | 1 | X | X | X | X |
| Using potable water to irrigate ornamental turf on public street medians | 1 | X | 1 | 1 | X | X | X | X |
| Unsolicited water service in eating/drinking establishments | 1 | 2 | 1 | 1 | X | X | X | X |
| Use of fire hydrants limited to firefighting activities | | 2 | 2 | 1 | | | X | X |
| Restaurants using non-conserving dish spray valves | 1 | | | | | | | |
| Lodging establishments must offer option to not launder daily | 2 | 3 | 1 | 1 | X | X | X | X |
| Failure to repair leaks within reasonable amount of time | | 2 | 1 | 1 | X | X | X | X |
| Irrigation during and within 48 hours after measurable rainfall | 1 | 3 | 1 | 1 | X | X | X | X |
| New landscaping restrictions | 1 | 3 | 2 | 1 | X | X | X | X |
| New turf/maximum allowable turf restrictions | | | 2 | | | | | |
| Water use on construction sites or for dust control | | | 4 | | | | | |
| New pool or spa construction and/or filling restrictions | | 3 | 3 | 2 | | X | X | X |
| Irrigation of golf courses and other water dependent industries restricted | | 3 | 1 | 2 | | | X | X |
| Watering limited to prescribed times | | 2 | 1 | 1 | | X | X | X |
| Watering limited to prescribed days | 1 | 3 | 2 | 2 | | | X | X |
| Additional dwelling construction prohibited | 3 | | 4 | | | | | |
| Watering of turf, landscape, or vehicles by bucket only | | 2 | | 3 | | | | |
| | **Enforcement** | | | | | | | |
| Water bill surcharge/fine | √ | √ | √ | √ | √ | √ | √ | √ |
| Flow restricting device, locking or removal of meter, shutting off mainline | √ | √ | √ | √ | √ | √ | √ | √ |

| **Key** | |
|---|---|
| 1 | Stage 1 |
| 2 | Stage 2 |
| 3 | Stage 3 |
| 4 | Stage 4 |
| X | No Defined Stage |

## 5.4 WFA Contingency Operations Plan

WFA's staff recognizes that the projected imported water supply reductions mandated by MWD's WSAP requires collaboration and coordination with its member agencies. In cooperation with its Technical Advisory Committee, the WFA has developed planning worksheets that identify possible delivery scenarios. It is important to note that any contingency operations plan requires adaptability due to changing conditions and circumstances and as water supply updates are provided.

WFA previously used a ten year rolling average formula for distributing the available imported water allocation amongst its member agencies. The ten year rolling average is from FY 2004-14 with a one year lag. The allocation formula results are summarized in Table 5-5.

**Table 5-5: WFA Determination of Available Deliveries**

| Agency | Allocation Formula (FY 10 Year Average) | | Available Deliveries |
|---|---|---|---|
| Chino | 3,575 | 12.6% | 3,462 |
| MVWD/Chino Hills* | 7,509 | 26.4% | 7,255 |
| Ontario | 12,286 | 43.2% | 11,871 |
| Upland | 5,066 | 17.8% | 4,891 |
| **Total** | **28,436** | **100.0%** | **27,479** |
| Notes: *Per Joint water supply agreement between MVWD and City of Chino Hills. | | | |

The contingency operations plan was designed when most of the projected available imported water supply would be delivered primarily during peak demand in the summer months, with emphasis on the months from July through October, while attempting to maintain minimum deliveries in the remainder or some portion of the year. The Agua de Lejos Water Treatment Plant has the ability to operate at a minimum 4 MGD flow since the construction of the Low Flow Modification Project. This is crucial during the off-peak months so that most of the available supplies can be directed to the higher demand peak months and a prolonged shutdown can be avoided. Therefore, the plan is to operate the Agua de Lejos Water Treatment Plant throughout the year, unless a brief shutdown is required by MWD (WFA, Contingency Operations Plan, May 2015).

## 5.5 Mutual Aid Agreements

Mutual aid agreements among local agencies in California are a typical way of dealing effectively with disasters such as brush fires, earthquakes, law enforcement shortages, etc., and the IEUA service area is no different.

As the agency that provides regional sewer service to the seven cities and agencies in the service area (referred to as Regional Contracting Agencies), IEUA took the lead to develop a United Response Guidance Plan for Sanitary Sewer Overflows at the request of the SARWQCB. The purpose of the SARWQCB's request was the need for a united and coordinated approach for sanitary sewer spills and their possible infiltration into the storm sewers of San Bernardino County. With the joint efforts of IEUA and the Regional Contracting Agencies, the United Response Plan was developed and submitted to the SARWQCB and the SBCFCD.

The agreement helps to minimize the environmental impact of a sanitary sewer overflow by facilitating communication, dispatching appropriate equipment, reducing spillage, and expediting cleanup. In addition to sewer spills, the Contracting Agencies also agree to provide mutual aid in the event of disruption of water service supply as well. This element of the agreement provides the basis for a full spectrum of mutual aid should any unforeseen disruption occur. Specifically, the agreement says:

"In the event of any disruption or damage to the ability of either Inland Empire Utilities Agency or the Regional Contracting Agencies to continue to serve the public or its customers with water service, sewer service or sewage treatment service, the other party will cooperate to a maximum extent possible, as determined in its discretion, to provide mutual aid assistance as requested."

## 5.6 Three-Year Minimum Water Supply

As a matter of practice, MWD does not provide annual estimates of the minimum supplies available to its member agencies. As such, MWD member agencies must develop their own estimates.

Section 135 of the MWD Water District Act declares that a member agency has the right to invoke its "preferential right" to water, which grants each member agency a preferential right to purchase a percentage of MWD's available supplies based on specified, cumulative financial contributions to MWD. Each year, MWD calculates and distributes each member agency's percentage of preferential rights. However, since MWD's creation in 1927, no member agency has ever invoked these rights as a means of acquiring limited supplies from MWD.

As captured in its 2015 UWMP, MWD believes that the water supply and demand management actions it is undertaking will increase its reliability throughout the 25-year period addressed in its plan. Thus for purposes of this estimate, it is assumed that MWD and IEUA will be able to maintain the identified supply amounts throughout the three-year period.

The three year minimum water supply is calculated from IEUA's baseline supplies for imported water and recycled water. IEUA's three year estimated minimum water supply is listed in Table 5-6.

**Table 5-6: IEUA Minimum Supply Next Three Years (AF)**

| Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 102,891 | 105,287 | 107,519 |
| NOTES: Three year minimum supply taken from the sum of IRP baseline supply for imported water, direct use recycled water, and groundwater recharge recycled water for each respective year. | | | |

WFA's three year minimum supply is estimated based on its annual allocation of MWD's Tier 1 water supply. WFA's three year estimated minimum water supply is listed in Table 5-7.

**Table 5-7: WFA Minimum Supply Next Three Years (AF)**

| Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 31,384 | 31,384 | 31,384 |
| NOTES: Three year minimum supply is from WFA's annual allocation of MWD's available Tier 1 water supply as specified in the 2016 IRP. | | | |

## 5.7 Catastrophic Supply Interruption

Given the great distances that imported supplies travel to reach the Inland Empire, the region is vulnerable to interruptions along hundreds of miles of aqueducts, pipelines and other facilities associated with delivering the supplies to the region. Additionally, the infrastructure in place to deliver supplies are susceptible to damage from earthquakes and other disasters.

MWD has comprehensive plans for stages of actions it would undertake to address a catastrophic interruption in water supplies through its WSDM and WSAP. MWD also developed an Emergency Storage Requirement to mitigate against potential interruption in water supplies resulting from catastrophic occurrences within the southern California region, including seismic events along the San Andreas Fault. In addition, MWD is working with the state to implement a comprehensive improvement plan to address catastrophic occurrences outside of the southern California region, such as a maximum probable seismic event in the Delta that would cause levee failure and disruption of SWP deliveries. For greater detail on MWD's planned responses to catastrophic interruption, please refer to MWD's 2015 UWMP.

In September 2005, IEUA adopted federal emergency response procedures called NIMS (National Incident Management System) which can be implemented by IEUA personnel for a localized event such

as an accident at one of IEUA's facilities or on a broader based regional event such as an earthquake or flood. This system provides a consistent nationwide template to enable federal, state, and local governments (and local private sector and non-governmental organizations) to work together effectively and efficiently to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of terrorism (Homeland Security, National Incident Management System Training Program, September 2011).

## 5.8 Impacts to Revenue

During a catastrophic interruption of local water supplies, prolonged drought, or water shortage of any kind, IEUA will experience a reduction in revenue due to purchasing of more expensive water from MWD to offset reductions in local supplies. Throughout this period of time, expenditures may increase or decrease with varying circumstances. Expenditures may increase due to loss of incremental rate revenue due to reduced water sales in a shortage and increased cost due to purchasing Tier 2 water during high demand episodes due to drought conditions. IEUA is a "pass-through" wholesaler; however, loss of revenue does have significant impacts on the water resources programs which includes water use efficiency and conservation. Revenue is collected through an AF surcharge and a meter connection charge, but will be converted to a MEU charge in FY 2016-17.

# 6 RECYCLED WATER

Recycled water opportunities have continued to grow in southern California as public acceptance and the need to expand local water supplies continues to be a priority. Recycled water also provides a degree of flexibility and added reliability during drought conditions when imported water supplies are restricted.

Recycled water is wastewater that is treated through primary, secondary and tertiary processes and is acceptable for most non-potable water purposes such as irrigation, and commercial and industrial process water following Title 22 requirements.

*WFA does not supply recycled water to its customers and does not have plans to do so; therefore, the remainder of Section 6 is applicable to IEUA only.*

IEUA began providing recycled water to customers in 1972. Initially, recycled water was delivered to a few large water users such as the Whispering Lakes Golf Course and Westwind Park in the City of Ontario, and Prado Park and Golf Course in the City of Chino.

In the early 1990's IEUA began the construction of the first phase of the CCWRF that included treatment facilities and distribution pipelines to serve customers in Chino and Chino Hills. In conjunction with the construction of the first phase of the CCWRF, IEUA began planning for a regional recycled water delivery system to provide recycled water throughout its service area. This planning effort culminated with the completion of the IEUA Regional Recycled Water Program Feasibility Study in January 2002. The Feasibility Study identified facilities to deliver over 70,000 AFY of recycled water to customers and recharge sites throughout the IEUA service area.

In 2004 IEUA developed a regional recycled water program implementation plan to prioritize the phased construction of the adopted 2002 Recycled Water Program Feasibility Study. This major planning effort resulted in the completion of the 2005 Recycled Water Implementation Plan (RWIP). The RWIP identified projects to deliver approximately 93,000 AFY of recycled water using an interconnected distribution system supplied from all four of IEUA's major recycled water plants.

In 2007, IEUA developed the Recycled Water Three Year Business Plan. The Business Plan was intended to guide the expansion of IEUA's recycled water system. The Plan focused on the most cost effective and quickest ways to increase the amount of recycled water available and used within IEUA's service area. The Plan focused on the following three years, to be revised and updated on an annual basis. Metrics and an annual use goal where identified for each year. Revisions/updates to the Plan were made with a FY 2010-11 update memo, the Wastewater Facilities Master Plan in 2014, the Recycled

Water Program Strategy (RWPS) in 2015, and the IEUA FY 2015-16 Budget and Ten Year Capital Improvement Plan (TYCIP).

## 6.1 Agency Coordination

**Regional Recycled Water Facilities**

In September 2000, the IEUA Board and Regional Technical and Policy Committees adopted a recycled water policy document that defined the roles and responsibilities of IEUA and the Regional Contracting Agencies for the construction and ownership of the regional and local facilities. Regional recycled water facilities are facilities, pipelines, pump stations, and reservoirs that serve recycled water to a recharge site or to more than one contracting agency. Regional facilities will be constructed and owned by IEUA. Local facilities deliver recycled water from the regional facilities to customers within a contracting agency's service area and are maintained by the contracting agency. Local facilities primarily consist of pipelines (local laterals) but can also include pump stations and reservoirs. The 2015 RWPS refined these policies regarding funding of local storage facilities that reduce regional storage needs, including provisions for joint regional/local facilities (local retail water agency or developer), and IEUA financing arrangements of local facilities and customer onsite retrofits to ensure the timely implementation of the recycled water program.

The regional recycled water facilities consist of a looped pipeline system that connects all four Regional Water Recycling Plants (RWRP). The treated effluent from the four regional wastewater recycling effluent pump stations is delivered to the recycled water member agencies and customers through five pressure zones, several hundred miles of pipelines, three booster pump stations, three storage reservoirs, and pressure regulating stations (IEUA, Recycled Water Program Strategy, April 2015).

**Local Recycled Water Facilities**

Local recycled water facilities are those that serve the customers of only one contracting agency. Each local agency is responsible for the planning, design, construction and operation of local laterals within their service area. IEUA staff is working closely with each agency to coordinate their recycled water planning efforts and is providing technical assistance.

## 6.2 Wastewater Description and Disposal

IEUA manages the Regional Sewage Service within its 242 square mile service area to collect, treat, and dispose of wastewater delivered by contracting local agencies. IEUA's facilities serve seven contracting agencies: cities of Chino, Chino Hills, Fontana, Montclair, Ontario, and Upland, and the CVWD. A system of regional trunk and interceptor sewers convey sewage to regional wastewater treatment plants that are owned and operated by IEUA. Local sewer systems are owned and operated by local agencies.

### 6.2.1 Regional Facilities

The wastewater collected in the regional sewer system is treated at the four RWRP's that IEUA owns and operates. The recycled water produced at the RWRP's meets Title 22 standards for non-potable reuse and groundwater recharge. All of the RWRP's have primary, secondary, and tertiary treatment and recycled water pumping facilities that are interconnected in a regional network that IEUA also owns and operates. Effluent that is not beneficially reused from the RWRP's is discharged to nearby creeks that feed into the Santa Ana River where it is recharged into the Chino Basin.

IEUA uses bypass and diversion facilities to optimize flow and capacity within the system through the San Bernardino Avenue Lift Station, Montclair Lift Station and Diversion Structure, RP-4 and CCWRF influent bypass (CCWRF influent bypass), RP-1 primary effluent diversion, and Etiwanda Trunk Line. Flows are routed between RWRP's to maximize recycled water deliveries while minimizing overall pumping and treatment costs. Aside from the San Bernardino Avenue Lift Station and the Montclair Lift Station, IEUA also operates the Prado Park Lift Station and RP-2 Lift Station in the sewer collection system to shift flows from one portions of the service area to another and to pump from low points to high points.

The four regional facilities are the RP-1, RP-4, RP-5, and CCWRF. RP-1 and RP-4 serve the northern parts of the service area and RP-5 and CCWRF serves the southern parts of the service area as shown on Figure 6-1. RP-4 and CCWRF are scalping plants for RP-1 and RP-5 (CH2MHILL, IEUA Wastewater Facilities Master Plan DRAFT, August 2014). The RWRP's are described in further detail below based on information from IEUA's Facilities website, FY 15/16 TYCIP, Wastewater Facilities Master Plan DRAFT 2014, and the Recycled Water Program Strategy.

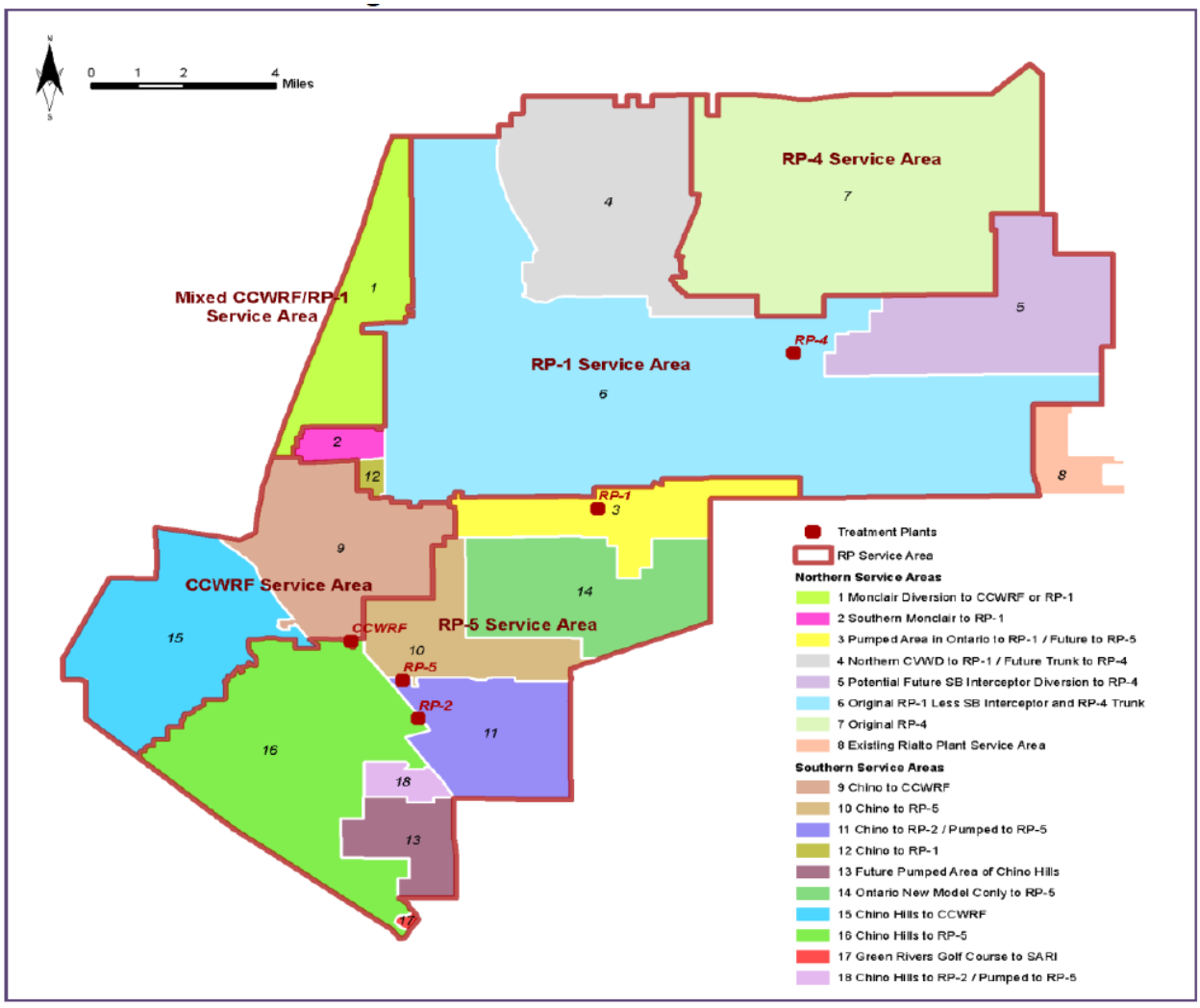



**Figure 6-1: Regional Water Recycling Plan Service Areas**

## RP-1

RP-1 is located in the City of Ontario, has been operational since 1948, and has undergone numerous expansions to increase wastewater treatment capacity. RP-1 was originally owned and operated through a joint powers agreement between the cities of Ontario and Upland. IEUA purchased RP-1 in 1973 when it was known as the Chino Basin Municipal Water District. RP-1 receives flow from areas of Chino, Fontana, Montclair, Ontario, Rancho Cucamonga, Upland, and an unincorporated area of San Bernardino County.

The current treatment capacity is 44 MGD and the wastewater undergoes preliminary screening and grit removal, primary clarification, secondary treatment by aeration basins and clarification, tertiary treatment by filtration and disinfection, and dechlorination. The solids removed through the treatment process also undergo processing and the biosolids produced at RP-4 are sent to RP-1 for thickening, digestion, and

dewatering at the solids handling facilities. Recycled water at RP-1 is sent to one of three recycled water effluent pump stations into the recycled water distribution system. Each pump station feeds three different pressure zones: 930, 1050, and 1158. The 930 Pressure Zone effluent pump station has a pumping capacity of approximately 27,030 gallons per minute (gpm) using VFD pumps. The 1050 Pressure Zone effluent pump station has a total pumping capacity of 11,250 gpm using VFD pumps. The 1158 Pressure Zone effluent pump station has a total pumping capacity of approximately 11,120 gpm.

**RP-4**

RP-4 is located in the City of Rancho Cucamonga and has been operating since 1997. RP-4 serves areas of Fontana, Rancho Cucamonga, and unincorporated areas of San Bernardino County. The plant underwent an expansion in 2009 increasing its treatment capacity to 14 MGD. The wastewater undergoes preliminary screening and grit removal, primary clarification, secondary treatment by aeration basins and clarification, tertiary treatment by filtration and disinfection. Biosolids from RP-4 are conveyed through the sewer system by gravity to RP-1 for processing.

Recycled water is discharged to the storage pond or pumped to provide utility water within the plant or to the recycled water distribution system for beneficial reuse. When the recycled water and utility water demand is less than the supply, the recycled water is discharged to the storage pond. RP-4 serves the 1158 Pressure Zone and the effluent pump station has a pumping capacity of 22,500 gpm.

**RP-5**

RP-5 is located in the City of Chino adjacent to IEUA's Administrative Headquarters. The plant serves areas of Chino, Chino Hills, and Ontario. The plant has been in operation since 2004 and has a treatment capacity of 16.3 MGD which includes 1.3 MGD of solids processing from RP-2. The treatment process consists of preliminary screening and grit removal, primary clarification, secondary treatment by aeration basins and clarification, tertiary treatment by filtration and disinfection, and dechlorination.

The solids from RP-5 are pumped to RP-2 for thickening, anaerobic digestion, and dewatering. The stabilized and dewatered solids are then transported to the Inland Empire Regional Composting Facility for processing into high quality compost for local landscaping and horticultural use. RP-2 is currently used only for processing solids as liquid wastewater processing was discontinued as portions of the plant are located in the 100-year flood plain. Biosolids processing will continue at RP-2 until solids handling facilities are constructed at RP-5 in 2022.

After disinfection, the recycled water is discharged to a creek by gravity and pumped to the recycled water distribution system. RP-5 serves the 800 Pressure Zone through the effluent pump station that has a pumping capacity of approximately 9,625 gpm.

**CCWRF**

The CCWRF is located in the City of Chino and has been operational since 1992 and serves areas of Chino, Chino Hills, Montclair, and Upland. The treatment capacity is 11.4 MGD and processing consists of preliminary screening and grit removal, primary clarification, secondary treatment by aeration basins and clarification, tertiary treatment by filtration and disinfection, and dechlorination. The solids are pumped to RP-2 for thickening, anaerobic digestion, and dewatering. After disinfection, the recycled water is distributed to the 930 Pressure Zone in the recycled water distribution through the effluent pump station that has a total pumping capacity of 12,925 gpm.

### 6.2.2 Historical, Current, and Future Wastewater Flows

IEUA's regional treated influent flow history and forecast and system capacity are shown on Figure 6-2 (IEUA, IEUA FY 15/16 Ten Year Capital Improvement Plan, March 2015). Since FY 2006-07, wastewater flows have decreased, but remained steady since FY 2010-11 due to economic conditions and conservation efforts associated with drought. Table 6-1 shows wastewater treated, recycled, and disposed in IEUA's service area in FY 2014-15. Forecast flows are based on historical wastewater flow trends, per dwelling unit wastewater generation factors, and expected future growth numbers provided by contracting agencies. Projected treated influent flow is expected to increase consistently through FY 2024-25.

Even with decreasing wastewater flows, IEUA has been able to recycle more water through diversion with the Montclair and San Bernardino Avenue Lift Stations. These lift stations provide the RWRP's in the northern service area with more wastewater as the recycled system has been expanded and is near the groundwater recharge basins.

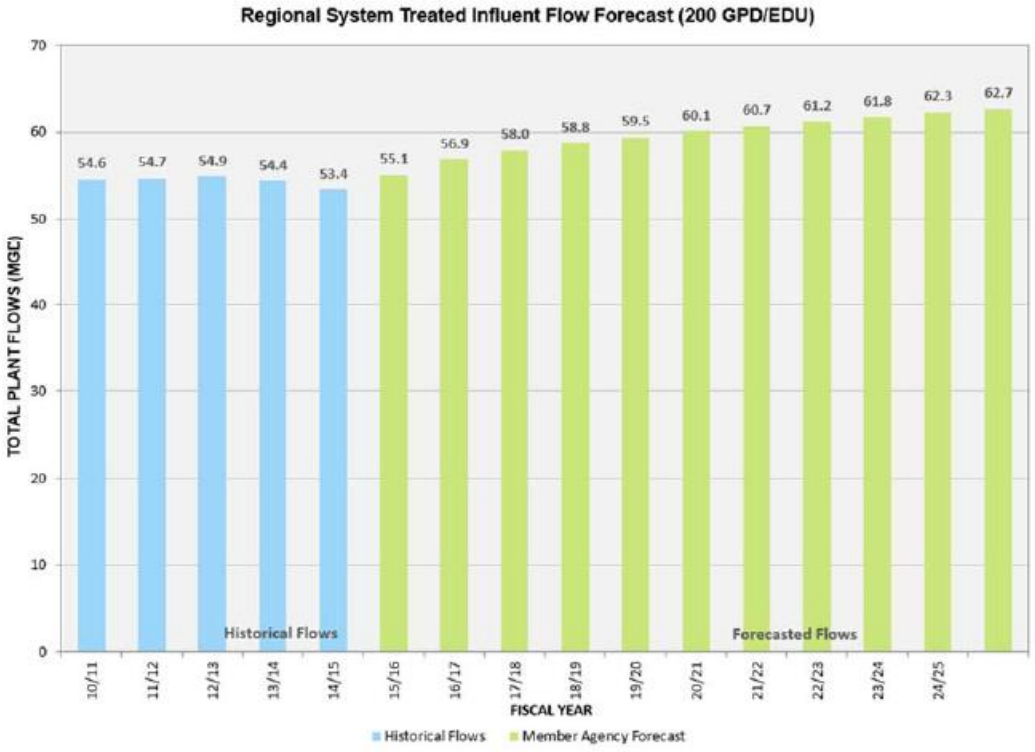



**Figure 6-2: Regional System Treated Influent Flow Forecast (IEUA, IEUA FY 15/16 Ten Year Capital Improvement Plan, April 2015)**

**Table 6-1: Wastewater Treatment and Discharge within Service Area in 2015**

| Wholesale: Wastewater Treatment and Discharge Within Service Area in 2015 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Treatment Plant Name | Discharge Location Name or Identifier | Discharge Location Description | Wastewater Discharge ID Number | Method of Disposal | Does This Plant Treat Wastewater Generated Outside the Service Area? | Treatment Level | 2015 volumes | | | |
| | | | | | | | Wastewater Treated | Discharged Treated Wastewater | Recycled Within Service Area | Recycled Outside of Service Area |
| RP-1 | | Santa Ana River | | River or creek outfall | No | Tertiary | 28,896 | 23,365 | 33,419 | |
| RP-4 | | Santa Ana River | | River or creek outfall | Yes | Tertiary | 10,976 | | | |
| RP-5 | | Santa Ana River | | River or creek outfall | No | Tertiary | 8,960 | | | |
| CCWRF | | Santa Ana River | | River or creek outfall | No | Tertiary | 7,952 | | | |
| | | | | | | **Total** | **56,784** | **23,365** | **33,419** | **0** |
| NOTES: From Recycled Water Program Strategy 2015, Table 2.1. | | | | | | | | | | |

## 6.3 Current Recycled Water Uses

IEUA has served recycled water to its retail agencies since formation of the Regional Sewage Service Contract in 1972. Recycled water was originally delivered to the Whispering Lakes Golf Course in and Westwind Park in the City of Ontario, and Prado Regional Park and El Prado Golf Course in San Bernardino County. After construction of the CCWRF in the early 1990's, recycled water was delivered to the cities of Chino and Chino Hills. In 2000, recycled water was identified as a critical regional water supply and IEUA embarked on a regional recycled water program. By 2014, over $250 million was invested in the program. Recycled water and groundwater recharge sales have increased by approximately 30,000 AFY since the early 2000's.

IEUA's recycled water distribution facilities consist of a pipeline network, booster pump stations, pressure regulating stations and reservoirs. These facilities allow distribution of recycled water into six pressure zones for non-potable reuse and groundwater recharge. A large transmission line connects RP-1 and RP-4 and serves the northern portion of IEUA's service area. The Edison and San Antonio Channel Pipelines were constructed to provide recycled water to areas of Ontario, Chino and Montclair. Another transmission line ties RP-1 into RP-5 and CCWRF. Four storage reservoirs provide operational storage and are located in the 930, 1158, 1299, and 1630 pressure zones with capacities varying from 3.0 million gallons (MG) to 5.0 MG. The three booster pump stations provide water from lower to higher pressure zones including: 1158 to 1299, 1299 to 1630 East, and 1299 to 1630 West. Three pressure reducing stations provide flow from higher pressure zones to lower pressure zones when the pressure drops below a certain point (Stantec, Recycled Water Program Strategy, April 2015). This system provides water for irrigating parks and golf courses. CCWRF's distribution system delivers water to the cities of Chino and Chino Hills. Currently, there are 560 recycled water connections to the recycled water distribution system.

In FY 2014-15, IEUA's recycled water production totaled approximately 33,419 AFY of which 22,579 AF was for non-potable reuse (outdoor irrigation, industrial processes, and agriculture) and 10,840 AF was for groundwater recharge. The remaining 23,365 AF of wastewater not used for recharge or recycling was discharged to the Santa Ana River. Current and projected recycled water through 2040 and are shown in Table 6-2. Non-potable reuse is expected to increase through 2040 to 51,715 AFY and groundwater recharge is expected to increase to 13,977 AFY by 2020, remain fairly constant through 2030, and increase again in 2035 to approximately 14,871 AFY.

**Table 6-2: Current and Projected Recycled Water Direct Beneficial Use within Service Area**

| Wholesale: Current and Projected Retailers Provided Recycled Water Within Service Area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name of Receiving Supplier or Direct Use by Wholesaler | Level of Treatment | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| GW Recharge | Tertiary | 10,840 | 13,977 | 13,027 | 13,707 | 14,871 | 16,254* |
| RW Direct Use | Tertiary | 22,579 | 30,757 | 36,507 | 40,320 | 43,019 | 51,715 |
| | **Total** | **33,419** | **44,734** | **49,534** | **54,027** | **57,890** | **67,969** |
| NOTES: FY2014/15 is actual use. Source: Projections are from 2015 Recycled Water Program Strategy (RWPS), Tables 2.1 and ES.1.<br>*2040 groundwater recharge volume is not provided by the RWPS therefore it is an extrapolation. | | | | | | | |

The projected 2015 recycled water use from the IEUA's 2010 UWMP was compared to the 2015 actual recycled water use as shown in Table 6-3. Recycled water for 2015 was projected higher in the 2010 UWMP than the actual recycled water use in 2015. The actual FY 2014-15 recycled water use was much lower than the projected recycled water use in the 2010 UWMP due to the decrease in demand as a result of the economic recession and slower development coupled with increased indoor conservation limiting available supply.

**Table 6-3: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual (AF)**

| Wholesale: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual | | |
|---|---|---|
| Name of Receiving Supplier or Direct Use by Wholesaler | 2010 Projection for 2015 | 2015 actual use |
| IEUA | 66,192 | 33,419 |
| **Total** | **66,192** | **33,419** |
| NOTES: FY 2014/15 actual use | | |

## 6.4 Potential Recycled Water Uses

The regional recycled water program is committed to maximizing the beneficial use of recycled water. IEUA will continue to develop, expand, and provide flexibility to allow the region to use available recycled water supplies. Expansion of the recycled water program relies on the treatment capacities at the RWRP's and wastewater flow projections (IEUA, Fiscal Year 2015/16 Ten-Year Capital Improvement Plan, March 2015).

IEUA's overall goal is to achieve maximum reuse of available recycled water. The 2015 Recycled Water Program Strategy identifies goals to increase non-potable reuse as well as provide recharge to additional basins through 2035. The 2035 recycled water demand is projected to be 43,019 AFY for non-potable reuse and 14,871 AFY for groundwater recharge.

The current distribution system is comprised of several regional pipelines that have been constructed to serve customers from the IEUA RWRP's. Recognizing that separate pumping stations, independent pressure zones (800, 930, 1050, 1158, 1299 & 1630), and multiple control interfaces will lead to complex and costly operations, the concept of a large, fully integrated regional distribution system was developed. The existing and proposed facilities will have the ability to provide recycled water to major industrial and municipal users while delivering recycled water, stormwater and imported water to groundwater recharge basins throughout IEUA's service area.

Recycled water used for groundwater recharge will be blended with MWD's imported SWP supplies and stormwater consistent with the water quality requirements of CBWM's OBMP, California Regional Water Quality Control Board, and the requirements of the California State Water Resources Control Board's (SWRCB) Division of Drinking Water (DDW).

Depending on basin specific measurements, the groundwater blending ratio will be calculated to achieve up to 50 percent with all other sources of water as determined by DDW over a 10 year period. Currently IEUA can recharge up to 14,000 AFY and may increase in the future. Additional facilities, development and modifications to new groundwater recharge basins, and additional pumping capacity will be needed to achieve the long term recycled water goals for the region.

Development of local recycled water facilities is key to expanding non-potable recycled water use. Non-potable reuse includes: irrigation for landscaping, industrial processes and cooling, and recreational uses such as decorative fountains. As the recycled water facilities expand into cities, IEUA will be looking to local water providers to construct sufficient local facilities that will reduce their dependence on imported water from MWD's Rialto Feeder.

IEUA maintains special pipelines for industries that produce wastewater that cannot be treated with conventional treatment before being discharged into the Santa Ana River or beneficially reused. These pipelines are referred to as the Non-reclaimable Wastewater System (NRWS). The NRWS carries non-reclaimable wastewater to the Los Angeles County Sanitation Districts facilities in Whittier or the OCSD for treatment and disposal. These industrial water users represent a significant amount of recycled water that could be provided for non-potable uses and are potential recycled water customers. Industrial use of recycled water is approved by DDW. In order to encourage recycled water use among NRWS users, IEUA provides incentives from time to time for the industrial users.

**Recycled Water Rate –** IEUA's rate for recycled water delivered to a contracting agency is $350 per AF for direct deliveries and $410 per AF for groundwater recharge. The retail water utilities that have established a recycled water rate that can be offered at a discount from their potable water rate. The amount of discount depends on each agency's existing potable water rate, existing potable infrastructure revenue needs and capital improvements needed to convey recycled water from IEUA's regional system to individual customers.

**Reliability –** Recycled water is a reliable resource not subject to droughts or imported water availability. Existing potable water service also remains available as a backup to recycled water, improving reliability.

**Mandatory Use –** In May 2002, IEUA's Board adopted Ordinance No. 75 establishing incentives and mandatory use of recycled water when available. Under the provisions of Ordinance No. 75, which is consistent with the CWC Sec 13550 and the SWRCB guidelines, potential recycled water customers who do not use recycled water when it is available are subject to a 50 percent surcharge on their potable water rate.

**Technical Assistance –** IEUA provides technical assistance to prepare necessary engineering reports and coordinate DDW approval of recycled water use at each customer's site. IEUA has also retained experts in industrial water use and quality to assist customers in assessing operational needs associated with using recycled water.

**Increased NRWS discount** – NRWS Line customers who use recycled water when available or agree to use when available will be eligible for the proposed NRWS "pass through" rate. The NRWS customer will otherwise pay the current NRWS rates. Those NRWS customers not using recycled water or not agreeing to use it will be retroactively credited the difference paid between the current rate and the "pass through" rate at the time they begin using recycled water, with the credit to first cover the cost of on-site retrofit and engineering report preparation.

### 6.4.1 Direct Non-Potable Potable Reuse

IEUA currently provides recycled water from their four RWRP's for direct non-potable reuse such as landscape irrigation.

### 6.4.2 Indirect Potable Reuse

IEUA provides recycled water for blending with imported water and stormwater to recharge the Chino Basin. IEUA's retail agencies benefit from the groundwater recharge as it provides indirect potable supplies through replenishment.

### 6.4.3 Recycled Water Rates

In order to encourage the use of recycled water, IEUA's Board of Directors has established service rates for FY 2015-16 through 2019-20. The recycled water rate is based on operating costs of the regional wastewater treatment system, regional wastewater distribution system, associated administrative expenses, and anticipated costs for the following fiscal year. Table 6-4 shows the rates charged for direct (non-potable uses) and recharge sales.

**Table 6-4: Recycled Water Rates per AF**

| Type of Sale | 2015/16 FY | 2016/17 FY | 2017/18 FY | 2018/19 FY | 2019/20 FY |
|---|---|---|---|---|---|
| Direct Sale | $350 | $410 | $470 | $480 | $490 |
| Recharge Sale | $410 | $470 | $530 | $540 | $550 |

## 6.5 Optimization Plan

### 6.5.1 Encouraging Recycled Water Use

IEUA has organized a regional program to encourage water reuse within its service area. The establishment of new supplemental funding sources through federal, state, and regional programs now provides significant financial incentives for local agencies to develop and make use of recycled water. This removes a significant obstacle to the implementation of recycling water projects and programs.

IEUA is working closely with its local retail agencies to complete the regional recycled water distribution program that will maximize water reuse for the entire IEUA service area. Staff of all the agencies meet monthly to recycled water system master planning, to ensure that optimal capital investments are prioritized and that all potential customers are contacted regarding connection to the recycled water

system. IEUA is also working with local retail agencies to ensure that all new residential, commercial and industrial developments have dual plumbing so that recycled water (when available) can be used for outdoor irrigation and other non-potable water uses. In addition, IEUA has proposed the following incentives to encourage the use of recycled water:

- Shared costs for service connections, water meters, and signage
- Loans to help finance local (non-regional) infrastructure and retrofit projects that contribute to use of recycled water
- Technical assistance with engineering, regulatory, and institutional issues, and preparation of funding applications
- Guarantee of recycled water supply reliability, especially during droughts

## 6.6 Funding

Implementation of the regional recycled water program has been coordinated with the availability of state and federal funds to minimize use of regional capital funds. IEUA has adopted a TYCIP that has a budget that breaks out the federal, state and local funding for recycled water projects. Local funding will be through the Regional Capital Fund, state grants, loans through DWR and the State Water Resources Control Board, and federal grant funding through the US Bureau of Reclamation's Title XVI program.

The capital and operation and maintenance funding required for recycled water system expansion are estimated at $81.8 million and $3.6 million for recharge water through FY 2025-26 per the FY 15/16 TYCIP.

As more supplemental funding becomes available, the recycled water infrastructure becomes more cost-effective to construct. IEUA staff evaluated the capital funding needs for the recycled water distribution system and determined that it can be funded through the Regional Program without an additional increase in the Regional Capital Capacity Reimbursement Amount (connection fee). This provides a significant opportunity for local retail agencies to implement the OBMP (capital costs) without impacting IEUA's water and sewer rates and charges.

Repayment of the various loans will occur through recycled water sales revenues. These revenues consist of sales of recycled water (current IEUA wholesale rate and through the MWD LRP). With certain contractual limitations, MWD provides a payment of $134 per AF of recycled water that is directly reused (not groundwater recharge) up to 13,500 AFY. This rebate expires in June 2017 (IEUA, Regional Sewerage Program Technical Committee Meeting, April 2015).

# 7 FUTURE WATER SUPPLY PROJECTS AND PROGRAMS

## 7.1 Water Management Tools

Resource optimization such as groundwater recharge minimizes IEUA's reliance on imported water. Optimization efforts are typically led by regional agencies in collaboration with local/retail agencies.

## 7.2 Transfer or Exchange Opportunities

Water transfers are a water management tool used to alleviate water shortages in IEUA's service area and the Santa Ana River Basin. Water transfers allow an agency to move or sell water from one service area to another, even when the agencies are not connected by pipelines. Water transfers can be effective during periods of severe drought or emergencies and take multiple forms to increase local reliability among agencies. The Chino Basin is a valuable resource for water transfers because it acts as a storage facility that has a capacity of up to 6 MAF.

IEUA has interconnections with the MVWD that provides an annual supplemental water supply up to 10,000 AFY to the City of Chino Hills. Interconnections also exist with CVWD and FWC. The Chino Basin Desalter Authority Chino 1 and Chino 2 Desalters have interconnections with all participating agencies with a common supply with booster pumps and storage reservoirs that provide flexibility and reliability during emergencies and drought conditions. The cities of Ontario and Chino also have interconnections.

WFA has interconnections with the MVWD that provides an annual supplemental water supply up to 10,000 AFY to the City of Chino Hills. Additional important interconnections have been established between the City of Ontario and the City of Chino as well as between the Chino Basin Desalter Authority and cities served within WFA's service area.

## 7.3 Desalination Opportunities

IEUA operates and maintains the Chino 1 Desalter that is managed by the CDA. The Chino Desalters, described in Section 7.4.2, treat groundwater from the Chino Basin with high TDS, nitrates, and VOC's. The treatment process consists of RO and ion exchange, and the Chino 1 Desalter also includes air stripping for VOC removal. There are currently no other plans to treat brackish groundwater in IEUA's service area.

*WFA does not treat brackish groundwater and does not have plans to treat any.*

## 7.4 IEUA Planned Water Supply Projects and Programs

IEUA's FY 2015-16 CIP includes recycled water, stormwater, groundwater, and conservation projects to increase local supplies for the service area. These projects provide supply reliability during drought conditions and reduce dependence on imported water. Future projects consist of groundwater recharge basin improvements, improving treatment and distribution of wastewater and recycled water facilities, and increasing conservation and water use efficiency programs. Since recycled water is not directly impacted by drought or climate change, investments in these types of projects help mitigate the impacts of regional and statewide water supply limitations. Larger volumes of high-quality stormwater, recycled water, and supplemental imported water can be captured, recharged and stored in the groundwater basin through enhancement of the recharge capacity in the Chino Basin. The additional storage would provide reliability for the region during droughts or imported water supply shortages. The expected future supply projects are described in a narrative format in this chapter and in Section 6.4 (recycled water). Additional detail is provided in the FY 2016-17 Ten Year Capital Improvement Plan.

### 7.4.1 Non-potable Reuse

IEUA plans to expand the capacity of RP-1 from 32 MGD to 40 MGD through the Regional Water Recycled Plant No. 1 Expansion project. This expansion project will meet the needs of projected development in the northern portion of IEUA's service area. RP-1 will be able to treat sewer flows according to regulatory requirements and produce recycled water according to Title 22 standards with this expansion project. This project is estimated to be complete in 2030.

IEUA plans to increase non-potable reuse by extending pipelines and adding pumping facilities to serve additional recycled water to the eastern portion of its service area. In addition, a pipeline will be constructed to develop a recycled water intertie between the Western Riverside County Regional Wastewater Authority and IEUA.

### 7.4.2 Groundwater Recovery

The projected ultimate development of the Chino Basin Desalter Program, managed by the CDA, will produce 40,000 AFY of potable water. In 2012, the Chino I and II Desalter's produced approximately 24,300 AFY of treated groundwater. Table 7-1 lists through Phase III expansion of the Chino Basin Desalter Program. The program will ultimately recover 40,000 AFY of groundwater for potable use from the Chino Basin. The Phase III expansion is expected to be complete between 2010 and 2015 with a capacity of approximately 10,000 AFY.

**Table 7-1: Chino Basin Desalter Projected Production Including Phase III Expansion (AF)**

| Desalter No. | Year Constructed | 2006 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|---|---|---|
| Desalter Phase I | 2000 | 15,900 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Desalter Phase II | 2006 | 11,200 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Desalter Phase III | 2014 | - | - | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| **Total** | | **27,100** | **30,000** | **40,000** | **40,000** | **40,000** | **40,000** | **40,000** |

### 7.4.3 Groundwater Storage Expansion

IEUA plans to expand its groundwater recharge operations with improvements at the following basins: San Sevaine, RP-3, Lower Day, and Victoria. The expansions will increase diversion and recharge capacity of recycled water, stormwater, and/or imported water. IEUA also plans to use recycled water to recharge the Wineville basin.

IEUA, CBWM and MWD are interested in expanding the existing storage account to 150,000 AF. In December 2008, the environmental study (CEQA) was completed. There are three key components to the proposed expansion:

- Increase the existing 25,000 AFY storage capacity by 15,000 AFY with Aquifer Storage Recovery wells and conveyance facilities.
- Increase the existing 33,000 AFY extraction capacity by 13,000 AFY with new wells, Ion Exchange Facilities, Aquifer Storage Recovery wells and conveyance facilities.
- Continue negotiations with MWD on expanding the conjunctive use program (CUP) to include a maximum capacity of over 300,000 AFY.

The initial MWD program is expected to be the initial phase of a CUP that will increase to 500,000 AF of storage (CBWM Peace Agreement and IEUA PEIR, July 2000).

### 7.4.4 Enhanced Stormwater Management

Program Element No. 2 of the OBMP was set forth to develop and implement a comprehensive recharge program. The key is to establish a well-coordinated stormwater management program to capture the maximum amount of stormwater.

**Principles for Stormwater Management**

It is widely recognized that the patterns of urban development, including hard surfaces (roads, roofs) and storm water management systems (concrete channels) have resulted in a significant reduction in natural infiltration of stormwater. CBMW estimated the Chino Basin was losing approximately 40,000 AF of stormwater annually that replenished the groundwater basin as a result of historic patterns of development (WEI, 2001).

LID measures reduce stormwater runoff by capturing water at or near the source of runoff and infiltrate water into the soil or harvest the water for later reuse to offset potable water supplies. LID uses a variety of innovative designs to improve the urban environment to retain, detain, filter, and recharge stormwater runoff.

Often perceived as a problem in the past due to the costs of controlling stormflows and pollutants, stormwater presents an opportunity for groundwater recharge as well as water quality improvement, water conservation, and flood reduction. LID provides options at the regional and local levels including parks, golf courses, schools, city and county streets, public and privately owned buildings and their parking facilities, and new subdivision developments.

## 7.5 WFA Planned Water Supply Projects and Programs

WFA does not currently have any planned future water supply projects.

*WFA does not currently have any planned future water supply projects*

# 8 VOLUNTARY REPORTING OF ENERGY INTENSITY

## 8.1 Overview

Water and energy resources are inextricably connected. Known as the "water-energy nexus", the California Energy Commission estimates the transport and treatment of water, treatment and disposal of wastewater, and the energy used to heat and consume water account for nearly 20 percent of the total electricity and 30 percent of non-power plant related natural gas consumed in California. In 2015, California issued new rules requiring 50 percent of its power to come from renewables, along with a reduction in GHG emissions to 40 percent below 1990 levels by 2030. Consistent with energy and water conservation, renewable energy production, and GHG mitigation initiatives, IEUA elected to voluntarily report the energy intensity of its water, wastewater, and recycled water operations.

The methodology for calculating water energy intensity outlined in Appendix O of the UWMP Guidebook was adapted from the California Institute for Energy Efficiency exploratory research study titled “Methodology for Analysis of the Energy Intensity of California’s Water Systems” (Wilkinson 2000). The study defines water energy intensity as the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

UWMP voluntary reporting is limited to energy intensity associated with water management processes occurring within an urban water supplier’s direct operational control. Operational control is defined as authority over normal business operations at the operational level. Any energy embedded in water supplies imparted by an upstream water supplier (e.g., water wholesaler) or consequently by a downstream water purveyor (e.g., retail water provider) is not included in the UWMP energy intensity tables. IEUA’s calculations conform to methodologies outlined in the UWMP Guidebook and Wilkinson study.

Similar to water supply energy intensity, wastewater and recycled water energy intensities were calculated for the 2014 calendar year (January 1 thru December 31).

*Energy intensity calculations for water supply, wastewater, and recycled water were done on a calendar year basis (CY 2014) consistent with The Climate Registry reporting.*

*Water demand and supply analyses and water use efficiency program reporting were done on a fiscal year basis consistent with IEUA IRP, Land-use based demand model, and WUEBP.*

## 8.2 Water Supply Energy Intensity

IEUA's water supply energy intensity is provided in Table 8-1. The basis for calculations are provided in more detail below.

**Table 8-1: Water Supply Energy Intensity**

***Urban Water Supplier:*** *Inland Enpire Utility Agency*

**Water Delivery Product** (If delivering more than one type of product use Table O-1C)
*Wholesale Non-Potable Deliveries*

**Table O-1A: Voluntary Energy Intensity - Water Supply Process Approach**

Enter Start Date for Reporting Period 1/1/2014
End Date 12/31/2014

| | Urban Water Supplier Operational Control | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water Management Process | | | | | | Non-Consequential Hydropower (if applicable) | |
| | Extract and Divert | Place into Storage | Conveyance | Treatment | Distribution | Total Utility | Hydropower | Net Utility |
| *Volume of Water Entering Process (AF)* | *0* | *19,958* | *0* | *0* | *0* | *0* | *0* | *0* |
| *Energy Consumed (kWh)* | *0* | *991,200* | *0* | *0* | *0* | *991,200* | | *991,200* |
| *Energy Intensity (kWh/AF)* | *0.0* | *49.7* | *0.0* | *0.0* | *0.0* | *0.0* | *0.0* | *0.0* |

**Quantity of Self-Generated Renewable Energy**
35,225,315 kWh
**Data Quality** *(Estimate, Metered Data, Combination of Estimates and Metered Data)*
*Metered Data*
**Data Quality Narrative:**
Volume of Water Entering Process: Total recycled, imported, and storm water recharge in 2014 calendar year (see Chino Basin Recycled Water Groundwater Recharge Program 2014 Annual Report)
**Narrative:**
IEUA recharges recycled, imported, and storm waters on behalf of its member agencies. Control is limited to groundwater recharge and does not include upstream embedded energy consumed prior to IEUA taking control, upstream embedded energy consumed by IEUA to treat and convey reclaimed water (see Table O-2), or downstream energy consumed by IEUA's member agencies to exact, treat, and/or distribute groundwater after it has been recharged. Self-Generated Renewable Energy is reported for the agency as a whole and is not attributed to a particular operation or water treatment process (see 2015 Energy Management Plan).

### 8.2.1 Operational Control and Reporting Period

As described in Section 3, IEUA is a wholesale distributor of imported water. IEUA also delivers recycled water to member agencies and some large retail agricultural customers for the purposes of agriculture, municipal irrigation, industrial uses and groundwater replenishment. The UWMP Guidebook excludes recycled water from water supply energy intensity calculations (included in wastewater and recycled water

intensity calculations in Section 8.3) and allows flexibility when reporting energy consumed from groundwater replenishment (banking). IEUA operationally controls groundwater replenishment in the region which is included in Table 8-1 under “Place into Storage”. While IEUA operates the Chino Desalters, operational control of the facilities is held by the Chino Basin Desalter Authority. Similarly, treatment and distribution of imported water is operationally-controlled by the WFA.

Water supply energy intensity was calculated for the 2014 calendar year. This is a standard for energy and GHG reporting to the Climate Registry, California Air Resources Board and the United States Environmental Protection Agency. Calendar year reporting provides consistency when assessing direct and indirect energy consumption within a larger geographical context, as fiscal year starting dates can vary between utilities and organizations.

### 8.2.2 Volume of Water Entering Processes

According to the 2014 Chino Basin Recycled Water Groundwater Recharge Program Annual Report, IEUA recharged 19,958 AF, which includes 8,166 AF of storm water and dry weather flows, 10,997 AF of recycled water, and 795 AF of imported water. Water volume is based on metered data.

### 8.2.3 Energy Consumption and Generation

According to IEUA’s 2014 Greenhouse Gas Report submitted to The Climate Registry, groundwater replenishment facilities consumed 991,200 kilowatt hours (kWh) of electricity. IEUA self-generated 35,225,315 kWh of renewable energy in 2014 from a variety of sources including solar, wind, and biogas. Currently, IEUA does not attribute renewable energy to specific operations but rather the agency as a whole. A description of IEUA’s energy portfolio and renewable energy goals are documented in the 2015 Energy Management Plan. Energy consumption is based on metered data.

## 8.3 Wastewater and Recycled Water Energy Intensity

IEUA’s wastewater and recycled water energy intensities are shown in Table 8-2. The basis for calculations are provided in more detail below.

**Table 8-2: Wastewater and Recycled Water Energy Intensity**

***Urban Water Supplier:*** *Inland Empire Utility Agency*

| Table O-2: Voluntary Energy Intensity - Wastewater & Recycled Water | | | | | | | |
|---|---|---|---|---|---|---|---|
| Enter Start Date for Reporting Period | 1/1/2014 | Urban Water Supplier Operational Control | | | | | |
| End Date | 12/31/2014 | Water Management Process | | | | | |
| | | Collection / Conveyance | Treatment | Discharge / Distribution | TCR Report | Indirect / Outside | Total |
| *Volume of Wastewater Entering Process (AF)* | | *57,938* | *57,938* | *55,563* | | | *57,938* |
| *Wastewater Energy Consumed (kWh)* | | *1,316,808* | *104,201,227* | *-* | *167,736,290* | *42,524,090* | *105,518,035* |
| *Wastewater Energy Intensity (kWh/AF)* | | *22.7* | *1798.5* | *0.0* | | | *1821.2* |
| *Volume of Recycled Water Entering Process (AF)* | | *55,563* | *55,563* | *55,563* | *38,250* | *38,250* | *52,835* |
| *Recycled Water Energy Consumed (kWh)* | | *-* | *-* | *16,755,061* | *167,736,290* | *111,311,030* | *16,755,061* |
| *Recycled Water Energy Intensity (kWh/AF)* | | *0.0* | *0.0* | *301.6* | | | *317.1* |

**Quantity of Self-Generated Renewable Energy related to recycled water and wastewater operations**

35,225,315 kWh

**Data Quality** *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

*Metered Data*

**Data Quality Narrative:**

Volume of Water Entering Process: based on 2014 metered data

**Narrative:**

IEUA manages regional sewage service within its 242 square mile service area to collect, treat, and dispose of wastewater delivered by contracting local agencies. A system of regional trunk and interceptor sewers convey sewage to five regional wastewater treatment plants owned and operated by IEUA. Wastewater facilities utilize tertiary treatment to produce recycled water meeting Title 22 standards for non-potable reuse and groundwater replenishment. Recycled water that is not reused or replenished is discharged to the Santa Ana River. IEUA delineates wastewater from recycled water at the point following chlorination and prior to the recycled water pumps stations.

In addition to wastewater and recycled water infrastructure, IEUA also operates the Prado Dechlorination Facility, Inland Empire Regional Composting Facility, and Chino Creek Wetlands & Educational Park. While operationally-controlled by IEUA, these facilities are not directly related to the collection, treatment, or distribution of wastewater or recycled water and thus considered outside the reporting boundaries. Similarly, while much of IEUA's headquarters and vehicles are dedicated to support wastewater and recycled water operations, to maintain consistency with the UWMP Guidebook, energy consumption from these operations has also been excluded.

Energy consumed during flaring and biosolids hauling are considered integral to IEUA's wastewater treatment operations and have been included in the intensity calculations. Energy is directly metered and reported in accordance with The Climate Registry Greenhouse Gas Protocol; 2014 data are currently undergoing independent verification.

A portion of biogas produced during wastewater treatment is captured and beneficially burned as part of IEUA's treatment process. Unused biogas is flared to convert methane to carbon dioxide to reduce greenhouse gas emissions from the facilities. In 2014, IEUA utilized approximately 44 percent of the biogas for beneficial use.

### 8.3.1 Operational Control and Reporting Period

As described in Section 6, IEUA manages regional sewage service within its 242 square mile service area to collect, treat, and dispose of wastewater delivered by contracting local agencies. A system of regional trunk and interceptor sewers convey sewage to five regional wastewater treatment plants owned and operated by IEUA. Wastewater facilities use tertiary treatment to produce recycled water meeting Title 22 standards for non-potable reuse and groundwater replenishment. Recycled water that is not reused or replenished is discharged to the Santa Ana River. IEUA delineates wastewater from recycled water at the point following chlorination and prior to the recycled water pumps stations.

In addition to wastewater and recycled water infrastructure, IEUA also operates the Prado Dechlorination Facility, Inland Empire Regional Composting Facility, and Chino Creek Wetlands & Educational Park. While operationally-controlled by IEUA, these facilities are not directly related to the collection, treatment, or distribution of wastewater or recycled water and thus considered outside the reporting boundaries. Similarly, while much of IEUA's headquarters and vehicles are dedicated to support wastewater and recycled water operations, to maintain consistency with the UWMP Guidebook, energy consumption from these operations has also been excluded.

Similar to water supply energy intensity, wastewater and recycled water energy intensities were calculated for the 2014 calendar year.

### 8.3.2 Volume of Water Entering Processes

In 2014, IEUA collected and treated 57,983 AF of wastewater. 55,563 AF of recycled water was produced of which 24,995 AF was distributed to member agencies and retail customers, 10,997 AF was recharged, and 19,571 AF was discharged to the Santa Ana River as part of IEUA's discharge obligation. All recycled water was used for beneficial reuse; hence, wastewater discharge was 0 AF. Wastewater volume is based on metered data.

### 8.3.3 Energy Consumption and Generation

A summary of energy consumed during wastewater and recycled water operations as reported to The Climate Registry is shown in Table 8-3. Energy consumed during flaring and biosolids hauling are considered integral to IEUA's wastewater treatment operations and have been included in the intensity calculations. Energy is directly metered and reported in accordance with The Climate Registry Greenhouse Gas Protocol; 2014 data are currently undergoing independent verification.

As shown in Table 8-3, a portion of biogas produced during wastewater treatment is captured and beneficially burned for electricity and heat as part of IEUA's treatment process. For electricity production from biogas, energy burned is reported in lieu of electricity produced and subsequently consumed. The difference results from efficiency of combustion and transmission line losses. These energy sinks would not otherwise be reported from a utility relying on imported electricity (indirect upstream energy consumption); however, it is equally important as this energy is directly consumed by the power utility making the electricity. Unused biogas is flared to convert methane to carbon dioxide to reduce GHG emissions from the facilities. Unused biogas energy is not included in Table 8.3. In 2014, IEUA used approximately 44 percent of the biogas for beneficial use. Other renewable energy generated include solar and wind. Renewable energy production was 35,225,315 kWh in 2014. IEUA's energy portfolio and renewable energy goals are documented in the 2015 Energy Management Plan.

**Table 8-3: Wastewater and Recycled Water Process Energy Consumption**

| Facility | Electricity (kWh) | Natural Gas (kWh) | Other Fuel (kWh) | Biogas (kWh) |
|---|---|---|---|---|
| **Wastewater Operations** | | | | |
| CCWRF | 6,808,570 | 26,500 | 51,800 | - |
| RP-1 | 11,966,813 | 32,395,000 | 289,000 | 15,745,000 |
| RP-2 | 481,675 | 2,001,900 | 31,800 | 11,896,000 |
| RP-4 | 8,754,269 | 3,960 | 138,100 | - |
| RP-5 | 10,028,840 | 2,576,900 | 76,300 | 164,800 |
| Lift Stations | 1,316,808 | - | - | - |
| Biosolids Hauling | - | - | 764,000 | - |
| **Total** | **39,356,975** | **37,004,260** | **1,351,000** | **27,805,800** |
| **Recycled Water Operations** | | | | |
| CCWRF | 1,893,569 | - | - | - |
| RP-1 | 6,634,673 | - | - | - |
| RP-2 | 0 | - | - | - |
| RP-4 | 4,138,123 | - | - | - |
| RP-5 | 2,849,104 | - | - | - |
| Booster Stations | 1,239,592 | | | |
| **Total** | **16,755,061** | **0** | **0** | **0** |

Wastewater contains organic constituents that, when treated biologically, produce biogas. Biogas can be released to the atmosphere, captured and flared, or captured and burned for heat or electricity. While the UWMP Guidebook permits energy produced from consequential hydropower to be subtracted from the urban supplier's total energy consumed, the Guidebook does not permit a similar credit for consequential biogas energy production. IEUA has identified biogas as a valuable renewable resource, critical to its renewable energy portfolio and goals. To demonstrate the value of biogas capture and energy production, a revised energy intensity table is shown in Table 8-4. Table 8-4 includes a credit for consequential biogas energy production.

**Table 8-4: Wastewater and Recycled Water Energy Intensity (Revised to Reflect Consequential Biogas Energy Production)**

***Urban Water Supplier:*** *Inland Empire Utility Agency*

| Table O-2: Voluntary Energy Intensity - Wastewater & Recycled Water (REFLECTING CONSEQUENTIAL BIOGAS GENERATION) | | | | | | |
|---|---|---|---|---|---|---|
| Enter Start Date for Reporting Period 1/1/2014<br>End Date 12/31/2014 | Urban Water Supplier Operational Control | | | | | |
| | Water Management Process | | | | | |
| | Collection / Conveyance | Treatment | Discharge / Distribution | TCR Report | Indirect / Outside | Total |
| *Volume of Wastewater Entering Process (AF)* | *57,938* | *57,938* | *55,563* | | | *57,938* |
| *Wastewater Energy Consumed (kWh)* | *1,316,808* | *76,395,427* | *-* | *167,736,290* | *70,329,890* | *77,712,235* |
| *Wastewater Energy Intensity (kWh/AF)* | *22.7* | *1318.6* | *0.0* | | | *1341.3* |
| *Volume of Recycled Water Entering Process (AF)* | *55,563* | *55,563* | *55,563* | *38,250* | *38,250* | *55,563* |
| *Recycled Water Energy Consumed (kWh)* | *-* | *-* | *16,755,061* | *167,736,290* | *111,311,030* | *16,755,061* |
| *Recycled Water Energy Intensity (kWh/AF)* | *0.0* | *0.0* | *301.6* | | | *301.6* |

**Quantity of Self-Generated Renewable Energy related to recycled water and wastewater operations**

7,419,515 kWh

**Data Quality** *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

*Metered Data*

**Data Quality Narrative:**

Volume of Water Entering Process: based on 2014 metered data

**Narrative:**

IEUA manages regional sewage service within its 242 square mile service area to collect, treat, and dispose of wastewater delivered by contracting local agencies. A system of regional trunk and interceptor sewers convey sewage to five regional wastewater treatment plants owned and operated by IEUA. Wastewater facilities utilize tertiary treatment to produce recycled water meeting Title 22 standards for non-potable reuse and groundwater replenishment. Recycled water that is not reused or replenished is discharged to the Santa Ana River. IEUA delineates wastewater from recycled water at the point following chlorination and prior to the recycled water pumps stations.

In addition to wastewater and recycled water infrastructure, IEUA also operates the Prado Dechlorination Facility, Inland Empire Regional Composting Facility, and Chino Creek Wetlands & Educational Park. While operationally-controlled by IEUA, these facilities are not directly related to the collection, treatment, or distribution of wastewater or recycled water and thus considered outside the reporting boundaries. Similarly, while much of IEUA's headquarters and vehicles are dedicated to support wastewater and recycled water operations, to maintain consistency with the UWMP Guidebook, energy consumption from these operations has also been excluded.

Energy consumed during flaring and biosolids hauling are considered integral to IEUA's wastewater treatment operations and have been included in the intensity calculations. Energy is directly metered and reported in accordance with The Climate Registry Greenhouse Gas Protocol; 2014 data are currently undergoing independent verification.

A portion of biogas produced during wastewater treatment is captured and beneficially burned as part of IEUA's treatment process. Unused biogas is flared to convert methane to carbon dioxide to reduce greenhouse gas emissions from the facilities. In 2014, IEUA utilized approximately 44 percent of the biogas for beneficial use.

## 8.4 Key Findings and Next Steps

In 2014, IEUA's energy intensity of groundwater replenishment was 49.7 kWh/AF. The energy intensity of wastewater collection and treatment was 1,821 kWh/AF[1]; production and distribution of recycled water was 317 kWh/AF. Considering consequential biogas energy production, the energy intensity of wastewater was reduced to a net value of 1,341 kWh/AF. This equates to more than a 26 percent reduction in energy use, emphasizing the importance of biogas to IEUA's operations.

[1] This figure is pending final split from IEUA.

Calculating and disclosing direct operationally-controlled energy intensities is another step towards understanding the water-energy nexus. However, much work is still needed to better understand upstream and downstream (indirect) water-energy impacts. When assessing water supply energy intensities or comparing intensities between providers, it is important to consider reporting boundaries as they do not convey the upstream embedded energy or impacts energy intensity has on downstream users. Engaging one's upstream and downstream supply chain can guide more informed decisions that holistically benefit the environment and are mutually beneficial to engaged parties. Suggestions for further study include:

- Supply-chain engagement – IEUA's retail agencies rely on a variety of water sources for their customers. While some studies have used life cycle assessment tools to estimate energy intensities, there is a need to confirm this data. IEUA staff are familiar with energy reporting and could assist their retail agencies in calculating intensities for all regional supplies. Understanding the regional energy and water balance may help IEUA and its retail agencies make more informed decisions that would benefit the region as a whole. A similar analysis could be performed with upstream supply chain energy, for example, with State Project Water or surface water supplies.
- Internal benchmarking and goal setting – With a focus on energy conservation and a projected increase in water demand despite energy conservation efforts, IEUA's energy intensities will likely decrease with time. Conceivably, in a case where water demand decreases, energy intensities may rise as the energy required to pump or treat is not always proportional to water delivered. In the course of exploring the water-energy nexus and pursuing renewable energy goals, there is a need to assess whether energy intensity is a meaningful indicator or if it makes sense to use a different indicator to reflect IEUA's commitment to energy and water conservation.
- Regional sustainability – Water and energy efficiency are two components of a sustainable future. Efforts to conserve water and energy, however, may impact the social, environmental, and economic livelihood of the region. In addition to the relationship between water and energy, over time, it may also be important to consider and assess the connection these resources have on other aspects of a sustainable future.

# 9 CLIMATE CHANGE VULNERABILITY ASSESSMENT

## 9.1 Overview

Climate change is a global issue with measureable impacts to every facet of society. In southern California, climate change impacts are creating critical challenges for water utilities in procuring sustainable water resources. Assessing climate change risks and identifying climate change vulnerabilities is the first step in planning for uncertainty. Upon identifying risk, mitigation strategies can be developed and implemented to reduce risk. Over time, impacts and indicators can be monitored and strategies adjusted as knowledge improves and unknowns become better defined.

IEUA and its retail agencies recently completed Phase 1 of the IEUA IRP, a blueprint for ensuring reliable, cost-effective, and environmentally responsible water supplies for the next 25 years. The blueprint takes into consideration availability of current and future water supplies and accounts for possible fluctuations in demand forecasts resulting from climate change impacts. This is the first time that the region's planning has gone beyond a regional UWMP and the cities and water agencies have worked collaboratively to develop a comprehensive water resources plan. Two goals of the IEUA IRP are to: 1) integrate and update water resource planning documents in a focused, holistic manner, and 2) develop an implementation strategy that will improve near-term and long-term water resources management for the region. The IEUA IRP evaluates new growth, development, and water demand patterns within the service area and conducts an assessment of water needs and supply source vulnerabilities under climate change.

In April 2015, climate change vulnerabilities and impacts from the IEUA IRP were compared against the checklist in the Climate Change Handbook for Regional Water Planning (USEPA and DWR, 2011). A summary of the assessment and the current state of climate change in the region is provided below. For a thorough discussion of climate change vulnerabilities as it relates to regional and water resources, refer to the IEUA IRP included as Appendix E.

## 9.2 Current State of Local and Regional Climate Change

Climate change impacts have already started to create critical challenges for water resources management in southern California. More intense storm events and the changing frequency and duration of drought years are becoming evident throughout the state and the west. This makes future water supplies available to the region more uncertain, particularly imported water resources that are uniquely vulnerable to changes in the state's snowpack.

General climate change trends projected for California are that temperatures will increase and precipitation will increasingly fall as rain rather than snow. These trends will impact water supplies in two ways: higher temperatures will cause increased water demands; additionally, infrastructure to capture rain runoff is limited as water infrastructure in California was designed to capture slow melting snowpack not rapid stormwater runoff.

In addition, droughts are expected to occur more frequently, more intensely, and last longer. The Natural Resources Defence Council (NRDC) estimates that if nothing is done to address the implications associated with climate change, between the years 2025 and 2100, the cost of providing water to the western United States will increase from $200 billion to $950 billion per year.

## 9.3 UWMP Climate Change Risk Assessment

In April 2015, IEUA IRP climate change vulnerabilities and impacts were compared against the checklist in the Climate Change Handbook for Regional Water Planning (Handbook). Using Handbook categories and questions as a guide, regional risks were assessed to identify key climate change vulnerabilities. To the extent possible, all questions in the Handbook were addressed. Questions relating to similar risk were combined. Risks were also added to reflect region-specific conditions and uncertainties.

To aid in identifying key vulnerabilities, a high-level qualitative assessment to gauge the likelihood of impact and magnitude of risk impact was also performed. Terms used to describe likelihood were taken from Intergovernmental Panel on Climate Change (IPCC) reports and Climate Disclosure Project (CDP) methodologies. While qualitative, likelihood terms are associated with probabilities, indicating the percentage likelihood of the event occurring. Calculated probabilities were not required for the assessment, however they can give an indication as to the meaning of the terms. Likelihood terms are: Virtually certain (greater than 99 percent probability); Very likely (greater than 90 percent probability); Likely (greater than 66 percent probability); More likely than not (greater than 50 percent probability); About as likely as not (between 33 percent and 66 percent probability); Unlikely (less than 33 percent probability); Very unlikely (less than 10 percent); Exceptionally unlikely (less than 1 percent probability); and Unknown.

Magnitude terms describe the extent to which the impact, if it occurred, would affect the region. It is more than likely not all agencies in the region will be affected the same and as such, magnitudes for a particular agency may vary from the regional assessment. Qualitative in nature, magnitude terms taken from CDP risk reporting methodologies are high, medium-high, medium, low-medium, low and unknown. Factors considered when assessing magnitude were: 1) the proportion of the region affected; 2) the size of the impact on the affected portion, and 3) the potential for stakeholder or customer concern.

Climate change risks and vulnerabilities are presented in Table 9-1. Included are references to supporting documentation and general comments to support the likelihood and magnitude of climate change risk impacts. Figure 9-1 visually depicts climate change risks in relation to one another. This figure was used to identify key vulnerabilities and confirm the assessment performed in the IEUA IRP.

**Table 9-1: IEUA Regional Risk Assessment Register**

| Category | Risk | Likelihood of Impact | Magnitude of Impact | Comments / Considerations |
|---|---|---|---|---|
| **Water Demand** | Large CII Water Users | About as likely as not | Low | CII water demand is approximately 17% of total water demand. See 2015 UWMP Table 2-5. |
| | Residential Water Users | Virtually certain | High | Residential water demand is approximately 63% of total water demand. See 2015 UWMP Table 2-5. |
| | Seasonal Water Fluctuations | Very likely | High | IEUA encourages regional members to evaluate sustainable rate structures based on an indoor/outdoor efficiency standard. |
| | Climate-Sensitive Crops and Agriculture | Likely | Low | Agriculture demand is less than 1% of total water demand. See 2015 UWMP Table 2-5. |
| | Water Curtailment Measures | Virtually certain | High | Conservation measures are expected to continue per State restrictions as seen during 2015. See Phase 1 IEUA IRP. |
| | Discharges to Water Bodies | Likely | Medium-high | SAR discharge is a joint obligation. Could be impacted by upstream SAR projects and minimum flow study. |
| **Water Supply** | Imported Water | Virtually certain | High | Warmer temperatures are expected to decrease snowpack that feeds SWP. This is currently the only type of imported water the region is equipped to accept. See Phase 1 IEUA IRP. |
| | Local Surface Water | Virtually certain | Low | Local surface supplies are understood to be directly impacted by annual precipitation, however surface water is 8% of regional supplies. See Phase 1 IEUA IRP. |
| | Coastal Aquifer Saltwater Intrusion | Likely | Medium | Saltwater intrusion in SWP water may reduce availability of imported water supply through reduced pumping. See Imported Water. |
| | Chino Basin Groundwater Resiliency | Very Unlikely | High | The region relies heavily on groundwater as a supply and for banking. Based on climate simulations, minimal impact is anticipated. See Phase 1 IEUA IRP. |
| | Chino Basin Groundwater Banking | Very Unlikely | High | The region relies heavily on groundwater as a supply and for banking. Based on climate simulations, minimal impact is anticipated. See Phase 1 IEUA IRP. |
| | Non-Chino Basin Groundwater Resiliency | Likely | Low-medium | The region relies heavily on groundwater as a supply and for banking. Based on climate simulations, minimal impact is anticipated. See Phase 1 IEUA IRP. |
| | Non-Chino Basin Groundwater Banking | Likely | Low-medium | The region relies heavily on groundwater as a supply and for banking. Based on climate simulations, minimal impact is anticipated. See Phase 1 IEUA IRP. |
| | Supply / Demand Drought Threshold | About as likely as not | Low-medium | Conservative demand estimates during climate change scenarios resulted in a small supply shortfall. See Phase 1 IEUA IRP. |
| | Stormwater | More likely than not | Medium | Tied to Chino Basin operating safe yield. See Phase 1 IEUA IRP. |

| Category | Risk | Likelihood of Impact | Magnitude of Impact | Comments / Considerations |
|---|---|---|---|---|
| | Recycled water | Unlikely | Medium | Phase 1 IEUA IRP findings indicate recycled water is not impacted by climate change. |
| | Invasive Species | Unlikely | Low | Quagga Mussels discovered in Colorado River Aqueduct; known to clog pipelines and disrupt water service. |
| | Endangered Species | Very likely | Medium-high | Delta smelt and Santa Ana sucker fish |
| **Water Quality** | Surface and Storm Water Quality | Likely | Low-medium | A high quality water source that improves the quality of groundwater supplies. See Phase 1 IEUA IRP. |
| | Imported Water Quality | Likely | High | Additional investments may need to be made to meet water quality restrictions if low-salinity imported water is not available See Phase 1 IEUA IRP. |
| | Groundwater Quality | Unlikely | High | Tied to Chino Basin operating safe yield. See Phase 1 IEUA IRP. |
| | Distribution System Water Quality | Unlikely | Low | No known historical occurrences in region. |
| | Wastewater Quality | Unlikely | Medium-high | Not impacted by climate change so much as conservation. See Phase 1 IEUA IRP. |
| | Recycled Water Quality | Unlikely | Medium-high | Not impacted by climate change so much as conservation. See Phase 1 IEUA IRP. |
| **Sea Level Rise** | Coastal Erosion / Structures | Unlikely | Low-medium | Impacts to coastal areas could drive residents inland. |
| | Coastal Flooding | Unlikely | Low-medium | Impacts to coastal areas could drive residents inland. |
| | Coastal Habitat | Very Unlikely | Low | Impacts to coastal areas could drive residents inland. |
| | Coastal Surges | Very Unlikely | Low | Impacts to coastal areas could drive residents inland. |
| **Flooding / Subsidence** | Direct Infrastructure Flooding | Likely | Medium-high | Region is upstream of Prado Dam. |
| | Indirect Infrastructure Flooding | Likely | Medium | SWP and levees could impact imported water supplies. |
| | Aging / Insufficient Flood Protection Infrastructure | Unlikely | Low | Region is upstream of Prado Dam and downstream of Seven Oaks Dam. |
| | Wildfire Related Flooding | Likely | Medium-high | Wildfires to the north could increase intensity of storm/surface water runoff |
| | Land Subsidence | About as likely as not | Low-medium | Despite safe yield, localized subsidence has been observed. |
| **Ecosystem and Habitat Vulnerability** | Aquatic Habitats | Likely | Medium | Prado Dam Flood Control Basin |
| | Estuarine Habitats | Very Unlikely | Low | Region lies inland. |
| | Flora and Fauna | About as likely as not | Low | Region lies south and outside San Bernardino National Forest |
| | Endangered or Threatened Species | More likely than not | Medium | Santa Ana sucker fish |
| | Recreational Water | Unlikely | Low | El Prado Park and Chino Creeks Wetlands and Educational Park supplied by recycled water |

| Category | Risk | Likelihood of Impact | Magnitude of Impact | Comments / Considerations |
|---|---|---|---|---|
| | Vulnerable Habitats | Very Unlikely | Low | Southwest Deserts are listed as one of the Top 10 habitats vulnerable to climate change. |
| | Movement and Migration Corridors | Very Unlikely | Low | California has a plan for migration corridors but status of implementation is unknown. |
| **Hydropower & Energy Security** | Hydropower | Very Unlikely | Low | Region relies on largely on imported grid energy. |
| | Renewable Supplies and Self Generation | Very likely | High | GHG reduction goals and more stringent emission limits, may require clean technologies and phase out internal combustion engines. See 2015 IEUA Energy Management Plan |
| | Diversification | More likely than not | Low-medium | Recommended to improve reliability. See 2015 IEUA Energy Management Plan. |
| | Peaking | Very likely | High | Participation in demand response and energy storage installation. See 2015 IEUA Energy Management Plan. |
| | Energy Efficiency | Likely | Medium | Water-energy nexus has spurred comprehensive energy efficiency goals. See 2015 IEUA Energy Management Plan. |
| | Carbon Emissions | Very likely | High | Impacts to energy usage and type of self-generation. See 2015 IEUA Energy Management Plan. |
| | Critical Infrastructure (Direct) | About as likely as not | Medium-high | Back up generation available to provide temporary power. Modification may be required to provide long term grid redundancy and independence. |
| | Critical Infrastructure (Indirect) | About as likely as not | Medium-high | Back up generation available to provide temporary power. Modification may be required to provide long term grid redundancy and independence. |

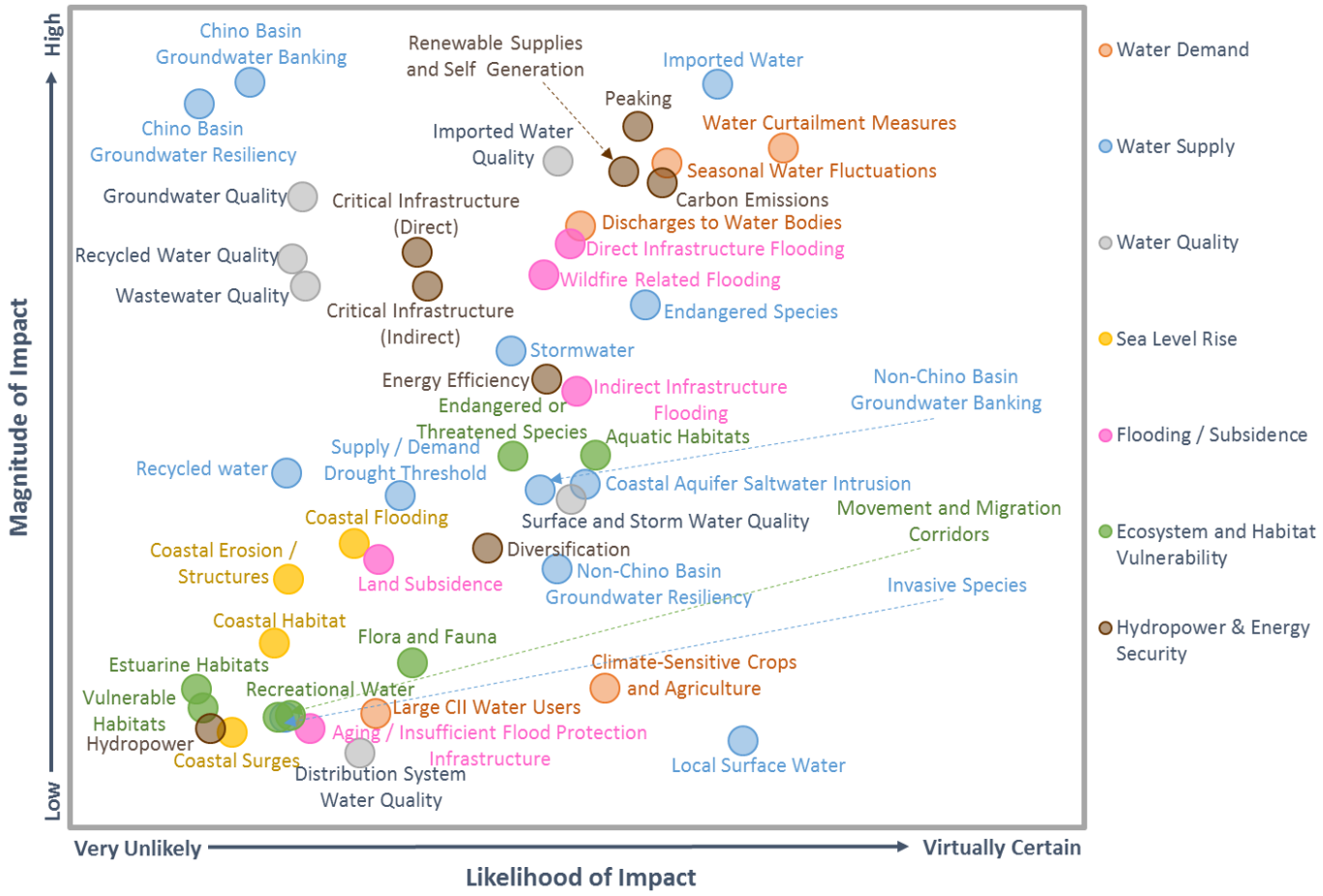



**Figure 9-1: IEUA Regional Risk Likelihood and Magnitude Assessment**

## 9.4 Climate Change Vulnerabilities and Next Steps

A summary of the climate change risk assessment and vulnerabilities is provided below:

- Consistent with the IEUA IRP, reliance on imported water supplies is a key vulnerability for the region. Indirectly, climate change impacts in northern California can affect the quality and quantity of water supplied to Inland Empire.
- Consistent with the IEUA IRP, water curtailment measures and seasonal fluctuations in water demand also have a high likelihood and magnitude of impacting the region. As drought continues in southern California, the importance of these risks will be further emphasized and more thoroughly understood as utilities focus their efforts on developing strategies to mitigate these risks.

- Although the anticipated magnitude of impact is high, the likelihood of climate change affecting groundwater resiliency, replenishment, and quality is low. This reflects the recognized importance groundwater plays in the region and the proactive steps that have already been taken to ensure sustainable groundwater supplies.
- Energy security has a high likelihood and magnitude of affecting the region as a result of climate change. While IEUA has started taking steps to reduce peaking, invest in local, renewable energy, and diversify its energy portfolio, there is a need to assess the region's energy dependence on outside energy resources to ensure sustainable water delivery in the future. While IEUA's 2015 Energy Management Plan addresses its organization's own energy risks and goals, no known plan has been developed at the regional level.
- Agriculture and large commercial, industrial, and institutional users are not anticipated to have an appreciable effect water demand. This is consistent with UWMP and IEUA IRP demand projections showing a decrease in agricultural water use and an increase in residential water use as the region grows.
- Although there are some cases where endangered species could impact the region's water supply, ecosystem and habitat vulnerability impacts to water utilities are projected to be low. This is likely the result of a largely urban region with scarce natural resources in its boundaries. However, as society places greater importance on the benefit of natural surroundings, impacts to water utilities may increase. This is the result of social, not climate change impacts and should be addressed independently.
- Climate change will inevitably have financial impacts to water utilities. While the initial climate assessment was limited to environmental impacts, there is a need to understand the financial cost of delaying risk mitigation and the financial benefit of pro-active mitigation in a time of uncertainty.

This climate change risk assessment and the climate change assessment performed in Phase 1 of the IEUA IRP demonstrate a regional commitment to identify, assess, and mitigate climate change vulnerabilities early and through partnerships and proactive engagement. Phase 2 of the IEUA IRP anticipated to begin in Summer 2016 will continue to address some of the water resource challenges in the region through the identification and prioritization of regional and local water projects. Phase 2 will also disaggregate region demand and supply and begin looking at the local retail level. It is anticipated that Phase 2 of the IEUA IRP will continue the climate change discussion and further examine the role energy plays in delivering water to communities and residents in the region.

# 10 UWMP ADOPTION PROCESS

## 10.1 Overview

Recognizing that close coordination among other relevant public agencies is key to the success of its UWMP, IEUA and WFA worked closely with entities such as MWD to develop and update this planning document. IEUA and WFA also encouraged public involvement by holding a public hearing for residents to learn and ask questions about their water supply.

This section provides the information required in Article 3 of the Water Code related to adoption and implementation of the UWMP. Table 10-1 summarizes external coordination and outreach activities carried out by the IEUA and WFA and their corresponding dates. The UWMP checklist to confirm compliance with the Water Code is provided in Appendix A.

**Table 10-1: External Coordination and Outreach**

| External Coordination and Outreach | Date | Reference |
|---|---|---|
| Encouraged public involvement | 06/02/16 & 06/09/16 (WFA)<br>05/27/16 & 06/06/16 (IEUA) | Appendix C |
| Notified city or county within supplier's service area that water supplier is preparing an updated UWMP (at least 60 days prior to public hearing) | 03/02/16 | Appendix C |
| Held public hearing | 06/15/16 | Appendix C |
| Adopted UWMP | 06/16/16 (WFA)<br>06/15/16 (IEUA) | Appendix D |
| Submitted UWMP to DWR (no later than 30 days after adoption) | 06/30/16 | - |
| Submitted UWMP to the California State Library and city or county within the supplier's service area (no later than 30 days after adoption) | 06/30/16 | - |
| Made UWMP available for public review (no later than 30 days after filing with DWR) | 05/02/16 | - |

This UWMP was adopted by IEUA's Board of Directors on June 15, 2016 and WFA's Board of Directors on June 16, 2016. A copy of the adopted resolution is provided in Appendix D.

A change from the 2004 legislative session to the 2009 legislative session required the IEUA to notify any city or county within its service area at least 60 days prior to the public hearing. As indicated in Table 10-2, IEUA sent a Letter of Notification to the County of San Bernardino and cities within its service area on March 2, 2016 to state that it was in the process of preparing an updated UWMP (Appendix C).

**Table 10-2: Notification to Cities and Counties**

| **Wholesale: Notification to Cities and Counties (select one)** | | |
|---|---|---|
| ☐ | Supplier has notified more than 10 cities or counties in accordance with CWC 10621 (b) and 10642. **Completion of the table below is not required. Provide a separate list of the cities and counties that were notified.** | |
| | Provide the page or location of this list in the UWMP. | |
| ☑ | Supplier has notified 10 or fewer cities or counties. **Complete the table below.** | |
| City Name | 60 Day Notice | Notice of Public Hearing |
| City of Chino | ☑ | ☑ |
| City of Chino Hills | ☑ | ☑ |
| Cucamonga Valley Water District | ☑ | ☑ |
| Fontana Water Company | ☑ | ☑ |
| Monte Vista Water District | ☑ | ☑ |
| City of Ontario | ☑ | ☑ |
| San Antonio Water Company | ☑ | ☑ |
| City of Upland | ☑ | ☑ |
| County Name | 60 Day Notice | Notice of Public Hearing |
| San Bernardino County | ☑ | ☑ |
| NOTES: Notifications to Cities and Counties within IEUA's service area were sent out on March 2, 2016. | | |

## 10.2 Public Participation

IEUA encouraged community and public interest involvement in the plan update through a public hearing and inspection of the draft document on June 15. Public hearing notifications were published in local newspapers. A copy of the published Notice of Public Hearing is included in Appendix C. The hearing provided an opportunity for all residents and employees in the service area to learn and ask questions

about their water supply in addition to the IEUA's plans for providing a reliable, safe, high-quality water supply. Copies of the draft plan were made available for public inspection at the IEUA headquarters and website.

## 10.3 Agency Coordination

IEUA's water supply planning relates to the policies, rules, and regulations of its regional and local water providers. IEUA is dependent on imported water from MWD, its regional wholesaler. As such, IEUA involved the water providers in this 2015 UWMP at various levels of contribution as summarized in Table 10-3.

**Table 10-3: Coordination with Appropriate Agencies**

| | Participated in Plan Development | Commented on Draft | Attended Public Meetings | Sent Notice of Plan Preparation | Received Copy of Draft Plan* | Sent Notice of Intention to Adopt | Received Copy of Adopted Plan |
|---|---|---|---|---|---|---|---|
| City of Chino | √ | | | √ | √ | √ | √ |
| City of Chino Hills | √ | | | √ | √ | √ | √ |
| City of Montclair | √ | | | √ | √ | √ | √ |
| City of Ontario | √ | | | √ | √ | √ | √ |
| City of Rancho Cucamonga | √ | | | √ | √ | √ | √ |
| City of Upland | √ | | | √ | √ | √ | √ |
| Chino Basin Watermaster | | | | √ | √ | √ | √ |
| Cucamonga Valley Water District | √ | | | √ | √ | √ | √ |
| Fontana Water Company | √ | | | √ | √ | √ | √ |

| | Participated in Plan Development | Commented on Draft | Attended Public Meetings | Sent Notice of Plan Preparation | Received Copy of Draft Plan* | Sent Notice of Intention to Adopt | Received Copy of Adopted Plan |
|---|---|---|---|---|---|---|---|
| Water Facilities Authority | √ | √ | √ | √ | √ | √ | √ |
| Monte Vista Water District | √ | | | √ | √ | √ | √ |
| MWD | | | | √ | √ | √ | √ |
| San Antonio Water Company | √ | | | √ | √ | √ | √ |
| Santa Ana Watershed Project | | | | √ | √ | √ | √ |
| Santa Ana RWQCB | | | | √ | √ | √ | √ |
| County, San Bernardino | | | | √ | √ | √ | √ |
| LAFCO | | | | √ | √ | √ | √ |

*IEUA posted the draft 2015 UWMP to its website on May 5, 2016.

## 10.4 UWMP Submittal

### 10.4.1 Review of 2010 UWMP Implementation

As required by California Water Code, the IEUA summarized Water Conservation Programs implemented to date, and compared them to those planned in its 2010 UWMP.

**Comparison of 2010 Planned Water Conservation Programs with 2015 Actual Programs**

As a wholesaler, IEUA did not include a specific implementation plan in its 2010 UWMP. As a signatory to the MOU regarding urban water use efficiency, IEUA is committed to implementing BMP-based water use efficiency programs. For IEUA's specific achievements in the area of conservation, please see Section 4 of this Plan.

### 10.4.2 Filing of 2015 UWMP

IEUA's Board of Directors reviewed the Final Draft Plan on May 18, 2016. The five-member Board of Directors approved the 2015 Regional UWMP on June 15, 2016. See Appendix D for the resolution approving the Plan.

By July 1, 2016, the adopted 2015 Regional UWMP was filed with DWR, California State Library, County of San Bernardino, and cities within its service area, if applicable.

# REFERENCES

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Inland Empire Utilities Agency, Fiscal Year 2015/16 Ten-Year Capital Improvement Plan (March 2015).

Inland Empire Utilities Agency, Integrated Water Resources Plan: Water Supply & Climate Change Impacts 2015-2040 (2016).

Inland Empire Utilities Agency, Recycled Water Program Strategy (October 2015).

Inland Empire Utilities Agency, Regional Sewerage Program Technical Committee Meeting (April 2015).

Inland Empire Utilities Agency, Wastewater Facilities Master Plan (August 2014).

Metropolitan Water District of Southern California, 2016. MWD Urban Water Management Plan 2015.

Urban Water Management Planning Act, California Water Code § 10610-10656 (2010).

Water Conservation Act of 2009, California Senate SB x7-7, 7th California Congress (2009).

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Water Systems Optimization, 2016. California Department of Water Resources: Water Audit Manual.

# APPENDIX A

## UWMP Checklist

# UWMP Checklist

This checklist is developed directly from the Urban Water Management Planning Act and SB X7-7. It is provided to support water suppliers during preparation of their UWMPs. Two versions of the UWMP Checklist are provided – the first one is organized according to the California Water Code and the second checklist according to subject matter. The two checklists contain duplicate information and the water supplier should use whichever checklist is more convenient. In the event that information or recommendations in these tables are inconsistent with, conflict with, or omit the requirements of the Act or applicable laws, the Act or other laws shall prevail.

Each water supplier submitting an UWMP can also provide DWR with the UWMP location of the required element by completing the last column of eitherchecklist. This will support DWR in its review of these UWMPs. The completed form can be included with the UWMP.

If an item does not pertain to a water supplier, then state the UWMP requirement and note that it does not apply to the agency. For example, if a water supplier does not use groundwater as a water supply source, then there should be a statement in the UWMP that groundwater is not a water supply source.

## Checklist Arranged by Subject

| CWC Section | UWMP Requirement | Subject | Guidebook Location | UWMP Location *(Optional Column for Agency Use)* |
|---|---|---|---|---|
| **10620(b)** | Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier. | Plan Preparation | Section 2.1 | **Section 1.1** |
| **10620(d)(2)** | Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable. | Plan Preparation | Section 2.5.2 | **Section 10.3** |
| **10642** | Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. | Plan Preparation | Section 2.5.2 | **Section 10.2** |
| **10631(a)** | Describe the water supplier service area. | System Description | Section 3.1 | **Section 1.4.1 and 1.5.1** |
| **10631(a)** | Describe the climate of the service area of the supplier. | System Description | Section 3.3 | **Section 1.4.3 and 1.5.3** |
| **10631(a)** | Provide population projections for 2020, 2025, 2030, and 2035. | System Description | Section 3.4 | **Section 1.4.4 and 1.5.4** |
| **10631(a)** | Describe other demographic factors affecting the supplier's water management planning. | System Description | Section 3.4 | **Section 1.4.4 and 1.5.4** |
| **10631(a)** | Indicate the current population of the service area. | System Description and Baselines and Targets | Sections 3.4 and 5.4 | **Section 1.4.4 and 1.5.4** |
| **10631(e)(1)** | Quantify past, current, and projected water use, identifying the uses among water use sectors. | System Water Use | Section 4.2 | **Section 2.3.2** |
| **10631(e)(3)(A)** | Report the distribution system water loss for the most recent 12-month period available. | System Water Use | Section 4.3 | **Section 2.5.4.1** |
| **10631.1(a)** | Include projected water use needed for lower income housing projected in the service area of the supplier. | System Water Use | Section 4.5 | **N/A** |
| **10608.20(b)** | Retail suppliers shall adopt a 2020 water use target using one of four methods. | Baselines and Targets | Section 5.7 and App E | **N/A** |
| **10608.20(e)** | Retail suppliers shall provide baseline daily | Baselines and | Chapter 5 and | **N/A** |

| | | | | |
|---|---|---|---|---|
| | per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data. | Targets | App E | |
| **10608.22** | Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100. | Baselines and Targets | Section 5.7.2 | **N/A** |
| **10608.24(a)** | Retail suppliers shall meet their interim target by December 31, 2015. | Baselines and Targets | Section 5.8 and App E | **N/A** |
| **10608.24(d)(2)** | If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment. | Baselines and Targets | Section 5.8.2 | **N/A** |
| **10608.36** | Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions. | Baselines and Targets | Section 5.1 | **Section 4.7** |
| **10608.40** | Retail suppliers shall report on their progress in meeting their water use targets. The data shall be reported using a standardized form. | Baselines and Targets | Section 5.8 and App E | **N/A** |
| **10631(b)** | Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, 2030, and 2035. | System Supplies | Chapter 6 | **Section 3.1** |
| **10631(b)** | Indicate whether groundwater is an existing or planned source of water available to the supplier. | System Supplies | Section 6.2 | **Section 3.2** |
| **10631(b)(1)** | Indicate whether a groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization. | System Supplies | Section 6.2.2 | **Section 3.2** |
| **10631(b)(2)** | Describe the groundwater basin. | System Supplies | Section 6.2.1 | **Section 3.2** |
| **10631(b)(2)** | Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump. | System Supplies | Section 6.2.2 | **Section 3.2.1** |
| **10631(b)(2)** | For unadjudicated basins, indicate whether or not the department has identified the basin as overdrafted, or projected to become overdrafted. Describe efforts by the supplier to eliminate the long-term overdraft condition. | System Supplies | Section 6.2.3 | **Section 3.2.1** |
| **10631(b)(3)** | Provide a detailed description and analysis | System Supplies | Section 6.2.4 | **Section 3.2** |

| | | | | |
|---|---|---|---|---|
| | of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years | | | |
| **10631(b)(4)** | Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped. | System Supplies | Sections 6.2 and 6.9 | **Section 3.1 and 3.2** |
| **10631(d)** | Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis. | System Supplies | Section 6.7 | **Section 7.2** |
| **10631(g)** | Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years. | System Supplies | Section 6.8 | **Section 7** |
| **10631(h)** | Describe desalinated water project opportunities for long-term supply. | System Supplies | Section 6.6 | **Section 7.3** |
| **10631(j)** | Retail suppliers will include documentation that they have provided their wholesale supplier(s) – if any - with water use projections from that source. | System Supplies | Section 2.5.1 | **N/A** |
| **10631(j)** | Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types. | System Supplies | Section 2.5.1 | **Section 2.4.1 and 2.5.1 and Table 1-4** |
| **10633** | For wastewater and recycled water, coordinate with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.1 | **Section 6.1** |
| **10633(a)** | Describe the wastewater collection and treatment systems in the supplier's service area. Include quantification of the amount of wastewater collected and treated and the methods of wastewater disposal. | System Supplies (Recycled Water) | Section 6.5.2 | **Section 6.2** |
| **10633(b)** | Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project. | System Supplies (Recycled Water) | Section 6.5.2.2 | **Section 6.2** |
| **10633(c)** | Describe the recycled water currently being used in the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.3 and 6.5.4 | **Section 6.3** |
| **10633(d)** | Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses. | System Supplies (Recycled Water) | Section 6.5.4 | **Section 6.4** |
| **10633(e)** | Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description | System Supplies (Recycled Water) | Section 6.5.4 | **Section 6.3 and 6.4** |

| | | | | |
|---|---|---|---|---|
| | of the actual use of recycled water in comparison to uses previously projected. | | | |
| **10633(f)** | Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year. | System Supplies (Recycled Water) | Section 6.5.5 | **Section 6.4** |
| **10633(g)** | Provide a plan for optimizing the use of recycled water in the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.5 | **Section 6.5** |
| **10620(f)** | Describe water management tools and options to maximize resources and minimize the need to import water from other regions. | Water Supply Reliability Assessment | Section 7.4 | **Section 3.2, 3.3, 3.5, 3.6, 3.7, 4.7, 4.9, and 6.4** |
| **10631(c)(1)** | Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage. | Water Supply Reliability Assessment | Section 7.1 | **Section 3.9.1** |
| **10631(c)(1)** | Provide data for an average water year, a single dry water year, and multiple dry water years | Water Supply Reliability Assessment | Section 7.2 | **Section 3.9.2 and 3.9.3** |
| **10631(c)(2)** | For any water source that may not be available at a consistent level of use, describe plans to supplement or replace that source. | Water Supply Reliability Assessment | Section 7.1 | **Section 3.9.1** |
| **10634** | Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability | Water Supply Reliability Assessment | Section 7.1 | **Section 3.9.1** |
| **10635(a)** | Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years. | Water Supply Reliability Assessment | Section 7.3 | **Section 3.9.2 and 3.9.3** |
| **10632(a) and 10632(a)(1)** | Provide an urban water shortage contingency analysis that specifies stages of action and an outline of specific water supply conditions at each stage. | Water Shortage Contingency Planning | Section 8.1 | **Section 5.3** |
| **10632(a)(2)** | Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency. | Water Shortage Contingency Planning | Section 8.9 | **Section 5.6** |
| **10632(a)(3)** | Identify actions to be undertaken by the urban water supplier in case of a catastrophic interruption of water supplies. | Water Shortage Contingency Planning | Section 8.8 | **Section 5.7** |
| **10632(a)(4)** | Identify mandatory prohibitions against specific water use practices during water shortages. | Water Shortage Contingency Planning | Section 8.2 | **Section 5.3** |
| **10632(a)(5)** | Specify consumption reduction methods in the most restrictive stages. | Water Shortage Contingency | Section 8.4 | **Section 5.3** |

| | | | | |
|---|---|---|---|---|
| | | Planning | | |
| **10632(a)(6)** | Indicated penalties or charges for excessive use, where applicable. | Water Shortage Contingency Planning | Section 8.3 | **Section 5.3** |
| **10632(a)(7)** | Provide an analysis of the impacts of each of the actions and conditions in the water shortage contingency analysis on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts. | Water Shortage Contingency Planning | Section 8.6 | **Section 5.8** |
| **10632(a)(8)** | Provide a draft water shortage contingency resolution or ordinance. | Water Shortage Contingency Planning | Section 8.7 | **Appendix K, L, and M** |
| **10632(a)(9)** | Indicate a mechanism for determining actual reductions in water use pursuant to the water shortage contingency analysis. | Water Shortage Contingency Planning | Section 8.5 | **Section 5.3** |
| **10631(f)(1)** | Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code. | Demand Management Measures | Sections 9.2 and 9.3 | **N/A** |
| **10631(f)(2)** | Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program. | Demand Management Measures | Sections 9.1 and 9.3 | **Section 4** |
| **10631(i)** | CUWCC members may submit their 2013-2014 CUWCC BMP annual reports in lieu of, or in addition to, describing the DMM implementation in their UWMPs. This option is only allowable if the supplier has been found to be in full compliance with the CUWCC MOU. | Demand Management Measures | Section 9.5 | **Section 4** |
| **10608.26(a)** | Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets. | Plan Adoption, Submittal, and Implementation | Section 10.3 | **N/A** |
| **10621(b)** | Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. | Plan Adoption, Submittal, and Implementation | Section 10.2.1 | **Appendix C** |
| **10621(d)** | Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016. | Plan Adoption, Submittal, and Implementation | Sections 10.3.1 and 10.4 | **Section 10.4.2 and Appendix D** |
| **10635(b)** | Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 60 days after the submission of the plan to DWR. | Plan Adoption, Submittal, and Implementation | Section 10.4.4 | **Section 10** |

| | | | | |
|---|---|---|---|---|
| **10642** | Provide supporting documentation that the urban water supplier made the plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan. | Plan Adoption, Submittal, and Implementation | Sections 10.2.2, 10.3, and 10.5 | **Section 10** |
| **10642** | The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. | Plan Adoption, Submittal, and Implementation | Sections 10.2.1 | **Appendix C** |
| **10642** | Provide supporting documentation that the plan has been adopted as prepared or modified. | Plan Adoption, Submittal, and Implementation | Section 10.3.1 | **Appendix D** |
| **10644(a)** | Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library. | Plan Adoption, Submittal, and Implementation | Section 10.4.3 | **Section 10.4.2** |
| **10644(a)(1)** | Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption. | Plan Adoption, Submittal, and Implementation | Section 10.4.4 | **Section 10** |
| **10644(a)(2)** | The plan, or amendments to the plan, submitted to the department shall be submitted electronically. | Plan Adoption, Submittal, and Implementation | Sections 10.4.1 and 10.4.2 | **Section 10** |
| **10645** | Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | Section 10.5 | **Section 10** |

# APPENDIX B

## Standardized Tables

| Table 2-2: Plan Identification | | | |
|---|---|---|---|
| **Select Only One** | **Type of Plan** | | **Name of RUWMP or Regional Alliance** *if applicable* *drop down list* |
| ☐ | **Individual UWMP** | | |
| | ☐ | Water Supplier is also a member of a RUWMP | |
| | ☐ | Water Supplier is also a member of a Regional Alliance | |
| ☑ | **Regional Urban Water Management Plan (RUWMP)** | | Other |
| NOTES: This UWMP covers the Inland Empire Utilities Agency (IEUA) and the Water Facilities Authority (WFA) | | | |

| Table 2-3: Agency Identification | |
|---|---|
| Type of Agency (select one or both) | |
| ☑ | Agency is a wholesaler |
| ☐ | Agency is a retailer |
| Fiscal or Calendar Year (select one) | |
| ☐ | UWMP Tables Are in Calendar Years |
| ☑ | UWMP Tables Are in Fiscal Years |
| If Using Fiscal Years Provide Month and Date that the Fiscal Year Begins (mm/dd) | |
| *7/1* | |
| Units of Measure Used in UWMP (select from Drop down) | |
| Unit | AF |
| NOTES: This agency identification table applies to both IEUA and the WFA | |

| Table 2-4 Wholesale: Water Supplier Information Exchange (select one) | |
|---|---|
| ☐ | Supplier has informed more than 10 other water suppliers of water supplies available in accordance with CWC 10631. Completion of the table below is optional. If not completed include a list of the water suppliers that were informed. |
| | **Provide page number for location of the list.** |
| ☑ | Supplier has informed 10 or fewer other water suppliers of water supplies available in accordance with CWC 10631.<br>**Complete the table below.** |

| Water Supplier Name *(Add additional rows as needed)* |
|---|
| City of Chino |
| City of Chino Hills |
| Cucamonga Valley Water District |
| Fontana Water Company |
| Monte Vista Water District |
| City of Ontario |
| San Antonio Water Company |
| City of Upland |
| NOTES: |

| Table 3-1 Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| | 856,168 | 896,533 | 955,569 | 1,009,349 | 1,067,946 | 1,125,203 |
| NOTES: Total population for IEUA service area from IEUA IRP (Appendix D) based on 2012 SCAG RTP including unincorporated area population. | | | | | | |

| Table 3-1 Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| | 450,041 | 471,259 | 502,291 | 530,560 | 561,361 | 591,458 |
| NOTES: 2015 population is the sum of 2015 population reported by each of WFA's five retail agencies (estimated using various methods) representing 52.6 percent of IEAU's service area population estimated by 2012 SCAG RTP. | | | | | | |

| Table 4-1 Wholesale: Demands for Potable and Raw Water - Actual | | | |
|---|---|---|---|
| Use Type<br>*(Add additional rows as needed)* | 2015 Actual | | |
| ***Drop down list***<br>*May select each use multiple times*<br>*These are the only use types that will be recognized by the WUE data online submittal tool* | Additional Description<br>*(as needed)* | Level of Treatment When Delivered<br>*Drop down list* | Volume |
| Sales to other agencies | | Drinking Water | 58,906 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | **TOTAL** | 58,906 |
| NOTES: Actual FY 2014/15 IEUA Annual Water Use Report/Database | | | |

| Table 4-1 Wholesale: Demands for Potable and Raw Water - Actual | | | |
|---|---|---|---|
| Use Type<br>*(Add additional rows as needed)* | 2015 Actual | | |
| ***Drop down list***<br>*May select each use multiple times*<br>*These are the only use types that will be recognized by the WUE data online submittal tool* | Additional Description<br>*(as needed)* | Level of Treatment When Delivered<br>*Drop down list* | Volume |
| Sales to other agencies | | Drinking Water | 27,606 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | **TOTAL** | 27,606 |
| NOTES: IEUA's imported water sales to WFA was 47 percent of its total imported water sales in FY 2014-15. | | | |

| Table 4-2 Wholesale: Demands for Potable and Raw Water - Projected | | | | | | |
|---|---|---|---|---|---|---|
| Use Type *(Add additional rows as needed)* | Additional Description *(as needed)* | Projected Water Use *Report To the Extent that Records are Available* | | | | |
| ***Drop down list*** *May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool.* | | 2020 | 2025 | 2030 | 2035 | 2040 *( opt)* |
| Sales to other agencies | | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **TOTAL** | | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| NOTE: From IEUA IRP baseline supply projections for imported water | | | | | | |

| Table 4-2 Wholesale: Demands for Potable and Raw Water - Projected | | | | | | |
|---|---|---|---|---|---|---|
| Use Type *(Add additional rows as needed)* | Additional Description *(as needed)* | Projected Water Use *Report To the Extent that Records are Available* | | | | |
| ***Drop down list*** *May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool.* | | 2020 | 2025 | 2030 | 2035 | 2040 *( opt)* |
| Sales to other agencies | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **TOTAL** | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |

NOTES: IEUA's imported water sales to WFA represented 47 percent of its total imported water sales in FY2014-15. Assumption is 47 percent for all future years.

| Table 4-3 Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| Potable and Raw Water<br>*From Tables 4-1 and 4-2* | 58,906 | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| Recycled Water Demand*<br>*From Table 6-4* | 33,419 | 44,734 | 49,534 | 54,027 | 57,890 | 67,969 |
| **TOTAL WATER DEMAND** | 92,325 | 114,486 | 119,286 | 123,779 | 127,642 | 137,721 |
| **Recycled water demand fields will be blank until Table 6-4 is complete.* | | | | | | |
| NOTES: 2015 values are FY 2014-15 actuals. Raw water projections are from IEUA IRP baseline projection and recycled water projections are derived from IEUA's RWPS (Table 5.4). | | | | | | |

| Table 4-3 Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| Potable and Raw Water<br>*From Tables 4-1 and 4-2* | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| Recycled Water Demand*<br>*From Table 6-4* | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL WATER DEMAND** | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| **Recycled water demand fields will be blank until Table 6-4 is complete.* | | | | | | |
| NOTES: 2015 value represents actual demand for FY 2014-15. Projected values assume WFA's demands represent 47 percent of IEUA's imported water demand. | | | | | | |

| Table 4-4 Wholesale: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss* |
| 07/2014 | 0 |
| ** Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* | |
| NOTES: IEUA does not own or operate any potable pipelines or connections | |

| Table 4-4 Wholesale: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss* |
| 07/2014 | 266.6 |
| ** Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* | |
| NOTES: WFA's AWWA water loss audit | |

**Table 5-1 Baselines and Targets Summary**

*Retail Agency or Regional Alliance Only*

| Baseline Period | Start Year | End Year | Average Baseline GPCD* | 2015 Interim Target * | Confirmed 2020 Target* |
|---|---|---|---|---|---|
| 10-15 year | *1995-1999* | *2004-2008* | *243* | *218* | *194* |
| 5 Year | *2003-2005* | *2007-2009* | *227* | | |

*All values are in Gallons per Capita per Day (GPCD)

NOTES: Baselines and targets were determined by calculating the weighted average of the retail agencies' values, taken from the verification forms for each retail agency within the Regional Alliance.

**Table 5-2: 2015 Compliance**
*Retail Agency or Regional Alliance Only*

| Actual 2015 GPCD* | 2015 Interim Target GPCD* | Optional Adjustments to 2015 GPCD *From Methodology 8* | | | | | 2015 GPCD* *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? Y/N |
|---|---|---|---|---|---|---|---|---|
| | | Extraordinary Events* | Economic Adjustment* | Weather Normalization* | TOTAL Adjustments* | Adjusted 2015 GPCD* | | |
| 160 | 218 | | | | 0 | 160 | 160 | Yes |

**All values are in Gallons per Capita per Day (GPCD)*

NOTES: Actual 2015 GPCD and 2015 target were determined by calculating the weighted average of the retail agencies' values taken from the verification forms for each retail agency within the Retail Alliance.

| Table 6-1 Wholesale: Groundwater Volume Pumped | | | | | | |
|---|---|---|---|---|---|---|
| ☑ | Supplier does not pump groundwater.<br>The supplier will not complete the table below. | | | | | |
| Groundwater Type<br>***Drop Down List***<br>*May use each category multiple times* | Location or Basin Name | 2011 | 2012 | 2013 | 2014 | 2015 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **TOTAL** | | 0 | 0 | 0 | 0 | 0 |
| NOTES: | | | | | | |

| Table 6-1 Wholesale: Groundwater Volume Pumped | | | | | | |
|---|---|---|---|---|---|---|
| ☑ | Supplier does not pump groundwater.<br>The supplier will not complete the table below. | | | | | |
| Groundwater Type<br>***Drop Down List***<br>*May use each category multiple times* | Location or Basin Name | 2011 | 2012 | 2013 | 2014 | 2015 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **TOTAL** | | 0 | 0 | 0 | 0 | 0 |
| NOTES: | | | | | | |

**Table 6-3 Wholesale: Wastewater Treatment and Discharge Within Service Area in 2015**

| ☐ | Wholesale supplier neither distributes nor provides supplemental treatment to recycled water. The supplier will not complete the table below. |
|---|---|

| Wastewater Treatment Plant Name | Discharge Location Name or Identifier | Discharge Location Description | Wastewater Discharge ID Number *(optional)* | Method of Disposal *Drop down list* | Does This Plant Treat Wastewater Generated Outside the Service Area? | Treatment Level *Drop down list* | 2015 volumes | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wastewater Treated | Discharged Treated Wastewater | Recycled Within Service Area | Recycled Outside of Service Area |
| *Add additional rows as needed* | | | | | | | | | | |
| RP-1 | | Santa Ana River | | River or creek outfall | No | Tertiary | 28,896 | 23,365 | 33,419 | |
| RP-4 | | Santa Ana River | | River or creek outfall | Yes | Tertiary | 10,976 | | | |
| RP-5 | | Santa Ana River | | River or creek outfall | No | Tertiary | 8,960 | | | |
| CCWRF | | Santa Ana River | | River or creek outfall | No | Tertiary | 7,952 | | | |
| | | | | | | **Total** | 56,784 | 23,365 | 33,419 | 0 |

NOTES: From Recycled Water Program Strategy 2015, Table 2.1

| Table 6-4 Wholesale: Current and Projected Retailers Provided Recycled Water Within Service Area | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☐ | Recycled water is not directly treated or distributed by the supplier. The supplier will not complete the table below. | | | | | | |
| Name of Receiving Supplier or Direct Use by Wholesaler | Level of Treatment *Drop down list* | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| *Add additional rows as needed* | | | | | | | |
| GW Recharge | Tertiary | 10,840 | 13,977 | 13,027 | 13,707 | 14,871 | 16,254 |
| RW Direct Use | Tertiary | 22,579 | 30,757 | 36,507 | 40,320 | 43,019 | 51,715 |
| | **Total** | 33,419 | 44,734 | 49,534 | 54,027 | 57,890 | 67,969 |
| NOTES: FY2014/15 is actual use. Source:Projections are from 2015 Recycled Water Program Strategy (RWPS), Tables 2.1 and ES.1.<br>*2040 groundwater recharge volume is not provided by the RWPS therefore it is an extrapolation. | | | | | | | |

| Table 6-5 Wholesale: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual | | |
|---|---|---|
| ☐ | Recycled water was not used or distributed by the supplier in 2010, nor projected for use or distribution in 2015.<br>The wholesale supplier will not complete the table below. | |
| Name of Receiving Supplier or Direct Use by Wholesaler | 2010 Projection for 2015 | 2015 actual use |
| *Add additional rows as needed* | | |
| IEUA | 66,192 | 33,419 |
| | | |
| | | |
| **Total** | 66,192 | 33,419 |
| NOTES: FY 2014/15 actual use | | |

| Table 6-7 Wholesale: Expected Future Water Supply Projects or Programs | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | No expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Supplier will not complete the table below. | | | | | |
| ☑ | Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format. | | | | | |
| Page 7-2 | Provide page location of narrative in the UWMP | | | | | |
| Name of Future Projects or Programs | Joint Project with other agencies? | | Description *(if needed)* | Planned Implementation Year | Planned for Use in Year Type *Drop Down list* | Expected Increase in Water Supply to Agency |
| | *Drop Down Menu* | *If Yes, Agency Name* | | | | |
| *Add additional rows as needed* | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| NOTES: | | | | | | |

| Table 6-8 Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| ***Drop down list*** *May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Actual Volume | Water Quality *Drop Down List* | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | |
| Purchased or Imported Water | | 58,906 | Raw Water | |
| Recycled Water | | 33,419 | Recycled Water | |
| | | | | |
| | | | | |
| **Total** | | 92,325 | | 0 |
| NOTES: Imported water from Actual FY 2014-15 IEUA Water Use Report/Database. Recycled water from IEUA database. | | | | |

| Table 6-8 Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| ***Drop down list*** *May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Actual Volume | Water Quality *Drop Down List* | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | |
| Purchased or Imported Water | | 27,606 | Drinking Water | |
| | | | | |
| | | | | |
| | | | | |
| **Total** | | 27,606 | | 0 |
| NOTES: IEUA's FY 2014-15 sales of imported water to WFA. | | | | |

**Table 6-9 Wholesale: Water Supplies — Projected**

| Water Supply | Additional Detail on Water Supply | Projected Water Supply *Report To the Extent Practicable* | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| ***Drop down list*** *May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| *Add additional rows as needed* | | | | | | |
| Purchased or Imported Water | | 69,752 | 69,752 | 69,752 | 69,752 | 69,752 |
| Recycled Water | Direct Use | 30,757 | 36,507 | 40,320 | 43,019 | 51,715 |
| Recycled Water | GW Recharge | 13,977 | 13,027 | 13,707 | 14,871 | 16,254 |
| | **Total** | 114,486 | 119,286 | 123,779 | 127,642 | 137,721 |

NOTES: Imported water from IEUA IRP Baseline Supply. Recycled water from 2015 RWPS, Tables 2.1 and ES.1. 2040 groundwater recharge volume is not provided by the RWPS therefore it is an extrapolation.

**Table 6-9 Wholesale: Water Supplies — Projected**

| Water Supply<br>***Drop down list***<br>*May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | Additional Detail on Water Supply | Projected Water Supply<br>*Report To the Extent Practicable*<br>**2020**<br>Reasonably Available Volume | **2025**<br>Reasonably Available Volume | **2030**<br>Reasonably Available Volume | **2035**<br>Reasonably Available Volume | **2040** *(opt)*<br>Reasonably Available Volume |
|---|---|---|---|---|---|---|
| *Add additional rows as needed* | | | | | | |
| Purchased or Imported Water | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Total** | | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |

NOTES: Assume 47 percent of IEUA's imported supply is for WFA for all future years (same proportion as in FY 2014-15 actual).

| Table 7-1 Wholesale: Basis of Water Year Data | | | |
|---|---|---|---|
| **Year Type** | **Base Year** *If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | **Available Supplies if Year Type Repeats** | |
| | | ☐ | Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location _____ |
| | | ☑ | Quantification of available supplies is provided in this table as either volume only, percent only, or both. |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 2010 | 294,642 | |
| Single-Dry Year | 2013 | 294,642 | |
| Multiple-Dry Years 1st Year | 2014 | 294,642 | |
| Multiple-Dry Years 2nd Year | 2015 | 294,642 | |
| Multiple-Dry Years 3rd Year | 2015 | 294,642 | |

Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.

NOTES: Volumes based on IRP baseline supply projections for 2040 plus supplemental supply opportunities to be developed (excluding recycled water for agricultural). The values represent the regional supply, not just IEUA wholesale supply.

**Table 7-1 Wholesale: Basis of Water Year Data**

| Year Type | Base Year<br>*If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | Available Supplies if Year Type Repeats | |
|---|---|---|---|
| | | ☐ Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location _____ | |
| | | ☑ Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 2010 | 32,783 | 100% |
| Single-Dry Year | 2013 | 34,010 | 104% |
| Multiple-Dry Years 1st Year | 2014 | 34,744 | 106% |
| Multiple-Dry Years 2nd Year | 2015 | 34,744 | 106% |
| Multiple-Dry Years 3rd Year | 2015 | 34,744 | 106% |

Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.

NOTES: Volume available during average year, single-dry year, and multiple-dry years represents IRP projection for 2040.

| Table 7-2 Regional: Normal Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,642 |
| Demand totals | 199,702 | 210,588 | 225,923 | 242,732 | 254,721 | 278,017 |
| Difference | 37,110 | 59,936 | 52,618 | 41,082 | 34,406 | 16,625 |

NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc. not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Supply numbers from IEUA IRP's baseline supplies plus supplemental supply opportunities (excluding recycled water for agriculture). Demand numbers also excludes recycled water for agriculture. Demand numbers from land use based model projection excluding demand for recycled water for agriculture.

| Table 7-2 Wholesale: Normal Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals *(autofill from Table 6-9)* | 92,325 | 114,486 | 119,286 | 123,779 | 127,642 | 137,721 |
| Demand totals *(autofill fm Table 4-3)* | 92,325 | 114,486 | 119,286 | 123,779 | 127,642 | 137,721 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 |

NOTES: This table is auto-filled from Table 4-3, 6-8 and 6-9 and represents IEUA's wholesale demand and supply only. This table is not included in the UWMP report but is included in the DWR submittal tool.

| Table 7-2 Wholesale: Normal Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals *(autofill from Table 6-9)* | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| Demand totals *(autofill fm Table 4-3)* | 27,606 | 32,783 | 32,783 | 32,783 | 32,783 | 32,783 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. | | | | | | |

| Table 7-3 Wholesale: Single Dry Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 289,127 | 294,642 |
| Demand totals | 200,947 | 213,213 | 230,148 | 248,784 | 262,660 | 288,415 |
| Difference | 35,865 | 57,311 | 48,393 | 35,030 | 26,467 | 6,228 |

NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc., not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Single dry year demands are normal year demand increased by 3.74% in 2040, prior year demands are interpolated. Supply numbers are IEUA IRP baseline numbers plus supplemental supply opportunities in 2035 and 2040.

| Table 7-3 Wholesale: Single Dry Year Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| Supply totals | 27,778 | 33,192 | 33,396 | 33,601 | 33,805 | 34,010 |
| Demand totals | 27,778 | 33,192 | 33,396 | 33,601 | 33,805 | 34,010 |
| Difference | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. Increase of 3.74 percent by 2040, interpolate for prior years. | | | | | | |

| Table 7-4 Wholesale: Multiple Dry Years Supply and Demand Comparison | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| First year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 267,415 | 294,642 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | Difference | 35,119 | 55,738 | 45,863 | 31,405 | 0 | 0 |
| Second year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 267,415 | 294,642 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | Difference | 35,119 | 55,738 | 45,863 | 31,405 | 0 | 0 |
| Third year | Supply totals | 236,812 | 270,524 | 278,541 | 283,814 | 267,415 | 294,642 |
| | Demand totals | 201,693 | 214,786 | 232,678 | 252,409 | 267,415 | 294,642 |
| | Difference | 35,119 | 55,738 | 45,863 | 31,405 | 0 | 0 |

NOTES: The values in this table provide the demand and supply values for the region not just IEUA wholesale (i.e. including groundwater, surface water, etc. not supplied by IEUA). These regional values align with IEUA's Integrated Water Resources Plan which examine the regional demand/supply not just IEUA wholesale. Multiple dry year demands are normal year demand increased by 5.98% in 2040, prior year demands are interpolated. Supply numbers are IEUA IRP baseline numbers plus local supplemental supply opportunities to close any supply gaps in 2035 and 2040.

| Table 7-4 Wholesale: Multiple Dry Years Supply and Demand Comparison | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| First year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Difference | 0 | 0 | 0 | 0 | 0 | 0 |
| Second year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Difference | 0 | 0 | 0 | 0 | 0 | 0 |
| Third year | Supply totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Demand totals | 27,881 | 33,437 | 33,764 | 34,090 | 34,417 | 34,744 |
| | Difference | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTES: In FY 2014-15, IEUA's imported water sales to WFA represented 47 percent of its total imported water sales. Assume 47 percent for all future years. Increase of 5.98 percent by 2040, interpolate for prior years. | | | | | | | |

| Table 8-1 Wholesale<br>Stages of Water Shortage Contingency Plan | | |
|---|---|---|
| Stage | Complete Both | |
| | Supply Reduction[1] | Water Supply Condition<br>(*Narrative description)* |
| *Add additional rows as needed* | | |
| | | |
| | | |
| | | |
| | | |
| [1] *One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.* | | |

NOTES: Water Shortage Contingency Plan stages are available only at the retail agency level. These stages are specific for each retail agency.

| Table 8-4 Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 102,891 | 105,287 | 107,519 |
| NOTES: Three year minimum supply (IEUA wholesale supply) taken from the sum of IRP baseline supply for imported water, direct use recycled water, and groundwater recharge recycled water for each respective year. | | | |

| Table 8-4 Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 31,384 | 31,384 | 31,384 |
| NOTES: Three year minimum supply is from WFA's annual allocatation of MWD's available Tier 1 water supply as specified in the 2016 IRP. | | | |

| Table 10-1 Wholesale: Notification to Cities and Counties (select one) | | |
|---|---|---|
| ☐ | Supplier has notified more than 10 cities or counties in accordance with CWC 10621 (b) and 10642.<br>**Completion of the table below is not required. Provide a separate list of the cities and counties that were notified.** | |
| | Provide the page or location of this list in the UWMP. | |
| ☑ | Supplier has notified 10 or fewer cities or counties.<br>**Complete the table below.** | |
| City Name | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| City of Chino | ☑ | ☑ |
| City of Chino Hills | ☑ | ☑ |
| Cucamonga Valley Water District | ☑ | ☑ |
| Fontana Water Company | ☑ | ☑ |
| Monte Vista Water District | ☑ | ☑ |
| City of Ontario | ☑ | ☑ |
| San Antonio Water Company | ☑ | ☑ |
| City of Upland | ☑ | ☑ |
| County Name<br>*Drop Down List* | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| San Bernardino County | ☑ | ☑ |
| | ☐ | ☐ |
| NOTES: Notifications to Cities and Counties within IEUA's service area were sent on March 2, 2016. | | |

# APPENDIX C

## Notification of Public and Service Area Suppliers

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

**NOTICE OF PUBLIC HEARING**
**BY THE BOARD OF DIRECTORS OF**
**THE INLAND EMPIRE UTILITIES AGENCY TO ADOPT**
**THE 2015 REGIONAL URBAN WATER MANAGEMENT PLAN**
**SAN BERNARDINO COUNTY, STATE OF CALIFORNIA**

NOTICE IS HEREBY GIVEN that the Board of Directors of the Inland Empire Utilities Agency has scheduled a public hearing to adopt the 2015 Regional Urban Water Management Plan, San Bernardino County, State of California.

NOTICE IS FURTHER GIVEN that said public hearing will be held at the following time and place for the purpose of hearing any and all public testimony on the above-stated issue.

DATE: Wednesday, June 15, 2016 – 10:00 a.m.

PLACE: Inland Empire Utilities Agency Board Room
6075 Kimball Avenue, Building A
Chino, CA 91710

All interested persons are invited to attend the public hearing and provide comments regarding the 2015 Regional Urban Water Management Plan that includes information for the Inland Empire Utilities Agency and the Water Facilities Authority. Oral statements will be heard, but for the accuracy of the record all important testimony should be submitted in writing.

NOTICE IS FURTHER GIVEN that a copy of the Draft 2015 Regional Urban Water Management Plan can be found on the Agency's website at http://www.ieua.org/news_reports/notices.html or a hard copy is available at the IEUA Headquarters. Please direct comments and questions to the Planning & Environmental Compliance Department, Lisa Morgan-Perales at (909) 993-1520.

wfa
Water Facilities Authority

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CHINO, CA 91710

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**NOTICE OF PUBLIC HEARING BY THE BOARD OF DIRECTORS OF THE INLAND EMPIRE UTILITIES AGENCY TO ADOPT THE 2015 REGIONAL URBAN WATER MANAGEMENT PLAN SAN BERNARDINO COUNTY, STATE OF CALIFORNIA**

NOTICE IS HEREBY GIVEN that the Board of Directors of the Inland Empire Utilities Agency has scheduled a public hearing to adopt the 2015 Regional Urban Water Management Plan, San Bernardino County, State of California.

NOTICE IS FURTHER GIVEN that said public hearing will be held at the following time and place for the purpose of hearing any and all public testimony on the above-stated issue.

DATE: Wednesday, June 15, 2016 – 10:00 a.m.

PLACE: Inland Empire Utilities Agency Board Room
6075 Kimball Avenue, Building A
Chino, CA 91710

All interested persons are invited to attend the public hearing and provide comments regarding the 2015 Regional Urban Water Management Plan that includes information for the Inland Empire Utilities Agency and the Water Facilities Authority. Oral statements will be heard, but for the accuracy of the record all important testimony should be submitted in writing.

NOTICE IS FURTHER GIVEN that a copy of the Draft 2015 Regional Urban Water Management Plan can be found on the Agency's website at http://www.ieua.org/news_reports/notices.html or a hard copy is available at the IEUA Headquarters. Please direct comments and questions to the Planning & Environmental Compliance Department, Lisa Morgan-Perales at (909) 993-1520.

Published: May 27, and June 6, 2016
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## County of San Bernardino

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:

6/2/2016

I declare under the penalty of perjury that the foregoing is true and correct.

Executed at Rancho Cucamonga, San Bernardino Co. California

On this 2 day of June ,20 16.

KA

Signature

Legal Notice | Legal Notice

**WATER FACILITIES AUTHORITY**
**NOTICE OF PUBLIC HEARING**
**2015 REGIONAL URBAN WATER MANAGEMENT PLAN**

NOTICE IS HEREBY GIVEN that on June 16, 2016 at 7:30 a.m., in the Board Room of the Monte Vista Water District, located at 10575 Central Avenue, Montclair, California, 91763, the Board of Directors of the Water Facilities Authority (WFA) will conduct a public hearing pursuant to California Water Code section 10642 to consider and receive comments and input on the 2015 Regional Urban Water Management Plan that has been prepared jointly for the WFA and the Inland Empire Utilities Agency (IEUA) pursuant to Water Code section 10620(d).

A copy of the 2015 Regional Urban Water Management Plan is available for public review during normal business hours at the offices of WFA located at 1775 North Benson Avenue, Upland, California 91784. In summary, the 2015 Regional Urban Water Management Plan has been developed in accordance with the requirements of the Urban Water Management Planning Act, California Water Code sections 10610 through 10656. Public input from diverse social, cultural and economic members of the community is strongly encouraged and will be considered as part of the 2015 Regional Urban Water Management Plan process.

Any written comments regarding the 2015 Regional Urban Water Management Plan should be submitted no later than 5:00 p.m. on June 10, 2016 to 1775 North Benson Avenue, Upland, California 91784, attention Terry Catlin. Public comments also can be made at the public hearing at the time and place first set forth above. Questions regarding the public hearing or the 2015 Regional Urban Water Management Plan should be directed to Terry Catlin at (909) 981-9454.

Date: _, 2016

WATER FACILITIES AUTHORITY

Published: June 2, 2016 #809170

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## PROOF OF PUBLICATION
## (2015.5 C.C.P.)

## STATE OF CALIFORNIA
## County of San Bernardino

I am a citizen of the United States, I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principle clerk of the printer of INLAND VALLEY DAILY BULLETIN, a newspaper of general circulation printed and published daily in the City of Ontario, County of San Bernardino, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of San Bernardino, State of California, on the date of August 24, 1951, Case Number 70663. The notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

6/2, 6/9/16

I declare under the penalty of perjury that the foregoing is true and correct.

Executed at Rancho Cucamonga, San Bernardino Co. California

This 9 Day of June, 2016

BW

Signature

**WATER FACILITIES AUTHORITY**
**NOTICE OF PUBLIC HEARING**
**2015 REGIONAL URBAN WATER MANAGEMENT PLAN**

NOTICE IS HEREBY GIVEN that on June 16, 2016 at 7:30 a.m., in the Board Room of the Monte Vista Water District, located at 10575 Central Avenue, Montclair, California, 91763, the Board of Directors of the Water Facilities Authority (WFA) will conduct a public hearing pursuant to California Water Code section 10642 to consider and receive comments and input on the 2015 Regional Urban Water Management Plan that has been prepared jointly for the WFA and the Inland Empire Utilities Agency (IEUA) pursuant to Water Code section 10620(d).

A copy of the 2015 Regional Urban Water Management Plan is available for public review during normal business hours at the offices of WFA located at 1775 North Benson Avenue, Upland, California 91784. In summary, the 2015 Regional Urban Water Management Plan has been developed in accordance with the requirements of the Urban Water Management Planning Act, California Water Code sections 10610 through 10656. Public input from diverse social, cultural and economic members of the community is strongly encouraged and will be considered as part of the 2015 Regional Urban Water Management Plan process.

Any written comments regarding the 2015 Regional Urban Water Management Plan should be submitted no later than 5:00 p.m. on June 10, 2016 to 1775 North Benson Avenue, Upland, California 91784, attention Terry Catlin. Public comments also can be made at the public hearing at the time and place first set forth above. Questions regarding the public hearing or the 2015 Regional Urban Water Management Plan should be directed to Terry Catlin at (909) 981-9454.

Date: _, 2016

WATER FACILITIES AUTHORITY

Published: June 2, 2016 #809170

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

6075 Kimball Avenue • Chino, CA 91708
P.O. Box 9020 • Chino Hills, CA 91709
TEL (909) 993-1600 • FAX (909) 993-1983

www.ieua.org

# NOTICE OF PREPARATION OF THE INLAND EMPIRE UTILITIES AGENCY'S 2015 URBAN WATER MANAGEMENT PLAN

December 9, 2015

Pursuant to the requirement of California Water Code, Division 6, Part 2.6 Urban Water Management Planning, Section 10621 (b), every urban water supplier required to prepare a plan shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan.

This letter is intended to notify your agency that the Inland Empire Utilities Agency (IEUA) is in the process of preparing the 2015 Urban Water Management Plan (UWMP). Based on the IEUA's current schedule, we expect to have a public review draft of the 2015 UWMP available for review in April 2016, at which point your agency will receive notification that the draft UWMP is available for public review and comment.

If your agency would like to submit comments or provide input to the IEUA in anticipation of the development of the 2015 UWMP, please submit written copies to:

Lisa Morgan-Perales
Senior Water Resources Analyst
Inland Empire Utilities Agency
6075 Kimball Avenue
Chino, California 91708
909-993-1520

Best Regards and Happy Holidays!

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

6075 Kimball Avenue • Chino, CA 91708
P.O. Box 9020 • Chino Hills, CA 91709
TEL (909) 993-1600 • FAX (909) 993-1983

www.ieua.org

# NOTICE OF PREPARATION OF THE INLAND EMPIRE UTILITIES AGENCY'S 2015 REGIONAL URBAN WATER MANAGEMENT PLAN

March 2, 2016

Pursuant to the requirement of California Water Code, Division 6, Part 2.6 Urban Water Management Planning, Section 10621 (b), every urban water supplier required to prepare a plan shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan.

This letter is intended to notify your agency that the Inland Empire Utilities Agency (IEUA) is in the process of preparing the 2015 Regional Urban Water Management Plan (UWMP). **Pursuant to Section 10620 (d), the Water Facilities Authority is participating in IEUA's Regional Urban Water Management Plan for purposes of the Act.** Based on the IEUA's current schedule, we expect to have a public review draft of the 2015 Regional UWMP available for review in April 2016, at which point your agency will receive notification that the draft Regional UWMP is available for public review and comment.

If your agency would like to submit comments or provide input to the IEUA in anticipation of the development of the 2015 Regional UWMP, please submit written copies to:

Lisa Morgan-Perales
Senior Water Resources Analyst
Inland Empire Utilities Agency
6075 Kimball Avenue
Chino, California 91708
909-993-1520

Best Regards



| Terry Catlin | Michael E. Camacho | Steven J. Elie | Gene Koopman | Jasmin A. Hall | P. Joseph Grindstaff |
|---|---|---|---|---|---|
| *President* | *Vice President* | *Secretary/Treasurer* | *Director* | *Director* | *General Manager* |

# APPENDIX D

## Adopted UWMP Resolution

**RESOLUTION NO. 2016-6-14**

**A RESOLUTION OF THE BOARD OF DIRECTORS OF THE INLAND EMPIRE UTILITIES AGENCY* (IEUA), SAN BERNARDINO COUNTY, CALIFORNIA, ADOPTING THE 2015 REGIONAL URBAN WATER MANAGEMENT PLAN FOR THE INLAND EMPIRE UTILITIES AGENCY AND THE WATER FACILITIES AUTHORITY**

**WHEREAS**, the California Legislature enacted Assembly Bill 797, (Water Code Section 10610 et seq., known as the Urban Water Management Planning Act) during the 1983-1984 Regular Session, and as amended subsequently, which mandates that every urban water supplier providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually, prepare an Urban Water Management Plan at least once every five years; and

**WHEREAS**, the Inland Empire Utilities Agency* is a wholesale supplier of water for 242-square miles in the western portion of San Bernardino County; and

**WHEREAS**, the Water Facilities Authority* is a wholesale supplier of water for 135-square miles in the west end of San Bernardino County; and

**WHEREAS**, pursuant to Section 10620 of the Urban Water Management Planning Act, the Inland Empire Utilities Agency and the Water Facilities Authority have participated together to prepare the 2015 Regional Urban Water Management Plan.

**NOW, THEREFORE**, the Board of Directors of the Inland Empire Utilities Agency* does hereby RESOLVE, DETERMINE, AND ORDER as follows:

Section 1. The 2015 Regional Urban Water Management Plan is hereby adopted.

Section 2. The General Manager is hereby authorized to file an electronic copy of the 2015 Regional Urban Water Management Plan with the State Department of Water Resources within 30 days following its adoption and no later than July 1, 2016.

Section 3. The General Manager is hereby authorized to file a CD or hardcopy of the 2015 Regional Urban Water Management Plan with the California State Library no later than 30 days after its adoption.

The undersigned certifies that this is a true copy as on file in the permanent records of the Agency. This stamp must be in purple ink to constitute a certified copy.
Inland Empire Utilities Agency*
*A Municipal Water Agency*
By _____ Date 6/15/16

Section 4. The General Manager is hereby authorized to submit an electronic copy or a CD or hardcopy of the adopted 2015 Regional Urban Water Management to any city or county in which the suppliers provide water no later than 30 days after its adoption.

Section 5. The General Manager is hereby authorized and directed to implement the adopted 2015 Regional Urban Water Management Plan, including recommendations to the Board of Directors regarding necessary procedures, rules, and regulations in an effort to carry out effective and equitable water programs.

Section 6. The Resolution shall take effect upon adoption.

ADOPTED this 15th day of June, 2016.

Terry Catlin
President of the Inland Empire Utilities Agency* and of the Board of Directors thereof

ATTEST:

Steven J. Elie
Secretary/Treasurer of the Inland Empire Utilities Agency* and of the Board of Directors thereof

(SEAL)

* A Municipal Water District

STATE OF CALIFORNIA )
) SS
COUNTY OF SAN BERNARDINO )

I, Steven J. Elie, Secretary/Treasurer of the Inland Empire Utilities Agency*, DO HEREBY CERTIFY that the foregoing Resolution being No. 2016-6-14 was adopted at a Regular Board Meeting on June 15, 2016, of said Agency by the following vote:

AYES: Hall, Elie, Camacho, Catlin

NOES: None

ABSTAIN: None

ABSENT: None

Steven J. Elie
Secretary/Treasurer of the Inland Empire Utilities Agency* and of the Board of Directors thereof

(seal)

* A Municipal Water District

**RESOLUTION NO. 2016-06-01**

**A RESOLUTION OF THE BOARD OF DIRECTORS OF THE WATER FACILITIES AUTHORITY ADOPTING THE 2015 REGIONAL URBAN WATER MANAGEMENT PLAN FOR THE INLAND EMPIRE UTILITIES AGENCY AND THE WATER FACILITIES AUTHORITY**

**WHEREAS**, the Urban Water Management Planning Act requires every urban water supplier providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to prepare an Urban Water Management Plan at least once every five years; and

**WHEREAS**, the Water Facilities Authority is a wholesale urban water supplier for 135-square miles in the west end of San Bernardino County; and

**WHEREAS**, pursuant to Section 10620(d) of the Urban Water Management Planning Act, the Inland Empire Utilities Agency and the Water Facilities Authority have participated together to prepare the 2015 Regional Urban Water Management Plan.

**NOW, THEREFORE**, the Board of Directors of the Water Facilities Authority does hereby RESOLVE, DETERMINE, AND ORDER as follows:

Section 1. Pursuant to the public hearing conducted on this date in accordance with Water Code section 10642, the 2015 Regional Urban Water Management Plan is hereby adopted.

Section 2. The General Manager is hereby authorized to file an electronic copy of the 2015 Regional Urban Water Management Plan with the California Department of Water Resources within 30 days following its adoption and no later than July 1, 2016.

Section 3. The General Manager is hereby authorized to file a CD or hardcopy of the 2015 Regional Urban Water Management Plan with the California State Library no later than 30 days after its adoption.

Section 4. The General Manager is hereby authorized to submit an electronic copy or a CD or hardcopy of the 2015 Regional Urban Water Management to any city or county within which the Water Facilities Authority provides water no later than 30 days after its adoption.

Section 5. This Resolution shall take effect upon adoption.

ADOPTED this 16th day of June, 2016.

Chair of the Board of Directors
Water Facilities Authority

ATTEST:

Secretary to the Board of Directors
Water Facilities Authority

# APPENDIX E

## IEUA 2015 Integrated Water Resources Plan

2016

# Integrated Water Resources Plan:

## Water Supply & Climate Change Impacts 2015—2040



Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

**“Our climate is rapidly changing, our population is growing and more extreme weather looms on the horizon. Now is not the time to shirk from responsibility. Storage or conveyance alone will not solve all of our problems. Recycling, groundwater management and conservation, individually, won't get us there either. It will take all of the above. *We must think differently and act boldly* -- and that's exactly what California is doing.”**

**—Governor Brown**

# Integrated Water Resources Plan:

## Water Supply & Climate Change Impacts 2015—2040

**Prepared by:**
Inland Empire Utilities Agency

**Technical Modeling by:**
A&N Technical Services
RAND Corp.
Wildermuth Environmental Inc.

**Technical Advisory Committee:**
City of Chino
City of Chino Hills
City of Ontario
City of Upland
Chino Basin Water Master
Cucamonga Valley Water District
Fontana Water Company
Monte Vista Water District

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2. Draft RAND Memo: "Evaluating Options for Improving the Climate Resilience of the Inland Empire Utilities Agency in Southern California"
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# Acronyms

| | |
|---|---|
| **AFY** | Acre-Feet of Water per Year |
| **CBWM** | Chino Basin Watermaster |
| **CDA** | Chino Desalter Authority |
| **CUWCC** | California Urban Water Conservation Council |
| **CVWD** | Cucamonga Valley Water District |
| **DWR** | Department of Water Resources |
| **DYY** | Dry Year Yield |
| **EDU** | Equivalent Dwelling Unit |
| **GPD** | Gallons per Day |
| **IERCF** | Inland Empire Regional Composting Facility |
| **IEUA** | Inland Empire Utilities Agency |
| **IRP** | Integrated Resource Plan |
| **MGD** | Million Gallons per Day |
| **MG** | Million Gallons |
| **MVWD** | Monte Vista Water District |
| **MWD** | Metropolitan Water District of Southern California |
| **NPDES** | National Pollutant Discharge Elimination System |
| **NRW** | Non-Reclaimable Wastewater |
| **OBMP** | Optimum Basin Management Plan |
| **OSY** | Operating Safe Yield |
| **OWOW** | One Water One Watershed |
| **PEIR** | Program Environmental Impact Report |
| **SAWPA** | Santa Ana Watershed Project Authority |
| **SBCFCD** | San Bernardino County Flood Control District |

| | |
|---|---|
| **SRF** | State Revolving Fund |
| **SWRCB** | State Water Resources Control Board |
| **TDS** | Total Dissolved Solids |
| **TYCIP** | Ten-Year Capital Improvement Plan |
| **USBR** | United States Bureau of Reclamation |
| **UWMP** | Urban Water Management Plan |
| **WFMP** | Wastewater Facilities Master Plan |
| **WUE** | Water Use Efficiency |



# 1. Overview & Purpose



**Project Background**

**Climate Change**

**Phases of the IRP**

**IRP Development**

**Planning Process**

Agricultural fields, in the City of Ontario.

# I. Overview & Purpose

## PROJECT BACKGROUND

The 2016 "Integrated Resources Plan: Water Supply & Climate Change Impacts 2015—2040" (IRP) is our region's blueprint for ensuring reliable, cost-effective, and environmentally responsible water supplies for the next 25 years. It takes into consideration availability of current and future water supplies and accounts for possible fluctuations in demand forecasts and climate change impacts. This is the first time that the region's planning has gone beyond a regional Urban Water Management Plan (UWMP) and the cities and water agencies (Agencies) have worked collaboratively to develop a comprehensive water resources plan. The sphere of influence for the 2015 IRP is the Inland Empire Utilities Agency's (IEUA) service area which is in southwestern San Bernardino County shown in Figure 1-1.

Two key goals of this IRP are to integrate and update water resource planning documents in a focused, holistic manner and to develop an implementation strategy that will improve near-term and long-term water resources management for the region. In addition, the IRP evaluates new growth, development, and water demand patterns within the service area and conducts an assessment of water needs and supply source vulnerabilities under climate change.

Although this is the first IRP that the region has developed, from 2000 to 2002 the region developed four foundational master planning documents which, together, functioned as an IRP. These historical documents illustrated how, since 2000, the region has recognized the increasingly uncertain future of imported water supply availability and the importance of local water supplies, particularly now with changing climate conditions. As part of its response, the region has focused infrastructure investments on local water supply development strategies to reduce dependence on imported supplies and increase drought resilient water sources (see Appendix 1 for a detailed description of foundational planning documents). These foundational documents are:

1. Chino Basin Water Master's Optimum Basin Management Plan (2000)
2. Chino Basin Organics Management Strategy (2001)
3. Recycled Water System Feasibility Study (2002)
4. Wastewater Facilities Master Plan (2002)

These documents were linked together in the Programmatic 2002 IEUA Facilities Master Plan Environmental Impact Report (EIR).

Water resources management strategies were further updated as part of the 2005 and 2010 UWMP. Individual programs were developed in reports such as the2002 Salinity Management Plan, 2005 Recycled Water Implementation Plan, 2007 Recycled Water Three Year Business Plan, 2013 Recharge Master Plan Update, 2015 Recycled Water Program Strategy, 2015 Facilities Master

Plan Update, 2015 WUE Business Plan Update, and 2015 Energy Management Plan. The number and scope of regional planning documents that have been developed in the past 15 years illustrates both the commitment to local resource development and the emphasis on water resources sustainability.

An additional driver for the creation of the IRP was the need to strategically position the region for upcoming funding opportunities. By leveraging these funding opportunities for local projects, the region will be less susceptible to the anticipated imported water rate increases of 4-5% annually through the next decade (MWD 2016 Forecast). The past success of the region to secure grant funding of over $258 million has made the expansion of the groundwater recharge, recycled water, and conservation programs possible. Over the next two years, more than a billion dollars of state and federal grants and loans will be available to support additional water supply development. The IRP will help position the region to pursue these funding opportunities by identifying regional water resources programs and ultimately project priorities.

## CLIMATE CHANGE

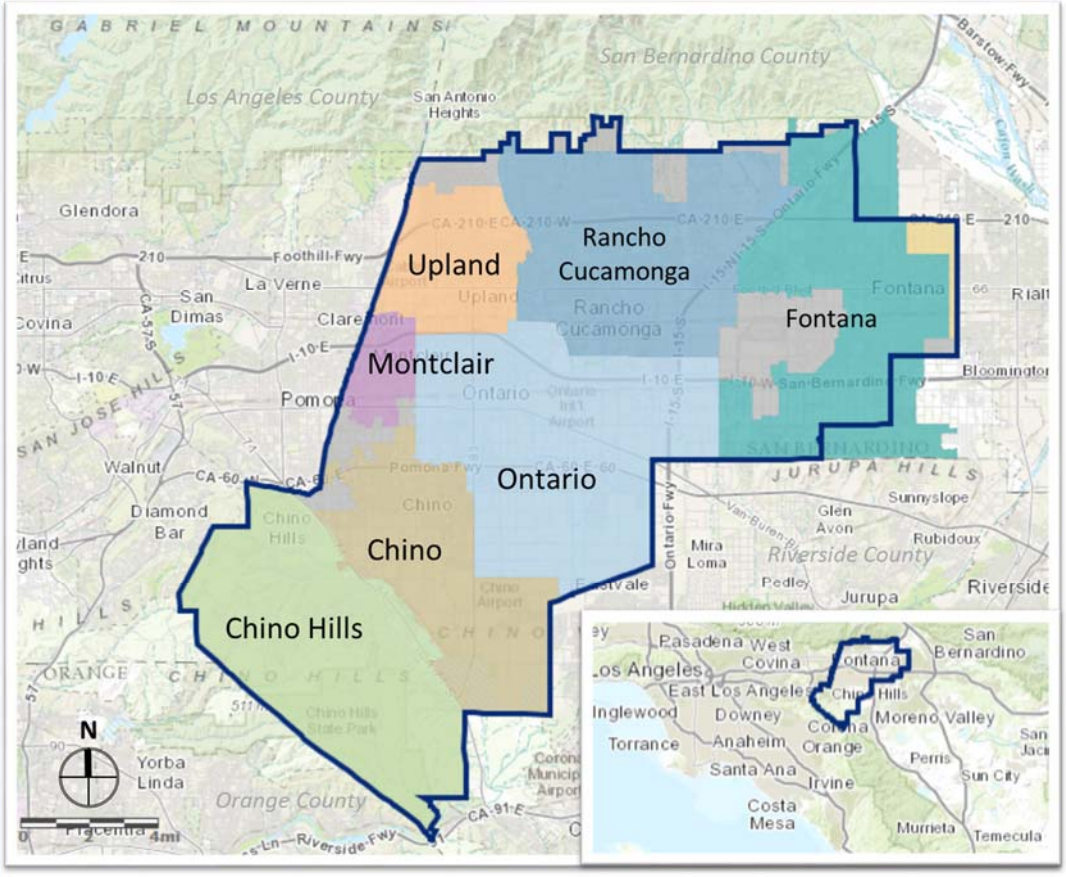
Climate change impacts have already started to create critical challenges for water resources management in Southern California. More intense storm events and the changing frequency and duration of drought years are becoming evident throughout the State and the West. This makes future water supplies available to the region more uncertain, particularly imported water resources that are uniquely vulnerable to changes in the state's snowpack.

General climate change trends projected for California are that temperatures will increase and precipitation will increasingly fall as rain rather than snow. These trends will impact water supplies in two ways: higher

The planning principal which guides the IRP is:

***"… to plan for a deeply uncertain future and develop a robust strategy that can adapt and respond to a wide range of possible futures with changing conditions."***

**Figure 1-1:** IRP Regional Planning Area Boundary



temperatures will cause increased water demands; however, infrastructure to capture rain runoff is limited as water infrastructure in California was designed to capture slow melting snowpack not rapid stormwater.

In addition, droughts are expected to occur more frequently, more intensely, and last longer. The Natural Resources Defenses Council (NRDC) estimates that if nothing is done to address the implications associated with climate change, between the years 2025 and 2100, the cost of providing water to the western United States will increase from $200 billion to $950 billion per year.

The IRP recognizes and incorporates an assessment of a range of impacts that climate change could have on water supplies for the State and region. This is done by using downscaled climate models from the Intergovernmental Panel on Climate Change (IPCC) Assessment. This IRP does not rely on historical hydrology to predict the future, but instead gathers data available from the latest climate models to project a wide range of possible future climate conditions. The information was used as a sensitivity analysis to help identify the most climate resilient water strategies and priorities for the region. This approach was selected to provide the region with a better understanding of how to effectively plan and prepare for how climate uncertainty affects our water supplies.

*"Paleoclimate climate analysis has established that hydrology has the potential to vary far more widely than has been recorded in the observed record. This means that, given the scientific evidence supporting climate change, we need to look beyond historical observations to ensure that we have adequate water supplies."*

*"Strategies and Resources for Evaluating and Adapting to Climate Change Effects: Climate Change is Real –Now What?" Stanford Report. Fall 2014.*

## PHASES OF THE IRP

The development of the IRP is being done in two phases.

**Phase 1 – Analysis and Recommendations**: Phase 1 focuses on an extensive analysis of future projected water needs and water supply strategies under conditions of climate change and growth. Results from Phase 1 include summaries of the recommended regional water resource strategies; corresponding ranges of costs for the various supply categories; and a regionally developed, all-inclusive list of potential supply projects (local and regional). This information will be used to complete a Programmatic Environmental Impact Report (PEIR), which is needed to ensure that selected projects are grant eligible. The IRP report is the culmination of Phase 1.

**Phase 2 – Implementation and Capital Improvement Program (CIP)**: Phase 2 will address additional detailed project level analysis including project scopes, costs, prioritization, and implementation scheduling. Phase 2 will also include the disaggregation of the regional demand and supply to the local retail level. Continued discussions will be facilitated through a Regional Water Forum. Phase 2 is anticipated to begin in Summer 2016.

## IRP DEVELOPMENT

The IRP was developed from 2013-2015 by the IEUA Planning and Environmental Resources Department in conjunction with stakeholders including regional technical staff, water managers, and joint IEUA Board and Regional Policy Committee workshops.

**IRP Technical Work Group:** The IRP Technical Work Group consisted of IEUA member agencies, which includes the seven contracting sewerage agencies, and the retail water agencies within the IEUA service area. Meetings were held one to two times each month to discuss modeling assumptions, verify projections, establish project lists, and examine modeling results in detail. Modifications to methodology and clarifications were made with this group.

**Water Managers Work Group:** After technical items had been discussed and vetted, core findings and recommendations were presented at the monthly Water Managers Work Group meetings.

**Joint Board and Policy Committee Workshops:** The results from the IRP modeling and recommendations from the Technical and Water Managers Work Groups were presented to regional policy makers. These special joint workshops included members from IEUA's Board of Directors and the regional policy makers from the Regional Sewerage Policy Committee, as well as board members from the Monte Vista Water District (MVWD), and the General Manager from Fontana Water Company. These meetings served to update policy makers about the progress being made with the IRP as well as to receive policy direction.

**Goals & Objectives:** IRP Goals and Phase 1 objectives were developed by stakeholders during multiple workshops with the IRP Technical and Water Managers Work Groups, and joint IEUA Board and Regional Policy committee workshops. The overarching goals that guided the IRP process and analysis are:

- *Resilience* — Develop regional water management flexibility to adapt to climate change and economic growth and to any changes that limit, reduce, or make water supplies unavailable.
- *Water Efficiency* — Meet or exceed rules and regulations for reasonable water use.
- *Sustainability* — Provide environmental benefits, including energy efficiency, reduced greenhouse gas emissions, and water quality improvements, to meet the needs of the present without compromising the ability of future generations to meet their own needs.
- *Cost-Effectiveness* — Supply regional water in a cost effective manner and maximize outside funding.

Planning objectives for the 2015 IRP were also developed by the stakeholders. These objectives are:

- Identify key water resource supply vulnerabilities and evaluate different options that could reduce these vulnerabilities.
- Develop multiple water supply strategies to reduce future water supply imbalances.
- Evaluate strategies with different project combinations, or portfolios, to assess resiliency to climate change, including mega droughts and decadal drought impacts across future scenarios, and how the portfolios could improve regional supplies.
- Analyze portfolio results from the Water Evaluation and Planning (WEAP) model simulations to identify key tradeoffs among the portfolios.
- Develop a long-term grant application strategy for priority water resources projects.

## PLANNING PROCESS

Phase I of the IRP was developed in three parts. The primary objective of Part I was to identity the water resource needs. Needs were developed based on an inventory of current and projected water supplies and demands. In Part 2, the IRP Technical Work Group discussed and developed regional water supply strategies that were then tested through modeling runs completed in Part 3. Individual Stages completed under each part are illustrated in Figure 1-2.

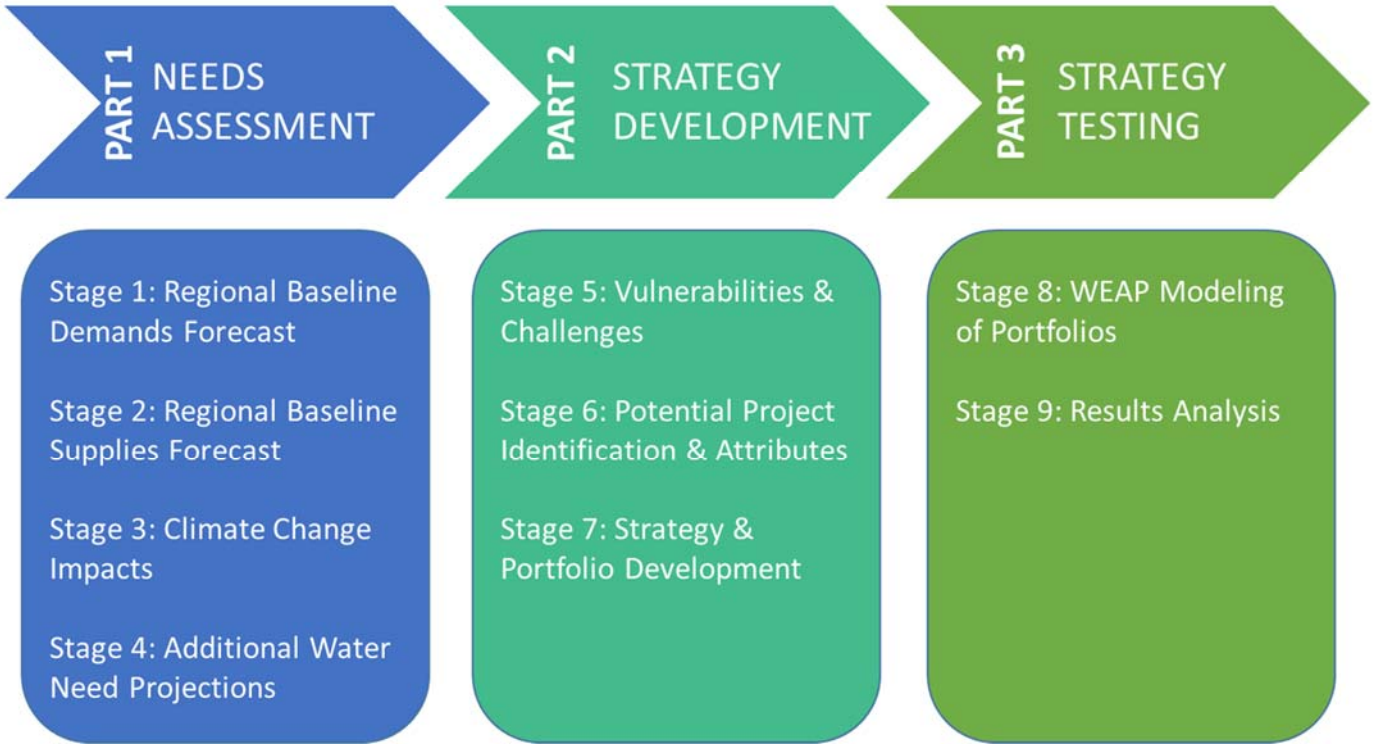
**Part 1: Needs Assessment**

***Stage 1 - Regional Demand Forecast.*** Water demands for the region were projected from 2015 to 2040 using an econometric model that incorporated factors for economic conditions, growth, water efficiency, housing density, and conservation program investments approved in the FY15/16 Capital Improvement Program. Projected demands were displayed as a range to reflect trend uncertainties. The regional demand forecast is further described in Section 2 of the IRP. A complete technical description of the demand projection modeling by A&N Technical Services for this project is contained in Appendix 1.

***Stage 2 - Regional Baseline Supply Forecast.*** Existing water resources utilized by the region were identified and analyzed to determine trends in water availability and usage through 2040. Water supplies from projects approved in the FY15/16 Ten Year Capital Improvement Program were included in this assessment. Together, these existing and new water supplies are defined as the baseline supplies through 2040.

***Stage 3 - Climate Change Impacts.*** IEUA worked with the RAND Corporation to develop a water demand and supply model to evaluate the impact of climate change

**Figure 1-2:** IRP Phase 1 Planning Process Diagram




on the IEUA service area. The model, used as a baseline, tabular estimates of IEUA's supplies and demands. A set of 106 climate scenarios for the IEUA region were derived from downscaled general circulation model results used for the Intergovernmental Panel on Climate Change Assessment Reports 3 & 5. These data suggest that regional temperatures would likely increase between 0.5-3.5°F by 2040. Precipitation was highly variable and showed no clear trend across the ensemble of scenarios.

The climate scenarios and baseline water demands and supplies were then entered into a water management model developed in the Water Evaluation and Planning (WEAP) modeling system. The WEAP model used these inputs to estimate how water demands, supplies, runoff, flows, and storage would change under the 106 climate scenarios. This approach highlighted supplies that provided greater reliability and were resilient to climate change impacts. The WEAP model results are summarized in Section 3 of the IRP. A technical description of the modeling and climate assessment is presented in Appendix 3.

***Stage 4 - Additional Water Need Projections.*** Based on the results from Stage 3, the IRP Technical Work Group evaluated the results of the climate modeling to identify the potential water supply shortfalls that the region would need to address to meet future demands. These potential shortfalls were used to develop regional water resources strategies and portfolios during Stage 7.

**Part 2: Regional Strategy Development**

***Stage 5 - Vulnerabilities & Challenges.*** Key water resources vulnerabilities and challenges facing the region were identified and prioritized by the IRP Technical Work Group. Vulnerabilities and challenges for the region include:

- *Groundwater & Stormwater* — maintaining operational safe yield (OSY); preventing land subsidence; maintaining water quality; preventing loss of natural infiltration
- *Recycled Water* — addressing increased total dissolved solids (TDS) as a result of indoor water use efficiency programs; regional interest in recycled water exceeding local supplies; competing uses of

existing supplies for direct use and for groundwater recharge; energy intensity of additional treatment levels for direct potable.

- *Imported Water*— potential for catastrophic interruption; dependence on the MWD Rialto feeder pipeline; constraints on supplies due to State Water Project (SWP) availability and Colorado River Basin over allocation and drought.
- *Other*— need for infrastructure redundancy; variability of surface water supplies; impact of new energy and water use efficiency standards; increasing salinity in source water; avoiding stranded assets.

***Stage 6 - Potential Project Identification and Attributes.*** A comprehensive list of potential water supply projects was developed based on previous and parallel planning efforts, including the Recycled Water Program Strategy, Wastewater Facilities Master Plan Update, 2013 Recharge Master Plan Update, Water Use Efficiency Business Plan (WUEBP), FY15/16 Ten Year Capital Improvement Plan, Santa Ana River Conservation and Conjunctive Use Program (SARCCUP), drought project list, and conceptual projects identified during the IRP process.

Individual projects were grouped into larger project categories. In some cases, categories were divided into multiple tiers which allowed the IRP Technical Work Group to either phase in similar projects over time or accelerate implementation by selected multiple tiers. Individual projects were also tagged according to their ability to address challenges and constraints facing the region.

***Stage 7 - Strategy and Portfolio Development.*** Drawing upon information from Stages 3 and 4, the IRP Technical Work Group developed five water supply strategies to understand how combinations of projects could meet future water needs and address the challenges and constraints facing the region. A decision support tool, developed by the RAND Corporation and described in Appendix 3, supported this process. The five water supply strategies are:

- *Strategy 1:* Maximize Chino basin groundwater, including prior stored groundwater
- *Strategy 2:* Recycled water program expansion
- *Strategy 3:* Recycled water & conservation program expansions
- *Strategy 4:* Maximize supplemental water supplies and recycled water supplies
- *Strategy 5:* Maximize imported water supplies with moderate conservation

A total of eight project portfolios were developed to test the five strategies under the WEAP model. Strategies and results are fully described in Section 4 of the IRP.

**Part 3: Strategy Testing**

***Stage 8 - WEAP modeling of Portfolios.*** Each portfolio was run through the WEAP model against the 106 climate scenarios. For comparison, a baseline portfolio that was limited to the baseline supplies identified in Stage 2, was also run through the WEAP model. WEAP model results were evaluated both in terms of the portfolio's ability to meet projected demands and whether surplus supplies were stored or used over time. Results are fully in Section 4 of the IRP.

***Stage 9 - Results Analysis.*** Portfolio performances were compared to the baseline portfolio results in order to determine the affect of the each portfolio on water supplies. Since there were 106 results per portfolio from the climate runs, it was beyond the scope of Phase 1 of the IRP to evaluate the nuances of the individual climate runs. Instead, the range of results that fell within 75% of the model runs were analyzed. The 75% criteria was chosen to eliminate outlier results which could have large cost implications.

Regional recommendations were developed based on: (a) the ability of a strategy to meet future demands and develop a surplus supply buffer and (b) input from the IRP Technical Work Group on the strategies that best met regional interests. Conclusions and are discussed in Section 5 of the IRP. These recommendations will be used to target future grant applications. The development of future water resources projects will be done during Phase 2 of the IRP.



# 2. Water Demand Forecast



**Introduction to Water Demands**

**Water Demand Setting**

**Methodology**

**Urban M&I Demand Projection Variables**

**Urban M&I Demand Forecast**

**Additional Water Needs Forecast**

**Total Regional Demand Forecast**

View of single family residential homes in Chino Hills

# II. Water Demand Forecast

## INTRODUCTION TO WATER DEMANDS

Section 2 outlines the process used to identify water demands for the region through 2040. These water demands include urban, environmental, and regulatory needs. Urban demands, also known as retail municipal and industrial (M&I) demands, represent the full spectrum of urban water use within the service area including commercial, institutional, industrial uses, and residential service for approximately 844,000 people. In addition to urban demands, regional water demands also include environmental discharge obligations to the Santa Ana River and contractual water commitments.

## WATER DEMAND SETTING

Since the 1990s, approximately 90% of the region's water demands have come from urban M&I users with the remaining 10% coming from agricultural users (source: 2010 IEUA UWMP). Overall urban water demand since 1995 has increased by approximately 20%, despite a regional growth of 30% (approximately 200,000 more residents). This is indicative of new water use behaviors, such as efficient irrigation and more efficient indoor fixtures, which prolong the availability of current regional water supplies into the future. The 2010 UWMP estimated total urban demand by the year 2015 to be approximately 272,000 acre-feet per year (AFY). However, actual demands have grown more slowly, increasing by only 3,000 acre-feet (AF) over the past four years from approximately 197,000 AFY in FY2010/11 to 200,000 AFY in FY2014/15 as shown in Figure 2-1. This is due in part to delayed growth as a result of the economic recession, as well as changes in plumbing code, implementation of water use efficiency programs, and responses to current water supply challenges such as the drought that California has been experiencing since 2012.

The impact of plumbing code changes and the implementation of water use efficiency programs was quantified in the recent 2015 Wastewater Facilities Master Plan (WFMP) flow monitoring. IEUA monitoring of new versus older residential developments showed that urban usage patterns have decreased from a regional indoor flow average of 55 gallons per capita per day (GPCD) down to 37 GPCD in new developments. This is consistent with new development trends throughout California (Codes and Standards Research Report: California's Residential Indoor Water Use. May 2015). This indicates that future developments will require less water, reducing the overall regional need for additional water supplies. This shift has significant implications for future wastewater and recycled water planning. Regional treatment plants may not need to be expanded for hydraulic capacity as quickly as previously thought (potentially saving regional capital); however, treatment plants will have to be expanded for treatment capacity for wastewater strength (because there will be greater concentrations of solids), and future available recycled water supplies may be lower than projected.

Outdoor water use provides the largest potential for improved water efficiency and additional water savings

in the region. As part of the IRP, A&N Technical Services conducted a study to estimate the amount of indoor and outdoor water use in the region. The study, which used data from the City of Ontario, found that outdoor irrigation accounts for approximately 60% of total urban demand. (Refer to Appendix 3 for the full technical memo.)

## METHODOLOGY

This IRP uses an econometric model to forecast urban water demands. This water demand model incorporates various influences which impact urban water demand such as population, employment, economics, weather, and conservation activities.

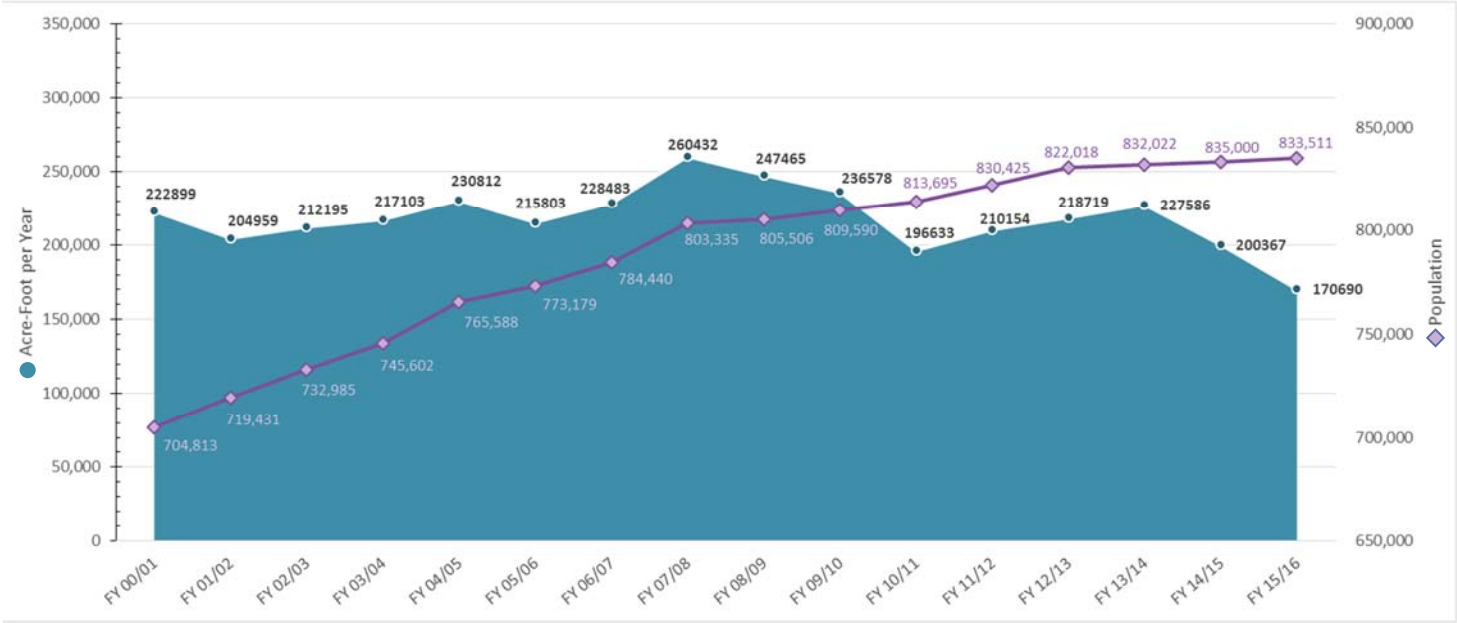
The IRP water demand model was developed by:

- Acquiring the latest regional demographic forecasts from the Southern California Association of Government "2012 Regional Transportation Plan".
- Inputting the demographic data into the econometric model equations to generate a base demand forecast.
- Calibrating the base demand forecast to identify corresponding water demand influences caused by factors including weather, employment, and economic cycles. For this IRP, a total of 12 factors were identified.
- Inputting the latest version of the Alliance for Water Efficiency (AWE) tracking tool for water savings that result from building codes and appliance standards (passive conservation) as well as regional programs that promote conservation (active conservation). Water savings are subtracted from water demand forecasts to ensure that water conservation is incorporated into the projections.
- Developing multiple water demand scenarios to plan for a range of possible futures.

## URBAN M&I DEMAND PROJECTION VARIABLES

To forecast urban M&I water demand through 2040, past and present urban water uses were assessed. This included an evaluation to determine which factors or influences impact demands and the corresponding

**Figure 2-1:** Regional Annual Water Use




Note: Annual water use includes imported water, surface water, groundwater, recycled and desalter production. FY 15/16 usage is projected based on 25% reduction from FY13/14

magnitude of their effect. A total of twelve water demand factors were identified along with their corresponding influence on water demand. Factors that influenced regional water demand were as follows:

1. Household size — single family residential (SFR), multi-family residential (MFR)
2. Land development and community density
3. Median household income
4. Customer response and water use behavior
5. Marginal water price
6. Active and passive conservation
7. Weather and climate change
8. Economic cycle
9. Short-term weather
10. Residential community mix of SFR and MFR
11. Weather and climate change
12. Conservation activities (demand management and water use efficiency)

Of the twelve factors, four were found to have a significant impact on regional urban M&I water demands and are described below. The remaining factors are described in Appendix 4. The four main factors were:

- ***Land Development and Community Density:*** regional development trends show that per capita water usage decreases with the shift towards higher density developments featuring smaller landscape areas.
- ***Weather and Climate Change:*** water use increases under hotter and drier conditions.
- ***Customer Response and Water Use Behavior:*** public increases conservation in response to statewide calls for conservation and permanent water use reductions.
- ***Economic Cycle:*** market conditions impact water usage, with recessions reducing water use and periods of growth increasing water use.

**Land Development and Community Density**

In the last decade, a relatively new type of housing development has emerged with higher housing densities. This is a national as well as a regional trend. These developments feature medium to large single family homes, usually built with minimal landscaping on small lots, also known as "zero-lot-line" housing. Irrigable landscaped areas in these developments are much smaller than traditional developments in the region have been. As a result, the higher density housing caused by these type of development trends lead to lower water use per housing unit because the reduced space for landscaping requires less irrigation.

For comparison purposes and to help anticipate a range of uncertain futures, Tables 2-1 and 2-2 summarize the sources of land use data and ranges of housing density incorporated into the demand forecast model. Land use data was sourced from the General Plans of the cities in the region, the Metropolitan Water District's (MWD) 2010 water demand model (2010 MWD_MAIN), and regional growth plans such as SCAG's 2012-2035 RTP/ Sustainable Communities Strategy (SCS) (2012 RTP/SCS).

Land use density is the variable that will have the largest impact on future demands. Comparing the demand forecast from the cities' General Plan data to the forecast presented in the 2010 Urban Water Management Plan (UWMP), there is a difference of at least 60,000 AF in total urban M&I demand by the year 2040.

This difference is further heightened when the UWMP urban M&I demand forecast is compared to the demands tied to higher housing density values described in recent General Plan EIR amendments throughout the region. These higher densities are also consistent with SCAG's 2012 SCS density levels. For example, when the 2010 UWMP demands are compared to the demand associated with high density presented in Tables 2-1 and 2-2, there is a difference in total urban M&I demand in the year 2040 of approximately 105,000 AF.

**Weather and Climate Change**

Weather has a large impact on the amount of water that customers need. Under hotter and drier conditions, water use increases at the same time that supplies may be constrained. With climate change, this trend is likely to be exacerbated in the near future.

**Table 2-1:** Single Family Housing Density Variability

| Data Source | Low (Units per Acre) | Average (Units per Acre) | High (Units per Acre) |
|---|---|---|---|
| **General Plans** | 1.2 | 2.7 | 4.2 |
| **2012 RTP/SCS** | 2.3 | 3.7 | 5.4 |
| **2010 MWD_MAIN** | 3.2 | 3.2 | 3.2 |

**Table 2-2:** Multi-Family Housing Density Variability

| Data Source | Low (Units per Acre) | Average (Units per Acre) | High (Units per Acre) |
|---|---|---|---|
| **General Plans** | 9.7 | 13.5 | 17.3 |
| **2012 RTP/SCS** | 8.4 | 13.5 | 17.0 |
| **2010 MWD_MAIN** | 10.9 | 10.9 | 10.9 |

**Table 2-3:** Climate and Weather Effect on Water Demands

| By Year | Increase in Temp. (F) | Effect on Water Demand | Probability |
|---|---|---|---|
| 2040 | 3.6 degrees | +4.3% | 80$^{th}$ percentile |
| Multiple Dry Years | | +5.98% | Varies by climate run |

In fact, climatologists have changed the way they view drought in years past and now recognize ongoing higher temperatures and longer drought conditions may be the "new normal" for California. A study conducted by scientists at Stanford University entitled "Anthropogenic Warming Has Increased Drought Risk in California" has linked climate change with "more frequent occurrences of high temperatures and low precipitation that will lead to increased severe drought conditions" (Stanford, 2015). In addition, over the past two decades, droughts have occurred more frequently than in the previous century, with 14 droughts occurring between 1896 and 1994, and six occurring between 1995 and 2014.

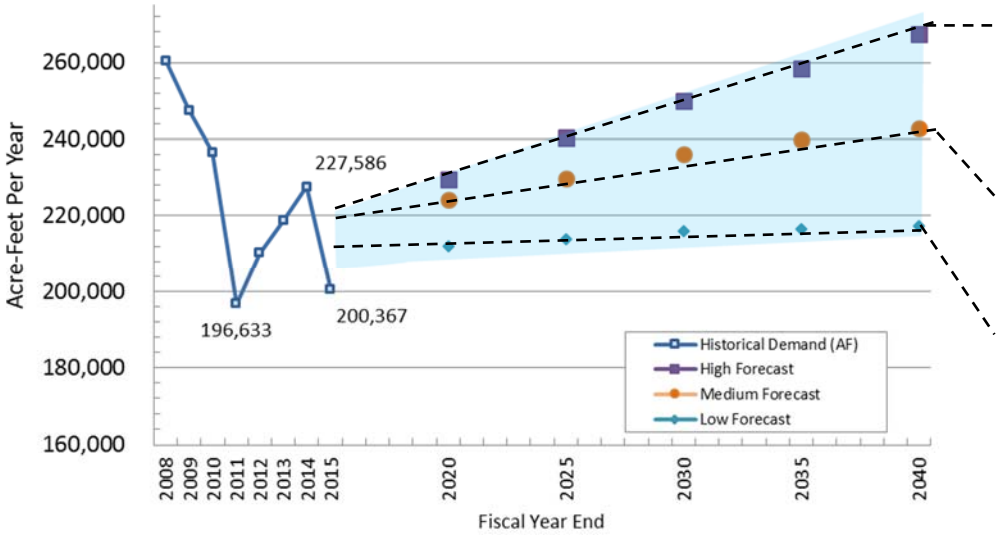
Weather-induced change in demands was accounted for in two ways. First, an adjustment was made for long term climate change based on the National Oceanic and Atmospheric Administration (NOAA) Technical Report, the National Environmental Satellite, Data, and Information Service (NESDIS) 142-5: Regional Climate Trends and Scenarios for U.S. National Climate Assessment. The report stated that increased atmospheric emissions have the potential to increase water use by as much as 4.3%.

As a result of these outlooks on future climate conditions and recent weather trends, the 2015 IRP demand forecast model includes outdoor water demand adjustments to account for climate change. IEUA performed a series of sensitivity analyses of urban outdoor demand and weather conditions. By 2040, IEUA estimated that one dry year would increase demand by 5.6%. Similarly, a one wet year would decrease outdoor demand by 5.6%. A longer period of dry weather (3-years) would increase demand by 8.9%. Separately IEUA estimated the long-term effect of warming on outdoor demand. They found that for each degree temperature increase (in Celsius), outdoor demand would increase by

## Table 2-4: Urban M&I Forecast

| Urban M&I Forecast | 2015 | 2020 | 2040 |
|---|---|---|---|
| High Forecast | 225,000 | 230,000 | 267,000 |
| Medium Demand Forecast | 225,000 | 220,100 | 238,600 |
| Low Demand Forecast | 225,000 | 212,000 | 217,400 |

## Figure 2-2: Regional Urban Water Demand Forecast




High Demand Forecast: traditional development and current usage patterns

Medium Demand Forecast: shift to higher density development and more efficient outdoor use

Low Demand Forecast: high density development, high outdoor efficiency

3%. Together these factors were applied to the climate scenarios to estimate how outdoor demand could change due to weather in the future.

Table 2-3 summarizes the climate factors applied to urban outdoor demand used during WEAP modeling outlined in Section 4.

**Customer Response and Water Use Behavior**

Since 2012, Southern California has been challenged by drought conditions. This led to calls for voluntary and mandatory water use reductions from Governor Brown, numerous news articles about water supply conditions, and massive public outreach campaigns from water agencies across the State. Increased public awareness of water supply conditions resulted in measurable water savings across the State.

Regionally, these behavioral changes reduced urban M&I demands by 4.6% in FY14/15. Lifestyle changes in combination with the anticipated permanent state water restrictions are expected to keep demands suppressed.

For the purpose of the IRP demand forecast model, it is assumed that changes in water use behavior will continue into the future and will maintain a reduced demand by 4.6% through the year 2040.

**Economic Cycle**

The economy is also susceptible to change and it is likely to continue to change between strong and weak market conditions. During weak market conditions, urban M&I demands decrease by 7%; conversely, during strong market conditions, demands increase by 7%.

Although this is a significant impact, for the purpose of the 2015 IRP M&I demand forecast model it is assumed that the market conditions remain normal and so no adjustment was incorporated.

## URBAN M&I DEMAND FORECAST

The IRP developed a range of demand possibilities to accommodate for future uncertainty caused by the various demand factors. To determine a range of urban demand possibilities, three water demand forecasts were created:

- *High Demand Forecast* – utilized housing densities from each city's General Plan and assumed that new development would use water consistent with current usage patterns—no change for outdoor, 55 gallons per capita per day (GPCD) indoor.
- *Medium Demand Forecast* — utilized 2012 SCAG RTP average housing density for occupied housing units and applied indoor and outdoor landscape efficiency standards established by Assembly Bill 1881 (also known as the Model Water Efficient Landscape Ordinance) for existing and future development. For the medium demand forecast, existing outdoor use is limited to 70% of evapotranspiration (ETo). Future outdoor use is limited to 60% ETo, and indoor water use is reduced from 55 GPCD in 2015 to 35 GPCD by 2040 for new development.
- *Low Demand Forecast* – utilized 2012 SCAG RTP high housing density and applied indoor and outdoor landscape efficiency standards established by AB 1881. For the low demand forecast, existing outdoor use is limited to 70% of ETo. Future outdoor use is limited to 60% ETo, and indoor water use is reduced from 55 GPCD in 2015 to 35 GPCD by 2040 for new development.

The range of urban water demand possibilities for the region through 2040 are shown in Table 2-4. When compared to historical demands, the region has experienced over 25,000 acre-feet (AF), or 12% reduction since FY2013/14 as shown in Figure 2-2. This is due in part to delayed growth as a result of the economic recession, but primarily from customer response from continued drought conditions and the State mandated water use restrictions. If demand continues to trend at FY2014/15 levels, the IRP demand model (created in 2014) will need to be updated to account for this regional shift in water use behavior. Additional technical data is provided in Appendix 1 which includes technical memorandums that detail the process used to develop the econometric water demand model.

To prepare the region for future uncertainty and to ensure sufficient water resources and adequate infrastructure capacity, the high urban water demand forecast was selected by the IRP Technical Work Group. This planning assumption was recognized to be a conservative forecast as recent residential developments within the region are currently more efficient (given that they use less water for indoors and outdoor landscaped areas) than presumed in the model.

The benefits of using this conservative forecast for the baseline demand are that it:

- Provides a sizeable water supply buffer which protects the region from future uncertainties.
- Allows conservation to be counted as a future water supply in the demand model.

## ADDITIONAL WATER NEEDS FORECAST

Current and future water demands include regional environmental and/or contractual stream flow obligations. These water needs are not subject to the same variables as the urban M&I demands and instead

### Table 2-4: Additional Water Needs Forecast

| Additional Water Needs Forecast | 2015 | 2020 | 2040 |
|---|---|---|---|
| SAR Discharge Joint Obligation (Chino Basin share) | 17,000 | 17,000 | 17,000 |
| Management Zone 1 Supp. Recharge | 6,500 | 6,500 | 0 |
| Chino Desalter Replenishment | 1,145 | 2,290 | 11,035 |
| **Total Additional Demand** | **24,645** | **25,790** | **28,035** |

**Figure 2-3:** Total Regional Demand Forecast

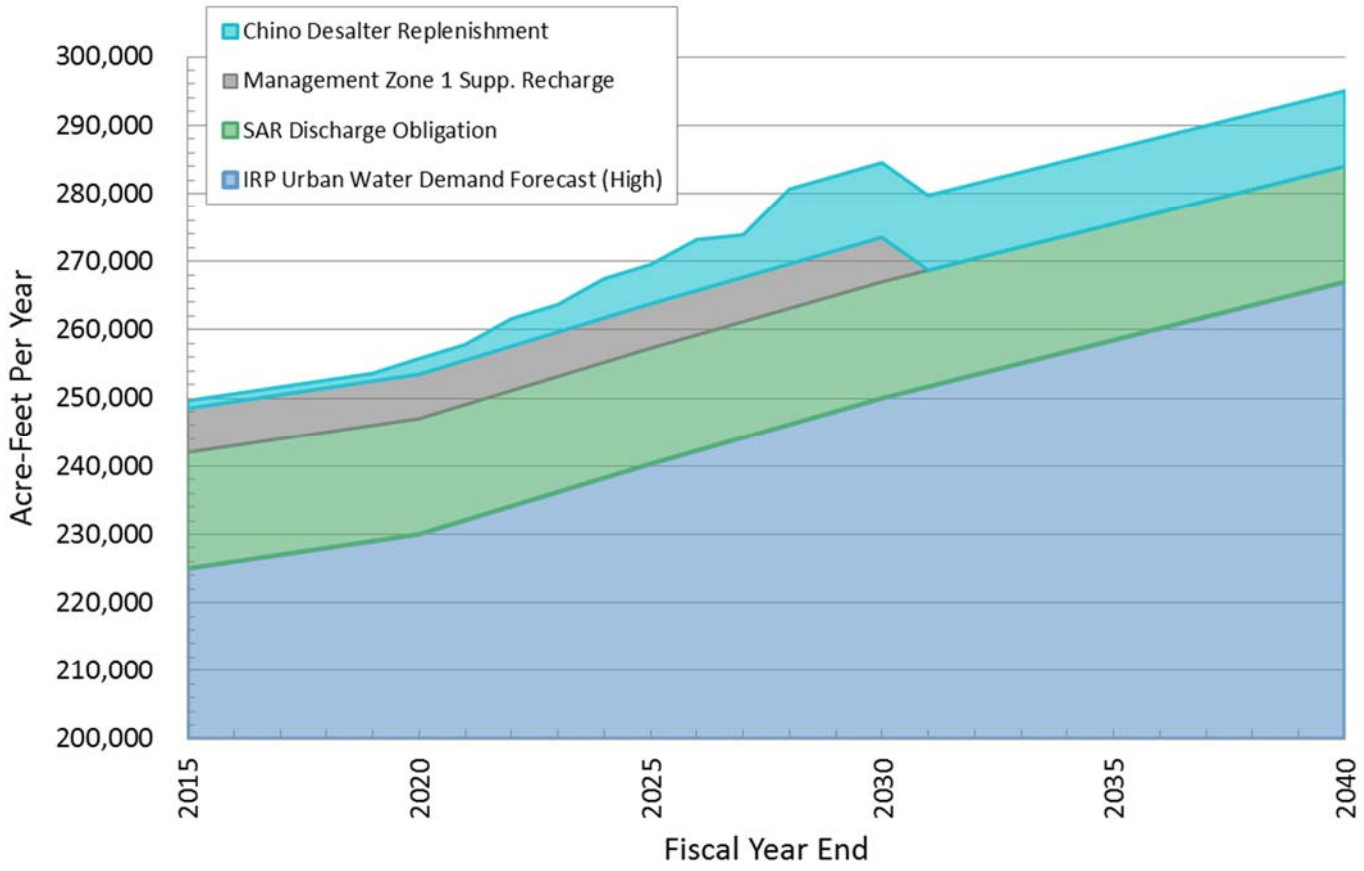



**Table 2-5:** Total Regional Demand Forecast

| Total Regional Demand Forecast | 2015 | 2020 | 2040 |
|---|---|---|---|
| Urban M&I Demand (High Forecast) | 225,000 | 230,000 | 267,000 |
| Additional Water Needs | 24,645 | 25,790 | 28,035 |
| **Total Regional Demand** | **249,645** | **255,790** | **295,035** |

are tied to standing contractual agreements and legal requirements. The water demand and supply models incorporate the following assumptions into the IRP forecasts:

- **Santa Ana River (SAR) Discharge Obligation** Santa Ana River (SAR) Discharge Obligation is a regional environmental obligation that requires annual water discharges to the Santa Ana River near Prado basin. For the purposes of the IRP, 17,000 AFY is used as the Agency's requirement to fulfill the obligation through 2040. The region currently meets this obligation by discharging treated wastewater to the Cucamonga and Chino Creeks.

- **Management Zone 1 Supplemental Recharge** pursuant to the PEACE II Agreement, Section 8.4. For the purposes of the IRP 6,500 acre-foot per year will be used to fulfill the supplemental groundwater recharge obligation within Management Zone 1. The obligation is met by Chino Basin Watermaster through recycled water recharge and/or imported

water recharge.

- **Chino Desalter Replenishment** pursuant to the PEACE II Agreement, Section 6.2. For the purposes of the IRP, Exhibit C dated August 16, 2015 of the safe yield reset implementation plan will be used for the groundwater replenishment obligation.

## TOTAL REGIONAL DEMAND FORECAST

Regional water demands for the 2015 IRP Phase 1 are the sum of the high urban M&I demand forecast and the total additional water needs forecast. Total water needs for the 2015 IRP are shown in Table 2-6. By 2040 it is projected that 45,400 AFY of additional supply will be needed to accommodate regional growth and other environmental and/or contractual stream flow obligations.



**Low water use plants, including succulents, on display at a local garden center**



# 3. Resources Inventory



**Water Resource Setting**

**Potential Water Resource Projects**

**Chino Basin Groundwater**

**Stormwater**

**Recycled Water**

**Chino Basin Desalter**

**Local Surface Water**

**Non-Chino Groundwater**

**Imported Water**

**Conservation**

A bio-swale slowly infiltrates stormwater runoff after a winter rain event in the City of Chino.

# Resources Inventory

## WATER RESOURCE SETTING

The region relies on imported and recycled water supplies provided by IEUA in addition to groundwater from both the Chino and non-Chino basins and local surface water from various creeks flowing through the service area which originate in the San Gabriel Mountains. As a response to the series of droughts that have impacted Southern California over the past 100 years, including the current drought that has lasted since 2012, the region has developed a sophisticated network of water supply facilities.

Climate change is one of the key factors that will have a substantial impact on water supplies. While recent droughts in California have been significant, climate change trends indicate a future of unprecedented "megadroughts" that have the potential to last multiple decades (Science Advances, 2015). To analyze the impact of potential climate change, RAND Corporation (a nonprofit research organization) evaluated IEUA's supply and demand balance under 106 climate scenarios that were selected from the IPCC Assessment Reports 3 & 5. Climate simulations were downscaled for the region and indicated that temperatures in the region would increase between 0.5-3.5°F. Indications for changes in precipitation varied greatly and had no clear trend.

Baseline water resource supplies were stress-tested across the 106 climate simulations to determine supply availability from 2015 to 2040 in order to establish annual expected resources. The simulations included water demand and supply inputs and calculated how demands, supplies, runoff, flows, and storage would function under each climate scenario. The individual sections of this section provide the results which illustrate the impact of climate change on future water supply. For a complete technical description of the climate simulation work by RAND see Appendix 2.

This Resources Inventory section provides an overview of the water supplies that the region relies upon:

- Chino Basin Groundwater
- Stormwater
- Recycled Water
- Chino Basin Desalter
- Local Surface Water
- Non-Chino Basin Groundwater
- Imported Water
- Water Use Efficiency

Each supply section includes an overview of current supply use, management, and prioritization; baseline assumptions through 2040; supply challenges that may impact the future availability; additional potential water resource projects by supply type; and water management implications for the region.

## POTENTIAL WATER RESOURCE PROJECTS

Additional future water resource projects were identified through the IRP Technical Work Group discussions. These projects are listed by category of supply. Many of these proposed projects were culled from existing planning documents, such as the Recharge Master Plan Update (RMPU) and the Recycled Water Program Strategy. The list includes conceptual level projects as well as those that have been under development but have not yet been included in adopted regional Ten Year Capitol Improvement Plans (TYCIP). For the full project list compiled by the IRP Technical Work Group see Appendix 2.

The proposed projects include capacity building and reliability investments, as well new sources of supply. Due to technical constraints, the Phase I climate simulations focused on the water supply benefits of these projects and to what extent they meet water demands. This information was used to identify portfolio scenarios where new supplies were added to the baseline annual supplies to assess water supply resilience in 2040. These scenarios are described in Section 4.



**California Buckwheat growing near San Antonio Dam**

## CHINO BASIN GROUNDWATER

**Resource Overview**

The Chino Basin is one of the largest groundwater basins in Southern California containing approximately 5,000,000 AF of water with an unused storage capacity of approximately 1,000,000 AF for a total potential of 6,000,000 AF (source: CBWM website). Groundwater from the Chino Basin accounts for approximately 40% of regional water supplies.

San Bernardino County Superior Court created the Chino Basin Watermaster (CBWM) in 1978 as a solution to lawsuits over historical water right allocations. CBWM is responsible for management of the Chino Basin in accordance with the 2000 Peace Agreement, 2007 Peace II Agreement, and the Chino Basin Optimum Basin Management Program (OBMP).

CBWM is governed by three stakeholder groups, called Pools. The three Pools consist of:

- **Overlying Agricultural Pool**: representing dairymen, farmers, and the State of California
- **Overlying Non-Agricultural Pool**: representing area industries
- **Appropriative Pool**: representing local cities, public water districts, and private water companies

Although groundwater is an important local supply, the water quality in the lower Chino Basin area has been impacted by historical agricultural uses and now has high levels of nitrates and total dissolved solids (TDS). There are also some areas that exceed standards for perchlorate and volatile organic chemicals (VOCs). This lower quality of water requires additional treatment, and/or blending with higher quality imported water. The Chino Basin Watermaster works in partnership with municipalities, IEUA, and the Santa Ana Regional Water Quality Control Board to address these water quality problems, including construction and operation of the Chino Basin Desalters.

The Basin is hydrologically subdivided into five groundwater zones or systems, referred to as management zones. Each management zone has a unique hydrology, and actions within one zone has little or no impact on adjacent zones. Management zones are used to characterize the groundwater level, storage, production, and water quality conditions. Throughout these management zones, there are 19 existing spreading basins that have the capability of recharging stormwater, recycled water, and/or imported water into the Chino Basin.

**Baseline Supply**

The court judgment allocates groundwater rights by establishing an annual pumping "safe yield" for each Pool. The Operating Safe Yield (OSY) is the annual amount of groundwater that can be pumped from the basin by the Pool parties free of replenishment obligations. For planning purposes, controlled overdraft for the Appropriative Pool was not included in the IRP. Annual groundwater production in excess of the OSY is allowed by the adjudication, provided that the pumped water is replaced and recharged back into the groundwater basin.

The baseline amount for groundwater production between 2015 and 2020 is assumed to be 90,550 AFY, based on historical production. This amount of groundwater pumping includes recharge from natural rainfall, stormwater capture, and recharge. It does not include recharge from recycled water.

The baseline amount for groundwater production between 2020 and 2040 is assumed to be 91,300 AFY, which is the Agencies' share of the forecasted OSY for this period and increased stormwater (SW) recharge from the Chino Basin Facilities Improvement Project. The Baseline does not include stormwater recharge from the proposed 2013 RMPU projects or recycled water used for groundwater recharge.

**Climate**

Chino Basin groundwater is dependent on rainfall and supplemental sources for recharge. Groundwater supply is impacted by climate change given that warmer temperatures and droughts increase the dryness of soil which results in less absorption when precipitation occurs and with predicted more intense periods of rainfall, water runoff will increase instead of percolating into the soil. Simulations by Wildermuth Environment Inc. showed that natural groundwater recharge (GWR) would decrease by 0.44% for each 1% decline in long-term precipitation. Groundwater supply is also impacted

## **Table 3-1:** Chino Basin Groundwater Supplies & Projects

| Baseline Chino Groundwater | | | |
|---|---|---|---|
| **Project Name** | **Description** | | **AF** |
| Baseline Chino Basin Groundwater -2015 – 2020 | Baseline groundwater production through 2020 is assumed to be 90,550 AFY, based on historical groundwater production by the Agencies from 2009-2014. Includes replenishment from natural rainfall, SW capture, and recharge. | | 90,550 |
| Baseline Chino Basin Groundwater | Baseline groundwater production from 2020 through 2040 is assumed to be 91,300 AFY: Includes Agencies' share of OSY (71.9%) of 127,000 AFY. Does not include SW from the 2013 CBWM RMPU or recycled water recharge as these are accounted for separately and in addition to the baseline Chino groundwater. | | 91,300 |

| Chino Basin Groundwater Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Groundwater Treatment (Rehab)-Increment 1, 2 | This project category will rehabilitate existing groundwater production wells decommissioned due to water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over OSY). Increased well operation could supplement annual demands or help offset losses in another water supply. Increment 1 will provide up to 5,000 AFY of production. Increment 1 & 2 will provide up to 10,000 AF. | 1 | 5,000 |
| | | 2 | 5,000 |
| Groundwater Treatment (new)-Increment 1, 2 | This project category will construct a new groundwater production well and treatment facility to address water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over OSY). Increased well operation could supplement annual demands or help offset losses in another water supply. Each increment will provide 5,000 AF. If all increments are selected, there is a potential of up to 10,000 AFY of production. | 3 | 5,000 |
| | | 4 | 5,000 |
| Production Wells-Increment 1, 2, 3, 4 | With increasing groundwater recharge to the Chino Basin, new production wells may need to be constructed to recover the additional groundwater. It is assumed that additional pumping would be limited by the volume of recharge occurring (over OSY). Well operation could supplement annual demands or intermittent to help offset losses in another water supply. Each increment will provide 5,000 AF. If all increments are selected, there is a potential of up to 20,000 AFY of production. | 5 | 5,000 |
| | | 6 | 5,000 |
| | | 7 | 5,000 |
| | | 8 | 5,000 |
| Desalter Recovery Improvement | The existing Chino Basin I Desalter (CD-1) recovers approximately 75 percent of water. Improvements could be done to increase recovery to approximately 90 percent. This water would be conveyed through the existing potable water system. | 18 | 1,500 |
| Six Basin Water Transfer | This project would explore the idea of developing a water transfer agreement with Six Basins. One concept is to purchase imported water for recharge into Six Basins and get in return equal volume of groundwater underflow plus agreed amount of stormwater. For example, 10,000 AF of imported water could be purchased in exchange for 10,000 AF of groundwater plus 7,000 AF of stormwater. Assume benefit 1 in 5 years. | 38 | 17,000 |
| Cucamonga Basin Improvements | This project category will identify projects that would result in additional groundwater production benefits coming into the IEUA service area from the Cucamonga Basin. Includes recharge facilities, treatment and production facilities to maximize supply coming into the Chino Basin. | 62 | 2,500 |
| Prior Stored Chino Groundwater | This category will allow supply to be taken from groundwater stored in the Chino Basin, pre 2014. It is estimated that approximately 400,000 AF of stored groundwater is available, of which 280,000 AF is made available for Agencies. This supply category will be managed on a case by case basis as selected into the Regional supply portfolios. The supply will be limited, but can be used annually or intermittent as needed. | 87 | 8,400 |
| Watershed Wide Water Transfers | This category of projects will construct or arrange other water transfers external to the Chino Basin. For example, dry weather flow exchange of recycled water to Orange County Water District for an equivalent amount of purchased imported water. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability and/or quality. To occur annually or intermittent. Resiliency and flexibility benefit only. | 98 | 5,000 |
| Chino Basin Water Transfers | This category of projects will construct or arrange other water transfers within the Chino Basin. Projects to also include inter-agency interties for increased reliability. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability. To occur annually or intermittent. | 99 | 5,000 |
| Reliability Production Wells | This project category will construct new production wells needed to replace lost production or under-performing facilities. These projects will maintain current annual groundwater production deliveries and are intended to increase operational flexibility and reliability. Increment 1 varies in capacity and will be determined on a case by case basis as selected into each of the regional supply portfolios. | 100 | 5,000 |

by development patterns (increased hardscaping) and more efficient irrigation practices.

A key conclusion drawn from the simulations is that it is important to secure supplemental water when available to recharge the Chino Basin (through direct or in lieu practices) to enable sustained or increased groundwater production during droughts and emergencies.

**Supply Challenges**
Supply challenges facing the Chino Groundwater Basin include the need to address:

- Sustainability or increased OSY for the Chino Basin.
- Loss of natural infiltration caused by higher density development, reduced outdoor landscaping, and irrigation efficiency measures.
- Targeting of groundwater recharge or limiting localized groundwater production in specific areas to help mitigate and/or prevent land subsidence.
- Recognition that different management practices may be required for groundwater recharge in each of the five management zones.
- Identification of additional supply sources for groundwater recharge to help meet Chino Basin recharge goals.
- Slowly rising levels total dissolved solids and nitrate levels in groundwater basin and corresponding potential future loss of available supply caused by this long term trend.
- Consideration of possible additional treatment infrastructure for groundwater.
- Containment of existing groundwater contamination plumes.

**Supply Opportunities**
The IRP process identified the potential projects listed in Table 3-1. Potential projects range from conceptual to well-developed proposals. Each project has the ability to increase the amount of supply available for groundwater recharge and/or increased groundwater production.

**Implications**
Groundwater stored in the Chino basin increases regional water supply reliability and resilience with minimal impacts from climate. It is important that the region account for diminished natural recharge resulting from climate and/or development impacts and take action to minimize these losses and to secure replacement sources. Otherwise future groundwater production will exceed sustainable levels. In addition, water quality is a key future constraint on groundwater production. The region will need to evaluate water quality improvement actions including the identification of potential blending water sources for recharge to attain long term salinity management and reliability goals.

Key findings indicate that Chino basin groundwater supplies:

- Are not impacted by climate once water is stored in the groundwater basin.
- Are slightly impacted by receiving reduced natural recharge within the basin resulting from climate and/or development impacts.
- Can be sustained or increased through use of supplemental water for groundwater recharge (through in lieu or direct recharge) when these resources are available.
- Are a vital local emergency resource to help mitigate abnormal or catastrophic events through additional groundwater production.
- Are a climate flexible supply that can be tapped to offset either short- or long-term water supply needs.
- Provide a means for sustainable regional water management by enabling exchanges and transfers among agencies within the watershed.
- Are generated locally and are the region's least energy intensive water supply and have minimal greenhouse gas emissions relative to imported water.
- Are cost effective relative to imported water supplies.
- Are critical to improving the region's water self-reliance and reducing dependence on climate variable supplies such as imported water.

## STORMWATER

### Resource Overview

Stormwater is water that originates during rainfall and snow melt. In the region, stormwater comes primarily from surface water runoff from rain and snow starting in the San Gabriel Mountains and moving down through the Santa Ana watershed. In undeveloped areas, the soil absorbs much of the runoff and helps retain the water within the groundwater basin. However, developed areas with a significant amount of hardscape tend to concentrate and accumulate runoff in large quantities in a relatively short amount of time. Stormwater runs off roofs, through streets, and into regional stormdrains, where these flows are largely diverted into the region's flood control channels.

The Chino basin has six flood control channels spread throughout the region. These channels collect and manage the stormwater generated within the watershed. Major flood control channels that convey stormwater within IEUA's service area include:

- San Sevaine Creek
- Day Creek
- Deer Creek
- Cucamonga and East Cucamonga Creek
- San Antonio Creek

Located adjacent to the channels are detention basins that are operated regionally under a multiple-use agreement for both flood control and groundwater recharge operations. IEUA, Chino Basin Watermaster, and other agencies work closely with the San Bernardino Flood Control District to maximize the amount of stormwater that can be captured and recharged into the Chino groundwater basin. These collection channels also pick up dry weather runoff from excessive outdoor irrigation.

Runoff that is not captured by these detention basins ultimately flows to the Santa Ana River. While there are efforts by agencies further downstream to capture these flows, large amounts of water discharge into the ocean during storm events.

### Baseline Supply

The baseline amount of water that is available for stormwater recharge from existing projects is already included in the groundwater supply, described under the Chino Basin Groundwater Basin resource section. To ensure there is no double-counting in the IRP simulations, this part of the supply is not counted in the stormwater baseline.

The stormwater supply projection through 2040 includes additional water captured as the result of the construction of projects listed in the 2013 RMPU (need consistent reference). As a result, the baseline stormwater supply assumed to be available between 2020 and 2040 is 6,410 AFY according to the estimated included in the 2013 RMPU.

### Climate

Stormwater supplies may also be impacted by temperature. Warmer temperatures cause soils to dry out through evaporation. This can lead to two competing effects. Because it is more difficult for water to penetrate dry soil, water runoff could increase. However, once the water is in the soil column, the ground retains this moisture until the soil is saturated which helps to replenish groundwater supplies. This outcome is also consistent to other larger basin studies performed by the Bureau of Reclamation and the Colorado River District. During dry conditions, IEUA has documented reductions in the expected amount of runoff from rain events into the groundwater recharge basins.

In absence of more detailed information on how future stormwater would vary with respect to precipitation, a regression formula was applied to develop baseline supplies as well as any additional supply that was selected as part of a water management strategy (see Section 4). Based on the results of the climate simulations, baseline stormwater supply estimates from 2015 and 2020 ranges between 900 AFY to 7,400 AFY.

### Supply Challenges

Supply challenges facing stormwater supplies include the need to address:

- Dependence of these supplies on annual rainfall and snow melt.

## Table 3-2: Stormwater Supplies & Projects

| Stormwater Baseline | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Stormwater 2015-2020 | 0 AF through 2020: Estimated completion of 2013 RMPU is 2020, therefore no new stormwater supply will be available until after 2020. | 0 |
| Baseline Stormwater 2021-2040 | 6,410 AFY for 2020 thru 2040: New stormwater supply generated from additional stormwater recharge from the recommended projects included in the 2013 CBWM RMPU. | 6,410 |

| Stormwater Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Day Creek SW Capture | Modify existing basins along Day Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the "big gulp" concept of approximately 2,500 AF. Assume benefit 1 in 5 years. | 54 | 2,500 |
| San Sevaine Creek SW Capture | Modify existing basins along San Sevaine Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the "big gulp" concept of approximately 2,500 AF. Assume benefit 1 in 5 years. | 55 | 2500 |
| Regional LID-Increments 1, 2 | Construct or modify urban development to better manage and infiltrate rainfall at the source. Projects could include bioswales and or pervious concrete installation in parking lots, street drainages. Each increment could provide up to 5,000 AFY of recharge for a total of up to 10,000 AFY recharge. | 58<br>59 | 5000<br>5000 |

- Supply variability such as storm frequency, intensity, seasonality of rainfall events which are exacerbated by climate change.
- Reductions in natural infiltration into the groundwater basin caused by channelization, new development, hardscape, increased outdoor water efficiency, and open space conversion.
- Construction of additional stormwater recharge facilities in a highly urbanized area where available land may not be available or not available in the right places to capture and recharge significant volumes of water.
- Compliance with Municipal Separate Storm Sewer System (MS4) Permit low impact development (LID) stormwater retention/recharge requirements for new and existing development and quantification of corresponding water supply benefits.

**Supply Opportunities**

The IRP process identified the following list of potential stormwater projects. Potential projects range from conceptual to well-developed proposals. Each project has the ability to increase the amount of supply available from stormwater by improving diversions to existing basins, constructing new basins and pumping facilities, or through on-site MS4 low impact development improvements.

**Implications**

Stormwater is an extremely valuable resource to the region because it is "free" once the necessary facilities to capture and use this water have been constructed. It is also a high quality water source that improves the quality of the groundwater supplies once it has infiltrated and become blended within the aquifer. Stormwater has and will likely continue to be an important element of the region's water resources as it can be stored and subsequently used. To capture large storm events additional infrastructure should be constructed. In addition, to help offset lost infiltration from increased urbanization and more efficient outdoor landscaping, increasing regional investment in MS4-compliant low impact development projects will be necessary.

Key findings indicate that stormwater supplies:

- Are generated locally, are the least energy intensive water supply and have minimal greenhouse gas emissions relative to imported water.
- Are cost effective relative to imported water supplies.
- Are highly dependent on weather and driven by climate.
- Will be significantly reduced during droughts when below average precipitation and drier conditions

exist.

- Require well-designed facilities that can operate under a wide range of flows.
- Are a high quality water supply and provide a supplemental source of water to blend with and improve groundwater quality.

## RECYCLED WATER

**Resource Overview**

IEUA owns and operates four water reclamation plants: Regional Plant No. 1 (RP-1), Regional Plant No. 2 (RP-2), Regional Plant No. 4 (RP-4), Regional Plant No. 5 (RP-5), and the Carbon Canyon Water Reclamation Facility (CCWRF). These facilities provide tertiary treated wastewater, also known as recycled water. Recycled water supplies can be used for direct non-potable uses, groundwater recharge for the Chino Basin, and for other regional discharge obligations. Recharge of recycled water is allowed by the Regional Water Quality Control Board (RWQCB) through the Optimum Basin Management Program, and currently provides approximately 17% of the region's urban water supply. The region secured a number of permits allowing for the direct use and groundwater recharge of recycled water. These permits define requirements for the use of recycled water (both direct use and recharge), including, but not limited to, uses, water quality levels, and monitoring requirements.

The recycled water program is operated based on the following order of priorities for recycled water supply:

- Regional discharge obligations (Santa Ana River Judgement, environmental, etc.)
- Agency direct use demands
- Regional groundwater recharge

Although recycled water is an important component of the groundwater recharge program, not all of the recharge basins are able to use recycled water. Currently, 10 of the region's 16 groundwater recharge basins have State permits to receive recycled water.

During FY2014-15, the 4 regional water reclamation plants produced approximately 62,000 AF of recycled water. Based on recent wastewater projections that were calculated as part of the Wastewater Facilities Master Plan (WFMP), treated flows are expected to increase to over 85,000 AFY by 2040 as shown in Table 3-4. It is important to note that these flow estimates were based on current existing indoor water usage levels in order to ensure that facilities and pipelines are adequately sized, and are consistent with the IRP's upper demand forecast (see Section 2). However, indoor water use efficiency is increasing and new plumbing code and appliance standards are being implemented. As a result, available wastewater flows by 2040 are expected to be lower than 80,000 AFY. These water flow trends are being carefully tracked by IEUA.

**Baseline Supply**

As part of the 2015 Recycled Water Program Strategy, regional direct use demand forecasts were developed. Direct use for recycled water is defined in the recycled water Program Strategy as the amount of water needed for landscaping, agricultural, and industrial processes. The forecasts indicate that by 2025 direct use demands will increase by 11,000 AFY. The projects required to achieve the direct use demand forecast by 2025 are included in IEUA's FY2015-16 Ten Year Capital Improvement Plan (TYCIP).

The TYCIP includes recycled water projects that will allow the region to increase both direct use and groundwater recharge deliveries. These projects will provide 30,640 AFY of direct use (including approximately 1,700 AF agriculture use) and 18,700 AFY of groundwater recharge supply by 2025. Because the TYCIP includes recycled water projects with prior commitments from the region, the corresponding amount of recycled water supply from those projects is considered baseline recycled water supply for the IRP.

In summary, the baseline recycled water supply for direct use demands is assumed to be:

- Near Term (2015 to 2020) = 25,000 AFY by 2020
- Mid Term (2020 to 2030)
- Long Term (2030 to 2040) = 31,300 AFY by 2025

Recycled water deliveries for groundwater recharge were also updated as part of the 2015 RWPS. Similar to direct use deliveries, projects required to contribute

## Table 3-3: Wastewater Projection

| | 2015 | 2020 | 2030 | 2040 |
|---|---|---|---|---|
| **Regional Recycled Water Supply** | 63,900 AF | 66,300 AF | 77,500 AF | 85,500 AF |

18,700 AFY to the groundwater recharge program by 2025 are included in the TYCIP.

Therefore, baseline recycled water supply for groundwater recharge is assumed to be:

- Near Term (2015 to 2020) = 16,900 AFY by 2020
- Mid Term (2020 to 2030)
- Long Term (2030 to 2040) = 18,700 AFY by 2025

Table 3-6 summarizes the baseline assumptions compared to the total available recycled water supply produced by the four water reclamation plants. Beyond 2025, there is a significant amount of recycled water supply that can be delivered for beneficial reuse. Additional projects will need to be constructed to increase the baseline amount of recycled water beneficially used to help meet the urban water demand for the region. Additional projects for increasing recycled water reuse are outlined below.

**Climate**

Under the climate simulations, wastewater flows were not impacted by climate. As a result, recycled water is the most climate resilient water supply available to the region.

**Supply Challenges**

Supply challenges facing recycled water supplies include the need to address:

- Projected available wastewater supply is not adequate to fulfill future demands for recycled water.
- Changes in the future amount of available wastewater as well as increases in wastewater strength (total dissolved solids and nitrate levels) and changes in treatment resulting from trend towards more efficient indoor water use.
- The efficient use of recycled water for outdoor irrigation (both urban and agriculture) and whether this use should be consistent with existing state efficiency standards.
- Increased energy needs for treatment and delivery of recycled water.
- Increasing regulatory and environmental issues for construction and operation of recycled water systems, in particular surface recharge of recycled water.

**Supply Opportunities**

The IRP process identified the following list of potential projects. Potential projects range from conceptual to well-developed proposals. Each project has the ability to increase the amount of supply available for recycled water direct use and groundwater recharge.

**Implications**

Due to its reliability and climate resilience, recycled water is one of the most valuable water supplies for the

## Table 3-4: Recycled Water Supply & Baseline Demands

| | 2015 | 2020 | 2025 | 2030 | 2040 |
|---|---|---|---|---|---|
| **Recycled Water Supply**[(1)] | 60,200 | 64,300 | 69,700 | 75,100 | 82,900 |
| **SAR Discharge Obligation**[(2)] | 17,000 | 17,000 | 17,000 | 17,000 | 17,000 |
| **Direct Use Demands**[(3,4)] | 24,700 | 28,800 | 30,700 | 30,700 | 30,700 |
| **Groundwater Recharge** [(3)] | 14,500 | 16,900 | 18,700 | 18,700 | 18,700 |
| **Remaining Recycled Water Supply** | ***4,000*** | ***1,600*** | ***3,300*** | ***8,700*** | ***16,500*** |

Notes:
(1) Regional supply per Wastewater Facilities Master Plan, includes 3% loss due to treatment waste streams.
(2) Minimum discharge required by SAR Obligation is 16,850 AFY. For planning purposes, assume 17,000 AFY
(3) Per 2015 Recycled Water Program Strategy and Agency FY2015/16 TYCIP.
(4) Includes agricultural demands.

## Table 3-5: Recycled Water Supplies & Projects

| Recycled Water Baseline | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Recycled Water for Groundwater Recharge 2015-2020 | 14,500 AFY by 2015 based on 5-year historical average from 2009-2014 | 14,500 |
| Baseline Recycled Water Direct Use 2015-2020 | 16,100 AFY by 2015 based on 5-year historical average from 2009-2014 | 16,100 |
| Baseline Recycled Water for Groundwater Recharge 2021-2025 | 2,400 AFY of additional Recycled water by 2020 for groundwater recharge per IEUA FY15-16 TYCIP | 2,400 |
| Baseline Recycled Water Direct Use 2021-2025 | 8,900 AFY of additional Recycled water direct use by 2020 per IEUA FY15-16 TYCIP | 8,900 |
| Baseline Recycled Water for Groundwater Recharge 2026-2040 | 1,800 AFY of additional Recycled water for groundwater recharge by 2025 per IEUA FY15-16 TYCIP | 1,800 |
| Baseline Recycled Water Direct Use 2026-2040 | 4,000 AFY of additional Recycled water for direct use by 2025 per IEUA FY15-16 TYCIP | 4,000 |

| Recycled Water Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| WRCRWA Recyled Water Intertie | The Western Riverside County Regional Wastewater Authority (WRCRWA) Plant intertie would allow for the delivery of recycled water from the WRCRWA Plant to be used in the IEUA southern service area. This would also allow additional recycled water to be delivered into the northern service area groundwater recharge basins by reducing the demand from the RP-1 930 pressure zone pump station. Intertie would occur within the 800/930 Pressure Zones. | 9 | 4,500 |
| Rialto Recycled Water Intertie | The Rialto intertie project would allow for delivery of recycled water from the Rialto Wastewater Treatment Plant (WWTP) to be used in the IEUA service area. The intertie could occur near the RP-3 groundwater recharge basins. This concept could involve the Inland Valley Pipeline, LLC to convey water between Rialto WWTP and IEUA's recycled water distribution system. Supply could be used for direct, groundwater recharge, or other reuse strategy. | 10 | 4,500 |
| Pomona Recycled Water Exchange/Transfer | The City of Pomona does not currently use all of the treated effluent from the Pomona Water Reclamation Plant. One concept would involve partnering to develop and expand their recycled water facilities in exchange for an agreed amount of their Chino Basin groundwater right. Could include other supply transfer agreement such as reclaimable waste and/or groundwater. | 11 | 2,500 |
| RP-1 Recycled Water Injection-Increment 1, 2, 3 | This project would construct an advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) facility at RP-1 to further treat tertiary effluent to allow the water to be injected directly into Chino Basin. The sizing of the facility and the volume to be produced will be determined as part of the portfolio development process. Increments 1-3 facility would be sized for 7,500 AFY. | 12<br>13<br>14 | 2,500<br>2,500<br>2,500 |
| Satellite Recycled Water Injection-Increment 1, 2, 3 | This project category would construct a satellite (outside of RP-1) wastewater treatment plant with advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) to allow the water to be injected directly into Chino Basin. The location, sizing, and volume to be produced will be determined as part of the portfolio development process. Increments 1-3 facility or facilities would have a capacity of 7,500 AFY. | 15<br>16<br>17 | 2,500<br>2,500<br>2,500 |
| Recycled Water Direct Use Expansion-Increment 1, 2, 3, 4 | IEUA developed a new Recycled Water Program Strategy concurrent with the IRP. This project category will be used to determine the potential interest in expanding the direct use system beyond IEUA's Ten Year CIP. Includes the reuse of regional wastewater supply, approximately 83,000 AFY by 2035, and potential recycled water interties. Each increment would increase direct use beyond baseline supply by 5,000 AFY. Increment 1-4 facilities would increase direct use beyond baseline supply by 20,000 AFY. | 19<br>20<br>21<br>22 | 5,000<br>5,000<br>5,000<br>5,000 |
| Existing Groundwater Recharge Basin Improvements beyond RMPU-Increment 1, 2, 3, 4 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1-4 facilities would increase recharge at existing basins within the Chino Basin by an additional 15,000 AF. | 23<br>24<br>25<br>26 | 2,500<br>2,500<br>5,000<br>5,000 |

## Table 3-6: Recycled Water Projects Continued

| Recycled Water Projects (*continued*) | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Construct New Groundwater Recharge Basins-Increment 1, 2, 3, 4 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water, and/or imported water for groundwater recharge. Increment 1-4 would provide up to an additional 9,800 AFY of recharge capacity, which is approximately 4 new basins at 350 AF per month for 7 months of operation. | 27<br>28<br>29<br>30 | 2,450<br>2,450<br>2,450<br>2,450 |
| Direct Potable Reuse-Increment 1, 2 | This project would construct an advanced water filtration and treatment (e.g. process treatment that combines micro or ultrafiltration) facility at a Regional Plant. The treatment process would allow the recycled water to be introduced into the potable water system. Increment 1+2 facility would have a capacity of 10,000 AFY. | 60<br>61 | 5,000<br>5,000 |
| RP-1 NRWS Treatment | The north Non-Reclaimable Wastewater System (NRWS) discharges approximately 3.5 MGD of brine to Los Angeles County annually. The project would construct a treatment facility to allow the Region to reuse this supply into the recycled water system. Requires plant expansion and partial reverse osmosis for blending. | 65 | 3,920 |
| Watershed Wide Water Transfers | This category of projects will construct or arrange other water transfers external to the Chino Basin. For example, dry weather flow exchange of recycled water to Orange County Water District for an equivalent amount of purchased imported water. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but will increase reliability and/or quality. To occur annually or intermittently. Resiliency and flexibility benefit only. | 98 | 5,000 AF |
| Chino Basin Water Transfers | This category of projects will construct or arrange other water transfers within the Chino Basin. Projects to also include inter-agency interties for increased reliability. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but will increase reliability. To occur annually or intermittently. | 99 | 5,000 AF |

region and is a high priority for additional investment. The region needs to account for the trend towards increased indoor water efficiency and evaluate opportunities to bring in supplemental wastewater flows through construction of collection systems in non-sewered areas and collaboration with neighboring jurisdictions to optimize regional infrastructure. Further, the region needs to improve efficiency of direct recycled water use to maximize its availability to all Agencies. This is particularly important for outdoor irrigation as improved efficiency can help make more recycled water available during the summer and fall when demands for recycled water are at their highest.

Findings indicate that recycled water supplies:

- Are not impacted by climate making recycled water the region's most climate resilient water supply.
- Are needed to maximize supplemental water for groundwater recharge.
- Are generated locally and can be beneficially used by all Agencies.
- Are critical to improving the region's water self-reliance and reducing dependence on climate variable supplies such as imported water.
- Are being impacted by indoor water efficiency trends so the region must anticipate the amount of supply that is likely to be available in the future and the changes in treatment that may be required to maintain the water quality of these supplies.
- Are a supplemental water source for the entire region with infrastructure that can be intertied with that of neighboring agencies to optimize availability and use of recycled water.
- Generally require a higher level of energy than other water supplies for treatment and distribution, but are less energy intensive than imported water supplies and use of this water can contribute to statewide reductions in greenhouse gas emissions.

### CHINO BASIN DESALTER

**Resource Overview**

The Chino Basin Desalter Authority (CDA) was formed to

manage the production, treatment, and distribution of highly treated potable water to cities and water agencies throughout the Chino Basin. A Joint Exercise of Powers Agency, the CDA was formed by the Jurupa Community Services District; Santa Ana River Water Company; Western Municipal Water District; the Cities of Chino, Chino Hills, Norco, and Ontario; and the Inland Empire Utilities Agency to treat brackish groundwater extracted from the lower portion of the Chino Basin. Brackish water is water that has more salt (about 1000 ppm of total dissolved solids) than fresh water, but not as high as seawater (about 3000 ppm of total dissolved solids).

The CDA operates two desalters: Chino I Desalter which began operation in 2000 and Chino II Desalter which began operation in 2006. The treatment processes at the Chino I and Chino II Desalters include Reverse Osmosis (RO) and Ion-Exchange (IX) for removal of nitrate and total dissolved solids (TDS). The Chino I Desalter also includes air stripping for removal of volatile organic chemicals (VOC).

These facilities serve three purposes. First, they convert unusable groundwater into a reliable potable water supply for the region and are part of a long-term pollution cleanup strategy for the Chino Basin. Second, they provide hydraulic control over the lower Chino Basin, which prevents the migration of poor quality water into the Santa Ana River as well as downstream impacts on groundwater basins in Orange County. Third, they maintain and enhance groundwater yield for the Chino Basin.

The Desalters are a critical component of a long-term salinity management strategy that enables the region to use recycled water in the Chino Basin. The Peace Agreement, Optimum Basin Management Program, and Maximum Benefit Plan approved by the Santa Ana Regional Water Quality Board and the State Water Resources Control Board require ongoing implementation of regional salt management and reduction actions as a condition of the regional recycled water use permits for outdoor irrigation as well as for groundwater recharge.

**Baseline Supply**

Chino I Desalter and Chino II Desalter currently produce 25,000 AFY of treated groundwater. These facilities are being expanded and will have the capacity to treat 35,200 AFY by 2017. The amount of water received by member agencies within IEUA's service area is approximately 50% of the total production from these facilities. The remaining water is sent to agencies within the Western Municipal Water District service area.

Member agencies that receive water from the Desalter facilities within IEUA's service area are:

- City of Chino
- City of Chino Hills
- City of Ontario

Based on information from the CDA, the baseline Chino Desalter supply for the Agency's service area is assumed to be 17,300 AFY through 2040.

**Climate**

Climate effects on water supply produced from the Chino Desalter facilities was not modeled as part of the IRP. Climate impacts were considered to be negligible as the quantity of water produced is dependent upon the capacity of the desalter facility and is not supply limited.

**Supply Challenges**

Supply challenges facing the Chino Desalters include the need to address:

The outstanding groundwater replenishment obligation to the Chino Basin of 152,900 AF through the duration of the Peace Agreement that must be fulfilled by the region.

Increased energy needs and costs for the expanded treatment of brackish water and brine disposal

The location of Desalter production wells near existing contaminated plumes in the groundwater basin, including potential costly impacts on Desalter treatment processes as well as opportunities to use the Desalters as part of a groundwater clean-up strategy.

**Supply Opportunities**

The IRP process identified the following list of potential projects. Each project has the ability to increase the

amount of supply available, treated or produced by the Desalter facilities.

**Implications**

The Chino Desalters provide a new source of potable water supplies for the region by treating currently unusable groundwater, as well as providing hydraulic control of the lower Chino Groundwater Basin. This infrastructure is critical to the continued use of recycled water in the region as well as improving groundwater quality and yield in the Chino Basin.

Key findings indicate that the Chino Desalter water supplies:

- Are not impacted by climate making recycled water the region's most climate resilient water supply.
- Are critical to improving the region's water self-reliance and reducing dependence on climate variable supplies such as imported water.
- Generally require a higher level of energy than other water supplies for treatment and distribution.
- Are an essential component of the regional commitment to remove salt and nitrates in the Chino Basin.
- Are critical to the continued use of recycled water in the region for groundwater recharge and outdoor irrigation.
- Provide hydraulic control for the Chino Basin which prevents poor quality water from migrating into the Santa Ana River and downstream groundwater basins.
- Are managed under the Peace Agreement and the Optimum Basin Management Plan, which require fulfillment of a groundwater replenishment obligation of 152,900 AF.
- Are limited on the amount of water that can be produced based on the capacity and performance of the Desalter facilities.

## LOCAL SURFACE WATER

**Resource Overview**

Agencies located the northern part of the region have long standing legal rights to divert and treat water from local creeks in the Santa Ana River watershed, including San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek, and other small surface creeks and tunnels. The amount of water from these local surface supplies is variable, depending on climate conditions.

The quality of local surface water is typically quite high as the creeks are filled by rainfall and snowmelt from the San Gabriel Mountains. However, the surface water must receive treatment to comply with state and federal drinking water quality standards before it can be served for public use. Large storm events can cause sedimentation levels to rise to levels that impact the water treatment plants. During these times, water is diverted downstream to groundwater recharge basins.

**Baseline Supply**

### Table 3-7: Chino Basin Desalter Baseline & Projects

| Baseline Chino Desalter Projects | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Chino Desalter | Phase 2 Chino Basin Desalter production for IEUA service area | 15,000 AF |
| Baseline Chino Desalter | Phase 3 Chino Basin Desalter production for IEUA service area | 2,730 AF |

| Chino Desalter Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Desalter Recovery Improvement | The existing Chino Basin I Desalter (CD-1) recovers approximately 75 percent of water. Improvements could be done to increase recovery to approximately 90 percent. This water would be conveyed through the existing potable water system. | 18 | 1,500 AF |

The most recent local surface water production data received from Agencies was used to forecast the baseline water supply. The amount of local surface water supply was established using a five-year average of production during the period of FY2009-10 through FY2013-14. This period of time includes three consecutive years of below average precipitation and two year of normal or above precipitation, providing a conservative projection. Baseline local surface water before considering climate modeling effects is therefore assumed to be 11,700 AFY through year 2040.

**Climate**

Local surface supplies are highly impacted by climate. Due to their dependence on precipitation and snow melt, the amount of water that can be obtained from local surface sources is highly variable from year to year.

However, annual surface water supplies are highly dependent on the weather and susceptible to changes in climate and was modeled under climate influences. Based on the results of the climate simulations, the projected baseline local surface water supplies available between 2015 and 2020 ranges from 2,000 to 12,600 AFY.

Local surface supplies may also be impacted by temperature. Higher temperatures cause more evaporation, reducing the amount of soil moisture. This means that the soil is more likely to absorb and hold water when rain occurs and this can reduce the amount of water flowing into creeks and streams.

Historical variability in local surface supplies is highly correlated with precipitation but also temperature.

Records indicate that local surface flows have declined and projections indicate that flows will decline in the near future from at least 2021-2040 (Seager 2012). Based on the results of the climate simulations, local surface water supplies are expected to vary from 2,000 AFY to 12,600 AFY.

**Supply Challenges**

Supply challenges facing local surface water supplies include the need to address:

- Extreme variability due to their dependence on rainfall and snow melt .

**Supply Opportunities**

The IRP process identified the following list of potential projects. Each project has the ability to increase the amount of supply available from local surface water by either diversion and/or treatment improvements.

**Implications**

Local surface water, when available, is an extremely valuable resource because it is “free”, with the cost to the Agencies being the operation of the necessary facilities to capture and use this water. Where possible, use of local surface water should be maximized.

Key findings indicate that local surface water supplies:

- Are generated locally and are the region’s least energy intensive water supply and have minimal greenhouse gas emissions relative to imported water .
- Are cost effective relative to imported water supplies.
- Are highly dependent on weather and driven by climate.
- Will be significantly reduced during droughts when below average precipitation and drier conditions exist.
- Are a high quality water supply and provide a supplemental source of water to blend with and improve groundwater quality.
- Are highly variable and require facilities to operate under a wide range of flows .

## NON-CHINO BASIN GROUNDWATER

**Resource Overview**

Member agencies pump groundwater from basins adjacent to the Chino Basin. These basins include Cucamonga, Rialto, Lytle Creek, Colton, and the Six Basins groundwater basins. The Six Basins are comprised of the Ganesha, Live Oak, Pomona, Lower Claremont Heights, Upper Claremont Heights and Canyon Basin.

There are four agencies within the service area that

include non-Chino groundwater as a water supply source. These agencies are the City of Upland, Cucamonga Valley Water District, Fontana Water Company, and San Antonio Water Company.

**Baseline Supply**
The most recent water production data was used to forecast the baseline water supply. The amount of non-Chino Basin groundwater supply was based on a five-year production average from FY2009-10 to FY2013-14. Baseline non-Chino groundwater supply is assumed to be 22,000 AFY through 2040.

**Climate**
Climate effect on non-Chino Basin groundwater was not evaluated as part of the IRP. However, it is expected that climate will have a minimal impact on these groundwater supplies based on the climate simulations performed on the Chino Basin. The non-Chino Basin groundwater baseline supply is assumed to remain constant at 22,100 through 2040.

**Supply Challenges**
These groundwater basins face similar supply challenges to those identified for the Chino Basin. Challenges include reduced natural infiltration, safe yield operating constraints, and water quality issues.

**Supply Opportunities**
The IRP process identified the following list of potential projects. Each project has the ability to increase the amount of supply available for groundwater recharge and/or increased groundwater production.

**Implications**
Groundwater basins outside of the Chino Basin face similar implementation hurdles as the Chino Basin.

Key findings indicate that non-Chino Basin groundwater supplies:

- Are not impacted by climate once water is stored in the groundwater basin.
- Are slightly impacted by receiving reduced natural recharge within the basin resulting from climate and/or development impacts.
- Can be sustained or increased through use of supplemental water for groundwater recharge (through in lieu or direct recharge) when these resources are available.
- Are a vital local emergency resource to help mitigate abnormal or catastrophic events through additional groundwater production.
- Provide a means for sustainable regional water management by enabling exchanges and transfers among agencies within the watershed.
- Are generated locally and are the region's least energy intensive water supply and have minimal greenhouse gas emissions relative to imported water.
- Are cost effective relative to imported water supplies.
- Are critical to improving the region's water self-reliance and reducing dependence on climate variable supplies such as imported water.

## Table 3-8: Local Surface Water Baseline & Projects

| Baseline Local Surface | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Local Surface | 11,700 AF based on 5-year historical average from 2009-2014. | 11,700 AF |

| Local Surface Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Dry Weather Flow Diversions | Capture and treat urban dry weather flow from Chino, Cucamonga and San Sevaine Creek into the Regional Plants. For the purposes of the IRP, a volume of 3,500 AFY was assumed as total available dry weather flow. | 48 | 3,500 AF |
| Maximize Local Surface Water | This category of projects will construct facilities needed to capture additional local surface water. Projects to be defined by IEUA's Agencies. For example, increase surface flows off Lytle Creek in wet years. Assume benefit 3 in 5 years. | 88 | 1,000 AF |

- Reduce the water resource need on the Chino Basin.

## IMPORTED WATER

**Overview**

IEUA was originally formed in 1950 as a municipal wholesale water district for the purpose of providing municipalities in the Chino Basin with supplemental imported water purchased from the Metropolitan Water District of Southern California (MWD).

MWD is a contractor to both the State Water Project (SWP), which imports water from northern California, and Colorado River Aqueduct (CRA) systems. The availability of imported water supplies is heavily dependent on hydrology and environmental regulations. This dependency can lead to high variability in the annual amount of water available to the Southern California region. For example, in the midst of the great drought, the California State Water Project was able to supply only 5 percent of its contract allocation in 2013-2014, which is a significant reduction from past allocations.

Due to water quality concerns in the Chino Basin, the region can only use imported water from the State Water Project. Imported purchases from MWD in recent decades have averaged about 70,000 AFY, providing about 30% of the water supply for the service area.

Imported water purchased from the MWD is limited by a purchase order agreement. The agreement allows the region to purchase up to a total of 93,283 AF per year at its lowest (Tier I) rate. This limit is based on historical imported water purchases for municipal use by the member agencies and for regional groundwater recharge. The agreement includes an annual minimum purchase commitment of 39,835 AF. Note that this amount is slightly less than the 40,000 AFY minimum needed for the operation of Agency treatment facilities.

There are four water treatment plants that treat imported water purchased from the MWD. These treatment facilities include:

- Water Facilities Authority's Agua de Lejos Treatment Plant (81 mgd capacity)
- Fontana Water Company's Sandhill Surface Water Treatment Plant (29 mgd capacity)
- CVWD's Lloyd W. Michael Water Treatment Plant (60 mgd capacity)
- CVWD's Royer Nesbit Water Treatment Plant (11 mgd capacity)

Each agency is allocated an annual portion of MWD's available Tier 1 water supply (shown below). The allocations do not confer a contractual right to MWD imported water but are used to determine the price paid for the water. Purchases in excess of the Tier 1 allocation are assessed by MWD at a higher Tier 2 rate.

- Water Facilities Authority - 31,384 AFY
- Cucamonga Valley Water District - 28,368 AFY
- Fontana Water Company - 10,000 AFY
- Inland Empire Utilities Agency/Chino Basin Watermaster – 23,531 AFY

The amount available to IEUA and/or the Chino Basin Watermaster is used only for groundwater recharge.

**Baseline Supply**

The baseline supplies for imported water are based on IEUA Resolution 2014-12-1. Supplies were set as follows:

- Current imported purchases by Agencies are assumed to be 65,000 AFY (consistent with FY2014/15 purchases).
- Imported water purchases between 2020 and 2040 are assumed to be 69,752 AFY.
- Minimum imported purchases are assumed to be 40,000 AFY to meet retail agency water treatment operational requirements .

**Climate**

The State Water Project's infrastructure was designed to capture snowmelt from snowpack in the Sierra Nevada Mountains. When the snow melts during the warmer spring months, this combination of reservoirs and conveyance facilities provides a steady water supply throughout the year but especially during the summer and fall when water demands peak and precipitation is limited.

## Table 3-9: Non-Chino Basin Groundwater Supplies & Projects

| Non Chino Basin Groundwater Baseline | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Non-Chino Groundwater | 22,100 AF Amount of water produced by an Agency from outside the Chino basin | 22,100 AF |

| Non Chino Basin Groundwater Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Maximize Other Groundwater | This project category will identify Agency projects that would result in additional groundwater production benefits coming into the IEUA service area outside of the Chino Basin. Such projects may have the potential of an additional 5,000 AF. | 63 | 5,000 AF |

However, climate change is expected to continue to significantly impact the timing and characteristics of snowpack on which the SWP system depends. Predicting MWD's ability to supply specific amounts of imported water to IEUA were beyond the scope of climate simulation. Instead, the IRP considered a wide range of potential changes in imported supply availability, including assumptions in which SWP supplies decline by 2040. To explore a range of possible climate effects of MWD supplies, the analysis varied the amount of reduction of the Tier 1 water above the minimum purchase level. Two levels were selected—a 40% reduction and an 80% reduction. This corresponds to a range of reduction of 17% to 34% in total MWD Tier 1 supplies.

An interesting finding from the climate modeling was the identification of times, particularly in the next ten years, when imported MWD water may not be needed to meet regional demand. This water, if purchased, could be placed into the Chino Basin for storage and made available to during future droughts, imported water deliveries, or catastrophic events (see Figure 3-12 below.) The modeling also shows that beyond the first ten years there are periods when there is shortage in the MWD supply, and available water is lower than the baseline assumption.

**Supply Challenges**

Supply challenges facing imported water supplies from Metropolitan Water District's State Water Project include the need to address:

- Catastrophic interruption—for example, an earthquake affecting the Delta or Tehachapis, or a Delta levee break.
- Maintenance interruptions—for example, Rialto line repairs.
- Operational constraints without improvements to the Bay Delta conveyance, such as the Delta Fix proposed by the Department of Water Resources.
- Colorado River over-allocation and the status of Lake Mead, including the potential impact on availability of MWD supplies which could constrain distribution of water from the State Water Project.
- The cost of supplies that are expected to increase 4-5% annually during the next decade.
- Vulnerability to climate change conditions, such as warmer temperatures, reduced snowpack, and more frequent droughts that will reduce supplies available from CRA and SWP given that both infrastructure projects are designed to capture slow melting snowpack.

**Supply Opportunities**

Additional opportunities for increasing supplemental water supplies from imported sources, both through MWD and from other locations, were identified during the IRP process and are summarized in Table 3-10.

**Implications**

Climate conditions, conveyance reliability, and the need to improve SWP infrastructure all affect the future

availability of imported water to the region. Due to its high quality, including having low TDSs, SWP water should be purchased when it is available to enhance groundwater recharge and to leverage other water supply programs that benefit the region.

Key findings indicate that imported water supplies:

- Are less reliable now than they have been in the past and may further decrease in reliability with climate change and continued uncertainty about infrastructure improvements.
- Are not fully reliable, and it will be important to develop alternative supplies so that the region has the flexibility to withstand reduced SWP supply caused by extended years of limited/reduced snowpack.
- Are not fully reliable, and so additional investments may need to be made to meet water quality restrictions if low-salinity imported water is not available, such as considerations to include CRA supply.
- Should be leveraged, when available in the near-term, by the region for storage, groundwater recharge, exchanges, transfers, or in-lieu.
- Will be more expensive. The cost of supplies is expected to increase 4-5% annually during the next decade .

## CONSERVATION

**Overview**

Unlike traditional water supplies, efficient use of water reduces demand in ways that are quantified indirectly. Demand is reduced through changes in consumer behavior and savings from water-efficient fixtures like toilets and showerheads. These water savings come from both "active" and "code-based" conservation efforts. "Active" efforts are Agency funded programs such as rebates, installations, and education. "Code-based" conservation consists of demand reductions attributable to more water efficient plumbing code and appliance standards and customer response to higher water costs and rates that encourage water efficiency.

Over the past 24 years, since signing the California Urban Water Conservation Council's (CUWCC) memorandum of understanding (MOU) regarding Urban Water Conservation in 1991, the region has been committed to developing and implementing conservation programs that serve as a key component in the overall water resource management portfolio for the region. Such active conservation programs have traditionally included rebates for water saving devices such as ultra-low-flow toilets and high efficiency clothes washers, which are primarily administered through MWD's "Save Water-Save A Buck" program for commercial, residential, and multi-family properties. Other programs include educational programs such as the award-winning Garden in Every School Program,

### Figure 3-11: Potential Climate Change Impact on SWP Supplies



## Table 3-10: Imported Water Baseline & Projects

| Baseline Imported Water | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Imported Water | Agencies can purchase up to 69,750 AFY per the Member Agency Tier 1 purchase limit per Resolution 2014-12-1 | 69,750 AF |

| Imported Water Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Existing Groundwater Recharge Basin Improvements beyond RMPU-Increment 1 ,2, 3, 4 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1 and 2 would increase recharge at existing basins within the Chino Basin by 2,500 AFY each. Increments 3 and 4 are 5,000 AF each. If all increments are selected there is a potential of up to 15,000 AFY of production. | 23 | 2,500 AF |
| | | 24 | 2,500 AF |
| | | 25 | 5,000 AF |
| | | 26 | 5,000 AF |
| Construct New Groundwater Recharge Basins-Increment 1, 2, 3, 4 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water and/or imported water for groundwater recharge. Each increment would provide up to an additional 2,450 AFY of recharge capacity, which is approximately one new basin at 350 AF per month for 7 months of operation. If all increments are selected, there is a potential production of 9,800 AFY. | 27 | 2,450 AF |
| | | 28 | 2,450 AF |
| | | 29 | 2,450 AF |
| | | 30 | 2,450 AF |
| ASR wells MZ1 and MZ2 | Construct aquifer storage and recovery (ASR) wells to increase imported water groundwater recharge within management zone 1 and 2. Reference projects were taken from the 2010 RMPU, Sections 6.7.2.1 and 3 for CVWD and the City of Ontario. | 31 | 11,500 AF |
| ASR wells MZ3 | Construct ASR wells to increase imported water groundwater recharge within management zone 3. Reference projects were taken from the 2010 RMPU, Sections 6.7.2.2 for JCSD. | 32 | 3,500 AF |
| Maximize ASR wells | Construct other ASR wells to increase imported water recharge by 3,500 AFY within the Chino Basin during wet and dry years. Assume benefit 40% of the time (2 in 5 years). Storage to be dependent on supplemental water availability in wet years. | 33 | 3,500 AF |
| Cadiz IW Transfer | The Cadiz project would allow for the import of unused groundwater from the remote Fenner Valley near Cadiz, California. For the purposes of the IRP, a 5,000 AFY increment of water is assumed. The Cadiz supply would be transferred and taken as SWP water into the Chino Basin. | 34 | 5,000 AF |
| Secure SWP IW transfer outside MWD | Imported water supply is solely from MWD via the SWP and is limited by the Agency's purchase order. Other permanent, temporary or seasonally available imported water supplies could be purchased and wheeled into the Chino Basin. The volume of water available varies depending on the source of water and timing. Supplies could be purchased from various Irrigation Districts or secured via Ag Transfer. Assume benefit 1 in 10 years. | 35 | 5,000 AF |
| SBVMWD IW Transfer | As a SWP contractor, San Bernardino Valley MWD (SBVMWD) has a Table A allocation. This option would involve constructing an intertie between SBVMWD's imported water system. The supply would be temporary or seasonally available and could be purchased and wheeled into the Chino Basin. Assume benefit 1 in 5 years. | 36 | 5,000 AF |
| Ocean Desalination Exchange | This project category would involve a partnership with another water agency pursuing ocean water desalination; through in-lieu exchange, the Chino basin would obtain an agreed amount of imported water. For the purposes of the IRP, a volume of 5,000 AFY was chosen. Opportunity to invest in upcoming ocean desalination plants includes Huntington Beach, Carlsbad and West Basin. | 37 | 5,000 AF |
| Water Banking Facility | This project category would invest into the Semitropic Groundwater Storage Bank in Kern County or similar program. The Chino Basin could bank additional purchases of wet year water when these supplies are available and Chino Basin facilities are capacity limited. | 56 | 5,000 AF |

| Imported Water Projects (*continued*) | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Max Tier 1 MWD Imported Water-Increment 1, 2, 3 | Maximize imported water from MWD at Tier 1 rate. Total available supply at Tier 1 rate is 93,283 AFY or cumulative purchase order maximum of 932,830 AF through December 31, 2024. Supply can be taken directly, in-lieu or for supplemental recharge. Each increment would allow for the purchase of an additional 7,850 AFY. If all increments are selected up to 23,550 AFY could be purchased purchased annually or intermittently. | 89 | 7,850 AF |
| | | 90 | 7,850 AF |
| | | 91 | 7,850 AF |
| Max Tier 2 MWD Imported Water-Increment 1, 2, 3 | Maximize imported water from MWD at Tier 2 rate. Could be taken annually or intermittent, availability pending MWD supply. Supply can be taken directly, in-lieu or for supplemental recharge. Each increment would allow for the purchase of an additional 5,000 AFY . If all increments are selected up to 15,000 AFY could be purchased annually or intermitently. | 92 | 5,000 AF |
| | | 93 | 5,000 AF |
| | | 94 | 5,000 AF |
| MWD Replenishment or discount wet year water-Increment 1, 2, 3 | Maximize replenishment or discount wet year imported water from MWD. Availability pending MWD supply and pricing. Supply can be taken in-lieu or for supplemental recharge. Each increment would allow for the purchase of an additional 10,000 AFY. If all increments are selected up to 30,000 AFY could be purchased annually or intermittently. Assumes benefits after 2 consecutive wet years (approx. 1 in 15 years) | 95 | 10,000 AF |
| | | 96 | 10,000 AF |
| | | 97 | 10,000 AF |
| Watershed Wide Water Transfers | This category of projects will construct or arrange other water transfers external to the Chino Basin. For example, dry weather flow exchange of recycled water to Orange County Water District for an equivalent amount of purchased imported water. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability and/or quality. To occur annually or intermittent. Resiliency and flexibility benefit only | 98 | 5,000 AF |
| Chino Basin Water Transfers | This category of projects will construct or arrange other water transfers within the Chino Basin. Projects to also include inter-agency interties for increased reliability. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability. To occur annually or intermittent. | 99 | 5,000 AF |

National Theatre for Children, monthly water conservation tips, landscape audits, and turf-grass removal programs.

Water conservation strategies have changed dramatically over the past few years as a result of state and local policies that require increased conservation and improved efficiency, technological improvements that increase water savings potential, and advancements in methods of communication that provide new opportunities to engage and educate the public. To address the shift, regional efforts include securing funding for technology-based software and supporting the development of sustainable water rate structures. Both technology-based software and sustainable rate structures establish an efficiency standard for each individual customer based on their existing indoor and outdoor water use profile. These programs also have the added benefit of targeting outdoor water use, which accounts for approximately 60% of urban M&I demands.

**Baseline Supply**

Conservation baseline supplies are water savings from existing conservation programs' active and passive savings. Baseline conservation savings are embedded in the demands forecast, based on current annual savings (see Table 3-11). These programs are expected to continue through 2040.

**Climate**

Climate does not have an impact on water supply savings from conservation.

**Supply Challenges**

Supply challenges facing conservation programs include the need to address:

- Existing development will need incentives such as conservation rebates to meet state regulations.
- Existing development will also need targeted messaging based on state established efficiency standards to meet responsible water use and establish a new water use practices.



*"And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way."*

**—John Steinbeck**

East of Eden

- Current efficiency standards do not include recycled water use.

**Supply Opportunities**

The IRP process identified the following list of potential projects. Conservation savings beyond baseline are shown as new water supplies because they offset water demands. Conservation project savings are tied to the IRP's upper demand forecast; therefore if actual demands are lower, there will be a corresponding reduction in conservation savings.

**Implications**

This is a key climate resistant water supply that has the best potential to augment and extend current available supplies. Since outdoor irrigation makes up 60% of urban M&I demands, this supply category has the largest potential impact for the region. The region will need to evaluate how to achieve targeted efficiency goals.

Findings indicate that water conservation programs:

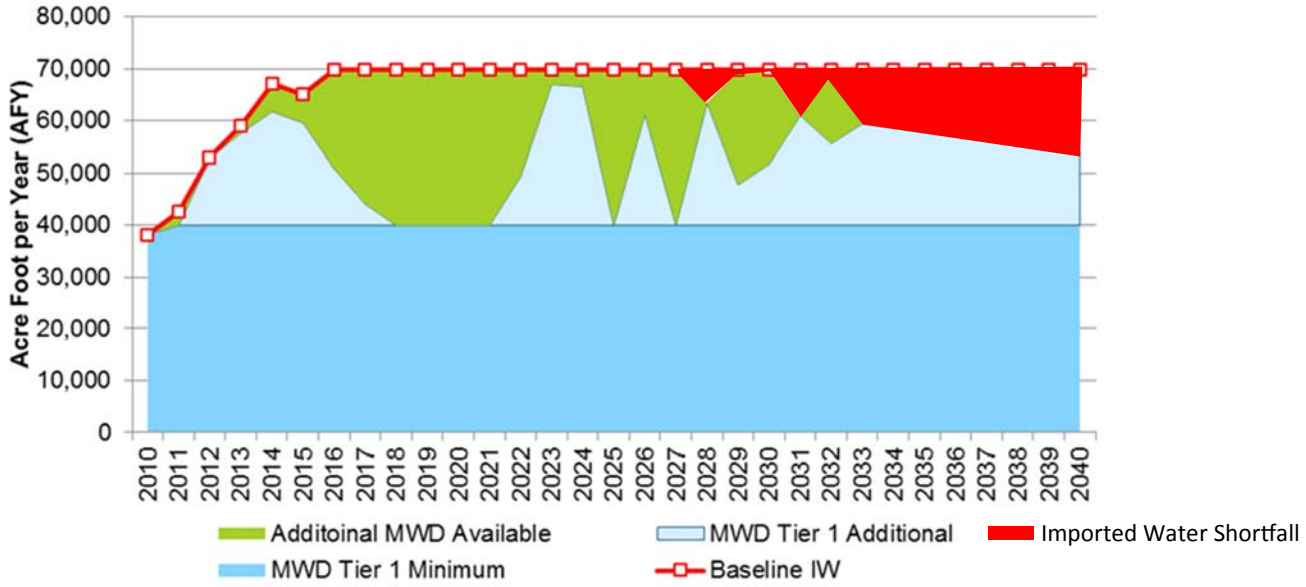
- Are cost effective relative to imported water supplies.
- Extend other water supplies and delays the need for additional system expansion because it is a demand offset.
- Are instrumental for the region to reduce dependence on climate variable supplies such as imported water.
- Are not impacted by climate change or water quality concerns.

## **Table 3-13:** Water Use Efficiency Baseline & Projects

| Water Use Efficiency Baseline | | |
|---|---|---|
| **Project Name** | **Description** | **AF** |
| Baseline Conservation | 1,000 AF per year from existing conservation programs' active and passive savings. | 1,000 AF |

| Water Use Effiency Projects | | | |
|---|---|---|---|
| **Project Name** | **Description** | **ID** | **AF** |
| Expand WUE Devices | Implement additional targeted device related savings to reduce demand beyond current annual water use efficiency (WUE) savings. Provide incentives and pilot programs to roll out extremely high efficient indoor fixtures and toilets. To be verified with Water Use Efficiency Business Plan (WUEBP). | 39 | 5,000 AF |
| WUE - Turf Removal-Increment 1, 2, 3 | Implement turf removal and landscape transformational programs to reduce outdoor demand. To be verified with WUEBP. Each increment would provide up to 5,000 AFY of savings. If all are selected, they can result in up to 15,000 AFY savings | 40<br>41<br>42 | 5,000 AF<br>5,000 AF<br>5,000 AF |
| WUE - Budget Rates-Increment 1, 2, 3 | Implement water budget based rates for 2 Agencies (assuming 15% total savings per Agency after 3 years). To be verified with WUEBP. Each increment would provide up to 13,350 AFY of savings. If all increments are selected, they can result in up to 40,050 AFY savings. | 43<br>44<br>45 | 13,350 AF<br>13,350 AF<br>13,350 AF |
| WUE- Recycled Water Demand Management-Increment 1, 2 | Implement demand management devices and programs for direct recycled water customers. Does not generate additional supply, aids in managing the supply during peak demand. Each increment would provide 2,500 AFY of demand management. If both are selected they could provide 5,000 AFY additional recycled water. This supply could be used for increasing direct use demands, groundwater recharge or other reuse strategy | 46<br>47 | 2,500 AF<br>2,500 AF |
| WUE - Advanced Metering Technologies | Install advanced metering infrastructure (AMI) between retail meters and a utility provider. Will provide real-time data about consumption and allow customers to make informed choices about usage. | 66 | 5,000 AF |

## **Table 3-12:** Sample model run of climate impacts on imported water supply availability





# 4. Supply Portfolio Themes



**Baseline Assessment**

**Single Variable Tests**

**Water Resource Strategies**

The desert globemallow, which requires very little water, grows in a low water use landscape.

# Supply Portfolio Themes

Section 4 presents the different water resource strategies developed through the IRP Technical Work Group. The purpose of each water resource strategy is to increase future water supplies, including water efficiency as a source of supply, to reduce the region's vulnerability to climate change and to ensure that future water needs for the region are met.

First, a baseline assessment was conducted to evaluate the ability of the baseline water supplies, established in Section 3, to meet projected baseline water demands. To do this, a water management mass balance model was developed by IEUA's technical consultants (see Appendix 2) to compare projections of water demand and supply under historical and future climate change conditions. Three demand scenarios were then evaluated across 106 different projections of future climate derived from two archives of downscaled global circulation models simulations. The results were reviewed to assess the extent to which baseline water supplies could NOT fulfill demands (described as supply shortfalls) under each future. This baseline assessment provided the foundation for the Work Group to identify the additional water resources needed to meet future demands.

Next, single variable tests were conducted to determine how well specific types of new water supplies could help the region meet projected demands under climate change. Single variable tests added individual supplies to the baseline to determine how well that single change performed under each of the 106 climate scenarios in the model.

Based on the outcomes of the single variable tests, the IRP Technical Work Group crafted 5 water resource strategies for further evaluation. Each strategy had an underlying theme, such as maximizing the use of recycled water or securing additional supplemental water supplies for groundwater replenishment. These five strategies were turned into project portfolios by selecting representative projects from proposed lists of future projects (see Section 3) that could be implemented to increase future water supplies above the baseline projections.

Finally, the performance of each water resource strategy was compared to the baseline assessment. The evaluation focused on two IRP criteria: (1) the ability of the scenario to generate sufficient water to meet future regional water demands under climate change conditions and (2) the amount of surplus water produced, defined as water not needed to meet demand, and placed into long term groundwater storage.

## BASELINE ASSESSMENT

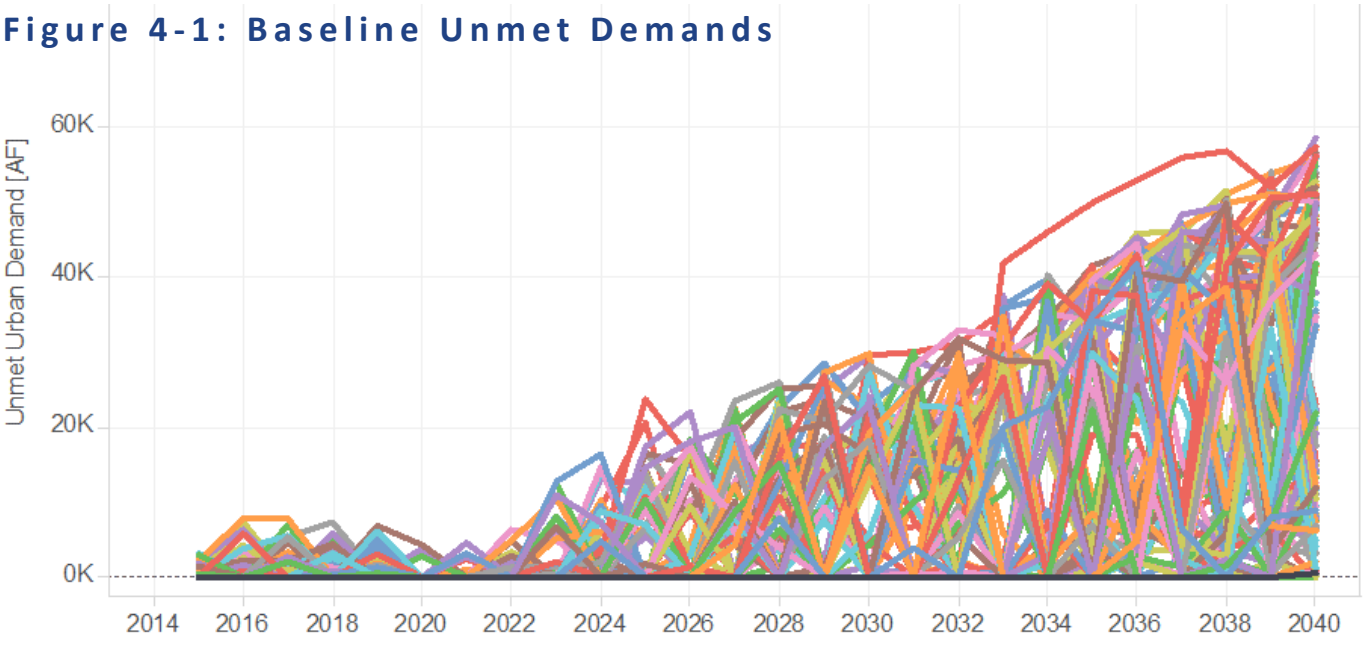
The regional baseline supplies and demand projections were developed in the first part of the IRP planning process and are summarized on p.X (see end of section 3). To establish how this baseline could be impacted by climate change, these projections were modeled and stress-tested under 106 separate climate scenarios, as referenced above and included in Appendix 2.

As a reminder, each of the 106 climate scenarios yields an independent model result and is depicted with a

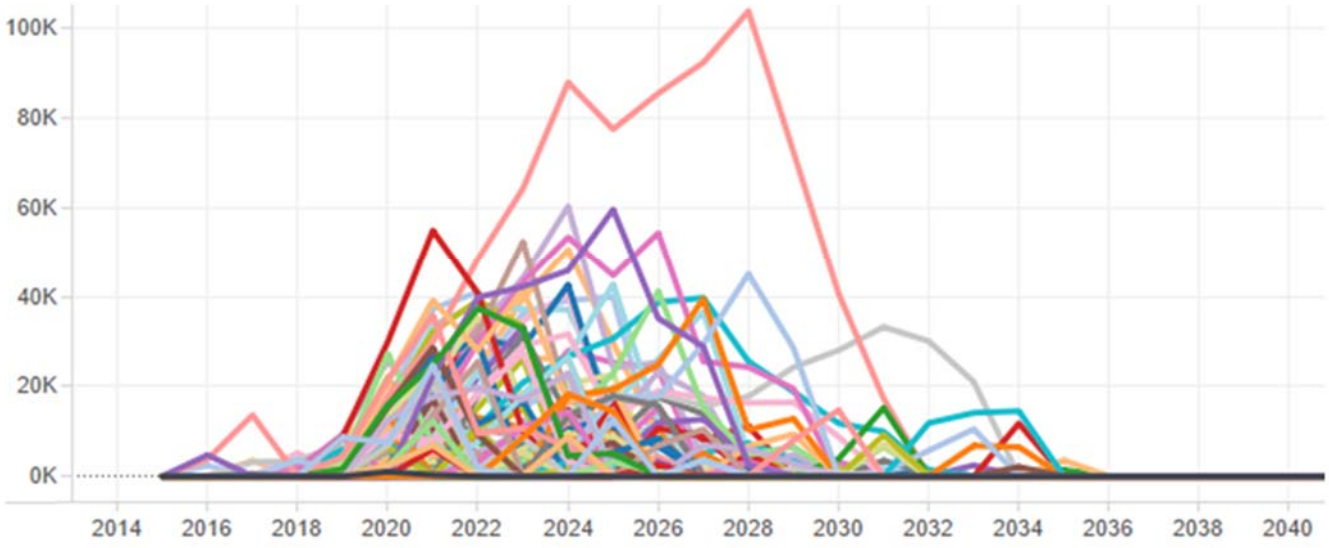
separate colored line in the figures below. Note that no one run is "more accurate" than another. However, some of the runs stand out as "outlying" results that are either higher or lower than the majority of the runs. These results are not included in the scenario evaluations. For the purposes of the IRP, the analysis was focused on the range of results for the majority (75%) of the climate scenarios.

Figure 4-1 shows the amount of unmet demand through 2040 under the baseline assessment with climate change. For the purposes of the IRP, unmet demands are defined as those times when demands exceed available water supplies. For the baseline conditions with climate change, the range of unmet demand is 0 AFY to 50,000 AFY . Note that the amount of unmet demand is smaller in the near term (about 20,000 AFY by 2030) and increases to 50,000 AFY by 2040. It is important to note that without additional water supply development the region would struggle to meet future

## Figure 4-1: Baseline Unmet Demands




## Figure 4-2: Baseline Stored Water Balance



water demands under climate change conditions.

In each climate run, there may be periods when water supplies exceed demands, creating surplus water supplies. The WEAP model tracks these surplus supplies by allocating the water to a groundwater storage account.

The IRP uses the 2014 groundwater storage level as the baseline for tracking the addition of surplus water to groundwater storage. Similarly, during periods when demands exceed supplies, the model deducts water from groundwater storage tracking account but cannot lower the groundwater below its 2014 level.

Figure 4-2 illustrates how stored water accumulates under each climate scenario through 2040. A positive or upward slope on the graphic indicates water surplus conditions and the excess water is added to the storage tracking account. A negative, or downward slope, indicates that demand is exceeding supplies, and water is pulled out of storage to meet, in whole or in part, the excess demands. As a result, the stored water creates a buffer supply that can be used offset future shortfalls. The model shows "unmet demands" only when demands exceed supplies AND no water remains in the storage tracking account created by the model.

For comparison, the thick black line in Figure 4-2 represents baseline assessment conditions without climate change. Note there is no accumulation of surplus supplies and therefore all available water supplies are needed to meet the regional demand, and no water is stored for future use.

Results of the baseline assessment with climate change indicate that the following is likely to be experienced by the region:

- 79% of the regional water demands are met by 2040.
- Water supply shortages, or unmet demand, will be more intense and frequent under climate change.
- Climate will drive unmet demand to 25,000 AFY by 2030 and up to 60,000 AFY by 2040.
- Significant water supply shortfalls could occur as soon as 2022.
- A "do nothing" approach is not sustainable, as projected demands exceed supplies under all scenarios.
- It may be possible to accumulate additional groundwater under baseline conditions, but the amount would depend on future climate scenarios (e.g., more rainfall, less variability, cooler temperatures) than currently predicted.

## SINGLE VARIABLE TESTS

To evaluate how the addition of a new water supply could enhance the region's current, or baseline water supplies under climate change, a series of four single variable tests were evaluated. These tests were used to determine the potential improvement of implementing an isolated or single water supply source to help improve baseline conditions impacted by climate change.

The four single variable tests are:

1. Maximizing the Use of Prior Stored Chino Basin Groundwater
2. Maximizing the Purchase of Metropolitan Water District (MWD) Imported Water
3. Maximizing Recycled Water Supply for Groundwater Recharge
4. Reducing Urban Water Demand by Increased Conservation and Water Use Efficiency

Conclusions from comparing the tests to the baseline assessment are summarized below.

**1 — Maximizing the use of prior stored Chino Basin groundwater.**
Test 1, Maximizing the Use of Prior Stored Chino Basin Groundwater, does not produce new water supplies because it relies only on prior (pre-2013) stored groundwater. It is assumed that up to 8,400 AFY of groundwater can be pumped above baseline levels, and that the total amount of additional groundwater pumping cannot exceed 280,000 AF.

Results of this test are illustrated in Figure 4-3. If the region only relies upon the addition of prior stored

Chino Basin groundwater to meet future water resource needs:

- 91% of regional demands are met by 2040.
- Water supply shortages, or unmet demands, will be moderately improved by 2040 over baseline conditions.
- Unmet demand would be reduced to 18,000 AFY by 2030 and 40,000 AFY by 2040.
- Significant water supply shortfalls could occur as early as 2024.
- The approach is not sustainable given that a significant amount of prior stored groundwater is needed to meet regional demands through 2040. The median of the climate scenarios shows a reduction in this storage from 280,000 AF to approximately 130,000 AF by 2040, with scenarios dropping as low as 80,000 AF.
- It may be possible to accumulate more stored water under this strategy, but the amount would depend on more benign future climate scenarios (e.g., more rainfall, less variability, cooler temperatures) than currently predicted.

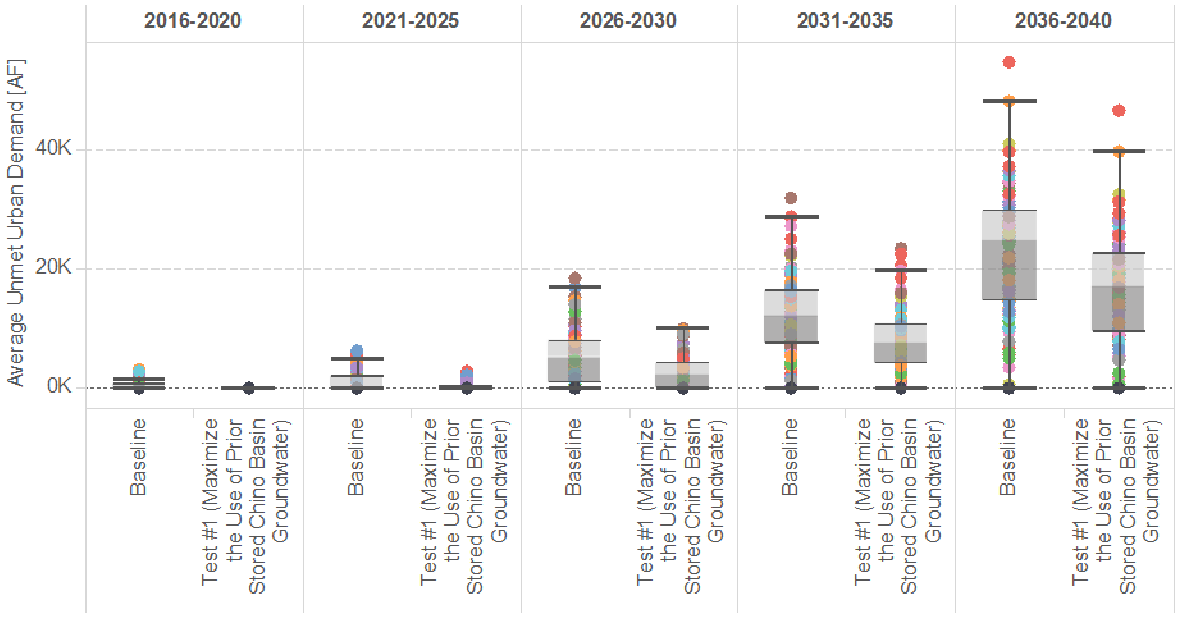
**2 – Maximizing the Purchase of Metropolitan Water District (MWD) Imported Water**

IEUA member agencies have the ability to purchase up to 70,000 AFY of imported water from the MWD. As discussed in Section 3, the baseline modeling assumption for imported water is that member Agencies could purchase up to 69,752 AFY (consistent with Resolution 2014-12-1), with a minimum total purchase of 40,000 AFY.

Due to the cost of imported water, Agencies typically only purchase the amount of water needed to meet their operational requirements or fulfill water demands that cannot be met through local supplies. This means there may be times when Agencies don't need the imported water but could decide to purchase this water and place it into storage for future use.

The approach of Maximizing the Purchase of MWD imported water does not add new imported water supplies to the baseline supply. However, the region's Agencies will purchase all of the water available, up to 70,000 AFY. This purchase would occur even if water supplies exceed demand. In years where Agencies make these purchases, the additional water would be put into

**Figure 4-3:** Baseline vs Test 1 Unmet Demand Comparison



storage via groundwater recharge or in-lieu of groundwater pumping. The quantity of supply would be dependent on imported water availability.

Results of this test are illustrated in Figure 4-4. If the region relies only upon maximizing imported water purchases to meet future needs:

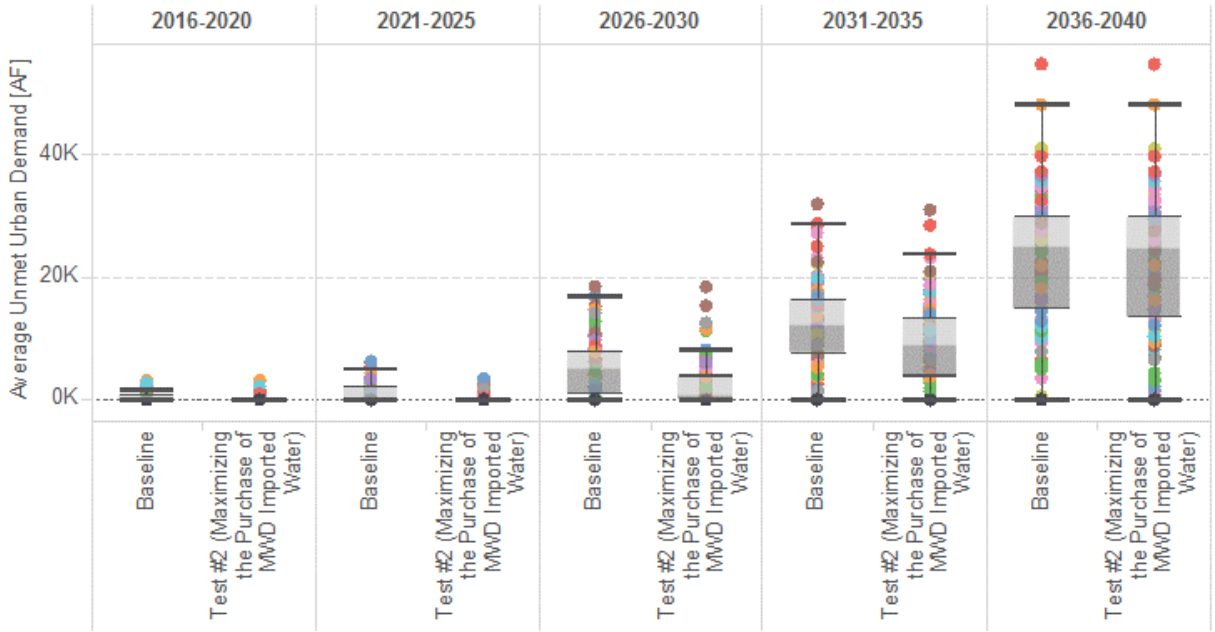
- 85% of regional demands are met by 2040.
- Water supply shortages, or unmet demands, will be slightly improved by 2040 over baseline conditions because imported water availability is adversely impacted by climate change.
- Unmet demand would be reduced to 22,000 AFY by 2030 and 55,000 AFY by 2040.
- Significant water supply shortfalls could occur as soon as 2024.
- This approach is not sustainable as a stand-alone approach and must be combined with other water resources to improve water supply conditions for the region.
- It may be possible to accumulate more stored water under this strategy, but the amount would depend on more benign future climate scenarios (e.g. more rainfall, less variability, cooler temperatures) than currently predicted.
- This could increase the region's dependence on imported water supplies, which could make the region more vulnerable to climate change.

**3 – Maximizing Recycled Water Supply for Groundwater Recharge**

The region has developed a successful regional Recycled Water Program for both direct use (landscaping, agricultural irrigation and industrial processing uses) and groundwater recharge. In 2000, the region identified recycled water as a critical resource needed for drought-proofing the region and maintaining its economic growth.

The approach of Maximizing Recycled Water Supply for Groundwater Recharge builds on the successful regional Recycled Water Program. As discussed in Section 3, the baseline assumption for available recycled water is 47,700 AFY by 2025. As the region continues to grow, new communities will be sewered and additional recycled water supplies will be generated. It is estimated that there will be approximately 85,500 AFY of recycled water supply from regional development by 2040.

**Figure 4-4:** Baseline vs Test 2 Unmet Demand Comparison



Therefore, this will deliver 37,800 AFY of additional recycled water to the groundwater recharge program.

Results of this test are illustrated in Figure 4-5. If the region relies only upon maximizing recycled water supply for groundwater recharge for future water needs:

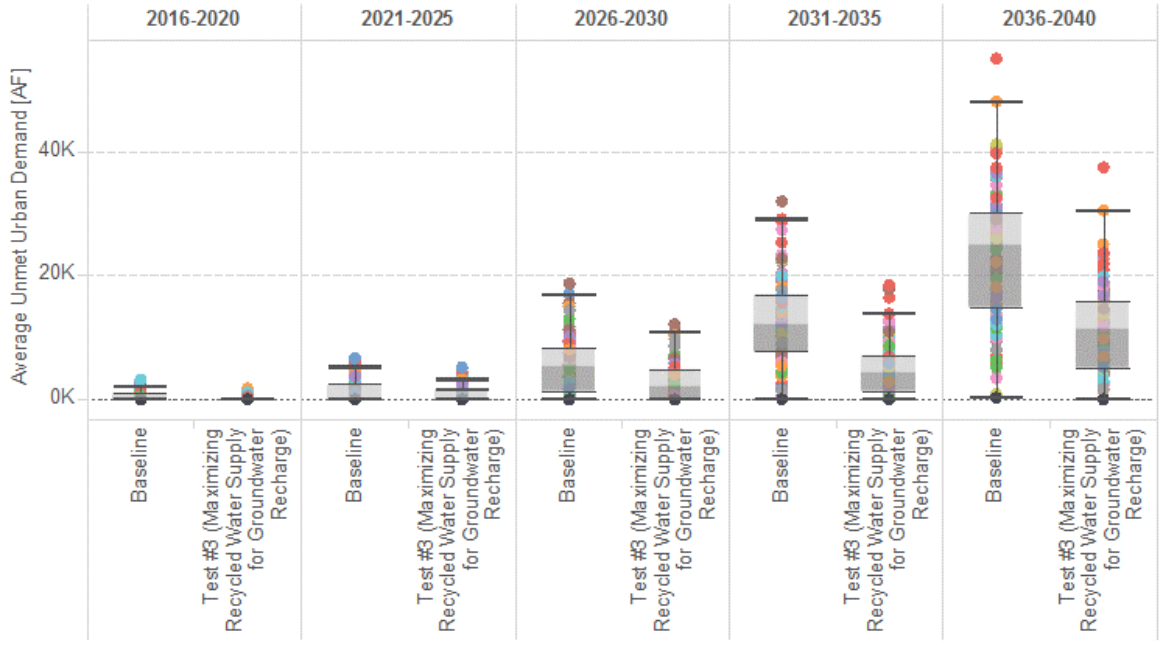
- 95% of the regional demands are met by 2040.
- Water supply shortages, or unmet demand, will be greatly improved by 2040 over baseline conditions.
- Unmet demand would be reduced to 10,000 AFY by 2030 and 17,000 AFY by 2040.
- Although water supply shortfalls are reduced, they could occur as early as 2024.
- Maximizing recycled water for groundwater recharge is sustainable as a stand-alone strategy, but would provide greater benefits if combined with other programs to enhance water supply conditions for the region.
- Provides flexibility by maximizing the amount of water stored in the Chino groundwater basin for future use.
- Recycled water is the most climate resilient water supply available to the region.
- It may is possible to accumulate more stored water under this strategy, but the amount depends on more benign future climate scenarios (e.g. more rainfall, less variability, cooler temperatures) than currently predicted.
- The volume of future recycled water supply is impacted by the amount and timing of new development in the region and indoor water efficiency trends. Additional tracking of wastewater flows is needed to accurately anticipate the amount of recycled water that will be available by 2040.

**4 – Reducing Urban Water Demand by Increased Outdoor Water Use Efficiency and Conservation**

Approximately 60% of the region's urban water use is for outdoor irrigation, particularly lawns. The IRP Technical Work Group requested a scenario to evaluate the implications of an increased outdoor efficiency and conservation program.

The approach of Reducing Urban Demand by Increasing Water Use Efficiency assumes that the region achieves a level of water savings that will reduce residential outdoor water usage to levels consistent with the requirements of the Department of Water Resources State Model Water Efficiency Landscape Ordinance (AB

**Figure 4-5:** Baseline vs Test 3 Unmet Demand Comparison



1881). This could be achieved by programs such as budget-based rates and continuation of active conservation programs. The region currently has one water agency on budget based rates.

This test assumed that four retail agencies would implement budget based rates structures by 2020. The savings are estimated to be 27,000 AFY from the rate structure changes and 11,000 AFY from active potable and recycled water conservation programs. Combined these measures are assumed to reduce urban demands by approximately 17% from 2013-14.

Results of this test are illustrated in Figure 4-6. If the region relies upon only reducing urban water demand by Increased Outdoor Water Use Efficiency and Conservation to meet future water needs:

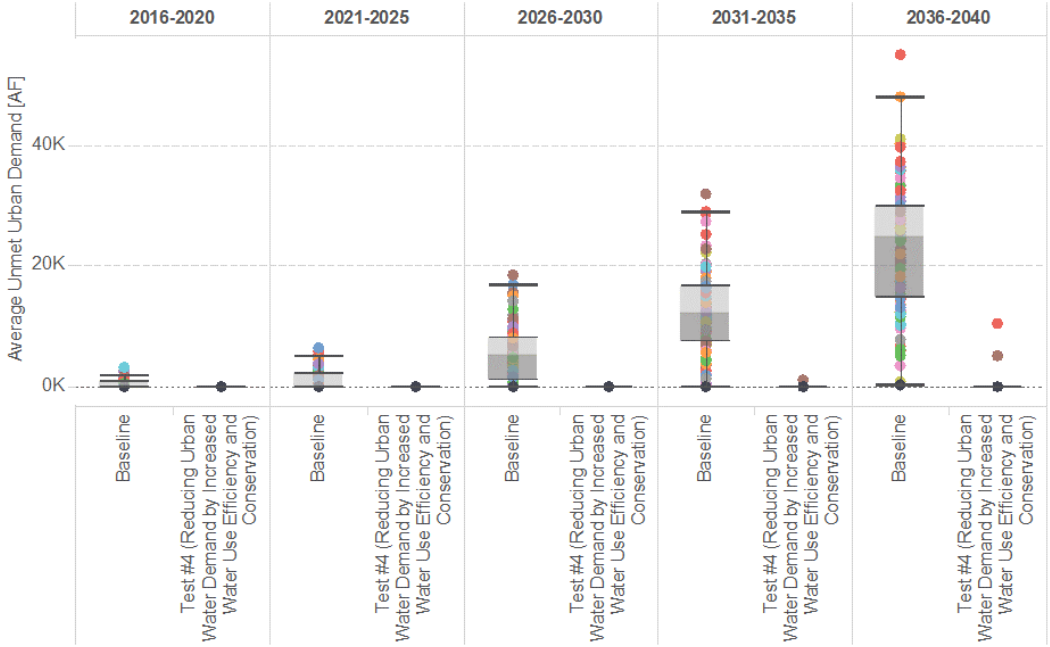
- 100% of the regional demands are met by 2040.
- Water supply shortages, or unmet demand, would be eliminated by 2040.
- Water supply shortfalls are delayed beyond 2040.
- Accumulation of stored water is very likely to occur, with more than 50% of the climate scenarios producing over 200,000 AF of stored water by 2040.
- Regional recycled water supplies would not be impacted because this approach targets outdoor conservation.
- Reduces dependence on climate dependent supplies and reduces the volume of additional water supplies needed to meet future demand.
- Requires expansion of water efficiency programs to support transition to budget based rate structure to achieve outdoor efficiency standards.

**Single Variable Test Conclusions**

Results from the four single variable tests show that all of the strategies helped to reduce and delay water supply shortages when compared to baseline conditions under climate change. Notably, water efficiency/ conservation is the only water supply approach that could eliminate water supply shortages through 2040 as a "stand-alone" approach. However, the expansion of local supplies such as recycled water and storm water ensures that the region is insulated from unforeseen or cataclysmic conditions.

The recommended approach in the IRP is to diversify the region's water supplies. The following conclusions were used as the basis for developing the next step in the IRP,

**Figure 4-6:** Baseline vs Test 4 Unmet Demand Comparison



the creation of water strategies:

- Water use efficiency and conservation provides the region with the greatest level of water supply reliability and resiliency.
- Diversification of region's water supplies minimizes the potential for water shortages under climate change and from catastrophic events.
- Increasing water supplies for Chino groundwater recharge increases storage and provides a supply buffer, enhancing the region's water supply flexibility and resilience.
- Implementing outdoor water use efficiency and conservation minimizes climate change impacts on urban water demand.

## WATER RESOURCE STRATEGIES

Each water resource strategy is a combination of water supply and conservation projects or opportunities that the region could pursue to achieve the goals of the IRP. Five water resource strategies were developed during the course of the IRP workshops, with a total of eight project portfolios. Each portfolio was modeled to determine performance and resiliency across the 106 climate scenarios. These strategies and portfolios are as follows:

**Strategy A** – Increase Chino Basin Groundwater Production

- ***Portfolio 1****:* Maximize the Use of Prior Stored Groundwater

**Strategy B–** Recycled Water Program Expansion

- ***Portfolio 2****:* Maximize Recycled Water (Including External Supplies) and Local Supply Projects and Implement Minimal Water Efficiency
- ***Portfolio 3****:* Portfolio 2A Plus Secure Supplemental Imported Water from MWD and Non-MWD Sources

**Strategy C**– Recycled Water & Water Efficiency Program Expansions

- ***Portfolio 4****:* Maximize Recycled Water (Including External Supplies) and Implement Moderate Water Efficiency
- ***Portfolio 5****:* Portfolio 4 Plus Implement High Water Efficiency

**Strategy D**– Increase Groundwater Recharge Supplies

- ***Portfolio 6*****:** Maximize Supplemental Water Supplies and Recycled Water Supplies

**Strategy E** – Maximize Imported Water Supplies with Moderate Water Efficiency

- ***Portfolio 7***: Maximize the Purchase of Imported Water from MWD and Implement Minimal-Moderate Level of Water Efficiency
- ***Portfolio 8***: Portfolio 7 Plus Maximize Recycled Water

## Table 4-1: Supply Totals for Portfolio 1

| Supply Type | Baseline | Portfolio 1 |
|---|---|---|
| **Chino Groundwater** | 91,300 | 8,400 |
| **Stormwater** | 6,400 | - |
| **Recycled Water** | | - |
| Locally Developed[(1)] | 64,700 | - |
| External Supplies | | - |
| **Chino Desalter** | 17,700 | - |
| **Local Surface** | 22,100 | - |
| **Non-Chino Groundwater** | 11,600 | - |
| **Imported Water** | | - |
| MWD | 69,750 | - |
| Other | | - |
| **WUE [(2)]** | 1,000 | - |
| *add'l supplies subtotal* | | *8,400* |
| **Total Water Supply** | **283,550** | **291,950** |

Notes:

(1) Baseline Supply of 18,700 GWR + 29,000 Direct + 17,000 SAR, or total of 64,700 AFY, based on Agency TYCIP and not total available wastewater supply. Estimated total available local RW supply by 2040 to be 85,550 AFY based on 2015 WWFMPU flow monitoring.

(2) Baseline WUE of 1,000 AFY already included in the Urdan Demand forecast. Therefore, not included in Supply Table to avoid double counting. Only new WUE in addition to Baseline to be counted in Total Supply.

**Strategy A – Increase Chino Basin Groundwater Production (Portfolio 1)**

Under Strategy A, the IRP Technical Work Group explored the implications of expanding groundwater production without bringing in additional water resources. Strategy A is similar to Single Variable Test 1 – Maximizing the Use of Prior Stored Chino Basin Groundwater. It includes capacity building projects, the use groundwater that was previously stored in the Chino Basin, and the implementation of water efficiency programs for direct recycled water customers. Although strategy this does not generate additional recycled water supply, it allows for additional recycled water to be used for groundwater recharge. One water supply portfolio, Portfolio 1, was developed for Strategy A, with additional supply amounts shown in Table 4-1.

Portfolio 1 assumes that an additional 8,400 AFY of groundwater supply would be pumped from the Chino Basin, with a 2040 "not to exceed" limit of 280,000 AF. Since new supplies in Portfolio 1 are limited to 8,400 AFY from stored Chino Basin groundwater the results are identical to the first test strategy. Implicit in this scenario, when there are periods where the portfolio's water supplies exceed demands, the resulting surplus water supplies is assumed to be recharged into the groundwater basin. When this occurs, the stored water can be used at a later time.

Figure 4-7 shows unmet demands for Portfolio 1 in comparison to the baseline model run. Potential shortfalls begin to appear around 2022, which is the same as the baseline. In the majority (75%) of model runs, Portfolio 1 reduces unmet demands by 2040 from up to 27,900 AF to 12,500 AF.

Stored water balances are shown in Figure 4-8. As illustrated, groundwater balances begin to accumulate in Portfolio 1 by 2020 with storage peaking around 2025. Stored groundwater starts to be used to meet demands by 2028 and continue to be drawn down through 2040.

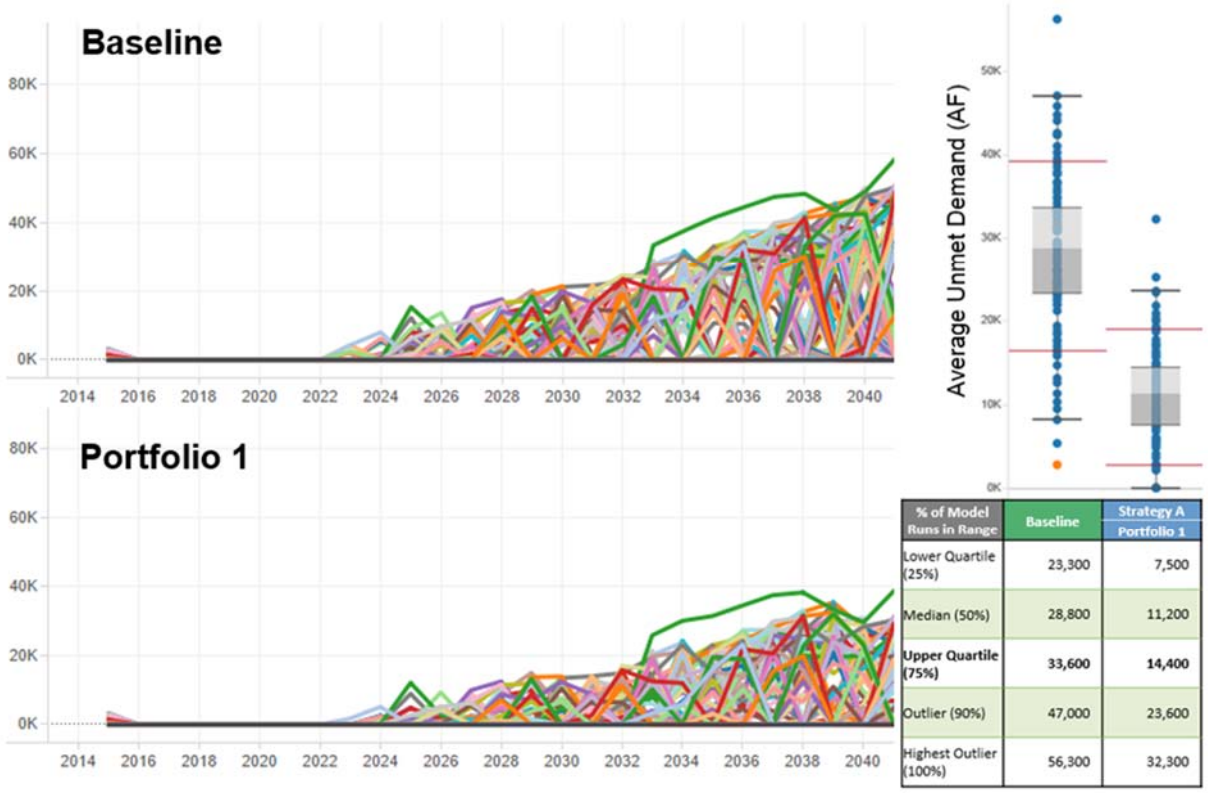
In summary, Portfolio 1

- Provides 95% of the demands under majority of climate scenarios
- Shows a 5% improvement over baseline conditions by utilizing existing stored groundwater on an annual basis
- However, the groundwater pulled from storage is a finite resource and due to the continued drawdown, this strategy is not sustainable without additional projects to replenish the storage or reduce demands.

**Strategy B– Recycled Water Program Expansion (Portfolios 2 & 3)**

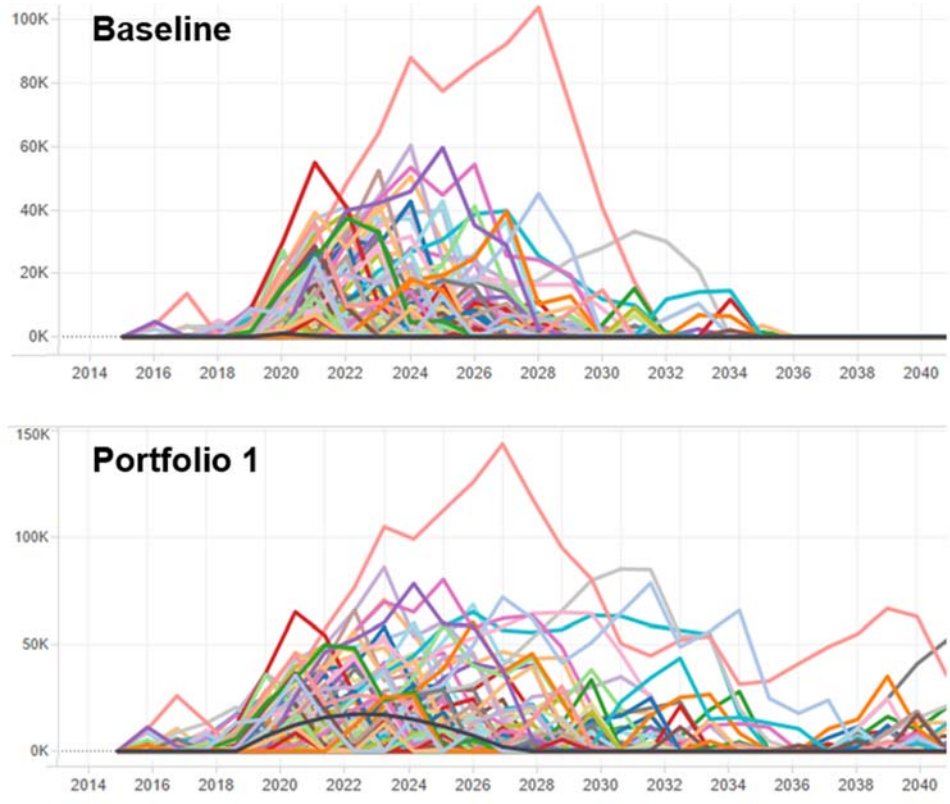
Under Strategy B, the IRP Technical Work Group explores the continued expansion of the recycled water program. Strategy B focuses on how achieving a 40% increase in recycled water supply over the baseline condition would benefit the region. The strategy accomplishes this goal by using an additional 17,000 AF of locally generated recycled water. As mentioned in Section 3, these additional recycled water supplies will be available as growth occurs in the service area. In addition, this strategy secures 10,500 AF of external recycle water supply from neighboring jurisdictions by

**Figure 4-7:** Unmet Demands of Portfolio 1 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy A Portfolio 1 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | 7,500 |
| Median (50%) | 28,800 | 11,200 |
| **Upper Quartile (75%)** | **33,600** | **14,400** |
| Outlier (90%) | 47,000 | 23,600 |
| Highest Outlier (100%) | 56,300 | 32,300 |

**Figure 4-8:** Stored Groundwater Balance of Portfolio 1



## Table 4-2: Supply Totals for Portfolio 2 & 3

| Supply Type | Baseline | Portfolio 2 | Portfolio 3 |
|---|---|---|---|
| **Chino Groundwater** | 91,300 | - | - |
| **Stormwater** | 6,400 | - | - |
| **Recycled Water** | | - | - |
| Locally Developed[(1)] | 64,700 | 17,000 | 17,000 |
| External Supplies | | 10,500 | 10,500 |
| **Chino Desalter** | 17,700 | - | - |
| **Local Surface** | 22,100 | - | - |
| **Non-Chino Groundwater** | 11,600 | - | - |
| **Imported Water** | | - | - |
| MWD | 69,750 | - | 7,850 |
| Other | | - | 4,900 |
| **WUE** [(2)] | 1,000 | 5,000 | 5,000 |
| *add'l supplies subtotal* | | *32,500* | *45,250* |
| **Total Water Supply** | **283,550** | **316,050** | **328,800** |

Notes:

(1) Baseline Supply of 18,700 GWR + 29,000 Direct + 17,000 SAR, or total of 64,700 AFY, based on Agency TYCIP and not total available wastewater supply. Estimated total available local RW supply by 2040 to be 85,550 AFY based on 2015 WWFMPU flow monitoring.

(2) Baseline WUE of 1,000 AFY already included in the Urdan Demand forecast. Therefore, not included in Supply Table to avoid double counting. Only new WUE in addition to Baseline to be counted in Total Supply.

2040. Strategy B also includes 5,000 AF of additional device based conservation savings.

Two water supply portfolios were developed for Strategy B. The first, Portfolio 2, models the additional water supplies as described above. The second, Portfolio 3 includes all of Portfolio 2 supplies plus additional imported water as shown in Table 4-2. Imported water supplies include MWD Tier 1 and/or wet year purchases of supplemental water for groundwater replenishment. A complete list of projects in Portfolios 2 and 3 can be found in Appendix 6.

Figure 4-10 shows unmet demands for Portfolio 2 in comparison to the baseline model run. Potential shortfalls for 2 begin to appear around 2024, which is two years later than baseline conditions. In the majority of model runs, Portfolio 2 reduces unmet demands by 2040 from up to 27,900 AF to 9,000 AF.

Stored water balances for Portfolio 2 are illustrated in Figure 4-10. Groundwater balances begin to accumulate by 2018 with the majority of the model runs building around 25,000 AF or less of stored water. By 2040 the quantity of stored water is depleted in approximately 90% of the climate runs.

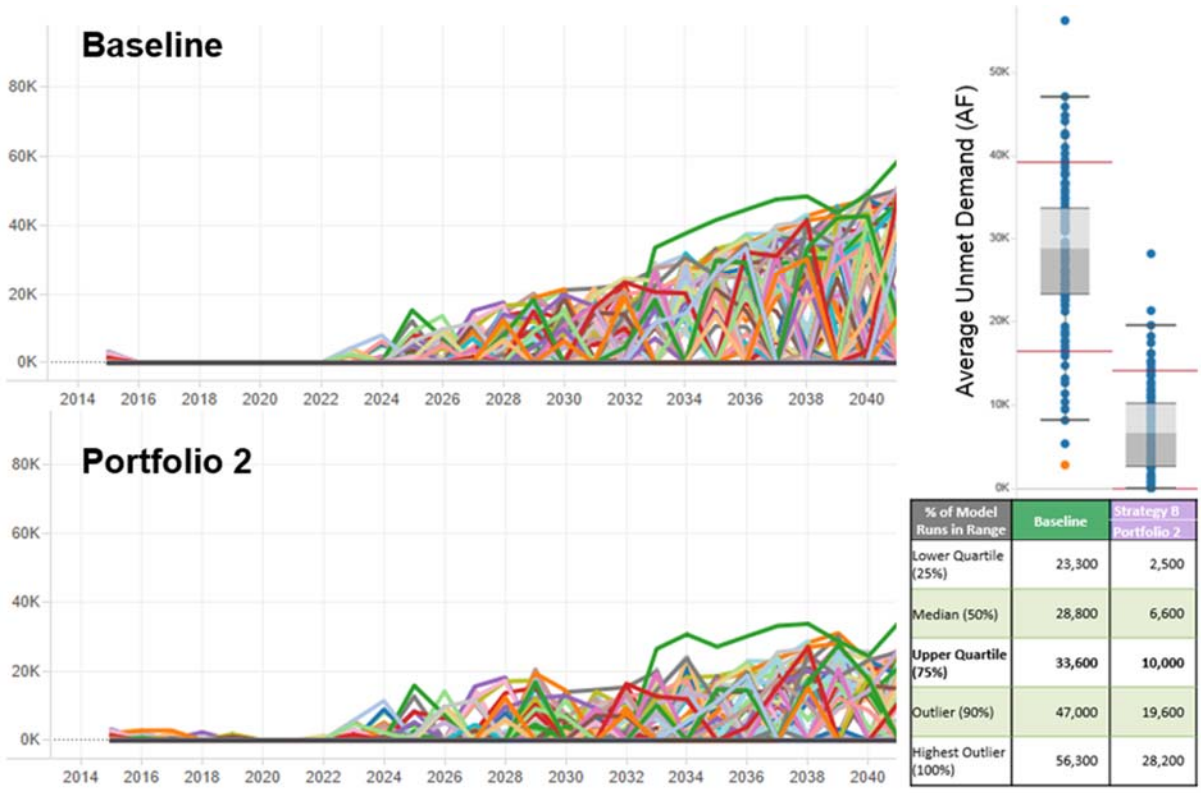
Unmet demands for Portfolio 3 in comparison to the baseline model run are shown in Figure 4-11. Potential shortfalls for Portfolio 3 begin to appear after 2035, 13 years after the baseline condition. In the majority of model runs, Portfolio 3 reduces unmet demands in 2040 from 27,900 AF to 9,000 AF.

Stored water balances for Portfolio 3 are illustrated in Figure 4-12. Portfolio 3 behaves in a similar fashion to Portfolio 2, however there is a much greater probability of accumulating stored water. Approximately 70% of the runs in Portfolio 3 have water in storage by 2040. The range of stored water falls between 0 AF and 280,000 AF.

In summary, Portfolios 2 and 3 under 75% of the climate scenarios:

- Provide 90% supply reliability under majority of climate conditions.
- Show a 5% improvement over baseline conditions by utilizing existing stored groundwater on an annual basis
- Water supply shortfalls are delayed by two years as compared to baseline conditions.
- Extend the ability to produce water stored water, with the majority of climate runs having the ability to build and maintain stored supplies through 2040

**Figure 4-9:** Unmet Demands of Portfolio 2 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy B Portfolio 2 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | 2,500 |
| Median (50%) | 28,800 | 6,600 |
| **Upper Quartile (75%)** | **33,600** | **10,000** |
| Outlier (90%) | 47,000 | 19,600 |
| Highest Outlier (100%) | 56,300 | 28,200 |

**Figure 4-10:** Stored Groundwater Balance of Portfolio 2

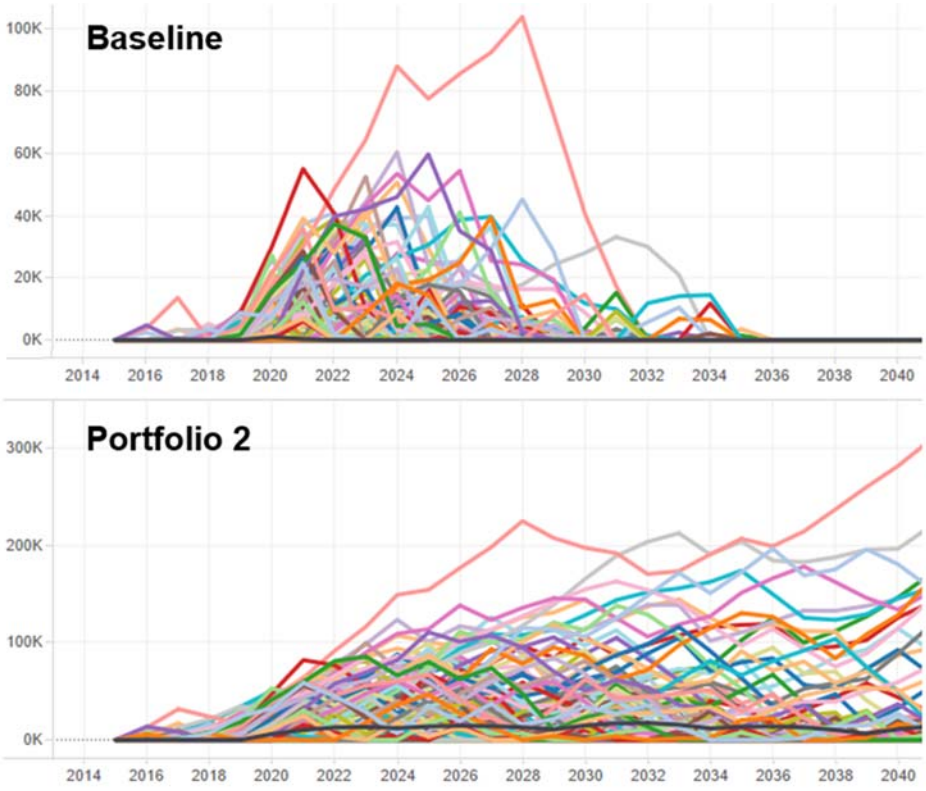
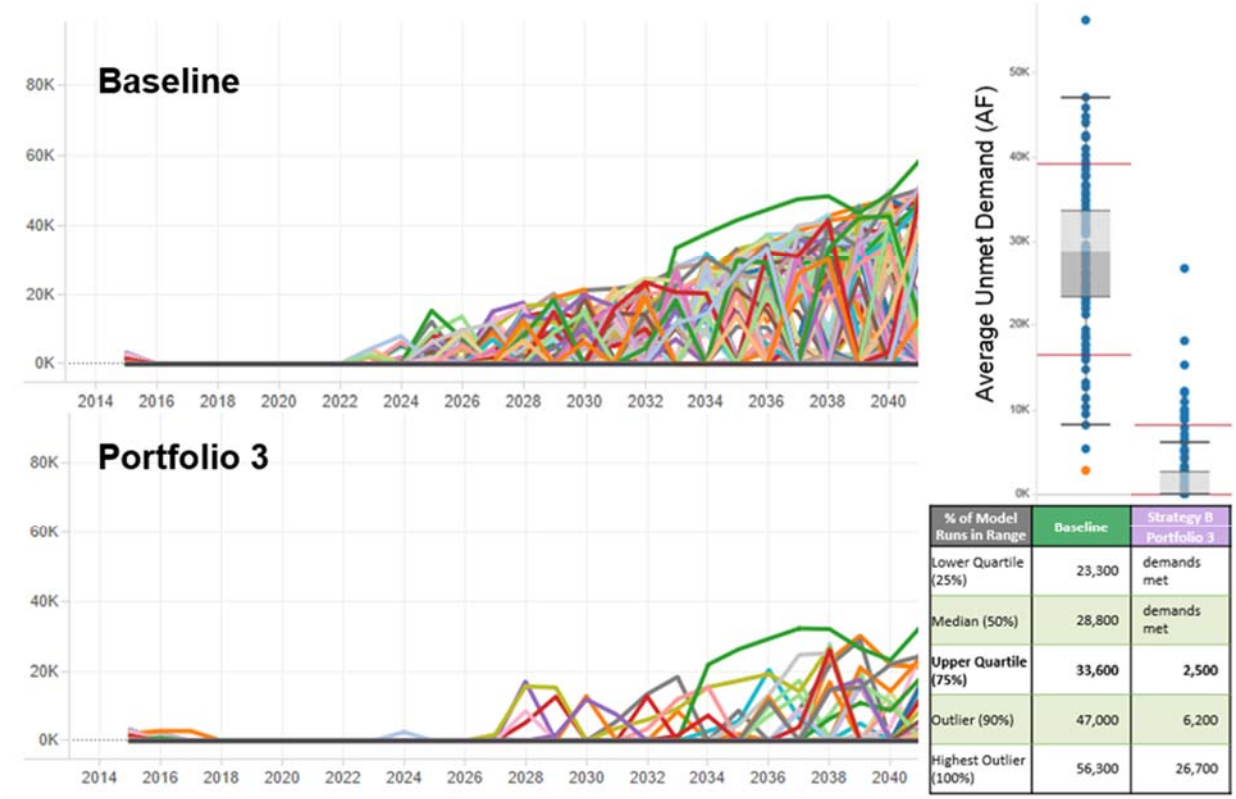
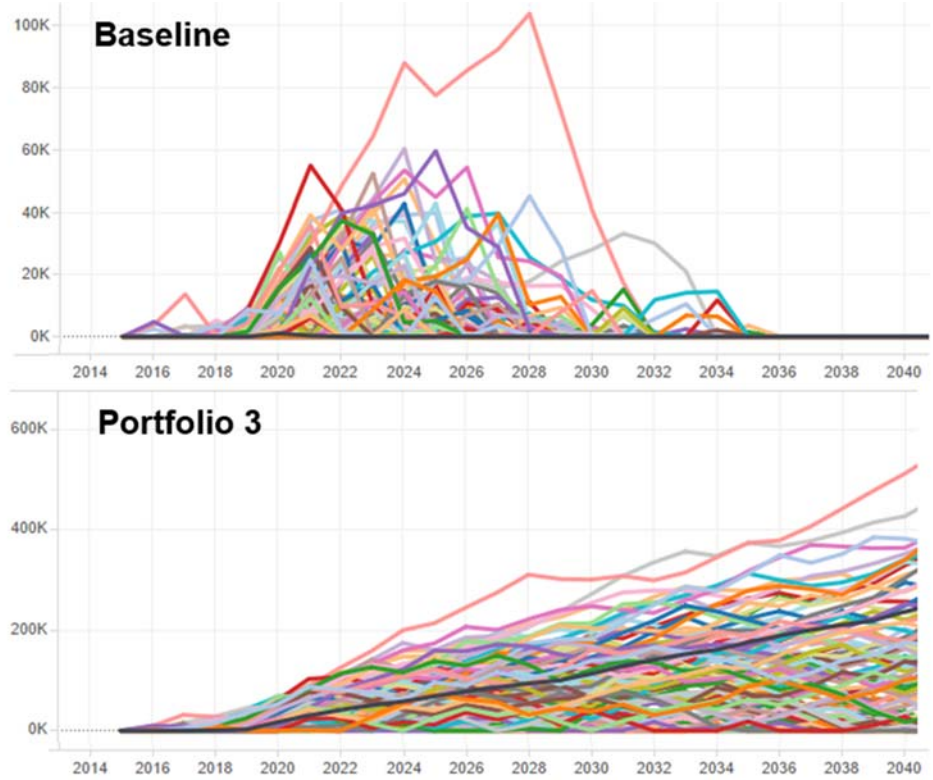


**Figure 4-11:** Unmet Demands of Portfolio 3 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy B Portfolio 3 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | demands met |
| **Upper Quartile (75%)** | **33,600** | **2,500** |
| Outlier (90%) | 47,000 | 6,200 |
| Highest Outlier (100%) | 56,300 | 26,700 |

**Figure 4-12:** Stored Groundwater Balance of Portfolio 3



**Strategy C – Recycled Water & Water Efficiency/ Conservation Program Expansions (Portfolios 4 & 5)**

Under Strategy C, the IRP Technical Work Group evaluated how increased recycled water and water efficiency/conservation programming could benefit the region. With the focus on outdoor irrigation efficiency, there is a signification amount of water savings that could be achieved in both existing and future developments when compared with baseline conditions.

Strategy C assumes that a minimum of four agencies within IEUA's service area are implementing budget-based rates and increasing device-based conservation programming by 2020. This strategy also increases recycled water supply by utilizing an additional 17,000 AF of locally generated recycled water, securing 10,500 AF of an external recycle water supply by 2040, and implementing recycled water use efficiency programs to extend supplies.

Two water supply portfolios were developed for Strategy C. The first, Portfolio 4, models the additional water supplies as described above. The second, Portfolio 5, includes all of Portfolio 4 supplies plus the addition of two additional agencies adopting budget-based rates by 2020 and the addition of supplemental imported water as shown in Table 4-3. Imported water supplies include MWD Tier 1 and/or wet year purchases of supplemental water for groundwater replenishment. A complete list of projects in Portfolios 4 and 5 can be found in Appendix 6.

Unmet demands for Portfolio 4 are shown in comparison to the baseline conditions in Figure 4-13. Portfolio 4 meets projected demands through 2040 100% of the time.

Stored water balances are illustrated in Figure 4-14 As illustrated, groundwater balances begin to accumulate in Portfolio 4 by 2022 with the majority of model runs continuing to build stored water through 2040. By 2040, 105 of the 106 model runs accumulated a minimum of 200,000 AF of stored water.

Unmet demands for Portfolio 5 are shown in comparison to the baseline model run in Figure 4-15. Portfolio 5 meets projected demands through 2040 100% of the time.

## Table 4-3: Supply Totals for Portfolio 4 & 5

| Supply Type | Baseline | Portfolio 4 | Portfolio 5 |
|---|---|---|---|
| **Chino Groundwater** | 91,300 | - | - |
| **Stormwater** | 6,400 | - | - |
| **Recycled Water** | | - | - |
| Locally Developed[(1)] | 64,700 | 17,000 | 17,000 |
| External Supplies | | 10,500 | 10,500 |
| **Chino Desalter** | 17,700 | - | - |
| **Local Surface** | 22,100 | - | - |
| **Non-Chino Groundwater** | 11,600 | - | - |
| **Imported Water** | | - | - |
| MWD | 69,750 | 667 | 667 |
| Other | | - | 4,900 |
| **WUE** [(2)] | 1,000 | 36,700 | 55,050 |
| *add'l supplies subtotal* | | *64,867* | *88,117* |
| **Total Water Supply** | **283,550** | **348,417** | **371,667** |

Notes:

(1) Baseline Supply of 18,700 GWR + 29,000 Direct + 17,000 SAR, or total of 64,700 AFY, based on Agency TYCIP and not total available wastewater supply. Estimated total available local RW supply by 2040 to be 85,550 AFY based on 2015 WWFMPU flow monitoring.

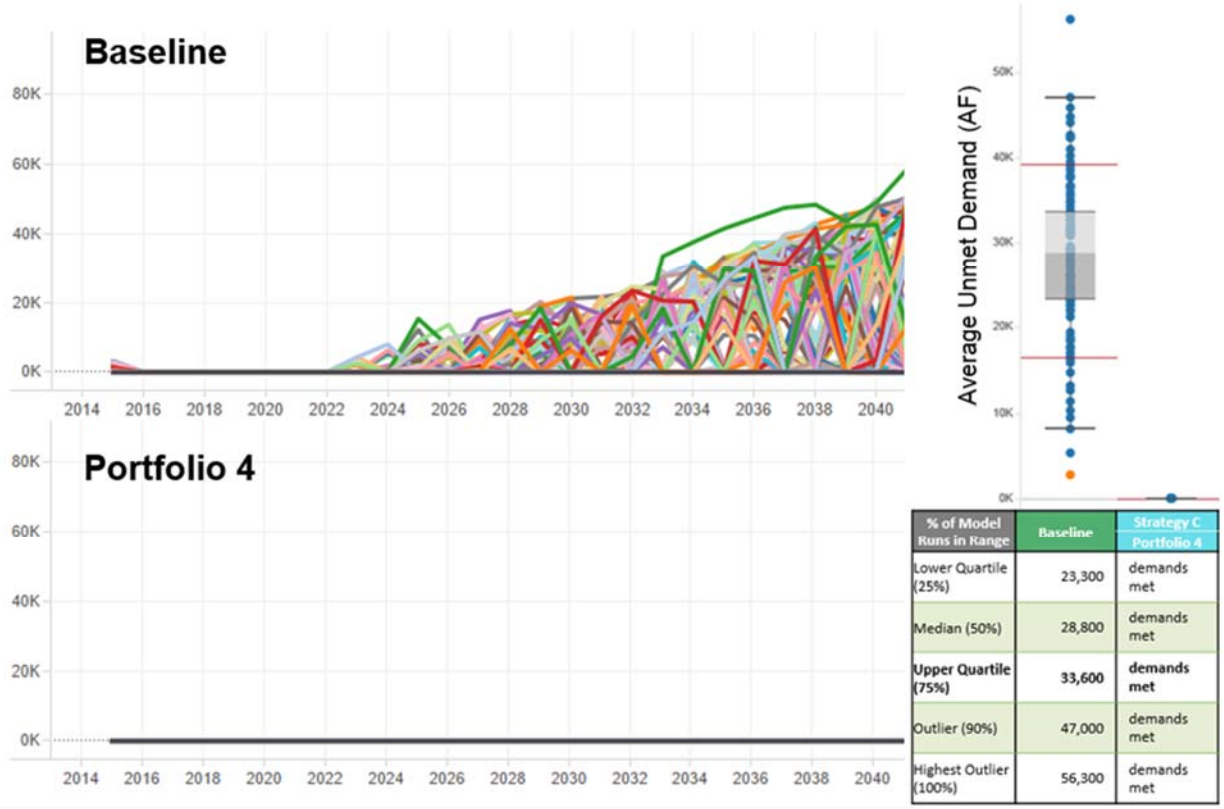
(2) Baseline WUE of 1,000 AFY already included in the Urdan Demand forecast. Therefore, not included in Supply Table to avoid double counting. Only new WUE in addition to Baseline to be counted in Total Supply.

Stored water balances for Portfolio 5 are illustrated in Figure 4-16. As illustrated, groundwater balances begin to accumulate in Portfolio 3B by 2020 with majority of model runs continuing to build stored water through 2040. By 2040, 105 of the 106 model runs accumulated a minimum of 500,000 AF of stored water.

In summary, Portfolios 4 and 5 perform under 75% of the climate scenarios:

- Have no unmet demands across all climate scenarios due to reduced need for water
- Build water in storage consistently across climate scenarios, which could create an opportunity to sell surplus water
- Portfolio 4 has the potential for stored groundwater to build to over 200,000 AF by 2040
- Portfolio 5 has the potential for stored groundwater to build to over 500,000 AF by 2040

**Figure 4-13:** Unmet Demands of Portfolio 4 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy C Portfolio 4 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | demands met |
| **Upper Quartile (75%)** | **33,600** | **demands met** |
| Outlier (90%) | 47,000 | demands met |
| Highest Outlier (100%) | 56,300 | demands met |

**Figure 4-14:** Stored Groundwater Balance of Portfolio 4

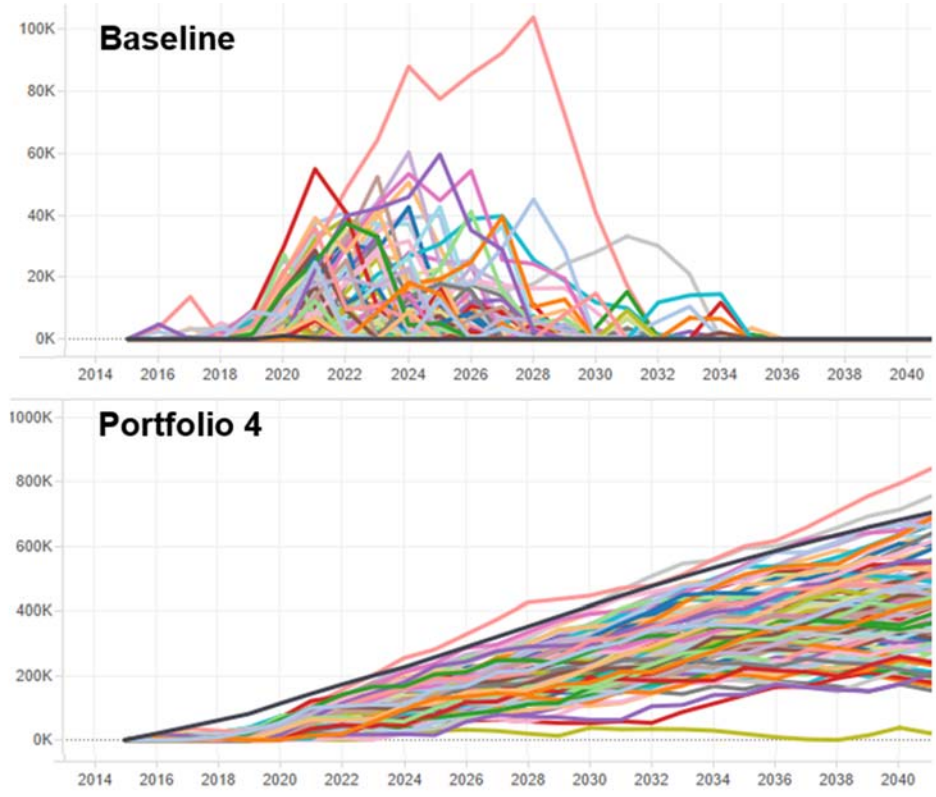
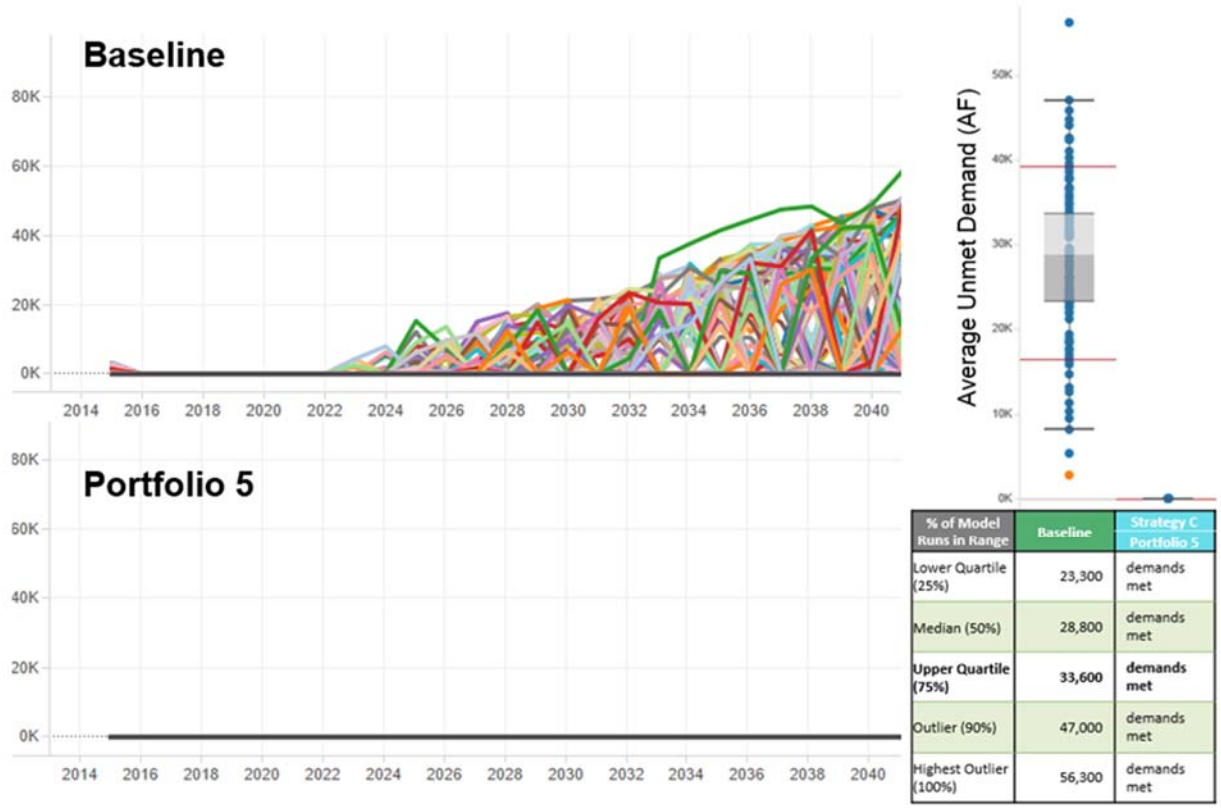
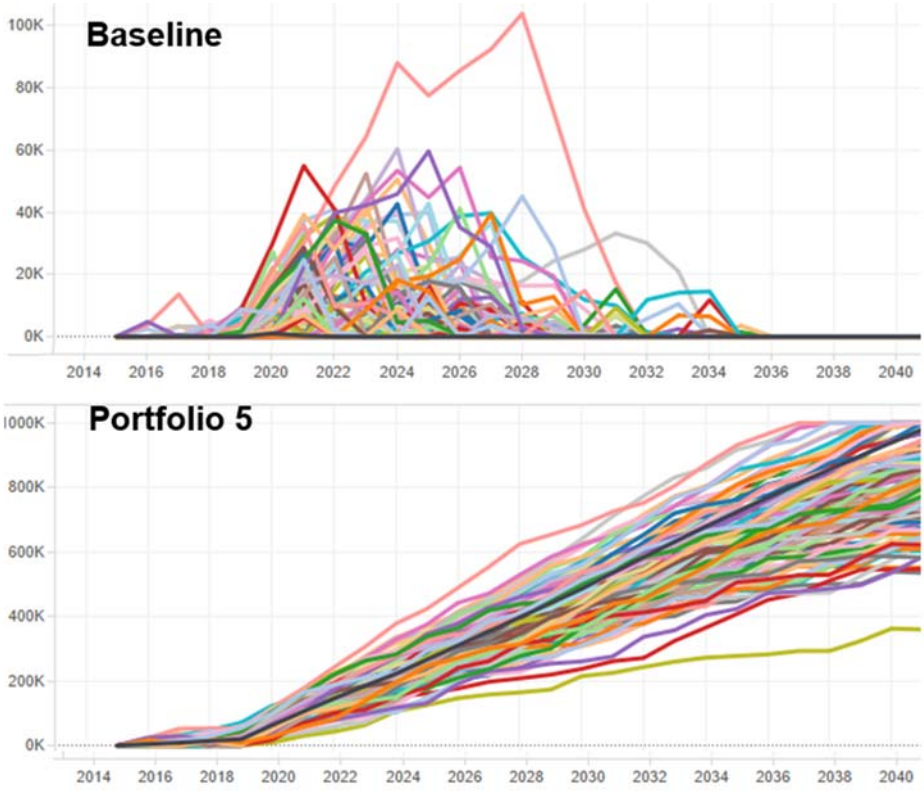


**Figure 4-15:** Unmet Demands of Portfolio 5 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy C Portfolio 5 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | demands met |
| **Upper Quartile (75%)** | **33,600** | **demands met** |
| Outlier (90%) | 47,000 | demands met |
| Highest Outlier (100%) | 56,300 | demands met |

**Figure 4-16:** Stored Groundwater Balance of Portfolio 5



## Table 4-4: Supply Totals for Portfolio 6

| Supply Type | Baseline | Portfolio 6 |
|---|---|---|
| **Chino Groundwater** | 91,300 | 8,400 |
| **Stormwater** | 6,400 | - |
| **Recycled Water** | | - |
| Locally Developed[(1)] | 64,700 | 20,800 |
| External Supplies | | 9,000 |
| **Chino Desalter** | 17,700 | - |
| **Local Surface** | 22,100 | - |
| **Non-Chino Groundwater** | 11,600 | 2,500 |
| **Imported Water** | | - |
| MWD | 69,750 | 667 |
| Other | | 6,400 |
| **WUE [(2)]** | 1,000 | 13,500 |
| *add'l supplies subtotal* | | *61,267* |
| **Total Water Supply** | **283,550** | **344,817** |

Notes:

(1) Baseline Supply of 18,700 GWR + 29,000 Direct + 17,000 SAR, or total of 64,700 AFY, based on Agency TYCIP and not total available wastewater supply. Estimated total available local RW supply by 2040 to be 85,550 AFY based on 2015 WWFMPU flow monitoring.

(2) Baseline WUE of 1,000 AFY already included in the Urdan Demand forecast. Therefore, not included in Supply Table to avoid double counting. Only new WUE in addition to Baseline to be counted in Total Supply.

**Strategy D– Increase Groundwater Recharge Supplies**

Under Strategy D, the IRP Technical Work Group focused on developing water supply interties with neighboring agencies in the watershed. Intermediate levels of water use efficiency/conservation are implemented in the form of two agencies adopting budget-based rates by 2020. In addition, all potential locally produced recycled water would be utilized in this strategy. One water supply portfolio, Portfolio 6, was developed for Strategy 6, with water supplies shown in Table 4-4. A complete list of projects in Portfolio 6 can be found in Appendix 6.

Unmet demands for Portfolio 6 in comparison to the baseline conditions are shown in Figure 4-17. Portfolio 6 meets projected demands through 2040 95% of the time.

Stored water balances are shown in Figure 4-18. As illustrated, groundwater balances begin to accumulate in Portfolio 4 by 2020. Due to variability in wet year supplemental supplies, stored water balances become highly variable and it is unclear whether stored water continues to build or draw down through 2040.

In summary, 75% of the time Portfolio 6:

- Eliminates unmet demand through 2040 due to reduced outdoor water demands from increased water use efficiency/conservation programming
- Has the potential to build stored groundwater through 2040, but the amount varies with climate conditions
- Takes advantage of climate resistant supplies by maximizing recycled water and water use efficiency

**Strategy E – Maximize Imported Water Supplies with Moderate Conservation**

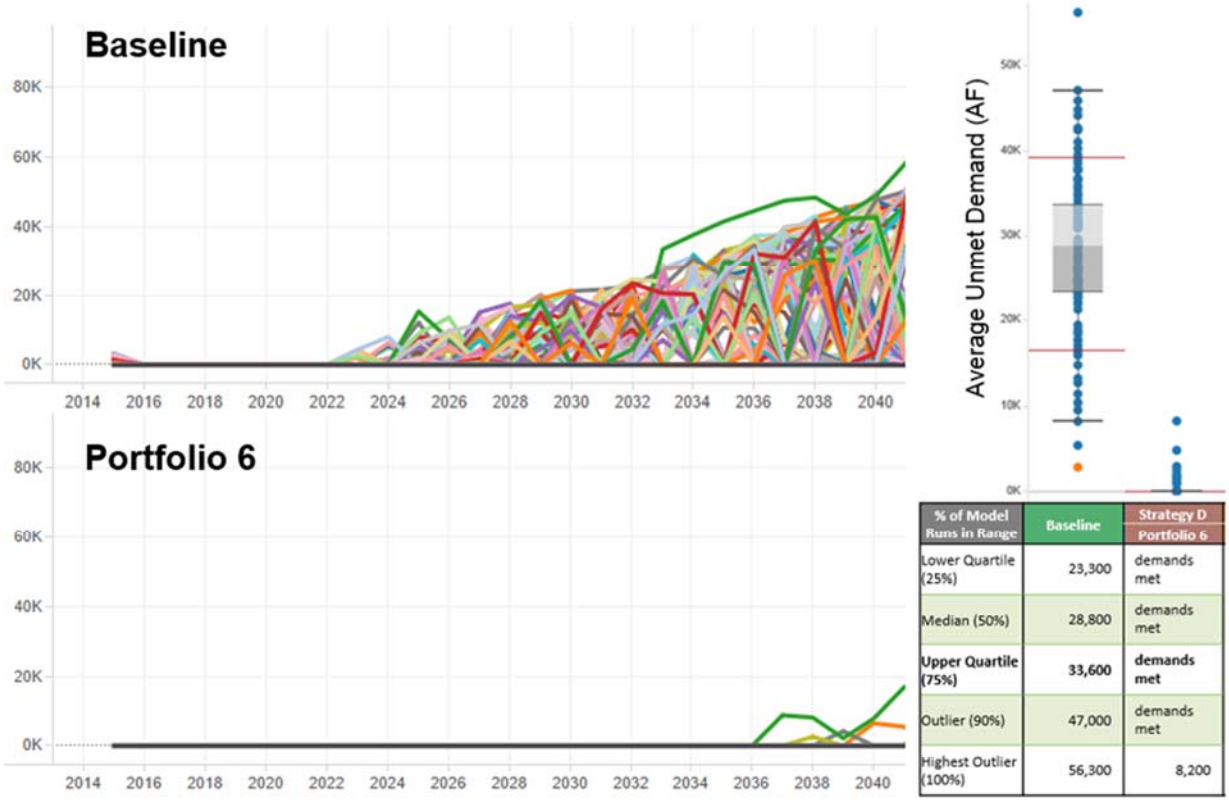
Under Strategy E, the IRP Technical Work Group evaluated how maximizing the purchase of imported water could alleviate pressure on and extend the availability of local water resources. This strategy allows for the purchase of up to 93,300 AF of imported water to meet urban demand or to be used for groundwater replenishment. In addition, the strategy includes an intermediate level of water use efficiency/conservation in the form of two agencies adopting budget-based rates by 2020.

Two water supply portfolios were developed for Strategy E. The first, Portfolio 7, models the additional water supplies as described above. The second, Portfolio 8, includes all of the supplies of Portfolio 7 plus the addition of maximizing all locally produced recycled water as shown in Table 4-5. A complete list of projects in Portfolios 7 and 8 can be found in Appendix 6.

Unmet demands for Portfolio 7 in comparison to the baseline conditions are shown in Figure 4-19. Portfolio 7 meets projected demands through 2040 across 25% of the model runs.

Stored water balances are illustrated in Figure 4-20. As shown, groundwater balances begin to accumulate in Portfolio 7 by 2020 with the majority of model runs continuing to build stored water through 2040. Due to variability in wet year supplemental supplies, stored water balances become highly variable and unclear

**Figure 4-17:** Unmet Demands of Portfolio 6 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy D Portfolio 6 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | demands met |
| **Upper Quartile (75%)** | **33,600** | **demands met** |
| Outlier (90%) | 47,000 | demands met |
| Highest Outlier (100%) | 56,300 | 8,200 |

**Figure 4-18:** Stored Groundwater Balance of Portfolio 6

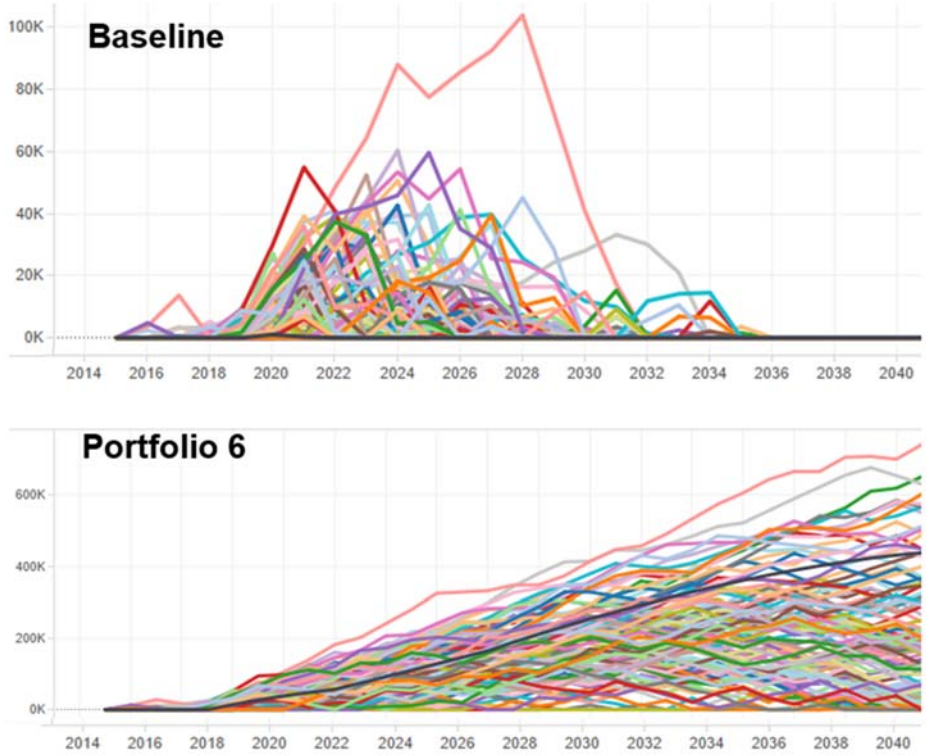
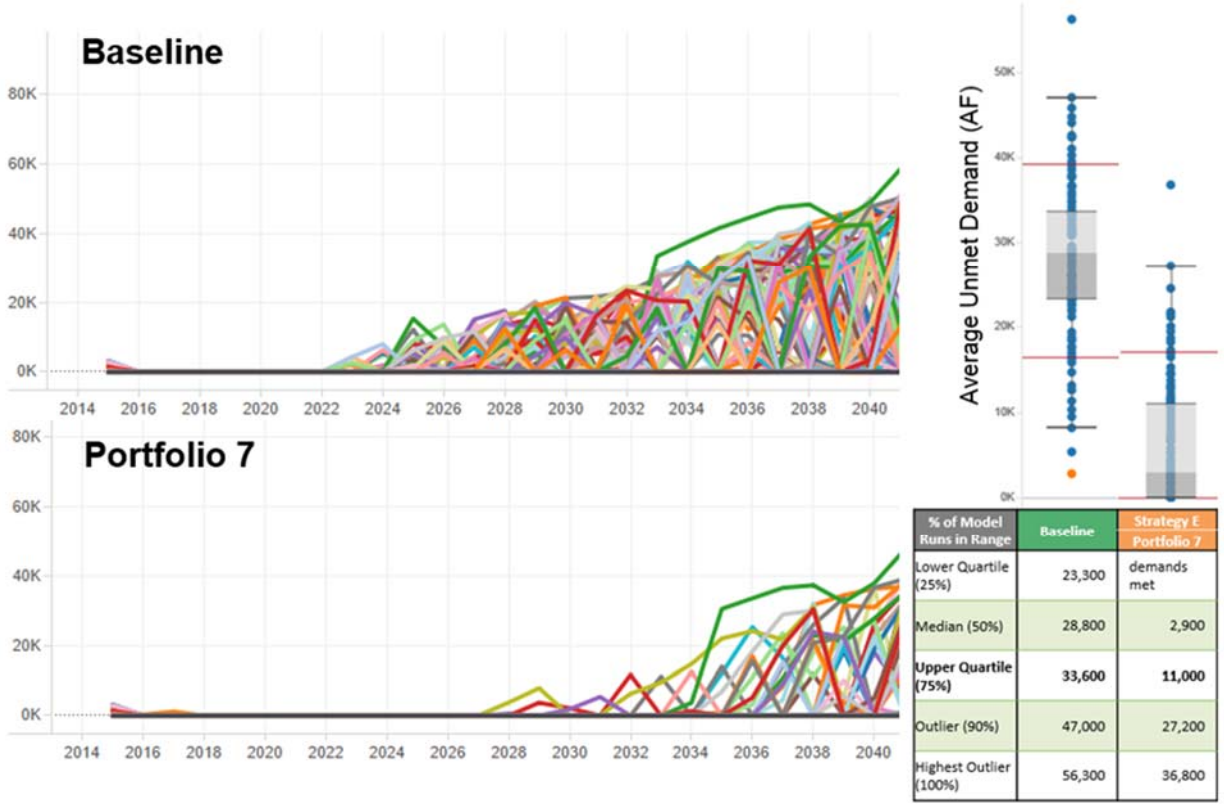
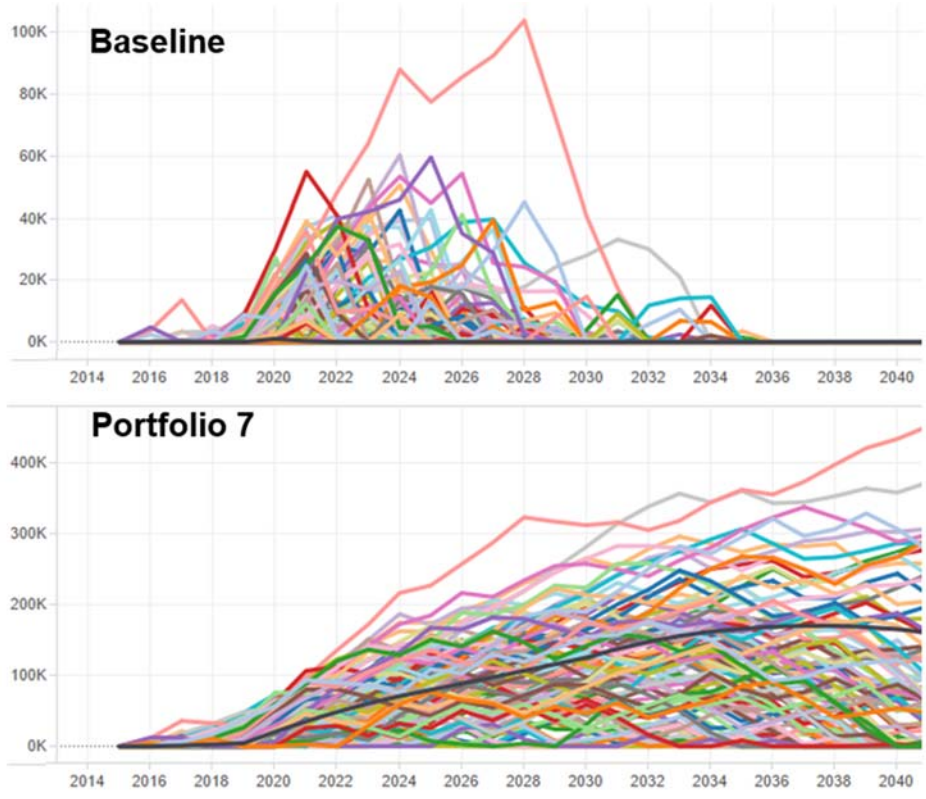


**Figure 4-19:** Unmet Demands of Portfolio 7 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy E Portfolio 7 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | 2,900 |
| **Upper Quartile (75%)** | **33,600** | **11,000** |
| Outlier (90%) | 47,000 | 27,200 |
| Highest Outlier (100%) | 56,300 | 36,800 |

**Figure 4-20:** Stored Groundwater Balance of Portfolio 7



whether stored water continues to build or drawn down through 2040.

Unmet demands for Portfolio 8 in comparison to the baseline model run are shown in Figure 4-21. Portfolio 8 meets projected demands through 2040 100% of the time.

Stored water balances are illustrated in Figure 4-22. As shown, groundwater balances begin to accumulate in Portfolio 8 by 2020 with majority of model runs continuing to build stored water through 2040. Due to variability in wet year supplemental supplies, stored water balances become highly variable and unclear whether stored water continues to build or drawn down through 2040.

In summary, Portfolio 7 and 8:

- Portfolio 7 has a supply shortfall of up to 11,000 AF under 75% of the climate scenarios
- Portfolio 8 meets demand under 100% of the climate scenarios, this increase in performance is due to the addition of recycled water.
- Both portfolios have the potential to build stored groundwater through 2040, but the amount in storage varies by climate conditions
- After 2030, Portfolio 8 builds stored groundwater under majority of climate scenarios due to the addition of recycled water.

## **Table 4-5:** Supply Totals for Portfolio 7 & 8

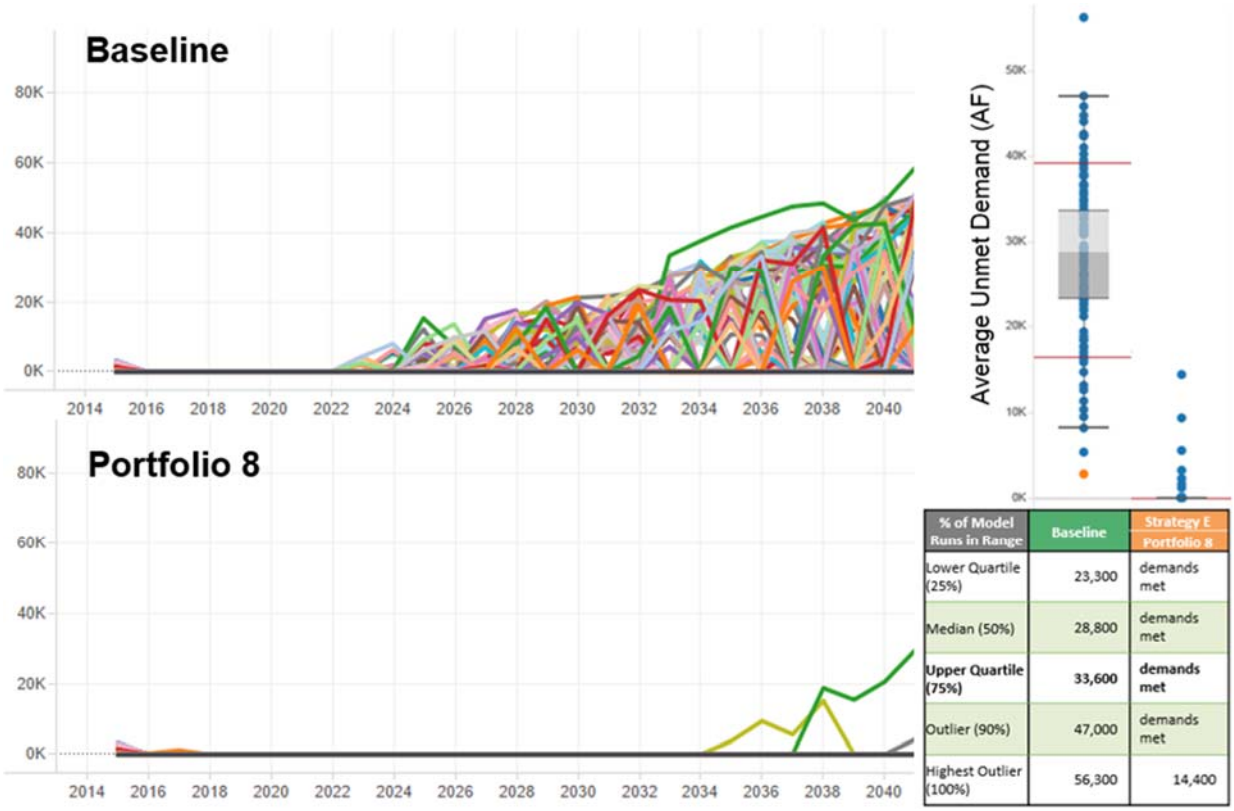
| Supply Type | Baseline | Portfolio 7 | Portfolio 8 |
|---|---|---|---|
| **Chino Groundwater** | 91,300 | - | - |
| **Stormwater** | 6,400 | - | - |
| **Recycled Water** | | - | - |
| Locally Developed[(1)] | 64,700 | - | 20,800 |
| External Supplies | | - | 7,000 |
| **Chino Desalter** | 17,700 | - | - |
| **Local Surface** | 22,100 | - | - |
| **Non-Chino Groundwater** | 11,600 | - | - |
| **Imported Water** | | - | - |
| MWD | 69,750 | 23,550 | 23,550 |
| Other | | 1,000 | 1,000 |
| **WUE** [(2)] | 1,000 | 18,500 | 18,500 |
| *add'l supplies subtotal* | | *43,050* | *70,850* |
| **Total Water Supply** | **283,550** | **326,600** | **354,400** |

Notes:

(1) Baseline Supply of 18,700 GWR + 29,000 Direct + 17,000 SAR, or total of 64,700 AFY, based on Agency TYCIP and not total available wastewater supply. Estimated total available local RW supply by 2040 to be 85,550 AFY based on 2015 WWFMPU flow monitoring.

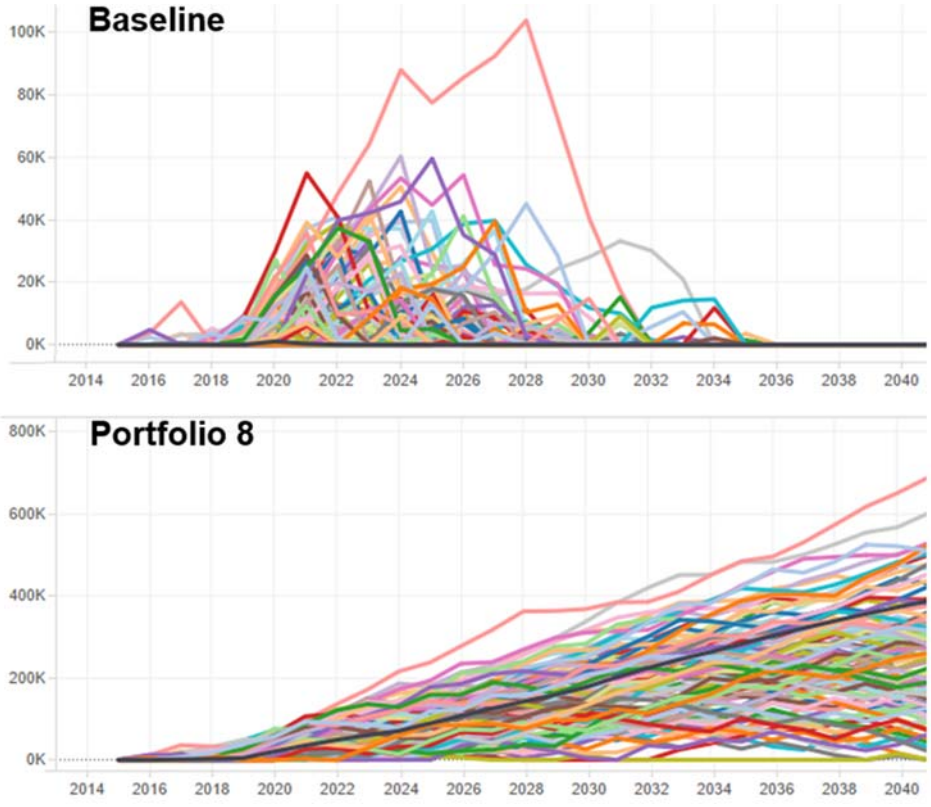
(2) Baseline WUE of 1,000 AFY already included in the Urdan Demand forecast. Therefore, not included in Supply Table to avoid double counting. Only new WUE in addition to Baseline to be counted in Total Supply.

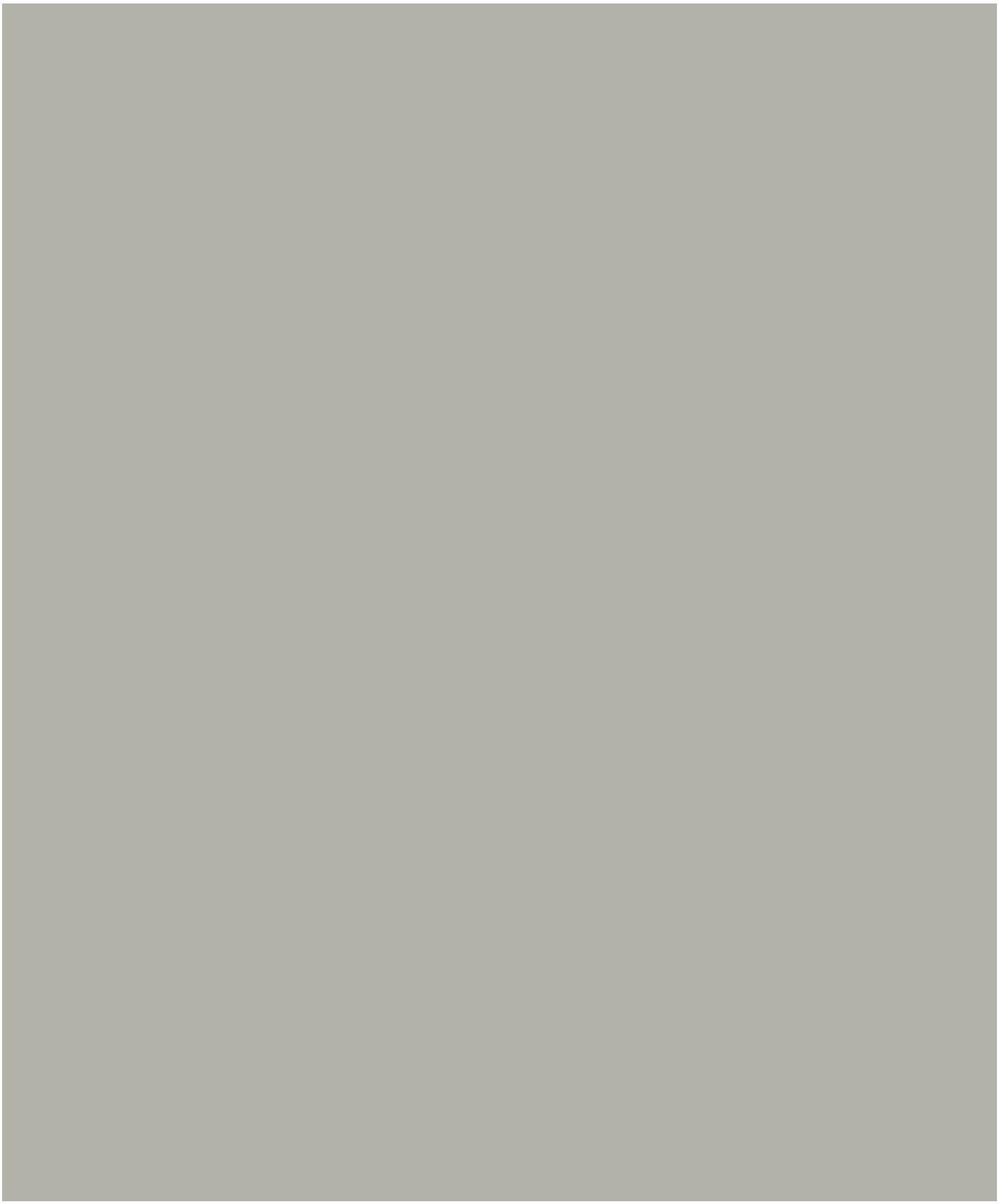
**Figure 4-19:** Unmet Demands of Portfolio 7 Compared to Baseline




| % of Model Runs in Range | Baseline | Strategy E Portfolio 8 |
|---|---|---|
| Lower Quartile (25%) | 23,300 | demands met |
| Median (50%) | 28,800 | demands met |
| **Upper Quartile (75%)** | **33,600** | **demands met** |
| Outlier (90%) | 47,000 | demands met |
| Highest Outlier (100%) | 56,300 | 14,400 |

**Figure 4-20:** Stored Groundwater Balance of Portfolio 7






OPEN

# 5. Conclusions & Next Steps



**Core Findings of the 2015 IRP**

**Lessons Learned from the Climate Simulations**

**Final IRP Recommendations and Next Steps**

Figure XXX: caption

# Conclusions & Next Steps

With the adoption of the Chino Basin Optimum Basin Management Plan in 2000, the region embarked on a new era of water management. Over the past fifteen years, more than $500 million was invested in the development of local water supplies. This resulted in the expansion of the regional recycled water program as well as in the development of significant groundwater capture, treatment, and storage programs.

As a result, when the record-breaking drought of 2012 began, the region was prepared. The region has had sufficient water supplies available to meet water needs during the great drought of the last four years without constraining new development or economic growth. These local water resource programs form the foundation for the region's future water resiliency.

Climate change is now creating uncertain conditions and new water management challenges for the region's future. The purpose of the 2015 IRP is to evaluate the resiliency of the region's water resources under climate change and to identify the best strategies for ensuring that the region's future water needs through 2040 can be sustainably met. With the information from the IRP, the region has a roadmap to guide the next 25 years of regional investments in water supply development and management programs.

## CORE FINDINGS

The region adopted goals for the 2015 IRP. In looking to the future, the region wanted a water development and management plan that would accomplish the following:

**Resilience —** Regional water management flexibility to adapt to climate change, economic growth, and any changes that limit, reduce, or make water supplies unavailable.

**Water Efficiency —** Meet or exceed rules and regulations for reasonable water use.

**Sustainability —** Provide environmental benefits, including energy efficiency, reduced green house gas emissions, and water quality improvements to meet the needs of the present without compromising the ability of future generations to meet their own needs.

**Cost Effectiveness —** Supply regional water in a cost-effective manner and maximize outside funding.

To achieve these goals, the IRP evaluated projected water needs and available water supplies through 2040. Future climate change scenarios were then used to "stress-test" an array of water development actions that were organized into "portfolios".

These results form the basis for the IRP's final recommendations. The core findings are:

1. The region's past investments in local water supplies and the diversification of the available water resources have positioned the region well to deal with the future impacts of climate change. If no further actions were taken beyond the currently planned investments in regional supplies and water use efficiency, the region would be able to meet 80-

90% of its projected water needs by 2040 (see baseline).

2. Portfolios that combined water supply and water efficiency actions yielded the most adaptive strategies for the region. Many portfolios were able to reduce the region's risk of not having sufficient water supplies to meet future needs. Several portfolios were able to dramatically increase the amount of water stored in the Chino Basin. The portfolios that performed the best under the climate change scenarios were:

    - 2B – Maximize recycled water (includes bringing in external recycled water supplies), implement modest water use efficiency, and access supplemental imported water
    - 3A – Maximize recycled water (includes bringing in external recycled water supplies) and implement moderate water use efficiency
    - 3B – Maximize recycled water (includes bringing in external recycled water supplies) and implement high water use efficiency
    - 4 – Maximize supplemental water supplies and recycled water (includes bringing in external recycled water supplies)
    - 5B – Maximize the purchase of MWD water supplies, use of recycled water (includes bringing in external recycled water), and implementation of modest water use efficiency

## LESSONS LEARNED FROM THE CLIMATE SIMULATIONS

**Value of Water Use Efficiency** — The climate scenarios reveal that the addition of very modest levels of water use efficiency (such as 10% reduction in water use) improved the performance of all portfolios and yielded significant benefits the region. The regional benefit is demonstrated through Portfolio 3B in which the actions of two Agencies achieving the State's existing water use efficiency standards results in the region's capacity to increase supplies in groundwater storage while meeting water needs through 2040.

**Value of Recycled Water** — The climate scenarios confirmed that recycled water is the region's most climate resilient water supply because the amount of available water to the region is not impacted by dry years. The regional benefit of maximizing recycled water is demonstrated through the comparison of Strategy B and C in which the use of recycled water enables the region to increase supplies in groundwater storage, especially in combination with increased water use efficiency.

**Value of Supplemental Water** — The climate scenarios highlight the importance of securing supplemental water – surface, imported, and external recycled water supplies – when it is available to build a stronger supply buffer for dry years or when State Water Project availability is limited. The regional benefit of opportunistically securing these external water supplies is demonstrated through the comparison of Portfolios 4, 5, and 6 which enables the region to increase supplies in groundwater storage, especially in combination with increased water use efficiency.

**Value of Increasing Groundwater Storage** — The climate scenarios affirmed the importance of adequate groundwater reserves in addressing future climate uncertainties or catastrophic events, such as a major facility or pipeline break or a loss in supplies. A broader regional benefit is the role that these reserves can play when managed as a regional water bank to enhance water supply reliability within the Santa Ana Watershed and across Southern California. Portfolios 4, 5, 6 and 8 highlight the value to the region of the increased flexibility and resiliency resulting from increased groundwater storage.

*Plans to protect air and water, wilderness and wildlife are in fact plans to protect man.*

-Stewart Udall



## RECOMMENDATIONS & NEXT STEPS

The region adopted the following core recommendations for the 2015 IRP:

- **Continue investment in recycled water** projects to maximize the beneficial reuse.
- **Acquire supplemental water to enhance groundwater quality** to sustain production and reduce salinity.
- **Implement water use efficiency measures** to reduce current urban demand by at least 10% to enhance water supply resiliency.
- **Strategically maximize the purchase of supplemental water** for recharge or in-lieu when available.
- **Include external supplies**, consisting of exchanges, storage, and water transfers, **strategically in combination with conservation** to augment groundwater recharge, recycled water, **and build storage reserves**. External supplies include surface, imported, and non-potable water.
- **Continue to maximize stormwater recharge projects**, including rainwater capture and infiltration.

These recommendations will be evaluated through a Programmatic Environmental Impact Report in mid-2016. As funding opportunities become available, specific project cost and environmental assessments will be conducted as needed, particularly in relation to the regional benefit of the proposed actions. Phase 2 of the IRP will address additional detailed project level analysis including project scopes, costs, prioritization, and implementation schedule.

## Table 5-1: Summary of How Phase 1 Recommendations Meet the IRP Goals

| Water Use Efficiency | |
|---|---|
| ***Water Efficiency*** | This would help meet rules and regulations for reasonable water use now and in the future. |
| ***Sustainability*** | Savings realized through the implementation of the program extends the groundwater production for future generations. |
| ***Resilience*** | When combined with other programs, such as recycled water, creates storage to accommodate for abnormal and catastrophic events. |

| Recycled Water | |
|---|---|
| ***Water Efficiency*** | This would help meet rules and regulations for reasonable water use now and in the future, especially meeting current state mandates. |
| ***Sustainability*** | As a climate resistant supply, the beneficial use of recycled water when combined with Water Use Efficiency builds reserves within the Chino Basin. |
| ***Resilience*** | When combined with other programs, such as Water Use Efficiency, creates storage to accommodate for abnormal and catastrophic events. |

| Supplemental Water | |
|---|---|
| ***Water Efficiency*** | This would help meet rules and regulations for reasonable water use now and in the future, especially meeting current state mandates. |
| ***Sustainability*** | This would help meet rules and regulations for reasonable water use now and in the future, especially meeting current state mandates. |
| ***Resilience*** | as a climate resistant supply, the beneficial use of recycled water when combined with Water Use Efficiency builds reserves within the Chino Basin. |

| Groundwater Storage | |
|---|---|
| ***Sustainability*** | Storage reserves reduce dependence on climate variable supplies and are not impacted by climate once the supplies are in storage. As a climate resistant supply, the reserves can be used responsibly by future generations without depleting the Chino Basin. |
| ***Resilience*** | When combined with other programs, such as Water Use Efficiency, Recycled Water and Supplemental Water, creates storage to accommodate for abnormal and catastrophic events. |



# Appendices



**1. A&N Technical Services Demand Forecast**

**2. Draft RAND Memo: "Evaluating Options for Improving the Climate Resilience of the Inland Empire Utilities Agency in Southern California"**

**3. A&N Technical Services Indoor/Outdoor Demands**

**4. A&N Technical Services Demand Influencing Factors**

**5. Full IRP Technical Committee Identified Project List**

**6. Project Lists for Water Resource Strategy Portfolios 1-8**

California native plant, *Heteromeles arbutifolia*, displays crimson berries during the winter in the Chino Creek Wetlands and Educational Park.

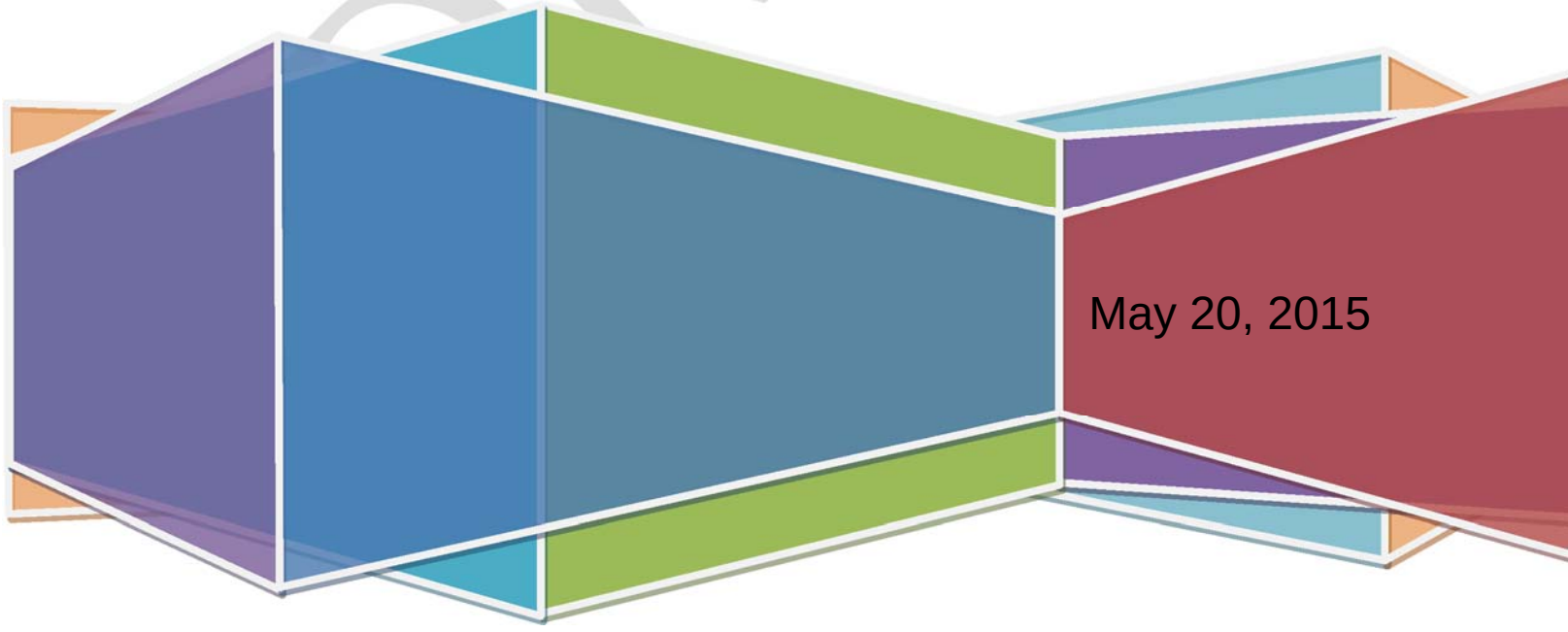
# Appendix 1:
# A&N Technical Services Demand Forecast

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

# IEUA Long Term Demand Forecast Model User Guide

DRAFT

**A & N Technical Services, Inc.**



May 20, 2015

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# Abbreviations List

AWE – Alliance for Water Efficiency
CDR – Center for Demographic Research
CII – Commercial-Industrial-Institutional
CVWD – Cucamonga Valley Water District
FIRE – Financial Activity & Real Estate
FWC – Fontana Water Company
GIS – Geographic Information Systems
IEUA – Inland Empire Utilities Agency
IRP – Integrated Resource Plane
MVWD – Monte Vista Water District
MWD – Metropolitan Water District of Southern California
NAICS – North American Industry Classification Systems
RMC – Raines Melton and Carella
RTP - Regional Transportation Plan
SCAG – Southern California Association of Governments
SCS – Sustainable Communities Strategy
SIC – Standard Industrial Classification
TAZ – Traffic Analysis Zone

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# Introduction

This user guide documents the structure and use of the IEUA Long Term Demand Forecast Model.

### Objectives

The model was constructed with the following objectives:

- Forecast demand and demand variability to 2040 in support of the IRP development process.
- Forecast demand as consumption, which we define as all of the consumption within IEUA service area boundaries.
- Base the demand forecast on the latest demographic forecast.
- Utilize a demand forecast method consistent with the MWD demand forecast methods.
- Utilize a conservation forecast method consistent with the AWE Tracking Tool that IEUA currently uses for conservation planning.
- Provide a way to assess the variability of future water demand forecasts to a wide range of scenarios that are built with a range of best-available data sources to accurately depict the effect of future uncertainties.

### Approach

The approach in model development can be characterized as:

1. Acquiring the latest demographic forecast data from the SCAG 2012 RTP for all of the area within IEUA, for its retail water service areas, for its cities, and for its waste water tributary areas. (Enacted by the Center for Demographic Research.)
2. Inputting the demographic forecast into the demand forecast econometric equations to create a base forecast.
3. Calibrating the base forecast to normal demand (weather-normalized, employment-normalized). A separate statistical model of historical IEUA monthly water demand was estimated to develop empirical relationships between weather variation, the business cycle, and IEUA demand variability.
4. Inputting the quantified active and passive conservation forecast from the latest version of the AWE Tracking Tool that IEUA uses for conservation planning.

### Discussion

Econometric Equations. MWD has cooperated with IEUA in the development of the demand forecast methods. Appendix A provides a review of the analytic structure of their long term water demand models.

Demand as Consumption. The base forecast has been calibrated to normalize demand –that is demand conditional on normal weather and normal economic activity. Note the caveat that some pumpers who are not accounted for by retailers may not be included.

Demographics 2035 to 2040. The SCAG 2012 RTP demographics only go out to the year 2035. We utilize a trend method similar to MWD for the years 2035 to 2040.

# Section A: Index

The sections of this document correspond to the worksheets in the Long Term Demand Forecast Model. The following table provides the view of the first worksheet "Index". Clicking on any hyperlink will navigate to that section of the spreadsheet.




**IEUA Long Term Demand Forecast Model**

**Index of Worksheets**

| Sheet Name | Description |
|---|---|
| Index | Index of worksheets for navigation |
| ControlPanel | Make scenario choices and see results. |
| Chart_Data | Arrays of data for charts |
| Model_Base | Base Case Scenario |
| Model_Scenario1 | Scenario 1 |
| Model_Scenario2 | Scenario 2 |
| Model_Scenario3 | Scenario 3 |
| WBBRS_Implementation | Inputs for water budget |
| WUE_Inputs | Inputs for water use efficiency plans |

# Section B: Control Panel

The *Control Panel* worksheet contains the "Scenario Manager" that allows the user to explore up to three different scenarios that use different combinations of future demand drivers. Demand drivers can include both short term drivers—such as one year weather swings--and long term drivers of future water demand such as population or employment growth. Water Use Efficiency drivers are broken out separately and include Water Budget Based Rate Structures and more traditional WUE/conservation programs. For more information on statistical analysis of Short Term IEUA Demand refer to Appendix E.

Each demand driver is discussed in sequence.

| | Scenario Manager |
|---|---|
| **Item** | |
| | Scenario Name |
| Short Term Drivers | Drought Persistence |
| | Economic Cycle |
| | Short-Term Weather |
| Long Term Drivers | Sustainable Communities Housing |
| | Dwelling Units per Land Area |
| | Median Household Income Growth |
| | Long Term Climate Change |
| WUE Drivers | Water Budget Based Rate Structure (WBBRS) |
| | WUE Level |

## Short Term Drivers – 5 Years – 2015 to 2020

- **Drought Persistence** defines how much of recent demand reductions will persist into the future
    - amount of recent reduction that is permanent
        - 0 percent implies that everything will return to the baseline forecast
        - 4.6% percent implies that the 4.6% recent reduction is a permanent lifestyle change

The unexpressed bugbear is what is the "recent reduction"? It is reasonable to assume that one would want to know how much of a raw change in consumption is due to recession or weather. Fortunately IEUA has an empirical basis for such a determination in the short term IEUA demand model that is the source of the 4.6% recent reduction in demand (not attributable to recessionary effects.)

- **Economic Cycle** –The user can specify how much recession or boom could bump demand in a single year using the estimated annual standard deviation of business cycle effects from the short term IEUA demand model.
    - Recession year – demand minus 1 standard deviation from the IEUA short run water demand forecasting model
    - Baseline year—normal business cycle, no change
    - Growth year – demand plus 1 standard deviation from the IEUA short run water demand forecasting model

- **Short Term Weather** – Single wet, single dry, three consecutive dry years (required by UWMP). The effect of weather variation is defined using the estimated annual standard deviation of weather effects from the short term IEUA demand model.
    - Single wet year – demand minus 1 standard deviation from the IEUA short run water demand forecasting model
    - Single dry year – demand plus 1 standard deviation from the IEUA short run water demand forecasting model
    - Multiple dry year – demand plus 1.6 standard deviations from the IEUA short run water demand forecasting model

## Long Term Drivers—2021 - 2050

- **Sustainable Communities Housing –** Derived scenarios explored in the SCAG Sustainable Communities Strategy, 2012 Regional Transportation Plan (p.114).
    - Baseline—future residential growth resembles the past, of which approximately 40% was high density multiple family.
    - More Sustainable—future residential growth resembles is approximately 71% high density multiple family.
    - Max Sustainable—future residential growth resembles is approximately 71% high density multiple family.

- **Dwelling Units per Land Area –**This driver allows another method of exploring effects of potential future densification.
    - Low Growth—future dwelling units per land area becomes less dense (minus one percent per year)
    - Baseline—future residential growth resembles past dwelling units per land area.
    - High Growth—future dwelling units per land area becomes more dense (plus one percent per year)
    - Very High Growth—future dwelling units per land area becomes more dense (plus two percent per year)

- **Median Household Income Growth –**3 alternative assumptions: low, baseline (2012 RTP), and high
    - Low Growth—median household income grows lower (minus one percent per year)
    - Baseline— median household income grows lower at predicted rate
    - High Growth— median household income grows faster than the baseline (plus one percent per year)

- **Long Term Climate Change –** Long term climate change is modeled by using recent GCC model predictions of potential increases in temperature with the short term IEUA demand model estimated temperature elasticity to depict this effect. (http://scenarios.globalchange.gov/report/regional-climate-trends-and-scenarios-us-national-climate-assessment-part-5-climate-southwest)
    - No Change— no long term climate change
    - P50 Median Expected Climate Change— 3.2% by 2040
    - P80 Median Expected Climate Change— 4.3% by 2040

## WUE Drivers

- **Water Budget Based Rate Structure (WBBRS)** are depicted with alterative assumptions of how many agencies will adopt and roll out WBBRS over the next 5 years. These will be modeled as separate activities within the AWE Water Conservation Tracking Tool.
    - Low_Rollout_1 Agency—This results in approximately 10% of Single Family and Irrigation customers being affected within 5 years.
    - Mid_Rollout_2 Agencies--This results in approximately 30% of Single Family and Irrigation customers being affected.
    - High_Rollout_All Agencies-- This results in all Single Family and Irrigation customers being affected.

Note that the Baseline IEUA Demand Model allows a "pure price" effect—how customers would respond to an increase in the real average price of water

- **WUE Level –** the level of WUE Programs being implemented derives from separate account in the AWE Water Conservation Tracking Tool

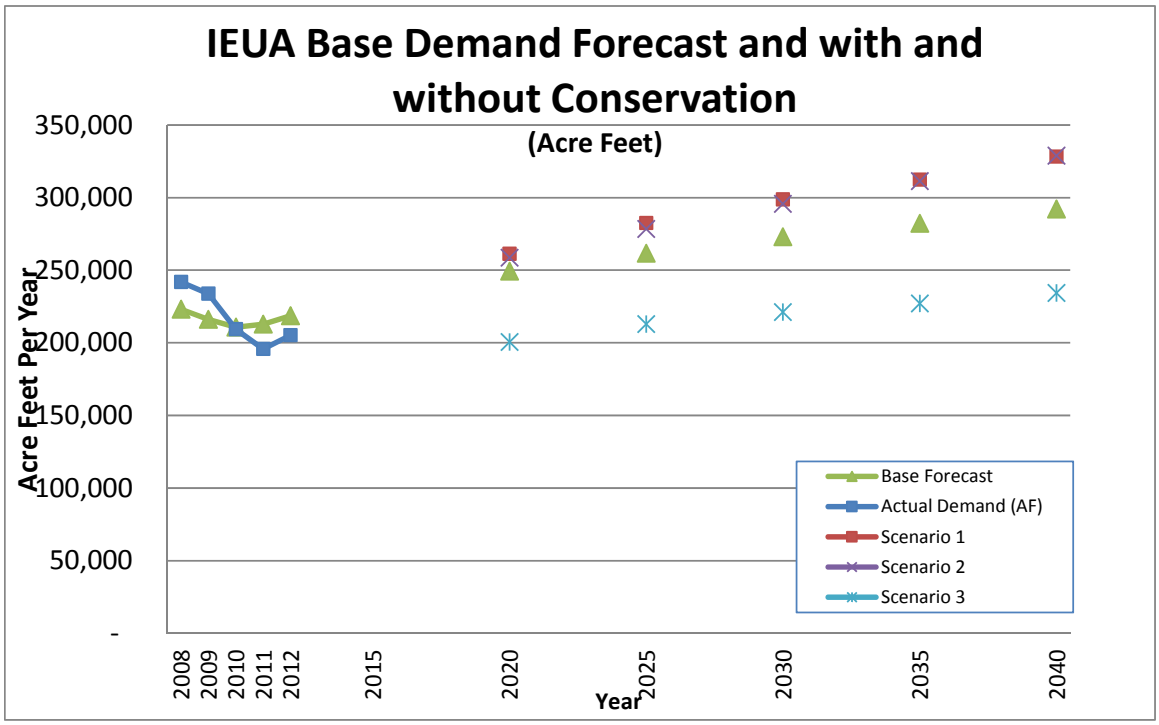
    - Programmatic (Device-driven) WUE Programs -- Tiers 1, 2, 3 developed as part of the WUE Business Plan.

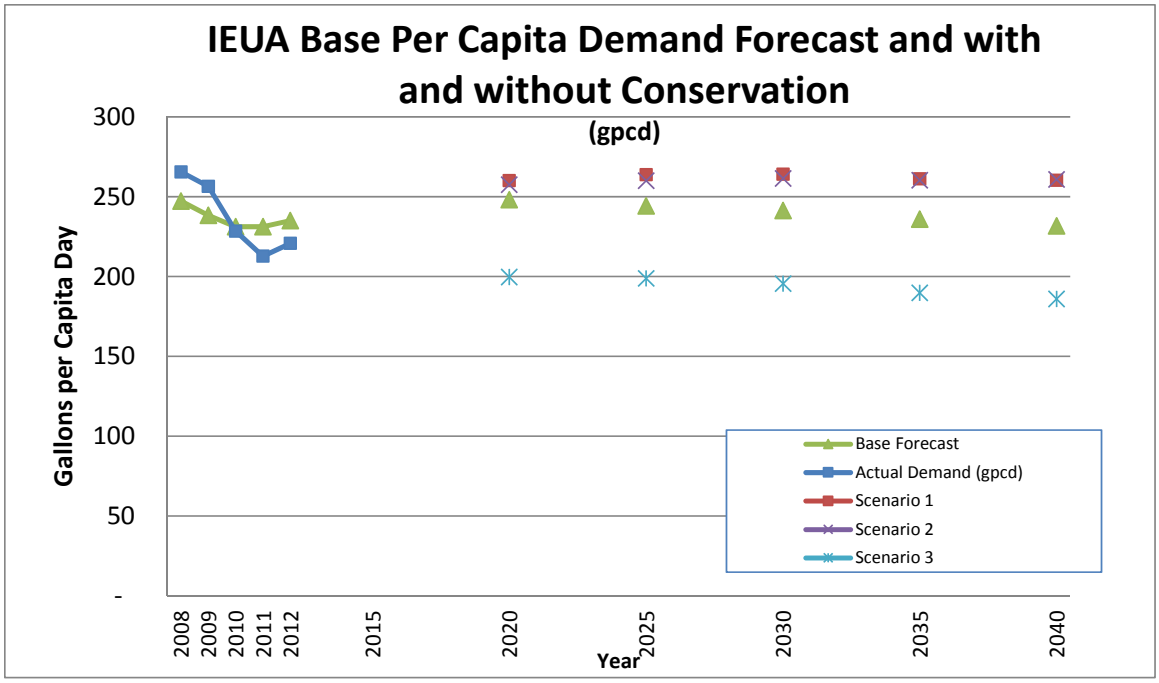
The Control Panel Worksheet contains drop down boxes to select values of demand drivers. A Collection of assumptions on demand drivers constitutes a demand forecasting scenario. Three scenarios are allowed. By allowing the user to define and control sources of forecast uncertainty in this control panel, one can more quickly develop a feel for which sources of uncertainty matter more than others using the visual feedback of dynamically changing plots of future water demand forecasts.

Each green box contains drop down boxes to choose values for each demand driver.

| Scenario Manager | | Use drop down box to enter values. Do not copy and paste unless you paste values only. | | |
|---|---|---|---|---|
| Item | | Scenario 1: | Scenario 2: | Scenario 3: |
| | Scenario Name | High | Intermediate | Low |
| Short Term | Drought Persistence | Drought_4.6%Permanent | Baseline | Drought_4.6%Permanent |
| Drivers | Economic Cycle | Growth Year | Baseline | Recession Year |
| | Short-Term Weather | Multi-Yr Dry | 1-Yr Dry | 1-Yr Wet |
| Long Term | Sustainable Communities Housing | Baseline (40% MF) | More Sustainable (71% MF) | Max Sustainable (96% MF) |
| Long Term | Dwelling Units per Land Area | Baseline | Baseline | Baseline |
| Drivers | Median Household Income Growth | Baseline | High Growth | Low Growth |
| | Long Term Climate Change | Change 4.3%_P80 | Change 3.2%_P50 | No Change |
| WUE | Water Budget Based Rate Structure (WBBRS) | None | Low_Rollout_10pctSF/Irr | High_Rollout_100All |
| Drivers | WUE Level | Level 3 | Level 2 | Level 3 |

The results can be readily observed in the forecast chart below the control panel.



## Section C: Chart Data

This worksheet collects and arranges data needed to create charts on the Control Panel worksheet.

# Section D: Model Base

The Model_Base worksheet contains the following:

- Base Model Parameters
  - Single Family
  - Multi-Family
  - Revised Non-Residential Models
  - Price effect
- Base Model Input - Region Dependent
- Base Model Output - Demand Forecast with Price-effect
- Demand Forecast Model

## *Base Model Parameters*

The Base Model Parameters table contains the econometric parameter estimates that drive the base model forecast. The Base Model Parameters are revised only for major updates and revisions to the model. For everyday policy scenario runs, the Base Model Parameters are left alone, generally, except for possible sensitivity testing. The lag variables refer to statistical effect at different periods of time. For example, Lag 1 indicates the effect that weather in one year has on the subsequent year. The Base Model Parameters table starts in Row 5 of the Model_Base worksheet, and the values are reproduced in Appendix D:

**Single Family Model**. The single family model was estimated as a function of the following:

1. Weather variables that include the amount of rain, rainy days, and temperature— all of which also included lag variables of one period. Rain and temperature included additional lag 2 variables in the model.
2. Socioeconomic variables include marginal price, income, density (housing units per acre), and people (persons per household).
3. Conservation variables include one that indicates mandatory conservation, and another that indicates voluntary conservation.
4. Drought indicates drought during the period.
5. Month variables are used to estimate the effect of month on seasonal demand.

| MODEL PARAMETERS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Single Family Model** | | | | | | | |
| | **WEATHER** | LAG 0 | LAG 1 | LAG 2 | | | |
| | Rain | -0.0482 | -0.0589 | -0.0192 | | | |
| | Rainy Days | -0.0088 | -0.0047 | | | | |
| | Temperature | 0.4647 | 0.3482 | 0.2942 | | | |
| | | | | | | | |
| | **SOCIOECONOMIC** | | | | | | |
| | Marginal Price | -0.1947 | | | | | |
| | Income | 0.2722 | | **MONTH** | | | |
| | Density | -0.6154 | | January | 0.0233 | July | 0.5785 |
| | People | 0.5485 | | February | | August | 0.5603 |
| | | | | March | 0.0659 | September | 0.4775 |
| | **CONSERVATION** | | | April | 0.2166 | October | 0.3361 |
| | Voluntary | -0.0258 | | May | 0.3799 | November | 0.1993 |
| | Mandatory | -0.1033 | | June | 0.5128 | December | 0.1056 |
| | | | | | | | |
| | **DROUGHT** | | | | | | |
| | | -0.0503 | | | | | |

**Multi-Family Model:**

1. Weather variables include the amount of rain and temperature. Rain includes a variable with no lag, and also variables with 1 and 2 lag periods. Temperature includes one variable with 1 lag period.
2. Socioeconomic variables included are the same set as for the single family model.
3. Conservation variables include one that indicates mandatory conservation, and another that indicates voluntary conservation.
4. Month variables included are the same set as for the single family model.

| Multi-Family Model | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **WEATHER** | LAG 0 | LAG 1 | LAG 2 | LAG 3 | | |
| | Rain | -0.0343 | -0.0205 | -0.0069 | | | |
| | Temperature | | 0.1375 | | | | |
| | | | | | | | |
| | **SOCIOECONOMIC** | | | | | | |
| | Marginal Price | -0.1626 | | **MONTH** | | | |
| | Income | 0.3102 | | January | 0.037 | July | 0.2255 |
| | Density | -0.5262 | | February | | August | 0.2353 |
| | People | 0.4496 | | March | 0.0009 | September | 0.1997 |
| | | | | April | 0.0715 | October | 0.1414 |
| | **CONSERVATION** | | | May | 0.1405 | November | 0.1037 |
| | Voluntary | -0.0452 | | June | 0.1951 | December | 0.0858 |
| | Mandatory | -0.1162 | | | | | |

**Revised Non-Residential Model:**

1. Weather variables include the amount of rain and cooling degree days, both with no lag, one period lag, and two periods lag.
2. Socioeconomic variables include one for the marginal price of water.
3. Conservation variables include one that indicates mandatory conservation, and another that indicates voluntary conservation.
4. Month variables included are the same set as for the single family model.
5. Employment variables included are Manufacture and Services as it is consistent with current MWD implementation. The model has the structure to accept, in addition, variables for Construction, Transportation, Wholesale, Retail, Finance, and Government employment.

| Revised Non-Residential Model | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **WEATHER** | LAG 0 | LAG 1 | LAG 2 | | | |
| | Rain | -0.05817 | -0.04906 | -0.01905 | | | |
| | Cooling degree Days | 0.01037 | 0.01171 | 0.01200 | | | |
| | | | | | | | |
| | **SOCIOECONOMIC** | | | **MONTH** | | | |
| | Marginal Price | -0.158920 | | January | 0.0005 | July | 0.4163 |
| | | | | February | | August | 0.4308 |
| | **CONSERVATION** | | | March | 0.0425 | September | 0.3713 |
| | Voluntary | -0.06655 | | April | 0.1613 | October | 0.2561 |
| | Mandatory | -0.13011 | | May | 0.2980 | November | 0.1438 |
| | | | | June | 0.3623 | December | 0.0658 |
| **EMPLOYMENT COEFFICIENTS** | | | | | | | |
| Construction | Manufacture | Transportation | Wholesale | Retail | Finance | Services | Government |
| 0.0000 | **0.80297** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.55242** | 0.0000 |

### Price Effect

The price effect parameters reduce the effect of price on demand to account for increasing levels of conservation over time. Customers may have fewer opportunities to conserve if they already have conservation devices and behaviors.

The Constant Price parameter (Cell J79) toggles on and off the use of constant 1990 prices. When prices are constant, there are no price impacts on demand. This parameter could be used for sensitivity testing.

| Price Effect | | | | | |
|---|---|---|---|---|---|
| The price effect is reduced to account for the effects of price captured in the End-Use module. The original MWD model had one price effect across the forecast. This updated model allows for the effect to be reduced in phases, as End-Use conservation increases. | Year | Price Effect | | Year | Price Effect |
| | 2008 | 56% | | 2025 | 33% |
| | 2009 | 54% | | 2030 | 33% |
| | 2010 | 52% | | 2035 | 33% |
| | 2011 | 50% | | 2040 | 33% |
| | 2012 | 48% | | 2045 | 33% |
| | 2015 | 42% | | 2050 | 33% |
| | 2020 | 33% | | | |
| Constant Price (effects of 1990 price across all years) Toggle: 1 = use current rate, 0 use 1990 rates | | | | | 1 |

## *Base Model Input*

The Base Model Input tables start in Row 82 of the Model_Base worksheet. These tables contain the demographic input data and the equations to create the demand forecast. The Base Forecast is the forecast under the assumption of no new conservation savings.

### Demographic Inputs

The latest demographic forecast for IEUA was acquired from the SCAG 2012 RTP data base. The Center for Demographic Research (CDR) at California State University, Fullerton utilized geographic information system (GIS) methods to extract data only for the area within IEUA service area boundaries. Detailed analysis of boundaries was conducted to assure that households, population, and employment were properly allocated. Appendix B contains detailed description of the GIS methods used to generate the demographic data set. Appendix D contains demographic input tables. The complete set of demographic inputs is as follows:

1. Population (Total Population, SCAG 2012 RTP data from CDR)
2. Occupied Housing Units (Households, SCAG 2012 RTP data from CDR)
3. Household size (Persons per Household, MWD)
4. Housing Density (Units per Acre, MWD)
5. Median Household Income (MWD)
6. Urban Employment by Sector (SCAG 2012 RTP data from CDR)
7. Marginal Water Price (MWD)

Demographics 2035 to 2040. The SCAG 2012 RTP demographics only go out to the year 2035. We utilize a trend method similar to MWD for the years 2035 to 2040, by applying the compounded average growth rate from 2008 to 2035.

The MWD employment categories are by grouped SIC codes and the SCAG 2012 RTP are grouped by NAICS codes. The following cross walk—developed by consulting SIC and NAICS definitions—was used to group SCAG NAICS into MWD SIC categories.

| MWD (SIC) | SCAG (NAICS) |
|---|---|
| Construction | CONST |
| Manufacturing | MANU, AG |
| Utilities | TRANS, .5*INFO |
| Trade | WHOLE |
| Retail Trade | RET |
| Real Estate | FIRE |
| Service | PROF, EDU, ARTENT, OTHER, .5*INFO |
| Government | PUBADM |

Source: Demographics_Compare_1.xlsx

**Employment Productivity Factors by Year**

1. Construction (MWD)
2. Manufacturing (MWD)
3. Transportation & Utility's Comm (MWD)
4. Wholesale Trade (MWD)
5. Retail Trade (MWD)
6. Finance, Insurance, and Real Estate (MWD)
7. Service (MWD)
8. Government (MWD)

**Drought Restrictions**

The table of drought restrictions contains the set of indicator variables that can be used to create forecast scenarios with conditions of drought and conservation restrictions.

1. Residential (Voluntary/Mandatory)
    a. Single Family
    b. Multi-Family
2. Employment (Voluntary/Mandatory)
3. Hot & Dry

**Model Intercept and Calibration Inputs**

The table labeled Model Intercept and Calibration Inputs contains the parameters to adjust the demand forecast to calibrate to the best estimate of normal weather demand. The table contains adjustments for the single family, multi family, and non-residential sectors. In addition the table below labeled Percentage Other can be used to adjust the other demand sector.

| Model Intercept and Calibration Inputs | | | |
|---|---|---|---|
| **Model Intercept Adjustments** | | | |
| | | Adjusted | Model Inter |
| | Single-Family | 5.10 | 4.83 |
| | Multi-Family | 5.31 | 5.66 |
| | Non-Residential | 0.86 | 0.94 |
| | | | med |
| | Model Calibration | 0.96 | |
| | SF Site Adjustment | 0.5065 | |
| | MF Site Adjustment | -0.1143 | |
| | NR Site Adjustment | -0.0441 | |

All of the values in the table are sourced from MWD with the exception of Model Calibration. Since we are calibrating for one agency, we set the Model Calibration parameter by minimizing the difference between the modeled demand and normal demand.

Normal demand was estimated by methods described in the technical memo "Statistical Analysis of Short Term IEUA Demand: Empirical Estimates of Demand Trends." This memo documents the weather-normalization and employment-normalization of time series data provided by IEUA. Water demand was approximated as the sum of delivered supplies. The advantage of using this data source is that the modeling effort was based on consistent system-wide monthly data. And in addition, the monthly water production could be adjusted for changes in storage. Although these models may be described as "demand" models, the data on which the models are estimates would be better described as "supply" measures. To the extent that storage issues are accounted for, the difference between these two constructs should be made small.

We have also provided a second calibration that isolates differences between IEUA and MWD methods. The second calibration option takes actual demand history provided by MWD and then applies the weather and employment effects from our statistical analysis to yield normal demand based on MWD data. The model provides a toggle to switch between the two calibration methods for comparison purposes (Cell G161).

| Minimize Delta to 2012 Normalized Demand by Adjusting Model Calibration in Cell E138 | | | | | |
|---|---|---|---|---|---|
| **Source of Actual Demand** | **Normal Effects Estimation** | **2012 Demand** | **Delta** | **Model Calibration** | **Toggle 1=IEUA** |
| IEUA | A&N | 218,614 | (0) | 0.956 | 1 |
| MWD | A&N | 243,922 | 25,308 | 0.983 | |

To run the calibration, run a Goal Seek in Excel that sets delta in Cell E161 (or E162) to zero by changing Cell E138. (In Excel, click on Data, What If, and then Goal Seek). This method calibrates the model to normal demand in the most recent year from the statistical analysis (2012).

**Adjusted Normal Weather by Month**

These values are from MWD and are calculated from tables labeled Actual Climate Data, which contain Median Rainfall, Median Rain Days, Normal Temperature, and Normal Cooling Degree Days.

## Base Model Output

The Base Model Output table (Row 171) is the base forecast that includes the price effect, but it does not include new conservation savings. The following is an example of the Base Model Output table for single family multi-family and total acre feet demand (Non-Residential and Other are not shown separately, but they are included in Total demand).

ACRE-FEET

| | Municipal and Industrial Water Demand - Base Forecast with Price Effect (Acre-Feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | by Sector | | | | | |
| | | TOTAL | | Single-Family | | | Multi-Family | | |
| YEAR | Annual | Summer | Winter | Annual | Summer | Winter | Annual | Summer | Winter |
| 2008 | 223,185 | 147,008 | 76,177 | 103,644 | 69,914 | 33,730 | 25,879 | 15,963 | 9,916 |
| 2009 | 216,118 | 142,398 | 73,720 | 103,031 | 69,501 | 33,531 | 25,815 | 15,924 | 9,891 |
| 2010 | 210,826 | 138,957 | 71,869 | 103,262 | 69,656 | 33,606 | 25,979 | 16,025 | 9,954 |
| 2011 | 212,918 | 140,330 | 72,588 | 103,706 | 69,956 | 33,750 | 25,967 | 16,018 | 9,949 |
| 2012 | 218,614 | 144,088 | 74,526 | 106,581 | 71,895 | 34,686 | 26,645 | 16,436 | 10,209 |
| 2015 | 232,443 | 153,406 | 79,037 | 113,054 | 76,315 | 36,740 | 27,994 | 17,268 | 10,726 |
| 2020 | 249,390 | 164,505 | 84,885 | 120,523 | 81,356 | 39,167 | 31,667 | 19,533 | 12,133 |
| 2025 | 263,113 | 173,501 | 89,613 | 126,358 | 85,295 | 41,063 | 34,301 | 21,158 | 13,143 |

## Demand Forecast Model

The Demand Forecast Model tables (starting in Row 225) contain the demand forecast equations for each forecast period.

## Conservation Inputs

The Conservation Inputs tables (starting in Row 696) contain output from the AWE Tracking Tool that IEUA uses to plan conservation activities.

- Plumbing Code Savings by sector
- Historically Achieved (Retrospective) Active Savings by sector for peak and off-peak sectors

The demand forecast calls for Summer and Winter demand, so we apply the peak and off-peak conservation estimates from the AWE Tracking tool to Summer and Winter respectively.

The demand forecast also calls for the following sectors: Single Family, Multi Family, Non Residential, and Other. The AWE Tracking Tool has Commercial, Industrial, and Institutional separately categorized as well as an Irrigation category. We summed these into the Non-Residential sector on the Conservation_Inputs Worksheet.

Note that refined adjustments to the conservation forecast are possible in the AWE Tracking Tool that accompanies the demand forecast model. For example, past and future conservation activities can be added or updated. Past active conservation is entered on the Model_Base worksheet. The Base

Scenario on the Model_Base worksheet assumes there is not additional future active conservation. Scenarios 1 – 3 each have different plans for future active conservation that are linked to the active conservation input worksheets on Model_Scenario1, Model_Scenario2, and Model_Scenario3 respectively.

Note also that the Conservation_Inputs Worksheet takes the results from the AWE Tracking Tool and calculates the future addition to active and passive conservation beyond what is embedded in 2012. That is the latest year of the statistical normalization analysis based on actual demand (which by definition embodies all past active and passive conservation to date). The calculations for the future additions to active conservation accounts for the fact that active conservation has a defined savings life. Unless the conservation activity is replicated in the AWE Tracking Tool, the conservation effect will expire and result in an increment rather than a decrement to future demand. As a default conditions, the model assumes that future active conservation will be maintained at the same level as the present active savings level. This is a place holder until IEUA has developed the next phase of their conservation planning.

## *Conservation Forecast*

The Conservation Forecast tables (Row 832) contains a forecast that is constructed by starting with the Base Forecast and subtracting out the added passive and active conservation forecast moving forward.

Note that since we have calibrated to a current estimate of normal demand, we subtract out only added future conservation above and beyond what is already embedded in the current estimates. The advantage of this approach is that it allows us to anchor the demand forecast to the best estimate of current measured demand data.

## *Cities Forecast*

The Cities Forecast (Row 937) was created by disaggregating the IEUA forecast using the following method:

- Single Family was disaggregated by the share of single family housing units in the city
- Multi Family was disaggregated by the share of multi-family housing units in the city
- Non Residential was disaggregated by the share of employment in the city
- Other was disaggregated by the share of population in the city

When comparing a disaggregate forecast of base demand at a City level to recent realized water demand, analysts will need to recognize that realized demand does not reflect, in general, normal weather and normal business cycle conditions. When comparing alternative forecasts, analysts should begin by comparing the demand driver measures of population, housing stock, and employment.

## *Retail Service Areas Forecast*

The Retail Service Areas Forecast (Row 1219) was created by disaggregating the IEUA forecast using the following method:

- Single Family was disaggregated by the share of single family housing units in the retail water service area

- Multi Family was disaggregated by the share of multi-family housing units in the retail water service area
- Non Residential was disaggregated by the share of employment in the retail water service area
- Other was disaggregated by the share of population in the retail water service area

When comparing a disaggregate forecast of base demand at a Retail Service Area level to recent realized water demand, analysts will need to recognize that realized demand does not reflect, in general, normal weather and normal business cycle conditions. When comparing alternative forecasts, analysts should begin by comparing the demand driver measures of population, housing stock, and employment.

## *Indoor/Outdoor Forecast*

The Indoor/Outdoor Forecast tables break down total forecasted demand into indoor and outdoor components (Row 1560).

Please refer to Appendix C for documentation on the estimate of Indoor/Outdoor end uses in the IEUA service area.

Two methods were examined to estimate outdoor use across customer classes (See Appendix C). The minimum month method is common practice, yet it ignores outdoor use in climates where there is winter irrigation. The seasonal variation method applies the seasonal variation from dedicated irrigation meters to mixed meter customer classes. This method definitively establishes that the assumption of zero winter irrigation is untenable. The recommended seasonal variation method estimates that 62 percent of total water demand in the IEUA service area is outdoor water use. The model can provide additional estimates of how indoor and outdoor end uses are divided seasonally:

| Summer (April to Oct.) | | Winter (Nov. to March) | |
|---|---|---|---|
| Indoor | Outdoor | Indoor | Outdoor |
| 33% | 67% | 49% | 51% |

Note that this split occurs in the model after the Base and Conservation Forecasts, and thus proportions of indoor and outdoor added active conservation savings will not be reflected. However, for the indoor outdoor analysis of passive conservation savings we performed to assist wastewater design team, we disaggregated passive conservation coming out of the AWE Tracking Tool into indoor and outdoor components. In addition, we disaggregated passive conservation into components derived from new construction and components derived from existing sites.

## Section E: Model Scenarios (1-3)

There are three Model_Scenario worksheets that contain each of three scenarios controlled by the Control Panel. Each of these worksheets is based structurally on the Base_Model worksheet with differences in either data sources or assumptions that comprise the defined scenarios.

## Section F: WBBRS Implementation

The WBBRS_Implementation worksheet contains the calculations and assumptions that underlie the alternative water budget based rate structures and their estimated water savings.

## Section G: WUE Inputs

The WUE_Inputs worksheet contains the planned active conservation savings from the alternative water use efficiency scenarios.

# Appendix A: Review of MWD Demand Model

## *Current econometric model specification*

Metropolitan currently uses a customized version of the IWR-MAIN (Municipal and Industrial) sometimes referred to as MWD-MAIN. This demand model features a separate model for different customer sectors—Single Family Residential, Multifamily Residential, and Commercial, Industrial, and Institutional (CII). Table 1 depicts these key relationships in the MWD demand model. In the residential sector, the forecasts of water demand per dwelling unit are ultimately combined with the forecasts of dwelling units from the regional planning agencies to yield an estimate of total sector water demand. Similarly, in the nonresidential sector, water use per employee is combined with forecasts of employment to yield an estimate of total nonresidential water demand.

**Table 1 MWD Demand Model Variables**

| Demand Sector | Projected Demographic | Dependent Variable | Explanatory Variables |
|---|---|---|---|
| Single Family Residential | Number of Single Family Households | Water use per household | Climate<br>Household Size<br>Income<br>Price and Conservation<br>Housing Density<br>Service Area Location |
| Multifamily Residential | Number of Multifamily Households | Water use per household | Climate<br>Household Size<br>Income<br>Price and Conservation<br>Housing Density<br>Service Area Location |
| Commercial, Industrial, Institutional (CII) | Total Urban Employment | Water use per employee | Climate<br>Price and Conservation<br>Industrial / Service Employment Share |
| System Loss / Unmetered Use | | | Percentage of total use |

Each statistical model will be analytically described.

### Specification of Single Family Residential Model

The systematic form of the single family residential model is:

**Equation 1**

$$\ln \frac{Use_{i,t}}{Unit_{i,t}} = \mu_i + \beta_M \cdot Month_t + \beta_W \cdot Weather_{i,t} + \beta_S \cdot SocioEconomic_{i,t} + \beta_D \cdot Drought_t$$

where $\frac{Use_{i,t}}{Unit_{i,t}}$ is the interpolated quantity of single family water use per occupied single family residence of retail agency *i* within month *t*,
the parameter $\mu_i$ represents a fixed intercept parameter for each agency *i*,
$Month_t$ is an indicator variable for the month,
$Weather_t$ is weather component,
$SocioEconomic_t$ is a set of socioeconomic measures, and
*Drought, are* indicator variables for the presence of drought response.

Taking a closer look at each component, the dependent variable is interpolated to reflect the fact that it is a measure taken from billed consumption data. (This type of "sales" data is required for the customer class specific models of MWDMAIN.) The interpolation was performed as follows:

$$\hat{Use}_t = 0.5 \cdot Use_t + 0.5 \cdot Use_{t-1}; monthly_data$$

*or*

$$\hat{Use}_t = 0.25 \cdot Use_t + 0.5 \cdot Use_{t-1} + 0.25 \cdot Use_{t-2}; bimonthly_data$$

The monthly seasonal component includes 11 binary indicator variables, one for each month:

$$Month_t = Jan + Mar + Apr + May + Jun + Jul + Aug + Sep + Oct + Nov + Dec$$

Since 12 monthly indicator variables are perfectly correlated with the intercept, one must be excluded. Identical predictions are generated no matter which month is excluded; only the interpretation of the monthly coefficients changes.

The weather component is comprised of weather measures (monthly rainfall, rainy days in the month, and air temperature) that are transformed logarithmically with their monthly average subtracted away. Contemporaneous values (rain in the same month as use) as well as lagged values are included.

$$Weather_{i,t} \equiv dlR_{i,t} + dlR_{i,t-1} + dlR_{i,t-2} + lRDays_{i,t} + lRDays_{i,t-1} + dlT_{i,t} + dlT_{i,t-1} + dlT_{i,t-2}$$

$$dlR_{i,t} \equiv \ln(Rain_{i,t} + 1) - \overline{\ln(Rain_{i,t} + 1)}$$

$$lRDays_{i,t} \equiv \ln(number_of_rainy_days_in_month + 1)$$

$$dlT_{i,t} \equiv \ln(Temp_{i,t}) - \overline{\ln(Temp_{i,t})}$$

The socioeconomic component for single family residential includes measures of water price, the number of occupied housing units per acre in 1990, the number of persons per household in 1990, and median household income in 1990.

$$Socioeconomic_{i,t} = \ln(real_marginal_price_{i,t}) + \ln(\frac{Units_{i,1990}}{Acres_{i,1990}}) + \ln(\frac{Persons_{i,1990}}{Units_{i,1990}}) + \ln(\frac{\overline{Income_{i,1990}}}{Unit_{i,1990}})$$

Because the estimation period included periods of drought, the model controlled for customer response to agency requested curtailments by using additional, agency-specific, binary indicators for voluntary or mandatory curtailments. An additional indicator for the severe drought period 1990-1992 was also included.

$$Drought_t = IndicatorforVoluntaryConservation_{i,t} + IndicatorforMandatoryConservation_{i,t} + IndicatorforDroughtPeriod(1990-1992)$$

The single family residential model was weighted by single family use/deliveries and estimated using ordinary least squares.

## Multifamily Residential

The systematic form of the multifamily residential model is:

**Equation 2**

$$\ln\frac{Use_{i,t}}{Unit_{i,t}} = \mu_i + \beta_M \cdot Month_t + \beta_W \cdot Weather_{i,t} + \beta_S \cdot SocioEconomic_{i,t} + \beta_D \cdot Drought_t$$

where $\frac{Use_{i,t}}{Unit_{i,t}}$ is the interpolated quantity of water use per occupied multifamily residence of retail agency *i* within month *t*, as in the single family model.

The parameter $\mu_i$ represents a fixed intercept parameter for each agency *i*,
$Month_t$ is an indicator variable for eleven months,
$Weather_t$ is a somewhat simpler weather component,
$SocioEconomic_t$ is a set of socioeconomic measures, and
$Drought_t$ are indicator variables for the presence of drought response.

The components of the multifamily residential model are somewhat simpler.

$$Weather_{i,t} \equiv dlR_{i,t} + dlR_{i,t-1} + dlR_{i,t-2} + dlT_{i,t-1}$$
$$dlR_{i,t} \equiv \ln(Rain_{i,t}+1) - \overline{\ln(Rain_{i,t}+1)}$$
$$dlT_{i,t} \equiv \ln(Temp_{i,t}) - \overline{\ln(Temp_{i,t})}$$
$$Drought_t = IndicatorforVoluntaryConservation_{i,t} + IndicatorforMandatoryConservation_{i,t}$$

The multifamily residential model was weighted by multifamily use/deliveries and estimated using ordinary least squares.

## Nonresidential—CII

For the nonresidential sector, the dependent variable is specified in terms of use per employee.

$$\ln\frac{Use_{i,t}}{Employee_{i,t}} = \mu_i + \beta_M \cdot Month_t + \beta_W \cdot Weather_{i,t} + \beta_S \cdot SocioEconomic_{i,t} + \beta_D \cdot Drought_t$$

In the documentation provided, the *Socioeconomic* component is formed by measures of eight major types of employment (the eight two digit SIC classifications of employment), that are adjusted for changes in productivity. A simpler form of this model is currently being used to generate nonresidential

projections; the working form of the nonresidential equation uses (unadjusted) measures of employment for the two largest employment groupings.

The nonresidential model was weighted by nonresidential use/deliveries and estimated using ordinary least squares.

## *Evaluation of current econometric model specification and estimation*

Any water demand model can be described as deriving from a separation of the explanatory variable into systematic and nonsystematic portions: $Y=f(X) + \varepsilon$.

Dependent Variable: Y
This type of "smoothing" will reduce variation in the original measure and can attenuate the effect of explanatory variables that vary monthly (e.g., weather measures). This said, the use of estimated monthly data represents an improvement over the annual or semi-annual measures used in previous MAIN modeling exercises.

Functional Form of Model: f(X)
The only agency-specific parameter is the intercept. This implies that all slope parameters are restricted to be the same for each agency. Though this may not appear to be a very plausible assumption on the face of it, it does reflect some of the difficult choices between available data and the number of parameters that the modeler attempts to estimate. For example, the current model specification imposes the restriction that the seasonal shape is identical for each agency *i*. Thus, in the single family model, each agency will have January use that is 2 percent above its intercept. Further, the weather effect is identical for each agency. It is implausible that inland agencies would have the same response to weather variation that primarily coastal agencies would have.

The weather effect also imposes the restriction that the percentage response to changes in temperature or rainfall are identical throughout the year. It is implausible that rainfall in June would have the same response as rainfall in January. The specification of the climate effects constitutes an area of potential further refinement.

Estimation Method of Model: $\hat{f}$ and $\varepsilon$
It is well known that fixed effect models, such as those used in estimating equations for MWD-MAIN cannot directly yield slope estimates for explanatory variables that only vary cross-sectionally. Thus, the elasticity's attached to variables that do not vary with time—housing density, persons per household, and median household income—are the result of the weighting procedure and a very small amount of cross-sectionally varying agency data from 1990. The signs of the estimated coefficients are correct but I cannot attest to their validity. However, the magnitude and signs of the estimated parameters are within reasonable ranges, based on my professional experience with demand models in the literature and in use nationally. The model would be improved by the use of modern panel data estimators.

Summary
The current MWD-MAIN models represent an improvement over previous models. The evolutionary path of the MWD-MAIN has several promising alternatives for further improvement.

This review was based on documents, interviews, and data provided by Metropolitan. These included:

*Development of Water Use Models for the Interim #5 Forecast: Memorandum Report*, January 1995, Jack C. Kiefer, Jerzy W. Kocik, Eva M. Opitz, and Benedykt Dziegielewski of PMCL, A report for the Metropolitan Water District of Southern California.

*Development of Water Use Models for the Interim #5 Forecast, ADDENDUM REPORT: MWDMOD Implementation and Calibration*, May 1995, Jack C. Kiefer, Jerzy W. Kocik, Eva M. Opitz, and Benedykt Dziegielewski of PMCL, A report for the Metropolitan Water District of Southern California.

*Development and Verification of Sectorial Water Demand Forecasting Models for the Metropolitan Water District of Southern California,* Draft Report, Feb. 1997, Jack C. Kiefer, Jerzy W. Kocik of PMCL, A report for the Metropolitan Water District of Southern California.

# Appendix B: Demographic Data Development

## *Summary Methodology for Socioeconomic Data Disaggregation to IEUA*

In fall 2013, the Center for Demographic Research (CDR) at California State University, Fullerton was contracted to disaggregate regional socioeconomic data for a water demand model for the Inland Empire Utilities Agency (IEUA). The specific objectives of this project were to develop estimates and projections of the following variables for 2008 and 2010 through 2035 for the cities, Retail Water Service Agencies, and Wastewater Tributaries within IEUA:

1. Total Population
2. Resident/Household Population
3. Group Quarters Population
4. Households (Occupied Housing Units)
5. Single-Family Households
6. Multi-Family Households
7. Employment (Jobs) by sector:
    a. Agriculture & Mining
    b. Construction
    c. Manufacturing
    d. Wholesale
    e. Retail
    f. Transportation, Warehousing, & Utility
    g. Information
    h. Financial Activity & Real Estate (FIRE)
    i. Professional & Business Services
    j. Education & Health Services
    k. Leisure & Hospitality
    l. Other Services
    m. Public Administration

The projections database used is the Southern California Association of Governments (SCAG) 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy (2012 RTP/SCS), which was allocated to the Traffic Analysis Zones (TAZ).

These were developed by first overlaying the city, water agency, and tributary boundaries on the TAZ boundaries using GIS software. Prior to overlaying the geographies, corrections and adjustments were made to the boundaries to minimize errors and differences.
First, a union of TAZ data to each of the three primary geographies (cities, Retail Service Water Agencies, and Wastewater Tributaries) was done using GIS software. TAZs wholly contained within a primary geography were assigned to that geography.
If a TAZ was split by a primary geography, the TAZ data was redistributed between two or more split polygons using a combination of GIS and Microsoft Excel. To distribute population and housing data, an area allocation method was used and then supplemented with a review of the 2010 aerial photo from ESRI. This was done by counting rooftops of single family detached homes. For multi-family housing,

Google Maps were used to find the property information, and then properties were contacted to obtain the number of housing units in the development.

Population was allocated based on the share of housing units in the split compared to the total number for the original TAZ data. For employment, employer point data from D&B was used which contained the address and number of employees by NAICS code. Each 2-digit NAICS code was assigned to one of the SCAG 13 employment sector categories. These were then subtotaled by the split TAZ geographies, and then controlled by sector to the original TAZ totals.

Summary Methodology for Socioeconomic Data Disaggregation to IEUA 2 of 2
Future growth after 2010 was allocated based on aerial review of open land by TAZ where splits occurred. After all population, housing, and employment data were allocated, the data were joined to each primary geography boundary file using GIS software. Each boundary file (shapefile) was quality-checked to verify the split TAZs correctly followed the source data for each geography type. Finally, the split TAZ data were dissolved on each of the primary geographies for cartographic representation. The outcomes were GIS shapefiles with spatially accurate, allocated population, housing, and employment data for three primary geographies: cities, Retail Water Service Agencies, and Wastewater Tributaries.

1. Total Population- Refers to all persons; sum of resident/household population and group quarters population.
2. Resident/Household Population- Resident population refers to the segment of the population that resides in non-institutionalized quarters, such as single and multiple family units, mobile homes, oats, recreational vehicles, and other miscellaneous types of residences. The resident population is synonymous with household population as defined by the California State Department of Finance.
3. Group Quarters Population- Group Quarters Population refers to the population residing in non-institutionalized group quarters, such as college dormitories, military barracks, convalescent hospitals, and shelters.
4. Total Households (Occupied Housing Units) - Occupied Total Dwelling Units and Households are synonymous. Households were calculated by summing Occupied Single-Family Households and Multi-Family Households.
5. Single-Family Households- Occupied single-family detached housing units.
6. Multi-Family Households- All other occupied housing units (includes single-family attached, multi-family, duplex, triplex, fourplex, mobile homes.
7. Employment: Total number of jobs, includes full time and part time jobs by sector
    a. Agriculture & Mining
    b. Construction
    c. Manufacturing
    d. Wholesale
    e. Retail
    f. Transportation, Warehousing, & Utility
    g. Information
    h. Financial Activity & Real Estate (FIRE)
    i. Professional & Business Services
    j. Education & Health Services
    k. Leisure & Hospitality
    l. Other Services
    m. Public Administration

**Boundary Details Documentation**

The IEUA official shape file was available for all IEUA-wide demographics.

To get the city boundaries, CDR utilized the RTP city files which are more accurate than the Census Tiger files.

To get the retail service area boundaries, CDR utilized the city files, and then overlaid the non-city water companies (MVWD, FWC, and CVWD).

Then special corrections were made for the following:

- West Valley Water District (northeastern IEUA area)
- Golden State Water Company (border of Upland and MVWD)
- Power Plant (Reliant Energy Etiwanda)
- IEUA facilities (adjacent to power plant)
- Yellowstone Circle (Chino Hills for water and Chino for wastewater)

To get the wastewater tributaries, RMC developed a boundary file in cooperation with IEUA.

# Appendix C: Indoor/Outdoor End Uses

## *Introduction*

This Appendix documents the estimation of indoor and outdoor water end uses for water demand in the IEUA service area. This estimation of indoor/outdoor end uses is conducted by customer class—single family residential, multi-family residential, and commercial-industrial-institutional (CII). Indoor end uses are of particular interest to planners tasked with designing wastewater systems and recycled water systems because it helps them establish capacity requirements. Both indoor and outdoor use is of great interest to planners tasked with designing Water Use Efficiency (conservation) programs. Although much has already been accomplished with indoor conservation, there is some level of remaining potential for water savings. WUE planners have particular interest in outdoor use because it is generally assumed to be a large share of total use with large remaining potential for savings.

Two methods were used to estimate outdoor use across customer classes. The first method is the minimum month method that has been historically used in the water industry—this method assumes that the minimum month of water demand is 100 percent indoor end uses. Though we believe that this is a counterfactual assumption in the IEUA service area (it assumes exactly zero outdoor irrigation in the winter) we provide estimates using the minimum month method to serve as a point of comparison. The second method develops an estimate of winter irrigation from dedicated irrigation meters and applies this nonzero assumption instead. Termed a "seasonal variation" method, it applies the seasonal variation from dedicated irrigation meters to mixed meter customer classes.

The seasonal variation method estimates outdoor end uses to compose 62 percent of overall water demand in the IEUA service area. (Presuming all water demand in the minimum month to be all indoor end use would estimate outdoor end uses to be 46 percent of total demand.) We recommend using the seasonal variation method because we know the minimum month method systematically underestimates outdoor water use in climates where there is winter irrigation such as IEUA.

## *Data*

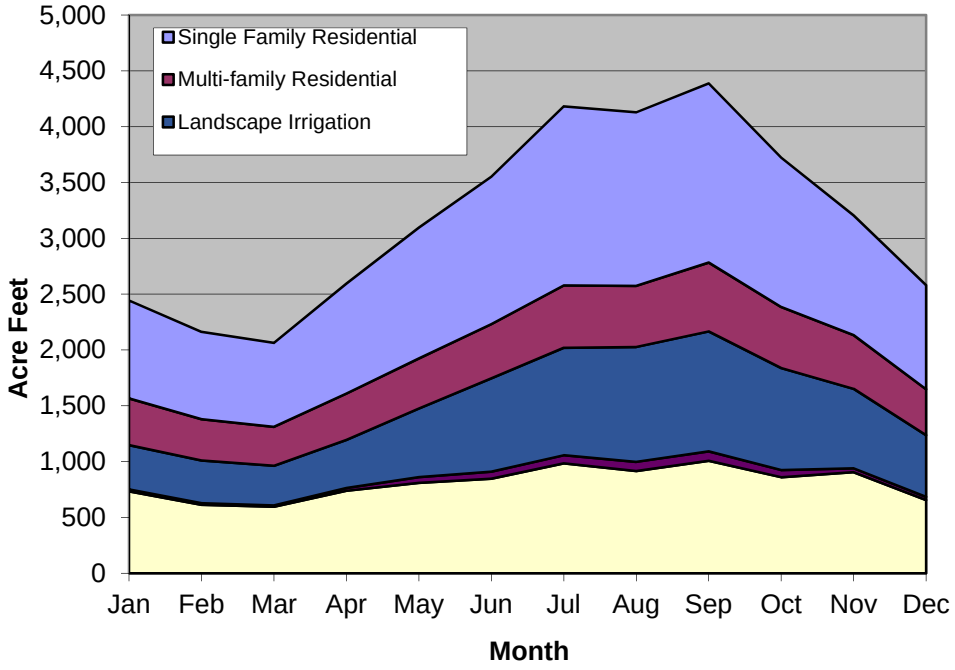
The data used are from the California Department of Water Resources, Public Water System Statistics filings for the City of Ontario for the years 1993 to 2012. These data are billing system summaries at the monthly level. Several other retailers provided monthly use summaries; however, these were generated with bimonthly billing cycles. Since different retailers can apportion bimonthly billing into calendar using different methods, we stick to the monthly data generated with monthly billing.

Table 1 shows the average use from 2008 to 2012 summed by customer class. Figure 1 shows the sum of water use by month. The strong seasonal pattern reflects irrigation needs during the characteristic hot and dry summers.

**Table 1 – Average Use, 2008 to 2012, City of Ontario**

| Class | Use (AF) | Percent |
|---|---|---|
| Single Family Residential | 13,993 | 36.7% |
| Multi-family Residential | 5,647 | 14.8% |
| Commercial/Industrial/Institutional | 9,666 | 25.4% |
| Landscape Irrigation | 8,259 | 21.7% |
| Other | 549 | 1.4% |
| Total | 38,114 | 100.0% |

**Figure 1--Monthly Use by Class**
**Average of Monthly Use from 2008-2012, City of Ontario**




## *Methods*

Outdoor end uses are directly measured by dedicated irrigation meters. Many other types of water meters--single family, multi family, commercial, industrial, and institutional--can be measuring both indoor and outdoor end uses. If not measured or observed directly, planners are forced to rely on inference or judgment. For IEUA, we have conducted two methods to infer outdoor use for all sectors.

### *Minimum Month Method*

The most common method employed to infer outdoor use is to assume the winter use is all indoors. (This assumption may be closer to the truth in wetter or colder climates.) For example, if we calculate winter minimum use times 12 months we have inferred total indoor use for the year. Total use for the year minus indoor use then equals outdoor use.

In Table 2 below, we find that outdoor use calculated with the "minimum winter use is indoor use" method is 46%. The method underestimates outdoor use because there is likely to be at least some winter irrigation in dry climates. Variations on this method include daily accounting and various ways

to define winter minimum. Note the results of this method will vary considerably from year to year; the reader is cautioned when using results from one year for planning
Purposes and we used for this analysis the monthly average over the five most recent years for which data were available (2008 to 2012).

**Table 2 – Percent Outdoor Use**

| Class | Total | Minimum Month Method | Seasonal Variation Method |
|---|---|---|---|
| Single Family Residential | 13,993 | 36% | 58% |
| Multi-family Residential | 5,647 | 26% | 43% |
| Commercial/Industrial/Institutional | 9,666 | 26% | 42% |
| Landscape Irrigation | 8,259 | 100% | 100% |
| Other | 549 | 75% | 100% |
| Total | 38,114 | 46% | 62% |

### *Seasonal Variation Method*

The second method to infer outdoor use consists of employing the pattern of seasonal variation with dedicated irrigation meters and applying it to other sectors with mixed meters. The reasoning is that with dedicated irrigation meters we can measure winter irrigation. Thus, we can observe the relative water use in winter and summer irrigation seasons and calculate a parameter from variables that are observable in other sectors. For example, by calculating the ratio of winter minimum to the seasonal range we have a function of variables observable for sectors other than dedicated irrigation meters. This method will result in a higher estimate of outdoor water use than using minimum month. The method relies on the assumption that the seasonal variation of outdoor use is the same for sites with dedicated meters as for sites with mixed meters.
Due to the variability of landscape water use from year to year, we expect the calculated parameter to vary considerably from year to year. For this reason, we calculated the parameter (ratio of winter minimum to seasonal range) for each year for which we could collect data (1993 to 2012) and took the average. We applied this long term average to the monthly average of the most recent five years of consumption data (2008 to 2012) because of the changing distribution of water use by customer class as more dedicated irrigation meters are employed.

Figure 2 shows the use from irrigation-only meters, with winter irrigation illustrated in blue and the seasonal range in red for one example year (2011).

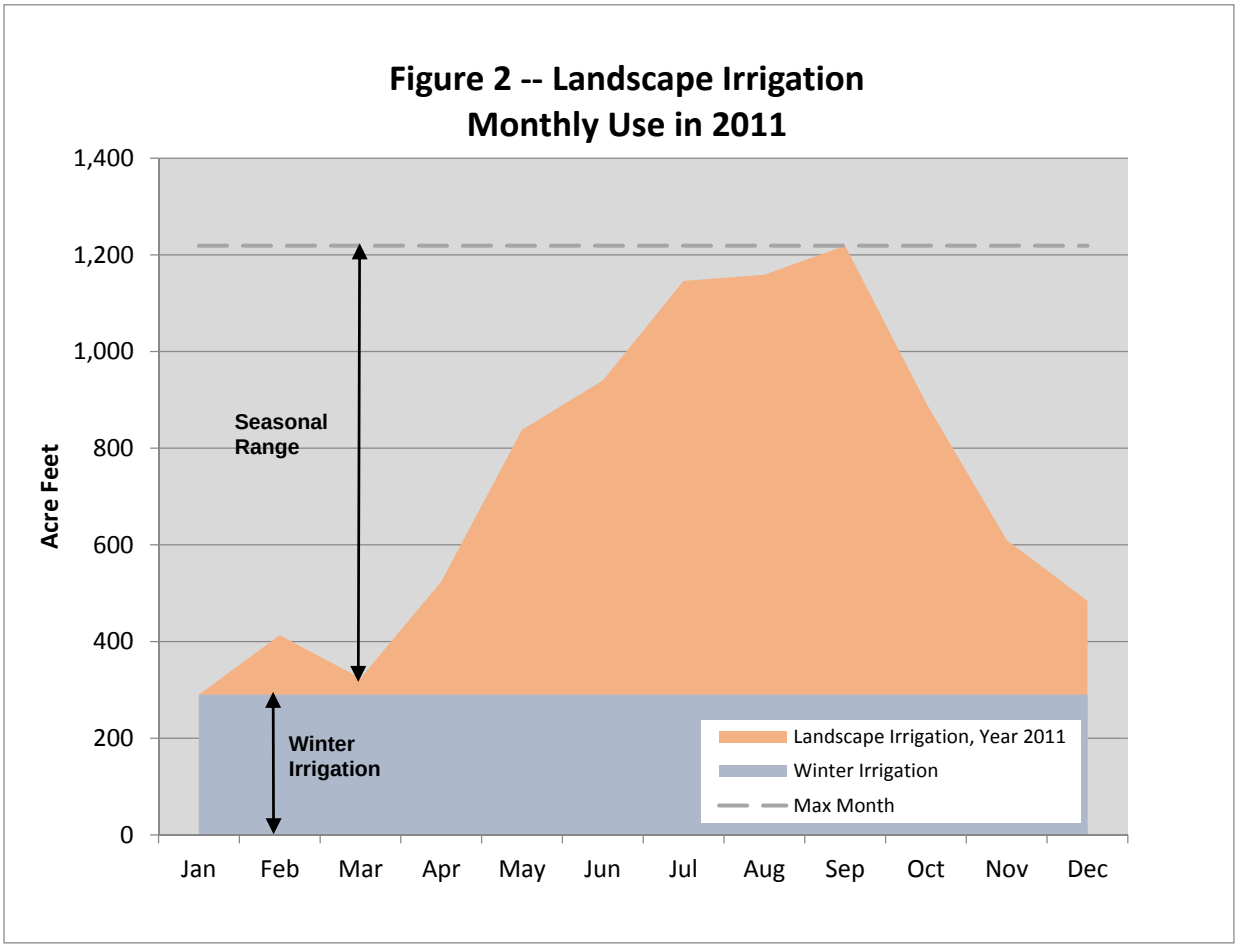
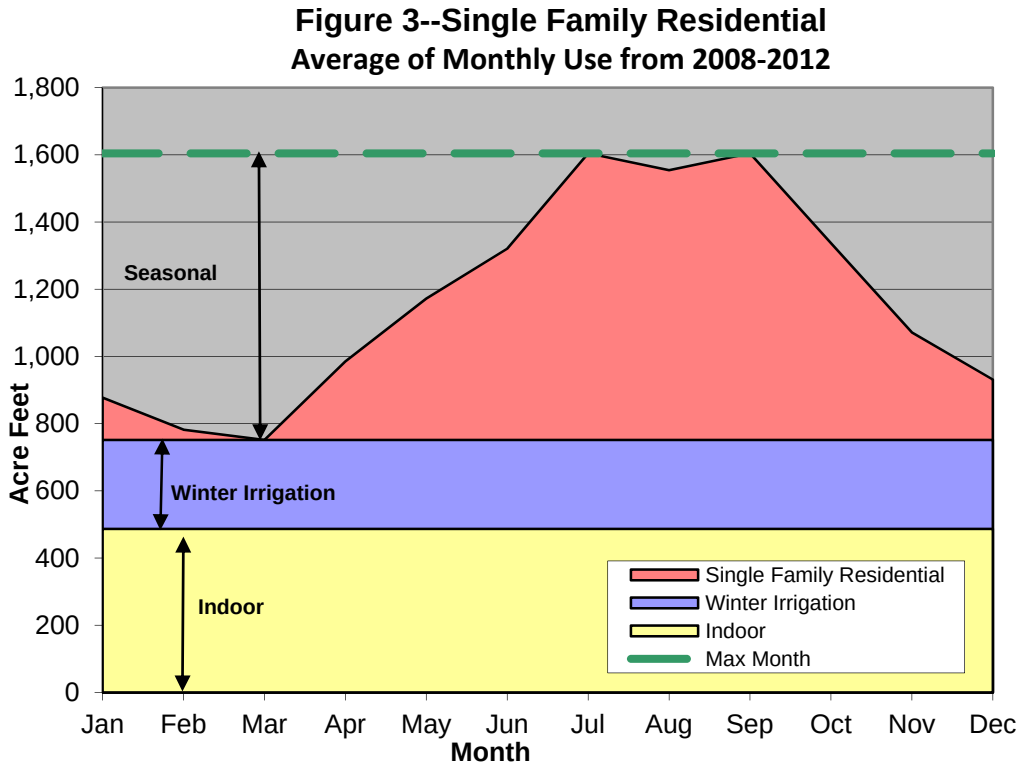



Figure 2 shows winter irrigation is 31% of seasonal range between summer and winter for dedicated irrigation accounts for the year 2011. We repeated this calculation for each year for which were able to collect data (1993 to 2012) and averaged the values to get the result we apply to customer sectors with mixed meters (31%).

Seasonal range and winter minimum are observable for non-irrigation classes. If we assume that winter irrigation is also 31% of seasonal range for the non-irrigation customer categories, we can infer their winter irrigation, and thus indoor and outdoor use.




For example, Figure 3 shows winter irrigation calculated as 31% of seasonal range for the single family residential sector. Total outdoor use (red+blue in this graph) is, thus, 58% of total use for the year (red+blue+yellow). In contrast, using the minimum month for the single family sector results in 36% outdoor use (red area only).

## *Recommendations*

The minimum month method systematically underestimates outdoor use and overestimates indoor use. As such we do not recommend using it for planning water resource investments in the IEUA service area. Since it is a commonly used method, it may have comparison value. We can improve the reliability of the results by using a longer time series of data to see how the percent outdoor varies from year to year with changes in weather; however, the systematic estimation bias remains.

We recommend the seasonal variation method over the minimum month in this analysis for IEUA because the seasonal variation method does not contain the same source of systematic bias. We have reliable empirical measures using monthly-billed data from one of the larger retail water service areas.

# Appendix D: Data Inputs

The following table is from the Parameters_Inputs Worksheet and it summarizes the econometrically estimated parameters that drive the demand equations. Section A defines these parameters in detail. These tables show the socioeconomic inputs from the Base_Forecast Worksheet as described in Section B:

**MODEL PARAMETERS**

**Single Family Model**

| | | LAG 0 | LAG 1 | LAG 2 | | | |
|---|---|---|---|---|---|---|---|
| | **WEATHER** | | | | | | |
| | Rain | -0.0482 | -0.0589 | -0.0192 | | | |
| | Rainy Days | -0.0088 | -0.0047 | | | | |
| | Temperature | 0.4647 | 0.3482 | 0.2942 | | | |
| | **SOCIOECONOMIC** | | | | | | |
| | Marginal Price | -0.1947 | | | | | |
| | Income | 0.2722 | | **MONTH** | | | |
| | Density | -0.6154 | | January | 0.0233 | July | 0.5785 |
| | People | 0.5485 | | February | | August | 0.5603 |
| | | | | March | 0.0659 | September | 0.4775 |
| | **CONSERVATION** | | | April | 0.2166 | October | 0.3361 |
| | Voluntary | -0.0258 | | May | 0.3799 | November | 0.1993 |
| | Mandatory | -0.1033 | | June | 0.5128 | December | 0.1056 |
| | **DROUGHT** | | | | | | |
| | | -0.0503 | | | | | |

**Multi-Family Model**

| | | LAG 0 | LAG 1 | LAG 2 | LAG 3 | | |
|---|---|---|---|---|---|---|---|
| | **WEATHER** | | | | | | |
| | Rain | -0.0343 | -0.0205 | -0.0069 | | | |
| | Temperature | | 0.1375 | | | | |
| | **SOCIOECONOMIC** | | | | | | |
| | Marginal Price | -0.1626 | | **MONTH** | | | |
| | Income | 0.3102 | | January | 0.037 | July | 0.2255 |
| | Density | -0.5262 | | February | | August | 0.2353 |
| | People | 0.4496 | | March | 0.0009 | September | 0.1997 |
| | | | | April | 0.0715 | October | 0.1414 |
| | **CONSERVATION** | | | May | 0.1405 | November | 0.1037 |
| | Voluntary | -0.0452 | | June | 0.1951 | December | 0.0858 |
| | Mandatory | -0.1162 | | | | | |

**Revised Non-Residential Model**

| | | LAG 0 | LAG 1 | LAG 2 | | | |
|---|---|---|---|---|---|---|---|
| | **WEATHER** | | | | | | |
| | Rain | -0.05817 | -0.04906 | -0.01905 | | | |
| | Cooling degree Days | 0.01037 | 0.01171 | 0.01200 | | | |
| | **SOCIOECONOMIC** | | | **MONTH** | | | |
| | Marginal Price | -0.158920 | | January | 0.0005 | July | 0.4163 |
| | | | | February | | August | 0.4308 |
| | **CONSERVATION** | | | March | 0.0425 | September | 0.3713 |
| | Voluntary | -0.06655 | | April | 0.1613 | October | 0.2561 |
| | Mandatory | -0.13011 | | May | 0.2980 | November | 0.1438 |
| | | | | June | 0.3623 | December | 0.0658 |

**EMPLOYMENT COEFFICIENTS**

| Construction | Manufacture | Transportation | Wholesale | Retail | Finance | Services | Government |
|---|---|---|---|---|---|---|---|
| 0.0000 | **0.80297** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | **0.55242** | 0.0000 |

**Price Effect**

| | Year | Price Effect | | Year | Price Effect |
|---|---|---|---|---|---|
| The price effect is reduced to | **Year** | **Price Effect** | | **Year** | **Price Effect** |
| account for the effects of price | 2008 | 56% | | 2025 | 33% |
| captured in the End-Use module. | 2009 | 54% | | 2030 | 33% |
| | 2010 | 52% | | 2035 | 33% |
| The original MWD model had one | 2011 | 50% | | 2040 | 33% |
| price effect accross the forecast. | 2012 | 48% | | 2045 | 33% |
| This updated model allows for the | 2015 | 42% | | 2050 | 33% |
| effect to be reduced in phases, as | 2020 | 33% | | | |
| End-Use conservation increases. | | | | | |

| YEAR | Population | | Occupied Housing Units | | | Household Size (persons / household) | | | Housing Density (units / acre | | Median Household Income (1990 dollars) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | by Sector | | | by Sector | | by Sector | | |
| | TOTAL Population | Household Population | TOTAL | Single-Family | Multi-Family | AVERAGE | Single-Family | Multi-Family | Single-Family | Multi-Family | |
| 2008 | 805,506 | 787,995 | 230,915 | 158,948 | 71,967 | 3.42 | 3.60 | 2.89 | 3.20 | 10.90 | 38.18 |
| 2009 | 809,590 | 792,072 | 232,091 | 159,548 | 72,542 | 3.41 | 3.59 | 2.87 | 3.20 | 10.90 | 37.38 |
| 2010 | 813,695 | 796,170 | 233,272 | 160,150 | 73,122 | 3.42 | 3.60 | 2.88 | 3.20 | 10.90 | 37.06 |
| 2011 | 822,018 | 804,344 | 235,913 | 162,158 | 73,754 | 3.43 | 3.61 | 2.90 | 3.20 | 10.90 | 35.82 |
| 2012 | 830,425 | 812,603 | 238,583 | 164,192 | 74,391 | 3.45 | 3.62 | 2.91 | 3.20 | 10.90 | 37.72 |
| 2015 | 856,168 | 837,890 | 246,777 | 170,447 | 76,337 | 3.40 | 3.58 | 2.87 | 3.20 | 10.90 | 41.70 |
| 2020 | 896,533 | 877,494 | 262,894 | 178,394 | 84,500 | 3.34 | 3.52 | 2.80 | 3.20 | 10.90 | 46.30 |
| 2025 | 955,569 | 935,762 | 279,209 | 187,488 | 91,721 | 3.35 | 3.54 | 2.82 | 3.20 | 10.90 | 46.05 |
| 2030 | 1,009,349 | 988,771 | 295,545 | 197,642 | 97,903 | 3.35 | 3.55 | 2.82 | 3.20 | 10.90 | 45.81 |
| 2035 | 1,067,946 | 1,046,605 | 311,860 | 207,794 | 104,066 | 3.36 | 3.56 | 2.83 | 3.20 | 10.90 | 45.59 |
| 2040 | 1,125,203 | 1,103,084 | 329,707 | 218,366 | 111,422 | 3.33 | 3.54 | 2.81 | 3.20 | 10.90 | 45.43 |
| 2045 | 1,185,530 | 1,162,611 | 348,575 | 229,475 | 119,298 | 3.33 | 3.53 | 2.81 | 3.20 | 10.90 | 45.23 |
| 2050 | 1,249,091 | 1,225,350 | 368,522 | 241,150 | 127,731 | 3.32 | 3.53 | 2.80 | 3.20 | 10.90 | 45.03 |

| YEAR | Urban Employment by Sector (Major SIC Code) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | by Sector | | | | | | | |
| | TOTAL | Construction | Manufacturing | Transportation and Public Utilities | Wholesale Trade | Retail Trade | Finance, Insurance, and Real Estate | Service | Government |
| 2008 | 330,533 | 21,107 | 42,701 | 39,443 | 24,545 | 46,478 | 13,138 | 137,549 | 5,572 |
| 2009 | 315,381 | 17,722 | 38,572 | 38,242 | 22,820 | 44,094 | 12,236 | 132,535 | 8,168 |
| 2010 | 300,924 | 14,880 | 34,843 | 37,077 | 21,217 | 41,833 | 11,396 | 127,704 | 11,974 |
| 2011 | 310,237 | 16,141 | 35,615 | 38,214 | 21,663 | 42,684 | 11,653 | 132,151 | 11,984 |
| 2012 | 319,838 | 17,510 | 36,404 | 39,385 | 22,118 | 43,552 | 11,915 | 136,754 | 11,993 |
| 2015 | 350,461 | 22,351 | 38,878 | 43,121 | 23,542 | 46,265 | 12,738 | 151,545 | 12,022 |
| 2020 | 375,653 | 29,099 | 41,667 | 45,467 | 25,409 | 53,494 | 13,213 | 159,272 | 8,032 |
| 2025 | 422,424 | 33,652 | 42,577 | 50,597 | 27,167 | 57,670 | 14,636 | 184,170 | 11,956 |
| 2030 | 462,518 | 37,906 | 43,051 | 54,733 | 28,720 | 62,530 | 16,165 | 206,525 | 12,888 |
| 2035 | 488,928 | 41,547 | 42,659 | 57,937 | 29,258 | 65,765 | 17,118 | 222,942 | 11,702 |
| 2040 | 525,693 | 47,098 | 42,651 | 62,213 | 30,225 | 70,131 | 17,978 | 243,799 | 13,426 |
| 2045 | 565,222 | 53,391 | 42,643 | 66,804 | 31,225 | 74,787 | 18,881 | 266,607 | 15,403 |
| 2050 | 607,724 | 60,525 | 42,636 | 71,734 | 32,257 | 79,752 | 19,829 | 291,549 | 17,672 |

# Appendix E: Statistical Analysis of Short Term IEUA Demand: Empirical Estimates of Demand Trends

## Introduction

For purposes of quantifying trends in IEUA Demand, one must estimate how water demand responds to predictable variations. There are numerous forces that drive demand growth in the long-term. These include changes in land use patterns and household size, growth in personal income and employment, and price and conservation. Weather conditions tend to make water demand go up or down in any given year.

For use in the Integrated Resource Plan and for calibrating long term water demand forecasts, the IEUA needs depiction of the predictable forces that cause demand to vary in the short-term so as to clarify remaining long term trends. This memorandum describes an empirical model developed to predict daily demand fluctuations. By nature, these models cannot replace long-term predictive models of water demand. However, by providing a better understanding of short-term demand variations, these models can clarify the direction of long term trends. The explanatory variables in this short-term model include:

- Deterministic functions of calendar time, including
  - The seasonal shape of demand
- Weather conditions
  - measures of maximum daily temperature, contemporaneous and time of year
  - measures of rainfall, contemporaneous and time of year
- Measures to control for long-term growth in demand
  - Trend
  - Employment growth different than trend
  - Customer response to voluntary curtailment in 2013 and 2014

The model documented here is used to create high resolution depictions of how variations in weather and the business cycle affect water demand over a wide range of conditions. These model-estimated weather and employment effects can then be used to (1) normalize observed demand and (2) serve as the basis for defining near term variability of demand and any planning dependent upon the trajectory of long term demand.

## Data and Methods

### *Data*

Water demand in the IEUA service area is approximated in this analysis as the sum of delivered supplies. This modeling effort used consistent system-wide monthly data—that is monthly water production adjusted for changes in storage. The reader is urged to keep in mind that though these models maybe described as "demand" models, the data on which these models are estimated would be better described as "supply" measures. To the extent that storage issues can be accounted for, the difference between these two constructs should be made small. Nonetheless, the issue remains.

The second major issue with using production data is the level and magnitude of noise in the data. The data generating mechanism for recording production can change over time as flow meters age or are replaced. Constructing a consistent time series requires matching two different—and possibly inconsistent—time-series. The records of flow can also embed non-ignorable meter miss-measurement.

To keep data inconsistencies from corrupting statistical estimates of model parameters, this modeling effort employed a sophisticated range of outlier-detection methods and models.

# Specification

## *A Model of Per Capita Water Demand*

The model for IEUA per capita water demand seeks to separate several important driving forces. In the short run, changes in weather can make demand increase or decrease in a given year. In the long run, increased population can drive demand higher. Strong regional economic growth can increase water demand through additional commercial or industrial water use. In addition, a rising economic tide can broadly increase personal income levels and economic activity can encourage or discourage additional population growth. Changes in water rates will change the relative attractiveness of water conservation.

These models are estimated at an aggregate level and, as such, should be interpreted as a condensation of many types of relationships — meteorological, physical, behavioral, managerial, legal, and chronological. Nonetheless, these models depict key short-run and long-run relationships and should serve as a solid point of departure for improved quantification of these linkages.

## *Systematic Effects*

This section specifies a water demand function that has several unique features. First, it models seasonal and climatic effects as continuous (as opposed to discrete monthly, semi-annual, or annual) function of time. Thus, the seasonal component in the water demand model can be specified on a continuous basis, then aggregated to a level comparable to measured water use (e.g. monthly). Second, the climatic component is specified in "difference" form as a similar continuous function of time. The climate measures are thereby made independent of the seasonal component. Third, the model permits interactions of the seasonal component and the climatic component. Thus, the season-specific response of water use can be specific to the season of the year.

The general form of the model is:

**Equation 2**

$$PerCapitaWaterUse_t[GPCD] = \frac{Use_t}{Pop_t} = f(S_t + C_t + T_t)$$

where ***Use*** is the volumetric quantity of retail water use within time *t*, $\boldsymbol{S_t}$ is a seasonal component, $\boldsymbol{C_t}$ is a climatic component, and $\boldsymbol{T_t}$ is the trend component of GPCD Demand. The function *f* is the functional form of the connection between per capita water use and its explanatory components. Each of these components is described below.

**Seasonal Component:** A monthly seasonal component could be formed using monthly dummy variables to represent a seasonal step function. Equivalently, one may form a combination of sine and cosine terms in a Fourier series to define the seasonal component as a continuous function of time.[1] The following harmonics are defined for a given day *T*, ignoring the slight complication of leap years:

[1] The use of a harmonic representation for a seasonal component in a regression context dates back to *Hannan* [1960]. *Jorgenson* [1964] extended these results to include least squares estimation of both trend and seasonal components.

**Equation 3**

$$S_t \equiv \sum_{1}^{6}\left[\beta_{i,j}\cdot\sin\left(\frac{2\pi\cdot jT}{365}\right)+\beta_{i,j}\cdot\cos\left(\frac{2\pi\cdot jT}{365}\right)\right]=Z\cdot\beta_S$$

where $T = (1,...365)$ and $j$ represents the frequency of each harmonic. Because the lower frequencies tend to explain most of the seasonal fluctuation, the higher frequencies can often be omitted with little predictive loss.

The percentage effect of the seasonal component on normal demand is given by:

**Equation 3**

$$S_t\% = \left[\frac{\exp(\widehat{Y}_t - T_t) - \exp(\widehat{Y}_t - T_t - S_t)}{\exp(\widehat{Y}_t - T_t - S_t)}\right]$$

where $\widehat{Y}$ is the predicted demand.

**Climatic Component:** The model incorporates two types of climate measures into the climatic component–rainfall and maximum daily air temperature.[2] The measures of temperature and rainfall are then logarithmically transformed to yield:

**Equation 4**

$$R_t \equiv \ln\left[1+\sum_{t=T}^{T_d} Rain_t\right], T_t \equiv \ln\left[\sum_{t=T}^{T_d}\frac{T_t}{d}\right]$$

Though this model extends to monthly measures while for daily measures, $d$ takes on the value of one. Because weather exhibits strong seasonal patterns, climatic measures are strongly correlated with the seasonal measures. In addition, the occurrence of rainfall can reduce expected temperature. To obtain valid estimates of a constant seasonal effect, the seasonal component is removed from the climatic measures by construction.

Specifically, climatic measures are constructed as a departure from their "normal" or expected value at a given time of the year. The expected value for rainfall during the year, for example, is derived from regression against the seasonal harmonics. The expected value of the climatic measures ($\hat{\boldsymbol{C}}=\boldsymbol{Z}\cdot\beta_C$) is subtracted from the original climatic measures:

**Equation 5**

$$C_t \equiv (R_t - \widehat{R}_t)\cdot\beta_R + (E_t - \widehat{E}_t)\cdot\beta_T$$

The climatic measures in this deviation-from-mean form are thereby separated from the constant seasonal effect.[3] Thus, the seasonal component of the model captures all constant seasonal effects, as it

[2] Specifically it uses the daily temperature and the total daily precipitation at the Ontario NOAA station summarized to a monthly level.

[3] The logarithmic transformation of the original climate variable implies that the seasonal mean climate effect is a geometric mean. Because the model is estimated on the logarithmic scale the departure-from-mean climatic effects would be more accurately termed departure-from-median. See *Goldberger* [1968].

should, even if these constant effects are due to normal climatic conditions. The remaining climate measures capture the effect of climate departing from its normal pattern.

The model can also specify a richer texture in the temporal effect of climate than the usual fixed contemporaneous effect. Seasonally-varying climatic effects can be created by interacting the climatic measures with the harmonic terms. In addition, the measures can be constructed to detect lagged effects of climate, such as the effect of rainfall a month ago on today's water demand.

The percentage effect of the climate on normal demand is given by:

**Equation 6**

$$C_t\% = \left[ \frac{\exp(\hat{Y}_t - T_t) - \exp(\hat{Y}_t - T_t - C_t)}{\exp(\hat{Y}_t - T_t - C_t)} \right]$$

where $\hat{Y}$ is the predicted demand.

**Trend Component :** For the IEUA Demand model, a deterministic annual trend term was used as the primary determinant of trends in per capita water demand in the long term.

**Equation 7**

$$\mathbf{T}_t \equiv AnnualTrend_t \cdot \beta_T + (\ln EmpDetrended) \cdot \beta_E$$

Thus the annual long term trend in IEUA Demand from 2002-2012 on is captured by $\beta_T$ while the effects of the business cycle are captured by the departure of employment from its long term trend.

## *Stochastic Effects*

To complete the model, we must account for the fact that not every data point will lie on the plane defined by Equation **(1)**. This fundamental characteristic of all systematic models can impose large inferential costs if ignored. Misspecification of this "error component" can lead to inefficient estimation of the coefficients defining the systematic forces, incorrect estimates of coefficient standard errors, and an invalid basis for inference about forecast uncertainty. The specification of the error component involves defining what departures from pure randomness are allowed. What is the functional form of model error? Just as the model of systematic forces can be thought of as an estimate of a function for the "mean" or expected value, so too can a model be developed to explain departures from the mean—i.e., a "variance function" If the vertical distance from any observation to the plane defined by **(1)** is the quantity $\boldsymbol{\varepsilon}$, then the error component is added to Equation **(1)**:

**Equation 8**

$$\ln \frac{Use}{Pop} = \mathbf{f}(\mathbf{S}_t, \mathbf{C}_t, \mathbf{T}_t) + \varepsilon$$

In an Ordinary Least Squares (OLS) Regression, the error term is assumed to be distributed normally with a constant variance.

$$\varepsilon \sim N(\mu_\varepsilon, \sigma_\varepsilon)$$

In the estimated retail demand model below, the variance is allowed to be nonconstant and separately modeled as an empirical variance (or link) function.

$$\sigma_{\varepsilon} = g(\mathbf{S}_t, \mathbf{C}_t, \mathbf{T}_t)$$

A variance function was estimated using the methods of Carroll and Ruppert as a two stage weighted least squares regression[4]. Briefly described, the first stage uses an OLS regression of the mean function (Equation 7) to derive a consistent estimate of the estimated error. The absolute value of the estimated error is used to estimate the variance function. The inverse of the predicted variance is used to weight the regression of the mean function in the second stage.

## *Estimated Per Capita Demand Model for IEUA*

Table C1 presents the estimation results for the model of mean monthly per capita demand in IEUA. The independent variables 1 to 8—made up of the sines and cosines of the Fourier series described in Equation 2—are used to depict the seasonal shape of daily retail water demand (that is, $Z \cdot \widehat{\beta}_S$); this is the shape of demand in a normal weather year. This seasonal shape is important in that it represents the point of departure for the estimated climate effects (expressed as departure from what is expected in an average month).

The estimated weather effect is specified in "departure-from-normal" form. Variable 9 is the departure of monthly precipitation from the average precipitation for that month in the season. (Average seasonal precipitation is derived from a regression of monthly precipitation on the seasonal harmonics—exactly equal to monthly precipitation averaged over all years in the record.) Temperature is treated in an analogous fashion (Variables 11). The contemporaneous weather effect is interacted with the harmonics (Variables 10, 12, and 13) to produce a seasonal shape to both the rainfall and the temperature elasticities. Thus, departures of temperature from normal produce the largest percentage effect in the spring. Similarly, departures from normal rainfall produce a larger effect upon daily demand in the summer than in the winter. The lagged effect of temperature can also be detected further in time than rainfall—a detectable effect one month long.

The departure of employment growth from trend (13) and the annual trend term (variable 14) and comprise the long term determinants of demand.[5] Indicators ("dummy") variables for the years 2013 and 2014 were used to detect any customer response to the drought-induced calls for voluntary demand curtailment. (These measure the annual change in demand that was surprising: not explainable due to weather variation, recession, or ongoing trends in demand.) The constant term (17) describes the intercept for this equation.

[4] See Carroll, R. J. and Ruppert, D. (1988). *Transformation and Weighting in Regression*. Chapman and Hall, London.

[5] A variation of the model was used to test for a detectable trend in the seasonal shape of demand by including an interaction of the trend term and the annual harmonic.

**Table 1-- Estimated IEUA Per Capita Demand Model (Mean Function)**

| Estimated IEUA Demand Model (Mean Function)<br>Ln IEUA Per Capita Use (Gl. Per Capita Per Day) | | |
|---|---|---|
| Independent Variable | **Coefficient** | **Std. Error** |
| 1. First Sine harmonic, 12 month (annual) frequency | -0.10278 | 0.00714 |
| 2. First Cosine harmonic, 12 month (annual) frequency | -0.37889 | 0.00642 |
| 3. Second Sine harmonic, 6 month (biannual) frequency | -0.00489 | 0.00688 |
| 4. Second Cosine harmonic, 6 month (biannual) frequency | -0.00438 | 0.00723 |
| 5. Third Sine harmonic, 4/12 frequency | -0.00510 | 0.00849 |
| 6. Third Cosine, 4/12 frequency | 0.02987 | 0.00699 |
| 7. Fourth Sine harmonic, 3 month (quarterly) frequency | 0.01300 | 0.00857 |
| 8. Fourth Cosine, 3 month (quarterly) frequency | 0.02357 | 0.00820 |
| 9. Contemporaneous Rainfall Deviation [(ln (Rain+1)) – Monthly mean] | -0.13102 | 0.02219 |
| 10. Interaction of contemporaneous rain with annual cosine harmonic | -0.04787 | 0.02701 |
| 11. Contemporaneous deviation from mean ln (temperature) in the month | 0.87760 | 0.12878 |
| 12. Interaction of contemporaneous temperature deviation with annual sine harmonic | 0.14438 | 0.16733 |
| 13. Deviation of ln(Employment in San Bernardino County) from Trend | 0.96640 | 0.09765 |
| 14. Overall Annual Trend 2003-2014 | -0.00147 | 0.00207 |
| 15. Indicator for 2013 | -0.02098 | 0.01367 |
| 16. Indicator for 2014 | -0.04618 | 0.02613 |
| 17. Intercept | 5.46346 | 0.01788 |
| Obs | 139 | |
| R^2 | 0.9760 | |
| Root Mean Squared Error | 0.03816 | |
| Time period (Fiscal Years) | 2003-2014 | |

Figures 1 and 2 plot Actual IEUA Per Capita Demand against the model predictions ($\hat{Y}$) and reveals a very tight fit of predictions to actual.

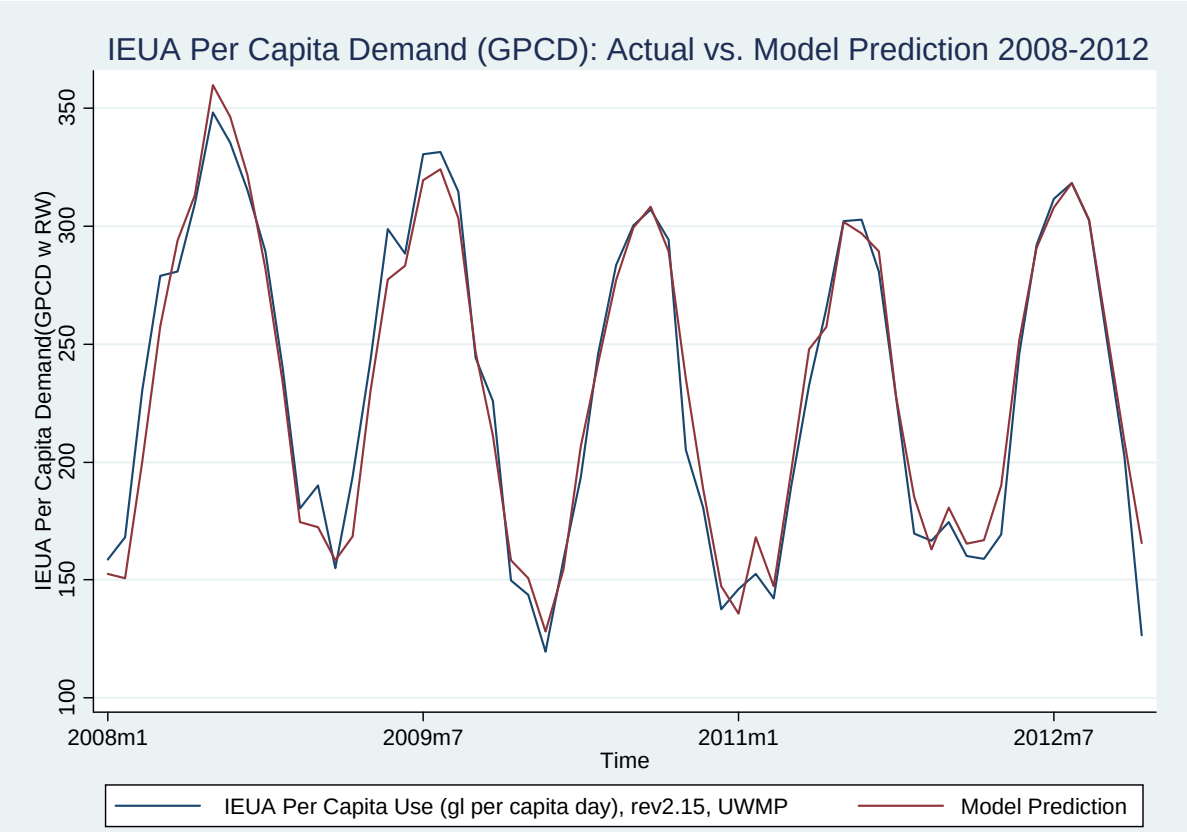



**Figure 1-- IEUA Per Capita Demand (GPCD): Actual vs. Model Prediction , FY 2008-2012**

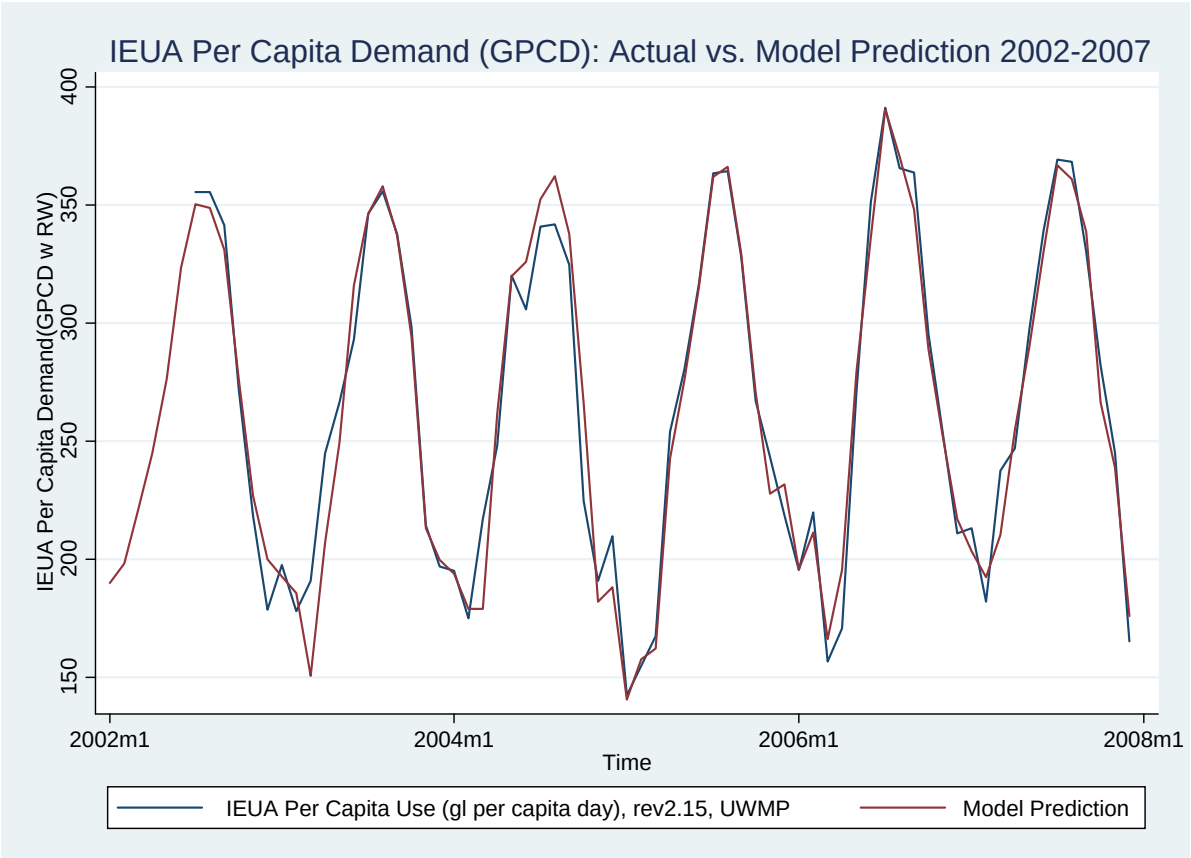



**Figure 2-- IEUA Per Capita Demand (GPCD): Actual vs. Model Prediction , FY 2002-2007**

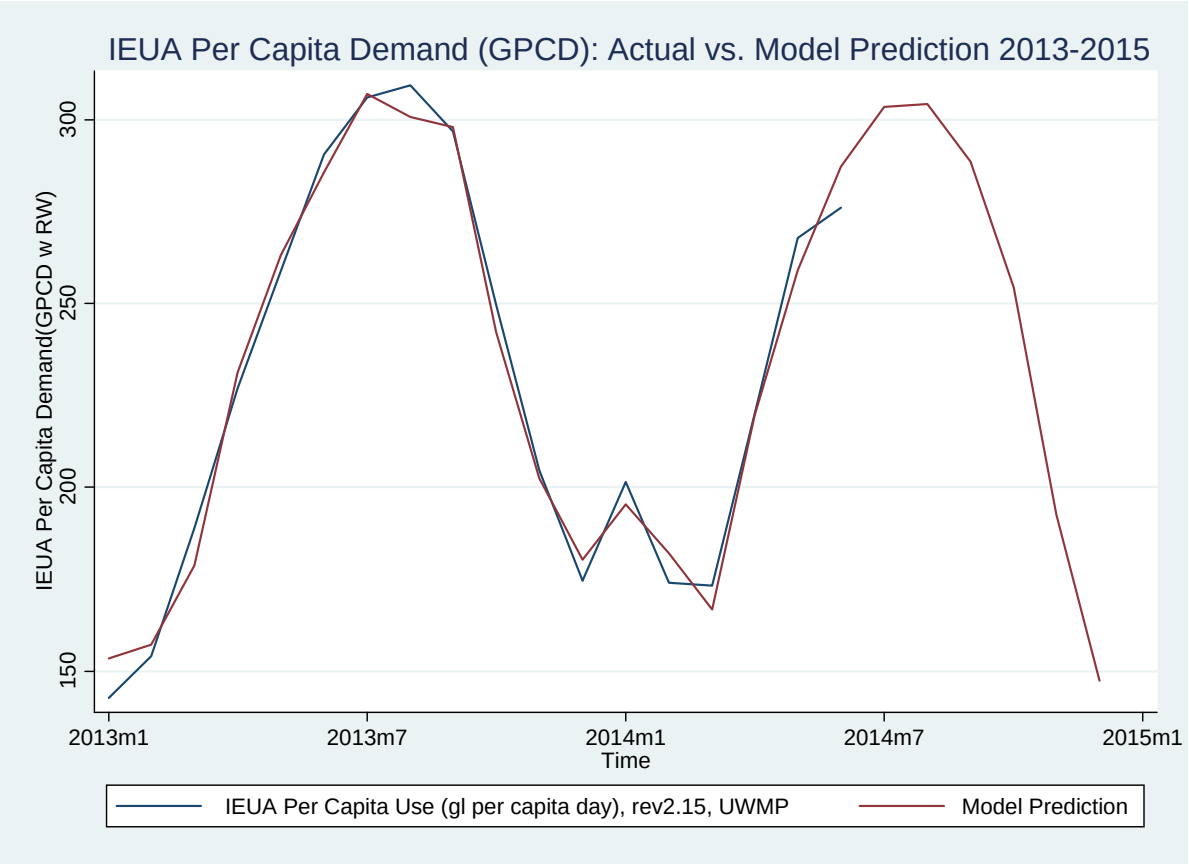



**Figure 3-- IEUA Per Capita Demand (GPCD): Actual vs. Model Prediction, 2013-2014**

## *Application to Demand Trends*

From the statistically estimated model documented above, one can calculate the effect of weather on per capita water demand as the difference between two predictions: a prediction of demand conditional on actual weather and a prediction of demand "as if" weather were normal[6]. Equation 5 specifies this relationship in percentage terms. Table 2 presents the summation of the estimated effect of weather for each year.

[6] Normal weather is defined as the average values of each weather variable in each month over the period of record 1950-2012.

**Table 2-- Effect of Weather on IEUA Per Capita Demand (GPCD)**

| IEUA Water Demand (GPCD) | | | | |
|---|---|---|---|---|
| | IEUA Water Demand | | | |
| Year | Effect of Weather on Water Demand (Change in GPCD) | Effect of Weather on Water Demand (Percent) | Precipitation (inches) | Max Temperature (F) |
| 2003 | -22.85 | -0.75% | 16.71 | 77.15 |
| 2004 | 114.88 | 3.58% | 8.66 | 79.71 |
| 2005 | -170.88 | -5.73% | 28.20 | 76.19 |
| 2006 | -10.02 | -0.32% | 12.78 | 78.15 |
| 2007 | 190.90 | 5.70% | 3.73 | 79.78 |
| 2008 | 43.61 | 1.40% | 11.75 | 78.58 |
| 2009 | 111.29 | 3.70% | 9.40 | 79.50 |
| 2010 | -15.18 | -0.56% | 15.34 | 77.95 |
| 2011 | -75.60 | -2.89% | 16.45 | 76.47 |
| 2012 | 14.05 | 0.52% | 9.12 | 78.14 |
| 2013 | 142.80 | 5.05% | 5.54 | 80.35 |
| 2014 | 197.84 | 6.97% | 4.38 | 81.13 |
| **Long Term Average** | 2003-2014 | | 11.84 | 78.6 |
| **Weather Station** | Ontario NOAA | | | |

Finally, these estimated effects of non-normal weather and employment different from trend are next used to estimate what per capita water demand would have been if weather had been normal and if employment had not differed from its historical trend (that is, if the recession had not occurred.) Actual demand with weather and employment effects removed will be referred to as "normalized" per capita water demand. Figure 4 below plots the mean monthly employment for San Bernardino County and reveals the sharp effects of the recent recession.

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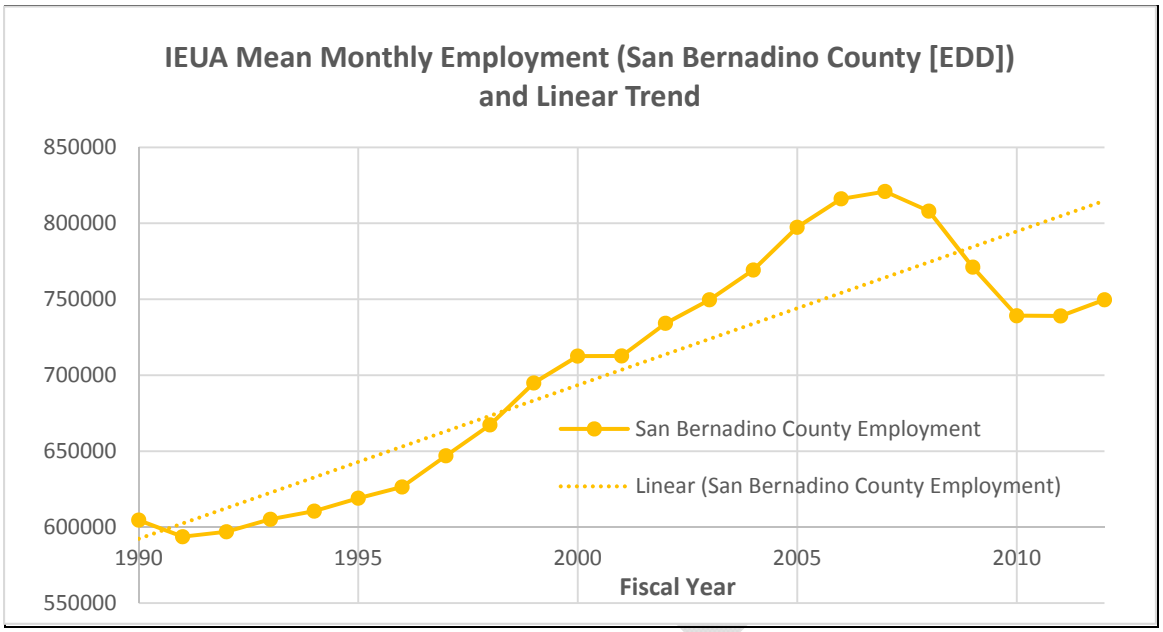



**Figure 4-- IEUA Mean Monthly Employment (San Bernardino County [EDD]) and Linear Trend**

Table 3 presents the derivation of normalized IEUA per capita water demand. The first column of raw demand data ("Actual Demand") is followed by demand normalized for weather. The estimated percentage effect of weather different from normal ("Effect of Weather on Water Demand (Percent)") explains how weather affected actual demand and is used to estimate the third column of retail demand ("Demand Normalized for Weather (GPCD)"). A similar estimate for the effect of employment different than trend is used to estimate the last column of retail demand ("Demand Normalized for Weather and Employment"). The assumptions implied by this "normalization" include that realized weather is exactly equal to average weather (monthly averages based on the period of record 1950-2012) and that employment continued along its long term trend (as depicted by the straight line in Figure 3).

Note that the variation of the percentage annual effect of weather and employment is summarized at the bottom of the table and is useful for risk analysis. Weather could knock per capita demand 7.3 percent either way in any year (90 percent confidence interval). The effect of the business cycle—as captured by the effect of employment swings—is very pronounced in recent years due to the Great Recession. Single year swings of 5 and a half percent occurred more than once with a very wide confidence interval required to contain 90 percent of expected annual variation due to employment variation (approximately 12.8 percent either way in any year).

The model also detects customer response in 2013 and 2014 to drought-induced calls for customers to voluntarily curtail water demand. These effects, though targeted mostly to residential customers, provide evidence of some customer response that cannot be

explained by the other forces in the model—weather variation, variation in employment, and long term trends in water demand.

**Table 3-- IEUA Per Capita Use (GPCD): Actual and Normalized**

| | IEUA Water Demand | | | | |
|---|---|---|---|---|---|
| **Fiscal Year** | Actual Demand (GPCD) | Effect of Weather on Water Demand (Percent) | Demand Normalized for Weather (GPCD) | Effect of Employment on Water Demand (Percent) | Demand Normalized for Weather and Employment (GPCD) |
| 2003 | 257.77 | -0.75% | 259.7 | 4.54% | 247.92 |
| 2004 | 267.63 | 3.58% | 258.1 | 5.64% | 243.51 |
| 2005 | 245.78 | -5.73% | 259.9 | 7.71% | 239.83 |
| 2006 | 262.56 | -0.32% | 263.4 | 8.70% | 240.47 |
| 2007 | 283.06 | 5.70% | 266.9 | 8.11% | 245.29 |
| 2008 | 265.58 | 1.40% | 261.9 | 5.52% | 247.43 |
| 2009 | 256.55 | 3.70% | 247.1 | 0.10% | 246.82 |
| 2010 | 228.42 | -0.56% | 229.7 | -5.56% | 242.47 |
| 2011 | 212.70 | -2.89% | 218.8 | -7.04% | 234.25 |
| 2012 | 220.83 | 0.52% | 219.7 | -7.08% | 235.24 |
| 2013 | 231.40 | 5.05% | 219.7 | -6.06% | 233.03 |
| 2014 | 237.75 | 6.97% | 221.2 | -5.25% | 232.80 |
| | **Standard Deviation of % Effects** | **+/- 3.74%** | | **+/- 6.55%** | |
| | **95% Confidence Interval** | **+/- 7.3%** | | **+/- 12.8%** | |
| **Percentage Annual Trend, FY2003-2007** | 2.4% | | 0.7% | | -0.3% |
| **Percentage Annual Trend, 2007-2012** | -2.7% | | -3.8% | | -0.8% |

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Table 4 presents the same results as in Table 3, but in terms of acre feet rather than GPCD. Again, the first column of raw demand data ("Actual Demand") is followed by demand normalized for weather. The estimated percentage effect of weather different from normal ("Effect of Weather on Water Demand (Percent)") explains how weather affected actual demand and is used to estimate the third column of retail demand ("Demand Normalized for Weather (AF)"). A similar estimate for the effect of employment different than trend is used to estimate the last column of retail demand ("Demand Normalized for Weather and Employment").

Taken from "peak to trough," from 2007 to 2012, Table 4 also shows the decline in actual demand was an average of 4.3 percent per year, for a total of 19.6 percent decline over the five-year period. After normalizing for weather and employment, the decline was an average of 0.2 percent per year, or about a one percent decline over the five-year period.

The effect on the trend in per capita demand is easier to discern in Figures 4 and 5. Figure C5 plots actual and normalized demand in terms of GPCD. The near three percent annual decline (2.7 percent) in actual GPCD demand between fiscal years 2007 and 2012 is reduced in magnitude to less than one percent decline (0.8 percent) after normalizing for weather and employment. Figure 5 plots actual and normalized demand in terms of acre feet. The decline in actual demand (in acre feet per year) between fiscal years 2007 and 2012 was 4.3 percent per year on average. After normalizing for weather and employment, there was actually a slight decrease of 0.2 percent.

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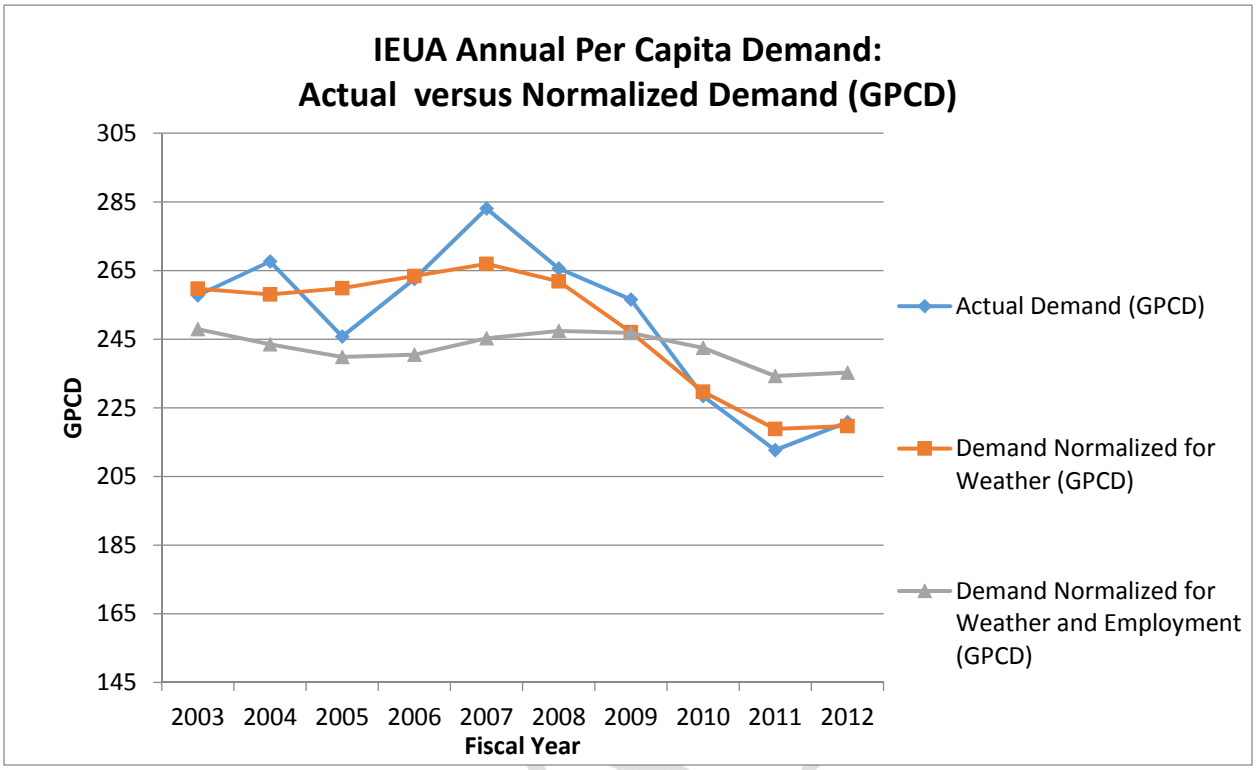



**Figure 5-- IEUA Annual Per Capita Demand: Actual versus Normalized Demand (GPCD)**

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**Table 4-- IEUA Use (Acre Feet): Actual and Normalized**

| | IEUA Water Demand | | | | |
|---|---|---|---|---|---|
| **Fiscal Year** | Actual Demand (AF) | Effect of Weather on Water Demand (Percent) | Demand Normalized for Weather (AF) | Effect of Employment on Water Demand (Percent) | Demand Normalized for Weather and Employment (AF) |
| 2003 | 215685 | -0.75% | 217309.4 | 4.54% | 207434.07 |
| 2004 | 230498 | 3.58% | 222247.4 | 5.64% | 209718.74 |
| 2005 | 213262 | -5.73% | 225476.5 | 7.71% | 208098.51 |
| 2006 | 230911 | -0.32% | 231640.4 | 8.70% | 211482.21 |
| 2007 | 255280 | 5.70% | 240727.8 | 8.11% | 221216.62 |
| 2008 | 241913 | 1.40% | 238528.0 | 5.52% | 225372.92 |
| 2009 | 233799 | 3.70% | 225147.9 | 0.10% | 224930.13 |
| 2010 | 209290 | -0.56% | 210457.9 | -5.56% | 222162.16 |
| 2011 | 195745 | -2.89% | 201392.7 | -7.04% | 215570.59 |
| 2012 | 205231 | 0.52% | 204166.6 | -7.08% | 218614.07 |
| 2013 | 216004 | 5.05% | 205103.5 | -6.06% | 217527.39 |
| 2014 | 223435 | 6.97% | 207870.6 | -5.25% | 218784.24 |
| | **Standard Deviation of % Effects** | **+/- 3.74%** | | **+/- 6.55%** | |
| | **95% Confidence Interval** | **+/- 7.3%** | | **+/- 12.8%** | |
| **Percentage Annual Trend, FY2003-2007** | 4.3% | | 2.6% | | 1.6% |
| **Percentage Annual Trend, 2007-2012** | -4.3% | | -3.2% | | -0.2% |

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# Appendix 2:

# RAND Memo "Evaluating Options for Improving Climate Resilience of the Inland Empire Utilities Agency in Southern California"

**DRAFT. NOT CLEARED FOR OPEN PUBLICATION. DO NOT CIRCULATE OR QUOTE.**

Project Report

# Evaluating Options for Improving the Climate Resilience of the Inland Empire Utilities Agency in Southern California

Abbie H. Tingstad, David G. Groves, and James Syme (RAND Corporation)
Elizabeth Hurst and Jason Pivovaroff (Inland Empire Utilities Agency)

March 2016

# Preface

The Inland Empire Utilities Agency (IEUA) and RAND worked together in 2003-2005 to demonstrate and evaluate how new approaches to decisionmaking under uncertainty could help a water utility evaluate the potential threats of climate change in their long-term planning. This work was performed outside IEUA's planning process and was documented in several RAND reports and scientific journal articles (Groves, Davis, *et al.*, 2008; Groves, Knopman, *et al.*, 2008; Groves, Lempert, *et al.*, 2008). In 2015, IEUA asked RAND to help it re-evaluate its water management system under a range of future conditions reflecting climate change and other drivers for its Integrated Resources Plan (IRP). This report documents the tools developed and analysis performed during 2015 for this effort. Questions or comments about this report should be sent to the project leaders, David Groves (groves@rand.org) and Abbie Tingstad (tingstad@rand.org).

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# Abbreviations

| | |
|---|---|
| BCSD | Bias-Corrected Statistically Downscaled |
| CMIP | Coupled Model Intercomparison Project |
| FWOA | Future Without Action |
| GCM | General Circulation Model |
| GHCND | Global Historical Climatology Network Database |
| IEUA | Inland Empire Utilities Agency |
| IRP | Integrated Resources Plan |
| MWD | Metropolitan Water District of Southern California |
| NOAA | National Oceanographic and Atmospheric Administration |
| PDT | Portfolio Development Tool |
| RDM | Robust Decision Making |
| SAR | Santa Ana River |
| SEI | Stockholm Environment Institute |
| UWMP | Urban Water Management Plan |
| WCRP | World Climate Research Programme |
| WEAP | Water Evaluation and Planning System |
| WEI | Wildermuth Environmental Inc. |

# Introduction

Water managers continue to face challenges related to climate non-stationarity (Milly *et al.*, 2008) in their long-term planning. Even when water supplies appear sufficient to meet present and short-term demand, uncertain future changes in temperature and precipitation make decisions about investments to ensure longer-term supply sufficiency difficult. In Southern California, the recent drought has refocused attention on water resources in this semi-arid, populous area. Although this drought appears to be consistent with long-term patterns of climate variability, its effects may be exacerbated by ongoing climate change, which is anticipated to have a strong effect on the region, including on its water supplies (e.g., with respect to the length and magnitude of droughts, timing of precipitation, and temperature-driven demand) (Diffenbaugh *et al.*, 2015; Mao *et al.*, 2015; Shukla *et al.*, 2015)

Adaptive management plans are designed to evolve over time in response to new information regarding future conditions. This type of flexible approach is becoming increasingly favored in the water management community as a mechanism for planning under uncertainty. Integrative approaches, which help facilitate adaptive plans, focus on combining a variety of management options, rather than a single type of solution.

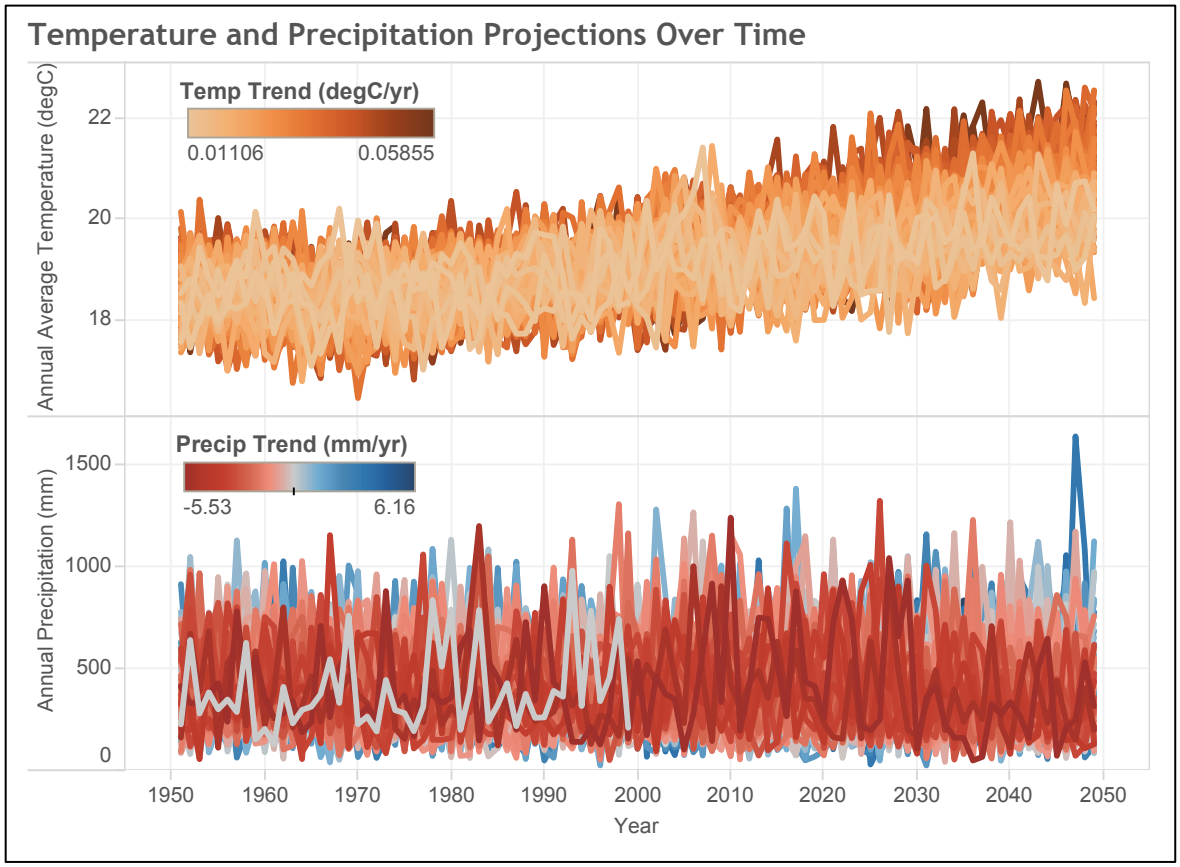
The Inland Empire Utilities Agency (IEUA), a water management agency in Southern California, recently partnered with the RAND Corporation, a multi-disciplinary, non-partisan research organization and educational institution headquartered in Santa Monica, California, to evaluate how adaptive, integrative water management options could improve IEUA's abilities to meet customer needs under a wide range of futures. This analysis was used to support the development of its Integrated Resources Plan (IRP). The purpose of the IRP is to evaluate the resiliency of water resources in the IEUA's service area over the next twenty-five years and to evaluate alternative management options for ensuring water deliveries to urban users. The IRP results will be used to recommend regional strategies and identify preferred water supply projects that, in turn, will help the IEUA and its member agencies to apply for grants and loans to implement new projects. RAND supported IEUA's IRP by developing a tool for constructing and visualizing different portfolios for water management investments and actions, and enabling an analysis of *status quo* and potential future water management activity success in meeting future urban water demand under different demand and climate change-impacted water supply conditions. This follows RAND's previous work supporting the IEUA's 2005 Urban Water Management Plan (UWMP) (Groves, Knopman, *et al.*, 2008; Groves, Lempert, *et al.*, 2008).

Current water demands in the IEUA service area are serviced by groundwater from the Chino Basin in addition to local surface supplies, recycled water, and imported water from Northern California via Metropolitan Water District of Southern California (MWD). In addition, IEUA implements water efficiency projects, such as low-flow toilet rebate programs. Depending on different estimates of future infrastructure water efficiency, this "baseline" supply (current and planned supplies from groundwater and other sources plus savings from water efficiency projects) is likely sufficient, or very nearly so, for meeting future demand assuming climatic conditions remain similar to those experienced in recent history. However, IEUA wanted to explore how shifts in stationarity assumptions through climate change, along with possible changes in demand, could impact its future water supplies and demands, and what water management projects could help meet future demand under uncertain future temperature and precipitation conditions.

A suite of global climate models suggests that temperatures over the IEUA service area will rise over the coming decades and that annual precipitation will continue to be highly variable, with no consensus on trends towards wetter or drier conditions. Figure 1 displays the annual average temperature and total precipitation estimates from 1950 to 2050 for the IEUA service area based on 106 downscaled projections of climate from a range of general circulation models (GCMs).[1] The temperature increases seen beginning around the 1980s and the uncertainty associated with local precipitation underscores the importance of carrying out an analysis of IEUA water management options to ensure that future demand can be met under a variety of different hydrologic circumstances against the backdrop of rising temperatures.

[1] Note that GCMs are not expected to simulate the precise interannual fluctuations of the historical period, because stochastic forces and sequences of events that are unresolvable by numerical models drive such historical variability. Instead, GCMs are validated based on their ability to characterize the statistical characteristics of historical climate, such as maximum and minimum temperatures or precipitation.

**Figure 1: Estimates of historical and future annual average temperature and total precipitation for the IEUA service area**




To support this analysis we developed (1) a simple mass balance water management model to estimate future supplies and demand across different future and (2) a decision support tool to help IEUA planners and stakeholders to compare attributes of different management options and develop portfolios for evaluation. We then performed a three-step analysis:

1. Evaluated the performance of the IEUA system under a wide range of futures to evaluate its vulnerability to climate and future demand
2. Constructed portfolios of water management projects that could help increase water management supplies in the future
3. Tested and compared how each proposed water management portfolio enhances the IEUA's ability to deliver urban water supplies in the future

In the next section we describe the methods and models used in each step. Due to the limited scope of this effort, we did not attempt to evaluate the cost-effectiveness or finer details (e.g., implementation potential at specific locations) of the different water management projects. We also did not conduct statistical analysis to determine the specific climatic conditions most

conducive to different portfolio success or failure in meeting urban water demand, nor did we consider uncertainties related to budget and/or other factors that could impact our results.

# Methods

The overarching methodological framework for this project is Robust Decision Making (RDM) (Groves and Lempert, 2007; Lempert *et al.*, 2003). RDM is an approach that seeks to determine what plans reduce risk over a range of assumptions, thereby facilitating deliberation among stakeholders that may have differing values and expectations about the future (Lempert, 2013). It is a methodological process, involving iterative steps including stakeholder interactions, modeling, and statistical analysis, that facilitates interactions and aims to shape decision-maker discussions around which factors lead to plan success or failure and the identification of robust solutions – those that perform well under a range of futures—rather than a single "best" solution (Hallegatte *et al.*, 2012; Lempert *et al.*, 2006). The RDM approach runs models on tens to thousands of different sets of assumptions to describe how plans perform in a range of plausible futures. Analysts then use visualization and statistical analysis of the resulting large database of model runs to help decision-makers distinguish future conditions in which their plans will perform well from those in which they will perform poorly (Bryant and Lempert, 2010). RDM has been used in a range of contexts, to include water management, flood risk assessment, and sea level rise planning (Groves *et al.*, 2013, 2014; Herman *et al.*, 2015; Tingstad *et al.*, 2013).

Many RDM analyses are conceptually organized using a framework called "XLRM", where key uncertainties (X), policy levers or strategies (L), relationships or models (R), and metrics or outcome measures (M) are summarized in a quad chart. The principal considerations around which this project is organized are summarized in XLRM format below.

**Table 1: Summary of uncertainties, projects, models, and outcome measures considered**

| Uncertainties (X) | Projects (L) |
|---|---|
| Climate conditions<br>Demand | 75 different projects in categories<br>• Chino Basin projects (13)<br>• Imported Water Direct, Imported Water Recharge (14)<br>• Imported Water Recharge (3)<br>• Imported Water Recharge / Recycled Water (4)<br>• Local Surface (2)<br>• Other Groundwater (1)<br>• Recycled Water (16)<br>• Stormwater (6)<br>• Stormwater, Recharge, Imported Water Recharge, Recycled Water (4)<br>• Water Use Efficiency (10)<br>• Chino Basin Groundwater, Recycled Water, Imported Water (2) |
| **Models (R)** | **Performance Metrics (M)** |
| WEAP IEUA<br>IEUA Portfolio Development Tool | Demand<br>Sources of supply to meet demand<br>Unmet demand |

## Water Management Mass Balance Model

RAND developed a water management model developed for the IEUA service area using a simulation platform called the Water Evaluation and Planning system (WEAP) (Yates *et al.*, 2005). The purpose of this model was to help address Step One of our analysis by creating a simulation model that could evaluate the performance of the IEUA system under a wide range of futures. In brief, WEAP enables integration of physical hydrologic processes with management of water demands and supplies using a link-and-node representation of a water management system, as constructed by a user. The WEAP model was used primarily to evaluate projected annual urban demands, sources of supply, and unmet demands.

RAND previously developed a WEAP model for the IEUA service area (Groves, Lempert, *et al.*, 2008) based on information available during the 2003-2005 time period. For the present study, RAND developed a new WEAP model based primarily on IEUA's latest spreadsheet-based information about current water supplies and demands, and annual projections of them through 2050. See Appendix 2 for more detail.

Absent available detailed analyses of how climate change could affect each element of IEUA's water supply portfolio, RAND worked with the best available data to develop some coarse approximations of how different supplies and demand would change under different assumptions and projections of climate conditions. These analyses were developed as a first step towards a more comprehensive assessment of IEUA resilience to climate change, and were vetted by IEUA water managers. For the purposes of this initial work, these coarse approximations provided sufficient insights into the potential impacts of climatic changes on supply and demand to facilitate deliberation over the usefulness of different types of water management projects.

Several "simple models" were developed to estimate the impacts of climatic changes on the following elements of the IEUA system (see Appendix 2 for details):

- *Local surface supplies, storm water, and replenishment supplies*: two regression models of historical annual local surface supplies and annual climate were used to estimate future local surface supplies based on projections of temperature and precipitation. These models were applied to estimate local surface supplies, available storm water supplies, and non-MWD replenishment supplies.
- *Groundwater safe yield*: Projections of future safe yield under different trends in climate conditions were developed by Wildermuth Environmental Inc. (WEI) and provided to IEUA and the study team. The current long-term sustainable yield of the groundwater basin was then modified for each climate projection based long-term precipitation trend perturbation factors derived from the WEI analysis.
- *Imported supplies via Metropolitan Water District*: A simple linear model of supply availability over time from Northern California via MWD was used to modify IEUA's contractually available supply from MWD. Two different climate response rates were

evaluated that effectively assumed a 17% and 34% reduction in imported available water by 2040.

- *Water demand*: Demand climate adjustment factors were developed using IEUA calculations of the sensitivity of demand to climate using MWD-MAIN. These factors were used together with the climate scenarios (annual average temperature and precipitation) to adjust the demand annually.

By imbedding these models into the WEAP model, we estimated future local surface water production, groundwater sustainable yield and replenishment, outdoor urban demand, and possible adjustments to water imports under changing climate. This WEAP model was used to both test baseline supply resiliency to climate change as well as determine expected benefits from new water management projects.

## Portfolio Development Tool

With inputs from the IEUA and its member agencies, RAND created a Portfolio Development Tool (PDT) using the visualization software platform Tableau. The purpose of this activity was to support Step Two of our analysis by creating a user-friendly interface through which the IEUA and its member agencies could explore a variety of water management projects and develop portfolios that included one or more projects. The PDT enables users to review individual project attributes—both quantitative (i.e., how much water they produce) and qualitative (e.g., whether they contribute to different IEUA regional goals)—and determine how combinations of these projects together would increase future supplies, moderate demand, and meet qualitative, regional goals. IEUA and RAND used the PDT to support a series of meetings between the IEUA and member agencies and a workshop co-run with member agency representatives to create different adaptive, integrative options for increasing future water supplies. The final list of portfolios selected by the IEUA using the PDT is represented in the table below (Table 2), and the IEUA IRP includes more detailed description and rationale for these portfolios.

**Table 2: Management portfolios developed using the Portfolio Development Tool**

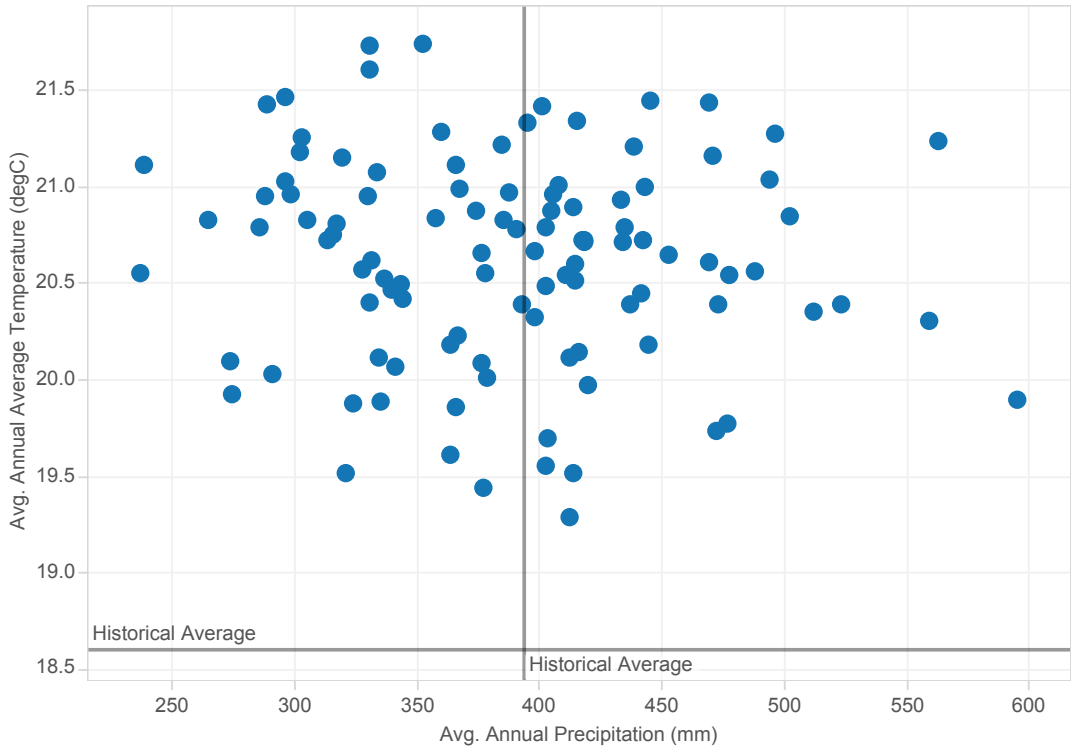
| Portfolio Name | Portfolio Description |
|---|---|
| Portfolio #1 | Maximize the Use of Prior Stored Groundwater |
| Portfolio #2A | Maximize Recycled Water (Including External Supplies) and Local Supply Projects and Implement Minimal Water Efficiency |
| Portfolio #2B | Portfolio 2A Plus Secure Supplemental Imported Water from MWD and Non-MWD Sources |
| Portfolio #3A | Maximize Recycled Water (Including External Supplies) and Implement Moderate Water Efficiency |
| Portfolio #3B | Portfolio 3A Plus Implement High Water Efficiency |

| | |
|---|---|
| Portfolio #4 | Maximize Supplemental Water Supplies and Recycled Water Supplies |
| Portfolio #5A | Maximize the Purchase of Imported Water from MWD and Implement Minimal-Moderate Level of Water Efficiency |
| Portfolio #5B | Portfolio 5A Plus Maximize Recycled Water |

## Climate and Demand Futures

The WEAP model was then used to "stress test" the resiliency of the IEUA service area's baseline water supplies, and baseline supplies plus the different future water management project portfolios, under different conditions of climate change and demand. This is Step Three of our analysis. The study considered the 106 projections of future climate displayed in Figure 1. These were downloaded from an archive of downscaled global climate model simulations, described in Appendix 2. These 106 projections of future climate were integral to our ability to stress test the IEUA water management system in its ability to meet future demand. Each projection represents a plausible climate future in our analysis. Although we cannot know with certainty what type of climatic change the future holds, having a diverse set of projections enables development of management alternatives that could be robust in adapting to a range of different conditions. Figure 2 plots the average annual temperature and precipitation from 2040-2049 for this set of climate projections.

**Figure 2: Average annual temperature and precipitation over the Inland Empire Utilities Agency service area from 106 climate projections (2040-2049)**




All the climate projections show higher average annual temperatures from 2040 – 2049 than the historical average (1951-1999). This is consistent with observed and projected changes around the world (IPCC, 2014). About half of the climate projections show higher precipitation and half show lower precipitation. Specifically, annual average precipitation varies between 237 mm/year to 595 mm/year, or between 60% and 151% of the historical record. This uncertainty in precipitation trends reflects the difficulty in modeling the complex atmospheric and oceanic processes that govern precipitation patterns in the Southwest United States and the stochasticity of these processes (Peterson *et al.*, 2013). Although these projections do not indicate whether the climate will get drier or wetter in the coming decades in the IEUA service area, they do provide a useful test bed of plausible climate conditions for which to stress test water management plans. Dry conditions can challenge the ability of the system to meet user demand whereas wet conditions can render additional supply investments unnecessary expenditures.

Scientists have confidence that the projections in Figure 2 are suggestive of future climate conditions that are impacted by higher greenhouse gas concentrations in the atmosphere. One reason is that these climate models, when evaluated for historical periods of time (e.g. 1950-2000), estimate past variability that is similar to the observed historical values. To illustrate this, Figure 3 shows the historical, observed annual average temperature and annual total precipitation from 1951 – 1999 for the IEUA service area (blue line on the left), along side the maximum and

minimum projected annual average temperature from the 106 climate scenarios for the same time period (box charts on the right). The models, when "backcasting" the same historical time period, estimate a range of maximum and minimum temperatures that are inclusive of the historical observed maximum and minimum temperature. Figure 4 shows the same comparison for annual total precipitation. Once again, the future and historical maxima and minima appear to have some overlap.

**Figure 3: Observed historical annual temperature record for the IEUA service area from 1951 – 1999 (left) compared to the distribution of predicted maximum and minimum temperatures across the 106 climate scenarios for the same historical time period (right)**

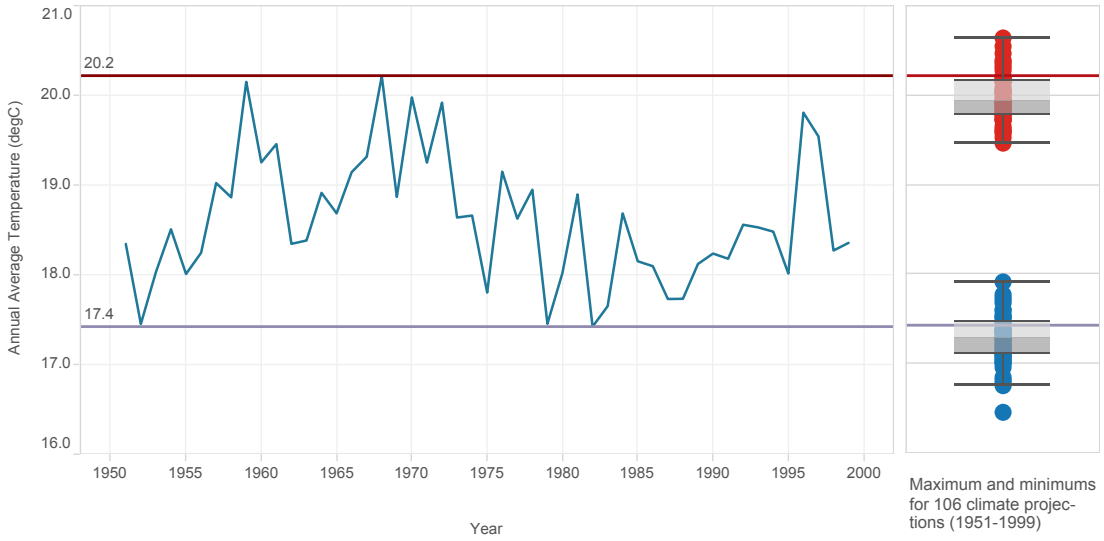
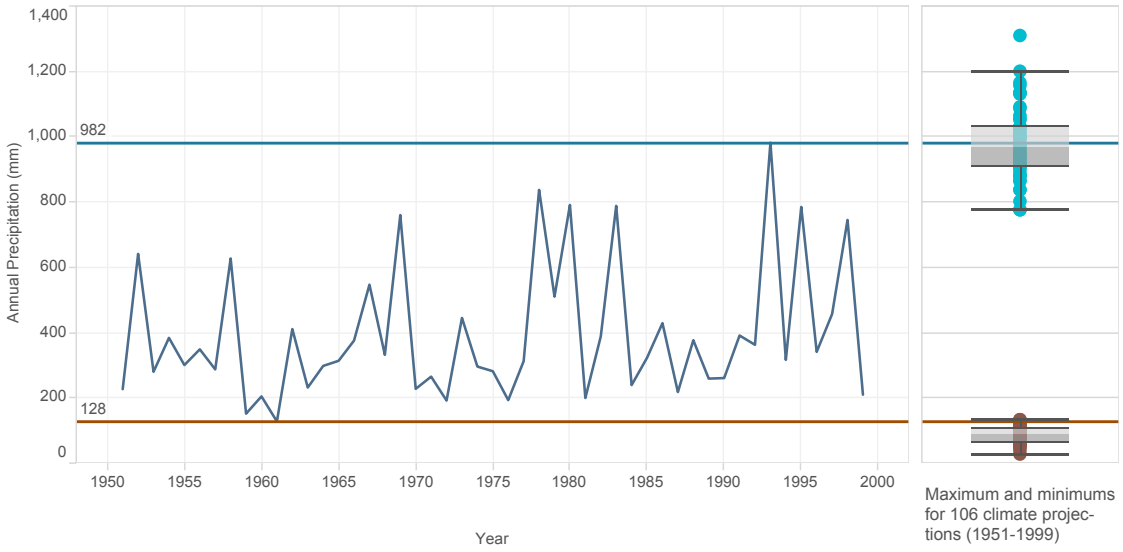
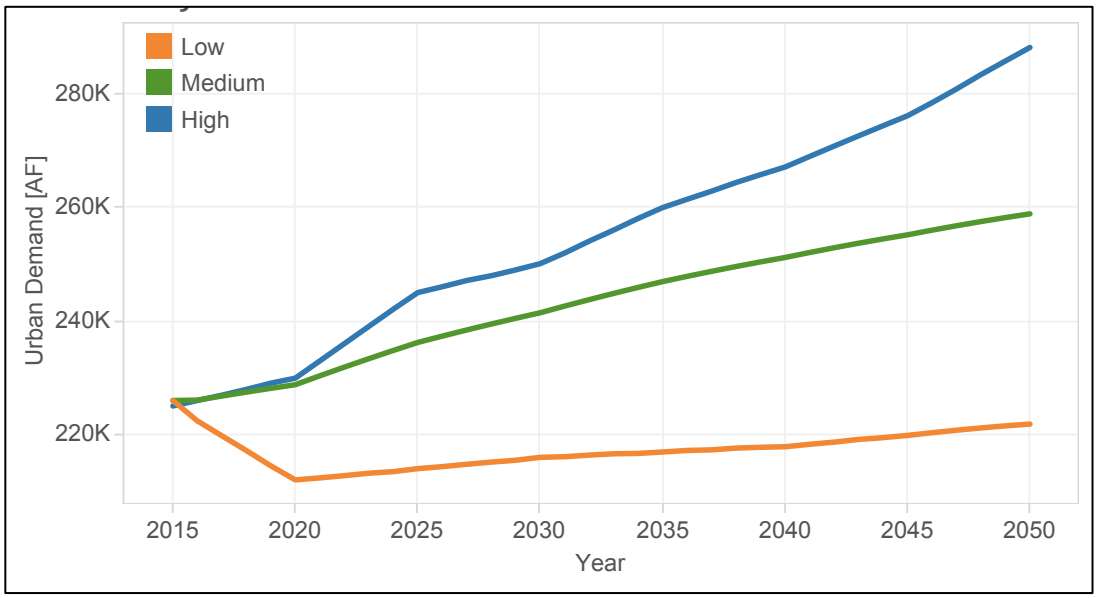


**Figure 4: Observed historical annual total precipitation record for the IEUA service area from 1951 – 1999 (left) compared to the distribution of predicted maximum and minimum precipitation across the 106 climate scenarios for the same historical time period (right)**




In addition to future climate, this work also examined impact of future demand. IEUA supplied two projections of future demand—a low and high demand estimate. A middle projection was then estimated within the water management model by specifying indoor and outdoor water use rates that were between those used for the high and low demand estimate. Figure 5 shows these three demand scenarios under conditions of no climate change. It also shows unmet demand under historical climate conditions.

**Figure 5: IEUA demand scenarios under no climate change**




## Simulating future conditions

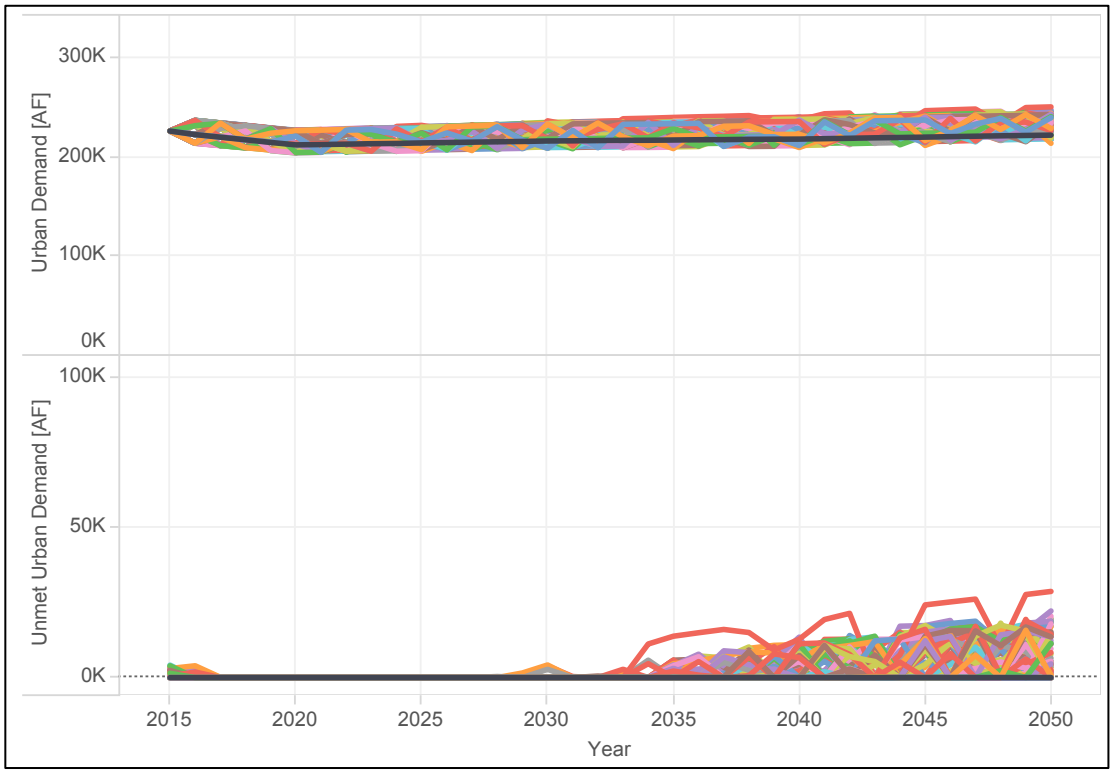
The study team used the WEAP IEUA model to stress test the IEUA's baseline supplies and proposed supply augmentation portfolios, and evaluated urban demand, supplies, and unmet demand from 2015 to 2050 for each of the 106 climate change projections as well as a projection that repeated historical climate conditions. Impacts of these 107 climate futures on IEUA's baseline supplies and proposed portfolios to augment supplies were examined in the context of the three future demand scenarios, as well as assumptions about the strength of climate change on imports, and the sensitivity of local supplies to temperature. In sum, IEUA's baseline supplies and each augmentation portfolio were tested against 1,284 futures (107 climate projections x 3 demand scenarios x 2 regressions to estimate climate impacts on local supplies x 2 levels of climate impact on water imports). The necessary computing capacity was obtained via Amazon Web Service, which enabled the WEAP model to be run hundreds of times simultaneously.

# Results

## IEUA baseline supplies may be insufficient to meet future demand

We found that, under the low demand scenario, supplies were sufficient under historical climate and mostly sufficient through mid-century with climate change (Figure 6). After 2035, some shortages begin to appear. The figure below shows results that assume the strongest effect of climate on imports, and that temperature changes affect local supplies. See Appendix 2 for more detail.

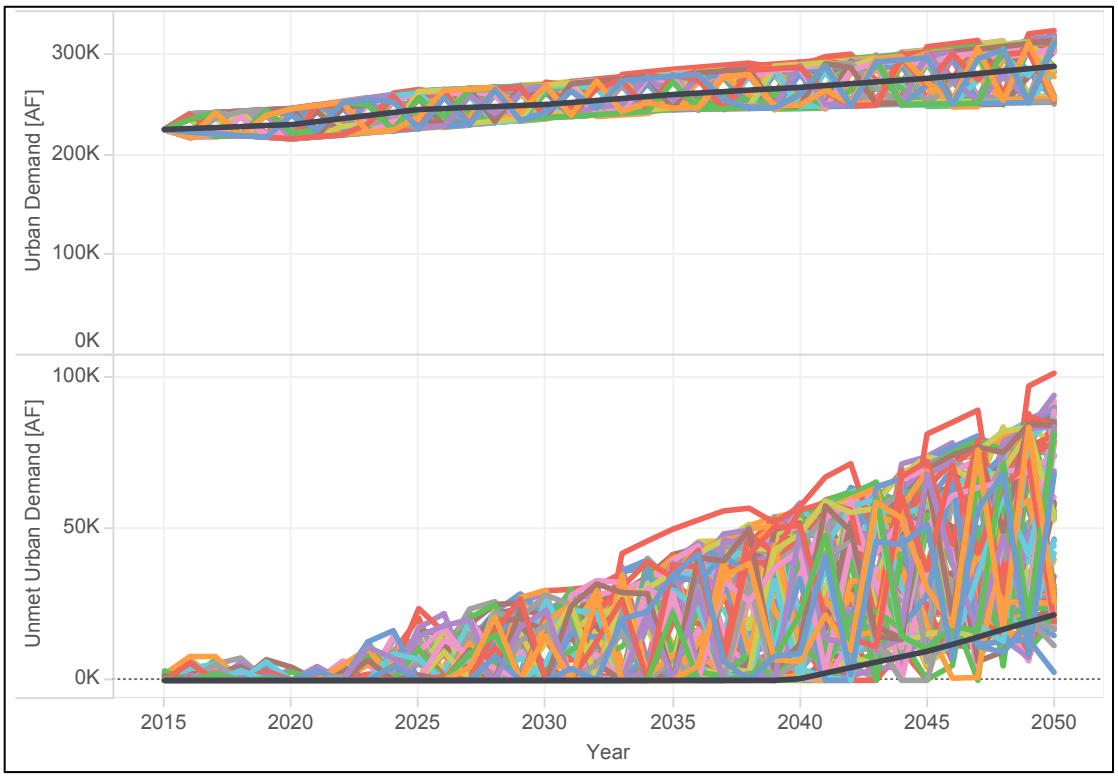
**Figure 6: Unmet demand for IEUA service area by climate change scenario over time (low demand scenario)**




Note: Colored lines correspond to the individual 106 climate scenarios. The black lines correspond to the historical climate scenario.

However, supplies do not appear sufficient to meet demand in the medium (not shown) and high demand scenarios as early as 2016, with the level of unmet demand ramping up significantly after 2020. Under the high demand scenario, unmet demand is nonzero even under historical climate conditions (Figure 7).

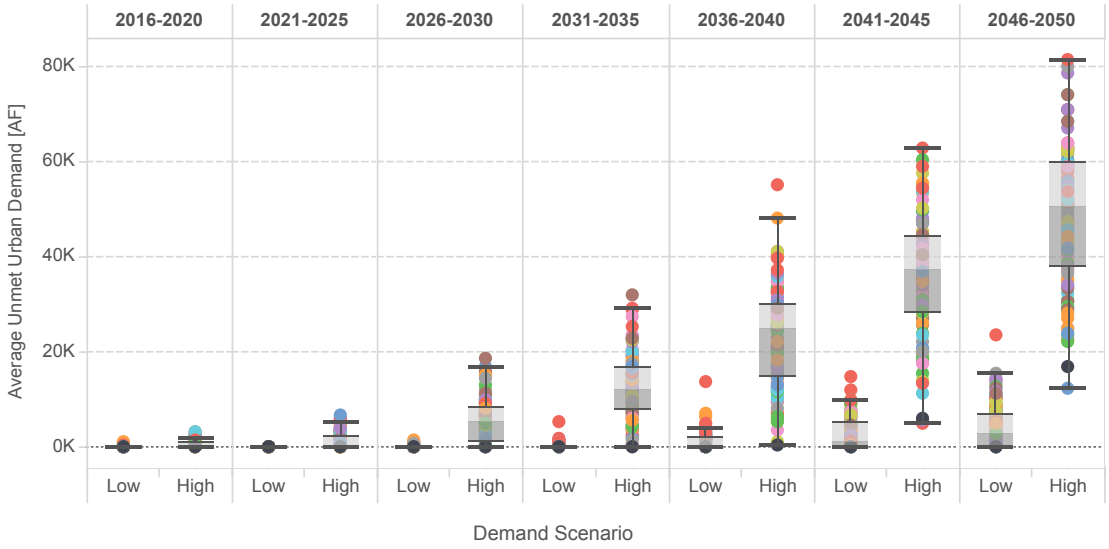
**Figure 7: Unmet demand for IEUA service area by climate change scenario over time (high demand scenario)**




Note: Colored lines correspond to the individual 106 climate scenarios. The black lines correspond to the historical climate scenario.

Figure 8 summarizes the results shown above by 5-year period. For the 2036-2040 period, which essentially reflects the end of IEUA's IRP timeframe, there is virtually no unmet demand for half of the 106 climate projections under the low demand scenario. In contrast, under the high demand scenario, the median result for unmet demand is about 25 TAF/year, and there is unmet demand in most of the future climates considered. Note that the IEUA IRP reports the 75$^{th}$ percentile unmet demand results as a characterization of the majority of plausible futures. The 75$^{th}$ percentile results are seen in the figure as the top of the shaded boxes.

**Figure 8: Summaries of unmet demand across climate scenarios by demand scenario and 5-year period**

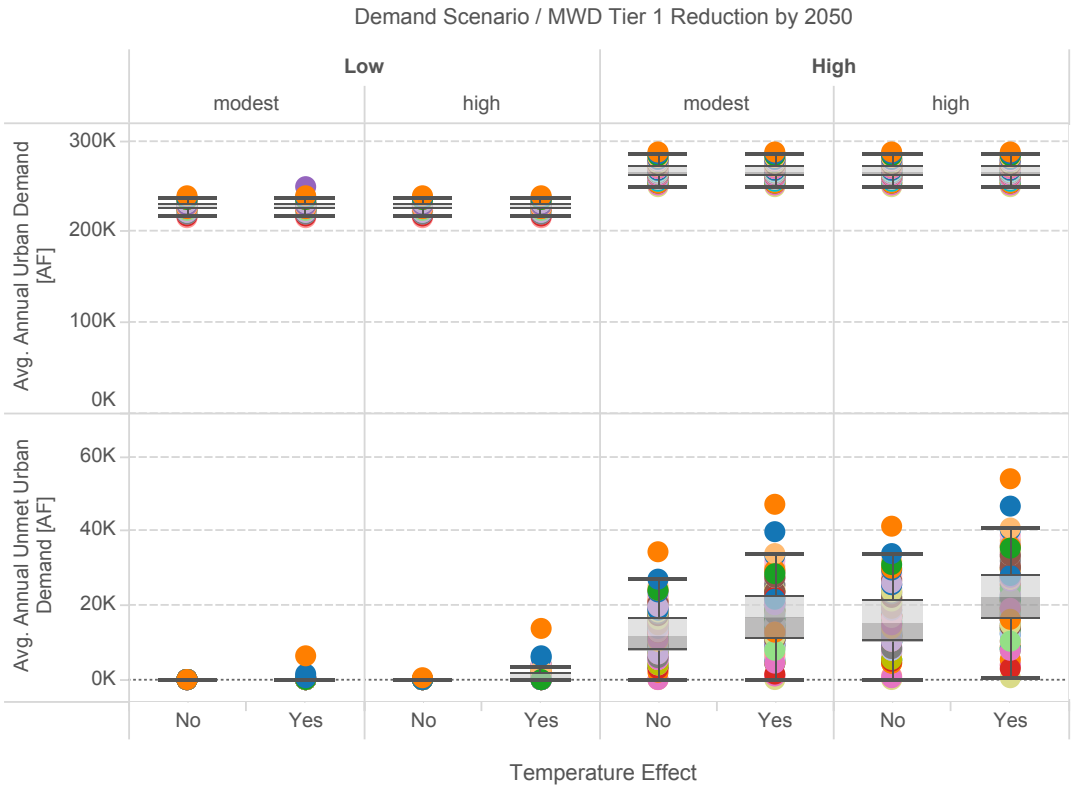



Note: Colored dots correspond to the individual 106 climate scenarios. The black dots correspond to the historical climate scenario. The boxes show the 25th, median, and 75th quartile results, with the vertical stems indicates 1.5 times the 25th-75th quartile range.

RAND also investigated how the results vary with different assumptions about how much MWD supplies might decline over time in response to climate change, and whether or not local supplies, stormwater, and non-MWD replenishment supplies will fluctuate due to temperature in addition to precipitation (see Appendix 2 for more detail). Figure 9 compares the range of unmet demands for the 2036-2040 period under different assumptions about temperature effects on local supplies and climate change on MWD supplies. For the low demand scenario, the assumptions appear to have little effect on the unmet demand results across the climate scenarios. For the high demand scenario, however, there are some modest changes. The effect of going from modest to high climate impact on MWD supplies is about equal to the effect of including the temperature impacts on local, stormwater, and replenishment water supplies. For both types of uncertainties, however, the effects on the results are modest, and are much smaller in scale than differences in results between demand scenarios.

For the IRP, IEUA selected the assumptions that (1) climate change would have a high impact on MWD supplies and that (2) there would be temperature effects on local, stormwater, and replenishment supplies in order to be able to plan for more stressing future situations. These assumptions were made to ensure that IEUA has sufficient resources and necessary infrastructure under a wide range of plausible futures.

**Figure 9: Average urban demand and unmet demand (2036-2040) across climate scenarios (boxes), demand scenarios (Low, Wide), climate effects on MWD supplies (modest, high), and temperature effects on local, stormwater, and replenishment supplies (No, Yes)**



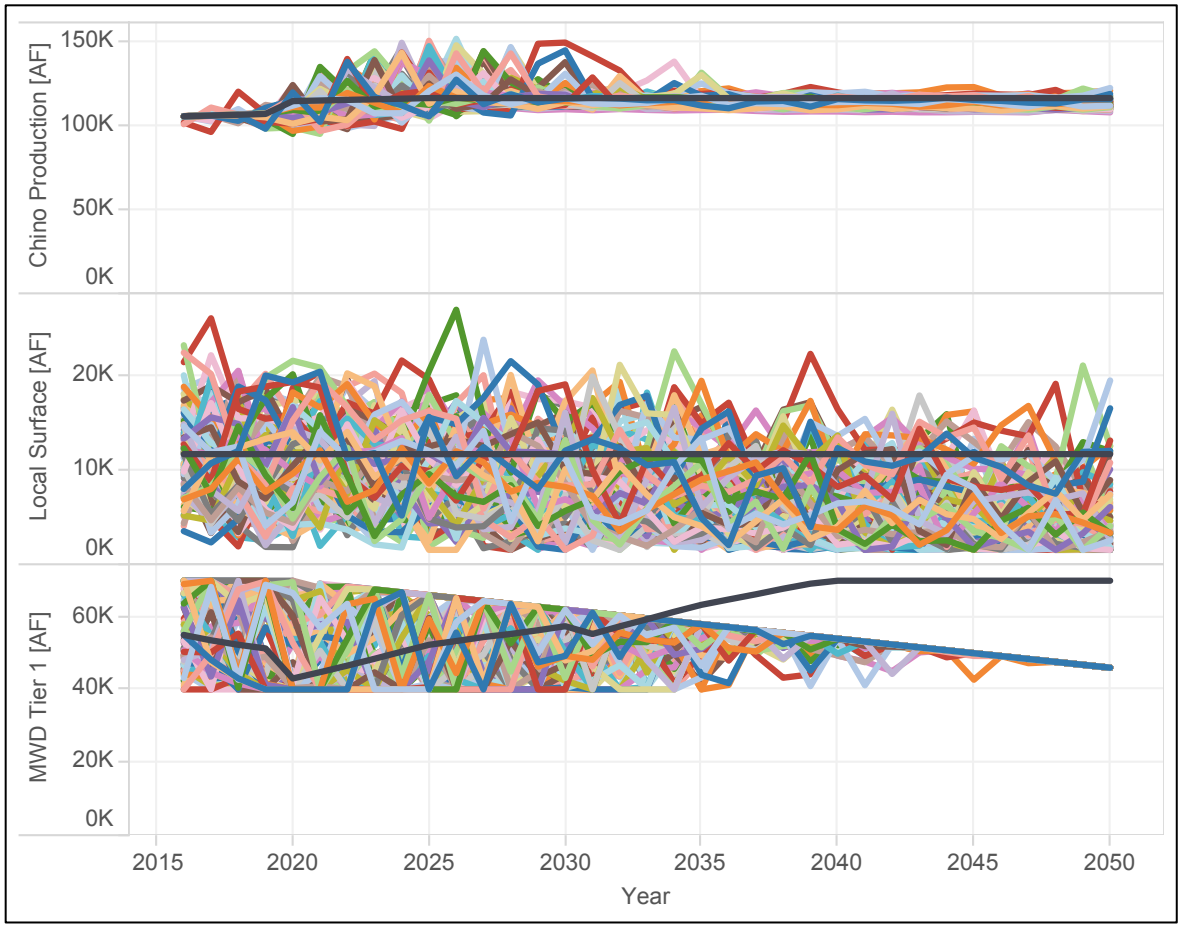

Note: Colored dots correspond to the individual 106 climate scenarios. The black dots correspond to the historical climate scenario. The boxes show the 25th, median, and 75th quartile results, with the vertical stems indicates 1.5 times the 25th-75th quartile range.

Figure 10 shows the major climate-dependent supplies used to meet demand over time for the 107 climate scenarios. The top panel shows these results for Chino Basin groundwater. The figure shows that during the next 15 years, when supplies generally exceed demand, there is a range of groundwater supply use, depending on the demand and availability of cheaper local surface supplies. The increased use during some years reflects deferred use of these supplies during wet years. Around 2030, increasing demand, coupled with declining surface supplies, groundwater supply becomes more stable at the maximum amount available. The slight range of use across the climate scenarios in the out years reflects the different climate effects on safe yield—which is small.

Local supply, some types of which are relatively low-cost (notably excluding recycled and desalted water), fluctuates due to its availability. Figure 10 shows significant variability as well as a tendency for declining amounts of supply, as compared to the typical IEUA assumption of stable supplies based on historical yields (the solid black line). These results reflect the projected warming conditions for all climate scenarios and variability in projected precipitation.

Lastly, the bottom panel of Figure 10 shows use of MWD Tier 1 water over time across the 107 climate scenarios. Future use under assumptions of historical climate declines initially as other supplies are developed. After 2020, however, IEUA increasingly relies on the assumed available MWD Tier 1 supply to meet growing demands. By 2040, all cheaper supplies are completely utilized and MWD Tier 1 supply is used at its maximum level. Note that 2040 is the year in which shortages are also shown to begin (see Figure 7). There is significant interannual variability in the use of MWD Tier 1 supplies across the futures, in response to variable demands and other supplies. In many years, Tier 1 use reaches the maximum available amount. Per the assumptions about climate's impact on available MWD supplies, the maximum amount available begins to decline in 2020. In those years and scenarios in which the MWD Tier 1 use is at this declining maximum level, there is also unmet demand as seen in Figure 7.

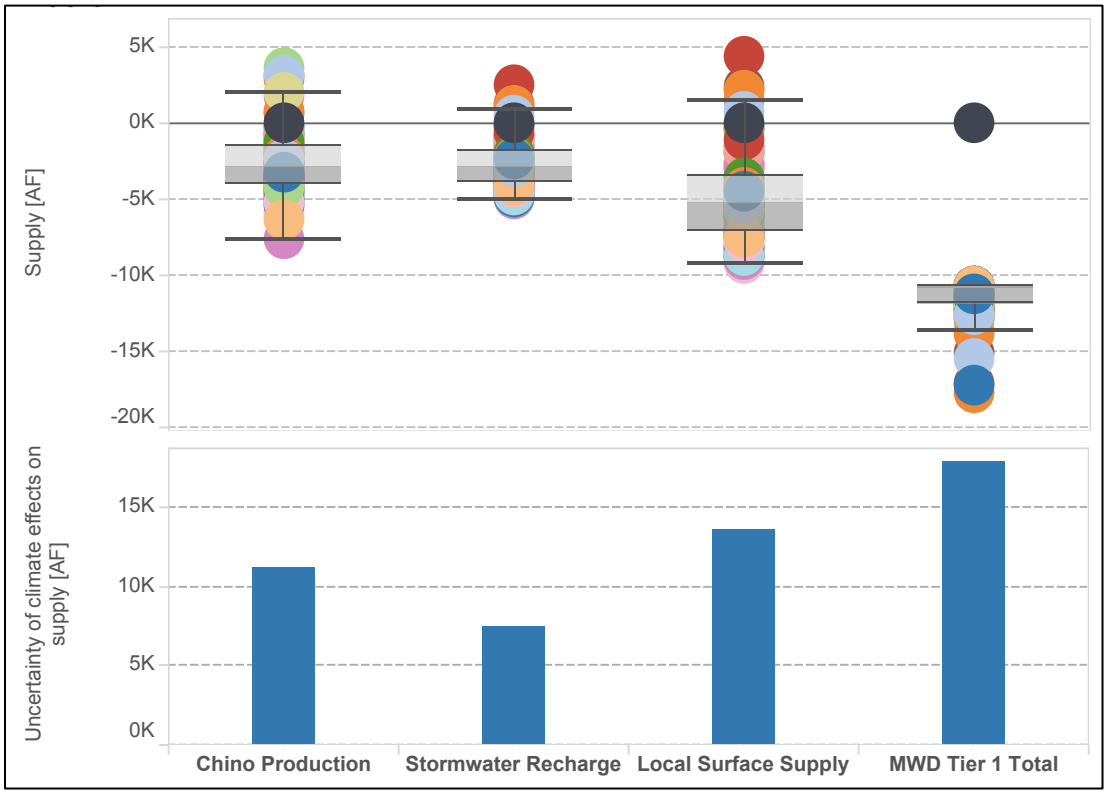
**Figure 10: Baseline supply ability to meet IEUA service area in the high demand scenario by climate projection**



While there is uncertainty over how climate change might affect IEUA's supplies, the climate scenarios used, combined with assumptions made in this analysis, show a tendency for supply reductions. The top panel of Figure 11 shows that for most scenarios, supplies are lower than they would be under historical climate conditions. The largest potential impact on supply is on MWD imported supply—with all climate scenarios showing a decline in accordance with the assumption that MWD supplies could experience a gradual decline in response to climate change. The second most impacted supply is on local surface supply, with a median decline of about 5 TAF/year. The overall effect on groundwater production is small, consistent with the assumptions about climate's effect on safe yield.

The bottom panel of Figure 11 shows the range in use of future supplies across the climate scenarios. For the resources that are utilized fully due to their lower cost, such as Chino groundwater and local surface supplies, the variability reflects the range of climate impacts on these supplies. For these, the larger range of uncertainty is seen in the local supplies. The range in uses of MWD Tier 1, however, reflects the range of availability of the less expensive supplies—not any assumptions of climate effects on MWD supplies. As described above, the only climate effect on MWD Tier 1 availability is specified through a steady decline in supply availability.

**Figure 11: Impacts of climate on IEUA supplies across climate futures (colored dots) (2036-2040) (top) and uncertainty in the magnitude of climate impacts uncertainty (bottom)**




Note: Colored dots correspond to the individual 106 climate scenarios. The black dots correspond to the historical climate scenario. The boxes show the 25th, median, and 75th quartile results, with the vertical stems indicates 1.5 times the 25th-75th quartile range. The blue bars indicate the range of supply outcomes across the climate scenarios (excluding the historical simulation shown by the black dot).

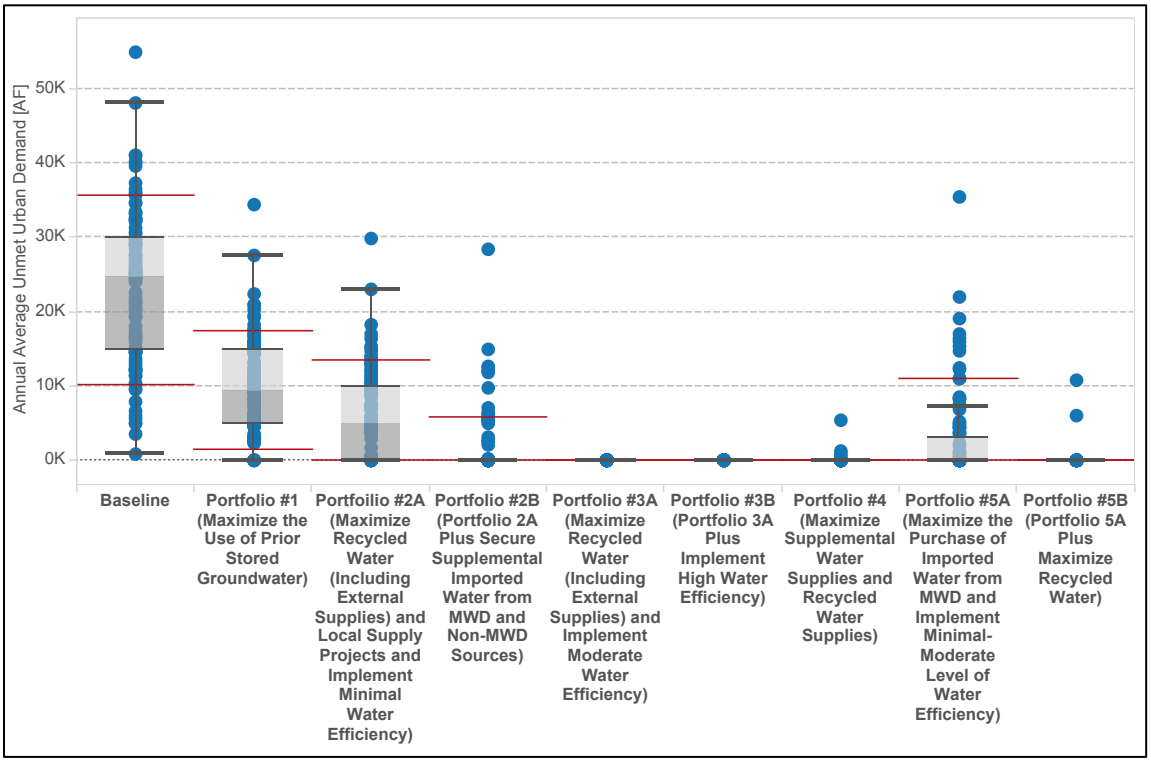
## Management strategies that focus on efficiency and maximizing use of recycled and imported water help close future gaps between supply and demand

Through interactions with member agencies and other stakeholders, the IEUA developed the seven portfolios discussed above in Table 2, consisting of different water management actions aimed at closing the future gap between supply and demand, and meeting other qualitative regional goals.

Using the WEAP model and the same climate projections used to "stress test" the IEUA baseline water supplies, we evaluated how well each of the seven strategies would meet demand in the future. Figure 12 summarizes the performance of the baseline strategy and the seven portfolios in terms on unmet demand from 2036-2040. All portfolios lead to an improvement in

unmet demand over the baseline supply. Portfolio 1, which uses previously stored groundwater, reduces unmet demand by more than half for the median climate scenario. Portfolio #2A, which increases use of recycled water and external supplies as well as implements additional efficiency, eliminates unmet demand for more than 25% of scenarios and reduces the median unmet demand to below 10 TAF. Portfolio #2B improves upon portfolio #2A by adding additional imports—all but eliminating unmet demand. Portfolio #5A combines moderate efficiency with increased imports to eliminate unmet demand in more than half of the scenarios. Lastly, four portfolios—#3A, #3B, #4, and #5B—eliminate unmet demand in at least 90% of the scenarios. The first two do so by significantly increasing efficiency—effectively ensuring that demand follow the low growth demand trajectory. The other two (#3B and #5B) improve performance by maximizing recycled water use while also increasing imported water supplies.

**Figure 12: Average unmet demand (2036-2040) across climates projections for high demand projection and different IEUA portfolios**



# Conclusion

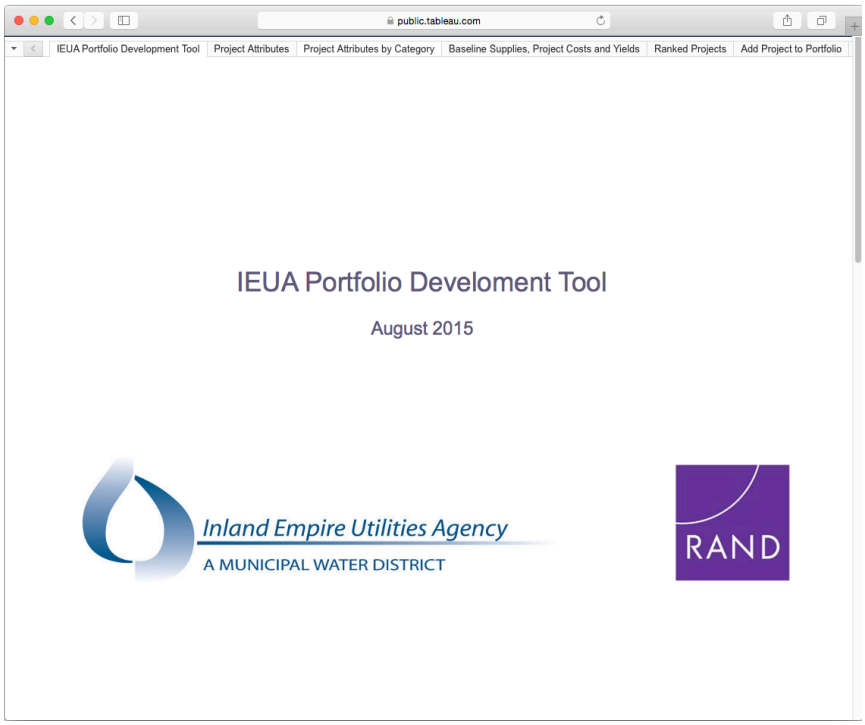
This is one of a growing number of water planning examples that highlights the benefits of examining the impacts of different climate change futures on meeting consumer demand. Here, assumptions about demand growth and climate future both had substantial impacts on ability to meet demand, and level of climate change impact on imported water as well as temperature impacts on local supplies also had some effect, especially in the most stressing demand future. Using these results, RAND and IEUA were able to identify types of management strategies focused on efficiency and maximizing available supplies that helped close the modeled future gaps between supply and demand. This work also demonstrates the value of visualization tools and water management simulations that can help facilitate discussion of alternatives for managing water resources in a very uncertain future.

For IEUA, participating in this process was not academic. As reported by IEUA management, it was a "game changer". This is because the analytic process described herein enabled understanding of how powerful water use efficiency and local supplies are in reducing the risk of future supply shortfalls in IEUA's service area, and also provided reassurance that their region is prepared for a future with uncertain shifts in climate. By engaging in this process, IEUA has not only identified how and when changes in temperature and precipitation could impact its water supplies, but also how demand influences the delicate balance between supply and demand. Both the timing of surges in unmet demand and the types of management actions that could help mitigate anticipated gaps in supply are helping to inform the construction of the IRP in a way that encourages adaptation and the use of integrative plans. Future work could investigate more specifically which assumptions related to future climate, demand, and supply lead to the greatest challenges in unmet demand, which could further help IEUA refine management practices and future plans.

# Appendix 1 – Portfolio Development Tool

This appendix describes the IEUA Portfolio Development Tool (PDT) developed by RAND (Figure 13), with input from IEUA on its function, design, and input data. The PDT is a decision support tool designed to help IEUA and its member agencies assemble different portfolios of water management options that could help ensure the IEUA meets future water demands. IEUA used the PDT to develop a set of portfolios that were then evaluated across different climate and demand scenarios using a water management model described in Appendix 2. Although the information within and specific design of the PDT are specific to IEUA's needs, the visualization platform and methodological process could be used in the context of any water agency with similar needs for long-range planning under uncertain future conditions.

**Figure 13: Title screen for the Portfolio Development Tool**




The PDT was developed using Tableau—a business analytics and visualization software package. All the data used to develop the PDT were provided to RAND by IEUA, and the PDT was deployed via the Internet for IEUA and stakeholders. In the series of figures below, we walk through each of the PDT's visualizations. Once again, the design and data shown here are

specific to IEUA, but this type of tool could be configured to support decision-making within numerous types of organizations.

## Overview of the Portfolio Development Tool

The PDT's main function is to help the user develop a portfolio of management options that meets specified near-term and long-term water supply and demand targets. To do this, the user first specifies the projects that he or she wishes to consider. Next, the user specifies the near-term and long-term targets. The PDT then identifies the projects that would best achieve the targets from the set of eligible projects using a cost effectiveness criterion. In this context cost effectiveness is expressed in terms of levelized cost—or average cost per unit of new supply or demand reduction. Lastly, the PDT summarizes the included projects, their overall attributes, their cumulative yields, and their cumulative costs.

## Portfolio Development Tool Visualizations

Figure 14 shows one visualization used to concisely display qualitative information about the attributes of different water management projects. Here, each row pertains to a different project, organized by type, with each column indicating one of 16 qualitative attributes related to IEUA's future goals (e.g., increasing water levels in critical groundwater management zones, increasing stormwater capture and associated groundwater recharge). Filled circles indicate that projects help meet certain goals, half circles indicate that a projects have no impact on goals, and open circles indicate that projects detract from efforts to meet goals. This visualization provided a reference for IEUA and member agencies used this tab to contrast how well different types of and individual projects helped meet goals.

**Figure 14: Summary of how a sample of IEUA potential projects would help meet qualitative goals**

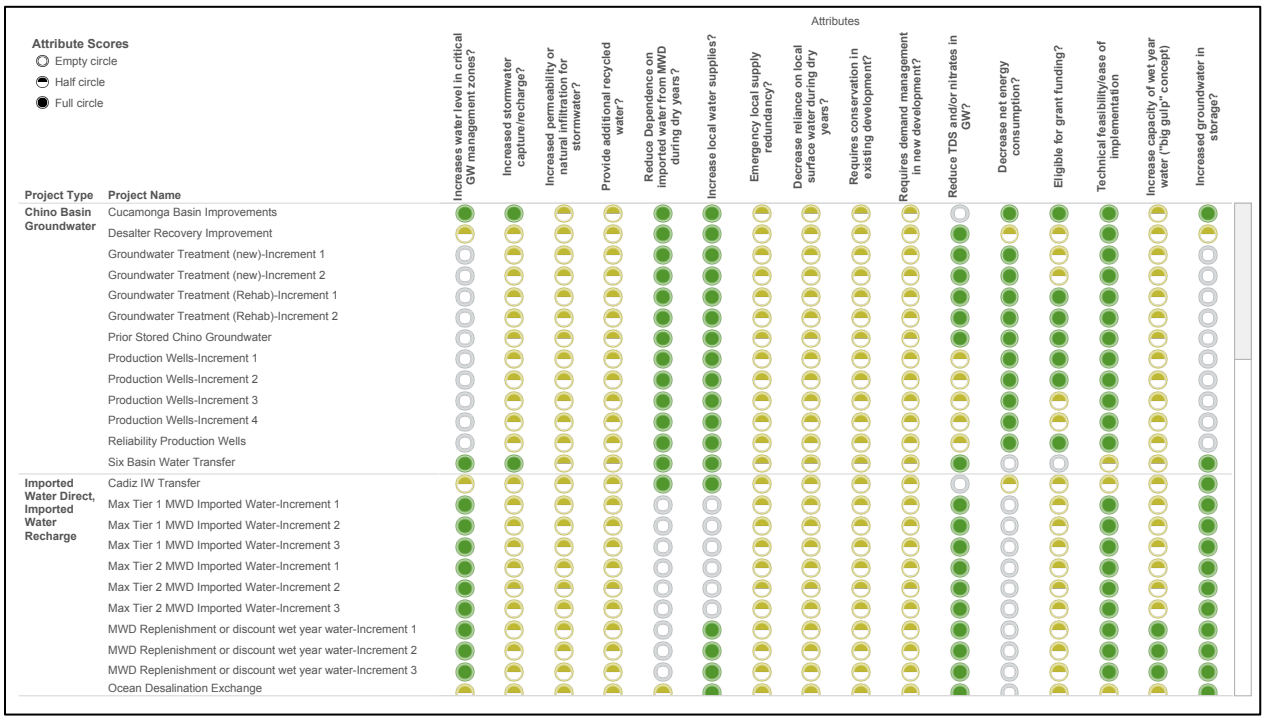
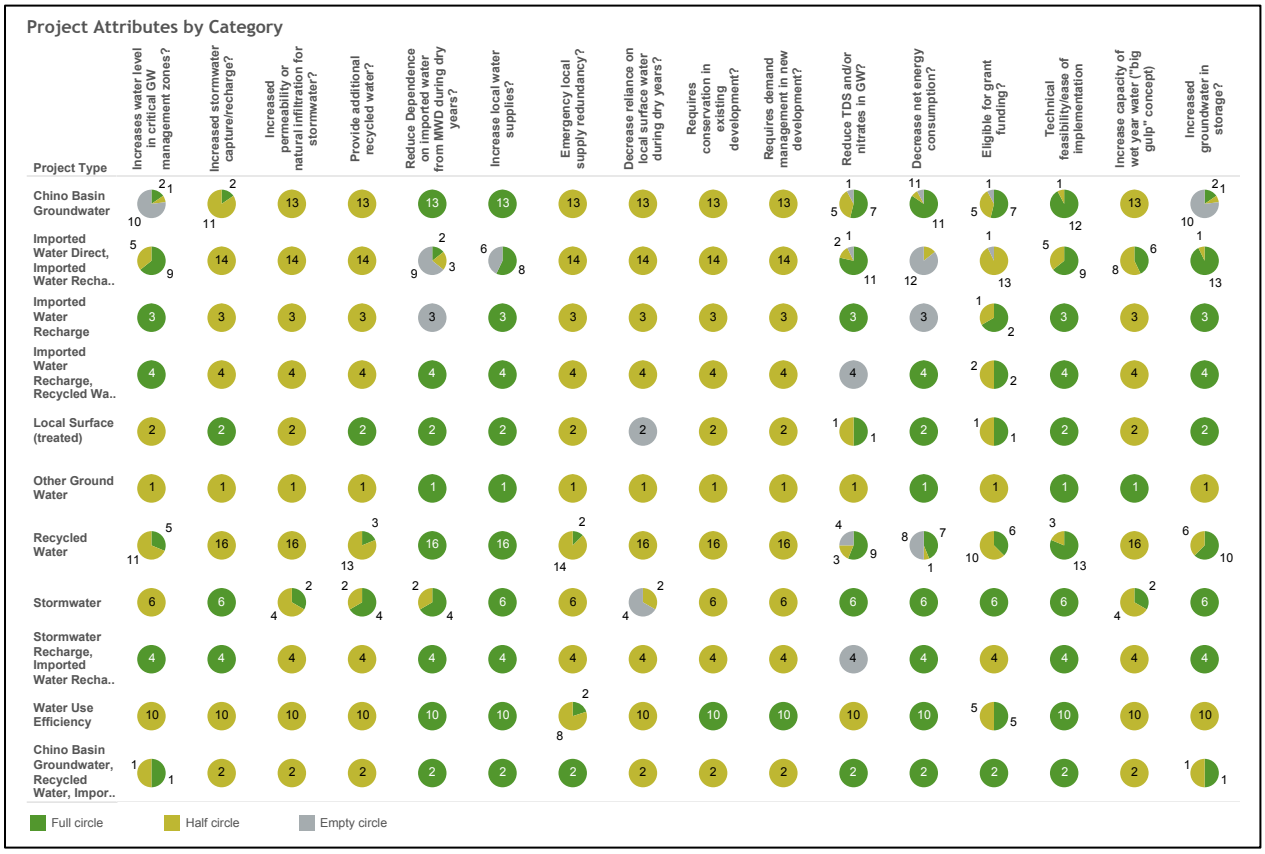



Figure 15 displays the same IEUA qualitative goals as in the previous screenshot (above), but summarizes their values within the different project categories. This shows, for example, how many projects within the more general category of "Chino Basin Groundwater" add to, detract from, or have neutral effects on different goals. This assists decision makers in identifying which categories have the most projects that might contribute to the achievement of particular goals.

**Figure 15: Summary of how well projects in different categories meet various IEUA qualitative goals**




IEUA has considerable supplies to meet current and future needs already. These are highlighted in the top panel of Figure 16, and include groundwater, recycled water, imported water, conservation measures, and other sources. The color bars indicate when these sources come online, and most are already available. (Note that those that come online in the future are already planned for implementation and are thus not considered in the portfolio options directly.) IEUA and member agencies requested this view of the baseline supplies because it serves as a useful perspective upon which to layer projects to bring additional future supplies. Below the baseline supply panel are the different potential projects, sorted by general categories, and with information about cost and amount of supply each is estimated to provide. Note that not all projects are visible in this screen shot.

**Figure 16: Summary of baseline supplies, estimated new project supply amounts, and new project costs**

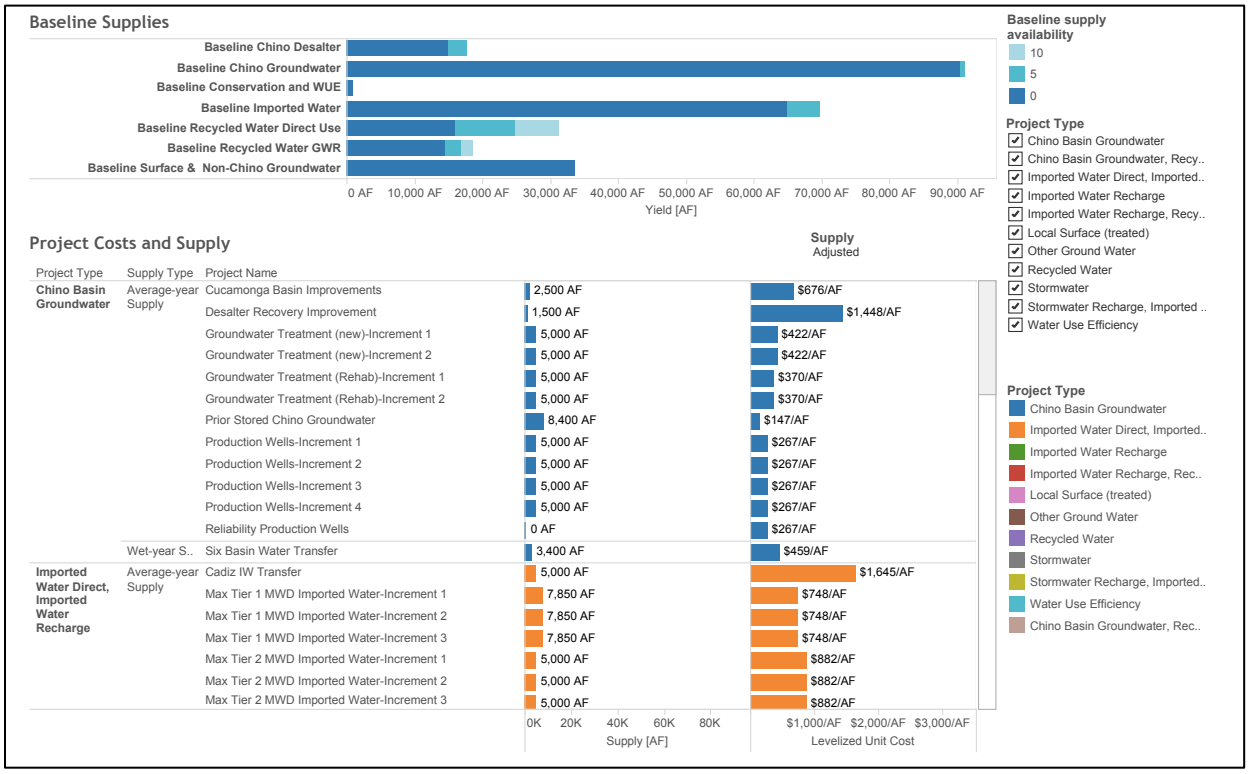
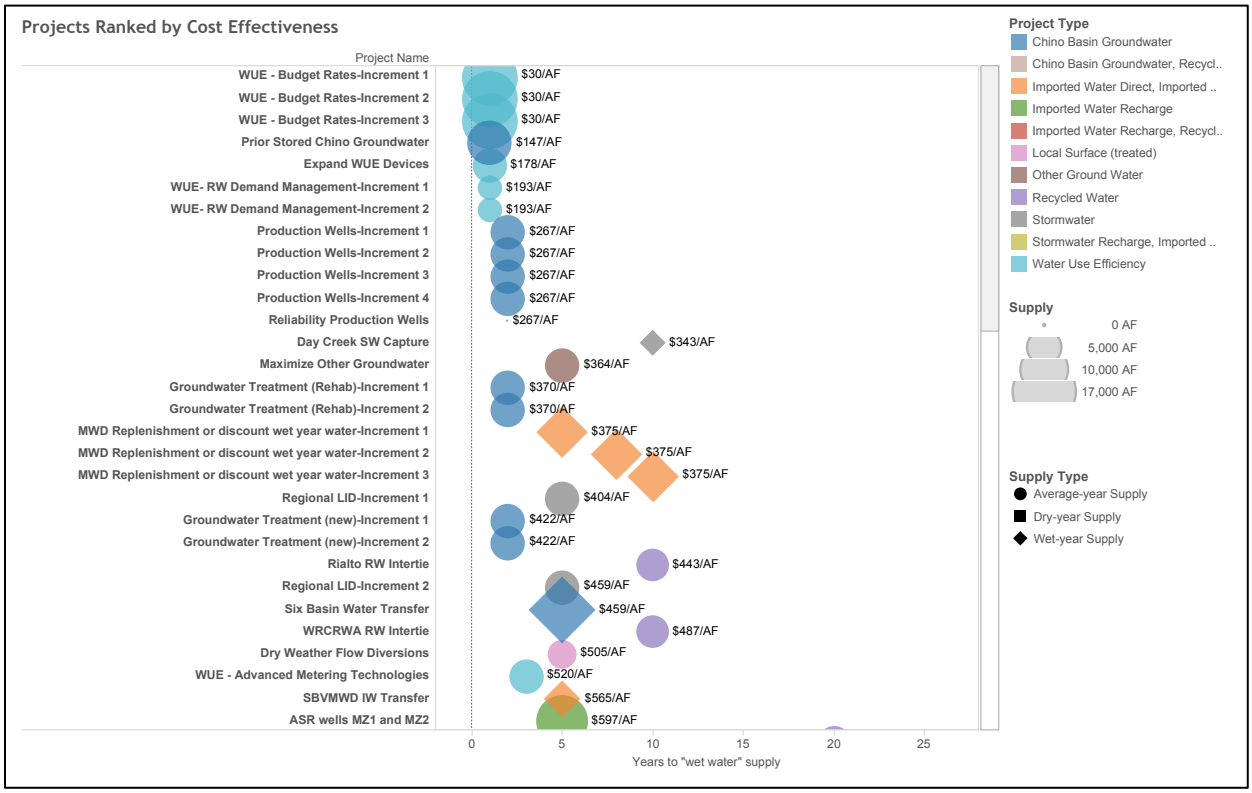


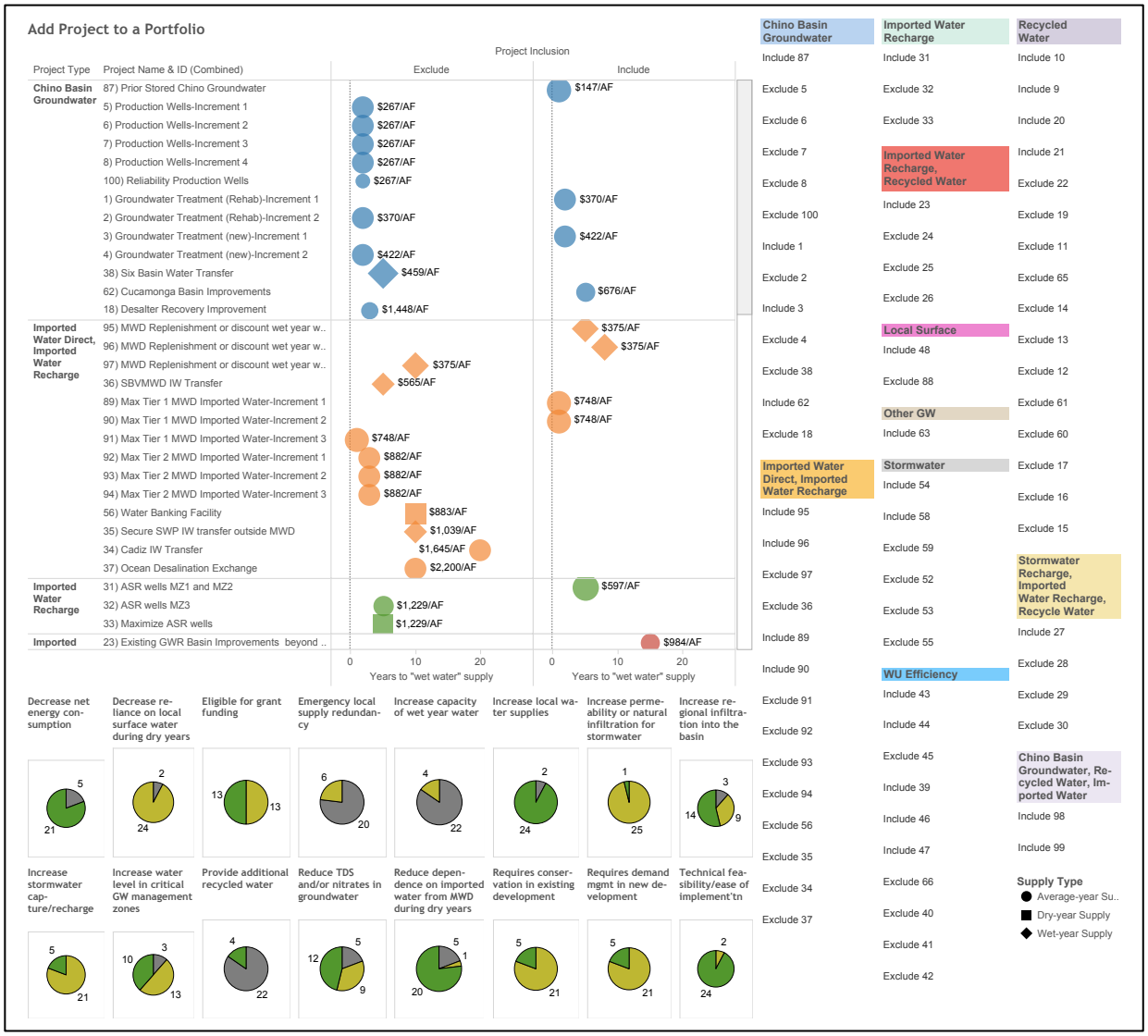

Figure 17 displays all the projects, sorted by preliminary estimates of per unit water cost (these have yet to be finalized). Symbol coloring indicates its category, size indicates its estimated volume; horizontal position indicates the number of years until which the project produces enough water to add to the supply IEUA distributes to stakeholders; the text label indicates its cost; and its symbol indicates whether the water is available during any given year or only under particularly wet or dry conditions. This view was useful for stakeholders to compare projects, and general categories of projects, by supply amount, timing, and cost.

**Figure 17: Project cost per acre-foot, with information on project type, supply amount, supply type, and number of years to "wet water" supply**



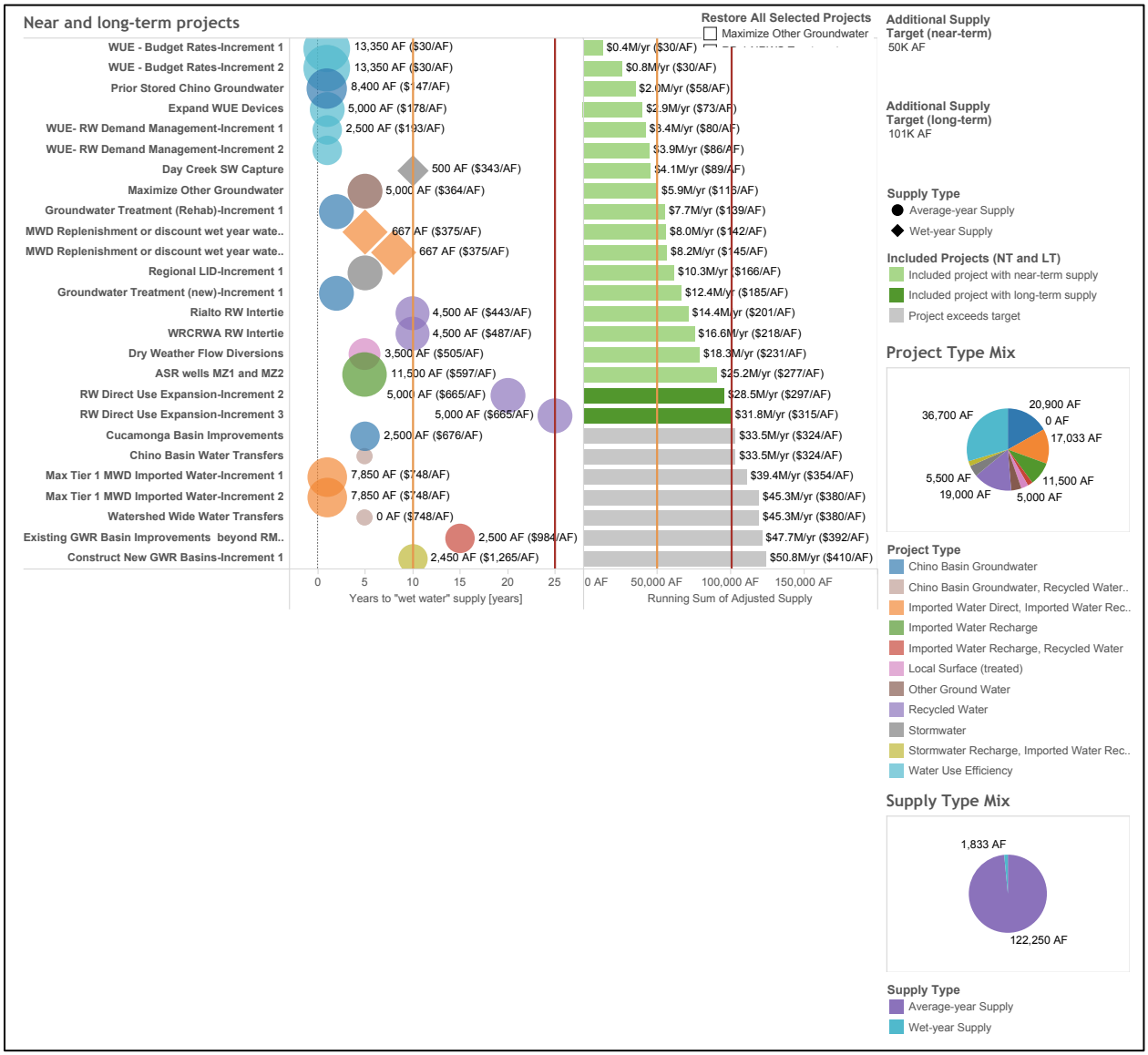

The next figures show how IEUA and member agencies were able to use the tool to create different potential portfolios of water management options. Figure 18 shows a tab in which the user is able to select individual projects to be considered in a portfolio. The user can exclude or include a project with a single click of the toggles on the right side of the screen shot. Projects' inclusion, category, cost, and years to wet water supply are tracked in real time on the left side of the screen. Aggregate summaries of the project attribute measures are shown as pie charts at the bottom of the screen. In this figure, a subset of projects is selected for inclusion, and only some projects are shown in the figure. In the tool, the user is able to scroll to see projects from all project categories.

**Figure 18: Portfolio building tab enabling user to include and exclude specific projects in real time and visually track different project categories, costs, and years to "wet water" supply**



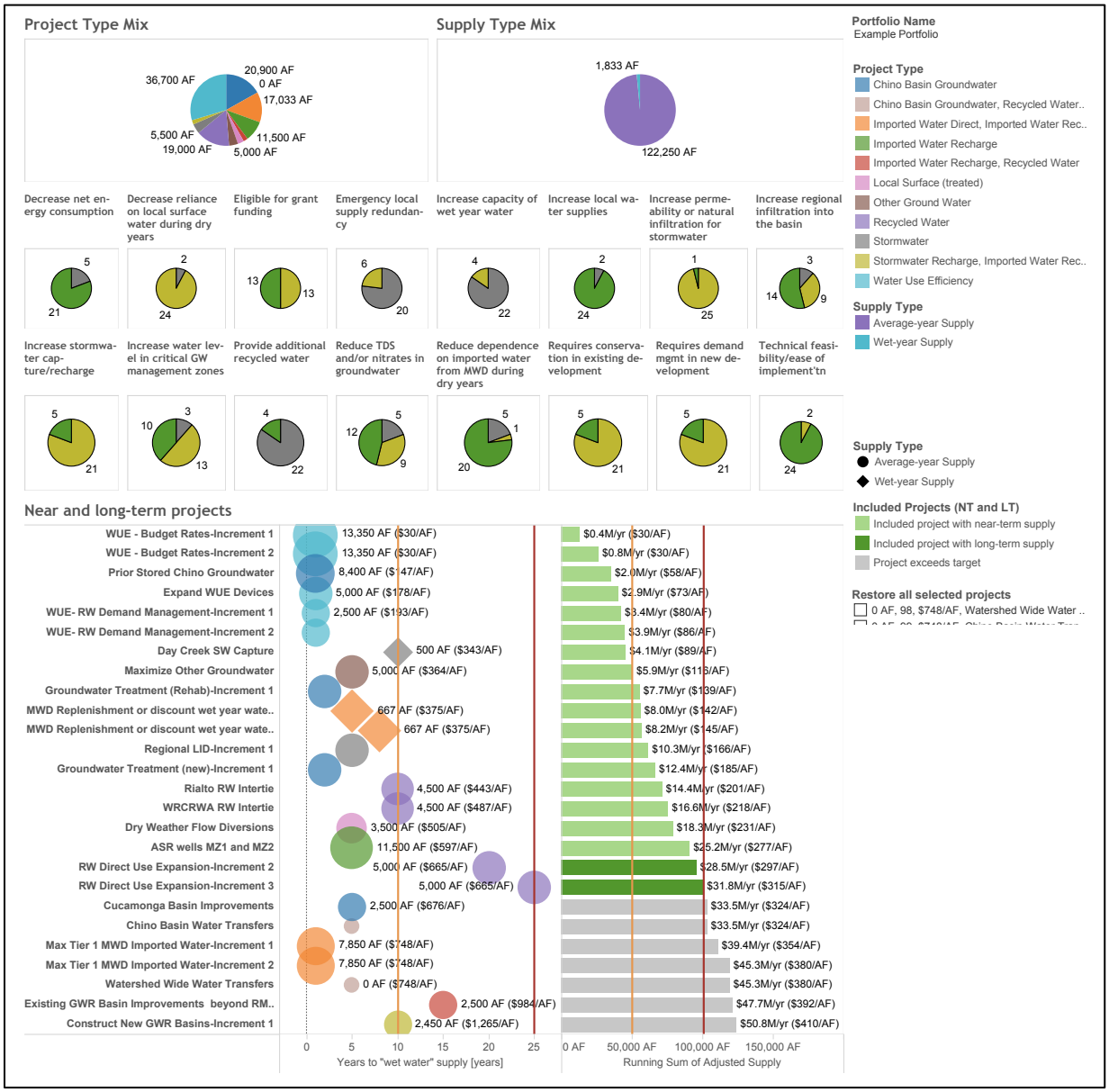

The next visualization (Figure 19) takes the options included in the previous screens and sorts them by cost effectiveness and availability to meet user-specified near-term (year 10) and long-term (year 25) targets. In this example, the near-term target is set to 50 TAF, whereas the long-term target is set to 101 TAF. On the left, projects are shown ordered by cost effectiveness. The bar chart to the right shows the cumulative new supply or demand reduction. Projects that meet the near-term or long-term targets are shaded green, indicating that they are included in the final portfolio. The project shaded dark green are only available to meet long-term demand. On the right, a pie chart summarizes the mixture of projects used to meet the supply targets and the type of projects with respect to availability (all year, wet year, or dry year).

**Figure 19: Example portfolio with information on projects included therein, and how well projects meet supply goals**




Lastly, Figure 20 provides another summary of the defined portfolio. This includes a summary of the supply and project category information in Figure 19, but also displays summaries of the project attributes—suggesting how well a particular portfolio meets different IEUA qualitative goals. IEUA and member agencies were able to use this display as a final summary chart for each portfolio they explored.

**Figure 20: Example project portfolio summary, including how well projects meet IEUA qualitative goals**



# Appendix 2 – Water Management Model And Assumptions

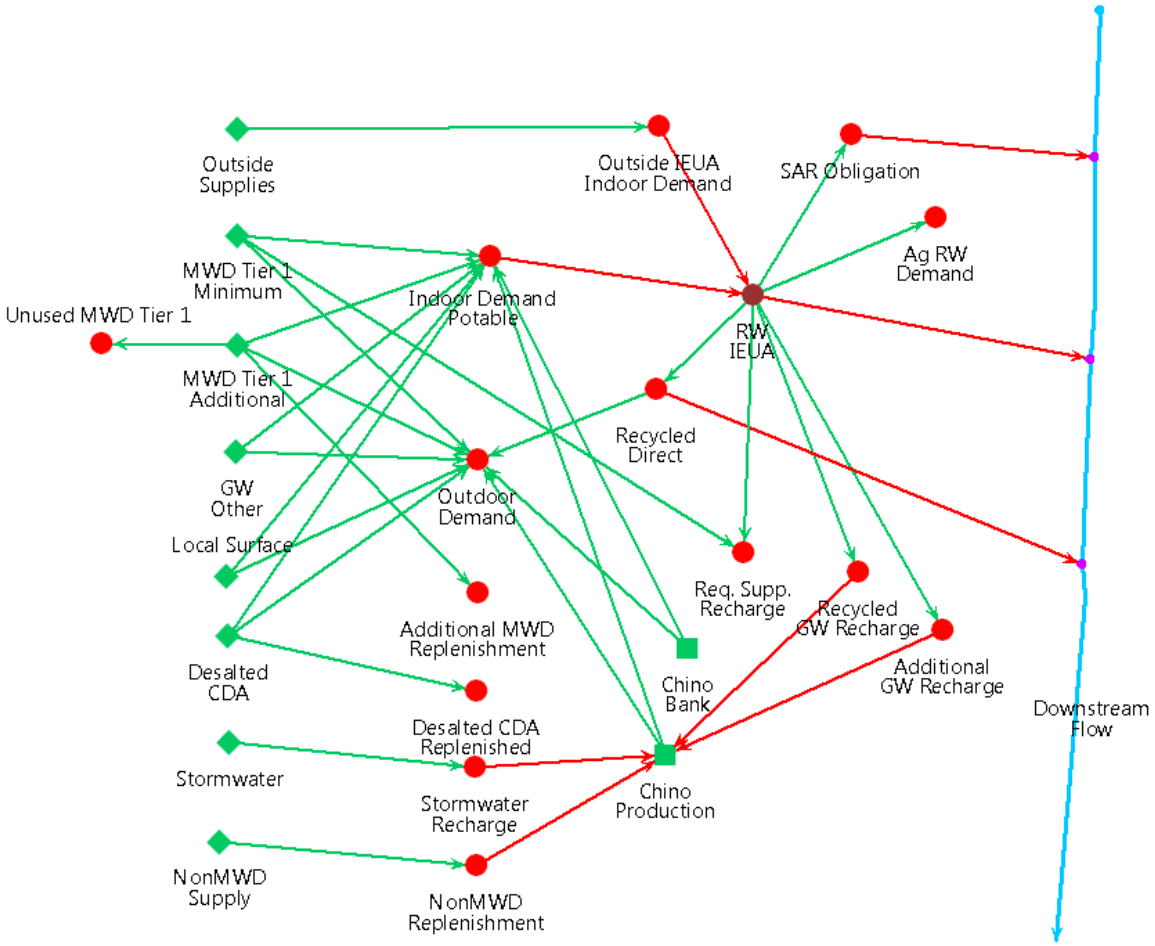
## Model Overview

The study team built a model of the IEUA water management system, based on tabular monthly and annual information on historical and projected IEUA water supplies and demands provided by IEUA. The model includes simple relationships and data on estimated future climate conditions to evaluate water supply and demand balance conditions under alternative futures. Lastly, the model evaluates how different water management portfolios, developed using the Portfolio Development Tool (see Appendix 1), would improve performance over these futures.

The model is built in the Water Evaluation And Planning (WEAP) system, developed by the Stockholm Environment Institute (SEI) (Yates *et al.*, 2005). The WEAP IEUA water management model represents the IEUA system through a set of arcs and nodes. Nodes represent locations of water inflows, storage (surface or groundwater), outflows, or demand. Arcs represent conveyance, either natural or constructed, between different nodes.

The IEUA WEAP model calculates how water demand would be met by various supplies based on a system of supply preferences and priorities for each demand node. The model schematic shows the connectivity of water flows among the nodes via the arcs within the model (Figure 21). The schematic is not intended to represent the specific locations of IEUA system elements, but rather show their connectivity. Table 3 lists and describes the demand and supply nodes shown in the model schematic. More details on select demands and supplies are provided in the sections below.

**Figure 21: Schematic of the WEAP model of the Inland Empire Utilities Agency service area**




Note: RW = recycled water; Ag = agricultural; SAR = Santa Ana River; MWD = Metropolitan Water District of Southern California; CDA = Chino Desalter Authority; GW = Groundwater.

**Table 3: IEUA WEAP model supply and demands**

| Node Name | Description |
|---|---|
| ***Demand*** | |
| Indoor Demand Potable | Indoor demand for potable (non recycled) water |
| Outdoor Demand | Outdoor demand for potable and recycled water |
| Recycled Direct | Total recycled water demand for outdoor use; met demand passes through to Outdoor Demand node or downstream flow if unneeded |
| Recycled GW Recharge | Demand for groundwater replenishment water; passes to Chino Production node |
| Additional GW Recharge | Demand for additional groundwater replenishment as specified by water management strategies; passes to Chino Production node |
| Outside IEUA Indoor Demand | Demand for water outside IEUA that is provided to IEUA for recycling via RW IEUA node |

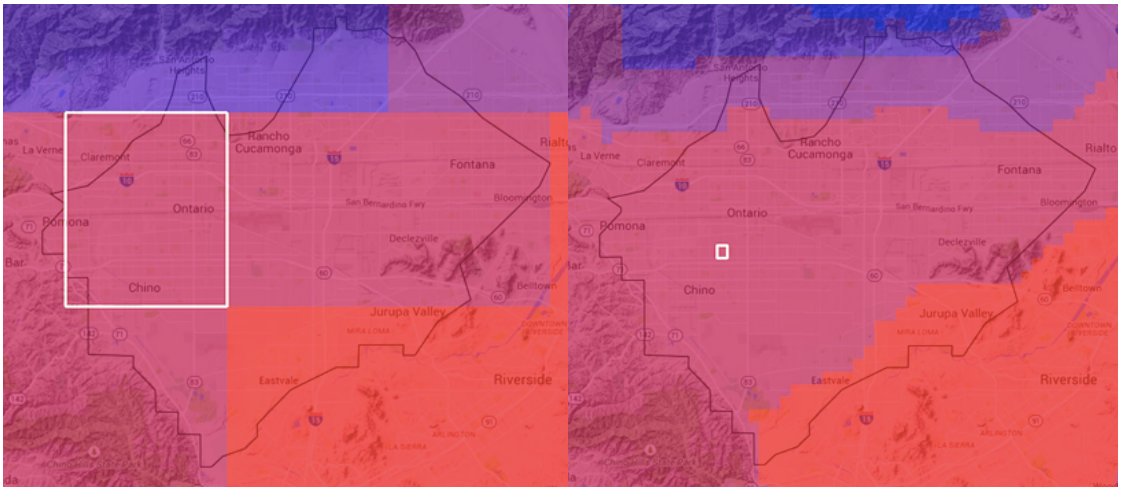
| | |
|---|---|
| SAR Obligation | Santa Ana River flow obligation; met by recycled water |
| Ag RW Demand | Agricultural water demand in IEUA service area met with recycled water |
| ***Supplies*** | |
| MWD Tier 1 Minimum | Specified annual minimum Tier 1 MWD imports (about 40 TAF) |
| MWD Tier 1 Additional | Additional annual Tier 1 MWD imports, constrained by contract with MWD |
| Local Surface | Water supplies obtained from watersheds within the IEUA boundary |
| Desalted CDA | Desalted brackish groundwater from the Chino Desalter Authority facilities |
| Chino Production | Groundwater from the Chino Basins |
| GW Other | Groundwater from sources outside the Chino Basin |
| Stormwater | Additional runoff from storms captured and treated for use |
| NonMWD Supply | External sources of water used for groundwater replenishment |

## Climate Scenarios

The study uses downscaled climate data from general circulation models as the basis for a wide range of plausible future climate conditions. Historical and projected climate data from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset were downloaded from the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive (Maurer *et al.*, 2007).[2] Climate data retrieved from this archive included bias-corrected statistically downscaled (BCSD) global climate model (GMD) monthly mean temperature and total precipitation observations and projections for 36 CMIP3 simulations and 70 CMIP5 model runs for years 1950-2050 (Brekke *et al.*, 2013). Note, however, that observed BCSD data were available only for years 1950-1999. These gridded climate data represented the gridded area bounded by latitudes 34.0N and 34.125N and longitudes 117.625W and 117.5W, roughly centered at Ontario International Airport (Figure 22).

[2] Data is available online at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/.

**Figure 22: Geographic scale of climate sources for CMIP-3 data (left) and CMIP-5 date (right)**




## Select Demands

### *Indoor Potable*

Indoor potable demand is calculated as the population within the IEUA service area times an annual water use rate. IEUA, assisted by A&N Technical Services, specified the high and low demand scenario by varying annual water use rates. The middle demand scenario is user definable by setting the indoor and water use rates for 2050. Indoor potable demand does not vary by climate.

**Table 4: Indoor potable demand parameters for historical data and scenario projections**

| Model Parameter | 2010 (data) | 2014 (data) | 2020 (projection) | 2050 (projection) |
|---|---|---|---|---|
| Population (people) | 813,695 | 847,587 | 896,533 | 1,249,091 (all) |
| Water Use rates (gal/person/year) | 26,061 | 23,981 | 24,090 (high)<br>22,959 (low) | 24,017 (high)<br>17,082 (low) |
| Water Use/Demand (taf/year) | 65.1 | 62.4 | 66.3 (high)<br>63.2 (low) | 92.1 (high)<br>65.5 (low) |

### *Outdoor*

Outdoor demand is calculated as the population within the IEUA service area times an annual water use rate. IEUA, assisted by A&N Technical Services, specified the high and low demand scenario by varying annual water use rates. The middle demand scenario is user definable by setting the nominal outdoor and water use rates for 2050.

IEUA performed a series of sensitivity analyses of urban outdoor demand and weather conditions. By 2040, IEUA estimated that one dry year would increase demand by 5.6%. Similarly, a one wet year would decrease outdoor demand by 5.6%. A longer period of dry weather (3-years) would increase demand by 8.9%. Separately IEUA estimated the long-term effect of warming on outdoor demand. They found that for each degree temperature increase (in Celsius), outdoor demand would increase by 3%. Together these factors were applied to the climate scenarios to estimate how outdoor demand could change due to weather in the future.

Outdoor demand varies by three outdoor water demand factors that are applied depending up the projected precipitation difference from historical (or perturbation), as shown in Table 5. The outdoor water demand factors were derived from IEUA analysis.

**Table 5: Climate effect factors on outdoor water demand**

| Precipitation Condition | Perturbation Threshold | Outdoor Water Demand Factor |
|---|---|---|
| Very dry | -5 cm/year | -0.089 |
| Dry | 0 cm/year | -0.056 |
| Wet | + 25 cm/year | +0.56 |

### *Agricultural recycled water demand*

Agricultural recycled water demand is specified based on IEUA projections and does not vary by climate. This demand declines from about 10,000 AF in 2015 to 2,000 AF by 2025 and then remains constant through 2050. This is due to the transition of agricultural land to urban use.

### *SAR Obligations*

IEUA's Santa Ana River (SAR) obligations are specified to be 17,000 AF/year per IEUA agreement.

## Select Supplies

### *Local Surface supplies*

Total monthly local surface supplies within the IEUA management boundary for water years (July through June) 2010 through 2015 were provided by IEUA member agencies and represent the amount of water that is diverted, not total stream flow. To estimate these total local surface water supplies under different climate scenarios, relationships between climate variables and surface supply were derived using historical data. These relationships were then used to estimate future supplies under each climate scenario included in the analysis. Several different regression models were evaluated, and two models were found to reasonably represent the relationship

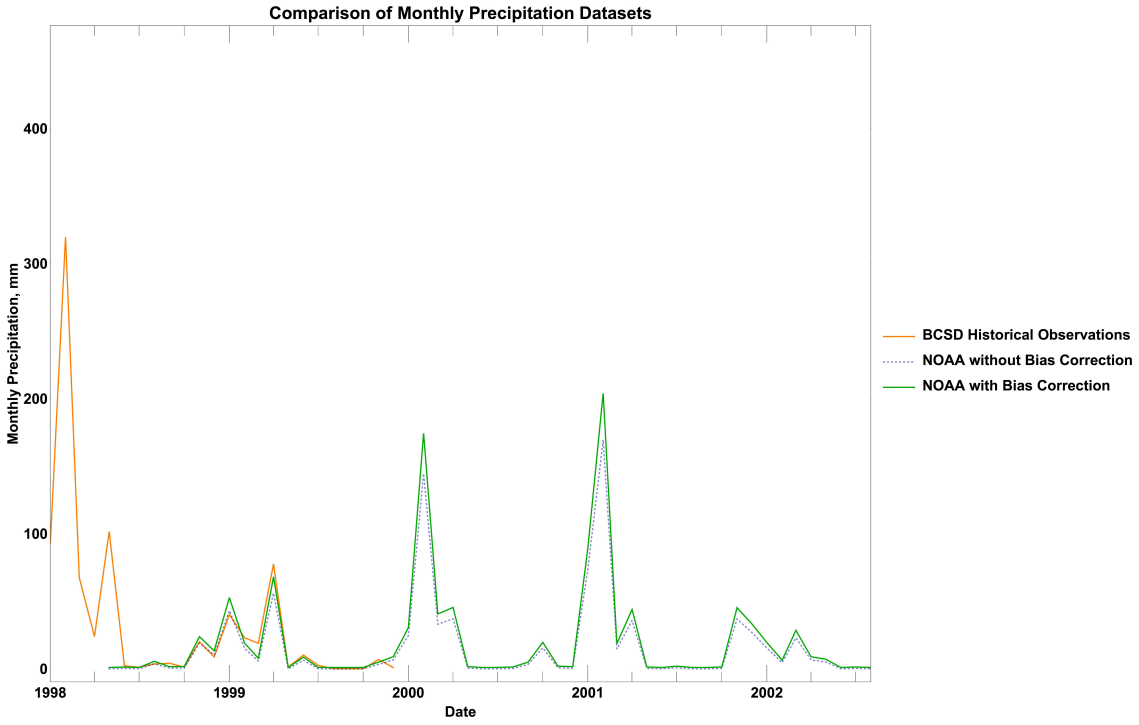
between historical climate and historical supplies. One included both temperature and precipitation variables and the other only precipitation.

At the time of the analysis, the gridded BCSD historical climate observations were available only between 1950 and 1999. Therefore, to compare climate observations to the surface supply results for 2010 to 2015 an additional proxy data set for the 2010 to 2015 period was developed. Specifically, we used weather station observation at Ontario International Airport[3] (coordinates 34.05N, 117.61667W) contained in the Global Historical Climatology Network Database (GHCND) (Menne *et al.*, 2012), maintained by the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center. The Ontario International Airport observation station reports monthly total precipitation and mean temperature observations from 1998 to present day.

We compared the monthly mean NOAA observed data to the monthly mean BCSD observed data for the overlapping period of May 1998 to June 2015. As expected we found very strong relationships for both monthly temperature and precipitation, although the NOAA observations were generally slightly drier than the BCSD data. We calculated a correction factor that we subsequently applied to the NOAA observed data to generate bias corrected datasets. Figure 23 shows a comparison of BCSD observed precipitation, NOAA observed monthly precipitation, and NOAA bias-corrected precipitation. This figure shows the strong relationship between the NOAA and BCSD datasets during the overlapping period of 1998 to 2000 and the very slight adjustment that was made to the NOAA data for months from 2000 and later.

[3] This station has Station ID GHCND:USW00003102 with latitude/longitude coordinates 34.05N, 117.61667W.

**Figure 23: Comparison of BCSD, NOAA, and NOAA bias corrected monthly precipitation data on overlapping dates**




NOAA bias corrected temperature and precipitation data, which were available until June 2015, were used to assess linear regressions relating monthly mean temperature and mean precipitation to total observed IEUA surface supplies. Additionally, given that a significant component of surface supply is due to melting snow pack, the potential of a delayed precipitation signal was evaluated. Four regressions were considered to estimate stream flow: (1) precipitation alone, (2) temperature alone, (3) precipitation and temperature, and (4) precipitation and a 12-month moving average of temperature. These regressions were analyzed with various lag times—applied to both temperature and precipitation—ranging from 0 to 6 months to search for a significant signal; a lag time of three months was found to have the lowest p-value among for all regressions and appeared to best reflect observed stream flow patterns. Note that the minimum p-value found with a lag time of 0 months was $\approx 0.429$, while the p-values of the three best-fitting regression models at a lag time of three months were $< 0.005$. Shown below in Figure 24 is a comparison of each of the four regressions considered—each mapped over the NOAA bias corrected precipitation and/or temperature data—against observed surface flows. Figure 25 shows the same models aggregated to annual totals.

**Figure 24: The four regression models versus observed flows**

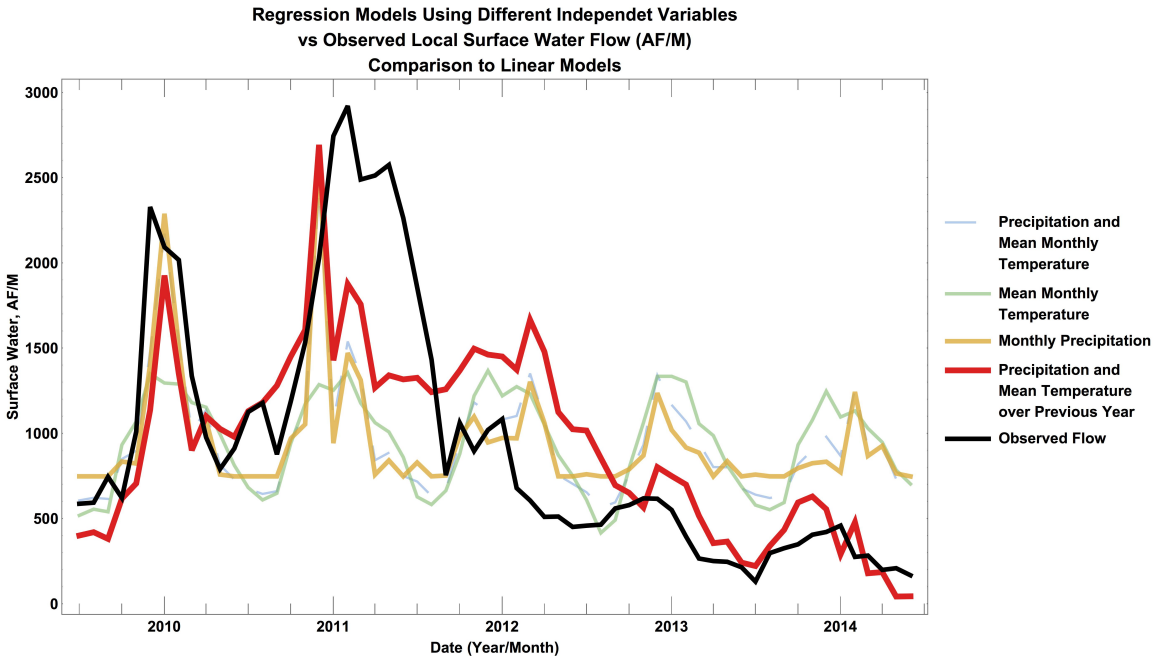
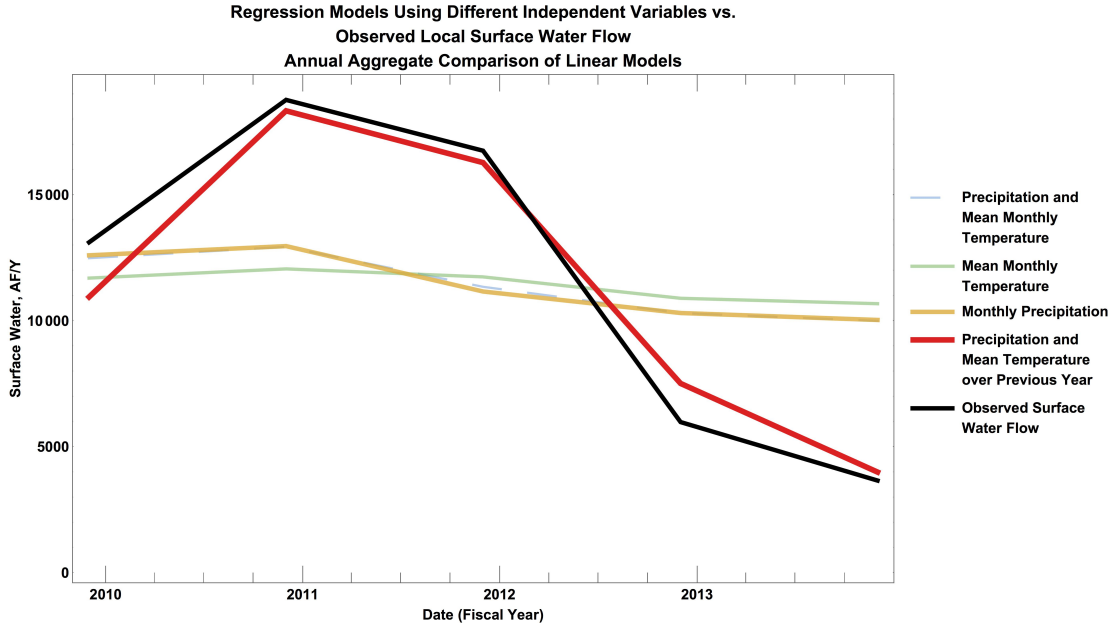



**Figure 25: Four regression models averaged annually**




The regression model using precipitation and the mean temperature of the previous year (a moving average of twelve months) appears to generally follow the downward trend, while the

precipitation only model, while accounting for much of the same variance, does not reflect the monthly downward trend in flow shown in Figure 24.

Estimated flows using both the precipitation and mean annual temperature under all 343 climate scenarios included, in addition to the mean estimated flow across all climate model outcomes, are shown in Figure 26. These same estimates generated using the precipitation only model are shown below in Figure 27.

**Figure 26: Annual projected IEUA surface supplies using the Precipitation and Temperature regression model**

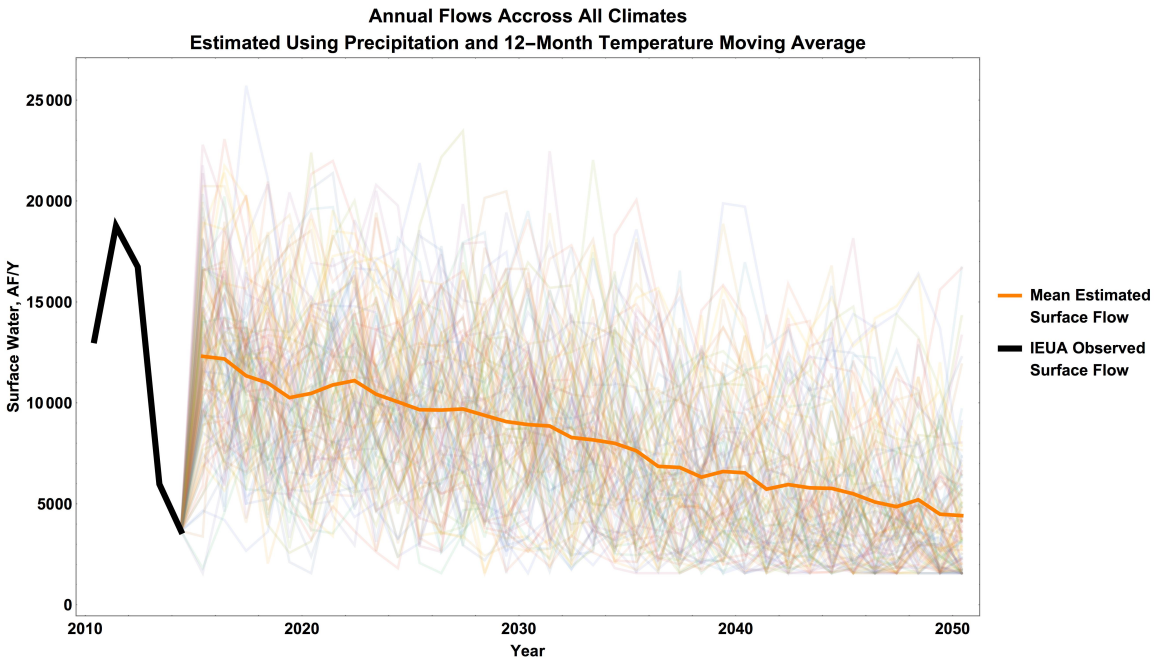
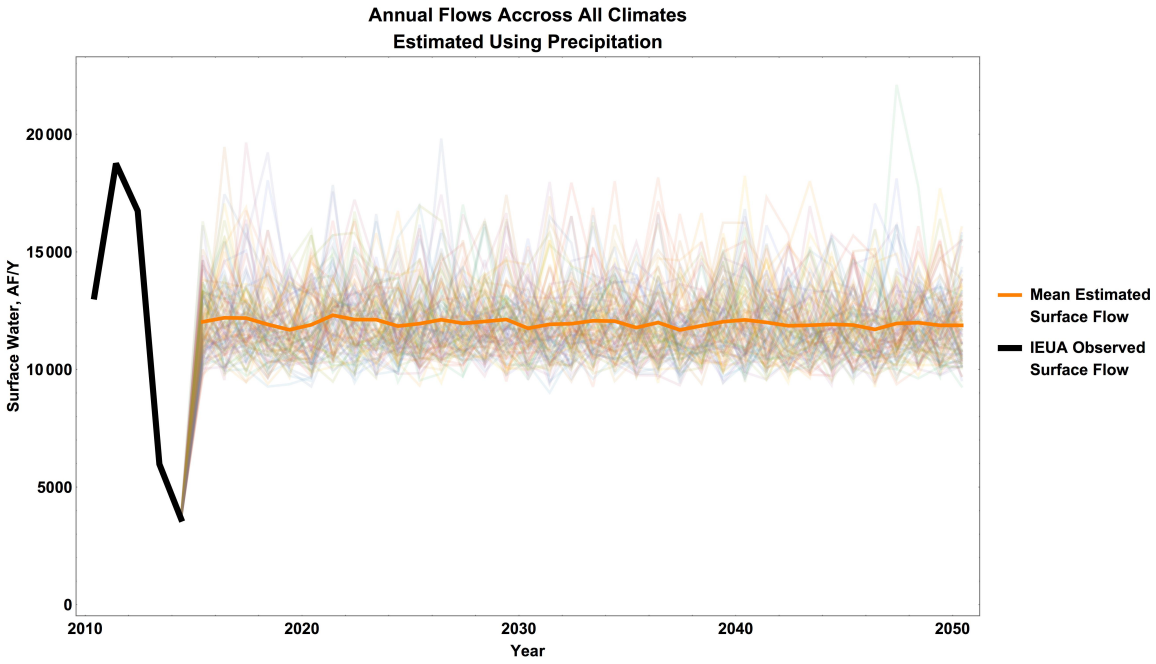


**Figure 27: Annual projected IEUA surface supplies using the Precipitation regression model**




### *Stormwater*

Stormwater used for Chino Basin groundwater replenishment is projected to increase from effectively 0 to 6,400 AF by 2020. The historical stormwater recharge has been included in the Chino basin groundwater supply. Any "new" stormwater supply could be from projects constructued under the 2013 Recharge Master Plan Update prepared by the Chino Basin Water Master. In absence of more detailed information on how future stormwater would vary with respect to precipitation, we apply the same regression formula develop for surface water supply to the baseline supply as well as any additional supply specified as part of a water management strategy.

### *Imports via Metropolitan Water District*

IEUA purchases water from MWD. Tier 1 water is generally used to meet urban indoor and outdoor demands. Per contract with MWD, IEUA must purchase at least 39,835 AF/year. Additional Tier 1 water, up to a total of 93,283 AF/year, is also typically made available to IEUA and is purchased when needed for direct use or groundwater replenishment. The baseline assumption for available additional Tier 1 water is 26,600 AF/year, for a total of just under 67,000 AF/year.

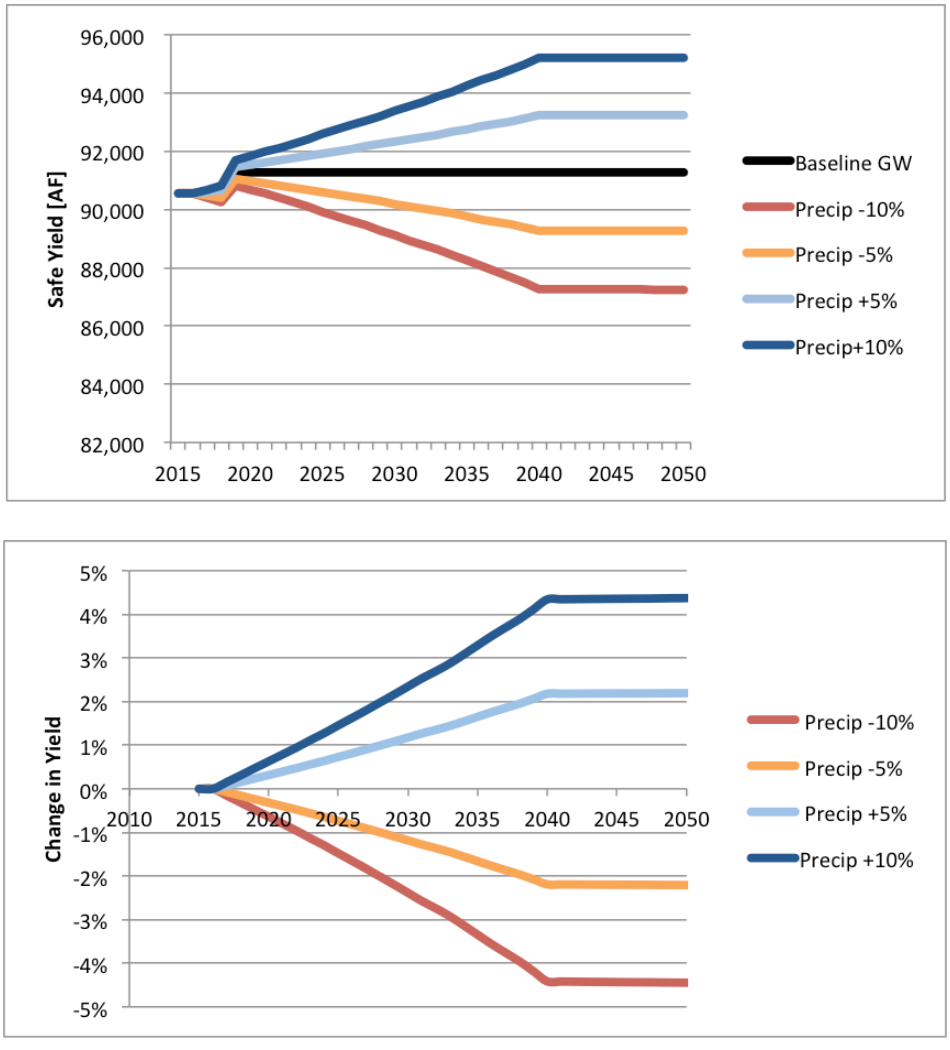
For this study we evaluate two possible levels of climate effect on additional Tier 1 water. In both cases, the total amount available declines beginning in 2021 through 2050. In one scenario, we assume additional Tier 1 water declines by 40%. In the other scenario, we assume declines of 80%. Note that these two level of water declines imply a total reduction in MWD Tier 1 water

from 62,600 AF in the without climate change condition to 51,960 (for the 40% decline in additional supplies) and to 41,320 (for the 80% decline in additional supplies).

### *Chino Groundwater Basin*

IEUA's share of Chino Basin's sustainable groundwater yield is set through actions of the Chino Basin Water Master. Under current basin conditions, the amount of groundwater available to the appropriators within the IEUA service area is 91,266 AF. An analysis by Wildermuth Environmental Inc. determined the sensitivity of IEUA's allowable production as a function of long-term precipitation trends (Figure 28). These data show that across the four scenarios evaluated, the safe yield would decline 0.44% for each 1% decline in long-term precipitation.

**Figure 28: Safe yield over time for the baseline and four trends in precipitation (top); change in safe yield (as compared to 2015 across four trends in precipitation (bottom)**



We then modified the Chino Basin safe yield by the product of the long-term precipitation trend and the empirically derived scaling factor. For example, groundwater safe yield would be reduced 4.4% by 2040 for a climate scenario that exhibits a long-term precipitation trend of -10%.

## Key Simulation Results

The WEAP IEUA model simulates annual water supply and demand from 2010 to 2015. For this analysis, the key outputs reviewed included:

- Urban indoor and outdoor demand
- Supplies used to meet urban demand
- Unmet urban demand
- Recycled water inflows and outflows
- Chino Basin inflows and outflows

This section shows results for these outputs from the WEAP IEUA model for a single simulation—high demand scenario and historical climate.

Figure 29 shows annual indoor potable demand and outdoor demand—both potable and recycled. Note that indoor demand gradually increases each year, whereas outdoor demand varies year-to-year. The outdoor demand variation is due to the historical climate used in this simulation.

**Figure 29: Urban indoor and outdoor demand for high demand scenario and historical climate**

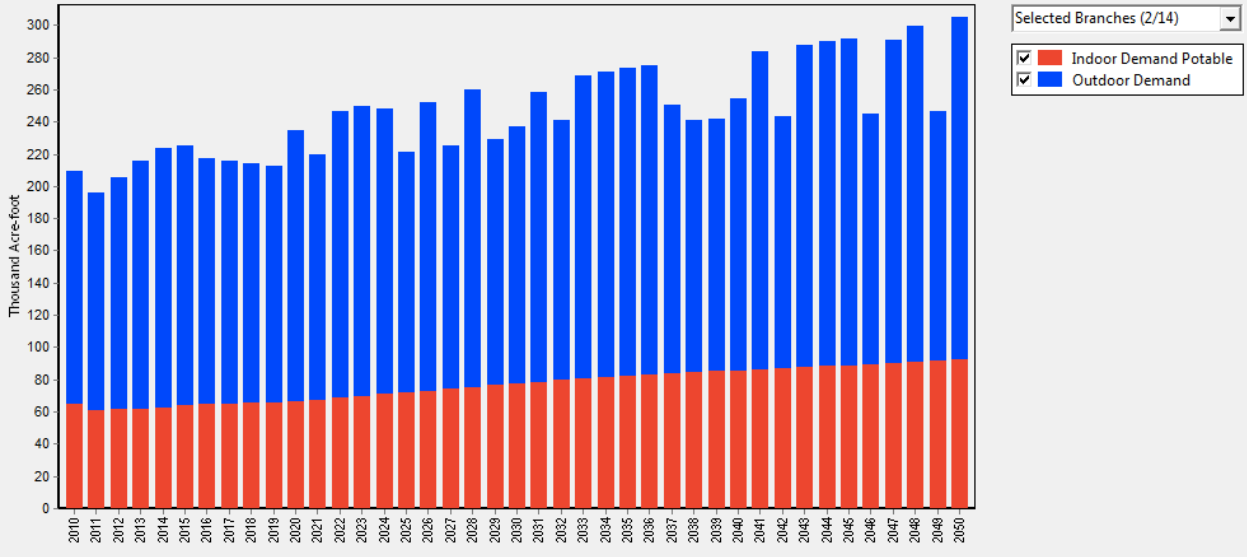



Figure 30 shows the mixture of supplies used to meet the demands in Figure 29. The largest source is Chino groundwater supplies. MWD Tier 1 supplies (minimum and additional) provide significant water. Lastly, recycled water provides about 20 percent of the supply.

**Figure 30: Supplies used to meet demand for high demand scenario and historical climate**

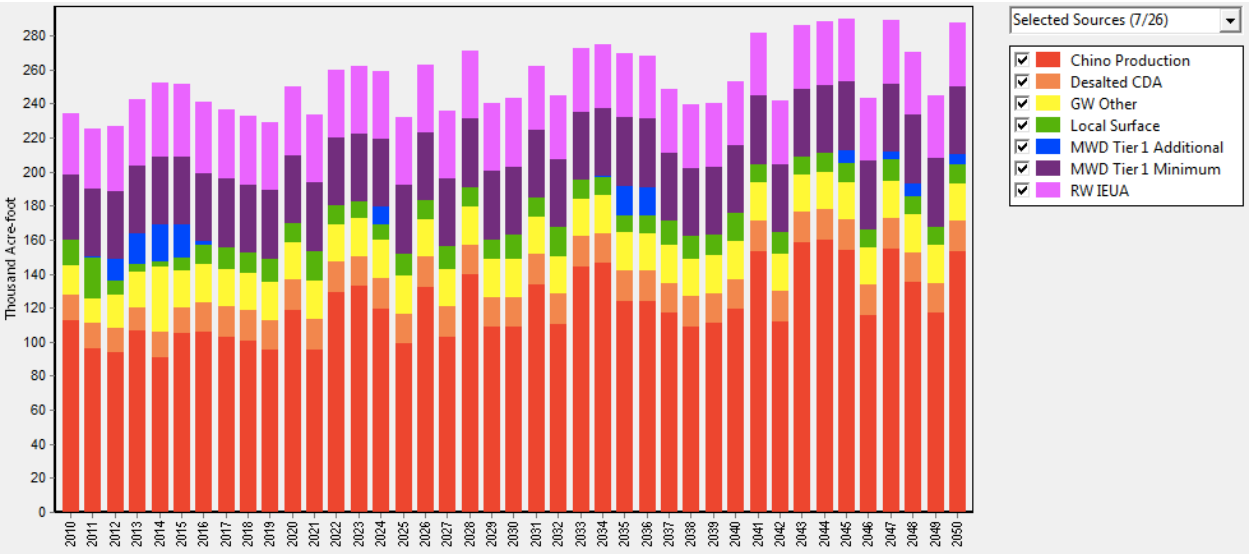



Figure 31 focuses on the recycled water portion of the IEUA system. The top bars show the inflows—return flow from IEUA indoor demand and some small amount of wastewater from outside the IEUA service area. The bottom bars show the destinations for the recycled water supply including: outdoor urban use (Recycled Direct), agricultural use (Ag RW Demand), the Santa Ana River (SAR Obligation and Downstream Flow), recharge to the Chino Basin (Req. Supp. Recharge and Recycled GW Recharge, Additional GW Recharge). Note that Downstream Flow represents more available recycled water than is needed to meet demand for recycled water. In simulations with low urban demand, there is no excess recycled water and instead shortages.

**Figure 31: Sources of recycled water (top) and uses of recycled water (bottom) for high demand scenario and historical climate**

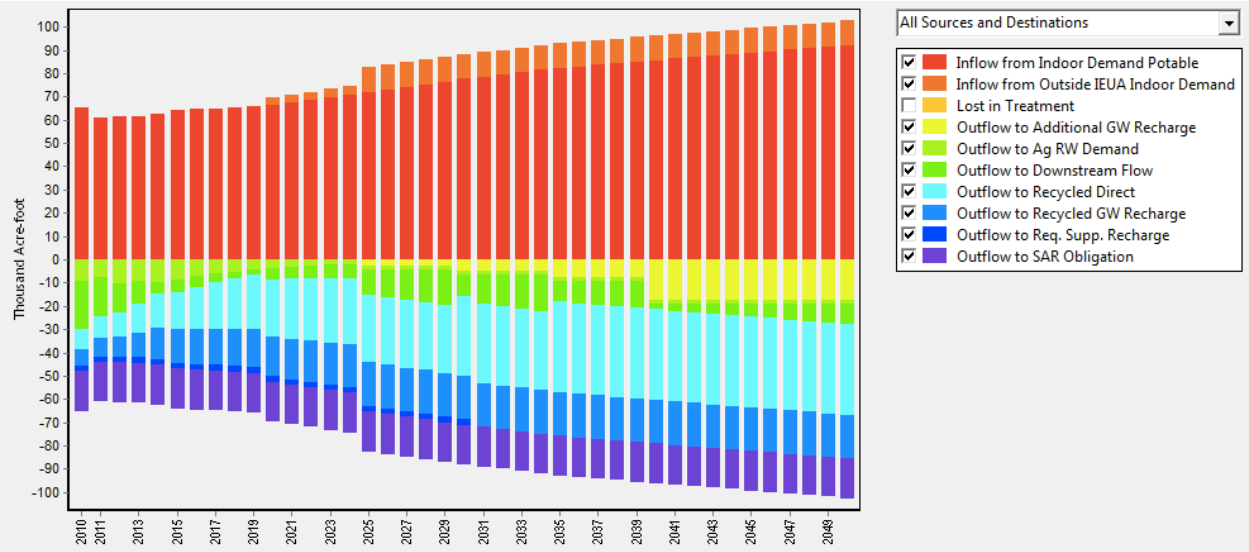
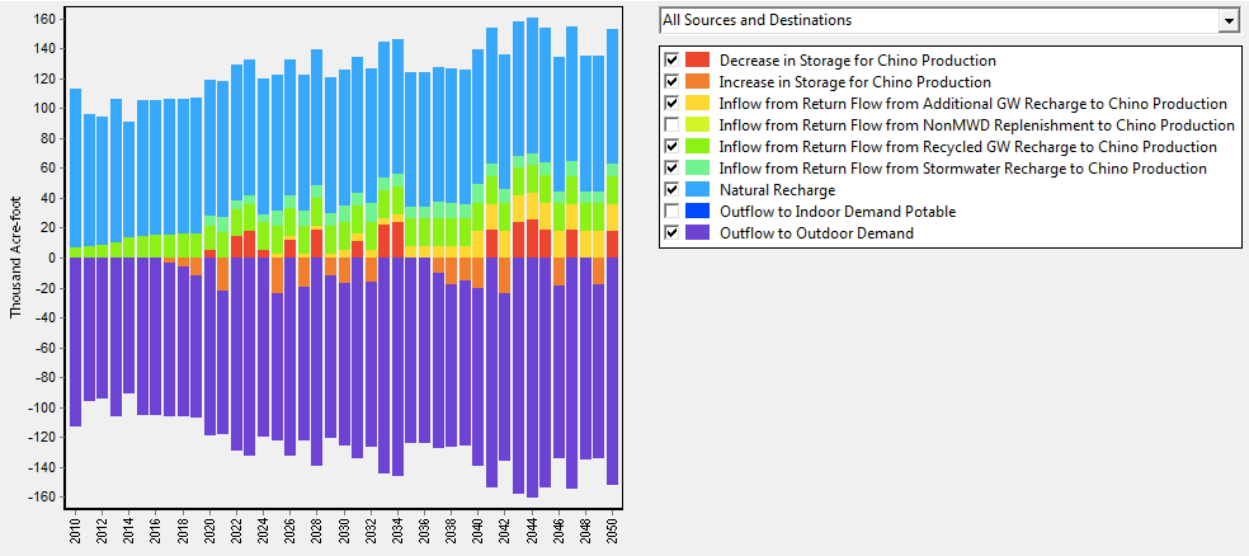



Figure 32 shows the inflows and outflows to the Chino Groundwater Basin. Natural Recharge is the largest source, but one can see how the different replenishment sources increase the inflows over time. The primary use of groundwater is to meet outdoor demands.[4] There is some modest increase and decrease in storage over the years.

[4] In reality, potable water for indoor and outdoor use are served using common water mains. The partitioning of supplies to indoor and outdoor potable use in the model reflects the priority structure used to ensure that shortages, if any, are experienced by outdoor uses first.

**Figure 32: Inflows (top) and outflows (bottom) to the Chino Basin for high demand scenario and historical climate**



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# Appendix 3:

# A&N Technical Services “Indoor and Outdoor Demands”

A & N Technical Services, Inc.

# Memorandum

**To:** Jason Pivovaroff, IEUA

**From:** **David Pekelney and Thomas Chesnutt**

**Date:** January 24, 2014

**Re:** **Inferring Indoor and Outdoor Water End Uses in the IEUA Service Area**

## *Introduction*

This memo documents the estimation of indoor and outdoor water end uses for water demand in the IEUA service area. This estimation of indoor/outdoor end uses is conducted by customer class—single family residential, multi-family residential, and commercial-industrial-institutional (CII). Indoor end uses are of particular interest to planners tasked with designing wastewater systems and recycled water systems because it helps them establish capacity requirements. Both indoor and outdoor use is of great interest to planners tasked with designing Water Use Efficiency (conservation) programs. Although much has already been accomplished with indoor conservation, there is some level of remaining potential for water savings. WUE planners have particular interest in outdoor use because it is generally assumed to be a large share of total use with large remaining potential for savings.

Two methods were used to estimate outdoor use across customer classes. The first method is the minimum month method that has been historically used in the water industry—this method assumes that the minimum month of water demand is 100 percent indoor end uses. Though we believe that this is a counterfactual assumption in the IEUA service area (it assumes exactly zero outdoor irrigation in the winter) we provide estimates using the minimum month method to serve as a point of comparison. The second method develops an estimate of winter irrigation from dedicated irrigation meters and applies this nonzero assumption instead. Termed a "seasonal variation" method, it applies the seasonal variation from dedicated irrigation meters to mixed meter customer classes.

## *Data*

The data used are from the California Department of Water Resources, Public Water System Statistics filings for the City of Ontario for the years 1993 to 2012. These data are billing system summaries at the monthly level. Several other retailers provided monthly use summaries; however, these were generated with bimonthly billing cycles. Since different retailers can apportion bimonthly billing into calendar months using different methods, it is more consistent to stick to the monthly data generated with monthly billing. Although CVWD, Upland, and MVWD

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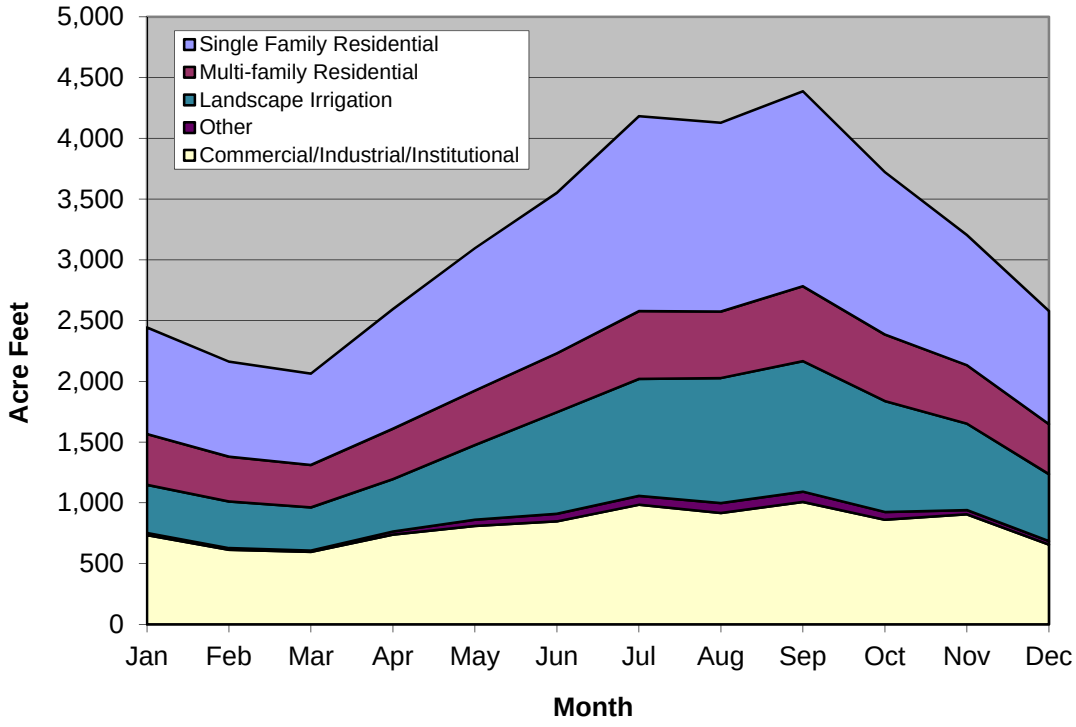
provided monthly data (based on bimonthly billing), we used the City of Ontario data for this analysis because it was the only retailer to provide monthly use data generated by monthly billing.

Table 1 shows the average use from 2008 to 2012 summed by customer class. Figure 1 shows the sum of water use by month. The strong seasonal pattern reflects irrigation needs during the characteristic hot and dry summers.

**Table 1 – Average Use, 2008 to 2012, City of Ontario**

| Class | Use (AF) | Percent |
|---|---|---|
| Single Family Residential | 13,993 | 36.7% |
| Multi-family Residential | 5,647 | 14.8% |
| Commercial/Industrial/Institutional | 9,666 | 25.4% |
| Landscape Irrigation | 8,259 | 21.7% |
| Other | 549 | 1.4% |
| Total | 38,114 | 100.0% |

**Figure 1--Monthly Use by Class**
**Average of Monthly Use from 2008-2012, City of Ontario**




### *Methods*

Outdoor end uses are directly measured by dedicated irrigation meters. Many other types of water meters--single family, multi family, commercial, industrial, and institutional--can be measuring

both indoor and outdoor end uses. If not measured or observed directly, planners are forced to rely on inference or judgment. For IEUA, we have conducted two methods to infer outdoor use for all sectors.

**Minimum Month Method**

The most common method employed to infer outdoor use is to assume the winter use is all indoors. (This assumption may be closer to the truth in wetter or colder climates.) For example, if we calculate winter minimum use times 12 months we have inferred total indoor use for the year. Total use for the year minus indoor use then equals outdoor use.

In Table 2 below, we find that outdoor use calculated with the "minimum winter use is indoor use" method is 46%. The method underestimates outdoor use because there is likely to be at least some winter irrigation in dry climates. Variations on this method include daily accounting and various ways to define winter minimum. Note the results of this method will vary considerably from year to year; the reader is cautioned when using results from one year for planning purposes and we used for this analysis the monthly average over the five most recent years for which data were available (2008 to 2012).

**Table 2 – Percent Outdoor Use**

| Class | Total | Minimum Month Method | Seasonal Variation Method |
|---|---|---|---|
| Single Family Residential | 13,993 | 36% | 58% |
| Multi-family Residential | 5,647 | 26% | 43% |
| Commercial/Industrial/Institutional | 9,666 | 26% | 42% |
| Landscape Irrigation | 8,259 | 100% | 100% |
| Other | 549 | 75% | 100% |
| Total | 38,114 | 46% | 62% |

**Seasonal Variation Method**

The second method to infer outdoor use consists of employing the pattern of seasonal variation with dedicated irrigation meters and applying it to other sectors with mixed meters. The reasoning is that with dedicated irrigation meters we can measure winter irrigation. Thus, we can observe the relative water use in winter and summer irrigation seasons and calculate a parameter from variables that are observable in other sectors. For example, by calculating the ratio of winter minimum to the seasonal range we have a function of variables observable for sectors other than dedicated irrigation meters. This method will result in a higher estimate of outdoor water use than using minimum month. The method relies on the assumption that the seasonal variation of outdoor use is the same for sites with dedicated meters as for sites with mixed meters.

Due to the variability of landscape water use from year to year, we expect the calculated parameter to vary considerably from year to year. For this reason, we calculated the parameter (ratio of winter minimum to seasonal range) for each year for which we could collect data (1993 to 2012) and took the average. We applied this long term average to the monthly average of the most recent five years of consumption data (2008 to 2012) because of the changing distribution of water use by customer class as more dedicated irrigation meters are employed.

Figure 2 shows the use from irrigation-only meters, with winter irrigation illustrated in blue and the seasonal range in red for one example year (2011).

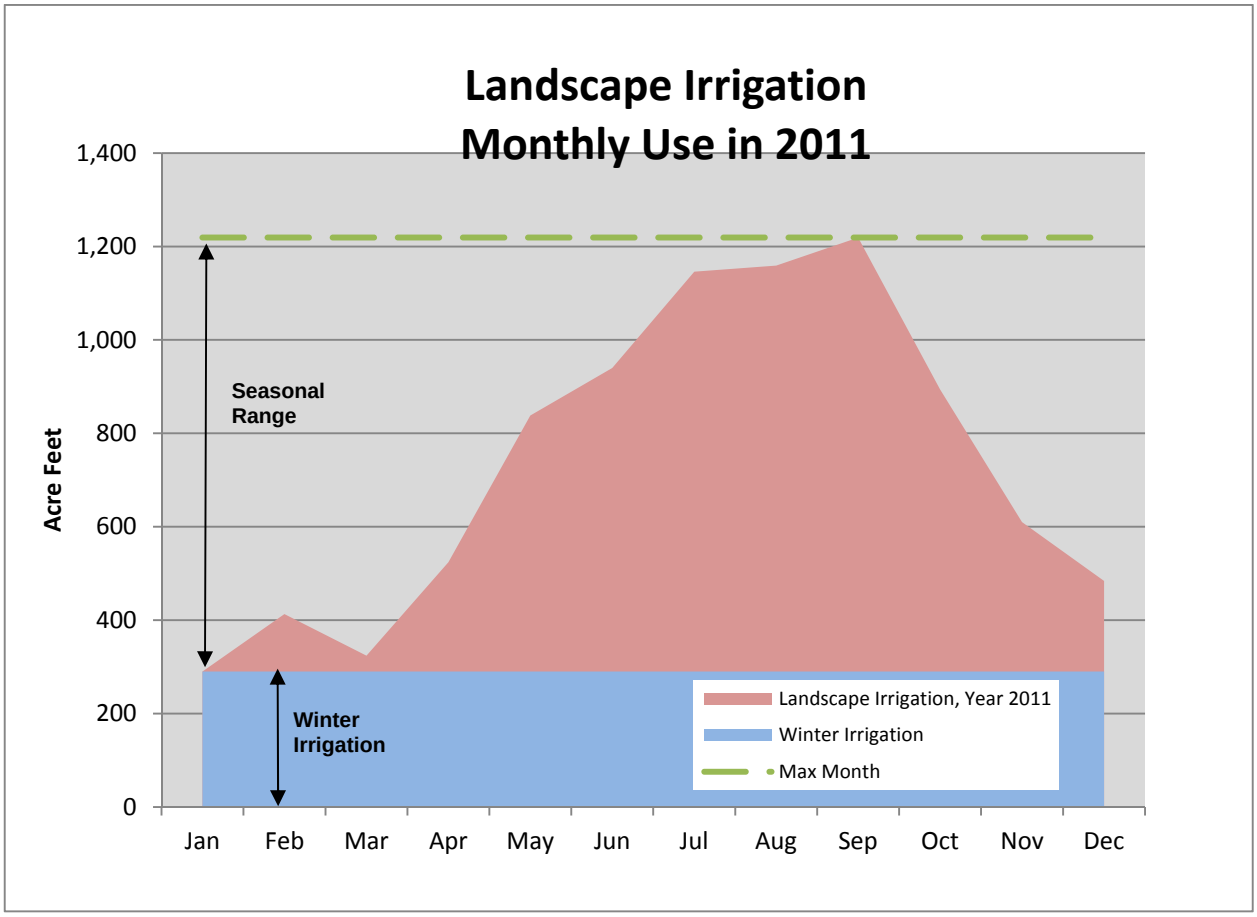
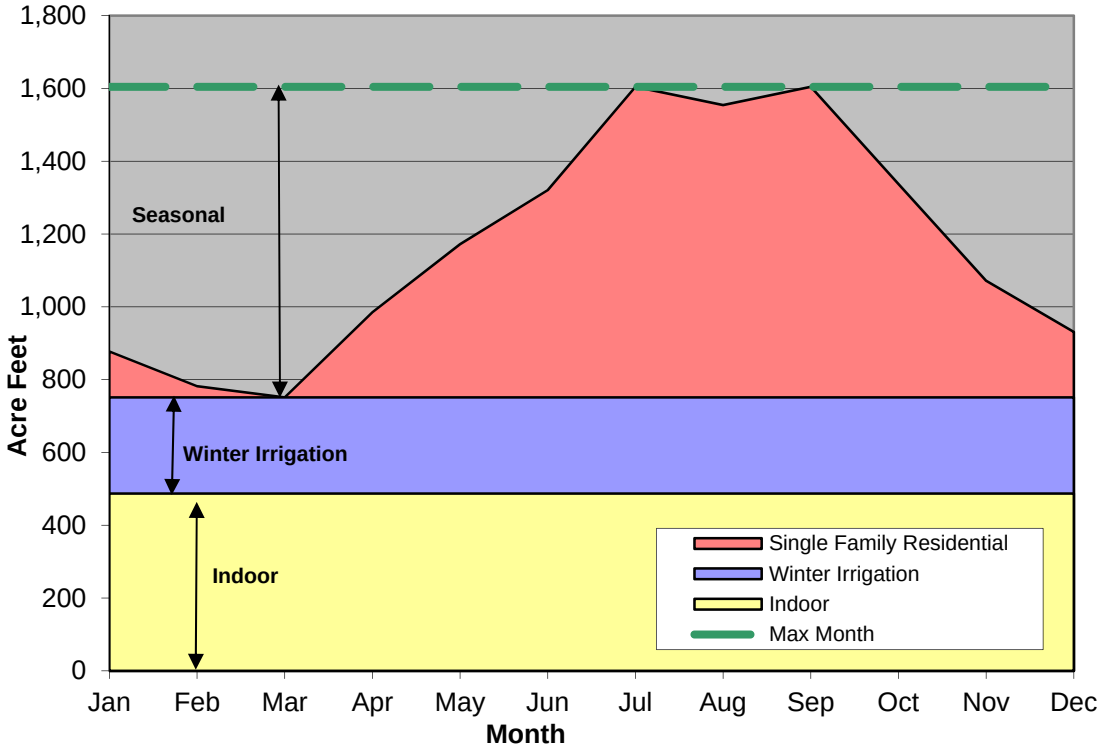



Figure 2 shows winter irrigation is 31% of seasonal range between summer and winter for dedicated irrigation accounts for the year 2011. We repeated this calculation for each year for which were able to collect data (1993 to 2012) and averaged the values to get the result we apply to customer sectors with mixed meters (31%).

Seasonal range and winter minimum are observable for non-irrigation classes. If we assume that winter irrigation is also 31% of seasonal range for the non-irrigation customer categories, we can infer their winter irrigation, and thus indoor and outdoor use.

**Figure 3--Single Family Residential**
**Average of Monthly Use from 2008-2012**




For example, Figure 3 shows winter irrigation calculated as 31% of seasonal range for the single family residential sector. Total outdoor use (red+blue in this graph) is, thus, 58% of total use for the year (red+blue+yellow). In contrast, using the minimum month for the single family sector results in 36% outdoor use (red area only).

### *Conclusions and Recommendations*

The seasonal variation method estimates outdoor end uses to compose 62 percent of M&I water demand (across all customer sectors) in the IEUA service area. We recommend using the seasonal variation method because we know the minimum month method systematically underestimates outdoor water use in climates where there is winter irrigation such as IEUA.

Although the minimum month method systematically underestimates outdoor use and overestimates indoor use--and we do not recommend using it for planning water resource investments--it is a commonly used method that is simple to implement and, thus, it may have value as a comparison benchmark.

This analysis used empirical measures using monthly-billed data from one of the larger retail water service areas. We can improve the reliability of the results by expanding the data set to include other IEUA service areas that utilize monthly billing.

As stated in the Introduction, estimation of indoor/outdoor split is of particular interest because it aids with designing wastewater system and recycled water systems to establish capacity requirements. Indoor use is directly related to wastewater flows; however, that does not mean

they should be directly compared. Indoor use and wastewater flows are not commensurate without accounting for the following:

- The water volume used in the indoor/outdoor estimate derives from customer consumption measures. If a comparison to production measures is desired, one must account for factors that explain the differences between production and consumption measures: system loss, unaccounted for water, meter accuracy, and unmetered water. Additionally, if applying the estimate of indoor water use to total production, agricultural use needs to be separately accounted for because the estimates of indoor water use were constructed with M&I consumption data only.
- Some indoor use does not go down the drain because of cooking, consumption, cleaning, indoor plants, and other uses. These indoor water uses do not translate into wastewater flows.
- Parts of the unincorporated areas of IEUA are not hooked up to the sewer system—they still use septic systems—and their indoor use also does not translate to sewer flow.
- Any loss or gain in volume between the customer and the wastewater treatment plant would also need to be accounted for. For example, infiltration and inflows, wastewater system loss, and evaporation are potential effects on wastewater volume.
- It is easy to observe that water consumption data is inherently more variable than wastewater inflow measures due to outdoor use and weather variability. The estimate of indoor water use as a proportion of total M&I use in the City of Ontario is 38% over the years 1992-2012. If this proportion is calculated using the most recent five years from 2008 to 2012, the proportion of indoor water use is only 36%. This proportion should clearly not be thought of as a constant over time.

In sum, although most of indoor water use does indeed flow to the treatment plant, the estimates of wastewater flow and the indoor water use are not directly comparable without accounting for the above factors.

# Appendix 4:

# A&N Technical Services “Demand Influencing Factors”

# Baseline Demand Influences

Table 1 summarizes the demand influences that were incorporated into the corresponding baseline demand forecast. The following sections define each level of influence, or adjustment that was applied to the normalized demand forecast.

Table 1: Baseline demand influences incorporated within each demand forecast

| | Baseline Demand Influences | | | | | |
|---|---|---|---|---|---|---|
| | **Economic Cycle** | **Household Income** | **Housing Density** | **Weather** | **Climate Change** | **Customer Response** |
| Upper Forecast | Baseline | Baseline | City General Plan | Multiple Dry | High | Permanent |
| Lower Forecast | Baseline | Baseline | SCAG | Dry | Baseline | Permanent |
| Planning Forecast | NA | NA | DWR | NA | NA | NA |

Notes: NA = Not Applicable

# Economic Cycle

Ability to specify how strong and weak market conditions impact demand. The effect from market conditions was defined from historical demand data through the normalizing process.

- **Weak** – implies weak market conditions and demand is reduced by 6.55%.
- **Baseline** – implies that demand will not change and market conditions will remain normal/average.
- **Strong** – implies strong market conditions and demand will increase by 6.55%

# Median Household Income

Ability to incorporate potential changes in demand related to household income. The following alternatives were based on the following assumptions.

- **Low** – median household income growth is below the baseline rate and reduces over time at minus 1% percent per year. Implies that demand will potentially be reduced.
- **Baseline**— median household income trends at the predicted rate per the 2012 SCAG RTP/SCS. Implies that demand will not change and will remain normal/average.
- **High** – median household income growth increases faster than the baseline rate and increases at plus 1% percent per year. Implies that demand will potentially be increased.

# Housing Density

Ability to adjust the water use factor applied to each occupied housing unit based upon the expected density of future development. The density values below are aggregated regional values for the Agency's service area. In general, higher housing densification tends to have lower water use per unit caused by reduced landscape areas and more stringent water use efficiency standards.

- **City General Plan** – incorporates housing density reflective of the 2014 City General Plans.
    - Single family residential density range 1.2 – 4.2 units per acre
    - Multi-family residential density range 9.7 – 17.3 units per acre
- **Baseline** – implies that future residential development resembles past/traditional dwelling units per land area.
- **SCAG -** incorporates housing density reflective of the 2012 S.California Association of Governments Regional Transportation Plan/Sustainable Communities Strategy (2012 SCAG RTP/SCS).
    - Single family residential density range 2.3 – 5.4 units per acre
    - Multi-family residential density range 8.4 – 17.0 units per acre
- **DWR** – does not incorporate housing density, assumed a modified version of the current DWR State Model Water Efficient Landscape Ordinance. Assumed the following efficiency standards:
    - 70% relative evapotranspiration (Eto) for existing landscapes
    - 60% relative Eto for new landscapes
    - Indoor water use for future development of 55 gallons per capita day (GPCD) in 2015 to 35 GPCD by 2040.
    - Number of occupied housing units per SCAG RTP/SCS
    - Assumed 62% of total demand for residential use

# Weather

Ability to specify how weather conditions impact demand from below and above average/normal conditions. The effect of weather variation was defined from historical demand data through the normalizing process.

- **Wet** – implies that demand will be decreased by 3.74% due to below normal temperature and increased wet periods.
- **Baseline** - implies that demand will not change and weather will remain normal/average conditions.
- **Dry** – implies that demand will increase by 3.74% due to above normal temperature and reduced wet periods.
- **Multiple Dry** – implies that demand will increase by 5.98% due to extended periods of above normal temperature and reduced wet periods.

# Climate Change

Long term climate change is modeled by using recent Global Climate Change model predictions of potential increases in temperature and corresponding impact to demands. The Regional Climate Trends and Scenarios from the Southwest U.S. were referenced from the National Oceanic and Atmospheric Administration (NOAA) Technical Report NESDIS 142-5. (http://scenarios.globalchange.gov/report/regional-climate-trends-and-scenarios-us-nationalclimate-assessment-part-5-climate-southwest)

- **Baseline -** implies that demand will not change and climate will remain at normal/average conditions.
- **Median** ($50^{th}$ percentile) – implies that expected temperature will increase by 2.7 degree Fahrenheit due to climate change. This would increase demands by 3.2% by 2040.
- **High** ($80^{th}$ percentile) – implies that expected temperature will increase by 3.6 degree Fahrenheit due to climate change. This would increase demands by 4.3% by 2040.

# Customer Response and Water Use Behavior

Defines how much of recent demand reductions will persist into the future that is permanent. The effect from recent customer response and water use behavior was defined from historical demand data through the normalizing process.

- **Baseline** – implies that demand will not change and everything will return to the normal, or bounce back to normal/average conditions.
- **Permanent** – implies that the 4.6% recent reduction is a permanent lifestyle change and continues to 2040.

# Baseline Demand Comparison: Normalized vs. Adjusted

Figure A presents the Upper, Lower and Planning Forecasts under Baseline assumptions, therefore all demand influences are assumed to be normal or under average conditions, except for housing density. Housing density remained as indicated in Table 1. Figure B presents the same demand forecasts with the demand influences indicated in Table 1. As shown, there is a slight difference in the forecast envelope when you compare Figure A to B. The common attribute between the two Figures is housing density; therefore as shown, the other demand influences did not have as much impact to the demand forecasts as housing density did. To note, each demand influence adjusts the normalized water use factors that are applied regional growth projections for number of households and employees per sector.

Figure A: Baseline demand forecasts under normal or average conditions.

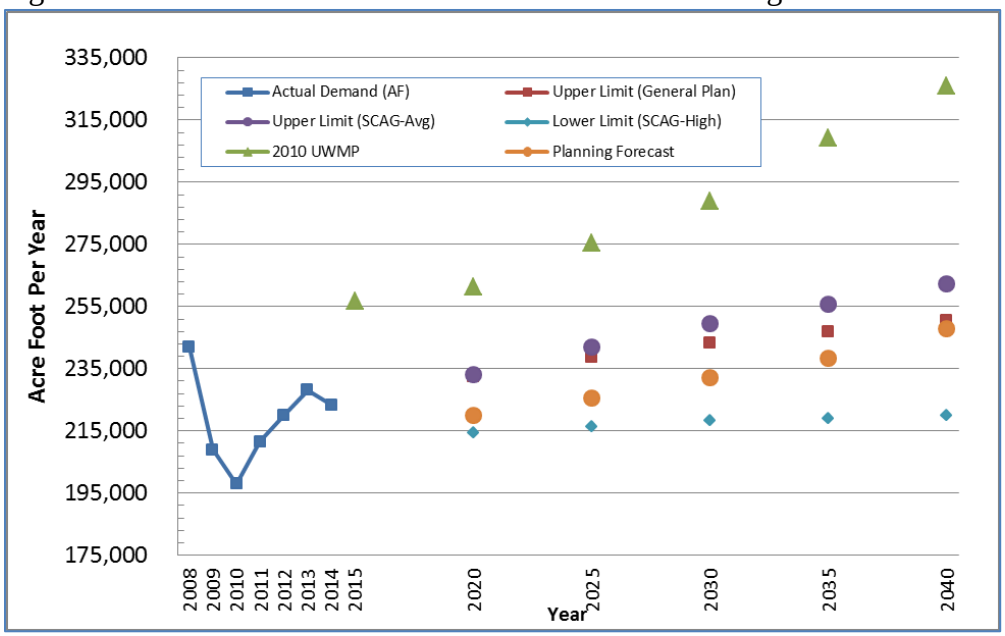
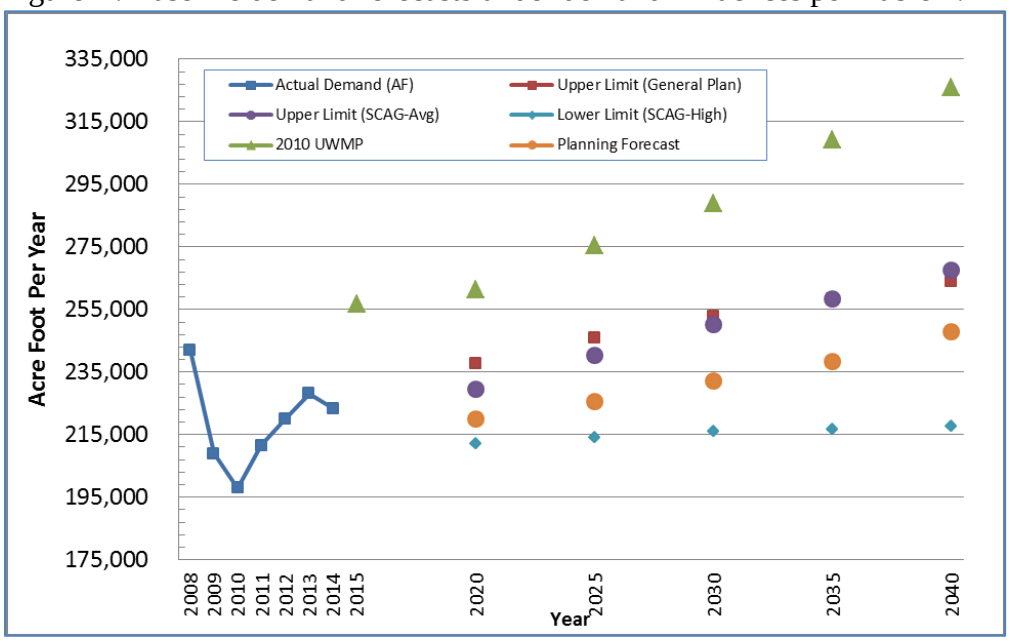



Figure B: Baseline demand forecasts under demand influences per Table 1.



# Appendix 5:
# Full IRP Technical Committee Identified Project List

| ID | Project Name | Description | AF yield | Years to "wet water" yield | Increased groundwater in storage? | Increases water level in critical GW management zones? | Increased stormwater capture/recharge? | Increased permeability or natural infiltration for | Provide additional recycled water? | Reduce Dependence on imported water from MWD during dry | Increase local water supplies? | Emergency local supply redundancy? | Decrease reliance on local surface water during dry years? | Requires conservation in existing development? | Requires demand management in new development? | Reduce TDS and/or nitrates in GW? | Decrease net energy consumption? | Increase capacity of wet year water ("big | Eligible for grant funding? | Technical feasibility/ease of |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Groundwater Treatment (Rehab)-Increment 1 | This project category will rehabilitate an existing groundwater production wells decommissioned due to water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Increased well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1 will provide up to 5,000 AFY of production. | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 2 | Groundwater Treatment (Rehab)-Increment 2 | This project category will rehabilitate an existing groundwater production wells decommissioned due to water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Increased well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1 + 2 will provide up to 10,000 AFY of production. | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 3 | Groundwater Treatment (new)-Increment 1 | This project category will construct a new groundwater production well and treatment facility to address water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Increased well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1 will provide up to 5,000 AFY of production. | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 |
| 4 | Groundwater Treatment (new)-Increment 2 | This project category will construct a new groundwater production well and treatment facility to address water quality concerns. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Increased well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1 + 2 will provide up to 10,000 AFY of production. | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 |
| 5 | Production Wells-Increment 1 | With increasing groundwater recharge to the Chino Basin, new production wells may need to be constructed to recover the additional groundwater. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1 will provide up to 5,000 AFY of production | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |
| 6 | Production Wells-Increment 2 | With increasing groundwater recharge to the Chino Basin, new production wells may need to be constructed to recover the additional groundwater. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1+2 will provide up to 10,000 AFY of production | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |
| 7 | Production Wells-Increment 3 | With increasing groundwater recharge to the Chino Basin, new production wells may need to be constructed to recover the additional groundwater. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1-3 will provide up to 15,000 AFY of production | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| 8 | Production Wells-Increment 4 | With increasing groundwater recharge to the Chino Basin, new production wells may need to be constructed to recover the additional groundwater. It is assumed that additional pumping would be limited by the volume of recharge occurring (over operating safe yield). Well operation could supplement annual demands or intermittent to help offset losses in another water supply. Increment 1-4 will provide up to 20,000 AFY of production | 5,000 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| 9 | WRCRWA RW Intertie | The Western Riverside County Regional Wastewater Authority (WRCRWA) Plant intertie would allow for the delivery of recycled water from the WRCRWA Plant to be used in the IEUA southern service area. This would also allow additional recycled water to be delivered into the northern service area groundwater recharge basins by reducing the demand from the RP-1 930 pressure zone pump station. Intertie would occur within the 800/930 Pressure Zones. | 4,500 | 10 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| 10 | Rialto RW Intertie | The Rialto intertie project would allow for delivery of recycled water from the Rialto WWTP to be used in the IEUA service area. The intertie could occur near the RP-3 groundwater recharge basins. This concept could involve the Inland Valley Pipeline, LLC (IVP) to convey water between Rialto WWTP and IEUA's recycled water distribution system. Supply could be used for direct, GWR or other reuse strategy. | 4,500 | 10 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| 11 | Pomona RW Exchange/Transfer | The City of Pomona does not currently use all of the treated effluent from the Pomona WRP. One concept would involve partnering to develop and expand their recycled water facilities in exchange for an agreed amount of their Chino Basin groundwater right. Could include other supply transfer agreement such as reclaimable waste and/or groundwater. | 2,500 | 10 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| 12 | RP-1 RW Injection-Increment 1 | This project would construct an advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) facility at RP-1 to further treat tertiary effluent to allow the water to be injected directly into Chino Basin. The sizing of the facility and the volume to be produced will be determined as part of the portfolio development process. Increment 1 facility would be sized for 2,500 AFY. | 2,500 | 9 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |

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| 13 | RP-1 RW Injection-Increment 2 | This project would construct an advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) facility at RP-1 to further treat tertiary effluent to allow the water to be injected directly into Chino Basin. The sizing of the facility and the volume to be produced will be determined as part of the portfolio development process. Increment 1+2 facility would be sized for 5,000 AFY. | 2,500 | 9 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 14 | RP-1 RW Injection-Increment 3 | This project would construct an advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) facility at RP-1 to further treat tertiary effluent to allow the water to be injected directly into Chino Basin. The sizing of the facility and the volume to be produced will be determined as part of the portfolio development process. Increment 1-3 facility would be sized for 7,500 AFY. | 2,500 | 9 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 15 | Satellite RW Injection-Increment 1 | This project category would construct a satellite (outside of RP-1) wastewater treatment plant with advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) to allow the water to be injected directly into Chino Basin. The location, sizing and volume to be produced will be determined as part of the portfolio development process. Increment 1 facility, or facilities would have a capacity of 2,500 AFY. | 2,500 | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 16 | Satellite RW Injection-Increment 2 | This project category would construct a satellite (outside of RP-1) wastewater treatment plant with advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) to allow the water to be injected directly into Chino Basin. The location, sizing and volume to be produced will be determined as part of the portfolio development process. Increment 1+2 facility, or facilities would have a capacity of 5,000 AFY. | 2,500 | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 17 | Satellite RW Injection-Increment 3 | This project category would construct a satellite (outside of RP-1) wastewater treatment plant with advanced water filtration (e.g. process treatment that combines micro or ultrafiltration) to allow the water to be injected directly into Chino Basin. The location, sizing and volume to be produced will be determined as part of the portfolio development process. Increment 1-3 facility, or facilities would have a capacity of 7,500 AFY. | 2,500 | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 18 | Desalter Recovery Improvement | The existing Chino Basin I Desalter (CD-1) recovers approximately 75 percent of water. Improvements could be done to increase recovery to approximately 90 percent. This water would be conveyed through the existing potable water system. | 1,500 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| 19 | RW Direct Use Expansion-Increment 1 | IEUA developed a new Recycled Water Program Strategy concurrent with the IRP. This project category will be used to determine the potential interest in expanding the direct use system beyond the Agency's Ten Year CIP. Includes the reuse of regional wastewater supply, approximately 83,000 AFY by 2035 and potential recycled water interties. Increment 1 facilities would increase direct use beyond baseline supply by 5,000 AFY. | 5,000 | 15 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 2 | 2 |
| 20 | RW Direct Use Expansion-Increment 2 | IEUA developed a new Recycled Water Program Strategy concurrent with the IRP. This project category will be used to determine the potential interest in expanding the direct use system beyond the Agency's Ten Year CIP. Includes the reuse of regional wastewater supply, approximately 83,000 AFY by 2035 and potential recycled water interties. Increment 1+2 facilities would increase direct use beyond baseline supply by 10,000 AFY. | 5,000 | 20 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 21 | RW Direct Use Expansion-Increment 3 | IEUA developed a new Recycled Water Program Strategy concurrent with the IRP. This project category will be used to determine the potential interest in expanding the direct use system beyond the Agency's Ten Year CIP. Includes the reuse of regional wastewater supply, approximately 83,000 AFY by 2035 and potential recycled water interties. Increment 1-3 facilities would increase direct use beyond baseline supply by 15,000 AFY. | 5,000 | 25 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 22 | RW Direct Use Expansion-Increment 4 | IEUA developed a new Recycled Water Program Strategy concurrent with the IRP. This project category will be used to determine the potential interest in expanding the direct use system beyond the Agency's Ten Year CIP. Includes the reuse of regional wastewater supply, approximately 83,000 AFY by 2035 and potential recycled water interties. Increment 1-4 facilities would increase direct use beyond baseline supply by 20,000 AFY. | 5,000 | 25 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 23 | Existing GWR Basin Improvements beyond RMPU-Increment 1 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1 facilities would increase recharge at existing basins within the Chino Basin by an additional 2,500 AFY. | 2,500 | 15 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 2 | 2 |
| 24 | Existing GWR Basin Improvements beyond RMPU-Increment 2 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1+2 facilities would increase recharge at existing basins within the Chino Basin by an additional 5,000 AFY. | 2,500 | 20 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 2 | 2 |
| 25 | Existing GWR Basin Improvements beyond RMPU-Increment 3 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1-3 facilities would increase recharge at existing basins within the Chino Basin by an additional 10,000 AFY. | 5,000 | 25 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |

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| 26 | Existing GWR Basin Improvements beyond RMPU-Increment 4 | The 2013 Chino Basin RMPU recommended a set of preferred projects to improve recharge at the existing groundwater spreading basins. This project category represents the next increment of additional groundwater recharge (imported water and/or recycled water) capable at the existing facilities. Increment 1-4 facilities would increase recharge at existing basins within the Chino Basin by an additional 15,000 AFY. | 5,000 | 25 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 27 | Construct New GWR Basins-Increment 1 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water and/or imported water for groundwater recharge. Increment 1 would provide up to an additional 2,450 AFY of recharge capacity, which is approximately one new basin at 350 AF per month for 7 months of operation. | 2,450 | 10 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 28 | Construct New GWR Basins-Increment 2 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water and/or imported water for groundwater recharge. Increment 1+2 would provide up to an additional 4,900 AFY of recharge capacity, which is approximately 2 new basins at 350 AF per month for 7 months of operation. | 2,450 | 15 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 29 | Construct New GWR Basins-Increment 3 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water and/or imported water for groundwater recharge. Increment 1-3 would provide up to an additional 7,350 AFY of recharge capacity, which is approximately 3 new basins at 350 AF per month for 7 months of operation. | 2,450 | 20 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 30 | Construct New GWR Basins-Increment 4 | Purchase land to construct new groundwater recharge basins in the service area to capture additional stormwater, recycled water and/or imported water for groundwater recharge. Increment 1-4 would provide up to an additional 9,800 AFY of recharge capacity, which is approximately 4 new basins at 350 AF per month for 7 months of operation. | 2,450 | 20 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 2 |
| 31 | ASR wells MZ1 and MZ2 | Construct aquifer storage and recovery (ASR) wells to increase improted water groundwater recharge within management zone 1 and 2. Reference projects were taken from the 2010 RMPU, Sections 6.7.2.1 and 3 for CVWD and the City of Ontario. | 11,500 | 5 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 32 | ASR wells MZ3 | Construct aquifer storage and recovery (ASR) wells to increase imported water groundwater recharge within management zone 3. Reference projects were taken from the 2010 RMPU, Sections 6.7.2.2 for JCSD. | 3,500 | 5 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 33 | Maximize ASR wells | Construct other aquifer storage and recovery (ASR) wells to increase imported water groundwater recharge by 3,500 AFY within the Chino Basin during wet and dry years. Assume benefit 40% of the time (2 in 5 years). Storage to be dependent on supplemental water availability in wet years | 3,500 | 5 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 34 | Cadiz IW Transfer | The Cadiz project would allow for the import of unused groundwater from the remote Fenner Valley near Cadiz, California. For the purposes of the IRP, a 5,000 AFY increment of water is assumed. The Cadiz supply would be transferred and taken as SWP water into the Chino Basin. | 5,000 | 20 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 35 | Secure SWP IW transfer outside MWD | Imported water supply is solely from MWD via the SWP and is limited by the Agency's purchase order. Other permanent, temporary or seasonally available imported water supplies could be purchased and wheeled into the Chino Basin. The volume of water available varies depending on the source of water and timing. Supplies could be purchased from various Irrigation Districts or secured via Ag Transfer. Assume benefit 1 in 10 years | 5,000 | 10 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 1 |
| 36 | SBVMWD IW Transfer | As a SWP contractor, San Bernardino Valley MWD (SBVMWD) has a Table A allocation. This option would involve constructing an intertie between SBVMWD's imported water system. The supply would be temporary or seasonally available and could be purchased and wheeled into the Chino Basin. Assume benefit 1 in 5 years. | 5,000 | 5 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 1 |
| 37 | Ocean Desalination Exchange | This project category would involve a partnership with another water agency pursuing ocean water desalination; through in-lieu exchange, the Chino basin would obtain an agreed amount of imported water. For the purposes of the IRP, a volume of 5,000 AFY was chosen. Opportunity to invest in upcoming ocean desalination plants includes Huntington Beach, Carlsbad and West Basin. | 5,000 | 10 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 1 |
| 38 | Six Basin Water Transfer | This project would explore the idea of developing a water transfer agreement with Six Basins. One concept is to purchase imported water for recharge into Six Basins and get in return equal volume of groundwater underflow plus agreed amount of stormwater. For example, could purchase 10,000 AF of IW for exchange of 10,000 AF of groundwater plus 7,000 AF of stormwater. Assume benefit 1 in 5 years. | 17,000 | 5 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 |
| 39 | Expand WUE Devices | Implement additional targeted device related savings to reduce demand beyond current annual water use efficiency savings. Provide incentives and pilot programs to roll out extremely high efficient indoor fixtures and toilets. To be verified with WUEBP. | 5,000 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 |
| 40 | WUE - Turf Removal-Increment 1 | Implement turf removal and landscape transformational programs to reduce outdoor demand. To be verified with WUEBP. Increment 1 would provide up to 5,000 AFY of savings. | 5,000 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 |
| 41 | WUE - Turf Removal-Increment 2 | Implement turf removal and landscape transformational programs to reduce outdoor demand. To be verified with WUEBP. Increment 1+2 would provide up to 10,000 AFY of savings. | 5,000 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 |
| 42 | WUE - Turf Removal-Increment 3 | Implement turf removal and landscape transformational programs to reduce outdoor demand. To be verified with WUEBP. Increment 1-3 would provide up to 15,000 AFY of savings. | 5,000 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 |
| 43 | WUE - Budget Rates-Increment 1 | Implement water budget based rates for 2 member agencies (assuming 15% total savings per Agency after 3 years). To be verified with WUEBP. Increment 1 would provide up to 13,350 AFY of savings. | 13,350 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |

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| 44 | WUE - Budget Rates-Increment 2 | Implement water budget based rates for 2 member agencies (assuming 15% total savings per Agency after 3 years). To be verified with WUEBP. Increment 1 would provide up to 26,700 AFY of savings. | 13,350 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| 45 | WUE - Budget Rates-Increment 3 | Implement water budget based rates for 2 member agencies (assuming 15% total savings per Agency after 3 years). To be verified with WUEBP. Increment 1 would provide up to 40,050 AFY of savings. | 13,350 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| 46 | WUE- RW Demand Management-Increment 1 | Implement demand management devices and programs for direct recycled water customers. Does not generate additional supply, aids in managing the supply during peak demand. Increment 1 would provide 2,500 AFY of demand management, this supply could be used for increasing direct use demands, groundwater recharge or other reuse strategy. | 2,500 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| 47 | WUE- RW Demand Management-Increment 2 | Implement demand management devices and programs for direct recycled water customers. Does not generate additional supply, aids in managing the supply during peak demand. Increment 1+2 would provide 5,000 AFY of demand management, this supply could be used for increasing direct use demands, groundwater recharge or other reuse strategy. | 2,500 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 2 |
| 48 | Dry Weather Flow Diversions | Capture and treat urban dry weather flow from Chino, Cucamonga and San Sevaine Creek into the Regional Plants. For the purposes of the IRP, a volume of 3,500 AFY was assumed as total available dry weather flow. | 3,500 | 5 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| 52 | San Antonio Creek SW Capture | Modify existing basins along San Antonio Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the “big gulp” concept. Assume benefit 1 in 5 years | 1,000 | 10 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 53 | Cucamonga Creek SW Capture | Modify existing basins along Cucamonga Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the “big gulp” concept. Assume benefit 1 in 5 years. | 2,500 | 10 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 54 | Day Creek SW Capture | Modify existing basins along Day Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the “big gulp” concept. Assume benefit 1 in 5 years. | 2,500 | 10 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 55 | San Sevaine Creek SW Capture | Modify existing basins along San Sevaine Creek to increase stormwater capture beyond the 2013 RMPU. Increase facilities to better accommodate the “big gulp” concept. Assume benefit 1 in 5 years. | 2,500 | 10 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 56 | Water Banking Facility | This project category would invest into the Semitropic Groundwater Storage Bank in Kern County or similar program. The Chino Basin could bank additional purchases of wet year water when these supplies are available and Chino Basin facilities are capacity limited. | 5,000 | 10 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 1 |
| 58 | Regional LID-Increment 1 | Construct or modify urban development to better manage and infiltrate rainfall at the source. Projects could include bioswales and or pervious concrete installation in parking lots, street drainages. Increment 1 facilities could provide up to 5,000 AFY of recharge. | 5,000 | 5 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| 59 | Regional LID-Increment 2 | Construct or modify urban development to better manage and infiltrate rainfall at the source. Projects could include bioswales and or pervious concrete installation in parking lots, street drainages. Increment 1+2 facilities could provide up to 10,000 AFY of recharge. | 5,000 | 5 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| 60 | Direct Potable Reuse-Increment 1 | This project would construct an advanced water filtration and treatment (e.g. process treatment that combines micro or ultrafiltration) facility at a Regional Plant. The treatment process would allow the recycled water to be introduced into the potable water system. Increment 1 facility would have a capacity of 5,000 AFY. | 5,000 | 10 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 61 | Direct Potable Reuse-Increment 2 | This project would construct an advanced water filtration and treatment (e.g. process treatment that combines micro or ultrafiltration) facility at a Regional Plant. The treatment process would allow the recycled water to be introduced into the potable water system. Increment 1+2 facility would have a capacity of 10,000 AFY. | 5,000 | 10 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 62 | Cucamonga Basin Improvements | This project category will identify projects that would result in additional groundwater production benefits coming into the IEUA service area from the Cucamonga Basin. Includes recharge facilities, treatment and production facilities to maximize supply coming into the Chino Basin. | 2,500 | 5 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 | 2 | 2 |
| 63 | Maximize Other Groundwater | This project category will identify local member agency projects that would result in additional groundwater production benefits coming into the IEUA service area outside of the Chino Basin. | 5,000 | 5 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 |
| 65 | RP-1 NRWS Treatment | The north Non Reclaimable Wastewater System (NRWS) discharges approx.. 3.5 MGD of brine to Los Angeles County annually. The project would construct a treatment facility to allow the Region to reuse this supply into the recycled water system. Requires plant expansion and partial reverse osmosis for blending. | 3,920 | 9 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| 66 | WUE - Advanced Metering Technologies | Install advanced metering infrastructure (AMI) between retail meters and a utility provider. Will provide real-time data about consumption and allow customers to make informed choices about usage. | 5,000 | $ 3 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 |
| 87 | Prior Stored Chino Groundwater | This category will allow supply to be taken from groundwater stored in the Chino Basin, pre 2014. It is estimated that approximately 400,000 AF of stored groundwater is available, of which 280,000 AF is made available for IEUA member agencies. This supply category will be managed on a case by case basis as selected into the Regional supply portfolios. The supply will be limited, but can be used annually or intermittent as needed. | 8,400 | 1 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 88 | Maximize Local Surface Water | This category of projects will construct facilities needed to capture additional local surface water. Projects to be defined by IEUA's member agencies. For example, increase surface flows off Lytle Creek in wet years. Assume benefit 3 in 5 years | 1,000 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |

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| 89 | Max Tier 1 MWD Imported Water-Increment 1 | Maximize imported water from MWD at Tier 1 rate. Total available supply at Tier 1 rate is 93,283 AFY or cumulative purchase order maximum of 932,830 AF through December 31, 2024. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1 would allow for the purchase of an additional 7,850 AFY. Can be purchased annually or intermittently. | 7,850 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 90 | Max Tier 1 MWD Imported Water-Increment 2 | Maximize imported water from MWD at Tier 1 rate. Total available supply at Tier 1 rate is 93,283 AFY or cumulative purchase order maximum of 932,830 AF through December 31, 2024. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1+2 would allow for the purchase of an additional 15,700 AFY. Can be purchased annually or intermittent. | 7,850 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 91 | Max Tier 1 MWD Imported Water-Increment 3 | Maximize imported water from MWD at Tier 1 rate. Total available supply at Tier 1 rate is 93,283 AFY or cumulative purchase order maximum of 932,830 AF through December 31, 2024. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1-3 would allow for the purchase of an additional 23,550 AFY. Can be purchased annually or intermittent. | 7,850 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 92 | Max Tier 2 MWD Imported Water-Increment 1 | Maximize imported water from MWD at Tier 2 rate. Could be taken annually or intermittent, availability pending MWD supply. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1 would allow for the purchase of an additional 5,000 AFY. Can be purchased annually or intermittent. | 5,000 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 93 | Max Tier 2 MWD Imported Water-Increment 2 | Maximize imported water from MWD at Tier 2 rate. Could be taken annually or intermittent, availability pending MWD supply. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1+2 would allow for the purchase of an additional 10,000 AFY. Can be purchased annually or intermittent. | 5,000 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 94 | Max Tier 2 MWD Imported Water-Increment 3 | Maximize imported water from MWD at Tier 2 rate. Could be taken annually or intermittent, availability pending MWD supply. Supply can be taken directly, in-lieu or for supplemental recharge. Increment 1-3 would allow for the purchase of an additional 15,000 AFY. Can be purchased annually or intermittently. | 5,000 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 2 |
| 95 | MWD Replenishment or discount wet year water-Increment 1 | Maximize replenishment or discount wet year imported water from MWD. Availability pending MWD supply and pricing. Supply can be taken in-lieu or for supplemental recharge. Increment 1 would allow for the purchase of an additional 10,000 AFY. Can be purchased annually or intermittently. Assume benefit after 2 consecutive wet years (assume 1 in 15 years) | 10,000 | 5 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 2 |
| 96 | MWD Replenishment or discount wet year water-Increment 2 | Maximize replenishment or discount wet year imported water from MWD. Availability pending MWD supply and pricing. Supply can be taken in-lieu or for supplemental recharge. Increment 1+2 would allow for the purchase of an additional 20,000 AFY. Can be purchased annually or intermittently. Assume benefit after 2 consecutive wet years (assume 1 in 15 years) | 10,000 | 8 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 2 |
| 97 | MWD Replenishment or discount wet year water-Increment 3 | Maximize replenishment or discount wet year imported water from MWD. Availability pending MWD supply and pricing. Supply can be taken in-lieu or for supplemental recharge. Increment 1-3 would allow for the purchase of an additional 30,000 AFY. Can be purchased annually or intermittently. Assume benefit after 2 consecutive wet years (assume 1 in 15 years) | 10,000 | 10 | 2 | 2 | 1 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 2 |
| 98 | Watershed Wide Water Transfers | This category of projects will construct or arrange other water transfers external to the Chino Basin. For example, dry weather flow exchange of recycled water to Orange County Water District for an equivalent amount of purchased imported water. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability and/or quality. To occur annually or intermittent. Resiliency and flexibility benefit only | - | 5 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 99 | Chino Basin Water Transfers | This category of projects will construct or arrange other water transfers within the Chino Basin. Projects to also include inter-agency interties for increased reliability. For the purposes of the IRP, it is assumed that this category of projects will not increase supply, but increases reliability. To occur annually or intermittent. | - | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 |
| 100 | Reliability Production Wells | This project category will construct new production wells needed to replace lost production or under performing facilities. These projects will maintain current annual groundwater production deliveries and are intended to increase operational flexibility and reliability. Increment 1 varies in capacity and will be determined on a case by case basis as selected into each of the regional supply portfolios. | - | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |

# Appendix 6:

# Project Lists for Water Resource Strategy Portfolios 1-8

# Project List for Strategy A Portfolio 1

| Strategy A | | |
|---|---|---|
| Project ID # | Portfolio 1 | Project Name |
| 1 | x | Groundwater Treatment (Rehab)-Increment 1 |
| 2 | x | Groundwater Treatment (Rehab)-Increment 2 |
| 5 | x | Production Wells-Increment 1 |
| 6 | x | Production Wells-Increment 2 |
| 23 | x | Existing GWR Basin Improvements beyond RMPU-Increment 1 |
| 24 | x | Existing GWR Basin Improvements beyond RMPU-Increment 2 |
| 25 | x | Existing GWR Basin Improvements beyond RMPU-Increment 3 |
| 26 | x | Existing GWR Basin Improvements beyond RMPU-Increment 4 |
| 46 | x | WUE- RW Demand Management-Increment 1 |
| 47 | x | WUE- RW Demand Management-Increment 2 |
| 87 | x | Prior Stored Chino Groundwater |
| 88 | x | Maximize Local Surface Water |

# Project List for Strategy B Portfolios 2 & 3

| Strategy B | | | |
|---|---|---|---|
| Project ID # | Portfolio 2 | Portfolio 3 | Project Name |
| 1 | x | x | Groundwater Treatment (Rehab)-Increment 1 |
| 5 | x | x | Production Wells-Increment 1 |
| 9 | x | x | WRCRWA RW Intertie |
| 11 | x | x | Pomona RW Exchange/Transfer |
| 12 | x | x | RP-1 RW Injection-Increment 1 |
| 19 | x | x | RW Direct Use Expansion-Increment 1 |
| 20 | x | x | RW Direct Use Expansion-Increment 2 |
| 23 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 1 |
| 24 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 2 |
| 25 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 3 |
| 26 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 4 |
| 27 | x | x | Construct New GWR Basins-Increment 1 |
| 35 | | x | Secure SWP IW transfer outside MWD from Irrigation Districts or Ag Transfers |
| 36 | | x | SBVMWD IW Transfer |
| 38 | | x | Six Basin Groundwater Transfer |
| 39 | x | x | Expand WUE Devices |
| 48 | x | x | Dry Weather Flow Diversions |
| 89 | | x | Max Tier 1 MWD Imported Water-Increment 1 |

# Project List for Strategy C Portfolios 4 & 5

| Strategy C | | | |
|---|---|---|---|
| Project ID # | Portfolio 4 | Portfolio 5 | Project Name |
| 12 | x | x | RP-1 RW Injection-Increment 1 |
| 13 | x | x | RP-1 RW Injection-Increment 2 |
| 14 | x | x | RP-1 RW Injection-Increment 3 |
| 21 | x | x | RW Direct Use Expansion-Increment 3 |
| 23 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 1 |
| 24 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 2 |
| 25 | x | x | Existing GWR Basin Improvements beyond RMPU-Increment 3 |
| 33 | x | x | Maximize ASR wells |
| 35 | | x | Secure SWP IW transfer outside MWD |
| 36 | | x | SBVMWD IW Transfer |
| 38 | | x | Six Basin Water Transfer |
| 39 | x | x | Expand WUE Devices |
| 40 | | x | WUE - Turf Removal-Increment 1 |
| 43 | x | x | WUE - Budget Rates-Increment 1 |
| 44 | x | x | WUE - Budget Rates-Increment 2 |
| 45 | | x | WUE - Budget Rates-Increment 3 |
| 46 | x | x | WUE- RW Demand Management-Increment 1 |
| 47 | x | x | WUE- RW Demand Management-Increment 2 |
| 66 | x | x | WUE - Advanced Metering Technologies |
| 88 | x | x | Maximize Local Surface Water |
| 95 | x | x | MWD Replenishment or discount wet year water-Increment 1 |
| 96 | | x | MWD Replenishment or discount wet year water-Increment 2 |

# Project List for Strategy D Portfolio 6

| Strategy D | | |
|---|---|---|
| Project ID # | Portfolio 6 | Project Name |
| 9 | x | WRCRWA Intertie |
| 10 | x | Rialto Intertie |
| 36 | x | SBVMWD IW Transfer |
| 38 | x | Six Basin Groundwater Transfer |
| 43 | x | WUE - Budget Rates- Increment 1 (2 agencies, 15% savings per agency) |
| 56 | x | Water Banking Facility - Increment 1 |
| 62 | x | Cucamonga Basin Upgrades |
| 87 | x | Prior Stored Chino Groundwater |
| 95 | x | MWD Replenishment or discount wet year water-Increment 1 |

# Project List for Strategy E Portfolios 7 & 8

| Strategy E | | | |
|---|---|---|---|
| Project ID # | Portfolio 7 | Portfolio 8 | Project Name |
| 9 | | x | WRCRWA Intertie |
| 11 | | x | Pomona RW Exchange/Transfer |
| 12 | | x | RP-1 advanced treatment RW Injection - Increment 1 |
| 19 | | x | Recycled Water Direct Use System Expansion - Increment 1 |
| 20 | | x | Recycled Water Direct Use System Expansion- 5,000 AF increment 2 |
| 23 | | x | Existing GWR Basin Improvements beyond RMPU - Increment 1 |
| 24 | | x | Existing GWR Basin Improvements beyond RMPU- 2,500 AF increment 2 |
| 25 | | x | Existing GWR Basin Improvements beyond RMPU- 5,000 AF increment 3 |
| 26 | | x | Existing GWR Basin Improvements beyond RMPU- 5,000 AF increment 4 |
| 27 | | x | Purchase Land to Construct New GWR Basins - Increment 1 |
| 36 | x | x | SBVMWD IW Transfer |
| 43 | x | x | WUE - Budget Rates- Increment 1 (2 agencies, 15% savings per agency) |
| 66 | x | x | Advanced Metering Technologies |
| 89 | x | x | Max Tier 1 MWD Imported Water-Increment 1 |
| 90 | x | x | Max Tier 1 MWD Imported Water-Increment 2 |
| 91 | x | x | Max Tier 1 MWD Imported Water-Increment 3 |

# Baseline Supply Forecast to 2040

Acre-Foot per Year (AFY)

| FY End | Total Regional Supply | Total Urban Supply | Total Potable Supply | Imported-MWD | GW-Chino | GW-Other | Local Surface | Total RW-Direct | RW-Direct Ag | StormWater | RW-Direct | RW-GWR | Desalted-CDA | Other | RW-SAR Obligation | Supp. Recharge |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 09-10 | 226,290.0 | 209,290.0 | 201,004.1 | 38,243.9 | 105,594.8 | 17,286.6 | 13,109.9 | 17,312.8 | 9,026.9 | - | 8,285.9 | 7,208.0 | 14,623.6 | 12,145.4 | 17,000.0 | |
| 11 | 232,744.8 | 195,744.8 | 186,762.4 | 42,730.2 | 88,366.5 | 14,459.1 | 18,761.3 | 16,655.9 | 7,673.5 | - | 8,982.4 | 8,028.0 | 14,440.8 | 8,004.6 | 17,000.0 | |
| 12 | 222,230.9 | 205,230.9 | 194,886.1 | 52,876.1 | 85,345.8 | 19,507.2 | 16,744.3 | 20,605.5 | 10,260.8 | - | 10,344.8 | 8,634.0 | 13,961.0 | 6,451.8 | 17,000.0 | |
| 13 | 233,004.3 | 216,004.3 | 203,379.7 | 59,013.0 | 95,955.5 | 21,145.4 | 5,980.2 | 21,840.0 | 9,215.4 | - | 12,624.6 | 10,479.0 | 13,671.4 | 7,614.2 | 17,000.0 | |
| 14 | 240,435.2 | 223,435.2 | 208,836.9 | 67,055.4 | 77,429.9 | 38,092.2 | 3,658.3 | 24,657.2 | 10,058.9 | - | 14,598.3 | 13,593.0 | 14,735.4 | 7,865.8 | 17,000.0 | |
| 15 | 242,000.0 | 225,000.0 | 208,950.0 | 65,000.0 | 90,538.5 | 22,098.1 | 11,650.8 | 24,600.0 | 8,550.0 | - | 16,050.0 | 14,500.0 | 15,000.0 | 8,416.4 | 17,000.0 | |
| 16 | 261,910.8 | 244,910.8 | | 69,752.0 | 90,538.5 | 22,098.1 | 11,650.8 | 25,426.0 | 7,267.5 | - | 18,158.5 | 14,980.0 | 17,733.0 | - | 17,000.0 | |
| 17 | 264,306.9 | 247,306.9 | | 69,752.0 | 90,538.5 | 22,098.1 | 11,650.8 | 26,252.0 | 6,177.4 | - | 20,074.6 | 15,460.0 | 17,733.0 | - | 17,000.0 | |
| 18 | 266,539.6 | 249,539.6 | | 69,752.0 | 90,538.5 | 22,098.1 | 11,650.8 | 27,078.0 | 5,250.8 | - | 21,827.2 | 15,940.0 | 17,733.0 | - | 17,000.0 | |
| 19 | 268,633.2 | 251,633.2 | | 69,752.0 | 90,538.5 | 22,098.1 | 11,650.8 | 27,904.0 | 4,463.2 | - | 23,440.8 | 16,420.0 | 17,733.0 | - | 17,000.0 | |
| 20 | 277,736.2 | 260,736.2 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 28,730.0 | 3,793.7 | 6,400 | 24,936.3 | 16,900.0 | 17,733.0 | - | 17,000.0 | |
| 21 | 279,047.2 | 262,047.2 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 29,112.0 | 3,224.6 | 6,400 | 25,887.4 | 17,260.0 | 17,733.0 | - | 17,000.0 | |
| 22 | 280,272.9 | 263,272.9 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 28,494.0 | 2,740.9 | 6,400 | 26,753.1 | 17,620.0 | 17,733.0 | - | 17,000.0 | |
| 23 | 281,426.1 | 264,426.1 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 29,876.0 | 2,329.8 | 6,400 | 27,546.2 | 17,980.0 | 17,733.0 | - | 17,000.0 | |
| 24 | 282,517.5 | 265,517.5 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,258.0 | 1,980.3 | 6,400 | 28,277.7 | 18,340.0 | 17,733.0 | - | 17,000.0 | |
| 25 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 26 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 27 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 28 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 29 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 30 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | |
| 31 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 32 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 33 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 34 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 35 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 36 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 37 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 38 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 39 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |
| 40 | 283,556.6 | 266,556.6 | | 69,752.0 | 91,266.0 | 22,098.1 | 11,650.8 | 30,640.0 | 1,683.3 | 6,400 | 28,956.7 | 18,700.0 | 17,733.0 | - | 17,000.0 | - |

# Chino Basin Groundwater - Baseline Supply Calculation

Chino Groundwater baseline Supply Calculation Sheet

| | | |
|---|---|---|
| GW Pumping - Available to Appropriators | Year 2040 | |
| Developed Yield | 135,000 | |
| SARUNY | - | 50% of CDA Production |
| Operating Safe Yield | 135,000 | OSY = DY - SARUNY |
| Ag | 5,000 | at 2040 |
| Non-Ag | 3,000 | at 2040 |
| Operating Safe Yield Available to Appropriators | 127,000 | AFY |
| IEUA Member Share of OSY Available to Appropriators (%) | 71.9% | See below |
| IEUA Member Share of OSY Available to Appropriators | 91,266 | AFY |
| IEUA Member Share of SARUNY Credit (%) | 57% | Based upon FY2012-13 productions |
| IEUA Member Share of SARUNY Credit | - | AFY |
| Total IEUA Member Share of GW available to Appropriators | 91,266 | Included SY + SARUNY credit |

**APPROPRIATIVE RIGHTS**
**(AS OF JUNE 30, 2011)**

| Party | Appropriative Right (Acre-Feet) | Share of Initial Operating Safe Yield (Acre-Feet) | Share of Operating Safe Yield (Percent) |
|---|---|---|---|
| City of Chino [A] | 5,794.25 | 4,033.857 | 7.356 |
| City of Chino Hills [B] | 3,032.86 | 2,111.422 | 3.851 |
| City of Norco | 289.50 | 201.545 | 0.368 |
| City of Ontario | 15,337.40 | 11,373.515 | 20.742 |
| City of Pomona | 15,110.50 | 11,215.852 | 20.454 |
| City of Upland | 4,007.20 | 2,882.401 | 5.202 |
| Cucamonga Valley Water District [C] | 5,199.00 | 3,619.454 | 6.601 |
| Jurupa Community Services District [D] | 2,960.60 | 2,061.115 | 3.759 |
| Monte Vista Water District [E] | 6,929.15 | 4,823.954 | 8.797 |
| West Valley Water District [F] | 926.50 | 644.817 | 1.175 |
| Fontana Union Water Company [G] | 9,161.12 | 6,381.736 | 11.667 |
| Fontana Water Company [H] | 1.44 | 1.000 | 0.002 |
| Los Serranos County Club [I] | - | - | - |
| Marygold Mutual Water Company | 941.30 | 655.317 | 1.195 |
| Monte Vista Irrigation Company | 972.10 | 676.759 | 1.234 |
| Niagara Bottling, LLC [J] | - | - | - |
| Nicholson Trust [K] | 5.75 | 4.000 | 0.007 |
| San Antonio Water Company | 2,164.50 | 1,506.888 | 2.748 |
| Santa Ana River Water Company | 1,860.30 | 1,301.374 | 2.373 |
| Golden State Water Company [L] | 591.05 | 411.475 | 0.750 |
| West End Consolidated Water Company | 1,361.30 | 947.714 | 1.728 |
| San Bernardino County (Shooting Park) [M] | - | - | - |
| Arrowhead Mountain Springs Water Company [N] | - | - | - |
| City of Fontana [O] | - | - | - |
| Total | 78,763.82 | 54,634.000 | 100.000 |

[A] In 1950, Chino received a portion of San Bernardino County Water Works #8 (WWW8) OSY (363.730 AF) as a result of a permanent transfer.
[B] City of Chino Hills incorporated in 1991 and assumed the responsibility for providing the public services formerly provided by WWW8. WWW8 acquired a portion of the rights of Park and Pomona Valley Water Companies in 1962.
[C] CCWD acquired the rights to Etiwanda Water Company (upon dissolution) in 1966. CCWD changed its name to CVWD in 2004.
[D] JCSD acquired the rights of Mira Loma Water Company in 1979 (775.940 AF OSY), Feldspar Gardens in 1986 (47.543AF OSY) and Mutual Water Company of Glen Avon Heights in 1997 (457.374 AF OSY).
[E] MVCWD changed its name to MVWD in 1980. In 1990, MVWD received 675.516 AF of WWW8 OSY as a result of a permanent transfer.
[F] WVBCWD changed its name to WVWD in 2003.
[G] In FY 01-02, 5,000 AF OSY was reassigned: 1,000 AF to FWC and 4,000 AF to the Nicholson Trust.
[H] FWC intervened in 1985 and was assigned 1.000 AF OSY as a result of a permanent transfer of water rights from FUWC.
[I] Los Serranos intervened into the Appropriative Pool in 1990 with 0.000 AF OSY, and it was later determined that they are not within the Basin.
[J] Niagara Bottling intervened in FY 02-03 with 0.000 AF OSY.
[K] Nicholson Trust intervened in FY 01-02 and was assigned 4.000 AF OSY as a result of a permanent transfer of water rights from FUWC.
[L] GSWC permanently transferred 823.500 AF OSY to Park Water Company in 1960. Park Water Co was acquired by WWW8 which was subsequently acquired by the City of Chino Hills. SGWC changed its name to GSWC in 2005.
[M] San Bernardino County Prado Tire (now known as Prado Shooting Park) was involuntarily reassigned to the Appropriative Pool from the Agricultural Pool in 1996.
[N] Arrowhead intervened in 1992 with 0.000 AF OSY.
[O] City of Fontana intervened in 1998 with 0.000 AF OSY.

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Chino, CA 91708
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# APPENDIX F

## IEUA 2015 Water Use Efficiency Business Plan



# INLAND EMPIRE UTILITIES AGENCY

## REGIONAL WATER USE EFFICIENCY

BUSINESS PLAN
2015–2020

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# Section 1 – Executive Summary

## Introduction

Inland Empire Utilities Agency (IEUA) and its regional water use efficiency (WUE) partners actively strive to increase regional sustainability through the development of local water supplies and reduced dependence on costly and increasingly unreliable imported water.

These efforts focus on using water more efficiently, eliminating water waste, and drought proofing the region through increased use of recycled water, groundwater, storm water and other local water supplies.

Water use efficiency is universally regarded as the most cost effective method in which to reduce water demand. As such, the region has heavily invested in water use efficiency initiatives over the years.

*Water Conservation VS Water Use Efficiency*

There is a major difference between ***water conservation*** and ***water use efficiency*** and it is important to understand the dissimilarity.

The objective of this plan is ***not*** to focus on ***water conservation*** with its short-term focus on current emergency conditions. This approach will not provide sustainable savings. As drought restrictions are lifted, per capita water use will gradually rebound upwards, although not as high as previously levels, as people breath a sigh of relief that the crisis is over and return to life as usual.

Instead the regional goal is to achieve ***water use efficiency,*** a sustainable reduction in water use, by creating a new resource value for water in the eyes of the end user.

For the most part, customers do not yet "get" water use efficiency. They believe that they're using water efficiently because they only water when requirements allow or don't wash their car. The State and the region must create a new reality about reasonable water usage for customers and show them the path to achieving it.

*Optimizing Results*

Traditional Water Use Efficiency (WUE) efforts characteristically offer programs to all customers without regard to their efficiency level. Often these program respondents are more sophisticated and aware of efficiency methods and measures – and are actually some of the most efficient users in the system.

The actual target should ***not be the "general responders"***, but instead, ***the inefficient water users***. To hit these target customers, the more sophisticated and effective strategies employ the rigorous use of data and analytics from GIS mapping, satellite imaging and disciplined water budget protocols, along with diligent measurement to ensure results. The results are broader and longer lasting across all market segments.

*State Efficiency Standards Effectively Facilitate WUE*

IEUA supports the reasonable and efficient use of water as defined by State standards. By creating broadly stated, but absolute, standards, the regional WUE partners can design programs that are tailored specifically to their customer base.

State water use efficiency standards are imbedded in both the SB X7-7 – requiring 20 percent per capita water use reduction by 2020 and Assembly Bill 1881, the Model Water Efficiency Landscape Ordinance (MWELO). Indoor efficiency is deemed to be 55 gallons per person per day (55 GPCD). Outdoor efficiency is levels are set at 80% of the local ET for existing landscapes.

This standard is supported by numerous agencies because it:

- Offers a more equitable method for considering conservation levels during drought.
- Will enable the State to consolidate the various conservation codes or actions into a single, impartial measurement.
- Provides a clear message to the public about what a reasonable amount of water to use is given their local conditions.
- Creates a single water management tool where efficiency targets can be ratcheted up or down as needed.

The use of water efficiency performance-based standards provides the foundation for more efficient regional and statewide water use that improves the resiliency of California's water supplies as we deal with population growth, future droughts and the serious impacts of climate change.

*The Regional Water Use Efficiency Business Plan*

The objective of the Regional WUE plan is to deliver a prolonged, increased level of water efficiency for a price far less than the region's cost to purchase water. To accomplish this, it is recommended IEUA and its regional partners seek out inefficient water use customers, educate them about WUE attainment, and provide a "road map" to accomplish this.

To create the WUE Business Plan, a thorough review of current, past and potential new programs was conducted, with calculations performed for costs, savings and overall benefits to the region. In addition, there was an evaluation of developing WUE trends, including emerging technologies such as Budget-Based Water Rates and Customer Engagement Software and Analytics. Potential Metropolitan Water District's (MWD) WUE funding availability and potential grants were additionally factored into the evaluation. A portfolio of recommended programs is presented in the WUE Business Plan. These are directly quantifiable and provide cost-effective water savings below the region's cost to purchase water from Metropolitan Water District.

It is important to recognize that IEUA's member agencies may elect to modify the design of one or more of the programs presented in the WUE plan. Each agency may choose to participate in all programs or opt in for a limited number only. IEUA will collaborate with all of the member agencies to continually evaluate and modify the plan to meet the goals and objectives of the region.

While it is up to each member agency to determine their specific course of action, IEUA encourages each agency to adapt new approaches and new technologies in order to increase the collective knowledge of *where* and *how* to best help end-users to use water efficiently and to keep water bills affordable.

## Water Reduction Goals and Regulatory Compliance

The Regional Water Use Efficiency Business Plan is to be used as a blueprint to help the region to plan and implement WUE activities and programs over the next five years. The strategies and programs included in the plan are designed to meet the requirements of the:

- Assembly Bill 1420 Statute requiring BMP compliance
- SB X7-7 requiring 20 percent per capita water use reduction by 2020
- Governor's Executive Order and Emergency Regulation mandating a 25 percent statewide reduction in water use including individual targets set for each agency

Table 1 on the following page highlights these regulatory statues, their general requirements, the local approach to meeting the requirements and the current status.

### *WUE Regulatory Compliance Requirements*

*Table 1: WUE Regulatory Compliance*

| Regulatory Statute | Requirements | Approach | Status |
|---|---|---|---|
| **Assembly Bill 1420** | Mandatory BMP Compliance. | Lines up with actions taken to meet CUWCC BMP compliance | In compliance – requirement sunsets July 1, 2016. |
| **20x2020 (**SB X7-7) | Reduce per capita water use by 10% by 2015. AND<br>Reduce per capita water use by 20% by 2020. | By implementing active WUE programs and policy Initiatives the Regional Alliance is projected to be on track to meet per capita reduction goals. | 2015 Target = 226<br>2015 Reported = 188<br><br>2020 Target = 201<br>2020 Projected = 182 |
| **Governor's Executive Order Regulations** | Mandatory statewide reduction of 25% of residential per capita water use.<br>Each agency assigned local target of 4 – 36%. | Implement active WUE programs, enforce mandatory watering days and eliminate water waste. | Most agencies at or near mandated %.<br>Collective % Goal = 28%<br>Collective % Saved = 29.5% |

The region is in compliance with the AB 1420 BMP requirements. Most agencies are currently at or near mandated conservation levels under the Governor's Executive Order. It is also expected that the region will exceed the 20x2020 goal. This will be accomplished through regional and local actions utilizing:

- **Water Use Efficiency Active Programs** – offering customers a program portfolio with cost-effective water efficiency measures,
- **WUE Passive Policy Initiatives –** including building codes and landscape ordinances,
- **Recycled Water Supply** – reducing demand for potable water by increasing recycled water supply.

Table 2 on the following page shows the anticipated GPCD reduction from the WUE activities and recycled water supply. The 2020 GPCD reduction estimates from WUE activities is shown as a range to represent the reduction with and without Budget-based Water Rate implementation. It is estimated that with 2 agencies implementing Budget-based Water Rates will represent a GPCD reduction of 11 by 2020 and without any agencies implementing the new rate it will be a reduction of 6.

*Impact of WUE Activities and Recycled Water Supply*

*Table 2: Impact of WUE Activities and Recycled Water Supply*

| | YEAR | |
|---|---|---|
| | **GPCD Reduction by 2015** | **GPCD Reduction by 2020** |
| Projected GPCD reduction from WUE Active and Passive Activities | 3 | 6 – 11* |
| Projected GPCD reduction from Recycled Water Supply | 21 | 35 |
| TOTAL Projected GPCD Reduction | 24 | 41 – 46* |
| 10 Year Baseline GPCD | **251** | |
| Regional GPCD Target | 226 | 201 |
| Regional GPCD Projected Achievement** | 188 | 169 – 174* |

**Range represents GPCD reduction with and without Budget-based Water Rate implementation.*
*** 2015 GPCD numbers are reported actuals*

In order to achieve the WUE active programs' goal, it is recommended IEUA and its regional partners implement nine active programs. The programs will deliver water savings through 2020 and beyond due to the life of the measures being offered. Table 3 below provides an overview of the lifetime water savings for each of the programs:

***Lifetime Water Savings by WUE Active Programs***

*Table 3: Lifetime Water Savings by WUE Active Programs*

| WUE Active Program | Estimated Lifetime Water Savings (AF) |
|---|---|
| Budget-Based Water Rates | 116,390 |
| Turf Removal | 16,900 |
| FreeSprinklerNozzles.com Program | 5,689 |
| SoCal Water$mart Regional Rebate Program | 3,262 |
| Customer Engagement Software | 3,093 |
| High Efficiency Nozzle Direct Installation Program | 1,101 |
| Residential Smart Controller Upgrade Program | 828 |
| Residential Landscape Retrofit Program | 447 |
| Landscape Evaluations | 126 |
| **Total** | **147,836** |

The plan, as designed with 2 agencies implementing Budget-based Water Rates, is estimated to save nearly 148,000 acre-feet of water at an expected cost to the region of $52 per acre-foot. This falls well below the region's avoided cost to purchase water from Metropolitan Water District of $1,122 per acre-foot[1] (MWD's Tier 1 rate for untreated water). The value of the avoided purchases of MWD imported equate to nearly $153 Million to the member agencies. If none of the agencies chose to implement Budget-based Water Rates, the plan is estimated to save over 31,000 acre-feet at a cost of $208 per acre-foot. This too falls well below the cost to purchase water from MWD.

Below are highlights of the plan with and without Budget-base Water Rate implementation:

*Table 4: Plan Overview*

| Plan Overview | | |
|---|---|---|
| | **With Budget-Based Rates** | **Without Budget-Based Rates** |
| **Regional IEUA Cost per Acre-foot** | $52 per acre-foot | $208 per acre-foot |
| **Five-Year Water Savings (*active programs*)** | 33,554 acre-feet | 16,095 |
| **Lifetime Water Savings (*active programs*)** | 147,836 acre-feet | 31,446 |
| **Avoided Costs (NVP)** | $152.7 Million | $28.9 Million |
| **Five-Year Total Budget*** | $7.5 Million | $7.5 Million |

**Budget includes IEUA regional program costs exclusive of outside funding.*
**Budget includes $300,000 per year for education and outreach programs.*

## Selected Programs

The Regional WUE Business Plan makes a number of recommendations moving forward. It is advised that the following changes be made:

- Scale and modify most of the existing programs
- Sunset several programs
- Incorporate new technologies and approaches for program outreach
- Implement a number of pilot programs

[1] The project team applied the CUWCC/WaterRF Avoided Cost Model to develop a forecast of avoided supply costs for IEUA. These avoided costs include the avoided variable operating costs of MWD's 2015 Tier 1 rate for full service treated water (923$/AF in 2015), an estimate of power costs past the point of imported water delivery (approximately 76$/AF) , plus MWD's Capacity Charge (approximately 67$/AF) with all costs adjusted upward for system loss. Tier 2 rates apply in 2020 as MWD's stated long run supply development costs. MWD's treatment costs embedded in the full service rate pertain as a reasonable proxy for long run avoided treatment costs. Since these costs do not include avoided Greenhouse Gas Emissions they can be considered as a lower bound. These costs are projected to increase in real terms during the forecast horizon.

The portfolio of programs included in the plan are directly quantifiable and provide cost-effective water savings below the region's cost to purchase water from Metropolitan Water District.

With 66% of demand being outdoor water usage, program offerings focus predominantly on landscape opportunities. An overview of the selected programs is below.

***Budget-Based Water Rates*** or allocation-based rates have proven to be one of the most cost effective WUE programs. Each individual account is allocated an amount that would be required for efficient indoor and outdoor water use, adjusted to real-time actual weather and customer characteristics such as size of landscape area. Budget-based rates are also designed to recover necessary agency costs recognizing that customers will be more water efficient over time. Customers are able to compare their individualized water budget with their actual usage. The appropriate economic signal rewards efficient use. With a clear financial incentive, the customer is motivated to maintain efficient use patterns. Budget-based rates also, when properly designed, target revenue generation specifically toward those inefficient customers who are causing higher costs. Budget-based rates are a legal method to increase the agency's ability to fund cost reducing and cost-effective WUE programs.

***Customer Engagement Software and Data Analytics*** – Customer engagement software and data analytics provide tools for water agencies to more accurately identify customers with excess water usage and communicate with customers on how their usage compares against accepted water use efficiency standards. It addition, the software offers the ability for a customer to track their usage against a budget through web-based and mobile interfaces and presents them with practical options to become a more efficient water user.

***Landscape Evaluations*** – Comprehensive landscape evaluations provide customers education and information on landscape and irrigation system upgrades specific to each individual site. Intended to motivate customers to make improvements in their landscape irrigation efficiency, the evaluations direct customers to applicable programs. Landscape evaluations would be targeted towards large landscape sites with the most potential to save water, as identified through water budget data.

***High Efficiency Nozzle Vouchers, Rebates, and Installations*** – Retrofitting pop-up spray heads with high efficiency nozzles is a low cost measure and delivers high water savings. The saturation rate of high efficiency nozzles is extremely low, and the sheer volume of spray heads offers a prime market opportunity.

***Smart Controller Installations and Rebates*** – Smart controllers are cost-effective for over irrigated sites, as well as large landscape areas. By offering direct installation for residential sites and rebates for large landscape sites, significant and cost-effective water savings can be achieved.

***MWD's SoCal Water$mart Regional Rebate Programs*** – The SoCal WaterSmart Program provides the region with continued funding and program administration for a variety of water use efficiency measures. Moving forward, IEUA and its regional partners would augment funding for landscape water use efficiency products to provide increased customer response.

***Turf Removal*** – Although turf removal delivers extremely high water savings in most retrofit projects, it requires a significant incentive to motivate customers. At this time, turf removal has not been included in the program portfolio after fiscal year 2015/16. And although it is not yet deemed cost-effective for the region to fund the full incentive, IEUA and its regional partners will continue evaluating turf removal as a customer program. IEUA and its regional partners will seek MWD and other outside funding as available.

***Education and Outreach Programs*** – IEUA and its regional partners will continue to provide regional educational and outreach programs. Current regional education and outreach programs include the following:

- National Theatre for Children Program
- Shows That Teach
- Regional Landscape Training Workshops
- Garden in Every School® Program
- WEWAC, The Water Education – Water Awareness Committee
- Water Saving Garden Friendly
- Water Softener Rebate Program

The table on the following pages lists the recommended programs, the reasoning for their selection and the associated savings. The list is ordered from highest volume of total water savings activity to lowest.

*Table 5: Recommended Programs*

| Recommend Program and Water Savings | Reasoning for Selection |
|---|---|
| **Budget-Based Water Rates:**<br>*116,390 Lifetime Water Savings*<br>*79% of Total Savings* | - Sends strong price signal, rewarding efficient users and penalizing inefficient users<br>- Motivates over-allocation customers to consider changes<br>- Proven effective for revenue stability, increased WUE and positive customer relations |
| **Turf Removal (All Measures):**<br>*16,900 Lifetime Water Savings*<br>*11% of Total Savings* | - Targets large water use<br>- Transforms landscape and irrigation market<br>- Significant funding provided by MWD |
| **FreeSprinklerNozzles.com Program:**<br>*5,689 Lifetime Water Savings*<br>*4% of Total Savings* | - Cost-effective<br>- Targets large water use<br>- Huge potential and scalability |
| **SoCal Water$mart Regional Rebates:**<br>*3,914 Lifetime Water Savings*<br>*3% of Total Savings* | - MWD funding and administration<br>- Ease of implementation |
| **Customer Engagement Software:**<br>*3,093 Lifetime Water Savings*<br>*2% of Total Savings* | - Technology based communication method<br>- Allows retailers to send messaging & program links to high water users<br>- Proven effective |
| **High Efficiency Nozzle Direct Installation:**<br>*1,101 Lifetime Water Savings*<br>*1% of Total Savings* | - Removes financial barrier of entry<br>- Ensures quality installation<br>- Huge potential and scalability |
| **Residential Smart Controller Upgrade:**<br>*828 Lifetime Water Savings*<br>*1% of Total Savings* | - Offering direct installation to smaller customer provides bigger pool of potential customers<br>- Site visit verifies there will be savings<br>- Education workshop ensures customer can program and maintain controller and therefore sustain savings |
| **Residential Landscape Retrofit Program:**<br>*447 Lifetime Water Savings*<br>*0.3% of Total Savings* | - Targets large water users<br>- Site visit verifies there will be savings<br>- Professional installation and programming of controller ensure savings |

| Recommend Program and Water Savings | Reasoning for Selection |
|---|---|
| **Landscape Evaluations:**<br><br>*126 Lifetime Water Savings*<br>*0.1% of Total Savings* | - Links customer with programs<br>- Provides one-on-one customer education<br>- Starts relationship with customer |
| **Education and Outreach Programs:**<br><br>*Savings not estimated** | - Provides education to students at all levels<br>- Equips customers with foundational information regarding value of water, water use and efficiency opportunities |

**Many of the programs have water savings, but due to the variability of the savings they were not included in the assessment.*

The following sections of the Regional Water Use Efficiency Business Plan provide details of the region's usage patterns, specific market opportunities, strategies for reaching water savings goals, and recommended programs. The plan provides the following information:

**Section 2 – Relevant Regulation and Policies** provides a summary and analysis of current water use efficiency regulations and requirements expected to impact future water use within IEUA's service area.

**Section 3 – Market Condition and Potential** assesses potential for water savings across customer classes and water uses. Specific opportunities are identified as well as barriers to market penetration for those measures.

**Section 4 – Implementation Strategy** outlines the recommended strategies and tactics needed in order for the region to drive down demand and increase water use efficiency.

**Section 5 – Potential Programs and Analysis** examines a comprehensive list of programs and measures that correspond to the region's water demand and measure savings potential.

**Section 6 – Selected Programs** provides a final list of cost-effective programs recommended for implementation and includes the following: program descriptions, measure(s) offered, target customer segments, delivery mechanisms, annual activity, program costs, and economic evaluation results.

**Section 7 – Five Year Plan** presents the implementation details for the plan if two agencies implement Budget-Based Water Rates. This includes annual program activity estimates, annual budgets, water savings, cost and benefits, as well as energy savings and greenhouse emission reduction.

# Section 2 – Relevant Regulations and Policies

As can be expected in a state with ongoing water resource issues, California's governing entities have issued a number of regulatory requirements and policies over the past several decades.

Some of the regulations and policies have successfully driven down California's per capita water usage and increased the manufacturing standards for a number of major water consuming products utilized across all markets. Other regulations are aimed at achieving a higher level of water conservation during times of severe drought through temporary water use cutbacks and associated reporting.

Listed in the charts below is a summary of the current state regulations and information about the designated implementer for each:

***WUE Laws and Agreements***

*Table 6: WUE Laws and Agreements*

| Regulatory Statute | Requirements | Agency or Regional Implementation | Approach |
|---|---|---|---|
| **Assembly Bill 1420** | Mandatory BMP Compliance. | Implemented by Agencies & IEUA | Lines up with actions taken to meet CUWCC BMP compliance – sunsets July 1, 2016 |
| **20x2020 (**SB X7-7) | Reduce per capita water use by 10% by 2015. AND<br>Reduce per capita water use by 20% by 2020. | Implemented by the Regional Alliance | By implementing active water use efficiency programs and policy Initiatives the Regional Alliance are projected to be on track to meet per capita water reduction goals. |
| **Governor's Executive Order and Emergency Regulation** | Mandatory statewide reduction of 25% of residential per capita water use.<br>Each agency assigned local target of 4 – 36%. | Implemented by each Agency | Implement active WUE programs, enforce mandatory watering days and eliminate water waste. All agencies are at, or near, compliance. |

### *WUE Codes, Standards and Regulations*

*Table 7: WUE Codes, Standards and Regulations*

| Regulatory Statute | Requirements | Agency or Regional Implementation | Approach |
|---|---|---|---|
| **AB1881 - Model Water Efficiency Landscape Ordinance (MWELO)** | ETo Allowances<br>Residential 0.55<br>Commercial 0.45 | Implemented locally by city and/or county | Agencies need to educate customers and developers about ordinance requirements |
| **Assembly Bill 715** | Requires any toilet or urinal sold or installed in California cannot have a flush rating exceeding 1.28 and 0.125 respectively | Manufacturers, distributors, retailers, plumbers and customers must all adhere to new standards | Supply chain removes non-conforming fixtures from marketplace and supplies only efficient and conforming fixtures |
| **Senate Bill 407** | Requires existing buildings comply with 1992 standards | Implemented locally by city and county | Difficult to enforce. Could be added to current criteria for change of ownership inspections and reporting |
| **CalGreen** | 20% reduction of water use prescriptively designated<br>Irrigation controllers shall be weather- or soil moisture-based | Implemented locally by city and county | Difficult to enforce. Could be added to current criteria for change of ownership inspections and reporting |
| **Senate Bill 555** | Requires water agencies to submit annual water loss reports | Implemented by Agencies | Agencies compile data and submit report to DWR |
| **Assembly Bill 1** | City or county cannot fine customers for failure to water | Local agencies to follow requirements of the bill | Agencies need to communicate requirements with cities and counties |
| **Assembly Bill 349** | HOAs cannot prohibit installation of artificial turf and allows for turf removal and installation of low water use plants | Local agencies to follow requirements of the bill | Agencies need to work with HOA's and community groups to educate about the bill |

The following section details current water use efficiency regulations and requirements. Divided into two parts, the first presents a comprehensive review of agreements, codes, and regulations guiding conservation by California urban water suppliers. The second part provides an assessment of the region's current and expected compliance status for each of these codes and regulations.

## Existing Codes, Regulations, and Agreements

Existing codes, regulations, and agreements affecting the efficiency of water using fixtures and landscapes, and establishing water use reduction targets for urban water suppliers will continue to reduce per capita residential and non-residential water demands over the coming decades. These codes, regulations, and agreements can be divided into three broad categories:

- Codes and standards that dictate the maximum acceptable level of water use by newly manufactured water using fixtures and appliances. Examples include statewide standards for toilet and urinal water use enacted under AB 715 and federal standards for residential and commercial clothes washer water use promulgated by the U.S. Department of Energy under the Energy Policy and Conservation Act.
- Regulations that govern the maximum acceptable level of water use by water using fixtures, appliances, and landscapes installed in existing and new residential and non-residential properties. Examples include SB 407, which enacted plumbing fixture efficiency requirements in new and existing buildings, and AB 1881, which established landscape design and water use requirements.
- Laws and agreements that establish water use reduction goals and targets for urban water supply agencies. An example is SB X7-7, which set maximum allowable GPCD targets for urban water suppliers.

The codes, regulations, and agreements, falling into one of the above three categories, are described in the following sections.

### Requirements for Newly Manufactured Plumbing Fixtures and Appliances

**Toilets, Urinals, and Showerheads** – AB 715, enacted in 2007, requires that any toilet or urinal sold or installed in California on or after January 1, 2014, cannot have a flush rating exceeding 1.28 and 0.5 gallons per flush, respectively. AB 715 superseded the state's previous standards for toilet and urinal water use set in 1991 of 1.6 and 1.0 gallons per flush, respectively. On April 8, 2015, in response to the Governor's Emergency Drought Response Executive Order (EO B-29-15), the California Energy Commission approved new standards for urinals requiring that they not consume more than 0.125 gallons per flush, 75% less than the standard set by AB 715.

The 1994 amendments to the Federal Energy Policy and Conservation Act established a maximum flow rate for newly manufactured showerheads of 2.5 gallons per minute. However, as will be discussed in the next section, California's Green Building Standards Code (CalGreen), which became effective January 1, 2011, mandates a maximum flow rate of 2.0 gallons per minute for showerheads in newly constructed residential and commercial buildings.

**Clothes Washers and Dishwashers** -- Water use standards for residential and commercial clothes washers and dishwashers are established by the U.S. Department of Energy through its authority under the federal Energy Policy and Conservation Act. The maximum water factor for residential clothes washers under current federal standards is 9.5.[2] In March of this year, the federal standard will reduce the maximum water factor for top- and front-loading machines to 8.4 and 4.7, respectively. In 2018, the maximum water factor for top-loading machines will be further reduced to 6.5. For commercial washers, the maximum water factors were reduced in 2010 to 8.5 and 5.5 for top- and front-loading machines, respectively. Starting this year, the maximum water factor for Energy Star certified washers is 3.7 for front-loading and 4.3 for top-loading machines. EPA estimates that Energy Star washers comprised more than 60% of the residential market and 30% of the commercial market circa 2011.[3] A new Energy Star compliant washer uses about two-thirds less water per cycle than washers manufactured in the 1990s. Effective May 30, 2013, the federal standard for the maximum allowable water use for standard and compact sized dishwashers is 5.0 and 3.5 gallons per cycle, respectively.

## Requirements for Existing and New Buildings and Landscapes.

**Indoor Water Use** -- SB 407, enacted in 2009, mandates all buildings in California come up to 1992 State plumbing fixture standards within this decade. This law establishes requirements that residential and commercial properties built and available for use on or before January 1, 1994, replace plumbing fixtures that are not water conserving, defined as "non-compliant plumbing fixtures" as follows:

- Any toilet manufactured to use more than 1.6 gallons of water per flush
- Any urinal manufactured to use more than one gallon of water per flush
- Any showerhead manufactured to have a flow capacity of more than 2.5 gallons of water per minute
- Any interior faucet that emits more than 2.2 gallons of water per minute

[2] Water factor equals the number of gallons used per cycle per cubic foot of capacity. Prior to 2000, the water factor for a typical new residential clothes washer was about 12.

[3] Energy Star Unit Shipment and Market Penetration Report Calendar year 2011 Summary. Accessed on January 28, 2015 from: http://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2011_USD_Summary_Report.pdf

The compliance date for single family residential properties is January 1, 2017. For multi-family and commercial properties, the date is January 1, 2019. State law required, as of January 1, 2014, that when there are building alterations and improvements to residential and commercial properties, water-conserving plumbing fixtures replace all noncompliant plumbing fixtures as a condition for issuance of a certificate of final completion and occupancy or final permit approval by the local building department.

SB 407 also requires, effective January 1, 2017, that a seller or transferor of a single family residential property disclose to the purchaser or transferee, in writing, the specified requirements for replacing plumbing fixtures and whether the real property includes noncompliant plumbing. Similar disclosure requirements go into effect for multi-family and commercial transactions January 1, 2019. SB 837, passed in 2011, reinforces the disclosure requirement by amending the statutorily required transfer disclosure statement to include disclosure about whether the property is in compliance with SB 407 requirements. Through these two laws, California has effectively adopted a statewide retrofit-on-resale requirement for single family residential properties effective January 1, 2017, and for multi-family and commercial properties effective January 1, 2019.

Although SB 407 allows for replacement of noncompliant toilets with toilets flushing no more than 1.6 gallons, noncompliant urinals with urinals flushing no more than 1.0 gallons, and noncompliant showerheads with showerheads using no more than 2.5 gallons per minute, the more stringent requirements in AB 715 and CalGreen Code supersede the equipment flow standards included in SB 407. Therefore, as of January 1, 2014, noncompliant toilets must be replaced with toilets flushing no more than 1.28 gallons, noncompliant urinals must be replaced with urinals flushing no more than 0.5 gallons, and noncompliant showerheads must be replaced with showerheads using no more than 2.0 gallons per minute.[4] As of January 1, 2016, noncompliant urinals must be replaced with urinals flushing no more than 0.125 gallons.

New construction and renovations in California are now subject to CalGreen Code requirements. Listed in Table 8 below are the CalGreen prescriptive indoor provisions for maximum water consumption of plumbing fixtures and fittings in new and renovated properties. CalGreen also allows for an optional performance path to compliance, which requires an overall aggregate 20% reduction in indoor water use from a calculated baseline using a set of worksheets provided with the CalGreen guidelines.

[4] As noted above, the CEC adopted new standards for urinals in April setting a maximum allowable flush volume of 0.125 gallons.

*Table 8: CalGreen Fixture Code Requirements*

| Fixture/Fitting | Baseline Consumption | Maximum Allowed Under CalGreen |
|---|---|---|
| Toilets | 1.6 gal/flush | 1.28 gal/flush |
| Urinals | 1.0 gal/flush | 0.5 gal/flush |
| Residential showerheads | 2.5 gal/minute | 2.0 gal/minute |
| Residential bathroom faucets | 2.2 gal/minute | 1.5 gal/minute[5] |
| Kitchen faucets | 2.2 gal/minute | 1.8 gal/minute |
| Replacement faucet aerators | 2.2 gal/minute | NA |
| Non-residential bathroom faucets | 0.5 gal/minute | 0.4 gal/minute |
| Metering faucets | 0.25 gal/minute | 0.2 gal/minute |

**Landscape Water Use** -- For landscape water use, CalGreen requires that automatic irrigation system controllers, provided by the builder and installed at the time of final inspection, be weather- or soil moisture-based controllers designed to automatically adjust irrigation in response to changes in plant water needs as weather or soil conditions change.

In addition to CalGreen's mandatory requirements, further efficiencies are possible through application of voluntary tiers, as follows:

- Tier 1 Residential – kitchen faucet flow rate not to exceed 1.5 gallons/minute; potable water use for landscape not to exceed 65% of ETo; and incorporation of at least one other measure from a list of measures provided by CalGreen (e.g. waterless toilet, rainwater capture system).

- Tier 2 Residential – kitchen faucet flow rate not to exceed 1.5 gallons/minute; potable water use for landscape not to exceed 60% of ETo; dishwashers be Energy Star qualified and use no more than 5.8 gallons per cycle; and incorporation of at least two other measures from a list of measures provided by CalGreen.

- Tier 1 Non-Residential – aggregate indoor water use reduction of 30% from the established baseline or 30% reduction in individual water use for each of the plumbing fixtures listed in Table 8; potable water use for landscape not to exceed 60% of ETo; and incorporation of at least one elective measure from a list of measures provided by CalGreen (e.g. efficient ice maker, graywater irrigation system).

[5] On April 8, 2015, the California Energy Commission adopted new standards reducing the maximum flow rate of residential bathroom faucets to 1.2 gallons per minute.

- Tier 2 Non-Residential – aggregate indoor water use reduction of 35% from the established baseline or 35% reduction in individual water use for each of the plumbing fixtures listed in Table 8; potable water use for landscape not to exceed 55% of ETo; and incorporation of at least three elective measures from a list of measures provided by CalGreen.

**Assembly Bill 1881 - The Water Conservation in Landscaping Act of 2006 -** Assembly Bill 1881 has had several revisions in recent years. The initial requirements and current changes are chronicled below. AB 1881 requires cities and counties to either adopt the state's model landscape ordinance or their own ordinance that is at least as effective as the state's model ordinance by January 1, 2010. At that time, the Department of Water Resources prepared a Model Water Efficient Landscape Ordinance for use by local agencies. After January 1, 2010, the model ordinance (or the locally adopted ordinance) applies to all of the following landscape projects:

1. New construction and rehabilitated landscapes for public agency projects and private development projects with a landscape area equal to or greater than 2,500 square feet requiring a building or landscape permit, plan check, or design review;
2. New construction and rehabilitated landscapes which are developer-installed in single family and multi-family projects with a landscape area equal to or greater than 2,500 square feet requiring a building or landscape permit, plan check, or design review; and
3. New construction landscapes which are homeowner-provided and/or homeowner-hired in single family and multi-family residential projects with a total project landscape area equal to or greater than 5,000 square feet requiring a building or landscape permit, plan check, or design review.

For new and rehabilitated landscapes installed on or after January 1, 2010 and meeting the above requirements, the model ordinance establishes a maximum water use allowance equal to 70% of reference evapotranspiration. The maximum water use allowance for special landscape areas, which include recreational turf projects (parks, golf courses, ball fields), projects irrigated with recycled water, and edible landscapes is 100% of reference evapotranspiration.

For existing landscapes of one acre or more installed before January 1, 2010, the model ordinance also requires cities and/or counties to administer programs that may include irrigation water use analyses, irrigation surveys, and irrigation audits to evaluate water use and provide recommendations as necessary to reduce landscape water use to a level that does not exceed the Maximum Applied Water Allowance for existing landscapes equal to 80% of reference evapotranspiration.

The model landscape ordinance is directed to cities and counties. However, a city or county may designate another agency, such as a water supplier, to assume some or all of

the responsibilities of enforcing the ordinance, provided the designated agency agrees to assume these responsibilities.

In 2006, IEUA and its regional partners developed the Inland Empire Landscape Alliance (IELA). The IELA spent two years working with local agencies to evaluate existing landscape policies and to provide information about all aspects of landscape water efficiency, through a series of educational newsletters, workshops and tours focused on plant palettes, irrigation materials and techniques, low impact development practices, and measures that cities are currently implementing within their communities to be wise water stewards.

When, in February 2008 the Department of Water Resources released the Model Water Efficient Landscape Ordinance, the IELA came together to evaluate and comment on the ordinance. Members found the February 2008 DWR Model Ordinance to be cumbersome. As a result, the IELA formed a Technical Committee that created the Chino Basin Water Efficient Landscape Ordinance in January 2009, incorporating the requirements of AB1881 while establishing regional consistency, and actively promoting the best interest of the region.

Governor Brown's Drought Executive Order of April 1, 2015 directed DWR to update the State's Model Water Efficient Landscape Ordinance (MWELO) through expedited regulation. The California Water Commission approved the revised MWELO Ordinance on July 15, 2015.

Local agencies had until December 1, 2015 to adopt the MWELO or to adopt a Local Ordinance which must be at least as effective in conserving water as MWELO. Local agencies working together to develop a regional ordinance had until February 1, 2016 to adopt, but they are still subject to the December 2015 reporting requirements. A local agency will either integrate MWELO into an existing ordinance or establish a new, separate program. To comply, a local agency must perform one of the following actions:

- Adopt by reference Sections 490-495, Chapter 2.7, Division 2, Title 23 in the California Code of Regulations
- Adopt the MWELO in detail - Sections 490-495, Chapter 2.7, Division 2, Title 23 in the California Code of Regulations
- Amend an existing or adopt a new local ordinance or regional ordinance to meet the requirements contained in the regulations
- Take no action and allow the MWELO to go into effect by default

A local agency may choose to allow MWELO to become effective by default and then adopt a local or regional ordinance at a later time. Subsequent reporting must include the details of local or regional ordinances.

**Changes to MWELO**

***Projects Subject to the Ordinance*** **-** The size of landscapes subject to the ordinance has been lowered from 2,500 sq. ft. to 500 sq. ft. The size threshold applies to residential, commercial, industrial and institutional projects that require a permit, plan check or design review. To reduce the complexity and costs for the smaller landscapes now subject to ordinance, the revised MWELO has a prescriptive compliance approach for landscapes between 500 and 2,500 sq. ft. The size threshold for existing landscapes that are being rehabilitated has not changed, remaining at 2,500 square feet. Only rehabilitated landscapes that are associated with a building or landscape permit, plan check, or design review are subject to the Ordinance.

***Water Efficient Worksheet and Water Budget*** - The maximum applied water allowance (MAWA) has been lowered from 70% of the reference evapotranspiration (ETo) to 55% for residential landscape projects, and to 45% of ETo for non-residential projects. This water allowance reduces the landscape area that can be planted with high water use plants such as cool season turf. For typical residential projects, the reduction in the MAWA reduces the percentage of landscape area that can be planted to high water use plants from 33% to 25%. In typical non-residential landscapes, the reduction in MAWA limits the planting of high water use plants to special landscape areas. The revised MWELO still uses a water budget approach and larger areas of high water use plants can be installed if the water use is reduced in the other areas provided the overall landscape stays within the budget. The use of special landscape areas was not changed in the revised MWELO.

**ETo Allowance in MAWA (Proportion of ETo)**

| | MWELO 2010 | MWELO 2015 | Percentage Reduction |
|---|---|---|---|
| Residential | 0.7 | 0.55 | 21.4% |
| Non-residential | 0.7 | 0.45 | 35.7% |

The revised ordinance also precludes the use of high water use plants in street median strips. Also because of the requirement to irrigate areas less than ten feet wide with subsurface irrigation or other means that produces no runoff or overspray, the use of cool season turf in parkways is limited.

***Soil Management Report*** - For multi-lot projects, the revised MWELO added clarification that soil testing should be completed using a soil sampling rate of approximately 1 in 7 lots or 15 percent.

***Landscape Design Plan*** - The following changes were made to Landscape Design Plan section: Prior to planting, 4 yards of compost must be incorporated per 1,000 sq. ft. of permeable area. Compacted soils must be transformed to a friable condition. The depth

of mulch required was increased from 2 to 3 inches. Graywater and storm retention components must be indicated on the landscape plan.

***Irrigation Design Plan*** - Dedicated landscape water meters or submeters are required for residential landscapes over 5,000 square feet and non-residential landscapes over 1,000 square feet. Irrigation systems are required to have pressure regulation to ensure correct and efficient operation. All irrigation emission devices must meet the American National Standards Institute standard, American Society of Agricultural and Biological Engineers'/International Code Council's 802-2014 "Landscape Irrigation Sprinkler and Emitter Standard". Flow sensors that detect and report high flow conditions due to broken pipes and/or popped sprinkler heads are required for landscape areas greater than 5,000 square feet. Master shut-off valves that prevent water waste in case of large failures of irrigation systems due to breakage or vandalism are required on all landscapes except where sprinklers can be individually controlled. The minimum width of areas that can be overhead irrigated was increased from 8 feet to 10 feet; areas less than 10 feet wide must be irrigated with subsurface drip or other technology that produces no over spray or runoff. The revised update requires the irrigation auditor to be a local agency auditor or third party auditor to reduce conflicts of interest. All landscape irrigation auditors must be certified by one of the U.S. EPA WaterSense labeled auditing programs.

***Graywater Systems*** - The revised MWELO added a graywater section that specifies that landscapes less than 2,500 square feet that are irrigated entirely with graywater or captured rainwater are subject only to the irrigation system requirements of the Prescriptive Compliance Option. Graywater is allowed throughout the state under the California Plumbing Code.

***Stormwater and Rainwater Retention*** - A requirement was added that landscape area should have friable soil to maximize stormwater infiltration. Additional stormwater measures were recommended, but not required.

***Reporting*** - Executive Order and the revised ordinance require that local agencies report on the implementation and enforcement of their single agency Local Ordinances to DWR by December 31, 2015. Local agencies developing a Regional Ordinance must report on adoption by March 1, 2016. Reporting for all agencies is due by January 31st of each year thereafter. The reporting requirement is a new addition to the MWELO.

In addition to the revised MWELO requirements and ordinance changes, there are several bills designed to increase state-wide performance standards and enhance water efficiency policies. Below are highlights of those requirements.

**Senate Bill 555**

Senate Bill 555 requires retail water suppliers to submit annual water loss audit reports starting October 2, 2017. The bill requires the Department of Water Resources to post the results of each agency's audit report to allow for comparison amongst water

suppliers. In addition, the bill requires the State Water Resources Control Board to set performance standards for volume of water losses by July 1, 2020.

**Assembly Bill 1**
AB 1 prohibits a city or county from imposing fines for a failure to water a lawn or having a brown lawn during a time in which the Governor has declared a State of Emergency based upon drought conditions.

**Assembly Bill 349**
AB 349 amends the Civil Code to state that homeowner associations can no longer prohibit the use of artificial turf or other synthetic surface that resembles grass. In addition, AB 349 prohibits associations from requiring the removal or reversal of water-efficient landscaping measures once the drought is declared over.

Now, under California law, an association's governing documents must:

- Allow artificial turf or other synthetic surface that resembles grass
- Allow at least some with low water-using plants
- Allow the replacement of existing turf with low water-using plants
- Not restrict an owner's compliance with a water-efficient landscape ordinance adopted by a local government or other restrictions on the use of water imposed by the state, a water agency or local government
- Not impose "a fine or assessment" against an owner for reducing or eliminating the water of vegetation or lawns during any period for which either the Governor or a local government has declared an emergency due to drought.
- Not require the removal or reversal of water-efficient landscaping measures installed in response to the drought once the Governor of California declares that the drought is over.

## Water Demand Reduction Requirements for Urban Water Suppliers

The primary laws and agreements establishing water use reduction goals and targets for urban water supply agencies are the Water Conservation Act of 2009 (SB X7-7) and the Memorandum of Understanding Regarding Urban Water Conservation in California (California Urban Water Conservation Council MOU). SB X7-7 set a requirement for urban water suppliers to reduce their per capita water use by the year 2020. The overall goal is to reach a statewide reduction in per capita urban water use of 20% by December 31, 2020. The MOU is a voluntary agreement. Signatories to the MOU agree to make a good faith effort to implement a prescribed set of urban water conservation best management practices (BMPs) or to take other actions resulting in an equivalent level of water savings. While the MOU is voluntary, state law (AB 1420) conditions eligibility for certain state grants and loans on compliance with it. AB 1420 sunsets in June of 2016 to be replaced by each agencies 20x2020 target for meeting the intent of AB 1420.

**SB X7-7** – Under SB X7-7 urban water suppliers were required to provide a target for per capita water use in 2020 in their 2010 UWMPs. The target must be calculated using one of four methods specified by the legislation. The four methods are:

1. Set the target to 80% of baseline per capita water use. The legislation dictates the method for calculating baseline per capita water use.
2. Set the target based on efficient water use standards for indoor residential water use, commercial, industrial, and institutional water use, landscape water use, and (optionally) agricultural water use.
3. Set the target to 95% of the applicable state hydrologic region target developed by DWR and published in the state's 20x2020 Water Conservation Plan.
4. Set the target based on expected reductions in residential and non-residential water use due to implementation of the MOU BMPs and other actions.

Urban water suppliers are required to calculate an interim GPCD target for 2015 from the 2020 target. The interim target is also reported in the 2010 UWMP. Urban water suppliers must report their compliance status with their interim and 2020 GPCD targets in their 2015 and 2020 UWMPs. Effective July 1, 2016, urban water supplier eligibility for water grants or loans awarded or administered by the state is conditional on compliance with these targets. Additionally, effective January 1, 2021, failure to meet the 2020 target can be used in administrative or judicial proceedings to establish a violation of state law by the urban water supplier.

**Executive Order B-29-15** - With California facing one of the most severe droughts on record, Governor Brown declared a drought State of Emergency in January 2014 and directed state officials to take all necessary actions to reduce water use.

On April 1, 2015, Governor Brown mandated a 25 percent water use reduction for cities and towns across California. In May 2015, the State Water Resources Control Board (SWRCB) adopted an emergency regulation requiring an immediate 25 percent reduction in overall potable urban water use. The regulation uses a sliding scale for setting conservation standards, so that communities that have already reduced their R-GPCD through past conservation will have lower mandates than those that have not made such gains since the last major drought.

The SWRCB tracks water conservation for each of the state's larger urban water suppliers on a monthly basis, but compliance with individual water supplier conservation requirements and the statewide 25 percent mandate is based on cumulative savings. Cumulative tracking means that conservation savings will be added together from one month to the next and compared to the amount of water used during the same months in 2013.

Table 9 below provides the reduction targets for each IEUA member agency.

*Table 9: Retail Agency Emergency Regulation Mandatory Reduction %*

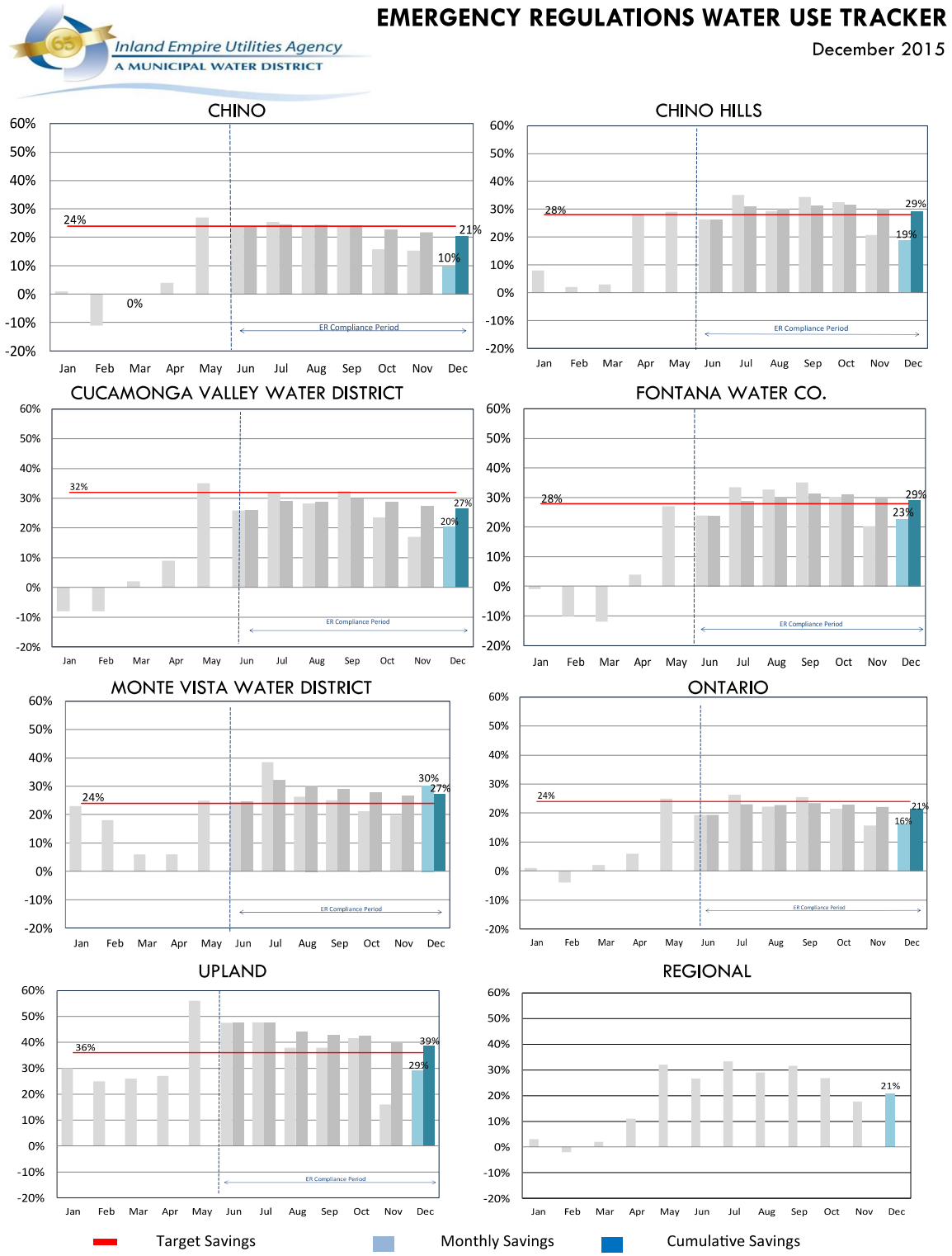
| Retail Agency | Mandatory Reduction Percent |
|---|---|
| Chino, City of | 24% |
| Chino Hills, City of | 28% |
| Cucamonga Valley Water District | 32% |
| Fontana Water Company | 28% |
| Monte Vista Water District | 24% |
| Ontario, City of | 24% |
| Upland, City of | 36% |

## Regional Compliance Status

As stated, IEUA and its regional partners are committed to meeting or exceeding all compliance requirements put forth.

**Governor's Executive Order and Emergency Regulation Compliance**
As stated above, the SWRCB approved an emergency regulation to implement a mandatory 25 percent statewide reduction in potable urban water use for the period between June 2015 and the end of February 2016. As of June 2015, member agencies are required to track monthly water use savings, as compared with 2013 water usage, and report the total potable water production to the SWRCB.

On the following page, Figure 1, is a copy of the December 2015 report submitted to the SWRCB. The report indicates that each water district exceeded or came close to meeting their respective reduction level for the June through December 2015 reporting period. The collective goal is 28% reduction and the collective saved through December is 29.5%.




◊ Monthly Savings compared to 2013 Water use

◊ Emergency Regulations of cumulative water use savings compliance begins June 2015

*Figure 1: Retail Agency Emergency Regulation Water Use Tracker*

**SB X7-7 Compliance**

IEUA and its regional partners, through their Regional Alliance, used method 1 to set its interim and 2020 GPCD targets. Because this method requires landscape area and population data in the compliance years (2015 and 2020) to calculate the targets, the targets reported in the Region's 2010 Urban Water Management Plan (UWMP) are estimates that will be updated in its 2015 and 2020 UWMPs. The estimated targets for 2015 and 2020 are 226 and 201 GPCD respectively.[6]

As shown in Table 10, measured GPCD within the Regional Alliance service area for the last five years has averaged 220 gallons, 3% less than the 2015 target. 2015 estimates show per capita use at 188 well below the 226 target. It is certain the region will comply with its 2015 interim target and absent a sharp rebound in per capita water use in the next five years, the odds are strongly in its favor that it will meet its 2020 target. The current projection for 2020 is reported GPCD of 169 - 174, well below the target of 201. The current numbers being used by IEUA's planning team shows a 6 GPCD reduction for WUE in 2020. The plan as projected in this document, assuming 2 agencies implement Budget-based Water Rates, estimates an 11 GPCD reduction for WUE.

Table 10 reports regional SB X7-7 compliance. In comparing per capita use to targets, the law allows accounting allowances for recycled water (RW) and water use efficiency (WUE) in the reported GPCD. Table 10 depicts this logic for showing how the per capita water use (Actual GPCD) is adjusted by WUE and RW to yield the reported GPCD.

*Table 10: 20x2020 Regional Compliance*

| Fiscal Year | GPCD without WUE & Recycled Water | Water Use Efficiency | Recycled Water | Reported GPCD* |
|---|---|---|---|---|
| **UWMP 2010 Baseline** | | | | **251** |
| 2010 | 260 | 1 | 10 | 249 |
| 2011 | 215 | 1 | 12 | 202 |
| 2012 | 229 | 2 | 15 | 212 |
| 2013 | 237 | 2 | 18 | 217 |
| 2014 | 243 | 2 | 21 | 219 |
| **2015 Target** | | | | **226** |
| 2015 Actual | 212 | 3 | 21 | 188 |
| **2020 Target** | | | | **201** |
| 2020 Projection* | 215 | 6 - 11 | 35 | 169 - 174 |

***Projection: 2020 assumes 2.5% increase/year water use from FY2014/15.*

[6] IEUA updated its service area population estimates and GPCD calculations following the release of 2010 Census data. The targets reported here differ from the targets reported in IEUA's 2010 UWMP. IEUA will be updating its baseline GPCD, interim, and compliance GPCD targets in its 2015 UWMP.

**California Urban Water Conservation Council MOU Compliance**

In December 1991, IEUA, along with 120 other urban water agencies and environmental groups signed a historic Memorandum of Understanding and since then the California Urban Water Conservation Council (Council) has grown to over 400 members. Those signing the MOU pledge to develop and implement urban water conservation practices to reduce the demand of urban water supplies. During its 20-year history, the Council has successfully established itself as a collaborative forum within which water agencies and the environmental community work together to advance urban water conservation throughout the state.

As a part of regional water use efficiency programming, IEUA and its regional partners agree to allocate funding annually to pay membership dues and to support Council activities. In addition, IEUA also has a designated staff person who serves as a Group 1 - Board Member.

**AB 715, SB 407, CalGreen, AB 1881 Compliance**

IEUA does not have statutory obligations under AB 715, SB 407, CalGreen, and AB 1881, which govern the manufacture, sale, installation, and replacement of toilets, urinals, and faucets and the installation and rehabilitation of landscaping in California. The property inspection, plan approval, and construction permitting obligations of SB 407 and AB 1881 fall to cities and/or counties, not special water districts. The same is also true for adoption and enforcement of CalGreen building codes.

IEUA and its regional partners will continue to support and pursue new building codes and landscape measures which drive water efficiency including adding irrigation and landscape measures to local and state retrofit on resale regulations.

In addition, IEUA and its regional partners will work with developers and push for installation of premium toilets and ultra-high efficient development projects. This will require that IEUA and its regional partners actively interact with developers, homeowner associations, and the real estate industry in order to educate all parties, focusing on single family projects and appropriate design and product choices for water efficient back yards.

The region should also consider focusing on efforts to drive up standards for irrigation equipment being sold in California including: pressure regulation spray bodies with built-in check valves, high efficiency sprinkler nozzles, smart controllers and other efficiency equipment.

# Section 3 - Market Condition and Potential

One of the first tasks undertaken in the WUE planning process was to collect and compile a database in order to disaggregate end-use data within the IEUA service area. Analysis of the region's customer demand is an important step in developing the WUE plan because it lays the foundation for understanding the potential for water savings from efficiency measures. For the purposes of this five-year plan, water consumption and inferred outdoor water use was used. The region's recent efforts with GIS mapping and analytics will provide significantly more accuracy regarding landscape area and irrigation use.

In addition, evaluating what's been achieved through past WUE activities helps assess the remaining potential. Lastly, appraising the market conditions and barriers to implementing WUE measures is necessary as they impact program feasibility and again potential to achieve water savings.

The following items were analyzed in order to determine remaining market potential in the IEUA's service area:

- Current Water Consumption
- Indoor and Outdoor Water Use
- Past Conservation and Device Saturation
- Market Conditions
- High Level Measure Potential

## Regional Water Consumption

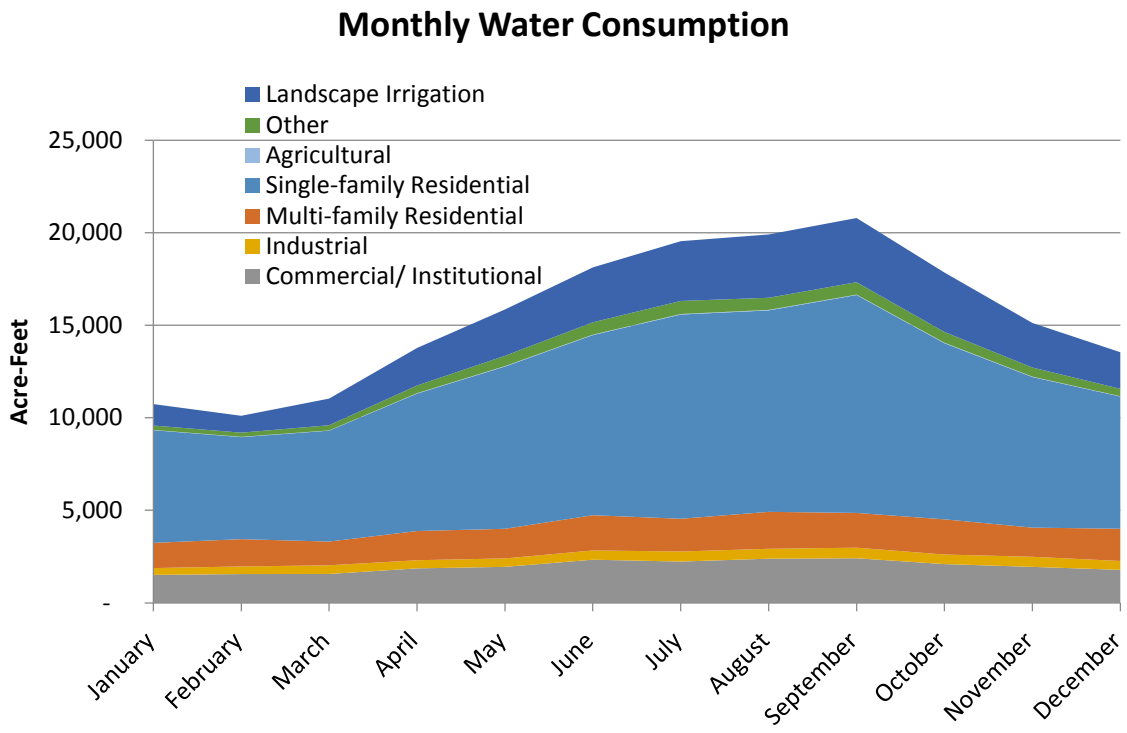
Table 11 shows the 2013 water consumption and number of water accounts by customer type for all seven IEUA member agencies combined.

*Table 11: 2013 Regional Water Consumption*

| Customer Type | Number of Accounts in 2013 (PWSS) | Annual Consumption (Weather Normalized AF) | Customer Class Share of Total Demand |
|---|---|---|---|
| Single Family | 171,309 | 112,171 | 48.5% |
| Multi-Family | 7,286 | 27,818 | 12.0% |
| Commercial | 12,912 | 25,668 | 11.1% |
| Industrial | 870 | 6,342 | 2.7% |
| Landscape | 5,332 | 31,119 | 13.5% |
| Other | 599 | 27,893 | 12.1% |
| **Total** | **198,308** | **231,092** | |

Figure 2 plots the monthly water consumption by month to reveal seasonal patterns by customer type. Note the pronounced seasonal variation with summer high deliveries approximately twice the level of winter deliveries. Single family and landscape irrigation show the largest seasonal variation. The graph is sorted with the highest seasonal variation presented on top. For example, landscape irrigation is the sector with the highest ratio of peak month to minimum month while commercial customers have the lowest.

*Figure 2: Monthly Water Consumption by Customer Type*




## Indoor vs. Outdoor Water Use

WUE measures address either indoor or outdoor water use. For this reason, it is important to know how much water is used for each. Determining water usage indoors vs. outdoors can be difficult. Some outdoor end uses can be directly measured by dedicated irrigation meters. However, many types of water meters -- single family, multi-family, and commercial -- are "mixed," measuring both indoor and outdoor end uses. Therefore, agencies are forced to rely on inference to determine outdoor water usage.

Two methods can be used to estimate outdoor use across customer classes. The first method is the minimum month method that has seen wide use due to its ease of implementation. This method assumes that the month of minimum water demand is completely made up of indoor end uses; thus, any water consumption greater than the minimum month would be outdoor water use. To be accurate, this method requires that

at least one month per year (typically in the winter) has zero outdoor water usage. Because of the region's location, irrigation occurs even in the winter and makes this method ineffective.

The second method, termed "seasonal variation," develops an estimate of winter irrigation from dedicated irrigation meters and applies this seasonal variation to mixed meter customers. The seasonal variation method will result in a higher estimate of outdoor water use than using minimum month because it captures winter irrigation end uses. This method was chosen for the region's planning process because it more accurately captures the winter irrigation occurring in the region's arid climate.

Table 12 shows the estimated outdoor end use constituting **66%** (153,435 acre-feet) of the total volume of water use.

With this high percentage of outdoor water usage, it is important to recognize that, with just a 20% reduction each year, over 30,000 acre-feet of water can be saved annually.

*Table 12 Inferred Outdoor Use*

| Inferred Outdoor Use | | | |
|---|---|---|---|
| Customer Class | Total Volume (AF/Year) | Seasonal Variation Method % Use | Estimated Outdoor Use (AF) |
| Single Family | 112,171 | 62% | 70,071 |
| Multi-Family | 27,818 | 33% | 9,314 |
| Commercial | 32,010 | 47% | 14,959 |
| Landscape | 31,199 | 100% | 31,199 |
| Other | 27,893 | 100% | 27,893 |
| Total | **231,092** | **66%** | **153,435** |

## Past Achieved Conservation

It is necessary to understand past achieved conservation when determining remaining conservation potential. Data from the region's locally administered programs, as well as MWD's regional rebate programs, was collected from IEUA's fiscal year reports 2002 through 2015. The data was entered into the AWE Tracking Tool and is summarized in the Table 13.

The total lifetime water savings for all of the measures is estimated at 89,161 acre-feet. Toilets, both HET and ULFT, have provided the most significant savings at 49,347 acre-feet over the life of measures. This represents over 55% of the total water savings. Smart controllers provide savings of 8,581 acre-feet representing over 9% of total savings. Over

half of the smart controller savings came from central irrigation control system rebates through MWD's Public Agency Program.

*Table 13: Lifetime Savings by Measure for Past Achieved Conservation*

| Measure | Lifetime Savings Acre-feet | % of Total Savings |
|---|---|---|
| High Efficiency and ULF Toilets (all markets) | 49,347 | 55.35% |
| Smart Controllers (all markets) | 8,581 | 9.62% |
| High Efficiency Clothes Washers (all markets) | 6,669 | 7.48% |
| High Efficiency Nozzles (all markets) | 5,966 | 6.69% |
| Fontana USD Retrofits | 4,170 | 4.68% |
| Ultra Low Volume Urinals | 4,155 | 4.66% |
| Residential Landscape Retrofits | 4,104 | 4.60% |
| Turf Removal (all markets) | 2,911 | 3.26% |
| Landscape Evaluations | 1,855 | 2.08% |
| Water Brooms | 416 | 0.47% |
| Pre-rinse Spray Valves | 379 | 0.43% |
| X-ray Film Processors | 304 | 0.34% |
| Cooling Tower Controllers | 142 | 0.16% |
| Laminar Flow Restrictors | 105 | 0.12% |
| Pool Cover | 28 | 0.03% |
| Large Rotatory Nozzles | 22 | 0.02% |
| Air-Cooled Ice Machines | 5 | 0.01% |
| Rain Barrels | 2 | 0.00% |
| Total | **89,161** | |

## Past Program Activity – Estimated Savings: FY2002 – 2015

In order to better understand activity and savings at a more granular level, Table 14 below displays the measures by market segment and delivery mechanism, if available. Of significance is that 23,395, or 26% of the total savings, came from ultra low flush toilets installed in multi-family sites through the region's locally administrated program. Other local programs with significant savings are:

- FreeSprinklerNozzles.com Program providing vouchers for free high efficiency sprinkler nozzles produced 4,696 acre-feet of savings.
- Fontana USD Retrofits, which provided free product and installation of high efficiency toilets and urinals as well as smart controllers and high efficiency sprinkler nozzles, shows savings of 4,170 acre-feet.
- Residential Landscape Retrofits providing free product and installation of smart controllers and high efficiency sprinkler nozzles delivered 4,104 acre-feet of savings.

*Table 14: Lifetime Savings by Measure and Delivery Mechanism for Past Achieved Conservation*

| Measure | Lifetime Savings Acre-feet |
|---|---|
| Ultra Low Flush Direct Install (MF) | 23,395 |
| Ultra Low Flush Toilet Rebates (SF) | 9,101 |
| Smart Controllers Rebates (CII) | 8,301 |
| High Efficiency Clothes Washer Rebates (SF) | 6,015 |
| High Efficiency Toilets Rebates (MF and CII) | 5,144 |
| Fontana USD Retrofits | 4,170 |
| Ultra Low Volume Urinal Rebates | 4,155 |
| Residential Landscape Retrofits | 4,104 |
| High Efficiency Toilets Rebates (SF) | 3,992 |
| High Efficiency Toilet Direct Install (MF) | 3,409 |
| High Efficiency Toilet Direct Install (SF) | 3,140 |
| FreeSprinklerNozzles (MF and CII) | 2,470 |
| FreeSprinklerNozzles (SF) | 2,226 |
| Turf Removal Rebates (CII) | 1,899 |
| Phase III Landscape Evaluations | 1,181 |
| Ultra Low Flush Toilet Rebates (MF and CII) | 1,166 |
| High Efficiency Nozzles Rebates (CII) | 1,111 |
| Turf Removal Rebates (SF) | 1,012 |
| Landscape Evaluations | 674 |
| High Efficiency Clothes Washer Rebates (CII) | 654 |
| Water Brooms Rebates | 416 |
| Pre-rinse Spray Valves | 379 |
| X-ray Film Processors Rebates | 304 |

| Measure | Lifetime Savings Acre-feet |
|---|---|
| Smart Controllers Rebates (SF) | 280 |
| High Efficiency Nozzles Rebates (SF) | 159 |
| Laminar Flow Restrictors Rebates | 105 |
| Cooling Tower Conductivity Controller Rebates | 84 |
| pH Controllers for Cooling Tower Rebates | 58 |
| Pool Covers | 28 |
| Large Rotatory Nozzle Rebates | 22 |
| Air-Cooled Ice Machine Rebates | 5 |
| Rain Barrel Rebates | 2 |

## Past Program Activity – Estimated Savings: FY2010 - 2015

When evaluating past performance, it's also important to view activity and performance in the most recent years. This allows for better identification of trends and assessment of a given program's ability to deliver results.

Below in Table 15 are the savings by program for the last five fiscal years, FY2010/11 – FY2014/15. The total lifetime water savings is estimated at 30,856 acre-feet. These savings are nearly double what was projected in the 2010 Water Use Efficiency Business Plan with estimated savings of 16,055 acre-feet.

*Table 15: Savings by Program - Last Five Fiscal Years*

| Measure | Lifetime Savings Acre-feet | % of Total Savings |
|---|---|---|
| High Efficiency Toilets (all markets) | 8,413 | 27.3% |
| FreeSprinklerNozzles.com | 5,679 | 18.4% |
| Fontana USD Retrofits | 4,170 | 13.5% |
| Residential Landscape Retrofits | 4,105 | 13.3% |
| High Efficiency Clothes Washers | 2,826 | 9.2% |
| Turf Removal (all markets) | 2,059 | 6.7% |
| Smart Controllers (all markets) | 1,973 | 6.4% |
| High Efficiency Nozzle Rebates (all markets) | 983 | 3.2% |
| Ultra Low Volume Urinals | 775 | 2.5% |

| Measure | Lifetime Savings Acre-feet | % of Total Savings |
|---|---|---|
| Landscape Evaluations | 674 | 2.2% |
| Laminar Flow Restrictors | 105 | 0.3% |
| Cooling Tower Conductivity Controllers | 71 | 0.2% |
| Air-Cooled Ice Machines | 5 | 0.0% |
| Rain Barrels | 2 | 0.0% |
| Total | 30,856 | |

As with previous years, toilets still represented the most significant savings (27.27%), however, the locally administered programs, FreeSprinkerNozzles.com, Fontana USD Retrofits, and Residential Landscape Retrofits represented over 45% of combined savings. Each of these programs provided landscape and irrigation measures and was implemented through voucher and direct install delivery mechanisms vs the standard rebate-style program.

In the last two years, savings from turf removal increased significantly (over 300%) due to the increased incentive available through MWD's Regional Rebate Program.

## Indoor Passive Water Savings and Saturation

Water agencies have promoted indoor water use efficiency since the early 90's. Indoor WUE has focused on upgrading high water use fixtures such as toilets, showerheads, and clothes washers. Examples of common programs are rebates to upgrade fixtures and direct installation programs (active conservation). In addition, water agencies have supported upgrading plumbing codes that require high efficiency fixtures (passive conservation). Both passive and active conservation has contributed to saturation of indoor measures. For future program planning it is important to understand the saturation and thereby the remaining potential.

The passive conservation engine from the AWE Tracking Tool was used to calculate device saturation for residential toilets and clothes washers to assess remaining use efficiency potential. Unfortunately, at this time there is not sufficient market information to conduct this analysis for commercial measures without significant investment. The AWE Tracking Tool creates a year-by-year inventory of water-consuming devices and the transformation over time to efficient devices driven by plumbing and building code.

Active conservation was then subtracted and thus, the remaining potential was calculated.

*Single Family Homes: Saturation of High Efficiency Toilets and Clothes Washers*

Table 16 shows the current saturation of high efficiency toilets and clothes washers in single family residences. "Efficient" toilets are defined as ULFT or better (saturation includes anything 1.6 gpf or better). Recent active programs have focused on high efficiency toilets (1.28 gpf) and current programs focus on "premium" fixtures (1 gpf or less).

For toilets, the saturation rate is a significant 79% percent. Of the inventory of 390,324 fixtures in IEUA's service area, there are approximately 83,383 non-efficient toilets remaining.

For high efficiency clothes washers, the saturation rate in single family homes is 53 percent. There are an estimated 161,925 clothes washers in the Region's single family residential sector. Of the inventory of fixtures in the IEUA service area, there are approximately 75,000 non-efficient clothes washers remaining. "Efficient" clothes washers have a water factor of 8 of better, which includes all residential front loaders and the most efficient of the newer top loaders.

*Table 16: Single Family Market Potential: Saturation of Efficient Toilets and Clothes Washers*

| Single Family | Toilets | Clothes Washers |
|---|---|---|
| Total Devices | 390,324 | 161,925 |
| Remaining (Non Efficient) Devices | 83,383 | 75,932 |
| Devices Actively Retrofitted | 18,940 | 15,359 |
| Devices Passively Retrofitted | 288,001 | 70,633 |
| Saturation | 79% | 53% |
| Total Water Savings Potential | 3,544 AFY | 8,163 AFY |

*Multi-family Homes: Saturation of High efficiency Toilets and Clothes Washers*

Table 17 shows the saturation in the multi-family sector. High efficiency toilet saturation is even higher at nearly 100% and saturation of high efficiency clothes washers is 44%. One reason for the high saturation rate for toilets is that the IEUA and its regional partners have been extremely aggressive implementing direct install programs for more than a decade.

*Table 17: Multi-Family Market Potential: Saturation of Efficient Toilets and Clothes Washers*

| Multi-Family | Toilets | Clothes Washers |
|---|---|---|
| Total Devices | 117,559 | 29,771 |

| | | |
|---|---|---|
| Remaining (Non Efficient) Devices | Very few | 16,785 |
| Devices Actively Retrofitted | 31,534 | Not categorized |
| Devices Passively Retrofitted | 94,956 | 12,987 |
| Saturation | Near 100% | 44% |
| Total Water Savings Potential | NA | 1,804 AFY |

*Remaining Potential for Toilets*

Due to the high saturation rate of residential toilets as well as current code, it is recommended that the region no longer offer programs for toilet replacements.

*Remaining Potential for Clothes Washers*

There is still some market for high efficiency clothes washers. Future programs should offer incentives for the highest efficiency models because many customers are already choosing efficient models without incentives.

## Market Conditions

As economic outlooks shift, so too do attitudes about major purchasing and upgrade decisions regarding homes and businesses. When economic indicators such as unemployment, interest rates, and property values are favorable, customers are much more likely to make longer term investments in their properties including WUE upgrades.

Figure 3 shows unemployment rates over the years for California and San Bernardino County:




Unemployment Rate San Bernardino County

| | |
|---|---|
| June '11 | 14.0% |
| June '12 | 12.8% |
| June '13 | 10.4% |
| June '14 | 8.4% |
| June '15 | 7.1% |

Source: BLS via CA DOF

*Figure 3: Regional Unemployment Trend*

Besides weathering California's drought emergency, IEUA's service area, like much of California, has experienced small steady improvements in its unemployment rate since the peak of the great recession. Median household income has also exhibited improvements since bottoming out in the recession. The real estate market has shown

upturns, with an increasing median price for single family homes and multifamily buildings, increasing occupancy and rents for commercial properties, and increasing single family housing new development.

The improving economic and real estate market conditions affect the different market segments targeted by WUE programs, and their drivers need to be considered when designing water use efficiency programs. Figure 4 *Market Conditions* address each market segment—broken into multifamily and HOA, Commercial/Industrial/Institutional (CII), and Single Family—for insights as to how market conditions can influence WUE program considerations.

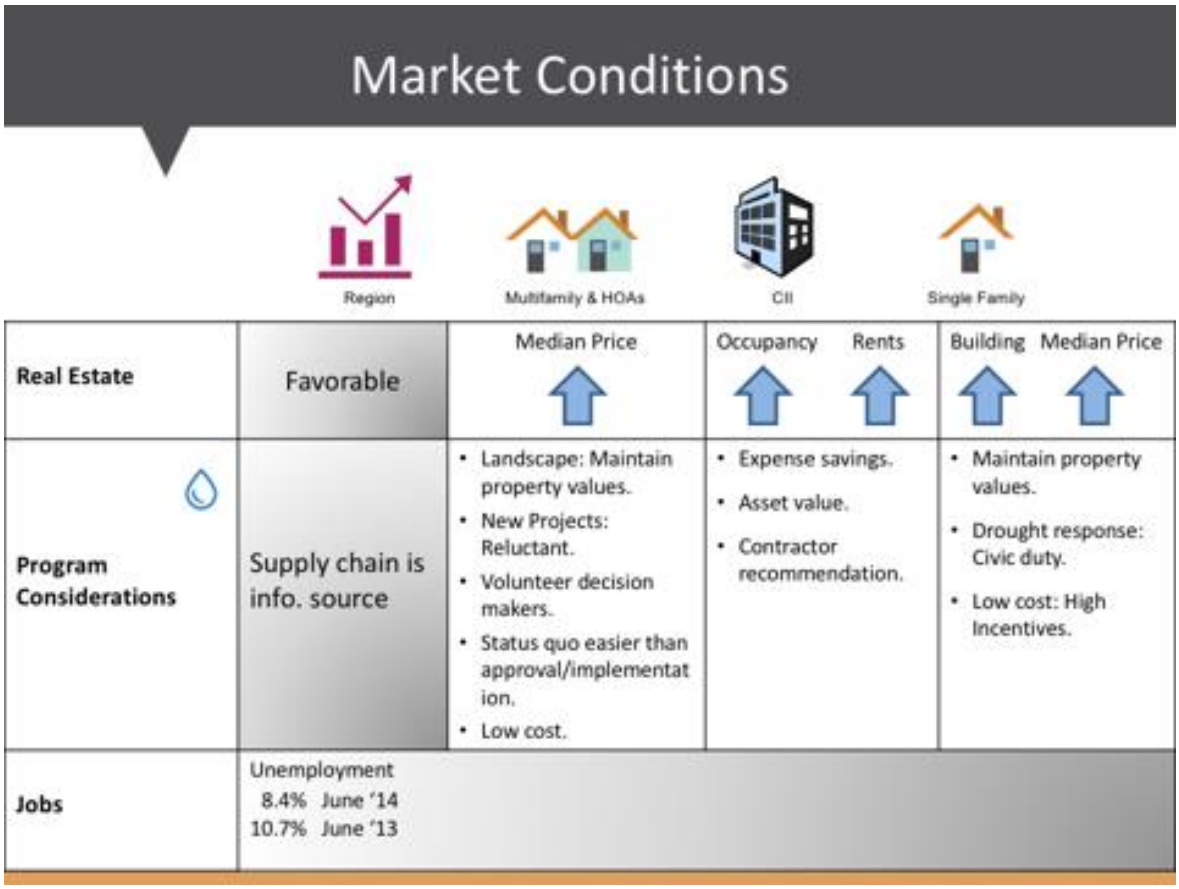



*Figure 4: Market Conditions*

The improving real estate market in the region gives new impetus for customers to make improvements to their properties. Since some landscape upgrades require fairly high up-front investments and longer term payback periods, customers need to believe that the real estate market will recognize the value of these investments.

The competitive multi-family and Homeowners Association (HOA) markets lead to customer's desire to have well-maintained and attractive landscapes to maintain property values. However, HOAs are typically governed by volunteer decision makers, and many are not willing to take risks or make investments in new technologies or alternative

landscape designs. As well, many HOAs lack the capital funds to make such improvements. They must plan years in advance to fund any large-scale project.

For commercial properties, business owners and managers have a known focus on the bottom line, requiring WUE measures to pay for themselves over a short time. Improving asset values is always a plus and contractors can have an inside edge in pushing new WUE technologies and practices due to years of developed business relationships.

The single family market sector is also characterized by customer demand for landscapes that maintains property values. However, single family customers take a more vested interest in maintaining their civic duty for drought response. Hence, messaging for support of community values such as drought response can have more traction. Increased new housing developments provides the opportunity to influence the highest efficiency fixtures, landscapes, and irrigation systems.

Significant economic incentives are motivating to all markets.

## New Water Savings Approaches and Technologies

As new approaches and technologies become available in the market, or have proven savings, it is important to evaluate these opportunities. Two approaches being considered by the IEUA and its regional partners are Budget-Based Water Rates and Customer Engagement Technologies.

### Budget-Based Water Rate Opportunities

Budget-based water pricing is a type of increasing block rate structure in which the block sizes vary according to household-specific characteristics (# of residents, irrigated area, local weather) and the use of indoor and outdoor efficiency standards (as a benchmark). Customers who manage their water consumption within their efficient allocation/water-budget pay a lower water rate; customers who exceed their efficient allocation/water-budget pay higher water rates.

The emphasis on account-by-account water use efficiency requires, with a budget-based design, that agency fixed costs be collected in large part on a fixed service charge and the remaining fixed costs are imbedded in the customers “efficiency” tiers. This helps protect the agency from losing necessary fixed revenues when customers save or use less water. Agencies with well-designed budget-based rates weather water demand changes associated with wet years, drought restrictions and economic downturns.

A recent UC Riverside study[7] of the impact of implementing budget-based water rate structures found a pronounced effect that this type of rate reform can have, specifically in a nearby service area, Eastern MWD (EMWD).

Examining more than 12,000 residential customer's consumption records from January 2003 through September 2012, the analysis arrived at the following findings:

- Average prices rose less than 4% under water budgeting, but would have had to rise 34% under flat rate pricing to achieve the same reduction in customer water use.

- EMWD's budget-based rate structure resulted in at least a **15% reduction in residential water use,** controlling for the effects of inflation and the recent economic downturn.

***Comparison of Observed Demand Against Model Predictions***

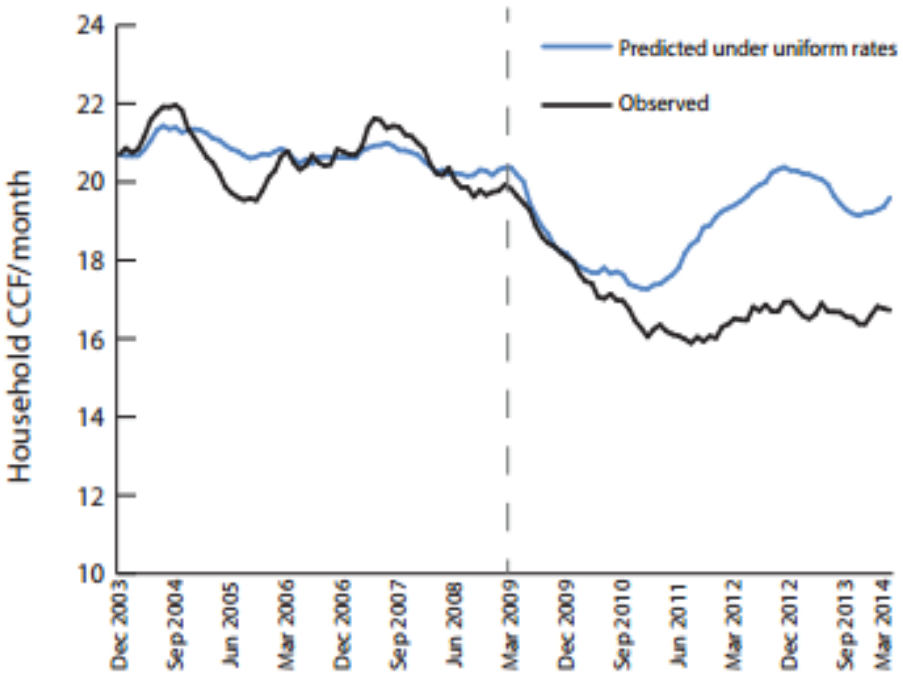



*Figure 5: EMWD BBR Demand Against Model Predictions*

There is also evidence that budget-based water rates are more desirable from a customer perspective especially when conservation targets must be achieved. Another UC Riverside Study[2] found that EMWD customers were better-off under budget-based water rates

[7] Baerenklau, Kenneth A., Kurt A. Schwabe and Ariel Dinar. 2014a. "The Residential Water Demand Effect of Increasing Block Rate Water Budgets." Forthcoming in Land Economics 90(4): 683-699. Baerenklau, Kenneth A., Kurt A. Schwabe, and Ariel Dinar. 2014b. "Allocation-Based Water Pricing Promotes Conservation While Keeping User Costs Low." Agricultural and Resource Economics Update 17(6): 1-4.

rates than under either a uniform price increase or a uniform curtailment that would achieve the same levels of conservation and agency revenues. Of the three policies examined, budget-based rates were the only policy that improved average customer welfare relative to the old pricing policy, and the only policy that effectively rewarded water use efficiency.

**Depicting Rate Change Savings**

For the purposes of this plan and savings modeling, budget-based water rates were depicted as a WUE activity in the AWE Tool by contrasting different numbers of the IEUA's member agencies rolling out the new rate over the 5-years of the implementation plan—either 2 or all of the member agencies. The agency-level savings assumption in Table 18 below is derived by translating the water use per account (AF/Account) into a weighted average water savings per account.

The econometric estimate of water savings includes the effect of the budget-based rates, increased customer outreach, and implemented water use efficiency measures. Another recent econometric study estimated customer engagement technology and associated increase in participation of water use efficiency programs to have resulted in a 4.6% reduction in a random sample controlled evaluation design.[8] To avoid double counting, a water savings assumption of 11% was determined to be a reliable savings estimate solely attributable to budget-based rates and directly applied to single family accounts. Multi-family accounts are typically composed of mostly indoor uses and only 40% of the level of single family savings was assumed to apply. The 11% water savings was also applied to irrigation accounts. A volumetrically weighted savings per account across these three customer classes was then obtained and is presented in the last row of the table below.

*Table 18: BBWR Water Savings Assumptions*

| Customer Type | AFY/ Account | Savings % | Savings AFY/Acct | Notes |
|---|---|---|---|---|
| Single Family | 0.79 | 11% | 0.09 | Direct Effect of BBRS Implementation, Reliable Est. |
| Multi-Family | 3.67 | 4.4% | 0.16 | MF mostly indoor, assume 40% of SF savings |
| Irrigation | 7.19 | 11% | 0.79 | CIII - CII not affected, Irrigation affected |
| Weighted Use in AF/Account | 1.09 | | 0.11074 | Weighted Average Savings (SF + MF + Irrig.) in AFY/ Acct |
| | | | Savings Gallons /Acct | (x325851 gallons/AF) |

[8] Mitchell, David and T.W. Chesnutt, *Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Water Reports,* Prepared for California Water Foundation & East Bay Municipal Utility District, December 2013.

| Customer Type | AFY/ Account | Savings % | Savings AFY/Acct | Notes |
|---|---|---|---|---|
| | | | 36,085 | Weighted Average Savings (SF + MF + Irrig.) in Gallons/ Acct |

Two additional member agencies rolling out budget-based rate structures was translated into two-sevens of the 183,927 applicable accounts (SF+MF+Irrig.) or 52,551 accounts. An all agency rollout was also modeled using all 183,927 accounts.

These per account savings translate into total annual savings for each model of:

- Two agency implementation of budget-based water rates: 5,820 AF
- Region-wide agency implementation of budget-based water rates: 20,368 AF

### Customer Engagement Technology Opportunities

Customer Engagement Software is used to better inform customers of their real time water use and possibilities for improving water use efficiency. As discussed above, a recent study estimated customer engagement software and increased participation in water use efficiency programs to have resulted in a 4.6% reduction in water use.[9]

Table 19 below provides the savings assumption used for savings directly attributable to Customer Engagement Software (excluding the effect of increased participation in WUE programs.)

*Table 19: Customer Engagement Software Water Savings Assumptions*

| Customer Class | AFY/ Account | Assumed Savings % | Savings AFY/Acct | Notes |
|---|---|---|---|---|
| Single Family | 0.79 | 2% | 0.0158 | Direct Effect of Customer Engagement Software, Reliable Estimate |
| | | | Savings Gallons /Acct | (x325851 gallons/AF) |
| | | | 5,148 Gallons per Year | Avg Savings (SF) in Gallons/ Acct |

## High Level Measure Potential Assessment

In order to select measures for further evaluation, it is necessary to understand the high level potential of specific measures within each market segment. Table 20 summarizes

[9] Mitchell, David and T.W. Chesnutt, *Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Water Reports,* Prepared for California Water Foundation & East Bay Municipal Utility District, December 2013.

sources of remaining water use efficiency potential by market sector. Within each sector the table lists sources of water use efficiency, the stage of programmatic development (early to late), and the qualitative range (low to high). This broad overview acts as a guide in selecting measures for further consideration.

*Table 20: High Level Market Potential by Measure*

| Sector, Measures, End Uses | Stage | Description of Potential | |
|---|---|---|---|
| **Residential Indoor** | | | |
| Toilets | Late | Small number 3.5gpf, ULF to HET less savings | Low |
| Faucets, Aerators, Flow Restrictors | Late | Small remaining potential | Low |
| Showerheads | Late | Very low flow rates existing fixtures | Low |
| Clothes Washers | Mid | Medium saturation - many freeriders | High |
| Pressure Regulating Valves | Pilot | Covers all end uses | High |
| Surveys, Education, Outreach | Ongoing | Gateway program | Low-Mid |
| Budget-Based Water Rates | Early | Covers all end uses | High |
| **Landscape** | | | |
| Controllers | Early | SF Residential large remaining potential | High |
| Nozzles | Early | Large remaining potential | High |
| Turf Replacement, Low Water Plants | Early | Large technical potential; small economic potential | High |
| Artificial Turf | Early | Large technical potential; small economic potential | High |
| Pressure Regulating Valves | Pilot | Covers all end uses | High |
| Landscape Management | Ongoing | Gateway program | High |
| Surveys, Education, Outreach | Ongoing | Gateway program | Low-Mid |
| Budget-Based Water Rates | Early | Covers all end uses | High |
| **CII (Non-Landscape)** | | | |
| Toilets | Mid | Small number 3.5gpf, valve type expensive replacement | Mid |
| Urinals | Mid | High traffic sites could be target | Mid |
| Faucets, Aerators, Flow Restrictors | Late | Small remaining potential | Low |
| Showerheads | Mid | Sports facilities, accommodation could be target | Mid |
| Food Service Equipment | Mid | Limited number of food steamers, offer upstream incentives | Mid |
| Laundry | Mid | Limited number in region | High |
| Industrial Processes and Manufacturing | Mid | Limited number in region | High |
| Cooling | Mid | Limited number in region | High |
| Pressure Regulating Valves | Pilot, Research | Covers all end uses | High |
| Surveys, Education, Outreach | Ongoing | Gateway program | Low-Mid |
| Budget-Based Water Rates | Early | Covers all end uses | High |

## Outdoor Water Savings Opportunities

Comprising an estimated 66% of the region's total demand, outdoor water use is clearly the prime opportunity for water savings.

Outdoor water efficiency is focused on reducing irrigation needs for landscapes by upgrading either the irrigation system or planted landscape to more water use efficient options. Examples of device upgrades for irrigation systems are high efficiency nozzles, micro and low precipitation irrigation, smart controllers, irrigation repairs, and pressure regulation. Turf removal and replacement with a more sustainable landscape is an example of an "upgrade" to a traditional landscape.

To determine the best water savings opportunities, the plan looks at two factors:

1) Sectors and customers with the highest outdoor water use and highest potential savings;
2) Available devices and programs with highest market potential.

*Opportunities by Customer Type*

The analysis of water usage by account type found that the account types with the highest total volume of water usage in the region, single family, multi-family and landscape accounts, also have the largest percentage of outdoor water use. These accounts use over an estimated 171,108 acre-feet of water per year and an estimated 110,584 acre-feet per year just for irrigation. A reduction of 10% could yield over 11,000 acre-feet in water annual water savings.

These account types should be targeted when pursuing outdoor water conservation programs.

## Opportunities by Measure

There are several existing outdoor water efficient technologies that have a high potential for water savings.

*High Efficiency Nozzles and Low Precipitation Systems*

Most customers in the region, no matter their type, have some irrigated area within their property. These areas are typically irrigated by in-ground systems with inefficient nozzles (ex: pop-up spray heads). There are virtually millions of nozzles in the region. These irrigation systems can be easily retrofitted with high efficiency nozzles or micro or low precipitation systems. Market studies show that only around 20% of irrigation purchases are for high efficiency products. This low market saturation, coupled with the incredibly

high number of nozzles within the region, provides a high potential for increased efficiency.

***Smart Controllers***

The majority of customer sites also utilize standard timers to operate their irrigation system. There are tens of thousands of timers throughout the region. As with nozzles, less than 20% of controllers purchased are smart controllers. Smart controllers can be a great water saving measure for sites over irrigating as well as large landscape areas. When offering smart controller programs, IEUA and its regional partners needs to incorporate potential savings verification into the program design.

***Turf Removal***

The square feet of irrigated turf within the region is estimated at 434 million square feet for single family residential parcels (OmniEarth aerial imagery). GIS data calculating irrigated area will be made available to every IEUA member agency. It is clear that cutting across all sectors with landscape, turf replacement has enormous potential. Turf is the predominant landscape in Southern California and the potential for turf removal within the Inland Empire market is high.

***Pressure Regulating Devices***

Excessive water pressure in an irrigation system can cause increased and unnecessary water output from nozzles, and can also increase the chance of damage or leaks in the system. It is unknown how many customers suffer from excessive water pressure, however, it is known that most customers do not install outdoor pressure regulating devices. Regulating pressure is a potential area of high water savings worth further exploration through pilot studies.

***Irrigation Repairs***

Irrigation repairs are also an area that could assist customers with ongoing excessive water use. Using customer level water budget data can help identify sites with leaks. It is unknown how many customers have irrigation leaks, but the potential for savings is high.

# Section 4 – Recommended Implementation Strategy

As discussed in the Executive Summary, there is a major difference between ***water conservation*** and ***water use efficiency*** and it is important to understand the dissimilarity.

The objective of this plan is ***not*** to focus on ***water conservation*** with its short-term focus on current emergency conditions. This approach will not provide prolonged savings. As drought restrictions are lifted, per capita water use will gradually rebound upwards as people breath a sigh of relief that the crisis is over and return to life as usual.

Instead the goal is to achieve ***water use efficiency,*** a sustainable reduction in water use, by creating a new resource value for water in the eyes of the end user.

The Regional WUE Business Plan proposes a five-year strategy to seek out inefficient water use customers, educating them about WUE goal attainment, and providing a "road map" to accomplish this.

It is important to understand that, while IEUA and its regional partners strive to offer an array of valuable programs and services, it is the retail water agency that ultimately determines the final design and level of participation for programs offered within their service area.

## Proposed Strategy for Customer Interactions

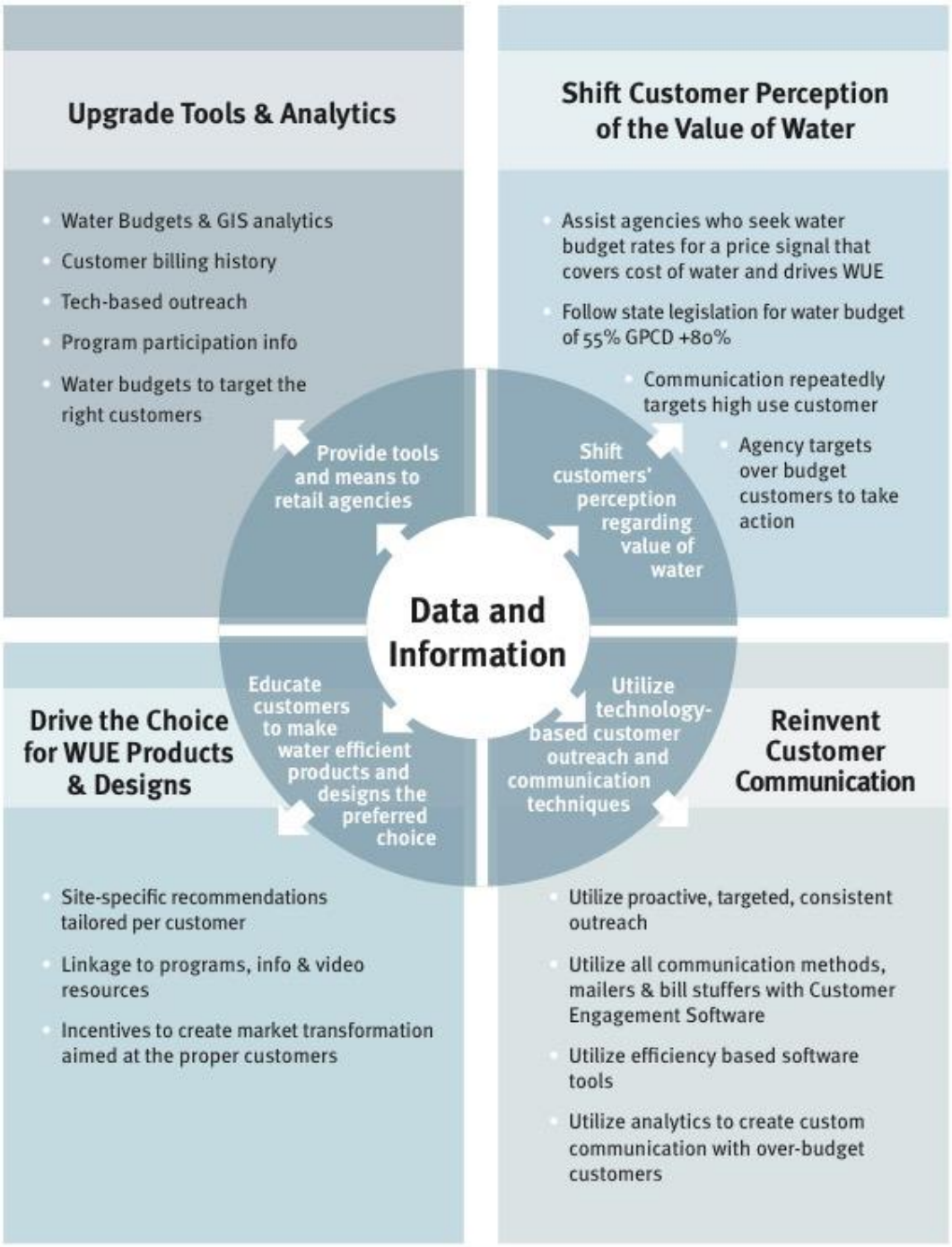
In order to achieve efficient water use, it is recommended IEUA and its regional partners conduct the in the following:

1. **Provide the tools and means** for retail water agencies to motivate the end use customers to meet reasonable and efficient water use targets. Personalized information, based on actual customer water use, measured against accepted State efficiency standards is necessary.
2. Accomplish this by **shifting customers' perception regarding acceptable levels of usage.**
3. Assist customers to **make water-efficient products and landscape designs the preferred choice.**
4. **Utilize technology outreach and communication techniques** to provide refined and individualized communication with each customer.

Figure 6 illustrates the four major changes, over traditional plans, which should be considered in order for the region to achieve reasonable and efficient water use.

## Four Major Changes to Achieve Efficient Regional Water Use

*Figure 6: Major Changes Required to Achieve Efficient Regional Water Use*



As illustrated in the chart above, there are a number of new, tech-based services and applications available to support WUE goals. These include:

***Geographic information systems*** (GIS) designed to capture, store, analyze, manage, and present an array of geographical data.

***Customer engagement software*** designed specifically for utilities to connect and communicate with their customers via web and mobile devices.

***Water budgeting software*** that provides parameters for efficient water usage per billing period and compare customers' actual usage.

Adaptors of these technologies are seeing a number of positive outcomes. Utilities have more robust data for strategic WUE program targeting and greater ability to manage supplies and distribution. Additionally, the end use customer receives accurate and personalized information about water usage at their site as well as steps to eliminate excessive water use.

It is recommended that IEUA and its regional partners consider utilizing the new tech-based software. The benefits of enhanced customer engagement for an agency can be achieved through implementation of a plan composed of eight strategic elements. Each was selected, as shown in the chart on the following page, because they provide an important piece of the puzzle for a successful customer engagement process:

## ***Eight Strategic Elements of the Regional Plan***

| **Strategic Element:** | → | **Reason Selected:** |
|---|---|---|
| Provide satellite-based COMPUTER MAPPING DATA for each retail agency | ..... | Delivers valuable site-specific data on all customers that can be used to target inefficient water users. |
| Encourage retail agencies to utilize WATER EFFICIENCY PRICING SIGNALS | ..... | Proven to be equitable and effect change at least cost to the agencies. Helps agencies achieve revenue and conservation balance. |
| Focus on OUTDOOR water use | ..... | Outdoor use is 66% of total water demand. |
| Use TECHNOLOGY-BASED SOFTWARE designed to engage, educate, and motivate customers | ..... | Provides convenient, interactive connection with customer via mobile device or computer. |
| Implement WUE CODE requirements for new construction | ..... | Lowest cost opportunity for lifetime water use efficiency. |
| TARGET OVER-ALLOCATION CUSTOMERS and offer ACTIONABLE water saving solutions | ..... | Best opportunities for cost effective savings . |
| Provide INCENTIVE-BASED & Regional INFORMATION-BASED Programs for IRRIGATION & LANDSCAPE MEASURES | ..... | Drives customers to act on their own and pushes market transformation. |
| TRACK WUE RESULTS & MAKE ADJUSTMENTS when necessary | ..... | To meet changing regional demand reduction goals. |

*Figure 7: Strategic Elements of the Regional Plan*

# Section 5 - Potential Programs and Analysis

With opportunities and markets identified for specific technologies and a recommended strategy developed, the next step in the WUE planning process was to evaluate all programs—both new and existing. A list of programs and measures was created and compared with the region's water demand and measure savings potential. At this stage of the process numerous possibilities were listed, with the understanding that many of these programs would not make the final cut.

The List of Potential Programs and the reasoning for consideration are shown in Table 21.

*Table 21 Potential Programs and Reasons for Consideration*

| Program/Measure | Reasons for Consideration |
|---|---|
| SoCal WaterSmart Rebate Program | - Majority of funding from MWD.<br>- Ease of operation. |
| High Efficiency Toilet Incentives and Direct Installation Programs | - Has provided long-term cost effective water savings in the past. |
| Turf Removal Incentives and Direct Installation | - Abundant opportunity that results in market transformation. |
| Smart Controller Direct Installation Programs | - Targets large use outdoor water and verifies savings will occur. |
| High Efficiency Nozzle Voucher and Direct Installation Programs | - Large number of pop-up heads to be retrofitted.<br>- Program is easily scalable. |
| Landscape Evaluations | - Targets over-allocation landscape customers and motivates them to make water use efficiency improvements. |
| Submetering Incentive Program | - Saturation is low and potential water savings are high volume. |
| Graywater Incentive Program | - High water savings potential. |
| Pressure Regulation Incentives | - Known issue with homes and irrigation system. |
| Irrigation Repair Incentives and Direct Installation | - Addresses fundamental issues. Issues are exasperated with installation of efficiency measures. |
| Leak Detection and Flow Monitoring Incentives | - Could save huge amounts of water and reduce damage at properties. |
| Drip Irrigation Incentives | - Currently most efficient and viable method for irrigation. |

| Program/Measure | Reasons for Consideration |
|---|---|
| Budget-Based Water Rates | - Sends strong price signal, stable agency revenue recovery, and provides excess revenue for local agency programs<br>- Drives over-allocation customers to consider changes, with little impact to low-income (UCR; Baerenklau)<br>- Proven effective for long-term water demand reduction |
| Customer Engagement Software | - Technology based communication method<br>- Allows retailers to send messaging & program links to over-allocation customers<br>- Proven effective elsewhere for reducing demand |

As importantly, it is necessary to understand the issues and possible risks when considering a potential program and/or measure. Table 22 lists these other considerations.

*Table 22: Potential Programs and Other Considerations*

| Program/Measure | Consideration |
|---|---|
| SoCal WaterSmart Rebate Program (multiple measures) | - MWD controls measures to be incentivized, incentive levels, and budgets.<br>- Marketing is not consistent. |
| High Efficiency Toilet Incentives and Direct Installation Programs | - Saturation is high.<br>- Code requires high efficiency fixtures.<br>- Premium fixtures are not easily available and provide only incremental savings. |
| Turf Removal Incentives and Direct Installation | - Expensive and not cost effective.<br>- Quality of installations vary.<br>- Drip systems have maintenance issues.<br>- Requires a significant amount of resources to manage a “best practices” program. |
| Smart Controller Voucher and Direct Installation Programs | - Cost is higher than traditional controllers.<br>- Many contractors have not bought into technology. Customers are unfamiliar with technology. Can be complicated to install and program.<br>- Many customer under-irrigate. |

| Program/Measure | Consideration |
|---|---|
| High Efficiency Nozzle Voucher and Direct Installation Programs | - More expensive than traditional nozzles.<br>- Many customers do not know what a nozzle is. |
| Landscape Evaluations | - Duration of behavioral savings are unknown.<br>- Measure savings are usually associated with another program. |
| Submetering Incentive Program | - Extremely expensive.<br>- Reading meters and billing is complicated. |
| Graywater Incentive Program | - As a retrofit option, graywater is not cost effective. Re-plumbing is costly. |
| Pressure Regulation Incentives | - Savings are not known. Hard to set average incentive.<br>- Requires more extensive installation. All installations are different. |
| Irrigation Repair Incentives and Direct Installation | - Savings are not known. Hard to set average incentive.<br>- Requires digging, additional equipment, etc. All installations are different.<br>- Potential liability for water agency if repairs conducted by staff or contractor. |
| Leak Detection and Flow Monitoring Incentives | - Savings are not known. Breaks are different sizes therefore different savings. Hard to set average incentive.<br>- Many solutions require extensive digging. Could create more liability for water agency. |
| Drip Irrigation Incentives | - Drip systems can have maintenance issues.<br>- Savings are not known. Hard to set average incentive. |
| Budget-Based Water Rates | - Requires significant investment of time, resources and dollars<br>- Must be clearly communicated to customers |
| Customer Engagement Software | - Duration of savings may be limited |

For each program, a high level of costs and water savings were estimated. Additionally, each program was assessed for its ability to deliver desired outcomes.

Program selection was not a cut-and-dry process. Some of the water efficiency possibilities would not meet other regional criteria for selection such as customer

acceptability or market need. Others could meet regional goals to achieve market transformation, although they were not cost-effective. IEUA and its regional partners also needed to take advantage of MWD funding and grant opportunities.

After the first pass, several programs were removed or otherwise not selected and are listed below:

- ***Toilet Replacement Programs.*** As discussed in the previous chapter, efficient toilets have a saturation of 80% in single family and nearly 100% in multi-family sites. Based on this evidence as well as the current code, it is recommended that IEUA and its regional partner not implement direct installation programs or offer enhanced incentives.
- ***Submetering Incentive Program.*** Submetering individual apartment units or landscape use for residential and mixed-use meters has proven to reduce water use. However, installing, maintaining and reading those meters is complicated and costly from both a water agency and customer perspective. Therefore, submetering was deemed not feasible or cost effective.

In addition, several programs were tabled for later consideration because although they have potential for significant savings there is not sufficient information on savings and costs necessary to conduct a comprehensive evaluation. These programs are:

- Graywater Incentiive Program
- Irrigation Repair Incentives and Direct Installation
- Leak Detection and Flow Monitoring Incentives

## Cost-Effectiveness Analysis

The next action was to run each of the remaining program measures through the economic analysis model and compare against the region's overall strategy to better examine the pros and cons of each. The AWE Tracking Tool v3 was utilized to conduct the analysis.

In order to determine the cost-effectiveness threshold for a program, it is first necessary to determine the avoided costs of supply. The significance of the avoided costs is that for each acre-foot of water savings, IEUA and its regional partners can avoid the variable costs, which include power costs and purchasing MWD water.

The region's avoided cost ranges from $1,122 in 2015 to $1,285 in 2020 and $2,231 in 2040.

The portfolio of programs being considered should fall below the current $1,122 avoided cost.

Cost-effectiveness analysis is the process of weighing the costs and benefits of a WUE program. For the regional plan, the relevant cost perspective for decision-making on WUE investments is the cost to IEUA and its member agencies alone. The benefits of the program are defined as the value of the water savings in dollar terms using the avoided costs estimates above. Finally, the dollar costs are compared to the dollar benefits. For sustainability purposes, the embedded energy savings and avoided greenhouse gas emissions calculated by the AWE Water Conservation Tracking Tool are also reported.

Table 23 shows the cost-effectiveness results for the potential program measures. A program such as SoCal WaterSmart has multiple measures and because each measure may have different savings and costs, it is represented on separate lines. Several measures are funded 100% by MWD or other grants and therefore have zero cost to the IEUA and its member agencies and are not listed in the table.

*Table 23: Potential Program Cost per Acre-foot*

| Activity Name | Regional Cost to IEUA ($/AF) |
|---|---|
| Budget-based Water Rates* | $0 |
| Residential Landscape Retrofit Program* | $0 |
| Cooling Tower Controllers SCWS Rebate | $124 |
| Technology Customer Engagement Software | $127 |
| Smart Controllers SCWS Rebate (Commercial ) $50 per Station | $130 |
| Ultra-Low Volume Urinals SCWS Rebate | $148 |
| FreeSprinklerNozzles.com Voucher (All Classes) | $185 |
| High Efficiency Sprinkler Nozzles SCWS Rebate (CII) | $202 |
| Smart Controllers SCWS Rebate (SF) | $221 |
| High Efficiency Clothes Washers SCWS Rebate (SF) | $303 |
| Air-Cooled Ice Machine SCWS Rebate | $744 |
| Turf Removal $1.00 | $879 |
| HE Sprinkler Nozzle Direct Installation Program (All classes) | $931 |
| Landscape Evaluation Program | $1,286 |
| Turf Removal $2.00 | $1,783 |
| Residential Smart Controller Upgrade Program | $2,215 |

** Program has outside funding.*

Most measures, except the programs/measures below, fall below the region's current avoided cost of $1,122 per acre-foot.

- Landscape Evaluations
- Residential Smart Controller Upgrade (direct installation)
- Turf Removal Rebates of $2.00 per square foot

These programs offer other benefits and assist in moving the landscape and irrigation efficiency (L&I) markets forward.

- Landscape evaluations provide customers with education as well as direction in implementing measures.
- The direct installation of smart controllers introduce customers to the new technology, educates them on their specific site water needs and ensures correct installation and programming.
- Enhanced turf removal incentives overcome the initial cash outlay barrier and drive market transformation.

Additionally, a scorecard was created and the programs rated by its ability to deliver desired outcomes.

*Table 24: Potential Program Qualitative Scoring*

| | Scalability | Impact on L&I Market Transformation | Speed of Implementation |
|---|---|---|---|
| Budget-Based Water Rates | High | High | Medium |
| Cooling Tower Controller SCWS Rebates | Low | Low | Immediate |
| Customer Engagement Software | High | High | Medium |
| FreeSprinklerNozzles.com Vouchers | High | Medium | Immediate |
| HE Clothes Washers SCWS Rebates (SF) | Low | Low | Immediate |
| HE Nozzle Direct Installations | High | Medium | Short |
| HE Sprinkler Nozzles SCWS Rebates (CII) | Medium | Medium | Immediate |
| Landscape Evaluations | Low | Medium | Immediate |
| Residential Landscape Retrofits | Low | Medium | Immediate |
| Residential Smart Controller Upgrades | Medium | Medium | Short |
| Smart Controllers SCWS Rebates (CII) | Low | Medium | Immediate |
| Smart Controllers SCWS Rebates (SF) | Low | Medium | Immediate |
| Turf Removal Rebates ($2.00) | High | High | Short |
| Ultra-Low Volume Urinals SCWS Rebates | Low | Low | Immediate |

The above programs offer varying levels of scalability; ability to transform the WUE market, and feasibility of implementation. Despite the range of ratings, each program contributes a worthwhile volume of cost-effective water savings. This high level scoring can be used as a guide in the future as conditions change such a needing to scale program activity.

# Section 6 - Selected Programs

With the analysis completed, it was clear that most of the current programs proved to be cost-effective and each provided significant benefits. Each program was next assessed for potential refinement.

The programs below are shown to deliver effective levels of water efficiency and are available whether or not an agency chooses to implement Budget-Based Water Rates or the Customer Engagement Software. Table 25 provides the final list of programs, along with the reasoning for selection and potential support actions to improve results.

*Table 25: Selected Programs and Reasoning*

| Program | Reasoning | Support Actions |
|---|---|---|
| Budget-Based Water Rates | - Sends strong price signal<br>- Drives over-allocation customers to consider changes<br>- Proven effective at reducing water demand | - Member agency education<br>- Rate evalution and implementation support through SAWPA grant |
| Customer Engagement Software | - Technology based communication method<br>- Allows retailers to send messaging & program links to over-allocation users<br>- Proven effective elsewhere for reducing demand | - Link new media and WUE programs with targeted customers. |
| Landscape Evaluations | - Links customer with programs<br>- Provides one-on-one customer education<br>- Starts relationship with customer | - Use water budget data to identify customers<br>- Provide more visual report<br>- Implement automated and consisent follow up<br>- Provide more cost/benefit information<br>- Modernize data collection and reporting |
| Residential Landscape Retrofit Program | - Target large water use<br>- Site visit verifies there will be savings<br>- Professional installation and programming of controller | - Provide electronic follow up with customer to ensure sustained savings. |

| Program | Reasoning | Support Actions |
|---|---|---|
| Residential Smart Controller Upgrade Program | - Offering to smaller customer provides bigger pool of potential customers<br>- Site vistis verifies there will be savings<br>- Education workshop ensures customer can program and maintain controller and therefore sustain savings | - Use water budget and potential savings to show return on investment<br>- Consider customer co-pay option to lower costs. |
| FreeSprinklerNozzles.com Program | - Cost effective<br>- Targets large water use<br>- Hugely scalable<br>- Gateway measure | - Target largest users and over-allocation users to maximize savings and MWD funding<br>- Market more aggressively |
| SoCal Water$mart Regional Rebate Program | - MWD funding<br>- MWD administration<br>- Ease of implementation | - Continue to add dollars to priority measures<br>- Market locally |
| High Efficiency Nozzle Direct Installation Program | - Removes financial barrier of entry<br>- Ensures quality installation<br>- Hugh potential and scalability | - Implement aggressive marketing campaign<br>- Hire additional contractors<br>- Offer multiple nozzle manufacturerers |

In addition to the nine selected active programs, IEUA and its regional partners will continue to provide regional educational and outreach programs. Current regional education and outreach programs include the following:

**National Theatre for Children Program** National Theatre for Children (NTC) delivers a package of live theatre, student curriculum and teacher guides to elementary schools throughout the region.

**Shows That Teach** Shows That Teach (STT*)* provides educational and motivational school assembly programs that focus on water education.

**Regional Landscape Training Workshops** In this series of regional sponsored courses; residential landscapers learn the latest ways to reduce water usage through workshops. The courses cover information on the basics of efficient irrigation systems, the benefits of properly watering and fertilizing landscaping, landscape design techniques and plant identification.

**Garden in Every School® Program** Grants are awarded to elementary schools within IEUA's service area for the establishment of a water-wise gardens. In addition, a blog is available for educators, parents, and community members to follow the development of the gardens, acquire gardening tips, curriculum tips and water savings tips at ieuagies.blogspost.com.

**Water Discovery Field Trip Program** Free educational field trips are provided at the Chino Creek Wetlands and Educational Park to promote the public understanding of the value of natural treatment wetlands, the creation of habitat for endangered/sensitive species and environmental stewardship. A busing mini-grant is offered to schools within the state of California to take part in the field trip program, partially funded by the California Department of Parks and Recreation.

**IEUA Water Softener Rebate Program** The IEUA Water Softener Rebate Program is part of the third phase of the IEUA's Salinity Reduction Program that is addressing the impacts of automatic water softeners on IEUA's recycled water. The goal of this project is to demonstrate the transferability of a financial incentive "rebate" for the removal of residential self-regenerating water softeners within the service area of IEUA.

**Water Saving Garden Friendly** The Water Saving Garden Friendly program was founded in 2011 to provide local communities with conservation-based educational opportunities, as well as information and access to climate-appropriate plants. Through partnerships with sponsors like Home Depot, Scotts Miracle Grow and others, the program hosts events, workshops, and other educational and "do-it-yourself" opportunities for local residents to learn about and enjoy sustainable landscaping. The Garden Friendly program is a public-private partnership that welcomes the participation of all members of the public as well as interested landscape retailers.

## ***Recommended Program Summary Pages***

Implementation details for each recommended program including: program descriptions, measure(s) offered, target customer segments, delivery mechanisms, annual activity, program costs and economic evaluation results are included on the following pages.

| Budget-based Water Rates | |
|---|---|
| **Target Customer**<br>Customers exceeding their water budget | A budget-based water rate design identifies efficient and inefficient water users. The rate, as designed, then sends an economic message to over-allocation water users. Customers are provided a context for efficient water use and driven to make efficiency improvement. Budget-Based Water Rates provide the retail agency with the most cost-effective means to reduce demand.<br><br>As depicted by university studies, the pace and longevity of achieving water use efficiency is significantly enhanced with budget-based rate implementation.<br><br>At least two IEUA member agencies are expected to utilize the SAWPA grant and IEUA assistance for Budget-Based Water Rate implementation.<br><br>Typical costs for agencies the size of those in the region range from $250,000 - $350,000. The SAWPA grant provides all single family residential landscape square footage and ET data for use by the local agency. Ongoing costs are similar to any tiered rate structure design. Agency costs for implementation are expected to be recovered within 3 months for every $1,000,000 dollars of agency revenue loss being incurred.<br><br>In addition, IEUA provides support for rate design, staff training, public outreach and Prop 218 assistance.<br><br>*Benefits*<br>- Customer educated on their specific water efficiency<br>- Sends strong price signal<br>- Drives over-allocation customers to consider changes and implement water use efficiency measures<br>- Proven effective at reducing demand and stabilizing agency revenue<br>- Water budgets, based on State efficiency standards, gives the local agency a defensible rate design and efficiency benchmark |
| **Potential for the Region**<br>High | |
| **Estimated Activity**<br>52,551 residential accounts | |
| **Water Savings**<br>11-15% average savings across the agency<br>*Program*: 5,819 AF over 5-year Lifetime | |
| **Costs**<br>Implementation: Average of $300,000 per agency $5.7 per account Paid for by grants or local agencies<br>Zero regional costs to IEUA | |
| **Funding Source**<br>SAWPA GRANT | |
| **Other Benefits**<br>Customer engagement and education | |

| FreeSprinklerNozzles.com Voucher Program | |
|---|---|
| **Target Customer**<br>All customers with pop-up spray irrigation systems. | There are millions of pop-up spray nozzles being used in IEUA's service area in all types of landscapes. These nozzles are installed as part of an in-ground irrigation systems and can be easily upgraded with high efficiency (HE) nozzles or rotating nozzles. When correctly installed, high efficiency fixed spray and rotating nozzles can have an immediate and drastic impact on outdoor water efficiency. All customers, even those with average or below average water usage, can see a reduction by upgrading to HE nozzles.<br><br>However, many customers without knowledge of their irrigation systems are intimidated by HE nozzle retrofits because the product is relatively unknown and more expensive than standard nozzles. The FreesprinklerNozzle.com program is designed to assist customers in gaining knowledge about HE nozzles and overcoming the initial cash outlay barrier.<br><br>*Program Delivery*<br>The FreeSprinklerNozzle.com program is a web-administered program that provides vouchers for free high efficiency nozzles to all eligible customers. Customers must first view online videos explaining how the nozzles work with their irrigation system, how to survey their landscape to determine which nozzles are needed, and how to install and adjust the nozzles. Customers are then given a voucher for free nozzles.<br><br>These vouchers can be redeemed at participating irrigation stores. Residential customers can receive up to 25 free nozzles. Commercial customers can receive as many nozzles as needed for their site.<br><br>*Benefits*<br>The most common barriers to purchase and installation of HE nozzles are: 1) lack of knowledge on how to choose, purchase, and install the appropriate nozzles; and 2) cost of nozzles. FreeSprinklerNozzle.com addresses both of these barriers with a voucher and required educational component. FreeSprinklerNozzle.com is a multi-agency program, administered by Western MWD. IEUA and its regional partners benefits from the economies of scale and ease of implementation. |
| **Potential for the Region**<br>High<br>Millions of pop-up spray nozzles with all customer types. | |
| **Estimated Activity**<br>60,000 nozzles/year | |
| **Water Savings**<br>*Device*: 757 gpy per nozzle<br>*Program*: 5,689 AF over Lifetime | |
| **Costs**<br>*Device*: $2.75<br>*Per AF savings:* $185 | |
| **Funding Source**<br>• IEUA and its regional partners<br>• MWD | |
| **Other Benefits**<br>• Reduced runoff<br>• Customer education<br>• Market transformation | |

| SoCal Water$mart Rebate Program | |
|---|---|
| **Target Customer**<br>All customers classes | SoCal Water$mart (SCWS) is MWD's regional rebate program offering incentives for a menu of indoor and outdoor water saving measures for both residential (RES) and commercial/industrial/institutional (CII) customers. Current incentives include:<br>• High Efficiency Sprinkler Nozzles (CII, RES)<br>• High Efficiency Clothes Washers (RES)<br>• Premium High Efficiency Toilets (MF 1.0 gpf/less)<br>• Smart Controllers (RES, CII)<br>• Cooling Tower Conductivity & pH Controllers (CII)<br>• Rain Barrels (RES)<br>• Air-Cooled Ice Machine (CII)<br>• Soil Moisture Sensors (RES, CII)<br>• Drip Irrigation (RES, CII) –*Available in 2016*<br>Member and retail agencies have the option of adding additional incentives onto MWD's base incentive. The region will add additional incentive dollars to several devices including:<br>• Residential high efficiency clothes washers<br>• Residential and commercial smart controllers<br>• High efficiency sprinkler nozzles<br>• Air-cooled ice machines<br>*Benefits*<br>SoCal Water$mart provides regional rebates to all Regional customers reducing customer confusion regarding availability in their specific area. The Region benefits from MWD paying for the majority of the incentive dollars as well as administration.<br>*Estimated Annual Activity*<br>• High Efficiency Sprinkler Nozzles - 10,750 across all markets per year<br>• High Efficiency Clothes Washers – 500 per year<br>• Smart Controllers (commercial sites) – 100 year 1, 50 years 2 - 5<br>• Smart Controllers (single family sites) – 50 per year<br>• Cooling Tower Controllers – 10 per year<br>All other measures have negligible participation and no additional funding from the Region. |
| **Potential for the Region**<br>High<br>Multiple measures available for all customers. | |
| **Estimated Activity**<br>See Estimated Activity in Table | |
| **Water Savings**<br>3,254 AF over Lifetime | |
| **Costs**<br>*FY16*: $1 Million for Turf Year 1 + $400,000 for devices<br>*FY17-20*: $100,000 | |
| **Funding Source**<br>• IEUA and its regional partners<br>• MWD | |
| **Other Benefits**<br>• Runoff reduction<br>• Waste water savings<br>• Market transformation | |

| Customer Engagement Technology and Data Analytics Program | |
|---|---|
| **Target Customer**<br>Customers exceeding their water budget<br><br>**Potential for the Region**<br>High<br><br>**Estimated Activity**<br>131,376 residential accounts<br><br>**Water Savings**<br>*Device*: 4.6% per account<br>*Program*: 3,093 AF over Lifetime<br><br>**Costs**<br>*Device*: $3.05 per account.<br>*Per AF*: $190<br>*Estimate include $.75 per GIS mapping SF account for all agencies for 2 years plus $2 per SF account for 2 agencies for 5 years for DropCountr.*<br><br>**Funding Source**<br>SAWPA GRANT<br>IEUA and its regional partners<br><br>**Other Benefits**<br>Customer engagement and education | OmniEarth is a new technology that combines physical characteristics of parcels collected through aerial/satellite imagery (ex: size, land cover type) with customer information (ex: current and historical water usage) to create water budgets for each customer. The program compares water budgets with actual usage to identify customers who are exceeding their water budget and have the most room for efficiency. This information is then consolidated and presented in layered maps and easy to understand graphs.<br><br>DropCountr is a complementary program that can share OmniEarth's information directly with customers. DropCountr utilizes OmniEarth's customer water budget information to show customers how their usage compares to households with similar geographic and household qualities. Customers can also track their usage and budget information through web-based and mobile interfaces. To maximize this information, DropCountr also provides personalized conservation tips.<br><br>*Program Delivery*<br>If a retail agency opts in, the Program utilizes OmniEarth to target high yield customers, identify geographic areas of highest water use for targeted marketing, and match customers with best-suited WUE programs.<br><br>*Benefits*<br>OmniEarth provides vital information for both targeting customers and executing efficient programs such as:<br><br>- logical and defendable water budgets for each customer<br>- Identification of over-allocation customers with high savings potential<br>- Geographical location of over-allocation customers for identifying trends<br><br>DropCountr takes this information to the next step by interacting directly with the customer. |

## High Efficiency Nozzle Direct Installation Program

**Target Customer**

High water use customers across all classes with pop-up spray head irrigation systems.

**Potential for the Region**

Medium-

For high water use customers only

**Estimated Activity**

10,000 nozzles/year

**Water Savings**

*Device*:
757 gpy per nozzle

*Program:*
1,101 AF over Lifetime

**Costs**

Device: $6

Per AF savings: $931

**Funding Source**

IEUA and its regional partners

MWD

**Other Benefits**

Reduced runoff

The largest water consumption in the region is outdoor landscape usage. Retrofitting existing systems with high efficiency (HE) nozzles is an easy way to increase efficiency of irrigation systems and reduce water usage. HE nozzles can be used to replace any inefficient standard pop-up sprinkler head creating instant water savings. However, the majority of customers are not aware of HE nozzles, where to purchase them, or how to install and maintain them.

*Program Delivery*

The goal of the HE Nozzle Direct Installation Program is to target high water use customers and assist them in overcoming any barriers to HE nozzle installation at their site. This program would be free to customers and executed by a contractor who would:

- Work with retail agencies to identify the highest water use customers.
- Market the program directly to high water use customers.
- Perform on-site visits to ensure customers have functional irrigation systems and meet other eligibility requirements.
- Schedule and perform retrofit of pop-up sprinkler heads with HE nozzles.
- Educate the customer while on-site about how to identify, install, adjust, and maintain the HE nozzles.
- Provide educational materials on HE nozzles and other water saving resources

*Benefits*

There are many benefits from a direct installation program including:

- Ability to target specific customers or sectors
- Assurance that HE nozzles were installed and not just purchased
- Guarantee that nozzles are installed correctly
- Opportunities for on-site customer education.

## Residential Smart Controller Upgrade Program

**Target Customer**

Residential customers with 500 sq ft – ¼ Acre of irrigated area

**Potential for the Region**

Medium

**Estimated Activity**

500 per year

**Water Savings**

*Device*: 13,490

*Program*: 828 AF over Lifetime

**Costs**

*Device*: $800

*Per AF*: $2,215

**Funding Source**

IEUA and its regional partners

**Other Benefits**

- Runoff reduction
- Customer education
- Market transformation

Smart controllers adjust irrigation based on weather, plant type, and other factors. These controllers save water by automatically adjusting irrigation to meet plant needs with minimal customer intervention.

*Program Delivery*

The Residential Smart Controller Upgrade Program will be offered to residential customers with 500 square feet to ¼ acre of irrigated area. The program will be implemented by a vendor and contains several steps.

- First, a site survey of the customer's property would be performed by a contractor to confirm that they have an eligible irrigation system and will in fact see water savings.
- Second, customers would attend a workshop to learn about the maintenance and use of their controller.
- Third, a contractor would install a smart controller at the customer's home and program it to meet the property's needs. Controllers and installation would be provided free of charge to the customer.

*Benefits*

There are several barriers stopping many residential customers from installing smart controllers including:

- complex installation process
- need for initial set-up/programming to meet site specific zones
- lack of knowledge on adjusting the automated controller

This direct installation program is designed to address all of these barriers. It ensures correct installation of the product and an opportunity for property-specific training by the installing contractor on the maintenance of the product.

## Residential Landscape Retrofit Program

**Target Customer**

Residential customers over ¼ Acre of irrigated area

**Potential for the Region**

Low

**Estimated Activity**

150 per year

**Water Savings**

*Device*: 13,490 gpy

*Program*: 447 AF over Lifetime

**Costs**

*Device*: $800

*Per AF*: $0

**Funding Source**

- MWD
- USBR Grant

**Other Benefits**

- Runoff reduction
- Customer education
- Market transformation

The largest water consumption sector in the region is single family residential landscape and irrigation. Single-family site with large landscape provide a significant opportunity to reduce water use. The goals of the Residential Landscape Retrofit Program is to reduce use through the installation of smart controllers and high efficiency (HE) sprinkler nozzles.

Smart controllers adjust irrigation based on weather, plant type, and other factors. These controllers save water by automatically adjusting irrigation to meet plant needs with minimal customer intervention.

High efficiency nozzles reduce use through reduced water flow.

*Program Delivery*

The Residential Landscape Retrofit Program is offered to residential customers with ¼ acre or more of irrigated area. The program is implemented by an outside contractor. The contractor conducts a site visit to verify eligibility. The contractor then installs the smart controller and nozzles at no cost to the customer.

*Benefits*

There are several barriers stopping many residential customers from installing smart controllers including:

- complex installation process
- need for initial set-up/programming to meet site specific zones
- lack of knowledge on adjusting the automated controller

This direct installation program is designed to address all of these barriers. It ensures correct installation of the product. The program is funded by MWD and a grant from USBR requiring no funding from IEUA and its regional partners.

| Landscape Evaluations | |
|---|---|
| **Target Customer**<br>Large landscape customers, residential and commercial | Customers with large landscapes require proportionally larger amounts of water to maintain the health of the landscapes. In addition, many large landscape sites are hard to irrigate such as turf located in street medians. Major areas of opportunities include: repairs to existing system, micro-zone planting, removal of non-functional turf, improvements to the distribution uniformity and finally hardware upgrades. Site surveys or customer audits are an effective tool for determining the best opportunities at a specific site and assisting the customer in evaluating the opportunity and moving forward with the measures.<br><br>*Program Delivery*<br>The Landscape Evaluation Program offers customers a comprehensive outdoor water use evaluation. Note that there are large landscape surveys offered by Metropolitan Water District. These are abbreviated versions of the evaluations conducted by the IEUA and its regional partners.<br><br>The Landscape Evaluations are free to customers and provide an assessment of a site's irrigation system, including the controllers, valves, heads, layout, and performance including:<br><br>• Pressure testing<br>• Valve operation per controller<br>• Distribution uniformity tests<br><br>The auditor also evaluates landscape design, vegetation types and local conditions for potential reductions in water use. The customer receives a written report that outlines recommended water efficiency measures and available programs and incentives.<br><br>*Benefits and Recommendations*<br>Landscape evaluations are an important tool in customer outreach and education. Recently, many energy and water audits have taken advantage of automation to reduce the time needed to survey the site or produce an customer report. A contractor utilizing an automated audit system could provide customers with immediate results and feedback while on-site. They would also have the opportunity to walk the customer through their options and answer any questions face-to-face. In addition, the customized reports should contain customer-friendly visuals, graphs, and aids that help customers understand their water usage and opportunities for efficiency.<br><br>Utilizing an automated audit system coupled with more comprehensive follow-up could significantly improve implementation of recommended water saving measures. |
| **Potential for the Region**<br>Low | |
| **Estimated Activity**<br>200 Year 1<br>150 Years 2 - 5 | |
| **Water Savings**<br>*Device*: 25,742 GPY<br>*Program*: 126 AF | |
| **Costs**<br>*Device*: $200<br>*Per AF*: $1,286 over Lifetime | |
| **Funding Source**<br>IEUA and its regional partners<br>MWD | |
| **Other Benefits**<br>• Runoff reduction<br>• Customer education<br>• Market transformation | |

## ***New Programs and Pilots Summary Pages***

IEUA and its regional partners will continue to test new technologies and program delivery mechanisms. A pilot scheduled for implementation in 2016 is the Home Pressure Regulator Pilot described below.

| **Residential Pressure Regulator Rebate Pilot Program** | |
|---|---|
| **Target Customer**<br>Residential customers with high water pressure | Pressure regulators are compact valves installed on water pipes to reduce the speed, or pressure, of water as it flows into a home or irrigation system. Water pressure in the distribution system can vary widely. Ten water districts in Southern California were surveyed in 2013 and found water pressure to range from 63 pounds per square inch (psi) to 113 psi. The ideal pressure for fixtures and irrigation systems at a residential home is 45 to 60 psi. A properly installed regulating valve at the main line into a residential property can reduce water flowing into irrigation systems and indoor fixtures to 60 psi or below. Regulating water pressure saves water by:<br><br>- Reducing the "push" of water coming out of fixtures and irrigation systems, and thus the amount of water per second. Even low-flow fixtures will have increased water use at higher pressures. Reducing water pressure ensures that every fixture lives up to its water conserving potential.<br>- Preventing slow leaks caused by increased wear and tear on fixtures, pipes, and irrigation systems.<br>- Reducing pipe breakages caused by elevated pressure.<br><br>*Program Delivery*<br>The pressure regulator rebate pilot program will provide a rebate for customers who install qualifying pressure regulating systems on their main line that will reduce pressure to both outdoor irrigation systems and indoor fixtures. IEUA would contract with a vendor to market the program, review rebate applications, verify eligibility, and issue incentives to qualifying customers. Site inspections of a set number of customers may take place.<br><br>*Benefits*<br>Not many customers know their water pressure or the importance of maintaining a proper pressure. This Pilot Program will create customer awareness of pressure regulators and proper pressure. It will also provide more information to the IEUA and its regional partners on the importance and effectiveness of pressure regulation within their service area. |
| **Potential for the Region**<br>TBD | |
| **Estimated Activity** 110 pressure regulating valves/year over | |
| **Water Savings**<br>Device: 57,050 gallons per year.<br>Program: 962 AF over Lifetime | |
| **Costs**<br>$30 - $140 per regulator | |
| **Funding Source**<br>• IEUA and its regional partners<br>• MWD | |
| **Other Benefits**<br>• Customer education | |

# Section 7 – Five Year Plan

At the inception of the Regional WUE Business Plan development the exact water savings goal and budgets had not yet been determined. Due to this uncertainty and as part of the initial Integrated Resource Planning (IRP) process, five levels of WUE budgets and productivity were modeled. These were conducted as a preliminary test to explore the impact varying amounts of water savings would have on water resources programs. Below are the modeled tiers estimated savings and costs. Details on the different models are described in Technical Memo, *IEUA Preliminary Test of WUE Tiers for IRP*, provided as an appendix.

| IEUA Preliminary Test of WUE Tiers for IRP Process | | |
|---|---|---|
| **Tier Name** | **Estimated Peak Annual Savings** (AF/Year) | **Estimated Annual Cost** (IEUA+Outside) |
| Tier 1: Current Path | 3,700 AF by 2020 | $1.5M |
| Tier 2: New Programs | 6,000 AF by 2020 | $3.5M |
| Tier 3: High WUE Implementation | 10,000 AF by 2029 | $6.5M |
| Tier 4: 20% reduction (WUE Active Programs Alone) | 48,000 AF 2035 | $30M |
| Tier 5: 40% reduction (WUE Active Programs Alone) | 98,700 AF by 2035 | $79M |

It is important to note that WUE projects included in the IRP were structured differently than in the WUE Business Plan. Project categories in the IRP which included WUE devices, turf removal, budget-based rates, recycled water demand management, and advanced metering technologies will be refined and updated in the portfolio building and modeling tools per the project specifications during the IRP Phase 2.

In addition, as part of the WUE Business Plan planning process and detailed in Section 3, Budget-Based Water Rates were depicted as a WUE activity by contrasting different levels of IEUA's member agencies rolling out the new rate structure—either 2 member agencies or region-wide implementation.

This plan is estimated to produce peak annual water savings of 11,000 acre-feet (active and passive savings) in fiscal year 2019/20. The annual peak savings are estimated at half the cost projected through the IRP process. This is because the majority of estimated savings, 5,820 acre-feet per year, are derived from Budget-Based Water Rates at zero cost to IEUA. The plan assumes the costs associated with implementing the new rates would be covered under the SAWPA grant. Table 26 presents an overview of the plan if 2 agencies implement Budget-based Water Rates.

*Table 26: Plan Overview with Budget-Based Water Rates*

| Plan Overview With Budget-Based Water Rates | |
|---|---|
| **Regional IEUA Cost per Acre-foot** | $52 per acre-foot |
| **Five-Year Water Savings (*active programs*)** | 33,554 acre-feet |
| **Lifetime Water Savings (*active programs*)** | 147,836 acre-feet |
| **Avoided Costs (NPV)** | $152.7 Million |
| **Five-Year Total Budget*** | $7.5 Million |

**Budget includes IEUA regional program costs exclusive of outside funding.*
**Budget includes $300,000 per year for education and outreach programs.*

Table 27 presents an overview if none of IEUA's member agencies elect to implement Budget-based Water Rates.

*Table 27: Plan Overview without Budget-based Water Rates*

| Plan Overview Without Budget-Based Water Rates | |
|---|---|
| **Regional IEUA Cost per Acre-foot** | $208 per acre-foot |
| **Five-Year Water Savings (*active programs*)** | 16,095 acre-feet |
| **Lifetime Water Savings (*active programs*)** | 31,446 acre-feet |
| **Avoided Costs (NPV)** | $28.9 Million |
| **Five-Year Total Budget*** | $7.5 Million |

## Implementation Schedule and Activities per Year

Table 28 displays the projected annual activity for each measure. Toilets are being phased out in FY2015/16. As of October 2015, MWD only provides rebates for premium efficiency fixtures at a much discounted incentive. The model includes toilet activity prior to the change. Turf removal was not modeled after FY2015/16. It is likely that MWD will lower the current turf removal incentive and impose caps. If the regional partners chose

to offer turf removal incentives more than likely they would have to fund the program themselves.

*Table 28: Annual Activities by Measure*

| Activity Name | Measure Metric | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|---|
| | Sites Evaluated | 200 | 150 | 150 | 150 | 150 |
| Cooling Tower Controller Rebates | Cooling Tower Controllers | 10 | 10 | 10 | 10 | 10 |
| FreeSprinklerNozzles.com | HE Nozzles | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| High Efficiency Clothes Washer Rebate | HE Clothes Washers | 500 | 500 | 500 | 500 | 500 |
| HE Nozzle Direct Install | HE Nozzles | -- | 30,000 | 30,000 | 30,000 | 30,000 |
| High Efficiency Nozzle Rebate (all markets) | HE Nozzles | 10,750 | 11,000 | 11,000 | 11,000 | 11,000 |
| High Efficiency Toilet Rebates (all markets) | HE Toilets | 2,600 | 0 | 0 | 0 | 0 |
| Premium Efficiency Toilet Rebate (MF) | HE Toilets | 750 | 0 | 0 | 0 | 0 |
| Rain Barrels | Rain Barrels | 50 | 50 | 50 | 50 | 50 |
| Residential Landscape Retrofit | Turf Removed (sites) | 200 | 250 | 250 | 250 | 250 |
| Residential Smart Controller Upgrade | Smart Controllers | 0 | 500 | 500 | 500 | 500 |
| Smart Controller Rebate (SF) | Smart Controllers | 50 | 50 | 50 | 50 | 50 |
| Smart Controller Rebate (CII) | Smart Controllers | 100 | 50 | 50 | 50 | 50 |
| Technology Customer Engagement Software | Customer Accounts | 0 | 131,376 | 131,376 | 131,376 | 131,376 |
| Turf Removal Rebate (CII ) | Turf Removed (SF) | 11.5 M | -- | -- | -- | -- |
| Turf Removal Rebate (SF) | Turf Removed (SF) | 1.5 M | -- | -- | -- | -- |
| Ultra Low Volume Urinals | ULV Urinals | 5 | -- | -- | -- | -- |
| Budget-Based Water Rates (2 Agencies) | Customer Accounts | -- | -- | 52,551 | -- | -- |

## Water Savings

The following chart depicts the annual savings from active water use efficiency activities for the five-year implementation FY2015/16 – FY2019/20.

*Table 29: Annual Water Savings*

| Annual Water Savings | |
|---|---|
| **Fiscal Year** | **Annual Water Savings (AF)** |
| **2015/16** | 1,975 |
| **2016/17** | 3,083 |
| **2017/18** | 9,206 |
| **2018/19** | 9,502 |
| **2019/20** | 9,788 |

### Water Savings by Sector

Table 30 below depicts the water savings by sector. Eighty-four percent of the projected savings will be procured from the single family sector predominately through landscape measures. When you add the savings from the program targeted at dedicated irrigation customers, nearly 99% of the savings are derived from landscape measures.

*Table 30: Water Savings by Sector*

| Sector | Lifetime Water Savings (Acre-feet) | % of Total Water Savings |
|---|---|---|
| Single Family | 124,389 | 84% |
| Multi-family | 103 | 0.07% |
| Commercial | 835 | 0.55% |
| Irrigation | 22,717 | 14.8% |
| Total | **147,836** | |

## Savings by Activity

Table 31 below presents the acre-feet savings by activity for the five-year period and the respective percent of total savings. Budget-Based Water Rates at 116,390 acre-feet or 79% is clearly the highest water savings.

*Table 31: Water Savings by Activity*

| Activity Name | Lifetime Water Savings (AF) | % of Total Savings |
|---|---|---|
| Budget-Based Water Rates | 116,390 | 79% |
| Turf Removal (CII) | 14,950 | 10% |
| FreeSprinklerNozzles.com Voucher (All Classes) | 5,689 | 4% |
| Technology Customer Engagement Software | 3,093 | 2% |
| Turf Removal (SF) | 1,950 | 13% |
| HE Sprinkler Nozzle Direct Installation Program (All classes) | 1,101 | 0.6% |
| High Efficiency Toilet SCWS Rebate (All markets) | 892 | 0.6% |
| High Efficiency Sprinkler Nozzles SCWS Rebate (All markets) | 890 | 0.6% |
| High Efficiency Clothes Washers SCWS Rebate (SF) | 863 | 0.6% |
| Residential Smart Controller Upgrade Program | 828 | 0.5% |
| Premium Efficiency Toilet Rebate (CII) | 561 | 0.4% |
| Residential Landscape Retrofit Program | 447 | 0.3% |
| Cooling Tower Controllers SCWS Rebate | 161 | 0.11% |
| Landscape Evaluation Program | 126 | 0.09% |
| Smart Controllers SCWS Rebate (SF) | 104 | 0.07% |
| Smart Controllers SCWS Rebate (Commercial ) | 39 | 0.03% |
| Ultra Low Volume Urinals SCWS Rebate | 12 | 0.01% |
| Air-Cooled Ice Machines | 2 | 0.00% |
| Rain Barrels | 2 | 0.00% |

## Passive vs Active Savings Assumptions

Some of the most significant and cost-effective water savings in California have come from state or national updates to plumbing and building codes. These changes are referred to as "passive", simply because they require no active program efforts for local water agencies. The AWE Tracking Tool calculate the passive savings from activities including:

- Residential and commercial high efficiency toilets
- Single family and multi-family high efficiency clothes washers

Below is the estimated passive and active water savings to be achieved through the five-year plan.

*Table 32: Estimated Passive and Active Water Savings*

| Water Savings Category | Five-Year Savings (AF) | Total Lifetime Savings (AF) |
|---|---|---|
| Passive Water Savings | 3,150 | 146,933 |
| Active Water Savings | 33,554 | 147,836 |
| **Total** | **36,704** | **294,769** |

## Budget by Year

IEUA prepares annual regional program budgets with line items dedicated to water use efficiency activities. The projected annual budget for each year of the five-year planning period is below. The budget amounts reflect the financial commitment only of IEUA and are exclusive of MWD or other financial contributions. The budgets presented below will not exactly line up with actual costs because they are based upon activity estimates which vary depending upon program participation rates.

*Table 33: Annual Budgets*

| Program Year | Annual Budget ($/Yr) |
|---|---|
| FY 2015/16 | $1,928,800 |
| FY 2016/17 | $1,394,335 |
| FY 2017/18 | $1,394,335 |
| FY 2018/19 | $1,394,335 |
| FY 2019/20 | $1,394,335 |
| **Total** | **$7,506,140** |

**Budget includes IEUA regional program costs exclusive of outside funding.*
**Budget includes $300,000 per year for education and outreach programs.*

## Regional Costs and Benefits

The plan is estimated to save over 147,836 acre-feet of water at a cost to IEUA and its regional partners of $52 per acre-foot. This falls well below the region's avoided cost to purchase water from MWD of $1,122 per acre-foot. The avoided purchases equate to a net present value (NPV) of over $152 Million. The overall benefit to cost ratio is 27.9.

Figure 8 and Table 34 show the cost per acre-foot per activity. The amounts reflect the financial commitment only of IEUA and are exclusive of MWD or other financial contributions.

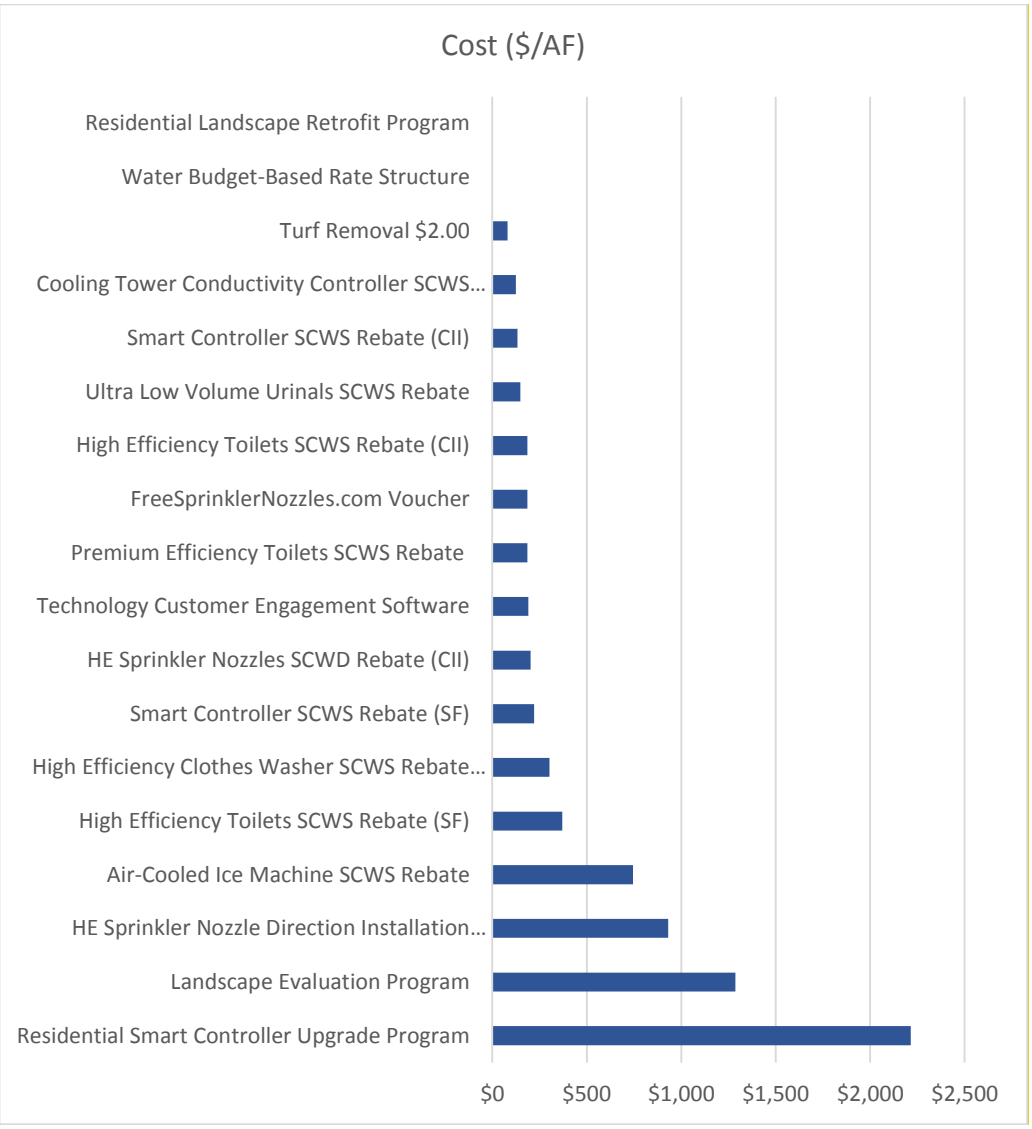



*Figure 8: Cost per Acre Foot*

Table 34 shows the cost-effectiveness for the selected program measures. A program such as SoCal WaterSmart has multiple measures and because each measure may have different savings and costs, it is represented on separate lines. Several measures are funded 100% by MWD or other grants and therefore have zero cost to the IEUA and its member agencies and are not listed in the table.

*Table 34: Selected Programs - IEUA Cost per Acre-foot*

| Measure | IEUA Only Cost ($/AF) |
|---|---|
| Budget-Based Water Rates | $0 |
| Residential Landscape Retrofit Program | $0 |
| Turf Removal $2.00 | $81 |
| Cooling Tower Controller SCWS Rebate | $124 |
| Smart Controller SCWS Rebate (CII) | $133 |
| Ultra Low Volume Urinals SCWS Rebate | $148 |
| FreeSprinklerNozzles.com Voucher | $185 |
| High Efficiency Toilets SCWS Rebate (CII) | $185 |
| Premium Efficiency Toilets SCWS Rebate | $186 |
| Customer Engagement Software | $190 |
| HE Sprinkler Nozzles SCWD Rebate (CII) | $202 |
| Smart Controller SCWS Rebate (SF) | $221 |
| High Efficiency Clothes Washer SCWS Rebate (SF) | $303 |
| High Efficiency Toilets SCWS Rebate (SF) | $370 |
| Air-Cooled Ice Machine SCWS Rebate | $744 |
| HE Sprinkler Nozzle Direction Installation Program | $931 |
| Landscape Evaluation Program | $1,286 |
| Residential Smart Controller Upgrade Program | $2,215 |

The Net Present Value (NPV) is the sum of the benefits of the water use efficiency program for all units implemented minus the sum of the costs - “net benefits” or also known as Net Present Value. NPV is, perhaps, the most useful of the cost-effectiveness criteria in that is shows the absolute size of the program benefits not just the value of one acre-foot of savings. The Benefit/Cost (B/C) column contains the ratio of benefits to costs. For B/C ratios greater than one the program is cost effective. The higher the ratio the most cost effective.

The avoided purchases equate to a NPV of over $152 Million. The overall benefit to cost ratio is 27.9. Table 35 on the following page details the NPV and B/C for each program/measure.

*Table 35: Benefits by Activity*

| Activity Name | NPV ($) | B/C Ratio |
|---|---|---|
| Budget-Based Water Rates | $123,792,926 | NA |
| Turf Removal $2.00 (CII) | $15,475,316 | 15.7 |
| FreeSprinklerNozzles.com Voucher (All Classes) | $5,373,192 | 7 |
| Technology Customer Engagement Software | $2,863,880 | 6.3 |
| Turf Removal $2.00 (SF) | $2,156,070 | NA |
| High Efficiency Sprinkler Nozzles SCWS Rebate (CII) | $755,762 | 6.4 |
| Premium High Efficiency Toilets SCWS Rebate (MF) | $502,097 | 7.4 |
| High Efficiency Toilets SCWS Rebate (SF) | $530,605 | 3.7 |
| Residential Landscape Retrofit Program | $491,254 | NA |
| High Efficiency Clothes Washers SCWS Rebate (SF) | $493,107 | 4.2 |
| HE Sprinkler Nozzle Direct Installation Program | $328,316 | 1.4 |
| Cooling Tower Controllers SCWS Rebate | $156,512 | 9.9 |
| High Efficiency Toilets SCWS Rebate (CII) | $94,591 | 7.3 |
| Smart Controllers SCWS Rebate (SF) | $94,725 | 6 |
| High Efficiency Sprinkler Nozzles SCWS Rebate (SF) | $85,163 | NA |
| High Efficiency Toilets SCWS Rebate (MF) | $79,591 | 3.7 |
| Smart Controllers SCWS Rebate $50 per Station | $38,231 | 9.9 |
| Ultra Low Volume Urinals SCWS Rebate | $8,110 | 9.1 |
| Rain Barrels SCWS Rebate (SF) | $2,637 | NA |
| Air-Cooled Ice Machine SCWS Rebate | $886 | 1.8 |
| Landscape Evaluation Program | -$10,117 | 0.9 |
| Residential Smart Controller Upgrade Program | -$574,331 | 0.6 |
| **Total** | **$152,738,523** | **27.9** |

## Energy and Greenhouse Emissions

The collection, distribution, and treatment of drinking water as well as wastewater treatment consume tremendous amounts of energy and release significant amounts of carbon dioxide (greenhouse emissions). Saving water reduces energy usage through out the water cycle and thereby greenhouse emissions. The following calculations as based on the energy embedded in delivering potable water through 2050, the region's five-year plan is expected to cumulatively save 182,555 MWh of electricity, 3,747 thousand therms of natural gas, and to avoid 505,983 tons of greenhouse emissions. Figures 9 -12 visually depict the annual savings and benefits. The embedded energy and avoided greenhouse gas emissions reflect all "upstream" embedded energy--source, conveyance, treatment, distribution pumping and pressurization. Wastewater flows and treatment that involve additional "downstream" embedded energy was not quantified.

*Figure 9: Annual Electric Savings*

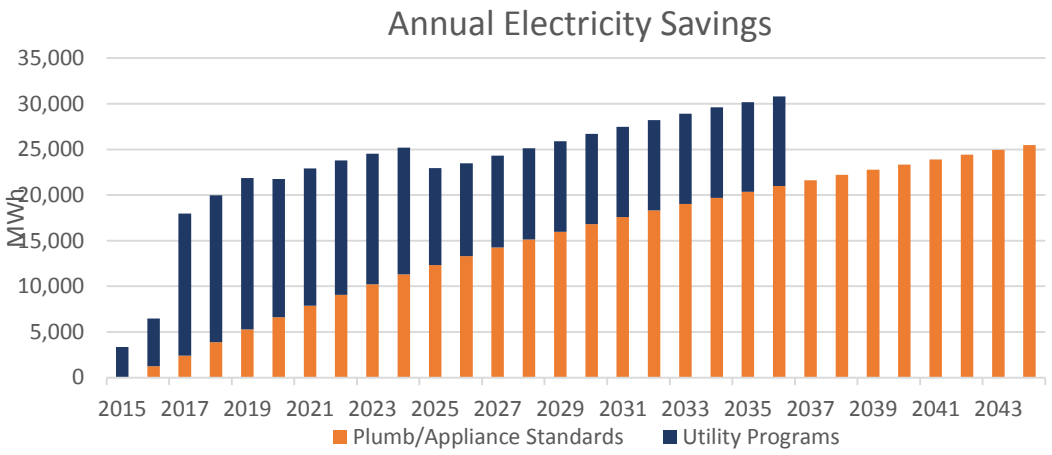



*Figure 10: Annual Gas Savings*

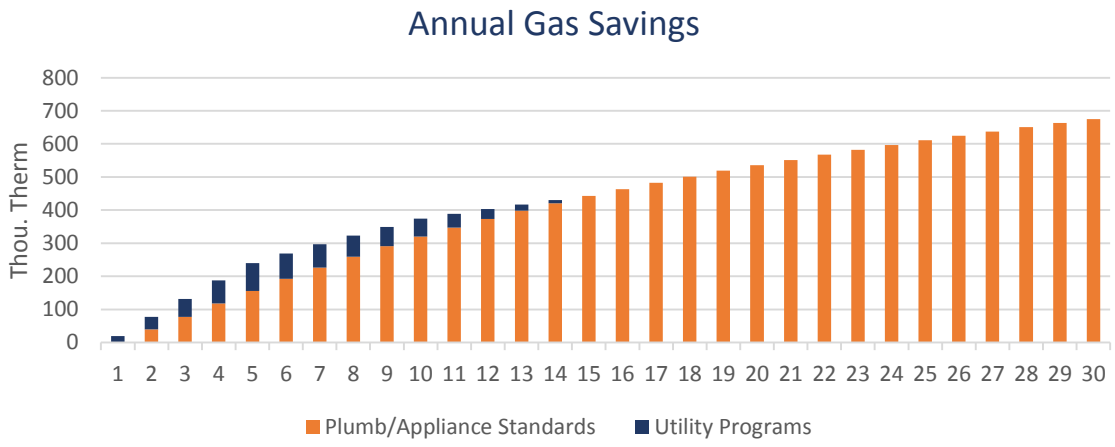


*Figure 11: Annual CO2-Equivalent Emission Reductions*

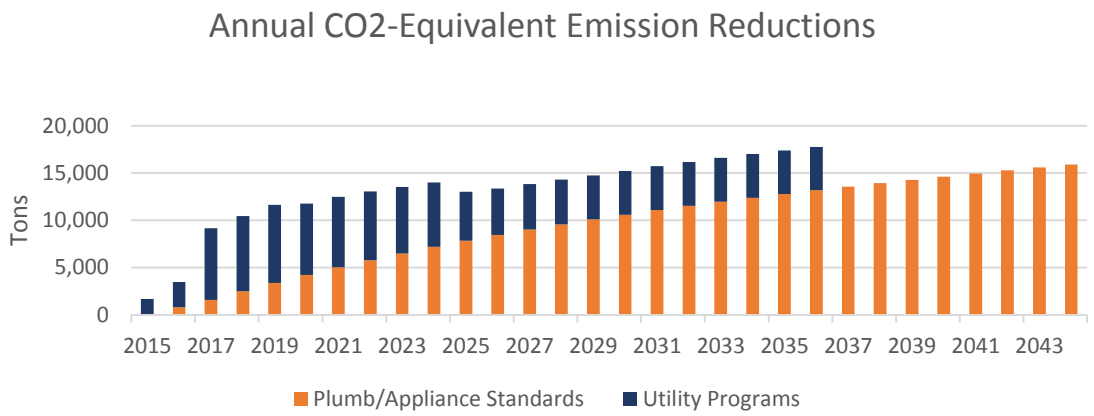
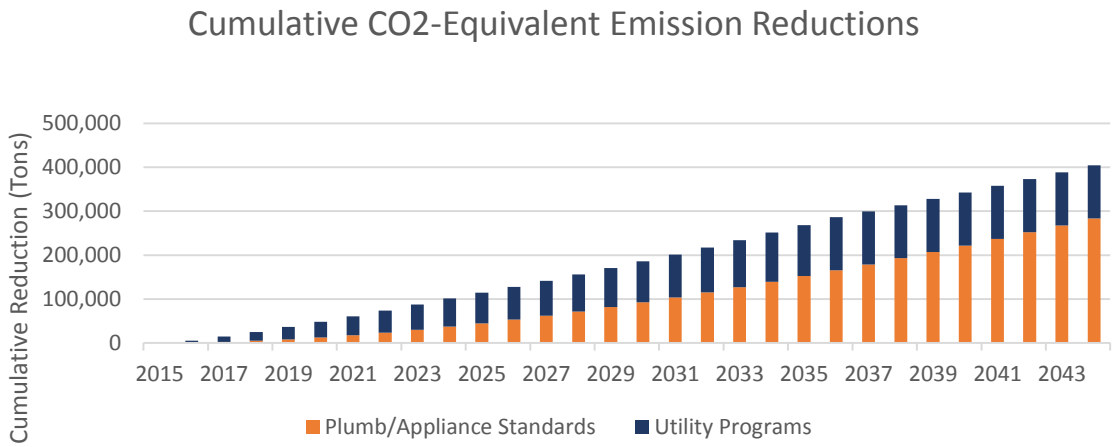



*Figure 12: Cumulative CO2-Equivalent Emission Reductions*




## Sustainable Communities Strategy

Drawing from IEUA's 2015 Integrated Resources Plan, the water demand analysis underlying the WUE Business Plan incorporated alternative low impact development/smart growth scenarios from the Sustainable Communities Strategy outlined in the 2012 Regional Transportation Plan of Southern California Association of Governments (RTP-SCAG).

RTP-SCAG's Sustainable Communities Strategy provides the regional planning assumptions for Southern California that integrates land-use, transportation and housing policies to achieve the greenhouse gas emissions targets for the region (consistent with the requirements of SB 375, the Sustainable Communities and Climate Protection Act of 2008). SCG's strategies for sustainable communities embed higher-density housing,

sustainable landscaping, living soils, and stormwater capture into an integrated watershed approach for future development.

Three demand scenarios were considered using IEUA's IRP Scenario Manager from the Water Demand Forecasting Model (CDR data based on 2012 RTP-SCAG):

1. "Sustainable" Strategy: 40% of new growth is anticipated to be Multi-Family housing in Baseline along with 60% of new growth captured in smaller single family lot sized homes;
2. "More Sustainable" Strategy: 71% of new growth is anticipated to be Multi-Family housing, with 29% of new single family housing development weighted toward much smaller lot sizes as compared to more traditional older developments;
3. "Maximum Sustainable" Strategy: 96% of new growth is anticipated to be Multi-Family housing.

New mandatory landscaping requirements also occurred when Governor Brown issued an Executive Drought Order in April 2015 to update the State's Model Water Efficient Landscape Ordnance (MWELO) through an expedited regulation. The directive outlined five specific areas to address:

1. More efficient irrigation systems
2. Limiting the percentage of turf planted in landscapes
3. Onsite stormwater capture
4. Graywater Usage
5. Required reporting on the implementation and enforcement of the ordinance by local agencies

All revisions to the MWELO became effective December 1, 2015 with affected agencies provided with a February 1, 2016 deadline to adopt the new requirements.

The WUE Business Plan is the product of collaboration across jurisdictions involving multiple agencies and stakeholders in the development of regional programs. The WUE Business Plan reflects a suite of innovative water management approaches that includes but goes beyond traditional water efficiency rebates. The new program emphases in the WUE Business Plan approach, consistent with the 2015 IRP include:

- Multi-beneficial projects and programs that are linked together for improved synergy
- Integration of water use efficiency, water-energy nexus (with quantifiable avoided Greenhouse Gas Emissions attributable to water use efficiency), low impact development, run-off prevention, stormwater management, including onsite capture/recharge and low impact development, and water quality, among others;

- Proactive, innovative, and sustainable solutions;
- Sustainable landscaping in which every garden is viewed as a mini-watershed, holding on to or cleaning all the water that falls on it and supporting a diverse habitat of plants and insects.
- Integrated regional solutions supporting local water reliability and local priorities for water management, and
- Watershed approaches based project and programs that effectively leverage limited resources and maximize the greatest potential benefits.

A snapshot of the proposed programs and their integration with Sustainable Communities are highlighted in the chart below.

*Table 36: Sustainable Communities - Program Integration*

| WUE Active Program | Multiple Benefits | Energy-Water Nexus | Run-off Prevention | Stormwater Mgmt | Sustainable Landscapes |
|---|---|---|---|---|---|
| Budget-Based Water Rates | √ | √ | √ | | √ |
| Turf Removal | √ | √ | √ | √ | √ |
| FreeSprinklerNozzles.com Program | √ | √ | √ | | √ |
| SoCal Water$mart Regional Rebate Program | √ | √ | √ | √ | √ |
| Customer Engagement Software | √ | √ | √ | | √ |
| High Efficiency Nozzle Direct Installation Program | √ | √ | √ | | √ |
| Residential Smart Controller Upgrade Program | √ | √ | √ | | √ |
| Residential Landscape Retrofit Program | √ | √ | √ | | √ |
| Landscape Evaluations | √ | √ | √ | √ | √ |
| Regional Landscape Training Workshops | √ | √ | √ | √ | √ |
| Water Saving Garden Friendly Program | √ | √ | √ | √ | √ |

# APPENDIX G

## IEUA 2015 Recycled Water Program Strategy

3rd DRAFT

# Recycled Water Program Strategy

Facility Master Planning Study



Prepared for:
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April 10, 2015

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"*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*", December 2013

# Abbreviations

| | |
|---|---|
| AF | Acre-Feet |
| AFM | Acre-Feet per Month |
| AFY | Acre-Feet per Year |
| BPS | Booster Pump Station |
| CBWCD | Chino Basin Water Conservation District |
| CBWM | Chino Basin Water Master |
| CCWRF | Carbon Canyon Wastewater Reclamation Facility |
| CIP | Capital Improvement Plan |
| CVWD | Cucamonga Valley Water District |
| ft | feet |
| fps | feet per second |
| FWC | Fontana Water Company |
| gpm | gallons per minute |
| GWR | Groundwater Recharge |
| HGL | Hydraulic Grade Line |
| Hp | Horsepower |
| HWL | High Water Level |
| IEUA | Inland Empire Utilities Agency |
| IW | Imported MWD Water |
| LF | Linear feet |
| LR | Local Runoff |
| MG | Million Gallons |
| MGD | Million Gallons per Day |
| MVWD | Monte Vista Water District |
| MWD | Metropolitan Water District |
| PRV | Pressure Reducing Valve |
| psi | pounds per square inch |
| RMPU | Recharge Master Plan Update |
| RP | Regional Recycling Plant |
| RW | Recycled Water |
| RWC | Recycled Water Contribution |
| RWIP | Recycled Water Implementation Plan |
| RWPS | Recycled Water Program Strategy |
| SARB | Santa Ana River Baseflow |
| SB | San Bernardino |
| SBCFCD | San Bernardino County Flood Control District |
| TDH | Total Dynamic Head |
| TYCIP | Ten Year Capital Improvement Plan |
| VFD | Variable Frequency Drive |
| WW | Wastewater |
| WFMP | Wastewater Facilities Master Plan |

# Executive Summary

The purpose of the Recycled Water Program Strategy (RWPS) was to update the 2005 Recycled Water Implementation Plan and the 2007 Recycled Water Three Year Business Plan. The primary objective of the RWPS was to update supply and demand forecasts and to help map changes for the Recycled Water Program (RW Program) to maximize the beneficial use of recycled water throughout the year. This approach is consistent with prior commitments of the Inland Empire Utilities Agency (Agency) to meet its projections for demands of recycled water for direct use. In addition to meeting the direct use demand projections from its member agencies, this RWPS also investigated the impacts and recommendations for elevating the priority of groundwater recharge of recycled water supply that is available throughout the year based on the latest recycled water effluent supply projections from the recent Wastewater Facilities Master Plan. The RWPS will be reevaluated at a minimum once every five years, but additional studies will be performed in the coming years to identify and present changes needed to accommodate any potential shift in recycled water use.

The planning period of the RWPS was through 2035, with a focus on the first ten years, through 2025. Through this planning period, modeling was performed for a variety of demand conditions, including changes in direct use and groundwater recharge. Modeling evaluated what the remaining supply (reuse supply) would be after direct use demands and the Santa Ana River discharge obligation have been met. To achieve a greater annual yield from the RW Program, groundwater recharge was maximized to utilize the reuse supply when available. The RWPS also performed modeling to determine the ability to accommodate and absorb changes in direct use demand. This would identify the capability to increase delivery to groundwater recharge if an increased in reuse supply was available.

The projects proposed through Year 2035 address improvements necessary to achieve the goal of maximizing beneficial use of recycled water throughout the year. Majority of the recommended projects focus on either increasing the ability to deliver reuse supply to groundwater recharge, or relieving capacity constraints in order to meet the demand (direct and groundwater recharge) forecast.

## ES.1 - Projected Recycled Water Demands and Supplies

The analyses and facility recommendations for this RWPS are based on the recycled water demands and effluent supplies provided by the Agency and their member agencies. Table ES.1 shows the demands and supplies used for this study. The total projected annual recycled water available for recharge into the proposed groundwater basins is also shown in Table ES.1. The total annual recharge projection is based on a 9-month recharge operation between March and November.

**Table ES.1 Summary of Recycled Water Demands and Supplies**

| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
|---|---|---|---|---|---|
| | AFY | | | | |
| Total Recycled Water Supply | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 |
| Total Direct Use Demand | 24,655 | 30,757 | 36,507 | 40,320 | 43,019 |
| Total Supply Available for GW Recharge[1] | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |

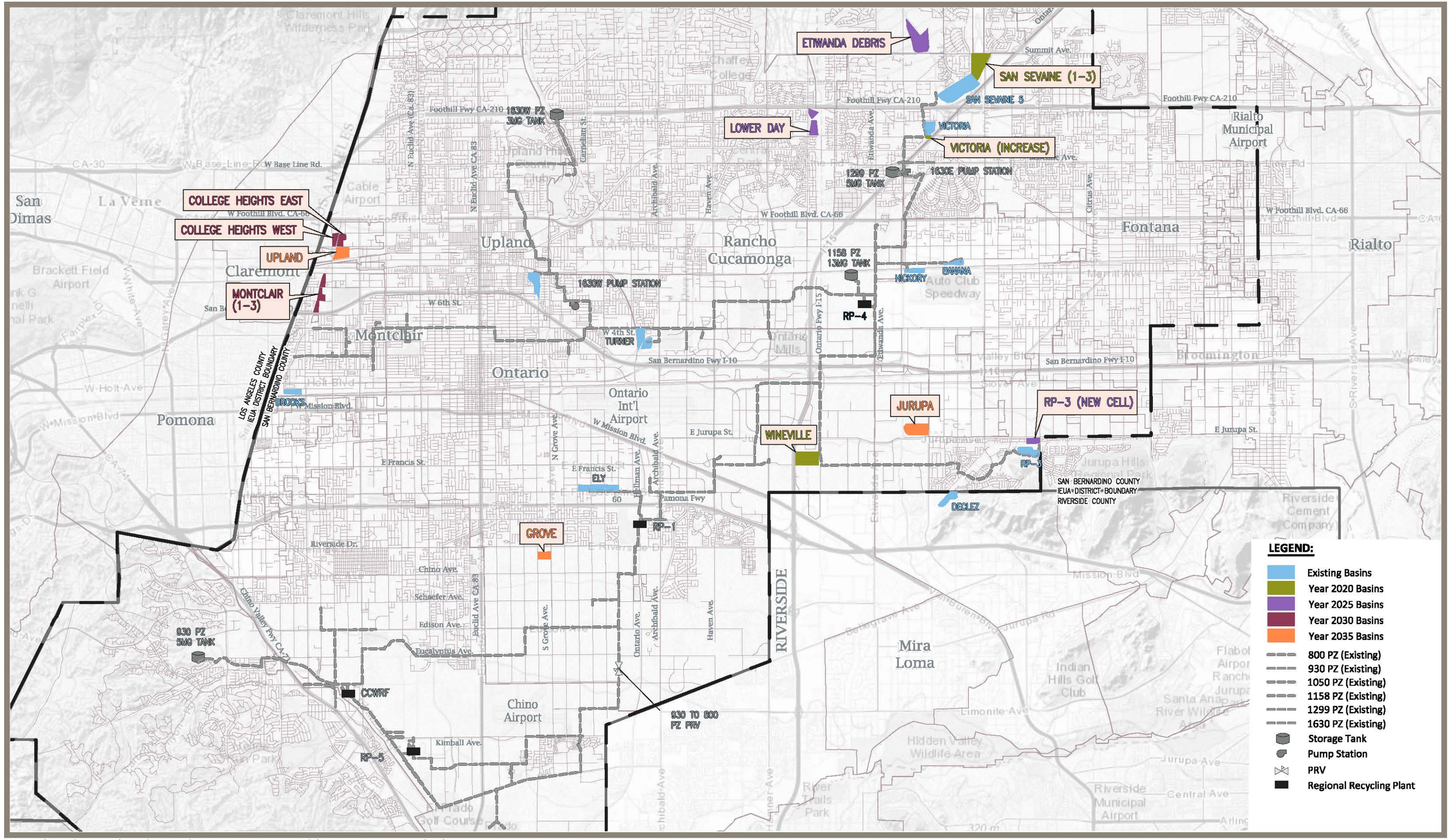
[1] Based on a 9-month recharge program between March and November and Monthly Mass Balance analyzed in this RWPS.

## ES.2 - Potential GWR Basin Implementation

The proposed recycled water implementation strategy associated with the Agency's goal to increase GWR to a higher priority use of recycled water along with direct use. The strategy proposed has a 20-year planning horizon, which is analyzed and planned in 5-year increments to Year 2035. The strategy includes identifying the proposed basins to be connected to the recycled water system, when they will be connected, and a mass balance of demands and basin flows versus the recycled water supply projections.

The Agency operates approximately 11 existing groundwater basins that are currently connected to the recycled water system (i.e., currently receiving recycled water for recharge). The Agency operates several other basins that are currently configured only to recharge storm water, local runoff, and/or imported MWD water. The new recycled water program assumes that each of these basins could potentially be connected to the recycled water system and could receive recycled water recharge. These basins are at various stages of planning and permitting. Some of these new basins are at existing basin sites where basin capacities will be expanded by adding new cells.

Table ES.2 provides a list of the basins that could be added to the recycled water groundwater recharge program and those that were studied for this RWPS, along with anticipated size and recharge capacity. Figure ES-1 is a map of the location of each of these basins.




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Prepared For:
Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Potential GWR Basin Implementation Strategy

FIGURE ES-1

**Table ES.2 Potential GWR Basins to Receive Recycled Water**

| Basin/Site | Basin Status[1] | Size (acres) | Storage Volume (AF) |
|---|---|---|---|
| Lower Day | RW Connection | 15.0 | 179 |
| Etiwanda Debris | RW Connection | 14.6 | 73 |
| San Sevaine (1-3) | RW Connection | 21.4 | 99 |
| Victoria (Increase) | RW Connection | 17.4 | 237 |
| Lower San Sevaine | New | 23.0 | 230 |
| Wineville | New | 30.0 | 240 |
| RP-3 (New Cell) | New | 3.5 | 35 |
| Vulcan | New | 30.0 | 450 |
| College Heights East | RW Connection | 6.2 | 112 |
| College Heights West | RW Connection | 5.8 | 110 |
| Grove | RW Connection | 10.0 | 114 |
| Jurupa | RW Connection | 17.0 | 249 |
| Montclair (1-3) | RW Connection | 22.5 | 518 |
| Montclair 4 | RW Connection | 5.8 | 139 |
| Upland | RW Connection | 16.6 | 392 |
| | **Total** | **238.8** | **3,177** |

[1] "RW Connection" implies that the basin is a currently operating basin as part of the groundwater recharge program for storm water/local runoff and imported water, and will require modifications and facilities to connect to the recycled water system to receive recycled water recharge. "New" is a new basin that is currently not in the groundwater recharge program.

For purposes of this RWPS, the GWR basins with potential to be converted to receive recycled water supply for recharge were analyzed and prioritized to determine which basins will be brought online for each of the planning years out to Year 2035 for this study. Based on the ranking criteria and priority determine, including committed basins from the 2013 RMPU, Table ES.3 shows the strategy proposed for the timing of implementing each of these basins for purposes of analysis for this RWPS. Table ES.3 also includes the proposed demand and flow rate assumed for this RWPS for each basin.

**Table ES.3 Potential GWR Basins**
**RWPS Implementation Strategy and Flows**

| Planning Year | Basin/Site | Daily Demand[1] (MGD) | Flow Rate[2] (gpm) |
|---|---|---|---|
| Year 2020 | Wineville | 2.8 | 3,889 |
| | Victoria (increase) | 5.5 | 7,639 |
| | San Sevaine (1-3) | 3.1 | 4,306 |
| Year 2025 | RP-3 (New Cell) | 0.8 | 1,111 |
| | Lower Day | 5.0 | 6,944 |
| | Etiwanda Debris | 1.7 | 2,361 |
| Year 2030 | Montclair (1-3) | 4.0 | 5,556 |
| | College Heights East | 2.6 | 3,611 |
| | College Heights West | 2.5 | 3,472 |
| Year 2035 | Upland | 6.8 | 9,444 |
| | Jurupa | 8.9 | 12,361 |
| | Grove | 2.7 | 3,750 |

[1] Daily demand is based on the basin storage volume divided by 14 days for a 14-day fill period.
[2] The flow rate for each basin is based on a 12-hour per day operation, with the fill period occurring during the day outside the peak irrigation direct use demand period.

## ES.3 - Summary of System Facilities Analysis

Hydraulic model analyses were performed for several demand and operational scenarios as described in Sections 6 and 7 of the RWPS. Section 6 describes the analyses for two baseline scenarios analyzed for 1) only the direct use demands and 2) the direct use demands plus GWR flows to all of the potential basins to be converted to receive recycled water supply as shown in Table ES.3 above.

Section 7 describes the Sensitivity Analysis scenarios that were analyzed to investigate the impacts of the proposed recommendations assuming a) an external supply sources is retained by the Agency to meet the SARBF at Prado Obligation demands and b) limiting the basins that are to receive recycled water supply for recharge to only the existing basins and the committed basins contained in the 2013 RMPU. Three (3) additional scenarios were analyzed for this Sensitivity Analysis in addition to the two baseline scenarios to better understand the impacts and improvements to be recommended for this RWPS.

A total of five (5) demand and operational scenarios were analyzed as described below.

**Table ES.4 Description of Hydraulic Analysis Scenarios**

| Scenario | Description |
|---|---|
| Direct Use Demands | Maximum Day Direct Use Demands anticipated during the Summer |
| Base GWR Implementation | Assumes all of the potential GWR Basins listed in Table ES.3 are converted and connected to the recycled water system to recharge available recycled water supply; includes analysis for Average Day (Spring/Fall) and Maximum Day (Summer) recycled water availability and recharge capability. The Agency also meets the SARBF at Prado Obligation from their recycled water effluent. |
| Sensitivity Analysis – Scenario A | Assumes that an external supply is obtained by the Agency to meet the SARBF at Prado Obligation demand and all of the potential GWR Basins listed in Table ES.3 are converted and connected to the recycled water system to recharge available recycled water supply. |
| Sensitivity Analysis – Scenario B | Assumes that only the existing GWR basins and committed 2013 RMPU Basins are connected to receive recycled water supply for recharge and that the Agency continues to meet the SARBF at Prado Obligation from their recycled water effluent. |
| Sensitivity Analysis – Scenario C | Assumes that only the existing GWR basins and committed 2013 RMPU Basins are connected to receive recycled water supply for recharge and that the Agency obtains an external supply to meet the SARBF at Prado Obligation. |

## ES.5 – Summary of Scenario and Project Cost Analysis

A comparison of total estimated project costs was performed to analyze and develop an overall recommendation for an implementation strategy. The Base GWR implementation project recommendations were compared with the project improvements recommended for the Sensitivity Analysis scenarios A, B, and C.

Table ES.5 on the following page shows the cost summary analysis that was performed. The overall project costs for each of the implementation scenarios are listed with the total estimated annual recycled water supply recharge benefit for that scenario.

Based on the total project costs for the different operational conditions, Scenario B of the Sensitivity Analysis herein shows the lowest total project costs. It also appears to be the lowest cost per annual acre-feet of recycled water recharge to the basins. This scenario assumes that IEUA will continue to meet SARBF at Prado Obligation as it currently does from the effluent supply from RP5 and RP-1.

## Table ES.5 Summary of Scenario Improvements Project Costs Analysis

| Year | Previous Costs | Direct Use (DU) Only Improvements Costs | DU Improvements Cumulative Costs | Annual DU Demands (AFY) | Spring/Fall DU plus GWR Improvement Costs | Summer DU plus GWR Improvement Costs | GWR plus DU Improvements Cumulative Costs | Total Annual Recharge (AFY) | Total Cumulative Costs | Total Annual Demand (AFY) |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASE GWR IMPLEMENTATION PROJECT IMPROVEMENTS (SEE CHAPTER 6) – All GWR Implementations with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Exist | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 7,250,000 | $ - | $ 7,250,000 | 13,977 | $ 13,470,000 | 44,734 |
| 2025 | $ 13,470,000 | $ 6,280,000 | $ 12,500,000 | 36,507 | $ 6,060,000 | $ 11,690,000 | $ 25,000,000 | 13,027 | $ 37,500,000 | 49,534 |
| 2030 | $ 37,500,000 | $ 34,300,000 | $ 46,800,000 | 40,320 | $ 39,000,000 | $ - | $ 64,000,000 | 13,707 | $ 110,800,000 | 54,027 |
| 2035 | $110,800,000 | $ 12,520,000 | $ 59,320,000 | 43,019 | $ 16,030,000 | $ - | $ 80,030,000 | 14,871 | $139,350,000 | 57,890 |
| **SCENARIO A - PROJECT IMPROVEMENTS – All GWR Implementation Basins plus External Supply for Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $ 20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 4,130,000 | $ - | $ 24,130,000 | 21,427 | $ 30,350,000 | 52,184 |
| 2025 | $ 30,350,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ 6,060,000 | $ - | $ 30,190,000 | 19,797 | $ 41,530,000 | 56,304 |
| 2030 | $ 41,530,000 | $ 41,550,000 | $ 52,890,000 | 40,320 | $ 71,730,000 | $ 7,610,000 | $ 109,530,000 | 19,422 | $ 162,420,000 | 59,742 |
| 2035 | $ 62,420,000 | $ 3,460,000 | $ 56,350,000 | 43,019 | $ 16,030,000 | $ - | $ 125,560,000 | 19,906 | $181,910,000 | 62,925 |
| **SCENARIO B - PROJECT IMPROVEMENTS – Existing/RMPU Basins with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 6,860,000 | $ - | $ 6,860,000 | 13,977 | $ 13,080,000 | 44,734 |
| 2025 | $ 13,080,000 | $ 17,970,000 | $ 24,190,000 | 36,507 | $ - | $ - | $ 6,860,000 | 13,027 | $ 31,050,000 | 49,534 |
| 2030 | $ 31,050,000 | $ 34,300,000 | $ 58,490,000 | 40,320 | $ - | $ - | $ 6,860,000 | 13,707 | $ 65,350,000 | 54,027 |
| 2035 | $ 65,350,000 | $ 12,520,000 | $ 71,010,000 | 43,019 | $ - | $ - | $ 6,860,000 | 14,871 | $ 77,870,000 | 57,890 |
| **SCENARIO C - PROJECT IMPROVEMENTS – Existing/RMPU Basins plus External Supply for Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 3,740,000 | $ - | $ 23,740,000 | 21,427 | $ 9,960,000 | 52,184 |
| 2025 | $29,960,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ - | $ - | $ 23,740,000 | 19,797 | $ 35,080,000 | 56,304 |
| 2030 | $35,080,000 | $ 41,110,000 | $ 52,450,000 | 40,320 | $ 33,310,000 | $ 7,610,000 | $ 64,660,000 | 19,422 | $117,110,000 | 59,742 |
| 2035 | $117,110,000 | $ 3,460,000 | $ 55,910,000 | 43,019 | $ - | $ - | $ 64,660,000 | 19,906 | $120,570,000 | 62,925 |

Additionally, it should be noted that the basins assumed for Existing/RMPU scenarios will be able to recharge the total annual recycled water supply available. Therefore, the cost of recharge of annual acre-feet of recycled water is much less than the program required for implementing all of the GWR proposed basins.

However, other considerations should be given to utilizing only the Existing/RMPU basins:

- Using only the Existing/RMPU basins limits the basins to be down for maintenance, leaving no operational redundancy.
- If the direct use demands do not meet the projections shown, the additional recycled water supply available would be limited for recharge use.
- If the Agency decides to secure an additional external supply source in the future to meet the SARBF at Prado Obligation, there would need to be additional basins to receive the additional recharge capacity available.

Based on the overall goals of the RWPS to meet the projected direct use and then to maximize the remaining recycled water supply effluent for GWR to the basins, the Scenario B facilities of the Sensitivity Analysis are recommended. This program meets the goals of the RWPS with the most cost efficiency to the Agency.

## ES.6 – Summary of Project Recommendations for the RWPS

Based on the sensitivity analysis performed and comparison of project costs and flows for each analysis scenario, the proposed RWPS projects recommended are those identified in Scenario B.

Table ES.6 is provided to show the comprehensive list of projects and project costs identified for each planning year. Since the proposed improvements recommended are required to either meet direct use demands or groundwater recharge purposes, the table includes a description of the demand condition that triggers the need for the project as well as the type of deficiency that the project is intended to mitigate. Figure ES-2 shows the locations of the recommended improvements.

Project costs and total CIP costs are based on 2015 dollars and do not include cost escalations.

These recommendations and analyses herein should be reevaluated at least every five (5) years or as planning policies and demand projections change from those described herein.

## Table ES.6 Recommended RWPS Projects

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | Unit Cost | Total Const. Cost | Cont. / Admin./ Eng. | Total Estimated Project Cost | Cumulative CIP Costs | GWR Program Improvement | Direct Use Improvement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 LS | $ 500,000 | $ 500,000 | $ 225,000 | $ 730,000 | $ 730,000 | $ 730,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6,715 LF | $ 495 | $ 3,323,925 | $ 1,495,766 | $ 4,820,000 | $ 5,550,000 | $ 4,820,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 LS | $ 900,000 | $ 900,000 | $ 405,000 | $ 1,310,000 | $ 6,860,000 | $ 1,310,000 | $ - |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12,620 LF | $ 340 | $ 4,290,800 | $ 1,930,860 | $ 6,220,000 | $ 13,080,000 | $ - | $ 6,220,000 |
| | | | | | | **Year 2020 Improvement Costs** | | **$13,080,000** | **$ 13,080,000** | **$ 6,860,000** | **$ 6,220,000** |
| 2025 | Max Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 LS | $ - | $ - | $ - | $ - | $ 13,080,000 | $ - | $ - |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, to serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15,289 LF | $ 225 | $ 3,440,025 | $ 1,548,011 | $ 4,990,000 | $ 18,070,000 | $ - | $ 4,990,000 |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13,600 LF | $ 340 | $ 4,624,000 | $ 2,080,800 | $ 6,700,000 | $ 24,770,000 | $ - | $ 6,700,000 |
| 2025 | Max Summer Direct Use | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 54-inch 930 PZ Parallel Pipeline | 2,300 LF | $ 860 | $ 1,978,000 | $ 890,100 | $ 2,870,000 | $ 27,640,000 | $ - | $ 2,870,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-4 1158 PZ PS Capacity Upgrades | 1 LS | $ 950,000 | $ 950,000 | $ 427,500 | $ 1,380,000 | $ 29,020,000 | $ - | $ 1,380,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 PZ PSCapacity Upgrades | 1 LS | $ 800,000 | $ 800,000 | $ 360,000 | $ 1,160,000 | $ 30,180,000 | $ - | $ 1,160,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | CCWRF PS Capacity Upgrades | 1 LS | $ 600,000 | $ 600,000 | $ 270,000 | $ 870,000 | $ 31,050,000 | $ - | $ 870,000 |
| | | | | | | **Year 2025 Improvement Costs** | | **$ 17,970,000** | **$ 31,050,000** | **$ -** | **$ 17,970,000** |
| 2030 | Max Summer Direct Use | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Ave. | 1,680 LF | $ 590 | $ 991,200 | $ 446,040 | $ 1,440,000 | $ 32,490,000 | $ - | $ 1,440,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31,800 LF | $ 420 | $ 13,356,000 | $ 6,010,200 | $ 19,370,000 | $ 51,860,000 | $ - | $ 19,370,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 MG | $ 1.50 | $ 7,500,000 | $ 3,375,000 | $ 10,880,000 | $ 62,740,000 | $ - | $ 10,880,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 LS | $1,800,000 | $ 1,800,000 | $ 810,000 | $ 2,610,000 | $ 65,350,000 | $ - | $ 2,610,000 |
| | | | | | | **Year 2030 Improvement Costs** | | **$ 34,300,000** | **$ 65,350,000** | **$ -** | **$ 34,300,000** |
| 2035 | Max Summer Direct Use | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 MG | $ 1.75 | $ 5,250,000 | $ 2,362,500 | $ 7,610,000 | $ 72,960,000 | $ - | $ 7,610,000 |
| 2035 | Max Summer Direct Use | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 74,410,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2,000 LF | $ 340 | $ 680,000 | $ 306,000 | $ 990,000 | $ 75,400,000 | $ - | $ 990,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 76,850,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 LS | $ 700,000 | $ 700,000 | $ 315,000 | $ 1,020,000 | $ 77,870,000 | $ - | $ 1,020,000 |
| | | | | | | **Year 2035 Improvement Costs** | | **$ 12,520,000** | **$ 77,870,000** | **$ -** | **$ 12,520,000** |
| | | | | | | **Total Program Improvement Costs** | | **$ 77,870,000** | | **$ 6,860,000** | **$ 71,010,000** |

INCREASE TURNOUT CAPACITIES:
- Brooks Basin
- Turner Basin
- Ely Basin
- Hickory Basin
- Victoria Basin

New 1630 Zone 18 MG Tank

1299 Zone Pump Station Upgrades

1158 to 1299 Zone Pump Station 6,000 GPM Capacity

1158 Zone Tank (5.0 MG - for Direct Use)

30" 1158 Zone Pipeline

RP-1 EQ Storage Increase to 24 MG
24" 1050 PZ Parallel Pipeline
Pump Upgrades RP-1 930 Zone Effluent Pump Station
Pump Upgrades RP-1 1050 Zone Effluent Pump Station
Pump Upgrades RP-1 1158 Zone Effluent Pump Station

42" Parallel 930 Zone Pipeline

CCWRF 3.0 MG EQ Storage

CCWRF 930 Zone Pump Station Upgrades

All of PRADO Met by RP-5

= DIRECT USE IMPROVEMENTS
= GWR IMPROVEMENTS

**LEGEND:**

- Existing Basins
- RMPU Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

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# IEUA RWPS
## Recommended Recycled Water System Improvements

FIGURE ES-2

# 1.0 INTRODUCTION

The purpose of this document is to update the information contained in the 2005 Recycled Water Implementation Plan based on changes to IEUA's recycled water priorities. IEUA plans to switch from treating direct use recycled water demands as the only high priority to including recycled water groundwater recharge as a high priority as well.

The primary objective of this study is to help map the changes in the region's needs to maximize groundwater recharge as opposed to the previous principle, which treated direct use as the only high priority, with an interruptible groundwater recharge system. The goal of this document is to have a cohesive transfer of information for additional sources of recycled water to augment IEUA's recycled water system to maximize the beneficial reuse of the recycled water at all times, with an increased focus in groundwater recharge.

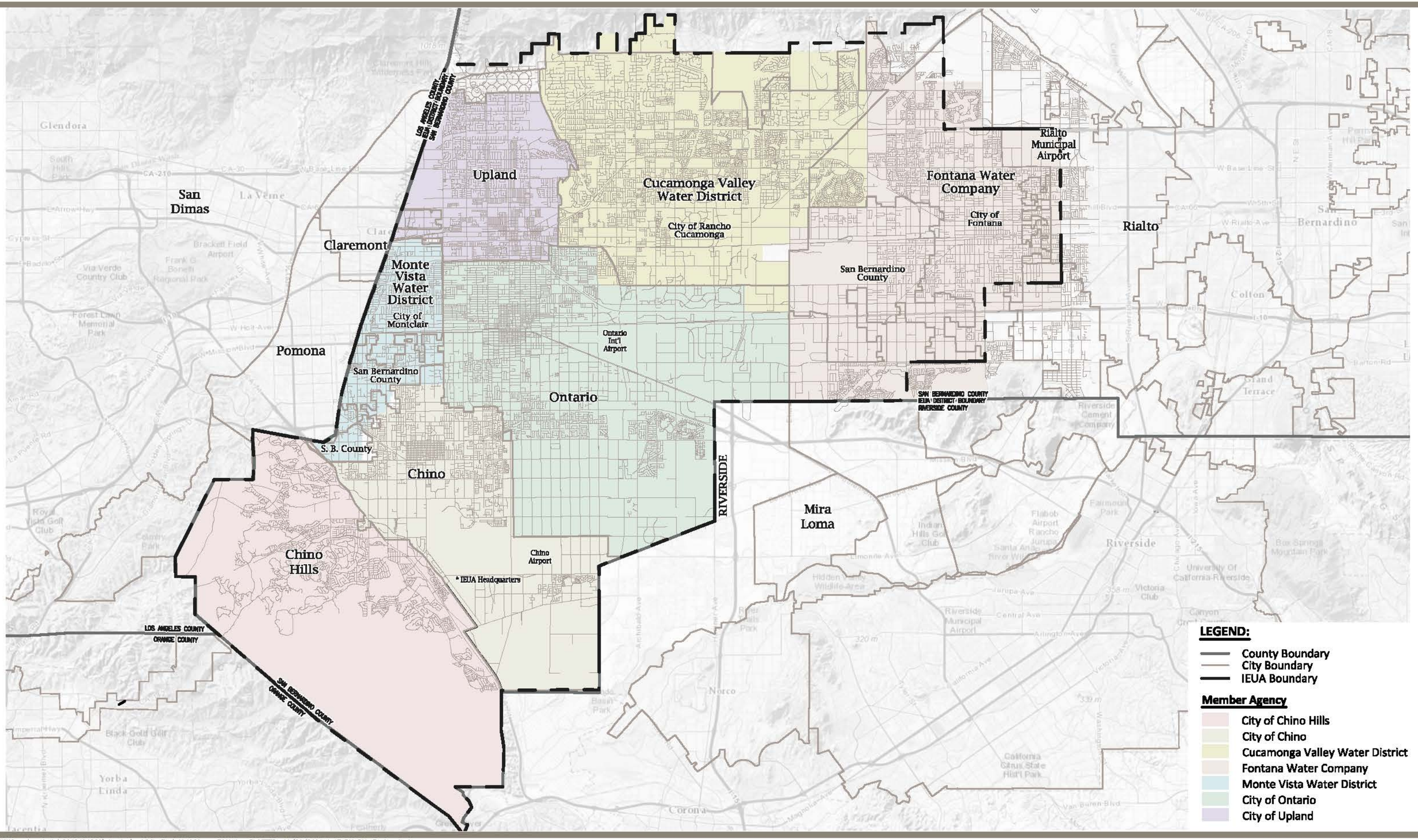
A new control strategy for the overall system will be developed in theory that can be utilized to develop the capital projects from this RWPS document. Since the priorities of the recycled water program have changed from the 2005 Recycled Water Implementation Plan, the current control strategy is updated to reflect the new direction to lead the region.

This RWPS is intended to analyze the recycled water demands over the next 20 years out to Year 2035, with implementation strategies for every 5 year incremental periods.

## 1.1 STUDY AREA

The IEUA service area encompasses approximately 242 square miles in the western end of the San Bernardino County. As shown in Figure 1-1, the service area is generally bordered by the San Gabriel Mountains to the north, Riverside County line to the southeast, County of Los Angeles to the northwest, County of Orange to the southwest, City of Chino Hills to the west, and Jurupa Mountains to the east.

IEUA owns and operates regional sewer pipelines that collect wastewater from all the cities within the IEUA service area. All the wastewater collected is treated at the four (4) IEUA owned and operated regional wastewater recycling plants. These four regional wastewater recycling plants provide recycled water supply to the IEUA owned and operated recycled water distribution system.




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GRAPHIC SCALE
0 6,000' 12,000' 24,000'
( IN FEET ) 1 inch = 12,000'

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# IEUA RWPS
## IEUA Service Area

FIGURE 1-1

### 1.1.1 Member Agencies

IEUA wholesales disinfected tertiary recycled water to its seven (7) member agencies. With the exception of Reliant Energy, located in the City of Rancho Cucamonga, the majority of the current recycled water users are located in IEUA's Southern Service Area. The following are the IEUA member agencies:

- City of Chino
- City of Chino Hills
- Cucamonga Valley Water District (CVWD)
- Fontana Water Company
- Monte Vista Water District (MVWD)
- City of Ontario
- City of Upland

### 1.1.2 Current Groundwater Recharge

IEUA, Chino Basin Watermaster (CBWM), Chino Basin Water Conservation District (CBWCD), and the San Bernadino County Flood Control District (SBCFCD) are partners in the implementation of the Chino Basin Recycled Water Groundwater Recharge Program. This recharge program is part of a comprehensive program to enhance water supply reliability and to improve groundwater quality in local drinking water wells throughout the portion of the Chino Groundwater Basin within IEUA's service area. The recharge program includes increasing recharge of storm water, imported water, and recycled water.

IEUA operates several groundwater recharge basin sites as part of the Chino Basin Recycled Water Groundwater Recharge Program. Table 1-1 lists these basins.

The total groundwater recharge was investigated for the previous twelve months from the time of this report preparation. Based on the IEUA GWR Quarterly Report for the First Quarter of 2014, between April 2013 and March 2104, approximately 16,373 AF of water was recharged in the Chino Basin, including 13,237 AF of recycled water, 2,780 AF of storm water and local runoff, and 356 AF of imported water. It should be noted that the recycled water recharge occurred during all twelve (12) months of the year.

**Table 1.1 IEUA Existing Groundwater Recharge Basins and Supply Source**

| Basin/Site | Supply Source | | |
|---|---|---|---|
| | SW/LR | IW | RW |
| 7th/8th Street | ✓ | ✓ | ✓ |
| Banana | ✓ | ✓ | ✓ |
| Brooks | ✓ | ✓ | ✓ |
| College Heights | ✓ | ✓ | |
| Declez | ✓ | ✓ | ✓ |
| Ely (1-3) | ✓ | ✓ | ✓ |
| Etiwanda Debris | ✓ | ✓ | |
| Grove | ✓ | | |
| Hickory | ✓ | ✓ | ✓ |
| Lower Day | ✓ | ✓ | |
| Montclair (1-4) | ✓ | ✓ | |
| RP-3 (1,3,4) | ✓ | ✓ | ✓ |
| RP-3 2 | ✓ | ✓ | |
| San Sevaine 5 | ✓ | ✓ | ✓ |
| San Sevaine (1-4) | ✓ | ✓ | |
| Turner (1-4) | ✓ | ✓ | ✓ |
| Upland | ✓ | ✓ | |
| Victoria | ✓ | ✓ | ✓ |

SW = Storm Water
LR = Local Runoff
IW = Imported MWD Water
RW = Recycled Water

# 2.0 RECYCLED WATER DEMANDS

This section provides the existing and projected recycled water direct use demands, as reported for each of the IEUA member agencies to IEUA staff. IEUA provided the direct use demands according to pressure zone as well as by member agency for each of the 5-year planning increments.

## 2.1 DIRECT USE DEMANDS BY MEMBER AGENCY

The direct use demands include uses for irrigation of golf courses, freeway and street landscaping, residential landscaping, parks, school yards, food crops, commercial car washes and laundries, industrial cooling towers, process water, and other miscellaneous construction and dust control uses.

Table 2.1 shows the existing and projected direct use demands used for this study. For purposes of this study period, the demands provided by IEUA for the Year 2015 are assumed to be the Existing Demand Conditions. The direct use demands are the projections provided to IEUA by each of the member agencies.

**Table 2.1 Existing and Projected Direct Use Demands by Member Agency**

| Member Agency | Demand Year (AFY) | | | | | |
|---|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 | Ultimate[1] |
| Chino | 8,915 | 9,935 | 8,523 | 6,844 | 6,257 | 6,210 |
| Chino Hills | 2,001 | 2,600 | 3,000 | 3,400 | 3,800 | 4,004 |
| CVWD | 1,651 | 1,540 | 1,770 | 2,000 | 2,000 | 2,000 |
| MVWD | 339 | 600 | 725 | 850 | 1,000 | 1,220 |
| Ontario | 8,427 | 10,323 | 15,705 | 18,440 | 21,176 | 26,645 |
| Upland | 868 | 800 | 800 | 800 | 800 | 800 |
| Fontana | 0 | 2,500 | 3,500 | 5,500 | 5,500 | 8,350 |
| *Other Usage*: | | | | | | |
| San Bernardino County | 1,611 | 1,611 | 1,611 | 1,611 | 1,611 | 1,611 |
| IEUA | 843 | 848 | 873 | 875 | 875 | 875 |
| **Total Direct Use Demand** | **24,655** | **30,757** | **36,507** | **40,320** | **43,019** | **51,715** |

[1] Ultimate demands are shown for reference only. This RWPS has a 20-year planning horizon to Year 2035. The direct use demands GWR implementation and system analyses herein include demand conditions out to Year 2035.
2 The direct use demand projections are the member agency projections that were provided to IEUA.

Table 2.2 shows the direct use demand projections by pressure zone.

**Table 2.2 Existing and Projected Direct Use Demands by Pressure Zone**

| Pressure Zone | Demand Year (AFY) | | | | | |
|---|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 | Ultimate[1] |
| 800 Zone | 8,884 | 9,696 | 7,728 | 6,207 | 5,374 | 4,667 |
| 930 Zone | 7,684 | 9,895 | 13,137 | 14,873 | 16,996 | 20,693 |
| 1050 Zone | 1,262 | 966 | 2,337 | 3,335 | 4,327 | 5,926 |
| 1158 Zone | 2,106 | 4,467 | 5,994 | 6,500 | 6,771 | 7,609 |
| 1299 Zone | 3,158 | 4,173 | 5,531 | 5,905 | 6,051 | 6,470 |
| 1630 Zone | 1,561 | 1,560 | 1,780 | 3,500 | 3,500 | 6,350 |
| **Total Direct Use Demand** | **24,655** | **30,757** | **36,507** | **40,320** | **43,019** | **51,715** |

[1] Ultimate demands are shown for reference only. This RWPS has a 20-year planning horizon to Year 2035. The GWR implementation and analyses herein include demand conditions out to Year 2035.
2 The direct use demand projections are the member agency projections that were provided to IEUA.

## 2.2 EXISTING GWR BASIN RECYCLED WATER RECHARGE DEMANDS

As described in Chapter 1, IEUA operates several groundwater recharge basins that are recharged with storm water/ local runoff, imported MWD water, and recycled water. Not all of the basins are permitted or have connections to receive recycled water supply. The existing basins that currently receive recycled water supply are listed in Table 2.3, which also includes previous year's annual recharge totals.

**Table 2.3 Existing GWR Basins Recycled Water Annual Demands**

| Basin/Site | Existing Annual Recharge[1] (AF) | Percent of Total Recycled Water Recharge |
|---|---|---|
| 7th/8th Street | 1,930 | 15% |
| Banana | 727 | 5% |
| Brooks | 1,697 | 13% |
| Ely (1-3) | 3,199 | 24% |
| Hickory | 1,221 | 9% |
| RP-3 | 2,022 | 15% |
| San Sevaine 5 | 328 | 2% |
| Turner (1-4) | 1,070 | 8% |
| Victoria | 1,043 | 8% |
| **Total** | **13,237** | **100%** |

[1] Based on the IEUA Chino Basin Recycled Water Groundwater Recharge Program Quarterly Monitoring Report for January through March 2014, Table 3-1. Existing Annual Recharge reported is for the previous 12 months of this report, April 2013 through March 2014.

It should be noted that recharge with recycled water to the existing groundwater basins shown in Table 2.3 was provided to each of the basins for all 12 months of the reporting period, including December, January, and February. The strategy proposed for this study for future planning conditions assumes these months are wet weather months and no recycled water is used for recharge to allow the basins to fully capture the storm water and local runoff.

# 3.0 RECYCLED WATER SYSTEM AND SUPPLY

This section provides a description of the recycled water supply and existing distribution system owned and operated by IEUA. The existing recycled water system includes the distribution facilities (i.e., pipelines, reservoirs, booster pump stations, and pressure regulating valves) that deliver to the recycled water users.

## 3.1 RECYCLED WATER SUPPLY

IEUA's supply to meet the direct use and GWR basin demands is the tertiary treated effluent from their four (4) regional wastewater recycling plants. IEUA is currently preparing a Wastewater Facilities Master Plan (WFMP) that will address facility improvements and supply projections related to the wastewater collection and treatment supply system. Descriptions of facilities herein are based on the current published information, and do not necessarily reflect the latest facility updates and planning from the WFMP. Estimated supply projections were obtained using information provided in the WFMP.

### 3.1.1 Recycled Water Supply Projections

Coordination was provided with the WFMP to obtain the latest wastewater flow projections to each of the regional wastewater recycling plants. This information is provided in Table 3.1 as the recycled water supply projections available to the recycled water system.

**Table 3.1 Recycled Water Supply Projections**

| Facility | Existing | Year 2020 | Year 2025[1] | Year 2030 | Year 2035[1] | Ultimate |
|---|---|---|---|---|---|---|
| | MGD | | | | | |
| RP-5 | 6.5 | 10.2 | 13.1 | 15.9 | 18.4 | 25.3 |
| CCWRF | 6.9 | 6.9 | 7.0 | 7.1 | 7.3 | 7.9 |
| RP-1 | 30.4 | 30.4 | 31.3 | 32.2 | 33.1 | 36.3 |
| RP-4 | 11.5 | 11.7 | 12.9 | 14.0 | 14.7 | 18.4 |
| **Total Recycled Water Supply, MGD** | **55.3** | **59.2** | **64.2** | **69.2** | **73.5** | **87.9** |
| Total Recycled Water Supply, AFY | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 | 98,460 |

[1] The Recycled Water Supply projections for the years 2025 and 2035 are estimated based on a linear interpolation from the Year 2020, Year 2030, and Year 2040 projections provided by the WFMP.

## 3.2 REGIONAL RECYCLING PLANTS AND EFFLUENT PUMP STATIONS

A brief description of the existing regional recycling plants and recycled water supply facilities is provided in the following sections. The regional water recycling plants are graphically shown on Figure 3-1.

### 3.2.1 RP-1

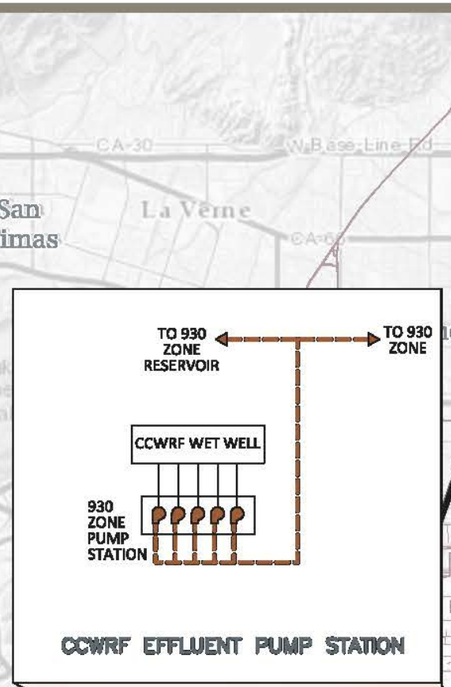
Regional Water Recycling Plant No. 1 (RP-1) is located in the City of Ontario near the intersection of State Highway 60 and Archibald Avenue. This facility was originally commissioned in1948 and has undergone several expansions to increase the design wastewater treatment capacity to the current 44.0 million gallons per day (MGD) and biosolids treatment capacity equivalent to a wastewater flow rate of 60.0 MGD. This facility serves the Cities of Ontario, Rancho Cucamonga, Upland, Montclair, Fontana, and an unincorporated area of San Bernardino County.

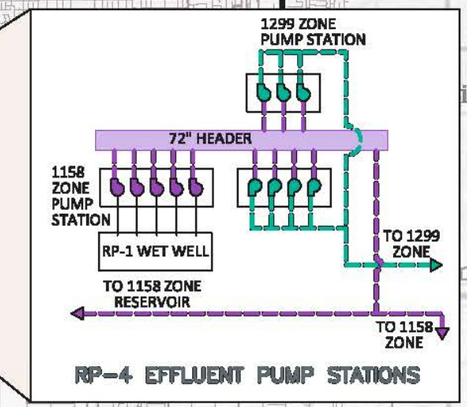
RP-1 includes several treatment processes that contribute to providing a quality recycle water pursuant to the State of California Title 22 regulations. The major treatment processes include preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, tertiary treatment, and biosolids treatment. Nitrified and de-nitrified secondary effluent flows by gravity to tertiary treatment containing a network of filters designed to remove in excess of 99% of the remaining total solids.

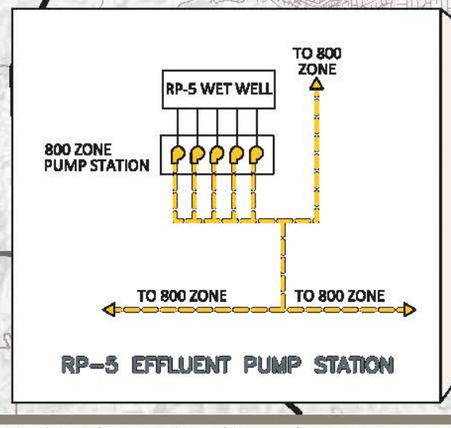
Before the filtered reclaimed wastewater (tertiary effluent and therefore, recycled water) can be used for irrigation and groundwater recharge purposes and/or be discharged to any other body of surface water, it must be disinfected to comply with the State of California Title 22 bacteriological water quality regulations.

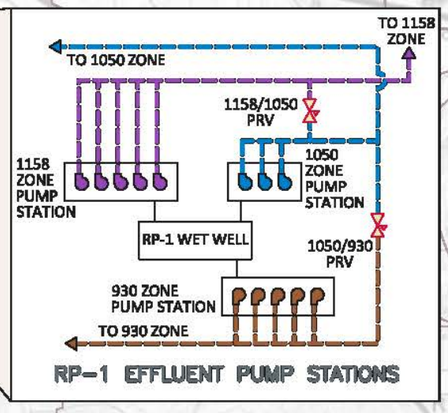
Upon being disinfected, the recycled water flows by gravity from the chlorine contact tanks to the recycled water pumping stations at RP-1. From these pumping facilities, the water is pumped into the recycled water distribution system.

There are three (3) sets of recycled water effluent pump stations that pump from RP-1 and supply three different pressure zones; the 930, 1050, and 1158 Pressure Zones.






**LEGEND:**

- Existing Basin
- 800 PZ (Existing)
- 930 PZ (Existing)
- 1050 PZ (Existing)
- 1158 PZ (Existing)
- 1299 PZ (Existing)
- 1630 PZ (Existing)
- Storage Tank
- Pump Station
- PZ — Pressure Zone
- 18 — Pipe Diameter (Inches)
- PRV
- Regional Recycling Plant

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GRAPHIC SCALE
0 4250' 8500' 17000'
( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Regional Recycling Plants and Effluent Pump Stations
## FIGURE 3-1

#### 3.2.1.1 RP-1 930 Zone Effluent Pump Station

The existing RP-1 930 Zone Effluent Pump Station includes 3 small identically sized pumps and 2 large identically sized pumps. Each pump is equipped with VFD driven motors. The pumps are staged on and off to maintain an operator adjustable set point pressure in the 930 Zone.

Supply from RP-1 into the 930 Zone has two control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the 930 Zone Effluent Pump Station pumps are first in the control sequence and the 1050/930 PRV is last. During wet weather low demand periods, the 1050/930 PRV is first in the control sequence, and the 930 Zone pumps are turned on when the 1050/930 PRV cannot maintain pressure.

#### 3.2.1.2 RP-1 1050 Zone Effluent Pump Station

The existing RP-1 1050 Zone Effluent Pump Station includes 3 identically sized pumps. Each pump is equipped with VFD driven 350 Hp motors. The pumps are staged on and off to maintain an operator adjustable set point pressure in the 1050 Zone.

Supply from RP-1 into the 1050 Zone has two control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the 1050 Zone Effluent Pump Station pumps are first in the control sequence and the 1158/1050 PRV is last. During wet weather low demand periods, the 1158/1050 PRV is first in the control sequence, and the 1050 Zone pumps are turned on when the 1158/1050 PRV cannot maintain pressure.

#### 3.2.1.3 RP-1 1158 Zone Effluent Pump Station

The existing RP-1 1158 Zone Effluent Pump station includes 4 identical pumps. Each pump is equipped with VFD driven 400 Hp motors. The pumps are controlled by the 1158 Zone Reservoir water level.

The 1158 Zone Effluent Pump Station is the third supply priority to the 1158 Zone after the RP-4 1158 Zone Pump Station and 1158 Zone Reservoir.

Table 3.2 shows the pump characteristics for the three RP-1 Effluent Pump Stations.

**Table 3.2 Existing RP-1 Effluent Supply Pump Stations**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-1 930 Zone Effluent Pump Station | 930 | 3 Pumps @ 2,790 gpm<br>2 Pumps @ 9,330 gpm<br>Total Capacity = 27,030 gpm | Pressure in 930 Zone (VFD pumps) |
| RP-1 1050 Zone Effluent Pump Station | 1050 | 3 Pumps @ 3,750 gpm<br>Total Capacity = 11,250 gpm | Pressure in 1050 Zone (VFD pumps) |
| RP-1 1158 Zone Effluent Pump Station | 1158 | 4 Pumps @ 2,780 gpm<br>Total Capacity = 11,120 gpm | 1158 Zone Reservoir Level |

### 3.2.2 RP-4

Located in the City of Rancho Cucamonga, the Regional Water Recycling Plant No. 4 (RP-4) has been in operation and producing recycled water since 1997. RP-4 treats an average flow of 10 MGD and is operated in conjunction with RP-1 to provide recycled water to non-potable water users. The RP-4 facility has been recently expanded to a capacity of 14 MGD.

RP-4 includes several treatment processes that contribute to providing quality recycled water pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the recycled water flows by gravity from the chlorine contact tanks into a common channel and wet well, where it can be discharged to the plant storage pond or pumped to provide utility water for within the facility and for beneficial reuse into the recycled water distribution system.

When the demand for utility water or recycled water is less than the amount of water being produced, the excess recycled water is discharged to the storage pond and the filter backwash water is sent to RP-1.

#### 3.2.2.1 RP-4 1158 Zone Effluent Pump Station

The existing RP-4 1158 Zone Effluent Pump station includes 2 large pumps and 3 small pumps. Each pump is equipped with VFD driven motors. The pumps are controlled by maintaining the RP-4 wet level at 13-ft.

The 1158 Zone Effluent Pump Station is the first supply priority to the 1158 Zone.

Table 3.3 shows the pump characteristics for the RP-4 1158 Zone Effluent Pump Station.

**Table 3.3 Existing RP-4 Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-4 1158 Zone Effluent Pump Station | 1158 | 2 Pumps @ 7,200 gpm<br>3 Pumps @ 2,700 gpm<br>Total Capacity = 22,500 gpm | RP-4 Wet Well (13-ft) |

### 3.2.3 RP-5

Regional Water Recycling Plant No. 5 (RP-5), located immediately east of the IEUA Administrative Headquarters in the City of Chino, began operation in March 2004. The first phase of RP-5 is designed to treat 15 million gallons of wastewater per day. Ultimately, RP-5 will treat 60 million gallons of wastewater per day and process 68 MGD of solids combined from RP-5 and IEUA's Carbon Canyon Waste Recycling Facility (CCWRF).

RP-5 includes several treatment processes that contribute to providing quality recycled water pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the recycled water flows by gravity from the chlorine contact tanks into a common channel, where it can be discharged to a creek by gravity and also pumped to the 800 Pressure Zone recycled water distribution system.

#### 3.2.3.1 RP-5 800 Zone Effluent Pump Station

The existing RP-5 800 Zone Effluent Pump station includes 5 pumps of equal size. Two of the pumps are equipped with VFDs and all five pumps have 150 Hp motors. The pumps are controlled by maintaining the RP-4 wet level at 13 feet.

Supply from RP-5 into the 800 Zone has two control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods the 800 Zone Effluent Pump Station pumps are first in the control sequence and the 930/800 PRV is last. During wet weather low demand periods, the 930/800 PRV is first in the control sequence, and the 800 Zone pumps are turned on when the 930/800 PRV cannot maintain pressure. The 800 Zone Effluent Pump Station will turn on when the pressure falls below 100 psi.

Table 3.4 shows the pump characteristics for the RP-5 800 Zone Effluent Pump Station.

**Table 3.4 Existing RP-5 Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| RP-5 800 Zone Effluent Pump Station | 800 | 5 Pumps @ 1,925 gpm<br>Total Capacity = 9,625 gpm | Operator defined Wet Well level, and system pressure |

### 3.2.4 CCWRF

CCWRF is located in the City of Chino, and has been in operation since May 1992. This facility serves the Cities of Chino, Chino Hills, Montclair, and Upland. Liquids are treated at CCWRF, while the solids removed from the waste flow are treated at RP-2. CCWRF treats an annual average flow of 9.5 MGD.

CCWRF includes several treatment processes that contribute to providing quality recycle water pursuant to the State of California Title 22 regulations. The major treatment processes include raw wastewater pumping, preliminary and primary treatment, primary effluent flow equalization and diversion, secondary treatment, and tertiary treatment.

Upon being disinfected, the recycled water flows by gravity from the chlorine contact tanks to the recycled water pumping station at CCWRF. From those pumping facilities, the water is pumped into the recycled water distribution system 930 Pressure Zone.

#### 3.2.4.1 CCWRF 930 Zone Effluent Pump Station

The existing CCWRF 930 Zone Effluent Pump station includes 5 pumps of equal size. Two of the pumps are equipped with VFD's motors and all five pumps have 150 Hp motors. The pumps are controlled by maintaining the RP-4 wet level at 13 feet.

Supply from CCWRF into the 930 Zone has two control strategies for dry weather peak demand periods and wet weather peak demand periods. During dry weather peak demand periods, the CCWRF 930 Zone Effluent Pump Station pumps are first in the control sequence, the RP-1 930 Zone Pump Station is second, and the 1050/930 PRV is last. During wet weather low demand periods, the priority sequence is reversed: the 1050/930 PRV is first in the control sequence, the RP-1 930 Zone Pump Station is second, and the CCWRF 930 Zone pumps are last priority.

Table 3.5 shows the pump characteristics for the CCWRF 930 Zone Effluent Pump Station.

**Table 3.5 Existing CCWRF Effluent Supply Pump Station**

| Effluent Supply Pump Station | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|
| CCWRF 930 Zone Effluent Pump Station | 930 | 5 Pumps @ 2,585 gpm<br>Total Capacity = 12,925 gpm | Operator defined Wet Well level, and 930 Zone Reservoir level |

## 3.3 EXISTING DISTRIBUTION SYSTEM FACILITIES

The treated effluent from the four (4) regional wastewater recycling effluent pump stations is delivered to the recycled water member agencies and customers via 5 pressures zones, several hundred miles of pipelines, three booster pump stations, three storage reservoirs, and pressure regulating stations. These facilities are shown in Figure 3-2.

### 3.3.1 Pressure Zones

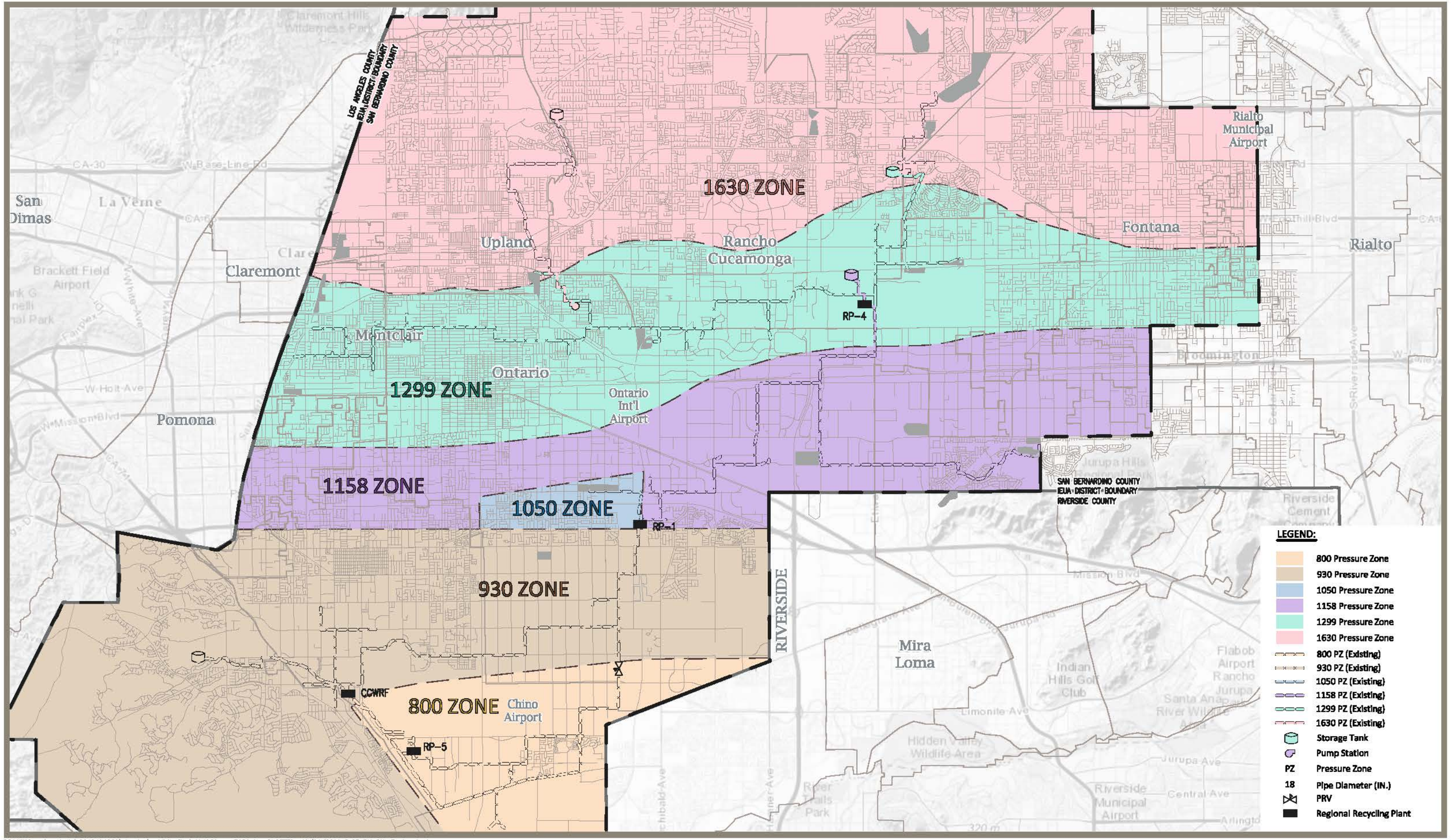
Six (6) pressure zones are utilized to deliver recycled water to the IEUA customers with the appropriate service pressures. These pressure zones are listed in Table 3.6 and illustrated in Figure 3-2. The pressure zones are established based on the following set of criteria:

- Minimum regional service pressure = 50 psi
- Maximum regional system pressure = 150 psi
- Minimum Basin service pressure = 25 psi

The regional system pressures listed above are used to establish pressure zones for appropriate service pressures to IEUA customers and member agencies. Localized pressures near reservoirs, regulating valves, and pump stations may vary from those listed.

**Table 3.6 Pressure Zone Characteristics**

| Pressure Zone/HGL | Minimum Elevation | Maximum Elevation | RP Supply |
|---|---|---|---|
| 800 | 510-ft | 660-ft | RP-5, RP-1 |
| 930 | 600-ft | 778-ft | CCWRF, RP-1 |
| 1050 | 746-ft | 843-ft | RP-1 |
| 1158 | 813-ft | 1,042-ft | RP-1, RP-4 |
| 1299 | 971-ft | 1,183-ft | RP-4 |
| 1630 (East & West) | 1,283-ft | 1,465-ft | RP-4 |




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( IN FEET ) 1 inch = 8500 FT

# IEUA RWPS
## Existing Recycled Water Pressure Zones

FIGURE 3-2

### 3.3.2 Storage Tanks

There are four (4) existing storage tank sites to provide operational storage for the recycled water system. These tanks and their characteristics are provided in Table 3.7.

**Table 3.7 Existing Storage Tanks**

| Storage Tank/ Pressure Zone | HWL | Capacity |
|---|---|---|
| 930 Reservoir | 930-ft | 5.0 MG |
| 1158 Reservoir | 1158-ft | 2 tanks – 4.0 MG each (8.0 MG Total) |
| 1299 Reservoir | 1299-ft | 3.5 MG |
| 1630 West Reservoir | 1630-ft | 3.0 MG |

### 3.3.3 Booster Pump Stations

In addition to the effluent pump stations supplying the distribution from the regional wastewater recycling plants, there are three (3) other booster pump stations to boost water from one pressure zone up to a higher pressure zone. These booster pump stations are described in Table 3.8.

**Table 3.8 Existing Booster Pump Stations**

| Booster Pump Station | From Pressure Zone | To Pressure Zone | No. of Pumps/Capacity | Control |
|---|---|---|---|---|
| 1299 Pump Station | 1158 | 1299 | 7 Pumps @ 4,600 gpm | 1299 Reservoir Level |
| 1630 East Pump Station | 1299 | 1630E | 2 Pumps @ 3,000 gpm<br>1 Pumps @ 1,500 gpm<br>2 Pumps @ 750 gpm | Pressure (VFDs) - 150 psi set point |
| 1630 West Pump Station | 1299 | 1630W | 3 Pumps @ 2,000 gpm | 1630 W Reservoir Level |

### 3.3.4 Pressure Reducing Stations

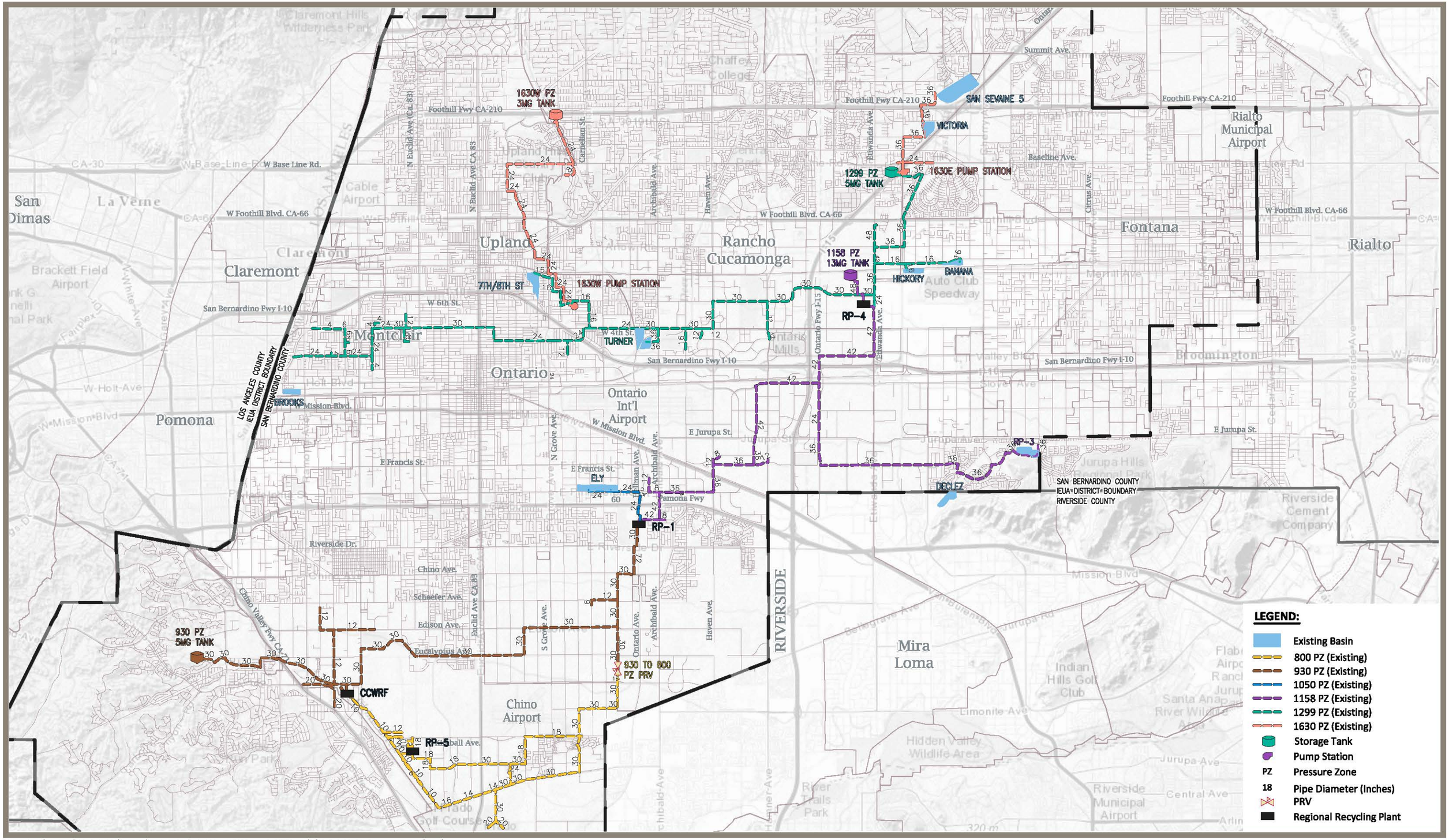
There are three (3) pressure reducing stations that allow flow from a higher pressure zone down to a lower pressure zone. These pressure reducing stations are designed to open and supplement the lower zone with recycled water when the system pressure drops below a set point in the lower zone. Table 3.5 is provided to show the characteristics for each station.

**Table 3.5 Existing Pressure Reducing Stations**

| Pressure Reducing Station | Location | Description | Downstream Pressure Setting[1] |
|---|---|---|---|
| 1630 West PRV to 1299 Zone | 1630 West Pump Station | Functions as Pressure Reducing, Manual Operation, Currently Normally Closed | n/a |
| 1158 PRV to 1050 Zone | RP-1 Effluent Pump Station | Functions as Pressure Sustaining and Reducing | 115-118 psi |
| 1050 PRV to 930 Zone[2] | RP-1 Effluent Pump Station | Functions as Pressure Sustaining and Reducing | 55-65 psi |
| 930 PRV to 800 Zone | Carpenter & Eucalyptus Ave | Pressure Reducing Only – No Electronic Controls | 55 psi |

[1] Pressure settings are subject to change periodically depending on demand conditions or system operation requirements, and actual settings in the field may be different from reported herein.

[2] As described in Section 3.2.1 for the RP-1 930 Zone Effluent Pump Station, the 1050/930 PRV is last in the control sequence during dry weather peak demand periods, but is first in the control sequence during wet weather low demand periods. The 1050/930 PRV is modulated by the operator.




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# IEUA RWPS
## Existing Recycled Water System Conveyance Facilities

FIGURE 3-3

# 4.0 IMPLEMENTATION OF PROPOSED GWR BASINS

This section describes the proposed recycled water implementation strategy associated with the IEUA goal to increase GWR to a high priority use of recycled water along with direct use. The strategy proposed has a 20-year planning horizon, which is analyzed and planned in 5-year increments to Year 2035. The strategy described in this section includes identifying the proposed basins to be connected to the recycled water system, when they will be connected, and a mass balance of demands and basin flows versus the recycled water supply projections.

## 4.1 PROPOSED GWR BASINS

Section 2.2 in this report identified the existing groundwater basins that are currently connected to the recycled water system and receive recycled water for recharge. IEUA operates several other basins that are currently configured only to recharge storm water, local runoff, and/or imported MWD water. The new recycled water program assumes that each of these basins will be connected to the recycled water system and receive recycled water recharge. In Table 4.1, each basin is given a label based on its status. A label of "RW Connection" status implies that the basin is a currently operating basin as part of the groundwater recharge program for storm water/local runoff and imported water, and will require modifications and facilities to connect to the recycled water system to receive recycled water for recharge.

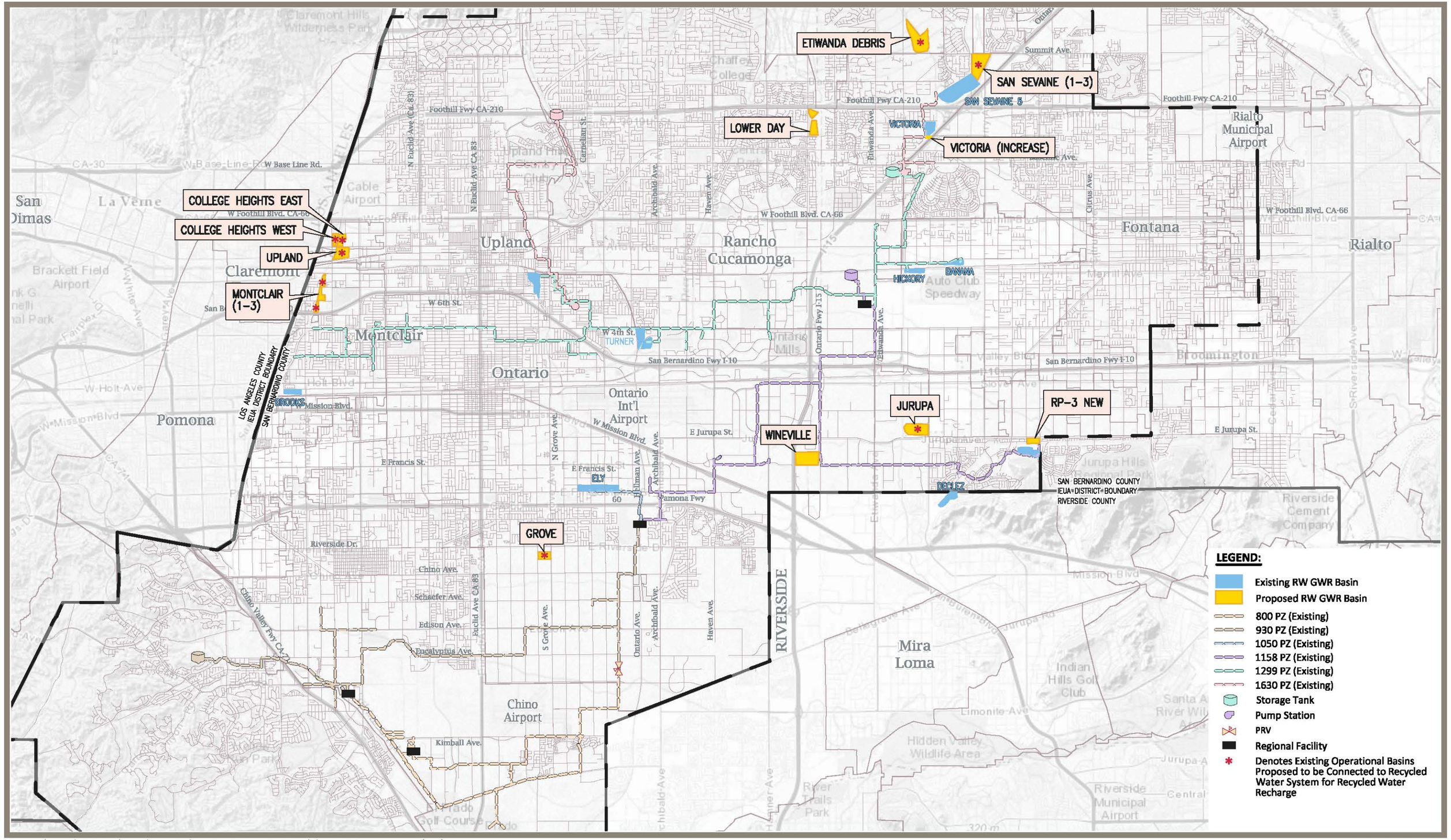
In addition to the existing basins that will be connected to the recycled water system, several sites or basins have been identified by IEUA as new basins that will come online in the future. These basins are at various stages of planning and permitting. Some of these new basins are at existing basin sites where basin capacities will be expanded by adding new cells.

Table 4.1 provides a list of the basins that are proposed to be added to the recycled water groundwater recharge program, along with anticipated size and recharge capacity. Figure 4-1 is a map of the location of each of these basins.

**Table 4.1 Proposed GWR Basins to Receive Recycled Water**

| Basin/Site | Basin Status[1] | Size (acres) | Storage Volume (AF) |
|---|---|---|---|
| Lower Day | RW Connection | 15.0 | 179 |
| Etiwanda Debris | RW Connection | 14.6 | 73 |
| San Sevaine (1-3) | RW Connection | 21.4 | 99 |
| Victoria (Increase) | RW Connection | 17.4 | 237 |
| Lower San Sevaine | New | 23.0 | 230 |
| Wineville | New | 30.0 | 240 |
| RP-3 (New Cell) | New | 3.5 | 35 |
| Vulcan | New | 30.0 | 450 |
| College Heights East | RW Connection | 6.2 | 112 |
| College Heights West | RW Connection | 5.8 | 110 |
| Grove | RW Connection | 10.0 | 114 |
| Jurupa | RW Connection | 17.0 | 249 |
| Montclair (1-3) | RW Connection | 22.5 | 518 |
| Montclair 4 | RW Connection | 5.8 | 139 |
| Upland | RW Connection | 16.6 | 392 |
| | **Total** | **238.8** | **3,177** |

[1] "RW Connection" implies that the basin is a currently operating basin as part of the groundwater recharge program for storm water/local runoff and imported water, and will require modifications and facilities to connect to the recycled water system to receive recycled water recharge. "New" is a new basin that is currently not in the groundwater recharge program.




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# IEUA RWPS
## Existing and Proposed Recycled Water GWR Basins

FIGURE 4-1

## 4.2 PROPOSED BASIN IMPLEMENTATION

The strategy for implementing the proposed basins listed in Table 4.1 is based on the basins coming online in the next 20 years, with a small group of basins coming online every 5 years. The general overall goal of the strategy is to implement basins in the early phases that will maximize infiltration and minimize facility improvements and costs at the same time.

Identifying the basins proposed to come online in each 5-year increment was performed by ranking the basins against a few simple criteria. The following sub-sections briefly describe the criteria and implementation strategy.

The implementation criteria described below are grouped into two major categories as they will either have impacts related to infrastructure costs and system operation efficiency primarily, or impacts related to scheduling and miscellaneous items.

### 4.2.1 Implementation Criteria

The criteria used to determine which basins will come online in each 5-year period during the next 20 years were based on the criteria described below.

Costs Related Criteria

- *Pressure Zone Demand Distribution* – consideration is given to how the basins will be implemented over the next 20 years based on the geographic location within each pressure zone, and how many basins are supplied by the same pressure zone. This criterion groups the basins for each 5-year increment to evenly spread out the basin demands within each pressure zone and spread the demands over multiple basins, if possible, in order to limit the amount of new infrastructure required during the same planning year. Based on the hydraulic evaluations, the pressure zones in the eastern portion of the system have more current available capacity than do those in the western portion of the system. Basins are ranked on a scale of 1 to 10 points, where points are assigned to the pressure zone service area where each basin is located, with 10 points given to the zone service area with the most available capacity. The criteria points assigned are as follows:

| Pressure Zone Service Area | Criteria Points |
|---|---|
| 1050 | 1 pt |
| 1158 | 5 pts |
| 1299 West Area | 1 pt |
| 1299 East Area | 5 pts |
| 1630 West | 1 pt |
| 1630 East | 10 pts |

- *Average Infiltration Rate* – the average infiltration rate for each basin was provided by IEUA and was utilized in determining the total infiltration rate for the pressure zones. The fifteen basins proposed are ranked from 1 to 15 points depending on the individual basin's infiltration rate, in acre-feet per month (AFM). The larger the infiltration rate, the higher the ranking points assigned. See the table below for infiltration rates and points assigned for each basin.

| GWR Basin | Average Infiltration Rate (AFM) | Criteria Points |
|---|---|---|
| Grove | 75 | 1 |
| Lower San Sevaine | 90 | 2 |
| Montclair 4 | 95 | 3 |
| Wineville | 117 | 4 |
| College Heights West | 155 | 5 |
| Vulcan Pit | 171 | 6 |
| Victoria (increase) | 212 | 7 |
| Jurupa | 233 | 8 |
| Etiwanda Debris | 263 | 9 |
| College Heights East | 302 | 10 |
| Lower Day | 340 | 11 |
| Upland | 370 | 12 |
| Montclair (1-3) | 1,107 | 13 |
| RP-3 (New Cell) | 1,366 | 14 |
| San Sevaine (1-3) | 1,508 | 15 |

- *Average 14-Day Fill Rate* – the 14-day fill rate as described in Section 4.3.2 is the basin storage volume divided by 14 days, based on the operation cycled assumed for this study. All of the basin fill rates are listed in Table 4.4. The fifteen (15) basins are ranked by points, 1 to 15 points, with the basin having the highest required fill rate ranked with the lowest points. This implies that a basin requiring a higher flow rate will have the most impact to the existing system and will require system upgrades and improvement costs accordingly.

| GWR Basin | 14-Day Fill Rate (MGD) | Criteria Points |
|---|---|---|
| Jurupa | 8.9 | 1 |
| Upland | 6.8 | 2 |
| Victoria (increase) | 5.5 | 3 |
| Lower San Sevaine | 5.4 | 4 |
| Grove | 5.3 | 5 |
| Lower Day | 5 | 6 |
| Montclair (1-3) | 4 | 7 |
| Montclair 4 | 3.3 | 8 |
| San Sevaine (1-3) | 3.1 | 9 |
| Wineville | 2.8 | 10 |
| College Heights East | 2.6 | 11 |
| College Heights West | 2.5 | 12 |
| Vulcan Pit | 2.1 | 13 |
| Etiwanda Debris | 1.7 | 14 |
| RP-3 (New Cell) | 0.8 | 15 |

- *Vicinity to Existing RW System* – this criterion ranks the basins based on their location relative to the existing recycled water system facilities. For example, a basin that is immediately adjacent to an existing transmission main would be of a higher priority to come online sooner than a basin that is further away, as it would require additional pipelines to receive recycled water. For ranking purposes, the following ranking scale of points are assigned to each basin:

| Vicinity to Existing RW System | Criteria Points |
|---|---|
| Greater than 1 ½ Miles from RW System | 1 pt |
| Within 1 ½ Miles from RW System | 5 pts |
| Immediately Adjacent to RW System | 10 pts |

Schedule Related Criteria

- *Basin Status* – as shown in Table 1.1, some basins are existing basins but are equipped or permitted to only recharge with storm water, local runoff, and/or imported MWD water. These basins are identified as "RW Connection" since they will only require the modifications and facilities necessary for them to be connected to the recycled water

system. The remaining proposed basins that are not identified as "RW Connection" are identified as "New."

| Basin Status | Criteria Points |
|---|---|
| RW Connection | 1 pt |
| New | 10 pts |

- *Permitted* – basins are ranked by points based on whether or not they are already permitted. Some existing basins may not be permitted for recycled water recharge. If the basin is already permitted, then it may be easier to recharge the basin with recycled water, and therefore, the basin would be ranked as a higher priority to implement.

| Permit Status | Criteria Points |
|---|---|
| No | 1 pt |
| Yes | 10 pts |

- *Property Ownership* – consideration is given to the property ownership for each basin. The different property owners may have different requirements in place for allowing IEUA to recharge the basin with recycled water. Ownerships where IEUA does not have a basin currently for example will receive fewer ranking points. The table below shows the points assigned for each property owner.

| Permit Status | Criteria Points |
|---|---|
| IEUA | 10 pts |
| SBCFCD | 8 pts |
| CBWCD | 6 pts |
| Upland | 4 pts |
| Calmat | 2 pts |

- *Planned Basin in RMPU* – some of the basins have already been planned in IEUA's RMPU. If a basin has already been planned in the RMPU, it will receive a higher priority ranking than those that have not yet been planned.

| Planned in RMPU | Criteria Points |
|---|---|
| No | 1 pt |
| Yes | 10 pts |

- *Production Wells* – some of basins include production wells for recovery of groundwater. The implementation strategy considers which basins have production wells to spread them out over the planning horizon to avoid added infrastructure costs, and even distribution of wells coming online. Basins are ranked with points according to the table below.

| Production Wells | Criteria Points |
|---|---|
| Not Existing | 1 pt |
| Existing | 10 pts |

### 4.2.2 Proposed Basin Implementation Strategy

For Years 2020, 2025, 2030, 2035, and Ultimate analysis scenarios, it was assumed that three (3) future or planned basins would come online in each 5-year planning increment. This provided for an even and balanced distribution of recycled water recharge demand and infrastructure costs while maintaining the goal to maximize the infiltration rate in the early phases with minimum cost allocations.

The priorities of the basins coming online are assigned according to the criteria described in Section 4.2.1.

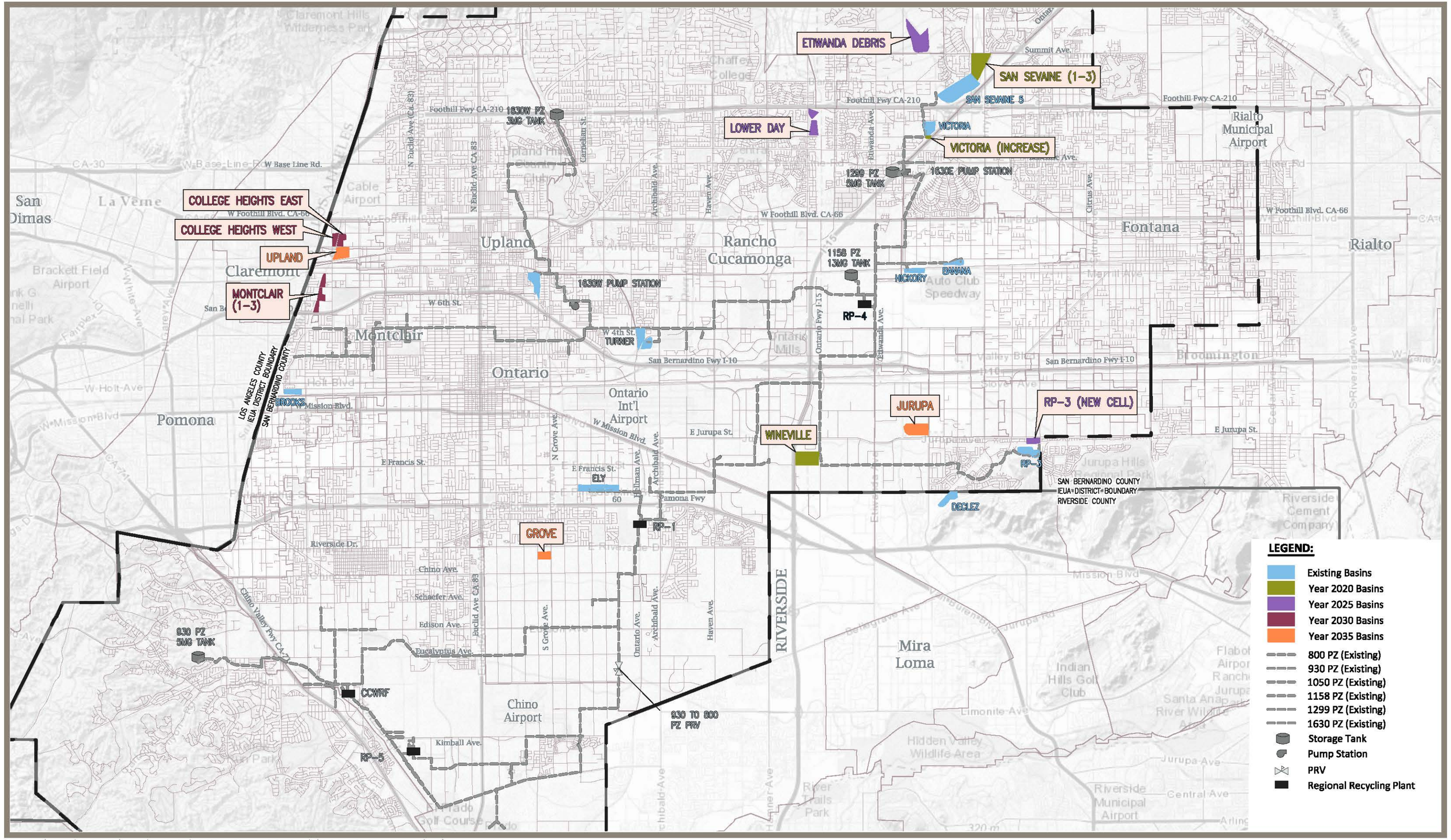
It should be noted though that the priority order in which the basins were grouped together for implementation considered the required total demand of all three basins for each planning year. The basins' implementation (or total flow requirements) was generally spread evenly throughout the planning horizon.

The GWR Basin implementation strategy is shown in Table 4.2. The ranking assumes that the basin with the highest total points is ranked as the highest priority. The basins shown for Year 2020 and 2025 are located in pressure zones near existing infrastructure that has sufficient existing capacity to supply the additional demand without requiring significant improvement costs. The majority of them are already permitted.

The GWR Basin implementation strategy is graphically illustrated in Figure 4-2.

**Table 4.2 Proposed GWR Basin Implementation Priority Ranking**

| Planning Year | Basin | Costs Related Criteria | | | | Schedule Related Criteria | | | | | Total Points | Total Priority Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pressure Zone | Ave. Infilt. Rate | 14-Day Fill Rate | Vicinity to Existing RW System | Basin Status | Permit Status | Property Owner | Planned Basin in RMPU | Prod. Well | | |
| Year 2020 | Wineville | 10 | 4 | 10 | 10 | 1 | 10 | 10 | 10 | 10 | **80** | **1** |
| | Victoria (increase) | 10 | 7 | 3 | 10 | 10 | 10 | 8 | 10 | 10 | **78** | **2** |
| | San Sevaine (1-3) | 10 | 15 | 9 | 10 | 10 | 10 | 8 | 10 | 1 | **83** | **3** |
| Year 2025 | RP-3 (New Cell) | 1 | 14 | 15 | 5 | 1 | 10 | 10 | 10 | 10 | **76** | **4** |
| | Lower Day | 10 | 2 | 4 | 10 | 1 | 10 | 8 | 10 | 10 | **65** | **5** |
| | Etiwanda Debris | 10 | 9 | 14 | 5 | 10 | 1 | 8 | 1 | 1 | **59** | **6** |
| Year 2030 | Montclair (1-3) | 5 | 13 | 7 | 5 | 10 | 1 | 6 | 1 | 1 | **49** | **7** |
| | College Heights East | 1 | 10 | 11 | 1 | 10 | 10 | 6 | 1 | 10 | **60** | **8** |
| | College Heights West | 1 | 5 | 12 | 1 | 10 | 10 | 6 | 1 | 10 | **56** | **9** |
| Year 2035 | Upland | 10 | 11 | 6 | 1 | 10 | 1 | 8 | 1 | 1 | **49** | **10** |
| | Jurupa | 1 | 8 | 1 | 5 | 10 | 10 | 8 | 1 | 10 | **54** | **11** |
| | Grove | 1 | 1 | 5 | 1 | 10 | 10 | 8 | 1 | 10 | **47** | **12** |
| Ultimate[1] | Vulcan Pit | 1 | 12 | 2 | 1 | 10 | 1 | 4 | 1 | 1 | **33** | **13** |
| | Lower San Sevaine | 5 | 6 | 13 | 1 | 1 | 10 | 2 | 10 | 10 | **58** | **14** |
| | Montclair 4 | 1 | 3 | 8 | 5 | 10 | 1 | 6 | 1 | 1 | **36** | **15** |




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# IEUA RWPS
# GWR Basin Implementation Strategy

## FIGURE 4-2

# 5.0 MASS BALANCE ANALYSIS

The following is a brief description of the approach taken in performing the mass balance of recycled water supply and direct use demands to determine the amount of recycled water supply that will be available for recharge in the existing and proposed groundwater basins.

## 5.1 EXISTING AND PROJECTED ANNUAL DEMANDS

The annual demand projections provided by IEUA were subtotaled by member agency and by pressure zone, and provided for existing demand conditions through Year 2035 demand conditions, in 5-year increments. These annual demands are used as the basis for the direct use demand projections for the study.

**Table 5.1 Summary of Supplies and Demands**

| | Planning Year | | | | |
|---|---|---|---|---|---|
| | **Existing** | **Year 2020** | **Year 2025** | **Year 2030** | **Year 2035** |
| | ***AFY*** | | | | |
| Total Supplies | 61,944 | 66,312 | 71,913 | 77,514 | 82,330 |
| Direct Use Demands | 24,655 | 30,757 | 36,507 | 40,320 | 43,019 |
| **Surplus** | **37,289** | **35,555** | **35,406** | **37,194** | **39,311** |

### 5.1.1 Monthly Demands

Direct use demands for existing Year 2013 conditions were obtained from Agency's monthly customer billing data. (The Agency recharge billings were separated from the direct use billing). This information was used to establish the existing direct use demands for each month, subtotaled by pressure zone.

Future demands for each member agency was provided by the Agency for each planning horizon. The monthly demand patterns from the 2013 billing information were extrapolated to the future annual demand projections for each 5-year increment to obtain future monthly direct use demand projections. The demand projections assume that existing agricultural irrigation will be reduced as development increases over time. These monthly demand estimates are used to analyze the spring (average demands) and summer (maximum demands) analysis scenarios for each 5-year planning increment.

#### 5.1.1.1 Santa Ana River Base Flow (SARBF) at Prado Obligation

In addition to the current direct use demands, IEUA maintains an annual base flow obligation to the Santa Ana River at Prado Dam. IEUA provided the SARBF at Prado Obligation annual demands and monthly management of the demands to be used for this study.

This obligation is an annual demand ranging from 14,000 AF to 17,000 AF. Due to other flows to the Santa Ana River and water quality credits, 14,000 AFY, or approximately 12.5 MGD, is used for this study. Approximately 2.0 MGD can be delivered from RP-5 through the 800 Pressure Zone. The remaining demand is met by discharging directly into the nearby creek from either RP-5 or RP-1. This study assumes that the SARBF at Prado Obligation is met by RP-5 as the first source of supply and then by RP-1 as the supplementary supply as necessary.

The supply priority assumed in this study is to first meet direct use demands, and then the SARBF at Prado Obligation. Therefore, the SARBF at Prado Obligation is assumed to be as much as 40% of the total annual obligation in the winter demand months of December, January, and February when the direct use demands are low. This will make available more supply to meet the direct use demands and proposed GWR flow in the higher summer demand months. The minimum flow rate to SARBF at Prado Obligation in any one month is 3.5 MGD, or approximately 5.4 cfs average.

#### 5.1.1.2 Existing and Projected Wastewater Supply

The wastewater flow projections were provided by IEUA from the WFMP project, and shown in Table 3.1. These flows were provided for existing conditions through Year 2035 conditions, in 5-year increments. The monthly wastewater supply is assumed to be constant for each month in each year of the planning study.

#### 5.1.1.3 Southern and Northern Service Areas

The supplies and demands were divided into two services areas; the Southern and Northern Service Areas. The service areas are grouped by the pressure zones that are primarily supplied by the regional recycling plants. Table 4.3 shows the service areas that are assumed for the mass balance analysis.

**Table 5.2 Southern and Northern Service Areas**

| Service Area | Supply from Regional Recycling Plant | Pressure Zones Served |
|---|---|---|
| Southern Area | RP-5<br>CCWRF | 800<br>930 |
| Northern Service Area | RP-1 [1]<br>RP-4 [2] | 1050<br>1158<br>1299<br>1630E<br>1630W |

[1] RP-1 is the only facility that can supply both the Southern and Northern Service Areas via the 930 PZ Effluent Pump Station, 1050 PZ Effluent Pump Station, and the 1158 PZ Effluent Pump Station. For the mass balance analysis, RP-1 is assumed to supply only the Northern Service Area for the calculations and tables presented herein.

[2] RP-4 supplies directly to the 1158 PZ. Other Booster Pump Stations are required to supply the higher pressure zones.

### 5.1.2 GWR Basin Demand Assumptions

For the existing scenario, the existing GWR Basins were assumed to flow at 14-day fill periods. The average daily base flow rate for each basin was assumed to be the basin volume divided by 14 days. Each basin's flow rate is listed in Table 5.3.

The GWR Basin recharge water was assumed to flow daily for a 12-hour period outside the normal night irrigation period; therefore, the instantaneous flow rate is twice the daily average flow rate. Reducing the hours of demand to the basins was done to accommodate the low wastewater flows from each treatment facility, and the peak irrigation demands during the night. Most of the additional supply available from each treatment facility is provided during the day outside the peak irrigation demand period.

The 14-day fill cycle repeats for every 6-week period for each basin when possible. Some large basins with a longer infiltration period may require a longer period between filling cycles. For the analysis in section 5.1.3, the GWR basin demands are limited by the supply of recycled water from the regional recycling plants.

It should be noted that all of the existing and proposed basins are within the Northern Service Area.

**Table 5.3 Proposed GWR Basins Recycled Water Demands**

| Basin/Site | Daily Demand[1] (MGD) | Flow Rate[2] (gpm) |
|---|---|---|
| 7th/8th Street | 5.3 | 7,361 |
| Banana | 1.0 | 1,389 |
| Brooks | 5.5 | 7,639 |
| Ely (1-3) | 4.9 | 6,806 |
| Hickory | 3.7 | 5,139 |
| RP-3/Declez | 4.3 | 5,972 |
| San Sevaine 5 | 17.4 | 24,167 |
| Turner (1-4) | 10.2 | 14,167 |
| Victoria | 3.7 | 5,139 |
| Wineville | 2.8 | 3,889 |
| Victoria (increase) | 5.5 | 7,639 |
| San Sevaine (1-3) | 3.1 | 4,306 |
| RP-3 (New Cell) | 0.8 | 1,111 |
| Lower Day | 5.0 | 6,944 |
| Etiwanda Debris | 1.7 | 2,361 |
| Montclair (1-3) | 4.0 | 5,556 |
| College Heights East | 2.6 | 3,611 |
| College Heights West | 2.5 | 3,472 |
| Upland | 6.8 | 9,444 |
| Jurupa | 8.9 | 12,361 |
| Grove | 2.7 | 3,750 |
| Vulcan Pit | 2.1 | 2,917 |
| Lower San Sevaine | 5.4 | 7,500 |
| Montclair 4 | 3.3 | 4,583 |
| **Total** | **113.2** | |

[1] Daily demand is based on the basin storage volume divided by 14 days for a 14-day fill period.

[2] The flow rate for each basin is based on a 12-hour per day operation, with the fill period occurring during the day outside the peak irrigation direct use demand period.

### 5.1.3 Supply versus Demands Analysis

For each 5-year demand scenario, a monthly supply versus direct use demands analysis was performed for the Southern and Northern Service Areas, which were defined previously in Section 5.1.1.3. The monthly direct use demand projections were compared with the monthly wastewater supply flow projections. It was assumed that the wastewater flows were constant for each month throughout the year. The difference between the wastewater supply and direct use demands plus the SARBF at Prado Obligation yields the supply available to the GWR program for each month.

Table 5.4 shows the supply and demand analysis, with the available supply to recharge the GWR basins by month for each planning year. This table assumes a 9-month GWR operation, where the monthly GWR is limited by the wastewater supply from the regional recycling plants.

**Table 5.4 Supply versus Demands Mass Balance**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| **Southern Service Area** | | | | | |
| Southern Area Recycled Water Supply (RP-5, CCWRF) | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Total to SARBF at Prado Obligation[1] | 4,497 | 5,428 | 6,513 | 8,168 | 9,446 |
| Southern Area Supply Surplus/(Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| **Northern Service Area** | | | | | |
| Northern Area Recycled Water Supply (RP-1, RP-4) | 46,934 | 47,158 | 49,454 | 51,750 | 53,543 |
| Northern Area Direct Use Demands | 8,087 | 11,166 | 15,642 | 19,240 | 20,650 |
| Supplemental Supply to Southern Area | 6,056 | 5,865 | 4,919 | 3,484 | 3,028 |
| Total to SARBF at Prado from North[2] | 9,502 | 8,571 | 7,487 | 5,832 | 4,554 |
| Northern Area Supply Surplus/(Deficit) | 23,289 | 21,556 | 21,406 | 23,194 | 25,311 |
| **GWR 9-Month Operation RW Availability[3]** | **16,095** | **13,977** | **13,027** | **13,707** | **14,871** |
| 3-Month Un-Used Winter Surplus | 7,194 | 7,579 | 8,379 | 9,487 | 10,440 |

[1] The Total to SARBF at Prado Obligation from the South is calculated based on the monthly mass balance analysis, and assumes a base flow of 2.6 MG per month, plus the sum of any additional available for each month.

[2] The Total to SARB at Prado Obligation from the North is calculated based on the monthly mass balance analysis, and assumes a base flow of 0.9 MG per month, plus additional flows needed to meet the 14,000 AFY requirement and limit the 3-month winter period to 40% of the annual flow.

[3] The GWR 9-Month Operation RW Availability shown is calculated based on the monthly mass balance and surplus analysis for the 9-month GWR operation period.

A summary of the mass balance analysis and total recycled water supply available for the GWR program, listed for each service area by planning horizon, is provided in Table 5.5.

**Table 5.5 Summary of Mass Balance**

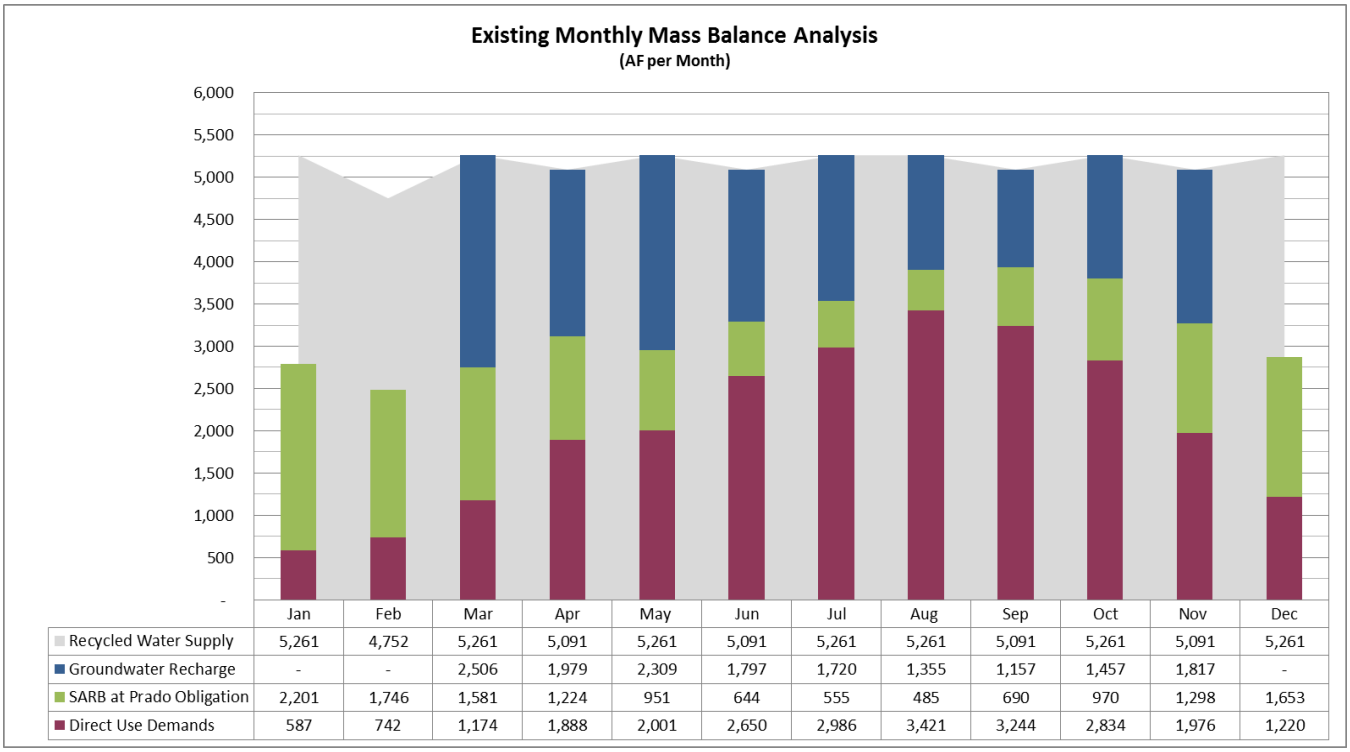
| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Southern Service Area Supply/(Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| Northern Service Area Supply/(Deficit) | 23,289 | 21,556 | 21,406 | 23,194 | 25,311 |
| GWR 9-Month Operation RW Availability | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Un-Used Winter Months RW Surplus | 7,194 | 7,579 | 8,379 | 9,487 | 10,440 |

Tables 5.6 through 5.10 on the following pages and Figures 5-1 through 5-5 illustrate the relationship of the mass balance shown in Tables 5.4 and 5.5 on a monthly basis for the IEUA service area as a whole. The monthly mass balance assumes a 9-month GWR operation.

## Table 5.6 Existing Monthly Mass Balance Analysis

| EXISTING | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 13.4 | 15,010 |
| Southern Area Direct Use Demands | 3.2 | 6.0 | 8.2 | 14.4 | 12.6 | 18.7 | 20.5 | 23.3 | 25.4 | 21.3 | 15.1 | 8.9 | 14.8 | 16,568 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 7.5 | 4.8 | 2.6 | - | - | - | - | - | - | - | - | 1.9 | 3.4 | 1,557 |
| Total to SARBF at Prado from Southern Area | 10.2 | 7.4 | 5.2 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 4.5 | 4.0 | 4,497 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | (3.6) | (1.8) | (7.9) | (9.7) | (12.5) | (14.7) | (10.6) | (4.3) | 0.0 | (9.0) | (6055.6) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 41.9 | 46,934 |
| Northern Area Direct Use Demands | 2.9 | 2.7 | 4.2 | 6.1 | 8.5 | 10.1 | 10.9 | 12.7 | 9.8 | 8.5 | 6.4 | 3.9 | 7.2 | 8,087 |
| Supplemental Supply to Southern Area | - | - | - | 3.6 | 1.8 | 7.9 | 9.7 | 12.5 | 14.7 | 10.6 | 4.3 | - | 9.0 | 6,056 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 12.1 | 12.0 | 10.5 | 9.8 | 6.5 | 3.5 | 2.3 | 1.6 | 4.0 | 6.7 | 10.6 | 12.0 | 7.6 | 8,522 |
| Total to SARBF at Prado from North Area | 13.0 | 12.9 | 11.4 | 10.7 | 7.4 | 4.4 | 3.2 | 2.5 | 4.9 | 7.6 | 11.5 | 12.9 | 8.5 | 9,502 |
| Northern Area Supply Surplus/(Deficit) | 26.0 | 26.4 | 26.3 | 21.5 | 24.3 | 19.5 | 18.1 | 14.2 | 12.6 | 15.3 | 19.7 | 25.1 | 20.7 | 23,289 |
| Total SARBF at Prado Obligation | 23.1 | 20.3 | 16.6 | 13.3 | 10.0 | 7.0 | 5.8 | 5.1 | 7.5 | 10.2 | 14.1 | 17.4 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | - | - | **26.3** | **21.5** | **24.3** | **19.5** | **18.1** | **14.2** | **12.6** | **15.3** | **19.7** | - | **19.1** | **16,095** |

Figure 5-1 EXISTING Monthly Mass Balance Analysis

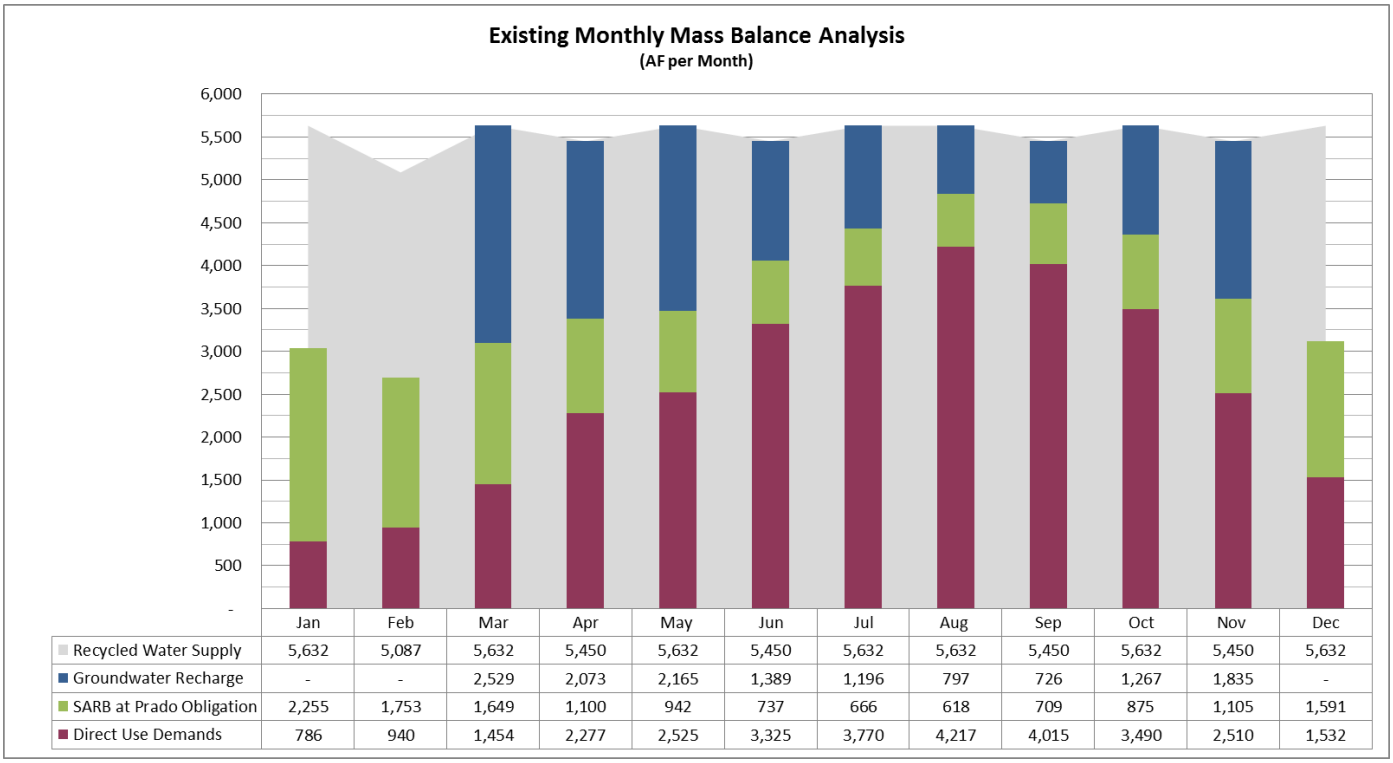



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 5,261 | 4,752 | 5,261 | 5,091 | 5,261 | 5,091 | 5,261 | 5,261 | 5,091 | 5,261 | 5,091 | 5,261 |
| Groundwater Recharge | - | - | 2,506 | 1,979 | 2,309 | 1,797 | 1,720 | 1,355 | 1,157 | 1,457 | 1,817 | - |
| SARB at Prado Obligation | 2,201 | 1,746 | 1,581 | 1,224 | 951 | 644 | 555 | 485 | 690 | 970 | 1,298 | 1,653 |
| Direct Use Demands | 587 | 742 | 1,174 | 1,888 | 2,001 | 2,650 | 2,986 | 3,421 | 3,244 | 2,834 | 1,976 | 1,220 |

## Table 5.7 YEAR 2020 Monthly Mass Balance Analysis

| Year 2020 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 17.1 | 19,154 |
| Southern Area Direct Use Demands | 3.8 | 7.0 | 9.6 | 16.7 | 15.0 | 22.1 | 24.4 | 27.6 | 30.0 | 25.1 | 18.0 | 10.6 | 17.5 | 19,591 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 10.7 | 7.5 | 4.8 | - | - | - | - | - | - | - | - | 3.8 | 5.4 | 2,488 |
| Total to SARBF at Prado from Southern Area | 13.3 | 10.1 | 7.5 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 6.5 | 4.9 | 5,428 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | (2.2) | (0.5) | (7.7) | (10.0) | (13.1) | (15.5) | (10.6) | (3.5) | 0.0 | (8.9) | (5865.2) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 42.1 | 47,158 |
| Northern Area Direct Use Demands | 4.5 | 4.0 | 5.6 | 8.1 | 11.6 | 14.0 | 15.2 | 16.8 | 13.6 | 11.6 | 9.3 | 5.5 | 10.0 | 11,166 |
| Supplemental Supply to Southern Area | - | - | - | 2.2 | 0.5 | 7.7 | 10.0 | 13.1 | 15.5 | 10.6 | 3.5 | - | 8.9 | 5,865 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 9.5 | 9.4 | 9.0 | 8.5 | 6.4 | 4.5 | 3.5 | 3.0 | 4.2 | 5.7 | 8.5 | 9.4 | 6.8 | 7,591 |
| Total to SARBF at Prado from North Area | 10.4 | 10.3 | 9.9 | 9.3 | 7.3 | 5.4 | 4.4 | 3.9 | 5.1 | 6.6 | 9.4 | 10.3 | 7.7 | 8,571 |
| Northern Area Supply Surplus/(Deficit) | 27.2 | 27.9 | 26.6 | 22.5 | 22.8 | 15.1 | 12.6 | 8.4 | 7.9 | 13.3 | 19.9 | 26.4 | 19.2 | 21,556 |
| Total SARBF at Prado Obligation | 23.7 | 20.4 | 17.3 | 12.0 | 9.9 | 8.0 | 7.0 | 6.5 | 7.7 | 9.2 | 12.0 | 16.7 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | - | - | **26.6** | **22.5** | **22.8** | **15.1** | **12.6** | **8.4** | **7.9** | **13.3** | **19.9** | - | **16.6** | **13,977** |

Figure 5-2 YEAR 2020 Monthly Mass Balance Analysis

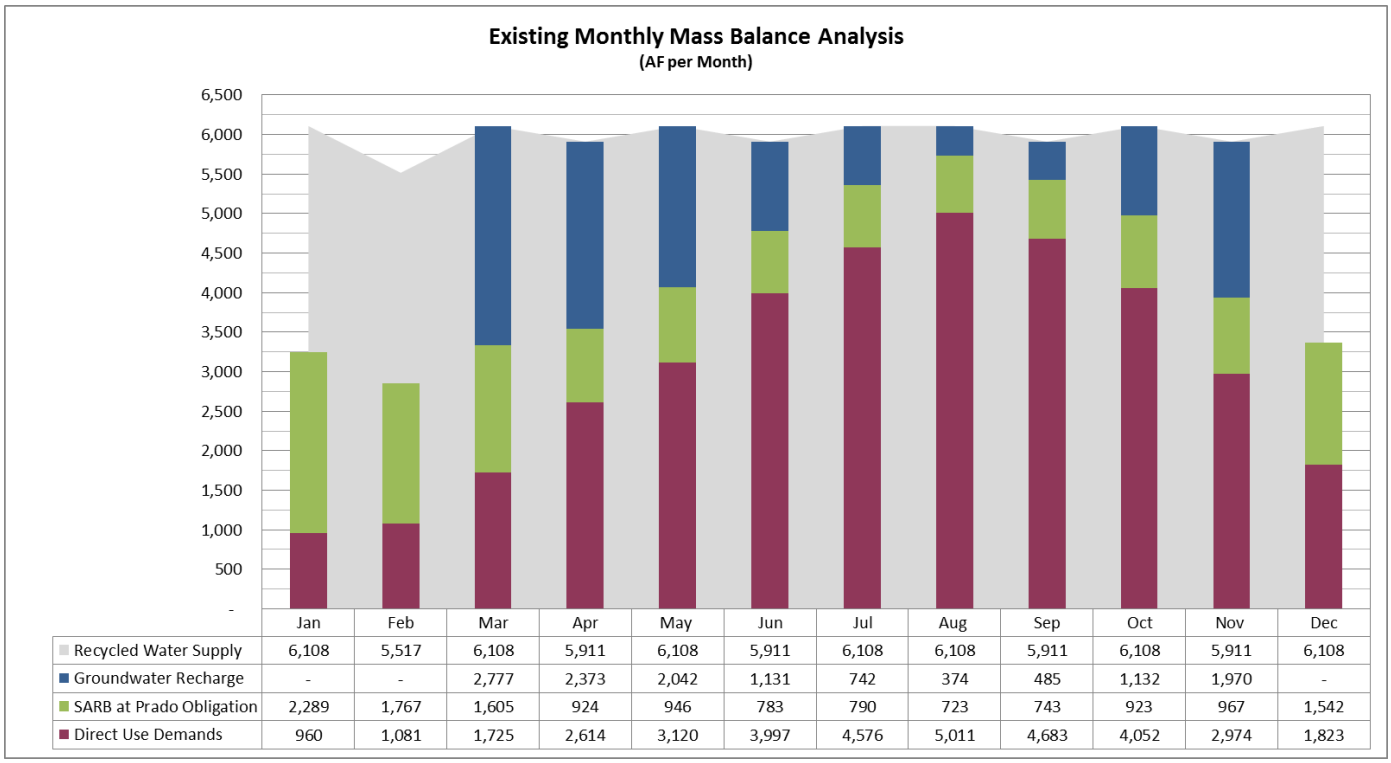



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 5,632 | 5,087 | 5,632 | 5,450 | 5,632 | 5,450 | 5,632 | 5,632 | 5,450 | 5,632 | 5,450 | 5,632 |
| Groundwater Recharge | - | - | 2,529 | 2,073 | 2,165 | 1,389 | 1,196 | 797 | 726 | 1,267 | 1,835 | - |
| SARB at Prado Obligation | 2,255 | 1,753 | 1,649 | 1,100 | 942 | 737 | 666 | 618 | 709 | 875 | 1,105 | 1,591 |
| Direct Use Demands | 786 | 940 | 1,454 | 2,277 | 2,525 | 3,325 | 3,770 | 4,217 | 4,015 | 3,490 | 2,510 | 1,532 |

## Table 5.8 YEAR 2025 Monthly Mass Balance Analysis

| Year 2025 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 20.1 | 22,459 |
| Southern Area Direct Use Demands | 3.9 | 7.2 | 10.3 | 16.7 | 16.4 | 23.6 | 26.8 | 29.5 | 31.6 | 26.4 | 19.6 | 11.6 | 18.6 | 20,865 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 13.6 | 10.3 | 7.2 | 0.7 | 1.0 | - | - | - | - | - | - | 5.8 | 7.6 | 3,572 |
| Total to SARBF at Prado from Southern Area | 16.2 | 12.9 | 9.8 | 3.4 | 3.7 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 8.4 | 5.8 | 6,513 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (6.2) | (9.3) | (12.1) | (14.2) | (9.0) | (2.2) | 0.0 | (7.6) | (4918.8) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 44.2 | 49,454 |
| Northern Area Direct Use Demands | 6.2 | 5.4 | 7.9 | 11.7 | 16.4 | 19.8 | 21.3 | 23.1 | 19.2 | 16.2 | 12.7 | 7.5 | 14.0 | 15,642 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 6.2 | 9.3 | 12.1 | 14.2 | 9.0 | 2.2 | - | 7.6 | 4,919 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 7.0 | 6.8 | 6.2 | 5.8 | 5.4 | 5.0 | 4.8 | 4.1 | 4.6 | 6.2 | 7.0 | 6.9 | 5.8 | 6,507 |
| Total to SARBF at Prado from North Area | 7.9 | 7.7 | 7.1 | 6.7 | 6.3 | 5.9 | 5.7 | 5.0 | 5.4 | 7.1 | 7.9 | 7.8 | 6.7 | 7,487 |
| Northern Area Supply Surplus/(Deficit) | 30.0 | 31.1 | 29.2 | 25.8 | 21.5 | 12.3 | 7.8 | 3.9 | 5.3 | 11.9 | 21.4 | 28.8 | 19.1 | 21,406 |
| Total SARBF at Prado Obligation | 24.1 | 20.6 | 16.9 | 10.0 | 9.9 | 8.5 | 8.3 | 7.6 | 8.1 | 9.7 | 10.5 | 16.2 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **29.2** | **25.8** | **21.5** | **12.3** | **7.8** | **3.9** | **5.3** | **11.9** | **21.4** | **-** | **15.4** | **13,027** |

Figure 5-3 YEAR 2025 Monthly Mass Balance Analysis

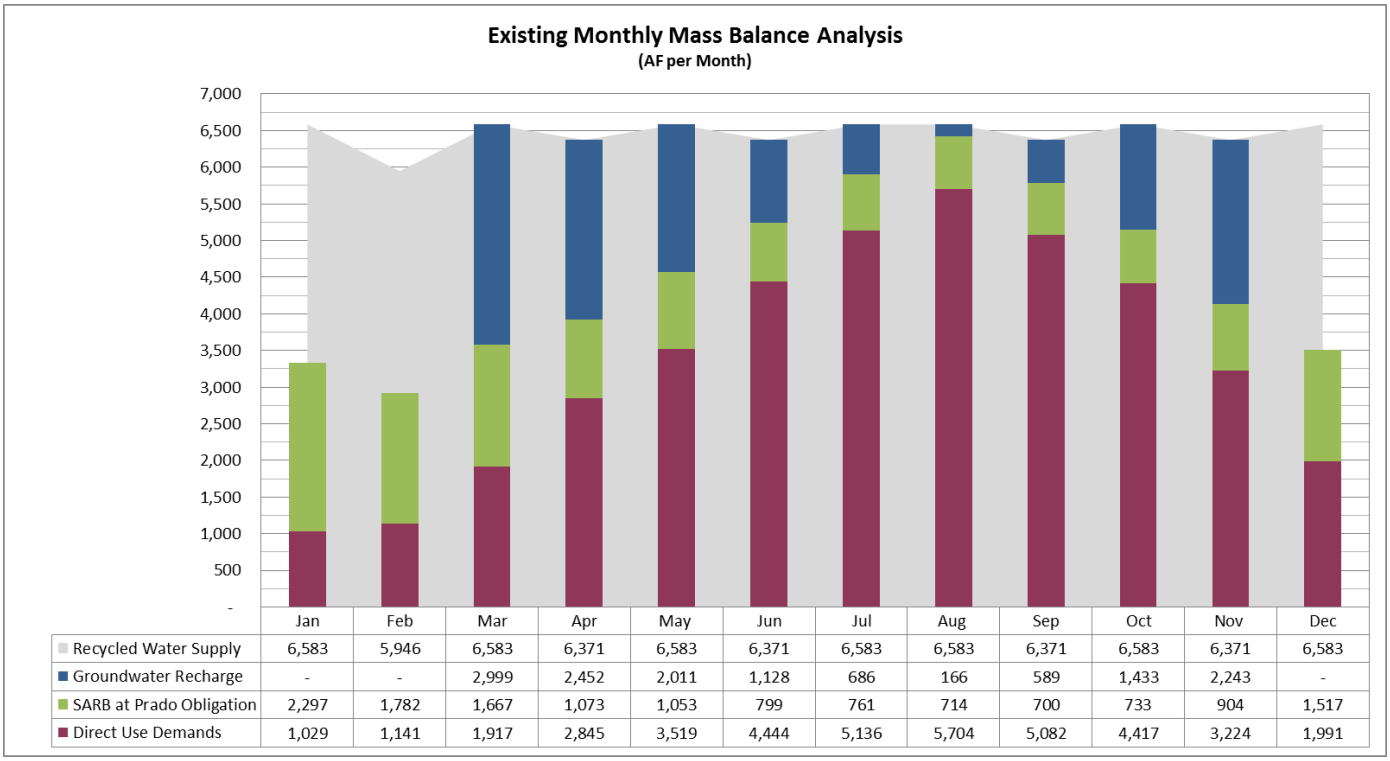



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,108 | 5,517 | 6,108 | 5,911 | 6,108 | 5,911 | 6,108 | 6,108 | 5,911 | 6,108 | 5,911 | 6,108 |
| Groundwater Recharge | - | - | 2,777 | 2,373 | 2,042 | 1,131 | 742 | 374 | 485 | 1,132 | 1,970 | - |
| SARB at Prado Obligation | 2,289 | 1,767 | 1,605 | 924 | 946 | 783 | 790 | 723 | 743 | 923 | 967 | 1,542 |
| Direct Use Demands | 960 | 1,081 | 1,725 | 2,614 | 3,120 | 3,997 | 4,576 | 5,011 | 4,683 | 4,052 | 2,974 | 1,823 |

## Table 5.9 YEAR 2030 Monthly Mass Balance Analysis

| Year 2030 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 25,763 |
| Southern Area Direct Use Demands | 3.8 | 7.1 | 10.4 | 16.2 | 16.8 | 23.9 | 27.5 | 30.0 | 31.8 | 26.4 | 20.1 | 11.9 | 18.8 | 21,080 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 16.6 | 13.3 | 10.0 | 4.2 | 3.6 | - | - | - | - | - | 0.3 | 8.4 | 10.4 | 5,228 |
| Total to SARBF at Prado from Southern Area | 19.2 | 15.9 | 12.6 | 6.8 | 6.2 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.9 | 11.1 | 7.3 | 8,168 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (3.6) | (7.1) | (9.6) | (11.4) | (6.1) | 0.0 | 0.0 | (5.4) | (3484.5) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 46.2 | 51,750 |
| Northern Area Direct Use Demands | 7.0 | 6.2 | 9.8 | 14.7 | 20.2 | 24.3 | 26.5 | 30.0 | 23.4 | 20.0 | 15.0 | 9.0 | 17.2 | 19,240 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 3.6 | 7.1 | 9.6 | 11.4 | 6.1 | - | - | 5.4 | 3,484 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 4.1 | 4.0 | 4.0 | 4.0 | 4.0 | 5.2 | 4.5 | 4.0 | 4.1 | 4.2 | 6.0 | 4.0 | 4.3 | 4,852 |
| Total to SARBF at Prado from North Area | 4.9 | 4.8 | 4.9 | 4.9 | 4.9 | 6.1 | 5.4 | 4.9 | 5.0 | 5.1 | 6.9 | 4.9 | 5.2 | 5,832 |
| Northern Area Supply Surplus/(Deficit) | 34.2 | 35.2 | 31.5 | 26.6 | 21.1 | 12.3 | 7.2 | 1.7 | 6.4 | 15.1 | 24.4 | 32.3 | 20.7 | 23,194 |
| Total SARBF at Prado Obligation | 24.1 | 20.7 | 17.5 | 11.7 | 11.1 | 8.7 | 8.0 | 7.5 | 7.6 | 7.7 | 9.8 | 15.9 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **31.5** | **26.6** | **21.1** | **12.3** | **7.2** | **1.7** | **6.4** | **15.1** | **24.4** | **-** | **16.3** | **13,707** |

Figure 5-4 YEAR 2030 Monthly Mass Balance Analysis

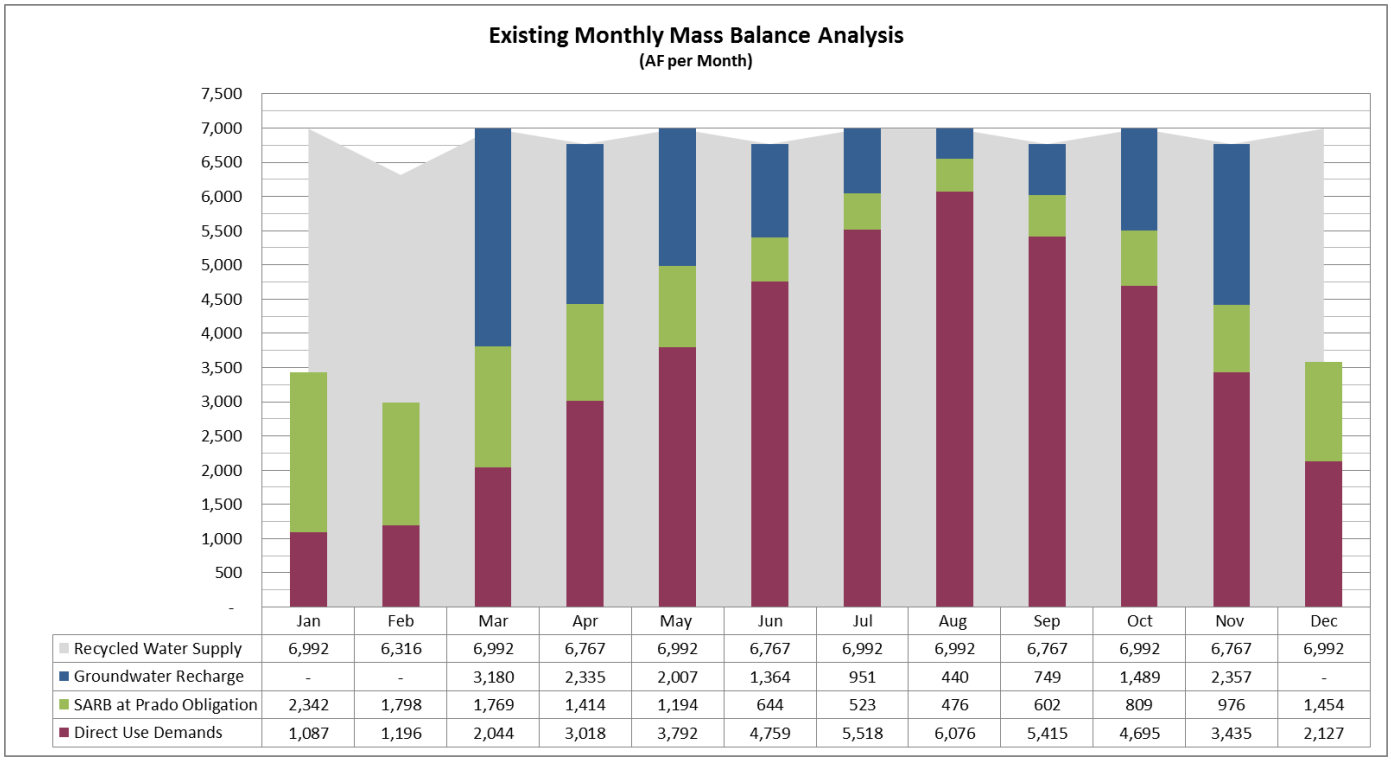



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,583 | 5,946 | 6,583 | 6,371 | 6,583 | 6,371 | 6,583 | 6,583 | 6,371 | 6,583 | 6,371 | 6,583 |
| Groundwater Recharge | - | - | 2,999 | 2,452 | 2,011 | 1,128 | 686 | 166 | 589 | 1,433 | 2,243 | - |
| SARB at Prado Obligation | 2,297 | 1,782 | 1,667 | 1,073 | 1,053 | 799 | 761 | 714 | 700 | 733 | 904 | 1,517 |
| Direct Use Demands | 1,029 | 1,141 | 1,917 | 2,845 | 3,519 | 4,444 | 5,136 | 5,704 | 5,082 | 4,417 | 3,224 | 1,991 |

## Table 5.10 YEAR 2035 Monthly Mass Balance Analysis

| Year 2035 | Monthly Flow/Demand (MGD) | | | | | | | | | | | | Ave. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (MGD) | (AFY) |
| **Southern Service Area** | | | | | | | | | | | | | | |
| Southern Area Recycled Water Supply | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 25.7 | 28,788 |
| Southern Area Direct Use Demands | 4.0 | 7.4 | 11.0 | 16.7 | 18.0 | 25.4 | 29.5 | 31.9 | 33.6 | 27.9 | 21.5 | 12.8 | 20.0 | 22,369 |
| Southern Area Min. Base Flow to SARBF at Prado | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2,940 |
| Additional Supply Available to SARBF at Prado | 19.1 | 15.7 | 12.1 | 6.4 | 5.0 | - | - | - | - | - | 1.6 | 10.3 | 12.4 | 6,506 |
| Total to SARBF at Prado from Southern Area | 21.7 | 18.3 | 14.7 | 9.0 | 7.7 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 4.2 | 12.9 | 8.5 | 9,446 |
| Southern Area Supply Surplus/(Deficit) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (2.3) | (6.5) | (8.8) | (10.5) | (4.8) | 0.0 | 0.0 | (4.7) | (3028.3) |
| **Northern Service Area** | | | | | | | | | | | | | | |
| Northern Area Recycled Water Supply | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 47.8 | 53,543 |
| Northern Area Direct Use Demands | 7.5 | 6.5 | 10.5 | 16.1 | 21.8 | 26.3 | 28.5 | 32.0 | 25.3 | 21.5 | 15.8 | 9.5 | 18.4 | 20,650 |
| Supplemental Supply to Southern Area | - | - | - | - | - | 2.3 | 6.5 | 8.8 | 10.5 | 4.8 | - | - | 4.7 | 3,028 |
| Northen Area Minimum Base Flow to SARBF at Prado | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 980 |
| Additional Supply to SARBF at Prado | 2.0 | 1.8 | 3.0 | 5.5 | 4.0 | 3.5 | 2.0 | 1.5 | 3.0 | 5.0 | 5.5 | 1.5 | 3.2 | 3,574 |
| Total to SARBF at Prado from North Area | 2.9 | 2.6 | 3.9 | 6.4 | 4.9 | 4.4 | 2.9 | 2.4 | 3.9 | 5.9 | 6.4 | 2.4 | 4.1 | 4,554 |
| Northern Area Supply Surplus/(Deficit) | 37.5 | 38.7 | 33.4 | 25.4 | 21.1 | 14.8 | 10.0 | 4.6 | 8.1 | 15.7 | 25.6 | 35.9 | 22.6 | 25,311 |
| Total SARBF at Prado Obligation | 24.6 | 20.9 | 18.6 | 15.4 | 12.5 | 7.0 | 5.5 | 5.0 | 6.5 | 8.5 | 10.6 | 15.3 | 12.5 | 14,000 |
| **GWR 9-Month Operation Availability** | **-** | **-** | **33.4** | **25.4** | **21.1** | **14.8** | **10.0** | **4.6** | **8.1** | **15.7** | **25.6** | **-** | **17.6** | **14,871** |

Figure 5-5 YEAR 2035 Monthly Mass Balance Analysis




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recycled Water Supply | 6,992 | 6,316 | 6,992 | 6,767 | 6,992 | 6,767 | 6,992 | 6,992 | 6,767 | 6,992 | 6,767 | 6,992 |
| Groundwater Recharge | - | - | 3,180 | 2,335 | 2,007 | 1,364 | 951 | 440 | 749 | 1,489 | 2,357 | - |
| SARB at Prado Obligation | 2,342 | 1,798 | 1,769 | 1,414 | 1,194 | 644 | 523 | 476 | 602 | 809 | 976 | 1,454 |
| Direct Use Demands | 1,087 | 1,196 | 2,044 | 3,018 | 3,792 | 4,759 | 5,518 | 6,076 | 5,415 | 4,695 | 3,435 | 2,127 |

### 5.1.4 Additional Supply Needed to Supplement Southern Area

This section evaluates the amount of additional external supply required to eliminate the need for the Northern Service Area to supplement the Southern Service Area. As shown in Table 5.2, the Southern Service Area (supplied by RP-5 and CCWRF) cannot meet all of the direct use demands and SARBF at Prado Obligation during the higher demand periods, particularly during the summer months.

The amount of water available to the GWR could be increased if additional external supply is provided to supplement the Southern Service Area. RP-1 could then be utilized to exclusively meet the needs for direct use and GWR to the Northern Service Area.

Table 5.11 is provided to identify the annual external supply for each planning year that would be required for the Southern Service Area.

**Table 5.11 Potential External Supply Needs to the Southern Service Area**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Southern Service Area Recycled Water Supply | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Service Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Southern Service Area Min. Base Flow to SARBF at Prado[1] | 2,940 | 2,940 | 2,940 | 2,940 | 2,940 |
| Additional Supply Available to SARBF at Prado[2] | 1,557 | 2,488 | 3,572 | 5,228 | 6,506 |
| Total to SARBF at Prado from Southern Area | 4,497 | 5,428 | 6,513 | 8,168 | 9,446 |
| Southern Area Supply (Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| *Total SARBF at Prado Obligation* | *14,000* | *14,000* | *14,000* | *14,000* | *14,000* |
| Remaining Required to Meet Full SARBF at Prado[3] | 9,502 | 8,571 | 7,487 | 5,832 | 4,554 |
| **Total Additional External Supply Needed for Southern Service Area** | **15,558** | **14,436** | **12,406** | **9,316** | **7,582** |

[1] Southern Service Area Min. Base Flow to SARBF at Prado Obligation is the base flow each month from RP-5 and CCWRF, and is assumed to be approximately 2.6 MGD, or 2,940 AFY.

[2] Additional Supply Available to SARBF at Prado Obligation is based on the monthly mass balance analysis, and is the amount of surplus of available water from RP-5 and CCWRF after the direct use demands and Min. Base Flow to SARBF at Prado Obligation are used. This surplus is typically only available during the winter or low direct use demand months.

[3] Remaining Required to Meet Full SARBF at Prado is the difference between the total 14,000 AF required and the total supply provided by the Southern Service Area, and is met by the Northern Service Area.

As shown in Table 5.11, the amount of additional supply would be needed to serve either the 800 or 930 Pressure Zones. With the growth anticipated in the 930 Pressure Zone, it would be recommended to supplement the 930 Pressure Zone with an additional supply. Supply to this pressure zone could be pressure reduced through the existing 930/800 PRV if supplemental supply to the 800 Pressure Zone is needed without additional pumping facilities.

### 5.1.5 Supply Needs to Maximize GWR

This section investigates the maximum potential of GWR assuming additional supplies would be acquired. The GWR maximum potential was previously investigated in a separate study for IEUA and addressed in the Technical Memorandum, dated December 13, 2013, entitled "Recycled Water System Hydraulic Analysis for the Enhanced GWR Program."

This previous Technical Memorandum assumed that the recycled water supply was unlimited and identified system improvements to deliver the maximum potential GWR flows. The GWR flows for that study were assumed to flow during the 14-day fill period cycle throughout the 9-month operation period without being reduced or limited by the available recycled water supply.

In order for the GWR program to operate in this fashion, additional supplies would need to be acquired. Table 5.12 shows the amount of additional supply that would be needed for each planning year.

## Table 5.12 Potential External Supply Needs for Maximum Basin Recharge

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Southern Service Area Recycled Water Supply | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Service Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Southern Service Area Min. Base Flow to SARBF at Prado[1] | 2,940 | 2,940 | 2,940 | 2,940 | 2,940 |
| Additional Supply Available to SARBF at Prado[2] | 1,557 | 2,488 | 3,572 | 5,228 | 6,506 |
| Total to SARBF at Prado from Southern Area | 4,497 | 5,428 | 6,513 | 8,168 | 9,446 |
| Southern Service Area Supply (Deficit) | (6,056) | (5,865) | (4,919) | (3,484) | (3,028) |
| *Total SARBF at Prado Obligation* | *14,000* | *14,000* | *14,000* | *14,000* | *14,000* |
| Remaining to Meet Full SARBF at Prado[3] | 9,502 | 8,571 | 7,487 | 5,832 | 4,554 |
| Southern Deficit plus SARBF at Prado Supplement from North[4] | 15,558 | 14,436 | 12,406 | 9,316 | 7,582 |
| *Proposed 9-Month GWR Program* | *16,095* | *13,977* | *13,027* | *13,707* | *14,871* |
| Maximum 9-Month GWR Program[5] | 23,272 | 23,272 | 23,272 | 23,272 | 23,272 |
| **Total Additional External Supply Needed[6]** | **22,734** | **23,731** | **22,651** | **18,881** | **15,983** |

[1] Southern Service Area Min. Base Flow to SARBF at Prado Obligation is the base flow each month from RP-5 and CCWRF, and is assumed to be approximately 2.6 MGD, or 2,940 AFY.

[2] Additional Supply Available to SARBF at Prado Obligation is based on the monthly mass balance analysis, and is the amount of surplus of available water from RP-5 and CCWRF after the direct use demands and Min. Base Flow to SARBF at Prado Obligation are used. This surplus is typically only available during the winter or low direct use demand months.

[3] Remaining Required to Meet Full SARBF at Prado is the difference between the total 14,000 AF required and the total supply provided by the Southern Service Area, and is met by the Northern Service Area.

[4] The Southern Deficit plus SARBF at Prado Supplement from North is the sum of the "*Southern Area Supply Deficit*" plus the "*Remaining to Meet Full SARBF at Prado*" demands.

[5] The Maximum 9-Month GWR Program is the total estimated maximum recycled water recharge potential as identified in the Technical Memorandum, dated December 13, 2013, entitled "*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*".

[6] The Total Additional External Supply Needed is the "*Southern Deficit plus SARBF at Prado Supplement from North*" plus the difference between the "*Maximum 9-Month GWR Program*" and the "*Proposed 9-Month GWR Program*".

# 6.0 IMPLEMENTATION OF GWR BASINS HYDRAULIC ANALYSIS

This section provides a brief description of the hydraulic model analysis performed based on the monthly mass balance analysis, and the proposed improvements from the results of the hydraulic model analysis for the planning years proposed. The groundwater recharge goals for the hydraulic model analysis were shown in Table 5.3.

## 6.1 HYDRAULIC MODEL ANALYSIS

IEUA's hydraulic computer model that was provided for use in the InfoWater modeling software was utilized for the hydraulic analysis. The computer model was analyzed as a 24-hour extended period simulation for average day and maximum day direct use demand conditions. The average day demand condition was assumed to be the spring and fall months of March, April, May and November. The average of the direct use demands for these four months was utilized in the model. The maximum day demand condition was assumed to be the maximum month demands between the months of June and October.

SARBF at Prado Obligation was accounted for in the computer model analysis by subtracting this demand from the net available recycled water supply after the direct use demands were met. The remaining available supply after the direct use and Prado Obligation is available for groundwater recharge.

Table 6.1 shows the demand conditions assumed for the hydraulic model analysis. The average demands (AD) for the direct use, Prado, and GWR demands shown in the table are the average demands for the months of March, April, May and November. The maximum demand conditions (MD) are the maximum month demand direct use demand conditions. The values for SARBF at Prado Obligation and GWR available flows are based on the average monthly demand between June and October.

**Table 6.1 Summary of Demands Used for Hydraulic Analysis**

| | Existing | | Year 2020 | | Year 2025 | | Year 2030 | | Year 2035 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AD | MD | AD | MD | AD | MD | AD | MD | AD | MD |
| | MGD | | | | | | | | | |
| Recycled Water Supply | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| Direct Use Demands[1] | 22.0 | 36.0 | 27.5 | 44.4 | 32.6 | 52.7 | 36.0 | 60.0 | 38.4 | 63.9 |
| SARBF at Prado Obligation[2] | 12.5 | 5.1 | 12.5 | 6.5 | 12.5 | 7.6 | 12.5 | 7.5 | 12.5 | 5.0 |
| **GWR Available Flows[3]** | **20.8** | **14.2** | **19.2** | **8.3** | **19.1** | **3.9** | **20.7** | **1.7** | **22.6** | **4.6** |
| Total Demand | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |

[1] The Direct Use Demands for the "AD" condition are the average demands for the spring/fall months of March, April, May, and November. The "MD" condition demands are the maximum month's demands between June and October.
[2] The SARBF at Prado Obligation demands are the average demands for the appropriate demand period described in Footnote 1 above.
[3] The GWR Available Flows are the average monthly flow available for the appropriate demand period described in Footnote 1 above.

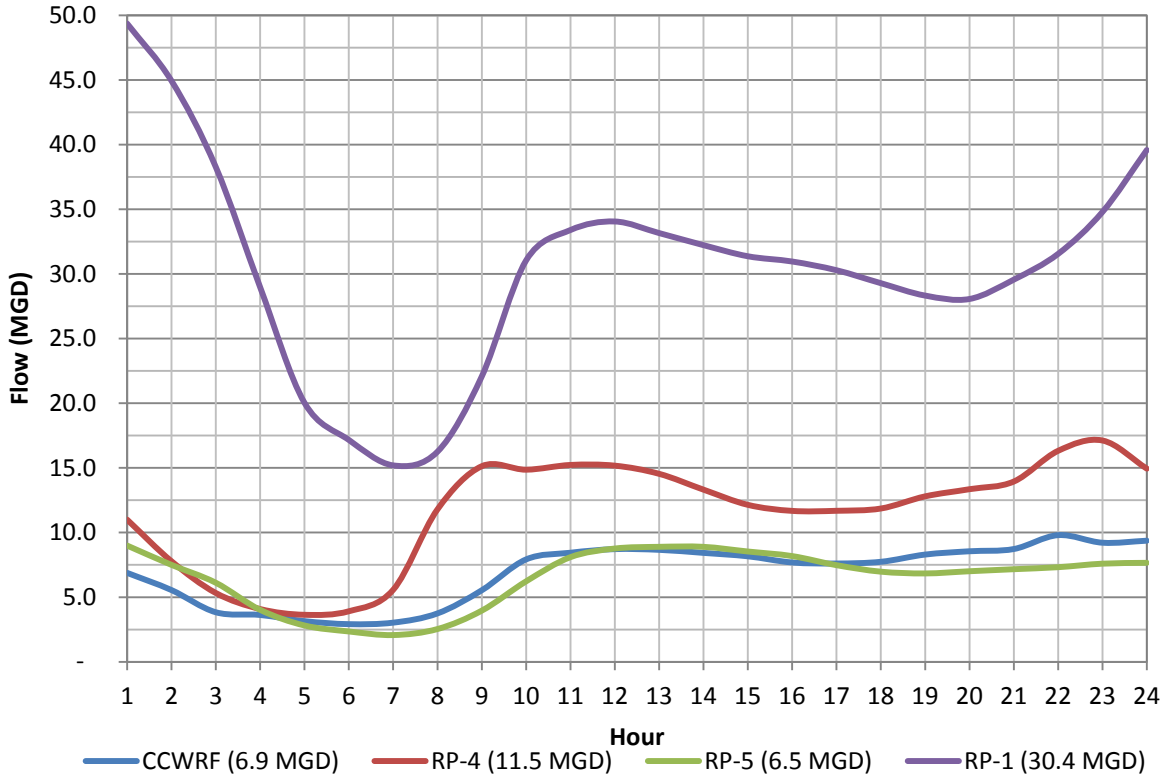
### 6.1.1 Summary of Model Analysis Assumptions

The flows to the GWR basins are based on the basin volumes and fill periods during the year to include only the spring, summer, and fall months where direct use demands are added with the GWR demands. However for modeling purposes, system performance is analyzed with average day demands and maximum day direct use demands plus GWR flows as shown in Table 6.1. IEUA provided the information regarding the basins volumes and infiltration data, as well as which basins will be supplied by recycled water.

The following assumptions are made for this study:

- Supply to the system was modeled to be from only the existing Regional Wastewater Recycling Plants.
- The effluent from each of the Regional Wastewater Recycling Plants was assumed to be available to the effluent pump stations based on the wastewater 24-hour diurnal pattern that was provided by IEUA in their calibrated hydraulic model.

**Figure 6-1 Wastewater Supply 24-Hour Diurnal Pattern**




Note: Existing daily flows are shown in the Legend for Figure 5-1.

- GWR fill rates are based on the basin storage volumes, areas, and infiltration rates, and filled in 14-days, and repeated every 6 weeks for the 9-month operation period. Additionally:
    - No RWC limitations (only for purposes of this study to determine maximum capacity limitations of the recycled water system)
    - No operational constraints (i.e., permits, agreements, land acquisitions, mounding, etc)
- The SARBF at Prado Obligation demands were assumed to be met directly from the Regional Wastewater Recycling Plants, and therefore, not included as demand nodes in the model. The available supply from the treatment plants were reduced accordingly in the model analyses. The exception to this is the minimum 2.6 MGD demand to Prado from the 800 Pressure Zone.
- Imported water would be made available if there are RWC issues; however, this study assumes the recharge volume is met 100% by recycled water.

#### 6.1.1.1 Model Analysis Criteria

The following criteria were used to evaluate facility performance and to determine any deficiencies in the conveyance system:

- Minimum regional service pressure = 50 psi (at demand nodes)
- Minimum Basin service pressure = 25 psi
- Maximum pipeline velocity = 7 fps

## 6.2 DIRECT USE DEMANDS ANALYSIS AND IMPROVEMENTS

The hydraulic model analysis first included an analysis of the projected direct use demands only, without any flow to the GWR basins. This analysis is intended to produce a set of recommendations that are directly as a result of the Agency's ability to meet the maximum day direct use demands as shown in Tables 2.2 and 6.1. Only the summer maximum day demand conditions were analyzed for this purpose.

### 6.2.1 Existing Direct Use Demands Analysis

The existing demands condition model analysis did not show any deficiencies that required recommended improvements.

### 6.2.2 Year 2020 Direct Use Demands Analysis

The Year 2020 direct use demands analysis showed two areas that are considered to be deficient. The first is the 800 Zone pipeline in Bickmore Avenue that experiences high velocities and limits the flow out of RP-5 into the 800 Zone distribution system. A new 24-inch pipeline is recommended in Kimball Avenue from the RP-5 Recycled Water Effluent Pump Station to approximately Rincon Meadows Avenue, approximately 12,260 lf. The second improvement area is the RP-1 1158 Zone Recycled Water Effluent Pump Station. This pump station operates too far out on their pump curves for the operation conditions resulting in lower pressures than desired. Therefore, it is recommended to replace two of the pumps with large capacity.

### 6.2.3 Year 2025 Direct Use Demands Analysis

The Year 2025 analysis showed deficiencies in the 1299 Zone, 930 Zone and in several recycled water effluent pump, station facilities. The 930 Zone supply facilities from the RP-1 930 Pump Station and CCWRF Effluent Pump Station could not meet the summer maximum day demands. These pump stations should be upgraded. The CCWRF Effluent Pump Station is recommended to have two pumps replaced with larger capacity pumps to increase the station output to 13,000 gpm. The RP-1 930 Zone Pump Station is recommended to have one of the smaller pumps replaced with a larger capacity pump to match the existing large capacity pumps.

Pump upgrades are also recommended for the RP-4 1158 Zone Pump Station to increase station capacity by replacing three pumps with the larger 7,200 gpm capacity and adding one pump as a standby pump.

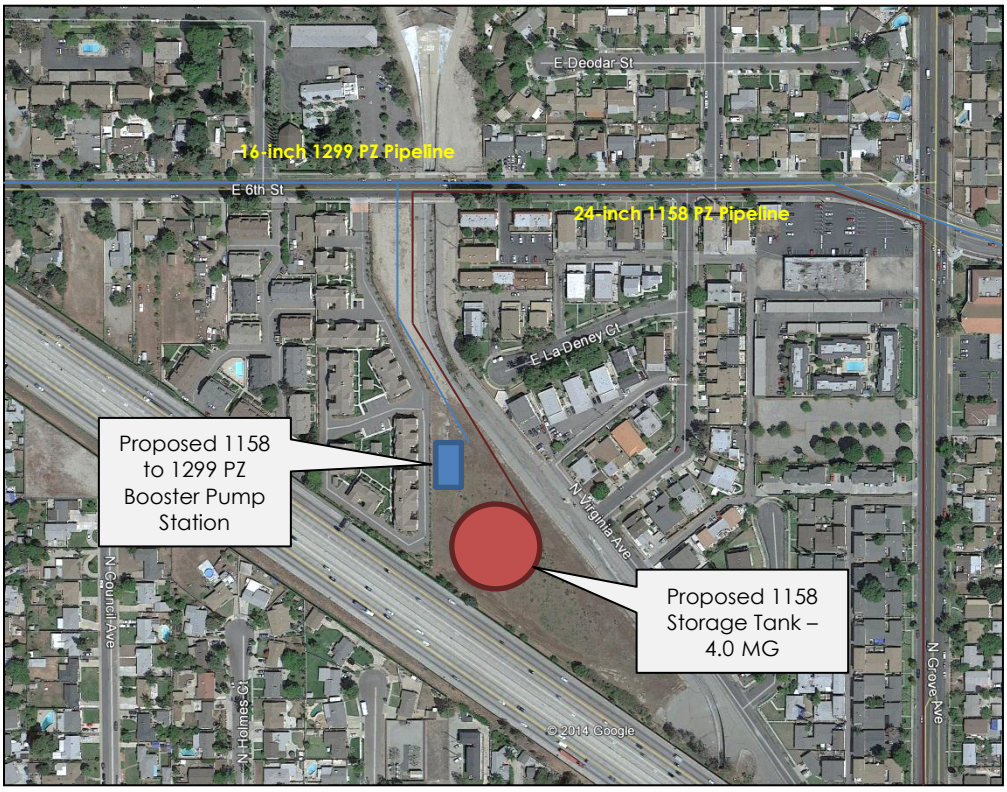
The 30-inch 930 Zone pipeline between RP-1 and Riverside Drive should be paralleled with a 42-inch pipeline to alleviate velocities and low pressures in the 930 Zone.

The 1299 Zone showed deficiencies and low service pressures in the western portion of the zone. To alleviate these concerns, a parallel pipeline system is recommended. A new 24-inch and 16-inch pipeline is recommended in 6th Street from Haven Avenue to Euclid Avenue, approximately 28,900 lf.

### 6.2.4 Year 2030 Direct Use Demands Analysis

The 1158 Zone and 1299 Zone in the western portion of the service areas were shown to be deficient with high velocities and low service pressures, in addition to the supply facilities inability to adequately keep up with the demands during the demand period. To mitigate these issues, it is recommended that a new 1158 Zone Storage Tank, 4.0 MG, be installed as shown in Figure 6-2.

Figure 6-2 Proposed 1158 Storage Tank Site



In addition to the storage tank, a new 30-inch 1158 Zone pipeline from RP-1 to the storage tank is required to be routed along East Francis Street and Grove Avenue to the tank site. A new 1299 Zone Pump Station will pump from the storage tank into the 1299 Zone pipeline in 6th Street.

### 6.2.5 Year 2035 Direct Use Demands Analysis

The Year 2035 analysis and recommendations are primarily due to the growth associated with development in the 930 Zone and 1050 Zone service areas.

To meet the 930 Zone summer demands requires additional upgrades to the RP-1 930 Zone Effluent Pump Station and CCWRF Effluent Pump Station. The RP-1 930 Zone Effluent Pump Station requires two pumps to be replaced with larger capacity pumps, assumed to be the same as the existing large capacity pumps with 9,330 gpm capacity. The CCWRF Effluent Pump Station requires the addition one pump with the same capacity as the existing large capacity pumps.

Additionally, the CCWRF facility will require an additional 3.0 MG of equalization storage to meet the flows required from the facility during low effluent flow periods.

To mitigate low pressures and high velocities in the 1050 Zone, it is recommended to upgrade the RP-1 1050 Zone Effluent Pump Station. Two of the pumps should be replaced with larger capacity pumps for a station capacity of 16,000 gpm. The 1050 Zone pipeline from RP-1 to Riverside Drive should have a 24-inch parallel pipeline installed, approximately 2,000 lf.

See Figures 6-3, 6-4, 6-5, and 6-6 for illustrations of the recommended improvements to meet the direct use demands.

PROPOSED IMPROVEMENT
- 24" Pipeline in Kimball Ave. – 800 PZ 12,620 LF
- RP–1 1158 Effluent Pump Station – Replace With 2 Large Pumps

1630W PZ 5MG TANK
1630W PUMP STATION
1630E PUMP STATION
1299 PZ 5MG TANK
1158 PZ 13MG TANK
SAN SEVAINE 5
VICTORIA
BANANA
HICKORY
RP–4
RP–3
RP–1
RP–5
BROOKS
ELY
DECLEZ
930 PZ 5MG TANK
CCWRF
930 TO 800 PZ PRV
24" PIPELINE
UPGRADES TO RP–1 1158 ZONE EFFLUENT PUMP STATION
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

Foothill Fwy CA-210
San Bernardino Fwy I-10
W Foothill Blvd. CA-66
W Base Line Rd.
Baseline Ave.
Summit Ave.
Ontario Fwy I-15
W 6th St.
W 4th St.
Holt Blvd
W Mission Blvd.
E Jurupa St.
Jurupa Ave
E Francis St.
Pamona Fwy
Riverside Dr.
Chino Ave.
Schaefer Ave.
Edison Ave.
Eucalyptus Ave
Kimball Ave.
Merrill Ave
Limonite Ave
Slover Ave
Valley Blvd
Mission Blvd
Claremont
Upland
Rancho Cucamonga
Ontario
Ontario Mills
Ontario Int'l Airport
Chino Airport
Fontana
Rialto
Rialto Municipal Airport
Broomington
Pomona
San Dimas
La Verne
Brackett Field Airport
Cable Airport
Auto Club Speedway
Jurupa Hills Regional Park
Riverside Cement Company
Mira Loma
Indian Hills Golf Club
Hidden Valley Wildlife Area
River Trails Park
Riverside Municipal Airport
Chaffey College
Upland Hills Country Club
Central Park
Hollow Run Park
Los Serranos Golf Course
RIVERSIDE

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 800 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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A MUNICIPAL WATER DISTRICT

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2020 - Direct Use Demands Only
## FIGURE 6-3

PROPOSED IMPROVEMENT

- 24" / 16" Pipeline in 6th St – 1299 PZ – 28,900 LF
- RP-4 1158 PZ Effluent Pump Station – Replace 3 Pumps W\ Larger 7,200 GPM, ADD 1 Pump Standby
- 54" Parallel Pipeline RP-1 TO Riverside Dr. – 2,300 LF
- Increase EQ Storage at RP-1 to 24 MG
- RP-1 930 PZ Effluent Pump Station – Replace 1 Pump W/ 9,330 GPM
- CCCWRF 930 PZ Effluent Pump Station – Replace 2 Pumps W/ Larger Capacity, Increase to 13,000 GPM PS Capacity

1630W PZ 3MG TANK
1630W PUMP STATION
24" PIPELINE 1299 ZONE
1299 PZ 5MG TANK
1630E PUMP STATION
SAN SEVAINE 5
VICTORIA
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
PUMP UPGRADES TO RP-4 1158 ZONE PS
INCREASE EQ. STORAGE AT RP-1 TO 24 MG
PARALLEL 42" PIPELINE 930 ZONE
RP-1
PUMP UPGRADES TO RP-1 930 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
PUMP UPGRADES @ CCWRF 930 ZONE PS
930 TO 800 PZ PRV
RP-5
WINEVILLE
ELY
DECLEZ
RP-3
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 930 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2025 - Direct Use Demands Only
## FIGURE 6-4

PROPOSED IMPROVEMENT

- 42" Parrallel 930 PZ Pipeline in Chino Ave. – 1,700 LF
- 30" Pipeline 1158 PZ From RP-1 to 1158 PZ Tank – 31,800 LF
- 1158 PZ Storage Tank – 5.0 MG
- 1158 to 1299 Booster Pump Station – 4 Pumps, 75 HP

1630W PZ 3MG TANK

1630W PUMP STATION

PROPOSED 1158 TO 1299 PUMP STATION

PROPOSED 1158 ZONE 5.0 MG TANK

30" 1158 ZONE PIPELINE

42" PARALLEL

1158 PZ 13MG TANK

1299 PZ 5MG TANK

1630E PUMP STATION

SAN SEVAINE 5

VICTORIA

BANANA

HICKORY

RP-4

RP-3 NEW

RP-3

RP-1

RP-5

WINEVILLE

ELY

DECLEZ

930 PZ 5MG TANK

930 TO 800 PZ PRV

CCWRF

BROOKS

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 1158 Improvements
- Zone 930 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2030 - Direct Use Demands Only
## FIGURE 6-5

PROPOSED IMPROVEMENT

- 24" Parallel Pipeline 1050 PZ from RP-1 to Riverside dr. – 2,000 LF
- RP-1 930 PZ Effluent Pump Station – Replace 2 Pumps W/ 9,330 GPM Pumps
- RP-1 1050 PZ Effluent Pump Station – Replace 2 Pumps W/ Larger Capacity for Station Capacity of 16,000 GPM
- CCWRF 930 PZ Effluent Pump Station Add 1 Pump
- 3.0 MG EQ Storage Tank at CCWRF

1630W PZ 3MG TANK
1630W PUMP STATION
SAN SEVAINE 5
VICTORIA
1299 PZ 5MG TANK
1630E PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
RP-3
ELY
DECLEZ
RP-1
RP-5
930 PZ 5MG TANK
CCWRF
930 TO 800 PZ PRV
BROOKS
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

24" 1050 PZ PARALLEL PIPELINE
PUMP UPGRADES RP-1 930 ZONE EFFLUENT PUMP STATION
PUMP UPGRADES RP-1 1050 ZONE EFFLUENT PUMP STATION

3.0 MG EQ STORAGE
CCWRF PS UPGRADES

**LEGEND:**

- Existing Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2035 - Direct Use Demands Only

FIGURE 6-6

# 6.3 GWR IMPLEMENTATION ANALYSIS AND IMPROVEMENTS

## 6.3.1 Existing GWR Conditions Analysis and Improvements

The existing analysis and demands were considered to be those for the Year 2015. The demands shown in Table 6.1 were applied to the model nodes and an EPS model was run. The results of the model show that for both average and maximum demand conditions there are no system improvements proposed other than to increase turnout capacities for some of the basins. The turnout capacity upgrades are required since the GWR Implementation program results in recharging additional recycled water supply than under current operations and within a 9-month period as opposed to be able to over the entire year. The following basin turnout capacity upgrades are proposed as shown in Table 6.2.

**Table 6.2 GWR Implementation Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Flow Capacity (cfs) | Proposed Flow/Turnout Capacity (cfs) |
|---|---|---|
| Ely (1-3) | 6.00 | 6.19 |
| Hickory | 4.00 | 4.64 |
| Turner | 8.00 | 9.28 |
| Victoria | 8.00 | 10.52 |

## 6.3.2 Year 2020 GWR Implementation Analysis and Improvements

### 6.3.2.1 Year 2020 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The hydraulic model analysis scenario analyzed the system for a GWR Basin demand of 20.8 MGD, including the Wineville, San Sevaine (1-3), and Victoria (increase) basins scheduled to come on line for this planning year.

The analysis showed that increased flow is required to the Northern Service Area to meet the increased direct use demands and demands to the GWR basins. More flow from the RP-1 effluent pump stations was required by the RP-1 1158 Pump Station. In order to increase the flow through this pump station without exceeding the capacity of the RP-1 supply, the 930 PS Pump Station was required to be limited.

To limit the flow from the RP-1 930 Pump Station, the flow through the 930/800 PRV could be reduced. This reduction in flow could take place if more effluent from RP-5 could be pumped to meet demands in the 800 PZ. The 18-inch pipeline in Bickmore is a restriction in the 800 PZ as it has velocities that exceed 7 fps, even under existing demand conditions. Therefore, a new 24-inch pipeline in Kimball Avenue, from RP-5 to connect to the existing 18-inch pipeline at Millcreek is proposed.

To meet the needs of the GWR Basins in the 1630E PZ while avoiding suction pressure concerns at the 1630E Booster Pump Station and depleting the 1299 Storage Tank, the proposed 18 MG 1630E Storage Tank is required. Therefore, it is recommended to install the 36-inch pipeline from the existing 1630E pipeline north of Baseline Road to the new 1630E Storage Tank. The proposed 18 MG 1630E Storage Tank is an existing tank build for the Lloyd W. Michael Water Treatment Plant by the CVWD. This tank will be converted to the IEUA recycled water system and 1630E pressure zone.

Additionally, the pressures to the 7th/8th Street Basins were low and even negative at some hours of the day. The suction line to the basins is 16-inch and is undersized to allow the full basin recharge demand as shown in Table 4.4 plus allow both pumps at the 1630 West Recycled Water Pump Station to operate. The fill rate to the 7th/8th Street Basins should be limited to approximately 1.1 MGD, or 1,500 gpm. When the 7th/8th Street Basins are flowing, the 1630 West Recycled Water Pump Station should be limited to one pump in operation.

#### 6.3.2.2 Year 2020 GWR plus Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 14.2 MGD from the 20.8 MGD during the average demand conditions for Year 2020.

No other deficiencies were recognized in the model analysis for the maximum day Year 2020 demand conditions.

For the Year 2020 analysis, one existing pump station is proposed to require upgrades, RP-1 1158 Zone Effluent Pump Station. The current design capacity and proposed pump station capacity is shown below. Other Year 2020 facility improvements are shown in Figure 6-7.

| Pump Station | Current Design Capacity | Year 2020 Proposed Design Capacity | Pump Upgrade |
|---|---|---|---|
| RP-1 1158 Zone Effluent Pump Station | 11,100 gpm | 12,700 gpm | Replace 2 Pumps with Larger Capacity |

PROPOSED IMPROVEMENT

- Conversion of 18 MG 1630E Storage Tank
- 36" 1630E Pipeline to 1630E Tank – 6,715 LF
- RP-1 1158 PS Upgrades – Replace Zone Pumps W/ Larger Capacity
- 16" Pipeline to Wineville Basin – 1,200 LF
- 24" 800 PZ Pipeline in Kimball Ave. – 12,620 LF

NEW 1630 ZONE 18 MG TANK
SAN SEVAINE (1-3)
SAN SEVAINE 5
VICTORIA
VICTORIA (INCREASE)
1630E PUMP STATION
1299 PZ 5MG TANK
1630W PZ 3MG TANK
1630W PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
BROOKS
ELY
WINEVILLE
16" PIPELINE
RP-3
DECLEZ
UPGRADES TO RP-1 1158 ZONE EFFLUENT PUMP STATION
RP-1
930 PZ 5MG TANK
CCWRF
24" PIPELINE
RP-5
930 TO 800 PZ PRV
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

LEGEND:

- Existing Basins
- Year 2025 Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 800 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2020 - Base GWR Implementation
## FIGURE 6-7

### 6.3.3 Year 2025 GWR Implementation Analysis and Improvements

#### 6.3.3.1 Year 2025 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2025 model analysis scenario analyzed the system for a GWR Basin demand of 19.2 MGD, including the addition of the following basins: RP-3 (New Cell), Lower Day, and Etiwanda Debris basins, which are scheduled to come on line for this planning year.

Due to the increased direct use demands, the RP-1 diurnal supply pattern is not able to meet the demands during the peak irrigation period. The supply pattern from the RP-1 facility will be required to flow more evenly throughout the day. This is proposed to be accomplished by increased equalization storage upstream of the RP-1 effluent pump stations. The existing 6.0 MG equalization storage should be increased to 13.0 MG.

In addition, a 16-inch pipeline is required from the existing 36-inch 1630E pipeline to the proposed Etiwanda Debris Basin.

#### 6.3.3.2 Year 2025 Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 12.6 MGD from the 19.2 MGD during the average demand conditions for Year 2025.

To meet the maximum day demands in the Southern Service Area, the RP-1 930 Zone Effluent Pump Station capacity should be increased. Also, the existing 30-inch diameter pipeline from the 930 Zone Effluent Pump Station to the existing 930 Zone pipeline in Riverside Drive experiences velocities up 8 fps. A parallel 42-inch diameter pipeline is recommended.

The CCWRF 930 Zone Effluent Pump Station is modeled to utilize all five of the existing pumps with each operating on far right side of the pump curve. Therefore, for reliability it is recommended that 2 new pumps of equal size to the existing pumps or replace a minimum of 2 pumps with larger capacity pumps.

The demand increase in the Northern Service Area requires additional capacity to the RP-4 1158 Zone Effluent Pump Station. It is recommended that two pumps are replaced with larger capacity pumps at this station.

The pressures in the west portion of the 1299 Zone do not meet the minimum pressure criteria and the 24-inch transmission main experiences high velocities. Therefore, a 16-inch diameter pipeline is proposed from the existing 30-inch along 6th Street to the existing 30-inch transmission main at Euclid Avenue. (See Figure 6-8)

For the Year 2025 analysis, three existing pump stations are proposed to require upgrades, CCRWF 930 Zone Effluent Pump Station, RP-1 930 Zone Effluent Pump Station, and RP-4 1158 Zone

Effluent Pump Station. The current design capacity and proposed pump station capacity is shown below. Other Year 2025 facility improvements are shown in Figure 6-8.

| Pump Station | Current Design Capacity | Year 2025 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| RP-4 1158 Zone Effluent Pump Station | 22,500 gpm | 29,100 gpm | Replace 3 pumps and add 1 pump with larger capacity |
| RP-1 930 Zone Effluent Pump Station | 27,030 gpm | 30,700 gpm | Replace 1 pump with larger capacity |
| CCWRF 930 Zone Effluent Pump Station | 10,340 gpm | 13,000 gpm | Replace 2 pumps with larger capacity |

PROPOSED IMPROVEMENT

- 24" Pipeline to Lower Day – 10,520 LF
- 16" 1630E Pipeline – 2,670 LF
- 16" Parallel 1299 PZ Pipeline – 15,289 LF
- 24" Parallel 1299 PZ Pipeline – 13,600 LF
- 54" 930 PZ Parallel Pipeline – 2,300 LF
- RP-4 1158 PZ Pump Station Capacity Upgrades – Replace 3 Pumps W/ 7,200 GPM
- RP-1 930 PZ Pump Station Capacity Upgrades – Replace 1 Pump W/ 9,330 GPM
- CCWRF Pump Station Capacity Upgrades – Replace 2 Pumps Larger Capacity
- Increase EQ Storage at RP-1 to 24 MG

ETIWANDA DEBRIS
16" PIPELINE
SAN SEVAINE (1-3)
SAN SEVAINE 5
VICTORIA
VICTORIA (INCREASE)
LOWER DAY
24" PIPELINE
1299 PZ 5MG TANK
1630E PUMP STATION
1630W PZ 3MG TANK
1630W PUMP STATION
24" / 16" PIPELINE 1299 ZONE
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
PUMP UPGRADES TO RP-4 1158 ZONE PS
RP-3 NEW
RP-3
WINEVILLE
DECLEZ
ELY
INCREASE EQ. STORAGE AT RP-1 TO 24 MG
PARALLEL 42" PIPELINE 930 ZONE
RP-1
PUMP UPGRADES TO RP-1 930 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
PUMP UPGRADES @ CCWRF 930 ZONE PS
930 TO 800 PZ PRV
RP-5
BROOKS
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Year 2025 Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 930 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2025 - Base GWR Implementation
## FIGURE 6-8

### 6.3.4 Year 2030 GWR Implementation Analysis and Improvements

#### 6.3.4.1 Year 2030 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2030 model analysis scenario analyzed the system for a GWR Basin demand of 20.7 MGD, including the addition of the following basins: Montclair (1-3), College Heights East, and College Heights West basins, which are scheduled to come on line for this planning year.

The additional College Heights East and West basins are located in the 1630W PZ and there are currently no pipelines to convey recycled water from the existing infrastructure to the basins. Approximately 19,600 lf of 36-inch new pipeline in Foothill Boulevard is required to serve these basins.

The Montclair basin in the 1299 PZ and will require approximately 7,800 lf of new 30-inch diameter pipeline.

The 1630W PZ is deficient in supply capacity for this GWR condition as well. The hydraulic analysis indicates additional capacity is needed at the 1299 to 1630W Booster Pump Station. Due to space constraints at this facility, it is assumed existing pumps will be replaced with larger capacity pumps.

#### 6.3.4.2 Year 2030 GWR plus Maximum Direct Use Demand Conditions (Summer)

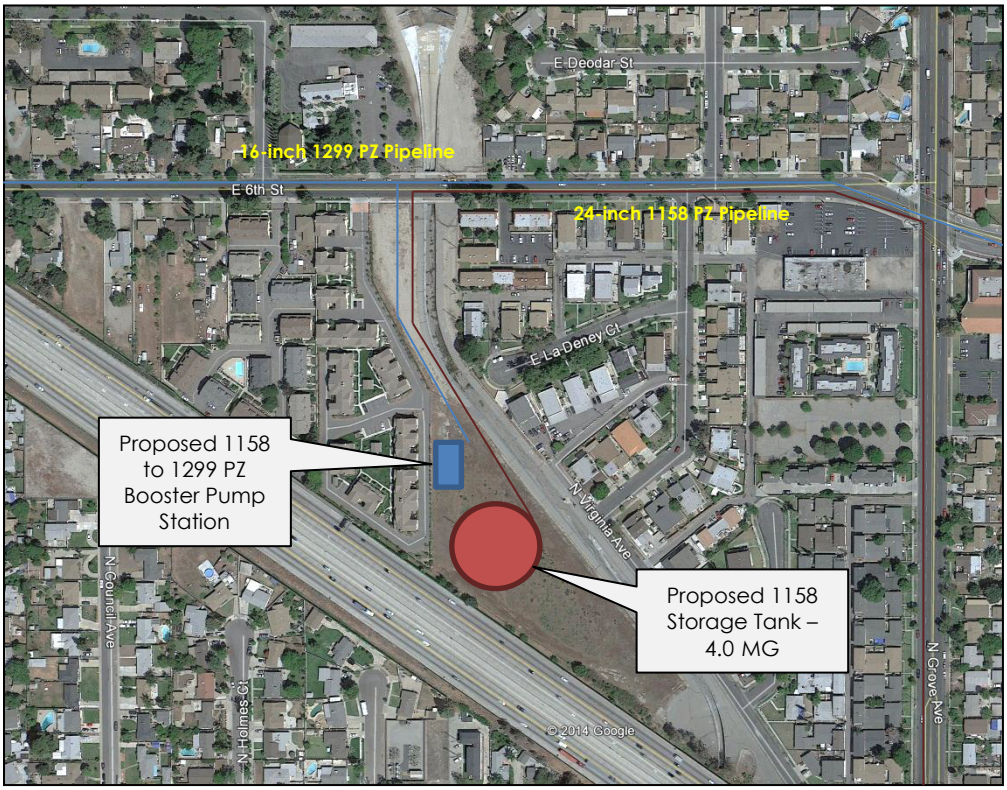
The same GWR Basins were analyzed as was the Year 2030 Average Demand Conditions; however, due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 1.7 MGD from the 20.7 MGD during the average demand conditions for Year 2030.

Due to the increased direct use demands, the 1158 PZ and 1299 PZ are deficient. Velocities in the pipelines exceed 7 fps and the effluent pumps from the RP-1 and RP-4 facilities cannot meet the demands.

In order to mitigate the deficiencies in the 1158 PZ and 1299 PZ, a new 1158 PZ Storage Tank, and new 1158 to 1299 Booster Pump Station are proposed.

The 1158 Storage Tank is proposed to be 4.0 MG and located in the City of Upland, between 6$^{th}$ Street and the 10-Fwy within the SBCFCD property along the existing flood control channel south of the 7$^{th}$/8$^{th}$ Street Basins. (See Figure 6-9)

Figure 6-9 Proposed 1158 Storage Tank Site




The proposed 1158 PZ pipeline would be routed from the RP-1 1158 Pump Station northerly to Francis Street, and then westerly along Francis Street to Grove Avenue. The pipeline would then be routed northerly along Grove Avenue to 6th Street, and then westerly along 6th Street to the 1158 Storage Tank site.

A new 1158 to 1299 Booster Pump Station is proposed to be located at the 1158 Storage Tank Site. The pump station will boost pressure in the westerly end of the 1299 PZ during peak demand and GWR basin fill periods. The pump station is assumed to have four (4) pumps of equal size, each with 75 Hp motors with VFD's.

Other Year 2030 facility improvements are shown in Figure 6-10.

PROPOSED IMPROVEMENT

- 36" 1630W Pipeline in Foothill Blvd – 19,600 LF
- 30" 1299 PZ Pipeline to Montclair Basins – 7,840 LF
- 1630W Pump Station Capacity Upgrades – Replace Pumps W/ Larger Capacity
- 15 MG 1630W Storage Tank
- 42" Parallel Pipeline in Chino Ave. – 930 PZ – 1,600 LF
- 30" 1158 PZ Pipeline RP-1 to 1158 PZ Tank – 31,800 LF
- 4.0 MG 1158 PZ Storage Tank
- New 1158 to 1299 Booster Pump Station – 4 Pumps, 75 HP

1630 ZONE 15 MG TANK
1630W PZ 3MG TANK
36" PIPELINE
COLLEGE HEIGHTS EAST
COLLEGE HEIGHTS WEST
MONTCLAIR (1-3)
30" PIPELINE
PUMP UPGRADES 1299 TO 1630 PUMP STATION
1630W PUMP STATION
PROPOSED 1158 TO 1299 PUMP STATION
PROPOSED 1158 ZONE 4.0 MG TANK
30" 1158 ZONE PIPELINE
BROOKS
ELY
RP-1
RP-5
930 PZ 5MG TANK
CCWRF
930 TO 800 PZ PRV
42" PARALLEL
ETIWANDA DEBRIS
SAN SEVAINE (1-3)
SAN SEVAINE 5
LOWER DAY
VICTORIA
VICTORIA (INCREASE)
1299 PZ 5MG TANK
1630E PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
WINEVILLE
RP-3 NEW
RP-3
DECLEZ
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Year 2030 Basins
- Zone 1630 Improvements
- Zone 1299 Improvements
- Zone 1158 Improvements
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2030 - Base GWR Implementation
## FIGURE 6-10

For the Year 2030 analysis, in addition to the new 1158 to 1299 Zone RW Pump Station, two existing pump stations are proposed to require upgrades, the 1630 West RW Pump Station and the 1630 East RW Pump Station. The current design capacity and proposed pump station capacity is shown below.

| Pump Station | Current Design Capacity | Year 2030 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| 1630 West RW Pump Station | 6,000 gpm | 6,350 gpm | Replace 3 pumps with larger capacity |
| 1630 East RW Pump Station | 8,250 gpm | 9,140 gpm | 1 New Pump |

### 6.3.5 Year 2035 GWR Implementation Analysis and Improvements

#### 6.3.5.1 Year 2035 GWR plus Average Direct Use Demand Conditions (Spring/Fall)

The Year 2035 model analysis scenario analyzed the system for a GWR Basin demand of 22.6 MGD, including the addition of the following basins: Upland, Jurupa, and Grove basins which are scheduled to come on line for this planning year.

The addition of the Upland Basin in the 1630W PZ will be supplied from the 36-inch pipeline in Foothill Boulevard that was constructed for the two College Heights Basins.

The Jurupa Basin will require a new 30-inch pipeline from the existing 36-inch Wineville Pipeline in Francis Street and the SBCFCD channel. This pipeline is proposed to be routed northerly along the SBCFCD channel to the Jurupa Basin.

In addition to the pipeline to the Jurupa Basin, the existing 1158 PZ is deficient and creates low pressures in the easterly end of the zone when applying the GWR Basin demands. To mitigate this condition, approximately 5,366-lf of 36-inch pipeline is proposed in Etiwanda Avenue from Valley Boulevard to Jurupa Street. A 30-inch pipeline is proposed in Jurupa Street from Etiwanda Avenue to the 30-inch Jurupa Basin pipeline. A 20-inch pipeline is proposed in Jurupa Street from Etiwanda Avenue westerly to the existing 20-inch pipeline. (See Figure 6-11)

The Grove Basin is within the 1050 PZ and is assumed to come online after the proposed New Model Colony streets and pipelines are installed. It is assumed that the New Model Colony will construct 24-inch and 20-inch pipelines in Riverside Drive. A 12-inch pipeline is required in Grove Avenue between Riverside Drive and Chino Avenue.

#### 6.3.5.2 Year 2035 GWR plus Maximum Direct Use Demand Conditions (Summer)

The same GWR Basins were analyzed for this condition as for the Year 2035 Average demand conditions. Due to the maximum direct use demands and limited wastewater supply, the GWR flows were reduced accordingly to not exceed the wastewater supply available. The total basin demand was reduced to 4.6 MGD from the 22.6 MGD during the average demand conditions for Year 2035.

The RP-1 930 Pump Station was not able to keep up with demands for the direct use peak demand periods. Therefore, two (2) pumps are proposed to be replaced with larger capacity pumps, each to be equal to the largest existing pump.

The pipeline from the RP-1 1050 Pump Station to Riverside Drive is deficient. A parallel 24-inch 1050 PZ pipeline is recommended.

For the Year 2035 analysis, two existing pump stations are proposed to require upgrades, the RP-1 930 Zone Effluent Pump Station and the RP-1 1050 Zone Effluent Pump Station. The current design capacity and proposed pump station capacity is shown below. Other Year 2035 facility improvements are shown in Figure 6-11.

| Pump Station | Current Design Capacity | Year 2035 Proposed Design Capacity | Pump Upgrades |
|---|---|---|---|
| RP-1 930 Zone Effluent Pump Station | 27,030 gpm | 39,000 gpm | Replace 2 pumps with larger capacity |
| RP-1 1050 Zone Effluent Pump Station | 11,250 gpm | 15,879 gpm | Replace 2 pumps with larger capacity |

### 6.3.6 Year 2035 Additional External Supply Analysis

A model analysis was conducted assuming an external supply source is provided to the 930 PZ, and to be supplied to the existing 30-inch pipeline just north of the existing 930 PZ to 800 PZ PRV's location. The average day demand analysis assumes an external supply of 15,000 AFY, which equates to approximately 13 MGD. In order for the system to operate, it was necessary to control the supply source by the 930 West Reservoir level. Approximately 7.7 MGD was able to be supplied into the system. This supply resulted in the CCWRF supply reduced to less than 1 MGD. No other system facility improvements were required.

The maximum day analysis shows that approximately 11 MGD can be provided by the supply source, and was also required to be controlled by the 930 West Reservoir level. Approximately 3.8 MGD was supplied by the CCWRF. The RP-1 930 Zone Effluent Pump Station pump capacity improvements for Year 2035 could be eliminated. No other changes to improvement recommendations are required.

PROPOSED IMPROVEMENT

- 12" to Grove Basin – 1,000 LF
- 36" Pipeline in 1158 PZ 19,600 LF
- 30" Pipeline in Jurupa Street to Jurupa Basin – 5,400 LF
- 20" Pipeline in Jurupa Street – 1,300 LF
- 3 MG EQ Storage at CCWRF
- CCWRF Pump Station Capacity Upgrades – Add 1 Pump
- 24" 1050 PZ Parallel Pipeline – 2,000 LF
- RP-1 930 Pump Station Capacity Upgrades – Replace 2 pumps at 9,300 GPM
- RP-1 1050 Pump Station Capacity Upgrades – Replace 2 pumps W/ Larger Capacity

ETIWANDA DEBRIS
SAN SEVAINE (1-3)
SAN SEVAINE 5
LOWER DAY
VICTORIA
VICTORIA (INCREASE)
1630E PUMP STATION
1299 PZ 5MG TANK
1630W PZ 3MG TANK
1630 ZONE 15 MG TANK
COLLEGE HEIGHTS EAST
COLLEGE HEIGHTS WEST
UPLAND
MONTCLAIR (1-3)
1630W PUMP STATION
1158 PZ 13MG TANK
HICKORY
BANANA
RP-4
BROOKS
LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY
36" PIPELINE
30" PIPELINE
JURUPA
WINEVILLE
RP-3 NEW
RP-3
DECLEZ
ELY
RP-1
16" PIPELINE
GROVE
24" 1050 PZ PARALLEL PIPELINE
PUMP UPGRADES RP-1 930 ZONE EFFLUENT PUMP STATION
PUMP UPGRADES RP-1 1050 ZONE EFFLUENT PUMP STATION
930 PZ 5MG TANK
CCWRF
CCWRF 3 MG EQ STORAGE
CCWRF 930 ZONE PUMP STATION UPGRADES
RP-5
ALL OF PRADO MET BY RP-5
930 TO 800 PZ PRV
SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- Year 2035 Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Proposed Recycled Water System Improvements
## YEAR 2035 - Base GWR Implementation
## FIGURE 6-11

# 7.0 PROGRAM SENSITIVITY ANALYSIS

Section 6 analyzed the recycled water system assuming the groundwater recharge program will include all potential basins listed and phased, or implemented, as shown in Table 4.2. This section analyzes various operational scenarios to understand the needs and impacts on the recycled water system assuming the number of groundwater basins to be converted to recycled water supply is limited and assuming an external supply is available for IEUA to meet their Prado Obligation. The basins that would be included in the analysis include only the already existing basins and those committed in the 2013 RMPU. Additionally, a brief analysis was conducted to estimate when the RMPU basins would be appropriate come on line.

## 7.1 SENSITIVITY ANALYSIS SCENARIOS

In addition to the GWR implementation analyses discussed in Section 6, three (3) additional sensitivity analysis scenarios were analyzed to understand the limitations on the recycled water system and recharge capacities, as described below:

**Scenario A – All Basins with External Supply to meet Prado Obligation**
This scenario assumes all of the GWR implementation basins are able to be recharged with recycled water as shown in Tables 4.2 and 5.3 in the previous sections. However, rather than IEUA meeting their entire Prado Obligation directly from treated effluent, the Prado Obligation is met by an external supply source. This external supply source is unknown at this time, but it is assumed to be able to replace IEUA's current Obligation met directly from RP-5 and RP-1.

**Scenario B – Existing/RMPU Basins Only and IEUA Meeting Prado Obligation**
This scenario assumes that the number of groundwater recharge basins to be converted and receive recycled water supply for recharge is limited to a few from the current RMPU. The analysis assumes all of the existing basins will remain operational plus the following RMPU basins:

- RP-3 New Cell
- WIneville
- Etiwanda Debris
- San Sevaine (1-3)

Also, under this scenario, IEUA will continue to fulfill the Prado Obligation directly from the treated effluent as is done for current operations.

**Sensitivity Scenario C – Existing/RMPU Basins Only with External Supply to meet Prado Obligation**
This scenario assumes that the number of groundwater recharge basins to be converted and receive recycled water supply for recharge is limited to a few from the current RMPU. The analysis assumes all of the existing basins will remain operational plus the following RMPU basins:

- RP-3 New Cell
- WIneville
- Etiwanda Debris
- San Sevaine (1-3)

However, rather than IEUA meeting their entire Prado Obligation directly from treated effluent, the Prado Obligation is met by an external supply source. This external supply source is unknown at this time, but it is assumed to be able to replace IEUA's current Obligation met directly from RP-5 and RP-1.

## 7.2 SENSITIVITY ANALYSIS MASS BALANCE ANALYSIS

Scenarios A and C as described above assume an external supply source will be able to meet the IEUA Prado Obligation. This type of operation will yield more recycled water supply that will become available from the IEUA treatment facilities. Therefore, a mass balance analyzing the proposed direct use demands versus the new supply availability was performed that removed the Prado Obligation annual demand. A summary of the annual supply availability to the GWR program is provided in Table 7.1.

**Table 7.1 Sensitivity Analysis Supply versus Demands Mass Balance**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| **Southern Service Area** | | | | | |
| Southern Area Recycled Water Supply (RP-5, CCWRF) | 15,010 | 19,154 | 22,459 | 25,763 | 28,788 |
| Southern Area Direct Use Demands | 16,568 | 19,591 | 20,865 | 21,080 | 22,369 |
| Total to SARBF at Prado Obligation[1] | - | - | - | - | - |
| Southern Area Supply Surplus/(Deficit) | (4,206) | (4,186) | (3,540) | (2,309) | (1,858) |
| **Northern Service Area** | | | | | |
| Northern Area Recycled Water Supply (RP-1, RP-4) | 46,934 | 47,158 | 49,454 | 51,750 | 53,543 |
| Northern Area Direct Use Demands | 8,087 | 11,166 | 15,642 | 19,240 | 20,650 |
| Supplemental Supply to Southern Area | 4,206 | 4,186 | 3,540 | 2,309 | 1,858 |
| Total to SARBF at Prado from North[1] | - | - | - | - | - |
| Northern Area Supply Surplus/(Deficit) | 33,083 | 31,369 | 30,272 | 30,201 | 31,035 |
| **Sensitivity Analysis GWR 9-Month Operation RW Availability[2]** | **23,917** | **21,427** | **19,797** | **19,422** | **19,906** |
| 3-Month Un-Used Winter Surplus | 9,165 | 9,942 | 10,475 | 10,779 | 11,129 |

[1] The SARBF at Prado Obligation is assumed to be met by an external supply source.

[2] The GWR 9-Month Operation RW Availability shown is calculated based on the monthly mass balance and surplus analysis for the 9-month GWR operating period.

The recycled water supply availability is significantly more assuming IEUA's Prado Obligation is met from an external supply source. This is shown in Table 7.2 below.

**Table 7.2 Comparison of Recycled Water Supply Availability**

| Description | Planning Year | | | | |
|---|---|---|---|---|---|
| | Existing | Year 2020 | Year 2025 | Year 2030 | Year 2035 |
| | AFY | | | | |
| Sensitivity Analysis GWR 9-Month Operation RW Availability – with External Supply Meeting Prado Obligation | 23,917 | 21,427 | 19,797 | 19,422 | 19,906 |
| GWR 9-Month Operation RW Availability – IEUA RW Effluent Meeting Prado Obligation | 16,095 | 13,977 | 13,027 | 13,707 | 14,871 |
| Difference in GWR Availability | 7,822 | 7,450 | 6,770 | 5,715 | 5,035 |

## 7.3 SENSITIVITY ANALYSIS HYDRAULIC ANALYSIS DEMANDS

The demands used for the sensitivity analysis hydraulic model analysis utilized the same direct use demands used for the GWR implementation analyses described in Section 6. The demand changes in the model were assumed to be the increased flow to the groundwater basins that resulted from the additional supply available, by not providing flow to the Prado Obligation.

**Table 7.3 Sensitivity Analysis Demands Used for Hydraulic Analysis**

| | Existing | | Year 2020 | | Year 2025 | | Year 2030 | | Year 2035 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AD | MD | AD | MD | AD | MD | AD | MD | AD | MD |
| | MGD | | | | | | | | | |
| Recycled Water Supply | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| Direct Use Demands[1] | 22.0 | 36.0 | 27.5 | 44.4 | 32.6 | 52.7 | 36.0 | 60.0 | 38.4 | 63.9 |
| SARBF at Prado Obligation[2] | - | - | - | - | - | - | - | - | - | - |
| **GWR Available Flows[3]** | **33.3** | **21.8** | **31.7** | **14.8** | **31.6** | **11.5** | **33.2** | **9.2** | **35.1** | **9.6** |
| Total Demands | 55.3 | 55.3 | 59.2 | 59.2 | 64.2 | 64.2 | 69.2 | 69.2 | 73.5 | 73.5 |
| **GWR Available Flows if IEUA Effluent Meets Prado Obligation[4]** | **20.8** | **14.2** | **19.2** | **8.3** | **19.1** | **3.9** | **20.7** | **1.7** | **22.6** | **4.6** |
| Net Increase to GWR | 12.5 | 7.6 | 12.5 | 6.5 | 12.5 | 7.6 | 12.5 | 7.5 | 12.5 | 5.0 |

[1] The Direct Use Demands for the "AD" condition are the average demands for the spring/fall months of March, April, May, and November. The "MD" condition demands are the maximum month's demands between June and October.
[2] The SARBF at Prado Obligation demands for this sensitivity analysis are assumed to be met from an external supply source.
[3] The GWR Available Flows are the average monthly flow available for the appropriate demand period described in Footnote 1 above.
[4] See Table 6.1.

# 7.4 SENSITIVITY HYDRAULIC ANALYSIS

Computer model analyses were conducted for the three (3) sensitivity analyses, and for each scenario the analysis was conducted for each the planning years out to Year 2035. The following is a brief description of the analysis and resulting improvements proposed.

## 7.4.1 Scenario A – Hydraulic Analysis

### 7.4.1.1 Scenario A - Existing Conditions Analysis

As a result of the increased flow to the GWR basins, some of the basins would require upgrades to the turnout and delivery structures to the basins to accommodate the higher flowrates to the basins. The following is a preliminary list of the basins that are proposed to require upgrades along with their proposed capacity required.

**Table 7.4 Scenario A Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Flow Capacity (cfs) | Proposed Flow/Turnout Capacity (cfs) |
|---|---|---|
| Brooks[1] | 12.00 | 13.93 |
| Ely (1-3) | 6.00 | 12.01 |
| Hickory | 4.00 | 7.98 |
| San Sevaine (5)[1] | 24.00 | 28.90 |
| Turner | 8.00 | 12.38 |
| Victoria | 8.00 | 11.45 |

[1] Additional basin requiring upgrades beyond those identified in the based GWR Implementation analysis.

Other system improvements were required for this existing conditions demand and basin flow scenario. The system improvements that were proposed and related to the Year 2020 GWR Implementation analysis are required earlier in the planning horizon for this Existing Conditions scenario. These improvements are shown in the summary of improvements table for Scenario A, Table 7.6.

### 7.4.1.2 Scenario A - Year 2020 Analysis

The Year 2020 analysis showed that in addition to the facilities proposed for GWR Implementation analysis, upgrades to the 1630 East Recycled Water Pump Station and a parallel 16-inch 1299 Zone pipeline are required. These improvements are shown in the summary of improvements table for Scenario A, Table 7.6.

### 7.4.1.3 Scenario A - Year 2025 Analysis

The Year 2025 analysis showed that no additional facility improvements are required than already are proposed to meet direct use demands and GWR Implementation as described in Section 6.

#### 7.4.1.4 Scenario A - Year 2030 Analysis

Significant system facility improvements are required to meet the Year 2030 conditions for this scenario. A new 30-inch 1158 Zone pipeline is proposed from RP-5 to the 30-inch 1158 Zone pipeline previously proposed for the direct use demands analysis. This will require a new 1158 Pump Station at RP-5. This scenario also requires capacity upgrades at the 1299 Zone Pump Station at RP-4 and increased equalization storage at RP-4 of approximately 1.6 MG. These improvements are shown in the summary of improvements table for Scenario A, Table 7.6.

#### 7.4.1.5 Scenario A - Year 2035 Analysis

No additional system improvements are required beyond those already identified from the direct use and GWR Implementation analysis scenarios discussed in Section 6.

See Figure 7-1 an illustration of the proposed facilities related to Scenario A for Years 2020 through Year 2035.

### 7.4.2 Scenario B – Hydraulic Analysis

This scenario assumes that IEUA will continue to meet Prado Obligation and that the proposed basins to be implemented for recycled water recharge are only the RMPU basins as described in Section 7.1.

#### 7.4.2.1 Scenario B - Existing Conditions Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6.

#### 7.4.2.2 Scenario B - Year 2020 Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation basins described in Section 6. These improvements are shown in the summary table for Scenario B, Table 7.7.

#### 7.4.2.3 Scenario B - Year 2025 Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6. However, since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. These improvements are shown in the summary of improvements table for Scenario B, Table 7.7.

#### 7.4.2.4 Scenario B - Year 2030 Analysis

Since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. The only additional improvement shown to be required beyond those required for the base GWR Implementation program is to increase the capacity of the proposed 1158 Zone Storage Tank from 5.0 MG to 8.0 MG. These improvements are shown in the summary of improvements table for Scenario B, Table 7.7.

#### 7.4.2.5 Scenario B - Year 2035 Analysis

Since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. No additional facilities other those required for the base GWR Implementation program in Section 6 are proposed. These improvements are shown in the summary of improvements table for Scenario B, Table 7.7.

See Figure 7-2 an illustration of the proposed facilities related to Scenario B for Years 2020 through Year 2035.

### 7.4.3 Scenario C – Hydraulic Analysis

This scenario assumes that IEUA will obtain an external supply source to meet Prado Obligation and that the proposed basins to be implemented for recycled water recharge are only the RMPU basins as described in Section 7.1.

#### 7.4.3.1 Scenario C - Existing Conditions Analysis

As a result of the increased flow to the GWR basins, some of the basins would require upgrades to the turnout and delivery structures to the basins to accommodate the higher flowrates to the basins. The following is a preliminary list of the basins that are proposed to require upgrades along with their proposed capacity required. It should be noted that the basin capacity upgrades shown are the same as those required for Scenario A conditions.

**Table 7.5 Scenario C Proposed Basin Turnout Upgrades**

| Basin | Existing Turnout Flow Capacity (cfs) | Proposed Flow/Turnout Capacity (cfs) |
|---|---|---|
| Brooks[1] | 12.00 | 13.93 |
| Ely (1-3) | 6.00 | 12.01 |
| Hickory | 4.00 | 7.98 |
| San Sevaine (5)[1] | 24.00 | 28.90 |
| Turner | 8.00 | 12.38 |
| Victoria | 8.00 | 11.45 |

[1] Additional basin requiring upgrades beyond those identified in the based GWR Implementation analysis.

Other system improvements were required for this existing conditions demand and basin flow scenario. The system improvements that were proposed and related to the Year 2020 base GWR Implementation analysis are required earlier in the planning horizon for this Existing Conditions scenario. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

#### 7.4.3.2 Scenario C - Year 2020 Analysis

The Year 2020 analysis showed that in addition to the facilities proposed for the base GWR Implementation analysis, upgrades to the 1630 East Recycled Water Pump Station and a parallel 16-inch 1299 Zone pipeline are required. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

#### 7.4.3.3 Scenario C - Year 2025 Analysis

No additional facility improvements are required for this scenario condition beyond those already identified for the direct use and base GWR Implementation program described in Section 6. However, since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

#### 7.4.3.4 Scenario C - Year 2030 Analysis

Significant system facility improvements are required to meet the Year 2030 conditions for this scenario. A new 30-inch 1158 Zone pipeline is proposed from RP-5 to the 30-inch 1158 Zone pipeline previously proposed for the direct use demands analysis. This will require a new 1158 Pump Station at RP-5. This scenario also requires capacity upgrades at the 1299 Zone Pump Station at RP-4 and increased equalization storage at RP-4 of approximately 1.6 MG. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

#### 7.4.3.5 Scenario C - Year 2035 Analysis

Since only the RMPU basins described in Section 7.1 are proposed, any facilities required for the other base GWR Implementation basins described in Section 6 are not included. No additional facilities other those required for the base GWR Implementation program in Section 6 are proposed. These improvements are shown in the summary of improvements table for Scenario C, Table 7.8.

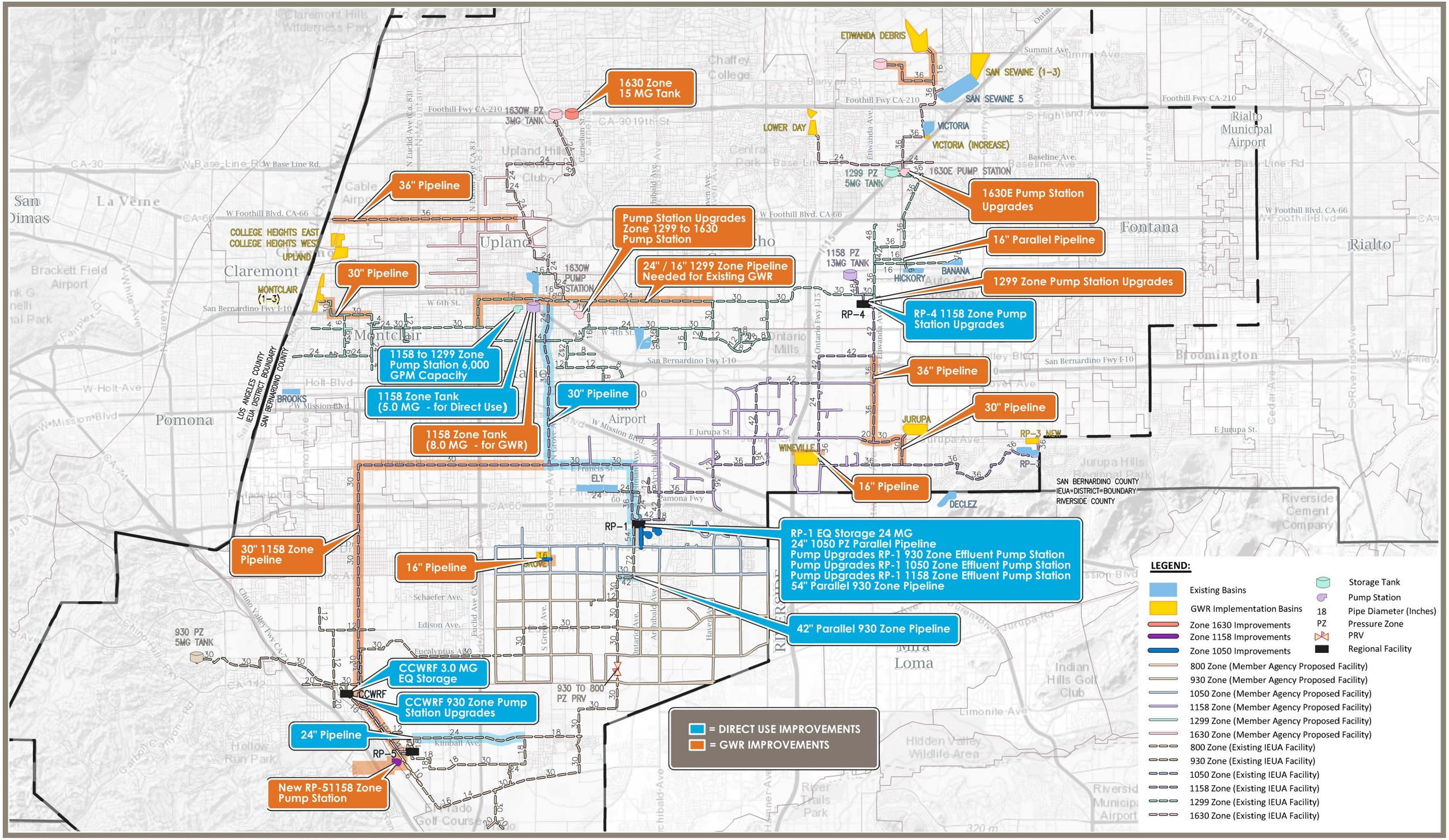
See Figure 7-3 an illustration of the proposed facilities related to Scenario C for Years 2020 through Year 2035.

## Table 7.6 Scenario A Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| Exist | GWR in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| Exist | GWR in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| Exist | GWR in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| Exist | GWR Increase Flow | Turnout Capacities undersized at Brooks, Ely, Hickory, Turner, Victoria | Increase Basin turnout capacities | 1 | LS |
| 2020 | GWR to Wineville Basin | System expansion to serve GWR Basin | 16-inch Pipeline to Wineville Basin | 1200 | lf |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2020 | GWR Increase to 1630E PZ | Capacity in 1630 E PZ | 1630E Pump Station Upgrades | 1 | LS |
| 2020 | GWR increase to Upper Zones | Pump capacity exceeded | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2020 | GWR to Banana | Pipe capacity exceeded from Etiwanda to Hickory turnout | 16-inch Parallel 1299 PZ Pipeline | 3000 | lf |
| 2025 | GWR to Lower Day Basin | System expansion to serve GWR Basin | 24-inch Pipeline to Lower Day | 10520 | lf |
| 2025 | GWR to Etiwanda Debris Basin | System expansion to serve GWR Basin | 16-inch 1630E Pipeline | 2670 | lf |
| 2025 | Max Summer Direct Use & GWR | Supply Deficiency in RP-1 | 24 MG EQ Storage | 1 | LS |
| 2025 | Max Summer DU | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 54-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR to College Heights Basin | System expansion to serve GWR Basin | 36-inch 1630W Pipeline in Foothill Blvd | 19600 | lf |
| 2030 | GWR to Montclair Basin | System expansion to serve GWR Basin | 30-inch 1299 PZ Pipeline to Montclair Basins | 7840 | lf |
| 2030 | GWR to 1630W PZ | System expansion to serve GWR Basin | 1630W Booster Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR to 1630W PZ | System operations for 1630W PZ and reduce impacts to 1299 PZ | 15 MG 1630W Storage Tank | 15 | MG |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP5 1158PZ Pump Station | 1 | LS |

## Table 7.6 Scenario A Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-6 | 30-inch 1158PZ Pipeline from RP5 | 48500 | lf |
| 2030 | GWR to 1630E PZ | Increased flow to 1630E PZ, deficient capacity in 1299 PS | Capacity Upgrades to 1299PS at RP-4 | 1 | LS |
| 2030 | Max Summer Direct Use & GWR | Supply Deficiency in RP-4 | 1.6 MG EQ Storage at RP-4 | 1.6 | MG |
| 2030 | Max Summer Direct Use & GWR | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2030 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 1158 PZ Storage Tank | 8 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2035 | GWR to Grove Basin | System expansion to serve GWR Basin | 12-inch to Grove Basin | 1000 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 36-inch Pipeline in 1158 PZ | 19600 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 30-inch Pipeline in Jurupa Street to Jurupa Basin | 5400 | lf |
| 2035 | GWR to Jurupa (1158 PZ) | System expansion to serve GWR Basin | 20-inch Pipeline in Jurupa Street | 1300 | lf |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |




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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario A
## FIGURE 7-1

## Table 7.7 Scenario B Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2025 | Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 | LS |
| 2025 | Summer DU & GWR | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| 2025 | Summer DU & GWR | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| 2025 | Summer DU & GWR | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 54-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Summer DU & GWR | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2035 | Max Summer DU | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2035 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |

INCREASE TURNOUT CAPACITIES:
- Brooks Basin
- Turner Basin
- Ely Basin
- Hickory Basin
- Victoria Basin

New 1630 Zone 18 MG Tank

1299 Zone Pump Station Upgrades

1158 to 1299 Zone Pump Station 6,000 GPM Capacity

1158 Zone Tank (5.0 MG - for Direct Use)

30" 1158 Zone Pipeline

RP-1 EQ Storage Increase to 24 MG
24" 1050 PZ Parallel Pipeline
Pump Upgrades RP-1 930 Zone Effluent Pump Station
Pump Upgrades RP-1 1050 Zone Effluent Pump Station
Pump Upgrades RP-1 1158 Zone Effluent Pump Station

42" Parallel 930 Zone Pipeline

CCWRF 3.0 MG EQ Storage

CCWRF 930 Zone Pump Station Upgrades

All of PRADO Met by RP-5

= DIRECT USE IMPROVEMENTS
= GWR IMPROVEMENTS

**LEGEND:**

- Existing Basins
- RMPU Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario B
## FIGURE 7-2

## Table 7.8 Scenario C Sensitivity Analysis Facility Improvements

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | |
|---|---|---|---|---|---|
| Exist | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 | LS |
| Exist | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 | lf |
| Exist | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 | LS |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 | lf |
| Exist | GWR Increase Flow | Deficient 1299 PZ transmission mains, serve east & 7th/8th St Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 | lf |
| Exist | GWR Increase Flow | Turnout Capacities undersized at Brooks, Ely, Hickory, Turner, Victoria | Increase Basin turnout capacities | 1 | LS |
| 2020 | Average Direct Use | Ex. 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 | lf |
| 2020 | GWR Increase to 1630E PZ | Capacity in 1630 E PZ | 1630E Pump Station Upgrades | 1 | LS |
| 2020 | GWR increase to Upper Zones | Pump capacity exceeded | RP-4 1158 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2020 | GWR to Banana | Pipe capacity exceeded from Etiwanda to Hickory turnout | 16-inch Parallel 1299 PZ Pipeline | 3000 | lf |
| 2025 | Summer DU & GWR | Supply Deficiency in RP-1 | 24 MG EQ Storage | 1 | LS |
| 2025 | Max Summer DU | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 54-inch 930 PZ Parallel Pipeline | 2300 | lf |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 PZ Pump Station Capacity Upgrades | 1 | LS |
| 2025 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP5 1158PZ Pump Station | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | 30-inch 1158PZ Pipeline from RP5 | 48500 | lf |
| 2030 | GWR to 1630E PZ | Increased flow to 1630E PZ, deficient capacity in 1299 PS | Capacity Upgrades to 1299PS at RP-4 | 1 | LS |
| 2030 | Summer DU & GWR | Supply Deficiency in RP-4 | 1.6 MG EQ Storage at RP-4 | 1.6 | MG |
| 2030 | Summer DU & GWR | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 | MG |
| 2030 | Max Summer DU | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 | LS |
| 2030 | Max Summer DU | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Avenue | 1680 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 | lf |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | 8.0 MG 1158 PZ Storage Tank | 8 | MG |
| 2030 | Max Summer DU | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 | LS |
| 2030 | GWR Supply to Upper Zones | Increased flow to upper zones, deficient supply from RP-1, surplus at RP-5 | New RP5 1158PZ Pump Station | 1 | LS |
| 2035 | Max Summer DU | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 | lf |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 | LS |
| 2035 | Max Summer DU | Pump capacity exceeded to serve peak DU demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 | LS |

INCREASE TURNOUT CAPACITIES:
- Brooks Basin
- Turner Basin
- Ely Basin
- Hickory Basin
- Victoria Basin

1630 Zone 15 MG Tank

New 1630 Zone 18 MG Tank

SAN SEVAINE (1–3)

SAN SEVAINE 5

VICTORIA

VICTORIA (INCREASE)

1630E PUMP STATION

1630E Pump Station Upgrades

16" Parallel Pipeline

1299 Zone Pump Station Upgrades

RP-4 1158 Zone Pump Station Upgrades

24" / 16" 1299 Zone Pipeline Needed for Existing GWR

RP-1 EQ Storage 24 MG
24" 1050 PZ Parallel Pipeline
Pump Upgrades RP-1 930 Zone Effluent Pump Station
Pump Upgrades RP-1 1050 Zone Effluent Pump Station
Pump Upgrades RP-1 1158 Zone Effluent Pump Station
54" Parallel 930 Zone Pipeline

42" Parallel 930 Zone Pipeline

New RP-51158 Zone Pump Station

= DIRECT USE IMPROVEMENTS
= GWR IMPROVEMENTS

1630W PZ 3MG TANK
1299 PZ 5MG TANK
1158 PZ 13MG TANK
930 PZ 5MG TANK
1630W PUMP STATION
930 TO 800 PZ PRV
BROOKS
HICKORY
BANANA
ELY
WINEVILLE
DECLEZ
CCWRF
RP-1
RP-3 NEW
RP-4
RP-5

LOS ANGELES COUNTY
IEUA DISTRICT BOUNDARY
SAN BERNARDINO COUNTY

SAN BERNARDINO COUNTY
IEUA DISTRICT BOUNDARY
RIVERSIDE COUNTY

**LEGEND:**

- Existing Basins
- RMPU Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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# IEUA RWPS
## Recycled Water System Improvements
## Sensitivity Analysis - Scenario C
## FIGURE 7-3

## 7.5 SENSITIVITY ANALYSIS PROJECT COSTS AND EVALUATIONS

A comparison of total estimated project costs was performed to analyze and develop an overall recommendation for an implementation strategy. The GWR implementation project recommendations described in Section 6 were compared with the project improvements recommended for the sensitivity analysis scenarios A, B, and C as shown in Tables 7.6, 7.7, and 7.8.

Table 7.9 on the following page shows the cost summary analysis that was performed. The overall projects costs for each of the implementation scenarios are listed with the total estimated annual recycled water supply recharge benefit for that scenario.

Based on the total project costs for the different operational conditions, Scenario B of the Sensitivity Analysis herein shows the lowest total project costs. It also shows to be the lowest cost per annual acre-feet of recycled water recharge to the basins. This scenario assumes that IEUA will continue to meet SARBF at Prado Obligation as it currently does from the effluent supply from RP5 and RP-1.

Additionally, it should be noted that the basins assumed for Existing/RMPU scenarios will be able to recharge the total annual recycled water supply available. Therefore, the cost of recharge of annual acre-feet of recycled water is much less than the program required for implementing all of the GWR proposed basins.

However, other considerations should be given to utilizing only the Existing/RMPU basins:

- Using only the Existing/RMPU basins limit the basins to be down for maintenance, leaving no operational redundancy.
- If the direct use demands do not meet the projections shown, the additional recycled water supply available would be limited for recharge use.
- If the Agency determines to secure an additional external supply source in the future to meet the SARBF at Prado Obligation, there would need to be additional basins to receive the additional recharge capacity available.

Based on the overall goals of the RWPS to meet the projected direct use and then maximize the remaining recycled water supply effluent for GWR to the basins, the Scenario B of the Sensitivity Analysis is recommended. This program most the goals of the RWPS with most cost efficiency to the Agency.

## Table 7.9 Sensitivity Analysis Project Costs Analysis

| Year | Previous Costs | Direct Use (DU) Only Improvements Costs | DU Improvements Cumulative Costs | Annual DU Demands (AFY) | Spring/Fall DU plus GWR Improvement Costs | Summer DU plus GWR Improvement Costs | GWR plus DU Improvements Cumulative Costs | Total Annual Recharge (AFY) | Total Cumulative Costs | Total Annual Demand (AFY) |
|---|---|---|---|---|---|---|---|---|---|---|
| **BASELINE GWR PROJECT IMPROVEMENTS (SEE CHAPTER 6) – All GWR Implementations with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Exist | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 7,250,000 | $ - | $ 7,250,000 | 13,977 | $ 13,470,000 | 44,734 |
| 2025 | $ 13,470,000 | $ 6,280,000 | $ 12,500,000 | 36,507 | $ 6,060,000 | $ 11,690,000 | $ 25,000,000 | 13,027 | $ 37,500,000 | 49,534 |
| 2030 | $ 37,500,000 | $ 34,300,000 | $ 46,800,000 | 40,320 | $ 39,000,000 | $ - | $ 64,000,000 | 13,707 | $ 110,800,000 | 54,027 |
| 2035 | $110,800,000 | $ 12,520,000 | $ 59,320,000 | 43,019 | $ 16,030,000 | $ - | $ 80,030,000 | **14,871** | **$139,350,000** | 57,890 |
| **SCENARIO A - PROJECT IMPROVEMENTS – All GWR Implementation Basins plus External Supply for Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $ 20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 4,130,000 | $ - | $ 24,130,000 | 21,427 | $ 30,350,000 | 52,184 |
| 2025 | $ 30,350,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ 6,060,000 | $ - | $ 30,190,000 | 19,797 | $ 41,530,000 | 56,304 |
| 2030 | $ 41,530,000 | $ 41,550,000 | $ 52,890,000 | 40,320 | $ 71,730,000 | $ 7,610,000 | $ 109,530,000 | 19,422 | $ 162,420,000 | 59,742 |
| 2035 | $ 62,420,000 | $ 3,460,000 | $ 56,350,000 | 43,019 | $ 16,030,000 | $ - | $ 125,560,000 | **19,906** | **$181,910,000** | 62,925 |
| **SCENARIO B - PROJECT IMPROVEMENTS – Existing/RMPU Basins with IEUA Meeting Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ - | $ - | $ - | 16,095 | $ - | 40,750 |
| 2020 | $ - | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 6,860,000 | $ - | $ 6,860,000 | 13,977 | $ 13,080,000 | 44,734 |
| 2025 | $ 13,080,000 | $ 17,970,000 | $ 24,190,000 | 36,507 | $ - | $ - | $ 6,860,000 | 13,027 | $ 31,050,000 | 49,534 |
| 2030 | $ 31,050,000 | $ 34,300,000 | $ 58,490,000 | 40,320 | $ - | $ - | $ 6,860,000 | 13,707 | $ 65,350,000 | 54,027 |
| 2035 | $ 65,350,000 | $ 12,520,000 | $ 71,010,000 | 43,019 | $ - | $ - | $ 6,860,000 | **14,871** | **$ 77,870,000** | 57,890 |
| **SCENARIO C - PROJECT IMPROVEMENTS – Existing/RMPU Basins plus External Supply for Prado Obligation** | | | | | | | | | | |
| Existing | $ - | $ - | $ - | 24,655 | $ 20,000,000 | $ - | $ 20,000,000 | 23,917 | $ 20,000,000 | 48,572 |
| 2020 | $20,000,000 | $ 6,220,000 | $ 6,220,000 | 30,757 | $ 3,740,000 | $ - | $ 23,740,000 | 21,427 | $ 9,960,000 | 52,184 |
| 2025 | $29,960,000 | $ 5,120,000 | $ 11,340,000 | 36,507 | $ - | $ - | $ 23,740,000 | 19,797 | $ 35,080,000 | 56,304 |
| 2030 | $35,080,000 | $ 41,110,000 | $ 52,450,000 | 40,320 | $ 33,310,000 | $ 7,610,000 | $ 64,660,000 | 19,422 | $117,110,000 | 59,742 |
| 2035 | $117,110,000 | $ 3,460,000 | $ 55,910,000 | 43,019 | $ - | $ - | $ 64,660,000 | **19,906** | **$120,570,000** | 62,925 |

# 8.0 RWPS RECOMMENDED PROJECTS

This section provides a list of the recommended projects and identifies the project to meet the Agency's projected direct use demands while maximizing the use of the available recycled water supply. The list of recommended projects is based on the Sensitivity Analysis Scenario B described in the previous section. Also, based on the project improvement costs, the total cost of water is determined for the proposed GWR Implementation Strategy proposed herein. All costs shown are in today's dollars.

## 8.1 PROPOSED RWPS RECOMMENDED PROJECTS

As described in Section 6 and Section 7, proposed facility improvements were recommended for every 5-years through Year 2035. Improvements were recommended based on the ability to meet the projected maximum day summer direct use demands, and delivery to the GWR basins assumed to be converted to receive the available recycled water supply for recharge.

Based on the sensitivity analysis performed and comparison of project costs and flows for each analysis scenario, the proposed RWPS projects recommended are those identified in Scenario B.

Table 8.1 is provided to show the comprehensive list of projects and project costs identified for each planning year. Since the proposed improvements recommended are required to either meet direct use demands or groundwater recharge purposes, the table includes a description of the demand condition that triggers the need for the project as well the type of deficiency the project is intended to mitigate.

Project costs and total CIP cost projects are based on 2015 dollars and do not include cost escalations.

The RWPS recommended facility improvements are shown in Figure 8-1.

## Table 8.1 Recommended RWPS Projects

| Year | Demand Condition Trigger | Deficiency | Proposed Improvement | Quantity | Unit Cost | Total Const. Cost | Cont. / Admin./ Eng. | Total Estimated Project Cost | Cumulative CIP Costs | GWR Program Improvement | Direct Use Improvement |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | Conversion of 18 MG 1630E Storage Tank | 1 LS | $ 500,000 | $ 500,000 | $ 225,000 | $ 730,000 | $ 730,000 | $ 730,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | System optimization for GWR flows, system expansion to serve GWR | 36-inch 1630E Pipeline to 1630E Tank | 6715 lf | $ 495 | $ 3,323,925 | $ 1,495,766 | $ 4,820,000 | $ 5,550,000 | $ 4,820,000 | $ - |
| 2020 | GWR to basins in 1630E PZ | Insufficient supply capacity to 1630E PZ for GWR flows, system expansion to serve GWR | RP-1 1158 PS Upgrades | 1 LS | $ 900,000 | $ 900,000 | $ 405,000 | $ 1,310,000 | $ 6,860,000 | $ 1,310,000 | $ - |
| 2020 | Average Direct Use | Existing 18-inch pipeline undersized in Bickmore, increase flow from RP-5 | 24-inch 800 PZ Pipeline in Kimball Ave | 12620 lf | $ 340 | $ 4,290,800 | $ 1,930,860 | $ 6,220,000 | $ 13,080,000 | $ - | $ 6,220,000 |
| | | | | | | **Year 2020 Improvement Costs** | | **$13,080,000** | **$ 13,080,000** | **$ 6,860,000** | **$ 6,220,000** |
| 2025 | Max Summer DU & GWR | Insufficient supply capacity from RP-1 | 24 MG EQ Storage at RP-1 | 1 LS | $ - | $ - | $ - | $ - | $ 13,080,000 | $ - | $ - |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, to serve east & 7th/8th Street Basins | 16-inch Parallel 1299 PZ Pipeline | 15289 lf | $ 225 | $ 3,440,025 | $ 1,548,011 | $ 4,990,000 | $ 18,070,000 | $ - | $ 4,990,000 |
| 2025 | Max Summer Direct Use | Deficient 1299 PZ transmission mains, serve east & 7th/8th Street Basins | 24-inch Parallel 1299 PZ Pipeline | 13600 lf | $ 340 | $ 4,624,000 | $ 2,080,800 | $ 6,700,000 | $ 24,770,000 | $ - | $ 6,700,000 |
| 2025 | Max Summer Direct Use | Existing 30-inch pipeline undersized from RP-1 to Riverside Dr. | 54-inch 930 PZ Parallel Pipeline | 2300 lf | $ 860 | $ 1,978,000 | $ 890,100 | $ 2,870,000 | $ 27,640,000 | $ - | $ 2,870,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-4 1158 PZ PS Capacity Upgrades | 1 LS | $ 950,000 | $ 950,000 | $ 427,500 | $ 1,380,000 | $ 29,020,000 | $ - | $ 1,380,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 PZ PSCapacity Upgrades | 1 LS | $ 800,000 | $ 800,000 | $ 360,000 | $ 1,160,000 | $ 30,180,000 | $ - | $ 1,160,000 |
| 2025 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | CCWRF PS Capacity Upgrades | 1 LS | $ 600,000 | $ 600,000 | $ 270,000 | $ 870,000 | $ 31,050,000 | $ - | $ 870,000 |
| | | | | | | **Year 2025 Improvement Costs** | | **$ 17,970,000** | **$ 31,050,000** | **$ -** | **$ 17,970,000** |
| 2030 | Max Summer Direct Use | Capacity in the 930 PZ | 42-inch Parallel Pipeline in Chino Ave. | 1680 lf | $ 590 | $ 991,200 | $ 446,040 | $ 1,440,000 | $ 32,490,000 | $ - | $ 1,440,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 30-inch 1158 PZ Pipeline | 31800 lf | $ 420 | $ 13,356,000 | $ 6,010,200 | $ 19,370,000 | $ 51,860,000 | $ - | $ 19,370,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | 5.0 MG 1158 PZ Storage Tank | 5 MG | $ 1.50 | $ 7,500,000 | $ 3,375,000 | $ 10,880,000 | $ 62,740,000 | $ - | $ 10,880,000 |
| 2030 | Max Summer Direct Use | Capacity in the 1158 PZ and 1299 PZ | New 1158 to 1299 Booster Pump Station | 1 LS | $1,800,000 | $ 1,800,000 | $ 810,000 | $ 2,610,000 | $ 65,350,000 | $ - | $ 2,610,000 |
| | | | | | | **Year 2030 Improvement Costs** | | **$ 34,300,000** | **$ 65,350,000** | **$ -** | **$ 34,300,000** |
| 2035 | Max Summer Direct Use | Capacity in the 930 PZ, reduce supply constraint from RP-1 | 3 MG EQ Storage at CCWRF | 3 MG | $ 1.75 | $ 5,250,000 | $ 2,362,500 | $ 7,610,000 | $ 72,960,000 | $ - | $ 7,610,000 |
| 2035 | Max Summer Direct Use | Increase capacity at the CCWRF 930 PZ Pump Station | CCWRF Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 74,410,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pipeline undersized for demands condition | 24-inch 1050 PZ Parallel Pipeline | 2000 lf | $ 340 | $ 680,000 | $ 306,000 | $ 990,000 | $ 75,400,000 | $ - | $ 990,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 930 Pump Station Capacity Upgrades | 1 LS | $ 1,000,000 | $ 1,000,000 | $ 450,000 | $ 1,450,000 | $ 76,850,000 | $ - | $ 1,450,000 |
| 2035 | Max Summer Direct Use | Pump capacity exceeded to serve peak direct use demand periods | RP-1 1050 Pump Station Capacity Upgrades | 1 LS | $ 700,000 | $ 700,000 | $ 315,000 | $ 1,020,000 | $ 77,870,000 | $ - | $ 1,020,000 |
| | | | | | | **Year 2035 Improvement Costs** | | **$ 12,520,000** | **$ 77,870,000** | **$ -** | **$ 12,520,000** |
| | | | | | | **Total Program Improvement Costs** | | **$ 77,870,000** | | **$ 6,860,000** | **$ 71,010,000** |

INCREASE TURNOUT CAPACITIES:
- Brooks Basin
- Turner Basin
- Ely Basin
- Hickory Basin
- Victoria Basin

New 1630 Zone 18 MG Tank

1299 Zone Pump Station Upgrades

1158 to 1299 Zone Pump Station 6,000 GPM Capacity

1158 Zone Tank (5.0 MG - for Direct Use)

30" 1158 Zone Pipeline

RP-1 EQ Storage Increase to 24 MG
24" 1050 PZ Parallel Pipeline
Parallel 930 PZ Pipeline
Pump Upgrades RP-1 930 Zone Effluent Pump Station
Pump Upgrades RP-1 1050 Zone Effluent Pump Station
Pump Upgrades RP-1 1158 Zone Effluent Pump Station

42" Parallel 930 Zone Pipeline

CCWRF 3.0 MG EQ Storage

CCWRF 930 Zone Pump Station Upgrades

All of PRADO Met by RP-5

= DIRECT USE IMPROVEMENTS
= GWR IMPROVEMENTS

**LEGEND:**

- Existing Basins
- RMPU Basins
- Zone 1630 Improvements
- Zone 1158 Improvements
- Zone 1050 Improvements
- 800 Zone (Member Agency Proposed Facility)
- 930 Zone (Member Agency Proposed Facility)
- 1050 Zone (Member Agency Proposed Facility)
- 1158 Zone (Member Agency Proposed Facility)
- 1299 Zone (Member Agency Proposed Facility)
- 1630 Zone (Member Agency Proposed Facility)
- 800 Zone (Existing IEUA Facility)
- 930 Zone (Existing IEUA Facility)
- 1050 Zone (Existing IEUA Facility)
- 1158 Zone (Existing IEUA Facility)
- 1299 Zone (Existing IEUA Facility)
- 1630 Zone (Existing IEUA Facility)
- Storage Tank
- Pump Station
- 18 Pipe Diameter (Inches)
- PZ Pressure Zone
- PRV
- Regional Facility

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A MUNICIPAL WATER DISTRICT

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# IEUA RWPS
## Recommended Recycled Water System Improvements

FIGURE 8-1

## 8.2 RWPS COST OF WATER

Table 8.2 is provided to show the differences in the cost of water for the recommended GWR program. The cost of water is assumed to be the total capital improvement costs for every acre-foot of water used to meet the projected direct use demands and that recharged into the groundwater basin for the 5-year planning increment. It should be noted the annual recharge shown in Table 8.2 reflects a 9-month recharge program throughout the year.

**Table 8.2 Summary of Recharge Water Costs**

| Planning Year | Total Annual Direct Use Demands (AFY) | Total Annual Recycled Water Supply Recharge (AFY) | Total Annual Recycled Water Use (AFY) | Estimated Cost of Water (per AFY) |
|---|---|---|---|---|
| Year 2020 | 30,757 | 13,977 | 44,734 | $ 3,283 |
| Year 2025 | 36,507 | 13,027 | 49,534 | $ 6,469 |
| Year 2030 | 40,320 | 13,707 | 54,027 | $ 4,922 |
| Year 2035 | 43,019 | 14,871 | 57,890 | $ 4,543 |
| | | | **20-Yr Average Cost Water** | **$ 4,804** |

## 8.3 SUMMARY OF RECOMMENDED PROJECT COSTS

Table 8.3 is provided below to show the project costs estimated for of the planning year horizons for the recommended RWPS program facilities.

**Table 8.3 Summary of Recommended Total Project Costs**

| Planning Year | Facility Construction Costs | Contingency/ Admin/Eng. | Total Planning Year Project Costs |
|---|---|---|---|
| Year 2020 | $ 9,014,725 | $ 4,056,626 | $ 13,080,000 |
| Year 2025 | $ 12,392,025 | $ 5,576,411 | $ 17,970,000 |
| Year 2030 | $ 23,647,200 | $ 10,641,240 | $ 34,300,000 |
| Year 2035 | $ 8,630,000 | $ 3,883,500 | $ 12,520,000 |
| **Total Capital Improvements** | **$ 71,010,000** | | **$ 77,870,000** |

# 9.0 OPERATIONAL CONTROL STRATEGY

This section provides a brief description of the general recycled water program operational control strategy regarding the general philosophy on how the recycled water system is to be operated for the various seasonal supply and demand needs. Descriptions are provided for each of the 5-year incremental planning year for the winter, spring/fall, and summer direct use demands and recharge conditions.

## 9.1 WINTER DEMAND CONDITIONS

The winter demand conditions are considered to be a three month duration including the months of December, January, and February for purposes of this study.

In general, for each of the planning years, during the winter demand months the recycled water system will be operated to meet only the direct use demands and the SARBF at Prado Obligation demands. No groundwater recharge during these months will occur.

To maximize the groundwater recharge during the other months of the year, as much of the surplus recycled water supply as possible will be used to meet as much of the SARBF at Prado Obligation demands as is feasible. For purposes of this study, a minimum of 40% of the annual SARBF at Prado Obligation assumed for this study will be met during the winter months.

Winter program operational strategy will be basically the same for each of the planning years, Year 2020, Year 2025, Year 2030, and Year 2035. The surplus supply from RP-5 will be used as the first priority to meet the SARBF at Prado Obligation during the winter months. The 930 PS demands will be met by RP-1 as the first priority. RP-4 will be the primary supply to the upper pressure zones.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.

## 9.2 SPRING/FALL DEMAND CONDITIONS

The spring/fall demand conditions are considered to be a four month duration including the months of March, April, May, and November for purposes of this study.

In general for each of the planning years, the direct use demands will be met first and then the SARBF at Prado Obligation needs. Based on the mass balance analysis approximately 35% of the total annual SARBF at Prado Obligation will be met during the Spring/Fall months.

The surplus supply from the Southern Service Area from RP-5 and CCWRF is assumed to the first priority to meet the SARBF at Prado Obligation demands.

The surplus from the RP-1 and RP-4 facilities, after meeting the direct use demand needs, is used to supply groundwater recharge to the existing and proposed groundwater basins.

Due to the low flow periods during the night from the wastewater supply, and the peak direct use demands during this same period, the groundwater recharge flows to the basin are met during a 12-hour period during the day, during non-direct use irrigation periods.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.

## 9.3 SUMMER DEMAND CONDITIONS

The summer demand conditions are considered to be a five month duration including the months between June and October for purposes of this study.

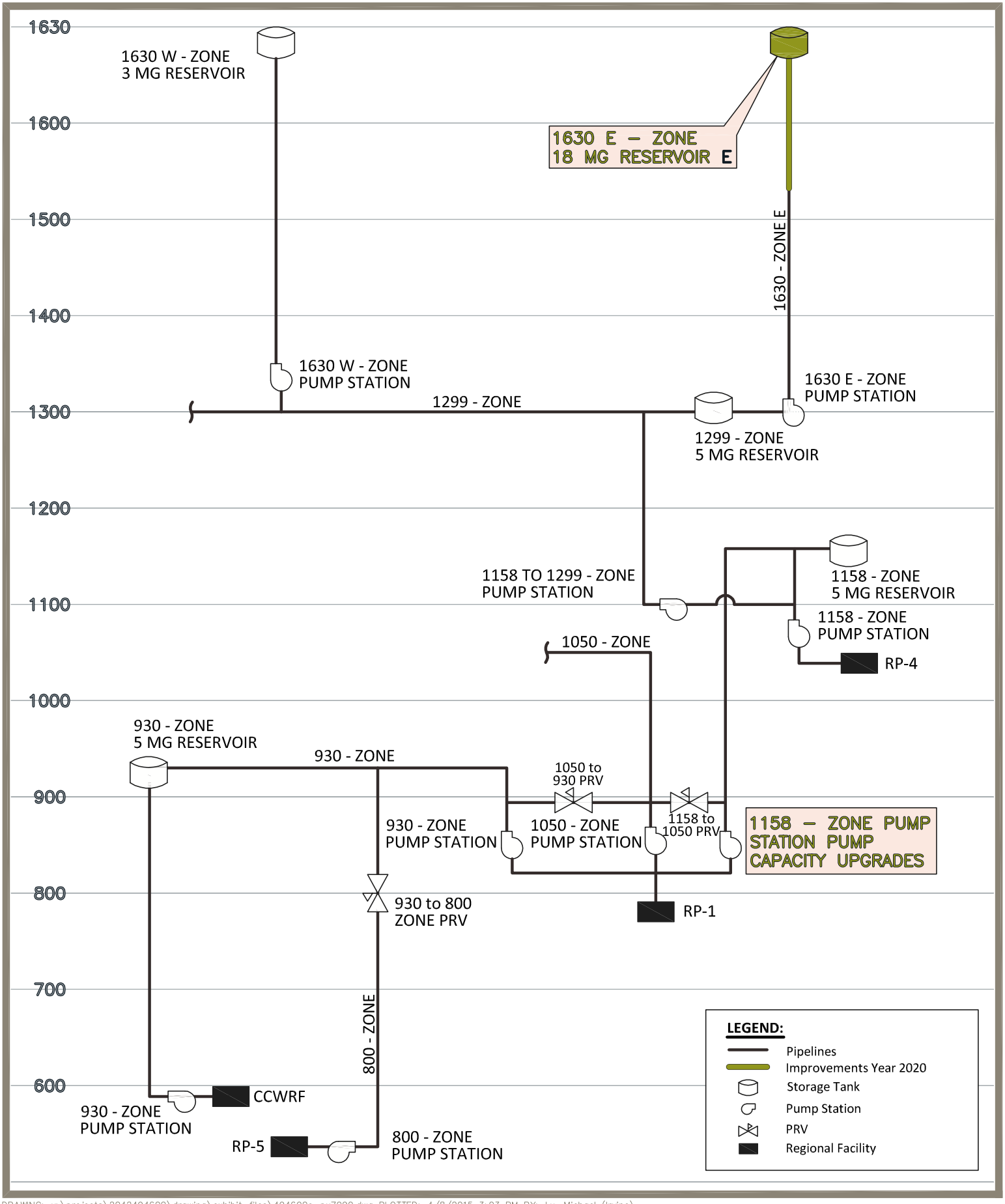
In general for each of the planning years, the direct use demands will be met first. For purposes of this study, approximately 24% of the total annual SARBF at Prado Obligation will be met during the summer months.

The surplus supply from the Southern Service Area from RP-5 and CCWRF is assumed to the first priority to meet the SARBF at Prado Obligation demands up to only 24%. The minimum flow to SARBF at Prado Obligation is 3.5 MGD.

The surplus from the RP-1 and RP-4 facilities, after meeting the direct use demand needs and supplementing the SARBF at Prado Obligation, is used to supply groundwater recharge to the existing and proposed groundwater basins. Due to the increase in direct use demands during the summer months, the groundwater recharge flows are reduced so the recycled water supply available from the treatment facilities is not exceeded.

Due to the low flow periods during the night from the wastewater supply, and that the direct use demands are peaked during this same period, the groundwater recharge flows to the basin are met during a 12-hour period during the day.

Figures 9-1 through 9-4 are provided to illustrate the operational strategy for each of the planning years.




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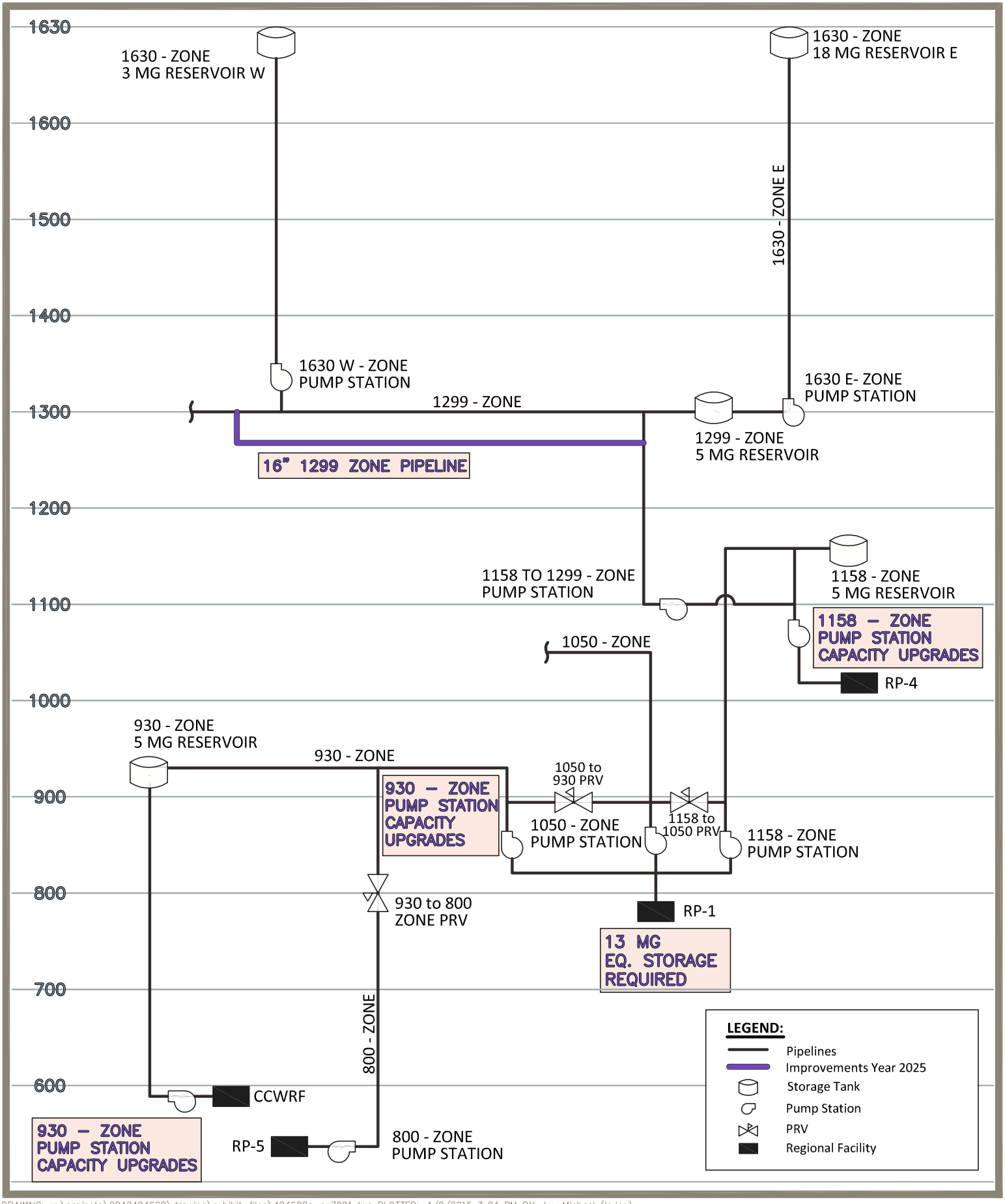
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A MUNICIPAL WATER DISTRICT

# IEUA RWPS
# Year 2020 System Profile

FIGURE 9-1




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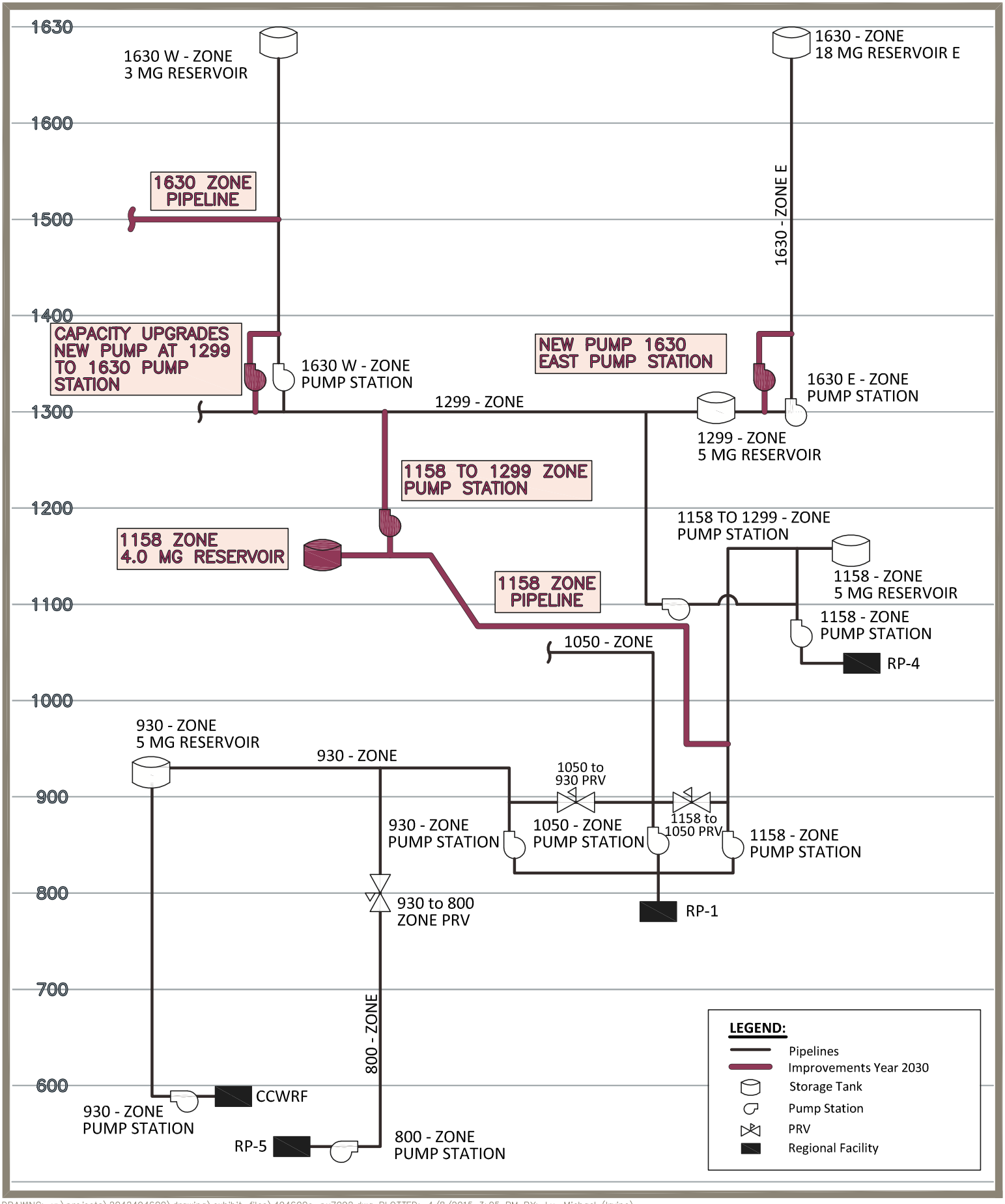
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# IEUA RWPS
# Year 2025 System Profile

FIGURE 9-2




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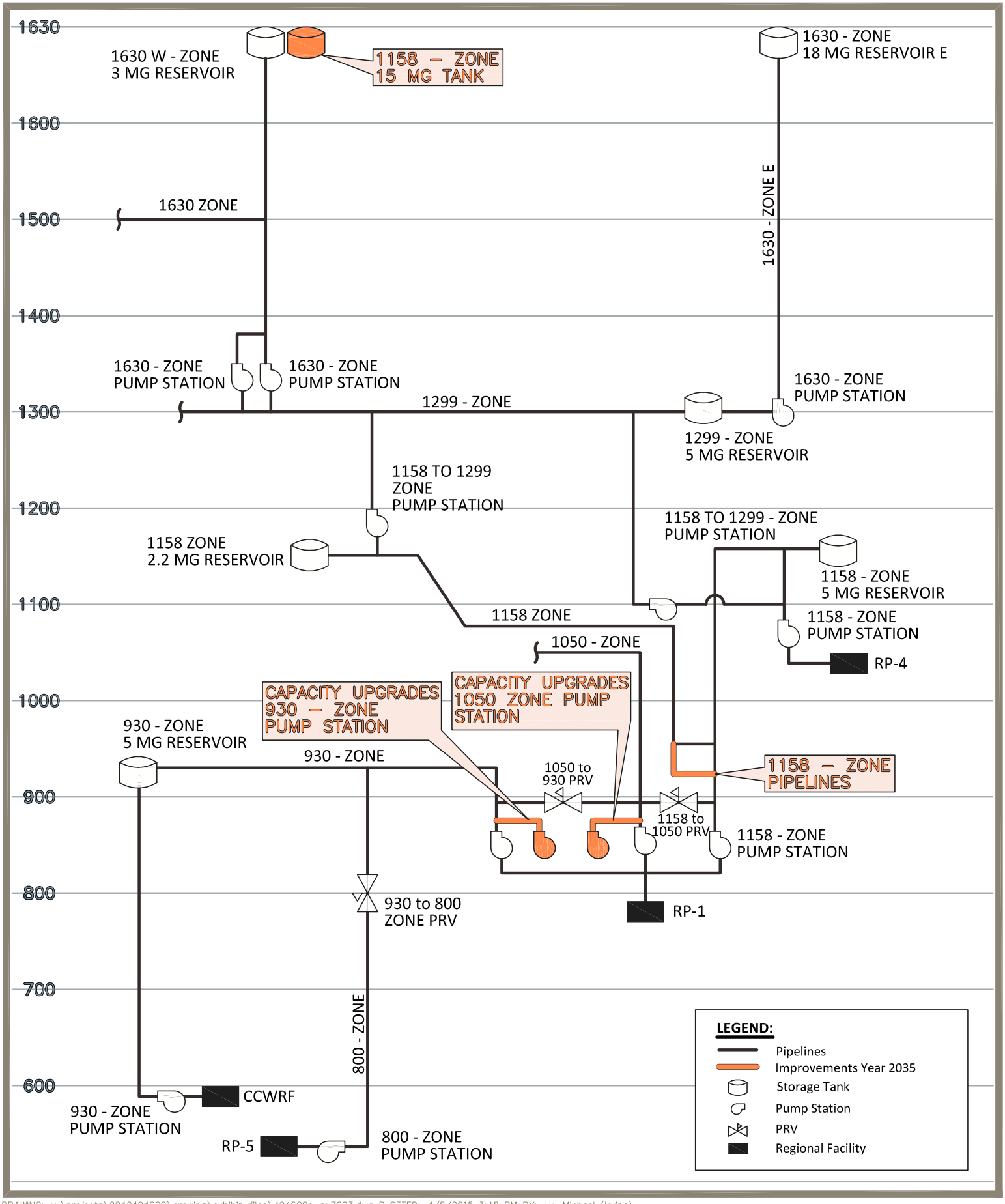
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# IEUA RWPS
# Year 2030 System Profile

FIGURE 9-3




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# IEUA RWPS
# Year 2035 System Profile

FIGURE 9-4

# Appendix A

Modeling Results are Bound Separately

# Appendix B

"*Recycled Water System Hydraulic Analysis for the Enhanced GWR Program*", December 2013

# APPENDIX H

## IEUA 2014 Wastewater Facilities Master Plan

# IEUA Wastewater Facilities Master Plan
# TM 3 Regional Trunk Sewer Analysis

| | |
|---|---|
| PREPARED FOR: | Inland Empire Utilities Agency |
| PREPARED BY: | Carollo Engineers, Inc. |
| REVIEWED BY: | CH2M HILL |
| DATE: | August 18, 2014 |

## Executive Summary

In accordance with the goals of the master planning effort, the Consultant Team evaluated the capacity of IEUA's collection system and developed flow diversion alternatives to optimize the use of recycled water within the service area for groundwater recharge. To achieve this goal, four flow diversion alternatives were developed as part of the WFMP that would allow IEUA to optimize recharge groundwater opportunities in the north.

As part of this analysis, the Consultant Team updated the IEUA collection system hydraulic model. This updated model was used to conduct an evaluation of the regional trunk sewer system under existing and projected future flow conditions. Results of the analysis indicate that IEUA's collection system generally maintains adequate capacity to convey peak flows. However, capacity limitations were identified in the Montclair pipeline reach that conveys flow to RP-1 from the Montclair diversion structure.

Flow diversion alternatives were evaluated using both monetary and non-monetary evaluation criteria and a benefit-cost analysis to identify the most suitable alternative for meeting IEUA's objectives. Alternative 2, which utilizes the existing Whispering Lakes and Haven Pump Stations to divert flows from RP-5 to RP-1 was identified as IEUA's preferred flow diversion alternative because it has a lower capital cost, is easier to implement and provides a relatively high benefit related to diverting additional flows to RP-1 for groundwater recharge. Alternative 2 also provides flexibility in that flows could still be conveyed to RP-5 by gravity should the need arise.

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## 1.0 Background and Objectives

The Inland Empire Utilities Agency (IEUA) contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a capital program. The capital program will guide IEUA in the development of major improvements to their treatment and conveyance facilities.

As part of the WFMP effort, the Consultant Team worked with IEUA to develop a series of flow diversion alternatives. The diversion alternatives were developed as a way to convey wastewater to Reclamation Plant (RP)-1 in an effort to maximize groundwater recharge opportunities in the northern portions of IEUA's service area. The flow diversion alternatives are described in Technical Memorandum (TM) No. 2. In conjunction with the analysis of the diversion alternatives, IEUA's existing conveyance system was evaluated to determine its ability to convey current and projected flows based on specified evaluation criteria. The purpose of this TM 3 is to summarize the analysis of IEUA's conveyance system and the results of the evaluation of the flow diversion alternatives presented in TM 2.

# 2.0 Evaluation and Planning Criteria

Evaluation criteria were established as a means to provide a framework for the analysis of the conveyance system and the evaluation of the flow diversion alternatives. The evaluation included the criteria to evaluate the collection system using the hydraulic model and the criteria used to evaluate the flow diversion alternatives. The evaluation of the flow diversion alternatives used a qualitative non-monetary approach called the Simple Multi-Attribute Rating Technique (SMART). The conveyance system criteria and the SMART system are summarized in this section of TM 3.

## 2.1 Collection System Evaluation Criteria

### 2.1.1 Gravity Conveyance System

Gravity sewer pipe capacities are dependent on many factors. The factors include roughness of the pipe, the chosen maximum allowable depth of flow downstream, and limiting velocity and slope. The following sections describe the factors that account for the determination of existing and future pipeline capacities in IEUA's collection system.

#### *Manning Coefficient (n)*

The manning coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system planning purposes. For this study, a manning "n" factor of 0.013 was assigned to all existing sewer collection system lines in the hydraulic model, and then refined as necessary during model verification to accurately simulate field measured levels and velocities.

#### *Peak Flow Criteria*

The primary criteria used to identify capacity deficient sewers or to size new sewer improvements is the maximum flow depth to pipe diameter ratio (d/D). The d/D value is defined as the depth of flow (d) in a pipe during peak (design) flow conditions divided by the pipe's diameter (D). Based on the Consultant Team's experience, IEUA staff input, and industry standards, the following criteria were used and are summarized in Table 3-1 for existing and new sewers:

- **Flow Depth for Existing Sewers.** Peak flow criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative criterion for evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, a lenient criterion could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable peak flow criterion should be established to be as cost effective as possible while at the same time reducing the risk of SSOs to the greatest extent possible.

  For IEUA, it was decided that a maximum d/D ratio of 0.92 would be used to identify capacity deficient sewers.

- **Flow Depth for New Sewers.** When designing sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags. Since IEUA collects wastewater flow from multiple agencies, IEUA's collection system primarily consists of larger diameter interceptors (i.e., greater than 18 inches in diameter). Therefore, sewer interceptor projects will be sized to a d/D of 0.75.

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TABLE 3-1
**Maximum Flow Depth Criteria**

| | Maximum d/D |
|---|---|
| Existing Sewers | 0.92 |
| New Sewers | 0.75[(1)] |

Notes:
[1] For pipe diameters larger than 18 inches

### 2.1.2 Pump Stations and Forcemains

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump the peak flow with the largest pump out of service (firm capacity).

Force main piping should be sized to provide a minimum velocity of 3 ft/s at the design flow rate of the lift station and no more than 8 ft/s. For the determination of head loss, the Hazen Williams Equation is used with a C-factor of 110. These factors are typical for sewer system master planning purposes.

## 2.2 Flow Diversion Evaluation Criteria

### 2.2.1 Non-Monetary Evaluation Criteria

The SMART method was used to evaluate alternatives. This approach includes development of a benefit score for each alternative based on non-monetary criteria and their assigned weighting factors. Once the benefit score is established for each alternative, a monetary evaluation is conducted to estimate life cycle costs for each alternative. A benefit-to-cost ratio is then determined for each alternative to establish the recommended alternative.

For the non-monetary evaluation, a multi-attribute analysis methodology was employed to develop clear and defensible benefit scores for identified alternatives. With multi-attribute analysis, a set of criteria is first developed for use in ranking the appropriateness of each alternative in satisfying the project objectives. Secondly, each criterion is assigned a weighting factor that reflects its relative importance. The weighting factors range from 1 (least important relative to other criteria) to 10 (most important relative to other criteria), allowing calculation of a weighted criterion score based on how important the criterion is for the project in the overall decision-making process.

The non-monetary evaluation criteria, definitions, and weighting factors for evaluating the flow diversion alternatives in TM 3 are presented in Table 3-2.

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TABLE 3-2

**Non-Monetary Evaluation Criteria, Definitions, and Assigned Weighting Factors**

| Criteria | Description | Weighting Factor |
|---|---|---|
| Optimize Groundwater Recharge | Evaluate each alternative relative to the volume of water available for recharge. | 10 |
| Operational Flexibility | Ability to divert flow to either RP-5 or RP-1. | 10 |
| Operational Risk and Reliability | Operational implications on system reliability and redundancy and the associated risk involved in the operation of the lift station(s) and other major facilities. | 10 |
| Ability to maximize use of existing assets | Ability to use existing infrastructure, lift stations, and other facilities. | 8 |
| Ease of operation and maintenance | Relative degree of ease and extent of time required to operate and maintain the facilities. Ability to operate one regional lift station versus operating multiple lift stations. | 8 |
| Recycled water pumping needs | Implications on pumping and conveying recycled water. | 6 |
| Impacts on liquid treatment facilities | Impacts on the required level of treatment at RP-5 or RP-1 (i.e., to achieve the corresponding TN limits for groundwater recharge). | 6 |
| Environmental considerations | Environmental considerations, impacts, permitting and documentation required for project implementation. | 6 |
| Construction impacts | Construction impacts on traffic, commuter schedules, ecosystems, etc. | 5 |
| Institutional feasibility | Extent of coordination required for rights-of-way and easement procurement, as well as major crossings across freeways, channels, etc. | 5 |
| Carbon footprint and sustainability | Potential impacts on the carbon footprint of each plant or conveyance system as a result of construction and operation of the facilities. | 4 |
| Footprint and space constraints | Overall footprint requirements and space constraints. | 3 |

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# 3.0 Evaluation of Existing Collection System

The hydraulic model developed for the WFMP was used to conduct an analysis of the capacity of IEUA's existing conveyance system. The analysis was conducted under the peak flow scenario.

In general, IEUA's collection system has adequate capacity to convey peak wastewater flows. The one facility that is currently lacking adequate capacity to convey existing flows is the 30-inch pipeline downstream of the Montclair diversion. The sections of pipeline that are currently deficient are illustrated on Figure 3-1.

The deficient reach of the Montclair pipeline includes approximately 24,000 linear feet of 36-inch diameter sewer. The hydraulic model was run under future system conditions as part of the analysis of the diversion alternatives discussed in the following sections of this memorandum. It was determined that in order to mitigate the capacity deficiencies the pipeline would need to be upsized to a 36-inch diameter sewer to convey peak buildout flows.

It is recommended that IEUA staff conduct further flow monitoring of this reach of pipeline to determine the extent of the deficiency. IEUA staff should conduct a focused flow monitoring effort on this reach to develop a clear picture of the flow conditions during peak flow periods to verify the modeling results and help size the pipeline during preliminary and final design of mitigation alternatives. While upsizing the pipeline is a viable alternative, other options may exist such as constructing parallel reaches of conveyance trunk lines.

# 4.0 Evaluation of Flow Diversion Alternatives

One of the goals of the WFMP is to plan the efficient use of IEUA's wastewater treatment plants and optimize the use of recycled water within IEUA's service area for groundwater recharge. One of the tasks in the project is to develop and evaluate flow diversion alternatives given an understanding of the constraints and goals of the treatment evaluations and plans for RWRP expansion. For instance, consideration of treatment plant expansions at RP-1 and RP-5 took into account nitrogen concentration limits at the groundwater recharge basin and the treatment plants.

Per the Waste Discharge Order No. R8-2009-0021 (NPDES No. CA8000409) and Water Recycling Order No. R8-2007-0039 (and subsequent amendments), the 12-month flow weighted running average Total Inorganic Nitrogen (TIN) concentration shall not exceed 8 mg/L. This limitation may be met on an agency-wide basis using flow weighted averages of discharges from RP-1, RP-4, RP-5, and CCWRF. Per the CDPH regulations for groundwater recharge and in accordance with Water Recycling Order No. R8-2007-0039, Total Nitrogen (TN) concentration of the recycled water used for recharge prior to reaching the regional groundwater table must not exceed 5 mg/L. The organic nitrogen content in plant effluent is typically in the range of 1.5 to 2.0 mg/L. Therefore, a plant effluent TIN of 8 mg/L corresponds to a TN of about 9.5 to 10 mg/L at the basins. In comparison, a plant effluent TIN of 5 mg/L corresponds to a TN of about 6.5 to 7 mg/L at the basins. To be conservative, this analysis assumes a plant effluent TIN of 5 mg/L for recharge. Therefore, RP-1 expansion needs are based on a plant effluent TIN of 5 mg/L. Similarly, for Alternatives 4A and 4B where flow from RP-5 is pumped to the north for groundwater recharge, the RP-5 expansion needs are based on a plant effluent TIN of 5 mg/L, reducing the overall plant capacity and causing expansions to occur sooner. For the capacity analysis of each RWRP in later TMs, capacities will be developed based on the permitted plant effluent TIN of 8 mg/L as confirmed by IEUA.

This section provides a summary of the proposed flow diversion alternatives, and details the results of the non-monetary evaluation of the flow diversion alternatives. The flow diversion alternatives are described in detail in Technical Memorandum TM 2 and are summarized below. The analysis is based on a planning horizon of 20 years (2035), which is then used to establish the infrastructure needs for each alternative. The flows diverted in each alternative are summarized in Table 3-3.

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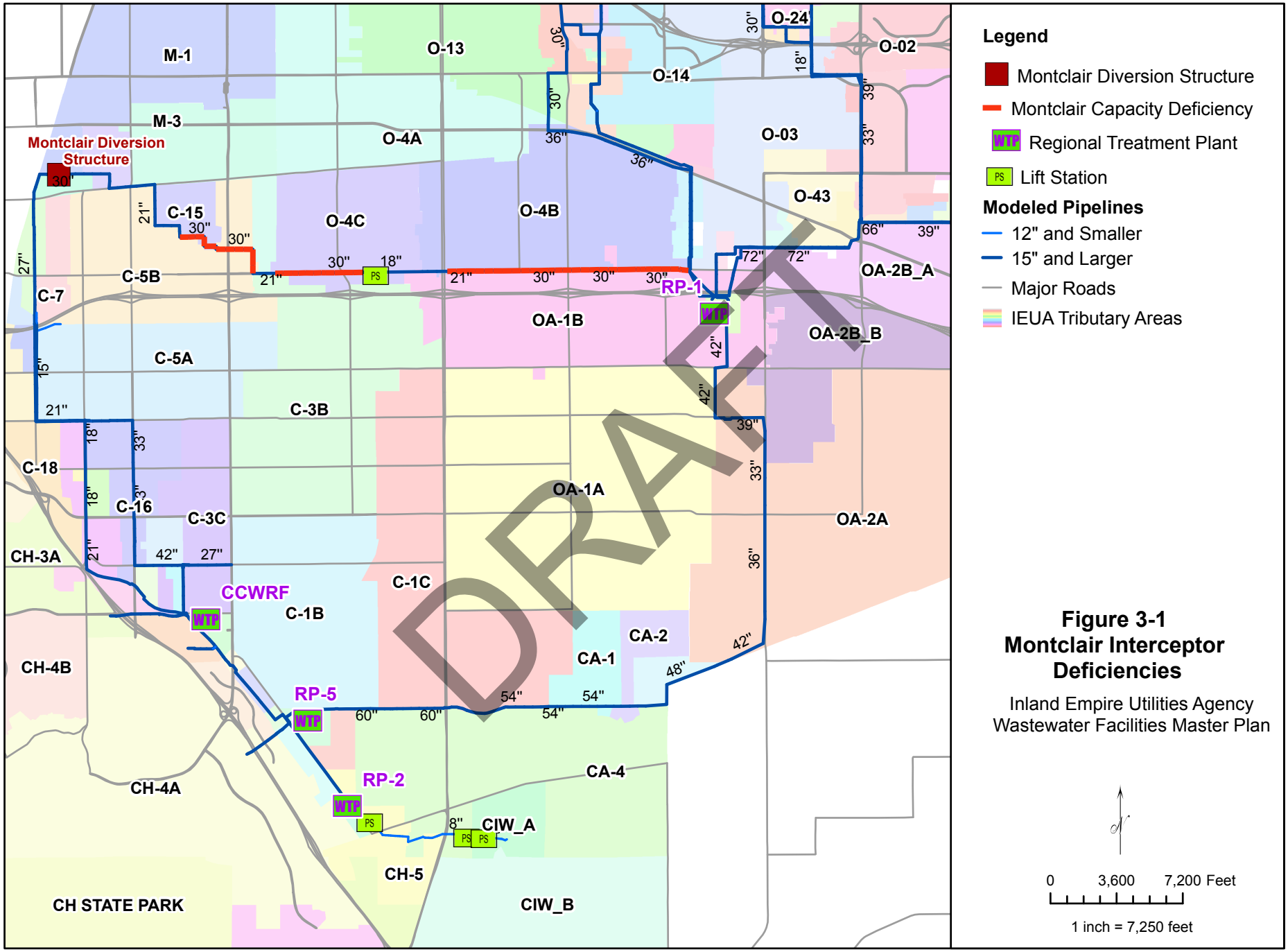



**Figure 3-1**
**Montclair Interceptor Deficiencies**

Inland Empire Utilities Agency
Wastewater Facilities Master Plan

M:\IEUA_FNO\GIS\Alternatives_with_Upgrades\Montclair Pipeline Deficiencies.mxd 8/14/2014

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## 4.1 Summary of Flow Diversion Alternatives

**Alternative 1**

Alternative 1 is the "Do Nothing" alternative. This alternative makes use of the future flow projections for RP-1 and RP-5 and determines how keeping the existing methodologies for flow routing in place affects IEUA's ability to meet its goals. The assumption is that all flows from the Whispering Lakes tributary area, as well as the flows from the Haven Pump Station tributary area, are conveyed by gravity to RP-5.

**Alternative 2**

Alternative 2 assumes that the flows from the Whispering Lakes pump station tributary area are pumped to RP-1 for treatment. Currently the Haven pump station conveys flow to RP-1 and this alternative assumes that the flows would continue to be conveyed to RP-1 in the future.

The Whispering Lakes pump station collects wastewater from agency tributary area OA-1B, while Haven pump station collects from tributary area OA-2B_A. This alternative provides flexibility where the wastewater is sent, since IEUA would still have the option to send the flows south to RP-5.

**Alternatives 3A, 3B, and 3C**

Alternative 3 assumes a new pump station would be installed south of the Archibald Ranch area to convey flows from the Whispering Lakes, Haven, and Archibald Ranch developments. The areas diverted to RP-1 include tributary areas OA-1B, OA-2B_A, OA-2B_B, OA-1A, and OA-2A. There would be three sub alternatives of this alternative. The sub alternatives compare different locations for the new pump station in order to maximize the collection of sewer flows from the New Model Colony in the City of Ontario and to optimize the amount of flow diverted to RP-1.

This Alternative includes additional flow diversions from the eastern portions of the New Model Colony. In comparison, Alternative 2 does not assume that any new flows outside the existing Whispering Lakes and Haven tributary areas would be conveyed to RP-1. This alternative maximizes the amount of flow going to RP-1 by taking flow from new growth. Potential locations for the new pump station are (a) south of Edison Avenue to intercept approximately 30 percent of the New Model Colony flows, (b) near the flood control channel and Hellman Avenue to intercept approximately 50 percent of the New Model Colony flows, and (c) near Euclid Avenue and Kimball Avenue to intercept all of the New Model Colony flows.

These locations have not been analyzed to determine the percentage of New Model Colony flows that could be captured. Rather, these locations are intended to serve as starting points for the analysis and the captured flow percentages will most likely be modified.

The other difference between Alternative 2 and Alternative 3 is that Alternative 3 includes the construction of a single regional pump station instead of utilizing the existing City of Ontario pump stations (Whispering Lakes and Haven). This alternative eliminates the operation and maintenance of multiple pump stations. There is still some flexibility with this alternative because the flows may be diverted to either RP-1 or RP-5.

**Alternatives 4A and 4B**

Alternative 4 assumes that instead of diverting flow to RP-1 for treatment, the flows are treated at RP-5 and pumped to RP-1 to be distributed in the recycled water distribution system in the northern portions of IEUA's service area. It is assumed that a recycled water pump station would be installed at RP-5 to pump the recycled water up to the recycled water facility at RP-1. This alternative requires an expansion of RP-5 in order to handle the increase in flow to the plant. This alternative is the least flexible of the alternatives since it is not able to divert water away from RP-5.

Alternative 4 has two sub-alternatives. Alternative 4A assumes that all flows at the Montclair Diversion are diverted east to the Montclair pump station and ultimately RP-1. Alternative 4B assumes that flows at the Montclair Diversion are diverted west/south to RP-5.

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TABLE 3-3
**Projected Sewer Flows for Diversion Alternatives**

| | Facility | 2013 Flow (mgd) | 2020 Flow (mgd) | 2030 Flow (mgd) | 2035 Flow[3] (mgd) | 2040 Flow (mgd) | 2050 Flow (mgd) | 2060 Flow (mgd) |
|---|---|---|---|---|---|---|---|---|
| Do Nothing | | | | | | | | |
| | RP-1 | 27.5 | 28.7 | 30.4 | **31.3** | 32.1 | 34.2 | 34.4 |
| | RP-5 | 8.2 | 11.9 | 17.7 | **20.3** | 22.8 | 26.7 | 27.2 |
| Alternative 2 | | | | | | | | |
| | RP-1 | 29.2 | 30.4 | 32.2 | **33.1** | 34.0 | 36.1 | 36.3 |
| | RP-5 | 6.4 | 10.2 | 15.9 | **18.4** | 20.9 | 24.8 | 25.3 |
| Alternative 3[1] | | | | | | | | |
| 3A | | | | | | | | |
| | RP-1 | 28.4 | 30.3 | 33.4 | **34.9** | 36.3 | 39.3 | 39.5 |
| | RP-5 | 7.3 | 10.3 | 14.8 | **16.7** | 18.6 | 21.6 | 22.1 |
| 3B | | | | | | | | |
| | RP-1 | 29.0 | 31.4 | 35.3 | **37.2** | 39.1 | 42.7 | 42.9 |
| | RP-5 | 6.7 | 9.2 | 12.8 | **14.3** | 15.8 | 18.2 | 18.7 |
| 3C | | | | | | | | |
| | RP-1 | 30.4 | 34.1 | 40.2 | **43.2** | 46.1 | 51.1 | 51.3 |
| | RP-5 | 5.3 | 6.5 | 7.9 | **8.4** | 8.9 | 9.8 | 10.3 |
| Alternative 4[2] | | | | | | | | |
| 4A | | | | | | | | |
| | RP-1 | 28.6 | 29.9 | 31.7 | **32.6** | 33.4 | 35.5 | 35.7 |
| | RP-5 | 7.1 | 10.7 | 16.4 | **19.0** | 21.5 | 25.4 | 25.9 |
| 4B | | | | | | | | |
| | RP-1 | 26.4 | 27.5 | 29.1 | **30.0** | 30.8 | 32.9 | 33.1 |
| | RP-5 | 9.3 | 13.1 | 19.0 | **21.6** | 24.1 | 28.0 | 28.5 |

Notes:
[1] Includes construction of a new regional lift station to convey flows to RP-1. Three sub alternatives were developed to evaluate diverting differing percentages of flows from City of Ontario's New Model Colony (NMC) growth area. Alternative 3A diverted 30 percent of NMC flow, Alternative 3B diverted 50 percent of NMC flow, and Alternative 3C diverted 100 percent of NMC flow.
[2] Alternative 4A evaluated the flows if 100 percent of flow at the Montclair diversion structure was diverted to RP-1, while Alternative 4B assumes 100 percent of the flows at the Montclair diversion were conveyed to CCWRF.
[3] Analysis based on 20-Year Planning Horizon.

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## 4.2 Infrastructure Implications

Once the flow diversion alternatives were established, the facilities needed to operate under the specifics of each were developed. The facilities were established using the hydraulic model discussed in TM 2 and an understanding of the treatment requirements for RP-1 and RP-5. For the expansions of the Reclamation Plants, it was assumed that additional capacity would be added in modules based on the current configuration of the unit processes. As discussed in the evaluation section, RP-1 expansion modules will provide 5 mgd capacity for a TIN concentration of 5 mg/L. RP-5 can be expanded in 7.5 mgd modules for a TIN concentration of 8 mg/L. These same modules will provide 6.5 mgd of capacity each for a TIN of 5 mg/L. The infrastructure implications for each alternative are listed in Table 3-4. As stated previously, a planning horizon of 20 years (2035) is used to establish the infrastructure needs for each alternative.

TABLE 3-4
**Alternative Infrastructure Implications**

| Facility | Type of Improvement | Existing Size/ Diameter | New Size/ Diameter |
|---|---|---|---|
| **Alternative 1** | | | |
| RP-1 | Expand 5 mgd | 29 mgd | 34 mgd |
| RP-5 | Expand 7.5 mgd | 15 mgd | 22.5 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 2** | | | |
| Whispering Lakes PS | Pump Station | 2.16 mgd | 4.68 mgd |
| RP-1 | Expand 5 mgd | 29 mgd | 34 mgd |
| RP-5 | Expand 7.5 mgd | 15 mgd | 22.5 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 3A** | | | |
| Proposed | Pump Station | - | 17 mgd |
| | Force Main | - | 24 in |
| RP-1 | Expand 10 mgd | 29 mgd | 39 mgd |
| RP-5 | Expand 7.5 mgd | 15 mgd | 22.5 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 3B** | | | |
| Proposed | Pump Station | - | 29 mgd |
| | Force Main | - | 30 in |
| RP-1 | Expand 10 mgd | 29 mgd | 39 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 3C** | | | |
| Proposed | Pump Station | - | 45.8 mgd |
| | Force Main | - | 42 in |
| RP-1 | Expand 15 mgd | 29 mgd | 44 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 4A[1]** | | | |
| Proposed | Pump Station | - | 22 mgd |
| | Storage Tank | - | 6 MG |
| | Recycled Water Pipeline | - | 24 in |
| RP-1 | Expand 5 mgd | 29 mgd | 34 mgd |
| RP-5 | Expand 6.5 mgd | 13 mgd | 19.5 mgd |
| Montclair Pipeline | Upsize | 30 in | 36 in |
| **Alternative 4B[1]** | | | |
| Proposed | Pump Station | - | 22 mgd |
| | Storage Tank | - | 6 MG |
| | Recycled Water Pipeline | - | 24 in |
| RP-1 | Expand 5 mgd | 29 mgd | 34 mgd |
| RP-5 | Expand 13 mgd | 13 mgd | 26 mgd |

Note:
[1] The RP-5 capacity and expansion needs for Alternatives 4A and 4B are based on a TIN of 5 mg/L. For all other alternatives, the RP-5 capacity and expansion needs are based on a TIN of 8 mg/L.

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**Alternative 1** – Facilities required include the expansions of RP-1 and RP-5 to accommodate the projected increases in wastewater flows. Currently RP-1 is rated at 29 mgd (5 mg/L TIN) and would need to be expanded to 34 mgd to accommodate the projected increase in flow. RP-5 is currently rated for 15 mgd (8 mg/L TIN) and would need to be expanded to 22.5 mgd. Alternative 1 would also include an upgrade of the Montclair pipeline downstream of the Montclair pump station from a 30-inch sewer to a 36-inch pipeline. The added facilities are shown on Figure 3-2 at the end of this section.

**Alternative 2** – Alternative 2 proposes to utilize the Whispering Lakes Pump station to convey wastewater back to RP-1. This alternative would require the expansion of the Whispering Lakes Pump Station by approximately 2.2 mgd to 4.7 mgd. Similar to Alternative 1, RP-1 and RP-5 would require expansions of 5 and 7.5 mgd, respectively. The added facilities are shown on Figure 3-3 at the end of this section.

**Alternative 3A** – The infrastructure required for Alternative 3A includes a 17 mgd pump station located South of Edison Avenue and a 24-inch diameter forcemain to convey wastewater back to RP-1. RP-1 and RP-5 would require expansions of 10 mgd and 7.5 mgd, respectively. RP-1 would expand from 29 mgd to 39 mgd and RP-5 would expand from 15 mgd to 22.5 mgd. This alternative would also require upsizing the Montclair pipeline downstream of the Montclair pump station, from a 30-inch sewer to a 36-inch sewer. The added facilities are shown on Figure 3-4 at the end of this section.

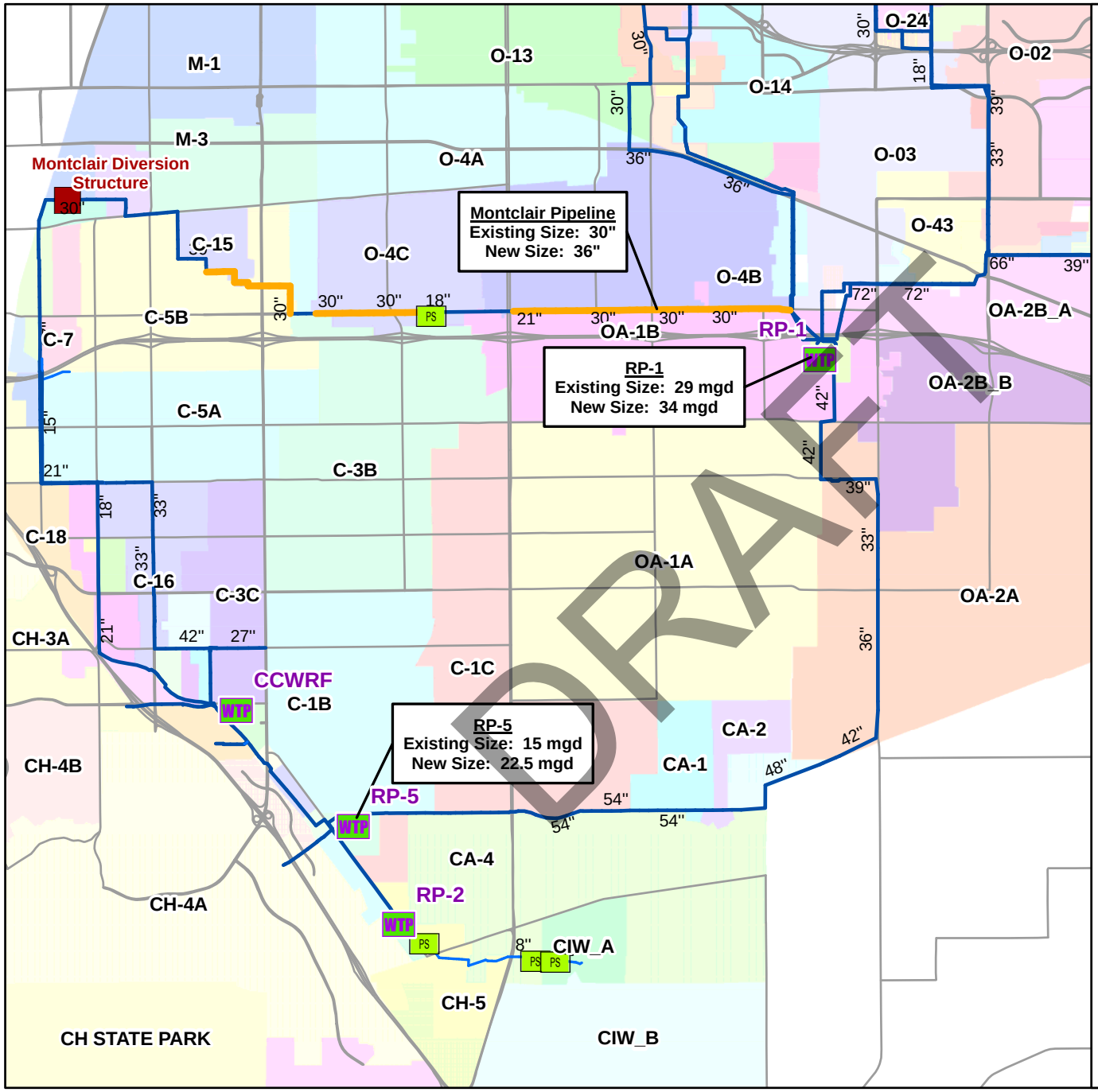
**Alternative 3B** – Alternative 3B is similar to Alternative 3A in terms of the treatment plant expansions for RP-1 and the upsizing of the Montclair pipeline. However, this alternative would require a 29 mgd pump station, located near the flood control channel and Hellman Avenue, and a 30-inch diameter forcemain to convey flows to RP-1. This alternative would not require an expansion of RP-5. Alternative 3B would also include an upgrade of the Montclair pipeline downstream of the Montclair pump station from a 30-inch sewer to a 36-inch pipeline. The added facilities are shown on Figure 3-5 at the end of this section.

**Alternative 3C** – This Alternative would require an expansion of RP-1 by 15 mgd, from 29 mgd to 44 mgd, and installation of a 46 mgd wastewater pump station and 42-inch diameter forcemain. Alternative 3C would also include an upgrade of the Montclair pipeline downstream of the Montclair pump station, from a 30-inch sewer to a 36-inch pipeline. The added facilities are shown on Figure 3-6 at the end of this section.

**Alternative 4A** – This alternative assumes that 22 mgd of wastewater would be treated for groundwater recharge and pumped to RP-1 in a 24-inch diameter recycled water pipeline. There would also need to be a recycled water storage tank located at RP-5. RP-1 would need to be expanded by 5 mgd, from 29 to 34 mgd, and RP-5 would be expanded by 6.5 mgd, from 13 mgd to 19.5 mgd. The difference in the expansions for RP-5 in this alternative is the lower TIN limit of 5 mg/L for RP-5 discussed in the evaluation criteria section. Alternative 4A would also include an upgrade of the Montclair pipeline downstream of the Montclair pump station, from a 30-inch sewer to a 36-inch pipeline. The added facilities are shown on Figure 3-7 at the end of this section.

**Alternative 4B** – Similar to Alternative 4A, the infrastructure required for this alternative includes a 22 mgd recycled water pump station, and a 24-inch diameter recycled water pipeline and a recycled water storage tank. RP-1 would be expanded by 5 mgd from 29 mgd to 34 mgd, and RP-5 would increase by 13 mgd from 13 mgd to 26 mgd. This is the only alternative that does not require the expansion of the Montclair pipeline. The added facilities are shown on Figure 3-7.

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**Legend**

- Montclair Capacity Deficiency
- Montclair Diversion Structure
- WTP Regional Treatment Plant
- PS Lift Station

**Modeled Pipelines**

- 12" and Smaller
- 15" and Larger
- Major Roads
- IEUA Tributary Areas

## Figure 3-2
## Alternative 1
## Infrastructure Implications

Inland Empire Utilities Agency
Wastewater Facilities Master Plan

0 3,600 7,200 Feet

1 inch = 7,250 feet



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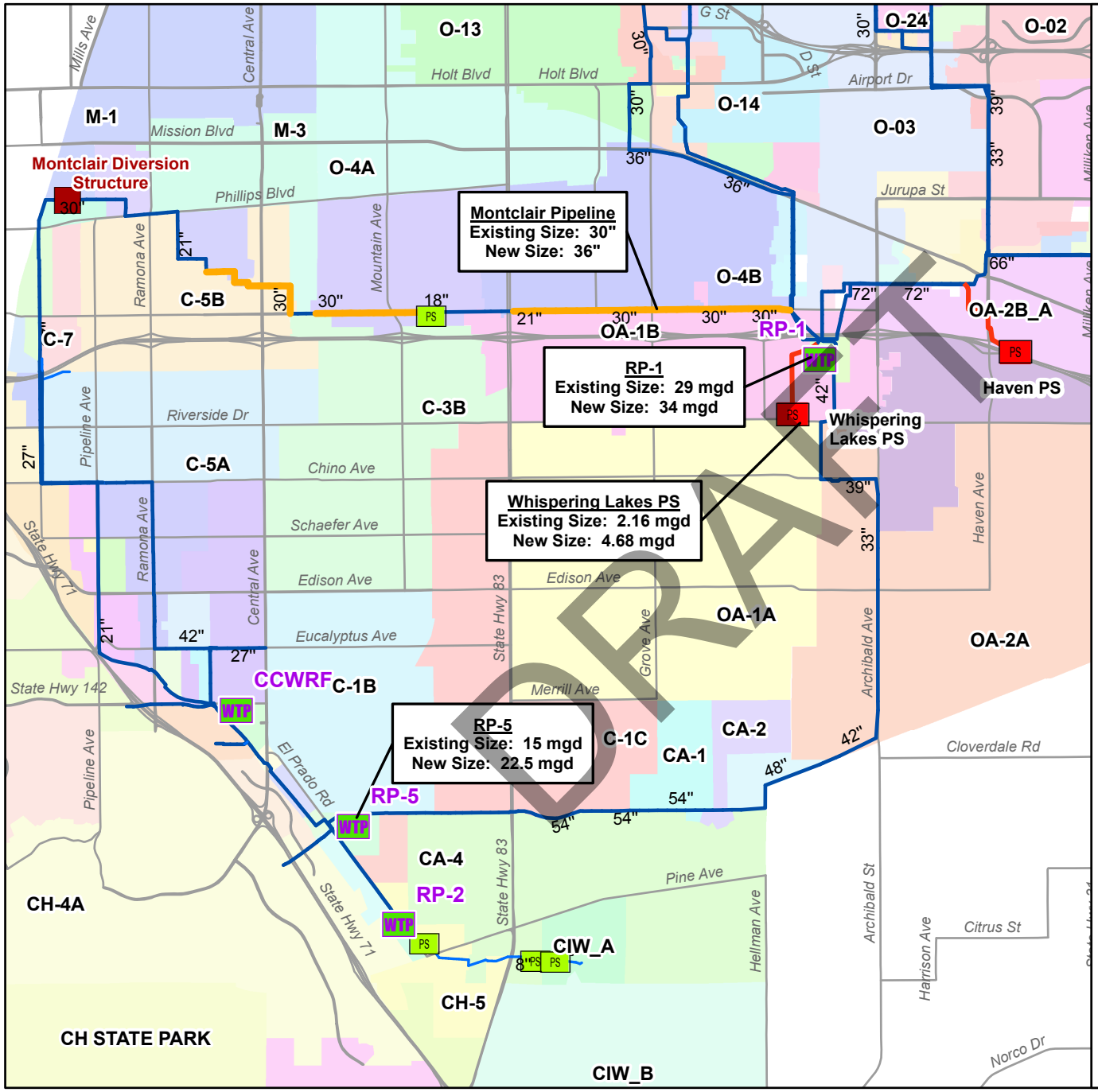



**Figure 3-3**
**Alternative 2**
**Infrastructure Implications**

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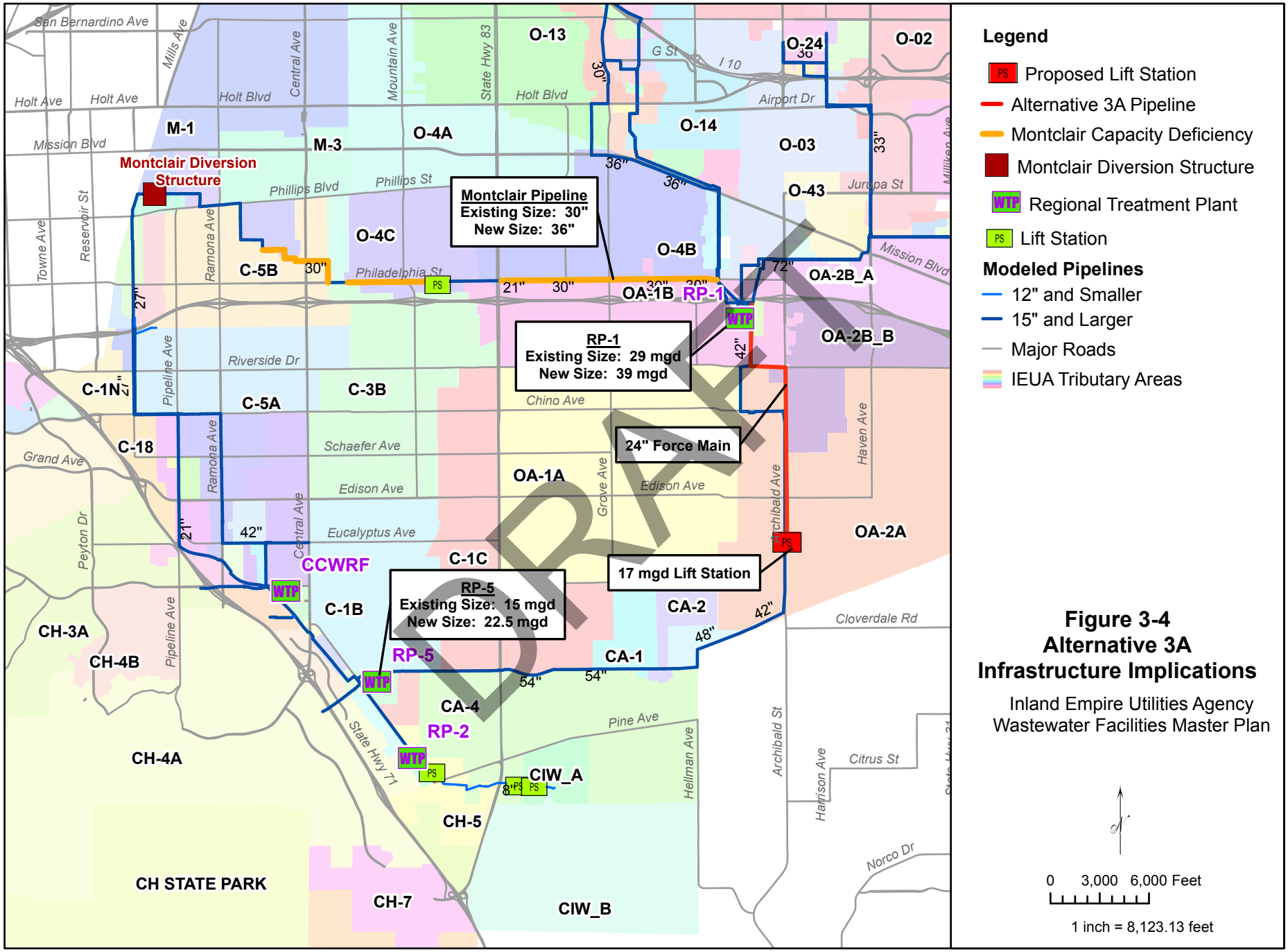
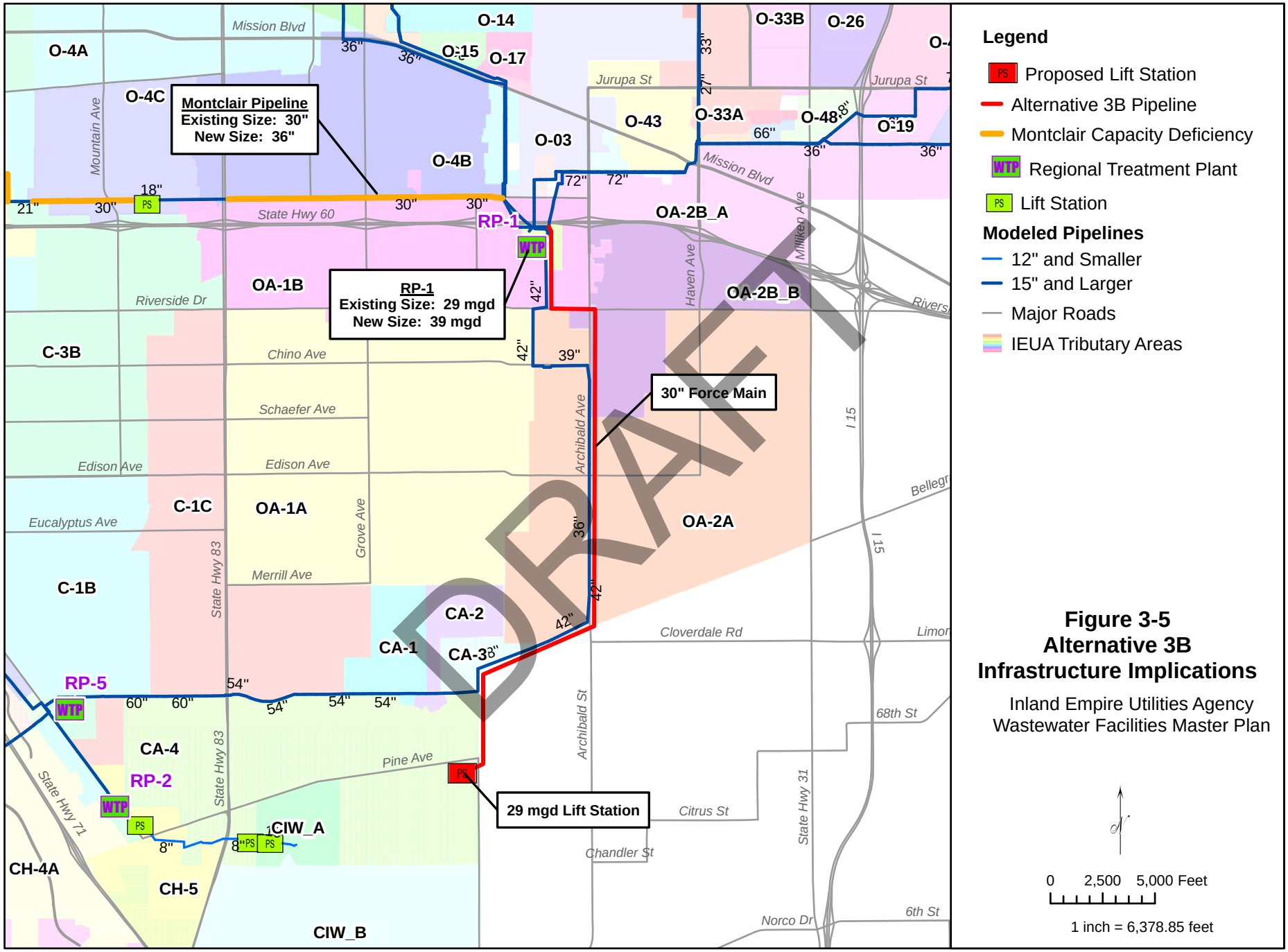


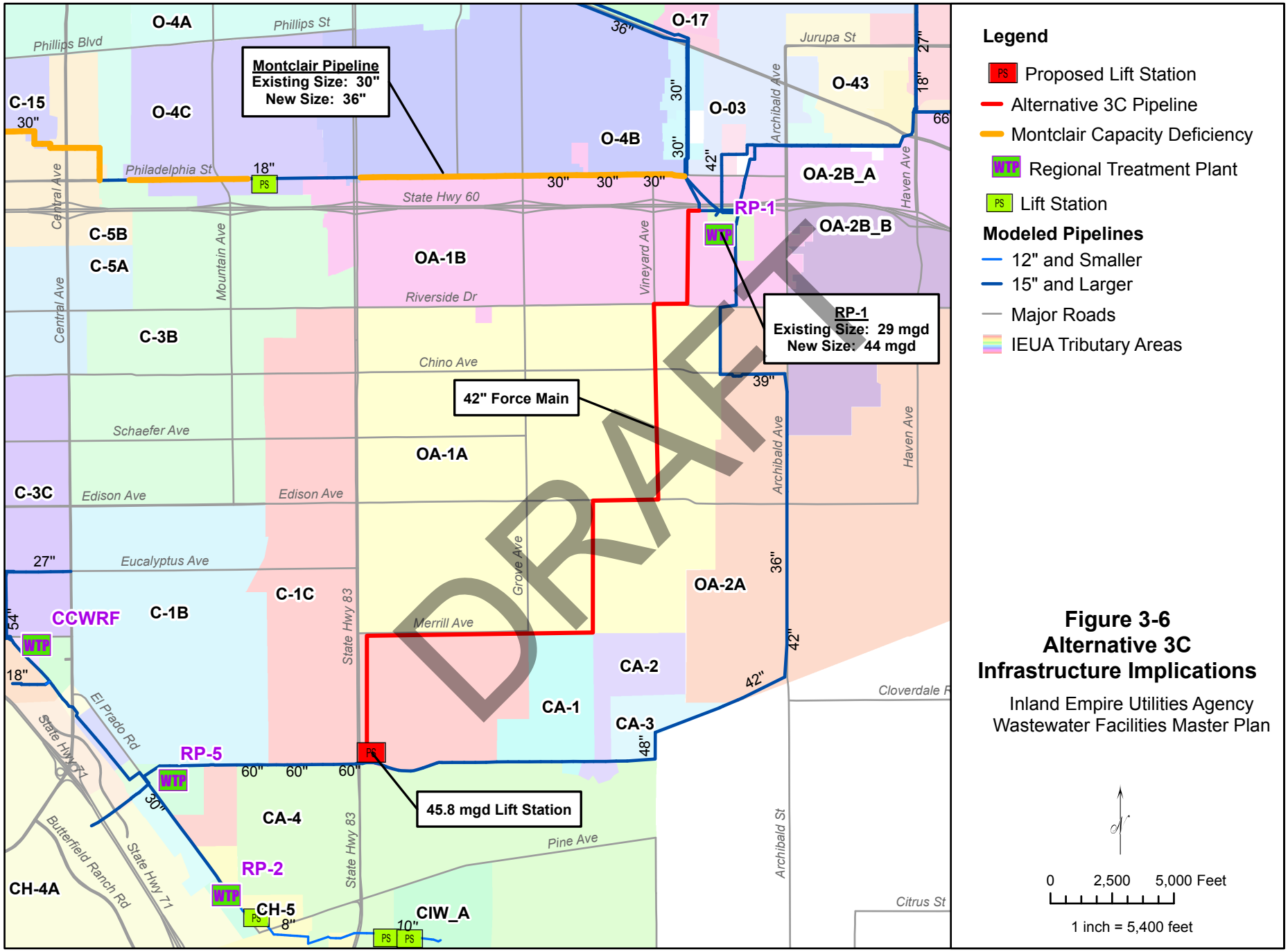

**Figure 3-4**
**Alternative 3A**
**Infrastructure Implications**

Inland Empire Utilities Agency
Wastewater Facilities Master Plan

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Montclair Pipeline
Existing Size: 30"
New Size: 36"
RP-1
Existing Size: 29 mgd
New Size: 39 mgd
30" Force Main
29 mgd Lift Station
RP-1
RP-2
RP-5
O-4A
O-4C
O-4B
O-14
O-15
O-17
O-03
O-43
O-33A
O-33B
O-26
O-48
O-19
OA-1B
OA-2B_A
OA-2B_B
OA-1A
OA-2A
C-3B
C-1C
C-1B
CA-1
CA-2
CA-3
CA-4
CH-4A
CH-5
CIW_A
CIW_B
Mission Blvd
State Hwy 60
Riverside Dr
Chino Ave
Schaefer Ave
Edison Ave
Eucalyptus Ave
Merrill Ave
Pine Ave
Jurupa St
Cloverdale Rd
Citrus St
Chandler St
Norco Dr
68th St
6th St
Mountain Ave
State Hwy 83
State Hwy 71
Grove Ave
Archibald Ave
Archibald St
Haven Ave
Milliken Ave
I 15
State Hwy 31
DRAFT
Legend
Proposed Lift Station
Alternative 3B Pipeline
Montclair Capacity Deficiency
Regional Treatment Plant
Lift Station
Modeled Pipelines
12" and Smaller
15" and Larger
Major Roads
IEUA Tributary Areas
Figure 3-5
Alternative 3B
Infrastructure Implications
Inland Empire Utilities Agency
Wastewater Facilities Master Plan
0 2,500 5,000 Feet
1 inch = 6,378.85 feet




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# Figure 3-6
# Alternative 3C
# Infrastructure Implications

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Wastewater Facilities Master Plan

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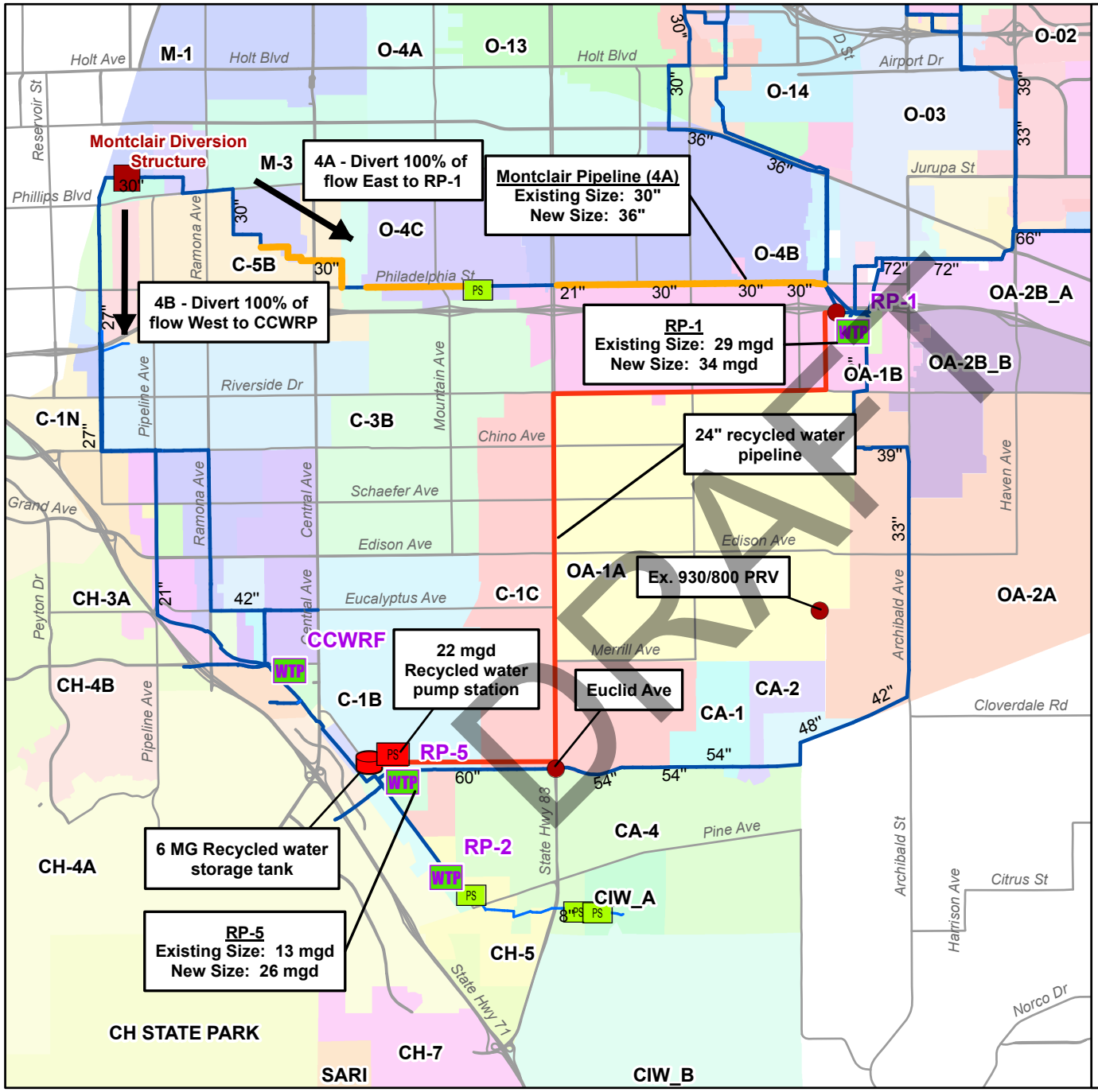



**Figure 3-7**
**Alternative 4A and 4B Infrastructure Implications**

Inland Empire Utilities Agency
Wastewater Facilities Master Plan

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## 4.3 Evaluation of Proposed Flow Diversion Alternatives

The Consultant Team used the SMART evaluation approach described above to conduct a non-monetary evaluation of the flow diversion alternatives. The non-monetary and monetary evaluations are summarized in this section of this technical memorandum. The non-monetary and monetary evaluations are ultimately combined as a means to develop a cost benefit analysis of the alternatives.

### 4.3.1 Non-monetary Evaluation

Each alternative was evaluated relative to one another using the SMART criteria described previously in this memorandum. Each evaluation criterion for each alternative was given a performance score between one (1) and five (5). The performance score was multiplied by the weighting factor for each criterion to develop a weighted score that criterion. The total weighted performance for each alternative was then determined by summing the weighted scores for each alternative. The results of the evaluations are summarized in Table 3-5.

As illustrated in Table 3-5, the scores ranged from a low for Alternative 1 of 217 to a high of 279 for Alternative 3B. Figure 3-8 depicts a summary of the relative weights of each criterion for each alternative. The bars show the contribution of each weighted score towards the total score for each alternative. As shown in the chart, Operational Flexibility, Optimizing Groundwater Recharge, and Ease of Operation and Maintenance had the biggest impact of the total performance scores for each alternative.

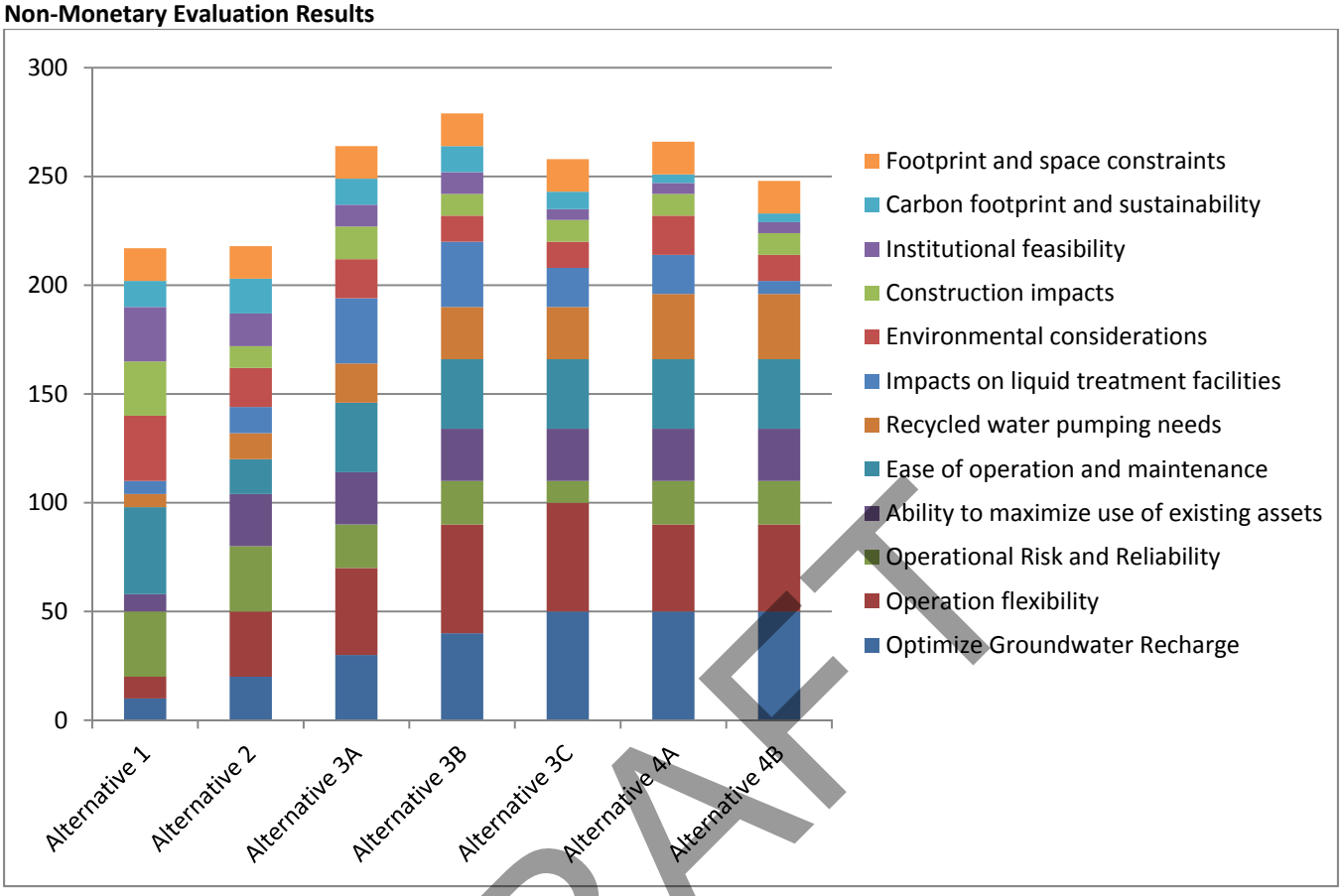
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TABLE 3-5
**Non-Monetary Evaluation Results**

| Criteria | Weighting Factor | Alternative 1 | | Alternative 2 | | Alternative 3A | | Alternative 3B | | Alternative 3C | | Alternative 4A | | Alternative 4B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Performance Score | Weighted Score | Performance Score | Weighted Score | Performance Score | Weighted Score | Performance Score | Weighted Score | Performance Score | Weighted Score | Performance Score | Weighted Score | Performance Score | Weighted Score |
| Optimize Groundwater Recharge | 10 | 1 | 10 | 2 | 20 | 3 | 30 | 4 | 40 | 5 | 50 | 5 | 50 | 5 | 50 |
| Operational Flexibility | 10 | 1 | 10 | 3 | 30 | 4 | 40 | 5 | 50 | 5 | 50 | 4 | 40 | 4 | 40 |
| Operational Risk and Reliability | 10 | 3 | 30 | 3 | 30 | 2 | 20 | 2 | 20 | 1 | 10 | 2 | 20 | 2 | 20 |
| Ability to maximize use of existing assets | 8 | 1 | 8 | 3 | 24 | 3 | 24 | 3 | 24 | 3 | 24 | 3 | 24 | 3 | 24 |
| Ease of operation and maintenance | 8 | 5 | 40 | 2 | 16 | 4 | 32 | 4 | 32 | 4 | 32 | 4 | 32 | 4 | 32 |
| Recycled water pumping needs | 6 | 1 | 6 | 2 | 12 | 3 | 18 | 4 | 24 | 4 | 24 | 5 | 30 | 5 | 30 |
| Impacts on liquid treatment facilities | 6 | 1 | 6 | 2 | 12 | 5 | 30 | 5 | 30 | 3 | 18 | 3 | 18 | 1 | 6 |
| Environmental considerations | 6 | 5 | 30 | 3 | 18 | 3 | 18 | 2 | 12 | 2 | 12 | 3 | 18 | 2 | 12 |
| Construction impacts | 5 | 5 | 25 | 3 | 15 | 3 | 15 | 2 | 10 | 2 | 10 | 2 | 10 | 2 | 10 |
| Institutional feasibility | 5 | 5 | 25 | 3 | 15 | 2 | 10 | 2 | 10 | 1 | 5 | 1 | 5 | 1 | 5 |
| Carbon footprint and sustainability | 4 | 3 | 12 | 4 | 16 | 3 | 12 | 3 | 12 | 2 | 8 | 1 | 4 | 1 | 4 |
| Footprint and space constraints | 3 | 5 | 15 | 5 | 15 | 5 | 15 | 5 | 15 | 5 | 15 | 5 | 15 | 5 | 15 |
| **Total Weighted Performance** | | | **217** | | **223** | | **264** | | **279** | | **258** | | **266** | | **248** |

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FIGURE 3-8
**Non-Monetary Evaluation Results**




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### 4.3.2 Monetary Evaluation

The Monetary Evaluation included several assumptions that had an impact on the cost estimates. The assumptions included the following:

- The WFMP assumed a 20-year planning period
- 3% inflation rate
- 6% bond (interest) rate
- $10 per gallon for liquid treatment capacity costs
- Pump Station costs were based on a cost curve established from historical pump station projects
- Pipeline costs were developed based on the costs per linear foot for varying diameters
- Labor and Power costs were provided based on IEUA cost factors.
- 30% contingency for unknown conditions
- 30% contingency for Engineering, Construction Management, Environmental, and Legal costs

Based on the flow curves for each diversion alternative, the year in which each treatment plant expansion will be required was determined. For each alternative, the costs for expansion was escalated to the mid-point of construction using the inflation rate, and was brought back to present worth with the bond interest rate. Operations and maintenance and power costs were annualized and brought to a net present value in the same manner.

With this method, the total life cycle cost for each alternative was developed. The estimated cost for each alternative is summarized in Table 3-6. These cost estimates range from a high of $341 million for Alternative 3C to a low of $172 million for Alternative 1. Alternative 2 was the second lowest cost at $178 million. The unit costs and the detailed cost breakdown is provided in Appendix A of this TM. Benefit/cost ratios are explained in the next subsection.

TABLE 3-6
**Life Cycle Cost and Benefit/Cost Ratio Summary**

| Alternative | Life Cycle Cost ($ Millions) | Benefit/Cost Ratio |
|---|---|---|
| 1 | $172 | 1.26 |
| 2 | $178 | 1.25 |
| 3A | $261 | 1.01 |
| 3B | $219 | 1.28 |
| 3C | $341 | 0.76 |
| 4A | $265 | 1.00 |
| 4B | $335 | 0.74 |

### 4.3.3 Benefit/Cost Ratio

The non-monetary scores and monetary cost estimates were used to develop a benefit cost ratio as a means to determine the alternative with the highest overall benefit for IEUA. For each Alternative, the weighted performance score was divided by the estimated life cycle cost to determine the Benefit/Cost (B/C) Ratio. The calculated B/C ratio for each alternative is summarized in Table 3-6.

The alternative with the highest weighted score is Alternative 3B with a score of 1.28. Both Alternatives 1 and 2 also scored high, and close to Alternative 3B, with scores of 1.26 and 1.25 respectively.

# 5.0 Conclusions

The results of the flow diversion alternatives evaluation and the benefit cost analysis were presented to IEUA staff at the WFMP Workshop No. 2 on June 11, 2014. The benefit cost analysis scores for Alternatives 1, 2 and 3B are very similar and vary by only 0.03 points. IEUA discussed the alternatives and ultimately selected Alternative 2 as the preferred alternative. Alternative 2 provides IEUA with near term benefits in diverting flow from both the Whispering Lakes and Haven pump stations while prolonging the treatment expansion of RP-1 and RP-5. Alternative 2 also offers a lower capital cost than alternative 3B.

The preferred Alternative 2 includes the following improvements during the planning horizon:

- Expand RP-1 by 5.0 mgd
- Expand RP-5 by 7.5 mgd
- Upgrade the Whispering Lakes Pump Station to a firm capacity of 4.7 mgd
- Construct improvements to mitigate the deficiencies in the Montclair pipeline

In order to provide greater system reliability and redundancy, IEUA also requested that, for RP-5 facilities planning, the Consultant Team assume both the Whispering Lakes and Haven pump stations are offline, whereby the full flow is conveyed to RP-5 instead of RP-1. This flow condition is reflected in TM 4 Flow and Loading Forecast and forms the basis for establishing RP-5 facilities planning and expansion, hereinafter.

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# Appendix A
# Cost Estimates

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| | Type of Improv. | Description / Limits | Ex. Size/ Diam. | New Size/ Diam. | Replace/ New | Length (ft) | 2014 Cost | Potential Flows for GW Recharge AF |
|---|---|---|---|---|---|---|---|---|
| **Proposed Alternatives** | | | | | | | | |
| **Alternative 1** | | | | | | | | |
| | Expand | Expand RP-1 by 5 mgd | 29 mgd | 34.0 mgd | Rehab | - | $ 70,834,000.00 | |
| | Expand | Expand RP-5 by 6.5 mgd | 15 mgd | 21.5 mgd | Rehab | - | $ 84,485,000.00 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 1 Total** | | | | | | | **$ 172,449,000** | **None** |
| **Alternative 2** | | | | | | | | |
| | Pump Station | Upgrade to 4.5mgd Firm Capacity | 2.16 mgd | 4.68 mgd | Rehab | - | $ 4,923,000 | |
| | Maintanence | Pump Station Maintanence | - | - | - | - | $ 760,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 582,000 | |
| | Expand | Expand RP-1 by 5 mgd | 29 mgd | 34.0 mgd | Rehab | - | $ 75,020,000 | |
| | Expand | Expand RP-5 by 6.5 mgd | 15 mgd | 21.5 mgd | Rehab | - | $ 79,771,000 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 2 Total** | | | | | | | **$ 178,186,000** | **42,559** |
| **Alternative 3A** | | | | | | | | |
| | Force Main | South of Edision to RP-1 | - | 24 in | New | 16,700 | $ 10,118,000 | |
| | Pump Station | 13.8 mgd Firm Capacity | - | 17.3 mgd | New | - | $ 7,258,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 3,981,000 | |
| | Maintanence | Pump Station Maintanence | - | - | - | - | $ 1,120,000 | |
| | Expand | Expand RP-1 by 10 mgd | 29 mgd | 39.0 mgd | Rehab | - | $ 150,041,000 | |
| | Expand | Expand RP-5 by 6.5 mgd | 15 mgd | 21.5 mgd | Rehab | - | $ 71,116,000 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 3A Total** | | | | | | | **$ 260,764,000** | **114,245** |
| **Alternative 3B** | | | | | | | | |
| | Force Main | South of Pine Ave and Hellman Ave to RP-1 | - | 30 in | New | 31,000 | $ 28,069,000 | |
| | Pump Station | 22.9 mgd Firm Capacity | - | 29 mgd | New | - | $ 12,033,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 9,622,208 | |
| | Maintanence | Pump Station Maintanence | | | | - | $ 1,857,000 | |
| | Expand | Expand RP-1 by 10 mgd | 29 mgd | 39 mgd | Rehab | - | $ 150,040,758 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 3B Total** | | | | | | | **$ 218,752,000** | **190,457** |
| **Alternative 3C** | | | | | | | | |
| | Force main | Forcemain | - | 42 | New | 35,000 | $ 49,186,000 | |
| | Pump Station | 45.8 mgd Firm Capacity | - | 57 mgd | New | - | $ 24,088,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 21,327,000 | |
| | Maintanence | Pump Station Maintanence | - | - | - | - | $ 3,718,000 | |
| | Expand | Expand RP-1 by 15 mgd | 29 mgd | 44 mgd | - | - | $ 225,061,000 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 3C Total** | | | | | | | **$ 340,510,000** | **378,578** |
| **Alternative 4A** | | | | | | | | |
| | Pump Station | 24 mgd Recycled Water PS | - | 22 mgd | New | - | $ 9,257,000 | |
| | Eg. Basin | 6 mgd Recycled Water Eq. basin | - | 6 mgd | - | - | $ 10,100,000 | |
| | Maintanence | Pump Station Maintanence | - | - | - | - | $ 1,429,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 23,316,000 | |
| | Force main | Recycled Water Pipeline | - | 30 in | New | 43,500 | $ 39,387,000 | |
| | Expand | Expand RP-1 by 5 mgd | 29 mgd | 34.0 mgd | Rehab | - | $ 75,020,000 | |
| | Expand | Expand RP-5 by 6.5 mgd | 13 | 19.5 mgd | Rehab | - | $ 89,478,000 | |
| | Upsize | Montclair Improvements | 30 in | 36 in | Replace | 24,000 | $ 17,130,000 | |
| **Alternative 4A Total** | | | | | | | **$ 265,117,000** | **492,823** |
| **Alternative 4B** | | | | | | | | |
| | Pump Station | 24 mgd Recycled Water PS | - | 22 mgd | New | - | $ 9,256,500 | |
| | Eg. Basin | 6 mgd Recycled Water Eq. basin | - | 6 mgd | - | - | $ 10,100,000 | |
| | Maintanence | Pump Station Maintanence | - | - | - | - | $ 1,429,000 | |
| | Pump Station | Energy Consumption | - | - | - | - | $ 23,316,000 | |
| | Expand | Expand RP-1 by 5 mgd | 29 mgd | 34.0 mgd | Rehab | - | $ 56,298,000 | |
| | Expand | Expand RP-5 by 13 mgd | 13 mgd | 26.0 mgd | Rehab | - | $ 195,053,000 | |
| | Force main | Recycled Water Pipeline | | 30 in | New | 43,500 | $ 39,387,000 | |
| **Alternative 4B Total** | | | | | | | **$ 334,840,000** | **492,823** |

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# IEUA Wastewater Facilities Master Plan
# TM 4 Wastewater Flow and Loading Forecast

| | |
|---|---|
| PREPARED FOR: | Inland Empire Utilities Agency |
| PREPARED BY: | CH2M HILL |
| DATE: | August 21, 2014 |

## Executive Summary

Analysis of the influent wastewater flow and quality data for each of the four treatment plants was conducted to establish average values and peaking factors. Results of the influent wastewater analysis presented in this Technical Memorandum (TM), as well as the results of the flow diversion alternatives analysis presented in TM 3 *Regional Trunk Sewer Analysis*, formed the basis of the treatment plant influent wastewater flow and loading forecast analysis presented herein. As discussed in TM 3, the Wastewater Facilities Master Plan (WFMP) planning effort will be based on the Inland Empire Utilities Agency (IEUA) preferred Flow Diversion Alternative 2, optimizing groundwater recharge by diverting flows from Whispering Lakes and Haven pump stations to Regional Water Recycling Plant (RWRP, or RP) RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035, as well as for the 2060 ultimate buildout year, are presented in this TM and will form the basis of the master planning effort for each of the treatment plants.

The data analysis is based on two consecutive years of recent data provided by IEUA for influent flow and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia as nitrogen (NH3-N), and Total Kjehldahl Nitrogen (TKN). As discussed in TM 3, influent wastewater flows are projected to increase at the Carbon Canyon Water Recycling Facility (CCWRF) between 2020 and 2060 by about 15 percent, with more significant flow increases expected at RP-1, RP-4 and RP-5. The increase in flows to RP-4 by approximately 60 percent is largely attributable to the gradual incorporation of septic flows into the system beginning in 2020. RP-1 flows are projected to increase by 20 percent, and RP-5 flows are projected to more than double by year 2060 as a result of population growth in Chino and other areas served by RP-5.

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## 1.0 Background and Objectives

IEUA owns and operates regional sewer pipelines and receives wastewater from the cities of Upland, Montclair, Ontario, Fontana, Chino, Chino Hills, and Cucamonga County Water District servicing the City of Rancho Cucamonga. Wastewater collected within these service areas is treated at one of the four regional water recycling plants. RP-1 and RP-4 serve the northern parts of the service area, while RP-5 and CCWRF serve the southern parts. Both RP-4 and CCWRF are designed to be scalping plants for RP-1 and RP-5, respectively.

The four RWRPs are interconnected in a regional network. IEUA staff routinely use the bypass and diversion facilities, such as the San Bernardino Lift Station, the Montclair Lift Station and Diversion Structure, and the Carbon Canyon bypass to optimize flow and capacity utilization within the system. For instance, RP-5 can receive bypassed flows from RP-1 (primary effluent) and CCWRF, in addition to receiving recycle flows from RP-2, the solids handling facility, and the RP-2 lift station flows. In general, flows are routed between RWRPs in order to optimize recycled water deliveries while minimizing overall pumping and treatment cost.

The objective of this TM is to summarize current influent wastewater flow and quality data for each of the four RWRPs, establish peaking factors, and develop flow and loading projections for the WFMP. The analysis is based on two consecutive years of recent data provided by IEUA for key wastewater quality constituents including

BOD, TOC, TSS, NH3-N, and TKN. Peaking factors are established for maximum month, maximum week, and maximum day conditions. Influent wastewater flow projections were developed by the IRP Consultant as part of the flow monitoring program, while the load projections are calculated based on these flow projections and analysis of the influent wastewater characteristics.

# 2.0 Overview of IEUA Wastewater System

Each of the four regional reclamation facilities is interconnected through an intricate network of diversion points within the member agency wastewater collection systems to enable plant influent flows to be shifted between the facilities in order to efficiently treat the wastewater and meet recycled water demands within the IEUA service area. A schematic of this network is depicted in Figure 4-1.

In order to effectively deliver recycled water to users in the north, IEUA uses both the San Bernardino Lift Station and the Montclair Lift Station to route additional wastewater to RP-1 and RP-4 where the groundwater recharge basins are located. A diversion structure located upstream of RP-1 allows IEUA to divert raw wastewater to RP-4 by way of the San Bernardino Lift Station. The RP-4 Influent Diversion Structure offers flexibility within the system to divert RP-4 influent flows downstream towards RP-1, thus enabling IEUA to control the volume of influent flow to RP-4.

The Montclair Lift Station intercepts raw wastewater from the cities of Montclair, Upland, and Chino and pumps them to RP-1 for treatment. A portion of the flows from Upland and Montclair can also be diverted to CCWRF by way of the Montclair Diversion Structure. Similar to RP-4, the CCWRF Influent Diversion Structure offers flexibility within the system to divert CCWRF influent flows to RP-5, thus enabling IEUA to control the influent flow to CCWRF. In addition, the Primary Effluent Diversion Structure at RP-1 offers IEUA flexibility to divert primary effluent from RP-1 to RP-5.

With bypassed and diverted flows ultimately reaching RP-5 from each of the upstream facilities as well as from the RP-2 Lift Station to the south, RP-5 is a critical treatment facility within the IEUA system. The flow diversion alternatives analysis presented in TM 3 evaluated options for diverting flow between the facilities to achieve greater reliability and redundancy within the system. The results of the flow diversion analysis, as well as the analysis of the current and projected influent wastewater flow and quality presented herein, will form the basis of the treatment plant capacity and expansion needs in subsequent TMs. A summary of the influent wastewater flow and quality for each RWRP and for the system as a whole is presented in the next section.

# 3.0 Influent Wastewater Flow and Quality

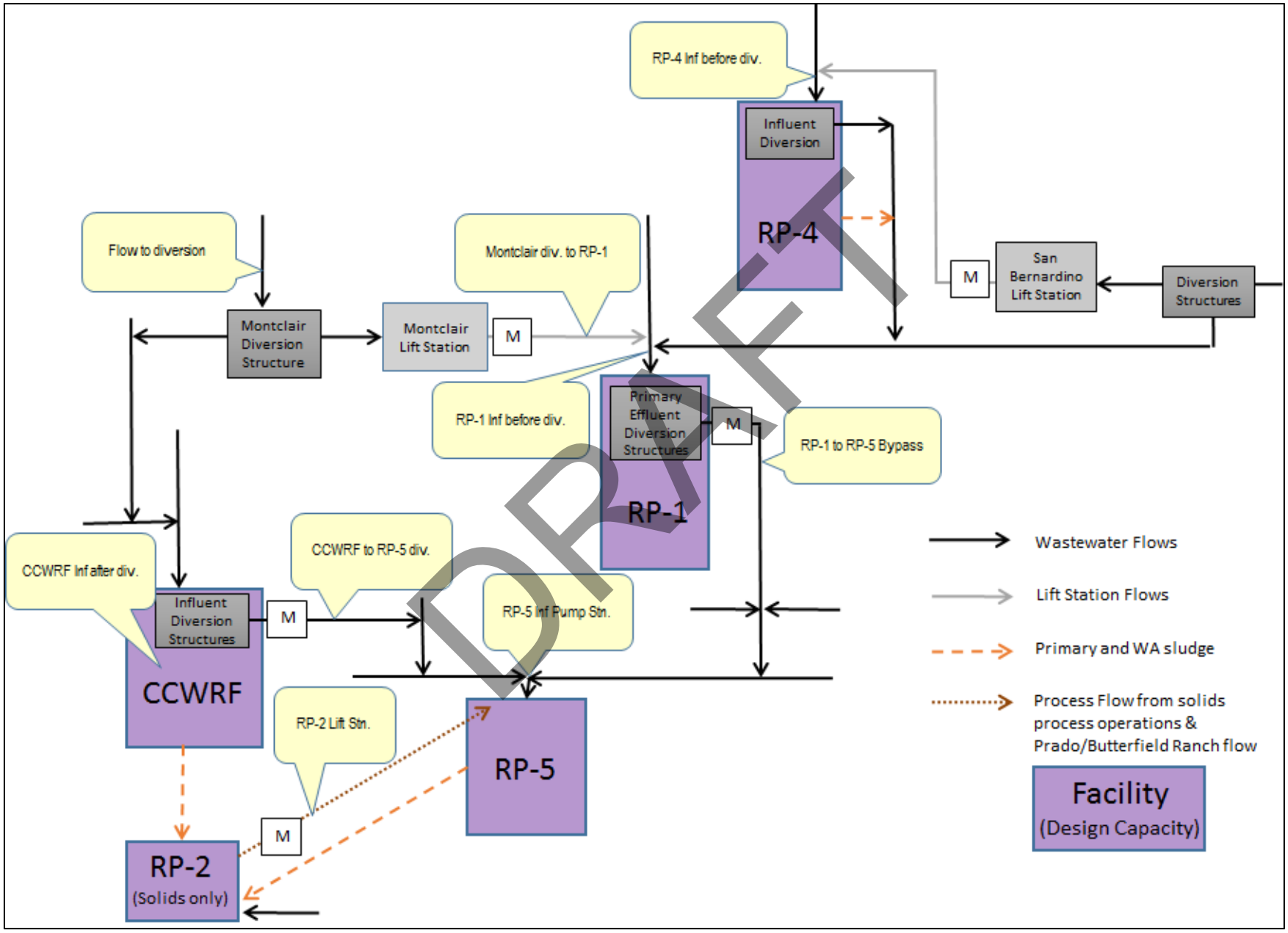
The Consultant Team reviewed the most recent two years of treatment plant flow and quality data to establish influent wastewater characteristics for each RWRP, which will form the basis of the treatment plant capacity evaluation conducted as part of the WFMP effort as well as the wastewater flow and loading projections presented in the next section. The recent data was analyzed to determine the annual average, maximum month, maximum week, and maximum day flows and corresponding peaking factors for each plant. Peaking factors are ratios of the particular flow or load event to the corresponding average values during the same time period. The same was done for the concentrations and loads for key constituents.

Plant influent flow data for the period of October 15, 2011 through October 15, 2013 was available on a daily basis for each of the RWRPs. Influent data for key parameters such as TOC, BOD, TSS, NH3-N, and TKN was also available for each plant. Constituent concentrations at each RWRP were measured using 24-hour composite samples collected and analyzed by plant personnel. The frequency at which these key parameters were measured during this time period varied from one time per week to three times per week depending on the plant and the constituent. Where BOD data was limited or unavailable, BOD concentrations were calculated using the measured influent TOC values and the parameter correlation currently employed by IEUA as provided in Equation 1. Review of the data indicated that this correlation is a good representation of influent BOD and was therefore used for this WFMP.

*Influent BOD (mg/L) = 1.92 x TOC – 13.19* *Equation 1*

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FIGURE 4-1
**IEUA Existing Wastewater System Schematic**



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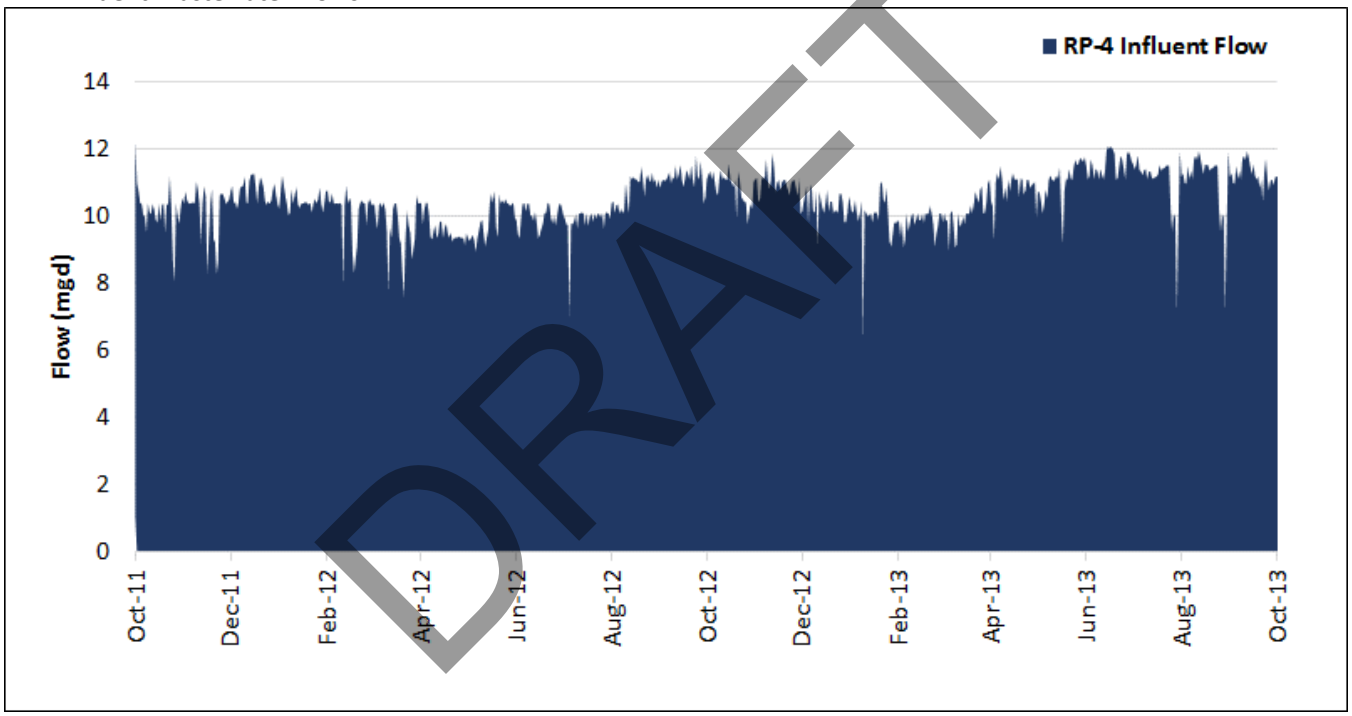
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Observations for each plant are discussed below. In general, plant influent flows and constituent concentrations have remained relatively constant over the two year period. A discussion of these observations is presented herein for each RWRP, from upstream-most plant to downstream-most plant. A summary of the influent flows, concentrations, and loads in terms of annual average, maximum month, maximum week, maximum day, and corresponding peaking factors is presented in Tables 4-1, 4-2, and 4-3 for all RWRPs at the end of this section.

## 3.1 RP-4 Influent Wastewater Flow and Quality

With the ability to divert northern flows to either RP-1 or RP-4, and to bypass influent RP-4 flows to RP-1, IEUA is able to control the influent flow to RP-4. As shown in Figure 4-2, the daily average influent flow values reported at RP-4 have been fairly stable over the last two year period, generally ranging between 8 and 12 mgd with an annual average of 10.5 mgd. Because RP-4 serves as a scalping plant for RP-1, routine flow diversions occurred during the analysis period but are not depicted in the figure due to the fact that RP-4 influent flows are measured after flow diversion has taken place. A summary of the average and maximum influent flows is presented in Table 4-1 at the end of this section.

FIGURE 4-2
**RP-4 Influent Wastewater Flows**

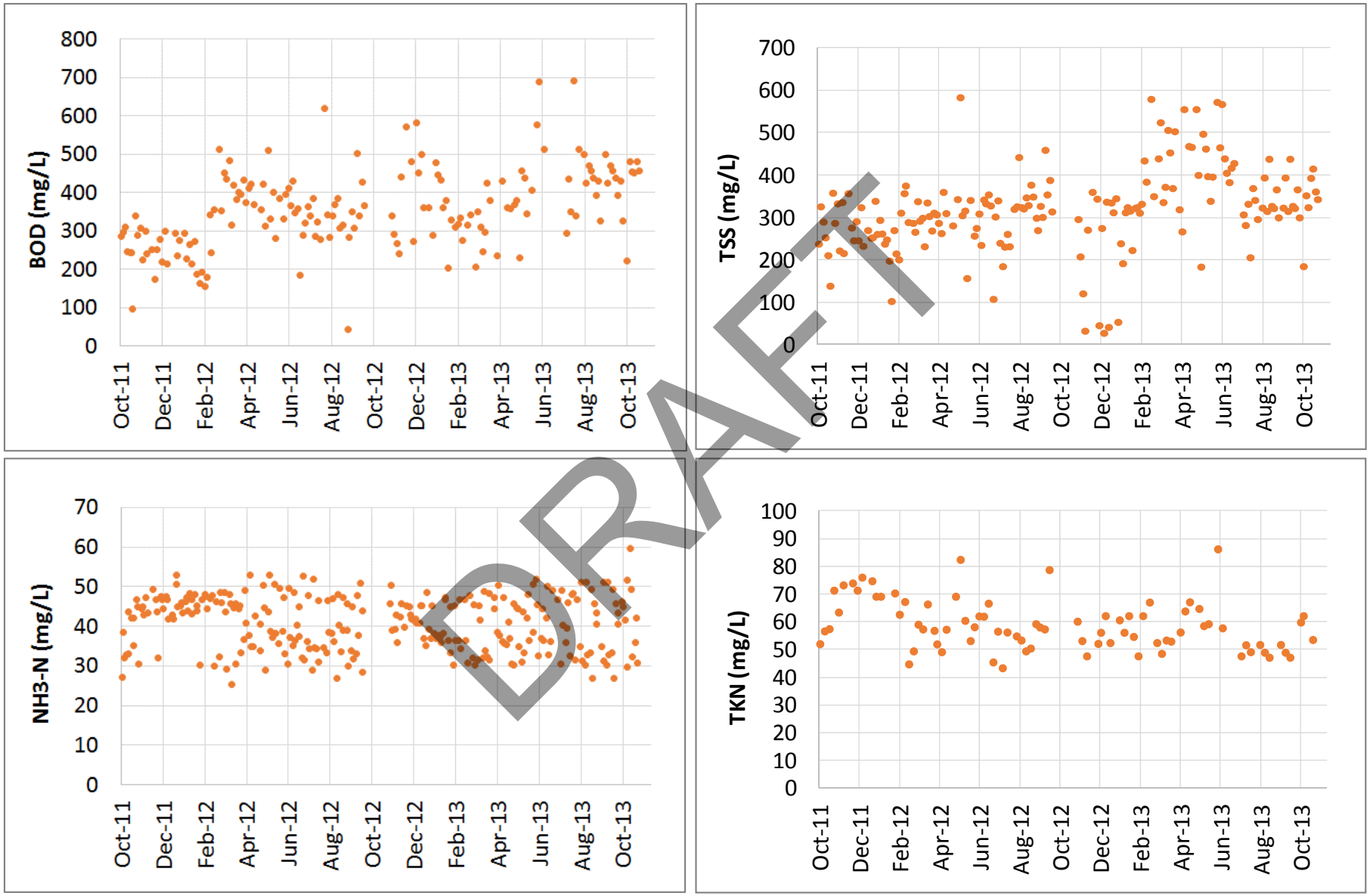



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The RP-4 influent wastewater quality for BOD, TSS, NH3-N, and TKN concentrations over the recent two year period is presented in Figure 4-3. Concentrations for TKN, TSS, and NH3-N were reported once, twice, and three times per week, respectively. TOC data was also available twice per week, as well as limited BOD data. For those months where BOD was measured, BOD data was available twice per week. For dates when both TOC and BOD data were available, BOD measurements were used. For dates when only TOC data was available, BOD concentrations were calculated using IEUA's equation derived from the correlation between TOC and BOD.

As shown in the concentration plots, influent BOD, TSS, NH3-N, and TKN concentrations have remained fairly constant during the two year period. A summary of the average and maximum concentrations and calculated loads for each of these constituents is presented in Tables 4-2 and 4-3 at the end of this section.

FIGURE 4-3
**RP-4 Influent Wastewater Quality**




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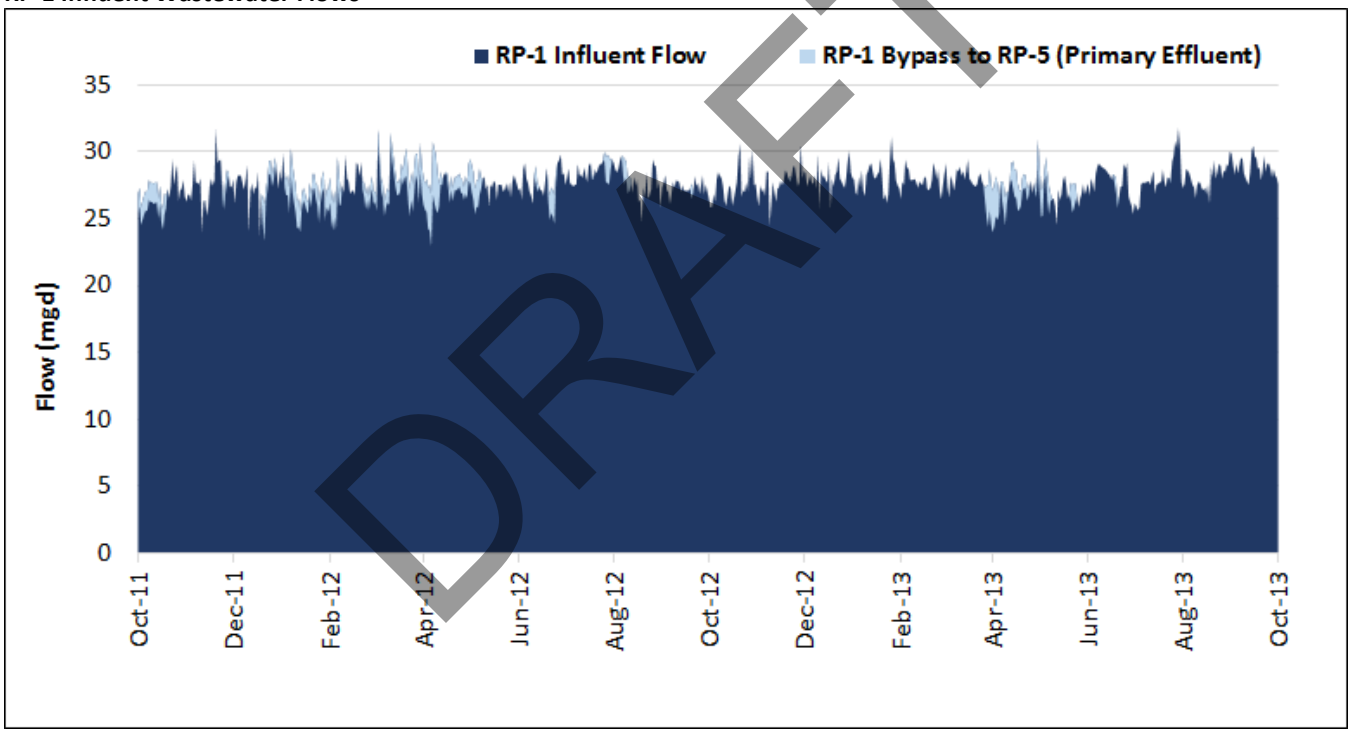
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## 3.2 RP-1 Influent Wastewater Flow and Quality

As described previously, RP-1 has the ability to bypass primary effluent flows to RP-5 to provide relief at RP-1 and/or to perform maintenance activities. Northern flows can also be diverted upstream of RP-1. As shown in Figure 4-4, the daily average flow values reported at RP-1 have been fairly stable over the last two year period, generally ranging between 25 and 30 mgd with an average of 28 mgd.

Periodic bypasses of primary effluent from RP-1 to RP-5 were observed during this period, primarily due to maintenance activities at RP-1. In addition, there were two instances during April 2012 and April 2013 when non-routine bypasses of RP-1 primary effluent flow to RP-5 occurred to allow IEUA to conduct maintenance activities at RP-1. Each of these occurrences was captured in the data and is represented in the figure. The Consultant Team analyzed the data with and without these unique occurrences and determined they did not affect analysis results. Therefore, the analysis presented herein represents the entire two year data set including routine and non-routine bypasses from RP-1 to RP-5. A summary of the average and maximum influent flows is presented in Table 4-1 at the end of this section.

FIGURE 4-4
**RP-1 Influent Wastewater Flows**

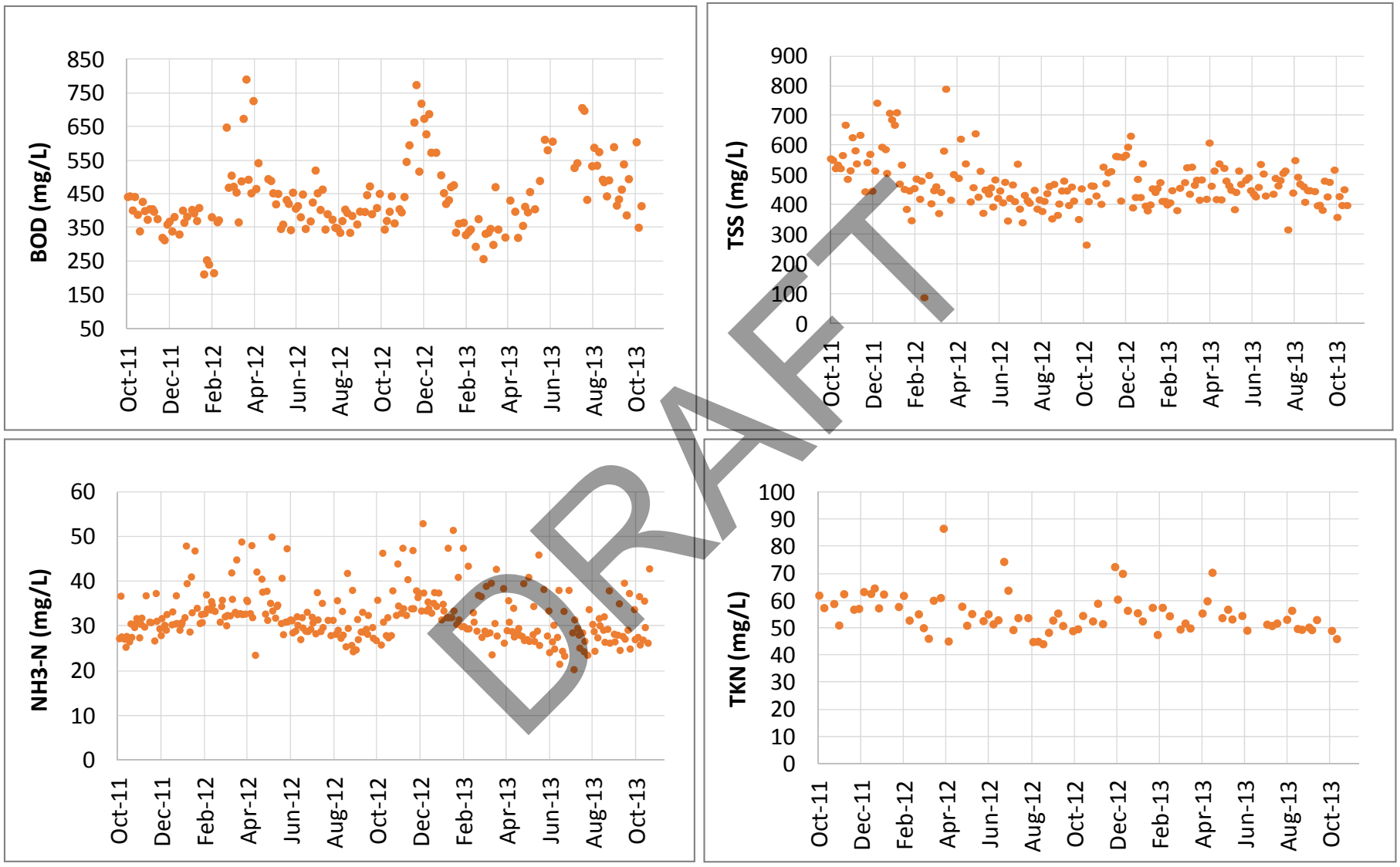



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The RP-1 influent wastewater quality for BOD, TSS, NH3-N, and TKN concentrations over the recent two year period is presented in Figure 4-5. Concentrations for TKN, TSS, and NH3-N were reported once, twice, and three times per week, respectively. TOC data was also available twice a week, as well as limited BOD data. For those months where BOD was measured, BOD data was available twice a week. For dates when both TOC and BOD data were available, BOD measurements were used. For dates when only TOC data was available, BOD concentrations were calculated using IEUA's equation derived from the correlation between TOC and BOD.

As shown in the concentration plots, concentrations of BOD, TSS, NH3-N, and TKN have remained fairly constant over the two year period aside from a couple of peak events. A summary of the average and maximum concentrations and calculated loads for each of these constituents is presented in Tables 4-2 and 4-3 at the end of this section.

FIGURE 4-5
**RP-1 Influent Wastewater Quality**




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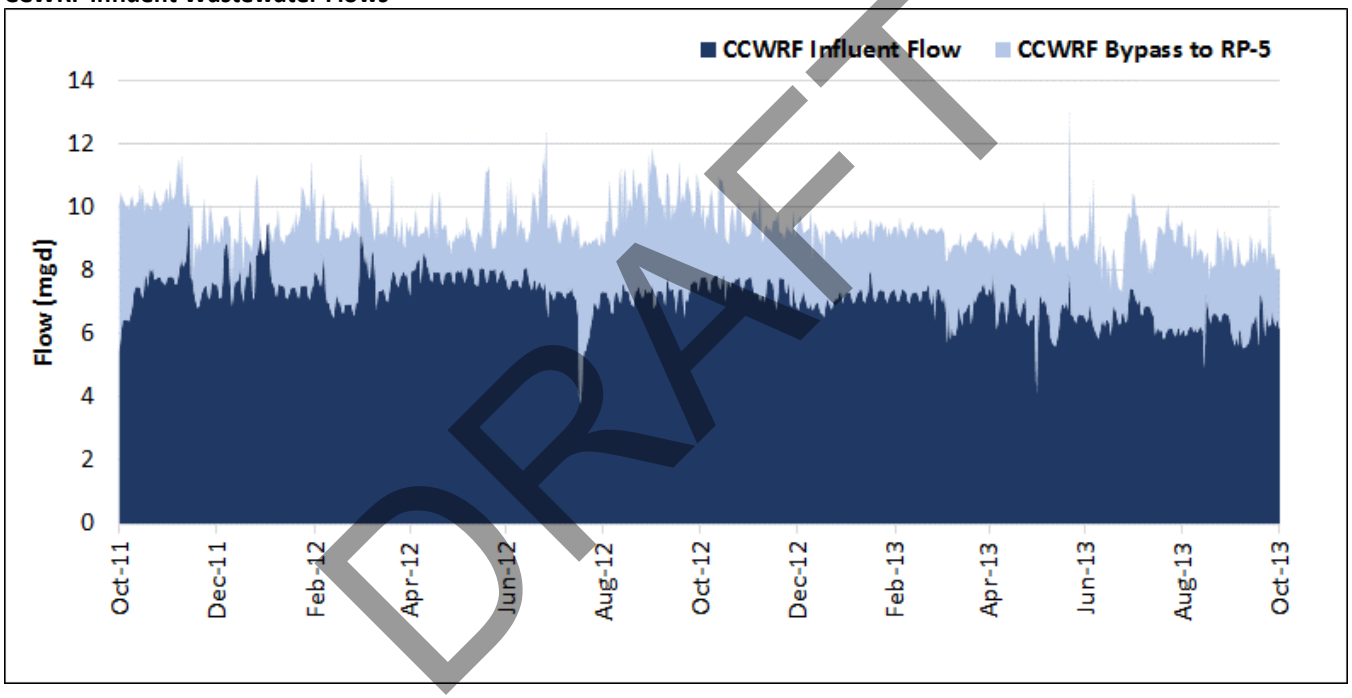
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## 3.3 CCWRF Influent Wastewater Flow and Quality

The operational relationship between CCWRF and RP-5 in the south is similar to that between RP-4 and RP-1 in the north, with CCWRF and RP-4 operating as scalping plants for RP-5 and RP-1, respectively. As discussed previously, the Montclair Diversion Structure upstream of CCWRF allows IEUA to bypasses a portion of the northern flows south to CCWRF to provide relief capacity for the Montclair Lift Station and RP-1. The CCWRF Influent Diversion Structure at CCWRF also allows flows influent to CCWRF to be diverted south to RP-5, allowing IEUA to control the volume of influent flow to CCWRF.

As shown in Figure 4-6, the daily average flow values reported at CCWRF have been fairly stable over the last two year period, generally ranging between 6 and 8 mgd with an average of 7.2 mgd. Routine bypasses from CCWRF to RP-5 were observed during this two year period, averaging about 2.2 mgd. A summary of the average and maximum influent flows is presented in Table 4-1 at the end of this section.

FIGURE 4-6
**CCWRF Influent Wastewater Flows**

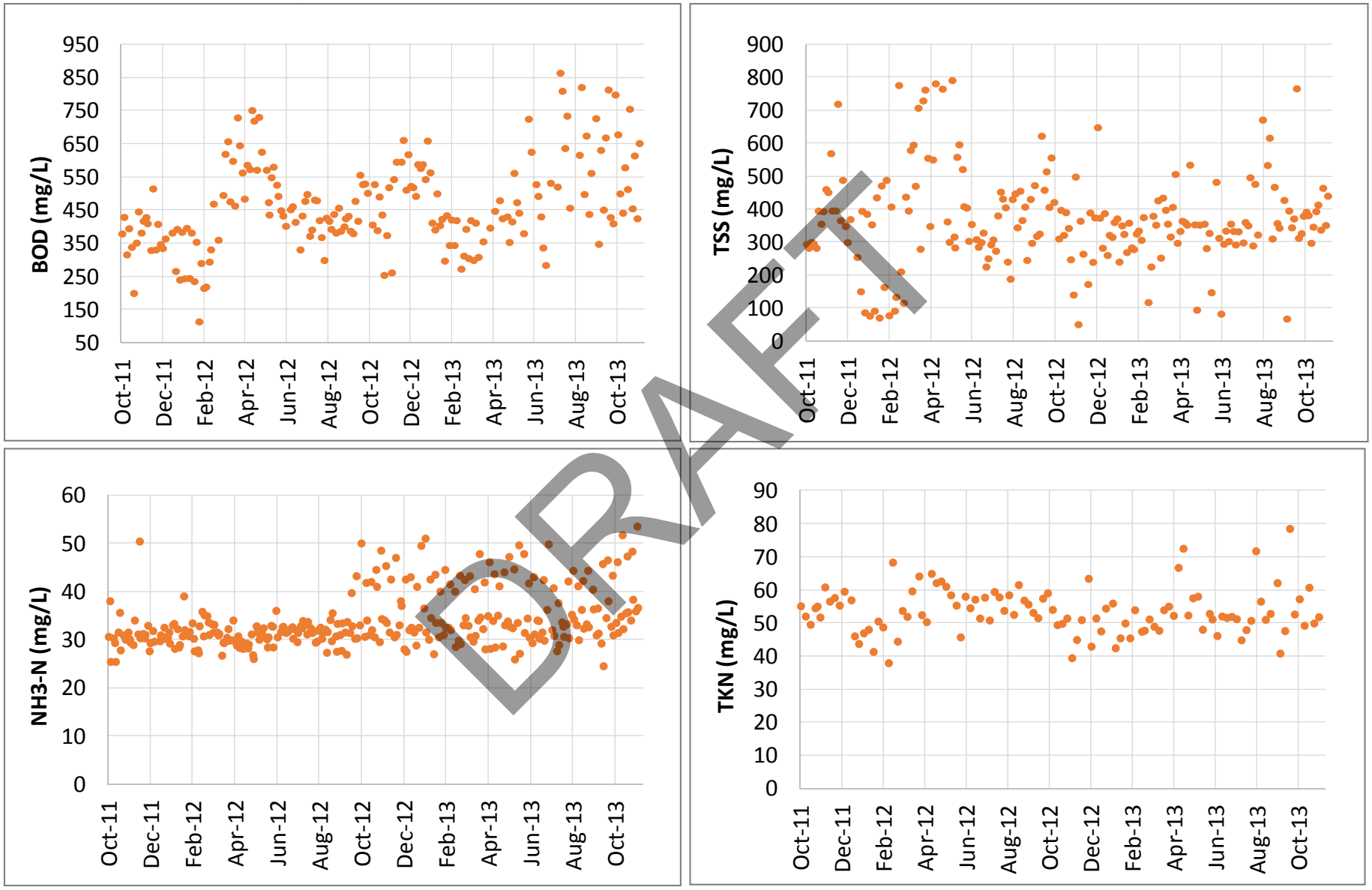



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The CCWRF influent wastewater quality for BOD, TSS, NH3-N, and TKN concentrations over the recent two year period is presented in Figure 4-7. Concentrations for TSS and NH3-N were reported three times per week, while TKN was reported once per week. TOC data was also available three times per week, as well as limited BOD data. For those months where BOD was measured, BOD data was available three times per week. For dates when both TOC and BOD data were available, BOD measurements were used. For dates when only TOC data was available, BOD concentrations were calculated using IEUA's equation derived from the correlation between TOC and BOD.

Influent BOD, TSS, NH3-N, and TKN concentrations have remained fairly constant over the two year period. The high degree of variability in the CCWRF influent ammonia data is due to the sampling practices employed at the plant during this period. Beginning in October 2012, the reported ammonia concentrations were generally higher on Tuesdays because these represent grab samples rather than composite samples. A summary of the average and maximum concentrations and calculated loads for each of these constituents is presented in Tables 4-2 and 4-3 at the end of this section.

FIGURE 4-7
**CCWRF Influent Wastewater Quality**




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## 3.4 RP-5 Influent Wastewater Flow and Quality

With bypassed and diverted flows ultimately reaching RP-5 from each of the upstream facilities as well as from the RP-2 Lift Station to the south, RP-5 serves as the system sink with no ability to divert or bypass flows elsewhere within the system. RP-5 receives flows from its surrounding sewershed, as well as bypassed flows from CCWRF, RP-1, and the RP-2 Lift Station. Each of these sources is captured in the RP-5 data analysis and illustrated in Figure 4-8. The CCWRF bypass flows to RP-5 have been fairly constant over the two year period, except during October and November 2011 when greater flows from CCWRF and RP-1 were bypassed to RP-5 for maintenance related activities. RP-5 influent flows also spiked in April 2012 and April 2013 as a result of increased RP-1 bypass flows. However, the Consultant Team analyzed the data with and without these unique occurrences and determined they did not affect analysis results. Therefore, the analysis presented herein represents the entire two year data set including routine and non-routine bypasses to RP-5.

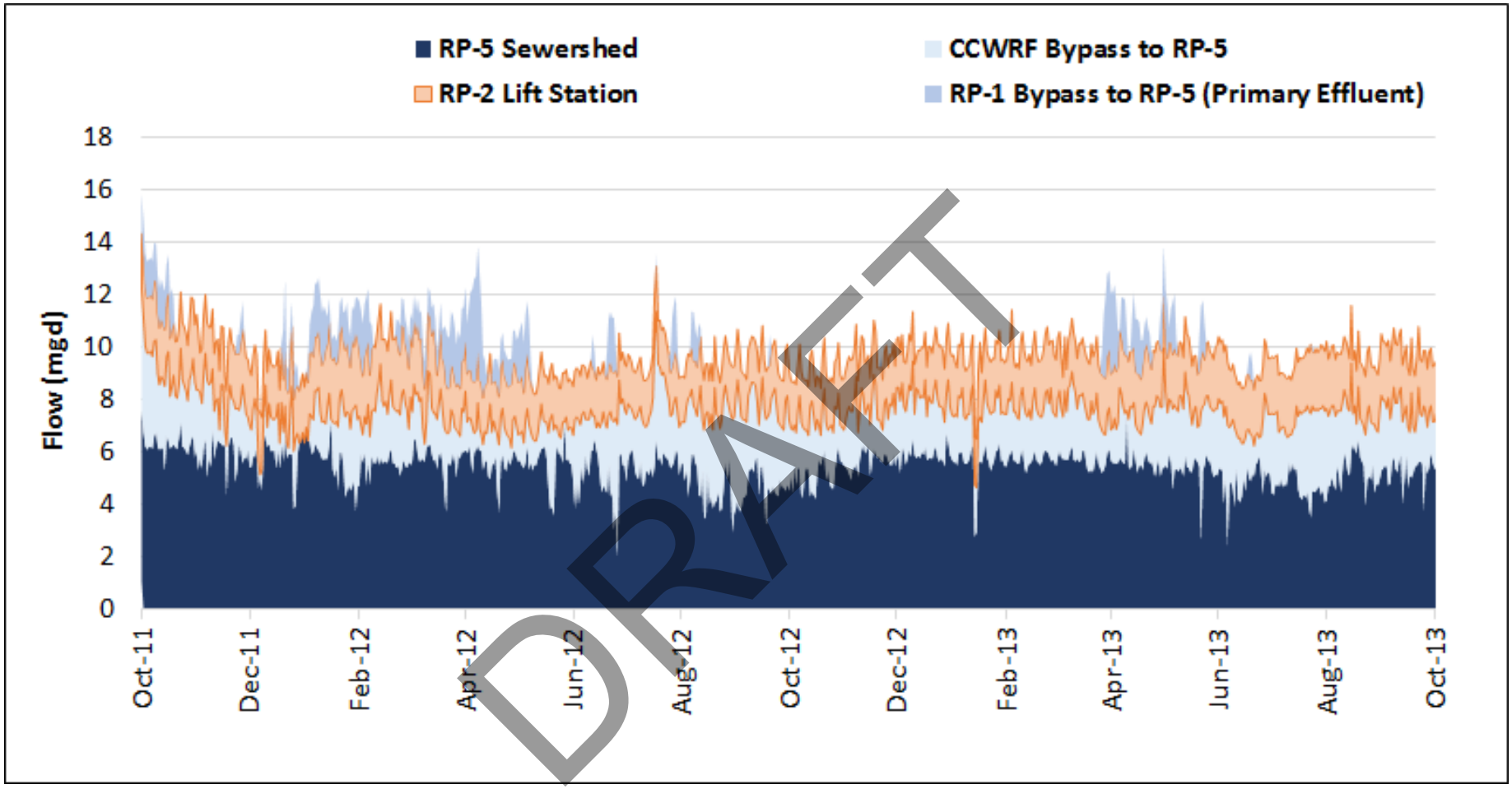
Routine flow diversions from CCWRF and the RP-2 Lift Station were observed during the two year period, with periodic bypasses from RP-1. For conservative planning purposes, the RP-5 influent flows presented in this analysis include raw wastewater contributions from the surrounding sewershed as well as bypassed flows from CCWRF and RP-1, in addition to RP-2 recycles and other flows from the RP-2 Lift Station. In general, RP-5 influent flows from all sources, as measured downstream of all diversions and bypasses, ranged between 8 and 12 mgd, with an average influent flow of 10 mgd. A summary of the average and maximum influent flows is presented in Table 4-1 at the end of this section.

The RP-5 influent wastewater quality for BOD, TSS, NH3-N, and TKN concentrations over the recent two year period is presented in Figure 4-9. Concentrations for TKN, TSS, and NH3-N were reported once, twice, and three times per week, respectively. TOC data was also available twice a week, as well as limited BOD data. For those months where BOD was measured, BOD data was available twice a week. For dates when both TOC and BOD data were available, BOD measurements were used. For dates when only TOC data was available, BOD concentrations were calculated using IEUA's equation derived from the correlation between TOC and BOD.

Influent concentrations of BOD, TSS, NH3-N, and TKN have remained fairly constant over the last two years. Higher TSS concentrations were observed in October and November of 2011 due to a temporary diversion of RP-1 flows and sludge to RP-5. A summary of the average and maximum concentrations and calculated loads for each of these constituents is presented in Tables 4-2 and 4-3 at the end of this section.

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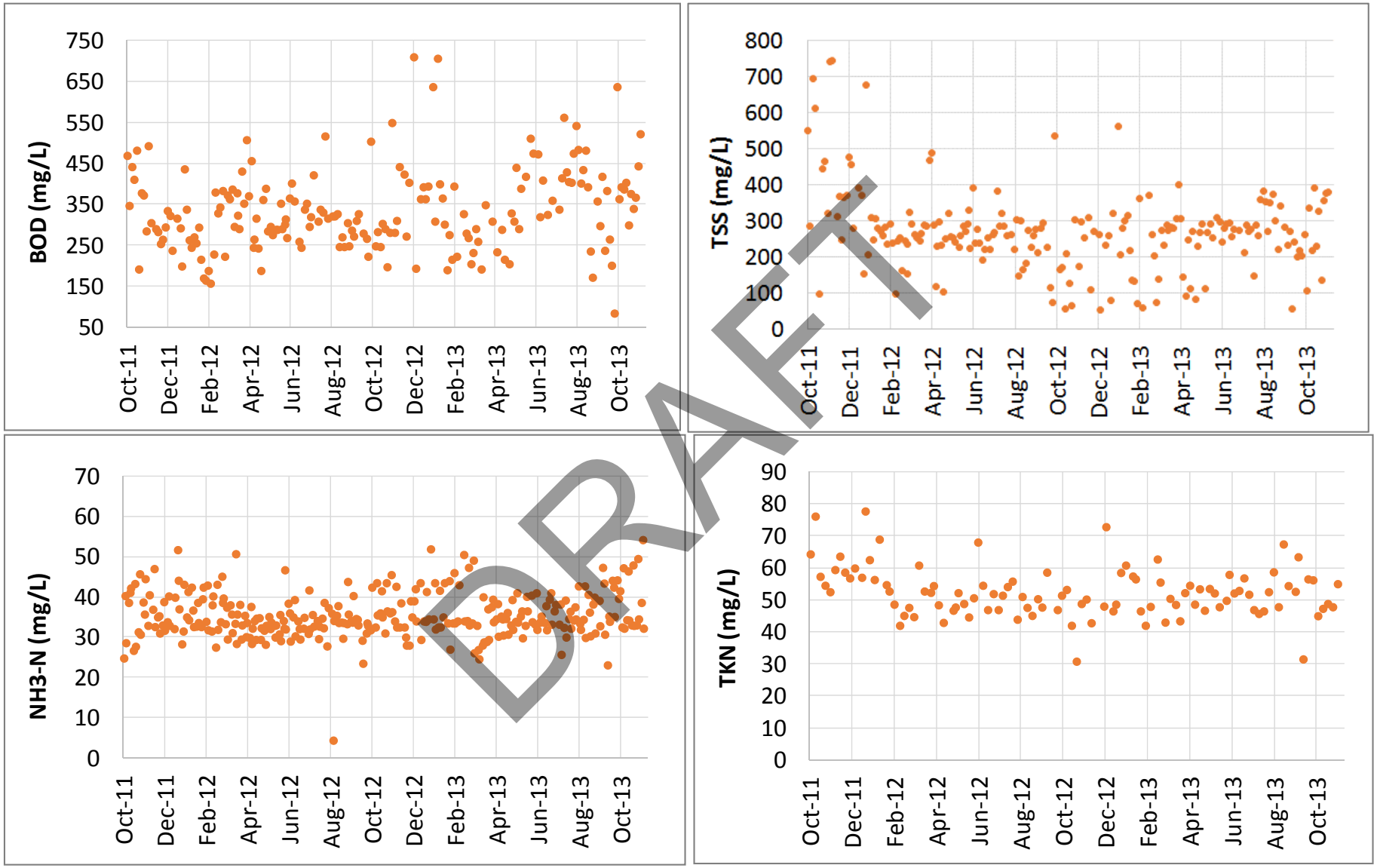
FIGURE 4-8
**RP-5 Influent Wastewater Flows**




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FIGURE 4-9

**RP-5 Influent Wastewater Quality**




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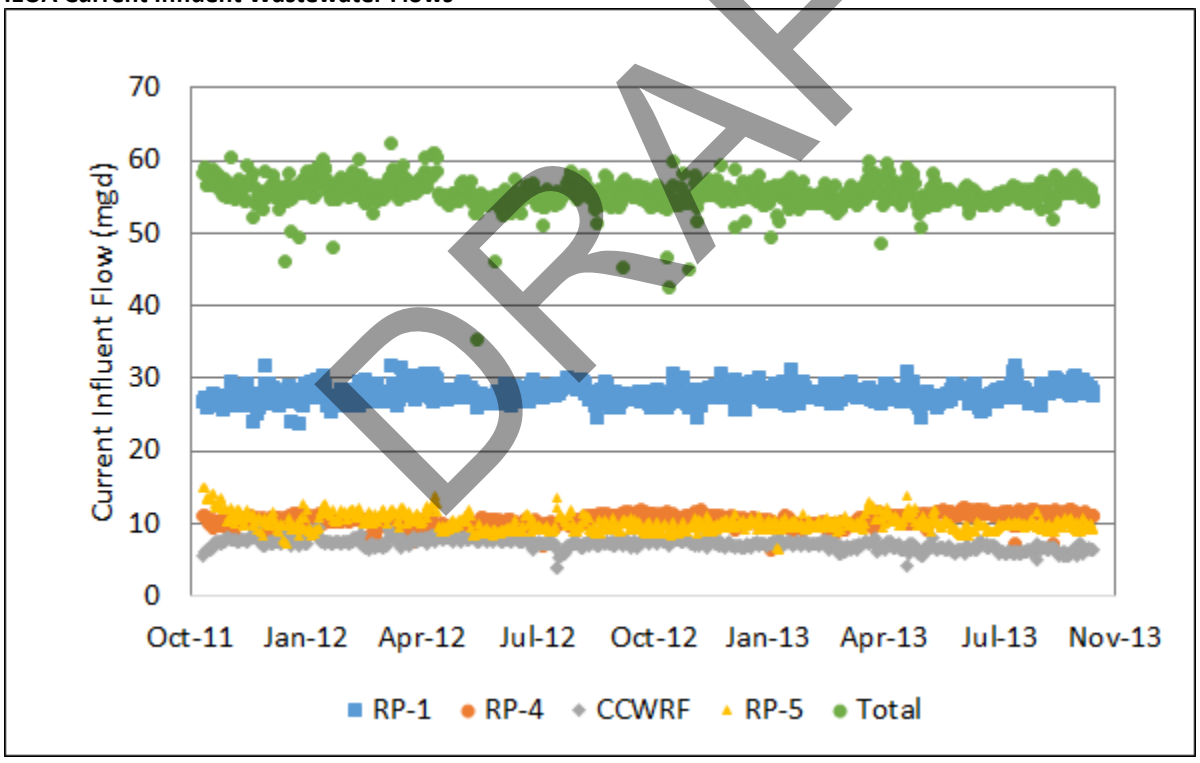
## 3.5 Summary of Current Influent Wastewater Flows and Quality

In summary, each of the RWRPs exhibited fairly constant influent wastewater flows and constituent concentrations during the recent two year analysis period. A summary of the current influent wastewater flows is illustrated in Figure 4-10 for each plant and for the system as a whole. As depicted, the average influent flow for the entire system was about 56 mgd during the two year period, with most of the flows being treated at RP-1 and the least of the flows being treated at CCWRF. The average and maximum flows and peaking factors for each of the individual RWRPs are summarized in Table 4-1. Peaking factors were developed for maximum month, maximum week, and maximum day.

The average concentrations for key constituents including BOD, TSS, NH3-N, and TKN for each of the RWRPs are summarized in Table 4-2. For comparison, the concentrations established previously for the 2002 WFMP are also presented in Table 4-2. A comparison of the two analyses demonstrates a substantial increase in wastewater strength since the 2002 WFMP.

For analysis of the current wastewater loads, loads were calculated based on the reported influent flow and constituent concentration for each reporting day. Therefore, the average and maximum loads and peaking factors presented in Table 4-3 represent load characteristics as calculated from flow and concentration data. These load peaking factors formed the basis of the influent wastewater load projections discussed in the next section.

FIGURE 4-10
**IEUA Current Influent Wastewater Flows**




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TABLE 4-1
**Summary of Current Influent Wastewater Flows[1]**

| | RP-4 | | RP-1 | | CCWRF | | RP-5 | |
|---|---|---|---|---|---|---|---|---|
| | Peaking Factor | Influent Flow (mgd) | Peaking Factor | Influent Flow (mgd) | Peaking Factor | Influent Flow (mgd) | Peaking Factor | Influent Flow (mgd) |
| Annual Average | - | 10.5 | - | 28 | - | 7.2 | - | 10.0 |
| Max Month | 1.10 | 11.6 | 1.04 | 29 | 1.13 | 8.1 | 1.27 | 12.8 |
| Max Week | 1.14 | 11.9 | 1.08 | 30 | 1.25 | 8.9 | 1.43 | 14.3 |
| Max Day | 1.15 | 12.1 | 1.14 | 32 | 1.34 | 9.6 | 1.47 | 14.8 |

Notes:
[1] Analysis based on plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.

TABLE 4-2
**Summary of Influent Wastewater Concentrations[1,2]**

| | Average Influent Water Quality (mg/L) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | RP-4 | | RP-1 | | CCWRF | | RP-5 | |
| | **Current** | **2002** | **Current** | **2002** | **Current** | **2002** | **Current** | **2002** |
| BOD | **352** | 245 | **434** | 243 | **455** | 240 | **321** | 240 |
| TSS | **318** | 256 | **472** | 301 | **367** | 300 | **267** | 300 |
| NH3-N | **41** | 28 | **32** | 23 | **34** | 23 | **35** | 23 |
| TKN | **59** | 43 | **55** | 42 | **53** | 42 | **52** | 42 |

Notes:
[1] Current concentrations based on plant influent data provided by IEUA for the period between Oct 15, 2011 and Oct 15, 2013.
[2] 2002 wastewater characteristics as presented in the 2002 WFMP Volume II memoranda. RP-4 concentrations based on plant influent data between Aug 1999 and Jul 2001. RP-1 concentrations based on plant influent data between Jul 1999 and May 2001. CCWRF and RP-5 concentrations established under the assumption that raw wastewater received at most of IEUA's wastewater treatment plants shared the same characteristics.

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TABLE 4-3
**Summary of Current Influent Wastewater Loads[1,2]**

| | RP-4 | | RP-1 | | CCWRF | | RP-5 | |
|---|---|---|---|---|---|---|---|---|
| | Peaking Factor | Load (lb/day) | Peaking Factor | Load (lb/day) | Peaking Factor | Load (lb/day) | Peaking Factor | Load (lb/day) |
| **BOD** | | | | | | | | |
| Annual Average | - | 30,543 | - | 101,197 | - | 26,839 | - | 27,771 |
| Max Month | 1.85 | 56,393 | 1.53 | 155,195 | 1.58 | 42,479 | 1.79 | 49,636 |
| Max Week | 2.09 | 63,735 | 1.74 | 175,768 | 1.88 | 50,430 | 2.48 | 69,009 |
| Max Day | 2.12 | 64,696 | 1.90 | 191,964 | 1.99 | 53,289 | 2.31 | 64,209 |
| **TSS** | | | | | | | | |
| Annual Average | - | 27,630 | - | 109,880 | - | 21,683 | - | 23,181 |
| Max Month | 1.59 | 43,963 | 1.38 | 151,459 | 1.88 | 40,837 | 2.47 | 57,295 |
| Max Week | 1.98 | 54,717 | 1.71 | 187,551 | 2.45 | 53,219 | 3.22 | 74,660 |
| Max Day | 1.98 | 54,717 | 1.71 | 187,551 | 2.45 | 53,219 | 3.48 | 80,742 |
| **NH3-N** | | | | | | | | |
| Annual Average | - | 3,550 | - | 7,544 | - | 1,993 | - | 3,005 |
| Max Month | 1.24 | 4,393 | 1.20 | 9,045 | 1.21 | 2,413 | 1.35 | 4,043 |
| Max Week | 1.32 | 4,692 | 1.33 | 10,023 | 1.42 | 2,823 | 1.65 | 4,953 |
| Max Day | 1.57 | 5,566 | 1.63 | 12,276 | 1.64 | 3,262 | 1.70 | 5,112 |
| **TKN** | | | | | | | | |
| Annual Average | - | 5,015 | - | 12,975 | - | 3,105 | - | 4,602 |
| Max Month | 1.46 | 7,322 | 1.24 | 16,027 | 1.28 | 3,963 | 1.60 | 7,349 |
| Max Week | 1.59 | 7,963 | 1.53 | 19,912 | 1.40 | 4,338 | 1.92 | 8,854 |
| Max Day | 1.59 | 7,963 | 1.53 | 19,912 | 1.40 | 4,338 | 1.92 | 8,854 |

Notes:
[1] Analysis based on plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013. Loads calculated from flow and concentration data.
[2] Maximum weekly and daily load values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.

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# 4.0 Wastewater Flow and Loading Forecast

The Consultant Team developed flow and loading projections for each of the RWRPs based on the results of the flow diversion analysis presented in TM 3 as well as the influent wastewater analysis presented in the previous section. The results of the flow and loading forecast discussed in this section will form the basis of establishing the capacity and expansion needs for each of the four RWRPs as part of this WFMP effort.

Flow projections were developed by the IRP Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. The year 2060 represents buildout or ultimate flows. A detailed discussion of the flow monitoring equipment, methodology, and data analysis is presented in the *IEUA IRP Temporary Flow Monitoring Report* (ADS, 2014). A discussion of the development of flow projections is presented in the *IEUA IRP Wastewater Flow Projections Technical Memorandum* (RMC 2013). These flow projections formed the basis of the flow diversion alternatives analysis presented in TM 3 *Regional Trunk Sewer Analysis* of the WFMP. Accordingly, several flow diversion alternatives were evaluated as part of this WFMP effort, each offering different means to divert flows to either RP-1 or RP-5 to optimize groundwater recharge and serve IEUA customers in each sewershed. As established in TM 3, IEUA's preferred flow diversion alternative

is Alternative 2, whereby flows from the existing Whispering Lakes and Haven pump stations will be conveyed to RP-1, while maintaining flexibility in the system to convey flows south to RP-5 if needed.

Under Flow Diversion Alternative 2, the CCWRF influent wastewater flows are projected to increase between 2020 and 2060 by about 15 percent, with more significant flow increases expected at RP-1, RP-4 and RP-5. The increase in flows to RP-4 by approximately 60 percent is largely attributable to the gradual incorporation of septic flows into the system beginning in 2020. RP-1 flows are projected to increase by 20 percent, and RP-5 flows are projected to more than double by year 2060 as a result of population growth in Chino and other areas served by RP-5. The forecasted influent wastewater flows for Alternative 2 are summarized in Table 4-4 for each of the four RWRPs and for the overall system.

TABLE 4-4
**Average Influent Wastewater Flow Projections for Preferred Flow Diversion Alternative 2[1]**

| Year | RP-1[2] (mgd) | RP-4[3] (mgd) | CCWRF (mgd) | RP-5 (mgd) | Total (mgd) |
|---|---|---|---|---|---|
| 2020 | 30.4 | 11.7 | 6.9 | 10.2 | **59.2** |
| 2030 | 32.2 | 14.0 | 7.1 | 15.9 | **69.2** |
| 2035[4] | 33.1 | 14.7 | 7.3 | 18.4 | **73.5** |
| 2040 | 34.0 | 15.4 | 7.4 | 20.9 | **77.7** |
| 2050 | 36.1 | 16.8 | 7.7 | 24.8 | **85.4** |
| 2060[4] | 36.3 | 18.4 | 7.9 | 25.3 | **87.9** |

Notes:
[1] Analysis performed by IRP Consultant during November 2013 flow monitoring period. Values adjusted by IEUA to reflect normal bypass and diversion operations between plants.
[2] Assumes Whispering Lakes Pump Station and Montclair Pipeline infrastructure improvements discussed in TM 3 are complete and operational by 2020, with both pump stations online and conveying flow to RP-1.
[3] Includes septic flows tributary to RP-4, introduced in 2020 at 1 mgd and increasing by 0.5 mgd every 10 years through 2060.
[4] WFMP planning effort based on 2035 planning year. For site footprint planning considerations, the ultimate flows (i.e., 2060 flow values) constitute the basis of systems sizing and site space requirements.

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At the request of IEUA, the Consultant Team evaluated as a subset of Alternative 2 the impact on RP-5 flow projections under the assumption that both the Whispering Lakes and Haven pump stations are offline. Under this scenario, the flows from each of these tributary areas would be conveyed to RP-5 rather than to RP-1. In order to provide greater system reliability and redundancy, RP-5 facilities planning will assume both pump stations are offline. These projected flows will form the basis for establishing RP-5 facilities planning and expansion needs in subsequent TMs, which will likely result in the need for RP-5 capacity enhancements to occur sooner. The RP-5 flow projections for the two scenarios (pump stations online and pump stations offline) are presented in Table 4-5.

TABLE 4-5
**RP-5 Average Influent Wastewater Flow Projections for Preferred Flow Diversion Alternative 2**

| Year | RP-5 w/ Pump Stations Online (mgd) | RP-5 w/ Pump Stations Offline[1] (mgd) |
|---|---|---|
| 2020 | 10.2 | 11.9 |
| 2030 | 15.9 | 17.7 |
| 2035[2] | 18.4 | 20.2 |
| 2040 | 20.9 | 22.8 |
| 2050 | 24.8 | 26.7 |
| 2060[2] | 25.3 | 27.2 |

Notes:
[1] Flow projections established for this scenario assumed both Whispering Lakes and Haven Pump Stations are offline.
[2] WFMP planning effort based on 2035 planning year. For site footprint planning considerations, the ultimate flows (i.e., 2060 flow values) constitute the basis of systems sizing and site space requirements.

The wastewater loading projections were developed for the four key wastewater parameters identified previously, for each of the four RWRPs for the 2035 planning year as well as the 2060 ultimate buildout year. These projections are based on the flow peaking factors presented in Table 4-1, the average influent wastewater constituent concentrations presented in Table 4-2, the load peaking factors presented in Table 4-3, and average influent wastewater flow projections established in Tables 4-4 and 4-5. The forecasted influent wastewater flow and loading values are summarized in Tables 4-6 through 4-10 for each of the four RWRPs and forms the basis of the master planning effort for each of these RWRPs in subsequent TMs. The results are presented below from upstream-most plant to downstream-most plant.

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TABLE 4-6
**RP-4 Influent Flow and Loading Projections for Preferred Flow Diversion Alternative 2**

| | Flows | | Loads[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOD | | TSS | | NH3-N | | TKN | |
| | PF | mgd | PF | lb/day | PF | lb/day | PF | lb/day | PF | lb/day |
| **Current (Based on 2011-2013 Data)** | | | | | | | | | | |
| Annual Average | - | 10.5 | - | 30,543 | - | 27,630 | - | 3,550 | - | 5,015 |
| Max Month | 1.10 | 11.6 | 1.85 | 56,393 | 1.59 | 43,963 | 1.24 | 4,393 | 1.46 | 7,322 |
| Max Week | 1.14 | 11.9 | 2.09 | 63,735 | 1.98 | 54,717 | 1.32 | 4,692 | 1.59 | 7,963 |
| Max Day | 1.15 | 12.1 | 2.12 | 64,696 | 1.98 | 54,717 | 1.57 | 5,566 | 1.59 | 7,963 |
| **Projections (Planning Year: 2035)[2]** | | | | | | | | | | |
| Annual Average | - | 14.7 | - | 43,207 | - | 38,948 | - | 5,010 | - | 7,186 |
| Max Month | 1.10 | 16.2 | 1.85 | 79,775 | 1.59 | 61,971 | 1.24 | 6,200 | 1.46 | 10,492 |
| Max Week | 1.14 | 16.7 | 2.09 | 90,161 | 1.98 | 77,132 | 1.32 | 6,621 | 1.59 | 11,410 |
| Max Day | 1.15 | 17.0 | 2.12 | 91,521 | 1.98 | 77,132 | 1.57 | 7,856 | 1.59 | 11,410 |
| **Projections (Planning Year: 2060)[3]** | | | | | | | | | | |
| Annual Average | - | 18.4 | - | 54,082 | - | 48,752 | - | 6,271 | - | 8,994 |
| Max Month | 1.10 | 20.3 | 1.85 | 99,854 | 1.59 | 77,570 | 1.24 | 7,761 | 1.46 | 13,132 |
| Max Week | 1.14 | 20.9 | 2.09 | 112,855 | 1.98 | 96,546 | 1.32 | 8,288 | 1.59 | 14,282 |
| Max Day | 1.15 | 21.2 | 2.12 | 114,556 | 1.98 | 96,546 | 1.57 | 9,833 | 1.59 | 14,282 |

Notes:
[1] Maximum weekly and daily loading values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.
[2] Analysis based on average influent wastewater flow projections presented in Table 4-4 and the average concentrations and loading peaking factors established from plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.
[3] Site planning considerations will be based on the projections established for the 2060 ultimate planning year.

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TABLE 4-7
**RP-1 Influent Flow and Loading Projections for Preferred Flow Diversion Alternative 2**

| | Flows | | Loads[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOD | | TSS | | NH3-N | | TKN | |
| | PF | mgd | PF | lb/day | PF | lb/day | PF | lb/day | PF | lb/day |
| **Current (Based on 2011-2013 Data)** | | | | | | | | | | |
| Annual Average | - | 27.8 | - | 101,197 | - | 109,880 | - | 7,544 | - | 12,975 |
| Max Month | 1.04 | 29.0 | 1.53 | 155,195 | 1.38 | 151,459 | 1.20 | 9,045 | 1.24 | 16,027 |
| Max Week | 1.08 | 30.0 | 1.74 | 175,768 | 1.71 | 187,551 | 1.33 | 10,023 | 1.53 | 19,912 |
| Max Day | 1.14 | 31.8 | 1.90 | 191,964 | 1.71 | 187,551 | 1.63 | 12,276 | 1.53 | 19,912 |
| **Projections (Planning Year: 2035)[2]** | | | | | | | | | | |
| Annual Average | - | 33.1 | - | 119,771 | - | 130,296 | - | 8,937 | - | 15,249 |
| Max Month | 1.04 | 34.4 | 1.53 | 183,680 | 1.38 | 179,602 | 1.20 | 10,716 | 1.24 | 18,835 |
| Max Week | 1.08 | 35.7 | 1.74 | 208,029 | 1.71 | 222,400 | 1.33 | 11,875 | 1.53 | 23,401 |
| Max Day | 1.14 | 37.7 | 1.90 | 227,197 | 1.71 | 222,400 | 1.63 | 14,544 | 1.53 | 23,401 |
| **Projections (Planning Year: 2060)[3]** | | | | | | | | | | |
| Annual Average | - | 36.3 | - | 131,350 | - | 142,893 | - | 9,801 | - | 16,723 |
| Max Month | 1.04 | 37.8 | 1.53 | 201,438 | 1.38 | 196,965 | 1.20 | 11,752 | 1.24 | 20,656 |
| Max Week | 1.08 | 39.1 | 1.74 | 228,141 | 1.71 | 243,900 | 1.33 | 13,023 | 1.53 | 25,663 |
| Max Day | 1.14 | 41.4 | 1.90 | 249,162 | 1.71 | 243,900 | 1.63 | 15,951 | 1.53 | 25,663 |

Notes:
[1] Maximum weekly and daily loading values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.
[2] Analysis based on average influent wastewater flow projections presented in Table 4-4 and the average concentrations and loading peaking factors established from plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.
[3] Site planning considerations will be based on the projections established for the 2060 ultimate planning year.

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TABLE 4-8
**CCWRF Influent Flow and Loading Projections for Preferred Flow Diversion Alternative 2**

| | Flows | | Loads[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOD | | TSS | | NH3-N | | TKN | |
| | PF | mgd | PF | lb/day | PF | lb/day | PF | lb/day | PF | lb/day |
| **Current (Based on 2011-2013 Data)** | | | | | | | | | | |
| Annual Average | - | 7.2 | - | 26,839 | - | 21,683 | - | 1,993 | - | 3,105 |
| Max Month | 1.13 | 8.1 | 1.58 | 42,479 | 1.88 | 40,837 | 1.21 | 2,413 | 1.28 | 3,963 |
| Max Week | 1.25 | 8.9 | 1.88 | 50,430 | 2.45 | 53,219 | 1.42 | 2,823 | 1.40 | 4,338 |
| Max Day | 1.34 | 9.6 | 1.99 | 53,289 | 2.45 | 53,219 | 1.64 | 3,262 | 1.40 | 4,338 |
| **Projections (Planning Year: 2035)[2]** | | | | | | | | | | |
| Annual Average | - | 7.3 | - | 27,708 | - | 22,353 | - | 2,048 | - | 3,257 |
| Max Month | 1.13 | 8.2 | 1.58 | 43,854 | 1.88 | 42,099 | 1.21 | 2,480 | 1.28 | 4,156 |
| Max Week | 1.25 | 9.1 | 1.88 | 52,063 | 2.45 | 54,863 | 1.42 | 2,901 | 1.40 | 4,550 |
| Max Day | 1.34 | 9.8 | 1.99 | 55,014 | 2.45 | 54,863 | 1.64 | 3,352 | 1.40 | 4,550 |
| **Projections (Planning Year: 2060)[3]** | | | | | | | | | | |
| Annual Average | - | 7.9 | - | 29,985 | - | 24,190 | - | 2,217 | - | 3,524 |
| Max Month | 1.13 | 8.9 | 1.58 | 47,459 | 1.88 | 45,559 | 1.21 | 2,684 | 1.28 | 4,498 |
| Max Week | 1.25 | 9.8 | 1.88 | 56,342 | 2.45 | 59,373 | 1.42 | 3,139 | 1.40 | 4,924 |
| Max Day | 1.34 | 10.6 | 1.99 | 59,535 | 2.45 | 59,373 | 1.64 | 3,628 | 1.40 | 4,924 |

Notes:
[1] Maximum weekly and daily loading values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.
[2] Analysis based on average influent wastewater flow projections presented in Table 4-4 and the average concentrations and loading peaking factors established from plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.
[3] Site planning considerations will be based on the projections established for the 2060 ultimate planning year.

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TABLE 4-9

**RP-5 Influent Flow and Loading Projections for Preferred Flow Diversion Alternative 2 w/ Haven & WL PS Online**

| | Flows | | Loads[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOD | | TSS | | NH3-N | | TKN | |
| | PF | mgd | PF | lb/day | PF | lb/day | PF | lb/day | PF | lb/day |
| **Current (Based on 2011-2013 Data)** | | | | | | | | | | |
| Annual Average | - | 10.0 | - | 27,771 | - | 23,181 | - | 3,005 | - | 4,602 |
| Max Month | 1.27 | 12.8 | 1.79 | 49,636 | 2.47 | 57,295 | 1.35 | 4,043 | 1.60 | 7,349 |
| Max Week | 1.43 | 14.3 | 2.48 | 69,009 | 3.22 | 74,660 | 1.65 | 4,953 | 1.92 | 8,854 |
| Max Day | 1.47 | 14.8 | 2.31 | 64,209 | 3.48 | 80,742 | 1.70 | 5,112 | 1.92 | 8,854 |
| **Projections (Planning Year: 2035)[2]** | | | | | | | | | | |
| Annual Average | - | 18.4 | - | 49,290 | - | 40,964 | - | 5,422 | - | 8,036 |
| Max Month | 1.27 | 23.4 | 1.79 | 88,099 | 2.47 | 101,247 | 1.35 | 7,294 | 1.60 | 12,835 |
| Max Week | 1.43 | 26.3 | 2.48 | 122,483 | 3.22 | 131,932 | 1.65 | 8,937 | 1.92 | 15,463 |
| Max Day | 1.47 | 27.1 | 2.31 | 113,964 | 3.48 | 142,680 | 1.70 | 9,223 | 1.92 | 15,463 |
| **Projections (Planning Year: 2060)[3]** | | | | | | | | | | |
| Annual Average | - | 25.3 | - | 67,774 | - | 56,326 | - | 7,456 | - | 11,050 |
| Max Month | 1.27 | 32.2 | 1.79 | 121,137 | 2.47 | 139,214 | 1.35 | 10,029 | 1.60 | 17,648 |
| Max Week | 1.43 | 36.1 | 2.48 | 168,415 | 3.22 | 181,406 | 1.65 | 12,288 | 1.92 | 21,261 |
| Max Day | 1.47 | 37.3 | 2.31 | 156,700 | 3.48 | 196,185 | 1.70 | 12,682 | 1.92 | 21,261 |

Notes:

[1] Maximum weekly and daily loading values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.

[2] Analysis based on average influent wastewater flow projections presented in Table 4-5 and the average concentrations and loading peaking factors established from plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.

[3] Site planning considerations will be based on the projections established for the 2060 ultimate planning year.

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TABLE 4-10
**RP-5 Influent Flow and Loading Projections for Preferred Flow Diversion Alternative 2 w/ Haven & WL PS Offline**

| | Flows | | Loads[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | BOD | | TSS | | NH3-N | | TKN | |
| | PF | mgd | PF | lb/day | PF | lb/day | PF | lb/day | PF | lb/day |
| **Current (Based on 2011-2013 Data)** | | | | | | | | | | |
| Annual Average | - | 10.0 | - | 27,771 | - | 23,181 | - | 3,005 | - | 4,602 |
| Max Month | 1.27 | 12.8 | 1.79 | 49,636 | 2.47 | 57,295 | 1.35 | 4,043 | 1.60 | 7,349 |
| Max Week | 1.43 | 14.3 | 2.48 | 69,009 | 3.22 | 74,660 | 1.65 | 4,953 | 1.92 | 8,854 |
| Max Day | 1.47 | 14.8 | 2.31 | 64,209 | 3.48 | 80,742 | 1.70 | 5,112 | 1.92 | 8,854 |
| **Projections (Planning Year: 2035)[2]** | | | | | | | | | | |
| Annual Average | - | 20.2 | - | 54,112 | - | 44,972 | - | 5,953 | - | 8,823 |
| Max Month | 1.27 | 25.7 | 1.79 | 96,718 | 2.47 | 111,151 | 1.35 | 8,007 | 1.60 | 14,090 |
| Max Week | 1.43 | 28.8 | 2.48 | 134,465 | 3.22 | 144,838 | 1.65 | 9,811 | 1.92 | 16,975 |
| Max Day | 1.47 | 29.8 | 2.31 | 125,113 | 3.48 | 156,638 | 1.70 | 10,125 | 1.92 | 16,975 |
| **Projections (Planning Year: 2060)[3]** | | | | | | | | | | |
| Annual Average | - | 27.2 | - | 72,864 | - | 60,556 | - | 8,016 | - | 11,880 |
| Max Month | 1.27 | 34.7 | 1.79 | 130,234 | 2.47 | 149,669 | 1.35 | 10,782 | 1.60 | 18,973 |
| Max Week | 1.43 | 38.8 | 2.48 | 181,062 | 3.22 | 195,030 | 1.65 | 13,211 | 1.92 | 22,858 |
| Max Day | 1.47 | 40.1 | 2.31 | 168,468 | 3.48 | 210,918 | 1.70 | 13,634 | 1.92 | 22,858 |

Notes:
[1] Maximum weekly and daily loading values are based on limited data with sampling frequencies ranging between 1 and 3 times per week.
[2] Analysis based on average influent wastewater flow projections presented in Table 4-5 and the average concentrations and loading peaking factors established from plant influent data provided by IEUA for the period between October 15, 2011 and October 15, 2013.
[3] Site planning considerations will be based on the projections established for the 2060 ultimate planning year.

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# 6.0 Conclusions

As discussed in TM 3, the WFMP planning effort will be based on IEUA's preferred Flow Diversion Alternative 2, optimizing groundwater recharge by diverting flows from Whispering Lakes and Haven pump stations to RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035 are presented in this TM and will form the basis of the master planning effort for each of the RWRPs in subsequent TMs. Projections are also presented for the 2060 ultimate buildout year, which will be used for site planning considerations. In order to provide greater system reliability and redundancy, RP-5 facilities planning will assume both the Whispering Lakes and Haven pump stations are offline. These projected flows will form the basis for establishing RP-5 facilities planning and expansion needs conducted as part of this WFMP effort.

# 7.0 References

ADS Environmental Services (ADS). January 2014. *IEUA IRP Temporary Flow Monitoring Report.* Prepared for RMC Water and Environment and IEUA for the Flow Monitoring Period between October 25, 2013 and November 7, 2013.

RMC Water and Environment (RMC). December 2013. *Technical Memorandum: IEUA IRP Wastewater Flow Projections.* Prepared for IEUA.

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# IEUA Wastewater Facilities Master Plan
# TM 5 RP-1 Future Plans

PREPARED FOR: Inland Empire Utilities Agency

PREPARED BY: CH2M HILL

DATE: October 31, 2014

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# Executive Summary

Regional Water Recycling Plant No. 1 (RP-1) has undergone many expansions since its initial construction in 1948 to serve the needs of the Cities of Ontario, Rancho Cucamonga, Upland, Fontana, Montclair, and Chino. RP-1 includes both liquid treatment and solids handling facilities, receiving and treating wastewater flows from tributary communities and Regional Water Recycling Plant No. 4 (RP-4). RP-1 also includes primary and secondary flow equalization which currently exhibit odor and lagoon maintenance challenges. This technical memorandum (TM) evaluates alternatives for improving RP-1 flow equalization, identifies RP-1 plant expansion projects within the 20-year planning period, and provides preliminary capital cost estimates for the projects. Information from this TM will be incorporated into the updated 20-year Capital Improvements Program (CIP).

The current and future flows and loads for RP-1 were estimated in *TM 4 Wastewater Flow and Loading Forecast*. An analysis of the influent wastewater characteristics at RP-1 was conducted to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and the 2060 ultimate buildout year. The influent flow and loading projections and the effluent requirements detailed in the Santa Ana Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0021 were used to evaluate the existing capacities of the RP-1 liquid treatment facilities. The estimated capacities were then compared to the projected flow and loads to determine the RP-1 facilities that require expansion within the 20-year planning period, and when those facilities would need to be online.

A nonmonetary evaluation of potential RP-1 flow equalization alternatives identified Alternative 3 (eliminating primary effluent equalization by adding secondary clarifiers, and converting the existing lagoons to secondary effluent equalization or recycled water storage) as being the most favorable alternative. This alternative offers a sustainable and cost-effective approach that significantly eliminates plant odors from primary effluent storage and pumping, and frees up the existing lagoons for other flow management needs such as secondary effluent or recycled water storage.

Three plant expansion projects were identified during the 20-year CIP: the RP-1 Primary Effluent Equalization Elimination Project, the RP-1 Liquid Treatment Expansion Project, and the RP-1 Solids Treatment Expansion Project. Together, these projects would include modifications to primary flow equalization piping and pumping systems to be able to use the lagoons for secondary effluent equalization, as well as construction of a new membrane bioreactor (MBR) facility, secondary clarifiers, and anaerobic digesters. The capital costs included in the 20-year CIP for these projects are summarized in Table 5-1.

The evaluation of RP-1 identified three main conclusions:

- Elimination of existing primary effluent flow equalization by adding secondary clarifiers and converting the existing lagoons to secondary effluent equalization or recycled water storage is the most favorable alternative.
- The RP-1 liquid treatment facilities will need to be expanded during the 20-year planning period with the construction of a new MBR facility (Train D).
- The RP-1 solids treatment facilities will need to be expanded during the 20-year planning period with the construction of new anaerobic digesters.

TABLE 5-1
**RP-1 Expansion Projects Capital Cost Estimate Summary**

| Component Description | RP-1 Primary Effluent Equalization Elimination Project | RP-1 Liquid Treatment Expansion Project | RP-1 Solids Treatment Expansion Project |
|---|---|---|---|
| Total Direct Cost[a] | $12,366,000 | $28,890,000 | $9,450,000 |
| Total Estimated Construction Cost[b] | $20,739,000 | $48,450,000 | $15,848,000 |
| Total Estimated Project Costs | $26,961,000 | $62,985,000 | $20,602,000 |

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TABLE 5-1
**RP-1 Expansion Projects Capital Cost Estimate Summary**

| Component Description | RP-1 Primary Effluent Equalization Elimination Project | RP-1 Liquid Treatment Expansion Project | RP-1 Solids Treatment Expansion Project |
|---|---|---|---|

[a] *Engineering-News Record* Construction Cost Index (ENR CCI) for Los Angeles (August 2014 - 10,737).

[b] Cost does not include escalation to midpoint of construction.

*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

# 1.0 Background and Objectives

The Inland Empire Utilities Agency (IEUA) contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a capital program. The capital program will guide IEUA in the development of major improvements to their treatment and conveyance facilities. There are five specific goals for this TM:

- Summarize information from TMs 1 through 4 as it pertains to RP-1.
- Evaluate the current capacities and limitations of the existing facilities.
- Evaluate three alternatives for improving RP-1 flow equalization.
- Determine treatment facilities required to treat projected flows and loads through planning year 2035.
- Estimate timing and preliminary capital costs for plant expansion projects required during the 20-year planning period.

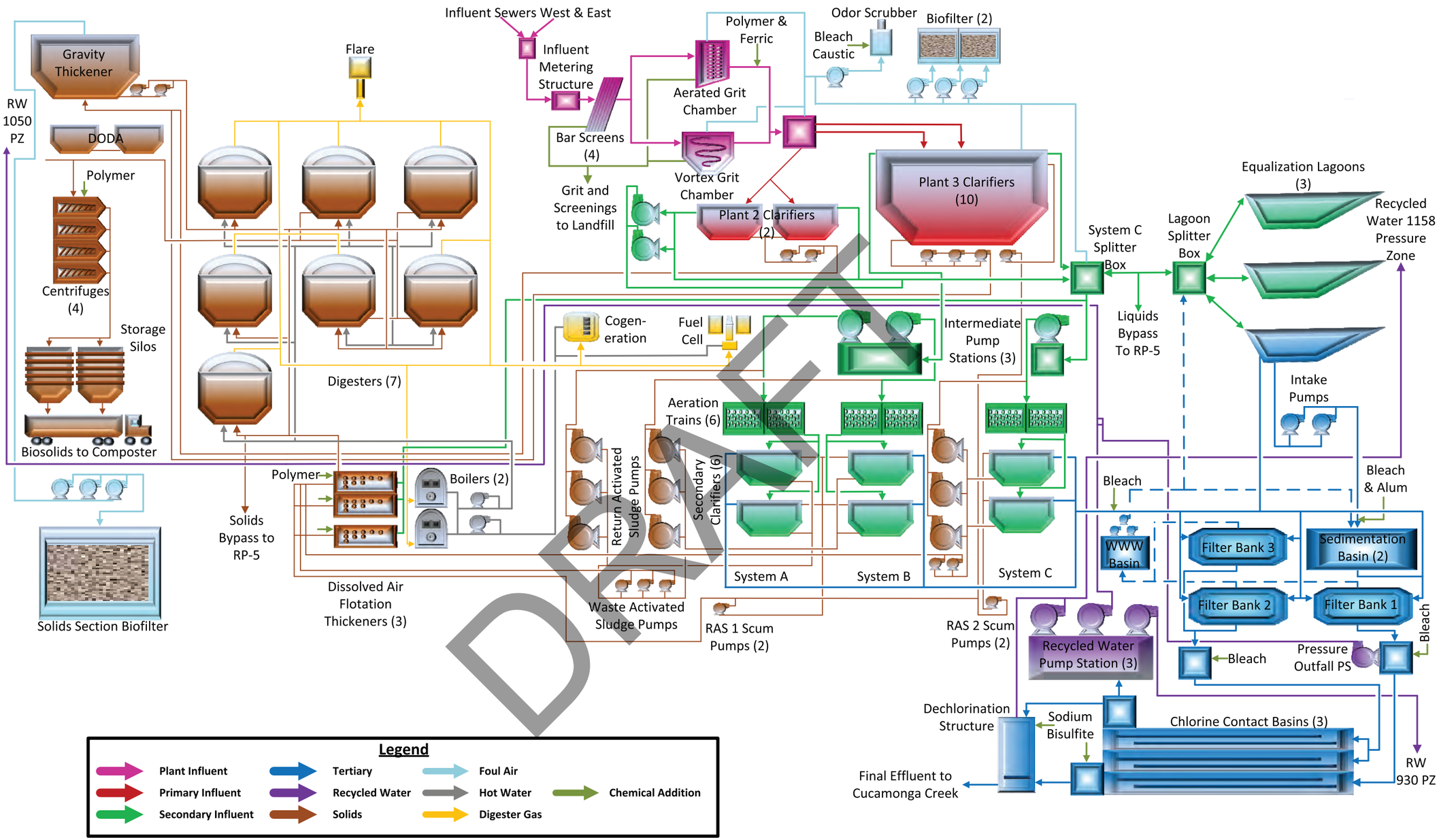
# 2.0 RP-1 Overview

RP-1 was originally constructed in 1948 and has undergone many expansions and improvements over the years to serve the needs of the Cities of Ontario, Rancho Cucamonga, Upland, Fontana, Montclair, and Chino. The treatment plant includes preliminary, primary, secondary, and tertiary liquid treatment facilities, and primary and secondary solids treatment facilities. The liquid facilities are designed to produce an effluent quality meeting Title 22 standards for spray irrigation, nonrestricted recreational and landscape impoundments, and groundwater recharge. The solids handling facilities are operated to achieve Class B biosolids, which are trucked to Inland Empire Regional Composting Facility (IERCF) for further treatment and composting. A schematic of the RP-1 facility process flow diagram is shown in Figure 5-1.

## 2.1 Liquid Treatment Facilities

Preliminary treatment at RP-1 involves flow measurement using two Parshall flumes, screening that consists of four mechanical and two manual bar screens, and grit removal consisting of an aerated grit chamber and a vortex-type grit basin. Foul air from the preliminary and primary treatment facilities is sent to a chemical scrubber or biofilter for treatment and discharge. Primary treatment consists of 10 rectangular primary clarifiers and 2 circular primary clarifiers. Ferric chloride and polymer are added upstream of the primary clarifiers to improve settling performance and reduce hydrogen sulfide and odors in digester gas in the solids handling facilities. Primary effluent flow can be equalized using two equalization basins.

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FIGURE 5-1

## REGIONAL WATER RECYCLING PLANT NO. 1 PROCESS FLOW SCHEMATIC

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The secondary treatment facilities consist of three parallel, suspended growth treatment systems, each made up of two aeration basins and two circular secondary clarifiers. Two are identical, while the third has slightly larger secondary clarifiers. Aeration basins use fine bubble diffused aeration panels supplied by four centrifugal blowers. Tertiary treatment consists of filtration, coagulation, and flocculation/sedimentation of filter backwash, disinfection, and distribution of the tertiary effluent. Filtration is achieved using 26 dual media gravity filters and alum is added in-line upstream. Although flocculation/clarification facilities are available upstream of filtration, the flocculation/clarification process is normally offline. Disinfection is achieved using sodium hypochlorite, and filter effluent is sent to three chlorine contact tanks. The disinfected recycled water can then be discharged directly to Cucamonga Creek or directed to the RP-1 Recycled Water Pump Station. Discharge to Cucamonga Creek or Prado Lake is dechlorinated using sodium bisulfite. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

## 2.2 Solids Handling Facilities

Solids from RP-1 and RP-4 are processed at the RP-1 solids handling facilities. RP-4 solids are discharged into downstream sewers and flow to RP-1; solids are removed from RP-1 primary and secondary treatment processes. RP-1 solids handling facilities consist of thickening, stabilization, and dewatering processes. There are two thickening processes in operation at RP-1: gravity thickening for primary solids, and dissolved air flotation (DAF) thickening for secondary solids. Thickened biosolids from the primary and secondary processes are stabilized in a three-stage anaerobic digestion process. Digesters No. 1 and 2 can be operated as mesophilic-acid digesters. Digesters No. 2 through 7 can be operated as either thermophilic or mesophilic digesters. Methane gas that is produced is sent to the cogeneration facility. Digested biosolids are then dewatered using centrifuges and sent to IERCF for composting. Foul air is diverted to a biofilter for treatment. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

# 3.0 Current and Future Flows and Loads

As presented in *TM 4 Wastewater Flow and Loading Forecast*, an analysis of the influent wastewater characteristics at RP-1 was conducted as part of this WFMP effort in order to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and 2060 ultimate buildout year. The data analysis is based on 2 consecutive years of recent data provided by IEUA for influent flow and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia as nitrogen (NH3-N), and total Kjeldahl nitrogen (TKN).

Flow projections were developed by the Integrated Water Resources Plan (IRP) Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. As discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis*, the WFMP planning effort is based on IEUA's preferred Flow Diversion Alternative 2, which includes diverting flows from Whispering Lakes and Haven Pump Stations to RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035 form the basis of the master planning effort and treatment plant capacity evaluation presented herein. Projections are also presented for the 2060 ultimate buildout year; these projections are used for site planning considerations. Influent wastewater flows are projected to increase at RP-1 between 2020 and 2060 as a result of population growth in areas served by RP-1.

A summary of the current and projected average influent wastewater flows and loads for RP-1 are presented in Tables 5-2 and 5-3, respectively.

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TABLE 5-2
**RP-1 Current and Projected Average Influent Wastewater Flows**

| | Current | 2035[a] | 2060[a,b] |
|---|---|---|---|
| Average Influent Flow (mgd)[c] | 27.8 | 33.1 | 36.3 |

[a] Projections developed by IRP Consultant and IEUA based on November 2013 flow monitoring period. Reflects projected flows for IEUA preferred Flow Diversion Alternative 2.
[b] Site planning considerations are based on the projections established for the 2060 ultimate buildout planning year.
[c] Assumes Whispering Lakes Pump Station and Montclair Pipeline infrastructure improvements discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis* are complete and operational by 2020, with both pump stations online and conveying flow to RP-1.

TABLE 5-3
**RP-1 Current and Projected Average Influent Wastewater Characteristics**

| | Current Concentration (mg/L) | Current Load (lb/day) | 2035 Load[a] (lb/day) | 2060 Load[a] (lb/day) |
|---|---|---|---|---|
| BOD | 434 | 101,197 | 119,771 | 131,350 |
| TSS | 472 | 109,880 | 130,296 | 142,893 |
| NH3-N | 32 | 7,544 | 8,937 | 9,801 |
| TKN | 55 | 12,975 | 15,249 | 16,723 |

[a] Load projections based on projected flows, concentrations, and load peaking factors presented in *TM 4 Wastewater Flow and Loading Forecast.*

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# 4.0 Treatment Requirements

IEUA operates under an umbrella permit and must meet water quality requirements for discharge and recycled water.

## 4.1 Discharge Requirements

The tertiary effluent from RP-1 is discharged at two discharge points (DPs) – Prado Park Lake (DP 001) and Cucamonga Creek (DP 002), both regulated by RWQCB Order No. R8-2009-0021, which replaced Order No. 01-1 and Order No. 95-43, National Pollutant Discharge Elimination System (NPDES) No. CA 0105279. This permit is an umbrella permit governing all of IEUA's wastewater treatment plants (RP-1, RP-4, RP-5, and Carbon Canyon Water Recycling Facility). It includes a stormwater discharge permit and the enforcement of an industrial pretreatment program. Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water contact recreation. A summary of the main effluent quality limits is provided in Table 5-4.

## 4.2 Recycled Water Requirements

As mentioned previously, effluent from RP-1 and RP-4 is used as recycled water for irrigation and groundwater recharge via spreading in seven Phase I recharge basin sites and six Phase II recharge basin sites. Specifically, recycled water from RP-1 is discharged to a use area overlying Chino North "Max Benefit" Groundwater Management Zone (DP 005). Recycled water quality requirements for groundwater recharge are governed under RWQCB Order No. R8-2007-0039. Table I, Table II, and Table III in the permit provide concentration limits for many constituents of concern, such as inorganic chemicals, volatile organic chemicals, radionuclides, metals, and disinfection byproducts. Recycled water quality for irrigation is regulated by Order No. R8-2009-0021 and must meet the discharge requirements described in Table 5-4.

TABLE 5-4
**Summary of Effluent Quality Limits[a]**

| Parameter | Weekly Average | Monthly Average | Annual Average | Daily Maximum | Notes |
|---|---|---|---|---|---|
| BOD | 30 mg/L[b] | 20 mg/L[b] | - | - | 45 mg/L weekly average and 30 mg/L monthly average with 20:1 dilution. |
| TSS | 30 mg/L[b] | 20 mg/L[b] | - | - | |
| $NH_4$-N | - | 4.5 mg/L | - | - | |
| Chlorine Residual | - | - | - | 0.1 | Instantaneous maximum ceiling 2 mg/L |
| TIN | - | - | 8 mg/L | - | |
| TDS | - | - | 550 mg/L | - | Shall not exceed 12-month running average TDS concentration in water supply by more than 250 mg/L |
| Turbidity | - | - | - | - | 1. Daily average – 2 NTU<br>2. 5% maximum in 24 hr – 5 NTU<br>3. Instantaneous maximum – 10 NTU |
| Coliform | < 2.2 MPN | - | - | - | Maximum 23 MPN, once per month |
| pH | - | - | - | 6.5 – 8.5 | 99% compliance |
| Free Cyanide | - | 4.2 µg/L | - | 8.5 µg/L | |
| Bis(2-ethylhexyl) Phthalate | - | 5.9 µg/L | - | 11.9 µg/L | |
| Selenium | - | 4.1 µg/L | - | 8.2 µg/L | |

[a] RWQCB Order No. R8-2009-0021
[b] Without 20:1 dilution and for recycled water.
TIN – total inorganic nitrogen
TDS – total dissolved solids
$NH_4$-N – ammonia as nitrogen
NTU – nephelometric turbidity unit(s)
MPN – most probable number
mg/L – milligrams per liter
µg/L – micrograms per liter

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# 5.0 Existing Plant Capacity and Limitations

Existing facilities and the current performance of RP-1 were used as the basis for process model development. A whole plant model was developed using PRO2D and calibrated based on plant influent data and plant operations data for the period between October 15, 2011, and October 15, 2013. This period was selected as the basis after a review of the influent and plant data to reflect a 2-year-long complete data set. Existing plant operation and the findings of the capacity evaluation through the use of process modeling is presented below for the liquid and solids treatment facilities at RP-1.

## 5.1 Existing Plant Operation

A summary of RP-1 plant operations is provided in Table 5-5 for the liquid treatment and solids handling facilities. Unit process performance values were averaged over the evaluation period, with operating ranges noted. These values were used in development and calibration of the process models. Detailed data summaries for the evaluation period are provided in Appendix 5-A.

TABLE 5-5
**RP-1 Average Plant Operations Summary**

| Parameter | Value |
|---|---|
| ***Primary Treatment*** | |
| TSS Removal Rate (%) | 73 |
| TOC Removal Rate (%) | 47 |
| Primary Sludge (mgd) | 1.01 |
| ***Secondary Treatment (Average of System A, B, C)*** | |
| MLSS (mg/L) | 4,400 |
| MLVSS (%) | 77 |
| RAS SS (mg/L) | 7,900 |
| Solids Inventory (Basins Only) (lb) | 141 |
| Solids Inventory (Basins, Clarifiers, RAS) (lb) | 194 |
| Secondary Clarifier Loading (gpd/ft$^2$) | 500 |
| Secondary Clarifier Loading (lb/d/ft$^2$) | 40 |
| SVI (mL/g) | 150-190 |
| SRT (Basins Only) (d) | 18 |
| Residual Alkalinity (mg as $CaCO_3$/L) | 138 |
| ***Solids Handling*** | |
| Gravity Thickened Solids (% TS) | 4-5 |
| DAF Thickened Solids (%TS) | 4.5-6.5 |
| Acid Phase (Digester 1) HRT (day) | 3 |
| Gas / Second Phase Digestion HRT (day) | 12 |
| Gas / Third Phase Digestion HRT (day) | 6 |
| Centrifuge Cake Solids (%TS) | 14-20 |

gpd – gallons per day
MLSS – mixed liquor suspended solids
MLVSS – mixed liquor volatile suspended solids
RAS SS – return activated sludge suspended solids
lb – pound(s)
mL/g – milliliters per gram
gpd/ft$^2$ – gallons per day per square foot
lb/d/ft$^2$ – pounds per day per square foot
SVI – sludge volume index
SRT – solids retention time
$CaCO_3$/L – calcium carbonate per liter
TS – thickened solids
HRT – hydraulic retention time

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A performance summary for the major treatment processes is presented in Table 5-6. These values, which represent the average over the evaluation period, were used in the subsequent plant process modeling and capacity evaluations for the major treatment units. Detailed data summaries for the evaluation period are provided in Appendix 5-A.

TABLE 5-6
**RP-1 Average Plant Performance Summary**

| Parameter | Primary Effluent | Secondary Effluent | | |
|---|---|---|---|---|
| | | System A | System B | System C |
| TOC (mg/L) | 125 | 6.1 | 5.8 | 5.1 |
| BOD (mg/L) | 224 | 1.7 | 1.6 | 1.4 |
| TSS (mg/L) | 126 | 6.3 | 3.9 | 4.4 |
| NH3-N (mg/L) | 29 | 0.17 | 0.12 | 0.22 |
| NO3-N (mg/L) | N/A | 6.9 | 7.1 | 6.2 |
| NO2-N (mg/L) | N/A | 0.20 | 0.07 | 0.19 |
| TIN (mg/L) | N/A | 7.3 | 7.3 | 6.6 |
| Alkalinity (mg as $CaCO_3$/L) | N/A | 138 | N/A | 139 |

N/A – Not applicable
NO3-N – nitrate as nitrogen
NO2-N – nitrite as nitrogen

The values above are for the current operation, which includes secondary treatment operation without internal mixed liquor recycling, configured in an anoxic-oxic-anoxic-oxic biological nutrient removal (BNR) configuration with step feed capability. IEUA is currently planning to add internal mixed liquor pumping capability to the bioreactors, converting them to be closer to a Modified Ludzack-Ettinger (MLE) configuration with step feed capability, which is expected to improve the nitrogen removal capability of the secondary treatment system.

## 5.2 Existing Plant Capacity

### 5.2.1 Process Modeling

The capacity of the existing system was evaluated through process modeling using CH2M HILL's whole plant simulator, PRO2D. PRO2D is a process simulation model that takes into account the mass balances through an entire facility for particulate and soluble components and, similar to other commercially available process models, is based on the International Water Association (IWA) ASM2D biological process kinetics. The base model was constructed to reflect the actual facility setup, including flow splits and backwash. The process model facility setup flow diagram is presented in Figure 5-2. The model was constructed with the operations and performance criteria reflective of the evaluation period, and then calibrated to reflect the actual performance, solids yields, and water quality data.

As shown in Figure 5-2, the model was constructed to represent the actual plant operation for all the major process units. The model also allows establishing sizing and design considerations for each major unit process tankage and equipment. Similar to the actual operations, the plant model was built with the filter backwash and solids thickening recycles being returned to the main plant for further treatment, with the dewatering recycles being diverted offsite. The liquid and solids mass balances calculated for the current conditions allow calibration of the model against the actual field data. The calibrated model is then used to evaluate current capacity as well as establish expansion needs and process bottlenecks.

The process model was constructed and calibrated using the current influent and operating data available for the facility. The purpose of the model calibration step is to establish a baseline condition that closely resembles current operations and provides a means to reliably predict operations and system limitations under different scenarios or alternatives. Key model calibration results are presented in Table 5-7. As the listed values show, the model was calibrated such that the simulation results are within a value range that is 5 percent or smaller

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relative to the actual data. This level of accuracy will allow reliable capacity estimations to be made for the various capacity scenarios and future operation needs.

TABLE 5-7
**RP-1 Average Plant Performance Summary**

| Parameter | Actual Data Average Values | Model Results |
|---|---|---|
| Effluent BOD (mg/L) | 1.43 | 2.6 |
| Effluent TSS (mg/L) | 4.9 | 5.2 |
| Effluent TIN (mg/L) | 7.3 | 7.2 |
| Effluent Alkalinity (mg as $CaCO_3$/L) | 139 | 144 |
| Total MLSS Inventory (lb) | 424,000 | 408,000 |
| Sludge VS Content | 77% | 76% |
| Biosolids (Dry Solids lb/day) | 44,400 | 47,400 |

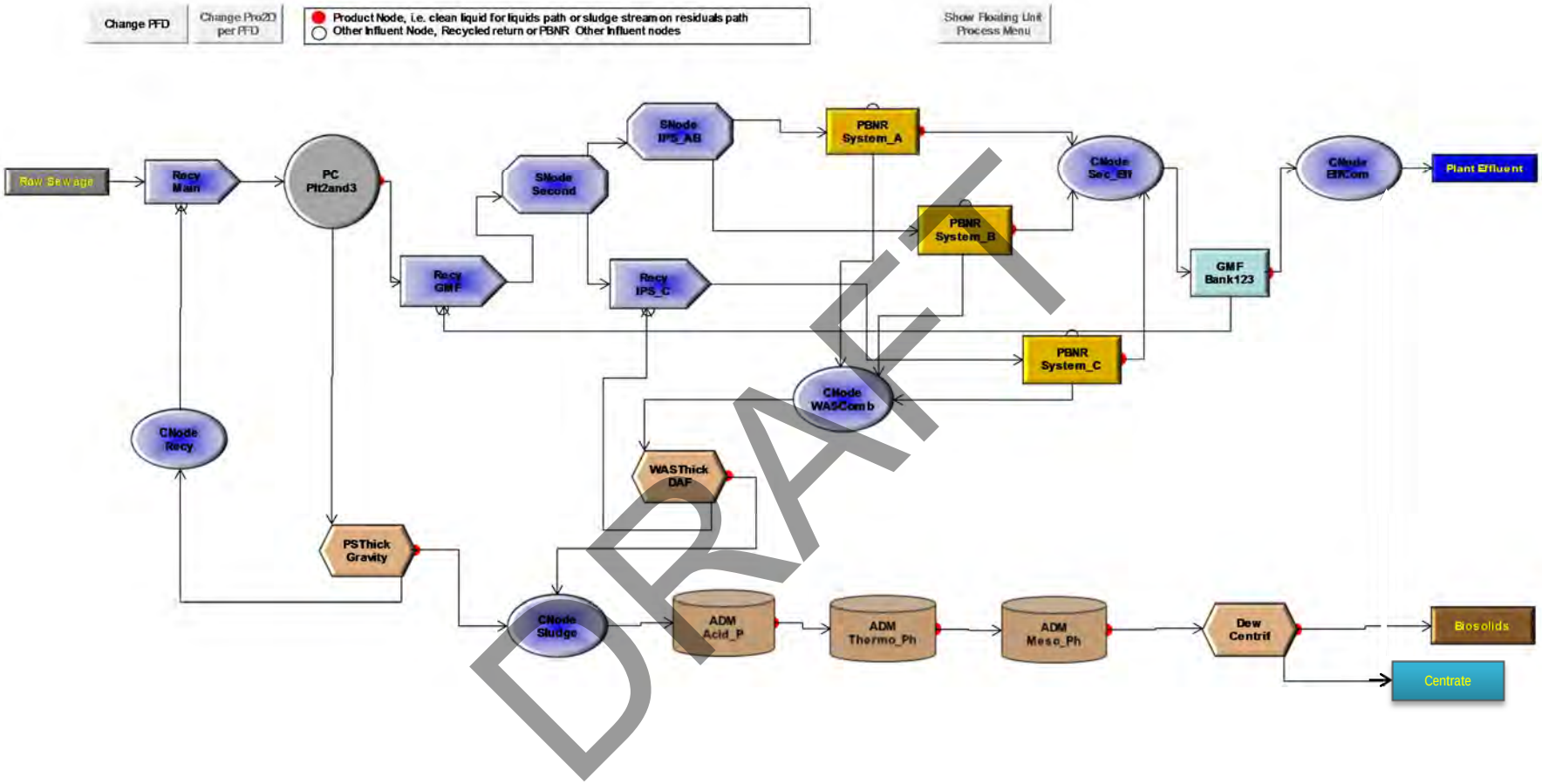
Subsequent process modeling using the calibrated model as the base model was conducted to evaluate the following scenarios:

- Current plant capacity
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under average and maximum month flow and load conditions
  - Liquid treatment capacity to meet 5-mg/L effluent TIN level under average and maximum month flow and load conditions
  - Solids handling capacity under average and maximum month flow and load conditions
- Flow equalization options and future capacity implications for the planning year 2035
- Future facility footprint implications for the planning years 2035 and 2060

Findings of the current plant capacity evaluation are presented next in this section. Flow equalization and future capacity needs are presented in Sections 6.0 and 7.0, respectively.

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FIGURE 5-2
**RP-1 Process Model Facility Setup**




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### 5.2.2 Liquid Treatment Capacity

An evaluation of the liquid treatment capacity was conducted using the whole plant process model under both the average and maximum month conditions. The capacity evaluation was conducted based on achieving a plant effluent TIN concentration of 8 mg/L and 5 mg/L. As established at the onset of the project, the facility reliability and redundancy considerations are based on the IEUA's overall wastewater treatment system, with RP-5 being the end-of-the-line facility receiving all flow diversions, if needed, from other Regional Water Recycling Plants. Additional reliability and redundancy considerations driven by the regulatory requirements, such as Title 22 requirements, were taken into account. Dewatering recycles were considered to be handled separately or treated separately onsite.

Process modeling showed that the primary treatment system is not capacity limiting, because the liquid treatment capacity is limited by the secondary treatment system. One of the limitations was found to be the aeration and the ability to control dissolved oxygen (DO) in the anoxic and oxic zones in the aeration basins. The implications of DO are TIN fluctuations in the effluent and SVI values that are greater than 150 mL/g, which indicates sludge settleability could be impaired at times.

Another limitation of the secondary treatment system was found to be the secondary clarification solids loading resulting from the current operations and the influent wastewater solids loading rates. Maintaining the SVI values at or below 150 mL/g is important for this reason also.

The capacity of the RP-1 tertiary processes also were evaluated; the methodologies employed are consistent with those presented in the Title 22 Engineering Report (DDB Engineering, Inc. [DDB], 2010). The filters were designed based on a California Department of Public Health (CDPH) maximum filter loading rate of 5 gallons per minute per square foot (gpm/ft$^2$) for dual-media gravity filters, with one filter in backwash and one filter offline. In order not to exceed the maximum approved filter loading rate, the maximum flow the filtration system can handle is 51.7 mgd. Applying a peak hourly dry weather peaking factor of 1.18, the resulting average filtration capacity is 43.8 mgd.

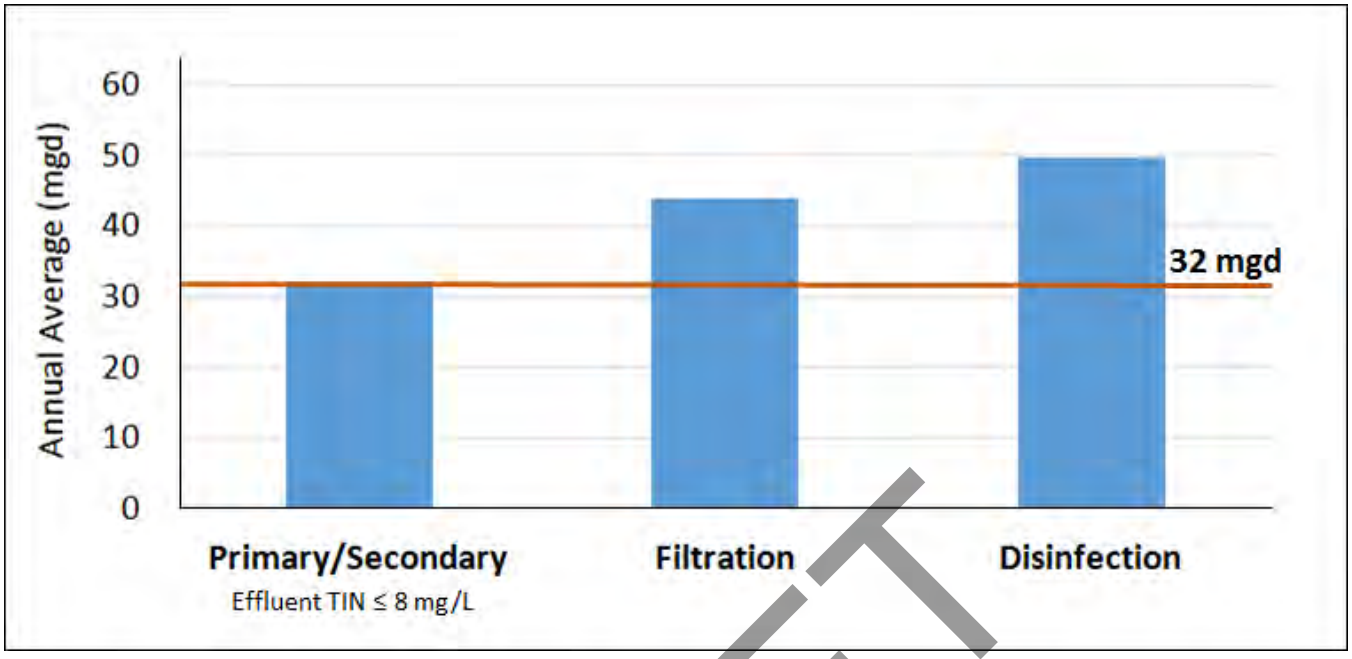
The disinfection system was designed based on the Title 22 concentration and time (CT) and modal contact requirements of 450 milligrams per minute per liter (mg-min/L), and 90 minutes during the peak hourly dry weather flow, respectively. Tracer testing completed in 2002 showed that Tanks 1 and 2 can handle a peak flow of 41.3 mgd while maintaining a modal contact time of 90 minutes (DDB, 2010). Applying a peak hourly dry weather peaking factor of 1.18, the resulting average disinfection capacity of Tanks 1 and 2 is 35 mgd. Tank 3 was designed based on 90 minutes modal contact time resulting in a peak dry weather capacity of 17.5 mgd. Applying a peak hourly dry weather peaking factor of 1.18, the resulting average disinfection capacity of Tank 3 is 14.8 mgd. Thus, the overall average disinfection capacity is approximately 49.8 mgd.

The overall liquid treatment capacity is determined by its most limiting process capacity. For RP-1, the secondary treatment is limited to 32 mgd with all units in service, with primary flow equalization, for an effluent TIN of 8 mg/L, assuming that the mixed liquor return system is installed and dewatering recycles go to the Non-Reclaimable Wastewater (NRW) system or are treated separately. Therefore, the RP-1 liquid treatment capacity is 32 mgd. As discussed previously, this is less than the rated capacity of 44 mgd. However, the rated capacity was based on completion of Train D, which has not been constructed.

The liquid treatment capacity of the plant to achieve an effluent TIN value of 8 mg/L is illustrated in Figure 5-3. As shown, the current plant influent represents 88 percent of the plant liquid treatment capacity. To achieve 5 mg/L effluent TIN, the plant can only treat 28 mgd and will be at capacity.

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FIGURE 5-3
**RP-1 Existing Liquid Treatment Capacity**




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## 5.2.3 Solids Handling Capacity

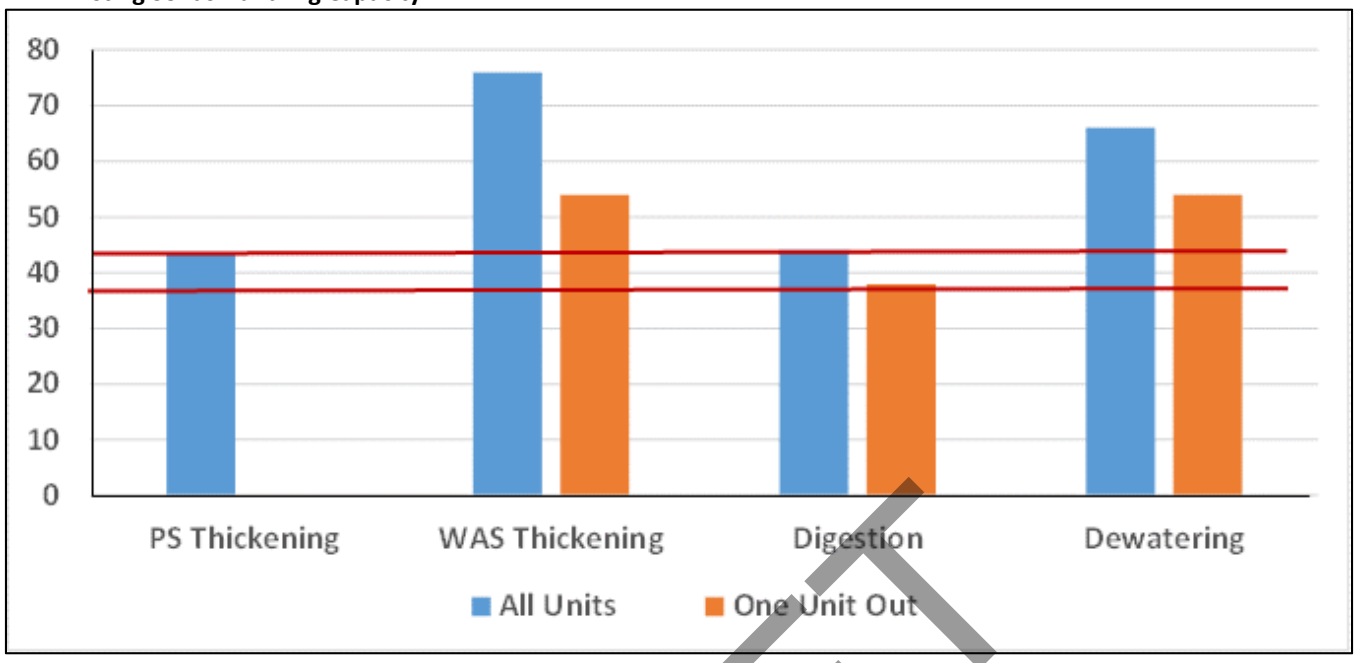
In evaluating the solids handling system capacity, operational considerations as well as Part 503 Rule requirements were taken into account when considering the average and maximum month loading. The system capacity with and without one unit out of service was evaluated using the industry standard loading rates and operational criteria. The capacity values calculated are considered to represent equivalent plant influent flow values at the current wastewater characteristics. The plant influent includes the RP-4 solids diverted to RP-1 via the sewer system for further treatment.

Primary sludge (PS) thickening is currently achieved using one gravity thickener; having a single thickener was not considered a key concern, based on the input from the IEUA staff. Thickening can be achieved in the primary clarifiers if the gravity thickener is taken out of service. WAS thickening is achieved in dissolved air floatation thickeners (DAFTs). Capacity was evaluated by maintaining a solids loading rate of 45 lb/d/ft$^2$ or less for the DAFTs.

Waste solids digestion, achieved in the phased digestion system, was evaluated based on the current operating conditions as well as Part 503 Rule requirements. Digester loading rates of 0.1 to 0.2 pounds per day per cubic foot (lb/d/ft$^3$) and a digester SRT of 15 days with one large unit out of service were used to establish digestion capacity, using an active digester volume of 90 percent of the total digester volume including the cone space. The dewatering capacity of the centrifuges was calculated considering the hydraulic loading rate to be maintained at or below 340 gallons per minute (gpm) under the current solids loading conditions.

The solids handling capacity of the plant to meet the Part 503 Rule requirements for Class B biosolids is illustrated in Figure 5-4. As shown, the digestion is the limiting unit process of the solids handling system. The current equivalent RP-1/RP-4 plant influent flows (28 + 10 = 38 mgd) represent 100 percent of the anaerobic digestion capacity with one large unit out of service at the current influent wastewater characteristics and RP-4 solids loading diversion.

FIGURE 5-4
**RP-1 Existing Solids Handling Capacity**




## 5.3 RP-1 Capacity Summary

The current RP-1 plant capacity is summarized in Table 5-8. These values constitute the basis of the future capacity requirements assessment presented later in this TM.

TABLE 5-8
**RP-1 Existing Process Capacity Summary**

| | All Units in Service | One Unit Out of Service |
|---|---|---|
| **Secondary Treatment** | | |
| Plant Effluent TIN ≤ 8 mg/L[b] | 32 mgd | 28 mgd[a] |
| Plant Effluent TIN ≤ 5 mg/L[b,c] | 29 mgd | 26 mgd |
| **Solids Handling**[d] | | |
| PS Thickening | 43.3 mgd | 0 mgd[e] |
| WAS Thickening | 76 mgd | 54 mgd[e] |
| Digestion | 44 mgd | 38 mgd[e] |
| Dewatering | 66 mgd | 54 mgd[e] |
| **Tertiary Treatment** | | |
| Filtration | 47.4 | 43.8[f] |
| Disinfection | 49.8 | N/A |

[a] One secondary clarifier and one aeration basin out of service.
[b] Assumes internal mixed liquor return (IMLR) is in place and SVI is 150 mL/g or better.
[c] Assumes IMLR is in place, DO control is added, and DO management is practiced.
[d] Values represent equivalent plant influent capacity and include RP-4 solids diverted to RP-1. Dewatering recycles were considered to be handled separately or treated onsite, not adding to the main plant nutrient loads.
[e] One large unit out of service.
[f] Two filter cells out of service, one in backwash one for maintenance.

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# 6.0 Flow Equalization Alternatives Evaluation

As part of the capacity and site planning for RP-1, primary flow equalization was evaluated for the projected RP-1 influent flows of 33.1 mgd in 2035 and 36.3 mgd in 2060 (ultimate capacity). The facility currently has three flow management lagoons as shown in Figures 5-5 and 5-6. These lagoons are used for flow management for primary effluent and secondary effluent. While all three lagoons were constructed to receive primary effluent, Lagoon 3 primarily receives secondary effluent. The primary effluent is diverted to remaining lagoons on an as needed basis to manage flow peaks at the facility. IEUA strives to minimize odors that are sometimes experienced with the storage of primary effluent in these lagoons that are not covered and are in close proximity to the neighboring community and businesses.

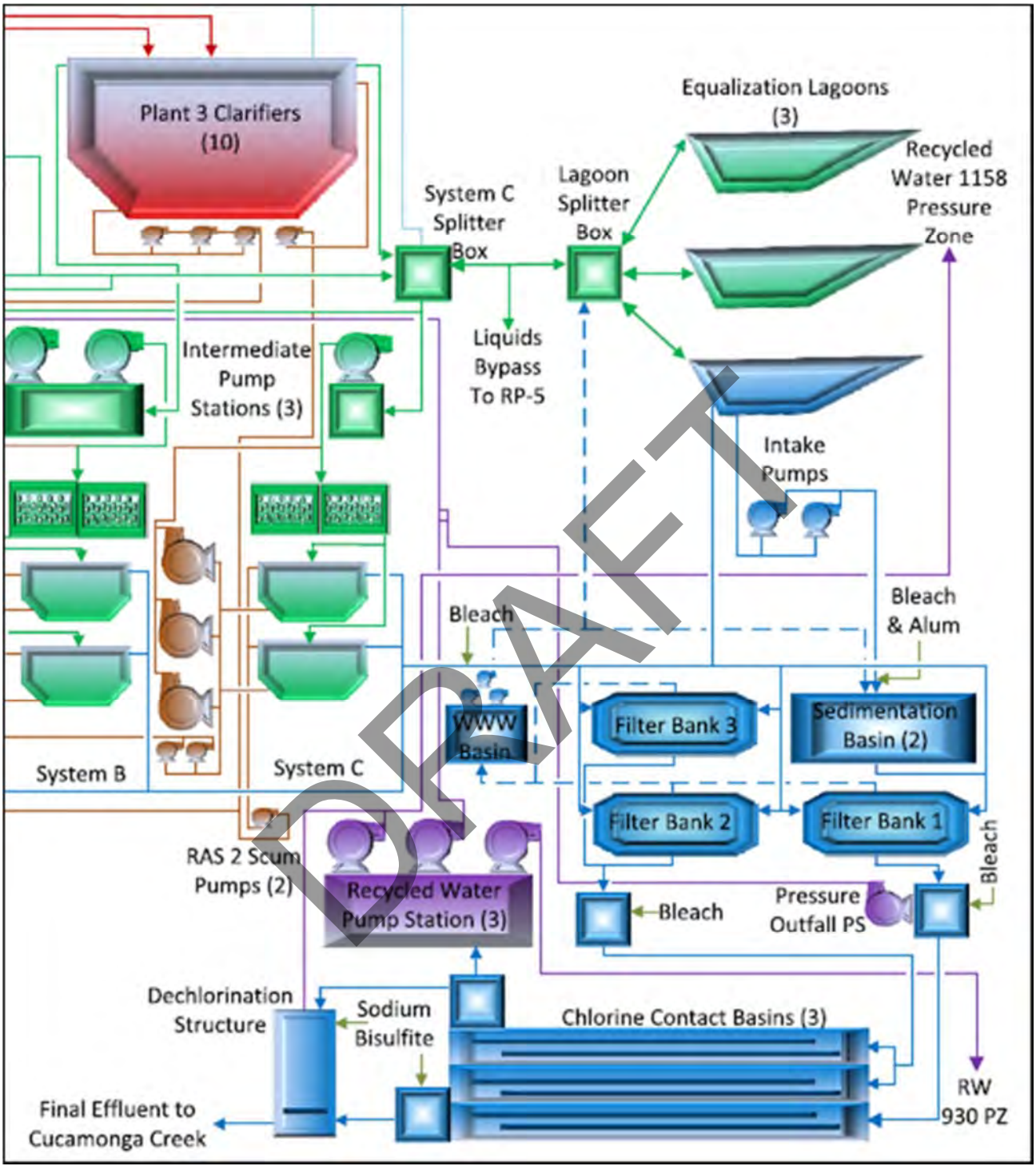
The following flow equalization alternatives were considered for detailed review of the monetary and nonmonetary considerations:

1. Keep the existing system, continuing the current operations as long as possible.
2. Replace with a modern covered tank system with the capability to mix, drain, and clean the contents of the equalization tanks, as well as provide continuous odor control for the tank headspace.
3. Eliminate primary effluent equalization by adding planned aeration basin improvements and secondary clarifiers, and converting the lagoons to secondary effluent equalization or recycled water storage.

A nonmonetary evaluation was completed considering the advantages and disadvantages of these flow equalization alternatives. The evaluation criteria included factors that are of varying levels of importance for IEUA. For example, operational flexibility, operational risk and reliability, and impacts on plant odors were of greatest importance, while footprint and space considerations had the lowest importance. The criteria, definitions, and weighting factors are listed in Table 5-9. As illustrated in Table 5-10 and Figure 5-7, the benefit scores were calculated for each alternative through independent evaluation of each criterion. Resultant total benefit scores show that Alternative 3 (eliminating the primary effluent equalization by adding secondary clarifiers, and converting the existing lagoons to secondary effluent equalization or recycled water storage) has the highest nonmonetary benefit for IEUA. This is in larger part due to the fact that this alternative significantly eliminates the plant odors from primary effluent storage and pumping, improves the overall plant aesthetics, does not have any constructability or space constraints, and provides ease of operation and maintenance because it eliminates primary effluent storage and associated pond/ mechanical equipment maintenance.

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FIGURE 5-5
**RP-1 Existing Flow Management Schematic**




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**Figure 5-6**
**RP-1 Existing Flow Management Infrastructure**

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TABLE 5-9
**Nonmonetary Evaluation Criteria, Definitions, and Assigned Weighting Factors**

| Criteria | Description | Weighting Factor |
|---|---|---|
| Operational flexibility | Ability of the system to respond to potential internal or external changes affecting delivery of equalized flow or treated solids without any impact on system performance. | 10 |
| Operational risk and reliability | Operational implications on system reliability and redundancy and the associated risk involved in operating major facilities. Use of proven systems and technologies, with similar installations currently in operation. | 10 |
| Impacts on plant odors | Impacts of new processes on plant odors, and the need for additional odor control facilities to minimize plant odors. | 10 |
| Constructability and implementation timing | Construction implications, ease of construction, and integration with the existing systems, and the ability to implement the proposed alternative in phases. | 9 |
| Treatment capacity impacts | Impacts of the new facilities on treatment plant capacity. | 8 |
| Impacts on existing facilities | Impacts on existing facilities and the ability to use existing infrastructure. Implications of site planning and the need to demolish or relocate existing facilities. | 8 |
| Ease of operation and maintenance | Relative degree of ease and extent of time required to operate and maintain the facilities. | 8 |
| Impacts on energy requirements | Additional energy required to construct and maintain new facilities, as well as the impact of the new facilities on the overall plant energy balance and power demand (for example, pumping, mixing, etc.). | 7 |
| Pumping and hydraulic requirements | Implications of pumping and conveying to new facilities, and complexity of pumping and yard piping requirements. | 6 |
| Overall aesthetics | Aesthetic and visual considerations as a result of the new facilities. | 6 |
| Carbon footprint and sustainability | Potential impacts on the carbon footprint of each plant and added sustainability features as a result of construction and operation of the facilities. | 4 |
| Footprint and space constraints | Overall footprint requirements and space constraints, and impacts on site planning for future facilities. | 3 |

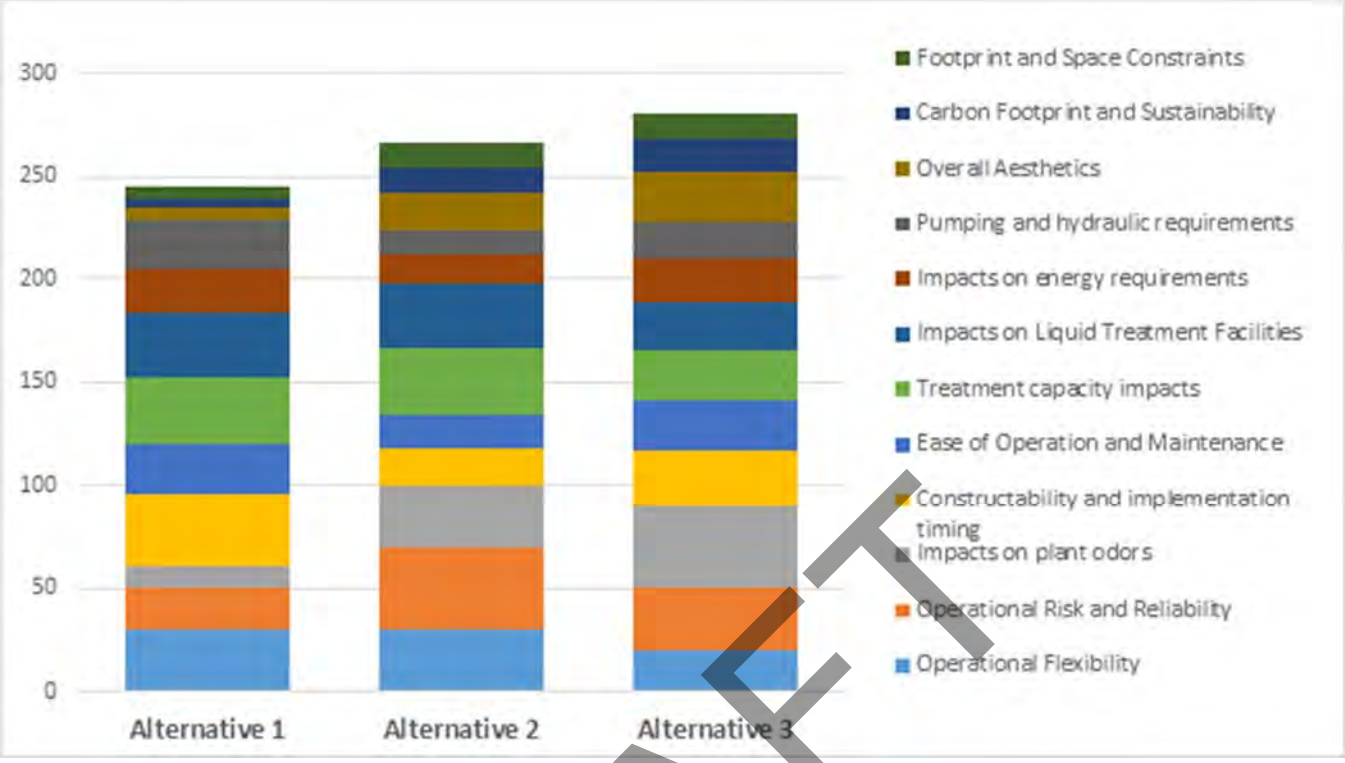
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TABLE 5-10
**RP-1 Flow Equalization Non-Monetary Evaluation Results**

| Criteria | Weighting Factor | Alternative 1 Keep Existing | | Alternative 2 Build New Tanks | | Alternative 3 Eliminate PE EQ | |
|---|---|---|---|---|---|---|---|
| | | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score |
| Operational Flexibility | 10 | 3 | 30 | 3 | 30 | 2 | 20 |
| Operational Risk and Reliability | 10 | 2 | 20 | 4 | 40 | 3 | 30 |
| Impacts on Plant Odors | 10 | 1 | 10 | 3 | 30 | 4 | 40 |
| Constructability and Implementation Timing | 9 | 4 | 36 | 2 | 18 | 3 | 27 |
| Treatment Capacity Impacts | 8 | 4 | 32 | 4 | 32 | 3 | 24 |
| Impacts on Existing Facilities | 8 | 4 | 32 | 4 | 32 | 3 | 24 |
| Ease of Operation and Maintenance | 8 | 3 | 24 | 2 | 16 | 3 | 24 |
| Impacts on Energy Requirements | 7 | 3 | 21 | 2 | 14 | 3 | 21 |
| Pumping and Hydraulic Requirements | 6 | 4 | 24 | 2 | 12 | 3 | 18 |
| Overall Aesthetics | 6 | 1 | 6 | 3 | 18 | 4 | 24 |
| Carbon Footprint and Sustainability | 4 | 1 | 4 | 3 | 12 | 4 | 16 |
| Footprint and Space Constraints | 3 | 2 | 6 | 4 | 12 | 4 | 12 |
| **Final Score** | | | **245** | | **266** | | **280** |

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FIGURE 5-7
**RP-1 Flow Equalization Non-Monetary Evaluation Summary**




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Monetary evaluation of these three flow equalization alternatives was completed to further assess the options. The monetary evaluation was conducted by developing life-cycle costs (LCC) for the three alternatives. The cost basis was the same for the overall master plan cost criteria:

- 20-year planning period
- 3 percent inflation
- 6 percent bond (interest) rate
- 30 percent contingency
- 30 percent engineering, construction management, environmental, legal, etc.

The monetary evaluation findings are listed in Table 5-11. Accordingly, Alternative 1 will have the lowest LCC because it is the baseline alternative with no addition of new infrastructure. Alternative 2 has the highest LCC because of the addition of new infrastructure including two 180-foot covered concrete primary effluent equalization tanks, associated recirculation and flow transfer pumps, mixing, cleaning and odor control components, and elimination of some of the existing lagoon volume to provide space to construct the new tanks. New infrastructure needed for Alternative 3 includes one new secondary clarifier for each secondary treatment train (two 120-foot units and one 130-foot unit) to accommodate the unequalized loads to the secondary treatment system and associated piping and flow splitting features. As a result, it has the second highest LCC value.

TABLE 5-11
**RP-1 Flow Equalization Monetary Evaluation Results**

| | Alternative 1 Keep Existing | Alternative 2 Build New Tanks | Alternative 3 Eliminate PE EQ |
|---|---|---|---|
| Capital Cost | $ - | $ 50,661,000 | $ 23,481,000 |
| O&M Cost | $ 50,000 | $ 468,000 | $ 130,000 |
| 20-yr LCC | $ 750,000 | $ 57,681,000 | $ 27,079,000 |

IEUA has decided that Alternative 1 is not a sustainable approach because this alternative does not eliminate the currently experienced odor problems or provide a resolution to the lagoon maintenance challenges (for example, the need to clean the open lagoons properly and promptly, etc.). Alternative 2 was not preferred due to its high cost and the operational complexity. IEUA desires to eventually move toward elimination of the current primary effluent flow equalization as in Alternative 3. This will free up the existing lagoons for other flow management needs such as secondary effluent or recycled water storage.

# 7.0 Plant Expansion Needs

The flow projections for the planning years 2035 and 2060 were established as described under Section 3.0 of this TM. Accordingly, 2035 flow projections will be the basis of the facility expansion and CIP planning effort, while the facilities needed for the 2060 flow conditions will constitute the basis of site planning. The corresponding planning flows are listed in Table 5-12.

TABLE 5-12
**RP-1 Expansion Flow Scenarios**

| Planning Year | RP-1 Influent | RP-4 Influent (Equivalent Waste Solids) |
|---|---|---|
| 2035 | 33.1 mgd | 14.7 mgd |
| 2060 | 36.3 mgd | 18.4 mgd |

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IEUA has decided to base the capacity expansion and footprint requirements on using the MBR technology for RP-1. The benefits of the MBR technology for long-term IEUA planning include small footprint requirements, elimination of secondary clarifiers and tertiary filters for recycled water production, superior water quality, and ability to produce thicker waste sludge compared to conventional technologies. The modular design capability of MBR technology also allows stepwise expansion of the treatment facility to meet both load capacity and different effluent TIN requirements. Also, the superior quality effluent can be directly fed to a reverse osmosis (RO) system if IEUA needs to produce higher-quality effluent or reduce final effluent TDS.

## 7.1 Facility Expansion Requirements

For the 2035 capacity expansion requirements that will constitute the basis of the CIP planning, facility sizing was determined using the whole plant PRO2D process model developed and calibrated for the current operation and wastewater quality. The PRO2D model simulations for average and maximum month flow and load conditions were completed to establish the facility requirements as well as liquid and mass balances for the facility. New facility sizing was based on the current IEUA operations as well as industry standards that apply to each unit process. RP-1 facility expansion requirements are summarized in Table 5-13.

TABLE 5-13
**RP-1 Facility Expansion Requirements for Planning Year 2035**

| Parameter | Size of New Units | Comments |
|---|---|---|
| Primary Clarifiers | - | No new units are needed. |
| Train D Secondary Treatment (MBR) | 1 module (8 mg/L TIN)<br>2 modules (5 mg/L TIN) | MBR system requirements include fine screening for the MBR system feed, MBR equipment includes permeate blowers and pumps. For site planning purposes, a 60-foot x 45-foot concrete equipment pad is reserved for this purpose. |
| Train D MBR Bioreactor Dimensions (Length x Width x Depth) | 1 module<br>130-foot x 60-foot x 18-foot | Two trains per module. |
| Train D Membrane Tank Dimensions (Length x Width x Depth) | 1 module<br>30-foot x 60-foot x 10-foot | Three trains per module. |
| Trains A, B, C New Secondary Clarifiers (PE EQ Elimination) | 2 x 120-foot (Trains A and B)<br>1 x 130-foot (Train C) | Flow-splitting structure for each of the trains, as well as considerations for new RAS/WAS piping and pumping requirements, were included. |
| Anaerobic Digesters | 2 digesters<br>110-foot diameter<br>30-foot sidewater depth | New digesters with complete sludge transfer and recirculation, mixing and heating, and pumping equipment. |
| Flow Management Lagoons | - | Modifications only to piping and pumping systems to be able to use the lagoons for secondary effluent equalization. |

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The facility expansion configured in Table 5-13 was used as the basis of the capital and site planning under this master plan because it allows independent implementation of various facilities listed in the table. For example, elimination of primary effluent equalization impacts on secondary treatment needs to be balanced with the addition of secondary clarifiers, as noted previously. Because the clarifier addition and the MBR system addition are independent projects, they can be implemented separately.

There is an alternative that combines the elimination of primary flow equalization and addition of an MBR system; this alternative needs to be further evaluated as a part of the preliminary design effort. It involves dedicating the existing six secondary clarifiers to Trains A and B, while converting Train C to MBR technology. Under this alternative, Trains A and B will have adequate capacity to handle diurnal peaks. After conversion to MBR through the addition of membrane tanks and bioreactors, as needed, Train C can provide additional capacity for treatment of RP-1 flows. Train D can be constructed in the future, if needed. This way, no new secondary clarifiers would be built, and more flows could be treated through MBR as compared to constructing Train D only. The constructability and sizing details for the conversion of existing infrastructure for this alternative need to be further evaluated during preliminary design.

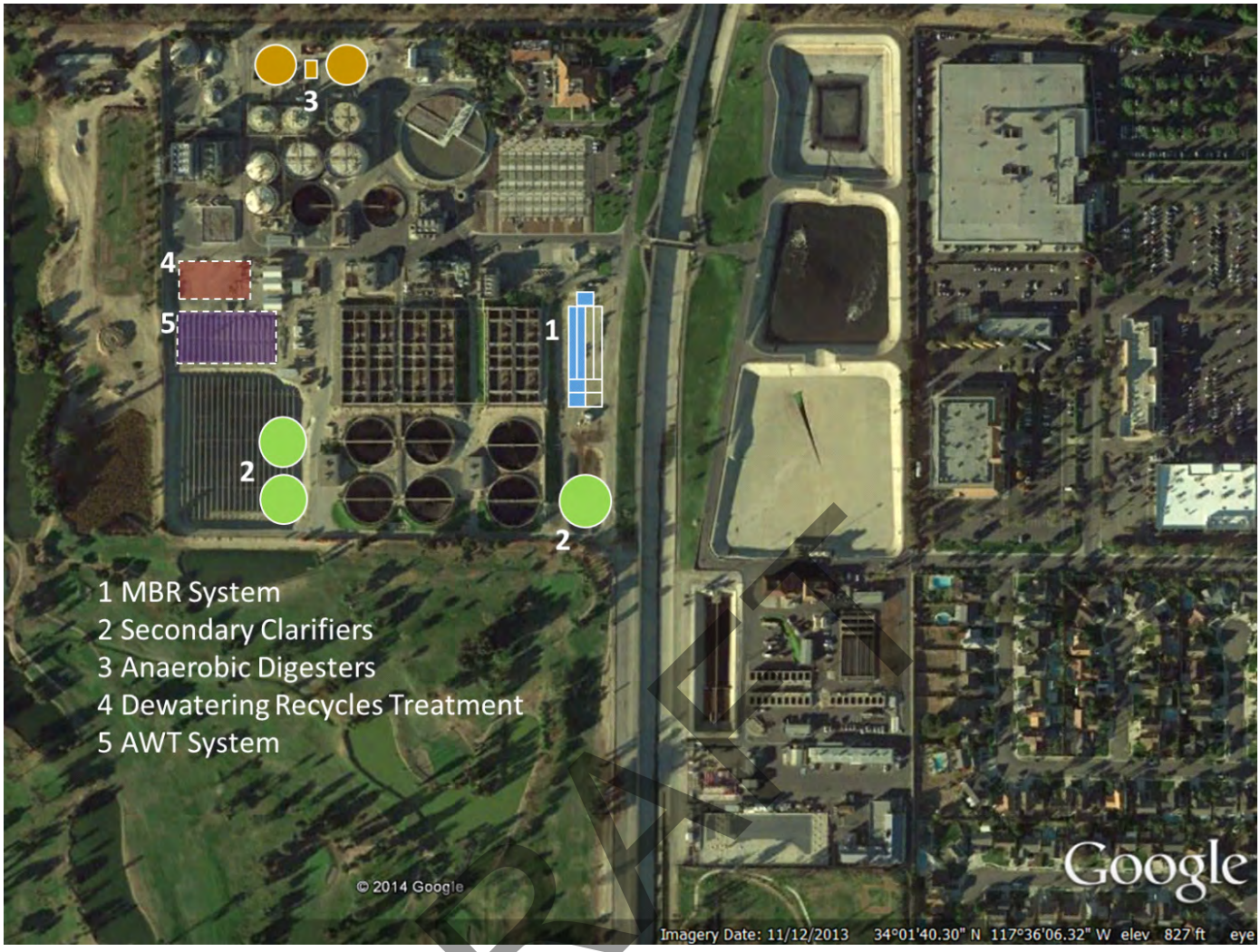
## 7.2 Ultimate Facilities Site Plan

For ultimate site planning purposes, the facilities for the ultimate capacity increase and other site planning considerations were established. In addition to the liquid treatment and solids handling facilities expansion requirements, the following site space needs were reserved for the listed future uses:

1. **Secondary Treatment**: Ultimate site space planning was completed using the expansion scheme listed in Table 5-13. To achieve 5-mg/L effluent TIN, both MBR modules of Train D needs to be implemented. However, an alternative ultimate site plan by converting Train C to MBR technology and adding Train D also could be implemented. As indicated above, Train C conversion requirements and related site planning requirements need to be further explored during preliminary design. The secondary treatment footprint, as shown in Figure 5-8, represents the worst-case scenario.

2. **Dewatering Recycles Treatment**: Currently, IEUA diverts the dewatering recycles to the NRW line through an interagency agreement. The NRW delivers non-reclaimable wastewater flows from the inland areas to the Los Angeles County Sanitation Districts (Sanitation Districts) Joint Water Pollution Control Facility (JWPCF) located in Carson, California. IEUA is planning to eliminate this discharge and manage the dewatering recycle flows onsite in the future. Dewatering recycles represent significant nutrient load (especially ammonia as nitrogen) that need to be treated. The flow can either be recycled back to the head of the plant, or be treated separately. Current advancements in treatment technologies, such as the Demon process, will allow IEUA to cost-effectively treat the ammonia load separately in a biological treatment system that uses the specialty microorganisms to achieve short-cut nitrogen removal. To reserve space to implement dewatering recycle treatment, a 20,000-$ft^2$ site space was reserved as shown in Figure 5-8.
3. **Advanced Water Treatment (AWT)**: Currently IEUA does not need to implement AWT to further treat the tertiary effluent. However, to manage the needs for higher-quality effluent or increasing TDS in the tertiary effluent, IEUA would like to reserve space for future implementation of an AWT system that could treat up to 5,000 acre feet per year (AFY) using a microfiltration (MF)/RO system and its appurtenances. If the MBR technology is implemented for the main plant expansion, the MF facility could be eliminated, depending on the AWT flow requirements. For this purpose, a 60,000-$ft^2$ site space was reserved as shown in Figure 5-8.

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**Figure 5-8**
**RP-1 Ultimate Facilities Site Plan**

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# 8.0 20-Year CIP Plant Expansion Projects and Capital Cost

Three plant expansion projects were identified during the 20-year CIP: the RP-1 Primary Effluent Equalization Elimination Project, the RP-1 Liquid Treatment Expansion Project, and the RP-1 Solids Treatment Expansion Project. Capital costs were estimated for each project and those costs were placed into the 20-year CIP. The planning-level capital costs for each facility identified were developed based on cost curves established from previous projects and known direct costs for similar-sized projects. Additionally, several assumptions were made to estimate the total construction cost and total project costs for each expansion project. The assumptions include the following:

- The WFMP assumed a 20-year planning period.
- 10 percent of facilities subtotal for civil/site work.
- 0 to 5 percent of facilities subtotal for demolition depending on existing site conditions.
- 20 percent of facilities subtotal for electrical and instrumentation.
- 10 percent of total direct cost for contractor general conditions.
- 15 percent of total direct cost for contractor overhead and profit.
- 8 percent sales tax was applied to 50 percent of the total direct cost.
- 30 percent for construction contingency.
- 30 percent for engineering, construction management, environmental, and legal costs was applied to the total construction cost to estimate the total project cost.

The total construction cost and total project cost for each expansion project are summarized in Table 5-14.

# 9.0 Conclusion

The following conclusions can be made from the evaluation of RP-1:

- Elimination of existing primary effluent flow equalization by adding secondary clarifiers and converting the existing lagoons to secondary effluent equalization or recycled water storage is the most favorable alternative.
- The RP-1 liquid treatment facilities will need to be expanded during the 20-year planning period with the construction of a new MBR facility (Train D).
- The RP-1 solids treatment facilities will need to be expanded during the 20-year planning period with the construction of new anaerobic digesters.

# 10.0 References

DDB Engineering, Inc. (DDB). 2010. *Inland Empire Utilities Agency Regional Plant No. 1 Title 22 Engineering Report.* January.

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TABLE 5-14
**RP-1 Expansion Projects Capital Cost Estimate**

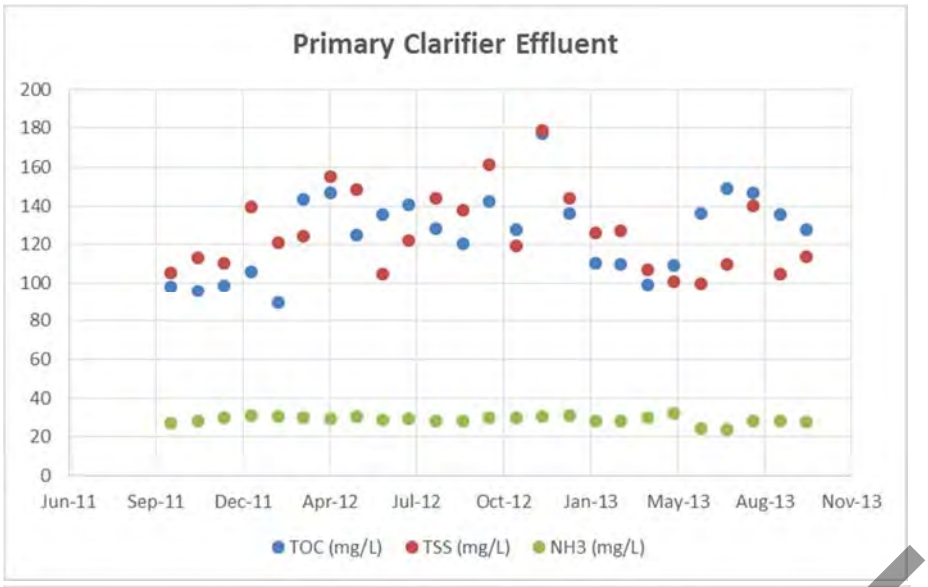
| Component Description | RP-1 Primary Effluent Equalization Elimination Project | RP-1 Liquid Treatment Expansion Project | RP-1 Solids Treatment Expansion Project |
|---|---|---|---|
| Secondary Treatment (MBR) – 5 mgd | - | $21,400,000 | |
| Secondary Clarifiers | $7,200,000 | - | |
| Aeration Basin Distribution Box Modifications | $360,000 | - | |
| RAS/WAS Pump Station Modifications | $1,100,000 | - | |
| Equalization Pond Piping Modifications | $500,000 | - | |
| Methane-Phase Digestion | - | | $7,000,000 |
| **Facilities Subtotal** | **$9,160,000** | **$21,400,000** | **$7,000,000** |
| Civil/Site Work (10%) | $916,000 | $2,140,000 | $700,000 |
| Demolition (5%) | $458,000 | $1,070,000 | $350,000 |
| Electrical and Instrumentation (20%) | $1,832,000 | $4,280,000 | $1,400,000 |
| **Total Direct Cost[a]** | **$12,366,000** | **$28,890,000** | **$9,450,000** |
| General Conditions (10%) | $1,237,000 | $2,889,000 | $945,000 |
| General Contractor Overhead and Profit (15%) | $1,855,000 | $4,334,000 | $1,418,000 |
| Sales Tax (8%)[b] | $495,000 | $1,156,000 | $378,000 |
| **Subtotal** | **$15,953,000** | **$37,269,000** | **$12,191,000** |
| Construction Contingency (30%) | $4,786,000 | $11,181,000 | $3,657,000 |
| **Total Estimated Construction Cost[c]** | **$20,739,000** | **$48,450,000** | **$15,848,000** |
| Engineering, Construction Management, Environmental, and Legal Costs (30%) | $6,222,000 | $14,535,000 | $4,754,000 |
| **Total Estimated Project Costs** | **$26,961,000** | **$62,985,000** | **$20,602,000** |

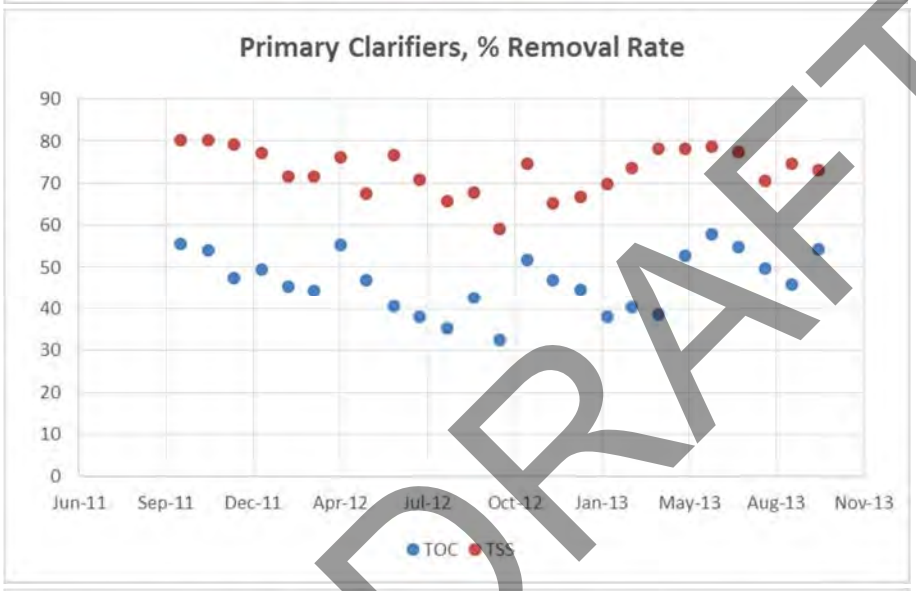
[a] ENR CCI Index for Los Angeles (August 2014 - 10,737).
[b] Calculated assuming 50% of direct costs are taxable.
[c] Cost does not include escalation to midpoint of construction.
*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

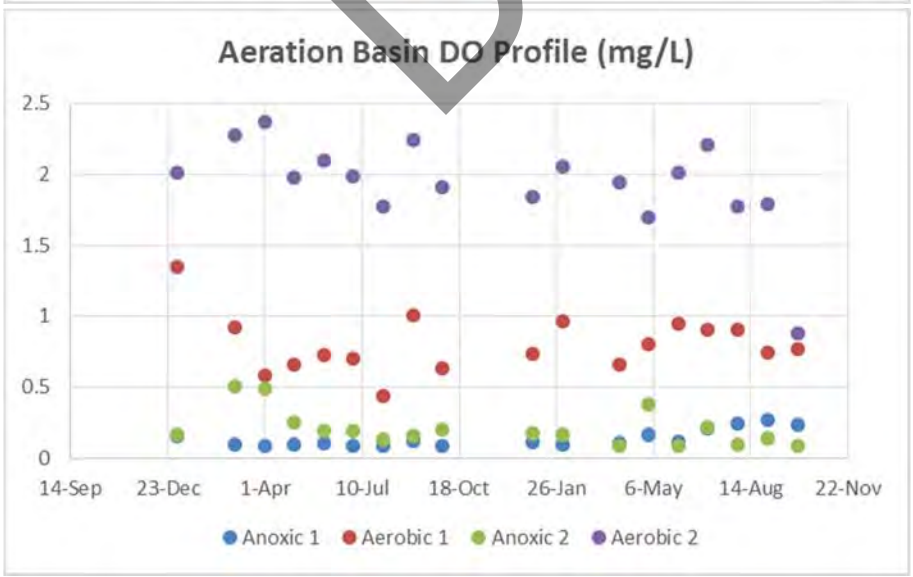
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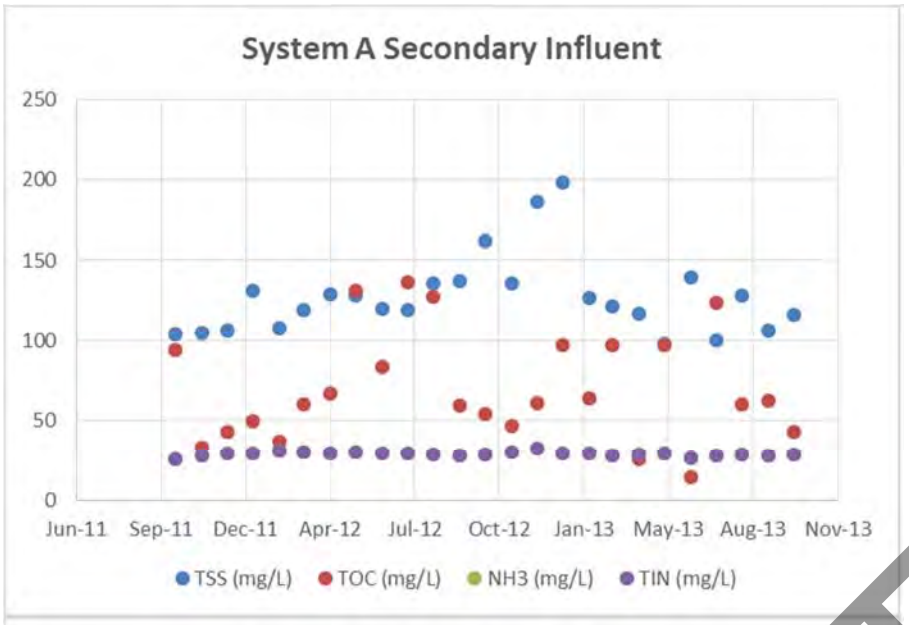
# Appendix 5-A
# RP-1 Plant Operations Summary (2011-2013)

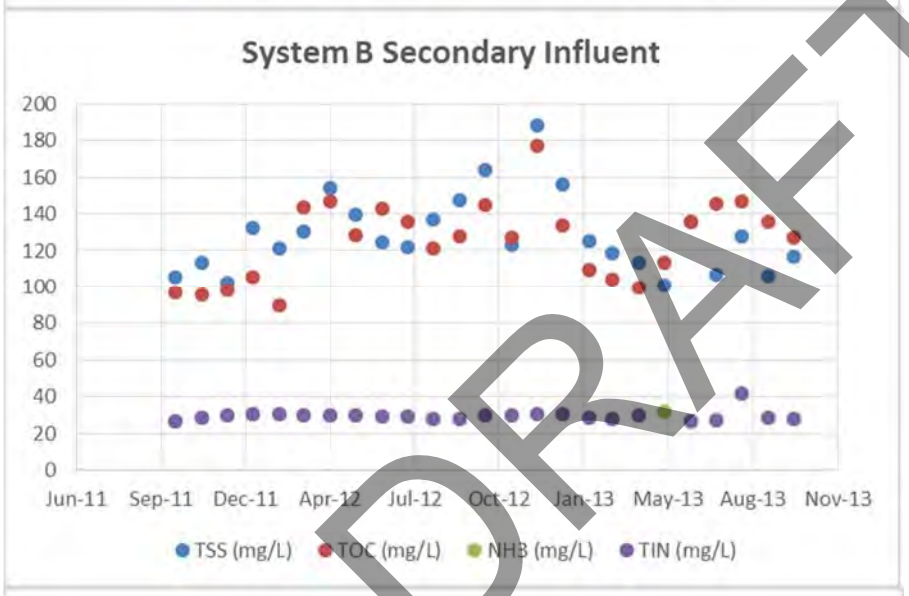

Primary Clarifier Effluent
200
180
160
140
120
100
80
60
40
20
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TOC (mg/L)
TSS (mg/L)
NH3 (mg/L)

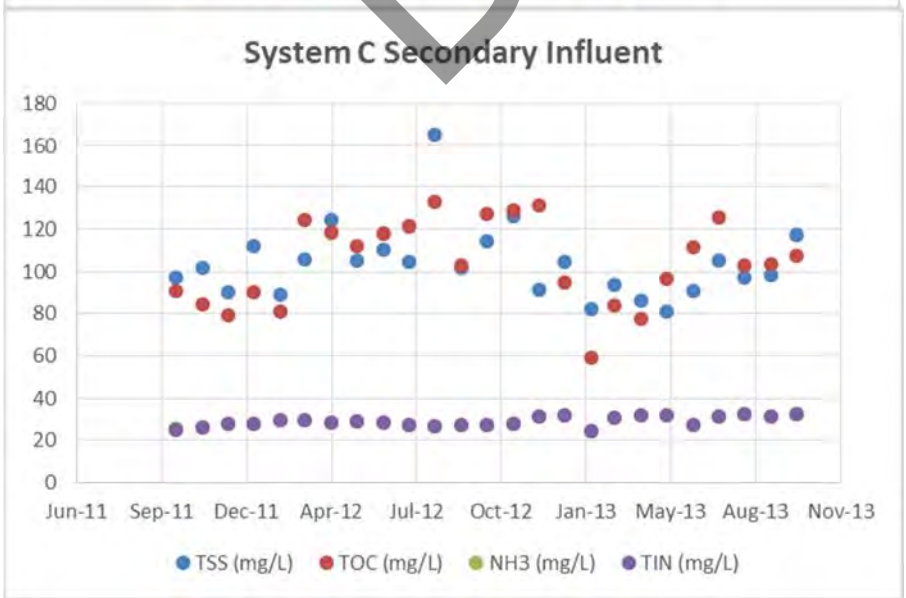

Primary Clarifiers, % Removal Rate
90
80
70
60
50
40
30
20
10
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TOC
TSS


Aeration Basin DO Profile (mg/L)
2.5
2
1.5
1
0.5
0
14-Sep
23-Dec
1-Apr
10-Jul
18-Oct
26-Jan
6-May
14-Aug
22-Nov
Anoxic 1
Aerobic 1
Anoxic 2
Aerobic 2

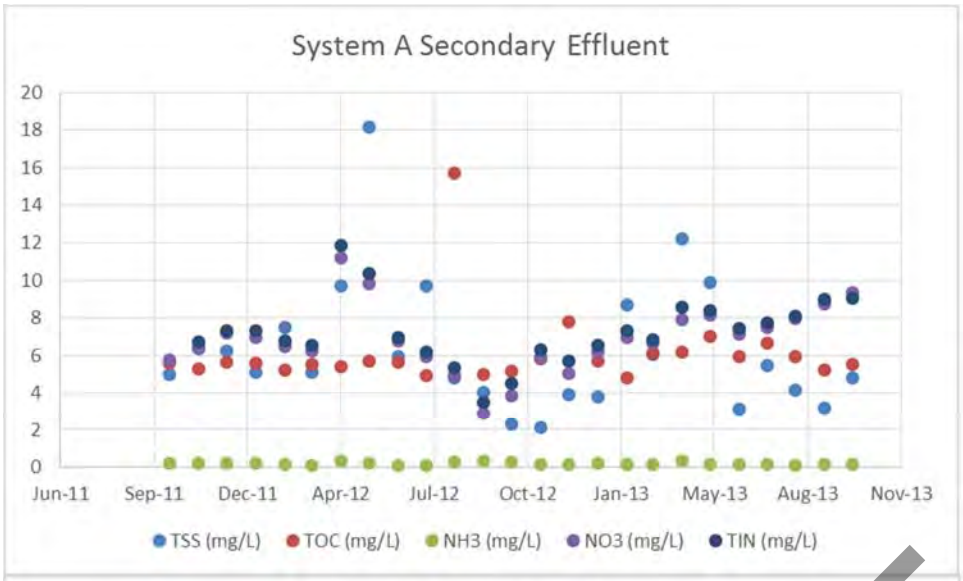
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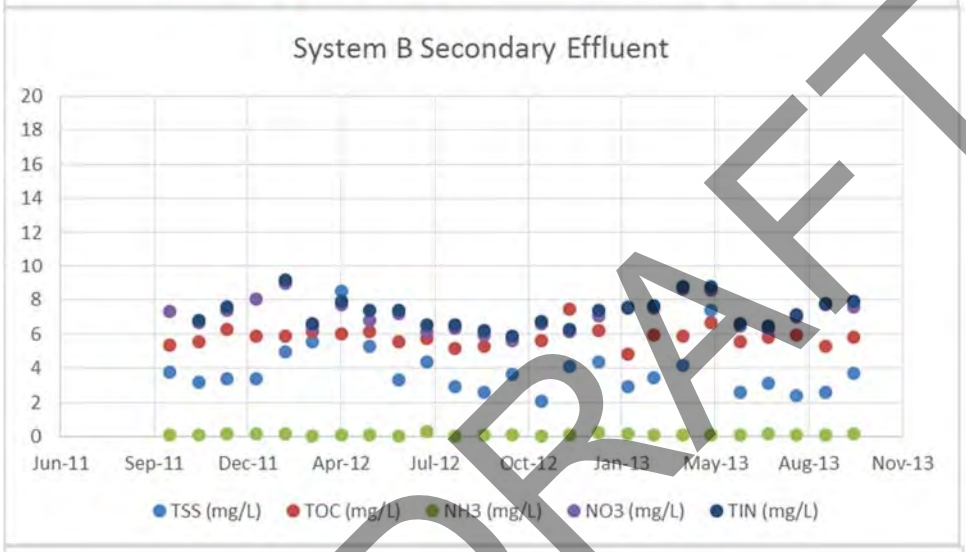

System A Secondary Influent
250
200
150
100
50
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
TIN (mg/L)

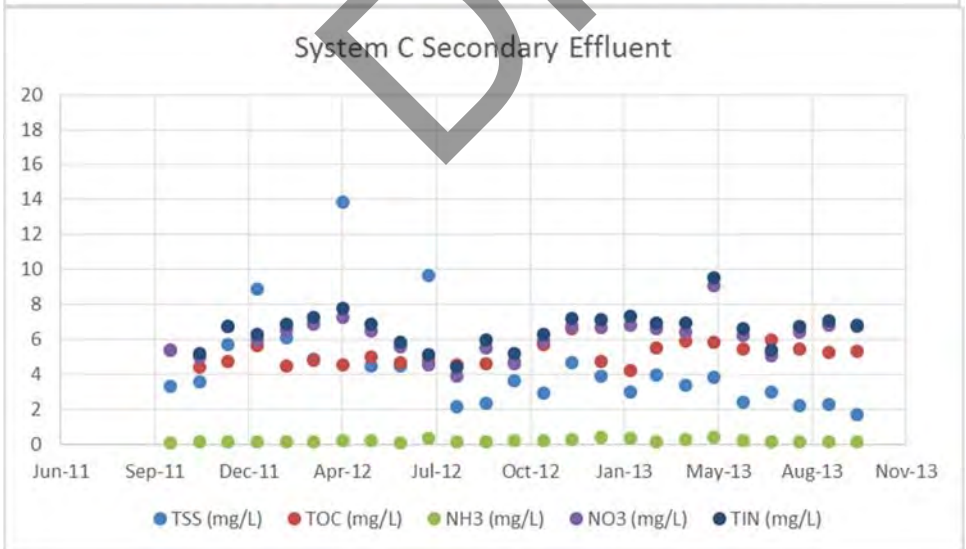

System B Secondary Influent
200
180
160
140
120
100
80
60
40
20
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
TIN (mg/L)


System C Secondary Influent
180
160
140
120
100
80
60
40
20
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
TIN (mg/L)

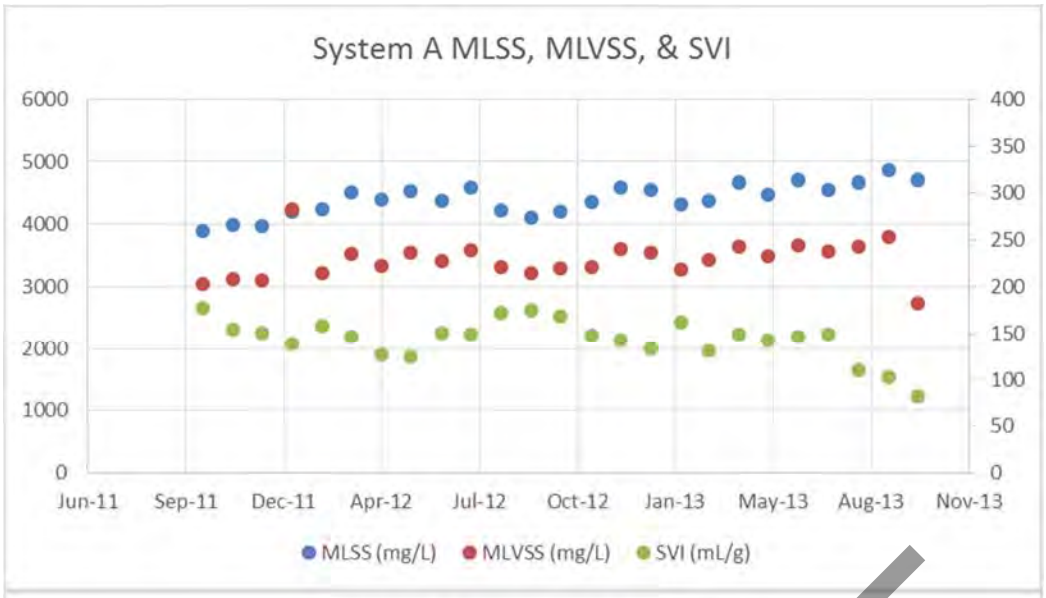
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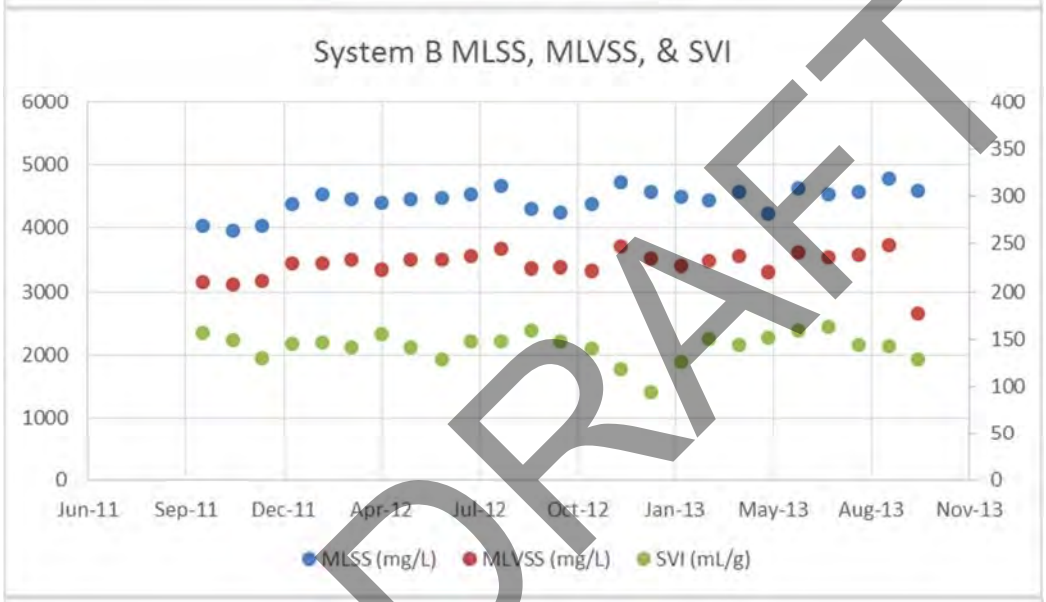

System A Secondary Effluent
20
18
16
14
12
10
8
6
4
2
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
NO3 (mg/L)
TIN (mg/L)

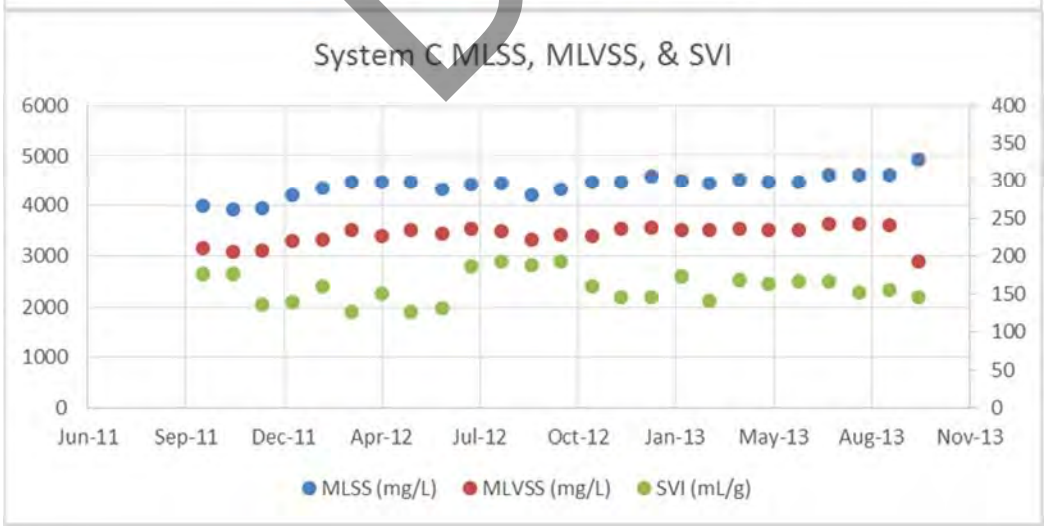

System B Secondary Effluent
20
18
16
14
12
10
8
6
4
2
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
NO3 (mg/L)
TIN (mg/L)


System C Secondary Effluent
20
18
16
14
12
10
8
6
4
2
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
NO3 (mg/L)
TIN (mg/L)

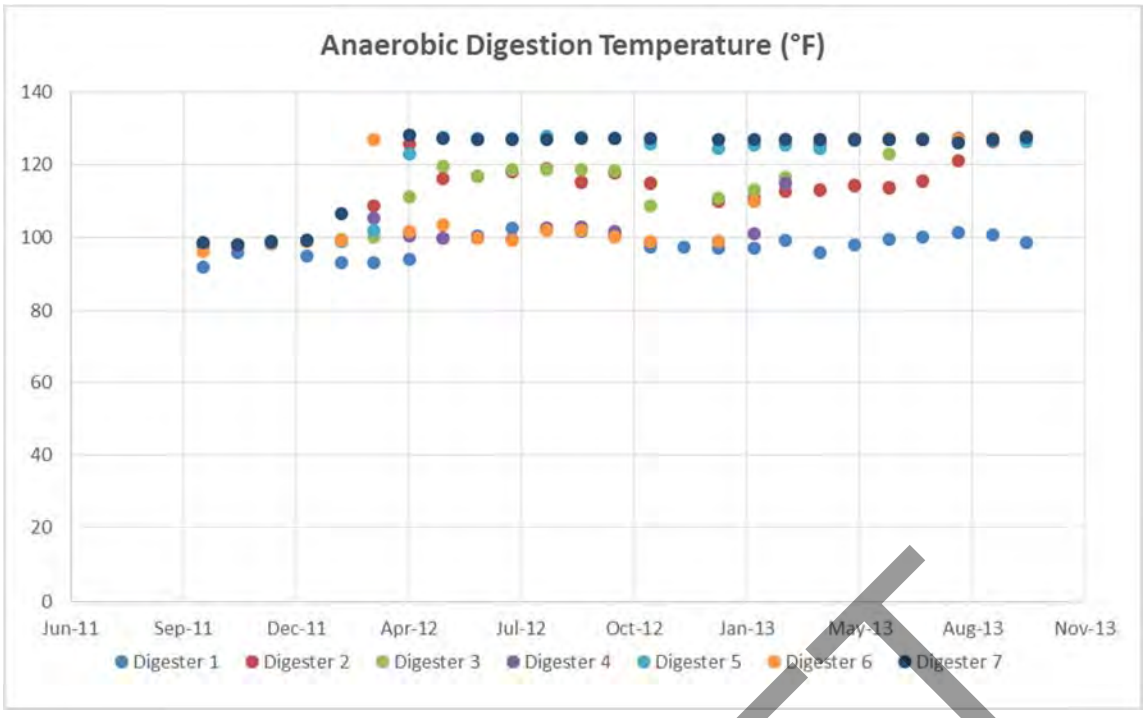
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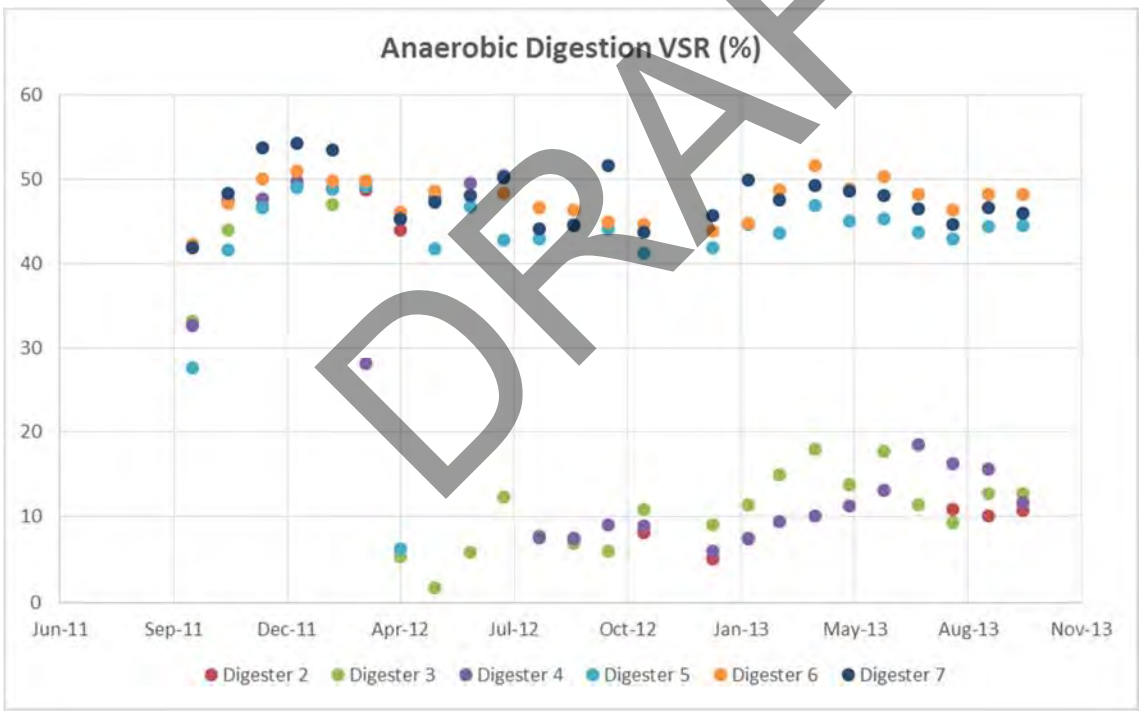

System A MLSS, MLVSS, & SVI
6000
5000
4000
3000
2000
1000
0
400
350
300
250
200
150
100
50
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
MLSS (mg/L)
MLVSS (mg/L)
SVI (mL/g)


System B MLSS, MLVSS, & SVI
6000
5000
4000
3000
2000
1000
0
400
350
300
250
200
150
100
50
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
MLSS (mg/L)
MLVSS (mg/L)
SVI (mL/g)

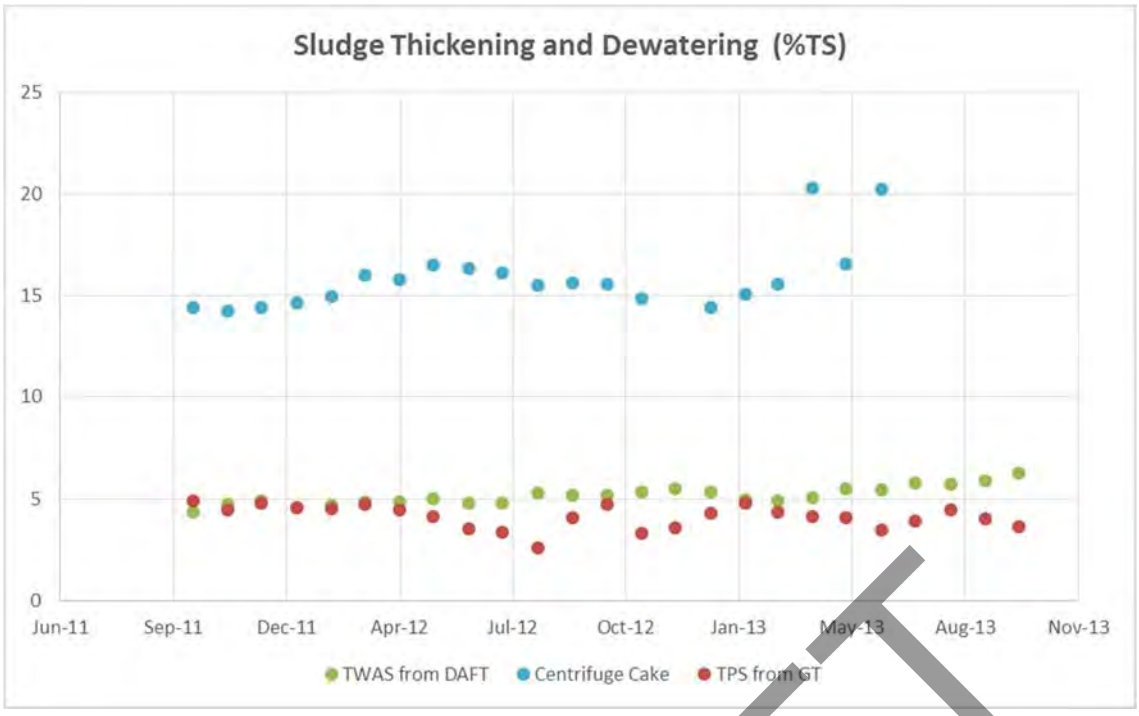

System C MLSS, MLVSS, & SVI
6000
5000
4000
3000
2000
1000
0
400
350
300
250
200
150
100
50
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
MLSS (mg/L)
MLVSS (mg/L)
SVI (mL/g)

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Anaerobic Digestion Temperature (°F)
140
120
100
80
60
40
20
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
Digester 1
Digester 2
Digester 3
Digester 4
Digester 5
Digester 6
Digester 7


Anaerobic Digestion VSR (%)
60
50
40
30
20
10
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
Digester 2
Digester 3
Digester 4
Digester 5
Digester 6
Digester 7

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Sludge Thickening and Dewatering (%TS)
25
20
15
10
5
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TWAS from DAFT
Centrifuge Cake
TPS from GT

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# IEUA Wastewater Facilities Master Plan
# TM 6 RP-4 Future Plans

PREPARED FOR: Inland Empire Utilities Agency

PREPARED BY: CH2M HILL

DATE: October 29, 2014

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# Executive Summary

Regional Water Recycling Plant No. 4 (RP-4) began operation in 1997 and treats wastewater from the Cities of Rancho Cucamonga and Fontana, as well as unincorporated areas of San Bernardino County. RP-4 consists of liquid treatment facilities and sends solids to Regional Water Recycling Plant No. 1 (RP-1) for treatment.

The current and future flows and loads for RP-4 were estimated in *Technical Memorandum (TM) 4 Wastewater Flow and Loading Forecast*. An analysis of the influent wastewater characteristics at RP-4 was conducted to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and the 2060 ultimate buildout year. These projections and the effluent requirements detailed in the Santa Ana Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0021 were used to evaluate the existing capacities of the RP-4 liquid treatment facilities. The estimated capacities were then compared to the projected flow and loads to determine the RP-4 processes that require expansion within the 20-year planning period, and when those facilities would need to be online.

Due to the incorporation of septic flows into the Inland Empire Utilities Agency (IEUA) sewer system, RP-4 plant influent flows and loads are projected to increase substantially by 2035. Although the existing primary and secondary treatment processes at RP-4 have sufficient capacity to treat projected flows and loads through planning year 2035, the tertiary processes will need to be expanded. Additional filtration and disinfection units will be needed by 2035 to handle the increased flows and loads. The RP-4 Tertiary Expansion Project would expand the RP-4 tertiary treatment capacity beyond 14 mgd to match that of the primary and secondary treatment processes. The capital costs included in the 20-year CIP for this project are summarized in Table 6-1.

TABLE 6-1
**RP-4 Expansion Projects Capital Cost Estimate Summary**

| Component Description | RP-4 Tertiary Expansion Project |
|---|---|
| Total Direct Cost[a] | $2,160,000 |
| Total Estimated Construction Cost[b] | $3,622,000 |
| Total Estimated Project Costs | $4,709,000 |

[a] *Engineering-News Record* Construction Cost Index (ENR CCI) for Los Angeles (August 2014 - 10,737).
[b] Cost does not include escalation to midpoint of construction.
*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

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# 1.0 Background and Objectives

IEUA contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a Capital Improvement Program (CIP). The capital program will guide IEUA in the development of major improvements to treatment and conveyance facilities. There are five goals for this TM:

- Summarize information from TMs 1 through 4 as it pertains to RP-4.
- Evaluate the current capacities and limitations of the existing facilities.
- Determine treatment facilities required to treat projected flows and loads through planning year 2035.
- Estimate timing and preliminary capital costs for plant expansion projects required during the 20-year planning period.

# 2.0 RP-4 Overview

RP-4 has been in operation since 1997 and serves the Cities of Rancho Cucamonga and Fontana, as well as unincorporated areas of San Bernardino County. It acts as an upstream satellite facility to RP-1 by scalping flow from the Etiwanda sewer, which is tributary to RP-1. RP-4 includes preliminary, primary, secondary, and tertiary liquid treatment facilities. The liquid facilities are permitted to treat an annual average flow of 14 million gallons per day (mgd) and produce an effluent quality meeting Title 22 standards for spray irrigation, nonrestricted recreational and landscape impoundments, and groundwater recharge. Solids produced at RP-4 are returned to the collection system and conveyed to RP-1 for treatment. A schematic of the RP-4 facility is shown in Figure 6-1.

Preliminary treatment at RP-4 includes screening that consists of two mechanical bar screens, influent pumping, flow measurement by magnetic flowmeter, and grit removal by two vortex-type grit chambers. As flow enters RP-4, it passes through the screening process and is pumped to the headworks splitter box, where it is split between two vortex grit basins. Foul air from the preliminary and primary treatment facilities is sent to a biofilter for treatment and discharge. Primary treatment consists of two circular primary clarifiers. Ferric chloride and polymer are added upstream to improve settling performance and reduce odors in the solids handling facilities.

Secondary treatment includes three parallel, multistage Bardenpho activated sludge treatment systems and three circular clarifiers. Each system consists of an anoxic basin and an aeration basin. Each aeration basin is divided into two trains; each train is further subdivided into four zones: an extended anoxic zone, oxic zone, anoxic zone, and oxic zone. Aerobic zones are equipped with fine bubble diffused air strips that are supplied with air by three centrifugal blowers. Tertiary treatment consists of coagulation/flocculation, filtration, and disinfection. Secondary effluent is split between two tertiary trains. In the first train, coagulation/flocculation and filtration processes are achieved using US Filter's "Trident" process. Alum is added upstream of an upflow "contra-clarifier" followed by dual media filtration. Effluent is sent to two chlorine contact basins operated in series. In the second train, alum is added upstream of three flocculation basins operated in series and followed by cloth disc filtration. Effluent is directed to a chlorine contact basin. Disinfection is achieved using sodium hypochlorite, and recycled water is pumped to the distribution system for reuse. Excess recycled water from RP-4 is conveyed to RP-1 where it is combined with effluent from RP-1, dechlorinated, and discharged. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

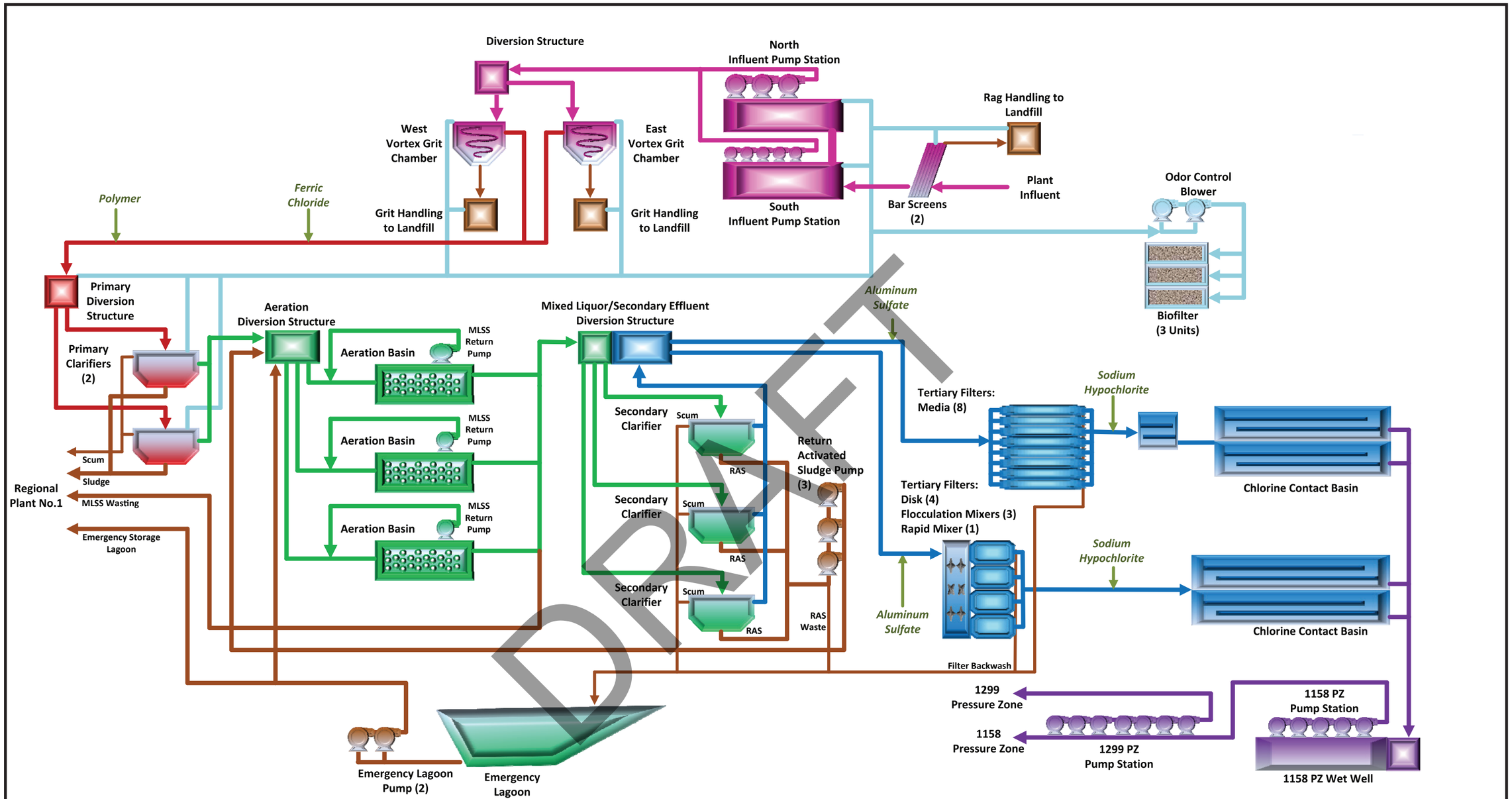
# 3.0 Current and Future Flows and Loads

As presented in *TM 4 Wastewater Flow and Loading Forecast*, an analysis of the influent wastewater characteristics at RP-4 was conducted as part of this WFMP effort to establish current average and peak influent flows, concentrations, and loads at the plant and to develop flow and load projections for the 2035 planning year and 2060 ultimate buildout year. The data analysis is based on 2 consecutive years of recent data provided by IEUA for influent flow and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia (NH3-N), and total Kjeldahl nitrogen (TKN).

Flow projections were developed by the Integrated Water Resources Plan (IRP) Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. As discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis*, the WFMP planning effort is based on IEUA's preferred Flow Diversion Alternative 2, which includes diverting flows from Whispering Lakes and Haven Pump Stations to RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035 form the basis of the master planning effort and treatment plant capacity evaluation presented herein. Projections are also presented for the 2060 ultimate buildout year; these projections are used for site planning considerations. Influent wastewater flows are projected to increase significantly at RP-4, largely due to the gradual incorporation of septic flows into the system between 2020 and 2060.

A summary of the current and projected average influent wastewater flows and loads for RP-4 are presented in Tables 6-2 and 6-3.

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FIGURE 6-1

## REGIONAL WATER RECYCLING PLANT NO. 4 PROCESS FLOW SCHEMATIC

INLAND EMPIRE UTILITIES AGENCY
*WASTEWATER FACILITIES MASTER PLAN*

20-IEUA-10-14F6-1-9370A00.AI

CH2MHILL® carollo
Engineers...Working Wonders With Water®

TABLE 6-2
**RP-4 Current and Projected Average Influent Wastewater Flows**

| | Current | 2035[a] | 2060[a,b] |
|---|---|---|---|
| Average Influent Flow (mgd) | 10.5 | 14.7 | 18.4 |

[a] Projections developed by IRP Consultant and IEUA based on November 2013 flow monitoring period. Reflects projected flows for IEUA preferred Flow Diversion Alternative 2 and includes septic flows tributary to RP-4.
[b] Site planning considerations are based on the projections established for the 2060 ultimate buildout planning year.

TABLE 6-3
**RP-4 Current and Projected Average Influent Wastewater Characteristics**

| | Current Concentration (mg/L) | Current Load (lb/day) | 2035 Load[a] (lb/day) | 2060 Load[a] (lb/day) |
|---|---|---|---|---|
| BOD | 352 | 30,543 | 43,207 | 54,082 |
| TSS | 318 | 27,630 | 38,948 | 48,752 |
| NH3-N | 41 | 3,550 | 5,010 | 6,271 |
| TKN | 59 | 5,015 | 7,186 | 8,994 |

[a] Load projections based on projected flows, concentrations, and load peaking factors presented in *TM 4 Wastewater Flow and Loading Forecast.*
mg/L – milligrams per liter
lb/day – pounds per day

# 4.0 Treatment Requirements

IEUA operates under an umbrella permit and must meet water quality requirements for discharge and recycled water.

## 4.1 Discharge Requirements

The tertiary effluent from RP-4 is discharged at Reach 1 of Cucamonga Creek (Discharge Point [DP] 002), regulated by RWQCB Order No. R8-2009-0021, which replaced Order No. 01-1 and Order No. 95-43, National Pollutant Discharge Elimination System (NPDES) No. CA 0105279. This permit is an umbrella permit governing all of IEUA's wastewater treatment plants (RP-1, RP-4, RP-5, and Carbon Canyon Water Recycling Facility [CCWRF]). It includes a stormwater discharge permit and the enforcement of an industrial pretreatment program. Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water contact recreation. A summary of the key effluent quality limits is provided in Table 6-4.

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TABLE 6-4
**Summary of Effluent Quality Limits[a]**

| Parameter | Weekly Average | Monthly Average | Annual Average | Daily Maximum | Notes |
|---|---|---|---|---|---|
| BOD | 30 mg/L[b] | 20 mg/L[b] | - | - | 45 mg/L weekly average and 30 mg/L monthly average with 20:1 dilution. |
| TSS | 30 mg/L/[b] | 20 mg/[b] | - | - | |
| $NH_4$-N | - | 4.5 mg/L | - | - | |
| Chlorine Residual | - | - | - | 0.1 | Instantaneous maximum ceiling 2 mg/L |
| TIN | - | - | 8 mg/L | - | |
| TDS | - | - | 550 mg/L | - | Shall not exceed 12-month running average TDS concentration in water supply by more than 250 mg/L |
| Turbidity | - | - | - | - | 1. Daily average – 2 NTU<br>2. 5% maximum in 24 hr – 5 NTU<br>3. Instantaneous maximum – 10 NTU |
| Coliform | < 2.2 MPN | - | - | - | Maximum 23 MPN, once per month |
| pH | - | - | - | 6.5 – 8.5 | 99% compliance |
| Free Cyanide | - | 4.2 µg/L | - | 8.5 µg/L | |
| Bis(2-ethylhexyl) Phthalate | - | 5.9 µg/L | - | 11.9 µg/L | |
| Selenium | - | 4.1 µg/L | - | 8.2 µg/L | |

[a] RWQCB Order No. R8-2009-0021.
[b] Without 20:1 dilution and for recycled water.
NTU – nephelometric turbidity unit(s)
MPN – most probable number
µg/L – micrograms per liter

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## 4.2 Recycled Water Requirements

As mentioned previously, effluent from RP-1 and RP-4 is used as recycled water for irrigation and groundwater recharge via spreading in seven Phase I recharge basin sites and six Phase II recharge basin sites. Specifically, recycled water from RP-1 is discharged to a use area overlying Chino North "Max Benefit" Groundwater Management Zone (DP 005). Recycled water quality requirements for groundwater recharge are governed under RWQCB Order No. R8-2007-0039. Table I, Table II, and Table III in the permit provide concentration limits for many constituents of concern, such as inorganic chemicals, volatile organic chemicals, radionuclides, metals, and disinfection byproducts. Recycled water quality for irrigation is regulated by Order No. R8-2009-0021 and must meet the discharge requirements described in Table 6-4.

# 5.0 Existing Plant Capacity and Limitations

Existing facilities and the current plant performance were used as the basis for RP-4 process model development. A whole plant model was developed using PRO2D and calibrated based on plant influent data and plant operations data for the period between October 15, 2011, and October 15, 2013. This period was selected as the basis after a review of the influent and plant data to reflect a 2-year-long complete data set. Existing plant operation and the findings of the capacity evaluation through the use of process modeling are presented below for the liquid treatment facilities at RP-4.

## 5.1 Existing Plant Operation

A summary of RP-4 plant operations is provided in Table 6-5 for the liquid treatment and solids handling facilities. Unit process performance values were averaged over the evaluation period, with operating ranges noted. These values were used in development and calibration of the process models. Detailed data summaries for the evaluation period are provided in Appendix 6-A.

TABLE 6-5
**RP-4 Average Plant Operations Summary**

| Parameter | Value |
|---|---|
| ***Primary Treatment*** | |
| TSS Removal Rate (%) | 69 |
| TOC Removal Rate (%) | 38 |
| Primary Sludge (gpd) | 174,000 |
| ***Secondary Treatment*** | |
| MLSS (mg/L) | 4,600 |
| MLVSS (%) | 81 |
| RAS SS (mg/L) | 7,430 |
| Solids Inventory (klb) | 350 – 385 |
| Basins DO (mg/L) | 0.8 – 1.5 |
| WAS (mgd) | 0.050 – 0.194 |
| SVI (ml/g) | 193 |
| SRT (Basins Only) (day) | 46 – 190[a] |
| Residual Alkalinity (mg as $CaCO_3$/L) | 135 |

[a] Wide range of SRT values experienced due to solids wasting practices.
gpd – gallons per day
MLSS – mixed liquor suspended solids
MLVSS – mixed liquor volatile suspended solids
RAS – return activated sludge
SS – suspended solids
klb – kilopounds
DO – dissolved oxygen
WAS – waste activated sludge
mL/g – milliliters per gram
SVI – sludge volume index
SRT – solids retention time
$CaCO_3$/L – calcium carbonate per liter

A performance summary for the major treatment processes is presented in Table 6-6. These values, which represent the average over the evaluation period, were used in the subsequent plant process modeling and the capacity evaluations for the major treatment units. Detailed data summaries for the evaluation period are provided in Appendix 6-A.

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TABLE 6-6
**RP-4 Average Plant Performance Summary**

| Parameter | Primary Effluent | Secondary Effluent |
|---|---|---|
| TOC (mg/L) | 120 | 4.2 |
| BOD (mg/L) | 217 | 1.2 |
| TSS (mg/L) | 91 | 3.5 |
| NH3-N (mg/L) | 30 | 0.2 |
| NO3-N (mg/L) | N/A | 4.2 |
| NO2-N (mg/L) | N/A | 0.1 |
| TIN (mg/L) | N/A | 4.5 |
| Alkalinity (mg as $CaCO_3$/L) | N/A | 135 |

NO3-N – nitrate as nitrogen
NO2-N – nitrite as nitrogen
TIN – total inorganic nitrogen

The values in Table 6-6 are for the current operation, which includes secondary treatment with internal mixed liquor recycling, configured in an anoxic-oxic-anoxic-oxic biological nutrient removal (BNR) configuration with step feed capability, consisting of pre-anoxic tanks followed by plug flow reactors.

## 5.2 Existing Plant Capacity

### 5.2.1 Process Modeling

The capacity of the existing system was evaluated through process modeling using CH2M HILL's whole plant simulator, PRO2D. PRO2D is a process simulation model that takes into account the mass balances through an entire facility for particulate and soluble components and, similar to other commercially available process models, is based on the International Water Association (IWA) ASM2D biological process kinetics. The base model was constructed to reflect the actual facility setup, including flow splits and backwash. The process model facility setup flow diagram is presented in Figure 6-2. The model was constructed with the operations and performance criteria reflective of the evaluation period, and then calibrated to reflect the actual performance, solids yields, and water quality data.

As shown in Figure 6-2, the model was constructed to represent the actual plant operation for all the major process units. The model also allows establishing sizing and design considerations for each major unit process tankage and equipment. Similar to the actual operations, the plant model was built with the filter backwash and solids thickening recycles being returned to the main plant for further treatment, with the dewatering recycles being diverted offsite. The liquid and solids mass balances calculated for the current conditions allow calibration of the model against the actual field data. The calibrated model is then used to evaluate current capacity as well as establish expansion needs and process bottlenecks.

The process model was constructed and calibrated using the current influent and operating data available for the facility. The purpose of the model calibration step is to establish a baseline condition that closely resembles current operations and provides a means to reliably predict operations and system limitations under different scenarios or alternatives. Key model calibration results are presented in Table 6-7. As the listed values show, the model was calibrated such that the simulation results are within a value range that is 5 percent or smaller as compared to the actual data. This level of accuracy will allow reliable capacity estimations to be made for the various capacity scenarios and future operation needs.

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TABLE 6-7
**RP-4 Average Plant Performance Summary**

| Parameter | Actual Data Average Values | Model Results |
|---|---|---|
| Effluent BOD (mg/L) | 1.2 | 0.1 |
| Effluent TSS (mg/L) | <5 | <5 |
| Effluent TIN (mg/L) | 4.5 | 4.3 |
| Effluent Alkalinity (mg as $CaCO_3$/L) | 135 | 140 |
| MLSS Inventory (lb) | 367,500 | 364,300 |
| Sludge Volatile Solids Content (%) | 81 | 80 |
| Total Waste Solids (Dry Solids lb/day) | 30,500 | 31,400 |

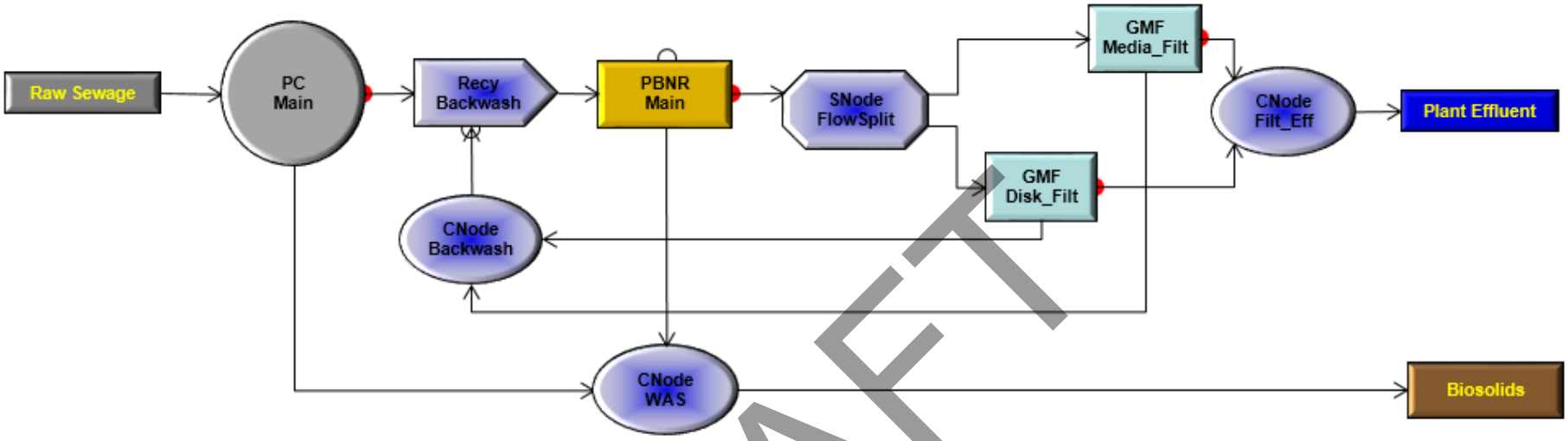
Subsequent process modeling using the calibrated model as the base model was conducted to evaluate the following scenarios:

- Current Plant Capacity
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under average and maximum month flow and load conditions
  - Liquid treatment capacity to meet 5-mg/L effluent TIN level under average and maximum month flow and load conditions
  - Solids generation rates under average and maximum month flow and load conditions
- Future capacity implications for the planning year 2035
- Future facility footprint implications for the planning years 2035 and 2060

Findings of the current plant capacity evaluation are presented next in this section. Future capacity needs are presented in Section 6.0.

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FIGURE 6-2
**RP-4 Process Model Facility Setup**




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### 5.2.2 Liquid Treatment Capacity

An evaluation of the liquid treatment capacity was conducted using the whole plant process model under both the average and maximum month conditions. The capacity evaluation was conducted based on achieving a plant effluent TIN concentration of 5 mg/L and 8 mg/L. As established at the onset of the project, the facility reliability and redundancy considerations are based on the IEUA's overall wastewater treatment system, with RP-5 being the end-of-the-line facility receiving all flow diversions if needed from other Regional Water Recycling Plants. Since redundancy is provided by taking the largest unit out of service for each process at RP-5, the RP-4 plant capacity is based on all RP-4 units in service.

The facility has two primary clarifiers in service. The average hydraulic loading rates with two units in service are around 800 gallons per day per square foot (gpd/ft$^2$). If one unit needs to be taken out of service, especially under peak flow conditions, the primary clarifiers will be hydraulically loaded at 1,600 gpd/ft$^2$ or greater. Considering that flow diversion to RP-5 is available for times if a primary clarifier needs to be taken out of service, chemically enhanced primary treatment (CEPT) could be implemented under these conditions to avoid overloading the downstream secondary treatment system. The facility already has a ferric chloride system in place and injecting 16 mg/L ferric on average.

Process modeling showed that the liquid treatment capacity can be limited by the secondary treatment system. SVI values are reportedly greater than 190 mL/g, which indicates sludge settleability could be impaired at times. One limitation of the secondary treatment system was found to be the secondary clarification solids loading resulting from the current operations and the influent wastewater solids loading rates. Maintaining the SVI values at or below 150 mL/g is important for this reason also.

Waste solids (primary sludge and WAS) generated at RP-4 are diverted to RP-1 via the sewer system. For this reason, there are no solids handling recycles processed at this facility. RP-4 waste solids will continue to be diverted offsite. The solids are not continuously discharged, but maintained in the system; wasting is achieved intermittently.

Primary and secondary treatment capacity is presented in Table 6-8.

TABLE 6-8
**RP-4 Existing Primary/Secondary Process Capacity**

| | All Units in Service | One Unit Out of Service[a] |
|---|---|---|
| Plant Effluent TIN $\leq$ 8 mg/L | 16 mgd | 14 mgd |
| Plant Effluent TIN $\leq$ 5 mg/L | 14 mgd | 12 mgd |

[a] One secondary clarifier out of service.

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The capacity of the RP-4 tertiary processes also were evaluated; the methodologies employed are consistent with those presented in the Title 22 Engineering Report (DDB Engineering, Inc. [DDB], 2009). The filters were designed based on a California Department of Public Health (CDPH) maximum filter loading rate of 5 gallons per minute per square foot (gpm/ft$^2$) for dual-media filters and 6 gpm/ ft$^2$ for cloth filters, with one dual-media filter cell in backwash and one cloth filter out of service. In order not to exceed the maximum approved filter loading rates, the maximum flow the filtration system can handle is 32.5 mgd. Applying a peak hourly wet weather peaking factor of 2.3, based on current plant data, the resulting average filtration capacity is 14.1 mgd.

As described in Section 2.0, the disinfection system consists of the original Chlorine Contact Basins No. 1A and 1B and the expanded Chlorine Contact Basin No. 2. Basins 1A and 1B were designed based on Title 22 requirements with a minimum concentration and time (CT) value of 450 milligrams per minute per liter (mg-min/L) and a minimum modal contact time of 90 minutes during the peak hourly dry weather flow. Tracer testing conducted by IEUA at RP-4 in 2005 showed that Basins 1A and 1B can handle a peak flow of 14.3 mgd while maintaining a modal contact time of 90 minutes (DDB, 2009). Applying a peak hourly dry weather peaking factor of 2.0, the resulting average disinfection capacity of Basins 1A and 1B is 7.2 mgd.

Basin 2 was designed based on an annual average capacity of 7 mgd and estimated peak dry weather capacity of 14 mgd while providing 90 minutes modal contact time (DDB, 2009). The Title 22 Engineering Report indicated the actual modal contact time and capacity of Basin 2 needs to be confirmed by tracer testing. Thus, the overall average disinfection capacity of Basins 1A, 1B, and 2 is approximately 14.2 mgd. The results of the tertiary treatment capacity evaluation are summarized in Table 6-9.

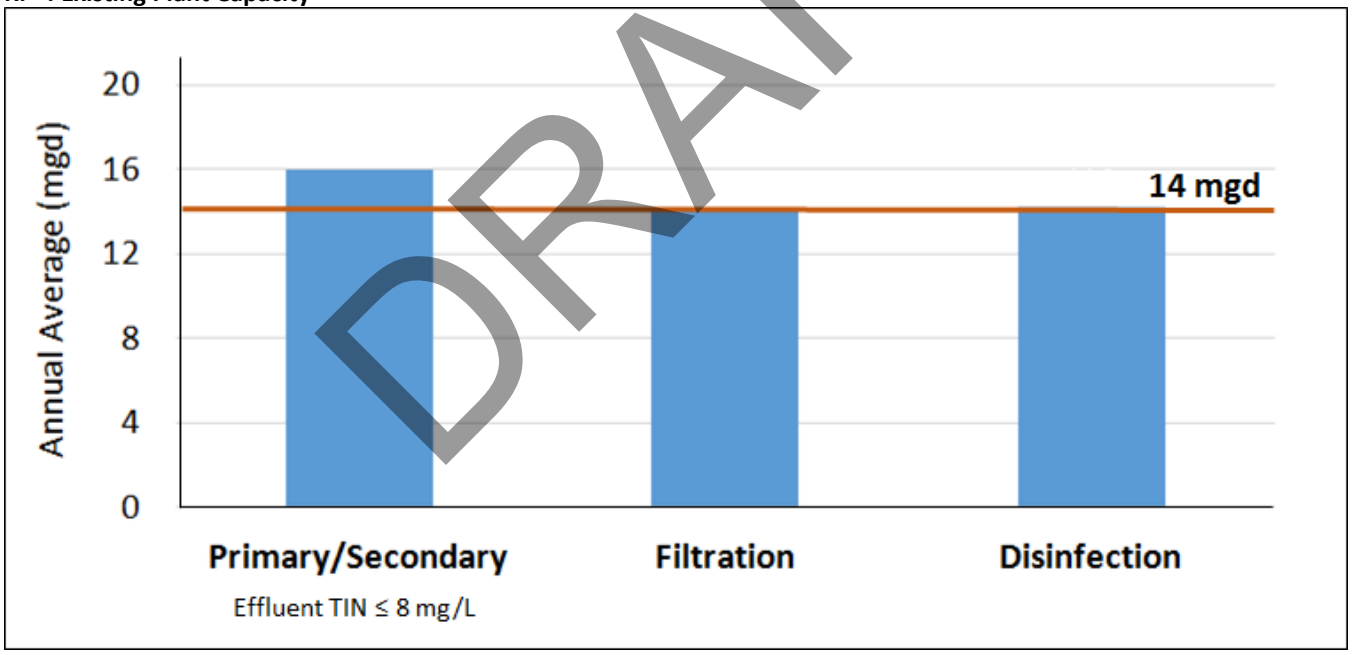
TABLE 6-9
**RP-4 Existing Tertiary Process Capacity**

| | All Units in Service | Two Filters Out of Service[a] |
|---|---|---|
| Average Filtration Capacity | 17.5 mgd | 14.1 mgd |
| Average Disinfection Capacity | 14.2 mgd | N/A |

[a] One dual-media filter cell in backwash and one cloth filter out of service.

The overall plant capacity is determined by its most limiting process capacity. For RP-4, the tertiary processes are limited to approximately 14 mgd. Therefore, the RP-4 plant capacity is approximately 14 mgd under the assumptions presented in this section including the system reliability and redundancy being provided at RP-5. The primary and secondary process capacity will be 14 mgd if one unit of service is considered to meet 8-mg/L effluent TIN. A summary of the individual process capacities in comparison to the overall plant capacity is depicted in Figure 6-3.

FIGURE 6-3
**RP-4 Existing Plant Capacity**




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# 6.0 Plant Expansion Needs

The flow projections for the planning years 2035 and 2060 were established as described under Section 3.0 of this TM. Accordingly, 2035 flow projections will be the basis of facility expansion and the CIP planning effort, while the facilities needed for the 2060 flow conditions will constitute the basis of site planning. The corresponding planning flows are listed in Table 6-2.

## 6.1 Facility Expansion Requirements

For the 2035 capacity expansion requirements that will constitute the basis of the CIP planning, facility sizing was determined using the whole plant PRO2D process model developed and calibrated for the current operation and wastewater quality, and for future average and maximum month flow and load conditions. Accordingly, the capacity requirement at RP-4 is in the tertiary treatment facilities for the 2035 flow projections, considering the facility could meet 5-mg/L or 8-mg/L effluent TIN with all primary and secondary process units in service. The expansion requirements are summarized in Table 6-10.

TABLE 6-10
**RP-4 Facility Expansion Requirements for Planning Year 2035**

| Parameter | Size of New Units | Comments |
|---|---|---|
| Primary Clarifiers | - | No new units are needed. |
| Secondary Treatment | - | No new units are needed. |
| Tertiary Filters | 1 Cloth Filter | Same size as existing cloth filters, with 12 discs per filter. |
| Disinfection | 1 Train | Same size as existing Chlorine Contact Tank No. 2 train, with 3 passes or channels per train. |

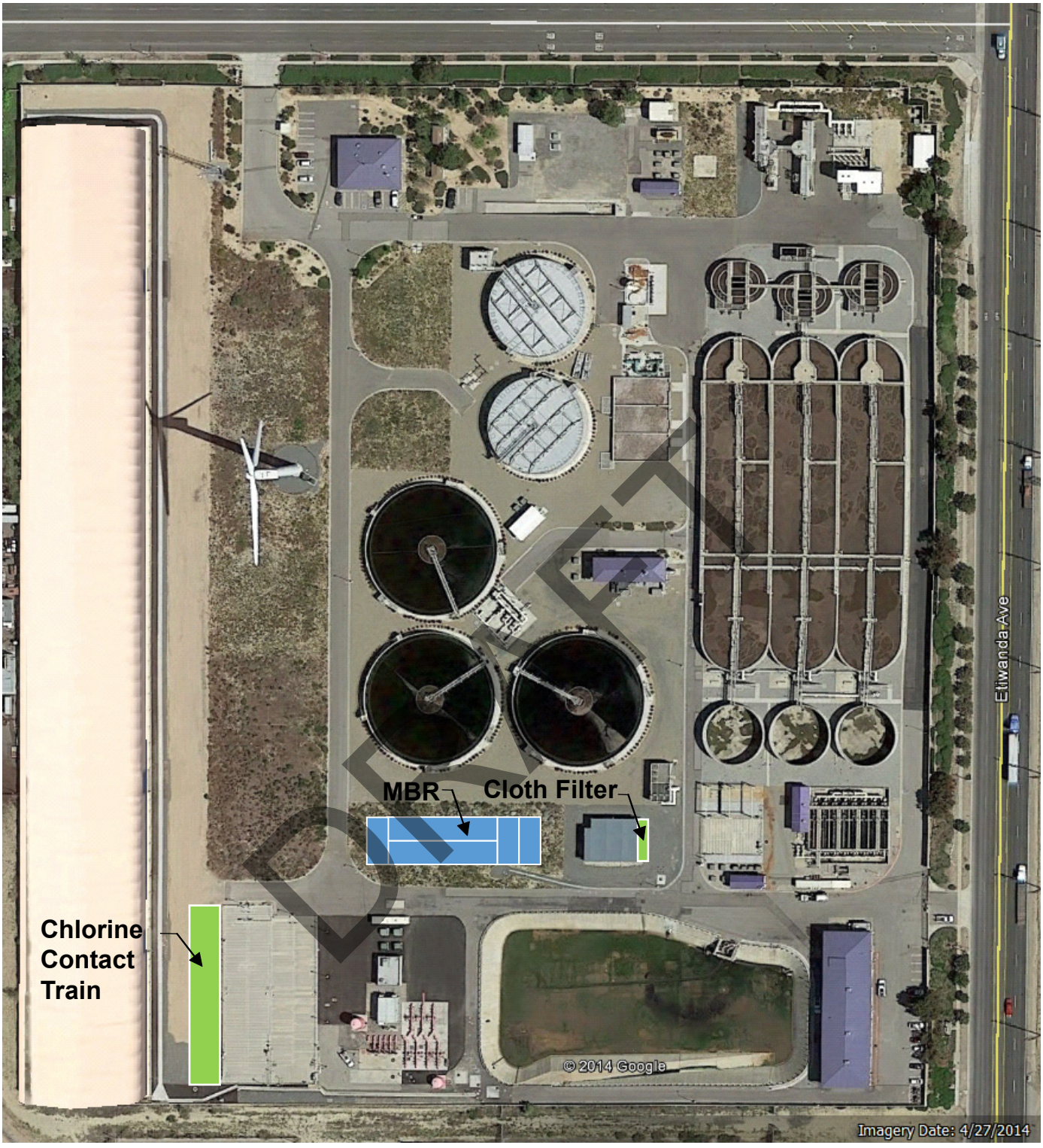
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## 6.2 Ultimate Facilities Site Plan

For ultimate site planning purposes, the facilities for the ultimate capacity increase were established and are presented in Figure 6-4. Facility sizing was determined using the whole plant PRO2D process model developed and calibrated for the current operation and wastewater quality, and for future average and maximum month flow and load conditions. Accordingly, the ultimate capacity needs include secondary treatment capacity expansion as well as tertiary treatment expansion, with RP-5 serving to provide reliability and redundancy for the system.

IEUA has decided to base the capacity expansion and footprint requirements on the membrane bioreactor (MBR) technology for RP-4. The benefits of the MBR technology for long term IEUA planning include small footprint requirements, elimination of secondary clarifiers as well as tertiary filters for recycled water production, superior water quality, and ability to produce thicker waste sludge compared to conventional technologies. Modular design capability of the MBR technology also allows stepwise expansion of the treatment facility to meet both load capacity and different effluent TIN requirements. Furthermore, the superior-quality effluent can be directly fed to a reverse osmosis (RO) system if IEUA needs to produce higher-quality effluent or reduce final effluent TDS. Therefore, a 4.5-mgd average capacity MBR train was included in site planning. This eliminates the need to implement filter expansion beyond planning year 2035.

No other site planning considerations were identified by the project team.




Aerial image © Google Earth, 2014. Annotation by CH2M HILL, 2014.

**Figure 6-4**
**RP-4 Ultimate Facilities Site Plan**

Inland Empire Utilities Agency
Wastewater Facilities Master Plan

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# 7.0 20-Year CIP Plant Expansion Projects and Capital Cost

One plant expansion project was identified during the 20-year CIP, the RP-4 Tertiary Expansion Project. Capital costs were estimated for the project and placed into the 20-year CIP. The planning-level capital costs for each process identified were developed based on cost curves established from previous projects and known direct costs for similar-size projects. Additionally, several assumptions were made to estimate the total construction cost and total project costs for the expansion project. The assumptions included the following:

- The WFMP assumed a 20-year planning period.
- 10 percent of facilities subtotal for civil/site work.
- 0 to 5 percent of facilities subtotal for demolition depending on existing site conditions.
- 20 percent of facilities subtotal for electrical and instrumentation.
- 10 percent of total direct cost for contractor general conditions.
- 15 percent of total direct cost for contractor overhead and profit.
- 8 percent sales tax was applied to 50 percent of the total direct cost.
- 30 percent for construction contingency.
- 30 percent for engineering, construction management, environmental, and legal costs was applied to the total construction cost to estimate the total project cost.

The total construction cost and total project cost for the expansion project are summarized in Table 6-11.

# 8.0 Conclusion

The following conclusions can be made from the evaluation of RP-4:

- RP-4 influent flows and loads are projected to increase substantially due to incorporation of septic flows tributary to RP-4.
- Primary and secondary treatment processes have sufficient capacity to treat projected liquid flows through the 20-year planning period.
- Additional filtration and disinfection capacity will be needed by 2035.

# 9.0 References

DDB Engineering, Inc. (DDB). 2009. *Inland Empire Utilities Agency Regional Plant No. 4 Title 22 Engineering Report.* September.

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TABLE 6-11
**RP-4 Expansion Projects Capital Cost Estimate**

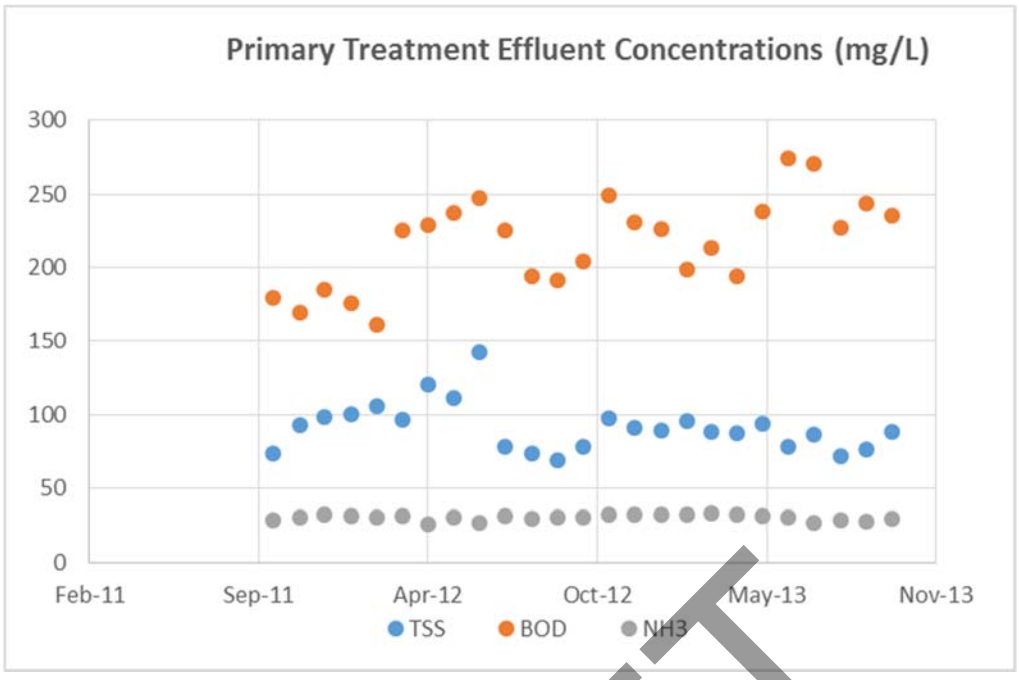
| Component Description | RP-4 Tertiary Expansion Project |
|---|---|
| Filtration | $700,000 |
| Chlorine Contact Basin | $900,000 |
| **Facilities Subtotal** | **$1,600,000** |
| Civil/Site Work (10%) | $160,000 |
| Demolition (5%) | $80,000 |
| Electrical and Instrumentation (20%) | $320,000 |
| **Total Direct Cost[a]** | **$2,160,000** |
| General Conditions (10%) | $216,000 |
| General Contractor Overhead and Profit (15%) | $324,000 |
| Sales Tax (8%)[b] | $86,000 |
| **Subtotal** | **$2,786,000** |
| Construction Contingency (30%) | $836,000 |
| **Total Estimated Construction Cost[c]** | **$3,622,000** |
| Engineering, Construction Management, Environmental, and Legal Costs (30%) | $1,087,000 |
| **Total Estimated Project Costs** | **$4,709,000** |

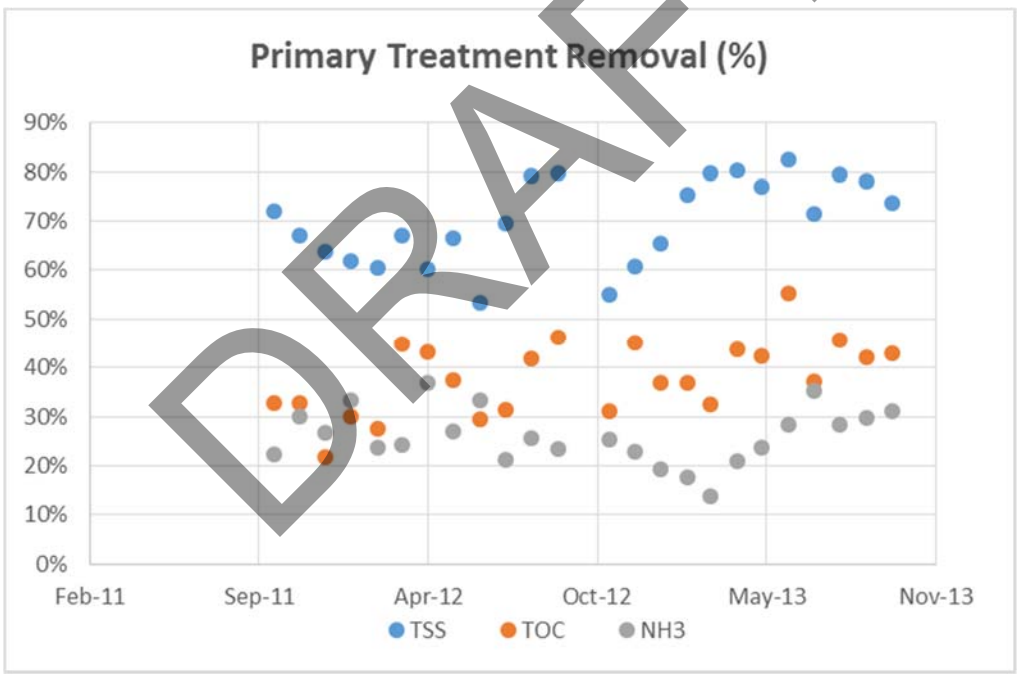
[a] *Engineering-News Record* Construction Cost Index (ENR CCI) for Los Angeles (August 2014 - 10,737).
[b] Calculated assuming 50% of direct costs are taxable.
[c] Cost does not include escalation to midpoint of construction.
*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

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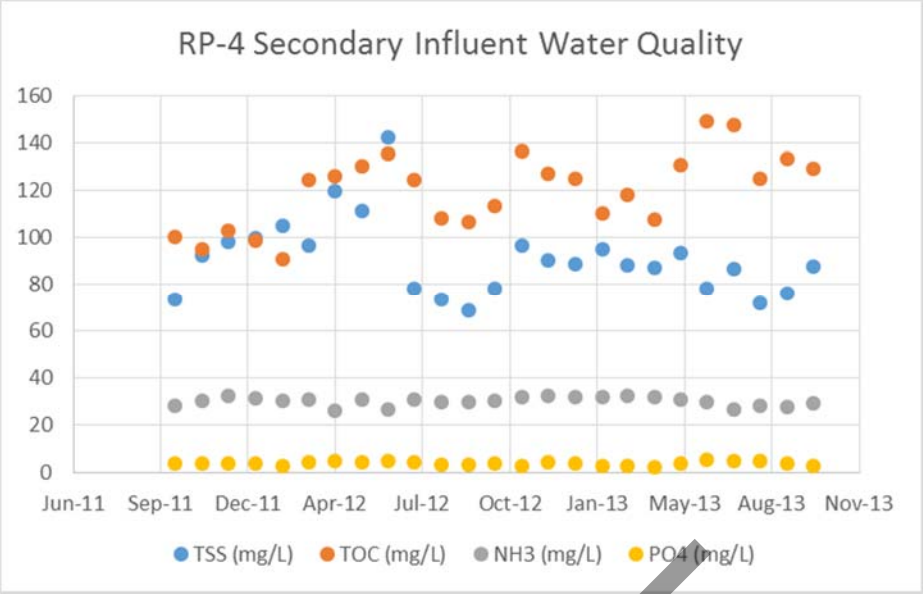
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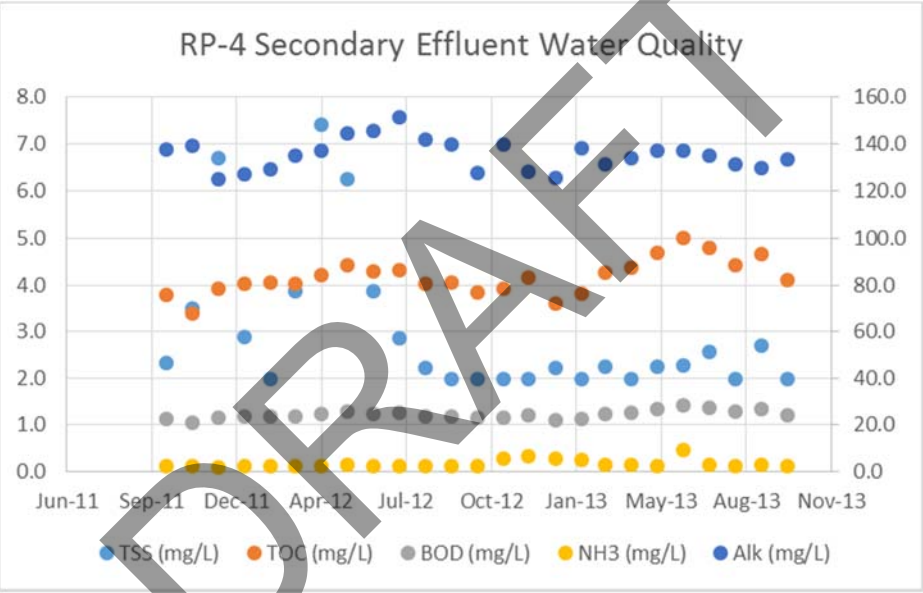
# Appendix 6-A
# RP-4 Plant Operations Summary (2011-2013)

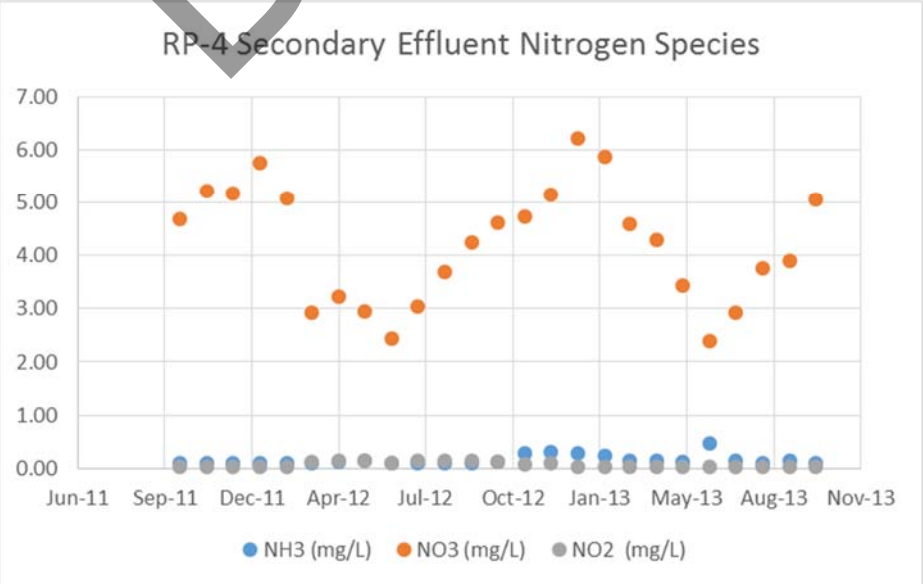

Primary Treatment Effluent Concentrations (mg/L)
300
250
200
150
100
50
0
Feb-11
Sep-11
Apr-12
Oct-12
May-13
Nov-13
TSS
BOD
NH3


Primary Treatment Removal (%)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Feb-11
Sep-11
Apr-12
Oct-12
May-13
Nov-13
TSS
TOC
NH3

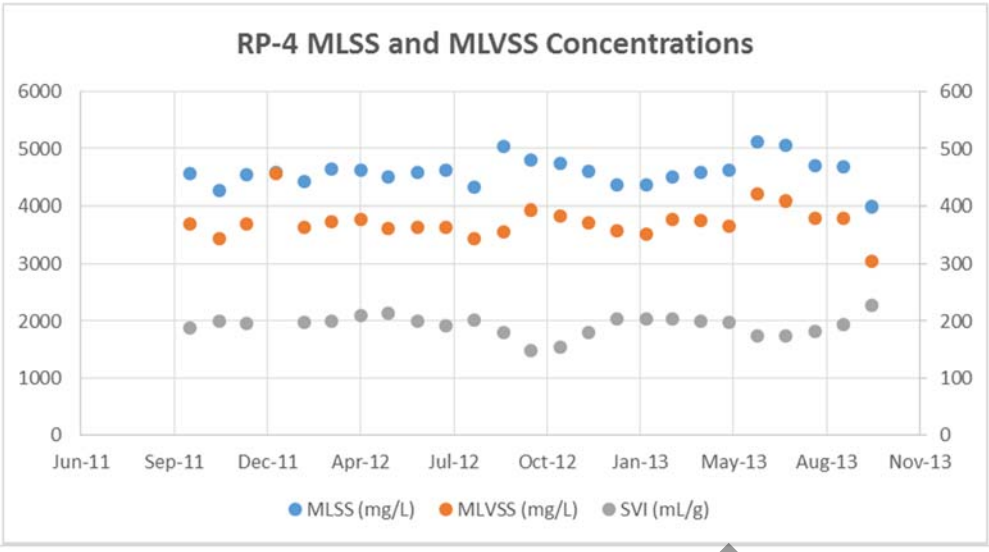
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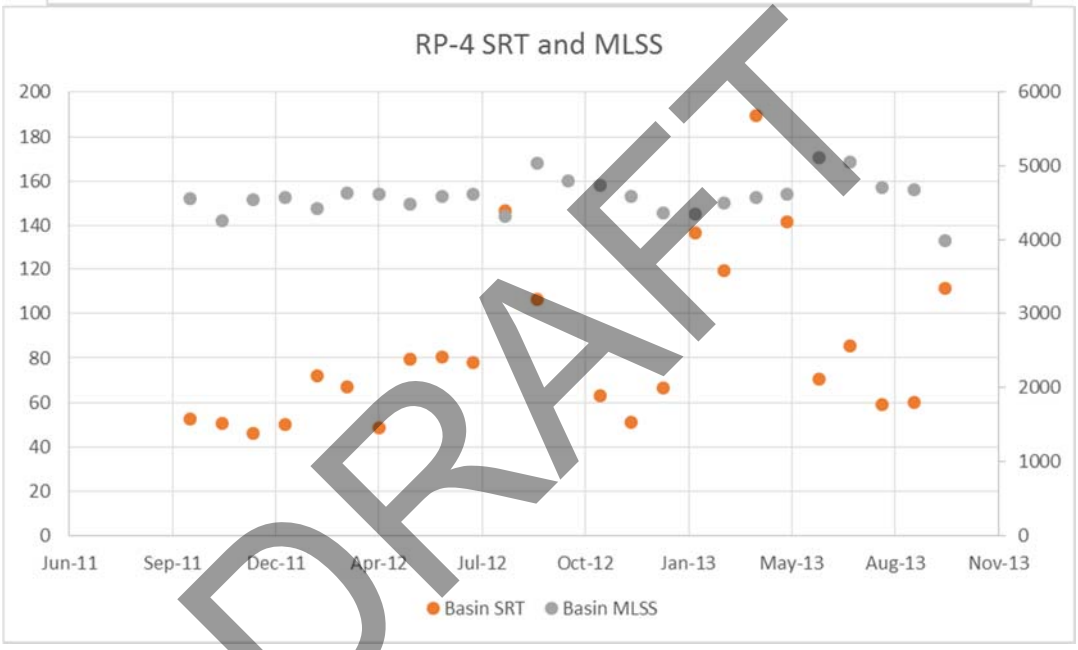

RP-4 Secondary Influent Water Quality
160
140
120
100
80
60
40
20
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
NH3 (mg/L)
PO4 (mg/L)


RP-4 Secondary Effluent Water Quality
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
TSS (mg/L)
TOC (mg/L)
BOD (mg/L)
NH3 (mg/L)
Alk (mg/L)


RP-4 Secondary Effluent Nitrogen Species
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
NH3 (mg/L)
NO3 (mg/L)
NO2 (mg/L)

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RP-4 MLSS and MLVSS Concentrations
6000
5000
4000
3000
2000
1000
0
600
500
400
300
200
100
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
MLSS (mg/L)
MLVSS (mg/L)
SVI (mL/g)


RP-4 SRT and MLSS
200
180
160
140
120
100
80
60
40
20
0
6000
5000
4000
3000
2000
1000
0
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
Nov-13
Basin SRT
Basin MLSS

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# IEUA Wastewater Facilities Master Plan
# TM 7 RP-5 and RP-2 Complex Future Plans

PREPARED FOR: Inland Empire Utilities Agency

PREPARED BY: Carollo Engineers, Inc.

REVIEWED BY: CH2M HILL

DATE: November 6, 2014

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# Executive Summary

Regional Water Recycling Plant No. 2 (RP-2) and Regional Water Recycling Plant No. 5 (RP-5) are located approximately 1 mile from each other. RP-5 treats wastewater from the Cities of Chino, Chino Hills, Ontario, Montclair, and Upland. RP-2 treats solids from RP-5 and Carbon Canyon Water Recycling Facility (CCWRF). Due to the United States Army Corps of Engineers (USACE) decision to raise the elevation of the Prado Dam, all facilities at RP-2 need to be abandoned and moved to RP-5. The liquid treatment capacity was relocated in March 2004; the solids facilities will be relocated during the 20-year planning period. This technical memorandum (TM) evaluates potential locations for the RP-2 solids facilities at RP-5, identifies RP-5 plant expansion projects within the 20-year planning period, and provides preliminary capital cost estimates for the projects. Information from this TM will be incorporated into the updated 20-year Capital Improvements Program (CIP).

The current and future flows and loads for RP-5 were estimated in *TM 4 Wastewater Flow and Loading Forecast*. An analysis of the influent wastewater characteristics at RP-5 was conducted to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and the 2060 ultimate buildout year. The influent flow and loading projections and the effluent requirements detailed in the Santa Ana Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0021 were used to evaluate the existing capacities of the RP-5 liquid treatment facilities. The estimated capacities were then compared to the projected flow and loads to determine the RP-5 facilities that require expansion within the 20-year planning period, and when those facilities would need to be online.

Two plant expansion projects were identified during the 20-year CIP: the RP-5 Solids Handling Facilities Project and the RP-5 Expansion Project. The RP-5 Solids Handling Facilities Project would relocate solids handling facilities from RP-2 to RP-5. This project would include the construction of thickening, digestion, dewatering, and ancillary facilities at RP-5. A nonmonetary evaluation of potential sites for the solids handling facilities identified the eastern side of the RP-5 site as the most favorable location for the solids handling facilities. The RP-5 Expansion Project would expand the RP-5 liquid treatment capacity from 15 million gallons per day (mgd) to 22.5 mgd, and would include the construction of primary treatment, a membrane bioreactor (MBR), disinfection, and ancillary facilities. The capital costs included in the 20-year CIP for these projects are summarized in Table 7-1.

The evaluation of RP-2 and RP-5 identified four main conclusions:

- Solids handling facilities will need to be relocated from RP-2 to RP-5 within the 20-year planning period.
- The location along the east side of the RP-5 site (Alternative 2) is the most favorable due to its location near the liquid treatment facilities and minimal impacts on the existing solar facilities.
- The RP-5 liquid treatment facilities will need to be expanded during the 20-year planning period.

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TABLE 7-1
**RP-5 Expansion Projects Capital Cost Estimate Summary**

| Component Description | RP-5 Solids Handling Facilities Project[a] | RP-5 Expansion Project |
|---|---|---|
| Total Direct Cost[b] | $51,805,000 | $47,580,000 |
| Total Estimated Construction Cost[c] | $86,878,000 | $79,791,000 |
| Total Estimated Project Costs | $112,941,000 | $103,728,000 |

[a] Costs do not include the demolition of the RP-2 facility.
[b] *Engineering-News Record* Construction Cost Index (ENR CCI) for Los Angeles (August 2014 - 10,737).
[c] Cost does not include escalation to midpoint of construction.

*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

# 1.0 Background and Objectives

Currently, RP-5 consists of liquid treatment facilities and sends primary and secondary solids to RP-2 for treatment. RP-2 only operates the solids handling facilities and accepts primary and secondary solids from CCWRF and RP-5. RP-2 was constructed in the 1960s and was purchased from the City of Chino at the onset of the regional wastewater program. Due to the USACE decision to raise the elevation of the Prado Dam, the RP-2 liquid treatment capacity was relocated to RP-5, which began operation in March 2004. The Inland Empire Utilities Agency (IEUA) decided to continue to use the RP-2 solids handling facilities until the end of their useful lives because they were constructed in 1990 and were above the 100-year flood plain at the time. Since that decision was made, USACE has decided to raise the Prado Dam. When the Prado Dam elevation change is complete, the RP-2 solids handling facilities will then be at risk of being inundated by a flood because they will be below the new 100-year flood elevation.

IEUA contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a capital program. The capital program will guide IEUA in the development of major improvements to their treatment and conveyance facilities. There are five specific goals for this TM:

- Summarize information from TMs 1 through 4 as it pertains to RP-2 and RP-5.
- Evaluate the current capacities and limitations of the existing facilities.
- Evaluate three location alternatives for the relocation of RP-2 solids handling facilities to RP-5.
- Determine treatment facilities required to treat predicted flows and loads through the planning year 2035.
- Estimate timing and preliminary capital costs for plant expansion projects required during the 20-year planning period.

# 2.0 RP-5/RP-2 Overview

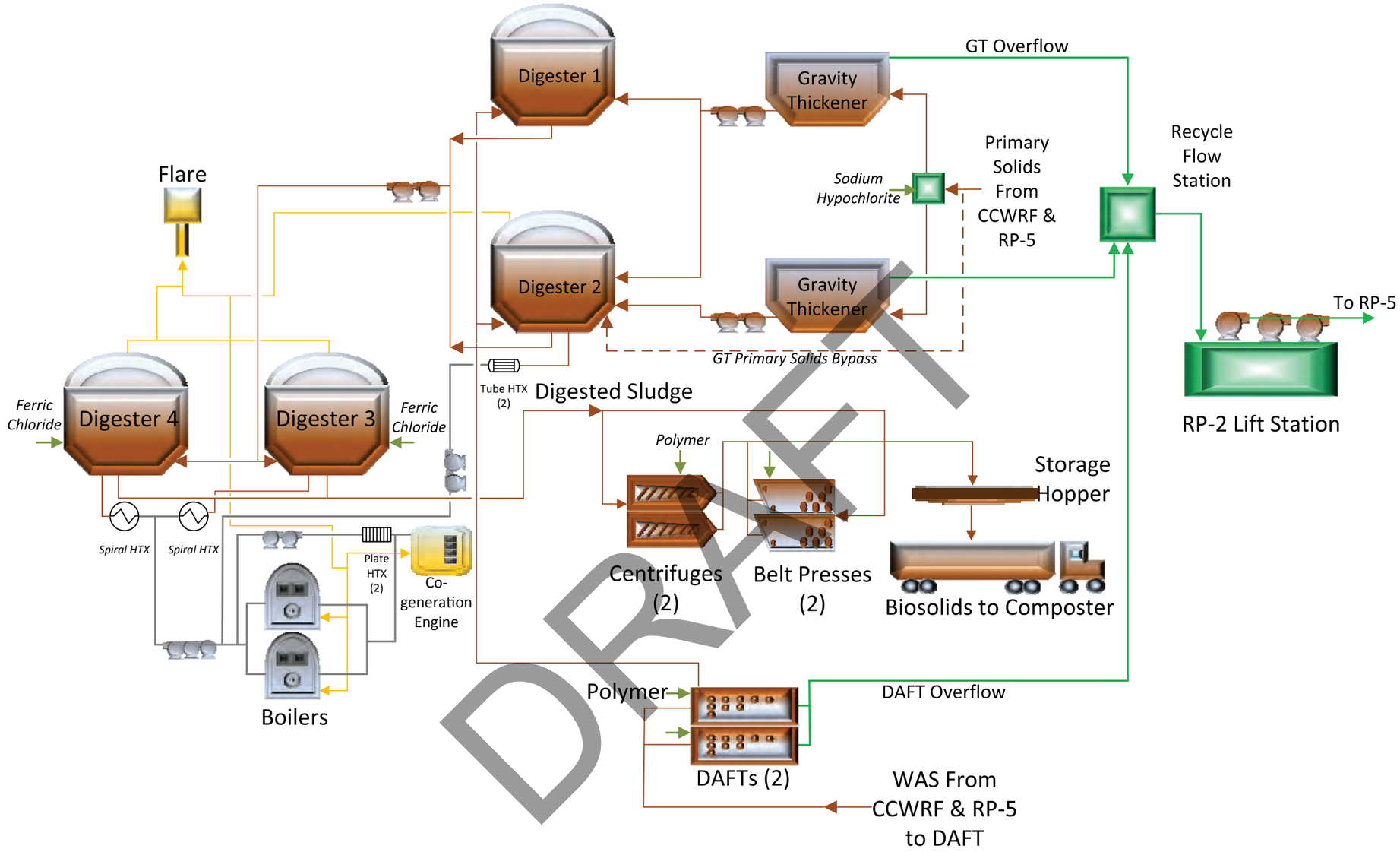
## 2.1 RP-2

Solids from RP-5 and CCWRF are processed in the RP-2 solids handling facilities. Facilities include thickening, stabilization, and dewatering processes. A schematic of the RP-2 facility is shown in Figure 7-1 There are two thickening processes in operation at RP-2: gravity thickening for primary solids, and dissolved air flotation (DAF) thickening for secondary solids. Thickened biosolids are stabilized in a two-stage anaerobic digestion process, consisting of mesophilic-acid and mesophilic stages. Methane gas produced is sent to the cogeneration facility, while biosolids are dewatered using belt filter presses or centrifuges and loaded onto trucks for delivery to the Inland Empire Regional Composting Facility for composting. Further details on the facilities are summarized in *TM 1 Existing Facilities*.

## 2.2 RP-5

Liquid treatment facilities at RP-5 include influent pumping, and preliminary, primary, secondary, and tertiary treatment; these facilities are designed to treat an annual average flow of 15 mgd plus 1.3 mgd of return flows from the RP-2 Lift Station. Recycled water is discharged to IEUA's recycled water distribution system for landscape irrigation and other approved recycled water uses. Recycled water in excess of demand is dechlorinated and discharged to Chino Creek. A schematic of the RP-5 facility is shown in Figure 7-2.

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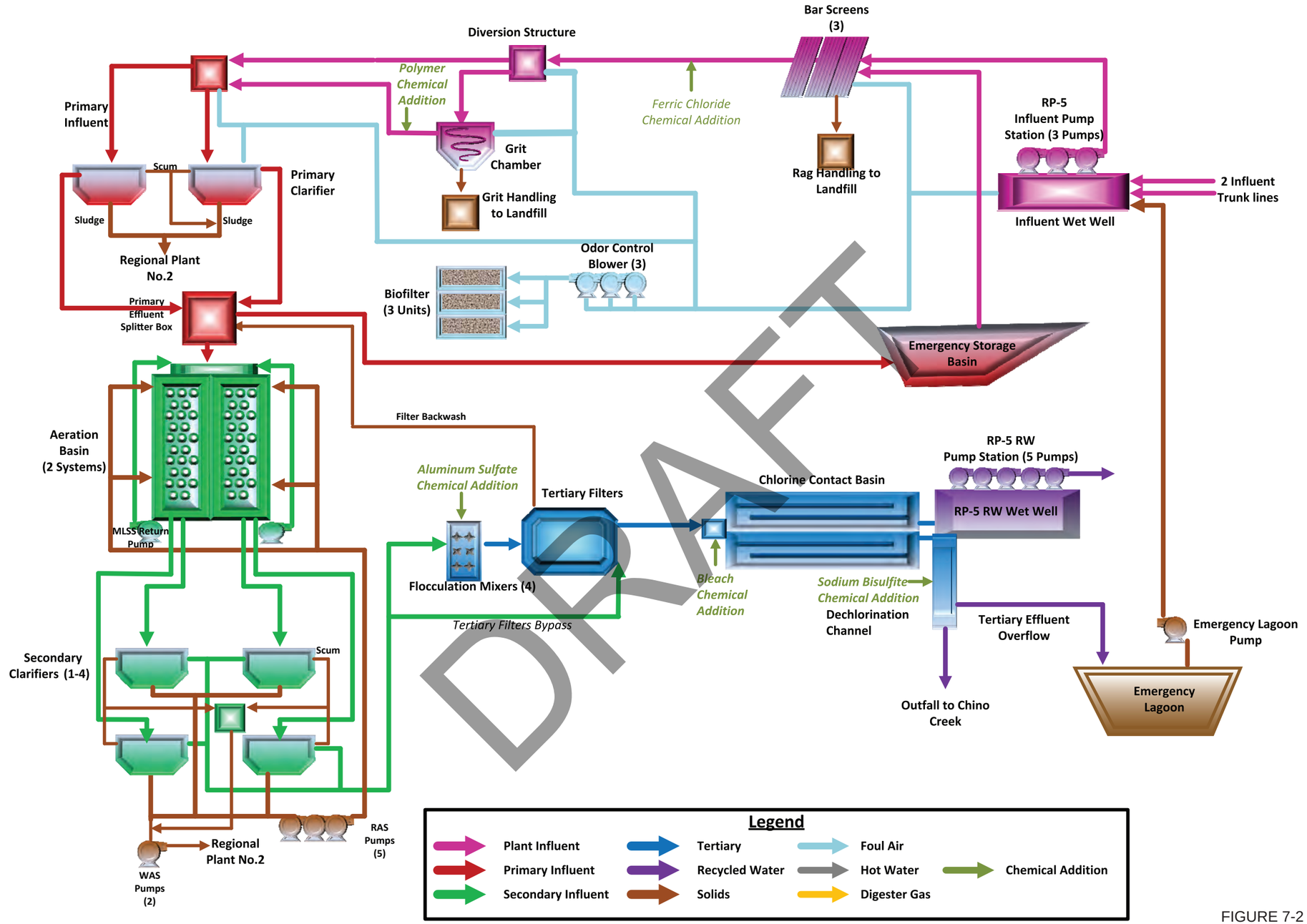
FIGURE 7-1

**REGIONAL WATER RECYCLING PLANT NO. 2 PROCESS FLOW SCHEMATIC**

INLAND EMPIRE UTILITIES AGENCY
*WASTEWATER FACILITIES MASTER PLAN*

20-IEUA-10-14F7-1-9370A00.AI

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FIGURE 7-2

## REGIONAL WATER RECYCLING PLANT NO. 5 PROCESS FLOW SCHEMATIC

INLAND EMPIRE UTILITIES AGENCY
*WASTEWATER FACILITIES MASTER PLAN*

20-IEUA-10-14F7-2-9370A00.AI

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Preliminary treatment includes screening and grit removal. Wastewater passes through the screening process, which consists of one manual and two mechanical bar screens. The screened influent is conveyed to one vortex grit basin. Foul air from preliminary and primary treatment facilities is sent to a biofilter for treatment and discharge. Primary treatment consists of two, 100-foot-diameter, circular primary clarifiers and a primary effluent emergency storage basin. The clarifiers are center-feed, peripheral-draw-off with sludge hoppers and scum removal. They have a common sludge and scum pump station, which pumps solids to RP-2 for processing.

Secondary treatment includes two parallel two-stage biological nutrient removal (BNR) activated sludge treatment trains and four circular secondary clarifiers. Aerobic zones are equipped with fine bubble diffused aeration panels supplied by two centrifugal blowers. Tertiary treatment consists of coagulation/flocculation, filtration, and disinfection. Secondary effluent is fed to a rapid mix basin, where alum is added upstream of four flocculation basins operated in series, and followed by 12 upflow, continuous backwash filters. Effluent is sent to a chlorine contact basin and then conveyed to the Recycled Water Pump Station. Disinfection is achieved using sodium hypochlorite; recycled water is pumped to the distribution system for reuse, or dechlorinated and discharged to Chino Creek. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

# 3.0 Current and Future Flows and Loads

As presented in *TM 4 Wastewater Flow and Loading Forecast*, an analysis of the influent wastewater characteristics at RP-5 was conducted as part of this WFMP effort in order to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and 2060 ultimate buildout year. The data analysis is based on two consecutive years of recent data provided by IEUA for influent flow, and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia as nitrogen (NH3-N), and total Kjeldahl nitrogen (TKN).

Flow projections were developed by the Integrated Resources Plan (IRP) Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. As discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis*, the WFMP planning effort is based on IEUA's preferred Flow Diversion Alternative 2, which includes diverting flows from Whispering Lakes and Haven Pump Stations to RP-1. At the request of IEUA and as a subset of Alternative 2, the Consultant Team evaluated what the impact would be on RP-5 flow projections if both the Whispering Lakes and Haven Pump Stations were offline. Under this scenario, the flows from each of these tributary areas would be conveyed to RP-5 rather than to RP-1. In order to provide greater system reliability and redundancy, RP-5 facilities planning assumes that both pump stations are offline. The influent wastewater flow and loading projections under this scenario for the planning year 2035 form the basis of the master planning effort and treatment plant capacity evaluation presented herein. Projections are also presented for the 2060 ultimate buildout year; these projections are used for site planning considerations. Influent wastewater flows are projected to more than double by the year 2060 at RP-5 as a result of population growth in Chino and other areas served by RP-5.

Summaries of the current and projected average influent wastewater flows and loads for RP-5 are presented in Tables 7-2 and 7-3. The RP-5 flow and load projections for the two scenarios (pump stations online and pump stations offline) are also presented.

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TABLE 7-2
**RP-5 Current and Projected Average Influent Wastewater Flows**

| | Current | 2035[a] | 2060[a,b] |
|---|---|---|---|
| Flow w/ Pump Stations Online (mgd)[c] | 10.0 | 18.4 | 25.3 |
| Flow w/ Pump Stations Offline (mgd) | 10.0 | 20.2 | 27.2 |

[a] Projections developed by IRP Consultant and IEUA based on November 2013 flow monitoring period. Reflects projected flows for IEUA preferred Flow Diversion Alternative 2.
[b] Site planning considerations are based on the projections established for the 2060 ultimate buildout planning year.
[c] Assumes Whispering Lakes Pump Station and Haven Pump Station are online and conveying flow to RP-1.The projected flow for each lift station in 2035 is 1.6 mgd (Whispering Lakes Pump Station) and 0.2 mgd (Haven Pump Station).

TABLE 7-3
**RP-5 Current and Projected Average Influent Wastewater Characteristics**

| | | | Pump Stations Online[a,b] | | Pump Stations Offline[a,c] | |
|---|---|---|---|---|---|---|
| | Current Concentration (mg/L) | Current Load (lb/day) | 2035 Load (lb/day) | 2060 Load (lb/day) | 2035 Load (lb/day) | 2060 Load (lb/day) |
| BOD | 321 | 27,771 | 49,290 | 67,774 | 54,112 | 72,864 |
| TSS | 267 | 23,181 | 40,964 | 56,326 | 44,972 | 60,556 |
| NH3-N | 35 | 3,005 | 5,422 | 7,456 | 5,953 | 8,016 |
| TKN | 52 | 4,602 | 8,036 | 11,050 | 8,823 | 11,880 |

[a] Load projections based on projected flows, concentrations, and load peaking factors presented in TM 4.
[b] Assumes Whispering Lakes Pump Station and Haven Pump Station are online and conveying flow to RP-1.
[c] Assumes Whispering Lakes Pump Station and Haven Pump Station are offline with flow conveyed by gravity to RP-5.
mg/L – milligrams per liter
lb/day – pounds per day

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# 4.0 Treatment Requirements

IEUA operates under an umbrella permit and must meet water quality requirements for discharge and recycled water.

## 4.1 Discharge Requirements

The tertiary effluent from RP-5 is discharged at Reach 1B of Chino Creek (Discharge Point [DP] 003), regulated by RWQCB Order No. R8-2009-0021, which replaced Order No. 01-1 and Order No. 95-43, National Pollutant Discharge Elimination System (NPDES) No. CA 0105279. This permit is an umbrella permit, governing all of IEUA's wastewater treatment plants (RP-1, RP-4, RP-5, and CCWRF). It includes a stormwater discharge permit and the enforcement of an industrial pretreatment program. Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water contact recreation. A summary of main effluent quality limits is provided in Table 7-4.

## 4.2 Recycled Water Requirements

Recycled water from RP-5 is used for irrigation in the area overlying Chino North "Max Benefit" Groundwater Management Zone (DP 007). Recycled water quality requirements are governed under RWQCB Order No. R8-2009-0021 and must meet the discharge requirements set forth in Table 7-4.

TABLE 7-4
**Summary of Effluent Quality Limits for RP-5[a]**

| Parameter | Weekly Average | Monthly Average | Annual Average | Daily Maximum | Notes |
|---|---|---|---|---|---|
| BOD | 30 mg/L[b] | 20 mg/L[b] | - | - | 45 mg/L weekly average and 30 mg/L monthly average with 20:1 dilution. |
| TSS | 30 mg/L[b] | 20 mg/L[b] | - | - | |
| $NH_4$-N | - | 4.5 mg/L | - | - | |
| Chlorine Residual | - | - | - | 0.1 | Instantaneous maximum ceiling 2 mg/L |
| TIN | - | - | 8 mg/L | - | |
| TDS | - | - | 550 mg/L | - | Shall not exceed 12-month running average TDS concentration in water supply by more than 250 mg/L |
| Turbidity | - | - | - | - | 1. Daily average – 2 NTU<br>2. 5% maximum in 24 hours – 5 NTU<br>3. Instantaneous maximum – 10 NTU |
| Coliform | < 2.2 MPN | - | - | - | Max 23 MPN, once per month |
| pH | - | - | - | 6.5 – 8.5 | 99% compliance |
| Free Cyanide | - | 4.6 µg/L | - | 7.3 µg/L | |
| Bromodichloro-methane | - | 46 µg/L | - | 92 µg/L | |

[a] RWQCB Order No. R8-2009-0021.
[b] Without 20:1 dilution and for recycled water.
TIN – total inorganic nitrogen
TDS – total dissolved solids
$NH_4$-N – ammonia as nitrogen
NTU – nephelometric turbidity unit(s)
MPN – most probable number
µg/L – micrograms per liter

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# 5.0 Existing Plant Capacity and Limitations

Existing facilities and current plant performance were used as the basis for RP-5/RP-2 process model development. A whole plant model was developed using PRO2D and calibrated based on plant influent data and plant operations data for the period between October 15, 2011, and October 15, 2013. This period was selected as the basis after a review of the influent and plant data to reflect a 2-year-long complete data set. Existing plant operation and the findings of the capacity evaluation through the use of process modeling are presented below for the liquid and the solids treatment facilities at RP-5/RP-2, respectively.

## 5.1 Existing Plant Operation

A summary of RP-5/RP-2 plant operations is provided in Table 7-5 for the liquid treatment and solids handling facilities. Unit process performance values were averaged over the evaluation period, with operating ranges noted. These values were used in development and calibration of the process models. Detailed data summaries for the evaluation period are provided in Appendix 7-A.

TABLE 7-5
**RP-5/ RP-2 Average Plant Operations Summary**

| Parameter | Value |
|---|---|
| ***Primary Treatment*** | |
| TSS Removal Rate (%) | 70 |
| TOC Removal Rate (%) | 41 |
| Primary Sludge (mgd) | 0.180 |
| ***Secondary Treatment*** | |
| MLSS (mg/L) | 3,920 |
| MLVSS (%) | 83 |
| RAS SS (mg/L) | 5,990 |
| Solids Inventory (Basins, Clarifiers, RAS) (lb) | 337,000 |
| Secondary Clarifier Loading (gpd/$ft^2$) | 200 (4 Clarifiers) |
| SVI (mL/g) | 210 |
| SRT (day) | >50 |
| Residual Alkalinity (mg as $CaCO_3$/L) | 145 |
| ***Solids Handling*** | |
| Gravity Thickened Solids (%TS) | 4.2 |
| DAF Thickened Solids (%TS) | 4.9 |
| Acid Phase (Digester 1) HRT (day) | 3.4 |
| Gas / Second Phase Digestion HRT (day) | 14.1 |
| Dewatered Solids (%TS) | N/A |

gpd – gallons per day
MLSS – mixed liquor suspended solids
MLVSS – mixed liquor volatile suspended solids
RAS – return activated sludge
SS – suspended solids
gpd/$ft^2$ – gallons per day per square foot
mL/g – milliliters per gram
SVI – sludge volume index
SRT – solids retention time
$CaCO_3$/L – calcium carbonate per liter
TS – thickened solids
HRT – hydraulic retention time

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A performance summary for the major treatment processes is presented in Table 7-6. These values, which represent the average over the evaluation period, were used in the subsequent plant process modeling and the capacity evaluations for the major treatment units. Detailed data summaries for the evaluation period are provided in Appendix 7-A.

TABLE 7-6
**RP-5/ RP-2 Average Plant Performance Summary**

| Parameter | Primary Effluent | Secondary Effluent |
|---|---|---|
| TOC (mg/L) | 102 | 4.5 |
| BOD (mg/L) | 180 | 1.5 |
| TSS (mg/L) | 72 | <5 |
| NH3-N (mg/L) | 32 | 0.15 |
| NO3-N (mg/L) | N/A | 6.60 |
| NO2-N (mg/L) | N/A | 0.06 |
| TIN (mg/L) | N/A | 6.81 |
| Alkalinity (mg as $CaCO_3$/L) | N/A | 145 |

N/A – Not applicable
NO3-N – nitrate as nitrogen
NO2-N – nitrite as nitrogen

The values in Table 7-6 represent the current operation including secondary treatment operation configured in an anoxic-oxic-anoxic-oxic BNR configuration with step feed capability. Both basins and all basin zones, as well as both primary clarifiers and three out of four secondary clarifiers, were in service throughout the evaluation period.

## 5.2 Existing Plant Capacity

### 5.2.1 Process Modeling

The capacity of the existing RP-5/RP-2 system was evaluated through process modeling using CH2M HILL's whole plant simulator, PRO2D. PRO2D is a process simulation model that takes into account the mass balances through an entire facility for particulate and soluble components, and similar to other commercially available process models, is based on the International Water Association (IWA) ASM2D biological process kinetics. The base model was constructed to reflect the actual facility setup, including flow splits and backwash. The process model facility setup flow diagram depicting the integrated RP-5/RP-2 operation is presented in Figure 7-3. The model was constructed with the operations and performance criteria reflective of the evaluation period, and then calibrated to reflect the actual performance, solids yields, and water quality data.

As shown in Figure 7-3, the model was constructed to represent the actual plant operation for all the major process units. The model also allows establishing sizing and design considerations for each major unit process tankage and equipment. Similar to the actual operations, the plant model was built with the filter backwash and solids thickening/dewatering recycles being returned to the main plant for further treatment, with the CCWRF sludge diverted to RP-2 for solids handling. The liquid and solids mass balances calculated for the whole system under the current conditions allow calibration of the model against the actual field data. The calibrated model is then used to evaluate current capacity as well as establish expansion needs and process bottlenecks.

The process model was constructed and calibrated using the current influent and operating data available for the facility. The purpose of the model calibration step is to establish a baseline condition that closely resembles current operations and provides a means to reliably predict operations and system limitations under different scenarios or alternatives. Key model calibration results are presented in Table 7-7. As the listed values show, the model was calibrated such that the simulation results are within a value range that is 5 percent or smaller relative to the actual data. This level of accuracy will allow reliable capacity estimations to be made for the various capacity scenarios and future operation needs.

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TABLE 7-7
**RP-5/ RP-2 Average Plant Performance Summary**

| Parameter | Actual Data Average Values | Model Results |
|---|---|---|
| Effluent BOD (mg/L) | 1.5 | 1.6 |
| Effluent TSS (mg/L) | <5 | <5 |
| Effluent TIN (mg/L) | 6.81 | 7.1 |
| Effluent Alkalinity (mg as $CaCO_3$/L) | 145 | 139 |
| MLSS (mg/L) | 3,922 | 3,910 |
| Total MLSS Inventory (lb) | 337,000 | 336,800 |
| Sludge Volatile Solids Content | 83 | 83 |
| RP-5/CCWRF Primary Sludge, Thickener Feed (gpd) | 378,800 | 382,400 |
| RP-5/CCWRF Waste Activated Sludge, Thickener Feed (gpd) | 246,100 | 247,200 |
| Biosolids (Dry Solids lb/day) | 25,800 | 25,500 |

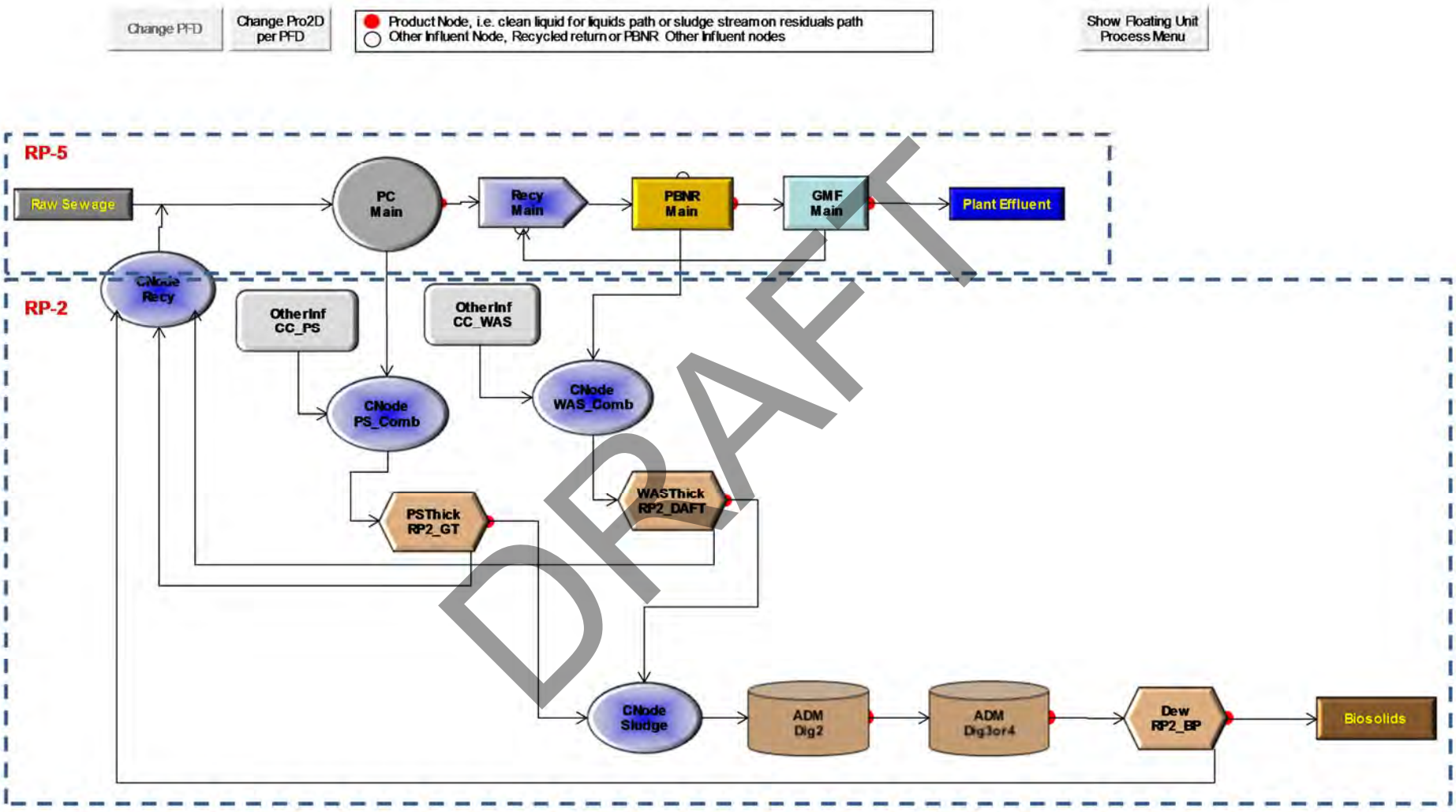
Subsequent process modeling using the calibrated model as the base model was conducted to evaluate the following scenarios:

- Current plant capacity
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under average and maximum month flow and load conditions with solids handling recycles
  - Liquid treatment capacity to meet 5-mg/L effluent TIN level under average and maximum month flow and load conditions without solids handling recycles
  - Solids handling capacity under average and maximum month flow and load conditions
- RP-2 (solids handling) facility relocation options and future capacity implications for the planning year 2035
- Future facility footprint implications for the planning years 2035 and 2060

Findings of the current plant capacity evaluation are presented next in this section. Flow equalization and future capacity needs are presented in Sections 6.0 and 7.0, respectively.

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FIGURE 7-3
**RP-5/RP-2 Process Model Facility Setup**




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### 5.2.2 Liquid Treatment Capacity

An evaluation of the liquid treatment capacity was conducted using the whole plant process model under both the average and maximum month conditions. The capacity evaluation was conducted based on achieving a plant effluent TIN concentration of 8 mg/L. As established at the onset of the project, the facility reliability and redundancy considerations are based on IEUA's overall wastewater treatment system, with RP-5 being the end-of-the-line facility receiving all flow diversions, if needed, from other Regional Water Recycling Plants (RWRPs). Additional reliability and redundancy considerations driven by the regulatory requirements, such as Title 22 requirements, were taken into account. Dewatering recycles were considered to be handled at RP-5 along with other plant recycles and filter backwash.

The facility has two primary clarifiers in service. The average hydraulic loading rates with two units in service are around 1,070 gallons per day per square foot (gpd/ft$^2$). Under peak day flow conditions, and especially if one unit needs to be taken out of service, the primary clarifiers will be hydraulically overloaded. Considering that flow diversions to RP-5 are available for all other RWRPs and RP-5 needs to have robust reliability to handle the diversions, this needs to be considered as part of future capacity evaluations. Chemically enhanced primary treatment is available and could be implemented under high primary clarifier loading conditions to avoid overloading the downstream secondary treatment system.

Process modeling showed that both the primary clarifiers and the secondary treatment system are the capacity limiting factors for liquid treatment. One of the key parameters was found to be the aeration and the ability to control dissolved oxygen (DO) in the anoxic and oxic zones in the aeration basins, especially under peak flows with one large aeration zone out of service. The implications of DO are TIN fluctuations in the effluent and SVI values that are greater than 200 mL/g, which indicates sludge settleability is impaired most of the time. Another limitation of the secondary treatment system was found to be the secondary clarification solids loading resulting from the current operations and the influent wastewater solids loading rates. Maintaining the SVI values at or below 150 mL/g is important for this reason as well. Also, the system is reportedly operated at SRT values greater than 50 days. Although the current lower flows could allow this practice, much lower SRT values will need to be maintained to be able to treat flows greater than currently experienced.

Primary and secondary treatment capacity values established through modeling are presented in Table 7-8.

TABLE 7-8
**RP-5 Existing Primary/Secondary Treatment Capacity**

| | All Units in Service | One Unit Out of Service[a] |
|---|---|---|
| Capacity with effluent TIN $\leq$ 8 mg/L and with dewatering recycles (1.3 mgd) | 17 mgd | 15 mgd |
| Capacity with effluent TIN $\leq$ 8 mg/L and without dewatering recycles | 20 mgd | 18 mgd |

[a] One large aeration zone and one secondary clarifier out of service.

The capacities of the RP-5 tertiary processes also were evaluated; the methodologies employed are consistent with those presented in the Title 22 Engineering Report (DDB Engineering, Inc. [DDB], 2010). The filters were designed based on a California Department of Public Health (CDPH) maximum filter loading rate of 5 gallons per minute per square foot (gpm/ft$^2$) for continuous backwash upflow sand filters, with one filter out of service. In order not to exceed the maximum approved filter loading rate, the maximum flow that the filtration system can handle is 23.8 mgd. Applying a tertiary system peaking factor of 1.44, based on the availability of short-term storage for primary effluent flow equalization, the resulting average filtration capacity is 16.5 mgd.

The chlorine contact basins were designed based on Title 22 requirements with a minimum concentration and time (CT) value of 450 milligrams per minute per liter (mg-min/L) and a minimum modal contact time of 90 minutes during the peak hourly dry weather flow. Tracer testing conducted by IEUA in 2004 showed that the disinfection system could handle a peak flow of 23.5 mgd while maintaining a modal contact time of 90 minutes

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(DDB, 2010). Applying a tertiary system peaking factor of 1.44, the resulting average disinfection capacity is 16.3 mgd.

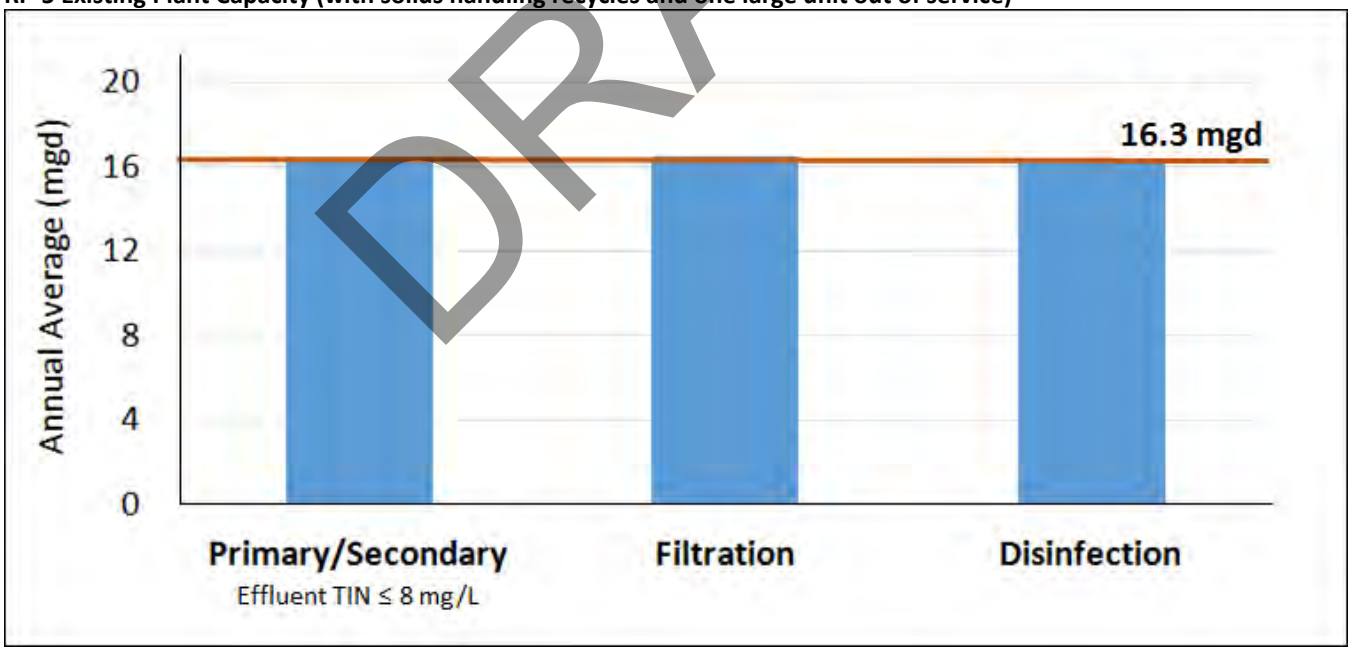
It is important to note that the primary effluent weir gate elevation is set to allow up to only 23.4 mgd to the downstream processes, with excess flow diverted to the Emergency Storage Pond. Thus, the tertiary processes do not receive more than 23.4 mgd of flow. The results of the tertiary capacity evaluation are summarized in Table 7-9.

TABLE 7-9
**RP-5 Existing Tertiary Process Capacity**

| | All Units in Service | One Filter Out of Service |
|---|---|---|
| Average Filtration Capacity | 18.0 mgd | 16.5 mgd |
| Average Disinfection Capacity | 16.3 mgd | N/A |

The overall plant capacity is determined by its most limiting process capacity. However, the RP-5 primary, secondary, and tertiary process capacities are all equally limited to about 16.3 mgd. The primary/secondary treatment capacity of 15 mgd with one unit out of service plus 1.3 mgd of return flow from the RP-2 Lift Station, results in a 16.3 mgd primary/secondary treatment capacity. Therefore, the RP-5 plant capacity is approximately 16.3 mgd under the assumptions presented in this section and the current wastewater characteristics. Flows considered in this evaluation include approximately 1.3 mgd of recycle flows and other flows diverted from the RP-2 Lift Station. Thus, the evaluated capacity is consistent with the permitted capacity of 15 mgd previously established for RP-5 during design. A summary of the individual process capacities in comparison to the overall plant capacity is depicted in Figure 7-4.

FIGURE 7-4
**RP-5 Existing Plant Capacity (with solids handling recycles and one large unit out of service)**




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## 5.2.3 Solids Handling Capacity

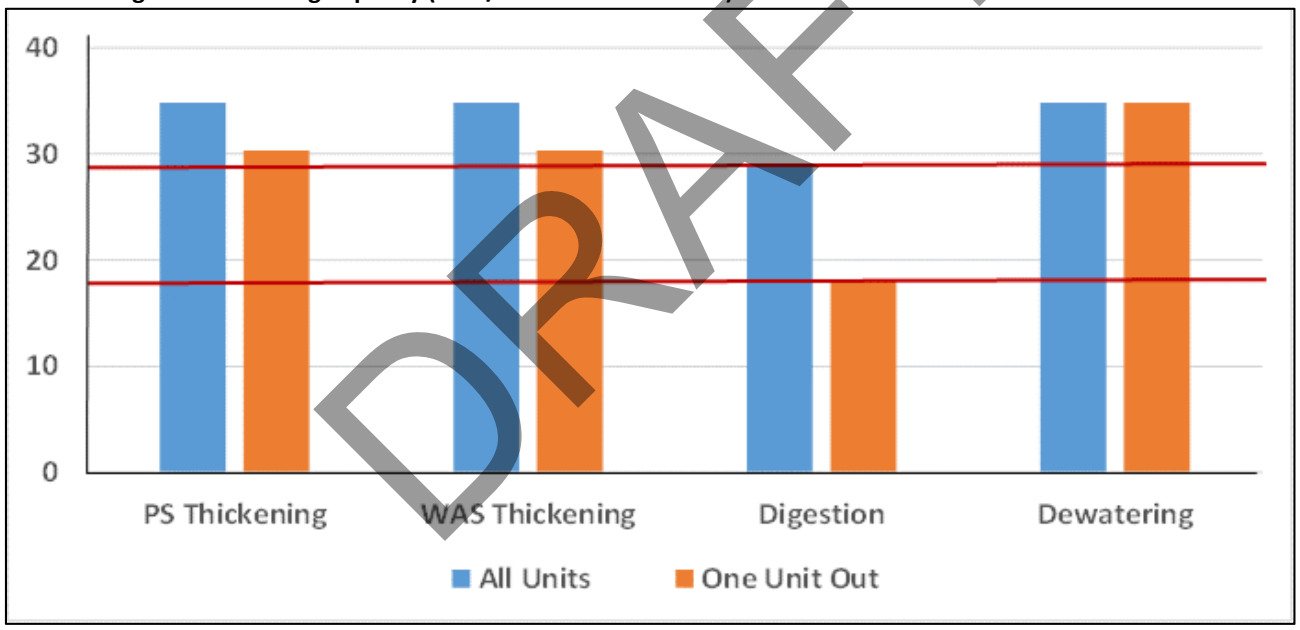
In evaluating the solids handling system capacity, operational considerations and Rule 503 requirements were taken into account considering the average and maximum month loading. The system capacity with and without one unit out of service was evaluated using the industry standard loading rates and operational criteria. The capacity values calculated are considered to represent equivalent plant influent flow values at the current wastewater characteristics.

Primary sludge (PS) thickening is currently achieved using gravity thickening. Thickening cannot be achieved in the primary clarifiers, because the sludge needs to be diverted to RP-2 at a solids content of about 1 to 1.5 percent solids. WAS thickening is achieved in dissolved air floatation thickeners (DAFT). Capacity was evaluated by maintaining a solids loading rate of 45 pounds per day per square foot (lb/d/ft$^2$) or less for the DAFTs.

Waste solids digestion, achieved in the phased digestion system, was evaluated based on the current operating conditions as well as Part 503 Rule requirements. A digester SRT of 15 day with one large unit out service was used to establish digestion capacity, using an active digester volume of 90 percent of the total digester volume including the cone space. Dewatering capacity of the belt filter presses was calculated considering the hydraulic loading rate to be maintained at or below 75 gallons per minute per meter (gpm/m) and the solids loading rate to be maintained at or below 1,000 pounds per hour per meter (lb/hr/m) under the current solids loading conditions.

The solids handling capacity of the plant to meet the Part 503 Rule requirements for Class B biosolids is illustrated in Figure 7-5. As shown, the digestion is the limiting unit process of the solids handling system. The current equivalent RP-5/CCWRF plant influent flows (10 + 7.2 = 17.2 mgd) represent almost 96 percent of the anaerobic digestion capacity with one large unit out of service at the current influent wastewater characteristics and CCWRF solids loading diversion.

FIGURE 7-5
**RP-2 Existing Solids Handling Capacity (RP-5/CCWRF Waste Solids)**




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## 5.3 RP-5/RP-2 Capacity Summary

Current RP-5/RP-2 liquid treatment and solids handling facility capacity values are summarized in Table 7-10. These values constitute the basis of the future capacity requirements assessment presented later in this TM.

TABLE 7-10
**RP-5/RP-2 Existing Process Capacity Summary**

| | All Units in Service | One Unit Out of Service |
|---|---|---|
| **Secondary Treatment** | | |
| Plant Effluent TIN ≤ 8 mg/L [b] | 17 mgd | 15 mgd[a] |
| Plant Effluent TIN ≤ 8 mg/L [c] | 20 mgd | 18 mgd[a] |
| **Solids Handling**[d] | | |
| PS Thickening | 34.8 mgd | 30.3 mgd[d] |
| WAS Thickening | 34.8 mgd | 30.3 mgd[d] |
| Digestion | 29 mgd | 18 mgd[d] |
| Dewatering | 34.8 mgd | 34.8 mgd[d] |
| **Tertiary Treatment** | | |
| Filtration | 18 | 16.5[e] |
| Disinfection | 16.3 | N/A |

[a] One secondary clarifier and one aeration basin out of service.
[b] With solids handling recycles.
[c] Without solids handling recycles.
[d] One large unit out of service.
[e] One filter out of service.

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# 6.0 Solids Handling Alternatives Evaluation

As previously mentioned, solids handling facilities at RP-2 will be below the 100-year flood plain with the rise of the Prado Dam elevation. Thus, the solids handling capacity of the RP-2 facility will be relocated to RP-5. Three solids facilities location alternatives were considered:

1. Southwest corner of the RP-5 site
2. East side of the RP-5 site
3. Solids Handling Site (SHS) at the corner of Flowers Street and Mountain Avenue

Figure 7-6 shows the three proposed site layouts for the RP-5 solids handling facilities. The RP-5 solids facilities were preliminarily sized based on flow and loading projections for RP-5 described in *TM 4 Wastewater Flow and Loading Forecast* and summarized in Section 3.0 of this TM, Current and Future Flows and Loads. Table 7-11 presents the various facilities, the number of units, and their corresponding size for expansion through 2060.

TABLE 7-11
**RP-5 Proposed Solids Handling Facilities (Ultimate)**

| Facility | Number of Units | Size |
|---|---|---|
| Gravity Thickener | 4 | 45-foot Diameter |
| Dissolved Air Flotation Thickening (DAFT) | 3 | 40-foot Diameter |
| ***Anaerobic Digestion*** | | |
| Acid-Phase | 10 Cells | 20-$ft^2$ 30-foot sidewater depth per cell |
| Methane-Phase | 5 | 90-foot diameter 35-foot sidewater depth |
| Sludge Holding | 1 | 90-foot diameter 35-foot sidewater depth |
| High Pressure Gas Storage | 1 | 35-foot diameter w/ 30- $ft^2$ equipment pad |
| Dewatering | 1 | 100-foot x 150-foot |
| Biofilter | 1 | 60-foot x 80-foot per cell (3 total cells) |

Using the facility sizes described in Table 7-11, site layouts were developed for each of the three alternatives. Figures 7-7 through 7-9 present the preliminary site layouts for Alternatives 1 through 3, respectively.

The three alternatives were evaluated based on both economic and nonmonetary criteria. The economic difference between the three alternatives was assumed to be negligible. Each alternative requires the same facilities and equipment and the site work during construction would also be similar. The difference between the alternatives is identified in the nonmonetary evaluation.

The three alternatives were evaluated based on 12 specific nonmonetary criteria. Each alternative was assigned a ranking of 1 through 5, with 1 being the least favorable and 5 being optimal, for each of the nonmonetary criteria. The assigned rankings were then multiplied by the weighting factor selected for each criterion and summed to determine the overall score for each alternative. Table 7-12 presents the nonmonetary evaluation criteria and the corresponding weighting factor that was utilized in the decision analysis matrix. The results of the evaluation are summarized in Table 7-13.

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FIGURE 7-6

## RP-5 SOLIDS HANDLING ALTERNATIVES

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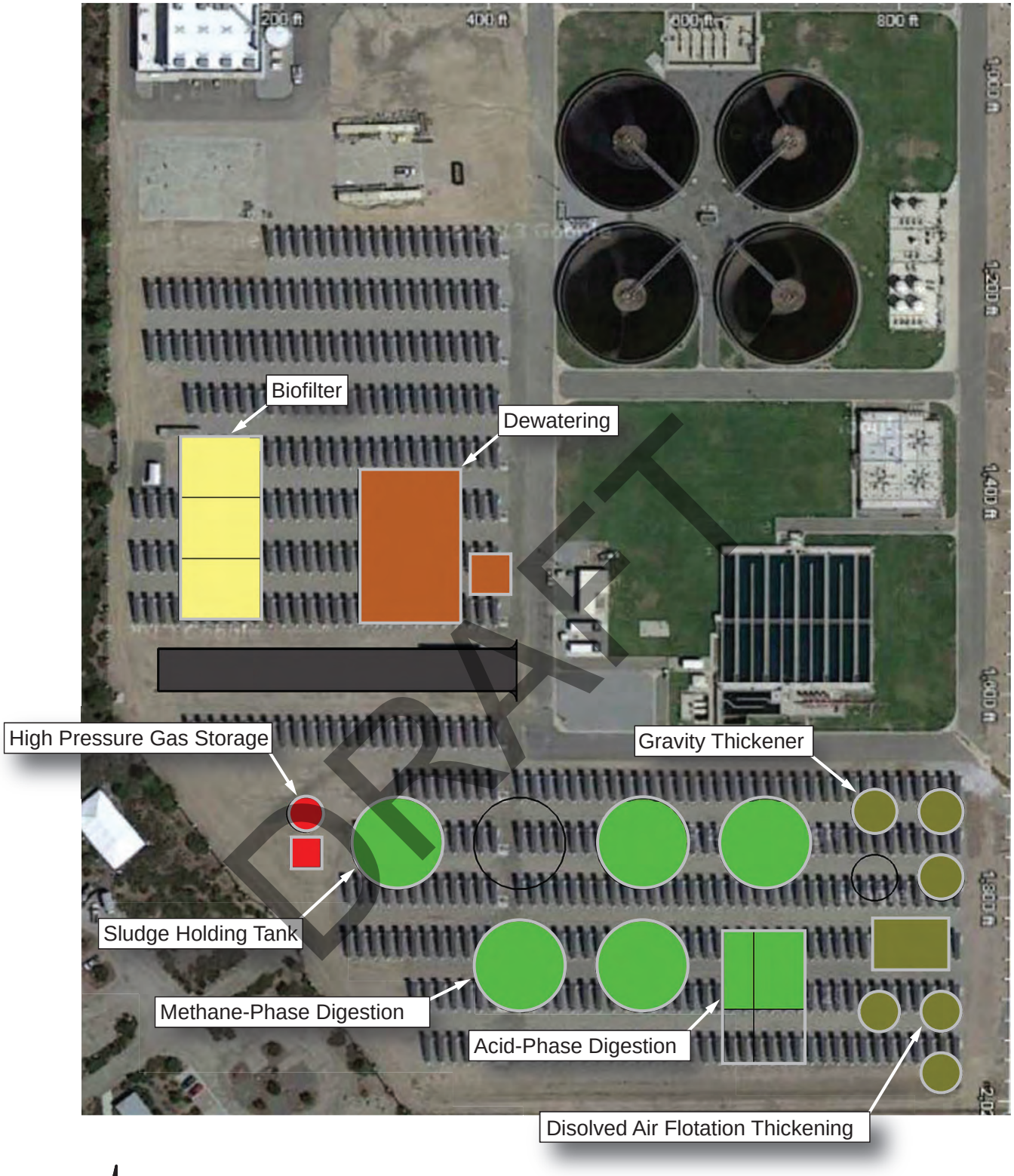


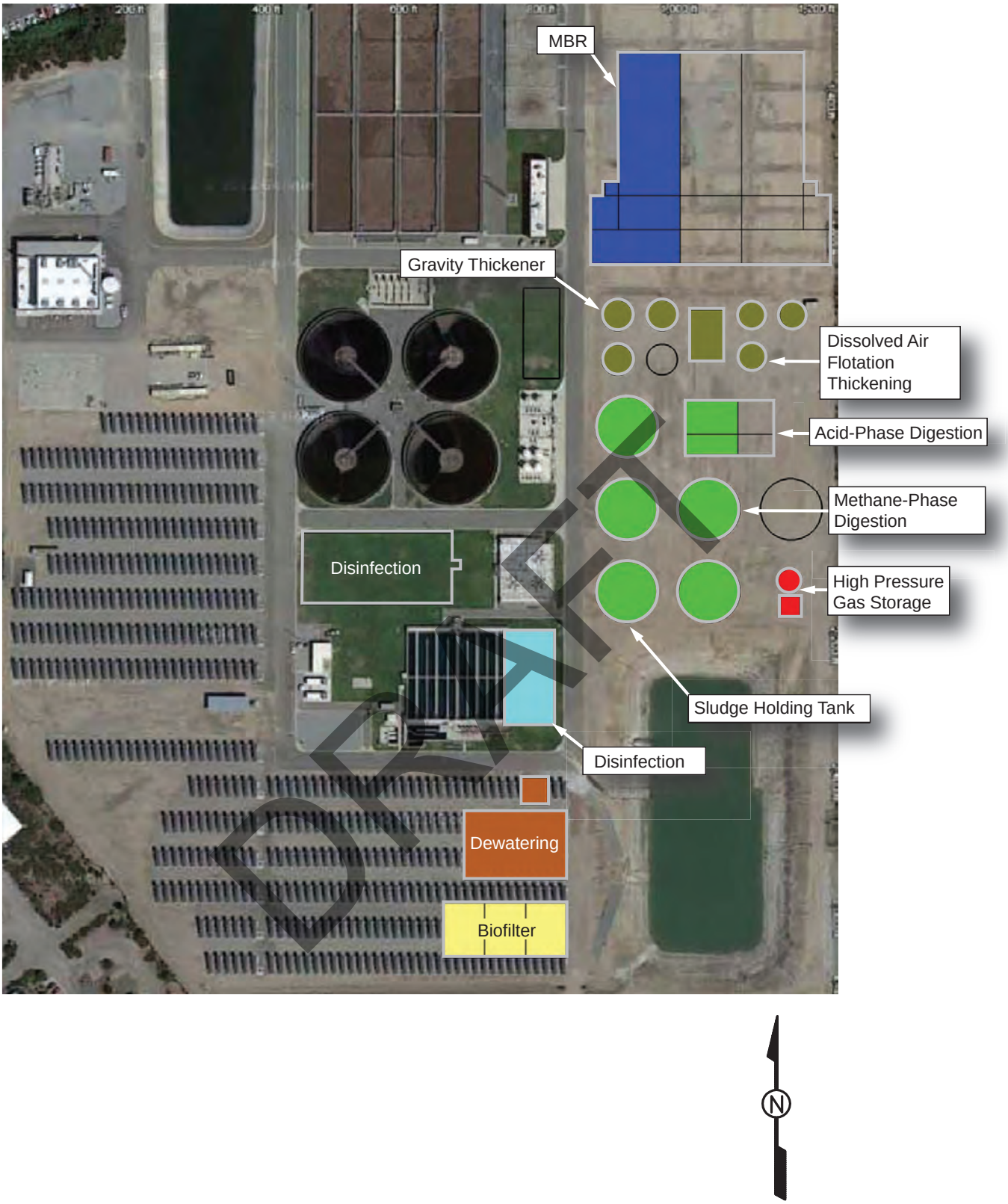

FIGURE 7-7

## SOLIDS HANDLING ALTERNATIVE 1

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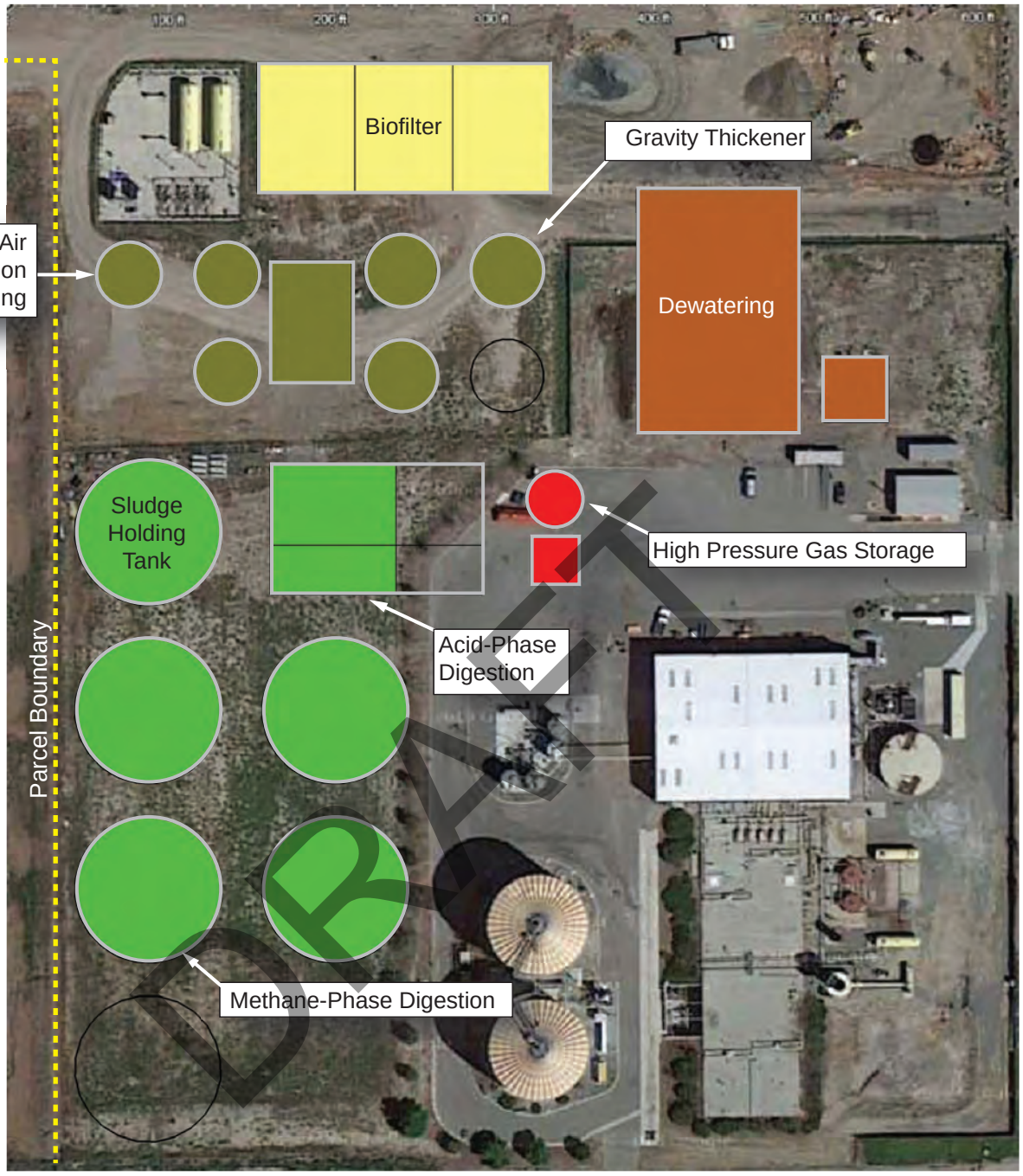



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FIGURE 7-8

## SOLIDS HANDLING ALTERNATIVE 2

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FIGURE 7-9

## SOLIDS HANDLING ALTERNATIVE 3

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TABLE 7-12
**Non-Monetary Evaluation Criteria, Definitions, and Assigned Weighting Factors**

| Criteria | Description | Weighting Factor |
|---|---|---|
| Operational flexibility | Ability of the system to respond to potential internal or external changes affecting delivery of equalized flow or treated solids without any impact on system performance. | 10 |
| Operational risk and reliability | Operational implications on system reliability and redundancy and the associated risk involved in operating major facilities. Use of proven systems and technologies, with similar installations currently in operation. | 10 |
| Impacts on plant odors | Impacts of new processes on plant odors, and the need for additional odor control facilities to minimize plant odors. | 10 |
| Constructability and implementation timing | Construction implications, ease of construction, and integration with the existing systems, and the ability to implement the proposed alternative in phases. | 9 |
| Treatment capacity impacts | Impacts of the new facilities on treatment plant capacity. | 8 |
| Impacts on existing facilities | Impacts on existing facilities and the ability to use existing infrastructure. Implications of site planning and the need to demolish or relocate existing facilities. | 8 |
| Ease of operation and maintenance | Relative degree of ease and extent of time required to operate and maintain the facilities. | 8 |
| Impacts on energy requirements | Additional energy required to construct and maintain new facilities, as well as the impact of the new facilities on the overall plant energy balance and power demand (for example, pumping, mixing, etc.). | 7 |
| Pumping and hydraulic requirements | Implications of pumping and conveying to new facilities, and complexity of pumping and yard piping requirements. | 6 |
| Overall aesthetics | Aesthetic and visual considerations as a result of the new facilities. | 6 |
| Carbon footprint and sustainability | Potential impacts on the carbon footprint of each plant and added sustainability features as a result of construction and operation of the facilities. | 4 |
| Footprint and space constraints | Overall footprint requirements and space constraints, and impacts on site planning for future facilities. | 3 |

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TABLE 7-13
**RP-5 Solids Handling Non-Monetary Evaluation Results**

| Criteria | Weighting Factor | Alternative 1 RP-5 Southwest Corner | | Alternative 2 RP-5 East Side | | Alternative 3 SHS | |
|---|---|---|---|---|---|---|---|
| | | Score | Weighted Score | Score | Weighted Score | Score | Weighted Score |
| Operational Flexibility | 10 | 4 | 40 | 4 | 40 | 1 | 10 |
| Operational Risk and Reliability | 10 | 3 | 30 | 3 | 30 | 3 | 30 |
| Impacts on Plant Odors | 10 | 3 | 30 | 3 | 30 | 3 | 30 |
| Constructability and Implementation Timing | 9 | 3 | 27 | 3 | 27 | 3 | 27 |
| Treatment Capacity Impacts | 8 | 3 | 24 | 3 | 24 | 3 | 24 |
| Impacts on Existing Facilities | 8 | 2 | 16 | 3 | 24 | 3 | 24 |
| Ease of Operation and Maintenance | 8 | 3 | 24 | 3 | 24 | 1 | 8 |
| Impacts on Energy Requirements | 7 | 4 | 28 | 4 | 28 | 1 | 7 |
| Pumping and Hydraulic Requirements | 6 | 4 | 24 | 4 | 24 | 1 | 6 |
| Overall Aesthetics | 6 | 3 | 18 | 3 | 18 | 3 | 18 |
| Carbon Footprint and Sustainability | 4 | 3 | 12 | 4 | 16 | 2 | 8 |
| Footprint and Space Constraints | 3 | 3 | 9 | 4 | 12 | 2 | 6 |
| **Final Score** | | | **282** | | **297** | | **198** |

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From Table 7-13, the recommended alternative is shown as the one with the greatest score. Using these nonmonetary criteria, Alternative 2 was selected as the proposed alternative and Alternative 3 (SHS) was the least favorable option using the evaluation matrix. Alternative 3 was ranked lower in several categories due to the location being further away from the RP-5 liquid treatment facilities, being closer to neighbors, and having space constraints compared to the other alternatives. As shown in Table 7-13, the scores for Alternatives 1 and 2 are close. The main difference between these two alternatives is their impact to the existing solar facility. Alternative 1 would require the demolition or relocation of a significant portion of the solar facility, while Alternative 2 would have much less impact.

# 7.0 Plant Expansion Needs

Using the flow and loading projections for RP-5 described in *TM 4 Wastewater Flow and Loading Forecast* and summarized in Section 3.0 of this TM, the RP-5 expansion needs were determined for the 20-year planning period and the estimated ultimate flow. Preliminary sizing of the solids and liquid facilities associated with expanding RP-5 are shown in Tables 7-11 and 7-14, respectively. The facility sizes shown in Tables 7-11 and 7-14 were used to determine the number of units required for planning years 2035 and 2060. Site layouts were then developed for each planning year.

TABLE 7-14
**RP-5 Proposed Liquid Treatment Facilities (Ultimate)**

| Facility | Number of Units | Size |
|---|---|---|
| Primary Clarifiers | 2 | 100-foot diameter |
| Secondary Treatment (MBR) | 2 | 7.5 mgd per module, includes fine screens, bioreactor, membrane tank, blowers, and RAS/WAS pump station |
| Chlorine Contact Tank | 2 | 0.8 million gallons (MG) per module |

## 7.1 Facility Expansion Requirements

### 7.1.1 Planning Year 2035

Flows at RP-5 were projected for planning year 2035, and are summarized below:

- 20.2-mgd RP-5 plant influent (represents influent flow with Whispering Lakes and Haven Pump Stations offline)
- 7.3-mgd CCWRF waste solids equivalent

The facilities required to treat the planning year 2035 flows and loads are described in Table 7-15 and shown in Figure 7-10. It is assumed that the RP-2 solids handling facilities will be relocated during the 20-year planning period.

TABLE 7-15
**RP-5 Facility Expansion Requirements for Planning Year 2035**

| Facility | Number of Units | Size of Unit |
|---|---|---|
| ***Liquid Treatment*** | | |
| Primary Clarifier | 2 | 100-foot diameter |
| Membrane Bioreactor | 1[a] | 7.5 mgd |
| Chlorine Contact Tank | 1 | 0.8 MG |
| ***Solids Treatment*** | | |
| Gravity Thickener | 3 | 45-foot diameter |
| DAFT | 3 | 40-foot diameter |
| ***Anaerobic Digestion*** | | |
| Acid-Phase | 6 Cells | 20-$ft^2$ 30-foot SWD per cell |
| Methane-Phase | 4 | 90-foot diameter 35-foot SWD |
| Sludge Holding Tank | 1 | 90-foot diameter 35-foot SWD |
| High-Pressure Gas Storage | 1 | 35-foot diameter w/ 30- $ft^2$ equipment pad |
| Dewatering | 1 | 100-foot x 150-foot Building |
| Biofilter | 3 Cells | 60-foot x 80-foot per cell |

[a] Includes fine screens, bioreactor, blowers, membrane tanks, RAS/WAS pump station, and associated equipment.

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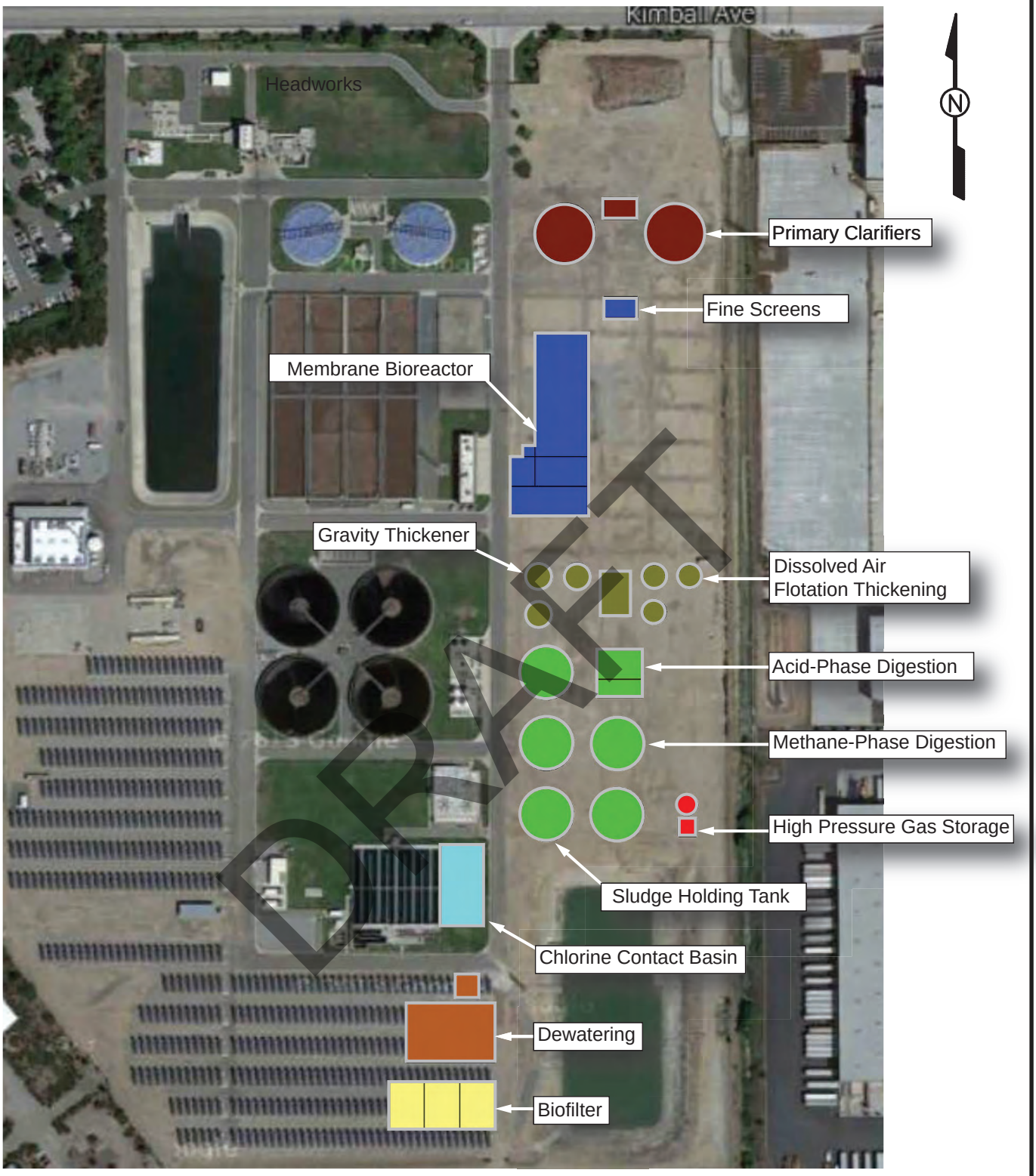



FIGURE 7-10

## RP-5 FACILITIES - PLANNING YEAR 2035

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### 7.1.2 Ultimate Buildout Year 2060

Flows at RP-5 were projected for planning year 2060, and are summarized below:

- 27.2 mgd RP-5 plant influent (represents influent flow with Whispering Lakes and Haven Pump Stations offline)
- 7.9 mgd CCWRF waste solids equivalent

The facilities required to treat the planning year 2060 flows and loads are described in Table 7-16 and shown in Figure 7-11.

TABLE 7-16
**RP-5 Facility Expansion Requirements for Ultimate Buildout Year 2060**

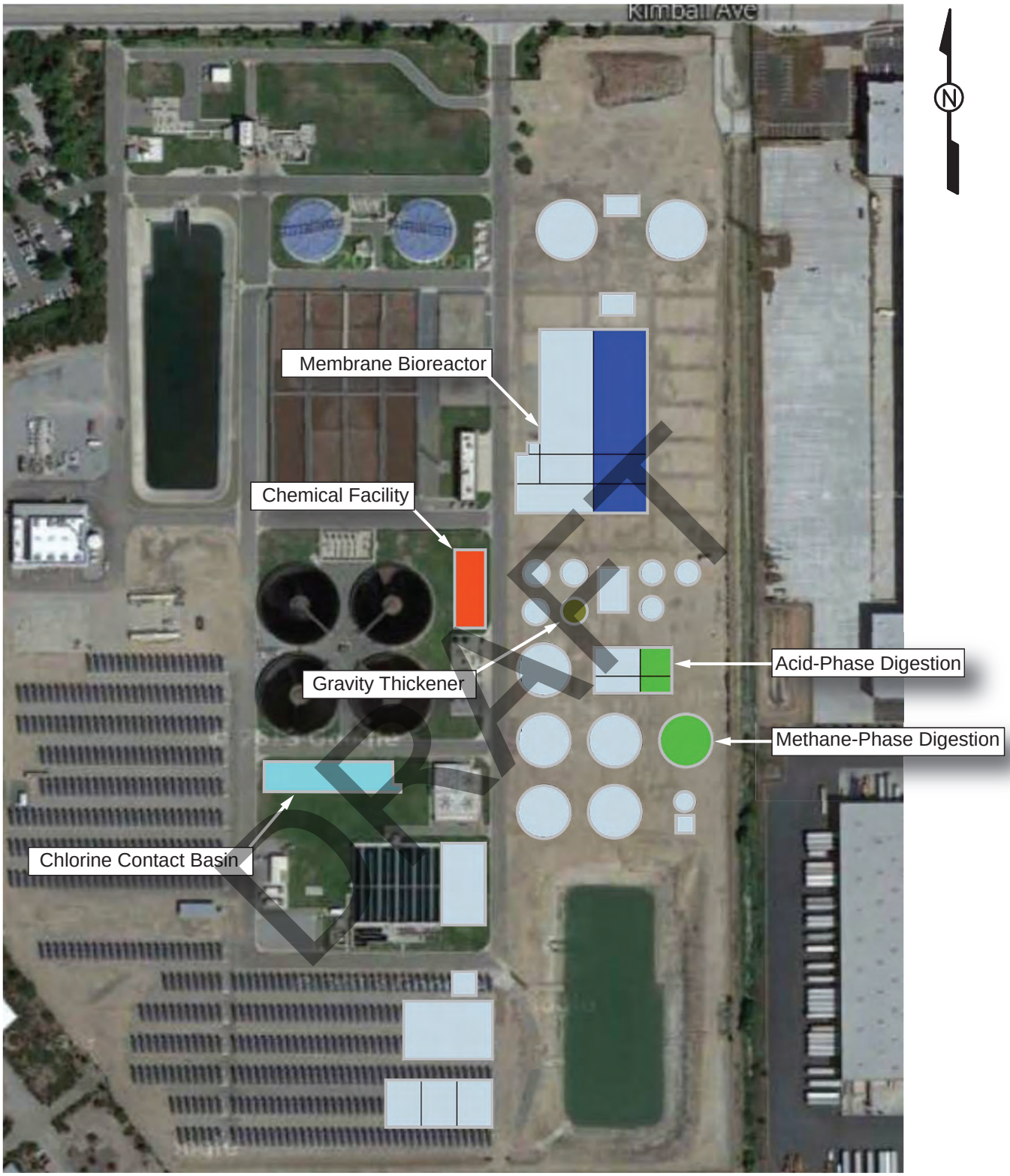
| Facility | Number of Units | Size of Unit |
|---|---|---|
| ***Liquid Treatment*** | | |
| Membrane Bioreactor | 1[a] | 7.5 mgd |
| Chlorine Contact Tank | 1 | 0.8 MG |
| Chemical Facilities | 1 | |
| ***Solids Treatment*** | | |
| Gravity Thickener | 1 | 45-foot diameter |
| ***Anaerobic Digestion*** | | |
| Acid-Phase | 4 Cells | 20- $ft^2$ 30-foot SWD per cell |
| Methane-Phase | 1 | 90-foot diameter 35-foot SWD |

[a] Includes fine screens, bioreactor, blowers, membrane tanks, RAS/WAS pump station, and associated equipment.

## 7.2 Ultimate Facilities Site Plan

The ultimate facilities site plan is presented in Figure 7-11. All proposed solid and liquid facilities expansions are shown.

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Legend:

Planning year 2035.

FIGURE 7-11

## RP-5 FACILITIES - PLANNING YEAR 2060

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# 8.0 20-Year CIP Plant Expansion Projects and Capital Cost

Two plant expansion projects were identified during the 20-year CIP: the RP-5 Solids Handling Facilities Project and the RP-5 Expansion Project. Capital costs were estimated for each project and those costs were placed into the 20-year CIP. The planning level capital costs for each process identified were developed based on cost curves established from previous projects and known direct costs for similar-sized projects. Additionally, several assumptions were made to estimate the total construction cost and total project costs for each expansion project. The assumptions include the following:

- The WFMP assumed a 20-year planning period.
- 10 percent of facilities subtotal for civil/site work.
- 0 to 5 percent of facilities subtotal for demolition depending on existing site conditions.
- 20 percent of facilities subtotal for electrical and instrumentation.
- 10 percent of total direct cost for contractor general conditions.
- 15 percent of total direct cost for contractor overhead and profit.
- 8 percent sales tax was applied to 50 percent of the total direct cost.
- 30 percent for construction contingency.
- 30 percent for engineering, construction management, environmental, and legal costs was applied to the total construction cost to estimate the total project cost.

The total construction cost and total project cost for each expansion project are summarized in Table 7-17.

# 9.0 Conclusion

The following conclusions can be made from the evaluation of RP-2 and RP-5:

- Solids handling facilities will need to be relocated from RP-2 to RP-5 within the 20-year planning period.
- The most favorable location for the relocated RP-2 solids handling facilities is along the east side of the RP-5 site (Alternative 2) near the existing liquid treatment facilities. This alternative has a minimal impact on the existing solar facility.
- The RP-5 liquid treatment facilities will need to be expanded during the 20-year planning period.

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# 10.0 References

DDB Engineering, Inc. (DDB). December 2010. *Inland Empire Utilities Agency Regional Plant No. 5 Title 22 Engineering Report.*

TABLE 7-17
**RP-5 Expansion Projects Capital Cost Estimate**

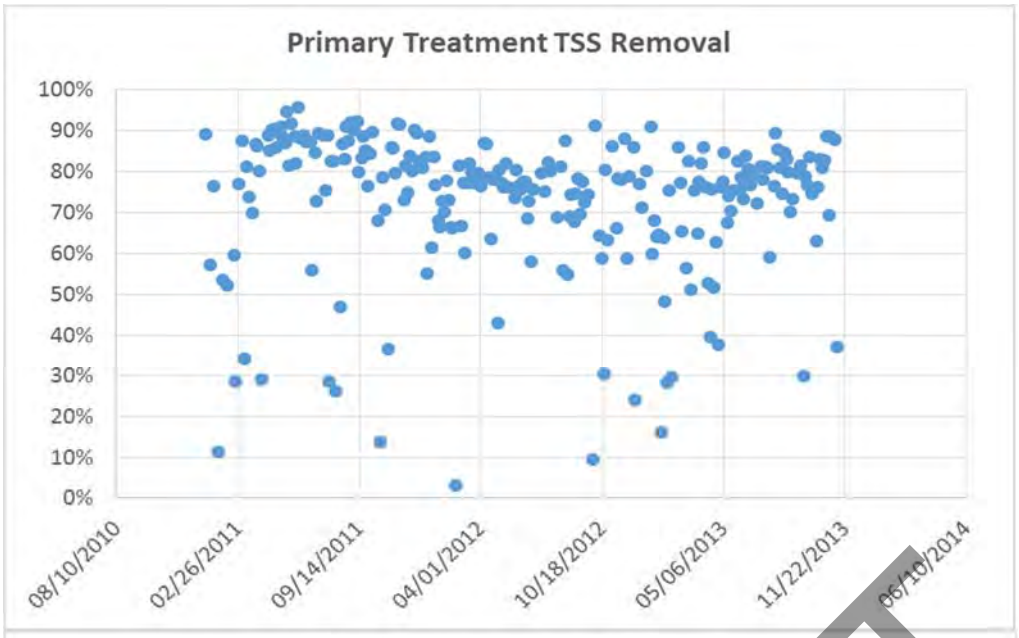
| Component Description | RP-5 Solids Handling Facilities Project[a] | RP-5 Expansion Project |
|---|---|---|
| Primary Clarifiers | | $3,600,000 |
| Primary Sludge Pump Station | | $1,600,000 |
| Secondary Treatment (MBR) – 7.5 mgd | | $30,200,000 |
| Chlorine Contact Basin | | $1,200,000 |
| Gravity Thickener | $2,400,000 | |
| Dissolved Air Flotation Thickening | $4,200,000 | |
| Acid-Phase Digestion | $4,900,000 | |
| Methane-Phase Digestion[b] | $14,000,000 | |
| High-Pressure Gas Storage | $3,000,000 | |
| Dewatering | $10,250,000 | |
| Biofilter | $1,100,000 | |
| **Facilities Subtotal** | **$39,850,000** | **$36,600,000** |
| Civil/Site Work (10%) | $3,985,000 | $3,660,000 |
| Demolition (0%) | $- | $- |
| Electrical and Instrumentation (20%) | $7,970,000 | $7,320,000 |
| **Total Direct Cost[c]** | **$51,805,000** | **$47,580,000** |
| General Conditions (10%) | $5,181,000 | $4,758,000 |
| General Contractor Overhead and Profit (15%) | $7,771,000 | $7,137,000 |
| Sales Tax (8%)[d] | $2,072,000 | $1,903,000 |
| **Subtotal** | **$66,829,000** | **$61,378,000** |
| Construction Contingency (30%) | $20,049,000 | $18,413,000 |
| **Total Estimated Construction Cost[e]** | **$86,878,000** | **$79,791,000** |
| Engineering, Construction Management, Environmental, and Legal Costs (30%) | $26,063,000 | $23,937,000 |
| **Total Estimated Project Costs** | **$112,941,000** | **$103,728,000** |

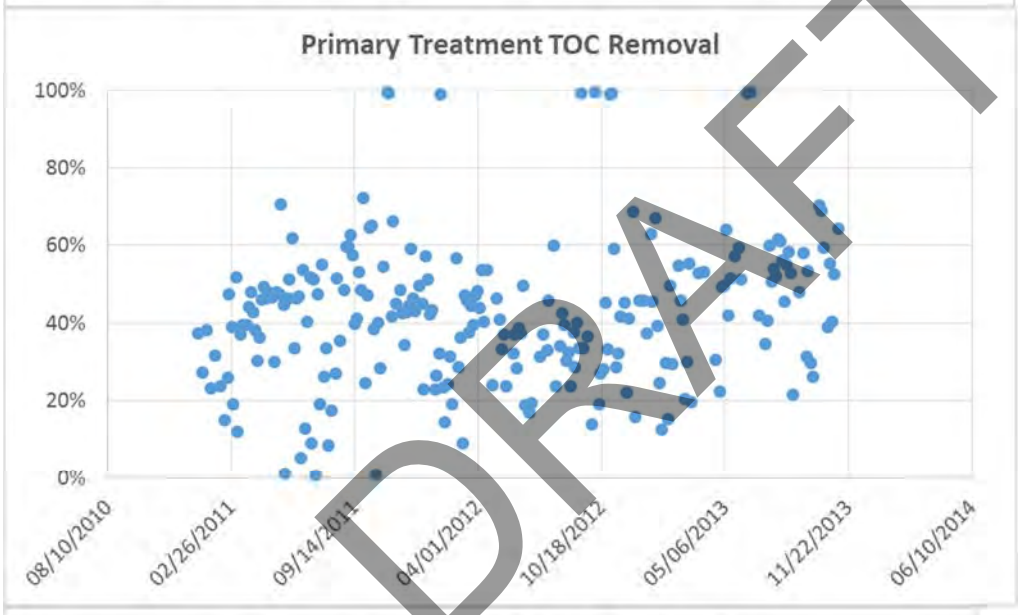
[a] Costs do not include the demolition of the RP-2 facility.
[b] Includes cost of sludge holding tank.
[c] ENR CCI Index for Los Angeles (August 2014 - 10,737).
[d] Calculated assuming 50% of direct costs are taxable.
[e] Cost does not include escalation to midpoint of construction.
*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. The Consultant Team has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices, or bidding strategies. The Consultant Team cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented as shown.*

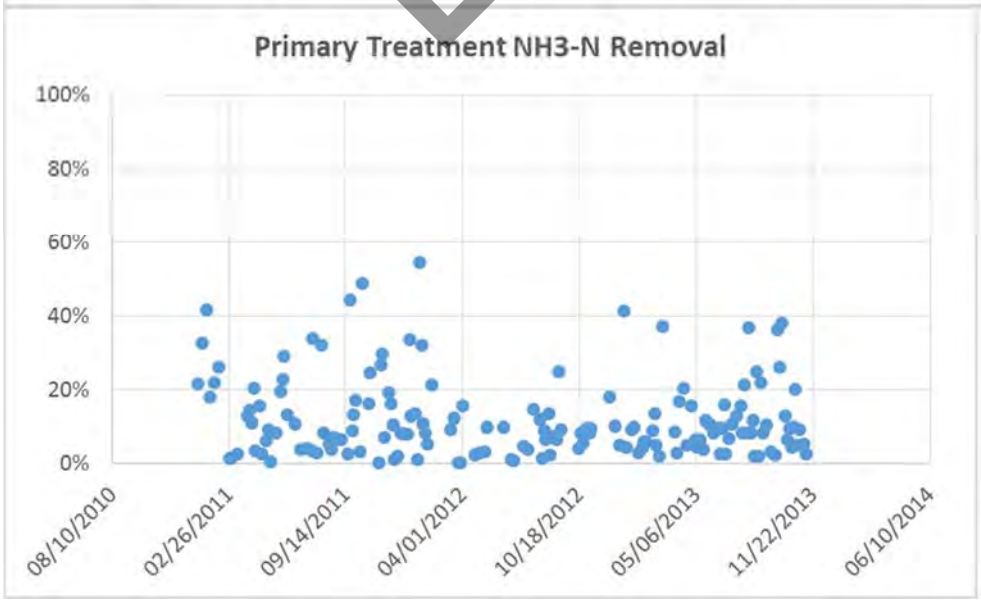
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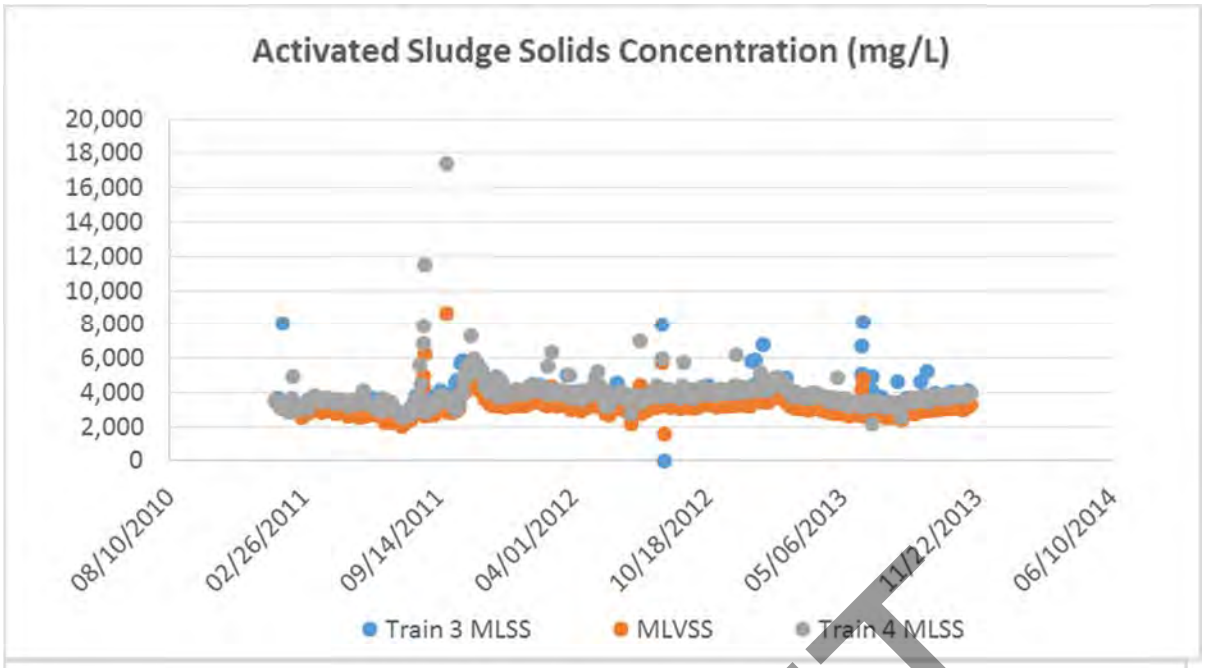
# Appendix 7-A
# RP-5 / RP-2 Plant Operation Summary (2011-2013)

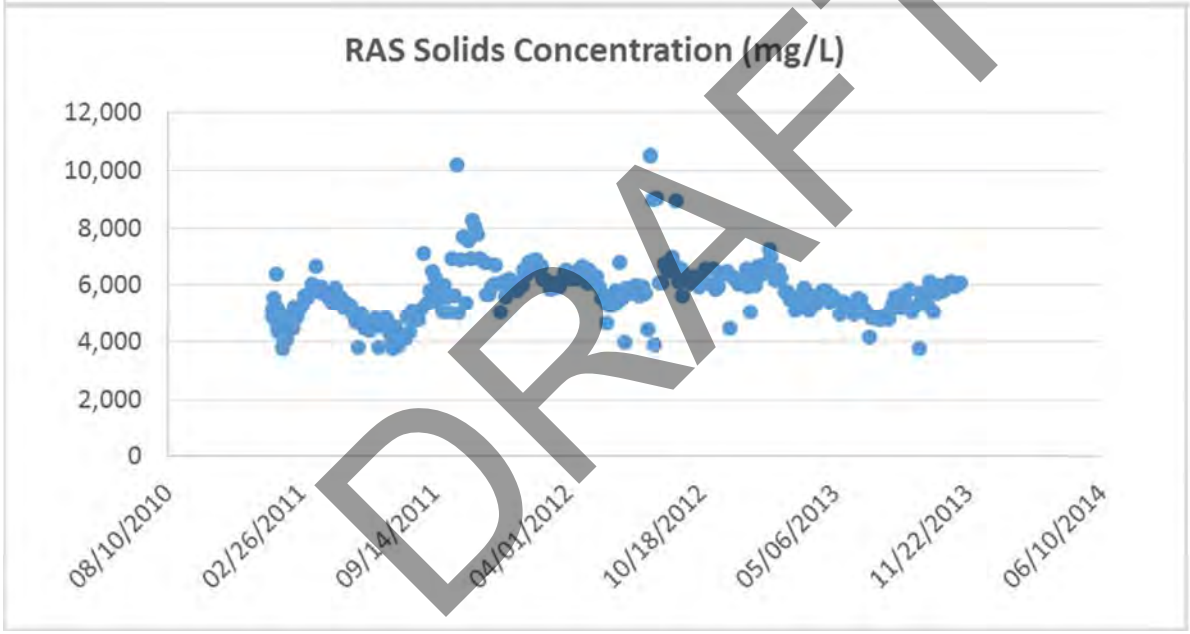

Primary Treatment TSS Removal
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014


Primary Treatment TOC Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014

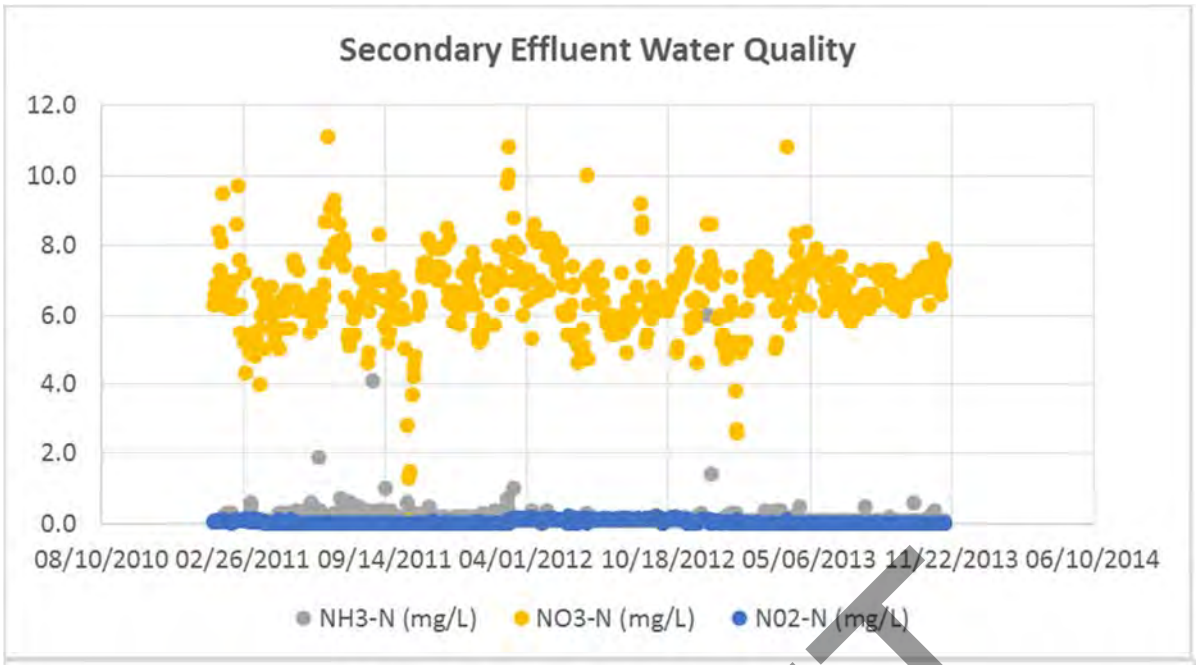

Primary Treatment NH3-N Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014

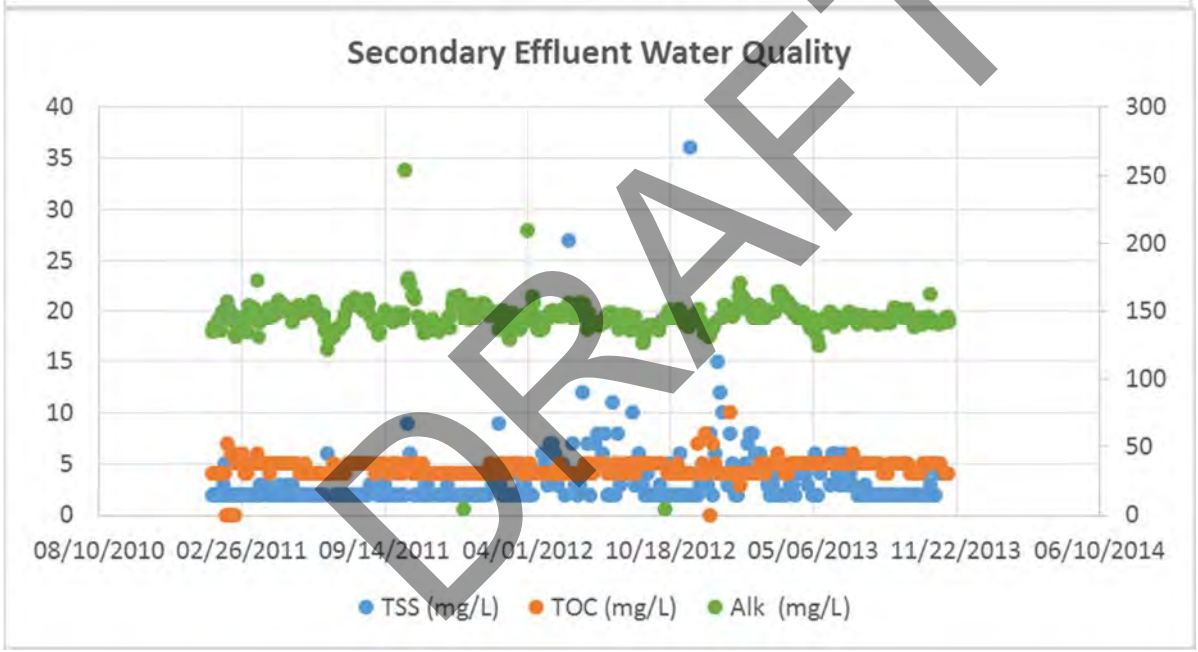
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Activated Sludge Solids Concentration (mg/L)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014
Train 3 MLSS
MLVSS
Train 4 MLSS


RAS Solids Concentration (mg/L)
12,000
10,000
8,000
6,000
4,000
2,000
0
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014

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Secondary Effluent Water Quality
12.0
10.0
8.0
6.0
4.0
2.0
0.0
08/10/2010 02/26/2011 09/14/2011 04/01/2012 10/18/2012 05/06/2013 11/22/2013 06/10/2014
NH3-N (mg/L)
NO3-N (mg/L)
N02-N (mg/L)


Secondary Effluent Water Quality
40
35
30
25
20
15
10
5
0
300
250
200
150
100
50
0
08/10/2010 02/26/2011 09/14/2011 04/01/2012 10/18/2012 05/06/2013 11/22/2013 06/10/2014
TSS (mg/L)
TOC (mg/L)
Alk (mg/L)

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# IEUA Wastewater Facilities Master Plan
# TM 8 CCWRF Future Plans

PREPARED FOR: Inland Empire Utilities Agency

PREPARED BY: Carollo Engineers, Inc.

REVIEWED BY: CH2M HILL

DATE: October 28, 2014

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# Executive Summary

Carbon Canyon Water Recycling Facility (CCWRF) began operation in 1992 and treats wastewater from the Cities of Chino, Chino Hills, Ontario, Montclair, and Upland. CCWRF consists of liquid treatment facilities and sends primary and secondary solids to RP-2 for treatment.

The current and future flows and loads for CCWRF were estimated in *TM 4 Wastewater Flow and Loading Forecast*. An analysis of the influent wastewater characteristics at CCWRF was conducted to establish current average and peak influent flows, concentrations, and loads at the plant, and to develop flow and load projections for the 2035 planning year and the 2060 ultimate buildout year. The influent flow and loading projections and the effluent requirements detailed in the Santa Ana Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0021 were used to evaluate the existing capacities of the CCWRF liquid treatment facilities. The estimated capacities were then compared to the projected flow and loads to determine the CCWRF processes that require expansion within the 20-year planning period and when those facilities would need to be online.

This evaluation indicated that the existing capacity of CCWRF was sufficient to treat predicted flows and loads through planning years 2035 and 2060. No expansion projects are planned during the 20-year planning period.

# 1.0 Background and Objectives

The Inland Empire Utilities Agency (IEUA) contracted with CH2M HILL and Carollo Engineers (Consultant Team) to develop a Wastewater Facilities Master Plan (WFMP). The objective of the WFMP is to plan IEUA's wastewater treatment and conveyance improvements and develop a capital improvement program (CIP). The capital program will guide IEUA in the development of major improvements to their treatment and conveyance facilities. There are five specific goals for this technical memorandum (TM):

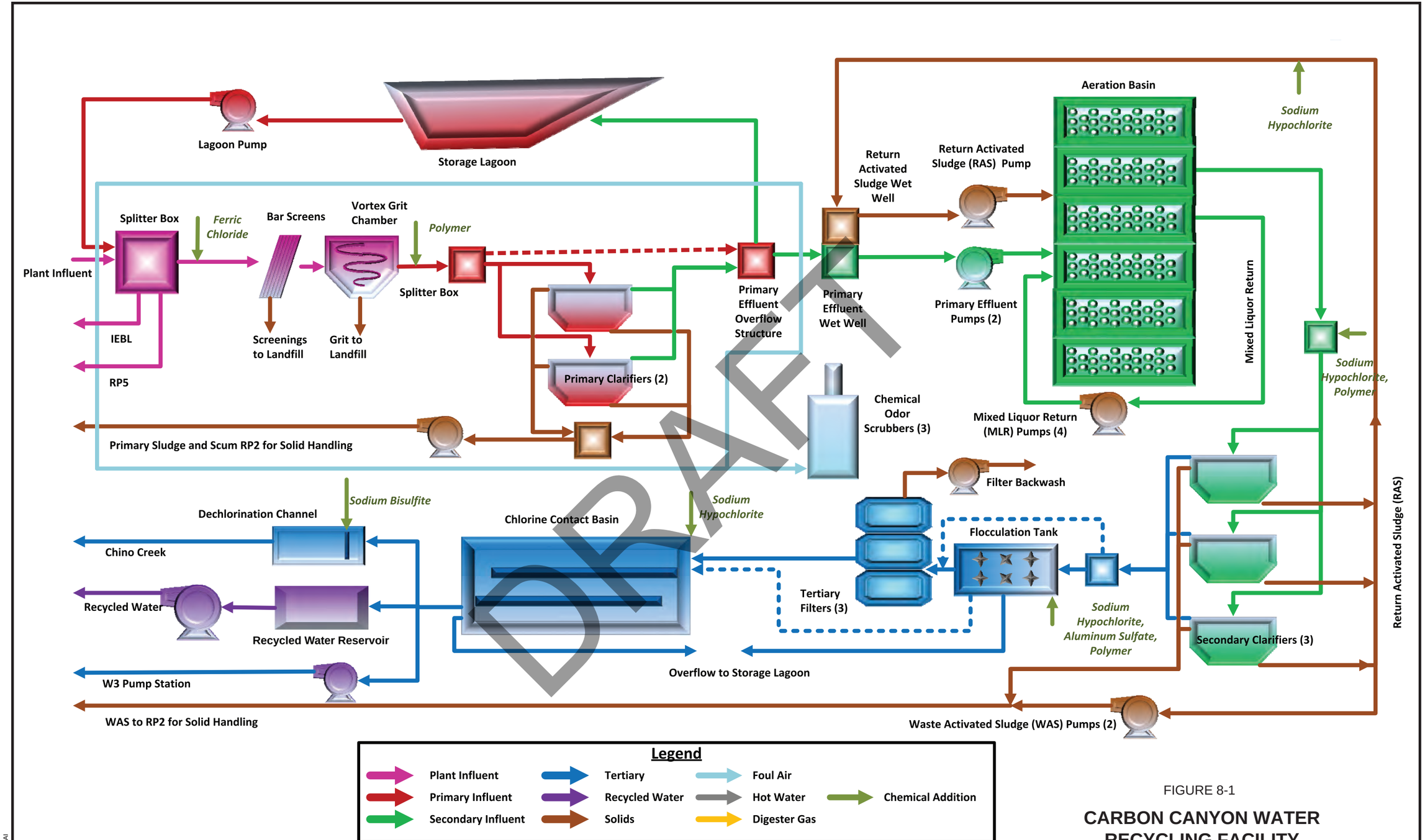
- Summarize information from TMs 1 through 4 as it pertains to CCWRF.
- Evaluate the current capacities and limitations of the existing facilities.
- Determine treatment facilities required to treat predicted flows and loads through planning year 2035.
- Estimate timing and preliminary capital costs for plant expansion projects required during the 20-year planning period.

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# 2.0 CCWRF Overview

Liquid facilities include influent pumping, and preliminary, primary, secondary, and tertiary treatment. The facilities are designed to treat an annual average flow of 11.4 million gallons per day (mgd). A schematic of the CCWRF is shown in Figure 8-1.

Preliminary treatment at CCWRF includes influent diversion, flow measurement, screening, and grit removal. Raw wastewater enters the plant through the influent diversion structure and then is directed to the headworks where it is split between two mechanical bar screens. Following screening, flow enters a vortex grit chamber and is then metered by a Parshall flume. Foul air from the preliminary and primary treatment facilities is sent to a chemical scrubber for treatment and discharge. Primary treatment at CCWRF consists of two 95-foot-diameter, circular primary clarifiers. Ferric chloride is added upstream of the headworks to enhance settling performance. The two clarifiers have a common sludge and scum pump station, which pumps solids to RP-2 for processing.




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FIGURE 8-1

# CARBON CANYON WATER RECYCLING FACILITY PROCESS FLOW SCHEMATIC

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Secondary treatment at CCWRF includes six parallel, two-stage biological nutrient removal activated sludge treatment trains and three circular secondary clarifiers. The aerobic zones are equipped with fine bubble tube diffusers supplied by three centrifugal blowers. Tertiary treatment at CCWRF consists of coagulation/flocculation (not typically used), filtration, and disinfection. Secondary effluent is fed to a rapid mix basin upstream of a baffled, serpentine flocculation basin. After the flocculation basin, secondary effluent is fed to one of three continuous backwash, shallow bed, traveling bridge filters. Following the filter, filter effluent is directed to a chlorine contact basin and finally conveyed to the Recycled Water Pump Station. Disinfection is achieved using sodium hypochlorite, which is added to either the filter influent or effluent and fed to the contact tank. Recycled water is sent to a water storage reservoir prior to being pumped to the distribution system for reuse; excess recycled water is dechlorinated using sodium bisulfite and discharged to Chino Creek. Further details of the facilities are summarized in *TM 1 Existing Facilities*.

# 3.0 Current and Future Flows and Loads

As presented in *TM 4 Wastewater Flow and Loading Forecast*, an analysis of the influent wastewater characteristics at CCWRF was conducted as part of this WFMP effort in order to establish current average and peak influent flows, concentrations, and loads at the plant and to develop flow and load projections for the 2035 planning year and 2060 ultimate buildout year. The data analysis is based on two consecutive years of recent data provided by IEUA for influent flow and key wastewater quality constituents including biological oxygen demand (BOD), total organic carbon (TOC), total suspended solids (TSS), ammonia as nitrogen (NH3-N), and total Kjeldahl nitrogen (TKN).

Flow projections were developed by the Integrated Resources Plan (IRP) Consultant and are based on the average influent wastewater flows measured during the flow monitoring period in November 2013 and projected through the year 2060 using population, employment, and land use information. As discussed in *TM 3 Regional Trunk Sewer Alternatives Analysis*, the WFMP planning effort is based on IEUA's preferred Flow Diversion Alternative 2, which includes diverting flows from Whispering Lakes and Haven Pump Stations to RP-1. The corresponding influent wastewater flow and loading projections under this alternative for the planning year 2035 form the basis of the master planning effort and treatment plant capacity evaluation presented herein. Projections are also presented for the 2060 ultimate buildout year and are used for site planning considerations. Influent wastewater flows are projected to increase slightly at CCWRF between 2020 and 2060 as a result of population growth in areas served by CCWRF.

A summary of the current and projected average influent wastewater flows and loads for CCWRF are presented in Tables 8-1 and 8-2.

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TABLE 8-1
**CCWRF Current and Projected Average Influent Wastewater Flows**

| | Current | 2035[a] | 2060 [a,b] |
|---|---|---|---|
| Average Influent Flow (mgd) | 7.2 | 7.3 | 7.9 |

[a] Projections developed by IRP Consultant and IEUA based on November 2013 flow monitoring period. Reflects projected flows for IEUA preferred Flow Diversion Alternative 2.
[b] Site planning considerations are based on the projections established for the 2060 ultimate buildout planning year.

TABLE 8-2
**CCWRF Current and Projected Average Influent Wastewater Characteristics**

| | Current Concentration (mg/L) | Current Load (lb/day) | 2035 Load[a] (lb/day) | 2060 Load[a] (lb/day) |
|---|---|---|---|---|
| BOD | 455 | 26,839 | 27,708 | 29,985 |
| TSS | 367 | 21,683 | 22,353 | 24,190 |
| NH3-N | 34 | 1,993 | 2,048 | 2,217 |
| TKN | 53 | 3,105 | 3,257 | 3,524 |

[a] Load projections based on projected flows, concentrations, and load peaking factors presented in TM 4.
mg/L – milligrams per liter
lb/day – pounds per day

# 4.0 Treatment Requirements

IEUA operates under an umbrella permit and must meet water quality requirements for discharge and recycled water.

## 4.1 Discharge Requirements

The tertiary effluent from CCWRF is discharged at Reach 2 of Chino Creek (Discharge Point [DP] 004), regulated by RWQCB Order No. R8-2009-0021, which replaced Order No. 01-1 and Order No. 95-43, National Pollutant Discharge Elimination System (NPDES) No. CA 0105279. This permit is an umbrella permit, governing over all of IEUA's water recycling plants (RP-1, RP-4, RP-5, and CCWRF). It includes a stormwater discharge permit and the enforcement of an industrial pretreatment program. Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water-contact recreation. A summary of the main effluent quality limits is provided in Table 8-3.

TABLE 8-3
**Summary of Effluent Quality Limits for RP-5[a]**

| Parameter | Weekly Average | Monthly Average | Annual Average | Daily Maximum | Notes |
|---|---|---|---|---|---|
| BOD | 30 mg/L[(b)] | 20 mg/L[(b)] | - | - | 45 mg/L weekly average and 30 mg/L monthly average with 20:1 dilution. |
| TSS | 30 mg/L[(b)] | 20 mg/L[(b)] | - | - | |
| $NH_4$-N | - | 4.5 mg/L | - | - | |
| Chlorine Residual | - | - | - | 0.1 | Instantaneous maximum ceiling 2 mg/L |
| TIN | - | - | 8 mg/L | - | |
| TDS | - | - | 550 mg/L | - | Shall not exceed 12-month running average TDS concentration in water supply by more than 250 mg/L |
| Turbidity | - | - | - | - | 1. Daily average – 2 NTU<br>2. 5% maximum in 24 hour – 5 NTU<br>3. Instantaneous maximum – 10 NTU |
| Coliform | < 2.2 MPN | - | - | - | Maximum 23 MPN, once per month |
| pH | - | - | - | 6.5 – 8.5 | 99% compliance |

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TABLE 8-3
**Summary of Effluent Quality Limits for RP-5[a]**

| Parameter | Weekly Average | Monthly Average | Annual Average | Daily Maximum | Notes |
|---|---|---|---|---|---|
| Free Cyanide | - | 4.3 µg/L | - | 8.5 µg/L | |
| Bis(2-ethylhexyl) Phthalate | - | 5.9 µg/L | - | 11.9 µg/L | |

[a] RWQCB Order No. R8-2009-0021
[b] Without 20:1 Dilution and for recycled water
TIN – total inorganic nitrogen
NTU – nephelometric turbidity unit(s)
MPN – most probable number
µg/L – micrograms per liter

## 4.2 Recycled Water Requirements

Recycled water from CCWRF is used for irrigation in the area overlying Chino North "Max Benefit" Groundwater Management Zone (DP 008). Recycled water quality requirements are governed under RWQCB Order No. R8-2009-0021 and must meet the discharge requirements set forth in Table 8-3.

# 5.0 Existing Plant Capacity and Limitations

Existing facilities and current plant performance were used as the basis for CCWRF process model development. A whole plant model was developed using PRO2D and calibrated based on plant influent data and plant operations data for the period between October 15, 2011, and October 15, 2013. This period was selected as the basis after a review of influent and plant data to reflect a 2-year-long complete data set. Existing plant operation and the findings of the capacity evaluation through the use of process modeling is presented below for the liquid treatment facilities at CCWRF.

## 5.1 Existing Plant Operation

A summary of CCWRF plant operations is provided in Table 8-4 for the liquid treatment and solids handling facilities. Unit process performance values were averaged over the evaluation period, with operating ranges noted. These values were used in development and calibration of the process models. Detailed data summaries for the evaluation period are provided in Appendix 8-A.

A performance summary for the major treatment processes is presented in Table 8-5. These values, which represent the average over the evaluation period, were used in the subsequent plant process modeling and the capacity evaluations for major treatment units. Detailed data summaries for the evaluation period are provided in Appendix 8-A.

TABLE 8-4
**CCWRF Average Plant Operations Summary**

| Parameter | Value |
|---|---|
| ***Primary Treatment*** | |
| TSS Removal Rate (%) | 73 |
| TOC Removal Rate (%) | 38 |
| Primary Sludge (gpd) | 80,500 |
| ***Secondary Treatment*** | |
| MLSS (mg/L) | 3,500 |

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TABLE 8-4
**CCWRF Average Plant Operations Summary**

| Parameter | Value |
|---|---|
| MLVSS (%) | 84 |
| RAS SS (mg/L) | 7,300 |
| Solids Inventory (Basins Only) (lb) | 260,000 |
| Solids Inventory (Basins, Clarifiers, RAS) (lb) | 281,000 |
| Secondary Clarifier Loading (gpd/$ft^2$) | 550 |
| Secondary Clarifier Loading (lb/d/ $ft^2$) | 16 |
| Basins DO (mg/L) | 1.75 |
| Waste Activated Sludge (WAS) (mgd) | 0.116 |
| SVI (mL/g) | 189 |
| SRT (Basins Only) (day) | 36 |
| Residual Alkalinity (mg as $CaCO_3$/L) | 142 |

Notes:
gpd – gallons per day
lb – pound(s)
RAS – return activated sludge
gpd/ $ft^2$ – gallons per day per square foot
lb/d/ $ft^2$ – pounds per day per square foot
SVI – sludge volume index
SRT – solids retention time
$CaCO_3$/L – calcium carbonate per liter

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TABLE 8-5
**CCWRF Average Plant Performance Summary**

| Parameter | Primary Effluent | Secondary Effluent | Final Effluent |
|---|---|---|---|
| TOC (mg/L) | 138 | 5 | 4.8 |
| BOD (mg/L) | 249 | 1.5 | 1.2 |
| TSS (mg/L) | 83 | 5 | 2 |
| NH3-N (mg/L) | 30 | 0.15 | 0.10 |
| NO3-N (mg/L) | N/A | 4.60 | 4.71 |
| NO2-N (mg/L) | N/A | 0.07 | 0.06 |
| TIN (mg/L) | N/A | 5.0 | 4.87 |
| Alkalinity (mg as $CaCO_3$/L) | N/A | 142 | 138 |

The values above are for the current operation, which includes secondary treatment operation with internal mixed liquor recycling, representing a Modified Ludzack-Ettinger biological nutrient removal (BNR) configuration.

## 5.2 Existing Plant Capacity

### 5.2.1 Process Modeling

The capacity of the existing system was evaluated through process modeling using CH2M HILL's whole plant simulator, PRO2D. PRO2D is a process simulation model that takes into account the mass balances through an entire facility for particulate and soluble components. Similar to other commercially available process models, PRO2D is based on the International Water Association (IWA) ASM2D biological process kinetics. The base model was constructed to reflect the actual facility setup, including flow splits and backwash. The process model facility setup flow diagram is presented in Figure 8-2. The model was constructed with operations and performance criteria reflective of the evaluation period; it was then calibrated to reflect the actual performance, solids yields and water quality data.

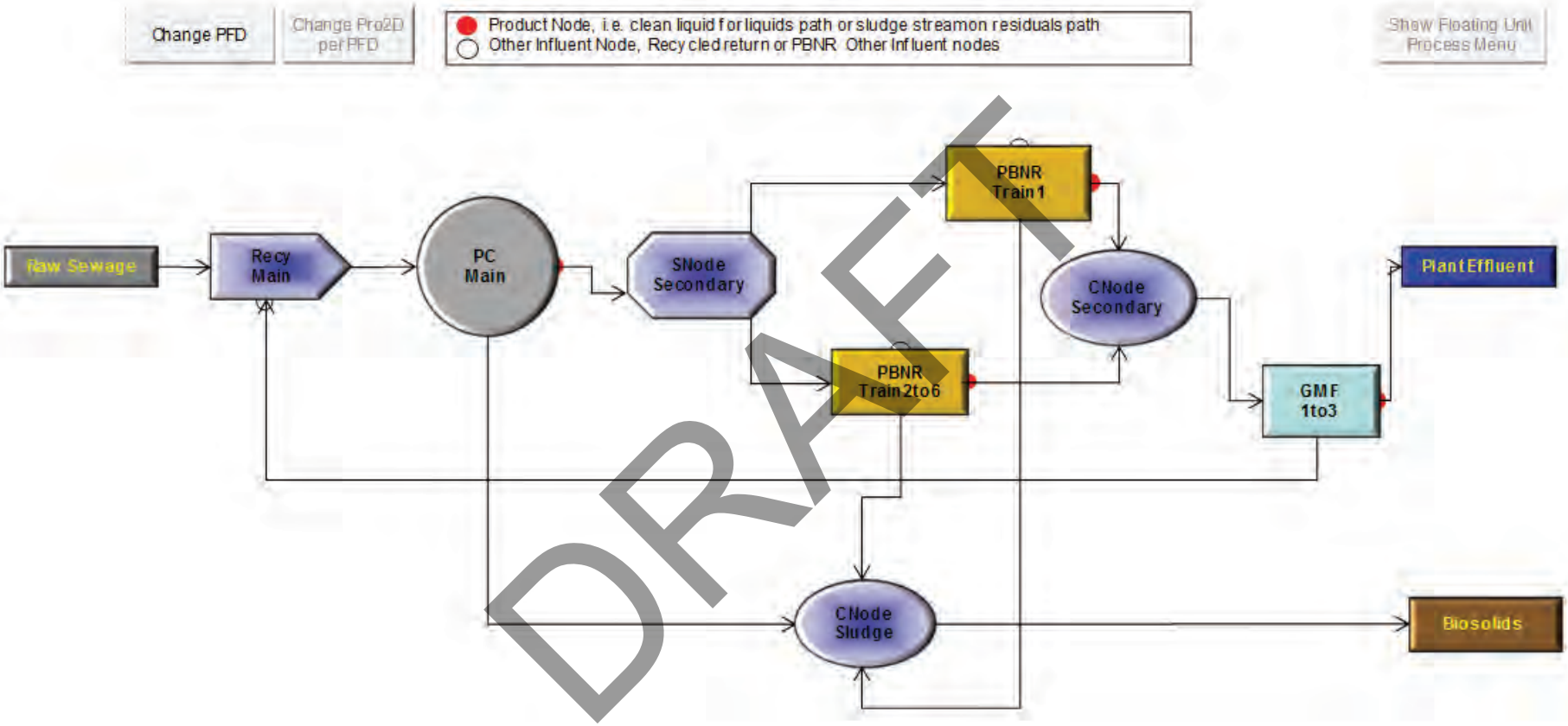
As shown in Figure 8-2, the model was constructed to represent the actual plant operation for all the major process units. The model also allows establishing sizing and design considerations for each major unit process tankage and equipment. Similar to the actual operations, the plant model was built with the filter backwash and solids thickening recycles being returned to the main plant for further treatment, with the dewatering recycles being diverted offsite. The liquid and solids mass balances calculated for the current conditions allow calibration of the model against the actual field data. The calibrated model is then used to evaluate current capacity as well as establish expansion needs and process bottlenecks.

The process model was constructed and calibrated using the current influent and operating data available for the facility. The purpose of the model calibration step is to establish a baseline condition that closely resembles current operations and provides a means to reliably predict operations and system limitations under different scenarios or alternatives. Key model calibration results are presented in Table 8-6. As the listed values show, the model was calibrated such that the simulation results and actual plant data are within a value range that is 5 percent or smaller relative to the actual data. This level of accuracy will allow reliable capacity estimations to be made for the various capacity scenarios and future operation needs.

TABLE 8-6
**CCWRF Average Plant Performance Summary**

| Parameter | Actual Data Average Values | Model Results |
|---|---|---|
| Effluent BOD (mg/L) | 1.5 | 1.5 |
| Effluent TSS (mg/L) | <5 | <5 |
| Effluent TIN (mg/L) | 4.71 | 4.86 |
| Effluent Alkalinity (mg as $CaCO_3$/L) | 138 | 141 |
| Train 2-6 MLSS Inventory (lb) | 215,600 | 217,320 |
| Train 1 MLSS Inventory (lb) | 44,200 | 43,960 |
| Sludge VS Content | 84 | 84 |
| Total Waste Solids (Dry Solids lb/d) | 7,000 | 6,720 |
| Total Primary Sludge (gpd) | 80,500 | 80,720 |
| Filter Backwash (gpd) | 90,200 | 91,200 |

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FIGURE 8-2

## CCWRF PROCESS MODEL FACILITY SETUP

Subsequent process modeling using the calibrated model as the base model was conducted to evaluate the following scenarios:

- Current Plant Capacity
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under flow and load conditions
  - Liquid treatment capacity to meet 8-mg/L effluent TIN level under maximum month flow and load conditions
  - Solids generation rates under average and maximum month flow and load conditions
- Future capacity implications for the planning year 2035
- Future facility footprint implications for the planning years 2035 and 2060

Findings of the current plant capacity evaluation are presented next in this section. Future capacity needs are presented in Section 6.0.

### 5.2.2 Liquid Treatment Capacity

An evaluation of the liquid treatment capacity was conducted using the whole plant process model under both the average and maximum month conditions. The capacity evaluation was conducted based on achieving a plant effluent TIN concentration of 8 mg/L. As established at the onset of the project, the facility reliability and redundancy considerations are based on the IEUA's overall wastewater treatment system, with RP-5 being the end of the line facility receiving all flow diversions if needed from other Regional Water Recycling Plants. Since redundancy is provided by taking the largest unit out of service for each process at RP-5, the CCWRF plant capacity is based on all CCWRF units in service.

The facility has two primary clarifiers in service. The average hydraulic loading rates with two units in service are around 1,100 gpd/ $ft^2$. Under peak day, and especially if one unit needs to be taken out of service, the primary clarifiers will be hydraulically overloaded. Considering that flow diversion to RP-5 is available for times if a primary clarifier needs to be taken out of service, the facility will need to operate at a lower treatment capacity under these temporary conditions. Alternatively, chemically enhanced primary treatment (CEPT) could be implemented under these conditions to avoid overloading the downstream secondary treatment system.

Waste solids (primary sludge and WAS) generated at CCWRF are diverted to RP-2 currently. CCWRF waste solids will continue to be diverted offsite, either to RP-2 or to the new solids handling facility that will be located at the RP-5 site. Therefore, there are no solids handling recycles processed at this facility.

Process modeling showed that the liquid treatment capacity is also limited by the secondary treatment system. One of the limitations was found to be the aeration and the ability to control dissolved oxygen (DO) in the anoxic and oxic zones in the aeration basins. The implications of DO are TIN fluctuations in the effluent and SVI values that are greater than 180 milliliters per gram (mL/g), which indicates sludge settleability could be impaired at times. Another limitation of the secondary treatment system was found to be the secondary clarification solids loading resulting from the current operations and the influent wastewater solids loading rates. Maintaining the SVI values at or below 150 mL/g is important for this reason also. Primary and secondary treatment capacity is presented in Table 8-7.

TABLE 8-7
**CCWRF Existing Primary/Secondary Treatment Capacity**

| | All Units in Service | One Unit Out of Service[a] |
|---|---|---|
| Capacity with Effluent TIN $\leq$ 8 mg/L | 14 mgd | 12 mgd |

[a] One secondary clarifier out of service.

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The CCWRF tertiary filters were designed based on a California Department of Public Health (CDPH) maximum filter loading rate of 4.0 gpm/ft$^2$ for shallow bed sand filters (RWQCB, 2010). As indicated in the Title 22 Engineering Report (DDB Engineering, Inc. [DDB], 2014) and confirmed by IEUA, the filters are rated based on all three filters in service, with average capacity equal to maximum capacity, on the premise that reliability and redundancy are provided by the ability to discharge peak flows to RP-5, the availability of short-term onsite storage, the availability of standby equipment, and the use of automatic flow controls. In order not to exceed the maximum approved filter loading rate, the maximum flow that the filtration system can handle is 27.6 mgd. Given the flexibilities discussed above, the Title 22 Engineering Report equates the average flow for the plant to the peak flow. As such, the CCWRF average filtration capacity is reported as 27.6 mgd in the current Title 22 report.

The disinfection system was designed based on the Title 22 concentration-time (CT) and modal contact requirements of 450 milligrams per minute per liter (mg-min/L) and 90 minutes during the peak hourly dry weather flow, respectively. Tracer testing conducted at CCWRF in 2004 showed that the disinfection system can handle a peak flow of 15.4 mgd while maintaining a modal contact time of 90 minutes (DDB, 2014). The resulting average disinfection capacity is therefore also 15.4 mgd for the reasons discussed above. The results of the tertiary capacity evaluation are summarized in Table 8-8.

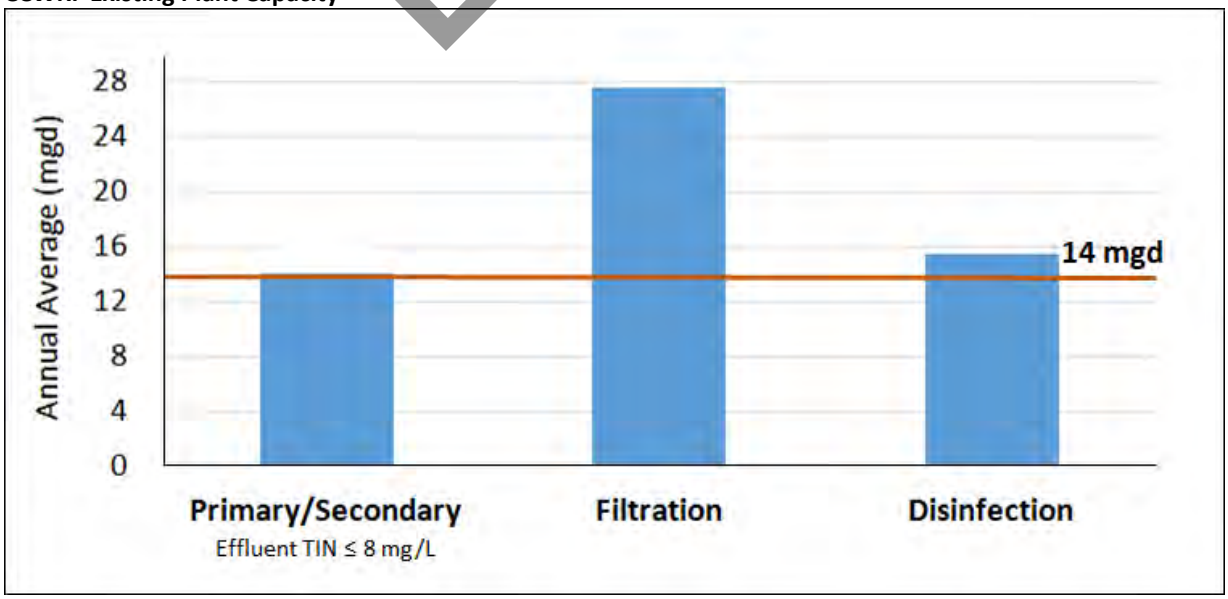
TABLE 8-8
**CCWRF Existing Tertiary Treatment Capacity**

| | All Units in Service | One Filter Out of Service |
|---|---|---|
| Average Filtration Capacity[a] | 27.6 mgd | 18.4 mgd |
| Average Disinfection Capacity[a] | 15.4 mgd | N/A |

[a] Per Title 22 Engineering Report, the reliable annual average capacity is equal to peak capacity due to the ability to discharge to RP-5, availability of short-term onsite storage, standby equipment, and use of automatic flow controls to provide reliability and redundancy.

The overall plant capacity is determined by its most limiting process capacity. As shown in Figure 8-3, the limiting treatment process is the secondary treatment system. Therefore, the average CCWRF plant capacity is 14 mgd under the current wastewater flow and loads, as well as the reliability and redundancy considerations outlined previously.

FIGURE 8-3
**CCWRF Existing Plant Capacity**




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# 6.0 Plant Expansion Needs

CCWRF has sufficient capacity to treat estimated flows and loads presented in Section 3.0 for planning years 2035 and 2060. There are no expansion projects planned for CCWRF during the 20-year planning period.

## 6.1 Facility Expansion Requirements

There are no projects planned for CCWRF in planning years 2035 or 2060.

## 6.2 Ultimate Facilities Site Plan

As there are no projects planned for the expansion of CCWRF, the plant will remain as currently operated. Figure 8-4 presents the current site layout, which is estimated to be the ultimate facilities site plan.

# 7.0 20-Year CIP Plant Expansion Projects and Capital Cost

CCWRF has sufficient capacity to treat estimated flows and loads projected for planning years 2035 and 2060. No expansion projects are planned during the 20-year planning period.

# 8.0 Conclusion

The following conclusions can be made from the evaluation of CCWRF:

- CCWRF has sufficient capacity to treat predicted liquid flows through the 20-year planning period.

# 9.0 References

DDB Engineering, Inc. (DDB). 2014. *Inland Empire Utilities Agency Carbon Canyon Water Recycling Facility Title 22 Engineering Report.* March.

Regional Water Quality Control Board (RWQCB). 2010. *Effluent Monitoring Point and Filter Loading Rate Approval – Waste Discharge and Producer/User Reclamation Requirements Order No. R8-2009-0021 for the Inland Empire Utilities Agency.* July 30.

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FIGURE 8-4

## CCWRF ULTIMATE FACILITIES SITE PLAN

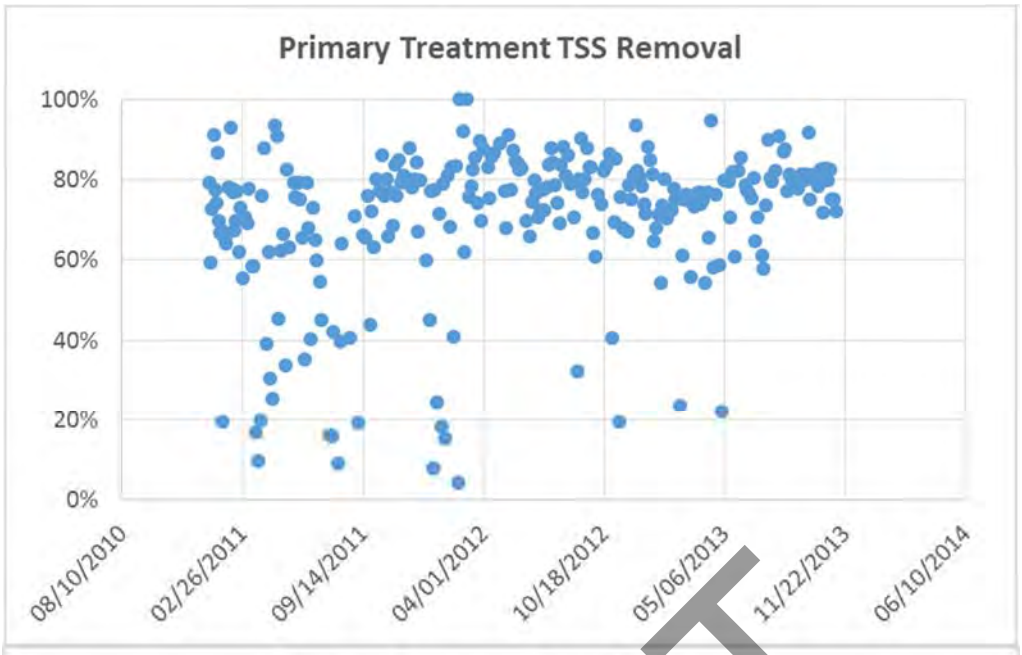
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*WASTEWATER FACILITIES MASTER PLAN*

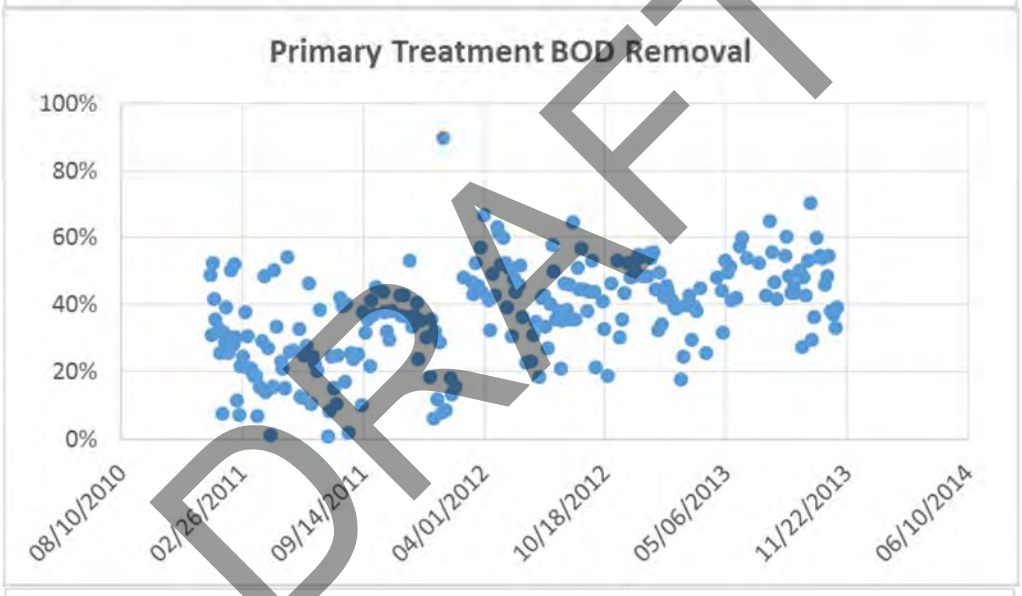
CH2MHILL® carollo
Engineers...Working Wonders With Water®

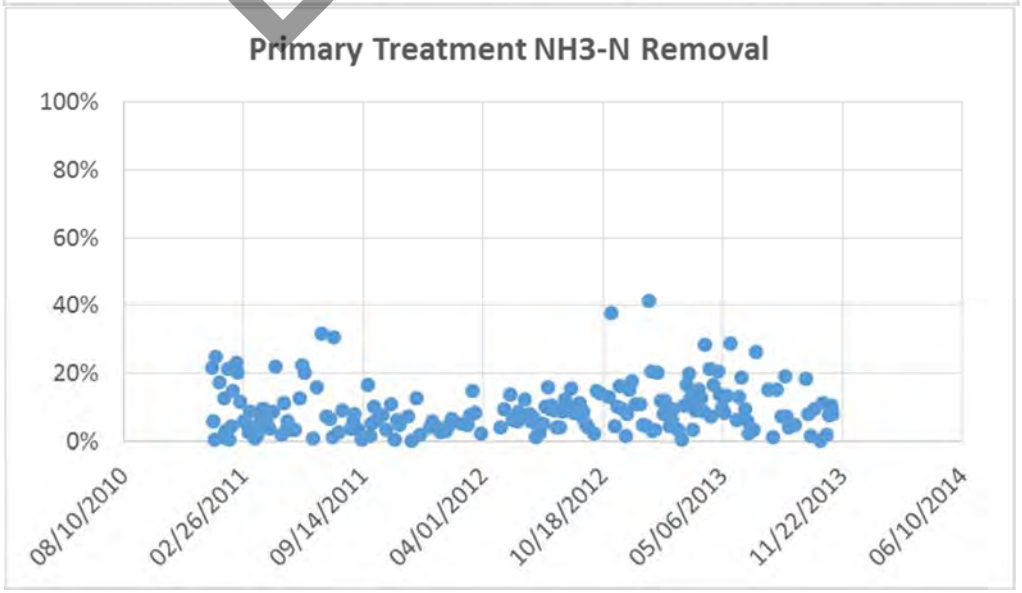
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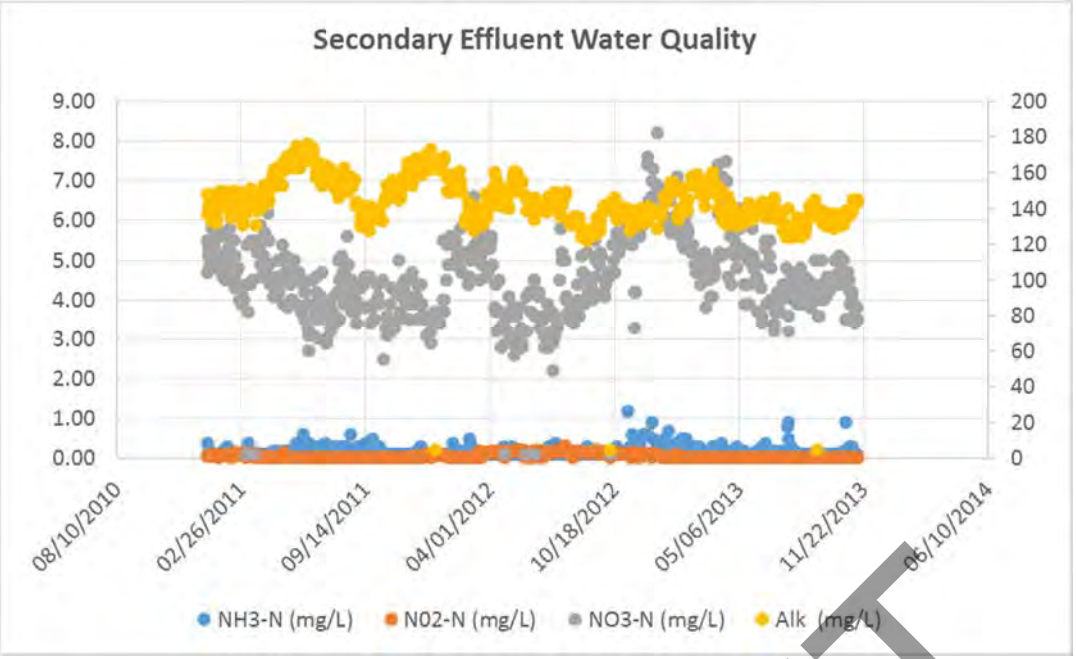
# Appendix 8-A
# CCWRF Plant Operations Summary (2011-2013)


Primary Treatment TSS Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014

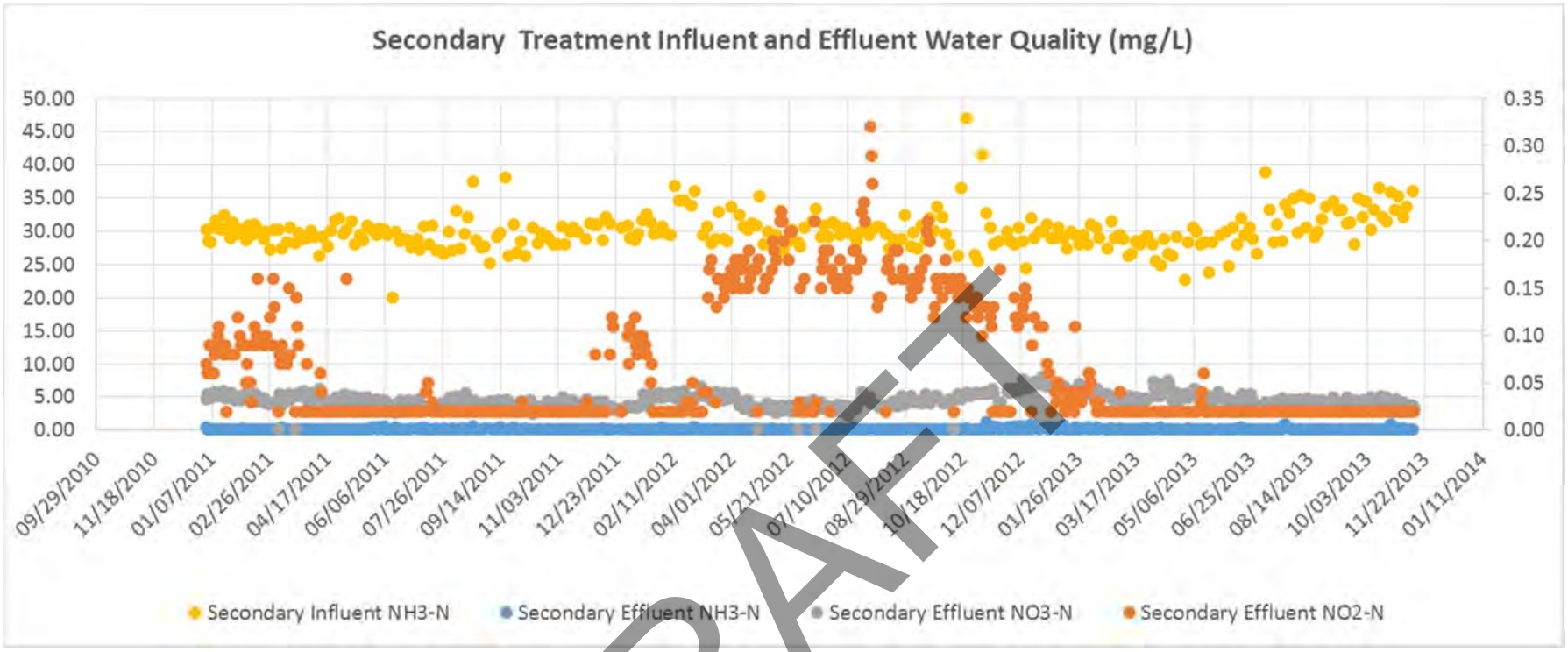

Primary Treatment BOD Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014


Primary Treatment NH3-N Removal
100%
80%
60%
40%
20%
0%
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014

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Secondary Effluent Water Quality
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
200
180
160
140
120
100
80
60
40
20
0
08/10/2010
02/26/2011
09/14/2011
04/01/2012
10/18/2012
05/06/2013
11/22/2013
06/10/2014
NH3-N (mg/L)
N02-N (mg/L)
NO3-N (mg/L)
Alk (mg/L)

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Secondary Treatment Influent and Effluent Water Quality (mg/L)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
09/29/2010
11/18/2010
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11/22/2013
01/11/2014
Secondary Influent NH3-N
Secondary Effluent NH3-N
Secondary Effluent NO3-N
Secondary Effluent NO2-N

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# IEUA Wastewater Facilities Master Plan
# TM 9 Organics Management Plan

PREPARED FOR: Inland Empire Utilities Agency

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DATE: October 30, 2014

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# Executive Summary

The purpose of the Inland Empire Utilities Agency (IEUA) Organics Management Plan is to assess the existing solids handling and composting capacities within the northern and southern service areas and determine the facilities expansion needs through the ultimate buildout year 2060 based on the projected plant influent flows and loads, and the corresponding projected biosolids quantities. Based on the influent flow and load projections presented in *Technical Memorandum (TM) 4 Wastewater Flow and Loading Forecast*, the solids handling facilities at RP-1 and RP-5/RP-2 will need to be expanded beyond their existing solids handling capacities of 38 million gallons per day (mgd) and 18 mgd, respectively, to meet future demands in the northern and southern service areas, respectively. RP-1 solids handling will require the addition of anaerobic digesters, while RP-5/RP-2 solids handling facilities need to be relocated to RP-5. The RP-2 solids handling facilities will need to be decommissioned and relocated to the RP-5 site by 2023 in anticipation of the United States Army Corps of Engineers (USACE) raising the Prado Spillway. New RP-5 solids handling facilities to be completed by 2035 include thickening, anaerobic digestion, dewatering, digester gas storage and utilization, and odor control. Additional thickening and digestion capacity would be needed at RP-5 by 2060 to meet the projected demands in the southern service area.

As a result of the anticipated increased flows and loads to each plant, the estimated biosolids quantities from the northern and southern service areas are projected to reach up to 198 wet tons per day by 2035 and 241 wet tons per day by 2060. Based on recent discussions with the Inland Empire Regional Composting Facility (IERCF) Manager of Operations and Organics, the facility currently has a throughput capacity of 209,625 annual wet tons of biosolids and amendment permitted by the Air Quality Management District (AQMD). Based on the joint powers agreement, IEUA may contribute up to half of this amount, which equates to 200 wet tons of biosolids per day. Thus, IERCF has adequate capacity to receive and process IEUA biosolids over the next 20 years. However, the projected ultimate biosolids are expected to surpass the current permitted capacity of IERCF by 2060, at which time IEUA needs to explore additional biosolids management options. Options may include implementing technologies such as heat drying, improved dewatering technologies to reduce the amount of wet tons produced, or diversifying biosolids management by contracting with private companies for land application, composting, energy production, and other biosolids product markets.

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# 1.0 Background and Objectives

As part of the Wastewater Facilities Master Plan (WFMP) effort, CH2M HILL and Carollo Engineers (the Consultant Team) have prepared this Organics Management Plan TM to summarize existing solids handling and composting facility capacities, establish biosolids projections through the ultimate buildout year 2060, and determine expansion needs for solids handling and composting facilities within the service area.

The expected solids generation in wet and dry tons per day from now until ultimate buildout was calculated based on the current wastewater characteristics and projected influent wastewater flows to each of the four Regional Water Recycling Plants (RWRPs) established in *TM 4 Wastewater Flow and Loading Forecast* as the basis of all capacity and planning considerations. Projected biosolids quantities were then compared to the existing capacity of the solids handling and composting facilities to assess the biosolids handling capacity requirements for the biosolids generated in the northern and southern portions of the IEUA service area, and determine what options are available for expansion, if expansion is deemed necessary.

As discussed in *TM 7 RP-5 and RP-2 Complex Future Plans*, the RP-2 solids handling facilities will need to be decommissioned and relocated to the RP-5 site by 2023 in anticipation of the USACE raising the Prado Spillway. For the northern part of the service area, the Consultant Team will determine the timing needed for developing a management strategy for handling the biosolids based on how long it may take to develop a strategy and when the current capacity will be exceeded.

# 2.0 Organics Management Plan Overview

The existing solids handling and composting facilities are described in *TM 1 Existing Facilities*. As presented in TM 1, biosolids are produced at each of the four RWRPs and require stabilization and beneficial use. Currently, IEUA operates two solids handling facilities located at RP-1 and RP-2. RP-1 solids handling processes treat biosolids produced at RP-1 and RP-4, while RP-2 solids handling processes treat biosolids produced at RP-5 and Carbon Canyon Water Recycling Facility (CCWRF). Biosolids are thickened, stabilized, and dewatered at RP-1 and RP-2 and then trucked to IERCF for composting. IERCF is operated by the Inland Empire Regional Composting Authority (IERCA), which was created by a joint powers agreement between IEUA and the Sanitation Districts of Los Angeles County (Sanitation Districts). IERCF accepts biosolids from both IEUA and the Sanitation Districts treatment facilities and produces a high-quality soil amendment.

# 3.0 Projections of Biosolids Quantities

In the northern service area, IEUA currently produces approximately 100 wet tons of biosolids per day at 24 percent solids content on average. In the southern service area, IEUA produces approximately 45 wet tons per day at 24 percent solids content on average. The resulting total biosolids production is currently about 145 wet tons per day.

With influent wastewater flows projected to increase through the ultimate buildout year 2060 as a result of increased population growth and incorporation of septic flows into the IEUA system, biosolids production is similarly expected to increase. Biosolids projections are calculated based on the projected influent flows to each RWRP and the wastewater characteristics established for each RWRP. A detailed discussion of the influent flow and load projections is presented in *TM 4 Wastewater Flow and Loading Forecast*. The projected average biosolids quantities for the northern and southern service areas for the 2035 and 2060 planning years are presented in Table 9-1.

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TABLE 9-1
**Estimated Current and Projected Average Biosolids Quantities**

| | Current | | | Planning Year 2035[a] | | | Planning Year 2060[a,b] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Influent Flow (mgd) | Biosolids (WT/d) | Biosolids (DT/d) | Influent Flow (mgd) | Biosolids (WT/d) | Biosolids (DT/d) | Influent Flow (mgd) | Biosolids (WT/d) | Biosolids (DT/d) |
| RP-1 / RP-4 | 38.5 | 100 | 24 | 47.8 | 130 | 31 | 54.7 | 139 | 33 |
| RP-5 / CCWRF | 17.2 | 45 | 11 | 25.7 | 68 | 16 | 33.2 | 102 | 25 |
| Total | 55.7 | 145 | 35 | 73.5 | 198 | 47 | 87.9 | 241 | 58 |

[a] Reflects projected flows for IEUA preferred Flow Diversion Alternative 2, with Whispering Lakes and Haven Pump Stations online, and a biosolids cake solids content of 24 percent.
[b] Site planning considerations are based on the projections established for the 2060 ultimate planning year.
WT/d = wet tons per day
DT/d = dry tons per day
TS = total solids

As listed in Table 9-1, the northern service area biosolids production is projected to increase by 30 percent from 100 to 130 wet tons per day by 2035, to as much as 139 wet tons per day by 2060. In comparison, the southern service area biosolids production is projected to increase by 51 percent from 45 to 68 wet tons per day by 2035, to as much as 102 wet tons per day by 2060, which is aligned with the projected increase in plant flows and loads. Overall, the total biosolids production is projected to increase by 37 percent from 145 to 198 wet tons per day by 2035, and up to 241 wet tons per day by 2060.

# 4.0 Summary of Existing Solids Handling Facilities Capacities

The existing capacity of the solids handling facilities and the composting facility are summarized briefly in this section. A description of each facility is presented in *TM 1 Existing Facilities*, and a detailed discussion of the capacity evaluation of each solids handling facility is presented in *TM 5 RP-1 Future Plans* and *TM 7 RP-5 and RP-2 Complex Future Plans.*

## 4.1 RP-1 Solids Handling Facilities

Solids removed from RP-1 and RP-4 liquid streams are processed in the RP-1 solids handling facilities. The RP-1 solids handling facilities consist of thickening, stabilization, and dewatering processes. Two thickening processes are in operation at RP-1: gravity thickening for primary solids, and dissolved air flotation (DAF) thickening for secondary solids. Thickened waste solids from the primary and secondary processes are stabilized in a three-stage anaerobic digestion process, which consists of acid and gas (thermophilic and mesophilic) digestion stages. Digested solids are then dewatered using centrifuges. Dewatered biosolids are loaded onto trucks and delivered to IERCF for composting.

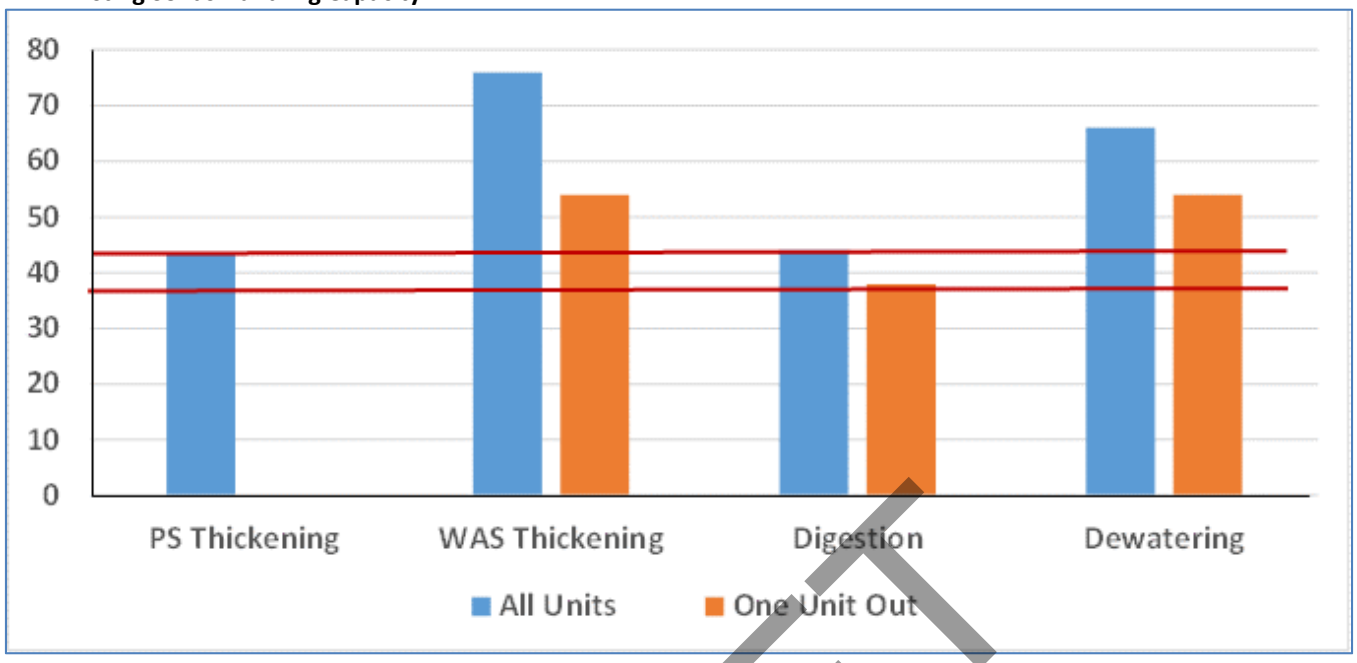
As presented in *TM 5 RP-1 Future Plans*, the existing RP-1 solids handling capacity is limited to 38 mgd due to digestion capacity limitations with one digester out of service. The plant influent includes the RP-4 solids diverted to RP-1 via the sewer system for further treatment. Primary sludge thickening is currently achieved using one gravity thickener. Having a single thickener was not considered a key concern by IEUA staff since thickening can be achieved in the primary clarifiers if the gravity thickener is taken out of service. The capacity of the DAF thickeners was evaluated using a maximum solids loading rate of 45 pounds per day per square foot. Waste solids digestion, achieved in the phased digestion system, was evaluated based on the current operating conditions as well as Part 503 Rule requirements for Class B biosolids. Digester loading rates and a digester solids retention time (SRT) of 15 days with one large unit out of service were used to establish digestion capacity, using an active digester volume of 90 percent of the total digester volume including the cone space. Dewatering capacities of the centrifuges were calculated considering the hydraulic loading rate to be maintained at or below 340 gallons per minute (gpm) under the current solids loading conditions. The existing RP-1 solids handling process capacities are summarized in Table 9-2 and illustrated in Figure 9-1.

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TABLE 9-2
**RP-1 Existing Solids Handling Capacity**

| | All Units in Service | One Unit Out of Service |
|---|---|---|
| Primary Sludge Thickening | 43.3 mgd | 0 mgd |
| Waste Activated Sludge Thickening | 76 mgd | 54 mgd |
| Digestion | 44 mgd | 38 mgd |
| Dewatering | 66 mgd | 54 mgd |

FIGURE 9-1
**RP-1 Existing Solids Handling Capacity**




## 4.2 RP-5/RP-2 Solids Handling Facilities

### 4.2.1 RP-2 Solids Handling Facilities

Solids removed from the RP-5 and CCWRF liquid streams are processed in the RP-2 solids handling facilities. RP-5 and CCWRF primary and secondary solids are individually conveyed to RP-2 for treatment. The RP-2 solids handling facilities consist of thickening, stabilization, and dewatering processes. There are two thickening processes in operation at RP-2: gravity thickening for primary solids, and DAF thickening for secondary solids. Thickened solids from the primary and secondary processes are stabilized in a two-stage anaerobic digestion process, which consists of mesophilic-acid and mesophilic gas digestion stages. Digested biosolids are then dewatered using belt filter presses or centrifuges. Currently, the belt filter presses are in operation with the centrifuges on standby. Dewatered biosolids are loaded onto trucks and delivered to IERCF for composting.

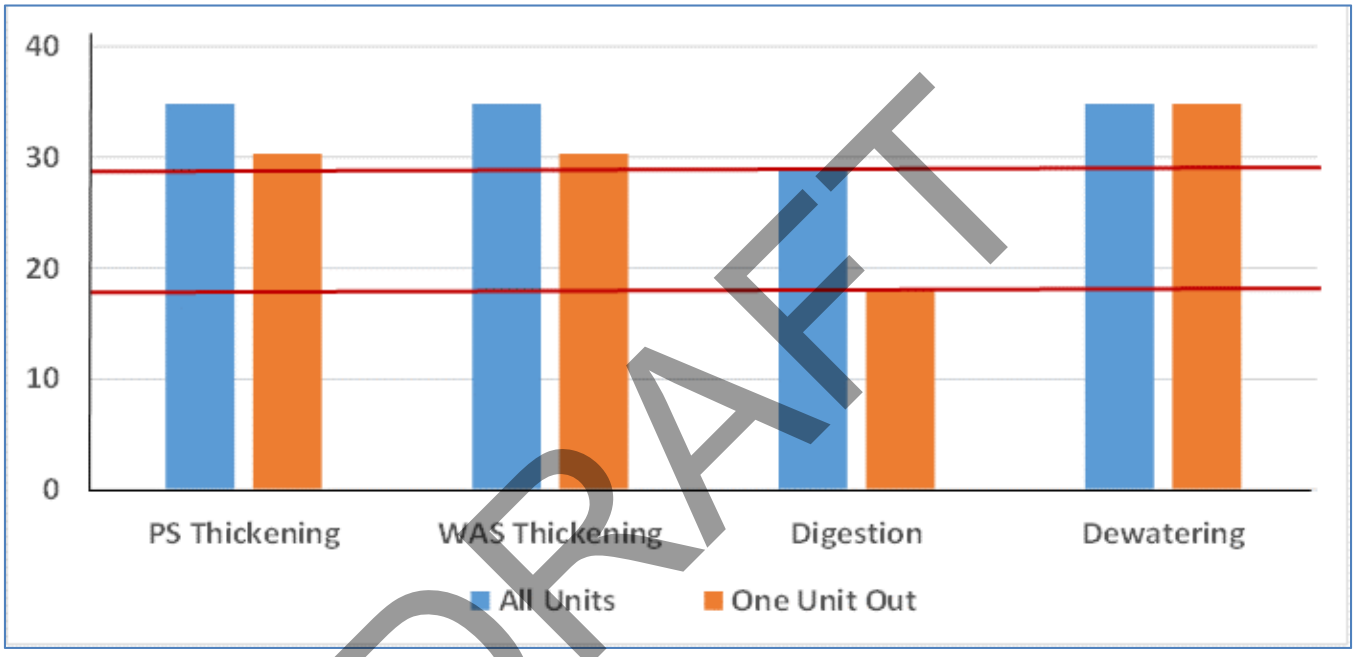
As presented in *TM 7 RP-5 and RP-2 Complex Future Plans*, the existing RP-2 solids handling capacity is limited to 18 mgd due to digestion capacity limitations with one digester out of service. Primary sludge thickening is currently achieved using gravity thickening. Thickening cannot be achieved in the primary clarifiers because the sludge needs to be diverted to RP-2 at a solids content of about 1 to 1.5 percent solids. WAS thickening is achieved in DAF thickeners. Waste solids digestion, achieved in the phased digestion system, was evaluated based on the current operating conditions as well as Part 503 Rule requirements. A digester SRT of 15 days with one large unit out of service was used to establish digestion capacity, using an active digester volume of 90 percent of the total digester volume including the cone space. The dewatering capacity of the belt filter presses was calculated considering the hydraulic loading rate to be maintained at or below 75 gallons per minute per meter, and the solids loading rate to be maintained at or below 1000 pounds per hour per meter under the current solids loading conditions. The existing RP-2 solids handling process capacities are summarized in Table 9-3 and illustrated in Figure 9-2.

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TABLE 9-3
**RP-2 Existing Solids Handling Capacity**

| | All Units in Service | One Unit Out of Service |
|---|---|---|
| Primary Sludge Thickening | 34.8 mgd | 30.3 mgd |
| Waste Activated Sludge Thickening | 34.8 mgd | 30.3 mgd |
| Digestion | 29 mgd | 18 mgd |
| Dewatering | 34.8 mgd | 34.8 mgd |

FIGURE 9-2
**RP-2 Existing Solids Handling Capacity**




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### 4.2.2 RP-5 Solids Handling Site

To help reduce the impacts of manure from dairy farms on local groundwater and produce energy, IEUA built a 5-million gallon (MG) plug flow digester at the RP-5 complex. This facility began accepting manure in 2001. In 2005, two aboveground vertical stirred digesters were added to allow food-waste processing in addition to the dairy manure. In 2009, IEUA shut down the food-waste processing unit and began looking for a third-party operator. In 2010, IEUA signed a 10-year lease agreement with Environ Strategy Consultants, Inc. (ESCI). ESCI operates the food-waste processing facility and sells power to IEUA. A capacity evaluation of this food-waste processing facility was therefore not conducted as part of this WFMP effort.

## 4.3 Inland Empire Regional Composting Facility

IERCF is North America's largest indoor biosolids composting facility, encompassing 24 acres with 445,275 square feet dedicated specifically to the compost process building. The facility is operated by the IERCA, a joint powers authority created by IEUA and the Sanitation Districts in 2002 to construct, operate, and maintain a regional composting facility. Both IEUA and the Sanitation Districts send biosolids to the facility for processing and reuse as a high-quality soil amendment. IERCF produces high-quality compost that is marketed under the name of SoilPro Premium Products and sold to landscapers, farmers, and gardeners around the region.

Biosolids and amendments are trucked to IERCF and deposited into solids hoppers prior to conveying the biosolids and amendment material to the pug mills via belt conveyors for mixing. After mixing in the pug mills, the material flows via belt conveyors to the active compost area and is piled using front-end loaders for approximately 21 days of active composting. Compost materials are then transferred via front-end loader to the curing area for approximately 30 days of curing. The cured materials are then transported to the screening belt conveyor using front-end loaders. After screening, the product flows via belt conveyors to the product load-out area, where it is loaded onto trucks and hauled to customers. A process flow schematic of IERCF is provided in Figure 9-3.

Based on recent discussions with the IERCF Manager of Operations and Organics, Mr. Jeff Ziegenbein, the facility currently processes up to approximately 205,000 wet tons of biosolids and amendment annually, or 98 percent of the maximum throughput permitted by the AQMD. The AQMD permits a total of 209,625 wet tons per year of biosolids and amendment throughput, excluding recycled material (AQMD, 2010) based on the air emissions control system capacity and emission limits. This includes approximately 150,000 tons of biosolids and 60,000 tons of amendment materials such as green waste, wood waste, and stable bedding. Thus, IERCF processes approximately 400 wet tons of biosolids on average per day. Based on the joint powers agreement, IEUA and the Sanitation Districts contribute equal shares of biosolids. Thus, IEUA may contribute up to approximately 200 wet tons of biosolids per day to IERCF.

# 5.0 Expansion Considerations

Expansion needs for the RP-1 solids handling facilities, RP-5/RP-2 solids handling facilities, and IERCF were determined based on the flow and load projections discussed in *TM 4 Wastewater Flow and Loading Forecast* and the biosolids projections presented above in Section 3.0 of this TM. Expansion needs for RP-1 and RP-5/RP-2 are discussed in detail in *TM 5 RP-1 Future Plans* and *TM 7 RP-5 and RP-2 Complex Future Plans*, respectively. Expansion needs for the solids handling and composting facilities for the planning year 2035 and ultimate buildout year 2060 are summarized below.

## 5.1 RP-1 Solids Handling Facilities

As discussed in Section 4.1, the existing RP-1 solids handling capacity is limited to 38 mgd due to digestion capacity limitations with one digester out of service. As presented in Table 9-1, the projected influent flow to RP-1 and RP-4 is approximately 47.8 mgd by 2035 and 54.7 mgd by 2060. Therefore, the existing solids handling facilities at RP-1 do not have adequate capacity to accommodate either the 2035 or ultimate projected influent flows in the northern service area. Two new anaerobic digesters with complete sludge transfer and recirculation, mixing and heating, and pumping equipment are recommended by 2035. No additional solids handling facilities are needed beyond this since the new digesters would provide adequate capacity for the planning year 2035 and ultimate buildout year 2060.

The RP-1 solids handling facilities expansion needs are summarized in Table 9-4. The ultimate site layout and estimated costs for the recommended improvements are presented in *TM 5 RP-1 Future Plans.*

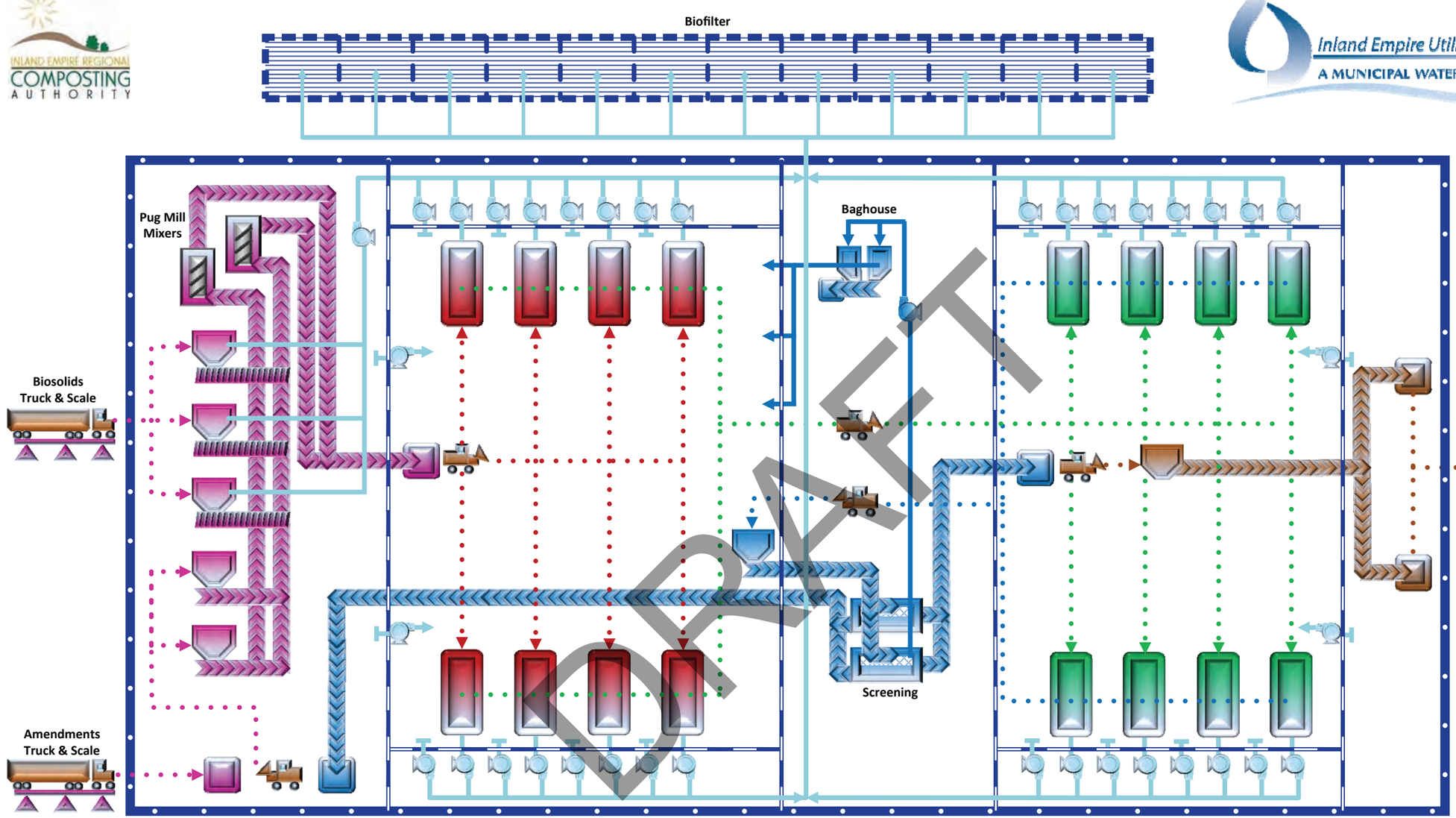
TABLE 9-4
**RP-1 Solids Handling Facilities Expansion Needs for Planning Year 2035**

| Facility | Number of Units | Size of Unit |
|---|---|---|
| Anaerobic Digesters | 2 | 110 ft diameter<br>30 ft sidewater depth |

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INLAND EMPIRE REGIONAL COMPOSTING AUTHORITY

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT




**Legend**

- Receiving & Mixing
- Active Compost
- Curing
- Screening
- Product Loadout
- Baghouse Supply
- Air Header
- Truck/Loader Route
- Blower/Fan
- Front End Loader
- Solids Hopper
- Conveyor
- Aerated Static Pile
- Conveyor Drop Pile
- Screw Conveyor

FIGURE 9-3

# INLAND EMPIRE REGIONAL COMPOSTING FACILITY PROCESS FLOW SCHEMATIC

INLAND EMPIRE UTILITIES AGENCY
*WASTEWATER FACILITIES MASTER PLAN*

20-IEUA-1-14F1-8-9370A00.AI

CH2MHILL® carollo
Engineers...Working Wonders With Water®

## 5.2 RP-5/RP-2 Solids Handling Facilities

The RP-2 solids handling facilities will be relocated to the RP-5 site by 2035 to meet biosolids management needs for the southern part of the service area. As discussed in Section 4.2, the existing RP-2 solids handling capacity is limited to 18 mgd due to digestion capacity limitations with one digester out of service. As presented in Table 9-1, the projected influent flow to RP-5 and CCWRF is approximately 25.7 mgd by 2035 and 33.2 mgd by 2060. Thus, the solids handling facilities do not have adequate capacity to accommodate either the 2035 or 2060 projected influent flows in the southern service area. RP-5 solids handling facilities expansion needs by 2035 include new thickening, anaerobic digestion, dewatering, digester gas storage and utilization, and odor control. Additional thickening and digestion capacity would be needed by 2060 to meet the projected demands.

The RP-5 solids handling facilities expansion needs for planning year 2035 and ultimate buildout year 2060 are summarized in Table 9-5 and Table 9-6, respectively. The ultimate site layout and estimated costs for the recommended improvements are presented in *TM 7 RP-5 and RP-2 Complex Future Plans.*

TABLE 9-5
**RP-5 Solids Handling Facilities Expansion Needs for Planning Year 2035**

| Facility | Number of Units | Size of Unit |
|---|---|---|
| Gravity Thickener | 3 | 45 ft diameter |
| DAF Thickener | 3 | 40 ft diameter |
| Anaerobic Digestion | | |
| Acid-Phase | 6 Cells | 20 $ft^2$, 30 ft sidewater depth per cell |
| Methane-Phase | 4 | 90 ft diameter 35 ft sidewater depth |
| Sludge Holding Tank | 1 | 90 ft diameter 35 ft sidewater depth |
| High-Pressure Gas Storage | 1 | 35 ft diameter w/ 30 $ft^2$ equipment pad |
| Dewatering | 1 | 100 ft x 150 ft building |
| Biofilter | 3 Cells | 60 ft x 80 ft per cell |

TABLE 9-6
**RP-5 Solids Handling Facilities Expansion Needs for Planning Year 2060**

| Facility | Number of Units | Size of Unit |
|---|---|---|
| Gravity Thickener | 1 | 45 ft diameter |
| Anaerobic Digestion | | |
| Acid-Phase | 4 Cells | 20 $ft^2$ 30 ft sidewater depth per cell |
| Methane-Phase | 1 | 90 ft diameter 35 ft sidewater depth |

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## 5.3 Inland Empire Regional Composting Facility

As shown in Table 9-1, the total projected biosolids quantities produced from the northern and southern service areas is approximately 198 wet tons per day by planning year 2035 and 241 wet tons per day by ultimate buildout year 2060. As described in Section 4.3, IEUA can contribute approximately 200 wet tons of biosolids per day to IERCF, based on the joint powers agreement between IEUA and the Sanitation Districts. Therefore, IERCF has adequate capacity to receive and process IEUA biosolids over the next 20 years.

The projected ultimate biosolids quantities in 2060 exceed the current permitted capacity of IERCF by approximately 40 wet tons per day, or 20 percent of the total IEUA daily biosolids production. The projection of biosolids quantities is based on a biosolids cake solids content of 24 percent. The biosolids quantities could be reduced if a higher solids content can be achieved. Additionally, the biosolids product markets in Southern California and its vicinity are still evolving and are subject to change. These product markets, in addition to composting, could include land application, heat drying to produce pellets, and pyrolysis or heat drying to generate energy. Given the changing nature of biosolids regulations and product markets, IEUA should consider these options at the time capacity expansion is needed.

IEUA may consider implementing different technologies such as heat drying for pellet production, similar to those installed at the City of Corona Plant 1 and Encina Water Pollution Control Facility in Carlsbad, both of which have been operational for over a decade. Irvine Ranch Water District is also currently constructing a heat drying facility at the Michelson Water Recycling Plant in Irvine. The new IEUA heat drying facility can be located either at RP-1 or RP-5 to reduce hauling costs.

IEUA may also consider diversifying biosolids management by contracting with private biosolids management companies who can utilize the excess 40 wet tons per day of biosolids for land application, composting, energy production, and other applications. With the biosolids management market changing rapidly, the Consultant Team recommends that IEUA explore these and other options to manage the 2060 projected biosolids quantities closer to this date.

# 6.0 Conclusion

Based on the projected plant influent flows and loads through 2060, the solids handling facilities at RP-1 and RP-5/RP-2 will need to be expanded to meet future demands in the northern and southern service areas, respectively. RP-1 solids handling will require the addition of anaerobic digesters by 2035, while the RP-2 solids handling facilities will need to be decommissioned and relocated to the RP-5 site by 2023 in anticipation of the USACE raising the Prado Spillway. RP-5 solids handling facilities expansion needs by 2035 include new thickening, anaerobic digestion, dewatering, digester gas storage and utilization, and odor control. Additional thickening and digestion capacity would be needed at RP-5 by 2060 to meet the projected demands in the southern service area.

As a result of the anticipated increased flows and loads to each plant, the estimated biosolids quantities from the northern and southern service areas are projected to reach up to 198 wet tons per day by 2035 and 241 wet tons per day by 2060. Since IEUA's capacity at IERCF is 200 wet tons of biosolids per day, IERCF has adequate capacity to receive and process IEUA biosolids over the next 20 years. However, the projected ultimate biosolids are expected to surpass the current permitted capacity of IERCF by 2060, at which time IEUA needs to explore additional biosolids management options. Options may include implementing technologies such as heat drying or improved dewatering technologies to produce dryer cake, or diversifying biosolids management by contracting with private companies for land application, composting, energy production, and other biosolids product markets.

# 7.0 References

Air Quality Management District (AQMD). 2010. *Facility Permit to Operate, Inland Empire Regional Composting Authority, Section H.* September.

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# APPENDIX I

## Regional Alliance SB X7-7 Calculations

| Deduct Recycled Water Use for Indirect Potable Reuse | | | | |
|---|---|---|---|---|
| FYE | Total Groundwater Recharge | (1) 5-Year Average Recharge (Acre-Feet) | (2) Loss Factor for Recharge & Recovery | (1) x (2) = (3) Volume Entering Distribution System (Acre-Feet) |
| 1995 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 |
| 2001 | 500.3 | 500.3 | 90% | 450.27 |
| 2002 | 504.6 | 502.5 | 90% | 452.21 |
| 2003 | 184.5 | 396.5 | 90% | 356.82 |
| 2004 | 48.5 | 309.5 | 90% | 278.53 |
| 2005 | 158.3 | 279.3 | 90% | 251.33 |
| 2006 | 1,303.0 | 439.8 | 90% | 395.81 |
| 2007 | 2,981.0 | 935.1 | 90% | 841.56 |
| 2008 | 2,340.0 | 1,366.2 | 90% | 1,229.55 |
| 2009 | 2,684.0 | 1,893.3 | 90% | 1,703.94 |
| 2010 | 7,208.0 | 3,303.2 | 90% | 2,972.88 |
| 2011 | 8,028.0 | 4,648.2 | 90% | 4,183.38 |
| 2012 | 8,634.0 | 5,778.8 | 90% | 5,200.92 |
| 2013 | 10,479.0 | 7,406.6 | 90% | 6,665.94 |
| 2014 | 13,593.0 | 9,588.4 | 90% | 8,629.56 |
| 2015 | 10,840.0 | 10,314.8 | 90% | 9,283.32 |

| Indirect Recycled Water (AFY) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FYE | Chino | Chino Hills | Ontario | Upland | Fontana | SBC | CVWD | Montclair /MVWD |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 21.7 | 0 | 0 | 0 | 0 | 0 | 0 | 29.3 |
| 2002 | 16.8 | 0 | 94.2 | 0.007 | 0 | 0 | 0 | 36.4 |
| 2003 | 13.0 | 0 | 75.3 | 0 | 0 | 0 | 0 | 28.9 |
| 2004 | 9.6 | 0 | 44.1 | 0 | 0 | 0 | 0 | 20.0 |
| 2005 | 8.9 | 0 | 42.0 | 0 | 0 | 0 | 0 | 15.7 |
| 2006 | 14.6 | 0 | 73.1 | 0 | 0 | 0 | 0 | 21.0 |
| 2007 | 43.5 | 7.8 | 136.7 | 0 | 0 | 0 | 0 | 57.0 |
| 2008 | 68.1 | 20.3 | 233.9 | 0 | 0 | 0 | 59.5 | 127.5 |
| 2009 | 119.4 | 28.4 | 447.5 | 0 | 0 | 0 | 37.3 | 218.6 |
| 2010 | 202.7 | 37.3 | 662.3 | 80.3 | 849.4 | 0 | 500.2 | 409.6 |
| 2011 | 268.8 | 74.1 | 725.0 | 27.1 | 966.4 | 0 | 747.8 | 443.0 |
| 2012 | 379.3 | 172.2 | 925.2 | 25.4 | 1388.0 | 0 | 721.7 | 508.8 |
| 2013 | 379.0 | 169.2 | 1122.8 | 127.3 | 1812.4 | 0 | 1011.5 | 557.3 |
| 2014 | 415.4 | 132.1 | 1341.8 | 174.3 | 949.8 | 0 | 995.8 | 773.4 |
| 2015 | 445.1 | 199.0 | 1193.8 | 234.0 | 914.2 | 0 | 992.6 | 576.0 |

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 20,782 | Acre Feet |
| | 2008 total volume of delivered recycled water | 1,479 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 7.12% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1995 | |
| | Year ending baseline period range[2] | 2004 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2005 | |
| | Year ending baseline period range[3] | 2009 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☑ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☐ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1995 | 50,527 |
| Year 2 | 1996 | 53,063 |
| Year 3 | 1997 | 56,083 |
| Year 4 | 1998 | 59,546 |
| Year 5 | 1999 | 63,399 |
| Year 6 | 2000 | 66,787 |
| Year 7 | 2001 | 68,124 |
| Year 8 | 2002 | 70,488 |
| Year 9 | 2003 | 71,854 |
| Year 10 | 2004 | 74,809 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2005 | 71,854 |
| Year 2 | 2006 | 74,809 |
| Year 3 | 2007 | 75,414 |
| Year 4 | 2008 | 74,943 |
| Year 5 | 2009 | 75,168 |
| 2015 Compliance Year Population | | |
| **2015** | | 77,596 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1995 | 13000 | | | 0 | | 0 | 13,000 |
| Year 2 | 1996 | 14151 | | | 0 | | 0 | 14,151 |
| Year 3 | 1997 | 14649 | | | 0 | | 0 | 14,649 |
| Year 4 | 1998 | 13178 | | | 0 | | 0 | 13,178 |
| Year 5 | 1999 | 15246 | | | 0 | | 0 | 15,246 |
| Year 6 | 2000 | 17241 | | | 0 | | 0 | 17,241 |
| Year 7 | 2001 | 15911 | | | 0 | | 0 | 15,911 |
| Year 8 | 2002 | 16707 | | | 0 | | 0 | 16,707 |
| Year 9 | 2003 | 15795 | | | 0 | | 0 | 15,795 |
| Year 10 | 2004 | 17339 | | | 0 | | 0 | 17,339 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 12* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 13* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 14* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 15* | 0 | 0 | | | 0 | | 0 | 0 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **15,322** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2005 | 15,795 | | | 0 | | 0 | 15,795 |
| Year 2 | 2006 | 17,339 | | | 0 | | 0 | 17,339 |
| Year 3 | 2007 | 15,953 | | | 8 | | 0 | 15,945 |
| Year 4 | 2008 | 16,398 | | | 20 | | 0 | 16,378 |
| Year 5 | 2009 | 18,700 | | | 28 | | 0 | 18,672 |
| **5 year baseline average gross water use** | | | | | | | | **16,826** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 14,260 | | | 199 | | 0 | 14,061 |

* NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3

NOTES:

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Chino Hills Wells |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 3437 | | 3,437 |
| Year 2 | 1996 | 4075 | | 4,075 |
| Year 3 | 1997 | 1941 | | 1,941 |
| Year 4 | 1998 | 2909 | | 2,909 |
| Year 5 | 1999 | 4404 | | 4,404 |
| Year 6 | 2000 | 4257 | | 4,257 |
| Year 7 | 2001 | 4239 | | 4,239 |
| Year 8 | 2002 | 3605 | | 3,605 |
| Year 9 | 2003 | 2027 | | 2,027 |
| Year 10 | 2004 | 2416 | | 2,416 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 2027 | | 2,027 |
| Year 2 | 2006 | 2416 | | 2,416 |
| Year 3 | 2007 | 2477 | | 2,477 |
| Year 4 | 2008 | 852 | | 852 |
| Year 5 | 2009 | 2010 | | 2,010 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 2904 | | 2,904 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | CDA&MVWD&WFA | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 9563 | | 9,563 |
| Year 2 | 1996 | 10076 | | 10,076 |
| Year 3 | 1997 | 12708 | | 12,708 |
| Year 4 | 1998 | 10269 | | 10,269 |
| Year 5 | 1999 | 10842 | | 10,842 |
| Year 6 | 2000 | 12984 | | 12,984 |
| Year 7 | 2001 | 11672 | | 11,672 |
| Year 8 | 2002 | 13102 | | 13,102 |
| Year 9 | 2003 | 13768 | | 13,768 |
| Year 10 | 2004 | 14923 | | 14,923 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 13768 | | 13,768 |
| Year 2 | 2006 | 14923 | | 14,923 |
| Year 3 | 2007 | 13476 | | 13,476 |
| Year 4 | 2008 | 15546 | | 15,546 |
| Year 5 | 2009 | 16690 | | 16,690 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 11,356 | | 11,356 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| Baseline Year *Fm SB X7-7 Table 3* | | Surface Reservoir Augmentation | | | | | Groundwater Recharge | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1995 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2001 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 8 | 2002 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 9 | 2003 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 10 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 2006 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 2007 | | | 0 | | 0 | 7.751145 | | 8 | 8 |
| Year 4 | 2008 | | | 0 | | 0 | 20.309346 | | 20 | 20 |
| Year 5 | 2009 | | | 0 | | 0 | 28.36353 | | 28 | 28 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 198.95118 | | 199 | 199 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | 13,000 | | 0% | NO |
| Year 2 | 1996 | 14,151 | | 0% | NO |
| Year 3 | 1997 | 14,649 | | 0% | NO |
| Year 4 | 1998 | 13,178 | | 0% | NO |
| Year 5 | 1999 | 15,246 | | 0% | NO |
| Year 6 | 2000 | 17,241 | | 0% | NO |
| Year 7 | 2001 | 15,911 | | 0% | NO |
| Year 8 | 2002 | 16,707 | | 0% | NO |
| Year 9 | 2003 | 15,795 | | 0% | NO |
| Year 10 | 2004 | 17,339 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2005 | 15,795 | | 0% | NO |
| Year 2 | 2006 | 17,339 | | 0% | NO |
| Year 3 | 2007 | 15,945 | | 0% | NO |
| Year 4 | 2008 | 16,378 | | 0% | NO |
| Year 5 | 2009 | 18,672 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 14,061 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | | 50,527 | 0 | NO |
| Year 2 | 1996 | | 53,063 | 0 | NO |
| Year 3 | 1997 | | 56,083 | 0 | NO |
| Year 4 | 1998 | | 59,546 | 0 | NO |
| Year 5 | 1999 | | 63,399 | 0 | NO |
| Year 6 | 2000 | | 66,787 | 0 | NO |
| Year 7 | 2001 | | 68,124 | 0 | NO |
| Year 8 | 2002 | | 70,488 | 0 | NO |
| Year 9 | 2003 | | 71,854 | 0 | NO |
| Year 10 | 2004 | | 74,809 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2005 | | 71,854 | 0 | NO |
| Year 2 | 2006 | | 74,809 | 0 | NO |
| Year 3 | 2007 | | 75,414 | 0 | NO |
| Year 4 | 2008 | | 74,943 | 0 | NO |
| Year 5 | 2009 | | 75,168 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 77,596 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1995 | 13,000 | | 13,000 | 50,527 | 230 | NO |
| Year 2 | 1996 | 14,151 | | 14,151 | 53,063 | 238 | NO |
| Year 3 | 1997 | 14,649 | | 14,649 | 56,083 | 233 | NO |
| Year 4 | 1998 | 13,178 | | 13,178 | 59,546 | 198 | NO |
| Year 5 | 1999 | 15,246 | | 15,246 | 63,399 | 215 | NO |
| Year 6 | 2000 | 17,241 | | 17,241 | 66,787 | 230 | NO |
| Year 7 | 2001 | 15,911 | | 15,911 | 68,124 | 209 | NO |
| Year 8 | 2002 | 16,707 | | 16,707 | 70,488 | 212 | NO |
| Year 9 | 2003 | 15,795 | | 15,795 | 71,854 | 196 | NO |
| Year 10 | 2004 | 17,339 | | 17,339 | 74,809 | 207 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2005 | 15,795 | | 15,795 | 71,854 | 196 | NO |
| Year 2 | 2006 | 17,339 | | 17,339 | 74,809 | 207 | NO |
| Year 3 | 2007 | 15,945 | | 15,945 | 75,414 | 189 | NO |
| Year 4 | 2008 | 16,378 | | 16,378 | 74,943 | 195 | NO |
| Year 5 | 2009 | 18,672 | | 18,672 | 75,168 | 222 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 14,061 | | 14,061 | 77,596 | 162 | NO |
| NOTES: | | | | | | | |

**SB X7-7 Table 4-C.4: Process Water Deduction Eligibility**

**Criteria 4**
Disadvantaged Community
*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm

| | California Median Household Income | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
|---|---|---|---|---|
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | $93,322 | 176% | NO |

*A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.*

NOTES:

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1995 | 50,527 | 13,000 | 230 |
| Year 2 | 1996 | 53,063 | 14,151 | 238 |
| Year 3 | 1997 | 56,083 | 14,649 | 233 |
| Year 4 | 1998 | 59,546 | 13,178 | 198 |
| Year 5 | 1999 | 63,399 | 15,246 | 215 |
| Year 6 | 2000 | 66,787 | 17,241 | 230 |
| Year 7 | 2001 | 68,124 | 15,911 | 209 |
| Year 8 | 2002 | 70,488 | 16,707 | 212 |
| Year 9 | 2003 | 71,854 | 15,795 | 196 |
| Year 10 | 2004 | 74,809 | 17,339 | 207 |
| *Year 11* | 0 | 0 | 0 | |
| *Year 12* | 0 | 0 | 0 | |
| *Year 13* | 0 | 0 | 0 | |
| *Year 14* | 0 | 0 | 0 | |
| *Year 15* | 0 | 0 | 0 | |
| **10-15 Year Average Baseline GPCD** | | | | **217** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2005 | 71,854 | 15,795 | 196 |
| Year 2 | 2006 | 74,809 | 17,339 | 207 |
| Year 3 | 2007 | 75,414 | 15,945 | 189 |
| Year 4 | 2008 | 74,943 | 16,378 | 195 |
| Year 5 | 2009 | 75,168 | 18,672 | 222 |
| **5 Year Average Baseline GPCD** | | | | **202** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 77,596 | 14,061 | 162 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 217 |
| 5 Year Baseline GPCD | 202 |
| 2015 Compliance Year GPCD | 162 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 217 | 173 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 202 | 192 | 173 | 173 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 173 | 217 | 195 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 162 | 195 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 161.7724547 | 161.7724547 | YES |
| NOTES: | | | | | | | | |

# City of Chino

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 21,963 | Acre Feet |
| | 2008 total volume of delivered recycled water | 4,574 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 20.82% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1995 | |
| | Year ending baseline period range[2] | 2004 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2004 | |
| | Year ending baseline period range[3] | 2008 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☑ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☑ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1995 | 52,082 |
| Year 2 | 1996 | 52,833 |
| Year 3 | 1997 | 53,584 |
| Year 4 | 1998 | 54,335 |
| Year 5 | 1999 | 55,086 |
| Year 6 | 2000 | 55,837 |
| Year 7 | 2001 | 56,927 |
| Year 8 | 2002 | 58,018 |
| Year 9 | 2003 | 59,108 |
| Year 10 | 2004 | 60,199 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2004 | 60,199 |
| Year 2 | 2005 | 61,290 |
| Year 3 | 2006 | 62,380 |
| Year 4 | 2007 | 63,471 |
| Year 5 | 2008 | 64,561 |
| 2015 Compliance Year Population | | |
| **2015** | | 73,966 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1995 | 13109.15 | | | 0 | | 0 | 13,109 |
| Year 2 | 1996 | 14847.84 | | | 0 | | 0 | 14,848 |
| Year 3 | 1997 | 14938.3 | | | 0 | | 0 | 14,938 |
| Year 4 | 1998 | 13077.37 | | | 0 | | 0 | 13,077 |
| Year 5 | 1999 | 14687.03 | | | 0 | | 0 | 14,687 |
| Year 6 | 2000 | 15144.97 | | | 0 | | 0 | 15,145 |
| Year 7 | 2001 | 14569.69 | | | 22 | | 0 | 14,548 |
| Year 8 | 2002 | 15574.03 | | | 17 | | 0 | 15,557 |
| Year 9 | 2003 | 15220.38 | | | 13 | | 0 | 15,207 |
| Year 10 | 2004 | 15630.3 | | | 10 | | 0 | 15,621 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 12* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 13* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 14* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 15* | 0 | 0 | | | 0 | | 0 | 0 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **14,674** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2004 | 15,630 | | | 10 | | 0 | 15,621 |
| Year 2 | 2005 | 15,644 | | | 9 | | 0 | 15,635 |
| Year 3 | 2006 | 16,306 | | | 15 | | 0 | 16,291 |
| Year 4 | 2007 | 17,963 | | | 43 | | 0 | 17,919 |
| Year 5 | 2008 | 17,390 | | | 68 | | 0 | 17,322 |
| **5 year baseline average gross water use** | | | | | | | | **16,558** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 13,433 | | | 445 | | 0 | 12,988 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | City Wells |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 8728.2 | | 8,728 |
| Year 2 | 1996 | 10163.88 | | 10,164 |
| Year 3 | 1997 | 10230.29 | | 10,230 |
| Year 4 | 1998 | 9508.74 | | 9,509 |
| Year 5 | 1999 | 10124.16 | | 10,124 |
| Year 6 | 2000 | 9693.85 | | 9,694 |
| Year 7 | 2001 | 6118.47 | | 6,118 |
| Year 8 | 2002 | 6552.03 | | 6,552 |
| Year 9 | 2003 | 5867.05 | | 5,867 |
| Year 10 | 2004 | 6316.8 | | 6,317 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 6316.8 | | 6,317 |
| Year 2 | 2005 | 5749.56 | | 5,750 |
| Year 3 | 2006 | 7159.06 | | 7,159 |
| Year 4 | 2007 | 8479.44 | | 8,479 |
| Year 5 | 2008 | 8315.93 | | 8,316 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 5873.13 | | 5,873 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | WFA (+ Desalter after 2000) | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 4380.95 | | 4,381 |
| Year 2 | 1996 | 4683.96 | | 4,684 |
| Year 3 | 1997 | 4708.01 | | 4,708 |
| Year 4 | 1998 | 3568.63 | | 3,569 |
| Year 5 | 1999 | 4562.87 | | 4,563 |
| Year 6 | 2000 | 5451.12 | | 5,451 |
| Year 7 | 2001 | 8451.22 | | 8,451 |
| Year 8 | 2002 | 9022 | | 9,022 |
| Year 9 | 2003 | 9353.33 | | 9,353 |
| Year 10 | 2004 | 9313.5 | | 9,314 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 9313.5 | | 9,314 |
| Year 2 | 2005 | 9894.43 | | 9,894 |
| Year 3 | 2006 | 9146.7 | | 9,147 |
| Year 4 | 2007 | 9483.41 | | 9,483 |
| Year 5 | 2008 | 9073.94 | | 9,074 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 7,560 | | 7,560 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1995 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2001 | | | 0 | | 0 | 21.681055 | | 22 | 22 |
| Year 8 | 2002 | | | 0 | | 0 | 16.805562 | | 17 | 17 |
| Year 9 | 2003 | | | 0 | | 0 | 13.040127 | | 13 | 13 |
| Year 10 | 2004 | | | 0 | | 0 | 9.628067 | | 10 | 10 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2004 | | | 0 | | 0 | 9.628067 | | 10 | 10 |
| Year 2 | 2005 | | | 0 | | 0 | 8.8520515 | | 9 | 9 |
| Year 3 | 2006 | | | 0 | | 0 | 14.560783 | | 15 | 15 |
| Year 4 | 2007 | | | 0 | | 0 | 43.485567 | | 43 | 43 |
| Year 5 | 2008 | | | 0 | | 0 | 68.070581 | | 68 | 68 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 445.12218 | | 445 | 445 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | 13,109 | | 0% | NO |
| Year 2 | 1996 | 14,848 | | 0% | NO |
| Year 3 | 1997 | 14,938 | | 0% | NO |
| Year 4 | 1998 | 13,077 | | 0% | NO |
| Year 5 | 1999 | 14,687 | | 0% | NO |
| Year 6 | 2000 | 15,145 | | 0% | NO |
| Year 7 | 2001 | 14,548 | | 0% | NO |
| Year 8 | 2002 | 15,557 | | 0% | NO |
| Year 9 | 2003 | 15,207 | | 0% | NO |
| Year 10 | 2004 | 15,621 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | 15,621 | | 0% | NO |
| Year 2 | 2005 | 15,635 | | 0% | NO |
| Year 3 | 2006 | 16,291 | | 0% | NO |
| Year 4 | 2007 | 17,919 | | 0% | NO |
| Year 5 | 2008 | 17,322 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 12,988 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | | 52,082 | 0 | NO |
| Year 2 | 1996 | | 52,833 | 0 | NO |
| Year 3 | 1997 | | 53,584 | 0 | NO |
| Year 4 | 1998 | | 54,335 | 0 | NO |
| Year 5 | 1999 | | 55,086 | 0 | NO |
| Year 6 | 2000 | | 55,837 | 0 | NO |
| Year 7 | 2001 | | 56,927 | 0 | NO |
| Year 8 | 2002 | | 58,018 | 0 | NO |
| Year 9 | 2003 | | 59,108 | 0 | NO |
| Year 10 | 2004 | | 60,199 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | | 60,199 | 0 | NO |
| Year 2 | 2005 | | 61,290 | 0 | NO |
| Year 3 | 2006 | | 62,380 | 0 | NO |
| Year 4 | 2007 | | 63,471 | 0 | NO |
| Year 5 | 2008 | | 64,561 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 73,966 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1995 | 13,109 | | 13,109 | 52,082 | 225 | NO |
| Year 2 | 1996 | 14,848 | | 14,848 | 52,833 | 251 | NO |
| Year 3 | 1997 | 14,938 | | 14,938 | 53,584 | 249 | NO |
| Year 4 | 1998 | 13,077 | | 13,077 | 54,335 | 215 | NO |
| Year 5 | 1999 | 14,687 | | 14,687 | 55,086 | 238 | NO |
| Year 6 | 2000 | 15,145 | | 15,145 | 55,837 | 242 | NO |
| Year 7 | 2001 | 14,548 | | 14,548 | 56,927 | 228 | NO |
| Year 8 | 2002 | 15,557 | | 15,557 | 58,018 | 239 | NO |
| Year 9 | 2003 | 15,207 | | 15,207 | 59,108 | 230 | NO |
| Year 10 | 2004 | 15,621 | | 15,621 | 60,199 | 232 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2004 | 15,621 | | 15,621 | 60,199 | 232 | NO |
| Year 2 | 2005 | 15,635 | | 15,635 | 61,290 | 228 | NO |
| Year 3 | 2006 | 16,291 | | 16,291 | 62,380 | 233 | NO |
| Year 4 | 2007 | 17,919 | | 17,919 | 63,471 | 252 | NO |
| Year 5 | 2008 | 17,322 | | 17,322 | 64,561 | 240 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 12,988 | | 12,988 | 73,966 | 157 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1995 | 52,082 | 13,109 | 225 |
| Year 2 | 1996 | 52,833 | 14,848 | 251 |
| Year 3 | 1997 | 53,584 | 14,938 | 249 |
| Year 4 | 1998 | 54,335 | 13,077 | 215 |
| Year 5 | 1999 | 55,086 | 14,687 | 238 |
| Year 6 | 2000 | 55,837 | 15,145 | 242 |
| Year 7 | 2001 | 56,927 | 14,548 | 228 |
| Year 8 | 2002 | 58,018 | 15,557 | 239 |
| Year 9 | 2003 | 59,108 | 15,207 | 230 |
| Year 10 | 2004 | 60,199 | 15,621 | 232 |
| *Year 11* | 0 | 0 | 0 | |
| *Year 12* | 0 | 0 | 0 | |
| *Year 13* | 0 | 0 | 0 | |
| *Year 14* | 0 | 0 | 0 | |
| *Year 15* | 0 | 0 | 0 | |
| **10-15 Year Average Baseline GPCD** | | | | **235** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2004 | 60,199 | 15,621 | 232 |
| Year 2 | 2005 | 61,290 | 15,635 | 228 |
| Year 3 | 2006 | 62,380 | 16,291 | 233 |
| Year 4 | 2007 | 63,471 | 17,919 | 252 |
| Year 5 | 2008 | 64,561 | 17,322 | 240 |
| **5 Year Average Baseline GPCD** | | | | **237** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 73,966 | 12,988 | 157 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 235 |
| 5 Year Baseline GPCD | 237 |
| 2015 Compliance Year GPCD | 157 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 235 | 188 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 237 | 225 | 188 | 188 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 188 | 235 | 211 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 157 | 211 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 156.7550549 | 156.7550549 | YES |
| NOTES: | | | | | | | | |

# Cucamonga Valley Water District

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 58,131 | Acre Feet |
| | 2008 total volume of delivered recycled water | 635 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 1.09% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1995 | |
| | Year ending baseline period range[2] | 2004 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2004 | |
| | Year ending baseline period range[3] | 2008 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☑ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☐ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1995 | 132,882 |
| Year 2 | 1996 | 135,001 |
| Year 3 | 1997 | 136,874 |
| Year 4 | 1998 | 139,556 |
| Year 5 | 1999 | 143,175 |
| Year 6 | 2000 | 148,159 |
| Year 7 | 2001 | 152,221 |
| Year 8 | 2002 | 161,267 |
| Year 9 | 2003 | 166,359 |
| Year 10 | 2004 | 170,784 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2004 | 170,784 |
| Year 2 | 2005 | 179,523 |
| Year 3 | 2006 | 182,035 |
| Year 4 | 2007 | 184,369 |
| Year 5 | 2008 | 184,669 |
| 2015 Compliance Year Population | | |
| **2015** | | 200,466 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1995 | 42131.565 | | | 0 | 0 | 0 | 42,132 |
| Year 2 | 1996 | 45476.188 | | | 0 | 0 | 0 | 45,476 |
| Year 3 | 1997 | 47218.695 | | | 0 | 0 | 0 | 47,219 |
| Year 4 | 1998 | 41864.75 | | | 0 | 0 | 0 | 41,865 |
| Year 5 | 1999 | 49409.59 | | | 0 | 0 | 0 | 49,410 |
| Year 6 | 2000 | 50716.806 | | | 0 | 0 | 0 | 50,717 |
| Year 7 | 2001 | 48062.783 | | | 0 | 0 | 0 | 48,063 |
| Year 8 | 2002 | 52409.177 | | | 0 | 0 | 0 | 52,409 |
| Year 9 | 2003 | 51899.242 | | | 0 | 0 | 0 | 51,899 |
| Year 10 | 2004 | 54825.81 | | | 0 | 0 | 0 | 54,826 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 12* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 13* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 14* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 15* | 0 | 0 | | | 0 | | 0 | 0 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **48,401** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2004 | 54,826 | | | 0 | 0 | 0 | 54,826 |
| Year 2 | 2005 | 55,933 | | | 0 | 0 | 0 | 55,933 |
| Year 3 | 2006 | 57,977 | | | 0 | 0 | 0 | 57,977 |
| Year 4 | 2007 | 61,035 | | | 0 | 0 | 0 | 61,035 |
| Year 5 | 2008 | 57,496 | | | 60 | 0 | 0 | 57,436 |
| **5 year baseline average gross water use** | | | | | | | | **57,441** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 41,443 | | | 993 | 0 | 0 | 40,451 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Chino Basin Groundwater |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 6297.41 | | 6,297 |
| Year 2 | 1996 | 7311.11 | | 7,311 |
| Year 3 | 1997 | 7764.41 | | 7,764 |
| Year 4 | 1998 | 5101.37 | | 5,101 |
| Year 5 | 1999 | 7737.49 | | 7,737 |
| Year 6 | 2000 | 6194.88 | | 6,195 |
| Year 7 | 2001 | 6899 | | 6,899 |
| Year 8 | 2002 | 10579.92 | | 10,580 |
| Year 9 | 2003 | 10020.304 | | 10,020 |
| Year 10 | 2004 | 12581.751 | | 12,582 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 12581.751 | | 12,582 |
| Year 2 | 2005 | 13328.276 | | 13,328 |
| Year 3 | 2006 | 16814.099 | | 16,814 |
| Year 4 | 2007 | 16781.12 | | 16,781 |
| Year 5 | 2008 | 19231.97 | | 19,232 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 18759.78 | | 18,760 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Cucamonga Basin Groundwater | | | |
| **This water source is:** | | | | |
| ☑ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 14199.855 | | 14,200 |
| Year 2 | 1996 | 15319.183 | | 15,319 |
| Year 3 | 1997 | 14179.856 | | 14,180 |
| Year 4 | 1998 | 9764.375 | | 9,764 |
| Year 5 | 1999 | 13660.961 | | 13,661 |
| Year 6 | 2000 | 10641.854 | | 10,642 |
| Year 7 | 2001 | 6604.26 | | 6,604 |
| Year 8 | 2002 | 6718.98 | | 6,719 |
| Year 9 | 2003 | 5051.103 | | 5,051 |
| Year 10 | 2004 | 6714.296 | | 6,714 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 6714.296 | | 6,714 |
| Year 2 | 2005 | 7518.004 | | 7,518 |
| Year 3 | 2006 | 6497.16 | | 6,497 |
| Year 4 | 2007 | 5019.25 | | 5,019 |
| Year 5 | 2008 | 4450.11 | | 4,450 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 8,439 | | 8,439 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Imported Water (State Project Water) | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 12412.209 | | 12,412 |
| Year 2 | 1996 | 16932.2 | | 16,932 |
| Year 3 | 1997 | 18586.51 | | 18,587 |
| Year 4 | 1998 | 17419.051 | | 17,419 |
| Year 5 | 1999 | 21853.883 | | 21,854 |
| Year 6 | 2000 | 29459.588 | | 29,460 |
| Year 7 | 2001 | 28904.505 | | 28,905 |
| Year 8 | 2002 | 32635.129 | | 32,635 |
| Year 9 | 2003 | 33328.97 | | 33,329 |
| Year 10 | 2004 | 33638.094 | | 33,638 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 33638.094 | | 33,638 |
| Year 2 | 2005 | 28108.628 | | 28,109 |
| Year 3 | 2006 | 29318.496 | | 29,318 |
| Year 4 | 2007 | 36040.672 | | 36,041 |
| Year 5 | 2008 | 28550.894 | | 28,551 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 13,195 | | 13,195 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Cucamonga Canyon Water | | | |
| **This water source is:** | | | | |
| ☑ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 0 | | 0 |
| Year 2 | 1996 | 0 | | 0 |
| Year 3 | 1997 | 586.091 | | 586 |
| Year 4 | 1998 | 1612.307 | | 1,612 |
| Year 5 | 1999 | 1664.435 | | 1,664 |
| Year 6 | 2000 | 1053.084 | | 1,053 |
| Year 7 | 2001 | 1648.199 | | 1,648 |
| Year 8 | 2002 | 491.737 | | 492 |
| Year 9 | 2003 | 958.017 | | 958 |
| Year 10 | 2004 | 410.182 | | 410 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 410.182 | | 410 |
| Year 2 | 2005 | 0 | | 0 |
| Year 3 | 2006 | 0 | | 0 |
| Year 4 | 2007 | 141.439 | | 141 |
| Year 5 | 2008 | 1700.365 | | 1,700 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 363 | | 363 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Deer Canyon Water | | | |
| **This water source is:** | | | | |
| ☑ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 2355.313 | | 2,355 |
| Year 2 | 1996 | 1090.817 | | 1,091 |
| Year 3 | 1997 | 1033.13 | | 1,033 |
| Year 4 | 1998 | 2027.55 | | 2,028 |
| Year 5 | 1999 | 640.11 | | 640 |
| Year 6 | 2000 | 503.8 | | 504 |
| Year 7 | 2001 | 578.9 | | 579 |
| Year 8 | 2002 | 208.5 | | 209 |
| Year 9 | 2003 | 453.01 | | 453 |
| Year 10 | 2004 | 248.79 | | 249 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 248.79 | | 249 |
| Year 2 | 2005 | 603.33 | | 603 |
| Year 3 | 2006 | 186.89 | | 187 |
| Year 4 | 2007 | 73.37 | | 73 |
| Year 5 | 2008 | 77.66 | | 78 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 189 | | 189 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Day/East Canyon Water | | | |
| **This water source is:** | | | | |
| ☑ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 6866.778 | | 6,867 |
| Year 2 | 1996 | 4822.878 | | 4,823 |
| Year 3 | 1997 | 5068.698 | | 5,069 |
| Year 4 | 1998 | 5940.097 | | 5,940 |
| Year 5 | 1999 | 3852.711 | | 3,853 |
| Year 6 | 2000 | 2863.6 | | 2,864 |
| Year 7 | 2001 | 3427.919 | | 3,428 |
| Year 8 | 2002 | 1774.911 | | 1,775 |
| Year 9 | 2003 | 2087.838 | | 2,088 |
| Year 10 | 2004 | 1232.697 | | 1,233 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 1232.697 | | 1,233 |
| Year 2 | 2005 | 6374.311 | | 6,374 |
| Year 3 | 2006 | 5160.607 | | 5,161 |
| Year 4 | 2007 | 2979.49 | | 2,979 |
| Year 5 | 2008 | 3484.717 | | 3,485 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 498 | | 498 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1995 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2001 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 8 | 2002 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 9 | 2003 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 10 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 2006 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 2007 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2008 | | | 0 | | 0 | 59.538843 | | 60 | 60 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 992.64589 | | 993 | 993 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | 42,132 | | 0% | NO |
| Year 2 | 1996 | 45,476 | | 0% | NO |
| Year 3 | 1997 | 47,219 | | 0% | NO |
| Year 4 | 1998 | 41,865 | | 0% | NO |
| Year 5 | 1999 | 49,410 | | 0% | NO |
| Year 6 | 2000 | 50,717 | | 0% | NO |
| Year 7 | 2001 | 48,063 | | 0% | NO |
| Year 8 | 2002 | 52,409 | | 0% | NO |
| Year 9 | 2003 | 51,899 | | 0% | NO |
| Year 10 | 2004 | 54,826 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | 54,826 | | 0% | NO |
| Year 2 | 2005 | 55,933 | | 0% | NO |
| Year 3 | 2006 | 57,977 | | 0% | NO |
| Year 4 | 2007 | 61,035 | | 0% | NO |
| Year 5 | 2008 | 57,436 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 40,451 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | | 132,882 | 0 | NO |
| Year 2 | 1996 | | 135,001 | 0 | NO |
| Year 3 | 1997 | | 136,874 | 0 | NO |
| Year 4 | 1998 | | 139,556 | 0 | NO |
| Year 5 | 1999 | | 143,175 | 0 | NO |
| Year 6 | 2000 | | 148,159 | 0 | NO |
| Year 7 | 2001 | | 152,221 | 0 | NO |
| Year 8 | 2002 | | 161,267 | 0 | NO |
| Year 9 | 2003 | | 166,359 | 0 | NO |
| Year 10 | 2004 | | 170,784 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | | 170,784 | 0 | NO |
| Year 2 | 2005 | | 179,523 | 0 | NO |
| Year 3 | 2006 | | 182,035 | 0 | NO |
| Year 4 | 2007 | | 184,369 | 0 | NO |
| Year 5 | 2008 | | 184,669 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 200,466 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1995 | 42,132 | | 42,132 | 132,882 | 283 | NO |
| Year 2 | 1996 | 45,476 | | 45,476 | 135,001 | 301 | NO |
| Year 3 | 1997 | 47,219 | | 47,219 | 136,874 | 308 | NO |
| Year 4 | 1998 | 41,865 | | 41,865 | 139,556 | 268 | NO |
| Year 5 | 1999 | 49,410 | | 49,410 | 143,175 | 308 | NO |
| Year 6 | 2000 | 50,717 | | 50,717 | 148,159 | 306 | NO |
| Year 7 | 2001 | 48,063 | | 48,063 | 152,221 | 282 | NO |
| Year 8 | 2002 | 52,409 | | 52,409 | 161,267 | 290 | NO |
| Year 9 | 2003 | 51,899 | | 51,899 | 166,359 | 279 | NO |
| Year 10 | 2004 | 54,826 | | 54,826 | 170,784 | 287 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2004 | 54,826 | | 54,826 | 170,784 | 287 | NO |
| Year 2 | 2005 | 55,933 | | 55,933 | 179,523 | 278 | NO |
| Year 3 | 2006 | 57,977 | | 57,977 | 182,035 | 284 | NO |
| Year 4 | 2007 | 61,035 | | 61,035 | 184,369 | 296 | NO |
| Year 5 | 2008 | 57,436 | | 57,436 | 184,669 | 278 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 40,451 | | 40,451 | 200,466 | 180 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1995 | 132,882 | 42,132 | 283 |
| Year 2 | 1996 | 135,001 | 45,476 | 301 |
| Year 3 | 1997 | 136,874 | 47,219 | 308 |
| Year 4 | 1998 | 139,556 | 41,865 | 268 |
| Year 5 | 1999 | 143,175 | 49,410 | 308 |
| Year 6 | 2000 | 148,159 | 50,717 | 306 |
| Year 7 | 2001 | 152,221 | 48,063 | 282 |
| Year 8 | 2002 | 161,267 | 52,409 | 290 |
| Year 9 | 2003 | 166,359 | 51,899 | 279 |
| Year 10 | 2004 | 170,784 | 54,826 | 287 |
| *Year 11* | 0 | 0 | 0 | |
| *Year 12* | 0 | 0 | 0 | |
| *Year 13* | 0 | 0 | 0 | |
| *Year 14* | 0 | 0 | 0 | |
| *Year 15* | 0 | 0 | 0 | |
| **10-15 Year Average Baseline GPCD** | | | | **291** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2004 | 170,784 | 54,826 | 287 |
| Year 2 | 2005 | 179,523 | 55,933 | 278 |
| Year 3 | 2006 | 182,035 | 57,977 | 284 |
| Year 4 | 2007 | 184,369 | 61,035 | 296 |
| Year 5 | 2008 | 184,669 | 57,436 | 278 |
| **5 Year Average Baseline GPCD** | | | | **284** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 200,466 | 40,451 | 180 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 291 |
| 5 Year Baseline GPCD | 284 |
| 2015 Compliance Year GPCD | 180 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 291 | 233 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape
Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 284 | 270 | 233 | 233 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 233 | 291 | 262 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 180 | 262 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 180.1412025 | 180.1412025 | YES |
| NOTES: | | | | | | | | |

# City of Fontana

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
| --- |
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 47,525 | Acre Feet |
| | 2008 total volume of delivered recycled water | 0 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 0.00% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1999 | |
| | Year ending baseline period range[2] | 2008 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2004 | |
| | Year ending baseline period range[3] | 2008 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☑ | **3. DWR Population Tool** |
| ☐ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1999 | 153,528 |
| Year 2 | 2000 | 160,195 |
| Year 3 | 2001 | 166,092 |
| Year 4 | 2002 | 172,765 |
| Year 5 | 2003 | 182,178 |
| Year 6 | 2004 | 187,554 |
| Year 7 | 2005 | 194,082 |
| Year 8 | 2006 | 199,419 |
| Year 9 | 2007 | 200,401 |
| Year 10 | 2008 | 200,517 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2004 | 187,554 |
| Year 2 | 2005 | 194,082 |
| Year 3 | 2006 | 199,419 |
| Year 4 | 2007 | 200,401 |
| Year 5 | 2008 | 200,517 |
| 2015 Compliance Year Population | | |
| **2015** | | 215,520 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1999 | 40984.07 | | | 0 | 0 | 0 | 40,984 |
| Year 2 | 2000 | 39979.44 | | | 0 | 0 | 0 | 39,979 |
| Year 3 | 2001 | 43001.41 | | | 0 | 0 | 0 | 43,001 |
| Year 4 | 2002 | 42229.29 | | | 0 | 0 | 0 | 42,229 |
| Year 5 | 2003 | 46608.59 | | | 0 | 0 | 0 | 46,609 |
| Year 6 | 2004 | 43219.86 | | | 0 | 0 | 0 | 43,220 |
| Year 7 | 2005 | 45081.9 | | | 0 | 0 | 0 | 45,082 |
| Year 8 | 2006 | 48396.07 | | | 0 | 0 | 0 | 48,396 |
| Year 9 | 2007 | 44771.52 | | | 0 | 0 | 0 | 44,772 |
| Year 10 | 2008 | 42731.71 | | | 0 | 0 | 0 | 42,732 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 12* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 13* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 14* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 15* | 0 | 0 | | | 0 | | 0 | 0 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **43,700** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2004 | 43,220 | | | 0 | 0 | 0 | 43,220 |
| Year 2 | 2005 | 45,082 | | | 0 | 0 | 0 | 45,082 |
| Year 3 | 2006 | 48,396 | | | 0 | 0 | 0 | 48,396 |
| Year 4 | 2007 | 44,772 | | | 0 | 0 | 0 | 44,772 |
| Year 5 | 2008 | 42,732 | | | 0 | 0 | 0 | 42,732 |
| **5 year baseline average gross water use** | | | | | | | | **44,840** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 34,241 | | | 914 | 0 | 0 | 33,326 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Source 1- Wells + Surface |
|---|---|
| **This water source is:** | |
| ☐ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1999 | 40982.12 | | 40,982 |
| Year 2 | 2000 | 39908.71 | | 39,909 |
| Year 3 | 2001 | 42885.7 | | 42,886 |
| Year 4 | 2002 | 41779.7 | | 41,780 |
| Year 5 | 2003 | 46228.56 | | 46,229 |
| Year 6 | 2004 | 42822.76 | | 42,823 |
| Year 7 | 2005 | 44626.07 | | 44,626 |
| Year 8 | 2006 | 48282.57 | | 48,283 |
| Year 9 | 2007 | 44625.72 | | 44,626 |
| Year 10 | 2008 | 37090.5 | | 37,091 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 42822.76 | | 42,823 |
| Year 2 | 2005 | 44626.07 | | 44,626 |
| Year 3 | 2006 | 48282.57 | | 48,283 |
| Year 4 | 2007 | 44625.72 | | 44,626 |
| Year 5 | 2008 | 37090.5 | | 37,091 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 26405.362 | | 26,405 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Source 2 - Imported | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☐ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1999 | 1.95 | | 2 |
| Year 2 | 2000 | 70.73 | | 71 |
| Year 3 | 2001 | 115.71 | | 116 |
| Year 4 | 2002 | 449.59 | | 450 |
| Year 5 | 2003 | 380.03 | | 380 |
| Year 6 | 2004 | 397.1 | | 397 |
| Year 7 | 2005 | 455.83 | | 456 |
| Year 8 | 2006 | 113.5 | | 114 |
| Year 9 | 2007 | 145.8 | | 146 |
| Year 10 | 2008 | 5641.21 | | 5,641 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 397.1 | | 397 |
| Year 2 | 2005 | 455.83 | | 456 |
| Year 3 | 2006 | 113.5 | | 114 |
| Year 4 | 2007 | 145.8 | | 146 |
| Year 5 | 2008 | 5641.21 | | 5,641 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 7,835 | | 7,835 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 2001 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 2002 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2003 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 8 | 2006 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 9 | 2007 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 10 | 2008 | | | 0 | | 0 | 0 | | 0 | 0 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 2006 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 2007 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2008 | | | 0 | | 0 | 0 | | 0 | 0 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 914.17455 | | 914 | 914 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

## SB X7-7 Table 4-C.1: Process Water Deduction Eligibility

**Criteria 1**
Industrial water use is equal to or greater than 12% of gross water use

| **Baseline Year** *Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
|---|---|---|---|---|---|
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1999 | 40,984 | | 0% | NO |
| Year 2 | 2000 | 39,979 | | 0% | NO |
| Year 3 | 2001 | 43,001 | | 0% | NO |
| Year 4 | 2002 | 42,229 | | 0% | NO |
| Year 5 | 2003 | 46,609 | | 0% | NO |
| Year 6 | 2004 | 43,220 | | 0% | NO |
| Year 7 | 2005 | 45,082 | | 0% | NO |
| Year 8 | 2006 | 48,396 | | 0% | NO |
| Year 9 | 2007 | 44,772 | | 0% | NO |
| Year 10 | 2008 | 42,732 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | 43,220 | | 0% | NO |
| Year 2 | 2005 | 45,082 | | 0% | NO |
| Year 3 | 2006 | 48,396 | | 0% | NO |
| Year 4 | 2007 | 44,772 | | 0% | NO |
| Year 5 | 2008 | 42,732 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 33,326 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1999 | | 153,528 | 0 | NO |
| Year 2 | 2000 | | 160,195 | 0 | NO |
| Year 3 | 2001 | | 166,092 | 0 | NO |
| Year 4 | 2002 | | 172,765 | 0 | NO |
| Year 5 | 2003 | | 182,178 | 0 | NO |
| Year 6 | 2004 | | 187,554 | 0 | NO |
| Year 7 | 2005 | | 194,082 | 0 | NO |
| Year 8 | 2006 | | 199,419 | 0 | NO |
| Year 9 | 2007 | | 200,401 | 0 | NO |
| Year 10 | 2008 | | 200,517 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | | 187,554 | 0 | NO |
| Year 2 | 2005 | | 194,082 | 0 | NO |
| Year 3 | 2006 | | 199,419 | 0 | NO |
| Year 4 | 2007 | | 200,401 | 0 | NO |
| Year 5 | 2008 | | 200,517 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 215,520 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1999 | 40,984 | | 40,984 | 153,528 | 238 | NO |
| Year 2 | 2000 | 39,979 | | 39,979 | 160,195 | 223 | NO |
| Year 3 | 2001 | 43,001 | | 43,001 | 166,092 | 231 | NO |
| Year 4 | 2002 | 42,229 | | 42,229 | 172,765 | 218 | NO |
| Year 5 | 2003 | 46,609 | | 46,609 | 182,178 | 228 | NO |
| Year 6 | 2004 | 43,220 | | 43,220 | 187,554 | 206 | NO |
| Year 7 | 2005 | 45,082 | | 45,082 | 194,082 | 207 | NO |
| Year 8 | 2006 | 48,396 | | 48,396 | 199,419 | 217 | NO |
| Year 9 | 2007 | 44,772 | | 44,772 | 200,401 | 199 | NO |
| Year 10 | 2008 | 42,732 | | 42,732 | 200,517 | 190 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2004 | 43,220 | | 43,220 | 187,554 | 206 | NO |
| Year 2 | 2005 | 45,082 | | 45,082 | 194,082 | 207 | NO |
| Year 3 | 2006 | 48,396 | | 48,396 | 199,419 | 217 | NO |
| Year 4 | 2007 | 44,772 | | 44,772 | 200,401 | 199 | NO |
| Year 5 | 2008 | 42,732 | | 42,732 | 200,517 | 190 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 33,326 | | 33,326 | 215,520 | 138 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1999 | 153,528 | 40,984 | 238 |
| Year 2 | 2000 | 160,195 | 39,979 | 223 |
| Year 3 | 2001 | 166,092 | 43,001 | 231 |
| Year 4 | 2002 | 172,765 | 42,229 | 218 |
| Year 5 | 2003 | 182,178 | 46,609 | 228 |
| Year 6 | 2004 | 187,554 | 43,220 | 206 |
| Year 7 | 2005 | 194,082 | 45,082 | 207 |
| Year 8 | 2006 | 199,419 | 48,396 | 217 |
| Year 9 | 2007 | 200,401 | 44,772 | 199 |
| Year 10 | 2008 | 200,517 | 42,732 | 190 |
| *Year 11* | 0 | 0 | 0 | |
| *Year 12* | 0 | 0 | 0 | |
| *Year 13* | 0 | 0 | 0 | |
| *Year 14* | 0 | 0 | 0 | |
| *Year 15* | 0 | 0 | 0 | |
| **10-15 Year Average Baseline GPCD** | | | | **216** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2004 | 187,554 | 43,220 | 206 |
| Year 2 | 2005 | 194,082 | 45,082 | 207 |
| Year 3 | 2006 | 199,419 | 48,396 | 217 |
| Year 4 | 2007 | 200,401 | 44,772 | 199 |
| Year 5 | 2008 | 200,517 | 42,732 | 190 |
| **5 Year Average Baseline GPCD** | | | | **204** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 215,520 | 33,326 | 138 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 216 |
| 5 Year Baseline GPCD | 204 |
| 2015 Compliance Year GPCD | 138 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 216 | 173 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 204 | 194 | 173 | 173 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 173 | 216 | 194 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 138 | 194 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 138.046896 | 138.046896 | YES |
| NOTES: | | | | | | | | |

# Monte Vista Water District

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 12,247 | Acre Feet |
| | 2008 total volume of delivered recycled water | 0 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 0.00% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1996 | |
| | Year ending baseline period range[2] | 2005 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2004 | |
| | Year ending baseline period range[3] | 2008 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☑ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1996 | 47,150 |
| Year 2 | 1997 | 47,225 |
| Year 3 | 1998 | 47,300 |
| Year 4 | 1999 | 48,900 |
| Year 5 | 2000 | 48,934 |
| Year 6 | 2001 | 49,200 |
| Year 7 | 2002 | 50,020 |
| Year 8 | 2003 | 50,520 |
| Year 9 | 2004 | 50,520 |
| Year 10 | 2005 | 51,230 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2004 | 50,520 |
| Year 2 | 2005 | 51,230 |
| Year 3 | 2006 | 53,690 |
| Year 4 | 2007 | 53,943 |
| Year 5 | 2008 | 54,593 |
| 2015 Compliance Year Population | | |
| **2015** | | 56,039 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1996 | 10708 | 0 | | 0 | 0 | 0 | 10,708 |
| Year 2 | 1997 | 11831.94 | 0 | | 0 | 0 | 0 | 11,832 |
| Year 3 | 1998 | 10146.31 | 0 | | 0 | 0 | 0 | 10,146 |
| Year 4 | 1999 | 11007 | 396 | | 0 | 0 | 0 | 10,611 |
| Year 5 | 2000 | 24547 | 12,624 | | 0 | 0 | 0 | 11,923 |
| Year 6 | 2001 | 21509.7278 | 9,775 | | 29 | 0 | 0 | 11,705 |
| Year 7 | 2002 | 23385.873 | 11,360 | | 36 | 0 | 0 | 11,990 |
| Year 8 | 2003 | 23783.3027 | 11,831 | | 29 | 0 | 0 | 11,923 |
| Year 9 | 2004 | 25468.5689 | 13,008 | | 20 | 0 | 0 | 12,441 |
| Year 10 | 2005 | 22926.5727 | 12,040 | | 16 | 0 | 0 | 10,871 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | |
| *Year 12* | 0 | 0 | | | 0 | | 0 | |
| *Year 13* | 0 | 0 | | | 0 | | 0 | |
| *Year 14* | 0 | 0 | | | 0 | | 0 | |
| *Year 15* | 0 | 0 | | | 0 | | 0 | |
| **10 - 15 year baseline average gross water use** | | | | | | | | **11,415** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2004 | 25,469 | 13,008 | | 20 | 0 | 0 | 12,441 |
| Year 2 | 2005 | 22,927 | 12,040 | | 16 | 0 | 0 | 10,871 |
| Year 3 | 2006 | 25,434 | 13,930 | | 21 | 0 | 0 | 11,484 |
| Year 4 | 2007 | 25,804 | 13,428 | 107 | 57 | 0 | 0 | 12,211 |
| Year 5 | 2008 | 26,078 | 12,614 | 1,217 | 128 | 0 | 0 | 12,119 |
| **5 year baseline average gross water use** | | | | | | | | **11,825** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 17,160 | 8,050 | | 576 | 0 | 0 | 8,534 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Chino Basin Groundwater |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 6902 | | 6,902 |
| Year 2 | 1997 | 9117.01 | | 9,117 |
| Year 3 | 1998 | 6828.21 | | 6,828 |
| Year 4 | 1999 | 8647 | | 8,647 |
| Year 5 | 2000 | 9312 | | 9,312 |
| Year 6 | 2001 | 10508.54 | | 10,509 |
| Year 7 | 2002 | 13418.44 | | 13,418 |
| Year 8 | 2003 | 13283.27 | | 13,283 |
| Year 9 | 2004 | 13049.62 | | 13,050 |
| Year 10 | 2005 | 10298.94 | | 10,299 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 13049.62 | | 13,050 |
| Year 2 | 2005 | 10298.94 | | 10,299 |
| Year 3 | 2006 | 8535.22 | | 8,535 |
| Year 4 | 2007 | 11619.91 | | 11,620 |
| Year 5 | 2008 | 14250.45 | | 14,250 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 8405.58508 | | 8,406 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Water Facilities Authority | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 3806 | | 3,806 |
| Year 2 | 1997 | 2714.93 | | 2,715 |
| Year 3 | 1998 | 3318.1 | | 3,318 |
| Year 4 | 1999 | 2360 | | 2,360 |
| Year 5 | 2000 | 15235 | | 15,235 |
| Year 6 | 2001 | 11001.1878 | | 11,001 |
| Year 7 | 2002 | 9967.433 | | 9,967 |
| Year 8 | 2003 | 10500.0327 | | 10,500 |
| Year 9 | 2004 | 12418.9489 | | 12,419 |
| Year 10 | 2005 | 12627.6327 | | 12,628 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 12418.9489 | | 12,419 |
| Year 2 | 2005 | 12627.6327 | | 12,628 |
| Year 3 | 2006 | 16898.8515 | | 16,899 |
| Year 4 | 2007 | 14183.698 | | 14,184 |
| Year 5 | 2008 | 11827.2141 | | 11,827 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 8,144 | | 8,144 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | San Antonio Water Company | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 0 | | 0 |
| Year 2 | 1997 | 0 | | 0 |
| Year 3 | 1998 | 0 | | 0 |
| Year 4 | 1999 | 0 | | 0 |
| Year 5 | 2000 | 0 | | 0 |
| Year 6 | 2001 | 0 | | 0 |
| Year 7 | 2002 | 0 | | 0 |
| Year 8 | 2003 | 0 | | 0 |
| Year 9 | 2004 | 0 | | 0 |
| Year 10 | 2005 | 0 | | 0 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2004 | 0 | | 0 |
| Year 2 | 2005 | 0 | | 0 |
| Year 3 | 2006 | 0 | | 0 |
| Year 4 | 2007 | 0 | | 0 |
| Year 5 | 2008 | 0 | | 0 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 611 | | 611 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2001 | | | 0 | | 0 | 29.298572 | | 29 | 29 |
| Year 7 | 2002 | | | 0 | | 0 | 36.438494 | | 36 | 36 |
| Year 8 | 2003 | | | 0 | | 0 | 28.922761 | | 29 | 29 |
| Year 9 | 2004 | | | 0 | | 0 | 19.997229 | | 20 | 20 |
| Year 10 | 2005 | | | 0 | | 0 | 15.726631 | | 16 | 16 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2004 | | | 0 | | 0 | 19.997229 | | 20 | 20 |
| Year 2 | 2005 | | | 0 | | 0 | 15.726631 | | 16 | 16 |
| Year 3 | 2006 | | | 0 | | 0 | 20.951633 | | 21 | 21 |
| Year 4 | 2007 | | | 0 | | 0 | 57.023301 | | 57 | 57 |
| Year 5 | 2008 | | | 0 | | 0 | 127.51217 | | 128 | 128 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 575.95069 | | 576 | 576 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1996 | 10,708 | | 0% | NO |
| Year 2 | 1997 | 11,832 | | 0% | NO |
| Year 3 | 1998 | 10,146 | | 0% | NO |
| Year 4 | 1999 | 10,611 | | 0% | NO |
| Year 5 | 2000 | 11,923 | | 0% | NO |
| Year 6 | 2001 | 11,705 | | 0% | NO |
| Year 7 | 2002 | 11,990 | | 0% | NO |
| Year 8 | 2003 | 11,923 | | 0% | NO |
| Year 9 | 2004 | 12,441 | | 0% | NO |
| Year 10 | 2005 | 10,871 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | 12,441 | | 0% | NO |
| Year 2 | 2005 | 10,871 | | 0% | NO |
| Year 3 | 2006 | 11,484 | | 0% | NO |
| Year 4 | 2007 | 12,211 | | 0% | NO |
| Year 5 | 2008 | 12,119 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 8,534 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1996 | | 47,150 | 0 | NO |
| Year 2 | 1997 | | 47,225 | 0 | NO |
| Year 3 | 1998 | | 47,300 | 0 | NO |
| Year 4 | 1999 | | 48,900 | 0 | NO |
| Year 5 | 2000 | | 48,934 | 0 | NO |
| Year 6 | 2001 | | 49,200 | 0 | NO |
| Year 7 | 2002 | | 50,020 | 0 | NO |
| Year 8 | 2003 | | 50,520 | 0 | NO |
| Year 9 | 2004 | | 50,520 | 0 | NO |
| Year 10 | 2005 | | 51,230 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2004 | | 50,520 | 0 | NO |
| Year 2 | 2005 | | 51,230 | 0 | NO |
| Year 3 | 2006 | | 53,690 | 0 | NO |
| Year 4 | 2007 | | 53,943 | 0 | NO |
| Year 5 | 2008 | | 54,593 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 56,039 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1996 | 10,708 | | 10,708 | 47,150 | 203 | NO |
| Year 2 | 1997 | 11,832 | | 11,832 | 47,225 | 224 | NO |
| Year 3 | 1998 | 10,146 | | 10,146 | 47,300 | 192 | NO |
| Year 4 | 1999 | 10,611 | | 10,611 | 48,900 | 194 | NO |
| Year 5 | 2000 | 11,923 | | 11,923 | 48,934 | 218 | NO |
| Year 6 | 2001 | 11,705 | | 11,705 | 49,200 | 212 | NO |
| Year 7 | 2002 | 11,990 | | 11,990 | 50,020 | 214 | NO |
| Year 8 | 2003 | 11,923 | | 11,923 | 50,520 | 211 | NO |
| Year 9 | 2004 | 12,441 | | 12,441 | 50,520 | 220 | NO |
| Year 10 | 2005 | 10,871 | | 10,871 | 51,230 | 189 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2004 | 12,441 | | 12,441 | 50,520 | 220 | NO |
| Year 2 | 2005 | 10,871 | | 10,871 | 51,230 | 189 | NO |
| Year 3 | 2006 | 11,484 | | 11,484 | 53,690 | 191 | NO |
| Year 4 | 2007 | 12,211 | | 12,211 | 53,943 | 202 | NO |
| Year 5 | 2008 | 12,119 | | 12,119 | 54,593 | 198 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 8,534 | | 8,534 | 56,039 | 136 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1996 | 47,150 | 10,708 | 203 |
| Year 2 | 1997 | 47,225 | 11,832 | 224 |
| Year 3 | 1998 | 47,300 | 10,146 | 192 |
| Year 4 | 1999 | 48,900 | 10,611 | 194 |
| Year 5 | 2000 | 48,934 | 11,923 | 218 |
| Year 6 | 2001 | 49,200 | 11,705 | 212 |
| Year 7 | 2002 | 50,020 | 11,990 | 214 |
| Year 8 | 2003 | 50,520 | 11,923 | 211 |
| Year 9 | 2004 | 50,520 | 12,441 | 220 |
| Year 10 | 2005 | 51,230 | 10,871 | 189 |
| *Year 11* | 0 | 0 | | |
| *Year 12* | 0 | 0 | | |
| *Year 13* | 0 | 0 | | |
| *Year 14* | 0 | 0 | | |
| *Year 15* | 0 | 0 | | |
| **10-15 Year Average Baseline GPCD** | | | | **208** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2004 | 50,520 | 12,441 | 220 |
| Year 2 | 2005 | 51,230 | 10,871 | 189 |
| Year 3 | 2006 | 53,690 | 11,484 | 191 |
| Year 4 | 2007 | 53,943 | 12,211 | 202 |
| Year 5 | 2008 | 54,593 | 12,119 | 198 |
| **5 Year Average Baseline GPCD** | | | | **200** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 56,039 | 8,534 | 136 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 208 |
| 5 Year Baseline GPCD | 200 |
| 2015 Compliance Year GPCD | 136 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 208 | 166 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 200 | 190 | 166 | 166 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 166 | 208 | 187 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 136 | 187 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 135.958895 | 135.958895 | YES |
| NOTES: | | | | | | | | |

# City of Ontario

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 42,072 | Acre Feet |
| | 2008 total volume of delivered recycled water | 2,637 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 6.27% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1995 | |
| | Year ending baseline period range[2] | 2004 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2003 | |
| | Year ending baseline period range[3] | 2007 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☑ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☐ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1995 | 138,976 |
| Year 2 | 1996 | 140,276 |
| Year 3 | 1997 | 142,064 |
| Year 4 | 1998 | 144,688 |
| Year 5 | 1999 | 147,005 |
| Year 6 | 2000 | 152,524 |
| Year 7 | 2001 | 153,951 |
| Year 8 | 2002 | 157,752 |
| Year 9 | 2003 | 160,641 |
| Year 10 | 2004 | 162,528 |
| *Year 11* | *2005* | 164,308 |
| *Year 12* | *2006* | 164,763 |
| *Year 13* | *2007* | 166,058 |
| *Year 14* | *2008* | 164,951 |
| *Year 15* | *2009* | 163,719 |
| 5 Year Baseline Population | | |
| Year 1 | 2003 | 164,515 |
| Year 2 | 2004 | 164,836 |
| Year 3 | 2005 | 165,790 |
| Year 4 | 2006 | 166,866 |
| Year 5 | 2007 | 167,240 |
| 2015 Compliance Year Population | | |
| **2015** | | 168,777 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1995 | 12262 | | | 0 | 0 | 0 | 12,262 |
| Year 2 | 1996 | 40764.7 | | | 0 | 0 | 0 | 40,765 |
| Year 3 | 1997 | 40115.4 | | | 0 | 0 | 0 | 40,115 |
| Year 4 | 1998 | 40066.1 | | | 0 | 0 | 0 | 40,066 |
| Year 5 | 1999 | 45144.16 | | | 0 | 0 | 0 | 45,144 |
| Year 6 | 2000 | 46100 | | | 0 | 0 | 0 | 46,100 |
| Year 7 | 2001 | 43951.48 | | | 0 | 0 | 0 | 43,951 |
| Year 8 | 2002 | 44708.9 | | | 94 | 0 | 0 | 44,615 |
| Year 9 | 2003 | 43447.24 | | | 75 | 0 | 0 | 43,372 |
| Year 10 | 2004 | 42967.19 | | | 44 | 0 | 0 | 42,923 |
| *Year 11* | 2005 | 42204.57 | | | 42 | | 0 | 42,163 |
| *Year 12* | 2006 | 43901.41 | | | 73 | | 0 | 43,828 |
| *Year 13* | 2007 | 44805.9 | | | 137 | | 0 | 44,669 |
| *Year 14* | 2008 | 43301 | | | 234 | | 0 | 43,067 |
| *Year 15* | 2009 | 39538 | | | 448 | | 0 | 39,090 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **40,809** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2003 | 34,990 | | | 75 | 0 | 0 | 34,915 |
| Year 2 | 2004 | 34,488 | | | 44 | 0 | 0 | 34,444 |
| Year 3 | 2005 | 35,297 | | | 42 | 0 | 0 | 35,255 |
| Year 4 | 2006 | 35,921 | | | 73 | 0 | 0 | 35,848 |
| Year 5 | 2007 | 35,670 | | | 137 | 0 | 0 | 35,533 |
| **5 year baseline average gross water use** | | | | | | | | **35,199** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 29,943 | | | 1,194 | 0 | 0 | 28,749 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Groundwater |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 10100 | | 10,100 |
| Year 2 | 1996 | 32005.8 | | 32,006 |
| Year 3 | 1997 | 32525.8 | | 32,526 |
| Year 4 | 1998 | 35484.1 | | 35,484 |
| Year 5 | 1999 | 37028.62 | | 37,029 |
| Year 6 | 2000 | 36842 | | 36,842 |
| Year 7 | 2001 | 35104.53 | | 35,105 |
| Year 8 | 2002 | 35383.5 | | 35,384 |
| Year 9 | 2003 | 30240.34 | | 30,240 |
| Year 10 | 2004 | 27824.25 | | 27,824 |
| Year 11 | 2005 | 28799 | | 28,799 |
| Year 12 | 2006 | 28793.18 | | 28,793 |
| Year 13 | 2007 | 26946.41 | | 26,946 |
| Year 14 | 2008 | 29061 | | 29,061 |
| Year 15 | 2009 | 28996 | | 28,996 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2003 | 21997.07 | | 21,997 |
| Year 2 | 2004 | 20442 | | 20,442 |
| Year 3 | 2005 | 20226.06 | | 20,226 |
| Year 4 | 2006 | 19966.97 | | 19,967 |
| Year 5 | 2007 | 20274 | | 20,274 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 19544 | | 19,544 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Purchased | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1995 | 2162 | | 2,162 |
| Year 2 | 1996 | 8758.9 | | 8,759 |
| Year 3 | 1997 | 7589.6 | | 7,590 |
| Year 4 | 1998 | 4582 | | 4,582 |
| Year 5 | 1999 | 8115.54 | | 8,116 |
| Year 6 | 2000 | 9258 | | 9,258 |
| Year 7 | 2001 | 8846.95 | | 8,847 |
| Year 8 | 2002 | 9325.4 | | 9,325 |
| Year 9 | 2003 | 13206.9 | | 13,207 |
| Year 10 | 2004 | 15142.94 | | 15,143 |
| Year 11 | 2005 | 13405.57 | | 13,406 |
| Year 12 | 2006 | 15108.23 | | 15,108 |
| Year 13 | 2007 | 17859.49 | | 17,859 |
| Year 14 | 2008 | 14240 | | 14,240 |
| Year 15 | 2009 | 10542 | | 10,542 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2003 | 12992.93 | | 12,993 |
| Year 2 | 2004 | 14046 | | 14,046 |
| Year 3 | 2005 | 15071.15 | | 15,071 |
| Year 4 | 2006 | 15953.79 | | 15,954 |
| Year 5 | 2007 | 15396 | | 15,396 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 10,399 | | 10,399 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1995 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2001 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 8 | 2002 | | | 0 | | 0 | 94.232488 | | 94 | 94 |
| Year 9 | 2003 | | | 0 | | 0 | 75.262967 | | 75 | 75 |
| Year 10 | 2004 | | | 0 | | 0 | 44.106833 | | 44 | 44 |
| *Year 11* | 2005 | | | 0 | | 0 | 42.029974 | | 42 | 42 |
| *Year 12* | 2006 | | | 0 | | 0 | 73.12223 | | 73 | 73 |
| *Year 13* | 2007 | | | 0 | | 0 | 136.71479 | | 137 | 137 |
| *Year 14* | 2008 | | | 0 | | 0 | 233.90843 | | 234 | 234 |
| *Year 15* | 2009 | | | 0 | | 0 | 447.53827 | | 448 | 448 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2003 | | | 0 | | 0 | 75.262967 | | 75 | 75 |
| Year 2 | 2004 | | | 0 | | 0 | 44.106833 | | 44 | 44 |
| Year 3 | 2005 | | | 0 | | 0 | 42.029974 | | 42 | 42 |
| Year 4 | 2006 | | | 0 | | 0 | 73.12223 | | 73 | 73 |
| Year 5 | 2007 | | | 0 | | 0 | 136.71479 | | 137 | 137 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 1193.7756 | | 1,194 | 1,194 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | 12,262 | | 0% | NO |
| Year 2 | 1996 | 40,765 | | 0% | NO |
| Year 3 | 1997 | 40,115 | | 0% | NO |
| Year 4 | 1998 | 40,066 | | 0% | NO |
| Year 5 | 1999 | 45,144 | | 0% | NO |
| Year 6 | 2000 | 46,100 | | 0% | NO |
| Year 7 | 2001 | 43,951 | | 0% | NO |
| Year 8 | 2002 | 44,615 | | 0% | NO |
| Year 9 | 2003 | 43,372 | | 0% | NO |
| Year 10 | 2004 | 42,923 | | 0% | NO |
| Year 11 | 2005 | 42,163 | | 0% | NO |
| Year 12 | 2006 | 43,828 | | 0% | NO |
| Year 13 | 2007 | 44,669 | | 0% | NO |
| Year 14 | 2008 | 43,067 | | 0% | NO |
| Year 15 | 2009 | 39,090 | | 0% | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2003 | 34,915 | | 0% | NO |
| Year 2 | 2004 | 34,444 | | 0% | NO |
| Year 3 | 2005 | 35,255 | | 0% | NO |
| Year 4 | 2006 | 35,848 | | 0% | NO |
| Year 5 | 2007 | 35,533 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 28,749 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1995 | | 138,976 | 0 | NO |
| Year 2 | 1996 | | 140,276 | 0 | NO |
| Year 3 | 1997 | | 142,064 | 0 | NO |
| Year 4 | 1998 | | 144,688 | 0 | NO |
| Year 5 | 1999 | | 147,005 | 0 | NO |
| Year 6 | 2000 | | 152,524 | 0 | NO |
| Year 7 | 2001 | | 153,951 | 0 | NO |
| Year 8 | 2002 | | 157,752 | 0 | NO |
| Year 9 | 2003 | | 160,641 | 0 | NO |
| Year 10 | 2004 | | 162,528 | 0 | NO |
| *Year 11* | 2005 | | 164,308 | 0 | NO |
| *Year 12* | 2006 | | 164,763 | 0 | NO |
| *Year 13* | 2007 | | 166,058 | 0 | NO |
| *Year 14* | 2008 | | 164,951 | 0 | NO |
| *Year 15* | 2009 | | 163,719 | 0 | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2003 | | 164,515 | 0 | NO |
| Year 2 | 2004 | | 164,836 | 0 | NO |
| Year 3 | 2005 | | 165,790 | 0 | NO |
| Year 4 | 2006 | | 166,866 | 0 | NO |
| Year 5 | 2007 | | 167,240 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 168,777 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1995 | 12,262 | | 12,262 | 138,976 | 79 | YES |
| Year 2 | 1996 | 40,765 | | 40,765 | 140,276 | 259 | NO |
| Year 3 | 1997 | 40,115 | | 40,115 | 142,064 | 252 | NO |
| Year 4 | 1998 | 40,066 | | 40,066 | 144,688 | 247 | NO |
| Year 5 | 1999 | 45,144 | | 45,144 | 147,005 | 274 | NO |
| Year 6 | 2000 | 46,100 | | 46,100 | 152,524 | 270 | NO |
| Year 7 | 2001 | 43,951 | | 43,951 | 153,951 | 255 | NO |
| Year 8 | 2002 | 44,615 | | 44,615 | 157,752 | 252 | NO |
| Year 9 | 2003 | 43,372 | | 43,372 | 160,641 | 241 | NO |
| Year 10 | 2004 | 42,923 | | 42,923 | 162,528 | 236 | NO |
| *Year 11* | 2005 | 42,163 | | 42,163 | 164,308 | 229 | NO |
| *Year 12* | 2006 | 43,828 | | 43,828 | 164,763 | 237 | NO |
| *Year 13* | 2007 | 44,669 | | 44,669 | 166,058 | 240 | NO |
| *Year 14* | 2008 | 43,067 | | 43,067 | 164,951 | 233 | NO |
| *Year 15* | 2009 | 39,090 | | 39,090 | 163,719 | 213 | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2003 | 34,915 | | 34,915 | 164,515 | 189 | NO |
| Year 2 | 2004 | 34,444 | | 34,444 | 164,836 | 187 | NO |
| Year 3 | 2005 | 35,255 | | 35,255 | 165,790 | 190 | NO |
| Year 4 | 2006 | 35,848 | | 35,848 | 166,866 | 192 | NO |
| Year 5 | 2007 | 35,533 | | 35,533 | 167,240 | 190 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 28,749 | | 28,749 | 168,777 | 152 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1995 | 138,976 | 12,262 | 79 |
| Year 2 | 1996 | 140,276 | 40,765 | 259 |
| Year 3 | 1997 | 142,064 | 40,115 | 252 |
| Year 4 | 1998 | 144,688 | 40,066 | 247 |
| Year 5 | 1999 | 147,005 | 45,144 | 274 |
| Year 6 | 2000 | 152,524 | 46,100 | 270 |
| Year 7 | 2001 | 153,951 | 43,951 | 255 |
| Year 8 | 2002 | 157,752 | 44,615 | 252 |
| Year 9 | 2003 | 160,641 | 43,372 | 241 |
| Year 10 | 2004 | 162,528 | 42,923 | 236 |
| *Year 11* | 2005 | 164,308 | 42,163 | 229 |
| *Year 12* | 2006 | 164,763 | 43,828 | 237 |
| *Year 13* | 2007 | 166,058 | 44,669 | 240 |
| *Year 14* | 2008 | 164,951 | 43,067 | 233 |
| *Year 15* | 2009 | 163,719 | 39,090 | 213 |
| **10-15 Year Average Baseline GPCD** | | | | **235** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2003 | 164,515 | 34,915 | 189 |
| Year 2 | 2004 | 164,836 | 34,444 | 187 |
| Year 3 | 2005 | 165,790 | 35,255 | 190 |
| Year 4 | 2006 | 166,866 | 35,848 | 192 |
| Year 5 | 2007 | 167,240 | 35,533 | 190 |
| **5 Year Average Baseline GPCD** | | | | **189** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 168,777 | 28,749 | 152 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 235 |
| 5 Year Baseline GPCD | 189 |
| 2015 Compliance Year GPCD | 152 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 235 | 188 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 189 | 180 | 188 | 180 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 180 | 235 | 207 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 152 | 207 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 152.0684304 | 152.0684304 | YES |
| NOTES: | | | | | | | | |

# City of Upland

| **SB X7-7 Table 0: Units of Measure Used in UWMP*** *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 21,505 | Acre Feet |
| | 2008 total volume of delivered recycled water | 0 | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 0.00% | Percent |
| | Number of years in baseline period[1] | 10 | Years |
| | Year beginning baseline period range | 1996 | |
| | Year ending baseline period range[2] | 2005 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2005 | |
| | Year ending baseline period range[3] | 2009 | |

[1] *If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.*

[2] *The ending year must be between December 31, 2004 and December 31, 2010.*

[3] *The ending year must be between December 31, 2007 and December 31, 2010.*

NOTES:

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☑ | **1. Department of Finance** (DOF)<br>DOF Table E-8 (1990 - 2000) and (2000-2010) and<br>DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☐ | **3. DWR Population Tool** |
| ☐ | **4. Other**<br>DWR recommends pre-review |
| NOTES: | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| **Year** | | **Population** |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1996 | 65,566 |
| Year 2 | 1997 | 65,961 |
| Year 3 | 1998 | 66,676 |
| Year 4 | 1999 | 67,289 |
| Year 5 | 2000 | 68,393 |
| Year 6 | 2001 | 69,058 |
| Year 7 | 2002 | 70,357 |
| Year 8 | 2003 | 71,200 |
| Year 9 | 2004 | 71,831 |
| Year 10 | 2005 | 72,216 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2005 | 72,216 |
| Year 2 | 2006 | 72,197 |
| Year 3 | 2007 | 72,981 |
| Year 4 | 2008 | 72,654 |
| Year 5 | 2009 | 72,715 |
| 2015 Compliance Year Population | | |
| **2015** | | 75,787 |
| NOTES: | | |

| SB X7-7 Table 4: Annual Gross Water Use * | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Baseline Year** *Fm SB X7-7 Table 3* | **Volume Into Distribution System** *Fm SB X7-7 Table(s) 4-A* | **Deductions** | | | | | **Annual Gross Water Use** |
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *Fm SB X7-7 Table 4-B* | Water Delivered for Agricultural Use | Process Water *Fm SB X7-7 Table(s) 4-D* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1996 | 21460.774 | | | 0 | 0 | 0 | 21,461 |
| Year 2 | 1997 | 21666.224 | | | 0 | 0 | 0 | 21,666 |
| Year 3 | 1998 | 18400.76 | | | 0 | 0 | 0 | 18,401 |
| Year 4 | 1999 | 20735.129 | | | 0 | 0 | 0 | 20,735 |
| Year 5 | 2000 | 23061.602 | | | 0 | 0 | 0 | 23,062 |
| Year 6 | 2001 | 21979.24 | | | 0 | 0 | 0 | 21,979 |
| Year 7 | 2002 | 22495.287 | | | 0 | 0 | 0 | 22,495 |
| Year 8 | 2003 | 20255.227 | | | 0 | 0 | 0 | 20,255 |
| Year 9 | 2004 | 20984.134 | | | 0 | 0 | 0 | 20,984 |
| Year 10 | 2005 | 17986.959 | | | 0 | 0 | 0 | 17,987 |
| *Year 11* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 12* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 13* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 14* | 0 | 0 | | | 0 | | 0 | 0 |
| *Year 15* | 0 | 0 | | | 0 | | 0 | 0 |
| **10 - 15 year baseline average gross water use** | | | | | | | | **20,903** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2005 | 17,987 | | | 0 | 0 | 0 | 17,987 |
| Year 2 | 2006 | 20,247 | | | 0 | 0 | 0 | 20,247 |
| Year 3 | 2007 | 22,847 | | | 0 | 0 | 0 | 22,847 |
| Year 4 | 2008 | 23,651 | | | 0 | 0 | 0 | 23,651 |
| Year 5 | 2009 | 21,931 | | | 0 | 0 | 0 | 21,931 |
| **5 year baseline average gross water use** | | | | | | | | **21,333** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 19,992 | | | 234 | 0 | 0 | 19,757 |
| * NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3 | | | | | | | | |
| NOTES: | | | | | | | | |

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | City Wells |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 11084.188 | | 11,084 |
| Year 2 | 1997 | 10090.542 | | 10,091 |
| Year 3 | 1998 | 8281.407 | | 8,281 |
| Year 4 | 1999 | 11099.058 | | 11,099 |
| Year 5 | 2000 | 7410.202 | | 7,410 |
| Year 6 | 2001 | 7545.283 | | 7,545 |
| Year 7 | 2002 | 6236.759 | | 6,237 |
| Year 8 | 2003 | 5962.61 | | 5,963 |
| Year 9 | 2004 | 5151.374 | | 5,151 |
| Year 10 | 2005 | 5132.058 | | 5,132 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 5132.058 | | 5,132 |
| Year 2 | 2006 | 7037.733 | | 7,038 |
| Year 3 | 2007 | 7471.704 | | 7,472 |
| Year 4 | 2008 | 7868.693 | | 7,869 |
| Year 5 | 2009 | 8919.82 | | 8,920 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 6846.46 | | 6,846 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | SAWCO Groundwater | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 4468.007 | | 4,468 |
| Year 2 | 1997 | 6667.908 | | 6,668 |
| Year 3 | 1998 | 5049.89 | | 5,050 |
| Year 4 | 1999 | 5242.082 | | 5,242 |
| Year 5 | 2000 | 11587.49 | | 11,587 |
| Year 6 | 2001 | 7394.429 | | 7,394 |
| Year 7 | 2002 | 6760.942 | | 6,761 |
| Year 8 | 2003 | 6125.555 | | 6,126 |
| Year 9 | 2004 | 6937.346 | | 6,937 |
| Year 10 | 2005 | 5760.622 | | 5,761 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 5760.622 | | 5,761 |
| Year 2 | 2006 | 7007.085 | | 7,007 |
| Year 3 | 2007 | 8112.855 | | 8,113 |
| Year 4 | 2008 | 9050.996 | | 9,051 |
| Year 5 | 2009 | 7765.412 | | 7,765 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 4,695 | | 4,695 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | SAWCO Surface Water | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 3454.591 | | 3,455 |
| Year 2 | 1997 | 2353.997 | | 2,354 |
| Year 3 | 1998 | 1257.461 | | 1,257 |
| Year 4 | 1999 | 4115.653 | | 4,116 |
| Year 5 | 2000 | 346.436 | | 346 |
| Year 6 | 2001 | 1999.176 | | 1,999 |
| Year 7 | 2002 | 1499.275 | | 1,499 |
| Year 8 | 2003 | 1155.159 | | 1,155 |
| Year 9 | 2004 | 718.359 | | 718 |
| Year 10 | 2005 | 467.328 | | 467 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 467.328 | | 467 |
| Year 2 | 2006 | 1134.669 | | 1,135 |
| Year 3 | 2007 | 2529.721 | | 2,530 |
| Year 4 | 2008 | 2133.085 | | 2,133 |
| Year 5 | 2009 | 1589.19 | | 1,589 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 1,403 | | 1,403 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Water Facility Authority | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment* *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 2453.988 | | 2,454 |
| Year 2 | 1997 | 2553.777 | | 2,554 |
| Year 3 | 1998 | 3812.002 | | 3,812 |
| Year 4 | 1999 | 278.336 | | 278 |
| Year 5 | 2000 | 3717.474 | | 3,717 |
| Year 6 | 2001 | 5040.352 | | 5,040 |
| Year 7 | 2002 | 7998.311 | | 7,998 |
| Year 8 | 2003 | 7011.903 | | 7,012 |
| Year 9 | 2004 | 8177.055 | | 8,177 |
| Year 10 | 2005 | 6626.951 | | 6,627 |
| Year 11 | 0 | | | 0 |
| Year 12 | 0 | | | 0 |
| Year 13 | 0 | | | 0 |
| Year 14 | 0 | | | 0 |
| Year 15 | 0 | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2005 | 6626.951 | | 6,627 |
| Year 2 | 2006 | 5067.201 | | 5,067 |
| Year 3 | 2007 | 4732.552 | | 4,733 |
| Year 4 | 2008 | 4598.25 | | 4,598 |
| Year 5 | 2009 | 3656.798 | | 3,657 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 7,048 | | 7,048 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| **Baseline Year** *Fm SB X7-7 Table 3* | | **Surface Reservoir Augmentation** | | | | | **Groundwater Recharge** | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1996 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 1997 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 1998 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 1999 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2000 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 6 | 2001 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 7 | 2002 | | | 0 | | 0 | 0.0073317 | | 0 | 0 |
| Year 8 | 2003 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 9 | 2004 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 10 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| *Year 11* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 12* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 13* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 14* | 0 | | | 0 | | 0 | | | 0 | 0 |
| *Year 15* | 0 | | | 0 | | 0 | | | 0 | 0 |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2005 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 2 | 2006 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 3 | 2007 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 4 | 2008 | | | 0 | | 0 | 0 | | 0 | 0 |
| Year 5 | 2009 | | | 0 | | 0 | 0 | | 0 | 0 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | 0 | | 0 | 234.04937 | | 234 | 234 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

| **SB X7-7 Table 4-C: Process Water Deduction Eligibility**<br>*(For use only by agencies that are deducting process water) Choose Only One* | |
|---|---|
| ☐ | **Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use.<br>Complete SB X7-7 Table 4-C.1 |
| ☐ | **Criteria 2** - Industrial water use is equal to or greater than 15 GPCD.<br>Complete SB X7-7 Table 4-C.2 |
| ☐ | **Criteria 3** - Non-industrial use is equal to or less than 120 GPCD.<br>Complete SB X7-7 Table 4-C.3 |
| ☐ | **Criteria 4** - Disadvantaged Community.<br>Complete SB x7-7 Table 4-C.4 |
| NOTES: | |

| SB X7-7 Table 4-C.1: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 1**<br>Industrial water use is equal to or greater than 12% of gross water use | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction | Industrial Water Use | Percent Industrial Water | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1996 | 21,461 | | 0% | NO |
| Year 2 | 1997 | 21,666 | | 0% | NO |
| Year 3 | 1998 | 18,401 | | 0% | NO |
| Year 4 | 1999 | 20,735 | | 0% | NO |
| Year 5 | 2000 | 23,062 | | 0% | NO |
| Year 6 | 2001 | 21,979 | | 0% | NO |
| Year 7 | 2002 | 22,495 | | 0% | NO |
| Year 8 | 2003 | 20,255 | | 0% | NO |
| Year 9 | 2004 | 20,984 | | 0% | NO |
| Year 10 | 2005 | 17,987 | | 0% | NO |
| Year 11 | 0 | 0 | | | NO |
| Year 12 | 0 | 0 | | | NO |
| Year 13 | 0 | 0 | | | NO |
| Year 14 | 0 | 0 | | | NO |
| Year 15 | 0 | 0 | | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2005 | 17,987 | | 0% | NO |
| Year 2 | 2006 | 20,247 | | 0% | NO |
| Year 3 | 2007 | 22,847 | | 0% | NO |
| Year 4 | 2008 | 23,651 | | 0% | NO |
| Year 5 | 2009 | 21,931 | | 0% | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | |
| **2015** | | 19,757 | | 0% | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.2: Process Water Deduction Eligibility | | | | | |
|---|---|---|---|---|---|
| **Criteria 2**<br>Industrial water use is equal to or greater than 15 GPCD | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Industrial Water Use | Population | Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 1996 | | 65,566 | 0 | NO |
| Year 2 | 1997 | | 65,961 | 0 | NO |
| Year 3 | 1998 | | 66,676 | 0 | NO |
| Year 4 | 1999 | | 67,289 | 0 | NO |
| Year 5 | 2000 | | 68,393 | 0 | NO |
| Year 6 | 2001 | | 69,058 | 0 | NO |
| Year 7 | 2002 | | 70,357 | 0 | NO |
| Year 8 | 2003 | | 71,200 | 0 | NO |
| Year 9 | 2004 | | 71,831 | 0 | NO |
| Year 10 | 2005 | | 72,216 | 0 | NO |
| *Year 11* | 0 | | 0 | | NO |
| *Year 12* | 0 | | 0 | | NO |
| *Year 13* | 0 | | 0 | | NO |
| *Year 14* | 0 | | 0 | | NO |
| *Year 15* | 0 | | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | |
| Year 1 | 2005 | | 72,216 | 0 | NO |
| Year 2 | 2006 | | 72,197 | 0 | NO |
| Year 3 | 2007 | | 72,981 | 0 | NO |
| Year 4 | 2008 | | 72,654 | 0 | NO |
| Year 5 | 2009 | | 72,715 | 0 | NO |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | | |
| **2015** | | | 75,787 | 0 | NO |
| NOTES: | | | | | |

| SB X7-7 Table 4-C.3: Process Water Deduction Eligibility | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Criteria 3**<br>Non-industrial use is equal to or less than 120 GPCD | | | | | | | |
| **Baseline Year**<br>*Fm SB X7-7 Table 3* | | Gross Water Use Without Process Water Deduction<br>*Fm SB X7-7 Table 4* | Industrial Water Use | Non-industrial Water Use | Population<br>*Fm SB X7-7 Table 3* | Non-Industrial GPCD | **Eligible for Exclusion Y/N** |
| 10 to 15 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 1996 | 21,461 | | 21,461 | 65,566 | 292 | NO |
| Year 2 | 1997 | 21,666 | | 21,666 | 65,961 | 293 | NO |
| Year 3 | 1998 | 18,401 | | 18,401 | 66,676 | 246 | NO |
| Year 4 | 1999 | 20,735 | | 20,735 | 67,289 | 275 | NO |
| Year 5 | 2000 | 23,062 | | 23,062 | 68,393 | 301 | NO |
| Year 6 | 2001 | 21,979 | | 21,979 | 69,058 | 284 | NO |
| Year 7 | 2002 | 22,495 | | 22,495 | 70,357 | 285 | NO |
| Year 8 | 2003 | 20,255 | | 20,255 | 71,200 | 254 | NO |
| Year 9 | 2004 | 20,984 | | 20,984 | 71,831 | 261 | NO |
| Year 10 | 2005 | 17,987 | | 17,987 | 72,216 | 222 | NO |
| *Year 11* | 0 | 0 | | 0 | 0 | | NO |
| *Year 12* | 0 | 0 | | 0 | 0 | | NO |
| *Year 13* | 0 | 0 | | 0 | 0 | | NO |
| *Year 14* | 0 | 0 | | 0 | 0 | | NO |
| *Year 15* | 0 | 0 | | 0 | 0 | | NO |
| 5 Year Baseline - Process Water Deduction Eligibility | | | | | | | |
| Year 1 | 2005 | 17,987 | | 17,987 | 72,216 | 222 | NO |
| Year 2 | 2006 | 20,247 | | 20,247 | 72,197 | 250 | NO |
| Year 3 | 2007 | 22,847 | | 22,847 | 72,981 | 279 | NO |
| Year 4 | 2008 | 23,651 | | 23,651 | 72,654 | 291 | NO |
| Year 5 | 2009 | 21,931 | | 21,931 | 72,715 | 269 | NO |
| 2015 Compliance Year - Process Water Deduction Eligiblity | | | | | | | |
| **2015** | | 19,757 | | 19,757 | 75,787 | 233 | NO |
| NOTES: | | | | | | | |

| SB X7-7 Table 4-C.4: Process Water Deduction Eligibility | | | | |
|---|---|---|---|---|
| **Criteria 4**<br>Disadvantaged Community<br>*Use IRWM DAC Mapping tool* http://www.water.ca.gov/irwm/grants/resources_dac.cfm | | | | |
| California Median Household Income | | Service Area Median Household Income | Percentage of Statewide Average | **Eligible for Exclusion? Y/N** |
| 2015 Compliance Year - Process Water Deduction Eligibility | | | | |
| 2010 | $53,046 | | 0% | YES |
| *A "Disadvantaged Community" is a community with a median household income less than 80 percent of the statewide average.* | | | | |
| NOTES: | | | | |

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1996 | 65,566 | 21,461 | 292 |
| Year 2 | 1997 | 65,961 | 21,666 | 293 |
| Year 3 | 1998 | 66,676 | 18,401 | 246 |
| Year 4 | 1999 | 67,289 | 20,735 | 275 |
| Year 5 | 2000 | 68,393 | 23,062 | 301 |
| Year 6 | 2001 | 69,058 | 21,979 | 284 |
| Year 7 | 2002 | 70,357 | 22,495 | 285 |
| Year 8 | 2003 | 71,200 | 20,255 | 254 |
| Year 9 | 2004 | 71,831 | 20,984 | 261 |
| Year 10 | 2005 | 72,216 | 17,987 | 222 |
| *Year 11* | 0 | 0 | 0 | |
| *Year 12* | 0 | 0 | 0 | |
| *Year 13* | 0 | 0 | 0 | |
| *Year 14* | 0 | 0 | 0 | |
| *Year 15* | 0 | 0 | 0 | |
| **10-15 Year Average Baseline GPCD** | | | | **271** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2005 | 72,216 | 17,987 | 222 |
| Year 2 | 2006 | 72,197 | 20,247 | 250 |
| Year 3 | 2007 | 72,981 | 22,847 | 279 |
| Year 4 | 2008 | 72,654 | 23,651 | 291 |
| Year 5 | 2009 | 72,715 | 21,931 | 269 |
| **5 Year Average Baseline GPCD** | | | | **262** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 75,787 | 19,757 | 233 |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 271 |
| 5 Year Baseline GPCD | 262 |
| 2015 Compliance Year GPCD | 233 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | 2020 Target GPCD |
| 271 | 217 |
| NOTES: | |

**SB X7-7 Table 7-B: Target Method 2** Target Landscape

Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-C: Target Method 2**

Target CII Water Use

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

**SB X7-7 Table 7-D: Target Method 2 Summary**

Tables for Target Method 2 (SB X7-7 Tables 7-B, 7-C, and 7-D) are not included in the SB X7-7 Verification Form, but are still required for water suppliers using Target Method 2. These water suppliers should contact Gwen Huff at (916) 651-9672 or gwen.huff@water.ca.gov

| SB X7-7 Table 7-E: Target Method 3 | | | | |
|---|---|---|---|---|
| Agency May Select More Than One as Applicable | Percentage of Service Area in This Hydrological Region | Hydrologic Region | "2020 Plan" Regional Targets | Method 3 Regional Targets (95%) |
| ☐ | | North Coast | 137 | 130 |
| ☐ | | North Lahontan | 173 | 164 |
| ☐ | | Sacramento River | 176 | 167 |
| ☐ | | San Francisco Bay | 131 | 124 |
| ☐ | | San Joaquin River | 174 | 165 |
| ☐ | | Central Coast | 123 | 117 |
| ☐ | | Tulare Lake | 188 | 179 |
| ☐ | | South Lahontan | 170 | 162 |
| ☑ | 100% | South Coast | 149 | 142 |
| ☐ | | Colorado River | 211 | 200 |
| **Target** *(If more than one region is selected, this value is calculated.)* | | | | **142** |
| NOTES: | | | | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target* | Calculated 2020 Target *Fm Appropriate Target Table* | Confirmed 2020 Target |
| 262 | 249 | 217 | 217 |
| ** Maximum 2020 Target is 95% of the 5 Year Baseline GPCD* | | | |
| NOTES: Method 1 | | | |

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | 2015 Interim Target GPCD |
| 217 | 271 | 244 |
| NOTES: | | |

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* | | | | | 2015 GPCD *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? |
| | | Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | | |
| 233 | 244 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | 0 | 232.733446 | 232.733446 | YES |
| NOTES: | | | | | | | | |

# APPENDIX J

## Metropolitan Demand Model Projections

***Draft***

(November 13, 2015)

# Inland Empire Utilities Agency

*Average Year*

(Average of 1922-2004 Hydrology)

| Demographics[1] | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Population | 888,858 | 947,352 | 1,000,595 | 1,058,666 | 1,102,569 |
| Occupied Housing Units | 261,554 | 277,701 | 293,893 | 310,049 | 325,275 |
| Single Family | 195,111 | 204,247 | 213,674 | 224,921 | 234,414 |
| Multi-Family | 66,443 | 73,454 | 80,219 | 85,128 | 90,861 |
| Persons Per Household | 3.34 | 3.35 | 3.35 | 3.36 | 3.33 |
| Urban Employment | 366,679 | 413,438 | 453,145 | 476,893 | 492,200 |

| Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Conservation[2] | 34,632 | 40,253 | 46,281 | 50,992 | 56,506 |
| Installed Active Device Through 2015 | 6,064 | 4,598 | 2,905 | 1,854 | 1,738 |
| Code-Based and Price-Effect Savings | 28,568 | 35,656 | 43,376 | 49,137 | 54,768 |

| Total Demands After Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Demand | 299,141 | 316,090 | 327,333 | 339,339 | 347,560 |
| Retail Municipal and Industrial[3] | 273,448 | 288,754 | 301,993 | 313,999 | 322,220 |
| Retail Agricultural | 5,344 | 6,986 | 4,990 | 4,990 | 4,990 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Groundwater Replenishment | 20,350 | 20,350 | 20,350 | 20,350 | 20,350 |

| Local Supplies | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Local Supplies | 239,778 | 246,362 | 248,712 | 250,283 | 251,853 |
| Groundwater Production | 149,544 | 149,600 | 149,600 | 149,600 | 149,600 |
| Surface Production | 32,480 | 32,480 | 32,480 | 32,480 | 32,480 |
| Los Angeles Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Seawater Desalination | 0 | 0 | 0 | 0 | 0 |
| Groundwater Recovery | 13,706 | 16,720 | 17,500 | 17,500 | 17,500 |
| Recycling | 44,048 | 47,562 | 49,132 | 50,703 | 52,273 |
| M&I and Agricultural | 30,198 | 33,712 | 35,282 | 36,853 | 38,423 |
| Groundwater Replenishment | 13,850 | 13,850 | 13,850 | 13,850 | 13,850 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Other Non-Metropolitan Imports | 0 | 0 | 0 | 0 | 0 |

| Demands on Metropolitan | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Metropolitan Demands | 59,364 | 69,728 | 78,620 | 89,056 | 95,707 |
| Consumptive Use | 52,864 | 63,228 | 72,120 | 82,556 | 89,207 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Replenishment Water[4] | 6,500 | 6,500 | 6,500 | 6,500 | 6,500 |

All units are acre-feet except in Demographics Section.

1. Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 Forecast.
2. Includes code-based, price-effect and existing active savings through FY2014; does not include future active conservation savings. Conservation is 1990 base year. Pre-1990 add 250,000 acre-feet.
3. Retail M&I projections include conservation.
4. Replenishment Water include direct and in-lieu replenishment.

***Draft***

(November 13, 2015)

# Inland Empire Utilities Agency

*Single Dry-Year*

(Repeat of 1977 Hydrology)

| Demographics[1] | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Population | 888,858 | 947,352 | 1,000,595 | 1,058,666 | 1,102,569 |
| Occupied Housing Units | 261,554 | 277,701 | 293,893 | 310,049 | 325,275 |
| Single Family | 195,111 | 204,247 | 213,674 | 224,921 | 234,414 |
| Multi-Family | 66,443 | 73,454 | 80,219 | 85,128 | 90,861 |
| Persons Per Household | 3.34 | 3.35 | 3.35 | 3.36 | 3.33 |
| Urban Employment | 366,679 | 413,438 | 453,145 | 476,893 | 492,200 |

| Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Conservation[2] | 34,632 | 40,253 | 46,281 | 50,992 | 56,506 |
| Installed Active Device Through 2015 | 6,064 | 4,598 | 2,905 | 1,854 | 1,738 |
| Code-Based and Price-Effect Savings | 28,568 | 35,656 | 43,376 | 49,137 | 54,768 |

| Total Demands After Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Demand | 300,828 | 317,879 | 329,189 | 341,268 | 349,539 |
| Retail Municipal and Industrial[3] | 275,102 | 290,501 | 303,819 | 315,898 | 324,169 |
| Retail Agricultural | 5,376 | 7,028 | 5,020 | 5,020 | 5,020 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Groundwater Replenishment | 20,350 | 20,350 | 20,350 | 20,350 | 20,350 |

| Local Supplies | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Local Supplies | 240,154 | 246,682 | 249,032 | 250,603 | 252,173 |
| Groundwater Production | 149,600 | 149,600 | 149,600 | 149,600 | 149,600 |
| Surface Production | 32,800 | 32,800 | 32,800 | 32,800 | 32,800 |
| Los Angeles Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Seawater Desalination | 0 | 0 | 0 | 0 | 0 |
| Groundwater Recovery | 13,706 | 16,720 | 17,500 | 17,500 | 17,500 |
| Recycling | 44,048 | 47,562 | 49,132 | 50,703 | 52,273 |
| M&I and Agricultural | 30,198 | 33,712 | 35,282 | 36,853 | 38,423 |
| Groundwater Replenishment | 13,850 | 13,850 | 13,850 | 13,850 | 13,850 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Other Non-Metropolitan Imports | 0 | 0 | 0 | 0 | 0 |

| Demands on Metropolitan | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Metropolitan Demands | 60,674 | 71,197 | 80,157 | 90,665 | 97,367 |
| Consumptive Use | 54,174 | 64,697 | 73,657 | 84,165 | 90,867 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Replenishment Water[4] | 6,500 | 6,500 | 6,500 | 6,500 | 6,500 |

All units are acre-feet except in Demographics Section.

1. Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 Forecast.
2. Includes code-based, price-effect and existing active savings through FY2014; does not include future active conservation savings. Conservation is 1990 base year. Pre-1990 add 250,000 acre-feet.
3. Retail M&I projections include conservation.
4. Replenishment Water include direct and in-lieu replenishment.

***Draft***

(November 13, 2015)

# Inland Empire Utilities Agency

*Multi Dry-Year*

(Repeat of 1990-1992 Hydrology)

| Demographics[1] | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Population | 888,858 | 947,352 | 1,000,595 | 1,058,666 | 1,102,569 |
| Occupied Housing Units | 261,554 | 277,701 | 293,893 | 310,049 | 325,275 |
| Single Family | 195,111 | 204,247 | 213,674 | 224,921 | 234,414 |
| Multi-Family | 66,443 | 73,454 | 80,219 | 85,128 | 90,861 |
| Persons Per Household | 3.34 | 3.35 | 3.35 | 3.36 | 3.33 |
| Urban Employment | 366,679 | 413,438 | 453,145 | 476,893 | 492,200 |

| Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Conservation[2] | 34,632 | 40,253 | 46,281 | 50,992 | 56,506 |
| Installed Active Device Through 2015 | 6,064 | 4,598 | 2,905 | 1,854 | 1,738 |
| Code-Based and Price-Effect Savings | 28,568 | 35,656 | 43,376 | 49,137 | 54,768 |

| Total Demands After Conservation | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Demand | 297,065 | 321,039 | 333,812 | 346,003 | 355,259 |
| Retail Municipal and Industrial[3] | 270,419 | 293,851 | 307,907 | 320,519 | 329,775 |
| Retail Agricultural | 6,361 | 6,838 | 5,555 | 5,134 | 5,134 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Groundwater Replenishment | 20,285 | 20,350 | 20,350 | 20,350 | 20,350 |

| Local Supplies | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Local Supplies | 240,906 | 247,069 | 250,151 | 251,722 | 253,292 |
| Groundwater Production | 149,600 | 149,600 | 149,600 | 149,600 | 149,600 |
| Surface Production | 34,233 | 34,233 | 34,233 | 34,233 | 34,233 |
| Los Angeles Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Seawater Desalination | 0 | 0 | 0 | 0 | 0 |
| Groundwater Recovery | 13,923 | 16,117 | 17,500 | 17,500 | 17,500 |
| Recycling | 43,150 | 47,119 | 48,818 | 50,389 | 51,959 |
| M&I and Agricultural | 29,365 | 33,269 | 34,968 | 36,539 | 38,109 |
| Groundwater Replenishment | 13,785 | 13,850 | 13,850 | 13,850 | 13,850 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Other Non-Metropolitan Imports | 0 | 0 | 0 | 0 | 0 |

| Demands on Metropolitan | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Metropolitan Demands | 56,158 | 73,969 | 83,660 | 94,281 | 101,967 |
| Consumptive Use | 49,658 | 67,469 | 77,160 | 87,781 | 95,467 |
| Seawater Barrier | 0 | 0 | 0 | 0 | 0 |
| Replenishment Water[4] | 6,500 | 6,500 | 6,500 | 6,500 | 6,500 |

All units are acre-feet except in Demographics Section.

1. Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 Forecast.
2. Includes code-based, price-effect and existing active savings through FY2014; does not include future active conservation savings. Conservation is 1990 base year. Pre-1990 add 250,000 acre-feet.
3. Retail M&I projections include conservation.
4. Replenishment Water include direct and in-lieu replenishment.

# APPENDIX K

## IEUA Drought Plan




# Inland Empire Utilities Agency

# Drought Plan

April 15, 2009

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## SECTION 1 – INTRODUCTION

The State of California and the Southern California Region is in the midst of a third consecutive year of drought and water levels in all of the state's major reservoirs are below normal. On February 27, 2009, Governor Schwarzenegger proclaimed a statewide drought emergency and directed state agencies to take immediate action to address the drought conditions and water delivery reductions.

Critically dry conditions are affecting all of the Metropolitan Water District of Southern California (MWD) water supply sources. In addition, recent court rulings and regulatory actions have further impacted State Water Project water and supplies. These legal and regulatory developments, along with the impacts of dry conditions, have raised the possibility that MWD may not have access to the supplies necessary to meet total firm demands and will have to allocate shortages in supplies to MWD Member Agencies.

In February 2008, in anticipation of possible water supply shortages, the MWD Board of Directors adopted the Water Supply Allocation Plan (MWD WSAP). The MWD WSAP provides guidance for allocating limited water supplies to Member Agencies should the need arise. MWD is closely monitoring water supply conditions. If it is determined the MWD WSAP needs to be implemented, this decision will be made by the MWD Board of Directors on April 14, 2009 and the plan would go into effect July 1$^{st}$, 2009.

The Inland Empire Utilities Agency (IEUA) Drought Plan was developed for the purpose of implementing the MWD WSAP, within the IEUA's service area in a manner that is fair and equitable to IEUA's Member Agencies. The IEUA Drought Plan is consistent with and supplements the MWD WSAP for specific IEUA service area drought planning issues. All MWD WSAP definitions, policies, principals and program provisions are incorporated here by reference and are considered to be a part of the IEUA Drought Plan. For example, if IEUA is not imposed a penalty from MWD then IEUA would not impose a penalty on a member agency within IEUA's service area. In addition, MWD does not allow resale or "marketing" of MWD WSAP allocation credits and IEUA will not allow IEUA Drought Plan credits to be sold internally within IEUA's service area or externally without IEUA's approval. A complete copy of the adopted MWD WSAP is provided as Appendix A.

IEUA's Drought Plan is consistent with and contributes to the existing IEUA imported water policies and programs. For example, the IEUA's Drought Plan principles encourage development and full utilization of local water resources, such as recycled water and conservation measures. The IEUA Drought Plan also addresses MWD's Chino Basin Groundwater Storage Dry Year Yield (DYY) program and the need for best management of DYY

program “shift” obligations concurrent with MWD WSAP reductions of imported water supplies to IEUA.

## SECTION 2 – IEUA Drought Plan Preparation

### 2.1 IEUA and Retail Agency Coordination

The process to prepare the IEUA Drought Plan has been in full consultation with all the retail agencies, cities, Chino Basin Water Conservation District and Chino Basin Watermaster. This has been a consensus based process which has included monthly meetings to discuss the development of the IEUA Drought Plan as well as numerous presentations and workshops at MWD, IEUA, IEUA Member Agency offices and the offices of the Chino Basin Watermaster. Throughout this process the IEUA Board of Directors was provided with regular progress reports on the status of the plan and the technical workgroup discussions. Since July 2007, there have been more than 55 public presentations, workshops and meetings. See Appendix B for a summary of these activities.

### 2.2 IEUA Drought Allocation Plan Principles

The following principles are intended to describe the development and implementation of the IEUA Drought Plan.

**Overall Plan**

- The IEUA Drought Plan was developed in cooperation with the Member Agencies and includes all aspects of drought planning such as actions to avoid rationing, drought response stages, allocation, methodology, pricing and communications strategy.

**Drought Supply Enhancement**

- IEUA and its Member Agencies worked cooperatively to avoid or minimize rationing during droughts through supply enhancement, such as the implementation of the Three Year Recycled Water Business Plan and voluntary demand reduction measures.

**Drought Response Stages**

- The drought response stages are consistent with MWD’s adopted MWD WSAP. MWD, IEUA and IEUA’s Member Agencies will coordinate the administration of MWD WSAP and DYY Program accounting and performance targets to minimize impacts to IEUA Member Agencies.

**Allocation Methodology**

- The allocation methodology was developed to be equitable, easy to administer, contain financial and pricing signals to ensure Member Agencies and the public are informed and understand the need to conserve. In order to protect the economic health of the entire region, it is important that the allocation methodology avoid large, uneven retail impacts across the region.

- A Member Agency that has developed local projects and instituted conservation measures should not be penalized in the computation of the shortage allocation. To help balance the financial costs and risks associated with the development of local resources, the shortage allocation methodology should provide an incentive to those Member Agencies that can develop additional local supplies.

**Metropolitan Water District Consistency**

- IEUA will administer the IEUA Drought Plan to be consistent with MWD policies and procedures.

**Communication Strategy**

- A regional communication strategy is included as a part the IEUA Drought Plan. IEUA and Member Agencies have agreed that a coordinated regional strategy be prepared, including development of a unified message and press activities to strengthen communication with the public about the serious nature of the drought and the actions that are needed to manage water demands and ensure a safe and reliable water supply during drought conditions.
- The development of an ongoing, coordinated and regional public outreach program has been initiated and provides a clear and consistent message to the public regarding support Member Agencies communication efforts that address specific retail level allocations. An Ad hoc committee comprised of IEUA and its Member Agencies has been established to develop and coordinate the information to be provided to the media, public officials and the general public. The communication message will include clear solutions – easy and inexpensive ways to conserve. It is essential that local print and news media are fully committed to covering the situation.
- The drought communication strategy will include the following:
    - Regular meetings with Member Agencies and Conservation Partners Ad hoc committee to develop and coordinate a regional conservation message starting in February, 2009.
    - Regular briefings to the Inland Valley Daily Bulletin and other editorial boards.
    - Joint press conferences with Member Agencies, Three Valley's MWD, Western MWD, and MWD to provide updates on the water supply status and actions that need to be taken to address the drought.

- A speaker's bureau which will provide timely presentations and updates to City Councils, Chambers of Commerce, and Service Organizations.
- Inland Valley Daily Bulletin feature advertising on conservation and monthly conservation tips and rebates.
- An advertising campaign using donated billboard space and Public Service Announcements.
- Distribution of information to the public about the drought and conservation tips and rebates through school programs, libraries and senior organizations.

### 2.3 IEUA Drought Allocation Plan Goals

- Ensure equity and fairness throughout IEUA's service area
- Avoid payment of MWD WSAP or DYY penalties to MWD
- Recognize IEUA/MWD investments in local supplies to "drought proof" the IEUA service area
- Encourage additional local investments to further drought proof the economy
  - Enhanced Conservation
  - Recycled Water – Connect parks, schools and other landscapes
  - Interconnections to promote flexibility (Azusa Pipeline)
  - Increased Chino Desalter production
  - Groundwater Recharge (recycled water and capture of storm water when available)
- Coordinate IEUA's service area communication strategy
- Implement IEUA's Drought Plan in a manner that is consistent with MWD's WSAP and DYY policies and contracts

## Section 3 – IEUA DROUGHT PLAN AND ALLOCATION SCENARIOS

### 3.1 Overview

IEUA is a MWD member agency, and is obligated to follow the MWD Board adopted MWD WSAP. The allocation methodology is based on the guiding principles and considerations described in MWD's WSDM Plan and updated through its nine-month planning process which culminated in the adoption of the MWD WSAP.

### 3.2 IEUA Baseline under MWD Water Supply Allocation Plan

MWD uses a three year 2004-2006 average from actual water demand data as the baseline for its calculation of the water supply allocation for its Member Agencies. Only potable water supplies are counted in the baseline (recycled water is not included). The baseline data

addresses imported water, groundwater, surface water, and desalter water supplies. In-lieu water is designated as a local groundwater supply.

Table 1 provides a summary of IEUA's baseline data. Total imported and local supplies are 261,343 acre-feet. IEUA's purchase of imported water (Tier1/Tier2) during the 2004-2006 period averaged 51,992 acre-feet.

**Table 1. Summary of IEUA's Baseline Data (2004-2006 Average)**

| Water Source | Baseline (2004-2006) AF |
|---|---|
| **Imported (MWD) Tier 1/Tier2 Purchases** | **51,992** |
| **Local Supplies** | |
| Groundwater | 166,815 |
| Surface Water | 18,361 |
| Chino Desalters | 6,228 |
| Recycled[1] | -- |
| In-Lieu | 17,947 |
| ***Local Supply SUB-TOTAL*** | **209,351** |
| **TOTAL (Imported and Local Supplies)** | **261,343** |

IEUA's 2009 Imported Water Baseline Allocation was developed by MWD according to the methodology defined in the MWD WSAP (see Appendix A). This methodology begins with the baseline demand of 261,343 AF and then adds a growth adjustment percentage based on the actual growth rate in IEUA's service area. For IEUA's service area, the growth adjustment percentages are as follows: for 2007 (1.89%), for 2008 (2.4%) and for 2009 (2.4%). These growth adjustment percentages are based upon the California Department of Finance most recent growth report. In addition, a water conservation adjustment factor is added. This adjustment recognizes previous investments in water conservation in the IEUA service area and the use of tiered-rate structures, where applicable.

As shown in Table 2, IEUA's imported water allocation increases from 51,992 AF (2004-2006 three-year average "Baseline") to 69,386 AF (2009 Imported Water Baseline Allocation).

[1] Recycled water is not included in IEUA's baseline data because the MWD WSAP does not take into account non-potable water supplies; however, during the base period (2004-2006) on average IEUA produced 11,468 AFY.

**Table 2. Comparison of IEUA's Baseline Imported Water Purchases and IEUA's 2009 Baseline Allocation under the MWD Water Supply Allocation Plan**

| Water Source | IEUA's Imported Water Baseline (2004-2006) AF | IEUA's 2009 Imported Water Baseline Allocation AF |
|---|---|---|
| **Imported Deliveries (MWD)** | **51,992** | **69,386** |

IEUA's 2009 Imported Water Baseline Allocation of 69,386 AF is allocated as summarized here. First, the imported water baseline amount of 51,992 AF is allocated based on the amount of imported water purchased during the base period. The Water Facilities Authority (WFA) on average purchased 21,671 AFY (42%) and Cucamonga Valley Water District (CVWD) on average purchased 30,321 AF (58%). Fontana Water Company (FWC) did not purchase imported water during the base period. Second, IEUA's additional imported water allocation (attributable to growth and water conservation adjustments) of 17,394 AF is allocated based on 2008 population. Therefore of this 17,394 AF amount, the WFA is allocated 9,045 AF or 52% and CVWD is allocated 8,349 or 48% (see appendix C). Table 3 summarizes IEUA's 2009 Imported Water Baseline Allocation to the WFA and CVWD. As previously noted, FWC did not purchase imported water during the base period and for this reason does not receive an allocation. This table is the foundation for the IEUA Drought Plan allocation scenarios in the following sections.

In April, 2009 the MWD Board of Directors is scheduled to consider whether or not to implement the MWD WSAP. If implemented, the MWD WSAP will take effect July 1, 2009 and continue for a twelve month period through June 30, 2010.

**Table 3. IEUA and Member Agencies 2009 Imported Water Baseline Allocation**

| Agency | IEUA & Member Agencies Baseline Allocation |
|---|---|
| **IEUA** | **69,386** |
| | |
| **Water Facilities Authority** | **30,716** |
| **Cucamonga Valley W.D.** | **38,670** |
| **Fontana Water Company** | **0** |
| **TOTAL** | **69,386** |

### 3.3 Level 2 (10%) Shortage Allocation Scenario

The MWD WSAP establishes twenty levels of water shortage with corresponding percentage reductions in imported water allocations. In the event an MWD Member Agency exceeds its imported water supply allocation, then a penalty will be assessed to that agency. Such penalties will be assessed by MWD at the end of the twelve month period.

For the purpose of developing a shortage allocation scenario, a MWD WSAP Level 2 (10%) shortage allocation is provided here as an example. Table 4 compares IEUA and its Member Agencies baseline allocations with a Level 2 (10%) shortage allocation. IEUA's allocation, under a Level 2 (10%) shortage is reduced from 69,386 AF to 59,601 AF. [2]

**Table 4. IEUA and Member Agencies Level 2 (10%) Allocation**

| Agency | IEUA & Member Agencies Baseline Allocation | Level 2 (10%) Allocation |
|---|---|---|
| **IEUA** | **69,386** | **59,601** |
| | | |
| **Water Facilities Authority** | **30,716** | **26,224** |
| **Cucamonga Valley W.D.** | **38,670** | **33,377** |
| **Fontana Water Company** | **0** | **0** |
| **TOTAL** | **69,386** | **59,601** |

### 3.4 IEUA's Drought Plan and DYY Performance Scenario

As noted above, the MWD WSAP may be implemented during the period July 1, 2009 through June 30, 2010. In addition to the MWD WSAP, MWD has notified IEUA that it will implement the second year of the Dry Year Yield (DYY) Program for the period May 1, 2009 through April 30, 2010 and will "call" for 31,000 AF of DYY Program groundwater in storage. One impact resulting from the implementation of both programs would be a greater reduction in the amount of imported water deliveries to the DYY Program participating agencies. Table 5 shows the impact that the DYY Program shift obligation has on the amount of imported water deliveries IEUA and its Member Agencies will receive. The last column in Table 5 shows the annual imported water deliveries that IEUA and its Member Agencies will receive after complying with their respective DYY Program shift obligation.

[2] Current MWD estimate for the IEUA Level 2 allocation is 59,601 AF but this may be adjusted in response to the final MWD calculation of conservation credits and potentially other amendments to the baseline.

**Table 5. IEUA and Member Agencies 2009 Imported Water Baseline Allocation With DYY Shift Obligation**

| Agency | IEUA & Member Agencies 2009 Baseline Allocation | DYY Shift Obligation | MWD Allocation after 2009 DYY Shift Obligation |
|---|---|---|---|
| IEUA | 69,386 | 31,000 | 38,386 |
| | | | |
| Water Facilities Authority | 30,716 | 19,647 | 11,069 |
| Cucamonga Valley W.D. | 38,670 | 11,353 | 27,317 |
| Fontana Water Company | 0 | 0 | 0 |
| TOTAL | 69,386 | 31,000 | 38,386 |

The impact of the implementation of the two programs (MWD WSAP and DYY) during a Level 2 (10%) shortage allocation is a further decrease in MWD imported water deliveries to IEUA. Table 6 summarizes this impact.

**Table 6. IEUA and Member Agencies Level 2 (10%) Allocation with DYY Shift Obligation**

| Agency | Level 2 (10%) Allocation | DYY Shift Obligation | MWD Allocation after 2009 DYY Shift Obligation |
|---|---|---|---|
| IEUA | 59,601 | 31,000 | 28,601 |
| | | | |
| Water Facilities Authority | 26,224 | 19,647 | 6,577 |
| Cucamonga Valley W.D. | 33,377 | 11,353 | 22,024 |
| Fontana Water Company | 0 | 0 | 0 |
| TOTAL | 59,601 | 31,000 | 28,601 |

MWD has officially approved the DYY Shift Obligation Period to be May 1, 2009 to April 30, 2010. Therefore, depending on the amount of the DYY shift that can occur during this two month period (May and June 2009), IEUA Member Agencies will be able to reduce the impact of the DYY Program during the MWD WSAP period (July 2009 to June 2010) and maximize their imported water allocation for surface deliveries at CB12 and CB16.

### 3.5 Maximize Local Water Supplies Scenario

One of the core principles of the IEUA Drought Plan is to maximize the development and use of local water supplies, including recycled water, desalter water, groundwater and increased water efficiency. Current water demands in the IEUA service area are significantly less than IEUA's projected water supplies for 2009, which include MWD's 69,386 AF baseline allocation to IEUA. This suggests that increased local supplies will greatly enhance the service area's ability to cope with MWD's imported water allocations.

Table 7 provides a comparison of the projected demands and supplies for the baseline period (2004-2006), the actual IEUA water use in 2007/2008 and the projected water supplies under a MWD WSAP Baseline Allocation. Table 8 is similar to Table 7, but includes an added column that summarizes how local water supplies will help to address the reduction in MWD imported deliveries under a MWD level 2 (10%) shortage allocation.

**Table 7. IEUA and Member Agencies Projected Water Supplies Table**

| Water Source | IEUA's Baseline (2004-2006) AF | IEUA 2007/08 Water Use AF | IEUA's 2009/10 Projected Supply AF |
|---|---|---|---|
| **Imported (MWD)** | 51,992 | 69,000 | 69,386 |
| 3-Year Average (2004-06) | | | 51,992 |
| **Local Supplies** | | | |
| Groundwater | 166,815 | 132,000 | 160,000 |
| Surface Water | 18,361 | 18,000 | 18,000 |
| Chino Desalters | **6,228** | **15,000** | **15,000** |
| Recycled | **--** | **8,000** | **20,000** |
| In-Lieu | 17,947 | -- | -- |
| ***SUB-TOTAL*** | ***209,351*** | ***190,000*** | ***213,000*** |
| **TOTAL Imported and Local Supplies** | **261,343** | **242,000** | **282,000** |
| **IEUA Projected Demand** | | **242,000** | **242,000** |

**Table 8. IEUA and Member Agencies Projected Water Supplies**
**At a Level 2 (10%) Shortage Allocation**

| Water Source | IEUA's Baseline (2004-2006) AF | IEUA FY 07/08 Water Use AF | IEUA's FY 09/10 Projected Supply AF | FY 09/10 Level 2 Shortage (10%) AF |
|---|---|---|---|---|
| **Imported (MWD)** | 51,992 | 69,000 | 69,386 | 59,601 |
| 3-Year Average (2004-06) | | | 51,992 | 51,992 |
| **Local Supplies** | | | | |
| Groundwater | 166,815 | 132,000 | 160,000 | 160,000 |
| Surface Water | 18,361 | 18,000 | 18,000 | 18,000 |
| Chino Desalters | **6,228** | **15,000** | **15,000** | 15,000 |
| Recycled | **--** | **8,000** | **20,000** | 20,000 |
| In-Lieu | 17,947 | -- | -- | -- |
| ***SUB-TOTAL*** | ***209,351*** | ***190,000*** | ***213,000*** | ***213,000*** |
| **TOTAL Import/Local Supplies** | **261,343** | **242,000** | **282,000** | **272,000** |
| **IEUA Projected Demand** | | **242,000** | **242,000** | **242,000** |

### 3.6 IEUA Penalties

MWD enforces Member Agency allocations through a penalty rate structure. The applicable rates are based on MWD's established tiered pricing structure. Penalty rates and charges will only be assessed to the extent that an agency's total annual usage exceeds its total annual allocation.

Funds collected by MWD (through penalty rates) will be applied towards investments in conservation and local resources development within the service area of the Member Agency that incurs the penalties. MWD will assess penalties at the end of the twelve-month allocation period and currently proposes to provide Member Agencies with three months to pay any penalties that are incurred.

If the MWD WSAP is implemented by MWD and IEUA is assessed penalties, IEUA will enact penalty rates consistent with the MWD WSAP and the IEUA Drought Plan pursuant to IEUA Ordinance 70, Division II, Part II, Section 201. IEUA will not assess penalties if the whole IEUA service area is in compliance with its MWD WSAP allocation after the July 2009 – June 2010 period, even though WFA, CVWD or possibly FWC may exceed its IEUA Drought Plan allocation. This is consistent with IEUA's historic Tier 1 and Tier 2 billing procedures.

**Table 9. MWD Penalty Rates under MWD Water Supply Allocation Plan**

| Standard MWD Penalty Rates | | | |
|---|---|---|---|
| **Water Use** | Base Water Rate | Penalty Rate | Total Rate |
| **100% of Allocation** | Tier 1 | 0 | Tier 1 |
| **Between 100% and 115%** | Tier 1 | 2 x Tier 2 | Tier 1 + (2 x Tier 2) |
| **Greater Than 115%** | Tier 1 | 4 x Tier 2 | Tier 1 + (4 x Tier 2) |

### 3.7 IEUA Billing Under an MWD Allocation

If the MWD WSAP is implemented by MWD, IEUA's monthly billing process will remain the same. At the end of the twelve-month allocation period, IEUA will receive from MWD an invoice that includes an assessment of penalties if IEUA's 2009 MWD WSAP allocation has been exceeded. IEUA will summarize WFA, CVWD and FWC total imported water purchases based upon the monthly MWD invoices to IEUA and determine whether either agency exceeded its individual allocation. Based on this determination, IEUA will assess penalties in accordance with IEUA's adopted Ordinance 70, but only if IEUA is assessed a penalty from MWD. If penalties are incurred, IEUA will allow payment of these penalties, consistent with the MWD WSAP, to be spread over three monthly billing periods. IEUA will work as needed with each member agency to develop an appropriate payment schedule.

MWD has an administrative procedure for reviewing and making changes to the MWD WSAP allocation based upon loss of local supplies and other extraordinary conditions. IEUA will work with the Member Agencies and MWD to ensure that any changes to the MWD WSAP allocation are appropriately considered before penalties are assessed to any agency within the IEUA service area.

### 3.8 IEUA Tracking and Reporting

Consistent with current IEUA practice and the requirements of the MWD WSAP and the DYY Program, Member Agency imported water purchases and local water use will be summarized and reported on a monthly basis. This information will help IEUA and its Member Agencies to monitor and evaluate water use demands, project annual usage and avoid any over usage that would result in MWD WSAP and DYY Program penalties. IEUA will rely on the full cooperation of Member Agencies to collect monthly water demand and supply information in a timely manner.

### 3.9 Revisiting the IEUA Drought Plan

Principal objectives in the development of the IEUA Drought Plan are to ensure equity and fairness throughout IEUA's service area. However, due to the complexity of these issues and the possibility that unforeseen circumstances may occur, IEUA offers the opportunity to review and refine components of this plan as appropriate.

IEUA and the Member Agencies will continue to meet regularly during the next year to monitor DYY Program and MWD WSAP performance and will have the opportunity to revisit the plan and offer any recommendations to the IEUA Board that will improve the method, calculation, and approach of this plan.

Metropolitan has a similar process which will allow opportunity to review the MWD WSAP as approved.

## Section 4 – Summary

In February 2008, in anticipation of possible water supply shortages, the MWD Board of Directors adopted the Water Supply Allocation Plan (MWD WSAP). The MWD WSAP provides guidance for allocating limited water supplies to Member Agencies should the need arise. MWD is closely monitoring water supply conditions. If it is determined the MWD WSAP needs to be implemented, this decision will be made by the MWD Board of Directors on April 14, 2009, and the plan would go into effect July 1$^{st}$, 2009.

The Inland Empire Utilities Agency (IEUA) Drought Plan was developed for the purpose of implementing the MWD WSAP within the IEUA's service area in a manner that is fair and equitable to IEUA's Member Agencies. The IEUA Drought Plan is an extension of the MWD WSAP. All MWD WSAP definitions, policies, principals and program provisions are incorporated here by reference and are considered to be a part of the IEUA Drought Plan. A complete copy of the adopted MWD WSAP is provided as Appendix A.

IEUA's Drought Plan is consistent with and contributes to the existing IEUA policies and programs. For example, the plan's principles encourage development and full utilization of local water resources, such as recycled water, and extraordinary conservation measures. The plan also addresses MWD's DYY Program and the need for best management of the DYY Program "shift" obligations in concurrence with the MWD WSAP reductions of imported water supplies to IEUA.

# APPENDIX L

## Retail Agency Drought Plans

ORDINANCE NO. 286

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF CHINO HILLS, CALIFORNIA, REPEALING CHAPTER 13.08 WATER CONSERVATION AND ORDINANCE NO. 214 OF THE CHINO HILLS MUNICIPAL CODE IN ITS ENTIRETY, AND ESTABLISHING A NEW CHAPTER 13.08 WATER CONSERVATION OF THE CHINO HILLS MUNICIPAL CODE AND FINDING THAT THIS PROJECT IS EXEMPT FROM REVIEW UNDER THE CALIFORNIA ENVIRONMENTAL QUALITY ACT.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF CHINO HILLS DOES HEREBY ORDAIN AS FOLLOWS:

SECTION 1. The City Council does hereby make the following findings of fact:

a. It is necessary to repeal the exisiting Chapter 13.08 Water Conservation and Ordinance No. 214 as both no longer comply with State of California regulations and current water enacted requirements.

b. It is necessary to establish a new Chapter 13.08 Water Conservation in its stead so as to comply with California State Water Resources Control Board Regulations as adopted on May 5, 2015.

c. It is necessary to minimize the potential for water shortage through the practice of water conservation pursuant to California Water Code § 375 et seq., based upon the need to conserve water supplies and to avoid or minimize the effects of any future shortage.

d. It is further necessary to reduce the potential effect of a water shortage on the residents, businesses and visitors of Chino Hills and to adopt provisions that will significantly reduce the inefficient consumption of water, thereby extending the available water resources necessary for the domestic, sanitation, and fire protection of the community to the greatest extent possible.

e. On January 17, 2014, the Governor issued a proclamation of a state of emergency under the California Emergency Services Act based on drought conditions.

f. On April 25, 2014, the Governor issued a proclamation of a continued state of emergency under the California Emergency Services Act based on continued drought conditions.

g. On April 1, 2015, the Governor issued an Executive Order that, in part, directs the Califonia State Water Resources Control Board to impose restrictions on water suppliers (including the City of Chino Hills) to achieve a statewide 25 percent reduction to potable urban usage through February 28, 2016.

h. The drought conditions that formed the basis of the Governor's emergency proclamations continue to exist.

i. The present year is critically dry and has been immediately preceded by two or more consecutive below normal, dry, or critically dry years.

j. The drought conditions will likely continue for the foreseeable future and additional action by both the California State Water Resources Control Board and local water suppliers will likely be necessary to prevent waste and unreasonable use of water and to further promote conservation.

k. On May 5, 2015, the California State Water Resources Control Board adopted California Code of Regulations, title 23, section 866 and re-adopted sections 863, 864, and 865 that requires, among other things, that, beginning June 1, 2015, the City of Chino Hills reduce its total potable water production by 28 percent for each month as compared to the amount used in the same month in 2013.

l. California Water Code section 375 et seq. empower any public entity which supplies water at retail or wholesale to adopt and enforce a water conservation program to reduce the quantity of water used by those within its service area after holding a public hearing and making appropriate findings of necessity for the adoption of a water conservation program.

m. Pursuant to California Water Code Section 375, on May 16, 2015, the City published notice in the Chino Champion, a regularly published newspaper, providing notice of the time and place of the May 26, 2015 public hearing on the proposed ordinance. A duly noticed public hearing before the City Council was conducted on May 26, 2015, at which time all interested persons were given an opportunity to testify.

n. Based on the facts noted above, and all other facts presented to the City Council, this ordinance is adopted for the immediate preservation of the public peace, health or safety and is passed by no less than a four-fifths vote of the City Council.

SECTION 2. The City Council finds that this ordinance is exempt from review under the California Environmental Quality Act (California Public Resources Code §§ 21000, et seq., "CEQA") and CEQA regulations (Title 14 California Code of Regulations §§ 15000, et seq.) because it consists of the operation of existing facilities involving no expansion of use and consists of actions taken to assure the maintenance, protection

and enhancement of natural resources and the environment. Consequently, it is categorically exempt from further CEQA review under California Code of Regulations Title 14, §§ 15301, 15307 and 15308.

SECTION 3. That Chapter 13.08 Water Conservation of the Chino Hills Municipal Code and Ordinance No. 214 are hereby repealed in their entirety.

SECTION 4. That Chapter 13.08 Water Conservation of the Chino Hills Municipal Code is hereby adopted and shall read as follows:

## Chapter 13.08
## WATER CONSERVATION

**Sections:**

**13.08.010 - Findings of Necessity.**

It is necessary to minimize the potential for water shortage through the practice of water conservation pursuant to California Water Code § 375 et seq., based upon the need to conserve water supplies and to avoid or minimize the effects of any future shortage. It is further necessary to reduce the potential effect of a water shortage on the residents, businesses and visitors of Chino Hills and to adopt provisions that will significantly reduce the inefficient consumption of water, thereby extending the available water resources necessary for the domestic, sanitation, and fire protection of the community to the greatest extent possible. Nothing in this chapter shall prevent the City from also declaring a water emergency pursuant to Water Code Section 350.

**13.08.020 - Water Customer.**

Water customer, for the purposes of this chapter, shall mean any person, partnership, business, corporation, or association or legal entity to whom the City of Chino Hills (City) supplies water or user of water supplied by the City.

**13.08.030 - Application.**

This chapter shall be applicable to all water customers.

**13.08.040 - Exceptions and Exemptions.**

A. **Exceptions**. The City Manager or his/her designee shall grant an exception from the requirements of this chapter for any of the following reasons:
   1. Water use is necessary for public health and safety; or
   2. Recycled water is being used; or
   3. Water use is necessary due to the medical needs of the water customer.

B. **Exemptions**. The Public Works Commission may grant an exemption to the requirements of this chapter, with or without conditions, if it determines that a water customer would otherwise experience extreme financial

hardship that cannot be mitigated. The Public Works Commission shall review any requests for an exemption from compliance with this chapter. A written request for an exemption must be submitted to the Public Works Department a minimum of two weeks prior to the Commission meeting at which the exemption is to be considered. If appropriate, the Public Works Commission may require the customer granted an exemption to reduce water use by other appropriate alternative methods. A decision of the Public Works Commission may be appealed to the City Council in accordance with Chino Hills Municipal Code Section 1.20.010. The City Council may establish by resolution an "exemption processing fee."

**13.08.050 - Authorization.**

The City Council may declare the conservation stage based on any of the following circumstances:

- Issuance of a water emergency executive order by the Governor of California; or
- Adoption of certain regulations by the California State Water Resources Control Board; or
- Major interruptions in water supply from Metropolitan Water District, the Inland Empire Utilities Agency or any other major water supplier to the City; or
- Occurrence of a major water emergency emanating from a natural or man-caused disaster.

As declared, the City Council shall see to the enforcement of all prohibitions and restrictions as outlined in the following four stages:

Stage 1 - Voluntary Water Conservation Alert;
Stage 2 - Moderate Water Conservation Alert;
Stage 3 - High Water Conservation Alert; and
Stage 4 - Severe Water Conservation Alert

**13.08.060 - Stage I Voluntary Water Conservation Alert.**

Chino Hills water customers are requested to voluntarily limit the amount of water used from March 1st through October 31st of each year to the amount absolutely necessary for health, safety, business, and irrigation. During Stage 1, all elements of the prohibitions and restrictions for moderate, high and severe conservation alerts shall apply on a voluntary basis.

**13.08.070 - Stage II Prohibitions and Restrictions — Moderate Water Conservation Alert.**

The following restrictions and exceptions shall be applicable during a Moderate Water Conservation Alert as declared by the City Council, whenever the City's water supply is anticipated to be reduced by up to ten (10) percent, and voluntary conservation does not achieve the desired reduction, or whenever any of the

conditions noted under Section 13.08.050 are met requiring conservation measures noted in this stage:

A. Sprinkling or irrigating any shrubbery, trees, lawns, grass, groundcovers, plants, vines, gardens, vegetables, flowers, or any other landscaped or vegetated areas between the hours of 9:00 a.m. and 6:00 p.m. This provision shall not apply to equestrian and livestock businesses, dairies, nurseries, golf courses, or other water dependent industries;
B. Applying potable water to outdoor landscapes in a manner that causes runoff such that water flows onto adjacent property, non-irrigated areas, private and public walkways, roadways, parking lots, or structures;
C. Applying potable water to any hard surface, including but not limited to driveways, sidewalks, parking areas, asphalt, patios, porches, verandas;
D. Permitting water to leak on any premises. Such leak shall be repaired in a timely manner after notification by the City, but in no case in excess of forty-eight (48) hours after notification;
E. Serving of drinking water other than upon request in eating or drinking establishments, including but not limited to restaurants, hotels, cafes, cafeterias, bars, or other public places where food or drink are served and/or purchased;
F. Using potable water in a non-residential fountain or other decorative water feature, except where the water is part of a recirculating system;
G. Using water from fire hydrants shall be limited to fire fighting and related activities necessary to maintain the public health, safety, and welfare. An exception may be made for construction use through a proper City-designated meter where recycled water is not available;
H. Permitting noncommercial washing of privately owned livestock, vehicles, trailers, buses or boats, except from a bucket and/or a hand-held hose equipped with a shut-off nozzle used for a quick rinse; and
I. Using a hand held hose that dispenses potable water without a shut-off valve. Such use shall not be in conflict with any provision within this code.

**13.08.080 - Stage III Prohibitions and Restrictions — High Water Conservation Alert.**

The following restrictions and exceptions shall be applicable during a High Water Conservation Alert as declared by the City Council whenever the City's water supply is anticipated to be reduced by more than ten (10%) percent and up to twenty-five (25%) percent or whenever any of the conditions noted under Section 13.08.050 are met requiring conservation measures noted in this Stage:

A. All prohibitions and restrictions in Section 13.08.070 shall be in effect;
B. All residential customers shall be limited in the outdoor use of water for sprinkling, watering, or irrigating any shrubbery, trees, lawns, grass, groundcovers, plants, vines, gardens, vegetables, flowers, or any other landscaped or vegetated areas to a two days per week schedule based on street address. Designated days of irrigation: Residential addresses ending in an even number may use water on Wednesdays and Saturdays and

residential addresses ending in an odd number may use water on Thursdays and Sundays. All such irrigation may only occur between 12:01 a.m. and 9:00 a.m. or between 6:00 p.m. and 12:00 a.m. and shall not exceed fifteen (15) minutes per watering-station, except for drip or micro-spray irrigation systems which shall not exceed 30 minutes per station. No irrigation shall occur between the hours of 9:00 a.m. and 6:00 p.m.;

C. Non-residential customers, including commercial nurseries, golf courses, institutions and other water dependent industries shall be prohibited from watering lawns, landscapes, or other turf areas more than twice per week. Such irrigation may only occur on Tuesdays and Fridays between 12:01 a.m. and 9:00 a.m. or between 6:00 p.m. and 12:00 a.m. and shall not exceed fifteen (15) minutes per watering-station during assigned days, except for drip or micro-spray irrigation systems which shall not exceed 30 minutes per station. No irrigation shall occur between the hours of 9:00 a.m. and 6:00 p.m. Entities using recycled water are exempted from this prohibition for their recycled water use. However, such entities are not exempted for their potable water use. Alternatively, non-residential customers may be exempted from this prohibition by reducing their potable water usage by 28 percent from their usage in 2013;
D. The outside irrigation of landscapes with City-supplied potable water for new construction of homes and buildings in a manner inconsistent with regulations or other requirements established by the California Building Standards Commission;
E. The application of potable water to outdoor landscapes during and within 48 hours after measurable rainfall is prohibited. Measureable rainfall is defined as rainfall of one tenth of an inch (1/10") or more falling within a forty eight (48) hour period;
F. To promote water conservation, operators of hotels and motels shall provide guests with the option of choosing not to have towels and linens laundered daily. The hotel or motel shall prominently display notice of this option in each guestroom using clear and easily understood language;
G. Swimming pool refilling or new-construction swimming pool filling shall be limited to the same days as set forth in subsection B for outdoor use of water;
H. Washing of vehicles or boats is prohibited except:
    1. When using a hose that is equipped with a shut-off valve; or
    2. When washed in either an automatic or manual commercial car wash. Notwithstanding the above, temporary car washes held for fundraising purposes are prohibited;
I. Use of misting systems, commonly used in business establishments for cooling purposes, are prohibited;
J. Use of potable water for dust control is prohibited where recycled water is readily available for connection by the property owner.

**13.08.090 - Stage IV Prohibitions and Restrictions—Severe Water Conservation Alert.**

In the event of a major earthquake, large-scale fire, or other so called "Act of Nature" which could have serious impacts on the City's total available water storage capacity, whether storage capacities have been reduced or not, or in the case of a reduction in City water supply anticipated to be more than twenty-five (25%) percent or whenever any of the conditions noted under Section 13.08.050 are met requiring conservation measures noted in this Stage, a Severe Water Conservation Alert shall be declared by the City Council. The following conservation measures shall apply:

A. All previous restrictions noted in Sections 13.08.070 and 13.08.080 shall be in effect;
B. There shall be no outdoor use of water at any time, including the use of a hand-held hose with shut-off valve;
C. All decorative fountains, decorative (i.e., non-swimming) pools shall be drained and made dry. Such fountains and pools shall not be refilled until the City has returned to a Stage III water conservation stage. Fountains, ponds or pools that are filled with recycled water are not subject to this provision. Decorative ponds that contain fish as a feature shall be exempt from this restriction as long as the system is maintained in good working order with measures taken to reduce the volume of makeup water required for evaporative losses; and
D. No commitments shall be made to provide water service as part of any new land use entitlement (general plan, specific plan or amendments requesting new water allocations) until the City has returned to a stage three drought restriction. Currently approved specific plans with accompanying development agreements and projects or properties that have received water allocations in advance of full entitlements may be issued building permits so long as they comply with the remainder of this chapter.

**13.08.100 - Penalties.**

A. No water customer of the City shall knowingly use, or permit the use of, water in a manner contrary to any provision of this chapter, or in an amount in excess of that use permitted by the provisions of this chapter;
B. Unless otherwise provided, any water customer violating any provision of this chapter shall be guilty of an infraction or misdemeanor as specified in this section, and each day or portion thereof such violation, which is in existence, shall be a new and separate offense;
C. Any violation of this chapter is deemed an infraction, punishable as provided in Section 1.36.020 of this code. Subsequent violations shall also be punished as provided in Section 1.36.020 of this code;
D. Notwithstanding the above, the City Attorney or Deputy District Attorney may charge and prosecute second and subsequent offenses as misdemeanors at the City's sole discretion pursuant to California Water Code § 377. In addition to the above penalties, the City may file an action

for civil abatement and, at the discretion of the court, be entitled to reimbursement for all necessary costs and attorney's fees incurred through investigation, discovery, analysis, inspection, abatement and other actual costs incurred by the City or its agents pertaining to the violation;

E. The court shall fix the amount of any such reimbursements upon submission of proof of such costs by the City. Payment of any penalty provided in this section shall not relieve a person, firm or corporation, or other entity from the responsibility of correcting the condition resulting from the violation; and

F. In addition to the above remedies, the City Manager or his/ her designee is empowered, to enforce any or all of the following penalties:
   1. Place a flow restricting device upon the water service;
   2. Lock off a water meter;
   3. Remove a water meter; and
   4. Shut off the service connection.

All costs or expenses incurred by the City for enforcement of this section shall be borne by the water customer. No water service shall be limited or discontinued until the City Manager or his/her designee provides a written notice of intent to so limit or discontinue such service and the reasons for such decision, and further, provides such water customer notice of the right to request an administrative review and hearing pursuant to the procedures set forth in Section 1.18.090 of this code, except that any reference to "citation" in that section shall instead be deemed a reference to a "notice of intent" as described in this section. A written notice of intent shall be provided either by first class mail, by personal service to the water customer, or by posting said notice in a conspicuous place on the property wherein the violation occurred. Notwithstanding any other provision of this code, there shall be no right to further administrative review or appeal.

**13.08.110 - Compliance.**

Any City Code Enforcement Officer, Utility Conservation Coordinator and any other employee designated by the City Manager shall enforce the provisions of this chapter.

**13.08.120 – Implementing policies.**

The City Manager is authorized to promulgate policies and procedures to implement this chapter.

SECTION 4. If any section, subsection, subdivision, sentence, clause, phrase, or portion of this Ordinance is, for any reason held to be invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it would have adopted this Ordinance, and each section, subsection, subdivision, sentence, clause, phrase, or portion thereof, irrespective of the fact that any one or

more sections, subsections, subdivisions, sentences, clauses, phrases, or portion thereof be declared invalid or unconstitutional.

SECTION 5. Upon the effective date of this Ordinance, the provisions hereof shall supersede any inconsistent or conflicting provisions of the San Bernardino County Code as the same were adopted by reference by City Ordinance Nos. 91-01 and 92-02.

SECTION 6. This Ordinance must be broadly construed in order to achieve the purposes stated in this Ordinance. It is the City Council's intent that the provisions of this Ordinance be interpreted or implemented by the City and others in a manner that facilitates the purposes set forth in this Ordinance.

SECTION 7. Repeal of any provision of the Chino Hills Municipal Code does not affect any penalty, forefeiture, or liability incurred before, or preclude prosecution and imposition of penalties for any violation occurring before, this Ordinance's effective date. Any such repealed part will remain in full force and effect for sustaining action or prosecuting violations occurring before the effective date of this ordinance.

SECTION 8. The City Clerk shall certify as to the adoption of this Ordinance and shall cause a summary thereof to be published within ten (10) days of the adoption and shall post a certified copy of this Ordinance, including the vote for and against the same, in the Office of the City Clerk, in accordance with Government Code Section 36933 and Water Code Section 376.

SECTION 9. This ordinance will become effective upon its passage and adoption as provided in Water Code Section 376, subdivision (a).

PASSED, APPROVED AND ADOPTED this 9th day of June, 2015.

CYNTHIA MORAN, MAYOR

ATTEST:

CHERYL BALZ, CITY CLERK

APPROVED AS TO FORM:

MARK D. HENSLEY, CITY ATTORNEY

STATE OF CALIFORNIA )
COUNTY OF SAN BERNARDINO ) ss
CITY OF CHINO HILLS )

I, CHERYL BALZ, City Clerk of the City of Chino Hills, DO HEREBY CERTIFY that Ordinance No. 286 was duly introduced at a regular meeting held May 26, 2015; and adopted at a regular meeting of the City Council held on the 9th day of June, 2015 by the following roll call vote, to wit:

| | | |
|---|---|---|
| AYES: | COUNCIL MEMBERS: | MORAN, BENNETT, GRAHAM, MARQUEZ, AND ROGERS. |
| NOES: | COUNCIL MEMBERS: | NONE |
| ABSENT: | COUNCIL MEMBERS: | NONE |

CHERYL BALZ, CITY CLERK

(SEAL)

I hereby certify that the foregoing is the original of Ordinance No. 286 duly passed and adopted by the Chino Hills City Council at their regular meeting held on June 9, 2015, and that Summaries of the Ordinance were published on May 30, 2015 and June 13, 2015 in the Chino Hills Champion newspaper.

CHERYL BALZ, CITY CLERK

(SEAL)

AFFIDAVIT OF POSTING

STATE OF CALIFORNIA )
CITY OF CHINO HILLS ) §.
COUNTY OF SAN BERNARDINO )

Cheryl Balz, being first duly sworn, deposes and says:

That she is the duly appointed and qualified City Clerk of the City of Chino Hills;

That in compliance with the State laws of the State of California, a certified copy of the full text of proposed Ordinance No. 286, being:

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF CHINO HILLS, CALIFORNIA, REPEALING CHAPTER 13.08 WATER CONSERVATION AND ORDINANCE NO. 214 OF THE CHINO HILLS MUNICIPAL CODE IN ITS ENTIRETY, AND ESTABLISHING A NEW CHAPTER 13.08 WATER CONSERVATION OF THE CHINO HILLS MUNICIPAL CODE AND FINDING THAT THIS PROJECT IS EXEMPT FROM REVIEW UNDER THE CALIFORNIA ENVIRONMENTAL QUALITY ACT

attached hereto and made a part hereof, was caused to be posted in the Office of the City Clerk.

Dated this 9th day of June, 2015.

CHERYL BALZ, CITY CLERK

(SEAL)

ORIG: Vault XC: H.Miller(PW); City Attorney

ORDINANCE NO 2009-04

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF CHINO, CALIFORNIA, AMENDING CHAPTER 13 05 (ORDINANCE NO 91-21) OF THE CHINO MUNICIPAL CODE

The City Council of the City of Chino hereby does ordain as follows:

Section 1. Chapter 13.05 of the Chino Municipal Code hereby is amended in full and it shall read as follows:

Chapter 13.05

WATER CONSERVATION

Sections:


13.05.010 Purpose and Policy
13.05.020 City Council Authority
13.05.030 Definitions
13.05.040 Applicability
13.05 050 Party Responsible for Compliance
13 05.060 Adequate Water Supply Conditions – Permanent Measures
13.05 070 Stage 1 Water Shortage – Restrictions to Take Effect
13.05.080 Stage 2 Water Shortage – Restrictions to Take Effect
13.05.090 Stage 3 Water Shortage – Restrictions to Take Effect
13 05 095 General Provisions
13 05 100 Exceptions to Provisions
13 05.105 Exemptions from Provisions
13.05.110 Hardship and Special Cases – Implementation/Review Board
13.05.120 Failure to Comply – Violation/Penalty


**13.05.010 Purpose and Policy**

It is declared that because of the water conditions prevailing in the State of California, the statewide drought and the declared policy of the state, it is necessary and appropriate for the City to adopt and implement a water conservation program to reduce the quantity of water used by persons in the city Furthermore, the general welfare requires the reasonable and efficient use of the City's water resources, the waste or unreasonable use of water to be prevented, and the implementation of water conservation measures that will reduce water consumption within the City's service area.

**13.05.020 City Council Authority**

A. The City Council shall authorize and direct implementation of the applicable provisions of this chapter upon determination that such implementation is necessary to

protect the public health, welfare and safety, or when the demand for water consumption threatens to exceed the City's available supply of potable water to the customer

B. When any water shortage stage of this chapter is declared by resolution of the City Council, the specific level called for shall be made by public announcement and shall be published at least twice in a newspaper of general circulation and shall become effective immediately on the date specified in the newspaper publications. When any other water shortage stage is declared or the drought conditions no longer exist, then publication of the applicable portion of this chapter, or a statement stating that the drought conditions no longer exist, shall be published an additional two times.

**13.05.030 Definitions**

Unless the context specifically indicates otherwise, the following terms and phrases, as used in this chapter, shall have the meanings hereinafter designated:

A. "City Council" means the Council of the City of Chino

B. "Conservation Offset" means the implementation of proven conservation techniques which, when installed, will result in no additional demand on water supplies.

C "Customer" means any person, persons, association, corporation, or governmental agency supplied and/or billed for water service by the City

D "Graywater" means untreated household wastewater which has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom wash basins, and clothes washing machines.

E. "Potable Water" means water which is suitable for drinking.

F "Recycled Water" means treated domestic water (effluent) from a wastewater treatment plant that is suitable for a direct beneficial use or a controlled use that would not otherwise occur

G. "Single Pass Cooling Systems" means equipment where water is circulated only once to cool equipment before being disposed.

H. "Water Shortage" means a determination by the City in consideration of the existing conditions of water production and/or an announcement by any state water agency, the Metropolitan Water District of Southern California, or any of its water suppliers.

**13.05.040 Applicability**

The provisions of this chapter shall apply to all persons, customers, or property, wherever situated, utilizing water provided by the City

**13.05.050 Party Responsible for Compliance**

A. For purposes of this chapter, it shall be presumed that a person, corporation or association in whose name the water service account with the City is or was last billed or who is receiving the economic benefit of said water supply will be responsible for complying with this chapter

B. For the purpose of this chapter, a use of water by a tenant or by an employee, agent, contractor or other acting on behalf of a customer, whether with real or ostensible authority, shall be imputed to the customer

**13.05.060 Adequate Water Supply Conditions – Permanent Measures**

The following activities are hereby prohibited at all times:

A. Allowing irrigation water to run off into a gutter, ditch, drain, driveway, sidewalk, street or onto pavement or other hard surface.

B. Outdoor irrigation of landscape for more than fifteen (15) minutes of watering per day per station. This restriction does not apply to landscapes that utilize drip irrigation systems.

C. Automated irrigation of landscape during the hours of six a.m. to eight p.m. Customers are encouraged to avoid the use of sprinklers on windy days. Irrigation by hand held hoses with automatic shutoff nozzles, drip irrigation, or hand held buckets is permitted anytime.

D Outdoor irrigation of landscape on rainy days.

E. Washing down hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking areas, patios, and alleys, except when necessary to alleviate safety or sanitary hazards.

F Excess use, loss or escape of water through breaks, leaks, or other malfunctions in the plumbing system or distribution system for any period of time after such escape of water should have reasonably been discovered and corrected.

G. Washing of automobiles, trucks, trailers, boats, airplanes, and other types of mobile equipment, unless done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses.

H. Restaurants serving water to their customers, except when specifically requested by their customers.

I Operating a decorative water fountain or feature, built or installed after the adoption of this ordinance, that does not include re-circulated water

J. Operating a commercial car wash or laundry, built or installed after the adoption of this ordinance, that does not use re-circulated water

K. Operating a single-pass cooling system built or installed after the adoption of this ordinance.

**13.05.070 Stage 1 Water Shortage – Restrictions to Take Effect**

The following additional measures shall take effect upon a declaration by the City Council that needed supplies are anticipated to be reduced approximately ten percent or less. Upon this declaration, the following restrictions shall apply to all customers or persons who use the water utility of the City·

A. Restaurants shall not use non-conserving dish spray valves.

B. Ornamental lakes or ponds shall not be filled or refilled with potable water, except to the extent needed to sustain aquatic life.

C Outdoor irrigation of landscape with potable water will only be allowed every other day from May 1st through September 30th.

**13.05.080 Stage 2 Water Shortage – Restrictions to Take Effect**

In the event the City Council determines that the measures outlined in Sections 13 05.060 and 13.05.070 do not produce a sufficient reduction in demand, or if the estimated needed supplies are reduced approximately ten percent to twenty percent, then the following additional restrictions shall be implemented:

A. Outdoor irrigation of landscape with potable water will only be allowed every other day

B Hotels, motels, and other commercial lodging establishments shall not launder towels and linen daily, except when specifically requested by their customer

**13.05.090 Stage 3 Water Shortage – Restrictions to Take Effect**

In the event the City Council determines that the measures outlined in Sections 13.05.060, 13.05.070 and 13.05.080 do not produce a sufficient reduction in demand or if the estimated needed supplies are reduced approximately twenty percent or more, then the following additional restriction shall be implemented:

A. Potable water service will not be provided to new land development projects except under the following circumstances:

1 A valid building permit has been issued for the project, or

2. The project is necessary to protect public health, safety, and welfare, or

3. The applicant provides evidence that the project will include conservation offsets prior to the provision of new water service.

**13.05.095 General Provisions**

A. Recycled water shall be used instead of potable water for landscape irrigation, construction, dust control, and other approved uses to the extent feasible where recycled water is available to supply all or some of the water demand.

B. All measures and restrictions outlined in this chapter shall apply to recycled water use except for Subsections 13.05.070(B), 13.05.070(C), 13.05.08(A), and 13.05.090(A).

C All restrictions resulting from any water shortage stage shall remain in effect with each successive and more severe water shortage stage until such time that the City Council changes a particular restriction or declares that drought conditions no longer exist.

D Additional restrictions may be implemented as determined by the City, after notice to customers.

**13.05.100 Exceptions to Provisions**

None of the restrictions outlined in this chapter shall apply to the following:

A. The routine and necessary use of water by a governmental entity in pursuit of its functions for protecting the public health, safety and welfare. This exception does not apply to landscape irrigation by a governmental agency

B. The necessary use of water for the routine maintenance and/or repair of water distribution facilities, residential and commercial plumbing, and existing landscape irrigation systems.

C The prohibited uses set forth in this subsection do not apply to Graywater This provision shall not be construed to authorize the use of Graywater if such use is otherwise prohibited by law

**13.05.105 Exemptions from Provisions**

Nothing contained in Sections 13.05.070 through 13.05.090 shall require any single-family residential customer to reduce the customer's consumption of water to any amount less than nine billing units per month (two hundred twenty-four gallons per day) during any billing period.

**13.05.110 Hardship and Special Cases – Implementation/Review Board**

A. A Review Board is established to review hardship and special cases which cannot follow the letter of this chapter The Review Board shall consist of any two of the following or their respective designees: Director of Community Development, Director of Finance, or Director of Public Works. Appeal of any Board decision shall be made to the City Manager

B. It is the purpose of the Review Board to review hardship or special cases and to determine whether or not said case warrants an exemption. The decision of the Review Board shall be prepared in writing, include terms and conditions, if any, set forth findings in support of the decision, and are promptly sent to the applicant. The Board shall consider the facts of each case and decide whether to grant an exemption within five working days of the receipt of a properly completed "Application for Exemption from Mandatory Water Restrictions" form. The application must include pertinent information and a written statement from the applicant. An exemption shall be granted for reasons of economic hardship which is defined as, but not limited to, a threat to an individual business's primary source of income (but under no circumstances shall inconvenience or the potential for damage of landscaping be considered an economic hardship which justifies an exemption.) An exemption may also be granted in instances where the water use restrictions cannot be met without threatening public health or safety, or there has been a significant change in the customer's circumstances. No exemption will be granted to any customer for any reason in the absence of a demonstration that the customer has achieved the maximum practical reduction in water consumption. The Board shall authorize only the implementation of equitable water use restrictions which further the purpose and intent of the emergency water conservation plan. The special water use restrictions authorized by the Board in each special or hardship case shall be set forth on the face of the exemption.

C An exemption to any element of this ordinance granted under any adequate water supply condition or water shortage condition shall not be valid upon implementation of any more severe water supply condition of this chapter An exemption expires under its own terms and conditions and/or when the next higher stage of the emergency water conservation ordinance takes effect. A separate application for exemption must be submitted at each higher stage of the water conservation ordinance unless the exemption conditions specifically do not require such separate application.

D Any person, corporation or association who is granted an exemption and makes use of the water utility of the City pursuant to said exemption shall provide proof of said exemption upon demand by any peace officer or person authorized by the City to enforce this chapter Upon conviction of any person, corporation or association for violating any provision of this part, the Review Board shall revoke any exemption previously granted. However, the Board shall notify applicant of the proposed revocation in writing no less than five working days before taking such action, and applicant shall be given the opportunity to be heard by the Review Board prior to its taking such action.

E. Persons wishing to appeal the decision of the Board shall have the right of appeal to the City Manager Appeal shall be made in writing within ten working days of the Board decision. The decision of the City Manager shall be final.

**13.05.120 Failure to Comply – Violation /Penalty**

A. Penalties. It is unlawful for any water customer to fail to comply with any of the provisions of this chapter Notwithstanding any other provision of the City Code, the penalties set forth herein shall be exclusive and not cumulative with any other provisions of this code. Furthermore, any and all violations that occur on any one day shall be treated as one violation for the purposes of determining a penalty under Subsection B. The penalties for failure to comply with the provisions of this chapter shall be as set out in subsection B of this section.

B. Range of Penalties

1 For the first violation by any customer of any of the provisions of sections 13.05.060, 13.05.070, 13.05.080, or 13.05 090, the City shall issue a written notice of the fact of such violation to the customer

2. For a second violation by any customer of any of the provisions of sections 13.05.060, 13.05.070, 13.05.080, or 13.05.090 within the same twelve month period beginning with the first violation, the City shall issue a final written notice of the fact of such violation to the customer

3. For a third violation by any customer of any of the provisions of sections 13.05.060, 13.05.070, 13.05.080, or 13.05.090 within the same twelve month period beginning with the first violation, a surcharge in the amount of fifty dollars shall be added to the customer's water bill.

4 For a fourth violation by any customer of any of the provisions of sections 13.05.060, 13.05.070, 13.05.080, or 13.05.090 within the same twelve month period beginning with the first violation, a surcharge in the amount of one hundred dollars shall be added to the customer's water bill that follows the customer's water bill containing the fifty dollar surcharge for the third violation.

5 For a fifth and any subsequent violation by any customer of any of the provisions of sections 13.05.060, 13.05.070, 13 05 080, or 13.05.090 within the same twelve month period beginning with the first violation, a surcharge in the amount of one hundred and fifty dollars shall be added to the customer's water bill that follows the customer's water bill containing the one hundred dollar surcharge for the fourth violation.

6. After a fifth violation of sections 13.05 060, 13.05.070, 13.05.080 or 13.05.090 within the same twelve month period beginning with the first violation, the City may install a flow restricting device of one gallon per minute (1 GPM) capacity for services up to one and one-half inch size and comparatively sized restrictors for larger services. Such action shall be taken only after a hearing

held by the Review Board where the customer has an opportunity to respond to the City's information or evidence that the customer has repeatedly violated this chapter's rules regarding the conservation of water and that such action is reasonably necessary to assure compliance with this chapter regarding the conservation of water Appeal of Board decisions shall be made in writing to the City Manager within ten working days of the Board hearing. The decision of the City Manager shall be final. Any such restricted service may be restored upon application of the customer made not less than forty-eight hours after the implementation of the action restricting service and only upon a showing by the customer that the customer is ready, willing and able to comply with the provisions of this chapter's rules regarding the conservation of water Prior to any restoration of service, the customer shall pay all City charges for any restriction of service and its restoration as provided for in a separate ordinance.

Section 2. Severability If any section, subsection, sentence, clause, phrase or portion of this Ordinance is held invalid or unconstitutional by any court of competent jurisdiction, such determination shall not affect the validity of the remaining portions of this Ordinance. The City Council declares that it would have enacted this Ordinance and each section, subsection, sentence, clause and phrase hereof irrespective of any determination of invalidity

Section 3. The City Clerk of the City of Chino shall certify to the passage and adoption of this Ordinance and shall cause the same to be published in a newspaper of general circulation, printed and published within said City in accordance with the provisions of the Government Code.

APPROVED AND ADOPTED THIS 5th DAY OF MAY 2009

DENNIS R. YATES, MAYOR

ATTEST

LENNA J. TANNER, CITY CLERK

State of California )
County of San Bernardino ) §
City of Chino )

I, Lenna J. Tanner, City Clerk of the City of Chino, do hereby certify the foregoing Ordinance was duly adopted by the Chino City Council at a regular meeting held on the 5th day of May 2009, by the following votes:

AYES: COUNCIL MEMBERS: YATES, DUNCAN, ELROD, HAUGHEY, ULLOA

NOES: COUNCIL MEMBERS: NONE

ABSENT COUNCIL MEMBERS: NONE

LENNA J. TANNER, CITY CLERK

# CHAPTER 8A: EMERGENCY WATER CONSERVATION


6-8.20 Scope and title

6-8.21 Statement of policy and declaration of purpose

6-8.22 Authorization

6-8.23 General prohibitions

6-8.24 Exceptions

6-8.25 Voluntary conservation

6-8.26 Stage 1 water shortage–water supply reduced by up to ten percent (10%)

6-8.27 Stage 2 water shortage–water supply reduced by ten percent (10%) to twenty percent (20%)

6-8.28 Stage 3 water shortage–water supply reduced by more than twenty percent (20%)

6-8.29 Stage 4 water shortage–emergency interruption in water supply

6-8.30 Relief from compliance

6-8.31 Failure to comply

6-8.32 Hearing regarding violations


**Sec. 6-8.20. Scope and title.**

This Chapter shall be known as “The Water Conservation Plan of the City of Ontario.”

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.21. Statement of policy and declaration of purpose.**

(a) Because of the water supply conditions prevailing in the City and/or the area from which the City obtains a portion of its supply, the general welfare requires that the water resources available to the City of Ontario be put to the maximum beneficial use to the extent to which they are capable, and that the waste or unreasonable use, or unreasonable method of use of water be prevented and that the conservation of such water be practiced with a view to that reasonable and beneficial use thereof in the interest of the people of the City.

(b) The purpose of this chapter is to minimize the potential for water shortage through the practice of water conservation, and to minimize the effect of a shortage of water supplies on the water customers of the City. It is furthermore the intent of this chapter to adopt provisions that will significantly reduce the inefficient consumption of water, thereby extending the available water resources necessary for the domestic, sanitation, and fire protection of the community to the greatest extent possible.

(c) This chapter shall be applicable to all water customers. For the purposes of this chapter, any person, business, corporation, or association to whom the city supplies water shall be considered a water customer.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.22. Authorization.**

(a) The City Council may declare a water shortage based on a determination by Metropolitan Water District or the Inland Empire Utilities Agency, or based upon any interruption in water supply or delivery that the City Council determines in its sole discretion necessitates water conservation pursuant to this chapter.

(b) In the event of an unplanned interruption of water supply causing a water shortage, the City Manager or his/her designee is authorized to restrict water use and apportion the available supply of water among its customers in the most equitable manner possible to continue service fairly and without discrimination, except that preference shall be given to such service as is essential to the public interest and to the preservation of life and health.

(c) A notice of a water shortage shall be published in a daily newspaper of general circulation within the City. Any restrictions on the use of water shall become effective immediately upon such publication.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.23. General prohibitions.**

(a) The following are prohibited in new connections:

(1) Non-recycling decorative fountains;

(2) Single-pass cooling systems; and

(3) Conveyor and in-bay vehicle wash and commercial laundry systems which do not reuse water.

(b) No water customer of the City shall make, cause, use, or permit the use of water from the City in a manner contrary to any provision of this chapter or in an amount in excess of the

use permitted by any restriction provisions then in effect pursuant to the provisions of this chapter.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.24. Exceptions.**

(a) The prohibited uses of water and water use restrictions provided within this chapter are not applicable for the use of recycled water or the use of potable water necessary to public health and safety or for essential government services such as police, fire and other similar services.

(b) Nothing contained within this chapter shall be construed to require the city to curtail the supply of water necessary for the health, safety, and welfare of any customer.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.25. Voluntary conservation.**

Water customers are encouraged to voluntarily limit the amount of water used to the amount absolutely necessary for health, business, and irrigation. The following elements of conservation apply at all times on a voluntary basis:

(a) Avoid hose washing of sidewalks, walkways, driveways, parking areas or other paved surfaces, except as required for sanitary purposes.

(b) Wash motor vehicles, trailers, boats and other types of mobile equipment using a hand held bucket or a hose equipped with a positive shutoff nozzle for quick rinses, or at the immediate premises of a commercial car wash or with recycled wastewater for approved uses.

(c) Avoid using water to clean, fill or maintain levels in decorative fountains, ponds, lakes or other

similar aesthetic structures unless such water is part of a recycling system.

(d) Encourage restaurants, hotels, cafés, cafeterias or other public places where food is sold, served or offered for sale, to serve drinking water only to those customers expressly requesting water.

(e) Promptly repair all leaks from indoor and outdoor plumbing fixtures.

(f) Avoid watering lawn, landscape or other turf area more often than every other day and during the hours between 6:00 a.m. and 6:00 p.m.

(g) Avoid causing or allowing the water to run off landscape areas into adjoining streets, sidewalks or other paved areas due to incorrectly directed or maintained sprinklers or excessive watering.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.26. Stage 1 water shortage-water supply reduced by up to ten percent (10%).**

(a) The following restrictions on the use of potable water shall be applicable when the City Council determines that the City's water conservation goals are not being met by voluntary water conservation measures, or that the City's water supplies are likely to be reduced by up to ten percent (10%).

(1) There shall be no hose washing of sidewalks, walkways, driveways, parking areas or other paved surfaces, except as required for sanitary purposes.

(2) Washing of motor vehicles, trailers, boats and other types of mobile equipment shall be done only with a hand-held bucket or a hose equipped with a positive shutoff nozzle for quick rinses, except that washing may be done at the immediate premises of a commercial car wash or with reclaimed wastewater.

(3) No water shall be used to clean, fill or maintain levels in decorative fountains, ponds, lakes or other similar aesthetic structures unless such water is part of a recycling system.

(4) No restaurant, hotel, café, cafeteria or other public place where food is sold, served or offered for sale, shall serve drinking water to any customer unless expressly requested.

(5) All water customers of the City shall promptly repair all leaks from indoor and outdoor plumbing fixtures. Such leak shall be repaired in a timely manner after notification by the city, but in no case after notification in excess of seventy-two (72) hours for the first violation and then every seventy-two (72) hours thereafter for the second and third violations.

(6) No person shall sprinkle, water, or irrigate any shrubbery, trees, lawns, grass, groundcovers, plants, vines, gardens, vegetables, flowers, or any other landscaped or vegetated areas between the hours of 9:00 a.m. and 4:00 p.m. In any event, such watering shall not be in excess of needs nor be of a manner that allows water to flow onto streets. The above mentioned plants may be watered by a hand-held hose equipped with a shut-off nozzle at any time of the day. This provision shall not apply to commercial nurseries, golf courses and other water-dependent industries.

(7) No water customer of the City shall cause or allow the water to run off landscape areas into adjoining streets, sidewalks or other paved areas due to incorrectly directed or maintained sprinkler or excessive watering.

(8) The use of water from fire hydrants shall be limited to fire fighting and related activities necessary to maintain the public health, safety, and welfare. An exception may be made for construction use through a proper city-designated meter. The use of potable water for construction activities shall be restricted in areas where recycled water is available for such use.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.27. Stage 2 water shortage-water supply reduced by ten percent (10%) to twenty percent (20%).**

(a) The following restrictions on the use of potable water shall be applicable when the City Council determines that it is likely that the City will suffer a reduction of more than ten percent (10%) but less than twenty percent (20%) in its water supplies.

(1) All prohibitions and restrictions in § 6-8.26 shall be in effect provided that more restrictive measures noted in this section shall take precedence.

(2) Commercial nurseries, golf courses, and other water dependent industries shall be prohibited from watering lawn, landscape, or other turf areas more than every other day. Irrigation shall occur between the hours of 6:00 p.m. and 6:00 a.m. only.

(3) All water customers other than commercial nurseries, golf courses, and other water dependent industries shall be limited in the use of outdoor watering for sprinkling, watering, or irrigating any shrubbery, trees, lawns, grass, groundcovers, plants, vines, gardens, vegetables, flowers, or any other landscaped or vegetated areas to a two (2) day per week schedule between the hours of 4:00 p.m. and 9:00 a.m. based on street address.

(i) All locations ending in an odd number shall have outdoor water scheduled on Mondays and Thursdays.

(ii) All locations ending in an even number shall have outdoor water scheduled on Wednesdays and Saturdays.

(iii) There shall be no outdoor watering on Tuesdays, Fridays, or Sundays.

(iv) The use of a hand-held hose with shut-off valve shall be permitted at any time.

(v) The replenishment of swimming pools shall be limited to the same days as other outdoor watering.

(4) Filling or refilling empty swimming pools shall not occur without permission from the City Manager or his/her designee.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.28. Stage 3 water shortage-water supply reduced by more than twenty percent (20%).**

(a) The following restrictions on the use of potable water shall be applicable when the City Council determines that it is likely that the City will suffer a reduction of more than twenty percent (20%) in its water supplies.

(b) All the prohibitions and restrictions in § 6-8.27 shall be in effect provided that the more restrictive measures noted in this section shall take precedence.

(c) Commercial nurseries, golf courses and other water dependent industries shall be prohibited from watering lawn, landscaping and other turf areas more often than every third day. Irrigation shall occur between the hours of 6:00 p.m. and 6:00 a.m. only. There shall be no restriction on watering utilizing recycled water.

(d) The use of water from fire hydrants shall be limited to fire fighting and related activities and other uses of water for municipal purposes shall be limited to activities necessary to maintain the public health, safety and welfare. The use of potable water for construction activities shall be prohibited.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.29. Stage 4 water shortage-emergency interruption in water supply.**

(a) The following restrictions on the use of potable water shall be applicable during an emergency water shortage which may be declared in the event of a major earthquake, large-scale fire, or other so called "Act of God" which could have serious impacts on the city's total available water supply.

(1) All the prohibitions and restrictions in § 6-8.28 shall be in effect provided that the more restrictive measures noted in this section shall take precedence.

(2) There shall be no use of outdoor water at any time except the minimal amount by hand-held hose equipped with a shut-off nozzle.

(3) Commercial nurseries, golf courses, and other water dependent industries shall be prohibited from the use of outside water except by a hand-held hose equipped with a shut-off nozzle.

(4) All nonessential uses of water shall be prohibited including the filling, cycling, filtering, or refilling swimming pools, spas, Jacuzzis, fountains or other like devices.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.30. Relief from compliance.**

(a) A water customer of the City may file a written application for relief in whole or in part, from the water use restriction provisions of this chapter. The City Manager or his/her designee shall review the request for a variance and take such steps as he or she deems reasonable to resolve the application for relief. The decision of the City Manager shall be final.

(b) A relief may be granted if the water customer shows that he or she has achieved the maximum practical reduction in water consumption other than in the specific areas in which

relief is being sought. No relief shall be granted to any water customer who, when requested by the City Manager, fails to provide any information necessary for resolution of the customer's application for relief.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.31. Failure to comply.**

(a) Violations of the provisions of this chapter:

(1) First violation. For a first violation, the City shall issue a written warning to the water customer.

(2) Second violation. For a second violation, the City shall impose a surcharge in an amount of One Hundred Dollars ($100.00) added to the water customer's water bill.

(3) Third violation. For a third violation, the City shall impose a surcharge in an amount of Two Hundred Dollars ($200.00) added to the water customer's water bill.

(4) Subsequent Violations. For the fourth and any subsequent violation during, the City shall impose a surcharge in an amount of Five Hundred Dollars ($500.00) added to the water customer's water bill. In addition to the surcharge, the City may also install a flow restricting device on the service of the customer at the premises at which the violation occurred for a period of not less than forty-eight (48) hours. The City shall charge the water customer the reasonable costs incurred for installing and for removing the flow-restricting devices and for restoration of normal service. The charge shall be paid before normal service can be restored.

(b) The City shall give notice of violation to the water customer committing the violation as follows:

(1) First notice of violation shall be given in writing by regular mail to the address at which the water customer is normally billed.

(2) Notice of second or subsequent violations shall be given in writing by certified mail to the address at which the water customer is normally billed.

(§ 2, Ord. 2907, eff. June 16, 2009)

**Sec. 6-8.32. Hearing regarding violations.**

(a) Any water customer receiving notice of a violation of §§ 6 8.23, 6-8.26, 6-8.27, 6-8.28, or 6-8.29, which includes the imposition of a surcharge, shall have a right to a hearing by the City Manager or his/her designee within fifteen (15) days of mailing or other delivery of the notice of violation.

(b) The water customer's timely written request for a hearing shall automatically stay installation of flow-restricting device on the customer's premises until after the City Manager or his/her designee renders his or her decision.

(c) The water customer's timely written request for a hearing shall not stay the imposition of a surcharge unless within the time period to request a hearing, the water customer deposits with the City money in the amount of any unpaid surcharge due. If it is determined that the surcharge was wrongly assessed, the City will refund any money deposited to the water customer.

(d) The decision of the City Manager or his/her designee shall be final except for judicial review.

(§ 2, Ord. 2907, eff. June 16, 2009)

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# Chapter 13.16 WATER CONSERVATION

## 13.16.010 Generally

A. Declaration of Policy. It is declared that because of the water conditions prevailing in the city, the general welfare requires that the water resources available to the city, region and state be put to the maximum beneficial use, that the waste or unreasonable use of water be prevented, and that the conservation of water is to be encouraged at all times.

B. Authorization.

1. The city manager shall request the city council to declare that demand for water is anticipated to be in excess of supply, immediately after it appears that such a situation exists or is threatened, if the city council is in session. If the council is not in session, the city manager shall immediately cause a request for a special meeting of the city council to be delivered to each council person who can be located.

2. The city council shall have the power to declare the necessity to implement the applicable provisions of this chapter when in its opinion the demand for water consumption exceeds the city's available supply (allowing for a safe reserve), or threatens to do so, provided there are no immediate resources available to remedy the situation. Such declaration shall be made by public announcement and shall be published in a newspaper of general circulation and shall become effective immediately upon such publication.

C. Application. The provisions of this chapter shall apply to all persons, customers within the city, or property utilizing city water wherever situated.

D. Presumption. For purposes of this title, it shall be presumed that a person, corporation or association in whose name the water utility of the city is or was last billed or who is receiving the economic benefit of the water supply has knowingly made, caused, used or permitted the use of water received from the city for a purpose in a manner contrary to any provision of this title. (Ord. 1786 § 1 (part), 2005: prior code § 7730.0)

## 13.16.020 Penalties

A. Compliance—Guidelines.

1. No customer of the city or person who uses water within the city shall knowingly use, or permit the use of water in a manner contrary to any provision of this chapter, or in an amount in excess of that use permitted by the provisions of this title or that is reasonably necessary to satisfy the water usage need.

2. Unless otherwise provided, any person, firm or corporation violating any provision of this title as adopted by reference above, other than the provisions of Sections 13.20.010 through 13.20.040 of this code, shall be guilty of an infraction or misdemeanor as hereinafter specified at the city's discretion, and each day or portion thereof such violation is in existence shall be a new and separate offense.

B. Any person so convicted shall be:

1. Guilty of an infraction offense and punished by a fine of not less than $25.00 but not exceeding $100.00 for a first violation during any calendar year or declared conservation stage, whichever time period is shorter in duration;

2. Guilty of an infraction offense and punished by a fine not less than $50.00 and not exceeding $200.00 for a second violation during any calendar year or declared conservation stage, whichever time period is shorter in duration;

3. On conviction of a third violation, guilty of a misdemeanor offense and shall be punished by a fine not less than $500.00 nor more than $1,000.00 during any calendar year or declared conservation stage, whichever time period is shorter in duration.

C. 1. Notwithstanding the above, a first or second offense may be charged and prosecuted as a misdemeanor at the city's sole discretion. In addition to the above penalties, such convicted person, firm, corporation or other entity may, in the discretion of the court, be ordered to reimburse the city for all necessary costs incurred through investigation, discovery, analysis, inspection, abatement and other actual costs incurred by the city or its agents pertaining to the violation.

2. The court shall fix the amount of any such reimbursements upon submission of proof of such costs by the city. Payment of any penalty herein provided shall not relieve a person, firm or corporation, or other entity from the responsibility of correcting the condition resulting from the violation.

D. In addition to the above, the water utility director is empowered to enact other penalties and restrictive measures that are intended to abate the conductor circumstances comprising the violation, including but not limited to the following: placement of a flow restricting device upon the water service, locking off of water meter, removal of water meter, and shutting off of the service line valve. (Ord. 1812 § 1 (part), 2006: prior code § 7731.00)

## 13.16.030 Conservation program—Year-round stage.

A. The following activities are prohibited:

1. The washing of sidewalks, walkways, driveways, public and private parking areas and all other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety;

2. Excessive or unreasonable runoff of water or unreasonable spray of the areas being watered. Every customer is deemed to have his or her water system under control at all times, to know the manner and extent of this water use and any runoff, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

3. Allowing, permitting or causing the escape of water through breaks or leaks within the customer's plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of 72 hours after the customer discovers such a break or leak or receives notice from the city of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak;

4. Outdoor irrigation of landscape by sprinklers during the hours of 10:00 a.m. to 6:00 p.m. Citizens are encouraged to avoid the use of sprinklers on windy days. Irrigation by handheld hose,

drip irrigation, hand-held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains;

5. Washing of automobiles, trucks, trailers, boats, airplanes, and other types of equipment (mobile or otherwise) unless done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff. However, this section does not apply to the washing of the above-listed vehicles or mobile equipment when conducted on the immediate premises of a commercial carwash;

6. All eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall not provide drinking water to any person unless it is expressly requested.

B. Exceptions. None of these restrictions shall apply to the following:

1. The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2. The necessary use of water for the routine maintenance and/or repair of water distribution facilities, residential and commercial plumbing and permanently installed landscaped irrigation systems. (Ord. 1786 § 1 (part), 2005: prior code § 7732.00)

## 13.16.040 Conservation program—Moderate shortage stage.

A. In the event the city council determines that the measures outlined in Section 13.16.030 fail to produce a sufficient reduction in demand so as to produce a sufficient supply, the use of water within the city shall be additionally restricted and the following provisions shall become effective upon a declaration by the city council and publication of same as follows:

1. The washing of sidewalks, walkways, driveways, public and private parking areas and all other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety.

2. Excessive or unreasonable runoff of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his or her water system under control at all times, to know the manner and extent of this water use and any runoff, and to employ available alternatives to apply irrigation water in a reasonably efficient manner.

3. Allowing, permitting or causing the escape of water through breaks or leaks within the customer's plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of 72 hours after the customer discovers such a break or leak or receives notice from the city of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak.

4. Outdoor irrigation of landscape by sprinklers is permitted only on even days of the month for those locations having a street address with an even last digit. Outdoor irrigation by sprinklers is

permitted only on odd days of the month for those locations having a street address with an odd last digit. Outdoor irrigation for locations not having a street address shall occur on even days of the month if located west of San Antonio Avenue or only on odd days of the month if located east of San Antonio Avenue. No outdoor irrigation shall take place between the hours of 10:00 a.m. and 6:00 p.m. Irrigation by hand-held hose, drip irrigation, hand-held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains.

5. Washing of Vehicles, Trailers, Boats, Airplanes and Mobile Equipment.

a. The washing of automobiles, trucks, trailers, boats, airplanes and other types of equipment (mobile or otherwise) is prohibited except on the designated outdoor water use days pursuant to subsection (A)(4) of this section between the hours of 12:00 midnight to 12:00 noon and sundown to 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff.

b. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin-operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved city standards with equipment to recycle water for use within their facility.

c. Washing trucks, trailers and other types of mobile equipment (such as garbage trucks and vehicles used to transport food and other perishables), when such washing is necessary in order to protect the health, safety and welfare of the public, shall be restricted to the hours of sundown to noon. Such washing, when allowed, shall be done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use.

d. Nonprofit and community based organizations' fundraising car washes shall be allowed, provided they are otherwise in accordance with all other provisions of the Upland Municipal Code and this section, and have obtained a permit to operate a nonprofit carwash from the finance department, the cost of same to be $5.00, which sum is found to cover the city's costs to issue the permit. Such activities shall be limited to no more than two times in one month. Permit shall become void upon the effective date of the declaration of severe shortage.

6. All eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall not provide drinking water to any person unless it is expressly requested.

7. The refilling or adding of water to swimming pools is prohibited except on designated outdoor water use days, which shall be the same days as outdoor watering is permitted pursuant to subsection (A)(4) of this section.

8. Any non-business, operation-related pond, ornamental fountain or other structure making similar use of water is prohibited.

9. The irrigation of golf course fairways is prohibited. This section shall not apply to the irrigation of any golf course solely with reclaimed wastewater.

10. The use of water from fire hydrants shall be limited to firefighting and emergency-related activities and/or other activities necessary to maintain the health, safety, and welfare of the citizens of Upland. This restriction shall not apply to businesses which require the use of water for land development and building construction processes, pursuant to prior written approval by the review board as defined in Section 13.16.070.

B. Exceptions. None of the moderate shortage restrictions shall apply to the following uses of water:

1. The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2. The routine and necessary use of water, other than for landscape irrigation, for land development (e.g., roadway base preparation, flushing of utility lines, dust control, concrete and asphalt work) and for building construction processes;

3. The necessary use of water for the routine maintenance and/or repair of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems;

4. The use of water necessary to irrigate large, landscaped areas in commercial and institutional establishments as authorized by the terms and conditions of an approved compliance agreement issued by the review board, as defined in Section 13.16.070;

5. The use of water pursuant to the approved terms and conditions of a variance granted by the review board as defined in Section 13.16.070. (Ord. 1786 § 1 (part), 2005: prior code § 7733.00)

## 13.16.050 Conservation program—High shortage stage.

A. In the event the city council determines that the measures outlined in Section 13.16.040 fail to produce a sufficient reduction in demand so as to produce a sufficient supply, the use of water within the city shall be additionally restricted and the following provisions shall become effective upon a declaration by the city council and publication of same as follows:

1. The washing of sidewalks, walkways, driveways, public and private parking areas and other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety is prohibited.

2. Excessive runoff of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his or her water system under control at all times, to know the manner and extent of this water use and any runoff, and to employ available alternatives to apply irrigation water in a reasonably efficient manner.

3. Allowing, permitting or causing the escape of water through breaks or leaks within the customer's plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of 72 hours after the customer discovers such a break or leak or receives notice from the city of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak.

4. Outdoor irrigation of landscape by sprinklers is permitted only on Wednesday and Sunday for those locations having street address with an even last digit. Outdoor irrigation by sprinklers is permitted only on Tuesday and Saturday for those locations having a street address with an odd last digit. Outdoor irrigation for locations not having a street address shall occur on Wednesday and Sunday if located west of San Antonio Avenue or only on Tuesday and Saturday if located east of San Antonio Avenue. No outdoor irrigation shall take place between 6:00 a.m. until one hour before

sundown. Irrigation by hand-held hose, drip irrigation, or handheld bucket or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains.

5. Washing of Vehicles, Trailers, Boats, Airplanes and Mobile Equipment.

a. The washing of automobiles, trucks, trailers, boats, airplanes and other types of equipment (mobile or otherwise) is prohibited except on the designated outdoor water use days pursuant to subsection (A)(4) of this section between the hours of 12:00 midnight to 12:00 noon and sundown to 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff.

b. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin-operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved city standards with equipment to recycle water for use within their facility.

c. Washing trucks, trailers and other types of mobile equipment (such as garbage trucks and vehicles used to transport food and other perishables), when such washing is necessary in order to protect the health, safety and welfare of the public, shall be restricted to the hours of sundown to noon. Such washing, when allowed, shall be done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use.

d. Nonprofit and community-based organizations' fundraising car washes shall be allowed, provided they are otherwise in accordance with all other provisions of the Upland Municipal Code and this section, and have obtained a permit to operate a nonprofit carwash from the finance department, the cost of same to be $5.00, which sum is found to cover the city's costs to issue the permit. Such activities shall be limited to no more than two times in one month. Permit shall become void upon the effective date of the declaration of severe shortage.

6. All eating and drinking establishments of any kind whatsoever including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall not provide drinking water to any person unless it is expressly requested.

7. The refilling or adding of water to existing swimming pools is prohibited except on designated outdoor water use days which shall be the same days as outdoor water is permitted pursuant to subsection (A)(4) of this section. New pool construction filling shall be by permit only.

8. Any non-business, operation-related pond, ornamental fountain or other structure making similar use of water is prohibited.

9. The watering of golf course tee areas and fairways is prohibited unless done with reclaimed wastewater.

10. The use of water from fire hydrants shall be limited to firefighting and emergency-related activities and/or other activities necessary to maintain the health, safety, and welfare of the citizens of Upland. This restriction shall not apply to businesses which require the use of water for land development and building construction processes, pursuant to prior written approval by the review board as defined in Section 13.16.070.

B. Exceptions. None of the high shortage restrictions shall apply to the following uses of water, provided there is prior written approval by the review board as defined in Section 13.16.070:

1. The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2. The routine and necessary use of water, other than for landscape irrigation, for land development (e.g., roadway base preparation, flushing of utility lines, dust control, concrete and asphalt work) and for building construction processes;

3. The necessary use of water for the routine maintenance and/or repair of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems;

4. The use of water necessary to irrigate large landscaped areas in commercial and institutional establishments as authorized by the terms and conditions of an approved compliance agreement issued by the review board, as defined in Section 13.16.070. (Ord. 1786 § 1 (part), 2005: prior code § 7734.00)

## 13.16.060 Conservation program—Severe shortage stage.

In the event the city council determines that the measures outlined in Section 13.16.050 fail to produce a sufficient reduction in demand so as to produce a sufficient supply, then the use of water within the city shall be additionally restricted and the following provisions shall become effective upon a declaration by the city council and publication of same as follows:

A. The washing of sidewalks, walkways, driveways, public and private parking areas and other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety is prohibited.

B. Excessive runoff of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his or her water system under control at all times, to know the manner and extent of this water use and any runoff, and to employ available alternatives to apply irrigation water in a reasonably efficient manner.

C. Allowing, permitting or causing the escape of water through breaks or leaks within the customer's plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of 72 hours after the customer discovers such a break or leak or receives notice from the city of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak.

D. Outdoor irrigation of landscape by sprinklers is permitted only on Sunday for those locations having street address with an even last digit. Outdoor irrigation by sprinklers is permitted only on Saturday for those locations having a street address with an odd last digit. Outdoor irrigation for locations not having a street address shall occur on Sunday if located west of San Antonio Avenue or only on Tuesday and Saturday if located east of San Antonio Avenue. No outdoor irrigation shall take place between 6:00 a.m. until one hour before sundown. Irrigation by hand-held hose, drip irrigation, or hand-held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted

anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains.

E. Washing of Vehicles, Trailers, Boats, Airplanes and Mobile Equipment.

1. The washing of automobiles, trucks, trailers, boats, airplanes, and other types of equipment (mobile or otherwise) is prohibited except as provided elsewhere in this section.

2. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin-operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved city standards with equipment to recycle water for use within their facility. Washing of vehicles in such facilities shall occur only between the hours of 6:00 a.m. and 12:00 noon.

3. Washing trucks, trailers, and other types of mobile equipment (such as garbage trucks and vehicles used to transport food and other perishables), when such washing is necessary in order to protect the health, safety and welfare of the public, shall be restricted to the hours of sundown to 12:00 noon. Such washing when allowed, shall be done with a hand-held bucket or hand-held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use.

F. All eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall not provide drinking water to any person unless it is expressly requested.

G. Washing sidewalks, driveways, public and private parking areas, tennis courts, patios, or other paved areas, except to alleviate an immediate health hazard, is prohibited.

H. The refilling or adding of water to existing swimming pools is prohibited except on designated outdoor water use days which shall be the same days as outdoor water is permitted pursuant to subsection D of this section. New pool construction filling shall be by permit only.

I. Any non-business, operation-related pond, ornamental fountain or other structure making similar use of water is prohibited.

J. The watering of golf course tee areas and fairways is prohibited unless done with reclaimed wastewater. (Ord. 1786 § 1 (part), 2005: prior code § 7735.00)

## 13.16.070 Implementation.

A. Review Board—Variances, Permits and Compliance Agreements. A review board is established to review special cases which cannot follow the letter of this chapter. The review board shall consist of the water utility director, the city engineer, the fire chief, the city planning director and the city attorney, or their appointed representative.

B. Appeal of review board decisions shall be made to the city council. It is the purpose of the review board to review special cases and to determine whether or not such cases warrant a variance, permit or compliance agreement including conditions of approval. The board shall consider the facts of each case and decide whether to grant a variance or a permit or to enter into a compliance agreement within five working days of the receipt of a properly completed application for variance/permit/compliance agreement form.

C. A variance shall be granted only for reasons of economic hardship, which is defined as a threat to an individual business's primary source of income. (Under no circumstances shall inconvenience or the potential for damage of landscaping be considered an economic hardship, which justifies a variance.) The

board shall authorize only the implementation of equitable water use restrictions which further the purpose and intent of the water conservation plan. The special water use restrictions authorized by the board in each case shall be set forth on the face of the variance, permit or compliance agreement. A nonrefundable fee of $50.00 per permit application for all requests shall be assessed to reimburse the city for administrative costs.

D. 1. A variance or permit issued under moderate shortage shall not be valid upon implementation of high or severe shortage stages unless the permit specifically addresses either or both of those stages upon initial issuance. The multistage permit would have to reflect significant additional savings of water, or nonuse of water, under progressively more critical shortage stages. A variance or permit shall expire under its own terms and conditions and/or when another water conservation stage is in effect.

2. Exception. If, within the period of the permit, the conservation stage for which the permit was originally issued is reinstated, the permit will be considered valid until the original expiration date, as long as that conservation stage is in effect.

E. Any person, corporation or association who is issued a variance or permit and makes use of water pursuant to the variance, permit or compliance agreement shall provide proof of the variance, permit or compliance agreement upon demand by any peace officer or person authorized by the city to enforce this title.

F. Upon conviction of a person, corporation or association of violating any provision of this chapter, the review board shall revoke any permit, variance, or compliance agreement previously granted. However, the board shall notify applicant of the proposed revocation five working days before taking such action, and applicant shall be given the opportunity to be heard by the review board prior to its taking such action.

G. Persons wishing to appeal the decision of the review board shall have the right of appeal to the city council. Appeal shall be made in writing within 10 working days of the review board decision. The decision of the city council shall be final. (Ord. 1786 § 1 (part), 2005: prior code § 7736.00)

# ORDINANCE NO. 47

## AN ORDINANCE OF THE CUCAMONGA VALLEY WATER DISTRICT OF SAN BERNARDINO COUNTY, CALIFORNIA, RESCINDING ORDINANCE 41 AND ENCOURAGING WATER USE EFFICIENCY

WHEREAS, the State of California and western United States has limited supplies of drinking water, and;

WHEREAS, Cucamonga Valley Water District practices diligent stewardship of this valuable resource, and;

WHEREAS, the District's Board of Directors encourages the efficient use of all water supplies.

WHEREAS, it is hereby declared that the conditions prevailing in areas served by Cucamonga Valley Water District, the areas of the State of California and elsewhere from which the District obtains its water supplies require that the water resources available to the District be put to the maximum beneficial use to the extent to which they are capable, and that waste or unreasonable method of use of water be prevented, and the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interests of the people of the District and for the public welfare.

WHEREAS, Water Code Section 31026 authorizes the District to restrict the use of water during any emergency caused by drought, or other threatened or existing water shortage, and to prohibit the waste of District water or the use of District water during such periods, for any purpose other than household use. Other restricted uses may be determined to be necessary by the District.

WHEREAS, Water Code Section 350 et seq. and Section 375 et seq. authorize the District to declare a water shortage emergency condition whenever it finds and determines that the ordinary demands and requirements of water consumers will not be satisfied without depleting the water supply of the District to the extent that there will be insufficient water for human consumption, sanitation and fire protection. The District has the power and authority to enact a water conservation measures pursuant to Water Code Section 350 et seq. and 375 et seq.

NOW, THEREFORE, THE BOARD OF DIRECTORS OF THE CUCAMONGA VALLEY WATER DISTRICT OF SAN BERNARDINO COUNTY, CALIFORNIA, DOES ORDAIN AS FOLLOWS:

**SECTION 1: As of the effective date of this Ordinance No. 47,** Ordinance No. 47 shall supersede, and otherwise control, over Ordinance 41 and Ordinance 41 shall be of no further force or effect.

## SECTION 2: DEFINITIONS

2.1 "DISTRICT": Cucamonga Valley Water District

2.2 "AREA OF SERVICE": For the purposes of this Ordinance, the area of service shall be defined as all of the Cucamonga Valley Water District

2.3 "CUSTOMER/PERSON": Any natural person, firm, or corporation.

2.4 "GENERAL MANAGER/CEO": The person designated by the District to supervise the operation of the public water system and who is charged with certain duties and responsibilities by this Ordinance, or his/her duly authorized representative.

## SECTION 3: AUTHORITY

This Ordinance is adopted pursuant to Water Code Sections 31026, 31027, 350 et seq., and 375 et seq. Pursuant to the Water Code Sections 31027, 350 et seq., and 375 et seq., a notice of public hearing was published at least seven (7) days prior to the date of the public hearing which was conducted on March 24, 2009 at 6:00 p.m., or as soon thereafter as practicable at 10440 Ashford Street, Rancho Cucamonga, CA 91730-2799 as part of the Regular Meeting of the Board of Directors. A certified copy of the proposed Ordinance was also posted at the District offices at least five (5) days before the hearing. Notice of the time and place of the public hearing was published in a newspaper of general circulation within the District. The Public Hearing was continued to the May 12, 2009 Regular Meeting of the Board of Directors and a subsequent notice of the continuation was published in the newspaper of general circulation, on the District's website and on the bulletin board at the District office.

## SECTION 4: WATER USE EFFICIENCY PRACTICES

Customers are required to practice the following activities:

(1) Hosing paved areas for health and safety purposes only with the use of a waterbroom or water-efficient pressure washer using not more than 5 gallons per minute.

(2) Wash vehicles using a hose equipped with a shutoff nozzle so that water does not flow to waste.

(3) All decorative fountains shall be equipped with recirculating systems.

(4) Upon notification by the District, repair all leaks.

(5) Adjust sprinklers so there is no run-off, over-spray or excessive irrigation from the property.

(6) Restaurants will only serve water on request.

(7) Hotels will offer guests the option to not launder linen daily.

(8) Industrial customers will review their water-using processes to evaluate ways to increase water conservation

No water customer of the District shall make, cause, use, or permit the use of water in a manner contrary to any provision of this Ordinance.

**SECTION 5: FAILURE TO COMPLY**

Financial penalties will be assessed when a customer who, in the reasonable discretion of the General Manager/CEO, or his/her representative, violates this Ordinance. Exhibit A, attached hereto and incorporated herein by reference, outlines those penalties and the method of notifying a customer that he/she is violating District's Ordinance. If the General Manager/CEO, or his/her representative deems it appropriate, water service will be terminated at the location where the violation occurred due to a failure to comply with this Ordinance or a failure to pay financial penalties. Any such service termination shall be implemented under the District's authority and procedures including, but not limited to, the District's rules and regulations for water service. The regulatory purpose of imposing the requirements and financial penalties, as set forth in this Ordinance and Exhibit "A," are to conserve water, deter waste and unreasonable use of water, encourage efficiency, and to cover the costs incident to the investigation, inspection, and administration of the enforcement of this Ordinance and Exhibit "A." Such costs of this regulatory program include, but are not necessarily limited to, the cost of District personnel for administration of this program, notices, publications, implementation of conservation measures/programs and the monitoring and enforcement of penalties.

**SECTION 6: SEVERABILITY**

If any provision, paragraph, word, section, or article of this Ordinance is invalidated by any court of competent jurisdiction, the remaining provision, paragraphs, words, sections, and articles shall not be affected and shall continue in full force and effect.

**SECTION 7: EFFECTIVE DATE OF ORDINANCE**

This Ordinance is effective immediately upon its adoption. Within ten (10) days after adoption of this Ordinance, this full Ordinance with the names of those Directors voting for and against the Ordinance shall be published in a newspaper of general circulation and a certified copy of this Ordinance, along with the names of those Directors voting for and against the Ordinance, will be posted in the District offices.

**ADOPTED May 12, 2009**

Randall J. Reed
President

ATTEST:

Robert A. DeLoach
Secretary

# ORDINANCE NO. 47

## EXHIBIT "A"

Financial penalties will be assessed when a customer violates the requirements outlined in Section 4 of Ordinance 47. The penalties are as follows:

(a) First violation. The District shall issue a written notice of a first violation to the water customer.

(b) Second violation. For a second violation, the District shall impose a penalty in the amount of Fifty Dollars ($50.00) which will be added to the water customer's water bill.

(c) Third violation. For a third violation, the District shall impose a penalty in the amount of One Hundred Dollars ($100.00) which will be added to the water customer's water bill.

(d) Fourth violation. After a fourth and any subsequent violation, the District shall impose a penalty in the amount of One Hundred Fifty Dollars ($150.00) which will be added to the water customer's water bill.

The regulatory purposes of imposing the requirements and financial penalties, as set forth in this Ordinance and Exhibit "A," are to conserve water, deter waste and unreasonable use of water, encourage efficiency, and to cover the costs incident to the investigation, inspection, and administration of the enforcement of this Ordinance and Exhibit "A." Such costs of this regulatory program include, but are not necessarily limited to, the cost of District personnel for administration of this program, notices, publications, implementation of conservation measures/programs and the monitoring and enforcement of penalties.

**NOTICING**

The District shall give notice of violation of Ordinance No. 47 to the water customer as follows:

(a) The first notice of violation shall be a warning given to the customer by using a door hanger.
(b) The second violation shall be in writing by regular mail to the address at which the water customer is normally billed.
(c) Notice of subsequent violations shall be given in writing in the following manner:

(i) By giving the notice to the customer at the property where the violation occurred; or

(ii) If the water customer is absent from or unavailable at the premises at which the violation occurred, by leaving a copy with some person of suitable age and discretion

at the premises and sending a copy through the regular mail to the address at which the water customer is normally billed; or

(iii) If a person of suitable age or discretion cannot be found, then by affixing a copy in a conspicuous place at the premises at which the violation occurred, and also sending a copy through the regular mail to the address at which the customer is normally billed.

The notice shall contain a description of the facts of the violation and a statement of the penalties for each violation.

**APPEAL PROCESS**

(1) The application of this Ordinance is not intended to have a disproportionate impact on customers who have implemented conservation methods or installed water saving devices.

(2) A water customer may appeal to the District in writing if he/she feels that this Ordinance causes an undue hardship. The written request shall provide a justification for a reduction of a restricted use violation. Documentation must be provided to support the request and reasons outlining the hardship must be included.

(3) The request shall be reviewed by the General Manager or designee(s) and the customer will receive a written response from the District.

(4) A customer may appeal the District's decision by requesting a review by a committee designated by the Board of Directors. The decision of this committee will be final.

DRAFT OF A

RESOLUTION IMPLEMENTING THE WATER SHORTAGE CONTINGENCY PLAN
(Ready for adoption should the need the arise)

SAN GABRIEL VALLEY WATER COMPANY

RESOLUTION ADOPTED BY THE BOARD OF DIRECTORS

_____
DATE

**WHEREAS**, the California Legislature enacted Assembly Bill 11X during the 1991 Extraordinary Session of the California Legislature (an act to amend California Water Code Sections 10620, 10631, and 10652, and to add Section 10656 to the California Water Code, relating to water); and

**WHEREAS**, AB11X requires that every urban water supplier providing potable water directly to more than 3,000 customers or supplying more than 3,000 acre feet of water to develop a Water Shortage Contingency Plan; and

**WHEREAS**, AB 11X mandates that said Water Shortage Contingency Plan be filed with the California Department of Water Resources by January 31, 1992; and

**WHEREAS**, San Gabriel Valley Water Company is an urban water supplier providing water to more than 3,000 customers, and therefore, has prepared and filed a Water Shortage Contingency Plan, in compliance with requirements of AB 11X.

**WHEREAS**, public hearings have been conducted regarding the implementation of the Company's Water Shortage Contingency Plan;

**NOW, THEREFORE, BE IT RESOLVED** that:

1. The Water Shortage Contingency Plan is hereby implemented;

2. The Company is hereby authorized (should the need arise) to declare a Water Shortage Emergency and implement the Water Shortage Contingency Plan;

3. The Company shall implement additional procedures regarding rules and regulations to carry out effective and equitable allocation of water during a declared water shortage, as approved and adopted by the California Public Utilities Commission.

5. The Company take necessary actions to mitigate the effects on customers of the water shortage while continuing to fulfill its duties as a public utility water company.

SAN GABRIEL VALLEY WATER COMPANY

11142 GARVEY AVENUE • P.O. BOX 6010 • EL MONTE, CALIFORNIA 91734 • (818) 448-6183

# IMPORTANT NOTICE

## 10% Voluntary Water Use Reduction Requested

Dear Customer:

Because of the severe 5-year drought we are experiencing, San Gabriel Valley Water Company is requesting that effective immediately all water customers reduce their water use, on a **voluntary basis**, by at least 10% compared to the same period last year.

As you may be aware, the Metropolitan Water District of Southern California (MWD) has adopted stringent water conservation measures to greatly reduce water usage because of the severe drought in California. Effective March 1, 1991, MWD has declared a Stage V water shortage. Fortunately, MWD supplies only a small portion of the water provided by San Gabriel Valley Water Company. Nevertheless, because of the drought, we also must request your cooperation in conserving water.

We believe that you and our other customers can achieve the requested 10% reduction on a voluntary basis and that it will not be necessary to implement strict water rationing and penalty rates. **Obviously, if our customers are unable to achieve the conservation goals on a voluntary basis, we would be forced to consider mandatory cutbacks and higher water costs.**

To assist you in meeting the conservation goal, your current water use and your use during the corresponding period last year is shown on your water bill. On future water bills we will be showing your conservation goal for the coming month. In addition, the water conservation measures shown on the back of this letter can help save water. Thank you for your cooperation.

Very truly yours,

SAN GABRIEL VALLEY WATER COMPANY

# SAN GABRIEL VALLEY WATER COMPANY
# WATER CONSERVATION MEASURES

1. Lawn watering and landscape irrigation should be done only between the hours of 4 p.m. and 8 a.m. every other day. Public and recreational facilities such as parks, school grounds, golf courses, and recreational fields can be irrigated on any day. Agricultural users and commercial nurseries and landscape contractors can continue to irrigate as necessary but should curtail all non-essential water uses.

2. Other watering can be done at any time if a handheld hose equipped with a positive shutoff nozzle is used, a handheld faucet-filled bucket of five gallons or less is used, or a drip irrigation system is used.

3. Do not allow water to run off landscaped areas into adjoining streets, sidewalks, or other paved areas because of excessive watering or incorrectly directed or maintained sprinklers.

4. Washing of cars, trucks, trailers, boats, airplanes, or buildings should only be done with a handheld bucket or with a handheld hose equipped with a positive shutoff nozzle for quick rinses.

5. Do not use water to wash down sidewalks, driveways, parking areas, tennis courts, patios, or other paved areas except to alleviate immediate fire, sanitation, or health hazards.

6. There should be no filling or refilling of ponds, fountains, or artificial lakes. Pools and spas should be filled or refilled only between 4 p.m. and 8 a.m.

7. Restaurants should not serve water to their customers unless specifically requested.

8. Leaks from indoor and outdoor plumbing fixtures should be repaired as soon as discovered and should not be allowed to continue for more than 48 hours.

9. Do not leave water running while brushing your teeth, shaving, soaping in the shower, or washing dishes in the sink.

Also, to further assist customers in conserving water, the company has water conservation kits available and water-saving information literature available free of charge at each of the company's commercial offices. You may call or stop by one of the company's commercial offices to avail yourself of these materials. The commercial offices are located at:

11142 Garvey Avenue, El Monte, CA
14404 East Valley Boulevard, Industry, CA
11579 Hadley Street, Whittier, CA

FONTANA WATER COMPANY
A DIVISION OF SAN GABRIEL VALLEY WATER COMPANY
8440 NUEVO AVENUE • P.O. BOX 987, FONTANA, CALIFORNIA 92334 • (714) 822-2201

# IMPORTANT NOTICE

## 10% Voluntary Water Use Reduction Requested

Dear Customer:

Because of the severe 5-year drought we are experiencing, Fontana Water Company is requesting that effective immediately all water customers reduce their water use, on a **voluntary basis**, by at least 10% compared to the same period last year.

As you may be aware, the Metropolitan Water District of Southern California (MWD) has adopted stringent water conservation measures to greatly reduce water usage because of the severe drought in California. Effective March 1, 1991, MWD has declared a Stage V water shortage. Fortunately, Fontana Water Company does not rely on water deliveries from MWD to supply its customers. Nevertheless, because of the drought, we also must request your cooperation in conserving water.

We believe that you and our other customers can achieve the requested 10% reduction on a voluntary basis and that it will not be necessary to implement strict water rationing and penalty rates. **Obviously, if our customers are unable to achieve the conservation goals on a voluntary basis, we would be forced to consider mandatory cutbacks and higher water costs.**

To assist you in meeting the conservation goal, your current water use and your use during the corresponding period last year is shown on your water bill. On future water bills we will be showing your conservation goal for the coming month. In addition, the water conservation measures shown on the back of this letter can help save water. Thank you for your cooperation.

Very truly yours,

FONTANA WATER COMPANY

# FONTANA WATER COMPANY
# WATER CONSERVATION MEASURES

1. Lawn watering and landscape irrigation should be done only between the hours of 4 p.m. and 8 a.m. every other day. Public and recreational facilities such as parks, school grounds, golf courses, and recreational fields can be irrigated on any day. Agricultural users and commercial nurseries and landscape contractors can continue to irrigate as necessary but should curtail all non-essential water uses.

2. Other watering can be done at any time if a handheld hose equipped with a positive shutoff nozzle is used, a handheld faucet-filled bucket of five gallons or less is used, or a drip irrigation system is used.

3. Do not allow water to run off landscaped areas into adjoining streets, sidewalks, or other paved areas because of excessive watering or incorrectly directed or maintained sprinklers.

4. Washing of cars, trucks, trailers, boats, airplanes, or buildings should only be done with a handheld bucket or with a handheld hose equipped with a positive shutoff nozzle for quick rinses.

5. Do not use water to wash down sidewalks, driveways, parking areas, tennis courts, patios, or other paved areas except to alleviate immediate fire, sanitation, or health hazards.

6. There should be no filling or refilling of ponds, fountains, or artificial lakes. Pools and spas should be filled or refilled only between 4 p.m. and 8 a.m.

7. Restaurants should not serve water to their customers unless specifically requested.

8. Leaks from indoor and outdoor plumbing fixtures should be repaired as soon as discovered and should not be allowed to continue for more than 48 hours.

9. Do not leave water running while brushing your teeth, shaving, soaping in the shower, or washing dishes in the sink.

Also, to further assist customers in conserving water, the company has water conservation kits available and water-saving information literature available free of charge at the company's commercial office. You may call or stop by the company's commercial office to avail yourself of these materials. The commercial office is located at:

8440 Nuevo Avenue, Fontana, CA

Cal. P.U.C. Sheet No. _____

Canceling _____ Cal. P.U.C. Sheet No. _____

# RULE NO. 14.1

## MANDATORY WATER CONSERVATION AND RATIONING PLAN

### GENERAL INFORMATION

If water supplies are projected to be insufficient to meet normal customer demand, the utility may elect to implement voluntary conservation using the portion of this plan set forth in Section A of this Rule after notifying the Commission's Water Utilities Branch of its intent. If in the opinion of the utility more stringent water conservation measures are required, the utility shall request Commission authorization to implement the mandatory conservation and rationing measures set forth in Section B.

The Commission shall authorize mandatory conservation and rationing by approving Tariff SCHEDULE NO. 14.1, MANDATORY WATER CONSERVATION AND RATIONING. When Tariff Schedule No. 14.1 has expired or is not in effect, mandatory conservation and rationing measures will not be in force. Tariff Schedule No. 14.1 will set forth water use allocations, excess water use penalties, charges for removal of flow restrictors, and the period during which mandatory conservation and rationing measures will be in effect.

When Tariff Schedule No. 14.1 is in effect and the utility determines that water supplies are again sufficient to meet normal demands and mandatory conservation and rationing measures are no longer necessary, the utility shall seek Commission approval to rescind Tariff Schedule No. 14.1 to discontinue rationing.

In the event of a water supply shortage requiring a voluntary or mandatory program, the utility shall make available to its customers water conservation kits as required by Rule No. 20. The utility shall notify all customers of the availability of conservation kits.

(continued)

JUL 90

RULE NO. 14.1
(continued)

A. CONSERVATION - NONESSENTIAL OR UNAUTHORIZED WATER USE

No customer shall use utility-supplied water for nonessential or unauthorized uses as defined below:

1. Use of water through any connection when the utility has notified the customer in writing to repair a broken or defective plumbing, sprinkler, watering or irrigation system and the customer has failed to make such repairs within 5 days after receipt of such notice.

2. Use of water which results in flooding or run-off in gutters, waterways, patios, driveways, or streets.

3. Use of water for washing aircraft, cars, buses, boats, trailers or other vehicles without a positive shutoff nozzle on the outlet end of the hose, except for the washing of vehicles at commercial or fleet vehicle washing facilities operated at fixed locations where equipment using water is properly maintained to avoid wasteful use.

4. Use of water through a hose for washing buildings, structures, sidewalks, walkways, driveways, patios, parking lots, tennis courts, or other hard-surfaced areas in a manner which results in excessive run-off or waste.

5. Use of water for watering streets with trucks, except for initial wash-down for construction purposes (if street sweeping is not feasible), or to protect the health and safety of the public.

6. Use of water for construction purposes, such as consolidation of backfill, dust control, or other uses unless no other source of water or other method can be used.

7. Use of water for more than minimal landscaping in connection with any new construction.

(continued)

JUL 90

RULE NO. 14.1
(continued)

A. 8. Use of water for outside plants, lawn, landscape and turf areas more often than every other day, with even numbered addresses watering on even numbered days of the month and odd numbered addresses watering on the odd numbered days of the month, except that this provision shall not apply to commercial nurseries, golf courses and other water-dependent industries.

9. Use of water for outside plants, lawn, landscape and turf areas during certain hours if and when specified in Tariff Schedule No. 14.1 when the schedule is in effect.

10. Use of water for watering outside plants and turf areas using a hand held hose without a positive shut-off valve.

11. Use of water for decorative fountains or the filling or topping off of decorative lakes or ponds. Exceptions are made for those decorative fountains, lakes, or ponds which utilize recycled water.

12. Use of water for the filling or refilling of swimming pools.

13. Service of water by any restaurant except upon the request of a patron.

B. RATIONING OF WATER USAGE

In the event the conservation measures required by Section A are insufficient to control the water shortage, the utility shall, upon Commission approval, impose mandatory conservation and rationing. The water allocated for each customer, the time period during which rationing shall be in effect, and any additional conditions, will be set forth in Tariff Schedule No. 14.1, which shall be filed for this purpose at the time such rationing is approved by the Commission.

Before rationing is authorized by the Commission the utility shall hold public meetings and take all other applicable steps required by Sections 350 through 358 of the California Water Code.

JUL 90

(continued)

Cal. P.U.C. Sheet No.

Canceling Cal. P.U.C. Sheet No.

RULE NO. 14.1
(continued)

C. ENFORCEMENT OF MANDATORY CONSERVATION AND RATIONING

1. The water use restrictions of the conservation program in Section A of this rule become mandatory when the rationing program goes into effect. These restrictions are applicable whether or not the customer exceeds the monthly water allocation.

2. Upon inception of the mandatory provisions of this Rule the utility may, after one verbal and two written warnings, install a flow-restricting device on the service line of any premises where utility personnel observe water being used for any nonessential or unauthorized use as defined in Section A.

3. A flow restrictor shall not restrict water delivery by greater than 50% of normal flow and shall provide the premises with a minimum of 6 Ccf/month. The restrictor may be removed only by the utility, after a three-day period has elapsed, and upon payment of the appropriate removal charge as set forth in Tariff Schedule No. 14.1.

4. After the removal of a restricting device, if any nonessential or unauthorized use of water continues, the utility may install another flow-restricting device. This device shall remain in place until rationing is no longer in effect and until the appropriate charge for removal has been paid to the utility.

5. Each customer's water allocation shall be shown on the water bill. Water allocations may be appealed in writing as provided in Section D of this Rule. If a customer uses water in excess of the allocated amount, the utility may charge the excess usage penalty shown in Tariff Schedule No. 14.1.

6. Any monies collected by the utility through excess usage penalties shall not be accounted for as income, but shall be accumulated by the utility in a separate account for disposition as directed or authorized from time to time by the Commission.

7. The charge for removal of a flow-restricting device shall be in accordance with Tariff Schedule No. 14.1.

JUL 90

(continued)

Cal. P.U.C. Sheet No.

Canceling Cal. P.U.C. Sheet No.

RULE NO. 14.1
(continued)

D. APPEAL PROCEDURE

Any customer who seeks a variance from any of the provisions of this mandatory water conservation and rationing plan or a change in water allocation shall notify the utility in writing, explaining in detail the reasons for such a variation. The utility shall respond to each such request.

Any customer not satisfied with the utility's response may file an appeal with the staff of the Commission. The customer and the utility will be notified of the disposition of such appeal by letter from the Executive Director of the Commission.

If the customer disagrees with such disposition, the customer shall have the right to file a formal complaint with the Commission. Except as set forth in this Section, no person shall have any right or claim in law or in equity, against the utility because of, or as a result of, any matter or thing done or threatened to be done pursuant to the provisions of this mandatory water conservation and rationing plan.

E. PUBLICITY

In the event the utility finds it necessary to implement this plan, it shall notify customers and hold public hearings concerning the water supply situation, in accordance with Chapter 3, Water Shortage Emergencies, Sections 350 through 358, of the California Water Code. The utility shall also provide each customer with a copy of this plan by means of billing inserts or special mailings; notifications shall take place prior to imposing any fines associated with this plan. In addition, the utility shall provide customers with periodic updates regarding its water supply status and the results of customers' conservation efforts. Updates may be by bill insert, special mailing, poster, flyer, newspaper, television or radio spot/ advertisement, community bulletin board, or other appropriate method(s).

JUL 90

## Sections of the California Water Code
## Chapter 3 - Water Shortage Emergencies

Section 350. The governing body of a distributor of a public water supply, whether publicly or privately owned and including a mutual water company, may declare a water shortage emergency condition to prevail within the area served by such distributor whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.

Section 351. Excepting in event of a breakage or failure of a dam, pump, pipe line or conduit causing an immediate emergency, the declaration shall be made only after a public hearing at which consumers of such water supply shall have an opportunity to be heard to protest against the declaration and to present their respective needs to said governing board.

Section 352. Notice of the time and place of hearing shall be published pursuant to Section 60 of the Government Code at least seven days prior to the date of hearing in a newspaper printed, published, and circulated within the area in which the water supply is distributed or if there is no such newspaper, in any newspaper printed, published, and circulated in the county in which the area is located.

Section 353. When the governing body has so determined and declared the existence of an emergency condition of water shortage within its service area, it shall thereupon adopt such regulations and restrictions on the delivery of water and the consumption within sa area of water supplied for public use as will in the sound discretion of such governing bod conserve the water supply for the greatest public benefit with particular regard to domest use, sanitation, and fire protection.

Section 354. After allocating and setting aside the amount of water which in the opinion of th governing body will be necessary to supply water needed for domestic use, sanitation, and fire protection, the regulations may establish priorities in the use of water for other purposes and provide for the allocation, distribution, and delivery of water for such other purposes, without discrimination between consumers using water for the same purpose purposes.

Section 355. The regulations and restrictions shall thereafter be and remain in full force and effect during the period of the emergency and until the supply of water available for distribution within such area has been replenished or augmented.

Section 356. The regulations and restrictions may include the right to deny such applications for new or additional service connections, and provision for their enforcement by discontinuing service to consumers willfully violating the regulations and restrictions.

Section 357. If the regulations and restrictions on delivery and consumption of water adopted pursuant to this chapter conflicts with any law establishing the rights of individual consumers to receive either specific or proportionate amounts of the water supply available for distribution within such service area, the regulations and restrictions adopted pursuant to this chapter shall prevail over the provisions of such laws relating to water rights for the duration of the period of emergency; provided, however, that any distributor of water which is subject to regulation by the State Public Utilities Commission shall before making such regulations and restrictions effective secure the approval thereof of the Public Utilities Commission.

Section 358. Nothing in this chapter shall be construed to prohibit or prevent review by any court of competent jurisdiction of any finding or determination by a governing board of the existence of an emergency or of regulations or restrictions adopted by such board, pursuant to this chapter, on the ground that any such action is fraudulent, arbitrary, or capricious.

# ORDINANCE 33

## AN ORDINANCE OF THE BOARD OF DIRECTORS OF THE MONTE VISTA WATER DISTRICT, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, TO ESTABLISH WATER USE EFFICIENCY BEST PRACTICES AND STAGED WATER SUPPLY SHORTAGE MEASURES

---

The Board of Directors of the Monte Vista Water District (District) of San Bernardino County, California, does hereby ordain the following:

**Section 1: Purpose**

Monte Vista Water District is responsible for providing reliable water supply for the beneficial use, health, safety and welfare of its customers. The District has worked diligently to educate its customers about the value of water use efficiency and available water supplies to the District. In the unlikely event of a water shortage, the District shall request that its customers make reasonable and necessary reductions in their water use, according to the provisions of this Ordinance.

**Section 2: Policy**

1. The waste or unreasonable use of water by District customers shall be prevented to the greatest extent possible, and the efficient use of water shall be encouraged.

2. The District shall meet its urban water efficiency targets as set forth in California Water Code Sections 10608-10608.60, requiring the District to achieve a 20% reduction in per capita water use or a comparable water use reduction goal by December 31, 2020.

3. The District shall declare respective water supply shortage stages only if the District determines one or more of the following situations has occurred or may occur in the foreseeable future:

   a. The District may be unable to acquire or produce adequate water supplies to meet projected customer demands; or,

   b. The cost to acquire or produce adequate water supplies to meet projected customer demands may rise above the projected revenues generated by currently adopted water rates.

   Such circumstances would most likely occur due to one or more of the following events: imported water supply cutbacks by Metropolitan Water District of Southern California, extended drought, equipment failure, act of terrorism, and/or natural disaster.

4. During a declared water supply shortage, the District shall reduce water deliveries to wholesale water customers equal to the percentage of water demand reduction requested from the District's retail customers. The wholesale customer shall be responsible for managing water demand within its service area to comply with reduced deliveries during the declared water supply shortage.

5. The District shall offer to local agencies within whose boundaries the District provides retail and wholesale water service, upon their request, reasonable levels of assistance in complying with California Government Code Sections 65591-65599 (Water Conservation in Landscaping Act), enacted by Assembly Bill No. 1881 (2006).

**Section 3: Authority and Implementation**

1. The Board of Directors has the statutory power to declare that water supply shortage conditions exist and to implement the various staged provisions of this Ordinance as required to maintain reliable and safe water service to District customers.

2. The General Manager shall request the Board of Directors to declare a water supply shortage at a regular or special meeting of the Board of Directors. The Board shall receive evidence of water supply conditions at a public hearing and shall make findings concerning the adequacy of water supplies for the District and the necessity, if any, of declaring a water supply shortage.

3. The declaration of the Board that a water supply shortage exists or is threatened to exist shall be made by Resolution and public announcement, and shall be published in a newspaper of general circulation within ten (10) calendar days of adoption. The declaration shall become effective immediately upon adoption. The Resolution shall set a time schedule for expiration after review of water supply shortage conditions as reported by the General Manager.

**Section 4: Compliance Responsibility**

The District customer whose name is on the account shall be responsible for compliance with the provisions of this Ordinance.

**Section 5: Water Use Efficiency Best Practices**

1. District customers are required to implement the following water use efficiency best practices at all times:

    a. Set automatic irrigation controllers to water outdoor landscaped areas only between the hours of 8 p.m. and 8 a.m. and for no more than fifteen (15) minutes per day per valve-controlled station. Exempt from this requirement:

        i. Watering by hand.

        ii. Drip irrigation.

        iii. Irrigation systems equipped with weather-based or soil moisture-based irrigation controllers.

    b. Adjust irrigation system so there is no run-off, over-spray or excessive irrigation causing irrigation water to flow off of the customer's property.

    c. Turn off outdoor irrigation during rain.

    d. Repair all plumbing and irrigation system leaks within seven (7) days of discovery.

e. Wash motor vehicles, trailers, boats and other types of mobile equipment with a hand-held bucket or a hand-held hose equipped with a shutoff nozzle, or use a commercial vehicle wash equipped with a water recycling system.

f. Wash paved areas for health and safety purposes only with the use of a waterbroom or water-efficient pressure washer.

g. Restaurants serve water only upon request.

h. Hotels offer guests the option to not launder linen daily.

2. The following technologies shall be equipped with water recycling, recirculation or reuse systems prior to the establishment of new water service:

   a. Cooling towers and evaporative cooling systems.

   b. Decorative water fountains.

   c. Conveyer vehicle washes and in-bay automatic vehicle washes.

3. The District shall offer local agencies and retail and wholesale customers reasonable assistance in complying with State and local water use efficiency guidelines and requirements.

**Section 6: Significant Water Supply Shortage**

If the Board of Directors finds that current or near-term water supply shortage conditions require a 10 to 25 percent demand reduction, the Board may pass a Significant Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Section 5 above:

1. Landscaping and Landscape Irrigation.

   a. All lawns, landscape or turf areas shall be irrigated only on Tuesday, Thursday and Saturday of each week. Exempt from this requirement:

      i. Commercial nurseries, golf courses and other water-dependent industries.

      ii. Watering by hand.

      iii. Drip irrigation.

      iv. Irrigation systems equipped with weather-based or soil moisture-based irrigation controllers.

   b. Water consumption through water meters designed for landscape irrigation shall not exceed 75 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

2. Potable water used on a one-time basis for construction and dust control shall be limited to that quantity identified in the plan submitted by the user which describes water use requirements. The plan shall be submitted to and approved by the General Manager. Upon availability, non-potable recycled water will be made available for these uses.

3. The use of water from fire hydrants shall be limited to fire fighting and related activities, or for municipal activities necessary to maintain the public health, safety and welfare, or for construction use and dust control as approved by the General Manager.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by 10 to 25 percent, effective upon the date of its public announcement of a Significant Water Supply Shortage. The General Manager shall consult with District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 7: Critical Water Supply Shortage**

If the Board of Directors finds that current or near-term water supply shortage conditions require a 25 to 40 percent demand reduction, the Board may pass a Critical Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Sections 5 and 6 above:

1. Landscaping and Landscape Irrigation.

    a. All lawns, landscape or turf areas shall be watered only on Tuesday and Saturday of each week.

    b. Water consumption through water meters designed for landscape irrigation shall not exceed 50 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

    c. No person or entity shall implement any landscaping requirements of any homeowners association, developer or governing agency if it will result in an increase in water consumption from the prior calendar year.

2. No washing of motor vehicles, trailers, boats and other types of mobile equipment shall be permitted, unless done on the premises of a commercial car wash.

3. No one shall empty or refill swimming pools, spas or ponds for cleaning purposes. Water levels may be maintained.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by 25 to 40 percent, effective upon the date of its public announcement of a Critical Water Supply Shortage. The General Manager shall consult with the District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 8: Emergency Water Supply Shortage**

If the Board of Directors finds that, due to emergency circumstances, current or near-term water supply shortage conditions require a 40 percent or higher demand reduction, the Board may pass an Emergency Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Sections 5, 6 and 7 above:

1. Landscaping and Landscape Irrigation.

    a. All lawns, landscape or turf areas shall be watered only on Saturday of each week.

    b. Water consumption through water meters designed for landscape irrigation shall not exceed 33 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

    c. No installation of new landscaping shall be permitted.

2. No potable water for construction and dust control shall be permitted. Upon availability, non-potable recycled water will be made available for these uses.

3. No water shall be used to fill or maintain swimming pools, spas or ponds.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by at least 40 percent, effective upon the date of its public announcement of an Emergency Water Supply Shortage. The General Manager shall consult with District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 9: Exceptions**

No water use requirements described in Sections 5, 6, 7 and 8 above shall apply to the following water uses:

1. The use of recycled water distributed through the District's recycled water distribution system and used for landscape irrigation, construction, dust control or other approved uses, or the use of recycled water produced for direct reuse by commercial car washes, commercial laundries and various industries utilizing industrial water reuse systems.

2. The routine and necessary use of water by a governmental entity in pursuit of its functions for protecting the public health, safety and welfare of its citizens. This exception does not apply to the use of potable water for landscape irrigation by a governmental agency.

3. The necessary use of water for the routine maintenance, testing and/or repair of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems.

4. The use of "gray water". For the purposes of this Ordinance, "gray water" is defined as non-septic domestic wastewater collected from clothes washers, bathtubs, showers, and sinks. This provision shall not be construed to authorize the use of "gray water" if such use is otherwise prohibited by law.

**Section 10: Immediate Water Shortage Response**

In the event that an immediate shortage of water supply occurs due to disaster, the General Manager shall declare the extent of the water supply shortage and shall implement the appropriate water supply shortage stage as defined herein. The General Manager shall report such water supply shortage condition and level of response to the Board of Directors at a time which is reasonable and practicable.

**Section 11: Failure to Comply**

1. Any District customer violating the provisions set forth in this Ordinance shall be subject to the procedures and/or penalties described in this Section.

2. The following table outlines the procedures and penalties for violating the provisions set forth in this Ordinance, and each subsequent violation which occurs at least seven (7) days subsequent to the previous violation:

| | First Violation | Second Violation | Third Violation | Fourth Violation | Fifth Violation |
|---|---|---|---|---|---|
| **Best Practices** | Written Notice | Final Written Notice | $50 Fine | $100 Fine | $150 Fine; Flow Restrictor |
| **Significant Water Supply Shortage** | Written Notice | $50 Fine | $100 Fine | $150 Fine | $200 Fine; Flow Restrictor |
| **Critical Water Supply Shortage** | Written Notice | $100 Fine | $200 Fine | $300 Fine; Flow Restrictor | --- |
| **Emergency Water Supply Shortage** | Written Notice | $150 Fine | $300 Fine; Flow Restrictor | --- | --- |

3. Written Notice

   a. Notice of a violation of Ordinance provisions, as outlined in Subsection 2 above, shall be given in writing by regular mail or personal delivery to the customer at the address on file with the District. If notice is given by mail, the person depositing the notice by mail shall complete a Proof of Service by Mail form indicating the time, date and place the notice was deposited in the U.S. Mail.

   b. If personal delivery is used, any notice of violation of the water use requirements shall be made in the following manner:

i. By handing the notice to the customer personally. The person serving the notice shall complete a Proof of Service form indicating the time, date and place of service.

ii. If the customer is absent from or unavailable at the premises at which the violation occurred, by leaving a copy with some person of suitable age and discretion at the premises and sending a copy through the regular mail to the customer at the address at which the customer is normally billed.

iii. If a person of suitable age or discretion cannot be found, by affixing a copy in a conspicuous place at the premises at which the violation occurred and also sending a copy through the regular mail to the customer at the address at which the customer is normally billed.

c. The notice shall contain a description of the facts of the violation, a statement of the possible penalties for each violation and a statement informing the customer of his or her right to request a waiver due to hardship or special circumstances.

4. After multiple violations of Ordinance provisions, as outlined under Subsection 2 above, the District may install a flow restricting device on a customer's water meter. The District may terminate a customer's landscape meter service upon a prior determination that the customer has repeatedly violated this Ordinance. Such action will only be taken after a hearing held by the Review Board where the customer will have the opportunity to respond to the District's evidence of repeated violation.

5. Any restricted or terminated service may be restored upon request of the customer made not less than forty-eight (48) hours after the implementation of the action restricting or terminating service and only upon a showing by the customer that the customer is ready, willing and able to comply with the provision of this Ordinance. Prior to any restoration of the service, the customer shall pay all District charges for any restriction or termination of service and its restoration.

**Section 12: Review Board**

1. A District customer may request a waiver from any provisions of this Ordinance due to hardship or special circumstances. A Review Board comprised of members of the District staff shall be designated by the General Manager to review such requests. The Review Board shall respond to a waiver request within ten (10) working days of receipt of request.

2. The Review Board shall review customer written requests for a waiver from Ordinance provisions due to hardship or special circumstances, and determine whether or not the case warrants a waiver. No waiver shall be granted unless the water customer shows that he or she has achieved the maximum practical reduction in water consumption other than in the specific area(s) in which a waiver is being sought. No waiver shall be granted to any water customer who, when requested by the District, fails to provide any information necessary for resolution of the customer's request for a waiver.

3. Any customer who is granted a waiver shall provide proof of compliance with said waiver upon demand by any person authorized by the District. If the customer is found to violate any provision of the waiver, the Review Board shall revoke the waiver. The Review Board shall notify the customer in writing of the proposed revocation five (5) working days before taking such action, and the customer shall be given the opportunity to be heard by the Review Board prior to its taking such action.

4. A waiver issued under a particular water supply shortage stage shall not be valid upon passage of a higher water supply shortage stage. A new waiver must be granted by the Review Board for each enacted water supply shortage stage.

5. Appeal of Review Board decisions shall be made in writing to the Board of Directors, whose decision shall be final. The Board of Directors shall consider the appeal within thirty (30) days from the date the appeal was filed. The appealing customer shall be given the opportunity to address the Board of Directors and submit evidence orally and in writing.

**Section 13: Validity**

If any section, sub-section, clause, phrase or portion of this Ordinance is for any reason held to be invalid or unconstitutional by any court of competent jurisdiction, such decision shall not affect the validity of remaining portions of this Ordinance.

**Section 14: Consistency**

1. This Ordinance is consistent with the provision of California Water Code Sections 375-378, inclusive, and Sections 31020-31035.1, inclusive.

2. This Ordinance fulfills the District's water supply shortage planning obligation as required by California Water Code Sections 10610-10656, inclusive (Urban Water Management Planning Act). Subsequent District Urban Water Management Plan updates shall comply with this Ordinance.

**Section 15: Effective Date**

This Ordinance shall be effective immediately upon adoption and shall be published in any newspaper of general circulation and distributed within the District as required by law.

The President of the Board of Directors shall sign this Ordinance and the Secretary shall attest to the same. The Secretary shall cause this Ordinance to be published within ten (10) days after its adoption, at least once in a newspaper of general circulation which is distributed within the boundaries of the Monte Vista Water District.

**Section 16: Repeal and Rescind**

Upon adoption of this Ordinance, Ordinance 32 shall be repealed and rescinded effective on the date of adoption of this Ordinance.

ADOPTED THIS 12th day of May 2010.

Sandra S. Rose
President of the Board of Directors
MONTE VISTA WATER DISTRICT

ATTEST:

Mark N. Kinsey
Secretary to the Board of Directors
MONTE VISTA WATER DISTRICT

RESOLUTION No. 2006–06-03
A RESOLUTION OF THE BOARD OF DIRECTORS OF THE
SAN ANTONIO WATER COMPANY ESTABLISHING PROCEDURES IN THE CASE OF A WATER SHORTAGE

Entitled

"WATER SHORTAGE CONTINGENCY PLAN"

WHEREAS, the Board of Directors at its regular meeting of September 19, 2006, did discuss and establish the protocols and procedures attendant to the conduct of meetings of the Board of Directors.

NOW THEREFORE, BE IT RESOLVED that the San Antonio Water Company establish a plan to respond to water shortages,

WHEREAS, the Board is concerned that our precious water resources are protected so shareholders can expect to receive a reliable supply of quality water on demand; and

WHEREAS, the Board has a responsibility to provide water to its shareholders through the creation and maintenance of the infrastructure necessary to pump, store and distribute water; and

WHEREAS, the Board acknowledges the City of Upland Water Conservation Ordinance No. 1786 and shares the City of Upland's City Council's concern regarding the proper management of our precious water resources to ensure a reliable supply of quality water; and

WHEREAS, the San Antonio Water Company periodically needs supplemental water supply service from the City of Upland, which in accordance with City of Upland Ordinance No. 1786, as a prerequisite for receiving water supply service from the City of Upland, requires the implementation of water conservation measures; and

WHEREAS, the Board has adopted a resolution to water conservation,

NOW, THEREFORE, THE SAN ANTONIO WATER BOARD, CALIFORNIA, DOES RESOLVE, DECLARE, DETERMINE AND ORDER AS FOLLOWS:

## I. GENERALLY

A. Declaration of policy. It is hereby declared that because of the water conditions prevailing in the Water Company service area, the general welfare requires that the water resources available to the Water Company, Region and State be put to the maximum beneficial use, that the waste or unreasonable use of water be prevented, and that the conservation of water is to be encouraged at all times.

B. Authorization. The General Manager shall request the Board to declare that demand for water is anticipated to be in excess of supply, immediately after it appears that such a situation exists or is threatened, if the Board is in session. If the Board is not in session, the General Manager immediately cause a request for a special meeting of the Board to be delivered to each Board Member who can be located. The Board shall have the power to declare the necessity to implement the applicable provisions of this part when in their opinion the demand for water consumption exceeds the Water Company's available supply (allowing for a safe reserve), or threatens to do so, provided there are no immediate resources available to remedy the situation. Said declaration shall be made by public announcement and shall be published in a newspaper of general circulation and shall become effective immediately upon such publication.

C. Application. The provisions of this chapter shall apply to all shareholders, customers within the Water Company's service area, or property serviced by the Water Company wherever situated.

II. CONSERVATION PROGRAM-YEAR ROUND STAGE

A. The following activities are hereby prohibited:

1.0 The washing of sidewalks, walkways, driveways, public and private parking areas and all other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety;

a. Excessive or unreasonable run off of water or unreasonable spray of the areas being watered. Every shareholder is deemed to have his/her water system under control at all times, to know the manner and extent of this water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

2.0 Allowing, permitting or causing the escape of water through breaks or leaks within the customers plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the Water Company of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak;

3.0 Outdoor irrigation of landscape by sprinklers during the hours of 10:00 a.m. to 6:00 p.m. Shareholders are encouraged to avoid the use of sprinklers on windy days. Irrigation by hand held hose, drip irrigation, hand held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, and alleys or storm drains;

4.0 Washing of automobiles, trucks, trailers, boats, and other types of equipment (mobile or otherwise) unless done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff. However, this section does not apply to the washing of the above-listed vehicles or mobile equipment when conducted on the immediate premises of a commercial carwash;

5.0 With respect to eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, that benefits from the supply of water by the Water Company shall not provide drinking water to any person unless expressly requested.

B. Exceptions: None of these restrictions shall apply to the following:

1.0 The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2.0 The necessary use of water for the routine maintenance, repair or construction of distribution and water supply facilities, residential and commercial plumbing and permanently installed landscaped irrigation systems.

3.0 Available non-potable water which is only delivered for irrigation purposes and/or not available for distribution by current Water Company production and conveyance facilities.

III. MODERATE SHORTAGE STAGE

A. In the event the Board determines that the measures outlined above fail to produce a sufficient reduction in demand so as to produce a sufficient supply, the use of water within the Water Company's service area shall be additionally restricted and the

following provisions shall become effective upon a declaration by the Board and publication of same as follows:

1.0 The washing of sidewalks, walkways, driveways, public and private parking areas and all other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety;

a. Excessive or unreasonable run off of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his/her water system under control at all times, to know the manner and extent of this water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

2.0 Allowing, permitting or causing the escape of water through breaks or leaks within the customers plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the Water Company of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak;

3.0 Outdoor irrigation of landscape by sprinklers is permitted only on even days of the month for those locations having a street address with an even last digit. Outdoor irrigation by sprinklers is permitted only on odd days of the month for those locations having a street address with an odd last digit. No outdoor irrigation shall take, place between the hours of 10:00 a.m. and 6:00 p.m. Irrigation by hand held hose, drip irrigation, hand held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains;

4.0 Washing of vehicles, trailers, boats, and mobile equipment:

a. The washing of automobiles, trucks, trailers, boats, and other types of equipment (mobile or otherwise) is prohibited except on the designated outdoor water use days between the hours of 12:00 midnight to 12:00 noon and sundown to 12:00 midnight. Such washing, when allowed, shall be done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff;

b. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved county standards with equipment to recycle water for use within their facility;

c. Nonprofit and community based organizations' fundraising car washes shall be allowed, provided they are otherwise in accordance with all other provisions of a permit to operate a nonprofit carwash.

5.0 With respect to eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, that benefits from the supply of water by the Water Company shall not provide drinking water to any person unless expressly requested.

6.0 The refilling or adding of water to swimming pools is prohibited except on designated outdoor water use days, which is restricted between the hours of 10am and 6 pm.

7.0 Any non-business, operation related pond, ornamental fountain or other structure making similar use of water is prohibited.

8.0 The irrigation of golf course fairways is prohibited. This section shall not apply to the irrigation of any golf course solely with available non-potable or reclaimed wastewater.

9.0 The use of water from fire hydrants shall be limited to firefighting and emergency related activities and/or other activities necessary to maintain the health, safety, and welfare of the citizens of the San Antonio Water Company's service area. This restriction shall not apply to businesses, which require the use of water for land development and building construction processes with prior written approval by the Water Company.

B. Exceptions: None of the moderate shortage restrictions shall apply to the following uses of water:

1.0 The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2.0 The routine and necessary use of water, other than for landscape irrigation, for land development (e.g., roadway base preparation, flushing of utility lines, dust control, concrete and asphalt work) and for building construction processes;

3.0 The necessary use of water for the routine maintenance and/or repair or construction of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems;

IV. CONSERVATION PROGRAM-HIGH SHORTAGE STAGE

A. In the event the Board determines that the measures fail to produce a sufficient reduction in demand so as to produce a sufficient supply, the use of water within the Water Company's service area shall be additionally restricted and the following provisions shall become effective upon a declaration by the Board and publication of same as follows:

1.0 The washing of sidewalks, walkways, driveways, public and private parking areas and other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety is prohibited;

a. Excessive run off of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his/her water system under control at all times, to know the manner and extent of this water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

2.0 Allowing, permitting or causing the escape of water through breaks or leaks within the customers plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the Water Company of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak;

3.0 Outdoor irrigation of landscape by sprinklers is permitted only on Wednesday and Sunday for those locations having street address with an even last digit. Outdoor irrigation by sprinklers is permitted only on Tuesday and Saturday for those locations having a street address with an odd last digit. Outdoor irrigation for locations not having a street address shall occur on Wednesday and Sunday if located west of San Antonio Avenue or only on Tuesday and Saturday if located east of San Antonio Avenue. No outdoor irrigation shall take place between 6:00 a.m. until one (1) hour before sundown. Irrigation by hand held hose, drip irrigation, or hand held bucket or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In

no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains;

4.0 Washing of vehicles, trailers, boats and mobile equipment:

a. The washing of automobiles, trucks, trailers, boats, airplanes and other types of equipment (mobile or otherwise) is prohibited except on the designated outdoor water use days between the hours of 12:00 midnight to 12:00 noon and sundown to 12:00 midnight. Such washing, when allowed, shall be done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use to ensure the water supply is shutoff;

b. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved county standards with equipment to recycle water for use within their facility;

c. Trucks, trailers and other types of mobile equipment (such as garbage trucks and vehicles used to transport food and other perishables) when said washing is necessary in order to protect the health, safety and welfare of the public, shall be restricted to the hours of sundown to noon. Such washing, when allowed, shall be done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use;

d. Nonprofit and community based organizations' fundraising car washes shall be allowed, provided they are otherwise in accordance with all other provisions of the appropriate agency with that jurisdiction and this section, and have obtained the necessary permits to operate a nonprofit carwash. Such activities shall be limited to no more than two (2) times in one (1) month. Permit shall become void upon the effective date of the declaration of severe shortage.

5.0 All eating and drinking establishments of any kind whatsoever including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall only provide drinking water to any person unless expressly requested.

6.0 The refilling or adding of water to existing swimming pools is prohibited except on designated outdoor water use days. New pool construction filling shall be by permit only.

7.0 Any non-business, operation related pond, ornamental fountain or other structure making similar use of water is prohibited.

8.0 The waters of golf course tee areas and fairways are prohibited unless done with reclaimed wastewater or non-potable water.

9.0 The use of water from fire hydrants shall be limited to firefighting and emergency related activities and/or other activities necessary to maintain the health, safety, and welfare of the citizens of the San Antonio Heights. This restriction shall not apply to businesses, which require the use of water for land development and building construction processes, pursuant to prior written approval by the Water Company.

B. Exceptions: None of the high shortage restrictions shall apply to the following uses of water provided there is prior written approval by the Board:

1.0 The routine and necessary use of water, other than for landscape irrigation, by a governmental entity in pursuit of its governmental functions for the benefit of the public, such as construction projects and for the cleaning of streets to prevent debris and harmful substances from entering water systems via storm drains;

2.0 The routine and necessary use of water, other than for landscape irrigation, for land development (e.g., roadway base preparation, flushing of utility lines, dust control, concrete and asphalt work) and for building construction processes;

3.0 The necessary use of water for the routine maintenance and/or repair or construction of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems;

V. CONSERVATION PROGRAM – SEVERE SHORTAGE STAGE

A. In the event the Board of Directors determines that the measures fail to produce a sufficient reduction in demand so as to produce a sufficient supply, then the use of water within the Company's service area shall be additionally restricted and the following provisions shall become effective upon a declaration by the Board of Directors and publication of same as follows:

1.0 The washing of sidewalks, walkways, driveways, public and private parking areas and other impervious hard surfaced areas by direct hosing when runoff water directly flows to a gutter or storm drain, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety is prohibited;

a. Excessive run off of water or unreasonable spray of the areas being watered is prohibited. Every customer is deemed to have his/her water system under control at all times, to know the manner and extent of this water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

2.0 Allowing, permitting or causing the escape of water through breaks or leaks within the customers plumbing or private water distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the Water Company of a break or leak, is a reasonable time within which to correct such break or leak, or, at a minimum, to stop the flow of water from such break or leak;

3.0 Outdoor irrigation of landscape by sprinklers is permitted only on Sunday for those locations having street address with an even last digit. Outdoor irrigation by sprinklers is permitted only on Saturday for those locations having a street address with an odd last digit. Outdoor irrigation for locations not having a street address shall occur on Sunday if located west of San Antonio Avenue or only on Saturdays if located east of San Antonio Avenue. No outdoor irrigation shall take place between 6:00 a.m. until one (1) hour before sundown. Irrigation by hand held hoses, drip irrigation, or hand held bucket, or similar container or by use of a cleaning machine equipped to recycle any water used are permitted anytime. In no event shall any water so used be permitted to run off into adjacent property, streets, alleys or storm drains;

4.0 Washing of vehicles, trailers, boats, and mobile equipment.

a. The washing of automobiles, trucks, trailers, boats, and other types of equipment (mobile or otherwise) is prohibited except as provided elsewhere in this section;

b. No individual, firm or business that regularly washes vehicles for remuneration or provides facilities for customers to do so through coin operated machinery shall be permitted to operate such a business unless their place of business is equipped and operating to approved county standards with equipment to recycle water for use within their facility. Washing of vehicles in such facilities shall occur only between the hours of 6:00 a.m. and 12:00 noon;

c. Trucks, trailers, and other types of mobile equipment (such as garbage trucks and vehicles used to transport food and other perishables) when said washing is necessary in order to protect the health, safety and welfare of the public, shall be restricted to the hours of sundown to 12:00 noon. Such washing when allowed, shall be done with a hand held bucket or hand held hose equipped with a positive shutoff nozzle for quick rinses. The nozzle shall be removed when the hose is not in use.

5.0 All eating and drinking establishments of any kind including, but not limited to, any restaurant, hotel, cafe, cafeteria, bar or club, whether public or private, shall only provide drinking water to any person unless expressly requested.

6.0 The refilling or adding of water to existing swimming pools is prohibited except on designated outdoor water use days. New pool construction filling shall be by permit only.

7.0 Any non-business, operation related pond, ornamental fountain or other structure making similar use of water is prohibited.

8.0 The watering of golf course tee areas and fairways is prohibited unless done with reclaimed wastewater.

VI. IMPLEMENTATION

A. In case of severe water shortage, which could occur due to a catastrophic failure of any of the Water Company's key water supply sources (i.e. SAWCo Tunnel) would result in an emergency meeting with the Board to set the appropriate reduction of entitlement per share effective upon a declaration by the Board of Directors and publication of same.

B. The Board shall review special cases, which cannot follow the letter of this part for recommendation to the Board who may grant variances.

1.0 A variance shall be granted only for reasons of economic hardship, which is defined as a threat to an individual business's primary source of income. (Under no circumstances shall inconvenience or the potential for damage of landscaping be considered an economic hardship, which justifies a variance.) The Board shall recommend only the implementation of equitable water use restrictions, which further the purpose and intent of the water conservation plan. The special water use restrictions recommended by the Board of Directors in each case shall be set forth on the face of the variance, permit or compliance agreement. A nonrefundable fee of fifty dollars ($50.00) per permit application for all requests shall be assessed to reimburse the Water Company for administrative costs.

2.0 A variance or permit issued under moderate shortage shall not be valid upon implementation of high or severe shortage stages unless the permit specifically addresses either or both of those stages upon initial issuance. Said multi-stage permit would have to reflect significant additional savings of water, or nonuse of water, under progressively more critical shortage stages. A variance or permit shall expire under its own terms and conditions and/or when another water conservation stage is in effect.

a. Exception: If, within the period of the permit, the conservation stage for which the permit was originally issued is reinstated, the permit will be considered valid until the original expiration date, as long as that conservation stage is in effect.

3.0 Any person, corporation or association who is issued a variance or permit and makes use of water pursuant to said variance, permit or compliance agreement shall provide proof of said variance, permit or compliance agreement upon demand by any person authorized by the Water Company.

4.0 Upon findings of non-compliance of a shareholder of any provision of this part, will cause revocation of any permit, variance, or compliance agreement previously granted. However, the applicant shall be notified of the proposed revocation five (5) working days before taking such action, and applicant shall be given the opportunity to be heard by the Board.

VI. ADDITIONAL ASSESSMENT FOR VIOLATION OF THIS RESOLUTION

A. Guidelines.

1.0 Any shareholder who uses water provided by the Water Company knowingly use, or permit the use of water in a manner contrary to any provision of this part, or in an amount in excess of that use permitted by the provisions of this resolution or that is reasonably necessary to satisfy the water usage need shall be found in non-compliance with this resolution and assessed the following:

a. If found in non-compliance of this resolution for a first occurrence during any calendar year or declared conservation stage, whichever time period is shorter in duration shall be assessed $50;

b. If found in non-compliance of this resolution for a second occurrence during any calendar year or declared conservation stage, whichever time period is shorter in duration shall be assessed $100;

c. If found in non-compliance of this resolution for a third occurrence or more during any calendar year or declared conservation stage, whichever time period is shorter in duration shall be assessed $500.

2.0 In addition to the above, the General Manager is hereby empowered to enact other restrictive measures that are intended to abate the conductor circumstances comprising the occurrence, including but not limited to the following: placement of a flow restricting device upon the water service, locking off of water meter, removal of water meter, and shutting off of the service line valve.

VII. If any section, subsection, sentence, clause, phrase, or portion of this Resolution is for any reason held to be invalid or unenforceable by a court of competent jurisdiction, the remaining portions of this Resolution shall nonetheless remain in full force and effect. The shareholders of the Water Company hereby declare that they would have adopted each section, subsection, sentence, clause, phrase, or portion of this Resolution, irrespective of the fact that anyone or more sections, subsections, sentences, clauses, phrases, or portions of this Resolution be declared invalid or unenforceable.

The foregoing ordinance was PASSED, APPROVED AND ADOPTED by the Board of Directors of the San Antonio Water Company on the ~~17~~ 19th day of ~~October~~ September, 2006.

Tom Thomas
Tom Thomas, President

ATTEST:

Ken Willis
Ken Willis, Secretary

I, Ken Willis, Secretary of the San Antonio Water Company Board of Directors, Upland, California, do hereby certify that the foregoing Resolution was introduced at a regular meeting of the Board of Directors of the San Antonio Water Company held on the ~~17~~ 19th day of ~~October~~ September, 2006, and was adopted at a regular meeting of the Water Company Board of the San Antonio Water Company on the ~~17~~ 19th day of ~~October~~ September, 2006, by the following roll call vote:

AYES: 6

NOES: 0

ABSENT: 1

ABSTAINED: 0

# APPENDIX M

## WFA Contingency Operations Plan

# CONTINGENCY OPERATIONS PLAN
## UNDER EXTREME/EXCEPTIONAL DROUGHT MANAGEMENT CONDITIONS

**Prepared by:**

**Terry Catlin**
**General Manager**

**Jake Stepp**
**Operations Superintendent**

**Water Facilities Authority, JPA**
**Agua de Lejos Treatment Plant**
**1775 North Benson Avenue**
**Upland, CA 91784**

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# 1.0 INTRODUCTION

The Water Facilities Authority (Authority) owns and operates the Agua de Lejos Water Treatment Plant (WTP), a conventional surface water treatment facility that treats and disinfects imported water supplies, primarily State Water Project (SWP) water that is purchased from the Metropolitan Water District (MWD) through the Inland Empire Utilities Agency (IEUA). The WTP is located on sixteen acres in Upland. It began operations in 1988 and has the capacity to treat 81 million gallons per day (mgd). Recent historical flows through the treatment plant is normally in the range of 55-60 mgd during the peak summer months and can be as low as 8 mgd during the lower demand winter months. (With an administrative minimum flow penalty waiver from Metropolitan Water District, the deliveries can be as low as 4 mgd.)

The three-year period from 2012 through 2014 was the driest three-year period on record in California, and 2015 opened with the driest January in the state's weather record history. The Sierra Nevada snowpack typically peaks by April 1; this year, the snowpack was measured at five percent of historic average, the lowest measurement in recorded history. Governor Brown declared a drought State of Emergency on January 17, 2014 and directed state officials to take all necessary actions to prepare for water shortages. The State Water Resources Control Board on March 17, 2015 announced new restrictions on water use, including limiting outdoor watering to two days per week and prohibiting lawn watering during rainfall and during the next two days. Earlier this month, the governor directed the State Water Resources Control Board to implement mandatory water reductions in cities and towns across California to reduce water usage by 25 percent.

MWD amended its Water Supply Allocation Plan at its Board of Directors meeting held on December 9, 2014, with the following adjustments:

- Update to base period to Fiscal Years ending 2013 and 2014;
- Update to Conservation Demand Hardening credit based on member agency per capita water use reductions with considerations of early enforcement of mandatory conservation requirements;
- Includes a separate allocation for drought-impacted groundwater basins; and
- Replaces current penalty rate with an Allocation Surcharge based on marginal water conservation program costs.

On April 14, 2015, the Board of Directors took action to declare a Condition 3 – Water Supply Allocation and implement the Water Supply Allocation at a Level 3 Regional Shortage Level (approximately 15%), effective July 1, 2015 through June 30, 2016.

In order to manage the limited imported water supply deliveries through the treatment plant, staff collaborated with the Technical Advisory Committee (TAC) to develop the current Contingency Operations Plan (COP) to provide a guide outlining monthly delivery allocations to each of the members.

# 2.0 DRY YEAR YIELD PROGRAM

In June 2003, a Conjunctive Use Program Agreement (Number 49960) was executed between MWD, Three Valleys MWD (TVMWD), Chino Basin Watermaster (CBWM) and IEUA to establish a 100,000 AF conjunctive use and storage program for MWD, called the Dry Year Yield Program.

The Agreement provides for storage of up to 25,000 AFY unless CBWM allows for more, and extraction, at MWD's call, during dry years of up to 33,000 AFY not to exceed the amount of water in the MWD storage account.

The Agreement was amended in September 2014 to improve and clarify measurement of storage and extraction from the MWD storage account, define baseline conditions for calculations in performance targets, define procedures for variances for performance targets, revise administrative milestones, and make miscellaneous updates. Exhibit G was revised providing for a safety-net condition of imported water delivery of a minimum 40,000 AFY during Call Years, establishing minimum needs for direct deliveries from MWD.

MWD's storage account has not been replenished since it was emptied in the last set of calls during the last drought condition (2008-2011). Therefore, performance by the DYY Program participants is not required at this time.

# 3.0 WATER SUPPLY ALLOCATION PLAN

IEUA, along with other MWD members, worked with MWD staff in developing the Water Supply Allocation Plan (WSAP) that outlines measures to be taken to further reduce demand on the MWD system, if required. Previously, the WSAP was implemented at a Regional Shortage Level 2 (10%) from July 1, 2009 through June 30, 2010 and again from July 1, 2010 through June 30, 2011. Due to vastly improved water supply conditions, the allocation was rescinded in April 2011.

Since June 2014, MWD convened a number of working group meetings to revisit the WSAP in preparation for mandatory supply allocations in 2015. The recent discussions focused on three areas of the WSAP: (1) the Base Period, (2) the Allocation Formula, and (3) the Allocation enforcement mechanism.

In December 2014, the MWD Board of Directors approved adjustments to the WSAP. The adjustments included the following:

1. **Base Period**. The previous base period of CY 2004-2006 is replaced with FY ending 2013 and FY 2014.

2. **Conservation Demand Hardening Credits**. The current calculation intensive method is replaced with observed reductions in GPCD, compared to the baseline GPCD. The Conservation Demand hardening credit will be based on an initial ten percent of the GPCD-based Conservation savings plus an additional five percent for each level of Regional shortage set by the MWD Board during implementation of the WSAP. The credit will also be adjusted for the overall percentage reduction in retail water demand and the member agency's dependence upon MWD.

3. **Drought-Impacted Groundwater Basins**. A limited allocation made for drought impacted groundwater basins based on overdraft conditions, water quality restrictions, and verified need for replenishment, with final amounts and allocations determined following consultation with groundwater basin managers and member agencies.

4. **WSAP Penalty Rates**. The current Penalty Rate is based on a multiple of the fully encumbered Tier 2 Untreated Rate, over and above the water rates for the use of the water. The Penalty Rate is replaced with an Allocation Surcharge, based on the current cost of the turf removal program.

Inland Empire Utilities Agency (IEUA) reports that a Level 3 (~15%) allocation was adopted by MWD. Estimated IEUA Member Agency WSAP Allocation based on % IW purchased during WSAP baseline FY13-FY14, is presented as follows:

| Agency | 2012-13 | 2013-14 | % IW Delivery | Baseline | Level 3 | Level 4 |
|---|---|---|---|---|---|---|
| CVWD | 25,845 | 28,825 | 43% | 28,069 | 26,640 | 25,602 |
| **WFA** | 27,954 | 28,438 | 45% | 28,953 | **27,479** | 26,408 |
| FWC | 5,215 | 9,792 | 12% | 7,705 | 7,313 | 7,028 |
| **TOTAL** | **59,014** | **67,055** | **100%** | **64,726** | **61,431** | **59,038** |

(1) Baseline values as calculated by MWDs WSAP formula, FY12/13 and FY13/14 were the initial years used to forecast FY15/16 needs. The Baseline value includes growth and other various credits as defined by the approved WSAP. Each IEUA member agency will receive their % share of IEUAs total allocation based upon the percent's provided in "%IW Delivery" column.

**(2) Values are estimates and are subject to change. Final allocations expected from MWD by end April or early May 2015.**

## 3.1 ALLOCATION SURCHARGE

The Allocation Surcharge is based on the costs that MWD and its Member Agencies are incurring to implement outdoor waster use reductions through turf removal programs. The Allocation Surcharge would provide a price signal based on the marginal conservation costs incurred to reduce water use in dry and shortage years. Any revenues collected from the Allocation Surcharge would be used to fund the implementation of the Turf Removal Program or other similar programs designed to conserve water and reduce future demands.

The Allocation Surcharge is based on MWD's current cost of the Turf Removal Program. MWD is currently paying $2 per square foot of turf removed. The estimated water savings is 44 gallons per year for each square foot of turf removed for a period of ten years. Based on this savings rate, the estimated cost of the program is $1,480 per acre-foot.

**Table 3. MWD Surcharge (per AF)**

| Water Use | Base Rate | Surcharge | Total Cost |
|---|---|---|---|
| 100% of Allocation | Tier 1 | 0 | Tier 1 |
| Between 100% & 115% | Tier 1 | $1,480 | Tier 1 + $1,480 |
| Greater than 115% | Tier 1 | $2,960 | Tier 1 + $2,960 |

# 4.0 CONTINGENCY OPERATIONS PLAN DEVELOPMENT

The Authority's Operations' staff recognizes that the projected imported water supply reductions mandated by the WSAP requires collaboration and coordination with it Member Agencies for the day-to-day operations. Further, the approximate level of reduced imported water deliveries available to the Authority under projected scenarios of program implementation are estimated for planning purposes.

Planning worksheets identifying possible delivery scenarios have been developed and discussed at length through the Technical Advisory Committee. It is important to note that any COP requires adaptability as conditions and circumstances change and as water supply updates are provided. Therefore, the content of the COP will be revisited as much as necessary to address changing conditions. While an expressed numerical analysis is presented, a number of assumptions were considered as they were known at the time of development to formulate these results and only serve to guide the Authority's staff in operating the WTP in a coordinated manner integrating the interests of the individual members and their demand for imported water supplies.

Further, the individual members are required to monitor and perform in accordance with any mandatory reductions required by the WSAP, certifying compliance accordingly to the appropriate administering agency.

## 4.1 BASELINE DETERMINATION

The revised WSAP relies upon an historical two-year period, being identified as FYE 2013 through FYE 2014 including a growth adjustment and other credits applied.

### 4.1.1 WSAP BASELINE (RAW DELIVERY DATA)

**Table 4 WSAP Baseline Determination (Historical Deliveries FYE 2013-2014) in AF**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 3,168 | 3,261 | 3,053 | 2,333 | 1,763 | 1,141 | 1,110 | 1,128 | 1,610 | 2,856 | 3,113 | 3,419 | **27,954** |
| 2014 | 3,782 | 3,678 | 3,341 | 2,199 | 1,507 | 1,049 | 1,643 | 1,290 | 1,625 | 2,052 | 2,993 | 3,296 | **28,455** |
| 2 Yr Average | 3,475 | 3,469 | 3,197 | 2,266 | 1,635 | 1,095 | 1,377 | 1,209 | 1,617 | 2,454 | 3,053 | 3,358 | **28,204** |

## 4.2 MEMBER ALLOCATION METHODOLOGY

Previously, the Authority utilized a formula for distributing the available imported water allocation amongst the members. This formula was the Ten Year Rolling Average (Fiscal Years 2004-2014 Basis with a one-year lag) of historical deliveries percentages (Table 5).

**Table 5 Allocation Methodology**

| Agency | Allocation Formula (FY 10 YRA) |
|---|---|
| Chino | 12.6% |
| MVWD/Chino Hills | 26.4% |
| Ontario | 43.2% |
| Upland | 17.8% |
| Total = | 100.0% |

### 4.2.1 MEMBERS WATER SUPPLY ALLOCATION

The FY 10 year rolling average of historical deliveries percentages in Table 6 was applied to the projected WSAP allocation (Level 3) identified in Table 6 below.

**Table 6 Determination of Available Deliveries**

| Agency | Allocation Formula (FY 10 YRA) | | Available Deliveries |
|---|---|---|---|
| Chino | 3,575 | **12.6%** | 3,462 |
| MVWD/Chino Hills[(1)] | 7,509 | **26.4%** | 7,255 |
| Ontario | 12,286 | **43.2%** | 11,871 |
| Upland | 5,066 | **17.8%** | 4,891 |
| Total = | 28,436 | 100.0% | **27,479** |

[(1)]Per Joint water supply agreement between Monte Vista WD and City of Chino Hills

# 4.3 CONTINGENCY OPERATIONS

After much discussion during the development of the COP through the Technical Advisory Committee, the majority opinion was to design the COP wherein most of the projected available imported water supply would be delivered primarily during peak demand in the summer months, with emphasis given to July through October, while attempting to maintain minimum deliveries in the remainder or some portion of the year.

Since the construction of the Low Flow Modification Project, the WTP has the flexibility to operate at a minimum 4-mgd flow, as presented in the following tables, during the off-peak months so that most of the available supplies would be directed to the higher demand peak months. Further, a prolonged shutdown can be avoided with the lower minimum flow capability. Therefore, the plan is to operate the WTP throughout the year, unless a brief shutdown is required by MWD for maintenance on the Rialto Pipeline or for special maintenance at the WTP.

It should be noted that MWD has previously granted the Authority a waiver of their Administrative Code 4504(b) during WSAP implementation to allow minimum raw water supply deliveries less than the required minimum 10% of influent valve capacity (8 mgd) or to avoid minimum 8 mgd purchase payments for deliveries at less than the minimum.

In the following planning scenarios, the projected annual volume of water available for deliveries is distributed or allocated to the Authority's members according to the FY 10 YRA methodology previously used and considered the members' preferences in accordance to their individual systems' demands.

## 4.3.1 MONTHLY WATER SUPPLY ALLOCATION SCENARIO

In this scenario, Table 7 and Table 8 illustrate the allocation of projected water deliveries in acre-feet and million gallons per day, respectively. The allocation is distributed to the members in accordance with the FY 10 YRA methodology based on the historical delivery pattern. Scenarios in Tables 9-10 provide a distribution based on a winter minimum flow pattern. Scenarios in Tables 11-12 provide a distribution based on a winter no flow pattern.

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Distribution Based on **Historical Delivery Pattern**:

**Table 7. Estimated Projected Available Deliveries (AF) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chino** | 441 | 456 | 378 | 295 | 202 | 183 | 214 | 118 | 234 | 284 | 299 | 358 | **3,462** |
| **MVWD/Chino Hills** [(1)] | 924 | 956 | 792 | 619 | 423 | 383 | 448 | 247 | 491 | 594 | 628 | 751 | **7,255** |
| **Ontario** | 1,511 | 1,565 | 1,295 | 1,013 | 692 | 627 | 734 | 404 | 804 | 972 | 1,027 | 1,229 | **11,871** |
| **Upland** | 623 | 645 | 534 | 417 | 285 | 258 | 302 | 166 | 331 | 401 | 423 | 506 | **4,891** |
| **Total** | **3,498** | **3,622** | **2,998** | **2,344** | **1602** | **1,451** | **1,698** | **934** | **1,860** | **2,251** | **2,377** | **2,844** | **27,479** |

**Table 8. Estimated Projected Available Deliveries (MGD) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chino** | 4.6 | 4.8 | 4.1 | 3.1 | 2.2 | 1.9 | 2.2 | 1.4 | 2.5 | 3.1 | 3.1 | 3.9 |
| **MVWD/Chino Hills** [(1)] | 9.7 | 10.1 | 8.8 | 6.5 | 4.6 | 4.0 | 4.7 | 2.9 | 5.2 | 6.5 | 6.6 | 8.2 |
| **Ontario** | 15.9 | 16.4 | 14.1 | 10.6 | 7.5 | 6.6 | 7.7 | 4.7 | 8.4 | 10.6 | 10.8 | 13.3 |
| **Upland** | 6.5 | 6.8 | 5.8 | 4.4 | 3.1 | 2.7 | 3.2 | 1.9 | 3.5 | 4.4 | 4.4 | 5.5 |
| **Total** | **36.8** | **38.1** | **32.6** | **24.6** | **17.4** | **15.3** | **17.9** | **10.9** | **19.6** | **24.4** | **25.0** | **30.9** |

[(1)] Per Joint water supply agreement between Monte Vista WD and City of Chino Hills

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Distribution Based on **Winter Minimum Flow Pattern** (Assumes Waiver of MWD Administrative Code 4504(b) is Granted):

**Table 9. Estimated Projected Available Deliveries (AF) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chino** | 578 | 583 | 512 | 277 | 208 | 48 | 48 | 45 | 242 | 277 | 298 | 346 | **3462** |
| **MVWD/Chino Hills** [(1)] | 1,212 | 1,222 | 1,072 | 580 | 435 | 101 | 101 | 93 | 508 | 580 | 625 | 726 | **5,980** |
| **Ontario** | 1,983 | 1,999 | 1,755 | 950 | 712 | 165 | 165 | 153 | 831 | 950 | 1,022 | 1,187 | **11,871** |
| **Upland** | 817 | 824 | 723 | 391 | 293 | 68 | 68 | 63 | 342 | 391 | 421 | 489 | **4,891** |
| **Total** | **4,591** | **4,627** | **4,061** | **2,198** | **1,649** | **381** | **381** | **354** | **1,924** | **2,198** | **2,366** | **2,748** | **27,479** |

**Table 10. Estimated Projected Available Deliveries (MGD) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chino** | 6.1 | 6.1 | 5.6 | 2.9 | 2.3 | 0.5 | 0.5 | 0.5 | 2.5 | 3.0 | 3.1 | 3.8 |
| **MVWD/Chino Hills** [(1)] | 12.7 | 12.8 | 11.6 | 6.1 | 4.7 | 1.1 | 1.1 | 1.1 | 5.3 | 6.3 | 6.6 | 7.9 |
| **Ontario** | 20.8 | 21.0 | 19.1 | 10.0 | 7.7 | 1.7 | 1.7 | 1.7 | 8.7 | 10.3 | 10.7 | 12.9 |
| **Upland** | 8.6 | 8.7 | 7.9 | 4.1 | 3.2 | 0.7 | 0.7 | 0.7 | 3.6 | 4.2 | 4.4 | 5.3 |
| **Total** | **48.3** | **48.6** | **44.1** | **23.1** | **17.9** | **4.0** | **4.0** | **4.0** | **20.2** | **23.9** | **24.9** | **29.8** |

[(1)] Per Joint water supply agreement between Monte Vista WD and City of Chino Hills

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Distribution Based on **One Month No Flow Pattern**:

**Table 11. Estimated Projected Available Deliveries (AF) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chino | 459 | 555 | 378 | 295 | 202 | 183 | 214 | 0.0 | 234 | 284 | 299 | 358 | **3462** |
| MVWD/Chino Hills[(1)] | 965 | 1,162 | 792 | 619 | 423 | 383 | 448 | 0.0 | 491 | 594 | 628 | 751 | **7,255** |
| Ontario | 1,578 | 1,902 | 1,295 | 1,013 | 692 | 627 | 734 | 0.0 | 804 | 972 | 1,027 | 1,229 | **11,871** |
| Upland | 651 | 783 | 534 | 417 | 285 | 258 | 302 | 0.0 | 331 | 401 | 423 | 506 | **4,891** |
| **Total** | **3,653** | **4,402** | **2,998** | **2,344** | **1,602** | **1,451** | **1,698** | **0.0** | **1,860** | **2,251** | **2,377** | **2,844** | **27,479** |

**Table 12. Estimated Projected Available Deliveries (MGD) July 2015 - June 2016**

| | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chino | 4.8 | 5.8 | 4.1 | 3.1 | 2.2 | 1.9 | 2.2 | 0.0 | 2.5 | 3.1 | 3.1 | 3.9 |
| MVWD/Chino Hills[(1)] | 10.1 | 12.2 | 8.6 | 6.5 | 4.6 | 4.0 | 4.7 | 0.0 | 5.2 | 6.5 | 6.6 | 8.2 |
| Ontario | 16.6 | 20.0 | 14.1 | 10.6 | 7.5 | 6.6 | 7.7 | 0.0 | 8.4 | 10.6 | 10.8 | 13.3 |
| Upland | 6.8 | 8.2 | 5.8 | 4.4 | 3.1 | 2.7 | 3.2 | 0.0 | 3.5 | 4.4 | 4.4 | 5.5 |
| **Total** | **38.4** | **46.3** | **32.6** | **24.6** | **17.4** | **15.3** | **17.9** | **0.0** | **19.6** | **24.4** | **25.0** | **30.9** |

[(1)] Per Joint water supply agreement between Monte Vista WD and City of Chino Hills

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# 5.0 APPENDIX (Available upon Request)

## 5.1 METROPOLITAN WATER DISTRICT BOARD LETTER ON WATER SUPPLY ALLOCATION PLAN IMPLEMENTATION, APRIL 2015

## 5.2 METROPOLITAN WATER DISTRICT BOARD LETTER ON WATER SUPPLY ALLOCATION PLAN AMENDMENT, DECEMBER 2014

## 5.3 HISTORICAL TEN YEAR ROLLING AVERAGE (FY 2004-14 PLUS ONE YEAR LAG BASIS)

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# APPENDIX 5.1

# METROPOLITAN WATER DISTRICT BOARD LETTER ON WATER SUPPLY ALLOCATION PLAN IMPLEMENTATION, APRIL 2015

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THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

BOARD ACTION

- Board of Directors
  *Water Planning and Stewardship*

4/14/2015 Board Meeting

**8-3**

## Subject

Express support for Governor's Executive Order B-29-15; declare Water Supply Condition for 2015; approve implementation of Water Supply Allocation Plan; adopt supporting resolution; and conduct public hearing

## Executive Summary

Based on the continuing drought conditions in California, Governor Brown's Executive Order calling for 25 percent reductions in water use, and a poor outlook for the final State Water Project Table A allocation, staff recommends the following actions:

1. Express support for the Governor's call for a 25 percent reduction in consumer water use and Executive Order B-29-15.
2. Declare a Condition 3 – Water Supply Allocation.
3. Implement Metropolitan's Water Supply Allocation Plan (WSAP) at a Level 3 Regional Shortage Level, effective July 1, 2015 through June 30, 2016.
4. Adopt the WSAP Level 3 allocation as a water conservation program pursuant to Water Code Section 375 et seq.
5. Adopt a resolution implementing the actions listed above.

## Details

### Background

On April 1, 2015, Governor Brown issued an Executive Order (Order) calling for a 25 percent reduction in consumer water use in response to the historically dry conditions throughout the state of California (**Attachment 1**). The Governor's Order also includes mandatory actions aimed at reducing water demands, with a particular focus on outdoor water use. In addition to the broad call for mandatory use reductions, the Order announces initiatives to:

- Remove and replace turf with drought tolerant landscape options
- Support rebate programs for water efficient devices
- Restrict water use on commercial, industrial, and institutional properties in order to achieve 25 percent reductions in potable water use
- Prohibit irrigation of ornamental turf on street medians with potable water supplies
- Prohibit irrigation of new construction with potable water unless drip or microspray systems are used
- Direct water suppliers to develop rate structures and pricing mechanisms to maximize water conservation consistent with statewide water restrictions

Metropolitan supports these efforts to respond to the historic drought conditions while taking actions that can have lasting benefits for the State of California in future years. Southern California has a proven track-record of aggressively implementing water conservation. Potable per capita water use in the region has declined by about 24 percent since 1990. These water use reductions have allowed the region to add an additional 5 million people while actually reducing reliance on imported supplies. Over the last 25 years, Metropolitan has invested more than $750 million in water use efficiency matched by significant local and consumer funding. The Governor's Executive Order recognizes the significant effort made by certain regions and directs the State Water Resources Control Board (SWRCB) to take that into account in setting specific reduction goals. Clearly Southern California's actions merit consideration by the SWRCB and staff will work with the SWRCB to ensure final actions are appropriate.

**Hydrologic Conditions**

2014 was an historically dry year in the State of California. According to the U.S. Drought Monitor, an estimated 58 percent of California was in "Exceptional Drought Conditions," the worst category possible, with over 80 percent of California in "Extreme Drought Conditions."

Immediately following the Governor's Emergency Drought Declaration in January 2014, Metropolitan took a series of actions to address drought conditions. In February 2014, Metropolitan declared a "Condition 2 – Water Supply Alert" to provide public messaging and to urge local water agencies within the Metropolitan service area to adopt and enact water saving ordinances. Metropolitan followed with the creation of the Water Management Fund (Fund) which set aside $232 million for financing drought-related projects and actions. Recognizing the importance of indoor and outdoor conservation in managing the ongoing drought and in establishing water efficiency for a sustainable future, the Board approved the addition of $40 million from the Water Management Fund to the conservation budget, increasing Metropolitan's total conservation budget to $100 million. Metropolitan also authorized additional expenditures from the Fund to improve storage withdrawal capabilities and acquire additional dry-year supplies through transfers and exchanges. In addition, Metropolitan conducted an enhanced public outreach program including an extensive radio and television advertising campaign that has greatly increased the public awareness of the water supply situation and has encouraged significant conservation savings.

The record dry and hot conditions of 2014 significantly impacted the water resources of both the State of California and Metropolitan. The California Department of Water Resources (DWR) limited supplies from the State Water Project (SWP) to only 5 percent of the contractors' SWP Table A amounts in 2014. This allocation was the lowest ever in the history of the SWP. Metropolitan was able to meet demands in 2014 by relying heavily on storage reserves to make up for the historically low allocation on the SWP. Metropolitan's dry-year storage reserves ended 2014 at approximately 1.2 million acre-feet (MAF).

Hydrologic conditions in 2015 have continued this severe dry trend. 2015 is the fourth consecutive drought year and the seventh dry year out of the last eight in California. The water year started with improved conditions, but the latter half of the winter has produced little additional snowpack. In fact, for the year to date, statewide snowpack is currently at its lowest level in recorded history. DWR announced an initial 2015 SWP allocation of 10 percent in December. Since then, the 2015 SWP allocation has only increased to 20 percent. DWR's recent SWP analysis indicates that an additional increase in the 2015 SWP allocation is possible, but the final allocation is unlikely to be more than 25 percent. Additionally, any increase in the 2015 SWP allocation is likely to occur later in the year, after DWR is able to assess the results of spring and summer SWP operations. Under these conditions, further withdrawals from Metropolitan's dry-year storage reserves will be necessary in order to meet demands. Although water demands in Southern California have reduced somewhat through ongoing conservation efforts and outreach, implementation of the WSAP to support the Governor's call for additional demand reductions and reduce withdrawals from Metropolitan's dry-year storage reserves is now necessary.

**Potential Shortage Allocation Scenarios**

By implementing the WSAP, Metropolitan places limits on the amount of water member agencies can purchase without facing a surcharge. Surcharges are from $1,480 per acre-foot up to $2,960 per acre-foot for water use in excess of a given member agency's allocation limit. Any revenues collected from these surcharges would be used to fund the implementation of Metropolitan's turf removal program or other similar programs designed to conserve water and reduce future demands. Once implemented, the WSAP would be in place from July 1, 2015 through June 30, 2016. Metropolitan estimates that the baseline deliveries plus losses under the WSAP would be approximately 2.2 MAF. However, current deliveries in Metropolitan's system are trending to be 2.1 MAF with losses. These lower deliveries reflect the positive response consumers have already shown to help manage with the drought conditions. Deliveries are expected to drop approximately 100 thousand acre-feet (TAF) with each level of allocation that is declared, unless member agencies exceed their allocations. While the numbers will vary among agencies based on their local supply conditions, each level of allocation is roughly a 5 percent reduction in wholesale water use on a regional level.

Staff considered the following objectives in developing the recommendation to implement the WSAP:

Set WSAP Level in 2015/16 while:

a. Supporting the Governor's April 1, 2015 Executive Order
b. Avoiding use of Emergency storage
c. Managing storage for the following years
d. Allowing for supply uncertainties
e. Avoiding steep increases in WSAP levels in future years, if dry conditions persist

The following table shows the balances of water supply and demand and the estimated impacts on regional storage through June 30, 2016, under two possible scenarios. A more detailed description of the supplies available to Metropolitan in calendar year 2015 is available in the April 2015 Water Surplus and Drought Management Report. Staff projects that approximately 128 TAF will be withdrawn from dry-year storage reserves in the first six months of 2015, leaving 1.057 MAF in dry-year storage reserves as of July 1. In Scenario A, a SWP Table A allocation of 25 percent is assumed. In Scenario B, a SWP Table A allocation of 20 percent is assumed. Both scenarios assume approximately 165 TAF of transfer/exchange supplies. Under Scenario A, staff estimates that a maximum of 459 TAF of dry-year storage could be withdrawn during the allocation period given projected capacity constraints. Under Scenario B, approximately 442 TAF of dry-year storage can be accessed due to the lower SWP allocation, which reduces the amount of storage that can be accessed via exchange.

| **SUPPLY DEMAND BALANCE** | **SCENARIO A** (25% SWP Allocation) | **SCENARIO B** (20% SWP Allocation) |
|---|---|---|
| SWP Supply | 478,000 | 382,000 |
| CRA Supply | 925,000 | 925,000 |
| Transfers/Exchanges | 165,000 | 165,000 |
| Total Supply | 1,568,000 | 1,472,000 |
| **WSAP Level 2 Option:** | | |
| Deliveries* (July 1, 2015 – June 30, 2016) | 1,900,000 | 1,900,000 |
| Dry-Year Storage (Take) | (332,000) | (428,000) |
| Dry-Year Storage Remaining For 2016/17 | 725,000 | 629,000 |

**WSAP level 3 Option:**

| | | |
|---|---|---|
| Deliveries* (July 1, 2015 – June 30, 2016) | 1,800,000 | 1,800,000 |
| Dry-Year Storage (Take) | (232,000) | (328,000) |
| Dry-Year Storage Remaining for 2016/17 | 825,000 | 729,000 |

**WSAP level 4 Option:**

| | | |
|---|---|---|
| Deliveries* (July 1, 2015 – June 30, 2016) | 1,700,000 | 1,700,000 |
| Dry-Year Storage (Take) | (132,000) | (228,000) |
| Dry-Year Storage Remaining for 2016/17 | 925,000 | 829,000 |

*Includes aggregate deliveries to member agencies available without an Allocation Surcharge, including losses.

**Assuming a WSAP Level 2** is implemented with supplies shown in Scenarios A or B above, it is possible that a sizable amount of Metropolitan's dry-year storage reserves could be required to meet demands; however, no use of emergency storage would be required. Staff also analyzed the potential WSAP levels that might be necessary to avoid any draws on emergency storage in 2016/17 should Scenario A or Scenario B be repeated. Under these conditions, if a WSAP Level 2 is implemented in 2015/16, then a Level 2 might be necessary in 2016/17 under Scenario A and an allocation as deep as a Level 5 might be necessary under Scenario B.

**Assuming a WSAP Level 3** is implemented with supplies shown in Scenarios A or B above, a lesser amount of Metropolitan's dry-year storage reserves would be required to meet demands. Should Scenario A occur again in 2016/17, then a WSAP Level 3 could be implemented again without any draw on emergency storage. Under a repeat of Scenario B, the WSAP Level would need to drop from Level 3 in 2015/16 to Level 4 in 2016/17 in order to eliminate any draw on emergency storage.

**Implementing a WSAP Level 4** under the same scenarios would reduce the need for withdrawals from storage and allow Metropolitan to maintain or even reduce the allocation level in the subsequent year, should the same conditions repeat. Of the three options, WSAP Level 4 is the most protective of regional storage.

**Supply Uncertainties**

Scenario A and B both make assumptions about the supplies that will be available to Metropolitan. If dry conditions persist, some risks to these assumptions are possible. Base supplies available to Metropolitan on the Colorado River Aqueduct could be reduced if higher priority users have high Colorado River water use this year. It is also possible that the Lower Basin of the Colorado River could be in shortage conditions as early as 2016, which could limit Metropolitan's ability to access Intentionally Created Surplus reserves currently stored in Lake Mead. Under certain conditions, the 2015 SWP allocation may not increase from 20 to 25 percent. It is also possible that some member agencies would actually exceed their allocation limits, which would result in higher deliveries than shown in Scenario A and B. On the other hand, consumer reductions could exceed the requirements of the allocation resulting in lesser draws from dry-year storage. Both scenarios assume the benefits of transfers and exchanges. While it is likely that some transfer supplies may be affected by curtailments to water districts in Northern California, staff is pursuing transfer supplies on both the SWP and Colorado River to achieve approximately165 TAF in total supplies across both systems. Actual supply availability may end up being higher or lower than this assumption.

In general, a deeper WSAP Level provides more protection against supply risks as compared to a lower WSAP Level.

**Recommendation on WSAP Implementation**

Staff recommends that the Board express support for the Governor's call for a 25 percent reduction in consumer water use and declare a water supply "Condition 3 – Water Supply Allocation". Metropolitan would implement surcharges on agencies should their deliveries exceed limits at a WSAP Level 3 Regional Shortage Level. A WSAP Level 3 will implement surcharges on member agencies that don't reduce their deliveries in order to

achieve a roughly 15 percent reduction in regional deliveries. In addition to this action, Metropolitan staff will bring to the Board additional tools that can be used to help retail agencies reduce water use further, in support of the Governor's call for greater reductions. These tools will include:

- A focused expanded outreach and media strategy geared at achieving greater consumer awareness and knowledge on how to reduce water use
- Additional budget approval to continue regional conservation incentives through FY 2015/16
- Partnering with the State on funding of rebate and outreach programs
- Modifications to the turf removal program to maintain and encourage broad participation while focusing on a long-term transition toward drought tolerant landscapes
- Monthly tracking and reporting of member agency water use and enforcement actions to achieve greater reductions in consumer water use
- Working with the State on accelerating funding from Proposition 1 for local projects
- Recommendations on key elements of local water use landscape ordinances, and tiered rate structures that can help achieve long-term changes in water use throughout the region

Based on the analysis provided in the previous section, a WSAP Level 3 meets the objectives outlined in this letter. Staff believes that implementing a WSAP Level 3 along with the additional actions listed above will help Southern California meet the Governor's outlined goals. However, a WSAP Level 4 is certainly more protective of regional water storage levels. While a WSAP Level 2 could be adequate to meet regional demands in combination with draws from storage, it is less supportive of the Governor's call for broad water use reductions.

Staff recommends a WSAP Level 3 based on current supply conditions, the recent DWR assessment of SWP allocations for 2015, and the Governor's Executive Order. Given the unprecedented drought occurring statewide, it is recognized that local and regional supply conditions still remain dynamic over the next several months. As a result, these conditions and response to the WSAP will be closely monitored and reported to the Board. If any significant changes in supply and demand conditions occur, staff will provide options on water use efficiencies and supply management for board consideration, if necessary.

Staff also recommends the Board adopt the WSAP allocation as a water conservation program pursuant to Water Code section 375 et set (**Attachment 2**). In addition to the general authorities provided under the MWD Act, Water Code section 375 specifically authorizes public agencies to adopt and enforce programs and rate structures aimed at encouraging water conservation. Adopting the WSAP allocation as a water conservation program is consistent with actions taken by our member agencies and retail agencies and will assist in public outreach efforts to communicate the severity of the current drought and the need for conservation in managing through the drought.

A resolution (**Attachment 3**) describing the water supply conditions in California and Metropolitan's service area and implementing the actions recommended above is attached.

**Key Implementation Items and Timelines**

Staff has been coordinating directly with member agencies to reconcile local supply and consumptive use estimates. Initial Member Agency WSAP allocations of supply will be provided to the member agencies for their use in implementing their local actions. Final member agency allocation limits are dependent on certified local supply production during the Allocation Year. There are several key implementation items to note following the Board's action to implement the WSAP.

- WSAP Effective Date – July 1, 2015, through June 30, 2016
- Member Agency Initial Allocations – May 15, 2015
- Water Use Tracking and reporting – May 2015 through June 2016

- Local Supply Certification – July 2016
- Allocation Surcharge assessment and billing – August 2016 through September 2016
- Member Agency Appeals – Process available throughout Allocation Year

Staff will report on a monthly basis the tracking of member agency deliveries during the allocation period and key updates to member agency data that affect the allocation limits.

## Policy

By Minute Item 47393, dated February 12, 2008, the Board adopted the Water Supply Allocation Plan

By Minute Item 48376, dated August 17, 2010, the Board approved adjustments to the Water Supply Allocation Plan

By Minute Item 48803, dated September 12, 2011, the Board approved adjustments to the Water Supply Allocation Plan

By Minute Item 74526, dated February 11, 2014, the Board adopted the Water Supply Alert Resolution

By Minute Item 49979, dated December 9, 2014, the Board approved adjustments to the Water Supply Allocation Plan

## California Environmental Quality Act (CEQA)

CEQA determination for Options #1 and #2:

Adoption of the WSAP previously was determined to be categorically and statutorily exempt under the provisions of CEQA and State CEQA Guidelines. Specifically, the WSAP was found to be exempt under Sections 15301 (Class 1), 15307 (Class 7), 15308 (Class 8) and 15378(b)(4) of the State CEQA Guidelines. In addition, the WSAP was found to be exempt pursuant to Water Code Section 10652, to the extent this plan serves as the basis for the urban water shortage contingency analysis required under Water Code Section 10632 and is incorporated into Metropolitan's RUWMP.

Similarly, the proposed actions are exempt from or otherwise not covered by CEQA. Specifically, implementation of the WSAP is statutorily exempt from CEQA under Water Code section 10652, which expressly exempts actions listed in and taken pursuant to a RUWMP's urban water shortage contingency analysis. Likewise, implementation of a WSAP allocation and its adoption as a water conservation program under Water Code section 375 are intended to promote conservation of scarce water supplies during a period of extreme drought. As such, these actions are categorically exempt from CEQA under Sections 15307 (Class 7) and 15308 (Class 8) of the State CEQA Guidelines. In addition, implementation of a WSAP allocation merely involves the potential application of a surcharge to those member agencies whose deliveries of water from Metropolitan exceed their allocations, but it does not otherwise prohibit or restrict such deliveries. As such, the proposed action is not defined as project under Section 15378(b)(4) of the State CEQA Guidelines, because it involves government fiscal activities that do not involve a commitment to any specific project that may result in a potentially significant impact. Finally, where it can be seen with certainty that there is no possibility that the proposed actions may have a significant impact on the environment, those actions are not subject to CEQA pursuant to Section 15061(b)(3) of the State CEQA Guidelines.

The CEQA determination is: Determine that the proposed actions are statutorily and categorically exempt, are not defined as a project and are not subject to CEQA, pursuant to Water Code section 10652 and Sections 15307, 15308, 15378(b)(4) and 15061(b)(3) of the State CEQA Guidelines.

CEQA determination for Option #3:

None required

## Board Options

**Option #1**

Adopt the CEQA determination that the proposed actions are statutorily and categorically exempt, are not defined as a project, and are not subject to CEQA, and

a. Express support for the Governor's call for a 25 percent reduction in consumer water use and Executive Order B-29-15;
b. Declare a "Water Supply Condition 3 – Water Supply Allocation";
c. Implement the Water Supply Allocation Plan at a Level 3 Regional Shortage Level, effective July 1, 2015, through June 30, 2016;
d. Adopt the WSAP Level 3 allocation as a water conservation program pursuant to Water Code Section 375 et seq.; and
e. Adopt the resolution shown in **Attachment 3** implementing the actions listed above.

**Fiscal Impact:** None directly related to the declaration of a water supply condition or to the implementation of the WSAP. Future water sales may be impacted due to any regional reductions in water use as a result of the implementation of the WSAP.

**Business Analysis:** Implementing a WSAP Level 3 would result in the delivery of supplies at a level that likely avoids the use of emergency storage, allows for some supply uncertainties during the allocation year, and helps avoid steep increases in the WSAP Level in future years, should dry conditions persist.

**Option #2**

Adopt the CEQA determination that the proposed actions are statutorily and categorically exempt, are not defined as a project, and are not subject to CEQA, and

a. Express support for the Governor's call for a 25 percent reduction in consumer water use and Executive Order B-29-15;
b. Declare a "Water supply Condition 3 – Water Supply Allocation";
c. Implement the Water Supply Allocation Plan at a Regional Shortage Level to be determined by the Board, effective July 1, 2015 through June 30, 2016;
d. Adopt the WSAP Level as a water conservation program pursuant to Water Code Section 375 et seq.; and
e. Adopt the resolution shown in **Attachment 3,** revised to implement the actions listed above.

**Fiscal Impact:** None directly related to the declaration of a water supply condition or to the implementation of the WSAP. Future water sales may be impacted due to any regional reductions in water use as a result of the implementation of the WSAP.

**Business Analysis:** Implementing a WSAP Level will help Metropolitan manage regional storage levels given current drought conditions. It may be more difficult for member and local water agencies to reduce water use in order to avoid surcharges under deeper WSAP Levels. However, a deeper WSAP Level in 2015/16 could be more protective of regional storage levels and could reduce the need for potential deeper allocations in a future year, if drought conditions persist. A lower WSAP level could be less supportive of the Governor's call for broad water use reductions.

**Option #3**

Direct staff to return to the Board at a later date to revisit WSAP implementation.

**Fiscal Impact:** None

**Business Analysis:** Delaying the decision to implement the WSAP would allow for more certain information on water supply conditions to be entered into the decision on the appropriate level for the WSAP. However, a later decision date would also delay communication and coordination needed to make an implementation of the WSAP effective region-wide and potentially impact storage resources.

## Staff Recommendation

Option #1

4/7/2015
*Deven N. Upadhyay* *Date*
*Manager, Water Resources Management*

4/7/2015
*Jeffrey Kightlinger* *Date*
*General Manager*

**Attachment 1 – Governor Brown's Executive Order B-29-15**

**Attachment 2 – California Water Code Section 375**

**Attachment 3 – Resolution of the Board of Directors of the Metropolitan Water District of Southern California supporting the Governor's Executive Order B-29-15, implementing its Water Supply Allocation Plan for 2015, establishing the Regional Shortage Level, and implementing a water conservation plan pursuant to California Water Code Section 375**

Ref# wrm12636036

Executive Department
State of California

## EXECUTIVE ORDER B-29-15

**WHEREAS** on January 17, 2014, I proclaimed a State of Emergency to exist throughout the State of California due to severe drought conditions; and

**WHEREAS** on April 25, 2014, I proclaimed a Continued State of Emergency to exist throughout the State of California due to the ongoing drought; and

**WHEREAS** California's water supplies continue to be severely depleted despite a limited amount of rain and snowfall this winter, with record low snowpack in the Sierra Nevada mountains, decreased water levels in most of California's reservoirs, reduced flows in the state's rivers and shrinking supplies in underground water basins; and

**WHEREAS** the severe drought conditions continue to present urgent challenges including: drinking water shortages in communities across the state, diminished water for agricultural production, degraded habitat for many fish and wildlife species, increased wildfire risk, and the threat of saltwater contamination to fresh water supplies in the Sacramento-San Joaquin Bay Delta; and

**WHEREAS** a distinct possibility exists that the current drought will stretch into a fifth straight year in 2016 and beyond; and

**WHEREAS** new expedited actions are needed to reduce the harmful impacts from water shortages and other impacts of the drought; and

**WHEREAS** the magnitude of the severe drought conditions continues to present threats beyond the control of the services, personnel, equipment, and facilities of any single local government and require the combined forces of a mutual aid region or regions to combat; and

**WHEREAS** under the provisions of section 8558(b) of the Government Code, I find that conditions of extreme peril to the safety of persons and property continue to exist in California due to water shortage and drought conditions with which local authority is unable to cope; and

**WHEREAS** under the provisions of section 8571 of the California Government Code, I find that strict compliance with various statutes and regulations specified in this order would prevent, hinder, or delay the mitigation of the effects of the drought.

**NOW, THEREFORE, I, EDMUND G. BROWN JR.,** Governor of the State of California, in accordance with the authority vested in me by the Constitution and statutes of the State of California, in particular Government Code sections 8567 and 8571 of the California Government Code, do hereby issue this Executive Order, effective immediately.

**IT IS HEREBY ORDERED THAT:**

1. The orders and provisions contained in my January 17, 2014 Proclamation, my April 25, 2014 Proclamation, and Executive Orders B-26-14 and B-28-14 remain in full force and effect except as modified herein.

**SAVE WATER**

2. The State Water Resources Control Board (Water Board) shall impose restrictions to achieve a statewide 25% reduction in potable urban water usage through February 28, 2016. These restrictions will require water suppliers to California's cities and towns to reduce usage as compared to the amount used in 2013. These restrictions should consider the relative per capita water usage of each water suppliers' service area, and require that those areas with high per capita use achieve proportionally greater reductions than those with low use. The California Public Utilities Commission is requested to take similar action with respect to investor-owned utilities providing water services.

3. The Department of Water Resources (the Department) shall lead a statewide initiative, in partnership with local agencies, to collectively replace 50 million square feet of lawns and ornamental turf with drought tolerant landscapes. The Department shall provide funding to allow for lawn replacement programs in underserved communities, which will complement local programs already underway across the state.

4. The California Energy Commission, jointly with the Department and the Water Board, shall implement a time-limited statewide appliance rebate program to provide monetary incentives for the replacement of inefficient household devices.

5. The Water Board shall impose restrictions to require that commercial, industrial, and institutional properties, such as campuses, golf courses, and cemeteries, immediately implement water efficiency measures to reduce potable water usage in an amount consistent with the reduction targets mandated by Directive 2 of this Executive Order.

6. The Water Board shall prohibit irrigation with potable water of ornamental turf on public street medians.

7. The Water Board shall prohibit irrigation with potable water outside of newly constructed homes and buildings that is not delivered by drip or microspray systems.

8. The Water Board shall direct urban water suppliers to develop rate structures and other pricing mechanisms, including but not limited to surcharges, fees, and penalties, to maximize water conservation consistent with statewide water restrictions. The Water Board is directed to adopt emergency regulations, as it deems necessary, pursuant to Water Code section 1058.5 to implement this directive. The Water Board is further directed to work with state agencies and water suppliers to identify mechanisms that would encourage and facilitate the adoption of rate structures and other pricing mechanisms that promote water conservation. The California Public Utilities Commission is requested to take similar action with respect to investor-owned utilities providing water services.

**INCREASE ENFORCEMENT AGAINST WATER WASTE**

9. The Water Board shall require urban water suppliers to provide monthly information on water usage, conservation, and enforcement on a permanent basis.

10. The Water Board shall require frequent reporting of water diversion and use by water right holders, conduct inspections to determine whether illegal diversions or wasteful and unreasonable use of water are occurring, and bring enforcement actions against illegal diverters and those engaging in the wasteful and unreasonable use of water. Pursuant to Government Code sections 8570 and 8627, the Water Board is granted authority to inspect property or diversion facilities to ascertain compliance with water rights laws and regulations where there is cause to believe such laws and regulations have been violated. When access is not granted by a property owner, the Water Board may obtain an inspection warrant pursuant to the procedures set forth in Title 13 (commencing with section 1822.50) of Part 3 of the Code of Civil Procedure for the purposes of conducting an inspection pursuant to this directive.

11. The Department shall update the State Model Water Efficient Landscape Ordinance through expedited regulation. This updated Ordinance shall increase water efficiency standards for new and existing landscapes through more efficient irrigation systems, greywater usage, onsite storm water capture, and by limiting the portion of landscapes that can be covered in turf. It will also require reporting on the implementation and enforcement of local ordinances, with required reports due by December 31, 2015. The Department shall provide information on local compliance to the Water Board, which shall consider adopting regulations or taking appropriate enforcement actions to promote compliance. The Department shall provide technical assistance and give priority in grant funding to public agencies for actions necessary to comply with local ordinances.

12. Agricultural water suppliers that supply water to more than 25,000 acres shall include in their required 2015 Agricultural Water Management Plans a detailed drought management plan that describes the actions and measures the supplier will take to manage water demand during drought. The Department shall require those plans to include quantification of water supplies and demands for 2013, 2014, and 2015 to the extent data is available. The Department will provide technical assistance to water suppliers in preparing the plans.

13. Agricultural water suppliers that supply water to 10,000 to 25,000 acres of irrigated lands shall develop Agricultural Water Management Plans and submit the plans to the Department by July 1, 2016. These plans shall include a detailed drought management plan and quantification of water supplies and demands in 2013, 2014, and 2015, to the extent that data is available. The Department shall give priority in grant funding to agricultural water suppliers that supply water to 10,000 to 25,000 acres of land for development and implementation of Agricultural Water Management Plans.

14. The Department shall report to Water Board on the status of the Agricultural Water Management Plan submittals within one month of receipt of those reports.

15. Local water agencies in high and medium priority groundwater basins shall immediately implement all requirements of the California Statewide Groundwater Elevation Monitoring Program pursuant to Water Code section 10933. The Department shall refer noncompliant local water agencies within high and medium priority groundwater basins to the Water Board by December 31, 2015, which shall consider adopting regulations or taking appropriate enforcement to promote compliance.

16. The California Energy Commission shall adopt emergency regulations establishing standards that improve the efficiency of water appliances, including toilets, urinals, and faucets available for sale and installation in new and existing buildings.

**INVEST IN NEW TECHNOLOGIES**

17. The California Energy Commission, jointly with the Department and the Water Board, shall implement a Water Energy Technology (WET) program to deploy innovative water management technologies for businesses, residents, industries, and agriculture. This program will achieve water and energy savings and greenhouse gas reductions by accelerating use of cutting-edge technologies such as renewable energy-powered desalination, integrated on-site reuse systems, water-use monitoring software, irrigation system timing and precision technology, and on-farm precision technology.

**STREAMLINE GOVERNMENT RESPONSE**

18. The Office of Emergency Services and the Department of Housing and Community Development shall work jointly with counties to provide temporary assistance for persons moving from housing units due to a lack of potable water who are served by a private well or water utility with less than 15 connections, and where all reasonable attempts to find a potable water source have been exhausted.

19. State permitting agencies shall prioritize review and approval of water infrastructure projects and programs that increase local water supplies, including water recycling facilities, reservoir improvement projects, surface water treatment plants, desalination plants, stormwater capture, and greywater systems. Agencies shall report to the Governor's Office on applications that have been pending for longer than 90 days.

20. The Department shall take actions required to plan and, if necessary, implement Emergency Drought Salinity Barriers in coordination and consultation with the Water Board and the Department of Fish and Wildlife at locations within the Sacramento - San Joaquin delta estuary. These barriers will be designed to conserve water for use later in the year to meet state and federal Endangered Species Act requirements, preserve to the extent possible water quality in the Delta, and retain water supply for essential human health and safety uses in 2015 and in the future.

21. The Water Board and the Department of Fish and Wildlife shall immediately consider any necessary regulatory approvals for the purpose of installation of the Emergency Drought Salinity Barriers.

22. The Department shall immediately consider voluntary crop idling water transfer and water exchange proposals of one year or less in duration that are initiated by local public agencies and approved in 2015 by the Department subject to the criteria set forth in Water Code section 1810.

23. The Water Board will prioritize new and amended safe drinking water permits that enhance water supply and reliability for community water systems facing water shortages or that expand service connections to include existing residences facing water shortages. As the Department of Public Health's drinking water program was transferred to the Water Board, any reference to the Department of Public Health in any prior Proclamation or Executive Order listed in Paragraph 1 is deemed to refer to the Water Board.

24. The California Department of Forestry and Fire Protection shall launch a public information campaign to educate the public on actions they can take to help to prevent wildfires including the proper treatment of dead and dying trees. Pursuant to Government Code section 8645, $1.2 million from the State Responsibility Area Fire Prevention Fund (Fund 3063) shall be allocated to the California Department of Forestry and Fire Protection to carry out this directive.

25. The Energy Commission shall expedite the processing of all applications or petitions for amendments to power plant certifications issued by the Energy Commission for the purpose of securing alternate water supply necessary for continued power plant operation. Title 20, section 1769 of the California Code of Regulations is hereby waived for any such petition, and the Energy Commission is authorized to create and implement an alternative process to consider such petitions. This process may delegate amendment approval authority, as appropriate, to the Energy Commission Executive Director. The Energy Commission shall give timely notice to all relevant local, regional, and state agencies of any petition subject to this directive, and shall post on its website any such petition.

26. For purposes of carrying out directives 2–9, 11, 16–17, 20–23, and 25, Division 13 (commencing with section 21000) of the Public Resources Code and regulations adopted pursuant to that Division are hereby suspended. This suspension applies to any actions taken by state agencies, and for actions taken by local agencies where the state agency with primary responsibility for implementing the directive concurs that local action is required, as well as for any necessary permits or approvals required to complete these actions. This suspension, and those specified in paragraph 9 of the January 17, 2014 Proclamation, paragraph 19 of the April 25, 2014 proclamation, and paragraph 4 of Executive Order B-26-14, shall remain in effect until May 31, 2016. Drought relief actions taken pursuant to these paragraphs that are started prior to May 31, 2016, but not completed, shall not be subject to Division 13 (commencing with section 21000) of the Public Resources Code for the time required to complete them.

27. For purposes of carrying out directives 20 and 21, section 13247 and Chapter 3 of Part 3 (commencing with section 85225) of the Water Code are suspended.

28. For actions called for in this proclamation in directive 20, the Department shall exercise any authority vested in the Central Valley Flood Protection Board, as codified in Water Code section 8521, et seq., that is necessary to enable these urgent actions to be taken more quickly than otherwise possible. The Director of the Department of Water Resources is specifically authorized, on behalf of the State of California, to request that the Secretary of the Army, on the recommendation of the Chief of Engineers of the Army Corps of Engineers, grant any permission required pursuant to section 14 of the Rivers and Harbors Act of 1899 and codified in section 48 of title 33 of the United States Code.

29. The Department is directed to enter into agreements with landowners for the purposes of planning and installation of the Emergency Drought Barriers in 2015 to the extent necessary to accommodate access to barrier locations, land-side and water-side construction, and materials staging in proximity to barrier locations. Where the Department is unable to reach an agreement with landowners, the Department may exercise the full authority of Government Code section 8572.

30. For purposes of this Executive Order, chapter 3.5 (commencing with section 11340) of part 1 of division 3 of the Government Code and chapter 5 (commencing with section 25400) of division 15 of the Public Resources Code are suspended for the development and adoption of regulations or guidelines needed to carry out the provisions in this Order. Any entity issuing regulations or guidelines pursuant to this directive shall conduct a public meeting on the regulations and guidelines prior to adopting them.

31. In order to ensure that equipment and services necessary for drought response can be procured quickly, the provisions of the Government Code and the Public Contract Code applicable to state contracts, including, but not limited to, advertising and competitive bidding requirements, are hereby suspended for directives 17, 20, and 24. Approval by the Department of Finance is required prior to the execution of any contract entered into pursuant to these directives.

This Executive Order is not intended to, and does not, create any rights or benefits, substantive or procedural, enforceable at law or in equity, against the State of California, its agencies, departments, entities, officers, employees, or any other person.

**I FURTHER DIRECT** that as soon as hereafter possible, this Order be filed in the Office of the Secretary of State and that widespread publicity and notice be given to this Order.

**IN WITNESS WHEREOF** I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this 1st day of April 2015.

EDMUND G. BROWN JR.
Governor of California

**ATTEST:**

ALEX PADILLA
Secretary of State

# WATER CONSERVATION PROGRAMS
# WATER CODE SECTIONS 375-378

**Section 375**

(a) Notwithstanding any other provision of the law, any public entity which supplies water at retail or wholesale for the benefit of persons within the service area or area of jurisdiction of the public entity may, by ordinance or resolution adopted by a majority of the members of the governing body after holding a public hearing upon notice and making appropriate findings of necessity for the adoption of a water conservation program, adopt and enforce a water conservation program to reduce the quantity of water used by those persons for the purpose of conserving the water supplies of the public entity.

(b) With regard to water delivered for other than agricultural uses, the ordinance or resolution may specifically require the installation of water-saving devices which are designed to reduce water consumption. The ordinance or resolution may also encourage water conservation through rate structure design.

(c) For the purposes of this section, "public entity" means a city, whether general law or chartered, county, city and county, special district, agency, authority, any other municipal public corporation or district, or any other political subdivision of the state.

**Section 375.5**

a) A public entity, as defined by Section 375, may undertake water conservation and public education programs in conjunction with school districts, public libraries, or any other public entity.

(b) (1) A public entity may undertake water conservation and public education programs using an information booklet or materials for use in connection with the use or transfer of real estate containing up to four residential units. For the purposes of this subdivision, the public entity may use water conservation materials prepared by the department.

(2) It is the intent of the Legislature that on or before December 31, 2007, a review of the program be conducted to obtain information on both of the following matters:

(A) The extent to which public entities have undertaken water conservation and public education programs referred to in paragraph (1).

(B) The extent to which water conservation may be attributable to the implementation of water conservation and public education programs referred to in paragraph (1).

(c) A public entity may take into account any programs undertaken pursuant to this section in a rate structure design implemented pursuant to Section 375.

(d) The Legislature finds and declares that a program undertaken pursuant to this section is in the public interest, serves a public purpose, and will promote the health, welfare, and safety of the people of the state.

**Section 376**

(a) Any ordinance or resolution adopted pursuant to Section 375 is effective upon adoption. Within 10days after its adoption, the ordinance or resolution shall be published pursuant to Section 6061 of the Government Code in full in a newspaper of general circulation that is printed, published, and circulated

in the public entity. If there is no such newspaper, the ordinance or resolution shall be posted within 10 days after its adoption in three public places within the public entity.

(b) The publication of ordinances or resolutions, as required by subdivision (a), may be satisfied by either of the following actions:

(1) The public entity may publish a summary of a proposed ordinance, resolution, or proposed amendment to an existing ordinance or resolution. The summary shall be prepared by an official designated by the governing body. A summary shall be published and a certified copy of the full text of the proposed ordinance, resolution, or amendment shall be posted in the office of the governing body at least five days prior to the governing body's meeting at which the proposed ordinance, resolution, or amendment is to be adopted. Within 15 days after adoption of the ordinance, resolution, or amendment, the governing body shall publish a summary of the ordinance, resolution, or amendment with the names of those members voting for and against the ordinance, resolution, or amendment and the official shall post in the office of the governing body a certified copy of the full text of the adopted ordinance, resolution, or amendment along with the names of those members voting for and against the ordinance, resolution, or amendment.

(2) If the official designated by the governing body determines that it is not feasible to prepare a fair and adequate summary of the proposed or adopted ordinance, resolution, or amendment, and if the governing body so orders, a display advertisement of at least one-quarter of a page in a newspaper of general circulation in the county shall be published at least five days prior to the governing body meeting at which the proposed ordinance, resolution, or amendment is to be adopted. Within 15 days after adoption of the ordinance, resolution, or amendment, a display advertisement of at least one-quarter of a page shall be published. The advertisement shall indicate the general nature of, and provide information about, the proposed or adopted ordinance, resolution, or amendment, including information sufficient to enable the public to obtain copies of the complete text of the ordinance, resolution, or amendment, and the names of those members voting for and against the ordinance, resolution, or amendment.

**Section 377**

From and after the publication or posting of any ordinance or resolution pursuant to Section 376, violation of a requirement of a water conservation program adopted pursuant to Section 376 is a misdemeanor. Upon conviction thereof such person shall be punished by imprisonment in the county jail for not more than 30 days, or by fine not exceeding one thousand dollars ($1,000), or by both.

**Section 378**

A public entity may enter into agreements with other public entities, businesses, community associations, or private entities to provide water conservation services and measures and materials for implementing water conservation programs adopted pursuant to this chapter.

RESOLUTION _____

**RESOLUTION OF THE BOARD OF DIRECTORS**

**OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA SUPPORTING THE GOVERNOR'S CALL FOR A 25 PERCENT REDUCTION IN CONSUMER WATER USE AND EXECUTIVE ORDER B-29-15,**

**IMPLEMENTING ITS WATER SUPPLY ALLOCATION**

**PLAN, ESTABLISHING THE**

**REGIONAL SHORTAGE LEVEL, AND IMPLEMENTING AN ALLOCATION SURCHARGE**

**PURSUANT TO CALIFORNIA WATER CODE SECTION 375**

**WHEREAS,** on January 17, 2014, the Governor proclaimed a State of Emergency to exist throughout the State of California due to severe drought conditions ; and

**WHEREAS**, on April 25, 2014, the Governor issued a second proclamation declaring a continuing State of Emergency and noting that drought conditions had persisted for the last three years; and

**WHEREAS,** Governor Brown issued Executive Order B-29-15 on April 1, 2015 instituting emergency actions and mandatory water use reductions for the State of California; and

**WHEREAS,** State snowpack levels, as indicated by manual surveys and automatic gauge measurements throughout the Sierra Nevada, have been below normal for four consecutive years; and

**WHEREAS,** the official projections for the State of California show well below normal runoff for the fourth consecutive year, with the runoff from the Sierra snowpack being below the amounts needed to fill California's storage reservoir system or support delivery of supplies requested by Metropolitan and other export contractors; and

**WHEREAS,** State runoff that replenishes the state's reservoir system, as indicated by the Department of Water Resources, have been below normal levels eight of the last nine years; and

**WHEREAS,** rainfall levels locally, as indicated by the measurement at the Los Angeles Civic Center, have been below normal for three consecutive years; and

**WHEREAS,** the dry year storage available to Metropolitan has been reduced by approximately 55 percent since January 2012; and

**WHEREAS,** storage in the state's reservoir system is well below normal levels, with Lake Oroville at 50 percent of capacity; and

**WHEREAS,** runoff in the Colorado River system, as indicated by the Bureau of Reclamation, have been below normal levels 13 of the last 16 years; and

**WHEREAS,** storage in the Colorado River system is well below normal levels, with Lake Mead at 40 percent of capacity; and

**WHEREAS,** Biological Opinions issued to protect Delta smelt, Central Valley salmon, longfin smelt and other species have continued to contribute to reduced water supplies available for delivery from the State Water Project; and

**WHEREAS,** the Department of Water Resources' current allocation of State Water Project water available to Metropolitan and the other state water contractors is only 20 percent of contracted supply as of the date of this resolution; and

**WHEREAS**, in February 2008, Metropolitan's Board of Directors adopted its Water Supply Allocation Plan under which the Board may determine that a regional shortage exists, establish a regional shortage level and implement an Allocation Surcharge for water use in excess of a member agency's annual allocation under the Water Supply Allocation Plan; and

**WHEREAS**, the Water Supply Allocation Plan is intended to be implemented during periods of regional water shortages in order to promote conservation of scarce water supplies; and

**WHEREAS**, pursuant to the Water Supply Allocation Plan, the Board may establish a regional shortage level and assess an allocation surcharge on water use in excess of a member agency's annual allocation under the plan; and

**WHEREAS**, in light of the extreme drought and poor water supply conditions noted above, the Board believes it is necessary and in the best interests of Metropolitan and its member agencies to implement the Water Supply Allocation Plan at a Level 3 Regional Shortage Level and to assess an allocation surcharge on any member agency whose use exceeds its Level 3 allocations; and

**WHEREAS**, California Water Code section 375 authorizes public agencies to adopt programs and rate structures aimed at encouraging water conservation after holding a public hearing and making appropriate findings of necessity; and

**WHEREAS**, adopting the Water Supply Allocation Plan Level 3 allocations and surcharges as a water conservation program is consistent with actions taken by our member agencies and other retail agencies and will assist Metropolitan and its member agencies in public outreach efforts to communicate the severity of the current drought and the need for conservation; and

**WHEREAS**, on April 13, 2015 Metropolitan conducted a public hearing and made appropriate findings of necessity for the adoption of the Water Supply Allocation Plan Level 3 allocations and surcharges as a water conservation program.

**NOW, THEREFORE,** the Board of Directors of Metropolitan does hereby resolve, determine and order as follows:

Section 1. Metropolitan's Board of Directors declare Metropolitan's support for the Governor's Executive Order B-29-15.

Section 2. Metropolitan's Board of Directors declare that the regional water shortage in Metropolitan's service area continues and declare a Water Supply Condition 3 – Water Supply Allocation.

Section 3. The Water Supply Allocation Plan shall be implemented, effective July 1, 2015 through June 30, 2016.

Section 4. The Water Supply Allocation Plan shall be set at Regional Shortage Level 3.

Section 5. The Allocation Surcharge, as part of the Water Supply Allocation Plan, shall be the means enabled by Section 375 of the California Water Code to encourage the regional conservation of water supplies.

Section 6. The General Manager is hereby authorized and directed to take all necessary action to implement the Water Supply Allocation Plan, consistent with its terms.

I HEREBY CERTIFY that the foregoing is a full, true and correct copy of a Resolution adopted by the Board of Directors of The Metropolitan Water District of Southern California, at its meeting held on April 14, 2015.

_____

Secretary of the Board of Directors
of The Metropolitan Water District
of Southern California

# APPENDIX 5.2

# METROPOLITAN WATER DISTRICT BOARD LETTER ON WATER SUPPLY ALLOCATION PLAN AMENDMENT, DECEMBER 2014

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THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

BOARD ACTION

- Board of Directors
  *Water Planning and Stewardship Committee*

12/9/2014 Board Meeting

**8-2**

## Subject

Approve adjustments to Metropolitan's Water Supply Allocation Plan

## Executive Summary

Staff is recommending several adjustments to Metropolitan's Water Supply Allocation Plan to address the current unprecedented drought conditions and water needs within the Metropolitan service area. The recommended adjustments were developed with the input of the member agency managers and staff through a member agency working group process that began in July 2014. The recommended adjustments include: (1) Updating the Base Period from Calendar Years 2004 - 2006 to Fiscal Years Ending 2013 and 2014; (2) updating the Conservation Demand Hardening credit to a method based on member agency per capita water use reductions with considerations for the early enforcement of mandatory conservation ordinances and requirements; (3) including a separate allocation for drought-impacted groundwater basins; and (4) replacing the current penalty rates with an Allocation Surcharge based on marginal water conservation program costs.

## Details

### Background

The state of California and Metropolitan have been managing through severe drought conditions, and 2014 has been called "unprecedented" in terms of drought and water supply[1]. Although Metropolitan has been able to successfully manage its operations during the California drought thus far, 2014 has required significant use of regional storage reserves. It is expected that the end of year total dry year storage reserves will approach levels similar to those in 2009 when mandatory supply allocations were imposed by Metropolitan. While storage levels remain relatively strong, as in 2009, prudent management of remaining storage if severe drought conditions continue into 2015 will likely result in Metropolitan imposing mandatory supply allocations.

In February 2008, the Board approved Metropolitan's Water Supply Allocation Plan (WSAP). The approved WSAP serves as the current policy for allocating water supplies to the member agencies in times of declared water shortages with the goal of reducing the quantity of water used within Metropolitan's service area to conserve supply. The WSAP includes specific formulas for calculating Metropolitan supply allocations to each member agency and also includes implementation elements needed for administering a water supply allocation. The WSAP was developed through an extensive working group process with the management and staff of the member agencies and with the Board. The resulting WSAP allocates supplies based on the needs of agencies throughout the service area and the proposed adjustments in this letter are consistent with that approach. The original development process covered an eight month period starting in July 2007. The WSAP was also formally reviewed on two separate occasions since its adoption. The review processes each resulted in board-adopted adjustments to the plan.

[1] The Governor of California proclaimed a State of Emergency due to drought conditions on January 17, 2014 and, on April 24, 2014 issued an Executive Order proclaiming a continued State of Emergency noting drought conditions have persisted for the last three years and authorizing adoption and implementation of emergency regulations.

The WSAP was implemented in the last drought. The WSAP was implemented at a Regional Shortage Level 2 from July 1, 2009 through June 30, 2010 and again from July 1, 2010 through June 30, 2011. The Board rescinded the allocation in April 2011 due to vastly improved water supply conditions.

**Process**

Following discussion at the June 2014 Water Planning and Stewardship Committee, Metropolitan staff convened a member agency working group to revisit the WSAP plan. The purpose of the working group was to collaborate with the member agencies to identify potential revisions to the WSAP in preparation for mandatory supply allocations in 2015. There have been eight working group meetings and three discussions at the monthly Member Agency Managers' Meeting. **Attachment 1** shows a listing of the meetings that were held as part of the WSAP working group process.

The process focused on three areas of the WSAP: the Base Period, the Allocation Formula, and the Allocation enforcement mechanism. To prepare the working group for discussion in each of the areas, Metropolitan staff conducted an in-depth review of the current WSAP and its supporting policies. The working group then discussed and reviewed potential revisions in each of the areas, developing or eliminating items from discussion. In some cases, items were deferred and are intended to be addressed at a later time. Based on the process and discussion from the working group, staff recommends the following adjustments to the WSAP.

**Recommended Adjustments to the Water Supply Allocation Plan**

Staff recommends that the Board consider four adjustments to the WSAP:

1. Update the WSAP Base Period to Fiscal Years Ending 2013 and 2014. This would include a process to account for agencies that had mandatory water use restrictions in place during the updated Base Period;
2. Update the method for calculating Conservation Demand Hardening Credits;
3. Add a separate allocation for drought-impacted groundwater basins; and
4. Replace the WSAP Penalty Rates with an Allocation Surcharge based on the marginal costs of conservation programs.

If approved, these adjustments would replace related elements of the current WSAP. The recommended adjustments are detailed below.

1. Update the WSAP Base Period to Fiscal Years Ending 2013 and 2014 - The WSAP "Base Period" is used to determine the retail consumptive water demands for each member agency. The "Base Period" retail demand is adjusted for growth in population, conservation savings, and non-potable recycling production occurring from the base period to the Allocation Year. The current method uses the average of retail consumptive water demand in Calendar Years 2004-2006. Keeping the current WSAP Base Period for a 2015 Allocation Year would require 10 years of estimated growth adjustments.

   The proposed update to the WSAP Base period replaces Calendar Years 2004-2006 with Fiscal Years 2013 and 2014. These more recent years provide a more up to-date-estimate of current retail consumptive water demand. For a 2015 Allocation Year, only one year of estimated growth adjustments would be required, thus minimizing any estimation error involved in adjusting retail water use. **Attachment 2** includes the data used to calculate retail consumptive water demands for each member agency and estimated Allocation Year amounts.

   There are member and retail agencies within Metropolitan's service area that were in mandatory water use restrictions and/or rationing during the updated Base Period. For those agencies, using the updated Base Period could reflect lower retail water use due to mandatory restrictions that were already in place. Without adjusting for this, those agencies could be required to enforce even higher levels of restrictions under an allocation than those agencies that have not started mandatory restrictions. Staff recommends a consultation process that would allow member agencies to describe mandatory restrictions that were in place during the updated Base Period. Restrictions vary among agencies, but include restricted water uses, fines, and water budget or penalty based rate structures that are enacted by the governing body of the member agency or retail agency. Following the consultation process, staff would recommend

adjustments for an agency based on evidence of reduced Gallons Per Capita Per Day (GPCD). To qualify for an adjustment, reductions would have to be observed that are beyond those expected from the agency's ongoing conservation efforts and trends. Any adjustments determined to be appropriate would be reported to the Board in conjunction with future staff recommendations for implementing the WSAP.

2. Update the methodology for calculating Conservation Demand Hardening Credits – Conservation Demand Hardening occurs at the retail water use level as consumers implement more conservation savings devices and programs. In short, member agencies whose customers have implemented conservation savings devices and programs have "harder" demands than those that have not. The current WSAP formula includes a method for estimating total conservation savings and providing additional supply allocation to account for demand hardening due to the conservation savings.

   The current WSAP method uses an extensive model calculation that includes installed conservation devices, water savings rates, demographic growth, plumbing codes/ordinances, and estimates of conservation due to price and water rate structures to determine conservation savings. The updated methodology would replace the current calculation-intensive method with one based on observed reductions in GPCD.

   In order to estimate conservation savings, each member agency will establish a historical baseline GPCD calculated in a manner consistent with California Senate Bill SBx7-7. Reductions from the baseline GPCD to the Allocation Year would be the basis used to calculate the equivalent conservation savings in acre-feet. The Conservation Demand hardening credit will be based on an initial 10 percent of the GPCD-based Conservation savings plus an additional 5 percent for each level of Regional Shortage set by the Board during implementation of the WSAP. The credit will also be adjusted for:

   a. The overall percentage reduction in retail water demand
   b. The member agency's dependence on MWD

   This provides a base demand hardening credit equal to 10 percent of conservation savings and increases the credit as deeper shortages occur, which is when conservation demand hardening has a bigger impact on the retail consumer. The credit also increases based on the percentage of an agency's demand that was reduced through conservation. This accounts for increased hardening that occurs as increasing amounts of conservation are implemented. Lastly, the credit is scaled to the member agency's dependence on Metropolitan to ensure that credits are being applied to the proportion of water demand that is being affected by reductions in Metropolitan supply.

3. Add a separate allocation for drought-impacted groundwater basins - The current WSAP does not provide an allocation specifically to assist drought impacted groundwater basins. Groundwater basins help provide vital local supplies that can buffer the region from short-term drought impacts. Longer droughts can result in reductions to the many sources of water that replenish groundwater basins, resulting in lower basin levels and potential impacts to the overlying consumptive demands. Limited imported deliveries under these conditions may help avoid impacts to the basins that may be drawn out of their normal operating range or subject to water quality or regulatory impacts. Staff recommends a limited allocation for drought impacted groundwater basins based on the following framework:

   a. Staff would hold a consultation with a requesting member agency and the appropriate groundwater basin manager to document whether the basin is in one of the following conditions:

      i. Groundwater basin overdraft conditions that will result in water levels being outside normal operating ranges during the WSAP allocation period; or

      ii. Violations of groundwater basin water quality and/or regulatory parameters that would occur without imported deliveries.

   b. Provide an allocation based on the verified need for groundwater replenishment. The allocation would start with a member agency's ten-year average purchases of imported groundwater replenishment supplies (excluding years in which deliveries were curtailed). The amount would

then be reduced by the declared WSAP Regional Shortage Level (5 percent for each Regional Shortage Level).

c. Any allocation provided under this provision for drought impacted groundwater basins is intended to help support and maintain groundwater production for consumptive use. As such, a member agency receiving an allocation under this provision will be expected to maintain groundwater production levels equivalent to the average pumping in the Base Period. Any adjustments to a member agency's M&I allocation due to lower groundwater production would be reduced by deliveries made under this provision.

d. Agencies for which this allocation does not provide sufficient supplies for the needs of the groundwater basin may use the WSAP Appeals Process to request additional supply (subject to Board approval). The appeal should include a Groundwater Management Plan that documents the need for additional supplies according to the following tenets:

i. Maintenance of groundwater production levels;

ii. Maintenance of, or reducing the further decline of, groundwater levels;

iii. Maintenance of key water quality factors/indicators;

iv. Avoidance of permanent impacts to groundwater infrastructure or geologic features; and

v. Consideration of severe and/or inequitable financial impacts.

While final amounts and allocations will be determined following consultation with groundwater basin managers and member agencies, **Attachment 3** shows the ten-year average of historical replenishment purchases for member agencies that have been active in purchasing replenishment water since 2010. **Attachment 3** also shows estimated allocations of Groundwater Replenishment under the different Regional Shortage Levels.

4. Replace the WSAP Penalty Rates with an Allocation Surcharge based on the marginal costs of conservation programs - The current WSAP uses a Penalty Rate to disincentivize member agencies from exceeding their supply allocations. The Penalty Rate is based on a multiple of Metropolitan's fully encumbered Tier 2 Untreated Rate for water. Water use between 100 percent to 115 percent of supply allocations is charged a Penalty Rate of two times the fully encumbered Tier 2 Untreated Rate, and use greater than 115 percent of supply allocations is charged a Penalty Rate of four times the fully encumbered Tier 2 Untreated Rate. The Penalty Rate is charged over and above the water rates for the use of the water.

Staff recommends replacing the WSAP Penalty Rates with an Allocation Surcharge. The proposed Allocation Surcharge is based on the costs that Metropolitan and its member agencies are incurring to implement outdoor water use reductions through turf removal programs. The Allocation Surcharge would provide a price signal based on the marginal conservation costs incurred to reduce water use in dry and shortage years. Any revenues collected from the Allocation Surcharge would be used to fund the implementation of the Turf Removal program or other similar programs designed to conserve water and reduce future demands.

The Allocation Surcharge is based on Metropolitan's current cost of the turf removal program. Metropolitan is currently paying $2 per square foot of turf removed. The estimated water savings is 44 gallons per year for each square foot of turf removed for a period of ten years. Based on this savings rate, the estimated cost of the program is $1,480 per acre-foot.

Water use between 100 percent and 115 percent of WSAP supply allocations would be charged with the Allocation Surcharge of $1,480 per acre-foot. Water use greater than 115 percent of WSAP supply allocations would be charged two times the Allocation Surcharge or $2,960 per acre-foot. Two times the Allocation Surcharge would allow the funding of additional turf removal and conservation programs to

conserve additional water and further reduce demand or, if appropriate, allow for a higher per square foot incentive payment.

**Recommendation**

Following the input from the member agencies during the WSAP working group process, staff recommends that the Board approve the four described adjustments to the WSAP. If approved, staff will incorporate the adjustments into the WSAP and prepare the plan for use in any upcoming implementations of the WSAP. Staff will also make available an updated version of the Water Supply Allocation Plan Handbook that incorporates the approved adjustments.

In the interest of completing WSAP revision discussions for board consideration in December, both Metropolitan and member agency staff recognize that not all outstanding issues can be resolved during this timeframe. Two issues have been identified that remain for future policy development and are not addressed in the current proposed revisions to the WSAP. One issue is to investigate how Metropolitan provides incentives through its varied programs, including the WSAP, to ensure development of locally produced supplies consistent with Metropolitan's Integrated Resource Plan objectives. The second issue is a desire to develop a policy framework for groundwater replenishment deliveries that recognizes the long-term consumptive demand on MWD, and establishes service provisions consistent with both the variable nature of replenishment demands and payment of Metropolitan's full service rate.

## Policy

By Minute Item 47393, dated February 12, 2008, the Board adopted the Water Supply Allocation Plan.

By Minute Item 48376, dated August 17, 2010, the Board adopted proposed adjustments to the Water Supply Allocation Plan, and approved the allocation of seawater barrier supplies for 2010/11.

By Minute Item 48803, dated September 13, 2011, the Board adopted proposed adjustments to the Water Supply Allocation Plan.

## California Environmental Quality Act (CEQA)

CEQA determination for Option #1

The Water Supply Allocation Plan previously was determined to be categorically and statutorily exempt under the provisions of CEQA and State CEQA Guidelines. Specifically, the WSAP was found to be exempt under 15301 (Class 1), 15307 (Class 7), 15308 (Class 8) and 15378(b)(4) of the State CEQA Guidelines. In addition, the WSAP was found to be exempt pursuant to Water Code Section 10652, to the extent this plan serves as the basis for the urban water shortage contingency analysis required under Water Code Section 10631 and is incorporated into Metropolitan's RUWMP. These determinations were made on February 12, 2008, and a Notice of Exemption (NOE) was filed shortly thereafter. With the current board action, there is no substantial change proposed to the project. Hence, the previous environmental documentation prepared in conjunction with the project fully complies with CEQA and the State CEQA Guidelines. In addition, the proposed action is not defined as a project under CEQA because it involves continuing administrative actions, such as general policy and procedure making (Section 15378(b)(2) of the State CEQA Guidelines), and other government fiscal activities which do not involve any commitment to any specific project which may result in a potentially significant physical impact on the environment (Section 15378(b)(4) of the State CEQA Guidelines). Accordingly, no further CEQA documentation is necessary for the Board to act with regard to the proposed action.

The CEQA determination is: Determine that the WSAP has been addressed previously in the original NOE, the proposed action is not defined as a project subject to CEQA, and that no further environmental analysis or documentation is required.

CEQA determination for Option #2:

None required

## Board Options

**Option #1**

Adopt the CEQA determination that the item is categorically and statutorily exempt and approve adjustments to the Water Supply Allocation Plan.

**Fiscal Impact:** None

**Business Analysis:** Recommended adjustments improve the existing WSAP and also address groundwater basin needs during shortage conditions.

**Option #2**

Do not approve adjustments to the Water Supply Allocation Plan and keep the current Water Supply Allocation Plan as Metropolitan's policy and method for allocating water to the member agencies.

**Fiscal Impact:** None

**Business Analysis:** Current Water Supply Allocation Plan has some deficiencies that will be kept in place without the approval of adjustments. Groundwater replenishment needs and deliveries will not be addressed under the current Water Supply Allocation Plan.

## Staff Recommendation

Option #1

11/26/2014
*Deven N. Upadhyay* *Date*
*Manager, Water Resource Management*

11/26/2014
*Jeffrey Kightlinger* *Date*
*General Manager*

**Attachment 1 – 2014 WSAP Review Process Meeting Summary**

**Attachment 2 – 2014 WSAP Member Agency Base Period and Allocation Year Data**

**Attachment 3 – 2014 WSAP Member Agency Maximum Potential Seawater Barrier and Replenishment Allocations**

Ref# wrm12633988

# 2014 WSAP Review Process Meeting Summary

**Meetings with Member Agencies to Discuss and Consider Improvements to the Water Supply Allocation Plan**

| Date | Meeting | Description |
|---|---|---|
| July 14, 2014 | WSAP Workgroup Meeting #1 | First meeting of the 2014 WSAP Review process; review of the existing WSAP policy and formula; review of the process timeline; began discussion of issues related to base period selection |
| July 25, 2014 | WSAP Workgroup Meeting #2 | Discussion of base period selection |
| August 27, 2014 | WSAP Workgroup Meeting #3 | Continuation of prior workshop discussion; comparison of base period alternatives |
| September 10, 2014 | WSAP Workgroup Meeting #4 | Discussion of a base period proposal; discussion of replenishment issues in the WSAP; discussion of 2015 water supply scenarios. |
| September 12, 2014 | Member Agency Managers Meeting | Review of WSAP workgroup process; discussion on issues related to base period, demand hardening, and local resources development |
| September 29, 2014 | WSAP Workgroup Meeting #5 | Review of base period recommendation; discussion of issues regarding agencies in mandatory conservation during a base period; discussion on replenishment in the WSAP |
| October 9, 2014 | WSAP Workgroup Meeting #6 | Continuation of prior workshop discussion; discussion of alternative methods for conservation demand hardening credit; discussion of new and existing local supplies |
| October 17, 2014 | Member Agency Managers Meeting | Review of WSAP workgroup process; discussion of issues related to base period and demand hardening |
| November 3, 2014 | WSAP Workgroup Meeting #7 | Review and discussion of issues and potential methods for base period selection and adjustment, replenishment allocation, and conservation demand hardening credit; review of estimated effects of potential WSAP changes at the regional level |
| November 14, 2014 | WSAP Workgroup Meeting #8 | Review of proposed recommendations for the WSAP based on workgroup discussion |
| November 21, 2014 | Member Agency Managers Meeting | Review of proposed recommendations for the WSAP based on workgroup discussion |

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# 2014 WSAP Member Agency Base Period and Allocation Year Data

| Member Agency | Local Supplies | | MWD Purchases | | Retail Demand | | Allocation Year 2015 | | |
|---|---|---|---|---|---|---|---|---|---|
| | FY2012-13 | FY2013-14 | FY2012-13 | FY2013-14 | FY2012-13 | FY2013-14 | Retail Demand | Local Supply | WSAP Baseline |
| **Anaheim** | 44,980 | 51,402 | 21,105 | 13,635 | 66,084 | 65,037 | 66,006 | 51,402 | 14,604 |
| **Beverly Hills** | 733 | 747 | 11,114 | 11,632 | 11,847 | 12,379 | 12,149 | 747 | 11,402 |
| **Burbank** | 11,754 | 10,976 | 7,628 | 8,817 | 19,382 | 19,793 | 19,885 | 10,976 | 8,908 |
| **Calleguas** | 37,490 | 42,451 | 109,933 | 116,685 | 147,423 | 159,136 | 153,911 | 42,451 | 111,460 |
| **Central Basin** | 185,830 | 183,330 | 37,501 | 33,951 | 223,331 | 217,280 | 215,719 | 183,330 | 32,390 |
| **Compton** | 6,347 | 7,858 | 1,683 | 44 | 8,030 | 7,902 | 8,012 | 7,858 | 154 |
| **Eastern** | 100,071 | 102,370 | 96,913 | 104,627 | 197,855 | 206,997 | 209,275 | 102,370 | 106,905 |
| **Foothill** | 9,519 | 8,845 | 8,112 | 10,018 | 17,631 | 18,863 | 18,304 | 8,845 | 9,459 |
| **Fullerton** | 19,489 | 21,279 | 9,205 | 8,776 | 28,694 | 30,055 | 29,567 | 21,279 | 8,288 |
| **Glendale** | 8,666 | 7,598 | 18,764 | 20,341 | 27,429 | 27,939 | 28,609 | 7,598 | 21,011 |
| **Inland Empire** | 192,972 | 199,330 | 59,051 | 67,038 | 252,023 | 266,367 | 267,791 | 199,330 | 68,461 |
| **Las Virgenes** | 141 | 144 | 22,741 | 22,360 | 22,882 | 22,504 | 22,951 | 144 | 22,807 |
| **Long Beach** | 32,399 | 29,085 | 27,376 | 30,540 | 59,775 | 59,625 | 60,060 | 29,085 | 30,975 |
| **Los Angeles** | 176,567 | 139,643 | 388,907 | 447,113 | 565,474 | 586,756 | 620,179 | 139,643 | 480,536 |
| **MWDOC** | 231,655 | 252,486 | 190,804 | 191,515 | 422,459 | 444,001 | 435,069 | 252,486 | 182,582 |
| **Pasadena** | 14,648 | 10,883 | 18,254 | 23,097 | 32,902 | 33,979 | 33,578 | 10,883 | 22,695 |
| **SDCWA** | 252,484 | 239,961 | 462,849 | 536,712 | 544,437 | 596,416 | 574,215 | 239,961 | 334,254 |
| **San Fernando** | 3,100 | 3,108 | 118 | 61 | 3,218 | 3,170 | 3,209 | 3,108 | 101 |
| **San Marino** | 4,552 | 4,418 | 814 | 1,583 | 5,367 | 6,001 | 5,695 | 4,418 | 1,277 |
| **Santa Ana** | 26,730 | 27,914 | 12,454 | 10,343 | 39,184 | 38,257 | 39,056 | 27,914 | 11,143 |
| **Santa Monica** | 7,231 | 8,551 | 6,331 | 5,900 | 13,562 | 14,452 | 14,005 | 8,551 | 5,454 |
| **Three Valleys** | 53,448 | 52,007 | 58,484 | 67,962 | 111,932 | 119,968 | 117,051 | 52,007 | 65,044 |
| **Torrance** | 4,691 | 4,623 | 16,855 | 17,210 | 21,546 | 21,833 | 21,278 | 4,623 | 16,655 |
| **Upper San Gabriel** | 161,506 | 164,038 | 3,529 | 3,490 | 165,035 | 167,528 | 166,695 | 164,038 | 2,657 |
| **West Basin** | 32,662 | 34,283 | 117,288 | 117,455 | 149,950 | 151,738 | 151,677 | 34,283 | 117,395 |
| **Western** | 186,497 | 183,858 | 68,457 | 75,910 | 260,997 | 259,768 | 261,793 | 183,858 | 77,934 |
| **TOTAL** | **1,806,162** | **1,791,189** | **1,776,268** | **1,946,813** | **3,418,448** | **3,557,746** | **3,555,737** | **1,791,189** | **1,764,548** |

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# 2014 WSAP Member Agency Maximum Potential Seawater Barrier and Replenishment Allocations

| Member Agency | Maximum Seawater Barrier Allocation | Maximum Replenishment Allocation | | | | | | | | | | | Total Maximum Seawater Barrier and Replenishment Allocations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Level 8 | Level 9 | Level 10 | Baseline | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Level 8 | Level 9 | Level 10 |
| **Anaheim** | - | 3,000 | 2,850 | 2,700 | 2,550 | 2,400 | 2,250 | 2,100 | 1,950 | 1,800 | 1,650 | 1,500 | 3,000 | 2,850 | 2,700 | 2,550 | 2,400 | 2,250 | 2,100 | 1,950 | 1,800 | 1,650 | 1,500 |
| **Beverly Hills** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Burbank** | - | 2,800 | 2,660 | 2,520 | 2,380 | 2,240 | 2,100 | 1,960 | 1,820 | 1,680 | 1,540 | 1,400 | 2,800 | 2,660 | 2,520 | 2,380 | 2,240 | 2,100 | 1,960 | 1,820 | 1,680 | 1,540 | 1,400 |
| **Calleguas** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Central Basin** | - | 23,100 | 21,945 | 20,790 | 19,635 | 18,480 | 17,325 | 16,170 | 15,015 | 13,860 | 12,705 | 11,550 | 23,100 | 21,945 | 20,790 | 19,635 | 18,480 | 17,325 | 16,170 | 15,015 | 13,860 | 12,705 | 11,550 |
| **Compton** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Eastern** | - | 7,000 | 6,650 | 6,300 | 5,950 | 5,600 | 5,250 | 4,900 | 4,550 | 4,200 | 3,850 | 3,500 | 7,000 | 6,650 | 6,300 | 5,950 | 5,600 | 5,250 | 4,900 | 4,550 | 4,200 | 3,850 | 3,500 |
| **Foothill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Fullerton** | - | 2,700 | 2,565 | 2,430 | 2,295 | 2,160 | 2,025 | 1,890 | 1,755 | 1,620 | 1,485 | 1,350 | 2,700 | 2,565 | 2,430 | 2,295 | 2,160 | 2,025 | 1,890 | 1,755 | 1,620 | 1,485 | 1,350 |
| **Glendale** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Inland Empire** | - | 17,100 | 16,245 | 15,390 | 14,535 | 13,680 | 12,825 | 11,970 | 11,115 | 10,260 | 9,405 | 8,550 | 17,100 | 16,245 | 15,390 | 14,535 | 13,680 | 12,825 | 11,970 | 11,115 | 10,260 | 9,405 | 8,550 |
| **Las Virgenes** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Long Beach** | 4,000 | 5,100 | 4,845 | 4,590 | 4,335 | 4,080 | 3,825 | 3,570 | 3,315 | 3,060 | 2,805 | 2,550 | 9,100 | 8,845 | 8,590 | 8,335 | 8,080 | 7,825 | 7,570 | 7,315 | 7,060 | 6,805 | 6,550 |
| **Los Angeles** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **MWDOC** | - | 51,100 | 48,545 | 45,990 | 43,435 | 40,880 | 38,325 | 35,770 | 33,215 | 30,660 | 28,105 | 25,550 | 51,100 | 48,545 | 45,990 | 43,435 | 40,880 | 38,325 | 35,770 | 33,215 | 30,660 | 28,105 | 25,550 |
| **Pasadena** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **SDCWA** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **San Fernando** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **San Marino** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Santa Ana** | - | 3,500 | 3,325 | 3,150 | 2,975 | 2,800 | 2,625 | 2,450 | 2,275 | 2,100 | 1,925 | 1,750 | 3,500 | 3,325 | 3,150 | 2,975 | 2,800 | 2,625 | 2,450 | 2,275 | 2,100 | 1,925 | 1,750 |
| **Santa Monica** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Three Valleys** | - | 5,100 | 4,845 | 4,590 | 4,335 | 4,080 | 3,825 | 3,570 | 3,315 | 3,060 | 2,805 | 2,550 | 5,100 | 4,845 | 4,590 | 4,335 | 4,080 | 3,825 | 3,570 | 3,315 | 3,060 | 2,805 | 2,550 |
| **Torrance** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Upper San Gabriel** | - | 29,500 | 28,025 | 26,550 | 25,075 | 23,600 | 22,125 | 20,650 | 19,175 | 17,700 | 16,225 | 14,750 | 29,500 | 28,025 | 26,550 | 25,075 | 23,600 | 22,125 | 20,650 | 19,175 | 17,700 | 16,225 | 14,750 |
| **West Basin** | 11,200 | - | - | - | - | - | - | - | - | - | - | - | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 |
| **Western** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **TOTAL** | **15,200** | **150,000** | **142,500** | **135,000** | **127,500** | **120,000** | **112,500** | **105,000** | **97,500** | **90,000** | **82,500** | **75,000** | **165,200** | **157,700** | **150,200** | **142,700** | **135,200** | **127,700** | **120,200** | **112,700** | **105,200** | **97,700** | **90,200** |

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# APPENDIX 5.3

# HISTORICAL TEN YEAR ROLLING AVERAGE (FY 2004-14 PLUS ONE YEAR LAG BASIS)

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**Tier 1 Annual Limit (AFY)**
**For CY 2015**

| Member Agency | 10 YRA FY 2004-14 | Percent Allocation | Tier 1 Volume |
|---|---|---|---|
| **City of Chino** | 3,575 | 12.6% | 3,946 |
| **City of Chino Hills[(1)]** | 136 | 26.4% | 8,287 |
| **Monte Vista WD[(1)]** | 7,373 | | |
| **City of Ontario** | 12,286 | 43.2% | 13,559 |
| **City of Upland** | 5,066 | 17.8% | 5,592 |
| **WFA Total** | **28,436** | **100.0%** | **31,384** |

[(1)] Chino Hills deliveries combined with MVWD, per agreement

Adopted Ordinance 2010-07-01 July 2010

Tier 1 Annual Limit (Effective CY): Ten-year rolling average of firm deliveries of treated water, excluding in-lieu deliveries for the Dry Year Yield Program, on a fiscal year basis trailing one-year. Beginning July 2010, utilized unsubscribed capacity volumes from that time forward shall be subtracted from the delivery volumes. An individual Member Agency's share of the Tier 1 Annual Limit shall be based on the Authority's 10 YRA. (The "ten-year running average" of metered deliveries utilized in Fund 1 and Fund 2 for allocating capital replacement costs remains unchanged and is not replaced by the "10 YRA" described above).

Indirect Operating Cost (Effective FY): The cost will be allocated to the Member Agencies based on each Agency's percentage of the 10 YRA. At the end of the fiscal year, each Member Agency's charges will be adjusted to reflect their proportionate share of the indirect operating net audited cost for that fiscal year. (In those instances where a negative value is given to the City of Chino Hills for its 10 YRA determination, due to its water supply agreement with Monte Vista Water District and use of in-lieu deliveries for the DYY Program, the values for these Member Agencies will be combined when applying the cost allocation for Indirect Operations.)

Capacity Charge (Effective FY): The Capacity Charge will be allocated to each Member Agency based on each Agency's percentage of average water deliveries in the 10 YRA.

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**WFA DELIVERIES (Acre-Feet), FY 2004 - 2005**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 675.2 | 670.5 | 653.6 | 641.4 | 367.9 | 392.0 | 407.8 | 346.0 | 385.3 | 495.3 | 592.0 | 636.1 | **6,263.1** |
| in-lieu | 0.0 | 0.0 | 0.0 | (257.7) | (224.9) | (212.6) | (156.7) | (120.1) | (198.7) | (112.9) | (321.0) | (287.8) | **(1,892.4)** |
| Adjusted Deliveries | 675.2 | 670.5 | 653.6 | 383.7 | 143.0 | 179.4 | 251.1 | 225.9 | 186.6 | 382.4 | 271.0 | 348.3 | **4,370.7** |
| City of Chino Hills | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 732.5 | 1,146.9 | **1,879.4** |
| in-lieu | 0.0 | 0.0 | 0.0 | 0.0 | (250.0) | (250.0) | (250.0) | (150.0) | (150.0) | (150.0) | (150.0) | (150.0) | **(1,500.0)** |
| Adjusted Deliveries | 0.0 | 0.0 | 0.0 | 0.0 | (250.0) | (250.0) | (250.0) | (150.0) | (150.0) | (150.0) | 582.5 | 996.9 | **379.4** |
| Monte Vista WD | 1,417.0 | 1,472.7 | 1,280.0 | 780.1 | 617.6 | 675.7 | 498.0 | 235.5 | 873.7 | 1,513.9 | 653.8 | 721.5 | **10,739.5** |
| in-lieu | (125.0) | (300.0) | (650.0) | (675.0) | (550.0) | (550.0) | (400.0) | (200.0) | (825.0) | (1,450.0) | (625.0) | (700.0) | **(7,050.0)** |
| Adjusted Deliveries | 1,292.0 | 1,172.7 | 630.0 | 105.1 | 67.6 | 125.7 | 98.0 | 35.5 | 48.7 | 63.9 | 28.8 | 21.5 | **3,689.5** |
| City of Ontario | 1,624.9 | 1,860.1 | 1,763.8 | 1,370.7 | 842.0 | 884.5 | 400.6 | 139.5 | 599.7 | 1,006.8 | 1,471.2 | 1,490.7 | **13,454.4** |
| in-lieu | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (600.0) | 0.0 | 600.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 1,624.9 | 1,860.1 | 1,763.8 | 1,370.7 | 842.0 | 884.5 | 400.6 | 139.5 | (0.3) | 1,006.8 | 2,071.2 | 1,490.7 | **13,454.4** |
| City of Upland | 1,267.5 | 1,287.6 | 1,239.4 | 635.7 | 257.5 | 205.7 | 107.1 | 101.1 | 60.5 | 287.7 | 624.5 | 830.7 | **6,905.1** |
| in-lieu | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (107.1) | (101.1) | (60.5) | (287.7) | (624.5) | (830.7) | **(2,011.6)** |
| Adjusted Deliveries | 1,267.5 | 1,287.6 | 1,239.4 | 635.7 | 257.5 | 205.7 | 0.0 | (0.0) | (0.0) | 0.0 | 0.0 | 0.0 | **4,893.5** |
| **Total Adj. Deliv.** | **4,859.6** | **4,990.9** | **4,286.9** | **2,495.2** | **1,060.0** | **1,145.3** | **499.7** | **250.9** | **85.0** | **1,303.1** | **2,953.4** | **2,857.5** | **26,787.5** |

**WFA DELIVERIES (Acre-Feet), FY 2005 - 2006**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 670.3 | 650.9 | 633.2 | 587.4 | 407.8 | 415.8 | 381.1 | 344.4 | 381.0 | 375.4 | 383.2 | 361.3 | **5,591.9** |
| in-lieu | 0.0 | 0.0 | 0.0 | (294.8) | (224.9) | (212.6) | (156.7) | (93.4) | (198.7) | (238.1) | (80.8) | 0.0 | **(1,500.0)** |
| Adjusted Deliveries | 670.3 | 650.9 | 633.2 | 292.6 | 182.9 | 203.2 | 224.4 | 251.0 | 182.3 | 137.3 | 302.4 | 361.3 | **4,091.9** |
| City of Chino Hills | 158.9 | 192.8 | 63.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **415.5** |
| in-lieu | 0.0 | (600.0) | (550.0) | (700.0) | (600.0) | (350.0) | (150.0) | (150.0) | (150.0) | (150.0) | (150.0) | 0.0 | **(3,550.0)** |
| Adjusted Deliveries | 158.9 | (407.2) | (486.2) | (700.0) | (600.0) | (350.0) | (150.0) | (150.0) | (150.0) | (150.0) | (150.0) | 0.0 | **(3,134.5)** |
| Monte Vista WD | 2,259.9 | 2,206.9 | 1,899.3 | 1,487.2 | 1,273.3 | 1,303.5 | 843.5 | 678.9 | 443.7 | 603.4 | 1,212.5 | 1,853.5 | **16,065.7** |
| in-lieu | (950.0) | (950.0) | (950.0) | (700.0) | (550.0) | (600.0) | (600.0) | (450.0) | (280.0) | (450.0) | (800.0) | (1,220.0) | **(8,500.0)** |
| Adjusted Deliveries | 1,309.9 | 1,256.9 | 949.3 | 787.2 | 723.3 | 703.5 | 243.5 | 228.9 | 163.7 | 153.4 | 412.5 | 633.5 | **7,565.7** |
| City of Ontario | 1,599.0 | 1,608.5 | 1,525.5 | 1,507.1 | 1,138.0 | 910.0 | 658.4 | 503.0 | 583.0 | 681.9 | 928.1 | 697.6 | **12,340.3** |
| in-lieu | (599.0) | (609.0) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **(1,208.0)** |
| Adjusted Deliveries | 1,000.0 | 999.5 | 1,525.5 | 1,507.1 | 1,138.0 | 910.0 | 658.4 | 503.0 | 583.0 | 681.9 | 928.1 | 697.6 | **11,132.3** |
| City of Upland | 1,304.0 | 847.7 | 495.7 | 381.0 | 202.6 | 374.6 | 293.2 | 406.4 | 93.7 | 4.8 | 260.9 | 286.8 | **4,951.6** |
| in-lieu | (1,304.0) | (847.7) | (495.7) | (353.6) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **(3,001.0)** |
| Adjusted Deliveries | 0.0 | 0.0 | 0.0 | 27.4 | 202.6 | 374.6 | 293.2 | 406.4 | 93.7 | 4.8 | 260.9 | 286.8 | **1,950.6** |
| **Total Adj. Deliv.** | **3,139.2** | **2,500.2** | **2,621.8** | **1,914.4** | **1,646.9** | **1,841.3** | **1,269.6** | **1,239.3** | **872.7** | **827.4** | **1,753.9** | **1,979.3** | **21,606.0** |

**WFA DELIVERIES (Acre-Feet), FY 2006 - 2007**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 420.2 | 444.8 | 431.1 | 440.0 | 417.0 | 419.4 | 380.7 | 195.0 | 224.2 | 227.0 | 324.4 | 355.7 | **4,279.5** |
| in-lieu | 0.0 | (447.5) | (434.5) | (448.9) | (423.2) | (423.9) | (380.7) | (199.1) | (223.1) | 0.0 | 0.0 | 0.0 | **(2,980.9)** |
| Adjusted Deliveries | 420.2 | (2.7) | (3.4) | (8.9) | (6.2) | (4.5) | (0.0) | (4.1) | 1.1 | 227.0 | 324.4 | 355.7 | **1,298.6** |
| City of Chino Hills | 85.0 | 40.5 | 45.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.7 | **180.2** |
| in-lieu | (600.0) | 0.0 | (600.0) | (450.0) | (400.0) | (400.0) | (300.0) | (150.0) | 0.0 | 0.0 | 0.0 | 0.0 | **(2,900.0)** |
| Adjusted Deliveries | (515.0) | 40.5 | (554.1) | (450.0) | (400.0) | (400.0) | (300.0) | (150.0) | 0.0 | 0.0 | 0.0 | 8.7 | **(2,719.9)** |
| Monte Vista WD | 2,035.0 | 1,986.5 | 1,782.9 | 1,328.8 | 1,010.7 | 835.0 | 721.3 | 314.4 | 740.4 | 688.2 | 1,121.6 | 1,438.5 | **14,003.3** |
| in-lieu | (1,300.0) | (1,300.0) | (1,200.0) | (550.0) | (500.0) | (400.0) | (400.0) | (300.0) | (650.0) | 0.0 | 0.0 | 0.0 | **(6,600.0)** |
| Adjusted Deliveries | 735.0 | 686.5 | 582.9 | 778.8 | 510.7 | 435.0 | 321.3 | 14.4 | 90.4 | 688.2 | 1,121.6 | 1,438.5 | **7,403.3** |
| City of Ontario | 1,509.8 | 1,502.8 | 1,084.5 | 1,473.7 | 1,416.4 | 1,202.6 | 995.6 | 328.7 | 706.3 | 685.7 | 1,110.8 | 1,205.4 | **13,222.2** |
| in-lieu | (510.0) | (790.0) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **(1,300.0)** |
| Adjusted Deliveries | 999.8 | 712.8 | 1,084.5 | 1,473.7 | 1,416.4 | 1,202.6 | 995.6 | 328.7 | 706.3 | 685.7 | 1,110.8 | 1,205.4 | **11,922.2** |
| City of Upland | 604.8 | 495.1 | 458.8 | 336.9 | 315.0 | 267.6 | 240.6 | 40.0 | 192.4 | 266.2 | 705.2 | 895.3 | **4,817.8** |
| in-lieu | (604.8) | (495.1) | (458.8) | (336.9) | (315.0) | (267.6) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **(2,478.2)** |
| Adjusted Deliveries | 0.0 | (0.0) | (0.0) | 0.0 | 0.0 | 0.0 | 240.6 | 40.0 | 192.4 | 266.2 | 705.2 | 895.3 | **2,339.6** |
| **Total Adj. Deliv.** | **1,640.0** | **1,437.1** | **1,110.0** | **1,793.6** | **1,520.9** | **1,233.0** | **1,257.5** | **229.0** | **990.1** | **1,867.1** | **3,262.0** | **3,903.6** | **20,243.9** |

**WFA DELIVERIES (Acre-Feet), FY 2007 - 2008**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 460.5 | 514.6 | 539.4 | 483.7 | 394.8 | 319.0 | 277.0 | 183.6 | 257.7 | 181.2 | 331.6 | 499.9 | **4,443.0** |
| DYY Cert. | | | | | | | | | | | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 460.5 | 514.6 | 539.4 | 483.7 | 394.8 | 319.0 | 277.0 | 183.6 | 257.7 | 181.2 | 331.6 | 499.9 | **4,443.0** |
| City of Chino Hills | 43.2 | 200.8 | 105.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.9 | 0.0 | **364.4** |
| DYY Cert. | | | | | | | | | | | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 43.2 | 200.8 | 105.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.9 | 0.0 | **364.4** |
| Monte Vista WD | 1,906.5 | 1,737.4 | 1,454.6 | 1,107.3 | 414.7 | 108.0 | 416.9 | 357.8 | 1,145.9 | 1,546.9 | 675.4 | 674.1 | **11,545.5** |
| DYY Cert. | | | | | | | | | | | 1,056.0 | 1,580.0 | **2,636.0** |
| Adjusted Deliveries | 1,906.5 | 1,737.4 | 1,454.6 | 1,107.3 | 414.7 | 108.0 | 416.9 | 357.8 | 1,145.9 | 1,546.9 | 1,731.4 | 2,254.1 | **14,181.5** |
| City of Ontario | 1,454.3 | 1,556.3 | 1,333.7 | 1,130.6 | 1,089.7 | 1,137.2 | 1,139.0 | 739.2 | 1,151.8 | 1,109.0 | 199.4 | 287.3 | **12,327.5** |
| DYY Cert. | | | | | | | | | | | 45.0 | 2,119.0 | **2,164.0** |
| Adjusted Deliveries | 1,454.3 | 1,556.3 | 1,333.7 | 1,130.6 | 1,089.7 | 1,137.2 | 1,139.0 | 739.2 | 1,151.8 | 1,109.0 | 244.4 | 2,406.3 | **14,491.5** |
| City of Upland | 938.0 | 963.2 | 680.7 | 497.9 | 300.0 | 427.3 | 500.5 | 1.5 | 0.0 | 250.7 | 110.4 | 220.6 | **4,890.8** |
| DYY Cert. | | | | | | | | | | | 337.0 | 309.4 | **646.4** |
| Adjusted Deliveries | 938.0 | 963.2 | 680.7 | 497.9 | 300.0 | 427.3 | 500.5 | 1.5 | 0.0 | 250.7 | 447.4 | 530.0 | **5,537.2** |
| **Total Adj. Deliv.** | 4,802.5 | 4,972.3 | 4,113.9 | 3,219.5 | 2,199.2 | 1,991.5 | **2,333.4** | **1,282.1** | **2,555.4** | **3,087.8** | **2,769.7** | **5,690.3** | **39,017.6** |

**WFA DELIVERIES (Acre-Feet), FY 2008 - 2009**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 505.3 | 459.8 | 299.6 | 253.9 | 200.4 | 146.9 | 36.7 | 0.0 | 0.0 | 216.1 | 335.6 | 266.9 | **2,721.2** |
| DYY Cert. | 0.0 | 0.0 | 0.0 | 238.4 | 629.5 | 175.2 | 0.0 | 0.0 | 0.0 | 0.0 | 353.1 | 315.9 | **1,712.1** |
| Adjusted Deliveries | 505.3 | 459.8 | 299.6 | 492.3 | 829.9 | 322.1 | 36.7 | 0.0 | 0.0 | 216.1 | 688.7 | 582.8 | **4,433.3** |
| City of Chino Hills | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| DYY Cert. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Monte Vista WD | 1,101.5 | 1,147.8 | 895.2 | 894.8 | 522.8 | 298.8 | 180.5 | 0.0 | 0.0 | 370.1 | 497.4 | 384.2 | **6,293.1** |
| DYY Cert. | 1,700.0 | 0.0 | 0.0 | 0.0 | 292.0 | 533.0 | 250.0 | 0.0 | 0.0 | 0.0 | 1,536.0 | 1,514.0 | **5,825.0** |
| Adjusted Deliveries | 2,801.5 | 1,147.8 | 895.2 | 894.8 | 814.8 | 831.8 | 430.5 | 0.0 | 0.0 | 370.1 | 2,033.4 | 1,898.2 | **12,118.1** |
| City of Ontario | 517.5 | 856.1 | 828.4 | 857.3 | 577.1 | 440.3 | 66.6 | 0.0 | 0.0 | 42.0 | 0.0 | 5.5 | **4,190.8** |
| DYY Cert. | 2,184.0 | 2,427.0 | 2,525.0 | 580.0 | 119.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3,489.1 | 3,249.0 | **14,573.6** |
| Adjusted Deliveries | 2,701.5 | 3,283.1 | 3,353.4 | 1,437.3 | 696.6 | 440.3 | 66.6 | 0.0 | 0.0 | 42.0 | 3,489.1 | 3,254.5 | **18,764.4** |
| City of Upland | 605.1 | 986.7 | 889.2 | 830.1 | 144.0 | 174.0 | 28.7 | 0.0 | 0.0 | 58.9 | 10.7 | 3.4 | **3,730.8** |
| DYY Cert. | 330.4 | 259.2 | 301.5 | 326.9 | 275.6 | 217.6 | 272.3 | 71.2 | 0.0 | 0.0 | 288.8 | 359.0 | **2,702.5** |
| Adjusted Deliveries | 935.5 | 1,245.9 | 1,190.7 | 1,157.0 | 419.6 | 391.6 | 301.0 | 71.2 | 0.0 | 58.9 | 299.5 | 362.4 | **6,433.3** |
| **Total Adj. Deliv.** | **6,943.8** | **6,136.6** | **5,738.9** | **3,981.4** | **2,760.9** | **1,985.8** | **834.8** | **71.2** | **0.0** | **687.1** | **6,510.7** | **6,097.9** | **41,749.1** |

**WFA DELIVERIES (Acre-Feet), FY 2009 - 2010**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 420.0 | 394.0 | 394.0 | 240.0 | 124.0 | 127.0 | 116.0 | 65.0 | 147.0 | 110.7 | 252.5 | 366.2 | **2,756.4** |
| DYY Cert. | 373.9 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 289.0 | 298.0 | **961.9** |
| Adjusted Deliveries | 793.9 | 395.0 | 394.0 | 240.0 | 124.0 | 127.0 | 116.0 | 65.0 | 147.0 | 110.7 | 541.5 | 664.2 | **3,718.3** |
| City of Chino Hills | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| DYY Cert. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Monte Vista WD | 663.0 | 597.0 | 703.0 | 275.0 | 208.0 | 222.0 | 425.0 | 32.0 | 188.0 | 213.7 | 385.9 | 553.1 | **4,465.7** |
| DYY Cert. | 1,825.8 | 1,073.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 510.0 | 510.0 | **3,918.8** |
| Adjusted Deliveries | 2,488.8 | 1,670.0 | 703.0 | 275.0 | 208.0 | 222.0 | 425.0 | 32.0 | 188.0 | 213.7 | 895.9 | 1,063.1 | **8,384.5** |
| City of Ontario | 416.0 | 575.0 | 611.0 | 632.0 | 584.0 | 565.0 | 590.0 | 255.0 | 143.0 | 65.1 | 68.1 | 378.8 | **4,883.0** |
| DYY Cert. | 2,022.0 | 250.0 | 340.0 | 360.0 | 289.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 100.0 | 678.8 | **4,040.7** |
| Adjusted Deliveries | 2,438.0 | 825.0 | 951.0 | 992.0 | 873.9 | 565.0 | 590.0 | 255.0 | 143.0 | 65.1 | 168.1 | 1,057.6 | **8,923.7** |
| City of Upland | 370.0 | 619.0 | 706.0 | 347.0 | 195.0 | 0.0 | 0.0 | 0.0 | 210.0 | 232.3 | 63.7 | 16.1 | **2,759.1** |
| DYY Cert. | 366.2 | 497.8 | 435.9 | 293.1 | 272.7 | 187.6 | 0.0 | 0.0 | 0.0 | 0.0 | 189.7 | 124.5 | **2,367.5** |
| Adjusted Deliveries | 736.2 | 1,116.8 | 1,141.9 | 640.1 | 467.7 | 187.6 | 0.0 | 0.0 | 210.0 | 232.3 | 253.4 | 140.6 | **5,126.6** |
| **Total Adj. Deliv.** | **6,456.9** | **4,006.8** | **3,189.9** | **2,147.1** | **1,673.6** | **1,101.6** | **1,131.0** | **352.0** | **688.0** | **621.8** | **1,858.9** | **2,925.5** | **26,153.1** |

**WFA DELIVERIES (Acre-Feet), FY 2010- 2011**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **City of Chino** | 378.9 | 365.6 | 316.3 | 160.6 | 177.2 | 132.9 | 135.9 | 170.0 | 143.8 | 135.9 | 233.0 | 270.0 | **2,620.1** |
| DYY Cert. | 0.0 | 0.0 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **17.1** |
| Adjusted Deliveries | 378.9 | 365.6 | 316.3 | 160.6 | 194.3 | 132.9 | 135.9 | 170.0 | 143.8 | 135.9 | 233.0 | 270.0 | **2,637.2** |
| **City of Chino Hills** | 0.0 | 0.0 | 0.0 | 0.0 | 208.1 | 251.1 | 253.6 | 224.4 | 57.4 | 81.6 | 181.5 | 253.9 | **1,511.6** |
| DYY Cert. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 0.0 | 0.0 | 0.0 | 0.0 | 208.1 | 251.1 | 253.6 | 224.4 | 57.4 | 81.6 | 181.5 | 253.9 | **1,511.6** |
| **Monte Vista WD** | 1,027.6 | 1,091.3 | 999.8 | 580.9 | 183.6 | 30.5 | 86.1 | 50.7 | 0.0 | 0.0 | 0.0 | 10.0 | **4,060.5** |
| DYY Cert.[(2)] | 300.0 | 300.0 | 335.0 | 335.0 | 330.4 | 200.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **1,800.4** |
| Adjusted Deliveries | 1,327.6 | 1,391.3 | 1,334.8 | 915.9 | 514.0 | 230.5 | 86.1 | 50.7 | 0.0 | 0.0 | 0.0 | 10.0 | **5,860.9** |
| **City of Ontario** | 683.4 | 1,466.7 | 1,417.9 | 1,068.3 | 697.1 | 532.7 | 486.6 | 430.1 | 441.0 | 580.5 | 852.1 | 867.5 | **9,523.9** |
| DYY Cert. | 155.0 | 2,065.0 | 846.6 | 468.7 | 529.1 | 408.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **4,473.2** |
| Adjusted Deliveries | 838.4 | 3,531.7 | 2,264.5 | 1,537.0 | 1,226.2 | 941.5 | 486.6 | 430.1 | 441.0 | 580.5 | 852.1 | 867.5 | **13,997.1** |
| **City of Upland** | 474.3 | 519.2 | 498.4 | 152.7 | 0.0 | 24.6 | 63.7 | 3.9 | 85.0 | 357.0 | 420.4 | 754.0 | **3,353.2** |
| DYY Cert.[(2)] | 210.0 | 210.0 | 210.0 | 210.0 | 210.0 | 200.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **1,250.0** |
| Adjusted Deliveries | 684.3 | 729.2 | 708.4 | 362.7 | 210.0 | 224.6 | 63.7 | 3.9 | 85.0 | 357.0 | 420.4 | 754.0 | **4,603.2** |
| **Total Adj. Deliv.** | **3,229.2** | **6,017.8** | **4,624.0** | **2,976.2** | **2,352.6** | **1,780.6** | **1,025.9** | **879.1** | **727.2** | **1,155.0** | **1,687.0** | **2,155.4** | **28,610.0** |

**WFA DELIVERIES (Acre-Feet), FY 2011- 2012**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **City of Chino** | 327.3 | 334.4 | 328.2 | 260.1 | 188.0 | 158.3 | 137.1 | 131.2 | 152.0 | 134.3 | 256.3 | 336.2 | **2,743.4** |
| **in-lieu** | 0.0 | 0.0 | 0.0 | | | | | | | | | | **0.0** |
| **Adjusted Deliveries** | 327.3 | 334.4 | 328.2 | 260.1 | 188.0 | 158.3 | 137.1 | 131.2 | 152.0 | 134.3 | 256.3 | 336.2 | **2,743.4** |
| **City of Chino Hills** | 256.1 | 258.2 | 240.5 | 172.0 | 15.6 | 19.3 | 0.7 | 214.0 | 250.1 | 245.4 | 256.7 | 244.9 | **2,173.5** |
| **in-lieu** | 0.0 | 0.0 | 0.0 | | | | | | | | | | **0.0** |
| **Adjusted Deliveries** | 256.1 | 258.2 | 240.5 | 172.0 | 15.6 | 19.3 | 0.7 | 214.0 | 250.1 | 245.4 | 256.7 | 244.9 | **2,173.5** |
| **Monte Vista WD** | 138.0 | 386.9 | 1,106.9 | 0.0 | 0.0 | 0.0 | 0.0 | 321.4 | 542.8 | 145.6 | 181.5 | 682.4 | **3,505.5** |
| **in-lieu** | 0.0 | 0.0 | (682.2) | | | | | | | | | | **(682.2)** |
| **Adjusted Deliveries** | 138.0 | 386.9 | 424.7 | 0.0 | 0.0 | 0.0 | 0.0 | 321.4 | 542.8 | 145.6 | 181.5 | 682.4 | **2,823.3** |
| **City of Ontario** | 1,040.2 | 1,052.0 | 1,107.0 | 203.7 | 813.3 | 997.4 | 906.7 | 911.8 | 958.9 | 879.0 | 981.6 | 955.9 | **10,807.5** |
| **in-lieu** | (492.5) | (69.4) | (222.6) | | | | | | | | | | **(784.5)** |
| **Adjusted Deliveries** | 547.7 | 982.6 | 884.4 | 203.7 | 813.3 | 997.4 | 906.7 | 911.8 | 958.9 | 879.0 | 981.6 | 955.9 | **10,023.0** |
| **City of Upland** | 1,063.2 | 1,028.7 | 756.4 | 313.0 | 179.8 | 184.1 | 335.5 | 210.8 | 181.9 | 351.8 | 827.5 | 1,013.6 | **6,446.3** |
| **in-lieu** | 0.0 | 0.0 | 0.0 | | | | | | | | | | **0.0** |
| **Adjusted Deliveries** | 1,063.2 | 1,028.7 | 756.4 | 313.0 | 179.8 | 184.1 | 335.5 | 210.8 | 181.9 | 351.8 | 827.5 | 1,013.6 | **6,446.3** |
| **Total Adj. Deliv.** | **2,332.3** | **2,990.8** | **2,634.2** | **948.8** | **1,196.7** | **1,359.1** | **1,380.0** | **1,789.2** | **2,085.7** | **1,756.1** | **2,503.6** | **3,233.0** | **24,209.5** |

**WFA DELIVERIES (Acre-Feet), FY 2012- 2013**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 398.5 | 467.5 | 440.9 | 412.4 | 243.8 | 185.0 | 185.6 | 166.5 | 254.0 | 389.1 | 452.6 | 488.7 | **4,084.6** |
| Unsubscribed Capacity | 0.0 | (25.8) | (22.4) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | (9.7) | (56.3) | **(114.2)** |
| Adjusted Deliveries | 398.5 | 441.7 | 418.5 | 412.4 | 243.8 | 185.0 | 185.6 | 166.5 | 254.0 | 389.1 | 442.9 | 432.4 | **3,970.4** |
| City of Chino Hills | 259.6 | 286.8 | 286.8 | 198.2 | 114.0 | 5.4 | 5.3 | 1.7 | 19.8 | 271.3 | 222.0 | 150.6 | **1,821.5** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 259.6 | 286.8 | 286.8 | 198.2 | 114.0 | 5.4 | 5.3 | 1.7 | 19.8 | 271.3 | 222.0 | 150.6 | **1,821.5** |
| Monte Vista WD | 730.3 | 990.6 | 903.3 | 624.2 | 359.0 | 17.0 | 16.7 | 5.3 | 62.3 | 854.4 | 699.2 | 474.3 | **5,736.6** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 730.3 | 990.6 | 903.3 | 624.2 | 359.0 | 17.0 | 16.7 | 5.3 | 62.3 | 854.4 | 699.2 | 474.3 | **5,736.6** |
| City of Ontario | 812.1 | 552.9 | 829.0 | 938.3 | 869.4 | 819.4 | 689.2 | 696.1 | 829.0 | 801.9 | 1,056.7 | 1,349.5 | **10,243.5** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 812.1 | 552.9 | 829.0 | 938.3 | 869.4 | 819.4 | 689.2 | 696.1 | 829.0 | 801.9 | 1,056.7 | 1,349.5 | **10,243.5** |
| City of Upland | 967.3 | 962.8 | 592.8 | 159.8 | 176.9 | 113.9 | 213.0 | 257.9 | 444.7 | 539.4 | 682.7 | 956.1 | **6,067.3** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 967.3 | 962.8 | 592.8 | 159.8 | 176.9 | 113.9 | 213.0 | 257.9 | 444.7 | 539.4 | 682.7 | 956.1 | **6,067.3** |
| **Total Adj. Deliv.** | **3,167.8** | **3,234.8** | **3,030.4** | **2,332.9** | **1,763.1** | **1,140.7** | **1,109.8** | **1,127.5** | **1,609.8** | **2,856.1** | **3,103.5** | **3,362.9** | **27,839.3** |

**WFA DELIVERIES (Acre-Feet), FY 2013- 2014**

| Member Agency | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | Total Deliveries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Chino | 545.2 | 536.7 | 479.6 | 336.4 | 274.3 | 345.7 | 436.4 | 253.9 | 257.7 | 263.6 | 304.3 | 324.7 | **4,358.5** |
| Unsubscribed Capacity | (102.8) | (90.3) | (67.2) | 0.0 | 0.0 | (5.5) | (49.1) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **(314.9)** |
| Adjusted Deliveries | 442.4 | 446.4 | 412.4 | 336.4 | 274.3 | 340.2 | 387.3 | 253.9 | 257.7 | 263.6 | 304.3 | 324.7 | **4,043.6** |
| City of Chino Hills | 81.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 81.0 | **962.0** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 81.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 81.0 | **962.0** |
| Monte Vista WD | 776.4 | 695.7 | 666.6 | 581.1 | 185.1 | 169.8 | 371.2 | 242.2 | 319.7 | 412.3 | 698.8 | 845.6 | **5,964.5** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 776.4 | 695.7 | 666.6 | 581.1 | 185.1 | 169.8 | 371.2 | 242.2 | 319.7 | 412.3 | 698.8 | 845.6 | **5,964.5** |
| City of Ontario | 1,435.6 | 1,439.6 | 1,310.1 | 667.4 | 464.0 | 228.2 | 366.5 | 562.9 | 756.0 | 802.4 | 964.6 | 906.9 | **9,904.2** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 1,435.6 | 1,439.6 | 1,310.1 | 667.4 | 464.0 | 228.2 | 366.5 | 562.9 | 756.0 | 802.4 | 964.6 | 906.9 | **9,904.2** |
| City of Upland | 943.6 | 926.2 | 804.4 | 534.1 | 503.2 | 225.4 | 389.0 | 150.9 | 211.6 | 493.7 | 945.1 | 1,138.1 | **7,265.3** |
| Unsubscribed Capacity | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** |
| Adjusted Deliveries | 943.6 | 926.2 | 804.4 | 534.1 | 503.2 | 225.4 | 389.0 | 150.9 | 211.6 | 493.7 | 945.1 | 1,138.1 | **7,265.3** |
| **Total Adj. Deliv.** | **3,679.0** | **3,587.9** | **3,273.5** | **2,199.0** | **1,506.6** | **1,043.6** | **1,594.0** | **1,289.9** | **1,625.0** | **2,052.0** | **2,992.8** | **3,296.3** | **28,139.6** |

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# APPENDIX N

## Land Use Based Demand Model Development Tech Memo




ARCADIS Design & Consultancy for natural and built assets

Inland Empire Utilities Agency

# LAND USE BASED DEMAND MODEL DEVELOPMENT

FINAL Technical Memorandum

May 24, 2016

# LAND USE BASED DEMAND MODEL DEVELOPMENT

Technical Memorandum



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05484017.0000
Date:
May 19, 2016

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# APPENDICES

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B - Land Use Maps
C - Acreage Inventories
D - Land Use Unit Demands
E - Demand Projections
F - Model User Guide

# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AF | acre-feet |
| af/ac/yr | acre-feet per acre per year |
| AFY | acre-feet per year |
| CEQA | California Environmental Quality Act |
| CVWD | Cucamonga Valley Water District |
| DU | Dwelling Units |
| du/ac | dwelling units per acre |
| FWC | Fontana Water Company |
| GIS | Geographic Information System |
| GIS | Geographic Information System |
| GPCD | gallons per capita per day |
| IEUA | Inland Empire Utilities Agency |
| IRP | Integrated Regional Plan |
| LAFCO | San Bernardino County Local Agency Formation Commission |
| LUD | Land Use Unit Demands |
| MVWD | Monte Vista Water District |
| MWD | Metropolitan Water District of Southern California |
| NOAA | National Oceanic and Atmospheric Administration |
| SAWCo | San Antonio Water Company |
| SOI | Sphere Of Influence |
| TM | Technical Memorandum |
| UWMP | Urban Water Management Plan |

# 1 INTRODUCTION

This Technical Memorandum (TM) summarizes the process used to develop a water demand projection model and identify land use based water demand projections for Inland Empire Utilities Agency (IEUA) and its member agencies. IEUA's member agencies include the cities of Chino, Chino Hills, Ontario, and Upland, Cucamonga Valley Water District (CVWD), Fontana Water Company (FWC), Monte Vista Water District (MVWD), and San Antonio Water Company (SAWCo).

Data development and assumptions are presented in this TM along with a description of the methodologies used to develop the model and projections. The demand projection analysis includes data development and assumptions; and a discussion of the model tool and resulting projections.

# 2 METHODOLOGY

Project objectives are described in this section along with the project study area, an overview of the projection methodology, and a summary of the Demand Model development and use.

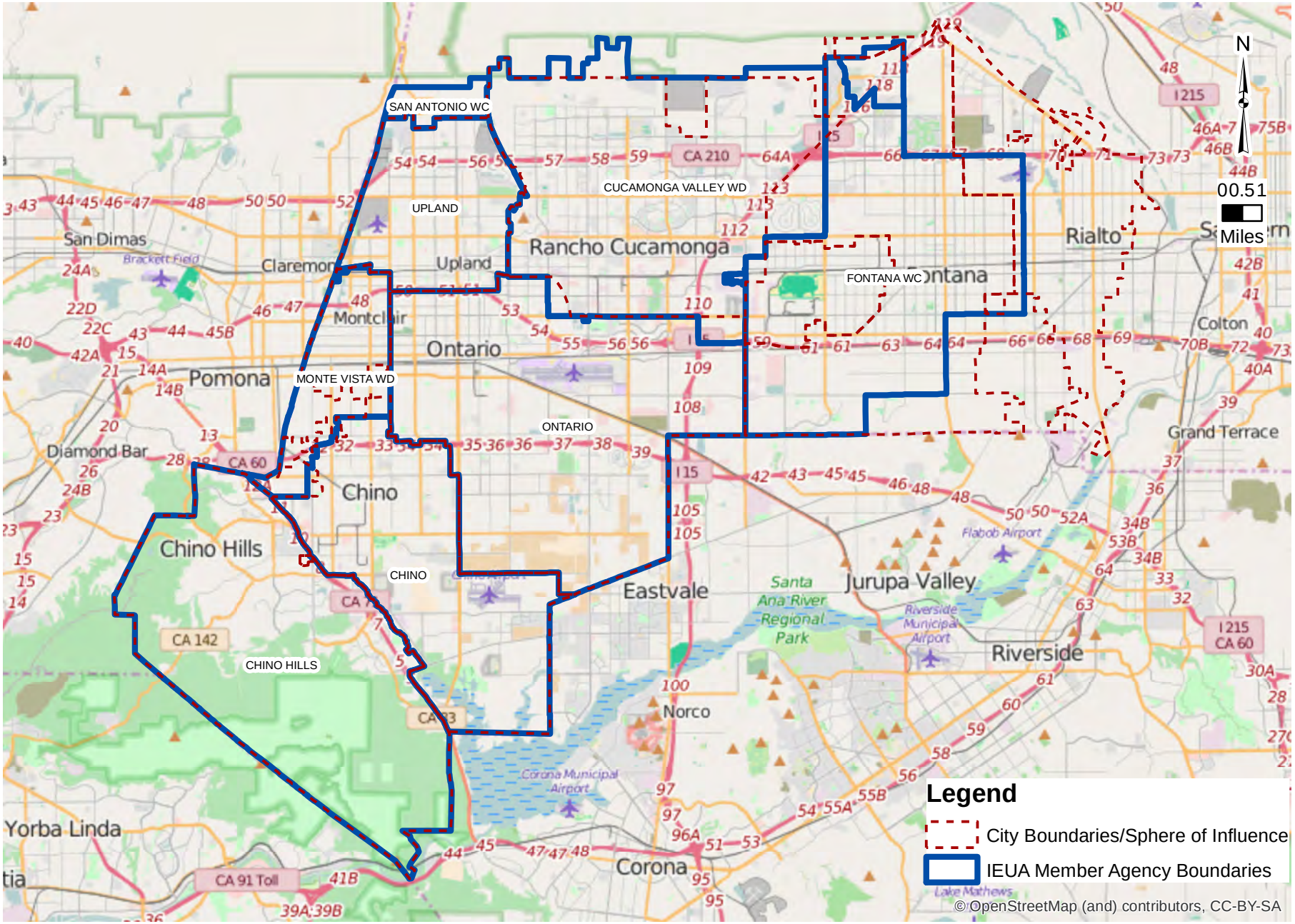
## 2.1 Objectives

To support its planning efforts, IEUA developed a Land Use Based Demand Model (Demand Model) to augment its Integrated Regional Plan (IRP) process in order to provide consistently developed member agency demand projections through 2040. The primary objective was to develop a land use based water demand model that disaggregates regional data to the member agency level for IEUA's Urban Water Management Plan (UWMP). The demand projections can be used by IEUA and member agencies for any system or supply planning purpose that requires detailed demand estimates and projections, such as conservation savings analyses.

## 2.2 Study Area and Boundaries

The study area is IEUA's sphere of influence (SOI). This boundary was established by IEUA to define its limit of future annexation to their existing service area. The SOI for IEUA is established by San Bernardino County Local Agency Formation Commission (LAFCO) to represent LAFCO's designation of the spatial extent of IEUA service. The IEUA SOI is the outermost extent of the study area, with demands projected within this boundary. The SOI delineation has undergone public review and California Environmental Quality Act (CEQA) analysis on growth inducing and other impacts.

Within this IEUA SOI boundary, the eight member agencies have boundaries established to prevent overlapping water service and demand projections. The SOIs for public water purveyors are also established by San Bernardino County LAFCO. Private water companies are governed by the State of California Public Utilities Commission, and do not have LAFCO designated SOIs, thus the use of their established member agency boundaries within IEUA is important. These boundaries are presented on Figure 2-1.




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**Study Area Boundaries**

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FIGURE 2-1

Within the study area and underlying each of the member agency boundaries, lie eight cities with land use planning authority. The cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, Rialto, and Upland, also have SOIs established by San Bernardino County LAFCO. These boundaries were useful in developing demand projections based on future land uses, as discussed in more detail in Section 3.

## 2.3 Overview of Projection Methodology

As presented on Figure 2-2, , the methodology used to create the Demand Model and identify demand projections relied on developing a land use database within a geographic information system (GIS), and determining Land Use Unit Demands (LUDs). LUDs measure water use on a per acre basis. Figure 2-2 presents the primary tasks for: 1) developing a land use database in orange, 2) unit demands in blue, and 3) demand projections in green.

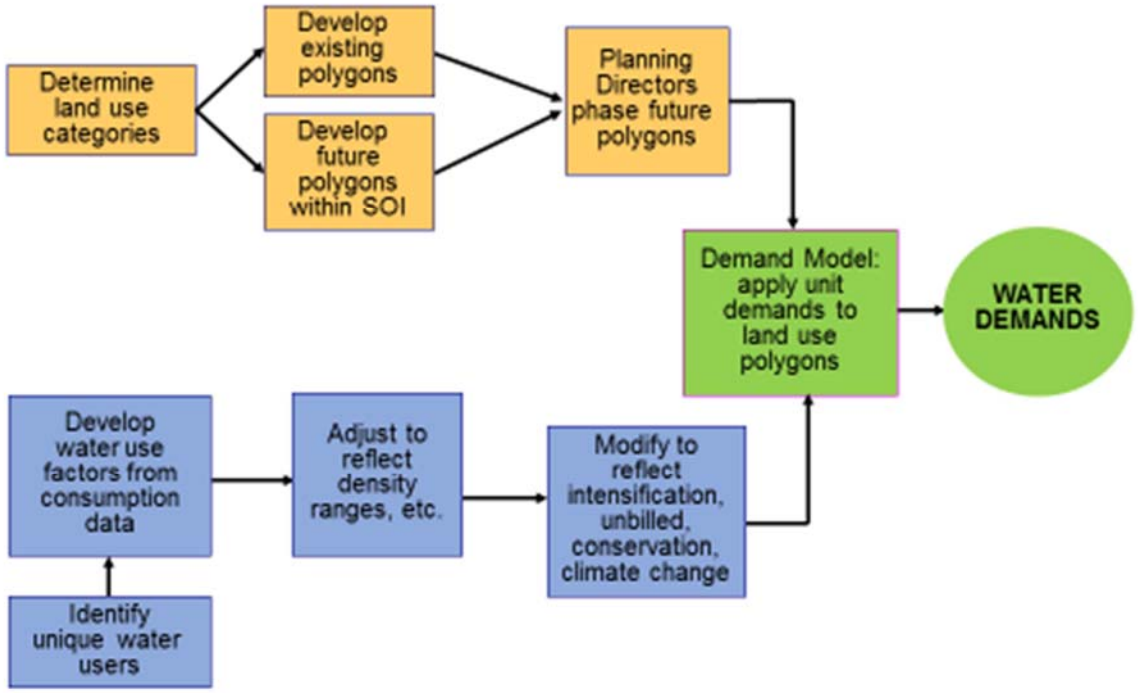



**Figure 2-2: Land Use Based Demand Model Development Process**

The demand projection process relied on the following key assumptions and data development steps.

*Land Use*

- The land use database relied on the SOIs as boundaries for IEUA, public member agencies, and cities.
- Because general plans reflect allowable development, not existing development, actual land uses were mapped by first using city parcel data that was updated as a part of the project to reflect actual land use, thus improving accuracy.
- The projections relied on using approved general plans, specifically the land use element and map for vacant lands identified for future development.
- Planning staff at each land use agency phased development by providing an estimate of potential construction dates for these future land uses.

*Land Use Unit Demands*

- Billing data and unbilled water estimates were provided by member agencies for the previous five years.
- The billing data from 2010 through 2014 were averaged to determine the existing year 2015 "normalized demands", thus smoothing out the annual and seasonal effects of weather and other variables. This approach to normalizing demands was used because of the difficulty separating out the economic complexities of the past eight years (i.e., the Great Recession) and years of drought. The normalized demand became the starting point for the demand projections.
- LUDs were generated for each member agency using existing land use acreage and member agency billing data to ensure that the LUDs reflected the unique demand characteristics of each water purveyor's service area.
- The unbilled water estimate (or unaccounted for water) reflects the percent difference between metered production and consumption; these percentages were provided by each member agency and used as an adjustment factor.
- Climate change impacts on estimated demands in 2040 were obtained from IRP assumptions and used as an adjustment factor.
- Redevelopment, increased densities, repurposing buildings, and other forms of land use intensification as land values increase can have a great effect on future water demands. This was accounted for in the adjustment factors based on an analysis of demand impacts associated with strong market conditions, which was noted in the IRP.
- Conservation savings were obtained from the IRP for plumbing code and efficiency regulation impacts.
- The Demand Model has an adjustment factor category called "Other" that is available to accommodate active conservation savings analyses, by percentage, for each land use, time frame, and member agency.

*Demand Model*

- The Demand Model relied on existing land use and LUDs normalized for 2015 existing demands.
- The Demand Model relied on future land uses and future LUDs, which were existing LUDs adjusted to reflect future changed conditions, to determine water demand projections in five year increments to 2040.
- Demands were identified and projected for each member agency separately which were combined for the IEUA service area in total.

More specific information follows regarding each of these key assumptions and data development steps.

## 2.4 Demand Model Development and Use

The project resulted in a GIS based software application, or tool, to calculate future water demands, called the Demand Model. The Demand Model linked GIS land use polygons and existing land use unit demands (input data) to calculate average annual projections 25 years into the future.

The Demand Model is a Microsoft Access database that contains GIS data collected from IEUA members and land use agencies including parcel data, member agency SOIs, and land use agency boundaries. Additionally, the database also contains layers for future land uses that were developed by the consultant team after consultation with each of the eight land use planning directors (described in Section 3.3 and 3.4). All original data in the individual parcel layer were maintained in this database. A few fields were added to each parcel layer, including the general plan land use, existing land use, year anticipated to be developed, and water purveyor serving the parcel.

The Demand Model can be used to develop demands spatially (by member agency and land use) and temporally (2015 to 2040 in five-year increments). Analysis, such as determining the savings associated with various demand management tools, can be conducted by land use and time frame for member agencies or the entire IEUA service area. The resulting study area Demand Model projections were similar to IRP projections, as described in Section 5.1. The Demand Model projection of approximately 278,000 AF at 2040 were four percent higher than the high range IRP projection.

# 3 LAND USE AND TRENDS

The process of consolidating general plan land use categories for all eight land use planning agencies into one master set of categories is described below, along with how existing and future land use GIS layers and the resulting land use inventories were developed.

## 3.1 Consolidation of Land Use Categories

All cities and counties in California have a general plan to provide and implement the vision for development of each community. All general plans contain a land use element and land use map to describe specific allowable land use and densities for each parcel. City general plans include all lands within their SOI overlapping in some areas with the San Bernardino County general plan that addresses all lands outside of city limits (unincorporated lands).

Each city uses different land use categories in their general plan; therefore, it was important to standardize these categories into a master set for the Demand Model. Appendix A presents the various general plan land use designations and the master set developed for the land use mapping and demand projections. Table 3-1 presents the resulting master set of land use categories and associated residential densities.

**Table 3-1: Land Use Categories**

| Master Land Use Categories |
|---|
| Very Low Residential (<1-2 dwelling units per acre [du/ac]) |
| Low Residential (3-7 du/ac) |
| Medium Residential (8-14 du/ac) |
| High Residential (15-24 du/ac) |
| Very High Residential (25+ du/ac) |
| Commercial |
| Industrial |
| Public/Institutional |
| Parks, Schools, Irrigation |
| Agriculture |
| Unique Water Users |
| Non-irrigated |
| Vacant |

These land use categories were grouped to reflect similar water demand patterns. For example, parks, and other large turf areas receiving irrigation water (served with potable or recycled water, versus private wells) were identified as Parks, Schools, Irrigation, and retained in the database. Lands that do not receive water service were removed or identified as non-irrigated lands. The parks, schools, and other primarily irrigation uses reflect outdoor irrigation water use that aids in analyzing outdoor water demands. This category includes homeowner association common area irrigation accounts wherever possible.

Residential densities were separated into five categories that reflect new development patterns, density groupings of most general plans, and general customer control over irrigation. For example, residential densities associated with apartment buildings and condominiums typically have no control over outdoor irrigation.

“Mixed use” designations in the general plans reflected different configurations of mixed uses such as different commercial use, or commercial and residential use within the same project boundary but not necessarily on the same parcel. A standard convention for mixed use designations is commercial use on the ground floor with residential above, with a “mixed use” land use category developed. However, since the model needs spatial land use data, and the standard convention was not used for these cities, mixed use lands were delineated to reflect the percentages identified in the general plan or specific plan of planned land uses for each individual development project.

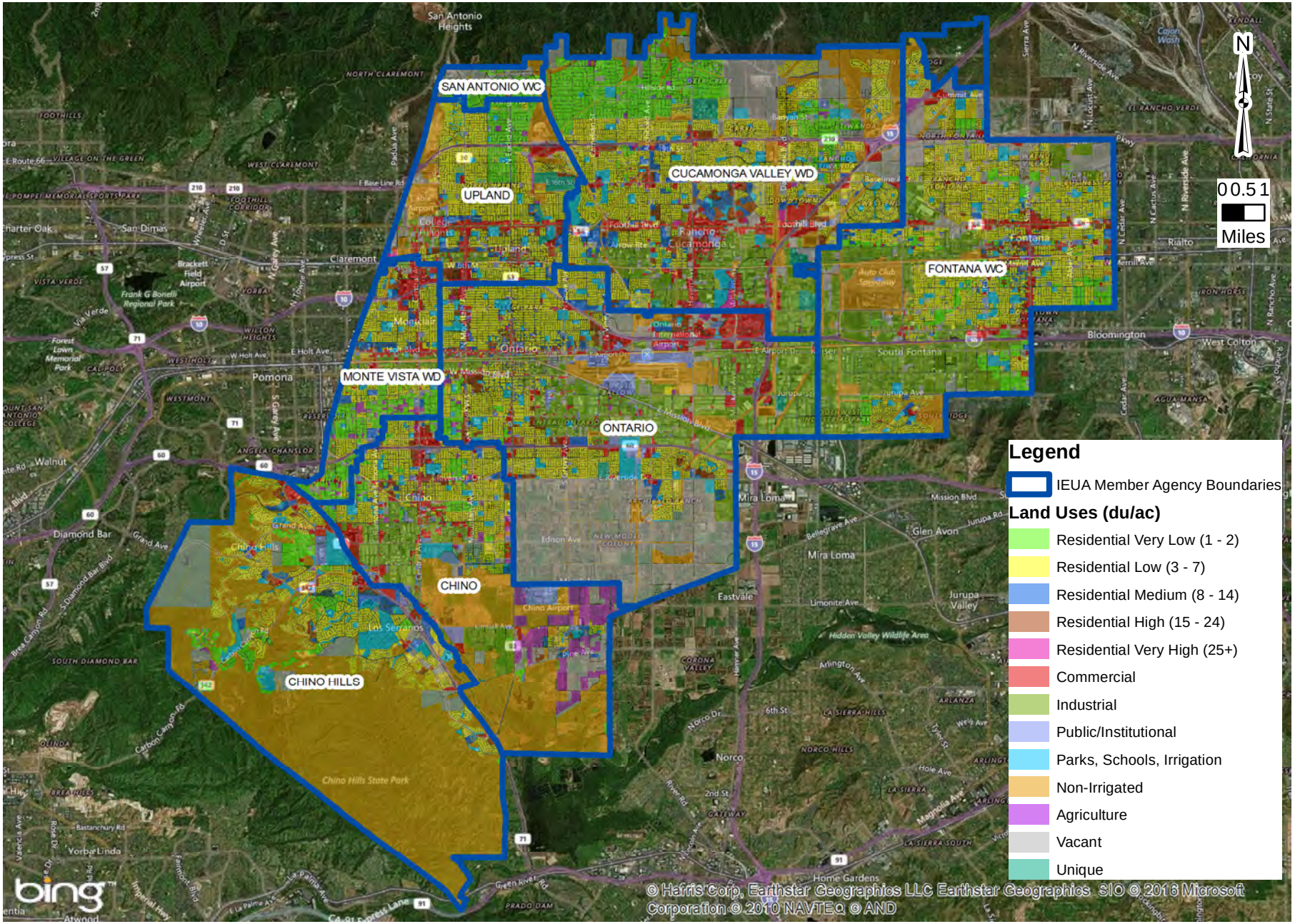
When the Demand Model is updated in the future, a new land use category should be considered to reflect higher densities of residential use. The Very High category in the model reflects densities of 25 du/ac or greater, which is appropriate now. As the region develops “up not out”, it is likely the general plans will be amended to accommodate higher density development.

## 3.2 Existing Land Use Layer Development

Spatially referenced existing land use polygons were created for the entire IEUA service area. Each polygon represents an area of predominant land use identified through parcel data provided by the cities and the county. The parcel data indicating existing land use typically have one category each for single family residential and multi-family residential use. In addition, many of the parcels are labeled “undefined”. For this study, existing land use categories were more specifically defined (e.g., five categories of residential land use and identification of all undefined parcels) using Google Earth maps and street view, windshield surveys, and meetings with community development departments. This extensive effort to improve the classification accuracy of over 70 percent of the existing land use resulted in a detailed database of existing land use that will yield increased accuracy of the LUDs.

The existing land use layer is not an exact replica of land uses but a best estimate. The process started with the use of parcel boundaries used to delineate each land use. But this often resulted in odd shaped polygons in areas such as airport tarmacs or new growth areas in southern Ontario where the ownership boundary does not match the general plan land use boundaries. Areas with parcel shapes that would have a significant impact on the accuracy of the demands, such as New Model Colony in Ontario, were modified to reflect the general plan land use map polygons.

“Unique water users” are identified as customers with consumption patterns determined by the agencies to be unusual, significantly higher (up to 1,240 percent higher) or lower (up to 340 percent lower) than the average customer of that sector. Unique users were separated from general land use categories to prevent a high or low water user from skewing the average unit demand for that particular land use for




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**Existing Land Uses**

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FIGURE 3-1

each member agency. The unique water users were maintained in the Demand Model as a separate land use.

The result is a GIS layer with existing land use that is presented on Figure 3-1 for the entire study area. Figure 3-2 presents an example of existing land use polygons. Existing land use maps for each member agency can be found in Appendix B.




**Figure 3-2: Detail of Existing Land Uses**

An important land use category in the existing land use database is “Vacant” lands. These vacant lands were defined as not having a current water demand but were designated on the general plans for future urban use having a demand for water. Vacant and agricultural lands that were not identified in the general plan for a future urban use were designated as “Non-irrigated” and include open space, agricultural lands with private water supply, or other lands with private water supplies that will remain private. Although open space lands could include uses with a water demand, each was carefully reviewed to determine if it was natural open space that was not irrigated or was irrigated by private well water. Non-irrigated lands also include significant road and highway rights-of-way and airport tarmacs; supporting airport uses with a water demand were not included in the non-irrigated tarmac polygons; these large land areas are an urban use but typically have minimal demand. The vacant lands with a future urban use were incorporated into a new GIS mapping layer for future land uses.

## 3.3 Future Land Use Layer Development

An important part of developing land use based water demand projections, is reliance on locally defined visions of how communities are to grow and change during the planning horizon. Using vacant land use parcels identified during existing GIS land use map development, the city general plan maps were applied to these vacant lands to identify future land uses. Future GIS land use maps were then generated to reflect these future developments. General plans are the most reliable indicators of future development policy because they have been subjected to extensive public review and rigorous environmental documentation prior to adoption. General plans, however, have a single hypothetical buildout date, used for analyses of environmental impacts associated with the full buildout of all lands in accordance with the

land use map. Actual development will occur at varying rates and times, and can extend beyond these general plan dates. Therefore, a more accurate method for identifying the timing of projected water demands based on the general plan was used and is described in the subsequent section.

## 3.4 Land Use Planning Agency Meetings

It is important to have city land use planners identify anticipated timing of development. They are the most knowledgeable of development activities, growth patterns, and trends within their city. The project team held meetings with planning or community development departments of each city (see inset below), with representatives of the applicable water purveyor in attendance, along with IEUA representative(s).

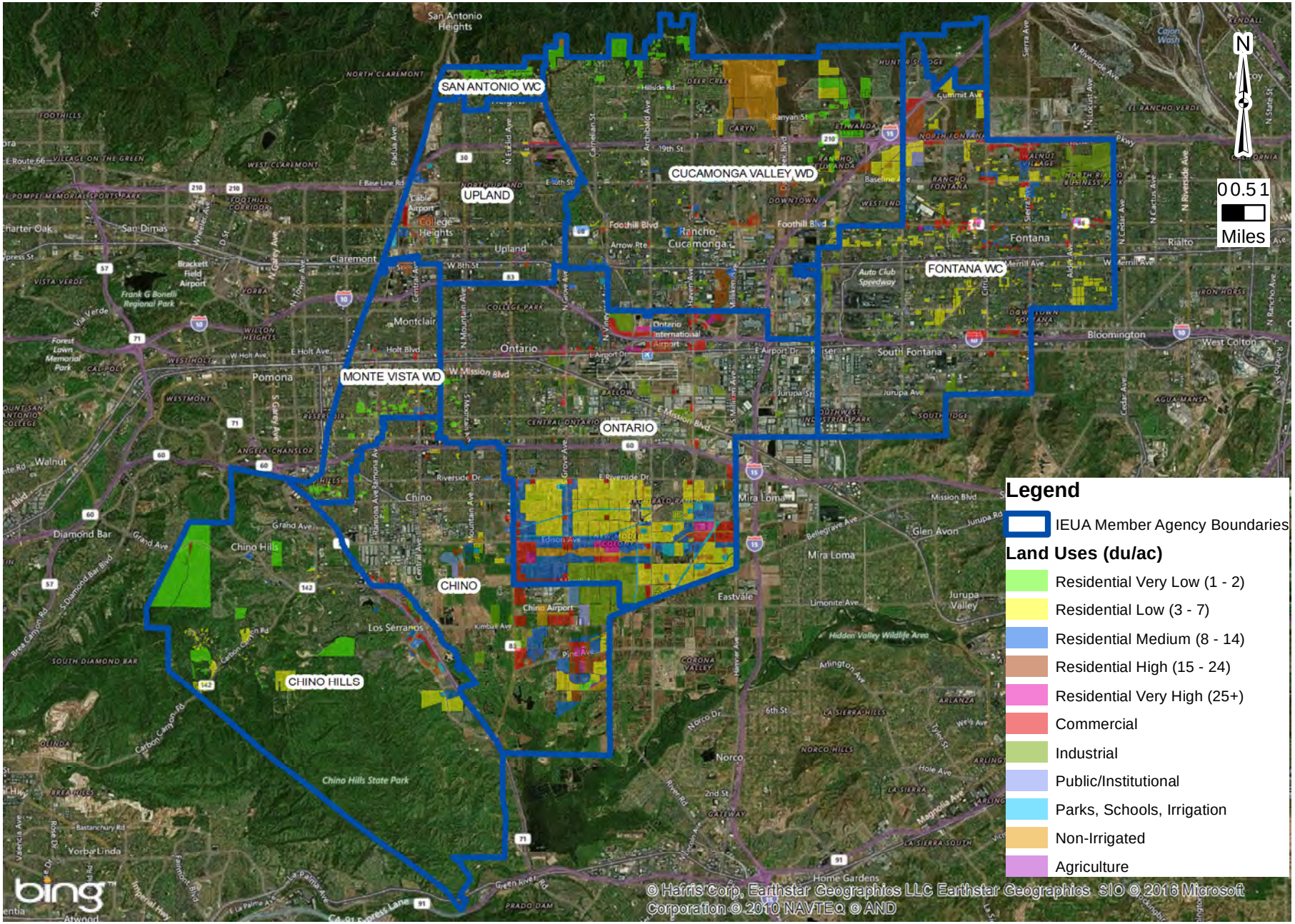
Existing land use maps were provided for each of the eight member agencies using their boundaries to capture service area land use. Future land use maps were also provided for each city within their SOIs. The meetings focused on the confirmation or identification of general plan land use for vacant land that is developable, and the planning representatives' best estimate of development time frame in five year increments through 2040. As 2015 is the year for existing demands, any development under way currently or in the recent past, and not in water billing data, was assigned a 2020 development date for water demand purposes. Also addressed at the meetings were confirmation of boundaries and a general review of existing land uses.

**Land Use Agencies**

- City of Chino
- City of Chino Hills
- City of Fontana
- City of Montclair
- City of Ontario
- City of Rancho Cucamonga
- City of Rialto (partially in Fontana Water Company boundary)

Planning staff provided information on observed land use trends and areas of redevelopment (creating denser development) and reuse (reusing existing buildings for different purposes) in their cities. Trends are discussed later in Section 4.3. Most densification changes are anticipated to not be a change in land use designation, but rather a reuse or repurposing of buildings or redevelopment of lands with higher density buildings within general plan-allowable ranges. These areas reflecting an intensification of use, will result in increased water demands but not necessarily a change in land use designation. The process to accommodate intensification of uses is discussed in Section 4.3.

The existing and future land use maps were edited in the GIS database based on these planning agency meetings. Figure 3-3 presents future land uses within the study area. Appendix B provides future land use maps for each of the member agencies.




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**Future Land Uses**

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FIGURE 3-3

## 3.5 Acreage Inventories

Based on the existing and future land use GIS mapping effort as described in previous sections, acreage inventories were generated in the Demand Model for each member agency. Table 3-2 presents the acreage of each land use within the study area to be developed over the planning horizon. The total acreage may not reflect the total IEUA service area because large areas of open space lands that will not have a water demand (e.g., most of Chino Hills State Park) were not included. Table 3-3 presents the net change in acreages for each land use.

**Table 3-2: Study Area Acreage Inventory**

| | Acreage Inventory by Year | | | | | |
|---|---|---|---|---|---|---|
| **Land Use (du/ac)** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| **Residential Very Low (<1 - 2)** | 9,089 | 9,504 | 10,155 | 10,282 | 10,115 | 11,522 |
| **Residential Low (3 - 7)** | 26,329 | 27,090 | 28,463 | 29,691 | 30,804 | 32,593 |
| **Residential Medium (8 - 14)** | 3,067 | 3,500 | 3,959 | 4,425 | 4,663 | 5,915 |
| **Residential High (15 - 24)** | 2,349 | 2,678 | 3,131 | 3,263 | 3,300 | 3,427 |
| **Residential Very High (25+)** | 231 | 256 | 283 | 408 | 466 | 646 |
| **Commercial** | 6,838 | 6,925 | 7,180 | 7,994 | 8,456 | 9,221 |
| **Industrial** | 16,974 | 18,587 | 19,856 | 20,141 | 20,306 | 20,420 |
| **Public/Institutional** | 2,979 | 2,990 | 3,066 | 3,095 | 3,289 | 3,334 |
| **Parks, Schools, Irrigation** | 5,629 | 5,687 | 5,657 | 5,890 | 5,963 | 6,154 |
| **Agriculture** | 2,026 | 1,534 | 1,175 | 630 | 376 | 68 |
| **Unique Water Users** | 863 | 863 | 852 | 852 | 852 | 852 |
| **Non-Irrigated** | 34,438 | 34,410 | 35,668 | 35,833 | 35,904 | 36,085 |
| **Vacant** | 19,724 | 16,512 | 11,090 | 8,032 | 6,042 | 298 |
| **Total** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** |

Acreage inventories from the Demand Model for each member agency can be found in Appendix C. As shown in Table 3-2, the largest percent increase in land use in the study area is very high density residential at 180 percent increase. The largest acreage increase by 2040 is low density residential by 6,264 acres. The majority of this new low density residential is attributed to new growth areas in Ontario's New Model Colony and Chino's The Preserve. These lands are currently agricultural lands, but as shown in Table 3-2, most agricultural lands will decline over time as they are converted to urban uses. Medium and high density residential lands are also anticipated to increase at a greater rate (percentage) than very low and low density.

Land use patterns that are unique to each member agency can be identified by studying the maps in Appendix B and the acreage inventories in Appendix C. This is where the agricultural conversions of Ontario and to a lesser extent, Chino, are apparent. And MVWD's service area does not have a lot of

vacant or agricultural land for development but is still growing as infill parcels are developed. Another interesting characteristic in the future acreage inventories in Appendix C is the decrease in acreage for the Parks, Schools, Irrigation land use designation for Rancho Cucamonga and Upland. This decrease in acreage reflects a statewide trend of golf courses replacing some or all of its lands with medium or other density residential uses.

**Table 3-3: Changes in Acreage from 2015 to 2040**

| Land Use (du/ac) | Percent Change |
|---|---|
| **Residential Very Low (1 - 2)** | 27 |
| **Residential Low (3 - 7)** | 24 |
| **Residential Medium (8 - 14)** | 93 |
| **Residential High (15 - 24)** | 46 |
| **Residential Very High (25+)** | 180 |
| **Commercial** | 35 |
| **Industrial** | 20 |
| **Public/Institutional** | 12 |
| **Parks, Schools, Irrigation** | 9 |
| **Agriculture** | -97 |

What is not apparent from the inventories are characteristics such as the extensive underutilized lands in the Fontana Water Company service area that will be consolidated and developed with higher densities. There are currently many acres of very low density (<1 to 2 du/ac) residential lands with a small house on a large unirrigated parcel, and is designated as low density residential. A development pattern has emerged where parcels have been consolidated and homes replaced with a subdivision reflecting a general plan designation of low density (up to 7.6 du/ac in the Fontana General Plan). An example is provided on Figure 3-4.

As discussed in Section 4, acreages have a LUD assigned to them that represents average conditions for that land use within that service area. The LUDs for each land use were adjusted to reflect changing conditions in the study area such as intensification of land uses. An exception to the use of LUD adjustment factors to accommodate intensification can be found with Fontana's very low density land use.



**Fontana Very Low Density Residential**

This is an example of very low density residential land use next to a subdivision of low density residential that was likely built from a consolidation of parcels.

**Figure 3-4: Fontana Very Low Density Residential**

# 4 WATER USE AND ADJUSTMENT FACTORS

Existing water demands are described in this section, along with the development of LUDs, LUD adjustment factors, and the resulting future LUDs.

## 4.1 Existing Demands

### 4.1.1 Establishing Existing Year Demands

Year 2015 was selected at the "existing year" to develop existing demands. To smooth out the effects of weather, and other annual variability, five years of billing data by billing sector were averaged. Averaging of data was used as the methodology to "normalize" demands because of the difficulty teasing out the effects of multiple dry years sandwiching a wet year versus conservation outreach to the public versus the economy partially rebounding from the Great Recession. Water billing data reflects metered consumption. Both the historical five year period of metered consumption and the normalized 2015 demand are presented on Figure 4-1. The existing year (2015) demands are 190,175 acre-feet (AF).

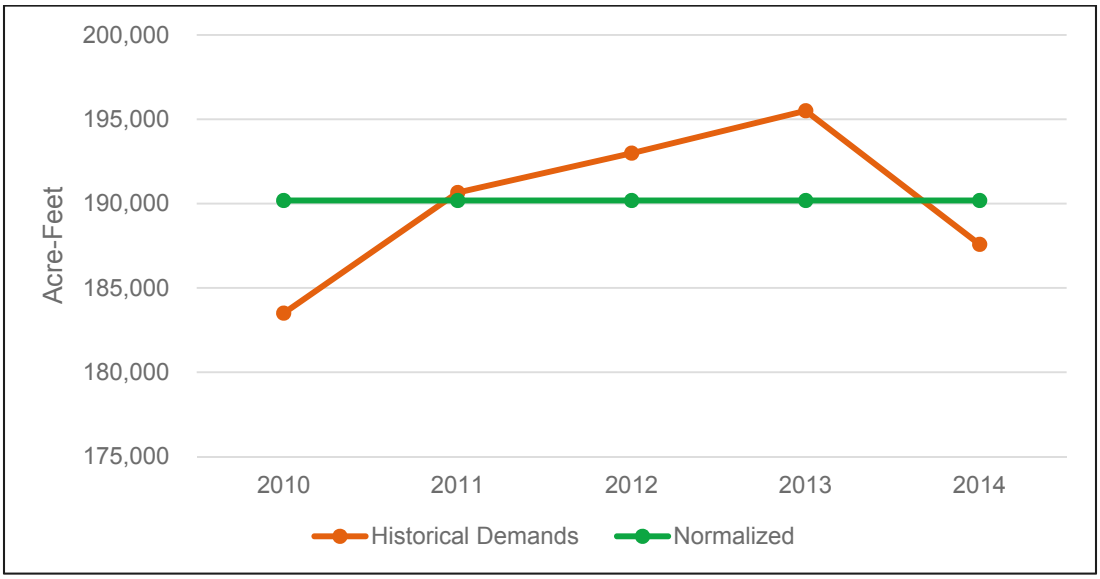



**Figure 4-1: Historical Water Demands**

## 4.2 Existing Land Use Unit Demands

Consumption patterns vary throughout IEUA's service area based on local conditions such as microclimate, demographics, economics, and land use densities. Land Use Unit Demands or LUDs were generated to represent these spatial characteristics of consumption patterns by developing existing LUDs on a per acre basis for each land use within each member agency boundary.

### 4.2.1 Disaggregation of Billing Data

In general, LUDs are calculated by dividing the estimated normalized consumption by the acres for a similar land use. This results in a unit demand of x acre-feet per acre per year (af/ac/yr) for each land use

for each member agency. For example, five years of commercial billing data in CVWD averaged 2,196 acre-feet per year (AFY). The total acreage of commercial use is 1,592 acres. Therefore, 2,196 divided by 1,592 equals an existing CVWD commercial LUD of 1.38 af/ac/yr.

Each member agency tracks and bills metered water consumption differently. The billing data range from 3 to 10 billing sectors or categories for each member agency. Since many of these do not align exactly with the 13 master land uses of the Demand Model, the billing data were disaggregated to apply to the land use categories. For example, data for a "single family residential" billing category were disaggregated into three land use categories: Very Low, Low, and Medium, by determining the prevalent average density of each of the three land use categories multiplied by the total number of existing acres of each land use (based on the Demand Model acreage inventory) to determine the approximate number of dwelling units.

An AFY)/Dwelling Unit (DU) factor was developed using the sum of the dwelling units; this unit factor was then apportioned to each of the three single family land use densities to reflect consumption patterns based on density. For example, approximately 40,600 single family residential dwelling units (i.e., very low, low, and medium densities) in CVWD's service area were calculated from identified densities. Single family residential billing data of 27,790 AFY was divided by 40,600 DUs resulting in 0.68 AFY/DU. Applying 0.68 AFY/DU to approximately 26,140 single family-low density dwelling units resulted in a distribution of Low Density Residential demands of approximately 17,900 AFY. The Very Low category has a higher consumption for the individual home (approximately 1 AF/DU) yet has a lower consumption on a per acre basis (1.85 af/ac/yr), compared with the other categories. Conversely, a Medium density residential dwelling unit has a lower consumption (0.46 AF/DU) than a Very Low and Low density dwelling unit, but has a higher consumption on a per acre basis (4.57 af/ac/yr) because there are more dwelling units per acre.

For multi-family residential billing data, since the majority of water demands are associated with indoor water consumption, the billing data were applied to the estimated total number of dwelling units (based on the prevalent average densities) and the same unit demand per dwelling unit was applied to the average prevalent density to obtain the calculated LUD.

Often the commercial, industrial, and other non-residential uses are combined in the billing data. LUDs from other communities were sometimes used to separate out the demands associated with a specific land use. For example, Fontana Water Company has a Public Authority billing category. The Public/Institutional LUDs from four other member agencies were averaged to obtain an LUD for Public/Institutional for Fontana Water Company with the balance of its Public Authority billing data assigned to Parks, Schools, and Irrigation. This resulted in LUDs for both categories that are within range of the other member agencies.

Another example is the City of Upland. Billing data from its Commercial/Industrial category was separated by applying a typical commercial LUD obtained from Irvine Ranch Water District and East Bay Municipal Utility District LUDs, which were similar, to the data with the balance assigned to Industrial. This resulted in an Industrial LUD for Upland which is higher than the other member agencies for Industrial. Since Upland does not have low water uses associated with warehousing and distribution that other member agencies have, the resulting LUDs are reasonable.

### 4.2.2 Existing LUDs

Table 4-1 presents a comparison of existing LUDs for each member agency by land use. These LUDs represent normalized consumption, but without unbilled water (production) estimates. As shown in Table 4-1, each agency has different service area characteristics represented in their unit demands. These LUDs are calculated outside of the Demand Model using current billing data. They can be easily updated in the future with new billing data and updated existing land use inventories for each agency.

**Table 4-1: Existing Land Use Unit Demands**

| Land Use | Existing Land Use Unit Demands (af/ac/yr) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Chino | Chino Hills | CVWD | FWC | MVWD | Ontario | SAWCO | Upland |
| **Residential Very Low (<1 - 2)** | 1.73 | 1.40 | 1.85 | 1.25 | 1.27 | 1.20 | 2.34 | 1.90 |
| **Residential Low (3 - 7)** | 2.60 | 2.47 | 2.88 | 2.75 | 2.11 | 2.12 | 0.00 | 2.84 |
| **Residential Medium (8 - 14)** | 4.36 | 4.10 | 4.57 | 6.70 | 4.67 | 5.27 | 4.95[1] | 4.95 |
| **Residential High (15 - 24)** | 4.78 | 4.28 | 6.07 | 11.55 | 9.86 | 7.60 | 6.36 | 8.95 |
| **Residential Very High (25+)** | 6.88 | 6.88[4] | 8.81 | 15.66 | 0.00 | 13.20 | 0.00 | 13.96 |
| **Commercial** | 1.31 | 3.34 | 1.38 | 6.54 | 2.13 | 2.82 | 2.20 | 2.13 |
| **Industrial** | 0.22[3] | 1.07 | 0.51 | 0.33 | 0.65 | 0.38 | 0.00 | 1.07 |
| **Public/Institutional** | 1.31 | 1.17 | 2.73[2] | 2.73[2] | 2.39 | 2.82 | 2.20 | 3.52 |
| **Parks, Schools, Irrigation** | 4.99 | 3.11 | 6.88 | 4.99 | 4.72 | 7.48 | 0.00 | 5.87 |
| **Agriculture** | 0.00 | 0.00 | 0.28 | 0.00 | 0.34 | 15.08 | 0.00 | 0.00 |
| **Unique Water Users #1** | 299[5] | | 3.62 | | 5.59 | 47.57 | | 1.33 |
| **Unique Water Users #2** | 186[5] | | 1.47 | | 43.49 | 18.81 | | 242[5] |
| **Unique Water Users #3** | 81[5] | | 7.43 | | | 10.07 | | 4.57 |
| **Unique Water Users #4** | | | 2.58 | | | | | 3.08 |

Note: Existing LUDs reflect normalized consumption billing data. Unbilled estimate (production) not included here.
[1] Used Upland Medium density residential LUD for SAWCO Medium density residential

[2] Average Public/Institutional LUD from four agencies applied to FWC and CVWD

[3] Highest Industrial LUD used for Chino Hills due to lack of warehousing and distribution uses

[4] Used Chino Very high density residential LUD for future Chino Hills Very high density residential

[5]Chino Unique Water Users and 1 Upland Unique are not located; 1 acre was used with full water demands.

## 4.3 Adjustment Factors

Looking back on Figure 2-2, the LUDs presented in Table 4-1 are applied in the Demand Model to the acreages of land use to determine existing and future demands. The land uses may be undeveloped or

agricultural lands presently to be converted to an urban use in the future – this is a simple calculation of changing the agricultural land use category for each polygon reflecting the City planning staff input on timing resulting in overall increased urban acreage. The next step is to adjust the resulting water demands to reflect more specific existing and future conditions. There are two types of adjustment factors applied to existing LUDs. One, an unbilled water estimate to change the demands from billed consumption to total production demands. The second type are future adjustment factors to approximate how water demands change over time due to climate change, intensification, and conservation. The land use changes over time were discussed in Section 3.3. The adjustment factors described here were applied to the Existing LUDs using the Demand Model to calculate Future LUDs. Each of these adjustment factors are described here along with their correlation to impacts on water demands.

### 4.3.1 Unbilled Water

The existing demand reflects metered consumption data, or billed water use. The Demand Model identified water needs for the quantity of water entering distribution systems, or production requirements. The difference between production and consumption demands has historically been called unaccounted for water or unmetered water. These uses reflect authorized water use that is not billed and other water losses. Authorized uses typically include fire flows, unmetered public facilities, and water main flushing. Other water system losses typically include losses from pipe breaks, storage facilities, and service connections. System losses also can include unauthorized consumption, metering inaccuracies, and other unidentified loss. For the Demand Model, the difference between production and billed consumption is called the unbilled water estimate.

Unbilled water, as provided by each member agency, ranged from two to nine percent of production. The unbilled water estimates were applied to the individual existing LUDs for each member agency. The total production demands are five percent higher than total normalized metered consumption data. It is recommended that as the member agencies conduct water loss analyses, or reduce system losses over time, that their adjustment factor be modified to reflect updated information.

### 4.3.2 Climate Change

The following impacts identified by the Department of Water Resources are associated with climate change that could also impact the study area.

- Increased surface temperature of 5.5 to 10.4 degrees fahrenheit anticipated by the end of the century
- Heat waves will increase in frequency, magnitude, and duration
- Longer, drier, and more frequent periods of droughts are anticipated with up to 2.5 times the number of critically dry years by the end of the century

The IEUA IRP analyzed long term climate change impacts on water demands by reviewing recent predictions of potential increases in temperature. Long term climate change assumptions were based on a National Oceanic and Atmospheric Administration (NOAA) Technical Report (NOAA, 2013), which stated that the anticipated increased temperatures of 3.6 degrees Fahrenheit have the potential to increase water use by as much as 4.3 percent by 2040. However, this number was reduced to 3.2 percent by 2040 for this Demand Model region and applied to four of the residential density demands and outdoor irrigation demands to reflect the trend of new development having less outdoor irrigated landscaping. Using 0

percent at 2015 and 3.2 percent at 2040, an adjustment factor for the intervening years was calculated as a linear interpolation and input to the Demand Model.

### 4.3.3 Intensification

There are many factors that influence water demands associated with land use development patterns, land uses, and activities. Our understanding of these factors is based on discussions during the eight land use planning agency meetings, research on local socioeconomic trends and conditions, analyses of land use patterns observed from the GIS database in the Demand Model, and land use planning trends observed throughout California. The study area is still rebounding from the Great Recession and market conditions for the region are noted by economists to be strong with higher employment and higher occupancy rates anticipated. As agricultural lands develop to urban uses, some communities are reaching "buildout". But the term buildout is a bit of a misnomer as lands are continually evolving over time, resulting in an "up not out" land use pattern shift. In addition, land values are increasing and are anticipated to increase over the 25 year planning horizon which contributes to higher densities and higher utilization of existing buildings or lands. Although difficult to quantify specifically, all of these conditions result in an intensification of land uses and thus higher water demands on a per acre basis. Visual examples are provided in the photos of denser commercial land use patterns (e.g., newer 2-story buildings with high occupancy, smaller floor space but more businesses, more food services, and less parking) reflecting intensification resulting in higher unit water use demands on a per acre basis.

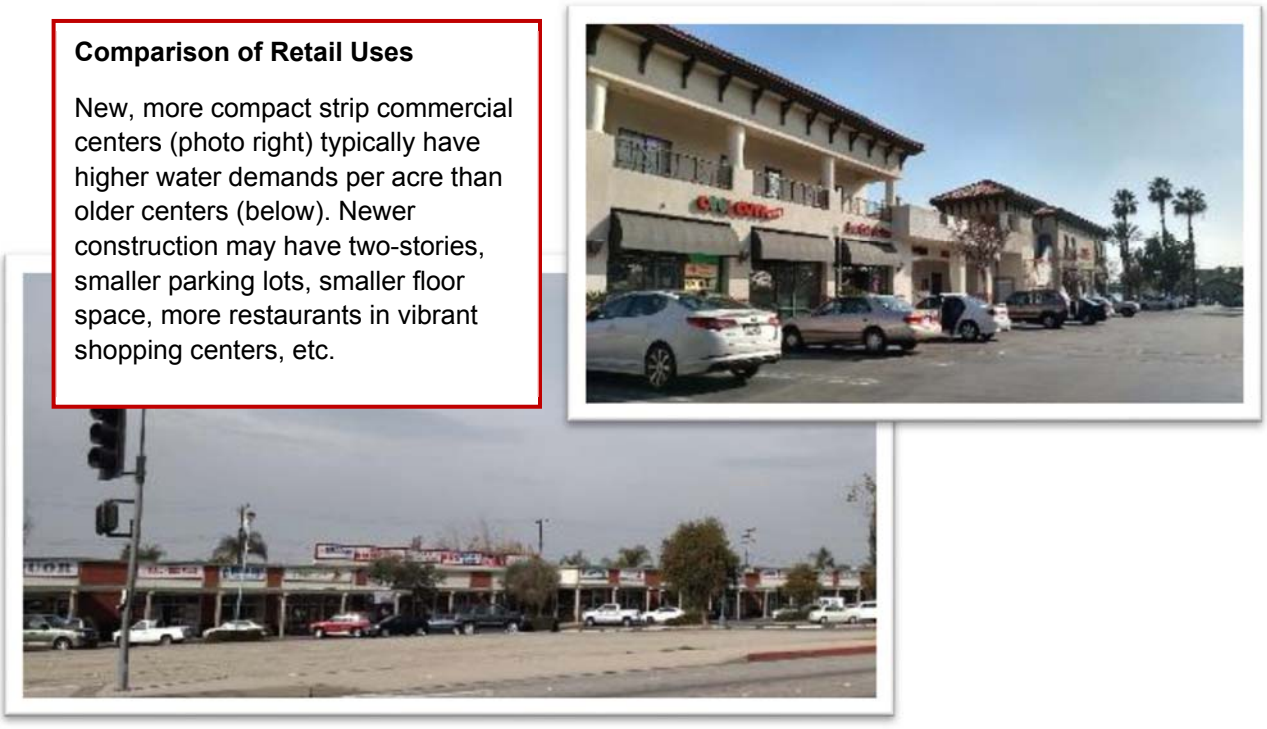



**Figure 4-2: Comparison of Retail Uses**

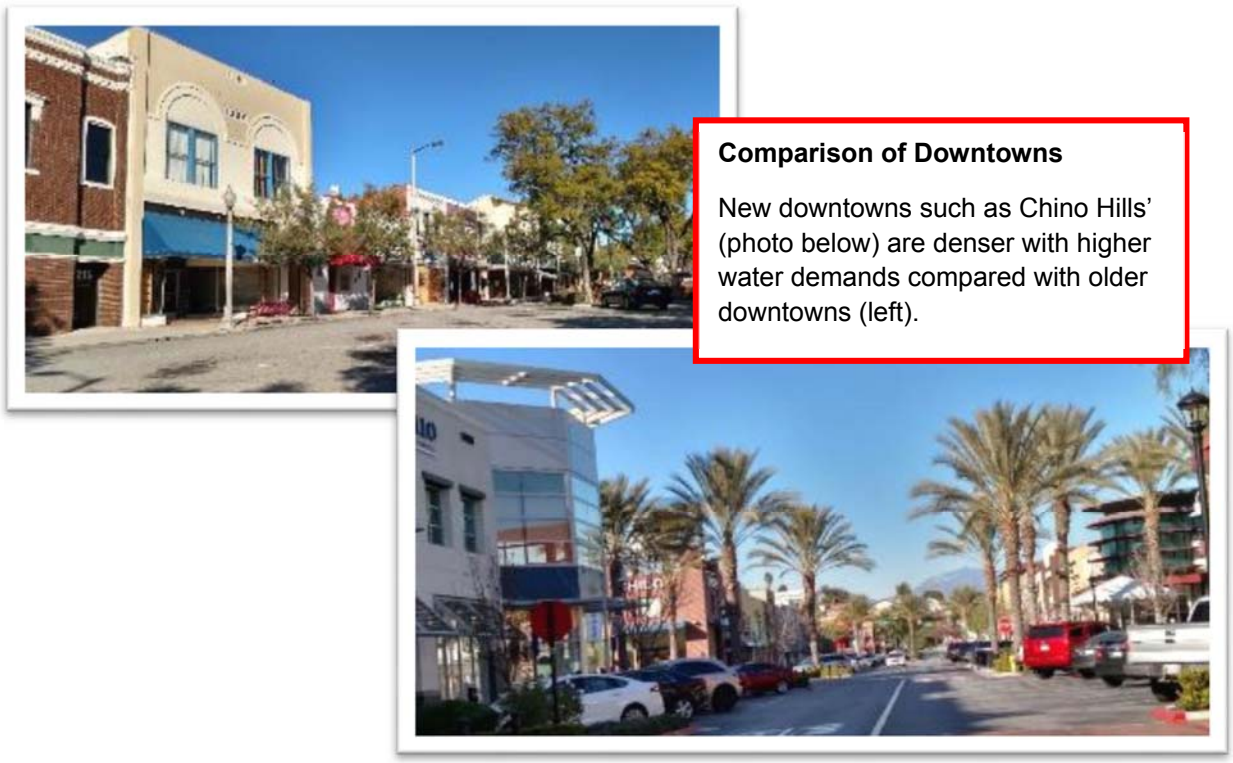



**Figure 4-3: Comparison of Downtowns**

As the member agencies observed during the past eight years, recessions result in reduced water use. Rebound from the Great Recession is still occurring in the study area with gradually increasing demands with strong market conditions anticipated through 2040. Vacant industrial lands are rapidly being developed, and although the predominant industrial use is warehousing and distribution – with low water use – most vacant industrial lands were anticipated by the land use agencies to be built out by 2025 if not sooner. When these large vacant parcels are built out, the region will likely see a consolidation of smaller parcels with currently underutilized uses, replaced with new industrial uses. For example, several city planning staff indicated that older industrial buildings that are vacant or have low occupancy or otherwise underutilized uses are being purchased with adjoining parcels with the intent to consolidate the lands and build larger industrial facilities. Although office commercial vacancy rates are currently very high, with no construction occurring in this sector, the lack of new construction will eventually result in vacancy rates decreasing with more employees per acre, until new commercial office lands are developed.

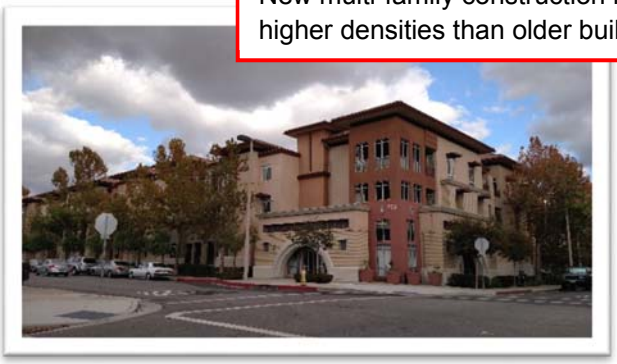
A "jobs per acre" analysis was conducted to determine the intensification of employment on non-residential lands. The total 2015 employment estimate of 350,460 for the study area (IRP data from Center for Demographic Research using Southern California Association of Governments data) was applied to the 2015 acreage inventory (for commercial, industrial, and public/ institutional land uses) resulting in 13.1 jobs per acre. The 2035 employment estimate of 488,930 was applied to the 2035 acreage, resulting in 15.3 jobs per acre, a 17 percent increase.

There are many acres of underutilized lands which will change in character as land values increase, such as the industrial example described above. Another example is new retail or office construction in shopping center parking lots. Most of the large areas of underutilized lands are in unincorporated areas under San Bernardino County development regulations, although all unincorporated lands in the study area are also within a sphere of influence of a city. Within cities, underutilized lands and buildings also exist, but aren't as prevalent. Land use planners discussed many redevelopment projects where obsolete buildings will be replaced with higher density and intensity of uses, within the same land use designation. This is likely to occur throughout the study area as land values continue to increase and population increases.

Existing residential land use, of which 35,420 acres are low and very low density residential (46 percent of 2015 lands with a water demand), will have changes in water demands associated with unpermitted conversion of garages to living spaces, increased numbers of multiple generational households under one roof, and expansion of homes to accommodate more people per household. A study in the Bay Area comparing water consumption between 1996 and 2005 for low density residential sample areas, found an increase in water demands ranging from 6 to 12 percent due increased intensification of existing land uses (EBMUD, 2009).

Repurposing buildings – for example a train station housing retail stores or restaurants – will likely occur throughout the study area as the economy improves. Another trend is that cities are allowing underutilized industrial buildings to accommodate more customer related functions, such as will-call centers or sports activities, resulting in more employees and customers per acre.

The most prominent trend discussed at the land use agency meetings and observed in the analysis of existing land uses, is the overall increased densities of residential land use occurring and planned in the study area. Increased residential densities have the greatest potential for increasing water demands on a per acre basis, although actual demands decrease on a per dwelling unit and per capita basis due to the reduction of outdoor landscaping associated with compact residential growth.



New multi-family construction has higher densities than older buildings.

Compact development is evident in the land use inventory data that shows the majority of land uses are low density residential but the greatest increase in residential land use is associated with very high density residential use. Each community is planning for higher densities and in general, developers are maximizing allowable densities as cities experience frequent general plan amendment requests. Smart growth is a concept typically associated with compact development along and near transportation corridors, and this trend is being observed in the cities' promoting a revitalization of their downtowns and near Metrolink stations.

Another form of intensification is typically found with the development of small infill parcels that are too small, less than five acres, to be identified on the GIS existing land use layer. However, for this analysis, because much of the existing land use data provided in the GIS parcel files needed clarification, it provided an opportunity to specifically identify many of these small vacant lots. They were therefore included with the land use inventory as vacant, instead of being included as another factor to consider in the development of an intensification adjustment factor.

The intensification adjustment factor was determined using economic data developed for the IRP. The impact to water demands associated with strong market conditions alone, were estimated to increase demands by seven percent. A more conservatively lower estimate of six percent by 2040, with an extrapolation from 2015 for interim demands, was applied in the Demand Model.

In the future when individual customer meters are geocoded and consumption data can be linked and saved in the Demand Model GIS, it is recommended that sample areas be analyzed to compare consumption patterns of older development to newer development of similar land use. This historical comparison data will contribute to quantifying part of the intensification adjustment factor.

### 4.3.4 Conservation

Conservation savings associated with plumbing code changes and water use efficiency programs were determined in IEUA's 2015 Wastewater Facilities Master Plan. Flow monitoring of older residential developments compared with new homes indicated a reduction of indoor flows from an average of 55 gallons per capita per day (GPCD) to 37 GPCD. The proportional share of this indoor reduction on total 2040 residential demands is approximately 2.8 percent. This 2.8 percent at 2040, with an extrapolation from 2015 for interim demands, was used as the conservation adjustment factor and applied to the member agencies' land uses in the Demand Model.

### 4.3.5 Other

The Demand Model has an additional tab in the adjustment factors to allow the user to conduct demand management or other scenarios. The conservation adjustment factor addresses the indoor plumbing code and other efficiency savings, but the "Other" adjustment factor tab could be used by IEUA or its member agencies to study savings potential associated with conservation program scenarios for different land uses.

## 4.4 Future Land Use Unit Demands

There are over 2,000 adjustment factors in the Demand Model. Tables with these adjustment factors can be found in Appendix D. The adjustment factors for each member agency, are applied in the Demand Model to the Existing LUDs to generate Future LUDs, for each land use under each planning period and each member agency. Appendix D Land Use Unit Demands, contains tables of the resulting LUDs after they were adjusted. The LUDs are applied in the Demand Model to the acreage inventories for each member agency to calculate the total production water demands.

# 5 WATER DEMAND PROJECTIONS

Based on the land use GIS layers (existing and future) and the LUDs (existing and future) developed for each member agency, future demands for each land use within each member agency were calculated. This process is summarized in this section along with a discussion of other projection methodologies. Use of the Demand Model is also summarized here with a reference to the User Guide.

## 5.1 Demand Projections through 2040

Future demands were calculated in the Demand Model by applying the Final LUDs (Appendix D) to the acreage inventories of land use for each member agency's service area. This resulted in a total IEUA demand of approximately 278,040 AF at 2040, a 38 percent increase over 2015 normalized production demands (production demands include system losses). Table 5-1 and Figure 5-1 presents the water demands for the IEUA service area for existing normalized 2015, and projected years 2020, 2025, 2030, 2035, and 2040.

**Table 5-1: Demand Projections for IEUA**

| Land Use (du/ac) | Five Year Incremental Demand Projections (AF) | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Residential Very Low (<1 - 2) | 15,761 | 16,753 | 18,097 | 18,557 | 18,778 | 21,303 |
| Residential Low (3 - 7) | 73,060 | 75,949 | 80,499 | 84,647 | 88,824 | 94,202 |
| Residential Medium (8 - 14) | 16,012 | 18,376 | 20,967 | 24,117 | 25,806 | 33,264 |
| Residential High (15 - 24) | 18,611 | 21,212 | 25,739 | 27,062 | 27,752 | 28,827 |
| Residential Very High (25+) | 2,634 | 2,904 | 3,300 | 5,105 | 6,009 | 8,292 |
| Commercial | 19,607 | 19,922 | 20,885 | 24,281 | 27,068 | 29,455 |
| Industrial | 6,974 | 7,601 | 8,143 | 8,318 | 8,436 | 8,529 |
| Public/Institutional | 7,285 | 7,354 | 7,627 | 7,746 | 8,138 | 8,257 |
| Parks, Schools, Irrigation | 32,890 | 33,607 | 33,756 | 35,988 | 36,975 | 38,926 |
| Agriculture | 2,274 | 1,466 | 1,188 | 559 | 309 | 23 |
| Unique Water User #1 | 3,848 | 3,872 | 3,878 | 3,903 | 3,926 | 3,949 |
| Unique Water User #2 | 1,487 | 1,498 | 1,507 | 1,515 | 1,523 | 1,533 |
| Unique Water User #3 | 1,068 | 1,074 | 1,082 | 1,088 | 1,095 | 1,101 |
| Unique Water User #4 | 368 | 371 | 373 | 375 | 377 | 379 |
| | **201,879** | **211,959** | **227,041** | **243,261** | **255,016** | **278,040** |

On Figure 5-1, total IEUA demands are shown using the shaded area and values read from the right vertical axis. The individual member agency demands are shown using different lines and values are reads from the left vertical axis.

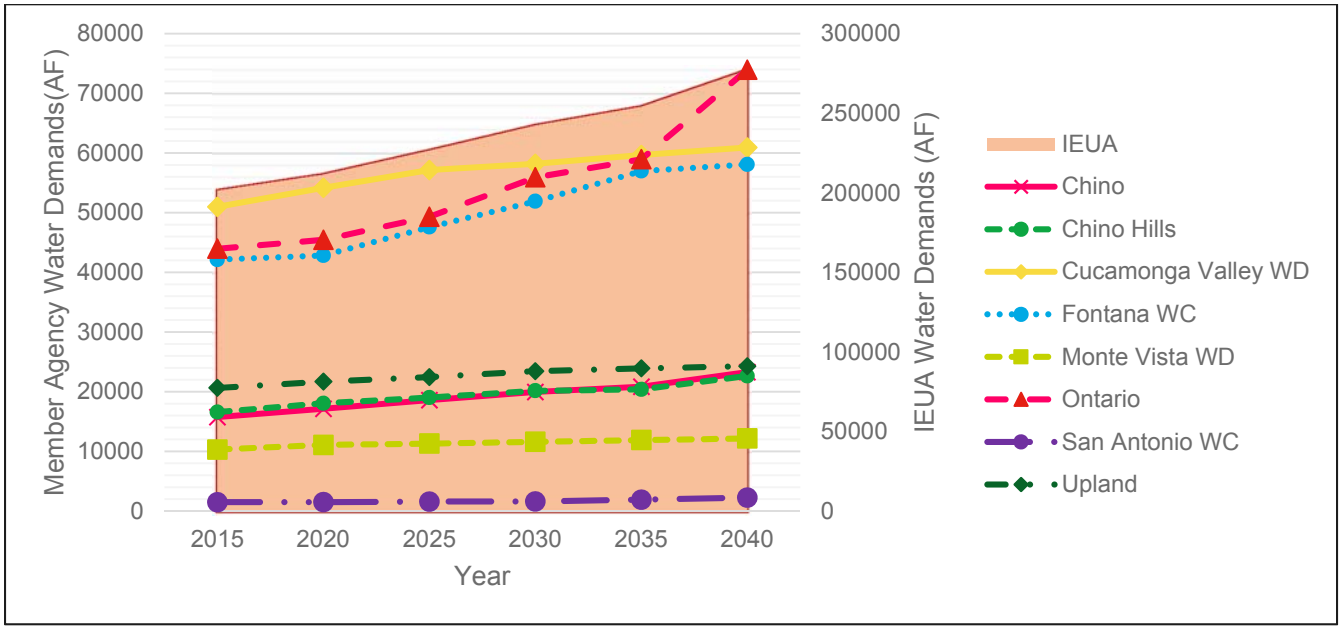



**Figure 5-1: Demand Projections by Member Agency**

As shown on Figure 5-1, total water demands increase gradually between 2015 and 2035 with a slightly steeper curve between 2035 and 2040. The steeper curve in later years is primarily attributed to the large amounts of residential land uses to be developed in Ontario's New Model Colony. Development this land is anticipated to be at the outer end of the study planning horizon. Appendix E contains tables of the resulting projection of water demands by member agency and combined into a total IEUA demand.

Because the projections do not include active conservation efforts, these projections should be considered an upper end. If the City of Ontario's New Model Colony developments are delayed, its projections will likely extend beyond 2040.

There are many methodologies used to project water demands, ranging from simple per capita projections to complex, data-intensive econometric models. The various methodologies rely on different data and assumptions in trying to project future conditions in a changing environment. The land use based demand projections are typically within approximately 10 percent above and 10 percent below actual demands when smoothed to remove annual climatic influences, assuming nothing significant occurs like a great recession. If something significant occurs, since the demands are based on general plan land uses, the later date projections typically remain while interim demands recover.

Different methods can result in slightly or significantly different projections. Per capita projections are inexpensive and simple to develop because they rely on easily available data. However, they are not rigorous, and do not reflect the complexities of water demand patterns or different community characteristics. Therefore, although the results may be consistent with land use based demands for the first few years, as the land use composition (changing percentage of each land use) and characteristics (e.g., higher densities) change over time to reflect that planned for by the community, the per capita demands do not reflect these changing conditions.

Econometric models can be rigorous if socioeconomic data are available and used, as with the IEUA IRP model. These models are typically more cost effective for large service areas, such as Metropolitan Water

District (MWD) or IEUA as a region, to capture regional demographic, economic, and other (e.g., climate change) characteristics and trends that are not site specific to smaller entities. IEUA's econometric model demand projections were similar to the land use based demand projections. Several of its analytical analyses quantifying demand characteristics, such as passive conservation, economic rebound, and climate change, were of particular value to the Demand Model, as presented in this TM.

In summary, different demand projection methodologies will result in different projections. The more rigorous methodologies typically result in projections within a range of plus 20 percent and minus 20 percent of each other. This may be attributable to the use of underlying source data. The similarity in projections of the land use based Demand Model and the IRP econometric model (within four percent) provides a very high level of confidence to use the results as a reliable predictor for future planning projects.

It is recommended that demand projections be updated every ten years or less. This will ensure that changing community characteristics are captured, and that accurate projections are continually relied on for planning purposes.

## 5.2 Use of Demand Model

The land use based Demand Model (welcome menu screenshot presented on Figure 5-2) was developed to perform the calculations described in the previous sections. The major inputs to the model included city general plans, parcel data, city boundaries, IEUA retail agency SOIs in GIS format, and LUDs calculated as described in sections 4.3 and 4.4.

The main purpose of the Demand Model was to provide detailed, rigorously developed demand projections for each member agency. The model does that, as well as test various scenarios to study the effects of conservation, for example, through the use of adjustment factors. The resulting projections described in Section 5.1 were developed using the best available data at a point in time.

As the cities and communities in IEUA's service area develop and change over time, the demand projections can be updated based on new data. For example, if new growth areas in the City of Ontario, which has large land areas converting from agricultural uses to urban over an extended period of time, change land use designations to higher densities than now planned, the acreage inventories can be modified through changes to the GIS files. The model would be re-run to determine the effect on the city's or IEUA's overall demand. Another example is with the intensification of the older commercial areas in the IEUA service area; higher densities are being proposed by developers for underutilized and infill sites. The land use categories can be easily modified in the GIS files to reflect these approved changes and the model re-run. The underlying GIS files and LUDs can also be updated if the development timelines assumed in this study change or updated LUDs are calculated by retail agencies. Appendix F contains a User Guide as a reference document to run these scenarios. The Demand Model, created in Microsoft Access, is completely open and customizable if IEUA or its member agencies choose to add more features in the future.

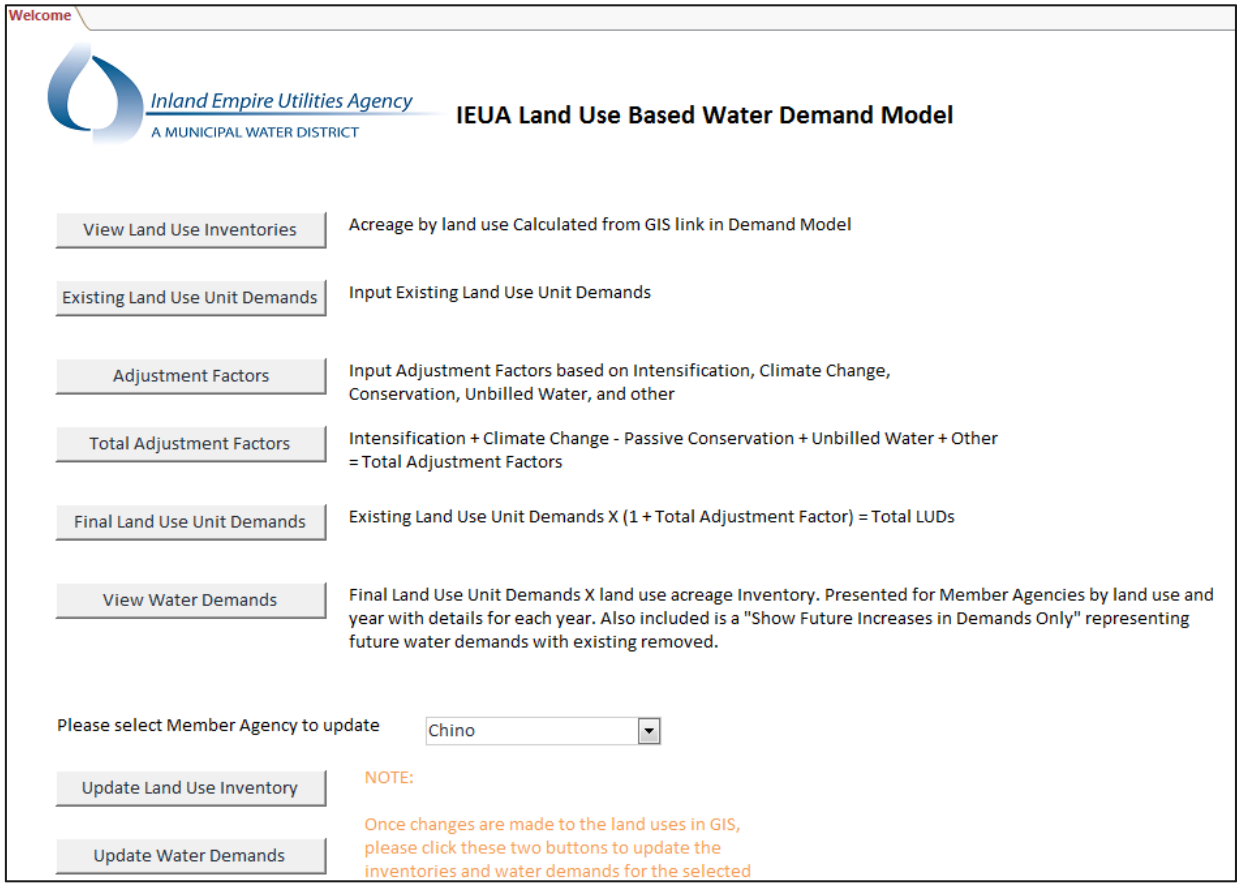



**Figure 5-2: Land Use Based Demand Model Screenshot**

# 6 REFERENCES

EBMUD, 2009. *2040 Demand Study*, Water Supply Management Program 2040. Prepared by East Bay Municipal Utility District, Karen Johnson Water Resources Planning, and EDAW/AECOM. February 2009.

IEUA, 2016. *Integrated Resources Plan – Draft Demand Forecast*. Prepared by Inland Empire Utilities Agency. Draft February 2016.

NOAA, 2013. *Regional Climate Trends and Scenarios for U.S. National Climate Assessment, Part 5. Climate of the Southwest US*. Technical Report NESDIS 142-5 prepared by the National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service (NESDIS). January 2013.

# APPENDIX A

## Land Use Categories

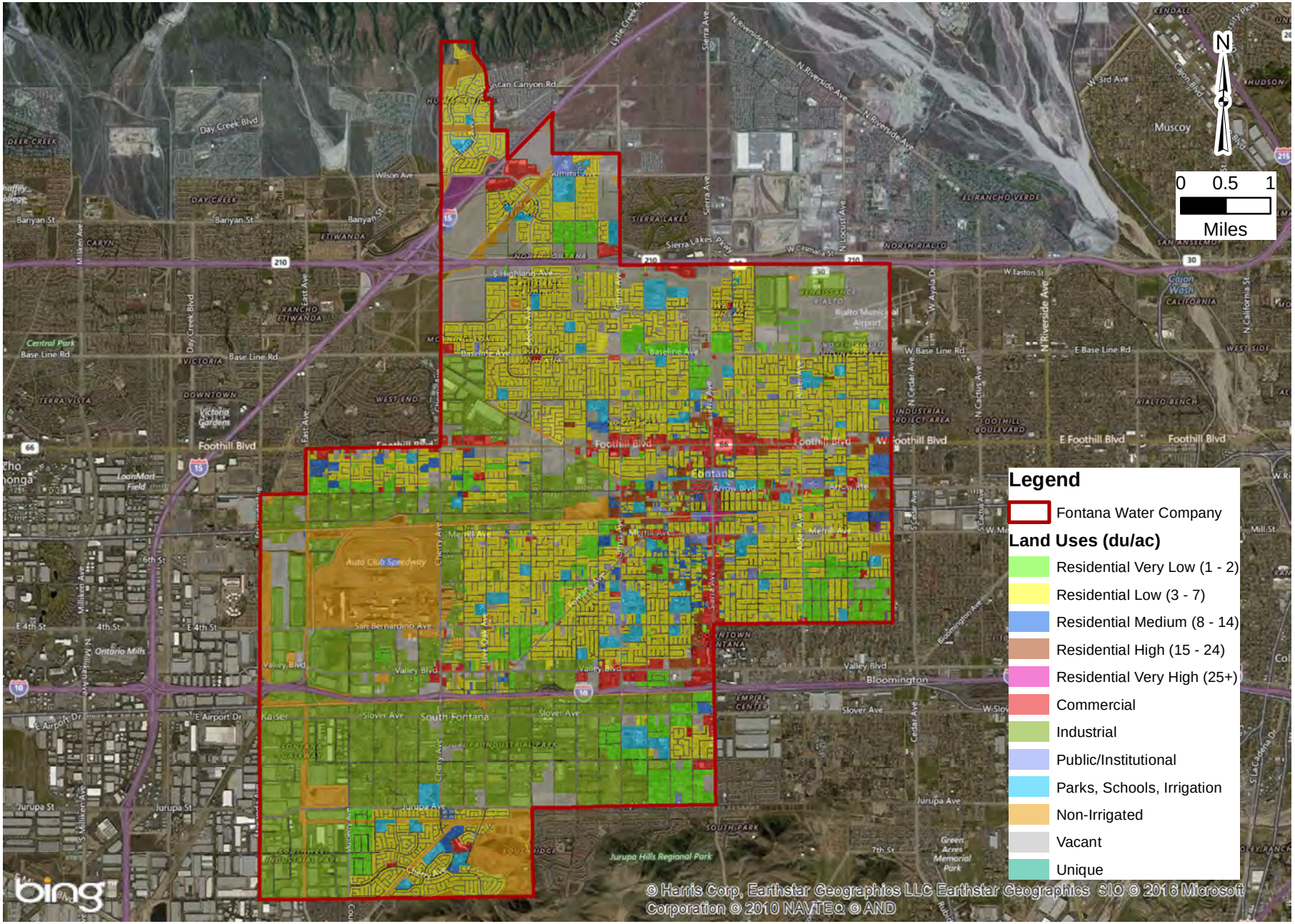
# Appendix A - Land Use Categories

| Master GP LU Categories | Density (du/ac) | City of Chino: Chino GP Land Uses | Density (du/ac) | City of Chino Hills: Chino Hills GP Land Uses | Density (du/ac) | City of Fontana: Fontana GP Land Uses | Density (du/ac) | City of Montclair: Montclair GP Land Uses | Density (du/ac) | City of Ontario: Ontario GP Land Uses | Density (du/ac) | City of Rancho Cucamonga: Rancho Cucamonga GP Land Uses | Density (du/ac) | City of Rialto: Rialto GP Land Uses | Density (du/ac) | City of Upland: Upland GP Land Uses | Density (du/ac) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Residential** | | Agriculture | | Agriculture/Ranches | 0-0.2 | | | | | | | Hillside Residential | 0.1-2 | Residential 2 | 0-2 | SFR | 0-2 |
| **Very Low** | <1.0-2.0 | RD 1 | 0-1 | Rural Residential | up to 2 | Residential Estates | 2.0 | Very Low | 0-2 | Rural | 0-2 | Very Low | 0.1-2 | | | SFR | 2-3 |
| | | RD 2 | 1-2 | | | | | | | | | | | | | | |
| **Low** | 3.0-7.0 | RD 4.5 | 3-4.5 | Low Density Res | up to 6 | Single Family Res | 2.1-5 | | | | | Low | 2-4 | Residential 6 | 2.1-6 | SFR | 3-4 |
| | | | | | | Residential Planned Community | 3-6.4 | Low | 3-7 | Low Density | 2.1-5 | Low Medium | 4-8 | | | SFR | 4-6 |
| | | RD 8 | 4.5-8 | | | Medium Density Res SFR detached | 5.1-7.6 | | | | | | | | | | |
| **Medium** | 8.0-14.0 | | | Medium Density Res | up to 12 | SFR attached or MFR | 7.7-12 | Medium | 8-14 | Low-Medium Density | 5.1-11 | Medium | 8-14 | Residential 12 | 6.1-12 | SFR | 7-10 |
| | | RD 12 | 8-12 | | | | | | | | | | | | | MFR / Condo | 7-12 |
| | | RD 14 | 12-14 | | | | | | | | | | | | | Mobile Home | 8-14 |
| **High** | 15.0-24 | | | High Density Res | up to 25 | Multi-Family Res | 12.1-24 | High | 15-30 | Medium Density | 11.1-25 | Medium High | 14-24 | Residential 21 | 12.1-21 | MFR | 12-20 |
| | | RD 20 | 14-20 | | | | | Senior Housing | | | | High | 24-30 | | | MFR Condo | 12-20 |
| | | Mixed Use 20 | 0-20; 1.25 FAR | | | | | | | | | | | | | | |
| **Very High** | 25.0+ | Mixed Use 30 | 0-30; 1.5 FAR | Very High Density Res | up to 35 | MFR Medium/High | 24.1-39 | | | High Density | 25.1-45 | | | Residential 30 | 22.1-30 | | |
| | | | | | | MFR High | 39.1-50 | | | | | | | | | | |
| **Mixed Uses were identified by actual planned uses** | | College Park Specific Plan | | Mixed Use | NA | Regional Mixed Use | 12-24 du/ac; 0.1-1.0 FAR | Planned Development (i.e., mixed uses) | | Mixed Uses: 12 identified areas | | Mixed Use: 13 identified areas | 0.25-1.0 | Downtown Mixed Use | 6.1-60 du/ac; 1.5 FAR | Specific Plans: 3 areas | |
| | | The Preserve Specific Plan | | | | | | | | | | Haven Ave Office Overlay | | Specific Plan Overlay | | | |
| **Commercial** | | Office Commercial | 1.0 FAR | Commercial | 0.3 FAR | Community Commercial | 0.1-1.0 FAR | Medical Center | | Hospitality | 1.0 FAR | Office | 0.4-1.0 | Office | 0.75 | Highway Commercial | |
| | | Neighborhood Commercial | 0.3 FAR | Business Park | 0.75:1 FAR | General Commercial | 0.1-1.0 FAR | Office Professional | | Office Commercial | 0.75 FAR | Neighborhood Commercial | 0.25-0.35 | Community Commercial | 0.35 | Central Trading | |
| | | General Commercial | 1.0 FAR | | | | | Neighborhood | | Neighborhood | | | | Business Park | 1.0 | Commercial Professional | |
| | | Regional Commercial | 0.6 FAR | | | | | Commercial | | Commercial | 0.4 FAR | Community Commercial | 0.25-0.35 | | | Office Only | |
| | | Business Park | 0.6 FAR | | | | | General Commercial | | General Commercial | 0.4 FAR | | | | | Transit Commercial | |
| | | Service Commercial | 0.6 FAR | | | | | Regional Commercial | | Business Park | 0.6 FAR | | | | | Regional Commercial | |
| | | | | | | | | Business Park | | | | | | | | Neighborhood Business - Specialty | |
| | | | | | | | | | | | | | | | | Neighborhood Conservation | |
| | | | | | | | | | | | | | | | | Mixed Use: Commercial/Industrial | |
| **Industrial** | | Light Industrial | 0.6 FAR | | | Light Industrial | 0.1-0.6 FAR | Industrial Park | | Industrial | 0.55 FAR | Industrial Park | 0.4-0.6 | Light Industrial | 1.0 | Light Industrial | |
| | | General Industrial | 0.6 FAR | | | General Industrial | 0.1-0.6 FAR | Limited Manufacturing | | Airport | | General Industrial | 0.5-0.6 | General Industrial | 1.0 | Industrial/Loft Mixed | |
| | | | | | | | | | | | | Heavy Industrial | 0.4-0.5 | | | Neighborhood Industrial | |
| | | | | | | | | | | | | | | | | Cable Airport | |
| | | | | | | | | | | | | | | | | Light Industrial/Neighborhood | |
| **Public/ Institutional** | | Public | | Institutional/Public | 0.5:1 | Public Facilities | 0.1 FAR | Public/Quasi Public Community Plan (unincorporated Narod Tract and Kadota Homes Tract) | | Public Facility | | Civic/Regional | 0.4-1.0 | Public Facility | 1.0 | | |
| | | | | Commercial Recreation | 0.10:1 | Activity Center Overlay | 7.1-24 du/ac; 0.1-1.0 FAR | | | | | | | | | Public/Gvnt: civic center, schools, public works, hospital, etc. | |
| **Parks, Schools, Irrigation** | | Public Schools | | Public Park | | Recreational Facilities | 0.1 FAR | Neighborhood Park | | Public School | | Schools | 0.1-0.2 | School Facility | | Park | |
| | | | | Private Open Space (HOAs etc) | | | | | | Open Space - park land | | Parks | | Open Space Recreation | | | |
| | | | | | | | | | | Open Space - NonRecreation | | | | | | | |
| **Non-Irrigated Open Space** | | Recreation/Open Space | | CH State Park | | Open Space | | Conservation Basins | | Open Space - Water | | Open Space | | Open Space Resources | | Open Space | |
| | | Urban Reserve | | Public Open Space | | Public Utility Corridors | | | | Rail | | Conservation | | | | Flood Control | |
| | | | | | | | | | | | | Flood Control/Utility | | | | | |
| | | | | | | | | | | Landfill | | Corridor | | | | Reservoir | |
| **Agriculture** | | Agriculture | | | | | | | | | | | | | | Edison Easement | |
| | | | | | | | | | | | | | | | | Landfill closed | |

Land Use Demand Model

# APPENDIX B

## Land Use Maps



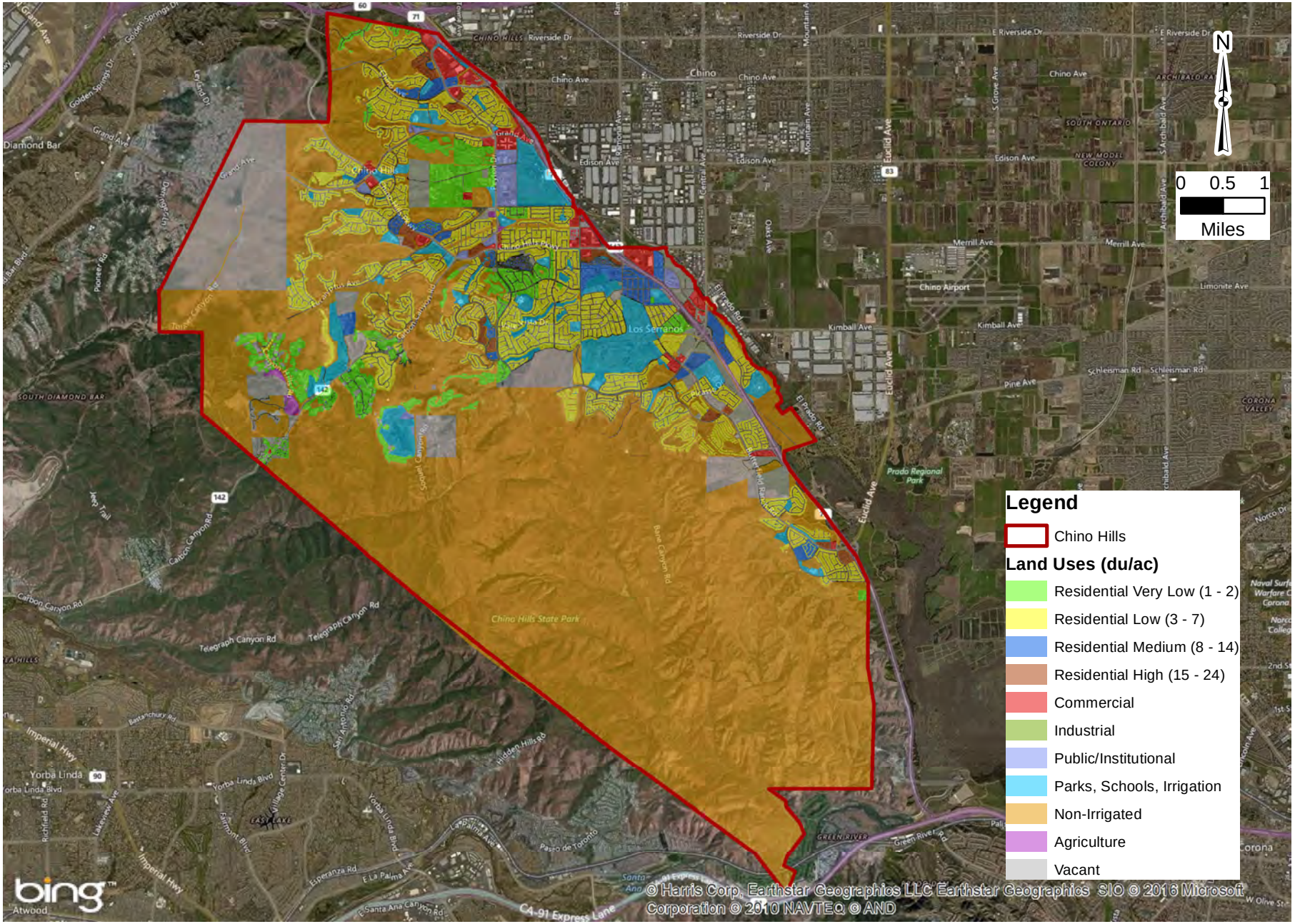

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Fontana Water Company – Existing Land Use**

ARCADIS

May 2016
FIGURE B-1



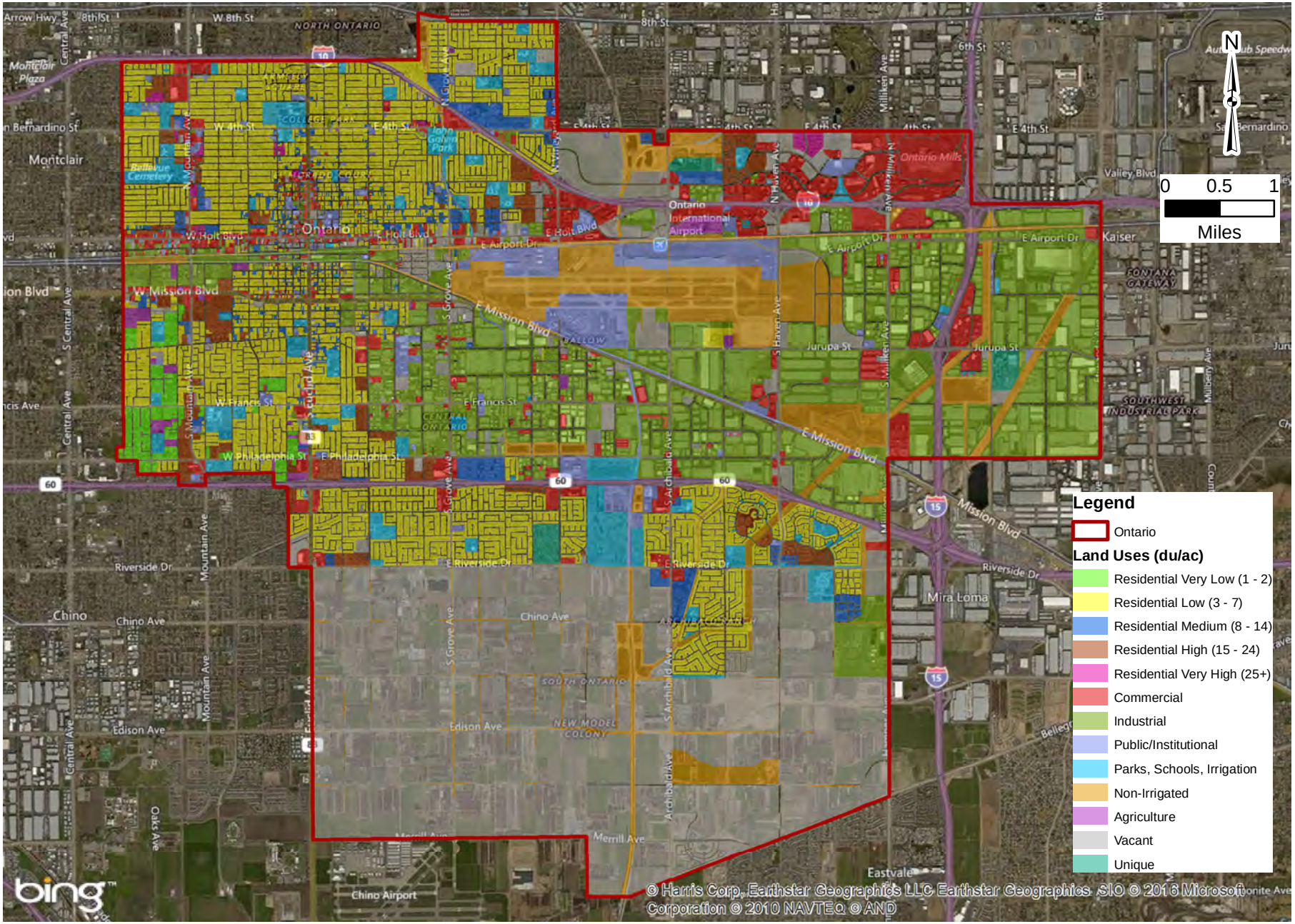

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino Hills – Existing Land Use**

ARCADIS

May 2016
FIGURE B-2



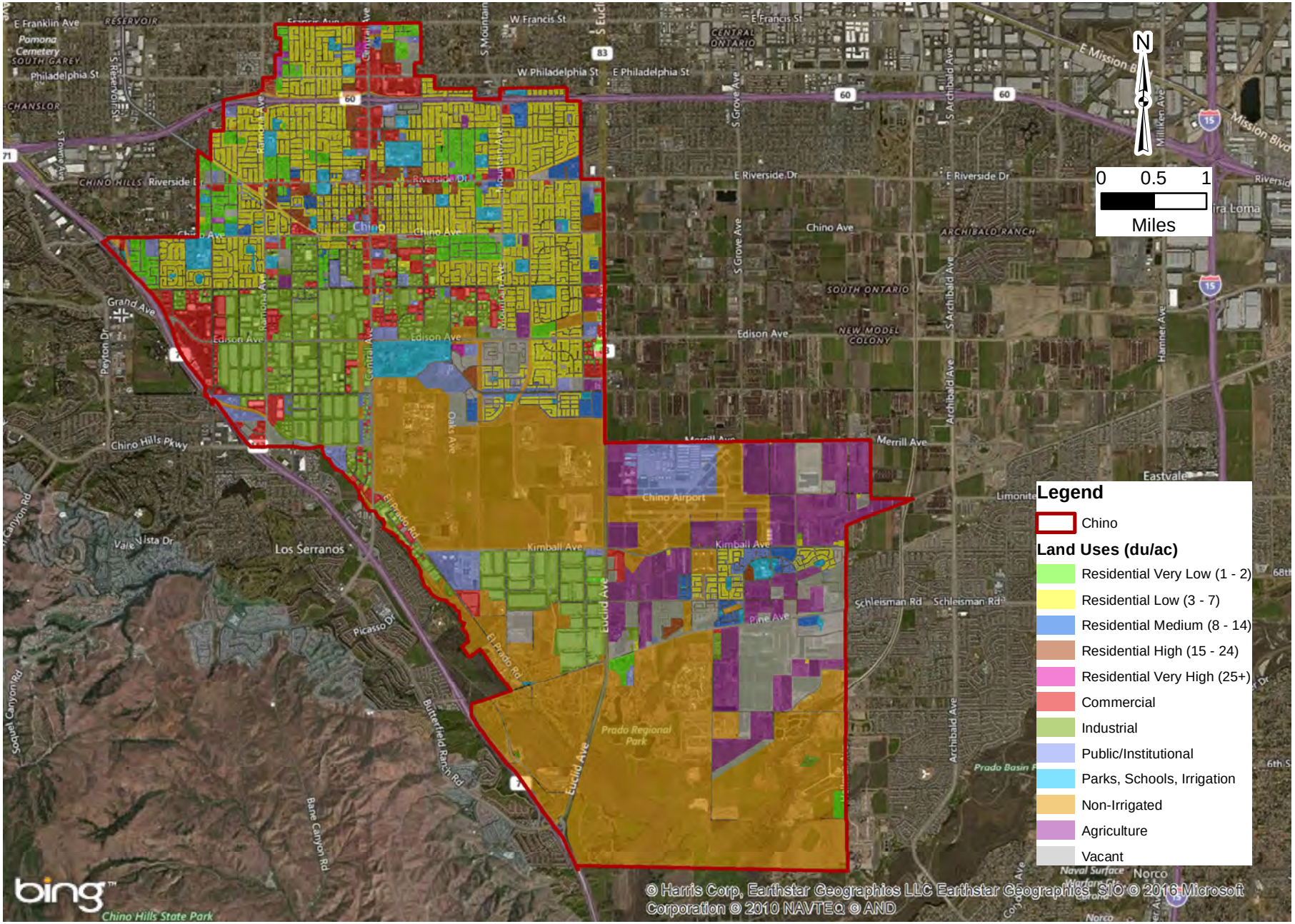

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Ontario – Existing Land Use**

ARCADIS

May 2016
FIGURE B-3



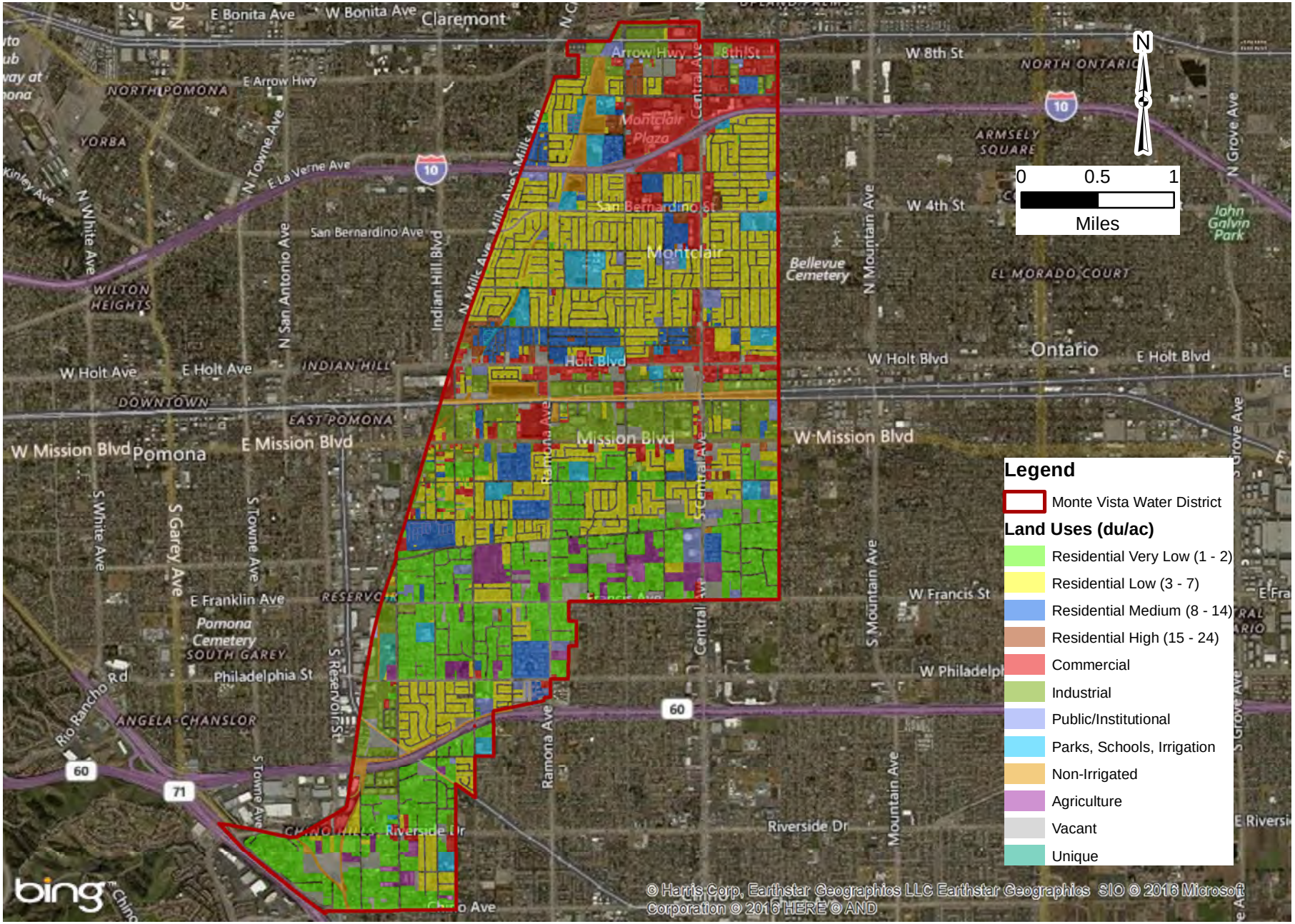

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino – Existing Land Use**

ARCADIS

May 2016
FIGURE B-4



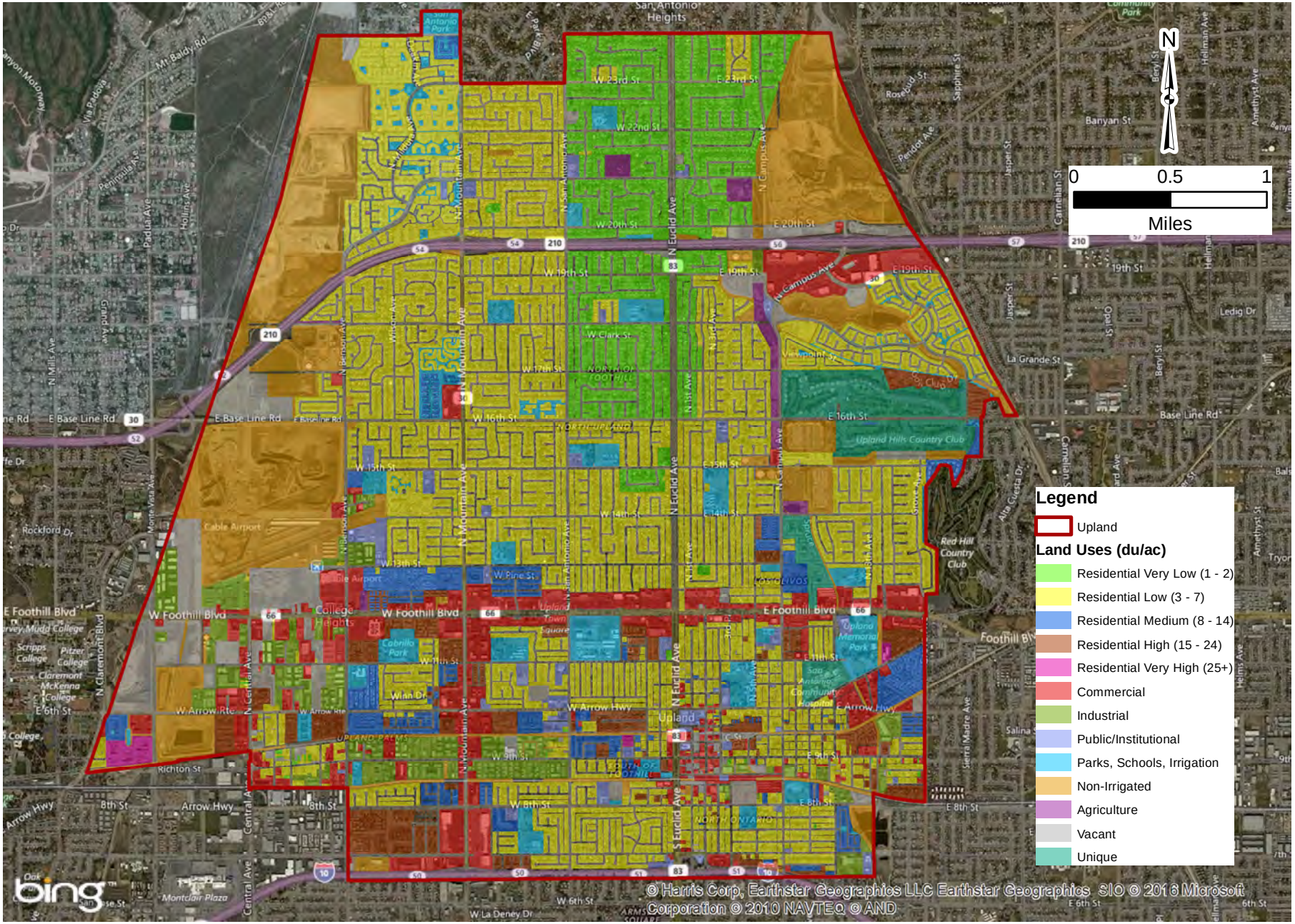

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Monte Vista Water District – Existing Land Use**

ARCADIS

May 2016
FIGURE B-5



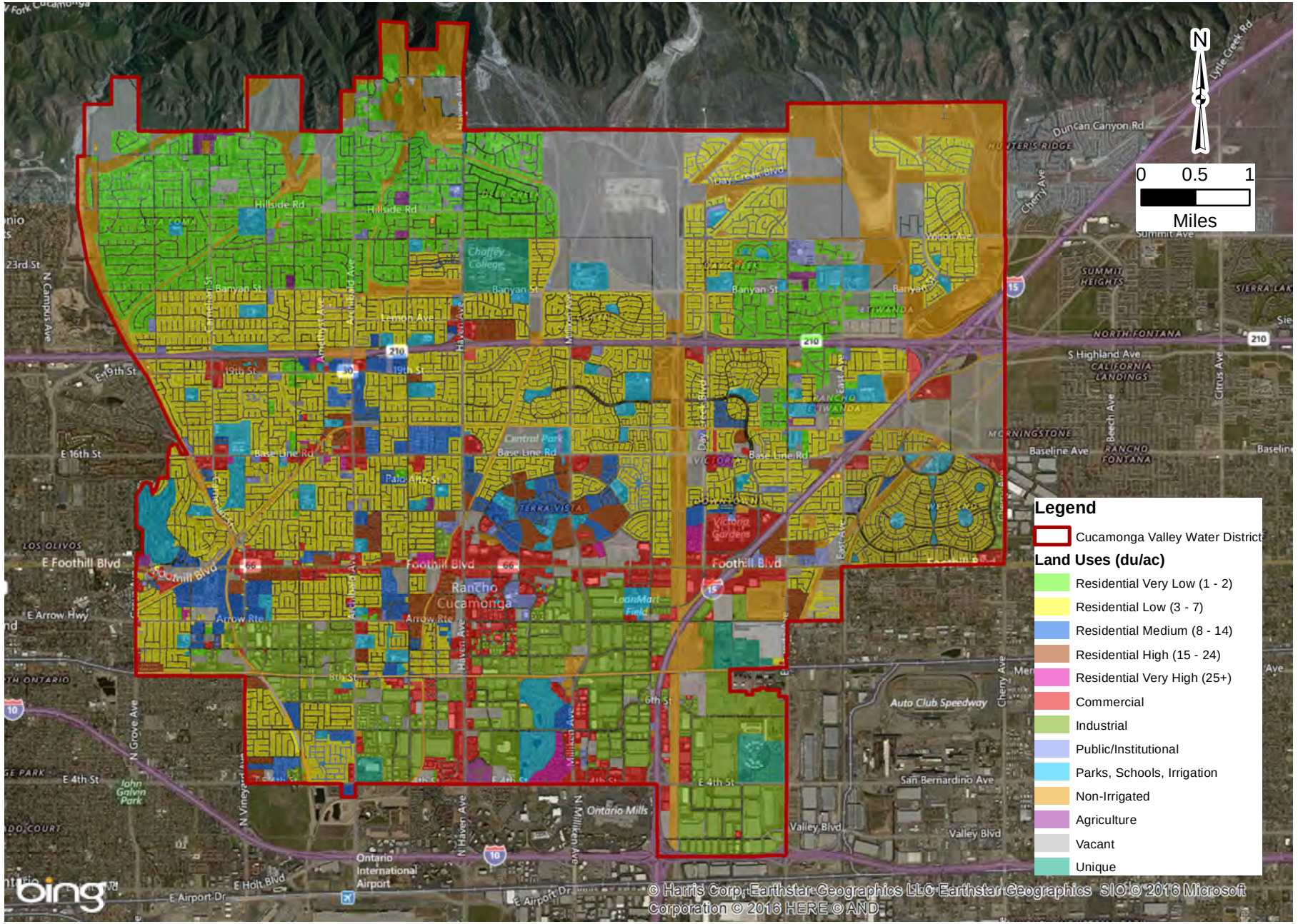

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Upland – Existing Land Use**

ARCADIS

May 2016
FIGURE B-6



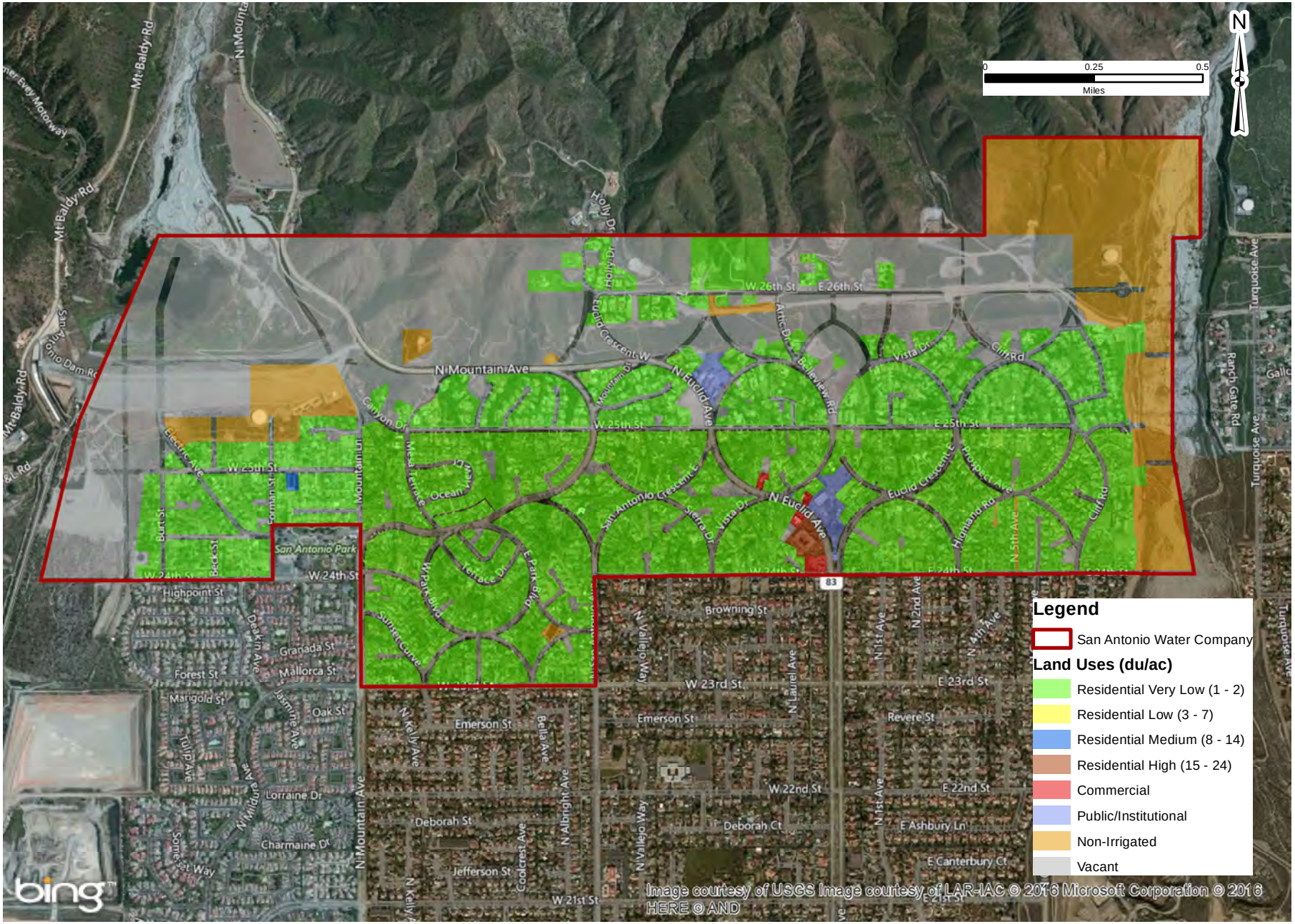

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Cucamonga Valley Water District – Existing Land Use**

ARCADIS

May 2016
FIGURE B-7



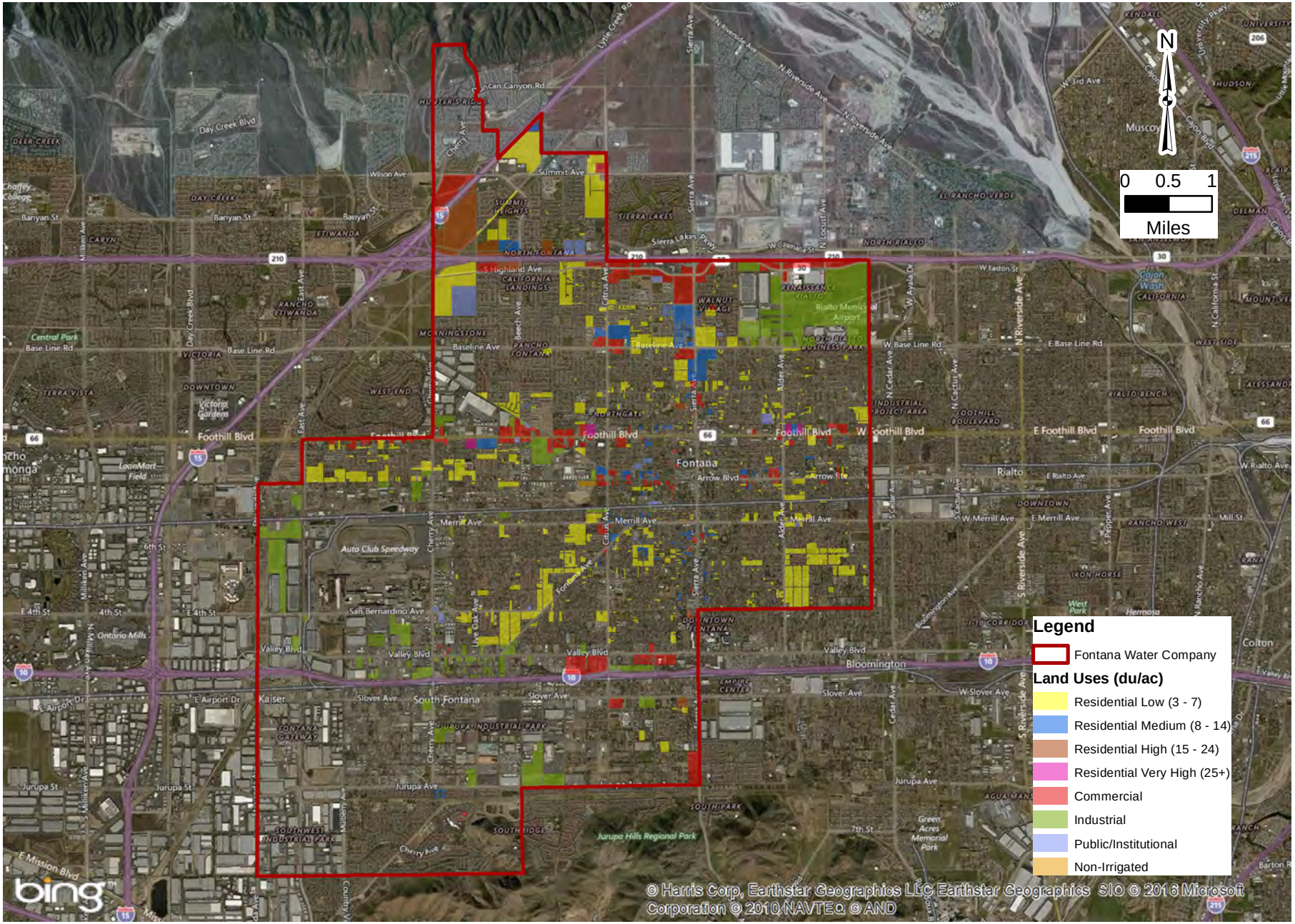

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**San Antonio Water Company – Existing Land Use**

ARCADIS

May 2016
FIGURE B-8



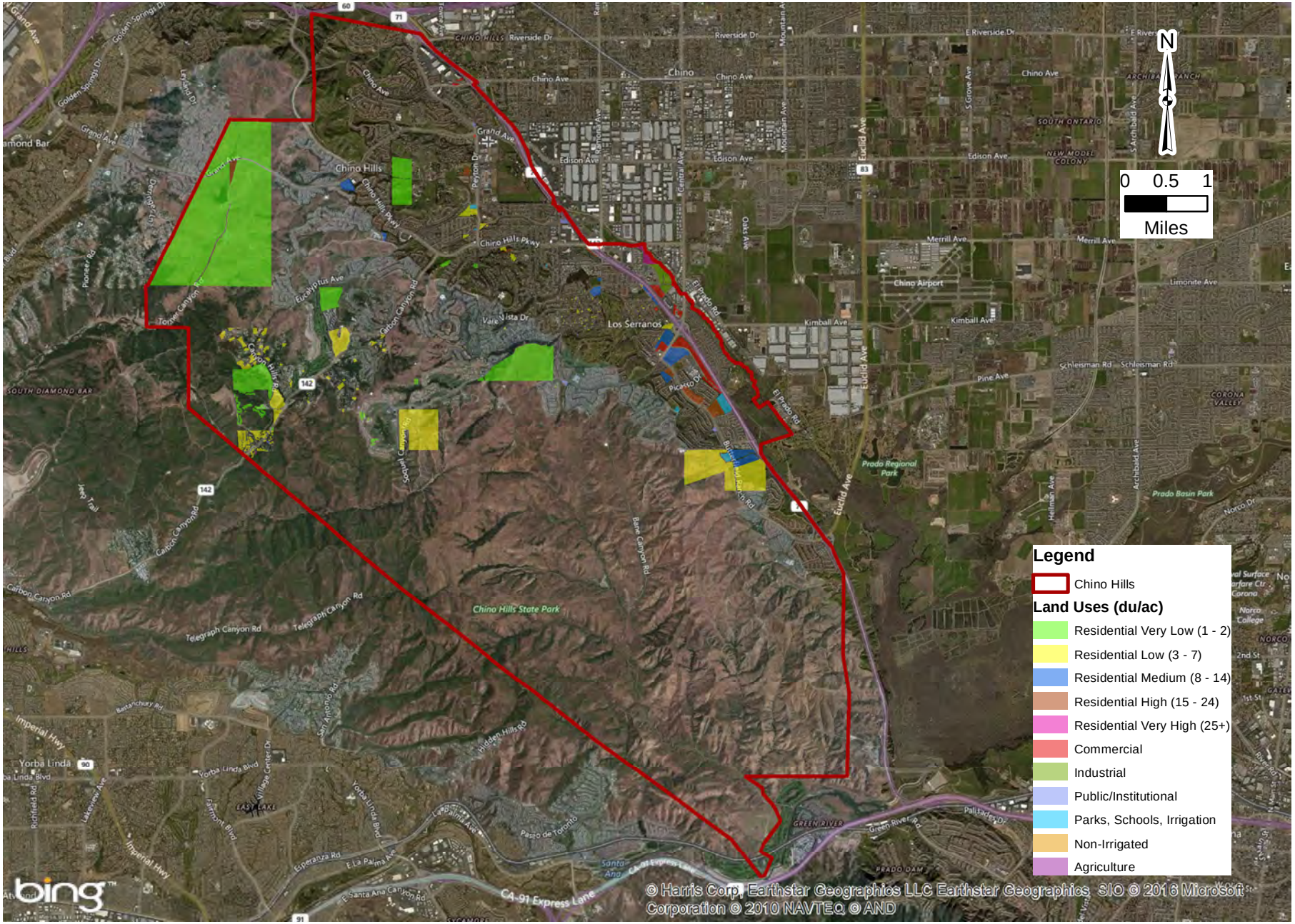

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Fontana Water Company – Future Land Use**

ARCADIS

May 2016
FIGURE B-9



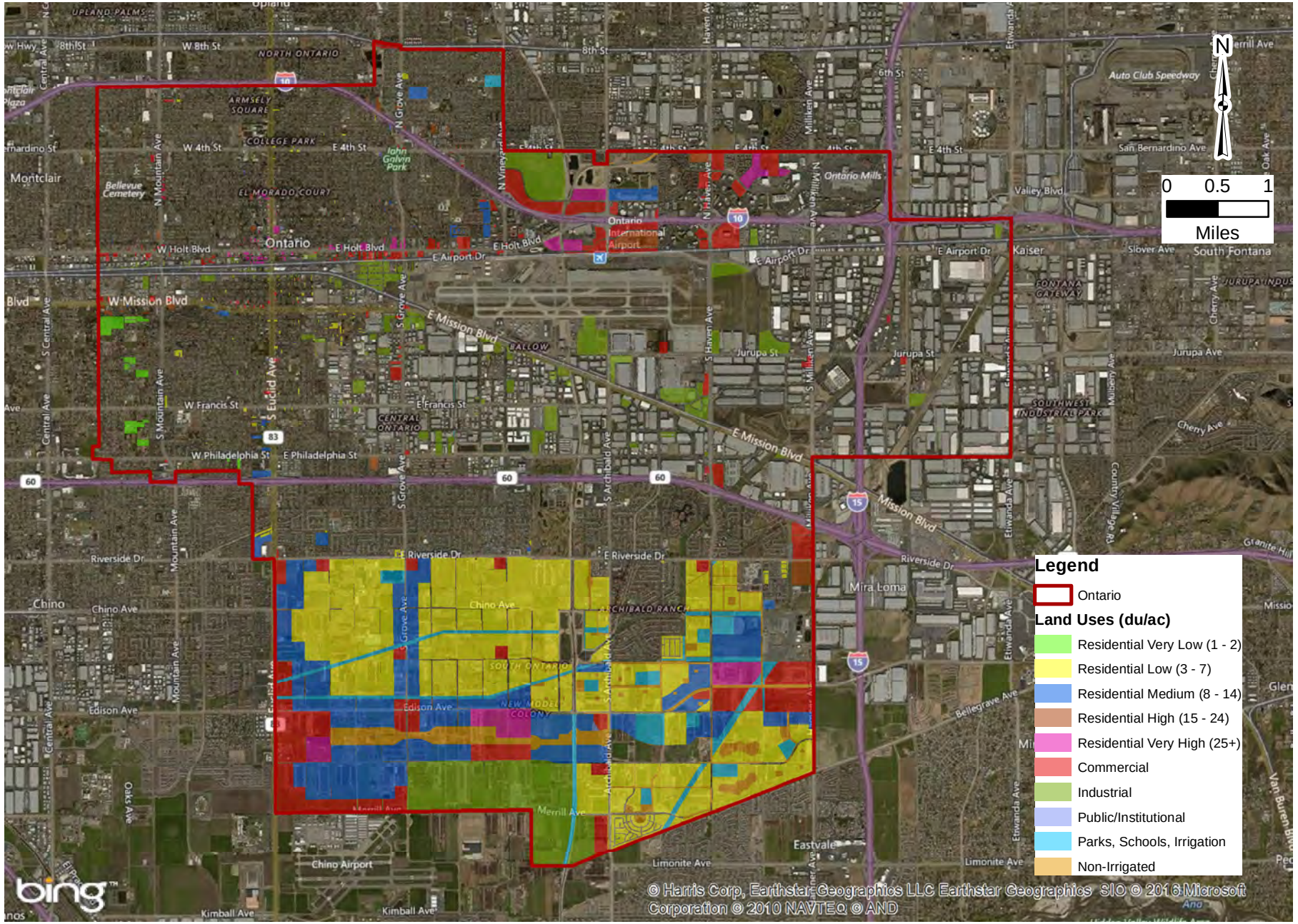

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino Hills – Future Land Use**

ARCADIS

May 2016
FIGURE B-10



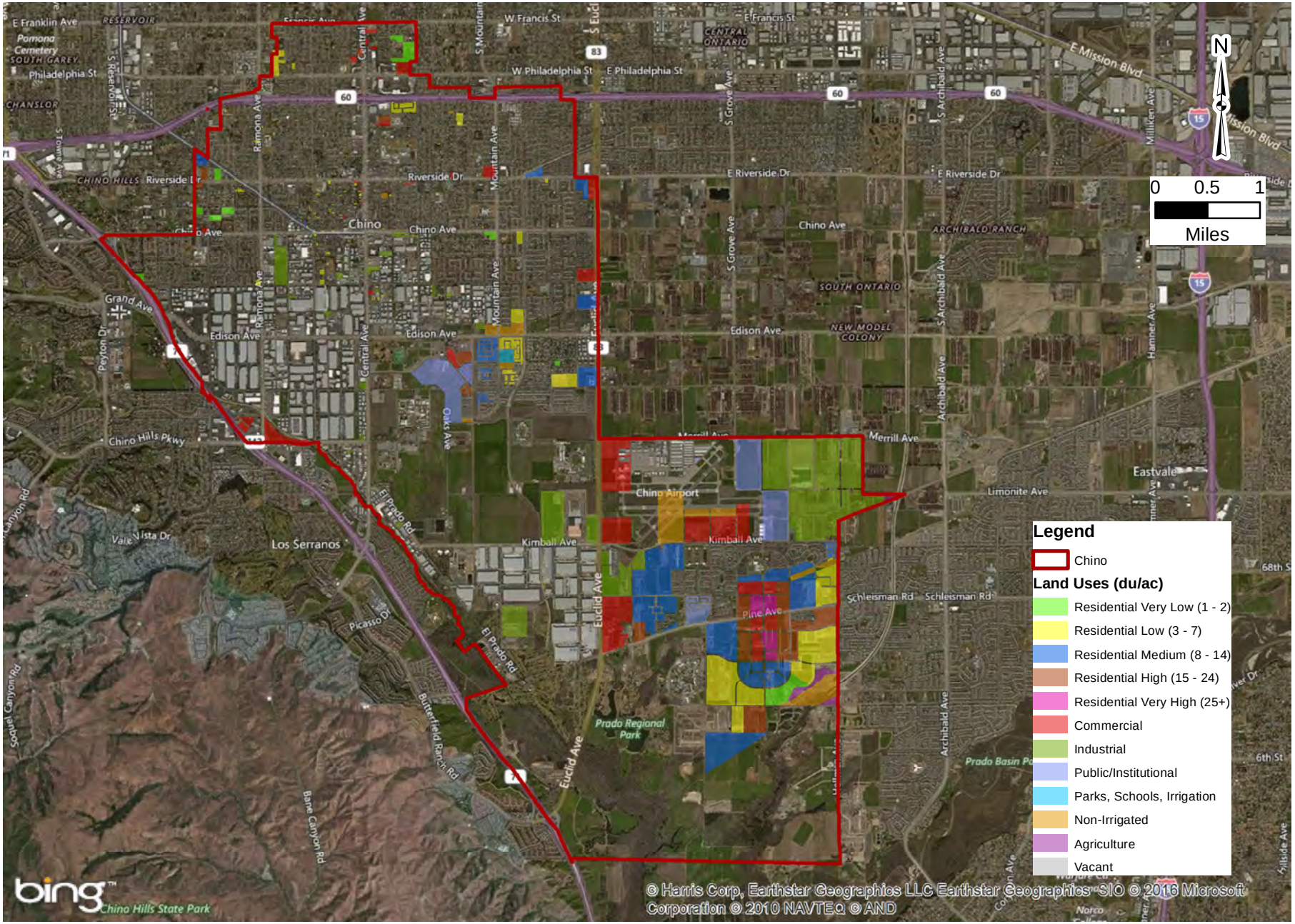

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Ontario – Future Land Use**

ARCADIS

May 2016
FIGURE B-11



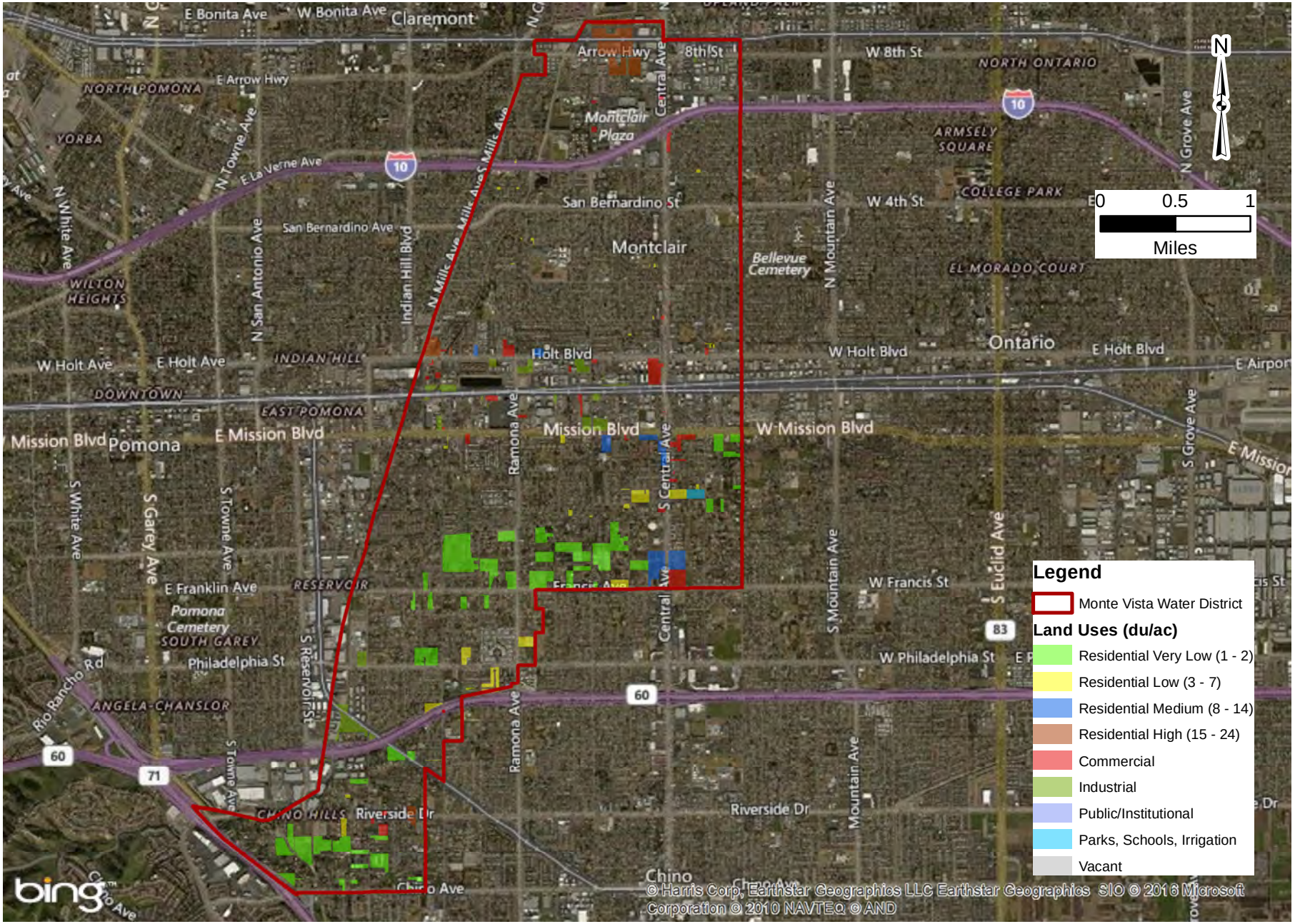

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino – Future Land Use**

ARCADIS

May 2016
FIGURE B-12



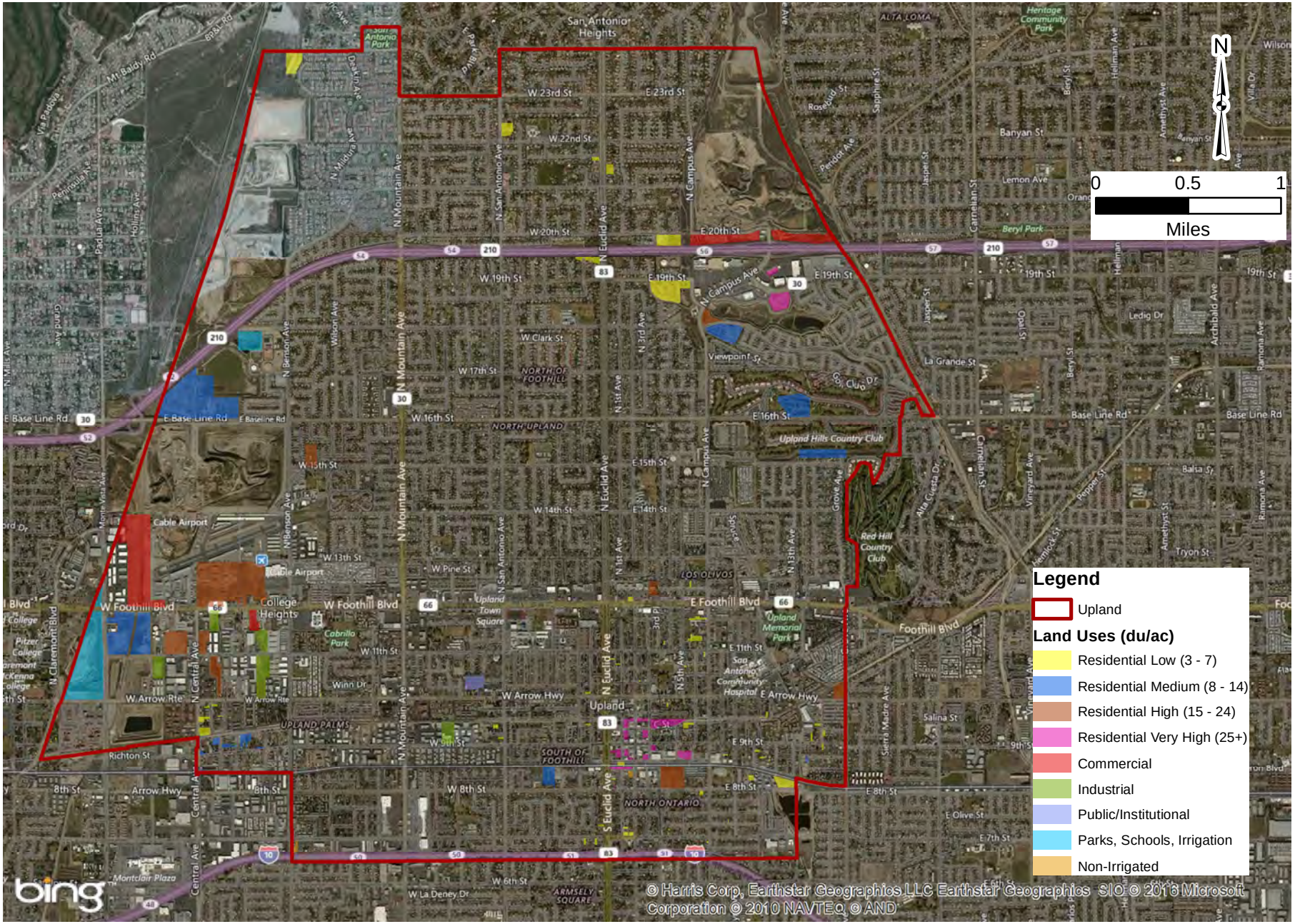

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Monte Vista Water District – Future Land Use**

ARCADIS

May 2016
FIGURE B-13



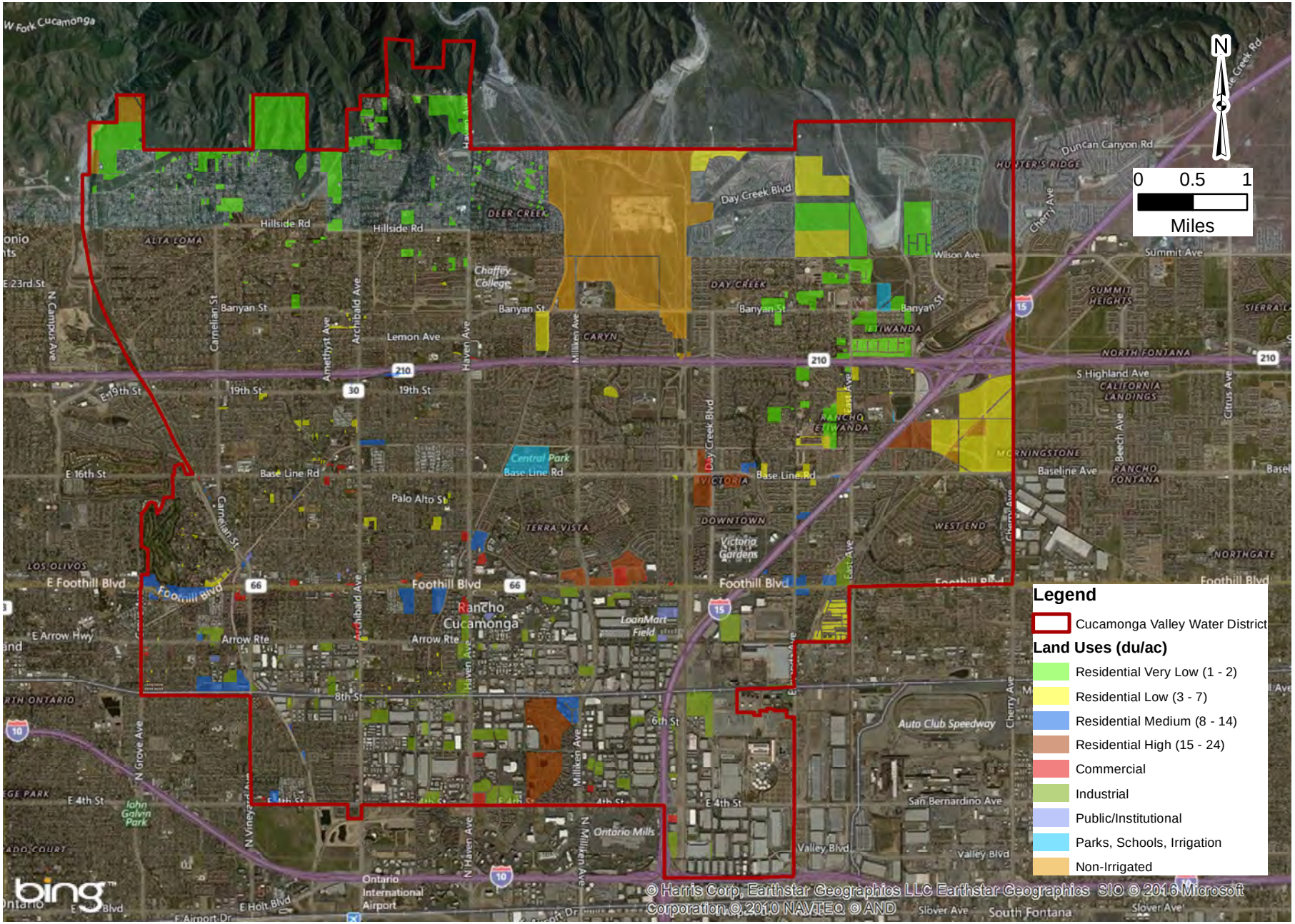

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Upland – Future Land Use**

ARCADIS

May 2016
FIGURE B-14



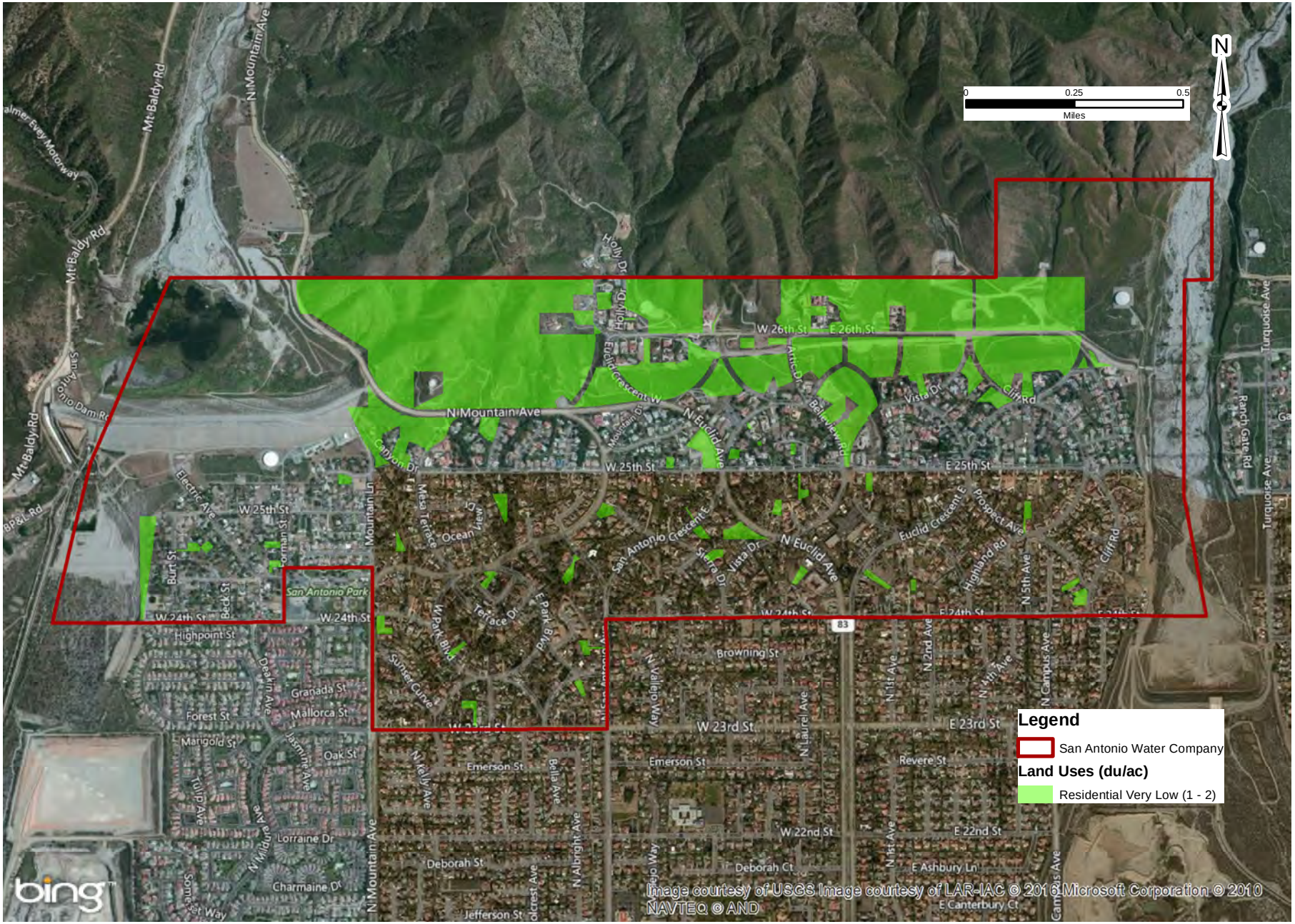

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Cucamonga Valley Water District – Future Land Use**

ARCADIS

May 2016
FIGURE B-15




Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**San Antonio Water Company – Future Land Use**

ARCADIS

May 2016
FIGURE B-16

# APPENDIX C

## Acreage Inventories

# Appendix C - Member Agency Acreages

**CHINO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 533 | 526 | 526 | 530 | 569 | 605 |
| Residential Low (3 - 7) | 2234 | 2286 | 2337 | 2365 | 2471 | 2602 |
| Residential Medium (8 - 14) | 204 | 312 | 528 | 631 | 636 | 754 |
| Residential High (15 - 24) | 205 | 267 | 267 | 315 | 321 | 411 |
| Residential Very High (25+) | 18 | 18 | 18 | 18 | 18 | 67 |
| Commercial | 894 | 923 | 953 | 1183 | 1195 | 1352 |
| Industrial | 2062 | 2611 | 2728 | 2746 | 2759 | 2771 |
| Public/Institutional | 793 | 806 | 806 | 806 | 959 | 1002 |
| Parks, Schools, Irrigation | 499 | 509 | 509 | 509 | 509 | 509 |
| Agriculture | 1497 | 1069 | 821 | 448 | 255 | 4 |
| Unique Water User #1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 6124 | 6096 | 6131 | 6132 | 6136 | 6137 |
| Undefined | - | - | - | - | - | - |
| Vacant | 1156 | 796 | 595 | 538 | 390 | 5 |
| **Total** | **16,222** | **16,222** | **16,222** | **16,224** | **16,221** | **16,222** |

**CHINO HILLS Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1034 | 1057 | 1411 | 1464 | 1464 | 2740 |
| Residential Low (3 - 7) | 2761 | 2973 | 3009 | 3290 | 3290 | 3290 |
| Residential Medium (8 - 14) | 413 | 479 | 480 | 488 | 488 | 494 |
| Residential High (15 - 24) | 174 | 210 | 215 | 219 | 219 | 228 |
| Residential Very High (25+) | 0 | 15 | 15 | 15 | 15 | 15 |
| Commercial | 369 | 387 | 420 | 430 | 430 | 430 |
| Industrial | 1 | 29 | 29 | 29 | 29 | 29 |
| Public/Institutional | 170 | 161 | 161 | 170 | 170 | 170 |
| Parks, Schools, Irrigation | 1277 | 1298 | 1298 | 1303 | 1303 | 1303 |
| Agriculture | 38 | 38 | 25 | 1 | 1 | 1 |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 18311 | 18294 | 18294 | 18294 | 18294 | 18294 |
| Undefined | - | - | - | - | - | - |
| Vacant | 2454 | 2059 | 1644 | 1300 | 1300 | 8 |
| **Total** | **27,002** | **27,000** | **27,001** | **27,003** | **27,003** | **27,002** |

# Appendix C - Member Agency Acreages

**CUCAMONGA VALLEY WATER DISTRICT Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 3206 | 3596 | 3895 | 4011 | 4178 | 4204 |
| Residential Low (3 - 7) | 6224 | 6481 | 6804 | 6827 | 6872 | 6876 |
| Residential Medium (8 - 14) | 869 | 928 | 1031 | 1031 | 1075 | 1076 |
| Residential High (15 - 24) | 652 | 745 | 959 | 975 | 975 | 988 |
| Residential Very High (25+) | 113 | 113 | 113 | 113 | 113 | 113 |
| Commercial | 1592 | 1611 | 1638 | 1643 | 1650 | 1651 |
| Industrial | 2675 | 2849 | 2984 | 3010 | 3011 | 3013 |
| Public/Institutional | 471 | 489 | 476 | 477 | 478 | 479 |
| Parks, Schools, Irrigation | 1326 | 1326 | 1165 | 1165 | 1185 | 1246 |
| Agriculture | 123 | 111 | 52 | 41 | 13 | 0 |
| Unique Water User #1 | 120 | 120 | 120 | 120 | 120 | 120 |
| Unique Water User #2 | 190 | 190 | 190 | 190 | 190 | 190 |
| Unique Water User #3 | 36 | 36 | 36 | 36 | 36 | 36 |
| Unique Water User #4 | 95 | 95 | 95 | 95 | 95 | 95 |
| Non-Irrigated | 3323 | 3312 | 4460 | 4517 | 4517 | 4517 |
| Undefined | 0 | 0 | 0 | 0 | 0 | 0 |
| Vacant | 3688 | 2703 | 687 | 452 | 196 | 100 |
| **Total** | **24,703** | **24,705** | **24,705** | **24,703** | **24,704** | **24,704** |

**FONTANA WATER COMPANY Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1534 | 1534 | 1492 | 1275 | 761 | 633 |
| Residential Low (3 - 7) | 6379 | 6392 | 6700 | 7051 | 7682 | 7823 |
| Residential Medium (8 - 14) | 360 | 360 | 390 | 578 | 624 | 624 |
| Residential High (15 - 24) | 320 | 320 | 519 | 524 | 544 | 544 |
| Residential Very High (25+) | 13 | 13 | 13 | 23 | 42 | 42 |
| Commercial | 930 | 934 | 973 | 1214 | 1524 | 1564 |
| Industrial | 5734 | 6306 | 6645 | 6708 | 6767 | 6806 |
| Public/Institutional | 231 | 231 | 317 | 335 | 362 | 362 |
| Parks, Schools, Irrigation | 861 | 861 | 861 | 861 | 861 | 861 |
| Agriculture | 65 | 65 | 65 | 7 | 7 | 7 |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 2370 | 2370 | 2371 | 2379 | 2379 | 2379 |
| Undefined | | | | | | |
| Vacant | 2870 | 2280 | 1320 | 711 | 113 | 21 |
| **Total** | **21,667** | **21,666** | **21,666** | **21,666** | **21,666** | **21,666** |

# Appendix C - Member Agency Acreages

**MONTE VISTA WATER DISTRICT Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1122 | 1122 | 1122 | 1251 | 1277 | 1345 |
| Residential Low (3 - 7) | 1388 | 1402 | 1403 | 1416 | 1428 | 1431 |
| Residential Medium (8 - 14) | 328 | 342 | 365 | 365 | 365 | 365 |
| Residential High (15 - 24) | 63 | 115 | 115 | 115 | 115 | 119 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 589 | 598 | 598 | 600 | 620 | 628 |
| Industrial | 528 | 516 | 516 | 520 | 541 | 543 |
| Public/Institutional | 127 | 128 | 128 | 129 | 137 | 137 |
| Parks, Schools, Irrigation | 223 | 223 | 223 | 223 | 228 | 228 |
| Agriculture | 167 | 167 | 146 | 46 | 27 | 0 |
| Unique Water User #1 | 16 | 16 | 16 | 16 | 16 | 16 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 195 | 195 | 195 | 195 | 195 | 195 |
| Undefined | | | | | 0 | 0 |
| Vacant | 261 | 184 | 180 | 132 | 58 | 0 |
| **Total** | **5,008** | **5,009** | **5,008** | **5,009** | **5,008** | **5,008** |

**ONTARIO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 271 | 280 | 293 | 334 | 334 | 335 |
| Residential Low (3 - 7) | 4532 | 4743 | 5397 | 5925 | 6215 | 7725 |
| Residential Medium (8 - 14) | 586 | 694 | 754 | 918 | 1060 | 2183 |
| Residential High (15 - 24) | 611 | 666 | 698 | 699 | 708 | 720 |
| Residential Very High (25+) | 62 | 66 | 93 | 200 | 239 | 364 |
| Commercial | 1777 | 1776 | 1888 | 2273 | 2337 | 2896 |
| Industrial | 5647 | 5939 | 6617 | 6774 | 6846 | 6904 |
| Public/Institutional | 1054 | 1047 | 1049 | 1050 | 1050 | 1050 |
| Parks, Schools, Irrigation | 1041 | 1068 | 1144 | 1371 | 1420 | 1550 |
| Agriculture | 139 | 86 | 70 | 33 | 18 | 1 |
| Ontario Unique Water User #1 | 54 | 54 | 54 | 54 | 54 | 54 |
| Ontario Unique Water User #2 | 35 | 35 | 35 | 35 | 35 | 35 |
| Ontario Unique Water User #3 | 55 | 55 | 55 | 55 | 55 | 55 |
| Ontario Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 2498 | 2526 | 2609 | 2708 | 2773 | 2953 |
| Undefined | - | - | - | - | - | - |
| Vacant | 8479 | 7806 | 6085 | 4413 | 3698 | 16 |
| **Total** | **26,841** | **26,841** | **26,841** | **26,842** | **26,842** | **26,841** |

# Appendix C - Member Agency Acreages

**SAN ANTONIO WATER CO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 603 | 603 | 631 | 631 | 745 | 874 |
| Residential Low (3 - 7) | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential Medium (8 - 14) | 1 | 1 | 1 | 1 | 1 | 1 |
| Residential High (15 - 24) | 3 | 3 | 3 | 3 | 3 | 3 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 3 | 3 | 3 | 3 | 3 | 3 |
| Industrial | - | - | - | - | - | - |
| Public/Institutional | 10 | 10 | 10 | 10 | 10 | 10 |
| Parks, Schools, Irrigation | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 167 | 167 | 167 | 167 | 167 | 167 |
| Undefined | 0 | | | | | |
| Vacant | 414 | 414 | 385 | 385 | 272 | 143 |
| **Total** | **1,201** | **1,201** | **1,200** | **1,200** | **1,201** | **1,201** |

**UPLAND Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 786 | 786 | 786 | 786 | 786 | 786 |
| Residential Low (3 - 7) | 2811 | 2813 | 2813 | 2817 | 2846 | 2846 |
| Residential Medium (8 - 14) | 306 | 384 | 410 | 414 | 414 | 418 |
| Residential High (15 - 24) | 319 | 351 | 354 | 413 | 413 | 413 |
| Residential Very High (25+) | 26 | 32 | 32 | 39 | 39 | 46 |
| Commercial | 685 | 693 | 706 | 706 | 755 | 755 |
| Industrial | 327 | 337 | 337 | 353 | 353 | 353 |
| Public/Institutional | 124 | 119 | 119 | 119 | 124 | 124 |
| Parks, Schools, Irrigation | 401 | 401 | 457 | 457 | 457 | 457 |
| Agriculture | 55 | 55 | 55 | 55 | 55 | 55 |
| Unique Water User #1 | 200 | 200 | 189 | 189 | 189 | 189 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 25 | 25 | 25 | 25 | 25 | 25 |
| Unique Water User #4 | 33 | 33 | 33 | 33 | 33 | 33 |
| Non-Irrigated | 1457 | 1457 | 1448 | 1449 | 1450 | 1450 |
| Undefined | - | - | - | - | - | - |
| Vacant | 401 | 269 | 192 | 100 | 16 | 5 |
| **Total** | **7,957** | **7,956** | **7,957** | **7,956** | **7,956** | **7,956** |

# APPENDIX D

## Land Use Unit Demands

## Appendix D - Land Use Unit Demands (af/ac/yr)

| | Chino* | Chino Hills | CVWD | FWC | MVWD | Ontario | SAWCO | Upland* |
|---|---|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1.73 | 1.40 | 1.85 | 1.25 | 1.27 | 1.20 | 2.34 | 1.90 |
| Residential Low (3 - 7) | 2.60 | 2.47 | 2.88 | 2.75 | 2.11 | 2.12 | 0.00 | 2.84 |
| Residential Medium (8 - 14) | 4.36 | 4.10 | 4.57 | 6.70 | 4.67 | 5.27 | 4.95 | 4.95 |
| Residential High (15 - 24) | 4.78 | 4.28 | 6.07 | 11.55 | 9.86 | 7.60 | 6.36 | 8.95 |
| Residential Very High (25+) | 6.88 | 6.88 | 8.81 | 15.66 | 0.00 | 13.20 | 0.00 | 13.96 |
| Commercial | 1.31 | 3.34 | 1.38 | 6.54 | 2.13 | 2.82 | 2.20 | 2.13 |
| Industrial | 0.22 | 1.07 | 0.51 | 0.33 | 0.65 | 0.38 | 0.00 | 1.07 |
| Public/Institutional | 1.31 | 1.17 | 2.73 | 2.73 | 2.39 | 2.82 | 2.20 | 3.52 |
| Parks, Schools, Irrigation | 4.99 | 3.11 | 6.88 | 4.99 | 4.72 | 7.48 | 0.00 | 5.87 |
| Agriculture | 0.00 | 0.00 | 0.28 | 0.00 | 0.34 | 15.08 | 0.00 | 0.00 |
| Unique Water Users #1 | 299.01 | | 3.62 | 0.00 | 5.59 | 47.57 | | 1.33 |
| Unique Water Users #2 | 186.62 | | 1.47 | | 43.49 | 18.81 | | 242.43 |
| Unique Water Users #3 | 81.60 | | 7.43 | | | 10.07 | | 4.57 |
| Unique Water Users #4 | | | 2.58 | | | | | 3.08 |

Notes:

Used Upland Medium for SAWCO Medium density residential (4.95 af/ac/yr)

Avg Public/Institutional from 4 agencies applied to FWC and CVWD (2.73 af/ac/yr)

Highest Industrial LUD used for Chino Hills due to lack of warehousing and distribution uses (1.07 af/ac/yr)

Used Chino VH for future Chino Hills VH density residential (6.88 af/ac/yr)

*Chino Unique users and 1 Upland Unique are not located; 1 acre was used with full water demands.

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CHINO** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.89 | 1.91 | 1.93 | 1.95 | 1.97 | 1.99 |
| Residential Low (3 - 7) | 2.83 | 2.87 | 2.90 | 2.93 | 2.96 | 3.00 |
| Residential Medium (8 - 14) | 4.75 | 4.81 | 4.86 | 4.91 | 4.97 | 5.02 |
| Residential High (15 - 24) | 5.21 | 5.27 | 5.33 | 5.39 | 5.45 | 5.51 |
| Residential Very High (25+) | 7.50 | 7.54 | 7.59 | 7.63 | 7.68 | 7.72 |
| Commercial | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Industrial | 0.24 | 0.24 | 0.24 | 0.24 | 0.25 | 0.25 |
| Public/Institutional | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.69 | 5.75 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | 325.92 | 327.83 | 329.75 | 331.66 | 333.58 | 335.49 |
| Unique Water User #2 | 203.42 | 204.61 | 205.80 | 207.00 | 208.19 | 209.39 |
| Unique Water User #3 | 88.94 | 89.47 | 89.99 | 90.51 | 91.03 | 91.56 |
| Unique Water User #4 | | | | | | |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CHINO HILLS** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.44 | 1.46 | 1.48 | 1.49 | 1.51 | 1.53 |
| Residential Low (3 - 7) | 2.54 | 2.57 | 2.61 | 2.64 | 2.67 | 2.70 |
| Residential Medium (8 - 14) | 4.22 | 4.27 | 4.32 | 4.38 | 4.43 | 4.48 |
| Residential High (15 - 24) | 4.41 | 4.46 | 4.51 | 4.57 | 4.62 | 4.67 |
| Residential Very High (25+) | 7.09 | 7.13 | 7.17 | 7.22 | 7.26 | 7.31 |
| Commercial | 3.44 | 3.46 | 3.48 | 3.50 | 3.53 | 3.55 |
| Industrial | 1.10 | 1.11 | 1.12 | 1.12 | 1.13 | 1.14 |
| Public/Institutional | 1.21 | 1.21 | 1.22 | 1.23 | 1.24 | 1.24 |
| Parks, Schools, Irrigation | 3.20 | 3.24 | 3.28 | 3.32 | 3.36 | 3.40 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | | | | | | |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CVWD** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.96 | 1.99 | 2.01 | 2.03 | 2.06 | 2.08 |
| Residential Low (3 - 7) | 3.06 | 3.09 | 3.13 | 3.17 | 3.20 | 3.24 |
| Residential Medium (8 - 14) | 4.85 | 4.91 | 4.97 | 5.02 | 5.08 | 5.14 |
| Residential High (15 - 24) | 6.45 | 6.52 | 6.60 | 6.67 | 6.75 | 6.82 |
| Residential Very High (25+) | 9.36 | 9.41 | 9.47 | 9.53 | 9.58 | 9.64 |
| Commercial | 1.47 | 1.47 | 1.48 | 1.49 | 1.50 | 1.51 |
| Industrial | 0.54 | 0.54 | 0.55 | 0.55 | 0.55 | 0.56 |
| Public/Institutional | 2.90 | 2.92 | 2.93 | 2.95 | 2.97 | 2.99 |
| Parks, Schools, Irrigation | 7.31 | 7.39 | 7.48 | 7.56 | 7.65 | 7.73 |
| Agriculture | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 |
| Unique Water User #1 | 3.84 | 3.87 | 3.89 | 3.91 | 3.94 | 3.96 |
| Unique Water User #2 | 1.56 | 1.57 | 1.58 | 1.59 | 1.60 | 1.61 |
| Unique Water User #3 | 7.89 | 7.94 | 7.99 | 8.03 | 8.08 | 8.13 |
| Unique Water User #4 | 2.74 | 2.76 | 2.77 | 2.79 | 2.81 | 2.82 |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Fontana WC** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.36 | 1.38 | 1.39 | 1.41 | 1.42 | 1.44 |
| Residential Low (3 - 7) | 3.00 | 3.03 | 3.06 | 3.10 | 3.13 | 3.17 |
| Residential Medium (8 - 14) | 7.30 | 7.38 | 7.47 | 7.55 | 7.63 | 7.71 |
| Residential High (15 - 24) | 12.58 | 12.73 | 12.87 | 13.01 | 13.16 | 13.30 |
| Residential Very High (25+) | 17.06 | 17.16 | 17.26 | 17.36 | 17.46 | 17.56 |
| Commercial | 7.12 | 7.17 | 7.21 | 7.25 | 7.29 | 7.33 |
| Industrial | 0.36 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 |
| Public/Institutional | 2.97 | 2.99 | 3.01 | 3.03 | 3.04 | 3.06 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.68 | 5.75 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Monte Vista WD** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.36 | 1.37 | 1.39 | 1.40 | 1.42 | 1.44 |
| Residential Low (3 - 7) | 2.25 | 2.28 | 2.31 | 2.33 | 2.36 | 2.38 |
| Residential Medium (8 - 14) | 4.99 | 5.05 | 5.10 | 5.16 | 5.22 | 5.28 |
| Residential High (15 - 24) | 10.53 | 10.65 | 10.78 | 10.90 | 11.02 | 11.14 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 2.28 | 2.29 | 2.30 | 2.32 | 2.33 | 2.34 |
| Industrial | 0.69 | 0.70 | 0.70 | 0.71 | 0.71 | 0.72 |
| Public/Institutional | 2.55 | 2.57 | 2.58 | 2.60 | 2.61 | 2.63 |
| Parks, Schools, Irrigation | 5.04 | 5.10 | 5.16 | 5.22 | 5.28 | 5.33 |
| Agriculture | 0.36 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 |
| Unique Water User #1 | 5.97 | 6.01 | 6.04 | 6.08 | 6.11 | 6.15 |
| Unique Water User #2 | 46.45 | 46.73 | 47.01 | 47.29 | 47.57 | 47.84 |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

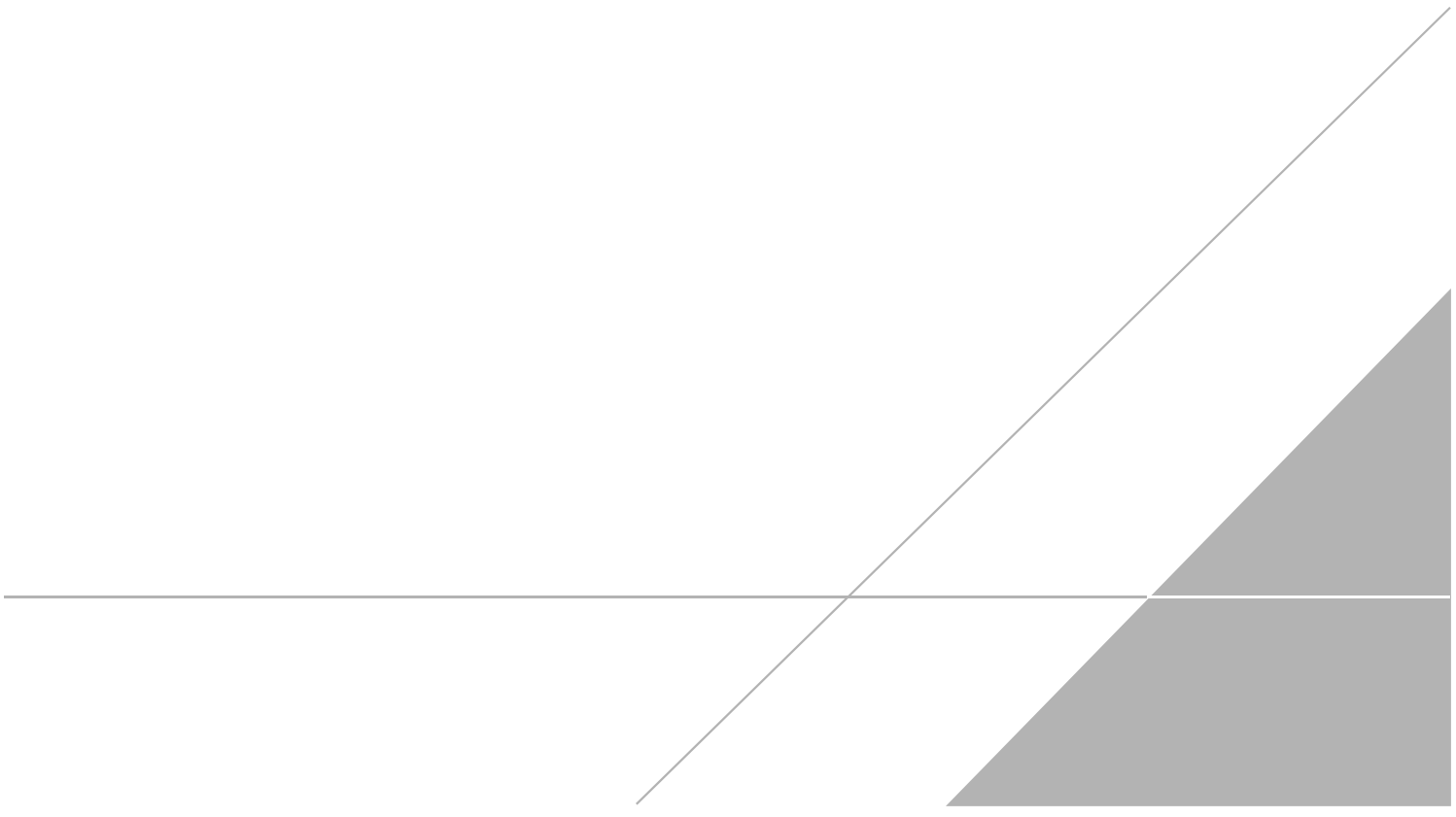
| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Ontario** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.25 | 1.26 | 1.28 | 1.29 | 1.31 | 1.32 |
| Residential Low (3 - 7) | 2.20 | 2.23 | 2.26 | 2.28 | 2.31 | 2.34 |
| Residential Medium (8 - 14) | 5.48 | 5.55 | 5.61 | 5.68 | 5.74 | 5.81 |
| Residential High (15 - 24) | 7.90 | 8.00 | 8.09 | 8.19 | 8.28 | 8.38 |
| Residential Very High (25+) | 13.73 | 13.81 | 13.90 | 13.98 | 14.07 | 14.15 |
| Commercial | 2.93 | 2.95 | 2.97 | 2.99 | 3.00 | 3.02 |
| Industrial | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.41 |
| Public/Institutional | 2.93 | 2.95 | 2.97 | 2.99 | 3.00 | 3.02 |
| Parks, Schools, Irrigation | 7.78 | 7.87 | 7.96 | 8.06 | 8.15 | 8.24 |
| Agriculture | 15.68 | 15.87 | 16.06 | 16.24 | 16.43 | 16.62 |
| Unique Water User #1 | 49.47 | 49.78 | 50.08 | 50.39 | 50.69 | 51.00 |
| Unique Water User #2 | 19.56 | 19.68 | 19.80 | 19.92 | 20.04 | 20.16 |
| Unique Water User #3 | 10.47 | 10.54 | 10.60 | 10.67 | 10.73 | 10.80 |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **San Antonio WC** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 2.39 | 2.42 | 2.44 | 2.47 | 2.50 | 2.53 |
| Residential Low (3 - 7) | - | - | - | - | - | - |
| Residential Medium (8 - 14) | 5.05 | 5.11 | 5.17 | 5.23 | 5.29 | 5.36 |
| Residential High (15 - 24) | 6.49 | 6.57 | 6.64 | 6.72 | 6.80 | 6.88 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 2.24 | 2.26 | 2.27 | 2.29 | 2.30 | 2.31 |
| Industrial | - | - | - | - | - | - |
| Public/Institutional | 2.24 | 2.26 | 2.27 | 2.29 | 2.30 | 2.31 |
| Parks, Schools, Irrigation | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Upland** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 2.01 | 2.03 | 2.06 | 2.08 | 2.10 | 2.13 |
| Residential Low (3 - 7) | 3.00 | 3.04 | 3.07 | 3.11 | 3.14 | 3.18 |
| Residential Medium (8 - 14) | 5.23 | 5.29 | 5.35 | 5.42 | 5.48 | 5.54 |
| Residential High (15 - 24) | 9.46 | 9.57 | 9.68 | 9.79 | 9.90 | 10.02 |
| Residential Very High (25+) | 14.76 | 14.85 | 14.93 | 15.02 | 15.11 | 15.20 |
| Commercial | 2.25 | 2.27 | 2.28 | 2.29 | 2.31 | 2.32 |
| Industrial | 1.13 | 1.14 | 1.14 | 1.15 | 1.16 | 1.17 |
| Public/Institutional | 3.72 | 3.74 | 3.77 | 3.79 | 3.81 | 3.83 |
| Parks, Schools, Irrigation | 6.20 | 6.28 | 6.35 | 6.42 | 6.50 | 6.57 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | 1.41 | 1.41 | 1.42 | 1.43 | 1.44 | 1.45 |
| Unique Water User #2 | 256.25 | 257.80 | 259.35 | 260.90 | 262.45 | 264.01 |
| Unique Water User #3 | 4.83 | 4.86 | 4.89 | 4.92 | 4.95 | 4.98 |
| Unique Water User #4 | 3.26 | 3.28 | 3.29 | 3.31 | 3.33 | 3.35 |

# APPENDIX E

## Demand Projections



# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CHINO** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,004 | 1,003 | 1,015 | 1,034 | 1,122 | 1,205 |
| Residential Low (3 - 7) | | 6,330 | 6,553 | 6,775 | 6,930 | 7,322 | 7,793 |
| Residential Medium (8 - 14) | | 967 | 1,499 | 2,566 | 3,099 | 3,158 | 3,787 |
| Residential High (15 - 24) | | 1,070 | 1,407 | 1,423 | 1,695 | 1,747 | 2,261 |
| Residential Very High (25+) | | 138 | 139 | 139 | 140 | 141 | 518 |
| Commercial | | 1,277 | 1,325 | 1,377 | 1,719 | 1,747 | 1,988 |
| Industrial | | 495 | 630 | 662 | 670 | 677 | 684 |
| Public/Institutional | | 1,132 | 1,157 | 1,164 | 1,171 | 1,402 | 1,473 |
| Parks, Schools, Irrigation | | 2,713 | 2,800 | 2,832 | 2,863 | 2,895 | 2,926 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | 326 | 328 | 330 | 332 | 334 | 335 |
| Unique Water User #2 | | 203 | 205 | 206 | 207 | 208 | 209 |
| Unique Water User #3 | | 89 | 89 | 90 | 91 | 91 | 92 |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **15,744** | **17,135** | **18,579** | **19,951** | **20,844** | **23,271** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CHINO HILLS** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,491 | 1,543 | 2,084 | 2,187 | 2,213 | 4,189 |
| Residential Low (3 - 7) | | 7,024 | 7,655 | 7,839 | 8,672 | 8,773 | 8,874 |
| Residential Medium (8 - 14) | | 1,745 | 2,048 | 2,078 | 2,133 | 2,158 | 2,212 |
| Residential High (15 - 24) | | 767 | 938 | 971 | 1,001 | 1,013 | 1,066 |
| Residential Very High (25+) | | - | 106 | 107 | 107 | 108 | 108 |
| Commercial | | 1,269 | 1,340 | 1,463 | 1,506 | 1,515 | 1,524 |
| Industrial | | 1 | 33 | 33 | 33 | 33 | 33 |
| Public/Institutional | | 204 | 196 | 197 | 208 | 209 | 211 |
| Parks, Schools, Irrigation | | 4,091 | 4,207 | 4,257 | 4,324 | 4,375 | 4,425 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **16,592** | **18,066** | **19,029** | **20,171** | **20,397** | **22,642** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CVWD** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 6,299 | 7,148 | 7,830 | 8,156 | 8,592 | 8,742 |
| Residential Low (3 - 7) | | 19,037 | 20,053 | 21,295 | 21,613 | 21,999 | 22,259 |
| Residential Medium (8 - 14) | | 4,217 | 4,556 | 5,122 | 5,180 | 5,463 | 5,525 |
| Residential High (15 - 24) | | 4,206 | 4,858 | 6,327 | 6,506 | 6,579 | 6,742 |
| Residential Very High (25+) | | 1,054 | 1,060 | 1,066 | 1,073 | 1,079 | 1,085 |
| Commercial | | 2,333 | 2,375 | 2,430 | 2,452 | 2,476 | 2,492 |
| Industrial | | 1,449 | 1,552 | 1,635 | 1,660 | 1,670 | 1,681 |
| Public/Institutional | | 1,366 | 1,425 | 1,397 | 1,409 | 1,418 | 1,431 |
| Parks, Schools, Irrigation | | 9,688 | 9,801 | 8,715 | 8,814 | 9,065 | 9,632 |
| Agriculture | | 36 | 33 | 16 | 13 | 4 | - |
| Unique Water User #1 | | 460 | 462 | 465 | 468 | 471 | 474 |
| Unique Water User #2 | | 296 | 298 | 300 | 301 | 303 | 305 |
| Unique Water User #3 | | 284 | 286 | 288 | 289 | 291 | 293 |
| Unique Water User #4 | | 261 | 263 | 264 | 266 | 267 | 269 |
| | **Total** | **50,986** | **54,170** | **57,150** | **58,200** | **59,677** | **60,930** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Fontana WC** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 2,088 | 2,112 | 2,077 | 1,796 | 1,084 | 911 |
| Residential Low (3 - 7) | | 19,110 | 19,366 | 20,529 | 21,846 | 24,061 | 24,771 |
| Residential Medium (8 - 14) | | 2,631 | 2,661 | 2,908 | 4,360 | 4,763 | 4,815 |
| Residential High (15 - 24) | | 4,029 | 4,075 | 6,682 | 6,820 | 7,161 | 7,239 |
| Residential Very High (25+) | | 216 | 217 | 219 | 399 | 728 | 732 |
| Commercial | | 6,628 | 6,697 | 7,016 | 8,801 | 11,117 | 11,467 |
| Industrial | | 2,061 | 2,281 | 2,417 | 2,454 | 2,490 | 2,519 |
| Public/Institutional | | 687 | 691 | 953 | 1,014 | 1,101 | 1,109 |
| Parks, Schools, Irrigation | | 4,682 | 4,735 | 4,789 | 4,842 | 4,895 | 4,949 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **42,132** | **42,835** | **47,590** | **52,332** | **57,400** | **58,512** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Monte Vista WD** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,522 | 1,540 | 1,557 | 1,756 | 1,813 | 1,930 |
| Residential Low (3 - 7) | | 3,129 | 3,197 | 3,235 | 3,301 | 3,367 | 3,413 |
| Residential Medium (8 - 14) | | 1,635 | 1,724 | 1,863 | 1,884 | 1,905 | 1,926 |
| Residential High (15 - 24) | | 666 | 1,223 | 1,237 | 1,251 | 1,272 | 1,326 |
| Residential Very High (25+) | | - | - | - | - | - | - |
| Commercial | | 1,339 | 1,368 | 1,378 | 1,389 | 1,444 | 1,472 |
| Industrial | | 367 | 360 | 363 | 367 | 385 | 388 |
| Public/Institutional | | 324 | 329 | 331 | 335 | 358 | 360 |
| Parks, Schools, Irrigation | | 1,125 | 1,138 | 1,152 | 1,165 | 1,203 | 1,216 |
| Agriculture | | 61 | 61 | 54 | 17 | 10 | - |
| Unique Water User #1 | | 93 | 94 | 94 | 95 | 95 | 96 |
| Unique Water User #2 | | 51 | 51 | 52 | 52 | 52 | 53 |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **10,312** | **11,085** | **11,316** | **11,612** | **11,904** | **12,180** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Ontario** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 338 | 353 | 374 | 432 | 437 | 442 |
| Residential Low (3 - 7) | | 9,993 | 10,581 | 12,183 | 13,531 | 14,357 | 18,047 |
| Residential Medium (8 - 14) | | 3,212 | 3,851 | 4,231 | 5,214 | 6,087 | 12,678 |
| Residential High (15 - 24) | | 4,830 | 5,327 | 5,652 | 5,719 | 5,864 | 6,031 |
| Residential Very High (25+) | | 845 | 914 | 1,298 | 2,793 | 3,357 | 5,157 |
| Commercial | | 5,213 | 5,241 | 5,606 | 6,789 | 7,021 | 8,754 |
| Industrial | | 2,232 | 2,361 | 2,647 | 2,727 | 2,772 | 2,813 |
| Public/Institutional | | 3,090 | 3,089 | 3,115 | 3,135 | 3,154 | 3,174 |
| Parks, Schools, Irrigation | | 8,101 | 8,407 | 9,111 | 11,046 | 11,575 | 12,778 |
| Agriculture | | 2,177 | 1,372 | 1,118 | 529 | 295 | 23 |
| Unique Water User #1 | | 2,688 | 2,705 | 2,721 | 2,738 | 2,755 | 2,771 |
| Unique Water User #2 | | 681 | 686 | 690 | 694 | 698 | 702 |
| Unique Water User #3 | | 573 | 577 | 581 | 584 | 588 | 591 |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **43,973** | **45,464** | **49,327** | **55,931** | **58,960** | **73,961** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **San Antonio WC** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,440 | 1,457 | 1,544 | 1,562 | 1,864 | 2,212 |
| Residential Low (3 - 7) | | - | - | - | - | - | - |
| Residential Medium (8 - 14) | | 4 | 4 | 4 | 4 | 4 | 4 |
| Residential High (15 - 24) | | 21 | 21 | 21 | 22 | 22 | 22 |
| Residential Very High (25+) | | - | - | - | - | - | - |
| Commercial | | 6 | 6 | 6 | 6 | 6 | 6 |
| Industrial | | - | - | - | - | - | - |
| Public/Institutional | | 22 | 22 | 22 | 23 | 23 | 23 |
| Parks, Schools, Irrigation | | - | - | - | - | - | - |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **1,493** | **1,510** | **1,597** | **1,617** | **1,919** | **2,267** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Upland** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,579 | 1,597 | 1,616 | 1,634 | 1,653 | 1,672 |
| Residential Low (3 - 7) | | 8,437 | 8,544 | 8,643 | 8,754 | 8,945 | 9,045 |
| Residential Medium (8 - 14) | | 1,601 | 2,033 | 2,195 | 2,243 | 2,268 | 2,317 |
| Residential High (15 - 24) | | 3,022 | 3,363 | 3,426 | 4,048 | 4,094 | 4,140 |
| Residential Very High (25+) | | 381 | 468 | 471 | 593 | 596 | 692 |
| Commercial | | 1,542 | 1,570 | 1,609 | 1,619 | 1,742 | 1,752 |
| Industrial | | 369 | 384 | 386 | 407 | 409 | 411 |
| Public/Institutional | | 460 | 445 | 448 | 451 | 473 | 476 |
| Parks, Schools, Irrigation | | 2,490 | 2,519 | 2,900 | 2,934 | 2,967 | 3,000 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | 281 | 283 | 268 | 270 | 271 | 273 |
| Unique Water User #2 | | 256 | 258 | 259 | 261 | 262 | 264 |
| Unique Water User #3 | | 122 | 122 | 123 | 124 | 125 | 125 |
| Unique Water User #4 | | 107 | 108 | 109 | 109 | 110 | 110 |
| | **Total** | **20,647** | **21,694** | **22,453** | **23,447** | **23,915** | **24,277** |

# APPENDIX N

## Model User Guide

# Land Use Base Water Demand Model User Guide

This Demand Model is built in Microsoft Access which is linked with ArcGIS and provides users with an easy-to-use interface to view and update factor and demands.

## 1 WELCOME

The Welcome page (Figure 1-1 ) is the first interface the user sees when they open the model and is the primary interface for viewing, entering and updating model parameters and inputs like acreages, Land Use Demand Factors (LUD), and adjustment factors.

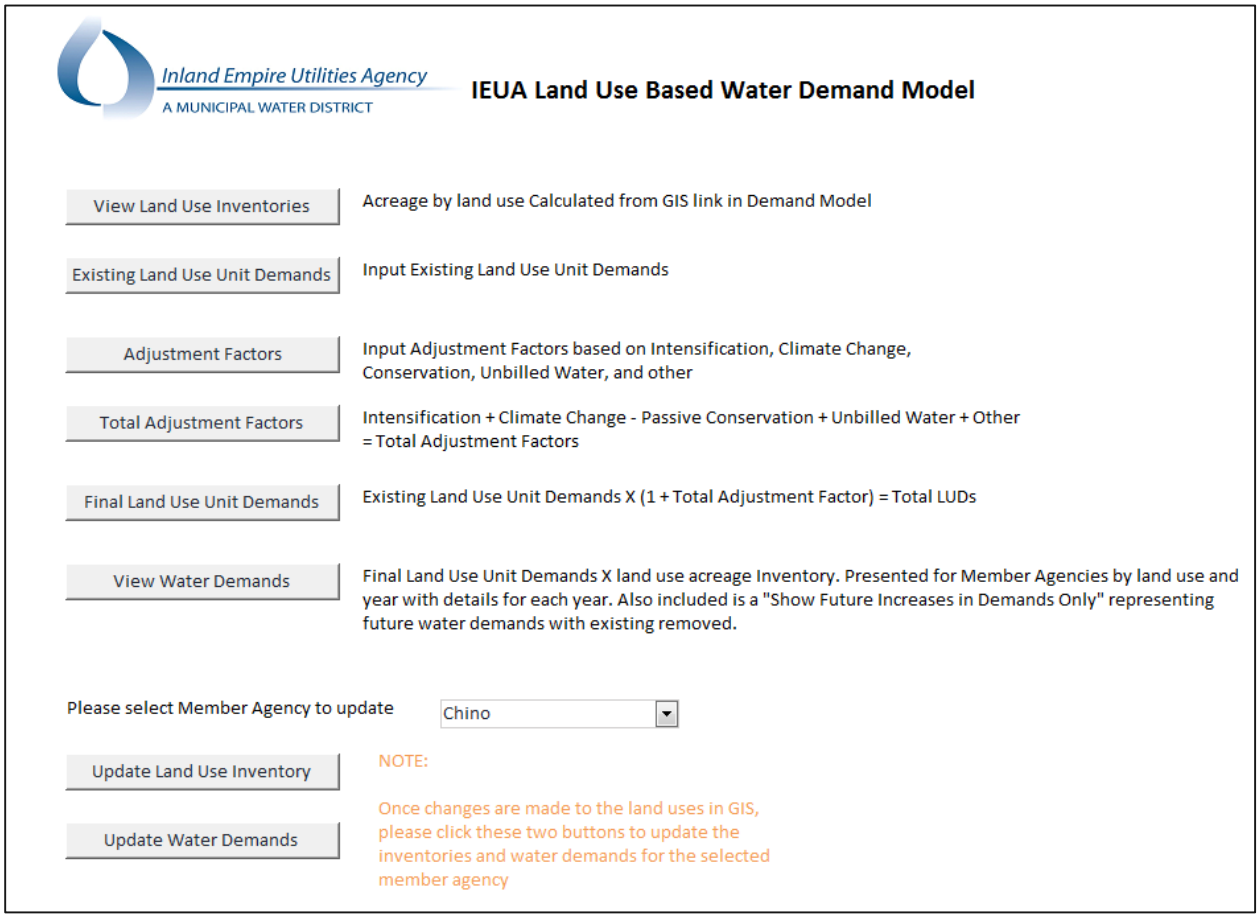



Figure 1-1 Welcome Form

Below list describes the functions for each of the buttons on the Welcome page -

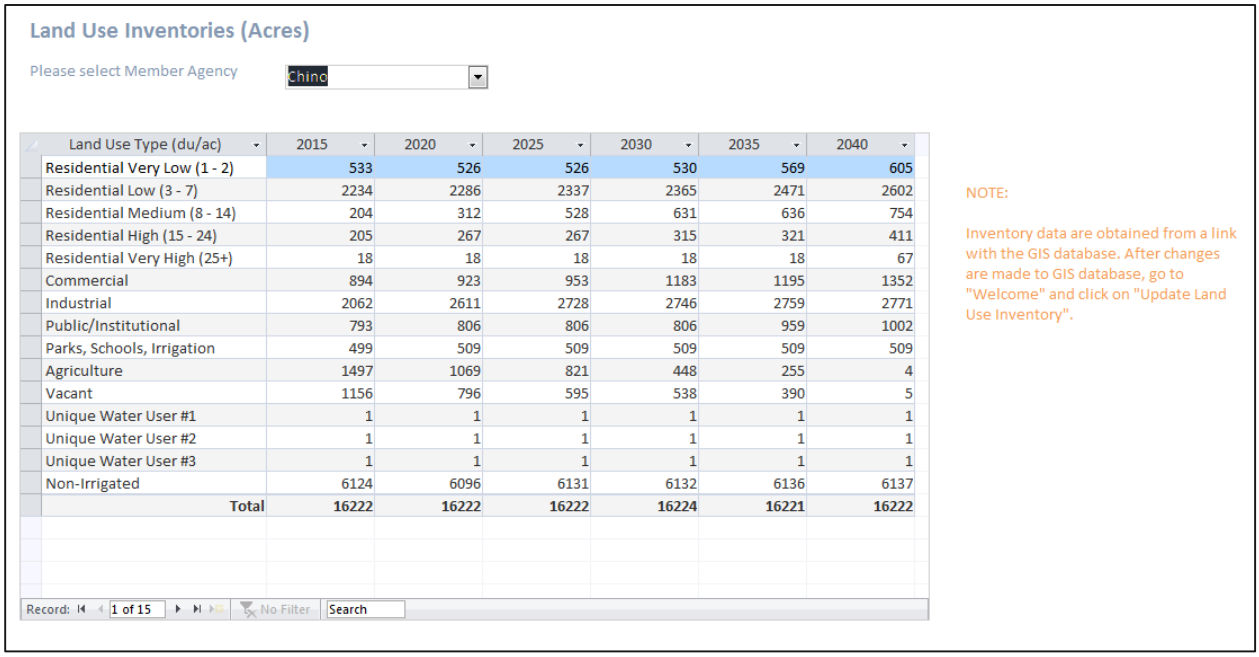
- Click “View Land Use Inventories” to view land use acreages by member agency which are calculated from GIS linked in the Demand Model. Any modification to the acreages and Landuse type must be done using GIS.
- Click “Existing Land Use Unit Demands” to view or update Existing LUD by member agency. LUDs are calculated outside the model as described in the memo. Users can manually update the LUDs when they are updated in the futures. Users can also update the Final Land Use Unit Demands from this form.

- Click “Adjustment Factors” to view or update Adjustment Factors by member agency. Users can also update the Total Adjustment Factors from this form.
- Click “Total Adjustment Factors” to view Total Adjustment Factors by member agency and update the Final Land Use Unit Demands.
- Click “Final Land Use Unit Demands” to view Final Land Use Unit Demands by member agency and update the Water Demands.

If updates are made to the GIS land use layers, users can select the appropriate member agency or all member agencies from the dropdown list and click ”Update Land Use Inventory” and “Update Water Demands” to update acreage inventories and total water demands.

# 2 VIEW LAND USE INVENTORIES

Click on View Land Use Inventories on the Welcome Page to view the acreages by land use. Select a member agency or “All Member Agencies” from the dropdown list to view their land use acreages. The acreages are calculated directly from the GIS database. This table cannot be manually updated without updating the background GIS layers.




| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 533 | 526 | 526 | 530 | 569 | 605 |
| Residential Low (3 - 7) | 2234 | 2286 | 2337 | 2365 | 2471 | 2602 |
| Residential Medium (8 - 14) | 204 | 312 | 528 | 631 | 636 | 754 |
| Residential High (15 - 24) | 205 | 267 | 267 | 315 | 321 | 411 |
| Residential Very High (25+) | 18 | 18 | 18 | 18 | 18 | 67 |
| Commercial | 894 | 923 | 953 | 1183 | 1195 | 1352 |
| Industrial | 2062 | 2611 | 2728 | 2746 | 2759 | 2771 |
| Public/Institutional | 793 | 806 | 806 | 806 | 959 | 1002 |
| Parks, Schools, Irrigation | 499 | 509 | 509 | 509 | 509 | 509 |
| Agriculture | 1497 | 1069 | 821 | 448 | 255 | 4 |
| Vacant | 1156 | 796 | 595 | 538 | 390 | 5 |
| Unique Water User #1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-Irrigated | 6124 | 6096 | 6131 | 6132 | 6136 | 6137 |
| Total | 16222 | 16222 | 16222 | 16224 | 16221 | 16222 |

Figure 2-1 Land Use Inventories Form

# 3 EXISTING LAND USE UNIT DEMANDS

Click on Existing Land Use Unit Demands on the Welcome Page to view and update the Existing land Use Unit Demands manually. The Dropdown menu on the Existing Land Use Unit Demand table can be used view and update LUDs. These Existing LUDs are calculated from the Existing Water Consumption based on the Land Uses (explained in the Technical Memorandum). Updates to LUDS can be made by simply entering the number in the appropriate cell in the table.

After updating the LUD values, Click “Update Final Land Use Unit Demands” to update the final unit demands of all member agencies with the adjustment factors applied.

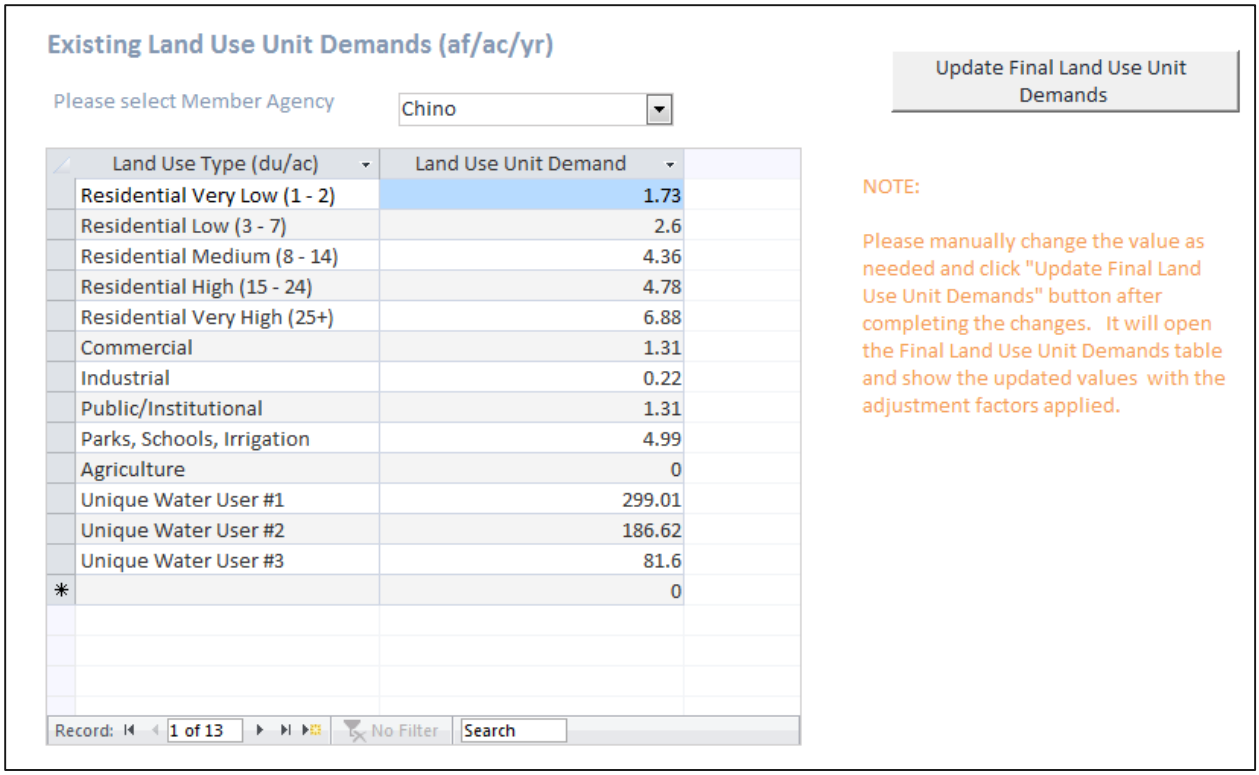



Figure 3-1 Existing land Use Unit Demands Form

# 4 ADJUSTMENT FACTORS

Click on 

on the Welcome Page to view and update the various Adjustment Factors (Figure 4-1). Select a member agency from the drop down menu on the Adjustment Factors table to view and update factor values in each factors. Definition for each Adjustment Factor and how it affects the existing LUDs is provided in the Technical Memorandum.

## 4.1 Intensification

Click on the “Intensification” tab to view the values for each land use by member agency and to update the intensification factors independently. To perform a global update for all land use types, enter a number in the "Update Intensification" box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

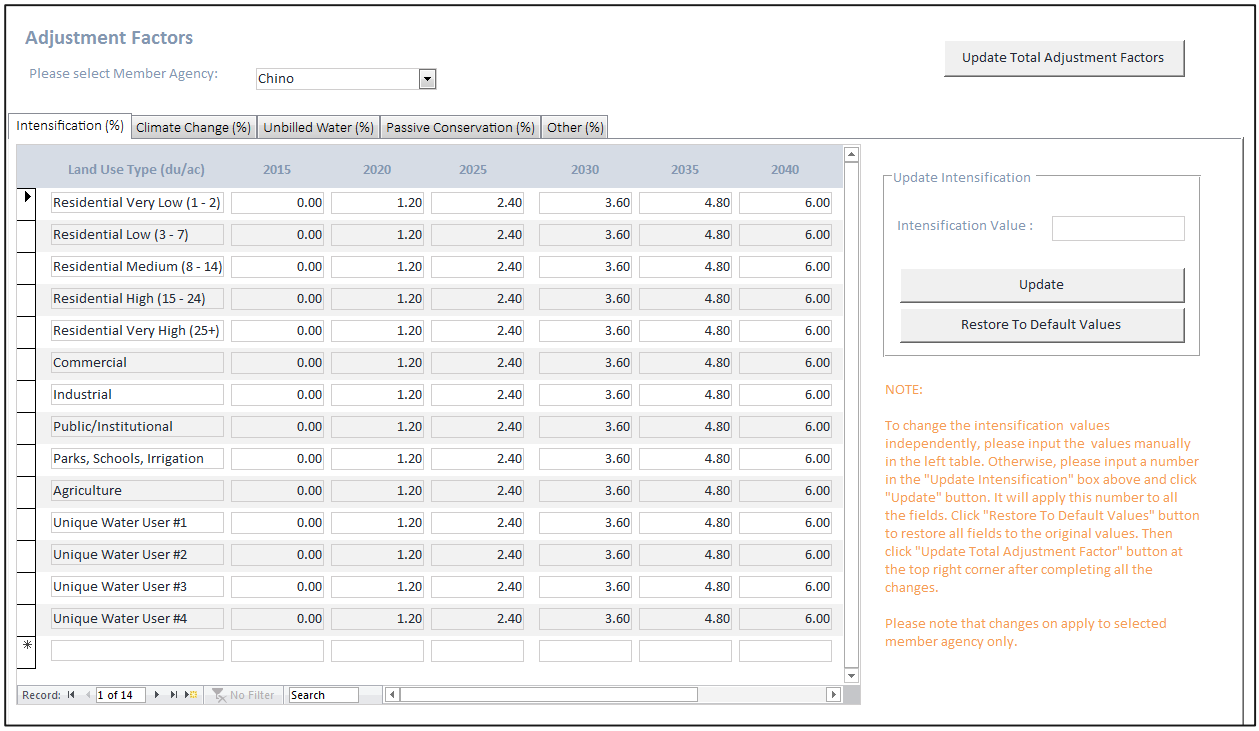



Figure 4-1 Intensification Form

## 4.2 Climate Change

Click on the “Climate Change” tab to view the values for each land use by member agency and to update the factors independently.

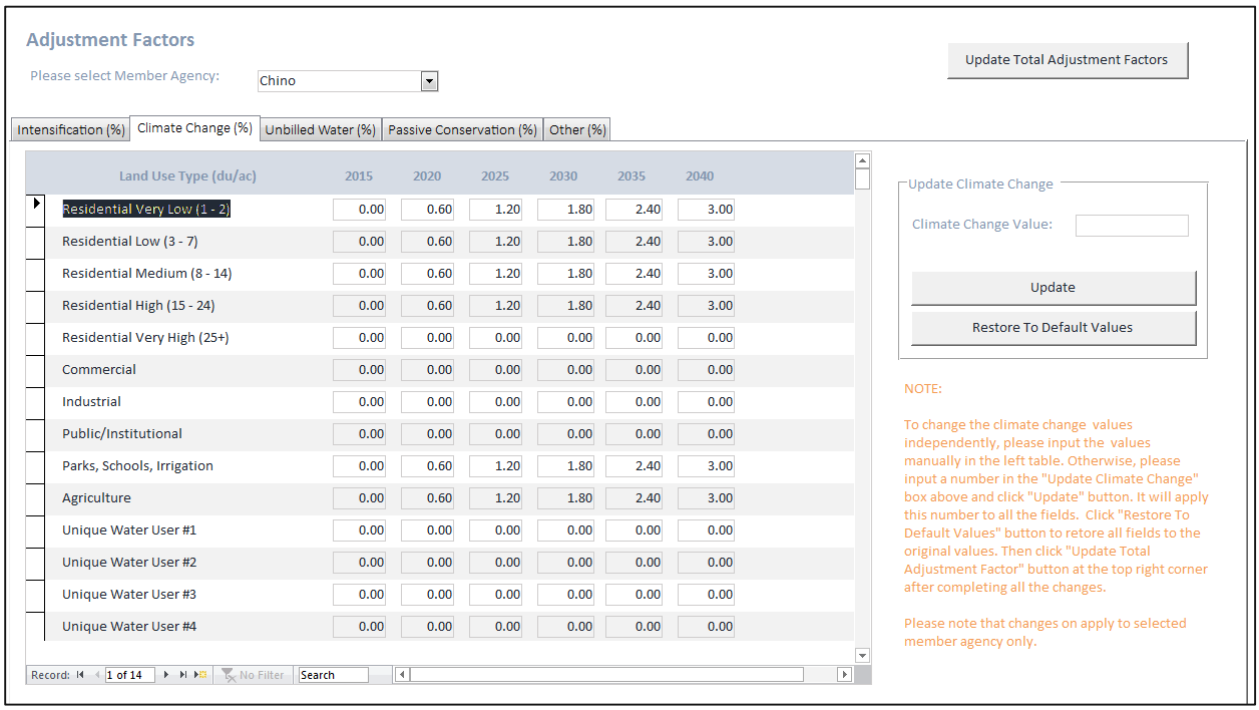



Figure 4-2 Climate Change Form

To perform a global update for all land use types, enter a number in the "Update Climate Change" box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

## 4.3 Unbilled Water

Click on the “Unbilled Water” tab to view the values by member agency and to update the factors. Unbilled Water factors is applied uniformly for all land uses. Click "Restore To Default Values" button to restore it to the original value.

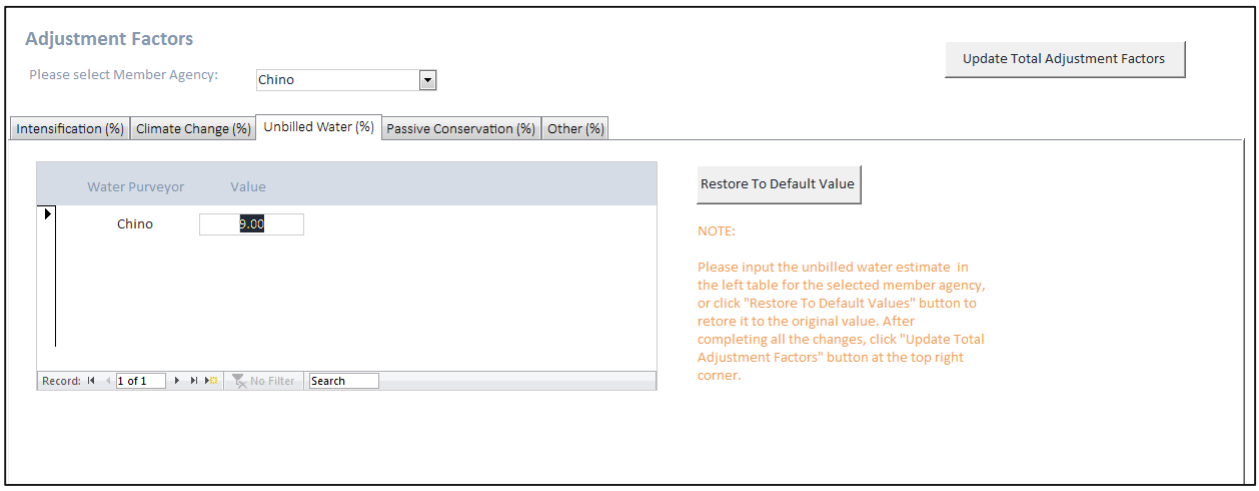



Figure 4-3 Unbilled Water Form

## 4.4 Passive Conservation

Click on the “Passive Conservation” tab to view the values for each land use by member agency and to update the factors independently. To perform a global update for all land use types, enter a number in the "Update Passive Conservation” box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

Entering a positive number for passive conservation to indicate decrease in adjustment factor and demand.

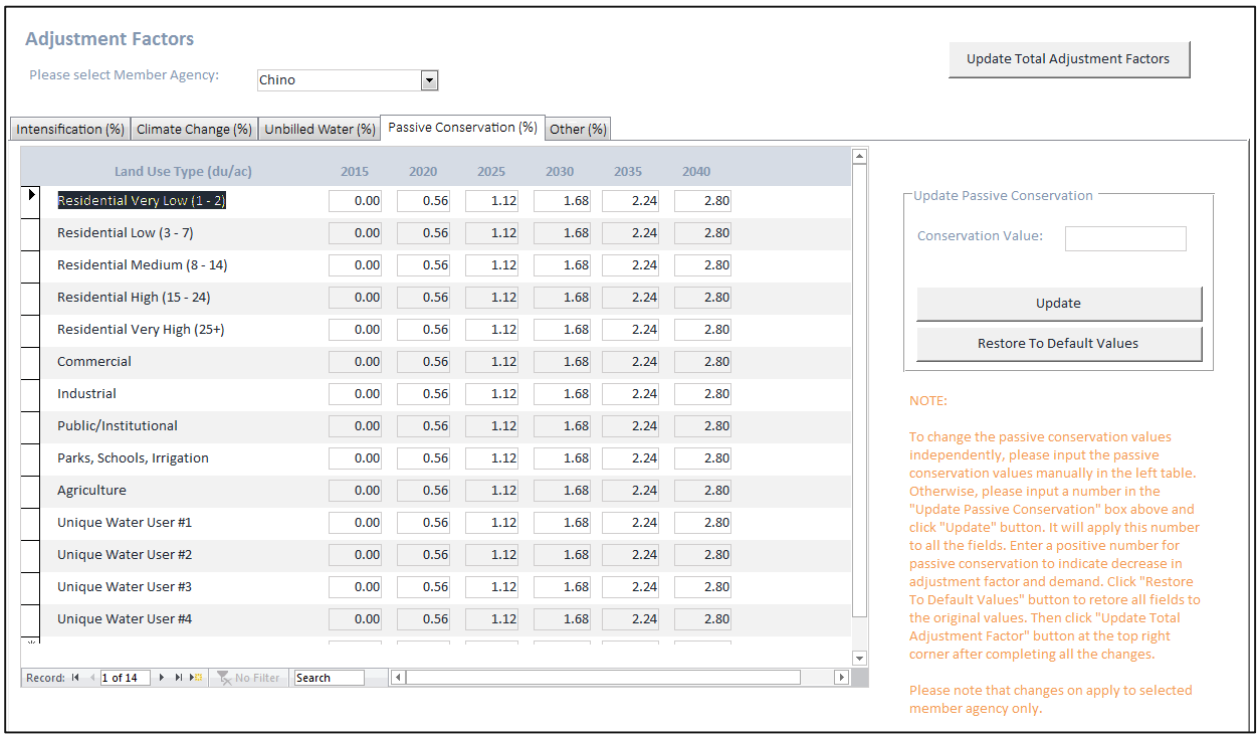



Figure 4-4 Passive Conservation Form

## 4.5 Other

The “Other” tab is an empty form that user can use to capture any additional adjustment factor not captures in the other tabs. The default value is 0 in all cells.

To perform a global update for all land use types, enter a number in the "Update Other Value” box and click "Update" button. Click "Restore To Default Values" button to restore all fields to 0.

A positive value will increase the Existing LUD and hence the total demand. And a negative number will decrease the Existing LUD.

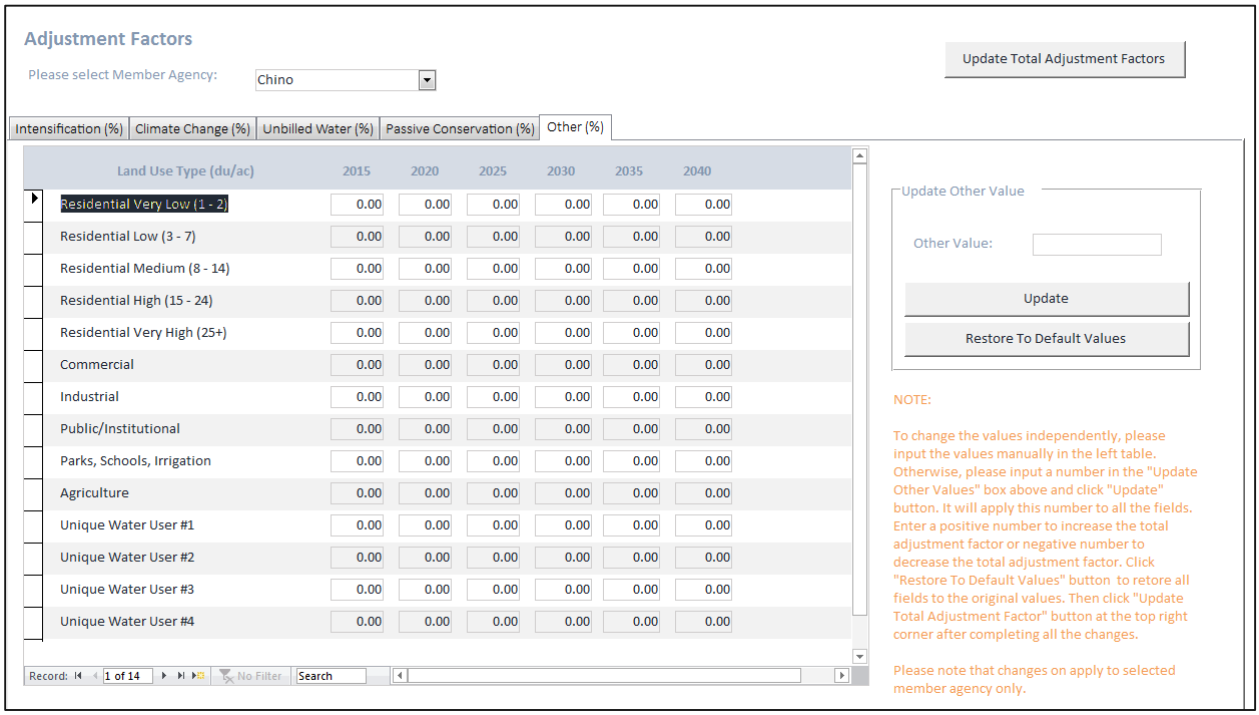



Figure 4-5 Other Form

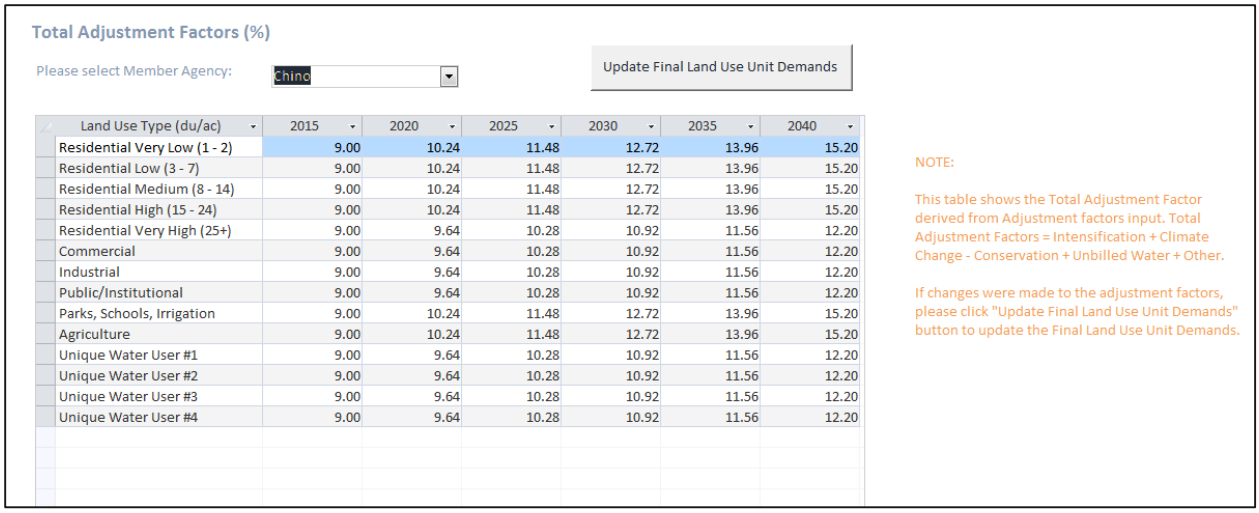
After updating or changing any adjustment factor, click "Update Total Adjustment Factor" button. It will recalculate the Total Adjacent Factors for all member agencies. Then the “Total Adjustment Factors” Form will pop up to show the new Adjustment Factors.

# 5 TOTAL ADJUSTMENT FACTORS

Click on Total Adjustment Factors on the Welcome Page to view the Total Adjustment Factors (Figure 5-1). Use the dropdown box to select the appropriate member agency. These values cannot be changed in this table. These values is calculated using the Adjustment Factors table using below equation

Total Adjustment Factors = Intensification + Climate Change - Conservation + Unbilled Water + Other.

If changes were made to the adjustment factors, please click "Update Final Land Use Unit Demands" button to update the Final Land Use Unit Demands of all member agencies. Then the “Final Land Use Unit Demands” form will pop up to show the results (Figure 6-1)



Total Adjustment Factors (%)

Please select Member Agency: Chino

Update Final Land Use Unit Demands

| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Low (3 - 7) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Medium (8 - 14) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential High (15 - 24) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Very High (25+) | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Commercial | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Industrial | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Public/Institutional | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Parks, Schools, Irrigation | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Agriculture | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Unique Water User #1 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #2 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #3 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #4 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |

NOTE:

This table shows the Total Adjustment Factor derived from Adjustment factors input. Total Adjustment Factors = Intensification + Climate Change - Conservation + Unbilled Water + Other.

If changes were made to the adjustment factors, please click "Update Final Land Use Unit Demands" button to update the Final Land Use Unit Demands.

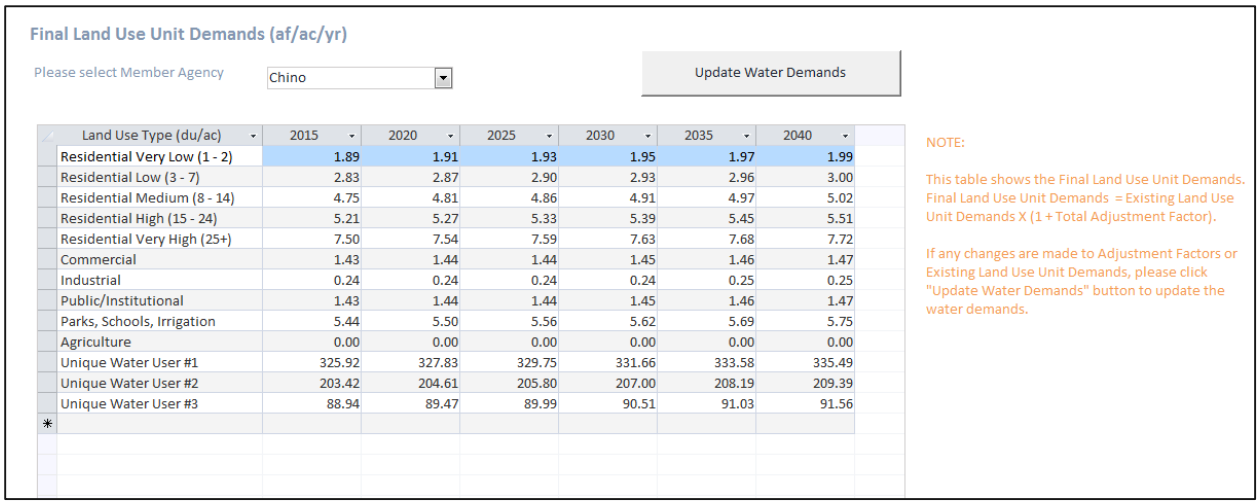
Figure 5-1 Total Adjustment Factors Form

# 6 FINAL LAND UNIT DEMANDS

Click on Final Land Use Unit Demands on the Welcome Page to view the Final LUDs (Figure 6-1) by member agency. Final LUDs is calculated using the below formula

Final Land Use Unit Demands = Existing Land Use Unit Demands X (1 + Total Adjustment Factor)

If changes were made to Adjustment Factors or Existing Land Use Unit Demands, please click "Update Water Demands" button to update the water demands of all member agencies. Then the “Water Demands” Form will pop up to show results.



Final Land Use Unit Demands (af/ac/yr)

Please select Member Agency Chino

Update Water Demands

| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1.89 | 1.91 | 1.93 | 1.95 | 1.97 | 1.99 |
| Residential Low (3 - 7) | 2.83 | 2.87 | 2.90 | 2.93 | 2.96 | 3.00 |
| Residential Medium (8 - 14) | 4.75 | 4.81 | 4.86 | 4.91 | 4.97 | 5.02 |
| Residential High (15 - 24) | 5.21 | 5.27 | 5.33 | 5.39 | 5.45 | 5.51 |
| Residential Very High (25+) | 7.50 | 7.54 | 7.59 | 7.63 | 7.68 | 7.72 |
| Commercial | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Industrial | 0.24 | 0.24 | 0.24 | 0.24 | 0.25 | 0.25 |
| Public/Institutional | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.69 | 5.75 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unique Water User #1 | 325.92 | 327.83 | 329.75 | 331.66 | 333.58 | 335.49 |
| Unique Water User #2 | 203.42 | 204.61 | 205.80 | 207.00 | 208.19 | 209.39 |
| Unique Water User #3 | 88.94 | 89.47 | 89.99 | 90.51 | 91.03 | 91.56 |

NOTE:

This table shows the Final Land Use Unit Demands. Final Land Use Unit Demands = Existing Land Use Unit Demands X (1 + Total Adjustment Factor).

If any changes are made to Adjustment Factors or Existing Land Use Unit Demands, please click "Update Water Demands" button to update the water demands.

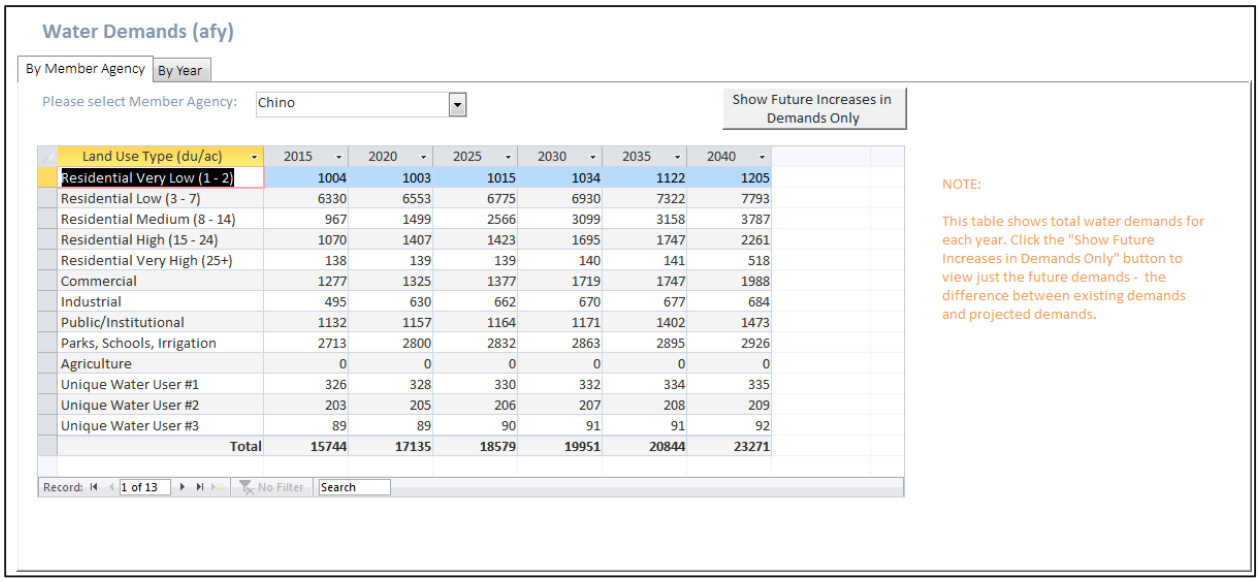
Figure 6-1 Final Land Unit Demands Form

# 7 VIEW WATER DEMANDS

Click on View Water Demands on the Welcome Page to view the Water Demands, either by Member Agency (Figure 7-1) or Year (Figure 7-3).

## 7.1 By Member Agency

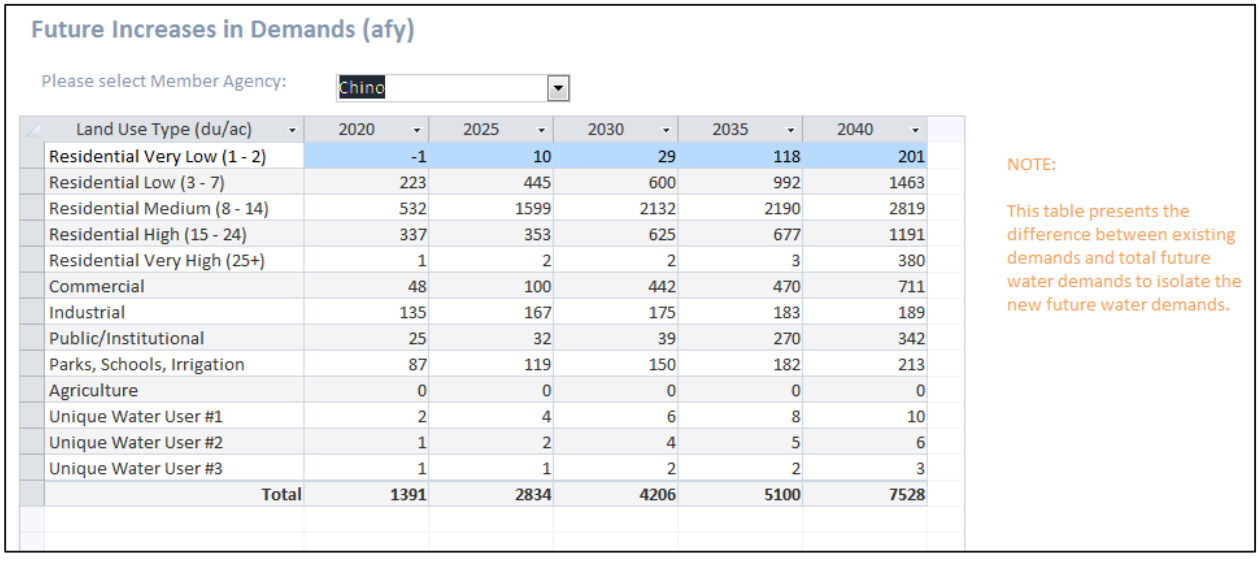
In “By Member Agency” tab, Use the dropdown menu to view the Water Demands by Member Agency.




| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1004 | 1003 | 1015 | 1034 | 1122 | 1205 |
| Residential Low (3 - 7) | 6330 | 6553 | 6775 | 6930 | 7322 | 7793 |
| Residential Medium (8 - 14) | 967 | 1499 | 2566 | 3099 | 3158 | 3787 |
| Residential High (15 - 24) | 1070 | 1407 | 1423 | 1695 | 1747 | 2261 |
| Residential Very High (25+) | 138 | 139 | 139 | 140 | 141 | 518 |
| Commercial | 1277 | 1325 | 1377 | 1719 | 1747 | 1988 |
| Industrial | 495 | 630 | 662 | 670 | 677 | 684 |
| Public/Institutional | 1132 | 1157 | 1164 | 1171 | 1402 | 1473 |
| Parks, Schools, Irrigation | 2713 | 2800 | 2832 | 2863 | 2895 | 2926 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 |
| Unique Water User #1 | 326 | 328 | 330 | 332 | 334 | 335 |
| Unique Water User #2 | 203 | 205 | 206 | 207 | 208 | 209 |
| Unique Water User #3 | 89 | 89 | 90 | 91 | 91 | 92 |
| Total | 15744 | 17135 | 18579 | 19951 | 20844 | 23271 |

Figure 7-1 Water Demands by Member Agency

Click the "Show Future Increases in Demands Only" button to view just the future demands - the difference between existing demands and projected demands.




| Land Use Type (du/ac) | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | -1 | 10 | 29 | 118 | 201 |
| Residential Low (3 - 7) | 223 | 445 | 600 | 992 | 1463 |
| Residential Medium (8 - 14) | 532 | 1599 | 2132 | 2190 | 2819 |
| Residential High (15 - 24) | 337 | 353 | 625 | 677 | 1191 |
| Residential Very High (25+) | 1 | 2 | 2 | 3 | 380 |
| Commercial | 48 | 100 | 442 | 470 | 711 |
| Industrial | 135 | 167 | 175 | 183 | 189 |
| Public/Institutional | 25 | 32 | 39 | 270 | 342 |
| Parks, Schools, Irrigation | 87 | 119 | 150 | 182 | 213 |
| Agriculture | 0 | 0 | 0 | 0 | 0 |
| Unique Water User #1 | 2 | 4 | 6 | 8 | 10 |
| Unique Water User #2 | 1 | 2 | 4 | 5 | 6 |
| Unique Water User #3 | 1 | 1 | 2 | 2 | 3 |
| Total | 1391 | 2834 | 4206 | 5100 | 7528 |

Figure 7-2 Future Increase in Demands by Member Agency

## 7.2 By Year

In “By Year” tab, use the dropdown menu to view the Water Demands for each year. This table also displays the total amounts in the last column and last row.

Water Demands (afy)

By Member Agency | By Year

Please select year: 2015

| Land Use Type (du/ac) | Chino | Chino Hills | Cucamonga Valley WD | Fontana WC | Monte Vista WD | Ontario | San Antonio WC | Upland | Total |
|---|---|---|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1004 | 1491 | 6299 | 2088 | 1522 | 338 | 1440 | 1579 | 15761 |
| Residential Low (3 - 7) | 6330 | 7024 | 19037 | 19110 | 3129 | 9993 | 0 | 8437 | 73060 |
| Residential Medium (8 - 14) | 967 | 1745 | 4217 | 2631 | 1635 | 3212 | 4 | 1601 | 16012 |
| Residential High (15 - 24) | 1070 | 767 | 4206 | 4029 | 666 | 4830 | 21 | 3022 | 18611 |
| Residential Very High (25+) | 138 | 0 | 1054 | 216 | 0 | 845 | 0 | 381 | 2634 |
| Commercial | 1277 | 1269 | 2333 | 6628 | 1339 | 5213 | 6 | 1542 | 19607 |
| Industrial | 495 | 1 | 1449 | 2061 | 367 | 2232 | 0 | 369 | 6974 |
| Public/Institutional | 1132 | 204 | 1366 | 687 | 324 | 3090 | 22 | 460 | 7285 |
| Parks, Schools, Irrigation | 2713 | 4091 | 9688 | 4682 | 1125 | 8101 | 0 | 2490 | 32890 |
| Agriculture | 0 | 0 | 36 | 0 | 61 | 2177 | 0 | 0 | 2274 |
| Unique Water User #1 | 326 | 0 | 460 | 0 | 93 | 2688 | 0 | 281 | 3848 |
| Unique Water User #2 | 203 | 0 | 296 | 0 | 51 | 681 | 0 | 256 | 1487 |
| Unique Water User #3 | 89 | 0 | 284 | 0 | 0 | 573 | 0 | 122 | 1068 |
| Unique Water User #4 | 0 | 0 | 261 | 0 | 0 | 0 | 0 | 107 | 368 |
| * | | | | | | | | | 0 |
| Total | 15744 | 16592 | 50986 | 42132 | 10312 | 43973 | 1493 | 20647 | 201879 |

Record: | No Filter | Search

Figure 7-3 Water Demands by Year

## 7.3 Water Demands Graph

Water Demands table also displays a graph of the water demands of all member agencies throughout the years. Total IEUA demands is shown as default. Click “Not Show IEUA” to show curves of member agencies only.

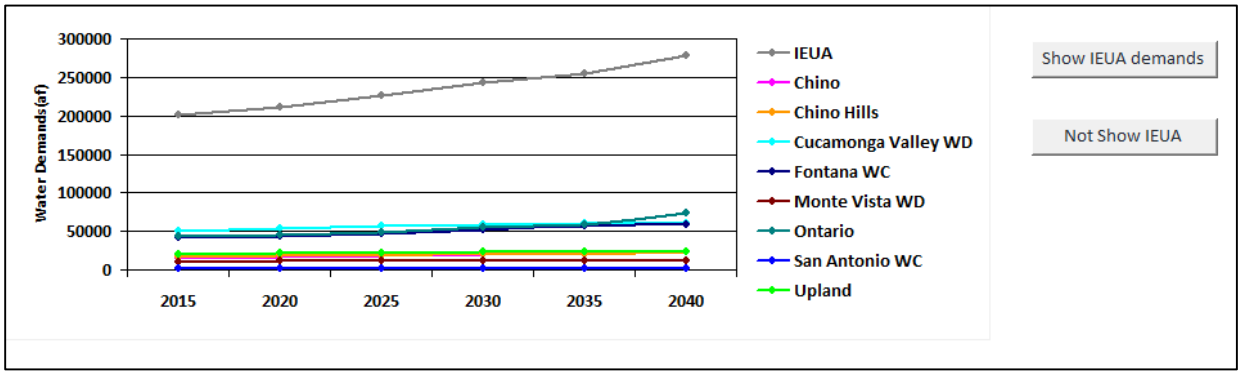



Figure 7-4 Water Demands Graph

# 8 UPDATE LAND USES IN ARCGIS

The model database contain multiple GIS feature classes with land use data which can be updated if changes to land uses occurs or year of development changes. These updates must be done within GIS.

The feature classes in the database is organized based on Cities within IEUA service area. Each city has two data tables: existing data and future data except City of Ontario and City of Upland. These two cities have existing and future data combined in one feature classes.

Since the land uses are mapped to existing parcel data, users only need to update the existing and future land use in the [CityName]_Existing or [CityName]_Existing_GeneralPlan tables. Below table shows which Feature Class is used to calculates acreages in the model. These can be updated within GIS when changes to Land Use type or development year happens.

| City Name | Feature Class Name | Used for Inventory Calculation |
|---|---|---|
| **Chino** | Chino_Existing | Y |
| | Chino_GeneralPlan | Y |
| **Chino Hills** | ChinoHills_Existing | Y |
| | ChinoHills_GeneralPlan | N |
| **Fontana** | Fontana_Existing | Y |
| | Fontana_GeneralPlan | N |
| **Montclair** | Montclair_Existing | Y |
| | Montclair_GeneralPlan | N |
| **Ontario** | Ontario_Existing_GeneralPlan | Y |
| **Rancho Cucamonga** | RanchoCucamonga_Existing | Y |
| | RanchoCucamonga_GeneralPlan | N |
| **Rialto** | Rialto_Existing | Y |
| | Rialto_GeneralPlan | N |
| **Unincorporated area between Montclair and Chino** | UINC_MontClair_Chino_Existing | Y |
| | UINC_MontClair_Chino_GP | N |
| **Upland** | Upland_Existing_GeneralPlan | Y |

In the [CityName]_Existing or [CityName]_Existing_GeneralPlan, besides the geographic information, a few new fields were added (below table).

| Field Name | Description |
|---|---|
| **Master_LU** | Existing land use (in 2015) |
| **GeneralPlan_LU** | Original planned future land use (Not used in inventory calculation) |
| **Future_LU** | Future land use |
| **Year_Developed** | The year the future land use developed |
| **WaterPurveyor** | The member agency belonged to |

To update land use in ArcGIS,

A) Be sure to close the database opened in MS Access
B) Add the needed feature classes to ArcMap and start Editor.
C) Change the land use in Master_LU for existing or change the land use in Future_LU for future and change the Year_Developed as well. Year_Developed value need to be multiples of 5 and starting from 2015 (till 2040). For example, a future land use will be developed in 2023, please input “2020” in Year_Developed field
D) Save the edits and close ArcGIS

Please note, Chino is a special case when editing future land uses. Since the parcels at southeast of Pine Ave & Chino Corona Rd changes significantly in future, the parcels in Chino_GeneralPlan are used for representing the land use in future. If future land uses in the colored area (shown in figure 8-1) needs to be changed, please update the Future_LU and Year_Developed fields in Chino_GeneralPlan feature class. For all other landuse changes, please update these two fields in Chino_Existing feature class.




Figure 8-1 Parcels representing future land uses in Chino

# 9 UPDATE WATER DEMAND MODEL

Once you have completed and saved the changes to the GIS feature classes, use the update features on Welcome page to update land use inventories and water demands.

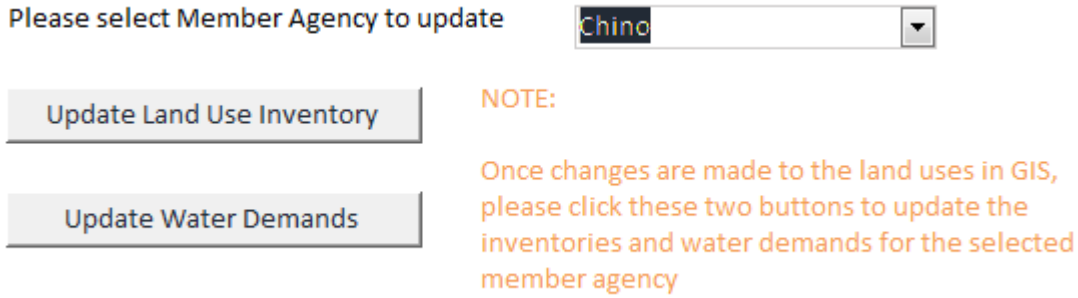



Figure 9-1 Update section in Welcome Form

## 9.1 Update Land Use Inventories

Before making the update, make sure the database is not opened in ArcGIS. Select a member agency or “All Member Agencies” in the dropdown list and click “Update Land Use Inventory” button to run the

calculation. This update procedure can take several minutes, please don't interrupt it. The "Land Use Inventories" window will pop up once the updating finished.

## 9.2 Update Water Demands

Once the inventories update is done, click "Update Water Demands" button to re-calculate the total water demands and the "Water Demands" form will pop up once the updating finished.

Arcadis U.S., Inc.

320 Commerce

Suite 200

Irvine, California  92602

Tel 714 730 9052

Fax 714 730 9345

**www.arcadis.com**

# APPENDIX O

## Water Loss Audit

# AWWA Free Water Audit Software v5.0

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This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

**Please begin by providing the following information**

| | | |
|---|---|---|
| Name of Contact Person: | Terry Caitlin | |
| Email Address: | tlcatlin@wfajpa.org | |
| Telephone \| Ext.: | 909-981-9454 | 12 |
| Name of City / Utility: | Water Facilities Authority | |
| City/Town/Municipality: | Upland | |
| State / Province: | California (CA) | |
| Country: | USA | |
| Year: | 2014 | Financial Year |
| Start Date: | 07/2014 | Enter MM/YYYY numeric format |
| End Date: | 06/2015 | Enter MM/YYYY numeric format |
| Audit Preparation Date: | 4/5/2016 | |
| Volume Reporting Units: | Acre-feet | |
| PWSID / Other ID: | | |

**The following guidance will help you complete the Audit**

All audit data are entered on the ***Reporting Worksheet***

- Value can be entered by user
- Value calculated based on input data
- These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: 0.25% Value:

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the right

**The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page**

***Instructions***
The current sheet. Enter contact information and basic audit details (year, units etc)

***Reporting Worksheet***
Enter the required data on this worksheet to calculate the water balance and data grading

***Comments***
Enter comments to explain how values were calculated or to document data sources

***Performance Indicators***
Review the performance indicators to evaluate the results of the audit

***Water Balance***
The values entered in the Reporting Worksheet are used to populate the Water Balance

***Dashboard***
A graphical summary of the water balance and Non-Revenue Water components

***Grading Matrix***
Presents the possible grading options for each input component of the audit

***Service Connection Diagram***
Diagrams depicting possible customer service connection line configurations

***Definitions***
Use this sheet to understand the terms used in the audit process

***Loss Control Planning***
Use this sheet to interpret the results of the audit validity score and performance indicators

***Example Audits***
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

***Acknowledgements***
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** Water Facilities Authority
**Reporting Year:** 2014 7/2014 - 6/2015

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<---------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |
| Water imported: | 8 | 27,605.500 | acre-ft/yr | 5 | | | acre-ft/yr |
| Water exported: | n/a | 0.000 | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 27,605.500 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 6 | 27,338.900 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled unmetered: | 10 | 0.001 | acre-ft/yr | | 0.001 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 27,338.901 acre-ft/yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 266.599 acre-ft/yr

**Apparent Losses**

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | 6 | 0.001 | acre-ft/yr | | 0.001 | acre-ft/yr |
| Customer metering inaccuracies: | 7 | 68.519 | acre-ft/yr | 0.25% | | acre-ft/yr |
| Systematic data handling errors: | | 68.347 | acre-ft/yr | 0.25% | | acre-ft/yr |

**Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed**

**Apparent Losses:** 136.867 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 129.732 acre-ft/yr

**WATER LOSSES:** 266.599 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** 266.600 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 7 | 4.9 | miles |
| Number of active AND inactive service connections: | 9 | 7 | |
| Service connection density: | | 1 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line:

(length of service line, beyond the property boundary, that is the responsibility of the utility)

**Average length of customer service line has been set to zero and a data grading score of 10 has been applied**

Average operating pressure: 9 89.5 psi

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | 9 | $3,342,185 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $1.50 | $/100 cubic feet (ccf) | |
| Variable production cost (applied to Real Losses): | 7 | $638.71 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 76 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Billed metered
3: Systematic data handling errors

# AWWA Free Water Audit Software:
## System Attributes and Performance Indicators

WAS v5.0
American Water Works Association.
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**Water Audit Report for:** Water Facilities Authority
**Reporting Year:** 2014 | 7/2014 - 6/2015

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 76 out of 100 ***

**System Attributes:**

| | | | |
|---|---|---|---|
| | Apparent Losses: | 136.867 | acre-ft/yr |
| + | Real Losses: | 129.732 | acre-ft/yr |
| = | **Water Losses:** | **266.599** | acre-ft/yr |
| ? | Unavoidable Annual Real Losses (UARL): | See limits in definition | acre-ft/yr |
| | Annual cost of Apparent Losses: | $89,429 | |
| | Annual cost of Real Losses: | $82,861 | Valued at **Variable Production Cost** |

Return to Reporting Worksheet to change this assumpiton

**Performance Indicators:**

| | | | |
|---|---|---|---|
| Financial: | Non-revenue water as percent by volume of Water Supplied: | 1.0% | |
| | Non-revenue water as percent by cost of operating system: | 5.2% | Real Losses valued at Variable Production Cost |
| Operational Efficiency: | Apparent Losses per service connection per day: | 17455.26 | gallons/connection/day |
| | Real Losses per service connection per day: | N/A | gallons/connection/day |
| | Real Losses per length of main per day*: | 23,636.21 | gallons/mile/day |
| | Real Losses per service connection per day per psi pressure: | N/A | gallons/connection/day/psi |

| | | | |
|---|---|---|---|
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 129.73 | acre-feet/year |
| ? | Infrastructure Leakage Index (ILI) [CARL/UARL]: | | |

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

# AWWA Free Water Audit Software:
# User Comments

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Use this worksheet to add comments or notes to explain how an input value was calculated, or to document the sources of the information used.

| | |
|---|---|
| **General Comment:** | Water Facilities Authority provides wholesale water treatment and delivery to its five Member Agencies. Scope of water audit software designed primarily for retail water delivery. Water supply volumes for Water Facilities Authority in this audit includes both water treatment process and distribution delivery volumes. |

| Audit Item | Comment |
|---|---|
| Volume from own sources: | |
| Vol. from own sources: Master meter error adjustment: | |
| Water imported: | Calibration results from 2011 for treatment plant process meters and Member Agency service meters, owned by Water Facilities Authority. Raw water supply received from Metropolitan's meter at CB-12 on the Rialto Feeder (#3). MWD meter serves the CB-12 connection and is used as the reference. Set score of 8. |
| Water imported: master meter error adjustment: | Standard |
| Water exported: | |
| Water exported: master meter error adjustment: | |
| Billed metered: | Member Agency service meters and MWD's CB-12 meter are reviewed and logged once a month (Audit Questionaire #2c). Meter calibration for treatment plant process meters and Member Agency service meters completed in 2011 and scheduled for 2016 per "Flow Meter" p. 8). Meter reads are manual on a monthly basis. Collective Member Agency service meters' readings is compared to single CB-12 treatment plant influent meter reading, resulting in variance adjustments to Member Agency service meters billing volume, compared to MWD's CB-12 meter. Net billed volume includes both Distribution & Treatment Plant process volumes. |
| Billed unmetered: | |
| Unbilled metered: | |

| Audit Item | Comment |
|---|---|
| Unbilled unmetered: | |
| Unauthorized consumption: | Not clear that actual policies or procedures are in place to identify or mitigate potential unauthorized consumption. |
| Customer metering inaccuracies: | Limited customer rmeter inaccuary testing is conducted. Meter population is small and fairly new (oldest from 2004). |
| Systematic data handling errors: | |
| Length of mains: | Wholesale transmission/distribution pipeline is 3.8 mile (14). Electronic model not used to store information (17). |
| Number of active AND inactive service connections: | 6 active and 1 inactive service connection (12). No fire hydrants or retail meters. Electronic system does not exist but location of meters assumed to be accurate due to number and frequency of reads (14). |
| Average length of customer service line: | N/A |
| Average operating pressure: | Weighted average for pipeline was calculated. Main pipeline (2.2 mi @ 87.9 psi); MVDW#1 (0.2 mi @ 183.5 psi); Ontario pipeline (2.5 mi @ 98 psi) |
| Total annual cost of operating water system: | Reliable cost accounting system in place, audited internally yearly. (25) |
| Customer retail unit cost (applied to Apparent Losses): | Used $593+15+45.71 = $653.71 per AF is equal to $1.50 per CCF from wholesale billing statement. Audited monthly and annualy by third party and CPA, not by third party aware of M36 methodology. |
| Variable production cost (applied to Real Losses): | Charge for MWD imported water purchases and WFA Direct Operating Cost ($593 + 45.71 = $638.71) |

# AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

| | |
|---|---|
| Water Audit Report for: | Water Facilities Authority |
| Reporting Year: | 2014 (7/2014 - 6/2015) |
| Data Validity Score: | 76 |

**Own Sources** (Adjusted for known errors)
*0.000*

**Water Imported**
*27,605.500*

**System Input**
*27,605.500*

**Water Exported**
*0.000*

**Water Supplied**
*27,605.500*

**Authorized Consumption**
*27,338.901*

**Billed Authorized Consumption**
*27,338.900*

**Billed Water Exported**
*27,338.900*

**Billed Metered Consumption (water exported is removed)**
*27,338.900*

**Billed Unmetered Consumption**
*0.000*

**Unbilled Authorized Consumption**
*0.001*

**Unbilled Metered Consumption**
*0.000*

**Unbilled Unmetered Consumption**
*0.001*

**Water Losses**
*266.599*

**Apparent Losses**
*136.867*

**Unauthorized Consumption**
*0.001*

**Customer Metering Inaccuracies**
*68.519*

**Systematic Data Handling Errors**
*68.347*

**Real Losses**
*129.732*

**Leakage on Transmission and/or Distribution Mains**
*Not broken down*

**Leakage and Overflows at Utility's Storage Tanks**
*Not broken down*

**Leakage on Service Connections**
*Not broken down*

**Revenue Water**
0.000

**Revenue Water**
27,338.900

**Non-Revenue Water (NRW)**
266.600

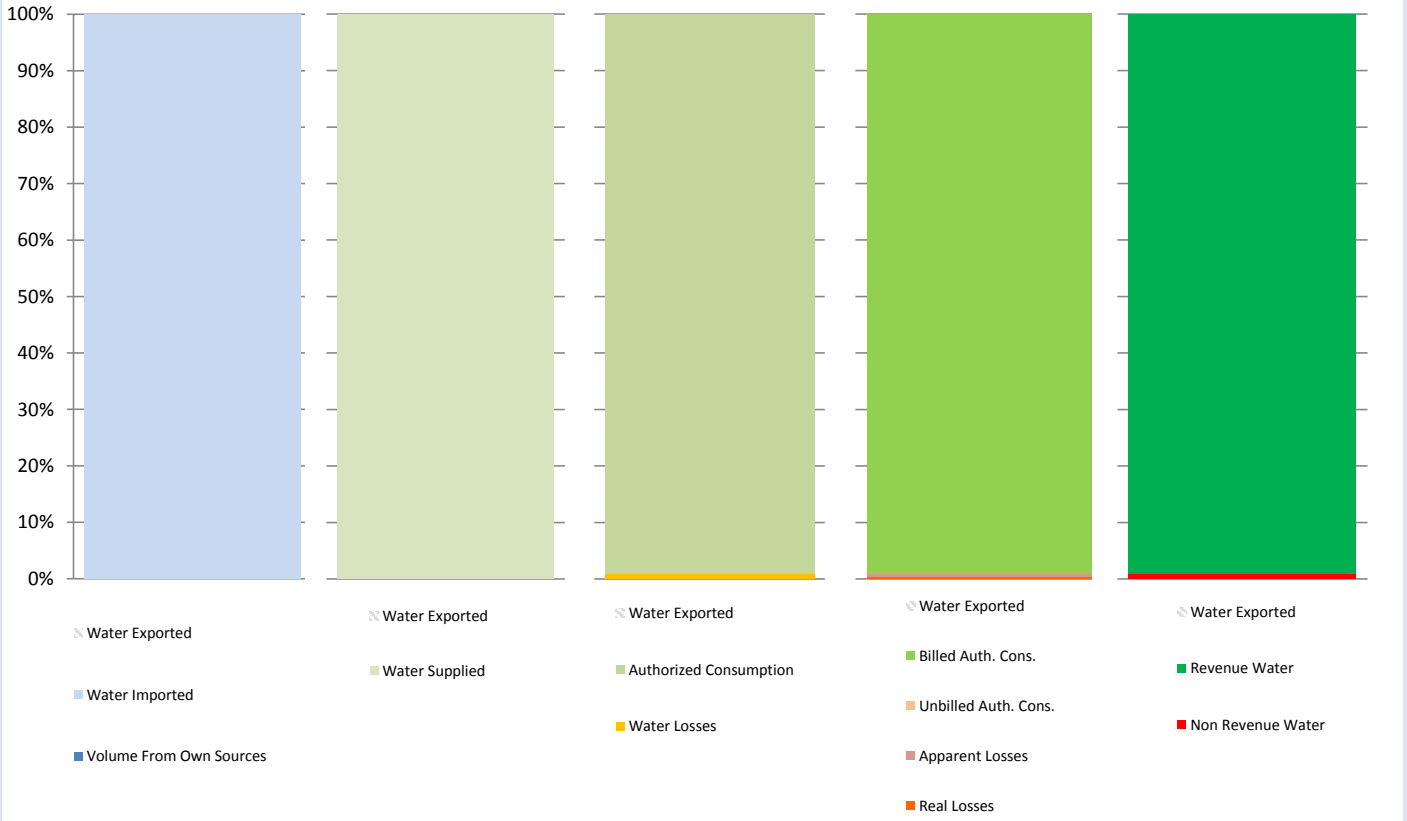
# AWWA Free Water Audit Software:
# Dashboard

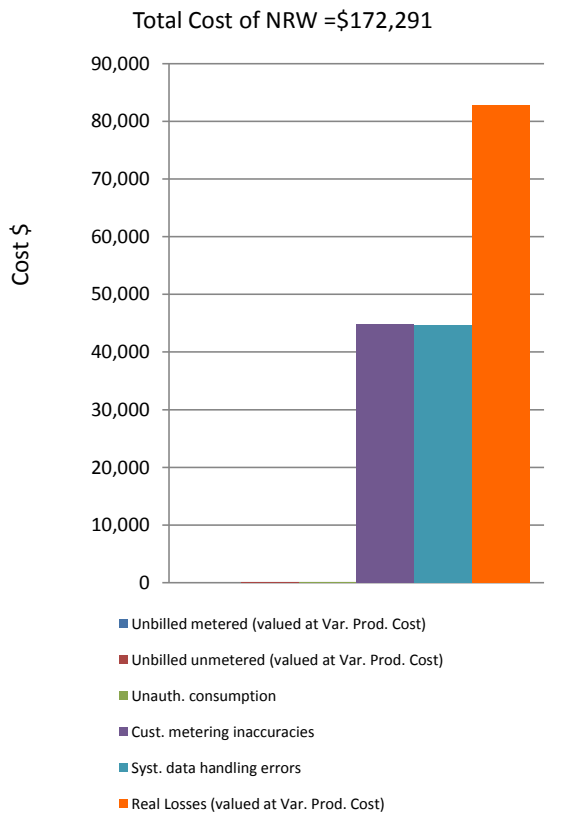
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The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

**Water Audit Report for:** Water Facilities Authority
**Reporting Year:** 2014 | 7/2014 - 6/2015
**Data Validity Score:** 76

○ Show me the VOLUME of Non-Revenue Water
◉ Show me the COST of Non-Revenue Water



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Suite 3650

Los Angeles, California 90071

Tel 213 486 9884

Fax 213 486 9894

**www.arcadis.com**

# RP-1 Recycled Water Quality (2017)

| Parameter | Units | Average [1] | Minimum [1] | Maximum [1] |
|---|---|---|---|---|
| BOD | mg/L | <2 | <2 | <2 |
| TSS | mg/L | <2 | <2 | <2 |
| pH | units | 7.1 | 6.8 | 7.2 |
| Turbidity | NTU | 0.5 | 0.4 | 0.7 |
| Total Coliform (7d median) | MPN/100mL | <1 | <1 | <1 |
| EC [2] | µmhos/cm | 753 | 719 | 787 |
| TDS | mg/L | 450 | 408 | 477 |
| TOC | mg/L | 5.8 | 5.3 | 6.4 |
| $NH_3$-N | mg/L | <0.1 | <0.1 | <0.3 |
| Bicarbonate Alkalinity | mg/L as $CaCO_3$ | 132 | 108 | 149 |
| TIN | mg/L | 6.6 | 5.4 | 8.3 |
| Boron | mg/L | 0.2 | 0.2 | 0.2 |
| Calcium | mg/L | 40 | 25 | 46 |
| Carbonate Alkalinity | mg/L as $CaCO_3$ | 0 | 0 | 0 |
| Chloride | mg/L | 105 | 96 | 115 |
| Fluoride | mg/L | 0.3 | 0.2 | 0.3 |
| Magnesium | mg/L | 9 | 7 | 10 |
| $NO_3$-N | mg/L | 6.6 | 5.4 | 8.3 |
| Sodium | mg/L | 86 | 79 | 96 |
| Sulfate | mg/L | 44 | 39 | 51 |
| Total Hardness | mg/L as $CaCO_3$ | 137 | 119 | 155 |
| TR Aluminium | µg/L | 94 | 41 | 140 |
| TR Arsenic | µg/L | <2 | <2 | <2 |
| TR Barium | µg/L | 15 | 11 | 21 |
| TR Chromium | µg/L | <0.5 | <0.5 | 0.6 |
| TR Copper | µg/L | 4 | 4 | 8 |
| TR Cadmium | µg/L | <0.25 | <0.25 | <0.25 |
| TR Lead | µg/L | <0.5 | <0.5 | <0.5 |
| TR Manganese | µg/L | 6 | 3 | 15 |
| TR Mercury | µg/L | <0.05 | <0.05 | <0.05 |
| TR Nickel | µg/L | 3 | 3 | 3 |
| TR Selenium | µg/L | <2 | <2 | <2 |
| TR Silver | µg/L | <0.25 | <0.25 | <0.25 |
| TR Zinc | µg/L | 28 | 23 | 41 |
| Silica | mg/L | 23 | 19 | 27 |
| Orthophosphate | mg/L | <0.6 | <0.6 | <0.6 |

*[1] Average, Minimum, and Maximum values based on monthly averages*

*[2] EC values based on 24-hour composite lab samples, not continuous monitoring*

# RP-4 Recycled Water Quality (2017)

| Parameter | Units | Average [1] | Minimum [1] | Maximum [1] |
|---|---|---|---|---|
| BOD | mg/L | <2 | <2 | <2 |
| TSS | mg/L | <2 | <2 | <2 |
| pH | units | 6.9 | 6.8 | 7.1 |
| Turbidity | NTU | 0.5 | 0.4 | 0.6 |
| Total Coliform (7d median) | MPN/100mL | <1 | <1 | <1 |
| EC [2] | µmhos/cm | 694 | 640 | 807 |
| TDS | mg/L | 412 | 384 | 481 |
| TOC | mg/L | 5.1 | 4.4 | 6.1 |
| $NH_3$-N | mg/L | <0.1 | <0.1 | <0.1 |
| Bicarbonate Alkalinity | mg/L as $CaCO_3$ | 118 | 82 | 138 |
| TIN | mg/L | 4.5 | 2.7 | 7.3 |
| Boron | mg/L | 0.2 | 0.2 | 0.3 |
| Calcium | mg/L | 34 | 28 | 40 |
| Carbonate Alkalinity | mg/L as $CaCO_3$ | 0 | 0 | 0 |
| Chloride | mg/L | 101 | 88 | 130 |
| Fluoride | mg/L | 0.2 | <0.1 | 0.2 |
| Iron | µg/L | 53 | 43 | 64 |
| Magnesium | mg/L | 9 | 7 | 11 |
| $NO_3$-N | mg/L | 4.5 | 2.7 | 7.3 |
| Sodium | mg/L | 84 | 75 | 97 |
| Sulfate | mg/L | 44 | 40 | 52 |
| Total Hardness | mg/L as $CaCO_3$ | 122 | 98 | 141 |
| Silica | mg/L | 18 | 4 | 21 |
| Orthophosphate | mg/L | 3.9 | 1.5 | 7.8 |

*[1] Average, Minimum, and Maximum values based on monthly averages*

*[2] EC values based on 24-hour composite lab samples, not continuous monitoring*

# RP-5 Recycled Water Quality (2017)

| Parameter | Units | Average [1] | Minimum [1] | Maximum [1] |
|---|---|---|---|---|
| BOD | mg/L | <2 | <2 | <2 |
| TSS | mg/L | <2 | <2 | <4 |
| pH | units | 7.0 | 6.8 | 7.2 |
| Turbidity | NTU | 0.8 | 0.6 | 1.0 |
| Total Coliform (7d median) | MPN/100mL | <1 | <1 | <1 |
| EC [2] | µmhos/cm | 842 | 802 | 868 |
| TDS | mg/L | 490 | 466 | 523 |
| TOC | mg/L | 5.0 | 4.4 | 5.7 |
| $NH_3$-N | mg/L | <0.1 | <0.1 | <0.1 |
| Bicarbonate Alkalinity | mg/L as $CaCO_3$ | 129 | 107 | 164 |
| TIN | mg/L | 6.2 | 5.2 | 7.0 |
| Boron | mg/L | 0.2 | 0.2 | 0.3 |
| Calcium | mg/L | 51 | 44 | 55 |
| Carbonate Alkalinity | mg/L as $CaCO_3$ | 0 | 0 | 0 |
| Chloride | mg/L | 128 | 119 | 137 |
| Fluoride | mg/L | 0.2 | 0.1 | 0.2 |
| Magnesium | mg/L | 11 | 10 | 12 |
| $NO_3$-N | mg/L | 6.2 | 5.2 | 7.0 |
| Sodium | mg/L | 92 | 83 | 104 |
| Sulfate | mg/L | 62 | 55 | 79 |
| Total Hardness | mg/L as $CaCO_3$ | 172 | 150 | 184 |
| TR Aluminium | µg/L | <42 | <25 | 146 |
| TR Arsenic | µg/L | <2 | <2 | <2 |
| TR Barium | µg/L | 23 | 19 | 34 |
| TR Chromium | µg/L | 0.7 | <0.5 | 1.4 |
| TR Copper | µg/L | 7 | 4 | 11 |
| TR Cadmium | µg/L | <0.25 | <0.25 | 0.55 |
| TR Lead | µg/L | <0.5 | <0.5 | <0.5 |
| TR Manganese | µg/L | 21 | 12 | 29 |
| TR Mercury | µg/L | <0.05 | <0.05 | <0.05 |
| TR Nickel | µg/L | 3 | 3 | 3 |
| TR Selenium | µg/L | <2 | <2 | <2 |
| TR Silver | µg/L | <0.25 | <0.25 | 0.29 |
| TR Zinc | µg/L | 41 | 21 | 55 |
| Silica | mg/L | 20 | 18 | 22 |

*[1] Average, Minimum, and Maximum values based on monthly averages*

*[2] EC values based on 24-hour composite lab samples, not continuous monitoring*

# CCWRF Recycled Water Quality (2017)

| Parameter | Units | Average [1] | Minimum [1] | Maximum [1] |
|---|---|---|---|---|
| BOD | mg/L | <2 | <2 | <2 |
| TSS | mg/L | <2 | <2 | 3 |
| pH | units | 6.9 | 6.8 | 7.2 |
| Turbidity | NTU | 0.7 | 0.4 | 1.0 |
| Total Coliform (7d median) | MPN/100mL | <1 | <1 | <1 |
| EC [2] | µmhos/cm | 817 | 758 | 869 |
| TDS | mg/L | 472 | 456 | 499 |
| TOC | mg/L | 5.7 | 5.2 | 6.7 |
| $NH_3$-N | mg/L | <0.1 | <0.1 | 0.2 |
| Bicarbonate Alkalinity | mg/L as $CaCO_3$ | 117 | 99 | 136 |
| TIN | mg/L | 5.3 | 4.1 | 6.3 |
| Boron | mg/L | 0.2 | 0.2 | 0.3 |
| Calcium | mg/L | 44 | 36 | 52 |
| Carbonate Alkalinity | mg/L as $CaCO_3$ | 0 | 0 | 0 |
| Chloride | mg/L | 119 | 111 | 128 |
| Fluoride | mg/L | 0.2 | 0.1 | 0.2 |
| Magnesium | mg/L | 9 | 8 | 10 |
| $NO_3$-N | mg/L | 5.3 | 4.1 | 6.3 |
| Sodium | mg/L | 99 | 92 | 113 |
| Sulfate | mg/L | 82 | 67 | 104 |
| Total Hardness | mg/L as $CaCO_3$ | 147 | 129 | 170 |
| TR Aluminium | µg/L | 72 | 36 | 152 |
| TR Arsenic | µg/L | <2 | <2 | <2 |
| TR Barium | µg/L | 14 | 9 | 20 |
| TR Chromium | µg/L | 0.7 | <0.5 | 1 |
| TR Copper | µg/L | 7 | 6 | 11 |
| TR Cadmium | µg/L | <0.25 | <0.25 | <0.25 |
| TR Lead | µg/L | <0.5 | <0.5 | <0.5 |
| TR Manganese | µg/L | 15 | 1 | 31 |
| TR Mercury | µg/L | <0.05 | <0.05 | <0.05 |
| TR Nickel | µg/L | 3 | 2 | 3 |
| TR Selenium | µg/L | <2 | <2 | 2 |
| TR Silver | µg/L | <0.25 | <0.25 | <0.25 |
| TR Zinc | µg/L | 54 | 39 | 64 |
| Silica | mg/L | 16 | 14 | 19 |

*[1] Average, Minimum, and Maximum values based on monthly averages*

*[2] EC values based on 24-hour composite lab samples, not continuous monitoring*

# IEUA Recycled Water Quality (2017) 1

| Parameter | Units | Average [2] | Minimum [2] | Maximum [2] |
|---|---|---|---|---|
| BOD | mg/L | <2 | <2 | <3 |
| TSS | mg/L | <2 | <2 | <4 |
| pH | units | 7.0 | 6.8 | 7.2 |
| Turbidity | NTU | 0.6 | 0.4 | 1.0 |
| Total Coliform (7d median) | MPN/100mL | <1 | <1 | <1 |
| EC [3] | µmhos/cm | 776 | 640 | 869 |
| TDS | mg/L | 456 | 384 | 523 |
| TOC | mg/L | 5.4 | 4.4 | 6.7 |
| $NH_3$-N | mg/L | <0.1 | <0.1 | <0.3 |
| Bicarbonate Alkalinity | mg/L as $CaCO_3$ | 124 | 82 | 164 |
| TIN | mg/L | 5.7 | 2.7 | 8.3 |
| Boron | mg/L | 0.2 | 0.2 | 0.3 |
| Calcium | mg/L | 42 | 25 | 55 |
| Carbonate Alkalinity | mg/L as $CaCO_3$ | 0 | 0 | 0 |
| Chloride | mg/L | 113 | 88 | 137 |
| Fluoride | mg/L | 0.2 | 0.1 | 0.3 |
| Magnesium | mg/L | 9 | 7 | 12 |
| $NO_3$-N | mg/L | 5.6 | 2.7 | 8.3 |
| Sodium | mg/L | 90 | 75 | 113 |
| Sulfate | mg/L | 58 | 39 | 104 |
| Total Hardness | mg/L as $CaCO_3$ | 145 | 98 | 184 |
| TR Aluminium | µg/L | 69 | <25 | 92 |
| TR Arsenic | µg/L | <2 | <2 | <2 |
| TR Barium | µg/L | 17 | 9 | 34 |
| TR Chromium | µg/L | 0.6 | <0.5 | 1.4 |
| TR Copper | µg/L | 6 | 4 | 11 |
| TR Cadmium | µg/L | <0.25 | <0.25 | 0.55 |
| TR Lead | µg/L | <0.5 | <0.5 | <0.5 |
| TR Manganese | µg/L | 14 | 1 | 31 |
| TR Mercury | µg/L | <0.05 | <0.05 | <0.05 |
| TR Nickel | µg/L | 3 | 2 | 3 |
| TR Selenium | µg/L | <2 | <2 | 2 |
| TR Silver | µg/L | <0.25 | <0.25 | <0.25 |
| TR Zinc | µg/L | 41 | 21 | 64 |
| Silica | mg/L | 19 | 4 | 27 |

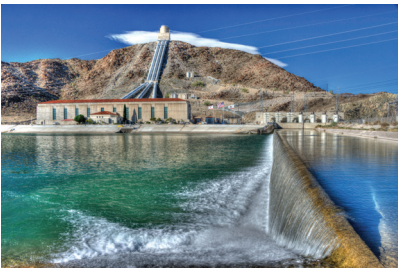
*[1] IEUA RW quality includes RP-1, RP-4, RP-5, and CCWRF. Some RW customers may receive RW from each of these facilities dependent upon regional demands*

*[2] Average, Minimum, and Maximum values based on monthly averages*

*[3] EC values based on 24-hour composite lab samples, not continuous monitoring*

# 2015
# URBAN WATER MANAGEMENT PLAN

JUNE 2016







THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

*THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA*

# 2015

# URBAN WATER MANAGEMENT PLAN

## JUNE 2016

WATER TOMORROW

Planning for the Future

*THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA*

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# LIST OF ABBREVIATIONS

| Abbreviation | Terms |
|---|---|
| **Units of Measurement** | |
| AF | Acre-Feet |
| AFY | Acre-feet per Year |
| TAF | Thousand Acre-Feet |
| MAF | Million Acre-Feet |
| cfs | Cubic feet per second |
| GPCD | Gallons per Capita per Day |
| MGD | Million gallons per Day |
| mg/L | Milligrams per liter |
| µg/L | Micrograms per liter |
| ng/L | Nanograms per liter |
| pCi/L | Picocuries per liter |
| kWh | Kilo-Watt Hour |
| **Acronyms** | |
| AGWA | Association of Ground Water Agencies |
| AMPAC | American Pacific Corporation |
| AVEK | Antelope Valley East Kern Water Agency |
| AWE | Alliance for Water Efficiency |
| AWWA | American Water Works Association |
| BDCP | Bay Delta Conservation Plan |
| BMPs | Best Management Practices |
| CAWCD | Central Arizona Water Conservation District |
| CBM | Condition-based maintenance |
| CCL3 | Contaminant Candidate List 3 |
| CCP | Conservation Credits Program |
| CCWD | Contra Costa Water District |
| CEC | California Energy Commission |
| CEQA | California Environmental Quality Act |
| CII | Commercial, Industrial, and Institutional |
| CMMS | Computerized Maintenance Management System |
| $CO_2$ | Carbon Dioxide |
| CPE | Comprehensive Program Evaluation |
| CRA | Colorado River Aqueduct |
| CUWCC | California Urban Water Conservation Council |
| CVP | Central Valley Project |
| CVWD | Coachella Valley Water District |
| CY | Calendar Year |
| D/DBP | Disinfectants/Disinfection Byproduct |
| DBP | Disinfection Byproduct |
| DDW | The SWRCB's Division of Drinking Water |
| DFW | Department of Fish and Wildlife |
| DLR | Detection Level for purposes of Reporting |
| DMM | Demand Management Measure |
| DOE | U.S. Department of Energy |

## LIST OF ABBREVIATIONS

| Abbreviation | Terms |
|---|---|
| DPC | Delta Protection Commission |
| DPR | Direct Potable Reuse |
| DTSC | California Department of Toxic Substances Control |
| DVL | Diamond Valley Lake |
| DWA | Desert Water Agency |
| DWCV | Desert Water Agency/Coachella Valley Water District |
| DWR | California Department of Water Resources |
| ECLO | Existing Conveyance and Low Outflow |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| ELPH | Equivalent Level of Public Health Protection |
| ESA | Endangered Species Act |
| $ET_o$ | Evapotranspiration |
| FWUA | Friant Water Users Authority |
| FY | Fiscal Year |
| GHG | Greenhouse Gas Emissions |
| GRP | Groundwater Recovery Program |
| GWRS | Groundwater Replenishment System |
| HECW | High Efficiency Clothes Washer |
| HET | High Efficiency Toilet |
| HTC | Hyatt/Thermalito Complex |
| ICP | Innovative Conservation Program |
| ICS | Intentionally Created Surplus |
| IEUA | Inland Empire Utilities Agency |
| IID | Imperial Irrigation District |
| IPR | Indirect Potable Reuse |
| IRP | Integrated Water Resources Plan |
| JWPCP | Joint Water Pollution Control Plant |
| LAA | Los Angeles Aqueduct |
| LADWP | Los Angeles Department of Water and Power |
| LRP | Local Resources Program |
| M&I | Municipal & Industrial |
| MCL | Maximum Contaminant Level |
| MFR | Multi-family Residential |
| MLPA | Marine Life Protected Area |
| MOU | Memorandum of Understanding |
| MWD | Metropolitan Water District |
| MWD-EDM | Metropolitan's Econometric Demand Model |
| MWDOC | Municipal Water District of Orange County |
| MWELO | Model Water Efficient Landscape Ordinance |
| MWQI | Municipal Water Quality Investigations |
| NASA | National Aeronautics and Space Administration |
| NDEP | Nevada Division of Environmental Protection |
| NDMA | N-nitrosodimethylamine |
| NEPA | National Environmental Policy Act |

## LIST OF ABBREVIATIONS

| Abbreviation | Terms |
|---|---|
| NERT | Nevada Environmental Response Trust |
| NMFS | National Marine Fisheries Services |
| OCWD | Orange County Water District |
| OEHHA | Office of Environmental Health Hazard Assessment |
| OMP&R | Operation, Maintenance, Power and Replacement |
| PG&E | Pacific Gas & Electric |
| PHG | Public Health Goal |
| polyDADMAC | polydiallyldimethylammonium chloride |
| PPCP | Pharmaceutical/Personal Care Product |
| PPRs | Present Perfected Rights |
| PVID | Palo Verde Irrigation District |
| QMCP | Quagga Mussel Control Program |
| QSA | Quantification Settlement Agreement |
| RDM | Robust Decision Making |
| RPAs | Reasonable and Prudent Alternatives |
| RTP-12 | 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy |
| RTS | Readiness-to-Serve |
| SANDAG | San Diego Association of Governments |
| SAR | System Access Rate |
| SARI Line | Santa Ana Regional Interceptor Line |
| SB X7-7 | Senate Bill X7-7, Water Conservation Act of 2009 |
| SCAG | Southern California Association of Governments |
| SCWC | Southern California Water Committee |
| SDCWA | San Diego County Water Authority |
| SDP | Seawater Desalination Program |
| Series 13 | SANDAG Series 13: 2050 Regional Growth Forecast |
| SFR | Single-Family Residential Model |
| SNMP | Salt and Nutrient Management Plan |
| SNWA | Southern Nevada Water Authority |
| SPR | System Power Rate |
| SRCSD | Sacramento Regional County Sanitation District |
| SWC | State Water Contractors |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| TDS | Total Dissolved Solids |
| TOC | Total Organic Carbon |
| TVMWD | Three Valleys Municipal Water District |
| UCMR2 | Unregulated Contaminant Monitoring Regulation 2 |
| USBR | U.S. Department of the Interior, Bureau of Reclamation |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Services |
| UWMP | Urban Water Management Plan |
| VOC | Volatile Organic Compound |
| WRD | Water Replenishment District of Southern California |

# LIST OF ABBREVIATIONS

| Abbreviation | Terms |
|---|---|
| WSAP | Water Supply Allocation Plan |
| WSDM Plan | Water Surplus and Drought Management Plan |
| WSR | Water Stewardship Rate |
| WUCA | Water Utility Climate Alliance |
| WUE | Water Use Efficiency |
| YCWA | Yuba County Water Agency |

**Phrases**

| | |
|---|---|
| 2015 IRP Update | 2015 Integrated Water Resources Plan, Water Tomorrow |
| Act | Urban Water Management Planning Act |
| Arvin-Edison | Arvin-Edison Water Storage District |
| Bay-Delta | San Francisco Bay/Sacramento-San Joaquin Delta |
| Conservancy | Sacramento-San Joaquin Delta Conservancy |
| Council | Delta Stewardship Council |
| Delta | Sacramento/San Joaquin River Delta |
| Forum | Colorado River Basin Salinity Control Forum |
| Kern Delta | Kern Delta Water District |
| Metropolitan | The Metropolitan Water District of Southern California |
| Metropolitan Act | Metropolitan Water District Act |
| Plan | Urban Water Management Plan |
| Policy | State Recycled Water Policy |
| Regional Board | Regional Water Quality Control Board |
| Sanitation District | County Sanitation District No. 2 of Los Angeles County |
| Science Board | Delta Independent Science Board |
| Semitropic | Semitropic Water Storage District |
| Urban MOU | California urban Water Conservation Council Memorandum of Understanding Regarding Water Conservation in California |

## Summary of Compliance

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|---|---|
| ***SB X7-7*** | |
| **Water Code § 10608.36 – Assessment of Measures, Programs, and Policies** | Assess present and proposed future measures, programs, and policies to help achieve water use reduction targets<br>• Metropolitan's actions to help achieve the urban per capita water use reduction pursuant to the goals set forth in SB X7-7 are discussed in Sections 3.4, 3.5, and 3.7. |
| ***Agency Coordination*** | |
| **Water Code § 10620(d)(2) Coordination with Appropriate Agencies** | Describe the coordination of the plan preparation.<br>• See Section 5. |
| **Water Code § 10620(f) - Describe Resource Maximization / Import Minimization Plan** | Discuss how water management tools and options are used to maximize resources and minimize the need to import water.<br>• Metropolitan's planning strategy within the IRP and adaptive implementation approach are discussed in Section 2 and provide an overview of the water management tools and options. See pages 2-1 through 2-9.<br>• Further details are provided in Sections 1.4 (conservation, page 1-23), 3.4 (demand management and conservation, pages 3-30 through 3-45), and 3.5 (recycling, groundwater recovery, and desalination, pages 3-46 through 3-63.) |
| **Water Code § 10621(b) - City and County Notification and Participation** | Notify any city or county within service area of Urban Water Management Plan (UWMP) review & revision at least 60 days before public hearing. May consult with and obtain comments from notified cities and counties.<br>• Notification and participation are discussed in Section 5, pages 5-1 through 5-10, and Appendix 10, DWR Table 10-1. |
| **Water Code § 10621(d) – Plan Submittal to Department of Water Resources (DWR)** | Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016<br>• Submission of the 2015 UWMP by the July 1, 2016 deadline is detailed in Section 5. |
| ***Contents of UWMP*** | |
| **Water Code § 10631(a) - Service Area Information** | Describe service area of supplier<br>• Service area is discussed on Section 1.2, pages 1-6 through 1-10 and shown in Figure 1-1.<br>Include current and projected population<br>• Population is discussed in Section 1.3 and shown in Table 1-1, Figure 1-2, and Figure 1-3.<br>• Population analysis is discussed in Appendix 1, page A.1-4. Projections are on page A.1-9, Table A.1-2.<br>• Current and projected population are shown in Appendix 10, DWR Table 3-1.<br>Population projections must be based on data from state, regional or local service agency projections<br>• See footnote Table A.1-2, page A.1-9.<br>Describe climate characteristics that affect water management<br>• See Section 1.3, pages I-14 through I-16, Figure 1-5, and Table 1-4, and Section 2.6, pages 2-26 through 2-29.<br>Describe other demographic factors affecting water management<br>• See Section 1.3, pages I-13 through 1-14 and Appendix 1. |

## Summary of Compliance

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| **Water Code § 10631(b) - Water Sources** | Identify existing and planned water supply sources<br>Provide existing and planned water supply quantities<br>• Current supplies and quantities are described in Section 1.4, pages 1-18 through 1-28.<br>• Historic and current water supplies are described in Appendix 2.<br>• Planned water supplies and quantities are discussed in Section 2, and details are provided in Appendix 3, and particularly in Table A.3-7, pages A.3-48 through A.3-60.<br>• See Appendix 10, DWR Table 6-8 and 6-9. |
| **Water Code § 10631(b)(1-4) - If Groundwater Identified as Existing or Planned Source** | • Metropolitan does not supply or plan to supply groundwater. However, Metropolitan does use groundwater basins for groundwater banking.<br>• See Section 3.6 and Appendix 2 (pages A.2-4 through A.2-5) and Appendix 3 (pages A.3-43 through A.3-46) for discussions of issues related to groundwater basins.<br>• See Section 4 for salinity issues related to groundwater basins. |
| **Water Code § 10631(c)(1) - Reliability of Supply** | Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage<br>• Section 2.3, pages 2-13 through 2-17 and the discussions presented under the Colorado River Aqueduct (CRA) and State Water Project (SWP), Sections 3.1 and 3.2.<br>Provide data for an average water year, single-dry water year, and multiple-dry water years<br>• Section 2, Tables 2-4 through 2-6, pages 2-15 through 2-17.<br>• See Appendix 10, DWR Table 7-1. |
| **Water Code § 10631(c)(2) - Water Sources Not Available on a Consistent Basis** | Describe plans to supplement or replace inconsistent sources with alternative sources or water Demand Management Measures (DMMs)<br>• For discussion of Metropolitan's recent and near-term drought response actions, see Section 1.4, pages 1-22 through 1-28.<br>• For a discussion on water DMMs, see Section 2.1, pages 2-2 through 2-5, and Section 3.4, pages 3-30 through 3-45.<br>• For discussion on how Metropolitan plans to meet Southern California's water supply needs in the future and supplement or replace inconsistent sources, see Sections 2 and 3. |
| **Water Code § 10631(d) - Transfer or Exchange Opportunities** | Describe short term and long term exchange or transfer opportunities<br>• Section 1.4 (augmenting water supplies), pages 1-24 through 1-26.<br>• Section 3.1 (pages 3-2 through 3-9) describes plans for banking, exchange and transfer opportunities along the Colorado River and Aqueduct.<br>• Section 3.2 (pages 3-10 through 3-23) describes plans for banking, exchange and transfer opportunities within the State Water Project.<br>• Section 3.3 (pages 3-24 through 3-29) describes plans for banking, exchange and transfer opportunities within the Central Valley/State Water Project.<br>• Section 3.6 (pages 3-64 through 3-67) describes plans for banking, exchange and transfer opportunities within the local region.<br>• Further details are provided in Appendix 3, particularly Table A.3-7 on pages A.3-48 through A.3-60. |

## Summary of Compliance

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| **Water Code §§ 10631(e)(1) and (2) - Past, Current, and Projected Water Use** | Quantify past, current, and projected water use by sector in five-year increments<br>• See Section 1.3, page 1-14 and Figure 1-4 for historical retail water demands.<br>• Past, current, and future water uses are shown in Appendix 1, Table A.1-13 on page A.1-13. Water uses by sector and county are shown in Tables A.1-6 through A.1-11 on pages A.1-11 through A.1-13. Water demands by sector are shown in DWR Tables 4-1, 4-2, and 4- 3, on pages A.10-3 and A.10-4.<br>Identify and quantify sales to other agencies<br>• See Section 1.3, page 1-13 and Figure 1-4 for historical retail water demands.<br>• Historic sales are presented in Table A.2-2 on page A.2-3.<br>• Metropolitan does not project sales by individual agency. However, total projected sales/demands to other agencies are shown in Section 2.2, pages 2-6 through 2-12. |
| **Water Code §§ 10631(e)(1)(J), (e)(3)(A)&(B) – Distribution System Water Loss** | Quantify distribution system water loss for most recent 12-month period available<br>• Section 2.6, page 2-26, Appendix 7, Table A.7-1, and Appendix 10 (DWR Table 4-4). |
| **Water Code § 10631(e)(4)(A) and (B) – Water Savings Estimate** | Water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans<br>Provide citations to the codes, standards, ordinances, or transportation and land use plans used to make projections<br>Indicate extent that water use projections consider savings from codes, standards, ordinances, or transportation and land use plans.<br>• See discussion on estimating demands and code based conservation in Section 2, page 2-6 and Appendix 6. |
| **Water Code §§ 10631(f)(2), 10631(i) – Description of Supplier's Water Demand Management Measures, Distribution System Asset Management, Assistance Programs; Option for CUWCC Members** | Provide narrative description of items in §10631(f)(1)(B)(ii), (iv), (vi), and (vii), distribution system asset management, and wholesale supplier assistance programs<br>• See discussion on metering, Section 3.4, page 3-37.<br>• See discussion on public education and outreach, Section 3.4, pages 3-32 through 3-35.<br>• See discussion on water conservation programs, Section 3.4, pages 3-35 through 3-37.<br>CUWCC members deemed to be in compliance with Water Code §10631(f) by complying with Dec. 10, 2008 MOU and submitting annual reports required by Section 6.2 of that MOU<br>• See CUWCC filings in Appendix 8.<br>• See discussion on demand management and conservation, Section 3.4, pages 3-30 through 3-42.<br>• See discussion on distribution system asset management, Section 3.4, pages 3-43 through 3-45.<br>• See discussion on assistance programs to retail water agencies (rebate programs, public education and outreach, and other efforts to reduce water demand), Section 3.4, pages 3-32 through 3-42. |

## Summary of Compliance

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| **Water Code § 10631(g) - Planned Water Supply Projects and Programs** | Detailed description of expected future supply projects & programs to meet projected water use<br>Timeline for each proposed project or program<br>Quantification of each projects average yield (AFY)<br>Quantification of each projects single dry-year yield (AFY)<br>Quantification of each projects multiple dry-year yield (AFY)<br>• Section 3.1 (pages 3-2 through 3-9) describes plans for banking, exchange and transfer opportunities along the Colorado River and Aqueduct.<br>• Section 3.2 (pages 3-10 through 3-23) describes plans for banking, exchange and transfer opportunities within the State Water Project.<br>• Section 3.3 (pages 3-24 through 3-29) describes plans for banking, exchange and transfer opportunities within the Central Valley/State Water Project.<br>• Section 3.6 (pages 3-64 through 3-67) describes plans for banking, exchange and transfer opportunities within the local region.<br>• Further details are provided in Appendix 3, particularly Table A.3-7 on pages A.3-48 through A.3-60.<br>• See Appendix 10, DWR Table 6-7. |
| **Water Code § 10631(h) - Opportunities for Development of Desalinated Water** | Describe opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply<br>• See discussion on groundwater recovery and seawater desalination in Section 1.4, pages 1-20 through 1-22, and Section 3.5, pages 3-46 through 3-63.<br>• See Appendix 5, Table A.5-2 on pages A.5-9 through A.5-11 for a list of existing and conceptual groundwater recovery projects and their ultimate yield/capacity.<br>• See Appendix 5, Table A.5-3 on page A.5-12 for a list of conceptual, planned, and under construction seawater desalination projects. |
| ***Determination of Demand Management Measures Implementation*** | |
| **Water Code § 10631(i) - Members of CUWCC Deemed in Compliance with §10631(f)** | CUWCC members must comply with MOU re Urban Water Conservation in California (Dec. 10, 2008) and submit required annual reports<br>• Metropolitan is a CUWCC member.<br>• 2011-2014 BMP annual updates are included in Appendix 8.<br>• See discussion in Section 3.4. |

## Summary of Compliance

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| **Water Code § 10631(j) – If Supplier Receives or Projects Receiving Water from a Wholesale Supplier** | Urban water suppliers that rely on wholesale agency for water source must provide wholesale agency with water use projections in 5-year increments to 20 years or as far as data is available. Wholesaler to provide existing and planned water supply availability projections, by source, and planned water supply quantities to member agencies<br>• See discussions on Metropolitan and member agency coordination for the IRP Process in Sections 2 and 5.<br>• See Appendix 3, Table A.3-7, and Appendix 10, DWR Table 2-4. |
| **Water Code § 10631.1 - Projected Water Use for Low-Income Housing** | Water use projections for single-family and multi-family residential housing for lower income household<br>• This is incorporated with the retail demand forecast, as reflected in Section 2 and Appendix 1. |
| **Water Code § 10631.2 – Voluntary Calculation or Estimation of Energy Intensity of Urban Water Systems** | May include any of the following: estimated amount of energy for extraction or diversion (from sources), conveyance, treatment, distribution, and storage of water, and any other appropriate energy-related information<br>• Estimate of the amount of energy used and energy intensity is presented in Appendix 9.<br>• See Section 3.8 for discussion of Metropolitan's Energy Management Initiative. |
| ***Water Shortage Contingency Plan*** | |
| **Water Code § 10632 - Water Shortage Contingency Analysis of Elements within Water Supplier's Authority**<br>**Water Code § 10632(a)(1) - Stages of Action** | Provide stages of action in response to water supply shortages<br>Provide the water supply conditions for each stage<br>Includes plan for up to 50 percent reduction in water supply<br>• Documentation of the stages of action Metropolitan would undertake to address up to 50 percent reduction in its water supplies and a catastrophic interruption in water supplies is included in its Water Surplus and Drought Management (Section 2.4) and Water Supply Allocation Plans (Section 2.4 and Appendix 4), in the discussion of the implementation of its Water Supply Allocation Plan in Section 1.4, page 1-26, in the discussion of its Water Shortage Contingency Analysis in Section 2.4, pages 2-18 through 2-23, in the discussion of its Water Supply Condition Framework in Section 2.4, pages 2-20 through 2-21, and in the discussion of its Emergency Storage Requirement developed under its catastrophic supply interruption plan in Section 2.5, page 2-24.<br>• See Appendix 10, DWR Table 8-1, |
| **Water Code § 10632(a)(2) - Three-Year Minimum Water Supply** | Identify driest 3-year historic sequence<br>Estimated minimum water supply available for each of the next three years<br>• Metropolitan has projected its supply capabilities for each of the next three years 2016 through 2018 under a multiple dry year hydrology (based on a repeat of 1990-1992 hydrology, which represents the three years of shortest supplies). See Section 1.4, page 1-28, Table 1-7 on page 1-28, and Appendix 10, DWR Table 8-4. |

## Summary of Compliance

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| **Water Code § 10632(a)(3) - Preparation for Catastrophic Water Supply Interruption** | Actions to prepare for and implement during catastrophic water supply interruption<br>Provide catastrophic supply interruption plan and summarize<br>Emergency Response Plan<br>Regional power outage<br>Earthquake<br>Delta levee failure<br>Aqueduct failure<br>• See Sections 2.5 and 2.6, pages 2-24 through 2-29. |
| **Water Code § 10632(a)(4) - Prohibitions on End Users** | List the mandatory prohibitions against specific water use practices during water shortages (i.e., prohibiting use of potable water for street cleaning)<br>• Not applicable to Metropolitan because prohibitions against specific water use practices are enforced on end users and are not within Metropolitan's authority as a wholesaler. |
| **Water Code § 10632(a)(5) - Consumption Reduction Methods** | List the consumption reduction methods the water supplier will use to reduce water use in the most restrictive stages with up to a 50 percent reduction in water supply.<br>• See Section 1.4, pages 1-22 through 1-28, for a description of Metropolitan's recent and near-term drought response actions.<br>• Section 2.4 for Metropolitan's Water Surplus and Drought Management Plan<br>• Section 2.4 and Appendix 4 for Water Supply Allocation Plan.<br>• See Section 3.4 for a description of Metropolitan's demand management through conservation. |
| **Water Code § 10632(a)(6) - Penalties or Charges** | List penalties or charges for excessive use, where applicable<br>• Not applicable to Metropolitan because enforcing penalties or charges for excessive use by end users is not within Metropolitan's authority as a wholesaler. However, Metropolitan's WSDM Plan and WSAP are described in Section 2.4.<br>• Metropolitan's WSAP is attached in Appendix 4. |
| **Water Code § 10632(a)(7) - Revenue and Expenditure Impacts** | Describe how actions and conditions impact revenues and expenditures<br>Describe proposed measures to overcome the revenue and expenditure impacts, such as development of reserves and rate adjustments<br>• See Section 2.7, pages 2-30 through 2-36, and Appendix 4. |
| **Water Code § 10632(a)(8) - Water Shortage Contingency Resolution or Ordinance** | Attach a copy of the draft water shortage contingency resolution or ordinance.<br>• Not applicable to Metropolitan. The WSDM Plan, Water Supply Condition Framework, and WSAP adopted to deal with water shortages are discussed in Section 2.4, pages 2-18 through 2-23. The WSAP is also included as Appendix 4. |
| **Water Code § 10632(a)(9) - Water Use Reduction Measuring Mechanism** | Provide mechanisms for determining actual reductions in water use<br>• Metropolitan's water sales are metered. See Section 3.4. |

## Summary of Compliance

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| **Water Code § 10632(b) – Water Features** | Analyze and define water features artificially supplied with water separately from swimming pools and spas when developing water shortage contingency analysis<br>• Not applicable to Metropolitan because prohibitions against specific water use practices are enforced on end users and are not within Metropolitan's authority as a wholesaler. |
| ***Recycled Water Plan*** | |
| **Water Code § 10633 - Recycled Water as Potential Water Source; Agency Coordination** | Provide information, to the extent available, on recycled water and its potential as a water source in the supplier's service area.<br>Coordinate plan preparation with local water, wastewater, groundwater, and planning agencies within supplier's service area.<br>• See Section 1.4, pages 1-20 through 1-26, Section 3.5, pages 3-46 through 3-63, Tables 3-12 and 3-13 on page 3-63, Appendix 2, pages A.2-8 through A.2-9, and Appendix 5, Table A.5-1.<br>• Coordination of the plan preparation is discussed in Section 5. |
| **Water Code § 10633(a) - Wastewater System Description** | Describe the wastewater collection and treatment systems in the supplier's service area<br>Quantify the volume of wastewater collected and treated<br>• Not applicable to Metropolitan because it does not collect or treat the wastewater generated within its service area. Instead, Metropolitan provides a general narrative description of the wastewater collection and treatment systems operated by others in its service area.<br>• See Section 3.5, pages 3-46 through 3-63, Table 3-8 on page 3-47, Tables 3-12 and 3-13 on page 3-63, Appendix 2, pages A.2-8 through A.2-9, and Appendix 5, Table A.5-1. |
| **Water Code § 10633(a) through (d) - Wastewater Disposal and Recycled Water Uses** | Describes methods of wastewater disposal in the supplier's service area<br>• Not applicable to Metropolitan because it does not dispose of wastewater within its service area. Instead, Metropolitan provides a general narrative description of wastewater disposal by others in its service area.<br>• See Section 3.5, pages 3-47 through 3-48.<br>Describe quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.<br>• Not applicable to Metropolitan because it does not treat or discharge recycled water. Instead, Metropolitan provides a general narrative description of the treatment and discharge of recycled water by others in its service area.<br>• See Section 3.5, pages 3-48 through 3-49.<br>Describe the current type, place and quantity of use of recycled water in supplier's service area<br>Describe and quantify potential uses of recycled water<br>Determination of technical and economic feasibility of serving the potential uses<br>• Not applicable to Metropolitan because it does not use recycled water in its service area. Instead, Metropolitan provides a general narrative description of the use of recycled water by others in its service area, including potential uses and the technical and economic feasibility of serving the potential uses of recycled water<br>• See Section 3.5, pages 3-46 through 3-63, Section 4, page 4-6, Appendix 2, pages A.2-8 through A.2-9, and Table A.5-1. |

## Summary of Compliance

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| **Water Code § 10633(e) - Projected Uses of Recycled Water** | Projected use of recycled water in service area<br>• See Section 2, Tables 2-1 through Table 2-3, pages 2-10 through 2-12 and Section 3.5.<br>Compare UWMP 2010 projections with UWMP 2015 actual use of recycled water<br>• The 2010 RUWMP, Tables 2-6, 2-7, and 2-8 included the following projections for recycled water use in 2015: 408 TAF for a single dry year; 400 TAF for a multiple dry year; and 404 TAF for an average year. In 2015, actual recycled water use is estimated at 414 TAF, as discussed in Table 3-12 on page 3-63 and Appendix 2, page A.2-8 of this 2015 UWMP.<br>• See Appendix 10, DWR Table 6-5. |
| **Water Code §§ 10633(f), (g) – Actions to Encourage Use of Recycled Water**<br>**Plan to Optimize Use of Recycled Water** | Describe actions, including financial incentives, that might be taken to encourage recycled water uses<br>Describe projected results of these actions in terms of acre-feet of recycled water used per year<br>Provide a plan to optimize the use of recycled water in the supplier's service area<br>• Metropolitan provides a general narrative description of the actions it takes to encourage recycled water uses in its service area<br>• See Section 1.4, pages 1-20 through 1-22, 1-24, Table 1-6, Section 3.5, pages 3-46 through 3-63, Tables 3-12 and 3-13 on page 3-63, and Appendix 5, Table A.5-1. |
| ***Water Quality Impacts on Reliability*** | |
| **Water Code § 10631(c)(2) - Water Sources Not Available at a Consistent Level of Use** | Discuss plans to supplement or replace with alternative sources or DMMs any water source that may not be available at a consistent level of use given specific water quality factors<br>• See Section 2.1, pages 2-2 through 2-5, and Section 3.4, pages 3-30 through 3-45, for water DMMs.<br>• See Section 3.2, SWP Water Quality, pages 3-18 through 3-19, 3-23.<br>• See Section 4, Water Quality, pages 4-1 through 4-17. |
| **Water Code § 10634 - Water quality impacts on availability of supply** | Discuss water quality impacts by source upon water management strategies and supply reliability<br>• See Section 3.2, SWP Water Quality, pages 3-18 through 3-19, 3-23.<br>• See Section 4, Water Quality, pages 4-1 through 4-17. |
| ***Water Service Reliability*** | |
| **Water Code § 10635(a) - Supply and Demand Comparison: Normal Water Year** | Compare the projected normal water supply to projected normal water use over the next 20 years, in 5-year increments.<br>• For projected water use, see Section 2, Table 2-3, page 2-12.<br>• For projected water supply, see Table 2-6, page 2-17 and Table A.3-7 in Appendix 3, pages A.3-48 through A.3-60, and Appendix 10, DWR Table 7-2. |
| **Water Code § 10635(a) - Supply and Demand Comparison: Single-Dry Year Scenario** | Compare the projected single-dry year water supply to projected single-dry year water use over the next 20 years, in 5-year increments.<br>• For projected water use, see Section 2, Table 2-1, page 2-10.<br>• For projected water supply, see Table 2-4, page 2-15 and Table A.3-7 in Appendix 3, pages A.3-48 through A.3-60, and Appendix 10, DWR Table 7-3. |

## Summary of Compliance

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| **Water Code § 10635(a) - Supply and Demand Comparison: Multiple-dry Year Scenario** | Project a multiple-dry year period occurring between 2015-2020 and compare projected supply and demand during those years<br>Project a multiple-dry year period occurring between 2021-2025 and compare projected supply and demand during those years<br>Project a multiple-dry year period occurring between 2026-2030 and compare projected supply and demand during those years<br>Project a multiple-dry year period occurring between 2031-2035 and compare projected supply and demand during those years<br>• Metropolitan has projected multiple dry year periods for years ending in "0" or "5". Its planning for multiple dry years is based on the three years of shortest supplies (1990-1992 hydrology). The results presented in Section 2 for multiple dry years are for an average of three years with this extreme hydrology.<br>• For projected water use, see Section 2, Table 2-2, page 2-11.<br>• For projected water supply, see Table 2-5, page 2-16 and Table A.3-7 in Appendix 3, pages A.3-48 through A.3-60.<br>• See Appendix 10, DWR Table 7-4. |
| **Water Code § 10635(b) – Plan Submittal to Cities and Counties** | Supplier to provide portion of plan on water service reliability to cities and counties within its service area no later than 60 days after plan submittal.<br>• Provision of Plan to cities and counties is described in Section 5. |
| **Water Code § 10641 – Consultations with public agency, state agency or experts** | Supplier may consult with and obtain comments from any public agency, state agency, or any person with special expertise as to water demand management methods and techniques<br>• Stakeholder, state agency, public agency, and expert participation, consultation, outreach, comments, and notification are described in Section 5. |
| **Water Code § 10642 – Public Hearing; Notice; Adoption** | Encourage involvement of diverse social, cultural & economic community groups prior to and during plan preparation<br>• See Section 5, pages 5-1 through 5-11.<br>Prior to adoption, plan available for public inspection and hold public hearing<br>• See Section 5, pages 5-5 and 5-11.<br>Provide proof of public hearing and notice<br>• See Section 5, page 5-10.<br>Provide meeting notice to any city or county in service area<br>• See Section 5, page 5-9, and Appendix 10, DWR Table 10-1.<br>After hearing, plan adopted as prepared or as modified after hearing.<br>• See Section 5, page 5-11. |

## Summary of Compliance

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| **Water Code §§ 10615, 10643 – Plan Implementation** | Include in plan strategy and time schedule for implementation<br>Implement plan in accordance with the schedule set forth in the plan<br>• Metropolitan has conducted a review of its planning progress through the 2015 IRP Update, discussed in Section 2. In addition, in each section, Metropolitan has included an "Achievement to Date" that discusses progress towards its planning goals, and discusses current issues and potential problems with continued implementation of the plan.<br>• Section 3 summarizes the implementation plan and continued progress in developing a diversified resource mix consistent with the IRP to meet the region's water supply needs<br>DMM Programs<br>• Metropolitan is a member of CUWCC, and has submitted its recent BMP reports to the CUWCC to comply with the UWMP requirements. In addition, Metropolitan has discussed its conservation plan and approach in Section 3.4. Individual conservation programs are discussed on pages 3-30 through 3-42. |
| **Water Code § 10644(a)(1) –Plan Submittal** | Submit to DWR, the California State Library, and any city or county within service area copy of plan no later than 30 days after adoption.<br>• Plan submission is described in Section 5. |
| **Water Code § 10644(a)(2) – Plan shall include any Standardized Forms, Tables, or Displays specified by DWR** | Submit plan electronically<br>Include in plan DWR standardized forms, tables, or displays<br>• Plan submission is described in Section 5.<br>• DWR standardized tables for wholesale urban water agencies are completed and presented in Appendix 10. |
| **Water Code § 10645 – Plan Available for Public Review** | No later than 30 days after plan submittal, the supplier and DWR to make the plan available for public review during normal business hours.<br>• Posting of Plan on Metropolitan's website for public review is described in Section 5. |

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# Executive Summary

Metropolitan's 2015 Urban Water Management Plan (UWMP) has been prepared in compliance with Water Code Section 10608.36 of SB X7-7, which was enacted in 2009, and Sections 10610 through 10656 of the Urban Water Management Planning Act (Act), which were added by Statute 1983, Chapter 1009, and became effective on January 1, 1984. This Act requires that every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually prepare and adopt, in accordance with prescribed requirements, an urban water management plan.

The Act requires urban water suppliers to describe and evaluate sources of water supply, efficient uses of water, demand management measures, implementation strategy and schedule, and other relevant information and programs. Urban water suppliers are required by the Act to update their UWMP and submit a complete plan to the California Department of Water Resources (DWR) every five years. An UWMP is required in order for a water supplier to be eligible for DWR administered state grants and loans and drought assistance.

As with Metropolitan's previous plans, the 2015 UWMP does not explicitly discuss specific activities undertaken by its member agencies unless they relate to one of Metropolitan's water demand or supply management programs. Presumably, each member agency will discuss these activities in its UWMP.

The information included in the 2015 UWMP represents the most current and available planning projections of supply capability and demand developed through a collaborative process with the member agencies. Metropolitan's Board recently adopted the 2015 Integrated Water Resources Plan, Water Tomorrow (2015 IRP Update), which represents Metropolitan's comprehensive planning process and will serve as Metropolitan's blueprint for long-term water reliability, including key supply development and water use efficiency goals.

## Factors Considered

The Act requires reporting agencies to describe their water reliability under a single dry-year, multiple dry-year, and average year conditions, with projected information in five-year increments for 20 years. The factors used to evaluate Metropolitan's supply and demand balance for the 2015 UWMP are presented below. Some of the considerations and resulting projections may change as Metropolitan's planning progresses. These changes may be reflected in future updates of the UWMP.

### *Demand Projections*

Within Metropolitan's service area, retail water demands can be met with local supplies or imported supplies. Metropolitan's supply reliability evaluation focuses on the future demands for Metropolitan's imported supplies. The expected firm demand on Metropolitan is the difference between total demands, adjusted for conservation, and projected total local supplies. Thus, in order to project the regional need for imported water, Metropolitan starts with a projection of total demand including retail Municipal and Industrial (M&I), retail agricultural,

seawater barrier, and replenishment demands, determines the adjustments from total conservation, and subtracts the total local supplies that are available to meet a portion of those demands.

### *Total Demands*

Metropolitan updates its retail M&I projection periodically based on the release of official regional demographic and economic projections. The projections of retail M&I water demands used in the 2015 UWMP are based on data from the following reports:

- Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan/Sustainable Community Strategy (April 2012)
- San Diego Association of Governments (SANDAG) Series 13: 2050 Regional Growth Forecast (October 2013)

The SCAG and SANDAG regional growth forecasts are the core assumptions that drive the estimating equations of the retail demand forecasting in Metropolitan's Econometric Demand Model (MWD-EDM). SCAG's and SANDAG's projections undergo extensive local review, incorporate zoning information from city and county general plans, and are supported by Environmental Impact Reports.

Retail agricultural demands consist of water use for irrigating crops. Metropolitan's member agencies estimate agricultural water use based on many factors, including farm acreage, crop types, historical water use, and land use conversion. Each member agency estimates its agricultural demands differently, depending on availability of information. Metropolitan relies on member agencies' estimates of agricultural demands for the 2015 UWMP.

Metropolitan also includes in its assessment of total demands the local groundwater requirements for seawater barrier and groundwater basin replenishment. Seawater barrier demands represent the amount of water needed to hold back seawater intrusion into the coastal groundwater basins. Replenishment demands represent the amount of water that member agencies plan to use to replenish the groundwater basins as available. Metropolitan relies on member and groundwater management agencies' projections for these demands.

### *Total Conservation*

Projected regional water demand is adjusted to account for water conserved by Best Management Practices from active, code-based, and price-effect conservation. Active conservation levels are derived by calculating water savings from all active program device-based savings installed to date. Code-based conservation levels are derived by calculating water savings from devices covered by existing water conservation ordinances and plumbing codes, including the state Model Water Efficient Landscape Ordinance, with replacement and new construction rates driven by demographic growth consistent with SCAG and SANDAG land use and transportation plans used to derive retail demand. Price-effect conservation is derived by calculating water savings by retail customers attributable to the effect of changes in the real (inflation adjusted) price of water.

Water use reduction under Senate Bill 7 (SB X7-7) (see description below) is factored into local water supplies. This has been done to recognize the fact that one method of compliance with SB X7-7 is the development of recycled water in addition to conservation.

### *Total Local Supplies*

Projections of local supplies are based on information gathered from a number of sources including past urban water management plans, Metropolitan's annual local production surveys, and communications between Metropolitan and member agency staff. The projections include groundwater and surface water production, recycled water and recovery of contaminated or degraded groundwater (funded under the Metropolitan's Local Resources Program, as well as local agency funded programs), and seawater desalination. The local supply projections presented in demand tables for the 2015 UWMP include existing projects that are currently producing water, projects that are under construction, and Metropolitan's IRP local supply targets included as programs under development.

The total local supplies presented in the 2015 UWMP also include Los Angeles Aqueduct deliveries and non-Metropolitan water supplies imported by or exchanged with member agencies from sources outside of Metropolitan's service area.

## *Water Use Reduction Achievement in 2015*

On November 10, 2009, the state Legislature passed Senate Bill 7 as part of the Seventh Extraordinary Session, referred to as SB X7-7 or the Water Conservation Act of 2009. This law is the water conservation component to the historic Delta legislative package, and seeks to achieve a 20 percent statewide reduction in urban per capita water use in California by December 31, 2020. According to Water Code § 10608.36, wholesale agencies are required to include in their UWMPs an assessment of present and proposed future measures, programs, and policies that would help achieve the water use reductions required under SB X7-7. Urban wholesale water suppliers are not required to comply with the target-setting and reporting requirements of SB X7-7.

As a wholesale water agency, Metropolitan is not required to establish or report on an urban water use reduction target. However, Metropolitan's regional conservation programs are designed to assist member agencies and retail water suppliers in the service area to comply with SB X7-7. Therefore, Metropolitan monitors the progress of its service area. Also, in compliance with SB X7-7, Metropolitan assesses its actions, programs, and policies to help achieve the water use reductions required by SB X7-7.

Based on an analysis of population, demand, and the methodologies for setting targets described in the legislation, Metropolitan's baseline is 181 GPCD and the 2020 reduction target is 145 GPCD. From 2011-2014, there was a slight increase in per capita water use explained in part by continued economic recovery and drier weather as compared to previous years. With mandatory restrictions from the state, Water Supply Allocation from Metropolitan and retail water suppliers, the 2015 gallons per capita per day (GPCD) is 131, a 28 percent reduction from the baseline.

Over the next five years, Metropolitan will periodically assess water supply conditions and trends in per capita demand within its service area and evaluate potential programs to ensure attainment of the goal. Metropolitan also continues to provide support for retail agency efforts through technical assistance, legislation, code and standards updates, and potential financial incentives where needed for market transformation to increase water use efficiency.

## *Supply Capabilities*

The 2015 UWMP reports on Metropolitan's water reliability and identifies projected supplies to meet the long-term demand within its service area. Metropolitan's supply capabilities are evaluated using the following assumptions:

### *Hydrologic Conditions and Reporting Period*

The 2015 UWMP presents Metropolitan's supply capabilities from 2020 through 2040 under the three hydrologic conditions specified in the Act: single dry-year (represented by a repeat of 1977 hydrology), multiple dry-year (represented by a repeat of 1990 to 1992 hydrologies), and average year (represented by the average of 1922 to 2012 hydrologies).

### *Colorado River Aqueduct Supplies*

Colorado River Aqueduct (CRA) supplies include supplies that would result from existing and committed programs and from implementation of the Quantification Settlement Agreement (QSA) and related agreements. The QSA establishes the baseline water use for each of the agreement parties and facilitates the transfer of water from agricultural agencies to urban uses. A detailed discussion of the QSA is included in Section 3. Colorado River Water Management Programs are potentially available to supply additional water up to the CRA capacity of 1.2 MAF on an as-needed basis.

### *State Water Project Supplies*

State Water Project (SWP) supplies are estimated using the 2015 SWP Delivery Capability Report distributed by DWR in July 2015. The 2015 Delivery Capability Report presents the current DWR estimate of the amount of water deliveries for current (2015) conditions and conditions 20 years in the future. These estimates incorporate restrictions on SWP and Central Valley Project (CVP) operations in accordance with the biological opinions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service issued on December 15, 2008, and June 4, 2009, respectively. Under the 2015 Delivery Capability Report with existing conveyance and low outflow requirements scenario, the delivery estimates for the SWP for 2020 conditions as percentage of Table A amounts are 12 percent, equivalent to 257 TAF for Metropolitan, under a single dry-year (1977) condition and 51 percent, equivalent to 976 TAF for Metropolitan, under the long-term average condition.

In dry, below-normal conditions, Metropolitan has increased the supplies received from the California Aqueduct by developing flexible Central Valley/SWP storage and transfer programs. Over the last two years under the pumping restrictions of the SWP, Metropolitan has worked collaboratively with the other contractors to develop numerous voluntary Central Valley/SWP storage and transfer programs. The goal of these storage/transfer programs is to develop additional dry-year supplies that can be conveyed through the California Aqueduct during dry hydrologic conditions and regulatory restrictions.

### *Storage*

A key component of Metropolitan's water supply capability is the amount of water in Metropolitan's storage facilities. Storage is a major component of Metropolitan's dry-year resource management strategy. Metropolitan's likelihood of having adequate supply capability to meet projected demands, without implementing the Water Supply Allocation Plan, is dependent on its storage resources.

In developing the supply capabilities for the 2015 UWMP, Metropolitan assumed the current (2015) storage levels at the start of simulation and used the median storage levels going into each of the five-year increments based on the balances of supplies and demands. Under the median storage condition, there is an estimated 50 percent probability that storage levels would be higher than the assumption used, and a 50 percent probability that storage levels would be lower than the assumption used. All storage capability figures shown in the 2015 UWMP reflect actual storage program conveyance constraints. It is important to note that

under some conditions, Metropolitan may choose to implement the WSAP in order to preserve storage reserves for a future year, instead of using the full supply capability. This can result in impacts at the retail level even under conditions where there may be adequate supply capabilities to meet demands.

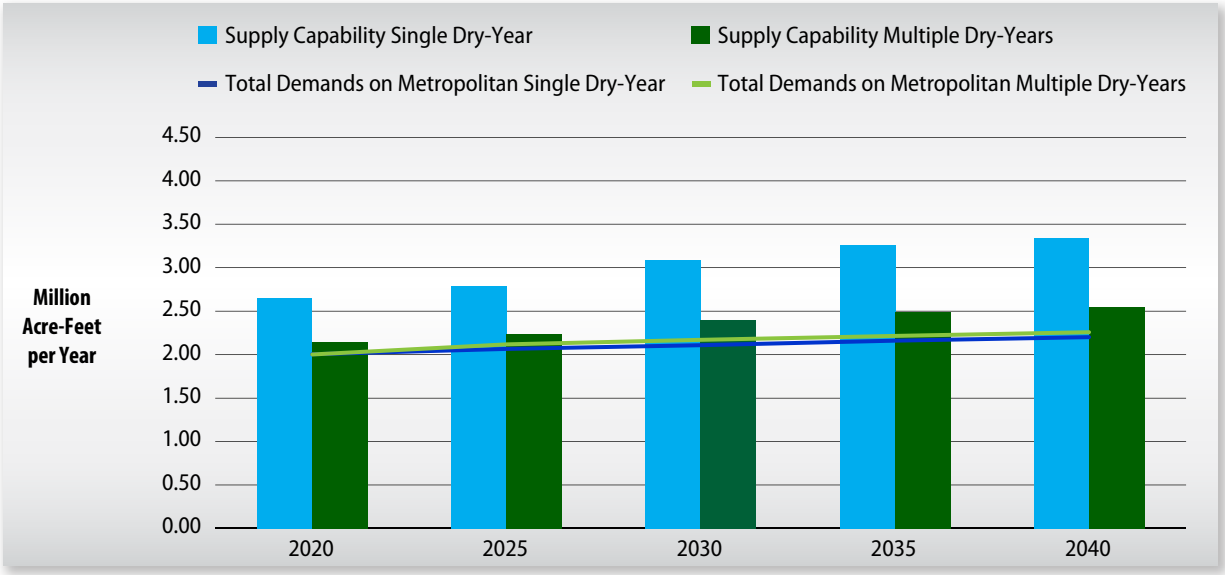
### *Findings of the 2015 Urban Water Management Plan*

The 2015 UWMP provides a comprehensive summary of Metropolitan's demand and supply outlook through 2040. As a reporting document, the UWMP will be updated every five years to reflect changes in water demand and supply projections.

The 2015 UWMP satisfies all the reporting requirements mandated by the Act. The key reporting points of this 2015 UWMP are as follows:

- Metropolitan has supply capabilities that would be sufficient to meet expected demands from 2020 through 2040 under single dry-year and multiple dry-year hydrologic conditions, as presented in Figure ES-1, as well as average year hydrologic conditions.
- Metropolitan has comprehensive plans for stages of actions it would undertake to address up to a 50 percent reduction in its water supplies and a catastrophic interruption in water supplies through its Water Surplus and Drought Management and Water Supply Allocation Plans. Metropolitan also developed an Emergency Storage Requirement to mitigate against potential interruption in water supplies resulting from catastrophic occurrences within the Southern California region, including seismic events along the San Andreas fault. In addition, Metropolitan is working with the State on the Delta Risk Management Strategy to reduce the impacts of a seismic event in the Delta that would cause levee failure and disruption of SWP deliveries.
- Metropolitan will continue investments in water use efficiency measures to help the region achieve the 20 percent per person potable water use reduction by 2020.
- Metropolitan has plans for supply implementation and continued development of a diversified resource portfolio including programs in the CRA, SWP, Central Valley storage and transfers programs, local resource projects, and in-region storage that enables the region to meet its water supply needs.
- Metropolitan has a collaborative process for its planning initiatives, including the preparation of the 2015 UWMP.

## Figure ES -1 Supply Capabilities under Single Dry-Year and Multiple Dry-Year Hydrologies




Note:

1. Supply capabilities are derived using the simulated median storage level going into each of five-year increments based on the balances of supplies and demands. Under the median storage condition, there is an estimated 50 percent probability that storage levels would be higher than the assumption used, and a 50 percent probability that storage levels would be lower than the assumption used.
2. Under some conditions, Metropolitan may choose to implement the WSAP in order to preserve storage reserves for a future year, instead of using the full supply capability. This can result in impacts at the retail level even under conditions where there may be adequate supply capabilities to meet firm demands.
3. All storage capability figures shown in the 2015 UWMP reflect actual storage program conveyance constraints.

# Introduction 1

## 1.1 Introduction to this Document and the Agency

### *Organization of this Document*

This report complies with the Urban Water Management Planning Act of 1984 (Act). In addition to complying with the Act, this report details Metropolitan's current situation and how it will meet the challenges of the future. This document contains five sections. The first section is the Introduction that defines Metropolitan in terms of governance, structure, and current water supply status. This section also briefly outlines how Metropolitan will meet current and future challenges. The second section describes Metropolitan's planning activities and explains how the agency will manage the region's water resources to ensure a reliable water supply for the region. The third section describes the actions Metropolitan has taken to implement the plans outlined in Section 2 and lists future programs and activities. The fourth section addresses the issue of water quality and steps taken to deliver high-quality water to Metropolitan's service area. The last section details the public outreach component integrated with Metropolitan's planning processes. Appendices that include supporting documents for this report are at the conclusion of this report. The sections are further described in detail below:

#### *Section 1 - Introduction*

In addition to demonstrating how this report complies with the Act, the 2015 Urban Water Management Plan (UWMP) details Metropolitan's current situation and outlines its plan for meeting the challenges of the future. The Introduction section includes:

- Discussion of the Act and Metropolitan's reporting responsibilities under the Act;
- Introduction to Metropolitan and description of its formation, purpose, service area, member agencies, and governance;
- Historical and demographic information on Metropolitan's service area;
- Discussion of Metropolitan's current condition, challenges, and resource planning strategies; and
- Evaluation of Metropolitan's supply capabilities for the next three years under a multiple dry-year scenario.

#### *Section 2 - Planning for the Future*

The Planning for the Future section discusses how Metropolitan plans to meet Southern California's water needs in the future. The section highlights the importance of Integrated Water Resources Planning by summarizing Metropolitan's planning processes over the years and emphasizes the need for Metropolitan to implement adaptive planning strategies that will prepare the region to deal with uncertainties. This section also includes:

- Evaluation of regional water demand under single dry-year, multiple dry-year, and average year conditions for years 2020 through 2040;

- Evaluation of supply capabilities under single dry-year, multiple dry-year, and average year conditions for years 2020 through 2040;
- Discussion of water shortage contingency analysis though the Water Surplus and Drought Management Plan and the Water Supply Allocation Plan;
- Discussion of other supply reliability risks including climate change; and
- Discussion of the different elements of Metropolitan's rate structure and revenue management.

### *Section 3 – Implementing the Plan*

The Implementing the Plan section summarizes Metropolitan's progress in developing a diversified resource mix that enables the region to meet its water supply needs. The investments that Metropolitan has made and its continuing efforts in many different areas coalesce toward its goal of long-term supply reliability for the region. This section includes:

- Discussion of resources and program development for the CRA, SWP, Central Valley/SWP storage and transfers programs, conservation, local resources program (groundwater recovery, recycling, desalination), and groundwater; and
- Discussion of Metropolitan's measures, programs, and policies to help meet the SB X7-7 goal of 20 percent water use reduction by 2020 and the region's progress in meeting this target.

### *Section 4 - Water Quality*

The Water Quality section identifies key regional water quality issues and discusses the protection of the quality of source water and development of water management programs that maintain and enhance water quality. This section also includes:

- Discussion of water quality issues of concern, constituents of emerging concern, and water quality programs that Metropolitan has undertaken to protect its water supplies.

### *Section 5 – Coordination and Public Outreach*

The Coordination and Public Outreach section presents the processes undertaken in the development of the 2015 IRP Update and 2015 UWMP with the public and other stakeholders. It provides a list of all meetings and workshops conducted to promote and achieve consensus and collaborative planning. Included in this section are the public notification letters and announcements distributed by Metropolitan as required by the Act and a copy of the Metropolitan resolution adopting and approving the 2015 UWMP for submittal to DWR.

### *Appendices*

The appendices provide detailed background on the information presented in the 2015 UWMP.

Appendix 1 - Demand Forecast

Appendix 2 - Existing Regional Water Supplies

Appendix 3 - Justifications for Supply Projections

Appendix 4 - Water Supply Allocation Plan

Appendix 5 - Local Projects

Appendix 6 - Conservation Estimates and Water Savings from Codes, Standards, and Ordinances

Appendix 7 - Distribution System Water Losses

Appendix 8 - Recent CUWCC Filings

Appendix 9 - Metropolitan's Energy Intensity Calculations, Including Conveyance and Distribution Generation

Appendix 10 - DWR's Standardized Tables

### *Urban Water Management Planning Act*

This report has been prepared in compliance with Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act (Act), which were added by Statute 1983, Chapter 1009, and became effective on January 1, 1984. This Act requires that "*every urban water supplier shall prepare and adopt an urban water management plan*" (Water Code § 10620(a)). An "urban water supplier" is defined as a supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually (Water Code § 10617). These plans must be filed with the California Department of Water Resources (DWR) every five years. However, the 2015 plans must be submitted to DWR by July 1, 2016. The Act's requirements include:

- Detailed evaluation of the supplies necessary to meet demands over at least a 20-year period, in five-year increments, for a single dry water year, in multi-year droughts, and during average year conditions;
- Documentation of the stages of actions an urban water supplier would undertake to address up to a 50 percent reduction in its water supplies;
- Description of the actions to be undertaken in the event of a catastrophic interruption in water supplies; and
- Evaluation of reasonable and practical efficient water uses, recycling, and conservation activities.

In addition, Water Code § 10608.36 requires wholesale agencies to include in their UWMPs an assessment of present and proposed future measures, programs, and policies that would help achieve water use reduction targets.

### *Changes in the Act Since 2010*

Since 2010, several amendments have been made to the Act. The following is a summary of the significant changes in the Act that have occurred from 2010 to the present:

- Changes the deadline for water suppliers to submit their 2015 UWMPs to DWR to July 1, 2016 (Water Code § 10621(d)).
- Adds "distribution system water loss" to the list of past, present, and projected future water uses that the UWMP is to quantify to the extent that records are available and over the same 5-year increments described in Water Code § 10631(a). (Water Code § 10631(e)(1)(J)). For the 2015 UWMP, the distribution system water loss must be quantified for the most recent 12-month period available. For all subsequent updates, the distribution system water loss must be quantified for each of the 5 years preceding the plan update. (Water Code § 10631(e)(3)(A)). The distribution system water loss quantification must be reported in accordance with a worksheet approved or developed by DWR through a public process. The water loss quantification worksheet must be based on the water system balance methodology developed by the American Water Works Association (AWWA) (Water Code § 10631(e)(3)(B)).
- If available and applicable to an urban water supplier, water use projections may display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as

applicable to the service area (Water Code § 10631(e)(4)(A)). To the extent that an urban water supplier reports the information described in § 10631(e)(4)(A), an urban water supplier shall do both of the following: (1) provide citations of the various codes, standards, ordinances, or transportation and land use plans used in making the projections; and (2) indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall note that fact (Water Code § 10631(e)(4)(B)).

- Requires plans by retail water suppliers to include a narrative description that addresses the nature and extent of each water demand management measure (DMM) implemented over the past 5 years. The narrative must describe the water DMMs that the supplier plans to implement to achieve its water use targets pursuant to Water Code § 10608.20 (Water Code § 10631(f)(1)(A)). The narrative must also include descriptions of the following water DMMs: water waste prevention ordinances, metering, conservation pricing, public education and outreach, programs to assess and manage distribution system real loss, water conservation program coordination and staffing support; and other DMMs that have a significant impact on water use as measured in GPCD, including innovative measures, if implemented (Water Code § 10631(f)(1)(B).
- Requires plans by wholesale water suppliers to include a narrative description of metering, public education and outreach, water conservation program coordination and staffing support, and other DMMs that have a significant impact on water use as measured in GPCD, including innovative measures, if implemented, as well as a narrative description of their distribution system asset management and wholesale supplier assistance programs (Water Code § 10631(f)(2)).
- Adds the voluntary reporting in the UWMP of any of the following information: an estimate of the amount of energy used: (1) to extract or divert water supplies; (2) to convey water supplies to water treatment plants or distribution systems; (3) to treat water supplies; (4) to distribute water supplies through the distribution system; (5) for treated water supplies in comparison to the amount used for non-treated water supplies; and (6) to place water into or to withdraw water from storage; and (7) any other energy-related information the urban water supplier deems appropriate (Water Code § 10631.2(a)). DWR included in its UWMP guidance a methodology for the voluntary calculation or estimation of the energy intensity of urban water systems (Water Code § 10631.2(b)).
- Requires urban water suppliers to submit plans or amendments to plans electronically and to include any standardized forms, tables, or displays specified by DWR (Water Code § 10644(a)(2)).

### *Senate Bill 7 of the Seventh Extraordinary Session of 2009, Water Conservation in the Delta Legislative Package*

In addition to changes to the Act, the state Legislature passed Senate Bill 7 as part of the Seventh Extraordinary Session, referred to as SB X7-7, on November 10, 2009, which became effective February 3, 2010. This law was the water conservation component to the historic Delta legislative package, and seeks to achieve a 20 percent statewide reduction in urban per capita water use in California by December 31, 2020. This implements the Governor's similar 2008 water use reduction goals. The law requires each urban retail water supplier to develop urban water use targets to help meet the 20 percent goal by 2020, and an interim urban water reduction target by 2015.

The bill states that the legislative intent is to require all water suppliers to increase the efficiency of use of water resources and to establish a framework to meet the state targets for urban water conservation called for by the Governor. The bill establishes methods for urban retail water suppliers to determine targets to help achieve increased water use efficiency by the year 2020. The law is intended to promote urban water conservation standards consistent with the California Urban Water Conservation Council's adopted best management practices.

An urban retail water supplier may update its 2020 urban water use target in its 2015 UWMP (Water Code § 10608.20(g)).

Urban wholesale water suppliers are not required to perform all of the target-setting and reporting requirements of SB X7-7. However, wholesale agencies must include in their UWMPs an assessment of present and proposed future measures, programs, and policies that would help achieve the water use reductions required under this law (Water Code § 10608.36).

Metropolitan addresses in Sections 3.4, 3.5, and 3.7 the actions it is taking to help urban retail water suppliers to achieve the urban per capita water use reduction pursuant to the goals set forth in SB X7-7.

### *Metropolitan's Compliance with the Urban Water Management Planning Act*

As with Metropolitan's previous plans, this Plan does not explicitly discuss specific activities undertaken by member agencies unless they relate to one of Metropolitan's water demand or supply management programs. Presumably, each member agency will discuss these activities in its Urban Water Management Plan, but elements of this Plan do not necessarily have to be adopted by the urban water suppliers or the public agencies directly providing retail water.

### *DWR Guidance*

In 2010, DWR provided a guidebook to aid water suppliers in developing their urban water management plans. These materials helped water suppliers to comply with the law and DWR staff to review submitted plans for regulatory compliance. The 2010 guidebook consisted of two parts: (1) preparing a UWMP – specific guidance for addressing UWMP requirements in the Water Code; and (2) UWMP supporting information – a detailed discussion of specific subjects or supporting documents related to preparing a UWMP. The 2010 guidebook also included a checklist for cross-referencing sections of the respondent water supplier's plan with the relevant sections of the Water Code to confirm that it addressed all relevant provisions of the Act.

In March 2016, DWR issued the Final 2015 UWMP Guidebook for Urban Water Suppliers. The 2015 guidebook has been updated from the 2010 version to reflect new legislation and to group the Water Code requirements by topic. As part of the guidebook, DWR has developed standardized tables for the reporting and submittal of UWMP data to DWR. As mentioned above, water suppliers are required to use these standardized tables for electronic submittal of their UWMPs to DWR to satisfy the new legislative requirement (Water Code § 10644(a)(2)). For the 2015 UWMP, Metropolitan electronically submitted the standardized tables to the designated DWR portal. In addition, Metropolitan included the standardized submittals in this Plan as Appendix 10.

The 2015 guidebook includes a voluntary checklist to show reporting of required elements to assist DWR with its review of the submitted UWMP. Included in the beginning of this Plan is a compliance checklist, organized by Water Code section, which summarizes Metropolitan's response to the requirements of the Water Code and indicates where each required element can be found in the Plan.

## 1.2 The Metropolitan Water District of Southern California

### *Formation and Purpose*

The Metropolitan Water District of Southern California (Metropolitan) is a public agency organized in 1928 by a vote of the electorates of 13 Southern California cities. The agency was enabled by the adoption of the original Metropolitan Water District Act (Metropolitan Act) by the California Legislature "for the purpose of developing, storing, and distributing water" to the residents of Southern California. The Metropolitan Act also allows Metropolitan to sell additional water, if available, for other beneficial uses. In 1992, the Metropolitan Board of Directors adopted the following mission statement:

> *"To provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way."*

The first function of Metropolitan was building the Colorado River Aqueduct (CRA) to convey water from the Colorado River. Deliveries through the aqueduct to member agencies began in 1941 and supplemented the local water supplies of the Southern California member cities. In 1960, to meet growing water demands in its service area, Metropolitan contracted for additional water supplies from the State Water Project (SWP) via the California Aqueduct, which is owned and operated by DWR. SWP deliveries began in 1972. Metropolitan currently receives imported water from both of these sources: (1) Colorado River water via the CRA, and (2) the SWP via the California Aqueduct.

### *Service Area*

Metropolitan's service area covers the Southern California coastal plain. It extends about 200 miles along the Pacific Ocean from the city of Oxnard on the north to the international boundary with Mexico on the south, and it reaches as far as 70 miles inland from the coast (Figure 1-1). The total area served is approximately 5,200 square miles, and it includes portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. Table 1-1 shows that although only 14 percent of the land area of the six Southern California counties is within Metropolitan's service area, nearly 85 percent of the populations of those counties reside within Metropolitan's boundaries.

### *Member Agencies*

Metropolitan is currently composed of 26 member agencies, including 14 cities, 11 municipal water districts, and one county water authority. Metropolitan is a water wholesaler with no retail customers. It provides treated and untreated water directly to its member agencies.

Metropolitan's 26 member agencies deliver to their customers a combination of local groundwater, local surface water, recycled water, and imported water purchased from or exchanged with Metropolitan. For some member agencies, Metropolitan supplies almost all the water used within that agency's service area, while others obtain varying amounts of water from Metropolitan to supplement local supplies. Over the last ten years (from 2006-2015), Metropolitan has provided between 50 and 60 percent of the municipal, industrial, and agricultural water used in its service area. The remaining water supply comes from local wells, local surface water, recycling, the city of Los Angeles' aqueducts from the Owens Valley/Mono Basin east of the Sierra Nevada, and water conserved by the Imperial Irrigation District and the All-American and Coachella Canal Lining Projects for the San Diego County Water Authority which is exchanged for water supplies delivered by Metropolitan. Member agencies also implement conservation programs that can be considered part of their supplies.

Some member agencies provide retail water service, while others provide water to the local area as wholesalers. Table 1-2 shows Metropolitan's member agencies and the type of service that they provide. As shown in the table, 15 member agencies provide retail service to customers, 9 provide only wholesale service, and 2 provide a combination of both. Throughout Metropolitan's service area, approximately 250 retail water suppliers directly serve the population.

Metropolitan's member agencies serve residents in 152 cities and 89 unincorporated communities. Table 1-3 shows the member agencies of Metropolitan, as well as the cities and communities served by those member agencies. Figure 1-1 also shows the geographical area served by the member agencies.

Currently, member agencies receive water from Metropolitan at various delivery points, and pay for service through a rate structure made up of multiple components. The majority of these components consist of uniform volumetric rates, and the majority of the revenue is collected through a tiered volumetric supply charge. The second tier of this rate is set at the cost of developing new supplies. Metropolitan's pricing and rate structure are described in detail in Section 2.7.

To aid in planning future water needs, member agencies advise Metropolitan in April of each year of how much water they anticipate they will need during the next five years. In addition, Metropolitan works with its member agencies to forecast future water demands.

**Table 1-1**
**July 1, 2015 Area and Population in the**
**Six Counties of Metropolitan's Service Area**

| County | Total County | In Metropolitan Service Area | Percent in Metropolitan |
|---|---|---|---|
| ***Land Area (Square Miles)*** | | | |
| Los Angeles County | 4,061 | 1,408 | 35% |
| Orange County | 789 | 699 | 89% |
| Riverside County | 7,208 | 1,057 | 15% |
| San Bernardino County | 20,052 | 242 | 1% |
| San Diego County | 4,200 | 1,420 | 34% |
| Ventura County | 1,845 | 365 | 20% |
| **Metropolitan's Service Area** | **38,155** | **5,191** | **14%** |
| ***Population (Persons)*** | | | |
| Los Angeles County | 10,192,000 | 9,267,000 | 91% |
| Orange County | 3,165,000 | 3,153,000 | 100% |
| Riverside County | 2,331,000 | 1,679,000 | 72% |
| San Bernardino County | 2,128,000 | 839,000 | 39% |
| San Diego County | 3,276,000 | 3,169,000 | 97% |
| Ventura County | 853,000 | 633,000 | 74% |
| **Metropolitan's Service Area** | **21,945,000** | **18,740,000** | **85%** |

**Table 1-2**
**Metropolitan's Member Agencies and Type of Water Service Provided**

| Member Agency | Retail or Wholesale |
|---|---|
| **Los Angeles County** | |
| Beverly Hills, City of | Retail |
| Burbank, City of | Retail |
| Central Basin Municipal Water District | Wholesale |
| Compton, City of | Retail |
| Foothill Municipal Water District | Wholesale |
| Glendale, City of | Retail |
| Las Virgenes Municipal Water District | Retail |
| Long Beach, City of | Retail |
| Los Angeles, City of | Retail |
| Pasadena, City of | Retail |
| San Fernando, City of | Retail |
| San Marino, City of | Retail |
| Santa Monica, City of | Retail |
| Three Valleys Municipal Water District | Wholesale |
| Torrance, City of | Retail |
| Upper San Gabriel Valley Municipal Water District | Wholesale |
| West Basin Municipal Water District | Wholesale |
| **Orange County** | |
| Anaheim, City of | Retail |
| Fullerton, City of | Retail |
| Municipal Water District of Orange County | Wholesale |
| Santa Ana, City of | Retail |
| **Riverside County** | |
| Eastern Municipal Water District | Retail & Wholesale |
| Western Municipal Water District | Retail & Wholesale |
| **San Bernardino County** | |
| Inland Empire Utilities Agency | Wholesale |
| **San Diego County** | |
| San Diego County Water Authority | Wholesale |
| **Ventura County** | |
| Calleguas Municipal Water District | Wholesale |

## Table 1-3
## Member Agencies

***THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA***

| Municipal Water Districts (11) | | Member Cities (14) | | | County Water Authorities (1) |
|---|---|---|---|---|---|
| Calleguas | Orange County | Anaheim | Glendale | San Marino | |
| Central Basin | Three Valleys | Beverly Hills | Long Beach | Santa Ana | |
| Foothill | Upper San Gabriel Valley | Burbank | Los Angeles | Santa Monica | San Diego |
| Inland Empire | West Basin | Compton | Pasadena | Torrance | |
| Eastern | Western | Fullerton | San Fernando | | |
| Las Virgenes | | | | | |

*Cities within Member Agencies*

***CALLEGUAS MWD***
*Camarillo*
*Camarillo Heights*
*Fairview*
*Lake Sherwood Valley*
*Las Posas*
*Moorpark*
*NAWS Point Mugu*
*NCBC Port Hueneme*
*Oak Park*
*Oxnard*
*Port Hueneme*
*Santa Rosa Valley*
*Simi Valley*
*Somis*
*Thousand Oaks*

**Central Basin MWD**
*Artesia*
*Bell*
*Bellflower*
*Bell Gardens*
*Cerritos*
*Commerce*
*Cudahy*
*Downey*
*East Los Angeles*
*Florence*
*Hawaiian Gardens*
*Huntington Park*
*La Habra Heights*
*Lakewood*
*La Mirada*
*Lynwood*
*Maywood*
*Montebello*
*Norwalk*
*Paramount*
*Pico Rivera*
*Santa Fe Springs*
*Signal Hill*
*South Gate*
*South Whittier*
*Vernon*
*Whittier*

**Foothill MWD**
*Altadena*
*La Cañada Flintridge*
*La Crescenta*
*Montrose*

***INLAND EMPIRE***
*Chino*
*Chino Hills*
*Fontana*
*Montclair*
*Ontario*
*Rancho Cucamonga*
*Upland*

***Eastern MWD***
*Good Hope*
*Hemet*
*Homeland*
*Juniper Flats*
*Lakeview*
*Mead Valley*
*Menifee*
*Moreno Valley*
*Murrieta*
*Murrieta Hot Springs*
*Nuevo*
*North Canyon Lake*
*Perris*
*Quail Valley*
*Romoland*
*San Jacinto*
*Sun City*
*Temecula*
*Valle Vista*
*Winchester*

**Las Virgenes MWD**
*Agoura*
*Agoura Hills*
*Calabasas*
*Chatsworth*
*Hidden Hills*
*Lake Manor*
*Malibu Lake*
*Monte Nido*
*Westlake Village*
*West Hills*

***MWD OF ORANGE COUNTY***
*Aliso Viejo*
*Brea*
*Buena Park*
*Capistrano Beach*
*Corona Del Mar*
*Costa Mesa*
*Coto De Caza*
*Cypress*
*Dana Point*
*Fountain Valley*
*Garden Grove*
*Huntington Beach*
*Irvine*
*Laguna Beach*
*Laguna Hills*
*Laguna Niguel*
*Laguna Woods*
*La Habra*
*Lake Forest*
*La Palma*
*Leisure World*
*Los Alamitos*
*Mission Viejo*
*Monarch Beach*
*Newport Beach*
*Orange*
*Placentia*
*Rancho Santa Margarita*
*San Clemente*
*South Laguna*

***MWD OF ORANGE COUNTY (cont.)***
*San Juan Capistrano*
*Seal Beach*
*Stanton*
*Tustin*
*Tustin Foothills*
*Villa Park*
*Westminster*
*Yorba Linda*

***Three Valleys MWD***
*Azusa*
*Charter Oak*
*Claremont*
*Covina*
*Covina Knolls*
*Diamond Bar*
*Glendora*
*Industry*
*La Verne*
*Pomona*
*Rowland Heights*
*San Dimas*
*So. San Jose Hills*
*Walnut*
*West Covina*

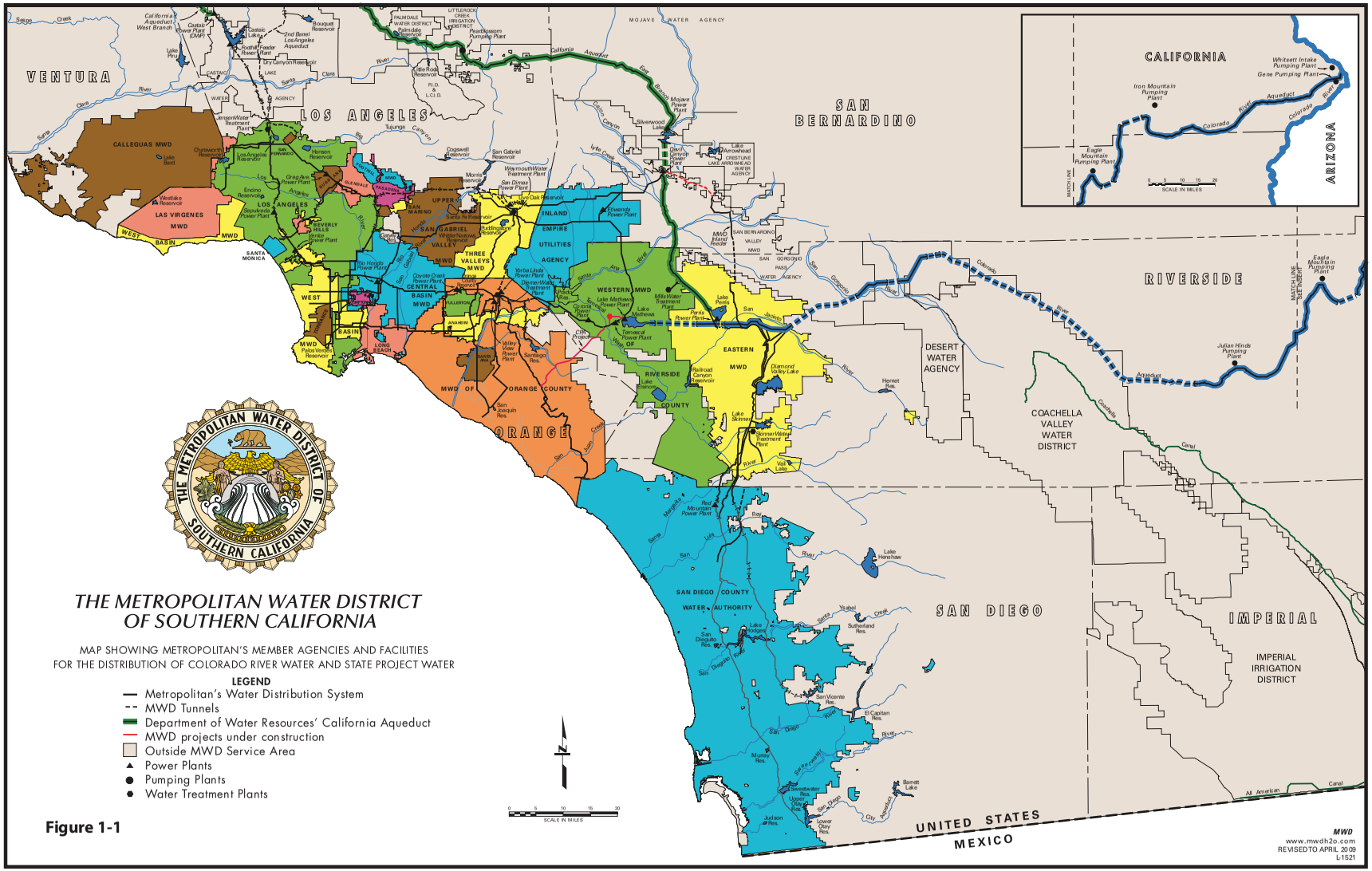
**Upper San Gabriel Valley MWD**
*Arcadia*
*Avocado Heights*
*Baldwin Park*
*Bradbury*
*Citrus*
*Covina*
*Duarte*
*El Monte*
*Glendora*
*Hacienda Heights*
*Industry*
*Irwindale*
*La Puente*
*Mayflower Village*
*Monrovia*
*Rosemead*
*San Gabriel*
*South El Monte*
*South Pasadena*
*South San Gabriel*
*Temple City*
*Valinda*
*West Covina*
*West Puente Valley*

***WEST BASIN MWD***
*Alondra Park*
*Carson*
*Culver City*
*El Segundo*
*Gardena*
*Hawthorne*
*Hermosa Beach*
*Inglewood*
*Ladera Heights*
*Lawndale*
*Lennox*

***WEST BASIN MWD (cont.)***
*Lomita*
*Malibu*
*Manhattan Beach*
*Marina Del Rey*
*Palos Verdes Estates*
*Rancho Palos Verdes*
*Redondo Beach*
*Rolling Hills*
*Rolling Hills Estates*
*Ross-Sexton*
*Topanga Canyon*
*West Athens*
*West Hollywood*

***WESTERN MWD OF*** **Riverside County**
*Bedford Heights*
*Canyon Lakes*
*Corona*
*Eagle Valley*
*El Sobrante*
*Jurupa*
*Lake Elsinore*
*Lake Mathews*
*March AFB*
*Murrieta*
*Norco*
*Riverside*
*Rubidoux*
*Temecula*
*Temescal Canyon*
*Woodcrest*

***SAN DIEGO CWA***
*Alpine*
*Bonita*
*Bonsall*
*Camp Pendleton*
*Carlsbad*
*Casa De Oro*
*Chula Vista*
*Del Mar*
*El Cajon*
*Encinitas*
*Escondido*
*Fallbrook*
*Lakeside*
*La Mesa*
*Lemon Grove*
*Mount Helix*
*National City*
*Oceanside*
*Pauma Valley*
*Poway*
*Rainbow*
*Ramona*
*Rancho Santa Fe*
*San Diego*
*San Marcos*
*Santee*
*Solana Beach*
*Spring Valley*
*Valley Center*
*Vista*


VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
IMPERIAL
CALIFORNIA
ARIZONA
MOJAVE WATER AGENCY
CALLEGUAS MWD
LAS VIRGENES MWD
WEST BASIN MWD
SANTA MONICA
LOS ANGELES
BEVERLY HILLS
SAN MARINO
UPPER SAN GABRIEL VALLEY MWD
THREE VALLEYS MWD
INLAND EMPIRE UTILITIES AGENCY
WESTERN MWD
CENTRAL BASIN MWD
WEST BASIN MWD
MWD OF ORANGE COUNTY
EASTERN MWD
RIVERSIDE COUNTY
SAN BERNARDINO VALLEY MWD
SAN GORGONIO PASS WATER AGENCY
DESERT WATER AGENCY
COACHELLA VALLEY WATER DISTRICT
IMPERIAL IRRIGATION DISTRICT
SAN DIEGO COUNTY WATER AUTHORITY
LAKE ARROWHEAD CRESTLINE WATER AGENCY
UNITED STATES
MEXICO
Colorado River Aqueduct
California Aqueduct
Whitsett Intake Pumping Plant
Gene Pumping Plant
Iron Mountain Pumping Plant
Eagle Mountain Pumping Plant
Julian Hinds Pumping Plant
Lake Mathews
Lake Skinner
Diamond Valley Lake
Lake Perris
Lake Hemet
Lake Henshaw
Lake Elsinore
Silverwood Lake
Lake Arrowhead
Lake Castaic
Lake Piru
Lake Pyramid
Lake Palmdale
Lake Elizabeth
Lake Hughes
Lake Castaic
Lake Baldwin Hills
Lake Balboa
Lake Sherman
Lake Los Angeles
Lake Gregory
Lake Arrowhead
Lake Silverwood
Lake Perris
Lake Skinner
Lake Matthews
Lake Elsinore
Lake Henshaw
Lake Hodges
Lake Sutherland
Lake Barrett
Lake Morena
Lake Cuyamaca
Lake Jennings
Lake Miramar
Lake Murray
Lake Sweetwater
Lake Otay
Lake Loveland
Lake Dulzura
Lake Jackson
Lake Judson
Lake Lower Otay
Lake Upper Otay

### *Board of Directors and Management Team*

Metropolitan's Board of Directors currently consists of 38 directors. The Board consists of at least one representative from each member agency, with each agency's assessed valuation determining its additional representation and voting rights. Directors can be appointed by the chief executive officer of the member agency or be elected by a majority vote of the governing body of the agency. Metropolitan does not compensate directors for their service. The Board includes business, professional, and civic leaders. Board meetings are generally held on the second Tuesday of each month and are open to the public.

Throughout its history, the Board has delegated certain tasks to Metropolitan staff, which are codified in Metropolitan's Administrative Code. In addition, Metropolitan has developed policy principles to help achieve its mission to provide adequate and reliable supplies of high-quality water in an environmentally and economically responsible way. These policies can be found in a variety of documents including: specific policy statements, the Administrative Code, Board-adopted policy principles, and letters submitted to the Board. Policy statements are also embedded in formal Board meeting discussions and recorded in meeting minutes. The policies established by the Board are subject to all applicable laws and regulations. The management of Metropolitan is under the direction of its General Manager, who serves at the discretion of the Board, as do Metropolitan's General Auditor, General Counsel, and Ethics Officer.

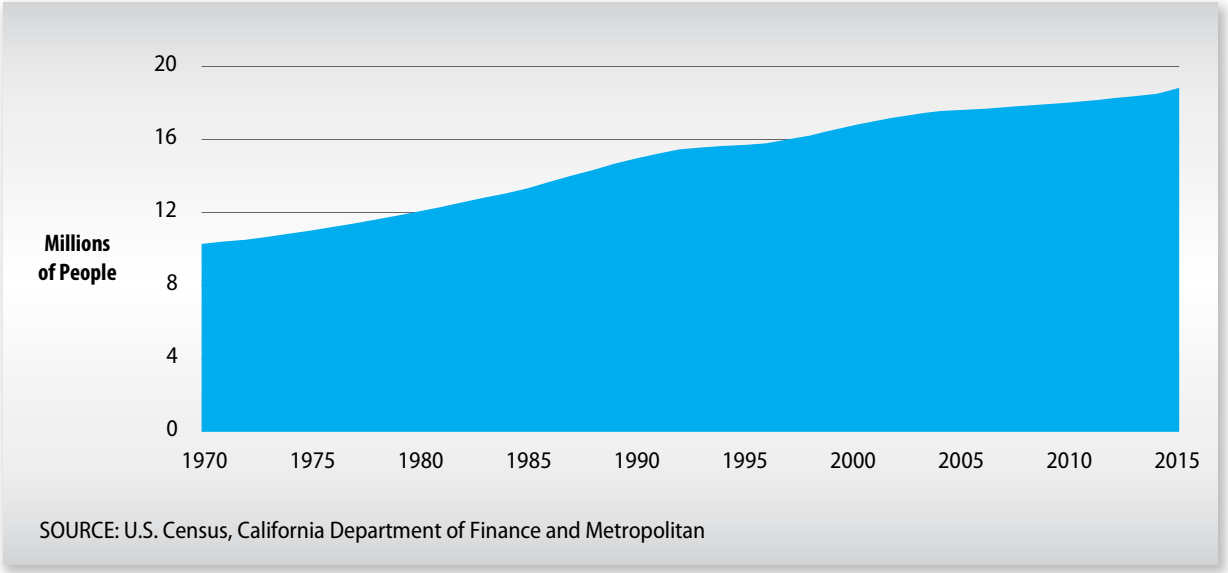
## 1.3 Metropolitan Service Area Historical Information

### *Population*

In 1990, the population of Metropolitan's service area was approximately 15.0 million people. By 2015, it had reached an estimated 18.7 million, representing almost half of the state's population. In the past, annual growth has varied from about 200,000 annually in the 1970s and early-to-mid-1980s to more than 300,000 annually in the late 1980s. Population growth slowed due to economic recession during the early 1990s to just over 50,000 in 1995, before again rising to more than 250,000 per year in the period 1999 through 2002. Growth has generally averaged 120,000 persons per year during the last 10 years from 2006 to 2015. Figure 1-2 shows the service area population growth from 1970-2015.

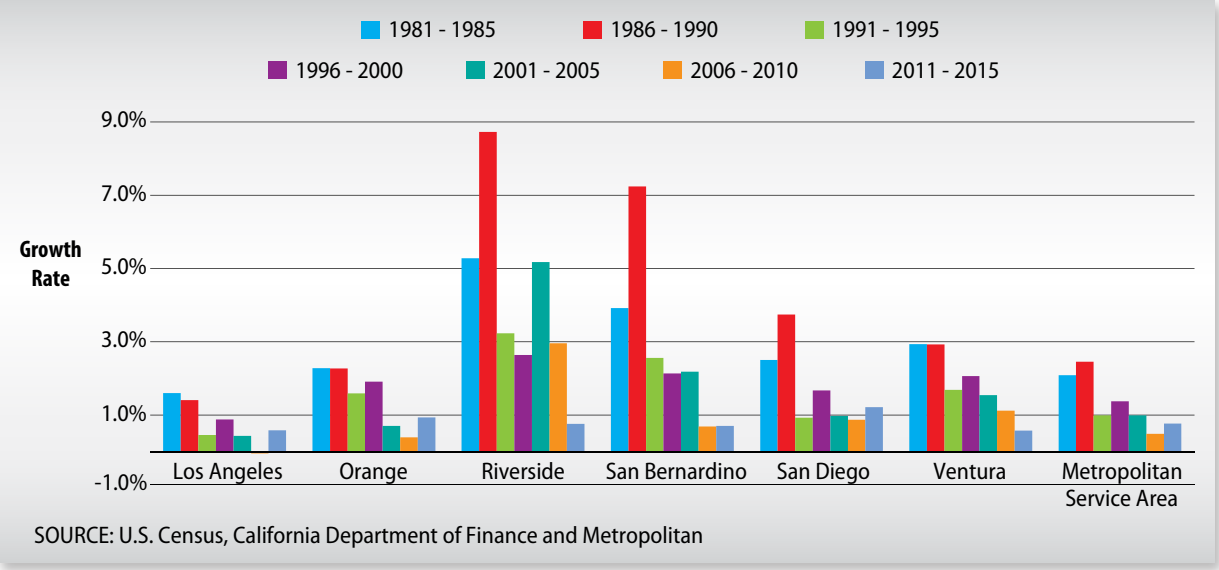
The most populated cities within Metropolitan's service area are Los Angeles (largest city in the state), San Diego (second largest in the state), Long Beach, Anaheim, Santa Ana, and Riverside. The Department of Finance State Population Report from May 2015 reports biggest numeric increases occurring in the cities of Los Angeles and San Diego, consistent with their larger population base. Figure 1-3 shows the 5-year growth rates for the six counties within Metropolitan's service area. As can be seen from this figure, there has been an overall increase in population growth rate in the last 5 years. Appendix 1 presents a detailed discussion of the demographic trends in Southern California and their impacts on regional demand forecasts.

**Figure 1-2 Service Area Population Growth 1970-2015**




SOURCE: U.S. Census, California Department of Finance and Metropolitan

**Figure 1-3 Average Annual Population Growth Rates in Metropolitan's Service Area**



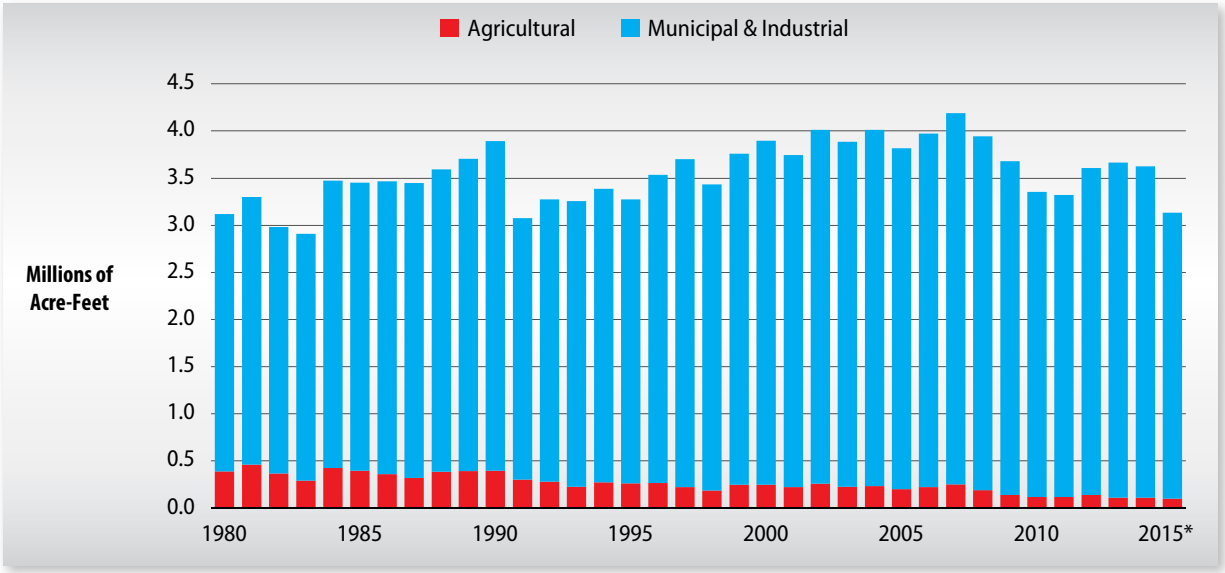

SOURCE: U.S. Census, California Department of Finance and Metropolitan

### *Historical Retail Water Demands*

Figure 1-4 presents historical retail water demands on a calendar year basis in Metropolitan's service area. Since 1980, retail water demands varied from 2.9 million acre-feet (MAF) in 1983 to nearly 4.2 MAF in 2007. Due to the economic recession, drought impacts, conservation, and mandatory water use restrictions, demands declined to 3.1 MAF in 1991. Demand remained below the peak level as a result of continuing effects from the recession and the drought coupled with a number of wet years and ongoing conservation efforts. In 2000, retail demands reached 3.9 MAF, surpassing the early peak level for the first time in a decade. Since 2000, retail demands reached a new peak level in 2007 with nearly 4.2 MAF. Calendar year 2007 was the driest year since 1989, with precipitation measured at 5.66 inches in Downtown Los Angeles. Since the peak retail demand in 2007, a decrease in demand was observed during the economic recession of 2008-2012. Starting in 2012, the severe drought in California led to a massive conservation campaign and water use restriction by the State, Metropolitan, and local water agencies resulting in a decrease in demand in 2015.

In 2015, about 97 percent of the retail demands were used for municipal and industrial purposes (M&I), and 3 percent for agricultural purposes. The relative share of agricultural water use has declined due to urbanization and market factors, including the price of water. Agricultural water use accounted for 19 percent of total regional water demand in 1970, 12 percent in 1980, 10 percent in 1990, and 3.5 percent in 2010.

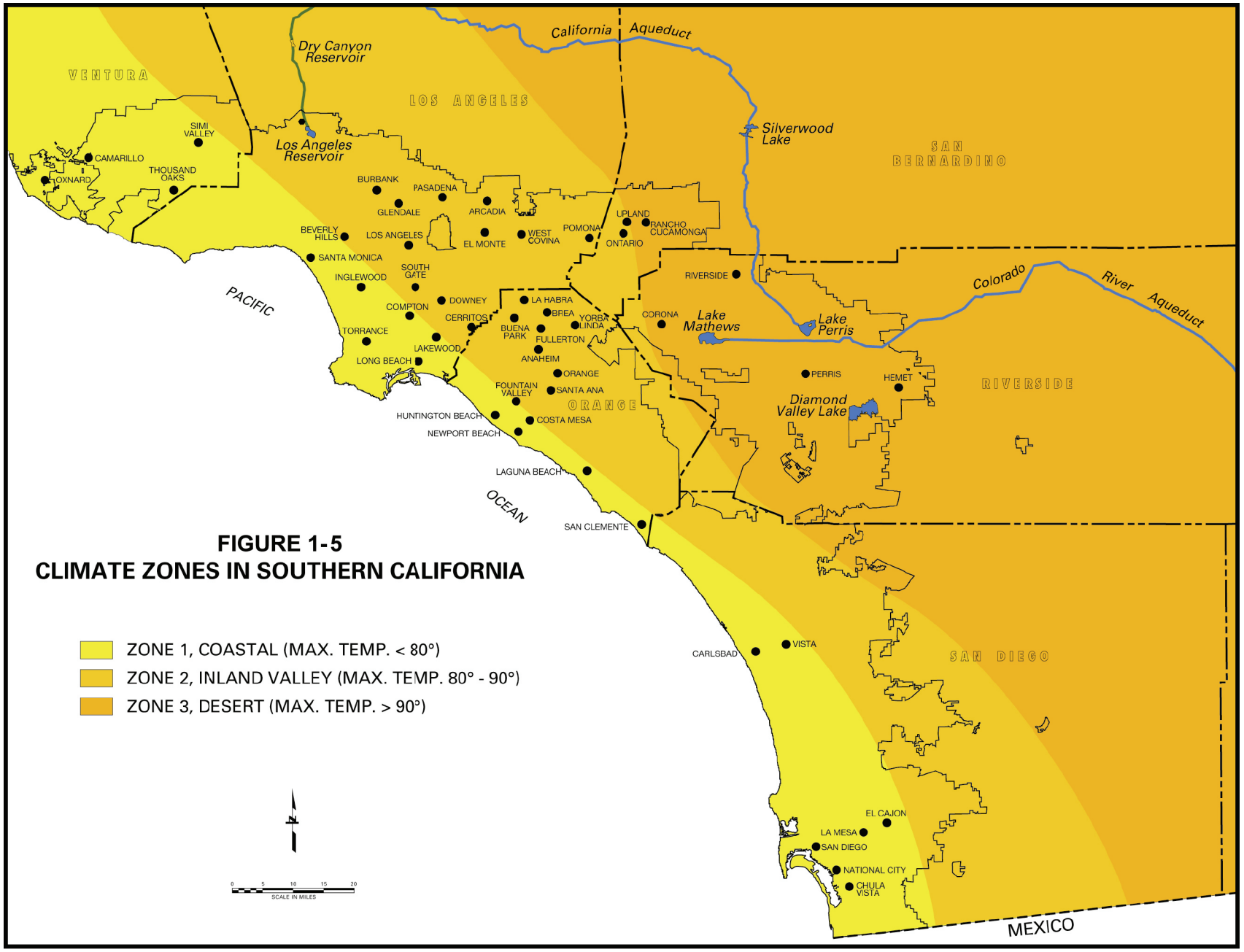
**Figure 1-4 Retail Demand in Metropolitan's Service Area**




* 2015 estimated based on best available data as of October 2015.

### *Climate and Rainfall*

As Figure 1-5 shows, Metropolitan's service area encompasses three major climate zones. Table 1-4 reports the 30-year (1985-2014) average temperature, rainfall, and evapotranspiration (expressed as $Et_o$) information for representative locations within those three zones.


VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SAN DIEGO
California Aqueduct
Dry Canyon Reservoir
Los Angeles Reservoir
Silverwood Lake
Lake Mathews
Lake Perris
Colorado River Aqueduct
Diamond Valley Lake
PACIFIC OCEAN
MEXICO
SIMI VALLEY
CAMARILLO
OXNARD
THOUSAND OAKS
BURBANK
PASADENA
GLENDALE
ARCADIA
BEVERLY HILLS
LOS ANGELES
EL MONTE
WEST COVINA
POMONA
UPLAND
RANCHO CUCAMONGA
ONTARIO
SANTA MONICA
SOUTH GATE
INGLEWOOD
DOWNEY
LA HABRA
COMPTON
CERRITOS
BREA
YORBA LINDA
BUENA PARK
FULLERTON
TORRANCE
LAKEWOOD
ANAHEIM
LONG BEACH
ORANGE
FOUNTAIN VALLEY
SANTA ANA
HUNTINGTON BEACH
COSTA MESA
NEWPORT BEACH
LAGUNA BEACH
SAN CLEMENTE
RIVERSIDE
CORONA
PERRIS
HEMET
CARLSBAD
VISTA
EL CAJON
LA MESA
SAN DIEGO
NATIONAL CITY
CHULA VISTA
N
0 5 10 15 20
SCALE IN MILES
FIGURE 1-5
CLIMATE ZONES IN SOUTHERN CALIFORNIA
ZONE 1, COASTAL (MAX. TEMP. < 80°)
ZONE 2, INLAND VALLEY (MAX. TEMP. 80° - 90°)
ZONE 3, DESERT (MAX. TEMP. > 90°)

## Table 1-4 Weather Variables in Three Zones in Metropolitan's Service Area

30-year Average (1985-2014)

| Average Temperature | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles County[1] | 58.06 | 58.54 | 60.62 | 63.52 | 65.96 | 68.87 | 72.62 | 73.44 | 72.20 | 68.19 | 62.46 | 57.38 | 65.15 |
| Riverside County[2] | 57.15 | 57.75 | 59.42 | 61.66 | 63.62 | 65.70 | 69.02 | 70.53 | 69.67 | 66.44 | 61.39 | 56.66 | 63.25 |
| San Diego County[3] | 54.01 | 54.85 | 57.76 | 61.83 | 66.19 | 70.76 | 75.80 | 76.54 | 73.31 | 66.43 | 58.69 | 52.97 | 64.09 |

30-year Average (1985-2014)

| Average Precipitation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles County[1] | 2.99 | 4.08 | 2.16 | 0.80 | 0.33 | 0.08 | 0.03 | 0.02 | 0.18 | 0.73 | 1.16 | 2.64 | 15.20 |
| San Diego[2] | 1.83 | 2.20 | 1.47 | 0.75 | 0.19 | 0.07 | 0.03 | 0.01 | 0.13 | 0.58 | 0.94 | 1.66 | 9.85 |
| Riverside[3] | 2.18 | 3.07 | 1.59 | 0.70 | 0.20 | 0.07 | 0.03 | 0.01 | 0.12 | 0.63 | 0.71 | 1.86 | 11.16 |

| $Et_o$[4] | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles County | 2.2 | 2 7 | 3 7 | 4 7 | 5 5 | 5 8 | 6 2 | 5 9 | 5 0 | 3 9 | 2 6 | 1 9 | 50.1 |
| San Diego | 2.5 | 2 9 | 4 2 | 5 3 | 5 9 | 6 6 | 7 2 | 6 9 | 5 4 | 4 1 | 2 9 | 2 6 | 56.4 |
| Riverside | 2.1 | 2 4 | 3 4 | 4 6 | 5 1 | 5 3 | 5 7 | 5 6 | 4 3 | 3 6 | 2 4 | 2 0 | 46.5 |

1. Temperature and precipitation data are from the National Oceanic and Atmospheric Administration, USC Station KCQT. Last updated July 1, 2015.
2. Temperature and precipitation data are from the National Oceanic and Atmospheric Administration, Riverside Station KNOC. Last updated July 1, 2015.
3. Temperature and precipitation data are from the National Oceanic and Atmospheric Administration, San Diego Airport Station KSAN. Last updated July 1, 2015.
4. Eto values are from Model Water Efficient Landscape Ordinance, September 10, 2009, Appendix A: Reference Evapotranspiration (Eto) Table.
   Eto values were derived from: 1) California irrigation Management Information System (CIMIS); 2) Reference Evapotranspiration Zone Map, UC Department of Land, Air and Water Resources and California Department of Water Resources 1999; 3) Reference Evapotranspiration for California, UC Department of Agriculture and Natural Resources, 1987, Bulletin 1922; and 4) Determining Daily Reference Evapotranspiration, UC Cooperative Extension, Division of Agriculture and Natural Resources, 1987, Publication Leaflet 21426.

## 1.4 Current Conditions

### *Current Challenges*

Metropolitan faces a number of challenges in providing adequate, reliable, and high quality supplemental water supplies for southern California. One of those challenges is dry hydrologic conditions that can have a significant impact on Metropolitan's imported water supply sources. This section offers a brief discussion of Metropolitan's current challenges, current available resources, short-term supply outlook, and recent and near-term actions to meet these challenges.

Dry conditions persisted into 2015, resulting in a fourth consecutive dry year for California. The year began with the driest January on record. The peak of the snowpack season traditionally occurs on April 1; however, in 2015, the snowpack peaked in January at only 17 percent of the April 1 average measurement, resulting in the earliest and lowest snowpack peak in recorded history. The statewide snowpack was all but gone by April 1, 2015, and registered a record low of 5 percent of average for that day. This dry hydrology produced only 51 percent of average runoff for the water year and consequently kept state reservoirs below average storage levels. As a result, Metropolitan only received 20 percent of its contract water supplies from the State Water Project (SWP) in 2015.

In 2015, the Upper Colorado River Basin snowpack peaked in March at 76 percent of normal. Runoff for that basin measured 94 percent of normal due to above normal rainfall in May, June and July, which averted a Colorado River shortage condition for 2016. This allowed Metropolitan to implement new water management programs and bolster supplies in 2015. The Colorado River, however, is experiencing a 16-year drought causing total storage levels in that system to steadily decline and increasing the likelihood of shortage in future years beyond 2016. The restrictions on water use generated a record demand for water-saving rebates and refocused efforts to increase development of local water resources.

#### *Sacramento-San Joaquin River Delta Issues*

The Sacramento-San Joaquin River Delta (Bay-Delta) is the hub of California's water supply and is critically important to the entire state. About 30 percent of Southern California's water supply moves across the Bay-Delta. The Bay-Delta's declining ecosystem, caused by a number of factors that include agricultural runoff, predation of native fish species, urban and agricultural discharge, changing ecosystem food supplies, and overall system operation, has led to reduction in water supply deliveries. SWP delivery restrictions due to regulatory requirements resulted in the loss of about 1.5 MAF of supplies to Metropolitan from 2008 through 2014, reducing the likelihood that regional storage can be refilled in the near-term. Operational constraints will likely continue until a long-term solution to the problems in the Bay-Delta is identified and implemented.

In April 2015, the Brown Administration announced California WaterFix, as well as a separate ecosystem restoration effort called California EcoRestore. Together, the California WaterFix and California EcoRestore will make significant contributions toward achieving the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem established in the Sacramento-San Joaquin Delta Reform Act of 2009. A detailed description of the Bay-Delta issues is included in Section 3.2.

### *Water Supply Conditions*

The water conditions that the region faced in 2015 were shaped by supply conditions and resource actions that occurred in the preceding years, including several extraordinary events, such as:

- Historic drought in California leading to record low contract supplies available from the SWP in 2014 (5 percent of contract supplies) and in 2015 (20 percent of contract supplies);
- An extended 16 year drought in the Colorado River watershed that has decreased storage levels in Lake Mead and Lake Powell to 38 percent and 51 percent of capacity, respectively, at the end of November 2015 and keeping storage below surplus levels despite an ease in drought conditions in 2014 and 2015;
- Groundwater basins and local reservoirs dropping to very low operating levels due to record-dry hydrology in Southern California;
- Restrictions of SWP deliveries by federal court orders due to endangered Delta smelt and salmon which resulted in the combined loss of approximately 3 MAF of SWP supplies between 2008 and 2014. These losses have impacted Metropolitan's ability to meet demands and refill regional storage;
- In 2014, Lake Oroville storage dropped within 10 TAF of its lowest operating levels since the historic drought of 1977; and
- Supply availability in the Los Angeles Aqueduct system continues to be affected by both the drought and environmental mitigation efforts related to Owens Lake and the Lower Owens River.

These dry hydrologic conditions and reduced imported water supplies have led to significant withdrawals from Metropolitan's storage reserves, including Diamond Valley Lake (DVL) and its groundwater banking and conjunctive use programs to meet scheduled water deliveries. During the 2007-2009 drought, Metropolitan withdrew a combined 1.2 MAF from storage reserves to balance supplies and demands. In 2014 alone, Metropolitan withdrew 1.1 MAF from dry-year storage to balance supplies and demands because of the historic low final SWP allocation in that year.

In addition, challenges such as the detection of the quagga mussel in the Metropolitan's CRA supplies and increasingly stringent water quality regulations to control disinfection byproducts exacerbate the water supply condition and underscore the importance of flexible and adaptive regional planning strategies.

## ***Current Available Resources***

Metropolitan's primary purpose is to provide a supplemental supply of water for domestic and municipal uses at wholesale rates to its member public agencies. Metropolitan's principal sources of water are the SWP and the Colorado River. Metropolitan's robust planning strategy continues to balance available local and imported water resources and member agencies' demands within Metropolitan's service area.

### *A. Imported Supplies*

Metropolitan receives water from the SWP through the California Aqueduct and from the Colorado River through the Colorado River Aqueduct (CRA). Figure 1-6 shows the historic annual deliveries from the SWP and the CRA.

Colorado River

The Colorado River was Metropolitan's original source of water after Metropolitan's establishment in 1928. Metropolitan has a legal entitlement to receive water from the Colorado River under a permanent service contract with the Secretary of the Interior. The CRA, which has a capacity of 1.2 MAF a year, is owned and operated by Metropolitan. It transports water from Lake Havasu, at the border of the state of California and Arizona, approximately 242 miles to its terminus at Lake Mathews in Riverside County.

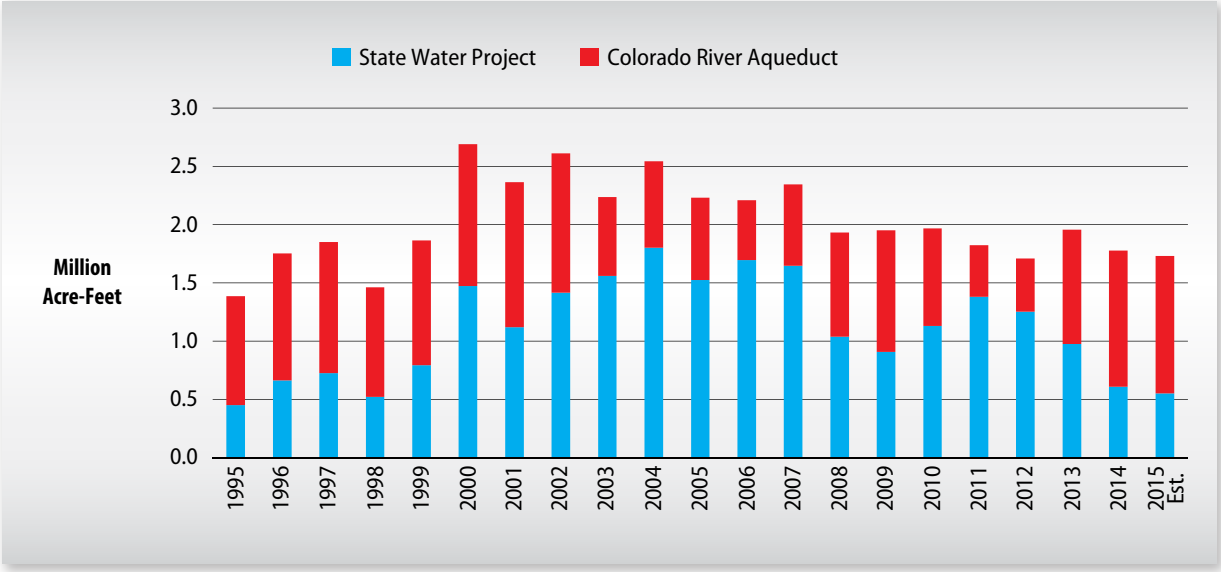
Over the years, Metropolitan increased reliable supply from the CRA through programs that it helped fund and implement including: farm and irrigation district conservation programs, improved reservoir system operations, land management programs, and water transfers and exchanges through arrangements with agricultural water districts in southern California, San Diego County Water Authority, and entities in Arizona and Nevada that use Colorado River water, and the U.S. Department of the Interior, Bureau of Reclamation (USBR). A detailed discussion of availability of Colorado River water for delivery to Metropolitan is described in Section 3.1.

State Water Project

Metropolitan imports water from the SWP, owned by the state of California and operated by the California Department of Water Resources (DWR). This project transports Feather River water stored in and released from Oroville Dam and conveyed through the Bay-Delta, as well as unregulated flows diverted directly from the Bay-Delta south via the California Aqueduct to four delivery points near the northern and eastern boundaries of Metropolitan's service area.

In 1960, Metropolitan signed a contract with DWR for SWP water supplies. Metropolitan is one of 29 agencies that have long-term contracts for water service from DWR, and is the largest agency in terms of the number of people it serves (nearly 19 million), the share of SWP water that it has contracted to receive (approximately 46 percent), and the percentage of total annual payments made to DWR by agencies with State water contracts (approximately 53 percent in 2015). A more detailed discussion of the SWP supplies is provided in Section 3.2.

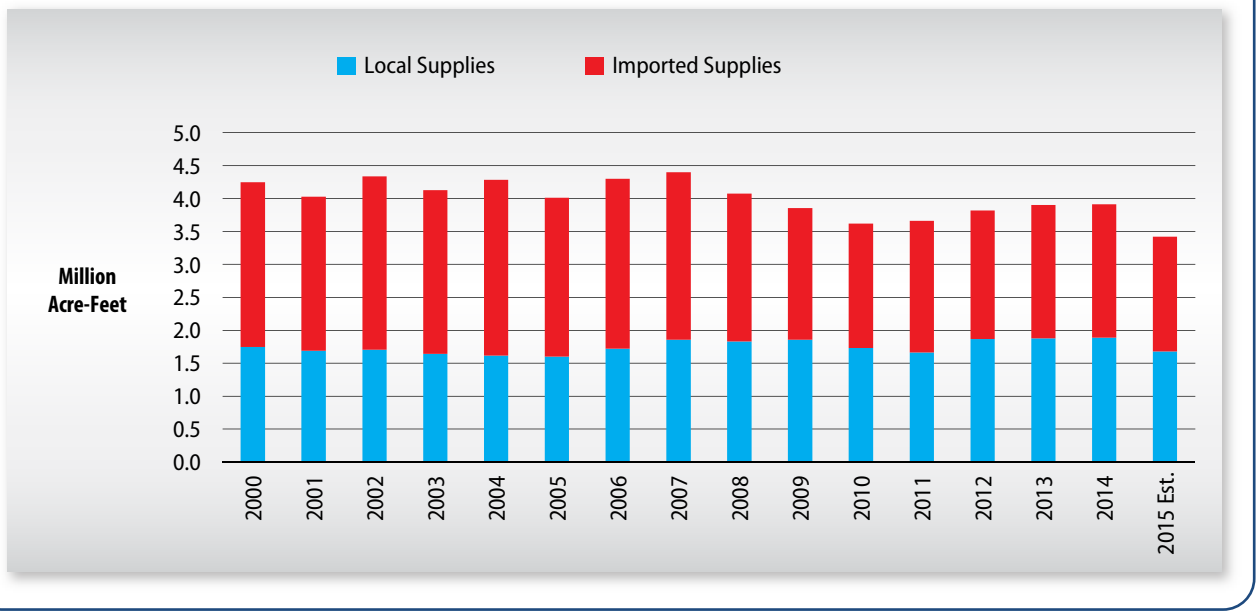
**Figure 1-6 Imported Water Supplies in Metropolitan's Service Area**



### *B. Local Supplies*

Approximately 50 percent of the region's water supplies come from resources controlled or operated by local water agencies. These resources include water extracted from local groundwater basins, catchment of local surface water, non-Metropolitan imported water supplied through the Los Angeles Aqueduct, and Colorado River water exchanged for Metropolitan supplies. Figure 1-7 shows the historic annual use of local and imported water suppplies within Metropolitan's service area.

**Figure 1-7 Annual Regional Water Supplies in Metropolitan's Service Area**




Groundwater

The groundwater basins that underlie the region provide nearly 35 percent of the water supply in Southern California. The major groundwater basins provide an annual average supply of approximately 1.35 MAF. Natural recharge of the groundwater basins is supplemented by active recharge of captured stormwater, recycled water, and imported water to support this level of annual production.

Estimates indicate that available storage space in the region's groundwater basins in mid-2015 is approximately 4.8 MAF. Successive dry years have resulted in groundwater depletions that will need to be replaced with natural recharge during wet years and active spreading of captured stormwater, recycled water, and imported water. Groundwater basin managers and water suppliers have taken steps to store water in advance of dry years to soften the potential impact on groundwater aquifers and to maintain reliable local water supplies during dry years.

Recycling, Groundwater Recovery, and Seawater Desalination

Recycling and groundwater recovery are local resources that add balance to Southern California's diverse water portfolio. In addition to replenishment groundwater basins described above, water recycling provides extensive treated wastewater for applicable municipal and industrial uses. Common uses of recycled water include landscape irrigation, agricultural

irrigation, and commercial and industrial applications. Groundwater recovery employs additional treatment techniques to effectively use degraded groundwater supplies that were previously not considered viable due to high salinity or other contamination.

While water recycling and groundwater recovery projects in the Southern California region are primarily developed by local water agencies, many newer projects have been developed with financial incentives provided through Metropolitan's Local Resources Program (LRP). The LRP is a performance-based program that provides incentives to expand water recycling and support recovery of degraded groundwater. In 2015, the regional water production from water recycling and groundwater recovery totaled approximately 530 TAF, of which 244 TAF was developed with Metropolitan funding assistance. A detailed discussion of recycling and groundwater recovery is presented in Section 3.5.

Seawater desalination represents a significant opportunity to diversify the region's water resource mix with a new, locally-controlled, reliable potable supply. Metropolitan supports seawater desalination to its member agencies by providing technical assistance, regional facilitation of research and information exchanges, and financial incentives through the LRP.

In the fall of 2015, the San Diego County Water Authority (SDCWA) began operation of the largest seawater desalination facility in the United States. The 56 TAF project will meet about eight percent of San Diego's demands and add a new, drought-resistant supply to the region. Seawater desalination is discussed in more detail in Section 3.5.

Surface Water

In addition to the groundwater basins, local agencies maintain surface reservoir capacity to capture local runoff. The average yield captured from local watersheds is estimated at approximately 104 TAF per year. The majority of this supply comes from reservoirs within the service area of the SDCWA.

Los Angeles Aqueduct

Although the Los Angeles Aqueduct (LAA) imports water from outside the region, Metropolitan classifies water provided by the LAA as a local resource because it is developed and imported by a local agency (the Los Angeles Department of Water and Power). This resource is estimated to provide approximately 260 TAF per year on average, which may be reduced to approximately 27 TAF during a historical dry period for a year like 2015.

Imperial Irrigation District / San Diego County Water Authority Transfer

The SDCWA has executed an agreement with the Imperial Irrigation District (IID) under which IID is transferring water to SDCWA. Since this supply is developed and transferred through an agreement by a local agency (SDCWA), Metropolitan also classifies this water as a local resource. Currently, the water transferred by IID is made available by SDCWA to Metropolitan for diversion at Lake Havasu. Metropolitan provides a matching volume of water to SDCWA by exchange. Under the transfer, 100 TAF was transferred and exchanged with Metropolitan in 2015. The transfer volumes increase beginning in 2018 in accordance with an annual build-up schedule, reaching 205 TAF in 2021 and stabilizing at 200 TAF annually in 2023. Currently, the water is being conserved through land fallowing and on-farm efficiency conservation arrangements made by IID with its customers. By 2017, all of the transferred water should be made available through efficiency conservation measures.

Coachella and All-American Canal Lining Projects

The Coachella Canal Lining Project consists of a 35-mile concrete-lined canal, including siphons, which replaced an earthen canal. The project was completed in December 2006. The project is conserving 30,850 AF annually. The All-American Canal Lining Project consists of a concrete-lined canal constructed parallel to 23 miles of earthen canal. Two reaches of the project were placed in service in 2008 with the third reach placed in service in 2009. In 2010, this project began conserving 67,700 AF annually.

Pursuant to the QSA and related agreements, the 98,550 AF of water resulting from these projects annually is allocated as follows in 2015: 16,000 AF to Metropolitan, 80,200 AF to SDCWA, and up to 2,350 AF for Coachella Canal Lining Project mitigation, with the amount not needed for mitigation becoming available to SDCWA. The water is made available at Lake Havasu for diversion by Metropolitan, and by exchange, Metropolitan delivers a volume of water to SDCWA equal to the amount made available by SDCWA to Metropolitan. Metropolitan classifies the portion of the supply exchanged with SDCWA as local resources.

Table 1-5 shows the projected local supplies estimated for average and dry years for 2020, 2030, and 2040.

**Table 1-5**
**Local Supplies for Average and Dry Years**
(Acre-Feet)

| | 2020 | | 2030 | | 2040 | |
|---|---|---|---|---|---|---|
| | Average Year[1] | Dry Year[2] | Average Year | Dry Year | Average Year | Dry Year |
| Local Groundwater | | | | | | |
| *From Natural Recharge* | 1,011,000 | 1,007,000 | 1,004,000 | 1,005,000 | 1,005,000 | 1,006,000 |
| *Replenishment* | 292,000 | 298,000 | 297,000 | 297,000 | 297,000 | 297,000 |
| Local Projects | | | | | | |
| *Groundwater Recovery* | 143,000 | 139,000 | 163,000 | 162,000 | 167,000 | 167,000 |
| *Recycling* | 436,000 | 427,000 | 486,000 | 482,000 | 509,000 | 507,000 |
| *Seawater Desalination* | 51,000 | 56,000 | 51,000 | 56,000 | 51,000 | 56,000 |
| Local Runoff Stored | 110,000 | 102,000 | 110,000 | 102,000 | 110,000 | 102,000 |
| Los Angeles Aqueduct | 261,000 | 113,000 | 264,000 | 125,000 | 268,000 | 133,000 |
| IID-SDCWA Transfer and Canal Linings | 274,000 | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **Total** | **2,578,000** | **2,416,000** | **2,657,000** | **2,511,000** | **2,689,000** | **2,550,000** |

[1] Average Year is based on 1922 through 2012.
[2] Dry Year is based on Multiple Dry Years (1990-92)

### *Metropolitan's Recent and Near-term Drought Response Actions*

Metropolitan progressively addressed the challenges of water shortages caused by the unprecedented drought since 2012. Metropolitan took actions that include: (1) Increasing water conservation by expanding outreach, adding devices, and increasing incentives to residents, (2) Increasing local resources by providing incentives for on-site recycled water hook-up and increasing incentives for the LRP, (3) Augmenting water supplies through water transfers and exchanges, (4) Improving return capability of storage programs,

(5) Modifying Metropolitan's distribution system to enhance Colorado River water delivery, and (6) Implementing the Water Supply Allocation Plan to distribute the limited imported supplies and preserve storage reserves.

### *Increasing Water Conservation*

When the most recent drought period started in 2012 and progressed into 2013, Metropolitan recognized the need to increase the efficiency and effectiveness of its conservation program. In September 2013, Metropolitan's Board added several new initiatives to its conservation program to target water reduction by public agencies, landscaping, fitness centers, and the commercial and multi-family housing sectors. In addition, rebates became available for new devices - soil moisture sensor system, plumbing flow control valves, and rain barrels – and increased incentives were provided for high-efficiency toilets (HETs) that are more efficient than the low-flush toilets sold in the market.

In January 2014, Governor Edmund G. Brown Jr. issued a drought emergency proclamation calling for Californians to reduce their water use by 20 percent and for water agencies to implement water shortage plans. In response to the governor's drought proclamation, Metropolitan ramped up conservation efforts in Southern California. In February 2014, Metropolitan declared a Water Supply Alert, calling upon local cities and water agencies to immediately implement extraordinary conservation measures and institute local drought ordinances. In addition, Metropolitan significantly expanded its water conservation and outreach programs and doubled funding for conservation incentive programs to $40 million.

In April 2014, the governor issued a second proclamation, asking the state to redouble drought actions and directing the SWRCB to adopt emergency regulations to implement the directive. Accordingly, the SWRCB adopted outdoor water restrictions on July 15, 2014 that targeted outdoor urban water use that would normally increase under the hot and dry conditions. In May 2014, Metropolitan increased its turf removal incentives from $1 to $2 per square foot; increased the funding for incentives for rain barrels and recycled water hookups; and continued funding rebates for high efficiency toilets to speed up conversion from non-conserving toilets.

In July 2014, Metropolitan launched a $5.5 million outreach campaign, the largest in Metropolitan's history. The campaign seeks to raise awareness of the drought and urges residents and businesses to save water. The campaign features multiple media platforms, including radio and television, with enhanced outreach to the region's ethnic communities. Activity on Metropolitan's bewaterwise.com® website quadrupled as a result of the campaign. Metropolitan's conservation programs saw record-breaking increases in applications for rebates. It is clear that Southern California is responding to these calls for increased conservation efforts. Metropolitan is committed to doing its part in promoting water-use efficiency and increasing local supplies while collaborating with other stakeholders to protect critical reserves. As a result of the strong response to its conservation incentive program, Metropolitan again increased its conservation budget to a total of $100 million in December 2014.

On April 1, 2015, Governor Brown issued an Executive Order (Order) calling for a 25 percent reduction in consumer water use in response to the historically dry conditions throughout the State of California. As a wholesale water agency providing a supplemental water supply to its member agencies, Metropolitan is not subject to the requirements of the Governor's Order, which applies to retail water agencies. However, in May 2015, Metropolitan again increased funding for its conservation program to a total amount of $450 million over fiscal years 2014-15 and 2015-16 due to strong response to the incentive program and to assist retail agencies in the

service area to meet their mandatory water reduction targets established by the SWRCB. Turf removal is the most popular element of Metropolitan's conservation incentive program, and it is expected to result in 172 million square feet of turf removed and water savings of 800 TAF over the next ten years.

### *Increasing Local Resources*

Since 1982, Metropolitan has assisted local agencies in the development of water recycling and groundwater recovery under the LRP. In light of hot and dry conditions in 2013 and the low SWP allocation in 2014, Metropolitan worked with member agencies to identify constraints to local resources development and proposed refinements to the LRP.

In February 2014, Metropolitan's Board approved the On-site Retrofit Pilot Program to offer incentives to modify existing water users' potable water systems to utilize recycled water. In October 2014, Metropolitan's Board approved the LRP refinements to support further development of local resources, which included increasing the maximum incentive amount, offering alternate incentive payment structures, including on-site recycled water retrofit costs, including other water resources (such as seawater desalination and stormwater), and providing reimbursable services for Metropolitan's technical assistance.

### *Augmenting Water Supplies*

Augmenting water supplies through water transfers and exchanges is an element of Metropolitan's IRP to mitigate water shortages during dry periods.

The Colorado River System has been suffering from the effects of drought since 2000, leading to substantially decreased water levels in both Lakes Mead and Powell. In March 2014, Metropolitan's Board approved entering into an agreement with the Central Arizona Water Conservation District, Denver Water, Southern Nevada Water Authority (SNWA), and the United States to establish a two-year pilot program to compensate entitled users of the Colorado River water for voluntary reductions in water use, including fallowing of agricultural lands.

Metropolitan also entered into several agreements to improve Metropolitan's operational flexibility in 2015:

- In January 2015, Metropolitan's Board authorized an exchange of up to 50,000 acre-feet with Westside Mutual Water Company and Kern County Water Agency. This one-for-one exchange provides water at a time in the year when SWP supplies are expected to be low and provides flexibility on timing of returning water.
- In September 2015, Metropolitan's Board authorized an amendment to the operational storage agreement with SNWA and the Colorado River Commission of Nevada allowing Metropolitan access to additional Colorado River water during 2015. Metropolitan would pay SNWA $44.375 million for 150,000 AF of water apportioned to but not used by SNWA during 2015. When SNWA requests return of water stored under this amendment, SNWA would reimburse Metropolitan for the costs paid for the initial delivery of water.
- In November 2015, Metropolitan's Board authorized entering into agreements with Antelope Valley-East Kern Water Agency (AVEK) to develop exchange and storage programs for SWP supplies. This would be an uneven exchange: for every two acre-feet provided to Metropolitan, AVEK would receive back one acre-foot in the future. Metropolitan may also store at least 30,000 AF of its SWP supplies in wet years in the Antelope Valley groundwater basin.

### *Improving Return Capabilities of Storage Programs*

Metropolitan has a number of storage programs with water agencies along the California Aqueduct that would allow it to store SWP supplies during surplus conditions and to have stored water returned when needed. In 2015, Metropolitan provided up-front capital costs to its water management program partners to build infrastructure to improve the return capabilities of several storage programs.

- In September 2014, Metropolitan's Board authorized providing capital funds to Semitropic Water Storage District to enhance the pumpback capacity of the Semitropic Groundwater Storage Program by 13,200 AFY. The capital costs would be reimbursed to Metropolitan should Semitropic market the added capacity to another party after Metropolitan has at least one year of recovery capability.
- In March 2015, Metropolitan's Board authorized entering into agreement with Arvin Edison Water Storage District to restore 2,500 AFY of return capability by replacing groundwater wells of the Arvin Edison/Metropolitan Water Management Program. The capital costs will be reimbursed as credits to future Program costs.
- Also in March 2015, Metropolitan's Board authorized entering into agreement with Kern-Delta Water District to improve the return reliability of the Kern-Delta Water District Water Management Program. The improvement includes a pipeline that would reduce losses when Kern River supplies are delivered for exchange. Metropolitan's upfront costs will be more than offset through an elimination of put regulation fees on the next 20,000 AF delivered into the Program.

### *Modifying Metropolitan's Distribution System*

As a result of ongoing extraordinary dry conditions throughout the state of California, the SWP allocation for calendar year 2014 was five percent, which represents about 96,000 acre-feet of SWP Table A water allocation for Metropolitan, the lowest in the history of the SWP. Although Metropolitan has been utilizing storage reserves to help bridge the gap between the low SWP supplies and the demand for SWP water, a number of extraordinary operational actions were taken in 2014 to deliver available Colorado River water and DVL storage supplies to areas that ordinarily only receive SWP supplies.

Metropolitan modified its normal operations in several areas of the system to deliver Colorado River water to areas as far west as the cities of Thousand Oaks and Calabasas, as well as other locations within Metropolitan's system, some of which had not received Colorado River water for extended periods since the completion of the SWP in the early 1970s. System modifications have also been implemented to increase system flexibility to deliver Colorado River water and DVL water into new areas of the system.

- In April 2014, Metropolitan's Board authorized the project to interconnect between the Inland Feeder and the Lakeview Pipeline, near San Jacinto, California. This project was completed in October 2014, and allowed Metropolitan to serve water from multiple sources, such as DVL, to the Mills Treatment Plant in Riverside.
- In May 2014, Metropolitan's Board authorized enhancing water supply reliability in the West Valley area by rehabilitating a pump station and constructing flow control modifications to the outlet of the Jensen Water Treatment Plant. This project allowed the West Valley area, which was served normally by SWP water only, to receive blended supplies from the SWP and the CRA.

Additionally, several Metropolitan member agencies made modifications within their own local systems to maximize the use of more readily available Colorado River water and DVL supplies, to further reduce the use of scarce SWP supplies.

### *Implementing the Water Supply Allocation Plan*

Metropolitan's Water Supply Allocation Plan (WSAP) was developed in 2008. The WSAP was developed to fairly distribute a limited amount of water supply and applies it through a detailed methodology to reflect a range of local conditions and needs of the region's retail water consumers. Metropolitan's Board authorized the implementation of the WSAP for the period of July 2009 through April 2011 in response to the drought and low storage reserves.

Dry periods resumed in 2012. In 2014, California was challenged with a third year of severe drought. Metropolitan managed its operations through significant use of regional storage reserves. It was anticipated that end of year total dry year storage reserves would approach levels similar to those when the WSAP was first implemented in 2009. On December 9, 2014, Metropolitan's Board approved adjustments to the formula for calculating member agency supply allocations for future implementation of the WSAP. On April 14, 2015, Metropolitan's Board approved implementation of the WSAP at a Level 3 Regional Shortage Level, effective July 1, 2015 through June 30, 2016. The WSAP allows member agencies the flexibility to choose among various local supply and conservation strategies to help ensure that demands on Metropolitan stay in balance with limited supplies. More details of the WSAP are included in Section 2.4 and Appendix 4.

As of December 2015, Metropolitan has observed an approximate 23 percent reduction in deliveries to member agencies under the WSAP for the rolling 12-month period ending December 31, 2015.

Table 1-6 gives a timeline of Metropolitan's Board authorization for the above actions. It shows Metropolitan's progressiveness and adaptation to changing water supply conditions.

**Table 1-6**
**Recent Metropolitan's Board Drought Response Actions**

| Year | Month | Actions |
|---|---|---|
| 2013 | September | Authorized new conservation program initiatives and devices for rebates |
| 2014 | February | Declared Water Supply Alert<br>Doubled conservation budget to $40 million<br>Approved incentives for on-site recycled water retrofit |
| | March | Authorized a pilot program to fund water use efficiency measures for increasing Colorado River storage |
| | April | Authorized and appropriated funds for final design of drought response to enhance water supply reliability for the Henry J. Mills Water Treatment Plant |
| | May | Increased turf removal incentives from $1 to $2 per square foot<br>Added rebates for new devices including rain barrels<br>Authorized projects to enhance water supply reliability in the West Valley Area |
| | September | Authorized improvement of the return capacity of the Semitropic Groundwater Storage Program |
| | October | Authorized refinements to the Local Resources Program to encourage and expedite local resource production |
| | December | Increased the conservation incentive budget to a total of $100 million |
| 2015 | January | Authorized an exchange of up to 50,000 AF with water agencies in Kern County to enhance Metropolitan's operational flexibility in 2015 |
| | March | Authorized projects to improve return capacity from storage programs with Arvin Edison Water Storage District and Kern-Delta Water District |
| | April | Declared Water Supply Allocation and approved the implementation of Water Supply Allocation Plan at a Regional Shortage Level 3 effective July 1, 2015 through June 30, 2016 |
| | May | Increased conservation incentive budget to a total of $450 million |
| | September | Authorized an amendment to the operational agreement with SNWA and the Colorado River Commission of Nevada allowing Metropolitan access to additional Colorado River water during 2015 |
| | November | Authorized entering into storage and exchange agreements with Antelope Valley-East Kern Water Agency |

### *Short-term Supply Outlook*

Metropolitan evaluated the short-term supply outlook during each of the next three years from 2016 through 2018 and determined the minimum water supplies available based on the driest three-year historic sequence of 1990 through 1992. This analysis incorporates the actual storage levels at the beginning of 2015 and the forecasted supplies and demands under a multiple dry-year sequence. This evaluation of supply capabilities also takes into account the actual storage program conveyance constraints. Table 1-7 shows the projected yields of the in-region storage and imported supplies from the SWP and CRA, for both current programs and those under development. Detailed descriptions of the current programs and programs under development are included in Appendix 3.

For this supply capability evaluation, SWP supplies are estimated using the 2015 SWP Delivery Capability Report distributed by DWR in July 2015. The 2015 Capability Report base scenario represents the current DWR estimate of the amount of water deliveries for current conditions. These estimates incorporate restrictions on SWP and Central Valley Project (CVP) operations in accordance with water quality objectives established by the State Water Resources Control Board and the biological opinions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service issued on December 15, 2008, and June 4, 2009, respectively.

Metropolitan's forecast shows that under a multi-dry year hydrology, Metropolitan could face reduced supply capability during the next three years. This places considerable emphasis on developing robust short-term actions that will increase supply reliability to Metropolitan's service area.

**Table 1-7**
**Multiple Dry-Year**
**Supply Capability[1]**
**Repeat of 1990-1992 Hydrologies**
(acre-feet per year)

| Forecast Year | 2016 | 2017 | 2018 |
|---|---|---|---|
| **Current Programs** | | | |
| In-Region Storage | 93,000 | 40,000 | 5,000 |
| California Aqueduct[2] | 770,000 | 491,000 | 673,000 |
| Colorado River Aqueduct[3] | 934,000 | 958,000 | 964,000 |
| ***Subtotal of Current Programs*** | ***1,797,000*** | ***1,489,000*** | ***1,642,000*** |
| **Programs Under Development** | | | |
| In-Region Storage | 8,371 | 17,530 | 26,633 |
| California Aqueduct | 50,000 | 50,000 | 50,000 |
| Colorado River Aqueduct | 80,000 | 80,000 | 80,000 |
| ***Subtotal of Proposed Programs*** | ***138,371*** | ***147,530*** | ***156,633*** |
| **Maximum Metropolitan Supply Capability** | **1,935,371** | **1,636,530** | **1,798,633** |

[1] Represents supply capability for resource programs under listed year type.
[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
[3] Colorado River Aqueduct includes water management programs, IID-SDCWA transfer and exchange and canal lining projects.
Maximum CRA deliveries limited to 1.20 MAF including IID-SDCWA transfer and exchange, and canal lining projects.

# Planning for the Future

2

The purpose of this section is to show how Metropolitan plans to meet Southern California's water supply needs in the future. In its role as supplemental supplier to the Southern California water community, Metropolitan faces ongoing challenges in meeting the region's needs for water supply reliability and quality. Increased environmental regulations and competition for water from outside the region have resulted in changes in delivery patterns and timing of imported water supply availability. At the same time, the Colorado River watershed has experienced a protracted drought since 2000.

As described in the previous chapter, the water used in Southern California comes from a number of sources. From 2006 through 2015, Metropolitan has provided 50 percent to 60 percent of the water needs in its service area from the Colorado River via the CRA, and from the Sacramento-San Joaquin River Watershed via the SWP. As Metropolitan continues to face various water supply challenges, development of adaptable strategies for managing resources to meet the range of estimated demands into the future and for adjusting to changing resource conditions is ongoing.

Metropolitan's continued progress in developing a diverse resource mix enables the region to meet its water supply needs. The investments that Metropolitan has made and its ongoing efforts in many different areas coalesce toward its goal of long-term regional water supply reliability. Metropolitan's actions have been focused on the following:

- Pursuing long-term solutions for the Delta
- Developing storage programs related to the SWP and the Colorado River
- Developing storage and groundwater management programs within the Southern California region
- Increasing conservation
- Increasing water recycling, groundwater recovery, and seawater desalination
- Developing water supply management programs outside of the region

Metropolitan has undertaken a number of planning initiatives over the years. This section summarizes these efforts, which include the Integrated Water Resources Plan (IRP), three IRP Updates, the Water Surplus and Drought Management Plan, and the Water Supply Allocation Plan. Collectively, they provide a policy framework guidelines and resource targets for Metropolitan to ensure regional water supply reliability.

While Metropolitan coordinates regional supply planning through its inclusive IRP process, Metropolitan's member agencies also conduct their own planning analyses – including their own urban water management plans – and may develop projects independently of Metropolitan. Appendix 5 shows a list of potential local projects provided to Metropolitan by its member agencies.

## 2.1 Integrated Water Resource Planning

In 1993, Metropolitan commenced an Integrated Water Resources Planning process as the beginning of a new era of regional reliability planning. As this planning process began, Metropolitan held a series of three regional assemblies from 1993 through 1995 addressing strategic planning issues. Attendance at these regional assemblies included Metropolitan's Board, Metropolitan's senior management, member agency managers, local retail water providers, groundwater basin managers, and invited public representatives. The purpose of these regional assemblies was to gain consensus on resource policy issues, provide direction for future work, and to endorse regional objectives, principles, and strategies.

A key outcome of the regional assemblies was the establishment and adoption of water supply principles which provided critical guidance for the development and adoption of future Metropolitan IRPs. In summary, these principles state:

- No water supplier in Southern California is an isolated, independent entity unto itself, and all, to varying degrees, are dependent upon a regional system of water importation, storage, and distribution.
- Metropolitan is Southern California's lead agency in regional water management, having the responsibility for importing water from outside the region and convening dialogues on regional water issues, encouraging local water development and conservation, advocating the region's interests to the state and federal governments, and leading the region's water community.
- Water suppliers at all levels have a responsibility to promote a strong water ethic both within the water community and among the public, developing plans through open processes, committing to achieving adopted regional goals and strategies, and committing to a policy of equity and fairness in development and implementation of water management programs.

These regional assemblies laid the foundation for Metropolitan's integrated regional planning path from 1996 to the present. This path has guided Metropolitan's water resources strategy from the initial adoption of the Metropolitan's IRP in 1996 to successive IRP updates in 2004, 2010, and 2015.

### *The 1996 IRP*

Metropolitan's IRP established a long-term, comprehensive water resources strategy to provide the region with a reliable and affordable water supply. One of the fundamental outcomes of the 1996 IRP was the implementation of a diverse portfolio of resource investments in both imported and in-region supplies, and in water conservation measures. The 1996 IRP further emphasized the construction and creation of a network of water storage facilities, both below and above ground.

The 1996 IRP process identified cost-effective solutions that offered long-term reliability to the region. Having identified the need for a portfolio of different supplies to meet its demands, the 1996 IRP analyzed numerous resource portfolios seeking to find a "Preferred Resource Mix" that would provide the region with reliable and affordable water supplies through 2020. The analysis determined the best mix of resources based on cost-effectiveness, diversification, and reliability. Establishing the "Preferred Resource Mix" was an integral part of the 1996 IRP, and subsequent updates have continued to focus on how best to diversify Metropolitan's water portfolio and establish the broad resource targets for the region.

### *The 2004 IRP Update*

The 2004 IRP Update reviewed the goals and achievements of the 1996 IRP, identified the changed conditions for water resource development, and updated resource development targets through 2025. These targets included increased conservation savings and planned increases in local supplies. The 2004 IRP Update also explicitly recognized the need to handle uncertainties inherent in any planning process. Some of these uncertainties include:

- Fluctuations in population and economic growth
- Changes in water quality regulations
- Discovery of new chemical contaminants
- Regulation of endangered species affecting sources of supplies
- Changes in climate and hydrology

As a result, a key component of the 2004 IRP Update was the addition of a 10 percent "planning buffer." The planning buffer identified additional supplies, both imported and locally developed, that could be implemented to address uncertainty in future supplies and demands.

### *The 2010 IRP Update*

In keeping with this reliability goal of meeting full-service demands at the retail level under all foreseeable hydrologic conditions, the 2010 IRP Update sought to stabilize Metropolitan's traditional imported water supplies and establish additional water resources to withstand California's inevitable dry cycles and growth in water demand. Metropolitan acknowledged the increasing impact that emerging challenges such as environmental regulations, threats to water quality, climate change, and economic unknowns and the uncertainty that these challenges would have on planning for a reliable, high quality, and affordable water supply. By 2010, the Colorado River had experienced below-average precipitation conditions for most of the previous decade, and the SWP was facing historic regulatory cutbacks that significantly reduced its supplies that pass through the Sacramento-San Joaquin Delta in Northern California. Recognizing that the conditions for developing and maintaining water supply reliability had changed, Metropolitan set out not only to update the IRP, but also to examine how best to adapt to the new water supply paradigm.

#### *Adaptive Management Strategy*

The 2010 IRP Update specifically planned for uncertainty with a range of adaptive management strategies that both meets demands under observed hydrology and responds to future uncertainty. The plan provided solutions by developing diverse and flexible resources that perform adequately under a wide range of future conditions. Specifically, the adaptive management strategy was a three-component plan that included the following:

- Core Resources Strategy – Designed to maintain reliable water supplies under known conditions. The Core Resources Strategy represented baseline efforts to manage water supply and demand conditions. This strategy was based on "what we know today," including detailed planning assumptions about future demographic scenarios, water supply yields, and a range of observed historical weather patterns. Under this strategy, Metropolitan and its member agencies would advance water use efficiency through conservation and recycled water, along with further local supply development such as groundwater recovery and seawater desalination. Metropolitan would also stabilize traditional imported supplies from the Colorado River and Northern California.

- Uncertainty Buffer – A suite of actions which help to mitigate short-term changes. The 2010 IRP set goals for a range of potential buffer supplies to protect the region from possible shortages in a cost-effective manner, starting with a further expansion of water use efficiency on a region-wide basis. The buffer would enable the region to adapt to future circumstances and foreseeable challenges that were not assumed under the Core Resources Strategy, such as short-term loss of local supplies or regulatory restrictions.
- Foundational Actions – Strategies for additional water resources to augment the core or buffer supplies. Foundational Actions were designed to prepare the region by determining viable alternative supply options for long-range planning. These preparatory actions, including feasibility studies, technological research, and regulatory review, were designed to lay the foundation for potential alternative resource development.

### *The 2015 IRP Update*

Since the 2010 IRP, drought in California and across the southwestern United States has put the IRP adaptive management strategy to the ultimate stress test. Dry conditions in California have persisted into 2015, resulting in a fourth consecutive year of drought. The year 2015 began with the driest January on record, resulting in the earliest and lowest snowpack peak in recorded history at only 17 percent of the traditional snowpack peak on April 1st. In the ten years since 2006, there were only two wet years, with the other eight years having been below normal, dry, or critically dry. The Colorado River watershed has also experienced an extended reduction in runoff. Within Southern California, continuing dry conditions have impacted the region's local supplies, including its groundwater basins.

Southern California has a remarkable, unparalleled tradition of meeting its water challenges as a single cohesive region. Metropolitan serves as both importer of water and regional water planner. For the past generation, the IRP has served as the reliability road map for the region.

Throughout 2015, Metropolitan engaged in a comprehensive process with its Board of Directors and member agencies to review how conditions have changed since the 2010 IRP Update and to establish targets for achieving regional reliability, taking into account known opportunities and risks. Areas reviewed in the 2015 IRP Update include demographics, hydrologic scenarios, water supplies from existing and new projects, water supply reliability analyses, and potential resource and conservation targets. Metropolitan's Board of Directors adopted the 2015 IRP Update on January 12, 2016.[1]

The 2015 IRP Update approach explicitly recognizes that there are remaining policy discussions that will be essential to guiding the development and maintenance of local supplies and conservation. Following adoption of the 2015 IRP Update and its targets for water supply reliability, Metropolitan has begun a process to address questions such as how to meet the targets for regional reliability, what are local and what are regional responsibilities, how to finance regional projects, etc. This discussion will involve extensive interaction with Metropolitan's Board of Directors and member agencies, with input from the public.

### *Findings and Conclusions*

The findings and conclusions of the 2015 IRP Update are:

- Action is needed – Without the investments in conservation, local supplies, and the California WaterFix targeted in the 2015 IRP Update, Metropolitan's service area would experience unacceptable level of shortage allocation frequency in the future.

[1] http://www.mwdh2o.com/PDF_About_Your_Water/2015_IRP_Update_Report.pdf

- Maintain Colorado River supplies – The plan to stabilize deliveries at 900,000 AF in a typical year will require more than 900,000 AF of planned actions.
- Stabilize SWP supplies – A collaborative approach with state and federal agencies to pursue better science for resolving questions about SWP operations and advancing coequal goals of Delta restoration and statewide water supply reliability in the near term. Also work collaboratively with state and federal agencies in the California WaterFix and EcoRestore efforts.
- Develop and protect local supplies and water conservation – The 2015 IRP Update embraces and advances the regional self-sufficiency ethics by increasing the targets for additional local supplies and conservation. These targets are discussed in detail in Section 3 of this UWMP.
- Maximize the effectiveness of storage and transfers – Rebuilding Metropolitan's supply of water reserves is imperative when the drought is over. A comprehensive water transfer approach that takes advantage of water when it is available will help to stabilize and build storage reserves, increasing the ability for Metropolitan to meet water demands in dry years.
- Continue with the adaptive management approach – The IRP is updated periodically to incorporate changed conditions, and an implementation report is prepared annually to monitor the progress in resources development. The 2015 IRP Update also includes Future Supply Actions that would advance a new generation of local supplies through public outreach; development of legislation and regulation; technical studies and support; and land and resource acquisitions.

## 2.2 Estimating Demands on Metropolitan

The Urban Water Management Planning Act requires that three basic planning analyses be conducted to evaluate supply reliability. The first is a water supply reliability assessment requiring development of a detailed evaluation of the supplies necessary to meet projected demands over at least a 20-year period. This analysis is to consider average, single-year, and multi-year drought conditions. The second is a water shortage contingency plan which documents the actions that would be implemented in addressing up to a 50 percent reduction in an agency's supplies. Finally, a plan must be developed specifying the steps that would be taken under a catastrophic interruption in water supplies.

To address these three requirements, Metropolitan developed estimates of future demands and supplies from local sources and from Metropolitan sources based on 91 years (1922-2012) of historic hydrology. The 91-year period was chosen because the USBR modeling for Colorado River supplies is only available for a period starting in 1922 and ending in 2012. Supply and demand analyses for the single-dry and multiple-dry year cases were based on conditions affecting the SWP as this supply availability fluctuates the most among Metropolitan's sources of supply. Using the same 91-year period of the SWP supply availability, 1977 is the single driest year and 1990-92 is the driest 3 consecutive years for SWP supplies to Metropolitan. In addition, staff analysis of the 8-river index indicated that 1977 is the single driest year and 1990-92 is the lowest 3 consecutive dry years from 1922 through 2015. The 8-river index is used widely by DWR and other water agencies as an estimate of the unimpaired runoff (or natural water production) of the Sacramento and San Joaquin River basins, which are sources of water for the SWP.

### *Demand Forecast*

Metropolitan developed its demand forecast by first estimating total retail demands for its service area and then factoring out water savings attributed to conservation.[2] Projections of local supplies then were derived using data from current and expected local supply programs and the IRP Local Resource Program Target. The resulting difference between total demands net of conservation and local supplies is the expected regional demands on Metropolitan supplies. These various estimates are shown in Tables 2-1 through 2-3. Major categories used in these tables are defined below.

#### *Total Demands*

Total demands are the sum of retail demand for M&I and agricultural, seawater barrier demand, and replenishment demand. Total demands represent the total amount of water needed by the member agencies. Total demands include:

- Retail Municipal and Industrial (M&I) Demand — Retail M&I demands represent the full spectrum of urban water use within the region. These include residential, commercial, industrial, institutional, and un-metered water uses. The demographic and economic data used in developing these forecasts were taken from the Southern California Association of Governments' (SCAG) 2012 Regional Transportation Plan/Sustainable Community Strategy (April 2012) and from the San Diego County Association of Governments' (SANDAG) Series 13: 2050 Regional Growth Forecast (October 2013). The SCAG and SANDAG regional growth forecasts are the core assumptions that drive the estimating equations in Metropolitan's Econometric Demand Model (MWD-EDM). SCAG's and SANDAG's projections undergo extensive local review and incorporate zoning information from city and county general plans and are backed by Environmental Impact Reports.

[2] Information generated as part of this analysis is contained in Appendix 1.

Impacts of potential annexation are not included in the demand projections for the 2015 UWMP. However, Metropolitan's Review of Annexation Procedures concluded that the impacts of annexation within the service area beyond 2020 would not exceed two percent of overall demands.

- Retail Agricultural Demand — Retail agricultural demands consist of water use for irrigating crops. Member agencies estimate agricultural water use based on many factors, including farm acreage, crop types, historical water use, and land use conversion. Each member agency estimates its agricultural demand differently, depending on the availability of information. Metropolitan relies on member agencies' estimates of agricultural demands for the 2015 UWMP.
- Seawater Barrier Demand — Seawater barrier demands represent the amount of water needed to hold back seawater intrusion into the coastal groundwater basins. Groundwater management agencies determine the barrier requirements based on groundwater levels, injection wells, and regulatory permits.
- Storage Replenishment Demand — Storage replenishment demands represent the amount of water member agencies plan to use to replenish their groundwater basins or surface reservoirs in order to maintain sustainable basin/reservoir heath and production. For the 2015 UWMP, replenishment deliveries are not included as part of firm demands.

### *Conservation Adjustment*

Savings from conservation reduces total retail demand. Conservation savings consists of the following:

- Code-Based Conservation — Water savings resulting from plumbing codes and other institutionalized water efficiency measures. Sometimes referred to as "passive conservation," this form of conservation would occur as a matter of course without any additional financial incentives from water agencies. Water savings from codes, standards, and ordinances are discussed in Appendix 6.
- Active Conservation — Water saved as a direct result of programs and practices directly funded by a water utility (e.g., measures outlined by the California Urban Water Conservation Council's "Best Management Practices"). Active conservation is unlikely to occur without agency action.
- Price Effect Conservation — Reductions in customer use attributable to changes in the real (inflation adjusted) cost of water. Because water has a positive price elasticity of demand, increases in water price will decrease the quantity demanded.
- Pre-1990 Savings — Conservation savings are commonly estimated from a base-year water-use profile. Beginning with the 1996 IRP, Metropolitan identified 1980 as the base year for estimating conservation because it marked the effective date of a new plumbing code in California requiring toilets in new construction to be rated at 3.5 gallons per flush or less. Between 1980 and 1990, Metropolitan's service area saved an estimated 250,000 acre-feet per year as the result of this 1980 plumbing code and unrelated water rate increases. Within Metropolitan's planning framework, these savings are referred to as "pre-1990 savings."

### *Local Supplies*

Local supplies represent water produced by the member agencies to meet their total demands. Local supplies are a key component in determining how much Metropolitan supply is needed. Projections of local supplies relied on information gathered from a number of

sources including past urban water management plans, Metropolitan's annual local production surveys, and communications between Metropolitan and member agency staff. Local supplies include:

- Groundwater and Surface Water — Groundwater production consists of extractions from local groundwater basins. Surface water comes from stream diversions and rainwater captured in reservoirs.
- The Los Angeles Aqueduct — A major source of imported water is conveyed from the Owens Valley via the Los Angeles Aqueduct (LAA) by Los Angeles Department of Water and Power (LADWP). Although LADWP imports water from outside of Metropolitan's service area, Metropolitan classifies water provided by the LAA as a local resource because it is developed and controlled by a local agency.
- Seawater desalination — Highly treated seawater suitable for municipal and industrial potable use.
- Groundwater Recovery and Recycled Water — Developed and operated by local water agencies, groundwater recovery projects treat degraded groundwater to meet potable use standards. Recycled water projects recycle wastewater for municipal and industrial use.
- Non-Metropolitan Imports — Water supplies imported or exchanged by member agencies from sources outside of the Metropolitan service area.

The local supplies projections presented in demand tables include existing projects currently producing water, projects under construction, and Metropolitan's IRP Local Supply targets. The method for including local supply projects begins with an inventory of local supplies that have been identified within Metropolitan's service area. Appendix 5 contains the inventory of local supplies by type of supply, and includes a classification that shows the current stage of development for each supply in the inventory. The stages of development included in Appendix 5 are: Existing, Under Construction, Fully Designed with Appropriated Funds, EIR/EIS Certified, Feasibility, and Conceptual. The project inventory in Appendix 5 was updated and completed as part of the 2015 IRP Update survey completed by Metropolitan's member agencies in April and July 2015.

Projects, potential supply yields, and online dates from the local supply inventory in Appendix 5 are used in two ways. First, projects that are classified as Existing or Under Construction are included in forecasts that reflect local supply production that is expected to occur without any additional development actions from Metropolitan or the local agencies. Projects in these categories of development are included here because they have a higher level of certainty. Second, projects that are classified as Fully Designed with Appropriated Funds, EIR/EIS Certified, Feasibility, and Conceptual are considered, along with the associated information on supply yield and online dates, as the potential projects that could be developed and go toward meeting IRP Local Supply targets described in Metropolitan's IRP. The IRP Local Supply targets are characterized in forecasts and tables that include Programs Under Development, which are described in Appendix 3.3 in the IRP Development Targets Section under In-Basin Storage and Supplies. It is anticipated that a combination of regional and local approaches will be required in order to meet the IRP Local Supply targets. The local supply inventory provides a connection of the IRP Local Supply targets with potential projects that have been identified, but not developed to a point of relative certainty. The inventory of potential projects is important, as historical implementation, timing, and ultimate production of local supply projects in the service area have fallen short of projections. This is increasingly true with the projects in the less than certain Feasibility and Conceptual categories. It is important that the inventory of

potential projects is greater than the IRP Local Supply targets for new local supply, as the development of projects in the inventory will also be needed under conditions where other existing local supplies are lost or their yields are reduced.

### *Determining Demands on Metropolitan*

Metropolitan serves imported water to its 26 member agencies. For most member agencies, they have other sources of water produced locally from groundwater basins, surface reservoirs, the LAA, recycled water projects, groundwater recovery projects, and seawater desalination projects. When local supplies are not enough to meet retail demands, member agencies purchase imported water from Metropolitan to meet their needs.

In determining demands for imported water, Metropolitan developed its Sales Model to calculate the difference between total forecasted retail demands and local supply projections. The balance is the demand on Metropolitan's imported water supply. The Sales Model calculates the difference between forecasted demands and projected local supplies after factoring in climate impacts. The Sales Model employs a modeling method using historical hydrologic conditions from 1922 to 2012 to simulate the expected demands on Metropolitan supplies based on hydrologic conditions. Each hydrologic condition results in one possible outcome for the forecast year in the planning horizon. For example, each forecast year, such as 2020, has 91 possible outcomes, one for each historical hydrology year during the period 1922 to 2012. This method of modeling produces a distribution of outcomes ranging from the driest to the wettest years within this historical period.

The Sales Model forecasts three types of demands on Metropolitan:

1. Consumptive Use – Metropolitan's supplies that are used to meet retail M&I demand.
2. Seawater Barrier – Imported water needed to hold back seawater intrusion into the coastal groundwater basins.
3. Replenishment – Water for groundwater or reservoir replenishment, when available, to meet replenishment demands.

For additional information on Metropolitan's demand forecast, see Appendix 1.

**Table 2-1**
**Metropolitan Regional Water Demands**
**Single Dry-Year**
(Acre-Feet)

| | | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **A.** | **Total Demands[1]** | **5,234,000** | **5,409,000** | **5,549,000** | **5,679,000** | **5,808,000** |
| | Retail Municipal and Industrial | 4,739,000 | 4,874,000 | 5,016,000 | 5,148,000 | 5,279,000 |
| | Retail Agricultural | 131,000 | 168,000 | 164,000 | 162,000 | 160,000 |
| | Seawater Barrier | 72,000 | 72,000 | 72,000 | 72,000 | 72,000 |
| | Storage Replenishment | 292,000 | 295,000 | 297,000 | 297,000 | 297,000 |
| **B.** | **Total Conservation** | **1,056,000** | **1,127,000** | **1,200,000** | **1,263,000** | **1,339,000** |
| | Existing Active (through 2015)[2] | 210,000 | 196,000 | 184,000 | 166,000 | 159,000 |
| | Code-based | 381,000 | 423,000 | 462,000 | 497,000 | 532,000 |
| | Price-Effect[3] | 215,000 | 258,000 | 304,000 | 350,000 | 398,000 |
| | Pre-1990 Conservation | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 |
| **C.** | **Total Local Supplies** | **2,447,000** | **2,497,000** | **2,523,000** | **2,538,000** | **2,550,000** |
| | Groundwater | 1,304,000 | 1,302,000 | 1,302,000 | 1,302,000 | 1,302,000 |
| | Surface Water | 107,000 | 107,000 | 107,000 | 107,000 | 107,000 |
| | Los Angeles Aqueduct | 127,000 | 127,000 | 127,000 | 127,000 | 127,000 |
| | Seawater Desalination | 56,000 | 56,000 | 56,000 | 56,000 | 56,000 |
| | Groundwater Recovery | 143,000 | 157,000 | 163,000 | 165,000 | 167,000 |
| | Recycling[4] | 436,000 | 466,000 | 486,000 | 499,000 | 509,000 |
| | Other Imported Supplies[5] | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **D.** | **Total Metropolitan Demands** | **1,731,000** | **1,784,000** | **1,826,000** | **1,878,000** | **1,919,000** |
| | Consumptive Use | 1,560,000 | 1,616,000 | 1,658,000 | 1,710,000 | 1,751,000 |
| | Seawater Barrier | 5,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| | Replenishment | 166,000 | 166,000 | 166,000 | 166,000 | 166,000 |

Notes:
All units are acre-feet unless specified, rounded to the nearest thousand.
Totals may not sum due to rounding.
[1] Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 2050 Regional Growth Forecast.
[2] Does not include future active conservation savings. 1990 is base year.
[3] Includes un-metered water use savings.
[4] Excludes Santa Ana River base flow, which is used for recharge of Orange County groundwater basin and reflected in the Groundwater production numbers.
[5] IID/SDCWA transfer and canal linings.

**Table 2-2**
**Metropolitan Regional Water Demands**
**Multiple Dry-Year**
(Acre-Feet)

| | | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **A.** | **Total Demands[1]** | **5,199,000** | **5,450,000** | **5,601,000** | **5,732,000** | **5,865,000** |
| | Retail Municipal and Industrial | 4,701,000 | 4,920,000 | 5,063,000 | 5,197,000 | 5,332,000 |
| | Retail Agricultural | 128,000 | 164,000 | 169,000 | 166,000 | 164,000 |
| | Seawater Barrier | 72,000 | 72,000 | 72,000 | 72,000 | 72,000 |
| | Storage Replenishment | 298,000 | 294,000 | 297,000 | 297,000 | 297,000 |
| **B.** | **Total Conservation** | **1,056,000** | **1,127,000** | **1,200,000** | **1,263,000** | **1,339,000** |
| | Existing Active (through 2015)[2] | 210,000 | 196,000 | 184,000 | 166,000 | 159,000 |
| | Code-based | 381,000 | 423,000 | 462,000 | 497,000 | 532,000 |
| | Price-Effect[3] | 215,000 | 258,000 | 304,000 | 350,000 | 398,000 |
| | Pre-1990 Conservation | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 |
| **C.** | **Total Local Supplies** | **2,416,000** | **2,487,000** | **2,511,000** | **2,535,000** | **2,550,000** |
| | Groundwater | 1,305,000 | 1,302,000 | 1,302,000 | 1,302,000 | 1,303,000 |
| | Surface Water | 102,000 | 102,000 | 102,000 | 102,000 | 102,000 |
| | Los Angeles Aqueduct | 113,000 | 129,000 | 125,000 | 131,000 | 133,000 |
| | Seawater Desalination | 56,000 | 56,000 | 56,000 | 56,000 | 56,000 |
| | Groundwater Recovery | 139,000 | 155,000 | 162,000 | 165,000 | 167,000 |
| | Recycling[4] | 427,000 | 461,000 | 482,000 | 497,000 | 507,000 |
| | Other Imported Supplies[5] | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **D.** | **Total Metropolitan Demands** | **1,727,000** | **1,836,000** | **1,889,000** | **1,934,000** | **1,976,000** |
| | Consumptive Use | 1,547,000 | 1,668,000 | 1,721,000 | 1,766,000 | 1,808,000 |
| | Seawater Barrier | 6,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| | Replenishment | 174,000 | 166,000 | 166,000 | 166,000 | 166,000 |

Notes:
All units are acre-feet unless specified, rounded to the nearest thousand.
Totals may not sum due to rounding.
[1] Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 2050 Regional Growth Forecast.
[2] Does not include future active conservation savings. 1990 is base year.
[3] Includes un-metered water use savings.
[4] Excludes Santa Ana River base flow, which is used for recharge of Orange County groundwater basin and reflected in the Groundwater production numbers.
[5] IID/SDCWA transfer and canal linings.

**Table 2-3**
**Metropolitan Regional Water Demands**
**Average Year**
(Acre-Feet)

| | | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **A.** | **Total Demands[1]** | **5,219,000** | **5,393,000** | **5,533,000** | **5,663,000** | **5,793,000** |
| | Retail Municipal and Industrial | 4,725,000 | 4,859,000 | 5,001,000 | 5,133,000 | 5,264,000 |
| | Retail Agricultural | 130,000 | 167,000 | 163,000 | 161,000 | 160,000 |
| | Seawater Barrier | 72,000 | 72,000 | 72,000 | 72,000 | 72,000 |
| | Storage Replenishment | 292,000 | 295,000 | 297,000 | 297,000 | 297,000 |
| **B.** | **Total Conservation** | **1,056,000** | **1,127,000** | **1,200,000** | **1,263,000** | **1,339,000** |
| | Existing Active (through 2015)[2] | 210,000 | 196,000 | 184,000 | 166,000 | 159,000 |
| | Code-based | 381,000 | 423,000 | 462,000 | 497,000 | 532,000 |
| | Price-Effect[3] | 215,000 | 258,000 | 304,000 | 350,000 | 398,000 |
| | Pre-1990 Conservation | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 |
| **C.** | **Total Local Supplies** | **2,578,000** | **2,631,000** | **2,657,000** | **2,674,000** | **2,689,000** |
| | Groundwater | 1,303,000 | 1,301,000 | 1,301,000 | 1,301,000 | 1,302,000 |
| | Surface Water | 110,000 | 110,000 | 110,000 | 110,000 | 110,000 |
| | Los Angeles Aqueduct | 261,000 | 264,000 | 264,000 | 266,000 | 268,000 |
| | Seawater Desalination | 51,000 | 51,000 | 51,000 | 51,000 | 51,000 |
| | Groundwater Recovery | 143,000 | 157,000 | 163,000 | 165,000 | 167,000 |
| | Recycling[4] | 436,000 | 466,000 | 486,000 | 499,000 | 509,000 |
| | Other Imported Supplies[5] | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **D.** | **Total Metropolitan Demands** | **1,586,000** | **1,636,000** | **1,677,000** | **1,726,000** | **1,765,000** |
| | Consumptive Use | 1,415,000 | 1,468,000 | 1,509,000 | 1,558,000 | 1,597,000 |
| | Seawater Barrier | 5,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| | Replenishment | 166,000 | 166,000 | 166,000 | 166,000 | 166,000 |

Notes:
All units are acre-feet unless specified, rounded to the nearest thousand.
Totals may not sum due to rounding.
[1] Growth projections are based on SCAG 2012 Regional Transportation Plan and SANDAG Series 13 2050 Regional Growth Forecast.
[2] Does not include future active conservation savings. 1990 is base year.
[3] Includes un-metered water use savings.
[4] Excludes Santa Ana River base flow, which is used for recharge of Orange County groundwater basin and reflected in the Groundwater production numbers.
[5] IID/SDCWA transfer and canal linings.

## 2.3 Water Supply Reliability

After estimating demands for single dry year, multiple dry years, and average years, the water reliability analysis requires urban water suppliers to identify projected supplies to meet these demands. Table 2-4 summarizes the sources of supply for the single dry year (1977 hydrology), while Table 2-5 shows the region's ability to respond in future years under a repeat of the 1990-92 hydrology. Table 2-5 provides results for the average of the three dry-year series rather than a year-by-year detail because most of Metropolitan's dry-year supplies are designed to provide equal amounts of water over each year of a three-year period. These tables show that the region can provide reliable water supplies under both the single driest year and the multiple dry-year hydrologies. Table 2-6 reports the expected situation on average over all of the historic hydrologies from 1922 to 2012. Appendix 3 contains detailed justifications for the sources of supply used for this analysis.

Metropolitan's supply capabilities are evaluated using the following assumptions:

### *Colorado River Aqueduct Supplies*

CRA supplies include supplies that would result from existing and committed programs and from implementation of the QSA and related agreements. The QSA establishes the baseline water use for each of the agreement parties and facilitates the transfer of water from agricultural agencies to urban uses. A detailed discussion of the QSA is included in Section 3.1. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.2 MAF on an as-needed basis.

### *State Water Project Supplies*

SWP supplies are estimated using the 2015 SWP Delivery Capability Report distributed by DWR in July 2015. The 2015 SWP Delivery Capability Report presents current DWR estimates of the amount of water deliveries for current (2015) conditions and conditions 20 years in the future. These estimates incorporate restrictions on SWP and Central Valley Project (CVP) operations in accordance with the biological opinions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service issued on December 15, 2008, and June 4, 2009, respectively. Under the 2015 SWP Delivery Capability Report with existing conveyance and low outflow requirements scenario, the delivery estimates for the SWP for 2020 conditions as percentage of Table A amounts are 12 percent, equivalent to 257 TAF for Metropolitan, under a single dry-year (1977) condition and 51 percent, equivalent to 976 TAF for Metropolitan, under long-term average condition.

The goal for the 2015 IRP Update for SWP supplies is to manage flow and export regulations in the near term and ultimately to achieve a long-term Bay-Delta solution. This goal involves continued engagement in collaborative science-based approaches to manage regulations in the near-term and continued participation in the long-term California WaterFix and the California EcoRestore efforts. This approach targets an average of 984 TAF of SWP supplies in the near-term and 1.2 MAF of supplies on average starting in 2030 when the long-term Delta solution is assumed to be in place. More detailed description of SWP supplies is included in Section 3.2.

In dry and below-normal conditions, Metropolitan has increased the supplies received from the California Aqueduct by developing flexible Central Valley/SWP storage and transfer programs. Further descriptions of these programs can be found in Section 3.3.

### *Storage*

A key component of Metropolitan's water supply capability is the amount of water in Metropolitan's storage facilities. Over the past two decades, Metropolitan has developed a large regional storage portfolio that includes both dry-year and emergency storage capacity. Storage is a key component of water management. Storage enables the capture of surplus amounts of water in normal and wet climate and hydrologic conditions when it is plentiful for supply and environmental uses. Stored water can then be used in dry years and in conditions where augmented water supplies are needed to meet demands. Metropolitan's resource analysis model considers all the capacities and constraints of its storage facilities and programs and simulates the fill and withdrawal of these facilities through the 91 hydrologic conditions from 1922-2012.

**Table 2-4**
**Single Dry-Year**
**Supply Capability[1] and Projected Demands**
**Repeat of 1977 Hydrology**
(Acre-feet per year)

| Forecast Year | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 693,000 | 774,000 | 852,000 | 956,000 | 992,000 |
| California Aqueduct[2] | 691,000 | 712,000 | 723,000 | 749,000 | 749,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,451,000 | 1,457,000 | 1,456,000 | 1,455,000 | 1,454,000 |
| *Aqueduct Capacity Limit[4]* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* |
| Colorado River Aqueduct Capability | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 |
| **Capability of Current Programs** | **2,584,000** | **2,686,000** | **2,775,000** | **2,905,000** | **2,941,000** |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,731,000 | 1,784,000 | 1,826,000 | 1,878,000 | 1,919,000 |
| IID-SDCWA Transfers and Canal Linings | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **Total Metropolitan Deliveries[5]** | **2,005,000** | **2,066,000** | **2,108,000** | **2,160,000** | **2,201,000** |
| **Surplus** | **579,000** | **620,000** | **667,000** | **745,000** | **740,000** |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 43,000 | 80,000 | 118,000 | 160,000 | 200,000 |
| California Aqueduct | 20,000 | 20,000 | 198,000 | 198,000 | 198,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 155,000 | 125,000 | 75,000 | 25,000 | 25,000 |
| *Aqueduct Capacity Limit[4]* | *0* | *0* | *0* | *0* | *0* |
| Colorado River Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Proposed Programs** | **63,000** | **100,000** | **316,000** | **358,000** | **398,000** |
| **Potential Surplus** | **642,000** | **720,000** | **983,000** | **1,103,000** | **1,138,000** |

[1] Represents Supply Capability for resource programs under listed year type.
[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
[3] Colorado River Aqueduct includes programs, IID-SDCWA transfer and exchange and canal linings conveyed by the aqueduct.
[4] Maximum CRA deliveries limited to 1.20 MAF including IID-SDCWA transfer and exchange and canal linings.
[5] Total demands are adjusted to include IID-SDCWA transfer and exchange and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.

**Table 2-5**
**Multiple Dry-Year**
**Supply Capability[1] and Projected Demands**
**Repeat of 1990-1992 Hydrology**
(Acre-feet per year)

| Forecast Year | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 239,000 | 272,000 | 303,000 | 346,000 | 364,000 |
| California Aqueduct[2] | 664,000 | 682,000 | 687,000 | 696,000 | 696,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,403,000 | 1,691,000 | 1,690,000 | 1,689,000 | 1,605,000 |
| *Aqueduct Capacity Limit[4]* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* |
| Colorado River Aqueduct Capability | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 |
| **Capability of Current Programs** | **2,103,000** | **2,154,000** | **2,190,000** | **2,242,000** | **2,260,000** |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,727,000 | 1,836,000 | 1,889,000 | 1,934,000 | 1,976,000 |
| IID-SDCWA Transfers and Canal Linings | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **Total Metropolitan Deliveries[5]** | **2,001,000** | **2,118,000** | **2,171,000** | **2,216,000** | **2,258,000** |
| **Surplus** | **102,000** | **36,000** | **19,000** | **26,000** | **2,000** |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 36,000 | 73,000 | 110,000 | 151,000 | 192,000 |
| California Aqueduct | 7,000 | 7,000 | 94,000 | 94,000 | 94,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 80,000 | 75,000 | 50,000 | 25,000 | 25,000 |
| *Aqueduct Capacity Limit[4]* | *0* | *0* | *0* | *0* | *0* |
| Colorado River Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Proposed Programs** | **43,000** | **80,000** | **204,000** | **245,000** | **286,000** |
| **Potential Surplus** | **145,000** | **116,000** | **223,000** | **271,000** | **288,000** |

[1] Represents Supply Capability for resource programs under listed year type.

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

[3] Colorado River Aqueduct includes programs, IID-SDCWA transfer and exchange and canal linings conveyed by the aqueduct.

[4] Maximum CRA deliveries limited to 1.20 MAF including IID-SDCWA transfer and exchange and canal linings.

[5] Total demands are adjusted to include IID-SDCWA transfer and exchange and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.

**Table 2-6**
**Average Year**
**Supply Capability[1] and Projected Demands**
**Average of 1922-2012 Hydrologies**
(Acre-feet per year)

| Forecast Year | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 693,000 | 774,000 | 852,000 | 956,000 | 992,000 |
| California Aqueduct[2] | 1,555,000 | 1,576,000 | 1,606,000 | 1,632,000 | 1,632,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,468,000 | 1,488,000 | 1,484,000 | 1,471,000 | 1,460,000 |
| *Aqueduct Capacity Limit[4]* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* | *1,200,000* |
| Colorado River Aqueduct Capability | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 | 1,200,000 |
| **Capability of Current Programs** | **3,448,000** | **3,550,000** | **3,658,000** | **3,788,000** | **3,824,000** |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,586,000 | 1,636,000 | 1,677,000 | 1,726,000 | 1,765,000 |
| IID-SDCWA Transfers and Canal Linings | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| **Total Metropolitan Deliveries[5]** | **1,860,000** | **1,918,000** | **1,959,000** | **2,008,000** | **2,047,000** |
| **Surplus** | **1,588,000** | **1,632,000** | **1,699,000** | **1,780,000** | **1,777,000** |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 43,000 | 80,000 | 118,000 | 160,000 | 200,000 |
| California Aqueduct | 20,000 | 20,000 | 268,000 | 268,000 | 268,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 5,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| *Aqueduct Capacity Limit[4]* | *0* | *0* | *0* | *0* | *0* |
| Colorado River Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Proposed Programs** | **63,000** | **100,000** | **386,000** | **428,000** | **468,000** |
| **Potential Surplus** | **1,651,000** | **1,732,000** | **2,085,000** | **2,208,000** | **2,245,000** |

[1] Represents Supply Capability for resource programs under listed year type.

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

[3] Colorado River Aqueduct includes programs, IID-SDCWA transfer and exchange and canal linings conveyed by the aqueduct.

[4] Maximum CRA deliveries limited to 1.20 MAF including IID-SDCWA transfer and exchange and canal linings.

[5] Total demands are adjusted to include IID-SDCWA transfer and exchange and canal linings. These supplies are calculated as local supply, but need to be shown for the purposes of CRA capacity limit calculations without double counting.

## 2.4 Water Shortage Contingency Analysis

In addition to the Water Supply Reliability analysis addressing average year and drought conditions, the Act requires agencies to document the stages of actions that they would undertake in response to water supply shortages, including up to a 50 percent reduction in their water supplies. Metropolitan has captured this planning in its Water Surplus and Drought Management (WSDM)[2] Plan which guides Metropolitan's planning and operations during both shortage and surplus conditions. Furthermore, Metropolitan developed the Water Supply Allocation Plan (WSAP)[3], which provides a standardized methodology for allocating supplies during times of shortage.

### *Water Surplus and Drought Management Plan*

Metropolitan's Board adopted the WSDM Plan in April 1999, which provides policy guidance for managing regional water supplies to achieve the reliability goals of the IRP and identifies the expected sequence of resource management actions that Metropolitan will execute during surpluses and shortages to minimize the probability of severe shortages and reduce the possibility of extreme shortages and shortage allocations. Unlike Metropolitan's previous shortage management plans, the WSDM Plan recognizes the link between surpluses and shortages, and it integrates planned operational actions with respect to both conditions.

#### *WSDM Plan Development*

Metropolitan and its member agencies jointly developed the WSDM Plan during 1998 and 1999. This planning effort included more than a dozen half-day and full-day workshops and more than three dozen meetings between Metropolitan and member agency staff. The result of the planning effort is a consensus plan that addresses a broad range of regional water management actions and strategies.

WSDM Plan Principles and Goals

The guiding principle of the WSDM Plan is to manage Metropolitan's water resources and management programs to maximize management of wet year supplies and minimize adverse impacts of water shortages to retail customers. From this guiding principle came the following supporting principles:

- Encourage efficient water use and economical local resource programs
- Coordinate operations with member agencies to make available as much surplus water as possible for use in dry years
- Pursue innovative transfer and banking programs to secure more imported water for use in dry years
- Increase public awareness about water supply issues

The WSDM plan also declared that if mandatory import water allocations become necessary, they would be calculated on the basis of need, as opposed to any type of historical purchases. The WSDM plan contains the following considerations that would go into an allocation of imported water:

- Impact on retail consumers and regional economy
- Investments in local resources, including recycling and conservation

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[2] Metropolitan Water District of Southern California. *Water Surplus and Drought Management Plan*, Report No. 1150, August, 1999.

[3] Metropolitan Water District of Southern California, Water Supply Allocation Plan, December 2014.

- Population growth
- Changes and/or losses in local supplies
- Participation in Metropolitan's non-firm (interruptible) programs
- Investment in Metropolitan's facilities

### *WSDM Plan Implementation*

Each year, Metropolitan evaluates the level of supplies available and existing levels of water in storage to determine the appropriate management stage. Each stage is associated with specific resource management actions designed to: (1) avoid an Extreme Shortage to the maximum extent possible; and (2) minimize adverse impacts to retail customers if an Extreme Shortage occurs. The current sequencing outlined in the WSDM Plan reflects anticipated responses based on detailed modeling of Metropolitan's existing and expected resource mix.

#### Surplus Stages

Metropolitan's supply situation is considered to be in surplus as long as net annual deliveries can be made to water storage programs. The WSDM Plan further defines four surplus management stages that guide the storage of surplus supplies in Metropolitan's storage portfolio. Deliveries for storage in DVL and in SWP terminal reservoirs continue through each surplus stage provided there is available storage capacity. Withdrawals from DVL for regulatory purposes or to meet seasonal demands may occur in any stage. Deliveries to other storage facilities may be interrupted, depending on the amount of the surplus.

#### Shortage Stages

The WSDM Plan distinguishes between Shortages, Severe Shortages, and Extreme Shortages. Within the WSDM Plan, these terms have specific meanings relating to Metropolitan's ability to deliver water to its customers.

*Shortage*: Metropolitan can meet full-service demands and partially meet or fully meet interruptible demands, using stored water or water transfers as necessary.

*Severe Shortage*: Metropolitan can meet full-service demands only by using stored water, transfers, and possibly calling for extraordinary conservation.

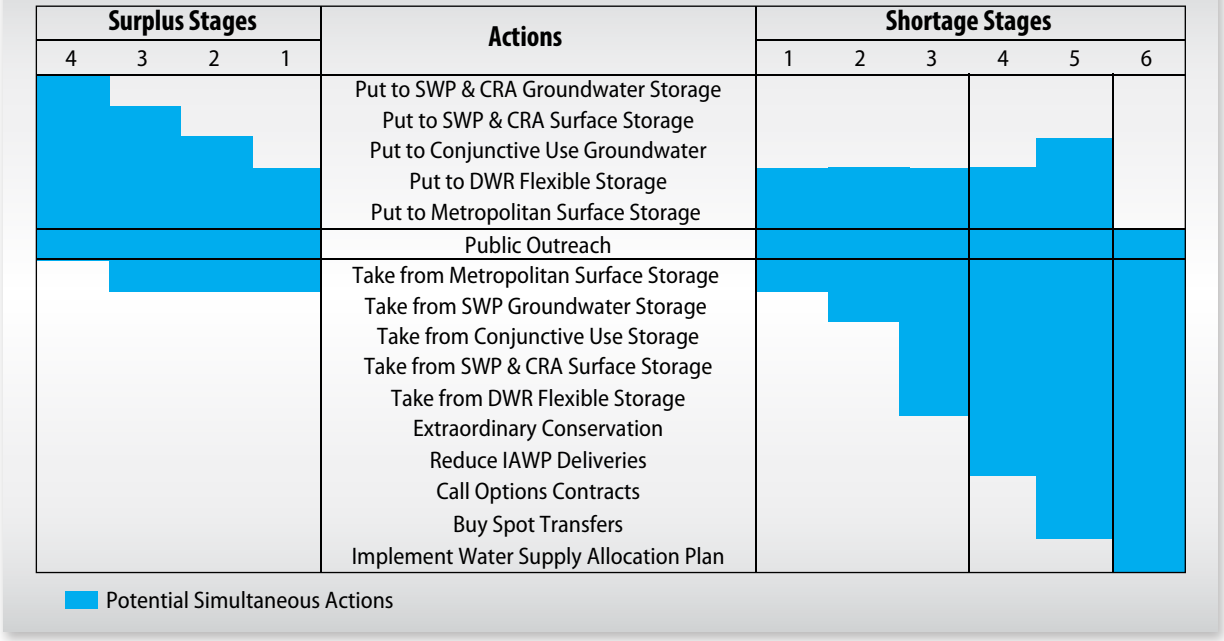
*Extreme Shortage*: Metropolitan allocates available supply to full-service customers.

The WSDM Plan also defines six shortage management stages to guide resource management activities. These stages are not defined merely by shortfalls in imported water supply, but also by the water balances in Metropolitan's storage programs. Thus, a 10 percent shortfall in imported supplies could be a stage one shortage if storage levels are high. If storage levels are already depleted, the same shortfall in imported supplies could potentially be defined as a more severe shortage.

When Metropolitan must make net withdrawals from storage to meet demands, it is considered to be in a shortage condition. Under most of these stages, Metropolitan is still able to meet all end-use demands for water. For shortage stages 1 through 3, Metropolitan will meet demands by withdrawing water from storage. At shortage stages 4 and 5, Metropolitan may undertake additional shortage management steps, including issuing public calls for extraordinary conservation and exercising water transfer options, or purchasing water on the open market.

Figure 2-1 shows the actions under surplus and shortage stages and when an allocation plan would be necessary to enforce mandatory cutbacks. The overriding goal of the WSDM Plan is to avoid reaching Shortage Stage 6, an Extreme Shortage.

**Figure 2-1 Resource Stages, Anticipated Actions, And Supply Declarations**




### *Water Supply Condition Framework*

Consistent with the WSDM Plan, Metropolitan's Board adopted a Water Supply Condition Framework in June 2008. The purpose of the framework is to communicate the urgency of the region's water supply situation and the need for further water conservation practices. The framework is intended to encourage proactive steps to reduce the region's water demand to mitigate the need for more severe actions, up to and including implementation of the WSAP to allocate water supply shortages to member agencies. The framework has four conditions, each calling for an increasingly heightened level of conservation response:

- Baseline Water Use Efficiency
- Condition 1: Water Supply Watch
- Condition 2: Water Supply Alert
- Condition 3: Water Supply Allocation

Table 2-7 below shows the framework and the associated conservation actions.

**Table 2-7**
**Water Supply Condition Framework**

| | Water Supply Condition Framework |
|---|---|
| **Baseline Water Use Efficiency** | Ongoing conservation, outreach, and recycling programs to achieve permanent reductions in water use and build storage reserves. |
| **Condition 1: Water Supply Watch** | Local agency voluntary dry-year conservation measures and use of regional storage reserves. |
| **Condition 2: Water Supply Alert** | Regional call for cities, counties, member agencies and retail water agencies to implement extraordinary conservation through drought ordinances and other measures to mitigate use of storage reserves. |
| **Condition 3: Water Supply Allocation** | Implement Metropolitan's Water Supply Allocation Plan. |

The drought periods of 2007-2011 and 2012-2015 provide an example of how the Water Supply Condition Framework is used. In June 2008, Metropolitan's Board declared a Condition 2: Water Supply Alert to highlight that storage reserves were dropping and that drought conditions were building, corresponding to WSDM shortage stages 1-5. In April 2009 and again in April 2010, Metropolitan's Board moved deeper into a Condition 3: Water Supply Allocation, corresponding to an extreme shortage stage 6 in the WSDM Plan. The April 2010 Water Supply Allocation condition was later terminated by Metropolitan's Board in April 2011 when hydrologic conditions improved during the 2010/2011 water year. The region returned to the Baseline Water Use Efficiency condition following the improvement in water supply. As dry conditions returned in 2012 and 2013, Metropolitan returned to using regional storage and sponsoring outreach efforts with member agencies to encourage voluntary conservation. In 2014, record dry and hot conditions significantly impacted the water resources of both the State of California and Metropolitan. In light of these conditions, which precipitated the January 2014 Emergency Drought Declaration by Governor Brown, Metropolitan's Board declared a Condition 2: Water Supply Alert in February 2014 to again provide public messaging and to urge local water agencies within Metropolitan's service area to adopt and enact water savings ordinances. Extremely dry conditions continued in 2015. In support of the Governor's Executive Order B-29-15 calling for 25 percent reductions in statewide consumer water use, Metropolitan's Board declared a Condition 3: Water Supply Allocation in April 2015.

### *Water Supply Allocation Plan*

The WSAP provides a formula for allocating available water supplies to the member agencies in case of extreme water shortages within Metropolitan's service area. The WSAP was approved by Metropolitan's Board in February 2008 and has since been implemented three times, most recently in April 2015. The WSAP was developed in consideration of the principles and guidelines described in the WSDM Plan, with the objective of creating an equitable needs-based allocation. The WSAP formula seeks to balance the impacts of a shortage at the retail level for shortages of Metropolitan supplies of up to 50 percent. The formula takes into account

growth, local investments, changes in supply conditions, and the demand hardening aspects of non-potable recycled water use and the implementation of conservation savings programs.

### *Water Supply Allocation Plan Development*

Between July 2007 and February 2008, Metropolitan staff worked jointly with Metropolitan's member agencies to develop the WSAP. Throughout the development process, Metropolitan's Board was provided with regular progress reports on the status of the WSAP. The WSAP was adopted at the February 12, 2008 Board meeting. Since the WSAP's adoption in 2008, Metropolitan has worked extensively with the member agencies to periodically review the WSAP formula. Following Board-directed formal review of the WSAP at 12 months after initial implementation and at 3 years after initial adoption, the Board approved adjustments to the WSAP formula on August 17, 2010, and September 13, 2011. In light of drought conditions, Metropolitan staff convened a member agency working group between July and November 2014 to revisit the WSAP before possible implementation in 2015. On December 9, 2014, the Board approved additional adjustments to the formula.

#### The WSAP Formula

The WSAP formula is calculated in three steps: base period calculations, allocation year calculations, and supply allocation calculations. The first two steps involve standard computations, while the third step contains specific methodology developed for the WSAP.

##### *Step 1: Base Period Calculations*

The first step in calculating a water supply allocation is to estimate water supply and demand using a historical base period with established water supply and delivery data. The base period for each of the different categories of demand and supply is calculated using data from fiscal years (July through June) ending 2013 and 2014.

##### *Step 2: Allocation Year Calculations*

The next step in calculating the water supply allocation is estimating water needs in the allocation year. This is done by adjusting the base period estimates of retail demand for population growth and changes in local supplies.

##### *Step 3: Supply Allocation Calculations*

The final step is calculating the water supply allocation for each member agency based on the allocation year water needs identified in Step 2. There are a number of adjustments that go into a member agency's water supply allocation. Each element and its application in the allocation formula are discussed in detail in Metropolitan's WSAP.

#### Annual Reporting Schedule on Supply/Demand Conditions

Managing Metropolitan's water supply resources to minimize the risk of shortages requires timely and accurate information on changing supply and demand conditions throughout the year. To facilitate effective resource management decisions, the WSDM Plan includes a monthly schedule for providing supply/demand information to Metropolitan's senior management and Board, and for making resource allocation decisions. Table 2-8 shows this schedule.

**Table 2-8**
**Schedule of Reporting and Water Supply Allocation Decision-Making**

| Month | Information Report/Management Decision |
|---|---|
| January | Initial supply/demand forecasts for year |
| February - March | Update supply/demand forecasts for year |
| April - May | Finalize supply/demand forecasts<br>Management decisions re: Contractual Groundwater and Option Transfer Programs<br>Board decision re: Need for Extraordinary Conservation |
| October - December | Report on Supply and Carryover Storage |

## 2.5 Catastrophic Supply Interruption Planning

The third type of planning needed to evaluate supply reliability is a catastrophic supply interruption plan that documents the actions necessary for a catastrophic interruption in water supplies. For Metropolitan, this planning is captured in the analysis that went into developing the Emergency Storage Requirements.

### *Emergency Storage Requirements*

Metropolitan established its criteria for determining emergency storage requirements in the October 1991 Final Environmental Impact Report for the Eastside Reservoir, which is now named Diamond Valley Lake. These criteria were again discussed in the 1996 IRP. Metropolitan's Board approved both of these documents.

Emergency storage requirements are based on the potential of a major earthquake damaging the aqueducts that transport Southern California's imported water supplies (SWP, CRA, and Los Angeles Aqueduct). The adopted criteria assume that damage from such an event could render the aqueducts out of service for six months. Therefore, Metropolitan has based its planning on a 100 percent reduction in these imported supplies for a period of six months, which is a greater shortage than required by the Act.

To safeguard the region from catastrophic loss of water supply, Metropolitan has made substantial investments in emergency storage. The emergency plan outlines that under such a catastrophe, non-firm service deliveries would be suspended, and firm supplies to member agencies would be restricted by a mandatory cutback of 25 percent from normal-year demand levels. At the same time, water stored in surface reservoirs and groundwater basins under Metropolitan's program would be made available, and Metropolitan would draw on its emergency storage, as well as other available storage. In addition to DVL, Metropolitan has access to emergency storage at its other reservoirs, and at the SWP terminal reservoirs, and in its groundwater conjunctive use storage accounts. With few exceptions, Metropolitan can deliver this emergency supply throughout its service area via gravity, thereby eliminating dependence on power sources that could also be disrupted by a major earthquake. The WSDM Plan shortage stages will guide Metropolitan's management of available supplies and resources during the emergency to minimize the impacts of the catastrophe. Additional discussion of emergency storage is included in Appendix A.3.3.

### *Electrical Outages*

Metropolitan has also developed contingency plans that enable it to deal with both planned and unplanned electrical outages. These plans include the following key points:

- In event of power outages, water supply can be maintained by gravity feed from regional reservoirs such as DVL, Lake Mathews, Castaic Lake, and Silverwood Lake.
- Maintaining water treatment operations is a key concern. As a result, all Metropolitan treatment plants have backup generation sufficient to continue operating in the event of supply failure on the main electrical grid.
- Valves at Lake Skinner can be operated by the backup generation at the Lake Skinner treatment plant.
- Metropolitan owns mobile generators that can be transported quickly to key locations if necessary.

## 2.6 Other Supply Reliability Risks

Metropolitan provides water to a broad and heterogeneous service area with water supplies from a variety of sources and geographic regions. Each of these demand areas and supplies has its own unique set of benefits and challenges. Among the challenges Metropolitan faces are the following:

### *Supplies*

- The region and Colorado River Basin have been experiencing drought conditions for multiple years. In the past 16 years (2000-2015), there have been only three years when the Colorado River flow has been above average. The last above-average year was 2011, when the unregulated water year inflow to Lake Powell was 139 percent of average.
- Endangered species protection and conveyance needs in the Sacramento-San Joaquin River Delta System have resulted in operational constraints that are particularly important because pumping restrictions impact many water resource programs – SWP supplies and additional voluntary transfers, Central Valley storage and transfers, in-region groundwater storage, and in-region surface water storage.
- Changing climate patterns are predicted to shift precipitation patterns and possibly affect water supply.
- Difficulty and implications of environmental review, documentation, and permitting for multi-year transfer agreements, recycled water projects, and seawater desalination plants.
- Public perception of recycled water use.
- Opposition to local seawater desalination projects from environmental groups and community organizations.

### *Operations and Water Quality*

- The cost and use of energy and greenhouse gas emissions.
- Water quality regulations and issues like the quagga mussels within the CRA. Controlling the spread and impacts of the quagga mussels will require more extensive maintenance and reduced operational flexibility.
- Salt and concentrate balance from a variety of sources.

### *Demand*

- Fluctuations in population and economic growth.
- Uncertain location of growth.
- Uncertain housing stock and density.
- Changes in outdoor water use patterns.

The challenges posed by continued population growth, environmental constraints on the reliability of imported supplies, and new uncertainties imposed by climate change demand that Metropolitan assert the same level of leadership and commitment to taking on large-scale regional solutions to providing water supply reliability. New solutions are potentially available in the form of dramatically improved water-use efficiency, indirect and direct potable use of recycled water, and large-scale application of ocean desalinization.

### *Distribution System Water Losses*

Metropolitan followed the AWWA Water Audit methodology to track all sources of water and uses of water within its system. The AWWA Water Audit methodology quantifies real and apparent water system losses in an agency's distribution system. Section 10631(e)(3)(A) of the California Water Code requires that the 2015 Urban Water Management Plan update quantify distribution system water losses for the most recent 12-month period available.

For the distribution system water losses assessment, Metropolitan included its water balance audit for calendar years 2014 and 2013. In addition, Metropolitan also included a memorandum that provides water balance assessment for year 2012.

The results of Metropolitan's audit showed that the total amount of distribution system water losses in 2014 was approximately 6.4 TAF. A detailed discussion of Metropolitan's distribution system water losses for 2014 is included in Appendix 7 and summarized in Table A.7-1. In addition to the distribution system losses described in the AWWA tables, Metropolitan estimates that 37 TAF was lost from reservoir evaporation occurring in Lake Mathews, Lake Skinner, and DVL during CY 2014.

### *Climate Change*

Climate change adds its own uncertainties to the challenges of planning. Metropolitan's water supply planning has been fortunate in having almost one-hundred years of hydrological data regarding weather and water supply. This history of rainfall data has provided a sound foundation for forecasting both the frequency and the severity of future drought conditions, as well as the frequency and abundance of above-normal rainfall. But, weather patterns can be expected to shift dramatically and unpredictably in a climate driven by increased concentrations of carbon dioxide in the atmosphere. These changes in weather significantly affect water supply planning, irrespective of the debate associated with the sources and cause of increasing concentrations of greenhouse gasses. As a major steward of the region's water supply resources, Metropolitan is committed to performing its due diligence with respect to climate change.

#### *Potential Impacts*

While uncertainties remain regarding the exact timing, magnitude, and regional impacts of these temperature and precipitation changes, researchers have identified several areas of concern for California water planners. These include:

- Reduction in Sierra Nevada snowpack;
- Increased intensity and frequency of extreme weather events; and
- Rising sea levels resulting in
    - Impacts to coastal groundwater basins due to seawater intrusion;
    - Increased risk of damage from storms, high-tide events, and the erosion of levees; and
    - Potential pumping cutbacks on the SWP and Central Valley Project (CVP).

Other important issues of concern due to global climate change include:

- Effects on local supplies such as groundwater;
- Changes in urban and agricultural demand levels and patterns;
- Impacts to human health from water-borne pathogens and water quality degradation;
- Declines in ecosystem health and function; and
- Alterations to power generation and pumping regimes.

### *Metropolitan's Activities Related to Climate Change Concerns*

Resource Planning

Under the 2015 IRP Update, Metropolitan recognizes additional risks and uncertainties from a variety of sources:

- Water quality
- Climate change
- Regulatory and operational changes
- Project construction and implementation issues
- Infrastructure reliability and maintenance
- Demographic and growth uncertainty

Any of these risks and uncertainties, should they occur individually or collectively, may result in a negative impact to water supply reliability. While it is impossible to know how much risk and uncertainty to guard against, the region's reliability will be more secure with a long-term plan that recognizes risk and provides resource development to offset that risk. Some risk and uncertainty will be addressed by following the findings of the 2015 IRP Update. But there are other risks that may take longer to manifest, like climate change or shifts in demographic growth patterns that increase or move the demands for water.

Metropolitan has established an intensive, comprehensive technical process to identify key vulnerabilities. This Robust Decision Making (RDM) approach was used with the 2010 IRP Update. The RDM approach can show how vulnerable the region's reliability is to longer-term risks and can also establish "signposts" that can be monitored to see when critical changes may be happening. Signposts include monitoring the direction of ever-changing impacts from improved Global Climate Models, and housing and population growth patterns. The RDM approach will be revisited with the new resource reliability targets identified in the 2015 IRP Update. Initial 2015 IRP analysis indicated an additional 200,000 AF of water conservation and local supplies may be needed to address these risks. This additional supply goal will be considered when examining implementation policies and approaches as the IRP process continues.

Knowledge Sharing and Research Support

Metropolitan is an active and founding member of the Water Utility Climate Alliance (WUCA). WUCA consists of ten nationwide water providers collaborating on climate change adaptation and greenhouse gas mitigation issues. As a part of this effort, WUCA pursues a variety of activities on multiple fronts.

Member agencies of WUCA annually share individual agency actions to mitigate greenhouse gas emissions to facilitate further implementation of these programs. WUCA also monitors development of climate change-related research, technology, programs, and federal legislation.

In addition to supporting federal and regional efforts, WUCA released a white paper entitled "Options for Improving Climate Modeling to Assist Water Utility Planning for Climate Change" in January 2010. The purpose of this paper was to assess Global Circulation Models, identify key aspects for water utility planning, and make seven initial recommendations for how climate modeling and downscaling techniques can be improved so that these tools and techniques can be more useful for the water sector. Another recent WUCA publication related to water

planning is: "Embracing Uncertainty: A Case Study Examination of How Climate Change is Shifting Water Utility Planning" (2015). A fundamental goal of this recent white paper is to provide water professionals with practical and relevant examples, with insights from their peers, on how and why to modify planning and decision-making processes to better prepare for a changing climate.

In addition to these efforts, the member agencies of WUCA annually share individual agency actions to mitigate greenhouse gas emissions to facilitate further implementation of these programs. At a September 2009 summit at the Aspen Global Change Institute, WUCA members met with global climate modelers, along with federal agencies, academic scientists, and climate researchers, to establish collaborative directions to progress climate science and modeling efforts. WUCA continues to pursue these opportunities and partnerships with water providers, climate scientists, federal agencies, research centers, academia and key stakeholders.

Metropolitan also continues to pursue knowledge sharing and research support activities outside of WUCA. Metropolitan regularly provides input and direction on California legislation related to climate change issues. Metropolitan is active in collaborating with other state and federal agencies, as well as non-governmental organizations, on climate change related planning issues. The following list provides a sampling of entities that Metropolitan has recently worked with on a collaborative basis:

- USBR
- U.S. Army Corps of Engineers
- AWWA Research Foundation
- National Center for Atmospheric Research
- California Energy Commission
- California Department of Water Resources

Quantification of Current Research

Metropolitan continues to incorporate current climate change science into its planning efforts. A major component of the current IRP update effort is to explicitly reflect uncertainty in Metropolitan's future water management environment. This involves evaluating a wider range of water management strategies, and seeking robust and adaptive plans that respond to uncertain conditions as they evolve over time, and that ultimately will perform adequately under a wide range of future conditions. The potential impacts and risks associated with climate change, as well as other major uncertainties and vulnerabilities, have been incorporated into the update. Overall, Metropolitan's planning activities strive to support the Board adopted policy principles on climate change by:

- Supporting reasonable, economically viable, and technologically feasible management strategies for reducing impacts on water supply,
- Supporting flexible "no regret" solutions that provide water supply and quality benefits while increasing the ability to manage future climate change impacts, and
- Evaluating staff recommendations regarding climate change and water resources under the California Environmental Quality Act (CEQA) to avoid adverse effects on the environment.

Implementation of Programs and Policies

Metropolitan has made great efforts to implement greenhouse gas mitigation programs and policies for its facilities and operations. To date, these programs and policies have focused on:

- Exploring water supply/energy relationships and opportunities to increase efficiencies;
- Participating in The Climate Registry, a nonprofit greenhouse gas emissions registry for North America that provides organizations with the tools and resources to help them calculate, verify, report, and manage their greenhouse gas emissions in a publicly transparent and credible way;
- Acquiring "green" fleet vehicles, and supporting an employee Rideshare program;
- Developing solar power at both the Skinner water treatment plant (completed) and the Weymouth water treatment plant (in progress); and
- Identifying and pursuing development of "green" renewable water and energy programs that support the efficient and sustainable use of water.

Metropolitan also continues to be a leader in efforts to increase regional water use efficiency. Metropolitan has worked to increase the availability of incentives for local conservation and recycling projects, as well as supporting conservation Best Management Practices for industry and commercial businesses.

## 2.7 Pricing and Rate Structures

### *Revenue Management*

A high proportion of Metropolitan's revenues come from volumetric water rates. Water sales revenues are approximately 80 percent of Metropolitan's total revenues. As a result, Metropolitan's revenues vary according to regional weather and the availability of statewide water supplies. In dry years, local demands increase, and Metropolitan may receive higher than anticipated revenues due to increased sales volumes. In contrast, in wet years, demands decrease, and revenues drop due to lower sales volumes. In addition, statewide supply shortages such as those in 2009 and 2015 also affect Metropolitan's revenues. Such revenue surpluses and shortages could cause instability in water rates. To mitigate this risk, Metropolitan maintains financial reserves, with a minimum and target balance, to stabilize water rates during times of reduced water sales. The reserves hold revenues collected during times of high water sales and are used to offset the need for revenues during times of low sales.

Another way to mitigate rate increases is by generating a larger portion of revenues from fixed sources. Metropolitan currently has two fixed charges, the Readiness-to-Serve Charge (RTS) and the Capacity Charge. Metropolitan also collects tax revenue from taxable property within its boundaries. The revenues from fixed charges generate approximately 18 percent of all Metropolitan revenues. RTS revenues have been increasing gradually, from $136 million in fiscal year 2011-12, to $155.5 million in fiscal year 2015-16.

Finally, Metropolitan generates revenue from interest income, hydroelectric power sales, and miscellaneous income such as rents and leases. For the last five fiscal years, these averaged approximately three percent of all Metropolitan revenues. These internally generated revenues are referred to as revenue offsets and reduce the amount of revenue that needs to be collected from rates and charges.

### *Elements of Rate Structure*

This section provides an overview of Metropolitan's rate structure. The different elements of the rate structure are discussed below and summarized in Table 2-9.

#### *System Access Rate (SAR)*

The SAR is a volumetric system-wide rate levied on each acre-foot of water that moves through the Metropolitan system. All system users (member agency or third party) pay the SAR to use Metropolitan's conveyance and distribution system. The SAR recovers the cost of providing conveyance and distribution capacity to meet average annual demands.

#### *Water Stewardship Rate (WSR)*

The WSR recovers the costs of providing financial incentives for existing and future investments in local resources including conservation and recycled water. These investments or incentive payments are identified as the "demand management" service function in the cost of service process. The WSR is a volumetric rate levied on each acre-foot of water that moves through the Metropolitan system.

#### *System Power Rate (SPR)*

The SPR recovers the costs of energy required to pump water to Southern California through the SWP and CRA. The cost of power is recovered through a uniform volumetric rate. The SPR is applied to all deliveries to member agencies.

### *Treatment Surcharge*

The treatment surcharge recovers the costs of providing treated water service through a uniform, volumetric rate. The treatment surcharge recovers all costs associated with providing treated water service, including commodity, demand, and standby related costs.

### *Capacity Charge*

The capacity charge is levied on the maximum summer day demand placed on the system between May 1 and September 30 for a three-calendar year period. Demands measured for the purposes of billing the capacity charge include all firm demands, including wheeling service and exchanges.

The capacity charge is intended to pay for the cost of peaking capacity on Metropolitan's system, while providing an incentive for local agencies to decrease their use of the Metropolitan system to meet peak day demands and to shift demands into lower use time periods. Over time, a member agency will benefit from local supply investments and operational strategies that reduce its peak day demand on the system in the form of a lower total capacity charge.

### *Readiness-To-Serve Charge (RTS)*

The costs of infrastructure projects needed to provide service, including emergency storage and those costs related to the conveyance and distribution system that are available but not used on average, are recovered by the RTS.

The RTS is allocated to the member agencies based on each agency's proportional share of a ten-year rolling average of all firm deliveries. A ten-year rolling average leads to a relatively stable RTS allocation that reasonably represents an agency's potential long-term need for standby service under different demand conditions. Member agencies may choose to have a portion of their total RTS obligation offset by standby charge collections levied by Metropolitan on behalf of the member agency. These standby charges are assessed on parcels of land within the boundaries of a given member agency.

### *Tier 1 Supply Rate*

The costs of maintaining existing supplies and developing additional supplies are recovered through a two-tiered pricing approach. The Tier 1 Supply Rate recovers the cost of maintaining a reliable amount of supply. Each member agency has a predetermined amount of water that can be purchased at the lower Tier 1 Supply Rate. Purchases in excess of this limit will be made at the higher Tier 2 Supply Rate.

### *Tier 2 Supply Rate*

The Tier 2 Supply Rate reflects Metropolitan's cost of purchasing water transfers north of the Delta. The Tier 2 Supply Rate encourages the member agencies and their customers to maintain existing local supplies and develop cost-effective local supply resources and conservation.

**Table 2-9**
**Rate Structure Components**

| Rate Design Elements | Service Provided/ Costs Recovered | Type of Charge |
|---|---|---|
| System Access Rate | Conveyance/Distribution (Average Capacity) | Volumetric ($/AF) |
| Water Stewardship Rate | Conservation/Local Resources | Volumetric ($/AF) |
| System Power Rate | Power | Volumetric ($/AF) |
| Treatment Surcharge | Treatment | Volumetric ($/AF) |
| Capacity Charge | Peak Distribution System Capacity | Fixed ($/cfs) |
| Readiness-To-Serve Charge | Conveyance/Distribution/Emergency Storage(infrastructure necessary to provide service) | Fixed ($Million) |
| Tier 1 Supply Rate | Supply | Volumetric ($/AF) |
| Tier 2 Supply Rate | Supply | Volumetric ($/AF) |

The following tables provide further information regarding Metropolitan's rates. Table 2-10 summarizes the rates and charges effective January 1, 2014, January 1, 2015, and January 1, 2016. Average costs by member agency will vary depending upon an agency's RTS allocation, Capacity Charge, and relative proportions of treated and untreated Tier 1, and Tier 2 water purchases. Table 2-11 provides the details of the Capacity Charge, calculated for calendar year 2016.

Table 2-12 provides the details of the Readiness-to-Serve Charge calculation for calendar year 2016 by member agency. Table 2-13 provides the current Purchase Order commitment quantities that member agencies will purchase from Metropolitan over the 10-year period starting January 2015 through December 2024. Tier 1 annual average limits for each member agency are also shown in this table.

**Table 2-10**
**Metropolitan Water Rates and Charges**

| Effective | Jan 1, 2014 | Jan 1, 2015 | Jan 1, 2016 |
|---|---|---|---|
| Tier 1 Supply Rate ($/AF) | $148 | $158 | $156 |
| Tier 2 Supply Rate ($/AF) | $290 | $290 | $290 |
| System Access Rate ($/AF) | $243 | $257 | $259 |
| Water Stewardship Rate ($/AF) | $41 | $41 | $41 |
| System Power Rate ($/AF) | $161 | $126 | $138 |
| Full Service Untreated Volumetric Cost ($/AF) | | | |
| Tier 1 | $593 | $582 | $594 |
| Tier 2 | $735 | $714 | $728 |
| Treatment Surcharge ($/AF) | $297 | $341 | $348 |
| Full Service Treated Volumetric Cost ($/AF) | | | |
| Tier 1 | $890 | $923 | $942 |
| Tier 2 | $1,032 | $1,055 | $1,076 |
| Readiness-to-Serve Charge ($M) | $166 | $158 | $153 |
| Capacity Charge ($/cfs) | $8,600 | $11,100 | $10,900 |

**Table 2-11**
**Capacity Charge Detail Calendar Year 2016**

| | Peak Day Demand (cfs) (May 1 through September 30) Calendar Year | | | | |
|---|---|---|---|---|---|
| Agency | 2012 | 2013 | 2014 | 3-Year Peak | Calendar Year 2016 Capacity Charge ($10,900/cfs) |
| Anaheim | 38.3 | 31.3 | 34.0 | 38.3 | $417,470 |
| Beverly Hills | 32.7 | 30.8 | 30.6 | 32.7 | $356,430 |
| Burbank | 20.9 | 19.7 | 22.6 | 22.6 | $246,340 |
| Calleguas | 224.0 | 228.7 | 240.8 | 240.8 | $2,624,720 |
| Central Basin | 74.5 | 73.6 | 61.0 | 74.5 | $812,050 |
| Compton | 2.3 | 2.9 | 0.0 | 2.9 | $31,610 |
| Eastern | 237.2 | 267.4 | 239.2 | 267.4 | $2,914,660 |
| Foothill | 17.6 | 18.9 | 19.9 | 19.9 | $216,910 |
| Fullerton | 24.4 | 20.0 | 22.2 | 24.4 | $265,960 |
| Glendale | 41.5 | 44.9 | 43.7 | 44.9 | $489,410 |
| Inland Empire | 126.7 | 153.9 | 144.0 | 153.9 | $1,677,510 |
| Las Virgenes | 41.9 | 43.2 | 46.1 | 46.1 | $502,490 |
| Long Beach | 60.4 | 66.9 | 67.8 | 67.8 | $739,020 |
| Los Angeles | 512.9 | 767.1 | 782.5 | 782.5 | $8,529,250 |
| MWDOC | 398.6 | 379.4 | 443.1 | 443.1 | $4,829,790 |
| Pasadena | 52.1 | 52.5 | 48.5 | 52.5 | $572,250 |
| San Diego | 961.5 | 967.4 | 1,138.2 | 1,138.2 | $12,406,380 |
| San Fernando | 2.8 | 4.9 | 0.0 | 4.9 | $53,410 |
| San Marino | 5.3 | 6.1 | 7.3 | 7.3 | $79,570 |
| Santa Ana | 19.2 | 19.6 | 17.5 | 19.6 | $213,640 |
| Santa Monica | 19.7 | 22.7 | 15.2 | 22.7 | $247,430 |
| Three Valleys | 133.0 | 178.6 | 151.4 | 178.6 | $1,946,740 |
| Torrance | 36.2 | 34.1 | 33.5 | 36.2 | $394,580 |
| Upper San Gabriel | 15.2 | 16.1 | 45.4 | 45.4 | $494,860 |
| West Basin | 222.6 | 230.2 | 217.5 | 230.2 | $2,509,180 |
| Western | 193.7 | 198.6 | 176.6 | 198.6 | $2,164,740 |
| **Total** | 3,515.3 | 3,879.5 | 4,058.5 | 4,196.0 | $45,736,400 |

Totals may not foot due to rounding

**Table 2-12**
**Readiness-to-Serve Charge (by Member Agency)**
**Calendar Year 2016**

| Member Agency | Rolling Ten-Year Average Firm Deliveries (Acre-Feet) FY2004-05 to FY2013-14 | RTS Share | 12 months @ $153 million per year (1/16-12/16) |
|---|---|---|---|
| Anaheim | 21,646 | 1.26% | 1,931,624 |
| Beverly Hills | 11,468 | 0.67% | 1,023,387 |
| Burbank | 12,769 | 0.74% | 1,139,430 |
| Calleguas MWD | 110,216 | 6.43% | 9,835,288 |
| Central Basin MWD | 53,106 | 3.10% | 4,739,002 |
| Compton | 2,222 | 0.13% | 198,301 |
| Eastern MWD | 98,854 | 5.77% | 8,821,351 |
| Foothill MWD | 9,999 | 0.58% | 892,228 |
| Fullerton | 9,902 | 0.58% | 883,599 |
| Glendale | 20,157 | 1.18% | 1,798,733 |
| Inland Empire Utilities Agency | 60,390 | 3.52% | 5,389,007 |
| Las Virgenes MWD | 22,702 | 1.32% | 2,025,866 |
| Long Beach | 33,643 | 1.96% | 3,002,172 |
| Los Angeles | 297,705 | 17.36% | 26,566,040 |
| Municipal Water District of Orange County | 220,916 | 12.88% | 19,713,676 |
| Pasadena | 21,506 | 1.25% | 1,919,148 |
| San Diego County Water Authority | 377,077 | 21.99% | 33,648,901 |
| San Fernando | 122 | 0.01% | 10,914 |
| San Marino | 1,000 | 0.06% | 89,227 |
| Santa Ana | 13,091 | 0.76% | 1,168,155 |
| Santa Monica | 10,146 | 0.59% | 905,408 |
| Three Valleys MWD | 66,509 | 3.88% | 5,935,016 |
| Torrance | 18,514 | 1.08% | 1,652,136 |
| Upper San Gabriel Valley MWD | 18,292 | 1.07% | 1,632,281 |
| West Basin MWD | 128,160 | 7.47% | 11,436,461 |
| Western MWD | 74,439 | 4.34% | 6,642,650 |
| **Metropolitan Total** | 1,714,552 | 100.00% | $153,000,000 |

Totals may not foot due to rounding

## Table 2-13
## Purchase Order Commitments and Tier 1 Limits
## (by Member Agency)
## January 2015 through December 2024

| Member Agency | Annual Average Tier 1 Maximum | Purchase Order Commitment (acre-feet) |
|---|---|---|
| Anaheim | 24,439 | 148,268 |
| Beverly Hills | 13,380 | 89,202 |
| Burbank | 16,776 | 108,910 |
| Calleguas MWD | 118,228 | 788,185 |
| Central Basin MWD[1] | 71,770 | |
| Compton[1] | 3,372 | |
| Eastern MWD | 117,585 | 783,898 |
| Foothill MWD | 11,773 | 73,312 |
| Fullerton | 11,299 | 75,322 |
| Glendale | 26,222 | 174,809 |
| Inland Empire Utilities Agency | 93,283 | 398,348 |
| Las Virgenes MWD | 24,358 | 162,387 |
| Long Beach | 51,804 | 263,143 |
| Los Angeles | 373,623 | 2,033,132 |
| Municipal Water District of Orange County | 321,635 | 2,144,233 |
| Pasadena | 22,965 | 153,102 |
| San Diego County Water Authority[1] | 393,542 | |
| San Fernando[1] | 629 | |
| San Marino | 1,442 | 9,610 |
| Santa Ana | 19,617 | 80,858 |
| Santa Monica[1] | 7,406 | |
| Three Valleys MWD | 80,687 | 537,916 |
| Torrance | 19,204 | 128,027 |
| Upper San Gabriel Valley MWD | 67,228 | 110,077 |
| West Basin MWD | 135,417 | 902,783 |
| Western MWD | 105,784 | 705,224 |
| **Total** | 2,133,468 | 9,870,746 |

[1] No Purchase Order; Tier 1 maximum is annual, not cumulative.
Totals may not foot due to rounding.

# Implementing the Plan 3

This section summarizes Metropolitan's implementation plans and continued progress in developing a diversified resource mix that enables the region to meet its water demands under a wide range of possible future conditions. The investments that Metropolitan has made and its on-going efforts in many different areas coalesce toward its goal of long-term regional water supply reliability. Many of the resource programs discussed are already successfully implemented. Others will take more time to execute. Considerations are also in place for emerging integrated supplies, which could augment sources of regional water supply from non-traditional sources. In addition, water demand reductions brought about by legislative mandates could also affect the landscape of future supply planning and implementation. The following sections discuss each of these programs, presenting both successes to date and the programs that are still underway.

Metropolitan's IRP implementation approach has been consistent with the Governor's California Water Action Plan that was released in January of 2014. The Governor's Plan is discussed briefly below.

### *California Water Action Plan*

California Water Action Plan: Actions for Reliability, Restoration and Resilience, was released by Governor Brown in January 2014. A collaborative effort of the California Natural Resources Agency, the California Environmental Protection Agency, and California Department of Food and Agriculture, the California Water Action Plan was developed to meet three broad objectives: more reliable water supplies, the restoration of important species and habitat, and a more resilient, sustainably managed water resources system (water supply, water quality, flood protection, and environment) that can better withstand inevitable and unforeseen pressures in the coming decades.

Over the next five years, the actions outlined below are designed to move California toward more sustainable water management by providing a more reliable water supply for farms and communities, restoring important wildlife habitat and species, and helping the state's water systems and environment become more resilient.

1. Make conservation a California way of life;
2. Increase regional self-reliance and integrated water management across all levels of government;
3. Achieve the co-equal goals for the Delta;
4. Protect and restore important ecosystems;
5. Manage and prepare for dry periods;
6. Expand water storage capacity and improve groundwater management;
7. Provide safe water for all communities;
8. Increase flood protection;
9. Increase operational and regulatory efficiency; and
10. Identify sustainable and integrated financing opportunities.

## 3.1 Colorado River Aqueduct

The goal for CRA supplies is to maintain current supplies and programs, while also maintaining flexibility through dry-year programs and storage. This goal involves protecting existing supply and storage programs in the face of risks that could impact CRA supplies in the future. To accomplish this goal, the 2015 IRP Update targets are to develop sufficient base supply programs to ensure that a minimum of 900 TAF of diversions are available when needed, and to ensure access to 1.2 MAF of supplies in dry years through flexible programs and storage.

### *Background*

Metropolitan was established to obtain an allotment of Colorado River water, and its first mission was to construct and operate the CRA. Under its contracts with the federal government, Metropolitan has a basic entitlement of 550 TAF per year of Colorado River water. Metropolitan also holds a fifth priority for an additional 662 TAF per year that exceeds California's 4.4 MAF per year basic apportionment, and another 180 TAF per year when surplus flows are available. Metropolitan can obtain water under the fifth priority from:

- Water unused by the California holders of priorities 1 through 3
- Water saved by the Palo Verde land management, crop rotation, and water supply program, or
- When the U.S. Secretary of the Interior makes available either or both:
    - Surplus water, and
    - Water apportioned to, but unused by, Arizona and/or Nevada.

To satisfy a condition imposed by Congress in the Boulder Canyon Project Act, California's legislature enacted the Limitation Act in 1929, agreeing to limit consumptive use of Colorado River water to 4.4 MAF per year, plus not more than one-half of any excess or surplus waters unapportioned by the Colorado River Compact. The 1931 Seven Party Agreement provides the basis for the priorities among California's contractors to use of Colorado River water made available to California. Palo Verde Irrigation District (PVID), the Yuma Project (Reservation Division), Imperial Irrigation District (IID), and Coachella Valley Water District (CVWD), collectively the "agricultural entities", and Metropolitan are the entities that currently hold the priorities. These priorities are included in the contracts that the Department of the Interior executed with the California agencies in the 1930s for delivery of water from Lake Mead. The first four priorities total 4.4 MAF per year. Metropolitan has the fourth priority of 550 TAF to California's basic apportionment and the fifth priority to 662 TAF per year. Under priorities 1 through 3, an amount not to exceed 3.85 MAF was apportioned to the agricultural entities for beneficial consumptive use. The Seven Party Agreement did not specify individual quantities for each of the first three priorities; rather, the amount of water available under the third priority was limited to the amount unused by the holders of priorities 1 and 2 on designated areas of land. This lack of quantification among the agricultural priorities posed an obstacle to the acquisition of water from the agricultural entities for use in Metropolitan's service area.

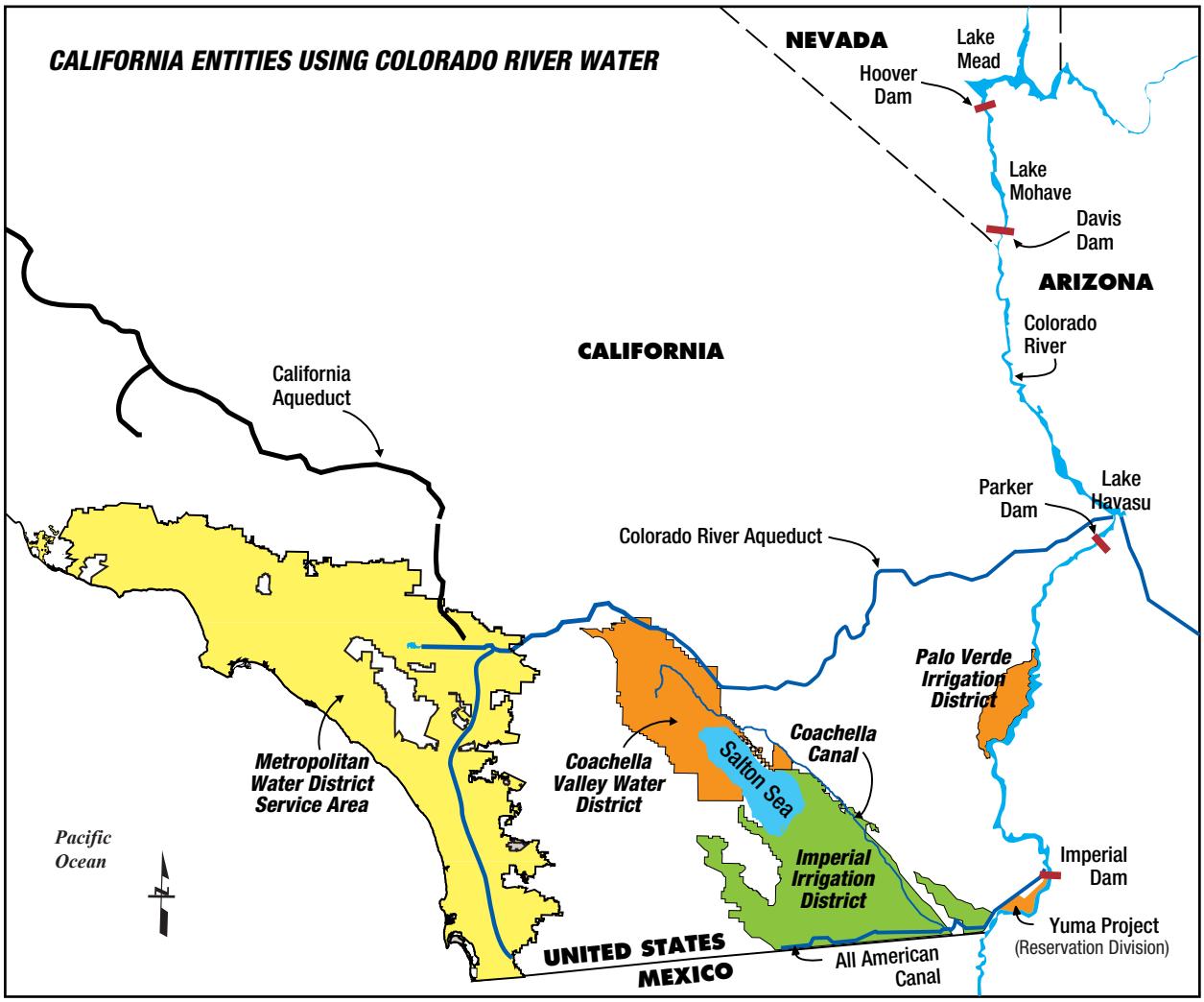
The Consolidated Decree issued in 2006 by the U.S. Supreme Court in *Arizona v. California*, preceded by a 1964 decree, confirmed the allocation of 4.4 MAF per year to California. This limit effectively reduced Metropolitan's dependable supply of Colorado River water to its fourth priority amount of 550 TAF per year. A 1979 decree quantified present perfected rights (PPRs) to the use of Colorado River water by certain Indian reservations, federal wildlife refuges, and other users. Some, but not all of these PPRs, are encompassed by the Seven Party Agreement. Consumptive use under these non-encompassed PPRs, known as "Miscellaneous and Indian

PPRs," could reach as much as 61 TAF annually. Since 1985, these PPR holders have used less than 20 TAF annually. Because over 5.362 MAF of Colorado River water were already allocated by California's Seven Party Agreement, it was not clear which rights would be affected by the use of these non-encompassed PPRs.

For a period following the Court's 1964 ruling, Metropolitan's fifth priority rights were satisfied with water allocated to, but unused by, Arizona and Nevada. With the commencement of Colorado River water deliveries to the Central Arizona Project in 1985, the availability of Colorado River water to meet Metropolitan's needs was determined on a year-by-year basis. At that time, no formal guidelines existed to determine whether surplus water would be available. Decisions regarding surplus water availability were to be made at the discretion of the Secretary of the Interior. As a result, the year-to-year availability of Colorado River water to Metropolitan was uncertain.

Figure 3-1 shows the major aqueducts within southern California including those from the Colorado River, and entities within the state having rights to use water from the Colorado River.

**Figure 3-1**



### *Changed Conditions*

#### *California's Colorado River Water Use Plan and the Quantification Settlement Agreement*

Metropolitan and the State of California acknowledged that Metropolitan would obtain less water from the Colorado River in the future than Metropolitan had in the past, but the lack of clearly quantified water rights hindered efforts to promote water management projects. The Secretary of the Interior asserted that California's users of Colorado River water had to limit their use to a total of 4.4 MAF per year, plus any available surplus water. Under the auspices of the state's Colorado River Board, these users developed a draft plan to resolve the problem, which was known as "California's Colorado River Water Use Plan" or the "California Plan." It characterized how California would develop a combination of programs to allow the state to limit its annual use of Colorado River water to 4.4 MAF per year plus any available surplus water. The 2003 QSA among IID, CVWD, and Metropolitan is a critical component of the California Plan. It establishes the baseline water use for each of the agencies, facilitates the transfer of water from agricultural agencies to urban uses, and specifies that IID, CVWD, and Metropolitan would forbear use of water to permit the Secretary of the Interior to satisfy the uses of the PPRs not covered by the Seven Party Agreement.

On November 5, 2003, IID filed a validation action in Imperial County Superior Court, seeking a judicial determination that thirteen agreements associated with the QSA are valid, legal, and binding. Other lawsuits also were filed challenging the execution, approval, and subsequent implementation of the QSA on various grounds. All of the QSA cases were coordinated in Sacramento County Superior Court. After more than a decade of litigation, the final challenges to the QSA were dismissed, and the agreements were upheld.

SDCWA is participating in two QSA-related projects that are providing additional water supplies to that agency.[4] The water conserved by these projects is made available to Metropolitan, resulting in increased amounts of Colorado River water being diverted into the CRA. In exchange, Metropolitan is delivering an amount of water equal to the amount conserved for SDCWA. Federal law allocates a portion of the water available as a result of the Coachella and All-American Canal lining projects for the benefit of parties, including five Indian Bands, involved in litigation over water rights to the San Luis Rey River in San Diego County once certain conditions have been satisfied. Metropolitan has agreed to exchange that water and provide an equal amount of water to the United States for use by the San Luis Rey Settlement Parties, and SDCWA has agreed to convey the water when capacity is available for use within the Settlement Parties' service areas. As the Settlement Parties have not yet satisfied the conditions required to receive the benefit of those supplies, Metropolitan has utilized this water. The remainder of the water available as a result of the canal lining projects is exchanged with SDCWA.

In 2005, Metropolitan entered into a settlement agreement in *Arizona v. California* with the Quechan Indian Tribe and other parties. The Tribe uses Colorado River water on the Fort Yuma Indian Reservation. Under the settlement agreement, the Tribe, in addition to the amounts of water decreed for the benefit of the Reservation in the 1964 decree, is entitled to (a) an additional 20 TAF of diversions from the Colorado River, or (b) the amount necessary to supply the consumptive use required for irrigation of a specified number of acres, and for the satisfaction of related uses, whichever is less. Of the additional water, 13 TAF became available to the Tribe in 2006. An additional 7 TAF becomes available to the Tribe in 2035. Metropolitan and the Tribe agreed that Metropolitan would provide incentive payments to the Tribe to limit

[4] These projects, the SDCWA/IID transfer and the Coachella and All-American canal lining projects, will be discussed in SDCWA's Urban Water Management Plan.

proposed development and utilization of their lands which would increase the tribal diversion of any of the additional water each year, thereby allowing the water to be diverted by Metropolitan.

### *Current Dry Condition*

The Colorado River Basin has been experiencing a prolonged drought, where runoff above Lake Powell has been below average for twelve of the last sixteen years. Within those sixteen years, runoff in the Colorado River Basin above Lake Powell from 2000 through 2007 was the lowest eight-year runoff on record. While runoff returned to near normal conditions during 2008-2010, drought returned in 2012 with runoff in 2012 being among the four driest in history. During these drought conditions, Colorado River system storage has decreased to 50 percent of capacity.

### *Quagga Mussels*

Quagga mussels were discovered in January of 2007 in Lake Mead and rapidly spread downstream to the Lower Colorado River. The presence and spawning of quagga mussels in the Lower Colorado River and in reservoirs located in southern California poses an immediate threat to water and power systems serving more than 25 million people in the southwestern United States. Quagga mussels (*Dreissena bugensis*) are a related species to the better-known zebra mussels (*Dreissena polymorpha*) and are indigenous to the Ukraine. They were introduced to the Great Lakes in the 1980s from fresh-water ballast of a transoceanic ship traveling from Eastern Europe. Although the introduction of these two species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments and infrastructure. If unmanaged, invasive mussel infestations have been known to severely impact the aquatic ecology of lakes and rivers; clog intakes and raw water conveyance systems; reduce the recreational and aesthetic value of lakes and beaches; alter or destroy fish habitats; and render lakes more susceptible to deleterious algae blooms.

## *Implementation Approach*

Metropolitan's planning strategy recognized explicitly that program development would play an important part in reaching the target level of deliveries from the CRA. The implementation approach explored a number of water conservation programs with water agencies that receive water from the Colorado River or are located in close proximity to the CRA. Negotiating the QSA was a necessary first step for all of these programs. On October 10, 2003, after lengthy negotiations, representatives from Metropolitan, IID, and CVWD executed the QSA and other related agreements. Parties involved also included SDCWA, the California Department of Water Resources (DWR), the California DFW, the U.S. Department of the Interior, and the San Luis Rey Settlement Parties. One of those related agreements was the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement which specifies to which agencies water will be delivered under priorities 3a and 6a of the Seven Party Agreement during its term.

Metropolitan has identified a number of programs that could be used to achieve the regional long-term development targets for the CRA, as shown in Table 3-1. Metropolitan has entered into or is exploring agreements with a number of agencies as described in this section. In addition, Appendix 3 provides a detailed discussion of these programs and describes whether the programs are being implemented, are deferred, or are under investigation.

### *Colorado River Water Management Programs*

Imperial Irrigation District / Metropolitan Water District Conservation Program

Under agreements executed in 1988 and 1989, Metropolitan has funded water efficiency improvements within IID's service area in return for the right to divert the water conserved by those investments. Under this program, IID implemented a number of structural and non-structural measures, including the lining of existing earthen canals with concrete, constructing local reservoirs and spill-interceptor canals, installing non-leak gates, and automating the distribution system. Other implemented programs include the delivery of water to farmers on a 12-hour rather than a 24-hour basis and improvements in on-farm water management through the installation of drip irrigation systems. Through this program, IID has conserved an additional 105 TAF per year on average upon completion of program implementation. Execution of the QSA and amendments to the 1988 and 1989 agreements resulted in changes in the availability of water under the program, extending the term to 2078 if the term of the QSA extends through 2077 and guaranteeing Metropolitan at least 85 TAF per year. The remainder of the conserved water is available to CVWD when needed.

Palo Verde Land Management, Crop Rotation, and Water Supply Program

In May 2004, Metropolitan's Board authorized a 35-year land management, crop rotation, and water supply program with PVID. Under the program, participating farmers in PVID are paid to reduce their water use by not irrigating a portion of their land. A maximum of 29 percent of the lands within the Palo Verde Valley can be fallowed in any given year. Under the terms of the QSA, water savings within the PVID service area are made available to Metropolitan. This program provides up to 133 TAF of water to be available to Metropolitan in certain years. In 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014 approximately 108.7, 105.0, 72.3, 94.3, 120.2, 116.3, 122.2, 73.7, 32.8, and 43.0 TAF of water, respectively, were saved and made available to Metropolitan. In March 2009, Metropolitan and PVID entered into a one-year supplemental fallowing program within PVID that provided for the fallowing of additional acreage, with savings of 24.1 TAF in 2009 and 32.3 TAF in 2010.

Management of Metropolitan-Owned Land in Palo Verde

In 2001, Metropolitan acquired 8,946 acres of irrigable farmland within the Palo Verde Irrigation District (PVID). These lands were leased to growers and were eventually enrolled in the PVID Land Management, Crop Rotation and Water Supply Program when it began in 2005. In 2015, Metropolitan acquired approximately 12,049 irrigable acres from Verbena LLC, bringing Metropolitan's ownership in the Palo Verde Valley to approximately 20,995 acres of irrigated farmland. The lands have historically been leased to growers who produced high water-using crops, such as alfalfa, using flood irrigation.

With the expiration of all leases in 2016, Metropolitan is currently identifying long-term management objectives for the land, including a shift toward less water-intensive agriculture. Strategies for reducing water use may include transitioning to low water-using crops, adopting efficient irrigation technologies such as microspray, and adopting deficit irrigation practices. In addition, Metropolitan is developing technologies for monitoring crop water use via remote sensing imagery and on-the-ground sensors.

By managing the lands for lower consumptive water use, Metropolitan expects to reduce water use in PVID by 15–29 TAF per year (additional to savings from the fallowing program), while maintaining the valley's agricultural economy. Under the terms of the QSA, any water savings within the PVID service area are made available to Metropolitan. The additional water savings are expected to accrue in 2017, after new leases for the lands are put into place.

Southern Nevada Water Authority and Metropolitan Storage and Interstate Release Agreement

SNWA has undertaken extraordinary water conservation measures to maintain its consumptive use within Nevada's basic apportionment of 300 TAF. The success of the conservation program has resulted in unused basic apportionment for Nevada. As SNWA expressed interest in storing a portion of the water with Metropolitan, the agencies, along with the United States and the Colorado River Commission of Nevada, entered into a storage and interstate release agreement in October 2004. Under the agreement, additional Colorado River water supplies are made available to Metropolitan when there is space available in the CRA to receive the water. SNWA stored approximately 330,000 acre-feet with Metropolitan through 2015. SNWA is not expected to call upon Metropolitan to return water until after 2019.

Lower Colorado Water Supply Project

In March 2007, Metropolitan, the City of Needles, and the USBR executed a Lower Colorado Water Supply Project contract. Under the contract, Metropolitan receives, on an annual basis, Lower Colorado Water Supply Project water unused by Needles and other entities adjacent to the river that do not have rights or have insufficient rights to use Colorado River water. The water supply for the project comes from groundwater wells located along the All-American Canal. A portion of the payments made by Metropolitan to Needles are placed in a trust fund for potentially acquiring a new water supply for the Project should the groundwater pumped from the project's wells become too saline for use. Metropolitan received 6.1 TAF from this project in 2014, and an estimated 5.9 TAF in 2015 based on the amount of water pumped and used by other project water users.

Lake Mead Storage Program

In May 2006, Metropolitan and the USBR executed an agreement for a demonstration program that allowed Metropolitan to leave conserved water in Lake Mead that Metropolitan would otherwise have used in 2006 and 2007. USBR would normally make unused water available to other Colorado River water users, so the program included a provision that water left in Lake Mead must be conserved through extraordinary conservation measures and not simply be water that was not needed by Metropolitan in the year it was stored. This extraordinary conservation was accomplished through savings realized under the Palo Verde Land Management, Crop Rotation, and Water Supply Program. Through the two-year demonstration program, Metropolitan created 44.8 TAF of "Intentionally Created Surplus" (ICS) water. In December 2007, Metropolitan entered into agreements to set forth the rules under which ICS water is developed, stored in, and delivered from Lake Mead. The amount of water stored in Lake Mead, created through extraordinary conservation, that is available for delivery in a subsequent year is reduced by a one-time deduction of five percent, resulting in additional system water in storage in the lake, and an annual evaporation loss of three percent, beginning in the year following the year the water is stored. Metropolitan created ICS water in 2009, 2010, 2011, and 2012 and withdrew ICS water in 2008, 2013, and 2014. As of January 1, 2015, Metropolitan had a total of 61.8 TAF of Extraordinary Conservation ICS water in Lake Mead.

The December 2007 federal guidelines concerning the operation of the Colorado River system reservoirs provided the ability for agencies to create "System Efficiency ICS" through the development and funding of system efficiency projects that save water that would otherwise be lost from the Colorado River. To that end, in 2008 the Central Arizona Water Conservation District (CAWCD), SNWA, and Metropolitan contributed funds for the construction of the Drop 2 (Brock) Reservoir by the USBR. The purpose of the Drop 2 (Brock) Reservoir is to increase the capacity to regulate deliveries of Colorado River water at Imperial Dam, reducing the amount

of excess flow downstream of the dam by approximately 70 TAF annually. In return for its $25 million net contribution toward construction, operation, and maintenance, 100 TAF of water that was stored in Lake Mead was assigned to Metropolitan as System Efficiency ICS. Through 2014, Metropolitan has diverted 35 TAF of this amount, with 65 TAF remaining in storage.

In 2009, Metropolitan entered into an agreement with the United States, SNWA, the Colorado River Commission of Nevada, and CAWCD to have USBR conduct a one-year pilot operation of the Yuma Desalting Plant at one-third capacity. The pilot project operated between May 2010 and March 2011 and provided data for future decision making regarding long-term operation of the Plant and developing a near-term water supply. Metropolitan's contribution toward plant operating costs secured 24.4 TAF of System Efficiency ICS which was stored in Lake Mead as of January 1, 2015.

Quagga Mussel Control Program

The presence and spawning of quagga mussels in the lower Colorado River from Lake Mead through Lake Havasu poses a threat to Metropolitan and other Colorado River water users due to the potential to continuously seed water conveyance systems with mussel larvae. Chlorination is the most frequently used means to control mussel larvae entering water systems.

Metropolitan developed the Quagga Mussel Control Program (QMCP) in 2007 to address the long term introduction of mussel larvae into the CRA from the lower Colorado River which is now heavily colonized from Lake Mead through Lake Havasu. The QMCP consists of surveillance activities and control measures. Surveillance activities are conducted annually alongside regularly scheduled 2-3 week-long CRA shutdowns. Control activities consist of continuous chlorination at the outlet of Copper Basin Reservoir (5 miles into the aqueduct), a mobile chlorinator for control of mussels on a quarterly basis at outlet towers, and physical removal of mussels from the trash racks at Whitsett Intake Pumping Plant in Lake Havasu. Since 2007, the CRA has scheduled 2 to 3 week-long shutdowns each year for maintenance and repairs which provide the opportunity for direct inspections for mussels and the additional benefit of desiccating quagga mussels. Recent shutdown inspections have demonstrated that the combined use of chlorine and regularly scheduled shutdowns effectively control mussel infestation in the CRA since only few and small mussels have been found during these inspections.

In addition, Metropolitan has appropriated $9.55 million to upgrade chlorination facilities in the aqueduct and at two additional locations in its system, the outlets of Lakes Mathews and Skinner. It is likely that additional upgrade costs will be incurred for these facilities. Chemical control (chlorination) at Copper Basin Reservoir, Lake Mathews, and the Lake Skinner Outlet costs approximately $3.0-3.2 million per year depending on the amount of Colorado River water conveyed through the aqueduct.

### *Achievements to Date*

Metropolitan has developed a number of supply and conservation programs to increase the amount of supply available from the CRA. However, other users along the River have rights that will allow their water use to increase as their water demands increase. The Colorado River faces long-term challenges of water demands exceeding available supply with additional uncertainties due to climate change. Because Metropolitan holds the lowest priority rights in California during a normal Lake Mead storage condition, future supply available could decrease. Metropolitan's supply and conservation programs, as well as planned additional water management programs for 2035, are shown in Table 3-1.

**Table 3-1**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 250,000 | 0 | 21,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 5,000 | 5,000 | 5,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (45,000) | (42,000) | (118,000) |
| DWCV SWP Table A Transfer Callback | 23,000 | 22,000 | 61,000 |
| DWCV Advance Delivery Account | 22,000 | 20,000 | 57,000 |
| SNWA Agreement Payback | 0 | 0 | (5,000) |
| ***Subtotal of Current Programs*** | ***1,391,000*** | ***1,157,000*** | ***1,173,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 0 | 0 | 0 |
| Additional Following Programs | 25,000 | 25,000 | 25,000 |
| ***Subtotal of Proposed Programs*** | ***25,000*** | ***25,000*** | ***25,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 200,000 | 200,000 | 200,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***298,000*** | ***298,000*** | ***298,000*** |
| **Maximum CRA Supply Capability[2]** | **1,714,000** | **1,480,000** | **1,496,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(464,000)* | *(230,000)* | *(246,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(298,000)* | *(298,000)* | *(298,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **902,000** | **902,000** | **902,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The Colorado River Aqueduct delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

## 3.2 State Water Project

Much of the SWP water supply passes through the San Francisco-San Joaquin Bay-Delta (Bay-Delta). The SWP consists of a series of pump stations, reservoirs, aqueducts, tunnels, and power plants operated by DWR. Figure 3-2 shows SWP facilities. This statewide water supply infrastructure provides water to 29 urban and agricultural agencies throughout California. More than two-thirds of California's residents obtain some of their drinking water from the Bay-Delta.

The original State Water Contract called for an ultimate delivery capacity of 4.2 MAF, with Metropolitan holding a contract for 1,911 TAF. For decades, the Bay-Delta has experienced water quality and supply reliability challenges and conflicts due to variable hydrology and environmental standards that limit pumping operations. SWP deliveries in the most recent critically dry years lagged these projections, and were 5 percent of contractual amounts in 2014 and 20 percent of contractual amounts in 2015. Consequently, Metropolitan's key concern is the continual deterioration of water supply reliability.

Another important concern for Metropolitan is sustained improvement in SWP water quality. Metropolitan must be able to meet the increasingly stringent drinking water regulations that are expected for disinfection by-products and pathogens in order to protect public health. Meeting these regulations will require improving the Bay-Delta water supply by cost effectively combining alternative source waters, source improvement, and treatment facilities. Additionally, Metropolitan requires water quality improvements of Bay-Delta water supplies to meet its 500 mg/L salinity blending objective in a cost-effective manner, while minimizing resource losses and helping to ensure the viability of regional recycling and groundwater management programs.

### *Background*

The listing of several fish species as threatened or endangered under the federal or California Endangered Species Acts (respectively, the "Federal ESA" and the "California ESA" and, collectively, the "ESAs") has adversely impacted operations and limited the flexibility of the SWP. Currently, five species (the winter-run and spring-run Chinook salmon, Delta smelt, North American green sturgeon, and Central Valley steelhead) are listed under the ESAs. In addition, on June 25, 2009, the California Fish and Game Commission declared the longfin smelt a threatened species under the California ESA.

In 2004 and 2005, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) issued biological opinions and incidental take statements that govern operations of the SWP and the CVP with respect to the Delta smelt, the winter-run and spring-run Chinook salmon, and the Central Valley steelhead. In July 2006, the USBR reinitiated consultation with the USFWS and NMFS with respect to the 2004 and 2005 biological opinions (with the addition of the North American green sturgeon, which was listed in April 2006) following the filing of legal challenges to those biological opinions and incidental take statements.

**Figure 3-2**
**Current and Projected Facilities of the State Water Project**



The Delta smelt, Sacramento River winter-run and spring-run salmon, and Central Valley steelhead are listed species under the Federal ESA. Because of the listing, the federal Central Valley Project (CVP) and SWP are prohibited from "taking" the fish in their operations and must consult with federal fisheries agencies to determine whether their operations will jeopardize the existence of the species, and if so, establish "reasonable and prudent alternatives" (RPAs) to normal project operations to minimize their impacts on the smelt and salmon.

In its revised Biological Opinion adopted on December 15, 2008, the USFWS provided criteria for operation of the CVP and SWP in a manner not likely to jeopardize the continued existence of the Delta smelt or adversely modify designated critical habitat. The NMFS made a similar finding with respect to project operation effects on the listed salmon and steelhead in its revised Biological Opinion issued on June 4, 2009. Earlier Biological Opinions were found invalid in litigation described in past annual audit-pending litigation reports. Consequently, both agencies issued an "incidental take statement" which allows the CVP and SWP to continue operation despite the fact that such operation would result in incidental take of some of the listed fish. Project operations must incorporate RPAs suggested by the agencies in the 2008 and 2009 Biological Opinions to ensure they are exempt from the otherwise applicable prohibition on "take" of Federal ESA-listed species.

In 2009, multiple lawsuits were filed by water contractors challenging the 2008 Delta smelt Biological Opinion and the USBR's failure to analyze the environmental impacts of accepting and implementing the Biological Opinion's RPAs under the National Environmental Policy Act (NEPA). The lawsuits were adjudicated before Judge Wanger in federal district court in Fresno, California. Following lengthy hearings, on December 14, 2010, the Court granted summary judgment to the water contractor plaintiffs, finding that the Delta smelt Biological Opinion was invalid and would have to be remanded to the USFWS to be redone. The Court issued a final amended judgment on May 18, 2011, remanding the matter to the USFWS. Appeals of the final amended judgment to the U.S. Court of Appeals for the Ninth Circuit were filed by the Federal Defendants and the Environmental-Interveners. The plaintiffs also filed cross-appeals. On March 13, 2014, the Ninth Circuit issued a 2-1 decision reversing the district court, and upholding the Delta smelt Biological Opinion *San Luis & Delta Mendota Water Authority v. Jewell*, 747 F.3d 581 (9th Cir. 2014). The two-judge majority ruled that the district court should not have considered extra-record testimony of experts retained by the parties, and that the Biological Opinion and RPA restrictions were supported by the best available science and were not arbitrary and capricious.[5] In October 2014, Metropolitan and other water contractors petitioned the U.S. Supreme Court for a writ of certiorari for the Court's review of whether USFWS must consider economic impacts of the RPA restrictions on the general public and third parties. On January 12, 2015, the U.S. Supreme Court denied the petitions. *Stewart & Jasper Orchards v. Jewell*, U.S., No. 14-377, *cert. denied* 1/12/15, *State Water Contractors v. Jewell*, U.S., No. 14-402, *cert. denied* 1/12/15. The Court's orders let stand the March 2014 Ninth Circuit ruling upholding the Biological Opinion and RPAs.

In 2009, multiple lawsuits were also filed challenging the 2009 salmon Biological Opinion and also adjudicated before Judge Wanger in federal district court. On September 20, 2011, the Court issued a decision that invalidated the salmon Biological Opinion and remanded it to NMFS for preparation of a new Biological Opinion. Both the Environmental-Interveners and the Federal Defendants appealed the final judgment to the Ninth Circuit. In a decision issued on

[5] The Ninth Circuit confirmed the District Court ruling that USBR must analyze the RPAs under NEPA. USBR has prepared a Final Environmental Impact Statement analyzing the impacts of implementing the RPAs in both Biological Opinions and expects to issue a Record of Decision in early 2016. It remains to be seen whether USBR will approve an alternative to the RPAs or how that may affect SWP supplies.

December 22, 2014, a three-judge panel of the Ninth Circuit unanimously reversed the district court decision by Judge Wanger. The ruling validates the Biological Opinion and the RPAs issued by NMFS in 2009, which include seasonal limits on export and river operations imposed to protect the salmonid species.

The impact on SWP deliveries attributable to the Delta smelt and salmonid species biological opinions combined is estimated to be 1.0 MAF in an average year, reducing SWP deliveries from approximately 3.3 MAF to approximately 2.3 MAF for the year under average hydrology.

In addition to the litigation under the Federal ESA, in March 2009, the State Water Contractors filed suit in Sacramento Superior Court challenging the California ESA 2081 permit that authorizes the incidental take of longfin smelt from SWP operations. The lawsuit alleges that the restrictions on water exports imposed under the 2081 California ESA permit are excessive and are not scientifically justified. This case was voluntarily dismissed without prejudice in February 2014 pursuant to a settlement agreement which provides for dismissal of the litigation and the establishment of a collaborative longfin smelt science study program.

DWR has altered the operations of the SWP to accommodate species of fish listed under the ESAs. These changes in project operations have adversely affected SWP deliveries. Between 2008 and 2014, restrictions on Bay-Delta pumping under the Biological Opinion have reduced deliveries of SWP water by 3 MAF to the state water contractors and by approximately 1.5 MAF to Metropolitan.

Operational constraints likely will continue until a long-term solution to the problems in the Bay-Delta is identified and implemented. The Delta Vision process, established by Governor Schwarzenegger, was aimed at identifying long-term solutions to the conflicts in the Bay-Delta, including natural resource, infrastructure, land use, and governance issues. In addition, State and federal resource agencies and various environmental and water user entities are currently engaged in the development of the Bay Delta Conservation Plan (BDCP)/California WaterFix, which is aimed at making physical and operational improvements to the SWP system in the Delta necessary to restore and protect ecosystem health, south-of-Delta SWP and CVP water supplies, and water quality.

Other issues, such as the recent decline of some fish populations in the Bay-Delta and surrounding regions and certain operational actions in the Bay-Delta, may significantly reduce Metropolitan's water supply from the Bay-Delta. Biological opinions or incidental take authorizations under the Federal ESA and California ESA might further adversely affect SWP and CVP operations. Additionally, new litigation, listings of additional species under the ESAs, or new regulatory requirements imposed by the SWRCB could further adversely affect SWP operations in the future by requiring additional export reductions, releases of additional water from storage, or other operational changes impacting water supply operations. Metropolitan cannot predict the ultimate outcome of any of the litigation or regulatory processes described above, but believes they could have an adverse impact on the operation of the SWP pumps, Metropolitan's SWP supplies, and Metropolitan's water reserves.

### *Changed Conditions*

In July 2015, DWR released the 2015 State Water Project Delivery Capability Report. The 2015 Delivery Capability Report provides estimates of the current (2015) and future (2035) SWP delivery capability for each SWP contractor under a range of hydrologic conditions. These estimates incorporate regulatory requirements in accordance with USFWS and NMFS biological opinions. In addition, these estimates of future capability also reflect potential impacts of climate change and sea level rise.

Metropolitan used a number of modeling studies from the 2015 Delivery Capability Report for its SWP supplies forecasts during the 2015 UWMP planning horizon. Metropolitan used the Base Scenario as the current 2015 condition and transitioned to the delivery capability from the Early Long-Term in the next five years. For 2020 through 2029, Metropolitan uses the forecasts from the Existing Conveyance Low Outflow (ECLO) scenario. Metropolitan uses the Alternative 4a study associated with the recirculated draft environmental impact report (EIR)/supplemental draft environmental impact statement (EIS) on the California Water Fix for SWP deliveries for 2030 and beyond.

### *Implementation Approach*

Metropolitan's implementation approach for the SWP depends on the full use of the current State Water Contract provisions, including its basic contractual amounts, Article 21 interruptible supplies, and Turnback Pool supply provisions. In addition, it requires successful negotiation and implementation of a number of agreements**,** including the Sacramento Valley Water Management (Phase 8 Settlement) Agreement, and the BDCP/California WaterFix. Each of these stakeholder processes or agreements involves substantial Metropolitan and member agency staff involvement to represent regional interests. Metropolitan is committed to working collaboratively with DWR, SWP contractors, and other stakeholders to ensure the success of these extended negotiations and programs.

#### *SWP Reliability*

This discussion provides details of the major actions Metropolitan is undertaking to improve SWP reliability. The BDCP/California WaterFix is being prepared through a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties. At the outset of the BDCP process, a planning agreement was developed and executed among the participating parties, and a Steering Committee was formed. The plan would identify a set of water flow and habitat restoration actions that would contribute to the recovery of endangered and sensitive species and their habitats in California's Bay-Delta. The goal of the BDCP was to provide for both species/habitat protection and improved reliability of water supplies.

The First Administrative Draft of the BDCP was released in March 2012. The Administrative Draft EIR/EIS analyzed 15 alternatives, including a broad combination of water delivery configurations, capacities, operations and habitat restoration targets, as well as a no action alternative. The alternatives are the result of public scoping sessions conducted in 2008 and 2009, the Sacramento-San Joaquin Delta Reform Act, ongoing public discussions, and input from responsible/trustee state agencies and NEPA cooperating agencies.

In July 2012, Governor Jerry Brown and U.S. Interior Secretary Ken Salazar outlined revisions to the proposed BDCP plan, along with a full range of alternative proposals. Elements of the preferred proposal include construction of two side-by-side tunnels and water intake facilities with a total capacity of 9,000 cfs - down from the earlier proposal of 15,000 cfs. Operation of the facilities was planned to be phased in over several years.

Throughout 2012 and 2013, additional public meetings were held to answer questions and gather public comments. In August 2013, an optimized proposal was released that balanced costs, engineering design, and ease of construction while significantly reducing local dislocation and disturbance in the Delta.

In December 2013, the State released the Draft BDCP and the Draft EIR/EIS. The documents detailed 22 specific actions, called Conservation Measures, which included new water delivery

facilities in the north Delta, as well as measures to restore or protect up to 150,000 acres of habitat and measures to address other stressors to fish and wildlife in the Delta.

In December 2014, the State announced further refinements to the water delivery facilities to reduce impacts to Delta communities, minimize disturbances or dislocation of Greater Sandhill Cranes, and improve the long-term reliability and operation of the proposed infrastructure. During the 2013-2014 public comment period, commenters expressed concerns about the impacts of a large-scale habitat restoration effort on the Delta economy and community character. Other comments articulated concerns about the expected effectiveness of certain habitat restoration measures, the nature of climate change, and the related level of scientific uncertainty. Additionally, there were widespread concerns that the 50-year permit term sought under the BDCP was too long given the uncertainties about climate change and the effectiveness of habitat restoration, and commenters suggested that DWR should pursue permits of shorter duration. These comments prompted the State to reconsider the BDCP's ability to justify the continued pursuit of 50-year permits associated with a comprehensive conservation plan and resulted in the consideration of a sub-alternative to the original proposed project, as well as additional sub-alternatives that do not include a 50-year permit application or associated conservation plan.

In April 2015, State agencies announced a modified preferred alternative, Alternative 4A. Alternative 4A (California WaterFix) was developed as the new CEQA and NEPA Preferred Alternative, replacing Alternative 4 (the proposed BDCP). Alternative 4A includes the conveyance facilities proposed under Alternative 4 and those mitigation measures and environmental commitments needed to obtain necessary permits and authorizations for implementation under Section 7 of the Federal ESA and through the California Department of Fish and Wildlife's 2081(b) process.

California WaterFix and EcoRestore would be implemented under different Federal and State ESA regulatory permitting process (Section 7 versus Section 10(a) of the Federal ESA, and pursuant to section 2081 of the State ESA instead of the Natural Community Conservation Planning Act). This would fulfill the requirement of the 2009 Delta Reform Act to contribute toward meeting the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem.

The new water conveyance facilities would be constructed and operated under the California WaterFix, which proposes design changes to the water conveyance facilities. Refinements to the design reduce the overall environmental/construction impacts, and increase long term operational and cost benefits. Some of the engineering configuration improvements include moving the tunnel alignment away from local communities and environmentally sensitive areas. Reconfiguration of intake and pumping facilities lessen construction impacts in local communities and longer term operational impacts.

The main objective under the EcoRestore Program is the restoration of at least 30,000 acres of Delta habitat, with the near-term goal of making significant strides toward that objective by 2020. These restoration programs would include projects and actions that are in compliance with pre-existing regulatory requirements designed to improve the overall health of the Delta. Other priority restoration projects would also be identified by the Sacramento-San Joaquin Delta Conservancy and other agencies and local governments. Funding would be provided through multiple sources, including various local and federal partners, state bonds, and other state-mandated funds. State Water Project/Central Valley Project contractors would provide funds as part of existing regulatory obligations. The California WaterFix is being evaluated in the partially recirculated draft EIR/supplemental EIS released in July 2015. In that document, the cumulative impacts of the California WaterFix and EcoRestore Program are evaluated,

along with other reasonably foreseeable future projects. The public comment period closed on October 30, 2015. DWR and USBR released a working draft of the ESA biological assessment on January 15, 2016 and the independent science peer review of the draft biological assessment began on March 25, 2016.

Lead agencies for the BDCP/California WaterFix EIR/EIS are DWR, USBR, the USFWS, and NMFS, in cooperation with the California DFW, the U.S. Environmental Protection Agency (USEPA), and the U.S. Army Corps of Engineers.

Monterey Amendment

The Monterey Amendment originated from disputes between the urban and agricultural SWP contractors over how contract supplies are to be allocated in times of shortage. In 1994, in settlement discussions in Monterey, the contractors and DWR reached an agreement to settle their disputes by amending certain provisions in the long-term water supply contracts. These changes, known as the Monterey Amendment, altered the water allocation procedures such that both shortages and surpluses would be shared in the same manner for all contractors, eliminating the prior "agriculture first" shortage provision. In turn, the agricultural contractors agreed to permanently transfer 130 TAF to urban contractors and permanently retire 45 TAF of their contracted supply. The amendment facilitated several important water supply management practices including groundwater banking, voluntary water marketing, and more flexible and efficient use of SWP facilities such as borrowing from Castaic Lake and Lake Perris and using carryover storage in San Luis Reservoir to enhance dry-year supplies. It also provided for the transfer of DWR land to the Kern County Water Agency for development of the Kern Water Bank. The Monterey Amendment was challenged in court, and the original EIR invalidated. Following a settlement, DWR completed a new EIR and concluded the CEQA review in May 2010.

However, the project has been challenged again in a new round of lawsuits. Central Delta Water Agency, South Delta Water Agency, California Water Impact Network, California Sportfishing Protection Alliance, and the Center For Biological Diversity filed a lawsuit against DWR in Sacramento County Superior Court challenging the validity of the EIR under CEQA and the validity of underlying agreements under a reverse validation action (the "*Central Delta I*" case). These same plaintiffs filed a reverse validation lawsuit against the Kern County Water Agency in Kern County Superior Court ("*Central Delta II*"). This lawsuit targets a transfer of land from Kern County Water Agency to the Kern Water Bank, which was completed as part of the original Monterey Agreement. The third lawsuit is an EIR challenge brought by Rosedale-Rio Bravo Water Storage District and Buena Vista Water Storage District against DWR in Kern County Superior Court ("*Rosedale*"). The *Central Delta II* and *Rosedale* cases were transferred to Sacramento Superior Court, and the three cases were consolidated for trial.

In January 2013, the Court ruled that the validation cause of action in *Central Delta I* was time-barred by the statute of limitations. On October 2, 2014, the court issued its final rulings in *Central Delta I* and *Rosedale*, holding that DWR must complete a limited scope remedial CEQA review addressing the potential impacts of the Kern Water Bank. However, the court's ruling also allows operation of the SWP to continue under the terms of the Monterey Agreement while the remedial CEQA review is prepared and leaves in place the underlying project approvals while DWR prepares the remedial CEQA review. The *Central Delta II* case was stayed pending resolution of the *Central Delta I* case. The plaintiffs have appealed the decision.

SWP Terminal Storage

Metropolitan has contractual rights to 65 TAF of flexible storage at Lake Perris (East Branch terminal reservoir) and 154 TAF of flexible storage at Castaic Lake (West Branch terminal

reservoir). This storage provides Metropolitan with additional options for managing SWP deliveries to maximize yield from the project. Over multiple dry years, it can provide Metropolitan with 73 TAF of additional supply. In a single dry year like 1977, it can provide up to 219 TAF of additional supply to Southern California.

Yuba Dry Year Water Purchase Program

In December 2007, Metropolitan entered into an agreement with DWR providing for Metropolitan's participation in the Yuba Dry Year Water Purchase Program between Yuba County Water Agency and DWR. This program provides for transfers of water from the Yuba County Water Agency during dry years through 2025.

Desert Water Agency/Coachella Valley WD SWP Table A Transfer

Under the transfer agreement, Metropolitan transferred 100 TAF of its SWP Table A contractual amount to Desert Water Agency/CVWD (DWCV). Under the terms of the agreement, DWCV pays all SWP charges for this water, including capital costs associated with capacity in the California Aqueduct to transport this water to Perris Reservoir, as well as the associated variable costs. The amount of water actually delivered in any given year depends on that year's SWP allocation. Water is delivered through the existing exchange agreements between Metropolitan and DWCV, under which Metropolitan delivers Colorado River supplies to DWVC equal to the SWP supplies delivered to Metropolitan. While Metropolitan transferred 100 TAF of its Table A amount, it retained other rights, including interruptible water service; its full carryover amounts in San Luis Reservoir; its full use of flexible storage in Castaic and Perris Reservoirs; and any rate management credits associated with the 100 TAF. In addition, Metropolitan is able to recall the SWP transfer water in years in which Metropolitan determines it needs the water to meet its water management goals. The main benefit of the agreement is to reduce Metropolitan's SWP fixed costs in wetter years when there are more than sufficient supplies to meet Metropolitan's water management goals, while at the same time preserving its dry-year SWP supply. In a single critically dry-year like 1977, the call-back provision of the entitlement transfer can provide Metropolitan about 13 TAF of SWP supply. In multiple dry years like 1990-1992, it can provide Metropolitan about 19 TAF of SWP supply.

Desert Water Agency/Coachella Valley WD Advance Delivery Program

Under this program, Metropolitan delivers Colorado River water to the Desert Water Agency and CVWD in advance of the exchange for their SWP Contract Table A allocations. In addition to their Table A supplies, Desert Water Agency and CVWD, subject to Metropolitan's written consent, may take delivery of SWP supplies available under Article 21 and the Turn-back Pool Program. By delivering enough water in advance to cover Metropolitan's exchange obligations, Metropolitan is able to receive Desert Water Agency and CVWD's available SWP supplies in years in which Metropolitan's supplies are insufficient without having to deliver an equivalent amount of Colorado River water. This program allows Metropolitan to maximize delivery of SWP and Colorado River water in such years. These Table A deliveries are incorporated into the estimate of SWP Deliveries under Current Programs shown in Table 3-2.

Desert Water Agency/Coachella Valley WD Other SWP Deliveries

Since 2008, Metropolitan has provided Desert Water Agency and CVWD written consent to take delivery of non-SWP supplies separately acquired by each agency from the SWP facilities. These deliveries include water acquired from the Yuba Dry Year Water Purchase Program and the 2009 Drought Water Bank. Metropolitan has also consented to:

- 10 TAF of exchange deliveries to CVWD for non-SWP water acquired from the San Joaquin Valley from 2008 through 2010,
- 36 TAF of exchange deliveries to Desert Water Agency for non-SWP water acquired from the San Joaquin Valley from 2008 through 2015, and
- 16.5 TAF of exchange deliveries to CVWD from groundwater storage of Kern River flood flows or SWP water delivered from Kern County Water Agency provided by Rosedale Rio Bravo Water Storage District from 2012 through 2035.

Table 3-2 summarizes Metropolitan's SWP supply range for 2035. Appendix 3 provides a detailed discussion of the current SWP programs and programs that are under development.

**Table 3-2**
**California Aqueduct**
**Program Capabilities**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 80,000 | 240,000 | 240,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| Yuba River Accord Purchase | 0 | 0 | 0 |
| ***Subtotal of Current Programs*** | ***479,000*** | ***523,000*** | ***1,323,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 87,000 | 178,000 | 248,000 |
| ***Subtotal of Proposed Programs*** | ***87,000*** | ***178,000*** | ***248,000*** |
| **Maximum Supply Capability** | **566,000** | **701,000** | **1,571,000** |

[1] Includes DWCV carryover.

### *SWP Water Quality*

Metropolitan requires a safe drinking water supply from the Bay-Delta to meet current and future regulatory requirements for public health protection. Finding cost-effective ways to reduce total organic carbon (TOC), bromide concentrations, pathogenic microbes, and other unknown contaminants from the Bay-Delta water supply is one of Metropolitan's top priorities. Metropolitan also requires a SWP supply that is consistently low in salinity - Total Dissolved Solids (TDS) - so it can blend SWP water with higher-salinity Colorado River water to achieve salinity goals for its member agencies. In addition, Metropolitan needs consistently low-salinity SWP water to increase in-basin water recycling and groundwater management programs. These programs require that blended water supplied to the member agencies meets the TDS goals adopted by Metropolitan's Board, which specify a salinity objective of 500 mg/L for blended imported water.

Metropolitan is actively involved in DWR's Municipal Water Quality Investigations (MWQI) Program. The highly variable quality of State Water Project water influences the operation of

Metropolitan's system and its water treatment process. Increasingly restrictive State and Federal drinking water standards, concerns over emerging contaminants such as personal care products and pharmaceuticals, algal taste and odors, and Delta ecosystem fisheries issues are critical variables. DWR's MWQI Program strives to monitor, protect, and improve drinking water quality of Delta water deliveries to the urban State Water Contractors and other users of Delta water. The program focuses on issues related to drinking water quality through regular water quality monitoring, special field and laboratory studies, the use of forecasting tools such as computer models and data management systems, and reporting. While the program has developed extensive monitoring in the Delta including real-time monitoring, increased monitoring along the California Aqueduct is the next major step.

Levee modifications at Franks Tract and other source control actions may significantly reduce ocean salinity concentrations in Delta water, which would benefit Delta water users and export interests alike. Franks Tract is an island located in the central Delta that was actively farmed until levee breaches in 1936 and 1938. Since 1938, the tract has remained a flooded island, and its levees remain in disrepair. Tidal flows in the Delta entrap saline ocean water in the flooded tract, resulting in degraded water quality for both in-Delta and export users. Recent computer modeling analyses by Metropolitan, DWR, and the US Geological Survey indicate that reducing this salinity intrusion by partially closing existing levee breach openings and/or building radial gate flow control structures will significantly reduce TDS and bromide[7] concentrations in water from the Delta during the summer and fall months and in drought years. Based on Metropolitan's analysis, improvements to Franks Tract alone could reduce peak bromide concentrations in the summer and fall months by about 33 percent at Contra Costa Water District's (CCWD) Rock Slough intake, by 27 percent at CCWD's Old River intake, and by 24 percent at the SWP intake in the South Delta.

DWR and USBR proposed to implement the Franks Tract Project to improve water quality and fisheries conditions in the Bay-Delta. DWR and USBR are evaluating installing operable gates to control the flow of water at key locations (Three Mile Slough and/or West False River) to reduce sea water intrusion, and to positively influence movement of fish species of concern to areas that provide favorable habitat conditions. By protecting fish resources, this project also would improve operational reliability of the SWP and CVP because curtailments in water exports (pumping restrictions) are likely to be less frequent.

The state has adopted an "equivalent level of public health protection" (ELPH) program that targets water quality actions outside the Delta. The Bay-Delta Program is coordinating a feasibility study on water quality improvement in the California Aqueduct.

Metropolitan and the Friant Water Users Authority (FWUA) have entered into a partnership to investigate the potential of enhancing the quantity and affordability of the eastern San Joaquin Valley's water supply while improving Southern California's water quality. The FWUA and Metropolitan studied projects that benefited both regions. Using Proposition 13 funds, an existing canal belonging to the Arvin-Edison Water Storage District was enlarged, enabling greater volumes of water to be exchanged between their groundwater and the California Aqueduct.

### *SWP System Outage and Capacity Constraints*

As its infrastructure ages, the SWP becomes increasingly vulnerable to natural disasters, particularly the Delta levee system and the California Aqueduct, which are both susceptible to floods and earthquakes. In June 2004, a levee in the Jones Tract of the Delta failed, resulting in

[7] The importance of bromides is discussed in the Water Quality chapter.

total inundation of the island and disrupting SWP operations. Catastrophic loss of either the Delta levee system or the aqueduct would shut down the project, affecting the welfare of millions. While Metropolitan has made substantial investments in local resources and in-basin storage to insulate Southern California against loss of its imported water supplies, additional investment is needed in the at-risk infrastructure.

The Bay-Delta Levees Program coordinates Delta levee maintenance and improvement activities. Its goal is to protect water supplies needed for the environment, agriculture, and urban uses by reducing the threat of levee failure and seawater intrusion. Over the next two to three years, DWR and other agencies will carry out a Comprehensive Program Evaluation (CPE). It will incorporate the risk study that has been commissioned by DWR, including the currently-proposed expanded scope of that study. The CPE will: (a) supplement the DWR risk study to ensure that it considers all relevant levee risks, (b) include the development of a formal strategic plan that contains a description of any proposed future program changes, and (c) recommend priorities and estimate funding needs for the Levees Program. For example, the Army Corps of Engineers' (P.L. 84-99 ROD) target will be reevaluated as part of the CPE using information from the Risk Study.

The California Aqueduct remains susceptible to floods at several points as it travels from the Delta along the west side of the San Joaquin Valley. Key among these is where the aqueduct crosses the Arroyo Pasajero, an alluvial fan located near Coalinga, California. At that spot, the aqueduct effectively forms a barrier to Arroyo flood flows. Although flood control facilities were built to protect the aqueduct, the volumes of runoff and sediment deposition are much greater than originally estimated, so a significant flood risk remains. The aqueduct was severely damaged during March of 1995 when a flood overwhelmed control facilities and overtopped the aqueduct with 10 TAF of floodwater and an estimated 800,000 cubic yards of sediment. Impacts to downstream water users lasted through the summer of 1995. In December of 2004, DWR began construction of "Phase I" improvements to the aqueduct where it crosses the Arroyo. These improvements will increase the size of the detention basins west of the aqueduct to protect it against a 50-year storm event.

DWR is also investing in the replacement of aging SWP infrastructure critical to SWP operations. It is midway into its Turbine Rehabilitation Program at Oroville Reservoir's Hyatt-Thermalito complex. In 2004, DWR awarded a contract to replace four pumps at the Edmonston Pumping Plant. Moreover, improved maintenance procedures have decreased the amount of time pumps at Edmonston come off-line for maintenance to less than 10 percent of the time.

Because of the risk of a prolonged shutdown of the SWP caused by seismic or hydrologic events either within the Delta or along the California Aqueduct, Metropolitan has acted decisively to ensure that Southern California has adequate emergency storage. Diamond Valley Lake (DVL) and SWP terminal reservoir storage, combined with member-agency emergency storage, are jointly capable of providing the region with a six-month supply of water if combined with a temporary 25 percent reduction in demand. Metropolitan engineering studies indicate this would provide sufficient time to repair the SWP and resume delivery.

Metropolitan is investigating potential opportunities for carbon sequestration in subsided islands within the legal Delta to create a potential revenue source for Delta landowners and other interested parties. Farming the Delta peat soils generates a large amount of carbon dioxide ($CO_2$), and growing native vegetation (versus continued farming operations) not only decreases greenhouse gas emissions, but can actually sequester an even larger amount of $CO_2$ over time while rebuilding new peat soils. With rebuilding new peat soils to historic elevations, the risk of levee failure would decrease, and may eventually be eliminated.

### *Achievements to Date*

#### *SWP Reliability*

Delta Vision

The Delta has suffered from multiple crises for years – ecosystem, water supply, levee stability, water quality, policy, program, and litigation. The ecosystem condition continues to deteriorate, with record-low reports of fish populations, Delta smelt, and other species on the brink of extinction, and the commercial salmon season shut down completely for two years in a row. Continued drought conditions and court-ordered restrictions on water exports have led to reductions in water deliveries to contractors. Deteriorating levees, land subsidence, earthquake risk, and climate change all contribute to growing concerns about mass Delta levee failure. Delta water quality also continues to be a critical issue, as both local agricultural and urban communities contribute contaminants to the system. Litigation related to Delta environmental concerns and the proposed California WaterFix/ EcoRestore/ BDCP will likely continue in the future.

Metropolitan's Long-Term Action Plan

Besides the short- and mid-term actions described earlier in Section 1.4, Metropolitan's adopted Delta action plan in June 2007 includes a long-term Delta Plan. The long-term action plan recognizes the need for a global, comprehensive approach to the fundamental issues and conflicts in the Delta to result in a truly sustainable Delta. A piecemeal approach cannot satisfy the many stakeholders that have an interest in the Delta and will fail; there must be a holistic approach that deals with all issues simultaneously. In dealing with the basic issues of the Delta, solutions must address the physical changes required, as well as the financing and governance. There are three basic elements that must be addressed: Delta ecosystem restoration, water supply conveyance, and flood control protection and storage development. In addition, the state needs to establish governance structures and financing approaches to implement and manage the three identified elements.

Governor's Delta Vision Process

Through this enduring Delta crisis, the Legislature and the Governor initiated, in 2006, a process to develop a new long-term vision for the Delta. SB 1574 (Kuehl/2006) required a cabinet committee to present recommendations for a Delta strategic vision. The governor created a Delta Vision Blue-Ribbon Task Force to advise the Cabinet Committee. The Task Force produced an October 2008 Strategic Plan, which the Cabinet Committee largely adopted and submitted, with its recommendations, to the Legislature on January 3, 2009. Metropolitan, as a stakeholder to the process, provided input to the Task Force.

The 2009 Delta Legislation

After delivery of the Delta Vision recommendations, the Legislature held informational hearings from Delta experts, Task Force members, and the Schwarzenegger Administration, as well as the public at large, and engaged in vigorous water policy discussions. Following the informational hearings, several legislators began developing detailed legislation which culminated in pre-print proposals being issued in early August of 2009 for public review and discussion over the summer recess. The Assembly Water, Parks and Wildlife Committee and the Senate Natural Resources and Water Committee then held joint informational hearings on the pre-print proposals and received extensive public comment. Thereafter, legislative leadership appointed a conference committee, which convened and held additional public hearings,

with further legislator discussions on key issues. That work continued into the 7th Extraordinary Session, which was called by the governor specifically to address the pending Delta and water issues, and culminated in the signing of a historic package of bills. One of the keystones of that package was SB X7-1, which reformed Delta policy and governance. Specifically, SB X7-1:

- Establishes a new legal framework for Delta management, emphasizing the coequal goals of "providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem" as foundation for state decisions as to Delta management.
- Reconstitutes and redefines role of the Delta Protection Commission (DPC), to narrow membership to focus on local representation and to expand the DPC's role in economic sustainability.
- Creates a new Sacramento-San Joaquin Delta Conservancy (Conservancy), to support efforts that advance environmental protection and the economic well-being of Delta residents.
- Creates the Delta Stewardship Council (Council) as an independent state agency to guide actions in the Delta which furthers the coequal goals of Delta restoration and water supply reliability.
- Repeals the CALFED Bay-Delta Authority Act and transfers existing staff, contracts, etc. to the Council.
- Creates the Delta Independent Science Board (Science Board) and Delta Science Program.
- Requires the State Water Resources Control Board (SWRCB), by August 12, 2010, to develop new flow criteria for the Delta ecosystem necessary to protect public trust resources.
- Requires the Department of Fish and Game (DFG), now the Department of Fish and Wildlife (DFW), by December 31, 2010, to develop and recommend to the SWRCB flow criteria and quantifiable biological objectives for aquatic and terrestrial species.
- Creates a Delta Watermaster as the enforcement officer for the SWRCB Division of Water Rights in the Delta.
- Requires the Council to develop, adopt, and commence implementation of the "Delta Plan" by January 1, 2012, with a report to the Legislature by March 31, 2012.
- Requires the DPC to develop a proposal to protect, enhance, and sustain the unique cultural, historical, recreational, agricultural, and economic values of the Delta as an evolving place.
- Requires the Delta Plan to further the coequal goals of Delta ecosystem restoration and a reliable water supply.
- Requires the Delta Plan to promote statewide water conservation, water use efficiency, and sustainable use of water, as well as improvements to water conveyance/storage and operation of both to achieve the coequal goals.
- Requires the Delta Plan to attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness, appropriate land uses, and strategic levee investments.
- Announces a statewide policy to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies,

conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

- Requires the Council to include the Bay Delta Conservation Plan (BDCP) in the Delta Plan and makes the BDCP eligible for state funding if:
  - The BDCP complies with Natural Community Conservation Planning Act (NCCPA) and is approved as a Habitat Conservation Plan under the Federal ESA.
  - The BDCP complies with the California Environmental Quality Act and includes a full range of alternatives, including a reasonable range of flow criteria, rates of diversion, and other operational criteria.
  - DWR consults with the Council and Science Board during development of the BDCP.
  - DFW approves the BDCP as a Natural Community Conservation Plan and determines that it meets the requirements for incorporation into the Delta Plan.

### *SWP Water Quality*

The most significant achievement for SWP water quality has been continued definition and advancement of the Delta Improvement Package. Most notably, the Franks Tract studies identified cost-effective ways to achieve significant improvements in the quality of Delta export water.

Progress was also made on the Southern California-San Joaquin Regional Water Quality Exchange Project. In 2009, Metropolitan and Arvin Edison Water Storage District enlarged their South Canal to enable exchanging more water between their groundwater basins and the California Aqueduct. Their relatively pure water allows Metropolitan to improve source water, and increase quantities, during times when quality and quantity are relatively poor. This project also allows Metropolitan better access to water it has stored in the Arvin Edison Groundwater Storage Project.

### *SWP System Reliability*

The completion and filling of DVL marked the most important achievement with respect to protecting Southern California against an SWP system outage. Water began pouring into the reservoir in November 1999, and the lake was filled by early 2003. The lake can hold up to 810 TAF which provides Southern California with a six-month emergency water supply, as well as carryover and regulatory storage.

#### The Inland Feeder Project

The Inland Feeder is a 44-mile-long conveyance system that connects the State Water Project to DVL and the CRA. The Inland Feeder provides greater flexibility in managing Metropolitan's major water supplies and allows greater amounts of State Water Project water to be accepted during wet seasons for storage in DVL. In addition, the Inland Feeder increases the conveyance capacity from the East Branch of the SWP by 1,000 cubic feet per second, allowing the East Branch to operate up to its full capacity. The project also improves the quality of the Southland's drinking water by allowing more uniform blending of better quality water from the SWP with Colorado River supplies, which have a higher mineral content. Construction of the Inland Feeder was completed in September 2009.

## 3.3 Central Valley/State Water Project Storage and Transfer Programs

Metropolitan endeavors to increase the reliability of supplies received from the California Aqueduct by developing flexible SWP storage and transfer programs. Over the years, Metropolitan has developed numerous voluntary SWP storage and transfer programs, to secure additional dry-year water supplies.

### *Background*

Metropolitan has a long history of managing the wide fluctuations of SWP supplies from year to year by forming partnerships with Central Valley agricultural districts along the California Aqueduct, as well as with other Southern California SWP Contractors. These partnerships allow Metropolitan to store its SWP supplies during wetter years for return in future drier years. Some programs also allow Metropolitan to purchase water in drier years for delivery via the California Aqueduct to Metropolitan's service area.

Because yields from individual programs can vary widely depending on hydrologic conditions and CVP/SWP operations, the dry-year yields for the various programs reported in this section are expected values only. In any given year, actual yields could depart from the expected values. Despite that uncertainty, Metropolitan's models of these programs indicate that in the aggregate, they can meet the resource target under a wide range of hydrologic conditions and CVP/SWP operations.

In addition, the SWP storage and transfer programs have served to demonstrate the value of partnering, and increasingly, Central Valley agricultural interests see partnering with Metropolitan as a sensible business practice beneficial to their local district and regional economy.

### *Implementation Approach*

Metropolitan is currently operating several SWP storage programs that serve to increase the reliability of supplies received from the California Aqueduct. Metropolitan is also pursuing a new storage program with Antelope Valley-East Kern Water Agency, which is currently under development. In addition, Metropolitan pursues SWP water transfers on an as needed basis. Table 3-3 lists the expected yields from these storage and transfer programs. Figure 3-3 shows the location of Metropolitan's statewide groundwater banking programs.

#### *Storage and Transfer Programs*

Semitropic Storage Program

Metropolitan has a groundwater storage program with Semitropic Water Storage District located in the southern part of the San Joaquin Valley. The maximum storage capacity of the program is 350 TAF. The specific amount of water Metropolitan can store in and subsequently expect to receive from the program depends upon hydrologic conditions, any regulatory requirements restricting Metropolitan's ability to export water for storage, and the demands placed on the Semitropic Program by other program participants. In 2014, Metropolitan amended the program to increase the return yield by an additional 13.2 TAF per year. The minimum annual yield available to Metropolitan from the program is currently 34.7 TAF, and the maximum annual yield is 236.2 TAF, depending on the available unused capacity and the SWP allocation. During wet years, Metropolitan has the discretion to use the program to store portions of its SWP water that are in excess of the amounts needed to meet Metropolitan's service area demand. In Semitropic, the water is delivered to district farmers who use the water in lieu of pumping groundwater. During dry years, the district returns Metropolitan's previously

stored water to Metropolitan by direct groundwater pump-in return and the exchange of SWP supplies.

Arvin-Edison Storage Program

Metropolitan amended the groundwater storage program with Arvin-Edison Water Storage District in 2008 to include the South Canal Improvement Project. The project increases the reliability of Arvin-Edison returning higher water quality to the California Aqueduct. In addition, Metropolitan and Arvin-Edison often enter into annual operational agreements to optimize program operations in any given year. The program storage capacity is 350 TAF. The specific amount of water Metropolitan can expect to store in and subsequently receive from the program depends upon hydrologic conditions and any regulatory requirements restricting Metropolitan's ability to export water for storage. The storage program is estimated to deliver 75 TAF. During wet years, Metropolitan has the discretion to use the program to store portions of its SWP supplies which are in excess of the amounts needed to meet Metropolitan's service area demand. The water can be either directly recharged into the groundwater basin or delivered to district farmers who use the water in lieu of pumping groundwater. During dry years, the district returns Metropolitan's previously stored water to Metropolitan by direct groundwater pump-in return or by exchange of surface water supplies. In 2015, Metropolitan funded the installation of three new wells at a cost of $3 million that will restore the return reliability by 2.5 TAF per year. The funding will ultimately be recovered through credits against future program costs.

Table 3-3 summarizes Metropolitan's Central Valley/SWP transfer programs supply range for 2035. The supply capabilities shown reflect actual storage program conveyance constraints. In addition, SWP supplies are estimated using DWR's 2015 SWP Delivery Capability Report released in July 2015. Appendix 3 provides a detailed discussion of the current Central Valley and SWP storage and transfers programs and programs that are under development.

**Table 3-3**
**Central Valley/State Water Project Storage and Transfer Programs**
**Supply Projection**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| San Bernardino Valley MWD Minimum Purchase | 3,000 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 16,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 50,000 | 49,000 | 70,000 |
| Arvin Edison Program | 63,000 | 75,000 | 75,000 |
| Mojave Storage Program | 2,000 | 0 | 26,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***217,000*** | ***226,000*** | ***309,000*** |
| **Programs Under Development** | | | |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***7,000*** | ***20,000*** | ***20,000*** |
| **Maximum Supply Capability** | **224,000** | **246,000** | **329,000** |

San Bernardino Valley MWD Storage Program

The San Bernardino Valley MWD Storage program allows for the purchase of a portion of San Bernardino Valley MWD's SWP supply. The program includes a minimum purchase provision of 20 TAF and the option of purchasing additional supplies when available. This program can deliver between 20 TAF and 70 TAF in dry years, depending on hydrologic conditions. The expected delivery for a single dry year similar to 1977 is 20 TAF should supplies be available. The agreement with San Bernardino Valley MWD also allows Metropolitan to store up to 50 TAF of transfer water for use in dry years. The agreement can be renewed until December 31, 2035.

San Gabriel Valley MWD Exchange Program

The San Gabriel Valley MWD program allows for the exchange of up to 5 TAF each year. For each acre-foot Metropolitan delivers to the City of Sierra Madre, a San Gabriel Valley MWD member agency, San Gabriel Valley MWD provides two acre-feet to Metropolitan in the Main San Gabriel Basin, up to 5 TAF. The program provides increased reliability to Metropolitan by allowing additional water to be delivered to Metropolitan's member agencies Three Valleys MWD and Upper San Gabriel Valley MWD.

Antelope Valley-East Kern Water Agency Exchange and Storage Program

The Antelope Valley-East Kern Water Agency (AVEK) exchange and storage program provides Metropolitan with additional supplies and increased reliability. Under the exchange program, for every two acre-feet Metropolitan receives, Metropolitan returns one acre-foot to AVEK to

improve its reliability. The exchange program is expected to deliver 30 TAF over ten years, with 10 TAF available in dry years. Under the program, Metropolitan will also be able to store up to 30 TAF in the AVEK's groundwater basin, with a dry year return capability of 10 TAF.

Kern-Delta Water District Storage Program

This groundwater storage program has 250 TAF of storage capacity. The program is capable of providing up to 50 TAF of dry-year supply. In 2015, Metropolitan funded the cross river pipeline that, when completed, will help improve Metropolitan's return reliability by reducing losses during exchanges. Water for storage can be either directly recharged into the groundwater basin or delivered to district farmers who use the water in lieu of pumping groundwater. During dry years, the district returns Metropolitan's previously stored water to Metropolitan by direct groundwater pump-in return or by exchange of surface water supplies.

Mojave Storage Program

Metropolitan entered into a groundwater banking and exchange transfer agreement with Mojave Water Agency on October 29, 2003. This agreement was amended in 2011 to allow for the cumulative storage of up to 390 TAF. The agreement allows for Metropolitan to store water in an exchange account for later return. Through 2021, and when the State Water Project allocation is 60 percent or less, Metropolitan can annually withdraw the Mojave Water Agency's SWP contractual amounts in excess of a 10 percent reserve. When the SWP allocation is over 60 percent, the reserved amount for Mojave's local needs increases to 20 percent. Under a 100 percent allocation, the State Water Contract provides Mojave Water Agency 82.8 TAF of water.

Central Valley Transfer Programs

Metropolitan secures Central Valley water transfer supplies via spot markets and option contracts to meet its service area demands when necessary. Hydrologic and market conditions, and regulatory measures governing Delta pumping plant operations, will determine the amount of water transfer activity occurring in any year. Recent transfer market activity, described below, provides examples of how Metropolitan has secured water transfer supplies as a resource to fill anticipated supply shortfalls needed to meet Metropolitan's service area demands.

In 2003, Metropolitan secured options to purchase approximately 145 TAF of water from willing sellers in the Sacramento Valley during the irrigation season. These options protected against potential shortages of up to 650 TAF within Metropolitan's service area that might have arisen from a decrease in Colorado River supply or as a result of drier-than-expected hydrologic conditions. Using these options, Metropolitan purchased approximately 125 TAF of water for delivery to the California Aqueduct.

In 2005, Metropolitan, in partnership with seven other State Water Contractors, secured options to purchase approximately 130 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was 113 TAF. Metropolitan also had the right to assume the options of the other State Water Contractors if they chose not to purchase the transfer water. Due to improved hydrologic conditions, Metropolitan and the other State Water Contractors did not exercise these options.

In 2008, Metropolitan, in partnership with seven other State Water Contractors, secured approximately 40 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was approximately 27 TAF.

In 2009, Metropolitan, in partnership with 8 other buyers and 21 sellers, participated in a statewide Drought Water Bank, which secured approximately 74 TAF, of which Metropolitan's share was approximately 37 TAF.

In 2010, Metropolitan, in partnership with three other State Water Contractors, secured approximately 100 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was approximately 88 TAF. Metropolitan also purchased approximately 18 TAF of water from Central Valley Project Contractors located in the San Joaquin Valley. In addition, Metropolitan entered into an unbalanced exchange agreement that resulted in Metropolitan receiving approximately 37 TAF.

In 2015, Metropolitan, in partnership with eight other State Water Contractors, secured approximately 20 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was approximately 13 TAF.

In addition, Metropolitan has secured water transfer supplies under the Yuba Accord, which is a long-term transfer agreement. To date, Metropolitan has purchased approximately 165 TAF.

Finally, Metropolitan has secured water transfer supplies under the Multi-Year Water Pool Demonstration Program. In 2013 and 2015, Metropolitan secured 30 TAF and 1.3 TAF, respectively.

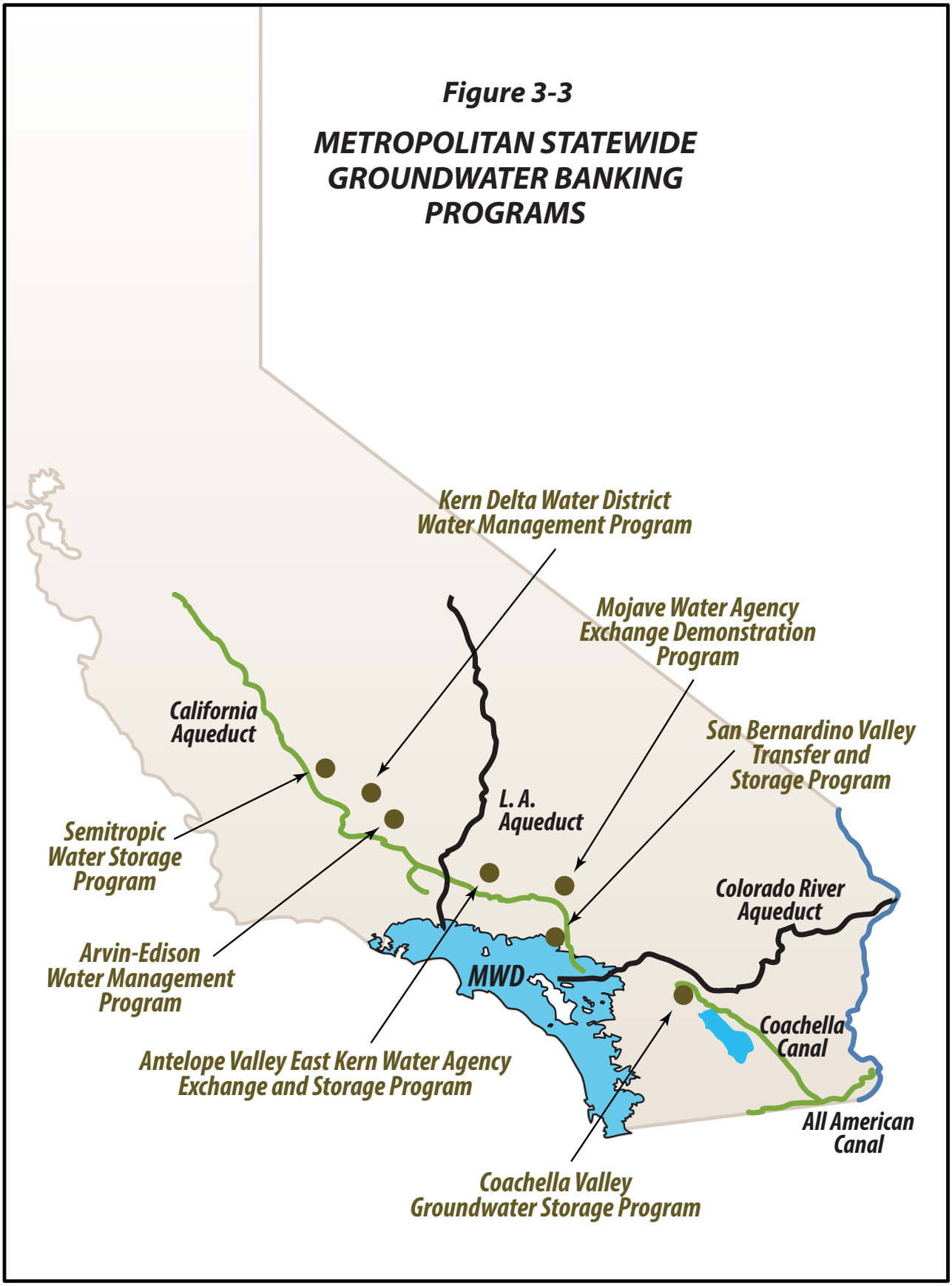
Metropolitan's recent water transfer activities demonstrate Metropolitan's ability to develop and negotiate water transfer agreements either working directly with the agricultural districts who are selling the water or through a statewide Drought Water Bank. Because of the complexity of cross-Delta transfers and the need to optimize the use of both CVP and SWP facilities, DWR and USBR are critical players in the water transfer process, especially when shortage conditions increase the general level of demand for transfers and amplify ecosystem and water quality issues associated with through-Delta conveyance of water. Therefore, Metropolitan views state and federal cooperation to facilitate voluntary, market-based exchanges and sales of water as a critical component of its overall water transfer strategy.

### *Achievements to Date*

Metropolitan has made rapid progress to date developing SWP storage and transfer programs. Most notably, Metropolitan has utilized approximately 457 TAF to supplement its SWP supplies during the recent 2012-2015 unprecedented drought. Of this total, approximately 325 TAF are from SWP storage program extractions in Semitropic, Arvin, Kern Delta, and Mojave; 57 TAF are from the San Bernardino and San Gabriel Valley MWD programs; and 78 TAF of SWP transfer supplies were purchased from the State Water Contractors Buyers Group, Multi-Year Water Pool, and Yuba water purchase programs.

## Figure 3-3

## METROPOLITAN STATEWIDE GROUNDWATER BANKING PROGRAMS



## 3.4 Demand Management and Conservation

Demand management through conservation is a core element of Metropolitan's long-term water management strategy. Metropolitan continues to build on a nearly 25-year investment in conservation of more than $495 million, reflecting a long-term commitment to water conservation. Among other measures, this investment has resulted in the replacement of more than 3.4 million toilets with more water efficient models, distribution of more than 530,000 high-efficiency clothes washers (HECWs), and removal of approximately 170 million square feet of grass from both commercial and residential properties. Collectively, Metropolitan's conservation programs and other conservation in the region will reduce Southern California's reliance on imported water by more than 1.0 MAF per year by 2025.

In response to the continuing drought, Metropolitan's Board of Directors took unprecedented action in fiscal year 2014-15 to increase conservation and permanently reduce demand within Southern California. In December 2014, the Board authorized an additional $40 million for regional conservation incentives, raising the two year conservation budget to $100 million (fiscal years 2014-15 and 2015-16). In May 2015, the Board further increased the two-year conservation budget to an unprecedented $450 million, with $340 million committed to turf removal incentives for fiscal years 2014-15 and 2015-16. The Board also authorized $11 million for multimedia, multicultural, water awareness and conservation outreach campaigns that were implemented in 2014 and 2015.

### *Background*

Metropolitan's conservation policies and programs are guided by the conservation savings target adopted in the IRP. These policies and programs directly relate to the demand management measures for wholesale water agencies in the Urban Water Management Planning Act and the urban water conservation Best Management Practices (BMPs) in the California Urban Water Conservation Council Memorandum of Understanding Regarding Water Conservation in California (Urban MOU). As a signatory to the Urban MOU, Metropolitan pledged to make a good faith attempt to implement the BMPs.

Conservation savings result from active, code-based, and price-effect conservation efforts. Active conservation consists of water-agency funded programs such as rebates and incentives for water efficient fixtures and equipment and turf removal. Code-based and price-based conservation consists of demand reductions attributable to conservation-oriented plumbing codes and usage reductions resulting from increases in the price of water. Metropolitan does not currently assign a savings value for public awareness campaigns and conservation education because any initial effect on demand reduction and the longevity of the effect are difficult to measure. It is generally accepted that these outreach programs prompt consumers to install water saving fixtures and change water-use behavior, thereby creating a residual benefit of increasing the effectiveness of complementary conservation programs.

Distinguishing between active, code-based, and price-effect conservation can be analytically complex when, for example, active programs for fixtures are concurrent with conservation-related plumbing codes. Metropolitan uses specially designed estimating models to quantify and project conservation savings. This plan combines active, code-based, and price-effect conservation savings using methods that avoid double counting.

Conservation savings are commonly estimated from a base-year water-use profile. Metropolitan uses 1980 as the base year because it marked the effective date of a new plumbing code in California requiring toilets in new construction to be rated at 3.5 gallons per flush or less. Between 1980 and 1990, the region saved an estimated 250 TAF per year as the

result of this 1980 plumbing code and unrelated water rate increases. These savings are referred to as "pre-1990 savings." Metropolitan's resource planning target combines pre-1990 savings and estimates of more recently achieved savings.

Including regional pre-1990 conservation savings, Metropolitan continues to pursue a 2025 total conservation target of approximately 1.13 MAF per year. A large share of the target has already been achieved through existing Metropolitan and member agency programs, pre-1990 savings, price-effects, and continued savings that accrue from plumbing codes. The remainder is expected to be achieved through additional agency-sponsored active conservation programs, code changes, and price-effects.

### *Implementation Approach*

Metropolitan's approach for achieving the conservation target includes implementing a suite of demand management measures, including public education and outreach, a variety of conservation programs, metering, research and development, and asset management. These programs include cost-effective BMP-oriented active conservation programs and new, innovative programs that address regional water uses. Metropolitan also provides support to member agencies for local programs that assist with implementing retail BMPs and reducing per capita water use. The stewardship charge in Metropolitan's rate structure provides the funding mechanism for active conservation programs and non-incentive strategies. Metropolitan continues to seek state and federal grant funding for conservation in coordination with its member agencies.

Metropolitan's conservation programs are closely linked to the efforts of the California Urban Water Conservation Council (CUWCC), the organization created to administer the Urban MOU. As a signatory to the Urban MOU, Metropolitan has pledged to make a good faith effort to implement a prescribed set of urban water conservation BMPs. Metropolitan provides technical and financial support needed by member agencies in meeting the terms of the Urban MOU. Enclosed with this report, as Appendix 8, are copies of the BMP reports Metropolitan has filed with the CUWCC since Metropolitan's 2010 urban water management plan.

In addition to implementing cost-effective BMPs, Metropolitan actively supports many CUWCC committee and research activities. For example, Metropolitan has historically assisted in CUWCC's ongoing efforts to document and increase the effectiveness of BMP-related conservation efforts. Presently, Metropolitan is represented on the following CUWCC committees:

- Board
- Commercial, Industrial, and Institutional Committee
- Residential Committee
- Landscape Committee
- Research and Evaluation Committee
- Utility Operations Committee
- Education Committee
- BMP Reporting Committee

Metropolitan also participates in national water efficiency efforts. Metropolitan is a USEPA WaterSense partner, helping to promote water efficient products and practices in Southern California. Metropolitan is also a member of the Alliance for Water Efficiency, participating in the committees on research, WaterSense and water efficient products, and education and outreach.

The following sections describe Metropolitan's demand management measures and conservation programs.

### *Public Education and Outreach*

Metropolitan provides comprehensive education and outreach programs throughout its service area. Metropolitan's wide-ranging and comprehensive education program recently received California's highest environmental honor: the Governor's Environmental and Economic Leadership Award.

#### *Public Education Programs*

Metropolitan's water education programs reach thousands of students every year with lessons on water quality, conservation, and stewardship. Free teacher workshops, classroom materials, field trips, and class instruction are provided to schools throughout the district. A comprehensive K-12 curriculum meets state standards for each grade level in the areas of science, math, language arts, and social studies. Table 3-4 shows Metropolitan's extensive commitment to conservation-related education programs.

Metropolitan also provides all-day instruction for grades 4-7 through the Diamond Valley Lake Education Program with several thousand students and teachers participating each year. Metropolitan also collaborated with the Western Science Center Outreach Program to provide activities for more than 5,000 students in grades 2-5, and oversaw the Diamond Valley Lake Visitor Center that educated over 10,000 people on Metropolitan's water systems and operations, programs, and water stewardship.

More than 20,000 people viewed student artwork from Metropolitan's "Water is Life" Student Art and Calendar program, which stresses the importance of conservation at home, school, and in the community. The 2015 Student Art Exhibit toured and was displayed at 27 member and retail agencies in 2015.

One of Metropolitan's signature events is the annual Solar Cup™ at Lake Skinner for high school students. This is a team-based educational program in which students develop and apply skills in math, engineering, and communications while learning about water resources and creating conservation-focused public service announcements. In 2015, 41 teams and more than 800 high school students built, equipped, and raced 16-foot solar powered boats in a successful three-day event that received extensive news coverage.

For college students, Metropolitan offers the Southern California World Water Forum College Grant Program with support from USBR and the Los Angeles County Sanitation Districts. The 2014–2017 program will provide 17 grants to colleges and universities for local and globally-focused projects that foster a better understanding and community awareness of water issues, while improving technology related to water supply and delivery, water conservation, and/or sanitation programs.

Metropolitan recently launched a new education resources website. This site highlights Metropolitan's water-based Science-Technology-Engineering-Arts-Math (STEAM) programs for pre-kindergarten through college students and hosts a downloadable curriculum, aligned to the state's education standards. This website, which has many mobile features, is a resource for

students, parents, teachers, and community educators interested in learning and teaching about water's critical role in society.

Metropolitan's education related Twitter postings received more than 37,000 impressions, and Metropolitan's education Web page for kindergarten through college students drew over 40,000 visitors.

### *Outreach*

In fiscal year 2013-14, Metropolitan implemented a variety of conservation and education outreach programs throughout our service area. Since late 2013, the primary focus of these programs has been on the drought and the need for additional conservation in order to maintain the region's water supply reserves. In March 2014, Metropolitan's Board of Directors authorized a $5.5 million regional outreach campaign for conservation and to raise water awareness. The multimedia campaign used television and radio advertisements and traffic report sponsorships, along with online, streaming radio and mobile ads, plus focused billboard and movie theater advertising. Many of the campaign elements were provided in-language to help engage the region's ethnically diverse population. Campaign tools, such as television and radio ads and graphics for bill inserts, billboards, and websites, were available to local agencies at no cost. As part of the campaign, Metropolitan conducted several interviews for television and radio and placed several "advertorial" news stories in the online editions of the *Los Angeles Times* and *Union Tribune-San Diego* newspapers. These elements promoted the ongoing need for conservation in Southern California, describing long-term investments in water storage and development of local water resources, and the availability of rebates and incentives for turf removal and purchase of water-saving devices and appliances.

In March 2015, Metropolitan's Board of Directors authorized $5.5 million for a second multi-lingual communications, outreach, and advertising campaign. The campaign tagline, "Let's All Take A Turn," emphasizes the seriousness of the drought and brings the message to residents that if we all do a little more to save water, it adds up to make a huge difference.

Metropolitan launched the research-based advertising campaign in the spring with digital and radio, in cooperation with the district's 26 member public agencies. For the first time, the entire campaign was produced in five languages: English, Spanish, Mandarin, Korean, and Vietnamese. The summer campaign called for online, social media, streaming radio, and mobile ads, along with billboards, television commercials, and special events -- such as the transformation of the iconic Randy's donut in Inglewood to the giant red Turn knob -- in order to effectively communicate the need for everyone to conserve water during the historic, ongoing drought.

Metropolitan also held press conferences on its own or in conjunction with others such as the Southern California Water Committee (SCWC) urging more conservation during the ongoing drought. These were augmented by op-ed pieces describing Southern California's response to the drought that were placed in newspapers such as the *Los Angeles Times* and *Orange County Register*.

Throughout the year, Metropolitan officials conducted dozens of interviews with news reporters to discuss a wide range of water-related topics such as the impact of the drought, water supply reliability, and conservation. As part of this public outreach, Metropolitan's General Manager blogged on Metropolitan's home web page, mwdh2o.com, about various water challenges facing the region.

In 2014, Metropolitan began a focused outreach effort for leading businesses and industries that are high volume water use customers within Metropolitan's service area. Metropolitan's

executive management has met with executives in the beverage, bottling, refining, aerospace, tourism, and golf industries to discuss Southern California's water outlook, key policy issues, and opportunities to collaborate on water use efficiency projects that will reduce demand for potable water.

Metropolitan's bewaterwise.com® web site continues to play a key role in educating the public, attracting nearly 760,000 unique visitors from July 1, 2014 through June 30, 2015. The website includes a new page focused on the drought and enhanced information on Metropolitan's rebate and incentive programs. Metropolitan also provides a Spanish language version of the site to help educate and inform the region's Spanish-speaking population. In addition, the website features California Friendly® Landscape training classes where home gardeners and landscape professionals can learn the latest ways to reduce water use in landscapes. Classes cover the basics of irrigation systems, watering and fertilizing, landscape design, and plant identification.

Metropolitan is active on social media, regularly posting to Facebook and Twitter. The Facebook page, mwdh2o, has over 12,000 likes, and the Bewaterwise Twitter account, @bewaterwiseh2o, has over 3,000 followers. Metropolitan's Instagram page began in September 2015. To increase collaboration with environmental organizations, Metropolitan helped organize a regional Twitter campaign, #WaterYouDoing, to help spread water-saving messages.

Metropolitan provides a speakers bureau and regularly presents for business and community organizations. Metropolitan also provides direct outreach to federal, state, and local government leaders and their staff to inform them of key water issues and provide updates on Metropolitan's activities and programs.

### *Community Partnering Program*

In fiscal year 2014-15, the Community Partnering Program sponsored and actively participated in nearly 60 water-related education and outreach programs for member agencies, community groups, educational institutions, public agencies, non-profit organizations, and professional associations. Projects included community festivals and events, conservation and garden projects, web-based information and social media, publications in multiple languages, educational materials dealing with watersheds, conservation, water recycling, and other initiatives.

### *California Friendly Landscape Education and Training Program*

Metropolitan provides education and training on ways to conserve water in homes and landscapes. Offerings include in-person and online classes, surveys, and audits.

#### Landscape Classes

Metropolitan offers in-person and online courses in irrigation efficiency and water-wise garden design through its California Friendly Landscape Training Program. In FY 2014-15, Metropolitan conducted 197 classes for 6,590 students throughout Metropolitan's service area.

#### Landscape Irrigation Audits

Metropolitan provides irrigation surveys for large landscape customers. These surveys are performed by a certified Landscape Irrigation Auditor and provide the customer with specific recommendations on how to improve irrigation efficiency at the site. The survey report

generated by the auditor also provides information on incentives to help the customer fund the needed improvements. In fiscal year 2014-15, 123 surveys covering 453 acres were conducted.

Irrigation Evaluations and Residential Surveys

Metropolitan provides funding to its member agencies that choose to implement irrigation evaluations and indoor surveys for residents. Irrigation evaluations provide customers with a recommended irrigation schedule and suggested improvements for irrigation systems. Indoor residential surveys provide customers with information on identifying leaks and making changes to water-using devices in the home.

### *Water Conservation Programs*

Metropolitan's water conservation programs focus on two main areas: (1) residential water use, and (2) commercial, industrial, and institutional water use. Metropolitan directly implements regional programs, and provides financial support for local programs that are implemented by the member agencies. Metropolitan's Water Use Efficiency team provides program development, implementation, administration, monitoring, evaluation, and research.

Metropolitan's Conservation Credits Program (CCP) provides the basis for financial incentives and funding for the conservation programs and other demand management related activities. Established in 1988, this funding mechanism supports Metropolitan's commitment to conservation as a long-term water management strategy.

The basis of Metropolitan's financial support to member agency conservation efforts is estimated at $195 per acre-foot of water saved up to the device cost. In general, CCP-funded water conservation project proposals must:

- Have demonstrable water savings;
- Reduce water demands on Metropolitan's system; and
- Be technically sound and require Metropolitan's participation to make the project financially and economically feasible.

Table 3-5 summarizes CCP savings and investments. Additional funding for conservation programs has been made available through federal and state government agencies. Metropolitan has worked to obtain a share of this funding to enhance the region's water conservation investments. Table 3-6 describes past sources and uses of these funds.

Table 3-7 summarizes the types and numbers of efficient devices that have been installed through Metropolitan's conservation programs since they began in fiscal year 1990-91.

### *Regional Conservation Programs*

As mentioned above, Metropolitan's conservation programs focus on two main sectors: (1) residential water use, and (2) commercial, industrial and institutional water use.

Residential Programs

Metropolitan's residential conservation activities consist of two major programs:

- SoCal Water$mart - Metropolitan provides a region-wide residential rebate program named SoCal Water$mart. Since its inception in 2008, rebate activity has increased dramatically as many residential customers became increasingly aware of the financial incentives available to them to help offset the purchase of water-efficient devices. To date, this program helped to replace over 3.3 million toilets, 530,000 washing machines, 37,000 urinals, 300,000 smart

irrigation controllers, 2.3 million rotating nozzles, and hundreds of thousands of other devices and appliances.

- Metropolitan-Funded Residential Programs Administered by Member Agencies - Metropolitan's member and retail agencies also implement local residential water conservation programs within their respective service areas and receive Metropolitan incentives for qualified retrofits and other water-saving actions. Typical projects include high-efficiency toilet (HET) distributions, locally administered clothes washer rebate programs, turf removal programs, and residential water audits.

*Residential Rebate Items*

Metropolitan provides incentives on a variety of water efficient devices for the residential sector. The following is a brief description of current and past devices that contribute to projected conservation savings:

- Turf Removal (Residential) - About 50 percent of residential household water demand is used for outside irrigation where opportunities to conserve water are substantial. Southern California residents have turned the turf removal program into Metropolitan's most popular conservation measure. With an increased incentive rate ($2 per square foot of turf removed) during this current drought, approximately 45 million square feet of grass have been removed from residential properties since July 2014 through the regional rebate program, and more turf removal projects are anticipated. To encourage market transformation, Metropolitan has committed over $282 million for the regional turf removal program for both residential and commercial properties for fiscal years 14-15 and 15-16.
- High-Efficiency Clothes Washers - HECWs continue to be a major component of indoor water conservation. The water efficiency of clothes washers is represented by the "integrated water factor," which is a measure of the amount of water used to wash a standard load of laundry. Washers with a lower integrated water factor will save more water. Metropolitan has continued to move the water conservation rebate standards by requiring lower integrated water factors for eligible washers. The program eligibility requirement is currently set at an integrated water factor 3.7, which saves over 10,000 gallons per year per washer over a conventional top loading washer.
- High-Efficiency Toilets - Metropolitan has provided incentives for water efficient toilets since 1988. Metropolitan recently changed its rebate program to provide funding for toilets that flush at 1.1 gallons or less. Metropolitan uses the USEPA's WaterSense list of performance tested high-efficiency toilets and the Maximum Performance of Premium Toilet Models testing list to distinguish qualifying models.
- Rotating Nozzles for Sprinklers - Pop-up spray heads with multi-stream, multi-trajectory rotating nozzles provide outdoor water savings. Field tests and studies have demonstrated these nozzles apply water more evenly than traditional nozzles with fixed fan spray patterns, offering the potential for water savings. Low precipitation rates associated with these nozzles can reduce run-off, thereby offering a significant value-added benefit when irrigating sloping landscapes.
- Irrigation Controllers - Smart irrigation controllers and soil moisture sensors adjust irrigation schedules based on rain, temperature, sunlight, soil moisture, soil conditions, plant types, slope or some combination of indicators. Metropolitan uses the USEPA WaterSense list for eligible controllers.

*Commercial, Industrial and Institutional Programs*

Metropolitan's commercial industrial and institutional (CII) conservation consists of three major rebate and incentive programs:

- SoCal Water$mart Program - The majority of the commercial conservation activity comes from Metropolitan's regional SoCal Water$mart program, which also extends rebates to multi-family properties. The SoCal Water$mart program had its largest year in fiscal year 2014-15, providing about $51.0 million in CII rebates for about 328,000 product replacements.
- Water Savings Incentive Program - The Water Savings Incentive Program provides financial incentives for customized landscape irrigation and industrial process improvements. This program allows large-scale water users to create their own conservation projects and receive incentives for up to 10 years of water savings for measured water-use efficiency improvements.
- Metropolitan-Funded Commercial Programs Administered by Member Agencies - Member and retail agencies also implement local commercial water conservation programs using Metropolitan incentives. Projects target specific commercial sectors, with some programs also receiving assistance from state or federal grant programs. Metropolitan incentives are also used as the basis for meeting cost-share requirements for the grants.

*Commercial Rebate Items*

Metropolitan's CII programs provide rebates for water-saving plumbing fixtures, landscaping equipment, food-service equipment, cleaning equipment, HVAC (heating, ventilation, air conditioning) equipment, and medical equipment.

- Turf Removal (Commercial) - Similar to the residential sector, water demand for landscape irrigation on commercial, industrial, and institutional properties is significant. Opportunities to conserve water are substantial, particularly in areas with ornamental turf. With an increased incentive rate ($2 per square foot of turf removed) during this current drought, approximately 27 million square feet of grass have been removed from commercial, industrial, and institutional properties since July 2014 through the regional rebate program, and more turf removal projects are anticipated. To encourage market transformation, Metropolitan has committed over $282 million for the regional turf removal program for both residential and commercial properties for fiscal years 2014-15 and 2015-16.
- Commercial Devices - Following is a list of current and past devices that contribute to projected conservation savings:
    - Connectionless Food Steamers
    - Cooling Tower Conductivity Meters
    - Dry Vacuum Pumps
    - High-Efficiency Clothes Washers
    - High-Efficiency Toilets
    - High-Efficiency Urinals
    - Ice Machines
    - In-Stem Flow Regulators
    - Large Rotors - High Efficiency Nozzles
    - Multi Stream Rotating Nozzles
    - pH Cooling Tower Controllers
    - Plumbing Flow Control Valves
    - Pre-rinse Spray Heads
    - Steam Sterilizers
    - Ultra-Low-Flush Toilets
    - Ultra-Low-Flush Urinals
    - Water Brooms
    - Weather-Based Irrigation Controllers
    - X-ray Processors
    - Zero Water Urinals

### Metering

Metropolitan's water distribution system is metered. Metropolitan has over 400 service connections that meter water deliveries to our member agencies. Meters at these service connections are checked every six months or sooner to verify that they are measuring correctly. More extensive maintenance is done on a yearly basis to ensure the meter systems continue to operate reliably.

### Research and Development Programs

Metropolitan is committed to conservation research as a way to advance technology, improve program results, and help transform markets. Self-funded studies include water savings analysis of various rotating nozzle incentive programs, water savings from turf removal projects, and water savings analysis of smart/weather based irrigation controllers.

Metropolitan's Innovative Conservation Program (ICP) is a competitive grant program that evaluates water savings and reliability of new water saving devices, technologies, and strategies. With funding provided by USBR, SNWA, Central Arizona Project, and Metropolitan, approximately $500,000 of funding was available for research for the 2013 ICP. After evaluating 50 project proposals, thirteen were selected. The majority focused on landscape water use, but there were also commercial, agricultural, and residential water use studies as well. The next round of grants will be implemented in fiscal year 2016-17.

Metropolitan has partnered with the Alliance for Water Efficiency (AWE) for water conservation research. Recent projects include: a drought management study of Australia, a water neutral development ordinance; and a study on commercial kitchen efficiency, outdoor impacts of the drought, and reasons and rationale for landscape choices.

#### Measurement and Evaluation

Measurement and evaluation are important components of Metropolitan's conservation programs. These serve four primary functions:

- Providing a means to measure and evaluate the effectiveness of current and potential conservation programs
- Developing reliable estimates of various conservation programs and assessing the relative benefits and costs of these interventions
- Providing technical assistance and support to member agencies in the areas of research methods, statistics, and program evaluation
- Documenting the results and the effectiveness of Metropolitan-assisted conservation efforts

Metropolitan's staff has served as technical advisors for a number of state and national studies involving the quantification and valuation of water savings.

### Recognition for Conservation Achievements

Conservation is an integral part of water supply planning at Metropolitan. Metropolitan works to improve the understanding of the costs and benefits of conservation so investment decisions are both efficient and effective at meeting program goals. As a cooperative member of California's water conservation community, Metropolitan has made significant contributions to the development and coordination of conservation activities throughout the state. These contributions have been recognized in the form of "Gold Star" certification from the Association of California Water Agencies and awards from the USBR and California Municipal Utilities Association. Metropolitan was recently awarded the AWWA's 2014 Public Communications Achievement Award for its water awareness and conservation outreach campaign.

**Table 3-4**
**School Education Programs**

| Program or Activity | Date Initiated | Date Updated | Current Status | Grades | Description |
|---|---|---|---|---|---|
| Admiral Splash | 1983 | 2006 | Ongoing | Grades 4-5 | A two-week program focusing on Southern California history, the water cycle, supply and the distribution system, water uses and conservation. |
| All About Water | 1991 | 2008 | Ongoing | K-2 | Activities to teach young students about droughts, conservation, water quality and physical properties of water. |
| Geography of Water | 1993 | 1998 | Ongoing | Grades 4-8 | A curriculum module on the relationship between population, precipitation, geography, economics, and water distribution. |
| Guzzler Gang | 1993 | 2004 | Ongoing | K-3 | Water conservation book introduces students to characters who are known for "guzzling" water. |
| Water Ways | 1995 | 2006 | Ongoing | Grade 5 | A supplement integrated into fifth-grade U.S. History curricula regarding water use, sources, ethics, and environment issues selected from three historical periods. This includes historical attitudes towards the stewardship of water. |
| Water Quality | 2001 | - | Ongoing | Grades 7-12 | Hands-on activities to investigate water quality issues, with conservation as an element of the overall picture. |
| Water Works | 2001 | - | Ongoing | Grades 7-12 | A school-to-career, job-specific program featuring activities and profiles on a variety of water-related careers, including conservation specialist. |
| Water Times | 2005 | - | Ongoing | Grade 6 | An age-appropriate newspaper that provides interdisciplinary concepts, tools, and calculations related to water conservation, and that conveys an overall ethic of water stewardship. |
| Conservation Connection: Water and Energy Use in Southern California | 2010 | - | Ongoing | Grades 6-8 | An activity-focused unit designed to engage students in finding solutions to conserve both water and energy at school and home. The curriculum also contains an online water and energy survey for students and their families. |
| Little Splash | 2012 | | Ongoing | K-3 | Collection of 21 activity and coloring pages including reading, writing, coloring, drawing, and working puzzles that teach concepts about water. |

**Table 3-5**
**Metropolitan's Conservation Credits Program**

| Fiscal Year | Annual Water Savings (AF) | Investment |
|---|---|---|
| 2014 – 2015 | 179,000 | $142 million |
| 2013 – 2014 | 157,000 | $16.9 million |
| 2012 – 2013 | 161,000 | $11.4 million |
| 2011 - 2012 | 156,000 | $12.9 million |
| 2010 - 2011 | 153,000 | $16.0 million |
| 2009 - 2010 | 147,000 | $36.7 million |

**Table 3-6**
**Grant Program Funding**

| Funding Source | Program/Project | Funding Amount ($1,000s) | Description | Status |
|---|---|---|---|---|
| **CALFED** | | | | |
| | Residential HECW | $925 | Increase rebate amount | Completed |
| | Protector del Agua | $100 | Course development | Completed |
| **Prop 13 Grants** | | | | |
| | HECW | $2,500 | Increase rebate amount | Completed |
| | ET Controllers | $1,800 | Initiate rebates | Completed |
| **CPUC (w/CUWCC)** | | | | |
| 2003 | Pre-Rinse Spray Valves: Phase 1 | $1,600[1] | 12,000 direct installations[1] | Completed |
| 2004 | Pre-Rinse Spray Valves: Phase 2 | $2,200[1] | 17,000 direct installations[1] | Completed |
| **USBR** | | | | |
| 2003 | CA-Friendly Landscapes | $182 | New home landscapes | Completed |
| 2003 | Data Loggers | $50 | Software error analysis | Deferred |
| 2004 | CA-Friendly Landscapes | $60 | New home landscapes | Completed |
| 2004 | Synthetic Turf pilot | $220 | Provide incentives | Completed |
| 2004 | World Forum | $50 | College/university grants | Completed |
| 2004 | CII Region wide | $250 | Additional dollars to rebate amounts and for administration | Completed |
| 2005 | Protector del Agua | $50 | Develop web classes | Completed |
| 2005 | Landscape Market Analysis | $50 | Analyze landscape conservation opportunities | Completed |
| 2005 | City Makeover | $50 | Public landscapes | Completed |
| 2006 | Innovative Conservation Program | $300 | Support research projects | Completed |
| 2008 | Innovative Conservation Program | $300 | Support research projects | In Progress |
| 2012 | Sprinkler Nozzle Incentive Program | $1,501 | Provide incentives | In Progress |
| 2013 | High Efficiency Clothes Washer Program | $500 | Provide incentives | In Progress |
| 2014 | California Friendly Turf Replacement – Phase 2 Incentive Program | $300 | Provide incentives | In Progress |
| **Water for the West** | | | | |
| | Protector del Agua | $25 | Develop web classes | Completed |
| **Prop 50** | | | | |
| | Residential HECW | $1,660 | Increase rebate amount | Completed |
| | CA-Friendly Landscapes | $423 | Common area landscapes | Completed |
| | High Efficiency Toilets | $1,000 | Increase rebate amount | Completed |
| | Protector del Agua | $78 | Develop on-line classes | Completed |
| 2008 | Residential HECW | $2,000 | Increase rebate amount | Completed |

[1] This is the funding amount and number of installations that represent Metropolitan's share of the project.

**Table 3-7**
**Conservation Achievements in Metropolitan's Service Area**

| | Qty | Units |
|---|---|---|
| **CII Rebated Devices (FY 1990-91 to FY 2014-15)** | | |
| Audits/Surveys | 13,432 | ea |
| Connectionless Food Steamers | 56 | ea |
| Cooling Tower Conductivity Controllers | 1,196 | ea |
| Dry Vacuum Pump | 33 | ea |
| Toilets | 196,939 | ea |
| Urinals | 37,162 | ea |
| Ice Machines | 56 | ea |
| In-stem Flow Regulators | 8,701 | ea |
| High Efficiency Washers | 36,427 | ea |
| pH Conductivity Controllers | 338 | ea |
| Plumbing Flow Control Valves | 13,770 | ea |
| Pre-Rinse Spray Heads | 17,177 | ea |
| Laminar Flow Restrictors | 13173 | ea |
| Multi-Stream Rotating Nozzles | 1,247,644 | ea |
| Soil Moisture Sensors | 21 | ea |
| Steam Sterilizers | 28 | ea |
| Water Brooms | 6,931 | ea |
| Weather Based Irrigation Controllers | 11,939 | acres |
| Weather Based Irrigation Controllers | 246,593 | stations |
| X-Ray Processors | 185 | ea |
| High Efficiency Nozzles | 78,105 | ea |
| Synthetic Turf | 7,455,647 | sq. ft. |
| Turf Removal | 27,194,789 | sq. ft. |
| **Residential Rebated Devices (FY 1990-91 to FY 2014-15)** | | |
| Aerators | 158,817 | ea |
| Audits/Surveys | 122,810 | ea |
| High Efficiency Clothes Washers | 496,511 | ea |
| Toilets | 3,184,362 | ea |
| Multi-Stream Rotating Nozzles | 1,007,352 | ea |
| Rain Barrels | 18,657 | ea |
| Soil Moisture Sensors | 39 | ea |
| Showerheads | 1,735,436 | ea |
| Turf Removal | 38,387,543 | sq. ft. |
| Weather Based Irrigation Controllers | 2,226 | acres |
| Weather Based Irrigation Controllers | 10,641 | stations |

### *Asset Management Program*

In fulfillment of California Water Code §10631(f)(2), provided below is a description of Metropolitan's distribution system asset management program.

Metropolitan's approach to asset management is contained within its Infrastructure Reliability Strategy. The goal of Metropolitan's Infrastructure Reliability Strategy is to ensure long-term reliable performance of the system in an efficient and cost-effective manner. Infrastructure reliability is addressed through two primary programs: the Maintenance Management Program and the Infrastructure Protection Plan. The activities performed under these programs allow for Metropolitan to extend the life span of its facilities and equipment and improve the overall reliability of the entire conveyance, treatment, and distribution system.

#### *Maintenance Management Program*

Metropolitan manages the maintenance on approximately 135,000 pieces of equipment located at its five treatment plants, sixteen hydro-electric power plants, five desert pumping plants, 242 miles of canals, and over five thousand structures on 819 miles of pipeline.

Computerized Maintenance Management System**:** A Computerized Maintenance Management System (CMMS) is used to track, plan, and schedule the required activities. The system currently has over 28,000 preventative maintenance cycles scheduled with approximately 96 percent of these performed at fixed intervals (Time Based). The remaining four percent are performed based on the condition or use of the equipment (Condition Based).

Routine Maintenance, Inspection, and Monitoring

Monitoring, inspection, and maintenance of equipment and facilities are a proactive effort to assess the overall condition of the assets. It encompasses identifying needed repairs and performing routine maintenance.

Time-Based Maintenance

Metropolitan currently uses time-based maintenance as the primary means of maintaining equipment reliability. Time-based maintenance for equipment is set at specific time intervals using manufacturer recommendations. These recommendations are used to develop Job Plans in the CMMS which detail the individual steps required for a particular maintenance operation.

Condition-Based Maintenance

Condition-based maintenance (CBM) relies on an understanding of how a piece of equipment degrades or fails to meet its intended function. It requires a greater depth of understanding of the manufacturer's recommended maintenance, industry standards, or practices. This knowledge is used in conjunction with field experience to develop a technique to gauge the equipment's condition. Through trending or analysis, a determination can then be made as to when the equipment may reach a point where corrective maintenance will be required including rehabilitation or replacement. A regular inspection cycle is set in the CMMS software to evaluate current equipment condition. High and low condition alarms are also set that trigger a corrective maintenance activity when equipment is starting to degrade or its use has reached a servicing checkpoint.

Predictive maintenance is a subcategory of CBM that uses diagnostic equipment or testing to determine the equipment condition. Predictive maintenance is also used to detect impending problems before the equipment malfunctions. In some cases, Metropolitan has automated the inspections such as through online vibration monitoring systems that trend the performance of

critical and large equipment. A fundamental characteristic of this type of maintenance is that it provides the capability to anticipate potential problems while the equipment is still operating. This provides several key benefits when compared to time-based maintenance or allowing equipment to reach a point where corrective maintenance is required. These benefits include: improved availability or uptime, enhanced reliability, and reduced cost.

Corrective Maintenance

Corrective maintenance is performed on equipment that either has already failed or has had a problem detected during routine (time or condition based) maintenance. Corrective maintenance needs to be scheduled, requires replacing equipment components, or involves a shutdown of the impacted system. Corrective maintenance is also tracked, planned, and scheduled in the CMMS.

Major Scheduled Outages/Shutdowns

In addition to the general maintenance described above, Metropolitan may take major systems out of service, such as water treatment plants, large pipelines, conveyance systems, or other large facilities, typically for periods of seven to twenty-one days. This is done to perform major maintenance or repairs on several components or systems, upgrade or add new processes, or perform other important work.

Reports and Metrics

Metropolitan produces internal reports that track maintenance management activities including overall backlog and past due work orders (including any missed regulatory preventive maintenance). In addition, other CMMS reports are available that provide managers, planners/schedulers, and maintenance staff with the data needed to evaluate and track work.

Metropolitan utilizes best management practices and performance metrics from the Society of Maintenance & Reliability Professionals to ensure a reliable and cost effective maintenance management program.

### *Infrastructure Protection Plan*

Activities under the Infrastructure Protection Plan ensure long-term infrastructure reliability by conducting special condition assessments and vulnerability assessments of Metropolitan's facilities.

Special Condition Assessments

Special Condition Assessments are extensive inspections, investigations, and evaluations of Metropolitan facilities and equipment that go beyond routine maintenance and monitoring activities. The assessments are conducted to identify needed rehabilitation and replacement projects which can lead to long-term reliability programs. These assessments include: inspections of facilities during shutdowns when the facility may otherwise be non-accessible, investigations of systemic issues, and evaluations of Metropolitan's ability to maintain deliveries in the event of an unplanned facility outage or loss of water supply.

Special Condition Assessments may be initiated through requests from Operations, in response to a specific event or concern within Metropolitan's system, or due to an issue identified within the water industry that could potentially affect Metropolitan. Through these activities, long-term infrastructure reliability programs are developed and executed to ensure that the

reliability of Metropolitan's distribution system is unimpeded and the overall life-expectancy of its assets is maintained to the most cost-effective standard possible.

Vulnerability Assessments

Vulnerability Assessments involve simulating hazards such as vehicle impact, flooding, fire, equipment failure, third-party impacts, and earthquakes in order to identify their potential impacts to Metropolitan's ability to deliver water. Like the condition assessments, Vulnerability Assessments utilize operator experience and event reviews to identify potential vulnerabilities and impacts. The assessments evaluate both the reliability of individual facilities, as well as the reliability of Metropolitan's system as a whole, if it is exposed to a potential hazard. It is through these assessments that mitigation options are identified to improve reliability.

Potential mitigation includes facility and equipment upgrades, and procedural changes for designing, operating, or maintaining facilities. In addition, mitigation options may include recommendations for Metropolitan's emergency response planning to improve the capability to respond to an unplanned outage and restore service as quickly as possible. The types of hazards assessed include: seismic activity, hydraulic surge, vehicle impact, equipment malfunction, erosion or flooding, fire, corrosion, wind-blown projectiles, third party construction, and vandalism.

As a part of the Vulnerability Assessments, a specific set of reliability design criteria for water treatment plants have been developed to ensure optimal reliability, starting in the design phase. These reliability design criteria establish design practices that ensure that reliability is designed into new facilities, and that the staff uses this criterion when reviewing each capital project.

## 3.5 Recycling, Groundwater Recovery, and Desalination

Metropolitan continues to support local resources development through its Local Resources Program. The Local Resources Program provides financial incentives for local agencies to develop supplies including water recycling, groundwater recovery, and seawater desalination.

Metropolitan's involvement in local resources development started in 1982 as the Local Projects Program to provide financial incentives to its member agencies to develop recycled water projects. In 1991, Metropolitan established the Groundwater Recovery Program to provide financial assistance for the development of groundwater recovery projects. In 1995, these two programs evolved into the Local Resources Program (LRP).

Water recycling projects involve further treatment of secondary treated wastewater that is currently discharged to the ocean, streams, or lands and use it for non-potable uses such as landscape and agricultural irrigation, commercial and industrial purposes, and for indirect potable uses such as groundwater recharge, seawater intrusion barriers, and surface water augmentation. Currently, more than half of the water recycling in California occurs in Metropolitan's service area.

Groundwater recovery projects involve treatment of high salinity or contaminated groundwater for potable uses. Groundwater recovery projects use a variety of treatment technologies to remove undesirable constituents such as nitrates, volatile organic compounds (VOCs), perchlorate, color, and salt. Desalination of brackish groundwater and other local supplies enhances the continued supply reliability of the region by maximizing local groundwater resources.

Metropolitan's service area is also leading the development of seawater desalination in California. The 56 TAF Carlsbad Project in San Diego County started operations in December 2015 and represents the largest seawater desalination project in the country. Several other local water agencies are also considering seawater desalination projects. These projects have the potential to help meet Metropolitan's current goals for new local supplies.

### *Background*

#### *Recycling*

This section provides a description of the wastewater sources that potentially could be recycled. This section also discusses the existing and potential uses of recycled water, as well as the technical and economic issues associated with those uses. In general, Metropolitan supports:

- Increasing water recycling in California and the Colorado River Basin
- Advocating funding assistance by parties that benefit both directly and indirectly from the use of recycled water
- Expanding recycled water uses
- Reviewing recycled water regulations to ensure streamlined administration, and public health and environmental protection
- Planning efforts and voluntary cooperative partnerships at the local and statewide levels
- Conducting research and studies to address public acceptance, new technologies, and health effects assessments
- Increasing cooperation between agencies to serve recycled water in other agency service areas

Wastewater Disposal in the Service Area

As part of regional planning that encourages use of recycled water, a database has been developed that includes the name of each wastewater treatment facility, operating agency, location and elevation of the facility, extent of wastewater treatment, capacity and anticipated production, method of effluent disposal, and influent and effluent water qualities. Shown in Table 3-8 are the existing and projected total effluent capacities of the wastewater treatment plants from a database of 89 plants identified within Metropolitan's service area.

Wastewater treatment capacity provides an indication of the amount of wastewater being generated and disposed in Metropolitan's service area. Most wastewater plants in the service area provide secondary treatment, a level of treatment that complies with the Clean Water Act. Inland wastewater plants generally provide treatment to tertiary levels so the effluent may be disposed of in a stream or other water body or for beneficial reuse. A small percentage of tertiary treated effluent undergoes reverse osmosis or electrodialysis reversal processes, producing high-quality recycled water for groundwater recharge, industrial uses, or, in some instances, municipal uses.

Within Metropolitan's service area, many local agencies collect and treat municipal wastewater. Some of the largest agencies include:

- Los Angeles County Sanitation Districts
- Orange County Sanitation District
- City of Los Angeles Bureau of Sanitation
- San Diego Metropolitan Wastewater Department
- Eastern Municipal Water District
- Inland Empire Utilities Agency

**Table 3-8**
**Existing and Projected Total Effluent Capacity**
**Wastewater Treatment Plants within Metropolitan's Service Area**

| Treatment Level | Existing Capacity (MGD) | 2040 Capacity (MGD) |
|---|---|---|
| Primary | 1,770 | 3,139 |
| Secondary | 1,169 | 2,708 |
| Tertiary | 434 | 1,464 |
| Advanced | 104 | 229 |

This data was compiled as part of the Southern California Comprehensive Water Reclamation and Reuse Study.

Many small special-purpose wastewater agencies, dual-purpose (water and wastewater) special districts, and municipal wastewater agencies also provide wastewater treatment and disposal services within Metropolitan's service area.

Wastewater is collected in a sewer collection system. From there, it flows to a wastewater treatment plant. Once treated, wastewater is disposed of through one of three mechanisms:

### *Ocean Outfalls*

Treated wastewater is either disposed of directly through an ocean outfall or conveyed to the ocean outfall via a land outfall.

### *Reuse*

Currently, about 414 TAF per year of recycled water is used for landscape irrigation, industrial processes, and groundwater recharge applications in the region. A few inland treatment plants (in Riverside and San Bernardino counties) irrigate feed and fodder crops with recycled water. While this use is considered beneficial, it is not necessarily the highest and best use for recycled water. Higher value uses of recycled water include landscape or agricultural irrigation, commercial and industrial applications, groundwater recharge, seawater intrusion barrier, and other uses such as street sweeping and dust control, etc.

### *Stream Discharge*

The majority of inland plants discharge treated effluent into local streams and rivers. That water is then used downstream for beneficial uses, eventually flowing to the ocean. Some of the affected rivers (or ephemeral streams) include:

- Los Angeles River
- Santa Ana River
- Calleguas Creek
- Rio Hondo & San Gabriel Rivers
- Santa Margarita River

### Uses of Recycled Water

Water recycling is a reliable water supply, and it helps local agencies comply with environmental regulations. Uses of recycled water can generally be categorized as below.

### *Industrial*

Industrial users represent a large potential market for recycled water, particularly in heavily industrialized areas, such as the cities of Vernon, Commerce, Industry, and the Wilmington area of Los Angeles. Additionally, refineries in West Basin MWD's service area and the city of Torrance use recycled water. Typical industrial uses include cooling tower makeup water, boiler feed water, paper manufacturing, carpet dying, and process water. Industrial users are high-demand, continuous-flow customers, which allows greater operational flexibility by allowing plants to base load operations rather than contend with seasonal and diurnal flow variations. Because of these operational benefits, industrial users reduce the need for storage and other peak demand facilities and management.

### *Irrigation*

Recycled water is used to irrigate golf courses, parks, schoolyards, cemeteries, greenbelts, roadway medians, and agricultural purposes throughout Southern California. Using recycled water for irrigation reduces the need for imported water during the critical summer months and in drought situations when water supplies are scarce. Unlike industrial uses, irrigation demands have large seasonal variations in reuse.

*Indirect Potable*

Indirect Potable Reuse (IPR) refers to the use of recycled water for groundwater recharge, and surface water reservoir augmentation purposes. These types of uses require additional treatment levels beyond irrigation uses and use of an environmental buffer.

1. *Groundwater Recharge* – Metropolitan's service area overlies numerous groundwater basins, most of which rely on artificial recharge to sustain groundwater production, and some of which are threatened by seawater intrusion. Water agencies along the Los Angeles and Orange Counties coastline inject water into the underlying groundwater basins to create a barrier against this seawater intrusion and protect groundwater quality. The use of recycled water for seawater intrusion barrier projects is increasing and is replacing imported water used for this purpose. Increasing the proportion of recycled water can free imported water for direct consumption. Table 3-9 presents a summary of this recycled water use.
2. *Surface Water Augmentation* – Surface Water Augmentation includes use of advanced treated recycled water to augment a surface water reservoir. The reservoir serves as an environmental buffer (similar to groundwater in the case of groundwater recharge) prior to when recycled water is treated for potable uses. Blended water from the reservoir is then treated at a conventional water treatment plant for potable purposes. There is currently no reservoir augmentation with recycled water in Metropolitan's service area. The Division of Drinking Water (DDW) of the State Water Resources Water Control Board (SWRCB) is required under SB 918 to establish surface water augmentation regulations by December 31, 2016. The City of San Diego is currently operating a demonstration project to evaluate the feasibility and expected permitting requirements of a full-scale reservoir augmentation project.

**Table 3-9**
**2015 Recycled Water Use for**
**Groundwater Replenishment and Seawater Barrier Injection**
(TAF per year)

| Groundwater Basin | Recycled Water Use |
|---|---|
| Central Basin | 45 |
| Chino Basin | 11 |
| Orange County Basin | 88 |
| West Coast Basin | 12 |
| Other Basins | 2 |
| **Total** | **158** |

*Direct Potable Reuse*

Direct Potable Reuse (DPR) refers to the use of advanced treated municipal recycled water as a direct supply to or immediately after a conventional water treatment plant. DPR differs from IPR by having no environmental buffer. DPR eliminates the need and cost to store water in an environmental buffer (groundwater or surface water reservoir) for several months and instead

requires additional treatment or testing to ensure public health requirements are achieved. Currently, there are no permitted DPR projects in California. DDW is required under SB 918 to review recommendations of an expert panel to evaluate and report on the feasibility of DPR to the legislature by December 31, 2016.

Technical and Economic Issues of Recycled Water

Recycled water use is growing rapidly in Metropolitan's service area. Further expansion depends on progress in research, regulatory change, public acceptance, water quality issues, cost, operational issues, and conflicting institutional objectives. Each of these challenges, as well as opportunities for recycled water use, lessons learned, and recommendations to enhance the development of recycled water, are discussed below.

Challenges

*Lengthy and Variable Permitting Process*

The SWRCB established the Recycled Water Policy (Policy). This Policy requires the SWRCB and the nine Regional Water Quality Control Boards (Regional Boards) to encourage the use of recycled water, consistent with state and federal water quality laws. The Policy provides additional directions to the Regional Boards on appropriate criteria to be used in regulating recycled water projects. The DDW and the nine Regional Boards are responsible for setting the rules and permitting for recycled water projects. The timeline and roadmap for getting a permit are challenging and inconsistently implemented in different regions of the state. Limited history and technical information (e.g., on direct potable reuse) to inform regulations and limited staffing at DDW and other agencies have challenged the ability to propose, revise, and adopt new regulations in a timely manner. Agencies planning and designing DPR and IPR projects face delays because of regulatory uncertainty. In addition, many project proponents hoping for grant or loan funding have identified lengthy CEQA review as a challenge.

Indirect potable reuse projects face regulatory constraints such as treatment, blend water, retention time, and Basin Plan Objectives, which are the designated uses assigned by the SWRCB and which may limit how much recycled water can feasibly be recharged into the groundwater basins. For example, the Basin Plan Objective for TDS of a particular basin may be lower than the quality of the tertiary water effluent available, resulting in the need for more blend water or advanced levels of treatment. These treatment requirements impact the economic feasibility of a project.

*Public Perception/Conflicting Messaging*

Conflicting messaging confuses the public about the safety of recycled water. There is not a clear understanding by the public of the difference between non-potable reuse, indirect potable reuse, and direct potable reuse uses. The public is most familiar with non-potable reuse as they see recycled water in use at parks, golf courses, schools, and other large landscapes. However, public perception and acceptance of drinking recycled water (IPR and DPR) is a much bigger challenge. Signage for non-potable reuse projects at parks, schools, and golf courses that read, "Using recycled water; do not drink" can adversely affect the public's acceptance of DPR and IPR. Although public acceptance of recycled drinking water has improved, effective education and public outreach is still needed. There is a need for new messaging to reduce the confusion.

### *Cost*

Cost, including up-front capital and ongoing operation and maintenance, remains a barrier to recycled water development. Most low-cost projects have been built. The price tag for expanding the recycled water distribution systems remains a barrier to full implementation of non-potable reuse projects – these projects require pipelines connecting the treatment plants and the individual users. Some agencies may also be considering indirect potable reuse and direct potable reuse projects to reduce the need to have extensive recycled water distribution systems because of the cost. Some non-potable reuse and indirect potable reuse projects and all direct potable reuse projects require advanced treatment facilities, which are comparatively expensive. Advanced treatment may also require additional brine concentrate disposal facilities (e.g., a brine line) and extensive infrastructure for injection wells/spreading facilities, or for delivery of the product water to a spreading ground, surface reservoir, or water treatment plant for potable uses. End users play a very important role for recycled water advancement. Site conversion costs (borne by the customer) and additional conveyance infrastructure for new customers can also be a barrier to reaching full non-potable reuse project capacity. Some agencies may be challenged with cash flow issues or cannot secure the funding needed to implement projects.

In addition, with the increasing prospect of statewide regulations for indirect potable reuse and direct potable reuse, some agencies pursuing indirect potable reuse are hesitant to extend their existing distribution system for non-potable reuse projects for fear of stranded facilities. Similarly, some agencies pursuing direct potable reuse may delay their planned indirect potable reuse projects to prevent stranded distribution facilities[7].

### *Source Control and Effluent Water Quality Needs*

Source water quality and flow control is essential to help safeguard the water recycling treatment process and the end use of the water by placing controls on the type, timing, and amount of wastewater that comes into the plant. A good source control program limits treatment plant disruptions and ensures treatment processes are capable of handling spikes in volume, industrial influent, and high salinity influent. When it comes to the treatment process, recycled water policy requires that the effluent meets certain water quality standards. Salt and nutrient management plans protect groundwater beneficial uses and prevent excess degradation, which may limit expanded indirect potable reuse applications if the agency does not have funds for advanced treatment to remove salts to meet the Basin Plan Objectives. In some cases, existing source control plans may need to be updated to deal with constituents of emerging concern and with more stringent needs of the users.

Water use efficiency helps conserve water, but also incidentally reduces wastewater volume resulting in an increase in the concentration of wastewater. As a result, additional treatment is needed, which increases operation and maintenance costs of the system. Source water quality is especially important for implementing indirect potable reuse and direct potable reuse projects to protect potable water systems.

### *Operational Issues*

While each agency is different, it is important to recognize the possible operational issues that may occur with the use of recycled water, including:

- Reduction in wastewater flows due to ongoing conservation and drought

[7] Indirect potable reuse projects usually require injection wells or a distribution system to a surface reservoir or recharge basin, and may also require improvements to a surface reservoir, recharge basin, or treatment facility.

- Lack of seasonal storage to address diurnal and seasonal demands; construction of storage facilities may be needed for flow equalization
- Brine disposal needs
- Environmental flow or stream discharge requirements may limit the ability to deliver recycled water during high demand periods
- Regulatory issues such as blend requirements and water quality objectives may impact the effectiveness of indirect potable reuse
- Lack of regional GIS data to optimize recycled water deliveries
- Need for multiple barriers to ensure recycled water quality and for monitoring techniques that provide feedback in real-time to respond to plant disruptions, especially with DPR projects
- Need for additional operator training and certification

#### *Conflicting Institutional Objectives*

Institutional coordination among drinking water, wastewater, and groundwater management agencies may be challenging, and the agencies may face barriers due to the difficulty in aligning varying institutional objectives. The main objective of a wastewater agency is to collect, treat, and safely dispose of wastewater based on a set of established standards. This may conflict with the objectives of a groundwater agency that is legally tasked to protect the quality of groundwater. At the same time, water agencies developing recycled water projects are usually seeking a consistent, higher quality treated wastewater for a successful recycling program – though the wastewater agency may not be treating the wastewater to such higher quality for its normal disposal, and the groundwater agency may still be concerned about the quality of the return flows of this recycled water to the groundwater basin.

### Opportunities

#### *Progress Towards New Regulatory Process*

The State of California has made some progress in developing permit standards that provide opportunities to expand recycled water use.

Non-potable reuse: The SWRCB developed a general permit for non-potable uses of recycled water in June 2014 that provides an opportunity for new projects to come online sooner with more standardized monitoring requirements. Further, revisions are being considered to attract additional users and further streamline recycled water projects.

Indirect and direct potable reuse: The SWRCB is facing a December 2016 deadline under SB 918 to develop regulations for surface water augmentation and to investigate and report to the legislature the feasibility of DPR.

Metropolitan is also working with the WateReuse Association and other agencies on legislative and regulatory issues to streamline permitting processes and to provide needed funding and support for increased use of the recycled water.

#### *New Funding Opportunities*

On January 17, 2014, as part of the governor's emergency drought declaration, the SWRCB, under the Clean Water State Revolving Fund, offered up to $800 million in low-interest loans for water recycling projects that offset or augment state water supplies and can be completed

within three years. Projects must apply for the funding through the SWRCB by December 2, 2015. As of May 27, 2015, over 30 projects had applied requesting more than $1.6 billion in funding.

Proposition 1 (Assembly Bill 1471, Rendon) authorized $7.545 billion in general obligation bonds for water projects with $725 million for water recycling and desalination projects. Another $625 million will be administered through SWRCB's Water Recycling Funding Program for water recycling and $100 million through DWR for desalination.

In 2014, Metropolitan increased the financial incentives under its Local Resources Program (LRP) for agencies to develop recycled water. Metropolitan also established the On-site Retrofit Pilot Program to provide rebates to customers that convert their irrigation and industrial system from potable water to recycled water. In addition, Metropolitan established the Reimbursable Services Program to provide technical and construction assistance to its member agencies for local project development. Under this program, Metropolitan advances funds and is reimbursed by the agency.

### *Improving Public Perception*

The drought has heightened water awareness in the region and has provided momentum for water conservation and reuse. The public is more willing to accept alternative supplies such as recycled water. Public outreach and education have also helped improve the public's perception of recycled water. Public sharing of information, open door stakeholder meetings, and focus groups have been very effective at distributing information and addressing public concerns. Case studies and demonstration projects are used to educate and improve public perception on recycled water.

Ample opportunities exist for cooperation among agencies to address the issue of conflicting and confusing messaging by branding or the use of alternative terminologies. A regional workgroup could explore and encourage outreach partnerships among agencies.

### *New Technologies, Research, and Information Sharing*

New technologies, research, and information sharing greatly enhance the development of recycled water. Programs such as Metropolitan's Foundational Actions Funding Program focus on technical studies and pilot projects that reduce barriers to future local production. Projects under this program include optimizing new treatment techniques for recycled water, exploring new monitoring methodologies, and testing innovative brine concentration technology. In addition to the technical portions of this program, the FAF Program supports collaboration between agencies and regional sharing of information.

Research is especially critical in advancing new water supply options, such as DPR. WateReuse, in partnership with other agencies (including Metropolitan), is leading the California Direct Potable Reuse Initiative[8] to advance DPR as a water supply option in California and to address regulatory, utility, and community concerns. WateReuse's report ***Direct Potable Reuse: A Path Forward***[9] provides an overview of DPR and identifies research needs.

Regional studies can also examine the needs of multi-jurisdictional areas and foster communication among agencies to promote the use of recycled water. For example, sharing regional information such as GIS data can identify areas of recycled water surpluses and needs.

[8] https://www.watereuse.org/foundation/research/direct potable reuse-Initiative
[9] https://www.watereuse.org/product/direct-potable-reuse-path-forward

In addition, a clearinghouse could be developed to collect and disseminate information on research and technology developments and studies.

*Partnerships*

Drinking water, wastewater, and groundwater management agencies share some common objectives, including access to source water, cost minimization, and protection of the environment. Many agencies are successfully cooperating and developing recycled water projects. These partnerships can allow sanitation districts to reduce the cost of disposing treated wastewater in the ocean, reduce impacts to the marine environment, and provide a source of reclaimed water to water agencies for recycling. At the same time, groundwater basin management agencies could be the recipients of final recycled water, helping maintain or increase groundwater levels.

*Lessons Learned*

There have been many success stories on recycled water development. Focusing on public outreach and education has improved public perception. Partnerships and joint efforts among water and wastewater agencies proved to be an effective way to remove barriers and make progress. Numerous studies and research funded by federal, state, and local agencies are benefitting local and regional effort.

*Public Outreach is Important*

Public outreach and education have helped improve the public's perception of recycled water. When the public is informed and takes part in the decision making process, they will likely be more accepting of a project.

Water shortages raise awareness for alternate ways to conserve. As a result, the public is more willing to accept alternative supplies such as recycled water, support the more expensive projects, and tolerate rate increases. Some residential property owners are interested in using recycled water for watering plants to help with the drought. For example, residents have access to recycled water from "residential recycled water fill stations" in the Irvine Ranch Water District. Developing similar programs throughout Southern California would help increase recycled water use and conservation of potable supplies.

*Additional Funding is Needed*

LRP incentives and onsite retrofit program funding have increased use of recycled water in the region by almost 200 percent. However, incentives alone may not be enough to spur project development - capital funding is also necessary because the LRP only provides funding after a project begins operation. As an example, even though Metropolitan recently increased its LRP incentive rates, there are only a few applications for new projects because agencies lack capital funding to construct the project in the first place. Although available construction funding for recycled water projects has increased under the recently passed Proposition 1, projects generally still require a 50 percent local match. One source of funding is typically not enough to fund a recycled water project.

Funding is also needed for studies, pilot projects, and research. Metropolitan's Foundational Actions Funding Program provided funding for studies and pilot projects to help advance the development of local supplies.

*Partnerships Can Be Successful*

History shows us that partnerships among agencies help advance use of recycled water and provide tangible benefits to each participating agency. A good example of partnerships working well is the agreement between Orange County Water District (OCWD) and the Orange County Sanitation District. This partnership began in the 1970s, when OCWD built the Water Factory 21 to produce recycled water to mitigate seawater intrusion in the Orange County Groundwater Basin. Twenty years later, the two agencies decided to jointly build the Groundwater Replenishment System (GWRS) recycled water project. The GWRS is the largest planned indirect potable reuse facility in the world with a current capacity of 100,000 AFY and future expansion to 130,000 AFY.

Other examples of cooperation between agencies to further recycled water use include partnerships between the city of Los Angeles and West Basin Municipal Water District (West Basin Water Recycling Program), the City of Los Angeles and the City of Burbank (North Hollywood Water Recycling Project), City of Long Beach and the Water Replenishment District (Alamitos Barrier Water Recycling Project), and the Sanitation Districts of Los Angeles County and Central Basin Municipal Water District (Century and Rio Hondo Water Recycling Project).

*Water Industry Organizations and Regional Collaboration Help Advance Recycled Water*

Recent advancements to recycled water development are due, in large part, to cooperation and collaboration among water and sanitation districts, as well as other water industry organizations. Historically, the WateReuse Association was one of the main advocates for recycled water development in the state. Their activities initially focused on permitting issues, public outreach/education, conferences for information sharing, and research related to recycled water. As recycled water became a core resource for water and wastewater agencies, they started to ramp up their activities to help advance recycled water and utilized partnerships with academia along with other trade organizations such as the Association of California Water Agencies, California Urban Water Agencies, WateReuse Association, and California Association of Sanitation Agencies. Professional organizations such as American Water Works Association (AWWA) are another vehicle to promote recycled water through research, technical seminars, and operator training and certification. These organizations have proven to be effective in promoting regional collaboration on research and leveraging resources.

Recommendations

*Explore Opportunities to Improve Permitting Process*

- Streamline and simplify water recycling regulations with uniform administration consistent with operations, public health, and the environment
- Support legislation and regulation that expands the types of recycled water uses consistent with the protection of public health and help achieve the state's recycled water goal (an additional 1 million acre-feet by 2020)
- Convene a forum to discuss projects, permitting, and treatment technologies

*Improve Public Education and Awareness of Water Recycling*

- Pursue unified, consistent messaging
- Consider expanding residential fill stations to further advance public acceptance of recycled water

*Explore Various Investment Strategies, Such as Incentives, Ownership, and Partnerships*

- Promote collaboration among stakeholders and agencies to facilitate implementation of recycled water projects in California
- Promote development of new financing to increase water recycling, advance research in science and technology, assess health effects, develop additional regional planning, and study innovative technologies
- Explore a business case for further development of recycled water partnerships or ownership
- Consider additional end user programs to replace potable water systems with recycled water
- Collaborate on pursuing grant funding

*Consider Joint Technical Studies and Projects*

- Explore a collaborative regional effort to develop a regional GIS data set
- Explore integration approaches
- Investigate programs for the development of new technologies, such as comprehensive real-time monitoring devices and techniques that improve water quality and ensure public health, and maintain public confidence
- Study opportunities to protect or improve the quality of wastewater source supplies
- Explore development of a regional study to help identify opportunities for seasonal storage

### *Groundwater Recovery*

All Southern California groundwater basins experience varying degrees of water quality challenges as a result of urban and agricultural uses. The accumulation of high-salinity water and degradation from volatile organics are two common constraints to the economic use of groundwater for urban applications. In some cases, the threat of increased salt buildup can also complicate conjunctive use of groundwater basins and imported supplies.

Use of degraded groundwater normally requires high levels of treatment. Membrane processes used to recover the majority of severely degraded water have a high capital cost and incur a high operational cost for power. Once treated, however, recovered groundwater may be integrated into potable water systems. Metropolitan initiated its Groundwater Recovery Program (GRP) in 1991 to encourage local agencies to treat and use degraded groundwater for municipal purposes. The GRP was open to all technologies that recovered and used degraded groundwater. It was retired in 1998 and folded into Metropolitan's LRP.

### *Seawater Desalination*

The constant availability of ocean water regardless of weather or climate is one of the key benefits of seawater desalination. Thus, Metropolitan and its member agencies have been considering seawater desalination as a potential new supply source since the 1960s. Up until the 1990s, seawater desalination was considered too expensive compared to other resource alternatives, especially imported water. However, advances in membrane technology, energy recovery, and process design in the 1990s lowered desalination costs compared to other new supply alternatives. By the early 2000s, several member agencies began pursuing local projects to diversify their resource portfolios. In 2001, Metropolitan created an incentive program, the

Seawater Desalination Program, to support these projects. Soon after, the Board approved Metropolitan's role as a regional facilitator for seawater desalination with the purpose of assisting the member agencies with state and regional development issues. In 2014, Metropolitan merged seawater desalination projects into the LRP to promote development of additional local supplies in the region.

### *Changed Conditions*

The status of locally planned projects changes from year to year. Metropolitan periodically surveys its member agencies for planned projects to coordinate local supply projections and plans. Recent changes in long-term strategies, regulations, and funding priorities could provide new opportunities to develop these resources.

#### *Recycled Water*

Several recent state policies and adopted codes help recycled water development as described below.

SWRCB adopted the State Recycled Water Policy (Policy) in February 2009 after several years of negotiation and amended it in 2013 to include the monitoring and analytical requirements for constituents of emerging concern (CEC). The Policy supports the SWRCB Strategic Plan to promote sustainable local water supplies and establishes a mandate to increase the use of recycled water in California by 1 MAF per year over 2002 levels (approximately 525,000 AF) by 2020 and by an additional 3 MAF per year by 2030. The Policy is organized into recycled water goals, roles of agencies, salt and nutrient management plans, landscape irrigation, groundwater recharge, anti-degradation, emerging constituents, and recycled water incentives.

SWRCB's General Permit for Recycled Water Use was adopted June 4, 2014, in response to the Governor's draught declaration and to facilitate the use of recycled water to offset potable water demands. Coverage is available to most treated municipal wastewater for non-potable uses, but specifically excludes groundwater replenishment. Monitoring for CECs is not required for non-potable uses. Application of recycled water for irrigation sites is limited to agronomic rates.

On November 18, 2009, the Building Standards Commission unanimously voted to approve the California Dual Plumbing Code that establishes statewide standards for installing both potable and recycled water plumbing systems in new commercial, retail, and office buildings, theaters, auditoriums, condominiums, schools, hotels, apartments, barracks, dormitories, jails, prisons, and reformatories. The code was adopted January 15, 2010, with an effective date of January 1, 2011.

Assembly Bill 2071 (Levine 2014) directs SWRCB by December 31, 2016, in consultation with other agencies, to determine if the voluntary use of disinfected treated recycled water for watering animals would pose a significant risk to the public and animal health. The SWRCB shall approve the use or establish uniform statewide recycling criteria to address identified risks. Use of recycled water would be prohibited for dairy animals that are producing items for human consumption.

Assembly Bill 2282 (Gatto 2014) directs the California Building Standards Commission to adopt in the 2016 Intervening Code Adoption Cycle mandatory building standards for the installation of recycled water systems for newly constructed commercial and residential buildings in areas where there is access to a water recycling facility.

### *Groundwater Recovery Brine Disposal*

The management of existing regional brine lines and the development of new brine line systems will be a critical factor in the continued growth in brackish groundwater desalination. The brine line will also be applicable for disposing brine from advanced treatment of wastewater for recycled water use. All processes that recover degraded groundwater also produce concentrated waste flows for which disposal can be problematic. Most importantly, membrane processes such as reverse osmosis – the predominant desalting technology used in Southern California – produce significant volumes of brine that can account for about 15 percent of the treated water. In Southern California, brines generated from brackish water desalination are typically disposed through dedicated brine lines to ocean outfalls or sanitary sewers.

The region currently has one fully operating brine line, the Santa Ana Regional Interceptor (SARI line). The SARI line collects brine from desalters in San Bernardino, Riverside, and Orange Counties. A key benefit of the SARI line is that it has allowed inland water agencies to recover impaired groundwater resources which would otherwise be unusable.

A lower portion of a second brine line, Calleguas Regional Salinity Management Pipeline, is in operation while the upper reach is still under construction. The Calleguas Regional Salinity Management Pipeline delivers brine from recycled water plants and groundwater desalination facilities in Ventura County to the ocean.

A third regional line is in the planning phase in San Diego County. The Southern California Salinity Coalition, a coalition of water and wastewater agencies, has advocated for state and federal financial assistance to build these regional brine lines.

### *Seawater Desalination*

In the past five years, State agencies have implemented new regulations which could negatively impact the future development of seawater desalination. This includes the SWRCB's Ocean Plan amendments and Once-Through Cooling regulations, as well as the establishment of Marine Life Protected Areas (MLPAs) in Southern California. At the same time, the impacts of the current drought and the potential for multi-decadal dry-periods due to climate change have increased interest in seawater desalination as a potential long-term response to water shortages.

#### Ocean Plan Regulations

In May 2015, after five years of development, the SWRCB updated California's Ocean Plan with regulations affecting new seawater desalination projects. The regulations include stringent requirements for intakes, outfalls, brine discharges, and marine life mitigation. Regional Water Quality Control Boards will be responsible for implementing the regulations and will have broad powers over project design elements. The new regulations may increase project costs and could limit the ability to develop regional-scale projects.

#### Once-Through Cooling Regulations

Prior to the revised Ocean Plan regulations, the SWRCB in 2010 adopted regulations requiring coastal power plants to phase out the use of once-through-cooling (the use of seawater to cool generators in a single-pass system) by 2030. As once-through-cooling is phased out, many of the environmental and operational benefits of co-locating seawater desalination projects with power plants will be diminished. However, coastal power plants remain attractive sites for

development due to the presence of coastal-dependent industrial zoned land, power infrastructure, and the potential to repurpose existing infrastructure.

Marine Life Protected Areas

In 2011, the California DFW adopted a system of 50 MLPAs covering approximately 15 percent of Southern California's coastline[11]. MLPAs are defined zones along the coast where certain commercial and recreational activities are restricted. Most construction and operational activities associated with seawater desalination are prohibited in MLPAs with the exception of certain types of subsurface intakes. MLPAs are located along the Channel Islands, as well as along the mainland coast. The MLPAs network includes areas near planned seawater desalination projects. Depending on how MLPAs enforcement regulations are interpreted, they could be a limiting factor for some planned seawater desalination projects.

## *Implementation Approach*

### *Local Resources Program*

The Local Resources Program (LRP) is the primary tool for Metropolitan to incentivize local resources development. The success of the LRP is due to its adaptability to changed conditions. Periodically, Metropolitan and its member agencies review and update the LRP in response to water supply conditions.

Metropolitan continues to explore ways to help increase recycled water use. In order for a site to receive recycled water, the potable water systems must be retrofitted for recycled water use. On-site conversion costs (borne by customers) are generally high. In July 2014, Metropolitan established the On-site Retrofit Pilot Program to provide financial incentives to customers for the conversion of their potable industrial and irrigation systems to recycled water.

Furthermore, in October 2014, Metropolitan made significant improvements to the LRP that included increasing the incentive amount and providing three incentive payment structures. Metropolitan offers three LRP incentive payment structure options to choose from: sliding scale incentives up to $340/AF over 25 years, sliding scale incentives up to $475/AF over 15 years, or fixed incentives up to $305/AF over 25 years. In addition, onsite retrofit costs for recycled water uses are eligible for LRP incentives. Under the enhanced program, LRP projects include other local water resources development including seawater desalination. To expedite development of ready-to-proceed projects, Metropolitan would also provide reimbursable services, such as engineering design, to member agencies.

### *Regional Recycling Program*

On November 10, 2015, Metropolitan's Board authorized Metropolitan to enter into an agreement with the County Sanitation District No. 2 of Los Angeles County (Sanitation District) to implement a demonstration-scale recycled water treatment plant and to establish the framework of terms and conditions for development of a regional recycled water supply program. Under this proposed agreement, Metropolitan has the opportunity to work collaboratively with the Sanitation District to develop a potential regional recycled water supply program that would purify and reuse water for the recharge of groundwater basins. Metropolitan and the Sanitation District would jointly develop this program to purify secondary effluent from the Sanitation District's Joint Water Pollution Control Plant (JWPCP) using advanced treatment technologies to produce water that is near-distilled in quality and that

[11] http://www.wildlife.ca.gov/Conservation/Marine/MPAs/Network/Southern-California

would be equal to or better than the quality of water currently used to replenish groundwater basins in the Southern California region. The secondary effluent from the JWPCP is currently discharged to the Pacific Ocean. The purified water would be delivered to Metropolitan's member agencies to meet their groundwater recharge and storage requirements. A collaboration between the two districts could advance the reuse of water at a scale, timing, and strategic location to serve the direct needs of multiple member agencies for recharge of groundwater basins in Southern California, and to augment regional supplies for Metropolitan's service area.

The demonstration project would serve as a proof of concept and would provide critical information needed for implementation of a potential regional recycled water supply program. The demonstration project would consist of three components: (1) a one million gallon per day (MGD) demonstration-scale treatment plant, which would verify source water quality criteria and confirm the advanced treatment process needed to purify water for groundwater recharge; (2) feasibility studies of the delivery system to determine the distribution facilities, routing, capacity, phasing, and timing needed to recharge various groundwater basins within Metropolitan's service area, and (3) a financing plan to assess the economic viability of a full-scale regional program. The proposed agreement also establishes the framework for the development of a full-scale regional recycled water supply program that would enable a potential reuse of up to 150 MGD of treated effluent from the Sanitation District's JWPCP.

### *Seawater Desalination Program*

Metropolitan's Seawater Desalination Program (SDP) was created in 2001 through a competitive Request for Proposals (RFP) to encourage the development of potential projects by local agencies. Like the LRP, it offers sliding-scale incentives to member and local agencies, providing up to $250 per AF for produced supplies. In response to the RFP in 2001, Metropolitan entered into SDP agreements with three member agencies. The Carlsbad Project was originally part of the SDP program, but has proceeded without an SDP agreement or incentives. A fifth potential project in the initial RFP was not pursued.[12] In 2014, Metropolitan expanded regional funding opportunities for seawater desalination by merging it into the LRP incentive program described above. Table 3-10 provides a summary of the status of the SDP projects. Local agencies are also considering a number of projects independent of the SDP with the potential to produce up to 360 TAF per year if developed. Table 3-11 provides a summary of these local agency projects.

Metropolitan also provides regional facilitation for seawater desalination by providing technical assistance, supporting member agency projects during permit hearings and other proceedings, coordinating responses to proposed legislation and regulations, and working with the member agencies to resolve related issues. To further these goals, Metropolitan help found and now participates in CalDesal, a consortium of water utility and private companies promoting desalination as an element of California's future supply portfolio.

## ***Achievements to Date***

Metropolitan has continued to develop and refine its programs to encourage the involvement of its member agencies in water recycling, groundwater recovery, and desalination. Developing and managing these programs requires considerable coordination and refinement. Changing conditions over the last five years have reduced the costs of these options and allow Metropolitan to rely on these sources for future water supply.

[12] The LADWP opted to not pursue its potential seawater desalination project in the mid-2000s.

Metropolitan is committed to providing financial assistance to the development of water recycling projects throughout its service area. Since 1982, Metropolitan has executed LRP contracts for 75 recycled water projects, 59 of which produced about 184 TAF in 2015. Local projects not receiving funding from Metropolitan provide an additional 272 TAF of recycled water to the region.

Since 1991, Metropolitan has executed GRP and LRP contracts for 24 recovered groundwater projects, 22 of which produced about 57 TAF in 2015. In addition to the projects under Metropolitan's programs, about 50 TAF of degraded groundwater is recovered by agencies in Metropolitan's service area without Metropolitan's financial assistance.

Table 3-12 provides a summary of recycled water use and groundwater recovery in 2015. To date, Metropolitan has invested $372 million in recycling programs and $132 million for groundwater recovery. Table 3-13 provides a summary of the groundwater and recycled water production and incentive payments under Metropolitan's programs to date.

Member agency seawater desalination projects under Metropolitan's SDP are still in the planning stages, though significant pilot testing and related studies have been completed by the local agencies in support of the projects. The 56 TAF Carlsbad project was completed and is now operational without Metropolitan's financial assistance.

**Table 3-10**
**Seawater Desalination Program Project Status**

| Project | Member Agency Service Area | Capacity Range AF per Year | Status | SDP Agreement |
|---|---|---|---|---|
| Long Beach Seawater Desalination Project | Long Beach Water Department | 10,000 | Long-term intake testing | Yes |
| Doheny Desalination Project | Municipal Water District of Orange County/ South Coast Water District | 5,000 – 16,000 | Pre-EIR Studies | Yes |
| Carlsbad Seawater Desalination Project | San Diego County Water Authority | 56,000 | Operational | No |
| West Basin Seawater Desalination Project | West Basin Municipal Water District | 20,000 – 60,000 | Pre-EIR Studies | Yes |
| **Total: Seawater Desalination Projects** | | **91,000 – 142,000** | | |

**Table 3-11**
**Other Potential Seawater Desalination Projects in Metropolitan's Service Area**

| Project | Member Agency Service Area | AF per Year | Status |
|---|---|---|---|
| Huntington Beach Seawater Desalination Project | Municipal Water District of Orange County / Orange County Water District | 56,000 | Permitting |
| Camp Pendleton Seawater Desalination Project | San Diego County Water Authority | 56,000 to 168,000 | Planning |
| Ventura County | Calleguas Municipal Water District | 20,000 to 80,000 | Feasibility Study |
| Rosarito Beach | San Diego County Water Authority, Otay Water District | 56,000 to 112,000[1] | Feasibility study |
| **Total: Other Potential Projects** | | **160,000 – 360,000** | |

[1] Metropolitan's service area would receive a share of the total supply produced by the project.

**Table 3-12**
**2015 Recycled Water Use and Groundwater Recovery**
(TAF)

| Type of Project | With Metropolitan Funding | Without Metropolitan Funding | Total |
|---|---|---|---|
| Recycled Water[1] | 184 | 230[1] | 414 |
| Groundwater Recovery | 60 | 55 | 115 |
| **Total** | **244** | **285** | **529** |

[1] Including 60 TAF of Santa Ana River baseflow.

**Table 3-13**
**Local Resources Program**

| | Recovered Groundwater | Recycled Water | Total |
|---|---|---|---|
| **Projects** | | | |
| In Operation | 24 | 75 | 99 |
| Ultimate Yield (TAF) | 112 | 310 | 422 |
| **Deliveries (TAF)** | | | |
| FY 2014-2015 | 60 | 184 | 244 |
| Since Inception | 791 | 2,237 | 3,028 |
| **Payments ($ millions)** | | | |
| FY 2014-2015 | $8 | $30 | $38 |
| Since Inception | $132 | $372 | $504 |

## 3.6 Surface Storage and Groundwater Management Programs: Within the Region

Since the 1950s, local water management in Metropolitan's service area has included the surface water storage and conjunctive use of groundwater. Conjunctive use of water refers to the use and storage of imported surface water supplies in groundwater basins and reservoirs during periods of abundance. This stored water is available for use during periods of low surface water supplies as a way of augmenting seasonal and multiyear shortages.

### *Background*

Metropolitan established general long-term storage guidelines in its WSDM Plan. The WSDM Plan provides for flexibility during dry years, allowing Metropolitan to use storage for managing water quality, hydrology, SWP, and CRA issues. Dry-year surface storage yields have been characterized in several ways, including delivery capabilities over two- and three-year dry periods. The approach used in Metropolitan's resource planning assumes that dry-year surface storage can be used as needed and as available within the WSDM planning framework. In addition to surface reservoirs in the region, storage capacity in the region's groundwater basins allows for conjunctive use programs. In 2000, the Association of Ground Water Agencies (AGWA) published Groundwater and Surface Water in Southern California: A Guide to Conjunctive Use that estimated the potential for dry-year or long-term conjunctive use in Metropolitan's service area at approximately 4.0 MAF. In 2007, Metropolitan published the Groundwater Assessment Study that estimated 3.2 MAF of space in groundwater basins available for storage within Metropolitan's service area. Metropolitan's 1996 IRP calls for the development of conjunctive use programs with member agencies and groundwater basin managers to store surplus imported supplies in wet years to provide dry-year supplies.

To prepare for supply disruptions, Metropolitan and its member agencies have adopted goals for water storage within the region. Metropolitan has identified in-region storage that should be set aside for use in emergencies, such as a disruption to imported supplies due to a major seismic event at the San Andreas Fault.

### *Implementation Approach*

#### *Surface Storage*

Since the beginning of the Metropolitan's planning process, two significant changes have occurred to regional surface storage. These two changes are the construction of DVL and Metropolitan receiving operational control of 218,940 AF in Castaic Lake and Lake Perris.

Diamond Valley Lake

Construction of Southern California's newest and largest reservoir nearly doubled the area's surface water storage capacity. Transport of imported water to the lake began in November 1999, and the lake reached capacity in early 2003. DVL holds up to 810 TAF, some of which is for dry-year or seasonal storage, and the remainder for emergency storage.

SWP Terminal Reservoirs

Under the 1994 Monterey Agreement and Amendment, Metropolitan received operational control of 218,940 AF in the reservoirs at the southern terminals of the California Aqueduct. Control of this storage capacity in Castaic Lake and Lake Perris gives Metropolitan greater flexibility in handling supply shortages. In 2005, seismic concerns arose regarding Perris Dam. In response, DWR reduced the storage amount at Lake Perris by half until those concerns can be studied and addressed; however, Metropolitan's operational storage remained the same. Since then, Metropolitan has continued to withdraw and replace water from the reservoir

operating from the lower level. In November 2011, DWR issued a Final EIR for the repair of the dam at Lake Perris. Construction work began on August 2014 and is anticipated to continue through 2017.

### *Groundwater Storage*

Many local groundwater storage programs have been implemented over the years to maximize the use of local water supplies. These programs have included the diversion of water flows into percolation ponds for recharging groundwater basins and the recovery of degraded groundwater.

- For many years, flood control agencies within Metropolitan's service area have captured and spread stormwater for groundwater replenishment. Local runoff and reclaimed water have been conserved via spreading grounds, injection wells, reservoirs, and unlined river channels. In addition, flood control agencies have operated seawater barrier projects in Los Angeles and Orange Counties to prevent seawater intrusion into the coastal groundwater basins.
- Water quality problems have raised serious concerns about the ability to sustain average annual production levels in some groundwater basins. The federal Superfund program, although slow to implement clean-up projects, has helped maintain or increase the usable groundwater. These increased levels have been augmented by groundwater water recovery projects discussed in Section 3.5.

Conjunctive use of the aquifers offers an even more important source of dry year supplies. Unused capacity in Southern California groundwater basins can be used to optimize imported water supplies, and the development of groundwater storage projects allows effective management and regulation of the region's major imported supplies from the Colorado River and SWP. Over the years, Metropolitan has implemented conjunctive water use through various programs. Typically, this storage takes place in one of two ways:

- Direct deliveries to storage – Metropolitan delivers recharge water directly to water storage facilities, including spreading sites and injection wells.
- In-lieu deliveries to storage – Metropolitan delivers additional water directly to a member agency's distribution system. The member agency then uses this water rather than pumping the groundwater it otherwise would have taken out of storage. The deferred local production results in water being left in local storage (surface or groundwater) for future use.

Metropolitan has developed a number of local programs to work with its member agencies to increase storage in groundwater basins. Metropolitan has encouraged storage through its cyclic and conjunctive use storage programs. These programs allow Metropolitan to deliver water into a groundwater basin in advance of agency demands. Cyclic storage agreements allow pre-delivery of imported water for recharge into groundwater basins in excess of an agency's planned and budgeted deliveries making best use of available capacity in conveyance pipelines, use of storm channels for delivery to spreading basins, and spreading basins. This water is then purchased at a later time when the agency has a need for groundwater replenishment deliveries. Conjunctive use agreements provide for storage of imported water that can be called for use by Metropolitan during dry, drought, or emergency conditions. During a dry period, Metropolitan has the option to call water stored in the groundwater basins pursuant to its contractual conjunctive use agreements. At the time of the call, the member agency pays Metropolitan the prevailing rate for that water. Metropolitan has drawn on dry-year supply from cyclic storage accounts and nine contractual conjunctive use storage programs to address shortages from the SWP and the CRA.

### *Achievements to Date*

In 2000, Metropolitan entered an agreement with DWR to administer $45 million of Proposition 13 state bond funds for Metropolitan's Southern California Water Supply Reliability Projects Program. Metropolitan paired the $45 million of state funds with $35 million of Metropolitan capital funds to develop nine groundwater storage programs in partnership with member and retail agencies and groundwater basin managers. These nine contractual storage programs provide for storage of up to 212 TAF and dry-year yield of up to 70 TAF. These programs are summarized in Table 3-14.

In 2007, Metropolitan prepared the Groundwater Assessment Study Report in collaboration with its member agencies and with groundwater basin managers. The report finds that while there is substantial storage space in service area groundwater basins that could be used for conjunctive use, there are significant challenges that must be overcome in order to implement additional storage programs. Use of additional storage opportunity requires:

- Capture, delivery, and recharge of additional local and imported surface supplies;
- Improved capability to store available surplus surface supplies with adequate conveyance and recharge capacity; and
- Resolution of constraints including: remediation of contamination, institutional and legal issues, funding for significant investment in capital infrastructure, and incongruity between aquifer capability with overlying demand for water supplies.

To follow up on the findings of the Groundwater Assessment Study Report, Metropolitan initiated a series of seven groundwater workshops beginning in July 2008 among Metropolitan, member agencies, groundwater basin managers, and stakeholders to discuss challenges for increasing conjunctive use and to develop recommendations for addressing the challenges. The workgroup's recommendations were submitted as a Board Report to Metropolitan's Board of Directors and provided as input to Metropolitan's current planning process. The recommendations are as follows:

1. Enhance groundwater recharge with increased stormwater, recycled water, and imported water recharge.
2. Streamline requirements, remove policy constraints, clarify procedures, increase coordination and sharing of information to accomplish recharge goals.
3. Develop flexible regional policies and programs that can be tailored to meet specific local needs of each groundwater basin.
4. Increase integration of local groundwater and regional water supplies with a proposal for a comprehensive modeling study to initiate review of innovative opportunities.
5. Use appropriate price signals to encourage conjunctive use and investments for storage.
6. Increase coordination among Metropolitan, member agencies, basin managers, groundwater producers, and stakeholders inclusive of collaboration for legislative, regulatory, and educational efforts in support of specific initiatives and funding needed for sound groundwater management.

As part of Metropolitan's 2015 IRP Update, two workshops focusing on sustainable local groundwater were held with member agencies and groundwater basin managers. Since 2013, Metropolitan has also been working with the SCWC Stormwater Task Force to evaluate the feasibility of further supporting groundwater production with increases in stormwater capture for groundwater recharge. In 2015, the SCWC's 4th Annual Stormwater Workshop was held to invite input to Metropolitan's IRP process.

**Table 3-14**
**Contractual Conjunctive Groundwater Projects**

| Project and Project Proponents | Storage Capacity (TAF) | Dry-Year Yield (TAF/Year) | Storage Account Balance as of 12/31/2015 (TAF) |
|---|---|---|---|
| **LOS ANGELES COUNTY** | | | |
| **Long Beach Conjunctive Use Project**<br>Long Beach | 13.0 | 4.3 | 0 |
| **Foothill Area GW Storage Project**<br>Foothill MWD | 9.0 | 3.0 | 0 |
| **Long Beach CUP: Expansion in Lakewood**<br>Long Beach | 3.6 | 1.2 | 0 |
| **City of Compton Conjunctive Use Program**<br>City of Compton | 2.3 | 0.8 | 0 |
| **Upper Claremont Heights Conjunctive Use**<br>Three Valleys MWD | 3.0 | 1.0 | 0.3 |
| **ORANGE COUNTY** | | | |
| **Orange County GW Conjunctive Use Program**<br>OCWD, MWDOC | 66.0 | 22.0 | 5.7 |
| **SAN BERNARDINO COUNTY** | | | |
| **Chino Basin Programs**<br>IEUA, TVMWD, Chino Basin Watermaster | 100.0 | 33.0 | 0 |
| **Live Oak Basin Conjunctive Use Project**<br>Three Valleys MWD | 3.0 | 1.0 | 0.7 |
| **RIVERSIDE COUNTY** | | | |
| **Elsinore Groundwater Storage Program**<br>Western MWD, Elsinore Valley MWD | 12.0 | 4.0 | 0.1 |
| **Total** | **211.9** | **70.3** | **6.8** |

## 3.7 Water Use Reduction

In November 2009, Governor Arnold Schwarzenegger signed the Water Conservation Act of 2009 (SB X7-7) into law as part of the historic comprehensive water package designed to address the State's growing water challenges. The Act represented the culmination of efforts by water industry leaders (including Metropolitan), the environmental community, and the Legislature to enact legislation that would answer the governor's call for the state to reduce per capita water use 20 percent by the year 2020 (referred to as "20x2020") as part of a larger effort to ensure reliable water supplies for future generations and restore the Bay-Delta.

The 20x2020 legislation requires urban retail water suppliers to develop urban water use targets to help meet the 20 percent reduction in water use by 2020, with interim targets for 2015. The legislation provides flexibility in how targets are established and achieved. Per capita reductions can be accomplished through any combination of increased water conservation, improved water use efficiency, and increased use of recycled water to offset potable demand. Potable demand offsets can occur through direct reuse of recycled water, such as for irrigation, or indirect potable reuse through groundwater recharge and reservoir augmentation. Retail water suppliers receive partial credit for past efforts in conservation and recycled water; therefore, not all agencies need to reduce demand by 20 percent in order to comply with the law.

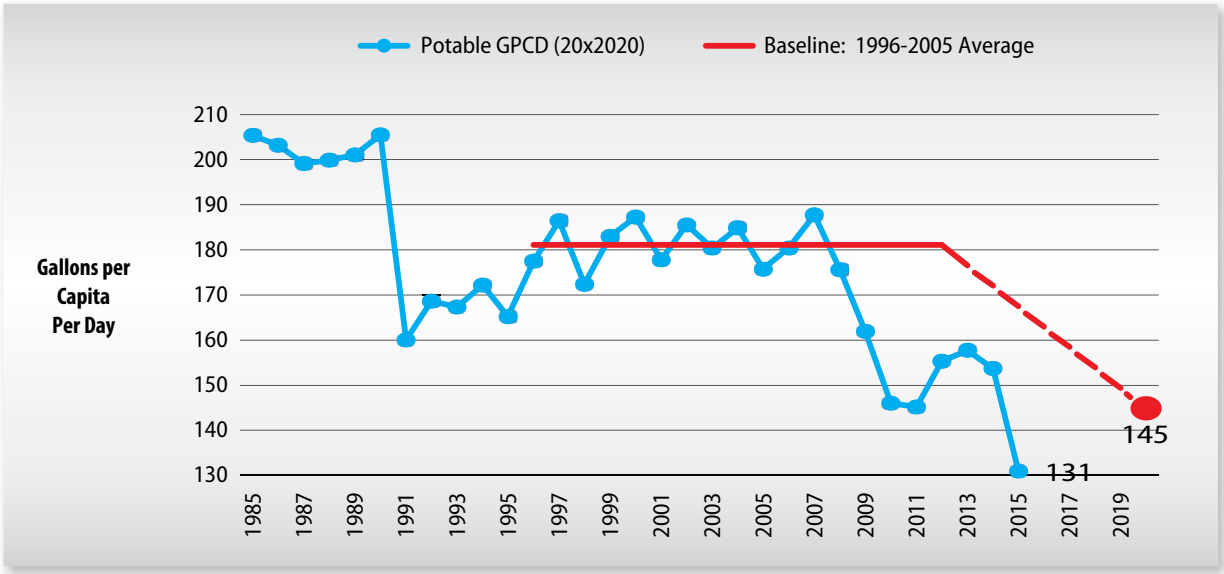
### *Achievement as of 2015*

As a wholesale water agency, Metropolitan is not required to establish or report an urban water use reduction target. However, Metropolitan's CCP and LRP are designed to assist member agencies and retail water suppliers in the service area to comply with SB X7-7. These programs are described in Sections 3.4 and 3.5. Therefore, Metropolitan monitors the progress of its service area.

Based on an analysis of population, demand, and the methodologies for setting targets described in the legislation, Metropolitan's baseline is 181 GPCD, and the 2020 reduction target is 145 GPCD, as illustrated in Figure 3-4. From 2011-2014, there was a slight increase in per capita water use explained in part by continued economic recovery and drier weather as compared to previous years. With mandatory restrictions from the state and water supply allocation from Metropolitan, the 2015 GPCD is 131, a 28 percent reduction from the baseline.

Over the next five years, Metropolitan will periodically assess water supply conditions and trends in per capita demand within its service area and evaluate potential programs to ensure attainment of the goal. Metropolitan also continues to provide support for retail agency efforts through technical assistance, legislation, code and standards updates, and potential financial incentives where needed for market transformation to increase water use efficiency.

**Figure 3-4 Potable Per Capita Water Use: 20% Reduction by 2020 Metropolitan's Service Area (Calendar Year)**



## 3.8 Energy Management Initiative

To further Metropolitan's mission to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way, Metropolitan has adopted an energy management initiative. The energy management policies guide the agency in energy-efficient design and operation of its facilities, cost-effective power acquisition strategies, and the implementation of cost-effective renewable energy technologies. To highlight a few recent accomplishments, Metropolitan completed the Energy Management & Reliability Study in December 2009 to identify the issues and potential future actions for Metropolitan to consider in achieving energy reliability and cost control. Metropolitan is a registered member in The Climate Registry and has prepared annual greenhouse gas emissions inventories since 2005, and also reports emissions data to the California Air Resources Board under mandatory reporting regulations.

In May 2009, Metropolitan completed a 10-acre field of solar panels at the Robert A. Skinner Water Treatment Plant in the Temecula Valley of southwestern Riverside County. The 1 megawatt solar installation is designed to generate approximately 2.4 million kilowatt-hours (kWh) of clean, renewable energy a year, equal to the power used by about 250 homes annually. Metropolitan received more than $5 million in rebates during the first five years of the facility's operation.

In August 2010, Metropolitan's Board adopted Energy Management Policies, to provide staff with the necessary guidance to move forward with cost-effective and environmentally responsible programs, projects, and initiatives. Identified projects are considered by Metropolitan's Board of Directors for authorization on a case-by-case basis. These policies recognize the upward pressure on costs caused by the reduction of Metropolitan's Hoover power allocation in 2017, by evolving power markets, by increased direct and indirect regulatory pressure to reduce greenhouse gas (GHG) emissions, and by the risk of reduced Colorado River hydropower supplies with climate change. The specific policies are as follows:

- Water/Energy Nexus: Identify collaborative programs and initiatives between the water and energy industries, constructing sustainable partnerships to reduce costs and provide enhanced reliability.
- Regulatory: Track federal and state greenhouse gas regulations and develop strategies to hedge against price and regulatory risks towards Metropolitan.
- Legislation: Pursue legislation to protect or enhance reliability of energy supply and mitigate energy cost risk.
- Contracts: Maintain maximum flexibility on existing and future contracts with Hoover and other energy contracts to hedge against cost and regulatory risks.
- Projects/Partnerships: Pursue cost-effective renewable energy projects and partnerships to hedge against energy price increases and regulatory risks, while reducing Metropolitan's carbon footprint.
- Revenue Stream: Pursue revenue stream renewable energy facilities on operational lands to assist in cost containment.
- Economic & Environmental Stewardship: Based on projected economic and regulatory conditions, develop cost-effective programs, projects, and initiatives to control operational costs.
- Energy Management Updates: Continue to consider/implement actions or projects consistent with Energy Management Policies and report progress to the Board.

On December 20, 2011, the President signed the Hoover Power Allocation Act. The Act stipulated that Metropolitan and the other Hoover power contractors would receive 95 percent of their current Hoover allocation when the new contract becomes effective in 2017. The new contract will have a term of 50 years, from 2017 to 2067.

Metropolitan also started construction work in 2015 for a 3-megawatt solar installation at the Weymouth plant. This planned solar installation would meet up to 20 percent of the Weymouth plant's expected daily power consumption. A 1-megawatt solar project planned for Metropolitan's Jensen facility is now in design.

Moving forward with these energy management initiatives will enhance Metropolitan's ability to provide long-term power reliability, to protect against energy market price volatility, and to hedge against overall cost risks for operation of Metropolitan's distribution system and the CRA.

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# Water Quality 4

Metropolitan's planning efforts have recognized the importance of the quality of its water supplies. To the extent possible, Metropolitan responds to water quality concerns by protecting the quality of the source water and developing water management programs that maintain and enhance water quality. Contaminants that cannot be sufficiently controlled through protection of source waters must be handled through changed water treatment protocols or blending. These practices can increase costs and/or reduce operating flexibility. This section discusses source water quality and issues of concern affecting water management strategies and water supply reliability.

## Background

Metropolitan's planning efforts for groundwater storage, recycled water, and other water management strategies require meeting specific water quality targets for imported water. Metropolitan has two major sources of water: the Colorado River and the State Water Project (SWP). Groundwater inflows are also received into the SWP through groundwater banking programs in the Central Valley. Each source has specific quality issues, which are summarized in this section. To date, Metropolitan has not identified any water quality risks that cannot be mitigated. As described in this section, the only potential effect of water quality on the level of water supplies based on current knowledge might be increases in the salinity of water resources. Under California's current drought conditions, decreased flows have altered Delta flow patterns and, while the effects of the drought have not been fully studied, there have been some observable changes in water quality such as increased salinity due to increased seawater intrusion. However, even under drought conditions, SWP salinity is significantly lower than Colorado River water salinity, and Metropolitan relies on blending imported water sources to mitigate for the higher salinity Colorado River water. During recent periods of drought, Metropolitan's SWP allocation has been reduced, including to a historical low of zero percent in January 2014, which affected blending operations. Metropolitan increased its reliance on Colorado River water in 2014 and 2015, and subsequently, salinity in treatment plant deliveries increased overall from the higher Colorado River salinity levels. Metropolitan anticipates no significant reductions in water supply availability from imported sources due to water quality concerns, such as salinity, over the next five years.

### Colorado River

High salinity levels remain a significant issue associated with Colorado River supplies. In addition, Metropolitan has been engaged in efforts to protect its Colorado River supplies from threats of uranium, perchlorate, and chromium-6, which are discussed later in this section. Metropolitan has also been active in efforts to protect these supplies from potential increases in nutrient loading due to agriculture and urbanization, as well as tracking the occurrence of constituents of emerging concern, such as N-nitrosodimethylamine (NDMA) and pharmaceuticals and personal care products (PPCPs). Metropolitan fully expects its source

water protection efforts to be successful, so the only foreseeable water quality constraint to the use of Colorado River water will be the need to blend (mix) it with SWP supplies to meet Metropolitan's Board-adopted salinity standards.

### *State Water Project*

The key water quality issues for the SWP are disinfection byproduct precursors, in particular, total organic carbon and bromide. Metropolitan is working to protect the water quality of this source, but it has needed to upgrade its water treatment plants to deal adequately with disinfection byproducts. Disinfection byproducts result from total organic carbon and bromide in the source water reacting with disinfectants at the water treatment plant, and they may place some near-term restrictions on Metropolitan's ability to use SWP water. Metropolitan is overcoming these treatment restrictions through the use of ozone disinfection at its treatment plants. Ozone facilities have been completed at four of Metropolitan's treatment plants, and construction is underway for ozone facilities at the Weymouth water treatment plant. Arsenic is also of concern in some groundwater storage programs. Groundwater inflows into the California Aqueduct are managed to comply with regulations and protect downstream water quality while meeting supply targets. Additionally, nutrient levels are significantly higher in the SWP system than within the Colorado River, leading to the potential for algal related concerns that can affect water management strategies. Metropolitan is engaged in efforts to protect the quality of SWP water from potential increases in nutrient loading from wastewater treatment plants.

### *Local Agency Supplies and Groundwater Storage*

Drinking water standards for contaminants, such as arsenic, chromium-6, and other emerging constituents, may add costs to the use of groundwater storage and may affect the availability of local agency groundwater sources. These contaminants are not expected to affect the availability of Metropolitan supplies, but they may affect the availability of local agency supplies. This could affect the level of demands on Metropolitan supplies if local agencies abandon supplies in lieu of treatment options. Metropolitan has not analyzed the effect that many of these water quality issues could have on local agency supply availability.

In summary, the major regional water quality concerns include the following:

- Salinity
- Perchlorate
- Total organic carbon and bromide (disinfection byproduct precursors)
- Nutrients (as they relate to algal productivity)
- Arsenic
- Uranium
- Chromium-6
- Constituents of Emerging Concern (e.g., NDMA and PPCPs)

Metropolitan has taken several actions and adopted programs to address these contaminants and to ensure a safe and reliable water supply. These actions, organized by contaminant, are discussed below, along with other water quality programs that Metropolitan has been engaged in to protect its water supplies.

## *Issues of Potential Concern*

### *Salinity*

The State Water Resources Control Board's Division of Drinking Water (DDW), formerly the California Department of Public Health, established a secondary drinking water standard for salinity, commonly expressed as total dissolved solids (TDS), with a recommended maximum contaminant level (MCL) of 500 milligrams per liter (mg/L) and upper limit MCL of 1,000 mg/L. Imported water from the Colorado River has high salinity levels, so it must be blended (mixed) with lower-salinity water from the SWP to meet salinity management goals. Higher salinity levels in Colorado River water would increase the proportion of SWP supplies required to meet Metropolitan's Board-adopted imported water salinity objectives. High levels of salinity can impact various water uses such as limiting groundwater and recycled water uses, reducing the lifespan of household appliances, and reducing crop yields. These salinity impacts affect various sectors including residential, agricultural, commercial, industrial, utility, groundwater, and recycled water. Metropolitan adopted an imported water salinity goal because higher salinity could increase costs and reduce operating flexibility. For example,

1. If diminished water quality causes a need for membrane treatment to remove TDS, the process typically results in losses of up to 15 percent of the water processed. These losses would result in both an increased requirement for additional water supplies and environmental constraints related to brine disposal. In addition, the process is costly. However, only a portion of the imported water would need to be processed, so the possible loss in supplies is small.
2. High TDS in water supplies leads to high TDS in wastewater, which lowers the usefulness and increases the cost of recycled water.
3. Water quality degradation of imported water supply could limit the use of local groundwater basins for storage because of standards controlling the quality of water recharged to the basins.

In addition to the link between water supply and water quality, Metropolitan has identified economic benefits from reducing the TDS concentrations of water supplies. Estimates show that a reduction in salinity concentrations of 100 mg/L in both the Colorado River and SWP supplies will yield economic benefits of $95 million per year (1999 dollars) within Metropolitan's service area.[12] This economic benefit provides an additional incentive to reduce salinity concentrations within the region's water supplies.

#### The Salinity Management Policy

Considering all of these factors, Metropolitan's Board approved a Salinity Management Policy on April 13, 1999. The policy set a goal of achieving salinity concentrations in delivered water of less than 500 mg/L TDS when practical, understanding that hydrologic conditions will make this infeasible at times. It also identified the need for both local and imported water sources to be managed comprehensively to maintain the ability to use recycled water and groundwater. To achieve these targets, lower TDS SWP water supplies are blended with Colorado River supplies. Using this approach, the salinity target could be met an estimated seven out of ten years. In the other three years, hydrologic conditions would result in a reduced volume of SWP supplies and increased salinity. Since 1999, Metropolitan has met the salinity objective, but due to drought conditions, the target goal was exceeded between 2008 and 2011 and again

[12] Metropolitan Water District of Southern California and U.S. Bureau of Reclamation, Salinity Management Study: Final Report (June 1999)

between 2013 and 2015. Metropolitan has alerted its local agencies that high salinity levels are inevitable under these drought conditions despite its best efforts. Metropolitan has also urged its member agencies to structure the operation of their local projects and groundwater supplies so they are prepared to mitigate the effect of higher salinity levels in imported waters. In addition, Metropolitan seeks to obtain better quality water in the spring/summer months (April through September) to maximize the use of recycled water in agriculture.

The adoption of the Salinity Management Policy resulted from the completion of a Salinity Management Study in 1999. Metropolitan worked collaboratively with multiple stakeholders to complete the salinity study which assessed regional salinity problems and developed management strategies. Metropolitan is currently working with the USBR and Southern California Salinity Coalition to update the study. The current study objectives include updating the economic impact model to complete a revised salinity economic damage assessment of Metropolitan's service area; developing regional salinity indicators to increase awareness and facilitate salinity management in groundwater basins; and assessing Metropolitan's long-term capability of delivering low-salinity water supplies and determining whether new salinity operational goals should be established.

Within Metropolitan's service area, local water sources account for approximately half of the salt loading, and imported water accounts for the remainder. All of these sources must be managed appropriately to sustain water quality and supply reliability goals. The following sections discuss the salinity issues relevant to each of Metropolitan's major supply sources and other resources.

Colorado River

Water imported via the CRA has the highest level of salinity of all of Metropolitan's sources of supply, averaging around 630 mg/L since 1976. Concern over salinity levels in the Colorado River has existed for many years.

To deal with the concern, the International Boundary and Water Commission approved Minute No. 242, Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River, in 1973, and the President approved the Colorado River Basin Salinity Control Act in 1974. High TDS in the Colorado River as it entered Mexico and the concerns of the seven Basin states regarding the quality of Colorado River water in the United States drove these initial actions. To foster interstate cooperation on this issue, the seven basin states formed the Colorado River Basin Salinity Control Forum (Forum).

The salts in the Colorado River system are indigenous and pervasive, mostly resulting from saline sediments in the Basin that were deposited in prehistoric marine environments. They are easily eroded, dissolved, and transported into the river system. The Colorado River Basin Salinity Control Program is designed to prevent a portion of this abundant salt supply from moving into the river system. The program targets the interception and control of non-point sources, such as surface runoff, as well as wastewater and saline hot springs. Examples of salinity control measures include improved irrigation practices, rangeland management, and the operation of a deep well brine injection project.

The Forum proposed, the states adopted, and the USEPA approved water quality standards in 1975, including numeric criteria and a plan for controlling salinity increases. The standards require that the plan ensure that the flow-weighted average annual salinity remain at or below the 1972 levels, while the Basin states continue to develop their 1922 Colorado River Compact-apportioned water supply. The Forum selected three stations on the main stream of the lower Colorado River as appropriate points to measure the river's salinity. These stations and numeric

criteria are: (1) below Hoover Dam, 723 mg/L; (2) below Parker Dam, 747 mg/L; and (3) at Imperial Dam, 879 mg/L.

Per the Forum, concentrations of salts in the Colorado River cause approximately $382 million in quantified damages (2014 dollars) in the lower Basin each year.[13] The salinity control program has proven to be very successful and cost-effective. Salinity control projects remove over a million tons of salts from Colorado River water, resulting in reduced salinity concentrations of over 100 mg/L as a long-term average.

During the high water flows of 1983-1986, salinity levels in the CRA dropped to a historic low of 525 mg/L. However, during the 1987-1992 drought, higher salinity levels of 600 to 650 mg/L returned. TDS in Lake Havasu was measured at 626 mg/L in June 2015 and is projected to continue increasing as water development occurs throughout the Colorado River basin, particularly as the Upper Colorado River Basin States continue to develop their apportioned water reducing dilution in the Colorado River. Also, under drought conditions, Lake Powell has received higher salinity water, and as the system normalizes, salinity is expected to increase in the lower Colorado River as water from Lake Powell is released downstream.

State Water Project

Water supplies from the SWP have significantly lower TDS concentrations than the Colorado River, averaging approximately 250 mg/L in water supplied through the East Branch and 325 mg/L on the West Branch over the long-term, with short term variability as a result of hydrologic conditions.[14] Because of this lower salinity, Metropolitan blends SWP water with high salinity CRA water to reduce the salinity concentrations of delivered water. However, both the supply and the TDS concentrations of SWP water can vary significantly in response to hydrologic conditions in the Sacramento-San Joaquin watersheds.

As indicated above, the TDS concentrations of SWP water can vary widely over short periods of time. These variations reflect seasonal and tidal flow patterns, and they pose an additional problem for use of blending as a management tool to lower the higher TDS from the Colorado River supply. For example, during the 1977 drought, the salinity of SWP water reaching Metropolitan increased to 430 mg/L, and supplies became limited. During this same event, salinity at the SWP's Banks pumping plant exceeded 700 mg/L. Under future similar circumstances, Metropolitan's 500 mg/L TDS objective could only be achieved by reducing imported water from the CRA. Thus, it may not always be possible to maintain both the salinity objective and water supply reliability unless salinity concentrations of source supplies can be reduced.

A federal court ruling and a resulting biological opinion issued through consultation with U.S. Fish and Wildlife Service addressing the effects of the water supply pumping operations on sensitive fish species in the Delta has limited SWP exports at specified times of the year since December 2007. These restrictions have increased reliance on higher salinity Colorado River water, impacting the ability at times to meet Metropolitan's goal of 500 mg/L TDS at its blend plants. Drought conditions leading to lower SWP water supply allocations in recent years also affect Metropolitan's ability to meet its salinity goal. The target goal was exceeded between 2008 and 2011 when water supply allocations were reduced to 35-50 percent. Similarly, the target goal has been exceeded between 2013 and 2015 under current drought conditions with

[13] Colorado River Basin Salinity Control Program–Briefing Document (May 1, 2015)

[14] The higher salinity in the West Branch deliveries is due to salt loadings from local streams, operational conditions, and evaporation at Pyramid and Castaic Lakes.

restricted annual water supply allocations reduced to 5-35 percent and briefly reduced to a historical zero percent allocation in January 2014.

TDS objectives in Article 19 of the SWP Water Service Contract specify a ten-year average of 220 mg/L and a maximum monthly average of 440 mg/L. These objectives have not been met, and Metropolitan is working with DWR and other agencies on programs aimed at reducing salinity in Delta supplies. These programs aim to reduce salinity on the San Joaquin River through modifying agricultural drainage and developing comprehensive basin plans. In addition, operable gates and channel barriers have been placed in strategic locations in the Delta to impede transport of seawater derived salt. For the first time since 1977, in response to California's drought emergency, DWR installed a temporary rock barrier across False River in May 2015 to help limit salt intrusion from the San Francisco Bay into the central Delta. DWR is also leading the development of the California WaterFix, which involves water delivery upgrades that could reduce SWP salinity levels by diverting a greater percentage of lower salinity Sacramento River flows to the South Delta export pumps.

Recycled Water

Wastewater flows always experience significantly higher salinity concentrations than the potable water supply. Typically, each cycle of urban water use adds 250 to 400 mg/L of TDS to the wastewater. Salinity increases tend to be higher where specific commercial or industrial processes add brines to the discharge stream or where brackish groundwater infiltrates into the sewer system.

Where wastewater flows have high salinity concentrations, the use of recycled water may be limited or require more expensive treatment (e.g., reverse osmosis). Landscape irrigation and industrial reuse become problematic at TDS concentrations over 1,000 mg/L. Some crops such as strawberries and avocados are particularly sensitive to high TDS concentrations, and the use of high-salinity recycled water may reduce yields of these crops. In addition, Basin Plan Objectives may lead to restrictions on the use of recycled water on lands overlying those groundwater basins.

These issues are exacerbated during times of drought, when the salinity of imported water supplies may increase salinity in wastewater flows and recycled water. Basin management plans and recycled water customers may restrict the use of recycled water at a time when its use would be most valuable. Therefore, to maintain the cost-effectiveness of recycled water, the salinity level of the region's potable water sources and wastewater flows must be controlled.

In May 2009, the SWRCB adopted a Recycled Water Policy[15] to help streamline the permitting process and to help establish uniform statewide criteria for recycled water projects. The policy was amended in January 2013 to include monitoring requirements for constituents of emerging concern. This policy promotes the development of watershed- or basin-wide salt management plans (to be adopted by the respective Regional Boards) to meet water quality objectives and protect beneficial uses, rather than imposing project-by-project restrictions. The Recycled Water Policy identifies several criteria to guide recycled water irrigation or groundwater recharge project proponents in developing a salt (and nutrient) management plan (SNMP).

[15] http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf

Groundwater Basins

Increased TDS in groundwater basins occurs either when basins near the ocean are over drafted, leading to seawater intrusion, or when agricultural and urban return flows add salts to the basins. Much of the water used for agricultural or urban irrigation infiltrates into the aquifer, so where irrigation water is high in TDS or where the water transports salts from overlying soil, the infiltrating water will increase the salinity of the aquifer. In addition, wastewater discharges in inland regions may lead to salt buildup from fertilizer and dairy waste. In the 1950s and 1960s, high-TDS Colorado River water was used to recharge severely overdrafted aquifers and prevent saltwater intrusion, resulting in significant salt loadings to the region's groundwater basins.

In the past, these high salt concentrations have caused some basins within Metropolitan's service area to be unsuitable for municipal uses if left untreated. The Arlington Basin in Riverside and the Mission Basin in San Diego required demineralization before they could be returned to municipal service. The capacity of the larger groundwater basins makes them better able to dilute the impact of increasing salinity. While most groundwater basins within the region still produce water of acceptable quality, this resource must be managed carefully to minimize further degradation. Even with today's more heightened concern regarding salinity, approximately 600,000 tons of salts per year accumulate within the region, leading to ever-increasing salinity concentrations in many groundwater basins.[16] Drought conditions have further impacted salinity levels in recycled water, reflective of increased salinity levels in source water. Increased recycled water salinity levels make it difficult for dischargers to comply with water quality objectives for groundwater basins.

To protect the quality of groundwater basins, Regional Boards often place restrictions on the salinity concentrations of water used for basin recharge or for irrigation of lands overlying the aquifers. Those situations may restrict water reuse and aquifer recharge, or they may require expensive mitigation measures. SNMPs offer an opportunity for stakeholders to work with Regional Boards to address salt and nutrient issues regionally. The SNMP development process is locally-driven and focuses on addressing all sources of salts and nutrients, instead of only regulating individual recycled water projects which may not address all sources impacting groundwater. The SNMP objectives include: optimizing recycled water use, protecting groundwater supply and beneficial uses, protecting agricultural beneficial uses, and protecting human health. SNMPs were to be completed by May 2014 with a possible two year extension. After completion, SNMPs may be adopted in a Basin Plan Amendment.

Several SNMPs were completed by the completion deadline, while other plans were granted an extension for completion in 2016. The Santa Ana Region Basin Plan updated its TDS and Nitrogen Management Plan with a subsequent SNMP amendment in 2014. This SNMP highlights efforts to implement extensive groundwater recharge projects using recycled water in the Chino Basin and expansion of the GWRS in Orange County. The Central Basin and West Coast Basin SNMP was approved as an amendment to the Los Angeles Region Basin Plan in February 2015. This SNMP highlights existing and planned implementation measures to ensure future compliance with water quality objectives including increased recharge at seawater intrusion barriers, increased groundwater pump and treat by the Goldsworthy and Brewer Desalters, and increased recycled water use for irrigation. Multiple SNMPs have been completed in the San Diego Region, and basin plan amendments are being considered. SNMPs are also being developed for the Main San Gabriel Basin, Raymond Basin, San Fernando Valley Basin, and Calleguas Creek and Oxnard Plains.

[16] Metropolitan Water District of Southern California and U.S. Bureau of Reclamation, Salinity Management Study: Final Report (June 1999)

### *Perchlorate*

Perchlorate compounds are used as a main component in solid rocket propellant, and are also found in some types of munitions and fireworks. Perchlorate compounds quickly dissolve and become highly mobile in groundwater. Unlike many other groundwater contaminants, perchlorate neither readily interacts with the soil matrix nor degrades in the environment. Conventional drinking water treatment (as utilized at Metropolitan's water treatment plants) is not effective for perchlorate removal.

The primary human health concern related to perchlorate is its effect on the thyroid. Perchlorate can interfere with the thyroid's ability to produce hormones required for normal growth and development. Pregnant women who are iodine deficient and their fetuses, infants and small children with low dietary iodide intake, and individuals with hypothyroidism may be more sensitive to the effects of perchlorate.

DDW established a primary drinking water standard for perchlorate in 2007 with an MCL of 6 micrograms per liter (μg/L). In February 2015, the California Office of Environmental Health Hazard Assessment (OEHHA) lowered the public health goal (PHG) for perchlorate from 6 μg/L to 1 μg/L. In response to the new PHG, DDW will review the perchlorate MCL. There is currently no federal drinking water standard for perchlorate, but the USEPA is in the process of developing a national primary drinking water regulation.

Perchlorate was first detected in Colorado River water in June 1997 and was traced back to Las Vegas Wash. The source of contamination was found to be emanating from a chemical manufacturing facility in Henderson, Nevada. Tronox, Inc. was responsible for the ongoing perchlorate remediation of the site, although contamination resulted from years of manufacturing operations from site predecessors. Another large perchlorate groundwater plume is also present in the Henderson area from a second industrial site. Remediation activities are ongoing for cleanup of that plume by American Pacific Corporation (AMPAC).

Following the detection of perchlorate in the Colorado River, Metropolitan, along with USEPA and agencies in Nevada including the Nevada Division of Environmental Protection (NDEP), organized the forces necessary to successfully treat and decrease the sources of perchlorate loading. Under NDEP oversight, remediation efforts began in 1998, and treatment operations became fully operational in 2004. These efforts have reduced perchlorate loading into Las Vegas Wash from over 1,000 lbs/day (prior to treatment) to 50-90 lbs/day since early 2007. This has resulted in over 90 percent reduction of the perchlorate loading entering the Colorado River system. In January 2009, Tronox filed for Chapter 11 bankruptcy protection citing significant environmental liabilities taken from the previous site owner. A settlement was reached in February 2011 which resulted in the formation of the Nevada Environmental Response Trust (NERT). NERT received $81 million for cleanup efforts while pursuing additional funding sources.

In April 2014, Tronox reached a $5.15 billion settlement with its predecessors which awarded approximately $1.1 billion, directed to NERT, to clean up perchlorate and other contaminants at the former Tronox site in Henderson. The settlement, which represents one of the largest environmental recoveries in history, went into effect in January 2015 and helps to ensure adequate funds are available for site cleanup and protection of the downstream Colorado River. NERT is currently conducting remedial investigations for long-term soil and groundwater cleanup, while NDEP is initiating a regional investigation of downstream perchlorate-contaminated areas to further reduce loading into Las Vegas Wash. The remedial plan has an established goal to reduce perchlorate loading into Las Vegas Wash to less than 10 lbs/day, which would result in levels well below 1 μg/L in the Colorado River. This would help ensure

compliance with any potential reduction of California's perchlorate MCL of 6 µg/L, in light of the new 1 µg/L public health goal.

As a result of the aggressive clean-up efforts, perchlorate levels in Colorado River water at Lake Havasu have decreased significantly in recent years from a peak of 9 µg/L in May 1998. Levels have remained less than 6 µg/L since October 2002, and have been typically less than 2 µg/L since June 2006. Metropolitan routinely monitors perchlorate at over 30 locations within its system, and levels currently remain below 2 µg/L. Metropolitan has not detected perchlorate in the SWP since monitoring began in 1997.

Perchlorate has also been found in groundwater basins within Metropolitan's service area, largely from local sources. The vast majority of locations where perchlorate has been detected in the groundwater are associated with the manufacturing or testing of solid rocket fuels for the Department of Defense and the National Aeronautics and Space Administration (NASA), or with the manufacture, storage, handling, or disposal of perchlorate (such as Aerojet in Azusa in the Main San Gabriel Basin and the Jet Propulsion Laboratory/NASA in the Raymond Basin). Past agricultural practices using fertilizers laden with naturally occurring perchlorate have also been implicated in some areas. Per SWRCB's water quality database, reported monitoring results from 2011 to 2014 indicate that 10 Metropolitan member agencies have detected perchlorate in their service areas at levels greater than 4 µg/L in 36 sources, while 7 member agencies have detected levels greater than 6 µg/L.

Metropolitan has investigated technologies to mitigate perchlorate contamination. Perchlorate cannot be removed using conventional water treatment. Nanofiltration and reverse osmosis do work effectively, but at a very high cost. AMPAC and NERT utilize a biological fluidized bed reactor (FBR) process train for the cleanup of their Henderson sites. A number of sites in Southern California have successfully installed ion exchange systems to treat perchlorate impacted groundwater. In November 2009, a study of biological treatment for perchlorate removal in the City of Pasadena's groundwater was completed with funding provided through a Congressional mandate from USEPA to Metropolitan. The City of Pasadena decided to continue using ion exchange treatment for perchlorate removal and expanded treatment to two well sites.

Treatment options are available to recover groundwater supplies contaminated with perchlorate. However, it is very difficult to predict whether treatment will be pursued to recover all lost production because local agencies will make decisions based largely on cost considerations, ability to identify potentially responsible parties for cleanup, and the availability of alternative supplies.

### *Total Organic Carbon and Bromide*

Disinfection byproducts (DBPs) form when source water containing high levels of total organic carbon (TOC) and bromide is treated with disinfectants such as chlorine or ozone. Studies have shown a link between certain cancers and DBP exposure. In addition, some studies have shown an association between reproductive and developmental effects and chlorinated water. While many DBPs have been identified and some are regulated under the Safe Drinking Water Act, there are others that are not yet known. Even for those that are known, the potential adverse health effects may not be fully characterized.

Water agencies began complying with new regulations to protect against the risk of DBP exposure in January 2002. This rule, known as the Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule, required water systems to comply with new MCLs and a treatment technique to improve control of DBPs. USEPA then promulgated the Stage 2 D/DBP Rule in

January 2006 requiring systems to comply at terminus locations in the distribution system to be more representative of maximum residence time and to protect the public. Metropolitan has been in compliance with the Stage 2 D/DBP Rule since it became effective.

Existing levels of TOC and bromide in Delta water supplies present challenges for water utilities to maintain safe drinking water supplies and comply with regulations. Levels of these constituents in SWP water increase several-fold due to agricultural drainage and seawater intrusion as water moves through the Delta.

Source water quality improvements must be combined with cost-effective water treatment technologies to ensure safe drinking water at a reasonable cost. Metropolitan has five treatment plants: two that receive SWP water exclusively, and three that receive a blend of SWP and Colorado River water. In 2003 and 2005, Metropolitan completed upgrades to its SWP-exclusive water treatment plants, Mills and Jensen, respectively, to utilize ozone as its primary disinfectant. This ozonation process minimizes the production of certain regulated disinfection byproducts that would otherwise form in the chlorine treatment of SWP water. The non-ozone plants utilizing blended water have met federal guidelines for these byproducts through managing the blend of SWP and Colorado River water. To maintain the byproducts at a level consistent with federal law, Metropolitan limits the percentage of water from the SWP for plants utilizing chlorine as the primary disinfectant. In 2010 and 2015, Metropolitan completed ozone upgrades at Skinner and Diemer water treatment plants, respectively. Construction of ozonation facilities is underway at Weymouth water treatment plant and is expected to be completed in 2017. The estimated ozone retrofit cost for all five treatment plants is over $1.1 billion.

### *Nutrients*

Elevated levels of nutrients (phosphorus and nitrogen compounds) can stimulate nuisance algal and aquatic weed growth that affects water system operations and consumer acceptability, including the production of noxious taste and odor compounds and algal toxins. In addition to taste and odor and toxin concerns, increases in algal and aquatic weed biomass can impede flow in conveyances, shorten filter run times, increase solids production at drinking water treatment plants, and add to organic carbon loading. Further, nutrients can provide an increasing food source that may lead to the proliferation of quagga and zebra mussels, and other invasive biological species. Studies have shown phosphorus to be the limiting nutrient in both SWP and Colorado River supplies. Therefore, any increase in phosphorus loading has the potential to stimulate algal growth, leading to the concerns identified above.

SWP supplies have significantly higher nutrient levels than Colorado River supplies. Wastewater discharges, agricultural drainage, and nutrient-rich soils in the Delta are primary sources of nutrient loading to the SWP. Metropolitan and other drinking water agencies receiving Delta water have been engaged in efforts to minimize the effects of nutrient loading from Delta wastewater plants. The Sacramento Regional County Sanitation District (SRCSD), the primary discharger to the Sacramento River, is in the process of constructing wastewater treatment plant upgrades to comply with its 2010 discharge permit requirements for ammonia and nitrate removal. Excessive levels of ammonia are suspected to be altering the Delta's food web which, in turn, has implications for SWP supply reliability. SRCSD expects to complete its EchoWater Project by 2023 and has stated that the project will serve multiple benefits including improving water quality in the Sacramento River, protecting the fragile Delta ecosystem, and expanding recycled water use opportunities. The improvements include a biological nutrient removal process for ammonia and nitrate removal. The project also includes tertiary treatment processes for filtration and enhanced disinfection. In 2014, the City of Stockton Wastewater

Treatment Plant, a discharger to the San Joaquin River, was issued a draft permit with a more stringent nitrate discharge limit consistent with the final discharge limits issued in SRCSD's permit. The City of Stockton may have to implement similar plant upgrades as SRCSD to comply with discharge permit requirements.

Metropolitan reservoirs receiving SWP water have experienced several taste and odor episodes in recent years. For example, between 2010 and 2014, Metropolitan reservoirs experienced 11 taste and odor events requiring treatment. A taste and odor event can cause a reservoir to be bypassed and potentially have a short-term effect on the availability of that supply. Metropolitan has a comprehensive program to monitor and manage algae in its source water reservoirs. This program was developed to provide an early warning of algae related problems and taste and odor events to best manage water quality in the system.

The issue of cyanotoxins has become a growing concern as a result of increasing occurrences both nationally and internationally. For example, in August 2014, an algae bloom producing Mycrocystin in Lake Erie significantly affected water supply for Toledo, Ohio, prompting the city to issue urgent notices to residents to not drink or boil the drinking water. This event stimulated state and federal legislation to develop health advisories and strategic plans for algal toxins. In June 2015, USEPA issued health advisories for two cyanobacterial toxins: Microcystins and Cylindrospermopsin. The health advisories serve as recommended precautionary levels and are not enforceable federal water quality standards. Cyanotoxins are included on the current Contaminant Candidate List (CCL3), which identifies contaminants considered for regulation under the Safe Drinking Water Act. USEPA is currently developing improved analytical methods for cyanotoxins to support nationwide monitoring for Microcystins, Anatoxin-a, and Cylindrospermopsin through the Unregulated Contaminant Monitoring Rule 4 program, which would be published in late 2016 and require monitoring to begin in January 2018. Metropolitan would comply with Unregulated Contaminant Monitoring Rule monitoring and reporting requirements.

Although phosphorus levels are much lower in the Colorado River than in the SWP, this nutrient is still of concern. Despite relatively low concentrations (Colorado River has been considered an oligotrophic, or low-productivity, system), any additions of phosphorus to Colorado River water can result in increased algal growth. In addition, low nutrient Colorado River water is relied upon by Metropolitan to blend down the high nutrient SWP water in Metropolitan's blend reservoirs. With population growth expected to continue in the Las Vegas area in the future, ensuring high levels of treatment at wastewater treatment plants to maintain existing phosphorus levels will be critical in minimizing the operational, financial, and public health impacts associated with excessive algal growth and protecting downstream drinking water uses. Metropolitan and other affected drinking water agencies collaborate with wastewater dischargers in the Las Vegas area to protect the phosphorus-limited Colorado River. Since 2001, wastewater dischargers have undertaken considerable efforts to improve treated effluent water quality by removing phosphorus on a year-round basis. In 2005, dischargers also began optimizing their treatment processes to remove greater amounts of phosphorus, maintaining levels well below current permit requirements.

Although current nutrient loading is of concern for Metropolitan and is anticipated to have cost implications, with its comprehensive monitoring program and response actions to manage algal related issues, there should be no impact on availability of water supplies. Metropolitan's source water protection program will continue to focus on preventing future increases in nutrient loading as a result of urban and agricultural sources.

### *Arsenic*

Arsenic is a naturally occurring element found in rocks, soil, water, and air. It is used in wood preservatives, alloying agents, certain agricultural applications, semi-conductors, paints, dyes, and soaps. Arsenic can get into water from the natural erosion of rocks, dissolution of ores and minerals, runoff from agricultural fields, and discharges from industrial processes. Long-term exposure to elevated levels of arsenic in drinking water has been linked to certain cancers, skin pigmentation changes, and hyperkeratosis (skin thickening).

In April 2004, OEHHA set a public health goal for arsenic of 0.004 µg/L, based on lung and urinary bladder cancer risk. The MCL for arsenic in domestic water supplies was lowered to 10 µg/L, with an effective date of January 2006 in the federal regulations, and an effective date of November 2008 in the California regulations. Monitoring results submitted to California Department of Public Health (now DDW) since 2010 showed that arsenic is ubiquitous in drinking water sources, reflecting its natural occurrence. They also showed that many sources have arsenic detections above the 10 µg/L MCL. Southern California drinking water sources that contain concentrations of arsenic over 10 µg/L include San Bernardino (25 sources), Los Angeles (27 sources), Riverside (12 sources), San Diego (2 sources), Orange (2 sources), and Ventura (2 sources).[17]

The arsenic drinking water standard impacts both groundwater and surface water supplies. Historically, Metropolitan's water supplies have had low levels of this contaminant and did not require treatment changes or capital investment to comply with the standard. However, some of Metropolitan's water supplies from groundwater storage programs are at levels near the MCL. These groundwater storage projects are called upon to supplement flow only during low SWP allocation years. Under drought conditions, Metropolitan has further relied on groundwater storage programs and continues to participate in the California Aqueduct Pump-in Facilitation Group to ensure that water quality in the SWP is not adversely affected when considering water supply decisions. Metropolitan has had to restrict flow from one program to limit arsenic increases in the SWP. Implementation of an arsenic treatment facility, which is operated by a groundwater banking partner, has increased groundwater supply costs. Moreover, Metropolitan has invested in solids handling facilities at its treatment plants and implemented operational changes to manage arsenic in the treatment process residual solids.

The state detection level for purposes of reporting (DLR) of arsenic is 2 µg/L. Between 2009 and 2014, arsenic levels in Metropolitan's water treatment plant effluents ranged from non-detect (< 2 µg/L) to 3.9 µg/L. For Metropolitan's source waters, levels in Colorado River water have ranged from not detected to 3.5 µg/L, while levels in SWP water have ranged from non-detect to 4.4 µg/L. Increasing coagulant doses at water treatment plants can reduce arsenic levels for delivered water.

Some member agencies may face greater problems with arsenic compliance due to naturally occurring arsenic in groundwater. Per the Water Replenishment District's 2013-2014 Regional Groundwater Monitoring Report, arsenic concentrations greater than the 10 µg/L MCL are detected in about a third of the Central Basin wells.[18] Water supplies imported by the Los Angeles Department of Water and Power may also contain arsenic above the MCL. The cost of arsenic removal from these supplies could vary significantly.

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[17] DDW data reported from web site: http://geotracker.waterboards.ca.gov. Numbers reported may change as the website is frequently updated. Also, the website includes additional source data reported by other entities.

[18] *Regional Groundwater Monitoring Report Water Year 2013-2014, Los Angeles County, California*, prepared by Water Replenishment District, February 2015.

### *Uranium*

The U.S. Department of Energy (DOE) has completed about 50 percent of a project to move a 16-million-ton pile of uranium mill tailings near Moab, Utah which lies approximately 750 feet from the Colorado River. Due to the proximity of the pile to the Colorado River, there is a potential for the tailings to enter the river as a result of a catastrophic flood event or other natural disaster. In addition, contaminated groundwater from the site is slowly seeping into the river. The DOE is responsible for remediating the site, which includes removal and offsite disposal of the tailings and onsite groundwater remediation.

Previous investigations have shown uranium concentrations contained within the pile at levels significantly above the California MCL of 20 picocuries per liter (pCi/L). Metropolitan has been monitoring for uranium in the CRA and at its treatment plants since 1986. Monitoring at Lake Powell began in 1998. Uranium levels measured at Metropolitan's intake have ranged from 1 to 6 pCi/L, well below the California MCL. Conventional drinking water treatment, as employed at Metropolitan's water treatment plants, can remove low levels of uranium; however, these processes would not be protective if a catastrophic event washed large volumes of tailings into the Colorado River. Public perception of drinking water safety is also of particular concern as to uranium.

Remedial actions at the site since 1999 have focused on removing contaminated water from the pile and groundwater. To date, over 4,400 pounds of uranium in contaminated groundwater have been removed. In July 2005, DOE issued its Final Environmental Impact Statement with the preferred alternative of permanent offsite disposal by rail to a disposal cell at Crescent Junction, Utah, located approximately 30 miles northwest of the Moab site.

Rail shipment and disposal of the uranium mill tailings pile from the Moab site began in April 2009 using American Recovery and Reinvestment Act 2009 funding which helped to accelerate initial cleanup efforts. Through August 2015, DOE has shipped over 7.7 million tons of mill tailings to the Crescent Junction disposal cell. DOE estimates completing movement of the tailings pile by 2025, depending on annual appropriations. Metropolitan continues to track progress of the remediation efforts and work with Congressional representatives to support increased annual appropriations and expedite cleanup.

Another uranium-related issue began receiving attention in 2008 due to a renewed worldwide interest in nuclear energy and a resulting increase in uranium mining claims filed throughout the western United States. Of particular interest were thousands of mining claims filed near Grand Canyon National Park and the Colorado River. Metropolitan sent letters to the Secretary of the Interior to highlight source water protection and consumer confidence concerns related to uranium exploration and mining activities near the Colorado River, and advocate for close federal oversight over these activities. In 2009, Secretary of the Interior Ken Salazar announced a two-year hold on new mining claims on 1 million acres adjacent to the Grand Canyon to allow necessary scientific studies and environmental analyses to be conducted. In January 2012, Secretary Salazar formally signed a 20-year moratorium on new uranium and other hard rock mining claims. The moratorium has been challenged by a number of industry groups and was most recently upheld by a U.S. District Court in September 2014. Meanwhile, local conservation groups continue to defend the moratorium and are seeking additional protection of lands with mines that have been inactive for long periods of time, but may resume operations. Although of no direct impact to Metropolitan due to its upstream location and resulting dilution, in August 2015, an accidental release of wastewater from an abandoned mine in southwest Colorado demonstrated the potential threat that mining activities can have on public health and the environment.

### *Chromium-6*

Chromium is a naturally occurring element found in rocks, soil, plants, and animals. Chromium III is typically the form found in soils and is an essential nutrient that helps the body use sugar, protein, and fat. Chromium-6 is used in electroplating, stainless steel production, leather tanning, textile manufacturing, dyes and pigments, wood preservation, and as an anti-corrosion agent. Chromium occurs naturally in deep aquifers and can also enter drinking water through discharges of dye and paint pigments, wood preservatives, chrome plating liquid wastes, and leaching from hazardous waste sites. In drinking water, chromium-6 is very stable and soluble, whereas chromium III is not very soluble. Chromium-6 is the more toxic species and is known to cause lung cancer in humans when inhaled, but the health effects in humans from ingestion are still in question. There is evidence that when chromium-6 enters the stomach, gastric acids may reduce it to chromium III. However, recent studies conducted by the National Toxicology Program have shown that chromium-6 can cause cancer in animals when administered orally.

Effective July 1, 2014, California's Office of Administrative Law approved a primary drinking water standard of 10 μg/L for chromium-6. USEPA regulates chromium-6 as part of the total chromium drinking water standard of 100 μg/L and is currently evaluating whether a new federal drinking water standard for chromium-6 is warranted based on new health effects information.

Metropolitan utilizes an analytical method with a minimum reporting level of 0.03 μg/L, which is less than the State DLR of 1 μg/L. In the past 5 years, the results from all of Metropolitan's source and treated waters are less than the State DLR. The following summarizes chromium-6 levels found in Metropolitan's system:

In the past 5 years, results of source and treated water monitoring for chromium-6 indicate the following:

- Levels in Colorado River water are mostly not detected (<0.03 μg/L), but when detected, levels range from 0.03 to 0.08 μg/L. SWP levels range from 0.03 to 0.8 μg/L. Treated water levels range from 0.03 to 0.7 μg/L.
- There is a slight increase in chromium-6 in the treated water from the oxidation (chlorination and ozonation) of natural background chromium (total) to chromium-6.
- Colorado River monitoring results upstream and downstream of the site of a Pacific Gas and Electric (PG&E) gas compressor station located along the Colorado River near Topock, Arizona (discussed below) have ranged from not detected (<0.03 μg/L) to 0.06 μg/L.
- Chromium-6 in Metropolitan's groundwater pump-in storage programs in the Central Valley has ranged from not detected (< 1 μg/L) to 8.9 μg/L in 2014, with the average for the different programs ranging from < 1 μg/L to 3 μg/L.

PG&E used chromium-6 as an anti-corrosion agent in its cooling towers at the Topock site from 1951 to 1985. Wastewater from the cooling towers was discharged from 1951 to 1968 into a dry wash next to the station. Monitoring wells show the plume concentration has peaked as high as 16,000 μg/L in groundwater. Since 2004, PG&E has operated an interim groundwater extraction and treatment system that is protecting the Colorado River. Quarterly monitoring of the river has shown levels of chromium-6 less than 1 μg/L, which are considered background levels. The California Department of Toxic Substances Control (DTSC) and the U. S. Department of the Interior are the lead state and federal agencies overseeing the cleanup efforts. Metropolitan participates through various stakeholder workgroups and partnerships that

include state and federal regulators, Indian tribes, and other stakeholders (e.g., Colorado River Board) involved in the corrective action process. In January 2011, a final treatment remedy was selected, and an Environmental Impact Report was certified. In November 2015, PG&E completed the final remedy design based on the selected remedy which involves the installation of an in-situ bioremediation treatment system. In April 2015, DTSC required the preparation of a Subsequent Environmental Impact Report (EIR) to address new design details. The Subsequent EIR will be completed in Spring 2017. Construction is expected to be completed in early 2022, followed by operation of the treatment system for an estimated 30 years.

The federal- and state-approved technologies for removing total chromium from drinking water include coagulation/filtration, ion exchange, reverse osmosis, and lime softening. For several years, the cities of Glendale, Burbank, and Los Angeles have been voluntarily limiting chromium-6 levels in their drinking water to 5 µg/L, which is significantly lower than the state MCL of 10 µg/L that went into effect on July 1, 2014.

### *Constituents of Emerging Concern*

#### *N-Nitrosodimethylamine*

N-Nitrosodimethylamine (NDMA) is part of a family of organic chemicals called nitrosamines. NDMA is a chloramine disinfection by-product, and it is the most abundantly detected nitrosamine in drinking water systems. Metropolitan utilizes chloramines as a secondary disinfectant at its treatment plants. Wastewater treatment plant discharges can contribute organic matter into source waters, which react with chloramines to form NDMA at drinking water treatment plants. Certain coagulation aid polymers used in water treatment, e.g., polydiallyldimethylammonium chloride (polyDADMAC), can also contribute to NDMA formation. Some NDMA control measures are being used to avoid adverse impacts on Southern California drinking water supplies. Metropolitan is involved in several projects to understand the impact of different treatment processes on NDMA and its precursors at drinking water treatment plants and in distribution systems. Certain pre-oxidation processes, such as chlorine and ozone, have been shown to destroy NDMA precursors. Additional studies are being conducted to better understand how polyDADMAC contributes to NDMA formation and to identify measures to reduce polymer-derived NDMA formation.

USEPA considers NDMA to be a probable human carcinogen. USEPA placed NDMA in the Unregulated Contaminant Monitoring Rule 2 (UCMR2) and on the Contaminant Candidate List 3 (CCL3). Although there is no federal regulation for nitrosamines in drinking water, DDW set a notification level of 0.01 µg/L each for NDMA and two other nitrosamines. Occurrences of NDMA in treated water supplies at concentrations greater than 0.01 µg/L are recommended to be included in a utility's annual Consumer Confidence Report. In December 2006, OEHHA set a public health goal for NDMA of 0.003 µg/L. Since 1999, Metropolitan has conducted voluntary monitoring of the five treatment plant effluents and representative distribution system locations semi-annually. In 2014, NDMA was the only detected nitrosamine in Metropolitan's treated water systems, and it was in a range of non-detect (<0.002 µg/L) to 0.005 µg/L. NDMA or a broader class of nitrosamines may likely be the next class of disinfection by-products to be regulated by USEPA.

#### *Pharmaceuticals and Personal Care Products*

Pharmaceuticals and personal care products (PPCPs) are a growing concern to the water industry. Numerous studies have reported the occurrence of these emerging contaminants in

treated wastewater, surface water, and sometimes, in finished drinking water in the United States and around the world. The use of ozone in treatment processes may have a beneficial effect on PPCP removal in drinking water. The sources of PPCPs in the aquatic environment include (but may not be limited to) treated wastewater and industrial discharge, agricultural run-off, and leaching of municipal landfills. Currently, there is no evidence of human health risks from long-term exposure to the low concentrations (low ng/L; parts per trillion) of PPCPs found in some drinking water. Furthermore, there are no regulatory requirements for PPCPs in drinking water. USEPA included 13 PPCPs on the CCL3; however, currently there are no standardized analytical methods for these compounds. USEPA's strategy for addressing PPCPs involves strengthening analytical methods, conducting source studies, improving public understanding of PPCPs in water, building partnerships and promoting stewardship opportunities, and taking regulatory action when appropriate.

In 2007, Metropolitan implemented a short-term monitoring program to determine the occurrence of PPCPs and other organic wastewater contaminants in Metropolitan's treatment plant effluents and selected source water locations within the Colorado River and SWP watersheds. Currently, PPCP monitoring is conducted on an annual basis for Metropolitan's source waters and treatment plants. Some PPCPs have been detected at very low ng/L levels, which is consistent with reports from other utilities. However, analytical methods are still being refined, and more work is required to fully understand occurrence issues. Metropolitan has been actively involved in studies related to PPCPs, including analytical methods improvements, and characterization of drinking water sources in California.

### *Other Water Quality Programs*

In addition to monitoring for and controlling specific identified chemicals in the water supply, Metropolitan has undertaken a number of programs to protect the quality of its water supplies. These programs are summarized below.

#### *Source Water Protection*

Source water protection is the first step in a multi-barrier approach to provide safe and reliable drinking water. In accordance with California's Surface Water Treatment Rule, Title 22 of the California Code of Regulations, DDW requires large utilities delivering surface water to complete a Watershed Sanitary Survey every five years to identify possible sources of drinking water contamination, evaluate source and treated water quality, and recommend watershed management activities that will protect and improve source water quality. The most recent sanitary surveys for Metropolitan's water sources are the Colorado River Watershed Sanitary Survey – 2010 Update and the State Water Project Watershed Sanitary Survey – 2011 Update.[20] The next Sanitary Surveys for the watersheds of the Colorado River and the SWP will report on watershed and water quality issues through 2015.

Metropolitan has an active source water protection program and continues to advocate on numerous issues to protect and enhance SWP and Colorado River water quality. As part of its source water protection program, Metropolitan monitors and forecasts source water quality, including closely monitoring the biology and limnology of lakes and aqueducts. Monitoring is conducted to comply with regulatory requirements, respond to water quality events, assess temporal variability, advise operations, and investigate emerging constituents and invasive species.

[20] Metropolitan Water District of Southern California, *Colorado River Watershed Sanitary Survey, 2010 Update*. For the State Water Project, the sanitary survey report was prepared on behalf of the State Water Project Contractors Authority, in 2011, and was titled *California State Water Project Watershed Sanitary Survey, 2011 Update*.

### *Colorado River Water Quality Partnerships*

Metropolitan collaborates with external partners to asses and manage watershed threats to Colorado River water quality. Metropolitan is a member of the Clean Colorado River Sustainability Coalition, which was formed in 1997 and focuses on protecting and enhancing the Colorado River through monitoring and analysis of water quality to assure and sustain high quality water for all users of the Colorado River. In 2011, Metropolitan formed the Lower Colorado River Water Quality Partnership with SNWA and Central Arizona Project to identify and implement collaborative solutions to address water quality issues facing the Colorado River. Metropolitan also participates in the Lake Mead Water Quality Forum which was formed in 2012, and its Lake Mead Ecosystem Monitoring Workgroup subcommittee. The Lake Mead Water Quality Forum's goals are to support the protection of human health and the environment and to preserve and improve the water quality of the Las Vegas Wash, Las Vegas Bay, and Lake Mead (and as a result, the Colorado River). In addition, as discussed earlier, Metropolitan is a member of the Colorado River Basin Salinity Control Forum which facilitates coordination between Basin states and federal agencies on salinity matters and the implementation of the Colorado River Basin Salinity Control Program.

### *SWP Water Quality Programs*

Metropolitan supports DWR policies and programs aimed at maintaining or improving the quality of SWP water delivered to Metropolitan. In particular, Metropolitan supported the DWR policy to govern the quality of non-project water conveyed by the California Aqueduct. In addition, Metropolitan has supported the expansion of DWR's Municipal Water Quality Investigations Program beyond its Bay-Delta core water quality monitoring and studies to include enhanced water quality monitoring and forecasting of the Delta and SWP. These programs are designed to provide early warning of water quality changes that will affect treatment plant operations both in the short-term (hours to weeks) and up to seasonally. The forecasting model is currently suitable for use in a planning mode. It is expected that with experience and model refinement, it will be suitable to use as a tool in operational decision making.

Metropolitan has implemented selective withdrawals from the Arvin-Edison storage program and exchanges with the Kern Water Bank to improve water quality. Although these programs were initially designed to provide dry-year supply reliability, they can also be used to store SWP water at periods of better water quality so the stored water may be withdrawn at times of lower water quality, thus diluting SWP water deliveries. Although elevated arsenic levels have been a concern in one groundwater banking program, there are also short-term water quality benefits that can be realized through storage programs, such as groundwater pump-ins into the California Aqueduct with lower TOC levels (as well as lower bromide and TDS, in some programs).

### *Regulatory and Legislative Actions*

Metropolitan conducts technical reviews of regulatory and legislative actions that may have an effect on the quality of Metropolitan's source waters. These may include changes in federal and state water quality standards; California Environmental Quality Act (CEQA) documents for projects or programs within Metropolitan's source watersheds; National Pollutant Discharge Elimination System permits for wastewater discharges into the Delta or Colorado River systems; and regulations or statewide policies and permits affecting source water quality or reservoir management issues. In addition, Metropolitan advocates and provides funding requests for key source water protection priorities, including the Moab uranium tailings cleanup and Colorado River salinity control.

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# Coordination and Public Outreach

5

### *Collaborative Regional Planning*

Southern California has a remarkable, unparalleled tradition of meeting its water challenges as a single cohesive region. Metropolitan serves as both importer of water and regional water planner, and for the past generation, Metropolitan's Integrated Water Resources Plan (IRP) and the related Urban Water Management Plan (UWMP) have served as the reliability road map for the region. Metropolitan's 2015 IRP Update and 2015 UWMP were prepared concurrently through a collaborative process that included extensive coordination with Southern California's wholesale and retail water agencies, as well as municipal service providers and public planning agencies. The process also included outreach to engage the general public, businesses, environmental organizations, diverse communities, and other stakeholders with an interest in the future of Southern California's water supplies.

This chapter describes how Metropolitan's process to develop the 2015 UWMP complies with the provisions for coordination and public outreach in the Urban Water Management Planning Act (CA Water Code §10610, et seq.).

### *Development of "Water Tomorrow," a Regional Plan*

In early 2015, Metropolitan initiated a process to concurrently update its 2010 IRP and prepare the 2015 UWMP. Metropolitan branded this IRP update as "Water Tomorrow," which underlines the purpose of the plan and its importance to the region. The 2015 IRP Update seeks to integrate into a single plan the many local water actions that take place throughout Metropolitan's service area. This information was then used to prepare the UWMP.

For Metropolitan, the process to update the IRP and prepare the UWMP began with considerable homework. Local supply surveys, estimates of retail demands, and data within local urban water management plans were among the many key building blocks. Regional planning agencies provided updated demographics and population projections. In addition, planning processes for the Colorado River supply and the SWP (the region's primary imported water supplies) provided estimates of water supply availability given a range of possible future circumstances. The data were analyzed through Metropolitan's own planning model.

Data and documents are important, but it is the collaboration – with Metropolitan's 26 member agencies, its 38-member Board of Directors, numerous important stakeholders, and the general public – that truly enriched this process and shaped the final plans. Broad policy discussions and reviews were held at the board level. Member agency workshops dug into considerable technical detail. Public meetings, even social media, provided important feedback on how best to plan for a reliable water future.

The end result was the integration of many strategies, and many possible future water scenarios, into an adaptable regional plan – an IRP – and the related UWMP. The comprehensive process behind the 2015 IRP Update and preparation of the 2015 UWMP continues the tradition of Southern California working together to have reliable supplies of water for tomorrow.

### *Coordination with Other Appropriate Agencies*

Metropolitan coordinated the preparation of this UWMP with its 26 member agencies, wastewater management agencies, municipal service providers, groundwater management agencies, and regional planning agencies. The extensive regional coordination is consistent with the requirements of California Water Code Sections 10620(d)(2), 10641, and 10642.

#### *Board of Directors Oversight*

Metropolitan's Board of Directors provided oversight throughout the concurrent process for the 2015 IRP Update and the preparation of the 2015 UWMP. The process began with a presentation to Metropolitan's Water Planning and Stewardship Committee in February 2015. To provide focused involvement of the Metropolitan Board, the board created an Integrated Resources Planning Committee (IRP Committee), which is made up of 17 Metropolitan board directors. Beginning in March 2015, the IRP Committee met on a regular basis to provide guidance and receive information from Metropolitan staff. The IRP Committee held 10 meetings between March 2015 and January 2016, as summarized in Table 5-1.

**Table 5-1**
**Summary of Metropolitan Board of Directors Committee Meetings**

| Date | Committee | Topic |
|---|---|---|
| February 9, 2015 | WP&S Committee | Overview of the upcoming IRP process |
| March 24, 2015 | IRP Committee | Overview of the upcoming 2015 IRP Update and UWMP process, including a historical overview of previous IRPs, and description of proposed topics and timeline |
| April 28, 2015 | IRP Committee | Detailed review of current IRP targets and initial look at changed conditions |
| May 26, 2015 | IRP Committee | Expert presenters on Conservation Rates and Conservation Potential; Member Agency Technical Process Update |
| June 23, 2015 | IRP Committee | Expert presenters on Groundwater and Stormwater; Member Agency Technical Process Update |
| July 28, 2015 | IRP Committee | Expert presenters on Climate Change and Uncertainty; Member Agency Technical Process Update |
| August 18, 2015 | IRP Committee | Initial Results and Water Balances, IRP/UWMP Outreach, Delta Assumptions |
| September 29, 2015 | IRP Committee | Draft Results; IRP/UWMP Outreach |
| October 27, 2015 | IRP Committee | IRP/UWMP Outreach, Technical Recommendations, Draft IRP Issue Paper Addendum |
| December 7, 2015 | IRP Committee | Draft 2015 IRP Update, Overview of Phase 1 Policy Inventory and Phase 2 Policy Process |
| January 12, 2016 | IRP Committee | Final 2015 IRP Update |

### *Collaboration with Member Agencies and Other Organizations*

For guidance, discussion, and information-sharing on technical topics, Metropolitan staff collaborated with Metropolitan's member agencies through an IRP Member Agency Technical Workgroup. The Technical Workgroup met 11 times between April and October 2015. Each meeting focused on specific subjects. Through the workgroup, member agency staff provided Metropolitan staff with data and information essential for updating the 2015 IRP Update forecasts, feedback on draft analyses, and policy topics for the policy discussions following the adoption of the 2015 IRP Update. Additionally, member agency staff and external experts provided input and direction on the development of the 2015 IRP Update Issue Paper Addendum and collaborated with Metropolitan staff during the writing process.

Metropolitan distributed data sets of demographics, total demands after conservation, local supplies, and demands on Metropolitan at the regional and member agency levels using a 25-year planning horizon. The data were provided to the member agencies in five-year increments under single-dry, multi-dry, and average-year conditions as required in California Water Code §10631(j). When requested, Metropolitan staff met individually with the member agencies to review the data sets and discuss any agency-specific questions or issues. Regional issues and analysis methodologies were discussed during the technical workgroup meetings. Demand and supply estimates were included in the draft copy of the 2015 UWMP distributed to the member agencies in December, 2015.

IRP/UWMP briefings were also periodically presented during regular Member Agency Managers meetings held at Metropolitan. Metropolitan's update process also coordinated dialogue with the monthly water use efficiency meeting held with conservation coordinators from Metropolitan's member agencies and their retail sub-agencies. These meetings served as a forum for input on Metropolitan's conservation model methodology. Metropolitan staff also met with the member agency Conservation Program Advisory Committee for technical discussion and comments on Metropolitan's Conservation Savings Model. Additional meetings included the Local Resources Program (LRP) Coordinator's meeting and webinar where member agencies and retailers provided input to the recycled water discussion. The Technical Workgroup and other member agency planning meetings are summarized in Table 5-2.

### *Public Outreach during IRP/UWMP Preparation*

Public involvement was an important element of the process to update the IRP and prepare the 2015 UWMP. Public outreach efforts complement the technical processes with the IRP committee and the member agencies. Most importantly, the efforts that were implemented during 2015 establish a means for the public to provide input to the policy discussions that are occurring following the adoption of the 2015 IRP Update.

Metropolitan's three key objectives for the public involvement element of the 2015 IRP Update and preparation of the UWMP are as follows:

- Ensure that the 2015 IRP Update/UWMP process is understandable and accessible to anyone who has an interest in Southern California's water supplies
- Provide opportunities for learning, dialogue, and input
- Create a pathway to encourage continued engagement in future policy discussions

To achieve the first objective, Metropolitan branded the 2015 IRP Update as "Water Tomorrow," which underlines the purpose of the plan and its importance to the region. Metropolitan then created a new website, MWDWaterTomorrow.com, which provides extensive information on the current update process, as well as the history of Metropolitan's IRP over the past two

decades. For the 2015 IRP Update, the site includes a calendar of past and future meetings, technical analysis and presentations, brief descriptions of Southern California's water resources, a comment section, and ways to participate. Metropolitan shares news and updates about Water Tomorrow through traditional and social media, Metropolitan's "Your Water" e-newsletter, and a variety of social media platforms. Metropolitan also provides speakers for community and business organizations throughout its service area.

While the first objective addresses public awareness, the second objective seeks to ensure that public involvement advances the region's understanding of water issues, challenges and perspectives and benefits Metropolitan's planning process. Metropolitan worked with the Southern California Water Committee to present the 2015 IRP Update process and technical issues at two workshops held at Metropolitan. Approximately 150 people participated in the first workshop in June to discuss a "Drought Proof Strategy." The second workshop was held in August where approximately 125 attendees discussed the future of outdoor water conservation. In September, Metropolitan met with the Southern California Water Dialogue whose diverse membership includes environmental organizations, private industry, and public agencies. The Southern California Association of Governments presented an overview of demographic projections, and Metropolitan staff provided an introduction to the technical analysis for the 2015 IRP Update. The IRP Committee Chair facilitated discussion on the 2015 IRP Update among the approximately 75 participants.

Following the three focused workshops held with the Southern California Water Committee and the Southern California Water Dialogue, Metropolitan convened the Water Tomorrow public workshop on October 22, 2015. More than 450 people participated in the all-day workshop, which was offered both in person and online to encourage broad participation throughout Metropolitan's service area. Staff recapped the technical analysis and key findings. Professional facilitators guided participant discussion in key resource areas: conservation, local resources, groundwater, and imported supplies. The key discussion points, ideas, and outcomes were reported to the IRP Committee to help inform future board policy discussions.

The third outreach objective looks to the future. One of Metropolitan's overarching communication goals is to develop the general public's knowledge of water resource issues and the range of solutions available to Southern California. An informed public is better able to contribute to the discussions and understand the implications and opportunities afforded by decisions. Metropolitan is building on the progress in the first phase of the 2015 IRP Update to encourage continued involvement in future discussions for the IRP and other water issues. These discussions will focus on solutions to challenges, and topics will range from policy and regulations to technology and behavior change.

As social media has become part of mainstream communications, Metropolitan tried a supplemental means of public engagement. Metropolitan worked with Northern Rift, a firm that has created a software platform to engage the public in raising and collaborating on ideas, to offer an online Water Tomorrow Innovation Game. Participants proposed ideas to solve Southern California's water challenges and then collaborated on the ideas to help grow them or discuss their limitations. The top ideas selected by the community of participants and those selected by a panel of water resource and policy experts were recognized at a reception hosted by Metropolitan. The Board of Directors may consider the ideas in future discussions on implementation of the 2015 IRP Update.

### *UWMP Public Notice and Adoption*

Metropolitan provided notice of the availability of the draft 2015 UWMP and the public hearing to consider adoption, in accordance with California Water Code Sections 10621(b) and 10642,

and Government Code Section 6066. The public review draft of the plan was posted prominently on Metropolitan's website, mwdh2o.com, on February 1, 2016, more than 60 days in advance of the public hearing on April 11, 2016. The notice of availability of the document was sent to the member agencies, as well as cities and counties in the Metropolitan service area. In addition, a public notice advertising the public hearing was published in six Southern California newspapers on February 1 and 8, 2016. A copy of the notification letter sent to the member agencies, cities and counties in Metropolitan's service area is included in this chapter, as well as the notice published in the newspapers. Table 5-3 provides a list of participating member agencies and other appropriate agencies that Metropolitan coordinated with in its regional planning, as well as the cities and counties that were notified about the preparation of its 2015 UWMP.

Metropolitan held the public hearing for the draft 2015 UWMP on April 11, 2016, at the Board's Water Planning and Stewardship Committee meeting. On May 10, 2016, Metropolitan's Board determined that the 2015 UWMP is consistent with the Act and an accurate representation of the water resources plan for the Metropolitan service area. As stated in Resolution 9209, the Board adopted the 2015 UWMP and authorized its submittal to the State of California. A copy of Resolution 9209 is included in this section.

### *Submission and Availability of Final 2015 UWMP*

In fulfillment of California Water Code §10645, Metropolitan's Final 2015 UWMP was posted on the mwdh2o.com website on May 10, 2016, following its adoption by the Metropolitan board.

In fulfillment of California Water Code §§ 10635(b) and 10644(a)(1), Metropolitan also mailed copies of the Final 2015 UWMP (in electronic pdf format) to the California State Library and all cities and counties within Metropolitan's service area within 30 days of Board adoption.

In fulfillment of California Water Code § 10621(d) and § 10644(a)(1) and (2), Metropolitan's Final 2015 UWMP was electronically submitted to the State of California through DWR's WUE data website https://wuedata.water.ca.gov/secure/ in June 2016.

**Table 5-2**
**2015 Technical Process Member Agency Participation**

| Date | Group | Topic |
|---|---|---|
| April 8, 2015 | Member Agency Technical Workgroup | Introduction to 2015 IRP Update/UWMP process |
| April 16, 2015 | Water Use Efficiency Meeting | Introduction to 2015 IRP Update/UWMP process, Conservation |
| April 22, 2015 | Member Agency Technical Workgroup | Uncertainty planning in the IRP |
| April 29, 2015 | Conservation Program Advisory Committee | Conservation model |
| May 18, 2015 | Member Agency Technical Workgroup | Imported Supplies (Colorado River Aqueduct, State Water Project, Central Valley Transfers and Storage) |
| May 20, 2015 | Water Use Efficiency Meeting | Conservation |
| May 27, 2015 | Member Agency Technical Workgroup | Groundwater (Part 1 of 2) |
| June 11, 2015 | Member Agency Technical Workgroup | Groundwater (Part 2 of 2) |
| June 16, 2015 | LRP Coordinators Meeting | Recycled Water Issue Paper |
| June 18, 2015 | Water Use Efficiency Meeting | Long-term impacts of current water use restrictions, Issue Paper chapter on Conservation |
| June 24, 2015 | Member Agency Technical Workgroup | Local Resources (Part 1 of 2) |
| July 8, 2015 | Member Agency Technical Workgroup | Local Resources (Part 2 of 2) |
| July 16, 2015 | Water-Use Efficiency Meeting | Conservation savings forecast, Draft 2015 IRP Update Issue Paper Addendum |
| July 22, 2015 | Member Agency Technical Workgroup | Retail Demands and Conservation |
| August 3, 2015 | Member Agency Technical Workgroup | Draft IRP Technical Results (Part 1 of 2) |
| August 21, 2015 | Member Agency Managers Meeting | Draft IRP Technical Results briefing |
| September 15, 2015 | Member Agency Technical Workgroup | Draft IRP Technical Results (Part 2 of 2) |
| September 25, 2015 | Member Agency Managers Meeting | IRP/UWMP Technical Process Overview |
| October 5, 2015 | Member Agency Technical Workgroup | Final Technical Results |
| October 16, 2015 | Member Agency Managers Meeting | Final Technical Results |
| November 16, 2015 | Member Agency and Sanitation Districts Coordination Meeting | Overview of draft 2015 UWMP and Water Service Reliability |

**Table 5-3**
**Water Supplier Information Exchange**

| **6 Counties** | | | |
|---|---|---|---|
| Los Angeles | Orange | Riverside | San Bernardino |
| San Diego | Ventura | | |
| **136 Cities** | | | |
| Agoura Hills | Fillmore | Long Beach | Rosemead |
| Aliso Viejo | Fontana | Los Alamitos | San Clemente |
| Arcadia | Fountain Valley | Lynwood | San Dimas |
| Artesia | Fullerton | Malibu | San Fernando |
| Azusa | Garden Grove | Manhattan Beach | San Gabriel |
| Bell Gardens | Gardena | Maywood | San Jacinto |
| Bellflower | Glendale | Menifee | San Marcos |
| Bradbury | Glendora | Mission Viejo | San Marino |
| Buena Park | Hawaiian Gardens | Monrovia | Santa Ana |
| Burbank | Hermosa Beach | Monterey Park | Santa Fe Springs |
| Calabasas | Hidden Hills | Moorpark | Santa Monica |
| Camarillo | Huntington Beach | Murrieta | Seal Beach |
| Carson | Imperial Beach | National City | Sierra Madre |
| Chino | Industry | Newport Beach | Signal Hill |
| Chino Hills | Inglewood | Norco | Simi Valley |
| Chula Vista | Irvine | Norwalk | Solana Beach |
| Claremont | Irwindale | Ontario | South El Monte |
| Compton | La Canada Flintridge | Oxnard | South Gate |
| Corona | La Habra | Palos Verdes Estates | South Pasadena |
| Covina | La Habra Heights | Paramount | Stanton |
| Cudahy | La Mesa | Pasadena | Temecula |
| Culver City | La Mesa | Perris | Temple City |
| Cypress | La Mirada | Pico Rivera | Thousand Oaks |
| Dana Point | La Palma | Placentia | Torrance |
| Del Mar | La Puente | Pomona | Upland |
| Diamond Bar | La Verne | Port Hueneme | Ventura |
| Downey | Laguna Beach | Poway | Villa Park |
| Duarte | Laguna Hills | Rancho Cucamonga | Vista |
| Eastvale | Laguna Niguel | Rancho Palos Verdes | Walnut |
| El Cajon | Laguna Woods | Rancho Santa Margarita | West Hollywood |
| El Monte | Lake Elsinore | Redondo Beach | Westlake Village |
| El Segundo | Lake Forest | Riverside | Westminster |
| Encinitas | Lakewood | Rolling Hills | Whittier |
| Escondido | Lawndale | Rolling Hills Estates | Wildomar |

**Table 5-3**
**Water Supplier Information Exchange** (continued)

| **26 Member Agencies** | | | |
|---|---|---|---|
| Anaheim | Foothill MWD | Municipal Water District of Orange County | Three Valleys MWD |
| Beverly Hills | Fullerton | Pasadena | Torrance |
| Burbank | Glendale | San Diego County Water Authority | Upper San Gabriel Valley MWD |
| Calleguas MWD | Inland Empire Utilities Agency | San Fernando | West Basin MWD |
| Central Basin MWD | Las Virgenes MWD | San Marino | Western MWD |
| Compton | Long Beach | Santa Ana | |
| Eastern MWD | Los Angeles | Santa Monica | |
| **9 Groundwater Basin Management Organizations** | | | |
| Santa Margarita River Watermaster | Ventura County Watershed Protection District | Water Replenishment District | Upper Los Angeles River Area Watermaster |
| San Bernardino County Flood Control District | Chino Basin Watermaster | Main San Gabriel Basin Watermaster/ | Orange County Water District |
| Raymond Basin Management Board | | | |
| **Other Agencies / Planning Organizations** | | | |
| Sanitation Districts of Los Angeles County | City of Los Angeles Bureau of Sanitation | Southern California Association of Governments | Western Riverside Council of Governments |
| Orange County Sanitation District | City of San Diego Metropolitan Wastewater Department | City of San Diego Recycled Water Section Public Utilities Department | San Diego Association of Governments |

**(Notification per California Water Code §10621(b) and §10642)**

# Letter Notifying Cities and Counties

February 1, 2016

[Sent via US Mail to Member Agencies, City Managers and County Administrators]

Notice of Public Hearing on The Metropolitan Water District of Southern California's Draft 2015 Urban Water Management Plan

The Metropolitan Water District of Southern California (Metropolitan) cordially invites you to participate and provide comments at a public hearing on the draft 2015 Urban Water Management Plan (UWMP). The UWMP presents Metropolitan's long-term plan for ensuring water supply reliability and water quality for the region. The draft UWMP complies with California state law requiring urban water suppliers to prepare and update urban water management plans every five years. The hearing will be held as part of the meeting of the Water Planning and Stewardship Committee whose board members are helping to shape a public dialogue on the future of water management and conservation in the region. The meeting is at:

The Metropolitan Water District of Southern California
700 North Alameda Street, Los Angeles, CA 90012
Water Planning and Stewardship Committee Meeting – Room 2-456
Monday, April 11, 2016 at 10:00 AM

The draft UWMP is posted on Metropolitan's web site, mwdh2o.com for your review. Public input is encouraged and will be considered during finalization of the 2015 UWMP. Written comments are due by **April 11, 2016**. Please send comments to:

The Metropolitan Water District of Southern California
PO Box 54153
Los Angeles, CA 90054-0153
**Attn: Edgar Fandialan**

If you would like more information or have any questions, please contact Edgar Fandialan at (213) 217-6764 or via email at efandialan@mwdh2o.com.

Very Truly Yours,

Devendra Upadhyay
Manager, Water Resource Management

**(Newspaper publication per California Water Code §10642 and Government Code §6066)**

# PUBLIC HEARING SCHEDULED ON DRAFT URBAN WATER MANAGEMENT PLAN

The Metropolitan Water District of Southern California (Metropolitan) will hold a public hearing on **Monday, April 11, 2016** to receive comments on its draft 2015 Urban Water Management Plan (UWMP).

The hearing will be held as part of the meeting of the Water Planning and Stewardship Committee whose board members are helping to shape a public dialogue on the future of water management and conservation in the region. The meeting is at:

The Metropolitan Water District of Southern California
700 North Alameda Street, Los Angeles, CA 90012
Water Planning and Stewardship Committee Meeting – Room 2-456
Monday, April 11, 2016 at 10:00 AM

The UWMP presents Metropolitan's long-term plan for ensuring water supply reliability and water quality for the region. The draft UWMP complies with California state law requiring urban water suppliers to prepare and update urban water management plans every five years.

The draft plan is available on Metropolitan's web site, mwdh2o.com. Public input is encouraged and will be considered during finalization of the 2015 UWMP. Metropolitan will accept written comments on the draft plan. All written comments must be received by **April 11, 2016**, by sending them to:

The Metropolitan Water District of Southern California
P.O. Box 54153
Los Angeles, CA 90054-0153
**Attn: Edgar Fandialan**

For more information on the draft UWMP, please contact Edgar Fandialan of Metropolitan's Water Resource Management Group at (213) 217-6764.

# Resolution 9209

**RESOLUTION**
**OF THE BOARD OF DIRECTORS**
**OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA**
**ADOPTING THE 2015 URBAN WATER MANAGEMENT PLAN**

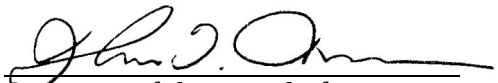
WHEREAS, the California Urban Water Management Planning Act requires urban water suppliers providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to prepare and adopt, in accordance with prescribed requirements, an urban water management plan every five years; and

WHEREAS, the California Urban Water Management Planning Act specifies the requirements and procedures for adopting such Urban Water Management Plans; and

WHEREAS, the Board of Directors of The Metropolitan Water District of Southern California has duly reviewed, discussed, and considered such Urban Water Management Plan and has determined the 2015 Urban Water Management Plan to be consistent with the California Urban Water Management Planning Act and to be an accurate representation of the water resources plan for The Metropolitan Water District of Southern California.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of The Metropolitan Water District of Southern California that, on May 10, 2016, this District hereby adopts this 2015 Urban Water Management Plan for submittal to the State of California.

I HEREBY CERTIFY that the foregoing is a full, true and correct copy of a resolution adopted by the Board of Directors of The Metropolitan Water District of Southern California, at its meeting held on May 10, 2016.



Secretary of the Board of Directors
of The Metropolitan Water District
of Southern California

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# Appendix 1

# DEMAND FORECAST

# Appendix 1
# DEMAND FORECAST

## Forecast Overview

Retail water demand forecasting is essential for planning total water requirements in Metropolitan's service area. Retail water demand can be met with conservation, local supplies, or imported supplies. As a wholesale imported water supplier, Metropolitan's long-term plans focus on the future demands for Metropolitan's supplies. In order to project the need for resources and system capacity, Metropolitan begins with a long-term projection of retail water demands.

Total retail demands include:

- Retail Municipal and Industrial (M&I) — Retail M&I demands represent urban water use within the region including residential, commercial, industrial, and institutional water uses. To forecast retail M&I demands, Metropolitan uses econometric models that have been adapted for conditions in Southern California. The econometric models are statistical models that can capture and explain the impacts of long-term socioeconomic trends on retail M&I demands. The econometric models incorporate projections of demographic and economic variables from regional transportation planning agencies to produce forecasts of water demand.
- Retail Agricultural Demand — Retail agricultural demands consist of water use for irrigating crops. Metropolitan's member agencies provide projections of agricultural water use based on many factors, including farm acreage, crop types, historical water use, and land use conversion. Metropolitan relies on member agencies' projections of agricultural demands.
- Seawater Barrier Demand — Seawater barrier demands represent the amount of water needed to hold back seawater intrusion into the coastal groundwater basins. Groundwater management agencies determine the barrier requirements based on groundwater levels, injection wells, and regulatory permits.
- Replenishment Demand — Replenishment demands represent the amount of water member agencies plan to use to replenish their groundwater basins in order to maintain sustainable basin health and production.

### *Retail M&I Demand Forecast*

In forecasting retail M&I water demand, Metropolitan adopted a new econometric model (the Metropolitan Water District – Econometric Demand Model or MWD-EDM) developed by The Brattle Group (January 2015). MWD-EDM utilizes multiple regression, which is generally favored by academics and practitioners for long-term water demand analysis. It uses demand relationships based on actual observed behavior to consider the effect of anticipated changes in demand factors on long-term demand.

MWD-EDM is comprised of three separate regression models described below. Each model is developed using historical water consumption and socio-demographic and economic data specific to the sector:

- Single-Family Residential (SFR) Model - SFR water demand is modeled as a function of price, weather, retailer level housing, socio-demographic characteristics, and member agency level fixed effects. The model used water consumption data from 153 retailers with 3,000 accounts or more in Metropolitan's service area. The dataset, ranging from 1994 to 2011, consisted of 1,225 observations and represented 80 percent of all SFR accounts from all 26 Metropolitan member agencies.
- Multi-family Residential (MFR) Model - MFR demand is modeled as a function of price, retailer level housing, socio-demographic characteristics, and member agency level fixed effects. Water consumption data was collected from 53 water retailers consisting of 469 observations and representing 23 out of 26 Metropolitan member agencies.
- Commercial, Industrial, and Institutional (CII) Model - CII demand is modeled as a function of price, weather, employment, the share of employment in the manufacturing sector, and member agency level fixed effects. Water consumption data was collected from 75 water retailers consisting of 709 observations and representing 25 out of 26 Metropolitan member agencies.

The SFR and MFR models forecast average monthly household consumption before conservation, while the CII model forecasts average monthly consumption per employee. Table A.1-1 shows the dependent and the covariates uses in the econometric models for each sector.

**Table A.1-1**
**MWD-EDM Variables**

| Sector | Dependent Variable | Independent Variable (Covariate) |
|---|---|---|
| SFR | Water-Use Per Household | Total Average Cost<br>Total Average Cost x Median Lot Size<br>Annual precipitation<br>Average Max Temperature<br>Median Income<br>Average Household Size<br>Median Lot Size |
| MFR | Water-Use Per Household | Median Tier Price<br>Median Income<br>Median Lot Size<br>Average Household Size |
| CII | Water-Use Per Employee | Median Tier Price<br>Cooling Degree Days<br>Average Max Temperature<br>Share of Employment In Manufacturing<br>Median Tier Price x Share of Manufacturing |

Total retail M&I demand is the product of projected household/employee and the average monthly consumption.

Price Elasticity

Price elasticity of demand is a measure used in economics to show the responsiveness of the quantity of water demanded to a change in its price. The assumed price increase reduces the water use. This reduction can be assessed in MWD-EDM and is considered a conservation savings due to price or "price-effect." Consumers can respond to price increases by installing water-conserving fixtures and appliances such as high-efficiency toilets. However, many of the fixture-based conservation savings options are already factored into Metropolitan's Conservation Savings Model. As more water efficient fixtures are installed, the impact of changing water using behavior through price or rates is reduced. Consider consumers who respond to rate increases by taking shorter showers. Their behavior adjustment will save less water if they use a water-efficient low-flow showerhead compared to a regular showerhead. This effect is known as demand hardening. In order to avoid double-counting conservation savings and account for demand hardening, the impact of price elasticity is reduced. In MWD-EDM, price elasticity is reduced to 33 percent by 2020 and is kept constant beyond 2020. Price-effect savings are reduced (and demands increased) as a result of this adjustment. The elasticity is reduced in proportion to increases in conservation savings from the conservation model. Reducing price elasticity to 1/3 of its originally estimated levels is based on professional judgment, assuming that much of the easily obtained water use efficiencies will be achieved by 2020, but allowing for new conservation technologies.

Fixed Effects

MWD-EDM forecasts retail M&I demand for each of the 26 member agencies. To account for the differences observed between each agency, MWD-EDM uses the fixed effects or the constant term that represents the member agency specific intercepts that account for all time-invariant unobserved factors common to an agency.

Demographics

Demographics are recognized by the water industry as drivers of water demand. Metropolitan's retail demand modelling is driven by key demographics such as projected population, households, employment, and median household income.

Metropolitan uses demographic growth projections produced by two regional transportation planning agencies: the Southern California Association of Governments (SCAG) and the San Diego Association of Governments (SANDAG). Together they represent more than 200 cities in Southern California and produce long-term transportation plans for sustainable communities. Among other responsibilities, SCAG and SANDAG also prepare projections of population, households, income, and employment for their regions. Both planning agencies update their regional growth forecasts approximately every four years, at different times. SCAG is the regional planning agency for six counties: Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura. SANDAG is the regional planning agency for San Diego County. Significantly, SCAG's and SANDAG's official growth projections are backed by environmental reports. These regional growth forecasts provide the core assumptions underlying Metropolitan's retail demand forecasting model.

In April 2012, SCAG released the *2012-2035 Regional Transportation Plan/Sustainable Communities Strategy* growth forecast (RTP-12). The RTP-12 incorporated updated data and assumptions that reflected the 2007-2009 economic recession, the 2010 Census count, and 2011 employment data from the California Employment Development Department for the Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties. Metropolitan uses the forecast for every county except Imperial, which is outside of Metropolitan's service area.

In October 2013, SANDAG released the *Series 13: 2050 Regional Growth Forecast* (Series 13). Series 13 is a comprehensive projection of the regional demographic, economic, and housing trends expected over the next four decades for the San Diego region. Metropolitan uses the forecast for the San Diego County Water Authority's service area in the retail demand forecast.

### *Effects of the Great Recession on SCAG's and SANDAG's Forecasts*

The Great Recession of 2007-09 severely impacted the region's economic growth. Economic growth is a major factor in population growth through migration. Job availability attracts people to the region. Conversely, a scarcity of employment leads to out-migration as people leave in search of work. Between 2007 and 2010, the region lost approximately 750,000 jobs. The state and the region experienced disproportionately high job losses compared with the nation. Because patterns of migration are influenced by job availability, Southern California saw net outbound domestic migration. Other major factors that affect population growth are fertility and mortality. The acute economic uncertainties also affected people's decision to start a family. Consequently, delayed family formation and reduced birth rate contributed to slower population growth than was anticipated before the recession. However, mortality rates were projected to be lower as the proportion of older people (age 65+) significantly increases. As a result, the net growth in population in the post-recession era is projected to be lower than previously projected in the 2010 IRP Update.

## Trends in Southern California

### *Population*

According to SCAG and SANDAG estimates, the population in Metropolitan's service area will reach 19.4 million in 2020, 20.0 million in 2025, and 21.8 million by 2040. While Los Angeles County leads in total population, the inland areas of Riverside and San Bernardino counties are projected to grow at the fastest rates over the next ten years. Generally speaking, however, annual growth rates will slow for all counties between 2010 and 2040. In part, this is due to changing patterns of migration. It also reflects the effects of the recession of the late 2000s and the ongoing restructuring of the Southern California economy.

### *Employment*

Within Metropolitan's service area, employment growth is likely to occur unevenly across the six counties. Over the 25-year period between 2015 and 2040, the greatest employment increases are expected to occur in Riverside, Los Angeles, and San Diego Counties with estimated increases of 383, 379, and 237 thousand jobs respectively. Relative to existing employment, Riverside and San Bernardino counties are expected to have the highest rates of employment growth.

Figure A.1-2 and Table A.1-3 summarize the projected growth of commercial, industrial, and institutional employment in Metropolitan's service area. Total urban employment is expected to increase from 8.2 million in 2015 to about 9.6 million in 2040. This increase of about 17 percent is greater than the projected population increase of 16 percent, suggesting a slightly increased share of the population will be employed over time.

**Figure A.1-1 Actual and Projected Population**

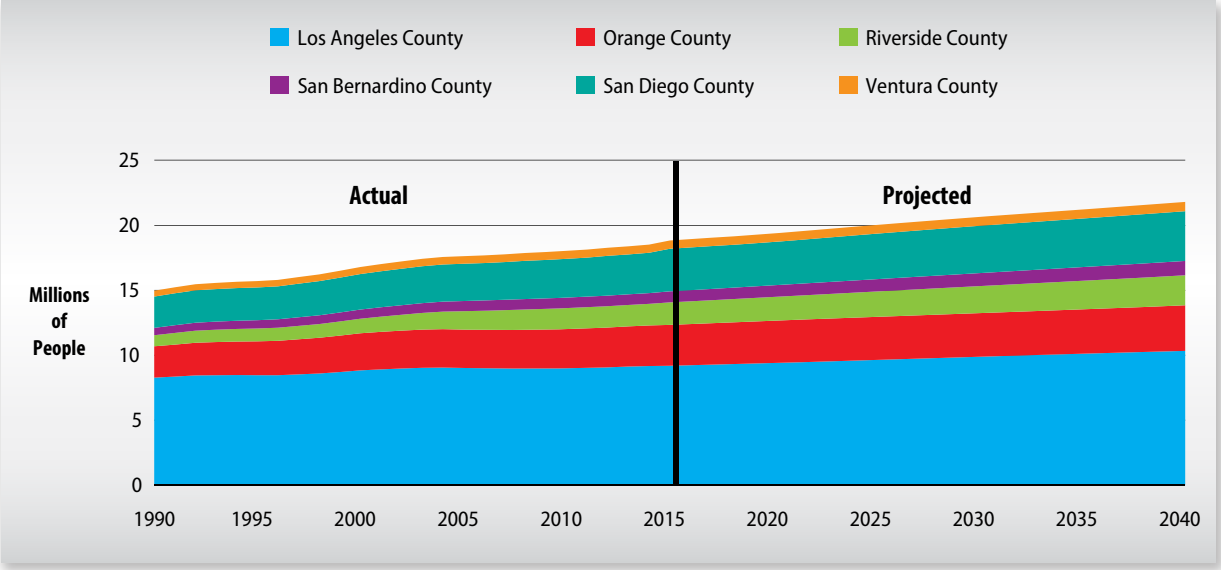
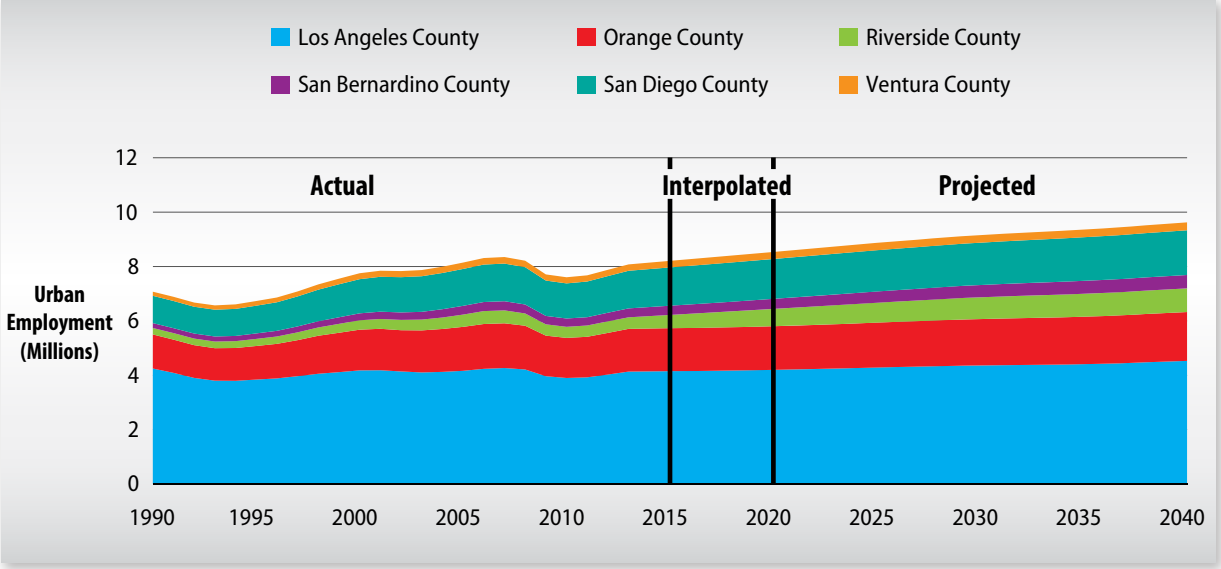



**Figure A.1-2 Actual and Projected Urban Employment**




### *Residential Consumers*

Southern California's regional planning agencies have forecast residential housing growth in all parts of the Metropolitan service area. These forecasts are shown in Figure A.1-3 and Table A.1-4. The total occupied housing stock is expected to increase more than 20 percent between 2015 and 2040, growing from 6.1 to around 7.3 million housing units. Much of this growth will likely occur in hotter inland areas of Southern California. Within the service territory, the household occupancy size (household population divided by total occupied dwelling units) is projected to decline slightly from about 3.0 persons per unit currently to 2.9 persons per unit by 2040.

Permits for new residential housing construction are another indicator of the future growth in water demand. Figure A.1-4 shows the pattern of historical growth in residential housing permits between 1970 and 2040. The effect of economic cycles can clearly be seen over time with the precipitous fall in housing construction during the 2007 to 2010 recession being most notable. There is a recent slight increase of construction from 2011 to 2014.

**Figure A.1-3 Actual and Projected Households**

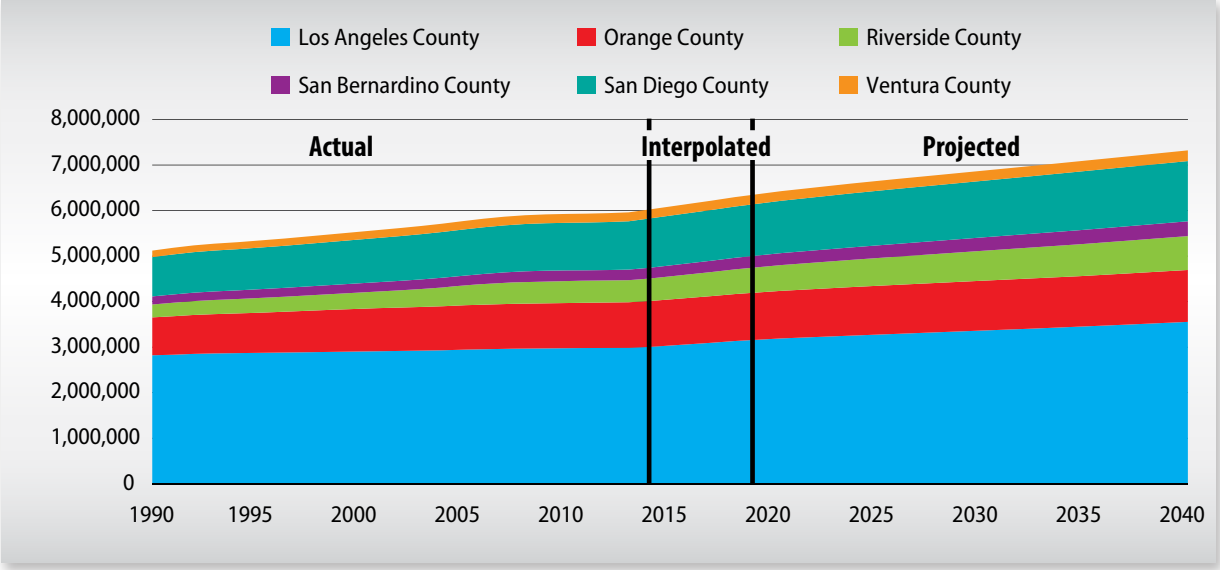
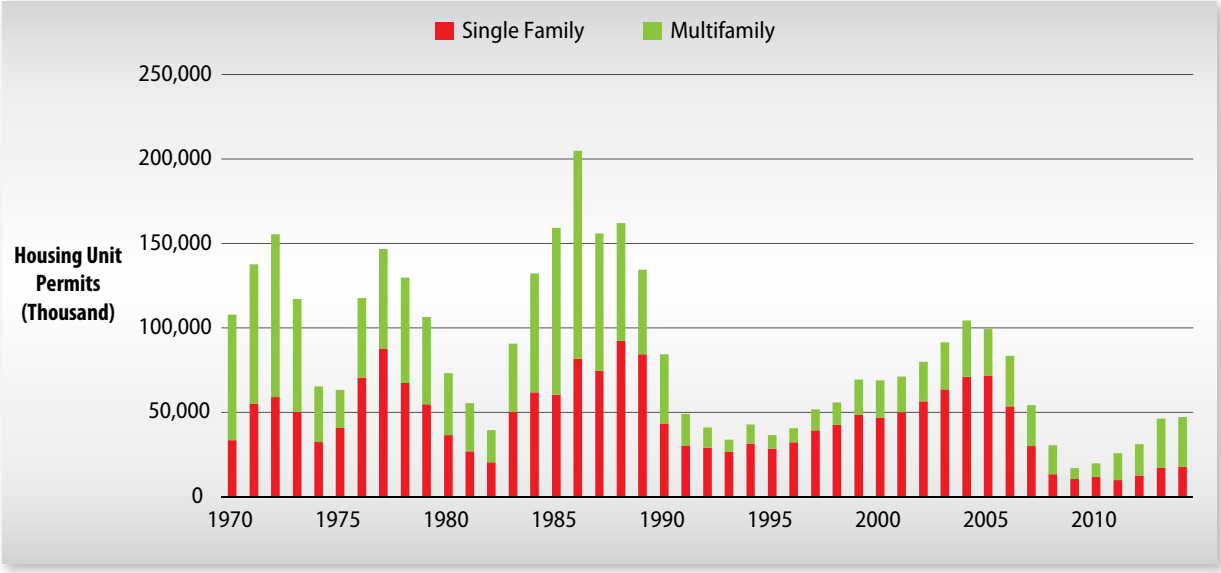



**Figure A.1-4 Residential Housing Permits in Six-County Region**



## Water Demands

As shown in Figure A.1-5 and Table A.1-5, actual retail water demands in 2015 was 3.1 million acre-feet (MAF), which is approximately the same as in 1980. This is due to a number of factors including an aggressive outreach campaign due the severe drought since 2012, advancement in conservation, and mandatory water use restriction.

Of the estimated 3.1 MAF of total retail water use in 2015, agricultural water use was only about 99 TAF. This is due to severe drought, water rate increases, and water use restrictions. By 2040, under average conditions, retail agricultural demand is expected to be about 160 TAF.

### *Retail Demand*

It is estimated that total M&I water use will grow from an annual average of 3.0 MAF in 2015 to 3.8 MAF in 2040. All water demand projections assume normal weather conditions. Future changes in estimated water demand assume continued water savings due to conservation measures such as water savings resulting from plumbing codes, price effects, and the continuing implementation of utility-funded conservation BMPs. Retail demand was greatly reduced in 2015 due to extraordinary response to statewide calls for a 25 percent reduction in water use in light of historic drought conditions. Regional water use is projected to increase slightly until 2020 as demands rebound towards more normal levels. Between 2020 and 2040, regional water use will grow slowly as driven by population and economic growth while water use efficiency increases.

#### By County

M&I water demand is not expected to grow uniformly across counties. Consistent with the general pattern of future demographic distributions, the largest absolute increases in urban water demands are expected to occur in Los Angeles and Riverside Counties, with respective estimated increases of about 231 TAF and 202 TAF between 2015 and 2040.

#### By Sector

Water use can also be broken down by sector. Between 2015 and 2040, single-family residential water use is expected to increase by 18.5 percent (Table A.1-8), while multifamily water use is estimated to increase by 32.9 percent (Table A.1-9). Table A.1-10 shows estimated nonresidential water use increasing by 19.0 percent between 2015 and 2040.

### *Residential Water Use*

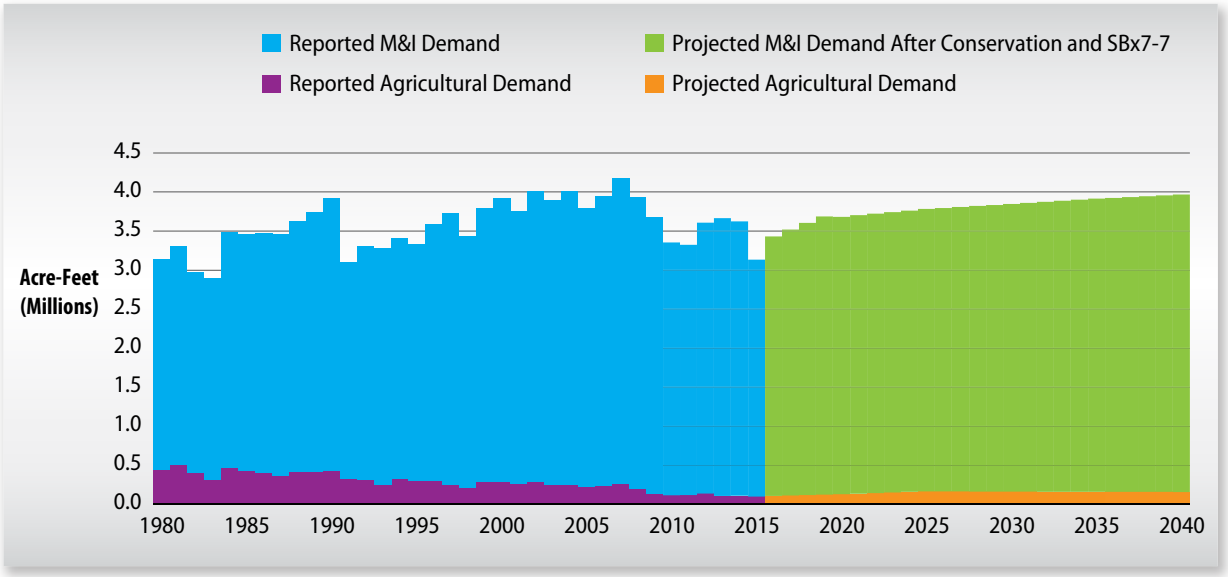
While single-family homes are estimated to account for about 60 percent of the total occupied housing stock in 2015, they are responsible for about 77 percent of total residential water demands (Tables A.1-8 and A.1-9). This is consistent with the fact that single-family households are known to use more water than multifamily households (e.g., those residing in duplexes, triplexes, apartment buildings and condo developments) on a per housing-unit basis. This is because single-family households tend to have more persons living in the household; they are likely to have more water-using appliances and fixtures; and they tend to have more landscaping.

### *Nonresidential Water Use*

Nonresidential water use represented approximately 25 percent of the total M&I demands in Metropolitan's service area in 2015 (Table A.1-10). This includes water that is used by businesses, services, government, institutions (such as hospitals and schools), and industrial (or manufacturing) establishments. Within the commercial/institutional category, the top water

users include schools, hospitals, hotels, amusement parks, colleges, laundries, and restaurants. In Southern California, major industrial users include electronics, aircraft, petroleum refining, beverages, food processing, and other industries that use water as a major component of the manufacturing process.

**Figure A.1-5 Actual and Projected Retail Water Demand**




### *Conservation Savings*

Table A.1-12 shows estimated conservation savings resulting from active conservation programs ("Active"), ongoing conservation from natural replacement of plumbing fixtures ("Code-Based"), and conservation induced by projected increases in the real price of water ("Price"). Code-Based savings account for the largest share of total conservation. However, aggressive utility-funded conservation programs have made a significant contribution in this area. For example, Metropolitan-assisted programs were responsible for an estimated 179 TAF in savings during FY 2014-15 and nearly 800 TAF in cumulative conservation savings since FY 1990/91.

### *Projected M&I Demand by Sector*

Table A.1-13 provides a summary of municipal and industrial demands, broken down by sector, along with each sector's share of total retail demand. In 2015, residential use accounted for about 70 percent of total projected M&I demand, while non-residential use constituted nearly 21 percent of projected M&I demand. These shares are expected to remain the same until 2040. System losses and unmetered use are expected to remain relatively constant over this period at about 9 percent.

## Table A.1-2 Population Growth in Metropolitan's Service Area (July)

(Acre-feet)

| County | Actual | | | | Estimated | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 8,461,000 | 8,833,000 | 9,025,000 | 9,004,000 | 9,267,000 | 9,397,000 | 9,636,000 | 9,875,000 | 10,122,000 | 10,332,000 |
| Orange County | 2,605,000 | 2,854,000 | 2,954,000 | 3,012,000 | 3,153,000 | 3,246,000 | 3,316,000 | 3,376,000 | 3,382,000 | 3,507,000 |
| Riverside County | 989,000 | 1,120,000 | 1,409,000 | 1,618,000 | 1,679,000 | 1,825,000 | 1,951,000 | 2,074,000 | 2,201,000 | 2,309,000 |
| San Bernardino County | 638,000 | 706,000 | 783,000 | 810,000 | 839,000 | 889,000 | 947,000 | 1,001,000 | 1,059,000 | 1,103,000 |
| San Diego County | 2,519,000 | 2,730,000 | 2,863,000 | 2,987,000 | 3,169,000 | 3,341,000 | 3,496,000 | 3,631,000 | 3,746,000 | 3,825,000 |
| Ventura County | 490,000 | 541,000 | 583,000 | 616,000 | 633,000 | 657,000 | 671,000 | 682,000 | 696,000 | 715,000 |
| **Metropolitan's Service Area** | **15,702,000** | **16,784,000** | **17,617,000** | **18,047,000** | **18,740,000** | **19,355,000** | **20,017,000** | **20,639,000** | **21,206,000** | **21,791,000** |

Source: US Census, CA Department of Finance, SCAG RTP-12, and SANDAG Series 13
Note: Totals may not foot due to rounding differences

## Table A.1-3 Urban Employment Growth in Metropolitan's Service Area (July)

(Acre-feet)

| County | Actual | | | | Estimated | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 3,841,000 | 4,180,000 | 4,163,000 | 3,900,000 | 4,151,000 | 4,191,000 | 4,288,000 | 4,364,000 | 4,400,000 | 4,530,000 |
| Orange County | 1,236,000 | 1,498,000 | 1,618,000 | 1,476,000 | 1,582,000 | 1,603,000 | 1,652,000 | 1,709,000 | 1,747,000 | 1,797,000 |
| Riverside County | 262,000 | 346,000 | 451,000 | 407,000 | 488,000 | 647,000 | 732,000 | 803,000 | 845,000 | 871,000 |
| San Bernardino County | 201,000 | 255,000 | 322,000 | 307,000 | 339,000 | 367,000 | 413,000 | 453,000 | 477,000 | 492,000 |
| San Diego County | 1,021,000 | 1,258,000 | 1,358,000 | 1,292,000 | 1,409,000 | 1,470,000 | 1,519,000 | 1,558,000 | 1,604,000 | 1,646,000 |
| Ventura County | 172,000 | 218,000 | 235,000 | 226,000 | 242,000 | 260,000 | 270,000 | 279,000 | 282,000 | 292,000 |
| **Metropolitan's Service Area** | **6,733,000** | **7,755,000** | **8,147,000** | **7,608,000** | **8,211,000** | **8,538,000** | **8,874,000** | **9,166,000** | **9,355,000** | **9,628,000** |

Source: US Census, CA Department of Finance, SCAG RTP-12, and SANDAG Series 13
Note: Totals may not foot due to rounding differences

## Table A.1-4 Occupied Housing Growth in Metropolitan's Service Area

(Acre-feet)

| County | Actual | | | | Estimated | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 2,876,000 | 2,909,000 | 2,944,000 | 2,980,000 | 3,038,000 | 3,189,000 | 3,277,000 | 3,366,000 | 3,455,000 | 3,557,000 |
| Orange County | 881,000 | 937,000 | 974,000 | 992,000 | 1,013,000 | 1,042,000 | 1,073,000 | 1,092,000 | 1,111,000 | 1,139,000 |
| Riverside County | 323,000 | 357,000 | 432,000 | 483,000 | 506,000 | 563,000 | 609,000 | 656,000 | 703,000 | 744,000 |
| San Bernardino County | 192,000 | 204,000 | 220,000 | 232,000 | 240,000 | 262,000 | 278,000 | 294,000 | 310,000 | 325,000 |
| San Diego County | 913,000 | 963,000 | 1,016,000 | 1,045,000 | 1,093,000 | 1,145,000 | 1,200,000 | 1,241,000 | 1,289,000 | 1,322,000 |
| Ventura County | 156,000 | 170,000 | 185,000 | 195,000 | 200,000 | 211,000 | 217,000 | 222,000 | 227,000 | 235,000 |
| **Metropolitan's Service Area** | **5,341,000** | **5,540,000** | **5,771,000** | **5,927,000** | **6,090,000** | **6,412,000** | **6,654,000** | **6,871,000** | **7,095,000** | **7,322,000** |

Source: US Census, CA Department of Finance, SCAG RTP-12, SANDAG Series 13 2050 Regional Growth Forecast (April 2015)
Note: Totals may not foot due to rounding differences

## Table A.1-5 Total Retail Demand in Metropolitan's Service Area with Conservation and SB X7-7

(Acre-feet)

| County | Actual | | | | | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 1,558,000 | 1,739,000 | 1,643,000 | 1,423,000 | 1,309,000 | 1,503,000 | 1,499,000 | 1,507,000 | 1,525,000 | 1,539,000 |
| Orange County | 577,000 | 660,000 | 629,000 | 546,000 | 539,000 | 604,000 | 613,000 | 617,000 | 613,000 | 619,000 |
| Riverside County | 404,000 | 492,000 | 495,000 | 467,000 | 420,000 | 551,000 | 593,000 | 622,000 | 650,000 | 666,000 |
| San Bernardino County | 184,000 | 251,000 | 264,000 | 249,000 | 216,000 | 279,000 | 296,000 | 307,000 | 319,000 | 327,000 |
| San Diego County | 502,000 | 661,000 | 614,000 | 533,000 | 520,000 | 597,000 | 628,000 | 639,000 | 652,000 | 658,000 |
| Ventura County | 108,000 | 132,000 | 158,000 | 136,000 | 131,000 | 149,000 | 153,000 | 154,000 | 155,000 | 157,000 |
| **Metropolitan's Service Area** | **3,333,000** | **3,935,000** | **3,803,000** | **3,354,000** | **3,135,000** | **3,683,000** | **3,782,000** | **3,846,000** | **3,914,000** | **3,966,000** |

*2015 based on best available data.

## Table A.1-6 Total Retail M&I Demand in Metropolitan's Service Area with Conservation and SB X7-7

(Acre-feet)

| County | Actual | | | | | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 1,550,000 | 1,738,000 | 1,643,000 | 1,422,000 | 1,308,000 | 1,502,000 | 1,499,000 | 1,506,000 | 1,524,000 | 1,539,000 |
| Orange County | 559,000 | 643,000 | 619,000 | 544,000 | 533,000 | 599,000 | 608,000 | 614,000 | 611,000 | 617,000 |
| Riverside County | 245,000 | 357,000 | 413,000 | 409,000 | 379,000 | 486,000 | 507,000 | 537,000 | 565,000 | 581,000 |
| San Bernardino County | 152,000 | 221,000 | 236,000 | 227,000 | 190,000 | 273,000 | 289,000 | 302,000 | 314,000 | 322,000 |
| San Diego County | 438,000 | 556,000 | 523,000 | 506,000 | 509,000 | 559,000 | 580,000 | 592,000 | 606,000 | 613,000 |
| Ventura County | 94,000 | 125,000 | 145,000 | 128,000 | 116,000 | 132,000 | 132,000 | 133,000 | 133,000 | 134,000 |
| **Metropolitan's Service Area** | **3,038,000** | **3,640,000** | **3,579,000** | **3,236,000** | **3,035,000** | **3,551,000** | **3,615,000** | **3,684,000** | **3,753,000** | **3,806,000** |

2015 based on best available data.

## Table A.1-7 Total Retail Agricultural Demand in Metropolitan's Service Area

(Acre-feet)

| County | Actual | | | | | Projected | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Los Angeles County | 7,500 | 500 | 400 | 1,000 | 1,000 | 300 | 400 | 400 | 400 | 400 |
| Orange County | 17,700 | 17,300 | 9,800 | 1,800 | 5,700 | 4,700 | 4,700 | 3,400 | 2,000 | 2,000 |
| Riverside County | 158,700 | 134,100 | 81,700 | 58,100 | 41,100 | 65,600 | 85,500 | 85,100 | 84,900 | 84,500 |
| San Bernardino County | 32,200 | 29,800 | 27,500 | 21,600 | 26,000 | 5,300 | 7,000 | 5,000 | 5,000 | 5,000 |
| San Diego County | 64,400 | 105,600 | 91,300 | 27,100 | 10,800 | 37,800 | 48,300 | 47,200 | 46,100 | 45,000 |
| Ventura County | 14,300 | 7,500 | 12,600 | 8,400 | 14,700 | 16,100 | 21,400 | 22,000 | 22,600 | 22,600 |
| **Metropolitan's Service Area** | **294,800** | **294,800** | **223,300** | **118,000** | **99,300** | **129,800** | **167,300** | **163,100** | **161,000** | **159,500** |

2015 based on best available data.

**Table A.1-8 Single Family Retail Demand in Metropolitan's Service Area[1]**

(Acre-feet)

| County | 2015 | Projected 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Los Angeles County | 770,000 | 854,000 | 833,000 | 836,000 | 850,000 | 849,000 |
| Orange County | 293,000 | 324,000 | 327,000 | 327,000 | 326,000 | 328,000 |
| Riverside County | 306,000 | 371,000 | 371,000 | 390,000 | 412,000 | 421,000 |
| San Bernardino County | 144,000 | 169,000 | 174,000 | 180,000 | 187,000 | 192,000 |
| San Diego County | 316,000 | 364,000 | 375,000 | 380,000 | 385,000 | 385,000 |
| Ventura County | 93,000 | 104,000 | 101,000 | 102,000 | 102,000 | 103,000 |
| **Metropolitan's Service Area** | 1,922,000 | 2,186,000 | 2,181,000 | 2,215,000 | 2,262,000 | 2,278,000 |

[1] Projections do not include savings estimates to meet SB X7-7.

**Table A.1-9 Multi-family Retail Demand in Metropolitan's Service Area[1]**

(Acre-feet)

| County | 2015 | Projected 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Los Angeles County | 301,000 | 330,000 | 349,000 | 355,000 | 362,000 | 376,000 |
| Orange County | 87,000 | 94,000 | 96,000 | 99,000 | 98,000 | 102,000 |
| Riverside County | 42,000 | 48,000 | 63,000 | 67,000 | 70,000 | 77,000 |
| San Bernardino County | 32,000 | 37,000 | 39,000 | 42,000 | 44,000 | 46,000 |
| San Diego County | 103,000 | 115,000 | 125,000 | 133,000 | 143,000 | 151,000 |
| Ventura County | 13,000 | 13,000 | 14,000 | 15,000 | 15,000 | 16,000 |
| **Metropolitan's Service Area** | 578,000 | 637,000 | 686,000 | 711,000 | 732,000 | 768,000 |

[1] Projections do not include savings estimates to meet SB X7-7.

**Table A.1-10 Commercial, Industrial and Institutional Retail Demand in Metropolitan's Service Area[1]**

(Acre-feet)

| County | 2015 | Projected 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Los Angeles County | 325,000 | 355,000 | 353,000 | 351,000 | 349,000 | 350,000 |
| Orange County | 165,000 | 183,000 | 186,000 | 189,000 | 189,000 | 189,000 |
| Riverside County | 65,000 | 96,000 | 104,000 | 110,000 | 113,000 | 113,000 |
| San Bernardino County | 57,000 | 69,000 | 76,000 | 81,000 | 84,000 | 85,000 |
| San Diego County | 99,000 | 111,000 | 112,000 | 110,000 | 110,000 | 110,000 |
| Ventura County | 33,000 | 39,000 | 39,000 | 39,000 | 38,000 | 38,000 |
| **Metropolitan's Service Area** | 744,000 | 853,000 | 870,000 | 880,000 | 883,000 | 885,000 |

[1] Projections do not include savings estimates to meet SB X7-7.

## Table A.1-11 Unmetered Use in Metropolitan's Service Area[1]

(Acre-feet)

| County | 2015 | Projected 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Los Angeles County | 149,000 | 154,000 | 156,000 | 159,000 | 162,000 | 165,000 |
| Orange County | 69,000 | 70,000 | 72,000 | 73,000 | 74,000 | 76,000 |
| Riverside County | 34,000 | 39,000 | 42,000 | 46,000 | 49,000 | 52,000 |
| San Bernardino County | 39,000 | 42,000 | 45,000 | 48,000 | 51,000 | 53,000 |
| San Diego County | 14,000 | 15,000 | 16,000 | 16,000 | 17,000 | 18,000 |
| Ventura County | 15,000 | 16,000 | 16,000 | 17,000 | 17,000 | 17,000 |
| **Metropolitan's Service Area** | 320,000 | 336,000 | 347,000 | 359,000 | 370,000 | 381,000 |

[1] Projections do not include savings estimates to meet SB X7-7.

## Table A.1-12 Conservation Savings in Metropolitan's Service Area – 1980 Base Year[1]

(Acre-feet)

| County | Estimated 1995 | 2000 | 2005 | 2010 | 2015 | Projected 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|---|---|---|---|
| Los Angeles | 81,000 | 166,000 | 235,000 | 296,000 | 364,000 | 406,000 | 436,000 | 465,000 | 484,000 | 513,000 |
| Orange County | 25,000 | 55,000 | 81,000 | 104,000 | 123,000 | 130,000 | 138,000 | 147,000 | 156,000 | 167,000 |
| Riverside | 10,000 | 22,000 | 37,000 | 52,000 | 67,000 | 76,000 | 88,000 | 100,000 | 113,000 | 126,000 |
| San Bernardino | 5,000 | 10,000 | 16,000 | 22,000 | 27,000 | 32,000 | 37,000 | 42,000 | 46,000 | 52,000 |
| San Diego | 25,000 | 56,000 | 78,000 | 96,000 | 114,000 | 138,000 | 152,000 | 167,000 | 182,000 | 197,000 |
| Ventura | 4,000 | 9,000 | 13,000 | 16,000 | 20,000 | 28,000 | 30,000 | 32,000 | 35,000 | 37,000 |
| Active, Code, Price | 150,000 | 318,000 | 460,000 | 586,000 | 715,000 | 810,000 | 881,000 | 953,000 | 1,016,000 | 1,092,000 |
| Pre-1990 Conservation | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 | 250,000 |
| **Total Conservation** | 400,000 | 568,000 | 710,000 | 836,000 | 965,000 | 1,060,000 | 1,131,000 | 1,203,000 | 1,266,000 | 1,342,000 |

[1] Estimated conservation savings with active savings installed as of 2015.
Savings projections do not include savings derived from SB X7-7.

## Table A.1-13 Projected Municipal and Industrial Demands by Sector

(Acre-feet)

| Sector | Historical[1] 1995 | 2000 | 2005 | 2010 | 2015 | Projected[2] 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|---|---|---|---|
| Single-Family | 1,792,000 | 2,169,000 | 2,150,000 | 1,925,000 | 1,922,000 | 2,186,000 | 2,181,000 | 2,215,000 | 2,262,000 | 2,278,000 |
| Multi-Family | 522,000 | 632,000 | 626,000 | 561,000 | 578,000 | 637,000 | 686,000 | 711,000 | 732,000 | 768,000 |
| Non-Residential | 699,000 | 847,000 | 839,000 | 751,000 | 744,000 | 853,000 | 870,000 | 880,000 | 883,000 | 885,000 |
| System Losses/Unmetered | 275,000 | 333,000 | 330,000 | 296,000 | 320,000 | 336,000 | 347,000 | 359,000 | 370,000 | 381,000 |
| **Metropolitan Total** | 3,288,000 | 3,981,000 | 3,945,000 | 3,533,000 | 3,564,000 | 4,012,000 | 4,084,000 | 4,165,000 | 4,247,000 | 4,312,000 |

[1] Estimates of historical water use are prorated using percentages from projected demands and actual water use.
[2] Projected demands are weather normalized and do not include savings estimates to meet SB X7-7

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# Appendix 2

# EXISTING REGIONAL WATER SUPPLIES

# Appendix 2
# EXISTING REGIONAL WATER SUPPLIES

Water used in Metropolitan's service area comes from both local and imported sources. Local sources include groundwater, surface water, and recycled water. Sources of imported water include the Colorado River, the State Water Project (SWP), and the Owens Valley/Mono Basin. On average over the last 10 years (from 2006 to 2015), local sources met about 45 percent of the water needs, while imported sources supplied the remaining 55 percent.

The City of Los Angeles imports water from the Owens Valley/Mono Basin east of the Sierra Nevada through the Los Angeles Aqueduct (LAA). This water currently meets about 4 percent of the region's water needs based on a ten-year average from 2006 to 2015, but is dedicated for use by the City of Los Angeles. Metropolitan provides imported water supplies to meet the remaining 51 percent of the region's water needs based on the same ten-year period. These imported supplies are received from Metropolitan's Colorado River Aqueduct (CRA) and the SWP's California Aqueduct. Table A.2-1 and Figure A.2-1 show the historical sources of local and imported supplies within Metropolitan's service area.

Table A.2-2 shows the quantities of Metropolitan water used by member agencies during the last ten years. Metropolitan's largest water customers are the San Diego County Water Authority (27 percent), City of Los Angeles (17 percent), and Municipal Water District of Orange County (13 percent).

The following sections describe the current supply sources in more detail. The main body of the Urban Water Management Plan contains descriptions of planned future supplies.

## Local Water Supplies

Local sources of water available to the region include surface water, groundwater, and recycled water. Some of the major river systems in Southern California have been developed into systems of dams, flood control channels, and percolation ponds for supplying local water and recharging groundwater basins. For example, the San Gabriel and Santa Ana Rivers capture over 85 percent of the runoff in their watersheds. The Los Angeles River system, however, is not as efficient in capturing runoff. In its upper reaches, which make up 25 percent of the watershed, most runoff is captured with recharge facilities. In its lower reaches, which comprise the remaining 75 percent of the watershed, the river and its tributaries are lined with concrete, so there are no recharge facilities. The Santa Clara River in Ventura County is outside of Metropolitan's service area, but it replenishes groundwater basins used by water agencies within Metropolitan's service area. Other rivers in Metropolitan's service area, such as the Santa Margarita and San Luis Rey, are essentially natural replenishment systems.

## Table A. 2-1
## Sources of Water Supply to the Metropolitan Service Area

(Acre-Feet)[1]

| Calendar Year | Local Supplies | L.A. Aqueduct | Colorado River Aqueduct[2] | State Water Project[3] | Total |
|---|---|---|---|---|---|
| 1976 | 1,363,000 | 430,000 | 778,000 | 638,000 | 3,209,000 |
| 1977 | 1,370,000 | 275,000 | 1,277,000 | 209,000 | 3,131,000 |
| 1978 | 1,253,000 | 472,000 | 710,000 | 576,000 | 3,011,000 |
| 1979 | 1,419,000 | 493,000 | 784,000 | 532,000 | 3,227,000 |
| 1980 | 1,452,000 | 515,000 | 791,000 | 560,000 | 3,317,000 |
| 1981 | 1,500,000 | 465,000 | 791,000 | 827,000 | 3,583,000 |
| 1982 | 1,392,000 | 483,000 | 686,000 | 737,000 | 3,298,000 |
| 1983 | 1,385,000 | 519,000 | 850,000 | 410,000 | 3,163,000 |
| 1984 | 1,621,000 | 516,000 | 1,150,000 | 498,000 | 3,785,000 |
| 1985 | 1,535,000 | 496,000 | 1,018,000 | 728,000 | 3,776,000 |
| 1986 | 1,510,000 | 521,000 | 1,001,000 | 756,000 | 3,789,000 |
| 1987 | 1,465,000 | 428,000 | 1,175,000 | 763,000 | 3,831,000 |
| 1988 | 1,521,000 | 369,000 | 1,199,000 | 957,000 | 4,047,000 |
| 1989 | 1,542,000 | 288,000 | 1,189,000 | 1,215,000 | 4,234,000 |
| 1990 | 1,470,000 | 106,000 | 1,183,000 | 1,458,000 | 4,217,000 |
| 1991 | 1,426,000 | 186,000 | 1,252,000 | 625,000 | 3,490,000 |
| 1992 | 1,512,000 | 177,000 | 1,153,000 | 744,000 | 3,586,000 |
| 1993 | 1,408,000 | 289,000 | 1,144,000 | 663,000 | 3,505,000 |
| 1994 | 1,527,000 | 133,000 | 1,263,000 | 845,000 | 3,768,000 |
| 1995 | 1,590,000 | 464,000 | 933,000 | 451,000 | 3,438,000 |
| 1996 | 1,715,000 | 425,000 | 1,089,000 | 663,000 | 3,892,000 |
| 1997 | 1,759,000 | 436,000 | 1,125,000 | 724,000 | 4,044,000 |
| 1998 | 1,726,000 | 467,000 | 941,000 | 521,000 | 3,655,000 |
| 1999 | 1,887,000 | 309,000 | 1,072,000 | 792,000 | 4,060,000 |
| 2000 | 1,768,000 | 255,000 | 1,217,000 | 1,473,000 | 4,714,000 |
| 2001 | 1,708,000 | 267,000 | 1,245,000 | 1,119,000 | 4,340,000 |
| 2002 | 1,706,000 | 179,000 | 1,198,000 | 1,415,000 | 4,498,000 |
| 2003 | 1,659,000 | 252,000 | 676,000 | 1,561,000 | 4,148,000 |
| 2004 | 1,627,000 | 203,000 | 741,000 | 1,802,000 | 4,373,000 |
| 2005 | 1,590,000 | 369,000 | 707,000 | 1,525,000 | 4,190,000 |
| 2006 | 1,710,000 | 379,000 | 514,000 | 1,695,000 | 4,297,000 |
| 2007 | 1,852,000 | 129,000 | 696,000 | 1,648,000 | 4,326,000 |
| 2008 | 1,842,000 | 147,000 | 896,000 | 1,037,000 | 3,922,000 |
| 2009 | 1,857,000 | 137,000 | 1,044,000 | 908,000 | 3,946,000 |
| 2010 | 1,729,000 | 251,000 | 837,000 | 1,129,000 | 3,946,000 |
| 2011 | 1,664,000 | 370,000 | 445,000 | 1,379,000 | 3,859,000 |
| 2012 | 1,867,000 | 167,000 | 455,000 | 1,252,000 | 3,741,000 |
| 2013 | 1,866,000 | 65,000 | 984,000 | 974,000 | 3,889,000 |
| 2014 | 1,885,000 | 62,000 | 1,168,000 | 607,000 | 3,723,000 |
| 2015 [4] | 1,676,000 | 27,000 | 1,180,000 | 550,000 | 3,442,000 |

1. Not including system losses.
2. Colorado River Aqueduct deliveries to service area: gross Havasu diversions less return flows, deliveries to USBR, Mexico, and storage.
3. State Water Project deliveries to service area: includes Table A, Art. 21, Art. 14(b), Art. 12(d), Art. 55, draws from storage & carryover, DWCV & other exchanges, transfers, Drought Water Bank and Dry Year Pool Purchases, Pools A&B, Flood Water, wheeling, Port Hueneme lease, SBVMWD Purchases.
4. Based on best available data and estimates as of October 2015.

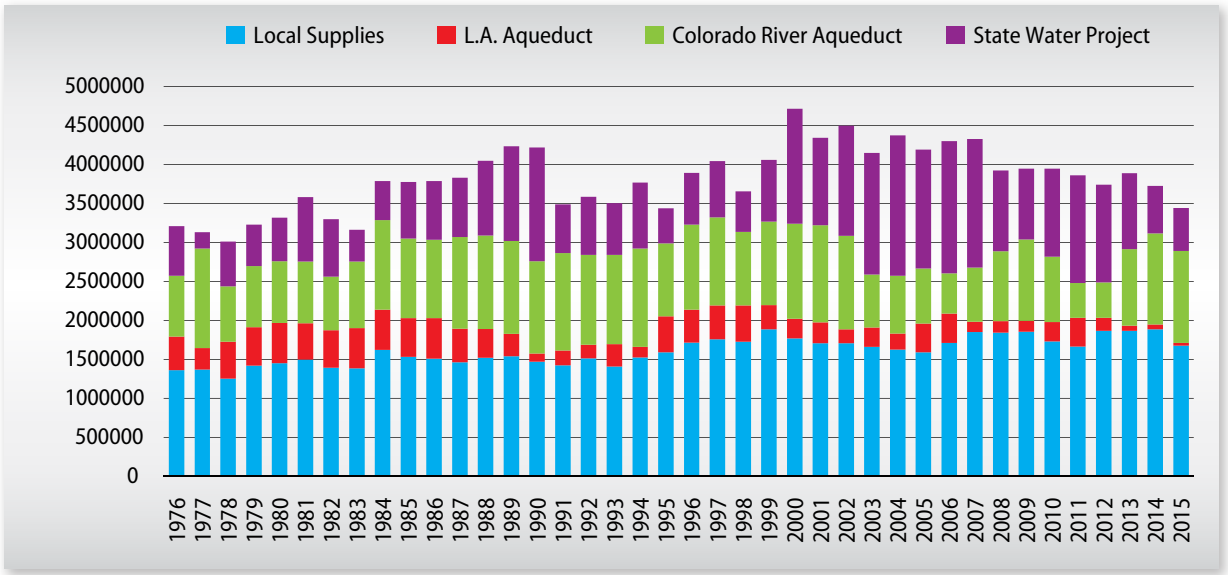
## Table A.2-2 Historical Metropolitan Water Deliveries to Member Agencies

(Acre-feet)

| Member Agency | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Anaheim | 33,000 | 25,000 | 21,000 | 16,000 | 21,000 | 22,000 | 29,000 | 20,000 | 20,000 | 18,000 | 13,000 |
| City of Beverly Hills | 12,000 | 12,000 | 12,000 | 12,000 | 11,000 | 10,000 | 10,000 | 11,000 | 11,000 | 12,000 | 10,000 |
| City of Burbank | 15,000 | 16,000 | 13,000 | 15,000 | 12,000 | 10,000 | 18,000 | 15,000 | 15,000 | 16,000 | 8,000 |
| Calleguas Municipal Water District | 120,000 | 126,000 | 131,000 | 121,000 | 101,000 | 87,000 | 97,000 | 106,000 | 112,000 | 110,000 | 85,000 |
| Central Basin Municipal Water District | 67,000 | 114,000 | 85,000 | 55,000 | 53,000 | 63,000 | 67,000 | 38,000 | 36,000 | 30,000 | 58,000 |
| City of Compton | 4,000 | 4,000 | 3,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 1,000 | 0 | 0 |
| Eastern Municipal Water District | 113,000 | 126,000 | 127,000 | 110,000 | 99,000 | 89,000 | 90,000 | 93,000 | 101,000 | 103,000 | 74,000 |
| Foothill Municipal Water District | 12,000 | 12,000 | 12,000 | 10,000 | 10,000 | 9,000 | 8,000 | 8,000 | 9,000 | 10,000 | 7,000 |
| City of Fullerton | 18,000 | 20,000 | 11,000 | 8,000 | 11,000 | 10,000 | 10,000 | 10,000 | 9,000 | 9,000 | 6,000 |
| City of Glendale | 22,000 | 22,000 | 23,000 | 21,000 | 19,000 | 16,000 | 18,000 | 18,000 | 19,000 | 19,000 | 14,000 |
| Inland Empire Utilities Agency | 93,000 | 112,000 | 75,000 | 58,000 | 36,000 | 45,000 | 76,000 | 57,000 | 64,000 | 68,000 | 38,000 |
| Las Virgenes Municipal Water District | 21,000 | 23,000 | 26,000 | 27,000 | 21,000 | 20,000 | 20,000 | 21,000 | 24,000 | 24,000 | 18,000 |
| City of Long Beach | 51,000 | 43,000 | 36,000 | 35,000 | 33,000 | 26,000 | 43,000 | 30,000 | 35,000 | 37,000 | 34,000 |
| City of Los Angeles | 184,000 | 185,000 | 441,000 | 430,000 | 352,000 | 206,000 | 120,000 | 328,000 | 439,000 | 384,000 | 389,000 |
| Municipal Water District of Orange County | 303,000 | 319,000 | 270,000 | 234,000 | 211,000 | 218,000 | 264,000 | 240,000 | 216,000 | 263,000 | 197,000 |
| City of Pasadena | 21,000 | 24,000 | 25,000 | 24,000 | 20,000 | 20,000 | 18,000 | 18,000 | 21,000 | 21,000 | 15,000 |
| San Diego County Water Authority | 547,000 | 598,000 | 698,000 | 566,000 | 540,000 | 447,000 | 408,000 | 455,000 | 492,000 | 518,000 | 466,000 |
| City of San Fernando | 1,000 | 0 | 1,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| City of San Marino | 1,000 | 2,000 | 1,000 | 1,000 | 1,000 | 1,000 | 0 | 1,000 | 1,000 | 1,000 | 1,000 |
| City of Santa Ana | 22,000 | 22,000 | 12,000 | 8,000 | 7,000 | 10,000 | 16,000 | 12,000 | 15,000 | 11,000 | 6,000 |
| City of Santa Monica | 13,000 | 13,000 | 13,000 | 12,000 | 12,000 | 10,000 | 6,000 | 7,000 | 6,000 | 5,000 | 3,000 |
| Three Valleys Municipal Water District | 69,000 | 68,000 | 74,000 | 68,000 | 58,000 | 62,000 | 66,000 | 64,000 | 69,000 | 67,000 | 44,000 |
| City of Torrance | 21,000 | 21,000 | 20,000 | 19,000 | 18,000 | 17,000 | 17,000 | 17,000 | 17,000 | 17,000 | 14,000 |
| Upper San Gabriel Valley Municipal Water District | 45,000 | 48,000 | 23,000 | 13,000 | 6,000 | 46,000 | 35,000 | 16,000 | 30,000 | 27,000 | 47,000 |
| West Basin Municipal Water District | 145,000 | 144,000 | 142,000 | 130,000 | 120,000 | 120,000 | 112,000 | 117,000 | 121,000 | 118,000 | 107,000 |
| Western Municipal Water District of Riverside County | 91,000 | 103,000 | 120,000 | 99,000 | 86,000 | 76,000 | 75,000 | 82,000 | 74,000 | 76,000 | 55,000 |
| Total of All Agencies | 2,044,000 | 2,202,000 | 2,415,000 | 2,094,000 | 1,860,000 | 1,642,000 | 1,625,000 | 1,786,000 | 1,957,000 | 1,964,000 | 1,709,000 |

1. Based on best available data and estimates as of September 2015.

**Figure A.2-1 Sources of Supply to Metropolitan's Service Area**




Local supplies fluctuate in response to variations in rainfall. During prolonged periods of below-normal rainfall, local water supplies decrease. Conversely, prolonged periods of above-normal rainfall increase local supplies. Sources of groundwater basin replenishment include local precipitation, runoff from the coastal ranges, and artificial recharge with imported water supplies. In addition to runoff, recycled water provides an increasingly important source of replenishment water for the region.

## Major Groundwater Basins

Groundwater sources account for about 90 percent of the local water supplies, which are found in many basins throughout the Southern California region and provide an annual average total production of about 1.35 MAF per year. Figure A.2-2 shows the location of the groundwater basins within Metropolitan's service area. Groundwater yield comes from natural recharge from the percolation of rainfall and stream runoff and active recharge from spreading and injection of captured stormwater, recycled water, and imported water. In certain major drainage areas, runoff is retained in flood control reservoirs and released into spreading basins for percolation into the ground. In Los Angeles County, many groundwater recharge facilities located along the upper reaches of the Los Angeles River and San Gabriel River systems provide recharge to San Fernando, Raymond, Main San Gabriel, Central, and West Coast groundwater basins. The Orange County Water District operates a system of diversion structures and recharge basins along the Santa Ana River that captures much of the storm runoff, as well as water from reclamation facilities in Riverside and San Bernardino counties. Storm runoff is also diverted to recharge basins in the Chino Basin. This water, which would otherwise flow into the Pacific Ocean, is allowed to percolate into the underlying aquifers so it may be pumped for local use when needed. Recycled water use for groundwater recharge has increased steadily. The Water Replenishment District of Southern California (WRD) has spread recycled water at the Montebello Forebay to recharge Central and West Coast basins for many years and is working to expand this practice. The Inland

Empire Utilities Agency (IEUA) provides recycled water for recharge of the Chino Basin. Orange County Water District has implemented the Groundwater Replenishment System (GWRS) to recharge over 100 TAF per year of highly-treated recycled water to the Orange County Basin. Highly treated recycled water is also used at seawater barriers in the West Coast, Central, and Orange County basins and has largely replaced use of imported water for this purpose.

Almost all major groundwater basins in Southern California are either adjudicated or managed by special districts or agencies. Over 90 percent of the groundwater used in Metropolitan's service area is produced from adjudicated or managed groundwater basins. Adjudicated basins in the region include: Raymond Basin, Upper Los Angeles River Area basins (which include San Fernando, Sylmar, Verdugo, and Eagle Rock Basins), Main San Gabriel Basin, Central Basin, West Coast Basin, Six Basins, Chino Basin, and Cucamonga Basin. The Orange County Groundwater Basin is managed by Orange County Water District; portions of the Ventura County Basins are managed by the Fox Canyon Groundwater Management Agency; and the West San Jacinto Basins and Hemet-San Jacinto Basins are managed by Eastern Municipal Water District. In general, these basins have management plans that include protection from seawater intrusion in the coastal region, water quality deterioration, and excessive lowering of water levels. Groundwater basin managers address treatment of contamination, manage recharge and storage programs, and monitor extraction, water levels, and water quality.

### Major River Systems and Reservoirs

Local surface water resources consist of runoff captured in storage reservoirs and diversions from streams. Reservoirs hold the runoff for later direct use, and diversions from streams are delivered directly to local water systems. As Table A.2-3 shows, local water agencies currently own and operate 34 reservoirs. These reservoirs provide a storage capacity of approximately 897 TAF. The historic average yield of these local surface supplies, which come from reservoir releases and stream diversions, is about 90 TAF per year. The annual yield varies widely between wet and dry years, and most reservoirs that capture local surface runoff are operated with minimal carry-over storage. San Diego County has the greatest storage capacity for these types of reservoirs, with approximately 84 percent of the total local agency storage capacity in Metropolitan's service area.

In addition to the storage that is owned and operated by local agencies, Metropolitan operates DVL, Lake Skinner, and Lake Mathews. DVL stores water imported during years of ample supply. Of DVL's 810 TAF capacity, up to half is dedicated to emergency storage; the remainder is available to augment supplies during dry years and for seasonal storage. In contrast, Lake Skinner and Lake Mathews are largely used for system operations rather than dry year storage. Table A.2-4 lists Metropolitan-owned reservoirs with significant storage capacity.

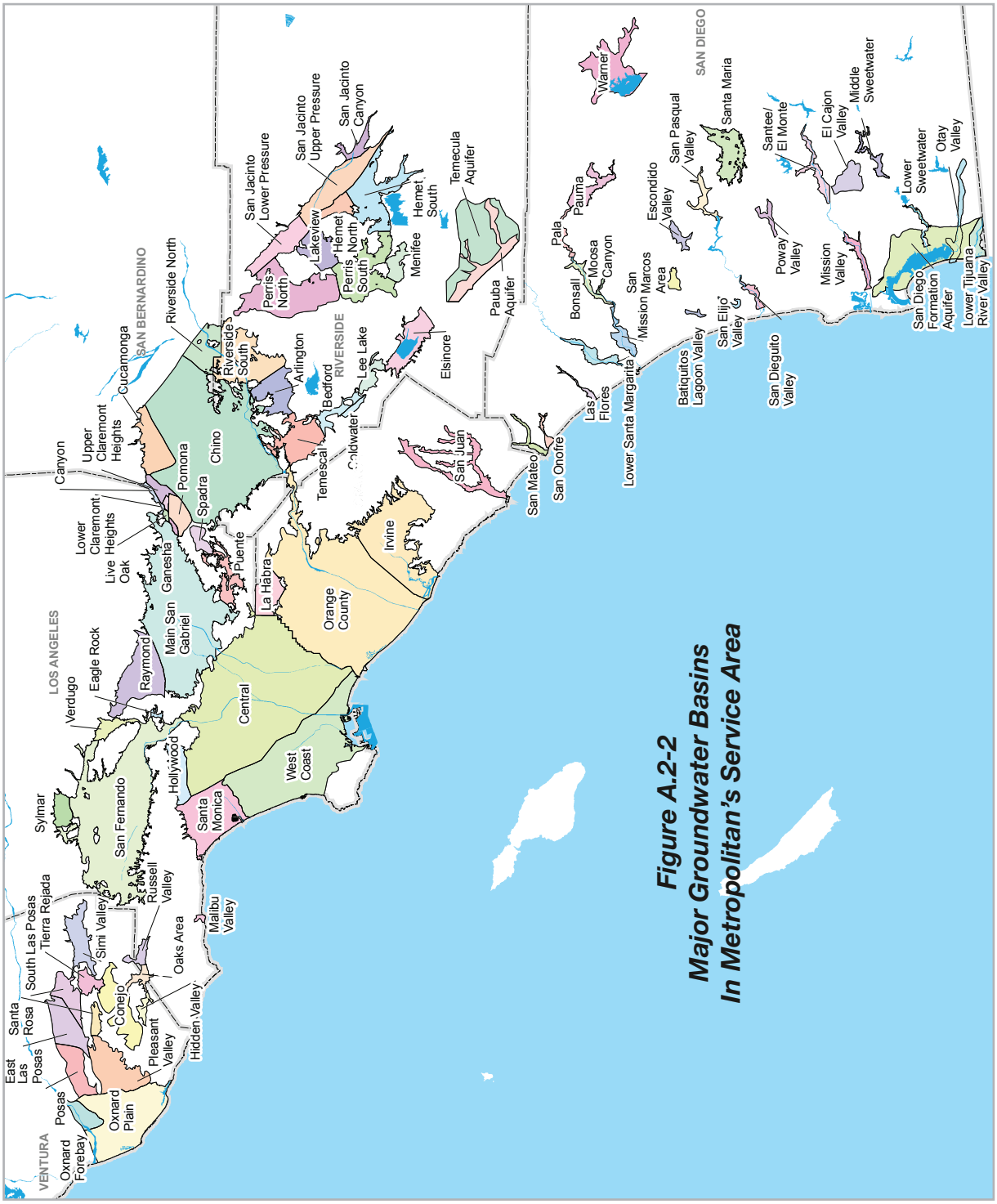



***Figure A.2-2***
***Major Groundwater Basins***
***In Metropolitan's Service Area***

**Table A.2-3**
**Local Storage Reservoirs in Metropolitan's Service Area**
(Thousands Acre-feet)

| Member Agency/Sub-agency | Reservoir | Storage Capacity |
|---|---|---|
| **Eastern MWD** | | |
| Rancho California WD | Vail Lake | 51.0 |
| Lake Hemet MWD | Lake Hemet | 14.0 |
| **Las Virgenes MWD** | Westlake Reservoir | 10.0 |
| **City of Los Angeles** | Los Angeles | 10.2 |
| | Encino | 9.8 |
| | Stone Canyon | 10.8 |
| | Hollywood | 4.2 |
| **MWD of Orange County** | | |
| Irvine Ranch WD & Serrano ID | Santiago | 25.0 |
| **San Diego County Water Authority** | | |
| Carlsbad MWD | Maerkle | 0.6 |
| Escondido, City of | Dixon | 2.6 |
| | Wohlford | 6.5 |
| Fallbrook PUD | Red Mountain | 1.3 |
| Helix WD | Cuyamaca | 8.2 |
| | Jennings | 9.8 |
| Poway, City of | Poway | 3.3 |
| Rainbow MWD | Beck | 0.6 |
| | Morro Hill | 0.5 |
| Ramona MWD | Ramona | 12.0 |
| San Diego County Water Authority | Olivenhain – CWA | 24.8 |
| San Diego, City of | Barrett | 37.9 |
| | El Capitan | 112.8 |
| | Hodges | 30.3 |
| | Lower Otay | 49.5 |
| | Miramar | 7.2 |
| | Morena | 50.2 |
| | Murray | 4.8 |
| | San Vicente | 249.4 |
| | Sutherland | 29.7 |
| San Dieguito WD | San Dieguito | 0.9 |
| Sweetwater Authority | Loveland | 25.4 |
| | Sweetwater | 28.1 |
| Valley Center MWD | Turner | 1.6 |
| Vista Irrigation District | Henshaw | 51.8 |
| **Western MWD of Riverside** | | |
| Temescal Water Company | Railroad Canyon | 12.0 |
| **Total** | | **896.8** |

**Table A.2-4**
**Regional Storage Reservoirs in Metropolitan's Service Area**
(Thousands Acre-feet)

| Reservoir | Capacity |
|---|---|
| Diamond Valley Lake | 810 |
| Lake Skinner[1] | 44 |
| Lake Mathews[1] | 182 |

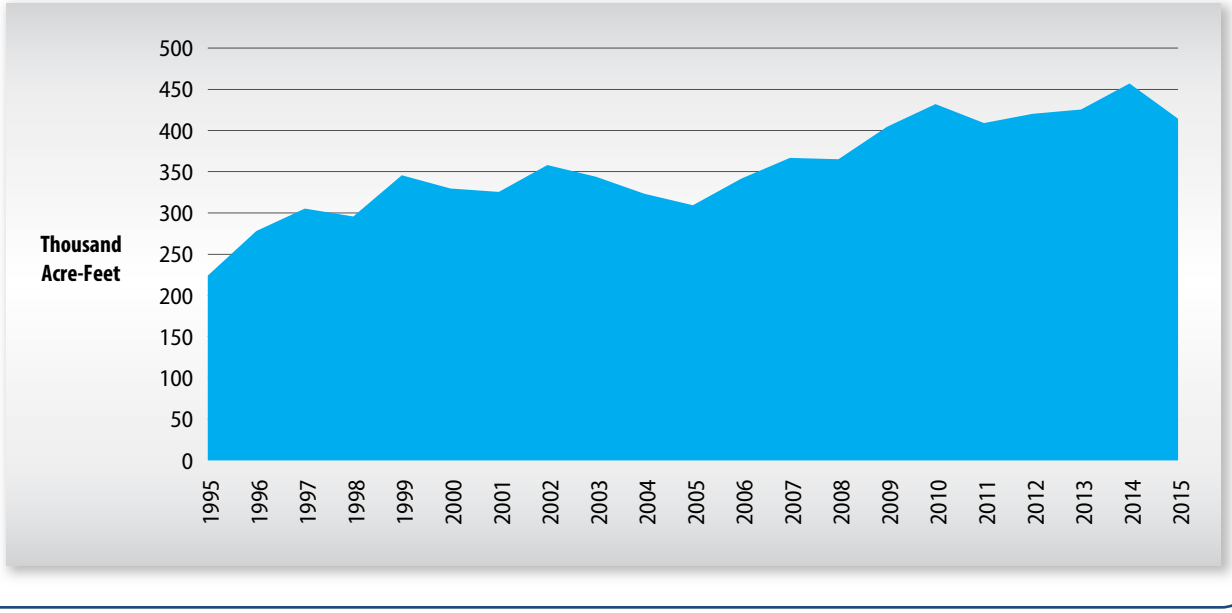
[1] These are used for operations and not primarily for dry year storage.

Lastly, Castaic and Perris are the terminal reservoirs to the West Branch and East Branch of the California Aqueduct operated by DWR. Through the Monterey Amendment to its SWP water service contract, Metropolitan has access to 219 TAF of flexible storage capacity in these SWP terminal reservoirs.

## Water Recycling and Groundwater Recovery

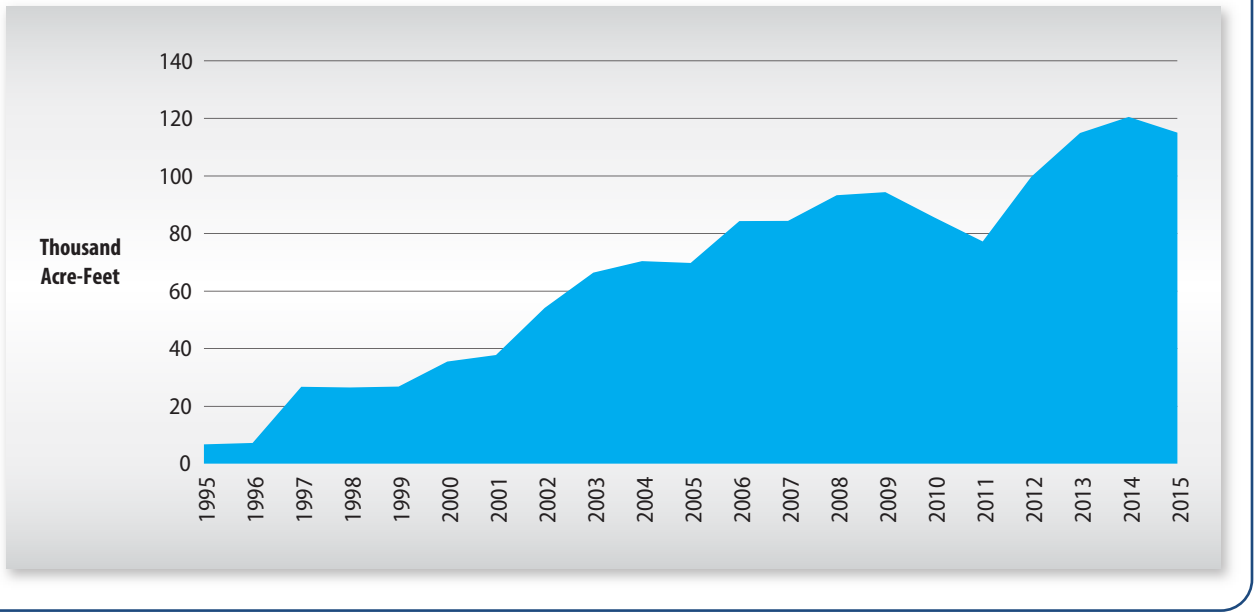
Water recycling projects involve treating wastewater to a level that is acceptable and safe for many non-potable applications. This resource is providing an increasing level of local water. In 1982, Metropolitan began helping to fund its member agencies' recycled water projects. Since that time, Metropolitan has invested approximately $372 million. In fiscal year 2014-15, water recycling projects in which Metropolitan has invested produced over 184 TAF. Local agency projects that did not receive financial assistance from Metropolitan produced an additional 170 TAF, and approximately 60 TAF of Santa Ana River base flow were used to recharge the Orange County basin. This brings the regional total to 414 TAF of recycled water use. Figure A.2-3 demonstrates the increase in this regional supply for direct use.

**Figure A.2-3 Recycled Water**



In addition, local agencies have implemented several projects to recover contaminated or degraded groundwater for potable uses. The groundwater recovery projects use a variety of treatment technologies to remove nitrates, volatile organic compounds, perchlorate, color, and salt. In 1991, Metropolitan began helping fund its member agencies' groundwater recovery projects. Since that time, Metropolitan has invested approximately $132 million. In FY 2014-15, these groundwater recovery projects produced 60 TAF. Other member agency projects that did not receive funding from Metropolitan produced another 55 TAF, for a regional total of 115 TAF. Figure A.2-4 shows this increase in supply.

**Figure A.2-4 Groundwater Recovery**




## Imported Water

Most member agencies and retail water suppliers depend on imported water for a portion of their water supply. For example, Los Angeles and San Diego (the largest and second largest cities in the state) have historically obtained up to 85 percent of their water from imported sources. These imported water requirements are similar to those of other metropolitan areas within the state, such as San Francisco and other cities around the San Francisco Bay.

Figure A.2-5 shows the conveyance facilities for the state's imported water supplies. Descriptions of each of the imported sources of water available to Metropolitan's service area follow. Justification for projected water supplies from these sources is provided in Appendix 3.

### *Colorado River*

A number of water agencies within California have rights to divert water from the Colorado River. Through the Seven Party Agreement (1931), seven agencies recommended apportionments of California's share of Colorado River water within the state. Table A.2-5 shows the historic apportionment of each agency, and the priority accorded that apportionment.

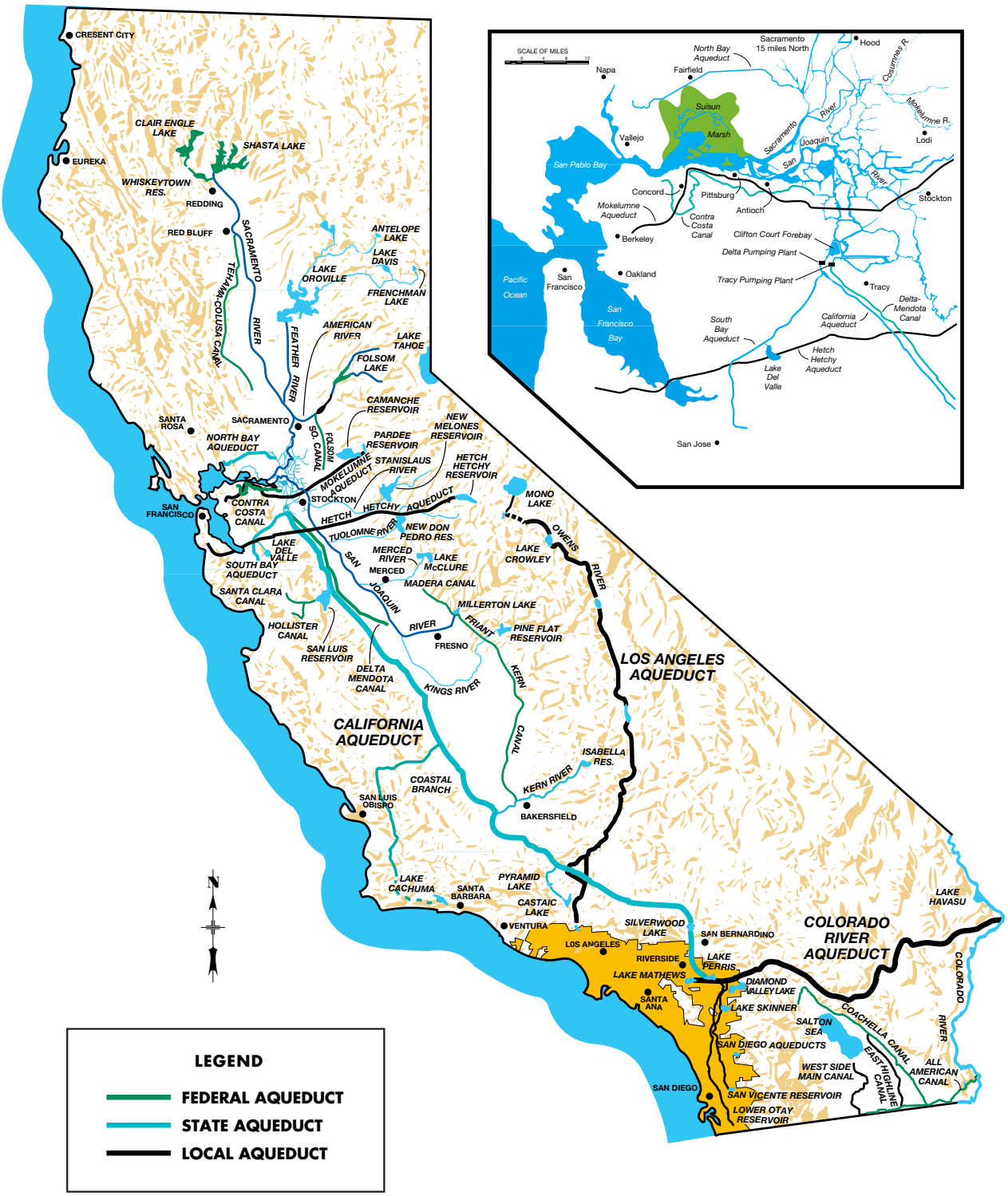
**Table A.2-5**
**Priorities in Seven-Party Agreement and Water Delivery Contracts**

| Priority | Description | TAF Annually |
|---|---|---|
| 1 | Palo Verde Irrigation District – gross area of 104,500 acres of land in the Palo Verde Valley | |
| 2 | Yuma Project (Reservation Division) – not exceeding a gross area of 25,000 acres in California | |
| 3(a) | Imperial Irrigation District and land in Imperial and Coachella Valleys[1] to be served by All American Canal | 3,850 |
| 3(b) | Palo Verde Irrigation District—16,000 acres of land on the Lower Palo Verde Mesa | |
| 4 | Metropolitan Water District of Southern California for use on the coastal plain of Southern California | 550 |
| Subtotal | | 4,400 |
| 5(a) | Metropolitan Water District of Southern California for use on the coastal plain of Southern California | 550 |
| 5(b) | Metropolitan Water District of Southern California for use on the coastal plain of Southern California[2] | 112 |
| 6(a) | Imperial Irrigation District and land in Imperial and Coachella Valleys[1] to be served by the All American Canal | |
| 6(b) | Palo Verde Irrigation District—16,000 acres of land on the Lower Palo Verde Mesa | 300 |
| 7 | Agricultural Use in the Colorado River Basin in California | |
| | **Total Prioritized Apportionment** | **5,362** |

[1] The Coachella Valley Water District now serves Coachella Valley.

[2] In 1946, the City of San Diego, the San Diego County Water Authority, Metropolitan, and the Secretary of the Interior entered into a contract that merged and added the City of San Diego's rights to store and deliver Colorado River water to the rights of Metropolitan. The conditions of that agreement have long since been satisfied.

**Figure A.2-5**
**MAJOR WATER CONVEYANCE FACILITIES IN CALIFORNIA**



The water is delivered to Metropolitan's service area by way of the Colorado River Aqueduct (CRA), which has a capacity of nearly 1,800 cfs. The CRA conveys water 242 miles from its Lake Havasu intake to its terminal reservoir, Lake Mathews, near the City of Riverside. Conveyance losses along the CRA of 10 TAF per year reduce the amount of Colorado River water received in the coastal plain.

Since the date of the original contract, several events have occurred that changed the dependable supply that Metropolitan expects from the CRA. The most significant event was the 1964 U.S. Supreme Court decree in *Arizona v. California* that reduced Metropolitan's dependable supply of Colorado River water to 550 TAF per year. The reduction in dependable supply occurred with the commencement of Colorado River water deliveries to the Central Arizona Project. In 1987, Metropolitan entered into a contract with the U.S. Bureau of Reclamation (USBR) for an additional 180 TAF per year of surplus water when surplus water is available. In addition, Metropolitan has obtained a minimum of approximately 85 TAF per year of Colorado River water since 1996 through a conservation program with the Imperial Irrigation District.

In 1979, the Present Perfected Rights (PPRs) of certain Indian reservations, cities, and individuals along the Colorado River were quantified. These PPRs predate the Seven-Party Agreement, but the rights holders were not included in the Seven Party Agreement prioritizing California's use and storage of Colorado River water.

In 1999, under the auspices of the Colorado River Board of California, a draft plan, "California's Colorado River Water Use Plan", was developed. The Colorado River Board of California protects California's rights and interests in the resources provided by the Colorado River and represents California in discussions and negotiations regarding the Colorado River and its management. The overall purpose of California's Colorado River Water Use Plan is to provide Colorado River water users with a framework by which programs, projects, and other activities may be coordinated and cooperatively implemented. This framework specified how California would make the transition from relying on surplus water supplies from the Colorado River to living within its normal (basic) water supply apportionment.

To implement these plans, a number of agreements have been executed. In October 2003, representatives from Metropolitan, IID, and Coachella Valley Water District (CVWD) executed the Quantification Settlement Agreement (QSA) and several other related agreements. Parties involved include the San Diego County Water Authority (SDCWA), the California Department of Water Resources (DWR), the California Department of Fish and Wildlife, the U.S. Department of the Interior, and the San Luis Rey Indian Water Rights Settlement Parties. The QSA quantifies the use of water under the third priority of the Seven Party Agreement and allows for implementation of agricultural conservation, land management, and other programs identified in Metropolitan's 1996 IRP. Quantification of the third priority provides the needed numeric baseline from which conservation and transfer programs may be measured. The QSA has helped California reduce its reliance on Colorado River water above its normal apportionment.

The quantification of the agricultural priorities under the QSA provided for the water saved under the Palo Verde Land Management and Crop Rotation Program to be made available to Metropolitan. This program provides up to 133 TAF of water to be available to Metropolitan in certain years and will supply a minimum of 33 TAF per year.

In October 2004, SNWA and Metropolitan entered into a storage and interstate release agreement. Under this program, SNWA can request that Metropolitan store unused Nevada apportionment. The amount of water which Metropolitan diverted through 2014 under this agreement was over 272 TAF. In subsequent years, SNWA may request return of approximately

205 TAF stored before 2015 and 125 TAF of the water stored in 2015. It is expected that SNWA will not request return of water stored prior to 2015 until after 2019. Water stored in 2015 allowed Metropolitan to augment its water supply from the Colorado River in 2015.

In December 2007, the Secretary of the Interior approved the adoption of specific interim guidelines for reductions in Colorado River water deliveries during declared shortages and coordinated operations of Lake Powell and Lake Mead. These guidelines provide water release criteria from Lake Powell and water storage and water release criteria from Lake Mead during shortage, normal, and surplus conditions in the Lower Basin; provide a mechanism for the storage and delivery of conserved system and non-system water in Lake Mead; and modify and extend interim surplus guidelines through 2026. The Record of Decision and accompanying agreement among the Colorado River Basin States protect reservoir levels by reducing deliveries during drought periods, encourage agencies to develop conservation programs, and allow the states to develop and store new water supplies. The Colorado River Basin Project Act of 1968 insulates California from shortages in all but the most extreme hydrologic conditions.

In May 2006, Metropolitan and the USBR executed an agreement for a demonstration program that allowed Metropolitan to leave conserved water in Lake Mead that Metropolitan would otherwise have used in 2006 and 2007. The water left in Lake Mead must have been made available through extraordinary conservation measures, which was accomplished in 2006 and 2007 through savings realized under the Palo Verde Land Management, Crop Rotation, and Water Supply Program. This demonstration program was an activity eligible for creation of Extraordinary Conservation Intentionally Created Surplus (ICS) under the provisions of the December 2007 federal guidelines for the operation of Lake Powell and Lake Mead. Metropolitan continued to store water in Lake Mead through extraordinary conservation measures as provided in the December 2007 federal guidelines in 2009, 2010, 2011, and 2012. Metropolitan took delivery of a portion of its extraordinary conservation ICS in 2013 and 2014. As of January 1, 2015, Metropolitan had approximately 61.8 TAF of extraordinary conservation ICS water in Lake Mead.

The December 2007 federal guidelines provided Colorado River contractors the ability to create System Efficiency ICS through development and funding of system efficiency projects. To that end, in 2008 the Central Arizona Water Conservation District, SNWA, and Metropolitan contributed funds for the construction of the Drop 2 (Brock) Reservoir by the USBR. The purpose of the Drop 2 reservoir is to increase the capacity to regulate deliveries of Colorado River water at Imperial Dam, reducing the amount of water released downstream by approximately 70 TAF annually. In return for funding one-sixth of the project cost, 100 TAF of water stored in Lake Mead was assigned to Metropolitan as System Efficiency ICS in 2008. Including the Drop 2 reservoir, Metropolitan created System Efficiency ICS storage of over 124 TAF from 2008-2011. Of this total, approximately 24 TAF of System Efficiency ICS was achieved through financially contributing to a one-year pilot operation of the Yuma Desalting Plant. As of January 1, 2015, Metropolitan had approximately 89 TAF of System Efficiency ICS water in Lake Mead.

Metropolitan is undertaking ongoing efforts to maintain and improve the flexibility and quality of its water supply from the Colorado River. Section 3.1 of this report describes current programs and plans related to flexibility, and Chapter 4 describes water quality programs.

### *State Water Project*

The State Water Project, which is owned by the state and operated by DWR, is the second source of Metropolitan's imported water supplies. The SWP comprises 32 storage facilities (reservoirs and lakes), 662 miles of aqueduct, and 25 power and pumping plants.

The SWP conveys water from Northern California to the north and south of the San Francisco Bay Area and areas south of the Bay Delta region. Water from the SWP originates at Lake Oroville, which is located on the Feather River in Northern California. That water, along with all additional unused water from the watershed, flows into the Sacramento/San Joaquin Delta. Water from the Delta is then either pumped to water users in the San Francisco Bay area or transported through the California Aqueduct to water users in Central and Southern California.

DWR contracted to deliver water in stages to 32 SWP contractors, with an ultimate delivery of 4,172 TAF per year. Currently, DWR is delivering water to 29 of these SWP contractors. Metropolitan is the largest, with a contractual amount of 1,911 TAF per year, or approximately 46 percent of the total contracted amount. Metropolitan receives deliveries of SWP supplies via the California Aqueduct at Castaic Lake in Los Angeles County, Devil Canyon Afterbay in San Bernardino County, and Box Springs Turnout and Lake Perris in Riverside County. The first delivery of SWP water to Metropolitan occurred in 1972.

The initial facilities of the SWP, completed in the early 1970s, were designed to meet the original needs of the SWP contractors. It was intended that additional SWP facilities would be built over time to meet projected increases in contractors' delivery needs. Each contractor's SWP contract provided for a buildup in contractual amount over time, with most contractors reaching their maximum annual contractual amount by the year 1990. Since the completion of the initial SWP facilities in the early 1970s, major improvements to the system have included: four new pumps added to the Banks Pumping Plant at the Delta, the completion of the Coastal Branch, and the East Branch enlargement. Even with these improvements, however, there are still significant capacity constraints within the SWP that limit the delivery capability of the full contracted amount. During the same time, the contractors' needs for water from the SWP have increased. As a result, the contractors' demands for SWP water currently exceed the dependable yield.[1] Metropolitan has developed groundwater storage programs with Semitropic Water Storage District, Arvin-Edison Water Storage District, and Kern Delta Water District to supplement the available water supply.

The amount of contractual supplies DWR approves for delivery varies annually with contractor demands and projected water supplies from tributary sources to the Delta, based on snowpack in the Sierra Nevada, reservoir storage, operational constraints, and demands of other water users. Deliveries to Metropolitan reached a high of 1,802 TAF in calendar year 2004. Metropolitan experienced shortages in SWP supplies in fiscal years 1991 and 1992, with reduced deliveries of 391 TAF and 710 TAF, respectively.[2] SWP deliveries were limited during the recent drought – a record low 5 percent of contractual amount in 2014 and 20 percent of contractual amount in 2015.

In recent years, the listing of several fish species in the Sacramento/San Joaquin River Delta (Delta) under both state and federal Endangered Species Acts has constrained SWP operations and created more uncertainty in SWP supply reliability. These listed species include Delta smelt, winter-run Chinook salmon, spring-run Chinook salmon, and splittail. In July 2015, DWR released the SWP Delivery Capability Report. The report shows that future SWP deliveries will be impacted by two significant factors. The first is significant restrictions on SWP and Central Valley Project (CVP) Delta pumping required by the biological opinions issued by the U.S. Fish and

[1] The dependable yield of the existing SWP facilities is considered to be the delivery capability during a critically dry seven-year period.

[2] These numbers are Metropolitan's allocated contractual amount. Total water deliveries to Metropolitan's service area are shown in Table A.2-1.

Wildlife Service (December 2008) and National Marine Fisheries Service (June 2009). The second is climate change, which is altering the hydrologic conditions in the State.

Metropolitan is undertaking ongoing efforts to maintain and improve the reliability and quality of its water supply from the State Water Project. Sections 3.2 and 3.3 in the 2015 UWMP describe current programs and plans for reliability, and Chapter 4 addresses water quality issues.

### *Los Angeles Aqueduct*

The City of Los Angeles imports water from the eastern Sierra Nevada through the Los Angeles Aqueduct (LAA). The original LAA, completed in 1913, imported water from the Owens Valley. In 1940, the aqueduct was extended to the Mono Basin. A second aqueduct, which parallels the original, was completed in 1970.

Prior to the 1990-1991 drought, the City of Los Angeles had imported an average of 440 TAF of water annually from the combined Owens Valley/Mono Basin system, of which about 90 TAF came from the Mono Basin. In 1986, the aqueduct delivered a record 520 TAF of water.

In the late 1980s, a series of court injunctions limited the amount of water that Los Angeles could receive from its aqueduct system. In 1990, these limitations, along with a persistent drought, limited the delivery from the aqueduct to only 106 TAF. The Mono Lake Water Rights Decision (Decision) in September of 1994 ended the litigation in the Mono Basin, while negotiations continued with Inyo County on the fate of the Owens Valley water supply. In the Decision, the state ruled that Mono Lake should rise 17 feet over the next 25 years. During this time, Los Angeles would only be permitted to divert a fraction of its historical amounts. After the lake had risen, the City of Los Angeles would still be allowed only significantly reduced diversions. However, the high precipitation during the 1990s allowed increased diversions of water to the LAA to occur at a much earlier time frame than had been foreseen at the time of the Decision.

More recently, the LAA diversions of water from the Owens Valley came under additional pressure. A long history of diversions of water from the Owens River had led to the drying up of Owens Lake by the end of the 1920s. This dry lakebed became a major source of windblown dust, resulting in EPA pressure to develop a State Implementation Plan to bring the region into compliance with federal air quality standards. In 1998, the Los Angeles Department of Water and Power entered into a Memorandum of Agreement with the Great Basin Air Pollution Control District that specified actions needed to control the problem. These actions included shallow flooding and managed vegetation at various lakebed locations. An estimated 54 TAF per year will be required to maintain the dust control measures, further restricting the water available for diversion through the LAA. More recently, the city has been required to restore portions of the Owens River, which could further restrict the water that can be provided from this source. During the last 5 years (2011 to 2015), LAA supplies ranged from 370 TAF in the wet 2011 year to a low of 27 TAF in 2015.

## Historic Total Regional Water Supplies

The previous sections have presented the various sources of Metropolitan and the region's water supply. The amount of water supplied by each local and imported source from 1976 through 2015 appears in Table A.2-1. The imported supplies represent the amount of water imported into Metropolitan's service area, not the amount delivered to member agencies, which is shown in Table A.2-2. The difference between Metropolitan's imports and deliveries is water placed into or withdrawn from storage.

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# Appendix 3

# JUSTIFICATIONS FOR SUPPLY PROJECTIONS

# Appendix 3
# JUSTIFICATIONS FOR SUPPLY PROJECTIONS

Water Code §10631 requires that urban agencies identify and quantify existing and planned sources of water and include a detailed description of all water supply projects and water supply programs that may be undertaken to meet the total projected water use. In addition, legislation authored by Senator Sheila Kuehl (Senate Bill 221 – now Water Code §10613, *et seq.*) and Senator Jim Costa (Senate Bill 610 – now Water Code §66473.7) requires water retailers to demonstrate that their water supplies are sufficient for certain proposed subdivisions and large development projects subject to the California Environmental Quality Act (CEQA). Although Metropolitan and other wholesalers do not have verification responsibilities under this legislation, information provided by Metropolitan may be useful to retailers in complying with these responsibilities. This Appendix provides the basis for the water availability contained in this report, by major source of supply. Such bases and proofs are required for supply verification under the legislation. Links to the copy of the guidebook for implementation of the legislation can be found at http://www.water.ca.gov/pubs/use/sb_610_sb_221_guidebook/guidebook.pdf.

Throughout this Appendix, references are made to Metropolitan's operating budget and its long-term capital investment plan. The most recent operating budget (for fiscal years 2014-15 and 2015-16) was adopted at the April 8, 2014 Board Meeting. A copy of the budget summary and the Capital Investment Plan for fiscal years 2014-15 and 2015-16 can be found at http://www.mwdh2o.com/PDF_Who_We_Are/1.4.7_Biennial_budget.pdf.

Another document of interest related to Metropolitan's water supply planning is its annual report to the state Legislature in compliance with Senate Bill 60 of 1999 (Hayden).[3] Senate Bill 60 requires that Metropolitan report on its progress in increasing its emphasis on cost-effective conservation, recycling, and groundwater recharge.

## A.3.1 Colorado River Aqueduct Deliveries

### *A. Colorado River Supplies*

Metropolitan obtains water from the Colorado River under a number of categories specified in its supplemental water storage and delivery contract with the Secretary of the Interior: its basic apportionment that is classified as Priority 4 water, unused and surplus water that is classified as Priority 5 and Priority 6(a) water, and water resulting from a number of conservation programs that is classified as Priority 3(a) water. Pursuant to a U.S. Supreme Court decree, and regulations and operating guidelines of the USBR, Metropolitan may receive as unused apportionment, water supplies unused by agricultural districts, supplies unused by the states of Arizona and Nevada, and as Intentionally Created Surplus, supplies stored from previous years'

[3] Metropolitan Water District of Southern California, *Annual Progress Report to the California State Legislature: Achievements in Conservation, Recycling and Groundwater Recharge* (February 2016), which can be found at http://www.mwdh2o.com/PDF_About_Your_Water/2.1.1_Regional_Progress_ReportSB60.pdf. The legislation requiring this information can be found at http://www.leginfo.ca.gov/pub/99-00/bill/sen/sb_0051-0100/sb_60_bill_19990916_chaptered.pdf. Similar reports have been filed with the Legislature since 2000.

extraordinary conservation and efficiency improvements to the operations of the Colorado River system. Subject to the terms of agreements, this stored water may be withdrawn as needed during years in which insufficient supplies are available. Appendix 2 describes the history of water supplies and the expected availability from this source, and Section 3.1 of the 2015 UWMP describes the agreements for water supplies.

### *Rationale for Expected Supply*

Historical Record

Water supply under Metropolitan's Priority 4 apportionment of Colorado River water has been delivered since 1939. By existing contract, it is expected to be available in perpetuity because of California's senior water rights to use of Colorado River water.

The historical record for available Colorado River water indicates that Metropolitan's fourth priority supply has been available in every year and can reasonably be expected to be available over the next 20 years.

Written Contracts or Other Proof

Metropolitan's entitlement to Colorado River water is based on a series of interstate compacts, federal laws, agreements, court decrees, and guidelines collectively known as "The Law of the River,"[4] which govern the distribution and management of Colorado River water. The following documents specifically determine Metropolitan's dependable supplies:

1931 Seven Party Agreement.[5] The 1931 Agreement recommended California's Colorado River use priorities and has no termination date. California's basic annual apportionment is 4.4 MAF. Palo Verde Irrigation District (PVID), Yuma Project (Reservation Division), Imperial Irrigation District (IID), Coachella Valley Water District (CVWD), and Metropolitan are the entities that hold the priorities. As shown in Table A.2-5, these priorities are included in the contracts that the Department of the Interior executed with the California agencies in the 1930s for water from Lake Mead. Metropolitan holds Priority 4 to California's basic apportionment of Colorado River water and utilizes this water – 550 TAF per year – every year. In addition, Metropolitan has access to additional Colorado River water – up to 662 and 38 TAF per year, respectively – through its Priority 5 and Priority 6(a) in the California apportionment. Appendix 2 describes the current status of water available under these priorities.

Metropolitan's Basic Contracts.[6] Metropolitan's 1930, 1931, and 1946 basic contracts with the Secretary of the Interior permit the delivery of 1.212 MAF per year when sufficient water is available. Metropolitan's 1987 surplus flow contract with USBR permits the delivery of water to fill the remainder of the Colorado River Aqueduct when water is available.

Consolidated Court Decree.[7] The 1964 U.S. Supreme Court Decree confirmed the Arizona, California, and Nevada basic apportionments of 2.8 MAF per year, 4.4 MAF per year, and 300 TAF per year, respectively. The 1964 Decree also permits the Secretary of the Interior to make water available that is unused by one of the states for use in the other two states. In addition, it permits the Secretary of the Interior to make surplus water available. A number of

[4] A description of many of these documents can be found at http://www.usbr.gov/lc/region/pao/lawofrvr.html.

[5] This agreement among the seven California agencies was dated August 18, 1931, and was codified in federal regulations promulgated by the Secretary of the Interior on September 28, 1931.

[6] Including contract number Ilr-645 dated April 9, 1930, supplemented September 28, 1931.

[7] The Consolidated Decree entered by the U.S. Supreme Court on March 27, 2006, in *Arizona v. California, et al.*, can be found at http://www.usbr.gov/lc/region/pao/pdfiles/scconsolidateddecree2006.pdf.

decrees were subsequently entered by the U.S. Supreme Court in the case *Arizona v. California, et al.*, culminating in the Consolidated Decree entered on March 27, 2006.

2003 Quantification Settlement Agreement (QSA) and several other related agreements were executed in October 2003.[8] The QSA quantifies the use of water under the third priority of the Seven Party Agreement, and further allocates 38 TAF of the sixth priority to Metropolitan. The QSA provides the numeric baseline needed to measure conservation and transfer programs, and it allows for implementation of agricultural conservation, land fallowing, and other programs identified in the 1996 IRP. Although this agreement does not directly impact Metropolitan's entitlements, Metropolitan agreed to forbear consumptive use when necessary so that the Secretary of the Interior can satisfy the uses of holders of miscellaneous and Indian present perfected rights in excess of 14.5 TAF.

2005 Settlement Agreement with Quechan Indian Tribe. In 2005, Metropolitan entered into a settlement agreement with the Quechan Indian Tribe and other parties. The Tribe uses Colorado River water on the Fort Yuma Indian Reservation. Under the settlement agreement, the Tribe, in addition to the amounts of water decreed for the benefit of the Reservation in 1964, is entitled to: (a) an additional 20 TAF of diversions from the Colorado River or (b) the amount necessary to supply the consumptive use required for irrigation of a specified number of acres, and for the satisfaction of related uses, whichever is less. Of the additional water, 13 TAF became available to the Quechan Indian in 2006. An additional 7 TAF becomes available to the Tribe in 2035. Metropolitan and the Tribe agreed that if the Tribe chooses to limit proposed development and utilization of their irrigable lands, which would require the diversion of any of the additional water in a year, and instead allows the water which would otherwise be used to be diverted by Metropolitan, Metropolitan provides an incentive payment to the Tribe to avoid or reduce a loss of supply.

Colorado River Interim Guidelines for Lower Basin Shortage and the Coordinated Operations for Lake Powell and Lake Mead. In December 2007, the Secretary of the Interior approved a Record of Decision establishing specific interim guidelines for reductions in Colorado River water deliveries in the Lower Basin during declared shortages and coordinated operations of Lake Powell and Lake Mead. These guidelines provide water release criteria from Lake Powell and water storage and water release criteria from Lake Mead during shortage, normal, and surplus conditions in the Lower Basin, and provide a mechanism for Metropolitan to store and take delivery of conserved system and non-system water in Lake Mead.

#### *Financing*

Metropolitan's operating budget (referenced at the beginning of this appendix) includes the cost of delivering Colorado River water and the payment to the Quechan Indian Tribe, which is paid from water sales revenue.

#### *Federal, State, and Local Permits/Approvals*

Metropolitan's fourth priority Colorado River water is currently available, and this priority assures delivery of the basic apportionment.

### *B. IID - Metropolitan Conservation Program*

#### *Source of Supply*

The IID-Metropolitan Conservation Program provides an annual supply that is delivered to Metropolitan's service area via its Colorado River Aqueduct (CRA). In 1988, Metropolitan

[8] These agreements can be found at http://www.iid.com/water/library/qsa-water-transfer.

executed a Conservation Agreement to fund water efficiency improvements within IID's service area in return for the right to divert the water conserved by those improvements. The program consists of structural and non-structural measures, including the concrete lining of existing canals, the construction of local reservoirs and spill-interceptor canals, installation of non-leak gates, and automation of the distribution system. Other implemented projects include the delivery of water to farmers on a 12-hour basis rather than a 24-hour basis and improvements in on-farm water management through drip irrigation systems.

### *Expected Supply Capability*

The IID-Metropolitan Conservation Program activity began in 1990, has been fully operational since 1998, and makes available 105 TAF of conserved water annually from 2016 onward. The initial program agreement provided CVWD the option to call up to about 45 TAF per year if needed to meet its demands. Execution of the QSA has reduced CVWD's option to a maximum of 20 TAF. This water is available to Metropolitan if not required by CVWD, but the minimum supply to MWD has been increased to 85 TAF from 2016 onward through a second amendment to the agreement, and the clarification on the number of 12-hour deliveries that would be included in the program through a letter agreement.

### *Rationale for Expected Supply*

Historical Record

The IID-Metropolitan Conservation Program has been fully operational since 1998. Existing agreements have extended the initial term to at least 2041 or 270 days after the termination of the QSA, whichever is later, and they guarantee Metropolitan a minimum of 85 TAF per year from 2016 onward.

With operations beginning in 1990, the program has conserved as much as 109.46 TAF per year to date. By an amendment to the program agreement beginning in 2007, and a 2014 letter agreement, the annual conserved water yield will be 105 TAF. The historical record indicates that Metropolitan's expected minimum supply of 85 TAF per year would be available over the next 26 years at least.

Written Contracts or Other Proof

Metropolitan's annual supply from the IID-Metropolitan Conservation Program is based on three agreements and amendments to the agreements.

1988 IID-Metropolitan Conservation and Use of Conserved Water Agreement. This Agreement was executed in December 1988 by IID and Metropolitan for a 35-year term following completion of program implementation (1998–2033).

1989 Approval Agreement. This Agreement secured the approval of PVID and CVWD to not divert an amount of water equal to the amount conserved except under limited circumstances. The Agreement was executed in December 1989.

1989 Supplemental Approval Agreement. This Agreement was executed in December 1989 between Metropolitan and CVWD to coordinate Colorado River diversions and the use of the conserved water provided by the Program.

2003 Amendments to 1988 Agreement and 1989 Approval Agreement. These amendments revise Metropolitan's potential obligation to reduce its use of the conserved water yield in favor of its use by CVWD down to 20 TAF annually. Any of this water not used by CVWD would be available to Metropolitan.

2007 Amendments to 1988 Agreement and 1989 Approval Agreement. These amendments specify that beginning in 2007, the annual conserved water yield has and will be 105 TAF with continued operation of 24 tailwater pumpback systems, of which up to 20 TAF would be made available to CVWD upon its request.

2014 Letter Agreement Related to the 1988 Agreement. This letter agreement specifies that beginning in 2016, the annual conserved water yield has and will be 105 TAF, of which up to 20 TAF would be made available to CVWD upon its request. This amendment also removes tailwater recovery systems from the conservation actions and quantifies the yield and number of 12-hour deliveries that are included in the program.

#### *Financing*

The water efficiency improvements under this Program have already been funded, constructed, and put into operation. Metropolitan's five-year financial forecast in the budget includes the cost of operating, maintaining, and delivering the conserved water under the IID-Metropolitan Conservation Program.

#### *Federal, State, and Local Permits/Approvals*

A comprehensive environmental review process supported implementation.

EIR for Program. The IID Board certified the final EIR for the Program in December 1986.[9]

EIR for Supplemental Program. The IID Board certified the final EIR for the Completion Program in June 1994.[10]

Program EIR for Quantification Settlement Agreement. Metropolitan's Board certified the final Program EIR for the QSA in June 2002.[11]

Addendums to the QSA Final Program EIR. Metropolitan's Board adopted the Addendum to the QSA Final Program EIR in December 2002 and a second addendum in September 2003. Metropolitan's Board also adopted the Findings of Fact and Statement of Overriding Considerations, and Mitigation and Monitoring and Reporting Program at that time.

### *C. Palo Verde Irrigation District Land Management, Crop Rotation and Water Supply Program*

#### *Source of Supply*

At its May 11, 2004 meeting, Metropolitan's Board authorized a 35-year land management, crop rotation, and water supply program with the PVID. Under the program, participating landowners in PVID are being paid to reduce their water use by not irrigating a portion of their land. A maximum of 29 percent of lands within PVID can be fallowed in any given year. Under the terms of the QSA, water savings within the PVID service area are made available to Metropolitan. PVID has the first priority for Colorado River water under the water delivery contracts with the USBR. Implementation of the program began in January 2005. The agreement also specifies that the participating landowners will fallow land in an amount equal to 25% of the landowner's total maximum fallowing commitment during each year.

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[9] Imperial Irrigation District, *Final EIR, Proposed Water Conservation Program and Initial Water Transfer, Imperial Irrigation District*, October, 1986. SCH Number: 1986012903.

[10] Imperial Irrigation District, *Final EIR for Modified East Lowline and Trifolium Interceptors, and Completion Projects*, May 1994. SCH Number: 1992071061.

[11] Coachella Valley Water District, Imperial Irrigation District, Metropolitan, San Diego County Water Authority, *Final Program EIR, Implementation of the Colorado River Quantification Settlement Agreement*, June 2002, SCH Number 2000061034.

### *Expected Supply Capability*

It is estimated that the PVID/Metropolitan Program would provide up to 133 TAF per year of additional Colorado River water. This water would be available in any year as needed and in accordance with the provisions described in the agreements with Palo Verde Valley landowners and PVID.

### *Rationale for Expected Supply*

Historical Record

Metropolitan and PVID tested the concept of developing a water supply for Metropolitan by entering into an agreement in 1992.[12] Agreements were signed with landowners and lessees in the Palo Verde Valley to forego irrigation for a two-year period from August 1992 to July 1994. Water unused by PVID, in the amount of 186 TAF, was stored in Lake Mead for Metropolitan. Both PVID and Metropolitan signed approved Principles of Agreement in 2001. PVID issued the Final EIR for the Proposed Palo Verde Irrigation District Land Management, Crop Rotation and Water Supply Program in September 2002.[13]

Implementation of the program began in January 2005. In March 2009, Metropolitan and PVID entered into a one-year supplemental fallowing program within PVID that provided for the fallowing of additional acreage, with savings of 24.1 TAF in 2009 and 32.3 TAF in 2010.

| **Calendar Year** | **Volume of Water Saved** (TAF) |
|---|---|
| 2005 | 108.7 |
| 2006 | 105.0 |
| 2007 | 72.3 |
| 2008 | 94.3 |
| 2009 | 120.2 |
| 2010 | 116.3 |
| 2011 | 122.2 |
| 2012 | 73.7 |
| 2013 | 32.8 |
| 2014 | 43.0 |
| 2015 | 85.0 (estimated) |

Written Contracts or Other Proof

Contracts for this program are listed below.

August 2004 Forbearance and Fallowing Program Agreement. This agreement establishes the PVID/Metropolitan Program, which provides for a solicitation of and provisional approval of landowner participation offers, specifies the process for incorporating offers into agreements with landowners, and states the terms and conditions for fallowing, including payments made by Metropolitan.

[12] Presented to Metropolitan's Board at its regular meeting on January 14, 1992.
[13] SCH Number 2001101149.

Landowner Agreements for Fallowing in PVID. These agreements specify an escrow process to consummate the transaction, an easement deed to encumber land for fallowing, a tenant agreement to subordinate a tenant's lease to the agreement and easement, and an encumbrance agreement to subordinate any encumbrance (e.g., a mortgage) to the easement. These agreements also state the landowner's fallowing obligation, payments to be made by Metropolitan, and land management measures to be implemented.

#### *Financing*

Metropolitan's annual O&M budget (referenced above) includes the cost of the PVID/Metropolitan Program.

#### *Federal, State and Local Permits*

EIR for Program. A Notice of Preparation for the PVID/Metropolitan Program was published on October 29, 2001. PVID issued the Final EIR for the Proposed Palo Verde Irrigation District Land Management, Crop Rotation, and Water Supply Program in September 2002 (see reference above).

### *D. Management of Metropolitan-Owned Land in Palo Verde*

#### *Source of Supply*

In 2016, Metropolitan will negotiate new leases on its 20,995 irrigable acres in the Palo Verde valley. Starting in 2017, additional water savings beyond what is achieved by the Land Management, Crop Rotation, and Water Supply Program will be generated on Metropolitan-owned farmland in PVID through a shift to less water-intensive crops, the adoption of more efficient irrigation technologies, and/or precision irrigation practices. Any conserved water created in PVID will flow to Metropolitan's fourth priority Colorado River allocation.

#### *Expected Supply Capability*

Metropolitan's lands in PVID already generate 24 – 94 TAF of water savings through the existing PVID Land Management, Crop Rotation and Water Supply Program, depending on the call. Changes in land management through cropping and irrigation practices are expected to generate an additional 15 and 29 TAF annually from 2017 onward. Savings will be small at first but are expected to increase over the first several years as new crops are planted and irrigation systems are upgraded. Because all Metropolitan-owned lands are enrolled in the PVID Land Management, Crop Rotation and Water Supply Program, the savings from agricultural practices will depend on the fallowing call for each year, with a high call resulting in lower savings due to lower baseline usage.

#### *Rationale for Expected Supply*

The exact water savings will depend on the details of the land management proposals developed by Metropolitan's lessees. However, Metropolitan's goal is to reduce the current consumptive water use on the lands by at least 1.5 AF per acre per year. This reduction is consistent with a switch from flood-irrigated alfalfa to deficit-irrigated alfalfa or to drip-irrigated vegetables, two possible cropping strategies that have been proposed.

Metropolitan owns 20,995 irrigable acres in the valley, but depending on the fallowing call, which varies from 7 to 35% of eligible acreage, only 13,647–19,525 acres are in production in any given year. If a 1.5 AF per acre reduction were realized on all of the irrigated acres in production in a given year, the resulting savings would be 20–29 TAF per year, depending on the call. Savings in the first few years are likely to be as low as 15 TAF while crops and irrigation systems are transitioned.

### *Financing*

Metropolitan's annual O&M budget includes the cost of the PVID land management program.

### *Federal, State and Local Permits*

This program is not subject to any permits or environmental impact reviews under federal, state, or local laws.

## *E. All-American and Coachella Canal Lining Projects*

### *Source of Supply*

Water is being conserved by the replacement of earthen portions of the Coachella Canal and the All-American Canal with concrete-lined canals. The concrete lining reduces the amount of water lost to seepage from the canals.

### *Expected Supply Capability*

Pursuant to the October 10, 2003 Allocation Agreement, Metropolitan is entitled to delivery of 16 TAF annually until the San Luis Rey Settlement Parties[14] satisfy the conditions described in Section 104 of the San Luis Rey Indian Water Rights Settlement Act (Public Law 100-675 Title 1 as amended). Once the statutory conditions have been met, Metropolitan will provide by exchange water to the United States for use by the Settlement Parties, and San Diego County Water Authority will convey the water for use by the Settlement Parties.

### *Rationale for Expected Supply*

The All-American and Coachella canal lining projects were implemented pursuant to the authorization contained in Title II of Public Law 100-675. The allocation of the water resulting from these projects is provided under the Allocation Agreement. The Allocation Agreement is a QSA-related agreement. The USBR, on behalf of the Secretary of the Interior, has issued interim determinations for the Coachella Canal Lining Project (January 31, 2008) and the All-American Canal Lining Project (December 4, 2009) that result in the annual delivery to Metropolitan of 4.5 TAF and 11.5 TAF, respectively. Delivery of this water for Metropolitan's use continues until conditions described in Section 104 of Public Law 100-675 and the Allocation Agreement are satisfied.

Program Facilities

The Coachella Canal is owned by the United States and is operated by CVWD. The All-American Canal is owned by the United States and is operated by IID. The water is conveyed through existing CRA facilities from Lake Havasu to Metropolitan.

Historical Record

The Coachella Canal Lining Project began conserving water in 2006 and reached its full conservation yield in calendar year 2009. The All-American Canal Lining Project began conserving water in 2008 and reached its full conservation yield in calendar year 2010. Actual annual deliveries to Metropolitan are as follows:

[14] The San Luis Rey Settlement Parties are the La Jolla, Pala, Pauma, Rincon and San Pasqual Bands of Mission Indians, the San Luis Rey Indian Water Authority, and the City of Escondido and Vista Irrigation District.

| Calendar Year | Volume Delivered to Metropolitan (AF) |
|---|---|
| 2006 | 172 |
| 2007 | 4,500 |
| 2008 | 6,013 |
| 2009 | 15,648 |
| 2010 | 16,000 |
| 2011 | 16,000 |
| 2012 | 16,000 |
| 2013 | 16,000 |
| 2014 | 16,000 |
| 2015 | 16,000 (estimated) |

Written Contracts or Other Proof

2003 Allocation Agreement. This agreement among the United States, Metropolitan, CVWD, IID, San Diego County Water Authority, and the San Luis Rey Settlement Parties provides for the determination by the Secretary of the Interior of the conserved water yield from the All-American Canal Lining Project and the Coachella Canal Lining Project, the allocation of water as a result of the Projects among IID, SDCWA, Metropolitan, and the Settlement Parties, and the delivery of the allocated amounts to the respective users by the Secretary of the Interior.

### *Financing*

Under the Allocation Agreement, water resulting from the All-American and Coachella Canal lining projects is made available to Metropolitan until the conditions specified in Sections 7.2.1, 7.2.2, and 7.2.4 of the Allocation Agreement have been satisfied. Metropolitan sets aside funding for the portion of the conserved water it receives in trust for the San Luis Rey Indian Water Authority as part of its annual O&M budget.[15]

### *Federal, State, and Local Permits/Approvals*

A comprehensive environmental review process supported implementation.

Program EIR for Quantification Settlement Agreement. Metropolitan's Board certified the final Program EIR for the QSA in June 2002.[16]

Addendums to the QSA Final Program EIR. Metropolitan's Board adopted the Addendum to the QSA Final Program EIR in December 2002 and a second addendum in September 2003. Metropolitan's Board also adopted the Findings of Fact and Statement of Overriding Considerations, and Mitigation and Monitoring and Reporting Program at that time.

EIR/EIS for the All-American Canal Lining Project. USBR approved the Record of Decision for the All American Canal Lining Project on July 29, 1994. IID certified the All-American Canal Lining Project Final EIS/EIR and approved the project on August 16, 1994. USBR released a Supplemental Information Report on the All American Canal Lining Project, dated January 12, 2006.

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[15] Payments from Metropolitan for Supplemental Water and Related Power Delivered Prior to Satisfaction of Section 104.

[16] Coachella Valley Water District, Imperial Irrigation District, Metropolitan, San Diego County Water Authority, Final Program EIR, Implementation of the Colorado River Quantification Settlement Agreement, June 2002, SCH Number 2000061034.

EIR/EIS for the Coachella Canal Lining Project. USBR approved the Record of Decision for the Coachella Canal Lining Project on March 27, 2002. CVWD certified the Coachella Canal Lining Project Final EIS/EIR and approved the project on May 15, 2001.

Metropolitan certified that it had reviewed and considered the information contained in those two documents and adopted the Lead Agencies' findings on December 13, 1994, for the All-American Canal Lining Project and on September 11, 2001, for the Coachella Canal Lining Project.

Addendum to EIS/EIR for the Coachella Canal Lining Project. An addendum to the Coachella Canal Lining Project Final EIS/EIR was published on February 27, 2004. CVWD certified the Addendum and approved the project on March 2, 2004.

### *F. Metropolitan-CVWD Delivery and Exchange Agreement for 35,000 Acre-Feet*

#### *Source of Supply*

Metropolitan delivers to CVWD up to 35 TAF from Metropolitan's available State Water Project (SWP) Table A supply without condition on the actual Department of Water Resources (DWR) allocation for that year. As CVWD does not have a connection to the SWP, the water is delivered to CVWD by an exchange with Colorado River water. Metropolitan takes delivery of the Table A supply in conjunction with forgoing diversion of an equal volume of its Colorado River supply, effectively leaving this water in the River for diversion by CVWD at Imperial Dam. Exchange deliveries may also be made at the CRA Whitewater service connection or through the Metropolitan-CVWD-Desert Water Agency Advance Delivery Agreement. This program represents a net debit to Metropolitan's supplies.

#### *Expected Capability*

Up to 35 TAF of Metropolitan's SWP Table A supply will be delivered annually to CVWD by exchange.

#### *Rationale for the Expected Supply*

This program is undertaken pursuant to the Delivery and Exchange Agreement between Metropolitan and Coachella for 35,000 AF dated October 10, 2003, and is a QSA-related agreement.

Program Facilities

Metropolitan takes delivery of the Table A supply from the East Branch of the California Aqueduct at Devil Canyon Afterbay. At Metropolitan's request, the USBR releases a portion of Metropolitan's available Colorado River supply from Lake Mead for diversion by CVWD at Imperial Dam and conveyance through the All-American Canal System.

Historical Record

Since the 2003 execution of the QSA and the Delivery and Exchange Agreement, the following volumes of exchange water were delivered to CVWD at Imperial Dam:

| Calendar Year | Volume of Exchange Water (AF) |
|---|---|
| 2003 | 0 |
| 2004 | 0 |
| 2005 | 0 |
| 2006 | 34,958 |
| 2007 | 0 |
| 2008 | 0 |
| 2009 | 0 |
| 2010 | 10,000 |
| 2011 | 0 |
| 2012 | 0 |
| 2013 | 0 |
| 2014 | 0 |
| 2015 | 313 |

Written Contracts or Other Proof

2003 Delivery and Exchange Agreement. This agreement between Metropolitan and CVWD provides for the delivery of up to 35,000 AF of Metropolitan SWP Table A supply by exchange with Colorado River water.

### *Federal, State, and Local Permits/Approvals*

Program EIR for Quantification Settlement Agreement. Metropolitan's Board certified the final Program EIR for the QSA in June 2002.[17]

Addendums to the QSA Final Program EIR. Metropolitan's Board adopted the Addendum to the QSA Final Program EIR in December 2002 and a second addendum in September 2003. Metropolitan's Board also adopted the Findings of Fact and Statement of Overriding Considerations, and Mitigation and Monitoring and Reporting Program at that time.

September 2002 Final Program EIR for Coachella Valley Water Management Plan and State Water Project Entitlement Transfer. The final Program EIR for the Coachella Valley Water Management Plan and SWP Entitlement Transfer was certified by the CVWD on October 8, 2002.

[17] Coachella Valley Water District, Imperial Irrigation District, Metropolitan, San Diego County Water Authority, Final Program EIR, Implementation of the Colorado River Quantification Settlement Agreement, June 2002, SCH Number 2000061034.

## G. SNWA and Metropolitan Storage and Interstate Release Agreement

### Source of Supply

The source of supply is SNWA's unused Nevada apportionment of Colorado River water made available to Metropolitan for diversion and storage. In later years, Metropolitan would return water through reduced diversions of Colorado River water made at the request of SNWA.

### Expected Capability

As of January 1, 2015, over 272 TAF had been diverted by Metropolitan since 2004. In 2015, Metropolitan diverted 150 TAF to SNWA.

Returns to SNWA are limited to no more than 30 TAF annually unless Metropolitan agrees to a larger amount. SNWA has agreed to forgo requesting return through 2019 of water stored prior to 2015 unless Metropolitan agrees to the return. In 2020 and 2021, SNWA may request return of an amount equal to the shortage allocated by the Secretary of the Interior to Nevada. If the Secretary of the Interior apportions less than 280 TAF of basic apportionment for use in Nevada, SNWA may request the return of up to 50 TAF, 1 acre-foot for each acre-foot less than the 280 TAF of basic apportionment apportioned for use in Nevada.

Of the amount proposed to be stored in 2015, 125 TAF would be available for return to SNWA.

If less than 75 TAF has been returned, then during each year prior to 2027 for which Lake Mead begins the year at or below elevation 1,045 feet, Metropolitan will create 50 TAF of Intentionally Created Surplus (ICS) in Lake Mead, until the combined sum of ICS and the amount of water stored for SNWA returned equals 75 TAF. Prior to 2027, Metropolitan would be able to request delivery of this ICS during a year in which Lake Mead begins the year at or above elevation 1,080 feet.

### Rationale for the Expected Supply

Program Facilities

Water is diverted through the CRA by Metropolitan. To return the water to SNWA, Metropolitan would reduce its CRA diversions, and the Secretary of the Interior would make water available to SNWA at Lake Mead.

Historical Record

The annual volumes of water diverted into the CRA, and the volume of water stored for SNWA by Metropolitan are as follows:

| Calendar Year | Volume of Water Diverted (AF) | Volume of Water Stored for SNWA (AF) |
|---|---|---|
| 2004 | 10,000 | 10,000 |
| 2005 | 10,000 | 10,000 |
| 2006 | 5,000 | 5,000 |
| 2007 | 0 | 0 |
| 2008 | 45,000 | 45,000 |
| 2009 | 0 | 0 |
| 2010 | 0 | 0 |
| 2011 | 0 | 0 |
| 2012 | 62,839 | 41,892 |
| 2013 | 75,000 | 50,000 |
| 2014 | 65,000 | 43,333 |
| 2015 | 150,000 | 125,000 |

No water has been returned to SNWA.

Written Contracts or Other Proof

2004 Storage and Interstate Release Agreement. This agreement among Metropolitan, the Colorado River Commission of Nevada, SNWA, and the United States provides for the Secretary of the Interior to make available to Metropolitan for diversion and storage unused Nevada apportionment. In subsequent years, the agreement provides for Metropolitan to make water available to SNWA by forgoing diversion of a portion of its available Colorado River supply.

Operational Agreement. As amended on August 11, 2009, on October 24, 2012, and on October 19, 2015, the Operational Agreement specifies the conditions under which Metropolitan would divert and store unused Nevada apportionment through 2026 and the return of water to SNWA.

## *H. Lower Colorado Water Supply Project*

### *Source of Supply*

Groundwater is pumped by the Lower Colorado Water Supply Project near the All-American Canal and is discharged to the Canal. IID reduces its net diversions of Colorado River water by an amount equal to the amount of Project water discharged into the Canal, permitting entities along the Colorado River that do not have rights or have insufficient rights to divert Colorado River water to obtain a supply of water. In 2007, Metropolitan entered into a contract with the USBR and the City of Needles to utilize the unused Project capacity.

### *Expected Capability*

Metropolitan estimates that it received 5.9 TAF of Lower Colorado Water Supply Project water in 2015.

### *Rationale for the Expected Supply*

Program Facilities

Two Lower Colorado Water Supply Project wells pump water into the All-American Canal. The groundwater level in one of the wells has declined to the point that it cannot operate at capacity with existing equipment. Replacement equipment to restore pumping capacity has been installed. Two new Project wells are expected to become operational in 2016 to augment pumping capacity.

Historical Record

Metropolitan has received the following amounts of Lower Colorado Water Supply Project water:

| **Calendar Year** | **Volume of Water** (AF) |
|---|---|
| 2007 | 5,011 |
| 2008 | 6,300 |
| 2009 | 2,349 |
| 2010 | 3,872 |
| 2011 | 3,611 |
| 2012 | 3,253 |
| 2013 | 4,208 |
| 2014 | 6,109 |
| 2015 | 5,965 (estimated) |

Written Contracts or Other Proof

2007 Lower Colorado Water Supply Project Contract among the United States, the City of Needles, and Metropolitan. This contract as amended in 2010 provides for the United States to deliver Colorado River water to Metropolitan, the availability of which results from the pumping of Lower Colorado Water Supply Project groundwater and the exchange of such water.

### *Financing*

Metropolitan's O&M budget includes the cost associated with receipt of Lower Colorado Water Supply Project water.

## *I. Lake Mead Storage Program, Drop 2 (Brock) Reservoir Funding, Yuma Desalting Plant Pilot Project, and Binational Intentionally Created Surplus*

### *Source of Supply*

Water has been and will be stored in Lake Mead as Intentionally Created Surplus (ICS) through extraordinary conservation measures, such as water saved through the Palo Verde Irrigation District Land Management, Crop Rotation, and Water Supply Program.

Water has been and will be stored in Lake Mead as ICS through system efficiency measures, such as Metropolitan's funding contributions toward construction of the Drop 2 (Brock) Reservoir near the All-American Canal and pilot operation of the Yuma Desalting Plant.

Water will be stored in Lake Mead as Binational ICS through implementation of pilot conservation projects in Mexico.

### *Expected Capability*

Metropolitan may create as much as 400 TAF of Extraordinary Conservation ICS water in a single year less the amount that may be created by IID, which could be as much as 25 TAF.

Upon creation, 5 percent of the Extraordinary Conservation ICS is deducted, resulting in additional system water in storage in Lake Mead and leaving 95 percent of the water available for release to Metropolitan. Each year thereafter, the remaining balance at the end of the year is reduced by three percent to account for evaporation losses.

The amount of Extraordinary Conservation ICS accumulated in Lake Mead for Metropolitan is limited to 1.5 MAF less the amount accumulated by IID which could be as much as 50 TAF.

Metropolitan may take delivery of as much as 400 TAF of Extraordinary Conservation ICS from Lake Mead in a year less the amount delivered to IID, which could be as much as 50 TAF.

Rather than storing Extraordinary Conservation ICS water in Lake Mead, IID may, with the written consent of Metropolitan, have up to 25 TAF of this water delivered to Metropolitan for storage in any one calendar year. Upon request by IID, Metropolitan would return 90 percent of the stored water to IID with the remaining 10 percent left for Metropolitan's use. Also, Metropolitan may make temporary use of IID's Extraordinary Conservation ICS accumulated in Lake Mead.

As of January 1, 2015, Metropolitan has 89 TAF of System Efficiency ICS stored in Lake Mead. There are no evaporation losses charged to stored System Efficiency ICS. Metropolitan may take delivery of as much as 24 TAF of this System Efficiency ICS resulting from pilot operation of the Yuma Desalting Plant and 25 TAF of this System Efficiency ICS resulting from construction of the Drop 2 (Brock) Reservoir beginning in 2015 annually. The USBR may reduce this delivery if it determines a reduction is necessary to avoid a shortage.

Metropolitan will receive 23.75 TAF of Binational ICS in Lake Mead by December 31, 2017.

### *Rationale for the Expected Supply*

Program Facilities

This program makes use of Lake Mead and the CRA.

Historical Record

From 2006 to 2010, Metropolitan created approximately 201.5 TAF of Extraordinary Conservation ICS. From 2008 to 2011, Metropolitan created approximately 124.4 TAF of System Efficiency ICS.

In 2008, the USBR assigned to Metropolitan 100 TAF of water stored in Lake Mead as System Efficiency ICS due to Metropolitan's contributions to the Drop 2 Reservoir project.

In 2010 and 2011, the USBR assigned to Metropolitan 16.75 TAF and 7.647 TAF of water stored in Lake Mead as System Efficiency ICS, respectively, due to Metropolitan's contributions to the Yuma Desalting Plant pilot project.

From 2011 to 2012, Metropolitan created approximately 348.7 TAF of Extraordinary Conservation ICS, and zero System Efficiency ICS.

As of January 1, 2015, Metropolitan's Extraordinary Conservation and System Efficiency ICS volumes in Lake Mead were approximately 61.8 TAF and 89.4 TAF, respectively.

Written Contracts or Other Proof

2007 Lower Colorado River Basin Intentionally Created Surplus Forbearance Agreement among the Arizona Department of Water Resources, PVID, IID, the City of Needles, CVWD, Metropolitan, SNWA, and the Colorado River Commission of Nevada. This agreement sets forth the rules under which ICS water is developed, stored in, and delivered from Lake Mead.

2007 California Agreement for the Creation and Delivery of Extraordinary Conservation Intentionally Created Surplus among Metropolitan, PVID, IID, CVWD, and the City of Needles. This agreement determines the conditions under which California contractors receiving Colorado River water may store and deliver water from Lake Mead.

2007 Agreement among the United States, the Colorado River Commission of Nevada, and the SNWA for the Funding and Construction of the Lower Colorado River Drop 2 Storage Reservoir Project. This agreement provides for: the United States to design and construct the Drop 2 Storage Reservoir Project; SNWA to fund the capital cost of the Project; the United States to credit SNWA's ICS account with 600 TAF of System Efficiency ICS; and allows Metropolitan to become a party to the agreement, requiring that Metropolitan provide funding for a portion of the capital cost.

2007 Delivery Agreement between the United States and Metropolitan. This agreement provides the procedures for creating the ICS water and guarantees delivery of the water to Metropolitan.

2008 Metropolitan Notice of Election to Participate as a Party to the Drop 2 Funding Agreement. This notice requires Metropolitan to provide funding for a portion of the capital cost of the Drop 2 Storage Reservoir Project, and the United States to credit Metropolitan's ICS account with 100 TAF of System Efficiency ICS, reducing the amount of System Efficiency ICS in SNWA's account by an equal amount.

2009 Agreement among the United States, Metropolitan, the Colorado River Commission of Nevada, SNWA, and the Central Arizona Water Conservation District for a Pilot Project for Operation of the Yuma Desalting Plant. This agreement provides for the allocation of the costs for the preparation and pilot operation of the Yuma Desalting Plant.

2010 Yuma Desalting Plant Pilot Project Delivery Agreement between the United States and Metropolitan. This agreement secures delivery of the ICS water created and specifies the manner in which this water will be accounted.

2012 Agreement among the United States, Metropolitan, the Colorado River Commission of Nevada, SNWA, and the Central Arizona Water Conservation District for a Pilot Program for the Conversion of Intentionally Created Mexican Allocation to Intentionally Created Surplus. This agreement provides for the allocation of the costs among the agencies for the implementation of pilot conservation projects within Mexico and the allocation of 95 TAF of conserved water among the non-federal agencies as Binational ICS in Lake Mead.

2012 Interim Operating Agreement for Implementation of Minute No. 319 of the International Boundary and Water Commission. This agreement among the United States, the Upper Basin states, and Lower Basin states' agencies, including Metropolitan, sets forth the rules under which Intentionally Created Mexican Allocation is to be converted to Binational ICS for storage in and delivery from Lake Mead.

2012 Lower Colorado River Basin Forbearance Agreement for Binational Intentionally Created Surplus. This agreement among the state of Arizona, the Colorado River Commission of Nevada and SNWA, and California Colorado River water contractors, including Metropolitan, ensures

that the Binational ICS made available to a contractor that invests in a project in Mexico would not be claimed by another contractor in another state.

2012 Binational ICS Delivery Agreement. This agreement between Metropolitan and the United States secures delivery of the Binational ICS water made available by exchange and specifies the manner in which this water would be accounted.

2013 Agreement between Metropolitan and IID Regarding Binational Intentionally Created Surplus. This agreement allows IID to provide a payment to Metropolitan of up to 50 percent of the financial contribution to be made to the United States by Metropolitan for the implementation of pilot conservation projects within Mexico. As a result of IID's payment, Metropolitan will receive 23.75 TAF and IID will receive 23.75 TAF of Binational ICS by December 31, 2017.

### *J. Programs Under Development*

Expansion of the Palo Verde Irrigation District (PVID) Land Management Program: Additional fallowing agreements may be developed in subsequent years as needed.

Arizona Storage and Interstate Release Agreement: A storage and interstate release program with the Central Arizona Project has been under consideration. In lieu of Arizona storing Colorado River water in groundwater basins, water would be stored with Metropolitan for later return.

Bard Water District Seasonal Fallowing Pilot Program: In January 2016, Metropolitan's Board of Directors authorized the General Manager to enter into a pilot seasonal fallowing program with Bard Water District (Bard). Farmers in Bard have expressed interest in participating in a two-year pilot program to conduct seasonal fallowing on their lands. A number of farmers in Bard grow one or more vegetable crops in the fall and winter followed by a field crop in the spring and summer. This rotation of crops provides an opportunity to fallow land for a four-month period from April to July. Based on the interest expressed by farmers in Bard, staff for Metropolitan and Bard have developed proposed terms for a two-year pilot program that could provide Metropolitan with an estimated 4.6 TAF in both 2016 and 2017. Metropolitan and Bard would enter into a pilot program agreement which would specify that a maximum of 2,000 acres within Bard would be fallowed per season and that Bard would not deliver any water to the fallowed acres from April 1 to July 31, 2016 and 2017. Metropolitan would enter into an agreement with each individual farmer through which the farmer would agree to fallow at least 10 contiguous acres for the four month period. Implementation of a pilot program would provide information that could lead to the development of a longer term land management and fallowing program with Bard.

## A.3.2 California Aqueduct Deliveries

### *A. State Water Project Deliveries*

#### *Source of Supply*

The State Water Project (SWP) provides imported water to the Metropolitan service area and has provided from 25 to 50 percent of Metropolitan's supplies. In accordance with its contract with the Department of Water Resources (DWR), Metropolitan has a Table A allocation of 1,911,500 AF per year under contract from the SWP. Actual deliveries have never reached this amount because they depend on the availability of supplies as determined by DWR. The availability of SWP supplies for delivery through the California Aqueduct over the next 18 years is estimated according to the historical record of hydrologic conditions, existing system capabilities as may be influenced by environmental permits, requests of the SWC and SWP contract provisions for allocating Table A, Article 21 and other SWP deliveries including San Luis carryover to each contractor. As shown in this 2015 UWMP, the estimates of SWP deliveries to Metropolitan are based on DWR's July 2015 SWP Delivery Capability Report.

As part of its contract with DWR, Metropolitan pays both the fixed costs of financing SWP facilities construction and the variable costs of operations, maintenance, power, and replacement costs for water delivered each year. SWP water is delivered to Metropolitan through the East Branch at Devil Canyon Power Plant afterbay, along the Santa Ana Valley Pipeline, and at Lake Perris. Metropolitan takes delivery from the West Branch at Castaic Lake.

#### *Expected Supply Capability*

The Edmund G. Brown California Aqueduct is capable of transporting Metropolitan's full contract amount of 1,911,500 AF per year. However, the quantity of water available for export through the California Aqueduct can vary significantly year to year. The amount of precipitation and runoff in the Sacramento and San Joaquin watersheds, system reservoir storage, regulatory requirements, and contractor demands for SWP supplies impact the quantity of water available to Metropolitan.

#### *Rationale for Expected Supply*

Metropolitan and 28 other public entities have contracts with the State of California for SWP water. These contracts require the state, through DWR, to use reasonable efforts to develop and maintain the SWP supply. The state has made significant investment in infrastructure. It has constructed 28 dams and reservoirs, 26 pumping and generation plants, and about 660 miles of aqueducts. More than 25 million California residents benefit from water from the SWP. DWR estimates that with current facilities and regulatory requirements, the project will deliver approximately 2.3 MAF under average hydrology considering impacts attributable to the combined Delta smelt and salmonid species biological opinions.

On a yearly basis, DWR estimates the amount of supplies that are available for that year. Metropolitan uses a forecasting method for SWP deliveries based on historical patterns of precipitation, runoff, and actual deliveries of water.

Further, under the water supply contract, DWR is required to use reasonable efforts to maintain and increase the reliability of service to Metropolitan. As discussed in a subsequent section, DWR is participating in the Bay-Delta process to achieve these requirements.

Historical Record

The historical record shows significant accomplishments by DWR in providing its contractors with SWP water supplies. Through 2013, the SWP has delivered over 90 MAF to its contractors. The maximum annual water supply was delivered in 2005, and totaled 3.75 MAF. In 2006 and 2011 the project delivered 3.7 MAF. DWR has continued to invest in SWP facilities to deliver water to its contractors.

Written Contracts or Other Proof

1960 Contract between the State of California and The Metropolitan Water District of Southern California for a Water Supply. This contract, initially executed in 1960 and amended numerous times since, is the basis for SWP deliveries to Metropolitan. It requires DWR to make reasonable efforts to secure water supplies for Metropolitan and its other contractors. The contract expires in 2035. At that time, Metropolitan has the option to renew the contract under the same basic conditions.

### *Financing*

Metropolitan's payments for its State Water contract obligation are approved each year by its Board of Directors and currently constitute approximately a third of the annual budget.

### *Federal, State and Local Permit/Approvals*

Operation of the SWP. The DWR is responsible for acquiring, maintaining, and complying with numerous federal and state permits for operation of the SWP. Metropolitan has been active in monitoring the issues affecting its contract with DWR.

EIR for the East Branch Enlargement. In April 1984, DWR prepared and finalized an EIR for the Enlargement of the East Branch of the Governor Edmund G. Brown California Aqueduct.

EIR for the Harvey O. Banks Pumping Plant. In January 1986, DWR prepared and finalized an EIR for the additional pumping units at Harvey O. Banks Delta Pumping Plant.

EIR for the Mission Hills Extension. In 1990, DWR prepared and finalized an EIR for the SWP Coastal Branch, Phase II and Mission Hills Extension.

East Branch Extension Project Phase 1. In 1998, DWR completed an EIR to extend the East Branch of the California Aqueduct to provide service to San Gorgonio Pass Water Agency. Phase 1 was completed in 2002.

U.S. Fish and Wildlife Service Biological Opinion. In December 2008, U.S. Fish and Wildlife issued a Biological Opinion for Delta smelt.

National Marine Fisheries Service Biological Opinion. In June 2009, the National Marine Fisheries Service issued a Biological Opinion for salmon.

## *B. Desert Water Agency/Coachella Valley Water District/Metropolitan Water Exchange and Advance Delivery Programs*

### *Source of Supply*

The Desert Water Agency (DWA) and CVWD, both in Riverside County, have rights to SWP deliveries, but do not have any physical connections to the SWP facilities. Both agencies are adjacent to the CRA. For DWA and CVWD to obtain water equal to their SWP allocations, Metropolitan has agreed to exchange an equal quantity of its Colorado River water for DWA and CVWD's SWP water. DWA has a SWP Table A contract right of 55.75 TAF per year, and CVWD has a SWP Table A contract right of 138.35 TAF per year, for a total of 194.1 TAF per year.

### *Expected Supply Capability*

Under the existing agreements, Metropolitan provides water from its CRA to DWA and CVWD in exchange for SWP deliveries. Metropolitan can deliver additional water to its DWA/CVWD service connections, permitting these agencies to store water. When supplies are needed, Metropolitan can then receive its full Colorado River supply, as well as the SWP allocation from the two agencies, while the two agencies can rely on the stored water for meeting their water supply needs. The amount of DWA and CVWD SWP Table A water available to Metropolitan depends on total SWP deliveries and varies from year to year.

In addition to their Table A supplies, DWA and CVWD, subject to Metropolitan's written consent, may take delivery of SWP supplies available under Article 21, the Turn-back Pool Program, and non-SWP water supplies they may acquire and convey through the SWP facilities. These other supplies are delivered to DWA and CVWD by exchange with Metropolitan in the same manner as Table A deliveries. DWA and CVWD are participants in the Yuba Dry Year Water Purchase Program. Additionally, DWA participated in the 2009 Drought Water Bank and the 2015-2016 Multi-Year Water Pool Demonstration Program. CVWD has also purchased non-project supplies from partners in the San Joaquin Valley on an annual basis since 2008. Metropolitan has also consented to:

- 10 TAF of exchange deliveries to CVWD for non-SWP water acquired from the San Joaquin Valley from 2008 through 2010, and
- 36 TAF of exchange deliveries to DWA for non-SWP water acquired from the San Joaquin Valley from 2008 through 2015.

### *Rationale for Expected Supply*

The DWR estimates the amount of supplies that are available each year. Metropolitan uses a forecasting method for SWP deliveries based on historical patterns of precipitation, runoff and actual deliveries of water.

Historical Record

DWA and CVWD Exchange Program is currently in operation. The Advance Delivery Agreement has been in place since 1984. Since 1973, Metropolitan has been taking delivery of these agencies' SWP Table A water and has provided equivalent water to those agencies from Metropolitan's CRA supplies. Metropolitan has also been delivering water in advance of the amount needed under the exchange agreements. With water having been delivered in advance, Metropolitan can reduce deliveries to DWA and CVWD as needed. Indeed, from the end of August 2012 through October 2015, Metropolitan drafted approximately 164 TAF, leaving 207 TAF in the Advance Delivery account.

Written Contracts or Other Proof

1967 and 1983 Water Exchange Contract and Agreements. The DWA and CVWD Program is currently in operation. The DWA and CVWD water exchange contract has been in place since 1967, was amended in 1972, and was modified with execution of additional agreements in 1983.

1984 Advance Delivery Agreement. The Advance Delivery Agreement allows Metropolitan to supply DWA and CVWD with Colorado River water in advance of the time these agencies are entitled to receive water under the exchange agreements. In future years, Metropolitan can recover this water by reducing its deliveries under the exchange agreements.

The 2003 Exchange Agreement. DWA, CVWD, and Metropolitan executed the 2003 Exchange Agreement under which Metropolitan transferred 88,100 AF and 11,900 AF of its SWP Table A water to DWA and CVWD, respectively, reducing Metropolitan's Table A volume from 2,011,500 AF to 1,911,500 AF. The 2003 Exchange Agreement became operational in calendar year 2005 with the execution of letter agreements among DWA, CVWD, and Metropolitan governing its implementation. The exhibits to the November 9, 2004, and November 19, 2007, letter agreements also modify certain provisions of the Water Exchange Contract and Agreements and the Advance Delivery Agreement.

November 2012 Letter Agreement. CVWD and Metropolitan executed the letter agreement to deliver non-SWP water in exchange for Colorado River water under which CVWD arranged for the delivery of up to 16.5 TAF per year of water to Metropolitan provided by Rosedale-Rio Bravo Water Storage District to CVWD. Metropolitan delivers to CVWD an equal amount of Colorado River water.

#### *Financing*

The funds for deliveries under this Program are included in Metropolitan's O&M budget and Long-Range Finance Plan (referenced above).

#### *Federal, State, and Local Permits/Approvals*

DWR is responsible for acquiring, maintaining, and complying with numerous Federal and State permits for operation of the SWP.

July 26, 1983, CVWD Negative Declaration, Whitewater River Spreading Area expansion Phase 1.

February 1983, DWA Final EIR for the proposed extension of time for utilizing Colorado River water to recharge the upper Coachella Valley groundwater basins to the year 2035, Volume I and II, April 1983, Volume III.

September 2002, Final Program EIR for Coachella Valley Water Management Plan and SWP Entitlement Transfer was certified by CVWD on October 8, 2002.

### *C. Semitropic Water Banking and Exchange Program*

#### *Source of Supply*

The agreement between Semitropic Water Storage District (Semitropic) and Metropolitan was executed in February 1994. Semitropic obtains water from the SWP through its contracts with the Kern County Water Agency. SWP supplies irrigate an area of 161,200 acres within Semitropic's service area. When this surface water is not available, these growers withdraw water from the underlying aquifer. The agreement between Semitropic and Metropolitan allows Metropolitan to make use of 350 TAF of storage in Semitropic's groundwater basin. In years of plentiful supply, Metropolitan can deliver available SWP supplies to Semitropic through the California Aqueduct. During dry years, Metropolitan can withdraw this stored water. Five other banking partners participate in this Program and use 650 TAF of storage in Semitropic's groundwater basin.

#### *Expected Supply Capability*

The Semitropic-Metropolitan Program provides Metropolitan with the capacity to store up to 350 TAF of water under the current agreement. During dry years, Metropolitan can recover its stored water through a combination of direct pumping of the groundwater and delivery of Semitropic's SWP Table A water in the California Aqueduct. In 2014, Metropolitan amended the program to increase the return yield by an additional 13.2 TAF per year. The minimum

annual yield available to Metropolitan from the program is currently 44.7 TAF, and the maximum annual yield is 236.2 TAF depending on the available unused capacity and the SWP allocation. The average annual supply capability for a single dry year similar to 1977 is 125 TAF or for multiple dry years similar to the period 1990-1992 is 107 TAF.

#### *Rationale for Expected Supply*

Historical Record

The Semitropic-Metropolitan Water Banking and Exchange Program has been operational since 1994. With existing agreements, it will continue to operate over the term of 41 years (1994-2035). By the end of 2015, the program had 137 TAF in its storage account.

Written Contracts or Other Proof

1992 Turn-in/out Construction, Operation and Maintenance Agreement. This Agreement was executed in 1992 by DWR and Semitropic to allow construction, operation, and maintenance of the Semitropic California Aqueduct Turn in/out.

1993 Temporary Semitropic-Metropolitan Water Banking Agreement. This Agreement was executed in February 1993 by Semitropic and Metropolitan to allow the storage of available Metropolitan supplies in advance of execution of the long-term agreement.

1994 Semitropic/Metropolitan Water Banking and Exchange Agreement. This Agreement was executed in December 1994 by Semitropic and Metropolitan to implement the program for a 41-year term (1994-2035).

1995 Point of Delivery Agreement. This agreement, with DWR, Kern County Water Agency, and Metropolitan, allows Metropolitan to divert water from the California Aqueduct into Semitropic's service area.

1995 Introduction of Local Water into the California Aqueduct. This agreement, with DWR, Kern County Water Agency, and Semitropic, allows Metropolitan to receive water from the program into the California Aqueduct.

2014 Amendment to Increase Program Yield. The amendment increased Metropolitan's minimum return yield by 13,200 acre-feet per year.

#### *Financing*

Metropolitan's O&M budget (referenced above) includes payments for the Semitropic Program.

#### *Federal, State, and Local Permits/Approvals*

Final EIR. Semitropic acting as the lead agency under CEQA and Metropolitan acting as a responsible agency jointly completed the EIR for the Program. The EIR was certified by Semitropic in July 1994 and adopted by Metropolitan in August 1994.

Regulatory Approvals. All regulatory approvals are in place, and the program is operational.

### *D. Arvin-Edison Water Management Program*

#### *Source of Supply*

The Arvin-Edison Water Storage District (Arvin-Edison) manages the delivery of local groundwater and water imported into its service area from the Central Valley Project's (CVP) Millerton Reservoir via the Friant-Kern Canal. The surface water service area consists of 132,000 acres of predominantly agricultural land, and to a minor degree, municipal and industrial uses. It is situated in Kern County. Arvin-Edison operates its supplies conjunctively, storing water in the underlying aquifer when imported supplies are available and withdrawing

that water when the availability of imported supplies is reduced. In 1997, Metropolitan entered into an agreement with the Arvin-Edison Water Storage District. The agreement allows Metropolitan to store available water in Arvin-Edison's groundwater basin, either through direct spreading operations, or through deliveries to growers in Arvin-Edison's service area. Similar to Arvin-Edison's own usage, this previously stored water could be withdrawn when the availability of imported supplies to Metropolitan is reduced.

### *Expected Supply Capability*

The Arvin-Edison/Metropolitan Program provides Metropolitan with the capacity to store up to 350 TAF of water under the current agreement. During dry years, Metropolitan can recover its stored water either through direct pumping of the groundwater or through exchange. Based on the terms and conditions of the program agreement, the return of water to Metropolitan ranges from a minimum of 40 TAF per year (peak 4-month summer period) up to 110 TAF (over a 12-month period). The average annual supply capability for this program is 75 TAF for either a single dry year similar to 1977 or for each year of a multiple dry year period similar to the period 1990-1992.

### *Rationale for Expected Supply*

Historical Record

The Arvin-Edison/Metropolitan Water Management Program has been operational since 1997. With existing agreements, it will continue to operate over the term of 38 years (1997-2035). By the end of 2015, the program had 124 TAF in its storage account.

Written Contracts or Other Proof

1997 Arvin-Edison/Metropolitan Water Management Agreement. This Agreement was executed in December 1997 by Arvin-Edison and Metropolitan to implement the program for a 30-year term (1997-2027).

1998 Turn-in/out Construction and Maintenance Agreement. This Agreement was executed in 1998 by DWR, Kern County Water Agency, Arvin-Edison, and Metropolitan to allow construction, operation and maintenance of the Arvin-Edison California Aqueduct Turn in/out.

1998-2002 Water Delivery and Return Agreements. These agreements, with DWR, Kern County Water Agency, Arvin-Edison, and Metropolitan, allow Metropolitan to divert water from, and introduce water to, the California Aqueduct.

2004 Point of Delivery Agreement. This agreement, with DWR, Kern County Water Agency, and Metropolitan, allows Metropolitan to divert water from the California Aqueduct into Arvin-Edison's service area.

2004 Introduction of Water into the California Aqueduct. This agreement, with DWR, Kern County Water Agency, and Arvin-Edison, allows Metropolitan to receive water from the program into the California Aqueduct.

2007 First Amended and Restated Agreement Between Arvin-Edison Water Storage District and The Metropolitan Water District of Southern California for a Water Management Program. This amendment increased the maximum storage level to 350 TAF, extended the agreement term to 2035, and provided for the construction of the South Canal Improvement Project. The project increases the reliability of Arvin-Edison returning higher water quality to the California Aqueduct.

### *Financing*

Metropolitan's O&M budget (referenced above) includes payments for the Arvin-Edison Program.

### *Federal, State, and Local Permits/Approvals*

Environmental Status: A Negative Declaration was completed in 1996.

An Addendum to the 1996 Negative Declaration was completed in 2003.

A Negative Declaration for the Arvin-Edison South Canal Improvement Project was completed in 2007.

Regulatory Approvals: All regulatory approvals are in place, and the program is operational.

## *E. San Bernardino Valley Municipal Water District Program*

### *Source of Supply*

The San Bernardino Valley Municipal Water District Program allows Metropolitan to purchase a dependable annual supply, as well as an additional supply for dry year needs. Under this program, Metropolitan purchases water provided to San Bernardino Valley Municipal Water District (Valley District) from its annual State Water Project (SWP) water allocation. Valley District delivers the purchased supplies to Metropolitan's service area through the coordinated use of facilities and interconnections within the water conveyance system of the two districts.

The purchased SWP supply is provided to Metropolitan as direct deliveries of annual SWP water through the California Aqueduct to Metropolitan's service area, as well as through deliveries of recaptured SWP water previously stored in the San Bernardino groundwater basin to Metropolitan's service area. Under this program, Metropolitan purchases a minimum of 20 TAF per year of SWP allocation every year. In addition, Metropolitan has the option to purchase Valley District's additional SWP allocation, if available, and the first right-of-refusal to purchase additional SWP supplies available beyond the minimum and option amounts. In the event that Metropolitan's operational needs do not require all, or a portion of the minimum purchased water, that unused amount may be carried forward up to a total of 50 TAF for later delivery. Finally, the program establishes a critical dry year supply account for Metropolitan that could provide additional amounts of dry year supplies. During any year designated by DWR as a critically dry year, Valley District could deliver from this account up to 50 TAF of recaptured SWP water previously stored in the San Bernardino groundwater basin.

To facilitate the transfer, the program also provides the coordinated use of existing facilities, including the Valley District's Foothill Pipeline and the Inland Feeder, to improve the conveyance capabilities of the delivery of SWP water to the service areas of both districts. The intertie between the Foothill Pipeline and the Inland Feeder has been constructed and was operational as of December 2002. This intertie allows Metropolitan to move SWP water from the East Branch of the California Aqueduct through the Foothill Pipeline and Inland Feeder, into DVL and the CRA. As a result of this intertie, Metropolitan has an alternative conveyance capacity of 260 cfs into Metropolitan's system should an outage occur on the upper section of the Inland Feeder.

### *Expected Supply Capability*

The average annual supply capability for a single dry year similar to 1977 is 70 TAF. For multiple dry years similar to the period 1990-1992, the expected supply capability is 37 TAF.

### *Rationale for Expected Supply*

Historical Record

The San Bernardino Valley Municipal Water District Program began operations in 2001 and is expected to be renewed continually in the future. Since its inception in 2001, this program has delivered 103 TAF to Metropolitan. There was no water remaining in the carryover account in 2009. Deliveries in 2013, 2014, and 2015 have been suspended by mutual agreement.

Written Contracts or Other Proof

Metropolitan's annual and dry-year supplies from the San Bernardino Valley Municipal Water District Program are based on Metropolitan Board actions and agreements.

2000 Board Approval of Coordinated Operating Agreement. In June 2000, Metropolitan's Board authorized entering into a Coordinated Operating Agreement between Metropolitan and Valley District to develop projects that could provide benefits to both districts through the coordinated use of facilities and SWP supplies.

2000 Coordinated Operating Agreement. The Coordinated Operating Agreement between Metropolitan and Valley District was executed in July 2000.

2001 Board Approval of the Coordinated Use Agreement. In April 2001, Metropolitan's Board authorized entering into the Coordinated Use Agreement for Conveyance Facilities and SWP Water Supplies between Metropolitan and Valley District for the purchase of dependable annual and dry year supplies by Metropolitan.

2001 Coordinated Use Agreement. The Coordinated Use Agreement for Conveyance Facilities and SWP Water Supplies between Metropolitan and Valley District for the purchase of dependable annual and dry year supplies by Metropolitan was executed May 2001. The Agreement is effective as of July 1, 2001, for an "evergreen" term (10-years with automatic annual extensions unless otherwise notified).

### *Financing*

Metropolitan's O&M budget (referenced above) includes the funds to purchase Program water.

### *Federal, State, and Local Permits/Approvals*

The Program became effective as of July 1, 2001. An environmental review process and regulatory approval supported implementation.

Final EIR. Final Regional Water Facilities Master Plan EIR dated February 1, 2001, was certified by Valley District, as lead agency, and by Metropolitan, as responsible agency. Notices of determinations were filed by Valley District and Metropolitan on May 29, 2001, and April 18, 2001, respectively.

State Water Contractors' Review. In May 2001, the SWC reviewed and issued a letter supporting the program.

DWR Review. DWR agreed to the program in December 2001.

## F. San Gabriel Valley Municipal Water District Program

### Source of Supply

The San Gabriel Valley Municipal Water District Program allows Metropolitan to exchange supplies to provide additional water for normal and dry year needs. Under this program, Metropolitan delivers supplies to the City of Sierra Madre, a San Gabriel Valley MWD member agency. In exchange for Metropolitan delivering one acre-foot, San Gabriel Valley MWD returns two acre-feet to Metropolitan in the Main San Gabriel Basin, up to 5 TAF. For any exchange amount less than 5 TAF, Metropolitan purchases the balance of the 5 TAF. The program provides increased reliability to Metropolitan by allowing additional water to be delivered to Metropolitan's member agencies Three Valleys MWD and Upper San Gabriel Valley MWD that rely upon the Main San Gabriel Basin for their supplies.

### Expected Supply Capability

The average annual supply capability for a single dry year similar to 1977 is a net 2 TAF. For multiple dry years similar to the period 1990-1992, the expected supply capability is 2 TAF.

### Rationale for Expected Supply

Historical Record

The San Gabriel Valley Municipal Water District Program began operations in 2013 and is expected to be renewed continually in the future. Since its inception in 2013, the program has completed the exchange of 10 TAF, with a net increase to Metropolitan's supply by an additional 7.3 TAF.

Written Contracts or Other Proof

Metropolitan's dependable annual and dry-year supplies from the San Gabriel Valley Municipal Water District Program are based on Metropolitan Board action and agreement.

2013 San Gabriel Valley MWD Exchange and Purchase Agreement. The agreement between Metropolitan and San Gabriel Valley MWD was executed in September 2013.

2013 Board Approval of the San Gabriel Valley MWD Exchange and Purchase Agreement. In August 2013, Metropolitan's Board authorized entering into the agreement with San Gabriel Valley MWD.

### Financing

Metropolitan's O&M budget (referenced above) includes the funds to purchase water.

### Federal, State, and Local Permits/Approvals

The Program became effective as of September 2013. An environmental review process supported implementation.

CEQA Compliance. The proposed action involved an exchange and purchase agreement associated with the leasing, licensing, and operating of existing public water conveyance facilities with negligible or no expansion of use and no possibility of significantly impacting the physical environment.

## G. Antelope Valley East Kern Water Agency Exchange and Storage Program

### Source of Supply

The Antelope Valley East Kern Water Agency (AVEK) Program allows Metropolitan to both exchange and store SWP supplies to provide additional water for normal and dry year needs.

Under this program, AVEK provides Metropolitan its unused SWP supplies. For every two acre-feet provided by AVEK, Metropolitan will return one acre-foot. The exchange program is expected to deliver 30 TAF over ten years, with 10 TAF available in dry years. Metropolitan will also have a storage capability in the groundwater basin, with a capacity of 30 TAF, and a dry year return capability of 10 TAF.

#### *Expected Supply Capability*

The average annual supply capability for a single dry year similar to 1977 is 10 TAF for each program. For multiple dry years similar to the period 1990-1992, the expected supply capability is 3 TAF for each program.

#### *Rationale for Expected Supply*

Historical Record

The AVEK Program is projected to provide benefits starting as early as 2016.

Written Contracts or Other Proof

Metropolitan's dependable annual and dry-year supplies from the AVEK Exchange and Storage Program are based on Metropolitan Board action and proposed agreement.

2015 Board Approval of the AVEK Exchange and Storage Agreement. In November 2015, Metropolitan's Board authorized entering into the agreement with AVEK.

#### *Financing*

Metropolitan's Board authorized up $16.6 million for the program with additional funds, if needed, from Metropolitan's O&M budget (referenced above).

#### *Federal, State, and Local Permits/Approvals*

The Program will become effective once the agreement is executed in 2016. An environmental review process supported implementation.

CEQA Compliance. The proposed action involved an exchange and purchase agreement associated with the leasing, licensing, and operating of existing public water conveyance facilities with negligible or no expansion of use and no possibility of significantly impacting the physical environment.

### *H. Bay-Delta Improvements*

#### *Source of Supply*

Improving the water supply reliability of the State Water Project (SWP) is a primary focus of Metropolitan's long-term planning efforts. Metropolitan's strategy is to reduce its dependence on SWP supplies during dry years, when risks to the Bay-Delta ecosystem are greatest, and to maximize its deliveries of available SWP water during wetter years to store in surface reservoirs and groundwater basins for later use during droughts and emergencies.

State and federal resource agencies and various environmental and water user entities are currently engaged in the development of the Bay Delta Conservation Plan (BDCP)/California WaterFix, which is aimed at making physical and operational improvements to the SWP system in the Delta necessary to restore and protect ecosystem health, south-of-Delta SWP and CVP water supplies, and water quality. The goal for the 2015 IRP Update for SWP supplies is to manage flow and export regulations in the near term and ultimately to achieve a long-term Bay-Delta solution. This goal involves continued engagement in collaborative science-based approaches to manage regulations in the near-term and continued participation in the long-

term California WaterFix and the California EcoRestore efforts. This approach targets an average of 984 TAF of SWP supplies in the near-term and an increase of 248 TAF to 1.2 MAF of supplies on average starting in 2030 when the long-term Bay-Delta solution is assumed to be in place. A more detailed description of SWP supplies is included in Section 3.2 of the 2015 UWMP, Section 3.2 and Technical Appendix 10 of the 2015 IRP Update.

The SWP conveys water from the western slope of the Sierra Nevada to water users both north and south of the Bay-Delta. Specifically, SWP water is delivered to Metropolitan's service area through a system of reservoirs, the Bay-Delta, pumping plants, and the California Aqueduct. Owned and operated by the California Department of Water Resources (DWR), the SWP provides municipal and agricultural water to 29 State Water Contractors. Annual deliveries for the SWP average about 2.5 MAF. Municipal uses account for about 60 percent of annual deliveries, with the remaining 40 percent going to agriculture.

SWP supplies are estimated using the 2015 SWP Delivery Capability Report distributed by DWR in July 2015. The 2015 Delivery Capability Report presents the current DWR estimate of the amount of water deliveries for current (2015) conditions and conditions 20 years in the future. These estimates incorporate restrictions on SWP and CVP operations in accordance with the biological opinions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service issued on December 15, 2008, and June 4, 2009, respectively. Under the 2015 Delivery Capability Report with existing conveyance and low outflow requirements scenario, the delivery estimates for the SWP for 2020 conditions as percentage of Table A amounts are 12 percent, equivalent to 257 TAF for Metropolitan, under a single dry-year (1977) condition and 51 percent, equivalent to 976 TAF for Metropolitan, under long-term average conditions.

In dry, below-normal conditions, Metropolitan has increased the supplies received from the California Aqueduct by developing flexible Central Valley/SWP storage and transfer programs. Over the last two years under the pumping restrictions of the SWP, Metropolitan has worked collaboratively with the other contractors to develop numerous voluntary Central Valley/SWP storage and transfer programs. The goal of these storage/transfer programs is to develop additional dry-year supplies that can be conveyed through the available Banks pumping capacity to maximize deliveries through the California Aqueduct during dry hydrologic conditions and regulatory restrictions.

### *The Bay Delta Conservation Plan*

The BDCP was prepared through a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties. At the outset of the BDCP process, a planning agreement was developed and executed among the participating parties, and a Steering Committee was formed. The BDCP identified a set of conservation measures including water conveyance improvements and restoration actions to contribute to the recovery of endangered and sensitive species and their habitats in California's Sacramento-San Joaquin Delta. The BDCP was formulated to contribute to the state's co-equal goals of water supply reliability and ecosystem restoration.

Lead agencies for the EIR/EIS were the DWR, the USBR, the United States Fish and Wildlife Service, and National Oceanic and Atmospheric Administration's National Marine Fisheries Service, in cooperation with the California DFW, the USEPA, and the United States Army Corps of Engineers. Metropolitan served on the steering committee. DWR and USBR are the lead agencies for the California WaterFix.

In order to select the most appropriate elements of the final conservation plan, the BDCP considered a range of options for accomplishing these goals using information developed as part of an environmental review process. Potential habitat restoration and water supply

conveyance options included in the BDCP were assessed through an Environmental Impact Report (EIR)/Environmental Impact Statement (EIS). The BDCP planning process and the supporting EIR/EIS process are being funded by state and federal water contractors. The First Administrative Draft BDCP was released in March 2012, a Second Administrative Draft BDCP and EIR/EIS was released in March 2012, and the Public Draft BDCP and EIR/EIS was released December 2013. Each of the above draft documents was released to the public. The official public comment draft was released in December 2013.

A new permitting approach and associated new alternatives to the BDCP were announced in April 2015. The California WaterFix and California EcoRestore would be implemented under a different Endangered Species Act permitting process. This would fulfill the requirement of the 2009 Delta Reform Act to contribute toward meeting the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem.

The new water conveyance facilities included in Alternative 4 (the BDCP) would be constructed and operated under the California WaterFix. Proposed changes to the design of the water conveyance facilities reduce the overall environmental/construction impacts to the environment, minimize disruptions to local communities, and increase long term operational and cost benefits. Some of the improvements would include moving the tunnel alignment away from local communities and environmentally sensitive areas. The elimination of pumping plants, reduction of permanent power lines and power use, and the reconfiguration of intake and pumping facilities sediment basins and reconfiguration/relocation of the construction staging sites in the North Delta will lessen construction and longer term operational impacts. If implemented, these would result in reduced environmental and construction impacts and increase improved long-term operational and cost benefits.

The main objective under the EcoRestore Program is to pursue at least 30,000 acres of Delta habitats over the next five years. These restoration programs would include projects and actions that are in compliance with pre-existing regulatory requirements designed to improve the overall health of the Delta. Other priority restoration projects would also be identified by the Delta Conservancy and other local governments. Funding would be provided through multiple sources including state bonds and other state-mandated funds, SWP/CVP contractors funds as part of existing regulatory obligations, and from various local and federal partners.

As part of the new alternatives and the state's proposed project, the regulatory approach to obtaining state and federal endangered species compliance is shifting from the BDCP Habitat Conservation Plan/Natural Community Conservation Plan strategy to an approach that contemplates a Biological Opinion pursuant to Federal ESA Section 7 and a State 2081 Permit. This approach, as well as the proposed revision to the new water facilities and ecosystem restoration actions, are evaluated in the partially Recirculated Draft EIR/EIS released in July 2015. The deadline for comments was October 2015.

The State Water Resources Control Board (SWRCB) is continuing its phased review and update of the 2006 Water Quality Control Plan (WQCP) for the Bay-Delta. The first phase focuses on the southern Delta salinity objectives for the protection of agriculture, San Joaquin River flow objectives for the protection of fish and wildlife, and a program of implementation for achieving those objectives. The second phase considers the comprehensive review of the other elements of the Bay-Delta WQCP, including but not limited to Sacramento River and Delta outflow objectives. Metropolitan has been collaborating with water users and other stakeholders to develop sound science and technical analyses in support of the WQCP review process, including sharing results in technical forums and publishing findings in peer-reviewed scientific journals. Metropolitan has been meeting with Board members and staff to share

findings as new science and analyses are developed and to encourage close coordination between BDCP and WQCP updates.

### *Rationale for Expected Supply*

Implementation Status

Expected supplies are projected in accordance with the approved implementation plan for CALFED's Bay-Delta Program and with the work plans for the Sacramento Valley Water Management Agreement.

Written Contracts or Other Proof

Metropolitan's projected dependable annual and dry-year supplies from planned Bay-Delta improvements are based on Metropolitan Board actions and agreements.

CALFED's Bay-Delta Program.

Bay-Delta Accord approved in December 1994.

Proposition 204 funds approved by voters in November 1996.

Metropolitan policy direction regarding CALFED's Bay-Delta Program adopted in July 1999. This policy direction established water supply goals.

Proposition 13 funds approved by voters in March 2000.

CALFED Framework announced in June 2000.

Final implementation plans for the first phase of CALFED's Bay-Delta Program approved in August 2000, in conjunction with the approval of the Program and conclusion of the environmental review process.

Proposition 50 funds approved by voters in November 2002.

Proposition 1, approved by the voters in 2014, authorized $7.545 billion in general obligation bonds for state water supply infrastructure projects, including surface and groundwater storage, ecosystem and watershed protection and restoration, and drinking water protection.

Annual Federal appropriations.

Metropolitan's Bay-Delta Policies/Agreements.

Execution of Planning Agreement for BDCP (Planning Agreement) approved in October 2006.

Execution of BDCP Cost-Sharing Agreement approved in November 2006.

Delta Action Plan Framework approved in June 2007.

Delta Conveyance Criteria approved in September 2007.

Delta Governance Principles approved in August 2008.

Execution of Initial Funding Agreement approved in December 2008.

Delta Vision Implementation policies approved in January 2009.

Delta-Related Legislation approved in April 2009.

Execution of Amendments to Planning Agreement approved in December 2009.

Execution of Planning Agreement Amendment (additional funds) approved in July 2010.

Execution of Amendment to Memorandum of Agreement approved in August 2011.

Sacramento Valley Water Management Agreement.

Work plans detailing projects that could provide benefits by the 2002 and 2003 water years were developed in October 2001.

Statement of settlement policy principles recommended in December 2001 by negotiators for approval.

Statement of settlement policy principles approved by Metropolitan's Board in January 2002.

A Sacramento Valley Water Management Agreement was signed and approved by settlement parties in December 2002.

### *Financing*

Funding for BDCP would come from federal, state, and local water supplier sources.

The California WaterFix would be paid for by public water agencies that rely on the supplies.

California EcoRestore is a program separate from California WaterFix. The state would pursue at least 30,000 acres of Delta habitat restoration over the next 5 years, pursuant to pre-existing regulatory requirements such as the 2008 and 2009 Biological Opinions and various enhancements to improve the overall health of the Delta ecosystem. Proposition 1 funds and other state public dollars will be directed exclusively for public benefits unassociated with any regulatory compliance responsibilities.

### *Federal, State, and Local Permits/Approvals*

CALFED's Bay-Delta Program.

Programmatic EIR/EIS finalized in July 2000.

Record of Decision issued in August 2000 for the final Programmatic EIR/EIS regarding the CALFED Bay-Delta Program.

Sacramento Valley Water Management Agreement.

Settlement parties approved Sacramento Valley Management Agreement in December 2002.

## *I. Kern Delta Water Management Program*

### *Source of Supply*

In December 1999, Metropolitan advertised a request for proposals for participation in "The California Aqueduct Dry-year Transfer Program." As a result of this request for proposals, four programs, including one from the Kern Delta Water District (Kern Delta), were selected for further consideration. In 2001, Metropolitan entered into Principles of Agreement with Kern Delta for the development of a dry-year supply program. Kern Delta serves 125,000 acres of actively farmed highly productive farmland located in the San Joaquin Valley portion of southern Kern County. Kern Delta has under contract 180 TAF per year of good quality, highly reliable pre-1914 Kern River water and 25.5 TAF per year of SWP Table A contract right (under contract with Kern County Water Agency).

The dry-year supply program between Kern Delta and Metropolitan involves the storage of water with Kern Delta. In years of plentiful supply, the agreement allows Metropolitan to store water in Kern Delta's groundwater basin, either through direct spreading operations or through deliveries to growers in Kern Delta's service area. Metropolitan has the ability to store up to 250 TAF of water. Agreement provisions may allow for storage beyond this amount. When needed, Metropolitan can recover its stored water either through direct pumping of the groundwater or exchange at a rate of 50 TAF per year. The program duration will be from 2002 to 2027 with provisions that allow the water to be withdrawn until 2033.

### *Expected Supply Capability*

The Kern Delta/Metropolitan Program provides Metropolitan with the capacity to store up to 250 TAF of water at any one time. When needed, Metropolitan can recover its stored water either through direct pumping of the groundwater or exchange at a rate of 50 TAF per year.

### *Rationale for Expected Supply*

Implementation Status

Expected supplies are projected in accordance with accepted detailed groundwater modeling that has been accomplished for the program. In addition, the Kern Delta/Metropolitan Water Management Program was operational and accepting water for storage by fall of 2003. By the end of 2015, the program had 119 TAF in its storage account.

Written Contracts or Other Proof

2001 Kern Delta/Metropolitan Principles of Agreement. Principles of agreement were entered into between Kern Delta and Metropolitan in June 2001, covering program costs, operational aspects, and risks/responsibilities.

2002 Kern Delta and Metropolitan Boards of Directors Approval. These actions approved execution of the long-term agreement, which delineates program operations, costs, and risks/responsibilities

### *Financing*

Metropolitan's O&M budget (referenced above) includes payments for the Kern Delta/ Metropolitan Program.

### *Federal, State, and Local Permits/Approvals*

Kern Delta, acting as lead agency under CEQA, has prepared a full EIR. As part of this EIR, Kern Delta published a Notice of Preparation and held meetings with the general public, interested agencies, and resource agencies. In November 2002, the Final EIR was certified by Kern Delta and adopted by Metropolitan.

## *J. Central Valley / State Water Project Storage and Water Transfers*

### *Source of Supply*

Up to 27 MAF of water (80 percent of California's developed water) is delivered for agricultural use every year. Over half of this water is used in the Central Valley; and much of it is delivered by, or adjacent to, SWP and Central Valley Project (CVP) conveyance facilities. This allows for the voluntary transfer of water to many urban areas, including Metropolitan, via the California Aqueduct.

In recent years, a portion of this agricultural water supply has been secured by Metropolitan through mutually beneficial transfer agreements:

The Governor's Water Bank (Bank) in 1991, 1992, 1994, and 2009 secured 75 to 820 TAF per year of water supply. Further, the DWR's Dry Year Water Purchase Program (Purchase Program) in 2001, 2002, and 2003 secured a total of 162 TAF. DWR established and administered the Bank and the Purchase Program by facilitating purchasing water from willing sellers and transferring the water to those with critical needs using the SWP facilities. Sellers, such as farmers and water districts, made water available for the Bank and Purchase Program by fallowing crops, shifting crops, releasing surplus reservoir storage, and by substituting groundwater for surface supplies.

In 2003, Metropolitan secured options to purchase approximately 145 TAF of water from willing sellers in the Sacramento Valley during the irrigation season. Using these options, Metropolitan purchased approximately 125 TAF of water for delivery to the California Aqueduct.

In 2005, Metropolitan, in partnership with three other SWC, secured options to purchase approximately 130 TAF of water from willing sellers in the Sacramento Valley during the irrigation season, of which Metropolitan's share was 113 TAF. Metropolitan also had the right to assume the other SWC options if they chose not to exercise their options. Due to improved hydrologic conditions, Metropolitan and the other SWC did not exercise these options.

In December 2007, Metropolitan entered into a long-term agreement with DWR providing for Metropolitan's participation in the Yuba Dry Year Water Purchase Program between Yuba County Water Agency and DWR that was approved by the SWRCB as part of the Yuba River Accord. This program provides for transfers of water from the Yuba County Water Agency during dry years through the year 2025, and Metropolitan has purchased approximately 165 TAF to date.

In 2008, Metropolitan, in partnership with eight other SWC, purchased approximately 40 TAF of water from willing sellers in the Sacramento Valley during the irrigation season, of which Metropolitan's share was approximately 27 TAF.

In 2009, Metropolitan participated in the Governor's Water Bank, which purchased approximately 74 TAF, of which Metropolitan's share was approximately 36.9 TAF.

In 2010, Metropolitan in partnership with three other SWC, secured approximately 100 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was approximately 88 TAF.

In 2010, Metropolitan purchased approximately 18 TAF of water from CVP Contractors located in the San Joaquin Valley. In addition, Metropolitan entered into an unbalanced exchange agreement that resulted in Metropolitan receiving approximately 37 TAF.

In 2015, Metropolitan, in partnership with eight other SWC, secured approximately 20 TAF of water from willing sellers in the Sacramento Valley, of which Metropolitan's share was approximately 12 TAF.

In addition, Metropolitan has secured water transfer supplies under the Multi-Year Water Pool Demonstration Program. In 2013 and 2015, Metropolitan secured 30 TAF and 1.3 TAF, respectively. Unlike the other transfer programs discussed herein, which were derived from agricultural sellers, a portion of these transfer supplies came from urban sellers.

### *Expected Supply Capability*

Metropolitan's recent water transfer activities demonstrate Metropolitan's ability to develop and negotiate water transfer agreements working either directly with the agricultural districts that are selling the water or with DWR acting as an intermediary via a Drought Water Bank. As discussed in the SWP section of this 2015 UWMP, significant restrictions on SWP and Central Valley Project (CVP) Delta pumping required by the biological opinions issued by the U.S. Fish and Wildlife Service (December 2008) and National Marine Fisheries Service (June 2009) will reduce anticipated SWP deliveries and therefore increase Metropolitan's need for Central Valley water transfer supplies. Unfortunately, these biological opinions result in SWP deliveries being shifted to the summer months thereby restricting the ability to pump water transfer supplies through the Delta pumping plants. On average, in dry years when Delta pumping capacity is available, Metropolitan expects to be able to purchase 125 TAF for delivery via the California Aqueduct.

### *Rationale for Expected Supply*

Historical Record

Metropolitan has made rapid progress in developing SWP transfer programs. This progress may be attributed to several factors, including Metropolitan dedicating additional staff to identify, develop, and implement SWP transfer programs; increased willingness of Central Valley agricultural interests to enter into transfer programs with Metropolitan; and Metropolitan staff's ability to work with DWR and USBR staff to facilitate SWP storage and transfer programs. The availability of dry year supplies has been demonstrated by the annual water purchase programs described above. In addition, Metropolitan participates in longer-term programs to secure water like the Yuba Accord and the Multi-Year Water Pool Demonstration Program.

The historical record for purchases from the Bank, Purchase Program, Metropolitan-initiated Central Valley programs, Yuba Accord, and Multi-Year Demonstration Program, as well as the number of sellers and buyers participating in these Programs, are strong indicators that there are significant amounts of water that can be purchased through spot market or long-term water transfers during dry years. This historical record is summarized in Table A.3-1 below.

Approximately 20 percent of these north of the Delta water transfers are dedicated to improving Delta water quality to comply with regulations governing Delta pumping.

Written Contracts or Other Proof

With near record-low precipitation in California in recent years, Governor Edmund G. Brown Jr. issued several executive orders to expedite processing of water transfers within the state:

Executive Order B-21-13 (May 20, 2013): The Department of Water Resources and the State Water Resources Control Board are to "take immediate action to address the dry conditions and water delivery limitations by doing the following: … (1) Expedite processing of one-year water transfers for 2013 and assist water transfer proponents and suppliers as necessary, provided that the transfers will not harm other legal users of water and will not unreasonably affect fish, wildlife, or other in-stream beneficial uses; (2) The SWRCB shall expedite review and processing of water transfer petitions in accordance with the applicable provisions of the Water Code; (3) The DWR shall expedite and facilitate water transfer proposals in accordance with applicable provisions of the Water Code..."

January 1, 2014 Drought Proclamation: "The Department of Water Resources and the State Water Resources Control Board will expedite the processing of water transfers, as called for in Executive Order B-21-13. Voluntary water transfers from one water right holder to another enables water to flow where it is needed most."

April 25, 2014 Drought Proclamation: "The Department of Water Resources and the State Water Resources Control Board will immediately and expeditiously process requests to move water to areas of need, including requests involving voluntary water transfers, forbearance agreements, water exchanges, or other means. If necessary, the Department will request that the Water Board consider changes to water right permits to enable such voluntary movements of water."

Executive Order B-29-15 (April 1, 2015): "The Department shall immediately consider voluntary crop idling water transfer and water exchange proposals of one year or less in duration that are initiated by local public agencies and approved in 2015 by the Department subject to the criteria set forth in Water Code section 1810." [This executive order incorporated by reference the previous drought proclamations.]

**Table A.3-1**
**Historical Record of MWD Central Valley Water Transfers**

| Program | Purchases (AF per year) | | Participants | |
|---|---|---|---|---|
| | Total | Metropolitan | Sellers | Buyers |
| 1991 Governor's Water Bank | 820,000 | 215,000 | 351 | 13 |
| 1992 Governor's Water Bank | 193,246 | 10,000 | 18 | 16 |
| 1994 Governor's Water Bank | 220,000 | 100 | 6 | 15 |
| 2001 Dry-Year Purchase Program | 138,806 | 80,000 | 9 | 8 |
| 2003 MWD Water Transfer Program | 146,230[1] | 126,230 | 11 | 1 |
| 2005 SWC Water Transfer Program | 127,275[2] | 0 | 3 | 4 |
| 2008 SWC Water Transfer Program | 39,152 | 26,621 | 4 | 8 |
| 2009 Governor's Water Bank | 47,505 | 36,900 | 10 | 9 |
| 2010 SWC Water Transfer Program | 98,959 | 88,159 | 11 | 4 |
| 2013 Multi-Year Water Pool Demo | 92,232 | 30,000 | 4 | 9 |
| 2015 Multi-Year Water Pool Demo | 3,000 | 1,374 | 1 | 14 |
| 2015 SWC Water Transfer Program | 19,686 | 12,358 | 5 | 9 |

[1] Quantities denote options Metropolitan secured, of which 20,000 AF were not exercised due to improved hydrologic conditions.
[2] Quantities denote options Metropolitan secured, but not exercised due to improved hydrologic conditions.

Agreements Between Sellers and Buyers. Since 1991, Metropolitan has entered into Central Valley water transfer agreements in eleven years with sellers, or DWR acting in an intermediary capacity for the Drought Water Banks. The essential terms and conditions for negotiating purchases, including maximum offering price, quantity of water needed, and the timing of delivery, were established in these agreements.

1999 Board Directive. Metropolitan's Board has authorized water transfers in accordance with the Water Surplus and Drought Management Plan (WSDM Plan) adopted in April 1999. The WSDM Plan is a comprehensive policy guideline for managing Metropolitan's water supply during periodic surplus and shortage conditions. During shortage conditions, the plan specifies the type, priority, and timing of drought actions, including the purchase of transfers on the spot market that could be taken in order to prevent or mitigate negative impacts on retail demands.

### *Financing*

Funds for Central Valley water transfers are included in Metropolitan's O&M budget (referenced above).

### *Federal, State, and Local Permits/Approvals*

Environmental documentation for the Drought Water Banks. In November 1993, DWR prepared and finalized a programmatic EIR for the operation of the drought water banks during future

drought events. In 2009, an emergency CEQA exemption was issued to support the Drought Water Bank.

Individual CEQA and NEPA documents for Metropolitan's 2003, 2005, and 2008 Central Valley water transfer programs. Individual sellers prepared CEQA documentation to support their transfers. In addition, the USBR prepared NEPA documentation for those transfers requiring federal approval.

### *K. Yuba Accord Dry Year Purchase Program*

#### *Source of Supply*

As part of a comprehensive settlement of a State Water Resources Control Board (SWRCB) proceeding in which the Yuba County Water Agency (YCWA) is required to increase Yuba River fishery flows, referred to as the "Yuba River Accord" (Accord), YCWA reached agreement with DWR and USBR to sell a portion of the water it would be required to release, plus additional water made available by reoperation of YCWA's storage reservoirs and groundwater substitution. DWR entered into a purchase agreement with YCWA under which one-half of the water available for purchase would be available to SWP contractors that elected to participate in the purchase program.

Under this 25-year program, the price for water is set by the agreement between DWR and the YCWA. There are four categories of water sold, and the price for each type of water depends on hydrology.

#### *Expected Supply Capability*

Metropolitan's share of the water made available under the Yuba Accord Dry Year Purchase Program is approximately 25 percent. Should other participating contractors decline to purchase their respective shares, that water is allocated to the remaining interested participating contractors. Metropolitan's likely share of assured YCWA transfer water would be at least 13,750 AF in dry years and up to 35,000 AF or more in other years. These volumes are as provided by YCWA north-of-the-Delta and are subject to conveyance losses through the Delta to the Banks Pumping Plant (approximately 20 percent).

#### *Rationale for Expected Supply*

Historical Record

Actual volumes purchased by Metropolitan during the eight years of this program were as follows:

| Year | Purchased Volume (AF) |
|---|---|
| 2008 | 26,430 |
| 2009 | 42,915 |
| 2010 | 67,068 |
| 2011 | 0 |
| 2012 | 0 |
| 2013 | 14,548 |
| 2014 | 10,962 |
| 2015 | 8,192 |

Written Contracts or Other Proof

DWR-YCWA Purchase Agreement. This December 4, 2007, agreement provides the annual determination of the amount of water to be made available by YCWA and purchased by DWR. The agreement also specifies the costs of various categories of water to be made available under a variety of hydrologic conditions.

DWR-Metropolitan Participation Agreement. This December 21, 2007, agreement provides Metropolitan's election to purchase water made available by YCWA to DWR and the scheduling delivery of the purchased water. The agreement provides for mechanisms for Metropolitan payments to DWR that are due to YCWA under the DWR-YCWA Purchase Agreement.

Amended DWR-Metropolitan Participation Agreement. This December 5, 2014, amendment established prices for surface water transfer supplies between 2016 and 2020 and clarifies YCWA's rights to sell to third parties.

#### *Financing*

Funds for purchases of water from the Yuba Accord Dry Year Purchase Program are included in Metropolitan's O&M budget (referenced above).

#### *Federal, State, and Local Permits/Approvals*

SWRCB Order WR 2008-0014. Approval of YCWA's petition to modify revised Water Right Decision 1644 related to Water Right Permits 15026, 15027, and 15030 (Applications 5632, 15204, and 15574), and petition for long-term transfer of up to 200,000 AF of water per year from YCWA to the DWR and the USBR under Permit 15026 (Application 5632) - Lower Yuba River in Yuba County.

### A.3.3 In-Basin Storage and Supplies

#### *A. Surface Storage*

#### *Source of Supply*

Surface storage is a critical element of Southern California's water resources strategy. Because California experiences dramatic swings in weather and hydrology, surface storage is important to regulate those swings and mitigate possible supply shortages. Surface storage provides a means of storing water during normal and wet years for later use during dry years, when imported supplies are limited. Since the early twentieth century, DWR and Metropolitan have constructed surface water reservoirs to meet emergency, drought/seasonal, and regulatory water needs for Southern California. These reservoirs include Pyramid Lake, Castaic Lake, Elderberry Forebay, Silverwood Lake, Lake Perris, Lake Skinner, Lake Mathews, Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, Orange County Reservoir, and Metropolitan's DVL. Some reservoirs such as Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, and Orange County Reservoir, which have a total combined capacity of about 3,500 AF, are used solely for regulating purposes. The remaining surface reservoirs are primarily used to meet emergency, drought, and seasonal requirements. The total gross storage capacity for these larger remaining reservoirs is 1,768,100 AF. However, not all of the gross storage capacity is available to Metropolitan; dead storage and storage allocated to others reduce the amount of storage that is available to Metropolitan to 1,669,100 AF.

### *Expected Supply Capability*

Surface storage reservoirs are an important tool that allows Metropolitan to meet the water needs of its service area. As discussed in the EIR for the Eastside Reservoir (DVL) Project dated October 1991 and Metropolitan's IRP, the allocation of available surface storage can be divided into two primary components: emergency and drought/seasonal. As specified by Metropolitan's Board of Directors in the Final EIR for DVL, "Metropolitan shall maintain sufficient water reserves within its service area to supplement local production during an emergency or severe water shortage." With DVL in operation, Metropolitan can now re-operate the surface reservoirs and meet the Board's stated objectives.

Updated Emergency Storage Requirements: Metropolitan's criteria for determining emergency storage requirements, which were approved by Metropolitan's Board, were established in the Final EIR for DVL and further discussed in the IRP. Emergency Storage requirements are based on the potential for a major earthquake to damage the CRA, LAA, and both branches of the California Aqueduct that could force the aqueducts out of service for six months. During this period, a mandatory reduction in water use of 25 percent from normal-year demand levels would be instituted, water stored in surface reservoirs and groundwater basins under Metropolitan's interruptible program would be made available, and full local groundwater production would be sustained.

The storage reserved in system reservoirs for emergency purposes is shown in Table A.3-2.

Updated Storage Requirements for Dry-Year Supply and Seasonal Needs: Storage capacity in system reservoirs, including DVL, is also earmarked for dry-year supply and system regulation purposes. Dry-year supply storage within Metropolitan's service area is required to meet the additional water demands that occur during single-year and extended droughts. As specified in the Final EIR for DVL and further discussed in the IRP, this storage requirement is defined as the difference between average-year demand and above average demand during dry years. In addition to dry-year storage, seasonal storage is required to meet seasonal peak demands, which are defined as the difference between average winter demands and average summer demands. The dry-year supply and seasonal storage also provides sufficient reserves to permit approximately five percent downtime for rehabilitation, repair, and maintenance of raw water transmission facilities.

**Table A.3-2**
**Surface Storage Utilization**
(acre-feet per year)

| Forecast Year | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| **MWD Dry-Year/Seasonal Surface Storage** | | | | | |
| DVL, Mathews, Skinner | 720,000 | 720,000 | 720,000 | 720,000 | 720,000 |
| Flexible Storage in Castaic & Perris | 219,000 | 219,000 | 219,000 | 219,000 | 219,000 |
| ***Subtotal of Dry-Year/Seasonal Storage*** | ***939,000*** | ***939,000*** | ***939,000*** | ***939,000*** | ***939,000*** |
| **MWD Emergency Storage** | | | | | |
| DVL, Mathews, Skinner | 312,000 | 312,000 | 312,000 | 312,000 | 312,000 |
| Emergency Storage in DWR Reservoirs | 334,000 | 334,000 | 334,000 | 334,000 | 334,000 |
| ***Subtotal of Emergency Storage*** | ***646,000*** | ***646,000*** | ***646,000*** | ***646,000*** | ***646,000*** |
| **Total MWD Surface Storage** | **1,585,000** | **1,585,000** | **1,585,000** | **1,585,000** | **1,585,000** |

Historical Record

Metropolitan has a contract with the DWR that allows use of its terminal reservoirs, such as Castaic Lake on the West Branch and Lake Perris on the East Branch of the California Aqueduct (see Section A.3.3.B for a discussion of Metropolitan's contractual rights to storage in these DWR reservoirs). In addition, Metropolitan owns and operates surface reservoirs such as Lake Skinner, Lake Mathews, and DVL to enhance water supply reliability for its member agencies.

Written Contracts or Other Proof of Usage

The surface reservoirs used by Metropolitan are available either by contract (in the case of the DWR terminal reservoirs) or by construction of its own facilities. The following historical record is provided:

November 1960 Contract between the State of California Department of Water Resources and the Metropolitan Water District of Southern California for a Water Supply. This Contract and its numerous amendments describe Metropolitan's legal access to and obligations for the operation of the SWP for the benefit of its Contractors. Metropolitan has an entitlement to 1,911,500 AF of water each year subject to availability. The terms of this Contract describe Metropolitan's rights to and obligations for the terminal surface reservoirs for water supply purposes.

November 1974 Memorandum of Understanding and Agreement on Operation of Lake Skinner. This MOU and the January 2005 Amendment, signed by Metropolitan and other affected parties, govern Metropolitan's operations of Lake Skinner in Riverside County. The DWR Division of Safety and Dams also reviews monitoring data on the safety of the dam annually.

November 1994 Memorandum of Understanding on Operation of Domenigoni Valley Reservoir (now known as Diamond Valley Lake). This MOU, signed by Metropolitan and other affected parties, governs Metropolitan's operations of DVL in Riverside County. The DWR Division of Safety and Dams also reviews monitoring data on the safety of the dam annually.

Elderberry Forebay Contract for Conditions for Use. Conditions for use of storage are described in the contract between the DWR, State of California, and the Department of Water and Power, City of Los Angeles, for Cooperative Development, West Branch, California Aqueduct; Amendment No. 1, July 3, 1969; and Amendment No. 4, June 27, 1985.

June 2002 Division of Safety of Dams Certificate of Approval. The DWR, Division of Safety of Dams issued the Certificate of Approval for operation of DVL in early 2000, with three conditions. These conditions were: (1) Satisfactory operation of the butterfly valves and emergency gate in the inlet/outlet tower, (2) completion of the Tank Saddle Cutoff remediation, and (3) completion of the Signal Spillway. Metropolitan completed these conditions in 2001, and DVL is currently operational in accordance with the Certificate of Approval.

October 1991 Final EIR for the Eastside Reservoir Project (DVL). The EIR established criteria for integrating the operations of Metropolitan's reservoirs and DWR's southern reservoirs for emergency purposes. These criteria also provided that Metropolitan reservoirs could be expected to withdraw all drought storage water within a two-year period.

## B. Flexible Storage Use of Castaic Lake and Lake Perris

### Source of Storage

Metropolitan's flexible storage accounts in Castaic Lake and Lake Perris, which are SWP reservoirs, is 153,940 AF and 65,000 AF, respectively. These accounts provide Metropolitan with dry-year supply that is independent of the Table A allocation. Metropolitan can withdraw water from these reservoirs in addition to its allocated supply in any year on an as-needed basis. Withdrawn water must be replaced from supplies available to Metropolitan within five years of each withdrawal. This "flexible storage" is available in Castaic Lake to Metropolitan, Ventura County Flood Control and Water Conservation District, and to the Castaic Lake Water Agency. It is available in Lake Perris to Metropolitan only.

### Expected Supply Capability

The dry year supply available to Metropolitan from the flexible storage use of Castaic Lake and Lake Perris totals 218,940 AF, made up of 153,940 AF in Castaic Lake and 65,000 AF in Lake Perris. Table A.3-3 shows the use of this available supply in accordance with Metropolitan's operating criteria.

In 2005, seismic concerns arose regarding the Lake Perris Dam. In response, DWR plans to reduce the storage amount at Lake Perris by half until those concerns can be studied and addressed. In the long-term, the reduction in storage may potentially impact the amount of flexible storage available to Metropolitan from Lake Perris, and also impact the total amount of emergency storage available. However, since 2005, Metropolitan has continued to withdraw and replace water from the reservoir, which is operating at a lower level. In November 2011, DWR issued a Final EIR for the repair of the Dam. Construction began in August 2014 and is anticipated to continue through 2017.

**Table A.3-3**
**Estimated Water Supplies Available for Metropolitan's Use**
**Under the Flexible Storage Use of**
**Castaic Lake and Lake Perris ***
(TAF per year)

| Year | Multiple Dry-Years (1990-1992) | Single Dry Year (1997) |
|---|---|---|
| 2020 | 73 | 219 |
| 2025 | 73 | 219 |
| 2030 | 73 | 219 |
| 2035 | 73 | 219 |
| 2040 | 73 | 219 |

* Source: Metropolitan's operating criteria.

### *Rationale for Expected Supply*

Implementation Status
Express provisions related to flexible storage have been incorporated in Metropolitan's SWP contract since 1995. The operating options have been available for use since that time and will continue to be in effect indefinitely as a part of the SWP contracts.

Historical Record
Metropolitan has exercised the flexible storage provision on numerous occasions through and including calendar year 2014. Its use is based on existing contract provisions.

DWR Bulletin 132-94. The use of Castaic Lake and Lake Perris is determined in accordance with the proportionate use factors from Bulletin 132-94, Table B, upon which capital cost repayment obligations are based. Based on its capital repayment obligations, Metropolitan's proportionate use of Castaic Lake is 96.2 percent and of Lake Perris is 100 percent. Per its SWP contract, Metropolitan has express rights to use certain portions of the SWP southern reservoirs independently of DWR to supply water in amounts in addition to approved SWP deliveries.

Metropolitan's SWP Contract. Metropolitan's SWP contract was amended in 1995 to include Article 54, "Usage of Lakes Castaic and Perris." This article provides flexible storage to contractors participating in repayment of the capital costs of Castaic Lake and Lake Perris. Each contractor shall be permitted to withdraw up to a Maximum Allocation from Castaic Lake and Lake Perris. These contractors may withdraw a collective Maximum Allocation up to 160 TAF in Castaic Lake and 65 TAF in Lake Perris, which shall be apportioned among them pursuant to the respective proportionate use factors, as shown in Table A.3-4 below.

### *Financing*

The cost associated with the withdrawal and replacement of water in the flexible storage is included in Metropolitan's annual payments under the State Water Contract.

### *Federal, State, and Local Permits/Approvals*

The flexible storage provision became effective in 1995. DWR has the approval authority to affect changes in the operations and usage of existing SWP facilities, including Castaic Lake and Lake Perris.

**Table A.3-4**
**Flexible Storage Allocations**

| Participating Contractor | Proportionate Use Factor | Maximum Flexible Storage Allocation (AF) |
|---|---|---|
| Castaic Lake | | |
| Metropolitan | .96212388 | 153,940 |
| Ventura County Flood Control and Water Conservation District | .00860328 | 1,376 |
| Castaic Lake Water Agency | .02927284 | 4,684 |
| Total Castaic Lake | 1.00000000 | 160,000 |
| Lake Perris[1] | 1.00000000 | 65,000 |
| Metropolitan | | |

[1] The 2003 Exchange Agreement among Metropolitan, CVWD, and DWA, among other things, transferred to CVWD and DWA a portion of Metropolitan's capacity in the California Aqueduct and the East Branch including Lake Perris. However, Metropolitan's rights to the full 65,000 AF of Lake Perris flexible storage account was retained by Metropolitan.

## C. Metropolitan Surface Reservoirs

### Source of Supply

Storage capacity in Metropolitan reservoirs, including Lake Skinner, Lake Mathews, Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, Orange County Reservoir, and DVL, is earmarked to meet emergency, dry-year/seasonal, and system regulation needs, as these have been defined above.

### Expected Supply Capability

The total available storage capacity for all Metropolitan-controlled surface reservoirs (Metropolitan-owned and DWR terminal reservoirs) is 1,585,300 AF. As discussed earlier, approximately 650 TAF has been set aside to meet the emergency storage requirements of the service area. After accounting for emergency storage, the surface storage available in Metropolitan-owned reservoirs to meet dry-year/seasonal requirements is presented in Table A.3-5.

### Rationale for Expected Supply

Program Facilities

Major facilities for Lake Mathews include an earthen dam to impound water and a recently completed new outlet tower. Major facilities for Lake Skinner include an earthen dam to impound water, an outlet tower, an inlet from the San Diego Canal to deliver water into the reservoir, a water treatment filtration facility, and recreational facilities consisting of a marina, parks, swimming areas, golf course, and hiking trails. Major facilities at DVL include three earthen dams to impound water, an inlet/outlet tower, a secondary inlet from the Inland Feeder, a large pumping station to deliver water into the reservoir, and power generating facilities. Recreational facilities consisting of a marina, parks, swimming areas, golf course, hiking trails, equestrian trails, and lodging are planned.

Historical Record

The DVL has been operational for more than 15 years. Lake Mathews and Lake Skinner have been in service for over 30 years.

November 1974 Memorandum of Understanding and Agreement on Operation of Lake Skinner. This MOU and the January 2005 Amendment, signed by Metropolitan and other affected parties, govern Metropolitan's operations of Lake Skinner in Riverside County. The DWR Division of Safety and Dams also reviews monitoring data on the safety of the dam annually.

October 1991 Final EIR for the Eastside Reservoir Project (DVL). The EIR established criteria for integrating the operations of Metropolitan's reservoirs and DWR's southern reservoirs for emergency purposes. These criteria also provided that Metropolitan reservoirs could be expected to withdraw all drought storage water within a two-year period.

November 1994 Memorandum of Understanding on Operation of Domenigoni Valley Reservoir (now known as Diamond Valley Lake). This MOU, signed by Metropolitan and other affected parties, governs Metropolitan's operations of DVL in Riverside County. The DWR Division of Safety and Dams also reviews monitoring data on the safety of the dam annually.

June 2002 Division of Safety of Dams Certificate of Approval. The DWR, Division of Safety of Dams issued the Certificate of Approval for operation of DVL in early 2000, with three conditions. These conditions were: (1) satisfactory operation of the butterfly valves and emergency gate in the inlet/outlet tower, (2) completion of the Tank Saddle Cutoff remediation, and (3) completion of the Signal Spillway. Metropolitan completed these conditions in 2001, and DVL is currently operational in accordance with the Certificate of Approval.

**Table A.3-5**
**Estimated Supplies Available from Metropolitan's Surface Storage**
Program Capabilities
(acre-feet per year)

| Forecast Year | Multiple Dry Years (1990-92) | Single Dry Year (1977) |
|---|---|---|
| 2020 | 189,000 | 566,000 |
| 2025 | 211,000 | 634,000 |
| 2030 | 234,000 | 702,000 |
| 2035 | 262,000 | 788,000 |
| 2040 | 271,000 | 814,000 |

Source: Metropolitan analysis

### *Financing*

The capital cost of DVL, Lake Mathews, and Lake Skinner was financed by a combination of revenue bonds and operating revenues. Annual operating costs, including maintenance and pumping, are included in Metropolitan's annual O&M budget (referenced above).

### *Federal, State, and Local Permits/Approvals*

All necessary permits have been obtained. A permit to generate and sell power has been acquired from the Federal Energy Regulatory Commission. No further regulatory permits are required.

## D. Groundwater Conjunctive Use Programs

### Source of Supply

Metropolitan's IRP established the strategy to store imported water that is most available during wet years in surface reservoirs or groundwater aquifers for later use during droughts and emergencies. In this way, Metropolitan can reduce its reliance on direct deliveries from the SWP and the Colorado River during dry years when competing demands by other users and risks to the watershed ecosystems are greatest.

Groundwater basins in Metropolitan's service area have potential to store more than 4.0 MAF of additional water supplies following depletions that have occurred since 2008 due to continuing extreme dry weather. In 2000, the Association of Ground Water Agencies (AGWA) published "Groundwater and Surface Water in Southern California: A Guide to Conjunctive Use," which estimated a substantial potential for developing dry-year or long term conjunctive use within Metropolitan's service area. In 2007, Metropolitan published the Groundwater Assessment Study which estimated 3.2 MAF of space in groundwater basins available for storage. Based on these studies and recent updates, Metropolitan has implemented a conjunctive use program for imported water storage in groundwater basins within the service area. Additionally, the 2015 Update of the Integrated Water Resources Plan (2015 IRP Update) identified policies and strategies for ensuring sustainable groundwater production in light of a potential for extended multiple-year dry conditions.

### Rationale for Expected Supply

Implementation Status:

The status of implementation for the groundwater conjunctive use programs has been described in the body of this report.

Historical Record

The Main San Gabriel Cyclic Storage Agreements. The cyclic agreements allow supplemental imported water to be delivered to the basin in advance of requirement to support groundwater production. This added flexibility allows scheduling to balance imported water supply availability and delivery capacity with available local conveyance and spreading capacity.

The Cyclic Storage Agreement with Upper San Gabriel Valley MWD allows pre-delivery and storage of up to 100 TAF of imported water. The agreement was originally signed in 1975 for a term of five years and has been extended in five year increments through November 2018. The Cyclic Storage Agreement with Three Valleys MWD allows for pre-delivery and storage of up to 40 TAF. This agreement was originally signed in 1991 for a term of five years and has been extended in five year increments. This agreement is currently extended until November 2018. Both agreements are expected to be renewed repeatedly in the future.

Written Contracts or Other Proof

Metropolitan's dry-year supply from the groundwater conjunctive use programs is based on Metropolitan's Board actions and agreements.

Proposition 13 Groundwater Conjunctive Use Programs.

AGWA published "Groundwater and Surface Water in Southern California: A Guide to Conjunctive Use" in 2000 identifying the potential storage capacity for groundwater basins.

Metropolitan Water District published the Groundwater Assessment Study Report in 2007 in collaboration with its member agencies and groundwater basin managers documenting existing use and development of groundwater resources in Metropolitan's service area and estimating additional groundwater basin storage potential.

Principles for groundwater storage adopted by the Metropolitan Board in January 2000.

Resolution for Proposition 13 Funds adopted by the Metropolitan Board in October 2000.

Agreement executed with the DWR for Interim Water Supply Construction Grant Commitment Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection (Proposition 13, Chapter 9, Article 4) providing for Metropolitan to administer $45 million in state Proposition 13 grant funds for groundwater reliability programs; October 2000

Agreement executed for Long Beach Conjunctive Use Project, July 2002

Agreement executed for Live Oak Conjunctive Use Project, October 2002

Agreement executed for Foothill Area Groundwater Storage Project, February 2003

Agreement executed for Chino Basin Programs, June 2003

Agreement executed for Orange County Groundwater Storage Program, June 2003

Agreement executed for Compton Conjunctive Use Program, February 2005

Agreement executed for Long Beach Conjunctive Use Project — Expansion in Lakewood, July 2005

Agreement executed for Upper Claremont Basin Groundwater Storage Program, September 2005

Agreement executed for Elsinore Basin Conjunctive Use Program, May 2008

All of these programs have an initial 25-year term, with provision for renewal or extension after that period.

### *Financing*

Financing has been supplied from multiple sources as discussed below:

Financing from Proposition 13 and Additional Groundwater Storage Programs.

Proposition 13 funds ($45 million) were allocated to Metropolitan by the state in May 2000 for the development of local groundwater storage projects.

Metropolitan has executed groundwater storage funding agreements for nine storage programs, expended $45 million of the Proposition 13 funds, and appropriated over $35 million of Metropolitan capital funds for the storage programs in the Orange County and Chino groundwater basins. All nine storage programs have completed facilities and are on-line. Metropolitan has called for production of stored water beginning in 2007.

Table A.3-6 provides details on groundwater storage programs.

### *Federal, State, and Local Permits/Approvals*

Long Beach Conjunctive-use Storage Project. Environmental documentation for the Long Beach Conjunctive-use Storage Project was certified by the City of Long Beach in August 2001.

Live Oak Basin Conjunctive-use Storage Project. Environmental documentation for the Live Oak Basin Conjunctive-use Storage Project was certified by Three Valleys MWD in January 2002.

Foothill Area Groundwater Storage Project. Environmental documentation for the Foothill Area Groundwater Storage Project was certified by Foothill Municipal Water District in January 2003.

Chino Basin Programs Groundwater Storage Project. Environmental documentation for the Chino Basin Programs Groundwater Storage Project was certified by Inland Empire Utility Agency in December 2002.

Long Beach Conjunctive Use Storage Project — Expansion in Lakewood. Environmental documentation for the project was certified by the City of Lakewood in May 2005.

City of Compton Conjunctive Use Program. Environmental documentation for the project was certified by the City of Compton in December 2004.

Orange County Groundwater Conjunctive Use Program. Environmental documentation for the project was certified by Orange County Water District in March 1999 and in July 2002.

Upper Claremont Basin Groundwater Storage Program. Environmental documentation for the project was certified by Three Valleys MWD in July 2005.

Elsinore Basin Conjunctive Use Program. Environmental documentation for the project was certified by Elsinore Valley MWD in February 2004.

### *E. Program under Development*

Regional Recycled Water Supply Program: Metropolitan is exploring the potential development of a regional recycled water program in partnership with the Sanitation Districts of Los Angeles County. This program would purify and reuse water for the recharge of groundwater basins and augment water supplies within the Southern California region.

### *F. IRP Development Targets*

Colorado River: The 2015 IRP Update calls for developing sufficient base supply programs to ensure that a minimum of 900 TAF of diversions are available when needed and to ensure access to 1.2 MAF of supplies in dry years through flexible programs and storage. This will require an approach that maintains existing base supply availability, minimizes reductions in base supplies from risks and challenges, and augments base supply amounts to increase resilience to any reductions that may occur.

State Water Project: The 2015 IRP Update goal for SWP supplies is to adaptively manage flow and export regulations in the near term and to achieve a long-term Delta solution that addresses ecosystem and water reliability challenges. The goal for SWP supplies in the 2015 IRP Update is an average of 984 TAF of SWP supplies in the near-term and 1.2 MAF on average starting in 2030 when a long-term Delta solution is estimated to be in place. The increase in supply due to Delta improvements is reflected in Table A.3-7 as a program under development for the California Aqueduct.

Conservation and Local Supplies: The 2015 IRP Update identifies that approximately 200 TAF of new local supply and water conservation is needed, in conjunction with stabilizing, protecting, and restoring the region's imported supplies. The approach for water conservation is targeting water-use reductions through aggressive implementation of the state's Model Water Efficient Landscape Ordinance standards. The water conservation approach, if successful, will result in approximately 180 TAF of new water conservation savings. The approach for local supplies is to develop the remaining 20 TAF of additional need through recycling, groundwater recovery, and seawater desalination. These 2015 IRP Update development targets are reflected in Table A.3-7 as programs under development for In-Region Storage and Programs.

**Table A.3-6**
**Metropolitan's In-Region Groundwater Storage Programs**

| Program | Metropolitan Agreement Partners | Program Term | Max Storage AF | Dry-Year Yield AF/Yr |
|---|---|---|---|---|
| Long Beach Conjunctive Use Storage Project (Central Basin) | Long Beach | June 2002-2027 | 13,000 | 4,300 |
| Foothill Area Groundwater Storage Program (Monkhill/ Raymond Basin) | Foothill MWD | February 2003-2028 | 9,000 | 3,000 |
| Orange County Groundwater Conjunctive Use Program | MWDOC<br>OCWD | June 2003-2028 | 66,000+ | 22,000 |
| Chino Basin Conjunctive Use Programs | IEUA<br>TVMWD<br>Watermaster | June 2003-2028 | 100,000 | 33,000 |
| Live Oak Basin Conjunctive Use Project (Six Basins) | TVMWD<br>City of La Verne | October 2002-2027 | 3,000 | 1,000 |
| City of Compton Conjunctive Use Project (Central Basin) | Compton | February 2005-2030 | 2,289 | 763 |
| Long Beach Conjunctive Use Program Expansion in Lakewood (Central Basin) | Long Beach | July 2005-2030 | 3,600 | 1,200 |
| Upper Claremont Basin Groundwater Storage Program (Six Basins) | TVMWD | Sept. 2005- 2030 | 3,000 | 1,000 |
| Elsinore Basin Conjunctive Use Storage Program | Western MWD<br>Elsinore Valley MWD | May 2008- 2033 | 12,000 | 4,000 |
| **TOTAL** | | | **211,889** | **70,263** |

**Table A.3-7**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2020**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 0 | 0 | 17,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 8,000 | 8,000 | 8,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (37,000) | (26,000) | (99,000) |
| DWCV SWP Table A Transfer Callback | 19,000 | 13,000 | 51,000 |
| DWCV Advance Delivery Account | 18,000 | 13,000 | 48,000 |
| SNWA Agreement Payback | 0 | 0 | 0 |
| ***Subtotal of Current Programs*** | ***1,144,000*** | ***1,160,000*** | ***1,177,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 75,000 | 150,000 | 0 |
| Additional Fallowing Programs | 5,000 | 5,000 | 5,000 |
| ***Subtotal of Proposed Programs*** | ***80,000*** | ***155,000*** | ***5,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 161,000 | 193,000 | 193,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***259,000*** | ***291,000*** | ***291,000*** |
| **Maximum CRA Supply Capability[2]** | **1,483,000** | **1,606,000** | **1,473,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(233,000)* | *(356,000)* | *(223,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(259,000)* | *(291,000)* | *(291,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **941,000** | **909,000** | **909,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties.
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The CRA delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All-American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

**Table A.3-7**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2025**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 250,000 | 0 | 31,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 7,000 | 7,000 | 7,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (37,000) | (26,000) | (99,000) |
| DWCV SWP Table A Transfer Callback | 19,000 | 13,000 | 51,000 |
| DWCV Advance Delivery Account | 18,000 | 13,000 | 48,000 |
| SNWA Agreement Payback | 0 | 0 | 0 |
| ***Subtotal of Current Programs*** | ***1,393,000*** | ***1,159,000*** | ***1,190,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 50,000 | 100,000 | 0 |
| Additional Fallowing Programs | 25,000 | 25,000 | 25,000 |
| ***Subtotal of Proposed Programs*** | ***75,000*** | ***125,000*** | ***25,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 200,000 | 200,000 | 200,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***298,000*** | ***298,000*** | ***298,000*** |
| **Maximum CRA Supply Capability[2]** | **1,766,000** | **1,582,000** | **1,513,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(516,000)* | *(332,000)* | *(263,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(298,000)* | *(298,000)* | *(298,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **902,000** | **902,000** | **902,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties.
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The CRA delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All-American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

**Table A.3-7**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2030**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 250,000 | 0 | 28,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 6,000 | 6,000 | 6,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (45,000) | (42,000) | (118,000) |
| DWCV SWP Table A Transfer Callback | 23,000 | 22,000 | 61,000 |
| DWCV Advance Delivery Account | 22,000 | 20,000 | 57,000 |
| SNWA Agreement Payback | 0 | 0 | 0 |
| ***Subtotal of Current Programs*** | ***1,392,000*** | ***1,158,000*** | ***1,186,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 25,000 | 50,000 | 0 |
| Additional Fallowing Programs | 25,000 | 25,000 | 25,000 |
| ***Subtotal of Proposed Programs*** | ***50,000*** | ***75,000*** | ***25,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 200,000 | 200,000 | 200,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***298,000*** | ***298,000*** | ***298,000*** |
| **Maximum CRA Supply Capability[2]** | **1,740,000** | **1,531,000** | **1,509,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(490,000)* | *(281,000)* | *(259,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(298,000)* | *(298,000)* | *(298,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **902,000** | **902,000** | **902,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties.
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The CRA delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All-American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

**Table A.3-7**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 250,000 | 0 | 21,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 5,000 | 5,000 | 5,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (45,000) | (42,000) | (118,000) |
| DWCV SWP Table A Transfer Callback | 23,000 | 22,000 | 61,000 |
| DWCV Advance Delivery Account | 22,000 | 20,000 | 57,000 |
| SNWA Agreement Payback | 0 | 0 | (5,000) |
| ***Subtotal of Current Programs*** | ***1,391,000*** | ***1,157,000*** | ***1,173,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 0 | 0 | 0 |
| Additional Fallowing Programs | 25,000 | 25,000 | 25,000 |
| ***Subtotal of Proposed Programs*** | ***25,000*** | ***25,000*** | ***25,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 200,000 | 200,000 | 200,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***298,000*** | ***298,000*** | ***298,000*** |
| **Maximum CRA Supply Capability[2]** | **1,714,000** | **1,480,000** | **1,496,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(464,000)* | *(230,000)* | *(246,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(298,000)* | *(298,000)* | *(298,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **902,000** | **902,000** | **902,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties.
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The CRA delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All-American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

**Table A.3-7**
**Colorado River Aqueduct**
**Program Capabilities**
**Year 2040**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Basic Apportionment – Priority 4 | 550,000 | 550,000 | 550,000 |
| IID/MWD Conservation Program | 85,000 | 85,000 | 85,000 |
| Priority 5 Apportionment (Surplus) | 167,000 | 0 | 16,000 |
| PVID Land Management, Crop Rotation, and Water Supply Program | 130,000 | 130,000 | 130,000 |
| Lower Colorado Water Supply Project | 4,000 | 4,000 | 4,000 |
| Lake Mead ICS Storage Program | 400,000 | 400,000 | 400,000 |
| Binational ICS | 8,000 | 24,000 | 24,000 |
| Forbearance for Present Perfected Rights | (2,000) | (2,000) | (2,000) |
| CVWD SWP/QSA Transfer Obligation | (35,000) | (35,000) | (35,000) |
| DWCV SWP Table A Obligation | (45,000) | (42,000) | (118,000) |
| DWCV SWP Table A Transfer Callback | 23,000 | 22,000 | 61,000 |
| DWCV Advance Delivery Account | 22,000 | 20,000 | 57,000 |
| SNWA Agreement Payback | 0 | 0 | (10,000) |
| ***Subtotal of Current Programs*** | ***1,307,000*** | ***1,156,000*** | ***1,162,000*** |
| **Programs Under Development** | | | |
| SNWA Interstate Banking Agreement | 0 | 0 | 0 |
| Additional Fallowing Programs | 25,000 | 25,000 | 25,000 |
| ***Subtotal of Proposed Programs*** | ***25,000*** | ***25,000*** | ***25,000*** |
| **Additional Non-Metropolitan CRA Supplies** | | | |
| SDCWA/IID Transfer | 200,000 | 200,000 | 200,000 |
| Coachella & All-American Canal Lining | | | |
| To SDCWA | 82,000 | 82,000 | 82,000 |
| To San Luis Rey Settlement Parties[1] | 16,000 | 16,000 | 16,000 |
| ***Subtotal of Non-Metropolitan Supplies*** | ***298,000*** | ***298,000*** | ***298,000*** |
| **Maximum CRA Supply Capability[2]** | **1,630,000** | **1,479,000** | **1,485,000** |
| *Less CRA Capacity Constraint (amount above 1.20 MAF)* | *(380,000)* | *(229,000)* | *(235,000)* |
| **Maximum Expected CRA Deliveries[3]** | **1,200,000** | **1,200,000** | **1,200,000** |
| *Less Non-Metropolitan Supplies[4]* | *(298,000)* | *(298,000)* | *(298,000)* |
| **Maximum Metropolitan Supply Capability[5]** | **902,000** | **902,000** | **902,000** |

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties.
[2] Total amount of supplies available without taking into consideration CRA capacity constraint.
[3] The CRA delivery capacity is 1.20 MAF annually.
[4] Exchange obligation for the SDCWA-IID transfer and exchange and the Coachella and All-American Canal Lining projects.
[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.
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**Table A.3-7**
**California Aqueduct**
**Program Capabilities**
**Year 2020**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 57,000 | 172,000 | 172,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| San Bernardino Valley MWD Minimum Purchase | 0 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 11,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Yuba River Accord Purchase | 12,000 | 14,000 | 8,000 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 48,000 | 45,000 | 65,000 |
| Arvin Edison Program | 49,000 | 75,000 | 75,000 |
| Mojave Program | 0 | 0 | 19,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***664,000*** | ***691,000*** | ***1,555,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 0 | 0 | 0 |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***7,000*** | ***20,000*** | ***20,000*** |
| **Maximum Supply Capability** | **671,000** | **711,000** | **1,575,000** |

[1] Includes DWCV carryover.

**Table A.3-7**
**California Aqueduct**
**Program Capabilities**
**Year 2025**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 64,000 | 193,000 | 193,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| San Bernardino Valley MWD Minimum Purchase | 0 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 11,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Yuba River Accord Purchase | 12,000 | 14,000 | 8,000 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 48,000 | 45,000 | 65,000 |
| Arvin Edison Program | 60,000 | 75,000 | 75,000 |
| Mojave Storage Program | 0 | 0 | 19,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***682,000*** | ***712,000*** | ***1,576,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 0 | 0 | 0 |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***7,000*** | ***20,000*** | ***20,000*** |
| **Maximum Supply Capability** | **689,000** | **732,000** | **1,596,000** |

[1] Includes DWCV carryover.

**Table A.3-7**
**California Aqueduct**
**Program Capabilities**
**Year 2030**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 71,000 | 214,000 | 214,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| San Bernardino Valley MWD Minimum Purchase | 3,000 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 16,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Yuba River Accord Purchase | 0 | 0 | 0 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 50,000 | 49,000 | 70,000 |
| Arvin Edison Program | 63,000 | 75,000 | 75,000 |
| Mojave Storage Program | 2,000 | 0 | 26,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***687,000*** | ***723,000*** | ***1,606,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 87,000 | 178,000 | 248,000 |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***94,000*** | ***198,000*** | ***268,000*** |
| **Maximum Supply Capability** | **781,000** | **921,000** | **1,874,000** |

[1] Includes DWCV carryover.

**Table A.3-7**
**California Aqueduct**
**Program Capabilities**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 80,000 | 240,000 | 240,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| San Bernardino Valley MWD Minimum Purchase | 3,000 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 16,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Yuba River Accord Purchase | 0 | 0 | 0 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 50,000 | 49,000 | 70,000 |
| Arvin Edison Program | 63,000 | 75,000 | 75,000 |
| Mojave Storage Program | 2,000 | 0 | 26,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***696,000*** | ***749,000*** | ***1,632,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 87,000 | 178,000 | 248,000 |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***94,000*** | ***198,000*** | ***268,000*** |
| **Maximum Supply Capability** | **790,000** | **947,000** | **1,900,000** |

[1] Includes DWCV carryover.

**Table A.3-7**
**California Aqueduct**
**Program Capabilities**
**Year 2040**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| MWD Table A | 362,000 | 257,000 | 976,000 |
| DWCV Table A | 37,000 | 26,000 | 99,000 |
| San Luis Carryover [1] | 80,000 | 240,000 | 240,000 |
| Article 21 Supplies | 0 | 0 | 8,000 |
| San Bernardino Valley MWD Minimum Purchase | 3,000 | 0 | 20,000 |
| San Bernardino Valley MWD Option Purchase | 0 | 0 | 16,000 |
| San Gabriel Valley MWD Exchange and Purchase | 2,000 | 2,000 | 2,000 |
| Yuba River Accord Purchase | 0 | 0 | 0 |
| Central Valley Storage and Transfers | | | |
| Semitropic Program | 50,000 | 49,000 | 70,000 |
| Arvin Edison Program | 63,000 | 75,000 | 75,000 |
| Mojave Storage Program | 2,000 | 0 | 26,000 |
| Kern Delta Program | 47,000 | 50,000 | 50,000 |
| Transfers and Exchanges | 50,000 | 50,000 | 50,000 |
| ***Subtotal of Current Programs*** | ***696,000*** | ***749,000*** | ***1,632,000*** |
| **Programs Under Development** | | | |
| Delta Improvements | 87,000 | 178,000 | 248,000 |
| Antelope Valley/East Kern Acquisition and Storage | 7,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***94,000*** | ***198,000*** | ***268,000*** |
| **Maximum Supply Capability** | **790,000** | **947,000** | **1,900,000** |

[1] Includes DWCV carryover.

**Table A.3-7**
**In-Region Storage and Programs**
**Program Capabilities**
**Year 2020**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Metropolitan Surface Storage | | | |
| (DVL, Mathews, Skinner) | 145,000 | 434,000 | 434,000 |
| Flexible Storage in Castaic & Perris | 44,000 | 132,000 | 132,000 |
| Groundwater Storage | | | |
| Conjunctive Use | 30,000 | 68,000 | 68,000 |
| Cyclic Storage | 20,000 | 59,000 | 59,000 |
| ***Subtotal of Current Programs*** | ***239,000*** | ***693,000*** | ***693,000*** |
| **Programs Under Development** | | | |
| IRP Development Targets | | | |
| Conservation | 33,000 | 40,000 | 40,000 |
| Local Resources | 3,000 | 3,000 | 3,000 |
| ***Subtotal of Proposed Programs*** | ***36,000*** | ***43,000*** | ***43,000*** |
| **Maximum Supply Capability** | **275,000** | **736,000** | **736,000** |

**Table A.3-7**
**In-Region Storage and Programs**
**Program Capabilities**
**Year 2025**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Metropolitan Surface Storage | | | |
| (DVL, Mathews, Skinner) | 162,000 | 486,000 | 486,000 |
| Flexible Storage in Castaic & Perris | 49,000 | 148,000 | 148,000 |
| Groundwater Storage | | | |
| Conjunctive Use | 37,000 | 68,000 | 68,000 |
| Cyclic Storage | 24,000 | 72,000 | 72,000 |
| ***Subtotal of Current Programs*** | ***272,000*** | ***774,000*** | ***774,000*** |
| **Programs Under Development** | | | |
| IRP Development Targets | | | |
| Conservation | 66,000 | 72,000 | 72,000 |
| Local Resources | 7,000 | 8,000 | 8,000 |
| ***Subtotal of Proposed Programs*** | ***73,000*** | ***80,000*** | ***80,000*** |
| **Maximum Supply Capability** | **345,000** | **854,000** | **854,000** |

**Table A.3-7**
**In-Region Storage and Programs**
**Program Capabilities**
**Year 2030**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Metropolitan Surface Storage | | | |
| (DVL, Mathews, Skinner) | 179,000 | 538,000 | 538,000 |
| Flexible Storage in Castaic & Perris | 55,000 | 164,000 | 164,000 |
| Groundwater Storage | | | |
| Conjunctive Use | 42,000 | 68,000 | 68,000 |
| Cyclic Storage | 27,000 | 82,000 | 82,000 |
| ***Subtotal of Current Programs*** | ***303,000*** | ***852,000*** | ***852,000*** |
| **Programs Under Development** | | | |
| IRP Development Targets | | | |
| Conservation | 99,000 | 106,000 | 106,000 |
| Local Resources | 11,000 | 12,000 | 12,000 |
| ***Subtotal of Proposed Programs*** | ***110,000*** | ***118,000*** | ***118,000*** |
| **Maximum Supply Capability** | **413,000** | **970,000** | **970,000** |

**Table A.3-7**
**In-Region Storage and Programs**
**Program Capabilities**
**Year 2035**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Metropolitan Surface Storage | | | |
| (DVL, Mathews, Skinner) | 201,000 | 604,000 | 604,000 |
| Flexible Storage in Castaic & Perris | 61,000 | 184,000 | 184,000 |
| Groundwater Storage | | | |
| Conjunctive Use | 51,000 | 68,000 | 68,000 |
| Cyclic Storage | 33,000 | 100,000 | 100,000 |
| ***Subtotal of Current Programs*** | ***346,000*** | ***956,000*** | ***956,000*** |
| **Programs Under Development** | | | |
| IRP Development Targets | | | |
| Conservation | 136,000 | 144,000 | 144,000 |
| Local Resources | 15,000 | 16,000 | 16,000 |
| ***Subtotal of Proposed Programs*** | ***151,000*** | ***160,000*** | ***160,000*** |
| **Maximum Supply Capability** | **497,000** | **1,116,000** | **1,116,000** |

**Table A.3-7**
**In-Region Storage and Programs**
**Program Capabilities**
**Year 2040**
(acre-feet per year)

| Hydrology | Multiple Dry Years (1990-92) | Single Dry Year (1977) | Average Year (1922-2012) |
|---|---|---|---|
| **Current Programs** | | | |
| Metropolitan Surface Storage (DVL, Mathews, Skinner) | 208,000 | 624,000 | 624,000 |
| Flexible Storage in Castaic & Perris | 63,000 | 190,000 | 190,000 |
| Groundwater Storage | | | |
| Conjunctive Use | 56,000 | 68,000 | 68,000 |
| Cyclic Storage | 37,000 | 110,000 | 110,000 |
| ***Subtotal of Current Programs*** | ***364,000*** | ***992,000*** | ***992,000*** |
| **Programs Under Development** | | | |
| IRP Development Targets | | | |
| Conservation | 173,000 | 180,000 | 180,000 |
| Local Resources | 19,000 | 20,000 | 20,000 |
| ***Subtotal of Proposed Programs*** | ***192,000*** | ***200,000*** | ***200,000*** |
| **Maximum Supply Capability** | **556,000** | **1,192,000** | **1,192,000** |

# Appendix 4

## WATER SUPPLY ALLOCATION PLAN

**December 2014**

# Water Supply Allocation Plan



## December 2014 Revision

Metropolitan Water District of Southern California

Inside cover: Photo courtesy of Cora Edmonds/ArtXchange for the Healing Planet

# Water Supply Allocation Plan

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## List of Acronyms

AF – Acre-feet
CUP – Groundwater Conjunctive Use Program
CWD – County Water District
DWP – Drought Management Plan
IAWP – Interim Agricultural Water Program Reductions and Rates
IICP – Incremental Interruption and Conservation Plan
IRP – Integrated Resources Plan
GPCD – Gallons per Capita per Day
M&I – Municipal and Industrial
MWD – Municipal Water District
RUWMP – Regional Urban Water Management Plan
SWP – State Water Project
WSAP – Water Supply Allocation Plan
WSDM – Water Surplus and Drought Management

## Definitions

**Extraordinary Supplies**- Deliberate actions taken by member agencies to augment the total regional water supply only when Metropolitan is allocating supplies through the WSAP.

**Groundwater Recovery**- The extraction and treatment of groundwater making it usable for a variety of applications by removing high levels of chemicals and/or salts.

**In-lieu deliveries**- Metropolitan-supplied water bought to replace water that would otherwise be pumped from the groundwater basins.

**Seawater Barrier**- The injection of fresh water into wells along the coast to protect coastal groundwater basins from seawater intrusion. The injected fresh water acts like a wall, blocking seawater that would otherwise seep into groundwater basins as a result of pumping.

## Section 1: Introduction

Calendar Year 2007 introduced a number of water supply challenges for the Metropolitan Water District of Southern California (Metropolitan) and its service area. Critically dry conditions affected all of Metropolitan's main supply sources. In addition, a ruling in the Federal Courts in August 2007 provided protective measures for the Delta Smelt in the Sacramento-San Joaquin River Delta which brought uncertainty about future pumping operations from the State Water Project. This uncertainty, along with the impacts of dry conditions, raised the possibility that Metropolitan would not have access to the supplies necessary to meet total firm demands[1] and would have to allocate shortages in supplies to the member agencies.[2]

In preparing for this possibility, Metropolitan staff worked jointly with the member agency managers and staff to develop a Water Supply Allocation Plan (WSAP). The WSAP includes the specific formulas for calculating member agency supply allocations and the key implementation elements needed for administering an allocation should a shortage be declared. The WSAP became the foundation for the urban water shortage contingency analysis required under Water Code Section 10632 and was incorporated into Metropolitan's 2010 Regional Urban Water Management Plan (RUWMP).

## Section 2: Development Process

### Member Agency Input

Between July 2007 and February 2008, Metropolitan staff worked cooperatively with the member agencies through a series of member agency manager meetings and workgroups to develop a formula and implementation plan to allocate supplies in case of shortage. These workgroups provided an arena for in-depth discussion of the objectives, mechanics, and policy aspects of the different parts of the WSAP. Metropolitan staff also met individually with fifteen member agencies for detailed discussions of the elements of the recommended proposal. Metropolitan introduced the elements of the proposal to many nonmember retail agencies in its service area by providing presentations and feedback to a number of member agency caucuses, working groups, and governing boards. The discussions, suggestions, and comments expressed by the member agencies during this process contributed significantly to the development of this WSAP.

### Board of Directors Input

Throughout the development process Metropolitan's Board of Directors was provided with regular progress reports on the status of this WSAP, with oral reports in September, October, and December 2007, an Information Board of Directors Letter with a draft of the WSAP in November 2007, and a Board of Directors Report with staff recommendations in January 2008. Based on Water Planning and Stewardship Committee discussion of the staff recommendations and further review of the report by

[1] Firm demands are also referred to as uninterruptable demands; likewise non-firm demands are also called interruptible demands.

[2] See Appendix A: Metropolitan Member Agencies.

the member agencies, refinements were incorporated into the WSAP for final consideration and action in February 2008. The WSAP was adopted at the February 12, 2008 Board of Directors meeting.[3]

## The 12-Month Review Process

When the Board adopted the WSAP in February 2008, the decision specified a formal revisit of the WSAP commencing in February 2010. The scheduled revisit was meant to ensure the opportunity for Metropolitan staff and the member agencies to re-evaluate the WSAP and recommend appropriate changes to the Board of Directors.

In April 2009, the Board voted to implement the WSAP for the first time. The WSAP was implemented at a Level 2 allocation level, and was in effect for the period of July 1, 2009, through June 30, 2010. Since implementation of the 2009/10 WSAP began in July 2009, a number of practical issues relating to the WSAP were identified by staff and the member agencies for further consideration during the 12-Month Review Process. Metropolitan staff engaged with the member agencies in a formal review of the WSAP from January through May 2010. During the review process the member agency managers participated in a series of six workshops. The focus of these workshops was to facilitate in-depth discussion on WSAP-related issues and lessons learned since the WSAP was implemented in July 2009. The proposed adjustments to the WSAP developed during the review process were adopted at the August 17, 2010 Board of Directors meeting[4].

## The Three-Year Review Process

The Board action to adopt of the WSAP in February 2008 also directed staff to review the WSAP formula three years after the February 2008 adoption. February 2011 marked the three-year anniversary since the adoption of the WSAP. Similar to the 12-Month Review Process, the purpose of the Three-Year Review Process was to provide an opportunity for Metropolitan staff and the member agencies to re-evaluate the plan and recommend appropriate changes for board consideration.

Metropolitan staff met with the member agencies in a formal review of the WSAP from February through August 2011. Staff and member agency managers participated in a series of eleven workshops. Proposed adjustments to the WSAP developed during the process were adopted at the September 13, 2011 Board of Directors meeting.[5]

[3] A complete listing of member agency meetings and Board of Directors reporting activities is contained in Appendix B: Water Supply Allocation Plan Process Timeline.

[4] A complete listing of member agency meetings and Board of Directors reporting activities is contained in Appendix C: 12-Month Review Process and Results.

[5] A complete listing of member agency meetings and Board of Directors reporting activities is contained in Appendix D: Three-Year Review Process and Results.

## 2014 Review Process

In 2014, California was challenged with a third year of severe drought.[6] Metropolitan managed its operations through significant use of regional storage reserves. It was anticipated that end of year total dry storage reserves would approach levels similar to those when the WSAP was last implemented in 2009.

Following discussion at the June 2014 Water Planning and Stewardship Committee, Metropolitan staff convened a member agency working group to revisit the WSAP. The purpose of the working group was to collaborate with member agencies to identify potential revisions to the WSAP in preparation for mandatory supply allocations in 2015. There were eight working group meetings and three discussions at the monthly Member Agency Managers' Meetings.

The process focused on three areas of the WSAP: the Base Period, the Allocation Formula, and the Allocation enforcement mechanism. Proposed adjustments to the WSAP developed during the process were adopted at the December 9, 2014 Board of Directors meeting. [7]

[6] The Governor of California proclaimed a State of Emergency due to drought conditions on January 17, 2014 and, on April 24, 2014 issued an Executive Order proclaiming a continued State of Emergency noting drought conditions have persisted for the last three years and authorizing adoption and implementation of emergency regulations.

[7] A complete listing of member agency meetings and Board of Directors reporting activities is contained in Appendix E: 2014 Review Process and Results.

## Section 3: Review of Historical Shortage Plans[8]

The WSAP incorporates key features and principles from the following historical shortage allocation plans but will supersede them as the primary and overarching decision tool for water shortage allocation.

### Interruptible Water Service Program

As part of the new rate structure implemented in 1981, Metropolitan's Board of Directors adopted the Interruptible Water Service Program (Interruptible Program) which was designed to address short-term shortages of imported supplies. Under the Interruptible Program, Metropolitan delivered water for particular types of use to its member agencies at a discounted rate. In return for this discounted rate, Metropolitan reserved the right to interrupt delivery of this Interruptible Program water so that available supplies could be used to meet municipal and industrial demands.

### Incremental Interruption and Conservation Plan

The ability to interrupt specific deliveries was an important element of Metropolitan's strategy for addressing shortage conditions when it adopted the Incremental Interruption and Conservation Plan (IICP) in December 1990. Reductions in IICP deliveries were used in concert with specific objectives for conservation savings to meet needs during shortages. The IICP reduced Interruptible Service deliveries in stages and provided a pricing incentive program to insure that reasonable conservation measures were implemented.

### 1995 Drought Management Plan

The 1995 Drought Management Plan (DMP) was a water management and allocation strategy designed to match supply and demand in the event that available imported water supplies were less than projected demands. Adopted by the Metropolitan Board of Directors in November 1994, the 1995 DMP was a short-term plan designed to provide for the 1995 calendar year only. The primary objective of the 1995 DMP was to identify methods to avoid implementation of mandatory reductions. The 1995 DMP included various phases and a step-by-step strategy for evaluating supply and demand conditions and utilizing Metropolitan's available options, with the final phase being implementation of the revised IICP.

### 1999 Water Surplus and Drought Management Plan

Metropolitan staff began work on the Water Surplus and Drought Management (WSDM) Plan in March 1997 as part of the Integrated Water Resources Plan (IRP), which was adopted by Metropolitan's Board of Directors in January 1996. The IRP established regional water resource targets, identifying the need for developing resource management policy to guide annual operations. The WSDM Plan defined Metropolitan's resource management policy by establishing priorities for the use of regional resources to achieve the region's reliability goal identified in the IRP. In April 1999, Metropolitan's Board of Directors adopted the WSDM Plan.

[8] A summary of the key elements in the following allocation plan is found in Appendix F: Summary of Historical Shortage Plans.

The WSDM Plan also included a set of principles and considerations for staff to address when developing specific allocation methods. The WSDM Plan stated the following guiding principle to be followed in developing any future allocation scheme:

> *"Metropolitan will encourage storage of water during periods of surplus and work jointly with its member agencies to minimize the impacts of water shortages on the region's retail consumers and economy during periods of shortage."*[9]

This principle reflects a central desire for allocation methods that are both equitable and minimize regional hardship to retail water consumers. The specific considerations postulated by the WSDM Plan to accomplish this principle include the following:[10]

- The impact on retail customers and the economy
- Allowance for population and growth
- Change and/or loss of local supply
- Reclamation/Recycling
- Conservation
- Investment in local resources
- Participation in Metropolitan's interruptible programs
- Investment in Metropolitan's facilities.

## Section 4: Water Supply Allocation Formula

Based on the guiding principle and considerations described in the WSDM Plan, Metropolitan staff and the member agencies developed a specific formula for allocating water supplies in times of shortage. The formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level, and takes into account growth, local investments, changes in supply conditions and the demand hardening[11] aspects of non-potable recycled water use and the implementation of conservation savings programs. The formula, described below, is calculated in three steps: base period calculations, allocation year calculations, and supply allocation calculations.[12] The first two steps involve standard computations, while the third section contains specific methodology developed for this WSAP.

### Base Period Calculations

The first step in calculating a water supply allocation is to estimate water supply and demand using a historical base period with established water supply and delivery data. The base period for each of the different categories of demand and supply is calculated using data from the fiscal years (July through June) ending 2013 and 2014.[13]

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[9] WSDM Plan, p. 1. Emphasis added.
[10] WSDM Plan, p. 2.
[11] Demand hardening is the effect that occurs when all low-cost methods of decreasing overall water demand have been applied (e.g., low-flow toilets, water recycling) and the remaining options to further decrease demand become increasingly expensive and difficult to implement.
[12] Detailed operational elements of these objectives and a numerical example are discussed in Appendix G: Water Supply Allocation Formula Example.
[13] Exceptions to this methodology are noted in the descriptions of base period calculations.

**Base Period Local Supplies:** Local supplies for the base period are calculated using a two-year average of groundwater production, groundwater recovery, Los Angeles Aqueduct supply, surface water production, and other imported supplies. Non-potable recycling production is not included in this calculation due to its demand hardening effect.

**Base Period Wholesale Demands:** Demands on Metropolitan for the base period are calculated using a two-year average of firm purchases and in-lieu deliveries to long-term groundwater replenishment, conjunctive use, cyclic, and supplemental storage programs.

**Base Period Retail Demands:** Total retail-level municipal and industrial (M&I) demands for the base period are calculated by adding the Base Period Wholesale Demands and the Base Period Local Supplies. This estimates an average total demand for water from each agency.

**Base Period Mandatory Conservation Credit:** Metropolitan allows a consultation process that enables member agencies to describe mandatory water use restrictions and/or rationing restrictions that were in place within their service areas during the Base Period. Restrictions may vary among agencies but include restricted water uses, fines, and water budget or penalty based rate structures that are enacted by the governing body of the member agency or retail agency. Following the consultation process, Metropolitan staff will recommend adjustments based on evidence of reduced GPCD. To qualify for an adjustment, GPCD reductions would have to be observed that are beyond those expected from the agency's ongoing conservation efforts and trends.

## Allocation Year Calculations

The next step in calculating the water supply allocation is estimating water needs in the allocation year. This is done by adjusting the base period estimates of retail demand for population or economic growth and changes in local supplies.

**Allocation Year Retail Demands:** Total retail M&I demands for the allocation year are calculated by adjusting the Base Period Retail Demands for baseline inflation and growth.

***Baseline Inflation Adjustment:*** Baseline inflation occurs when non-potable recycling or conservation is developed after the Base Period. The development of these supplies reduces actual demands for water in the Allocation Year. Because non-potable-recycling and conservation are excluded from the WSAP formula, the actual need for water in the Allocation year is overestimated. The Baseline Inflation Adjustment removes increases in non-potable recycling and conservation annually from the Base Period forward to better reflect the true need for water in the Allocation Year.

***Growth Adjustment:*** The growth adjustment is calculated using the estimated actual annual rate of population growth at the county level, as generated by the California Department of Finance, whenever possible. For years without complete data, the growth rate is calculated using an average of the three most recent years available. Growth will be allocated based on historical per capita water use during the Base Period, with a cap equal to Metropolitan's IRP Target for Water Use Efficiency. For

allocation years up to and including 2014, the cap will be 163 GPCD, and for allocation years 2015-2020 the cap will reduce linearly from 163 to 145 GPCD. On an appeals basis, member agencies may request that their adjustment be calculated using member agency level population growth. A weighted combination of actual population and actual employment growth rates may also be requested.

**Allocation Year Local Supplies:** Allocation Year Local Supplies include groundwater production, groundwater recovery, Los Angeles Aqueduct supply, surface water production, seawater desalination, and other imported supplies. Estimates of Allocation Year Local Supplies are provided by the member agencies upon implementation of a WSAP. If estimates are not provided, Metropolitan will use the sum of the Base Period Local Supplies and Base Period In-Lieu Deliveries as a default. Agencies may provide updated estimates at any time during the Allocation Year to more accurately reflect their demand for Metropolitan supplies.

**Extraordinary Supplies:** Under the WSAP formula, local supply production in the Allocation Year can either be designated as a "planned" supply, or as an "extraordinary" supply.[14] This is an important designation for a member agency because the two types of supplies are accounted for differently in the WSAP formula. Local supplies classified at Extraordinary Supply are only partially included (scaled depending on the WSAP Level) as local supplies. This has the effect of providing significantly more benefit to the member agency in terms of total water supply that is available to the retail customer.[15]

**Allocation Year Wholesale Demands:** Demands on Metropolitan for the allocation year are calculated by subtracting the Allocation Year Local Supplies from the Allocation Year Retail Demands.

## Water Supply Allocation Calculations

The final step is calculating the water supply allocation for each member agency based on the allocation year water needs identified in Step 2. The following table displays the elements that form the basis for calculating the supply allocation. Each element and its application in the allocation formula are discussed below.

Table 1: Shortage Allocation Index

| (a) Regional Shortage Level | (b) Wholesale Minimum Percentage | (c) Maximum Retail Impact Adjustment Percentage |
|---|---|---|
| 1 | 92.5% | 2.5% |
| 2 | 85.0% | 5.0% |
| 3 | 77.5% | 7.5% |
| 4 | 70.0% | 10.0% |

[14] Appendix H: Board Policy Principles on Determining the Status of Extraordinary Supply lists the key Board principles used in determining if a supply qualifies as an Extraordinary Supply.

[15] See Appendix G: Water Supply Allocation Formula Example for specific allocation formulae.

| | | |
|---|---|---|
| 5 | 62.5% | 12.5% |
| 6 | 55.0% | 15.0% |
| 7 | 47.5% | 17.5% |
| 8 | 40.0% | 20.0% |
| 9 | 32.5% | 22.5% |
| 10 | 25.0% | 25.0% |

**Regional Shortage Level:** The WSAP formula allocates shortages of Metropolitan supplies over ten levels.

**Wholesale Minimum Allocation:** The Wholesale Minimum Allocation ensures a minimum level of Metropolitan supplied wholesale water service to each member agency.

**Maximum Retail Impact Adjustment:** The purpose of this adjustment is to ensure that agencies with a high level of dependence on Metropolitan do not experience disparate shortages at the retail level compared to other agencies when faced with a reduction in wholesale water supplies. The Maximum Retail Impact Percentage is prorated on a linear scale based on each member agency's dependence on Metropolitan at the retail level. This percentage is then multiplied by the agency's Allocation Year Wholesale Demand to determine an additional allocation.

**Conservation Demand Hardening Credit:** The Conservation Demand Hardening Credit addresses the increased difficulty in achieving additional water savings at the retail level that comes as a result of successful implementation of water conserving devices and conservation savings programs. To estimate conservation savings, each member agency will establish a historical baseline Gallons Per Person Per Day (GPCD) calculated in a manner consistent with California Senate Bill SBx7-7.[16] Reductions from the baseline GPCD to the Allocation Year are used to calculate the equivalent conservation savings in acre-feet. The Conservation Demand Hardening Credit is based on an initial 10 percent of the GPCD-based Conservation savings plus an additional 5 percent for each level of Regional Shortage set by the Board during implementation of the WSAP. The credit will also be adjusted for:

- The overall percentage reduction in retail water demand
- The member agency's dependence on Metropolitan

The credit is calculated using the following formula:

*Conservation Demand Harding Credit = Conservation Savings x (10% + Regional Shortage Level Percentage) x (1 +((Baseline GPCD – Allocation Year GPCD)/Baseline GCPD)) x Dependence on MWD Percentage*

[16] California Department of Water Resources, February 2011, "Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use. Available at: http://www.water.ca.gov/wateruseefficiency/sb7/docs/MethodologiesCalculatingBaseline_Final_03_01_2011.pdf

This provides a base demand hardening credit equal to 10 percent of conservation savings and increases the credit as deeper shortages occur, which is when conservation demand hardening has a bigger impact on the retail consumer. The credit also increases based on the percentage of an agency's demand that was reduced through conservation. This accounts for increased hardening that occurs as increasing amounts of conservation are implemented. Lastly, the credit is scaled to the member agency's dependence on Metropolitan to ensure that credits are being applied to the proportion of water demand that is being affected by reductions in Metropolitan supply.

**Minimum Per-Capita Water Use Credit:** This adjustment creates a minimum per capita water use threshold. Member agencies' retail-level water use is compared to two different thresholds. The proposed minimum thresholds are based upon compliance guidelines established under Senate Bill X7-7.

- 100 GPCD total water use
- 55 GPCD residential water use

Agencies that fall below either threshold under the WSAP will receive additional allocation from Metropolitan to bring them up to the minimum GPCD water use level. If an agency qualifies under both thresholds, the one resulting in the maximum allocation adjustment will be given.[17] To qualify for this credit, member agencies must provide documentation of the total agency level population and the percent of retail level demands that are residential; no appeal is necessary.

**Total WSAP Allocation:** The allocation to an agency for its M&I retail demand is the sum of the Wholesale Minimum Allocation, the Retail Impact Adjustment, the Conservation Demand Hardening Credit, and the Minimum Per-Capita Water Use Credit.[18]

**Total Metropolitan Supply Allocations:** In addition to the WSAP Allocation described above, agencies may also receive separate allocations of supplies for and seawater barrier and groundwater replenishment demands. Allocations of supplies to meet seawater barrier demands are to be determined by the Board of Directors independently but in conjunction with the WSAP. Separating the seawater barrier allocation from the WSAP allocation allows the Board to consider actual barrier requirements in the Allocation Year and address the demand hardening issues associated with cutting seawater barrier deliveries. According to the principles outlined for allocating seawater barrier demands, allocations should be no deeper than the WSAP Wholesale Minimum Percentage implemented at that time.

The WSAP also provides a limited allocation for drought-impacted groundwater basins based on the following framework:[19]

[17] See Appendix J: Per Capita Water Use Minimum Example for specific minimum per-capita water use credit formulae and example.
[18] See Appendix G: Water Supply Allocation Formula Example for specific allocation formulae.
[19] See Appendix L: Groundwater Replenishment Allocation for more information.

1. Metropolitan staff will hold a consultation with the requesting member agency and the appropriate groundwater basin manager to document whether the basin is in one of the following conditions:
    a. Groundwater basin overdraft conditions that will result in water levels being outside normal operating ranges during the WSAP allocation period; or
    b. Violations of groundwater basin water quality and/or regulatory parameters that would occur without imported deliveries
2. An allocation is provided based on the verified need for groundwater replenishment. The allocation would start with a member agency's ten-year average purchases of imported groundwater replenishment supplies (excluding years in which deliveries were curtailed). The amount would then be reduced by the declared WSAP Regional Shortage Level.

# Section 5: WSAP Implementation

The WSAP will take effect if a regional shortage is declared by the Board of Directors. The following implementation elements are necessary for administering the WSAP during a time of shortage. These elements cover the processes needed to declare a regional shortage level as well as provide information pertaining to the allocation surcharge.

## Allocation Period

The allocation period covers twelve consecutive months, from July of a given year through the following June. This period was selected to minimize the impacts of varying State Water Project (SWP) allocations and to provide member agencies with sufficient time to implement their outreach strategies and rate modifications.

## Setting the Regional Shortage Level

Metropolitan staff is responsible for recommending a Regional Shortage Level for the Board of Directors' consideration. The recommendation shall be based on water supply availability, and the implementation of Metropolitan's water management actions as outlined in the WSDM Plan. Metropolitan staff will keep the Board of Directors apprised to the status of water supply conditions and management actions through monthly reports to the Water Planning and Stewardship Committee. To further facilitate staff in the development of a recommended regional shortage level, member agency requests for local supply adjustments shall be submitted by April 1st.

Metropolitan's Board of Directors, through the Water Planning and Stewardship Committee, is responsible for approving the final Regional Shortage Level at its April meeting. By the April meeting, the majority of the winter snowfall accumulation period will have passed and will allow staff to make an allocation based on more stable water supply estimates. Barring unforeseen large-scale circumstances, the Regional Shortage Level will be set for the entire allocation period, which will provide the member agencies an established water supply level for their planning.

## Exit Strategy

While the Board ultimately has discretion to implement or lift and allocation at any point of time during the year; the WSAP includes a two-part exit strategy that is meant to streamline the WSAP implementation decision making process.

- If the Board decides to implement the WSAP, then any current WSAP allocation would remain in place until the end of the Allocation Year.
- If the Board decides not to implement the WSAP, then any current WSAP allocation would be terminated concurrent with the Board decision.

## Allocation Appeals Process

An appeals process is necessary for the administration of any changes or corrections to an agency's allocation. Metropolitan's General Manager will designate, subsequent to a declaration of an allocation by the Board of Directors, an Appeals Liaison as the official point of contact for all information and inquiries regarding appeals. All member agency General Managers will be notified in writing of the name and contact information of the Appeals Liaison. Only appeals that are made through the Appeals Liaison and in accordance with the provisions outlined in Appendix N: Allocation Appeals Process will be evaluated. Basis for appeals claims can include but are not limited to:

- Adjusting erroneous historical data used in base period calculations
- Adjusting for population growth rates
- Determining if a local supply qualifies as Extraordinary Supply

Additional details and a checklist for the appeals process are available in Appendix N: Allocation Appeals Process and Appendix O: Appeals Submittal Checklist.

## Allocation Surcharge

Member agency allocations are supported by an Allocation Surcharge. The Allocation Surcharge is charged to water use above the Member Agency allocation and is charged in addition to Metropolitan's standard rates for water service. Allocation Surcharges will only be assessed to the extent that an agency's total annual usage exceeds its total annual allocation. Any revenues collected through the Allocation Surcharge will be applied towards Metropolitan's Water Management Fund, which is used to in part to fund expenditures in dry-year conservation. No billing or assessment of allocation surcharges rates will take place until the end of the twelve-month allocation period.

**Allocation Surcharge:** The application of the Allocation Surcharge structure is a two tier structure that provides a lower level of Allocation Surcharge for minor overuse of allocations and a higher level of Allocation Surcharge for major overuse of allocations. The structure and applicable Allocation Surcharges are listed in Table 2.

| Table 2: Allocation Surcharge | | | |
|---|---|---|---|
| **Water Use** | **Base Water Rate[20]** | **Allocation Surcharge[21]** | **Total Rate** |
| 100% of Allocation | Tier 1 | 0 | Tier 1 |
| Between 100% and 115% | Tier 1 | $1,480 | Tier 1 + ($1,480) |
| Greater than 115% | Tier 1 | $2,960 | Tier 1 + ($2,960) |

**Qualifying Income-Based Rate Allocation Surcharge Adjustment:**[22] Any Allocation Surcharges incurred by a member agency under the WSAP will be adjusted to reflect the extent to which retail customers within a member agency's service area are served under a "lifeline" or similar qualified discounted rate program based on income or ability to pay ("Income-Based Rate").

Any member agency who is assessed Allocation Surcharges under the WSAP may submit an acre-foot equivalent of water used by retail customers served under a qualifying Income-Based Rate.[23] This amount of water use would be multiplied by the percentage of retail-level reduction in allocation year demand necessary for that member agency to avoid exceeding its WSAP allocation. The monetary amounts resulting from these acre feet are subtracted from the total monetary amounts incurred by an agency for exceeding its allocation. In the case that the monetary amounts associated with the Income-Based Rate are greater than the total Allocation Surcharges an agency incurs, no Allocation Surcharges will be incurred. The end result of this adjustment is that the member agency will not be subject to Allocation Surcharges for the use of water by their retail customers served under a qualifying Income-Based Rate.

**Growth Rate Allocation Surcharge Adjustment":** In recognition of member agency differences in geography and climate, a Growth Rate Allocation Surcharge Adjustment will be given to any agency that exceeds its WSAP Allocation. The Allocation Surcharge reduction will be based on the difference in acre-feet between the Growth Adjustment applied at Metropolitan's IRP planning goal rate, and the greater of the following:

- The IRP planning goal rate adjusted for the member agency's ETo, or
- The member agency's certified and documented 20x2020 targeted GPCD

If both of these alternatives result in a lower growth adjustment than the IRP planning goal, no Allocation Surcharge reduction will be made.

[20] The base water rate shall be the applicable water rate for the water being purchased. In most cases, it will be the Tier 1 rate (plus Treatment Surcharge for treated water deliveries). However, it is possible that the water being purchased would be in the amount that would put an agency beyond its Tier 1 limit. In that case, the base water rate will be the Tier 2 rate (plus Treatment Surcharge for treated water deliveries).

[21] Allocation Surcharge is applied to water use in excess of an agency's WSAP allocation.

[22] See Appendix K: Qualifying Income-Based Rate Allocation Surcharge Adjustment Example for specific penalty adjustment formulae and example.

[23] Appropriate documentation and certification will be required.

## Tracking and Reporting

Subsequent to a declared regional shortage by the Board of Directors, Metropolitan staff will produce monthly reports of each member agency's water use compared to its allocations based on monthly delivery patterns to be submitted by the member agency. In order to produce these reports, member agencies are requested to submit their local supply use on a monthly basis and certify end of allocation year local supply use. These reports and comparisons are to be used for the purposes of tracking and communicating potential underage/overage of an agency's annual allocations.

## Key Dates for Water Supply Allocation Implementation

The timeline for implementation of an allocation is shown in Table 3. A brief description of this timeline follows:

**January to March**: Water Surplus and Drought Management reporting occurs at Metropolitan's Water Planning and Stewardship Committee meetings. These reports will provide updated information on storage reserve levels and projected supply and demand conditions.

**April**: Member agencies report their projected local supplies for the coming allocation year. This information is incorporated in staff analysis of storage reserves and projected supply and demand conditions in order to provide an allocation recommendation to the Board. Metropolitan's Board will consider whether an allocation is needed. A declaration of an allocation will include the level of allocation to be in effect for the allocation year. Likewise, member agencies will report their projected demands and local supplies needed to meet seawater barrier and groundwater replenishment requirements for the allocation year. Metropolitan's Board will consider whether allocations for seawater barrier demands and groundwater replenishment demands are needed independently from the WSAP allocation decision.**July 1st**: If the Board declared an allocation in April, then it will be effective starting July 1st. The allocation level will be held through June 30th, barring unforeseen circumstances. Member agencies will now be requested to submit their local supply use on a monthly basis and certify end of allocation year local supply use. Local production data must be reported to Metropolitan by the end of the month following the month of use (use in July must be reported by the end of August). This information will be combined with Metropolitan sales information in order to track retail water use throughout Metropolitan's service area. Each month Metropolitan will report on member agency water sales compared to their allocation amounts.

**June 30th**: The allocation year is complete.

**July**: Member agency local supplies must be certified for the month of June, the last month of the previous allocation year.

**August**: Metropolitan will calculate each member agency's total potable water use based on local supply certifications and actual sales data for the allocation year of July through June. Allocation surcharges will be assessed for usage above a given member agency's final adjusted allocation (reflecting the actual local supply and imported water use that occurred in the allocation year).

| Table 3: Board Adopted Allocation Timeline | | | | | |
|---|---|---|---|---|---|
| **Year** | **Month** | **Year 1 Board Decision** | **Year 1 Allocation Year** | **Year 2 Board Decision** | **Year 2 Allocation Year** |
| Year 1 | January | | | | |
| | February | | | | |
| | March | | | | |
| | April | Declaration * | | | |
| | May | | | | |
| | June | | | | |
| | July | | **Effective Period** Continuous Tracking of Member Agency Local Supply and Imported Water Use | | |
| | August | | | | |
| | September | | | | |
| | October | | | | |
| | November | | | | |
| | December | | | | |
| Year 2 | January | | | | |
| | February | | | | |
| | March | | | | |
| | April | | | Declaration * | |
| | May | | | | |
| | June | | | | |
| | July | | | | **Effective Period** Continuous Tracking of Member Agency Local Supply and Imported Water Use |
| | August | | Assess | | |
| | September | | | | |
| | October | | | | |
| | November | | | | |
| | December | | | | |
| Year 3 | January | | | | |
| | February | | | | |
| | March | | | | |
| | April | | | | |
| | May | | | | |
| | June | | | | |

*Member agency projections of local supplies are due on April 1st to assist Metropolitan staff in determining the need for an allocation in the coming allocation year.

## Appendix A: Metropolitan Member Agencies

| Table 4: Member Agencies | | |
|---|---|---|
| City of Anaheim | City of Glendale | City of San Marino |
| City of Beverly Hills | Inland Empire Utilities Agency | City of Santa Ana |
| City of Burbank | Las Virgenes MWD | City of Santa Monica |
| Calleguas MWD | City of Long Beach | Three Valleys MWD |
| Central Basin MWD | City of Los Angeles | City of Torrance |
| City of Compton | MWD of Orange County | Upper San Gabriel MWD |
| Eastern MWD | City of Pasadena | West Basin MWD |
| Foothill MWD | San Diego CWA | Western MWD |
| City of Fullerton | City of San Fernando | |

Source: http://mwdh2o.com/WhoWeAre/Member-Agencies/

# Appendix B: Water Supply Allocation Plan Process Timeline

### July 2007

- City of Long Beach Water Department staff briefing
- Member Agency Managers/Member Agency Workgroup meeting
- Northern Managers Group meeting
    - Foothill MWD, City of Pasadena, City of Long Beach, Calleguas MWD, City of Los Angeles, West Basin MWD, City of Burbank, Three Valleys MWD, City of Glendale, Upper San Gabriel MWD

### August 2007

- Central Basin MWD staff briefing
- Eastern MWD staff briefing
- San Diego CWA staff briefing
- Member Agency Managers/Member Agency Workgroup meeting
- Western MWD staff briefing
- City of Beverly Hills staff briefing

### September 2007

- Member Agency Subgroup meetings
    - MWD of Orange County, San Diego CWA, West Basin MWD, Central Basin MWD
- MWD of Orange County staff briefing
- Member Agency Workgroup meeting
- Member Agency Workgroup meeting
- MWD Board of Directors Oral Report

### October 2007

- Inland Empire Utilities Agency staff briefing
- Central Basin MWD Caucus Meeting (included sub-agencies)
- Three Valleys MWD staff briefing
- MWD of Orange County staff briefing
- West Basin MWD staff briefing
- MWD Board of Directors Oral Report

### November 2007

- West Basin MWD Caucus Meeting (included sub-agencies)
- West Basin Water Users Association presentation
- Walnut Valley MWD staff briefing (sub-agency of Three Valleys MWD)
- Foothill MWD Managers Meeting (included sub-agencies)
- Central Basin MWD staff briefing
- City of Claremont City Council (sub-agency of Three Valleys MWD)
- MWD Board of Directors Information Letter with Draft Proposal

### December 2007

- Northern Managers Group Meeting
- California Department of Public Health staff briefing
- City of Long Beach Water Department staff briefing
- Santa Ana River Watershed Project Authority presentation
- Foothill MWD Managers Meeting (included sub-agencies)
- MWD Board of Directors Oral Report

### January 2008

- Northern Managers Group Meeting
- Water Replenishment District Board of Directors presentation
- Three Valleys MWD staff briefing
- Member Agency Conservation Coordinator's Group presentation
- Member Agency Managers/Member Agency Workgroup meeting
- City of Chino Hills presentation (sub-agency of IEUA)
- Member Agency Workgroup meeting
- Hemet/San Jacinto Exchange Club presentation
- MWD Board of Directors Report with Staff Recommended Water Supply Allocation Plan

### February 2008

- MWD of Orange County and Irvine Ranch WD staff briefing
- MWD Board of Directors Action Item
- San Gabriel Valley Water Association Meeting
- Orange County Water Policy Meeting
- SCAG Water Policy Task Force Meeting

# Appendix C: 12-Month Review Process and Results

### January 2010

- WSAP 12-Month Review Process workshop #1
    - Focused discussion of WSAP issues identified by Metropolitan staff and by member agencies since the July 2009 implementation began.

### February 2010

- WSAP 12-Month Review Process workshop #2
    - Continuation of focused discussion
- WSAP 12-Month Review Process workshop #3
    - Continuation of focused discussion

### March 2010

- WSAP 12-Month Review Process workshop #4
    - Continuation of focused discussion
- MWD Board of Directors information item
    - Review of potential modifications to the WSAP definition of Extraordinary Supply

### April 2010

- WSAP 12-Month Review Process workshop #5
    - Recap of identified issues and discussion of Metropolitan staff proposals for adjustments to the WSAP
- Member Agency Managers Meeting
    - Update on the 12-Month Review Process
- WSAP 12-Month Review Process workshop #6
    - Discussion of WSAP issues related to groundwater replenishment
- Member Agency Managers conference call
    - Clarification of WSAP definition for Extraordinary Supply

### May 2010

- Member Agency Managers Meeting
    - Discussion of proposed Extraordinary Supply policy principles and WSAP Local Supply certification process.
- Member Agency Managers conference call
    - Discussion of proposed Extraordinary Supply policy principles

### June 2010

- MWD Board of Directors action item

### July 2010

- MWD Board of Directors information item
    - Review of proposed adjustments to the WSAP developed in the 12-Month Review Process

### August 2010

- MWD Board of Directors action item

## Resulting Changes

- Removed references to Gains and Losses of Local Supply
    - Removed references in the WSAP to "gains and losses of local supplies" in order to better facilitate the accounting of historical base year and allocation year local supplies. This change did not affect the WSAP formula or allocations.
- Removed references to the Regional Shortage Percentage
    - Removed references to the "Regional Shortage Percentage" in the WSAP to reduce unintended confusion between calculation factors and shortage amounts. This change did not affect the WSAP formula or allocations.
- Included the Retail Impact Adjustment in all shortage levels
    - Included the Retail Impact Adjustment for Regional Shortage Levels 1 and 2. This change results in additional allocations to Metropolitan-dependent agencies under Level 1 and Level 2 regional shortages.
- Revised the accounting of Extraordinary Supplies
    - Revised the methodology for accounting of Extraordinary Supply in the WSAP formula by:
        - Removing the Base Period Local Supply threshold provision,
        - Removing the sliding-scale sharing mechanism from the formula, and
        - Including the full amount of the Extraordinary Supply in the calculation of the Retail Impact Adjustment.
- Included a Minimum Per Capita Water Use Threshold
    - Developed a minimum water use credit based on two GPCD water use thresholds. Member agencies would receive additional Metropolitan allocation for an acre-foot equivalent of GPCD below the minimum threshold. Member agency water use, on a gallon per capita per day (GPCD) basis, is compared to the following minimum thresholds established under Senate Bill X7-7 (Water Conservation Act of 2009)
        - 100 GPCD total use or
        - 55 GPCD residential indoor use
- Excluded Seawater Barrier from the WSAP Formula
    - Excluded seawater barrier supplies from the WSAP Base Period and Allocation Year local supply calculations. This allows the Board to determine allocations for seawater barrier demands separately from the WSAP.

# Appendix D: Three-Year Review Process and Results

### February 2011

- WSAP 3-Year Review Process workshop #1
    - Review of the existing WSAP policy formula; review of the process timeline; and focused discussion of WSAP issues identified by Metropolitan staff and by member agencies since the WSAP's adoption in February 2008

### March 2011

- WSAP 3-Year Review Process workshop #2
    - Discussion of issues related to local supplies and baseline inflation due to adjustments for recycling in the WSAP formula
- WSAP 3-Year Review Process workshop #3
    - Continuation of prior workshop

### April 2011

- WSAP 3-Year Review Process workshop #4
    - Discussion of issues and alternatives related to base period selection and baseline inflation in the WSAP formula
- WSAP 3-Year Review Process workshop #5
    - Discussion of recommendations to address baseline inflation in the WSAP formula

### May 2011

- WSAP 3-Year Review Process workshop #6
    - Discussion of issues and alternatives for the growth adjustment methodology in the WSAP formula
- WSAP 3-Year Review Process workshop #7
    - Continuation of prior workshop

### June 2011

- WSAP 3-Year Review Process workshop #8
    - Continuation of prior workshop, discussion of WSAP implementation exit strategy
- WSAP 3-Year Review Process workshop #9
    - Continuation of exit strategy discussion, discussion of baseline inflation due to conservation and related conservation demand hardening issues

### July 2011

- WSAP 3-Year Review Process workshop #9
    - Continued discussion of baseline inflation and conservation issues, and discussion of sharing allocations between agencies with common local resources

### August 2011

- WSAP 3-Year Review Process workshop #10
    - Discussion of WSAP Allocation Year timing vs. Tier 1-Tier 2 rate cycle timing, discussion of approaches for encouraging completion of WSAP local supply certifications
- Review WSAP at Member Agency Managers Meeting
    - Discussion of proposed WSAP adjustments to address baseline inflation issues, revise the growth adjustment methodology, and establish a WSAP exit strategy

## September 2011

- MWD Board of Directors action item

## Resulting Changes

- Baseline Inflation Adjustment
    - Removed non-potable recycling and conservation from the WSAP baseline
        - Increases in recycling and conservation will be subtracted annually from the Base Period forward
        - The annual population growth rate will be applied after deducting the annual increases in recycling and conservation
        - If an agency ends up in allocation penalty, a penalty reduction will be applied in an amount equal to the Code-Based and rate Structure conservation savings that were removed from the WSAP baseline
- Changed the Growth Adjustment methodology
    - Growth will be allocated at historical per capita rate capped at the 2010 Integrated Water Resource Plan (IRP) Target for Water Use Efficiency
        - For years up to and including 2014, the cap will be 163 GPCD
        - For years 2015-2020, the cap will reduce linearly from 163 to 145 GPCD
    - If an agency exceeds its allocation, a penalty reduction will be applied based on either:
        - The differential Evapotranspiration (ETo) of its service area compared to the MWD average, or
        - Certified and documented 20 x 2020 targeted GPCD
- Exit Strategy
    - Clarified the course of action for an existing WSAP allocation when Metropolitan's Board makes a declaration decision for the following WSAP year
        - If there is an allocation for the next year, then the current allocation stays in place
        - If there is no allocation for the next year, then the current allocation is lifted concurrent with the April decision

# Appendix E: 2014 Review Process and Results

### July 2014

- WSAP Workgroup Meeting #1
  - First meeting of the 2014 WSAP Review process; review of the existing WSAP policy and formula; review of the process timeline; began discussion of issues related to base period selection
- WSAP Workgroup Meeting #2
  - Discussion of base period selection

### August 2014

- WSAP Workgroup Meeting #3
  - Continuation of prior workshop discussion; comparison of base period alternatives

### September 2014

- WSAP Workgroup Meeting #4
  - Discussion of a base period proposal; discussion of replenishment issues in the WSAP; discussion of 2015 water supply scenarios
- Review WSAP at Member Agency Managers Meeting
  - Review of WSAP workgroup process; discussion on issues related to base period, demand hardening, and local resources development
- WSAP Workgroup Meeting #5
  - Review of base period recommendation; discussion of issues regarding agencies in mandatory conservation during a base period; discussion on replenishment in the WSAP

### October 2014

- WSAP Workgroup Meeting #6
  - Continuation of prior workshop discussion; discussion of alternative methods for conservation demand hardening credit; discussion of new and existing local supplies
- Review WSAP at Member Agency Managers Meeting
  - Review of WSAP workgroup process; discussion of issues related to base period and demand hardening

### November 2014

- WSAP Workgroup Meeting #7
  - Review and discussion of issues and potential methods for base period selection and adjustment, replenishment allocation, and conservation demand hardening credit; review of estimated effects of potential WSAP changes at the regional level
- WSAP Workgroup Meeting #8
  - Review of proposed recommendations for the WSAP based on workgroup discussion
- Review WSAP at Member Agency Managers Meeting
  - Review of proposed recommendations for the WSAP based on workgroup discussion

## Resulting Changes

- Base Period Update to FY2013 and FY2014
    - Changed the WSAP Base Period from calendar years 2004-2006 to fiscal years ending July 2013 and 2014
    - Mandatory Conservation Adjustment
        - Agencies with mandatory conservation in effect during the base period (FY 2013 and/or FY 2014) may qualify for a demand hardening adjustment, adjustment is subject to a consultation process that includes consideration historical demand and GPCD information

- Modify Conservation Demand Hardening Credit
    - Replaced device calculation-based estimates of conservation savings with a GPCD-based method
        - Conservation savings are calculated by comparing GPCD from a historical baseline to the Allocation Year; the difference is converted to acre-feet using the Allocation Year population.
            - Baseline GCPD is 10-year average ending between 2004 and 2010, with gross water, using gross water use minus non-potable recycled water production and documented historical population
    - Replaced formula for calculating the credit for each Regional Shortage Level
    - Conservation Demand hardening credit will be based on an initial 10 percent of GPCD-based conservation savings plus an additional 5 percent for each level of Regional Shortage; the credit will also be adjusted for the overall percentage reduction in retail water demand and the member agency's dependence on Metropolitan.
- Allocation Surcharge
    - Replaced the WSAP Penalty Rate with an Allocation Surcharge based on the estimated cost of Turf Replacement conservation programs

## Appendix F: Summary of Historical Shortage Plans

These five elements incorporated into the WSAP have, in four out of five instances, been used in previous shortage plans. Both the IICP and the 1995 DMP used a historical base period calculation, adjusted for growth, made local supply adjustments, and used conservation hardening credits in their formulations. The retail impact adjustment is the only feature of the WSAP that has not been used historically.

Table 5: Historical Shortage Plan Overview

| Plan Element | 1991 IICP | 1995 DMP | WSAP |
|---|---|---|---|
| Historical Base Period | √ | √ | √ |
| Growth Adjustment | √ | √ | √ |
| Local Supply Adjustment | √ | √ | √ |
| Conservation Hardening Credit | √ | √ | √ |
| Retail Impact Adjustment | | | √ |

# Appendix G: Water Supply Allocation Formula Example

The following example gives a step-by-step description of how the formula would be used to calculate an allocation of Metropolitan supplies for a hypothetical member agency. All numbers are hypothetical for the purpose of the example and do not reflect any specific member agency.

## Step 1: Calculate Base Period Retail Demand

**Base Period Local Supplies:** Calculated using a two-year average of groundwater (gw), groundwater recovery (gwr), Los Angeles Aqueduct supply (laa), surface water (sw), seawater desalination (sd), and other non-Metropolitan imported supplies (os). For the purpose of this example, assume that the two year average is 59,000 af.

$$[(gw1+gwr1+laa1+sw1+sd1+os1) + (gw2+gwr2+laa2+sw2+sd2+os2)] \div 2 = 59{,}000 \text{ af}$$

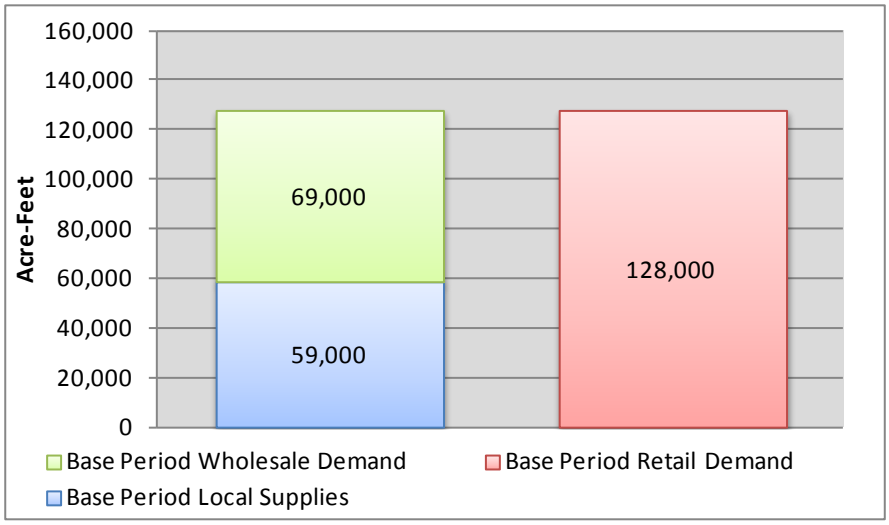
**Base Period Wholesale Demands:** Calculated using the same two-year time period as the Base Period Local Supplies. The Base Period Wholesale Demands include firm purchases (fp) and in-lieu deliveries to long-term groundwater replenishment (il), conjunctive use (cup), cyclic (cyc), and supplemental storage programs (ss). For the purpose of this example, assume that the two year average is 69,000 af.

$$[(fp^1{+}{+}il^1{+}cup^1{+}cyc^1{+}ss^1) + (fp^2{+}il^2{+}cup^2{+}cyc^2{+}ss^2)] \div 2 = 69{,}000 \text{ af}$$

**Base Period Retail Demands:** Calculated as the sum of the Base Period Local Supplies and Base Period Wholesale Demand.

$$59{,}000 + 69{,}000 = 128{,}000 \text{ af}$$

**Figure 1: Base Period Retail Demand Calculation**



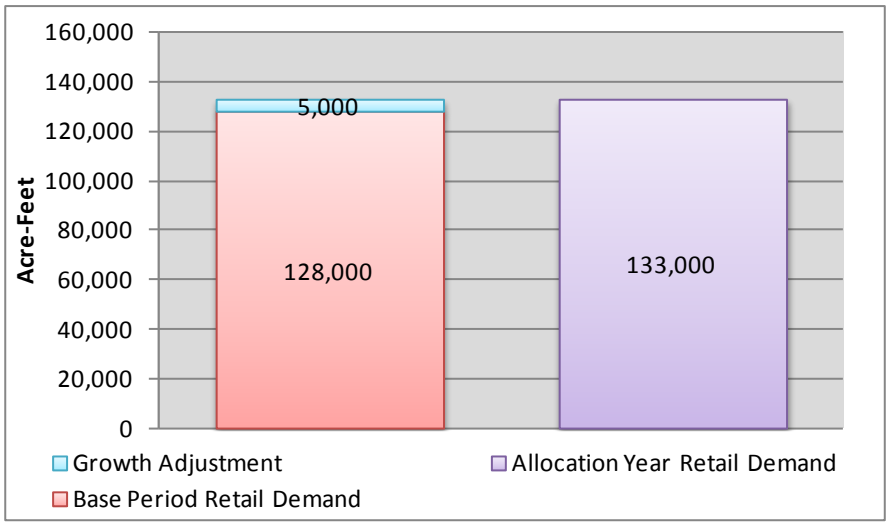
**Calculate Adjustment for Base Period Mandatory Rationing (if applicable):** The hypothetical agency used in this example is assumed not to qualify for the Base Period Mandatory Rationing Adjustment. A detailed discussion of the adjustment methodology can be found in Appendix I: Base Period Rationing Adjustment Example.

### Step 2: Calculate Allocation Year Retail Demand

**Allocation Year Retail Demand:** Calculated by adjusting the Base Period Retail Demand for any baseline inflation and growth that occurred since the Base Period.

128,000 af + 5,000 af (net adjustment to retail demand) = 133,000 af

**Figure 2: Allocation Year Retail Demand Calculation**




### Step 3: Calculate Allocation Year Wholesale Demand

**Allocation Year Local Supplies:** Estimates of Allocation Year Local Supplies are provided by the member agencies upon implementation of a WSAP. If estimates are not provided, Metropolitan will use the sum of the Base Period Local Supplies and Base Period In-Lieu Deliveries as a default. Agencies may provide updated estimates at any time during the Allocation Year to more accurately reflect their demand for Metropolitan supplies. For this example assume that the Allocation Year Local Supplies total 65,000 acre-feet.

Allocation Year Local Supplies = 65,000 af

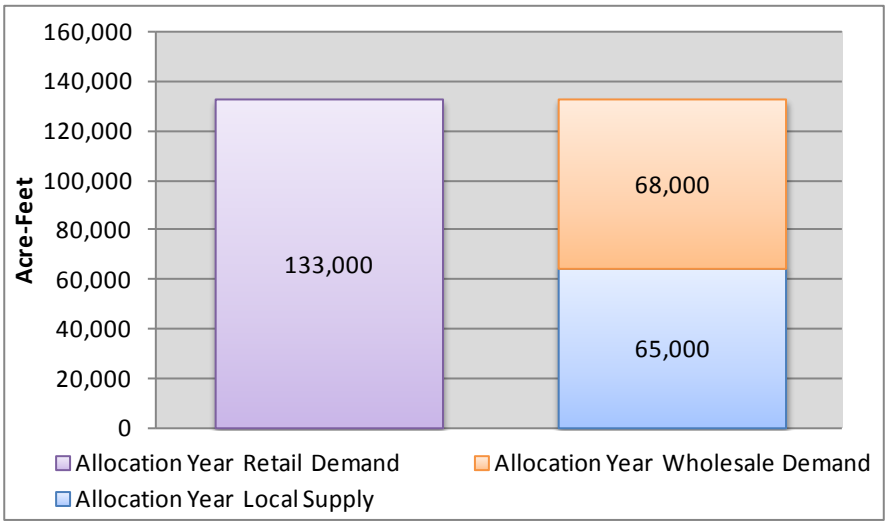
For this example assume also that this agency has an additional 5,000 acre-feet of supplies that meet the determinations for Extraordinary Supply. These supplies are withheld from the allocation formula except for in calculating the Retail Impact Adjustment Allocation.

Extraordinary Local Supplies = 5,000 af

**Allocation Year Wholesale Demands:** Calculated by subtracting the Allocation Year Local Supplies (65,000 af) from the Allocation Year Retail Demands (133,000 af).

133,000 af - 65,000 af = 68,000 af

**Figure 3: Allocation Year Wholesale Demand Calculation**




### Step 4: Calculate the Wholesale Minimum Allocation

**Wholesale Minimum Percentage:** Calculate from Table 1 for Regional Shortage Level 4.

| Table 1: Shortage Allocation Index | | |
|---|---|---|
| (a) Regional Shortage Level | (b) Wholesale Minimum Percentage | (c) Maximum Retail Impact Adjustment Percentage |
| 4 | 70.0% | 10.0% |

**Wholesale Minimum Allocation:** Calculated by multiplying the agency's Allocation Year Wholesale Demand (68,000 af) by the Wholesale Minimum Percentage (70%) from the Table 1 for Regional Shortage Level 4.

68,000 af * 70% = 47,600 af

### Step 5: Calculate the Retail Impact Adjustment Allocation

**Maximum Retail Impact Adjustment Percentage:** Calculate from Table 1 for Regional Shortage Level 4.

**Retail Impact Adjustment Allocation:** Calculated first by determining the agency's dependence on Metropolitan by dividing the Allocation Year Wholesale Demand (68,000 af) minus the Extraordinary Supply (5,000 af) by the Allocation Year Retail Demand (133,000 af) and multiplying by 100.

[(68,000 af - 5,000 af)/ 133,000 af] * 100 = 47%

Next, this percentage dependence on Metropolitan (47%) is multiplied by the Maximum Retail Impact Percentage for Shortage Level 4 (10%).

47% * 10% = 4.7%

This percentage is now multiplied by the Allocation Year Wholesale Demand (68,000 af) for the Retail Impact Adjustment Allocation.

68,000 af * 4.7% = 3,221 af

### Step 7: Calculate the Conservation Demand Hardening Adjustment

**Calculate Baseline GPCD:** To estimate conservation savings, each member agency will establish a historical baseline GPCD calculated in a manner consistent with California Senate Bill SBx7-7, using a 10 or 15-year average ending between 2004 and 2010, using gross water use minus non-potable recycle water production and documented historical population. For this example assume that the Baseline GPCD is 154 GPCD

Baseline GPCD = 154 GPCD

**Calculate Allocation Year GPCD:** Next, calculate the allocation year GPCD by converting the Allocation Year Retail Demand to GPCD and dividing by the Allocation Year Population from the WSAP. For this example the Allocation Year Retail Demand is 133,000 AF (see Step 2 above) and assume the Allocation Year Population is 905,000 persons. The resulting GPCD is 131 GPCD.

Allocation Year GPCD = 133,000 af/year * 325,851 gallons/af ÷ 365 days/year ÷ 905,000 persons = 131 GPCD

**Calculate Reduction in GPCD:** Subtract Allocation Year GPCD from Baseline GPCD to determine the GPCD Reduction.

GPCD Reduction = 154 GPCD – 131 GPCD = 23 GPCD

**Calculate Conservation Savings:** Convert the GPCD Reduction to the equivalent annual conservation savings in acre-feet, using the Allocation Year Population.

$$\text{Conservation Savings} = \frac{(\text{GPCD Reduction}) \times 365 \text{ days/yr} \times \text{Population})}{325{,}851 \text{ gallons/af}}$$

Conservation Savings = 23 x 365 x 905,000 ÷ 325,851 = 23,316 af

**Multiply by Regional Shortage Level Percentage:** Multiply the Conservation Savings by 10 percent plus an additional 5 percent for each level of Regional Shortage (see Step 4 above). This example assumes a Regional Shortage Level of 4. This scales the hardening credit by the level of regional shortage, thereby increasing the credit as deeper shortages occur when demand hardening has a larger impact on the retail consumer.

23,316 af x (10% + (4 x 5%) = 6,995 af

**Multiply by Conservation Savings Percentage:** Next, multiply by the percentage of an agency's demand that was reduced through conservation. This scales the hardening by the total percentage reduction to recognize that increased hardening occurs as increasing amounts of conservation are implemented.

Conservation Savings Percentage = 1 + ((Baseline GPCD – Allocation Year GPCD)/Baseline GPCD)

Conservation Savings Percentage = 1+ ((154 GPCD – 131 GPCD)/154 GPCD) = 115%

6,995 af x 115% = 8,044 af

**Multiply by Dependence on MWD:** Next, multiply by the agency's percentage dependence on MWD as shown in Step 5 above. This scales the credit to the member agency's dependence on MWD to ensure that credits are being applied to the proportion of water demand that is being affected by reductions in MWD's supply. For this example, dependence on MWD is 47%.

8.044 af x 47% = 3,781 af

**Summary:** The Conservation Demand Hardening Adjustment calculation is summarized by the following formula:

Conservation Demand Hardening Adjustment = Conservation Savings x (10% + Regional Shortage Level %) x (1+Conservation%) x Dependence on MWD %

Conservation Demand Hardening Adjustment = 23,316 af x (10% + (4 x 5%)) x (115%) x (47%) = 3,781 af

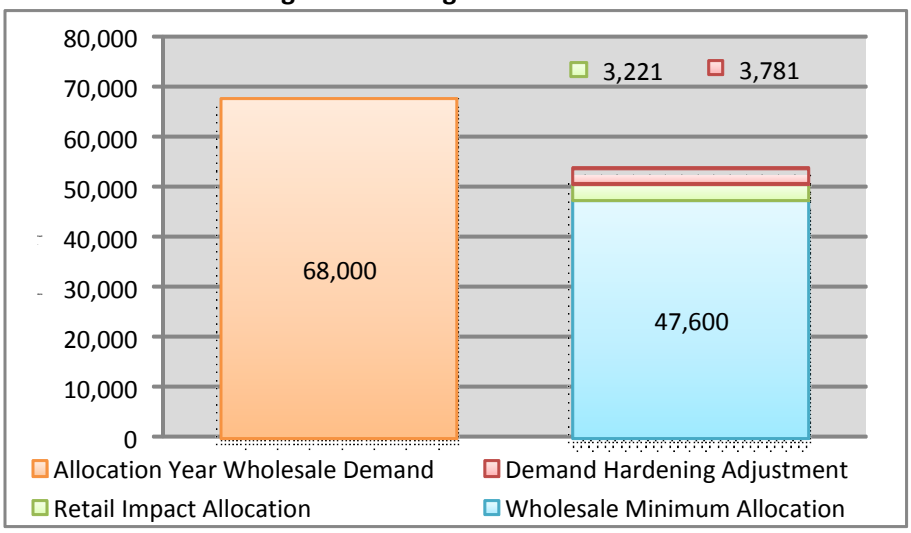
**Step 8: Calculate the Low Per-Capita Adjustment Allocation:** The hypothetical agency used in this example is assumed not to qualify for the Low Per-Capita Adjustment. A detailed discussion and example of the Low Per-Capita Adjustment calculation can be found in Appendix J: Per Capita Water Use Minimum Example.

**Step 9: Calculate the total WSAP Allocation**

**WSAP Allocation:** Calculated by adding the Wholesale Minimum Allocation (47,600 af), the Maximum Retail Impact Adjustment (3,221 af), the Demand Hardening Adjustment (3,781 af), and the Low Per-Capita Adjustment (0 af).

47,600 af + 3,221 af + 3,781 af + 0 af = 54,602 af

**Figure 4: WSAP Allocation Regional Shortage Level 4**




## Step 10: Calculate total retail level reliability

**Retail level reliability:** Calculated by adding the WSAP Allocation (54,602 af), the Allocation Year Local Supply (65,000 af) and the Extraordinary Local Supply (5,000 af) and dividing by the Allocation Year Retail Demand (133,000 af).

(54,602 af + 65,000 af + 5,000 af) ÷ 133,000 af = 93.7%

**Total Metropolitan Supply Allocations:** In addition to the WSAP Allocation described above, agencies may also receive separate allocations of supplies for groundwater replenishment and seawater barrier demands. More information on the groundwater replenishment allocation is located in Appendix L: Groundwater Replenishment Allocation.

# Appendix H: Board Policy Principles on Determining the Status of Extraordinary Supply

At the June 8, 2010 Water Planning and Stewardship Committee meeting Metropolitan's Board of Directors adopted the following policy principles to guide staff in determining the Extraordinary Supply status of future member agency supply programs.

### No Negative Impacts to Other Member Agencies

A potential Extraordinary Supply for a member agency should not decrease the amount of Metropolitan water supply that would be available to the other member agencies in a WSAP. Programs that utilize Metropolitan supplies as a primary or in-lieu source or as a means of payback or future replenishment may have the effect of decreasing supplies, available to other agencies, if designated as Extraordinary Supply.

### Provides Supply in Addition to Existing Regional Supplies

A potential Extraordinary Supply should provide a water supply that increases the overall water supplies that are available to the region in a WSAP. A program that is designed to move existing regional supplies from year to year would not qualify.

### Specifically Designed Program or Supply Action

A potential Extraordinary Supply must be intentionally created and operated to provide additional supply yield. Normal variations in existing and planned local supply programs would not qualify.

### Intended for Consumptive Use in a WSAP

A potential Extraordinary Supply should be designed with the primary intention to deliver water supply to a member agency only at a time when Metropolitan is allocating supplies. Programs designed to deliver water on a regular basis would not qualify. Exceptions for reasonable use of a supply program for emergency or other extenuating local circumstances should be considered.

### Fully Documented Resource Management Actions

A potential Extraordinary Supply should have a full description as to the source, transmission, distribution, storage, and delivery of the water supply.

These principles are intended to identify deliberate actions taken by member agencies to augment supplies only when Metropolitan is allocating supplies through the WSAP. Production from existing local supplies, programs that are operated on an ongoing basis, and incidental increases in water supply would not qualify as Extraordinary Supply. The intent of the Extraordinary Supply designation is to recognize programs and actions that are additive to the total regional water supply as the region continues to confront the water supply challenges from drought and regulatory conditions. To that end, any supply actions taken after the initial implementation of the WSAP in July 2009 that utilize Metropolitan supplies either as a primary source, or to refill or replenish an incurred obligation or deficit at a future date would not qualify as Extraordinary Supply.

## Appendix I: Base Period Mandatory Rationing Adjustment

Agencies that were under mandatory water use restrictions during the Base Period may have water use that is lower due to the mandatory actions already taken. Without adjusting for this, those agencies could be required to enforce even higher levels of restrictions under an allocation than those agencies that had not started mandatory restrictions.

To qualify for a Base Period Mandatory Rationing Adjustment, the member agency must provide Metropolitan staff with the following information:

- Time period when the mandatory conservation was in effect; it must be in effect during the Base Period
- A statement, with documentation, of how drought restrictions comply with the following Mandatory Conservation qualifications:
    - Governing Body-authorized or enacted
    - Includes mandatory demand reduction actions, restrictions or usage limitations including penalty-backed water budgets
    - Enforced by assessing penalties, fines, or rates based upon violating restrictions or exceeding usage limitations
- If the agency in question is a retail subagency, then the retailer's base period water demands during the Base Period in order to determine proportion to the member agency's total demand
- Historical data to construct GPCD base and trend for the consultation

Calculating the Base Period Rationing Adjustment involves following steps:

- Use the Baseline GPCD 10 or 15-year period selected by member agency for the Conservation Demand Hardening Adjustment calculation.
- Interpolate from the GPCD value of the midpoint of the Baseline GPCD period to the average GPCD of the two years preceding the agency's mandatory conservation
- Extrapolate to the WSAP Base Period (FY2013 and FY2014)
- Calculate the difference between estimated and observed GPCD for FY2013 and FY2014
- Convert to Acre-Feet and add to the member agency's Base Period Retail Demands

# Appendix J: Per-Capita Water Use Minimum Example

This adjustment creates a minimum per capita water use threshold. Member agencies' retail-level water use under the WSAP is compared to two different thresholds. The minimum water use levels are based on compliance guidelines for total and residential water use established under Senate Bill X7-7.

**Total Retail Level Use:** 100 GPCD
**Residential Retail Level Use:** 55 GPCD

Agencies that fall below either threshold under the WSAP would receive additional allocation from Metropolitan to bring them up to the minimum GPCD water use level. To qualify for this credit, member agencies must provide documentation of the total agency level population and the percent of retail level demands that are residential; no appeal is necessary.

The following example gives a step-by-step description of how the Low Per-Capita Water Use Adjustment would be calculated for a hypothetical member agency. All numbers are hypothetical for the purpose of the example and do not reflect any specific member agency. This example was calculated using the following assumptions:

**Allocation Year Retail Demand:** 50,000 acre-feet
**Allocation Year Local Supplies:** 25,000 acre-feet;
**Allocation Year Wholesale Demand:** 25,000 acre-feet
**Base Period Conservation:** 5,000 acre-feet
**Agency Population:** 375,000
**Percent of Retail Demands that are Residential:** 60%

### Step 1: Calculate Total Retail-Level Allocation Year Supplies

Table 6 shows the Allocation Year Local Supply, WSAP Allocation, and the total Allocation Year Supplies for the example agency at each Regional Shortage Level. The WSAP Allocation was calculated using the methodology detailed in Appendix G: Water Supply Allocation Formula Example and the assumptions listed above.

| Table 6: Total Retail Level Allocation Year Supplies | | | |
|---|---|---|---|
| **Regional Shortage Level** | **Allocation Year Local Supply** | **WSAP Allocation** | **Total Allocation Year Supply** |
| 1 | 25,000 | 23,594 | 48,594 |
| 2 | 25,000 | 22,188 | 47,188 |
| 3 | 25,000 | 20,781 | 45,781 |
| 4 | 25,000 | 19,375 | 44,375 |
| 5 | 25,000 | 17,969 | 42,969 |
| 6 | 25,000 | 16,563 | 41,563 |
| 7 | 25,000 | 15,156 | 40,156 |
| 8 | 25,000 | 13,750 | 38,750 |
| 9 | 25,000 | 12,344 | 37,344 |
| 10 | 25,000 | 10,938 | 35,938 |

### Step 2: Calculate the Equivalent Total and Residential GPCD

The next step is to calculate the equivalent water use in gallons per capita per day (GPCD) for the Total Allocation Year Supply. The following equation shows the GPCD calculation under Regional Shortage Level 10.

35,938 af * 325,851 gallons ÷ 375,000 people ÷ 365 days = 85.6 GPCD

The residential per-capita water use is calculated in the same manner. Based on the assumption that 60% of the agency demands are residential, the following equation shows the residential GPCD calculation under Regional Shortage Level 10.

35,938 af * 60% * 325,851 gallons ÷ 375,000 people ÷ 365 days = 51.3 GPCD

### Step 3: Compare the Total and Residential GPCD to the Minimum Water Use Thresholds

The next step is to compare the total GPCD water use to the 100 GPCD total water use threshold. In a Regional Shortage Level 10, the WSAP results in an allocation that is 14.4 GPCD below the minimum threshold.

100 GPCD – 85.6 GPCD = 14.4 GPCD

Likewise the residential GPCD water use is compared to the 55 GPCD residential water use threshold.

55 GPCD – 51.3 GPCD = 3.7 GPCD

### Step 4: Determine the Allocation Adjustment in Acre-Feet

The final step is to calculate the acre-foot equivalent of the GPCD that fell below the minimum threshold. In a Regional Shortage Level 10, the adjustment provides 6,068 acre-feet of additional allocation to the agency; the results for Shortage Levels 1-10 are shown in Table 7.

14.4 GPCD ÷ 325,851 gallons * 375,000 people * 365 days = 6,068 acre-feet

| Table 7: Total Per-Capita Water Use Adjustment | | | | |
|---|---|---|---|---|
| **Regional Shortage Level** | **Allocation Year Supply** | **Equivalent GPCD** | **GPCD Below Threshold** | **Allocation Adjustment** |
| 1 | 48,594 | 115.7 | 0 | 0 |
| 2 | 47,188 | 112.3 | 0 | 0 |
| 3 | 45,781 | 109.0 | 0 | 0 |
| 4 | 44,375 | 105.6 | 0 | 0 |
| 5 | 42,969 | 102.3 | 0 | 0 |
| 6 | 41,563 | 98.9 | 1.1 | 443 |
| 7 | 40,156 | 95.6 | 4.4 | 1,849 |
| 8 | 38,750 | 92.3 | 7.7 | 3,255 |
| 9 | 37,344 | 88.9 | 11.1 | 4,662 |
| 10 | 35,938 | 85.6 | 14.4 | 6,068 |

Again, this step is repeated for the residential water use. In a Regional Shortage Level 10, the adjustment provides 1,540 acre-feet of additional allocation to the agency; the residential water use results for Regional Shortage Levels 1-10 are shown in Table 8.

3.7 GPCD ÷ 325,851 gallons * 375,000 people * 365 days = 1,540 acre-feet

| Table 8: Residential Per-Capita Water Use Adjustment | | | | |
|---|---|---|---|---|
| **Regional Shortage Level** | **Allocation Year Supply** | **Equivalent GPCD** | **GPCD Below Threshold** | **Allocation Adjustment** |
| 1 | 29,156 | 69.4 | 0 | 0 |
| 2 | 28,313 | 67.4 | 0 | 0 |
| 3 | 27,469 | 65.4 | 0 | 0 |
| 4 | 26,625 | 63.4 | 0 | 0 |
| 5 | 25,781 | 61.4 | 0 | 0 |
| 6 | 24,938 | 59.4 | 0 | 0 |
| 7 | 24,094 | 57.4 | 0 | 0 |
| 8 | 23,250 | 55.4 | 0 | 0 |
| 9 | 22,406 | 53.3 | 1.7 | 697 |
| 10 | 21,563 | 51.3 | 3.7 | 1,540 |

Agencies that fall below either threshold under the WSAP would receive additional allocation from Metropolitan to bring them up to the minimum GPCD water use level. If an agency qualifies under both thresholds, the one resulting in the maximum allocation adjustment would be given. Under this example the agency would receive 6,068 acre-feet of additional allocation in a Regional Shortage Level 10.

# Appendix K: Qualifying Income-Based Rate Allocation Surcharge Adjustment Example

The following example provides a step by step description of how the qualifying income-based rate allocation surcharge adjustment is calculated. To qualify for this adjustment, member agencies must provide documentation showing the amount of retail demands that are covered by a qualifying income-based rate; no appeal is necessary.

The following list summarizes the allocation year demands, local supplies, and allocation as calculated in Appendix G: Water Supply Allocation Formula Example for a hypothetical agency under a Level 4 Regional Shortage. For detailed instructions on how to calculate these figures, reference Appendix G: Water Supply Allocation Formula Example.

**Allocation Year Retail Demand:** 133,000 acre-feet
**Allocation Year Local Supplies:** 68,000 acre-feet;
**Level 4 WSAP Allocation:** 52,735 acre-feet

## Step 1: Allocation Surcharge Calculation

(a) **Water Use above Allocation:** The first step in calculating the income-based rate Allocation Surcharge adjustment is to calculate the agency's total Allocation Surcharge under the WSAP. If the agency did not incur any Allocation Surcharge from the allocation year, the income-based rate allocation surcharge adjustment would not apply. For the purpose of this example, the agency used 61,000 acre-feet of MWD supplies in the allocation year. This represents 8,265 acre-feet of use above the water supply allocation.

| | |
|---|---|
| WSAP Allocation | 52,735 af |
| Actual MWD Water Use | 61,000 af |
| **Use Above WSAP Allocation** | 8,265 af |

(b) **Total Allocation Surcharge:** In this example the agency used 115.7% of its water supply allocation. 7,910 of the 8,265 acre-feet of use above the allocation would be assessed the Allocation Surcharge at an amount of $1,480 per acre-foot and 354 of the 8,265 acre-feet of use above the allocation would be assessed the Allocation Surcharge at an amount of $2,960.

| | | | |
|---|---|---|---|
| Between 100% and 115% of Allocation | 7,910 af | $1,480/af | $11,706,800 |
| Greater than 115% of Allocation | 354 af | $2,960/af | $1,047,840 |
| **Total** | 8,265 af | | $12,754,640 |

## Step 2: Effective Income-Based Rate Cutback

(a) **Calculate Retail Cutback:** The second step in calculating the income-based rate allocation surcharge adjustment is to calculate the amount of supply cutback that would have been expected from qualifying income-based rate customers under the WSAP. Using the water supply allocation that was calculated above, the total retail level impact on the agency can be

determined. In this example the agency receives a retail level cutback of 15,265 acre-feet, or 11.5% of their retail level demand.

| | |
|---|---|
| WSAP Allocation + Allocation Year Local Supplies | 117,735 af |
| Allocation Year Retail Demand | 133,000 af |
| **Effective Cutback** | **15,265 af (11.5%)** |

**(b) Income-based Rate Customer Retail Cutback:** To calculate the effective income-based rate cutback, the amount of demand covered by a qualifying income-based rate is multiplied by the effective retail level cutback. For this example assume that the agency has 10,000 acre-feet of qualifying demands.

| | |
|---|---|
| Qualifying Income-Based Rate Demand | 10,000 af |
| Effective Cutback Percentage | 11.5% |
| **Effective Income-Based Rate Cutback** | **1,148 af** |

**(c) Income-based Rate Cutback Allocation Surcharge:** Once the effective cutback has been calculated, the amount of Allocation Surcharge that is associated with qualifying income-based rate customers can be determined.

| | | | |
|---|---|---|---|
| Between 100% and 115% of Allocation | 794 af | $1,480/af | $1,175,120 |
| Greater than 115% of Allocation | 354 af | $2,960/af | $1,047,840 |
| **Total** | **1,148 af** | | **$2,222,960** |

**(d) Adjusted Allocation Surcharge Calculation:** Finally, the Allocation Surcharge attributable to qualifying income-based rate customers is subtracted from the total Allocation Surcharge that was calculated above to determine the qualifying income-based rate adjusted allocation surcharge. In the case that the monetary amounts associated with the Income-Based Rate are greater than the total amounts an agency incurs, no Allocation Surcharge will be incurred.

| | |
|---|---|
| Total Allocation Surcharge | $12,754,640 |
| Qualifying Income-Based Rate Allocation Surcharge | $2,222,960 |
| **Qualifying Income-Based Rate Adjusted Allocation** | **$10,531,680** |

## Appendix L: Groundwater Replenishment Allocation

Groundwater basins help provide vital local supplies that can buffer the region from short-term drought impacts. Longer droughts can result in reductions to the many sources of water that replenish groundwater basins, resulting in lower basin levels and potential impacts to the overlying consumptive demands. Limited imported deliveries under these conditions may help avoid impacts to the basins that may be drawn out of their normal operating range or subject to water quality or regulatory impacts. To this end, Metropolitan provides a limited allocation for drought impacted groundwater basins based on the following framework:

a) Staff hold a consultation with qualifying member agencies who have taken groundwater replenishment deliveries since 2010 and the appropriate groundwater basin managers to document whether their basins are in one of the following conditions:
    i. Groundwater basin overdraft conditions that will result in water levels being outside normal operating ranges during the WSAP allocation period; or
    ii. Violations of groundwater basin water quality and/or regulatory parameters that would occur without imported deliveries.

b) Provide an allocation based on the verified need for groundwater replenishment. The allocation would start with a member agency's ten-year average purchases of imported groundwater replenishment supplies (excluding years in which deliveries were curtailed). The amount would then be reduced by the declared WSAP Regional Shortage Level (5 percent for each Regional Shortage Level).

c) Any allocation provided under this provision for drought impacted groundwater basins is intended to help support and maintain groundwater production for consumptive use. As such, a member agency receiving an allocation under this provision will be expected to maintain groundwater production levels equivalent to the average pumping in the Base Period. Any adjustments to a member agency's M&I allocation due to lower groundwater production would be reduced by deliveries made under this provision.

d) Agencies for which this allocation does not provide sufficient supplies for the needs of the groundwater basin may use the WSAP Appeals Process to request additional supply (subject to Board approval). The appeal should include a Groundwater Management Plan that documents the need for additional supplies according to the following tenets:
    i. Maintenance of groundwater production levels;
    ii. Maintenance of, or reducing the further decline of, groundwater levels;
    iii. Maintenance of key water quality factors/indicators;
    iv. Avoidance of permanent impacts to groundwater infrastructure or geologic features; and
    v. Consideration of severe and/or inequitable financial impacts.

Final amounts and allocations will be determined following the consultations with groundwater basin managers and member agencies.

# Appendix M: Water Rates, Charges, and Definitions

| Table 9: Water Rates and Charges<br>Dollars per acre-foot (except where noted) | | | |
|---|---|---|---|
| **Rate** | **Effective 1/1/2014** | **Effective 1/1/2015** | **Effective 1/1/2016** |
| Tier 1 Supply Rate | $148 | $158 | $156 |
| Tier 2 Supply Rate | $290 | $290 | $290 |
| System Access Rate | $243 | $257 | $259 |
| Water Stewardship Rate | $41 | $41 | $41 |
| System Power Rate | 161 | $126 | $138 |
| Tier 1 | $593 | $582 | $594 |
| Tier 2 | $735 | $714 | $728 |
| Treatment Surcharge | $297 | $341 | $348 |
| Full Service Treated Volumetric Cost | | | |
| Tier 1 | $890 | $923 | $942 |
| Tier 2 | $1,032 | $1,055 | $1,076 |
| Readiness-to-Serve Charge (millions of dollars) | $166 | $158 | $153 |
| Capacity Charge (dollars per cubic foot second) | $8,600 | $11,100 | $10,900 |

### Definitions:

(1) **Tier 1 Supply Rate -** recovers the cost of maintaining a reliable amount of supply.

(2) **Tier 2 Supply Rate** - set at Metropolitan's cost of developing additional supply to encourage efficient use of local resources**.**

(3) **System Access Rate** – recovers a portion of the costs associated with the delivery of supplies.

(4) **System Power Rate** – recovers Metropolitan's power costs for pumping supplies to Southern California.

(5) **Water Stewardship Rate** – recovers the cost of Metropolitan's financial commitment to conservation, water recycling, groundwater clean-up and other local resource management programs.

(6) **Treatment Surcharge** – recovers the costs of treating imported water.

(7) **Readiness-to-Serve Charge -** a fixed charge that recovers the cost of the portion of system capacity that is on standby to provide emergency service and operational flexibility.

(8) **Capacity Charge** – the capacity charge recovers the cost of providing peak capacity within the distribution system.

Source: http://www.mwdh2o.com/WhoWeAre/Management/Financial-Information

# Appendix N: Allocation Appeals Process

### Step 1: Appeals Submittal

All appeals shall be submitted to the Appeals Liaison in the form of a written letter signed by the member agency General Manager. Each appeal must be submitted as a separate request, submittals with more than one appeal will not be considered. The appeal request is to include:

- A designated member agency staff person to serve as point of contact.
- The type of appeal (erroneous baseline data, loss of local supply, etc.).
- The quantity (in acre-feet) of the appeal.
- A justification for the appeal which includes supporting documentation.

A minimum of 60 days are required to coordinate the appeals process with Metropolitan's Board process.

### Step 2: Notification of Response and Start of Appeals Process

The Appeals Liaison will phone the designated member agency staff contact within 3 business days of receiving the appeal to provide an initial receipt notification, and schedule an appeals conference. Subsequent to the phone call, the Liaison will send an e-mail to the Agency General Manager and designated staff contact documenting the conversation. An official notification letter confirming both receipt of the appeal submittal, and the date of the appeals conference, will be mailed within 2 business days following the phone contact

### Step 3: Appeals Conference

All practical efforts will be made to hold an appeals conference between Metropolitan staff and member agency staff at Metropolitan's Union Station Headquarters within 15 business days of receiving the appeal submittal. The appeals conference will serve as a forum to review the submittal materials and ensure that there is consensus understanding as to the spirit of the appeal. Metropolitan staff will provide an initial determination of the size of the appeal (small or large) and review the corresponding steps and timeline for completing the appeals process.

### *Steps 4-7 of the appeals process differ depending upon the size of the appeal*

### *Small Appeals*

Small appeals are defined as those that would change an agency's allocation by less than 10 percent, or are less than 5,000 acre-feet in quantity. Small appeals are evaluated and approved or denied by Metropolitan staff.

### Step 4: Preliminary Decision

Metropolitan staff will provide a preliminary notice of decision to the member agency within 10 business days of the appeals conference. The preliminary decision timeline may be extended to accommodate requests for additional information, data, and documentation. The Appeals Liaison will mail a written letter to the member agency staff contact and General Manager, stating the preliminary decision and the rationale for approving or denying the appeal.

### Step 5: Clarification Conference

Following the preliminary decision the Appeals Liaison will schedule a clarification conference. The member agency may choose to decline the clarification conference if they are satisfied with the preliminary decision. Declining the clarification conference serves as acceptance of the preliminary decision, and the decision becomes final upon approval by Metropolitan's executive staff.

### Step 6: Final Decision

Metropolitan staff will provide a final notice of decision to the member agency within 10 business days of the clarification conference, pending review by Metropolitan's executive staff. The Appeals Liaison will mail a written letter to the member agency staff contact and General Manager, stating the final decision and the rationale for the decision. A copy of the letter will also be provided to Metropolitan executive staff.

#### Step 6a: Board Resolution of Small Appeal Claims

Member agencies may request to forward appeals that are denied by Metropolitan staff to the Board of Directors through the Water Planning and Stewardship Committee for final resolution. The request for Board resolution shall be submitted to the Appeals Liaison in the form of a written letter signed by the member agency General Manager. This request will be administered according to Steps 6 and 7 of the large appeals process.

### Step 7: Board Notification

Metropolitan staff will provide a report to the Board of Directors, through the Water Planning and Stewardship Committee, on all submitted appeals including the basis for determination of the outcome of the appeal.

### *Large Appeals*

Large appeals are defined as those that would change an agency's allocation by more than 10 percent, and are larger than 5,000 acre-feet. Large appeals are evaluated and approved or denied by the Board of Directors.

### Step 4: Preliminary Recommendation

Metropolitan staff will provide a preliminary notice of recommendation to the member agency within 10 business days of the appeals conference. The preliminary decision timeline may be extended to accommodate requests for additional information, data, and documentation. The Appeals Liaison will mail a written letter to the member agency staff contact and General Manager, stating the preliminary recommendation and the rationale for the recommendation. A copy of the draft recommendation will also be provided to Metropolitan executive staff.

### Step 5: Clarification Conference

Following the preliminary recommendation the Appeals Liaison will schedule a clarification conference. The member agency may choose to decline the clarification conference if the satisfied with preliminary recommendation. Declining the clarification conference signifies acceptance of the preliminary recommendation, and the recommendation becomes final upon approval by Metropolitan's executive staff.

### Step 6: Final recommendation

Metropolitan staff will provide a final notice of recommendation to the member agency within 10 business days of the clarification conference, pending review by Metropolitan executive staff. The Appeals Liaison will mail a written letter to the member agency staff contact and General Manager, stating the final recommendation and the rationale for the recommendation. A copy of the final recommendation will also be provided for Metropolitan executive review.

### Step 7: Board Action

Metropolitan staff shall refer the appeal to the Board of Directors through the Water Planning and Stewardship Committee for approval.

# Appendix O: Appeals Submittal Checklist

## Appeal Submittal

- ☐ Written letter (E-mail or other electronic formats will not be accepted)
- ☐ Signed by the Agency General Manager

## Mailed to the appointed Metropolitan Appeals Liaison

## Contact Information

- ☐ Designated staff contact
  - o Name
  - o Address
  - o Phone Number
  - o E-mail Address
- ☐ General Manager
  - o Name
  - o Address
  - o Phone Number
  - o E-mail Address

## Type of Appeal

- ☐ State the type of appeal
  - o Erroneous historical data used in base period calculations
    - Metropolitan Deliveries
    - Local Production
    - Growth adjustment
    - Conservation savings
  - o Exclusion of physically isolated areas
  - o Extraordinary supply designation
  - o Groundwater Replenishment Allocation
  - o Base Period Mandatory Rationing Adjustment
  - o Other

## Quantity of Appeal

- ☐ State the quantity in acre-feet of the appeal

## Justification and Supporting Documentation

- ☐ State the rationale for the appeal
- ☐ Provide verifiable documentation to support the stated rationale
  - o Examples of verifiable documentation Include, but are not limited to:
    - Billing Statements
    - Invoices for conservation device installations
    - Basin Groundwater/Watermaster Reports
    - California Department of Finance economic or population data
    - California Department of Public Health reports

# Appendix 5

# LOCAL PROJECTS

**(From 2015 IRP local supply project survey April and July 2015)**

## Table A.5-1
## Recycled Water Projects

| Existing Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Anaheim | | |
| Anaheim Water Recycling Demonstration Project | 110 | 2012 |
| OCWD Groundwater Replenishment System - Anaheim Canyon Power Plant | 200 | 2011 |
| OCWD Groundwater Replenishment System - Anaheim Regional Transportation Intermodal Center | 10 | 2014 |
| City of Burbank | | |
| Burbank Recycled Water System Expansion Phase 2 Project | 960 | 2009 |
| Burbank Reclaimed Water System Expansion Project | 850 | 1995 |
| BWP Power Plant | 1,500 | 1985 |
| Calleguas Municipal Water District | | |
| Oxnard Advanced Water Purification Facility Ph. 1 | 2,310 | 2011 |
| Camrosa Water District Recycling System | 1,230 | 2005 |
| Camrosa Water District Recycling System | 450 | 1990 |
| Lake Sherwood Reclaimed Water System | 400 | 1997 |
| VCWWD No. 1 WWTP Recycled Water Distribution System | 2,200 | 2003 |
| VCWWD No. 8 Recycled Water Distribution System | 1,100 | 2001 |
| Central Basin Municipal Water District | | |
| Century/Rio Hondo Reclamation Program | 10,500 | 1992 |
| Montebello Forebay | 50,000 | 1990 |
| Cerritos Reclaimed Water Project | 4,000 | 1993 |
| Eastern Municipal Water District | | |
| Eastern Reach 1, Phase II Water Reclamation Project | 1,700 | 2000 |
| Eastern Regional Reclaimed Water System Reach 3 Reach 7 | 4,830 | 2013 |
| Eastern Recycled Water Expansion Project | 5,000 | 2013 |
| Recycled Water Pipeline Reach 16 Project | 820 | 2006 |
| Rancho California Reclamation Expansion Project | 6,000 | 1993 |
| Rancho California Reclamation | 4,950 | 1993 |
| Eastern Regional Reclaimed Water System (Non-LRP) | 21,200 | 1989 |
| Eastern Regional Reclaimed Water System (Non-LRP) | 22,400 | 1975 |
| Foothill Municipal Water District | | |
| La Canada-Flintridge Country Club | 90 | 1962 |
| City of Glendale | | |
| Glendale Water Reclamation Expansion Project | 500 | 1992 |
| Glendale Verdugo-Scholl Canyon Brand Park Reclaimed Water Project | 2,225 | 1995 |
| Glendale Grayson Power Plant Project | 460 | 1986 |
| Glendale Water Reclamation Expansion Project | 100 | 2013 |

| | | |
|---|---|---|
| Inland Empire Utilities Agency | | |
| IEUA Regional Recycling Water Distribution System | 3,500 | 1998 |
| IEUA Regional Recycling Water Distribution System | 13,500 | 1998 |
| IEUA Regional Recycled Water Distribution System (Non-LRP) | 7,550 | 2007 |
| IEUA Regional Recycled Water Distribution System (Non-LRP) | 15,000 | 1997 |
| IEUA Regional Recycled Water Distribution System (Non-LRP) (IPR) | 13,850 | 2005 |
| Las Virgenes Municipal Water District | | |
| Calabasas Reclaimed Water System | 4,000 | 1997 |
| Las Virgenes Valley Reclaimed Water System | 500 | 1997 |
| City of Long Beach | | |
| Alamitos Barrier Recycled Water Expansion Project | 3,475 | 2013 |
| Alamitos Barrier Reclaimed Water Project | 3,025 | 2005 |
| Long Beach Reclaimed Water Master Plan, Phase I System Expansion | 2,750 | 1986 |
| Long Beach Reclamation Project (Non-LRP Floor) | 2,100 | 2004 |
| THUMS | 1,429 | 1981 |
| City of Los Angeles | | |
| Hansen Area Water Recycling Project, Phase 1 | 2,115 | 2008 |
| Hansen Dam Golf Course Water Recycling Project | 500 | 2015 |
| Harbor Water Recycling Project | 50 | 2005 |
| Harbor Water Recycling Project | 4,950 | 2005 |
| Sepulveda Basin Water Recycling Project Phase IV | 550 | 2009 |
| Los Angeles Taylor Yard Park Water Recycling Project | 150 | 2009 |
| Van Nuys Area Water Recycling Project | 150 | 2009 |
| Griffith Park | 900 | 1997 |
| MCA/Universal | 300 | 1997 |
| Municipal Water District of Orange County | | |
| El Toro Recycled Water System Expansion | 1,175 | 2015 |
| Green Acres Reclamation Project - Coastal | 320 | 1991 |
| San Clemente Water Reclamation Project | 500 | 1990 |
| Trabuco Canyon Reclamation Expansion Project | 800 | 1992 |
| Green Acres Reclamation Project - Orange County | 2,160 | 1991 |
| Capistrano Valley Non Domestic Water System Expansion | 2,360 | 2006 |
| (SMWD Chiquita) Development Of Non-Domestic Water System Expansion in Ladera Ranch & Talega Valley. | 2,772 | 2005 |
| Michelson – Los Alisos WRP Upgrades | 8,500 | 2007 |
| Moulton Niguel Water Reclamation Project/Moulton Niguel Phase 4 Reclamation System Expansion | 9,276 | 2006 |
| OCWD Groundwater Replenishment System Seawater Barrier Project | 35,000 | 2008 |
| OCWD Groundwater Replenishment System Spreading Project | 35,000 | 2008 |
| South Coast WD South Laguna Reclamation Project | 1,450 | 2004 |
| IRWD Michelson Reclamation Project | 8,200 | 1997 |
| OCWD Groundwater Replenishment System Spreading Project, Phase II | 30,000 | 2015 |

| | | |
|---|---|---|
| Trabuco Canyon Reclamation Expansion Project (Non-LRP Floor) | 280 | 1992 |
| SMWD purchase from IRWD | 321 | 2001 |
| Trabuco Canyon Reclamation Expansion Project (Non-LRP) | 350 | 1992 |
| MNWD Moulton Niguel Water Reclamation Project (Non-LRP Floor) | 470 | 2006 |
| El Toro WD Recycling | 500 | 1997 |
| San Clemente Water Reclamation Project (Non-LRP) | 500 | 1997 |
| SJC Capistrano Valley Non-Domestic Water System Expansion (Non-LRP) | 565 | 1999 |
| IRWD Los Alisos Water Reclamation Plant | 1,500 | 1997 |
| OCWD Groundwater Replenishment System Spreading Project | 2,500 | 2008 |
| OCWD Groundwater Replenishment System Seawater Barrier Project (Non-LRP Floor/old Water Factory 21) | 5,000 | 1975 |
| City of Santa Ana | | |
| Green Acres Reclamation Project - Santa Ana | 320 | 1991 |
| City of Santa Monica | | |
| Dry Weather Runoff Reclamation Facility (SMURRF) | 280 | 2005 |
| San Diego County Water Authority | | |
| Oceanside Water Reclamation Project | 200 | 1992 |
| Santa Maria Water Reclamation Project | 400 | 1999 |
| San Elijo Water Reclamation System | 640 | 2000 |
| Escondido Regional Reclaimed Water Project | 650 | 2004 |
| Padre Dam Reclaimed Water System, Phase 1 | 850 | 1998 |
| San Elijo Water Reclamation System | 960 | 2000 |
| Fallbrook Public Utility District Water Reclamation Project | 1,200 | 1990 |
| Olivenhain Recycled Project – Southeast Quadrant (4S Ranch WRF) | 1,788 | 2003 |
| Encina Basin Water Reclamation Program - Phase I and II | 5,000 | 2005 |
| Otay Water Reclamation Project, Phase I/Otay Recycled Water System | 7,500 | 2005 |
| North City Water Reclamation Project | 11,000 | 1998 |
| Camp Pendleton | 680 | 1997 |
| Camp Pendleton | 1,020 | 1997 |
| Fairbanks Ranch | 308 | 1997 |
| North City Water Reclamation Project - City of Poway | 750 | 2009 |
| Olivenhain Northwest Quadrant Recycled Water Project (Meadowlark WRF) (Vallecitos) | 1,000 | 2009 |
| Olivenhain Recycled Project (SE Quad) - RG San Diego | 1,000 | 2009 |
| Olivenhain Southeast Quadrant Recycled Water Project (Non-LRP) (Santa Fe Valley WRF) | 100 | 2005 |
| Padre Dam MWD Recycled Water System (Non-LRP Floor) | 65 | 1998 |
| San Vincente Water Recycling Project (Non-LRP) | 235 | 2003 |
| San Vincente Water Recycling Project (Non-LRP) | 350 | 1996 |
| Rancho Santa Fe Water Pollution Control Facility | 500 | 1997 |
| Rincon del Diablo MWD Recycled Water Program (Non-LRP) | 3,426 | 2006 |
| San Diego Wild Animal Park | 168 | 1997 |
| South Bay Water Reclamation Project | 1,520 | 2006 |

| | | |
|---|---|---|
| Valley Center - Lower Moosa Canyon | 493 | 1974 |
| Valley Center MWD - Woods Valley Ranch | 84 | 2005 |
| Whispering Palms | 179 | 1997 |
| Whispering Palms | 269 | 1997 |
| Three Valleys Municipal Water District | | |
| City of Industry Regional Recycled Water Project - Suburban (7%) | 228 | 2012 |
| City of Industry Regional Recycled Water Project - Rowland | 1,536 | 2012 |
| City of Industry Regional Recycled Water Project - Walnut Valley | 2,531 | 2008 |
| Pomona Reclamation Project | 9,320 | 1975 |
| Pomona Reclamation Project - Cal-Poly Pomona | 1,500 | 1997 |
| Rowland Reclamation Project | 2,000 | 1997 |
| Fairway, Grand Crossing, Industry & Lycoming Wells into Reclamation System | 1,184 | 1997 |
| Walnut Valley Reclamation Project | 2,550 | 1985 |
| City of Torrance | | |
| Edward C. Little Water Recycling Facility (ELWRF) Treatment Facility, Phase I-IV | 7,800 | 1995 |
| Upper San Gabriel Valley Municipal Water District | | |
| Direct Reuse Project Phase IIA | 2,258 | 2006 |
| City of Industry Regional Recycled Water Project - Suburban (93%) | 3,032 | 2011 |
| Direct Reuse, Phase I | 1,000 | 2003 |
| Direct Reuse, Phase IIA Expansion/Rosemead Extension Project | 720 | 2012 |
| Direct Reuse, Phase IIB - Industry (Package 2) | 360 | 2012 |
| Direct Reuse, Phase IIB - Industry (Package 3) | 310 | 2012 |
| Direct Reuse, Phase IIB - Industry (Package 4) | 210 | 2012 |
| Los Angeles County Sanitation District Projects | 4,375 | 1985 |
| Norman's Nursery | 100 | 1997 |
| West Basin Municipal Water District | | |
| West Basin Water Recycling Phase V Expansion Project | 8,000 | 2013 |
| Edward C. Little Water Recycling Facility (ELWRF) Treatment Facility, Phase I-IV | 10,500 | 1995 |
| Edward C. Little Water Recycling Facility (ELWRF) Treatment Facility, Phase I-IV | 25,556 | 1995 |
| Western Municipal Water District of Riverside County | | |
| Elsinore Valley (Wildomar) Recycled Water System - Phase I Project | 300 | 2013 |
| City of Corona Reclaimed Water Distribution System | 16,800 | 1968 |
| Elsinore Valley/Horse Thief Reclamation | 560 | 1997 |
| Elsinore Valley/ Railroad Canyon Reclamation | 1,050 | 1997 |
| March Air Reserve Base Reclamation Project | 896 | 1997 |
| Rancho California Reclamation | 4,950 | 1997 |

| Under Construction Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Glendale | | |
| Glendale Public Works Yard | 80 | 2016 |
| City of Los Angeles | | |
| South Griffith Park Recycled Water Project | 370 | 2017 |
| Harbor Industrial Recycled Water Project | 9,300 | 2015 |
| North Atwater, Chevy Chase Park, Los Feliz Water Recycling Project | 50 | 2015 |
| Municipal Water District of Orange County | | |
| San Clemente Water Reclamation Project Expansion | 1,000 | 2017 |
| San Diego County Water Authority | | |
| Olivenhain Northwest Quadrant Recycled Water Project, Phase B | 300 | 2016 |
| Valley Center MWD - Wood Valley Water Recycling Facility Phase II Expansion | 196 | 2020 |
| Escondido Regional Reclaimed Water Project (Easterly Ag Distribution & MFRO with Mains and Brine)/Primary | 1,258 | 2019 |
| Western Municipal Water District of Riverside County | | |
| March Air Reserve Base Reclamation Project Expansion | 448 | 2012 |

| Full Design & Appropriated Funds Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Los Angeles | | |
| Terminal Island Expansion Project | 7,880 | 2018 |
| San Diego County Water Authority | | |
| Encina Basin Water Reclamation Program - Phase III | 3,314 | 2016 |
| City of San Diego PURE Water - Phase 1 North City | 33,630 | 2022 |
| Escondido Regional Reclaimed Water Project (HARRF Upgrades)/Primary | 2,492 | 2019 |
| Upper San Gabriel Valley Municipal Water District | | |
| Direct Reuse, Future Extensions of the Recycled Water Program | 130 | 2016 |
| Direct Reuse, Phase I - Rose Hills Expansion | 600 | 2016 |
| Indirect Reuse Replenishment Project (IRRP) | 10,000 | 2018 |
| Western Municipal Water District of Riverside County | | |
| Elsinore Valley/Tuscany, Phase IA | 1,225 | 2017 |

| Advanced Planning (EIR/EIS Certified) Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| Calleguas Municipal Water District | | |
| VCWWD No. 8 Recycled Water Distribution System | 1,250 | 2020 |
| Central Basin Municipal Water District | | |
| West San Gabriel Recycled Water Expansion Project | 500 | 2018 |
| East Los Angeles Recycled Water Expansion Project | 1,000 | 2021 |

| | | |
|---|---|---|
| Foothill Municipal Water District | | |
| Recycled Water Scalping Plant | 300 | 2018 |
| Inland Empire Utilities Agency | | |
| IEUA Regional Recycled Water Distribution System/IEUA Regional Recycled Water Distribution System (Non-LRP) | 20,000 | 2020 |
| City of Long Beach | | |
| Long Beach Reclamation Project Expansion, Phase II Boeing/Douglas Park | 450 | 2020 |
| City of Los Angeles | | |
| Downtown Water Recycling Project | 2,350 | 2020 |
| Sepulveda Basin Water Recycling Project Phase IV Expansion | 250 | 2017 |
| Municipal Water District of Orange County | | |
| SMWD Chiquita Development of Non-Domestic Water System Expansion I | 3,360 | 2018 |
| SMWD Chiquita Development of Non-Domestic Water System Expansion II | 5,600 | 2018 |
| City of Pasadena | | |
| Pasadena Non-Potable Water Project | 3,056 | 2019 |
| San Diego County Water Authority | | |
| Escondido Regional Potable Reuse Project | 5,000 | 2025 |
| Live Oak WRF | 42 | 2020 |
| North District Recycled Water System | 1,200 | 2020 |
| Western Municipal Water District of Riverside County | | |
| Elsinore Valley/Summerly | 1,380 | 2020 |

| Feasibility Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Anaheim | | |
| OCWD Groundwater Replenishment System - Anaheim Resort and Platinum Triangle | 1,100 | 2017 |
| Calleguas Municipal Water District | | |
| Oxnard Advanced Water Purification Facility Ph. 2 | 5,000 | 2020 |
| Eastern Municipal Water District | | |
| EMWD Indirect Potable Reuse (IPR) | 15,000 | 2020 |
| Rancho Indirect Potable Reuse | 9,070 | 2020 |
| Las Virgenes Municipal Water District | | |
| Woodland Hills Golf Course Extension | 324 | 2018 |
| City of Los Angeles | | |
| San Pedro Waterfront Water Recycling Project | 100 | 2022 |
| Water Recycling Small Pipeline Extension Projects | 1,000 | 2020 |
| Woodland Hills Water Recycling Project | 290 | 2019 |
| Tillman Groundwater Replenishment System | 30,000 | 2022 |
| Los Angeles Greenbelt Project Extension | 250 | 2018 |
| LA Zoo Water Recycling Project | 85 | 2020 |
| LAX Cooling Towers | 240 | 2021 |
| Elysian Park Tank & Pumping Station Water Recycling Project | 400 | 2022 |
| Garber Street Tank Water Recycling Project | 500 | 2018 |

| | | |
|---|---|---|
| Municipal Water District of Orange County | | |
| South Coast WD J.B. Latham AWT Joint project | 7,841 | 2020 |
| San Diego County Water Authority | | |
| Oceanside IPR Project | 2,500 | 2020 |
| Olivenhain Joint RW Transmission Project with SFID and OMWD | 1,200 | 2020 |
| Otay WD - North District Recycled Water System | 4,400 | 2025 |
| Padre Dam Phase 1 East County, 2.2 mgd Potable Reuse | 2,464 | 2019 |
| Padre Dam Phase 1 East County, T22 Expansion from 2 to 6 mgd | 1,008 | 2019 |
| Padre Dam Phase 2 East County,11.6 mgd Potable Reuse | 12,992 | 2022 |
| Santa Maria Water Reclamation Project | 3,000 | 2020 |
| Santa Fe ID Eastern Service Area Recycled Water Project | 689 | 2025 |
| Santa Fe ID Western Service Area Recycled Water System Expansion Project | 111 | 2020 |
| Upper San Gabriel Valley Municipal Water District | | |
| Miller Coors Direct Reuse and Groundwater Recharge Project | 1,000 | 2020 |
| West Basin Municipal Water District | | |
| Carson Regional Water Recycling Facility (CRWRF) Phase III Expansion Project - BP Expansion | 2,100 | 2018 |
| Western Municipal Water District of Riverside County | | |
| Rancho California Reclamation Expansion/demineralization Western AG | 13,800 | 2018 |

| Conceptual Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Burbank | | |
| Direct potable reuse of recycled water | 4,000 | 2025 |
| Foothill Municipal Water District | | |
| Verdugo Basin Project | 560 | 2020 |
| City of Los Angeles | | |
| Natural Advanced Treatment Concept | 19,000 | 2025 |
| Encino Reservoir Recycled Water Storage Concept | 1,550 | 2025 |
| LA Westside Title 22 | 5,500 | 2030 |
| Harbor Area Water Recycling Expansion and Storage | 12,220 | 2022 |
| Municipal Water District of Orange County | | |
| IRWD Michelson Reclamation Project Expansion, Phase II | 2,300 | 2025 |
| OCWD Groundwater Replenishment System Spreading Project, Phase III | 30,000 | 2025 |
| LBCWD Laguna Canyon Recycling Project | 200 | 2025 |
| El Toro WD Recycling/El Toro Recycled Water System Expansion II | 225 | 2025 |
| San Diego County Water Authority | | |
| City of San Diego PURE Water - Phase 2 Central Area | 42,598 | 2035 |
| City of San Diego PURE Water - Phase 3 South Bay | 16,815 | 2035 |
| Lake Turner Non-Potable Distribution System | 440 | 2025 |
| Lakeside Riverview Well Field Groundwater Recovery | 500 | 2020 |

| | | |
|---|---|---|
| Olivenhain Wanket Reservoir RW Conversion | 200 | 2020 |
| Santa Fe ID Advanced Water Purification Project | 1,100 | 2030 |
| Valley Center MWD - Welk WRF | 84 | 2025 |
| Valley Center MWD - Lilac Ranch WRF | 140 | 2020 |
| Lower Moosa Canyon WRF - AWT Upgrade | 280 | 2020 |
| Valley Center MWD - Woods Valley Ranch WRF Phase 3 Expansion | 179 | 2020 |
| City of Torrance | | |
| Joint Water Pollution Control Plant (JWPCP) | 5,000 | 2020 |
| Upper San Gabriel Valley Municipal Water District | | |
| Direct Reuse, Phase II - Satellite Treatment Plant | 500 | 2020 |
| Western Municipal Water District of Riverside County | | |
| City of Riverside Recycled Water Program | 2,270 | 2025 |
| City of Riverside Recycled Water Program Expansion | 19,130 | 2025 |
| City of Riverside Recycled Water Program Expansion | 20,000 | 2025 |

## Table A.5-2
## Groundwater Recovery Projects

| Existing Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Beverly Hills | | |
| Beverly Hills Desalter Project | 3,120 | 2003 |
| City of Burbank | | |
| Burbank Operable Unit/Lockheed Valley Plant | 11,000 | 1996 |
| Calleguas Municipal Water District | | |
| Round Mountain Water Treatment Plant | 1,000 | 2013 |
| Tapo Canyon Water Treatment Plant | 1,445 | 2010 |
| Central Basin Municipal Water District | | |
| Water Quality Protection Project | 5,807 | 2004 |
| Eastern Municipal Water District | | |
| Menifee Basin Desalter Project | 4,032 | 2002 |
| Perris Desalter | 4,500 | 2006 |
| Foothill Municipal Water District | | |
| Glenwood Nitrate Water Reclamation Project | 150 | 2003 |
| City of Glendale | | |
| San Fernando Wells Basin - Glendale Operable Units | 8,469 | 2001 |
| Verdugo Basin Wells A & B | 2,750 | 1997 |
| Inland Empire Utilities Agency | | |
| Chino Basin Desalination Program, Phase I / Inland Empire | 17,500 | 2000 |
| Municipal Water District of Orange County | | |
| Capistrano Beach Desalter Project | 1,560 | 2007 |
| Tustin Desalter Project (17th St.) | 3,840 | 1996 |
| San Juan Basin Desalter Project | 5,760 | 2004 |
| IRWD Wells 21 & 22 | 6,400 | 2013 |
| Irvine Desalter Project | 6,700 | 2007 |
| Colored Water Treatment Facility Project | 11,300 | 2001 |
| IRWD DATS Project | 8,300 | 2001 |
| Tustin Main Street Nitrate | 2,000 | 1997 |
| Well 28 | 4,300 | 1997 |
| San Diego County Water Authority | | |
| Lower Sweetwater River Basin Groundwater Demineralization Project, Phase I | 3,600 | 2000 |
| Oceanside Desalter Project/Oceanside (Mission Basin) Desalter Expansion Project | 7,800 | 2003 |
| San Vicente & El Capitan Seepage Recovery | 500 | 2015 |

| | | |
|---|---|---|
| Three Valleys Municipal Water District | | |
| Cal-Poly Pomona Water Treatment Plant | 250 | 2013 |
| Pomona Well #37 – Harrison Well Groundwater Treatment Project | 1,000 | 2006 |
| City of Pomona VOC Plant | 4,678 | 1997 |
| Pomona Well #37 – Harrison Well Groundwater Treatment Project (Non-LRP) | 1,200 | 2011 |
| City of Torrance | | |
| Madrona Desalination Facility (Goldsworthy Desalter) | 2,880 | 2002 |
| Western Municipal Water District of Riverside County | | |
| Temescal Basin Desalting Facility Project | 10,000 | 2001 |
| Chino Basin Desalination Program, Phase I / Western | 17,500 | 2000 |
| Temescal Basin Desalting Facility Project (Non-LRP) | 5,600 | 2001 |
| **Under Construction Projects** | **Ultimate Yield/Capacity (Acre-Feet)** | **Online Date** |
| Eastern Municipal Water District | | |
| Moreno Valley Groundwater Development Program | 2,000 | 2018 |
| City of Glendale | | |
| Verdugo Basin Rockhaven Well | 500 | 2016 |
| San Diego County Water Authority | | |
| Lower Sweetwater Desalter, Phase II | 5,200 | 2017 |
| **Full Design & Appropriated Funds Projects** | **Ultimate Yield/Capacity (Acre-Feet)** | **Online Date** |
| Eastern Municipal Water District | | |
| Brackish Wells 94, 95, and 96 | 2,250 | 2018 |
| Perris Desalter II | 4,000 | 2020 |
| San Diego County Water Authority | | |
| Rancho del Rey Well Desalination | 400 | 2025 |
| City of Torrance | | |
| Madrona Desalter (Goldsworthy) Expansion | 2,400 | 2017 |
| **Advanced Planning (EIR/EIS Certified) Projects** | **Ultimate Yield/Capacity (Acre-Feet)** | **Online Date** |
| Calleguas Municipal Water District | | |
| North Pleasant Valley Desalter | 7,300 | 2020 |
| City of Los Angeles | | |
| Tujunga Well Treatment | 24,000 | 2020 |
| Municipal Water District of Orange County | | |
| SJC San Juan Desalter Project Expansion | 2,000 | 2020 |
| Tustin Legacy Well # 1 | 2,200 | 2020 |

| Feasibility Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Beverly Hills | | |
| Groundwater Development | 2,000 | 2023 |
| Calleguas Municipal Water District | | |
| Moorpark/South Las Posas Desalter Phase 1 | 5,000 | 2020 |
| West Simi Desalter (District 8) | 2,800 | 2025 |
| Eastern Municipal Water District | | |
| Perris Groundwater Development (Well and Pipeline) | 1,000 | 2018 |
| Municipal Water District of Orange County | | |
| IRWD Wells 51, 52 & 53 Potable (Non-exempt) | 2,400 | 2020 |
| City of San Marino | | |
| San Marino GWR Project | 2,500 | 2018 |
| San Diego County Water Authority | | |
| Middle Sweetwater River Basin Groundwater Well System (Otay WD) | 1,500 | 2025 |
| Mission Valley Brackish Groundwater Recovery Project (City of San Diego) | 1,680 | 2025 |
| Oceanside Mission Basin Desalter Expansion/Seawater Recovery and Treatment | 5,600 | 2025 |
| Otay Mesa Lot 7 Well Desalination (Otay WD) | 400 | 2025 |
| San Diego Formation / Diamond BID Pilot Production Well | 1,600 | 2025 |
| San Paqual Brackish Groundwater Recovery Project (City of San Diego) | 1,619 | 2020 |
| Sweetwater Authority/Otay WD San Diego Formation Recovery | 3,900 | 2025 |

| Conceptual Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| City of Beverly Hills | | |
| Shallow Groundwater Development | 500 | 2020 |
| Calleguas Municipal Water District | | |
| Camrosa Santa Rosa Basin Desalter | 1,000 | 2022 |
| Municipal Water District of Orange County | | |
| LBCWD Groundwater Facility | 2,025 | 2025 |
| Mesa Colored Water Treatment Facility Project, Phase II | 5,650 | 2018 |
| South Coast WD Capistrano Beach Desalter Expansion | 1,200 | 2025 |
| San Diego County Water Authority | | |
| San Dieguito River Basin Brackish GW Recovery and Treatment | 1,500 | 2025 |
| Western Municipal Water District of Riverside County | | |
| Arlington Basin Groundwater Desalter Project Expansion | 2,000 | 2020 |
| Arlington Basin Groundwater Desalter Project Expansion Advanced Brine Treatment | 1,900 | 2020 |
| Arlington Basin Groundwater Desalter Project Expansion Biological Denitrification | 4,100 | 2020 |

## Table A.5-3
## Seawater Desalination Projects

| Existing Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| San Diego County Water Authority | | |
| Carlsbad Seawater Desalination Project | 56,000 | 2015 |

| Advanced Planning (EIR/EIS Certified) Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| Municipal Water District of Orange County | | |
| Huntington Beach Seawater Desalination Project | 56,000 | 2017 |

| Feasibility Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| San Diego County Water Authority | | |
| Rosarito Beach Seawater Desalination Feasibility Study (Otay WD) | 28,000 | 2025 |
| West Basin Municipal Water District | | |
| West Basin Seawater Desalination Project | 22,400 | 2022 |

| Conceptual Projects | Ultimate Yield/Capacity (Acre-Feet) | Online Date |
|---|---|---|
| Municipal Water District of Orange County | | |
| South Orange (Dana Point) Coastal Ocean Desalination Project | 16,800 | 2020 |
| San Diego County Water Authority | | |
| Camp Pendleton Seawater Desalination Project | 56,000 | 2035 |

# Appendix 6

# CONSERVATION ESTIMATES AND WATER SAVINGS FROM CODES, STANDARDS, AND ORDINANCES

# Appendix 6
# CONSERVATION ESTIMATES AND WATER SAVINGS FROM CODES, STANDARDS, AND ORDINANCES

## Background

Unlike traditional water supplies, which can be directly measured, conservation reduces water demand in ways that are quantified indirectly. Demand is reduced through changes in consumer behavior and savings from water-efficient fixtures. There are numerous approaches for estimating and projecting conservation savings, and many of them are utility-specific to meet the unique needs of different water agencies. Metropolitan estimates savings from the extensive existing conservation programs that it funds, as well as savings produced by plumbing codes. Metropolitan also incorporates the savings due to the impacts of price on consumers in its demand forecasts. These conservation savings estimates are incorporated into Metropolitan's long-term planning such as the Integrated Water Resources Plan (IRP) and included in its Urban Water Management Plan (UWMP).

Conservation savings are commonly estimated from a base-year water-use profile. Beginning with the 1996 IRP, Metropolitan identified 1980 as the base year for estimating conservation because it marked the effective date of a new plumbing code in California requiring toilets in new construction to be rated at 3.5 gallons per flush or less. Between 1980 and 1990, the Metropolitan service area saved an estimated 250 TAF per year as the result of this 1980 plumbing code and unrelated water rate increases. Within Metropolitan's planning framework, these savings are referred to as "pre-1990 savings." Metropolitan's conservation accounting combines pre-1990 savings and estimates of more recently achieved savings from the following sources of conservation:

- Active Conservation – Water saved directly as a result of conservation programs by water agencies, including implementation of Best Management Practices by the California Urban Water Conservation Council (CUWCC). Active conservation is unlikely to occur without agency action.
- Code-Based Conservation – Water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes. Sometimes referred to as "passive conservation," this form of conservation would occur as a matter for course without any additional action from water agencies.
- Price-Effect Conservation – Water saved by retail customers attributable to the effect of changes in the real (inflation-adjusted) price of water. Because water has a positive price elasticity of demand, increases in water price will decrease the quantity demanded.

## Metropolitan's Conservation Estimate

In September 19, 2014, Governor Brown signed SB 1420 (Wolk, D-Davis), which added Section 10631(e)(4) to the Water Code. This Section provides that "water use projections may display and account for the water savings estimated to result from adopted codes, standards,

ordinances, or transportation and land use plans" if that information is available and applicable to an urban water supplier.

Metropolitan's conservation estimate involves a comprehensive representation of Metropolitan's active conservation activities, which utilizes a combination of: (1) fixture/program savings rates based on CUWCC reports and other sources, and (2) a measurement of code-based plumbing code conservation from a 1990 base year. In addition, the price-effect savings is also calculated using Metropolitan's MWD-EDM, a statistical model used for forecasting retail water demands. Potential savings from public outreach and education programs are not included in Metropolitan's conservation estimate.

Distinguishing between active, code-based, and price-effect conservation can be complex when, for example, active programs for fixtures are concurrent with conservation-related plumbing codes. Metropolitan's conservation estimate combines active, code-based, and price-effect conservation savings using methods that avoid double counting. Currently, there are 74 devices and programs accounted for in estimating active conservation. These devices are aggregated into residential, landscape, commercial, industrial, and institutional sectors. There are eight fixtures tied to Code-based conservation estimate. Metropolitan's conservation estimate is developed in cooperation with its 26 member agencies and is categorized into:

- Single-family residential (SFR),
- Multi-family residential (MFR), and
- Commercial, industrial, and institutional (CII).

### *Active Conservation*

The estimated savings from active conservation take into account programs administered by Metropolitan and its member agencies since 1990. The savings are calculated by combining counts of active program activity – numbers of devices and/or program implementations – with device-related savings factors. The factors include:

- Savings per device/implementation
- Device life expressed in years
- Decay rate expressed as percent decay per year

Device savings estimates are determined by key assumptions described above. Devices may be represented more than once due to different implementation methods or savings factors. Assumptions are periodically reviewed to ensure they represent the best savings estimates available. Device savings are limited by decay rates, or device life, but not both at the same time. For example, a residential high-efficiency toilet (HET) saves about 38 gallons per day over a lifetime of 20 years with no assumed decay rate.

### *Code-Based Conservation*

Code-Based conservation accounts for water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes. Plumbing code conservation is the impact of plumbing codes and other ordinances on water demand. Metropolitan's Code-Based conservation estimate represents plumbing code conservation with demographically-driven stock models. The stock models are device- or fixture- specific and are based on the same demographic data used in Metropolitan's retail demand projection. Each stock model tracks the stocks and flows of conserving and non-conserving water devices, allowing it to estimate the impacts of plumbing codes on device saturation and overall savings.

The Metropolitan's Code-Based conservation estimate accounts for the following:

- New Construction: Water fixtures installed due to new construction are assumed to be in compliance with the plumbing codes in effect when the new construction occurs. For instance, a house built in 1997 would meet the efficiency standards set by California's 1992 plumbing code. Therefore, new construction is assumed to result in measurable savings from 1990, which is the baseline for conservation savings calculations. Estimates and projections of the number of fixtures added through new housing units and offices are based on growth in housing units or employment.
- Natural Replacement: Natural replacement accounts for the savings that accrue when fixtures are replaced with more efficient models due to remodeling, failure, or other reasons. Metropolitan's savings estimate represents this effect with a "natural replacement rate" that is expressed as a percentage of existing fixtures that are replaced in a given year. Natural replacement rates vary by device and are linked to the expected life of the device. Devices with short lifespans will be replaced more frequently and thus have higher natural replacement rates. A simple percentage is used to account for this natural turn-over in non-conserving fixtures because it is difficult to back-calculate the age of the fixtures in pre-1990 construction.
- Fixtures Up for Renewal: As water-conserving fixtures reach their useful lives and become defective or inefficient, they may be replaced with water conserving fixtures due to plumbing codes. The water savings from the device is then considered "renewed" savings, which is tracked in Metropolitan's savings estimate. For example, a fixture that was installed through an active conservation program provides water savings that otherwise would not have been realized without plumbing codes. However, subsequent adoption of efficient plumbing codes means that when the fixture reaches the end of its life, it will be replaced by the same or more water-efficient model.

### *Stock Models*

The number of efficient fixtures for each stock model is the sum of fixtures from active programs, new construction, natural replacement, and fixtures up for renewal. Table A.6-1 below shows the fixtures and devices that are assigned stock models based on existing plumbing codes.

**Table A.6-1**
**Stock Models**

| Residential | CII |
|---|---|
| Toilets | Toilets |
| Showerheads | Urinals |
| Faucet Aerators | Pre-Rinse Spray Heads |
| Washing Machines | Washing Machines |

The Stock Models generate separate annual estimates of devices and fixtures for tracking active conservation savings, while also accounting for the impacts of active programs on the overall device saturation rate. As a result, increased levels of active conservation lead to lower levels of plumbing code conservation. This helps avoid double counting in Metropolitan's conservation savings estimate.

### *Plumbing Code Assumptions*

Plumbing code savings are determined by the device-specific assumptions used in the stock models, presented in Table A.6-2. The stock models are driven by projections of housing and employment consistent with the demand projections. Initial device counts and growth in the number of devices are determined by the demographics combined with the following assumptions:

- Devices per Household or Per Employee: This factor represents the average number of devices per household or per employee and is multiplied by the demographic projections to develop estimates of total number of devices or "stock." Devices per household and employee can vary by agency and change over time.
- Plumbing Code Compliance Rate: The plumbing code compliance rate is expressed as a percent and serves two purposes: (1) it indicates the presence of a plumbing code in a specific year, and (2) it determines the overall compliance rate with the plumbing code. This allows plumbing code effects to be phased in over several years.
- Natural Replacement Rate: This represents the rate at which existing non-conserving devices are converted to conserving devices due to remodeling or device failure. It has a strong impact on the saturation rate of devices that existed prior to plumbing codes, such as pre-1992 toilets.
- Device Life: The stock models also account for device life for water-efficient devices installed after 1990. This allows the stock model to track devices installed through active conservation as they reach the end of their life and are replaced due to plumbing codes. The stock models use the same device life specified in the savings assumptions.

**Table A.6-2**
**Plumbing Code Assumptions**

| Stock Model | Device per Household/ Employee | Compliance Rate | Natural Replacement Rate | Plumbing Code Year |
|---|---|---|---|---|
| Res. Toilets | 2 | 99% | 2% | 1992/2014 |
| Res. Shower Heads | 1.8 | 95% | 10% | 1992 |
| Res. Aerators | 3.5 | 90% | 33% | 1992 |
| Res. Washing Machine | 0.74 | 100% | 6.7% | 2007 |
| CII Toilets | 0.27* | 100% | 2% | 1992/2014 |
| CII Urinals | 0.06 | 100% | 4% | 1992 |
| CII Pre-Rinse Spray Heads | 0.0055* | 95% | 16.7% | 2006 |
| CII Washing Machine | 0.0073* | 100% | 5% | 2007 |

* Varies over time and by agency (based on CUWCC BMPs savings factors)

These assumptions are derived from CUWCC conservation reports, American Water Works Association Research Foundation's 1999 end use study, Metropolitan's Orange County Saturation Study, and other sources. In the residential sector, devices per household combine single family and multifamily trends.

### *Model Water Efficient Landscape Ordinance*

The California Water Commission adopted an updated Model Water Efficient Landscape Ordinance (MWELO) on July 15, 2015. The MWELO promotes efficient landscapes in new developments and retrofitted landscapes. The MWELO increases water efficiency standards for new and retrofitted landscapes through more efficient irrigation systems, greywater usage, onsite storm water capture, and by limiting the portion of landscapes that can be covered in turf. Local agencies had until December 1, 2015 to adopt the MWELO or to adopt a Local Ordinance which must be at least as effective in conserving water as MWELO. Local agencies working together to develop a Regional Ordinance had until February 1, 2016 to adopt, but they are still subject to the December 2015 reporting requirements. Local agencies were required to report on the implementation and enforcement of local ordinances by December 31, 2015.

Metropolitan's modeling of code-based conservation includes a calculation of savings that would result from 50 percent of new households having efficient outdoor water use consistent with MWELO. The 50 percent compliance rate for new households is a conservative estimate based on an assessment of the efficacy of the current MWELO ordinance.

Metropolitan's 2015 IRP Update includes a regional target for additional conservation development. This target is based on estimates calculated from the potential savings that could result from increasing MWELO compliance from 50 percent to 100 percent of new households, and on the potential savings that could result from one percent per year of all existing households reducing outdoor water use in a manner consistent with MWELO. Because MWELO does not apply to existing households, it is anticipated that achieving the equivalent MWELO efficient water savings will require a combination of approaches that can target reductions in outdoor water use.

### *Price Savings Assumptions*

Price-effect savings are calculated by comparing MWD-EDM demand projections with price increases to demand projections with constant 1990 water rates. The difference is the price-effect savings measured from a 1990 base. Price-effect savings increase as prices rise over time; they also increase as the household and employment base grow. A price increase applied to 1,000 households will generate more water savings than the same price increase applied to 500 households.

### *Un-metered Water Use Savings*

A final category of savings tracked by Metropolitan is a product of other conservation efforts. MWD-EDM projects un-metered water use as a fixed percentage of total retail M&I demand. As conservation savings lowers residential and CII demands, it lowers un-metered use by the same percent. For instance, if conservation reduces M&I demands by 10 percent in 2020 (compared to demands before conservation), un-metered water use is also reduced 10 percent. This reduction is based on the assumption that un-metered use varies according to overall demand and that reducing overall use also reduces un-metered use. The reduction in un-metered water use is captured in the MWD-EDM model and included as a conservation source.

The total passive savings are shown in Table A.6-3 below.

**Table A.6-3**
**Passive Savings**[1]
**(Acre-feet)**

| | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|---|
| **Total** | 701,000 | 765,000 | 846,000 | 931,000 | 1,016,000 | 1,097,000 | 1,180,000 |

[1] Passive savings are accounted for in water use projections in Section 2.

# Appendix 7

# DISTRIBUTION SYSTEM WATER LOSSES

# Appendix 7
# DISTRIBUTION SYSTEM WATER LOSSES

Metropolitan followed the American Water Works Association (AWWA) Water Audit methodology to track all sources of water and uses of water within its system. The AWWA Audit methodology quantifies real and apparent water system losses in an agency's distribution system. Section 10631(e)(3)(A) of the California Water Code requires that the 2015 Urban Water Management Plan quantify distribution system water losses for the most recent 12-month period available.

For the distribution system water losses assessment, Metropolitan is including its water balance audit for calendar years 2014 and 2013, as presented in tables A.7-1 and A.7-2, respectively. In addition, this appendix also includes a memorandum entitled "Metropolitan Water District – Water Balance Validation & Component Analysis Feasibility Study" dated January 16, 2013. This memorandum discusses the water balance assessment for year 2012. The 2014 and 2013 assessments were updated using the methods and worksheets developed in the 2012 assessment, and results were submitted as part of Metropolitan's CUWCC filings included in Appendix 8.

In addition to the distribution system losses described in the AWWA tables, Metropolitan estimates that 37 TAF was lost from reservoir evaporation occurring in Lake Mathews, Lake Skinner, and Diamond Valley Lake during calendar year 2014.

**Table A.7-1**
**Metropolitan's Distribution**
**System Water Loss (AF)**
**Calendar Year 2014**

## AWWA Free Water Audit Software: Water Balance

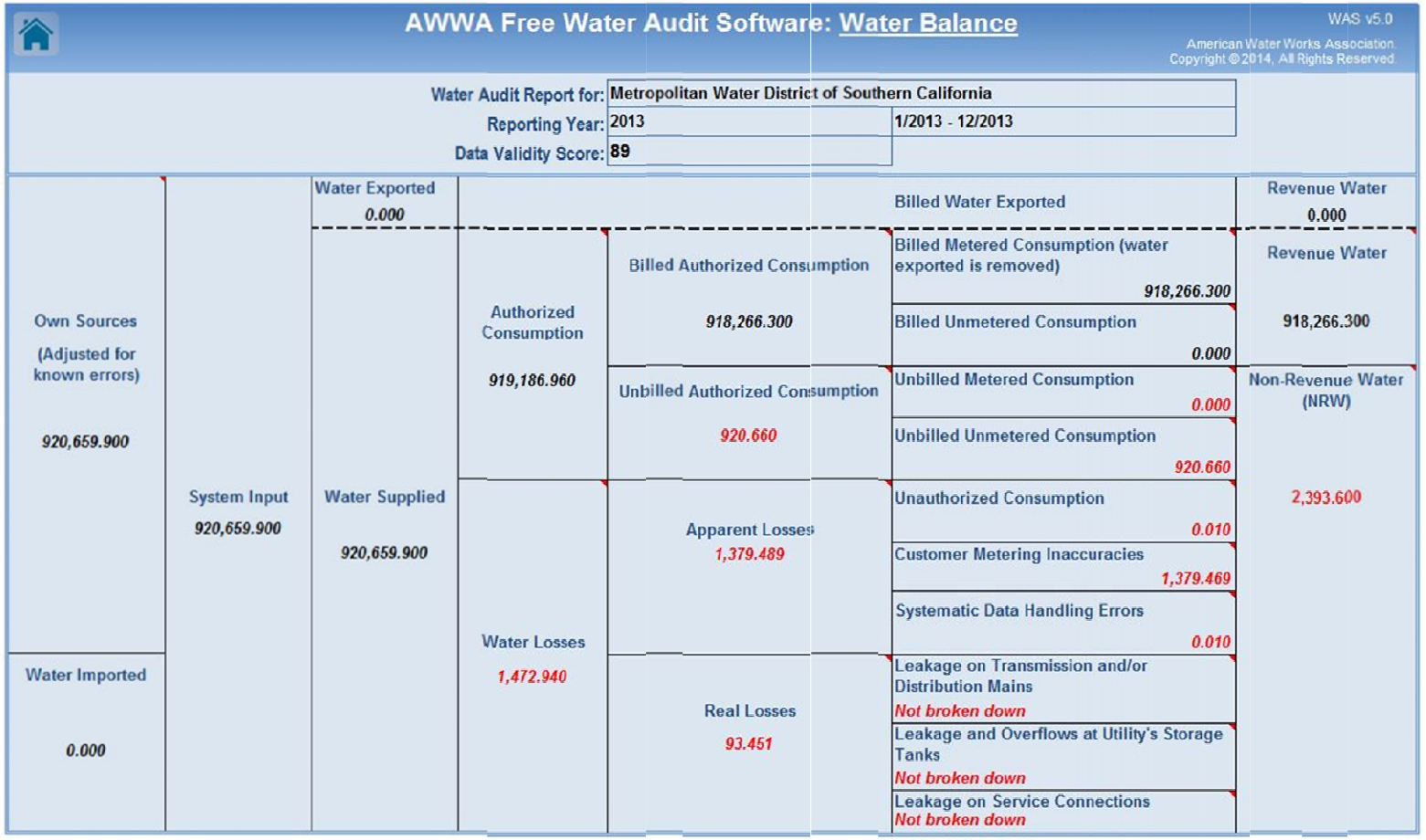
WAS v5.0

American Water Works Association.
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| | |
|---|---|
| Water Audit Report for: | Metropolitan Water District of Southern California |
| Reporting Year: | 2014 (1/2014 - 12/2014) |
| Data Validity Score: | 89 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Own Sources (Adjusted for known errors) 898,936.768 | System Input 898,936.768 | Water Exported 0.000 | | | Billed Water Exported | Revenue Water 0.000 |
| | | Water Supplied 898,936.768 | Authorized Consumption 892,528.150 | Billed Authorized Consumption 891,638.200 | Billed Metered Consumption (water exported is removed) 891,638.200 | Revenue Water 891,638.200 |
| | | | | | Billed Unmetered Consumption 0.000 | |
| | | | | Unbilled Authorized Consumption 889.950 | Unbilled Metered Consumption 0.000 | Non-Revenue Water (NRW) 7,298.568 |
| | | | | | Unbilled Unmetered Consumption 889.950 | |
| | | | Water Losses 6,408.618 | Apparent Losses 1,394.466 | Unauthorized Consumption 5.000 | |
| | | | | | Customer Metering Inaccuracies 1,339.466 | |
| | | | | | Systematic Data Handling Errors 50.000 | |
| Water Imported 0.000 | | | | Real Losses 5,014.151 | Leakage on Transmission and/or Distribution Mains Not broken down | |
| | | | | | Leakage and Overflows at Utility's Storage Tanks Not broken down | |
| | | | | | Leakage on Service Connections Not broken down | |

**Table A.7-2**
**Metropolitan's Distribution**
**System Water Loss (AF)**
**Calendar Year 2013**



AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.
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Water Audit Report for: Metropolitan Water District of Southern California
Reporting Year: 2013 (1/2013 - 12/2013)
Data Validity Score: 89

| | | | | | | |
|---|---|---|---|---|---|---|
| Own Sources (Adjusted for known errors) 920,659.900 | System Input 920,659.900 | Water Exported 0.000 | | | Billed Water Exported | Revenue Water 0.000 |
| | | Water Supplied 920,659.900 | Authorized Consumption 919,186.960 | Billed Authorized Consumption 918,266.300 | Billed Metered Consumption (water exported is removed) 918,266.300 | Revenue Water 918,266.300 |
| | | | | | Billed Unmetered Consumption 0.000 | |
| | | | | Unbilled Authorized Consumption 920.660 | Unbilled Metered Consumption 0.000 | Non-Revenue Water (NRW) 2,393.600 |
| | | | | | Unbilled Unmetered Consumption 920.660 | |
| | | | Water Losses 1,472.940 | Apparent Losses 1,379.489 | Unauthorized Consumption 0.010 | |
| | | | | | Customer Metering Inaccuracies 1,379.469 | |
| | | | | | Systematic Data Handling Errors 0.010 | |
| Water Imported 0.000 | | | | Real Losses 93.451 | Leakage on Transmission and/or Distribution Mains Not broken down | |
| | | | | | Leakage and Overflows at Utility's Storage Tanks Not broken down | |
| | | | | | Leakage on Service Connections Not broken down | |

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San Francisco, CA 94103
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WSO

**TO:** **Mark Graham, Keith Nobriga, Timothy Schaadt**
**FROM:** **WSO**
**DATE:** **January 16, 2013**
**RE:** **Metropolitan Water District – Water Balance Validation & Component Analysis Feasibility Study**

## I. Introduction

Water loss assessment is the focus of the Best Management Practice (BMP) 1.2 in the California Urban Water Conservation Council (CUWCC)'s Memorandum of Understanding (MOU). As a signee of this MOU, the Metropolitan Water District (MWD) is required to submit standard water balances annually and complete a component analysis of real losses every four years. Beyond compliance with the CUWCC BMP 1.2 requirements, regularly assessing water loss provides an opportunity for MWD to realize efficiency improvements and water savings.

Water Systems Optimization (WSO) was hired to validate MWD's water balance and investigate the feasibility of a component analysis of real losses for a transmission system. The standards used in the water balance and component analysis assumptions are geared toward distribution systems with significantly smaller pipe sizes and lower pressures; it is important to evaluate whether this methodology can provide useful insight for a transmission system.

## II. Treated Water Balance Findings

The following outlines the findings from the water loss assessment and highlights important assumptions applied to present a realistic water balance for MWD.

For the treated water system, WSO compiled a basic water balance for the calendar year of 2012. First, the inputs into the treated water system were totaled from MWD's master meter data. Next WSO inventoried all of the treated water service connections. Reviewed and confirmed by MWD staff, WSO tabulated the total volume of water deliveries – or authorized consumption – for the potable water system. Non-revenue water is the difference between these two volumes (Total Water Supplied minus Billed Metered Consumption).

Table 1 presents the non-revenue water determination for the treated water system.

**Table 1: Non-Revenue Water Determination for Treated Water System**

| | | |
|---|---|---|
| **TOTAL WATER SUPPLIED (A)** | 891,434.20 | AF |
| **BILLED CONSUMPTION (B)** | 886,370.10 | AF |
| **NON-REVENUE WATER (A-B)** | 5,064.10 | AF |
| **NON-REVENUE WATER** *as a % of supply* | 0.57% | |

The non-revenue water determination shows that MWD successfully delivered and generated revenue for nearly all of the treated water it produced in CY 2012.

To satisfy the AWWA Water Balance requirements, non-revenue water must be broken down into its three components: 1) Unbilled Consumption, 2) Apparent Losses consisting of meter under-registration and water theft and 3) Real Losses - physical water losses from infrastructure failures.

The assumptions outlined in Table 2 were applied to address these volume of non-revenue water for MWD. It is important to note that many of the AWWA Free Water Audit Software's suggested default values were changed to account for the unique nature of MWD's transmission-only system.

**Table 2: Assumptions Used in Treated Water Balance**

| **Non-Revenue Water** | **Value Used for MWD** | **Notes on Assumption** |
|---|---|---|
| Unbilled Unmetered Consumption | 0.1% of Water Supplied | *This is the volume of water used for operational purposes throughout the year (neither billed nor metered). Though the default value for distribution systems is 1.25% of Water Supplied, a much lower value is applied here.* |
| Meter Under-Registration | 0.25% Meter Under-Registration | *This is the assumed inaccuracy of customer meters. Though Venturi meters are quoted at +/-0.75% accuracy, a lower under-registration is applied to accommodate for the low total of non-revenue water.* |
| Unauthorized Use (Theft) | Zero | *MWD staff reported that water theft in the system is negligible if it exists at all.* |

With these assumptions, a complete water balance – including the real loss volume estimation - was produced. Table 3 presents the finalized water balance for the MWD treated water system

(additionally, the free AWWA Water Audit Software which outlines the same volumes is included in Appendix A).

**Table 3: Water Balance for MWD Treated Water CY 2012**

| WATER BALANCE COMPONENT | CY 2012 VOLUME |
|---|---|
| | (AF) |
| **WATER SUPPLIED** | **891,434.20** |
| Billed Metered Authorized Consumption | 886,370.10 |
| Billed Un-metered Authorized Consumption | NA |
| **BILLED AUTHORIZED CONSUMPTION** | **886,370.10** |
| Un-billed Metered Authorized Consumption | NA |
| Un-billed Un-metered Authorized Consumption | 891.43 |
| **UN-BILLED AUTHORIZED CONSUMPTION** | **891.43** |
| **AUTHORIZED CONSUMPTION** | **887,261.53** |
| **WATER LOSSES** | **4,172.67** |
| Unauthorized Consumption | NA |
| Meter Error | 2,215.93 |
| **APPARENT LOSSES** | **2,215.93** |
| **REAL LOSSES** | **1,956.74** |

It is expected for a system exclusively composed of transmission lines to experience low losses: a large diameter pipe network with low service connection density has few points of infrastructural vulnerability.

**Non-Revenue Water by Zone**

To take a closer look at the treated water system, WSO divided MWD's treated water system into five zones. Examining separate water balances for each of these zones allowed for a more detailed picture of water loss throughout the system. Table 4 describes the parameters for each zone's boundaries.

It is important to note that a number of these zones are overlapping. The combination of Zone A and Zone D capture the total treated water system. Zones, B, C, and E are all within the bigger Zone A.

**Table 4: Zone Boundary Designations**

| ZONE | BOUNDARY DETAILS |
|---|---|
| A | The total treated water zone, excluding the portion off of Skinner Lake |
| B | Exclusively the Allan McColloch Pipeline ("AMP") |
| C | Exclusively the West Valley Feeder #2 and the Calabasas Feeder |
| D | Treated water off of Skinner Lake |
| E | "Los Angeles Central Zone" refers to the the zone where different sources of treated water overlap, boundaries defined as:<br>*Inputs into the Los Angeles Central Zone:*<br>• PVF-0 serves as one of the northern boundaries<br>• MF-1 serves as one of eastern boundaries<br>• 2LF-4W serves as one of the eastern boundaries<br>• MFBP-0 serves as one of the eastern boundaries<br>• WC-0 serves as one of the eastern boundaries<br>• LF-2W serves as one of the eastern boundaries<br>• SC-OS serves as one of the eastern boundaries<br>• SF-V serves as the western boundary<br><br>*Outputs from the Los Angeles Central Zone (distinct from customers):*<br>• LF-2E serves as an outlet on the eastern boundary<br>• 2LF-3E serves as an outlet on the eastern boundary<br>• 2LF/WOCS serves as an outlet on the eastern boundary<br>• SC-ON serves as an outlet on the eastern boundary |

For each zone, WSO determined the non-revenue water volume for the calendar year of 2012. First, the inputs into each zone - metered by one or many of the MWD's master meters – were totaled. Next WSO inventoried all of the service connections by zone. Reviewed and confirmed by MWD staff, WSO tabulated the total volume of water deliveries – or authorized consumption – for each zone. Non-revenue water is the difference between these two volumes (Total Water Supplied minus Billed Metered Consumption).

Table 5 presents the non-revenue determinations for MWD's treated system by zone alongside the number of service connections and mileage for each zone.

**Table 5: Non-Revenue Water Determinations by Zone**

| ZONE | | A | B | C | D | E |
|---|---|---|---|---|---|---|
| **Mileage** | (miles) | 485.29 | 22.96 | 17.95 | 42.08 | 152.09 |
| **Service Connections** | | 284 | 28 | 4 | 12 | 117 |
| | | | | | | |
| **TOTAL WATER SUPPLIED:** | (AF) | | 99,722.30 | 124,294.60 | 153,329.70 | 231,175.50 |
| **BILLED CONSUMPTION** | (AF) | | 100,590.60 | 123,618.20 | 152,790.60 | 232,513.80 |
| **NON-REVENUE WATER:** | (AF) | 4,525.00 | (868.30) | 676.40 | 539.10 | (1,338.30) |
| **NON-REVENUE WATER** *as a % of supply* | | 0.61% | -0.87% | 0.54% | 0.35% | -0.58% |

Examining the non-revenue water determinations by zone confirms that MWD experiences very low water loss levels across its treated water system. The calculations in Zones B and E show that more consumption was billed than entered the particular zone. This implausible scenario likely suggests the impact of meter inaccuracy in the master meter, the customer meters, or both. It is important to note that when non-revenue water is so low, any metering inaccuracy will have significant impacts in the water balance.

**III. Recommendations for Improved Water Loss Assessment**

For future water balances, it is recommended to replace any assumptions applied here with documentation of use specific to MWD's practices. Going forward it will be useful to keep track or actively estimate the following volumes:

- Unbilled Unmetered Authorized Consumption: all operational uses for flushing, maintenance, etc.
- Unauthorized Consumption: documentation of any water theft

It is also recommended to calculate non-revenue water for the whole treated water system – and by zone – on a frequent basis. After inventorying the appropriate inputs and outputs, the designation of zones will serve to highlight smaller areas of attention if the non-revenue water determinations vary. Ongoing attention to the trends of non-revenue water throughout the year will allow for further investigation if it increases and presents a larger problem.

Lastly, it is recommended to continue the current maintenance and testing schedule of all input meters and wholesale customer meters.

**IV. Component Analysis Feasibility and Results**

Transmission mains have long been a challenging component to address effectively in water network audits and modelling of real losses. The lack of reliable methods for assessing this component of real water loss has forced the use of educated guesses and assumptions (Laven and Lambert, 2012).

It is important to note that The Bursts and Background Estimates (BABE) Concept was developed for component analysis of Real Losses on distribution systems (Lambert, 1994; Lambert and Morrison, 1995). It classifies leakage events into three different categories – undetectable background leakage, unreported bursts and reported bursts – each with different characteristics in terms of typical frequencies, flow rates and run-times. Because of this methodology's focus on distribution systems, it becomes challenging to use it to produce a reliable real loss component analysis for a transmission system. The results need to be interpreted in the context of the limitations of conducting a real loss component analysis for a transmission system. A Real Loss component analysis separates the leak and break volumes of real loss into the following categories (see Figure 1).

- **Reported leaks**: those leaks that are called in during the normal course of the day. Reported leaks may be called in by the public, meter readers or by other utility personnel.
- **Unreported leaks**: are those leaks that are not called in and have to be located by proactive leak detection methods.
- **Background Leakage:** the collective weeps and seeps in pipe joints and connections. They have flow rates that are typically too small (1gpm or less) to be detected by conventional acoustic leak detection equipment. They run continuously until they gradually worsen to the point when they can be detected. The only ways of reducing background leakage is through pressure management or infrastructure replacement.

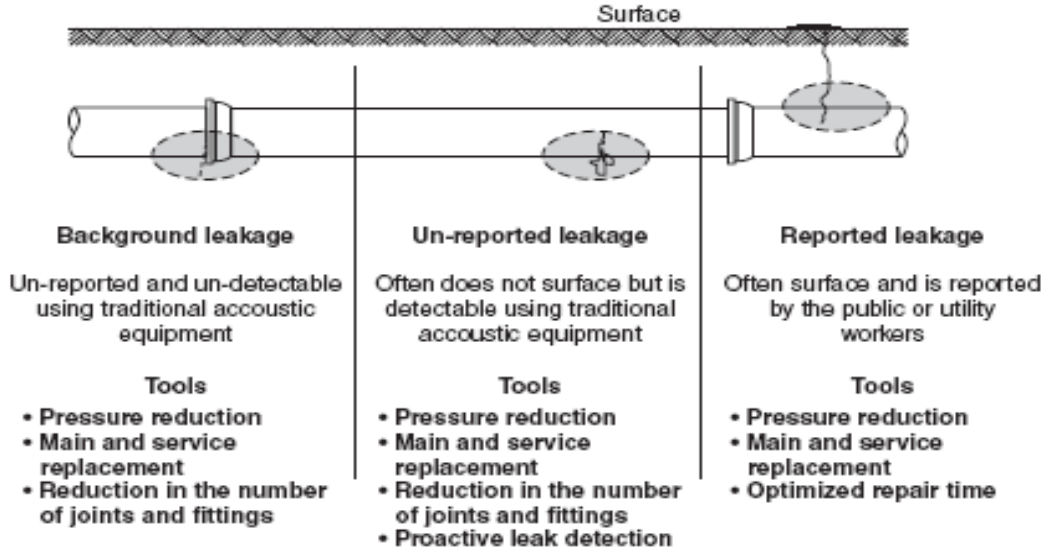



**Figure 1: Components of Real Losses and Tools for Intervention**

## IV. a – Background Leakage

The total volume of estimated background leakage on MWD's treated water transmission system was calculated using an Infrastructure Condition Factor (ICF) of 1.5, which assumes that background leakage is 1.5 times higher than the technical minimum. This assumption was informed by the transmission's high operating pressure and the generally very good condition of the infrastructure. Under this assumption, the total volume of background losses for MWD's treated water transmission system was calculated to be 1,318 AF. This background losses volume accounts for about 67% of the total volume of real losses calculated for CY 2012 (see Figure 2 for the calculation details). Given the high average pressure in the transmission system and the nature of the transmission system infrastructure it appears reasonable that two thirds of the total real loss volume is caused by background leakage, which comprises of weeps and seeps in pipe joints and connections.

**Step 2: BACKGROUND LEAKAGE ON MAINS AND SERVICES**

**Instructions:** The background leakage volume from mains and service connections will be automatically calculated after selecting one of the default Infrastructure Condition Factors (ICF) based on infrastructure age or after a utility specific ICF has been selected and entered in cell P43. The level of background leakage tends to increase with infrastructure age and is higher for systems with higher pressure. The volume of background losses is generally a significant component of the total real loss volume, at times up to 50% of the total volume of real losses. Overestimating (ICF used in model is too high) or underestimating (ICF used in model is too low) the background leakage volume might lead to a real loss control strategy that is not truly optimized. Selecting the ICF based on general age of the distribution network should only be seen as a starting point. It is strongly recommended that over time a utility specific ICF is assessed and confirmed through field tests using one of the recommended approaches outlined in the AWWA M36 manual.

| | | | | | | Pressure Corrected Calculation | |
|---|---|---|---|---|---|---|---|
| System Component | Units | Quantity | Component UARL Values (g/unit/d/psi) | Infrastructure Condition Factor | Average Pressure (psi) | N1 (Leakage-Pressure Exponent) Value | Annual Volume Acre-feet |
| Mains | miles | 527.4 | 2.87 | 1.5 | 261.6 | 1.5 | 1,289.68 |
| Services - Main to Curb-Stop | number | 296 | 0.112 | 1.5 | 261.6 | 1.5 | 28.25 |
| Services - Curb-Stop to Meter | miles | - | 4.78 | 1.5 | 261.6 | 1.5 | - |
| | | | | | **Total Background Leakage on Mains and Services** | | **1,317.93** |

**Select Infrastructure Condition Factor (ICF) based on age of distribution network**

| | |
|---|---|
| ○ ICF 1 for System Age <50 years | 1.0 |
| ◉ ICF 1.5 for System Age 50 - 70 years | 1.5 |
| ○ ICF 2.5 for System Age >70 years | 2.5 |
| OR | |
| ○ Enter ICF values assessed through implementing the approaches outlined in the AWWA M36 manual | |

**Figure 2: Calculation of Background Leakage for MWD Treated Water Transmission System**

## IV. b – Reported Leakage/Failures

There were no reported leaks/failures during CY 2012. Therefore the total volume from reported leakage for 2012 is zero.

## IV. c – Un-Reported Leakage/Failures

There were no un-reported leaks/failures during CY2012 identified through proactive leak detection efforts. Therefore the total volume from un-reported leakage for 2012 is zero.

## IV. d – Real Loss Component Analysis Summary

Figure 3 provides a summary of the real loss component analysis for MWD's treated water transmission system. As mentioned in the introduction to this section the results need to be interpreted in the context of the limitations of conducting a real loss component analysis for a transmission system. The results would indicate that about two thirds of the total real loss volume are due to background leakage, which can only be reduced through pressure reduction or infrastructure replacement. The component analysis model indicates that about 639AF are

due to unreported leaks that are currently running undetected and could possibly be detected by utilizing in-line leak detection technologies. However, given the cost for in-line leak detection services there does not appear to be an economic incentive for MWD to change their current leakage control strategy.

| SUMMARY: REAL LOSS COMPONENT ANALYSIS | | | | |
|---|---|---|---|---|
| System Component | Background Leakage (Acre-feet) | Reported Failures (Acre-feet) | Unreported Failures (Acre-feet) | Total (Acre-feet) |
| Reservoirs | - | - | - | - |
| Mains and Appurtenances | 1,289.68 | - | - | **1,289.68** |
| Service Connections | 28.25 | - | - | **28.25** |
| Total Annual Real Loss | **1,317.93** | - | - | **1,317.93** |
| **Real Losses as Calculated by Water Audit** | | | | **1,956.74** |
| **Hidden Losses/Unreported Leakage Currently Running Undetected** | | | | **638.81** |

**Figure 3: Real Loss Component Analysis Results**

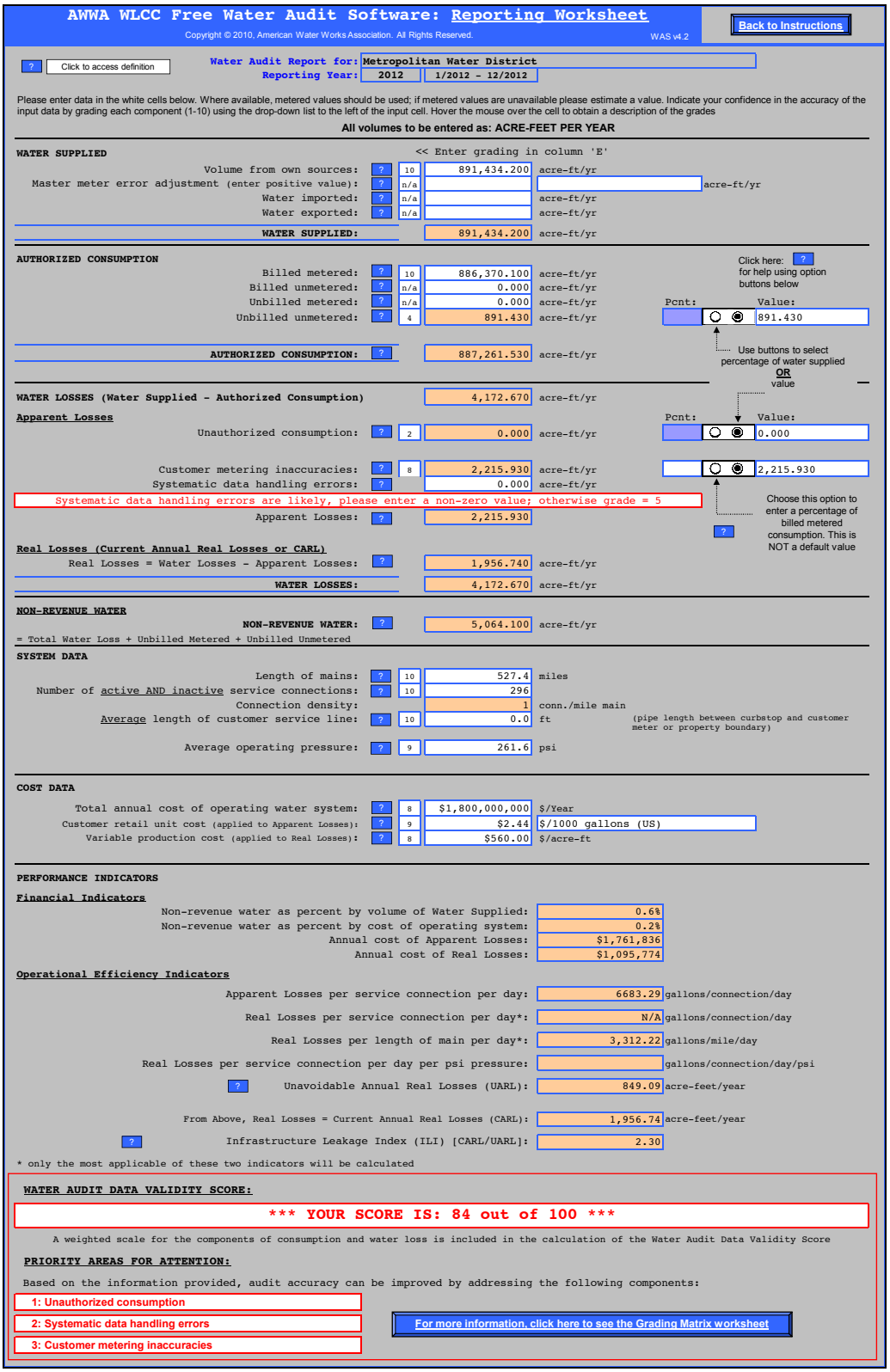
## References

Laven, K. and A.O. Lambert. 2012. What Do We Know About Real Losses on Transmission Mains? Presented at IWA Water Loss Conference, Manila, Philippines, February 22 – 26, 2012.

Lambert (1994). Accounting for Losses: The Bursts and Background Concept. Journal of the Institution of Water and Environmental Management, 1994, Volume 8 (2), pp 205-214.

Lambert, A.O and J.A.E Morrison (1996). Recent Developments in Application of 'Bursts and Background Estimates' Concepts of Leakage Management. J.CIWEM, 1996, 10, April, 100-104

# APPENDIX A: AWWA Free Water Audit Software



**AWWA WLCC Free Water Audit Software: Reporting Worksheet**

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WAS v4.2

Back to Instructions

Click to access definition

Water Audit Report for: Metropolitan Water District
Reporting Year: 2012 1/2012 - 12/2012

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

| | | | | |
|---|---|---|---|---|
| **WATER SUPPLIED** | | << Enter grading in column 'E' | | |
| Volume from own sources: | 10 | 891,434.200 | acre-ft/yr | |
| Master meter error adjustment (enter positive value): | n/a | | acre-ft/yr | |
| Water imported: | n/a | | acre-ft/yr | |
| Water exported: | n/a | | acre-ft/yr | |
| **WATER SUPPLIED:** | | 891,434.200 | acre-ft/yr | |
| **AUTHORIZED CONSUMPTION** | | | | |
| Billed metered: | 10 | 886,370.100 | acre-ft/yr | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | |
| Unbilled metered: | n/a | 0.000 | acre-ft/yr | |
| Unbilled unmetered: | 4 | 891.430 | acre-ft/yr | Pcnt: Value: 891.430 |
| **AUTHORIZED CONSUMPTION:** | | 887,261.530 | acre-ft/yr | |
| **WATER LOSSES (Water Supplied - Authorized Consumption)** | | 4,172.670 | acre-ft/yr | |
| **Apparent Losses** | | | | Pcnt: Value: |
| Unauthorized consumption: | 2 | 0.000 | acre-ft/yr | 0.000 |
| Customer metering inaccuracies: | 8 | 2,215.930 | acre-ft/yr | 2,215.930 |
| Systematic data handling errors: | | 0.000 | acre-ft/yr | |
| Systematic data handling errors are likely, please enter a non-zero value; otherwise grade = 5 | | | | |
| Apparent Losses: | | 2,215.930 | | |
| **Real Losses (Current Annual Real Losses or CARL)** | | | | |
| Real Losses = Water Losses - Apparent Losses: | | 1,956.740 | acre-ft/yr | |
| **WATER LOSSES:** | | 4,172.670 | acre-ft/yr | |
| **NON-REVENUE WATER** | | | | |
| **NON-REVENUE WATER:** | | 5,064.100 | acre-ft/yr | |
| = Total Water Loss + Unbilled Metered + Unbilled Unmetered | | | | |
| **SYSTEM DATA** | | | | |
| Length of mains: | 10 | 527.4 | miles | |
| Number of active AND inactive service connections: | 10 | 296 | | |
| Connection density: | | 1 | conn./mile main | |
| Average length of customer service line: | 10 | 0.0 | ft | (pipe length between curbstop and customer meter or property boundary) |
| Average operating pressure: | 9 | 261.6 | psi | |
| **COST DATA** | | | | |
| Total annual cost of operating water system: | 8 | $1,800,000,000 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $2.44 | $/1000 gallons (US) | |
| Variable production cost (applied to Real Losses): | 8 | $560.00 | $/acre-ft | |

Click here: for help using option buttons below

Use buttons to select percentage of water supplied OR value

Choose this option to enter a percentage of billed metered consumption. This is NOT a default value

**PERFORMANCE INDICATORS**

**Financial Indicators**

| | |
|---|---|
| Non-revenue water as percent by volume of Water Supplied: | 0.6% |
| Non-revenue water as percent by cost of operating system: | 0.2% |
| Annual cost of Apparent Losses: | $1,761,836 |
| Annual cost of Real Losses: | $1,095,774 |

**Operational Efficiency Indicators**

| | | |
|---|---|---|
| Apparent Losses per service connection per day: | 6683.29 | gallons/connection/day |
| Real Losses per service connection per day*: | N/A | gallons/connection/day |
| Real Losses per length of main per day*: | 3,312.22 | gallons/mile/day |
| Real Losses per service connection per day per psi pressure: | | gallons/connection/day/psi |
| Unavoidable Annual Real Losses (UARL): | 849.09 | acre-feet/year |
| From Above, Real Losses = Current Annual Real Losses (CARL): | 1,956.74 | acre-feet/year |
| Infrastructure Leakage Index (ILI) [CARL/UARL]: | 2.30 | |

* only the most applicable of these two indicators will be calculated

**WATER AUDIT DATA VALIDITY SCORE:**

*** YOUR SCORE IS: 84 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

**PRIORITY AREAS FOR ATTENTION:**

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Unauthorized consumption
2: Systematic data handling errors
3: Customer metering inaccuracies

For more information, click here to see the Grading Matrix worksheet

# Appendix 8

## RECENT CUWCC FILINGS

| Enter District ID No. | 161 | Data File Name | BASE Year | 2009WBMP1.1 | 2010 WBMP1.1 | 2009 BMP 1.2 | 2010 BMP 1.2 | 2009 BMP 1.3 | 2010 BMP 1.3 |
|---|---|---|---|---|---|---|---|---|---|

# CUWCC BMP COVERAGE REPORT FOR WHOLESALE AGENCIES

## Foundation Best Management Practices for Urban Water Efficiency

**Agency:** Metropolitan Water District of SC **District Name:** Metropolitan Water District of SC **CUWCC Unit #:** 161

**Primary Contact** Alice Webb-Cole **Email:** awebb@mwdh2o.com

Base Year: Calendar or FiscalYear Reporting Report Date: 27-May-11

**Foundational BMPs**

**BMP 1.1.3 Wholesale Agency Assistance Programs**

Date of 2009 Data Download July 5, 2011

Date of 2010 Data Download July 5, 2011

| a) Financial investments and building partnerships Value of resources provided to retailers for: 2009 | 2009 Monetary Amount for Financial Incentives | 2009 Monetary Amount for Equivalent Resources |
|---|---|---|
| BMP 3 Residential | $ 22,503,457 | no data |
| BMP 4 CII | $ 9,367,212 | no data |
| BMP 5 Landscape | $ 12,695,902 | no data |
| Total Value of Resources | $ 44,566,571 | $ - |
| | On Track | |

| a) Financial investments and building partnerships Value of resources provided to retailers for: 2010 | 2010 Monetary Amount for Financial Incentives | 2010 Monetary Amount for Equivalent Resources |
|---|---|---|
| BMP 3 Residential | $ 20,631,899 | no data |
| BMP 4 CII | $ 8,303,652 | no data |
| BMP 5 Landscape | $ 7,776,340 | no data |
| Total Value of Resources | $ 36,711,891 | $ - |
| | On Track | |

"On Track" if Retailer accepted offer and Wholesaler provided resources. "Not on Track" if Retailer accepted offer and Wholesaler did not provde resources.

**Agency:** Metropolitan Water District of SC **District Name:** Metropolitan Water District of SC **CUWCC Unit #:** 161

| | 2009 Technical Support Description | 2010 Technical Support Description | |
|---|---|---|---|
| b) Technical Support | Posted results from Innovative Conservation Program on bewaterwise.com<br>Host monthly meetings with member and retail water agenices that include research and new technology.<br>10.5 FTE working on developing and administering conservation programs. | In December 2009, Metropolitan completed an online survey of Residential customers that determined approximate saturation of 1.6 gpf (or lesser) toilets. Posted results from Innovative Conservation Program on bewaterwise.com.<br>Hosted monthly meetings with member and retail agencies that inlcude research and new technology when appropriate.10.5 FTEs working on developing and administering conservation programs. | " On Track" if Retailer accepted and Wholesaler provided and described Technical Support |
| | On Track | On Track | |

| | 2009 | | 2010 | | |
|---|---|---|---|---|---|
| c) Retail Agency | Programs Managed for Retailers | | c) Retail Agency | Programs Managed for Retailers | |
| 26 members&300 retailer | Regional Incentive Programs (RES and CII) | | 26 member&300 retailers | Regional Incentive Programs | " On Track" if Retailer accepted and Wholesaler provided and lists programs managed for retailers |
| | On Track | | | On Track | |

| | 2009 | | 2010 | |
|---|---|---|---|---|
| d) Water Shortage Allocation | | | | |
| Has Water shortage plan or policy been adopted? | 2/12/2008 | Adoption Date<br>File Name | 2/12/2008 | "OnTrack" if plan /policy adopted and document provided. "Not on Track" if no water shortage plan or policy adopted or document not provided. |
| | On Track | | | |
| e) Non signatory Reporting of BMP implementation by non-signatory agencies | MWDSC Allocation Plan.pdf | | MWDSC Allocation Plan.pdf | Report if possible |

| | List Efforts to recruit retailers | | |
|---|---|---|---|
| f) Encourage CUWCC Membership<br>List Efforts to recruit retailers | Metropolitan pays half dues for all agencies within Metropolitan's service area; | Quarterly meetings hosted by MWDSC covering CUWCC topics,<br>Annexations into MWDSC service area are required to be signatories to the CUWCC | "On Track" if efforts listed or dues paid. |
| | On Track | On Track | |

**Agency:** Metropolitan Water District of SC **District Name:** Metropolitan Water District of SC **CUWCC Unit #:** 161

## BMP 1.2 Water Loss Control

Date of 2009 Data Submittal: #N/A
Date of 2010 Data Submittal: July 5, 2011

| | 2009 | |
|---|---|---|
| Complete a prescreening Audit | No | On Track if Yes |
| Metered Sales AF | 2,045,104 | Metered sales to retail agencies |
| Verifiable Other Uses AF | 9,582 | |
| Total Supply AF | 211,998 | Into wholesale system |
| (Metered Sales + System uses)/ Total Supply >0.89 | 9.69 | On Track if =>.89, Not on Track if No |
| If ratio is less than 0.9, complete a full scale Audit in 2009? | Off | On Track if Yes |
| Verify Data with Records on File? | Yes | On Track if Yes |
| Operate a system Leak Detection Program? | Yes | On Track if Yes |
| | On Track | |

Comments

*Metropolitan's system is monitored by 10+ patrols including staff collecting water quality samples, If evidence of leaking is detected near any of our facilite pilots flying the CRA and SWP pipeline staff during the normal course of operations.*
*If evidence of leaking is detected near any of our facilite*

For wholesalers AWWA methodology applies to supplies to wholesalers, sales to retail agencies or sub wholesalers, and pipelines operated by wholesalers. End use retail customers are not considered in this

| | 2010 | |
|---|---|---|
| Compile Standard Water Audit using AWWA Software? | No | On Track if Yes, Not on Track if No |
| AWWA file provided to CUWCC? | No | On Track if Yes, Not on Track if No |
| AWWA Water Audit Validity Score? | no data | Info only until 2012 |
| Completed Training in AWWA Audit Method? | no | Info only until 2012 |
| Completed Training in Component Analysis Process? | No | Info only until 2012 |
| Complete Component Analysis? | no | Info only until 2012 |
| Repaired all leaks and breaks to the extent cost effective? | Yes | On Track if Yes, Not on Track if No |
| Locate and repair unreported leaks to the extent cost effective. | Yes | On Track if Yes, Not on Track if No |
| Maintain a record-keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | | Info only until 2012 |

Provided 7 types of Water Loss Control Info

| Leaks Repaire | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Interventions | Water Lost from Leaks AF |
|---|---|---|---|---|---|---|
| no data | $ - | $ - | 0 | No | $ - | no data |

info only until 2012

**Agency:** Metropolitan Water District of SC **District Name:** Metropolitan Water District of SC **CUWCC Unit #:** 161

Not On Track

## 1.3 METERING WITH COMMODITY RATES FOR ALL NEW CONNECTIONS AND RETROFIT OF EXISTING CONNECTIONS

Date of 2009 Data Submittal: July 5, 2011
Date of 2010 Data Submittal: July 5, 2011

| | 2009 | 2010 | |
|---|---|---|---|
| Exemption requested? | No | No | |
| At least as Effective As Requested? | No | No | |
| Does Agency have Unmetered Deliveries to Retail Agencies or Other Wholesalers? | No | No | |
| Metered Accounts billed by volume of use | Yes | Yes | Volumetric billing required for all connections on same schedule as metering |
| Completed a written plan, policy or program to test, repair and replace meters | No | No | On Track if Yes, Not on Track if No |
| | Not On Track | Not On Track | |

| Enter District ID No. | 161 |
|---|---|

| Agency Row # | 50 | 50 | 55 | 161 |
|---|---|---|---|---|
| Data File Name | 2009 BMP2.1 | 2010 BMP2.1 | 2009 BMP2.2 | 2010 BMP2.2 |

# CUWCC BMP COVERAGE REPORT FOR WHOLESALE AGENCIES

## Foundation Best Management Practices for Urban Water Efficiency

**Agency:** Metropolitan Water District of SC
WHOLESALE Water Supplier

**District Name:** Metropolitan Water District of SC **CUWCC Unit #:** 161

Coverage Report Date: May 19, 2011

**Primary Contact** Alice Webb-Cole **Email:** awebb@mwdh2o.com

## BMP 2. EDUCATION PROGRAMS

date 2009 datafile downloaded: July 5, 2011
date 2010 datafile downloaded: July 5, 2011

### BMP 2.1 Public Outreach Actions Implemented and Reported to CUWCC

| | 2009 | 2010 |
|---|---|---|
| 1) Contacts with the public (minimum = 4 times per year) | 22,000 | 88,000 |
| 2) Water supplier contacts with media (minimum = 4 times per year, i.e., at least quarterly). | 10 | 9 |
| 3) An actively maintained website that is updated regularly (minimum = 4 times per year, i.e., at least quarterly). | Yes | Yes |
| 4) Description of materials used to meet minimum requirement. | Newsletter articles on conservation<br>Newsletter articles on conservation<br>Website<br><br>Newspaper contacts<br>Television contacts<br>News releases<br>Radio contacts | Newsletter articles on conservation<br>Newsletter articles on conservation<br>Website<br><br>Newspaper contacts<br>News releases<br>Television contacts<br>Radio contacts |
| 5) Annual budget for public outreach program. | $ 5,450,000 | $ 4,405,796 |
| 6) Description of all other outreach programs | Conservation messaging including Television, Radio, and Online. | Conservation messaging including Television, Radio, and Online. |
| | On Track | On Track |

All 6 action types implemented and reported to CUWCC to be 'On Track')

**Agency:** Metropolitan Water District of SC
WHOLESALE Water Supplier

**District Name:** Metropolitan Water District of SC

**CUWCC Unit #:** 161

Coverage Report Date: May 19, 2011
date 2009 datafile downloaded: July 5, 2011
date 2010 datafile downloaded: May 26, 2011

## 2.2 School Education Programs Implemented and Reported to CUWCC

| | 2009 | 2010 | |
|---|---|---|---|
| Does this wholesale agency implement School Education Programs for Sub Wholesalers or Retail unility's benefit? | Yes | Yes | |
| Names of Sub Wholesale and Retail Agencies benefiting from Program? | Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura | Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. | |
| 1) Curriculum materials developed and/or provided by wholesale agency | All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA. standards and frameworks. | All of our developed curriculum units include formal framework linkages. In addition, all supplements, activities and programs address CA. standards and frameworks. | All 5 actions types implemented and reported to CUWCC to be 'On Track' |
| 2) Materials meet state education framework requirements and are grade-level appropriate? | Yes | Yes | |
| 3) Materials Distributed to K-6? | Yes | Yes | |
| Describe K-6 Materials | Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6) | Channing Bete Co., Inc.- "Let's Learn about Using Water Wisely", "Let's Learn about Water", "My Book About Water", "Water Conservation" and Activity Materials Created In-house related to own brand marketing program | Describe materials to meet minimum requirements |
| Materials distributed to 7-12 students? | Yes | No | Info Only |
| 4) Annual budget for school education program. | $ 476,000 | $ 7,500 | |
| 5) Description of all other water supplier education programs | An array of supplemental materials and activities that can be ordered from Metropolitan's Education Website. | "Team Green Kids Club" -The club offers the opportunity for young stewards to exchange ideas and information on how to work together to recycle, conserve and preserve the natural resources of our community. | |
| | **On Track** | **On Track** | |

## CUWCC BMP Wholesale Coverage Report 2011

*Foundational Best Managemant Practices for Urban Water Efficiency*

### BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**161** **Metropolitan Water District of SC**

Name: Mark Graham Email: mgraham@mwdh2o.com

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 3 Residential | 10541446 | 0 | |
| BMP 4 CII | 5001703 | 0 | |
| BMP 5 Landscape | 543269 | 0 | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 2/12/2008

File Name:

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Conduct quarterly state wide meetings with California water agencies on conservation issues affecting the state.

197187.14

**At Least As effective As** No

**Exemption** No 0

**Comments:**

CUWCC BMP Coverage Report 2011

*Foundational Best Management Practices For Urban Water Efficiency*

BMP 1.2 Water Loss Control **On Track**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | No |
| AWWA File provided to CUWCC? | No |
| AWWA Water Audit Validity Score? | |
| Complete Training in AWWA Audit Method | No |
| Complete Training in Component Analysis Process? | No |
| Component Analysis? | No |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | No |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| | | | | | | |

**At Least As effective As** No

Exemption No 0

Comments:

CUWCC BMP Coverage Report 2011

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | 0 |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |

Date: 12:00:00 AM

Uploaded file name:

| | |
|---|---|
| Completed a written plan, policy or program to test, repair and replace meters | No |

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| | | |
| **Exemption** | No | 0 |

Comments:

Metropolitan as a wholesale agency only provides water to other water agencies.

CUWCC BMP Coverage Report 2011

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale Only**

Does your agency perform Public Outreach programs? Yes

The list of retail agencies your agency assists with public outreach

| |
|---|
| Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. |

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| Website | 394909 |
| Landscape water conservation media campaigns | 17660022 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 290754 |
| Newsletter articles on conservation | 89904 |
| **Total** | **18435589** |

Did at least one contact take place during each quater of the reporting year? Yes

| Number Media Contacts | Number |
|---|---|
| Newspaper contacts | 17 |
| Written editorials | 8 |
| News releases | 6 |
| Radio contacts | 3 |
| Television contacts | 2 |
| Articles or stories resulting from outreach | 4 |
| **Total** | **40** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Advertising | 1200000 |
| CPP | 150000 |

CUWCC BMP Coverage Report 2011

*Foundational Best Management Practices For Urban Water Efficiency*

**BMP 2.1 Public Outreach** **ON TRACK**

| Annual Budget Category | Annual Budget Amount |
|---|---|
| CFLT | 105000 |
| **Total Amount:** | **1455000** |

| Public Outreah Additional Programs |
|---|
| Advertising Campaign/Google Search Media Buy |
| Speakers Bureau |
| Community Partnering Program |
| California Friendly Landscape Training Program |

Description of all other Public Outreach programs

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| | | |
| **Exemption** | No | 0 |

CUWCC BMP Coverage Report 2011

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs — ON TRACK

**161 Metropolitan Water District of SC** — **Wholesale Only**

Does your agency implement School Education programs? Yes

The list of retail agencies your agency assists with public outreach

Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

Materials meet state education framework requirements? Yes

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks.

Materials distributed to K-6? Yes

Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6)

Materials distributed to 7-12 students? Yes (Info Only)

Water Quality: The Qualities and Science of Water and Water Works: School to Career Curriculum

Annual budget for school education program: 480000.00

Description of all other water supplier education programs

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks. Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6) An array of supplemental materials and activities that can be ordered from Metropolitan's Education Website. N/A Student Art Contest for 2011
Calendar. 36 artists selected from 143 submitted by 24 agencies. Solar Cup 2011; a seven-month program, worked with 40 high school teams, 1100 students toward May event at Metropolitan's Lake Skinner.

Comments:

**At Least As effective As** No

**Exemption** No 0

## CUWCC BMP Wholesale Coverage Report 2012

*Foundational Best Management Practices for Urban Water Efficiency*

### BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**161** **Metropolitan Water District of SC**

Name: Mark Graham Email: mgraham@mwdh2o.com

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 4 CII | 4395825 | | |
| BMP 5 Landscape | 881228 | | |
| BMP 3 Residential | 7585882 | | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 2/12/2008

File Name:

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Conduct quarterly state wide meetings with California water agencies on conservation issues affecting the state.

216930.20

**At Least As effective As** No

**Exemption** No 0

**Comments:**

CUWCC BMP Coverage Report 2012

*Foundational Best Management Practices For Urban Water Efficiency*

BMP 1.2 Water Loss Control **On Track**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| Copy of AWWA_WATER_AUDIT_SOFTWARE_4 2 PC ONLY _ MWD 2012.xls | |
| AWWA Water Audit Validity Score? | 84 |
| Complete Training in AWWA Audit Method | No |
| Complete Training in Component Analysis Process? | No |
| Component Analysis? | No |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| | | | | | | |

**At Least As effective As** No

Exemption No 0

Comments:

CUWCC BMP Coverage Report 2012

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commoditv

**ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | 0 |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |
| Date: 12:00:00 AM | |
| Uploaded file name: | |
| Completed a written plan, policy or program to test, repair and replace meters | No |

**At Least As effective As** No

**Exemption** No 0

Comments:

Metropolitan as a wholesale agency only provides water to other water agencies.

CUWCC BMP Coverage Report 2012

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale Only**

Does your agency perform Public Outreach programs? Yes

The list of retail agencies your agency assists with public outreach

Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| Newsletter articles on conservation | 142052 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 319027 |
| Landscape water conservation media campaigns | 31030433 |
| Website | 403631 |
| **Total** | **31895143** |

Did at least one contact take place during each quater of the reporting year? Yes

| Number Media Contacts | Number |
|---|---|
| Newspaper contacts | 6 |
| News releases | 1 |
| Television contacts | 3 |
| Articles or stories resulting from outreach | 5 |
| **Total** | **15** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Advertising | 1200000 |
| CPP | 150000 |
| **Total Amount:** | **1350000** |

| Public Outreah Additional Programs |
|---|
| Advertising Campaign/Google Search Media Buy |

CUWCC BMP Coverage Report 2012

*Foundational Best Management Practices For Urban Water Efficiency*

**BMP 2.1 Public Outreach** **ON TRACK**

| **Public Outreah Additional Programs** |
|---|
| Speakers Bureau |
| Community Partnering Program |
| Online Training |

Description of all other Public Outreach programs

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| | | |
| **Exemption** | No | 0 |

CUWCC BMP Coverage Report 2012

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs — ON TRACK

**161 Metropolitan Water District of SC** — **Wholesale Only**

Does your agency implement School Education programs? No

The list of retail agencies your agency assists with public outreach

Materials meet state education framework requirements? Yes

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks.

Materials distributed to K-6? Yes

Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6)

Materials distributed to 7-12 students? Yes (Info Only)

Water Quality: The Qualities and Science of Water and Water Works: School to Career Curriculum

Annual budget for school education program: 480000.00

Description of all other water supplier education programs

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks. Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6) An array of supplemental materials and activities that can be ordered from Metropolitan's Education Website. Student Art Contest for 2012 Calendar. 36 artists selected from 120 submitted by 19 agencies. Solar Cup 2012, a seven-month program, worked with 39 high school teams and approxmiately 1200 students towards May event at Metropolitan's Lake Skinner.

Comments:

**At Least As effective As** No

**Exemption** No 0

## CUWCC BMP Wholesale Coverage Report 2013

*Foundational Best Management Practices for Urban Water Efficiency*

### BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**161** **Metropolitan Water District of SC**

Name: Mark Graham Email: mgraham@mwdh2o.com

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 3 Residential | 13347068 | | |
| BMP 4 CII | 1376957 | | |
| BMP 5 Landscape | 4696061 | | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 2/12/2008

File Name: http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003724356-1.pdf

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Metropolitan serves on the Board, chairs the R&E Committee, serves on various committees and relays that information to its member agencies at its monthly conservation coordinators meetings. Metropolitan encourages membership and hosts CUWCC speakers

0.00

**At Least As effective As** No

**Exemption** No

**Comments:**

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

BMP 1.2 Water Loss Control **ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| Copy_of_2013_AWWA-WAS-v5-09152014.xls | |
| AWWA Water Audit Validity Score? | 89 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 0 | 18223 | 269100 | 527 | False | 250000 | 150 |

**At Least As effective As** No

Exemption No

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |
| Date: | |
| Uploaded file name: | |
| Completed a written plan, policy or program to test, repair and replace meters | Yes |
| **At Least As effective As** | No |
| **Exemption** | No |

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale**

Does your agency perform Public Outreach programs? Yes

The list of retail agencies your agency assists with public outreach

City of Anaheim, PUD,City of Beverly Hills,City of Burbank, PSD,City of Compton, Water Dept.,City of Fullerton,City of Glendale, Water and Power,City of Pasadena,City of San Fernando,City of Santa Ana,City of Santa Monica,City of Torrance, Water Division,Las Virgenes Municipal Water District,Long Beach Water Department,Los Angeles Dept. of Water and Power,Western MWD of Riverside County - Retail

Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

| Agency Name | ID number |
|---|---|
| City of Anaheim, PUD | 45 |
| City of Beverly Hills | 6972 |
| City of Burbank, PSD | 48 |
| City of Compton, Water Dept. | 52 |
| City of Fullerton | 59 |
| City of Glendale, Water and Power | 61 |
| City of Pasadena | 72 |
| City of San Fernando | 83 |
| City of Santa Ana | 258 |
| City of Santa Monica | 89 |
| City of Torrance, Water Division | 93 |
| Las Virgenes Municipal Water District | 147 |
| Long Beach Water Department | 66 |
| Los Angeles Dept. of Water and Power | 152 |
| Western MWD of Riverside County - Retail | 1006 |

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| Newsletter articles on conservation | 10417 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 174253 |
| General water conservation information | 16546797 |
| Website | 186770 |
| **Total** | **16918237** |

Did at least one contact take place during each quater of the reporting year? Yes

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

| Number Media Contacts | Number |
|---|---|
| Newspaper contacts | 520 |
| News releases | 17 |
| Television contacts | 105 |
| Articles or stories resulting from outreach | 120 |
| **Total** | **762** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Advertising | 1986300 |
| CPP | 100000 |
| **Total Amount:** | **2086300** |

| Public Outreah Additional Programs |
|---|
| Mulit-lingual Advertising Campaign/Google Search Media Buy |
| Website, Social Media, Online Outreach |
| Community Partnering Program |
| Speaking Events and Speakers Bureau |

Description of all other Public Outreach programs

Comments:

**At Least As effective As** No

**Exemption** No 0

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale**

Does your agency implement School Education programs? Yes

The list of retail agencies your agency assists with public outreach

City of Anaheim, PUD,City of Beverly Hills,City of Burbank, PSD,City of Compton, Water Dept.,City of Fullerton,City of Glendale, Water and Power,City of Pasadena,City of San Fernando,City of Santa Ana,City of Santa Monica,City of Torrance, Water Division,Las Virgenes Municipal Water District,Long Beach Water Department,Los Angeles Dept. of Water and Power,Western MWD of Riverside County - Retail

| Agencies Name | ID number |
|---|---|
| City of Anaheim, PUD | 45 |
| City of Beverly Hills | 6972 |
| City of Burbank, PSD | 48 |
| City of Compton, Water Dept. | 52 |
| City of Fullerton | 59 |
| City of Glendale, Water and Power | 61 |
| City of Pasadena | 72 |
| City of San Fernando | 83 |
| City of Santa Ana | 258 |
| City of Santa Monica | 89 |
| City of Torrance, Water Division | 93 |
| Las Virgenes Municipal Water District | 147 |
| Long Beach Water Department | 66 |
| Los Angeles Dept. of Water and Power | 152 |
| Western MWD of Riverside County - Retail | 1006 |

Materials meet state education framework requirements? Yes

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks including Common Core and Next Generation Science Standards.

Materials distributed to K-6? Yes

Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6)

Materials distributed to 7-12 students? Yes (Info Only)

Water Quality: The Qualities and Science of Water, Conservation Connection and Water Works: School to Career Curriculum

Annual budget for school education program: 490000.00

Description of all other water supplier education programs

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

**BMP 2.2 School Education Programs** **ON TRACK**

| |
|---|
| An array of supplemental materials and activities that can be ordered from Metropolitan's Education Website: www.mwdh2o.com/education |

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| | | |
| **Exemption** | No | 0 |

## CUWCC BMP Wholesale Coverage Report 2014

*Foundational Best Management Practices for Urban Water Efficiency*

### BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**161** **Metropolitan Water District of SC**

Name: Mark Graham Email: mgraham@mwdh2o.com

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 3 Residential | 16843175 | | |
| BMP 4 CII | 1241465 | | |
| BMP 5 Landscape | 21564361 | | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 2/12/2008

File Name: http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003724356-1.pdf

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Metropolitan serves on the Board, chairs the R&E Committee, serves on various committees and relays that information to its member agencies at its monthly conservation coordinators meetings. Metropolitan encourages membership and hosts CUWCC speakers

**At Least As effective As** No

**Exemption** No

**Comments:**

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

BMP 1.2 Water Loss Control **ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| AWWA-MWD-2014.xls | |
| AWWA Water Audit Validity Score? | 89 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 0 | 975000 | 272000 | 527 | False | 250000 | 150 |

**At Least As effective As** No

Exemption No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

**161 Metropolitan Water District of SC**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |
| Date: | |
| Uploaded file name: | |
| Completed a written plan, policy or program to test, repair and replace meters | Yes |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale**

Does your agency perform Public Outreach programs? Yes

The list of retail agencies your agency assists with public outreach

City of Anaheim, PUD,City of Beverly Hills,City of Burbank, PSD,City of Compton, Water Dept.,City of Fullerton,City of Glendale, Water and Power,City of Pasadena,City of San Fernando,City of Santa Ana,City of Santa Monica,City of Torrance, Water Division,Las Virgenes Municipal Water District,Long Beach Water Department,Los Angeles Dept. of Water and Power,Western MWD of Riverside County - Retail

Metropolitan provides public outreach to its 26 member agencies throughout parts of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

| Agency Name | ID number |
|---|---|
| City of Anaheim, PUD | 45 |
| City of Beverly Hills | 6972 |
| City of Burbank, PSD | 48 |
| City of Compton, Water Dept. | 52 |
| City of Fullerton | 59 |
| City of Glendale, Water and Power | 61 |
| City of Pasadena | 72 |
| City of San Fernando | 83 |
| City of Santa Ana | 258 |
| City of Santa Monica | 89 |
| City of Torrance, Water Division | 93 |
| Las Virgenes Municipal Water District | 147 |
| Long Beach Water Department | 66 |
| Los Angeles Dept. of Water and Power | 152 |
| Western MWD of Riverside County - Retail | 1006 |

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| Newsletter articles on conservation | 12061 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 364276 |
| General water conservation information | 12773042 |
| Website | 522006 |
| **Total** | **13671385** |

Did at least one contact take place during each quater of the reporting year? Yes

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

| Number Media Contacts | Number |
|---|---|
| Newspaper contacts | 520 |
| News releases | 40 |
| Television contacts | 104 |
| Articles or stories resulting from outreach | 120 |
| **Total** | **784** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Advertising | 2214600 |
| CPP | 100000 |
| **Total Amount:** | **2314600** |

| Public Outreah Additional Programs |
|---|
| Advertising Campaign/Google Search Media Buy |
| Speakers Bureau |
| Community Partnering Program |
| Website |

Description of all other Public Outreach programs

Comments:

**At Least As effective As** No

**Exemption** No 0

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**161 Metropolitan Water District of SC** **Wholesale**

Does your agency implement School Education programs? Yes

The list of retail agencies your agency assists with public outreach

City of Anaheim, PUD,City of Beverly Hills,City of Burbank, PSD,City of Compton, Water Dept.,City of Fullerton,City of Pasadena,City of San Fernando,City of Santa Ana,City of Santa Monica,City of Torrance, Water Division,Las Virgenes Municipal Water District,Long Beach Water Department,Los Angeles Dept. of Water and Power,Western MWD of Riverside County - Retail

| Agencies Name | ID number |
|---|---|
| City of Anaheim, PUD | 45 |
| City of Beverly Hills | 6972 |
| City of Burbank, PSD | 48 |
| City of Compton, Water Dept. | 52 |
| City of Fullerton | 59 |
| City of Pasadena | 72 |
| City of San Fernando | 83 |
| City of Santa Ana | 258 |
| City of Santa Monica | 89 |
| City of Torrance, Water Division | 93 |
| Las Virgenes Municipal Water District | 147 |
| Long Beach Water Department | 66 |
| Los Angeles Dept. of Water and Power | 152 |
| Western MWD of Riverside County - Retail | 1006 |

Materials meet state education framework requirements? Yes

All of our developed curriculum units include formal linkages. In addition, all supplements, activities and programs address CA standards and frameworks including Common Core and Next Generation Science Standards.

Materials distributed to K-6? Yes

Little Splash: K-3 Activity/Coloring Book, All About Water (K-3), Admiral Splash (gr. 4), Water Ways (gr. 5) and Water Times (gr. 6)

Materials distributed to 7-12 students? Yes (Info Only)

Water Quality: The Qualities and Science of Water, Conservation Connection and Water Works: School to Career Curriculum

Annual budget for school education program: 450000.00

Description of all other water supplier education programs

An array of supplemental materials and activities that can be ordered from Metropolitan's Education Website: www.mwdh2o.com/education

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

**BMP 2.2 School Education Programs** **ON TRACK**

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| | | |
| **Exemption** | No | 0 |

# Appendix 9

# METROPOLITAN'S ENERGY INTENSITY CALCULATIONS, INCLUDING CONVEYANCE AND DISTRIBUTION GENERATION

# Appendix 9
# METROPOLITAN'S ENERGY INTENSITY CALCULATIONS, INCLUDING CONVEYANCE AND DISTRIBUTION GENERATION

## Introduction

The Metropolitan Water District of Southern California is a wholesale water agency that distributes water to its 26 Member Agencies. These agencies receive treated and untreated water through Metropolitan's 830 miles of interconnected pipelines. There are over 400 service connections to the 26 Member Agencies located throughout Metropolitan's 5200 square mile service area.

## Water-Related Energy Use in California

Water supply by its nature is energy intensive, and it is widely reported that California's "Water Sector" uses 19 percent of the state's electricity and 32 percent of the state's natural gas not used for power generation. However, these facts are often misinterpreted by attributing the entire water-related energy use to urban water agencies such Metropolitan and the Department of Water Resources.

The original source for these figures is the California Energy Commission's 2005 "California's Water – Energy Relationship" report (CEC-700-2005-011-SF, Nov. 2005), which analyzed water-related energy use data for 2001. Based on the information in the report, approximately 3 percent of the electrical use is associated with urban water agency conveyance, treatment, and distribution. Of the remaining 16 percent, 0.8 percent is attributed to wastewater treatment, 4.2 percent is associated with agricultural use, and 11 percent is due to urban end uses – including the heating and cooling of water by customers. For non-power plant natural gas, over 99 percent of use is attributed to urban end uses, while 0.14 percent is used for urban water supply. Table A.9-1 presents the water related energy use in California and is adapted from the 2005 CEC report.

The 3 percent of electricity associated with urban water supply represents the "embedded energy" in water, whereas the 11 percent of electricity and 31 percent of natural gas attributed to end uses represent a direct use of energy by consumers.

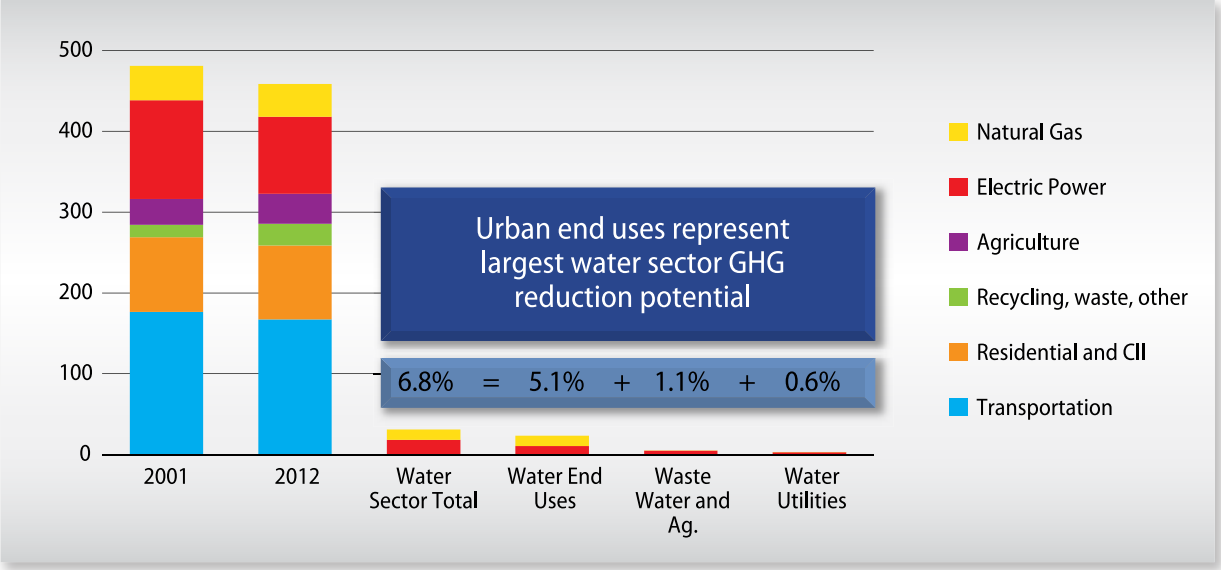
This distinction is essential for state policy issues currently under consideration related to energy use and GHG emissions in the water sector. When the results from the CEC study are compared to California's overall GHG emissions from all sectors, it becomes clear that the greatest potential for reducing water-related GHG emissions lies with consumer end uses. Figure A-9.1 shows that while the water sector contributes about 6.8 percent of the State's measured GHG emissions, water utilities contribute just 0.6% of the total. By comparison, water end uses – again, including the heating and cooling of water – account for 5.1 percent.

**Table A.9-1**
**Water Related Energy Use in California**

| | Electricity (Gigawatt-hour) | Natural Gas (Million Therms) |
|---|---|---|
| **Urban Water Supply** | **7,554** | **19** |
| Waste Water Treatment | 2,012 | 27 |
| Urban End Users | 27,887 | 4,220 |
| Agricultural Total | 10,560 | 18 |
| **Total Water Sector Use** | **48,013** | **4,284** |
| | | |
| **Total California Use** | **250,494** | **13,571** |
| | | |
| **Urban Water Supply** | **3.0%** | **0.1%** |
| Waste Water Treatment | 0.8% | 0.2% |
| Urban End Users | 11.1% | 31.1% |
| Agricultural Total | 4.2% | 0.1% |
| **Total Water Sector Use** | **19.2%** | **31.6%** |

Energy has always been a key factor in the development of California's water supply infrastructure. Most water projects in the state are designed to minimize energy use and maximize energy recovery. In response to California's GHG emission goals, Metropolitan and many other water utilities are proactively taking steps to reduce water-related energy use. This includes increasing energy recovery in conveyance and distribution systems, developing renewable energy projects, performing energy studies, auditing facility energy usage, and other related actions. Additionally, the conservation programs administered by Metropolitan and the member agencies save embedded energy, as well as the energy associated with consumer end uses.

**Figure A.9-1 Greenhouse Gas Emissions in California**
**Metric Tonnes of $CO_2$ Equivalent**




Note: Based on the Air Resources Board GHG inventory from 2000 to 2012 data;
http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-12_2014-03-24.pdf;
Percentages for the water sector are based on CEC's 2005 Energy Intensity Report: CEC-700-2005-011-SF, Nov. 2005

## Voluntary Energy Use Reporting

SB 1036 (Pavley 2014) added Section 10631.2 to the Water Code, which states that water agencies may voluntarily provide information on estimated energy usage in their Urban Water Management Plans. This Appendix explains how Metropolitan will provide that information. Due to the mixing of water supplies before and after treatment, and the large number of service connections, Metropolitan will provide system-wide Energy Intensity values. In addition, it should be noted that as water supply, water quality, and operational conditions change, including Member Agencies' demands, the annual values for energy use and energy intensity will vary from year to year.

Metropolitan's Energy Intensity for the water it provides to its Member Agencies is broken down into the following functions:

- Source
- Conveyance
- Treatment
- Distribution
- Storage

## Source

The water Metropolitan receives comes from two sources; (1) the California Department of Water Resources' (DWR) State Water Project (SWP), and (2) the Colorado River. The water flows naturally into these sources and does not require energy for extraction or diversion. Therefore, there is no energy used to extract or divert water from these sources.

## Conveyance

To estimate the amount of energy used to convey water supplies to Metropolitan's water treatment plants and distribution system, the energy requirements from the two conveyance systems supplying Metropolitan's water have been combined, along with the volume of water delivered, into a single weighted energy intensity value for conveyance. As the blend of water from the SWP and the Colorado River changes each year due to availability, water quality, and demands, the total energy consumption and energy intensity for the conveyance function vary year to year.

### *State Water Project*

Metropolitan is a contractor for water from DWR's SWP. The SWP uses a combination of natural and man-made systems to move water from Lake Oroville on the Feather River in northern California, through the Sacramento/San Joaquin River Delta (Delta), and into the California Aqueduct for delivery to central and southern California. DWR conveys water through the California Aqueduct using a series of pumps and hydro generators. Metropolitan receives water from DWR through the West Branch of the California Aqueduct at Castaic Lake and from the East Branch of the California Aqueduct at several locations in San Bernardino and Riverside Counties.

The California Aqueduct's net Energy Intensity for the water received from the West Branch is 2,580 kWh/AF and for the East branch it is 3,236 kWh/AF. These values are the nominal pumping requirements of the SWP pumps (Banks, Dos Amigos, Buena Vista, Wheeler Ridge, Wind Gap, Edmonston, Oso, and Pear Blossom) less the nominal generation values from the West and East Branch recovery generating plants (Warne, Castaic, Alamo, Mojave, and Devil Canyon). These values do not incorporate any pumping or generating at the San Luis Gianelli Plant.

The SWP also produces power at its Hyatt/Thermalito complex (HTC) near Lake Oroville and the Feather River in northern California. DWR releases water from Lake Oroville that flows through the HTC hydro generators and produces power for the SWP. Given water operations in the Delta and interactions between the Central Valley Project and the SWP, there is not a direct link from HTC power generation and SWP deliveries; however, the contractors for State Project water, including Metropolitan, pay for the HTC based on their share of the SWP's Variable Operation, Maintenance, Power and Replacement (OMP&R) Component of the Transportation Charge. To determine the benefit Metropolitan receives from the HTC generation in calculating the Energy Intensity of SWP conveyance, this same OMP&R share (percentage) has been used with the total generation from the HTC. From 2004 through 2013, Metropolitan's share of the HTC costs has ranged from 60.2% to 74.3%. A multi-year average percentage has been used to reduce the year-to-year volatility of this factor.

The SWP contract has specific provisions on how and when to account for various water deliveries and the associated costs. This will result in differences between the SWP billing values and the amount of water delivered to Metropolitan from the SWP.

### *Colorado River*

Metropolitan conveys water from the Colorado River through its Colorado River Aqueduct (CRA). The water is pumped through five pumping plants to reach Metropolitan's service area. The nominal Energy Intensity of water conveyed through the CRA is 2000 kWh/AF.

There are no recovery generating plants along the CRA, however, the water that Metropolitan pumps from the Colorado River has been released from Lake Mead through the Hoover Dam generators. Metropolitan receives 28.5% of the energy produced at Hoover. This energy is

used exclusively to power the CRA pumps. The production rate (kWh/AF) is dependent on several factors, including the elevation of Lake Mead. The USBR updates this value monthly. Metropolitan has used its share of the energy produced at Hoover from its water releases in the calculation of the CRA conveyance energy requirement. This calculation utilizes the volume of water delivered into Metropolitan's service territory.

| | | |
|---|---|---|
| 2013 Conveyance Total: | Energy used | 3,627,553,292 kWh |
| | Water Delivered | 1,945,801 AF |
| | Energy Intensity | 1,864 kWh/AF |
| 2014 Conveyance Total: | Energy used | 3,448,714,628 kWh |
| | Water Delivered | 1,768,121 AF |
| | Energy Intensity | 1,951 kWh/AF |

### Treatment

Metropolitan has five treatment plants to provide potable water to its Member Agencies. The estimated amount of energy used to treat water supplies has been calculated by dividing the annual amount of energy consumed at the plant sites by the amount of water treated.

| | | |
|---|---|---|
| 2013 Treatment Total: | Energy used | 46,914,223 kWh |
| | Water Treated | 1,072,870 AF |
| | Energy Intensity | 44 kWh/AF |
| 2014 Treatment Total: | Energy used | 46,695,775 kWh |
| | Water Treated | 1,016,046 AF |
| | Energy Intensity | 46 kWh/AF |

### Distribution

Due to the high elevation at which Metropolitan receives water from the SWP and CRA, very little pumping (and electricity use) is needed to distribute treated and untreated water to its Member Agencies. Instead, gravity, not electricity, is primarily used to deliver water supplies through Metropolitan's distribution system.

In addition, Metropolitan has 16 recovery hydroelectric generating plants in its distribution system that produce greater amounts of power than is consumed from distribution pumping. These generators are on distribution pipelines located throughout Metropolitan's service area. The generators produce electricity from the water flowing through the pipelines. Without the hydrogenerators, the energy in the water would be reduced at facilities called pressure control structures and the potential for greenhouse gas free electricity lost. The energy used in the pumping plants and produced by the generators has been netted, with the result divided by the water delivered to the Member Agencies to calculate the distribution Energy Intensity.

| | | |
|---|---|---|
| 2013 Distribution Total: | Energy used | -239,069,895 kWh (net generation) |
| | Water Delivered | 1,959,867 |
| | Energy Intensity | -122 kWh/AF |
| 2014 Distribution Total: | Energy used | -118,895,649 kWh (net generation) |
| | Water Delivered | 2,015,911 AF |
| | Energy Intensity | -59 kWh/AF |

### Storage

Metropolitan does not use any energy for its internal storage programs. Water is delivered by gravity flow. External water storage and recovery is managed by other parties and is often transacted through exchange arrangements. Any water delivered to Metropolitan from storage programs would be accounted for in the conveyance deliveries. Therefore, there is no energy used for placing water into storage.

### Metropolitan's Annual Energy and Energy Intensity

Energy and Energy Intensity values are provided for each of the non-zero functions listed above: Conveyance; Treatment; and Distribution. As noted previously, these values vary from year to year due to operational changes and differences in source use due to changes in water supply availability and other factors. An estimated overall Energy Intensity is provided for untreated water deliveries and treated water deliveries.

2013

| | |
|---|---|
| Estimated Delivered Untreated Water Energy Intensity: | 1,742 kWh/AF |
| Estimated Delivered Treated Water Energy Intensity: | 1,786 kWh/AF |

2014

| | |
|---|---|
| Estimated Delivered Untreated Water Energy Intensity: | 1,892 kWh/AF |
| Estimated Delivered Treated Water Energy Intensity: | 1,938 kWh/AF |

### Water Energy Tables

Provided in Tables A.9-2 and A.9-3 are the Water Energy Tables for CY 2013 and 2014 using the Water Supply Process Approach in Table O-1A from the 2015 UWMP Guidebook Appendix O.

## Table A.9-2 (Table O-1A for Year 2013): Water Supply Process Approach

| **Reporting Date: CY 2013** | **Urban Water Wholesale Supplies Includes SWP Embedded Energy and Non-Consequential Generation** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water Management Process | | | | | | Non-Consequential | |
| | **Extract** | **Storage** | **Conveyance[1]** | **Treatment** | **Distribution** | **Total** | **Hydro** | **Net** |
| Volume (AF) | - | - | 1,945,801 | 1,072,870 | 1,959,867 | - | [2] | [2] |
| Energy (kWh) | - | - | 3,627,553,292 | 46,914,223 | -239,069,895 | - | [2] | [2] |
| **Energy Intensity** | - | - | **1,864** | **44** | **-122** | - | - | - |
| **Treated Energy Intensity** (kWh/AF) | | | | | | **1,786** | - | - |
| **Untreated Energy Intensity** (kWh/AF) | | | | | | **1,742** | - | - |

### Non Hydropower Self Generated Energy

Metropolitan generated 2,239,621 kWh at its Skinner treatment plant solar facility in CY2013.

### Data Quality Narative

[1] Includes SWP deliveries of 973,943 AF at 2,780,057,816 kWhs

[2] Conveyance accounts for hydropower genergation from Hyatt Thermalito Complex at 976,000,000 kWhs, and Hoover Dam generation at 119,770,224 kWhs

### Narative

See above section on Voluntary Energy Reporting.

## Table A.9-3 (Table O-1A for Year 2014): Water Supply Process Approach

| **Reporting Date: CY 2014** | **Urban Water Wholesaler: MWD Operational Control (Includes SWP Embedded Energy and Non-Consequential Generation)** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Water Management Process | | | | | | Non-Consequential | |
| | **Extract** | **Storage** | **Conveyance[3]** | **Treatment** | **Distribution** | **Total** | **Hydro** | **Net** |
| Volume (AF) | - | - | 1,768,121 | 1,016,046 | 2,015,911 | - | [4] | [4] |
| Energy (kWh) | - | - | 3,448,714,628 | 46,695,775 | -118,895,649 | - | [4] | [4] |
| **Energy Intensity** | - | - | **1,951** | **46** | **-59** | - | - | - |
| **Treated Energy Intensity** (kWh/AF) | | | | | | **1,938** | - | - |
| **Untreated Energy Intensity** (kWh/AF) | | | | | | **1,892** | - | - |

### Non Hydropower Self Generated Energy

Metropolitan generated 2,330,246 kWh at its Skinner treatment plant solar facility in CY2014.

### Data Quality Narative

[3] Includes SWP deliveries of 607,344 AF at 1,683,268,784 kWhs

[4] Conveyance accounts for hydropower genergation from Hyatt Thermalito Complex at 423,752,000 kWhs, and Hoover Dam generation at 132,339,396 kWhs

### Narative

See above section on Voluntary Energy Reporting.

# Appendix 10

# DWR's STANDARDIZED TABLES

# Appendix 10
# DWR's STANDARDIZED TABLES

In fulfillment of CA Water Code § 10621(d) and § 10644(a)(1) and (2), Metropolitan's Final 2015 UWMP was electronically submitted to the State of California through DWR's the WUE data website https://wuedata.water.ca.gov/secure/ in June 2016. This appendix contains the mandatory DWR tables that were uploaded to the WUE data website.

| Table 2-2: Plan Identification | | | |
|---|---|---|---|
| **Select Only One** | **Type of Plan** | | **Name of RUWMP or Regional Alliance** *if applicable* *drop down list* |
| ☑ | **Individual UWMP** | | |
| | ☐ | Water Supplier is also a member of a RUWMP | |
| | ☐ | Water Supplier is also a member of a Regional Alliance | |
| ☐ | **Regional Urban Water Management Plan (RUWMP)** | | |
| NOTES: | | | |

| Table 2-3: Agency Identification | |
|---|---|
| Type of Agency (select one or both) | |
| ☑ | Agency is a wholesaler |
| ☐ | Agency is a retailer |
| Fiscal or Calendar Year (select one) | |
| ☑ | UWMP Tables Are in Calendar Years |
| ☐ | UWMP Tables Are in Fiscal Years |
| If Using Fiscal Years Provide Month and Date that the Fiscal Year Begins (mm/dd) | |
| | |
| Units of Measure Used in UWMP (select from Drop down) | |
| Unit | AF |
| NOTES: | |

| Table 2-4 Wholesale: Water Supplier Information Exchange (select one) | |
|---|---|
| ☑ | Supplier has informed more than 10 other water suppliers of water supplies available in accordance with CWC 10631. Completion of the table below is optional. If not completed include a list of the water suppliers that were informed. |
| 2015 UWMP Section 5 Table 5-3 | **Provide page number for location of the list.** |
| ☐ | Supplier has informed 10 or fewer other water suppliers of water supplies available in accordance with CWC 10631. **Complete the table below.** |
| Water Supplier Name *(Add additional rows as needed)* | |
| | |
| | |
| | |
| NOTES: See 2015 UWMP Sections 2 and 5 for discussion on Metropolitan's planning coordination, outreach, and notification (list provided in Table 5-3). | |

| Table 3-1 Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| | 18,740,000 | 19,355,000 | 20,017,000 | 20,639,000 | 21,206,000 | 21,791,000 |
| NOTES: See 2015 UWMP Appendix 1 Table A.1-2. | | | | | | |

| Table 4-1 Wholesale: Demands for Potable and Raw Water - Actual | | | |
|---|---|---|---|
| Use Type *(Add additional rows as needed)* | 2015 Actual | | |
| ***Drop down list*** *May select each use multiple times These are the only use types that will be recognized by the WUE data online submittal tool* | Additional Description *(as needed)* | Level of Treatment When Delivered *Drop down list* | Volume |
| Sales to other agencies | | Drinking Water | 815,431 |
| Sales to other agencies | | Raw Water | 944,248 |
| Losses | | | 44,049 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | **TOTAL** | 1,803,728 |

NOTES: Sales to other agecies include Metropolitan deliveries to member and non-member agencies and deliveries from conjunctive use programs. Some of these deliveries are not revenue producing nor sales.
Losses include evaporation losses from storage reservoirs, distribution system losses (2014 estimate), and water within Metropolitan's distribution system and regulating reservoirs. Water losses are both drinking and raw water.

| Table 4-2 Wholesale: Demands for Potable and Raw Water - Projected | | | | | | |
|---|---|---|---|---|---|---|
| Use Type *(Add additional rows as needed)* | Additional Description *(as needed)* | Projected Water Use *Report To the Extent that Records are Available* | | | | |
| ***Drop down list*** *May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool.* | | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| Other | | 1,586,000 | 1,636,000 | 1,677,000 | 1,726,000 | 1,765,000 |
| Transfers to other agencies | | 274,000 | 282,000 | 282,000 | 282,000 | 282,000 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **TOTAL** | | 1,860,000 | 1,918,000 | 1,959,000 | 2,008,000 | 2,047,000 |
| NOTES: See 2015 UWMP detailed discussion in Section 2, Metropolitan's Regional Water Demands Table 2-3 for Average Year, and Supply Capability and Projected Demands Table 2-6 for Average Year (average of 1922-2012 hydrologies). | | | | | | |

| Table 4-3 Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| Potable and Raw Water *From Tables 4-1 and 4-2* | 1,803,728 | 1,860,000 | 1,918,000 | 1,959,000 | 2,008,000 | 2,047,000 |
| Recycled Water Demand* *From Table 6-4* | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL WATER DEMAND** | 1,803,728 | 1,860,000 | 1,918,000 | 1,959,000 | 2,008,000 | 2,047,000 |
| **Recycled water demand fields will be blank until Table 6-4 is complete.* | | | | | | |
| NOTES: | | | | | | |

| Table 4-4 Wholesale: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss* |
| 01/2014 | 6,409 AF |
| ** Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* | |
| NOTES: See 2015 UWMP discussions in Section 2.6 and Appendix 7, and summary of 2014 distribution system losses in Table A.7-1. | |

| Table 6-1 Wholesale: Groundwater Volume Pumped | | | | | | |
|---|---|---|---|---|---|---|
| ☑ | Supplier does not pump groundwater. The supplier will not complete the table below. | | | | | |
| Groundwater Type *Drop Down List May use each category multiple times* | Location or Basin Name | 2011 | 2012 | 2013 | 2014 | 2015 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | **TOTAL** | 0 | 0 | 0 | 0 | 0 |
| NOTES: | | | | | | |

| Table 6-3 Wholesale: Wastewater Treatment and Discharge Within Service Area in 2015 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ☑ | Wholesale supplier neither distributes nor provides supplemental treatment to recycled water. The supplier will not complete the table below. | | | | | | | | | |
| Wastewater Treatment Plant Name | Discharge Location Name or Identifier | Discharge Location Description | Wastewater Discharge ID Number *(optional)* | Method of Disposal *Drop down list* | Does This Plant Treat Wastewater Generated Outside the Service Area? | Treatment Level *Drop down list* | 2015 volumes | | | |
| | | | | | | | Wastewater Treated | Discharged Treated Wastewater | Recycled Within Service Area | Recycled Outside of Service Area |
| *Add additional rows as needed* | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | **Total** | 0 | 0 | 0 | 0 |
| NOTES: | | | | | | | | | | |

| Table 6-4 Wholesale: Current and Projected Retailers Provided Recycled Water Within Service Area | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☑ | Recycled water is not directly treated or distributed by the supplier. The supplier will not complete the table below. | | | | | | |
| Name of Receiving Supplier or Direct Use by Wholesaler | Level of Treatment *Drop down list* | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| *Add additional rows as needed* | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | **Total** | 0 | 0 | 0 | 0 | 0 | 0 |
| NOTES: | | | | | | | |

| Table 6-5 Wholesale: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual | | |
|---|---|---|
| ☑ | Recycled water was not used or distributed by the supplier in 2010, nor projected for use or distribution in 2015. The wholesale supplier will not complete the table below. | |
| Name of Receiving Supplier or Direct Use by Wholesaler | 2010 Projection for 2015 | 2015 actual use |
| *Add additional rows as needed* | | |
| | | |
| | | |
| | | |
| **Total** | 0 | 0 |

NOTES: The 2010 RUWMP Table 2-8 included projection for recycled water use in 2015 of 404 TAF under average hydrology. In 2015, the actual recycled water use (regional total within Metropolitan service area) is estimated at 414 TAF, as discussed in this 2015 UWMP Section 3.5 on Table 3-12, page 3-62, and Appendix 2, page A.2-8. Regional total represents the projected production of existing and underconstruction projects by Metropolitan member agencies. Additional recycled production may materialize from the local resources target under Metropolitan's IRP (see 2015 IRP Update Section 2.1).

| Table 6-7 Wholesale: Expected Future Water Supply Projects or Programs | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | No expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Supplier will not complete the table below. | | | | | |
| ☑ | Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format. | | | | | |
| 2015 UWMP Section 3 and Appendix 3 | Provide page location of narrative in the UWMP | | | | | |
| Name of Future Projects or Programs | Joint Project with other agencies? | | Description *(if needed)* | Planned Implementation Year | Planned for Use in Year Type *Drop Down list* | Expected Increase in Water Supply to Agency |
| | *Drop Down Menu* | *If Yes, Agency Name* | | | | |
| *Add additional rows as needed* | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

NOTES: See 2015 UWMP Section 3 description of resources and program development for the CRA, SWP, Central Valley/SWP storage and transfers programs, conservation, LRP (groundwater recovery, recycling, desalination), and groundwater. Also see Appendix 3 detailed discussion on all supply programs and justifications for supply projections.

| Table 6-8 Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| ***Drop down list*** *May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Actual Volume | Water Quality *Drop Down List* | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | |
| Purchased or Imported Water | | 1,318,925 | Raw Water | |
| Supply from Storage | | 317,289 | Raw Water | |
| Transfers | | 17,514 | Raw Water | |
| Exchanges | | 150,000 | Raw Water | |
| | **Total** | 1,803,728 | | 0 |
| NOTES: | | | | |

| Table 6-9 Wholesale: Water Supplies — Projected | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply *Report To the Extent Practicable* | | | | | | | | | |
| | | 2020 | | 2025 | | 2030 | | 2035 | | 2040 *(opt)* | |
| ***Drop down list*** *May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | | | | | | | | |
| Other | | 3,511,000 | | 3,650,000 | | 4,044,000 | | 4,216,000 | | 4,292,000 | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | **Total** | 3,511,000 | 0 | 3,650,000 | 0 | 4,044,000 | 0 | 4,216,000 | 0 | 4,292,000 | 0 |
| NOTES: See 2015 UWMP detailed discussion in Section 2 and Supply Capability and Projected Demands Table 2-6 for Average Year (average of 1922-2012 hydrologies). | | | | | | | | | | | |

| Table 7-1 Wholesale: Basis of Water Year Data | | | |
|---|---|---|---|
| **Year Type** | **Base Year** *If not using a calendar year, type in the last year of the fiscal or water year, for example, water year 1999-2000, use 2000* | **Available Supplies if Year Type Repeats** | |
| | | ☑ Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location: 2015 UWMP Section 2 Tables 2-4, 2-5, 2-6, and Appendix 3. | |
| | | ☐ Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 1922-2012 | | 100% |
| Single-Dry Year | 1977 | | |
| Multiple-Dry Years 1st Year | 1990 | | |
| Multiple-Dry Years 2nd Year | 1991 | | |
| Multiple-Dry Years 3rd Year | 1992 | | |
| Multiple-Dry Years 4th Year *Optional* | | | |
| Multiple-Dry Years 5th Year *Optional* | | | |
| Multiple-Dry Years 6th Year *Optional* | | | |
| Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table. | | | |
| NOTES: See 2015 UWMP Section 2.3 discussion of sources of supply and water supply reliability assessment under average year, single-dry year, and multiple-dry year hydrologies (summarized in Tables 2-4, 2-5, and 2-6). Also see Appendix 3 for a detailed discussion on all supply programs and justifications for supply projections. | | | |

| Table 7-2 Wholesale: Normal Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals *(autofill from Table 6-9)* | 3,511,000 | 3,650,000 | 4,044,000 | 4,216,000 | 4,292,000 |
| Demand totals *(autofill fm Table 4-3)* | 1,860,000 | 1,918,000 | 1,959,000 | 2,008,000 | 2,047,000 |
| Difference | 1,651,000 | 1,732,000 | 2,085,000 | 2,208,000 | 2,245,000 |
| NOTES: See 2015 UWMP detailed discussion in Section 2 and Supply Capabilities in Table 2-6 for Average Year hydrology. | | | | | |

| Table 7-3 Wholesale: Single Dry Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| Supply totals | 2,647,000 | 2,786,000 | 3,091,000 | 3,263,000 | 3,339,000 |
| Demand totals | 2,005,000 | 2,066,000 | 2,108,000 | 2,160,000 | 2,201,000 |
| Difference | 642,000 | 720,000 | 983,000 | 1,103,000 | 1,138,000 |
| NOTES: See 2015 UWMP detailed discussion in Section 2 and Supply Capabilities in Table 2-4 for Single Dry-Year condition (repeat of 1977 hydrology). | | | | | |

| Table 7-4 Wholesale: Multiple Dry Years Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| First year | Supply totals | 2,146,000 | 2,234,000 | 2,394,000 | 2,487,000 | 2,546,000 |
| | Demand totals | 2,001,000 | 2,118,000 | 2,171,000 | 2,216,000 | 2,258,000 |
| | Difference | 145,000 | 116,000 | 223,000 | 271,000 | 288,000 |
| Second year | Supply totals | 2,146,000 | 2,234,000 | 2,394,000 | 2,487,000 | 2,546,000 |
| | Demand totals | 2,001,000 | 2,118,000 | 2,171,000 | 2,216,000 | 2,258,000 |
| | Difference | 145,000 | 116,000 | 223,000 | 271,000 | 288,000 |
| Third year | Supply totals | 2,146,000 | 2,234,000 | 2,394,000 | 2,487,000 | 2,546,000 |
| | Demand totals | 2,001,000 | 2,118,000 | 2,171,000 | 2,216,000 | 2,258,000 |
| | Difference | 145,000 | 116,000 | 223,000 | 271,000 | 288,000 |
| Fourth year *(optional)* | Supply totals | | | | | |
| | Demand totals | | | | | |
| | Difference | 0 | 0 | 0 | 0 | 0 |
| Fifth year *(optional)* | Supply totals | | | | | |
| | Demand totals | | | | | |
| | Difference | 0 | 0 | 0 | 0 | 0 |
| Sixth year *(optional)* | Supply totals | | | | | |
| | Demand totals | | | | | |
| | Difference | 0 | 0 | 0 | 0 | 0 |
| NOTES: See 2015 UWMP detailed discussion in Section 2 and Supply Capabilities in Table 2-5 for Multiple Dry-Year condition (repeat of 1990-1992 hydrology). | | | | | | |

| Table 8-1 Wholesale<br>Stages of Water Shortage Contingency Plan | | |
|---|---|---|
| Stage | Complete Both | |
| | Supply Reduction[1] | Water Supply Condition<br>(*Narrative description*) |
| *Add additional rows as needed* | | |
| Baseline Water Use Efficiency | Long-term conservation | Ongoing conservation, outreach, and recycling programs to achieve permanent reductions in water use and build storage reserves. |
| Condition 1: Water Supply Watch | Variable | Local agency voluntary dry-year conservation measures and use of regional storage reserves. |
| Condition 2: Water Supply Alert | Variable | Regional call for cities, counties, member agencies and retail water agencies to implement extraordinary conservation through drought ordinances and other measures to mitigate use of storage reserves. |
| Condition 3: Water Supply Allocation | 5% - 50% | Implement Metropolitan's Water Supply Allocation Plan. |
| [1] *One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.* | | |
| NOTES: See 2015 UWMP Section 2.4 discussion on Water Shortage Contingency Analysis, Water Surplus and Drought Management Plan, Water Supply Allocation Plan, and Water Supply Condition Framework (specifically Table 2-7).<br>As part of Catastrophic Supply Interruption Planning in Section 2.5, Metropolitan's Emergency Storage Requirements discuss planning based on a 100% reduction in imported supplies for a period of 6 months, which is greater than the 50% shortage required by the Act. In addition, the WSAP (included in Appendix 4) includes a Level 10 Regional Shortage Level that addresses regional shortage percentage of 50%. | | |

| Table 8-4 Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 1,935,371 | 1,636,530 | 1,798,633 |
| NOTES: See 2015 UWMP Section 1 discussion of Metropolitan's Short-term Supply Outlook and Supply Capability summarized in Table 1-7. | | | |

| Table 10-1 Wholesale: Notification to Cities and Counties (select one) | | |
|---|---|---|
| ☑ | Supplier has notified more than 10 cities or counties in accordance with CWC 10621 (b) and 10642. **Completion of the table below is not required. Provide a separate list of the cities and counties that were notified.** | |
| 2015 UWMP Section 5 Table 5-3 | Provide the page or location of this list in the UWMP. | |
| ☐ | Supplier has notified 10 or fewer cities or counties. **Complete the table below.** | |
| City Name | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| | ☐ | ☐ |
| | ☐ | ☐ |
| | ☐ | ☐ |
| County Name *Drop Down List* | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| | ☐ | ☐ |
| | ☐ | ☐ |
| NOTES: See 2015 UWMP Section 5 discussion on Metropolitan's notification to cities and counties (list provided in Table 5-3). | | |

# THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

# ANNUAL REPORT 2017



*Diamond Valley Lake experienced a major rebound between 2016 (top) and 2017.*

# THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

## ANNUAL REPORT FOR THE FISCAL YEAR

*July 1, 2016 to June 30, 2017*

LOS ANGELES, CALIFORNIA
2017

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## LIST OF ABBREVIATIONS

| Abbreviation | Term |
|---|---|
| AB | Assembly Bill |
| ACWA | Association of California Water Agencies |
| AEPCO | Arizona Electric Power Cooperative |
| AF | Acre-feet or acre-foot |
| AFY | Acre-feet or acre-foot per year |
| BDI | Bay-Delta Initiatives |
| CAISO | California Independent System Operator |
| CalPERS | California Public Employee Retirement System |
| CDFW | California Department of Fish and Wildlife |
| CEQA | California Environmental Quality Act |
| CFO | Chief Financial Officer |
| CIP | Capital Investment Plan |
| CRA | Colorado River Aqueduct |
| CUEA | California Utilities Emergency Association |
| CY | Calendar year |
| DBP | Disinfection Byproducts |
| DDW | Division of Drinking Water |
| DOE | Department of Energy |
| DSOD | Division of Safety of Dams |
| DVL | Diamond Valley Lake |
| DWR | Department of Water Resources |
| EEO | Equal Employment Opportunity |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| ERT | Emergency Response Tool |
| ESA | Endangered Species Act |
| FSA | Future Supply Actions |
| FY | Fiscal year |
| GFOA | Government Finance Officers Association |
| HAA5 | Five haloacetic acids |
| HRIS | Human Resources Information System |
| IIA | Institute of Internal Auditors |
| IID | Imperial Irrigation District |

## LIST OF ABBREVIATIONS

| Abbreviation | Term |
|---|---|
| IRP | Integrated Water Resources Plan |
| LRP | Local Resources Program |
| LT2 | Long Term 2 Enhanced Surface Water Treatment Rule |
| µg/L | Micrograms per liter |
| MAF | Million acre-feet |
| MCL | Maximum Contaminant Level |
| MIB | Methylisoborneol |
| MOU | Memorandum of Understanding |
| ND | Not detected |
| NDMA | N-Nitrosodimethylamine |
| OFAC | Office of Foreign Assets Control |
| O&M | Operations & Maintenance |
| PCCP | Prestressed Concrete Cylinder Pipe |
| PPB | Parts per billion |
| QSA | Quantification Settlement Agreement |
| RAA | Running Annual Average |
| RFP | Request for Proposal |
| RSI | Rate Structure Integrity |
| SB | Senate Bill |
| SDCWA | San Diego County Water Authority |
| SIFMA | Securities Industry & Financial Markets Association |
| SWC | State Water Contractors |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| T&O | Taste and odor |
| TDS | Total dissolved solids |
| TTHM | Total trihalomethane |
| USBR | U.S. Bureau of Reclamation |
| WAPA | Western Area Power Administration |
| WIIN | Water Infrastructure Improvements for the Nation |
| WRM | Water Resource Management |
| WSO | Water System Operations |
| WSR | Water Stewardship Rate |



*A balloon soars over Lake Skinner.*




*The Metropolitan board room served as the site for the State of MWD address (July 2016) and the election of new board officers (November 2016).*

# About Metropolitan

The Metropolitan Water District of Southern California is a regional wholesaler that delivers water to 26 member public agencies serving about 19 million people living in Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties.

Metropolitan is governed by a 38-member board of directors representing the 26 member agencies consisting of 14 cities, 11 municipal water districts and one county water authority, which directly or through their subagencies serve the residents and businesses of more than 300 cities and numerous unincorporated communities.

Metropolitan directors are selected by their respective member agencies and may serve on the board of that particular member agency. It is a diverse group drawn from a variety of sectors, including business, government, engineering and agriculture. The board operates under a weighted voting system, with voting share determined by assessed property valuation.

The mission of Metropolitan is to provide its 5,200-square-mile service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

To supply Southern California with reliable and safe water, Metropolitan owns and operates an extensive range of capital facilities including the Colorado River Aqueduct, 16 hydroelectric facilities, nine reservoirs, 830 miles of large-scale pipes, and five water treatment plants. Four of these treatment plants are among the 10 largest plants in the nation. In fact, Metropolitan is the largest distributor of treated drinking water in the United States.

The district imports water from the Colorado River and Northern California to supplement local supplies, and helps its member agencies develop increased water conservation, recycling, storage and other local resource programs.

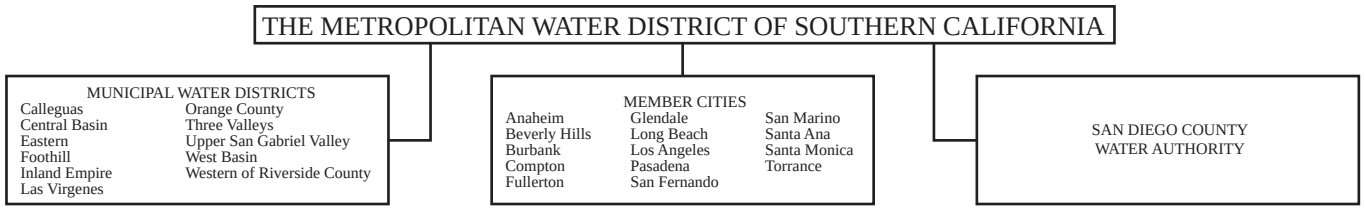
Metropolitan was established in 1928 under an act of the state Legislature to construct and operate the 242-mile Colorado River Aqueduct, which runs from an intake at Lake Havasu on the California-Arizona border, to an endpoint at Metropolitan's Lake Mathews reservoir in Riverside County.

When Metropolitan began delivering water, its service area consisted of approximately 625 square miles. Its service area has increased by 4,575 square miles since that time. The expansion is primarily the result of annexation of the service areas of member agencies.

In 1960, Metropolitan, followed by 30 other public agencies, signed a long-term contract that made possible the construction of the State Water Project's 444-mile California Aqueduct, which currently serves urban and agricultural agencies from the San Francisco Bay Area to Southern California. As the largest of the State Water Contractors, Metropolitan contracts with the state Department of Water Resources, which operates the SWP, for slightly less than half of all State Water Project supplies.

Water supplies from the State Water Project travel to Southern California via the California Aqueduct. Metropolitan also has ground-water banking partnerships and water transfer arrangements that secure additional supplies, and provides financial incentives to its member agencies for local investments in water management projects and programs. An increasing percentage of Southern California's water supply comes from these local sources, including conservation, water recycling and recovered groundwater.

Metropolitan's Board of Directors typically meets on the second Tuesday of each month. Board committee meetings usually occur on the Monday preceding the board meeting, and the second and fourth Tuesday of the month. Board and committee meetings are open to the public and are broadcast on the internet through Metropolitan's website, www.mwdh2o.com. A schedule of board and committee meetings is available on the website.




***Calleguas MWD***
Berylwood Heights Mutual Water
Brandeis Mutual
Butler Ranch
California American Water Company
California Water Service Company
Camarillo
Camrosa Water District
Crestview Mutual Water Company
Golden State Water Company
Oak Park Water Service
Oxnard
Pleasant Valley Mutual Water Company
Simi Valley
Solano Verde Mutual Water Company
Thousand Oaks
Ventura Co. Waterworks Dists. (Nos.1, 19 and 38)
Zone Mutual Water Company

***Central Basin MWD***
Bell Gardens
Bellflower-Somerset Mutual Water Co.
California Water Service Company
Cerritos
Commerce
Downey
Golden State Water Company
Huntington Park
La Habra Heights County Water District
Lakewood
Liberty Utilities
L.A. County Rancho Los Amigos
Lynwood
Maywood Mutual Water Co. Nos. 1, 2 and 3
Montebello
Norwalk
Orchard Dale Water District
Paramount
San Gabriel Valley Water Company
Santa Fe Springs
Signal Hill
South Gate
Suburban Water Systems
Vernon
Walnut Park Mutual Water Company
Water Replenishment District of So. Cal.

***Eastern MWD***
Hemet
Lake Hemet Municipal Water District
Nuevo Water Company
Perris
Rancho California Water District
San Jacinto

***Foothill MWD***
Crescenta Valley Water District
La Canada Irrigation District
Las Flores Water Company
Lincoln Avenue Water Company
Mesa Crest Water Company
Rubio Canon Land & Water Assoc.
Valley Water Company

***Inland Empire Utilities Agency***
Chino
Chino Hills
Cucamonga Valley Water District
Fontana Water Company
Monte Vista Water District
Ontario
San Antonio Water Company
Upland
Water Facilities Authority

***MWD of Orange County***
Brea
Buena Park
East Orange County Water District
El Toro Water District
Emerald Bay Service District
Fountain Valley
Garden Grove
Golden State Water Company
Huntington Beach
Irvine Ranch Water District
La Habra
La Palma
Laguna Beach County Water Dist.
Mesa Water District
Moulton Niguel Water District
Newport Beach
Orange
Orange County Water District
San Clemente
San Juan Capistrano
Santa Margarita Water District
Seal Beach
Serrano Water District
South Coast Water District
Trabuco Canyon Water District
Tustin
Westminster
Yorba Linda Water District

***San Diego County Water Authority***
Carlsbad Municipal Water District
Del Mar
Escondido
Fallbrook Public Utility District
Helix Water District
Lakeside Water District
National City
Oceanside
Olivenhain Municipal Water District
Otay Water District
Padre Dam Municipal Water District
Camp Pendleton Marine Corps Base
Poway
Rainbow Municipal Water District
Ramona Municipal Water District
Rincon del Diablo Municipal Water District
San Diego
San Dieguito Water District
Santa Fe Irrigation District
South Bay Irrigation District
Sweetwater Authority
Vallecitos Water District
Valley Center Municipal Water District
Vista Irrigation District
Yuima Municipal Water District

***Three Valleys MWD***
Boy Scouts of America, Firestone Ranch Reserv.
Cal Poly Pomona
Covina
Covina Irrigating Company
Glendora
Golden State Water Co. (Claremont & San Dimas)
La Verne
Mt. San Antonio College
Pomona
Rowland Water District
Suburban Water Systems
Valencia Heights Water Company
Walnut Valley Water District

***Upper San Gabriel Valley MWD***
Arcadia
Azusa
Monrovia
Main San Gabriel Basin Watermaster/Alhambra
Golden State Water Company
South Pasadena
Suburban Water Systems
Valley County Water District

***West Basin MWD***
California American Water (L.A. Division)
California Water Service
Golden State Water Company
El Segundo
Inglewood
Lomita
Los Angeles County Waterworks District #29
Manhattan Beach
Water Replenishment Dist. of So. Cal.

***Western MWD of Riverside County***
Box Springs Mutual Water Company
Corona
Eagle Valley Mutual Water Company
Elsinore Valley MWD
Norco
Rancho California Water District
Riverside
Temescal Valley Water District

*Figure 1. Composition of The Metropolitan Water District of Southern California*

# DIRECTORS
JUNE 30, 2017



**Chairman**
Randy A. Record
*Eastern Municipal Water District*



**Vice Chair**
Linda Ackerman
*Municipal Water District of Orange County*



**Vice Chair**
David D. De Jesus
*Three Valleys Municipal Water District*



**Vice Chair**
Gloria Gray
*West Basin Municipal Water District*



**Vice Chair**
John W. Murray Jr.
*Los Angeles*



**Secretary**
Steve Blois
*Calleguas Municipal Water District*

# DIRECTORS
JUNE 30, 2017



Judy Abdo
*Santa Monica*



Richard W. Atwater
*Foothill Municipal Water District*



Sylvia Ballin
*San Fernando*



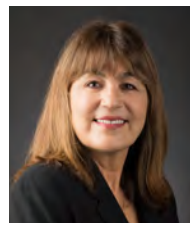
Brett R. Barbre
*Municipal Water District of Orange County*



Peter A. Beard
*Fullerton*



Michael Camacho
*Inland Empire Utilities Agency*



Gloria Cordero
*Long Beach*



Glen C. Dake
*Los Angeles*



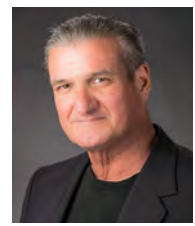
Donald L. Dear
*West Basin Municipal Water District*



Larry D. Dick
*Municipal Water District of Orange County*



Stephen J. Faessel
*Anaheim*



Donald Galleano
*Western Municipal Water District of Riverside County*

# DIRECTORS
JUNE 30, 2017



William Gedney
*Central Basin Municipal Water District*



Mark Gold
*Los Angeles*



Michael T. Hogan
*San Diego County Water Authority*



Cynthia Kurtz
*Pasadena*



Russell Lefevre
*Torrance*



Keith Lewinger
*San Diego County Water Authority*



Michele Martinez
*Santa Ana*



Larry McKenney
*Municipal Water District of Orange County*



John T. Morris
*San Marino*



Lorraine A. Paskett
*Los Angeles*



Glen D. Peterson
*Las Virgenes Municipal Water District*



Jesús E. Quiñonez
*Los Angeles*

# DIRECTORS
JUNE 30, 2017



Marsha Ramos
*Burbank*



Elsa Saxod
*San Diego County Water Authority*



Zareh Sinanyan
*Glendale*



Fern Steiner
*San Diego County Water Authority*



Charles Treviño
*Upper San Gabriel Valley Municipal Water District*



Leticia Vasquez Wilson
*Central Basin Municipal Water District*



Robert Wunderlich
*Beverly Hills*



Janna Zurita
*Compton*

## BOARD OF DIRECTORS
## July 1, 2016 to June 30, 2017

### OFFICERS OF THE BOARD

Chairman ..... Randy A. Record
Vice Chair ..... Linda Ackerman
Vice Chair ..... Gloria Gray
Vice Chair ..... John W. Murray Jr.
Vice Chair ..... Michael Touhey
Secretary ..... John T. Morris
Secretary ..... Steve Blois

### MEMBERS OF THE BOARD

Anaheim ..... Stephen J. Faessel
Beverly Hills ..... Robert Wunderlich
Burbank ..... Marsha Ramos
Calleguas Municipal Water District ..... Steve Blois
Central Basin Municipal Water District ..... Robert Apodaca
Central Basin Municipal Water District ..... Leticia Vasquez Wilson
Central Basin Municipal Water District ..... Phillip D. Hawkins
Central Basin Municipal Water District ..... Pedro Aceituno
Central Basin Municipal Water District ..... William C. Gedney
Compton ..... Janna Zurita
Eastern Municipal Water District ..... Randy A. Record
Foothill Municipal Water District ..... Richard W. Atwater
Fullerton ..... Peter A. Beard
Glendale ..... Laura Friedman
Glendale ..... Zareh Sinanyan
Inland Empire Utilities Agency ..... Michael Camacho
Las Virgenes Municipal Water District ..... Glen D. Peterson
Long Beach ..... Gloria Cordero
Los Angeles ..... Glen C. Dake
Los Angeles ..... John W. Murray Jr.
Los Angeles ..... Jesús E. Quiñonez
Los Angeles ..... Lorraine Paskett
Los Angeles ..... Mark Gold

Municipal Water District of Orange County ..... Linda Ackerman
Municipal Water District of Orange County ..... Brett R. Barbre
Municipal Water District of Orange County ..... Larry D. Dick
Municipal Water District of Orange County ..... Larry McKenney
Pasadena ..... Cynthia Kurtz
San Diego County Water Authority..... Michael Hogan
San Diego County Water Authority..... Keith Lewinger
San Diego County Water Authority..... Fern Steiner
San Diego County Water Authority..... Yen C. Tu
San Diego County Water Authority..... Elsa Saxod
San Fernando ..... Sylvia Ballin
San Marino..... John T. Morris
Santa Ana..... Michele Martinez
Santa Monica ..... Judy Abdo
Three Valleys Municipal Water District..... David D. De Jesus
Torrance..... Russell Lefevre
Upper San Gabriel Valley
Municipal Water District ..... Michael Touhey
Upper San Gabriel Valley
Municipal Water District ..... Charles M. Treviño
West Basin Municipal Water District..... Donald L. Dear
West Basin Municipal Water District..... Gloria Gray
Western Municipal Water District
of Riverside County..... Donald Galleano

Note:
This list includes all officers and members who served on the board at any time during the fiscal year.

## BOARD OF DIRECTORS
## MEMBERS OF STANDING COMMITTEES
## June 30, 2017

### EXECUTIVE COMMITTEE

Randy A. Record, Chair
Linda Ackerman, Vice Chair
David D. De Jesus, Vice Chair
Gloria Gray, Vice Chair
John W. Murray Jr., Vice Chair
Steve Blois, Secretary
Brett R. Barbre
Michael Camacho
Larry D. Dick
Michael T. Hogan
Cynthia Kurtz
Glen D. Peterson
Jesús E. Quiñonez
Robert Wunderlich

### COMMUNICATIONS AND LEGISLATION

Cynthia Kurtz, Chair
Gloria Gray, Vice Chair
Judy Abdo
Linda Ackerman
Sylvia Ballin
Brett R. Barbre
Michael Camacho
Donald Galleano
Mark Gold
Russell Lefevre
Keith Lewinger
John T. Morris
John W. Murray Jr.
Glen D. Peterson
Elsa Saxod
Leticia Vasquez Wilson

### ENGINEERING AND OPERATIONS

Glen D. Peterson, Chair
Steve Blois, Vice Chair
Brett R. Barbre
Peter A. Beard
Michael Camacho
Glen C. Dake
David D. De Jesus
Larry D. Dick
Stephen Faessel
Donald Galleano
William C. Gedney
Russell Lefevre
John T. Morris
Fern Steiner
Charles M. Treviño
Janna Zurita

### FINANCE AND INSURANCE

Brett R. Barbre, Chair
Robert Wunderlich, Vice Chair
Steve Blois
Glen C. Dake
Donald L. Dear
David D. De Jesus
Stephen Faessel
William C. Gedney
Cynthia Kurtz
Keith Lewinger
Michele Martinez
Larry McKenney
Lorraine Paskett
Marsha Ramos
Elsa Saxod
Zareh Sinanyan

**LEGAL AND CLAIMS**

Jesús E. Quiñonez, Chair
Larry McKenney, Vice Chair
Richard W. Atwater
Michael Camacho
Gloria Cordero
Donald L. Dear
Larry D. Dick
John W. Murray Jr.
Lorraine Paskett
Zareh Sinanyan
Fern Steiner
Robert Wunderlich

**ORGANIZATION, PERSONNEL AND TECHNOLOGY**

Robert Wunderlich, Chair
Michael Camacho, Vice Chair
Sylvia Ballin
Brett Barbre
Gloria Cordero
Stephen Faessel
William C. Gedney
Gloria Gray
Michael T. Hogan
Larry McKenney
John W. Murray Jr.
Jesús E. Quiñonez
Charles M. Treviño
Leticia Vasquez Wilson
Janna Zurita

**REAL PROPERTY AND ASSET MANAGEMENT**

Michael Camacho, Chair
Glen C. Dake, Vice Chair
Peter Beard
Donald L. Dear
Larry D. Dick
Michael T. Hogan
Glen D. Peterson
Marsha Ramos
Charles M. Treviño
Robert Wunderlich

**WATER PLANNING AND STEWARDSHIP**

Gloria Gray, Chair
Richard W. Atwater, Vice Chair
Judy Abdo
Linda Ackerman
Michael Camacho
David D. De Jesus
Larry D. Dick
Keith Lewinger
John T. Morris
Lorraine Paskett
Glen D. Peterson
Jesús E. Quiñonez
Fern Steiner
Robert Wunderlich

**HISTORICAL**
**ROLL OF DIRECTORS**
**June 30, 2017**

ANAHEIM

A. W. Franzen.....March 1, 1929 to April 11, 1930
O. E. Steward.....April 18, 1930 to April 12, 1935
E. P. Hapgood.....May 3, 1935 to June 14, 1960
Charles A. Pearson .....July 12, 1960 to May 8, 1972
Keith A. Murdoch.....June 13, 1972 to May 29, 1979
Joseph C. Truxaw .....August 17, 1979 to November 20, 1990
Bob Kazarian .....November 20, 1990 to July 12, 1994
Edward G. Alario.....November 8, 1994 to April 14, 1998
S. Dale Stanton .....April 14, 1998 to July 8, 2004
Tom Tait .....July 8, 2004 to December 13, 2005
Marcie L. Edwards .....December 13, 2005 to August 18, 2009
Kristine L. Murray.....August 18, 2009 to August 20, 2014
Don Calkins.....October 3, 2014 to June 8, 2015
STEPHEN J. FAESSEL .....June 8, 2015 to

BEVERLY HILLS

Paul E. Schwab.....March 1, 1929 to June 19, 1931
George R. Barker.....June 19, 1931 to August 2, 1935
Arthur Taylor.....August 2, 1935 to August 2, 1951
Floyd E. Fischer.....August 17, 1951 to December 2, 1977
Ellen Stern Harris .....January 10, 1978 to March 10, 1981
Nicholas H. Cominos.....March 10, 1981 to September 1, 1984
Mel Odom.....January 11, 1983 to February 14, 1984
Ina S. Roth .....February 14, 1984 to February 11, 1992
Dan Webster .....March 10, 1992 to September 8, 1999
Betty H. Harris.....September 8, 1999 to June 14, 2007
ROBERT WUNDERLICH.....July 6, 2007 to

BURBANK

Harvey E. Bruce .....March 1, 1929 to February 11, 1933
James L. Norwood.....March 10, 1933 to April 30, 1943
May 9, 1947 to October 13, 1953
Frank C. Tillson.....May 14, 1943 to May 9, 1947
Walter H. Long.....October 13, 1953 to June 13, 1961
Earle C. Blais.....June 13, 1961 to June 11, 1985
Michael A. Nolan .....June 11, 1985 to July 9, 1991

Larry L. Stamper ..... July 9, 1991 to June 6, 1995
Thomas H. McCauley ..... June 6, 1995 to December 16, 1998
Fred Lantz ..... January 12, 1999 to March 9, 1999
George E. Battey Jr. ..... March 9, 1999 to December 10, 2001
Glenn A. Brown ..... December 10, 2001 to January 13, 2015
MARSHA RAMOS ..... January 13, 2015 to

CALLEGUAS MUNICIPAL WATER DISTRICT

Richard Bard ..... January 10, 1961 to August 22, 1969
Carl E. Ward ..... September 16, 1969 to February 9, 1993
Vincent M. Hardy ..... October 14, 1980 to June 30, 1990
Patrick H. Miller ..... August 21, 1990 to February 1, 1999
Jeffrey A. Borenstein ..... April 7, 1999 to December 31, 2000
Ted Grandsen ..... February 9, 1993 to December 11, 2012
Gail Pringle ..... December 11, 2012 to March 10, 2014
STEVE BLOIS ..... March 10, 2014 to

CENTRAL BASIN MUNICIPAL WATER DISTRICT

Milo Dellmann ..... November 23, 1954 to November 23, 1983
Claire S. Thompson ..... November 23, 1954 to November 30, 1959
Frank H. Wheelock ..... November 23, 1954 to April 10, 1973
Victor H. York ..... November 23, 1954 to November 30, 1963
E. Thornton Ibbetson ..... December 8, 1959 to January 12, 1998
William H. Kent ..... October 10, 1961 to April 7, 1977
Carl Fossette ..... March 13, 1973 to May 30, 1986
Douglas W. Ferguson ..... June 14, 1977 to August 11, 1993
Leonis C. Malburg ..... July 8, 1986 to May 8, 1995
Gary A. Morse ..... August 11, 1993 to February 10, 1997
January 5, 1999 to June 6, 2003
Jorge G. Castro ..... February 10, 1997 to March 9, 1999
Phillip J. Pace ..... May 8, 1995 to January 8, 2008
Richard F. Mayér ..... January 12, 1998 to January 5, 1999
Charles M. Treviño ..... March 9, 1999 to December 31, 2000
Robert Apodaca ..... June 6, 2003 to August 18, 2009
February 11, 2013 to January 4, 2017
Phillip D. Hawkins ..... January 8, 2008 to February 11, 2013
July 7, 2014 to February 10, 2015
February 13, 2017 to March 13, 2017
Edward C. Vasquez ..... August 18, 2009 to July 13, 2010

Rudy C. Montalvo..... July 13, 2010 to February 11, 2013
LETICIA VASQUEZ WILSON.. February 11, 2013 to July 7, 2014
February 10, 2015 to January 4, 2017
March 14, 2017 to
Pedro Aceituno ..... February 14, 2017 to March 13, 2017
WILLIAM C. GEDNEY..... March 14, 2017 to

COASTAL MUNICIPAL WATER DISTRICT
(absorbed into MWDOC in 2001)

C. C. Cravath ..... August 14, 1942 to January 22, 1957
Lynndon L. Aufdenkamp..... January 22, 1957 to February 12, 1991
James E. O'Connor..... December 7, 1976 to July 1, 1979
John Killefer ..... January 12, 1982 to September 9, 1993
Wayne T. McMurray ..... February 12, 1991 to December 31, 2000
Donald C. Simpson ..... October 7, 1996 to December 9, 1996
Langdon W. Owen..... December 9, 1996 to January 17, 2001

COMPTON

C. A. Dickison ..... July 17, 1931 to January 20, 1933
William H. Foster ..... January 20, 1933 to June 28, 1935
Warren W. Butler..... June 28, 1935 to January 24, 1980
Regina Murph ..... March 11, 1980 to March 25, 2003
Kenneth M. Orduna ..... April 8, 2003 to January 14, 2004
Isadore Hall III..... February 9, 2004 to April 13, 2009
Yvonne Arcenaux ..... April 13, 2009 to September 14, 2010
March 11, 2014 to November 10, 2015
Diane Sanchez..... September 14, 2010 to March 11, 2014
JANNA ZURITA..... November 10, 2015 to

EASTERN MUNICIPAL WATER DISTRICT

Irwin E. Farrar..... August 31, 1951 to March 1, 1982
Doyle F. Boen ..... March 9, 1982 to October 11, 1994
Chester C. Gilbert ..... October 11, 1994 to June 1, 1999
Clayton A. Record Jr..... June 1, 1999 to January 9, 2001
Marion V. Ashley..... January 9, 2001 to January 6, 2003
RANDY A. RECORD ..... January 14, 2003 to

## FOOTHILL MUNICIPAL WATER DISTRICT

Nelson Hayward..... February 8, 1955 to July 4, 1959
Conrad R. Fanton..... November 10, 1959 to November 2, 1964
A. B. Smedley..... April 13, 1965 to August 1, 1990
Brooks T. Morris..... September 11, 1990 to November 27, 1991
William T. O'Neil ..... January 14, 1992 to May 10, 1999
James T. Edwards ..... May 10, 1999 to April 1, 2014
RICHARD W. ATWATER ..... April 3, 2014 to

## FULLERTON

Walter Humphreys..... April 10, 1931 to January 19, 1945
H. H. Kohlenberger..... July 27, 1945 to March 7, 1959
Hubert C. Ferry..... February 23, 1960 to February 8, 1983
Norman L. De Vilbiss..... February 8, 1983 to April 12, 1988
James H. Blake ..... August 23, 1988 to August 3, 2012
Thomas Babcock..... September 6, 2012 to February 11, 2014
Jennifer Fitzgerald ..... February 11, 2014 to July 7, 2014
PETER A. BEARD..... July 7, 2014 to

## GLENDALE

W. Turney Fox..... March 1, 1929 to November 27, 1931
Samuel G. McClure ..... November 27, 1931 to January 13, 1933
Frank P. Taggart ..... January 13, 1933 to August 31, 1934
Bernard C. Brennan ..... August 31, 1934 to April 23, 1937
Herman Nelson ..... June 4, 1937 to August 27, 1954
Paul L. Burkhard..... September 28, 1954 to June 10, 1958
Normal C. Hayhurst..... June 10, 1958 to June 9, 1970
Lauren W. Grayson..... June 9, 1970 to May 21, 1972
William H. Fell ..... June 13, 1972 to July 13, 1976
C. E. Perkins ..... July 13, 1976 to July 13, 1988
James M. Rez..... August 23, 1988 to March 9, 2009
Peter Kavounas ..... March 9, 2009 to December 8, 2009
Laura Friedman..... December 8, 2009 to December 4, 2016
ZAREH SINANYAN ..... February 14, 2017 to

INLAND EMPIRE UTILITIES AGENCY
(formerly Chino Basin MWD)

A. C. Reynolds..... February 12, 1952 to March 12, 1963
Ray W. Ferguson ..... March 12, 1963 to December 31, 1980
Carl B. Masingale ..... March 10, 1981 to August 9, 1984
John G. Gilday ..... September 11, 1984 to February 15, 1985
Edward A. Girard..... March 12, 1985 to May 31, 1990
Anne W. Dunihue ..... September 20, 1988 to February 11, 1992
Bill M. Hill..... August 21, 1990 to February 9, 1999
Dwight F. French ..... February 11, 1992 to August 18, 1994
Wyatt L. Troxel..... August 19, 1994 to November 14, 2003
Gene Koopman ..... February 9, 1999 to December 31, 2000
November 14, 2003 to February 10, 2009
Angel Santiago..... February 10, 2009 to February 3, 2011
MICHAEL CAMACHO..... February 3, 2011 to

LAS VIRGENES MUNICIPAL WATER DISTRICT

Earle Brookins ..... December 13, 1960 to March 26, 1963
A. Myron McBride..... March 26, 1963 to May 11, 1965
A. Macneil Stelle ..... June 8, 1965 to October 23, 1967
March 11, 1975 to February 9, 1993
Whitney P. Reeve ..... December 19, 1967 to March 11, 1975
GLEN D. PETERSON..... February 9, 1993 to

LONG BEACH

Nowland M. Reid..... April 10, 1931 to January 27, 1933
W. M. Cook ..... January 27, 1933 to April 30, 1943
Gus A. Walker ..... April 30, 1943 to December 31, 1976
Lloyd C. Leedom ..... May 9, 1947 to June 30, 1979
Samuel C. Rue ..... October 9, 1979 to March 12, 1985
Ida Frances Lowry ..... March 12, 1985 to February 9, 1993
Henry J. Meyer ..... February 9, 1993 to August 19, 1997
Helen Z. Hansen ..... August 19, 1997 to May 13, 2008
Suja Lowenthal ..... May 13, 2008 to September 13, 2016
GLORIA CORDERO……September 13, 2016 to

## LOS ANGELES

John R. Haynes ..... March 1, 1929 to February 4, 1930
John R. Richards ..... March 1, 1929 to October 28, 1947
W. P. Whitsett ..... March 1, 1929 to January 10, 1947
John G. Bullock ..... November 1, 1929 to September 15, 1933
O. T. Johnson Jr. ..... November 5, 1929 to August 29, 1930
W. L. Honnold ..... February 28, 1930 to July 21, 1933
J. Eisner ..... August 29, 1930 to July 2, 1937
Walter A. Ham ..... January 20, 1933 to January 4, 1935
D. W. Pontius ..... January 20, 1933 to September 3, 1955
Perry H. Greer ..... July 21, 1933 to August 14, 1950
V. H. Rossetti ..... October 13, 1933 to November 19, 1960
Otto J. Emme ..... January 11, 1935 to October 22, 1947
Louis S. Nordlinger ..... August 13, 1937 to June 8, 1940
Joseph Jensen ..... August 16, 1940 to February 3, 1944
March 8, 1946 to July 8, 1974
Ransom W. Chase ..... March 14, 1947 to February 11, 1975
Gordon B. Crary ..... March 14, 1947 to November 8, 1959
Howard D. Mills ..... March 14, 1947 to March 17, 1965
W. R. Fawcett ..... May 13, 1952 to November 27, 1953
Luther C. Anderson ..... January 12, 1954 to February 11, 1975
Noah Dietrich ..... November 8, 1955 to November 23, 1970
Ferdinand Mendenhall ..... July 29, 1958 to October 8, 1974
Ben P. Griffith ..... August 9, 1960 to June 7, 1961
Pietro Di Carlo ..... February 14, 1961 to November 7, 1967
William S. Peterson ..... February 14, 1961 to August 10, 1979
Aubrey E. Austin Jr. ..... February 28, 1961 to May 13, 1975
Albert F. Bush ..... November 14, 1961 to February 11, 1975
John W. Luhring ..... January 16, 1962 to August 8, 1967
Joseph M. Quinn ..... May 14, 1968 to September 18, 1973
B. Walter Hicks ..... May 8, 1973 to August 20, 1974
Samuel B. Nelson ..... September 18, 1973 to October 9, 1984
Katherine B. Dunlap ..... August 20, 1974 to September 11, 1984
Jerry Godell ..... October 8, 1974 to October 9, 1984
Edward L. Kussman ..... October 8, 1974 to November 8, 1993
Herman Leavitt ..... February 11, 1975 to August 19, 1975
Yolanda M. Nava ..... February 11, 1975 to September 14, 1976
S. Dell Scott ..... February 11, 1975 to October 12, 1993
Willie J. Stennis ..... May 13, 1975 to December 31, 1978
Mladin Zarubica ..... August 19, 1975 to March 16, 1981

Soledad S. Garcia..... September 14, 1976 to September 11, 1984
Mark Lainer ..... November 13, 1979 to February 12, 1991
Mark Nathanson..... April 14, 1981 to September 11, 1984
Michael Glazer..... September 11, 1984 to April 9, 1991
Helen Romero Shaw ..... September 11, 1984 to November 8, 1993
Marilyn L. Garcia..... October 9, 1984 to February 9, 1993
Rachel Levin ..... October 9, 1984 to April 4, 1989
Frank S. Wyle ..... October 9, 1984 to August 1, 1991
Robert Abernethy..... April 4, 1989 to October 13, 1992
February 9, 1993 to November 8, 1993
Vernon R. Watkins..... February 12, 1991 to August 20, 1992
Alf W. Brandt ..... April 9, 1991 to February 13, 1996
Michael J. Gage ..... August 1, 1991 to September 21, 1993
Carolyn L. Green ..... August 20, 1992 to December 31, 1995
April 30, 1996 to May 16, 1997
William G. Luddy..... October 13, 1992 to May 10, 2005
George Wein..... October 12, 1992 to August 20, 2002
David Y. Handelman ..... November 8, 1993 to November 14, 1995
Kenneth T. Lombard..... November 8, 1993 to April 11, 1995
Katherine W. Moret ..... November 8, 1993 to December 31, 2000
Christopher C. Pak..... November 8, 1993 to December 19, 1995
Bonny L. Herman..... April 11, 1995 to April 12, 2004
Larry J. Kosmont ..... February 13, 1996 to December 31, 2000
Aaron E. Michaelsen..... February 13, 1996 to January 13, 1997
L. Michael Russell ..... June 11, 1996 to January 12, 1998
S. David Freeman..... January 12, 1998 to December 31, 2000
Ronald R. Gastelum..... January 12, 1998 to November 10, 1998
Jorge G. Castro ..... June 7, 1999 to October 7, 2003
Deborah Dentler..... August 20, 2002 to January 6, 2006
David Farrar..... October 7, 2003 to January 6, 2006
Robert B. Simonds..... April 12, 2004 to January 6, 2006
Ronald F. Deaton ..... May 10, 2005 to January 6, 2006
Aaron A. Grunfeld ..... January 6, 2006 to May 12, 2014
JOHN W. MURRAY JR..... January 6, 2006 to
JESÚS E. QUIÑONEZ ..... January 6, 2006 to
Nancy Sutley..... January 6, 2006 to May 12, 2009
David W. Fleming..... May 12, 2009 to January 14, 2014
Paul Koretz ..... January 14, 2014 to April 11, 2016
GLEN C. DAKE ..... May 12, 2014 to
LORRAINE PASKETT..... December 7, 2015 to
MARK GOLD ..... April 11, 2016 to

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Glenn P. Allen..... December 11, 1951 to December 17, 1986
W. B. Hellis ..... August 19, 1955 to February 9, 1975
William J. Teague ..... February 11, 1969 to October 10, 1972
Robert R. Dowling..... September 14, 1971 to May 11, 1976
Doyle Miller..... October 10, 1972 to October 31, 1987
Carl J. Kymla ..... October 9, 1973 to October 20, 1993
Philip J. Reilly..... December 9, 1975 to December 8, 1978
Gerald E. Price..... May 11, 1976 to December 31, 1988
M. Roy Knauft Jr. ..... September 13, 1977 to January 12, 1993
Kenneth H. Witt..... October 13, 1981 to December 31, 2000
William F. Davenport ..... January 13, 1987 to February 14, 1995
John V. Foley..... August 22, 1989 to March 21, 2014
Wesley M. Bannister..... January 12, 1993 to October 31, 2006
Jerry A. King..... January 11, 1994 to July 21, 1999
Robert J. Huntley ..... February 14, 1995 to October 31, 1999
Peer A. Swan..... August 31, 1999 to June 30, 2002
Ed Royce Sr. ..... February 7, 2000 to December 31, 2000
Langdon W. Owen..... January 17, 2001 to April 24, 2003
Ergun Bakall ..... July 1, 2002 to December 8, 2009
LARRY D. DICK ..... August 12, 2003 to
Steve Anderson..... January 30, 2007 to January 16, 2008
LINDA ACKERMAN ..... April 8, 2008 to
BRETT R. BARBRE ..... December 8, 2009 to
LARRY MCKENNEY ..... October 13, 2014 to

PASADENA

Franklin Thomas..... March 1, 1929 to August 27, 1952
Morris S. Jones ..... September 16, 1952 to October 10, 1961
Robert B. Diemer..... January 16, 1962 to October 27, 1966
Don C. McMillan..... January 10, 1967 to October 26, 1975
Karl A. Johnson ..... December 9, 1975 to April 11, 1980
Martin Goldsmith..... July 8, 1980 to June 11, 1985
Timothy F. Brick..... June 11, 1985 to December 31, 2012
CYNTHIA KURTZ ..... April 8, 2013 to

SAN DIEGO COUNTY WATER AUTHORITY

Fred A. Heilbron..... January 10, 1947 to February 14, 1973
J. L. Burkholder ..... January 24, 1947 to April 6, 1953

Richard S. Holmgren ..... August 11, 1953 to February 19, 1963
J. William Fisher..... April 12, 1955 to October 11, 1955
Hans H. Doe..... August 20, 1959 to October 20, 1986
Paul Beermann..... February 19, 1963 to July 9, 1963
Harry Griffen ..... February 19, 1963 to October 13, 1997
George R. Henderson..... August 13, 1963 to November 29, 1964
Ralph E. Graham..... September 14, 1971 to January 14, 1975
August 17, 1979 to June 28, 1982
Raymond E. Badger..... September 18, 1973 to May 14, 1979
Lloyd L. Lee ..... November 20, 1973 to December 31, 1980
John M. Cranston..... January 14, 1975 to December 31, 1986
John P. Starkey ..... January 13, 1981 to March 12, 1992
Michael D. Madigan ..... August 18, 1982 to October 13, 1992
Francesca M. Krauel ..... November 8, 1983 to August 20, 2001
John F. Hennigar..... November 18, 1986 to October 31, 1989
Dale Mason..... January 13, 1987 to February 8, 1999
Herbert H. Stickney ..... November 14, 1989 to April 13, 1993
Christine M. Frahm..... April 14, 1992 to March 12, 1999
John M. Leach..... October 13, 1992 to October 25, 1993
Joseph Parker..... April 13, 1993 to January 11, 1999
June 7, 1999 to February 10, 2009
Mark W. Watton ..... December 13, 1993 to January 12, 1998
February 8, 1999 to May 14, 2001
Gordon W. Tinker..... October 12, 1997 to December 31, 2000
Claude A. “Bud” Lewis ..... January 12, 1998 to December 7, 2006
James F. Turner..... January 11, 1999 to December 31, 2000
February 10, 2003 to August 17, 2004
Harold W. Ball..... May 14, 2001 to February 10, 2003
George I. Loveland ..... October 15, 2001 to November 1, 2006
W.D. “Bud” Pocklington ..... August 17, 2004 to December 14, 2010
James H. “Jim” Bond..... November 1, 2006 to February 10, 2009
James M. Barrett..... December 7, 2006 to July 12, 2010
KEITH LEWINGER..... February 10, 2009 to
FERN STEINER..... February 10, 2009 to
Lynne L. Heidel ..... July 12, 2010 to November 5, 2012
James Bowersox ..... December 14, 2010 to December 12, 2011
Douglas Wilson..... December 12, 2011 to August 27, 2013
Vincent Mudd ..... November 5, 2012 to October 13, 2014
MICHAEL T. HOGAN ..... August 27, 2013 to
Yen C. Tu..... October 13, 2014 to July 5, 2016
ELSA SAXOD..... October 11, 2016

SAN FERNANDO

Neville R. Lewis ..... December 14, 1971 to August 21, 1984
Pat J. Modugno ..... August 21, 1984 to August 8, 1986
Doude Wysbeek ..... December 9, 1986 to June 10, 1997
Sergio Rascon ..... June 10, 1997 to July 7, 2000
Hugo C. Mejia..... July 7, 2000 to November 8, 2004
Steven Veres ..... November 8, 2004 to September 5, 2007
SYLVIA BALLIN ..... September 5, 2007 to

SAN MARINO

Harry L. Heffner ..... March 1, 1929 to September 29, 1933
John H. Ramboz..... September 29, 1933 to November 18, 1960
Howard A. Miller..... January 10, 1961 to April 26, 1975
Preston Hotchkis ..... June 10, 1975 to September 10, 1986
Preston B. Hotchkis ..... March 10, 1987 to March 13, 1990
JOHN T. MORRIS..... March 13, 1990 to

SANTA ANA

S.H. Finley ..... March 1, 1929 to April 10, 1942
A. H. Allen..... April 10, 1942 to December 10, 1968
Howard W. Crooke ..... December 10, 1968 to September 1, 1977
John Garthe ..... November 8, 1977 to July 9, 1991
Daniel H. Young ..... July 9, 1991 to December 31, 1993
Lee Harry ..... February 8, 1994 to April 8, 1997
Thom Coughran ..... April 8, 1997 to February 3, 2005
Daniel E. Griset..... February 3, 2005 to March 10, 2015
MICHELE MARTINEZ ..... March 10, 2015 to

SANTA MONICA

George H. Hutton..... March 1, 1929 to January 16, 1931
Arthur A. Weber ..... January 16, 1931 to October 12, 1934
William H. Carter ..... February 15, 1935 to March 13, 1936
Edmond S. Gillette..... June 12, 1936 to January 8, 1937
Arthur P. Creel..... January 8, 1937 to March 3, 1941
Samuel G. McClure ..... March 21, 1941 to November 14, 1947
Samuel J. Crawford..... December 5, 1947 to September 15, 1959
Mark T. Gates ..... January 12, 1960 to July 12, 1972
Francis A. Goplen ..... August 18, 1972 to December 9, 1980
Robert Gottlieb ..... December 9, 1980 to December 8, 1987

Christine E. Reed ..... March 8, 1988 to April 24, 1996
JUDY ABDO ..... June 11, 1996 to

THREE VALLEYS MUNICIPAL WATER DISTRICT

Hugh W. Stiles ..... December 8, 1950 to December 31, 1961
Arthur H. Cox ..... January 16, 1962 to April 16, 1974
William C. Leech ..... April 16, 1974 to February 9, 1982
William H. Koch ..... February 9, 1982 to February 12, 1985
Mel Harper ..... February 12, 1985 to February 18, 1986
Richard W. Hansen ..... June 10, 1986 to August 20, 1991
Bruce R. J. Milne ..... August 20, 1991 to February 10, 1997
Henry S. Barbosa ..... February 10, 1997 to February 20, 2002
DAVID D. DE JESUS ..... March 8, 2002 to

TORRANCE

John Dennis ..... March 17, 1931 to April 14, 1933
J. R. Jensen ..... April 14, 1933 to December 31, 1933
Charles T. Rippy ..... January 19, 1934 to August 8, 1950
George W. Stevens ..... September 22, 1950 to June 13, 1961
George A. Bradford ..... June 13, 1961 to October 13, 1964
George Vico ..... November 17, 1964 to August 13, 1968
Ben Haggott ..... August 13, 1968 to November 14, 1982
Marvin Brewer ..... March 8, 1983 to November 27, 1993
Bill D. Wright ..... March 8, 1994 to July 1, 2013
RUSSELL LEFEVRE ..... September 24, 2013 to

UPPER SAN GABRIEL VALLEY MUNICIPAL WATER DISTRICT

J. Ercel Cleminson ..... April 9, 1963 to January 30, 1964
Howard H. Hawkins ..... April 9, 1963 to December 31, 1989
February 9, 1993 to March 4, 1997
Frank E. Vachon ..... March 10, 1964 to March 10, 1970
Robert T. Radford ..... March 10, 1970 to December 31, 1970
Travis L. Manning ..... January 12, 1971 to December 31, 1978
Burton E. Jones ..... January 9, 1979 to February 9, 1993
John E. Maulding ..... January 9, 1990 to February 9, 1993
Anthony R. Fellow ..... February 9, 1993 to February 10, 2009
February 9, 2010 to July 19, 2011
Edward L. Chavez ..... August 30, 2011 to January 9, 2012
Frank F. Forbes ..... March 4, 1997 to December 31, 2000
R. William "Bill" Robinson ..... February 10, 2009 to February 9, 2010

Stephen Millard..... January 9, 2012 to February 8, 2013
Michael Touhey ..... February 8, 2013 to January 3, 2017
CHARLES M. TREVIÑO.....January 10, 2017

WEST BASIN MUNICIPAL WATER DISTRICT

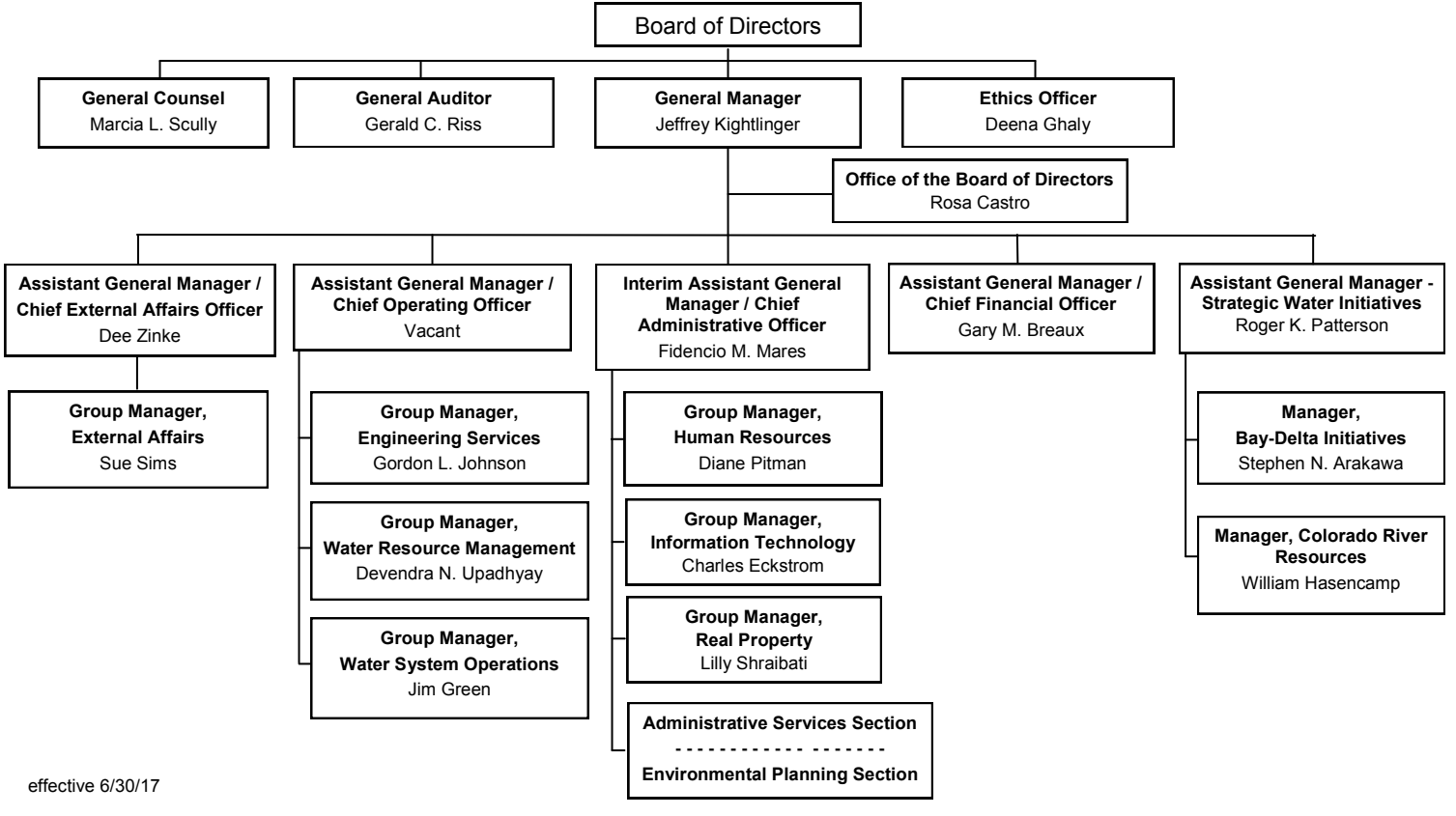
Robert E. Austin ..... August 20, 1948 to October 21, 1968
Ben Haggott ..... March 10, 1953 to October 8, 1956
W. C. Farquhar..... August 19, 1955 to July 13, 1976
T. V. Tallon..... August 9, 1960 to April 9, 1963
Louis J. Alexander ..... August 13, 1963 to March 30, 1972
Charles D. Barker ..... September 10, 1963 to December 31, 2000
Einar C. Matson ..... November 12, 1968 to February 12, 1984
Lester E. Carlson..... October 8, 1974 to September 2, 1988
E. L. Balmer..... August 19, 1976 to May 23, 1989
Harold E. Crozier..... October 25, 1988 to April 9, 1991
Charles L. Stuart ..... July 11, 1989 to April 11, 1995
Robert Goldsworthy..... April 9, 1991 to March 8, 1994
Edward C. Little..... March 8, 1994 to January 12, 1998
January 5, 1999 to September 5, 2001
April 9, 2007 to September 24, 2013
Bondie O. Gambrell ..... April 11, 1995 to February 10, 1997
Mark S. Dymally..... February 10, 1997 to January 5, 1999
Carol W. Kwan ..... January 12, 1998 to January 5, 1999
September 5, 2001 to April 9, 2007
Willard H. Murray Jr..... January 5, 1999 to April 13, 2009
GLORIA GRAY ..... April 13, 2009 to
DONALD L. DEAR ..... September 24, 2013 to

WESTERN MUNICIPAL WATER DISTRICT OF RIVERSIDE COUNTY

Howard Boylan ..... December 14, 1954 to July 13, 1976
Lois B. Krieger ..... August 19, 1976 to December 31, 2000
John M. Mylne III ..... October 12, 1993 to January 7, 2008
S.R. “Al” Lopez ..... January 7, 2008 to July 13, 2009
Thomas P. Evans..... July 13, 2009 to May 11, 2015
DONALD GALLEANO ..... May 11, 2015 to

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Notes:
Current Directors’ names are shown in capital letters.
A 2001 reorganization reduced the number of directors on the board from 51 to 37.
In late 2015, a one-seat addition for Los Angeles (based on assessed property valuation) increased the number of directors to 38.




effective 6/30/17

# STAFF

June 30, 2017

## EXECUTIVE MANAGEMENT

General Manager ..... J. Kightlinger
General Counsel ..... M.L. Scully
General Auditor ..... G.C. Riss
Ethics Officer ..... D. Ghaly
Assistant General Manager/Chief Operating Officer ..... Vacant
Interim Assistant General Manager/Chief Administrative Officer ..... F.M. Mares
Assistant General Manager/Chief Financial Officer ..... G. Breaux
Assistant General Manager/Strategic Water Initiatives ..... R.K. Patterson
Assistant General Manager/Chief External Affairs Officer ..... D. Zinke

## ADMINISTRATION

Manager, Administrative Services Section ..... O.T. Tucker
Manager, Environmental Planning Section ..... D. West

## CHIEF FINANCIAL OFFICER

Controller ..... H.S. Soper
Manager, Budget & Treasury ..... J.M. Skillman

## ENGINEERING SERVICES

Group Manager/Chief Engineer ..... G. Johnson
Manager, Facility Development Section ..... M. Rojas
Manager, Infrastructure Reliability Section ..... J. Bednarski
Manager, Program Management Section ..... Vacant

## ETHICS

Assistant Ethics Officer ..... P.E. von Haam

## EXTERNAL AFFAIRS

Group Manager ..... S. Sims
State Legislative Representative ..... K. Cole
Federal Legislative Representative ..... B. Hiltscher
Manager, Business Outreach Section ..... J. Arena
Manager, Conservation & Community Services Section ..... Y.L. Martinez
Manager, Legislative Services Section ..... N. Purkiss
Manager, Media Services Section ..... A. Acuña
Executive Strategist ..... T. Philp
Special Projects Manager ..... M. Westford

## HUMAN RESOURCES

Group Manager ..... D. Pitman
Manager, Employee Relations Section ..... S. Lem

**STAFF**
June 30, 2017

INFORMATION TECHNOLOGY

Group Manager ..... C. Eckstrom
Director, Information Technology Section..... T.D. Miller

INTERNAL AUDIT

Deputy General Auditor..... J. Tonsick

LEGAL

Assistant General Counsel ..... H.C. Beatty
Assistant General Counsel ..... A. Kear

OFFICE OF THE BOARD OF DIRECTORS

Board Administrator..... R. Castro

REAL PROPERTY

Group Manager ..... L.L. Shraibati

STRATEGIC WATER INITIATIVES

Manager, Bay-Delta Initiatives ..... S.N. Arakawa
Manager, Colorado River Resources..... W.J. Hasencamp
Special Projects Manager..... R.D. Neudeck
Executive Strategist..... M.J. Wheeler

WATER RESOURCE MANAGEMENT

Group Manager ..... D. Upadhyay
Manager, Resource Implementation Section..... K. Donhoff
Manager, Resource Planning & Development Section ..... G.L. Chan

WATER SYSTEM OPERATIONS

Group Manager ..... J.F. Green
Assistant Group Manager..... B. Coffey
Interim Assistant Group Managers..... B. Koch, B.M. Yamasaki
Interim Manager, Conveyance & Distribution Section ..... J. Kostelecky
Interim Manager, Operational Safety & Regulatory Services Section .... D. Guillory
Manager, Operations Support Services Section ..... C. Spradling
Manager, Power Operations & Planning Section..... J. Lambeck
Interim Manager, Water Operations & Planning Section..... G. Boyd
Manager, Water Quality Section ..... M.H. Stewart
Manager, Water Treatment Section..... H. Collins




*General Manager Jeffrey Kightlinger greets the crowd at the Spring Green Expo, April 2017.*




*Metropolitan board chair Randy Record speaks to reporters on evolving water supply situation, October 2016.*

# Introduction

It was a year punctuated by the spectacular end of California's five-year historic drought, with a record wet winter rapidly filling reservoirs and a dramatic series of events at the State Water Project's Oroville facilities. In Southern California, Metropolitan faced a different challenge—identifying places to store the abundant water supplies. Meanwhile, water agencies throughout the state approached a historic investment decision on the California WaterFix modernization project in the Sacramento/San Joaquin Bay-Delta. The fiscal year drew to a close on June 30 with major progress on a number of fronts.

**Drought Ends, Challenges Begin:** In April 2017, Gov. Edmund G. Brown Jr. officially ended the drought state of emergency as much of the state sought to manage what would be record precipitation for the year. In February of 2015, Brown had imposed the first-ever statewide requirements for urban communities to reduce water use and report to the State Water Resources Control Board. With the drought's end, the state sought to sustain California's conservation ethic as weather patterns became more favorable. "Gov. Brown's mandate that each and every Californian immediately reduce water use sent the right message that we are one state and we can never take water for granted," Metropolitan General Manager Jeffrey Kightlinger said as the governor declared the drought emergency officially over.

Metropolitan's operations team faced significant challenges to manage and maximize the dramatic increase in available supplies, and to place as much water as possible into local storage. The supply windfall allowed Metropolitan to keep a record amount of its Colorado River supply in Lake Mead, providing a much-welcome increase in reservoir levels. Meanwhile, State Water Project supplies comprised the bulk of deliveries in Metropolitan's service area, as other supplies were banked in the Central Valley, stored in groundwater basins and put in Diamond Valley Lake.

**Oroville:** The wet start to the California rainy season had Lake Oroville brimming. In February, the high releases from the lake caused severe damage to the 3,000-foot concrete main spillway and prompted its temporary closure as operators inspected the damage. As a series of atmospheric river storms approached, operators once again initiated limited releases down the battered spillway. Despite the actions, higher-than-expected inflows from the storm into the lake caused water to cascade over Oroville's emergency spillway for the first time in the dam's history. Concerns about the emergency spillway's integrity prompted public safety officials to order an evacuation of 180,000 downstream residents as flows down the main spillway increased.

The incident captured national attention and triggered a historic effort to review dam safety in California. Oroville became a national example of aging infrastructure and the need to improve dam safety activities and infrastructure investments to maintain operational reliability and secure public safety. Once the storms had passed, the Department of Water Resources moved swiftly in a race to beat the clock to repair the main spillway and bolster the emergency spillway before the onset of another winter.

Winter storms also underscored the importance of Metropolitan's long-term water strategy of continuing to lower demand through conservation and increase local baseline supplies. It also demonstrated the value of reliably capturing stormwater from the Sierra Nevada and having a diverse portfolio of storage options to increase the reliability of future water deliveries.

**Recycling and Conservation:** In January 2017, Metropolitan's board reviewed a feasibility study confirming the potential of a large-scale project to treat and purify wastewater in collaboration with the Sanitation Districts of Los Angeles County. Plans progressed toward building a demonstration facility at the Sanitation Districts' wastewater facility in Carson to potentially recycle more than 150,000 acre-feet a year for replenishment of groundwater basins in Los Angeles and Orange counties.

Metropolitan actively promoted conservation and water use efficiencies, ultimately investing $3.5 million for the summer 2016 and spring 2017 advertising campaigns to reinforce the importance of making conservation a California way of life, despite the drought's end.

Efforts to incentivize local supply development advanced in November 2016, with the board approving up to $44 million through Metropolitan's Local Resources Program for four new recycling projects in Los Angeles and Riverside counties. The projects will treat and deliver as much as 5.3 billion gallons per year.

Farther afield, efforts continued to formulate a Colorado River drought contingency plan as voluntary reductions in water deliveries by users in the Lower Basin helped stave off a potential shortage declaration on the river that would have prompted cutbacks in deliveries to Arizona and Nevada. Negotiations with Mexico, meanwhile, brought the Lower Basin closer to a new agreement to further develop conservation, storage and environmental restoration projects.

**California WaterFix:** The California WaterFix project approached historic milestones as state and federal water agencies prepared for important decisions on the proposed project aimed at modernizing the statewide water delivery system in the Delta.

In December 2016, state and federal officials released the project's final environmental impact report and statement. The identified preferred alternative calls for three new intakes in the northern Delta on the Sacramento River and a twin-tunnel pipeline system capable of transporting as much as 9,000 cubic feet per second of supplies. "After more than 10 years of planning analysis and debate, the time for decisions is finally in sight," General Manager Kightlinger said at the time.

In June 2017, permitting under the federal Endangered Species Act was largely completed with the release of biological opinions from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. As the fiscal year came to a close, the state Department of Fish and Wildlife was finalizing its companion permit for compliance with California environmental statutes.

Metropolitan's board began its deliberations in the summer of 2017 with a comprehensive set of workshops and policy- based white papers on the construction, operations and financing of the project, coupled with a robust outreach and public participation process. The board was slated to vote on the project in the fall.

**Rate structure litigation:** Metropolitan and its member agencies achieved an important legal and financial victory when the California Court of Appeal ruled that the State Water Project is an integral part of Metropolitan's system and therefore Metropolitan may recover State Water Project transportation costs in its transportation rates.

The San Diego County Water Authority had challenged the inclusion of these costs in Metropolitan's transportation rates and in the price term of the parties' 2003 Exchange Agreement. Under that agreement, SDCWA makes available to Metropolitan at Lake Havasu an independent supply of conserved water from the Imperial Irrigation District and the lining of canals, and in exchange Metropolitan delivers a like amount of Metropolitan water to SDCWA. SDCWA had requested that the price be based on Metropolitan's generally applicable transportation rates—which are the same blended rates for transportation costs (regional, Colorado River and State Water Project) charged to all member agencies, reflecting the integrated nature of the Metropolitan system and equitable charges to all agencies—but later challenged that price.

On June 21, 2017, the Court of Appeal upheld this key element of Metropolitan's rate structure and its inclusion in the Exchange Agreement price. "The Water Authority's years-long effort to shift costs relating to their own water supply onto ratepayers elsewhere in Southern California has failed," Kightlinger said. "While Metropolitan has prevailed as to the overwhelming majority of costs under challenge in this litigation, nobody is a winner when water districts decide to fight in court rather than resolve their differences in a democratic and collaborative fashion."

**Leadership continuity:** Metropolitan's board leadership maintained continuity, meanwhile, with the re-election of Randy Record in October 2016 to another two-year term as chairman. Representing the Eastern Municipal Water District since January 2003, Record is the second member of his family to serve on Metropolitan's board (his father, Clayton A. Record, serving from 1999 to 2001).

"These have been incredibly challenging times for Californians and water agencies," Record said at the time of his re-election. "I am grateful for the support of my board and proud of the leadership we have provided during my first term to ensure we prudently manage through the current drought, promote conservation and stewardship, invest in infrastructure and look to the future."

As the fiscal year drew to a close, Metropolitan was better positioned for future challenges and to provide broad regional benefits. It was a year that saw a dramatic rebound in storage reserves, with important steps to promote the development of local supplies and sustain conservation activities. Metropolitan continued to provide strong support for infrastructure investments including an improved Oroville spillway, and the California WaterFix project. Finally, an important appellate court decision upheld a critical element of Metropolitan's rate structure validating Metropolitan's long-standing commitment to regionalism and shared responsibility.



*The Sepulveda Feeder was among many Metropolitan facilities shut down for repairs and inspections during 2016 and 2017.*

# Delivering Metropolitan's Water Supplies

Metropolitan supplies water to its 5,200-square-mile service area through a conveyance and distribution system that consists of the 242-mile-long Colorado River Aqueduct, five pumping plants, approximately 830 miles of pipeline, five water treatment plants and nine reservoirs, plus a participation right in the State Water Project. Metropolitan also has 16 hydroelectric power recovery plants throughout its system. See Table 1-1 for the rated capacity of Metropolitan's five treatment plants.

**TABLE 1-1**
**METROPOLITAN'S DISTRIBUTION SYSTEM**
**WATER TREATMENT PLANTS**

| Plant (Location) | Process/ Water Type | Rated Capacity (MGD) |
|---|---|---|
| Joseph Jensen Water Treatment Plant (Granada Hills) | Conventional treatment with ozone SPW | 750 |
| Robert A. Skinner Water Treatment Plants #1 , #2, & #3 (Winchester)* | Conventional treatment and direct filtration with ozone, blend of CRW/SPW | 630 |
| F. E. Weymouth Water Treatment Plant (La Verne) | Conventional treatment, blend of CRW/SPW | 520 |
| Robert B. Diemer Water Treatment Plant (Yorba Linda) | Conventional treatment with ozone, blend of CRW/SPW | 520 |
| Henry J. Mills Water Treatment Plant (Riverside) | Conventional treatment with ozone SPW | 220 |

SPW = State Project Water
CRW = Colorado River Water
MGD = Million Gallons per Day
* Consists of three separately regulated water treatment plants

Over the past few years, the region has experienced dramatic swings in water supply conditions from the driest to the wettest periods in California's recorded history. As conditions shifted, so did Metropolitan's operations, from implementing extraordinary drought actions to maximizing the delivery and storage of supplies to ensure continued water supply reliability.

In the first half of FY 2016/17, Metropolitan experienced a significant turnaround in its storage reserves, with a gain of over 300,000 AF by the end of December 2016, due in part to a final 2016 SWP allocation of 60 percent, or approximately 1.15 MAF for Metropolitan. By the end of FY 2016/17, northern California had already experienced its wettest water year on record, with the Northern Sierra Eight-Station Index registering 94.2 inches of precipitation (194 percent of normal). The record precipitation led to a SWP allocation of 85 percent, or approximately 1.62 MAF for Metropolitan. Metropolitan was also able to secure 124,000 AF of surplus Article 21 supplies, which are in addition to the regularly allocated SWP supplies, and haven't been available since 2011.

To effectively manage and take full advantage of the extraordinarily high amounts of SWP supplies, Metropolitan reduced the delivery of Colorado River water into the service area to under 300,000 AF, which is the lowest delivery to the service area since the early years of the CRA. This was accomplished by cutting back CRA pumping from the full CRA operations of recent years to only a 3- to 4-pump flow in March through June, leaving the Colorado River supplies in Lake Mead Intentionally Created Surplus to maximize Metropolitan's storage in Lake Mead. An expedited design and construction of a new weir gate in the CRA, downstream of the Whitewater River west of Palm Springs, enabled Metropolitan to also maximize deliveries of Colorado River water into the Advance Delivery Account with Desert Water Agency and Coachella Valley Water District. The 2017 deliveries to this account are on track to be the highest ever in a single calendar year and could well exceed 350,000 AF, far more than the prior record of 298,000 AF in 1986.

Continued conservation, along with significantly higher than normal local supplies due to the wet conditions, suppressed water demands on Metropolitan and reduced Metropolitan's water sales for FY 2016/17 to about 1.5 MAF. This level of sales is significantly

below the 10-year average annual sales of 1.92 MAF. Maximum daily system deliveries were about 6,400 AF per day for the fiscal year compared to 6,050 AF per day last fiscal year and 8,250 AF per day in FY 2006/07. Table 1-2 shows Metropolitan's monthly water sales for FY 2016/17. Additional figures and tables at the end of this chapter show total fiscal year water sales by category, monthly water sales by category, a comparison of water sales by category for the past two fiscal years, historical water sales by calendar and fiscal year, and water use by member agency.

**TABLE 1-2**
**MONTHLY WATER SALES FOR ALL MEMBER AGENCIES**
Fiscal Year 2016/17
(Acre-Feet)

| Month | Full Service[1] | Storage Program[2] | Totals |
|---|---|---|---|
| July | 157,257 | 1,412 | 158,669 |
| August | 156,321 | 2,168 | 158,488 |
| September | 145,064 | 2,349 | 147,413 |
| October | 178,209 | 10,571 | 188,780 |
| November | 156,101 | 10,543 | 166,644 |
| December | 118,952 | 15,963 | 134,915 |
| January | 72,150 | 1,108 | 73,258 |
| February | 57,791 | 613 | 58,404 |
| March | 72,004 | 712 | 72,716 |
| April | 103,879 | 1,629 | 105,508 |
| May | 112,005 | 2,275 | 114,280 |
| June | 123,848 | 1,732 | 125,580 |
| **Totals** | **1,453,580** | **51,074** | **1,504,654** |

[1] Includes Full Service and Exchange sales.
[2] Includes sales from the Conjunctive Use, Cyclic Storage and Soboba Settlement programs.

The combination of high supplies, low demands, and strategic operations resulted in record-breaking increases to storage. It is estimated that over 1 MAF will be added to storage by the end of calendar year 2017, surpassing the previous record of approximately 700,000 AF added to storage in 2011. By the end of calendar year 2016, storage increased by 364,000 AF to a dry-year storage total of 1.3 MAF. Groundwater storage was also repositioned to surface storage in 2016 to make sure ample storage reserves were easily

accessible in case 2017 turned out to be another extremely dry year. However, as supplies rapidly increased, Metropolitan maximized deliveries into every available storage account. Carryover stored in San Luis Reservoir at the end of 2016 was quickly moved down into Metropolitan's system by March 2017 to avoid carryover spill and to make room for incoming SWP supplies. Castaic Lake, which had been drawn down at the end of 2016 for the Department of Water Resources' shutdown work, was completely refilled. Perris Flexible storage, which had not recovered from the drought, was completely full by the end of February 2017. Metropolitan also pursued water management actions to increase deliveries to local groundwater basins. By the end of FY 2016/17, total dry-year storage reserves climbed to over 1.6 MAF, with over 700,000 AF in Diamond Valley Lake.

Overall, with the success of the Metropolitan actions taken this fiscal year to fully maximize storage recovery under high supply conditions, the region is now better positioned to manage future droughts.

# *Major Accomplishments for Fiscal Year 2016/17*

***System Operations and Planning***

- Effectively managed surplus supplies and refilled storage reserves (530,000 AF in FY 2016/17).
- Dramatically adjusted system operations to maximize delivery and storage of abundant SWP supplies, after years of SWP supply shortages.
- Worked with DWR to prevent any interruption of SWP deliveries and negotiated special terms to allow surplus Article 21 supplies to remain available during repairs of the damaged DWR Clifton Court facilities.
- Successfully managed critical shutdowns for system improvements, maintenance and repairs (major shutdowns and service interruptions are shown in Table 1-5).

***Colorado River***

- Maximized storage of Colorado River supplies, positioning Metropolitan to be on track to store a single calendar-year record amount of about 750,000 AF—roughly three-quarters of the available Colorado River supplies—by the end of CY 2017.
- Collaborated with Engineering Services to implement capital projects to deliver record amounts of water to the Advanced Delivery Account with Desert Water Agency and Coachella Valley Water District.

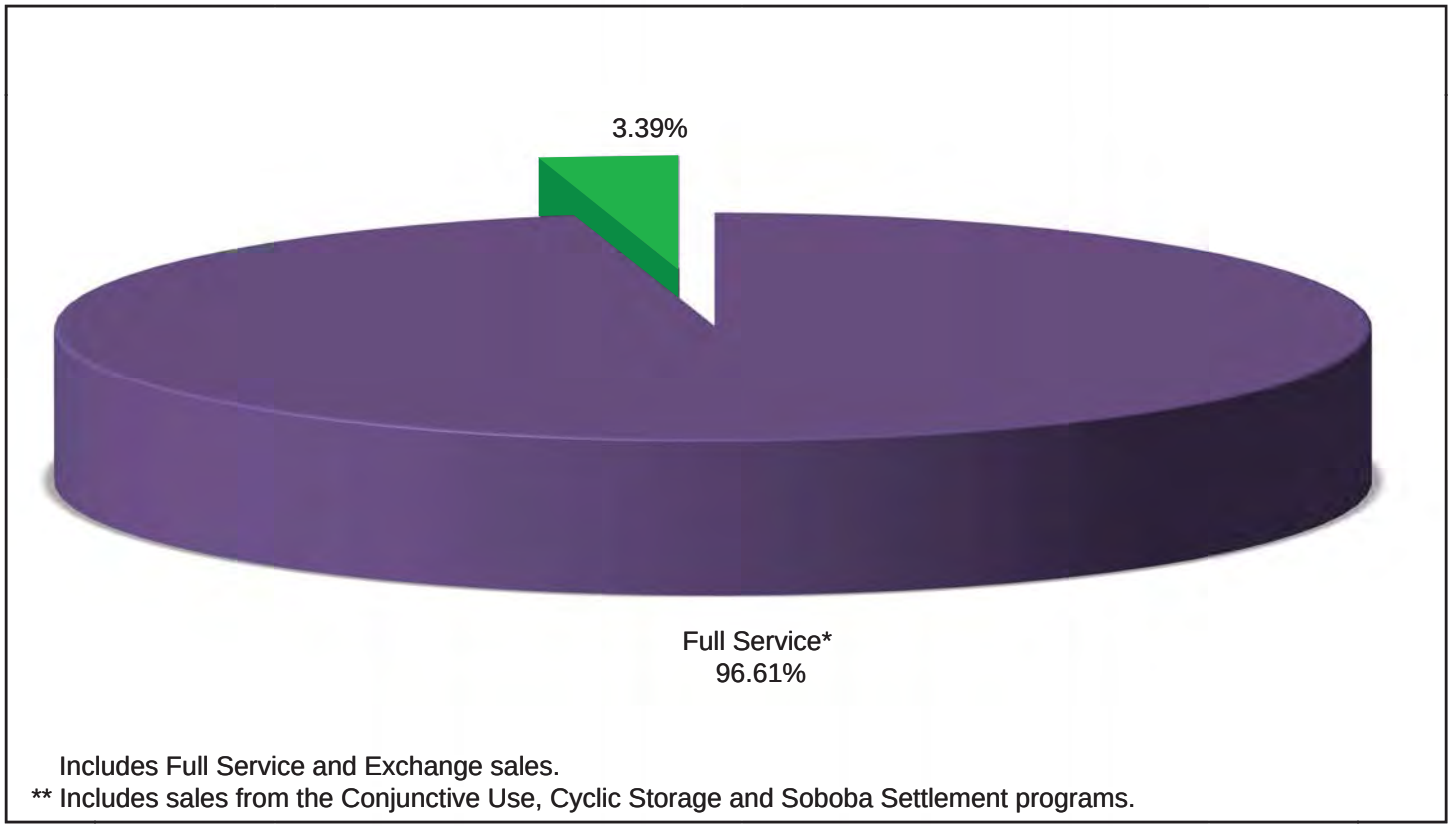



*Figure 1-1. Total Water Sales for Fiscal Year 2016/17 - All Member Agencies*

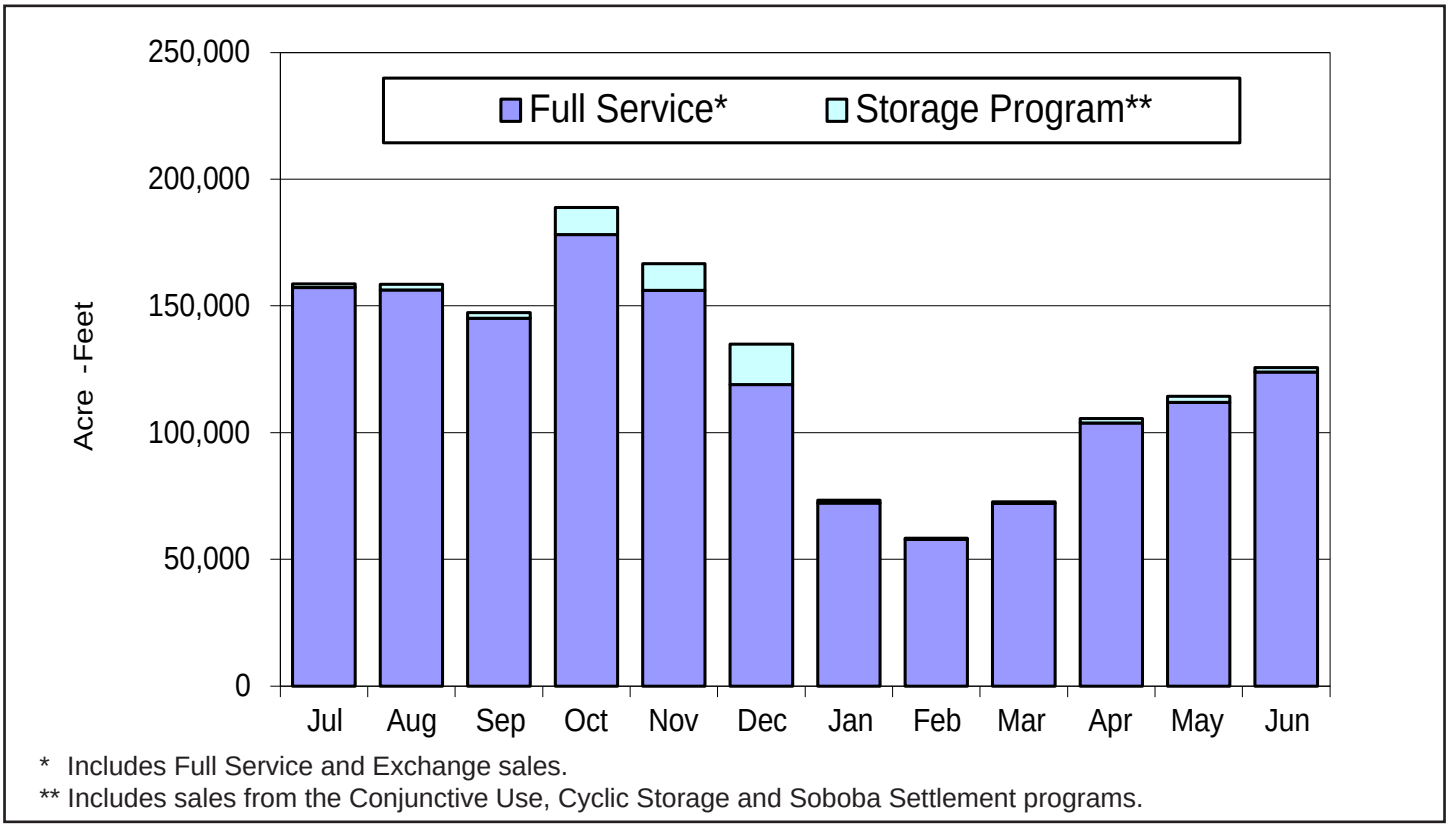



*Figure 1-2. Monthly Water Sales for Fiscal Year 2016/17 - All Member Agencies*

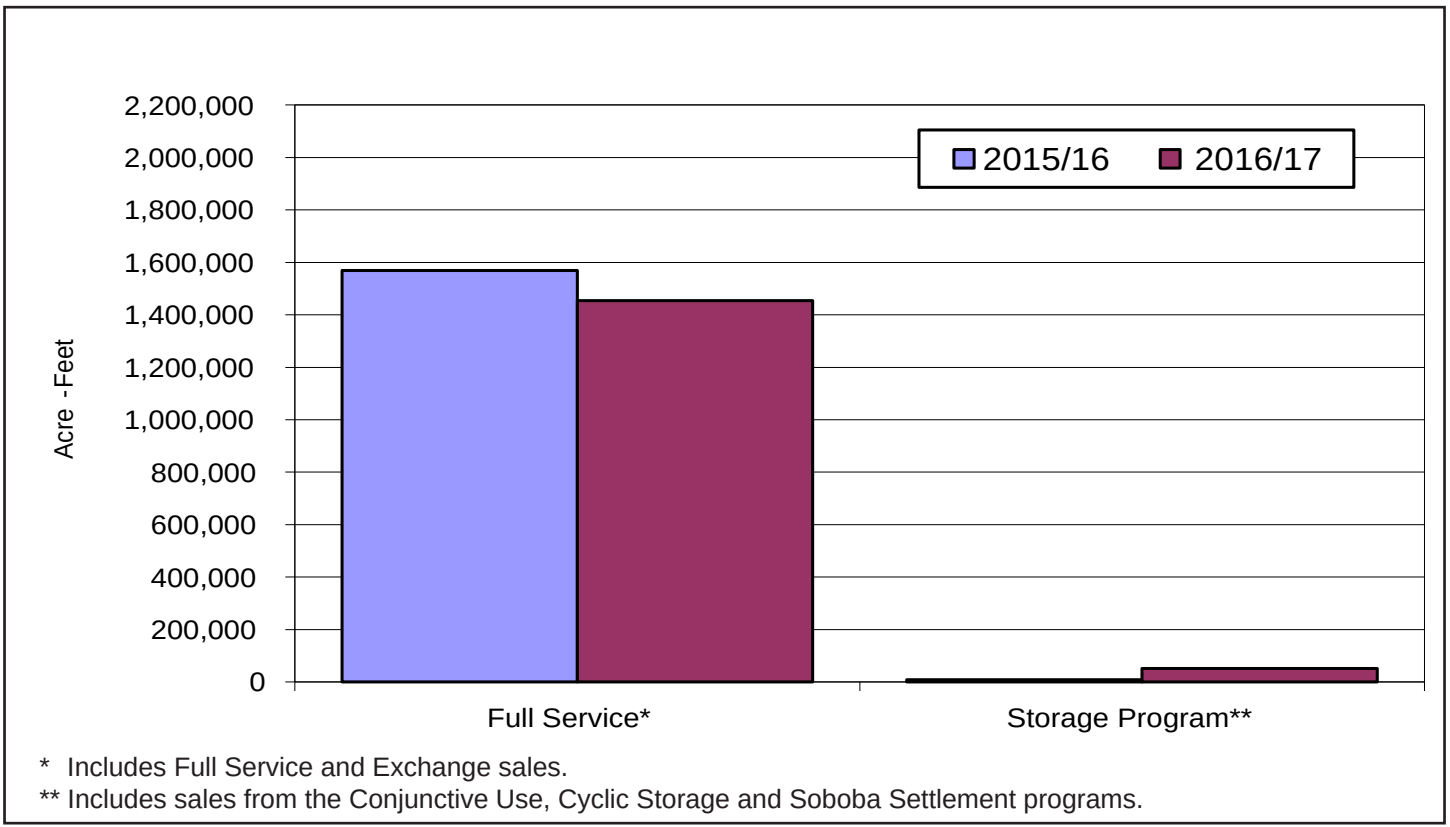



*Figure 1-3. Comparison of Water Sales to Member Agencies For The Past Two Fiscal Years*

**TABLE 1-3**
**HISTORICAL WATER SALES**
Calendar Year & Fiscal Year Totals
(Acre-Feet)

| | Calendar Year | Fiscal Year | | Calendar Year | Fiscal Year |
|---|---|---|---|---|---|
| 1941 | 4,444 | | 1980 | 1,295,903 | 1,282,064 |
| 1942 | 12,391 | 9,739 | 1981 | 1,597,315 | 1,462,825 |
| 1943 | 16,355 | 14,566 | 1982 | 1,366,664 | 1,502,949 |
| 1944 | 24,567 | 15,875 | 1983 | 1,180,616 | 1,226,783 |
| 1945 | 37,883 | 30,606 | 1984 | 1,547,078 | 1,428,253 |
| 1946 | 54,134 | 46,686 | 1985 | 1,653,414 | 1,574,216 |
| 1947 | 73,573 | 59,721 | 1986 | 1,685,359 | 1,642,249 |
| 1948 | 148,178 | 113,090 | 1987 | 1,857,591 | 1,825,657 |
| 1949* | 163,817 | 145,008 | 1988 | 2,017,403 | 1,923,824 |
| 1950* | 170,825 | 165,616 | 1989 | 2,371,479 | 2,095,079 |
| 1951* | 192,416 | 165,473 | 1990 | 2,626,124 | 2,511,375 |
| 1952 | 203,068 | 197,210 | 1991 | 1,809,606 | 2,264,864 |
| 1953 | 221,022 | 219,397 | 1992 | 1,989,165 | 1,888,907 |
| 1954 | 333,968 | 245,875 | 1993 | 1,812,644 | 1,910,644 |
| 1955 | 386,341 | 385,946 | 1994 | 1,955,411 | 1,930,529 |
| 1956 | 482,909 | 405,962 | 1995 | 1,458,237 | 1,591,496 |
| 1957 | 518,754 | 543,706 | 1996 | 1,675,254 | 1,641,670 |
| 1958 | 578,384 | 539,734 | 1997 | 1,838,675 | 1,787,857 |
| 1959 | 660,718 | 601,099 | 1998 | 1,413,674 | 1,569,024 |
| 1960 | 816,722 | 734,919 | 1999 | 1,776,306 | 1,593,687 |
| 1961 | 977,795 | 935,228 | 2000 | 2,325,836 | 2,075,680 |
| 1962 | 1,033,361 | 931,795 | 2001 | 2,100,771 | 2,164,556 |
| 1963 | 943,745 | 1,020,822 | 2002 | 2,438,570 | 2,326,920 |
| 1964 | 1,122,880 | 1,064,381 | 2003 | 2,251,051 | 2,271,628 |
| 1965 | 1,105,809 | 1,148,847 | 2004 | 2,440,724 | 2,437,678 |
| 1966 | 1,115,040 | 1,059,631 | 2005 | 2,003,041 | 2,076,100 |
| 1967 | 1,008,946 | 1,059,354 | 2006 | 2,129,518 | 2,116,039 |
| 1968 | 1,208,064 | 1,077,178 | 2007 | 2,390,535 | 2,351,927 |
| 1969 | 997,623 | 1,057,335 | 2008 | 2,178,630 | 2,250,184 |
| 1970 | 1,152,914 | 1,165,866 | 2009 | 1,963,448 | 2,137,979 |
| 1971 | 1,184,697 | 1,113,968 | 2010 | 1,658,597 | 1,780,030 |
| 1972 | 1,213,417 | 1,248,710 | 2011 | 1,650,260 | 1,613,529 |
| 1973 | 1,218,156 | 1,177,860 | 2012 | 1,748,167 | 1,708,565 |
| 1974 | 1,223,256 | 1,139,175 | 2013 | 1,955,799 | 1,856,537 |
| 1975 | 1,294,650 | 1,329,636 | 2014 | 2,015,848 | 2,056,396 |
| 1976 | 1,390,822 | 1,389,248 | 2015 | 1,732,324 | 1,905,480 |
| 1977 | 1,312,876 | 1,390,466 | 2016 | 1,672,077 | 1,578,495 |
| 1978 | 1,302,312 | 1,198,325 | 2017 | | 1,504,654 |
| 1979 | 1,230,068 | 1,235,193 | | | |

Note:
* Calendar years 1949, 1950, and 1951 are estimated values.
Figures from 1979 to present consist of billable sales of treated and untreated water, including exchanges.

# TABLE 1-4
# WATER USE BY METROPOLITAN'S MEMBER AGENCIES
Fiscal Year 2016/17[1]
(Acre-Feet)

| Member Agency | Total Local Production[2] | Total Local Use[3] | MWD Direct Deliveries[4] | MWD Indirect Deliveries[5] | MWD Total Deliveries | Total Water Use[6] | MWD Direct Deliveries as % of Total Use |
|---|---|---|---|---|---|---|---|
| Anaheim | 44,806 | 44,806 | 12,797 | | 12,797 | 57,603 | 22% |
| Beverly Hills | 0 | 0 | 9,471 | | 9,471 | 9,471 | 100% |
| Burbank | 12,636 | 12,636 | 5,271 | 6,967 | 12,238 | 17,907 | 29% |
| Calleguas | 37,632 | 46,819 | 87,293 | | 87,293 | 134,112 | 65% |
| Central Basin | 208,589 | 231,370 | 18,507 | 32,689 | 51,196 | 249,877 | 7% |
| Compton | 6,963 | 6,963 | 5.2 | | 5.2 | 6,968 | 0% |
| Eastern | 115,962 | 115,962 | 96,692 | 10,848 | 107,540 | 212,654 | 45% |
| Foothill | 7,179 | 7,179 | 8,102 | | 8,102 | 15,281 | 53% |
| Fullerton | 18,673 | 18,673 | 6,471 | | 6,471 | 25,144 | 26% |
| Glendale | 9,255 | 9,255 | 14,111 | | 14,111 | 23,366 | 60% |
| Inland Empire | 191,850 | 190,719 | 42,604 | 11,563 | 54,167 | 233,323 | 18% |
| Las Virgenes | 3,340 | 3,448 | 18,106 | | 18,106 | 21,554 | 84% |
| Long Beach | 39,469 | 39,469 | 23,333 | | 23,333 | 62,802 | 37% |
| Los Angeles | 178,098 | 178,098 | 219,779 | | 219,779 | 397,877 | 55% |
| MWDOC | 348,378 | 360,899 | 131,900 | 50,475 | 182,375 | 492,799 | 27% |
| Pasadena | 10,673 | 10,748 | 16,865 | | 16,865 | 27,613 | 61% |
| San Diego CWA | 104,034 | 104,034 | 379,942 | | 379,942 | 483,976 | 79% |
| San Fernando | 2,766 | 2,766 | 0 | | 0 | 2,766 | 0% |

## TABLE 1-4
## WATER USE BY METROPOLITAN'S MEMBER AGENCIES
Fiscal Year 2016/17[1]
(Acre-Feet)

| Member Agency | Total Local Production[2] | Total Local Use[3] | MWD Direct Deliveries[4] | MWD Indirect Deliveries[5] | MWD Total Deliveries | Total Water Use[6] | MWD Direct Deliveries as % of Total Use |
|---|---|---|---|---|---|---|---|
| San Marino | 3,154 | 3,154 | 971 | | 971 | 4,125 | 24% |
| Santa Ana | 29,104 | 29,104 | 8,211 | | 8,211 | 37,315 | 22% |
| Santa Monica | 8,681 | 8,681 | 3,571 | | 3,571 | 12,252 | 29% |
| Three Valleys | 41,322 | 41,322 | 51,527 | 15,311 | 66,837 | 92,849 | 55% |
| Torrance | 7,055 | 7,055 | 16,380 | | 16,380 | 23,435 | 70% |
| Upper San Gabriel | 168,481 | 134,054 | 3,197 | 40,500 | 43,696 | 137,251 | 2% |
| West Basin | 51,581 | 54,900 | 109,896 | | 109,896 | 164,796 | 67% |
| Western | 183,933 | 183,933 | 63,410 | | 63,410 | 247,343 | 26% |
| | 1,833,614 | 1,846,047 | 1,348,410 | 168,352 | 1,516,762 | 3,194,457 | 42% |

**Footnotes:**

[1] Local supply data includes three year averages for those sources unavailable at time of publication.

[2] Total Local Production = groundwater, groundwater recovery, surface water, recycled water, seawater desalination, and Los Angeles Aqueduct supplies produced, but not necessarily used, within a member agency boundary, not including water used for environmental purposes.

[3] Total Local Use = Total Local Production adjusted for inter-agency water transfers and locally produced water, not including water used for environmental purposes.

[4] MWD Direct Deliveries includes SDCWA/IID exchange.

[5] Indirect deliveries: Non-consumptive water being delivered to storage for later use.

[6] Total Water Use = Total Local Use + MWD Direct Deliveries.

# TABLE 1-5
## 2016/17 MAJOR SHUTDOWNS & SERVICE INTERRUPTIONS

| FACILITY | DATES | NO. OF DAYS | LIMITS OF SHUTDOWN | PURPOSE |
|---|---|---|---|---|
| ETIWANDA PIPELINE | Jul 1-Jun 30, 2017 | 365 | From the Rialto Feeder to the Upper Feeder (Untr) | For Phase 2 of 3 Lining Repair Project |
| SEPULVEDA FEEDER | Jul 1-Aug 23, 2016 | 55 | From Roscoe Blvd sectionalizing valve to Venice Pressure Control Structure | For repairs and return to service |
| SECOND LOWER FEEDER<br>-Palos Verdes Reservoir | Aug 22-Aug 29, 2016 | 8 | From Oak Street Pressure Control Structure to Palos Verdes Reservoir/Second Lower Feeder By-Pass Line | For installation of two bulkheads and a relief pipe on by-pass and weir structure |
| SANTIAGO LATERAL | Oct 4-Oct 6, 2016 | 3 | From Weir Canyon sectionalizing valve to Irvine Lake | For inspection and repairs |
| MIDDLE FEEDER (South)<br>-Victoria 223rd Street Cross Feeder<br>-Victoria Street Lateral | Oct 24-Oct 28, 2016 | 5 | From sectionalizing valve near Greenleaf Blvd. & Atlantic Dr. on the Middle Feeder to the Victoria St. Lateral/Victoria to 223rd St. Cross Feeder interconnection | For replacement of two plug valves |
| SAN DIEGO PIPELINE No.3 | Nov 6-Nov 10, 2016 | 5 | From Lake Skinner to SDCWA jurisdiction line | SDCWA requested shutdown to perform inspections in its jurisdiction |
| LAKEVIEW PIPELINE | Nov 7, 2016 | 1 | From PC-1 to San Diego Canal | For inspection |
| RIALTO FEEDER | Nov 14-Nov 19, 2016 | 6 | From Live Oak Reservoir to DWR's Devil Canyon Power Plant | For visual and electromagnetic inspection, and maintenance work |
| SECOND LOWER FEEDER | Nov 28-Dec 4, 2016 | 7 | From sectionalizing valve near Carson St. and Bataan Ave. to 223rd St. and Western Ave. | For visual and electromagnetic inspection, and maintenance work |
| SAN DIEGO PIPELINE No.5 | Jan 8-Jan 17, 2017 | 10 | From Red Mountain Pressure Control Structure to SDCWA jurisdiction line | SDCWA requested shutdown to perform inspections and bulkhead installation in its jurisdiction. |
| PALOS VERDES FEEDER | Jan 30-Feb 7, 2017 | 9 | From Monterey Rd./Kolle Ave. sectionalizing valve to the Ascot Wasteway Tower | For replacement of the sectionalizing valve and the by-pass valves at Collis Ave. |
| ORANGE COUNTY FEEDER<br>-Irvine Cross Feeder | Feb 6-Feb 9, 2017 | 4 | From the Willits St. Pressure Control Structure to the pipeline terminus | For repair of packing box on Irvine Cross Feeder sectionalizing valve |
| ORANGE COUNTY FEEDER | Feb 6-Feb 12, 2017 | 7 | From the Lincoln Ave. and East St. Sectionalizing valve to the Willits St. Pressure Control Structure | For lining repair and installation of bulkhead downstream of Service Connection SA-01 |

## TABLE 1-5 (Continued)
## 2016/17 MAJOR SHUTDOWNS & SERVICE INTERRUPTIONS

| FACILITY | DATES | NO. OF DAYS | LIMITS OF SHUTDOWN | PURPOSE |
|---|---|---|---|---|
| ORANGE COUNTY FEEDER | Feb 13-May 20, 2017 | 97 | From downstream of Service Connection SA-01 to the Willits St. Pressure Control Structure | For re-lining project |
| COLORADO RIVER AQUEDUCT<br>-San Jacinto Pipeline 1&2 | Feb 14-Mar 10, 2017 | 25 | From Whitsett Intake Pumping Plant to Lake Mathews | For sandtrap upgrades at Hinds/Eagle/Iron, concrete damage repair at Eagle Mtn. sand trap, switch house seismic upgrades, electrical testing, and San Jacinto Tunnel seepage measurements |
| SAN DIEGO PIPELINE No.4 | Feb 17-Feb 26, 2017 | 10 | From Skinner plant to SDCWA jurisdiction line | SDCWA requested shutdown to perform inspections in its jurisdiction |
| MILLS TREATMENT PLANT | Feb 28-Mar 1, 2017 | 2 | Mills plant | For inspection of Reservoirs 1 and 2 effluent slide gates, emergency generator testing, new ammonia feed system tie-in, and service water loop backflow valves replacement |
| LOWER FEEDER<br>-Santiago Lateral | Mar 6-Mar 12, 2017 | 7 | From Lake Mathews To Diemer plant | For removal of service valve from Service Connection WR-01 |
| ORANGE COUNTY FEEDER | Mar 13-Mar 15, 2017 | 3 | From the Lincoln Ave. & East St. sectionalizing valve to the Willits St. Pressure Control Structure | For replacement of air release/vacuum valve |
| FOOTHILL FEEDER<br>-San Fernando Tunnel<br>-Jensen Treatment Plant<br>-Sepulveda Feeder<br>-East Valley Feeder<br>-West Valley Feeder No. 1<br>-West Valley Feeder No. 2<br>-Calabasas Feeder | Mar 27-Apr 3, 2017 | 8 | From Castaic Lake to Jensen plant | For Jensen switchgear retrofit work, repair of two isolation valves, installation of new flow meter, and inspections |
| ORANGE COUNTY FEEDER | Jun 19-Jun 23, 2017 | 5 | From the Lincoln Ave. & East St. sectionalizing valve to the Willits St. Pressure Control Structure | For removal of bulkhead and refilling pipeline |





*Agricultural production continues for Metropolitan-owned Delta islands.*

CHAPTER 2

# Strategic Water Initiatives

Metropolitan provides imported water supplies to its member agencies from two primary sources, the Colorado River and the State Water Project. The staff of Strategic Water Initiatives coordinates resources throughout the organization to manage and protect Metropolitan's interests in the watersheds that support these two key systems.

## *Bay-Delta Initiatives*

Bay-Delta Initiatives continued collaboration with state, federal and other water agencies to support actions to improve State Water Project water supply reliability related to the Bay-Delta. Staff supported efforts to: complete the California WaterFix planning phase to improve Delta conveyance; implement habitat restoration in the Bay-Delta system; pursue new and improved fishery management through collaborative science; and participate in key regulatory processes. Figure 2-1 shows a map of the Delta region.

### ***Near-Term Actions***

#### *Habitat Restoration*

BDI has been working with other stakeholders and agencies in evaluating options to improve the floodplain fishery habitat in the Yolo Bypass flood control system. This project, if implemented, will help prevent undesirable flooding impacts to the Yolo Bypass Wildlife Area from subsequent projects designed to provide adult fish passage and salmonid rearing habitat as required by the Yolo Bypass Biological Opinion. BDI has also been involved in the Tule Red Restoration Project through the State and Federal Contractors Water Agency. The objective of this project is to restore about 350 acres of tidal wetlands in the Suisun Marsh.

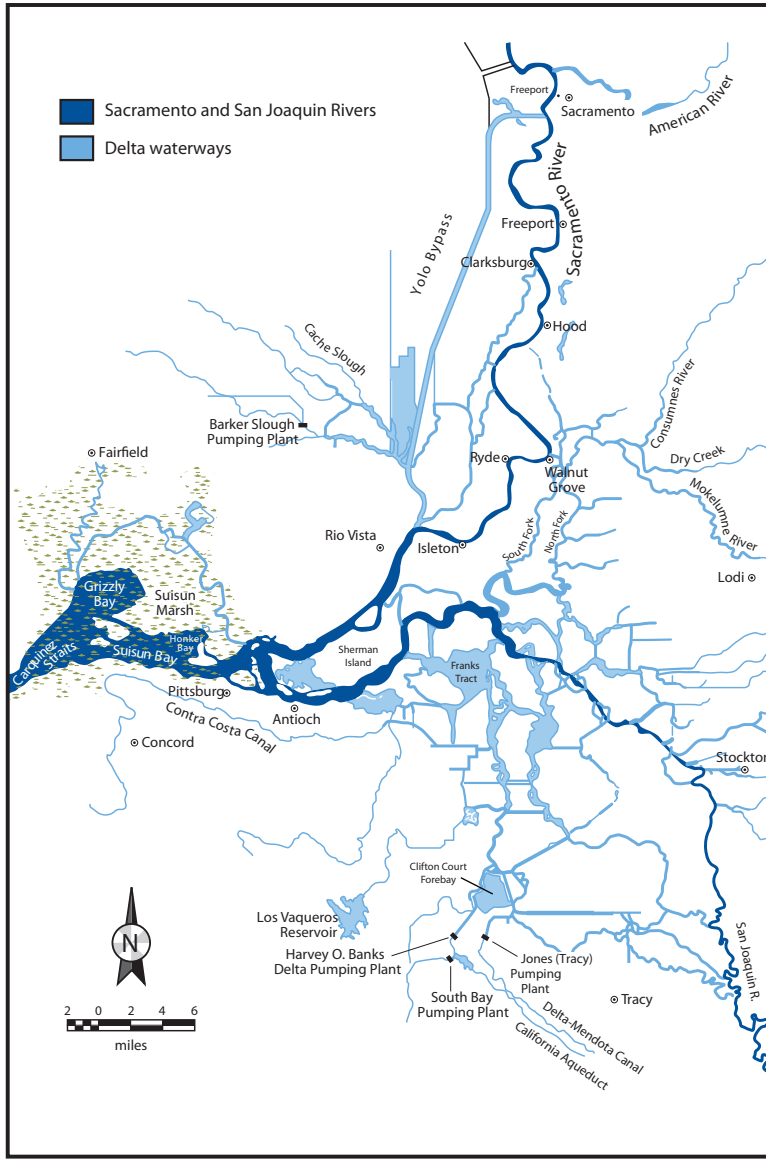



*Figure 2-1. Map of the Delta Region*

*Science Activities*

Metropolitan's water supply reliability is affected by regulatory actions related to the SWP in the Bay-Delta system. For that reason, Metropolitan has an interest in participating in efforts to increase scientific understanding and developing measures that can improve the fish and wildlife conditions in the Bay-Delta system while at the same time providing for more reliability of supply. To further this effort, BDI science staff continues to participate in the Collaborative Science and Adaptive Management Program, initiated in 2013 by the participants in the litigation challenging the U.S. Fish and Wildlife Service and National Marine Fisheries Service biological opinions. Staff is assisting on current Delta smelt studies and work plans addressing priority salmon and Delta smelt science questions. In February, this collaborative program released a report summarizing research on salmon survival in the South Delta. Also, the collaborative process is focusing on the state's Delta Smelt Resiliency Strategy actions and monitoring planned for this year. The process is also assessing the scientific basis for the Fall X2 action in the U.S. Fish and Wildlife Service 2008 Biological Opinion (X2 indicates the location of the low-salinity zone which is a parameter for managing Delta outflow). Staff provided input to the Sacramento Valley Salmon Resiliency Strategy released by the California Natural Resources Agency on June 2. The strategy is a science-based document that addresses near- and long-term needs of Sacramento Valley salmon and steelhead, including actions to restore habitat, improve stream flow, remove stream barriers and reintroduce salmon and steelhead to ideal habitat.

Staff worked with consulting scientists to design and conduct a longfin smelt habitat study, which included field survey work in late September 2016. The study mainly seeks to quantify the factors that affect distribution of longfin smelt and food sources like zooplankton and mysid shrimp in San Pablo Bay. Current research has provided findings and a publication that strongly suggests that the relationship between flow and longfin smelt is locally positively influenced by increases in flows in tributaries throughout the San Francisco Bay rather than just through Delta outflow.

In September, a study on the feasibility of implanting PIT tags and acoustic tags into adult Delta smelt was published in the North

American Journal of Fisheries Management. The study was funded by Metropolitan, and staff participated in the study and co-authored the publication. The development of improved tagging and tracking capabilities for Delta smelt will be essential in understanding Delta smelt behavior and habitat, leading to more effective management actions.

Staff also initiated a project to evaluate the reliability of correlations between environmental variables such as water quality or habitat characteristics and fish populations in the Delta. The project will consist of a literature search of environmental correlations that have been used in the Delta, a re-analysis of the correlations to determine if they hold up in the face of updated data, and recommendations for best practices when using environmental correlations as policy tools. A project report is expected by the end of 2017.

In 2016, staff submitted several grant applications of which two were approved for funding by the CDFW. Two grant agreements were executed, one involving the role of striped bass in Chinook salmon mortality, and the other analyzing factors impacting longfin smelt in the Upper San Francisco Estuary. These grant-funded studies will be important to management decisions in the Delta and will facilitate a continued beneficial relationship with well-respected researchers. Field and analytical work will continue for the next two to three years.

BDI's science staff prepared and submitted a Central Valley Project Improvement Act joint charter study proposal to better understand if modifying or eliminating points of contact between predators and juvenile salmonid can increase their survival. The charter was prepared in collaboration with federal fish agencies and the East Bay Municipal Utility District.

*Regulatory Activities*

The California WaterFix petition proceedings before the State Water Resources Control Board are ongoing, with Part 1 hearings addressing the effects of the proposed project on legal users of water. Part 2 of the hearings are scheduled to begin after the approval of Environmental Impact Report/Environmental Impact Statement, and Endangered Species Act permits. This will address the effects of the proposed project on fish and wildlife, including consideration of

appropriate Delta flow criteria. Staff is participating in collaboration with the State Water Contractors.

*Emergency Preparedness Plan*

Metropolitan has worked extensively with state and federal agencies on how to develop plans for delivering water through the Delta to the export pumps in the event of a major seismic emergency and levee failures. The Delta Flood Emergency Management Plan is currently planned to be completed in 2017. DWR is documenting results of their Emergency Response Tool simulation runs, which will lead to the completion of the plan. The ERT runs have demonstrated strategies to limit the period of export disruption to less than six months following the breach of multiple levees and island flooding from severe earthquake or storm events.

The state Office of Emergency Services has indicated that work is nearly complete on their Northern California Catastrophic Flood Management Plan, including the Delta region. The plan elements were put into practice at an interagency level during the Oroville Spillway failure emergency operations and performed favorably.

*Delta Islands*

In July 2016, Metropolitan purchased Bacon Island, Bouldin Island, Webb Tract and parts of Holland Tract and Chipps Island, located in the Sacramento-San Joaquin Delta, and continued with transfer of titles, leases, and other associated activities. In the first year of Metropolitan's ownership of the Delta Islands properties, staff organized an internal multi-disciplinary team and management structure for ongoing status-quo activities. Farming leases on Metropolitan's islands continue with agricultural production as long-term plans are being developed. Recent accomplishments include the execution of the Semitropic Water Storage District master lease for both Bouldin Island and Webb Tract. Staff is currently working on completing the Holland Tract lease for 2017 and preparing for the Bacon Island lease in 2018. Metropolitan, in assuming ongoing regulatory compliance responsibilities for 2016 Senate Bill 88 (measurement and reporting requirements for water diversions), implemented an approved first-year experiment plan for measuring Delta water diversions, which will provide valuable compliance information through coordination with the Delta Watermaster.

**Long-Term Actions**

*California WaterFix*

After extensive consultation with the DWR and U.S. Bureau of Reclamation, the National Marine Fisheries Service and U.S. Fish and Wildlife Service released their biological opinions for the proposed construction and operation of California WaterFix on June 26. These agencies are responsible for the protection of species listed under the federal ESA. Both biological opinions found that the construction and operation of California WaterFix as proposed would not jeopardize the continued existence of ESA-listed species, destroy, or adversely modify critical habitat for those species. Action on the final EIR/EIS is expected soon, since the action follows the issuance of the biological opinions. Issuance of the state ESA and other state permits will occur after DWR's action on the final EIR.

*California EcoRestore*

California EcoRestore is making progress in advancing restoration actions in the Sacramento-San Joaquin Delta geared toward achieving the goal of restoring at least 30,000 acres of tidal, floodplain and riparian habitats by 2020.

DWR initiated a Request for Proposal inviting private sector companies, non-profit groups and individuals to partner in restoration projects in the Delta. This effort is designed to help achieve California EcoRestore's tidal and other habitat restoration goals. The Delta Science Program convened an interagency adaptive management technical team to aid in developing a Delta ecosystem restoration adaptive management program. It will initially support current EcoRestore projects and provide a strong foundation for a long-term program that would support future restoration in the Delta.

# *Colorado River Resources*

For the first time since 2011, precipitation was above normal in the Colorado River Basin in fiscal year 2016/2017, with total storage in the Colorado River system increasing by about 2.4 million acre-feet. Lake Mead, the largest reservoir in the United States, increased by 8 feet during the fiscal year, but still ended the year with storage at

only 38 percent of capacity. The increase in storage in Lake Mead was due to both the improved hydrology and also the ongoing efforts of agencies, including Metropolitan, to fund conservation activities to conserve water and increase storage levels in Lake Mead.

Figure 2-2 shows a map of the Colorado River Basin and the states that rely on the Colorado River system for water. The map also shows California's major water agencies with federal water supply contracts. California has a basic apportionment of 4.4 million acre-feet, most of which is used by higher-priority agricultural users (Palo Verde Irrigation District, Yuma Project Reservation Division, Imperial Irrigation District and Coachella Valley Water District), as well as Metropolitan.

***Bard Seasonal Fallowing Pilot Program***

During the fiscal year, Metropolitan concluded a two-year seasonal fallowing pilot program with Bard Water District. This pilot program tested the water savings potential of providing financial incentives to farmers to forego planting a crop during a four-month period of spring and summer, when water use is high and crop production is low. The resulting reduction in consumptive water use was made available for use by Metropolitan. In the second year of the program, a total of 1,641 acres were fallowed beginning in the spring of 2017. After the conclusion of the pilot program, Metropolitan will use the information obtained to evaluate whether to explore a longer-term fallowing program with Bard Water District.

***Palo Verde Farmland Leases***

Metropolitan continues to be the largest landowner in the Palo Verde Valley under a September 2015 purchase of about 12,000 acres of land to support the reliability of Colorado River water supplies, in addition to the 8,000 acres of land it had previously owned. The leases on all of Metropolitan's lands terminated in late calendar year 2016. With fee title to more than 20 percent of the irrigated acres, Metropolitan's goals for its land holdings are to maintain agricultural productivity while improving efficient irrigation practices on its land. In 2017, Metropolitan renewed leases with its long-time tenants on its original land purchase and issued leases of its new land purchase after an open bid process. The leases provide farmers financial incentives to reduce historical water use by 25 to 30 percent.

### *IID Storage Agreement*

In calendar year 2016, Imperial Irrigation District conserved and stored a record volume of over 56,000 acre-feet with Metropolitan, in addition to the 38,000 AF delivered in late 2015, under an amended intrastate storage agreement that allows IID to temporarily store additional conserved water in Metropolitan's system. The water, less storage losses, due to evaporation and other factors, will be returned to IID in a future year.

### *Managing Colorado River Programs*

During the fiscal year, Metropolitan continued partnering with IID to fund and implement their agricultural conservation program, saving a total of 105,000 acre-feet in 2016. In fiscal year 2017, under a maximum fallowing call, Metropolitan received about 130,000 acre-feet of water. In FY 2017/18, the fallowing call will be reduced to 90 percent of the contractual limit, under a decision that was made one year in advance, on July 31, 2016.

### *Colorado Drought Response*

During the fiscal year, representatives from Reclamation, Arizona, California, Nevada, and water agencies, including Metropolitan, negotiated key terms for a Lower Basin Drought Contingency Plan. The plan would use voluntary reductions to reduce the risk of Lake Mead falling below critically low elevations. Cutbacks would be taken first by Arizona and Nevada, and then, if needed, by California. Those reductions would be recoverable when Lake Mead's elevation increases. The plan would also increase flexibility for agencies to meet dry-year water needs by allowing them to take delivery of Intentionally Created Surplus water stored in Lake Mead at lower lake elevations, benefitting water users in California, especially Metropolitan. It is anticipated that the agreement will be finalized and brought to the implementing agencies' boards for approval in fiscal year 2018.




*Figure 2-2. Map of the Colorado River Basin*




*Metropolitan provided incentives for retrofit of this irrigation system at Valhalla Memorial Park in Burbank.*

CHAPTER 3

# Water Resource Management

The Water Resource Management Group is responsible for planning, securing and managing high-quality water resources for Metropolitan's member agencies in a reliable, cost-effective and environmentally responsible manner. Principal responsibilities include managing imported water supplies and quality, advancing water-use efficiency and local resource development, and providing supply and demand forecasts that are the foundation for resource and facility planning. Other responsibilities include developing and implementing timely resource programs and projects, assisting member agencies in optimizing local resources to benefit the entire Metropolitan service area, and ensuring a fair return on Metropolitan's contractual investments in local and imported resources.

On May 9, 2017, in response to continued and significantly improved statewide hydrologic conditions, Metropolitan moved from the Water Supply Alert implemented in the previous fiscal year to a Water Supply Watch. Metropolitan's water supply and dry-year storage reserves had steadily declined to record low levels during the unprecedented drought that extended from water years 2012-13 through 2014-15 (a water year runs from October 1 through September 30). Restrictions on wholesale water deliveries began in July 2015 and were finally lifted in May 2016, several months after precipitation levels in northern California reached normal conditions for the first time since the drought began.

The voluntary conservation efforts supported by the Water Supply Watch are consistent with Gov. Brown's call to make conservation a California way of life. In April 2017, the same month that annual Northern California precipitation exceeded the highest amount on record, Gov. Brown declared an end to the drought emergency initially declared in January 2014. By the end of calendar year 2017, Metropolitan expects to put over 1 million acre-feet into dry-year storage reserves, the largest single year addition to storage programs in its history.

# *State Water Project Resources*

Metropolitan holds a water supply contract for 1,911,500 acre-feet annually with the California Department of Water Resources, subject to availability, and participation rights in the State Water Project. Record high precipitation and above-average snowpack during water year 2016-17 allowed for an 85 percent allocation of State Water Project contract supplies for CY 2017, representing the highest SWP allocation since 2006, and an improvement over the previous year's 60 percent allocation. The SWP supplies managed by Metropolitan for FY 2016/17 spanned half of the 85 percent allocation and half of the 60 percent allocation. In addition to allocated contract supplies, Metropolitan received nearly 124,000 acre-feet of Article 21 supplies in FY 2016/17 (Article 21 provides water supplies to SWP contractors when water in excess of the current SWP need is available.) As a result, Metropolitan managed 1,551,872 AF through the SWP system (Fig. 3-1), almost twice as much water as in the previous fiscal year. (FY 2016/17 deliveries and storage are subject to change based on future reconciliations by the Department of Water Resources.) With improved supply conditions, Metropolitan resumed deliveries to San Joaquin Valley groundwater storage programs that were depleted during the recent drought, and restored 70,000 AF to its flexible storage accounts, bringing them to full capacity.

Metropolitan's net SWP payments during FY 2016/17 were $526 million (Table 3-1) on a modified accrual basis. Metropolitan also administered existing storage programs located outside its service area along the SWP system, as described on the following pages.

### ***Water Storage Programs***

*Semitropic/Metropolitan Water Banking and Exchange Program*

In 1994, Metropolitan entered into a groundwater storage agreement with Semitropic Water Storage District in Kern County that allows storage of up to 350,000 AF. During FY 2016/17, Metropolitan stored 24,339 AF with Semitropic. The total water in storage on June 30, 2017 was 146,688 AF.

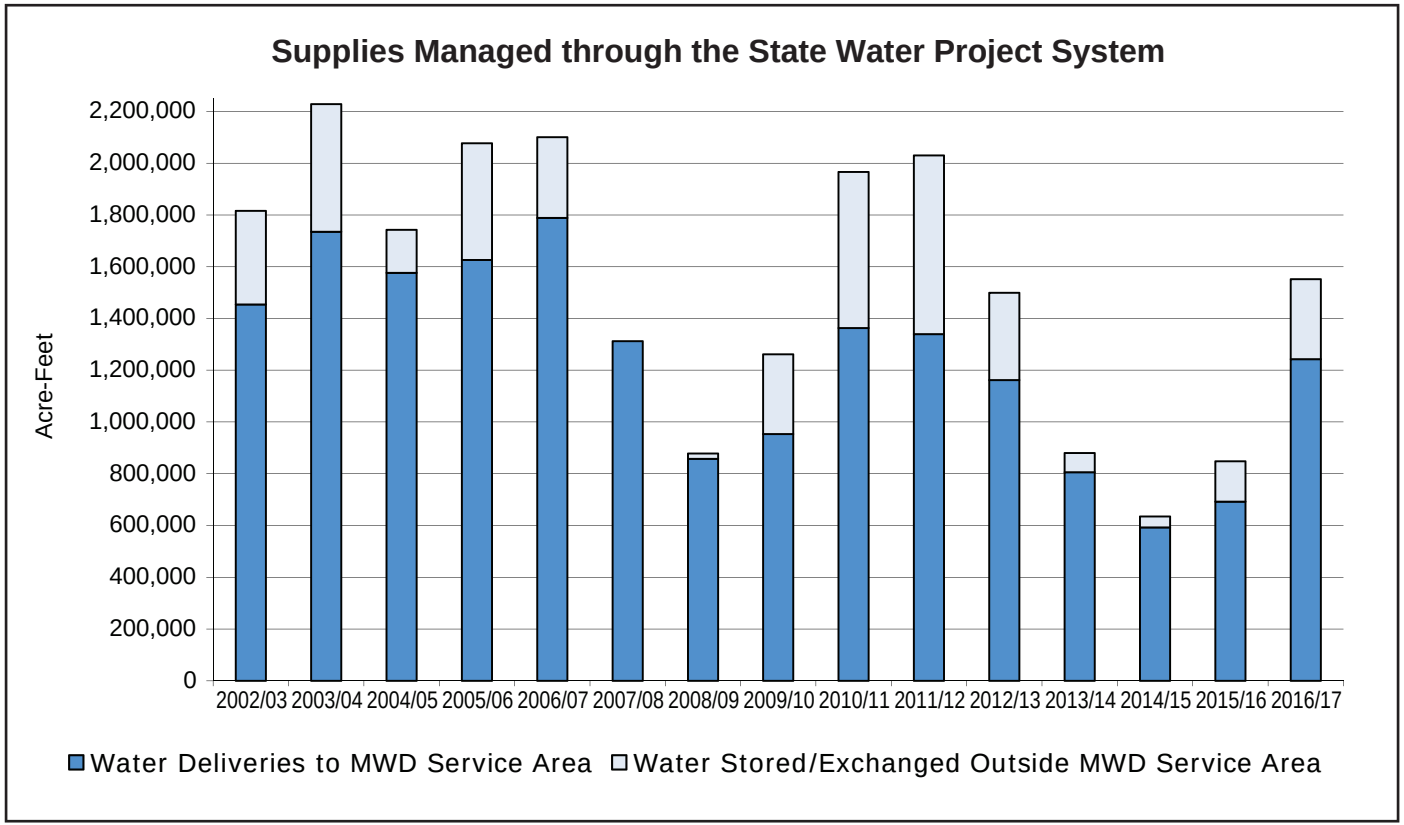



*Figure 3-1. Supplies Managed through the State Water Project System*

# TABLE 3-1
# CHARGES, PAYMENTS AND CREDITS UNDER THE STATE WATER AND DEVIL CANYON CASTAIC CONTRACTS

(Millions of Dollars)

| | Conservation ( Delta ) | | Transportation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fiscal Year | Capital | Minimum OMP&R [1] | Capital | Minimum OMP&R [1] | Variable | Extra * Capacity Costs | Devil Canyon/ Castaic | Subtotals | Credits | Totals | Accumulated Totals |
| 1963-73 | 2.50 | 0.66 | 197.31 | 19.33 | 1.02 | 39.16 | 3.56 | 263.54 | (15.62) | 247.91 | 247.91 |
| 1973-83 | 80.68 | 29.43 | 484.57 | 181.61 | 59.06 | | 70.74 | 906.09 | (49.53) | 856.56 | 1,104.47 |
| 1983-93 | 163.85 | 127.62 | 662.42 | 1,391.73 | 88.29 | 85.62 | 88.50 | 2,608.03 | (373.17) | 2,234.86 | 3,339.33 |
| 1993/94 | 23.50 | 16.92 | 74.35 | 147.75 | (5.86) | 25.24 | 9.89 | 291.79 | (101.81) | 189.98 | 3,529.31 |
| 1994/95 | 22.58 | 17.29 | 77.05 | 150.63 | 8.96 | 24.01 | 10.24 | 310.76 | (94.13) | 216.63 | 3,745.94 |
| 1995/96 | 21.85 | 19.68 | 81.31 | 111.87 | 3.11 | 26.08 | 10.60 | 274.49 | (65.33) | 209.16 | 3,955.10 |
| 1996/97 | 21.51 | 21.19 | 85.23 | 109.56 | 10.00 | 29.18 | 10.44 | 287.11 | (38.30) | 248.81 | 4,203.91 |
| 1997/98 | 21.79 | 22.87 | 90.07 | 138.35 | 6.67 | 27.58 | 9.56 | 316.87 | (64.74) | 252.14 | 4,456.05 |
| 1998/99 | 20.56 | 23.07 | 90.58 | 139.60 | 6.50 | 29.48 | 9.40 | 319.19 | (74.96) | 244.23 | 4,700.28 |
| 1999/00 | 19.16 | 24.11 | 89.26 | 164.26 | 12.05 | 29.99 | 10.32 | 349.15 | (70.06) | 279.09 | 4,979.37 |
| 2000/01 | 26.91 [2] | 24.60 | 115.99 [2] | 156.53 | 35.73 | 32.99 | 10.81 | 403.57 | (27.19) | 376.38 | 5,355.75 |
| 2001/02 | 8.46 | 25.20 | 60.24 | 147.23 | 111.75 | 38.99 | 10.53 | 402.40 | (68.44) | 333.97 | 5,689.72 |
| 2002/03 | 16.32 | 25.90 | 88.45 | 161.36 | 64.83 | 32.95 | 10.26 | 400.07 | (57.10) | 342.97 | 6,032.68 |
| 2003/04 | 18.39 | 27.86 | 94.86 | 169.12 | 110.22 | 31.49 | 10.23 | 462.18 | (69.47) | 392.71 | 6,425.39 |
| 2004/05 | 20.60 | 29.65 | 98.51 | 149.53 | 102.39 | 28.28 | 10.99 | 439.94 | (66.68) | 373.26 | 6,798.65 |
| 2005/06 | 17.36 | 28.37 | 88.80 | 140.92 | 130.82 | 23.60 | 11.10 | 440.97 | (41.33) | 399.64 | 7,198.30 |
| 2006/07 | 21.34 | 25.40 | 87.95 | 172.78 | 88.82 | 28.64 | 11.90 | 436.83 | (74.20) | 362.63 | 7,560.92 |
| 2007/08 | 23.95 | 15.33 | 80.98 | 188.78 | 165.49 | 36.24 | 12.12 | 522.90 | (58.60) | 464.30 | 8,025.22 |
| 2008/09 | 23.18 | 30.50 | 73.30 | 224.90 | 56.72 | 31.30 | 13.40 | 453.30 | (58.59) | 394.71 | 8,419.93 |
| 2009/10 | 34.69 | 39.06 | 91.87 | 205.72 | 71.27 | 35.93 | 13.97 | 492.49 | (54.28) | 438.22 | 8,858.15 |
| 2010/11 | 34.70 | 49.13 | 97.02 | 206.13 | 100.66 | 36.22 | 14.10 | 537.96 | (46.08) | 491.88 | 9,350.03 |
| 2011/12 | 26.52 | 57.29 | 94.26 | 197.73 | 109.67 | 38.73 | 14.68 | 538.88 | (59.04) | 479.84 | 9,829.87 |
| 2012/13 [3] | 34.62 | 61.06 | 72.72 | 170.08 | 135.15 | 35.30 | 14.35 | 523.28 | (42.33) | 480.95 | 10,310.81 |
| 2013/14 | 27.13 | 60.51 | 93.50 | 163.40 | 91.77 | 30.64 | 14.21 | 481.17 | (49.77) | 431.40 | 10,742.21 |
| 2014/15 | 25.74 | 68.67 | 97.40 | 160.18 | 97.27 | 26.84 | 15.63 | 491.73 | (51.74) | 439.99 | 11,182.20 |
| 2015/16 | 33.95 | 85.43 | 97.75 | 193.95 | 115.63 | 31.52 | 16.95 | 575.17 | (63.72) | 511.45 | 11,693.65 |
| 2016/17 | 36.55 | 91.18 | 99.40 | 131.59 | 148.57 | 37.96 | 17.65 | 562.90 | (37.16) | 525.74 | 12,219.39 |
| TOTALS | 828.41 | 1,047.99 | 3,465.14 | 5,494.61 | 1,926.56 | 873.93 | 456.11 | 14,092.76 | (1,873.37) | 12,219.39 | |

* Includes costs for excess capacity constructed for Metropolitan on the System and East Branch Enlargement

[1] Minimum Operations, Maintenance, Power, and Replacement charge

[2] DWR requested early payment of $36M to manage cash shortages due to 2001 California's energy crisis

[3] Reporting changed from cash to modified accrual basis in FY 2012/13

*Arvin-Edison/Metropolitan Water Management Program*

Under the December 1997 agreement with Arvin-Edison Water Storage District, Metropolitan can store up to 350,000 AF. During FY 2016/17, Metropolitan cycled the program to provide water quality improvements to the SWP deliveries and reduce program put costs by recovering 12,239 AF of high-quality Arvin-Edison water and returning the same amount of water to Arvin-Edison storage within the same program year. This operation reduced future program put costs by around $600,000. The total water in storage on June 30, 2017 was 108,125 AF.

*San Bernardino/Metropolitan Coordinated Operating Agreement*

A July 2000 coordinated operating agreement with San Bernardino Valley Municipal Water District provided for the annual purchase of 20,000 AF and a carryover storage account of 50,000 AF. It also provided Metropolitan with the option to purchase additional water when available. The agreement terminated on December 31, 2016. The program was successful in providing Metropolitan with 223,500 AF of supplies. In addition, the agreement allowed Metropolitan to convey 556,203 AF of Metropolitan's supplies to Diamond Valley Lake during the construction of the Inland Feeder.

*Kern Delta/Metropolitan Water Management Program*

A 2003 agreement with the Kern Delta Water District allows Metropolitan to store up to 250,000 AF in the groundwater basin underlying Kern Delta and retrieves up to 50,000 AF per year. During FY 2016/17, Metropolitan stored 4,322 AF with Kern Delta. Total water in storage on June 30, 2017 was 102,841 AF.

*Mojave/Metropolitan Water Storage Program*

In 2003, Metropolitan entered into a demonstration agreement with Mojave Water Agency. The agreement allows for the exchange of SWP water on the basis of one acre-foot of return water for each acre-foot of water previously delivered to Mojave. In July 2011, the agreement was amended to extend the term to 2035 and reduce program costs. There was no program activity during FY 2016/17, leaving 27,392 AF in the exchange account on June 30, 2017.

***Water Transfers and Exchanges***

Improved hydrologic conditions in the SWP watershed resulted in no available capacity to convey water transfer supplies at Banks Pumping Plant. Accordingly, Metropolitan did not pursue north of Delta opportunities, but rather focused on south of the Delta purchases and exchanges.

*Multi-Year Water Pool Demonstration Program*

In summer 2016, Metropolitan purchased 6,871 AF of SWP supplies made available under the Multi-Year Water Pool Demonstration Program. This two-year demonstration program terminated on December 31, 2016.

*Central Coast Water Authority/Castaic Lake*

In February 2017, Metropolitan entered into exchange agreements with Central Coast Water Authority and Castaic Lake Water Agency, which had 46,000 AF of supplies at risk of spilling as DWR filled up San Luis Reservoir. By returning two AF of supplies for every three AF received, Metropolitan secured 17,940 AF of additional supplies.

*San Gabriel Valley Municipal Water District Exchange*

Metropolitan entered into a purchase and exchange agreement with San Gabriel Valley Municipal Water District in September 2013. During FY 2016/17, Metropolitan developed 2,471 AF of additional supply by exchange and secured a purchase of 58 AF.

# *Colorado River Resources*

Acquisitions and exchanges made possible by the 2003 Quantification Settlement Agreement continued during FY 2016/17. Metropolitan conveyed 997,023 AF in its Colorado River Aqueduct during CY 2016. As of January 2017, Metropolitan had 85,049 AF of intentionally created surplus stored in Lake Mead. Figure 3-2 illustrates annual water supplies managed through the CRA. These supplies include diversions into Metropolitan's service area and water stored or exchanged outside Metropolitan's service area for Coachella Valley Water District, Desert Water Agency and IID (including

intentionally created surplus supplies) since CY 2004. This figure has been updated with new information since the last annual report.

Figure 3-3 illustrates the storage levels of lakes Mead and Powell through fiscal year 2017. Long-term dry conditions through CY 2016 have delayed equalization releases from Lake Powell to Lake Mead. Above-average precipitation from December 2016 through February 2017 resulted in a projected unregulated inflow to Lake Powell of approximately 116 percent of the April-July average, and approximately 114 percent of average for the water year.

***Water Supply Acquisitions and Exchanges***

In CY 2016, Metropolitan obtained 90,374 AF from its agricultural conservation program with IID, while an additional 125,432 AF was made available from Metropolitan's land fallowing agreements with farmers in the Palo Verde Valley. Metropolitan continued its two-year pilot program with Bard Water District that could provide up to 3,775 AF of Colorado River water in CY 2017. In CY 2016, 178,278 AF of Metropolitan water was delivered to San Diego County Water Authority in exchange for 100,000 AF of IID conserved water plus 78,278 AF of conserved water from the Coachella Canal and All-American Canal lining projects, which was made available to Metropolitan at Lake Havasu. The lining projects also conserved an additional 16,000 AF that was used by Metropolitan.

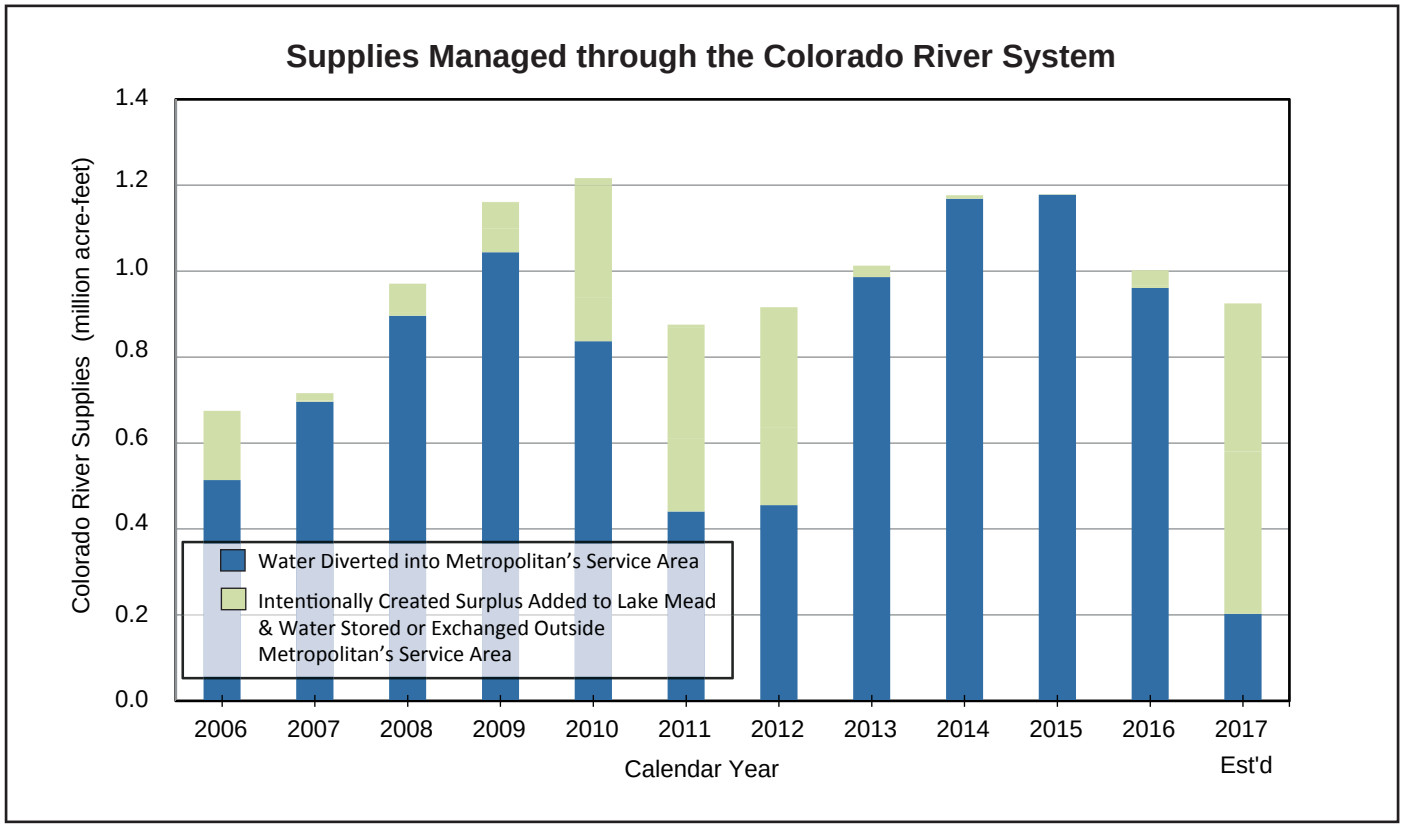



*Figure 3-2. Supplies Managed through the Colorado River System*

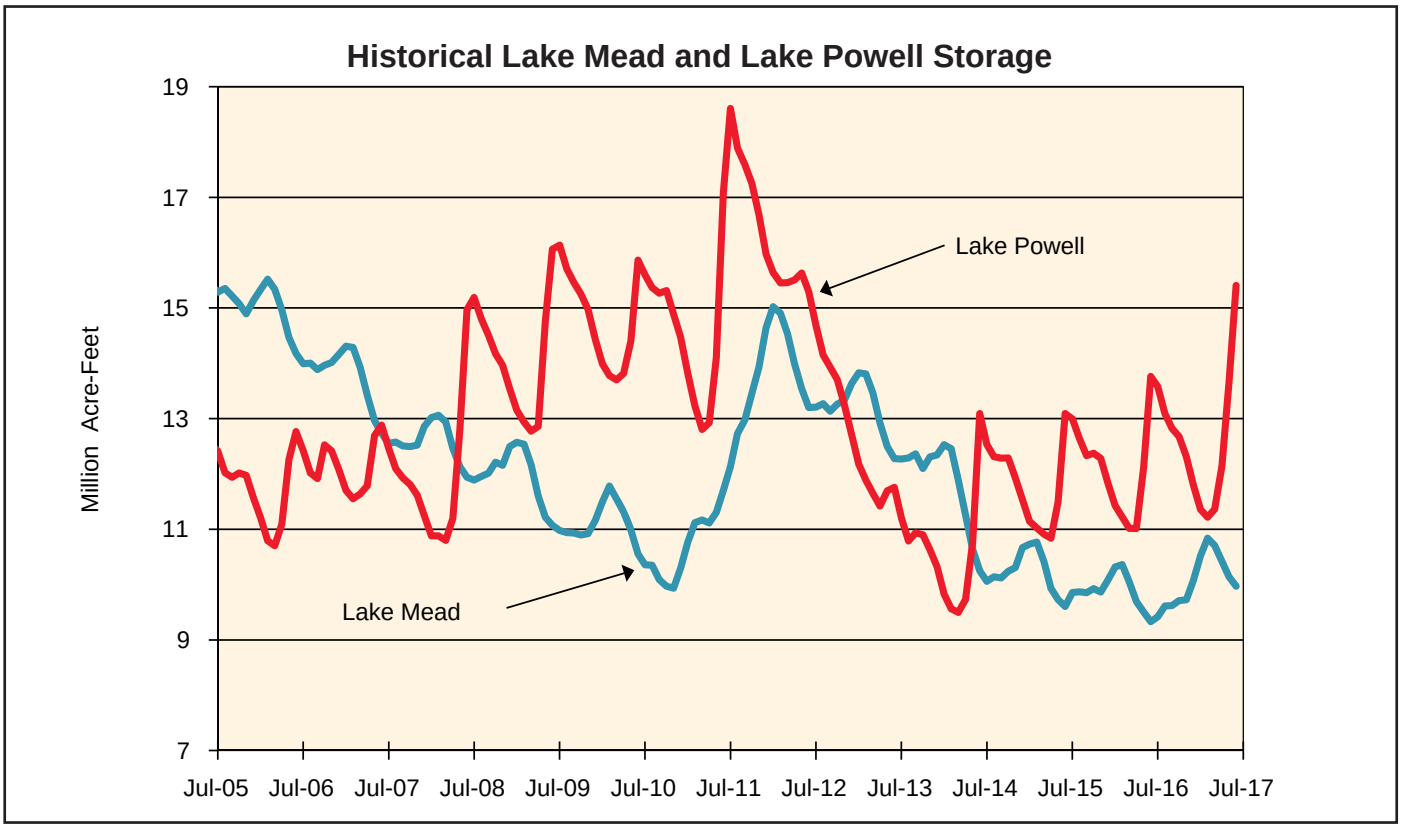



*Figure 3-3. Historical Lake Mead and Lake Powell Storage Fiscal Years 2005/06 - 2016/17*

# *Local Resources*

***Water Recycling and Groundwater Recovery***

Metropolitan's Local Resources Program provided about $607 million since its inception in 1982, producing about 3.53 MAF of recycled water and recovered groundwater, through financial incentives of up to $340/AF. During FY 2016/17, Metropolitan provided $36 million for production of 228,815 AF under the LRP. Currently, there are 107 projects under contract expected to produce about 441,000 AF per year once fully implemented. Contracts include performance targets that are assessed every year and when targets are not met, reductions to the contract can be made. Including LRP projects, the region used about 460,000 AF of recycled water (Fig. 3-4), and about 89,000 AF of recovered groundwater (Fig. 3-5).

To help increase use of recycled water, Metropolitan provides incentives to customers to retrofit their irrigation and industrial potable water systems to recycled water. Since 2014, Metropolitan has committed to provide $8.6 million for 9,800 AFY of recycled water at 305 sites.

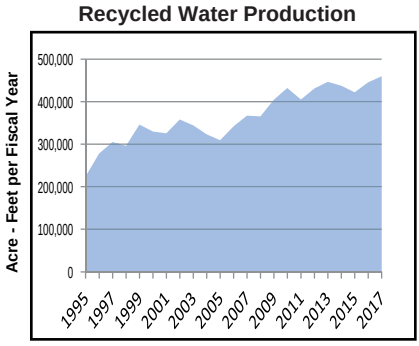



*Figure 3-4.*

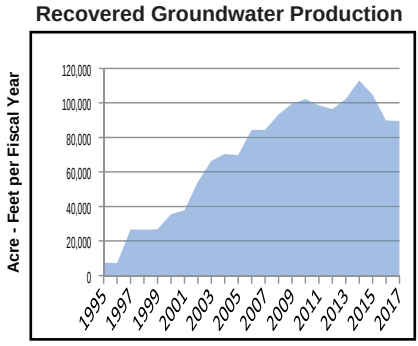



*Figure 3-5.*

*Figures reflect total regional production (including Metropolitan-assisted project production through June 2017), and subject to change due to annual assessments and late invoices. Recycled water production includes Santa Ana River base flows below Prado Dam.*

### *Seawater Desalination*

Since 2001, Metropolitan has maintained agreements with its member agencies to fund three local seawater desalination projects representing 46,000 AFY of potential future supplies. The three projects are currently in the planning stages. During FY 2016/17, Metropolitan supported member agency desalination efforts and continued coordinating regulatory policy for seawater desalination through financial support and participation in CalDesal, a consortium of California water agencies and other stakeholders working to advance seawater and groundwater desalination. Seawater desalination has also been eligible for LRP incentives since 2014.

### *Groundwater Storage*

Metropolitan's conjunctive use programs store imported supplies to enhance reliability during dry, drought and emergency conditions. In FY 2017, due to improved hydrologic conditions, Metropolitan called upon agencies to store water in the conjunctive use accounts. Continued storage over the coming year will increase storage in these accounts. Table 3-2 shows the balance of stored water in each in-region groundwater conjunctive use program as of June 30, 2017.

On April 11, 2017, the board authorized the General Manager to enter into Cyclic Storage Agreements with Metropolitan's member agencies. No new cyclic agreements have been executed as of June 30, 2017. Under the existing cyclic agreements with Upper San Gabriel Valley Municipal Water District and Three Valleys Municipal Water District, 26,532 acre-feet was stored.

## TABLE 3-2
## METROPOLITAN'S CONJUNCTIVE USE PROGRAMS

| Conjunctive Use Program | Total Storage Capacity (AF) | 2016/17 Beginning Balance (AF) | Change in Storage (AF) | 2016/17 Ending (AF) |
|---|---|---|---|---|
| **Los Angeles County** | | | | |
| Claremont | 3,000 | 0 | 0 | 0 |
| Compton | 2,289 | 0 | 0 | 0 |
| Foothill | 9,000 | 0 | 0 | 0 |
| Live Oak | 3,000 | 667 | 0 | 667 |
| Long Beach Phase 1 | 13,000 | 0 | 0 | 0 |
| Long Beach – Lakewood | 3,600 | 0 | 0 | 0 |
| **Orange County** | | | | |
| Orange County | 66,000 | 177 | 1,556 | 1,733 |
| **San Bernardino County** | | | | |
| Chino Basin | 100,000 | 0 | 6,315 | 6,315 |
| **Riverside County** | | | | |
| Elsinore Basin | 12,000 | 0 | 0 | 0 |
| **TOTAL** | **211,889** | **844** | **7,871** | **8,715** |

Some 2016-17 beginning balances differ from 2015-16 ending balances due to data received after publication of the 2016 Annual Report. 2016/17 data presented in this table includes CUP production data that was received by June 30, 2017 and are subject to change.

# *Conservation and Water-Use Efficiency*

The past fiscal year saw California continue to endure one of its worst droughts, followed by one of the wettest years ever on record. Metropolitan's conservation program saw numerous changes from the previous two years of record high conservation activity, as focus shifted from providing incentives and rebates to developing additional training and research programs. The new focus teaches customers the benefits of water efficient landscaping. Ongoing efforts include turf removal classes and development of a residential landscape design assistance program, along with research studies in cooling tower water use and the effects on household water pressure. Metropolitan continues to search for opportunities to increase water-use efficiency in its service territory.

In this past fiscal year, Metropolitan paid a total of $41.2 million in conservation incentives to its customers. The projected lifetime water savings from these conservation expenditures is approximately 91,000 AF of water.

Since 1985, the population within Metropolitan's service area has increased by about 5.5 million, but demands remain flat. Potable per capita water use has declined by about 38 percent during this period, largely attributed to conservation efforts.

# *Water Resource and System Planning*

***Integrated Water Resources Planning***

Throughout the fiscal year, Metropolitan engaged in discussions aimed at developing policy needed to implement the Integrated Water Resources Plan. First adopted by Metropolitan's board in 1996 and updated in 2004, 2010 and 2015, the IRP has fostered supply reliability through diversified investments in water conservation, recycling, groundwater treatment, storage and transfers.

Fiscal year 2016/17 built on a process launched late in the previous fiscal year, during an April 2016 board workshop. The board's Integrated Resources Planning Committee held a series of meetings to review and discuss Metropolitan's historic and current role and

activities in the areas of local resources and conservation development. The committee worked to develop policy principles to be considered by the board early fiscal year 2017/18 relating to the role of Metropolitan in developing local resources, achieving regional reliability, and increasing outdoor water use efficiency to achieve future conservation.

In response to the governor's Executive Order B-37-16 directing state agencies to establish a long-term framework for water conservation and drought planning, Metropolitan participated in an urban stakeholder group advising the state on new long-term water use efficiency targets and new requirements for Water Shortage Contingency Plans. In April 2017, the governor's administration released a package of proposed legislation to implement Executive Order B-37-16 and a report "Making Water Conservation a California Way of Life, Implementing Executive Order B-37-16." Some of the actions described in the report would require additional legislation and expansion of state authority, while others could be implemented under existing authorities.

***Future Supply Actions***

The Future Supply Actions Program consisted of 13 technical studies and pilot projects in the areas of groundwater, recycled water, seawater desalination and stormwater – all of which were completed by 2017. Under the FSA Program, Metropolitan funded up to $500,000 per project per member agency, with participating member agencies providing dollar-for-dollar matching funds. Metropolitan provided approximately $3 million of funding.

Future Supply Actions are relatively low-cost, low risk supply development efforts to better prepare the region for unforeseen water supply challenges. Collectively, the projects funded by this program reduce barriers and enhance regional understanding of the challenges and technical requirements necessary to develop future water supplies.

***Water Resource Data***

Figure 3-6 displays precipitation for FY 2016/17 compared to average annual precipitation figures for three weather stations within Metropolitan's service area. Above-normal annual precipitation

figures for these stations reflect significant easing of drought conditions throughout the service area. For FY 2016/17, downtown Los Angeles recorded precipitation of 19 inches, about 129 percent of the average annual precipitation of 14.77 inches.

Figure 3-7 displays population within Metropolitan's service area since 1990, with historical population based on state Department of Finance estimates and projections based on regional transportation planning agencies. Since 1990, the population served has increased from approximately 15 million to nearly 19 million.

Figure 3-8 displays Metropolitan's historical water sales and exchanges since FY 1989/90, which have ranged between 1.5 MAF and 2.51 MAF. Variations in sales are attributed to many factors that include weather, hydrologic conditions and economic activity.

Figure 3-9 displays Metropolitan's calendar year ending storage reserves for the past 10 years. While long-range forecasts suggested that a strong El Niño favored a wet year for the southwestern United States and the Colorado River Basin in CY 2016, these conditions did not materialize. Southern California received well below-normal precipitation while northern California received above-normal precipitation. These improved supply conditions along with ongoing conservation efforts and water use efficiency achievements allowed Metropolitan to store water for the first time in three years, resulting in storage of about 400,000 AF and allow for rebuilding of its dry-year storage accounts. At the end of CY 2016, Metropolitan had total storage reserves of 1.9 MAF, consisting of 1.3 MAF of dry-year storage and 630,000 AF of emergency storage. Record precipitation and above-average snowpack during the winter of 2016/17 should further rebuild Metropolitan's storage in CY 2017.

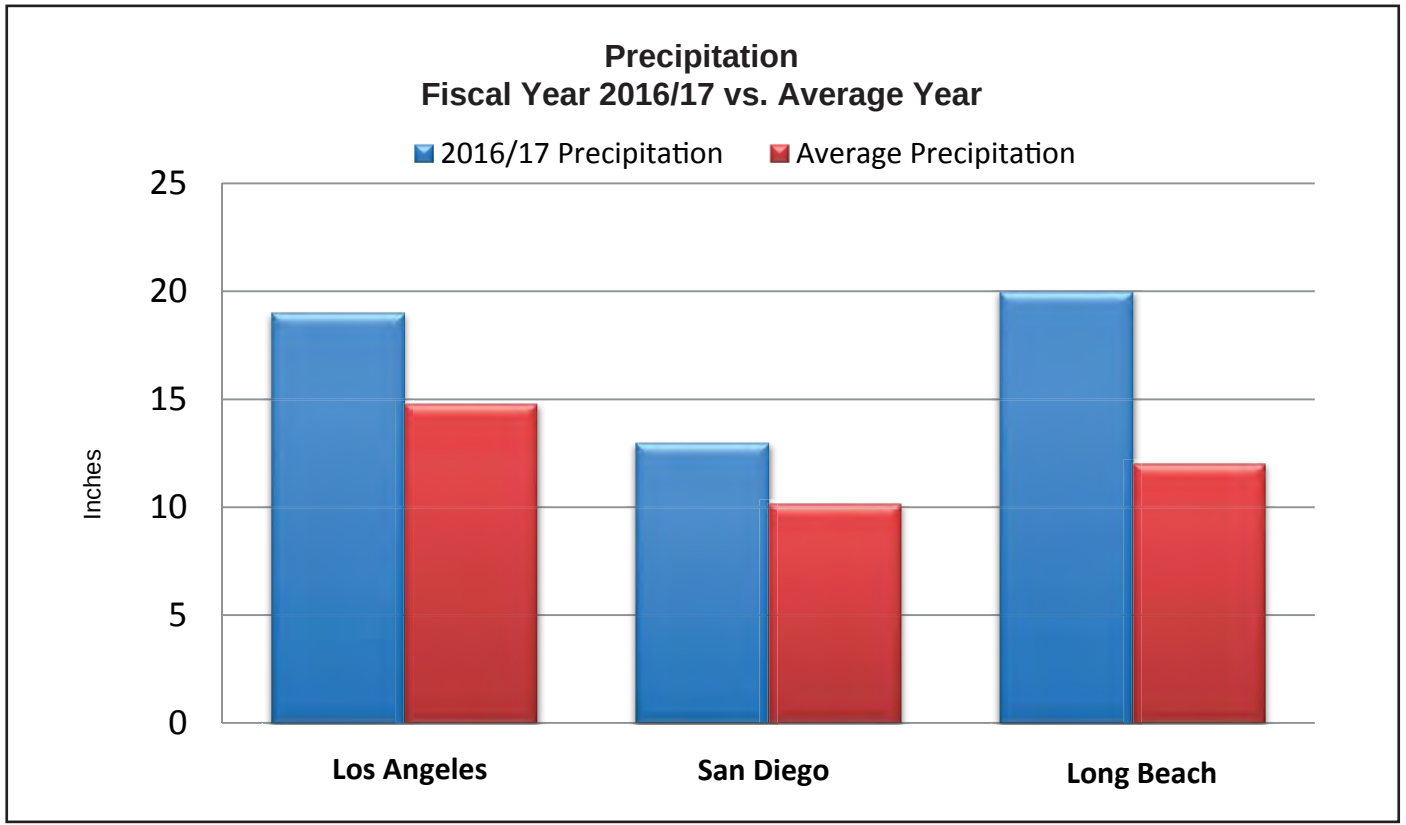



*Figure 3-6. Precipitation*

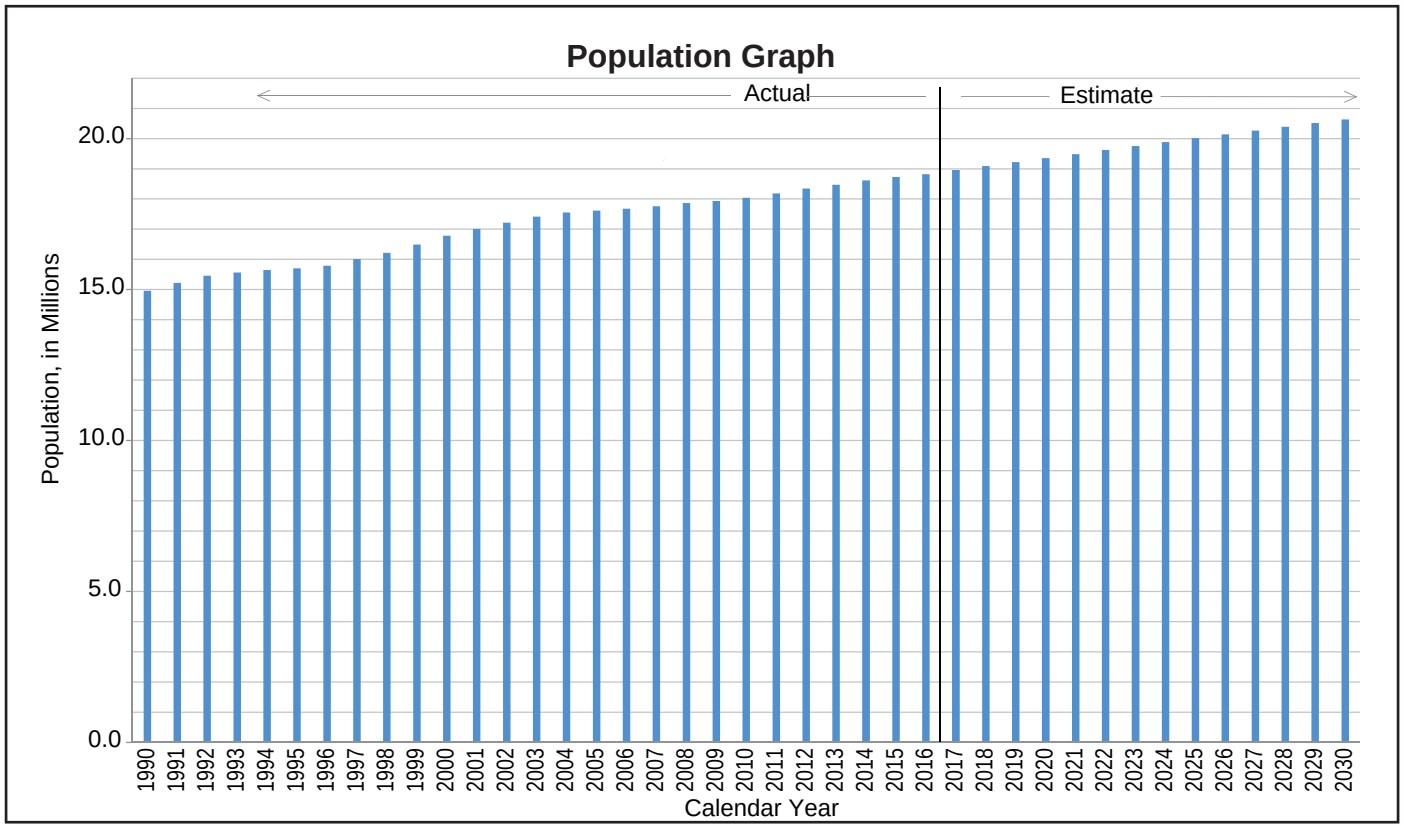



*Figure 3-7. Population Growth*

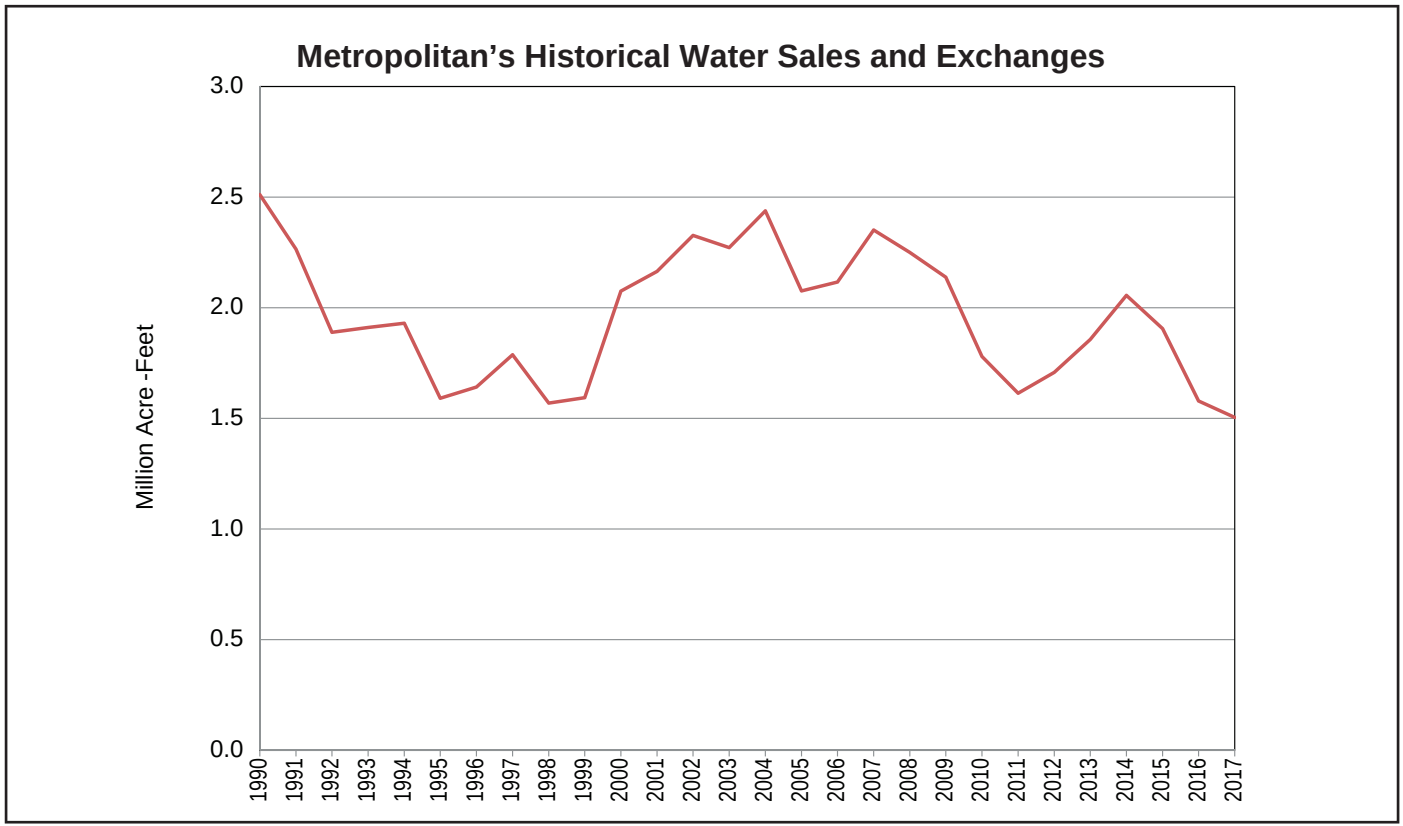



*Figure 3-8. Metropolitan's Historical Water Sales and Exchanges*

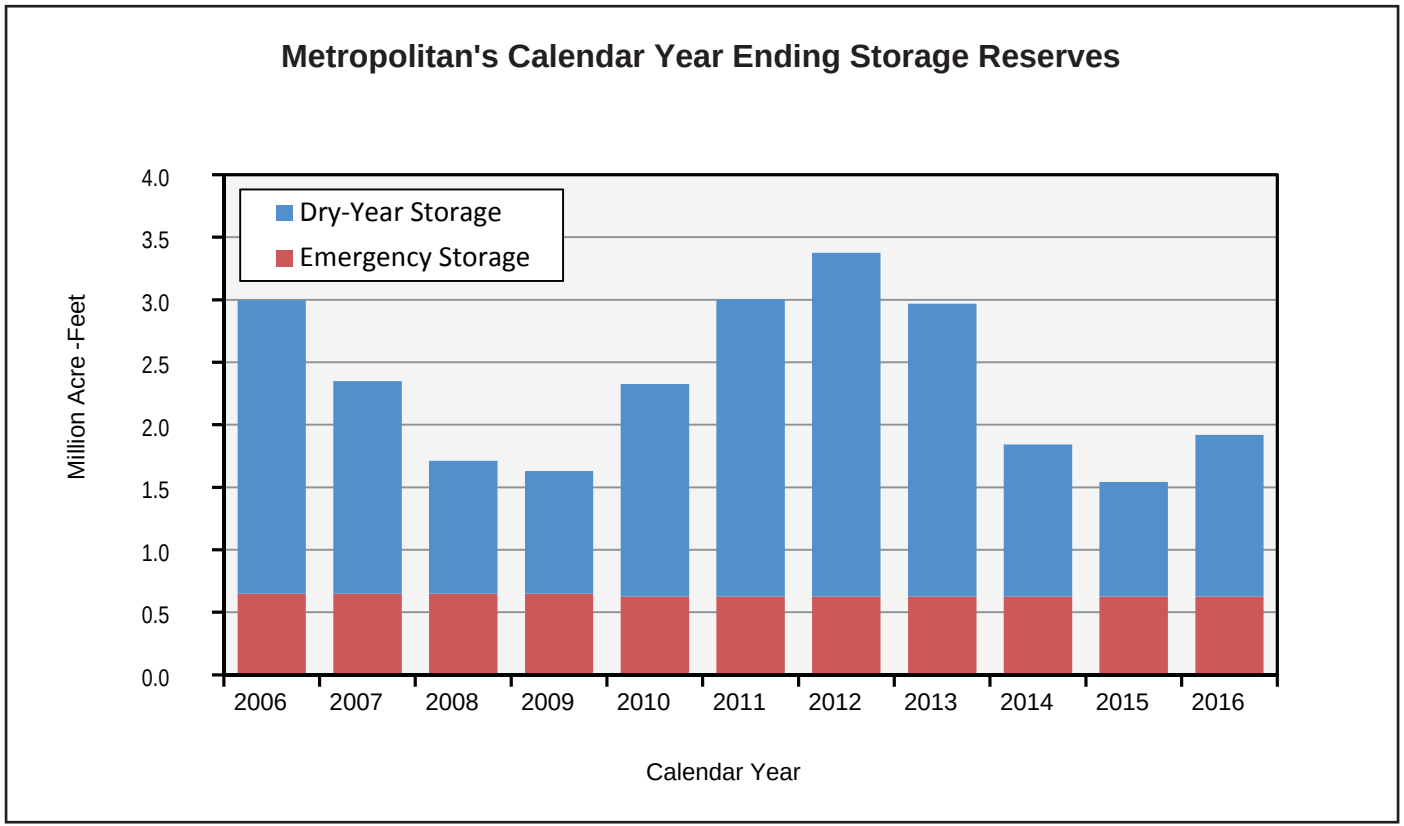



*Figure 3-9. Metropolitan's Calendar Year Ending Storage Reserves*



*A student intern cleans an oil sump vent pipe at Gene Pumping Plant.*

CHAPTER 4

# Water System Operations

The Water System Operations Group conveys, treats and distributes water to member agencies that, directly or through their sub-agencies, serve nearly 19 million Southern Californians. WSO ensures excellent water quality for Metropolitan's six-county service area that meets all primary drinking water standards, and operates and maintains Metropolitan's five treatment plants with a combined capacity of more than 2.6 billion gallons of water per day. WSO balances demand and supply as it operates, manages and maintains Metropolitan's water and power systems. It also oversees security; provides machine and fabrication services to support Metropolitan infrastructure; offers technical advice and support to member agencies, customers and other entities; provides technical training to ensure an effective, efficient and safe work environment; runs Metropolitan's Apprenticeship Program; assists in planning, design and construction of new facilities; and responds to emergencies to restore service in the shortest time possible.

## *Water Treatment*

Metropolitan's five water treatment plants treat water from the Colorado River and Northern California. The Robert B. Diemer Water Treatment Plant provides treated water to areas of Orange County and coastal Los Angeles. The Joseph Jensen Water Treatment Plant supplements local water supplies in the San Fernando Valley, Ventura County and central Los Angeles, while the F.E. Weymouth Water Treatment Plant generally serves eastern Los Angeles County, the San Gabriel Valley and parts of Orange County. The Henry J. Mills Water Treatment Plant serves western Riverside County and Moreno Valley. The Robert A. Skinner Water Treatment Plant serves parts of Riverside County and meets the supplemental treated water needs of San Diego County. The Jensen and Mills plants only treat State Water Project supplies, while the other three plants treat a blend of supplies from the SWP and Colorado River.

Construction of ozone facilities continued throughout the year at the Weymouth plant, with a scheduled start date of late calendar year 2017. The Weymouth oxidation retrofit will complete Metropolitan's $1.2 billion water quality improvement program to install ozone systems at all five water treatment plants. Crews installed and integrated ozone mechanical, electrical and instrumentation equipment and added sulfuric acid, liquid oxygen, hydrogen peroxide and ammonia feed equipment. Ozone testing and startup activities commenced this year, involving commissioning of ozone generators and extensive performance testing to ensure ozone production meets design standards.

At the Weymouth plant, rehabilitation of 48 filters was completed in June 2017. Each filter received a new underdrain system and filter media. The backwash troughs were raised to allow more effective backwashing with fewer filter media losses. This upgrade will allow more efficient filtering of the finished water and higher turbidity removal.

The Diemer plant is undergoing a major rehabilitation project on the original east side of the plant, which includes modernizing and improving the four basins, replacing flocculators, and improving flow characteristics through the plant. This project is expected to be completed in August 2017. Staff also completed replacement of the filter valves and seismic improvements to the filter building on the east side of the plant in October 2016. Staff replaced the filter influent, effluent, backwash, surface wash and drain valves for filters 1 through 24, as well as isolation and metering valves on the backwash and surface wash headers. These replacements will improve filter performance and increase reliability. Once work on the east side of the plant is complete, the west side of the plant will be rehabilitated. Work has also begun at the Diemer plant to reinforce the main administration building against damage from earthquakes, with completion expected in early 2018.

At the Jensen plant, rehabilitation projects continued to improve treatment plant performance, power reliability, and solids handling. The November 2016 replacement of module 1 filter valves and controls improved filter performance and increased plant reliability. Following a major shutdown of the Jensen plant in March 2017, the connection of new high-voltage electrical switchgear improved

emergency power reliability for the site. During this shutdown, adjustments to the effluent weir plate and cleaning of jet mix pumps allowed for increased flow of SWP supplies through the Jensen plant in response to increased water supply from Northern California. Completion of a permanent solids transfer pipeline to the Los Angeles Aqueduct Filtration Plant's solids handling lagoons will ensure delivery and storage of solids produced by the Jensen plant treatment process. This replaces a temporary pipeline to the lagoons, which are owned by the L.A. Department of Water and Power, and will ensure long-term plant reliability with improved plant performance, especially under variable water quality conditions. The new solids transfer system will be completed in July 2017.

The Skinner plant continued to optimize plant efficiency and treatment process effectiveness with the installation of an ammonia jet mixing system on the finished water reservoir inlet channel which improved chemical mixing. This project was completed in February 2017. Skinner relocated electrical equipment and pumps for the main mixing process to better protect them from the heat and weather, improving both the efficiency of the units and their reliability for water treatment.

The Mills plant completed construction of a new industrial waste water collection system in May 2017. The system allowed the plant to treat plant runoff water prior to pumping it into the sanitary sewer, resulting in significant savings when compared to hauling the material offsite. Mills plant also upgraded chemical feed systems to provide better control and optimized water treatment across widely varying flow rates. Replacement of coagulant pump needle valves and ammonia feed lances provided finer flow control and better mixing at lower flow ranges.

During fiscal year 2016/17, Metropolitan invested about $59.5 million in refurbishing and upgrading its five water treatment plants to ensure that treated water reliability goals continue to be met. Another $22.9 million was invested in water quality improvement projects, with a major portion of the funds dedicated to construction of the Weymouth ozone facilities.

# *Water Quality*

### *Regulations*

Metropolitan's treated water supplies met all regulatory requirements during fiscal year 2016/17.

On May 31, 2017, the Sacramento County Superior Court invalidated the state's chromium 6 maximum contaminant level for drinking water, which had been set at 10 parts per billion in 2014. The court also ordered the State Water Resources Control Board, Division of Drinking Water to adopt a new MCL for chromium 6. Metropolitan's source and treated water supplies remain below the invalidated MCL and will require no additional treatment. The total chromium MCL of 50 ppb remains in effect.

Metropolitan began compliance monitoring of its potable water system under the federal Revised Total Coliform Rule in April 2016. California has not yet adopted the revised federal rules, so utilities must adhere to the current and revised standards. Based on Metropolitan's past low coliform bacteria results, no compliance issues with the federal and the future state standards are expected.

In March 2017, Metropolitan completed the monthly two-year monitoring of treatment plant influents for *Cryptosporidium* under round 2 of the Long Term 2 (LT2) Enhanced Surface Water Treatment Rule. During 24 months of monitoring, no *Cryptosporidium* oocysts were detected in any of the samples, meaning that no additional surface water treatment will be required.

### *Water Quality Monitoring*

Water Quality Laboratory staff performed 164,396 analytical tests using 183 methods on nearly 45,000 samples this year. Treatment plant laboratory staff performed an additional 150,000 analytical tests using 13 methods in FY 2016/17. The number of samples and analyses for Metropolitan's sources, treatment plants, and distribution system may change each year depending on regulations, monitoring plan, operations and water quality studies. The water quality data presented here represent FY 2016/17 rather than calendar year data that are reported in the annual Water Quality Report. As such, minor differences in reported metrics may be observed.

*Chemical/Physical*

Staff analyzed Metropolitan's source and treated waters for inorganic and organic compounds, physical properties and other constituents. Table 4-1 lists the locations sampled for organic chemicals. No herbicides, pesticides, or synthetic organic compounds were detected. Tables 4-2, 4-3, and 4-4 show locations and results for trace metals, radiologicals (most recent triennial monitoring results summary), and general minerals and physical analyses, respectively.

**TABLE 4-1**
**SAMPLE LOCATIONS FOR ORGANIC COMPOUNDS**
Fiscal Year 2016/17

| Source Water | Treated Water |
|---|---|
| Devil Canyon Afterbay | Diemer Plant Effluent |
| Diamond Valley Lake | Jensen Plant Effluent |
| Jensen Plant Influent | Mills Plant Effluent |
| Lake Havasu Intake | Skinner Reservoir Effluent[1] |
| Lake Mathews Headworks | Weymouth Plant Effluent |
| Lake Perris | |
| Lake Skinner Outlet Conduit | |
| San Jacinto Tunnel | |

[1]Skinner Reservoir Effluent is a combined effluent from three Skinner plants.

*Total Dissolved Solids*

Salinity of the Colorado River Aqueduct is typically higher than the State Water Project, largely due to natural mineral salt deposits within the geology of the Colorado River watershed (Figure 4-1). Changes in salinity tend to occur more rapidly in water from the SWP as opposed to supplies from the CRA, due to the hydrodynamic fluctuations of the system. Figure 4-2 presents salinity as flow-weighted averages of the total dissolved solids levels in the effluents from all five treatment plants. While salinity levels dropped compared to the previous year, during a portion of FY 2016/17, the Diemer, Skinner and Weymouth plants treated lower blends of SWP supply due to its limited availability during the last stages of the drought. As such, flow-weighted TDS averages were above Metropolitan's water quality goal of 500 milligrams per liter (mg/L).

# TABLE 4-2
# TRACE METALS IN METROPOLITAN'S WATER SUPPLIES
Fiscal Year 2016/2017 (in micrograms per liter [µg/L])

| Metal | Maximum Contaminant Level (MCL) | Minimum Reporting Level | SOURCE WATERS | | | | | | | | | | | TREATMENT PLANT EFFLUENTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lake Havasu | San Jacinto Tunnel | Lake Mathews | Castaic Lake at Jensen Influent | Silverwood Lake | Mills Influent | Lake Perris | Weymouth Influent | Diemer Influent | Diamond Valley Lake | Lake Skinner | Weymouth | Diemer | Jensen | Skinner | Mills |
| Aluminum[1] | 1000 (200) | 10 | 11 | ND | 64 | 66 | 120 | 150 | 72 | 210 | 140 | ND | 40 | 160 | 130 | 80 | ND | 74 |
| Antimony | 6 | 2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Arsenic | 10 | 0.5 | 2.6 | 2.6 | 2.6 | 3.8 | 2.4 | 2.5 | 2.8 | 2.4 | 2.4 | 3.3 | 2.5 | 1.1 | 1.4 | 2.7 | ND | 1.0 |
| Barium | 1000 | 5 | 130 | 120 | 130 | 37 | 25 | 25 | 56 | 80 | 87 | 38 | 87 | 80 | 88 | 36 | 83 | 24 |
| Beryllium | 4 | 0.5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Boron[2] | 1000 | 20 | 120 | 120 | 130 | 210 | 100 | 100 | 220 | 120 | 120 | 180 | 120 | 120 | 110 | 220 | 130 | 100 |
| Cadmium | 5 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Chromium | 50 | 1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Chromium 6[3] | 10 | 0.03 | ND | ND | ND | 0.33 | 0.08 | 0.08 | ND | ND | ND | 0.07 | ND | 0.05 | 0.04 | 0.34 | 0.05 | 0.10 |
| Copper[4(1)] | 1300 (1000) | 10 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Iron[1] | 300 | 50 | ND | ND | 64 | 78 | 97 | 135 | 84 | 139 | 97 | ND | ND | ND | ND | ND | ND | ND |
| Lead[4] | 15 | 1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Lithium | -- | 10 | 42 | 46 | 45 | ND | ND | ND | ND | 24 | 23 | ND | 27 | 24 | 23 | ND | 28 | ND |
| Manganese[1] | 50 | 5 | ND | ND | ND | 12 | 20 | 21 | 8 | 10 | 6 | ND | 7 | ND | ND | ND | 14 | ND |
| Mercury | 2 | 0.2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Molybdenum | -- | 2 | 5 | 7 | 5 | 4 | ND | ND | 5 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | ND |
| Nickel | 100 | 2 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Selenium | 50 | 5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Silver[1] | 100 | 5 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Strontium | -- | 20 | 1120 | 1080 | 1140 | 290 | 140 | 150 | 300 | 610 | 680 | 280 | 680 | 630 | 690 | 280 | 690 | 140 |
| Thallium | 2 | 1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Vanadium[2] | 50 | 1 | 2.5 | 2.4 | 2.9 | 5.2 | 3.9 | 3.8 | 4.7 | 3.1 | 3.3 | 2.9 | 3.1 | 2.4 | 2.7 | 5.0 | ND | 3.2 |
| Zinc[1] | 5000 | 20 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

ND = Not Detected

-- = no MCL

[1] Secondary standard based on consumer acceptance rather than health considerations.

[2] California notification level: a health-based advisory level.

[3] California MCL remanded by Sacramento County Superior Court on May 31, 2017.

[4] Action level. The MCL for lead has been replaced with a treatment technique requiring agencies to optimize corrosion control treatment when the action level is exceeded in more than 10 percent of samples collected at the consumers' tap. Copper has a similar treatment technique requirement in addition to the secondary MCL. (Per EPA's Lead and Copper Rule.)

# TABLE 4-3
# RADIOLOGICAL COMPLIANCE MONITORING[1]
## 2014 Four Quarter Ranges (in pCi/L)

| LOCATION | GROSS ALPHA | GROSS BETA | COMBINED RADIUM 226 & 228 | STRONTIUM 90 | TRITIUM | URANIUM |
|---|---|---|---|---|---|---|
| **MCL** | **15** | **50[3]** | **5** | **8** | **20,000** | **20** |
| **DLR** | **3** | **4** | **1** | **2** | **1,000** | **1** |
| Lake Havasu Intake | ND–3 | 4–6 | ND | ND | ND | 2–3 |
| San Jacinto Tunnel West Portal | ND–4 | 5–6 | ND | ND | ND | 2–3 |
| Lake Mathews | ND–4 | 5–6 | ND | ND | ND | 2–3 |
| Silverwood Lake | ND–4 | ND | ND | ND | ND | 2–4 |
| Lake Perris | ND | ND–4 | ND | ND | ND | 2 |
| Diamond Valley Lake | ND | ND | ND | ND | ND | 1 |
| Lake Skinner | ND–6 | ND–5 | ND | ND | ND | 2–3 |
| Jensen Plant Influent | ND–5 | ND–4 | ND | ND | ND | 2–3 |
| Diemer Plant Effluent | ND–4 | 4–6 | ND | ND | ND | 2–3 |
| Jensen Plant Effluent | ND–5 | ND–5 | ND | ND | ND | 2–3 |
| Mills Plant Effluent | ND–4 | ND | ND | ND | ND | ND-4 |
| Skinner Reservoir Effluent[2] | ND–5 | 5–6 | ND | ND | ND | 1–3 |
| Weymouth Plant Effluent | ND–4 | 4–6 | ND | ND | ND | 2–3 |

[1] Results obtained during Calendar Year 2014 triennial monitoring. Data are reported for three years until the next scheduled monitoring.

[2] This is a combined effluent from Skinner plants 1, 2, and 3.

[3] The gross beta particle activity MCL is 4 millirem/year annual dose equivalent to the total body or any internal organ. The screening level is 50 pCi/L (picoCuries/liter).

DLR = Detection Limits for Purposes of Reporting

MCL = Maximum Contaminant Level

ND = Not Detected. All results less than DLR were reported as ND.

# TABLE 4-4
# GENERAL MINERAL AND PHYSICAL ANALYSIS OF METROPOLITAN'S WATER SUPPLIES
## Fiscal Year 2016/17 Averages

| CONSTITUENTS | UNITS | SOURCE WATERS | | | | | | | | TREATMENT PLANT EFFLUENTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lake Havasu | San Jacinto Tunnel | Lake Mathews | Castaic Lake at Jensen Influent | Silverwood Lake at Devil Canyon | Lake Perris | Diamond Valley Lake | Lake Skinner | Weymouth | Diemer | Jensen | Skinner | Mills |
| Silica | mg/L | 7.7 | 7.9 | 8.0 | 13.6 | 10.3 | 7.3 | 7.8 | 7.9 | 8.8 | 8.8 | 13.5 | 8.3 | 10.4 |
| Calcium | mg/L | 76 | 75 | 74 | 29 | 17 | 27 | 28 | 54 | 49 | 51 | 29 | 59 | 17 |
| Magnesium | mg/L | 25 | 25 | 26 | 13 | 10 | 14 | 13 | 19 | 18 | 19 | 13 | 21 | 9 |
| Sodium | mg/L | 96 | 95 | 100 | 72 | 46 | 79 | 62 | 76 | 78 | 80 | 83 | 89 | 54 |
| Potassium | mg/L | 4.7 | 4.7 | 4.9 | 3.2 | 2.7 | 3.9 | 3.6 | 4.0 | 3.9 | 3.9 | 3.2 | 4.4 | 2.7 |
| Carbonate | mg/L | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Bicarbonate | mg/L | 158 | 155 | 151 | 104 | 73 | 107 | 104 | 124 | 104 | 109 | 108 | 127 | 66 |
| Sulfate | mg/L | 241 | 238 | 247 | 67 | 29 | 64 | 64 | 166 | 163 | 172 | 81 | 181 | 38 |
| Chloride | mg/L | 92 | 92 | 96 | 92 | 66 | 103 | 80 | 79 | 77 | 78 | 93 | 94 | 70 |
| Nitrate | mg/L | 1.4 | 1.2 | 0.9 | 2.8 | 1.5 | 0.2 | 0.6 | 1.0 | 1.4 | 1.4 | 2.9 | 1.3 | 2.2 |
| Fluoride | mg/L | 0.3 | 0.3 | 0.3 | 0.1 | < 0.1 | 0.1 | 0.1 | 0.2 | 0.7 | 0.8 | 0.7 | 0.7 | 0.7 |
| Total Dissolved Solids (TDS) | mg/L | 623 | 616 | 633 | 344 | 218 | 352 | 312 | 469 | 452 | 468 | 374 | 522 | 239 |
| Total Hardness as $CaCO_3$ | mg/L | 292 | 285 | 288 | 122 | 80 | 121 | 125 | 212 | 194 | 200 | 123 | 229 | 81 |
| Total Alkalinity as $CaCO_3$ | mg/L | 129 | 127 | 124 | 85 | 60 | 87 | 87 | 102 | 86 | 89 | 89 | 104 | 57 |
| Free Carbon Dioxide | mg/L | 2.5 | 1.7 | 2.8 | 4.8 | 2.5 | 2.4 | 2.6 | 1.8 | 1.2 | 1.2 | 1.0 | 1.6 | 0.3 |
| pH | pH | 8.04 | 8.19 | 8.00 | 7.61 | 7.72 | 7.92 | 7.98 | 8.07 | 8.29 | 8.27 | 8.29 | 8.14 | 8.62 |
| Specific Conductance | µS/cm | 992 | 975 | 1000 | 613 | 402 | 636 | 559 | 770 | 742 | 763 | 656 | 850 | 434 |
| Color | CU | 3 | 2 | 2 | 7 | 12 | 7 | 5 | 6 | 1 | 1 | 1 | 1 | 1 |
| Turbidity | NTU | 0.64 | 0.92 | 2.1 | 1.6 | 2.4 | 1.9 | 0.69 | 0.95 | 0.05 | 0.05 | 0.04 | 0.07 | 0.07 |
| Temperature | °C | 20 | 21 | 20 | 15 | 17 | 19 | 18 | 20 | 20 | 22 | 19 | 23 | 21 |
| Bromide | mg/L | 0.08 | 0.06 | 0.07 | 0.29 | 0.20 | 0.34 | 0.25 | 0.10 | — | — | — | — | — |
| Total Organic Carbon | mg/L | 3.03 | 3.01 | 2.94 | 3.25 | 4.06 | 4.58 | 3.14 | 3.66 | — | — | — | — | — |
| Cyanide | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Foaming Agents (MBAS) | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Threshold Odor Number (TON) | - | 5 | 4 | 5 | 2 | 7 | 10 | 7 | 10 | 3 | 2 | 2 | 3 | 3 |
| Saturation Index | - | — | — | — | — | — | — | — | — | 0.36 | 0.41 | 0.28 | 0.47 | 0.22 |
| Aggressiveness Index | - | 12 | 13 | 12 | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| State Project Water | % | 0 | 0 | 0 | 100 | 100 | 100 | 100 | 34 | 44 | 43 | 100 | 30 | 100 |

ND = Not Detected
— = Not Reported

mg/L - milligrams per liter
µS/cm - microSiemen per centimeter
NTU - Nephelometric Turbidity Unit
CU - Color Units

*Disinfection Byproducts*

Metropolitan has monitored for byproducts from disinfection in treatment plant effluents since 1979. Table 4-5 summarizes the levels of disinfection byproducts total trihalomethanes, haloacetic acids and bromate in plant effluents during FY 2016/17. Compliance under the Stage 2 Disinfectants and Disinfection Byproducts Rule began in 2013, requiring drinking water systems to monitor distribution system locations with the highest TTHMs and HAAs in the distribution system and report results as locational running annual averages. The highest locational running annual averages were below the MCLs of 80 micrograms per liter (µg/L) for TTHMs and 60 µg/L for HAA5. Bromate was below 10 µg/L. Figures 4-3 and 4-4 summarize the long-term trends for TTHMs and HAA5, respectively. Locational running annual averages for both TTHMs and HAAs are higher in the distribution system than running annual averages at treatment plant effluents because the required disinfectant residual in the distribution system can increase DBPs. However, overall DBP trends have declined since Metropolitan began using ozone, although changing source water conditions and operational changes can cause locational averages to periodically increase. This conservative monitoring and reporting framework provides the most representative DBP water quality for Metropolitan's customers.

Figure 4-5 exhibits the plant influent levels of the DBP precursors, total organic carbon and bromide. The gap in bromide data for the Skinner plant is due to influent chlorination to control quagga mussels during fiscal years 2008/09 and 2009/10. Bromide levels naturally fluctuate every spring and summer due to mountain snowmelt in the Sierra Nevada and increased outflow from the Sacramento-San Joaquin Delta. Bromate, a byproduct of ozone treatment, was monitored after ozone came online at Mills in 2003, Jensen in 2005, Skinner in 2010 and Diemer in July 2015. Figure 4-6 shows trends in bromate levels. Application of an ammonia-chlorine bromate control strategy began in October 2010 at the Mills plant. The strategy results in lower bromate levels and operating costs when demands justify its use.

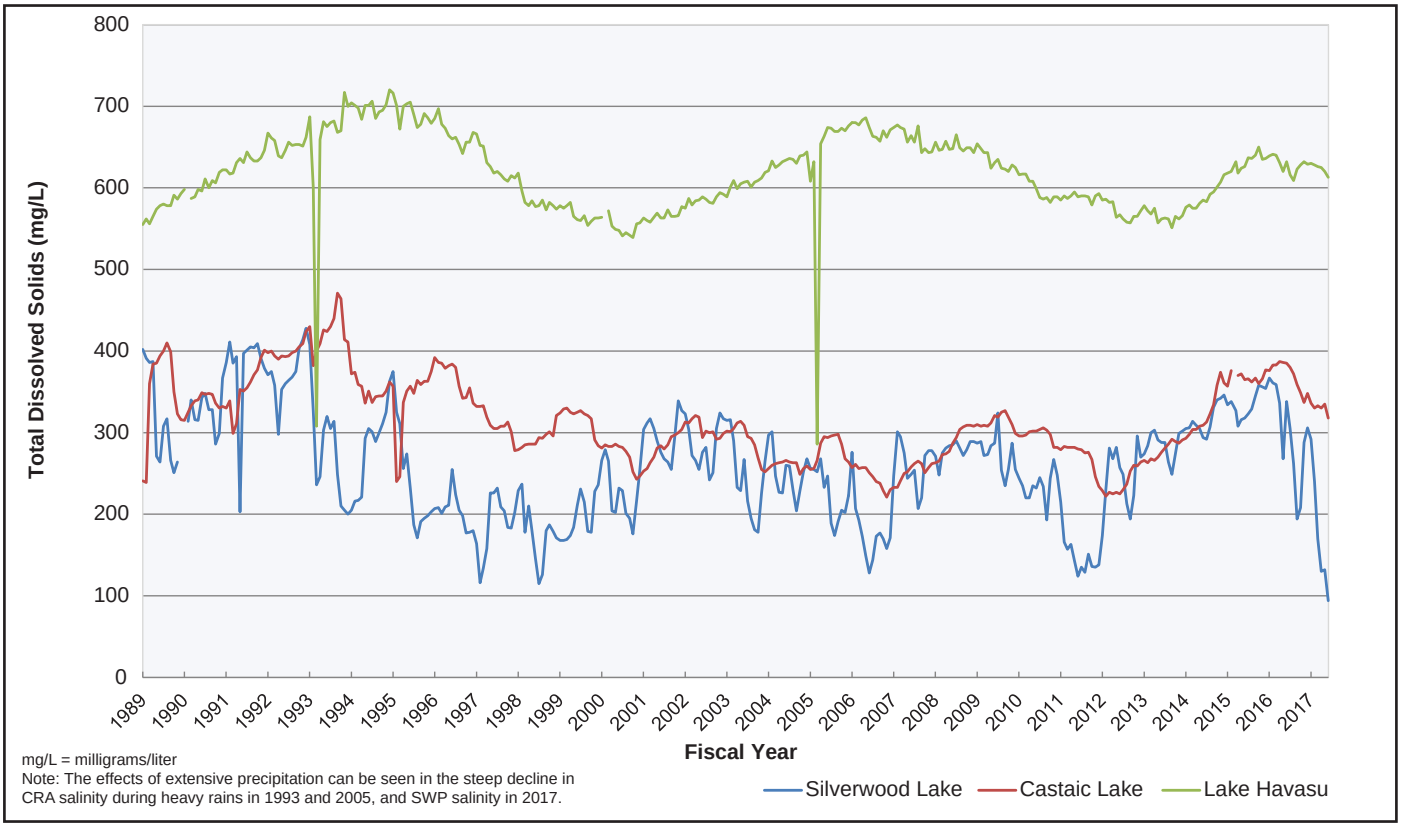



*Figure 4-1. Total Dissolved Solids in East Branch State Water Project (Silverwood Lake), West Branch State Water Project (Castaic Lake), and Colorado River Aqueduct (Lake Havasu), 1989 to 2017*

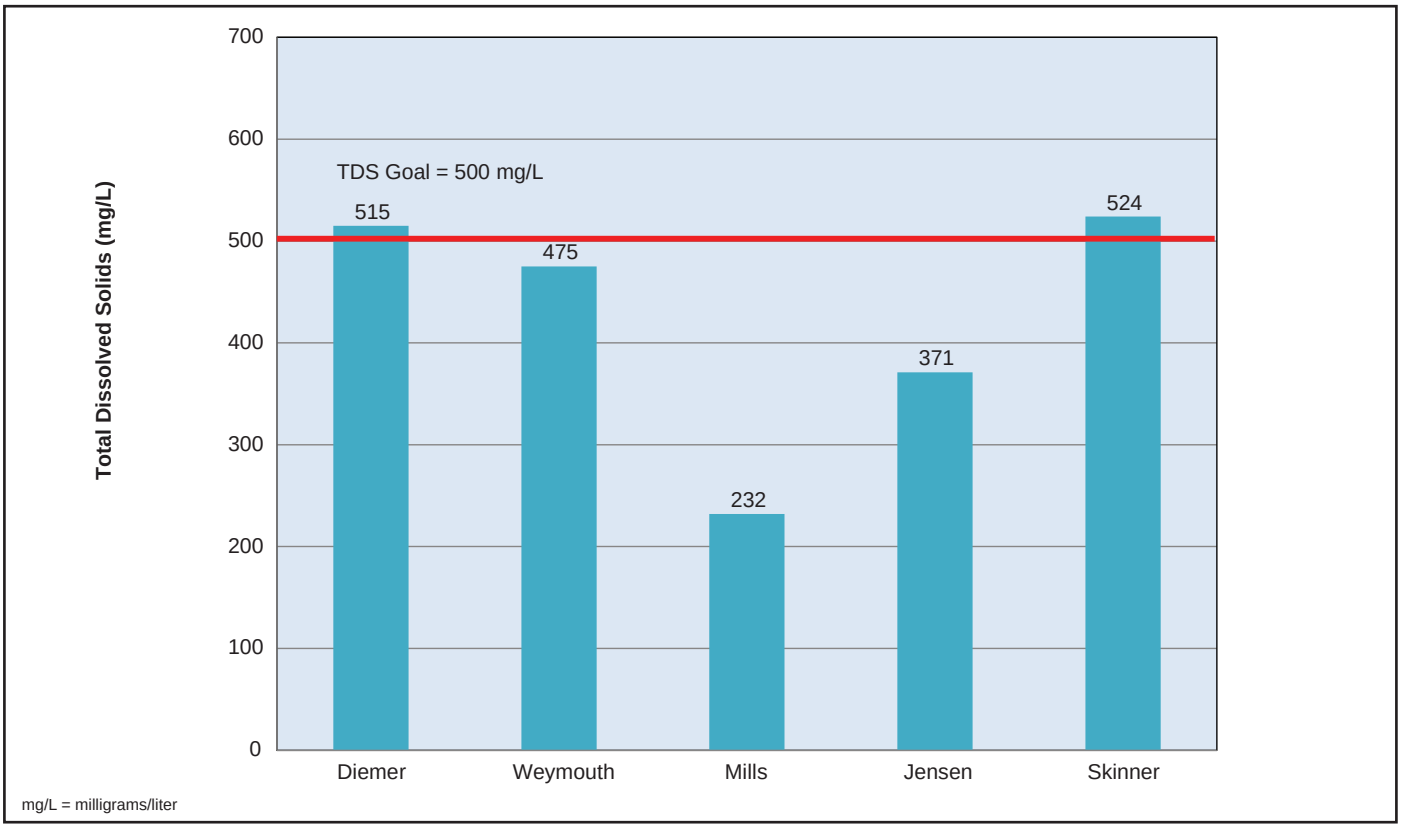



*Figure 4-2. Total Dissolved Solids (TDS) in Plant Effluent, Annual Flow-Weighted Averages, FY 2016/17*

**TABLE 4-5**
**DISINFECTION BYPRODUCT CONCENTRATIONS**
**IN PLANT EFFLUENT**

Fiscal Year 2016/17 (in µg/L)

| | **TTHMs** MCL = 80 | | **HAA5** MCL = 60 | | **Bromate** MCL = 10 | |
|---|---|---|---|---|---|---|
| **Plant Effluent** | **Range** | **Annual Average** | **Range** | **Annual Average** | **Range** | **Annual Average** |
| Diemer | 11–26 | 19 | ND–5.2 | 4.2 | 0.4–3.4 | 2.3 |
| Jensen | 13–20 | 18 | 2.7–6.4 | 4.8 | 6.5–7.8 | 7.4 |
| Mills | 22–33 | 27 | 4–11 | 7.7 | 1.2–3.5 | 2.6 |
| Skinner | 14–19 | 17 | 1.6–8.8 | 4.8 | 2.3–5.8 | 3.9 |
| Weymouth | 26–45 | 36 | 7.4–22 | 14 | NA | NA |
| **Distribution System** | **Range** | **LRAA** | **Range** | **LRAA** | **Range** | **LRAA** |
| | 15–61 | 18–44 | 1.9–26 | 4.4–17 | NA | NA |

µg/L - micrograms per liter

TTHMs = total trihalomethanes

HAA5 = five regulated haloacetic acids

MCL - Maximum Contaminant Level

NA - Not analyzed

ND - Not detected

LRAA - Locational Running Annual Average

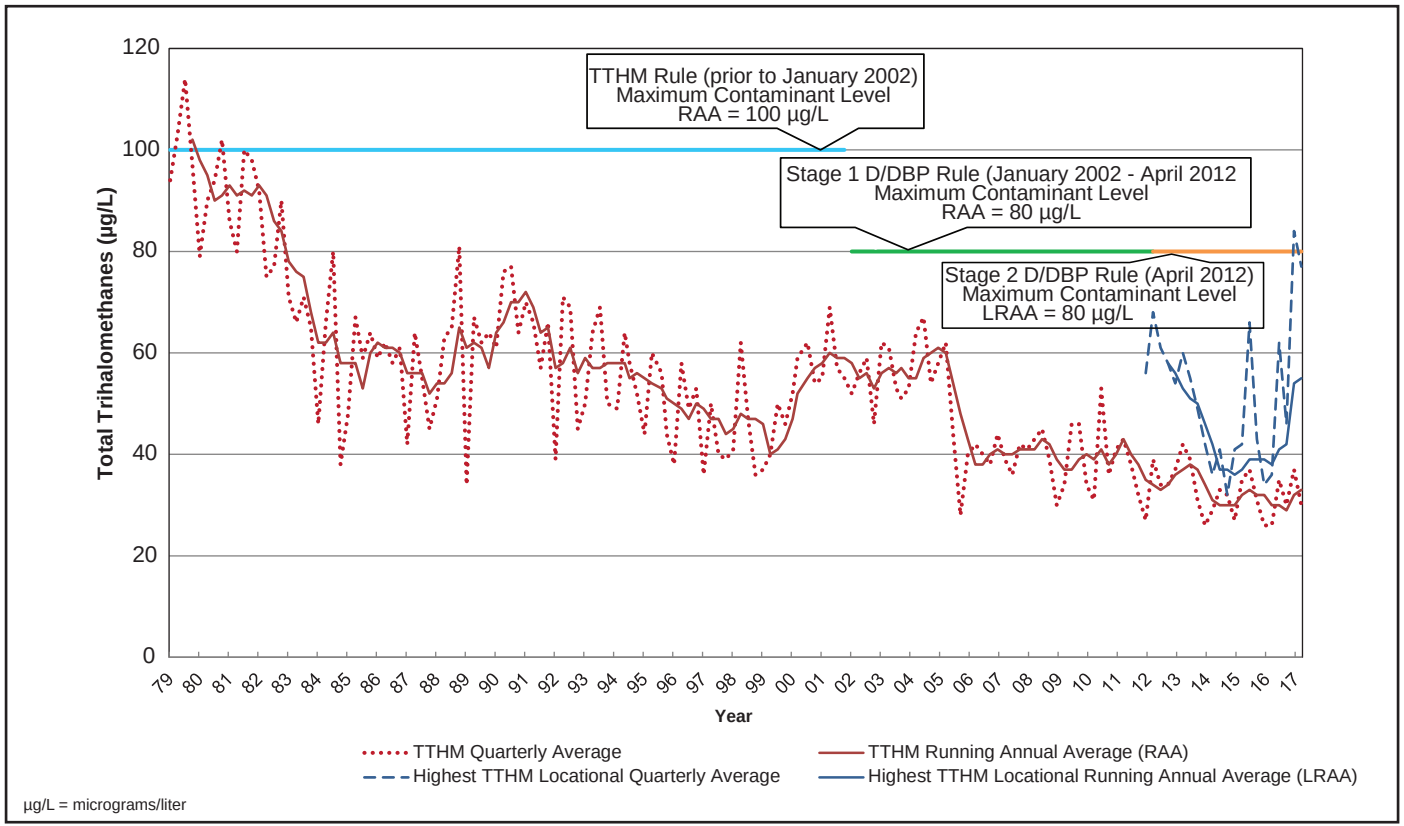



*Figure 4-3. Total Trihalomethane (TTHM) Levels Throughout the Distribution System, Quarterly and Running Annual Averages 1979 to 2017*

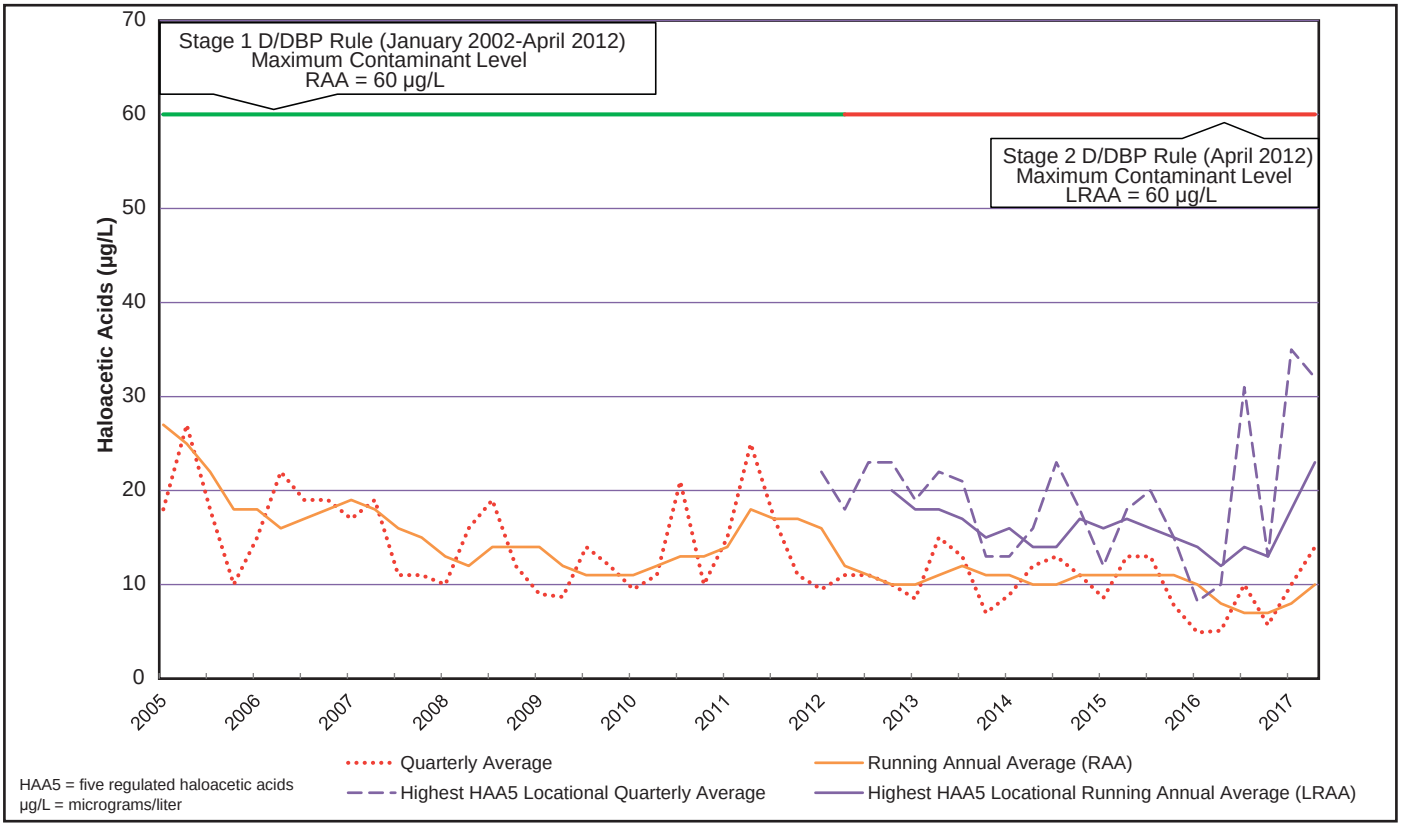



*Figure 4-4. Haloacetic Acids Throughout the Distribution System, Quarterly and Running Annual Averages, 2005 to 2017*

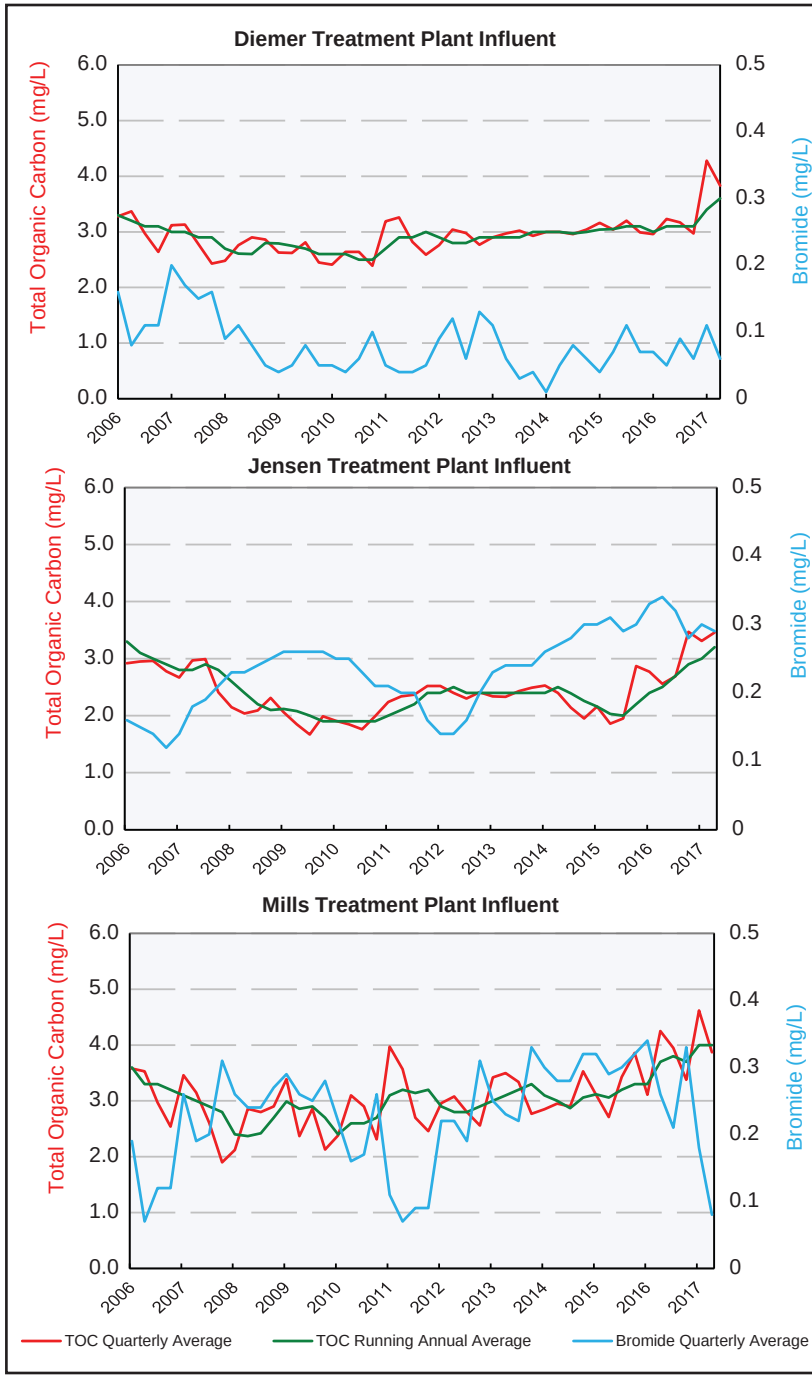



*Figure 4-5. Total Organic Carbon (TOC) and Bromide Levels in Treatment Plant Influent, 2006 to 2017*

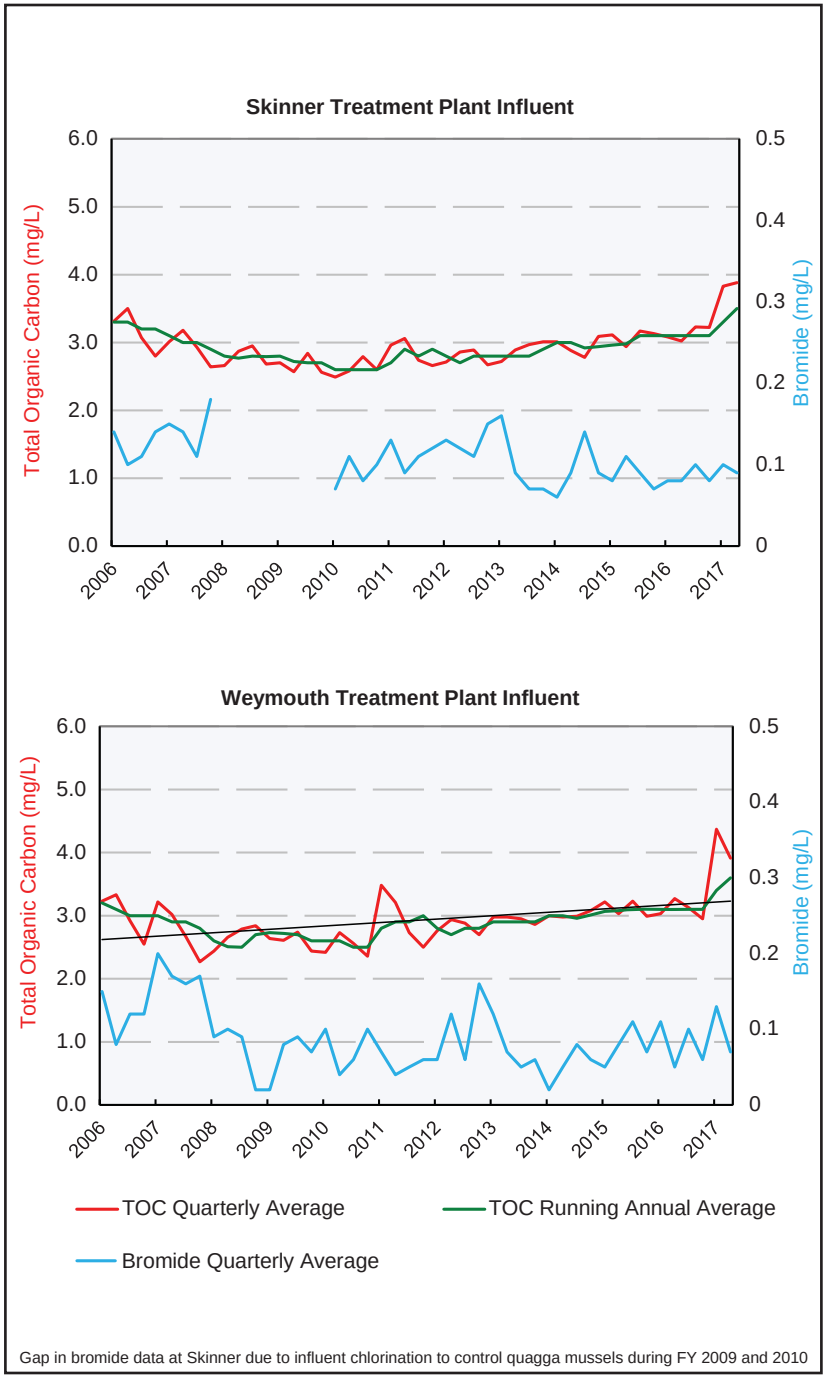



*Figure 4-5 (continued). Total Organic Carbon (TOC) and Bromide Levels in Treatment Plant Influent, 2006 to 2017*

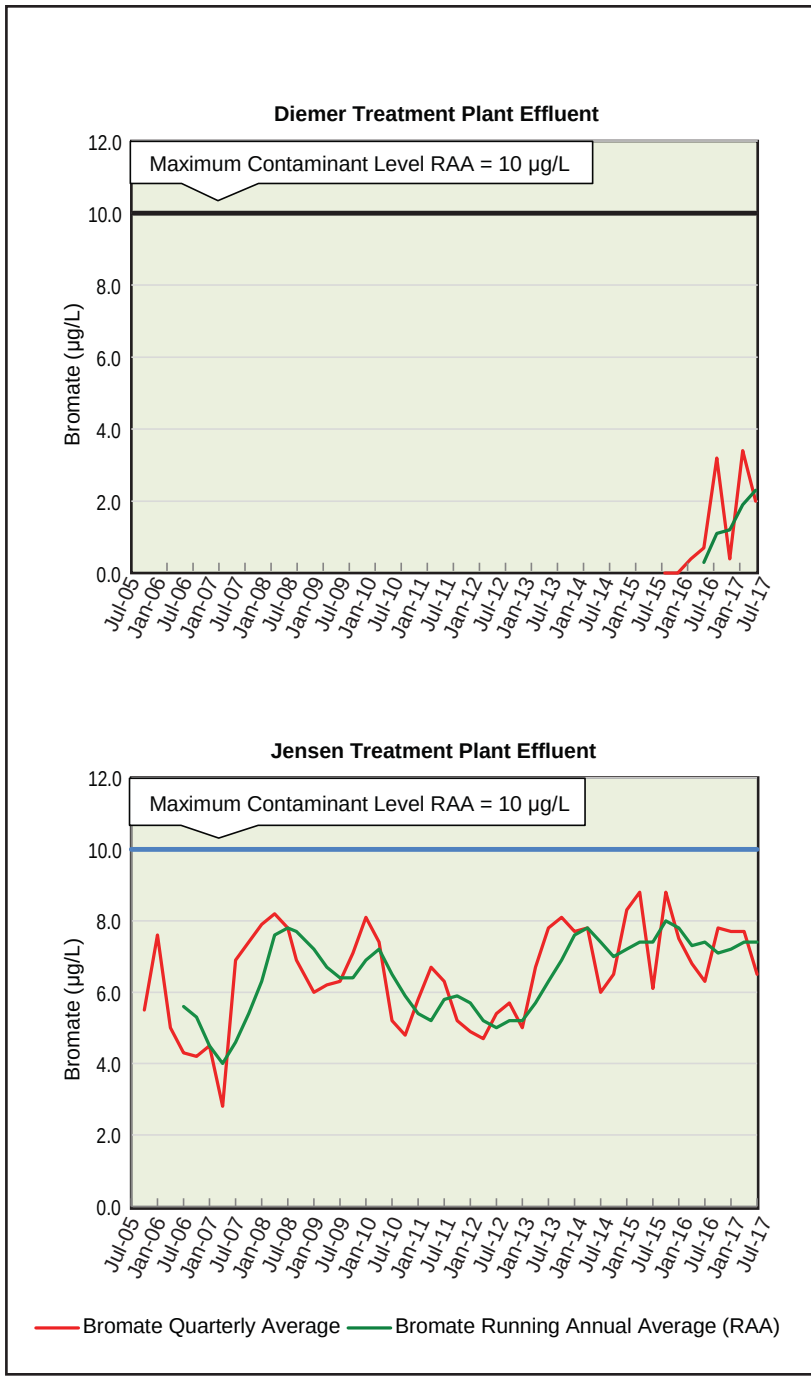



*Figure 4-6. Bromate Levels in Treatment Plant Effluent, 2005 to 2017 (Jensen, Skinner, and Diemer Ozone came online in 2005, 2010, and 2015, respectively)*

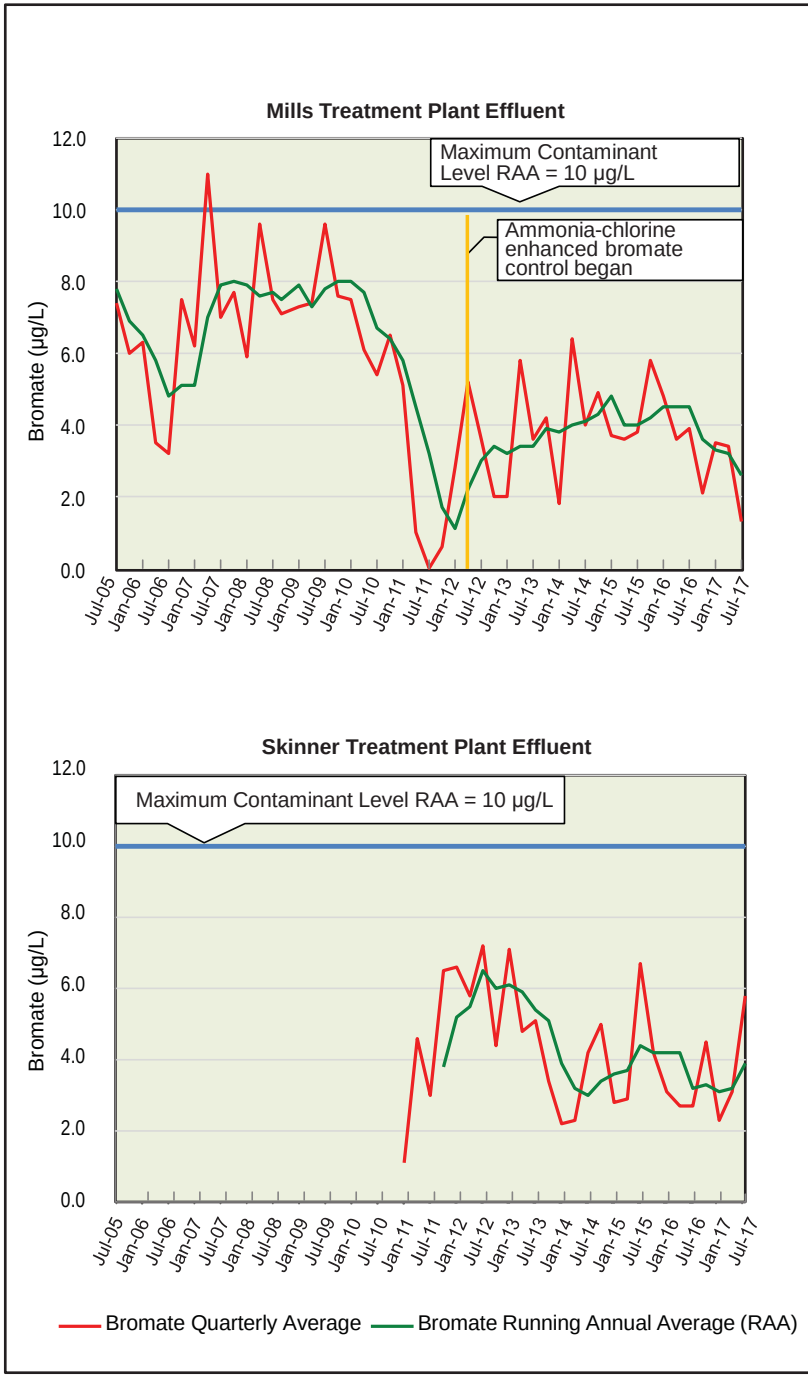



*Figure 4-6 (continued). Bromate Levels in Treatment Plant Effluent, 2005 to 2017 (Jensen, Skinner, and Diemer Ozone came online in 2005, 2010, and 2015, respectively)*

*Microbiological*

Metropolitan complied with state and federal drinking water regulations by monitoring treatment plant influents for total coliforms and Escherichia coli (Table 4-6). Coliforms are bacteria that naturally occur in the environment while *E. coli*, a coliform that may indicate fecal contamination, is a factor used in measuring the quality of influent water. The different ranges observed at the plants—from below 100 to tens of thousands—may be influenced by the natural variability of raw water coliforms, storm events, changes in source water, or other factors.

Metropolitan also analyzed nearly 8,000 bacteriological compliance samples in the distribution system to monitor the microbial quality downstream of the water treatment plants. The monthly average of 0.07 percent total coliform-positive samples was well below the regulatory standard of 5.0 percent.

**TABLE 4-6**
**RAW WATER COLIFORM RESULTS**
Fiscal Year 2016/17

| | Treatment Plant Influent[1] | | | | |
|---|---|---|---|---|---|
| | **Diemer** | **Jensen** | **Mills** | **Skinner** | **Weymouth** |
| | **(CFU/100 mL)** | | | | |
| Total Coliforms | | | | | |
| Range | 43-42,000 | 30-2,600 | 110-6,800 | 97-4,000 | 23-28,000 |
| Average[2] | 4,600 | 640 | 1,900 | 1,200 | 4,100 |
| E. coli | | | | | |
| Range | ND-7 | ND-1 | ND-6 | 1-11 | ND-8 |
| Average[2] | 2 | ND | 2 | 3 | 2 |

Notes:
[1] Samples were collected weekly and analyzed by membrane filtration.
[2] Annual average of monthly averages.
CFU/100 mL = Colony-forming units per 100 milliliters
ND = Not Detected; method detection limit is 1 CFU/100 mL.

Metropolitan tests all five treatment plant influent and effluent sites monthly for the protozoan parasites *Cryptosporidium* and *Giardia*. During the fiscal year 2016/17, *Giardia* was detected in one treatment plant influent sample, at a concentration of 1 cyst per 10 liters. In the last 16 years of monitoring, less than one percent of monthly plant influent samples tested positive for either microbe, and all treated water samples were negative.

***System Management Monitoring***

*Cyanobacteria and Algae Control Program*

Staff analyzed more than 2,900 samples for the earthy/musty taste-and-odor compounds MIB (2-methylisoborneol) and geosmin to monitor and manage T&O events in Metropolitan's source water (Fig. 4-7). Half of the samples were used to evaluate T&O problems caused by cyanobacteria in the State Water Project. This reflects the high cyanobacterial production potential of SWP supplies, which resulted in the California Department of Water Resources treating their lakes several times during the year. Metropolitan treated Lake Skinner five times during the year with a total of 33 tons of copper sulfate. No treatments were conducted on Lake Mathews or Diamond Valley Lake during the current reporting period. (Figure 4-8).

The U.S. Environmental Protection Agency published non-enforceable health advisories for cyanobacterial toxins (cyanotoxins) in drinking water in 2015, and many states, including California, have developed guidelines for recreational water. During FY 2016/17, DWR posted warning and cautionary notices at Pyramid, Castaic, and Silverwood lakes, closing the swim beaches and sometimes the entire lake to bathers and swimmers. However, water delivered to Metropolitan's treatment plants is withdrawn from the deeper parts of the lakes away from the recreational areas, and is usually not impacted by the relatively high concentrations of cyanotoxins that initiate the recreational warnings. Metropolitan has an active monitoring program for cyanotoxins and continues to research and optimize control methods to ensure the safety of its treated water. Ozone, which is Metropolitan's primary disinfectant at four of the treatment plants (all five plants by the end of 2017), is very effective at inactivating cyanotoxins in drinking water supplies.

*Quagga Mussel Control Program*

With the discovery of invasive quagga mussels in the SWP for the first time during FY 2016/17, Metropolitan has intensified its monitoring program and is developing potential control strategies for SWP facilities, in case of confirmed detections and subsequent imposition of regulatory restrictions. Metropolitan's program for monitoring and controlling quagga mussels has been in effect since their detection in the Lower Colorado River in 2007. Quagga control

strategies in the CRA system include chlorination at strategic sites along with desiccation and removal of mussels during shutdowns. Mussel populations in the CRA continue to show seasonal fluctuations but the control measures have successfully limited further population increases. In December 2016, however, a few adult quagga mussels were found in DWR's Angeles Tunnel that connects Pyramid Lake to Castaic Lake on the west branch of the SWP. A few weeks later, suspect but unconfirmed quagga mussel larvae (veligers) were found at two locations downstream of Silverwood Lake. Since the larvae were not confirmed, state regulations on control of invasive mussels weren't triggered. Therefore, as of June 2017, there are no regulatory restrictions on the movement and use of raw water from the Santa Ana Valley and Rialto pipelines and the Inland Feeder, which deliver water from Silverwood Lake on the east branch of the SWP.

### *N-Nitrosodimethylamine*

Since 1999, Metropolitan has monitored its distribution system for NDMA (N-nitrosodimethylamine), a byproduct of the disinfection process that occurs during chloramination. Table 4-7 shows NDMA levels in the distribution system for FY 2016/17. The concentrations were all below the notification level of 10 nanograms per liter (ng/L) established in 2002.

**TABLE 4-7**
**N-NITROSODIMETHYLAMINE LEVELS**
**IN THE DISTRIBUTION SYSTEM**
Fiscal Year 2016/17 [in nanograms per liter (ng/L) or parts per trillion]

| Sample Location[1] | Range[2] |
|---|---|
| Diemer Plant | ND-2 |
| Jensen Plant | 2-3 |
| Mills Plant | ND-4 |
| Skinner Plant | 3 |
| Weymouth Plant | ND |
| Central Pool Sites[3] | ND-5 |

ND - Not Detected; NDMA reporting level is 2 ng/L.
[1] Plant locations are distribution system sites associated with each treatment plant.
[2] SWRCB-DDW notification level is 10 ng/L
[3] Sample locations in the distribution system that can receive water from multiple plants

# *Source Water Protection*

### *Watershed Management and Protection*

Metropolitan continued its oversight and coordination on water quality issues with key Colorado River stakeholders through active participation in the Lower Colorado River Water Quality Partnership, Lake Mead Water Quality Forum and Clean Colorado River Sustainability Coalition. Staff also collaborated with DWR and the State Water Contractors on Delta and SWP water quality monitoring and forecasting programs.

Metropolitan completed the 2015 Update of the Colorado River Watershed Sanitary Survey and submitted it to Division of Drinking Water in December 2016. Metropolitan and other State Water Contractors also prepared the 2016 Update of the SWP Watershed Sanitary Survey for submission to DDW in July 2017. These sanitary surveys identify potential sources of watershed contamination, analyze water quality data, assess effects on treatment, and recommend strategies to protect source waters.

### *Salinity Control*

Metropolitan continued to engage in salinity control efforts through the Colorado River Basin Salinity Control Forum to mitigate salt loading into the Colorado River. Metropolitan also continued to work with the federal Bureau of Reclamation and the Southern California Salinity Coalition on technical studies to update the 1999 Salinity Management Study that estimated economic damages from salinity. Metropolitan updated water supply and water usage information in the salinity economic impact model used to conduct an economic damage assessment for the forum's 2017 Triennial Review. Metropolitan also coordinated with USBR and the forum to restructure the economic impact model to facilitate future uses and validate the current model. A comprehensive model update is anticipated to begin in 2018.

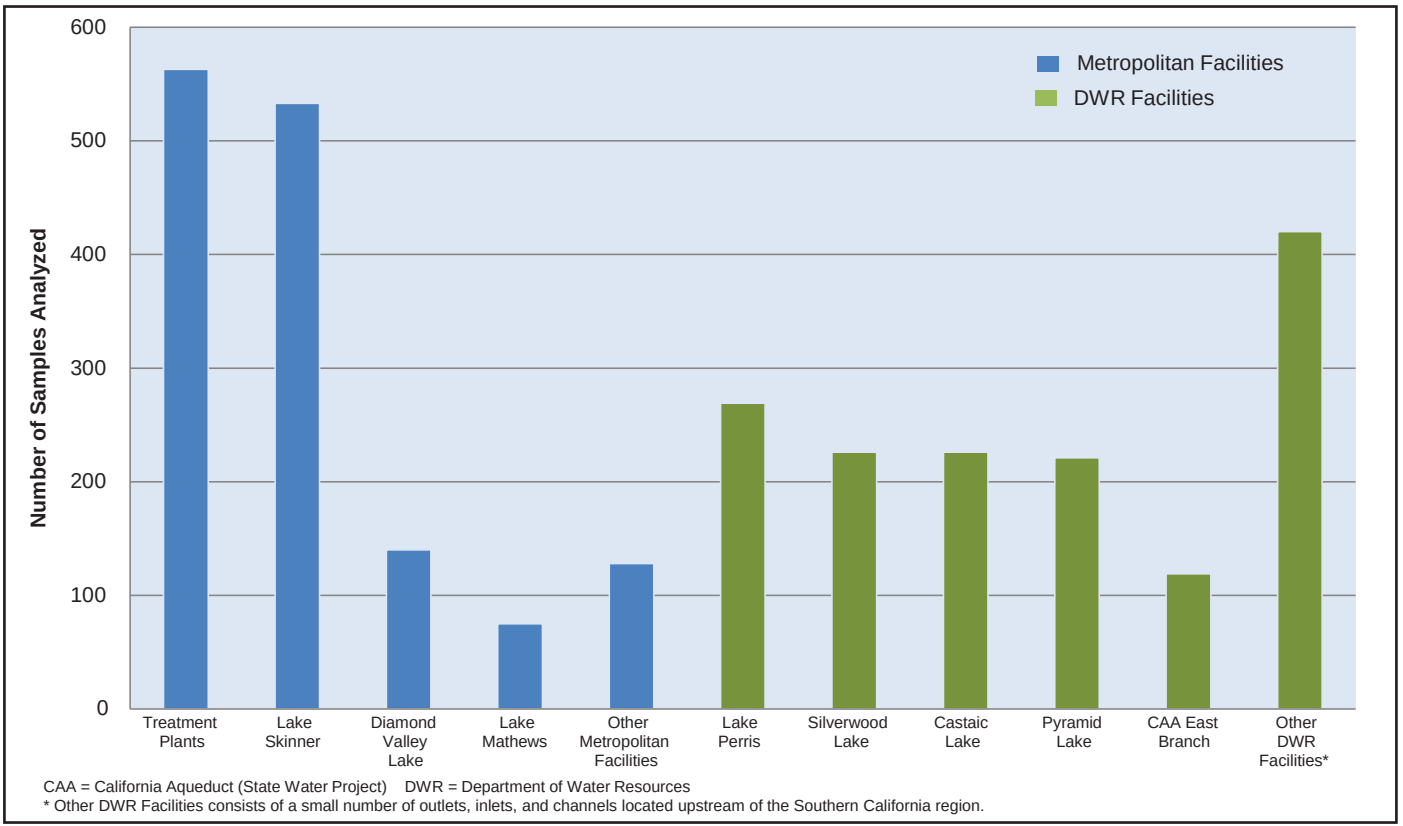



*Figure 4-7. Number of Samples Analyzed for the Taste-and-Odor Compounds 2-Methylisoborneol (MIB) and Geosmin in Source and Treated Water, FY 2016/17*

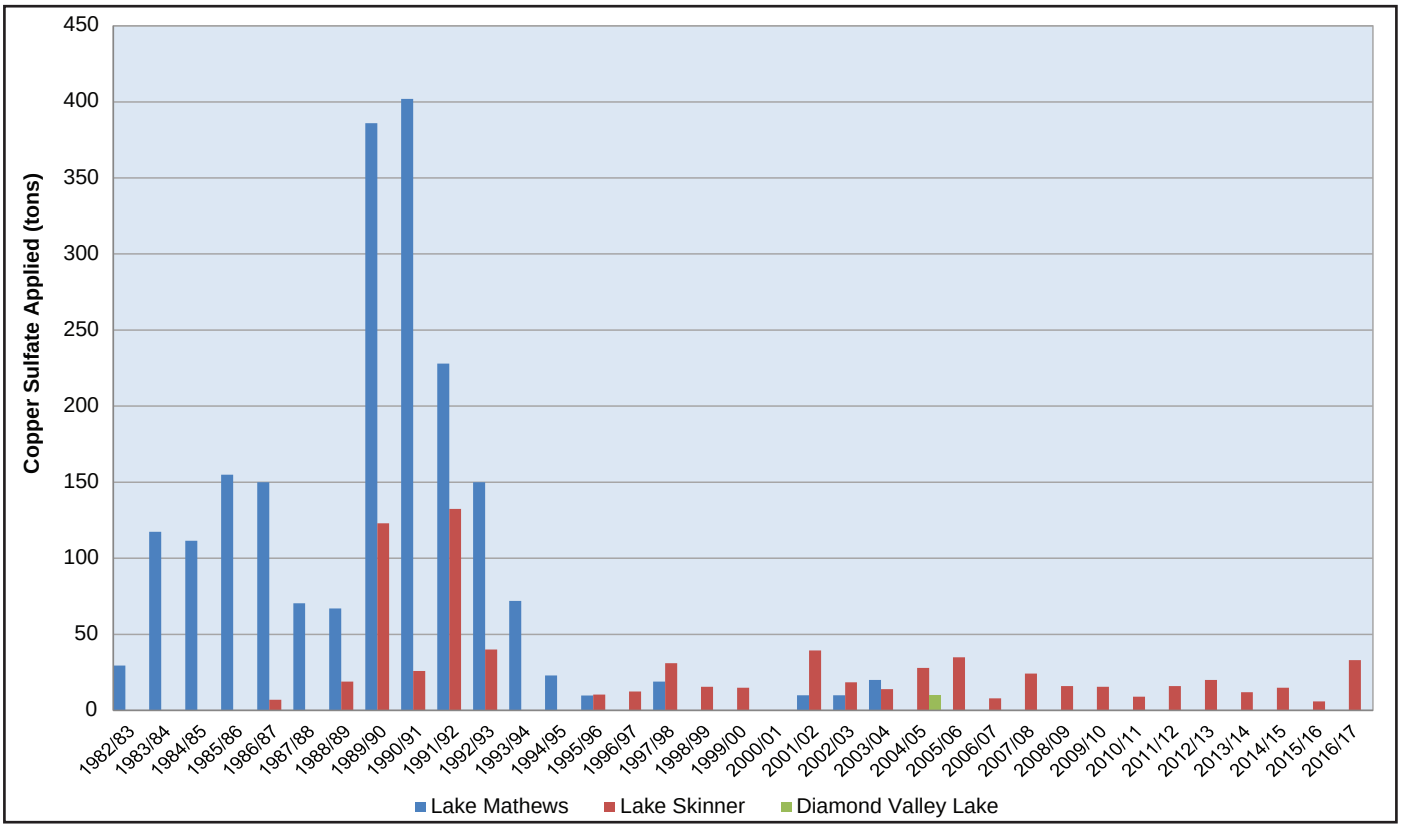



*Figure 4-8. Copper Sulfate Usage in Metropolitan's Reservoirs, FY 1982/83 to 2016/17*

### *Uranium Mill Tailings Cleanup*

Metropolitan continued to monitor remedial efforts and advocate for increased funding to expedite removal of the uranium mill tailings pile along the banks of the Colorado River near Moab, Utah. Since 2009, the U.S. Department of Energy has shipped over 7 million tons of mill tailings via rail to an engineered disposal site approximately 30 miles northwest of Moab. With revised figures showing the DOE less than halfway toward removing the 16 million-ton pile, Metropolitan sent a letter to the Secretary of Energy and the California, Arizona and Utah congressional delegations in June 2017 advocating for increased fiscal year 2017/18 funding to expedite cleanup and meet the targeted completion date of 2025.

### *Chromium 6 Remediation*

Metropolitan continued working with stakeholders to support Pacific Gas & Electric's chromium 6 groundwater remediation efforts along the Colorado River near Topock, Arizona. Metropolitan provided comments on the final design for the selected groundwater treatment remedy involving biological treatment within the groundwater basin, the groundwater model used to measure effectiveness of the final remedy, and the subsequent Environmental Impact Report. Metropolitan also provided a presentation to Topock stakeholders on Colorado River water quality and emphasized the importance of expeditiously implementing the groundwater remedy to ensure protection of Colorado River supplies.

Approval of the final design and certification of the Subsequent Environmental Impact Report is anticipated in fall 2017. Construction is expected to be completed in 2022, followed by operation of the treatment system for an estimated 30 years. Interim measures, consisting of groundwater extraction and treatment, have been in place since 2004 to prevent chromium 6 migration to the Colorado River. Levels of chromium 6 in the river typically remain at non-detect levels (less than three parts per billion).

### *Perchlorate Remediation*

Perchlorate loading into the Las Vegas Wash has dropped more than 90 percent since 1998 as a result of remediation at the former

Tronox, Inc. site, now owned by the Nevada Environmental Response Trust (Figure 4-9). Levels have consistently remained below 2 ppb at Metropolitan's Lake Havasu intake (Figure 4-10).

The trust is currently conducting remedial investigations for long-term soil and groundwater cleanup. Metropolitan continued to monitor performance of the current groundwater remediation system and the development of the long-term treatment remedy for the perchlorate plume. Staff reviewed and commented on remedial documents, participated in stakeholder meetings and technical roundtables, and monitored site operations including disbursement of funds from a $1.1 billion settlement between Tronox and its predecessors for site cleanup. The Nevada Division of Environmental Protection is also conducting a regional investigation of downstream perchlorate-contaminated areas to further reduce loading into the Las Vegas Wash. The remedial plan has a goal to reduce perchlorate loading into the Las Vegas Wash to meet the federal Interim Drinking Water Health Advisory and Preliminary Remediation Goal of 15 ppb. This would further lower perchlorate levels in the Colorado River and help ensure compliance with any potential reduction in California's perchlorate MCL of 6 ppb in light of a 1 ppb public health goal adopted in February 2015.

# *Technology Assessment*

### ***Treatment Process Optimization and Development***

Staff conducted pilot testing of an alternative coagulant while investigating future options for reducing potential formation of NDMA through the water treatment process. Staff continued laboratory studies to treat cyanotoxins using ozone, and investigations to improve and optimize ozone and biofiltration operations at Metropolitan's water treatment plants. Staff conducted a review of the existing domestic water systems at the CRA pumping plants, evaluated technology alternatives, and developed process design criteria for replacement systems. Staff also completed an extensive update of the Operations, Maintenance, and Monitoring Plan for the Weymouth plant. The Operations Plan is required by the Division of Drinking Water for the permit on how Weymouth staff operates, monitors and maintains the facility. The Weymouth plant is the last of

Metropolitan's five treatment plants to add disinfection by ozone, which is anticipated to be the primary disinfectant in fall 2017. This will help improve the aesthetics of the water by reducing taste-and-odor compounds and minimizing the formation of disinfection byproducts associated with chlorine disinfection.

***Service to Member Agencies and Drinking Water Industry***

Metropolitan hosted a Member Agency Water Quality Managers meeting in March 2017, and conducted a specialty workshop on the use of chloramine disinfection and nitrification prevention and control in the distribution system. In addition, staff provided an update to member agency general managers on the occurrence, detection, and control of cyanotoxins, as well as an overview of Metropolitan's response plan. Metropolitan also conducted a workshop on invasive quagga mussels in the SWP, with participants from Metropolitan member agencies, the California Department of Fish and Wildlife, DWR, and other utilities that use water from the SWP.

Metropolitan continued its involvement with the industry's principal advocates, most notably the Association of California Water Agencies, American Water Works Association, Association of Metropolitan Water Agencies, and the California Municipal Utilities Association. These organizations provided regulatory and legislative input on behalf of Metropolitan and other member agencies on federal, state and local drinking water issues.

**TABLE 4-8**
**ACTIVE WATER QUALITY GRANTS**
Fiscal Year 2016/17

| Prime Funding Agency | Title of Grant Project | Total Project Budget | Amount of Award to MWD |
|---|---|---|---|
| | Several grant proposals were submitted but no new projects were initiated and there were no active grants during FY 2016/17. | | |
| | **TOTALS** | $ – | $ – |

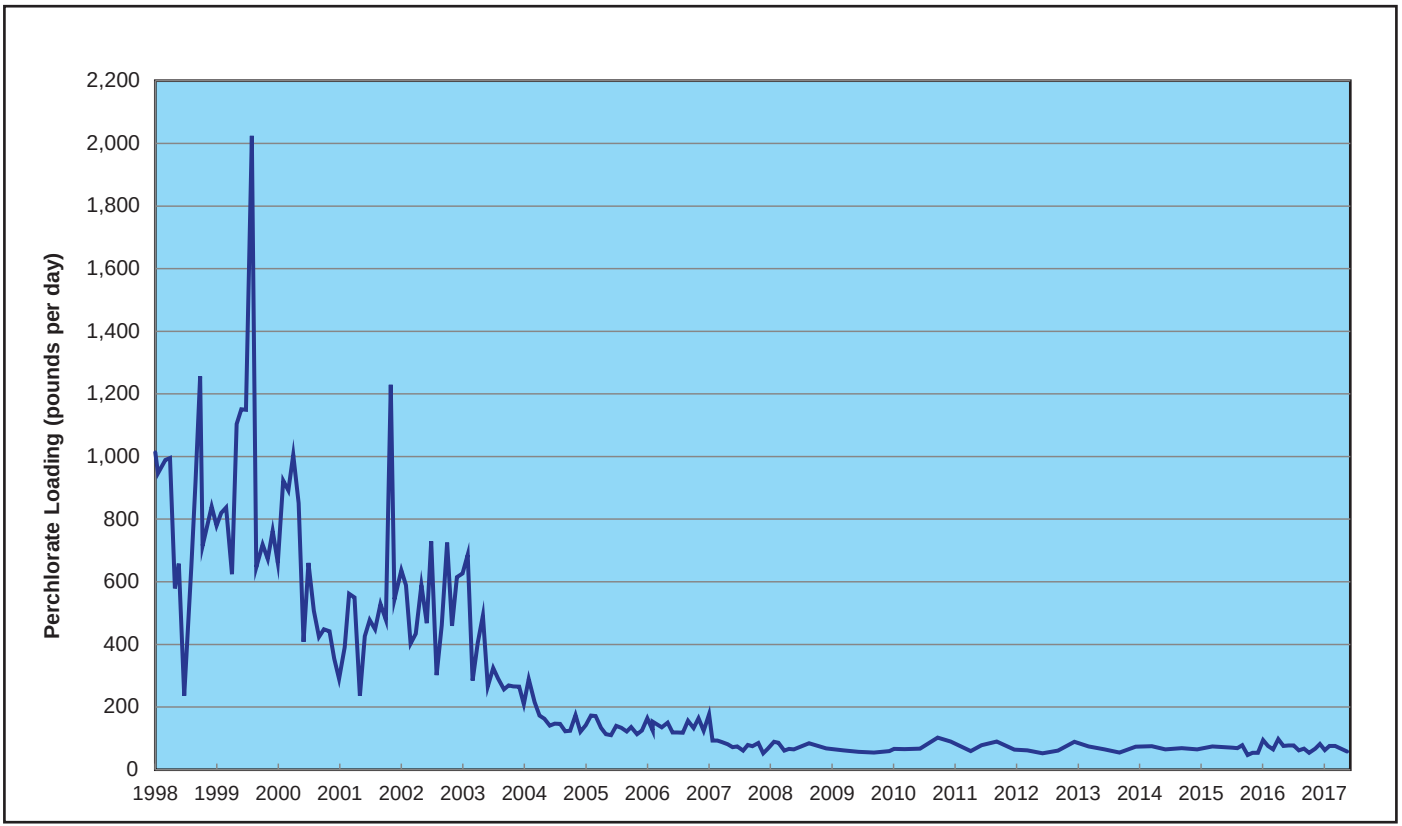



*Figure 4-9. Perchlorate Loading in Las Vegas Wash, half a mile upstream of Lake Mead, 1998 to 2017*

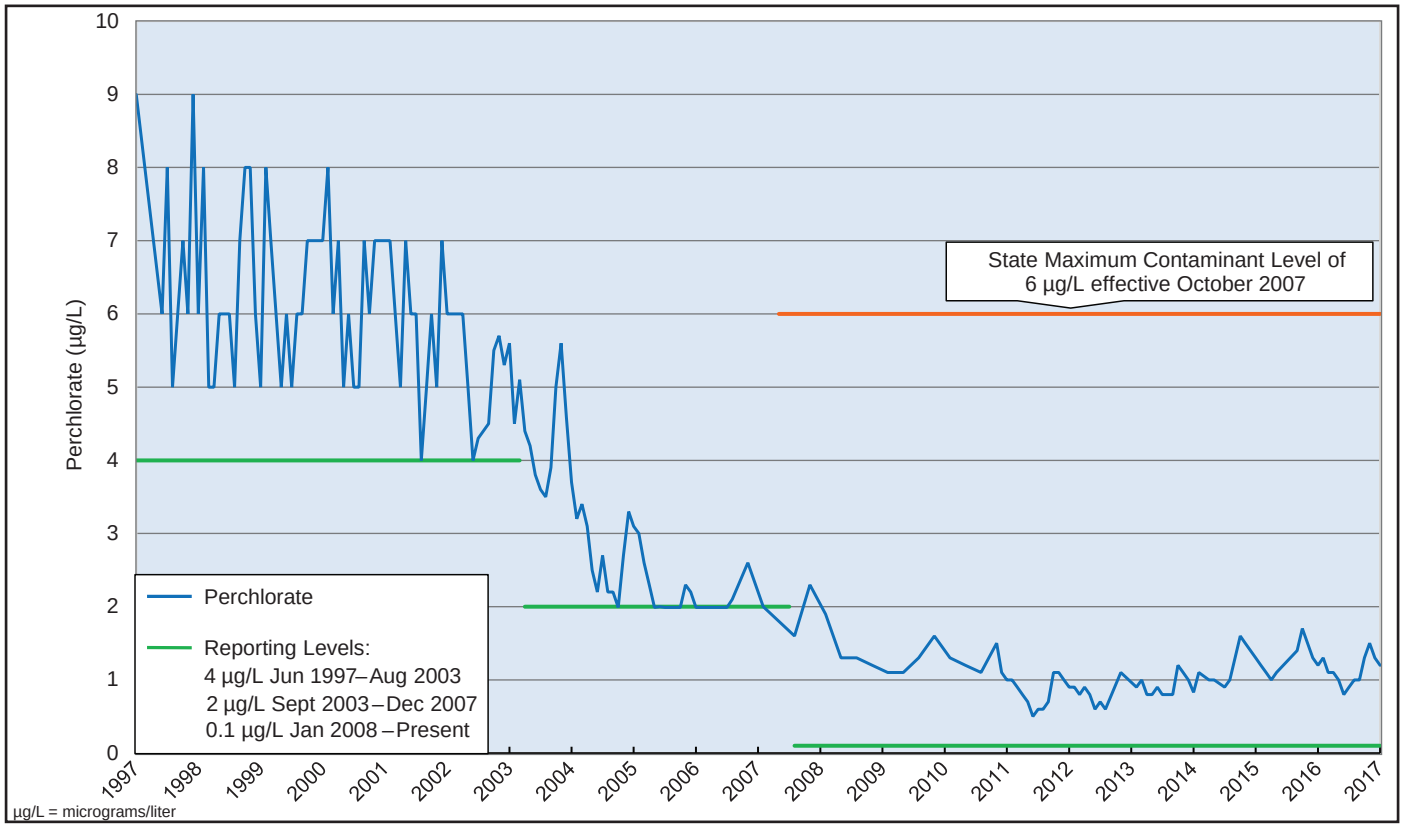



*Figure 4-10. Perchlorate Levels at Lake Havasu, 1997 to 2017*

# *Conveyance, Distribution and Support*

***Conveyance and Distribution***

Water System Operations' Conveyance and Distribution Section performs preventive and corrective maintenance activities throughout the year with the objective of ensuring reliable deliveries to member agencies. In addition, the section plans and performs shutdowns to complete pipeline and facility inspections, performs local repairs on pipelines or equipment, and supports capital improvement program projects. A description of fiscal year 2016/17 activities follows:

Staff successfully completed shutdowns on the CRA and pipelines throughout Metropolitan's service area. Using visual inspections and eddy-current inspection technology, staff inspected approximately 26 miles of pipeline to assess the condition of steel mortar-lined and pre-stressed concrete cylinder pipe. Electromagnetic inspections revealed excessive wire breaks on 80 feet of PCCP on the Sepulveda Feeder that required urgent repairs. Completed over a 2-week period, the repairs involved the insertion of steel reinforcement sleeves where the PCCP had become weakened. Operational flexibility within the distribution system allowed this work to be completed without affecting member agency deliveries.

Throughout FY 2016/17, WSO maintained an eight-pump flow capability on the Colorado River Aqueduct. To ensure consistent operation and reliability, refurbishment work took place during a 24-day shutdown of the CRA. Work performed included survey and engineering inspections of the San Andreas Siphon, Big Morongo Siphon, and other areas along the CRA; seismic upgrades; sand trap improvements to prevent abrasive sediment from flowing into the pump units; Copper Basin storage tank inspections; installation of isolation valves and lateral lines; and repairs and testing of high-voltage equipment. No tunnel cleaning was performed during this shutdown, due to the low likelihood of high CRA flows in calendar year 2017.

Although quite rare, one leak was detected in Metropolitan's distribution system this year. During the CRA shutdown, staff installed 15 new internal seals and adjusted three existing seals in the Casa

Loma Siphon No. 1 pipeline to address this small leak. This section of the CRA is located in the city of San Jacinto. In late 2016, staff identified a leak that was small enough to allow repairs to be deferred until the scheduled CRA shutdown, instead of shutting down the CRA at the time the leak was found. Inspection of previously installed seals revealed that they were in good condition, needing only minor adjustments to ensure continued reliability.

The Coatings Program protects Metropolitan's physical assets from corrosion and harsh environments to maximize the useful life of pumps, valves, meters, pipes, buildings and delivery lines. When not focusing on 2016/17 shutdown activities, staff coated 820 pieces of equipment and structures. Structures that are particularly vulnerable to water damage—such as vaults located below road grade—were sealed to prevent water intrusion that accelerates corrosion.

During FY 2016/17, crews performed nearly 228,000 hours of maintenance on conveyance and distribution infrastructure, including shutdowns. See Table 1-5 for a full list of shutdowns that occurred during the year.

### *Operations Support Services*

Operations Support Services provides a wide range of support services to Metropolitan's core operational functions and, on a reimbursable contract basis, to the Department of Water Resources, member agencies and other public entities. Services include maintenance engineering, manufacturing, rehabilitation, new construction and emergency response.

#### *Manufacturing Services*

Manufacturing services provided by the La Verne shops include fabrication, machining and coating services, repairing and testing of valves and pumps, refurbishing equipment, diving inspections, floating reservoir cover maintenance, as well as crane maintenance and annual certification.

As part of the Colorado River Aqueduct Whitewater Flow Augmentation Project, the La Verne shops manufactured three 16-foot-long stainless steel gate guides and a 16-by-16-foot weir gate.

Installing the weir gate and gate guides in the Whitewater siphon transition structure enabled the delivery of a record amount of Colorado River water to groundwater storage programs being operated under an existing agreement with Desert Water Agency and Coachella Valley Water District.

Using a reimbursable agreement, the La Verne shops provided support for DWR's SWP facilities. The shops manufactured new pump components for the Gianelli Pump/Generating Plant Unit No. 3. The shops also fabricated two 12-by-10-foot steel trash gates for Oso Pumping Plant. The new gates replaced two existing ones which had extensive corrosion damage from many years of service.

The La Verne shops also maintained Metropolitan's infrastructure by fabricating 92-inch diameter steel liner pipe for urgent PCCP repair work on the Sepulveda Feeder. Use of Metropolitan's pipe fabrication facility at La Verne expedited the repairs and was less costly than other potential sources for the pipe.

*Construction Services*

Construction Services staff and equipment are deployed throughout Metropolitan's service area to perform general construction, install and transport large equipment, maintain pipeline easements and access roads, support shutdown activities and respond to emergency construction needs.

Staff installed a new 16-inch-diameter potable water and fire line as part of the Weymouth plant upgrades to support the ozone facilities. Staff also completed electrical improvements which will connect to the newly constructed bromate tank farm at the Weymouth plant.

In February 2017, staff constructed a new 24-inch blow off structure along the Orange County feeder that will provide safer access to the pipeline and reduce the amount of discharge water required during future shutdowns. In March 2017, staff installed a new acoustic meter at the LA-29 meter structure on the Sepulveda Feeder.

During heavy rainstorms in early 2017, Metropolitan's patrol roads suffered major erosion damage. Staff surveyed the damaged areas throughout the distribution system and made several repairs and

improvements to reestablish the existing patrol roads and mitigate future storm impacts.

*Power Equipment and Reliability*

The Power Equipment and Reliability staff evaluates maintenance and reliability engineering issues, and maintains hydroelectric power plants, high voltage systems, and HVAC (heating, ventilation, and air conditioning) systems throughout Metropolitan's facilities. Staff also performs technical investigations related to water billing meters.

The North American Electric Reliability Corporation sets reliability standards for owners of large electric transmission systems. The CRA's 230-kilovolt electrical transmission system, a key part of the Metropolitan system, was maintained by staff in compliance with the applicable reliability standards. Staff supported compliance activities required for Metropolitan's power operations, which included implementing recommendations from Southern California Edison-MWD annual transmission reliability assessments, successfully achieving self-certification for 2016, and supporting the Critical Infrastructure Protection cybersecurity training program.

Staff completed quarterly inspections at all 16 hydroelectric plants, including transformer and equipment oil testing, as part of its predictive maintenance program. At the OC-88 pump station, staff refurbished two of the older 12 kV transformers. Transformers are part of the high voltage transmission system into the plant that convert higher voltage power (12 kV) from Southern California Edison to a lower voltage (900 V) that the pumps can utilize for operation. Staff refurbished these transformers after testing and inspections indicated signs of degradation. Staff also completed 2-year maintenance work at Lake Mathews, Foothill, and Rio Hondo hydroelectric power plants. Six-year maintenance and high voltage testing work were completed at Etiwanda, Perris, Corona, and Temescal hydroelectric plants.

Protection relays are critical devices on high voltage systems that shut off power and protect equipment when a malfunction is detected. Two-year testing and calibration of these devices were completed at San Dimas, Foothill, Coyote Creek, Red Mountain, Corona, Temescal, Lake Mathews, Etiwanda, and Sepulveda hydroelectric power plants. Five-year high voltage electrical testing and maintenance work were

completed on the main switchgear at the Skinner, Diemer and Mills plants as well as the Wadsworth pumping plant switchyard at Diamond Valley Lake.

Staff continued to implement improvements in the infrastructure reliability of district facilities. This year maintenance staff completed the initial roll-out of condition-based maintenance practices at all treatment plants. These practices allow Metropolitan staff to diagnose impending equipment problems using diagnostic equipment and tools. Initially staff focused on vertical and horizontal pumps at the treatment plants. The effort will continue in the conveyance and distribution system. This is a multi-year effort that will incorporate other types of equipment over time, such as emergency generators and motors.

*Fleet Services*

WSO's fleet personnel assess, procure, and maintain more than 1,400 mobile assets, as well as approximately 570 facility assets. In FY 2016/17, staff completed some 5,900 preventive maintenance work orders and 2,900 corrective work orders on district equipment and strategically replaced aging vehicles and equipment while meeting air quality regulations.

## *Security and Emergency Management*

Protecting critical infrastructure and safeguarding people and assets are primary Metropolitan objectives. Security professionals provide 24/7 security monitoring and response working with a contracted guard force and a physical security system that protects 72 facilities with more than 1,000 monitoring points, which include card readers, door alarms, motion detectors, and closed-circuit cameras.

Security has been implementing the Security Action Plan developed in 2016. A number of immediate security enhancements have been developed and implemented as a result, including personal security awareness training to over 1,600 employees and the Board of Directors, in an effort to increase employee safety and awareness in response to an increase in workplace violence events nationwide.

Security has reduced metal theft incidents districtwide from over 15 occurrences in 2015 to zero over the past year. This achievement was made possible by hardening the security of prospective targets for metal theft and closely working with an alliance of utilities, law enforcement and vigilant employees.

Metropolitan has renewed a five-year maintenance agreement for the physical security system and initiated an upgrade project for electronic security surveillance and access control. This upgrade project features encrypted card readers and badges, new computer servers, network controllers, and video management system software.

Security has been working with local, state and federal law enforcement partners to meet its objectives. A partnership has been developed with the California Highway Patrol to assist with security emergencies at any of the pumping plants in the desert. Security has facilitated local law enforcement and emergency response exercises at multiple facilities and has performed threat and vulnerability assessments with the assistance of the Department of Homeland Security. This collaboration provides useful feedback and information that is used to enhance Metropolitan's safety and security.

Metropolitan continues to participate on the Board of Directors for the California Utilities Emergency Association and is a founding member of CUEA, since the start of the organization in 1952. CUEA focuses on improving collaboration among member utilities and ensuring clear lines of communication between those agencies and California's Office of Emergency Services. CUEA brings together utilities throughout the state from the water, wastewater, electric, gas, petroleum pipeline and telecommunication industries.

Staff conducted several meetings with member agencies and other utilities to develop two large emergency exercises in fiscal year 2016/17. Both exercises concentrated on realistic emergency scenarios in the Southern California region. The first simulation focused on responding to credible terrorist threats with an emphasis on interagency coordination. Metropolitan and member agency staff, as well as representatives from local and state emergency management agencies, participated in an advanced tabletop exercise where participants discussed how they would jointly respond to terrorist acts at multiple locations.

The second exercise concentrated on assessing Metropolitan's emergency communication systems, including high-volume message testing of Metropolitan's new two-way radio system, and expanded use of an online emergency information sharing system. All Metropolitan emergency response command centers, and most member agencies, participated in this full-scale exercise. These communications systems allow key Metropolitan facilities and the member agencies to receive information through multiple communication platforms across the service area and share the information quickly during an emergency.

These exercises mark the fourth year of a five-year plan to invite all of Metropolitan's member agencies to collaborate and participate in at least one Metropolitan exercise.

# *Energy Management*

### ***Hydroelectric Power Recovery Plant Operations***

Metropolitan has 16 small-conduit hydroelectric power recovery plants that generated a total of 242 million kilowatt-hours for fiscal year 2016/17 (Table 4-9), and earned revenues of $15.2 million. This was about 105 million kilowatt-hours more generation and $7.7 million more revenue compared to FY 2015/16. The boost in energy production was the result of increased State Water Project resources that allowed the Greg Avenue, Sepulveda Canyon, and Etiwanda hydroelectric generators to come back on-line or significantly increase generation. Generation from all 16 power plants was sold under contractual agreements with Pacific Gas & Electric, Southern California Public Power Authority, Los Angeles Department of Water and Power, and two separate agreements with the Department of Water Resources. The overall contracted price for the energy from Metropolitan's 16 hydroelectric generators averaged approximately $63/megawatt-hour, which is comparable with the value of California certified renewable energy. Metropolitan and the SCPPA negotiated a pricing change in the agreement to sell energy from Metropolitan's Rio Hondo, Coyote Creek, Valley View, and Perris hydroelectric generators. The pricing change was in lieu of SCPPA's request for an early termination of the agreement in 2018 rather than the normal termination date of December 31, 2023, due to the contracted price being significantly higher than what was available

in the renewable energy marketplace. Both parties were provided the option of an early termination under the provisions of the agreement. Metropolitan and SCPPA agreed to modify the price rather than terminate the agreement, effective July 1, 2017 through the end of the contracted term with no further provision for an early termination.

### *Solar Power Energy Production*

Metropolitan has three solar photovoltaic energy facilities. The facility at the Skinner plant is rated at one megawatt, the Diamond Valley Lake Visitor Center facility is rated at 0.52 megawatts, and the newest facility, which came online at the end of June 2016 at the Weymouth plant, has a rating of three megawatts. During fiscal year 2016/17, the Skinner plant produced 2,198 megawatt-hours (MWh) of energy and the visitor center produced an estimated 650 MWh, all of which offsets retail energy purchases at the two locations from Southern California Edison.

### *Greenhouse Gases*

Power utilities that emit greenhouse gases from power plants or import energy into California that emitted greenhouse gases when the energy was produced, are obligated to surrender permits or allowances to the California Air Resources Board to cover the amount of gas emitted. In November 2016, Metropolitan submitted allowances to cover its obligation for energy imported into California to serve the CRA pumping load in calendar year 2015. This was the second year Metropolitan had to make such a submittal. The value of the allowances was approximately $210,000.

## TABLE 4-9
## HYDROELECTRIC POWER RECOVERY PLANTS[1]
## PRODUCTION FOR THE PAST TWO FISCAL YEARS

| Power Plant[2] | Nameplate Capacity (Megawatts) | 2016/17 Production (kWh) | 2015/16 Production (kWh) |
|---|---|---|---|
| Greg Ave. | 1 | 1,968,000 | 0 |
| Lake Mathews | 5 | 18,706,183 | 32,835,903 |
| Foothill Feeder | 9 | 42,852,309 | 4,618,409 |
| San Dimas | 10 | 64,728,518 | 14,470,905 |
| Yorba Linda | 5 | 8,289,209 | 2,308,480 |
| Sepulveda Canyon | 9 | 13,457,422 | 0 |
| Venice | 10 | 0 | 0 |
| Temescal | 3 | 8,582,271 | 18,427,367 |
| Corona | 3 | 11,809,510 | 19,103,374 |
| Perris | 8 | 19,322,860 | 712,036 |
| Rio Hondo | 2 | 1,735,277 | 170,378 |
| Coyote Creek | 3 | 3,649,966 | 6,651,452 |
| Red Mountain | 6 | 29,887,522 | 22,770,534 |
| Valley View | 4 | 5,844,349 | 12,456,991 |
| Etiwanda | 24 | 4,623,000 | 27,944 |
| Wadsworth (DVL) | 30 | 6,939,451 | 2,090,548 |
| **TOTAL[3]** | **131** | **242,395,847** | **136,644,321** |

[1] Annual power generation varies significantly, depending on: Member agency demands, mix of water sources (Colorado River Aqueduct vs. State Water Project), what shutdowns/outages are taking place and each generator's operational constraints.

[2] Power plants are listed in the order they became operational. Greg Avenue was first and Wadsworth last.

[3] Nameplate Capacity may be off due to rounding

### *Colorado River Aqueduct Power*

In FY 2016/17, Metropolitan pumped nearly 766,000 AF through the Colorado River Aqueduct, requiring about 1.5 billion kilowatt-hours of electricity. Energy costs for pumping Colorado River water are shown in Table 4-10. The current and historical energy resources used to meet CRA water delivery energy requirements are shown in Table 4-11 and Figures 4-11 and 4-12.

During FY 2016/17, the increase in SWP allocation meant less reliance on CRA water, which lowered the need for energy resources for CRA pumping operations. This was a big change from FY 2015/16, when the CRA pumping had operated at near capacity for most of the year. Metropolitan's FY 2016/17 net energy purchases declined significantly to 32 million kWh. This 657 million kWh decline reduced the purchased energy cost by $15.4 million as compared to FY 2015/16. Metropolitan also maximized the Benefit Energy available from Southern California Edison through the 1987 Service and Interchange Agreement to support CRA pumping.

**TABLE 4-10**
**ENERGY COST FOR PUMPING**
**COLORADO RIVER WATER**
Fiscal Year 2016/17

| Energy Source | Cost ($) |
|---|---|
| Hoover Power Plant | 16,775,002 |
| Parker Power Plant | 3,251,294 |
| Energy Purchases/Sales [1] | 1,245,424 |
| Exchange (Edison & DWR ) [2] | 1,194 |
| Colorado River Water Pumping Revenue [3] | (870,554) |
| Benefit Energy and Exchange Surcharge [4] | 138,129 |
| Reduction in Energy Surcharge [5] | 87,423 |
| **TOTAL** | **20,453,066** |

Notes:
[1] Energy Purchases/Sales. A negative number indicates net revenue to Metropolitan
[2] Cost of exchanging energy with another utility
[3] Payments received for energy costs associated with moving non-Metropolitan water on the CRA
[4] Tax paid to state of California for Edison Benefit and Exchange energy
[5] Reduction in tax due to transmission losses and small hydro generation

# TABLE 4-11
# METROPOLITAN'S HISTORICAL CRA ELECTRIC ENERGY USE
## Kilowatt Hours



| | Hoover | Parker | Edison Benefit [1] | Edison Exchange [2] | DWR Exchange [2] | Edison & DWR Exchange & Edison Benefit | Energy Purchases/Sales [3] | Total |
|---|---|---|---|---|---|---|---|---|
| 1987/88* | 1,432,001,000 | 290,400,000 | 216,981,190 | 1,764,000 | 0 | 218,745,190 | 832,498,639 | 2,773,644,829 |
| 1988/89 | 1,231,206,000 | 237,142,000 | 215,485,363 | (27,764,000) | 0 | 187,721,363 | 735,276,330 | 2,391,345,693 |
| 1989/90 | 1,205,476,000 | 230,545,000 | 219,139,828 | 24,777,000 | 0 | 243,916,828 | 754,629,485 | 2,434,567,313 |
| 1990/91 | 1,130,155,000 | 223,831,000 | 221,837,010 | 13,298,000 | 0 | 235,135,010 | 871,799,953 | 2,460,920,963 |
| 1991/92 | 1,086,888,000 | 206,513,000 | 210,490,214 | 16,145,000 | 0 | 226,635,214 | 891,296,400 | 2,411,332,614 |
| 1992/93 | 966,614,000 | 182,606,000 | 208,800,738 | (28,220,000) | 0 | 180,580,738 | 1,035,586,974 | 2,365,387,712 |
| 1993/94 | 1,256,009,000 | 214,961,000 | 199,304,945 | (16,175,000) | 0 | 183,129,945 | 914,591,730 | 2,568,691,675 |
| 1994/95 | 1,166,517,000 | 217,365,000 | 186,648,325 | (88,977,000) | 0 | 97,671,325 | 680,010,352 | 2,161,563,677 |
| 1995/96 | 1,357,937,000 | 237,627,000 | 286,971,075 | (32,150,000) | 0 | 254,821,075 | 401,318,041 | 2,251,703,116 |
| 1996/97 | 1,292,375,000 | 243,993,000 | 253,134,785 | 47,302,000 | 0 | 300,436,785 | 595,050,513 | 2,431,855,298 |
| 1997/98 | 1,370,317,000 | 302,069,000 | 200,076,045 | 90,000,000 | (123,316,955) | 166,759,090 | 327,992,313 | 2,167,137,403 |
| 1998/99 | 1,411,403,000 | 297,219,000 | 212,312,000 | 13,490,000 | 108,417,736 | 334,219,736 | 329,691,494 | 2,372,533,230 |
| 1999/00 | 1,392,515,000 | 262,383,000 | 263,326,907 | (26,405,000) | 3,967,942 | 240,889,849 | 646,961,000 | 2,542,748,849 |
| 2000/01 | 1,311,068,000 | 243,647,000 | 173,785,599 | 21,586,000 | 0 | 195,371,599 | 788,937,000 | 2,539,023,599 |
| 2001/02 | 1,322,037,000 | 241,048,000 | 199,205,189 | (54,931,000) | 0 | 144,274,189 | 804,044,166 | 2,511,403,355 |
| 2002/03 | 1,193,682,000 | 230,871,000 | 284,085,067 | 50,371,800 | (162,807,504) | 171,649,363 | 232,051,017 | 1,828,253,380 |
| 2003/04 | 1,179,118,000 | 229,886,000 | 164,721,756 | (61,823,800) | 105,280,095 | 208,178,051 | (141,923,768) | 1,475,258,283 |
| 2004/05 | 931,893,000 | 198,606,000 | 381,481,989 | 18,022,000 | 5,059,196 | 404,563,185 | (39,632,380) | 1,495,429,805 |
| 2005/06 | 1,158,901,000 | 212,687,000 | 405,612,265 | (116,265,000) | 37,054,891 | 326,402,156 | 74,465,049 | 1,772,455,205 |
| 2006/07 | 1,143,870,000 | 229,881,000 | 387,630,441 | (38,400,000) | 68,876 | 349,299,317 | (421,365,512) | 1,301,684,805 |
| 2007/08 | 1,117,068,000 | 217,106,000 | 431,283,980 | 70,272,000 | 0 | 501,555,980 | (250,140,000) | 1,585,589,980 |
| 2008/09 | 1,075,217,000 | 223,056,000 | 260,209,614 | 90,363,000 | 0 | 350,572,614 | 371,765,025 | 2,020,610,639 |
| 2009/10 | 994,222,000 | 195,063,000 | 233,871,837 | 21,870,000 | 0 | 255,741,837 | 595,894,000 | 2,040,920,837 |
| 2010/11 | 1,094,130,000 | 225,236,000 | 227,018,084 | (160,574,000) | 0 | 66,444,084 | 583,958,000 | 1,969,768,084 |
| 2011/12 | 1,165,206,000 | 214,680,000 | 35,860,567 | (33,725,000) | 0 | 2,135,567 | 33,603,000 | 1,415,624,567 |
| 2012/13 | 1,075,958,000 | 236,045,000 | 234,852,498 | 53,437,000 | 0 | 288,289,498 | (100,968,000) | 1,499,324,498 |
| 2013/14 | 1,099,377,000 | 224,957,000 | 574,836,315 | 90,393,000 | 0 | 665,229,315 | 203,715,000 | 2,193,278,315 |
| 2014/15 | 1,023,690,000 | 214,130,000 | 401,355,532 | 44,943,000 | 0 | 446,298,532 | 709,652,000 | 2,393,770,532 |
| 2015/16 | 1,023,789,000 | 214,109,000 | 289,902,322 | (41,954,000) | 0 | 247,948,322 | 689,547,000 | 2,175,393,322 |
| 2016/17 | 939,410,000 | 211,118,000 | 340,445,225 | (15,061,000) | 0 | 325,384,225 | 32,092,255 | 1,508,004,480 |

Notes:

* Includes June 1987 data

[1] Energy provided by Southern California Edison (Edison) at no cost pursuant to 1987 Service and Interchange Agreement.

[2] Energy exchanged with Edison. Negative number indicates net energy banked with Edison.
Positive number indicates net energy received from Edison. These numbers represent what is in the Exchange Balance as of June 30.

[3] Energy Purchases/Sales. A negative number indicates net energy sold to others.

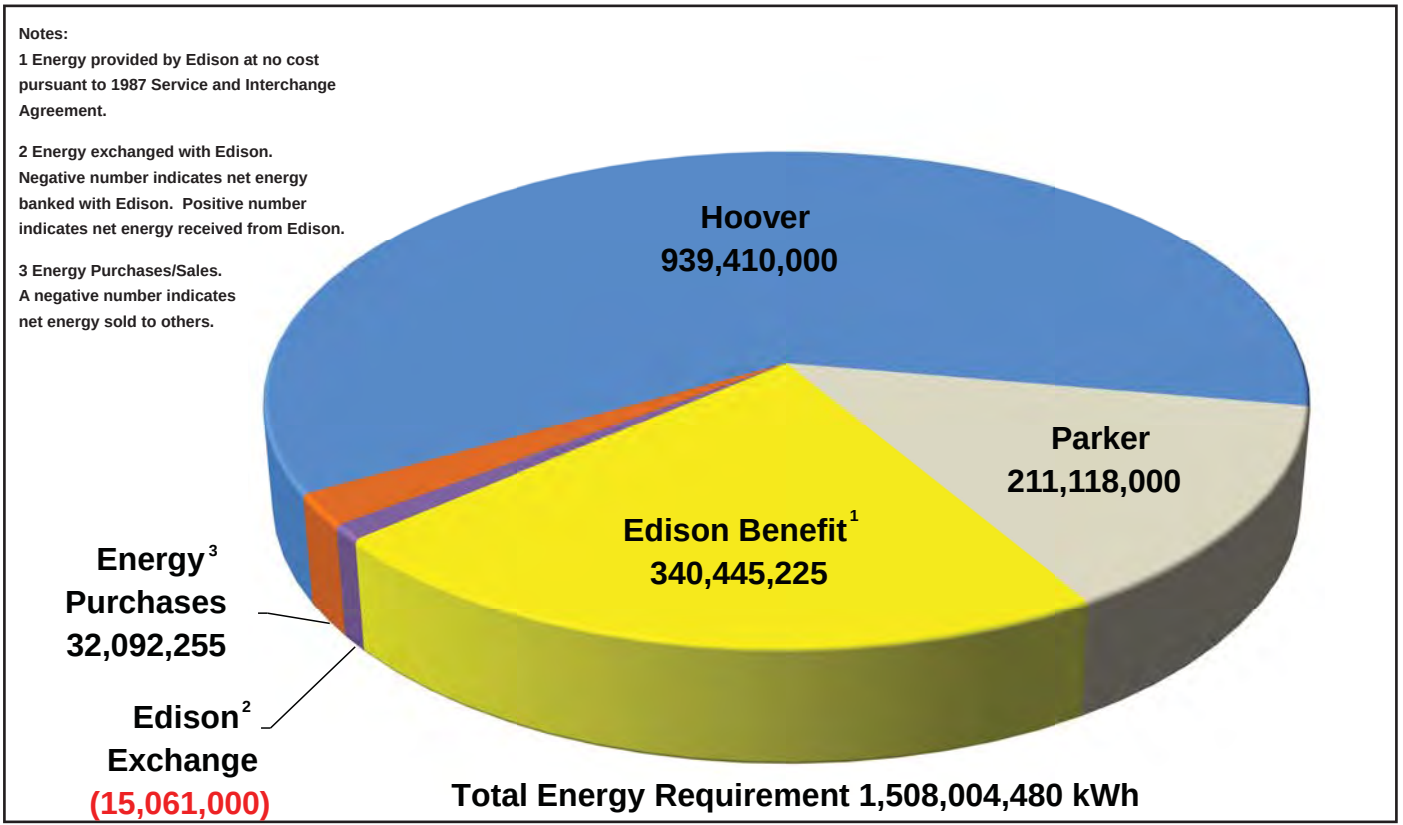



*Figure 4-11 Metropolitan's CRA Electric Energy Use (kWh) Fiscal Year 2016/2017*

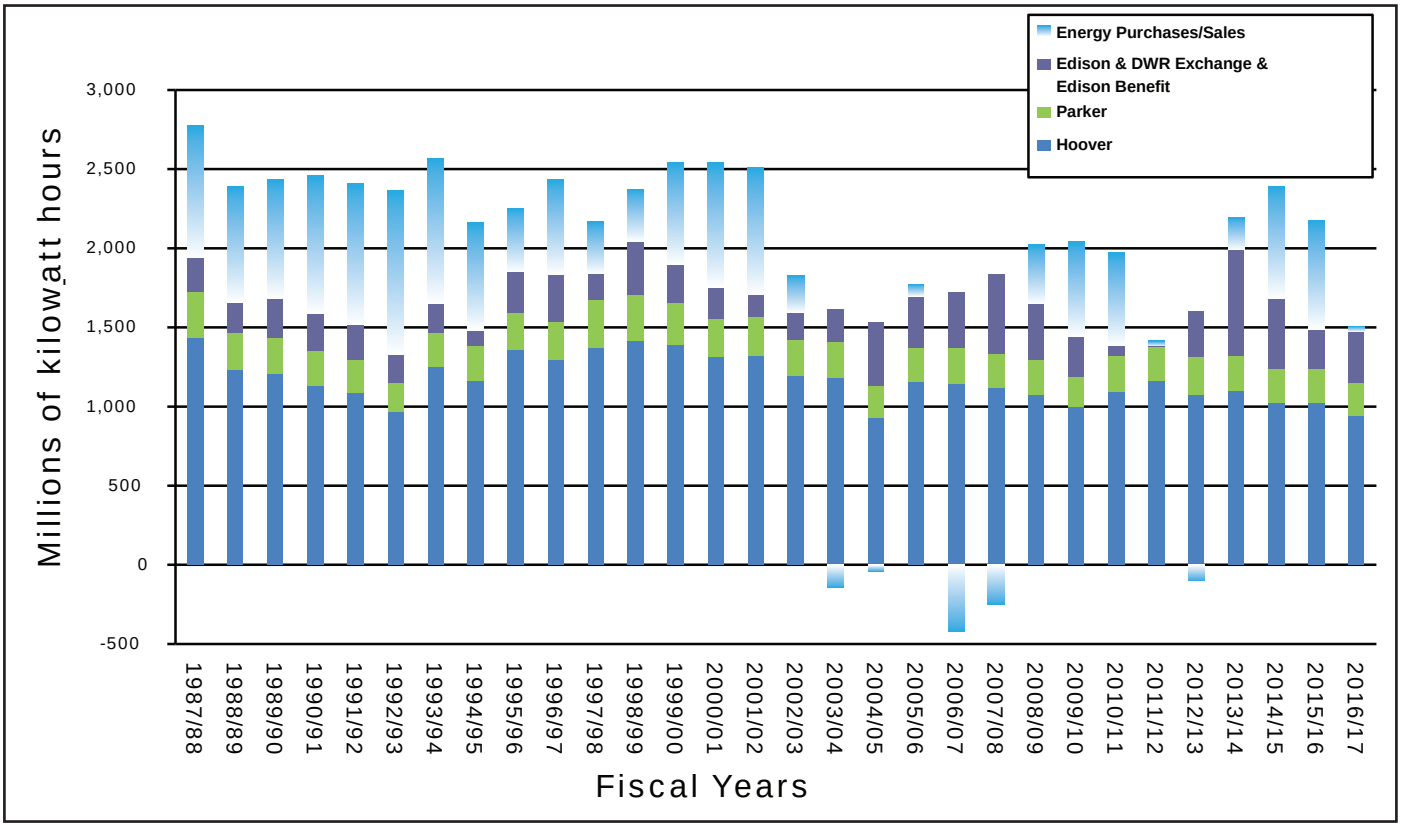



*Figure 4-12 CRA Energy Mix 1987 to 2017*

### *Power Transactions with Southern California Edison*

The Service and Interchange Agreement establishes the operating practices between Southern California Edison and Metropolitan in regards to the integrated electrical systems of the CRA and Edison. A key provision of the agreement is the ability of Metropolitan to engage in energy sales and purchases with Edison. During the first part of fiscal year 2016/17, from July 2016 to January 2017, Metropolitan purchased approximately 314 million kilowatt-hours of energy for CRA pumping from Edison for approximately $7.8 million. This was a savings of approximately $1.5 million over purchasing the energy from out-of-state sources. This value includes the savings from avoiding the acquisition of allowances to offset the greenhouse gases associated with energy imported into California. During the second part of FY 2016/17, when CRA pumping was significantly reduced due to the dramatic improvement in the availability of water from the SWP, Metropolitan sold approximately 282 million kilowatt-hours of excess energy to Edison for approximately $6.5 million. The result was a net purchase of 32 million kWh of energy at $1.25 million to support CRA operations.

### *Expiration and Replacement of Edison Agreement*

The Service and Interchange Agreement with Edison will terminate on September 30, 2017. Edison has stated that it is not interested in continuing to provide transmission-related services under a new agreement. In anticipation of the termination of the agreement, Metropolitan evaluated options for replacing the services previously provided by Edison with a series of new agreements that would provide the most cost-effective and operationally desirable outcome for Metropolitan.

Metropolitan has been in discussions with the Arizona Electric Power Cooperative, a non-profit, membership-based generation and transmission cooperative that can provide transmission services to Metropolitan. AEPCO's services would cost less than if Metropolitan provided the services itself. Negotiations with AEPCO are nearly complete with the goal of having agreements in place before the Edison agreement expires on September 30, 2017. AEPCO would provide services to Metropolitan under the terms of two agreements, both running from October 1, 2017 through December 31, 2035. One

agreement covers transmission system operation services that ensure Metropolitan's facilities comply with national electric reliability standards. Under the other agreement, AEPCO would schedule Metropolitan's energy resources from Hoover and Parker dams, and procure supplemental energy for CRA operations when the available energy from Hoover and Parker is insufficient.

In June 2017, the Metropolitan board authorized approval of an operating agreement with CAISO (California Independent System Operator). The operating agreement will govern the operation of Metropolitan's CRA power system within CAISO's balancing area and allow CAISO to accept Metropolitan's imports and exports of capacity, energy, and ancillary services.

The board also adopted a Resource Adequacy Resolution that will satisfy requirements for the CRA power system to provide sufficient resources to reliably meet its power needs.

Although Edison has indicated that it does not plan to extend the term of the Service and Interchange Agreement, it has requested retention of all the existing points of interconnection at four of Metropolitan's pumping plants and one switching station along the CRA transmission system. This will allow Edison to serve its remote desert retail loads and maintain interconnections with other entities. Interconnection agreements are being negotiated for the Camino Switching Station and the Gene, Iron Mountain, Eagle Mountain and Hinds pumping plants.

***Hoover Electric Service Contract***

The current Hoover Electric Service Contract will terminate on September 30, 2017. Metropolitan and the other Hoover power contractors have been negotiating for several years with the Western Area Power Administration and Bureau of Reclamation on successor contracts. These negotiations were successfully concluded in May 2016 and Metropolitan executed the contracts in March 2017 with an effective date of October 1, 2017. The new Energy Service Contract and Implementation Agreement will provide Metropolitan with 95 percent of its current share of the Hoover project, energy and capacity, for a period of 50 years (2017–2067). This will ensure a

continuing source of reliable and economic energy to power the CRA pumps for another 50 years.

***Mead Substation Interconnection Contract***

The original Mead Substation Interconnection Agreement commenced in 1968 and terminated on May 31, 2017. Metropolitan and the Western Area Power Administration have successfully negotiated the terms of a new 50-year Operation, Maintenance, and Replacement Agreement, which establishes points of ownership and interconnection rights for Metropolitan to continue its existing transmission interconnections to WAPA's Mead Substation. The new agreement will allow Metropolitan to maintain interconnections of its two transmission lines from Metropolitan's Camino Switching Station to the Mead Substation, and to continue to receive power from Hoover and other power resources to serve Metropolitan's CRA pumps. The agreement was executed in March 2017, with an effective date of June 1, 2017.

## *Safety and Regulatory Services*

Operational Safety and Regulatory Services staff continued to oversee compliance with environmental and safety regulations and procedures. Staff conducted numerous site inspections to proactively address environmental and safety issues. In addition, there were 82 routine regulatory inspections in the areas of air quality, wastewater, hazardous materials, hazardous waste, stormwater, underground and aboveground petroleum storage tanks, and safety. Staff coordinated and tracked all identified corrective actions.

***Regulatory***

Staff provided all required compliance reporting for air quality, wastewater, stormwater, underground storage tanks, and hazardous materials/hazardous waste. Staff negotiated with and secured dewatering permits from regulatory agencies in support of Metropolitan's shutdown projects. Staff also managed 395 air quality permits for portable and stationary equipment.

Staff prepared and submitted more than 92 wastewater, storm water and air quality reports, plans, and permits to comply with regulatory requirements. Staff continued to update and implement 20 plans for oil spill prevention control and countermeasures to comply with regulations for aboveground fuel tanks. Staff submitted nearly 38 annual disclosures and business plans dealing with hazardous materials for required Metropolitan sites.

Despite its public health benefit, cost-effectiveness and superior disinfection properties, chlorine is a highly regulated chemical. Staff took the lead in several important regulatory compliance-related activities involving Metropolitan's chlorine systems, including two very successful regulatory inspections and revalidations for the chlorine systems at two treatment plants. In addition, comprehensive internal audits were conducted at all six chlorine facilities. Regulatory authorities found that Metropolitan was 100 percent compliant with the federal Risk Management Program and California Accidental Release Program regulations. The regulators praised the treatment plants' operations, appearance, housekeeping, and high degree of compliance.

***Health & Safety***

Staff provided safety coverage during the FY 2016/17 shutdown season to successfully minimize accidents and injuries. This included safe work practices and ventilation monitoring for all underground operations.

Staff proactively addressed safety performance through site inspections, safety toolbox talks, safety committee communications, and revision of safety procedures. Staff prepared a book of general and specialized Safety Talks for managers to use when conducting weekly safety toolbox meetings. These meetings heighten safety awareness by discussing project plans and reviewing job hazard assessment and requirements. Table 4-12 shows the injuries, illnesses and incidents that required time off from work during FY 2016/17 for each Metropolitan facility. The Occupational Health and Safety Administration defines Total Incident Rate (also known as injury/illness rate), as the number of recordable incidents in a year per 100 employees. Overall, Metropolitan's Total Incident Rate is below the average federal Total Incident Rate for water utilities. A recordable incident is

generally defined as a new work-related injury or illness that results in death, lost time from work, work restriction, or medical treatment beyond first aid.

Staff investigated each incident and worked with managers to implement proactive measures to protect employees. In addition, staff provided training courses to ensure employee safety and compliance with regulations. Course curriculum was updated in accordance with regulatory changes and was provided through a combination of classroom and online eLearning opportunities. Approximately 660 classes covering more than 90 individual topics were presented. Online courses continued to provide flexibility for diverse work schedules and accounted for over one-third of training provided.

### *Apprenticeship Program Training*

The Apprenticeship Program trains industrial mechanics and electricians to ensure skilled trade persons are available to repair and maintain Metropolitan's water treatment and conveyance and distribution system. The state Department of Apprenticeship Standards continues to recognize Metropolitan's curriculum as meeting the breadth and level commensurate with journey-level mechanical and electrical trades.

Metropolitan's Apprenticeship Program has several classes in progress to train electricians and mechanics to the journey level. Over a four-year period, apprentices attend over 700 hours of classroom instruction, must pass more than 90 tests, and complete over 7,200 hours of on-the-job training. To date, the Apprenticeship Program has supplied Metropolitan with a total of 91 journey and electrical craft persons which comprises over 40 percent of the current apprenticeable trades workforce. A recruitment to establish a new two-year hiring eligibility list was conducted in FY 2016/17.

**TABLE 4-12**
**ACCIDENT INCIDENTS**
Fiscal Year 2016/17

| Location | Total* Incident Rate | DART** Incident Rate |
|---|---|---|
| Diemer | 12.3 | 3.1 |
| Diamond Valley Lake | 14.3 | 5.7 |
| Eagle Mountain | 40.7 | 20.3 |
| Eagle Rock | 5.9 | 5.9 |
| Gene Camp | 3.9 | 2.9 |
| Hinds | 22.4 | 11.2 |
| Iron Mountain | 4.7 | 0 |
| Jensen Plant | 7.9 | 4.7 |
| La Verne | 4.0 | 3.3 |
| Lake Mathews | 13.1 | 7.3 |
| Lake Skinner | 3.0 | 1.5 |
| Mills Plant | 2.2 | 0 |
| Sacramento | 6.6 | 0 |
| San Diego | 0 | 0 |
| Soto Street | 11.6 | 3.9 |
| Sunset | 0 | 0 |
| Union Station | 0.6 | 0.4 |
| Washington, D.C. | 0 | 0 |
| **AVERAGE RATE** | **3.0** | 2.2 |
| **Federal Utility Average** | **5.5** | 3.0 |
| **State Utility Average** | **6.9** | 3.0 |

*Total Incident Rate – Number of recordable incidents in a year per 100 employees. Total Incident Rate is calculated by multiplying the number of recordable incidents by 200,000 and then dividing that number by the number of total labor hours at the facility.

**DART Incident Rate – Number of incidents with days away, restriction, and/or transfer in a year per 100 employees.



*Side view of a 120-inch butterfly valve on the Rialto Feeder.*




*Weymouth Oxidation Retrofit Program –*
*Ozone Generation Building.*

CHAPTER 5

# Engineering Services

The Engineering Services Group is a full-service engineering organization that provides technical resources and delivers projects so that Metropolitan can treat and distribute water reliably to its member agencies. Engineering Services provides a wide range of technical services with a focus on cost-effectiveness and customer service. Its key functions include program management, engineering design, construction management, facility planning, geodetics and field survey, dam surveillance and corrosion engineering. In addition to performing its core operation and maintenance activities, Engineering Services provides oversight of Metropolitan's Capital Investment Plan, which represents MWD's commitment to construct and rehabilitate facilities that enable long-term, reliable water deliveries.

## *Capital Investment Plan*

Each year, Engineering Services manages and executes capital projects that range in cost from less than $100,000 to more than $100 million. Projects within Metropolitan's CIP are prioritized and scheduled to reflect the strategic goals of providing a reliable supply of high-quality water at the lowest cost possible. The CIP is comprised of 12 major capital programs based on project type, business driver, and location.

During fiscal year 2016/17, expenditures totaled approximately $372 million for all capital programs. This amount includes $174.3 million for the Delta Islands purchase. All other capital expenditures for the fiscal year are depicted in Figure 5-1, while Figure 5-2 shows long-term expenditures for each capital program. During the year, 17 construction contracts were completed with a total value of $222 million, while 23 construction contracts (as shown in

Table 5-2) and seven procurement contracts remained underway with a total value of approximately $174 million.

For a detailed list of projects that completed construction during the year or were under construction or design, see Tables 5-1 through 5-3.

Below are highlights of Engineering Services' major activities for each capital program during FY 2016/17.

***Water Quality/Oxidation Retrofit Program***

Metropolitan initiated the Oxidation Retrofit Program in 1990 to enable ozone to serve as primary disinfectant, reduce the level of disinfection byproducts, and improve the water quality at Metropolitan's five treatment plants. Construction of the main ozonation facilities at the F. E. Weymouth Water Treatment Plant was completed in FY 2016/17. Start-up of the Weymouth system, which represents the final step for the Oxidation Retrofit Program, will be completed within the first half of FY 2017/18. Ozone has been employed as the primary disinfectant at the Joseph Jensen, Henry J. Mills, Robert A. Skinner and Robert B. Diemer water treatment plants for several years.

***Treatment Plant Reliability Program***

Projects under this program maintain reliability and improve the operating efficiency of Metropolitan's water treatment plants. Specific accomplishments included: completion of electrical upgrades at the Diemer plant; completion of upgrades to replace deteriorated filter valves at the Jensen plant; completion of industrial wastewater handling improvements at the Mills plant; continued seismic upgrades to the Administration Building at the Diemer plant; and continued filter and basin structural and equipment upgrades at the Weymouth and Diemer plants.

***Distribution System Reliability Program***

Projects within this program maintain delivery reliability to Metropolitan's member agencies. Specific accomplishments included: completion of the second stage of lining repairs on the Etiwanda Pipeline; completion of a pilot construction project to replace the deteriorated lining on the Orange County Feeder; completion of the

installation of cathodic protection along the Allen-McColloch Pipeline; and continued construction to rehabilitate Palos Verdes Reservoir.

***Colorado River Aqueduct Reliability Program***

Projects within this program maintain the reliability of the Colorado River Aqueduct. Specific accomplishments included: initiating repairs to the delivery line expansion joints at all five CRA pumping plants; initiating construction of erosion protection for the Whitewater Siphons; continued construction to replace the original sand trap equipment at the Iron Mountain, Eagle Mountain and Hinds pumping plants; and continued seismic upgrades to the 6.9 kV switch houses at each CRA pumping plant.

***PCCP Reliability Program***

This long-term, comprehensive program will rehabilitate 100 miles of Metropolitan's 163 miles of prestressed concrete cylinder pipe. Through FY 2016/17, four miles of PCCP have been rehabilitated, leaving 96 miles that remain to be lined or replaced. Specific accomplishments included: completion of electromagnetic inspections along portions of the Rialto Pipeline, Second Lower Feeder, Sepulveda Feeder, Calabasas Feeder and West Valley Feeder No. 2; completion of urgent repairs on the Sepulveda Feeder; board certification of the programmatic Environmental Impact Report for five priority PCCP feeders; and completion of design of the program's initial construction contract to line Reach 1 of the Second Lower Feeder.

***Right of Way and Infrastructure Protection Program***

This comprehensive program protects access rights, minimizes erosion, and secures programmatic environmental permits along all of Metropolitan's feeders throughout the distribution system. This effort will enable rehabilitation work and operational activities to proceed with a minimum of delays over a 10- to 15-year period, and will provide relief from escalating permitting costs. During the year, staff continued to execute the initial phase of the program, including design of improvements, preparation of programmatic environmental impact reports, and identification and resolution of right-of-way issues throughout the distribution system.

***System Flexibility/Supply Reliability Program***

In response to the recent drought and resulting low allocation of State Water Project supplies to Metropolitan, staff continues to execute projects to expand the reach of CRA water throughout Metropolitan's distribution system. During FY 2016/17, staff substantially completed the design to rehabilitate the Greg Avenue Pump Station, which will provide a long-term, reliable backup supply to the Jensen service area.

***System Reliability Program***

Projects within this program will improve or modify facilities located throughout Metropolitan's service area in order to utilize new processes and/or technologies, and improve facility and overall reliability. Specific accomplishments included: completion of preliminary design of building improvements at the Headquarters Building in Los Angeles; and initiation of full-scale upgrades to the control and electrical protection systems for the pump/turbine units at Wadsworth Pumping Plant.

***Regulatory Compliance Program***

This program provides for prudent use and management of Metropolitan's assets in compliance with regulations and codes other than water quality. FY 2016/17 marked the completion of construction upgrades to Metropolitan's Chemical Unloading Facility. This project represents the final stage of a long-term effort to upgrade containment facilities to enhance safety and security.

***Cost Efficiency and Productivity Program***

This program provides economic savings through enhanced business and operating processes, and through reduced energy costs. Construction of a 1-megawatt solar generating facility at the Jensen plant is underway and is expected to be completed in the first half of FY 2017/18. This project will provide a long-term hedge against utility power cost increases at the plant.

***Minor Capital Projects Program***

This program executes refurbishments, replacements, or upgrades at Metropolitan facilities that cost less than $250,000. During FY 2016/17, 24 projects were authorized under this program.

***Potential Regional Recycled Water Program***

This program involves the design and construction of an Advanced Water Treatment Demonstration Plant, which represents the initial step to develop a potential regional recycled water system. The system would purify wastewater for recharge of groundwater basins throughout Southern California. During FY 2016/17, design of the 500,000 gallon-per-day demonstration plant was completed. This work is being undertaken in collaboration with the Sanitation Districts of Los Angeles County.

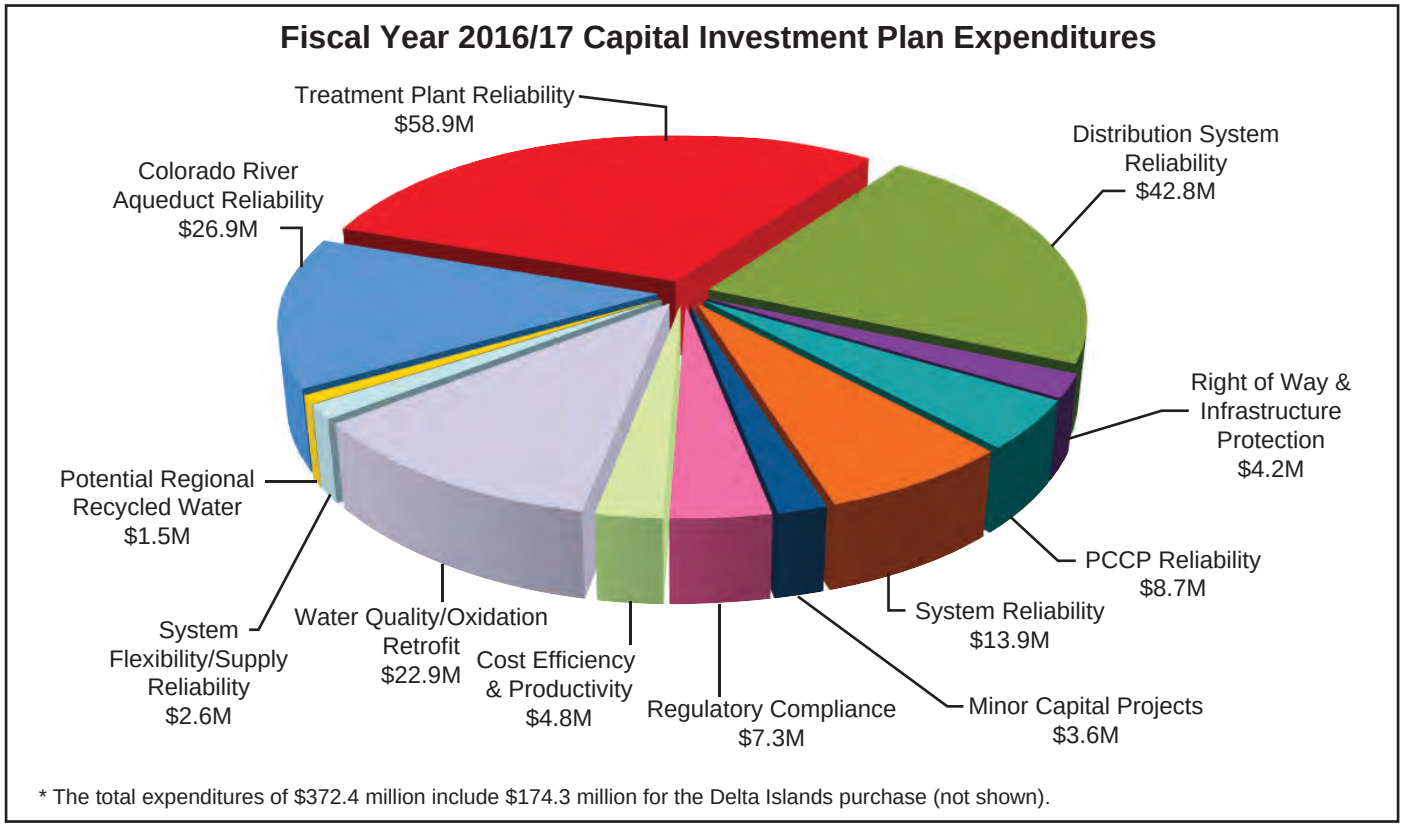



*Figure 5-1. Fiscal Year 2016/17 Capital Investment Plan Expenditures*

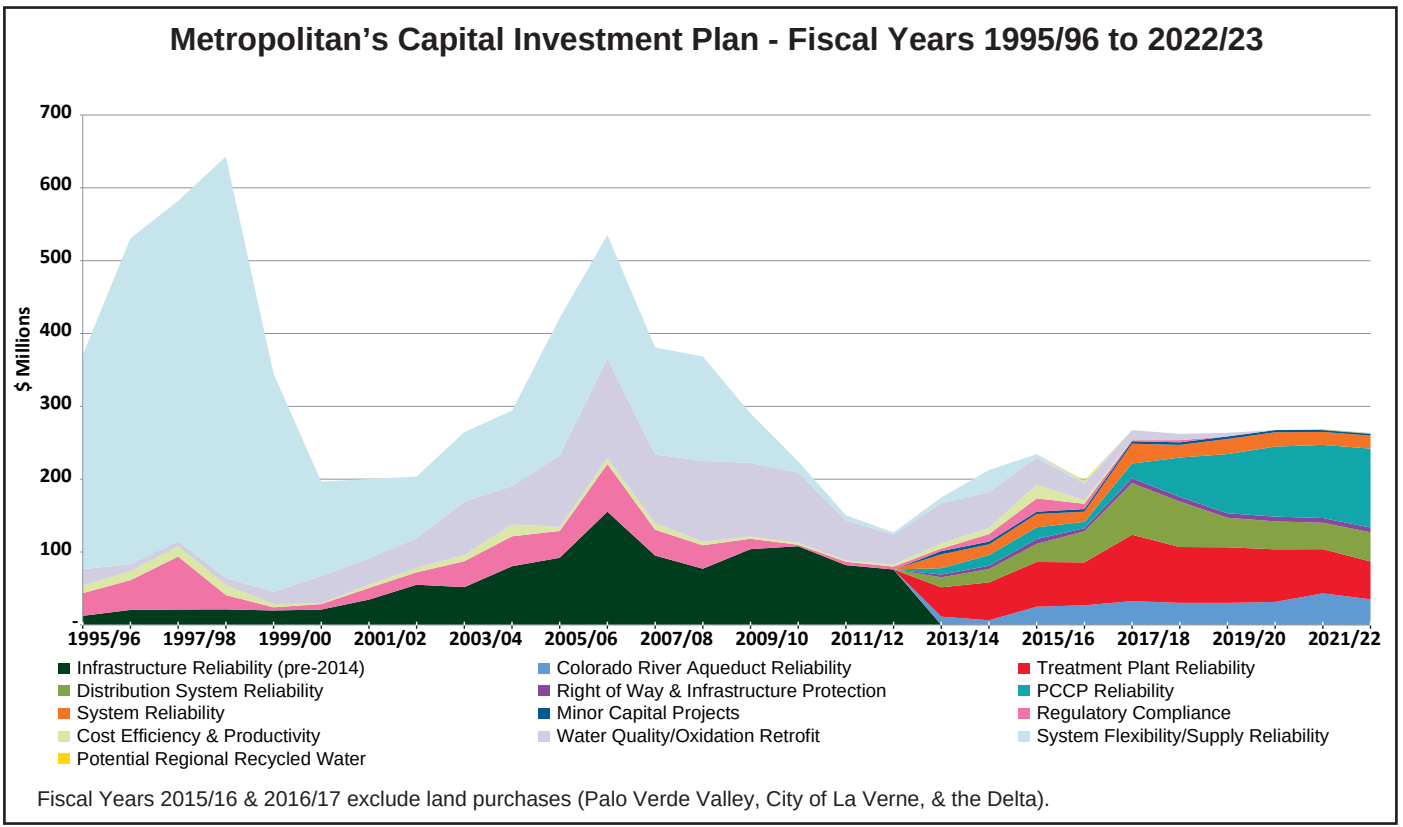



*Figure 5-2. Metropolitan's Capital Investment Plan – Fiscal Years 1995/96 to 2022/23*

## TABLE 5-1
## CONSTRUCTION CONTRACTS COMPLETED AS OF JUNE 30, 2017 (Unaudited)

| Completion Date | Contract / Spec. No. | Project | Base Bid Amount ($) | Final Amount ($) |
|---|---|---|---|---|
| 7/18/16 | 1817/1749 | Weymouth Plant Scrubber Platform | 371,800 | 388,600 |
| 8/26/16 | 1832/1871 | Sepulveda Feeder Urgent PCCP Repairs | 9,150,000 | 10,625,967 |
| 10/5/16 | 1823/1796 | Colorado River Aqueduct Erosion Protection Curbing | 16,640,000 | 16,674,000 |
| 10/20/16 | 1811/1780 | Water Quality Lab HVAC Chiller Replacement | 989,215 | 989,215 |
| 10/31/16 | 1808/1782 | Diemer Plant South Slope Revegetation | 996,600 | 1,018,600 |
| 11/1/16 | 1829/1776A | Diamond Valley Lake Visitors Center Building Improvements | 161,525 | 177,028 |
| 11/1/16 | 1826/1813 | Diamond Valley Lake Fuel Tank Monitoring and Inventory System Upgrades | 195,771 | 230,238 |
| 11/10/16 | 1838/1841 | Middle Feeder South Blowoff Valve Replacement at Sta. 782+53 | 343,625 | 343,625 |
| 11/28/16 | 1812/1825 | La Verne Solar Power Plant | 10,065,865 | 10,022,256 |
| 12/5/16 | 1828/1808 | Weymouth Plant Filter Building No. 1 Window Replacement | 130,000 | 130,000 |
| 12/16/16 | 1773/1705 | Diemer Plant Electrical Upgrades, Stage 2 | 11,110,000 | 11,352,044 |
| 2/27/17 | 1802/1744A | Jensen Plant Module No. 1 Filter Valve Replacement | 3,637,083 | 3,887,082 |
| 3/23/17 | 1830/1832 | Etiwanda Pipeline Lining Repairs, Stage 2 | 11,555,000 | 11,735,900 |
| 5/10/17 | 1804/1753 | Diemer Plant East Filter Upgrades | 9,310,000 | 9,748,678 |
| 5/19/17 | 1741/1600 | Weymouth Oxidation Retrofit Program - Main Ozonation Facilities | 95,497,513 | 118,432,136 |
| 6/1/17 | 1800/1707A | Mills Plant Industrial Wastewater Handling Facility | 2,565,063 | 2,565,063 |
| 6/30/17 | 1785/1709 | Chemical Unloading Facility Containment and Handling Facilities | 22,888,888 | 23,659,678 |

# TABLE 5-2
# MAJOR CONSTRUCTION CONTRACTS IN PROGRESS
# AS OF JUNE 30, 2017 (UNAUDITED)
Accrual Basis

| Contract No. | Project | Percent Contract Complete through 6/30/2017 | Estimated Contract Completion Date | Contract Earnings ($) through 6/30/2017 [1] | Base Bid Amount ($) |
|---|---|---|---|---|---|
| 1803 | Jensen Plant - LADWP Lagoon Refurbishment | 92% | Aug. 2017 | 3,102,497 | 3,067,900 |
| 1809 | Weymouth Plant Filter Rehabilitation | 99% | Dec. 2017 | 32,310,254 | 31,762,914 |
| 1814 | Diemer Plant East Basin Rehabilitation | 96% | Aug. 2017 | 20,962,494 | 21,524,084 |
| 1818 | Weymouth Plant Chemical Upgrades | 89% | Jun. 2018 | 9,092,261 | 10,267,000 |
| 1822 | CRA Sand Trap Rehabilitation | 71% | Sep. 2017 | 6,964,620 | 9,777,000 |
| 1825 | Palos Verdes Reservoir Cover and Liner Replacement | 35% | Aug. 2018 | 10,443,684 | 29,560,000 |
| 1827 | Jensen Plant Electrical Upgrades, Stage 1 | 76% | Feb. 2019 | 12,009,047 | 15,800,000 |
| 1834 | Diamond Valley Lake East Dam Electrical Upgrades | 79% | Aug. 2017 | 562,658 | 708,000 |
| 1835 | La Verne Shops Fire Sprinkler System | 84% | Jul. 2017 | 226,100 | 268,000 |
| 1836 | Diamond Valley Lake East Marina Restroom | 10% | Oct. 2017 | 20,790 | 204,000 |
| 1837 | Diamond Valley Lake Inlet/Outlet Tower Fish Screen Replacement | 8% | Jan. 2018 | 156,124 | 1,885,150 |
| 1839 | Palos Verdes Feeder Collis Avenue Structure Valve Replacement | 99% | Jul. 2017 | 1,651,962 | 1,422,082 |
| 1841 | Jensen Solar Power Plant | 53% | Sep. 2017 | 2,402,121 | 4,878,635 |
| 1842 | Allen-McColloch Pipeline Cathodic Protection | 98% | Jul. 2017 | 1,149,789 | 1,171,293 |

## TABLE 5-2 (Continued)
## MAJOR CONSTRUCTION CONTRACTS IN PROGRESS
## AS OF JUNE 30, 2017 (UNAUDITED)
Accrual Basis

| Contract No. | Project | Percent Contract Complete through 6/30/2017 | Estimated Contract Completion Date | Contract Earnings ($) through 6/30/2017 [1] | Base Bid Amount ($) |
|---|---|---|---|---|---|
| 1843 | Diemer Plant Administration Building Seismic Upgrades | 20% | Apr. 2018 | 890,500 | 4,426,000 |
| 1844 | CRA Pumping Plants - Seismic Retrofit of 6.9 kV Switch Houses | 42% | Sep. 2018 | 4,019,713 | 9,595,000 |
| 1845 | Orange County Feeder Lining Repairs, Stage 1 | 82% | Jul. 2017 | 3,772,068 | 4,580,000 |
| 1847 | Allen-McColloch Pipeline Flow Control Structure Seismic Upgrades | 46% | Oct. 2017 | 497,250 | 1,092,092 |
| 1848 | CRA Pumping Plants Delivery Line Expansion Joint Repairs, Stage 2 | 4% | Oct. 2017 | 43,000 | 1,109,254 |
| 1849 | Lake Mathews Power Plant Concrete Repairs | 3% | Apr. 2018 | 5,250 | 207,800 |
| 1850 | CRA Whitewater Siphons Erosion Protection | 0% | Dec. 2018 | - | 5,285,000 |
| 1853 | Employee Housing Rehabilitation at Julian Hinds and Eagle Mountain Pumping Plants | 0% | Feb. 2018 | - | 1,219,809 |
| 1854 | Employee Housing Rehabilitation at Iron Mountain and Gene Pumping Plants | 0% | Feb. 2018 | - | 1,219,809 |

[1] Earnings reflected represent the value of work performed by the contractor as of the date indicated and include contract retention and other similar deductions from amounts earned by the contractor but otherwise required to be withheld by Metropolitan by law or contract.

# TABLE 5-3
# MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| **Cost Efficiency & Productivity Program** | | | | |
| 15490 | Project Controls and Reporting System | $4,300,000 | Project Controls and Reporting System | September 2019 |
| **Colorado River Aqueduct Reliability Program** | | | | |
| 15341 | Whitewater Siphon Protection | $15,300,000 | CRA Whitewater Siphon Protection | October 2016 |
| 15373 | CRA Conveyance Reliability | $186,000,000 | CRA Discharge Line Isolation Gates | April 2019 |
| | | | Copper Basin & Gene Wash Dam Discharge Valve Replacement | January 2018 |
| 15374 | CRA Pumping Plant Reliability | $25,500,000 | CRA Main Pump Expansion Joint Repairs | June 2017 |
| 15384 | CRA Electrical/Power Systems Reliability | $48,600,000 | CRA UPS Replacement | October 2017 |
| | | | CRA Power Cable Replacement | October 2017 |
| | | | CRA Auxiliary Power Systems | August 2017 |
| 15438 | CRA Reliability - FY2006/07 Through FY2011/12 | $110,200,000 | CRA Pump Plant Sump System Rehabilitation | December 2017 |
| | | | CRA Seismic Retrofit of 6.9 kV Switch Houses | July 2016 |
| | | | CRA Radial Gates Rehabilitation | August 2018 |
| | | | Intake Pumping Plant Standby Generator Replacement | November 2018 |
| | | | Intake Power and Communication Line Relocation | November 2018 |
| | | | CRA Mile 12 Flow Monitoring Station Upgrades | December 2016 |
| 15481 | CRA Main Pump Reliability | $177,200,000 | CRA Overhead Crane Replacement | June 2018 |
| | | | CRA Discharge Line Isolation Couplings | June 2018 |
| 15483 | CRA Reliability - FY2012/13 Through FY2017/18 | $67,600,000 | CRA and Iron Mountain Reservoir Panel Repairs | August 2017 |
| | | | CRA Delivery Line Expansion Joints Rehabilitation | January 2017 |
| | | | CRA Water Distribution System Replacement | August 2018 |
| | | | CRA Conduit Structural Protection | January 2018 |
| | | | CRA Domestic Water Treatment System Replacement | April 2019 |
| | | | CRA Storage Buildings at Hinds, Eagle Mountain and Iron Mountain | November 2018 |

## TABLE 5-3 (Continued)
## MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| **Distribution System Reliability Program** | | | | |
| 15377 | Conveyance and Distribution System | $119,500,000 | Orange County Feeder Lining Repairs | May 2018 |
| | | | Upper Newport Bay Blow-Off Structure Rehabilitation | November 2017 |
| | | | Coyote Creek Hydroelectric Plant Rehabilitation | February 2018 |
| | | | West Valley Feeder No. 1 Valve Structure Rehabilitation, Stage 3 | September 2018 |
| 15417 | Reservoir Cover and Replacement | $41,500,000 | Mills Finished Water Reservoirs Rehabilitation | August 2020 |
| 15419 | Dam Rehabilitation & Safety Improvements | $8,900,000 | DVL Dam Monitoring System Upgrade | December 2017 |
| 15441 | Conveyance and Distribution System Rehabilitation - FY2006/07 Through FY2011/12 | $182,700,000 | Lake Mathews Forebay Repairs | December 2018 |
| | | | OC-88 Pump Plant Surge Tank Upgrade | December 2018 |
| | | | Sepulveda Canyon Control Facility Seismic Upgrades | July 2019 |
| | | | Santa Ana River Bridge Seismic Upgrades | May 2017 |
| | | | Santiago Lateral Sectionalizing Valve Replacement | January 2019 |
| | | | Lake Mathews Forebay Upgrades | December 2017 |
| | | | Orange County Feeder Cathodic Protection | October 2017 |
| | | | Lake Mathews Hydroelectric Plant Repairs | December 2017 |
| | | | Seismic Upgrade of 10 Facilities on the Allen-McColloch Pipeline | December 2017 |
| | | | Etiwanda Pipeline Lining Repairs, Stage 3 | October 2017 |
| | | | Palos Verdes Reservoir Sodium Hypochlorite Feed System Upgrade | September 2016 |
| 15458 | Hydroelectric Power Plant Improvements | $39,300,000 | Foothill Hydroelectric Plant Rehabilitation | July 2018 |
| | | | Carbon Creek Pressure Control Structure Seismic Upgrades | December 2018 |
| | | | Foothill Hydroelectric Plant Seismic Upgrades | January 2019 |
| | | | San Dimas Hydroelectric Plant Rehabilitation | February 2020 |
| | | | Sepulveda Canyon Hydroelectric Plant Rehabilitation | February 2020 |
| | | | Venice Hydroelectric Plant Rehabilitation | January 2019 |

## TABLE 5-3 (Continued)
## MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| 15480 | Conveyance and Distribution System Rehabilitation - FY2012/13 Through FY2017/18 | $332,500,000 | Allen-McColloch Pipeline Service Connection OC-76 Turnout | September 2017 |
| | | | East Orange County Feeder No. 2 Service Connection A-6 Venturi Meter Replacement | December 2017 |
| | | | Rialto Pipeline Service Connections CB-12 and CB-16 Valve Replacement & Electrical Improvements | January 2018 |
| | | | Sepulveda Canyon Control Facility Bypass | January 2019 |
| | | | Electrical Upgrade of 14 Structures within Orange County | June 2018 |
| | | | Garvey Reservoir Drainage and Erosion Improvements | December 2016 |
| | | | Lakeview Pipeline Rehabilitation | June 2018 |
| | | | West Orange County Feeder Valve Replacement | September 2018 |
| | | | San Dimas and Red Mountain Power Plants Standby Generator Replacement | July 2017 |
| | | | Lake Mathews Electrical Upgrades | December 2017 |
| | | | Orange County Region Service Center | April 2017 |
| **Minor Capital Projects Program** | | | | |
| 15476 | Capital Program for Projects Costing Less Than $250,000 for FY2012/13 Through FY2013/14 | $10,000,000 | Various | N/A |
| 15489 | Capital Program for Projects Costing Less Than $250,000 for FY2014/15 Through FY2015/16 | $8,000,000 | Various | N/A |
| 16810 | Capital Program for Projects Costing Less Than $250,000 for FY2016/17 Through FY2017/18 | $10,000,000 | Various | N/A |
| **System Reliability Program** | | | | |
| 15395 | La Verne Shop Facilities Upgrades | $60,900,000 | La Verne Shops - Building Completion & Equipment Installation | March 2018 |
| | | | La Verne Shops - Equipment Design and Procurement | March 2018 |
| 15473 | Headquarters Building Improvements | $42,200,000 | Headquarters Building Improvements | May 2018 |

## TABLE 5-3 (Continued)
## MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| **PCCP Reliability Program** | | | | |
| 15497 | Second Lower Feeder PCCP Rehabilitation | $625,000,000 | Second Lower Feeder PCCP Rehabilitation - Preliminary Design | December 2018 |
| | | | Second Lower Feeder PCCP Rehabilitation - Reach 1 | June 2017 |
| | | | Second Lower Feeder PCCP Rehabilitation - Reach 2 | March 2018 |
| | | | Second Lower Feeder PCCP Rehabilitation - Reach 3 | October 2018 |
| | | | Second Lower Feeder Pipe Procurement - Reaches 2/3 | February 2019 |
| | | | Second Lower Feeder Valve Procurement | December 2018 |
| **Potential Regional Recycled Water Program** | | | | |
| 15493 | Advanced Water Treatment Demonstration Plant | $15,000,000 | Demonstration-Scale Recycled Water Treatment Plant | March 2017 |
| **Regulatory Compliance Program** | | | | |
| 15385 | CRA Discharge Containment | $19,800,000 | CRA Wastewater System Replacement - Gene & Iron Mountain | August 2018 |
| | | | CRA Wastewater System Replacement - Intake | August 2018 |
| **Right of Way & Infrastructure Protection Program** | | | | |
| 15474 | Right of Way and Infrastructure Protection | $71,200,000 | Infrastructure Improvements for Los Angeles County Region | November 2021 |
| | | | Infrastructure Improvements for Riverside/San Diego County Region | November 2019 |
| | | | Infrastructure Improvements for Orange County Region | September 2017 |
| | | | Infrastructure Improvements for Western San Bernardino County Region | March 2019 |
| **System Flexibility/Supply Reliability Program** | | | | |
| 15402 | Hayfield Groundwater Storage | $40,500,000 | Lake Perris Seepage Water Conveyance Pipeline | June 2018 |
| 15488 | Water Delivery System Improvements | $40,500,000 | Greg Avenue Pump Station Rehabilitation | November 2017 |
| **Treatment Plant Reliability Program** | | | | |
| 15369 | Weymouth Improvements - FY2000/01 Through FY2005/06 | $240,700,000 | Weymouth Filter Valve Replacement | Phase I - August 2017<br>Phase II - May 2018 |
| | | | Weymouth West Washwater Tank Seismic Upgrades | November 2017 |
| | | | Basin Drop Gate Replacement | N/A |
| | | | Weymouth Structural Upgrades | December 2017 |
| | | | Weymouth Administrative Building Seismic Retrofit | December 2017 |

## TABLE 5-3 (Continued)
## MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| 15371 | Jensen Improvements - FY2000/01 Through FY2005/06 | $75,100,000 | Jensen Tank Farm Chemical Containment | June 2018 |
| | | | Jensen Modules Nos. 2 & 3 Traveling Bridge Repairs | February 2018 |
| | | | Jensen Washwater Return Pump Modifications, Stage 2 | December 2018 |
| 15380 | Diemer Improvements | $238,000,000 | Diemer East Basin Rehabilitation | September 2017 |
| | | | Diemer Main Washwater Reclamation Plant | June 2019 |
| | | | Diemer Filter Outlet Conduit Seismic Upgrades | August 2017 |
| 15381 | Mills Improvements | $8,200,000 | Mills Solids Removal Automation | December 2018 |
| 15436 | Diemer Improvements - FY2006/07 Through FY2011/12 | $79,500,000 | Diemer Administration Building Seismic Upgrades | April 2018 |
| | | | Diemer West Filter Valve Refurbishment | February 2018 |
| | | | Diemer West Filter Building Seismic Upgrades | February 2018 |
| | | | Diemer Water Sampling System Improvements | December 2020 |
| | | | Diemer Chemical Feed System Improvements | June 2020 |
| 15440 | Weymouth Improvements - FY2006/07 Through FY2011/12 | $57,000,000 | Weymouth Dry Polymer System Replacement | July 2019 |
| | | | Weymouth Basins Nos. 5-8 Refurbishment | January 2019 |
| 15442 | Jensen Improvements - FY2006/07 Through FY2011/12 | $146,000,000 | Jensen Modules Nos. 2 & 3 Flocculator Refurbishment | August 2018 |
| | | | Jensen Electrical Upgrades, Stage 2 | December 2018 |

## TABLE 5-3 (Continued)
## MAJOR PROJECTS UNDER DESIGN

| Appropriation Number | Appropriation Title | Appropriation Estimate | Project Description | Estimated or Actual Completion Date for Final Design |
|---|---|---|---|---|
| 15452 | Mills Improvements - FY2006/07 Through FY2011/12 | $27,500,000 | Mills Electrical Improvements | August 2017 |
| | | | Mills Inlet Flash Mix Chemical Containment | December 2017 |
| | | | Mills Solid Removal Automation | December 2018 |
| 15477 | Weymouth Improvements - FY2012/13 Through FY2017/18 | $81,000,000 | Weymouth Domestic Fire and Water System Improvements | October 2017 |
| | | | Weymouth Chlorine System Upgrades | May 2019 |
| | | | Weymouth Basin Inlet Gate Improvements | May 2022 |
| | | | ODP Rehabilitation | February 2021 |
| | | | East Washwater Tank Pump Replacement | December 2017 |
| | | | Water Quality Instrumentation Improvements | April 2018 |
| | | | Seismic Assessment for Buildings Nos. 30, 40, and 50 | January 2019 |
| | | | Weymouth Washwater Pump Station Improvements | July 2020 |
| 15478 | Diemer Improvements - FY2012/13 Through FY2017/18 | $10,400,000 | Diemer Chemical Tank Farm Improvements | July 2020 |
| 15479 | Mills Improvements - FY2012/13 Through FY2017/18 | $36,500,000 | Mills Finished Water Reservoir Improvements | June 2019 |
| 15486 | Jensen Improvements - FY2012/13 Through FY2017/18 | $16,300,000 | Jensen Chemical Unloading Containment Upgrades | October 2016 |
| | | | Jensen Finished Water Reservoir No. 1 Roof Refurbishment | April 2019 |
| | | | Jensen Inlet Water Quality Instrumentation Enclosure | June 2019 |
| | | | Jensen Filter Backwash Biological Control System | June 2018 |
| | | | Jensen Fluoride Tank Replacement | November 2018 |
| **Water Quality/Oxidation Retrofit Program** | | | | |
| 15472 | Enhanced Bromate Control | $13,300,000 | Mills Enhanced Bromate Control | June 2019 |

Following are highlights of Engineering Services' operation and maintenance activities during fiscal year 2016/17:

## *California WaterFix*

Engineering Services provided direct support for the California WaterFix in collaboration with Metropolitan's Bay-Delta Initiatives office. Key activities during the fiscal year included: appearing before the State Water Resources Control Board to deliver testimony related to the California WaterFix program's Change of Point of Diversion hearings; continued participation in the Design and Construction Enterprise to provide program management leadership, including preparation of potential program budgets and schedules, while also conducting studies for the Department of Water Resources to answer questions related to comments on the program's Final Environmental Impact Report/Statement. Staff also met with state and federal resource agencies on the Biological Assessment and Final Biological Opinions as they relate to eventual design and construction of the program facilities, and met with stakeholders on the design and construction aspects of the program.

## *Infrastructure Protection*

Engineering Services regularly monitors critical facilities including dams, reservoirs, pipelines and chemical tanks to assess their condition and identify needed repairs to maintain reliable operation. Staff also reviews third-party requests for crossings or use of Metropolitan's right of way. Key activities during the fiscal year included: external corrosion monitoring of the 450 miles of electrically continuous pipelines within the distribution system; monitoring of over 100 miles of pipelines for corrosion by stray current interference; and maintaining cathodic protection systems throughout the distribution system.

## *Dam Safety*

Engineering Services regularly performs inspection of Metropolitan's dams and conducts deformation monitoring to ensure public safety and avoid unplanned outages. Key activities during the fiscal year included: maintained a continuous safety/surveillance program for all 23 dams permitted by the California Division of Safety of Dams; performed detailed field inspections of all dams, and submitted surveillance reports to DSOD; continued preparation of Emergency Action Plans, in anticipation of new legislation that will require specific features to be included in those plans; completed updating inundation maps for seven dams, and initiated updates for 16 other dams.

## *Seismic Resilience*

Engineering Services has developed a proactive seismic resilience strategy with the goal of ensuring that Metropolitan continues water deliveries after a major seismic event. This approach involves regularly assessing the structural capacity of specific facilities and upgrading them as needed; evaluating the vulnerability of the system as a whole and increasing operational flexibility when needed; and improving the seismic resilience of the distribution system over time by incorporating new, seismic-resilient components, such as flexible pipe joints, where effective and economical. Metropolitan also collaborated with the Los Angeles Department of Water and Power and the California Department of Water Resources to create a task force that addresses the unique vulnerabilities of the major imported water aqueducts crossing the San Andreas Fault, in order to improve the overall seismic resilience of imported water supplies to Southern California.

## *Cooperative Education Program*

Engineering Services continued to offer summer and year-round student intern positions for the 15th consecutive year. This program is designed to provide engineering students with an opportunity to augment their studies with practical work experience in the water industry. Seventeen students participated during FY 2016/17.

## *Technical Leadership*

Engineering Services' staff continued participating in technical and professional organizations, including the publication of three technical papers and presentations at nine conferences. Staff continued active participation on committees of professional organizations including the American Water Works Association, American Society of Civil Engineers, American Public Works Association, American Concrete Institute, Greenbook Committee of Public Works Standards, Inc., International Society of Automation, Society for Mining, Metallurgy and Exploration, and Society of American Value Engineers.



*Metropolitan acquired more than 20,000 acres in the Bay-Delta.*

CHAPTER 6

# Legal

The Legal Department represents Metropolitan, its directors, officers and, on occasion, employees in litigation and administrative proceedings; renders legal advice; prepares or reviews contracts; and monitors litigation, administrative proceedings, and state and federal legislative and regulatory proposals that could affect Metropolitan.

## *Major Events*

***Bay-Delta***

*California WaterFix*

Metropolitan supported efforts by the state Department of Water Resources in proceedings before the SWRCB (State Water Resources Control Board) for additional points of diversion for the State Water Project as part of the California WaterFix. Metropolitan is participating as a party in the petition proceedings through the State Water Contractors.

*Delta Wetlands Land Acquisition and Litigation*

Legal Department attorneys assisted in negotiating and drafting the purchase and sale agreement for acquiring over 20,000 acres in the Sacramento-San Joaquin Delta. They also assisted in conducting pre-acquisition due diligence before escrow closed in July 2016.

Legal Department attorneys also have defended Metropolitan in four lawsuits over the purchase: three CEQA (California Environmental Quality Act) cases; and, one interference with contract case filed in three different courts. They successfully defeated requests for temporary restraining orders and a motion for preliminary injunction in the CEQA and interference with contract actions.

Metropolitan settled two of the CEQA cases on favorable terms. The remaining CEQA case is pending in San Joaquin County, where petitioners are preparing the record and have moved for permission to conduct discovery. In the interference with contract case, Metropolitan successfully moved to dismiss some claims in December 2016. In May 2017, the court tentatively granted MWD's motion to dismiss the remaining claims, with a final ruling expected in August.

***State Water Project***

*SWP Contract Extension*

Staff attorneys provided legal advice and support in connection with proposed amendments of Metropolitan's long-term SWP contract with DWR that would extend the duration of the contract and separately implement the California WaterFix and ancillary Delta projects.

*Diversions*

Working on behalf of Metropolitan and the State Water Contractors, Legal staff participated in SWRCB curtailment enforcement proceedings against Byron-Bethany Irrigation District and Westside Irrigation District and intervened along with SWC and other SWC member agencies in the subsequent cases in Contra Costa County Superior Court to protect Metropolitan interests in State Water Project stored water supplies. Staff participated in studies promoted by the Delta Watermaster to test water monitoring technology and studies to further scientific understanding of in-Delta water use. Legal staff also participated with General Manager staff in developing a Metropolitan study plan to investigate the water balance on Metropolitan's Delta islands properties.

***Colorado River***

*Additional Conservation Agreements*

Working with Reclamation, the Central Arizona Water Conservation District, Denver Water, the Southern Nevada Water Authority, the Upper Colorado River Commission, staff helped negotiate and draft 16 agreements with various water users throughout the Colorado River basin. These agreements implement a pilot program for the creation of Colorado River System water to maintain water levels in Lake Mead and prevent shortage through voluntary water conservation and reductions in use.

*Colorado River Drought Contingency Planning*

Staff attorneys participated in negotiations with other Colorado River water users in California and the seven Colorado River Basin States regarding drought contingency plans, including negotiation of projects to increase Lake Mead and Lake Powell reservoir levels.

***Legislation***

Legal staff reviews and provides advice on a broad range of proposed legislation that may affect Metropolitan. As one example, in-house counsel assisted in drafting legislation introduced as AB 2488, to authorize the California Department of Fish and Wildlife to issue a permit to Metropolitan for incidental take of unarmored threespine stickleback, a fully protected fish species that may be impacted by Metropolitan operations and maintenance activities. AB 2488 was enacted in September 2016 and became effective January 1, 2017.

*Drought Legislation*

Metropolitan attorneys provided legal analyses of draft language for state and federal drought relief actions, including proposed federal drought relief legislation and state emergency drought regulations.

***Water Quality***

Legal staff monitored activities of Regional Water Quality Control Boards considering adoption of municipal stormwater discharge permits with potential impact on Metropolitan's operations. Attorneys provided legal advice to Water Quality staff in connection with an Emerging Constituents Task Force established by Santa Ana Regional Water Quality Control Board to study approaches for potential new regulation of trace chemicals in surface and groundwater supplies. The Legal Department assisted water quality staff in a stakeholder advisory process regarding the proposed remediation plan for chromium 6 groundwater contamination adjacent to the Colorado River at the Pacific Gas & Electric Topock compressor station site. Legal staff continued to monitor remediation of perchlorate and other contaminants at the Tronox site. Staff provided legal assistance to the Environmental Planning Team on analysis and comments on Army Corps of Engineers' Clean Water Act general permit and draft federal and state policies regulating wetlands and other waters subject to Clean Water Act jurisdiction.

Legal staff provided legal assistance regarding detections of quagga mussels in Colorado River and State Water Project supplies; developed quagga mussel control plans and other operational measures to address potential water supply impacts from invasive species, including potential impacts to groundwater recharge or replenishment.

***Finance***

In-house counsel, with special counsel, assisted in the closing of Metropolitan financial transactions totaling over $1.2 billion. As part of due diligence associated with debt issuance, legal staff researched methods of compliance with laws, regulations and executive orders relating to terrorism, trade embargoes or money laundering including executive orders on terrorist financing, the Patriot Act, and regulations administered by OFAC (the Office of Foreign Assets Control) of the U.S Department of Treasury. Legal developed and incorporated provisions into contracts for construction, procurement, and professional services, concerning prohibited relationships with sanctioned countries and persons. Legal staff also researched and recommended firms to assist with screening of Metropolitan's vendors against OFAC's list of Specially Designated Nationals and Blocked Persons List.

*San Diego County Water Authority v. Metropolitan et al.*

Legal staff represented Metropolitan in conjunction with outside counsel in litigation challenging the validity of Metropolitan's rates adopted in 2010, 2012, 2014, and 2016, and its charges adopted in 2016 and 2017. In the 2010 and 2012 cases, the San Diego County Water Authority alleged that Metropolitan's allocation of certain SWP costs and demand management program costs to transportation rates rather than supply rates is unlawful, and that Metropolitan's rates do not account for "dry year peaking." SDCWA also alleged breach of the Exchange Agreement entered into between Metropolitan and SDCWA as part of the QSA (Quantification Settlement Agreement) based on allegedly unlawful rates, miscalculation of member agencies' preferential rights to Metropolitan's water supplies, and that a Rate Structure Integrity clause used in certain contracts is unlawful.

The trial court ruled that 100 percent of the SWP and demand management costs in question could not be allocated to transportation rates and, based on that ruling, found that Metropolitan breached the price term in the Exchange Agreement. The court also ruled in SDCWA's favor

on the preferential rights claim. The court ruled in Metropolitan's favor on the "dry year peaking" and RSI clause claims. The court also limited SDCWA's attorneys' fee award to the amount Metropolitan asserted was proper. The judgments issued in the 2010 and 2012 cases were appealed by Metropolitan and nine member agencies supporting Metropolitan, and by SDCWA. The 2014 and 2016 cases have been stayed pending the outcome of the appeal, and the 2017 case is expected to be similarly stayed. In October 2016, the parties' appellate briefing concluded. Oral argument before the California Court of Appeal took place on May 10, 2017 and an appellate decision was issued on June 21, 2017.

The Court of Appeal ruled in Metropolitan's favor on the key issue of SWP costs. The court held that it is lawful for Metropolitan to recover its SWP transportation costs in the transportation rates charged under the Exchange Agreement with SDCWA and in its wheeling rate. The court held that the rates which include SWP costs—the System Access Rate and System Power Rate—comply with all asserted laws, including Proposition 26. The court further stated that the decision does not preclude inclusion of the Water Stewardship Rate (WSR), which recovers demand management costs, in the full-service rate. The court ruled that, based on the record, Metropolitan cannot include the WSR as a transportation cost in the agreement price or the wheeling rate. The court ruled that because the WSR was included in the agreement price, there was a breach. The court remanded the case to the trial court for a redetermination of damages in light of its WSR ruling. The appellate court held in SDCWA's favor on preferential rights, the RSI clause, prejudgment interest, and interpretation of the agreement's attorneys' fees clause. The court stated that on remand, the trial court is to review attorneys' fees to determine whether one party recovered greater relief than the other.

***Litigation***

*Copper Pitting Cases*

Metropolitan and other water agencies prevailed in a "legal issues trial" dealing with allegations that Metropolitan provided "aggressive and/or corrosive" water to its member agencies and the other defendant water agencies delivered "aggressive and/or corrosive" water to consumers which caused pinhole leaks in residential copper plumbing. The court ruled in the water agencies' favor on all key legal issues. Metropolitan was represented by in-house counsel. Some of the plaintiffs

appealed the trial court's decision. The appeal has been fully briefed, and the parties are waiting for the court to schedule oral argument.

*Construction Litigation – Shimmick Construction Company, Inc. et al. v. Metropolitan Water District*

Shimmick alleges it was damaged by Metropolitan's project changes, delays, disruption, and interference and that Metropolitan improperly withheld $2.5 million in liquidated damages from contract payments. The complaint seeks monetary and equitable relief in excess of $10 million, plus interest. Following unsuccessful settlement discussions, the parties have engaged in extensive discovery.

Metropolitan has produced roughly 100,300 documents and reviewed roughly 455,000 documents produced by Shimmick/Obayashi a joint venture. The trial in the case is scheduled for January 16, 2018. Metropolitan is represented by in-house counsel and special counsel.

***Real Estate Matters***

*Palo Verde Irrigation District Land Holdings*

Metropolitan attorneys assisted staff in negotiating renewals of two leases. Following the review of proposals submitted, Legal assisted staff in negotiating new agricultural leases, with provisions to reduce water use by 30 percent and to encourage innovative agricultural practices in the Palo Verde Valley.

*In re Holy Hill Community Church (US Bankruptcy Court)*

Legal defended Metropolitan real property management interests put at issue in a legal battle between different factions of a bankrupt church. The settlement, approved in 2017, provides for a short term lease of up to five years to a developer entity for the use of the upper floors of the Metropolitan-owned parking structure, with an option to purchase the entire property for $10,000,000. In addition, Metropolitan receives certain protections against any environmental clean-up costs and the dismissal of all litigation involving Metropolitan in this matter.

*Pechanga Tribe Agreement*

Metropolitan staff continued to work with Eastern Municipal Water District and Rancho California Water District to finalize modification of Metropolitan's service area boundaries to provide water to portions of the Pechanga Tribal Reservation in Riverside County. Congress approved the settlement agreement in December 2016 which was a precursor to completion of the related water delivery agreements. Staff continues to work with the parties to complete and implement the agreements.

***Managing Energy Costs***

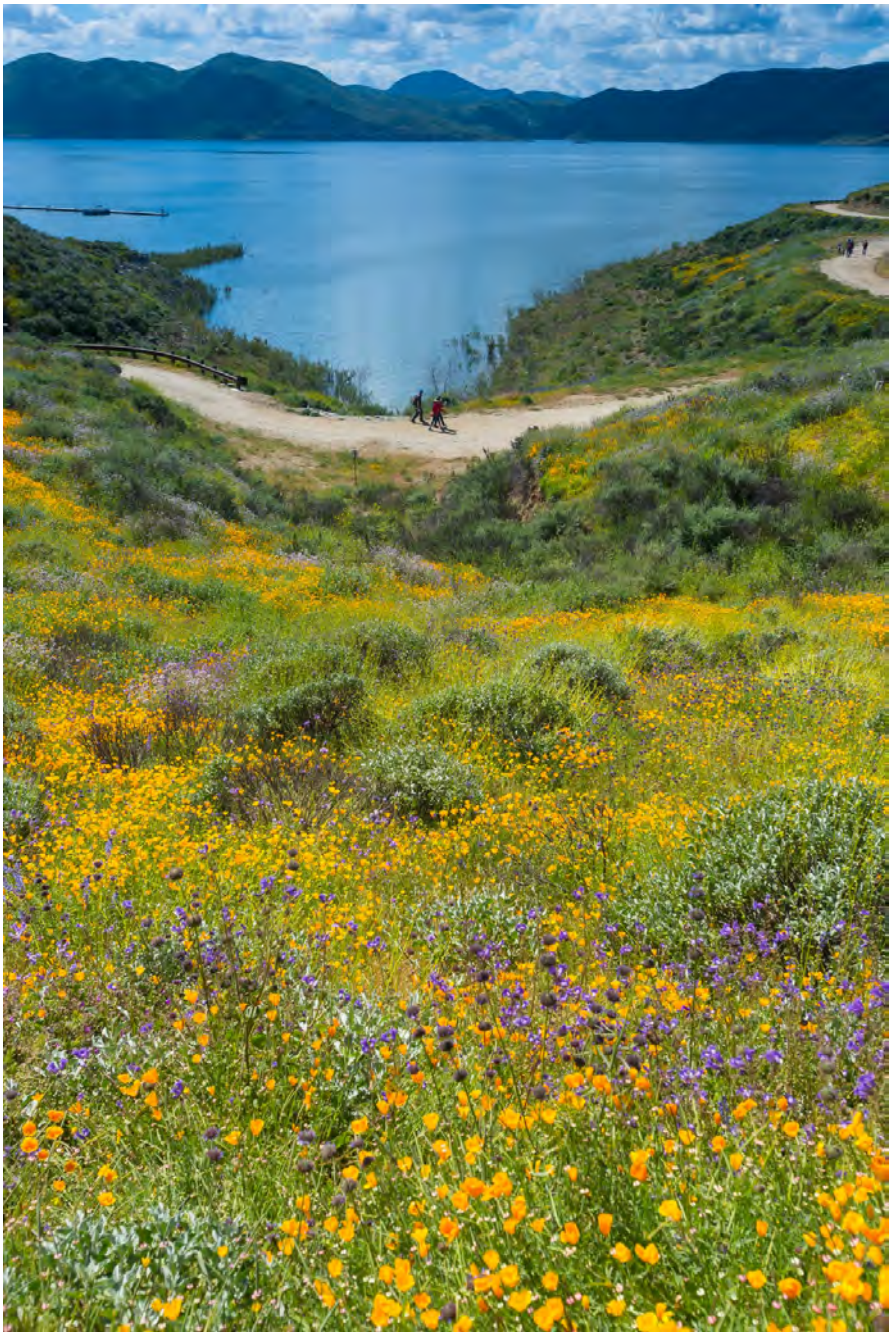
Metropolitan attorneys assisted staff in the negotiation and drafting of a new 50-year agreement with the Western Area Power Administration for Metropolitan's interconnection with WAPA at the Mead Substation. The use of WAPA's transmission facilities is necessary for Metropolitan to obtain its entitlement to energy and capacity from the Hoover Power Plant.

***Workforce Matters***

Following a jury verdict in Metropolitan's favor, which rejected a $7 million claim for damages based on allegations of religious discrimination and retaliation by a former employee terminated for misconduct, the trial judge on January 30, 2017, awarded Metropolitan $43,430 in costs against the plaintiff. This sum represents the expert fees incurred by Metropolitan after making a settlement offer pursuant to Code of Civil Procedure Section 998. Metropolitan was jointly represented by in-house and special counsel.

***Public Records Act Requests***

Legal staff coordinated Metropolitan's responses to over 165 requests under the Public Records Act, including review of all documents for responsiveness and privilege. Requests related to all areas of Metropolitan's business including bids, proposals, contracts and agreements, water quality data, water treatment, conservation-related rebates, data on uncashed checks, water supply, deliveries, sales and transfers, Metropolitan's land purchases and leases, staff compensation, benefits and expenses, history of Metropolitan's facilities, service area, easements and rights-of-way, and the proposed Bay Delta Conservation Plan/California WaterFix.



*A replenished Diamond Valley Lake improved Southern California water supplies and provided a colorful landscape for recreational activities.*

CHAPTER 7

# Finance

The Office of the Chief Financial Officer is responsible for providing innovative, proactive and strategic financial direction in support of the mission of Metropolitan's Board of Directors, management and employees; maintaining Metropolitan's strong financial position and high credit ratings; developing water rates and charges that are fair and equitable and generate sufficient revenues; assisting in the efficient management of Metropolitan's financial resources; and ensuring that adequate financial controls are in place to accurately record financial transactions, communicate financial results and protect Metropolitan assets.

## *Finance Department Overview*

The roles and responsibilities of the Office of the CFO include:

- Providing comprehensive financial analyses and development of the biennial revenue requirement, supporting cost-of-service studies, the recommended water rates and charges, and long-range financial forecasts.
- Developing a biennial budget that supports Metropolitan's mission and business planning and performance measurement programs.
- Maintaining Metropolitan's official accounting records, cash control and accounting services related to vendor, payroll, and other payments.
- Collecting, investing, safekeeping, and disbursing Metropolitan's funds.
- Maintaining effective financial controls to safeguard assets.

- Issuing debt to efficiently fund Metropolitan's Capital Investment Plan at the lowest possible cost.
- Continuing and improving relations with Metropolitan's bond investors, including investors supporting Metropolitan's diversified variable rate bond portfolio.
- Developing and maintaining accounting guidelines and policies for accurate and timely financial reporting and control.
- Accounting for all assets, liabilities, revenues and expenditures, and determining the availability of funds for investment.
- Providing timely financial reporting, preparing the annual tax levy and annexation fee calculations, and administering rates and charges.
- Managing Metropolitan's Business Continuity Program to ensure critical business processes can continue in the event of a disaster.
- Providing risk management to prevent, control, transfer, and minimize exposure to liability risk to protect Metropolitan's assets.

Details on the biennial budget, rates and charges, financial statements, financial policies, and financing documents can be found at the financial information webpage.

***FY 2016/17 Major Financial Activities and Accomplishments***

*Security Sales/Debt Administration*

Metropolitan maintained Standard & Poor's highest long-term water revenue bond rating of AAA, and the second highest credit rating for Moody's and Fitch of Aa1 and AA+ on its senior lien debt.

In August 2016 and September 2016 Metropolitan successfully repriced the 2009 Series A-2, the 2011 Series A-1 and A-3, SIFMA Index Notes, and the 2013 Series E Flexible Index Notes. The SIFMA notes were repriced at rates that ranged from the SIFMA index plus 12

to plus 16 basis points. SIFMA stands for Securities Industry and Financial Markets Association.

In September 2016, Metropolitan issued $103.6 million Special Variable Rate Water Revenue Refunding Bonds, 2016 Series A1 and A2 to refund a series of variable rate bonds and notes. The refunding is projected to provide approximately $3.1 million in total debt service savings.

In December 2016, Metropolitan issued $175 million Subordinate Water Revenue Bonds, 2016 Authorization Series A (Taxable), to reimburse the purchase of lands from Delta Wetlands Properties. These were the first series of bonds issued under Metropolitan's new Master Subordinate Resolution, adopted by the board in March 2016.

In March 2017, Metropolitan issued $80 million Water Revenue Bonds, 2017 Authorization Series A, to fund a portion of Metropolitan's capital expenditures.

In April 2017 Metropolitan issued $125 million Taxable Flexible Rate Refunding Note, Series A-1 and $125 million Index Notes (Taxable and Refunding), Subseries B-1, to refund notes issued in April 2016. The proceeds of the original note financings were used to replenish financial reserves, after set-aside funds were transferred to fund the Exchange Agreement Set-aside Fund related to the San Diego County Water Authority litigation.

In June 2017 Metropolitan issued $238 million Subordinate Water Revenue Refunding Bonds, 2017 Series A to refund several series of fixed and variable rate bonds and a State of California Revolving Fund loan. The refunding is projected to provide $21.8 million in debt service savings.

In June 2017 Metropolitan issued $12 million Tax Exempt Flexible Rate Revolving Notes, Series 2017 B-1 to partially refund a series of fixed rate bonds. The notes were anticipated to be refunded by bonds issued in July 2017.

*Treasury Operations*

- Successfully managed Short Term and Bond Reserve portfolios averaging $869.8 million, complying with the state Government Code and Metropolitan's Statement of Investment Policy.
- Earned total returns of 0.90, -1.91, and -0.13 percent respectively for the Core, Bond Reserve, and Long-Term portfolios.
- Monitored performance by the external managers of the $344.5 million long-term portfolio, to ensure compliance with Metropolitan's Statement of Investment Policy.
- Provided the necessary liquidity to fund approximately $1.9 billion in expenditures during fiscal year 2016/17.
- Managed debt service, which includes the calculation and coordination of approximately $333.7 million in debt service and swap payments.
- Managed net interest exposure within board-approved parameters.

*Accounting Operations*

- Provided accurate, timely and transparent financial reports to the board and member agencies.
- Recorded and reported Metropolitan's financial activities in a timely manner, ensuring sufficient financial controls to protect Metropolitan's assets.
- Completed the FY 2015/16 external audit with an unmodified (i.e. "clean") opinion.
- Achieved internal financial audit reviews with ratings of generally satisfactory or higher and no major findings.
- Maintained the 90-day past-due amounts on non-DWR accounts receivable to below $600,000.
- Continued the documentation and testing of internal controls over financial reporting, concluding that the controls were effective for the fiscal year ending June 30, 2016.

- Received the Award of Excellence from the Government Finance Officers Association for FY 2015/16 for financial reporting.

*Budget and Financial Planning*

- Implemented Metropolitan's biennial budget and water rates and charges for FY 2016/17.
- Prepared financial analyses to evaluate the financial impacts of the Regional Recycled Water Program.
- Coordinated a member agency workgroup and prepared analyses to support and implement a potential Treatment Fixed Charge and policy principles.
- Worked with the Legal Department to maintain Metropolitan's ad valorem property tax assessment at the FY 2014/15 rate to offset a portion of State Water Contract costs; prepared the analysis to support the updated annexation fee.
- Received the GFOA Distinguished Budget Presentation Award for the FY 2016/17 and 2017/18 biennial budget.

*Business Continuity*

- Enhanced the Business Continuity Management software (Fusion) to capture better information during the Business Impact Analysis and align with industry best practices; enhanced the business continuity plan template to be more comprehensive and produce an actionable and easy-to-follow outline of steps to be taken to resume critical operations.
- Created a SharePoint site to serve as a resource for the business continuity coordinators, providing a cloud-based secure environment to serve as a one-stop repository for training resources, collaboration, FAQ's, schedules for various business continuity activities and more.
- Conducted business continuity tabletop exercises for all plans to create awareness and set the foundation for plan updates in cooperation with leadership and other key personnel.

*Risk Management*

- Completed incident reports involving Metropolitan property damage, liability issues, workplace injuries, regulatory visits, criminal activity and spills; managed Metropolitan's self-insured liability and property claims program.

- Completed risk assessments of professional service agreements, purchase orders, construction contracts, entry permits, easements, special events and film permits within required timeframes.

- Collaborated with the Legal Department to accurately manage liability reserves, and also provided feedback into the claims settlement and litigation process with the Legal Department; renewed excess and specialty insurance coverages below anticipated premium costs and within budget.

# *Financial Information*

Metropolitan operates as a utility enterprise and maintains its accounting records in accordance with generally accepted accounting principles for proprietary funds as prescribed by the Governmental Accounting Standards Board. Metropolitan's financial reports can be found at the financial information webpage.

***Revenues***

Metropolitan's principal revenue source is water sales, which include all revenues received by Metropolitan from charges for the sale and availability of water, including Metropolitan's water rates, readiness-to-serve charge and capacity charge. Other sources of revenue include property taxes, investment income and power sales. Water rates and charges are established by the board of directors on a biennial basis and are not subject to regulation by the California Public Utilities Commission or any other governing body.

The rate structure implemented on January 1, 2003 unbundled Metropolitan's previous water rate into separate rates and charges (a power rate, a treatment surcharge, a system access rate, a water stewardship rate and a capacity charge) to provide transparency

regarding the cost of specific functions to member agencies. This rate structure also includes a two-tiered block pricing structure for water supply. Effective January 1, 2017, the full service Tier 1 rate (including all rate elements), which is based on recovering the cost of maintaining a reliable amount of supply, was $666 per acre-foot for untreated water. Likewise, the full service Tier 2 rate of $760 per acre-foot is set at Metropolitan's cost of purchasing water transfers north of the Delta and encourages member agencies to maintain existing local supplies and develop cost-effective local supply resources and conservation. A complete list of current water rates and charges is available in Table 7-1. Overall, Metropolitan increased rates and charges 4.0 percent effective January 1, 2017.

Metropolitan is empowered under the Metropolitan Water District Act to levy and collect taxes on all taxable property within its boundaries for the purpose of carrying on its operations and paying obligations. Property taxes are levied annually by the board to pay Metropolitan's general obligation bond debt service and part of its State Water Contract costs.

Metropolitan’s revenues in fiscal year 2016/17 totaled $1.484 billion. Sources of revenues include water sales, readiness-to-serve charges, capacity charges, power sales, property taxes, investment income and other income, such as rents. Total revenues were $27 million lower than the prior fiscal year, primarily due to lower water sales.

# TABLE 7-1
# WATER SALES RATE STRUCTURE-CURRENT

(Dollars per acre-foot-unless otherwise specified)

| | Calendar Year[1] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 |
| Tier 1 Supply Rate | $ 201 | $ 156 | $ 158 | $ 148 | $ 140 | $ 106 | $ 104 | $ 101 | $ 109 | $ 73 |
| Delta Supply Surcharge[2] | n/a | n/a | n/a | n/a | n/a | 58 | 51 | 69 | -- | -- |
| Tier 2 Supply Rate | 295 | 290 | 290 | 290 | 290 | 290 | 280 | 280 | 250 | 171 |
| Water Supply Surcharge | -- | -- | -- | -- | -- | -- | -- | -- | 25 | -- |
| System Access Rate | 289 | 259 | 257 | 243 | 223 | 217 | 204 | 154 | 143 | 143 |
| Water Stewardship Rate | 52 | 41 | 41 | 41 | 41 | 43 | 41 | 41 | 25 | 25 |
| System Power Rate | 124 | 138 | 126 | 161 | 189 | 136 | 127 | 119 | 110 | 110 |
| Full Service Untreated: | | | | | | | | | | |
| Tier 1 | 666 | 594 | 582 | 593 | 593 | 560 | 527 | 484 | 412 | 351 |
| Tier 2 | 760 | 728 | 714 | 735 | 743 | 686 | 652 | 594 | 528 | 449 |
| Replenishment Water Rate[3]: | | | | | | | | | | |
| Untreated | n/a | n/a | n/a | n/a | n/a | 422 | 409 | 366 | 294 | 258 |
| Treated | n/a | n/a | n/a | n/a | n/a | 651 | 601 | 558 | 436 | 390 |
| Interim Agricultural Water Program[4]: | | | | | | | | | | |
| Untreated | n/a | n/a | n/a | n/a | n/a | 537 | 482 | 416 | 322 | 261 |
| Treated | n/a | n/a | n/a | n/a | n/a | 765 | 687 | 615 | 465 | 394 |
| Treatment Surcharge | 313 | 348 | 341 | 297 | 254 | 234 | 217 | 217 | 167 | 157 |
| Full Service Treated: | | | | | | | | | | |
| Tier 1 | 979 | 942 | 923 | 890 | 847 | 794 | 744 | 701 | 579 | 508 |
| Tier 2 | 1,073 | 1,076 | 1,055 | 1,032 | 997 | 920 | 869 | 811 | 695 | 606 |
| Capacity Charge ($ per cubic foot second) | 8,000 | 10,900 | 11,100 | 8,600 | 6,400 | 7,400 | 7,200 | 7,200 | 6,800 | 6,800 |
| Readiness-to-Serve Charge ($Millions) | 135 | 153 | 158 | 166 | 142 | 146 | 125 | 114 | 92 | 82 |

[1] Rates are set on a calendar year basis.

[2] The Delta Supply Surcharge was suspended after 2012.

[3] The Replenishment Program was discontinued after 2012.

[4] The Interim Agricultural Water Program was discontinued after 2012.

Table 7-2 lists revenues by source and the change in revenues from the prior year.

**TABLE 7-2**
**REVENUES**
(Dollars in Millions)

| | Year Ended June 30, | | |
|---|---|---|---|
| | **2017** | **2016** | **Change** |
| Water sales | $ 1,151 | $ 1,166 | $ (15) |
| Capacity Charge [1] | 40 | 45 | (5) |
| Readiness-To-Serve Charge | 144 | 156 | (12) |
| Power Sales [2] | 21 | 7 | 14 |
| Taxes (Net) | 115 | 108 | 7 |
| Investment Income (loss) | 6 | 19 | (13) |
| Other | 7 | 10 | (3) |
| **Total** | **$ 1,484** | **$ 1,511** | $ (27) |

[1] Previously reported as part of water sales.

[2] Previously referred to as power recoveries or hydroelectric power sales.

### *Expenses*

Metropolitan continued its efforts to manage finances, control costs, enhance productivity, pay for conservation and local resource programs, and procure additional supplies during the fiscal year. Major components of Metropolitan operations and maintenance costs include labor, chemicals, utilities, outside services, materials and operating equipment. Table 7-3 lists expenses by function and the changes from the prior year, while Table 7-4 summarizes changes in net position (revenues and expenses).

Metropolitan is one of 29 contractors to the State Water Project. Under the contract, Metropolitan is obligated to pay the state Department of Water Resources its portion of the costs for construction of the system as well as the minimum operations, maintenance, power and replacement costs of the project regardless of the amount of water actually delivered. Variable power charges are based on actual deliveries of supplies from the State Water Project.

In addition, Metropolitan has an obligation to pay its share of the ongoing capital and remediation costs of certain off-aqueduct power facilities regardless of the amount of water delivered.

Metropolitan also buys power to pump Colorado River water into its service area. The power is secured by Metropolitan under federal energy contracts and from purchases of supplemental energy from a variety of sources as available. In addition, Metropolitan has entered into, and is negotiating, a number of agreements with entities along the Colorado River that have higher priority rights to water on the Colorado River. These agreements give Metropolitan firm rights to water that it otherwise would not have.

Construction requirements to rehabilitate and repair facilities, and provide enhanced water treatment capability are being funded by a combination of long-term debt as well as from operating revenues. General obligation bond debt service is funded from ad valorem property taxes. Tables 7-5 and 7-6 show assessed valuations and property tax rates for FY 2016/17 and the preceding nine years, while Table 7-7 shows property tax levies and collections. Revenue bond debt service is funded from water sales revenues. Table 7-8 is a 10-year summary of net operating income and revenue bond service coverage, while Table 7-9 is a listing of Metropolitan's 10 largest water customers.

Fiscal year expenses totaled $1.410 billion. Expenses include power and water costs, operations and maintenance costs, depreciation and amortization, and interest on debt obligations. Total expenses were $301 million less than the prior year, mainly due to $97 million in lower power and water costs, and $162 million less in operations and maintenance costs associated with funding conservation incentives.

**TABLE 7-3**
**EXPENSES**
(Dollars in Millions)

| | Year Ended June 30, | | |
|---|---|---|---|
| | **2017** | **2016** | **Change** |
| Power and Water Costs | $ 455 | $ 552 | $ (97) |
| Operations and Maintenance | 488 | 650 | (162) |
| Depreciation and Amortization | 302 | 377 | (75) |
| Bond Interest | 135 | 127 | 8 |
| Other | 30 | 5 | 25 |
| **Total** | **$ 1,410** | **$ 1,711** | **$ (301)** |

***Budget Process***

Metropolitan combines elements of program budgeting and performance reporting in its budget system. These elements provide for funding, analysis, review and control. The biennial budget for fiscal years 2016/17 and 2017/18 was presented to and discussed by the board during February and March 2016, and approved in April 2016.

The biennial budget process begins in July of odd-numbered years (e.g., July 2015 for the FY 2016/17 and FY 2017/18 biennial budget) when each group identifies major maintenance and capital projects. Project requests are submitted to Engineering Services beginning in July, giving staff adequate time to plan project design and construction schedules, and to allow Water System Operations to plan for system shutdowns. Each department and group prepares operating budgets from August to November. Each program is analyzed and reviewed as to resources required and the extent to which the program is consistent with the priorities and strategies of the General Manager's Business Plan. All recommended programs are then incorporated into the overall budget. The proposed biennial budget includes a 10-year forecast of revenues, expenditures, unrestricted reserve balances and projected rates and charges. These forecasts incorporate projected costs associated with the repair and replacement of existing infrastructure, and also the projected costs of a California WaterFix, to help member agencies and the general public understand long-term cost trends and potential future water rate impacts.

Budgetary control is maintained through monthly variance reports, which compare budget estimates with actual revenues and expenses for board and management information and form the basis for corrective actions. All major expense categories are controlled via the board-approved biennial budget and authorized appropriations. Since adopting a biennial budget, a mid-cycle update is provided to the Metropolitan Board of Directors at the midpoint of the two-year period.

***Treasury Operations and Cash Management***

Annually, Metropolitan's board approves the Statement of Investment Policy and delegates to the Treasurer the authority to invest Metropolitan funds.

Investments by the Treasurer are limited to those instruments specified in the board-approved Statement of Investment Policy, which sets out, in order of priority, three fundamental criteria to be followed: safety, liquidity and return.

Metropolitan is permitted by state law and board policy to invest in a variety of instruments including U.S. Treasury securities, federal agencies, repurchase agreements, negotiable certificates of deposit, bankers' acceptances, prime commercial paper, asset and mortgage-backed securities, and California local agency securities, including securities issued by Metropolitan. Investments can also be made in corporate notes, time deposits, investment contracts, shares of beneficial interest, and the Local Agency Investment Fund.

Treasury activities during the year included the management of the short-term and bond reserve portfolios and oversight of the firms managing the long-term investment portfolios. Metropolitan's total portfolio averaged approximately $1.2 billion during fiscal year 2016/17, with cash basis investment earnings of approximately $15.4 million. As of June 30, 2017, the market value of Metropolitan's investment portfolio was approximately $1.4 billion.

# TABLE 7-4

## TEN-YEAR SUMMARY OF CHANGES IN NET POSITION (UNAUDITED) - ACCRUAL BASIS[1]

(Dollars in Millions)

| | Fiscal Year Ended June 30, | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2015 [2] As Adjusted | 2014 | 2013 | 2012 [3] As Adjusted | 2011 [3] As Adjusted | 2010 | 2009 [4] As Adjusted | 2008 |
| Water sales | $ 1,150.5 | $ 1,166.0 | $ 1,382.9 | $ 1,484.7 | $ 1,282.5 | $ 1,123.3 | $ 1,001.0 | $ 1,010.9 | $ 999.5 | $ 958.7 |
| Readiness-to-serve charges | 144.0 | 155.5 | 162.0 | 154.0 | 144.0 | 135.5 | 119.5 | 103.0 | 87.0 | 82.1 |
| Capacity charge | 39.7 | 44.7 | 37.5 | 28.4 | 28.7 | 33.0 | 34.4 | 33.4 | 32.6 | 32.6 |
| Power recoveries | 20.9 | 7.5 | 8.4 | 14.6 | 24.5 | 31.5 | 22.9 | 18.3 | 17.4 | 23.1 |
| **Operating revenues** | 1,355.1 | 1,373.7 | 1,590.8 | 1,681.7 | 1,479.7 | 1,323.3 | 1,177.8 | 1,165.6 | 1,136.5 | 1,096.5 |
| Taxes, net | 115.4 | 107.9 | 102.3 | 94.5 | 94.8 | 79.2 | 79.3 | 98.1 | 105.6 | 98.7 |
| Investment income | 6.2 | 19.4 | (3.6) | 5.7 | (0.4) | 4.1 | 2.0 | 40.6 | 27.3 | 65.9 |
| Other, net | 7.3 | 10.2 | 5.4 | - | 6.1 | 0.6 | 22.0 | 6.4 | 6.0 | 2.9 |
| **Nonoperating revenues** | 128.9 | 137.5 | 104.1 | 100.2 | 100.5 | 83.9 | 103.3 | 145.1 | 138.9 | 167.5 |
| **Total revenues** | 1,484.0 | 1,511.2 | 1,694.9 | 1,781.9 | 1,580.2 | 1,407.2 | 1,281.1 | 1,310.7 | 1,275.4 | 1,264.0 |
| Power and water costs | (455.4) | (552.3) | (473.6) | (510.1) | (371.3) | (384.0) | (364.8) | (433.7) | (402.1) | (350.3) |
| Operations and maintenance | (487.5) | (650.1) | (543.4) | (439.7) | (419.8) | (433.5) | (394.9) | (395.6) | (440.0) | (405.0) |
| Depreciation and amortization | (301.7) | (376.5) | (374.8) | (261.5) | (265.4) | (290.1) | (286.4) | (246.4) | (226.1) | (228.9) |
| **Operating expenses** | (1,244.6) | (1,578.9) | (1,391.8) | (1,211.3) | (1,056.5) | (1,107.6) | (1,046.1) | (1,075.7) | (1,068.2) | (984.2) |
| Bond interest | (134.6) | (126.9) | (132.5) | (146.7) | (150.2) | (135.8) | (135.7) | (133.3) | (103.4) | (120.0) |
| Interest and adjustments on OAPF [5] | (0.6) | (0.8) | (1.2) | (1.6) | (2.1) | (2.6) | (3.0) | (3.4) | (3.8) | (4.1) |
| Other, net | (30.3) | (4.6) | - | (23.7) | | | | | | |
| **Nonoperating expenses** | (165.5) | (132.3) | (133.7) | (172.0) | (152.3) | (138.4) | (138.7) | (136.7) | (107.2) | (124.1) |
| **Total expenses** | (1,410.1) | (1,711.2) | (1,525.5) | (1,383.3) | (1,208.8) | (1,246.0) | (1,184.8) | (1,212.4) | (1,175.4) | (1,108.3) |
| Contributed capital | - | 2.1 | 2.3 | 2.2 | 1.7 | 13.6 | 17.7 | 4.6 | 66.1 | 15.6 |
| Cumulative effect of change in accounting principle | - | | (491.0) | | | | (8.2) | | 0.5 | |
| **Change in net position** | $ 73.9 | $ (197.9) | $ (319.3) | $ 400.8 | $ 373.1 | $ 174.8 | $ 105.8 | $ 102.9 | $ 166.6 | $ 171.3 |

[1] Metropolitan implemented Governmental Accounting Standards Board (GASB) Statement No. 63, *Financial Reporting of Deferred Outflows of Resources, Deferred Inflows of Resources and Net Position*, in fiscal 2012. This pronouncement requires that the difference between assets and liabilities be reported as net position, therefore, net assets are now referred to as net position.

[2] Adjustment relates to Metropolitan's implementation of GASB Statement No. 68 (GASB 68), *Accounting and Financial Reporting for Pensions - an amendment of GASB Statement No. 27,* and GASB Statement No. 71. (GASB 71), *Pension Transition for Contributions Made Subsequent to the Measurement Date - an amendment of GASB Statement No. 68.* GASB 68 requires the reporting of net pension liability in the basic financial statements when an organization's pension liability exceeds the net position available for paying benefits while GASB 71 requires the recognition of beginning deferred outflow of resources for pension contributions made after the measurement date. Fiscal years 2008 through 2014 have not been adjusted.

[3] Adjustment relates to the adoption of GASB No. 65, *Items Previously Reported as Assets and Liabilities*. This pronouncement requires debt issuance costs (except prepaid insurance costs) to be recognized as expense in the period incurred. Fiscal years 2008 through 2010 have not been adjusted.

[4] Adjustment relates to implementation of GASB Statement No. 53, *Accounting and Financial Reporting for Derivative Instruments* . This pronouncement requires derivative instruments to be reported at their fair value on the statements of net position along with a related deferred outflow to be recorded for effective hedges.

[5] Off-Aqueduct Power Facilities.

## TABLE 7-5
## TEN MEMBER AGENCIES WITH LARGEST ASSESSED VALUATIONS
## YEAR ENDED JUNE 30, 2017
(Dollars in Billions)

| Member Agency | Assessed Valuation | *Percent of Total |
|---|---|---|
| Los Angeles | $ 523.4 | 20.26 |
| San Diego County Water Authority | 451.9 | 17.49 |
| MWD of Orange County | 441.4 | 17.09 |
| West Basin MWD | 176.2 | 6.82 |
| Central Basin MWD | 133.0 | 5.15 |
| Inland Empire Utilities Agency | 97.8 | 3.79 |
| Calleguas MWD | 94.7 | 3.67 |
| Upper San Gabriel Valley MWD | 93.8 | 3.63 |
| Western MWD | 93.5 | 3.62 |
| Eastern MWD | 69.6 | 2.69 |
| | **$2,175.3** | **84.20** |
| **Total Gross Assessed Valuation (All 26 Member Agencies)** | **$2,583.4** | |

* Total may not foot due to rounding.

## TABLE 7-6
## TEN-YEAR SUMMARY OF ASSESSED VALUATIONS AND PROPERTY TAX RATES
(Dollars in Billions)

| Fiscal Year Ended June 30, | Gross Assessed Valuation [1] | Homeowner's Exemption | Net Assessed Valuation [2] | Secured Property Percentage Tax Rate |
|---|---|---|---|---|
| 2017 | $ 2,583.4 | $ 15.8 | $ 2,567.6 | 0.0035 |
| 2016 | 2,451.0 | 15.9 | 2,435.1 | 0.0035 |
| 2015 | 2,314.9 | 16.2 | 2,298.8 | 0.0035 |
| 2014 | 2,183.4 | 16.3 | 2,167.0 | 0.0035 |
| 2013 | 2,097.4 | 16.7 | 2,080.7 | 0.0035 |
| 2012 | 2,067.5 | 16.9 | 2,050.5 | 0.0037 |
| 2011 | 2,049.1 | 17.1 | 2,031.9 | 0.0037 |
| 2010 | 2,081.9 | 17.2 | 2,064.7 | 0.0043 |
| 2009 | 2,120.9 | 17.2 | 2,103.7 | 0.0043 |
| 2008 | 2,015.4 | 17.1 | 1,998.3 | 0.0045 |

[1] Gross assessed valuations (before deduction of Homeowner's and Business Inventory Exemptions), as of August each year, of all secured and unsecured property within Metropolitan's service area, as certified by the County Auditor-Controllers for the respective counties.

[2] May not foot due to rounding.

# TABLE 7-7

## TEN-YEAR SUMMARY OF PROPERTY TAX LEVIES AND COLLECTIONS (UNAUDITED) CASH BASIS

(Dollars in Thousands)

| Fiscal Year Ended June 30, | Total Tax Levy | Tax Collections | | | Outstanding Delinquent Taxes [2] | Percent of Current Taxes Collected to Total Tax Levy | Percent of Total Tax Collections to Total Tax Levy | Percent of Delinquent Taxes to Total Tax Levy |
|---|---|---|---|---|---|---|---|---|
| | | Current | Delinquent | Total [1] | | | | |
| 2017 | $ 112,727 | $ 112,727 | $ 2,410 | $ 115,137 | $ - | 100.0 % | 102.1 % | 0.0 % |
| 2016 | 104,829 | 104,829 | 5,825 [3] | 110,654 [3] | - | 100.0 | 105.6 [3] | 0.0 |
| 2015 | 100,066 | 97,687 | 5,320 [3] | 103,007 [3] | 2,379 | 97.6 | 102.9 [3] | 2.4 |
| 2014 | 94,963 | 94,963 | 3,744 | 98,707 | - | 100.0 | 103.9 | 0.0 |
| 2013 | 92,247 | 89,576 | 7,078 | 96,654 | 2,671 | 97.1 | 104.8 | 2.9 |
| 2012 | 94,810 | 80,775 | 9,478 | 90,253 | 4,076 | 85.2 | 95.2 | 4.3 |
| 2011 | 95,385 | 71,069 | 16,987 | 88,056 | 9,478 | 74.5 | 92.3 | 9.9 |
| 2010 | 107,867 | 82,164 | 15,083 | 97,247 | 16,987 | 76.2 | 90.2 | 15.7 |
| 2009 | 109,755 | 91,632 | 12,951 | 104,583 | 15,083 | 83.5 | 95.3 | 13.7 |
| 2008 | 107,059 | 87,670 | 11,224 | 98,894 | 12,951 | 81.9 | 92.4 | 12.1 |

[1] Total tax collections exclude cash payments on new annexations.

[2] Delinquent taxes shown are net of the "Allowance for Uncollectibles" - determined by historical trends of collections and payments.

[3] Amounts were updated subsequent to the Annual Report submission deadline.

# TABLE 7-8

## TEN-YEAR SUMMARY OF NET OPERATING INCOME AND REVENUE BOND DEBT SERVICE COVERAGE[1] (UNAUDITED)

(Dollars in Millions)

| | Fiscal Year Ended June 30, | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 |
| Water Sales [2] | $ 1,151 | $ 1,166 | $ 1,383 | $ 1,485 | $ 1,283 | $ 1,062 | $ 996 | $ 1,011 | $ 988 | $ 968 |
| Additional Revenues [2] | 184 | 200 | 199 | 182 | 173 | 168 | 153 | 135 | 120 | 114 |
| Total Revenues | 1,335 | 1,366 | 1,582 | 1,667 | 1,456 | 1,230 | 1,149 | 1,146 | 1,108 | 1,082 |
| Operating Expenses | (927) | (1,201) | (1,005) | (854) | (793) | (792) | (853) | (825) | (782) | (792) |
| Net Operating Revenues | 408 | 165 | 577 | 813 | 663 | 438 | 296 | 321 | 326 | 290 |
| Hydroelectric Power Revenue & Other | 39 | 30 | 29 | 34 | 48 | 87 | 96 | 52 | 43 | 48 |
| Transfer from Reserve Funds | 33 | 222 | 142 | - | - | - | - | - | - | - |
| Interest on Investments [3] | 4 | 18 | 13 | 19 | (2) | 11 | 17 | 19 | 32 | 46 |
| Adjusted Net Operating Revenues | 484 | 435 | 761 | 866 | 709 | 536 | 409 | 392 | 401 | 384 |
| Bonds and Additional Bonds Debt Service | (306) | (309) | (280) | (343) | (298) | (297) | (277) | (244) | (223) | (219) |
| Subordinate Revenue Obligations | (2) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Funds Available from Operations | $ 176 | $ 125 | $ 480 | $ 522 | $ 410 | $ 238 | $ 131 | $ 147 | $ 177 | $ 164 |
| **Ratios** | | | | | | | | | | |
| Bonds and Additional Bonds Debt Service Coverage | 1.58 | 1.41 | 2.72 | 2.52 | 2.38 | 1.81 | 1.48 | 1.61 | 1.80 | 1.76 |
| Debt Service Coverage on all Obligations | 1.57 | 1.41 | 2.71 | 2.51 | 2.37 | 1.80 | 1.47 | 1.60 | 1.79 | 1.75 |

[1] Prepared on a modified accrual basis for fiscal years 2013-2017 and on a cash basis for fiscal years 2008-2012.

[2] Fiscal years 2008-2011 restated to include exchange sales in Water Sales. They were previously reported under Additional Revenue.

[3] Excludes interest applicable to Bond Construction accounts, Excess Earning account(s), Other Trust accounts, and the Deferred Compensation Trust account.

Minor differences are due to rounding.

# TABLE 7-9
# TEN LARGEST WATER CUSTOMERS
## Year Ended June 30, 2017
Accrual Basis (Dollars In Millions)

| Agency | | Water Sales and Exchanges | * Percent of Total | Water Sales and Exchanges in Acre-Feet | * Percent of Total |
|---|---|---|---|---|---|
| San Diego CWA | $ | 223.9 | 19.5% | 377,327 | 24.5% |
| City of Los Angeles | | 159.5 | 13.9% | 216,319 | 14.0% |
| MWD of Orange County | | 148.8 | 12.9% | 181,428 | 11.8% |
| West Basin MWD | | 105.5 | 9.2% | 109,896 | 7.1% |
| Calleguas MWD | | 83.6 | 7.3% | 87,293 | 5.7% |
| Eastern MWD | | 79.1 | 6.9% | 101,284 | 6.6% |
| Western MWD of Riverside | | 54.6 | 4.7% | 65,054 | 4.2% |
| Three Valleys MWD Central | | 52.3 | 4.5% | 66,235 | 4.3% |
| Basin MWD | | 37.2 | 3.2% | 51,196 | 3.3% |
| Inland Empire Utilities Agency | | 29.9 | 2.6% | 47,848 | 3.1% |
| **Total** | **$** | **974.4** | **84.7%** | **1,303,880** | **84.6%** |
| **Total Revenue** | **$** | **1,150.5** | **Total Acre-Feet** | **1,540,915** | |

* Total may not foot due to rounding.




*IT introduced the idea of supporting Metropolitan operations via unmanned aerial vehicles, such as the drone seen in this simulated montage.*

CHAPTER 8

# Information Technology-Administration

This fiscal year, the former Business Technology Group was reorganized into the Information Technology Group, with administrative services and annexation administration reporting directly to the Chief Administrative Officer, along with environmental planning, which was formerly part of Engineering Services.

## *Information Technology*

The IT Group delivers technology options, services and solutions for enterprise and business applications, mobile/wireless computing, control systems, telecommunications, network services and cyber/information security.

### *IT Strategic Plan Update*

Staff continued implementing initiatives outlined in the IT Strategic Plan optimizing water system operations, improving asset management, streamlining business operations and managing costs.

### *Highlights for Fiscal Year 2016/17*

- Completed the Emergency Response Two-Way Radio Project.
- Initiated deployment of a new phone system.
- Completed 95 percent of the design phase to replace and upgrade the control and electrical protection systems at the Wadsworth Pumping Plant.
- Completed a systemwide hydraulic model to assist with rehabilitation of the pre-stressed concrete cylinder pipe portions of the Second Lower Feeder.

- Obtained board authorization and appropriated $1.54 million to upgrade Metropolitan's cybersecurity capabilities.
- Introduced the use of unmanned aerial vehicles (drones) to support Metropolitan operations, such as the 2017 Solar Cup.
- Implemented Skype for Business for online meetings and conferences.
- Remediated business and security risks associated with 350 computers that were running on older, less-secure operating systems.
- Redesigned bewaterwise.com to be mobile-friendly.
- Implemented a project management enhancement program, which included an extensive training component.

## *Administrative Services*

The Administrative Services Section focuses on business process sustainability and achieving cost reductions and efficiencies. These include contracting services, warehousing, procurement of goods and nonprofessional services, inventory management, Rideshare Program and Spring Green Expo events.

### *Spring Green Expo*

Metropolitan hosted the 10th Annual Spring Green Expo and ECO Innovators Showcase college competition for staff, member agencies and the surrounding community. This year's event showcased over 30 sustainability concept projects designed by nearly 100 students, representing 15 Southern California universities and colleges in Riverside, San Bernardino, San Luis Obispo, San Diego, Orange and Los Angeles counties.

### *Highlights for Fiscal Year 2016/17*

- Enhanced the leave request electronic form, enabling approvals via mobile devices and expanding use of mobile technology to increase productivity.
- Initiated an information enterprise content management system, with information policies and procedures to be

developed in partnership with Information Technology and other Metropolitan business groups.

- Improved online access to warehouse inventory utilizing web-based shopping, with “MyWarehouse” providing an overview of available items throughout Metropolitan’s warehouses.

# *Annexations*

Metropolitan processes member agency requests involving annexation into its service area. One annexation totaling approximately 8.3 acres was completed this year, while four annexation requests are pending completion. One pending annexation has the potential to increase Metropolitan’s service area by approximately 460 acres.

# *Environmental Planning*

The Environmental Planning Section provides specialized services for Water System Operations, Water Resources Management, Engineering Services, Real Property, and External Affairs. These services include CEQA (California Environmental Quality Act) compliance, regulatory clearance, construction monitoring, environmental training, reserve management, sustainability planning, and environmental technical support to Metropolitan, members, and outside agencies.

***Highlights for Fiscal Year 2016/17***

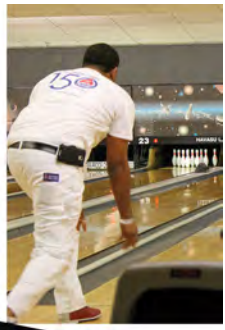
- Completed CEQA documentation, including two Programmatic Environmental Impact Reports; prepared multiple addenda to previously-certified EIRs; and filed 45 Notices of Exemption.
- Provided planning support, CEQA and/or regulatory compliance for 143 engineering projects and 106 operations and maintenance projects.
- Provided CEQA clearance for 204 board letters.
- Reviewed and submitted comment letters on 236 external projects with the potential to impact Metropolitan facilities or water supply.

- Procured Clean Water Act, state and federal endangered species acts, and Fish and Game Code permits for two capital and five O&M projects.
- Obtained emergency permits to repair roads damaged by heavy winter rains.
- Participated in 30 legislative actions impacting Metropolitan's interests in environmental regulatory proposals on climate change, endangered species, wetlands, and CEQA.
- Advocated and provided technical expertise on a legislative solution that allows the issuance of a permit to handle and rescue the endangered unarmored threespine stickleback during shutdown, inspection, and maintenance of the Foothill Feeder, culminating in the successful passage of Assembly Bill 2488.
- Participated in print and radio interviews, and collaborated with External Affairs on the award-winning brochure "Leaders in Environmental Stewardship."



*During 2016/17, a blue grosbeak made a rare visit to DVL East Recreation Basin (top) while endangered bighorn sheep were spotted at Hinds Pumping Plant.*








# Employee Appreciation 2016












*Employee Appreciation events were held throughout Metropolitan during fiscal year 2016/17.*

CHAPTER 9

# Human Resources

The Human Resources Group maintained its focus on effective people management, while building strong partnerships with management on selecting, engaging, motivating, developing and valuing staff accomplishments. Employee development, a strategic priority of the General Manager, focused on preparing the workforce to meet current and future business needs. Work continued on updating HR systems, policies and processes to meet changing compliance requirements, and to further improve the delivery of Human Resources services.

## *Major Activities and Accomplishments*

HR continued to emphasize the importance of effective leadership in engaging and motivating the workforce, complying with laws and regulations and consistently delivering cost-effective HR services. It expanded recruitment outreach to fill job openings with diverse and capable talent, and increased talent development opportunities throughout the organization. HR met monthly with group managers to identify areas of needed support, and worked closely with management on the effective deployment of initiatives and early resolution of issues.

The General Manager launched an annual Employee Appreciation Day event during fall 2016. These events were designed and organized by employee committees at each of Metropolitan's facilities, supported by HR. The events successfully recognized the contributions of employees and their commitment to Metropolitan, and provided an opportunity for employees to interact with each other and have fun.

***Strategic Priority: Employee Development***

HR implemented several initiatives to support the General Manager's strategic priority of Employee Development and ensure that Metropolitan is prepared for continuing retirements, which this year reached a record total of 108.

HR staff provided the board and management with workforce analytics to facilitate planning for pending workforce retirements and expanded diversity outreach efforts. This year, minority representation in the workforce grew to 51 percent. Staff also participated in regional workforce development committees and met with universities and colleges to help align the educational curriculum with Metropolitan business needs.

All groups are addressing the loss of talent – primarily due to retirements. HR staff continued efforts with management to ensure talent is available to fill critical positions. HR expanded internal staff development and training opportunities and worked with local management to identify and assess skill gaps, and facilitated various leadership and management development workshops and succession planning. Staff also supported internship and mentoring programs, and expanded use of job rotations and cross-functional training opportunities throughout Metropolitan.

***Organizational Development and Training***

Management development programs were expanded to address the needs of different levels of management. For employees aspiring to become managers, Management Academies have been established to introduce them to managerial roles and responsibilities. Metropolitan Management University, a new six-day management development program, is mandatory for all new managers and strongly encouraged for existing managers. Instruction is provided by staff, in-house experts and expert consultants on effectively leading, engaging and motivating employees. To date, 60 percent of team managers have completed MMU, while 15 unit managers have completed a more advanced version of the program.

Staff also facilitated various initiatives at the group level, such as the Water Resource Management Group's leadership workshops; the Engineering Group's Career Launch; the Water System Operations Group's Development Camp for its Chemistry Unit; and a Leading Technical People program for managers in various groups.

Training curriculum focused on subjects such as: improved teamwork and collaboration, communication and business writing, effective performance conversations, conflict resolution, project management, problem-solving, plus basic and advanced Microsoft Office skills. Staff expanded online and mobile learning offerings to provide all employees and managers 24/7 access to videos, readings and courses on topics

relevant to their work or career needs. Staff hosted a post-probation, "Day 2" orientation focused on early-career financial planning for 60 new employees.

Staff facilitated group leadership forums and management workshops, and supported team-building, conflict resolution, organizational planning, and mentoring for new associate engineers in Engineering Services.

Eighty-four percent of managers completed mandatory drug and alcohol reasonable-suspicion training, 93 percent of Metropolitan's non-management employees completed drug and alcohol awareness training and 93 percent of employees completed personal security awareness training.

Metropolitan's tuition reimbursement program had 116 participants and staff established partnering agreements with eight local universities to provide tuition discounts, grants and other additional educational benefits for employees. Staff also supported on-site certificate programs such as Water Leadership and Management by partnering with the California State University campuses at Los Angeles and San Luis Obispo, and the Augmented Leader programs from Rady School of Management at the University of California, San Diego.

Sixty managers attended in-depth workshops by leading management experts through the Institute of Management Studies which provided access to state-of-the-art management approaches. Internally, HR provided more than 240 managers opportunities to attend presentations on management topics including leadership development, persuasive communication, executive decision-making, business-case writing, collaborative management, and overseeing technical staff. HR also arranged for workshops on legal aspects of managing people and performance and partnered with the Ethics Office to provide ethics training to the Board of Directors. Eight external coaches provided internal coaching and consultations for managers on issues ranging from transition management and personal development to succession planning.

***Performance Management***

The MyPerformance Evaluation process completed its sixth year of providing a year-round performance planning process that sets clear expectations for work products, goals and performance factors for both employees and managers. It is aligned with Metropolitan business

planning cycles and fosters continuing performance conversations and progress checks throughout the year.

HR also facilitated the Department Head Performance Evaluations of executive staff who report directly to the board. In July 2016, 83 percent of the board participated by providing direct feedback about strategic and operational leadership, board relationships and business results during the previous fiscal year. The Home Committees for each department head conducted progress checks on follow-up actions.

***Recruitment and Classification/Compensation***

More than 24,000 people submitted resumes for job openings during fiscal 2016/2017 and 194 regular and part-time positions were filled – almost three times the number filled in the previous year. HR processed 850 applicants and placed 34 new Pre-Apprentices into Metropolitan's Apprenticeship Program, while supporting student intern recruiting for the Real Property, Business Technology, and Water Resource Management and Water System Operations groups. Equal Employment Opportunity staff participated in several job fairs and outreach efforts to promote the hiring of military veterans and individuals with disabilities.

Staff continued to optimize technologies such as Skype for remote interviews, and eSkill online pre-employment skills-testing for some entry-level positions. Staff completed contracting for a new automated recruitment tracking system providing for improved communication and coordination between job candidates and hiring managers. At the start of each recruitment, HR held strategic partnership meetings with hiring managers to speed the recruitment of each position.

Classification staff validated the merits of more than 100 job promotional requests to ensure the proper classification of employees. Staff reviewed, modified, or created job descriptions, as needed, keeping them current with business needs. HR also completed a market salary survey on department heads and other positions based on various salary surveys.

*Benefits*

Staff updated PeopleSoft to maintain compliance of benefits programs and coordinated with Metropolitan's deferred compensation third-party record-keeper, TIAA Financial Services. To assess participant satisfaction with the services provided by TIAA 401(k) / 457(b) support, focus groups

and a satisfaction feedback survey was sent to all 2,700 employee and retiree plan active participants, with 43 percent submitting their feedback. Staff worked with TIAA to enhance the Self-Directed Brokerage platform and TIAA website user-friendliness and key features.

Benefits staff conducted open enrollment for all employees and met in one-on-one sessions with 685 employees. Staff sent benefits confirmation letters and provided data to CalPERS for an audit of member earnings and enrollments. A Patient Care Advocacy program assisted employees with medical referrals, pre-authorizations and claim issues. Benefits also sent every employee a 2016 Total Compensation Statement to convey the value of benefits and salary provided by Metropolitan. Staff partnered with in-house technical staff to provide 2016 IRS-mandated 1095-C forms to all employees and complete the new 1094-C employer report, both in connection with the Affordable Care Act.

To meet fiduciary responsibilities, Benefits hosted instructor-led workshops and webcasts available to all employees on financial planning, budgeting, the new fund lineup, investment basics, pre-retirement and retirement issues at various Metropolitan locations. More than 350 employees participated in these workshops to help participants with their financial planning and transition into retirement or to simply seek more value from the benefits that Metropolitan provides. In addition, a new class, "Your Survivor Benefits and Beneficiary Designation" was launched at the Gene desert facility to address issues for which surviving family members may need to plan ahead.

Staff coordinated with Payroll and Information Technology to respond and close a CalPERS Audit. Two semi-annual Service Awards Program luncheons with executive management and board members recognized more than 123 employees with 20 to 35 years of service.

A new Wellness program has been developed, with implementation set to begin in 2018.

***Employee Relations/Equal Employment Opportunity Program***

The Employee Relations Section successfully negotiated two five-year memoranda of understanding with the Management and Professional Employees Association and the Association of Confidential Employees. Negotiations continued on a successor MOU with the remaining two bargaining units. Staff responded to all grievances within the prescribed timeframes and worked collaboratively with the bargaining units,

whenever possible, to resolve grievances. Staff was also involved in a number of single-item negotiations, primarily over new or revised job descriptions. The Employee Relations Section also continued to partner with Legal on unfair labor practice charges, hearing officer appeals and employment litigation.

Equal Employment Opportunity staff conducted 10 investigations and 21 informal investigations of unlawful discrimination allegations within the timeframes prescribed by Metropolitan procedures. EEO Investigations staff also worked successfully with outside agencies, such as the State Department of Fair Employment and Housing, to resolve complaints filed against Metropolitan with those offices.

Human Resources staff worked with Water System Operations and the four bargaining units in the Desert Housing Workgroup to improve living conditions and bolster recruitment and retention at select desert facilities.

Metropolitan's Affirmative Action program for protected veterans and individuals with disabilities was updated along with the Nondiscrimination Program for women and minorities. Staff also conducted a workforce self-identification survey on the revised race/ethnicity categories to comply with reporting requirements. Staff partnered with internal volunteer-led employee resource groups to plan expanded outreach opportunities.

Outreach and inclusion efforts included the launching of a new employee resource group, Women at Metropolitan, and continued partnership with Women in Non Traditional Roles, Inc. to provide opportunities for women in the skilled trades. New outreach partnerships and events included a successful veterans job fair at Union Station Headquarters, where Metropolitan also participated in a Veterans Breakfast and Apprenticeship event. Discussions with management groups addressed their responsibilities to provide reasonable accommodations for disabilities.

Staff presented semi-annual reports on EEO and Affirmative Action to the Organization, Personnel and Technology Committee, including an assessment of organizational diversity. A 98 percent completion rate was achieved on mandatory EEO workforce training.

Staff attended the annual CALPELRA (California Public Employees Labor Relations Association) conference which provides legal and legislative updates, as well as topical discussions on various employee relations issues. The Human Resources group manager participated in the

ACWA (Association of California Water Agencies) conference on Defining the Modern Workplace: When Generational Diversity Takes Shape.

### *Workers' Compensation and Medical Screening*

Staff reduced outstanding funding reserves (based on outstanding reserves-per-claim) by 11.7 percent and total workers' compensation payments by 4.6 percent during fiscal year 2016/17. Staff continued to work with employees on workers' compensation or personal medical leave to ensure their timely return to work, with accommodations as necessary.

### *Human Resources Information Systems*

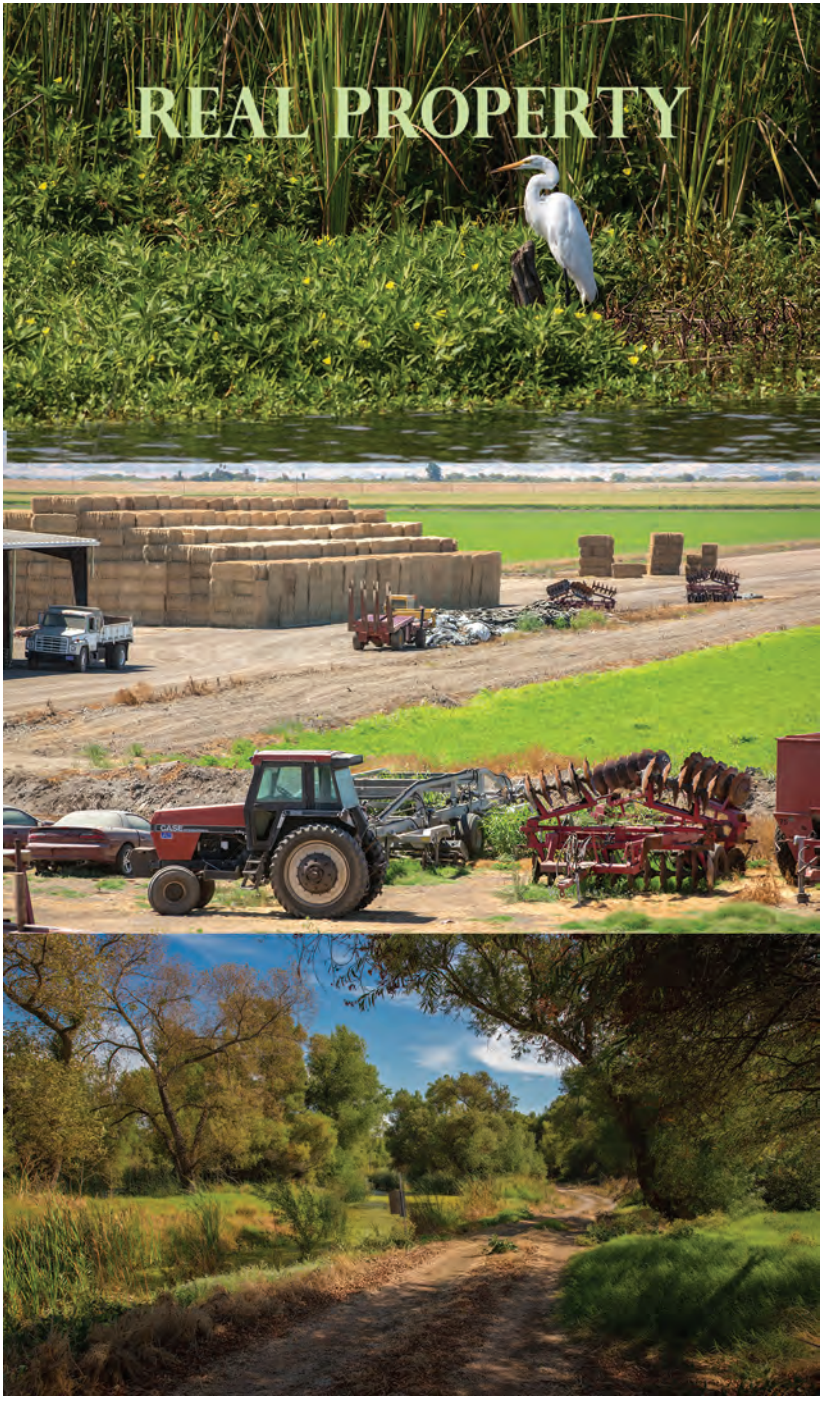
Staff updated HR systems to comply with changes required by new tax laws, MOU agreements, the Affordable Care Act and other technical and security requirements. This entailed creating new benefits structures, leave plans, and records to ensure compliance. Staff also implemented a classification/compensation database to streamline the process and new database to assist with COBRA compliance and administration.

HRIS staff processed all Metropolitan employee job actions, open enrollment processing, salary adjustments and organizational changes keeping MyHR, the employee data system of record, up-to-date and provided reports and analyses for effective people management.

Staff worked to transition Metropolitan's "Reverse 9-1-1" communication system to the Office of the CFO. This is a critical system that can be used to communicate with the workforce during emergencies.

### *Going Forward*

Organizations are continuing to face the challenges fostering an engaged and motivated workforce, competing for talent, adapting to a multi-generational workforce, integrating changing technologies and maintaining compliance with changing requirements. Human Resources continues spearheading efforts to ensure that Metropolitan is prepared to meet future business challenges.


REAL PROPERTY

CHAPTER 10

# Real Property

The Real Property Group applies strategic approaches to the acquisition, management and protection of Metropolitan's real property assets, and seeks to effectively optimize revenues and control land management expenses. Real Property operates under the leadership of the Office of the Chief Administrative Officer, in accordance with policy and principles adopted by the board in August 2011 on managing Metropolitan's real property assets. During fiscal year 2016/17, the group worked to achieve key organizational objectives as outlined in the General Manager's Business Plan.

## *Planning and Acquisition*

The Planning and Acquisition Unit performs property planning, research, valuation, appraisals and acquisition in support of strategic water resources management, environmental mitigation requirements, near and long-term water conveyance, treatment and operational needs. Staff is responsible for ensuring that all rights, interests and benefits inherent in the ownership of real estate are utilized by Metropolitan. Typical processes include performing initial visual inspections to identify environmental concerns; determining historical property uses as part of a qualitative assessment; performing qualitative assessments to identify risk management and implementation; applying real estate valuation principles in conducting highest and best use appraisals; identifying right-of-way needs; conducting complex and detailed property negotiations; and providing relocation assistance services when necessary.

### *Accomplishments for Fiscal Year 2016/17*

- Completed the strategic purchase of four islands in the Sacramento-San Joaquin Delta and a portion of Chipps Island in the Suisun Marsh region, a 20,400-acre investment with

multiple potential values consistent with California's goals of ecosystem restoration and water supply reliability.

- Executed 26 permanent and temporary easements, fallowing easements, entry permits, licenses, consent letters, settlement and release of claims agreements, and leases in pipeline repair and rehabilitation projects including Santa Monica Feeder Pipeline Repair, Rialto Pipeline, San Diego Pipeline No. 3, the Orange County Feeder Relining Project, Calabasas Feeder, Allen-McColloch Pipeline, and the Santa Ana River Bridge Bellows Expansion Joint Replacement.
- Completed review of four independent appraisals for the lease of temporary construction staging areas for the Etiwanda Pipeline North Liner Repair Project; reviewed two easement appraisals for access for the Allen-McColloch Pipeline in Orange County.
- Evaluated proposed alternative alignment options and prepared a study recommending the Preferred Alternative Alignment for the Regional Recycled Water Supply Program.

## *Property Management*

The Property Management Unit ensures that Metropolitan's real property assets and rights are protected, working in conjunction with internal stakeholders and external law enforcement as required. In addition, via secondary land uses, the unit identifies surplus properties and seeks revenue generating opportunities in such market segments as agriculture, telecommunications, energy development, film production, sustainable technology and research. During fiscal year 2016/17, Metropolitan generated over $7.2 million in related revenue.

***Property Management Accomplishments***

- Executed 63 transactions, including secondary use requests; access permits, letters of consent, telecommunication uses, filming permits and infrastructure permits and easements.
- Executed six farm-lease agreements for approximately 22,000 acres within Palo Verde Irrigation District to support Metropolitan's fallowing program and promote agricultural

water use efficiency and innovation, generating approximately $3.5 million per year.

- Executed a lease with Semitropic Water Storage District on Metropolitan-owned islands with anticipated annual revenue of $1 million.
- Collected $1.6 million in revenue from the leases at the Headquarters building.
- Sold 2.75 acres of surplus property near the Inland Feeder Pipeline for $130,000.
- Successfully amended the Sacramento office lease to include two 5-year options, four new offices and six cubicle spaces, four months free rent, and $118,000 of tenant improvements.
- Negotiated a settlement agreement for the Metropolitan-owned parking structure at the Sunset Garage, which provided for a lease with an option to purchase through July 5, 2022 and a release from certain litigation.

## *Facility Management*

The Facility Management Unit is responsible for maintaining and operating the Headquarters building and the Diamond Valley Lake Visitors Center in an energy efficient and sustainable manner. Staff responsibilities include testing and maintenance of all mechanical, electrical and life safety systems.

***Headquarters***

- Performed annual Energy Star audit resulting in an overall rating of 97 out of 100 possible points.
- Completed over 2,000 preventive maintenance tasks to building equipment including the central air-conditioning system, certification and testing of the fire life safety system, and emergency power system.
- Upgraded the building, courtyard fountain, and landscape lighting systems to energy efficient LED fixtures resulting in increased lighting performance and lower maintenance costs.

- Coordinated and completed over 200 employee moves and office reconfigurations creating employee collaboration areas.
- Partnered with Contracting Services to select a vendor for janitorial services.
- Installed hands-free paper towel dispensers and eliminated counter top dispensers, resulting in a projected savings of $20,000 and 1,560 cases of paper towels.
- Certified staging equipment, procured service provider and scheduled window washing services which ceased in 2011 to support water conservation efforts.
- Conducted the biennial food services survey at the Headquarters' building resulting in a satisfaction rating of 3.18 based on a 1.0-4.0 scale, and began working with the vendor to identify areas of improvement.
- Coordinated the hydro-jetting efforts of the entire headquarters sewage system which removed excessive build-up, addressed building plumbing concerns, and reduced plumbing related services by 90 percent.

***Diamond Valley Lake Visitors Center***

- Completed over 500 preventive maintenance tasks to building equipment including the central air-conditioning system, certification and testing of the fire life safety system, and emergency power system.
- Replaced 15 failed solar power inverters, and power washed solar panels to ensure maximum generation and performance of the solar power system.

# *Diamond Valley Lake Recreation Area*

The DVL Recreation Area contains public recreation and education facilities, including the DVL Marina, Lakeview and North Hills trails, and Valley-Wide Recreation and Park District's DVL Community Park and DVL Aquatic Center.

It also contains a Multi-Species Reserve with a seasonal flower trail that opened to the public on February 24 and drew a record

number of visitors to see the rare abundance of color called the "super bloom." Since its 2003 public opening, DVL has hosted approximately 730,000 visitors at its marina facilities and about 160,000 private boats have launched.

The DVL Visitor Center houses key functions of the External Affairs Education program, and is also partially leased to the Western Science Center for the Western Center Academy administrative offices. The DVL Visitor Center and Western Science Center continue to attract year-round visitors for a variety of educational/community events and uses.

***Highlights for Fiscal Year 2016/17***

- Entered into a non-binding Memorandum of Intent with Valley-Wide Park and Recreation District, Eastern Municipal Water District, the city of Hemet, and Riverside Regional Park and Open Space District that will help guide the development of DVL recreation.
- Completed improvements to the DVL Visitor Center Building #4 and then leased the building to the Western Science Center to be used by the Western Center Academy.
- Hosted the 10th annual Bass Fishing Tournament held by the Lake Elsinore Bass Club and National Bass West to honor soldiers who served in Iraq.

## *Staff Training and Development*

Staff attended numerous Metropolitan-sponsored training classes and seminars, webinars and courses offered by the International Right of Way Association and Southern California Chapter of the Appraisal Institute.

Staff has achieved the following state of California professional designations or licenses: Senior Right of Way Professional, Real Estate Salespersons, Broker, Certified General Appraisers, Notary and Facility Management Administrator designation.


H2
Loving water means saving water.
bewaterwise.com
SOLAR SUB
H2O
MWD INNOVATION & TECHNOLOGY
DISCOVER • CONNECT • IGNITE
Why a California Water "Fix"?
Five Reasons:
1. The Big One
2. Drought
3. Groundwater
4. Big Storms
5. The Highest Quality – More Local Supplies
H2
California WaterFix
Securing Reliable Water Supplies for Future Generations
METROPOLITAN: A TRADITION OF SOUND SPENDING
INVESTMENTS TODAY FOR WATER TOMORROW

CHAPTER 11

# External Affairs

The External Affairs Group is responsible for Metropolitan's communication, public outreach, education, legislative and innovation activities. With the emergence of a "new normal" directly impacting California water conditions, External Affairs worked with the general public, news media, legislators, regulators, educators, community groups, labor, business, Metropolitan public member agencies and other stakeholders to communicate the district's interests and its board-adopted policies, using an evolving set of tools to reach a diverse audience.

## *Major Activities and Accomplishments*

### *Advertising and Outreach Campaign*

Metropolitan's award-winning advertising and public outreach efforts continued to evolve in FY 2016/17. Metropolitan's H2Love conservation campaign, which was initiated as a call to action in response to the drought emergency, adapted to California's improved water supply conditions and the end of the drought by encouraging consumers and businesses to make conservation a lifelong habit. Over the course of the fiscal year, the campaign delivered more than 734 million media impressions in five languages. In addition, the district's H2Love branding and marketing was shared with other utilities that incorporated it into their own advertising, broadening the reach of the conservation messaging. Metropolitan's social media growth rates accelerated and a partnership with Major League Soccer's L.A. Galaxy also contributed to the success of the multimedia, multilingual advertising and outreach campaign valued at approximately $4.8 million, including $1.4 million in bonus advertising.

***Media Activities***

Over the past fiscal year, Metropolitan conducted editorial board meetings, press conferences and briefings, while issuing nearly three dozen press releases, including several statements from the general manager and chairman. External Affairs regularly prepared informational materials, videos, talking points and other tools to communicate Metropolitan's operations, policies, news and programs. The Press Office responded to more than 150 media requests for information and interviews on drought conditions, along with queries about the state's record water year, California WaterFix, the damage to the Oroville Dam spillway, the region's water conservation efforts, San Diego vs. Metropolitan rate litigation, drought contingency planning in the Lower Colorado River Basin, finance, Metropolitan's purchase of land on five Delta islands, a proposed regional water recycling program, conservation rebates, planning for the proposed Sites Reservoir, and other key issues.

***Web and Social Media Activities***

Microsites were created to provide informational resources for many of Metropolitan's key initiatives including Water Tomorrow, providing a gateway to existing and new webpages for California WaterFix, the Colorado River, the proposed Regional Recycled Water Project, the Integrated Water Resources Plan, and the innovation and water conservation outreach programs. Metropolitan's California WaterFix site included an online toolkit containing key documents, fact sheets, presentation materials, videos, photos and maps.

MWDinnovates.com was created to highlight Metropolitan's growing portfolio of programs and activities that support innovation, new technologies and entrepreneurs.

Metropolitan's online conservation portal, bewaterwise.com®, was redesigned with a fresh, mobile-friendly navigation and layout, and translated into Chinese and Spanish.

Metropolitan's Facebook page received more than 10 million impressions, with the number of followers increasing 12 percent. A conservation tip posted in June 2017 received 1 million impressions alone. The district's Twitter followers increased by 20 percent, with

engagement increasing nearly 450 percent. Metropolitan used Facebook Live and Snapchat geofilters to reach a broader audience during its conservation campaign.

In 2017, Metropolitan expanded its use of several e-newsletters, raising the number of subscribers to nearly 30,000 and covering a variety of topics including California WaterFix, water education, and key Metropolitan projects and initiatives.

***Legislative and Policy Activities***

Metropolitan sponsored Assembly Bill 2488, which was signed into law by Governor Brown in September 2016. The legislation will allow Metropolitan to perform important work on the Foothill Feeder by authorizing the state to issue incidental take permits for the unarmored threespine stickleback, a fully protected species under the state Endangered Species Act.

Metropolitan worked with U.S. Senator Feinstein, along with congressional members throughout the West to pursue administrative and legislative remedies to would clarify that water conservation rebates should not be taxed. Metropolitan also supported S. 612, the WIIN (Water Infrastructure Improvements for the Nation) Act signed by President Obama in December 2016. The bill provided funding for water infrastructure as well as flexibility in water delivery operations while protecting existing environmental laws.

***Community Partnerships***

More than 50 Community Partnering Program sponsored projects included community gardens and signage, water resource conferences, Earth Day events, garden classrooms, publications, and educational materials on conservation messaging, watershed issues and recycling.

External Affairs maintained a strong speakers bureau, providing presentation materials and arranging speakers, for more than 100 presentations to service organizations and various community groups in all six Southland counties. The most requested topics included water supply updates, Metropolitan's history and regional benefits, conservation programs and water-saving rebates.

***Water Stewardship Education***

Education staff worked with member agencies to hold more than 400 events and engage nearly 300,000 students, teachers, parents and participants through activities, social media and curriculum materials during the fiscal year. Metropolitan continues to develop K-12 water education curriculum in support of California's Education and Environment Initiative. These educational resources align to modern education standards and support early bilingual education (Spanish and Mandarin). During FY 2016/17, more than 18,000 public visitors and students toured the Diamond Valley Lake Visitor Center to learn more about Metropolitan's water systems and operations, programs and water stewardship.

The World Water Forum College Grant Program concluded during Metropolitan's Spring Green event at Union Station, showcasing water conservation and treatment projects. Solar Cup, the nation's largest high school solar boat race, engaged 43 teams and more than 800 high school students in the STEAM (science, technology, engineering, art and math) topics of water stewardship and renewable energy. Metropolitan's "Water is Life" Student Art Exhibit and Calendar annually compiles over 14,000 pieces of art generated by K-12 students throughout Metropolitan's service area.

Inspection trips of State Water Project facilities and the Sacramento/San Joaquin Bay-Delta as well as Metropolitan's Colorado River Aqueduct, Diamond Valley Lake and other district facilities helped inform and engage elected officials, community leaders and the public about Southern California's water resources. This year, nearly 2,100 participants visited these facilities on 70 inspection trips.

***Publications, Video***

External Affairs designed, wrote, distributed and posted roughly 50 new publications. The materials covered a wide range of topics including California WaterFix, the Colorado River and programs to strengthen urban-agriculture partnerships, innovation and climate change, the annual Water Quality Report, the SB 60 annual progress report to the state legislature on conservation, recycling and reuse. Other materials included multi-faceted explanations of conservation program and cutting edge local-supply projects, and environmental

and financial stewardship. Metropolitan also produced the 2016 Annual Report and two California Water maps. Staff also helped design, create and disseminate promotional materials for meetings, special events and other forums, and wrote employee/retiree obituaries.

Metropolitan produced informational videos on California WaterFix, solar technology and the district's purchase of Delta islands, along with the general manager's H20Talk video blog. Metropolitan's "Wings Over the Colorado River Aqueduct" video received nearly 350,000 views.

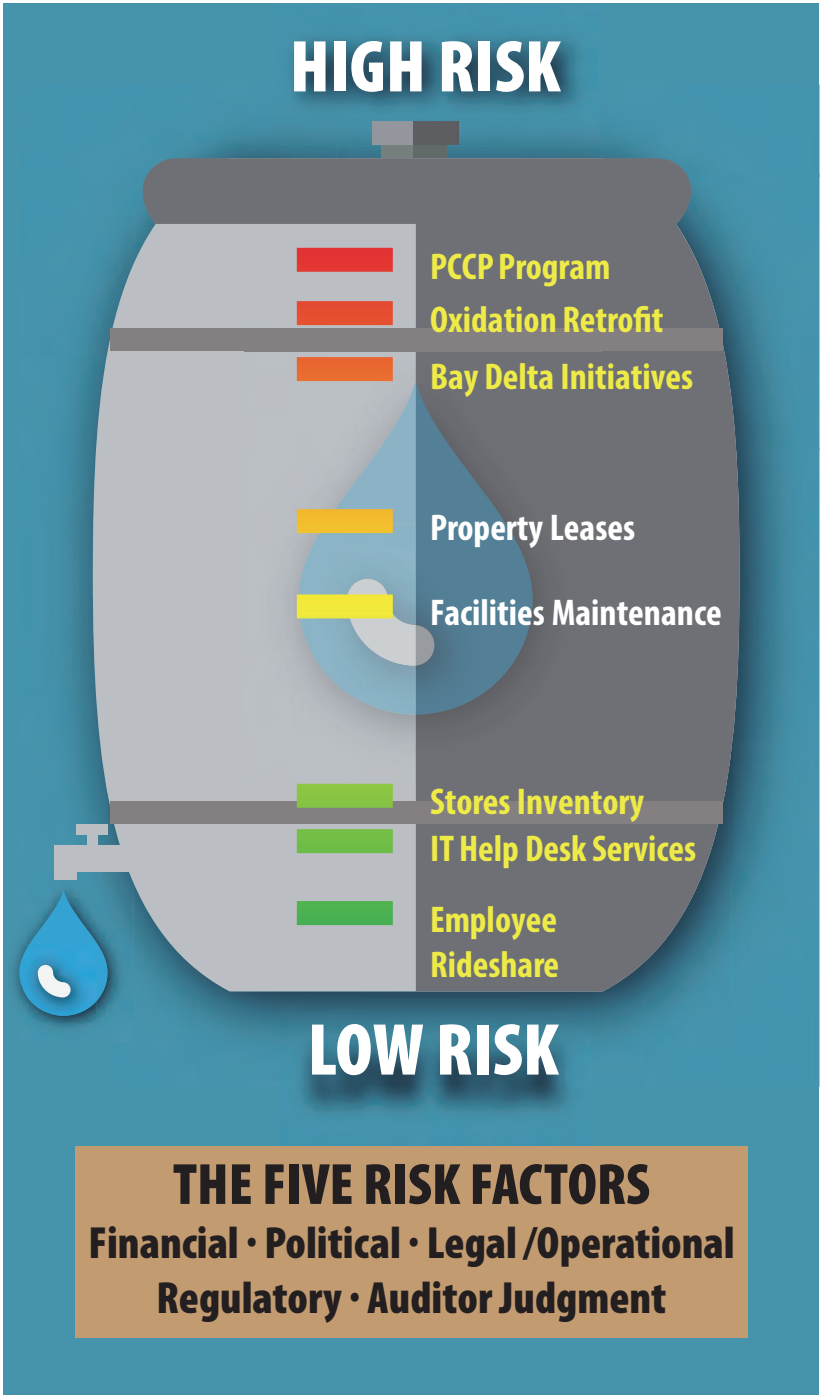
***Outreach for Infrastructure Projects***

External Affairs provided community outreach for major capital and system maintenance projects including pipeline relining, valve replacements, cathodic protection, and maintenance shutdowns. Nearly 6,400 notices were provided, along with community meetings and briefings for city officials.

***Business Outreach, Innovation***

Metropolitan increased its profile as a leader in business outreach and innovation activities including co-hosting the Annual California Construction Expo, which generated more than 1,200 attendees and represented over $150 billion in construction projects. The district's Connect 2 Vet event promoted contracting opportunities to disabled veteran businesses. More than 110 veterans and several member agency representatives attended.

Metropolitan also hosted the Canadian Water Roadshow, at which water technology companies made presentations to Metropolitan member agency staff, and sponsored the "Pilots and Trials" conference featuring technologies pioneered by Metropolitan and its member agencies, as well as other water utilities.




*Audit considers five risk factors when assessing the risks associated with various programs.*

CHAPTER 12

# Internal Audit

Internal Audit provides independent, objective assurance and consulting services designed to add value and improve operations. Internal Audit responsibilities are carried out by audit professionals, who evaluate the extent to which internal controls mitigate risks. Internal Audit also determines whether activities are consistent with policies, procedures, regulatory requirements and contracts. In this way, the audit staff assists management and the Board of Directors in assessing risks that could impact the achievement of their objectives.

Audits are performed in accordance with The Institute of Internal Auditors International Standards for the Professional Practice of Internal Auditing. These standards help define Internal Audit's responsibilities and establish expectations for auditor professionalism and independence. This independence is assured through the Internal Audit Department Charter, which establishes the General Auditor's reporting line to the Board of Directors and the Audit and Ethics Committee.

The Audit and Ethics Committee directs the focus of Internal Audit resources by review and approval of the General Auditor's Annual Audit Plan. The fiscal year 2016/17 Audit Plan resulted from an internal assessment of risks and input from key stakeholders including board members, management and staff.

## *Major Activities and Accomplishments*

During FY 2016/17, Internal Audit contributed to governance activities through the following major actions:

- Successfully carried out the FY 2016/17 Audit Plan, including an audit of the Turf Removal Program that required extensive audit resources and careful coordination with Metropolitan management and contractors.

- Reassessed the Audit Plan quarterly to evaluate whether it met the needs and requests of the Board of Directors and management, focused on highest risks and areas of greatest concern and ascertained whether sufficient progress was being achieved.
- Completed and issued 20 audits and three special projects; monitored five higher risk areas, including board and management requests; issued seven bond comfort letters.

| | **Number of Reports** |
|---|---|
| **Audits:** | **20** |
| Accounts Payable Automation | |
| AECOM, HDR and MWH Americas | |
| Assist External Auditors (2) | |
| AST, Advanced Electronics & Johnson Controls | |
| CH2M Hill & Kennedy Jenks | |
| Chlorine Containment & Handling Facilities | |
| CRA Reliability Program Phase II | |
| Diemer Water Treatment Plant East Basin Rehabilitation | |
| Employee & Director Expenses | |
| Jensen Business Support & Administrative Activities | |
| Lee & Ro, Richard Brady & Associates, Black & Veatch | |
| MWD Web Platform Infrastructure | |
| Oracle Financial Applications | |
| PCCP Rehabilitation and Replacement Program | |
| Power Reliability & Energy Conservation | |
| Safety & Regulatory Services | |
| Stores Inventory | |
| Turf Removal Program | |
| Weymouth Filter Rehabilitation | |
| **Special Projects:** | **3** |
| Purchases Outside Normal Procurement | |
| Turf Member Agency Program | |
| Quality Assurance Self-Assessment | |
| **Monitoring:** | **5** |
| Consulting Contracts (3) | |
| Systems Development Life Cycle 2-Way Radio | |
| Colorado River Water Users Association | |
| **Bond Comfort Letters:** | **7** |
| Water Revenue Refunding Bonds (7) | |

- Evaluated management's response to all significant control issues noted in audit reports; tracked and reviewed management responses on 21 recommendations included in audit reports and ensured timely responses to all reports.
- Assisted the external auditors, Macias Gini & O'Connell, with the performance of the June 30 Annual Financial Audit and Colorado River Joint Powers Authority Reports.
- Completed a reorganization of internal audit staff to enhance communication and promote consistency.
- Conducted department-wide training on group dynamics and team building employing the Myers-Briggs Type Indicator personality tool.

## *Quality Assurance Activities*

Professional auditing standards require internal auditors to maintain a quality enhancement and continuous improvement program. Accordingly, Internal Audit conducts a comprehensive Quality Assurance and Improvement Program annually. For FY 2016/17, the department contracted with the IIA to perform an external review. The broad objectives of this review were to:

- Assess conformity to IIA Standards
- Assess effectiveness in carrying out the department's mission, as set forth in the Audit Department Charter
- Identify opportunities to strengthen the department's value to Metropolitan

The IIA's report, issued May 30, 2017, judged the department to be in "general conformance" with IIA standards, the highest possible rating.

# *Office of* ETHiCS

*Integrity, Transparency and Compliance*




The Metropolitan Water District of Southern California

CHAPTER 13

# Ethics

Created by state legislation in 1999, Metropolitan's Ethics Office promotes and maximizes Metropolitan's transparency, integrity and good government practices. At a time when ethical principles and standards are being analyzed at the highest levels of government, the Ethics Office is committed to safeguarding one of Metropolitan's most valuable assets—its integrity.

The Ethics Officer's core responsibilities are to provide education and advice; investigate potential violations of Metropolitan's internal ethics rules; develop policy; and promote compliance with state ethics laws. Preventing ethical missteps in the first instance is the cornerstone of the ethics program. However, Ethics also has a robust investigation process intended to fairly and objectively address potential violations and encourage accountability.

***Advice and Education***

To assist Metropolitan directors, employees and others in addressing ethics requirements, the Ethics Office offers advice and provides training tailored to meet the specific needs of the targeted audience. One example was the November 2016 district-wide training designed to fulfill state-mandated ethics training for officials. In addition, a monthly conflicts bulletin provides Metropolitan's governing body with detailed information about agendized items, including the sources of potential conflicts of interest affected by the decisions before them and corresponding conflict of interest regulations, to help determine whether their recusal from certain matters is required.

The office also developed an online training program to assist the hundreds of Metropolitan employees who will be required to disclose personal financial interests for the first time in calendar year 2017. The training introduces employees to the concept of financial disclosure and informs employees of their obligations under state law.

***Policies and Procedures***

The Ethics Office is responsible for continuously evaluating its policies and procedures to ensure that they meet the highest standards for effectively implementing Metropolitan's governmental ethics program, while ensuring fairness for all stakeholders involved. This year, the Ethics Office began a review of multiple ethics-related provisions in the Administrative Code to improve Ethics Office processes and procedures and to strengthen the ability to meet mandates.

***Compliance***

Monitoring for compliance with various state-mandated ethics requirements is one of the office's core duties. This year, the Assistant Ethics Officer ushered in a comprehensive overhaul of Metropolitan's conflict of interest code in compliance with applicable state regulations. The new conflict of interest code has been approved by the board and the Fair Political Practices Commission and will take effect in the coming year.

The Ethics Office continues to perform all filing officer duties for Metropolitan to comply with mandatory disclosures of financial interests of designated officials to the Fair Political Practices Commission. In fiscal year 2016/17, the office handled over 400 financial disclosure reports.

***Investigations***

An essential part of the Ethics Office's mandate is to independently investigate and report on alleged violations of Metropolitan's ethics rules. Investigations promote accountability and identify systemic changes for avoiding future missteps.

The past fiscal year has been notable in requiring more attention and resources for investigations. Ethics began the year with a request from the General Manager to investigate alleged conflicts of interest between a manager's personal investments and official Metropolitan duties. The process, which resulted in minor findings that were readily corrected, was more notable for demonstrating Metropolitan's

commitment to accountability, internal monitoring, and self-correction.

Also this year, the Ethics Office undertook investigations involving core issues of governance. While such investigations often face controversy, the ability to work through the issues, find their root causes, and work toward better solutions is a key part of any ethics program.

***Staffing and Professional Resources***

The Ethics Office is responsible for continuously evaluating whether professional staffing levels are sufficient for compliance with its statutory mandate.

This marked the first fiscal year in which the office had two new Deputy Ethics Officer positions. The office experienced a notable increase in the number of matters resolved and a reduction in the amount of time spent to resolve them. The office also established and filled a permanent administrative support position.

In support of the office's ongoing effort to operate in accordance with best practices in the industry, the Deputy Ethics Officers attended the Council on Governmental Ethics Laws conference, where they engaged with experts and colleagues in the fields of governmental ethics, public records legislation, and other areas. The Ethics Officer also attended the California State Bar's conference on the California Public Records Act and Ralph M. Brown Act. The office continues to increase its involvement with professional organizations in the field of governmental ethics and compliance.

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# MONTE VISTA WATER DISTRICT

# 2015 URBAN WATER MANAGEMENT PLAN

June 2016

**Final Draft**










Monte Vista Water District

# MONTE VISTA WATER DISTRICT
# 2015 URBAN WATER MANAGEMENT PLAN

**FINAL DRAFT**

JUNE 2016


**Prepared by Monte Vista Water District Staff:**

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## ACRONYMS and ABBREVIATIONS

| | |
|---|---|
| AB | Assembly Bill |
| AF | Acre-Foot/Feet |
| AFY | Acre-Feet per Year |
| ASR | Aquifer Storage and Recovery |
| BMP | Best Management Practice |
| CBWCD | Chino Basin Water Conservation District |
| CCF | Hundred Cubic Feet |
| CCWRF | Carbon Canyon Water Reclamation Facility |
| CDA | Chino Basin Desalter Authority |
| CIP | Capital Improvement Plan |
| CUWCC | California Urban Water Conservation Council |
| CWC | California Water Code |
| DBCP | Dibromochloropropane |
| DMM | Demand Management Measure |
| DWR | California Department of Water Resources |
| DYY | Dry Year Yield |
| e.g. | For Example |
| ETo | Evapotranspiration |

| | |
|---|---|
| EPA | U.S. Environmental Protection Agency |
| FY | Fiscal Year |
| FYE | Fiscal Year Ending |
| GPCD | Gallons Per Capita Per Day |
| gpf | Gallons Per Flush |
| gpm | Gallons Per Minute |
| IEUA | Inland Empire Utilities Agency |
| IRP | Integrated Resources Plan |
| LEAP | Landscape Evaluation/Audit Program |
| LHMP | Local Hazard Mitigation Plan |
| MCL | Maximum Contaminant Level |
| mgd | Million Gallons per Day |
| mg/L | Milligrams Per Liter |
| MI | Miner's Inch(es) |
| MOU | *Memorandum of Understanding Regarding Urban Water Use in California* |
| MWD | Metropolitan Water District of Southern California |
| MZ | Management Zone |
| OBMP | Optimum Basin Management Program |
| OSY | Operating Safe Yield |
| ppm | Parts Per Million |
| ppt | Parts Per Trillion |
| RP | Regional Plant |
| SAWCo | San Antonio Water Company |
| SAWPA | Santa Ana Watershed Project Authority |
| SB | Senate Bill |
| SCADA | Supervisory Control Data Acquisition System |
| State Board | State Water Resources Control Board |
| SWP | State Water Project |
| TDS | Total Dissolved Solids |
| ULFT | Ultra Low Flush Toilet |
| USC | Urban Stakeholder Committee |
| UWMP | Urban Water Management Plan |
| WFA | Water Facilities Authority |
| WET | Water Education for Teachers |
| WEWAC | Water Education – Water Awareness Committee |
| WSDM | Water Surplus and Drought Management |
| 20x2020 | Water Conservation Act of 2009 (SBX 7-7) Urban Water Use Reduction Requirements |
| Act | California Urban Water Management Planning Act of 1983 |
| Basin | Chino Groundwater Basin |
| Company | Monte Vista Irrigation Company |
| District | Monte Vista Water District |
| Guidebook | Guidebook to Assist Urban Water Suppliers to Prepare a 2015 Urban Water Management Plan |
| Max | Maximum |
| Methodologies | Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (2016 Update) |
| Min | Minimum |
| Plan | Urban Water Management Plan |
| Watermaster | Chino Basin Watermaster |

# EXECUTIVE SUMMARY

California urban water providers are required by the Urban Water Management Planning Act to develop an Urban Water Management Plan (UWMP or Plan) every five years to ensure they have sufficient water supplies available to meet the long-term needs of its various categories of customers during normal, dry, or multiple-dry years. The Water Conservation Act of 2009 (SB X7-7) added additional UWMP reporting requirements.

The Monte Vista Water District (District) 2015 UWMP has been prepared in compliance with these requirements. In summary, the water reliability analysis in Section 5 of this Plan indicates the District can expect its available supplies to significantly exceed anticipated demands over the 25-year planning period. As a result of these surplus supplies, the District should not experience any problems in meetings its demands during normal, single, or multiple dry-year periods over the next 25 years.

### *Service Area and System Descriptions*

The District is a county water district officially formed in 1927 to provide domestic water service to a primarily agricultural area. In the early days, groundwater was the major water supply. Gradually, additional water supplies were identified and developed, including connections to the Colorado River Aqueduct, the creation of the Water Facilities Authority (WFA) to treat northern California imported surface water, the acquisitions of the Monte Vista Irrigation Company and shares in the San Antonio Water Company (SAWCO), and development of a recycled water distribution system. In addition to its retail customers, the District provides wholesale water supply to the City of Chino Hills. At the current time, the District relies on approximately 75 percent of its water supply from groundwater and other local supplies and 25 percent from imported water. The District's 2008 Water Master Plan addresses its water system, supply, and storage infrastructure needs for the next 30 years.

The District's 9.56-square-mile retail service area includes the City of Montclair, portions of the City of Chino, and unincorporated areas of San Bernardino County. The local climate is generally Mediterranean and semi-arid, with little or no summer rainfall. The District's combined retail and wholesale service area population over the next 25 years is projected to grow 19 percent (from 133,177 to 158,849) by 2035. Growth in the retail service area includes a significant development of high density multi-family residential properties within the North Montclair Downtown Specific Plan area of the City of Montclair.

The District currently has 12 active groundwater wells with a combined capacity of approximately 28.2 million gallons per day (mgd). The District's retail water distribution system is comprised of four pressure zones, 198 miles of pipelines, six reservoirs, seven booster stations, three hydrogenerators, and six emergency interconnections with neighboring water agencies. Water is transported to Chino Hills via transmission mains and delivered through two turnout facilities.

***Water System Demands***

Over the past ten years, the District's retail customers have achieved a significant and sustained reduction in demands. As of the writing of this report (May 2016), retail customer demands are 36 percent less than in 2007.

The District used a Land Use Based Water Demand Model for projecting future retail water demands through 2040. Although historical wholesale demand by Chino Hills has ranged between 8,000 and 14,000 AFY, the District will use its full contractual obligation of 20.22 mgd, or 22,650 AFY, in estimating potential future demands by Chino Hills on the District's water system.

**Past, Current, and Projected Water Demand (AFY)**

| Sector | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Total Retail Potable Demand | 9,110 | 11,519 | 11,756 | 12,060 | 12,361 | 12,645 |
| Wholesale Potable Demand | 6,933 | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| **Total Potable Demand** | **16,043** | **34,169** | **34,406** | **34,710** | **35,011** | **35,295** |
| Recycled Water | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Water Demand** | **16,834** | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |

The Water Conservation Act of 2009 requires all California urban water agencies to set and meet certain demand reduction targets, measured in gallons per capita per day (GPCD), in order to assist the state in reducing urban water use by 20 percent by 2020.

The District's Baseline GPCD, the 10-year GPCD average of the years 1996-2005, is 209 GPCD. Opting for a simple 20 percent reduction in total demand, the District's Target GPCD for 2020 is 167 GPCD and its Interim Target GPCD for 2015 is 188 GPCD.

**District Urban Water Use Targets and 2015 Compliance (GPCD)**

| **Baseline Water Use** *(1996-2005)* | **2020 Water Use Target** (-20%) | **2015 Interim Water Use Target** (-10%) | **2015 District Water Use** | **Reduction from Baseline** |
|---|---|---|---|---|
| **209** | **167** | **188** | **137** | **34%** |

The District is required to report in its 2015 UWMP whether we achieved our 2015 Interim Urban Water Use Target of 10 percent reduction from Baseline GPCD. As shown above, **District customers used 137 GPCD in 2015, or 34 percent below our Baseline GPCD, far exceeding our regulatory target of 188 GPCD.**

### *Water System Supplies*

Over the past 15 years, Monte Vista Water District has invested over $50 million in its infrastructure and has increased its water supply capacity to over 50 million gallons per day. Key investments in local groundwater, surface water, and recycled water have focused on building a diverse, drought-resilient water supply portfolio and reducing reliance on imported water.

The District is dependent on four sources for its long-term water supply:

- Groundwater produced from the Chino Groundwater Basin, an adjudicated basin managed by the Chino Basin Watermaster;
- Imported State Water Project surface water received from the Metropolitan Water District of Southern California (MWD) through the Inland Empire Utilities Agency (IEUA) and the WFA;
- Entitlement water deliveries from SAWCO, including groundwater produced from local adjudicated groundwater basins and surface water produced from the San Antonio Creek Watershed; and,
- Recycled water from IEUA.

**Current and Projected Water Supplies**

| Water Supply Sources | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Chino Groundwater Basin | 8,406 | 28,183 | 28,183 | 28,183 | 28,183 | 28,183 |
| Water Facilities Authority | 7,025 | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 611 | 800 | 800 | 800 | 800 | 800 |
| IEUA – Recycled Water | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Water Supply** | **16,833** | **51,790** | **51,749** | **51,778** | **51,828** | **51,828** |

### *Water Supply Reliability*

Reliability is a measure of a water service system's expected success in managing water shortages. In addition to climate, other factors that can cause supply shortages are natural disasters such as earthquakes, chemical spills, energy outages, and water quality issues.

The District safeguards the quality of its water supply by exceeding state and federal monitoring requirements. The District blends its various sources of water to ensure that the quality of drinking water is in strict compliance with standards. Additionally, local and imported water supplies are being constantly monitored and remediated through regional programs.

The reliability of Chino Basin groundwater is based on long-term hydrology and is not directly impacted by single year or multi-year droughts. SAWCo's local surface water supplies can be impacted by short-term drought events. Northern California climate can impact imported surface water supply reliability, but MWD has mitigated these impacts. Recycled water is considered "drought proof" and is not impacted by climate.

The following tables compare the District's current and projected water supplies and demands in normal, single dry-year and multiple dry-year scenarios for the District. **These projections demonstrate that the District can expect its available supplies to significantly exceed anticipated demands over the 25-year planning period. As a result of these surplus supplies, the District should not experience any problems in meetings its demands during normal, single or multiple dry year scenarios during the next 25 years.**

**Supply and Demand Comparisons (AFY)**

*Normal Year*

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Supply | 51,790 | 51,749 | 51,778 | 51,828 | 51,828 |
| Total Demand | 35,200 | 35,396 | 35,730 | 36,081 | 36,364 |
| **Difference** | **16,590** | **16,353** | **16,048** | **15,748** | **15,464** |

*Single Dry Year*

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Total Supply | 51,646 | 51,605 | 51,634 | 51,684 | 51,684 |
| Total Demand | 35,200 | 35,396 | 35,730 | 36,081 | 36,364 |
| **Difference** | **16,446** | **16,209** | **15,904** | **15,604** | **15,320** |

*Multiple Dry Years*

| | | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **Year 1** | Total Supply | 51,646 | 51,605 | 51,634 | 51,684 | 51,684 |
| | Total Demand | 35,200 | 35,396 | 35,730 | 36,081 | 36,364 |
| | **Difference** | **16,446** | **16,209** | **15,904** | **15,604** | **15,320** |
| **Year 2** | Total Supply | 51,547 | 51,507 | 51,536 | 51,586 | 51,586 |
| | Total Demand | 35,200 | 35,396 | 35,730 | 36,081 | 36,364 |
| | **Difference** | **16,347** | **16,111** | **15,806** | **15,505** | **15,221** |
| **Year 3** | Total Supply | 51,547 | 51,507 | 51,536 | 51,586 | 51,586 |
| | Total Demand | 35,200 | 35,396 | 35,730 | 36,081 | 36,364 |
| | **Difference** | **16,347** | **16,111** | **15,806** | **15,505** | **15,221** |

### *Water Demand Management*

The District is a regional leader in developing and implementing proactive demand management programs that protect existing water resources so that adequate water supplies will be available for sustainable future growth. Investments in reliable local resources have been critical to maintaining current and future water supplies. Equally critical is the promotion of water use efficiency as an integral component of current and future water strategy for the service area.

The District is a charter signatory to the California Urban Water Conservation Council's Memorandum of Understanding Regarding Urban Water Conservation and has maintained its compliance with its Best Management Practices (BMPs—see Appendix M). In addition, the District is required to comply with the Water Conservation Act of 2009's requirements to set and then to meet its urban water use reduction targets of 188 GPCD by 2015 and 167 GPCD by 2020. The District is currently meeting its targets, both individually and regionally, and plans to continue assisting customers in maintaining and enhancing their current water use efficiency practices.

The District was an early adopter in implementing a budget-based tiered rate structure which incentivizes efficient residential and landscape water use. In addition to maintaining and enhancing its local conservation programs, the District will continue to participate in IEUA's Regional Conservation Workgroup, the Water Education Water Awareness Committee, and Chino Basin Water Conservation District programs.

### *Water Shortage Contingency Plan*

The District's Water Shortage Contingency Plan is incorporated into District Ordinance 33 (Appendix O), which establishes year-round water use efficiency best practices and staged water supply shortage measures. This plan addresses emergency shortages, including catastrophic interruptions, and contains mandatory prohibitions, penalties, and consumption reduction methods. The District's stages of action present the measures by which customers are required to implement mandatory water conservation practices during a declared water shortage. The District may declare a shortage due to imported water supply cutbacks by MWD, as well as extended drought, equipment failure, act of terrorism, and/or natural disaster.

During periods of water supply shortages, state-mandated water use restrictions, or emergency conditions, the District may require its customers to reduce demands below levels projected by the current rate structure. This circumstance may result in insufficient revenues to meet necessary expenses. In order to protect the District financially in such circumstances, the District recently adopted "demand reduction rates" as part of its normal rate adoption process in order to ensure financial stability and high quality water service.

# SECTION 1
# INTRODUCTION

## 1.1 PURPOSE AND OVERVIEW

California urban water providers are required by state law to develop an Urban Water Management Plan (UWMP) to ensure they have sufficient water supplies available to meet the long-term needs of its various categories of customers during normal, dry, or multiple-dry years. State of California Water Code (CWC) Sections 10610 through 10656, known as the Urban Water Management Planning Act (Act), requires urban water suppliers (providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually) to develop an UWMP every five years in the years ending in zero and five. Senate Bill (SB) X7-7 (2009), known as the Water Conservation Act of 2009, added additional UWMP reporting requirements.

In the Act, the California Legislature declared that the waters of the state are a limited and renewable resource subject to ever increasing demands; that the conservation and efficient use of urban water supplies are of statewide concern; that successful implementation of plans is best accomplished at the local level; that conservation and efficient use of water shall be actively pursued to protect both the people of the state and their water resources; that conservation and efficient use of urban water supplies shall be a guiding criterion in public decisions; and that urban water suppliers shall be required to develop water management plans to achieve conservation and efficient use.

The Monte Vista Water District (District)[1] 2015 UWMP has been prepared in compliance with the requirements of the Act as amended through 2015 (Appendix A) [2], as well as the additional reporting requirements of the Water Conservation Act of 2009 (Appendix B)[3]. The District's 2015 UWMP is an update of its 2010 UWMP, and incorporates significant information from the District's 2008 Water Master Plan, 2011 Recycled Water Master Plan, and other local and regional planning documents. The District relies on the California Department of Water Resources's (DWR) Guidebook to Assist Urban Water Suppliers to Prepare a 2015 Urban Water Management Plan (March 2016) for the Plan's organization and DWR's Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (updated February 2016) for its compliance with the Water Conservation Act of 2009. A completed DWR 2015 UWMP Checklist, which provides an index showing where Water Code requirements are met in this plan, is included as Appendix C. Appendix D includes reproductions of the standardized tables[4] submitted electronically to DWR along with the 2015 UWMP. All water use and supply data provided in the plan are based on the fiscal year (July through June).

[1] Public Water System Number 3610029.
[2] CWC, Division 6, Part 2.6; §10610, et. seq. Established by AB 797 (1983). Legislation amending the Act since 2010 include AB 2409 (2010), AB 2067 (2014), SB 1420 (2014), and SB 1036 (2014).
[3] CWC, Division 6, Part 2.55; §10608, et. seq.
[4] Tables and content in this plan present the same information as what is included in the DWR standardized tables. However, the table numbers in the plan are not the same as DWR's standardized table numbers. Alignment between the 2015 UWMP's tables and DWR's standardized tables are indicated in both sets of tables.

The UWMP is intended to serve as a general, flexible, and open-ended document that periodically can be updated to reflect changes in regional water supply trends, and conservation and water use efficiency policies. This plan, along with the District's Water Master Plan and other planning documents, will be used by District staff to guide water use and management efforts through the year 2020, when the UWMP is required to be updated.

The Plan is organized into the following sections:

- Introduction
- Water System Description
- Water System Demands
- Water System Supplies
- Water Supply Reliability
- Water Demand Management
- Water Shortage Contingency Plan

In summary, the water reliability analysis in Section 5 of this plan indicates the District can expect its available supplies to significantly exceed anticipated demands over the 25-year planning period. As a result of these surplus supplies, the District should not experience any problems in meetings its demands during normal, single, or multiple dry-year periods over the next 25 years.

## 1.2 PREPARATION

### 1.2.1 Plan Adoption, Submittal, and Implementation

Water Code section 10644(a) requires the District to prepare and adopt the UWMP on or before December 31, and file with the DWR within 30 days after adoption. AB 2067 (2014) provides a six-month extension for adoption of the 2015 UWMP until July 1, 2016. The District's 2015 UWMP was adopted by resolution of the Board of Directors on June 22, 2016, following a public hearing which included discussion of the District's method of revising its urban water use targets under the Water Conservation Act of 2009, certification of meeting its 2015 Interim Urban Water Use Target, and plan to meet its 2020 Urban Water Use Target, as well as the potential economic impacts of meeting these targets (see Sections 3 and 6). This Plan was submitted to local agencies within which the District provides water service, DWR, and the State Library within 30 days of Board adoption. Copies of the Notice of Public Hearing and the Resolution of Plan Adoption are included in Appendix E.

The Draft Plan was made available to the public prior to the Public Hearing and the final adopted Plan was made available to the public within thirty (30) days following District Board approval. This Plan will be used by District staff to guide the District's water use planning and efficiency efforts through 2020 and beyond.

### 1.2.2 Local Agency Coordination and Public Participation

An important component of developing an UWMP is coordination with local public and private stakeholders. These include the following entities:

- Cities and counties that receive water service through the District and direct local land use planning efforts;
- Regional water agencies who work in partnership with the District on regional water resource management strategies; and,
- Local organizations that reflect diverse social, cultural, and economic elements of the District's service population.

Recognizing the importance of this coordination, and in compliance with Water Code Sections 10621(b), 10631(k), and 10642, the District sent letters to the cities of Montclair, Chino, and Chino Hills, to San Bernardino County, and to 11 local community stakeholder organizations in mid-December 2015, notifying them of the District's intent to update its UWMP for 2015 and providing them an opportunity to participate. The District has also communicated with eight additional neighboring cities and local water agencies concerning the District's progress in updating its Plan. A wide range of information and data was obtained, discussed, and used from many of these agencies to assist in the preparation of the Plan. Additionally, these agencies, organizations, and entities were notified of the public hearing and the availability of a draft 2015 UWMP for comment prior to its adoption. A listing of the agencies, organizations, and entities invited to participate in the development of the District's UWMP are listed in Table 1-1. Copies of notifications are included in Appendix E.

### 1.2.3 Regional Alliance

In 2011, the District signed a Memorandum of Understanding for establishing a Regional Alliance to comply with the Water Conservation Act of 2009 (SBX 7-7). SB X 7-7 provides a regional compliance option, where a group of agencies that regionally coordinate conservation efforts can set collective urban water use targets and determine regional methods to achieve said targets through a Regional Alliance. Many of the District's conservation activities are implemented on a regional basis (see Section 6). Other members of the Regional Alliance include the cities of Chino, Chino Hills, Ontario, and Upland, Cucamonga Valley Water District, Fontana Water Company, and San Antonio Water Company. For the Regional Alliance report regarding SBX 7-7 regional compliance, please see Inland Empire Utilities Agency's 2015 UWMP.

**Table 1-1:**
**Local Agency and Organization Coordination**

| **Local Agencies Receiving Water Service from District** (Required) | **60-Day Notice** | **Notice of Public Hearing** |
|---|---|---|
| City of Chino | X | X |
| City of Chino Hills | X | X |
| City of Montclair | X | X |
| County of San Bernardino | X | X |
| **Local Agencies Providing Wholesale Service to District** | | |
| Inland Empire Utilities Agency | X | X |
| Metropolitan Water District of Southern California | X | X |
| San Antonio Water Company | X | X |
| Water Facilities Authority | X | X |
| **Local Agencies Associated with Regional Water Planning** | | |
| Chino Basin Water Conservation District | X | X |
| Chino Basin Watermaster | X | X |
| Santa Ana Regional Water Quality Control Board | X | X |
| Santa Ana Watershed Project Authority | X | X |
| **Local Community and Stakeholder Organizations** | | |
| Building Industry of America, Baldy View Chapter | X | X |
| Chaffey Joint Union High School District | X | X |
| Chino Valley Chamber of Commerce | X | X |
| Chino Valley Unified School District | X | X |
| Inland Empire Economic Partnership | X | X |
| Montclair Chamber of Commerce | X | X |
| Montclair Community Collaborative | X | X |
| Neighborhood Partnership Housing Services | X | X |
| Ontario Montclair School District | X | X |
| San Bernardino County Economic Development Agency | X | X |
| San Bernardino County Superintendent of Schools | X | X |

Aligns with data in DWR Standardized Tables 10-1 R and 10-1 W.

# SECTION 2
# WATER SYSTEM DESCRIPTION

## 2.1 DISTRICT HISTORY AND PURPOSE

Monte Vista Water District (District) is a county water district that was officially formed in 1927 under CWC, County Water District Law, Division 12, Section 30000 et seq. The District's origins date back to the early 1900s, when a land developer first surveyed a tract of land bounded by the railroad tracks and Phillips Street to the north and south, and the wash and State Street to the east and west. This area of land was then known as the "Monte Vista Land Tract" and was used largely for agricultural purposes, primarily citrus orchard farming. Water that was needed for irrigation for the numerous orange and lemon groves in the area was provided by the Limited Mutual Water Company. Limited Mutual Water Company later made the decision to provide domestic water service, and a number of other companies began to express a similar interest. The desire to form a water district under state law led to the election and formation of the District.

After its formation, the District began the long process of purchasing and accumulating facilities for providing domestic water service, including reservoirs, pipelines, pumps, wells, and other water companies. Land was purchased for facility development, and several annexations were accomplished over the decades, the largest of which occurring in 1989 with the addition of a portion of San Bernardino County Water Works #8 service area. This annexation included a population of over 12,000, increasing the total population served by the District to over 46,000 and resulting in peak demand of 14 million gallons per day (mgd) in the 1990s.

In the early days, groundwater was the major water supply. Enough naturally occurring recharge meant the groundwater was sufficient to meet the needs of the area. Gradually, additional water supplies were identified and developed to meet periods of increased demand and also to blend with high-nitrate groundwater supplies in order to meet state and federal regulatory standards. After the construction of the Colorado River Aqueduct in 1935, connections to that supply source assisted in bringing supplemental water to the rapidly growing region. In the 1980s, the District, along with the cities of Chino, Chino Hills, Ontario, and Upland, entered into a joint powers authority agreement to create the Water Facilities Authority (WFA) treatment plant. The WFA can treat up to 81 mgd of surface water imported from northern California through the State Water Project.

More recently, due to the increased unreliability of imported water supplies, the District has made key acquisitions to further develop its local water supply portfolio. In February 1999, the District purchased the Monte Vista Irrigation Company, a private water company founded in 1908, previously involved with agricultural and domestic water supply to the cities of Montclair and Ontario. Through this acquisition, the District increased its production rights in the Chino Groundwater Basin by approximately 1,000 acre-feet per year (AFY). In 2010, the District purchased 300 shares in the San Antonio Water Company, a local mutual stock water company, providing access to approximately 800 AFY of additional water supply.

Finally, the District has successfully implemented a recycled water distribution system. The system currently delivers 300 AFY of recycled water through a separate non-potable distribution system for landscape irrigation. The District eventually plans to deliver 430 AFY of recycled water to offset demand on its potable water system.

At the current time, the District relies on approximately 75 percent of its water supply from groundwater and other local supplies and 25 percent from imported water. These percentages vary according to changing supply conditions.

In addition to its retail customers, the District provides wholesale water supply to the City of Chino Hills. Under the provisions of a long-term agreement executed in July 1998, the District is contracted to deliver to Chino Hills up to 20.22 mgd. Since initiation of full deliveries in 1999, the District has delivered between 7,500 and 14,000 AFY of water to the City under the terms of the agreement.

In 2009, the District Board of Directors adopted the District's 2008 Water Master Plan as its Capital Improvement Plan (CIP) document, addressing water system, supply, and storage infrastructure needs for the next 30 years. The District's Financial Master Plan was most recently updated in January 2016 to provide a mechanism for funding the identified capital projects at a cost of nearly $100 million. Since adoption of its CIP, the District has completed replacement of several miles of pipeline, the construction of three groundwater wells, the development of a recycled water distribution system, and the purchase of San Antonio Water Company stock.

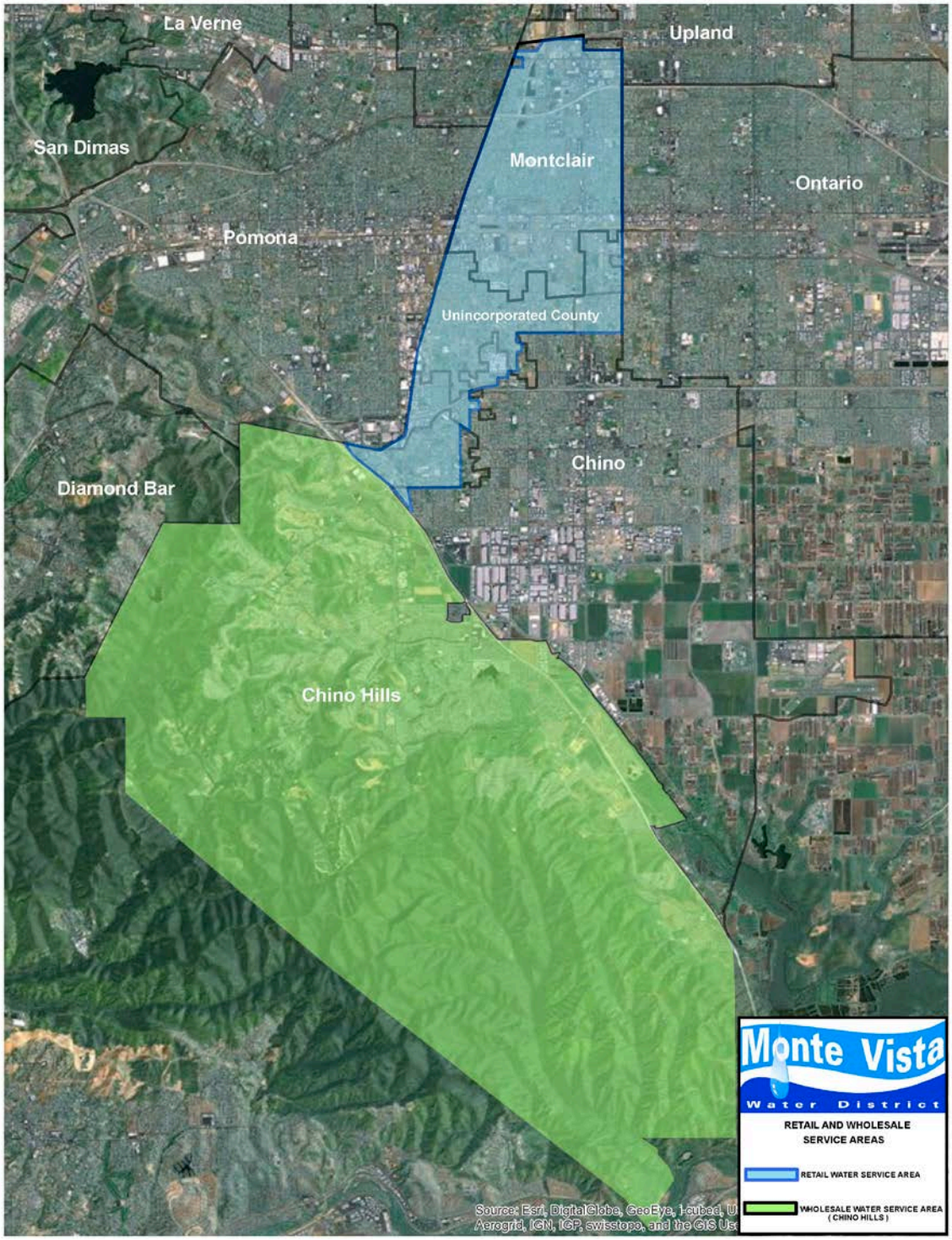
The operation of the District is governed by a Board of Directors, comprised of five members, elected at large within the District. The Board appoints, by majority vote, a General Manager/Secretary, Manager of Finance and Administration, and Legal Counsel, who serve at the pleasure of the Board. The District currently has 36 full-time employees who work in the areas of engineering, operations, maintenance, field service, customer service, billing, finance, human resources, public affairs and administration.

## 2.2 SERVICE AREA CHARACTERISTICS

### 2.2.1 Location

The District's retail service area contains approximately 6,120 acres (9.56 square miles) and includes the City of Montclair and portions of the City of Chino and unincorporated county areas. The retail service area lies adjacent to the westerly boundary of San Bernardino County, bordered by the cities of Upland and Claremont to the north, Ontario to the east, Chino, Chino Hills, and unincorporated areas to the south, and Pomona in Los Angeles County to the west. Interstate 10 runs east and west through the northern portion of the water service area and California State Route 60 runs east and west through the southern portion. The retail service area lies between 700 and 1,250 feet above mean sea level, rising gently northward toward the San Bernardino Mountains, approximately six miles from the northernmost boundary of the District.

**Figure 2-1:**
**District Retail and Wholesale Service Area**



The District's wholesale service area is comprised of the City of Chino Hills, which was incorporated in 1991 and currently encompasses 46 square miles.

See Figure 2-1 for a map of the District's retail and wholesale service areas.

### 2.2.2 Climate

The District is located in a general drainage area known as the Chino Basin, the largest such basin in the upper Santa Ana River Watershed. The Basin's southern California climate is generally Mediterranean, with low historical precipitation rates with wide periodic variations. The local climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, and Santa Ana winds.

**Table 2-1:**
**Service Area ETo, Temperatures and Rainfall**

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total/ Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Average ETo[1] (inches)** | | 1.96 | 2.28 | 3.71 | 4.64 | 5.23 | 5.93 | 6.50 | 6.38 | 4.87 | 3.4 | 2.28 | 1.70 | 48.88 |
| **Temperature[2] (Fahrenheit)** | **Max** | 65.5 | 67.6 | 70.1 | 74.2 | 77.8 | 84.1 | 91.0 | 91.1 | 88.4 | 80.6 | 73.2 | 66.4 | 77.5 |
| | **Min** | 38.1 | 40.3 | 42.3 | 45.6 | 50.0 | 53.4 | 57.7 | 58.1 | 55.3 | 49.8 | 42.6 | 38.4 | 47.6 |
| **Rainfall[2] (inches)** | | 3.56 | 3.49 | 2.82 | 1.22 | 0.35 | 0.10 | 0.01 | 0.07 | 0.26 | 0.78 | 1.56 | 2.77 | 16.97 |

[1] California Irrigation Management Information System, Station #78 (Pomona), wwwcimis.water.ca.gov.
[2] Western Regional Climate Center, Pomona Fairplex (047050), Monthly Climate Summary, Period of Record : 11/1/1893 to 1/20/2015, accessed May 17, 2016. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7050.

Table 2-1 lists the average annual Evapotranspiration ($ET_o$)[5], temperatures, and rainfall for the District's service area. Average high temperatures range from 65 degrees Fahrenheit in January to 91 degrees Fahrenheit in July and August. Average annual precipitation is approximately 17 inches, with most precipitation typically occurring between November and April. There is usually little or no summer rainfall and often the predominant periods of rain do not occur until January. ETo averages 49 inches annually.

### 2.2.3 Population

The high cost of land in Los Angeles area increased the attraction of the Chino Basin and other suburban areas where land was still plentiful during the "urban sprawl" era. Following the economic downturn in the late 2000s, development is starting to return to the region, but there are differing opinions on how rapidly the area will grow in population during the coming decades.

[5] ET is the loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues). It is an indicator of how much water crops, lawns, gardens, and trees need for healthy growth and productivity. ET from a standardized grass is commonly denoted at $ET_o$.

Current and projected population estimates for the District's retail service area are provided in Table 2-2. The 2015 population estimate was developed based on city growth estimates and known development in the service area since 2010 (see Appendix F). In order to project the District's service area population for the next 25 years, it is necessary to divide the service area by municipal boundaries and use population estimates and growth projections for each subarea, as described in the footnotes to Table 2-2.

As shown in the table, the District's retail service area population over the next 25 years is projected to grow by approximately 18 percent (from 55,581 to 65,649). The largest demographic shift in the foreseeable future for the District retail service area will be a continued increase in multi-family housing units in proportion to single-family housing units. This shift will largely be due to the development of high density residential properties within the North Montclair Downtown Specific Plan area of the City of Montclair. The maximum number of dwelling units projected for the Specific Plan area at build-out is 2,800.[6]

The current population of the District's wholesale customer, the City of Chino Hills, is 77,596. The city projects its population will grow to 94,895, or 22 percent, in 20 years (a 2040 population projection was not provided). For more information on the city's population projections, see Chino Hills's 2015 UWMP.

In total, the District's retail and wholesale population is projected to grow by just over 19 percent (from 133,177 to 158,849) by 2035.

**Table 2-2:**
**Service Area Population – Current and Projected**

| Area | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| City of Montclair[1] | 38,332 | 39,700 | 41,100 | 42,500 | 43,900 | 45,346 |
| City of Chino[2] | 4,235 | 4,955 | 4,955 | 4,955 | 4,955 | 4,955 |
| Unincorporated[3] | 13,014 | 14,352 | 14,605 | 14,854 | 15,099 | 15,347 |
| **Total Retail[4]** | **55,581** | **59,007** | **60,660** | **62,309** | **63,954** | **65,649** |
| City of Chino Hills[5] | 77,596 | 89,314 | 91,137 | 92,997 | 94,895 | --- |
| **Total Wholesale** | **77,596** | **89,314** | **91,137** | **92,997** | **94,895** | **---** |
| **Total Retail/Wholesale** | **133,177** | **148,321** | **151,797** | **155,306** | **158,849** | **---** |

Aligns with data in DWR Standardized Tables 3-1 R and 3-1 W.
[1] 2015 estimate: State of California, Department of Finance, E-1: City/County Population Estimates with Annual Percent Change — January 1, 2015 and 2016. Sacramento, California, April 2016. 2020-2040 estimates: Southern California Association of Governments, Population, Household, and Employment Integrated Growth Forecast, 2012.
[2] City of Chino, May 18, 2016.
[3] 2015 estimate: Difference between 2015 total population and cities of Montclair and Chino population estimates. 2020-2040 estimates based on melded Montclair and Chino service area growth rates.
[3] 2015 total based on city growth estimates and known development in the service area since 2010 (see Appendix F). 2020-2040 totals are sum of above data.
[5] City of Chino Hills, May 12, 2016.

[6] City of Montclair, May 16, 2016.

### 2.2.4 Land Use

The area within the District retail service boundary was once mainly used for agricultural purposes, namely citrus orchard farming. Over the course of time, this land has gone through a series of developments, ultimately resulting in the variety of land use types as seen today. The primary land use of this area is now residential, although there is still a large commercial sector as well as some light industrial/manufacturing and agricultural areas. The majority of land within the District's retail service area has already been built out, but there is significant potential for future in-fill developments. Figure 2-2 and Figure 2-3 show existing and future land uses in the retail service area (see Section 3.2).

## 2.3 DISTRICT WATER DISTRIBUTION SYSTEM

The District's water distribution system is comprised of groundwater wells, reservoirs, transmission and distribution pipelines, pump stations, pressure reducing stations, and a hydrogenation station. The system is used to meet the water demands of the District's retail and wholesale customers.

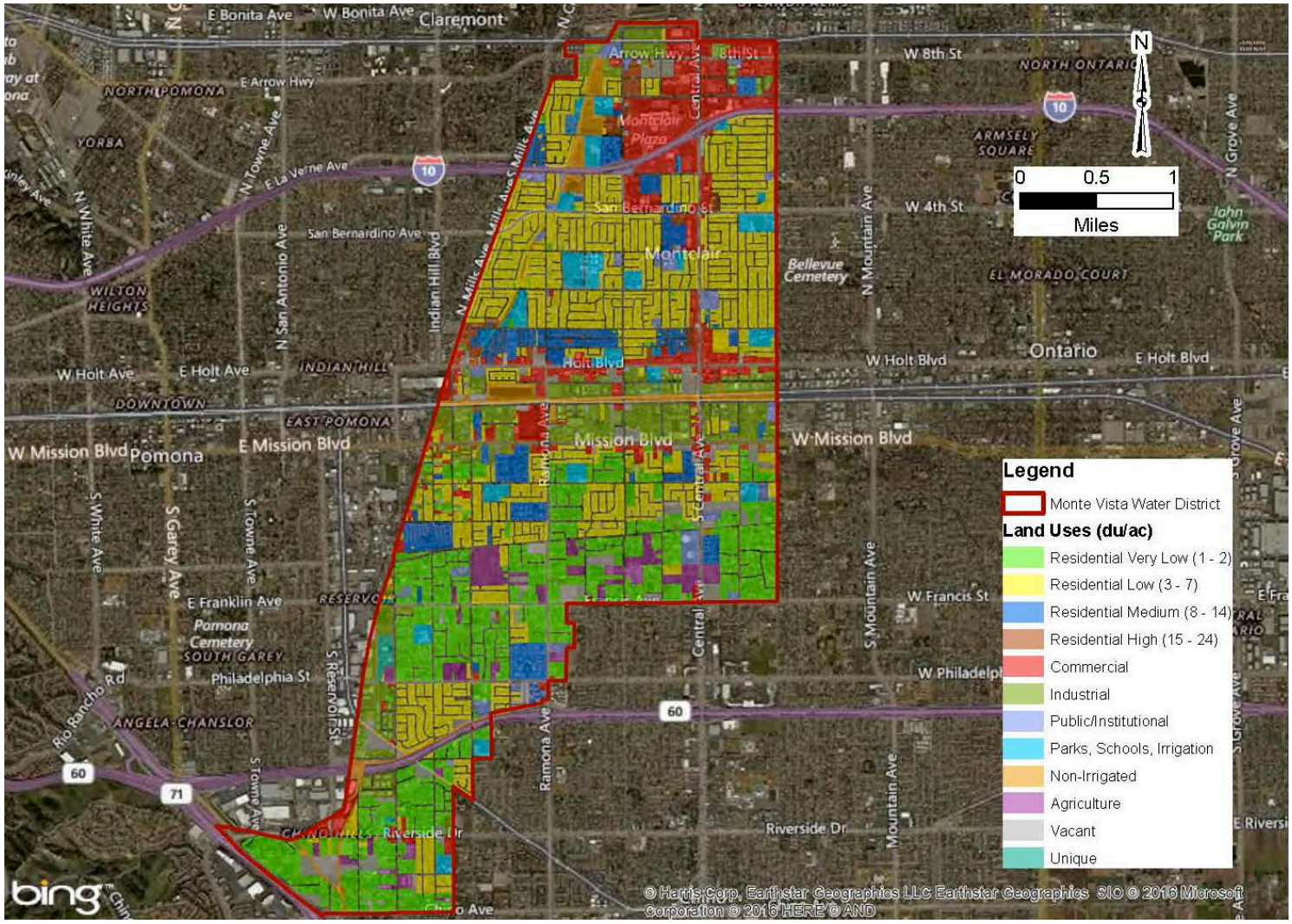
The District's retail water distribution system serves four separate pressure zones and includes approximately 198 miles of water distribution mains ranging in size from four to 42 inches in diameter, six reservoirs with a combined capacity of 12 million gallons, and seven active pump booster stations used to boost water throughout the system. The District currently has 12 active groundwater wells with a combined production capacity of approximately 28 mgd. Table 2-3 lists the District's wells and capacities.

The District's 2008 Water Master Plan calls for significant pipeline replacements in the next 30 years, as a large portion of its pipelines were constructed around the 1950s and are approaching the end of service life. The Master Plan also calls for the construction or rehabilitation of additional storage facilities to meet needed capacity at build-out.

The District's Water Master Plan includes recommendations for four new or renovated wells to provide for system reliability and continued groundwater pumping. As these wells are primarily to replace capacity of existing older wells which will soon go out of service, no additional capacity is expected within the master planning horizon.

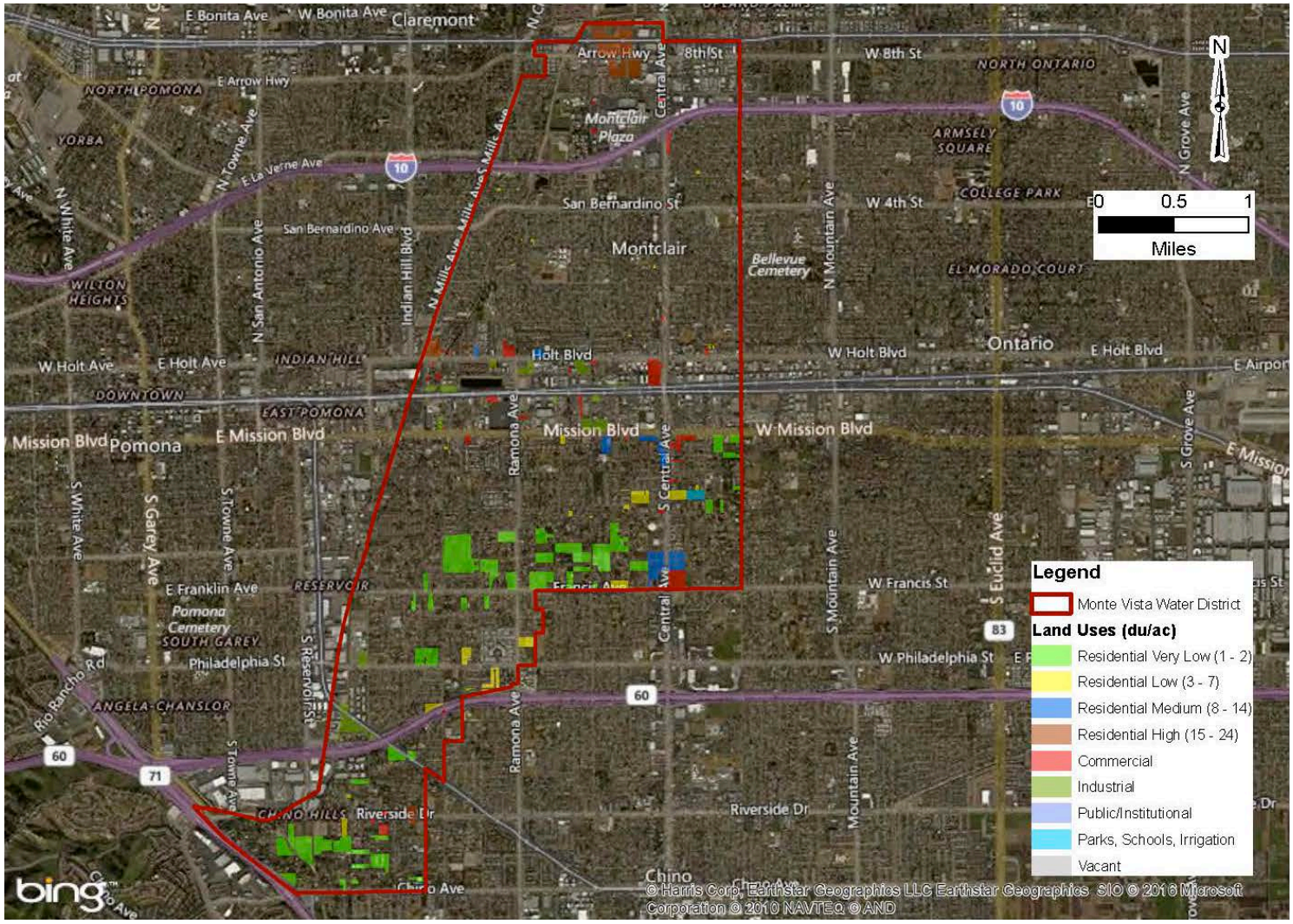
The District currently has six emergency interconnections with neighboring water agencies: Golden State Water Company (formerly Southern California Water Company) and the cities of Chino (x3), Upland, and Chino Hills. Over the last two decades, only the interconnection with Golden State Water has ever been activated, at which time the District delivered water to Golden State Water. The District has also discussed installing interconnections with the cities of Pomona and Ontario. Water is transported from the District to Chino Hills via transmission mains and ultimately delivered through two turnout facilities.

**Figure 2-2:**
**Existing Land Uses – Retail Service Area**




*IEUA/Arcadis, Land Use Based Demand Model Technical Memorandum, 2016 (Appendix G)*

**Figure 2-3:**
**Future Land Uses – Retail Service Area**




*IEUA/Arcadis, Land Use Based Demand Model Technical Memorandum, 2016 (Appendix G)*

**Table 2-3:**
**Active Groundwater Wells and Total Production Capacity (mgd)**

| Well Number | Capacity (mgd) |
|---|---|
| 4 | 0.6 |
| 5 | 2 |
| 10 | 1.5 |
| 19 | 2.6 |
| 26 | 2.8 |
| 27 | 2.9 |
| 28 | 2.7 |
| 30 | 2.9 |
| 31 | 2.9 |
| 32 | 2.9 |
| 33[1] | 1.5 |
| 34 | 2.9 |
| **Total** | 28.2 |

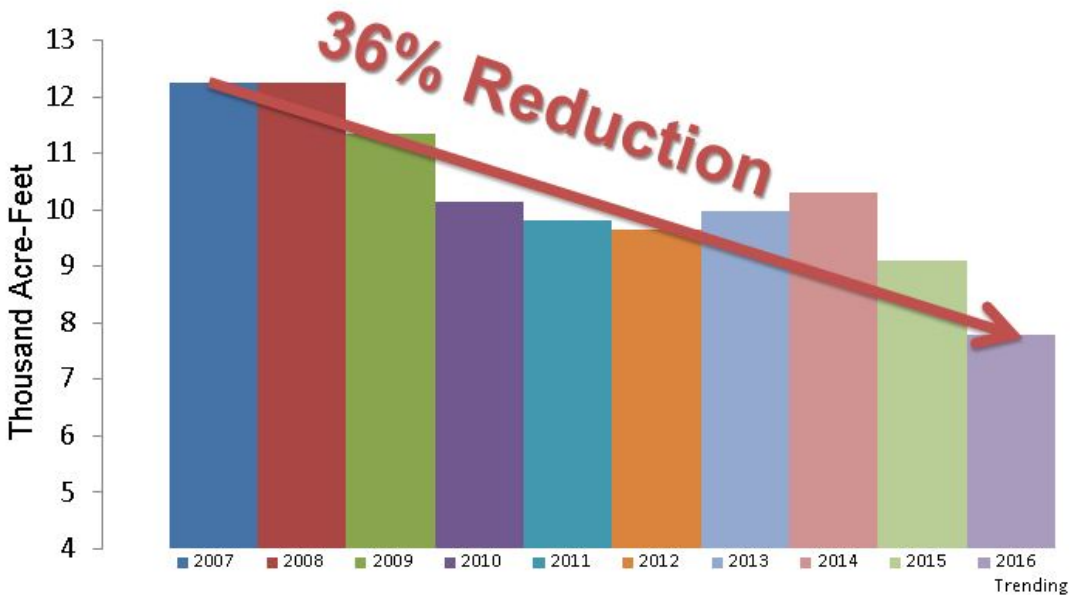
[1] Full Well 33 capacity 2.9 mgd; the City of Chino owns half of the well's capacity.

# SECTION 3
# WATER SYSTEM DEMANDS

## 3.1 RECENT WATER DEMAND TRENDS

Over the past ten years, Monte Vista Water District's retail customers have achieved a significant and sustained reduction in demands. As of the writing of this report (May 2016), retail customer demands are 36 percent less than in 2007 (see Figure 3-1).

**Figure 3-1:**
**District Retail Customer Demand – 2007-2016**




The District has consistently and actively promoted water use efficiency and provided educational and financial resources to assist customers in wise and efficient water use. In 2010 the District adopted mandatory year-round water use efficiency "best practices," as well as the region's first budget-based tiered rate structure for single-family residential customers (80 percent of total metered accounts) which incentivizes efficient use. See Sections 6 and 7 below for more information on these programs and activities.

In January 2014, Governor Brown proclaimed a State of Emergency in recognition of record-setting drought conditions across California and the western United States. On April 1, 2015, he issued an executive order requiring a mandatory 25 percent reduction in urban water use across the State – an unprecedented action in California history. In May 2015, the District's Board of Directors declared a Significant Water Supply Shortage in response to Governor Brown's order.

Consistent with the Water Conservation Act of 2009, the District is required to reduce water use on a gallons per person per day basis by 20 percent compared to a ten-year baseline average (see Section 3.6 below)—a goal that District customers have already accomplished! While the District expects overall water demands to slowly increase as drought conditions improve and the current emergency order is lifted, the District will work with its customers to maintain and enhance their water use efficiency in order to comply with the State's requirements and District policy goals.

## 3.2 RETAIL DEMAND PROJECTIONS – LAND USE BASED MODEL

In 2015, as part of its regional integrated resource planning effort, Inland Empire Utilities Agency (IEUA) developed a Land Use Based Water Demand Model for projecting water demands through 2040 for each of its retail water agencies, including the District. This model updates the demand projections used in the District's 2008 Water Master Plan to plan and size future District facilities. For a description of the methodology used by the model to project the District's future retail water demands, including the extent to which passive savings are considered, please see Appendix G. For existing and future land uses, see Figure 2-2 and Figure 2-3.

## 3.3 PAST, CURRENT, AND PROJECTED WATER DEMANDS

Table 3-2 provides the District's existing and projected demands on its water system by customer and water use sector. The projected retail demands are based on Land Use Model projections Section 3.2 and consistent with the demand reduction requirements and urban water use targets described in Section 3.6. Although historical wholesale demand by the City of Chino Hills has been between 8,000 and 14,000 AFY, the District will use its full contractual obligation of 20.22 mgd, or 22,650 AFY, in estimating future potential demands by Chino Hills on the District's water system.

## 3.4 SYSTEM WATER LOSS

Beginning in 2015, water suppliers are required to quantify their distribution system losses for the most recent 12-month period using the American Water Works Association's (AWWA) water system balance methodology. The District has tracked water system loss using AWWA's methodology since 2009. Table 3-1 provides water loss data for Fiscal Year Ending (FYE) 2015. The District's FYE 2015 water system audit using AWWA's Free Water Audit Software (v5.0) is included in Appendix H.

**Table 3-1:**
**District Water Loss – 2015 (AFY)**

| Reporting Period | Volume of Water Loss[1] |
|---|---|
| FYE 2015 | 497 |

Aligns with DWR Standardized Tables 4-4 R and 4-4 W.
[1] Includes both apparent and real losses (Appendix H).

**Table 3-2:**
**Current and Projected Water Demand by Sector (AFY)**

| Sector | 2015 Actual[1] | 2020 Projected | 2025 Projected | 2030 Projected | 2035 Projected | 2040 Projected |
|---|---|---|---|---|---|---|
| Single-family Residential[2] | 4,521 | 5,079 | 5,187 | 5,447 | 5,574 | 5,739 |
| Multi-family Residential[2] | 1,380 | 2,116 | 2,209 | 2,236 | 2,270 | 2,334 |
| Commercial[2] | 1,543 | 1,414 | 1,425 | 1,437 | 1,490 | 1,517 |
| Institutional/governmental[2] | 265 | 309 | 311 | 315 | 336 | 338 |
| Industrial[2] | 31 | 338 | 340 | 344 | 361 | 364 |
| Landscape[2] | 712 | 1,067 | 1,080 | 1,093 | 1,129 | 1,143 |
| Agriculture[2] | 50 | 58 | 51 | 16 | 10 | 0 |
| Hydrant and Fire Service[3] | 28 | 30 | 30 | 30 | 30 | 30 |
| Unbilled Metered Uses[4] | 73 | 175 | 175 | 175 | 175 | 175 |
| Unbilled Unmetered Uses[4] | 7 | 8 | 8 | 8 | 8 | 8 |
| Water Loss[5] | 497 | 525 | 541 | 560 | 579 | 597 |
| Groundwater Recharge (ASR)[6] | 1 | 400 | 400 | 400 | 400 | 400 |
| **Total Retail Potable Demand** | **9,110** | **11,519** | **11,756** | **12,060** | **12,361** | **12,645** |
| Wholesale Potable Demand[7] | 6,933 | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| **Total Potable Demand** | **16,043** | **34,169** | **34,406** | **34,710** | **35,011** | **35,295** |
| Recycled Water (Direct Sales)[8] | 308 | 430 | 430 | 430 | 430 | 430 |
| Recycled Water (Recharge)[8] | 483 | 601 | 560 | 589 | 639 | 639 |
| **Total Non-Potable Demand** | **791** | **1,031** | **990** | **1,019** | **1,069** | **1,069** |
| **Total Water Demand** | **16,834** | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |

Aligns with data in DWR Standardized Tables 4-1 R, 4-1 W, 4-2 R, and 4-2 W.

[1] 2015 demands obtained from District billing, production, distribution, and water loss audit data for fiscal years (July-June) ending in above year.

[2] Residential, commercial, institutional/governmental, industrial, landscape, and agricultural water demand calculated using the Land Use Based Demand Model, 2015 (Appendix G). Water loss and unbilled metered and unmetered uses subtracted out of total demand factor per customer use category. Single-family residential demands include very low, low, and medium (40 percent) model projected residential demands; multi-family residential demands include medium (60 percent) and high density model projected residential demands. Projected landscape demands include all park and school yard landscape demands, some of which are metered as institutional/governmental.

[3] Includes hydrant meters used during construction and detector check (DC) fire accounts.

[4] Unbilled metered uses include hydrant flushing, fire flow tests, District facility landscape irrigation, and groundwater well pump to waste. Unbilled unmetered uses include groundwater well water quality analyzers, facility washdown, street sweeping, and local firefighting. All approved but unbilled uses are tracked and reported in the annual water system audit (Section 3.4). Usage can be highly variable year to year. Projections based on average use over the past five years.

[5] Includes both real losses (leaks) and apparent losses (customer meter inaccuracies, billing errors, and theft) as reported in the annual water system audit (Section 3.4). Projections based on average loss over the past five years.

[6] The District estimates that available and affordable imported water will be available in one out of five future years for treatment and injection into the Chino Groundwater Basin through the District's Aquifer Storage and Recovery (ASR) wells. During such years, the District estimates it will be able to inject 2,000 AF. As a result, 400 AF is projected as an average annual availability of injection water for conjunctive use (see Section 4.6.2).

[7] 2020-2040 wholesale demand equals full contractual obligation to the City of Chino Hills.

[8] Recycled water direct sales are deliveries to the District's recycled water customers through its retail recycled water distribution system. Recycled water groundwater recharge is the District's purchased City of Montclair share of regional recycled water recharge in the Chino Groundwater Basin (see Section 4.6.5).

## 3.5 LOWER INCOME HOUSING DEMANDS

SB 1087 requires water providers to grant priority service hook-ups to lower income housing developments. The UWMP Act requires documentation of future water demands associated with planned new lower income housing by the local land use planning jurisdiction. A lower income household has an income below 80 percent of area median income, adjusted for family size.

The City of Montclair's updated 2014-2021 Housing Element of the General Plan (adopted February 2014) indicates a quantitative directive for the construction of 278 new low and very low income housing units within the City by 2021. The District is unaware of any lower income housing developments planned for the City of Chino or County of San Bernardino areas of the District service area.

Water demands for planned low income housing by 2021 were based on the average multi-family unit factor from the updated demand projections. New demands associated with planned low income housing are approximately 122 AF by 2020. The District confirms that this demand is included in the projected water demands represented in Table 3-2.

## 3.6 DEMAND REDUCTION REQUIREMENTS

The Water Conservation Act of 2009 requires all California urban water agencies to set and meet certain demand reduction targets in order to assist the State in reducing urban water use by 20 percent by 2020. This collective goal is commonly known as "20 percent by 2020" or "20x2020." The prescribed way to determine the District's compliance is by measuring the per person (or "per capita") daily water usage by District customers.

The Act requires DWR to develop, in consultation with an Urban Stakeholder Committee (USC) comprised of water agency representatives and water use experts, specific methodologies for determining per capita water use and other information required to meet 20x2020 water use reduction requirements. DWR published its Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use (Methodologies) in October 2010 and published an updated version of the Methodologies in February 2016. The District is required to follow the Methodologies when estimating past, current, and projected water system demands in its UWMP in order to establish water use reduction targets for 20x2020 compliance. Additionally, the 2016 Methodologies require the District to update its water use reduction targets using the most recent 2010 U.S. Census data.

This section of the plan outlines the District's process in estimating its system demands and establishing its 20x2020 water use reduction targets. The District's Board of Directors will formally adopt its 2020 water use target as part of its resolution adopting the 2015 UWMP (see Appendix E).

### 3.6.1 Baseline Gallons Per Capita Per Day

The first step toward achieving 20x2020 compliance is to determine the District's Base Daily Per Capita Water Use which is used to form a baseline for the agency's 20 percent reduction in water use target for 2020. The Methodologies require water agencies to identify a continuous 10-year period ending no earlier than 2004 and no later than 2010, and then calculate the gallons per capita per day (GPCD) demands of their customers for each of these years.[7] The average GPCD over this 10-year period forms the agency's Base Daily Per Capita Water Use, or Baseline GPCD.

Following the 2016 Methodologies and using the DWR Population Tool (https://wuedata.water.ca.gov/secure/wue_supplier_tool.asp), the District has recalculated its service area population for the years 1996-2005 using updated 2010 U.S. Census data,[8] and then divided its population by the total gross potable water supply entering its potable water distribution system. As shown in Table 3-3, the final calculation of the District's Baseline GPCD, using the 10-year GPCD average of the years 1996-2005, is 209 GPCD.

The following sections describe how the District determined its population and gross potable water supply for these historical periods.

**Table 3-3:**
**Baseline Gallons Per Capita Per Day Calculation – 10-Year Range**

| Calendar Year | Service Area Population | Annual Gross Water Use (AFY) | Daily Per Capita Water Use (GPCD) |
|---|---|---|---|
| 1996 | 47,020 | 10,708 | 203 |
| 1997 | 46,778 | 11,832 | 226 |
| 1998 | 46,508 | 10,146 | 195 |
| 1999 | 48,048 | 10,612 | 197 |
| 2000 | 48,996 | 11,925 | 217 |
| 2001 | 49,459 | 11,708 | 211 |
| 2002 | 49,648 | 11,990 | 216 |
| 2003 | 50,189 | 11,924 | 212 |
| 2004 | 50,784 | 12,441 | 219 |
| 2005 | 50,960 | 10,871 | 190 |
| **Baseline Gallons Per Capita Per Day (10-Year Average):** | | | **209** |

Aligns with data in DWR Standardized SBX 7-7 Tables 4 and 5.

[7] Water agencies which met at least 10 percent of their total 2008 demand through recycled water could expand their baseline window to 15 years; the District had just started deliveries of recycled water in 2008.
[8] Data from the 2010 U.S. Census was not yet available when the District initially calculated its Baseline GPCD in its 2010 UWMP.

### *Population*

DWR's Methodologies provide a specific method for urban water agencies to estimate their past and present service area populations, depending on available information. The District's service area is not contiguous with one municipal incorporated area, and so it is not able to rely solely on California Department of Finance population estimates for individual incorporated cities. Neither does a regional or wholesale agency provide the District with annual population estimates for its service area. The District, therefore, is required to follow the methods outlined in Methodology 2 of the Methodologies, using the DWR Population Tool which matches data from the most recent U.S. Census with the District's active accounts for each year, to come up with annual population estimates. For its 2015 population, the District used an alternative methodology based on local knowledge. For documentation associated with population estimates, see Appendix F.

### *Gross Potable Water Use*

Gross potable water use is defined by DWR's Methodologies as the total amount of water entering the District's potable water system, minus water exports to other agencies, water placed into long-term storage (e.g., water injected into the groundwater basin), and indirect reuse of recycled water through groundwater recharge.

The District directly meters and accounts for water entering into its potable water distribution system. Water production and deliveries to the District's wholesale agency customer, the City of Chino Hills, is separately metered. Since 2002, the District has purchased the City of Montclair's portion of the regional recycled water recharge into the Chino Groundwater Basin (see Section 4.5); the annual amount of indirect recycled water reuse is calculated using the process outlined in DWR's Methodologies and subtracted from its retail potable water supply, resulting in a calculated gross potable water supply. For documentation associated with indirect recycled water reuse calculation, see Appendix I.

## 3.6.2 Target Gallons Per Capita Per Day

Having established its Baseline GPCD, the District is required by DWR's Methodologies to determine its Urban Water Use Target GPCD for 2020 and its Interim Urban Water Use Target for 2015. The Water Conservation Act of 2009 provides water agencies with four methods for setting its urban water use targets:

- **Method 1:** Reduce total demand on the water system by 20 percent, measured by comparing baseline gallons per capita per day (GPCD) historical usage to GPCD usage in 2020.

- **Method 2:** Meet system-wide water use performance standards for indoor residential water use, landscaped area water use, and other uses.

- **Method 3:** Meet 95 percent of the water agency's hydrologic regional target, as determined by the State's 20x2020 Water Conservation Plan.

- **Method 4:** An additional compliance option, developed by DWR in consultation with the USC, based on water use sector performance standards and past conservation activity.

The District has evaluated each method and reconfirms that Method 1 is the most feasible for the District to use in setting its urban water use targets. Following Method 1, the District's Target GPCD for 2020 must be 80 percent of its Baseline GPCD, or 167 GPCD. The District's Interim Target GPCD for 2015 is calculated by adding the Baseline GPCD and the Target GPCD together, and dividing by two; the result is an Interim Target GPCD of 188 GPCD (see Table 3-4).

**Table 3-4:**
**District Urban Water Use Targets**

| Baseline GPCD | 2020 Urban Water Use Target[1] | 2015 Interim Urban Water Use Target[2] |
|---|---|---|
| **209** | **167** | **188** |

Aligns with data in DWR Standardized Table 5-1 and SBX 7-7 Tables 7-A, 7-F, and 8.
[1] 80% of Baseline GPCD.
[2] (Baseline GPCD + 2020 Urban Water Use Target) / 2

### *Confirm Urban Water Use Targets*

The District's final step in setting its urban water use targets is to confirm that its target meets the minimum threshold set by the Water Conservation Act of 2009 of a five percent reduction from the average GPCD of a five-year contiguous base period between 2003-2010. As demonstrated in Table 3-5, a five percent reduction from the baseline average GPCD for the years 2003-2007 provides a maximum target of 192 GPCD. The District's urban water use target of 167 GPCD is well below this maximum target.

**Table 3-5:**
**Baseline Gallons Per Capita Per Day Calculation – 5-Year Range**

| Calendar Year | Service Area Population | Annual Gross Water Use (AFY) | Daily Per Capita Water Use (GPCD) |
|---|---|---|---|
| 2003 | 50,189 | 11,924 | 212 |
| 2004 | 50,784 | 12,441 | 219 |
| 2005 | 50,960 | 10,871 | 190 |
| 2006 | 51,578 | 11,423 | 198 |
| 2007 | 52,416 | 11,101 | 189 |
| **Baseline Gallons Per Capita Per Day (5-Year Average):** | | | 202 |
| **95% of Baseline Gallons Per Capita Per Day:** | | | **192** |

Aligns with data in DWR Standardized SBX 7-7 Tables 5 and 7-F.

### 3.6.3 Compliance with 2015 Interim Urban Water Use Target

The District is required to report in its 2015 UWMP whether it has achieved its 2015 Interim Urban Water Use Target as required by SBX7-7. As shown in Table 3-6, District customers used 137 GPCD in 2015, which is 34 percent below the Baseline GPCD of 209, far exceeding the 10 percent reduction requirement.

**Table 3-6:**
**Compliance with 2015 Interim Urban Water Use Target**

| Calendar Year | Service Area Population | Annual Gross Water Use (AFY) | Daily Per Capita Water Use (GPCD) |
|---|---|---|---|
| 2015 | 55,581 | 8,532 | **137** |
| **Interim Urban Water Use Target** | | | **188** |
| **Did the District Achieve Targeted Reduction for 2015?** | | | **Yes** |

Aligns with data in DWR Standardized Table 5-2 and SBX 7-7 Table 9.

### 3.6.4 Wholesale Agency Assistance in Meeting Urban Water Use Target

The City of Chino Hills's Base Daily Per Capita Water Use (average of 1995-2004) is 217 GPCD, resulting in a 2020 Urban Water Use Target of 173 GPCD and a 2015 Interim Urban Water Use Target of 195 GPCD. Chino Hills's actual 2015 GPCD was 164 GPCD, which is 24 percent below its Baseline GPCD and well below its 10 percent reduction requirement.[9]

Chino Hills, at this time, has not requested and does not appear to need assistance from the District in achieving its 20x2020 reduction requirements. The District has in the past, and at the request of the city, provided general assistance in meeting California Urban Water Conservation Council Best Management Practices reporting requirements (see Section 6.1.1). The District and Chino Hills also collaborate in various regional conservation programs (Section 6.3.1) and through the Regional Alliance (Section 1.2.3).

[9] City of Chino Hills, May 12, 2016.

# SECTION 4
# WATER SYSTEM SUPPLIES

## 4.1 WATER SUPPLY OVERVIEW

Over the past 15 years, Monte Vista Water District has invested over $50 million in its infrastructure and has increased its water supply capacity to over 50 million gallons per day. Key investments in local groundwater, surface water, and recycled water have focused on building a diverse, drought-resilient water supply portfolio and reducing reliance on imported water. For a full list of investments, see Table 4-2 below.

The District currently receives its water supply from four sources:

- Groundwater produced from the Chino Groundwater Basin, an adjudicated basin managed through the Chino Basin Watermaster process;
- Imported State Water Project surface water from northern California received from the Metropolitan Water District of Southern California through the Inland Empire Utilities Agency and the Water Facilities Authority;
- Entitlement water deliveries from the San Antonio Water Company, including groundwater produced from local adjudicated groundwater basins and surface water produced from the San Antonio Creek Watershed; and,
- Recycled water from Inland Empire Utilities Agency.

**Table 4-1:**
**Water Supplies – Current and Projected (AFY)**

| Water Supply Sources | 2015 Actual[1] | 2020 Projected | 2025 Projected | 2030 Projected | 2035 Projected | 2040 Projected |
|---|---|---|---|---|---|---|
| Chino Groundwater Basin[2] | 8,406 | 28,183 | 28,183 | 28,183 | 28,183 | 28,183 |
| Water Facilities Authority[3] | 7,025 | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company[4] | 611 | 800 | 800 | 800 | 800 | 800 |
| Inland Empire Utilities Agency – Recycled Water[5] | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Water Supply** | **16,833** | **51,790** | **51,749** | **51,778** | **51,828** | **51,828** |

Aligns with data in DWR Standardized Tables 6-8 R, 6-8 W, 6-9 R, and 6-9 W.
[1] Actual production and purchases for Fiscal Year Ending 2015 (July 2014 – June 2015).
[2] District groundwater well production capacity minus 15% to account for potential well shutdowns for maintenance or testing.
[3] The District may use up to its full share (24%) of WFA treatment plant capacity (81 mgd) at any time, subject to Tier 2 and penalty rates.
[4] Annual non-shortage entitlement through District ownership of outstanding SAWCo shares.
[5] Includes recycled water purchased for direct reuse and groundwater recharge (Table 4-7).

The District's current and projected available water supplies are listed in Table 4-1. All supplies are available for use to meet both retail and wholesale water demands.

**Table 4-2:**
**Investments in Local Water Supply**

| Facilities | Completed | Investment | Supply |
|---|---|---|---|
| Agua de Lejos Water Treatment Plant | 1988 (2016 debt) | $25 million (MVWD share) | 19.4 mgd (MVWD share) |
| Monte Vista Irrigation Company | 1999 | $4.4 million | 1,000 AFY (6,700 AF stored) |
| Well 26 | 2002 | $1.1 million | 2,000 gpm |
| Well 27 | 2002 | $1.7 million | 500-2,000 gpm |
| Well 28 | 2002 | $1.9 million | 2,100 gpm |
| Well 30 (ASR) | 2007 | $3.6 million | 2,000 gpm (1,000 gpm injection) |
| Well 32 (ASR) | 2008 | $3.1 million | 2,000 gpm (1,000 gpm injection) |
| Well 4 (ASR retrofit) | 2008 | $0.5 million | 800 gpm (400 gpm injection) |
| Well 31 | 2009 | $4 million | 2,000 gpm |
| Well 33 (ASR, ion exchange) | 2009 | $3.5 million (MVWD share) | 2,000 gpm (1,000 gpm injection) |
| Well 34 | 2009 | $4.6 million | 2,100 gpm |
| Recycled Water System | 2009 | $1.1 million (MVWD share) | 400 AFY |
| San Antonio Water Company Shares (300) | 2009 | $9 million | 800 AFY |
| | **Totals** | **$63.5 million** | **50.8 mgd**[1] |

[1] *Based on current total capacity of acquired resources.*

## 4.2 CHINO GROUNDWATER BASIN

### 4.2.1 Basin Overview

The District's primary source of water supply is the Chino Groundwater Basin (Chino Basin). This basin is located in the Santa Ana River Watershed under a surface area of approximately 220 square miles. The Chino Basin underlies a relatively flat alluvial valley from east to west which slopes from north to south at a one to two percent grade. Valley elevations range from about 2,000 feet in the foothills below the San Gabriel Mountain to about 500 feet near Prado Dam.

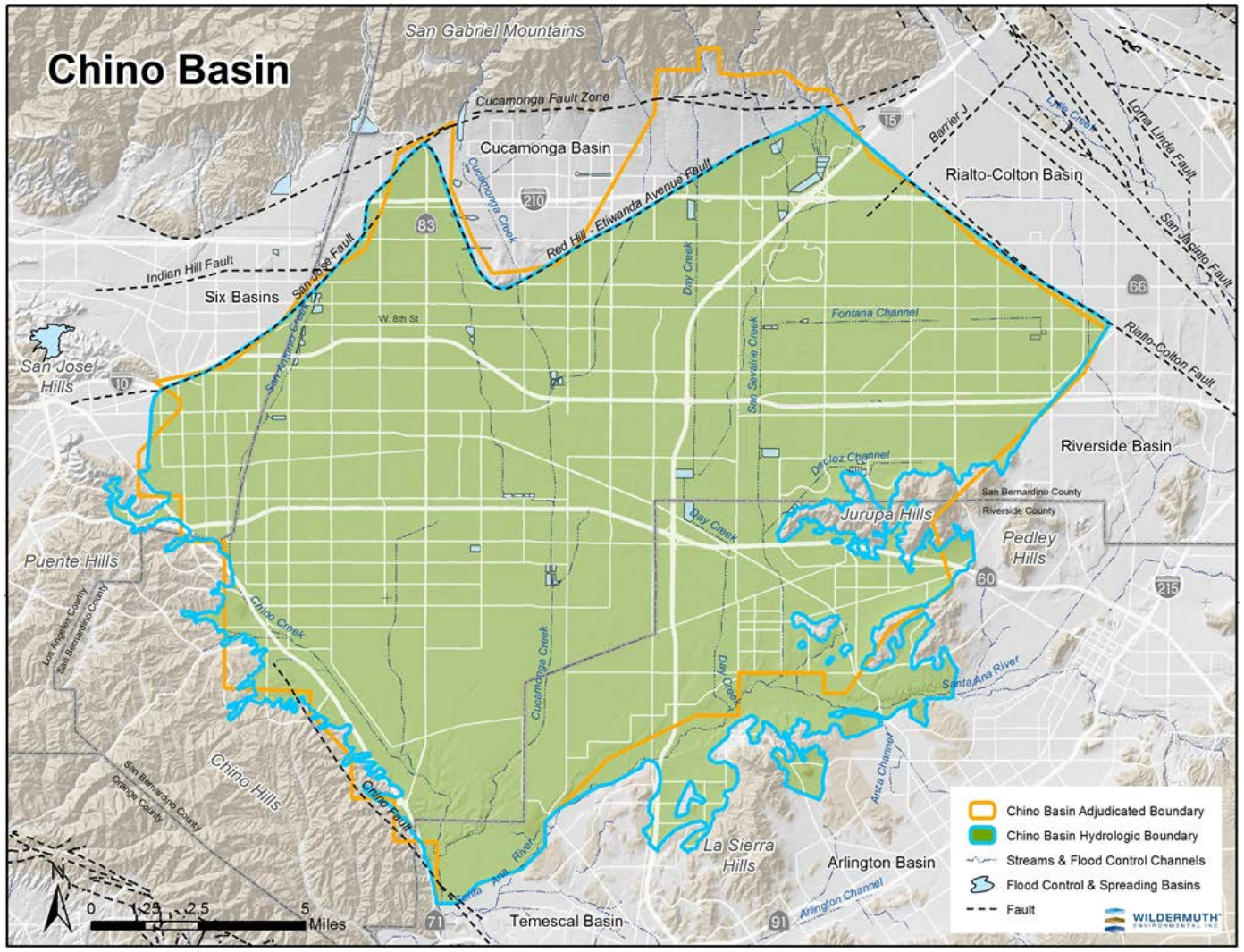
The principal surface drainage for the Chino Basin is the Santa Ana River. Year-round flow occurs along the entire reach of the Santa Ana River due to surface inflows at Riverside Narrows, discharges from municipal water recycling plants to the Santa Ana River, and rising groundwater. Multiple concrete-lined channels, including the San Antonio, Chino, Cucamonga, Day, and San Sevaine creeks, collect and drain snowmelt, stormwater, and urban runoff from the foothills and valley area and flow directly into the river or mix with rising groundwater in the wetlands above Prado Dam. Recharge basins have been constructed and are maintained along these channels to capture and recharge native flows, as well as imported water and recycled water, back into the groundwater.

While still considered to be a single groundwater basin, the Chino Basin is hydraulically divided into five distinct underground drainage areas, or Management Zones (MZs), based upon similar hydrologic conditions, and three sub-basins as defined in the Optimum Basin Management Program, June 2000, and the 1995 Water Quality Control Plan for the Santa Ana Watershed (Region 8).

The Chino Basin has a total underground water storage capacity of approximately 6 million acre-feet (MAF) and currently holds approximately 5 MAF of groundwater. The Chino Basin Judgment, adopted by the California Superior Court in 1978 under stipulation by local groundwater producers, designated a safe yield for the basin of 140,000 AF, which is the amount of groundwater that can be pumped from the basin each year without causing undesirable results. Purchasing imported water from MWD through IEUA for basin recharge generally makes up any excess of pumping over the safe yield, although supplemental water may be obtained from any available source including recycled water and imported water. The Judgment also allows for the transfer and storage of excess rights and supplemental supplies (see Section 4.2.2).

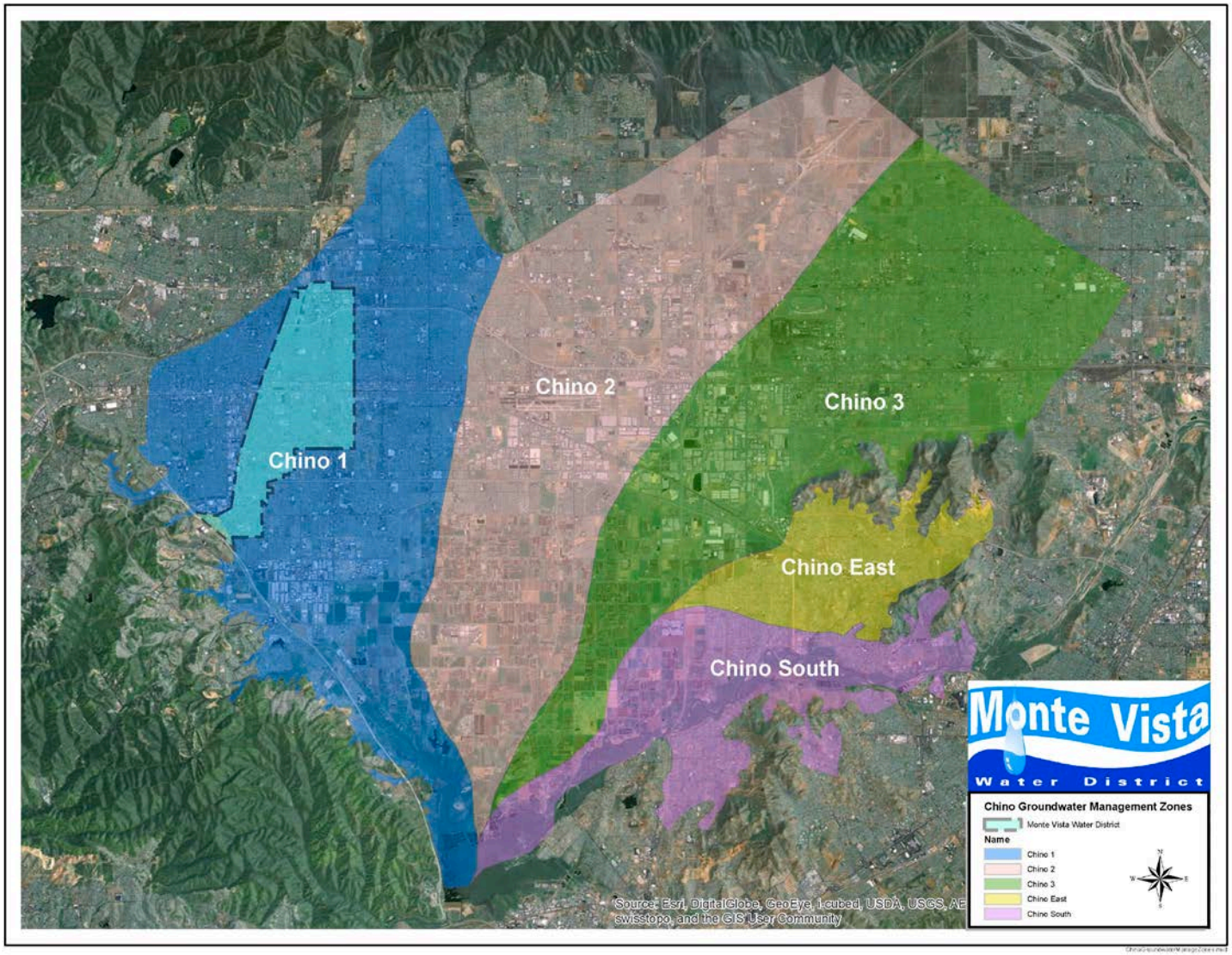
The Chino Basin Judgment provides the California Superior Court with continuing jurisdiction over management of the Chino Basin for the benefit of the producing parties and the public. The Judgment creates the Chino Basin Watermaster to serve as an arm of the Court in overseeing implementation of the Judgment, as well as subsequent management agreements, to ensure that the groundwater basin is properly managed. The Judgment and management agreements establish groundwater production rights and a "physical solution" which provides for replenishment of any production over and above a producing party's share of safe yield.

**Figure 4-1:**
**Chino Groundwater Basin Boundaries and Water Features**




*Courtesy of Chino Basin Watermaster, 2016*

**Figure 4-2:**
**Chino Groundwater Basins with Management Zones**



The District currently has base water rights, or an assigned share of the safe yield, of 4,824 AFY. The District also receives annual water rights from reallocations of unpumped agricultural rights, annual transfers from other parties, and recharged recycled water credit. Additionally, the District owns the Monte Vista Irrigation Company, which has 677 AFY of base rights and receives its share of unpumped agricultural rights.

In October 2015, Watermaster submitted to the Court the 2015 Safe Yield Reset Agreement which resets safe yield from 140,000 AFY to 135,000 AFY and administers the resulting reallocation of rights based on existing agreements (see below). If the Court approves the agreement, the District's annual allocation of production rights will decline, but the District's access to basin groundwater will remain unchanged.

### 4.2.2 Chino Basin Watermaster

#### *Governance and Agreements*

Chino Basin Watermaster (Watermaster) was created pursuant to the terms of Court Judgment entered in Superior Court of California, County of San Bernardino Case No. RCV 51010 (formerly Case No. SCV 164327) entitled *Chino Basin Municipal Water District v. City of Chino, et al.* (Appendix J). The Judgment establishes safe yield and annual production rights for the Chino Basin, and provides a forum for basin stakeholders to work cooperatively in managing the basin to meet regional water supply needs.

The Judgment, which was entered on January 27, 1978, established three groundwater "pool" committees: (1) the Overlying Agricultural Pool, which includes the State of California, non-producing water districts, and all producers of water for uses other than industrial or commercial purposes; (2) the Overlying Non-Agricultural Pool, which represents producers of water for industrial or commercial purposes; and (3) the Appropriative Pool, which represents cities, districts and other public or private utilities and water purveyors. Representatives from the pool committees constitute an Advisory Committee that sets basin management policies and advises Watermaster's nine-member Board, which is comprised of designated representatives from the three pools and non-producing municipal water districts. The Watermaster Board, in turn, advises and serves as an arm of the Court in its continuing jurisdiction over the basin under the Judgment.

The Judgment was amended in 2000 through the signing of the Peace Agreement which, among other things, established procedures to implement an Optimum Basin Management Program (OBMP) to preserve and enhance basin yield and water quality, and again in 2007 through the signing of the Peace II Agreement which, among other things, provided for the construction of desalters to treat groundwater degraded by past agricultural practices. These agreements and subsequent court orders also establish a process, consistent with the Judgment, for unproduced Agricultural Pool rights to be transferred to the Appropriative Pool. Finally, these agreements foster a market for the lease or sale of pumping rights within the basin. Annual water exchanges occur regularly among agencies within the Appropriative Pool and between the Non-Agricultural Pool and the Appropriative Pool.

### *Basin Yield and Allocation of Rights*

The Judgment defines "Safe Yield" as the amount of water that can be safely extracted from the basin on an annual basis and sets it at 140,000 AFY.[10] Safe Yield is allocated first to the Agricultural Pool and the Non-Agricultural Pool in fixed quantities of 82,800 AFY and 7,366 AFY, respectively, to satisfy their prioritized overlying (or riparian) water rights as recognized under the Judgment. Once the overlying pools are satisfied, the remainder of Safe Yield is allocated to Appropriative Pool parties based on established percentages. While the allocations to the overlying pools are fixed, the allocation to the Appropriative Pool may increase or decrease depending on changes to Safe Yield or the development of additional yields.

The Judgment defines all basin yield allocated to the Appropriative Pool as "Operating Safe Yield" (OSY). OSY includes the Appropriative Pool's share of Safe Yield, any overdraft of the basin that has been approved by the Court, and any additional yield to the basin not included in Safe Yield. To date, the Court has approved two quantities of basin overdraft:

1. An overdraft of 200,000 AF, allocated to OSY at 5,000 AFY over the first 30 years of the Judgment (1978-2017); and,

2. An overdraft of 400,000 AF to facilitate a basin management program known as "Basin Re-operation," allocated annually by agreement not to the OSY but instead to offset the replenishment obligation of the Chino Desalter Authority production wells.

Yield that has been developed but not incorporated into Safe Yield is defined by the Peace Agreement as "New Yield" and is included in OSY by agreement (except for New Yield generated by desalter wells—see below). To date, and again by agreement, annual quantities of New Yield generated by newly constructed stormwater capture facilities were allocated to Appropriative Pool parties between 2004 and 2008.

Additionally, the Judgment—unique among California groundwater basin adjudications—envisioned a long-term transition in the Chino Basin from agricultural to urban land uses, and incorporated a mechanism for unproduced Agricultural Pool rights to transfer to the Appropriative Pool as the land was developed. The Judgment establishes a priority for distribution of these rights: first to offset the impact of a decline in Safe Yield, then to satisfy land conversion claims, then to all Appropriative Pool parties. Through a series of agreements and court orders, a process was developed to implement this transfer by way of two equal priority methods: an "early transfer" of 32,800 AFY to the entire Appropriative Pool, and a 2 AF per acre transfer to individual Appropriative Pool parties with agricultural land use conversion claims. If the total transfer plus Agricultural Pool production exceeds the Agricultural Pool's share of Safe Yield, each Appropriative Pool party's share of the total transfer is reduced proportionately. The Court also approved a similar reduction of the total transfer when Safe Yield declines.

[10] This summarizes the legal definition that can be found in the Chino Basin Judgment, ¶4(x) (Appendix J).

As stated above, Watermaster has submitted to the Court the 2015 Safe Yield Reset Agreement. If adopted by the Court, the terms of the agreement will go into effect beginning with the 2014-15 production year (July 1, 2014 through June 30, 2015). According to the terms of the agreement, Safe Yield is reduced from 140,000 AFY to 135,000 AFY, inclusive of all New Yield up to this time. Additionally, the agreement finds that up to 20,000 AFY of New Yield generated by the Chino Desalter Authority groundwater wells is enjoined by agreement from being considered part of Safe Yield, thus effectively reducing Safe Yield by an additional 20,000 AFY. This combined 25,000 AFY reduction of Safe Yield must be offset by unproduced Agricultural Pool rights, thus effectively reducing the amount of rights available for reallocation through early transfer and land use conversion claims.

Finally, the Judgment allows Appropriative Pool parties to "carry over" unproduced production rights equal to their annual share of OSY to the following year. Any quantity carried over in excess of OSY must be placed in a local storage account (see below).

A key element of the Judgment's "physical solution" is the provision of replenishment water for production of groundwater in excess of production rights. Watermaster or individual parties may use imported water, recycled water, stored water, and water transfers from other parties as replenishment water to offset overproduction. As long as the producing party does not cause physical injury to another producer or to the basin, they may produce groundwater in excess of their production rights.

### *District Groundwater Production Rights*

The District's total annual Chino Basin production rights vary based on Watermaster's allocation of unused Agricultural Pool rights, District annual purchases from other producers, and other factors. Over the last decade, the District has transitioned from being an overproducer to an underproducer of its available groundwater production rights, resulting in carryover for production in subsequent years and the building up of stored groundwater (see below). Additionally, the District owns and may use some or all of Monte Vista Irrigation Company's (Company) annual production rights, receives production rights credit for a portion of IEUA's regional recycled water recharge (see Section 4.5.2), may receive transfers from SAWCo as part of its entitlement (see Section 4.4), and may purchase additional production rights from other parties. If the District produces in excess of its production rights in any given year, it may transfer stored water, purchase water from another party, or pay Watermaster a replenishment assessment fee.

In Fiscal Year Ending (FYE) 2015 (July 2014 through June 2015), the District's total rights to produce groundwater from the Chino Basin, including Company production rights, recycled water recharge credits, and transfers from SAWCO and the Agricultural and Non-Agricultural Pools, were equal to approximately 14,217 AF. This estimate assumes that the 2015 Safe Yield Agreement is approved by the Court.[11]

[11] The District's fiscal year aligns with Watermaster's production year. Watermaster prepares an Assessment Package each November to determine the assessments for each groundwater producer from the prior fiscal year.

The following are the criteria used for this estimate:

- OSY, comprised of the Appropriative Pool share of the reset Safe Yield, excluding New Yield generated by the Chino Desalter Authority groundwater wells, and including approved overdraft, is 29,834 AFY (135,000 – 82,800 – 7,366 – 20,000 + 5,000 = 29,834). However, as described above, the first priority of use for unproduced Agricultural Pool rights is to offset the impact of a decline in Safe Yield. Therefore, OSY is made whole and increased by 25,000 AFY to 54,834 AFY. The District's share of OSY is 8.797 percent, or 4,824 AFY, and the Company's share of OSY is 1.234 percent, or 677 AFY.

- According to Watermaster records, the Agricultural Pool produced 28,521 AF in FYE 2015, resulting in unproduced rights of 54,279 AF available for reallocation (82,800 – 28,521 = 54,279). The first 25,000 AF is reallocated to offset the decline in Safe Yield, resulting in 29,279 AF remaining to be reallocated through early transfer and land use conversion claims. Using land use conversion claims from the prior year and resulting reallocation adjustments (see Table 4-3), the District estimates that the District and Company will receive 1,460 AF and 201 AF in reallocated Agricultural Pool rights, respectively.

- In FYE 2015, the District and Company participated in the transfer of Non-Agricultural Pool rights under the Peace II Agreement's Exhibit "G" provisions, and purchased 452 AF and 35 AF, respectively. Additionally, SAWCo transferred 387 AF of entitlement deliveries to the District, and the District received a 213 AF transfer from the Non-Agricultural Pool under the Peace II Agreement, Section 9.2 provisions.

- In FYE 2015, the District was allocated 468 AF of supplemental water credit as its share of the regional recycled water recharge program.

Table 4-3 shows how the total FYE 2015 production right is calculated, and then compares it to the total amount produced by the District. As shown, the District underproduced its annual rights by 6,197 AF. Of this amount, 5,284 AF will be carried over into next year's production right and 913 AF will be placed in the Company's excess carryover local storage account (see below).

While the District is currently an under-producer from the Basin, the District has in the past and may in the future overproduce if it is deemed necessary and appropriate to do so. The only consequence to the District when pumping above its basin production water right in any given year is to purchase additional replenishment water for the benefit of the basin, as governed by the Judgment and managed by Watermaster.

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The most recently completed Assessment Package titled FY 2014/15 is for FY 2013/14 production rights. Due to ongoing litigation associated with the 2015 Safe Yield Reset Agreement, Watermaster was unable to complete a FY 2015/16 Assessment Package for FY 2014/15 production rights; however, Watermaster did publish information associated with FY 2014/15 production rights as part of an interim assessment process.

**Table 4-3:**
**Chino Groundwater Basin Total Annual Production Right,**
**Actual Production and Underproduction – FYE 2015 (AFY)**

| FYE 2015 | Monte Vista Water District | Monte Vista Irrigation Company |
|---|---|---|
| Early Transfer | 2,885 | 405 |
| Land Use Conversion[1] | 55 | 0 |
| Reallocation Adjustment[1] | <1,480> | <204> |
| **Total Ag Pool Safe Yield Reallocation** | **1,460** | **201** |
| Assigned Share of Safe Yield | 4,824 | 677 |
| Carryover from FYE 2014 Underproduction | 4,824 | 677 |
| Transfers[2] | 839 | 35 |
| **Total FYE 2015 Production Right** | **12,628** | **1,590** |
| **Total Assessable FYE 2015 Production[3]** | **<7,553>** | **0** |
| **Net Under-production** | **4,607** | **1,590** |

[1] Subject to change annually.
[2] For the District, includes 452 AF purchased from the Non-Agricultural Pool under Peace II, 387 AF of assigned water rights in lieu of direct deliveries from SAWCo, and 213 AF transferred from the Non-Agricultural Pool under Peace II. For the Company, includes 35 AF purchased from the Non-Agricultural Pool under Peace II.
[3] In FYE 2015, the District produced 853 AF of the City of Chino Hills's production rights. While this amount is included in the District's total groundwater production volume in Table 4-4, it is not included in this table which quantifies production rights.

Table 4-4 provides the amount of groundwater pumped for the last five years. Future groundwater production will be determined based on retail and wholesale demand, as well as replenishment water and imported water supply availability and cost. It is assumed that the District will lease additional groundwater rights or pay Watermaster replenishment rates when its adjudicated supply is exceeded.

**Table 4-4:**
**Groundwater – Volume Pumped (AFY)**

| Well Production | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Retail | 9,301 | 6,944 | 6,897 | 7,163 | 5,943 |
| Wholesale | 2,732 | 3,594 | 3,428 | 5,359 | 2,462 |
| **Totals** | **12,032** | **10,539** | **10,324** | **12,522** | **8,406** |

Aligns with data in DWR Standardized Tables 6-1 R and 6-1 W.

### *Groundwater Management*

The 1978 Chino Basin Judgment, included in Appendix J,[12] requires that Watermaster develop a management plan for the Chino Basin that meets water quality and water quantity objectives for the region. Three primary agreements govern the adjudication and management of the basin: 1) the 1978 Chino Basin Judgment; 2) the 2000 Peace Agreement, incorporating the Optimum Basin Management Program (OBMP) Implementation Plan; and 3) the 2007 Peace II Agreement. Links to full copies of these agreements are included on the Watermaster website, www.cbwm.org. A detailed discussion of these agreements and the complexities of Chino Basin groundwater management is included in Appendix K.

### *Groundwater Storage*

As stated above, the Chino Basin has approximately 5 MAF of groundwater in storage and has the capacity for storing an additional 1 MAF. The Judgment and Peace Agreements have developed a system for managing storage in the Chino Basin that prioritizes use of basin storage capacity for the benefit of the producing parties (see Appendix K). Each Appropriative Pool and Overlying Non-Agricultural Pool party has the right to store supplemental water and un-produced carryover water in the basin.

As of June 30, 2015, the District estimates it has a total of 26,484 AF of water in its excess carryover and local supplemental storage accounts. This quantity represents a significant reserve for use in times of drought and restrictions on other sources of supply.

### *Conjunctive Use / Dry Year Yield Program*

Conjunctive use is the coordinated operation of surface and groundwater resources, storage, and conveyance facilities to ensure full utilization of available supplies. During wet years when surface water is more readily available, its usage is increased and/or placed into groundwater storage. Then, during dry years, usage of groundwater is increased, offsetting demands on constrained surface water supplies.

Chino Basin producing parties, including the District, have actively engaged with Watermaster, IEUA, and MWD to develop conjunctive use programs that make use of available basin storage and production facilities. In 2004, a series of agreements were executed to implement the Dry Year Yield (DYY) Program with MWD. The DYY Program provided financing to develop facilities capable of producing 33,000 AFY during a dry year out of a designated 100,000 AF storage account. The participants are required to reduce (shift) their imported water usage by a predetermined amount during a dry year. Each participating agency has a specific shift obligation that, when added together, provide MWD with a total of 33,000 AFY of dry year supply. The DYY Program storage account is currently empty.

[12] In September 2012, the Court ordered that a Restated Judgment serve as the official and legally operative copy of the Judgment. All Judgment references in this plan are to the 2012 Restated Judgment.

## 4.3 STATE WATER PROJECT

The State Water Project (SWP) is a water storage and delivery system that provides supplemental water to 25 million people, two-thirds of California's population, and approximately 750,000 acres of irrigated farmland. The SWP is comprised of 34 storage facilities, 20 pumping plants, four pumping-generating plants, five hydroelectric power plants, and about 701 miles of open canals and pipelines. Its main purpose is to store water and distribute it to 29 urban and agricultural water suppliers in northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and southern California. The SWP is maintained and operated by the California Department of Water Resources.

Over the past decade, approximately 40 percent of the District's water supply portfolio is obtained from the SWP. The imported SWP surface water originates in northern California and is transported via the California Aqueduct to Lake Silverwood in the San Bernardino Mountains. This water is extracted from the lake and directed to the Rialto Feeder, a large pipeline owned by Metropolitan Water District of Southern California that travels along the foothills delivering water to area surface water treatment plants. The Water Facility Authority's Aqua de Lejos Treatment Plant in Upland treats the surface water delivered by this pipeline to meet drinking water standards and then distributes it to its member agency owners, including the District.

### 4.3.1 Metropolitan Water District of Southern California

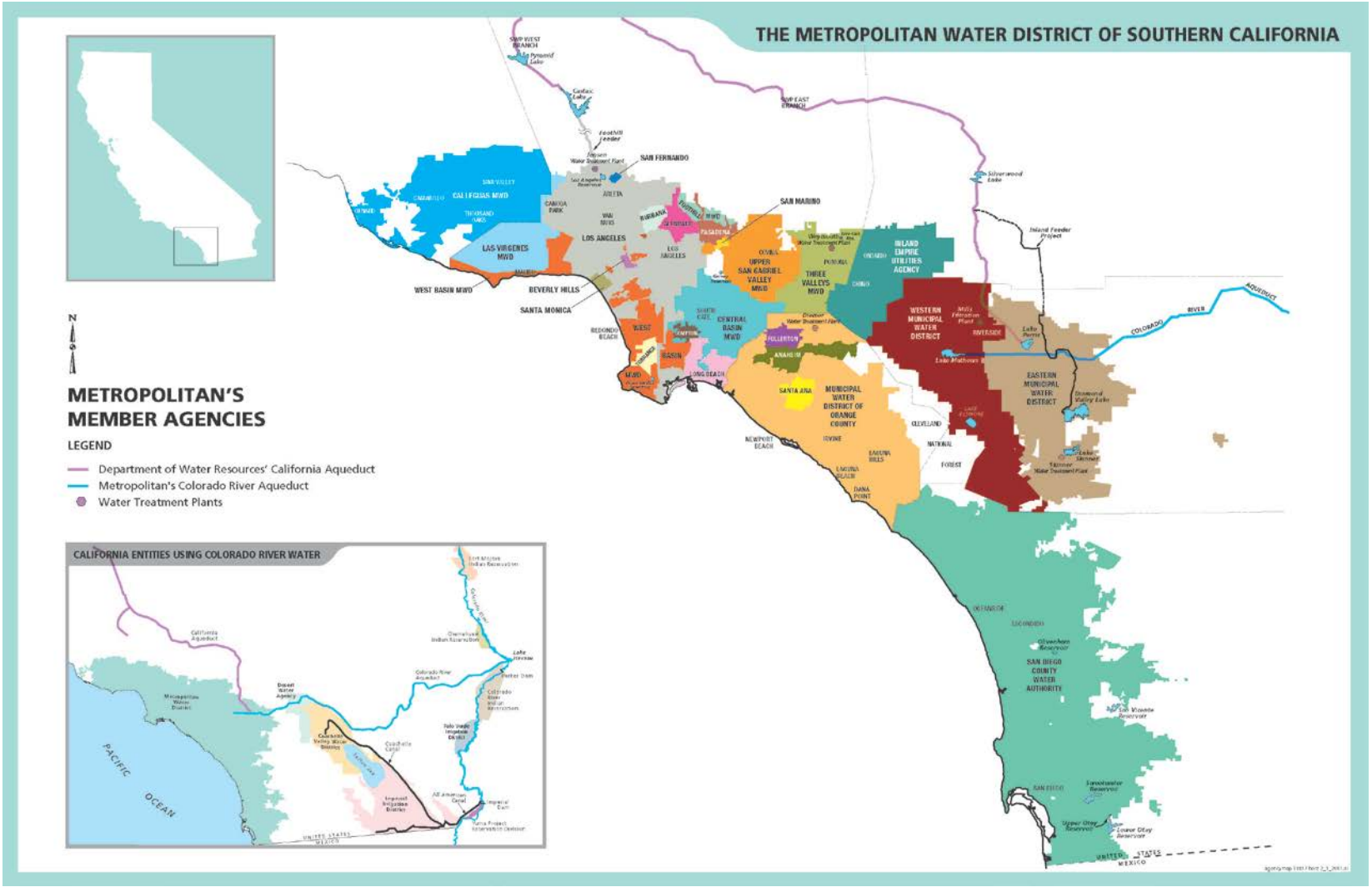
Metropolitan Water District of Southern California (MWD) was formed in the late 1920s to bring imported water to the southern California region. Collectively, the 13 charter members recognized the limited water supplies available within the region, and realized that continued prosperity and economic development of southern California depended on the acquisition and careful management of an adequate supplemental water supply. This foresight made the continued development of southern California possible.

MWD acquires water from northern California via the SWP and from the Colorado River to supply water to most of southern California. As a wholesaler, MWD has no retail customers, and distributes treated and/or untreated water directly to its 26 member agencies, including Inland Empire Utilities Agency (Figure 4-3).

MWD member agencies receive imported water at various delivery points on its system, and pay for it at uniform rates for each class of service established by the Board of Directors. Historically, MWD has been responsible for importing water into the region through its Colorado River Aqueduct and the SWP. Recently, MWD has increased its ability to supply water, particularly in dry years, through implementation of storage and transfer programs. Over the last decade, MWD supplied between 50-60 percent of the municipal, industrial, and agricultural water used within its boundaries.[13]

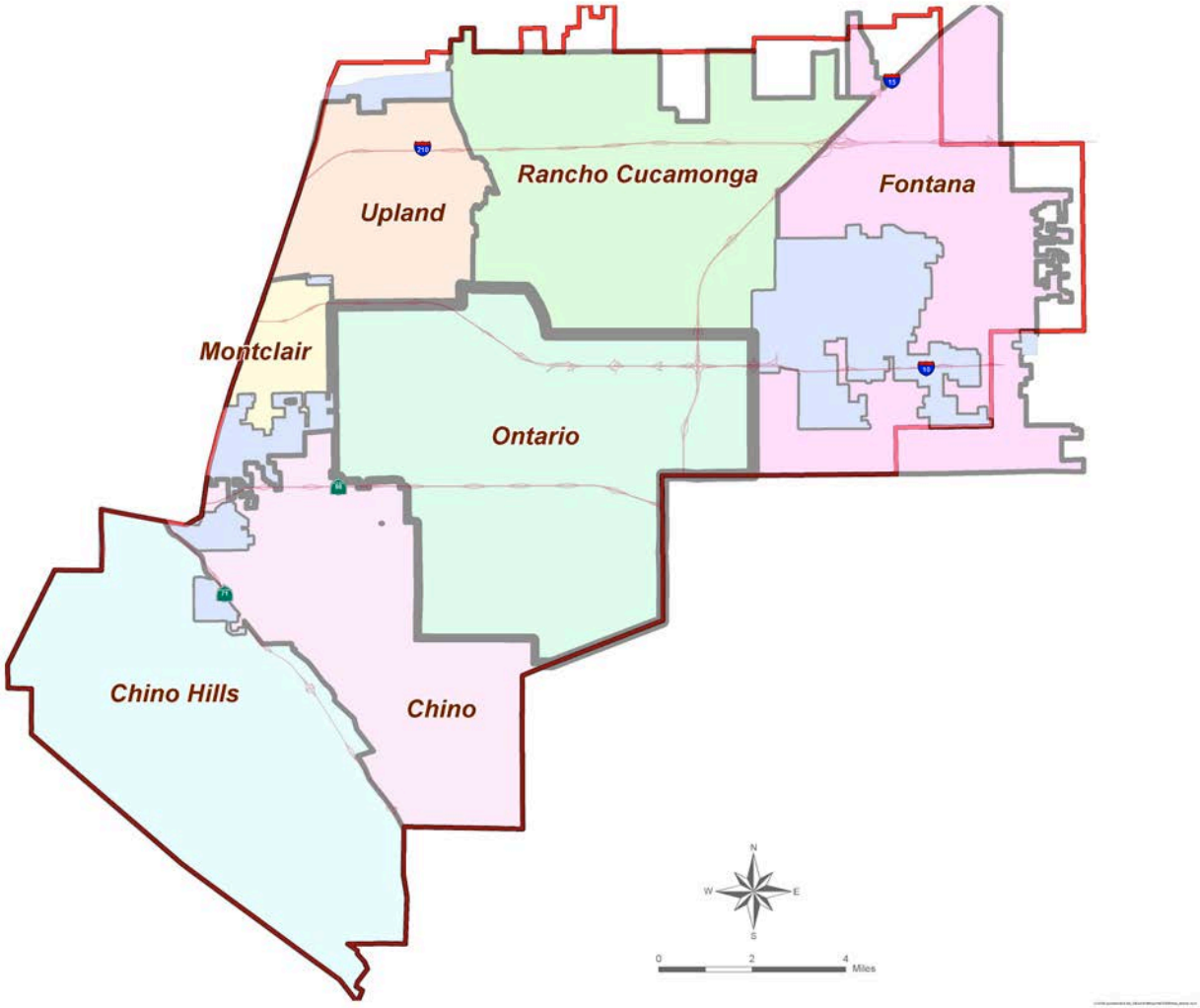
[13] MWD 2015 UWMP (Draft March 2016).

**Figure 4-3:**
**Metropolitan Water District of Southern California Boundaries and Member Agencies**




*Metropolitan Water District of Southern California, www.mwdh2o.com, 2016*

**Figure 4-4:**
**Inland Empire Utilities Agency Boundaries**




*Courtesy of Inland Empire Utilities Agency, 2016*

**Figure 4-5:**
**Water Facilities Authority Member Agencies**

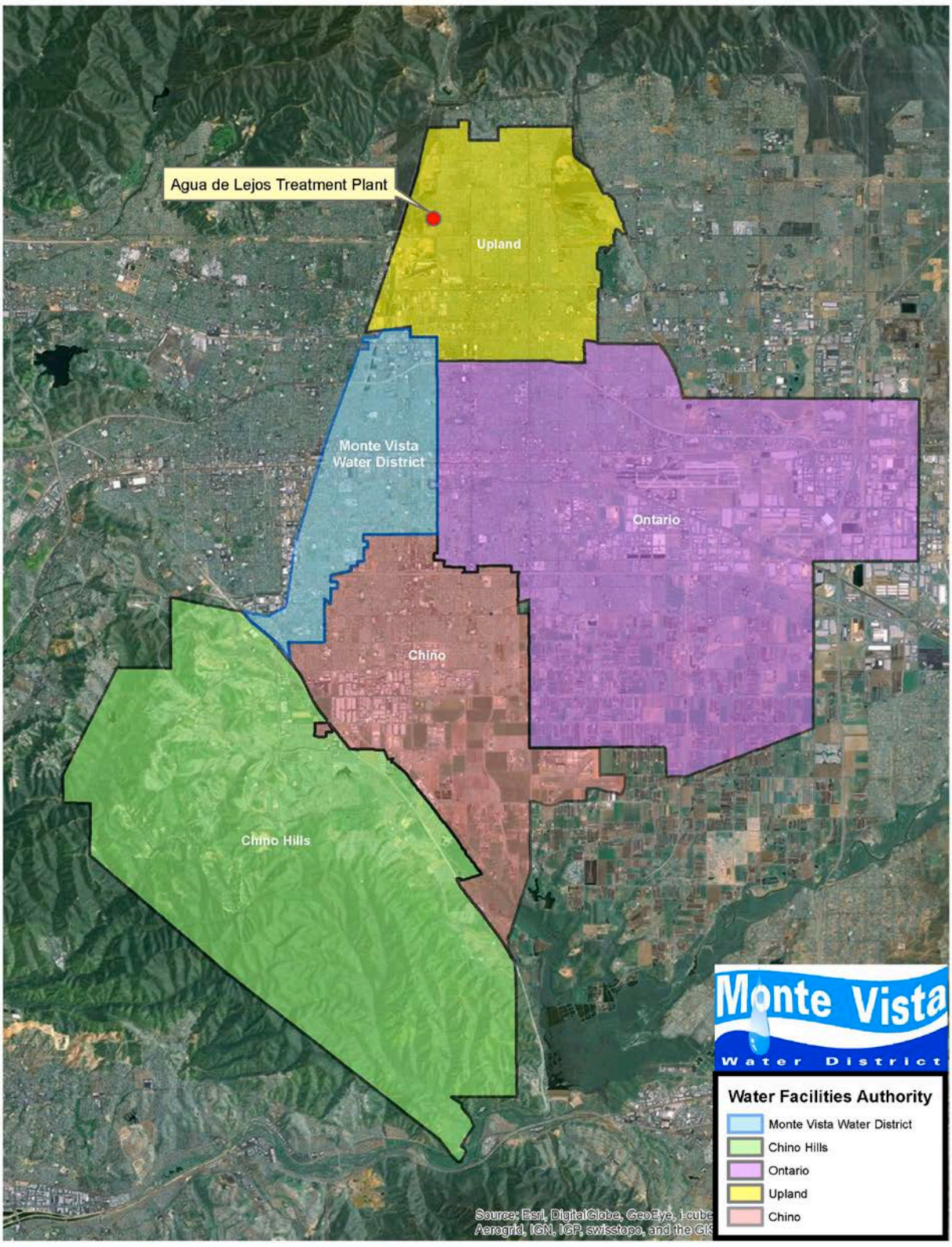
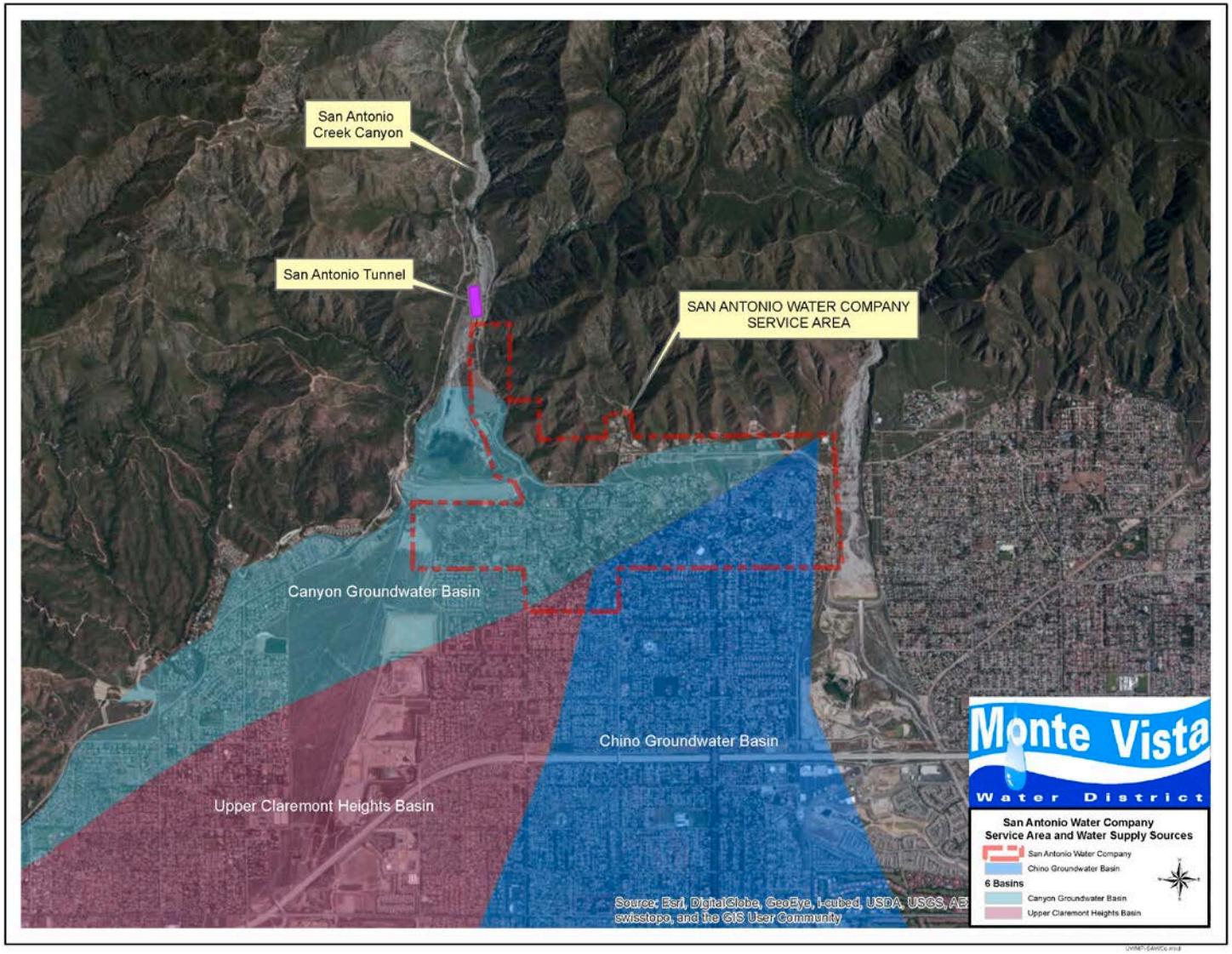


**Figure 4-6:**
**San Antonio Water Company Water Supply Sources**



### 4.3.2 Inland Empire Utilities Agency

Inland Empire Utilities Agency (IEUA) was formed in 1950 to become a member of MWD for the purpose of importing supplemental water to augment local supplies. Since its formation, IEUA has expanded its services to include production of recycled water, distribution of imported and recycled water supplies, sewage treatment, co-composting of manure and municipal biosolids, desalinization of groundwater supplies, and disposal of non-reclaimable industrial wastewater and brine.

IEUA wholesales MWD imported water to three entities: Cucamonga Valley Water District, Fontana Water Company, and the Water Facilities Authority. Although both SWP and Colorado River supplies are available to the region, only SWP supplies are currently used due to groundwater quality constraints (see Section 5.2.2). All three entities take raw imported water deliveries from IEUA and treat it to drinking water standards through independently owned water treatment plants.

### 4.3.3 Water Facilities Authority

The Water Facilities Authority (WFA) is a joint exercise of powers authority formed in 1980 under California Government Code Section 6500 et seq. to provide water supply and distribution services to its members. Currently there are five WFA members: the District and the cities of Chino, Upland, Ontario, and Chino Hills (see Figure 4-5).

In 1986-88, the WFA built the Agua de Lejos Water Treatment Plant, located in Upland, to receive raw SWP water, treat it to drinking water standards, and distribute the treated water to its five member agencies. The WFA currently is permitted to treat 81 mgd of SWP water, which it receives through MWD's Rialto Branch of the Foothill Feeder.

Over the past 10 years, treated water deliveries to the District have ranged from none in the winter months to as high as 30.5 mgd (July 13, 2016) in the summer. WFA water enters the District's potable water distribution system through two turnouts, and the District provides WFA water to Chino Hills through another:

- Turnout Number 1 at Arrow Highway and Benson Avenue
- Turnout Number 2 at Benson Avenue and 17th Street
- City of Chino Hills turnout at Ramona Avenue, south of Philadelphia Street

Treated water is normally delivered into the District's distribution system at Plant 4 after recovering energy using three hydroelectric turbine generators. Water can also be diverted from the Ramona Feeder to reservoirs or through pressure reducing valves.

The District is entitled to 24 percent of the WFA Agua de Lejos Plant capacity (21,776 AFY). The District can take delivery of more than its entitlement when other WFA members are not taking delivery of their full entitlements. Historically, there has always been unused capacity and the District has always had an opportunity to meet water quality standards and demands through additional WFA imported water. Many of the WFA members desire less dependence on imported water and greater reliability and control on local supplies. As a result, development of water supply programs has increased and the continued opportunity for purchase of unused capacity is anticipated.

Discussions on the opportunity to increase the capacity of the WFA treatment plant have occurred; however, analysis would need to be done to determine feasibility and economic benefits considering the climate of imported water reliability. The plant could be increased to 88 mgd through re-rating of the existing plant, and further capacity increases would need to be accomplished by plant expansion.

## 4.4 SAN ANTONIO WATER COMPANY

San Antonio Water Company (SAWCo), which was incorporated in October 25, 1882, is a privately owned mutual water company. Its shareholders are entitled to water supply based on the amount of owned shares and available water supply or SAWCo's ability to produce water.

SAWCo delivers domestic and irrigation water to a variety of shareholders. These shareholders include most residents of San Antonio Heights (an unincorporated area of San Bernardino County), the District, the cities of Upland and Ontario, local golf courses, rock quarries, and grove irrigators. There are a total of 6,389 outstanding SAWCo shares. Upland is the largest shareholder with over 70 percent of the total outstanding shares, and the domestic customers of San Antonio Heights as a group represents the second largest block of shares owning roughly 10 percent of the outstanding shares. The District currently owns 329.75 SAWCo outstanding shares, about 5.2 percent of the total.

According to the current Bylaws of SAWCo, there are two classes of service determined by the principal use known respectively as "domestic" and "irrigation." Any water delivered to a user other than domestic customers in San Antonio Heights is considered "irrigation" use. SAWCo's sources of domestic water supply include groundwater from the San Antonio Tunnel, Chino Groundwater Basin, and Cucamonga Groundwater Basin, and a small amount of purchased water from the City of Upland. SAWCo's sources of irrigation water supply include both surface water from the San Antonio Canyon and groundwater from Chino Groundwater Basin, Cucamonga Groundwater Basin, and the Six Basins area. Surface water from the San Antonio Canyon is used for irrigation, spreading over the San Antonio Tunnel for domestic supply, and delivered to the City of Upland's Surface Water Treatment Plant for domestic supply.

Total annual water supply over the past decade ranged from 20,213 AFY in 2005 to 9,074 AFY in 2015. SAWCO's production rights total approximately 30,000 AFY. Roughly 80 percent of total deliveries are to non-domestic irrigation customers, primarily municipalities. SAWCo has generally fully utilized its water rights in all sources except San Antonio Creek.[14]

Currently, each share is entitled to 1.808 AFY of water deliveries, for a total annual supply of 11,552 AFY. This is a decline from a pre-drought entitlement of 2.594 AFY per share, or 16,574 AFY in total annual supply. For the purposes of this Plan, the District will utilize SAWCo's pre-drought entitlement for normal year and post-drought entitlement for single and multi-dry years.

In September 2010, SAWCO and the District entered into a Water Service Agreement, pursuant to which SAWCO may transfer to the District the right to pump the District's share of the SAWCO entitlement from the Chino Groundwater Basin. Since then, SAWCo and the District have developed additional delivery options, including a wheeling agreement with the City of Upland, an interconnection with the WFA, and transfer of groundwater production rights from Six Basins to the Chino Basin through the City of Pomona. Due to the drought, SAWCo allowed the District's Water Service Agreement lapse at the end of its five-year term (December 31, 2015). The District is currently coordinating with SAWCo and its other municipal shareholders to develop new service agreements consistent with existing conditions.

SAWCo's water supply sources include surface water and groundwater. Surface water is obtained from the San Antonio Watershed. Groundwater sources include the San Antonio Tunnel, Chino Groundwater Basin, Cucamonga Groundwater Basin, and the Six Basins area. The following sections provide detailed descriptions of each source.

### 4.4.1 Surface Water Supply – San Antonio Canyon

SAWCo has rights to surface flow from San Antonio Creek, which appear to be pre-1914 rights and over the years have been supported by court judgments. These water rights are expressed in "miner's inches" (MI), which are equivalent to one cubic foot per second (cfs).

SAWCo has surface water rights in the San Antonio Canyon as follows:

- SAWCo has rights to the first 17 percent of all flow from the San Antonio Creek.
- After deducting 17 percent of the total flow, SAWCo has a priority to the next 18 MI of the remaining flow.

[14] SAWCo, May 18, 2016; SAWCo 2014 Annual Report; SAWCo Water System Master Plan, February 2010.

- After deducting the 17 percent of the total flow and the 18 MI, the balance is divided equally between SAWCo and the West Side Owners (WSO) (currently Pomona Utility Service District), until WSO's share equals 312 MI.

- After WSO's entitlement of up to 312 MI, SAWCo is entitled to divert all additional flow as long as its total diversion does not exceed 740 MI (January 1 to March 31) or 965 MI (April 1 to December 31) annually.

- It is not clear what rights SAWCo has to diversions in excess of the above amounts for domestic use. SAWCo does have rights to spread flows in excess of 10,000 MI for recharge of local groundwater basins.[15]

According to SAWCo, its total rights to surface water from San Antonio Canyon is 17,460 AFY.[16]

Surface water diverted from the San Antonio Creek and the San Antonio Tunnel water (discussed below) may be used for domestic purposes, irrigation, and/or spreading in the Cucamonga Basin or elsewhere.

### 4.4.2 Groundwater Supply[17]

SAWCo utilizes various groundwater sources including the San Antonio Tunnel and groundwater wells in Chino Groundwater Basin, Cucamonga Groundwater Basin and the Six Basins area. SAWCo also engages in spreading operations that enhance the groundwater supply available to SAWCo. These groundwater sources are described below and shown in Figure 4-6.

#### *San Antonio Tunnel*

The San Antonio Tunnel is the primary water supply for SAWCo's domestic water system. SAWCo has rights to all water flowing in the San Antonio Tunnel. Groundwater wells are available to augment the tunnel water supply. Since 1988, the maximum production measured from the San Antonio Tunnel was 4,171 AFY which occurred in 1993. However, the natural supply available to SAWCo from this source is uncertain considering tunnel water flow is enhanced when natural flows are low from spreading San Antonio Canyon water, which is already counted as a source. In general there appears to be a potential correlation between the San Antonio Canyon flow and base flow in the San Antonio tunnel, which is estimated to be approximately 1,050 AFY.

[15] SAWCo Water System Master Plan, February 2010.
[16] SAWCo 2014 Annual Report.
[17] SAWCo Water System Master Plan, February 2010, unless otherwise indicated.

Portions of the deep rock tunnel, a 4-foot by 4-foot rectangular tunnel constructed in 1885, are supported by redwood and rock beams and are situated approximately 100 feet below the ground surface. The deep rock tunnel is fed by groundwater that naturally percolates through the subsurface into the deep rock tunnel. The tunnel is also fed by a portion of water from the San Antonio Canyon, which is diverted into spreading grounds above the tunnel. Water collects in the deep rock tunnel, is piped to SAWCo's Forebay, chlorinated, and piped to SAWCo's potable water reservoirs.

### *Chino Groundwater Basin*

SAWCo overlies the northwesterly portion of the Chino Groundwater Basin and has an appropriative right of 2,164.5 AFY, which represents 2.748 percent of the Basin OSY.

Although subject to change, the OSY of the Basin has historically been 54,834 AFY, of which SAWCo is entitled to 1,506.888 AFY. Recently, agricultural pool water transfers to SAWCo have averaged approximately 795 AFY, though these will decline significantly upon Court adoption of the 2015 Safe Yield Reset Agreement.

For more information on the Chino Groundwater Basin, see Section 4.2.

### *Cucamonga Groundwater Basin*

The Cucamonga Groundwater Basin is located east and north of the Red Hill Fault in the northeastern section of the City of Upland. In 1958, a stipulated Cucamonga Basin Judgment allocated groundwater within the Cucamonga Basin to 24 stipulating parties, which today consists of SAWCo, West End Consolidated Water Company, and Cucamonga Valley Water District.

The Cucamonga Basin Judgment stipulates SAWCo's water production as 6,500 AFY, provided SAWCo spreads an average 2,000 AFY of imported water (from the San Antonio Canyon and/or Creek) into the Cucamonga Groundwater Basin, based on a 10-year rolling average. However, if SAWCo's average annual spreading is less than 2,000 AFY during the 10-year average, SAWCo's stipulated water right of 6,500 AFY can be reduced by up to 2,000 AFY, to a minimum total of 4,500 AFY. Conversely, if SAWCo's average annual spreading is more than 2,000 AFY, SAWCo's stipulated water right of 6,500 AFY can be increased by up to 2,000 AFY, to a maximum total of 8,500 AFY. Only 95 percent of the water spread (up to a maximum of 2,105 AF spread) can be used to augment SAWCo's stipulated right above 6,500 AFY. In summary, to maximize its stipulated water right up to 8,500 AFY, SAWCo is required to spread an average of 4,105 AFY (2,000 + 2,105) of imported water over a rolling 10-year period.

There are currently discussions underway regarding revising the management of the Cucamonga Groundwater Basin to modernize the Judgment and establish storage accounts.

### *Six Basins Area*

The Six Basins area is located north of the San Jose Hills, west of Chino Basin, south of the San Gabriel Mountains, and east of the Main San Gabriel Basin. The Six Basins area consists of six interconnected groundwater basins, which includes the "Four Basins" (Canyon, Upper Claremont Heights, Lower Claremont Heights, and Pomona) and the "Two Basins" (Live Oak and Ganesha).

SAWCo operates groundwater wells overlying the Upper Claremont Heights Groundwater Basin and owns rights to produce groundwater from the Four Basins area. SAWCo's initial water right in Six Basins is about 1,383 AFY, or 7.166 percent of the Four Basins annual OSY as determined by Six Basins Watermaster. In 2006, SAWCo established a storage and recovery account with Six Basins Watermaster that allows SAWCo to recharge up to 1,000 AFY and up to two years of storage. Thus SAWCo's stipulated initial water right in Six Basins can be increased by up to 2,000 AFY to a maximum total of 3,383 AFY. The OSY of Four Basins for 2016 is 16,000 AFY. SAWCo is currently entitled to 1,146.6 AFY and has a storage account balance of 1,390.7 AF.[18]

The Six Basin Judgment did not allocate any production rights from the Two Basins to SAWCo. In addition, rights to the Four Basins and Two Basins are not transferable between the two basins. However, rights may be transferable from within the Four Basins if certain conditions are met.

Parties to the Six Basins Judgment are authorized to produce groundwater in addition to the allocated amounts within Four Basins. Such extractions result in an assessment by Six Basins Watermaster to pay for water to replenish Four Basins through imported surface water recharge.

## 4.5 INLAND EMPIRE UTILITIES AGENCY – RECYCLED WATER

The District receives recycled water from IEUA's wastewater treatment plants and regional recycled water distribution system, which the District then delivers through its retail distribution system to 18 sites for non-potable landscape irrigation.

Water recycling is a critical component of the water resources management strategy for the region. Reuse of highly treated tertiary water is a source of water available to meet the growing water demands of the region, including the District. Recycled water is a proven technology and a dependable, drought-resilient local water supply. In addition, the use of recycled water for groundwater recharge is an integral part of local groundwater management.

[18] Six Basins Watermaster Board Packet, May 25, 2016.

For background information on IEUA's regional recycled water program, see Section 2.2 of the District's Recycled Water Master Plan (Appendix L). Figure 4-7 shows the current extent and planned expansion of IEUA's regional recycled water distribution system.

IEUA operates four regional wastewater treatment plants that produce disinfected and filtered tertiary treated recycled water in compliance with California's Title 22 regulations: Regional Plants (RP)-1, RP-4, RP-5 and the Carbon Canyon Water Reclamation Facility (CCWRF). A fifth treatment plant, RP-2, was decommissioned in 2004 because it is located in a potential flood zone. Additional sources of recycled water that is received and used within IEUA's service area include the Upland Hills Water Reclamation Plant (operated by the City of Upland) and the California Institution for Men Water Reclamation Plant (operated by the California Institution for Men at Chino).

IEUA's facilities serve eight contracting agencies: the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, and Upland, Cucamonga Valley Water District, and unincorporated areas of San Bernardino County within the IEUA service area.

The District has developed a retail recycled water distribution system to deliver recycled water purchased from the City of Montclair and delivered by IEUA's regional distribution system (Figure 4-8). The District currently delivers an average of 340 AFY to seven District customers at 18 different locations for landscape irrigation. The District developed a Recycled Water Master Plan in 2011 which projects near-term expansion of its recycled water distribution system to serve up to 430 AFY (see Section 4.6.5 and Appendix L).

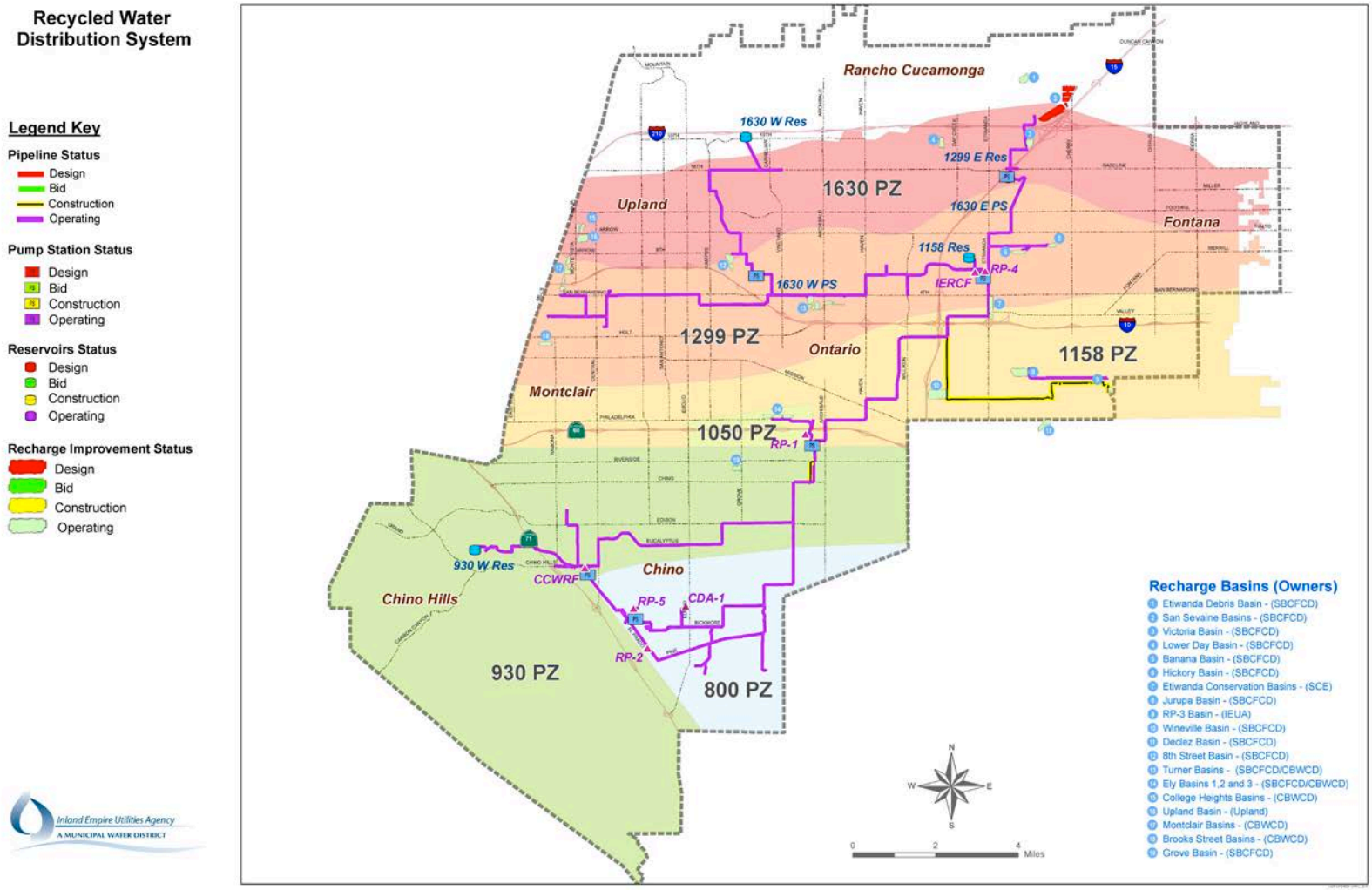
### 4.5.1 Wastewater Treatment

IEUA manages the Regional Sewage Service System within its 242-square miles service area to collect, treat, and dispose of wastewater delivered by contracting local agencies. IEUA's facilities serve seven contracting agencies: the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, and Upland, and Cucamonga Valley Water District. A system of regional trunk and interceptor sewers convey sewage to regional wastewater treatment plants, which are all owned and operated by IEUA. Local sewer systems are owned and operated by local agencies.

#### *Wastewater Treatment Plants*

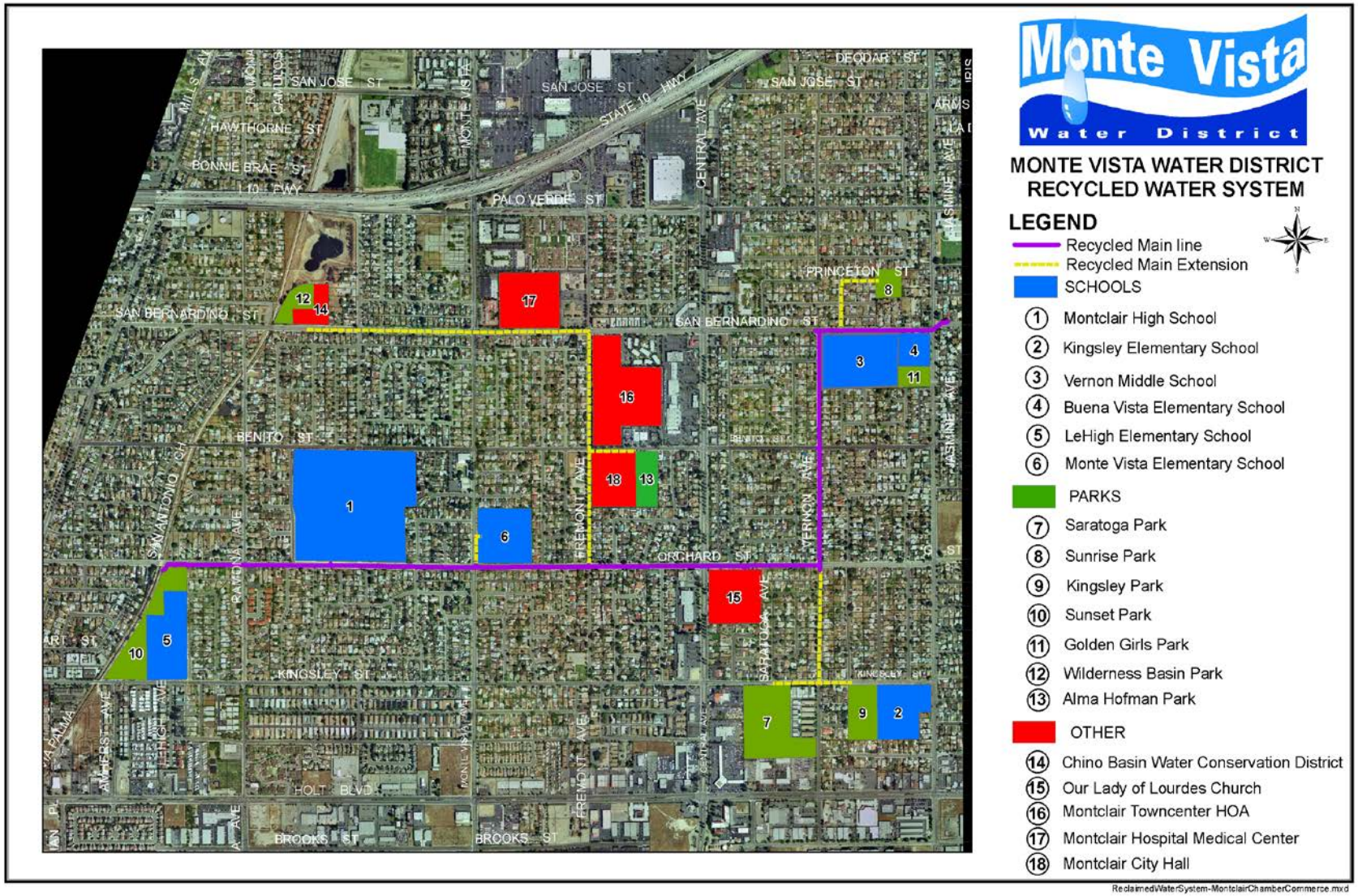
IEUA operates four regional water recycling production plants: Regional Plant No.1 (RP-1), RP-4, RP-5, and the CCWRF. A fifth treatment plant, RP-2, was decommissioned in 2004 because it was in a potential flood zone due to of the Prado Dam project. Each facility that produces recycled water is briefly described below:

**Figure 4-7:**
**IEUA Regional Recycled Water Distribution System – Current and Projected**




*Inland Empire Utilities Agency, www.ieua.org, 2016.*

**Figure 4-8:**
**Existing Retail Recycled Water Distribution System**



- **RP-1** began operation in 1948 through a joint powers agreement between the cities of Ontario and Upland. IEUA, then known as Chino Basin Municipal Water District, purchased RP-1 in January 1973. Its current capacity is 44 mgd. RP-1 serves all or part of the cities of Ontario, Rancho Cucamonga, Upland, Montclair, Fontana, and unincorporated areas of San Bernardino County.

- **CCWRF** has been in operation since 1992. The recycled water plant capacity is 11.4 mgd, while solids are treated at RP-2. CCWRF serves the cities of Chino, Chino Hills, Montclair, and Upland.

- **RP-4** was completed in 1997 and recently expanded to 14 mgd. RP-4 serves Cucamonga Valley Water District, the City of Fontana, and unincorporated areas of San Bernardino County in the northeast portion of the IEUA service area.

- **RP-5** began operation in March 2004. The 15 mgd plant serves existing and planned development in the cities of Chino, Chino Hills, and Ontario.

Figure 4-7 shows the location of regional wastewater treatment plants and recycled water distribution lines. The combined production of the current wastewater treatment plants is 61,944 AFY (55.3 mgd). By 2035, the plants are expected to produce 82,330 AF of water (73.5 mgd).[19]

Table 4-5 shows the estimated wastewater collected and treated from the District's service area in 2015. It should be noted that, because IEUA's regional recycled water system is fully integrated, the District's recycled water customers are not necessarily delivered recycled water which originated from its service area.

**Table 4-5:**
**Estimated Wastewater Collection from Retail Service Area (AFY)**

| Wastewater Collection | 2015 |
|---|---|
| Wastewater Collected in District Service Area | 2,464 |

Aligns with data in DWR Standardized Table 6-2 R.
IEUA, May 18, 2016. Estimate based on Montclair's percentage of total IEUA wastewater flows.

### *Wastewater Treatment Process*

All of IEUA's wastewater treatment plants produce recycled water that meets or exceeds the requirements of the California State Water Resources Control Board Title 22 for recycled water.

[19] IEUA 2015 Recycled Water Program Strategy, October 2015.

The treatment process begins with raw sewage that is collected from the local cities. The raw sewerage is passed through screening and grit removal units, primary clarifiers, aeration basins, secondary clarifiers, chemical addition, tertiary filters, chlorination, and finally dechlorination facilities prior to discharge. Some of the effluent flow is placed into the nearby creeks and allowed to flow ultimately into the Santa Ana River where it is recharged into Orange County's groundwater basin. The remainder of the flow is pumped into IEUA's recycled water distribution system for reuse.

Solids removed from the liquid treatment processes are thickened and stabilized in anaerobic digesters before being dewatered and transported to the Agency's composting facility in Rancho Cucamonga which is a joint venture with Los Angeles County Sanitation District.

IEUA maintains a federal- and state-approved industrial pre-treatment program for industrial discharges to the sewage system that requires dischargers to comply with water quality objectives and to submit periodic monitoring reports to IEUA.

IEUA produces a supply of highly polished tertiary-treated water suitable for irrigation, industrial water supply, groundwater recharge, environmental enhancement, and unrestricted recreation use such as boating and fishing.

### 4.5.2 Existing Recycled Water Program Supplies

Currently, IEUA produces about 56,000 AFY of recycled water and uses just over 33,000 AF annually (see Table 4-8). The remaining supply of recycled water, about 23,000 AF, was discharged to the Santa Ana River for reuse in Orange County. Recharge of recycled water into the Chino Basin is projected to increase over the 25-year planning horizon (see Section 4.6.5 and Table 4-8).

A transmission line connecting RP-1 and RP-4 serves as part of the backbone system for recycled water use in the northern portion of IEUA's service area. The District's current retail recycled water distribution system relies on deliveries from this portion of IEUA's regional system, specifically through the San Antonio Channel Pipeline which provide recycled water service to Ontario and Montclair. It should be noted that, because IEUA's regional recycled water system is fully integrated, IEUA is capable of delivering recycled water from any of its RPs to meet the demands of the District's recycled water customers.

In 2015, the District delivered 308 AF to its recycled water customers and purchased 483 AF of the City of Montclair's share of regional recycled water groundwater recharge. As shown in Table 4-6, this is 515 AF less than the amount projected in the District's 2010 UWMP, mostly due to delay in expanding the District's recycled water distribution system and the regional recharge program. With the connection of additional customers, it is estimated that recycled water sales will eventually reach 430 AFY.

**Table 4-6:**
**2015 Recycled Water Use vs. 2010 UWMP Projection (AFY)**

| Use Type | 2015 Actual Use | 2010 Projection for 2015 |
|---|---|---|
| Landscape Irrigation | 308 | 430 |
| Groundwater Recharge | 483 | 876 |

Aligns with data in DWR Standardized Table 6-5 R.
All amounts in AF for fiscal year totals.

### 4.5.3 Current and Projected Recycled Water Use in District Service Area

Table 4-7 shows the current and projected recycled water usage in the District's service area through 2040. This includes direct reuse by the District's recycled water customers and indirect reuse through groundwater recharge credits. The recycled water use projections to 2040 are consistent with IEUA's projections included in its 2015 Recycled Water Program Strategy (October 2015).

**Table 4-7:**
**Current and Projected Recycled Water Uses (AFY)**

| | 2015[1] | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **Landscape Irrigation** | 308 | 430 | 430 | 430 | 430 | 430 |
| **Groundwater Recharge**[2] | 483 | 601 | 560 | 589 | 639 | 639 |
| **Totals** | **791** | **1,031** | **990** | **1,019** | **1,069** | **1,069** |

Aligns with data in DWR Standardized Table 6-4 R.
[1] Actual values from District records.
[2] 2020-2040: City of Montclair estimated portion (4.3%) of IEUA's projected recycled water recharge (Table 4-8).

## 4.6 PLANNED WATER SUPPLY ENHANCEMENT PROJECTS

Due to past investments, the District currently has a reliable and drought-resilient water supply capable of meeting projected demands over the next 25 years and beyond. However, the District continues to invest in maintaining existing water supplies and infrastructure, and actively seeks opportunities to further enhance the reliability, affordability, and resiliency of its water supply portfolio.

This section summarizes planned District and local projects to enhance the reliability of the District's water supplies, including a review of the District's capital improvement plan and consideration of partnership, groundwater recharge, transfer and exchange, recycled water, and desalination opportunities available to the District.

For information on regional and wholesale water supply enhancement projects, please refer to the SAWCo, WFA, IEUA, and MWD 2015 Urban Water Management Plans.

### 4.6.1 Capital Improvement Plan

The District's Capital Improvement Plan (CIP), last updated in its 2008 Water Master Plan, is a comprehensive, prioritized outline of recommended projects that involve the repair and/or replacement of existing domestic water system facilities and improvements for future needs. The CIP lists specific prioritized capital improvement projects over the next 10 years and general improvements and projects envisioned over the next 30 years.

The CIP includes a variety of potable water system improvements that are necessary to eliminate current deficiencies as well as improvements for the purpose of providing reliable water services through the year 2039. The accompanying Financial Master Plan, last updated in 2015, provides a mechanism for funding the identified capital projects at a cost of $35.5 million over the next 10 years and $96.7 million over the next 30 years. Projects include:

- A comprehensive pipeline replacement/rehabilitation program;
- Construction of three new wells and retrofitting an existing well maintain existing groundwater production capacity;
- Installation of two back-up power generators at key wells for additional supply reliability during emergency conditions;
- A booster pump station retrofit and capacity enhancement project; and,
- Seismic and plant improvements to various District facilities.

### 4.6.2 Groundwater Recharge Opportunities

In 2013, Chino Basin Watermaster, in partnership with IEUA, completed a stakeholder process of developing an amendment to its 2010 Recharge Master Plan Update (2013 RMPU). The 2013 RMPU identifies a suite of yield enhancement and production sustainability projects to increase recharge and maintain sustainable production in the Chino Basin. The projects are estimated to achieve 6,780 AFY in increased stormwater capture and recharge and 4,900 AFY in recycled water recharge, for a combined increased recharge of 11,680 AFY.

Watermaster and IEUA have begun the process of implementation. Some projects have been determined to be no longer viable, and some additional projects have been recommended for inclusion, but the process continues to move forward. Additionally, the 2015 Safe Yield Reset Agreement, if approved by the Court, establishes a process for Appropriative Pool parties to opt-in and opt-out of participation in project development. The District will continue to participate in the process of developing these projects, and may decide to participate in financing project construction in return for additional basin yield.

### 4.6.3 Partnership Opportunities

The District is constantly seeking partnership opportunities with local and neighboring agencies to develop more reliable, cost-effective water supplies.

#### *City of Pomona*

The District and the City of Pomona have developed a strong working relationship and are collaborating on a number of water supply development projects. In addition to working together with IEUA on a recycled water interconnection study (see below), the District and City have identified significant opportunities to share rights, resources, and infrastructure in order to access and develop low-cost water supplies for the mutual benefit of each agency.

In September 2015, the District and City entered into a Memorandum of Understanding (MOU) to cooperate in the development of water supplies, implement best practices, and reduce operational costs.

#### *Water Facilities Authority*

Historically, there has always been unused capacity in the WFA's Agua de Lejos water treatment plant, and the District has always had an opportunity to meet water quality standards and demands through additional WFA imported water. Many of the WFA members desire less dependence on imported water and greater reliability and control on local supplies. As a result, the development of local water supply programs has received increased attention and the continued opportunity for utilization of unused WFA treatment capacity is anticipated.

Discussions on the opportunity to increase the capacity of the WFA treatment plant have occurred; however, analysis would need to be done to determine feasibility and economic benefits considering the climate of imported water reliability. The plant could be increased to 88 mgd through re-rating of the existing plant, and further capacity increases would need to be accomplished by plant expansion.

### 4.6.4 Transfer and Exchange Opportunities

Water transfers are a water management concept with great potential for helping to alleviate water shortages in the region and across the state. The concept is that two agencies, one willing seller of water and one willing buyer, can enter into an exchange agreement that is mutually beneficial from a water management point of view. Water transfers allow an agency to "move" water from one service area to another, even when the two agencies are not connected by any pipelines.

As a water management tool, water transfers can be effective during periods of severe drought or emergencies. Water transfers, as shown below, can take multiple forms to increase water supply reliability among agencies.

#### *Chino Groundwater Basin Transfers and Conjunctive Use*

The District's ability and right to use a portion of the vast storage capacity of the Chino Basin, and ability to spread significant quantities, gives additional flexibility, particularly if transfer water is available. According to the Peace Agreement, transfers include the assignment, lease, or sale of a right to produce water to another producer within the basin or to another person or entity for use outside the basin whether the transfer is temporary or permanent. Lease of water rights are also permissible to allow producers to make up for the lessee's over-production.

The Chino Basin is also a valuable resource for water transfers because of its ability to be a storage facility for multiple sources of water. Because of the basin's tremendous capability to store water, outside agencies are encouraged to enter into agreements with producing parties to store water. For example, another agency who is a contractor to the SWP may wish to store their surplus SWP water in the basin for future droughts or emergencies. When they need their stored water, the outside agency simply asks the basin agency to pump and utilize the stored water while the outside agency takes direct delivery through the SWP.

Funding was allocated for conjunctive use programs through Proposition 13, the Water Bond passed by California voters in March 2000. The District participated in the groundwater recovery program by constructing new wells and converting inactive wells to injections/recovery wells that utilize imported water during period of low demand to recharge the basin. Water stored under this program could be utilized to meet demand during periods of drought.

In the near future, the Santa Ana River Conservation and Conjunctive Use Program (SARCCUP) is being developed through the Santa Ana Watershed Project Authority (SAWPA) utilizing Proposition 28 Integrated Regional Resource Planning grant funds. Though still in its formative stages, SARCCUP seeks to create a watershed-wide conjunctive use program.

### *Interconnections*

Local water agencies have the ability to enter into contracts between each other to provide water on an annual basis or on an as-needed basis. The District currently has six emergency connections to receive water from the Golden State Water Company and the cities of Chino, Chino Hills, and Upland. The connection with the company can be used for emergencies to serve the City of Claremont. The other interconnections allow water to be supplied or received. The District has utilized the emergency connection when the WFA treated deliveries were interrupted, as well as to received deliveries of purchased or entitlement water supply from the City of Upland and SAWCo.

## 4.6.5 Recycled Water Opportunities

There are many opportunities for the District to expand the direct and indirect reuse of recycled water to offset or enhance potable water supplies. Although the District has established a recycled water retail distribution system to serve most of its major landscape irrigation customers in the City of Montclair, it has identified additional potential recycled water customers in its 2011 Recycled Water Master Plan (Appendix L) for a potential additional use up to 100 AFY of recycled water by 2020. Also, recycled water used to recharge the Chino Basin is expected to expand and increase the District's pumping rights in the basin.

### *Recycled Water Availability*

Region-wide, available recycled water supplies are projected to reach 66,312 AFY in 2020. In conformance with the 1969 Santa Ana River Judgment, a minimum of 17,000 AFY of water will be discharged to the Santa Ana River. This leaves more than 49,000 AFY of recycled water available for beneficial reuse within the IEUA service area by 2020. Table 4-8 shows the projected future uses of IEUA's recycled water supply.

**Table 4-8:**
**Current and Projected Regional Recycled Water Supplies and Usage (AFY)**

| | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| **Recycled Water Supply** | 56,384 | 66,312 | 71,913 | 77,514 | 82,330 |
| **Santa Ana River Discharge** | 17,000 | 17,000 | 17,000 | 17,000 | 17,000 |
| **Direct Use Demand Forecast** | 22,579 | 30,757 | 36,507 | 40,320 | 43,019 |
| **Groundwater Recharge** | 10,840 | 13,977 | 13,027 | 13,707 | 14,871 |
| **Remaining Supply** | 5,965 | 4,578 | 5,379 | 6,487 | 7,440 |

Sources: IEUA, May 19, 2016; IEUA 2015 Recycled Water Program Strategy.

### *Recycled Water for Groundwater Recharge*

As shown in Table 4-8, recharge of recycled water in the Chino Basin is expected to peak at roughly 15,000 AFY in 2035. The City of Montclair's percentage allocation of this recharge is currently 4.3 percent, providing the District with up to 640 AFY of recycled water recharge which becomes part of the District's groundwater production rights (see Section 4.2.2). Montclair's percentage allocation of this total recharge is expected to decrease due to increased wastewater contributions from the cities of Ontario and Chino.

### *Recycled Water Interconnection and Recharge Study*

In 2015, the District, the City of Pomona, and IEUA contracted with Carollo Engineers to develop a recycled water interconnection and recharge feasibility study. The study assessed the viability of interconnecting facilities owned and operated by the District, City, and IEUA to convey treated recycled water to direct use recycled water customers, groundwater recharge basins, and aquifer storage and recovery (ASR) well locations. The study identified a preferred alternative which would generate an estimated 3,500 AFY of additional water supply for the region. The agencies are further evaluating alternatives and seeking grant funding for the proposed project.

### *Encouraging Recycled Water Use*

The District has and will continue to encourage recycled water use by potential recycled water users through a variety of measures. The District is confident that, when performed collectively, these measures will result in an increase in recycled water use through 2040.

**Customer Development Process**

Through the first phase of its recycled water system development, the District successfully implemented the process of developing recycled water customers from identification to final system connection. However, the expansion of the District's recycled water system as described in this Plan will require a more comprehensive customer development process.

The District's first recycled water users have for the most part been large public sector institutional customers, most notably the City of Montclair, Ontario Montclair School District, and Chaffey Joint Union High School District. While the District will continue to work with these large customers in identifying new sites for recycled water use, the District will also focus more on smaller private sector customers, including nurseries, farms, multi-family residential developments, and commercial establishments. The District will draw on its experience working with its initial customers, including public agency partners as well as Montclair Hospital Medical Center, Montclair Towncenter Homeowners Association, and Our Lady of Lourdes Catholic Church, in developing a more robust private sector customer development process.

**Table 4-9:**
**Ten-Step Process for Recycled Water Customer Development**

| Step | Description | Share of Total Effort |
|---|---|---|
| 1. Site Information | Confirm location and status of site | 3% |
| 2. Site Assessment | Contact site representative; introduce District, opportunity of recycled water availability | 20% |
| 3. Site Assessment Summary | Gather onsite water system information; develop schematics; determine tasks to convert to recycled water; develop cost estimate | 5% |
| **Milestone 1** | Sufficient viable potential customers exist along alignment to proceed with recycled water lateral development | |
| 4. Letter of Commitment | Recommend at this stage using letters of commitment rather than formal agreements to secure intent without threat of punitive action | 5% |
| 5. Regulatory Approval | Prepare draft schematics of conversion to recycled water; confirm accuracy with end user; send to State Board and County Department of Health Services for review and tentative approval | 42% |
| 6. Construction Estimates | Obtain three bids from qualified contractors; select one to complete retrofit work | 5% |
| 7. Retrofit Financing Agreement | As required, prepare and circulate retrofit financing agreement | 5% |
| **Milestone 2** | Sufficient progress achieved prior to lateral construction | |
| 8. Construction Oversight | Perform site inspections; document compliance with State Board regulations | 5% |
| 9. Final Cross-Connection Test | Perform final cross-connection test with County State Board; obtain final project approval | 5% |
| 10. Prepare As-Built Drawings | Modify schematics to comply with actual construction; distribute to customer, regulators | 5% |

The District will also build on the experience of other recycled water distribution systems in developing a diverse and robust recycled water customer base. Central Basin and West Basin Municipal Water Districts in Los Angeles County developed a ten-step customer development process that assisted them to quickly identify, assess, and secure potential recycled water customers in order to secure available MWD funding. The steps, outlined in Table 4-9, represent the major events during their customer development process and estimate the effort associated with those steps.

Many potential customers have in the past expressed interest in converting their sites to use recycled water. These customers, including the City of Montclair, Omnitrans, Montclair Towncenter Shopping Center, The Pines Apartments, and the Girl Scouts, have responded positively to the District's initial inquiries and preliminary site investigations to determine near-term expansion possibilities (see Appendix L, Section 9.2).

**Financial Incentives**

The District's recycled water rate is lower than its potable flat water rate, which helps to incentivize use of recycled water. The District has also identified external funding to assist potential recycled water customers in offsetting the expense of retrofitting their onsite irrigation systems to use recycled water (see Appendix L, Section 6).

**Plumbing Codes**

The District's Ordinance 31 requires all new residential, commercial, and industrial developments have dual plumbing so that recycled water (when available) can be used for outdoor irrigation and other non-potable water uses. Additionally, the City of Montclair's AB 1881-compliant Water Efficient Landscape and Conservation Ordinance requires all applicable new developments to dual plumb and use recycled water, if available. The District works closely with the cities and county in which is serves regarding plumbing codes.

#### *Optimizing Recycled Water Use*

The District's 2011 Recycled Water Master Plan, incorporated into this UWMP as Appendix L, is the District's plan to optimize recycled water use within its service area.

### 4.6.6 Desalinated Water Opportunities

Desalination is used to develop a local, reliable source of water that assists agencies in reducing their demand on imported water. Desalination technology currently is being used by the Chino Desalter Authority (CDA) to treat brackish groundwater at the southern end of the Chino Basin for municipal uses. The District currently does not use desalted water from the CDA. However, from a regional perspective, the CDA and other desalination projects within the region indirectly benefit the District.

#### *Desalted Groundwater – Chino Groundwater Basin*

Consistent with the OBMP and the Maximum Benefit Program (approved by the State Board in 2005), desalting facilities must be constructed in the lower portion of the Chino Basin to remove salt and nitrates as well as to prevent poor quality water from the Basin from moving down the watershed and eventually into Orange County groundwater basins. The desalters use a combination of reverse osmosis and ion exchange technology to treat the pumped groundwater. The concentrated brine from the desalter operations is delivered by the Inland Empire Brine Line to the Orange County Sanitation District for treatment and ultimate disposal in the Pacific Ocean.

The Chino I Desalter was constructed in 2000 through a joint participation agreement among five agencies: SAWPA, Western Municipal Water District, Orange County Water District, MWD and IEUA. Located in Chino, the facility currently produces 10,000 AFY of which approximately 9,000 AF is provided as potable water supply to the cities of Chino and Chino Hills. In 2002 the CDA, a joint powers authority comprised of the Jurupa Community Services District, the Santa Ana River Water Company, and the cities of Chino, Chino Hills, Ontario, and Norco, was formed to manage the production, treatment, and distribution of water produced by this facility. The Chino II Desalter was constructed in 2007 and currently produces between 14,000 and 15,900 AFY of potable water. The Chino III Desalter is expected to be complete by 2016 and expand existing capacity by another 14,000 AFY to a total of 40,000 AFY.

# SECTION 5
# WATER SUPPLY RELIABILITY

## 5.1 RELIABILITY OF DISTRICT WATER SUPPLIES

Reliability is a measure of a water service system's expected success in managing water shortages. In addition to climate, other factors that can cause water supply shortages are natural disaster, such as earthquakes, chemical spills, energy outages, and water quality issues.

The District and all southern California communities and water agencies are facing increasing challenges and opportunities in their role as stewards of our publicly owned water resources. The region faces a growing gap between its water requirements and its firm water supplies. Increased environmental regulations and the collaborative competition for water from outside the region have resulted in reduced supplies of imported water. Continued population and economic growth increase water demand within the region, putting an even larger burden on water supplies.

Fortunately, as described in Section 4, the District and other regional agencies have invested hundreds of millions of public dollars to develop, manage, and maintain a robust portfolio of reliable water supplies. These include the Chino Groundwater Basin—one of the largest groundwater basins in southern California which has been sustainably managed for nearly 40 years—as well as a regional recycled water program which provides highly treated non-potable water for both direct use and groundwater recharge, and other local surface and groundwater resources. Metropolitan Water District, our regional supplemental water provider, has invested billions of ratepayer dollars in local and imported water supply reliability, and as a result is able to provide reliable imported water supply even under severe drought conditions.

Due to ongoing investments in reliable supplies, the District and other regional agencies are able to reduce use of imported water during times of drought, as well as store significant amounts of surplus water during wet years for use in dry years. Over the decades, Chino Basin producers have saved nearly 400,000 acre-feet of water stored in the groundwater basin which can be safely accessed during periods of extended drought.

Finally, the District provided leadership in implementing demand management and water use efficiency programs, including turf replacements, landscape irrigation survey and retrofits, efficient appliance rebates, and innovative rate structures.

This section starts with a brief description of the reliability of the District's various water supplies, followed by discussions of the potential impacts on reliability due to water quality and climate. Finally, the section ends with an analysis of the District's overall water supply reliability during normal, single dry-year, and multiple dry-year periods through 2040.

### 5.1.1 Chino Groundwater Basin Supply Reliability

The total maximum daily production capacity of the District's groundwater wells from the Chino Groundwater Basin is approximately 28 mgd (Table 2-3). This production capacity is sufficient to supply significantly more than the total current and projected retail water demand within the District. The District's 2008 Water Master Plan, functioning as its Capital Improvement Program, has developed a schedule of groundwater well replacement and rehabilitation to maintain, if not enhance, this production capacity through 2038.

District groundwater pumping can be influenced by Chino Basin Watermaster policies, including optimizing the basin's safe yield, providing replenishment supplies to offset overproduction, levying and collecting administrative and replenishment assessments, and findings of material physical injury. Nevertheless, under the Judgment and management agreements, the District has the ability to pump sufficient groundwater to meet its water supply needs. For the purposes of reliability planning, in order to allow for equipment breakdown and other contingencies, the District estimates that its full groundwater production capacity will be available 90 percent of the time.

For potential water quality impacts to the District's available groundwater supply, see Section 5.2.1.

### 5.1.2 Water Facilities Authority Supply Reliability

As discussed in Section 4.3.3, the District is entitled to 24 percent of the WFA's Agua de Lejos Plant capacity, or up to 21,776 AFY. The District has never drawn its full contractual amount from WFA, having historically considered its imported water supply as supplemental to and providing redundancy for its local groundwater supply. However, even during dry years, the District may draw its full contractual amount of imported water supply through WFA; the only limitations on the District are higher Tier 2 rates during normal years and, during dry years, its DYY shift obligation and potential MWD penalty rates under allocation requirements.

WFA receives imported water from MWD via the SWP. In its 2015 UWMP, MWD demonstrates its ability to provide imported water supply to its member agencies 100 percent of the time through 2040 during normal, single dry, and multi-dry year scenarios.[20] Even under a simultaneous implementation of MWD's Water Surplus and Drought Management (WSDM) Plan and the regional DYY Program, imported water supply is 100 percent reliable, although potentially subject to penalty rates (see Section 5.3).

[20] MWD 2015 UWMP (Draft March 2016).

***MWD's Water Surplus and Drought Management Plan***

In 1998, MWD's Board of Directors adopted the Water Surplus and Drought Management Plan (WSDM). The guiding principle of the WSDM Plan is to manage MWD's water resources and management programs to maximize management to wet year supplies and minimize adverse impacts of water shortages to retail customers. From this guiding principle come the following supporting principles:

- Encourage efficient water use and economical local resource programs;
- Coordinate operations with member agencies to make as much surplus water as possible available for use in dry years;
- Pursue innovative transfer and banking programs to secure more imported water for use in dry years; and,
- Increase public awareness about water supply issues.

In February of 2008, MWD's Board of Directors adopted the Water Supply Allocation Plan (WSAP). The WSAP was developed in consideration of the principles and guidelines described in the WSDM Plan, with the objective of creating an equitable needs-based allocation. The WSAP formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level for shortages of MWD supplies of up to 50 percent. The WSAP was revised and readopted in 2014.

For an analysis of the impact of this program's implementation in conjunction with the DYY Program see Section 5.3.

### 5.1.3 Recycled Water Supply Reliability

Recycled water is an exceedingly reliable local water resource. According to IEUA, during a single dry year, it has been assumed that recycled water will be 100 percent reliable. During multiple dry years, reliability remains constant and continues to help reduce potable water demands as new recycled water users are added to the regional recycled water system. It has been assumed that during multiple dry years, the production of recycled water will gradually increase from 100 percent during the first dry year to 105 and 110 percent, respectively, during the next two subsequent dry years as more customers become connected to the recycled water system. Recycled water is a reliable resource not subject to droughts or imported water availability.

### 5.1.4 San Antonio Water Company Supply Reliability

SAWCo is responsible for providing water service to its domestic and irrigation shareholders. Water is currently delivered to shareholders based on monthly entitlement and available water supply. If SAWCo is able to produce more water, entitlement increases; if less, entitlement decreases.

The last three years have provided an example of SAWCo actions in the face of reductions to its water supply. In February 2014 and then again in March 2015, due to severe drought conditions, SAWCo reduced its per-share entitlement deliveries by 18 percent and 15 percent, respectively.

However, as SAWCo improves its water supply facilities and increases its ability to produce water over the next 20 years, total water supply and water supply reliability to the shareholders is expected to return to former levels and even increase. The increased water supply would also be driven by the company's shareholders looking to the water company for maximum deliveries of their entitlements. Water deliveries to these shareholders are provided by SAWCo based on the entitled shares and available water supply during different periods of the year. Maximizing the water company's deliveries to its shareholders requires making full use of the groundwater and surface water rights owned by SAWCo. The District will work with SAWCo to maximize its supply and potentially increase its per-share entitlement, thus increasing the District's total annual SAWCo entitlement.

## 5.2 WATER QUALITY IMPACTS ON RELIABILITY

Federal regulations require the U.S. Environmental Protection Agency (EPA) to safeguard drinking water by establishing standards that limit the amount of substances in drinking water. In California, the State Water Resources Control Board (State Board) also safeguards drinking water by establishing standards that are as stringent as the EPA's. These standards, also known as maximum contaminant levels (MCL), are established in two categories: 1) primary standard: to protect the public health; and 2) secondary standard: to preserve water's aesthetic qualities such as taste, odor, clarity, and color.

The District safeguards its water supply by exceeding the monitoring requirements set by the EPA and State Board. In addition to the 165 contaminants for which it regularly monitors and reports in its Annual Water Quality Report, the District safeguards the distribution system by monitoring for coliform bacteria in the distribution system and at each active well. Coliform bacteria are not necessarily harmful, but indicate the possible presence of disease-causing organisms. The District samples 16 State Board-approved locations within the distribution system weekly, and samples each active well monthly. The District also completed two source water assessment in 2002 and 2008 for its active wells to evaluate the vulnerability of water sources to contamination.[21]

### 5.2.1 Chino Groundwater Basin Water Quality

The Chino Groundwater Basin is a critical resource to the District. From a regulatory perspective, the use of basin groundwater to serve potable demands is limited by drinking water standards, groundwater basin water quality objectives, and Santa Ana River water quality objectives.

[21] 2015 Annual Water Quality Report, www.report.mvwd.org.

The groundwater quality in basin is generally very good, with better groundwater quality found in the northern portions of the basin where recharge occurs and where District groundwater wells are primarily located. Salinity and nitrate concentrations increase in the southern portion of the basin resulting from past and continuing agricultural uses.

Other constituents that have the potential to impact groundwater quality from a regulatory standpoint are certain volatile organic compounds, arsenic, and perchlorate. There are a number of point source releases of VOCs in the basin that are in various stages of investigation or cleanup. There are also known point source releases of perchlorate (Milliken Valley Sanitary Landfill, Stringfellow, etc.), and non-point source related perchlorate contamination appears to have resulted from natural and artificial sources. Arsenic at levels above the water quality standard appears to be limited to the deeper aquifer zone near the City of Chino Hills.

The principal groundwater quality issues facing the District involve nitrate dibromochloropropane, total dissolved solids, and perchlorate.

### *Nitrates*

Areas of the basin with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by citrus in the northern parts of management zones (MZs) 1, 2 and 3, and dairy areas in the southern parts of MZs 1, 2 and 3 and all of MZ 5.

Nitrate in drinking water at levels above 10 ppm can interfere with the capacity of the infant's blood to carry oxygen, causing shortness of breath and blueness of the skin. High nitrate levels may also affect the ability of the blood to carry oxygen in other individuals, such as pregnant women and those with certain specific enzyme deficiencies.

In 2015, average nitrate concentration in the District wells was 10.7 ppm, while the concentrations ranged from 2.9 to 18.7 ppm. The State Board requires the District to provide a finished blended product that has a nitrate (N) MCL of no more than 8 ppm, or 80 percent of the MCL of 10 ppm. Water from several District wells with higher levels of nitrates is combined with water from other wells with lower levels or with imported water to create a blended supply that is below the MCL. One of the District's wells is equipped with an ion exchange treatment facility that removes salts, in particular nitrates, from the pumped groundwater.

The District's Aquifer Storage and Recovery (ASR) Program, which consists of recharging the groundwater basin through direct injection of treated imported water and subsequent extraction during summer months and dry years, is expected to enhance water quality over time. ASR wells inject higher quality water into an aquifer of lesser quality; the wells operate to create a zone or "bubble" of better quality water to be recovered at a later time. Four ASR wells are now operational.

### *Dibromochloropropane*

Dibromochloropropane (DBCP), an organic chemical, is a banned nematocide (pesticide) that remains in the soils due to run-off or leaching from former use on soybeans, cotton, vineyards, tomatoes, and tree fruit. In 1977, 831,000 pounds of DBCP was used in California, mainly on grapes and tomatoes. In 1979, all registrations of end use products were canceled except for use as soil fumigant for pineapple horticulture in Hawaii. The use was completely canceled in 1985. Some people who drink water containing DBCP in excess of the MCL of 0.0002 million gallons per liter (mg/L) or 200 parts per trillion (ppt) over many years may experience reproductive difficulties and may have an increased risk of developing cancer.

In 2015, average DBCP concentration in the District wells was 0.06 ppt, while the concentrations ranged from non-detect to 0.23 ppt. The State Board requires the District to blend the water so that the concentration is below 0.16 ppt, or 80 percent of the MCL.

### *Total Dissolved Solids*

Total Dissolved Solids (TDS) concentrations in the northeast part of the basin range from about 170 to about 300 mg/L, with typical concentrations in the mid- to low 200s. TDS concentrations in excess of 200 mg/L indicate degradation from overlying land use. With few exceptions, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. Most of these degraded areas are located south of the Interstate 10 Freeway. The impact of agriculture on TDS in groundwater primarily is caused by fertilizer use on crops, consumptive use, and dairy waste disposal.

TDS concentrations in groundwater have increased slightly or remained relatively constant in northern parts of the MZs 1, 2, and 3. TDS concentrations are significantly higher in the southern parts of these zones and in all of MZ 5, where they typically exceed the 500 mg/L recommended secondary MCL and frequently exceed the upper limit secondary MCL of 1,000 mg/L. In 2015, the average TDS concentration in District wells was 250 mg/L.

### *Perchlorate*

The State Board has indicated that perchlorate in groundwater in California likely reflects its use in the aerospace industry as a solid rocket propellant (in the form of ammonium perchlorate). Perchlorate is a regulated drinking water contaminant in California, with an MCL of 6 ppb. Perchlorate is believed to inhibit the thyroid's ability to process iodide. Normal body metabolism requires thyroid hormones, as do normal prenatal and postnatal development and growth.

In 2015, average perchlorate concentration in the District wells was 1.9 ppb, while the concentrations ranged from non-detect to 6.6 ppb. The State Board requires the District to blend the water so that the concentrations are below the MCL of 6 ppb.

### 5.2.2 Water Facilities Authority Water Quality

The District receives imported water through IEUA from MWD, which receives raw water from northern California through the SWP. The SWP water is delivered to the WFA Agua de Lejos Water Treatment Plant through the MWD Rialto Reach of the Foothill Feeder. The WFA receives and treats SWP raw water. The quality of water from the WFA is generally and consistently quite good, although it can vary depending on hydrologic conditions in both northern and southern California.

#### *State Water Project Water Quality*

The key water quality issues on the SWP are disinfection byproduct precursors, in particular total organic carbon and bromide. MWD is working to protect the water quality of this source, but it has needed to upgrade its water treatment plants to deal adequately with disinfection byproducts. Disinfection byproducts result from total organic carbon and bromide in the source water reacting with disinfectants at the water treatment plant, and they may place some near term restrictions on MWD's ability to use SWP water. MWD expects these treatment restrictions to be overcome through the addition of ozone disinfection at its treatment plants. Arsenic is also of concern in some groundwater storage programs.

Groundwater inflows into the California Aqueduct are managed to comply with regulations and protect downstream water quality while meeting supply targets. Additionally, nutrient levels are significantly higher in the SWP system than within the Colorado River, leading to the potential for algal related concerns that can affect water management strategies. MWD is engaged in efforts to protect the quality of SWP water from potential increases in nutrient loading from wastewater treatment plants. Also, as in the Colorado River watershed, MWD is active in studies on the occurrence, sources, and fate and transport of constituents of emerging concern.

### 5.2.3 San Antonio Water Company Water Quality

Surface water from local sources that originate in the San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several other smaller surface streams is generally of high quality, as these creeks are fed by snowmelt and other precipitation in the San Gabriel Mountains. Nevertheless, surface water sources are treated prior to introduction to the potable water supply in order to insure bacteriological quality and compliance with state and federal drinking water quality standards.

### 5.2.4 Recycled Water Quality

The State Water Resources Control Board has established regulations and guidelines for the use of recycled water under the California Code of Regulations, Title 22. In addition, IEUA sets requirements on recycled water retailers, including the District, that are incorporated in its agreements with retailers and in IEUA Ordinance No. 69, which regulates the availability and use of recycled water.

All of IEUA water recycling treatment plants produce recycled water suitable for full body contact recreation and generally meet the more stringent aquatic habitat criteria. Due to salinity management and the exclusive use of the SWP supply for imported water, TDS concentrations in recycled water remain relatively low for recycled water (typically 500 mg/L). Since recycled water is regulated and monitored carefully, water quality is expected to remain high.

### 5.2.5 Impact on Water Management Strategies and Supply Reliability

While the Chino Groundwater Basin water quality is very good, the District will continue with its blending program for groundwater high in nitrates. Imported water that is treated and delivered through the WFA is consistently of good quality. MWD has identified those water quality issues that are of concern and has implemented necessary water management strategies to minimize the impact on water supplies. SAWCo water is consistently of high quality, as is IEUA's recycled water supply.

If water quality does impact the water supply to the District in the future, the District will continue to implement its Water Master Plan and Capital Improvement Program, which provides for system redundancy and supply. For example, if groundwater becomes unusable due to water quality concerns, more imported water will be required. If imported water becomes limited due to diminished water quality, then more treatment is necessary, and more groundwater may be used.

## 5.3 CLIMATIC IMPACTS ON RELIABILITY

The reliability of Chino Basin's groundwater supply is based on long-term hydrology due to its ability to store groundwater, and therefore it is not directly impacted by single year or multi-year drought events. In contrast, San Antonio Water Company's local surface water supplies can be impacted by short-term drought events, as is currently being experienced (see Section 4.4). The climate of northern California can impact the reliability of the District's imported surface water supply; however, MWD has mitigated these impacts through supply and storage development.[22] Finally, recycled water is considered "drought proof" because it originates from the wastewater resulting from indoor uses which are not impacted by changes in the climate.

Table 5-1 summarizes the projected supply reliability impacts of single and multiple dry-year scenarios for each of the District's water supply sources. The historical bases for the supply reliability data is presented in Table 5-2.

[22] MWD 2015 UWMP (Draft March 2016).

**Table 5-1:**
**Supply Reliability as Percentage of Normal Water Year Supply**

| | | | Multiple Dry Years | | |
|---|---|---|---|---|---|
| **Supply Source** | **Normal Year** | **Single Dry Year** | **Year 1** | **Year 2** | **Year 3** |
| **Chino Groundwater Basin** | 100% | 100% | 100% | 100% | 100% |
| **Water Facilities Authority** | 100% | 100% | 100% | 100% | 100% |
| **San Antonio Water Company**[1] | 100% | 82% | 82% | 70% | 70% |
| **Recycled Water** | 100% | 100% | 100% | 100% | 100% |

Aligns with data in DWR Standardized Tables 7-1 R (multiple versions).
[1] Based on aggregated per-share allocation percentage reductions (Section 4.4).

**Table 5-2:**
**Bases of Water Year Data**

| **Supply Source** | **Normal Year** | **Single Dry Year** | **Multiple Dry Years** |
|---|---|---|---|
| **Chino Groundwater Basin**[1] | 1893-2015 | 2013 | 2013-2015 |
| **Water Facilities Authority**[2] | 1922-2012 | 1977 | 1990-1992 |
| **San Antonio Water Company**[1] | 1893-2015 | 2013 | 2013-2015 |

Aligns with data in DWR Standardized Tables 7-1 R (multiple versions).
[1] Western Regional Climate Center, Pomona Fairplex (047050), Monthly Sum of Precipitation, Period of Record: 11/1/1893 to 12/31/2015, accessed May 19, 2016. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7050.
[2] MWD 2015 Urban Water Management Plan (Draft March 2016), Table 7-1 W.

### *Dry Year Yield Program and Water Supply Allocation Plan*

On May 1, 2010, MWD implemented a third consecutive year of the Dry Year Yield (DYY) Program (Section 4.2.2), reducing the amount of direct imported water deliveries IEUA retail agencies could purchase by 31,000 AF. Two months later, on July 1, 2010, MWD implemented a Level 2 regional shortage under WSAP (Section 5.1.2).

The overlap of these two programs brought significant challenges to IEUA's member agencies and changed in how each retailer used its individual water supply. The District responded by reducing its reliance on imported water from MWD by 40 percent during this period through implementation of water use restrictions, public information campaigns, and prudent management and diversification of its water supply portfolio.

As discussed in Section 5.1.2, during normal and dry years MWD will have available supply to meet 100 percent of the District's imported water demands. However, the District can expect to be called upon by MWD to reduce its imported water demand through its DYY Program shift obligation. Simultaneously, the District can expect to have its Tier 1- and Tier 2-priced imported water supplies reduced by 10-40 percent, depending on the level of implementation of MWD's WSAP. Nevertheless, the overlap of these two programs, while creating challenges, does not in any way impact the reliability of the District's water supplies.

### 5.3.1 Demand Modifications during Dry Years

Demands on the District's water system can be impacted by changes in climate conditions. This is mostly due to shifts in outdoor water use patterns that result from wet or dry weather conditions. Demands can also be impacted by increased drought-messaging and calls for conservation, as has been experienced over the past two years during the Governor's emergency conservation regulations.

The District's 2005 UWMP established water demand patterns for single and multiple dry–year periods based on the most recent five years of production and rainfall data. It found that District customers increased their water use during dry years on average about 5 percent over normal years' usage levels. The District's 2010 UWMP, written at the end of a three-year drought, found that customers responded to significantly expanded customer communications and implementation of water waste restrictions with sizeable reductions in water use during these dry years.

The District is again writing its UWMP at (hopefully) the end of a three-year drought, and has found customers once again responsive to local, regional, and statewide calls for conservation by reducing their water use to historically low levels (see Section 4). Therefore, the District confirms that the minimal demand increases experienced in the past during dry years will be more than be offset by the increased awareness and responsiveness of District customers to the need to conserve, as experienced in the most recent dry-year period. For conservative planning purposes, the District's 2015 UWMP will not adjust customers' demands on its water supply for its dry-year reliability analyses.

### 5.3.2 Climate Change Impacts on Water Supply Reliability

Water resource managers have long strived to meet their goals of system reliability and environmental protection in the face of many uncertainties, including demographic and economic forecasts and intrinsic weather variability. Now water managers also face a new uncertainty—the potential for climate change, which in coming years may significantly affect patterns of water demand and the availability of supplies. However, information about the future impacts of climate change is deeply uncertain and likely to remain so for the foreseeable future.

In March 2016, IEUA published a draft regional Integrated Water Resources Plan (IRP), developed in partnership with its member agencies, which incorporates a comprehensive assessment of regional water supply vulnerabilities to climate change. The IRP identifies general climate change trends for California of increasing temperatures and shifts of precipitation from snow to rain. These trends will impact water supplies in two ways: higher temperatures will cause increased water demands; however, infrastructure to capture rain runoff is limited as water infrastructure in California was designed to capture slow melting snowpack, not rapid stormwater. In addition, droughts are expected to occur more frequently, more intensely, and last longer.

A set of 106 climate scenarios for the IEUA region were derived from downscaled general circulation model results used for the Intergovernmental Panel on Climate Change Assessment Reports 3 & 5. These data suggest that regional temperatures would likely increase between 0.5-3.5 degrees Fahrenheit by 2040. Precipitation was highly variable and showed no clear trend across the scenarios. Using this information, the IRP "stress tested" existing and potential regional water supplies and used the resulting analysis to identify future regional water supply needs and opportunities.

It should be noted that the IRP's analysis is regional and does not apply to individual member agencies such as the District. As stated earlier, the District's past investments in a diverse water supply portfolio provides it with a very reliable water supply. In the coming year, IEUA plans to conduct a "Phase 2" IRP analysis which disaggregates member agencies' water demands and future supply needs due to climate change and other factors.

## 5.4 RELIABILITY ANALYSES – NORMAL, SINGLE, MULTIPLE DRY YEARS

The following tables compare the District's current and projected water supplies and demands in normal, single dry-year and multiple dry-year scenarios for the District.

***Projections presented in Table 5-3 through Table 5-5 indicate the District can expect its available supplies to significantly exceed anticipated demands over the 25-year planning period. As a result of these surplus supplies, the District should not experience any problems in meetings its demands during normal, single, or multiple dry-year scenarios during the next 25 years.***

**Table 5-3:**
**Supply and Demand Comparison – Normal Year (AFY)**

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 800 | 800 | 800 | 800 | 800 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply**[1] | **51,790** | **51,749** | **51,778** | **51,828** | **51,828** |
| **Total Demand**[2] | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |
| **Difference** | **16,590** | **16,353** | **16,048** | **15,748** | **15,464** |

Aligns with data in DWR Standardized Tables 7-2 R and 7-2 W.
[1] Table 4-1: Total available water supply capacity.
[2] Table 3-2.

**Table 5-4:**
**Supply and Demand Comparison – Single Dry Year (AFY)**

| | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company | 656 | 656 | 656 | 656 | 656 |
| Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **Total Supply**[1] | **51,646** | **51,605** | **51,634** | **51,684** | **51,684** |
| **Total Demand**[2] | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |
| **Difference** | **16,446** | **16,209** | **15,904** | **15,604** | **15,320** |

Aligns with data in DWR Standardized Tables 7-3 R and 7-3 W.
[1] Total available water supply capacity (Table 4-1) x single dry-year adjustment (Table 5-1)
[2] Table 3-2.

**Table 5-5:**
**Supply and Demand Comparison – Multiple Dry Years (AFY)**

| | | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| **Year 1** | Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| | Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| | San Antonio Water Company | 656 | 656 | 656 | 656 | 656 |
| | Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| | **Total Supply**[1] | **51,646** | **51,605** | **51,634** | **51,684** | **51,684** |
| | **Total Demand**[2] | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |
| | **Difference** | **16,446** | **16,209** | **15,904** | **15,604** | **15,320** |
| **Year 2** | Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| | Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| | San Antonio Water Company | 558 | 558 | 558 | 558 | 558 |
| | Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| | **Total Supply**[1] | **51,547** | **51,507** | **51,536** | **51,586** | **51,586** |
| | **Total Demand**[2] | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |
| | **Difference** | **16,347** | **16,111** | **15,806** | **15,505** | **15,221** |
| **Year 3** | Chino Groundwater Basin | 29,841 | 29,841 | 29,841 | 29,841 | 29,841 |
| | Water Facilities Authority | 21,776 | 21,776 | 21,776 | 21,776 | 21,776 |
| | San Antonio Water Company | 558 | 558 | 558 | 558 | 558 |
| | Recycled Water | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| | **Total Supply**[1] | **51,547** | **51,507** | **51,536** | **51,586** | **51,586** |
| | **Total Demand**[2] | **35,200** | **35,396** | **35,730** | **36,081** | **36,364** |
| | **Difference** | **16,347** | **16,111** | **15,806** | **15,505** | **15,221** |

Aligns with data in DWR Standardized Tables 7-4 R and 7-4 W.
[1]Total available water supply capacity (Table 4-1) x multiple dry-year adjustment (Table 5-1)
[2] Table 3-2.

# SECTION 6
# WATER DEMAND MANAGEMENT

Monte Vista Water District is a regional leader in developing and implementing proactive demand management programs that protect existing water resources so that adequate water supplies will be available for sustainable future growth. Investments in reliable local resources have been critical to maintaining current and future water supplies. Equally critical is the promotion of water use efficiency as an integral component of current and future water strategy for the service area.

In 1991, the District became one of the first water agencies to sign the California Urban Water Conservation Council's *Memorandum of Understanding Regarding Urban Water Conservation*, accepting its obligation to implement a prescribed set of urban water conservation Best Management Practices (BMPs). The BMPs, which are equivalent to the demand management measures set forth in the Urban Water Management Planning Act, have been a key element in the District's conservation program strategy. The District has maintained its compliance with the BMPs, as demonstrated in its coverage reports included as Appendix M of this Plan.

In addition to the BMPs, the District is required to comply with the Water Conservation Act of 2009's requirements to set and then to meet its urban water use reduction targets of 188 GPCD by 2015 and 167 GPCD by 2020. Section 3.6.2 of this Plan describes how these targets are determined. As many of the District's conservation activities are implemented on a regional basis, the District is an active participant in a regional alliance coordinated by IEUA to achieve regional compliance with the Water Conservation Act of 2009. Both on an individual and regional basis, the District is currently exceeding its urban water use reduction targets.

In the following section, the District will describe its past, current, and future conservation efforts and demonstrate how the District plans to assist its customers in maintaining and enhancing their current water use efficiency practices.

## 6.1 LEGISLATIVE AND REGULATORY REQUIREMENTS

The strategies, programs, and regulations included in this section are designed to meet the following as well as any future statewide compliance requirements:

- CUWCC's BMPs
- Assembly Bill (AB) 1420 – Implementation of Demand Management Measures
- SB X7-7 – The Water Conservation Act of 2009, which requires urban water suppliers to achieve a 20 percent per capita reduction in urban water use by 2020

### 6.1.1 California Urban Water Conservation Council

The California Urban Water Conservation Council (CUWCC) is a voluntary state-wide organization of water agencies, public interest organizations, and private entities tasked with overseeing the BMP reporting process, implementing and revising the *Memorandum of Understanding Regarding Urban Water Conservation* (MOU), and generally promoting urban water use efficiency in California. Membership in CUWCC consists of three groups: Group 1: Urban Water Suppliers; Group 2: Public Advocacy Organizations; and Group 3: Other Interested Parties. Only Groups 1 and 2 have voting rights to alter MOU provisions, and both groups must agree to any alterations. The MOU was last amended in June 2010.

The District became a Group 1 member of CUWCC in 1991, when it was one of 120 water agencies and environmental groups to become charter signatories to the MOU. There are currently over 400 CUWCC members.[23]

In 2010, the District amended its signatory status to become a wholesale as well as a retail water agency signatory to the MOU.

#### *Best Management Practices*

As an MOU signatory, the District is obligated to make "good faith efforts" to meet coverage requirements for the BMPs for efficient urban water usage as set forth in the MOU. Every two years, water agencies that are signatories to the MOU are required to fill out and submit online BMP reports on conservation program activities as they relate to individual BMPs. The District submitted its latest reports for FYE 2013 and FYE 2014 in December 2015.

A BMP is defined by the MOU as a policy, program, practice, rule, regulation or ordinance or the use of devices, equipment or facilities which meets either of the following criteria:

- An established and generally accepted practice among water suppliers that results in more efficient use or conservation of water; or,

- A practice for which sufficient data are available from existing water conservation projects to indicate that significant conservation or conservation-related benefits can be achieved; that the practice is technically and economically reasonable and not environmentally or socially unacceptable; and that the practice is not otherwise unreasonable for most water suppliers to carry out.

The BMPs listed below are incorporated into the MOU:

[23] CUWCC website, www.cuwcc.org.

- BMP 1: Utility Operations
    - BMP 1.1: Conservation Coordinator
    - BMP 1.2: Water Waste Prevention
    - BMP 1.3: Wholesale Agency Assistance Programs
    - BMP 1.4: System Water Audits, Leak Detection and Repair
    - BMP 1.5: Metering with Commodity Rates For All New Connections and Retrofit of Existing Connections
- BMP 2: Education Programs
    - BMP 2.1: Public Information Programs
    - BMP 2.2: School Education
- BMP 3: Residential Programs
    - BMP 3.1: Residential Landscape Water Survey Program
    - BMP 3.2: Residential Leak Assistance Program
    - BMP 3.3: High Efficiency Clothes Washers
    - BMP 3.4: WaterSense Specification Toilets
- BMP 4: Commercial, Institutional, Industrial
- BMP 5: Landscape

BMPs 1 and 2 are considered "Foundational" because they are essential water conservation activities and are adopted for implementation by all signatories to the MOU as ongoing practices with no time limits. The remaining BMPs are considered "Programmatic" and provide minimal levels of activity in order to achieve coverage. Coverage requirements for the current BMPs are meant to achieve conservation-related activity and water savings goals over a ten-year period ending in 2018.

Compliance with the Programmatic BMPs can be accomplished in one of three ways:

1. Accomplishing the specific BMP measures;
2. Accomplish a set of alternative measures which achieves equal or greater water savings, referred to in the MOU as the Flex Track Menu; or
3. Accomplish a GPCD water savings goal.

The latter option is similar but not identical to the GPCD target required in the Water Conservation Act of 2009.

A water agency may also achieve coverage for an individual BMP by doing one of the following:

- File for an exemption from the BMP based on "good faith" efforts, lack of cost-effectiveness, inadequate funds, or lack of legal authority to implement the BMP; or,

- Provide evidence that the agency has implemented an "at least as effective as" conservation activity that would provide equal water savings to implementing the BMP.

Retail agencies are required to achieve coverage for all the BMPs except BMP 1.3. Wholesale agencies are required to achieve coverage for all the Foundational BMPs except BMPs 1.2 and 1.5. Coverage reports are issued by CUWCC upon submittal of annual reports by its Group 1 members. The District's coverage reports for 2013 and 2014 are incorporated as Appendix M.

### 6.1.2 Assembly Bill 1420

Under AB 1420 (2007), effective January 1, 2009, the terms of, and eligibility for, a water management grant or loan made to an urban water supplier and awarded or administered by DWR and the State Board shall be conditioned on the implementation of the Demand Management Measures (DMMs) incorporated into the Urban Water Management Planning Act. Under State Law, achieving compliance under the CUWCC's BMPs is equivalent to implementing the DMMs.

DWR must consider whether an agency is implementing or has scheduled to implement the DMM activities that an agency has identified in its UWMP in evaluating applications for grants and loans financed by specified bond funds. This requirement sunsets on July 1, 2016.

### 6.1.3 The Water Conservation Act of 2009

Enacted in November 2009 as part of an historic package of bills concerning California water management, SBX 7-7 establishes a statewide urban per capita water use reduction of 20 percent by 2020. This initiative applies to all urban retail water suppliers serving a minimum of 3,000 customers or supplying 3,000 AFY or more. Urban retail water suppliers were required to establish a baseline GPCD and report it in their 2010 UWMPs by July 1, 2011.

Beginning in 2010, an urban retail water supplier must establish a baseline and continue to implement required DMMs under AB 1420. On July 1, 2016, compliance with SBX 7-7 will replace compliance with AB 1420 as a condition eligibility of all state water management grants and loans. Awarding of state grants and loans will then be contingent on meeting or exceeding the 20 percent water use reduction target by 2020. An interim reduction target of 10 percent must also be met by December 31, 2015, as certified in each urban agency's 2015 UWMP.

For baseline criteria and establishment of the District compliance's with this legislation, see Section 3.6.1; for District compliance with its 2015 Interim Urban Water Use Target, see Section 3.6.3.

### 6.1.4 Assembly Bill 1881

AB 1881 (Laird 2006), the Water Conservation in Landscaping Act, requires statewide land use agencies to update and adopt local landscaping ordinances by January 1, 2010. The adopted landscaping ordinances must be "at least as effective as" the State Model Water Efficient Landscape Ordinance (MWELO) developed by DWR. In 2015, Governor Brown issued an executive order (B-29-15) requiring significant changes to the MWELO.

Key elements in the updated MWELO include: applying a water budget approach to large new and redeveloped landscapes which require a permit, reducing the ETo adjustment factor used in the calculation of a landscape's budget, increasing the public's awareness of the importance of water use efficiency in landscaping, requiring "smart" (e.g., weather-based) irrigation controllers, and adopting and enforcing statewide prohibitions on overspray and runoff.

The District is not a land use agency and is not required to implement AB 1881. However, the District was directly engaged with its local land use agencies in the process of developing a model landscape ordinance for the Chino Basin region through the Inland Empire Landscape Alliance, convened by IEUA. The District also assisted the City of Montclair in adapting the regional ordinance for adoption into the City Code. The District will continue to work with the City and its other land use agencies in updating and implementing their ordinances for applicable new and rehabilitated developments.

## 6.2 DEMAND MANAGEMENT MEASURE IMPLEMENTATION

As mentioned earlier, the District has maintained its compliance with the BMPs, as demonstrated in its most recent 2013-2014 coverage reports included as Appendix M of this Plan. According to Section 10631(i) of the Urban Water Management Planning Act, submission of CUWCC BMP coverage reports meets the Act's requirement to describe the water supplier's DMM implementation process.

The District has chosen the GPCD compliance option for achieving all of the Programmatic BMP water savings goals. The method of determining GPCD compliance under the MOU differs slightly from that of the Water Conservation Act of 2009, but not enough to be consequential to the District's plans to maintain compliance under both requirements.

## 6.3 DEMAND MANAGEMENT PLANNING

The following is a general description of the District's demand management strategies to maintain compliance with the Water Conservation Act of 2009 and with the DMMs/BMPs under the GPCD compliance option.

### 6.3.1 Regional Conservation Programs

A significant portion of the District's water conservation efforts are conducted through regional programs. The District, through IEUA, has access to MWD's extensive array of conservation programs. In addition, the District is a member of two major regional conservation groups: IEUA's Regional Conservation Workgroup, which facilitates and supplements MWD programs in the IEUA service area; and the Water Education Water Awareness Committee (WEWAC), which manages a number of regional water education and public information programs. The District also has a strong working relationship with CBWCD, which provides conservation and education programs for District customers.

#### *MWD's Regional Conservation Programs*

MWD currently provides financial support for local water projects and water conservation projects implemented by its member agencies that contribute to an increase in the reliable regional water supplies available to the region. The District participates in many MWD regional programs through its MWD member agency, IEUA, as described below.

#### *IEUA's Regional Conservation Workgroup*

IEUA coordinates a comprehensive regional conservation program through its Regional Conservation Workgroup. The Workgroup, comprised of representatives from each of IEUA's eight member retail agencies, advises IEUA on the implementation of conservation and education programs funded through a per-AF surcharge on imported water purchased by the member agencies from IEUA. The program also receives funds through retail meter revenues collected by IEUA. These funds are used to leverage additional funding from MWD, DWR, and the U.S. Bureau of Reclamation, resulting in an annual conservation budget which is consistently over $1 million.[24] The District actively works through the Regional Conservation Workgroup to advocate for conservation and education programs that will be of direct benefit to District customers.

[24] In FYE 2017 IEUA will change this funding structure to a fixed member agency meter equivalent unit charge.

From FYE 2011 through 2015, the IEUA region has achieved 3,630 AF in annual savings and 34,610 AF in lifetime savings, and the District has achieved 169 AF in annual savings and 1,713 AF in lifetime savings from IEUA's regional conservation programs over the same time period.[25] The programs are described below. For District device/rebate numbers and savings by program, please see Appendix N.

- **MWD's SoCal Water$mart Rebate Program**: See above. The Workgroup often supplements MWD's rebate amounts with local funds to increase regional participation in the program.

- **Residential Landscape Transformation Program**: Provides contractor services to replace 500-1,000 square feet of turf with water efficient landscaping. Participants provided nominal co-pay of $0.30 per square foot.

- **Regional Residential Large Landscape Retrofit Program**: Provides outdoor irrigation evaluations and retrofits of landscape devices for ¼-acre and larger sites.

- **FreeSprinklerNozzles.com Voucher Program**: Provides voucher for free high efficiency irrigation spray nozzles through a web-based portal.

- **Turf Rebate**: In FYE 2015, MWD committed an unprecedented $340 million to turf removal incentives for FYE 2015 and 2016.

In addition, IEUA provides the following additional agency support, conservation, and education programs to the District and its customers through the Workgroup process:

- **Regional Landscape Training Workshops**: Residential workshops on the basics of efficient irrigation systems, the benefits of properly watering and fertilizing landscaping, landscape design techniques and plant identification.

- **Water Saving Garden Friendly**: Public-private partnership with Home Depot to promote water efficient plants through decals, plant sales, and workshops.

- **Garden-In-Every School® Program**: Installs water wise gardens in elementary schools.

- **National Theatre for Children**: Live theatre, student curriculum and teacher guides for elementary schools.

- **Shows That Teach**: Educational and motivational school assembly programs that focus on water education.

[25] IEUA Annual Water Use Efficiency Programs Report, FY 2014-2015.

- **Water Discovery Field Trip Program**; Free school field trips to Chino Creek Wetlands and Educational Park to promote the public understanding of the value of natural treatment wetlands, the creation of habitat for endangered/sensitive species and environmental stewardship.

- **Water Conservation Outreach Campaign**: Conservation and drought outreach messaging via monthly ads in local newspaper and movie theaters.

- **BMP Support Grant**: An annual grant of $2,000 to each member agency for a BMP-related program or project.

- **Regional Water and Landscape Conservation Fair**: Held annually in October, the Fair is a community awareness partnering event with CBWCD, IEUA, and its member agencies created to educate the public on the importance of using water efficiently.

IEUA has just developed its third Regional Water Use Efficiency Business Plan to guide its water use efficiency programs through 2020. The plan focuses on assisting retail water agencies in developing budget-based tiered rate structures to incentivize efficient water use. The District developed its budget-based tiered rate structure in 2010 (see Section 6.3.2). Additional identified water use efficiency programs include:

- **Customer Engagement Software and Data Analytics**: Tools for water agencies to identify customers with excess water usage and communicate with customers on how their usage compares against accepted water use efficiency standards. Also offers customers the ability to track usage against a budget through web-based and mobile interfaces.

- **Regional Residential Small Landscape Retrofit Program**: Provides outdoor irrigation evaluations and retrofits of landscape devices for 500-square-foot and larger sites.

- **High Efficiency Nozzle Direct Installations**: Retrofitting pop-up spray heads with high efficiency nozzles. District began program independently in 2015 (see Section 6.3.2).

#### *Water Education Water Awareness Committee*

The Water Education Water Awareness Committee (WEWAC) is a voluntary consortium of 14 local water agencies formed to promote the efficient use of water and to increase public awareness of the importance of water in southern California. WEWAC was founded originally as the "West End Water Awareness Committee" by the District and other local water agencies in the west end of San Bernardino County in 1986 during a severe drought, and it has since grown to include agencies in Los Angeles County (hence the change in the organization's name).

WEWAC implements the following annual education and public outreach programs:

- **EduGrant Program** – Provides $600 grants to local educators for water-related classroom activities. District staff help organize the program and select grant recipients.

- **Project WET Workshops** – Free workshop to introduce local educators to the Project WET ("Water Education for Teachers") *Curriculum & Activity Guide*, a collection of field-tested, innovative, interdisciplinary, water-related lessons and activities aligned with the California Content Standards. The District pays substitute costs for the first five teachers from schools within its service area who register. District staff receive Project WET facilitator training and help organize and run the workshops.

- **Water Awareness Broadcast Media and Digital Art Contest** – Competition among local junior high and high school students to produce a broadcast media or digital art public communication focused on water conservation and awareness.

- **Water Scholar Program** – provides financial support to high school seniors planning to attend a two- or four year college in the following school year.

- **WEWAC Website** – The WEWAC website, www.UseWaterWisely.com, provides education resources in an attractive and engaging way. Includes signup for the monthly *Next Wave* email newsletter, a water quiz, links to other online resources, and information on WEWAC education programs.

- **Quakes Messaging** – Messages on how to use water efficiently posted on the video board during Rancho Cucamonga Quakes minor league baseball games.

As noted above, District staff are actively engaged in assisting in the implementation of WEWAC programs.

#### *Chino Basin Water Conservation District*

CBWCD was established in 1949 to protect and replenish the Chino Groundwater Basin with rainfall and storm water runoff from the San Gabriel Mountains. CBWCD uses an extensive system of percolation ponds and spreading grounds to augment the natural capacity of the region to capture runoff for the recharge of the groundwater basin. CBWCD also promotes water conservation through public education programs, water conservation services, and a newly completed Water Conservation Center – all provided free of charge to residents within its service area. Finally, CBWCD provides funding through its Public Sector Program for onsite retrofits of parks and school yards within its service area to use recycled water.

The District's retail service area lies fully within CBWCD's service area, providing District customers with full access to all CBWCD conservation, education, and funding programs and resources. CBWCD and the District work closely together to promote these programs and communicate their availability to District customers.

The following are brief descriptions of CBWCD's conservation, education, and funding programs and resources which provide direct benefit to the District's conservation programs:

- **Landscape Evaluation and Audit Program (LEAP)** – Certified irrigation system evaluators visit customers' properties, conduct a landscape irrigation evaluation, and provide a comprehensive evaluation report. Partially funded through IEUA.

- **Landscape Design Room** – Resources to assist in retrofitting to water efficient landscaping. Appointments for a free consultation with conservation specialists.

- **Gardening Workshops** – Free gardening workshops for both professionals and homeowners. CBWCD contracts with IEUA to hold workshops exclusively for its member agencies, upon request.

- **Qualified Water Efficient Landscaper (QWEL) Training** – Professional bilingual training on water efficient principles for irrigation systems and landscape design. QWEL is an EPA WaterSense labeled certification.

- **Drought-Tolerant Demonstration Garden** – Showcases a variety of water efficient plants growing in their native environment. Free, open 7 days a week (excluding holidays), guided and unguided tours available.

- **Earth Day Festival** – Annual event for 1,000-1,200 fifth-grade students from local schools. District provides sponsorship funding, hosts water education display booths, and provides educational materials to teachers and students.

- **Education Grants** – Scholarships of up to $5,000 to local students focusing on water related majors.

- **Poster-Art Contest** – Annual themed contest for K-6$^{th}$ grade and 7$^{th}$-12$^{th}$ grade categories. Cash prizes.

- **Recycled Water Conversion Incentive Program** – Funding for conversion of city parks and school yards to recycled water.

- **Mulch Giveaways** – Free mulch, self-help, available twice a week.

#### *Regional Compliance with Water Conservation Act of 2009*

Many of the District's conservation activities are implemented on a regional basis through IEUA's Regional Conservation Workgroup. The Water Conservation Act of 2009 provides a regional compliance option, where a group of agencies that regionally coordinate conservation efforts can set collective urban water use targets and determine regional methods to achieve said targets through a Regional Alliance.

IEUA's eight retail member agencies formed a Regional Alliance, together with IEUA, in 2011. All member agencies within IEUA's service area have agreed to the formation of a Regional Alliance, and will continue to cooperatively participate in developing programs and meeting regional and local water conservation goals. The District is an active participant in regional conservation programs and supports the Regional Alliance's effort to exceed its collective water use reduction goal of 20 percent by 2020 through regional conservation programs and aggressive recycled water development, as described in IEUA's 2015 UWMP.

### 6.3.2 District Conservation Programs

In the late 1980s, faced with a significant drought, the District provided regional leadership in helping to form WEWAC to communicate to the region's water users the need to conserve limited water resources. In 1996, the District initiated its comprehensive conservation incentive programs with free toilet distributions, in partnership with IEUA. Since then, the District has generated over 570 AFY in water savings, or 6,890 AF over the lifetime of the incentivized high efficiency devices. This represents over 6% of the District's current retail water demand. The District has also developed ongoing and effective public information and outreach campaigns.

In addition to the District's leadership, active engagement, and full utilization of regional conservation programs to benefit its customers, the District has also developed District-specific programs to address the particular needs and generate additional water savings and value for its customers.

#### *Budget-Based Tiered Rate Structure*

In August 2010, the District implemented a budget-based tiered rate structure for its single-family residential customers. A budget rate structure relies on a calculation of the indoor and outdoor water needs for each individual customer per billing period which, added together, form the customer's "budget." Customers who stay within their budget will pay lower rates than those who exceed their budget, thus incentivizing efficient use.

The District has revised its budget allocation criteria twice, in 2012 and most recently in 2016, to better align with state efficiency standards. Table 6-1 shows the current default values and formulas that the District uses to determine each customer's water budget. These default values represent a sufficient allocation of water to cover efficient indoor and outdoor water needs. If, due to special circumstances, individual customers require greater amounts of water to meet their indoor or outdoor needs, they may seek a budget variance. In 2016, the District expanded its budget rate structure to include customers with dedicated irrigation meters.

**Table 6-1:**
**Budget-Based Tiered Rate Structure Assumptions – 2016**

| Residential Tier | Residential Formulas |
|---|---|
| **Tier 1** | 4 persons * 55 gallons * 30.4 days / 748 gallons |
| **Tier 2** | Lot Size – Residential Structure Footprint – Hardscape (25% Remaining Lot) * 38 inches |
| **Tier 3** | 50% of Tier 1 + 50% of Tier 2 |
| **Tier 4** | All usage above Tier 3 |
| **Irrigation Tier** | **Irrigation Formulas** |
| **Tier 1** | Lot/Irrigated Size * 45 inches |
| **Tier 2** | All usage above Tier 1 |

Budget-based rate structures are widely considered to be a very effective way to incentivize water customers to use water efficiently. A recent University of California Riverside study of one budget rate structure concluded that it achieved a 15 percent water savings.[26] Additionally, the District dedicates revenues received through its highest penalty tier for conservation program expenses.

***Mandatory Year-Round Water Use Efficiency "Best Practices"***

In May 2010, the District Board of Directors adopted Ordinance 33 (Appendix O), establishing water use efficiency "best practices" and staged water shortage demand management measures (for more information on these stages, see Section 7.2 below). Under Ordinance 33, District customers are required to implement the following water use efficiency "best practices" on a permanent, year-round basis:

- Set automatic irrigation timers to water only before 8:00 a.m. or after 8:00 p.m. and for 15 minutes or less per cycle (exceptions: hand-watering, drip irrigation, weather-based or soil moisture sensing irrigation controllers);

- No runoff from excessive watering;

[26] Kenneth Baerenklau, Kurt Schwabe, and Ariel Dinar, "Allocation-Based Water Pricing Promotes Conservation While Keeping User Costs Low." Agricultural and Resource Economics Update 17(6), 2014.

- No watering during rain;
- Repair leaks within seven days of discovery;
- Use shutoff nozzle to wash vehicles, or use commercial wash that recycles;
- No hosing or washing paved surfaces (except when required for health and safety reasons, and then only with a high-pressure washer);
- Restaurants provide water service only on request;
- Hotels provide option for no daily linen service; and,
- Water recycling systems for conveyer and in-bay automatic vehicle washes, decorative water features, and cooling towers and evaporative cooling systems.

Recycled water customers are exempt from these practices, but they must follow the water use requirements under the District's Ordinance 31 (Appendix L) governing recycled water use within the District's service area.

The District's enforcement of year-round water use efficiency best practices is dictated by established courtesy notice and enforcement procedures, as well as by water supply conditions and staff availability. If violations are reported by customers or witnessed by District staff, the District provides one or more courtesy notices by door hanger, phone call, or letter, informing the customer about the violation and requesting that it be addressed in a timely manner. If the violation is witnessed again by District staff after at least seven (7) days, the District initiates official notifications by letter. If the customer receives two such notifications and the violation is still not addressed after at least seven (7) days from receipt of the last and final notice, the customer is subject to fines and possible flow restriction on the schedule in Table 6-2.

**Table 6-2:**
**Best Practice Notifications and Penalties**

| | First Violation | Second Violation | Third Violation | Fourth Violation | Fifth Violation |
|---|---|---|---|---|---|
| **Best Practices** | Written Notice | Final Written Notice | $50 Fine | $100 Fine | $150 Fine; Flow Restrictor |

Customers have the right to request in writing a waiver for hardship or special circumstances. A staff review board reviews written waivers and grants or revokes waivers. Review board appeals may be heard by the District Board of Directors.

### *Residential Nozzle Retrofit Program*

In 2014, the District contracted with ConServ Construction, Inc. to provide customers with a free irrigation survey and nozzle retrofit program. This program, funded through Tier 4 revenues from its budget-based tiered rate structure (see above), targets customers who exceed their budget or otherwise are identified as high users.

The program provides a site visit, evaluation of the customer's irrigation system, and installation of high-efficiency spray nozzles, as well as a consultation on the many existing regional and local conservation programs would best meet the customer's needs and help reduce water use to within their budget allocation.

### *Enhanced Conservation Program*

In response to Governor Brown's declaration of drought emergency and mandatory conservation order, and in conjunction with a declared Significant Water Supply Shortage under Ordinance 33 (see Section 3.1), the District launched an Enhanced Conservation Program to assist customers in achieving immediate and lasting water savings.

Transferred $250,000 from reserves into its conservation program budget, the District funded the following enhanced programs:

- Enhanced rebates for turf removal, high-efficiency toilets, and weather-based irrigation controllers;
- Enhanced irrigation retrofits to supplement local and regional installations of high-efficiency irrigation technologies;
- A public sector assistance program that provided matching funds to public sector partners in reducing near-term water use while achieving long-term savings; and
- Enhanced promotions through additional customer communications and consultant assistance on developing effective promotional strategy and materials.

### *Drought Response Clinics*

Also in response to the Governor's mandatory conservation actions, the District initiated a series of "clinics" to assist customers with a variety of options to reduce their water use. Customers who attend the clinics receive one-on-one assistance with conservation programs and attend bilingual gardening mini-classes and demonstration garden tours to learn more about water-efficient plants. Customers were able to sign up for free landscape irrigation evaluations, free sprinkler nozzles, free weather-based irrigation controller installations, and free comprehensive landscape retrofits, depending on their qualifications. Customers were also provided with information on available rebates for toilets and clothes washers, as well as tips on how to change water use habits to avoid waste.

***"Water Is Life" Art Poster Contest***

The District has conducted an annual "Water is Life" Art Poster Contest since 2002 for students in Kindergarten through 12th grade that attend schools located within the District's service area. Winners in several grade categories are selected by District staff and members of the Board of Directors. The winning entries of the District's contest are entered into MWD's regional contest which selects 36 posters to feature in a calendar.

***Bruce J. Lance, Jr. Water Scholarship***

In 2013, the District recognized Bruce Lance's 44 years of service as its general counsel by establishing the "Bruce J. Lance, Jr. Water Scholarship" for Montclair High School graduating seniors who plan to attend college. Two $500 scholarships are awarded annually. Applicants are required to write an essay on the importance of water.

***Website and Email Newsletter***

The District's website, www.mvwd.org, has a special conservation section which features conservation programs and resources, a "Watch the Water" news section, rotating water savings tips, a form for reporting water wasters, a garden class signup form, and a full listing of programs and resources for teachers and students. Figure 6-1 shows the website section's current front page. The District has also developed an email newsletter, the e-Waterline, which delivers information from the website conservation section directly to customer inboxes.

### 6.3.3 Potential Customer Sector and Economic Impacts

Conservation has multiple benefits, one of which is the value of conservation to the District's ratepayers, in that it saves them from paying higher rates. The District's conservation strategies are equally targeted to all of its customer sectors, and any economic benefits are expected to be borne equally by all customer sectors. That said, conservation can negatively impact the District through decreased revenues. The District protects itself from such impacts through us of a budget-based tiered rate structure (see Section 6.3.2), which matches the District's revenue needs to efficient water use, as well as through the balanced use of the District's diverse water supply portfolio.

The District expects a long-term reduction in water demands as customers become more efficient. In the future, the District may be required to reduce demands even further by either state regulatory action or other unforeseen situations, resulting in insufficient revenues to meet projected expenses. In order to protect the District financially in such circumstances, the District recently adopted "demand reduction rates" as part of its normal rate adoption process in order to ensure financial stability and high quality water service. These rates are set in four stages representing rate adjustments to address a 10 percent, 20 percent, 30 percent, and 40 percent reduction in demand below baseline levels. Implementation of demand reduction rates would require separate action by the Board of Directors before they take effect, and do not apply to recycled water customers.

**Figure 6-1:**
**District Website Conservation Section**



# SECTION 7
# WATER SHORTAGE CONTINGENCY PLAN

The District's Water Shortage Contingency Plan is District Ordinance 33, which establishes year-round water use efficiency best practices (Section 6.3.2) and staged water supply shortage measures. This Plan addresses emergency shortages, including catastrophic interruptions, and contains mandatory prohibitions, penalties, and consumption reduction methods. Ordinance 33 is incorporated into this UWMP as Appendix O.

The District's stages of action present the measures by which customers are required to implement mandatory water conservation practices during a declared water shortage. The District may declare a shortage due to imported water supply cutbacks by MWD, as well as extended drought, equipment failure, act of terrorism, and/or natural disaster. Although the District will respond to the implementation of MWD's WSDM Plan (Section 5.1.2), the District will focus on implementing its own stages of action with consideration of IEUA's response to a declared water shortage throughout its service area.

## 7.1 WATER SHORTAGE CONTINGENCY ORDINANCE

See Section 6.3.2 for a description of the development of District Ordinance 33.

Ordinance 33 identifies actions to be taken by water consumers within the District's service area during periods of adequate water supply, during "significant" water shortages, "critical" water shortages, and "emergency" water shortages including shortages of up to 50 percent. Each shortage stage includes such actions as limiting outside irrigation, leak repair, avoiding water use during peak demand hours, and reduced overall water usage.

## 7.2 STAGES OF ACTION

Ordinance 33 describes mandatory conservation measures to be implemented during a declared Significant, Critical, and Emergency Water Supply Shortage. Table 7-1 summarizes the expected demand reduction for each declared stage.

Recent experience demonstrates that the District can achieve up to 10 percent reduction in demand through a heightened public awareness campaign without the need of declaring a shortage.

Ordinance 33 establishes water use restrictions based on three phases or shortage conditions: "Significant," "Critical," and "Emergency." Table 7-2 outlines which conservation measures are to be implemented during each stage, as identified in Ordinance 33.

**Table 7-1:**
**Water Shortage Stages and Demand Reductions**

| Stage No. | Water Supply Conditions | % Shortage |
|---|---|---|
| Significant Water Supply Shortage | Current or near-term water supply shortage conditions require a 10 to 25 percent demand reduction | 10-25% |
| Critical Water Supply Shortage | Current or near-term water supply shortage conditions require a 25 to 40 percent demand reduction | 25-40% |
| Emergency Water Supply Shortage | Current or near-term water supply shortage conditions require a 40 percent or higher demand reduction | 40+% |

Aligns with data in DWR Standardized Tables 8-1 R and 8-1 W.

The implementation of the water shortage stages above will result in a significant reduction in water consumption. In the most severe water shortage, the collective implementation of residential and commercial landscape irrigation restrictions may achieve a reduction of up to 50 percent in irrigation water use. Combined with other use restrictions on top of a total customer percentage curtailment of 20 percent, such restrictions are expected to result in an overall water consumption reduction of 50 percent for all water use sectors within the District's service area. The District will measure such reductions relying upon water meters to record the production and consumption of water.

**Table 7-2:**
**Water Shortage Phase Mandatory Prohibitions**

| Prohibitions | Stage When Mandatory |
|---|---|
| Outdoor irrigation except on Tuesday, Thursday and Saturday (exemptions for water-dependent industries, efficient irrigation practices) | Significant |
| Dedicated irrigation use above 75% prior non-shortage year's use | Significant |
| Potable water used for construction, dust control without plan authorization | Significant |
| Fire hydrant use other than approved uses (fire prevention, public welfare) | Significant |
| Outdoor irrigation except on Tuesday and Saturday | Critical |
| Dedicated irrigation use above 50% prior non-shortage year's use | Critical |
| Implementation of local landscape requirements resulting in increased water use | Critical |
| Vehicle washing except at commercial car wash | Critical |
| Refilling swimming pools, spas or ponds for cleaning purposes | Critical |
| Outdoor irrigation except on Saturday | Emergency |
| Dedicated irrigation use above 33% prior non-shortage year's use | Emergency |
| Installation of new landscaping | Emergency |
| Use of potable water for construction and dust control | Emergency |
| Filling swimming pools, spas or ponds | Emergency |
| Wholesale customer demand reduction equal to retail customers | All |

Aligns with data in DWR Standardized Table 8-2 R.

## 7.3 REGIONAL WATER SHORTAGE CONTINGENCY PLANNING

### 7.3.1 MWD's Water Surplus and Drought Management Plan

In 1998, MWD's Board of Directors adopted the Water Surplus and Drought Management (WSDM) Plan. This plan addresses both surplus and shortage operating strategies. The WSDM plan reflects anticipated responses based on the water supplies available to MWD.

The WSDM Plan's guiding principle is to minimize adverse impacts of water shortage and ensure regional reliability. From this guiding principle come the following supporting principles:

- Encourage efficient water use and economical local resource programs.
- Coordinate operations with member agencies to make as much surplus water as possible available for use in dry years.
- Pursue innovative transfers and banking programs to secure more replacement water for use in dry years.
- Increase public awareness about water supply issues.

The WSDM Plan guides the operations of water resources (local resources, Colorado River, SWP, and regional storage) to ensure regional reliability. It identifies the expected sequence of resource management actions MWD will take during surpluses and shortages of water to minimize the probability of severe shortages that require curtailment of full-service demands. Mandatory allocations are avoided to the extent practicable, however, in the event of an extreme shortage an allocation plan will be adopted in accordance with the principles of the WSDM Plan.

The WSDM Plan distinguishes between *Surpluses*, *Shortages*, *Severe Shortages*, and *Extreme Shortages.* Within the WSDM Plan, these terms have specific meaning relating to MWD's capability to deliver water to the IEUA and the District.

- **Surplus:** MWD can meet full-service and interruptible program demands, and it can deliver water to local and regional storage.
- **Shortage:** MWD can meet full-service demands and partially meet or fully meet interruptible demands, using stored water or water transfers as necessary.
- **Severe Shortage:** MWD can meet full-service demands only by using stored water, transfers, and possibly calling for extraordinary conservation. In a Severe Shortage, MWD may have to curtail Interim Agricultural Water Program.
- **Extreme Shortage:** MWD must allocate available supply to full-service customers.

Except in severe or extreme shortages or emergencies, MWD's resource management will allow shortages to be mitigated without impacting municipal and industrial customers.

The equitable allocation of supplies is addressed by the Implementation Goals for the WSDM Plan, with the first goal being to "avoid mandatory import water allocations to the extent practicable." However, the second fundamental goal of the WSDM Plan is to "equitably allocate imported water on the basis of agencies' needs." Factors for consideration in establishing the equitable allocation include retail and economic impacts, recycled water production, conservation levels, growth, local supply production, and participation and investment in MWD's system and programs. In the event of an extreme shortage, an allocation plan is to be adopted in accordance with the principles of the WSDM Plan. Such an allocation plan was adopted by MWD in 2008 and updated in 2015.

### 7.3.2 IEUA's Drought Plan

In response to MWD's WSAP, IEUA developed a Drought Plan for the purpose of implementing the WSAP within the IEUA's service area in a manner that is fair and equitable to IEUA's member agencies. The Drought Plan is consistent with and supplements the WSAP for specific IEUA service area drought planning issues. All WSAP definitions, policies, principals, and program provisions are incorporated into the Drought Plan by reference and are considered to be a part of the Drought Plan. For example, if IEUA is not imposed a penalty from MWD then IEUA would not impose a penalty on a member agency within IEUA's service area. In addition, MWD does not allow resale or "marketing" of WSAP allocation credits and IEUA will not allow IEUA Drought Plan credits to be sold internally within IEUA's service area or externally without IEUA's approval.

IEUA's Drought Plan is consistent with and contributes to the existing IEUA imported water policies and programs. For example, the IEUA's Drought Plan principles encourage development and full utilization of local water resources, such as recycled water and conservation measures. The IEUA Drought Plan also addresses MWD's Chino Groundwater Basin DYY program and the need for best management of DYY program "shift" obligations concurrent with WSAP reductions of imported water supplies to IEUA.

## 7.4 MINIMUM SHORT-TERM SUPPLY AVAILABILITY

The District has evaluated the short-term supply outlook during each of the next three years from 2016 through 2018 and determined the minimum water supplies available for retail and wholesale potable and non-potable demands, as shown in Table 7-3. Local supplies are projected to exceed demand.

**Table 7-3:**
**Minimum Short-Term Retail and Wholesale Supply Availability (AFY)**

| Source | 2016 | 2017 | 2018 |
|---|---|---|---|
| Chino Groundwater Basin[1] | 29,841 | 29,841 | 29,841 |
| Water Facilities Authority[1] | 21,776 | 21,776 | 21,776 |
| San Antonio Water Company[1] | 558 | 558 | 558 |
| Recycled[1] | 1,031 | 1,031 | 1,031 |
| **Total** | **53,205** | **53,205** | **53,205** |

Aligns with data in DWR Standardized Tables 8-4 R and 8-4 W.
[1]Consistent with Table 5-5 , 2020 Year 3 supply estimate (most conservative estimate based on best available information).

## 7.5 CATASTROPHIC SUPPLY INTERRUPTION PLAN

The District's imported water supply source, the SWP, crosses the San Andreas Fault, and many other fault lines bisect major water facilities throughout the region. Experts consider it likely that one or more of these supplies will be disrupted in the event of a major earthquake.

MWD estimates that restoring service on any of its imported water supply facilities following a catastrophic outage could take up to six months. This, in turn, could reduce annual deliveries by roughly up to 50 percent for MWD-supplied water. The Urban Water Management Planning Act requires agencies to consider the effect of a 50 percent cutback in water supplies. This corresponds approximately to the degree of cutback contemplated by MWD's earthquake disruption scenario.

### 7.5.1 Water Shortage Emergency Response

A water shortage emergency could be the result of a catastrophic event such as result of drought, failures of transmission facilities, a regional power outage, earthquake, flooding, supply contamination from chemical spills, or other adverse conditions. In response to such an emergency, the District General Manager is authorized under Ordinance 33, Section 10, to declare the extent of the water supply shortage and implement the appropriate water supply shortage stage as defined by the Ordinance, and then report such water supply shortage condition and level of response to the District Board as soon as possible. Subsequently, the District Board shall be responsible for authorizing and directing implementation of the water conservation stages described in Ordinance 33, as appropriate, to address emergencies.

The District may also activate its Emergency Response Plan, developed and maintained by the District as required under the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (Public Law 107-188). The plan calls for the creation of an Emergency Response Coordinator and Team, emergency conditions staffing plan, a public information and inter-agency communications plan, listing of District facilities, maps and other pertinent information. In addition, the Vulnerability Assessment and Local Hazard Mitigation Plan will assist in meeting emergency needs through operational and facility adjustments.

The District also provides wholesale water supply to the City of Chino Hills through a long-term contractual arrangement. The agreement between the two agencies contains provisions regarding water delivery limitations during emergency situations such as natural or other disasters.

The District will consider such actions as stretching existing water storage and obtaining additional water supplies from neighboring agencies if appropriate. The District has interconnections with four other agencies: Golden State Water Company and the cities of Chino, Chino Hills, and Upland. A supply connection with Golden State can be used for emergencies to serve the City of Claremont. The interconnections with the three cities will allow water to be supplied or received.

The City of Montclair Fire Department houses an emergency command center for Zone 1 of the San Bernardino County and State Office of Emergency Services. The District is currently a member of the Montclair Disaster Group to coordinate disaster preparedness planning for the entire community. Members include the local hospital, the high school, the elementary/middle school district, the major retail mall in the city, police and fire departments, and the Red Cross and related groups. The group assists each other in updating disaster plans and keeps abreast of new information in the area of disaster planning.

The District is a member of the Emergency Response Network of the Inland Empire (ERNIE) and the California Water/Wastewater Agency Response Network (CalWARN), both of which include agreements to facilitate mutual assistance in times of disaster. Construction equipment owned by IEUA is also available to the District to use in disaster recovery for the initial emergency period when danger to life and to property exists.

Public health notifications conforming to state laws will be distributed if District management determines that any damage to the water supply distribution system has compromised water quality, i.e., some level of contamination to the drinking water supply has occurred. Public advisories include directives to use bottled water or to boil tap water prior to consumption. In the case of the absence of natural gas or electricity, instructions on the use of household bleach to disinfect tap water will be provided.

If the imported water supplies are reduced dramatically and power supply is not available for extended periods of time, the District will rely on the implementation of MWD's regional emergency water supply plan in coordination with IEUA.

The District has formed an Emergency Response Committee to coordinate all District emergency and disaster response preparation and implementation. The committee reviews and maintains the District's Emergency Response Plan and provides resources and training for District personnel.

### *Vulnerability Assessment*

In compliance with federal regulations, the District conducted a Vulnerability Assessment to identify areas for security enhancement and to develop a prioritized plan for the mitigation of risks to critical assets. The plan was completed and submitted to the EPA in March 2003, followed by the development of the required revised Emergency Response Plan in September 2003, which complies with Section 1433(b) of the Safe Drinking Water Act as amended by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (Public Law 107-188, Title IV – Drinking Water Safety and Security).

### *Local Hazard Mitigation Plan*

The purpose of mitigation planning is to recognize hazards, analyze risks, and identify actions, measures, and projects to implement during the pre-disaster period. This District is required by Cal-EMA and FEMA to update its Local Hazard Mitigation Plan every five years.

### *Health and Safety Requirements*

The primary goal of the District's water system is to preserve the health and safety of its personnel and the public. Meeting this goal is a continuous function of the water system—before, during and after a disaster or water shortage. Fire suppression capabilities will continue to be maintained during any water shortage contingency stage. Some water needs are more immediate than others. The following list of public health needs and the allowable time without potable water is a guideline and will depend on the magnitude of the water shortage:

- Hospitals – continuous need
- Emergency shelters – immediate need
- Kidney dialysis – 24 hours
- Drinking water – 72 hours
- Personal hygiene, waste disposal – 72 hours

Based on commonly accepted estimates of interior residential water use in the United States, Table 7-4 indicates per capita health and safety water requirements.

**Table 7-4:**
**Per Capita Health and Safety Water Quantity Calculations**

| | Non-Conserving Fixtures | | Conserving Fixtures[1] | |
|---|---|---|---|---|
| Toilet | 5 flushes x 3.6 gpf | 18.0 | 5 flushes x 1.6 gpf | 8.0 |
| Shower /Bath | 12.7 shower / 2.6 bath | 15.3 | 9.2 shower / 2.6 bath | 11.8 |
| Washer | 1/3 load | 14.7 | 1/3 load | 7.8 |
| Kitchen | Faucets and Dishwasher | 5.0 | Faucets and Dishwasher | 3.0 |
| Other | Faucets etc. | 5.0 | Faucets etc. | 3.7 |
| Total | | 58.0 | | 34.3 |

All data in GPCD.
Source: DWR Urban Drought Guidebook, 2008 Updated Edition.
[1] Fixtures include ULFTs (1.6 gpf), 2.5 gpm showerheads, and efficient clothes washers.

***Priority by Use***

Conditions prevailing in the District area require that the water resources available be put to maximum beneficial use to the extent to which they are capable. The waste of water should be prevented and water conservation, along with water use efficiency, will be encouraged to the maximum reasonable and beneficial use of the District customers and the public welfare. Preservation of health and safety will be a top priority for the District.

## 7.6 PENALTIES AND CONSUMPTION REDUCTION METHODS

District customers who violate the provisions of Ordinance 33 are subject to the procedures and/or penalties described in the Ordinance (Section 11). Table 7-5 outlines the procedures and penalties for violating Ordinance 33 provisions, including year-round best practices and each declared water supply shortage stage, and for subsequent violations which occurs at least 7 days subsequent to the previous violation.

After multiple violations of Ordinance provisions, the District may install a flow restricting device on a customer's water meter. The District may also terminate a customer's landscape meter service upon a prior determination that the customer has repeatedly violated the Ordinance. Any restricted or terminated service may be restored upon showing that the customer is ready, willing, and able to comply with the provision of the Ordinance. Customers may request waivers and appeal staff decisions to the District General Manager and Board of Directors.

**Table 7-5:**
**Penalties and Procedures for Ordinance 33 Violations**

| | First Violation | Second Violation | Third Violation | Fourth Violation | Fifth Violation |
|---|---|---|---|---|---|
| **Best Practices** | Written Notice | Final Written Notice | $50 Fine | $100 Fine | $150 Fine; Flow Restrictor |
| **Significant Water Supply Shortage** | Written Notice | $50 Fine | $100 Fine | $150 Fine | $200 Fine; Flow Restrictor |
| **Critical Water Supply Shortage** | Written Notice | $100 Fine | $200 Fine | $300 Fine; Flow Restrictor | --- |
| **Emergency Water Supply Shortage** | Written Notice | $150 Fine | $300 Fine; Flow Restrictor | --- | --- |

In order to fully implement Ordinance 33 provisions, the District will conduct an expansive public information campaign regarding the declared shortage stage, including newspaper announcements, direct mail, and publicity. The District will also increase its enforcement of water use restrictions through additional water waste patrolling by staff. Typically, in order to reinforce the message of needed reductions in use, the District will also decrease flushing activities to the minimum required to meet water quality objectives. Finally, the District may implement demand reduction rates as described below.

### 7.6.1 Revenue and Expenditure Impacts

As stated in Section 6.3.3, during periods of water supply shortages, state-mandated water use restrictions, or emergency conditions, the District may require its customers to reduce demands below levels projected by the current rate structure. This circumstance may result in insufficient revenues to meet necessary expenses.

The District may rely on its reserves to offset declines in revenues. The District maintains an operating reserve with a target funding level of three months of its annual operating budget, and an emergency reserve with a target funding level of $1 to $4 million, consistent with the District's cash reserve policy (Resolution 612-07).

In order to protect the District financially in such circumstances, the District recently adopted "demand reduction rates" as part of its normal rate adoption process in order to ensure financial stability and high quality water service. The demand reduction rates are set in four stages representing potential rate adjustments to address a 10 percent, 20 percent, 30 percent, and 40 percent reduction in demand below baseline levels. Implementation of demand reduction rates would require separate action by the Board of Directors before they take effect, and do not apply to recycled water customers.

## 7.7 MECHANISMS TO DETERMINE ACTUAL REDUCTIONS IN WATER USE

The District tracks water production through use of the real-time Supervisory Control Data Acquisition System (SCADA) system. Production is monitored through use of the blending station (Plant 17), real time trend screens indicating reservoir storage and monitoring of WFA supply flows. Operations personnel conduct daily rounds and maintenance checks on the groundwater wells. Production reports are prepared monthly and quarterly.

Historically, during a water supply shortage, operations personnel have conducted production facility inspections twice a day with increased monitoring of the SCADA system screens. Reservoir storage trend screens are the key indicators of overall system demand. In addition, field staff has monitored the District service area for signs of system or individual service leaks or excessive landscape watering.

The District will also follow implementation of stages of water shortage declared by MWD through its WSAP and continue to monitor water demand levels. In the event that MWD may call for a Level 5 or 25 percent reduction in demand or higher, the District will coordinate emergency activities with IEUA staff and MWD's Drought Program Officer, and monitor the effectiveness of ongoing conservation programs. Monthly or more frequent reporting on estimated conservation water savings will be provided and reviewed. Water consumption reports, water facility condition, watershed hydrology information, and basin conditions, will all be considered for further appropriate action in response to the water shortage.

# Appendix A:
# Urban Water Management Planning Act of 1983 as Amended to 2015

*from*
*Department of Water Resources*
*2015 Urban Water Management Plan Guidebook*

# Appendix A

## California Water Code
## Urban Water Management Planning

**California Water Code Division 6, Part 2.6.**

**Chapter 1. General Declaration and Policy** §10610-10610.4
**Chapter 2. Definitions** §10611-10617
**Chapter 3. Urban Water Management Plans**
Article 1. General Provisions §10620-10621
Article 2. Contents of Plans §10630-10634
Article 2.5. Water Service Reliability §10635
Article 3. Adoption And Implementation of Plans §10640-10645
**Chapter 4. Miscellaneous Provisions** §10650-10656

# Chapter 1. General Declaration and Policy

SECTION 10610-10610.4

10610. This part shall be known and may be cited as the "Urban Water Management Planning Act."

10610.2. (a) The Legislature finds and declares all of the following:

(1) The waters of the state are a limited and renewable resource subject to ever-increasing demands.

(2) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

(3) A long-term, reliable supply of water is essential to protect the productivity of California's businesses and economic climate.

(4) As part of its long-range planning activities, every urban water supplier should make every effort to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry water years.

(5) Public health issues have been raised over a number of contaminants that have been identified in certain local and imported water supplies.

(6) Implementing effective water management strategies, including groundwater storage projects and recycled water projects, may require specific water quality and salinity targets for meeting groundwater basins water quality objectives and promoting beneficial use of recycled water.

(7) Water quality regulations are becoming an increasingly important factor in water agencies' selection of raw water sources, treatment alternatives, and modifications to existing treatment facilities.

(8) Changes in drinking water quality standards may also impact the usefulness of water supplies and may ultimately impact supply reliability.

(9) The quality of source supplies can have a significant impact on water management strategies and supply reliability.

(b) This part is intended to provide assistance to water agencies in carrying out their long-term resource planning responsibilities to ensure adequate water supplies to meet existing and future demands for water.

10610.4. The Legislature finds and declares that it is the policy of the state as follows:

(a) The management of urban water demands and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The management of urban water demands and efficient use of urban water supplies shall be a guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to actively pursue the efficient use of available supplies.

## Chapter 2. Definitions

SECTION 10611-10617

10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

10611.5. “Demand management" means those water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable and efficient use and reuse of available supplies.

10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

10614. "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses,

reclamation and demand management activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water demand management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for implementation shall be included in the plan.

10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

10616.5. "Recycled water" means the reclamation and reuse of wastewater for beneficial use.

10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 4 (commencing with Section 116275) of Part 12 of Division 104 of the Health and Safety Code.

## Chapter 3. Urban Water Management Plans

**Article 1. General Provisions**

SECTION 10620-10621

10620. (a) Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) (1) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(2) Each urban water supplier shall coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that

share a common source, water management agencies, and relevant public agencies, to the extent practicable.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

(f) An urban water supplier shall describe in the plan water management tools and options used by that entity that will maximize resources and minimize the need to import water from other regions.

10621. (a) Each urban water supplier shall update its plan at least once every five years on or before December 31, in years ending in five and zero, except as provided in subdivision (d).

(b) Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days before the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision.

(c) The amendments to, or changes in, the plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

(d) Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016.

**Article 2. Contents of Plan**

SECTION 10630-10634

10630. It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

10631. A plan shall be adopted in accordance with this chapter that shall do all of the following:

(a) Describe the service area of the supplier, including current and projected population, climate, and other demographic factors affecting the supplier's water management planning. The projected population estimates shall be based upon data from the state, regional, or local service agency population projections within the service area of the urban water supplier and shall be in five-year increments to 20 years or as far as data is available.

(b) Identify and quantify, to the extent practicable, the existing and planned sources of water available to the supplier over the same five-year increments described in subdivision (a). If groundwater is identified as an existing or planned source of

water available to the supplier, all of the following information shall be included in the plan:

(1) A copy of any groundwater management plan adopted by the urban water supplier, including plans adopted pursuant to Part 2.75 (commencing with Section 10750), or any other specific authorization for groundwater management.

(2) A description of any groundwater basin or basins from which the urban water supplier pumps groundwater. For basins that a court or the board has adjudicated the rights to pump groundwater, a copy of the order or decree adopted by the court or the board and a description of the amount of groundwater the urban water supplier has the legal right to pump under the order or decree. For basins that have not been adjudicated, information as to whether the department has identified the basin or basins as overdrafted or has projected that the basin will become overdrafted if present management conditions continue, in the most current official departmental bulletin that characterizes the condition of the groundwater basin, and a detailed description of the efforts being undertaken by the urban water supplier to eliminate the long-term overdraft condition.

(3) A detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(4) A detailed description and analysis of the amount and location of groundwater that is projected to be pumped by the urban water supplier. The description and analysis shall be based on information that is reasonably available, including, but not limited to, historic use records.

(c) (1) Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage, to the extent practicable, and provide data for each of the following:

(A) An average water year.

(B) A single-dry water year.

(C) Multiple-dry water years.

(2) For any water source that may not be available at a consistent level of use, given specific legal, environmental, water quality, or climatic factors, describe plans to supplement or replace that source with alternative sources or water demand management measures, to the extent practicable.

(d) Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis.

(e) (1) Quantify, to the extent records are available, past and current water use, over the same five-year increments described in subdivision (a), and projected water use, identifying the uses among water use sectors, including, but not necessarily limited to, all of the following uses:

(A) Single-family residential.

(B) Multifamily.

(C) Commercial.

(D) Industrial.

(E) Institutional and governmental.

(F) Landscape.

(G) Sales to other agencies.

(H) Saline water intrusion barriers, groundwater recharge, or conjunctive use, or any combination thereof.

(I) Agricultural.

(J) Distribution system water loss.

(2) The water use projections shall be in the same five-year increments described in subdivision (a).

(3) (A) For the 2015 urban water management plan update, the distribution system water loss shall be quantified for the most recent 12-month period available. For all subsequent updates, the distribution system water loss shall be quantified for each of the five years preceding the plan update.

(B) The distribution system water loss quantification shall be reported in accordance with a worksheet approved or developed by the department through a public process. The water loss quantification worksheet shall be based on the water system balance methodology developed by the American Water Works Association.

(4) (A) If available and applicable to an urban water supplier, water use projections may display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as applicable to the service area.

(B) To the extent that an urban water supplier reports the information described in subparagraph (A), an urban water supplier shall do both of the following:

(i) Provide citations of the various codes, standards, ordinances, or transportation and land use plans utilized in making the projections.

(ii) Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact.

(f) Provide a description of the supplier's water demand management measures. This description shall include all of the following:

(1) (A) For an urban retail water supplier, as defined in Section 10608.12, a narrative description that addresses the nature and extent of each water demand management measure implemented over the past five years. The narrative shall describe the water demand management measures that the supplier plans to implement to achieve its water use targets pursuant to Section 10608.20.

(B) The narrative pursuant to this paragraph shall include descriptions of the following water demand management measures:

(i) Water waste prevention ordinances.

(ii) Metering.

(iii) Conservation pricing.

(iv) Public education and outreach.

(v) Programs to assess and manage distribution system real loss.

(vi) Water conservation program coordination and staffing support.

(vii) Other demand management measures that have a significant impact on water use as measured in gallons per capita per day, including innovative measures, if implemented.

(2) For an urban wholesale water supplier, as defined in Section 10608.12, a narrative description of the items in clauses (ii), (iv), (vi), and (vii) of subparagraph (B) of paragraph (1), and a narrative description of its distribution system asset management and wholesale supplier assistance programs.

(g) Include a description of all water supply projects and water supply programs that may be undertaken by the urban water supplier to meet the total projected water

use, as established pursuant to subdivision (a) of Section 10635. The urban water supplier shall include a detailed description of expected future projects and programs that the urban water supplier may implement to increase the amount of the water supply available to the urban water supplier in average, single-dry, and multiple-dry water years. The description shall identify specific projects and include a description of the increase in water supply that is expected to be available from each project. The description shall include an estimate with regard to the implementation timeline for each project or program.

(h) Describe the opportunities for development of desalinated water, including, but not limited to, ocean water, brackish water, and groundwater, as a long-term supply.

(i) For purposes of this part, urban water suppliers that are members of the California Urban Water Conservation Council shall be deemed in compliance with the requirements of subdivision (f) by complying with all the provisions of the "Memorandum of Understanding Regarding Urban Water Conservation in California," dated December 10, 2008, as it may be amended, and by submitting the annual reports required by Section 6.2 of that memorandum.

(j) An urban water supplier that relies upon a wholesale agency for a source of water shall provide the wholesale agency with water use projections from that agency for that source of water in five-year increments to 20 years or as far as data is available. The wholesale agency shall provide information to the urban water supplier for inclusion in the urban water supplier's plan that identifies and quantifies, to the extent practicable, the existing and planned sources of water as required by subdivision (b), available from the wholesale agency to the urban water supplier over the same five-year increments, and during various water-year types in accordance with subdivision (c). An urban water supplier may rely upon water supply information provided by the wholesale agency in fulfilling the plan informational requirements of subdivisions (b) and (c).

10631.1. (a) The water use projections required by Section 10631 shall include projected water use for single-family and multifamily residential housing needed for lower income households, as defined in Section 50079.5 of the Health and Safety Code, as identified in the housing element of any city, county, or city and county in the service area of the supplier.

(b) It is the intent of the Legislature that the identification of projected water use for single-family and multifamily residential housing for lower income households will assist a supplier in complying with the requirement under Section 65589.7 of the Government Code to grant a priority for the provision of service to housing units affordable to lower income households.

10631.2. (a) In addition to the requirements of Section 10631, an urban water management plan may, but is not required to, include any of the following information:

(1) An estimate of the amount of energy used to extract or divert water supplies.

(2) An estimate of the amount of energy used to convey water supplies to the water treatment plants or distribution systems.

(3) An estimate of the amount of energy used to treat water supplies.

(4) An estimate of the amount of energy used to distribute water supplies through its distribution systems.

(5) An estimate of the amount of energy used for treated water supplies in comparison to the amount used for nontreated water supplies.

(6) An estimate of the amount of energy used to place water into or withdraw from storage.

(7) Any other energy-related information the urban water supplier deems appropriate.

(b) The department shall include in its guidance for the preparation of urban water management plans a methodology for the voluntary calculation or estimation of the energy intensity of urban water systems. The department may consider studies and calculations conducted by the Public Utilities Commission in developing the methodology.

10631.5. (a) (1) Beginning January 1, 2009, the terms of, and eligibility for, a water management grant or loan made to an urban water supplier and awarded or administered by the department, state board, or California Bay-Delta Authority or its successor agency shall be conditioned on the implementation of the water demand management measures described in Section 10631, as determined by the department pursuant to subdivision (b).

(2) For the purposes of this section, water management grants and loans include funding for programs and projects for surface water or groundwater storage, recycling, desalination, water conservation, water supply reliability, and water supply augmentation. This section does not apply to water management projects funded by the federal American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

(3) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if the urban water supplier has

submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the water demand management measures. The supplier may request grant or loan funds to implement the water demand management measures to the extent the request is consistent with the eligibility requirements applicable to the water management funds.

(4) (A) Notwithstanding paragraph (1), the department shall determine that an urban water supplier is eligible for a water management grant or loan even though the supplier is not implementing all of the water demand management measures described in Section 10631, if an urban water supplier submits to the department for approval documentation demonstrating that a water demand management measure is not locally cost effective. If the department determines that the documentation submitted by the urban water supplier fails to demonstrate that a water demand management measure is not locally cost effective, the department shall notify the urban water supplier and the agency administering the grant or loan program within 120 days that the documentation does not satisfy the requirements for an exemption, and include in that notification a detailed statement to support the determination.

(B) For purposes of this paragraph, "not locally cost effective" means that the present value of the local benefits of implementing a water demand management measure is less than the present value of the local costs of implementing that measure.

(b) (1) The department, in consultation with the state board and the California Bay-Delta Authority or its successor agency, and after soliciting public comment regarding eligibility requirements, shall develop eligibility requirements to implement the requirement of paragraph (1) of subdivision (a). In establishing these eligibility requirements, the department shall do both of the following:

(A) Consider the conservation measures described in the Memorandum of Understanding Regarding Urban Water Conservation in California, and alternative conservation approaches that provide equal or greater water savings.

(B) Recognize the different legal, technical, fiscal, and practical roles and responsibilities of wholesale water suppliers and retail water suppliers.

(2) (A) For the purposes of this section, the department shall determine whether an urban water supplier is implementing all of the water demand management measures described in Section 10631 based on either, or a combination, of the following:

(i) Compliance on an individual basis.

(ii) Compliance on a regional basis. Regional compliance shall require participation in a regional conservation program consisting of two or more urban water suppliers that achieves the level of conservation or water efficiency savings equivalent to the amount of conservation or savings achieved if each of the participating urban water suppliers implemented the water demand management measures. The urban water supplier administering the regional program shall provide participating urban water suppliers and the department with data to demonstrate that the regional program is consistent with this clause. The department shall review the data to determine whether the urban water suppliers in the regional program are meeting the eligibility requirements.

(B) The department may require additional information for any determination pursuant to this section.

(3) The department shall not deny eligibility to an urban water supplier in compliance with the requirements of this section that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of the agencies participating in the project or plan is not implementing all of the water demand management measures described in Section 10631.

(c) In establishing guidelines pursuant to the specific funding authorization for any water management grant or loan program subject to this section, the agency administering the grant or loan program shall include in the guidelines the eligibility requirements developed by the department pursuant to subdivision (b).

(d) Upon receipt of a water management grant or loan application by an agency administering a grant and loan program subject to this section, the agency shall request an eligibility determination from the department with respect to the requirements of this section. The department shall respond to the request within 60 days of the request.

(e) The urban water supplier may submit to the department copies of its annual reports and other relevant documents to assist the department in determining whether the urban water supplier is implementing or scheduling the implementation of water demand management activities. In addition, for urban water suppliers that are signatories to the Memorandum of Understanding Regarding Urban Water Conservation in California and submit biennial reports to the California Urban Water Conservation Council in accordance with the memorandum, the department may use these reports to assist in tracking the implementation of water demand management measures.

(f) This section shall remain in effect only until July 1, 2016, and as of that date is repealed, unless a later enacted statute, that is enacted before July 1, 2016, deletes or extends that date.

10631.7. The department, in consultation with the California Urban Water Conservation Council, shall convene an independent technical panel to provide information and recommendations to the department and the Legislature on new demand management measures, technologies, and approaches. The panel shall consist of no more than seven members, who shall be selected by the department to reflect a balanced representation of experts. The panel shall have at least one, but no more than two, representatives from each of the following: retail water suppliers, environmental organizations, the business community, wholesale water suppliers, and academia. The panel shall be convened by January 1, 2009, and shall report to the Legislature no later than January 1, 2010, and every five years thereafter. The department shall review the panel report and include in the final report to the Legislature the department's recommendations and comments regarding the panel process and the panel's recommendations.

10632. (a) The plan shall provide an urban water shortage contingency analysis that includes each of the following elements that are within the authority of the urban water supplier:

(1) Stages of action to be undertaken by the urban water supplier in response to water supply shortages, including up to a 50 percent reduction in water supply, and an outline of specific water supply conditions that are applicable to each stage.

(2) An estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency's water supply.

(3) Actions to be undertaken by the urban water supplier to prepare for, and implement during, a catastrophic interruption of water supplies including, but not limited to, a regional power outage, an earthquake, or other disaster.

(4) Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, prohibiting the use of potable water for street cleaning.

(5) Consumption reduction methods in the most restrictive stages. Each urban water supplier may use any type of consumption reduction methods in its water shortage contingency analysis that would reduce water use, are

appropriate for its area, and have the ability to achieve a water use reduction consistent with up to a 50 percent reduction in water supply.

(6) Penalties or charges for excessive use, where applicable.

(7) An analysis of the impacts of each of the actions and conditions described in paragraphs (1) to (6), inclusive, on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts, such as the development of reserves and rate adjustments.

(8) A draft water shortage contingency resolution or ordinance.

(9) A mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.

(b) Commencing with the urban water management plan update due July 1, 2016, for purposes of developing the water shortage contingency analysis pursuant to subdivision (a), the urban water supplier shall analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas, as defined in subdivision (a) of Section 115921 of the Health and Safety Code.

10633. The plan shall provide, to the extent available, information on recycled water and its potential for use as a water source in the service area of the urban water supplier. The preparation of the plan shall be coordinated with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area, and shall include all of the following:

(a) A description of the wastewater collection and treatment systems in the supplier's service area, including a quantification of the amount of wastewater collected and treated and the methods of wastewater disposal.

(b) A description of the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project.

(c) A description of the recycled water currently being used in the supplier's service area, including, but not limited to, the type, place, and quantity of use.

(d) A description and quantification of the potential uses of recycled water, including, but not limited to, agricultural irrigation, landscape irrigation, wildlife habitat enhancement, wetlands, industrial reuse, groundwater recharge, indirect potable reuse, and other appropriate uses, and a determination with regard to the technical and economic feasibility of serving those uses.

(e) The projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected pursuant to this subdivision.

(f) A description of actions, including financial incentives, which may be taken to encourage the use of recycled water, and the projected results of these actions in terms of acre-feet of recycled water used per year.

(g) A plan for optimizing the use of recycled water in the supplier's service area, including actions to facilitate the installation of dual distribution systems, to promote recirculating uses, to facilitate the increased use of treated wastewater that meets recycled water standards, and to overcome any obstacles to achieving that increased use.

10634. The plan shall include information, to the extent practicable, relating to the quality of existing sources of water available to the supplier over the same five-year increments as described in subdivision (a) of Section 10631, and the manner in which water quality affects water management strategies and supply reliability.

**Article 2.5. Water Service Reliability**

SECTION 10635

10635. (a) Every urban water supplier shall include, as part of its urban water management plan, an assessment of the reliability of its water service to its customers during normal, dry, and multiple dry water years. This water supply and demand assessment shall compare the total water supply sources available to the water supplier with the total projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and multiple dry water years. The water service reliability assessment shall be based upon the information compiled pursuant to Section 10631, including available data from state, regional, or local agency population projections within the service area of the urban water supplier.

(b) The urban water supplier shall provide that portion of its urban water management plan prepared pursuant to this article to any city or county within which it provides water supplies no later than 60 days after the submission of its urban water management plan.

(c) Nothing in this article is intended to create a right or entitlement to water service or any specific level of water service.

(d) Nothing in this article is intended to change existing law concerning an urban water supplier's obligation to provide water service to its existing customers or to any potential future customers.

**Article 3. Adoption and Implementation of Plans**

SECTION 10640-10645

10640. Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630). The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

10641. An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water demand management methods and techniques.

10642. Each urban water supplier shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. The urban water supplier shall provide notice of the time and place of hearing to any city or county within which the supplier provides water supplies. A privately owned water supplier shall provide an equivalent notice within its service area.

After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

10644. (a) (1) An urban water supplier shall submit to the department, the California State Library, and any city or county within which the supplier provides water supplies a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be submitted to the department, the California State Library, and any city or county within which the supplier provides water supplies within 30 days after adoption.

(2) The plan, or amendments to the plan, submitted to the department pursuant to paragraph (1) shall be submitted electronically and shall include any standardized forms, tables, or displays specified by the department.

(b) (1) Notwithstanding Section 10231.5 of the Government Code, the department shall prepare and submit to the Legislature, on or before December 31, in the years ending in six and one, a report summarizing the status of the plans adopted pursuant to this part.

The report prepared by the department shall identify the exemplary elements of the individual plans. The department shall provide a copy of the report to each urban water supplier that has submitted its plan to the department. The department shall also prepare reports and provide data for any legislative hearings designed to consider the effectiveness of plans submitted pursuant to this part.

(2) A report to be submitted pursuant to paragraph (1) shall be submitted in compliance with Section 9795 of the Government Code.

(c) (1) For the purpose of identifying the exemplary elements of the individual plans, the department shall identify in the report water demand management measures adopted and implemented by specific urban water suppliers, and identified pursuant to Section 10631, that achieve water savings significantly above the levels established by the department to meet the requirements of Section 10631.5.

(2) The department shall distribute to the panel convened pursuant to Section 10631.7 the results achieved by the implementation of those water demand management measures described in paragraph (1).

(3) The department shall make available to the public the standard the department will use to identify exemplary water demand management measures.

10645. Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

## Chapter 4. Miscellaneous Provisions

### SECTION 10650-10656

10650. Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

10651. In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plan by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplier is not supported by substantial evidence.

10652. The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans pursuant to this part or to the implementation of actions taken pursuant to Section 10632. Nothing in this part shall be interpreted as exempting from the California Environmental Quality Act any project that would significantly affect water supplies for fish and wildlife, or any project for implementation of the plan, other than projects implementing Section 10632, or any project for expanded or additional water supplies.

10653. The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board and the Public Utilities Commission, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board or the Public Utilities Commission requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board or the commission in obtaining that information. The requirements of this part shall be satisfied by any urban water demand management plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing urban water management plan which includes the contents of a plan required under this part.

10654. An urban water supplier may recover in its rates the costs incurred in preparing its plan and implementing the reasonable water conservation measures included in the plan. Any best water management practice that is included in the plan that is identified in the "Memorandum of Understanding Regarding Urban Water Conservation in California" is deemed to be reasonable for the purposes of this section.

10655. If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

10656. An urban water supplier that does not prepare, adopt, and submit its urban water management plan to the department in accordance with this part, is ineligible to receive funding pursuant to Division 24 (commencing with Section 78500) or Division 26

(commencing with Section 79000), or receive drought assistance from the state until the urban water management plan is submitted pursuant to this article.

# Appendix B:
# Water Conservation Act of 2009 (SBX7-7)

*from*
*Department of Water Resources*
*2015 Urban Water Management Plan Guidebook*

# Appendix B

## California Water Code
## Sustainable Water Use and Demand Reduction

**California Water Code Division 6, Part 2.55.**

**Chapter 1. General Declarations and Policy** §10608-10608.8
**Chapter 2. Definitions** §10608.12
**Chapter 3. Urban Retail Water Suppliers** §10608.16-10608.44
**Chapter 4. Agricultural Water Suppliers** §10608.48
**Chapter 5. Sustainable Water Management** §10608.50
**Chapter 6 Standardized Data Collection** §10608.52
**Chapter 7 Funding Provisions** §10608.56-10608.60
**Chapter 8 Quantifying Agricultural Water Use Efficiency** §10608.64

# Chapter 1. General Declarations and Policy

SECTION 10608-10608.8

10608. The Legislature finds and declares all of the following:

(a) Water is a public resource that the California Constitution protects against waste and unreasonable use.

(b) Growing population, climate change, and the need to protect and grow California's economy while protecting and restoring our fish and wildlife habitats make it essential that the state manage its water resources as efficiently as possible.

(c) Diverse regional water supply portfolios will increase water supply reliability and reduce dependence on the Delta.

(d) Reduced water use through conservation provides significant energy and environmental benefits, and can help protect water quality, improve streamflows, and reduce greenhouse gas emissions.

(e) The success of state and local water conservation programs to increase efficiency of water use is best determined on the basis of measurable outcomes related to water use or efficiency.

(f) Improvements in technology and management practices offer the potential for increasing water efficiency in California over time, providing an essential water management tool to meet the need for water for urban, agricultural, and environmental uses.

(g) The Governor has called for a 20 percent per capita reduction in urban water use statewide by 2020.

(h) The factors used to formulate water use efficiency targets can vary significantly from location to location based on factors including weather, patterns of urban and suburban development, and past efforts to enhance water use efficiency.

(i) Per capita water use is a valid measure of a water provider's efforts to reduce urban water use within its service area. However, per capita water use is less useful for measuring relative water use efficiency between different water providers. Differences in weather, historical patterns of urban and suburban development, and density of housing in a particular location need to be considered when assessing per capita water use as a measure of efficiency.

10608.4. It is the intent of the Legislature, by the enactment of this part, to do all of the following:

(a) Require all water suppliers to increase the efficiency of use of this essential resource.

(b) Establish a framework to meet the state targets for urban water conservation identified in this part and called for by the Governor.

(c) Measure increased efficiency of urban water use on a per capita basis.

(d) Establish a method or methods for urban retail water suppliers to determine targets for achieving increased water use efficiency by the year 2020, in accordance with the Governor's goal of a 20-percent reduction.

(e) Establish consistent water use efficiency planning and implementation standards for urban water suppliers and agricultural water suppliers.

(f) Promote urban water conservation standards that are consistent with the California Urban Water Conservation Council's adopted best management practices and the requirements for demand management in Section 10631.

(g) Establish standards that recognize and provide credit to water suppliers that made substantial capital investments in urban water conservation since the drought of the early 1990s.

(h) Recognize and account for the investment of urban retail water suppliers in providing recycled water for beneficial uses.

(i) Require implementation of specified efficient water management practices for agricultural water suppliers.

(j) Support the economic productivity of California's agricultural, commercial, and industrial sectors.

(k) Advance regional water resources management.

10608.8. (a) (1) Water use efficiency measures adopted and implemented pursuant to this part or Part 2.8 (commencing with Section 10800) are water conservation measures subject to the protections provided under Section 1011.

(2) Because an urban agency is not required to meet its urban water use target until 2020 pursuant to subdivision (b) of Section 10608.24, an urban retail water supplier's failure to meet those targets shall not establish a violation of law for purposes of any state administrative or judicial proceeding prior to

January 1, 2021. Nothing in this paragraph limits the use of data reported to the department or the board in litigation or an administrative proceeding. This paragraph shall become inoperative on January 1, 2021.

(3) To the extent feasible, the department and the board shall provide for the use of water conservation reports required under this part to meet the requirements of Section 1011 for water conservation reporting.

(b) This part does not limit or otherwise affect the application of Chapter 3.5 (commencing with Section 11340), Chapter 4 (commencing with Section 11370), Chapter 4.5 (commencing with Section 11400), and Chapter 5 (commencing with Section 11500) of Part 1 of Division 3 of Title 2 of the Government Code.

(c) This part does not require a reduction in the total water used in the agricultural or urban sectors, because other factors, including, but not limited to, changes in agricultural economics or population growth may have greater effects on water use. This part does not limit the economic productivity of California's agricultural, commercial, or industrial sectors.

(d) The requirements of this part do not apply to an agricultural water supplier that is a party to the Quantification Settlement Agreement, as defined in subdivision (a) of Section 1 of Chapter 617 of the Statutes of 2002, during the period within which the Quantification Settlement Agreement remains in effect. After the expiration of the Quantification Settlement Agreement, to the extent conservation water projects implemented as part of the Quantification Settlement Agreement remain in effect, the conserved water created as part of those projects shall be credited against the obligations of the agricultural water supplier pursuant to this part.

## Chapter 2 Definitions

SECTION 10608.12

10608.12. Unless the context otherwise requires, the following definitions govern the construction of this part:

(a) "Agricultural water supplier" means a water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water. "Agricultural water supplier" includes a supplier or contractor for water, regardless of the basis of right, that distributes or sells water for ultimate resale to customers. "Agricultural water supplier" does not include the department.

(b) "Base daily per capita water use" means any of the following:

(1) The urban retail water supplier's estimate of its average gross water use, reported in gallons per capita per day and calculated over a continuous 10-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

(2) For an urban retail water supplier that meets at least 10 percent of its 2008 measured retail water demand through recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier, the urban retail water supplier may extend the calculation described in paragraph (1) up to an additional five years to a maximum of a continuous 15-year period ending no earlier than December 31, 2004, and no later than December 31, 2010.

(3) For the purposes of Section 10608.22, the urban retail water supplier's estimate of its average gross water use, reported in gallons per capita per day and calculated over a continuous five-year period ending no earlier than December 31, 2007, and no later than December 31, 2010.

(c) "Baseline commercial, industrial, and institutional water use" means an urban retail water supplier's base daily per capita water use for commercial, industrial, and institutional users.

(d) "Commercial water user" means a water user that provides or distributes a product or service.

(e) "Compliance daily per capita water use" means the gross water use during the final year of the reporting period, reported in gallons per capita per day.

(f) "Disadvantaged community" means a community with an annual median household income that is less than 80 percent of the statewide annual median household income.

(g) "Gross water use" means the total volume of water, whether treated or untreated, entering the distribution system of an urban retail water supplier, excluding all of the following:

(1) Recycled water that is delivered within the service area of an urban retail water supplier or its urban wholesale water supplier.

(2) The net volume of water that the urban retail water supplier places into long-term storage.

(3) The volume of water the urban retail water supplier conveys for use by another urban water supplier.

(4) The volume of water delivered for agricultural use, except as otherwise provided in subdivision (f) of Section 10608.24.

(h) "Industrial water user" means a water user that is primarily a manufacturer or processor of materials as defined by the North American Industry Classification System code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development.

(i) "Institutional water user" means a water user dedicated to public service. This type of user includes, among other users, higher education institutions, schools, courts, churches, hospitals, government facilities, and nonprofit research institutions.

(j) "Interim urban water use target" means the midpoint between the urban retail water supplier's base daily per capita water use and the urban retail water supplier's urban water use target for 2020.

(k) "Locally cost effective" means that the present value of the local benefits of implementing an agricultural efficiency water management practice is greater than or equal to the present value of the local cost of implementing that measure.

(l) "Process water" means water used for producing a product or product content or water used for research and development, including, but not limited to, continuous manufacturing processes, water used for testing and maintaining equipment used in producing a product or product content, and water used in combined heat and power facilities used in producing a product or product content. Process water does not mean incidental water uses not related to the production of a product or product content, including, but not limited to, water used for restrooms, landscaping, air conditioning, heating, kitchens, and laundry.

(m) "Recycled water" means recycled water, as defined in subdivision (n) of Section 13050, that is used to offset potable demand, including recycled water supplied for direct use and indirect potable reuse, that meets the following requirements, where applicable:

(1) For groundwater recharge, including recharge through spreading basins, water supplies that are all of the following:

(A) Metered.

(B) Developed through planned investment by the urban water supplier or a wastewater treatment agency.

(C) Treated to a minimum tertiary level.

(D) Delivered within the service area of an urban retail water supplier or its urban wholesale water supplier that helps an urban retail water supplier meet its urban water use target.

(2) For reservoir augmentation, water supplies that meet the criteria of paragraph (1) and are conveyed through a distribution system constructed specifically for recycled water.

(n) "Regional water resources management" means sources of supply resulting from watershed-based planning for sustainable local water reliability or any of the following alternative sources of water:

(1) The capture and reuse of stormwater or rainwater.

(2) The use of recycled water.

(3) The desalination of brackish groundwater.

(4) The conjunctive use of surface water and groundwater in a manner that is consistent with the safe yield of the groundwater basin.

(o) "Reporting period" means the years for which an urban retail water supplier reports compliance with the urban water use targets.

(p) "Urban retail water supplier" means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(q) "Urban water use target" means the urban retail water supplier's targeted future daily per capita water use.

(r) "Urban wholesale water supplier," means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of water annually at wholesale for potable municipal purposes.

## Chapter 3 Urban Retail Water Suppliers

SECTION 10608.16-10608.44

10608.16.(a) The state shall achieve a 20-percent reduction in urban per capita water use in California on or before December 31, 2020.

(b) The state shall make incremental progress towards the state target specified in subdivision (a) by reducing urban per capita water use by at least 10 percent on or before December 31, 2015.

10608.20.(a) (1) Each urban retail water supplier shall develop urban water use targets and an interim urban water use target by July 1, 2011. Urban retail water suppliers may elect to determine and report progress toward achieving these targets on an individual or regional basis, as provided in subdivision (a) of Section 10608.28, and may determine the targets on a fiscal year or calendar year basis.

(2) It is the intent of the Legislature that the urban water use targets described in paragraph (1) cumulatively result in a 20-percent reduction from the baseline daily per capita water use by December 31, 2020.

(b) An urban retail water supplier shall adopt one of the following methods for determining its urban water use target pursuant to subdivision (a):

(1) Eighty percent of the urban retail water supplier's baseline per capita daily water use.

(2) The per capita daily water use that is estimated using the sum of the following performance standards:

(A) For indoor residential water use, 55 gallons per capita daily water use as a provisional standard. Upon completion of the department's 2016 report to the Legislature pursuant to Section 10608.42, this standard may be adjusted by the Legislature by statute.

(B) For landscape irrigated through dedicated or residential meters or connections, water efficiency equivalent to the standards of the Model Water Efficient Landscape Ordinance set forth in Chapter 2.7 (commencing with Section 490) of Division 2 of Title 23 of the California Code of Regulations, as in effect the later of the year of the landscape's installation or 1992. An urban retail water supplier using the approach specified in this subparagraph shall use satellite imagery, site visits, or other best available technology to develop an accurate estimate of landscaped areas.

(C) For commercial, industrial, and institutional uses, a 10-percent reduction in water use from the baseline commercial, industrial, and institutional water use by 2020.

(3) Ninety-five percent of the applicable state hydrologic region target, as set forth in the state's draft 20x2020 Water Conservation Plan (dated April 30, 2009). If the service area of an urban water supplier includes more than one hydrologic region, the supplier shall apportion its service area to each region based on population or area.

(4) A method that shall be identified and developed by the department, through a public process, and reported to the Legislature no later than December 31, 2010. The method developed by the department shall identify per capita targets that cumulatively result in a statewide 20-percent reduction in urban daily per capita water use by December 31, 2020. In developing urban daily per capita water use targets, the department shall do all of the following:

(A) Consider climatic differences within the state.

(B) Consider population density differences within the state.

(C) Provide flexibility to communities and regions in meeting the targets.

(D) Consider different levels of per capita water use according to plant water needs in different regions.

(E) Consider different levels of commercial, industrial, and institutional water use in different regions of the state.

(F) Avoid placing an undue hardship on communities that have implemented conservation measures or taken actions to keep per capita water use low.

(c) If the department adopts a regulation pursuant to paragraph (4) of subdivision (b) that results in a requirement that an urban retail water supplier achieve a reduction in daily per capita water use that is greater than 20 percent by December 31, 2020, an urban retail water supplier that adopted the method

described in paragraph (4) of subdivision (b) may limit its urban water use target to a reduction of not more than 20 percent by December 31, 2020, by adopting the method described in paragraph (1) of subdivision (b).

(d) The department shall update the method described in paragraph (4) of subdivision (b) and report to the Legislature by December 31, 2014. An urban retail water supplier that adopted the method described in paragraph (4) of subdivision (b) may adopt a new urban daily per capita water use target pursuant to this updated method.

(e) An urban retail water supplier shall include in its urban water management plan due in 2010 pursuant to Part 2.6 (commencing with Section 10610) the baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data.

(f) When calculating per capita values for the purposes of this chapter, an urban retail water supplier shall determine population using federal, state, and local population reports and projections.

(g) An urban retail water supplier may update its 2020 urban water use target in its 2015 urban water management plan required pursuant to Part 2.6 (commencing with Section 10610).

(h) (1) The department, through a public process and in consultation with the California Urban Water Conservation Council, shall develop technical methodologies and criteria for the consistent implementation of this part, including, but not limited to, both of the following:

(A) Methodologies for calculating base daily per capita water use, baseline commercial, industrial, and institutional water use, compliance daily per capita water use, gross water use, service area population, indoor residential water use, and landscaped area water use.

(B) Criteria for adjustments pursuant to subdivisions (d) and (e) of Section 10608.24.

(2) The department shall post the methodologies and criteria developed pursuant to this subdivision on its Internet Web site, and make written copies available, by October 1, 2010. An urban retail water supplier shall use the methods developed by the department in compliance with this part.

(i) (1) The department shall adopt regulations for implementation of the provisions relating to process water in accordance with subdivision (l) of Section 10608.12, subdivision (e) of Section 10608.24, and subdivision (d) of Section 10608.26.

(2) The initial adoption of a regulation authorized by this subdivision is deemed to address an emergency, for purposes of Sections 11346.1 and 11349.6 of the Government Code, and the department is hereby exempted for that purpose from the requirements of subdivision (b) of Section 11346.1 of the

Government Code. After the initial adoption of an emergency regulation pursuant to this subdivision, the department shall not request approval from the Office of Administrative Law to readopt the regulation as an emergency regulation pursuant to Section 11346.1 of the Government Code.

(j) (1) An urban retail water supplier is granted an extension to July 1, 2011, for adoption of an urban water management plan pursuant to Part 2.6 (commencing with Section 10610) due in 2010 to allow the use of technical methodologies developed by the department pursuant to paragraph (4) of subdivision (b) and subdivision (h). An urban retail water supplier that adopts an urban water management plan due in 2010 that does not use the methodologies developed by the department pursuant to subdivision (h) shall amend the plan by July 1, 2011, to comply with this part.

(2) An urban wholesale water supplier whose urban water management plan prepared pursuant to Part 2.6 (commencing with Section 10610) was due and not submitted in 2010 is granted an extension to July 1, 2011, to permit coordination between an urban wholesale water supplier and urban retail water suppliers.

10608.22. Notwithstanding the method adopted by an urban retail water supplier pursuant to Section 10608.20, an urban retail water supplier's per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use as defined in paragraph(3) of subdivision (b) of Section 10608.12. This section does not apply to an urban retail water supplier with a base daily per capita water use at or below 100 gallons per capita per day.

10608.24.(a) Each urban retail water supplier shall meet its interim urban water use target by December 31, 2015.

(b) Each urban retail water supplier shall meet its urban water use target by December 31, 2020.

(c) An urban retail water supplier's compliance daily per capita water use shall be the measure of progress toward achievement of its urban water use target.

(d) (1) When determining compliance daily per capita water use, an urban retail water supplier may consider the following factors:

(A) Differences in evapotranspiration and rainfall in the baseline period compared to the compliance reporting period.
(B) Substantial changes to commercial or industrial water use resulting from increased business output and economic development that have occurred during the reporting period.

(C) Substantial changes to institutional water use resulting from fire suppression services or other extraordinary events, or from new or expanded operations, that have occurred during the reporting period.

(2) If the urban retail water supplier elects to adjust its estimate of compliance daily per capita water use due to one or more of the factors described in

paragraph (1), it shall provide the basis for, and data supporting, the adjustment in the report required by Section 10608.40.

(e) When developing the urban water use target pursuant to Section 10608.20, an urban retail water supplier that has a substantial percentage of industrial water use in its service area may exclude process water from the calculation of gross water use to avoid a disproportionate burden on another customer sector.

(f) (1) An urban retail water supplier that includes agricultural water use in an urban water management plan pursuant to Part 2.6 (commencing with Section 10610) may include the agricultural water use in determining gross water use. An urban retail water supplier that includes agricultural water use in determining gross water use and develops its urban water use target pursuant to paragraph (2) of subdivision (b) of Section 10608.20 shall use a water efficient standard for agricultural irrigation of 100 percent of reference evapotranspiration multiplied by the crop coefficient for irrigated acres.

(2) An urban retail water supplier, that is also an agricultural water supplier, is not subject to the requirements of Chapter 4 (commencing with Section 10608.48), if the agricultural water use is incorporated into its urban water use target pursuant to paragraph (1).

10608.26.(a) In complying with this part, an urban retail water supplier shall conduct at least one public hearing to accomplish all of the following:

(1) Allow community input regarding the urban retail water supplier's implementation plan for complying with this part.

(2) Consider the economic impacts of the urban retail water supplier's implementation plan for complying with this part.

(3) Adopt a method, pursuant to subdivision (b) of Section 10608.20, for determining its urban water use target.

(b) In complying with this part, an urban retail water supplier may meet its urban water use target through efficiency improvements in any combination among its customer sectors. An urban retail water supplier shall avoid placing a disproportionate burden on any customer sector.

(c) For an urban retail water supplier that supplies water to a United States Department of Defense military installation, the urban retail water supplier's implementation plan for complying with this part shall consider the conservation of that military installation under federal Executive Order 13514.

(d) (1) Any ordinance or resolution adopted by an urban retail water supplier after the effective date of this section shall not require existing customers as of the effective date of this section, to undertake changes in product formulation, operations, or equipment that would reduce process water use, but may provide technical assistance and financial incentives to those customers to implement efficiency measures for process water. This section shall not limit

an ordinance or resolution adopted pursuant to a declaration of drought emergency by an urban retail water supplier.

(2) This part shall not be construed or enforced so as to interfere with the requirements of Chapter 4 (commencing with Section 113980) to Chapter 13 (commencing with Section 114380), inclusive, of Part 7 of Division 104 of the Health and Safety Code, or any requirement or standard for the protection of public health, public safety, or worker safety established by federal, state, or local government or recommended by recognized standard setting organizations or trade associations.

10608.28.(a) An urban retail water supplier may meet its urban water use target within its retail service area, or through mutual agreement, by any of the following:

(1) Through an urban wholesale water supplier.

(2) Through a regional agency authorized to plan and implement water conservation, including, but not limited to, an agency established under the Bay Area Water Supply and Conservation Agency Act (Division 31 (commencing with Section 81300)).

(3) Through a regional water management group as defined in Section 10537.

(4) By an integrated regional water management funding area.

(5) By hydrologic region.

(6) Through other appropriate geographic scales for which computation methods have been developed by the department.

(b) A regional water management group, with the written consent of its member agencies, may undertake any or all planning, reporting, and implementation functions under this chapter for the member agencies that consent to those activities. Any data or reports shall provide information both for the regional water management group and separately for each consenting urban retail water supplier and urban wholesale water supplier.

10608.32. All costs incurred pursuant to this part by a water utility regulated by the Public Utilities Commission may be recoverable in rates subject to review and approval by the Public Utilities Commission, and may be recorded in a memorandum account and reviewed for reasonableness by the Public Utilities Commission.

10608.36. Urban wholesale water suppliers shall include in the urban water management plans required pursuant to Part 2.6 (commencing with Section 10610) an assessment of their present and proposed future measures, programs, and policies to help achieve the water use reductions required by this part.

10608.40. Urban water retail suppliers shall report to the department on their progress in meeting their urban water use targets as part of their urban water management plans

submitted pursuant to Section 10631. The data shall be reported using a standardized form developed pursuant to Section 10608.52.

10608.42.(a) The department shall review the 2015 urban water management plans and report to the Legislature by July 1, 2017, on progress towards achieving a 20-percent reduction in urban water use by December 31, 2020. The report shall include recommendations on changes to water efficiency standards or urban water use targets to achieve the 20-percent reduction and to reflect updated efficiency information and technology changes.

(b) A report to be submitted pursuant to subdivision (a) shall be submitted in compliance with Section 9795 of the Government Code.

10608.43. The department, in conjunction with the California Urban Water Conservation Council, by April 1, 2010, shall convene a representative task force consisting of academic experts, urban retail water suppliers, environmental organizations, commercial water users, industrial water users, and institutional water users to develop alternative best management practices for commercial, industrial, and institutional users and an assessment of the potential statewide water use efficiency improvement in the commercial, industrial, and institutional sectors that would result from implementation of these best management practices. The taskforce, in conjunction with the department, shall submit a report to the Legislature by April 1, 2012, that shall include a review of multiple sectors within commercial, industrial, and institutional users and that shall recommend water use efficiency standards for commercial, industrial, and institutional users among various sectors of water use. The report shall include, but not be limited to, the following:

(a) Appropriate metrics for evaluating commercial, industrial, and institutional water use.

(b) Evaluation of water demands for manufacturing processes, goods, and cooling.

(c) Evaluation of public infrastructure necessary for delivery of recycled water to the commercial, industrial, and institutional sectors.

(d) Evaluation of institutional and economic barriers to increased recycled water use within the commercial, industrial, and institutional sectors.

(e) Identification of technical feasibility and cost of the best management practices to achieve more efficient water use statewide in the commercial, industrial, and institutional sectors that is consistent with the public interest and reflects past investments in water use efficiency.

10608.44. Each state agency shall reduce water use at facilities it operates to support urban retail water suppliers in meeting the target identified in Section 10608.16.

# Chapter 4 Agricultural Water Suppliers

SECTION 10608.48

10608.48.(a) On or before July 31, 2012, an agricultural water supplier shall implement efficient water management practices pursuant to subdivisions (b) and (c).

(b) Agricultural water suppliers shall implement all of the following critical efficient management practices:

(1) Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2).

(2) Adopt a pricing structure for water customers based at least in part on quantity delivered.

(c) Agricultural water suppliers shall implement additional efficient management practices, including, but not limited to, practices to accomplish all of the following, if the measures are locally cost effective and technically feasible:

(1) Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.

(2) Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.

(3) Facilitate the financing of capital improvements for on-farm irrigation systems.

(4) Implement an incentive pricing structure that promotes one or more of the following goals:

(A) More efficient water use at the farm level.

(B) Conjunctive use of groundwater.

(C) Appropriate increase of groundwater recharge.

(D) Reduction in problem drainage.

(E) Improved management of environmental resources.

(F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.

(5) Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance, and reduce seepage.

(6) Increase flexibility in water ordering by, and delivery to, water customers within operational limits.

(7) Construct and operate supplier spill and tailwater recovery systems.

(8) Increase planned conjunctive use of surface water and groundwater within the supplier service area.

(9) Automate canal control structures.

(10) Facilitate or promote customer pump testing and evaluation.

(11) Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.

(12) Provide for the availability of water management services to water users. These services may include, but are not limited to, all of the following:

(A) On-farm irrigation and drainage system evaluations.

(B) Normal year and real-time irrigation scheduling and crop evapotranspiration information.

(C) Surface water, groundwater, and drainage water quantity and quality data.

(D) Agricultural water management educational programs and materials for farmers, staff, and the public.

(13) Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.

(14) Evaluate and improve the efficiencies of the supplier's pumps.

(d) Agricultural water suppliers shall include in the agricultural water management plans required pursuant to Part 2.8 (commencing with Section 10800) a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future. If an agricultural water supplier determines that an efficient water management practice is not locally cost effective or technically feasible, the supplier shall submit information documenting that determination.

(e) The data shall be reported using a standardized form developed pursuant to Section 10608.52.

(f) An agricultural water supplier may meet the requirements of subdivisions (d) and (e) by submitting to the department a water conservation plan submitted to the United States Bureau of Reclamation that meets the requirements described in Section 10828.

(g) On or before December 31, 2013, December 31, 2016, and December 31, 2021, the department, in consultation with the board, shall submit to the Legislature a report on the agricultural efficient water management practices that have been implemented and are planned to be implemented and an assessment of the manner in which the implementation of those efficient water management practices has affected and will affect agricultural operations, including estimated water use efficiency improvements, if any.

(h) The department may update the efficient water management practices required pursuant to subdivision (c), in consultation with the Agricultural Water Management Council, the United States Bureau of Reclamation, and the board. All efficient water management practices for agricultural water use pursuant to this chapter shall be adopted or revised by the department only after the department conducts public hearings to allow participation of the diverse geographical areas and interests of the state.

(i) (1) The department shall adopt regulations that provide for a range of options that agricultural water suppliers may use or implement to comply with the measurement requirement in paragraph (1) of subdivision (b).

(2) The initial adoption of a regulation authorized by this subdivision is deemed to address an emergency, for purposes of Sections 11346.1 and 11349.6 of the Government Code, and the department is hereby exempted for that purpose from the requirements of subdivision (b) of Section 11346.1 of the Government Code. After the initial adoption of an emergency regulation pursuant to this subdivision, the department shall not request approval from the Office of Administrative Law to readopt the regulation as an emergency regulation pursuant to Section 11346.1 of the Government Code.

## Chapter 5 Sustainable Water Management

Section 10608.50

10608.50.(a) The department, in consultation with the board, shall promote implementation of regional water resources management practices through increased incentives and removal of barriers consistent with state and federal law. Potential changes may include, but are not limited to, all of the following:

(1) Revisions to the requirements for urban and agricultural water management plans.

(2) Revisions to the requirements for integrated regional water management plans.

(3) Revisions to the eligibility for state water management grants and loans.

(4) Revisions to state or local permitting requirements that increase water supply opportunities, but do not weaken water quality protection under state and federal law.

(5) Increased funding for research, feasibility studies, and project construction.

(6) Expanding technical and educational support for local land use and water management agencies.

(b) No later than January 1, 2011, and updated as part of the California Water Plan, the department, in consultation with the board, and with public input, shall propose new statewide targets, or review and update existing statewide targets, for regional water resources management practices, including, but not limited to, recycled water, brackish groundwater desalination, and infiltration and direct use of urban stormwater runoff.

## Chapter 6 Standardized Data Collection

SECTION 10608.52

10608.52.(a) The department, in consultation with the board, the California Bay-Delta Authority or its successor agency, the State Department of Public Health, and the Public Utilities Commission, shall develop a single standardized water use reporting form to meet the water use information needs of each agency, including the needs of urban water suppliers that elect to determine and report progress toward achieving targets on a regional basis as provided in subdivision (a) of Section 10608.28.

(b) At a minimum, the form shall be developed to accommodate information sufficient to assess an urban water supplier's compliance with conservation targets pursuant to Section 10608.24 and an agricultural water supplier's compliance with implementation of efficient water management practices pursuant to subdivision (a) of Section 10608.48. The form shall accommodate reporting by urban water suppliers on an individual or regional basis as provided in subdivision (a) of Section 10608.28.

## Chapter 7 Funding Provisions

Section 10608.56-10608.60

10608.56.(a) On and after July 1, 2016, an urban retail water supplier is not eligible for a water grant or loan awarded or administered by the state unless the supplier complies with this part.

(b) On and after July 1, 2013, an agricultural water supplier is not eligible for a water grant or loan awarded or administered by the state unless the supplier complies with this part.

(c) Notwithstanding subdivision (a), the department shall determine that an urban retail water supplier is eligible for a water grant or loan even though the supplier has not met the per capita reductions required pursuant to Section 10608.24, if the urban retail water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for achieving the per capita reductions. The supplier may request grant or loan funds to achieve the per capita reductions to the extent the request is consistent with the eligibility requirements applicable to the water funds.

(d) Notwithstanding subdivision (b), the department shall determine that an agricultural water supplier is eligible for a water grant or loan even though the supplier is not implementing all of the efficient water management practices described in Section 10608.48, if the agricultural water supplier has submitted to the department for approval a schedule, financing plan, and budget, to be included in the grant or loan agreement, for implementation of the efficient water management practices. The supplier may request grant or loan funds to implement the efficient water management practices to the extent the request is consistent with the eligibility requirements applicable to the water funds.

(e) Notwithstanding subdivision (a), the department shall determine that an urban retail water supplier is eligible for a water grant or loan even though the supplier has not met the per capita reductions required pursuant to Section 10608.24, if the urban retail water supplier has submitted to the department for approval documentation demonstrating that its entire service area qualifies as a disadvantaged community.

(f) The department shall not deny eligibility to an urban retail water supplier or agricultural water supplier in compliance with the requirements of this part and Part 2.8 (commencing with Section 10800), that is participating in a multiagency water project, or an integrated regional water management plan, developed pursuant to Section 75026 of the Public Resources Code, solely on the basis that one or more of the agencies participating in the project or plan is not implementing all of the requirements of this part or Part 2.8 (commencing with Section 10800).

10608.60.(a) It is the intent of the Legislature that funds made available by Section 75026 of the Public Resources Code should be expended, consistent with Division 43 (commencing with Section 75001) of the Public Resources Code and upon appropriation by the Legislature, for grants to implement this part. In the allocation of funding, it is the intent of the Legislature that the department give consideration to disadvantaged communities to assist in implementing the requirements of this part.

(b) It is the intent of the Legislature that funds made available by Section 75041 of the Public Resources Code, should be expended, consistent with Division 43 (commencing with Section 75001) of the Public Resources Code and upon appropriation by the Legislature, for direct expenditures to implement this part.

# Chapter 8 Quantifying Agricultural Water Use Efficiency

SECTION 10608.64

10608.64. The department, in consultation with the Agricultural Water Management Council, academic experts, and other stakeholders, shall develop a methodology for quantifying the efficiency of agricultural water use. Alternatives to be assessed shall include, but not be limited to, determination of efficiency levels based on crop type or irrigation system distribution uniformity. On or before December 31, 2011, the department shall report to the Legislature on a proposed methodology and a plan for implementation. The plan shall include the estimated implementation costs and the types of data needed to support the methodology. Nothing in this section authorizes the department to implement a methodology established pursuant to this section.

# Appendix C:
# Department of Water Resources
# 2015 Urban Water Management Plan
# Checklist

# Department of Water Resources
# 2015 Urban Water Management Plan
# Checklist

### Arranged by Subject

| CWC Section | UWMP Requirement | Subject | Guidebook Location | UWMP Location |
|---|---|---|---|---|
| **10620(b)** | Every person that becomes an urban water supplier shall adopt an urban water management plan within one year after it has become an urban water supplier. | Plan Preparation | Section 2.1 | **Section 1.2.1** |
| **10620(d)(2)** | Coordinate the preparation of its plan with other appropriate agencies in the area, including other water suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable. | Plan Preparation | Section 2.5.2 | **Section 1.2.2, Table 1-1** |
| **10642** | Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan. | Plan Preparation | Section 2.5.2 | **Section 1.2.2, Appendix F** |
| **10631(a)** | Describe the water supplier service area. | System Description | Section 3.1 | **Section 2.2** |
| **10631(a)** | Describe the climate of the service area of the supplier. | System Description | Section 3.3 | **Section 2.2.2, Table 2-1** |
| **10631(a)** | Provide population projections for 2020, 2025, 2030, and 2035. | System Description | Section 3.4 | **Section 2.2.3, Table 2-2** |
| **10631(a)** | Describe other demographic factors affecting the supplier's water management planning. | System Description | Section 3.4 | **Section 2.2.3, Section 2.2.4** |
| **10631(a)** | Indicate the current population of the service area. | System Description and Baselines and Targets | Sections 3.4 and 5.4 | **Section 2.2.3, Table 2-2** |
| **10631(e)(1)** | Quantify past, current, and projected water use, identifying the uses among water use sectors. | System Water Use | Section 4.2 | **Section 3.3, Table 3-2** |
| **10631(e)(3)(A)** | Report the distribution system water loss for the most recent 12-month period available. | System Water Use | Section 4.3 | **Section 3.4, Table 3-1** |
| **10631.1(a)** | Include projected water use needed for lower income housing projected in the service area of the supplier. | System Water Use | Section 4.5 | **Section 3.5, Table 3-2** |
| **10608.20(b)** | Retail suppliers shall adopt a 2020 water use target using one of four methods. | Baselines and Targets | Section 5.7 and App E | **Section 3.6, Section 3.6.2, Appendix F** |

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| **10608.20(e)** | Retail suppliers shall provide baseline daily per capita water use, urban water use target, interim urban water use target, and compliance daily per capita water use, along with the bases for determining those estimates, including references to supporting data. | Baselines and Targets | Chapter 5 and App E | **Section 3.6.1, Section 3.6.2, Table 3-3, Table 3-4** |
| **10608.22** | Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100. | Baselines and Targets | Section 5.7.2 | **Section 3.6.2, Table 3-5** |
| **10608.24(a)** | Retail suppliers shall meet their interim target by December 31, 2015. | Baselines and Targets | Section 5.8 and App E | **Section 3.6.3, Table 3-6** |
| **10608.24(d)(2)** | If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment. | Baselines and Targets | Section 5.8.2 | **N/A** |
| **10608.36** | Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions. | Baselines and Targets | Section 5.1 | **Section 3.6.4** |
| **10608.40** | Retail suppliers shall report on their progress in meeting their water use targets. The data shall be reported using a standardized form. | Baselines and Targets | Section 5.8 and App E | **Section 3.6.3, Appendix D** |
| **10631(b)** | Identify and quantify the existing and planned sources of water available for 2015, 2020, 2025, 2030, and 2035. | System Supplies | Chapter 6 | **Section 4.1, Table 4-1** |
| **10631(b)** | Indicate whether groundwater is an existing or planned source of water available to the supplier. | System Supplies | Section 6.2 | **Section 4.2** |
| **10631(b)(1)** | Indicate whether a groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization. | System Supplies | Section 6.2.2 | **Section 4.2.2, Appendix K** |
| **10631(b)(2)** | Describe the groundwater basin. | System Supplies | Section 6.2.1 | **Section 4.2.1** |
| **10631(b)(2)** | Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump. | System Supplies | Section 6.2.2 | **Section 4.2.2, Table 4-3, Appendix K** |
| **10631(b)(2)** | For unadjudicated basins, indicate whether or not the department has identified the basin as overdrafted, or projected to become overdrafted. Describe efforts by the supplier to eliminate the long-term overdraft condition. | System Supplies | Section 6.2.3 | **N/A** |

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| **10631(b)(3)** | Provide a detailed description and analysis of the location, amount, and sufficiency of groundwater pumped by the urban water supplier for the past five years | System Supplies | Section 6.2.4 | **Section 4.2.2, Table 4-4** |
| **10631(b)(4)** | Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped. | System Supplies | Sections 6.2 and 6.9 | **Section 4.2.2, Table 4-1** |
| **10631(d)** | Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis. | System Supplies | Section 6.7 | **Section 4.6.4** |
| **10631(g)** | Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and multiple-dry years. | System Supplies | Section 6.8 | **Section 4.6** |
| **10631(h)** | Describe desalinated water project opportunities for long-term supply. | System Supplies | Section 6.6 | **Section 4.6.6** |
| **10631(j)** | Retail suppliers will include documentation that they have provided their wholesale supplier(s) – if any - with water use projections from that source. | System Supplies | Section 2.5.1 | **Section 1.2.2, Appendix F** |
| **10631(j)** | Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types. | System Supplies | Section 2.5.1 | **Section 1.2.2, Appendix F** |
| **10633** | For wastewater and recycled water, coordinate with local water, wastewater, groundwater, and planning agencies that operate within the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.1 | **Section 1.2.2, Appendix F** |
| **10633(a)** | Describe the wastewater collection and treatment systems in the supplier's service area. Include quantification of the amount of wastewater collected and treated and the methods of wastewater disposal. | System Supplies (Recycled Water) | Section 6.5.2 | **Section 4.5.1, Table 4-5, Appendix M** |
| **10633(b)** | Describe the quantity of treated wastewater that meets recycled water standards, is being discharged, and is otherwise available for use in a recycled water project. | System Supplies (Recycled Water) | Section 6.5.2.2 | **Section 4.5.1, Section 4.5.2, Section 4.5.3, Section 4.6.5, Table 4-8, Appendix M** |
| **10633(c)** | Describe the recycled water currently being used in the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.3 and 6.5.4 | **Section 4.5.3, Table 4-7** |
| **10633(d)** | Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses. | System Supplies (Recycled Water) | Section 6.5.4 | **Section 4.5.2, Section 4.6.5, Table 4-7, Appendix M** |

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| **10633(e)** | Describe the projected use of recycled water within the supplier's service area at the end of 5, 10, 15, and 20 years, and a description of the actual use of recycled water in comparison to uses previously projected. | System Supplies (Recycled Water) | Section 6.5.4 | **Section 4.5.3, Table 4-6, Table 4-7** |
| **10633(f)** | Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year. | System Supplies (Recycled Water) | Section 6.5.5 | **Section 4.6.5, Appendix M** |
| **10633(g)** | Provide a plan for optimizing the use of recycled water in the supplier's service area. | System Supplies (Recycled Water) | Section 6.5.5 | **Section 4.6.5, Appendix M** |
| **10620(f)** | Describe water management tools and options to maximize resources and minimize the need to import water from other regions. | Water Supply Reliability Assessment | Section 7.4 | **Section 4.1, Section 5.1** |
| **10631(c)(1)** | Describe the reliability of the water supply and vulnerability to seasonal or climatic shortage. | Water Supply Reliability Assessment | Section 7.1 | **Section 5.1, Section 5.1.1, Section 5.1.2, Section 5.1.3, Section 5.1.4, Section 5.3** |
| **10631(c)(1)** | Provide data for an average water year, a single dry water year, and multiple dry water years | Water Supply Reliability Assessment | Section 7.2 | **Section 5.3, Section 5.3.1, Table 5-1, Table 5-2** |
| **10631(c)(2)** | For any water source that may not be available at a consistent level of use, describe plans to supplement or replace that source. | Water Supply Reliability Assessment | Section 7.1 | **N/A** |
| **10634** | Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability | Water Supply Reliability Assessment | Section 7.1 | **Section 5.2, Section 5.2.1, Section 5.2.2, Section 5.2.3, Section 5.2.4, Section 5.2.5** |
| **10635(a)** | Assess the water supply reliability during normal, dry, and multiple dry water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years. | Water Supply Reliability Assessment | Section 7.3 | **Section 5.4, Table 5-3, Table 5-4, Table 5-5** |
| **10632(a) and 10632(a)(1)** | Provide an urban water shortage contingency analysis that specifies stages of action and an outline of specific water supply conditions at each stage. | Water Shortage Contingency Planning | Section 8.1 | **Section 7, Section 7.1, Section 7.2, Table 7-1, Appendix P** |
| **10632(a)(2)** | Provide an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historic sequence for the agency. | Water Shortage Contingency Planning | Section 8.9 | **Section 7.4, Table 7-3** |

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| **10632(a)(3)** | Identify actions to be undertaken by the urban water supplier in case of a catastrophic interruption of water supplies. | Water Shortage Contingency Planning | Section 8.8 | **Section 7.5, Section 7.5.1, Appendix P** |
| **10632(a)(4)** | Identify mandatory prohibitions against specific water use practices during water shortages. | Water Shortage Contingency Planning | Section 8.2 | **Section 7.2, Section 7.6, Table 7-2, Appendix P** |
| **10632(a)(5)** | Specify consumption reduction methods in the most restrictive stages. | Water Shortage Contingency Planning | Section 8.4 | **Section 7.2, Section 7.6, Table 7-2, Appendix P** |
| **10632(a)(6)** | Indicated penalties or charges for excessive use, where applicable. | Water Shortage Contingency Planning | Section 8.3 | **Section 7.6, Table 7-5, Appendix P** |
| **10632(a)(7)** | Provide an analysis of the impacts of each of the actions and conditions in the water shortage contingency analysis on the revenues and expenditures of the urban water supplier, and proposed measures to overcome those impacts. | Water Shortage Contingency Planning | Section 8.6 | **Section 7.6.1** |
| **10632(a)(8)** | Provide a draft water shortage contingency resolution or ordinance. | Water Shortage Contingency Planning | Section 8.7 | **Section 7.1, Appendix P** |
| **10632(a)(9)** | Indicate a mechanism for determining actual reductions in water use pursuant to the water shortage contingency analysis. | Water Shortage Contingency Planning | Section 8.5 | **Section 7.7** |
| **10631(f)(1)** | Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will address specific measures listed in code. | Demand Management Measures | Sections 9.2 and 9.3 | **See 10631(i)** |
| **10631(f)(2)** | Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program. | Demand Management Measures | Sections 9.1 and 9.3 | **See 10631(i)** |
| **10631(i)** | CUWCC members may submit their 2013-2014 CUWCC BMP annual reports in lieu of, or in addition to, describing the DMM implementation in their UWMPs. This option is only allowable if the supplier has been found to be in full compliance with the CUWCC MOU. | Demand Management Measures | Section 9.5 | **Section 6.2, Appendix N** |
| **10608.26(a)** | Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets. | Plan Adoption, Submittal, and Implementation | Section 10.3 | **Section 1.2.1, Appendix F** |

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| **10621(b)** | Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. | Plan Adoption, Submittal, and Implementation | Section 10.2.1 | **Section 1.2.2, Appendix F** |
| **10621(d)** | Each urban water supplier shall update and submit its 2015 plan to the department by July 1, 2016. | Plan Adoption, Submittal, and Implementation | Sections 10.3.1 and 10.4 | **Section 1.2.1** |
| **10635(b)** | Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 60 days after the submission of the plan to DWR. | Plan Adoption, Submittal, and Implementation | Section 10.4.4 | **Section 1.2.2, Appendix F** |
| **10642** | Provide supporting documentation that the urban water supplier made the plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan. | Plan Adoption, Submittal, and Implementation | Sections 10.2.2, 10.3, and 10.5 | **Section 1.2.1, Section 1.2.2, Appendix F** |
| **10642** | The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water. | Plan Adoption, Submittal, and Implementation | Sections 10.2.1 | **Section 1.2.2, Appendix F** |
| **10642** | Provide supporting documentation that the plan has been adopted as prepared or modified. | Plan Adoption, Submittal, and Implementation | Section 10.3.1 | **Section 1.2.1, Appendix F** |
| **10644(a)** | Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library. | Plan Adoption, Submittal, and Implementation | Section 10.4.3 | **Section 1.2.1, Appendix F** |
| **10644(a)(1)** | Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption. | Plan Adoption, Submittal, and Implementation | Section 10.4.4 | **Section 1.2.2, Appendix F** |
| **10644(a)(2)** | The plan, or amendments to the plan, submitted to the department shall be submitted electronically. | Plan Adoption, Submittal, and Implementation | Sections 10.4.1 and 10.4.2 | **Section 1.2.1, Appendix F** |
| **10645** | Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours. | Plan Adoption, Submittal, and Implementation | Section 10.5 | **Section 1.2.1, Appendix F** |

# Appendix D:
# Department of Water Resources
# 2015 Urban Water Management Plan
# and SBX 7-7
# Standardized Tables

| Table 2-1 Retail Only: Public Water Systems | | | |
|---|---|---|---|
| Public Water System Number | Public Water System Name | Number of Municipal Connections 2015 | Volume of Water Supplied 2015 |
| 3610029 | Monte Vista Water District | 11,975 | 9,110 |
| | **TOTAL** | 11,975 | 9,110 |
| NOTES: Number of active connections ("...directly provides potable municipal water to more than 3,000 end users..." CWC 10608.12). See District 2015 UWMP Section 1.1, Table 4-1. | | | |

| Table 2-2: Plan Identification | | | |
|---|---|---|---|
| **Select Only One** | **Type of Plan** | | **Name of RUWMP or Regional Alliance** *if applicable* *drop down list* |
| ☑ | **Individual UWMP** | | |
| | ☐ | Water Supplier is also a member of a RUWMP | |
| | ☑ | Water Supplier is also a member of a Regional Alliance | Inland Empire Utilities Agency Alliance |
| ☐ | **Regional Urban Water Management Plan (RUWMP)** | | |
| NOTES: See District 2015 UWMP Section 1.2.3. | | | |

| Table 2-3: Agency Identification | |
|---|---|
| Type of Agency (select one or both) | |
| | Agency is a wholesaler |
| | Agency is a retailer |
| Fiscal or Calendar Year (select one) | |
| | UWMP Tables Are in Calendar Years |
| | UWMP Tables Are in Fiscal Years |
| If Using Fiscal Years Provide Month and Date that the Fiscal Year Begins (mm/dd) | |
| *7/1* | |
| Units of Measure Used in UWMP (select from Drop down) | |
| Unit | AF |
| NOTES: See District 2015 UWMP Sections 1.1, 2.1. | |

| Table 2-4 Retail: Water Supplier Information Exchange |
|---|
| The retail supplier has informed the following wholesale supplier(s) of projected water use in accordance with CWC 10631. |
| Wholesale Water Supplier Name *(Add additional rows as needed)* |
| Water Facilities Authority |
| San Antonio Water Company |
| Inland Empire Utilities Agency |
| NOTES: See District 2015 UWMP Section 4.1. |

| Table 2-4 Wholesale: Water Supplier Information Exchange (select one) | |
|---|---|
| ☐ | Supplier has informed more than 10 other water suppliers of water supplies available in accordance with CWC 10631. Completion of the table below is optional. If not completed include a list of the water suppliers that were informed. |
| | **Provide page number for location of the list.** |
| ☑ | Supplier has informed 10 or fewer other water suppliers of water supplies available in accordance with CWC 10631. **Complete the table below.** |
| Water Supplier Name *(Add additional rows as needed)* | |
| City of Chino Hills | |
| NOTES: Available water supplies per long-term water supply agreement that provides up to 20.22 million gallons of water per day to the City. See District 2015 UWMP Section 3.3, Table 3-2. | |

| Table 3-1 Retail: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| | 55,581 | 59,007 | 60,660 | 62,309 | 63,954 | 65,649 |
| NOTES: Based on city growth estimates, known development in the service area since 2010, and data from California Department of Finance and Southern California Association of Governments. See District 2015 UWMP Section 2.2.3, Table 2-2, Appendix F. | | | | | | |

| Table 3-1 Wholesale: Population - Current and Projected | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| | 77,596 | 89,314 | 91,137 | 92,997 | 94,895 | |
| NOTES: Provided by City of Chino Hills. See District 2015 UWMP Section 2.2.3, Table 2-2. | | | | | | |

| Table 4-1 Retail: Demands for Potable and Raw Water - Actual | | | |
|---|---|---|---|
| Use Type *(Add additional rows as needed)* | 2015 Actual | | |
| ***Drop down list*** *May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool* | Additional Description *(as needed)* | Level of Treatment When Delivered *Drop down list* | Volume |
| Single Family | | Drinking Water | 4,521 |
| Multi-Family | | Drinking Water | 1,380 |
| Commercial | | Drinking Water | 1,543 |
| Institutional/Governmental | | Drinking Water | 265 |
| Industrial | | Drinking Water | 31 |
| Landscape | | Drinking Water | 712 |
| Agricultural irrigation | | Drinking Water | 50 |
| Other | Hydrant and fire service meters | Drinking Water | 28 |
| Other | Unbilled Metered | Drinking Water | 73 |
| Other | Unbilled Unmetered | Drinking Water | 7 |
| Losses | Apparent and Real Losses | Drinking Water | 497 |
| Groundwater recharge | Injection Wells | Drinking Water | 1 |
| | | **TOTAL** | 9,110 |
| NOTES: Unbilled uses and losses based on AWWA audit as presented in Table 4-4. See District 2015 UWMP Section 3.3, Table 3-2. | | | |

| Table 4-1 Wholesale: Demands for Potable and Raw Water - Actual | | | |
|---|---|---|---|
| Use Type *(Add additional rows as needed)* | 2015 Actual | | |
| ***Drop down list*** *May select each use multiple times These are the only use types that will be recognized by the WUE data online submittal tool* | Additional Description *(as needed)* | Level of Treatment When Delivered *Drop down list* | Volume |
| Sales to other agencies | City of Chino Hills | Drinking Water | 6,933 |
| | | **TOTAL** | 6,933 |
| NOTES: Includes direct delivery of City of Chino Hills's Water Facilities Authority entitlement through District transmission system. See District 2015 UWMP Section 3.3, Table 3-2. | | | |

**Table 4-2 Retail: Demands for Potable and Raw Water - Projected**

| Use Type *(Add additional rows as needed)*<br>***Drop down list***<br>*May select each use multiple times*<br>*These are the only Use Types that will be recognized by the WUEdata online submittal tool* | Additional Description *(as needed)* | Projected Water Use *Report To the Extent that Records are Available* | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040-opt |
| Single Family | | 5,079 | 5,187 | 5,447 | 5,574 | 5,739 |
| Multi-Family | | 2,116 | 2,209 | 2,236 | 2,270 | 2,334 |
| Commercial | | 1,414 | 1,425 | 1,437 | 1,490 | 1,517 |
| Institutional/Governmental | | 309 | 311 | 315 | 336 | 338 |
| Industrial | | 338 | 340 | 344 | 361 | 364 |
| Landscape | | 1,067 | 1,080 | 1,093 | 1,129 | 1,143 |
| Agricultural irrigation | | 58 | 51 | 16 | 10 | 0 |
| Other | Hydrant and Fire Service | 30 | 30 | 30 | 30 | 30 |
| Other | Unbilled Metered Uses | 175 | 175 | 175 | 175 | 175 |
| Other | Unbilled Unmetered Uses | 8 | 8 | 8 | 8 | 8 |
| Losses | Apparent and Real Losses | 525 | 541 | 560 | 579 | 597 |
| Groundwater recharge | Injection Wells | 400 | 400 | 400 | 400 | 400 |
| | **TOTAL** | 11,519 | 11,756 | 12,060 | 12,361 | 12,645 |

NOTES: First seven categories based on IEUA Land Use Based Demand Model, 2015; see Appendix G for technical memorandum. Water loss and unbilled metered and unmetered uses subtracted out of total demand factor per customer use category. Single-family residential demands include very low, low, and medium (40 percent) model projected residential demands; multi-family residential demands include medium (60 percent) and high density model projected residential demands. Projected landscape demands include all park and school yard landscape demands, some of which are metered under institutional/governmental. All other categories described in footnotes for Table 3-2 in body of report. See District 2015 UWMP Section 3.3, Table 3-2.

**Table 4-2 Wholesale: Demands for Potable and Raw Water - Projected**

| Use Type *(Add additional rows as needed)*<br>***Drop down list***<br>*May select each use multiple times*<br>*These are the only Use Types that will be recognized by the WUEdata online submittal tool.* | Additional Description *(as needed)* | Projected Water Use *Report To the Extent that Records are Available* | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| Sales to other agencies | City of Chino Hills | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | **TOTAL** | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |

NOTES: Full contractual obligation (20.22 mgd). See District 2015 UWMP Section 3.3, Table 3-2.

| Table 4-3 Retail: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
| Potable and Raw Water *From Tables 4-1 and 4-2* | 9,110 | 11,519 | 11,756 | 12,060 | 12,361 | 12,645 |
| Recycled Water Demand* *From Table 6-4* | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |
| **TOTAL WATER DEMAND** | 9,901 | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| **Recycled water demand fields will be blank until Table 6-4 is complete.* | | | | | | |
| NOTES: See District 2015 UWMP Section 3.3, Table 3-2. | | | | | | |

| Table 4-3 Wholesale: Total Water Demands | | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040*(opt)* |
| Potable and Raw Water *From Tables 4-1 and 4-2* | 6,933 | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Recycled Water Demand* *From Table 6-4* | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL WATER DEMAND** | 6,933 | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| **Recycled water demand fields will be blank until Table 6-4 is complete.* | | | | | | |
| NOTES: See District 2015 UWMP Section 3.3, Table 3-2. | | | | | | |

| Table 4-4 Retail: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss* |
| 07/2014 | 497 |
| ** Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* | |
| NOTES: See District 2015 UWMP Section 3.4, Table 3-1. | |

| Table 4-4 Wholesale: 12 Month Water Loss Audit Reporting | |
|---|---|
| Reporting Period Start Date (mm/yyyy) | Volume of Water Loss* |
| 07/2016 | 0 |
| ** Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.* | |
| NOTES: District tracks retail and wholesale water loss collectively due to integrated system; see Table 4-4 R. | |

| Table 4-5 Retail Only: Inclusion in Water Use Projections | |
|---|---|
| Are Future Water Savings Included in Projections?<br>(Refer to Appendix K of UWMP Guidebook)<br>*Drop down list (y/n)* | No |
| If "Yes" to above, state the section or page number, in the cell to the right, where citations of the codes, ordinances, etc... utilized in demand projections are found. | |
| Are Lower Income Residential Demands Included In Projections?<br>*Drop down list (y/n)* | Yes |
| NOTES: See District 2015 UWMP Section 3.5, Appendix G. | |

**Table 5-1 Baselines and Targets Summary**
*Retail Agency or Regional Alliance Only*

| Baseline Period | Start Year | End Year | Average Baseline GPCD* | 2015 Interim Target * | Confirmed 2020 Target* |
|---|---|---|---|---|---|
| 10-15 year | *1996* | *2005* | *209* | *188* | *167* |
| 5 Year | *2003* | *2007* | *202* | | |

*All values are in Gallons per Capita per Day (GPCD)

NOTES: See District 2015 UWMP Section 3.6 inclusive, Tables 3-3 and 3-4.

**Table 5-2: 2015 Compliance**
*Retail Agency or Regional Alliance Only*

| Actual 2015 GPCD* | 2015 Interim Target GPCD* | Optional Adjustments to 2015 GPCD<br>Enter "0" if no adjustment is made<br>*From Methodology 8* | | | | | 2015 GPCD* *(Adjusted if applicable)* | Did Supplier Achieve Targeted Reduction for 2015? Y/N |
|---|---|---|---|---|---|---|---|---|
| | | Extraordinary Events* | Economic Adjustment* | Weather Normalization* | TOTAL Adjustments* | Adjusted 2015 GPCD* | | |
| 137 | 188 | 0 | 0 | 0 | 0 | 137 | 137 | Yes |

*All values are in Gallons per Capita per Day (GPCD)*

NOTES: See District 2015 UWMP Section 3.6.3, Table 3-6.

| Table 6-1 Retail: Groundwater Volume Pumped | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | Supplier does not pump groundwater. The supplier will not complete the table below. | | | | | |
| Groundwater Type *Drop Down List May use each category multiple times* | Location or Basin Name | 2011 | 2012 | 2013 | 2014 | 2015 |
| *Add additional rows as needed* | | | | | | |
| Alluvial Basin | Chino Groundwater Basin | 9,301 | 6,944 | 6,897 | 7,163 | 5,943 |
| | **TOTAL** | 9,301 | 6,944 | 6,897 | 7,163 | 5,943 |
| NOTES: See District 2015 UWMP Section 4.2, Table 4-4. | | | | | | |

| Table 6-1 Wholesale: Groundwater Volume Pumped | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | Supplier does not pump groundwater. The supplier will not complete the table below. | | | | | |
| Groundwater Type *Drop Down List May use each category multiple times* | Location or Basin Name | 2011 | 2012 | 2013 | 2014 | 2015 |
| Alluvial Basin | Chino Groundwater Basin | 2,732 | 3,594 | 3,428 | 5,359 | 2,462 |
| | **TOTAL** | 2,732 | 3,594 | 3,428 | 5,359 | 2,462 |
| NOTES: See District 2015 UWMP Section 4.2, Table 4-4. | | | | | | |

| Table 6-2 Retail: Wastewater Collected Within Service Area in 2015 | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | There is no wastewater collection system. The supplier will not complete the table below. | | | | | |
| | Percentage of 2015 service area covered by wastewater collection system *(optional)* | | | | | |
| | Percentage of 2015 service area population covered by wastewater collection system *(optional)* | | | | | |
| **Wastewater Collection** | | | **Recipient of Collected Wastewater** | | | |
| Name of Wastewater Collection Agency | Wastewater Volume Metered or Estimated? *Drop Down List* | Volume of Wastewater Collected from UWMP Service Area 2015 | Name of Wastewater Treatment Agency Receiving Collected Wastewater | Treatment Plant Name | Is WWTP Located Within UWMP Area? *Drop Down List* | Is WWTP Operation Contracted to a Third Party? *(optional)* *Drop Down List* |
| *Add additional rows as needed* | | | | | | |
| City of Montclair | Estimated | 2,464 | Inland Empire Utilities Agency | RP-1/RP-4 | No | No |
| **Total Wastewater Collected from Service Area in 2015:** | | 2,464 | | | | |
| NOTES: Estimate based on Montclair's percentage of total IEUA wastewater flows. See District 2015 UWMP Section 4.5.1, Table 4-5. | | | | | | |

**Table 6-3 Retail: Wastewater Treatment and Discharge Within Service Area in 2015**

☑ No wastewater is treated or disposed of within the UWMP service area.
The supplier will not complete the table below.

| Wastewater Treatment Plant Name | Discharge Location Name or Identifier | Discharge Location Description | Wastewater Discharge ID Number *(optional)* | Method of Disposal *Drop down list* | Does This Plant Treat Wastewater Generated Outside the Service Area? | Treatment Level *Drop down list* | 2015 volumes | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wastewater Treated | Discharged Treated Wastewater | Recycled Within Service Area | Recycled Outside of Service Area |
| *Add additional rows as needed* | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | **Total** | 0 | 0 | 0 | 0 |

NOTES:

**Table 6-3 Wholesale: Wastewater Treatment and Discharge Within Service Area in 2015**

☑ Wholesale supplier neither distributes nor provides supplemental treatment to recycled water.
The supplier will not complete the table below.

| Wastewater Treatment Plant Name | Discharge Location Name or Identifier | Discharge Location Description | Wastewater Discharge ID Number *(optional)* | Method of Disposal *Drop down list* | Does This Plant Treat Wastewater Generated Outside the Service Area? | Treatment Level *Drop down list* | 2015 volumes | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wastewater Treated | Discharged Treated Wastewater | Recycled Within Service Area | Recycled Outside of Service Area |
| *Add additional rows as needed* | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | **Total** | 0 | 0 | 0 | 0 |

NOTES:

**Table 6-4 Retail: Current and Projected Recycled Water Direct Beneficial Uses Within Service Area**

☐ Recycled water is not used and is not planned for use within the service area of the supplier. The supplier will not complete the table below.

| | |
|---|---|
| Name of Agency Producing (Treating) the Recycled Water: | Inland Empire Utilities Agency |
| Name of Agency Operating the Recycled Water Distribution System: | Monte Vista Water District |
| Supplemental Water Added in 2015 | N/A |
| Source of 2015 Supplemental Water | N/A |

| Beneficial Use Type | General Description of 2015 Uses | Level of Treatment *Drop down list* | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 (opt) |
|---|---|---|---|---|---|---|---|---|
| Agricultural irrigation | | | | | | | | |
| Landscape irrigation (excludes golf courses) | Parks, school yards, other sites | Tertiary | 308 | 430 | 430 | 430 | 430 | 430 |
| Golf course irrigation | | | | | | | | |
| Commercial use | | | | | | | | |
| Industrial use | | | | | | | | |
| Geothermal and other energy production | | | | | | | | |
| Seawater intrusion barrier | | | | | | | | |
| Recreational impoundment | | | | | | | | |
| Wetlands or wildlife habitat | | | | | | | | |
| Groundwater recharge (IPR)* | Share of regional program | Tertiary | 483 | 601 | 560 | 589 | 639 | 639 |
| Surface water augmentation (IPR)* | | | | | | | | |
| Direct potable reuse | | | | | | | | |
| Other *(Provide General Description)* | | | | | | | | |
| | | **Total:** | 791 | 1,031 | 990 | 1,019 | 1,069 | 1,069 |

**IPR - Indirect Potable Reuse*

NOTES: See District 2015 UWMP Section 4.5.3, Table 4-7.

**Table 6-4 Wholesale: Current and Projected Retailers Provided Recycled Water Within Service Area**

☑ Recycled water is not directly treated or distributed by the supplier. The supplier will not complete the table below.

| Name of Receiving Supplier or Direct Use by Wholesaler | Level of Treatment *Drop down list* | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 *(opt)* |
|---|---|---|---|---|---|---|---|
| *Add additional rows as needed* | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | **Total** | 0 | 0 | 0 | 0 | 0 | 0 |

NOTES:

| Table 6-5 Retail: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual | | | |
|---|---|---|---|
| ☐ | Recycled water was not used in 2010 nor projected for use in 2015.<br>The supplier will not complete the table below. | | |
| **Use Type** | | **2010 Projection for 2015** | **2015 Actual Use** |
| Agricultural irrigation | | | |
| Landscape irrigation (excludes golf courses) | | 430 | 308 |
| Golf course irrigation | | | |
| Commercial use | | | |
| Industrial use | | | |
| Geothermal and other energy production | | | |
| Seawater intrusion barrier | | | |
| Recreational impoundment | | | |
| Wetlands or wildlife habitat | | | |
| Groundwater recharge (IPR) | | 876 | 483 |
| Surface water augmentation (IPR) | | | |
| Direct potable reuse | | | |
| Other | *Type of Use* | | |
| | **Total** | 1,306 | 791 |
| NOTES: See District 2015 UWMP Section 4.5.2, Table 4-6. | | | |

| Table 6-5 Wholesale: 2010 UWMP Recycled Water Use Projection Compared to 2015 Actual | | |
|---|---|---|
| ☑ | Recycled water was not used or distributed by the supplier in 2010, nor projected for use or distribution in 2015.<br>The wholesale supplier will not complete the table below. | |
| Name of Receiving Supplier or Direct Use by Wholesaler | 2010 Projection for 2015 | 2015 actual use |
| *Add additional rows as needed* | | |
| | | |
| **Total** | 0 | 0 |
| NOTES: | | |

| Table 6-6 Retail: Methods to Expand Future Recycled Water Use | | | |
|---|---|---|---|
| ☐ | Supplier does not plan to expand recycled water use in the future. Supplier will not complete the table below but will provide narrative explanation. | | |
| | Provide page location of narrative in UWMP | | |
| Name of Action | Description | Planned Implementation Year | Expected Increase in Recycled Water Use |
| *Add additional rows as needed* | | | |
| Customer development process; financial incentives; plumbing codes | See UWMP Section 4.6.5; Recycled Water Master Plan, Appendix L | Ongoing | 100 |
| | | **Total** | 100 |
| NOTES: See District 2015 UWMP Section 4.6.5. | | | |

| Table 6-7 Retail: Expected Future Water Supply Projects or Programs | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | No expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Supplier will not complete the table below. | | | | | |
| ☑ | Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format. | | | | | |
| Section 4.6 | Provide page location of narrative in the UWMP | | | | | |
| Name of Future Projects or Programs | Joint Project with other agencies? | | Description (if needed) | Planned Implementation Year | Planned for Use in Year Type *Drop Down List* | Expected Increase in Water Supply to Agency *This may be a range* |
| | *Drop Down List (y/n)* | *If Yes, Agency Name* | | | | |
| *Add additional rows as needed* | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

NOTES: See District 2015 UWMP Section 4.6 inclusive. District has sufficient water supplies to meet demands for the planning period under all drought conditions; however, the District actively seeks opportunities to further enhance reliability, affordability, and resiliency of its water supply portfolio.

| Table 6-7 Wholesale: Expected Future Water Supply Projects or Programs | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | No expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Supplier will not complete the table below. | | | | | |
| ☑ | Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format. | | | | | |
| Section 4.6 | Provide page location of narrative in the UWMP | | | | | |
| Name of Future Projects or Programs | Joint Project with other agencies? | | Description *(if needed)* | Planned Implementation Year | Planned for Use in Year Type *Drop Down list* | Expected Increase in Water Supply to Agency |
| | *Drop Down Menu* | *If Yes, Agency Name* | | | | |
| *Add additional rows as needed* | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

NOTES: See District 2015 UWMP Section 4.6 inclusive. District has sufficient water supplies to meet demands for the planning period under all drought conditions; however, the District actively seeks opportunities to further enhance reliability, affordability, and resiliency of its water supply portfolio.

| Table 6-8 Retail: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| *Drop down list* *May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Actual Volume | Water Quality *Drop Down List* | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | |
| Groundwater | Chino Basin Groundwater | 5,943 | Drinking Water | |
| Purchased or Imported Water | Water Facilities Authority | 2,556 | Drinking Water | |
| Purchased or Imported Water | San Antonio Water Company | 611 | Drinking Water | |
| Recycled Water | Inland Empire Utilities Agency | 791 | Recycled Water | |
| | **Total** | 9,901 | | 0 |
| NOTES: See District 2015 UWMP Section 4.1, Table 4-1. | | | | |

| Table 6-8 Wholesale: Water Supplies — Actual | | | | |
|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | 2015 | | |
| *Drop down list* *May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | Actual Volume | Water Quality *Drop Down List* | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | |
| Groundwater | Chino Basin Groundwater | 2,462 | Drinking Water | |
| Purchased or Imported Water | Water Facilities Authority | 4,469 | Drinking Water | |
| | **Total** | 6,931 | | 0 |
| NOTES: See District 2015 UWMP Section 4.1, Table 4-1. Includes direct delivery of City of Chino Hills's Water Facilities Authority entitlement through District transmission system. | | | | |

**Table 6-9 Retail: Water Supplies — Projected**

| Water Supply | Additional Detail on Water Supply | Projected Water Supply *Report To the Extent Practicable* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Drop down list* *May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | 2020 | | 2025 | | 2030 | | 2035 | | 2040 *(opt)* | |
| | | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | | | | | | | | |
| Groundwater | Chino Basin | 15,234 | | 15,234 | | 15,234 | | 15,234 | | 15,234 | |
| Purchased or Imported Water | WFA | 12,074 | | 12,074 | | 12,074 | | 12,074 | | 12,074 | |
| Purchased or Imported Water | SAWCo | 800 | | 800 | | 800 | | 800 | | 800 | |
| Recycled Water | IEUA | 1,031 | | 990 | | 1,019 | | 1,069 | | 1,069 | |
| **Total** | | 29,139 | 0 | 29,099 | 0 | 29,128 | 0 | 29,178 | 0 | 29,178 | 0 |

NOTES: See District 2015 UWMP Section 4.1, Table 4-1. Groundwater capacity of wells dedicated to retail service minus 15% adjustment to account for potential well shutdowns for maintenance/testing. District may use up to its full contractural share (24%) of WFA treatment plant capacity (81 mgd) at any time, subject to Tier 2 and penalty rates; estimated retail availability after delivery of full wholesale contractual entitlement to City of Chino Hills (see Table 6-9 W). Please note that District supplies are fully integrated and capable of meeting retail and wholesale demands as needed.

**Table 6-9 Wholesale: Water Supplies — Projected**

| Water Supply | Additional Detail on Water Supply | Projected Water Supply *Report To the Extent Practicable* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Drop down list* *May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool* | | 2020 | | 2025 | | 2030 | | 2035 | | 2040 *(opt)* | |
| | | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* | Reasonably Available Volume | Total Right or Safe Yield *(optional)* |
| *Add additional rows as needed* | | | | | | | | | | | |
| Groundwater | Chino Basin | 12,949 | | 12,949 | | 12,949 | | 12,949 | | 12,949 | |
| Purchased or Imported Water | WFA | 9,701 | | 9,701 | | 9,701 | | 9,701 | | 9,701 | |
| **Total** | | 22,650 | 0 | 22,650 | 0 | 22,650 | 0 | 22,650 | 0 | 22,650 | 0 |

NOTES: See District 2015 UWMP Section 4.1, Table 4-1. Groundwater capacity of wells dedicated to wholesale service minus 15% adjustment to account for potential well shutdowns for maintenance/testing. District may use up to its full contractural share (24%) of WFA treatment plant capacity (81 mgd) at any time, subject to Tier 2 and penalty rates; sufficient capacity allocated to meet full wholesale contractural entitlement of up to 20.22 mgd (22,650 AFY). Please note that District supplies are fully integrated and capable of meeting retail and wholesale demands as needed.

**Table 7-1 Retail: Basis of Water Year Data**

| Year Type | Base Year *If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | Available Supplies if Year Type Repeats | |
|---|---|---|---|
| | | ☐ Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location | |
| | | ☑ Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 1893-2015 | | 100% |
| Single-Dry Year | 2013 | | 100% |
| Multiple-Dry Years 1st Year | 2013 | | 100% |
| Multiple-Dry Years 2nd Year | 2014 | | 100% |
| Multiple-Dry Years 3rd Year | 2015 | | 100% |

Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.

NOTES: See District 2015 UWMP Section 5.3, Tables 5-1 and 5-2. Multiple versions of Table 7-1 are being used. This version of Table 7-1 is for Chino Groundwater Basin supply. Based on local hydrologic data.

**Table 7-1 Retail: Basis of Water Year Data**

| Year Type | Base Year *If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | Available Supplies if Year Type Repeats | |
|---|---|---|---|
| | | ☐ Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location | |
| | | ☑ Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 1922-2012 | | 100% |
| Single-Dry Year | 1977 | | 100% |
| Multiple-Dry Years 1st Year | 1990 | | 100% |
| Multiple-Dry Years 2nd Year | 1991 | | 100% |
| Multiple-Dry Years 3rd Year | 1992 | | 100% |

Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.

NOTES: See District 2015 UWMP Section 5.3, Tables 5-1 and 5-2. Multiple versions of Table 7-1 are being used. This version of Table 7-1 is for Water Facilities Authority. Based on MWD 2015 UWMP.

| Table 7-1 Retail: Basis of Water Year Data | | | |
|---|---|---|---|
| Year Type | Base Year *If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | Available Supplies if Year Type Repeats | |
| | | ☐ | Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location |
| | | ☑ | Quantification of available supplies is provided in this table as either volume only, percent only, or both. |
| | | Volume Available | % of Average Supply |
| Average Year | 1893-2015 | | 100% |
| Single-Dry Year | 2013 | | 82% |
| Multiple-Dry Years 1st Year | 2013 | | 82% |
| Multiple-Dry Years 2nd Year | 2014 | | 70% |
| Multiple-Dry Years 3rd Year | 2015 | | 70% |
| Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table. | | | |
| NOTES: See District 2015 UWMP Section 5.3, Tables 5-1 and 5-2. Multiple versions of Table 7-1 are being used. This version of Table 7-1 is for San Antonio Water Company supply. Based on local hydrologic data and aggregated per-share allocation percentage reductions. | | | |

| Table 7-1 Wholesale: Basis of Water Year Data | | | |
|---|---|---|---|
| Year Type | Base Year *If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 1999-2000, use 2000* | Available Supplies if Year Type Repeats | |
| | | ☑ | Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location: See note below. |
| | | ☐ | Quantification of available supplies is provided in this table as either volume only, percent only, or both. |
| | | Volume Available | % of Average Supply |
| Average Year | | | 100% |
| Single-Dry Year | | | |
| Multiple-Dry Years 1st Year | | | |
| Multiple-Dry Years 2nd Year | | | |
| Multiple-Dry Years 3rd Year | | | |
| Agency may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If an agency uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table. Suppliers may create an additional worksheet for the additional | | | |
| NOTES: Wholesale supplies fully integrated with retail supplies and reflect retail supplies' reliability. Please see Tables 7-1 for retail supplies. | | | |

| Table 7-2 Retail: Normal Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals *(autofill from Table 6-9)* | 29,139 | 29,099 | 29,128 | 29,178 | 29,178 |
| Demand totals *(autofill from Table 4-3)* | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| Difference | 16,589 | 16,353 | 16,048 | 15,747 | 15,463 |
| NOTES: See District 2015 UWMP Section 5.4, Table 5-3 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | | | |

| Table 7-2 Wholesale: Normal Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 *(Opt)* |
| Supply totals *(autofill from Table 6-9)* | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Demand totals *(autofill fm Table 4-3)* | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Difference | 0 | 0 | 0 | 0 | 0 |
| NOTES: See District 2015 UWMP Section 5.4, Table 5-3 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | | | |

| Table 7-3 Retail: Single Dry Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| Supply totals | 28,996 | 28,955 | 28,984 | 29,034 | 29,034 |
| Demand totals | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| Difference | 16,446 | 16,209 | 15,904 | 15,604 | 15,320 |
| NOTES: See District 2015 UWMP Section 5.4, Table 5-4 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | | | |

| Table 7-3 Wholesale: Single Dry Year Supply and Demand Comparison | | | | | |
|---|---|---|---|---|---|
| | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| Supply totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Demand totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| Difference | 0 | 0 | 0 | 0 | 0 |
| NOTES: See District 2015 UWMP Section 5.4, Table 5-4 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | | | |

| Table 7-4 Retail: Multiple Dry Years Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| First year | Supply totals | 28,996 | 28,955 | 28,984 | 29,034 | 29,034 |
| | Demand totals | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| | Difference | 16,446 | 16,209 | 15,904 | 15,604 | 15,320 |
| Second year | Supply totals | 28,897 | 28,857 | 28,886 | 28,936 | 28,936 |
| | Demand totals | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| | Difference | 16,347 | 16,111 | 15,806 | 15,505 | 15,221 |
| Third year | Supply totals | 28,897 | 28,857 | 28,886 | 28,936 | 28,936 |
| | Demand totals | 12,550 | 12,746 | 13,080 | 13,431 | 13,714 |
| | Difference | 16,347 | 16,111 | 15,806 | 15,505 | 15,221 |

NOTES: See District 2015 UWMP Section 5.4, Table 5-5 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers.

| Table 7-4 Wholesale: Multiple Dry Years Supply and Demand Comparison | | | | | | |
|---|---|---|---|---|---|---|
| | | 2020 | 2025 | 2030 | 2035 | 2040 (Opt) |
| First year | Supply totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Demand totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Difference | 0 | 0 | 0 | 0 | 0 |
| Second year | Supply totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Demand totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Difference | 0 | 0 | 0 | 0 | 0 |
| Third year | Supply totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Demand totals | 22,650 | 22,650 | 22,650 | 22,650 | 22,650 |
| | Difference | 0 | 0 | 0 | 0 | 0 |

NOTES: See District 2015 UWMP Section 5.4, Table 5-5 (combined retail and wholesale). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers.

| Table 8-1 Retail<br>Stages of Water Shortage Contingency Plan | | |
|---|---|---|
| Stage | Complete Both | |
| | Percent Supply Reduction[1]<br>*Numerical value as a percent* | Water Supply Condition<br>*(Narrative description)* |
| *Add additional rows as needed* | | |
| Significant Water Supply Shortage | 10-25% | Current or near-term water supply shortage conditions require a 10 to 25 percent demand reduction |
| Critical Water Supply Shortage | 25-40% | Current or near-term water supply shortage conditions require a 25 to 40 percent demand reduction |
| Emergency Water Supply Shortage | 40+% | Due to emergency circumstances, current or near-term water supply shortage conditions require a 40 percent or higher demand reduction |
| [1] *One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.* | | |
| NOTES: See District 2015 UWMP Section 7.2, Table 7-1, Appendix O. | | |

| Table 8-1 Wholesale<br>Stages of Water Shortage Contingency Plan | | |
|---|---|---|
| Stage | Complete Both | |
| | Supply Reduction[1] | Water Supply Condition<br>*(Narrative description)* |
| *Add additional rows as needed* | | |
| Significant Water Supply Shortage | 10-25% | Current or near-term water supply shortage conditions require a 10 to 25 percent demand reduction |
| Critical Water Supply Shortage | 25-40% | Current or near-term water supply shortage conditions require a 25 to 40 percent demand reduction |
| Emergency Water Supply Shortage | 40+% | Due to emergency circumstances, current or near-term water supply shortage conditions require a 40 percent or higher demand reduction |
| [1] *One stage in the Water Shortage Contingency Plan must address a water shortage of 50%.* | | |
| NOTES: See District 2015 UWMP Section 7.2, Table 7-1, Appendix O. Under District Ordinance 33, during a shortage declaration wholesale customers must reduce demand on the District at the same level as retail customers. | | |

| Table 8-2 Retail Only: Restrictions and Prohibitions on End Uses | | | |
|---|---|---|---|
| Stage | Restrictions and Prohibitions on End Users<br>***Drop down list***<br>*These are the only categories that will be accepted by the WUEdata online submittal tool* | Additional Explanation or Reference<br>*(optional)* | Penalty, Charge, or Other Enforcement?<br>*Drop Down List* |
| *Add additional rows as needed* | | | |
| Permanent | Landscape - Limit landscape irrigation to specific times | Before 8am or after 8pm; 15 mins per station; exemptions for hand-watering, drip, smart controllers | Yes |
| Permanent | Landscape - Restrict or prohibit runoff from landscape irrigation | | Yes |
| Permanent | Landscape - Other landscape restriction or prohibition | Turn off outdoor irrigation during rain | Yes |
| Permanent | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Within 7 days of discovery | Yes |
| Permanent | Other - Require automatic shut of hoses | Or use commercial vehicle wash equipped with recycyling system | Yes |
| Permanent | Other - Prohibit use of potable water for washing hard surfaces | Unless for health and safety purposes and only with a waterbroom or water-efficient pressure washer | Yes |
| Permanent | CII - Restaurants may only serve water upon request | | Yes |
| Permanent | CII - Lodging establishment must offer opt out of linen service | | Yes |
| Permanent | CII - Other CII restriction or prohibition | Require recirculation systems for all cooling towers and evaporative cooling systems, decorative water fountains, and conveyor and in-bay vehicle washes | Yes |

| | | | |
|---|---|---|---|
| Significant | Landscape - Limit landscape irrigation to specific days | Tuesdays, Thursdays, Saturdays; exemptions for water-dependent industries, hand-watering, drip, smart controllers | Yes |
| Significant | Landscape - Other landscape restriction or prohibition | Dedicated irrigation meters limited to 75% pre-shortage use | Yes |
| Significant | Other | Require water use plan for construction/dust control use; make recycled water available | Yes |
| Significant | Other | Restrict use of hydrants | Yes |
| Critical | Landscape - Limit landscape irrigation to specific days | Tuesdays, Saturdays | Yes |
| Critical | Landscape - Other landscape restriction or prohibition | Dedicated irrigation meters limited to 50% pre-shortage use | Yes |
| Critical | Landscape - Other landscape restriction or prohibition | No landscaping requirements that result in increased water use | Yes |
| Critical | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | | Yes |
| Critical | Other water feature or swimming pool restriction | No emptying/refilling pools; water levels may be maintained | Yes |
| Emergency | Landscape - Limit landscape irrigation to specific days | Saturdays | Yes |
| Emergency | Landscape - Other landscape restriction or prohibition | Dedicated irrigation meters limited to 33% pre-shortage use | Yes |
| Emergency | Landscape - Other landscape restriction or prohibition | No installation of new landscaping | Yes |
| Emergency | Other - Prohibit use of potable water for construction and dust control | | Yes |
| Emergency | Other water feature or swimming pool restriction | No emptying/refilling/maintaining pool | Yes |
| All stages | Other | Wholesale customer demand reduction same percentage as retail customers | Yes |

NOTES: See District 2015 UWMP Section 7.2, Table 7-2, Appendix O.

| Table 8-3 Retail Only:<br>Stages of Water Shortage Contingency Plan - Consumption Reduction Methods | | |
|---|---|---|
| Stage | Consumption Reduction Methods by Water Supplier<br>*Drop down list*<br>*These are the only categories that will be accepted by the WUEdata online submittal tool* | Additional Explanation or Reference<br>*(optional)* |
| *Add additional rows as needed* | | |
| All | Expand Public Information Campaign | As needed to achieve shortage stage demand reduction goal |
| All | Decrease Line Flushing | As needed to achieve shortage stage demand reduction goal |
| All | Increase Water Waste Patrols | As needed to achieve shortage stage demand reduction goal |
| All | Implement or Modify Drought Rate Structure or Surcharge | Demand reduction rate may be implemented by Board to offset projected decrease in revenues due to required demand reductions; may further incentivize conservation |
| NOTES: See District 2015 UWMP Section 7.6, Appendix O. | | |

| Table 8-4 Retail: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 30,555 | 30,555 | 30,555 |
| NOTES: See District 2015 UWMP Section 7.4, Table 7-3. Consistent with Table 7-4 R, 2020 Year 3 supply (conservative estimate). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | |

| Table 8-4 Wholesale: Minimum Supply Next Three Years | | | |
|---|---|---|---|
| | 2016 | 2017 | 2018 |
| Available Water Supply | 22,650 | 22,650 | 22,650 |
| NOTES: See District 2015 UWMP Section 7.4, Table 7-3. Consistent with Table 7-4 R, 2020 Year 3 supply (conservative estimate). For the purpose of DWR standardized tables, sufficient supply is made available to meet the District's total wholesale demand up to the contractual entitlement of 20.22 mgd (22,650 AFY), with the balance of supply made available to retail customers. | | | |

| Table 10-1 Retail: Notification to Cities and Counties | | |
|---|---|---|
| City Name | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| Montclair | ☑ | ☑ |
| Chino | ☑ | ☑ |
| County Name *Drop Down List* | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| San Bernardino County | ☑ | ☑ |
| NOTES: See District 2015 UWMP Sections 1.2.1 and 1.2.2, Table 1-1. | | |

| Table 10-1 Wholesale: Notification to Cities and Counties (select one) | | |
|---|---|---|
| ☐ | Supplier has notified more than 10 cities or counties in accordance with CWC 10621 (b) and 10642. **Completion of the table below is not required. Provide a separate list of the cities and counties that were notified.** | |
| | Provide the page or location of this list in the UWMP. | |
| ☑ | Supplier has notified 10 or fewer cities or counties. **Complete the table below.** | |
| City Name | 60 Day Notice | Notice of Public Hearing |
| *Add additional rows as needed* | | |
| Chino Hills | ☑ | ☑ |
| NOTES: See District 2015 UWMP Sections 1.2.1 and 1.2.2, Table 1-1. | | |

| SB X7-7 Table 0: Units of Measure Used in UWMP* *(select one from the drop down list)* |
|---|
| Acre Feet |
| **The unit of measure must be consistent with Table 2-3* |
| NOTES: |

| SB X7-7 Table-1: Baseline Period Ranges | | | |
|---|---|---|---|
| **Baseline** | **Parameter** | **Value** | **Units** |
| 10- to 15-year baseline period | 2008 total water deliveries | 12,247 | Acre Feet |
| | 2008 total volume of delivered recycled water | - | Acre Feet |
| | 2008 recycled water as a percent of total deliveries | 0.00% | Percent |
| | Number of years in baseline period[1, 2] | 10 | Years |
| | Year beginning baseline period range | 1996 | |
| | Year ending baseline period range[3] | 2005 | |
| 5-year baseline period | Number of years in baseline period | 5 | Years |
| | Year beginning baseline period range | 2003 | |
| | Year ending baseline period range[4] | 2007 | |
| *[1] If the 2008 recycled water percent is less than 10 percent, then the first baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater, the first baseline period is a continuous 10- to 15-year period.* | | | |
| *[2] The Water Code requires that the baseline period is between 10 and 15 years. However, DWR recognizes that some water suppliers may not have the minimum 10 years of baseline data.* | | | |
| *[3] The ending year must be between December 31, 2004 and December 31, 2010.* | | | |
| *[4] The ending year must be between December 31, 2007 and December 31, 2010.* | | | |
| NOTES: | | | |

| SB X7-7 Table 2: Method for Population Estimates | |
|---|---|
| **Method Used to Determine Population** (may check more than one) | |
| ☐ | **1. Department of Finance** (DOF) DOF Table E-8 (1990 - 2000) and (2000-2010) and DOF Table E-5 (2011 - 2015) when available |
| ☐ | **2. Persons-per-Connection Method** |
| ☑ | **3. DWR Population Tool** |
| ☑ | **4. Other** DWR recommends pre-review |
| NOTES: For 2015, using alternative methodology based on city growth estimates and known development in the service area since 2010. DWR provided pre-approval on June 21, 2016. See 2015 UWMP Appendix F. | |

| SB X7-7 Table 3: Service Area Population | | |
|---|---|---|
| Year | | Population |
| 10 to 15 Year Baseline Population | | |
| Year 1 | 1996 | 47,020 |
| Year 2 | 1997 | 46,778 |
| Year 3 | 1998 | 46,508 |
| Year 4 | 1999 | 48,048 |
| Year 5 | 2000 | 48,996 |
| Year 6 | 2001 | 49,459 |
| Year 7 | 2002 | 49,648 |
| Year 8 | 2003 | 50,189 |
| Year 9 | 2004 | 50,784 |
| Year 10 | 2005 | 50,960 |
| *Year 11* | | |
| *Year 12* | | |
| *Year 13* | | |
| *Year 14* | | |
| *Year 15* | | |
| 5 Year Baseline Population | | |
| Year 1 | 2003 | 50,189 |
| Year 2 | 2004 | 50,784 |
| Year 3 | 2005 | 50,960 |
| Year 4 | 2006 | 51,578 |
| Year 5 | 2007 | 52,416 |
| 2015 Compliance Year Population | | |
| **2015** | | 55,581 |
| NOTES: | | |

**SB X7-7 Table 4: Annual Gross Water Use ***

| Baseline Year *Fm SB X7-7 Table 3* | | Volume Into Distribution System *This column will remain blank until SB X7-7 Table 4-A is completed.* | Deductions | | | | | Annual Gross Water Use |
|---|---|---|---|---|---|---|---|---|
| | | | Exported Water | Change in Dist. System Storage (+/-) | Indirect Recycled Water *This column will remain blank until SB X7-7 Table 4-B is completed.* | Water Delivered for Agricultural Use | Process Water *This column will remain blank until SB X7-7 Table 4-D is completed.* | |
| 10 to 15 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 1996 | 10,708 | - | | - | | | 10,708 |
| Year 2 | 1997 | 11,832 | - | | - | | | 11,832 |
| Year 3 | 1998 | 10,146 | - | | - | | | 10,146 |
| Year 4 | 1999 | 18,697 | 7,751 | | - | | | 10,946 |
| Year 5 | 2000 | 25,193 | 13,257 | | - | | | 11,936 |
| Year 6 | 2001 | 21,682 | 9,943 | | 29 | | | 11,710 |
| Year 7 | 2002 | 23,386 | 11,360 | | 36 | | | 11,990 |
| Year 8 | 2003 | 23,783 | 11,831 | | 29 | | | 11,923 |
| Year 9 | 2004 | 25,471 | 13,008 | | 20 | | | 12,443 |
| Year 10 | 2005 | 22,918 | 12,031 | | 16 | | | 10,871 |
| *Year 11* | 0 | - | | | - | | | - |
| *Year 12* | 0 | - | | | - | | | - |
| *Year 13* | 0 | - | | | - | | | - |
| *Year 14* | 0 | - | | | - | | | - |
| *Year 15* | 0 | - | | | - | | | - |
| **10 - 15 year baseline average gross water use** | | | | | | | | **11,451** |
| 5 Year Baseline - Gross Water Use | | | | | | | | |
| Year 1 | 2003 | 23,783 | 11,831 | | 29 | | | 11,923 |
| Year 2 | 2004 | 25,471 | 13,008 | | 20 | | | 12,443 |
| Year 3 | 2005 | 22,918 | 12,031 | | 16 | | | 10,871 |
| Year 4 | 2006 | 25,021 | 13,517 | 107 | 21 | | | 11,376 |
| Year 5 | 2007 | 25,812 | 13,437 | 1,217 | 57 | | | 11,101 |
| **5 year baseline average gross water use** | | | | | | | | **11,543** |
| 2015 Compliance Year - Gross Water Use | | | | | | | | |
| **2015** | | 16,042 | 6,931 | | 576 | | | **8,534** |

* NOTE that the units of measure must remain consistent throughout the UWMP, as reported in Table 2-3

NOTES: Change in storage due to groundwater injection.

**SB X7-7 Table 4-A: Volume Entering the Distribution System(s)**

Complete one table for each source.

| **Name of Source** | Chino Basin Groundwater |
|---|---|
| **This water source is:** | |
| ☑ | The supplier's own water source |
| ☐ | A purchased or imported source |

| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment ** Optional (+/-)* | Corrected Volume Entering Distribution System |
|---|---|---|---|---|
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 6,902 | | 6,902 |
| Year 2 | 1997 | 9,117 | | 9,117 |
| Year 3 | 1998 | 6,828 | | 6,828 |
| Year 4 | 1999 | 8,647 | | 8,647 |
| Year 5 | 2000 | 9,324 | | 9,324 |
| Year 6 | 2001 | 10,515 | | 10,515 |
| Year 7 | 2002 | 13,418 | | 13,418 |
| Year 8 | 2003 | 13,283 | | 13,283 |
| Year 9 | 2004 | 13,050 | | 13,050 |
| Year 10 | 2005 | 10,299 | | 10,299 |
| Year 11 | 0 | | | - |
| Year 12 | 0 | | | - |
| Year 13 | 0 | | | - |
| Year 14 | 0 | | | - |
| Year 15 | 0 | | | - |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2003 | 13,283 | | 13,283 |
| Year 2 | 2004 | 13,050 | | 13,050 |
| Year 3 | 2005 | 10,299 | | 10,299 |
| Year 4 | 2006 | 8,535 | | 8,535 |
| Year 5 | 2007 | 11,620 | | 11,620 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 8,406 | | 8,406 |

** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document*

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | Water Facilities Authority | | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment * *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 3,806 | | 3,806 |
| Year 2 | 1997 | 2,715 | | 2,715 |
| Year 3 | 1998 | 3,318 | | 3,318 |
| Year 4 | 1999 | 10,050 | | 10,050 |
| Year 5 | 2000 | 15,869 | | 15,869 |
| Year 6 | 2001 | 11,167 | | 11,167 |
| Year 7 | 2002 | 9,968 | | 9,968 |
| Year 8 | 2003 | 10,500 | | 10,500 |
| Year 9 | 2004 | 12,421 | | 12,421 |
| Year 10 | 2005 | 12,619 | | 12,619 |
| Year 11 | - | | | 0 |
| Year 12 | - | | | 0 |
| Year 13 | - | | | 0 |
| Year 14 | - | | | 0 |
| Year 15 | - | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2003 | 10,500 | | 10,500 |
| Year 2 | 2004 | 12,421 | | 12,421 |
| Year 3 | 2005 | 12,619 | | 12,619 |
| Year 4 | 2006 | 16,486 | | 16,486 |
| Year 5 | 2007 | 14,192 | | 14,192 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 7,025 | | 7,025 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: Includes direct WFA deliveries to City of Chino Hills. | | | | |

| SB X7-7 Table 4-A: Volume Entering the Distribution | | | | |
|---|---|---|---|---|
| **Name of Source** | | San Antonio Water Company | | |
| **This water source is:** | | | | |
| ☐ | The supplier's own water source | | | |
| ☑ | A purchased or imported source | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Volume Entering Distribution System | Meter Error Adjustment * *Optional (+/-)* | Corrected Volume Entering Distribution System |
| 10 to 15 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 1996 | 0 | | 0 |
| Year 2 | 1997 | 0 | | 0 |
| Year 3 | 1998 | 0 | | 0 |
| Year 4 | 1999 | 0 | | 0 |
| Year 5 | 2000 | 0 | | 0 |
| Year 6 | 2001 | 0 | | 0 |
| Year 7 | 2002 | 0 | | 0 |
| Year 8 | 2003 | 0 | | 0 |
| Year 9 | 2004 | 0 | | 0 |
| Year 10 | 2005 | 0 | | 0 |
| Year 11 | - | | | 0 |
| Year 12 | - | | | 0 |
| Year 13 | - | | | 0 |
| Year 14 | - | | | 0 |
| Year 15 | - | | | 0 |
| 5 Year Baseline - Water into Distribution System | | | | |
| Year 1 | 2003 | 0 | | 0 |
| Year 2 | 2004 | 0 | | 0 |
| Year 3 | 2005 | 0 | | 0 |
| Year 4 | 2006 | 0 | | 0 |
| Year 5 | 2007 | 0 | | 0 |
| 2015 Compliance Year - Water into Distribution System | | | | |
| **2015** | | 611 | | 611 |
| ** Meter Error Adjustment - See guidance in Methodology 1, Step 3 of Methodologies Document* | | | | |
| NOTES: Deliveries wheeled through City of Upland. | | | | |

**SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction** *(For use only by agencies that are deducting indirect recycled water)*

| Baseline Year *Fm SB X7-7 Table 3* | | Surface Reservoir Augmentation | | | | | Groundwater Recharge | | | **Total Deductible Volume of Indirect Recycled Water Entering the Distribution System** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volume Discharged from Reservoir for Distribution System Delivery | Percent Recycled Water | Recycled Water Delivered to Treatment Plant | Transmission/ Treatment Loss | Recycled Volume Entering Distribution System from Surface Reservoir Augmentation | Recycled Water Pumped by Utility* | Transmission/ Treatment Losses | Recycled Volume Entering Distribution System from Groundwater Recharge | |
| 10-15 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 1996 | | | - | | - | | | - | - |
| Year 2 | 1997 | | | - | | - | | | - | - |
| Year 3 | 1998 | | | - | | - | | | - | - |
| Year 4 | 1999 | | | - | | - | | | - | - |
| Year 5 | 2000 | | | - | | - | | | - | - |
| Year 6 | 2001 | | | - | | - | 29 | | 29 | 29 |
| Year 7 | 2002 | | | - | | - | 36 | | 36 | 36 |
| Year 8 | 2003 | | | - | | - | 29 | | 29 | 29 |
| Year 9 | 2004 | | | - | | - | 20 | | 20 | 20 |
| Year 10 | 2005 | | | - | | - | 16 | | 16 | 16 |
| *Year 11* | 0 | | | - | | - | | | - | - |
| *Year 12* | 0 | | | - | | - | | | - | - |
| *Year 13* | 0 | | | - | | - | | | - | - |
| *Year 14* | 0 | | | - | | - | | | - | - |
| *Year 15* | 0 | | | - | | - | | | - | - |
| 5 Year Baseline - Indirect Recycled Water Use | | | | | | | | | | |
| Year 1 | 2003 | | | - | | - | 29 | | 29 | 29 |
| Year 2 | 2004 | | | - | | - | 20 | | 20 | 20 |
| Year 3 | 2005 | | | - | | - | 16 | | 16 | 16 |
| Year 4 | 2006 | | | - | | - | 21 | | 21 | 21 |
| Year 5 | 2007 | | | - | | - | 57 | | 57 | 57 |
| 2015 Compliance - Indirect Recycled Water Use | | | | | | | | | | |
| **2015** | | | | - | | - | 576 | | 576 | 576 |

**Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES: Documentation included in UWMP Appendix J.

| SB X7-7 Table 5: Gallons Per Capita Per Day (GPCD) | | | | |
|---|---|---|---|---|
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Annual Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use (GPCD) |
| 10 to 15 Year Baseline GPCD | | | | |
| Year 1 | 1996 | 47,020 | 10,708 | 203 |
| Year 2 | 1997 | 46,778 | 11,832 | 226 |
| Year 3 | 1998 | 46,508 | 10,146 | 195 |
| Year 4 | 1999 | 48,048 | 10,946 | 203 |
| Year 5 | 2000 | 48,996 | 11,936 | 217 |
| Year 6 | 2001 | 49,459 | 11,710 | 211 |
| Year 7 | 2002 | 49,648 | 11,990 | 216 |
| Year 8 | 2003 | 50,189 | 11,923 | 212 |
| Year 9 | 2004 | 50,784 | 12,443 | 219 |
| Year 10 | 2005 | 50,960 | 10,871 | 190 |
| *Year 11* | 0 | - | - | |
| *Year 12* | 0 | - | - | |
| *Year 13* | 0 | - | - | |
| *Year 14* | 0 | - | - | |
| *Year 15* | 0 | - | - | |
| 10-15 Year Average Baseline GPCD | | | | **209** |
| 5 Year Baseline GPCD | | | | |
| **Baseline Year** *Fm SB X7-7 Table 3* | | Service Area Population *Fm SB X7-7 Table 3* | Gross Water Use *Fm SB X7-7 Table 4* | Daily Per Capita Water Use |
| Year 1 | 2003 | 50,189 | 11,923 | 212 |
| Year 2 | 2004 | 50,784 | 12,443 | 219 |
| Year 3 | 2005 | 50,960 | 10,871 | 190 |
| Year 4 | 2006 | 51,578 | 11,376 | 197 |
| Year 5 | 2007 | 52,416 | 11,101 | 189 |
| 5 Year Average Baseline GPCD | | | | **201** |
| 2015 Compliance Year GPCD | | | | |
| **2015** | | 55,581 | 8,534 | **137** |
| NOTES: | | | | |

| **SB X7-7 Table 6**: Gallons per Capita per Day<br>*Summary From Table SB X7-7 Table 5* | |
|---|---|
| 10-15 Year Baseline GPCD | 209 |
| 5 Year Baseline GPCD | 201 |
| 2015 Compliance Year GPCD | 137 |
| NOTES: | |

| **SB X7-7 Table 7: 2020 Target Method**<br>*Select Only One* | | |
|---|---|---|
| Target Method | | Supporting Documentation |
| ☑ | Method 1 | SB X7-7 Table 7A |
| ☐ | Method 2 | SB X7-7 Tables 7B, 7C, and 7D<br>*Contact DWR for these tables* |
| ☐ | Method 3 | SB X7-7 Table 7-E |
| ☐ | Method 4 | Method 4 Calculator |
| NOTES: | | |

| **SB X7-7 Table 7-A: Target Method 1**<br>20% Reduction | |
|---|---|
| 10-15 Year Baseline GPCD | **2020 Target GPCD** |
| 209 | **167** |
| NOTES: | |

| SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target | | | |
|---|---|---|---|
| 5 Year Baseline GPCD *From SB X7-7 Table 5* | Maximum 2020 Target[1] | Calculated 2020 Target[2] | **Confirmed 2020 Target** |
| 201 | 191 | 167 | **167** |

[1] *Maximum 2020 Target is 95% of the 5 Year Baseline GPCD*

[2] *2020 Target is calculated based on the selected Target Method, see SB X7-7 Table 7 and corresponding tables for agency's calculated target.*

NOTES:

| SB X7-7 Table 8: 2015 Interim Target GPCD | | |
|---|---|---|
| Confirmed 2020 Target *Fm SB X7-7 Table 7-F* | 10-15 year Baseline GPCD *Fm SB X7-7 Table 5* | **2015 Interim Target GPCD** |
| 167 | 209 | **188** |

NOTES:

| SB X7-7 Table 9: 2015 Compliance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Actual 2015 GPCD | 2015 Interim Target GPCD | Optional Adjustments *(in GPCD)* Enter "0" if Adjustment Not Used: Extraordinary Events | Weather Normalization | Economic Adjustment | TOTAL Adjustments | Adjusted 2015 GPCD | 2015 GPCD *(Adjusted if applicable)* | **Did Supplier Achieve Targeted Reduction for 2015?** |
| 137 | 188 | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | *From Methodology 8 (Optional)* | - | 137 | 137 | **YES** |

NOTES:

# Appendix E:
# Notifications, Notice of Public Hearing, and Resolution for Plan Adoption

**Inland Valley Daily Bulletin**
(formerly The Daily Report)
9616 Archibald Avenue, Suite 100
Rancho Cucamonga, CA 91730
909-987-6397
legals@inlandnewspapers.com

COPY

(Space below for use of County Clerk Only)

RECEIVED JUN 22 2016

# PROOF OF PUBLICATION
## (2015.5 C.C.P.)

## STATE OF CALIFORNIA
## County of San Bernardino

I am a citizen of the United States, I am over the age of eighteen years, and not a party to or interested in the above-entitled matter. I am the principal clerk of the printer of INLAND VALLEY DAILY BULLETIN, a newspaper of general circulation printed and published daily in the City of Ontario, County of San Bernardino, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of San Bernardino, State of California, on the date of August 24, 1951, Case Number 70663. The notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

:

6/13, 6/20/2016

I declare under the penalty of perjury that the foregoing is true and correct.

Executed at Rancho Cucamonga, San Bernardino Co. California

On this 20 day of June ,2016.

Signature

**Public Notice**

NOTICE IS HEREBY GIVEN that the Monte Vista Water District will conduct a public hearing in the Board room at its District offices, 10575 Central Avenue, Montclair, on Wednesday, June 22, 2016, at 6:30 p.m., to receive public input on adoption of the District's 2015 Urban Water Management Plan. A copy of the plan is available for review Monday – Friday from 8:00 a.m. to 5:00 p.m. at the District office or on the District website at www.mvwd.org.

The public is invited to attend and comment on this issue. Any person unable to attend the public hearing may submit written comments to the District prior to the public hearing. All comments or inquiries should be directed to Justin Scott-Coe at (909) 267-2116 or jscottcoe@mvwd.org.

Published June 13, 2016, June 20, 2016. #810977

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COPY

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Published June 13, 2016, June 20, 2016. #810977

Monte Vista
Dedicated to Quality, Service and Innovation

Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Edward Starr
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Starr,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

The District's Board of Directors has set a public hearing for 6:30 p.m., Wednesday, June 22, 2016, to consider adoption of the District's 2015 Urban Water Management Plan. The public hearing will take place at the District Administrative Office, 10575 Central Avenue, Montclair. The District would appreciate receiving comments on the draft plan prior to the public hearing.

This and future announcements concerning progress in updating the District's 2015 Urban Water Management Plan will be posted on the District website, www.mvwd.org, in the "District News" section. Upon adoption, the final Plan will be available on the District website's "Public Documents" section and provided to local cities and counties within which the District provides water service.

For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

Water District
10575 Central Avenue, Post Office Box 71 • Montclair, CA 91763 • (909) 624-0035 • FAX (909) 624-4725 • www.mvwd.org

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G. Michael Milhiser, DIRECTOR
Manny Martinez, DIRECTOR

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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Steve Lustro
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Lustro,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

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For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

Water District
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Manny Martinez, DIRECTOR

Monte Vista

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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Marilyn Staats
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Ms. Staats,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

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For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager



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Manny Martinez, DIRECTOR

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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Matthew Ballantyne
City of Chino
13220 Central Avenue
City of Chino, CA 91710

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Ballantyne,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

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For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Jose Alire
City of Chino
13220 Central Avenue
City of Chino, CA 91710

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Alire,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

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For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Konradt Bartlam
City of Chino Hills
14000 City Center Drive
City of Chino Hills, CA 91709

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Bartlam,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

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EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

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G. Michael Milhiser, DIRECTOR
Manny Martinez, DIRECTOR

Monte Vista
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Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Nadeem Majaj
City of Chino Hills
14000 City Center Drive
City of Chino Hills, CA 91709

**Notification of Availability of Public Review Draft – 2015 Urban Water Management Plan**

Dear Mr. Majaj,

This letter is an update to Monte Vista Water District's process of developing its 2015 Urban Water Management Plan, in compliance with the California Urban Water Management Planning Act.

A draft of the District's Plan is now available for public review. The plan can be downloaded from the District's website, www.mvwd.org, following the "Public Documents" and "Planning Documents" menu links. A hard copy is also available to review at the District Administrative Office located at 10575 Central Avenue, Montclair. The District will also provide a copy of the Plan electronically or in hard copy upon request.

The District's Board of Directors has set a public hearing for 6:30 p.m., Wednesday, June 22, 2016, to consider adoption of the District's 2015 Urban Water Management Plan. The public hearing will take place at the District Administrative Office, 10575 Central Avenue, Montclair. The District would appreciate receiving comments on the draft plan prior to the public hearing.

This and future announcements concerning progress in updating the District's 2015 Urban Water Management Plan will be posted on the District website, www.mvwd.org, in the "District News" section. Upon adoption, the final Plan will be available on the District website's "Public Documents" section and provided to local cities and counties within which the District provides water service.

For more information, please contact Justin Scott-Coe, public affairs director, at (909) 267-2116 or at jscottcoe@mvwd.org.

EdwardSincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

Water District
10575 Central Avenue, Post Office Box 71 • Montclair, CA 91763 • (909) 624-0035 • FAX (909) 624-4725 • www.mvwd.org

Sandra S. Rose, PRESIDENT
Tony Lopez, VICE PRESIDENT
Philip L. Erwin, DIRECTOR / BOARD AUDITOR
G. Michael Milhiser, DIRECTOR
Manny Martinez, DIRECTOR

Monte Vista
Dedicated to Quality, Service and Innovation

Mark N. Kinsey
GENERAL MANAGER

May 27, 2016

Greg Devereaux
County of San Bernardino
385 North Arrowhead
San Bernardino, CA 92415

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GENERAL MANAGER

May 27, 2016

Tom Hudson
County of San Bernardino
385 North Arrowhead
San Bernardino, CA 92415

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Mark N. Kinsey
GENERAL MANAGER

December 15, 2015

Edward Starr
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Update to Urban Water Management Plan**

Dear Mr. Starr,

Monte Vista Water District is initiating the process of updating its Urban Water Management Plan for 2015, in compliance with the California Urban Water Management Planning Act. Urban water agencies are required to update this planning document every five years.

Water Code Section 10621 states, "Every urban water supplier required to prepare a plan pursuant to this part shall, at least 60 days prior to the public hearing on the plan required by Section 10642, notify any city or county within which the supplier provides water supplies that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. The urban water supplier may consult with, and obtain comments from, any city or county that receives notice pursuant to this subdivision."

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Sincerely,

***Monte Vista Water District***

Mark N. Kinsey
General Manager

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Mark N. Kinsey
GENERAL MANAGER

December 15, 2015

Steve Lustro
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Update to Urban Water Management Plan**

Dear Mr. Lustro,

Monte Vista Water District is initiating the process of updating its Urban Water Management Plan for 2015, in compliance with the California Urban Water Management Planning Act. Urban water agencies are required to update this planning document every five years.

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Mark N. Kinsey
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Mark N. Kinsey
GENERAL MANAGER

December 15, 2015

Marilyn Staats
City of Montclair
5111 Benito Street
Montclair, CA 91763

**Notification of Update to Urban Water Management Plan**

Dear Ms. Staats,

Monte Vista Water District is initiating the process of updating its Urban Water Management Plan for 2015, in compliance with the California Urban Water Management Planning Act. Urban water agencies are required to update this planning document every five years.

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Mark N. Kinsey
GENERAL MANAGER

December 15, 2015

Matthew Ballantyne
City of Chino
13220 Central Avenue
Chino, California 91710

**Notification of Update to Urban Water Management Plan**

Dear Mr. Ballantyne,

Monte Vista Water District is initiating the process of updating its Urban Water Management Plan for 2015, in compliance with the California Urban Water Management Planning Act. Urban water agencies are required to update this planning document every five years.

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***Monte Vista Water District***

Mark N. Kinsey
General Manager

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Mark N. Kinsey
GENERAL MANAGER

December 15, 2015

Jose Alire
City of Chino
13220 Central Avenue
Chino, California 91710

**Notification of Update to Urban Water Management Plan**

Dear Mr. Alire,

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GENERAL MANAGER

December 15, 2015

Konradt Bartlam
City of Chino Hills
14000 City Center Drive
Chino Hills, CA 91709

**Notification of Update to Urban Water Management Plan**

Dear Mr. Bartlam,

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December 15, 2015

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City of Chino Hills
14000 City Center Drive
Chino Hills, CA 91709

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December 15, 2015

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County of San Bernardino
385 North Arrowhead
San Bernardino, CA 92415

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December 15, 2015

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**RESOLUTION 703-16**

**RESOLUTION OF THE BOARD OF DIRECTORS OF THE MONTE VISTA WATER DISTRICT, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ADOPTING THE MONTE VISTA WATER DISTRICT'S 2015 URBAN WATER MANAGEMENT PLAN**

---

**WHEREAS,** the California Legislature enacted Assembly Bill 797 (Water Code Section 10610 et seq., known as the Urban Water Management Planning Act) during the 1983-84 Regular Session, and as amended subsequently, mandating that every supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually, prepare an Urban Water Management Plan, the primary objective of which is to plan for the conservation and efficient use of water; and

**WHEREAS,** the Urban Water Management Plan shall be periodically reviewed at least once every five years, and that the District shall make any amendments or changes to its plan which are indicated in the review; and

**WHEREAS,** the California Legislature enacted Senate Bill X7-7 (California Water Code Section 10608 et. seq, known as the Water Conservation Act of 2009) during the 2009 Extraordinary Session, mandating that retail municipal water suppliers establish and include in their 2010 Urban Water Management Plan urban water use reduction targets to assist the state in achieving a 20 percent reduction in urban water use by 2020; and

**WHEREAS,** under California Water Code Section 10608.20, the California Department of Water Resources requires that all water suppliers who filed their 2010 Urban Water Management Plans before 2010 U.S. Census data was available to recalculate their urban water use reduction targets in their 2015 Urban Water Management Plans; and

**WHEREAS,** under California Water Code Section 10608.24, the District is required to determine in its 2015 Urban Water Management Plan whether or not it has met its 2015 urban water use reduction target and to assess its progress toward meeting its 2020 urban water use reduction target; and

**WHEREAS,** Monte Vista Water District is an urban supplier of retail and wholesale water services which, in Fiscal Year Ending 2015, supplied over 16,000 acre-feet of potable and non-potable water to nearly 12,000 retail customers and to its wholesale customer, the City of Chino Hills; and

**WHEREAS,** Monte Vista Water District filed its 2010 Urban Water Management Plan in July 2011, and the full 2010 U.S. Census data set was not available until 2012, thus requiring the District to recalculate its urban water use reduction targets; and

**WHEREAS,** the District's 2015 Urban Water Management Plan demonstrates that the District is currently meeting and exceeding both its 2015 and 2020 urban water use reduction targets; and

**WHEREAS,** the Urban Water Management Plan must be adopted by July 1, 2016, after public review and hearing, and filed with the California Department of Water Resources within thirty days of adoption; and

**WHEREAS,** the District has therefore prepared and circulated for public review a draft 2015 Urban Water Management Plan, including its recalculated urban water use reduction targets; and

**WHEREAS,** a properly noticed public hearing regarding said Urban Water Management Plan, including discussion of the District's method of determining its urban water use targets under the Water Conservation Act of 2009, its compliance with meeting its 2015 interim target, its plan to meet its 2020 target, and the potential economic impacts of meeting these targets, was held by the Board of Directors on June 22, 2016; and

**WHEREAS,** the District did prepare and shall file the said Urban Water Management Plan with the California Department of Resources.

**NOW, THEREFORE BE IT RESOLVED,** the Board of Directors of the Monte Vista Water District does hereby, by this resolution, authorize the adoption of its 2015 Urban Water Management Plan and orders the filing of the plan with the California Department of Water Resources.

ADOPTED this 22nd day of June 2016.

Sandra S. Rose
President of the Board of Directors
MONTE VISTA WATER DISTRICT

ATTEST:

Mark N. Kinsey
Secretary to the Board of Directors
MONTE VISTA WATER DISTRICT

# Appendix F:
# Population Estimate Calculations and Methodologies

# Alternative Methodology to Estimate 2015 Retail Service Area Population

Monte Vista Water District (MVWD) is using the California Department of Water Resources (DWR) online population tool to determine historical population and gallons per capita per day (GPCD) estimates for the purposes of establishing SBX7-7 baselines. The results are attached.

The population tool uses the same methodology for calculating historical MVWD retail service area population to project MVWD's 2015 population as 54,198, which equates to a retail service area population growth of 1.7% since 2010 based on U.S. Census data (54198 - 53284 = 914 / 53284 = 0.017).

However, this rate of growth is inconsistent with the following local knowledge about population growth in the MVWD retail service area:

- At least three multi-family residential complexes with 552 additional residential units have been developed in MVWD's retail service area between 2010 and 2015. Multiplying added multi-family residential units since 2010 (all in Montclair) by the average persons per household and occupancy rate for Montclair in 2015 (California Department of Finance estimates) results in the following calculation: 552 x 3.89 = 2147 x 94.8% = 2036. Added to the 2010 Census service area population provides a 2015 estimated population of 55,320, which equates to a service area population growth of 3.8%.

- The Department of Finance estimates that the population of the City of Montclair, which is served entirely by MVWD and comprises two-thirds of MVWD's retail service area, grew by 4.5% between 2010 and 2015.

- The City of Chino has provided detailed estimates of population growth in the portion of the city served by MVWD, which equates to a 3.3% growth in population.

While the population tool is useful in estimating population between Census years, it appears to have underestimated the growth that has occurred within MVWD's service area since 2010.

MVWD has developed an alternative methodology to calculate its 2015 service area population by using the data from the cities of Montclair and Chino cited above, and applying a melded growth rate since 2010 of 3.9% to the balance of the service area (unincorporated county), resulting in an estimated 2015 population of 55,581 (see attached calculation).

On June 21, 2016, DWR approved the use of the above methodology for estimating MVWD's 2015 retail service area population. MVWD will use the same methodology for estimating population for all other state reporting purposes to maintain consistency of data.

## MVWD 2015 Population Calculation

| Area | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| City of Montclair* | 36,664 | 36,909 | 37,086 | 37,172 | 37,332 | 38,332 |
| City of Chino** | 4,099 | 4,099 | 4,099 | 4,099 | 4,167 | 4,235 |
| Unincorporated*** | 12,521 | 12,563 | 12,593 | 12,608 | 12,739 | 13,014 |
| **Service Area Total**** | **53,284** | **53,571** | **53,778** | **53,879** | **54,238** | **55,581** |

| | | | | | |
|---|---|---|---|---|---|
| Montclair annual growth rates: | 0.7% | 0.5% | 0.2% | 0.4% | 2.7% |
| Chino annual growth rates: | 0.0% | 0.0% | 0.0% | 1.7% | 1.6% |
| Montclair/Chino melded growth rate: | 0.3% | 0.2% | 0.1% | 1.0% | 2.2% |
| | | | | | |
| Montclair growth since 2010: | 0.7% | 1.2% | 1.4% | 1.8% | 4.5% |
| Chino growth since 2010: | 0.0% | 0.0% | 0.0% | 1.7% | 3.3% |
| Montclair/Chino melded growth rate since 2010: | 0.3% | 0.6% | 0.7% | 1.7% | 3.9% |
| | | | | | |
| Retail service area growth since 2010: | 0.5% | 0.9% | 1.1% | 1.8% | 4.3% |

* Department of Finance data.

*** City of Chino 2010-15 estimate, increased by Montclair annual growth rate.*

**** 2010 difference between total and Montclair and Chino population estimates, increased by melded Montclair/Chino annual growth rate.*

***** 2010 total based on 2010 Census data using DWR Population Tool*

# WUEdata - Monte Vista Water District

Sign Out

*Please print this page to a PDF and include as part of your UWMP submittal.*

## Confirmation Information

| Generated By | Water Supplier Name | Confirmation # | Generated On |
|---|---|---|---|
| Justin Scott-Coe | Monte Vista Water District | 6097760856 | 5/24/2016 10:13:08 AM |

## Boundary Information

| Census Year | Boundary Filename | Internal Boundary ID |
|---|---|---|
| 1990 | BoundaryLine.kml | 409 |
| 2000 | BoundaryLine.kml | 409 |
| 2010 | BoundaryLine.kml | 409 |

## Baseline Period Ranges

### 10 to 15-year baseline period

Number of years in baseline period: 10

Year beginning baseline period range: 1996

Year ending baseline period range[1]: **2005**

### 5-year baseline period

Year beginning baseline period range: 2003

Year ending baseline period range[2]: **2007**

[1] The ending year must be between December 31, 2004 and December 31, 2010.

[2] The ending year must be between December 31, 2007 and December 31, 2010.

## Persons per Connection

| Year | Census Block Level Total Population | Number of Connections * | Persons per Connection |
|---|---|---|---|
| **1990** | **43,021** | 9678 | **4.45** |
| 1991 | - | - | 4.51 |
| 1992 | - | - | 4.58 |
| 1993 | - | - | 4.64 |
| 1994 | - | - | 4.70 |
| 1995 | - | - | 4.77 |
| 1996 | - | - | 4.83 |
| 1997 | - | - | 4.89 |
| 1998 | - | - | 4.95 |
| 1999 | - | - | 5.02 |
| **2000** | **48,996** | 9636 | **5.08** |
| 2001 | - | - | 5.09 |
| 2002 | - | - | 5.10 |
| 2003 | - | - | 5.11 |
| 2004 | - | - | 5.12 |
| 2005 | - | - | 5.14 |
| 2006 | - | - | 5.15 |
| 2007 | - | - | 5.16 |
| 2008 | - | - | 5.17 |
| 2009 | - | - | 5.18 |
| **2010** | **53,284** | 10260 | **5.19** |
| **2015** | **-** | **-** | **5.25 **** |

## Population Using Persons-Per-Connection

| Year | | Number of Connections * | Persons per Connection | Total Population |
|---|---|---|---|---|
| **10 to 15 Year Baseline Population Calculations** | | | | |
| Year 1 | 1996 | 9739 | 4.83 | 47,020 |
| Year 2 | 1997 | 9564 | 4.89 | 46,778 |
| Year 3 | 1998 | 9388 | 4.95 | 46,508 |
| Year 4 | 1999 | 9577 | 5.02 | 48,048 |
| Year 5 | 2000 | 9636 | 5.08 | 48,996 |
| Year 6 | 2001 | 9715 | 5.09 | 49,459 |
| Year 7 | 2002 | 9731 | 5.10 | 49,648 |
| Year 8 | 2003 | 9816 | 5.11 | 50,189 |
| Year 9 | 2004 | 9911 | 5.12 | 50,784 |
| Year 10 | 2005 | 9924 | 5.14 | 50,960 |
| **5 Year Baseline Population Calculations** | | | | |
| Year 1 | 2003 | 9816 | 5.11 | 50,189 |
| Year 2 | 2004 | 9911 | 5.12 | 50,784 |
| Year 3 | 2005 | 9924 | 5.14 | 50,960 |
| Year 4 | 2006 | 10023 | 5.15 | 51,578 |
| Year 5 | 2007 | 10164 | 5.16 | 52,416 |
| **2015 Compliance Year Population Calculations** | | | | |
| 2015 | | 10320 | 5.25 ** | 54,198 |

Hide Print Confirmation

# Appendix G:
# Land Use Based Water Demand Model
# Technical Memorandum




ARCADIS Design & Consultancy for natural and built assets

Inland Empire Utilities Agency

# LAND USE BASED DEMAND MODEL DEVELOPMENT

FINAL Technical Memorandum

May 24, 2016

# LAND USE BASED DEMAND MODEL DEVELOPMENT

Technical Memorandum



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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AF | acre-feet |
| af/ac/yr | acre-feet per acre per year |
| AFY | acre-feet per year |
| CEQA | California Environmental Quality Act |
| CVWD | Cucamonga Valley Water District |
| DU | Dwelling Units |
| du/ac | dwelling units per acre |
| FWC | Fontana Water Company |
| GIS | Geographic Information System |
| GIS | Geographic Information System |
| GPCD | gallons per capita per day |
| IEUA | Inland Empire Utilities Agency |
| IRP | Integrated Regional Plan |
| LAFCO | San Bernardino County Local Agency Formation Commission |
| LUD | Land Use Unit Demands |
| MVWD | Monte Vista Water District |
| MWD | Metropolitan Water District of Southern California |
| NOAA | National Oceanic and Atmospheric Administration |
| SAWCo | San Antonio Water Company |
| SOI | Sphere Of Influence |
| TM | Technical Memorandum |
| UWMP | Urban Water Management Plan |

# 1 INTRODUCTION

This Technical Memorandum (TM) summarizes the process used to develop a water demand projection model and identify land use based water demand projections for Inland Empire Utilities Agency (IEUA) and its member agencies. IEUA's member agencies include the cities of Chino, Chino Hills, Ontario, and Upland, Cucamonga Valley Water District (CVWD), Fontana Water Company (FWC), Monte Vista Water District (MVWD), and San Antonio Water Company (SAWCo).

Data development and assumptions are presented in this TM along with a description of the methodologies used to develop the model and projections. The demand projection analysis includes data development and assumptions; and a discussion of the model tool and resulting projections.

# 2 METHODOLOGY

Project objectives are described in this section along with the project study area, an overview of the projection methodology, and a summary of the Demand Model development and use.

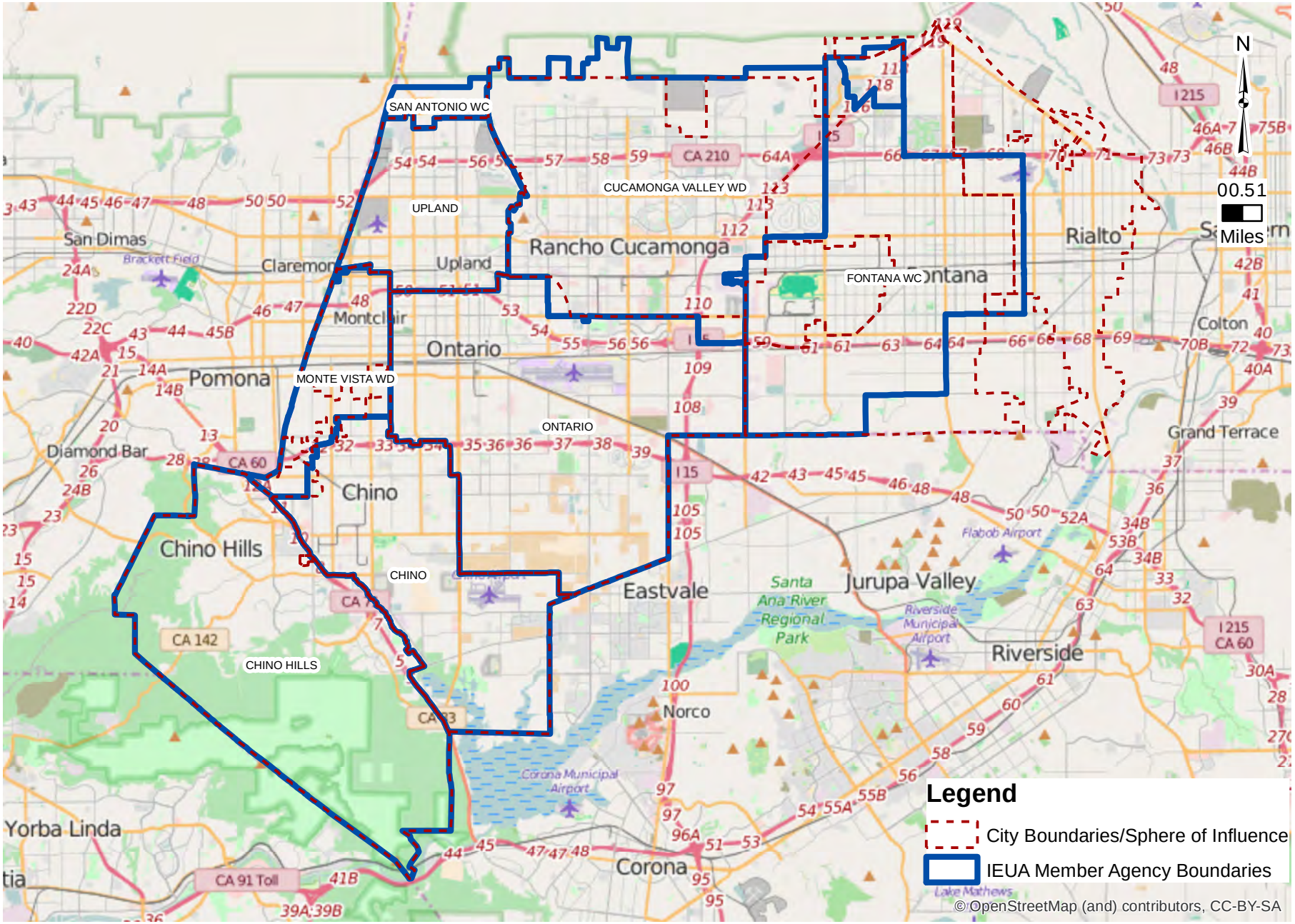
## 2.1 Objectives

To support its planning efforts, IEUA developed a Land Use Based Demand Model (Demand Model) to augment its Integrated Regional Plan (IRP) process in order to provide consistently developed member agency demand projections through 2040. The primary objective was to develop a land use based water demand model that disaggregates regional data to the member agency level for IEUA's Urban Water Management Plan (UWMP). The demand projections can be used by IEUA and member agencies for any system or supply planning purpose that requires detailed demand estimates and projections, such as conservation savings analyses.

## 2.2 Study Area and Boundaries

The study area is IEUA's sphere of influence (SOI). This boundary was established by IEUA to define its limit of future annexation to their existing service area. The SOI for IEUA is established by San Bernardino County Local Agency Formation Commission (LAFCO) to represent LAFCO's designation of the spatial extent of IEUA service. The IEUA SOI is the outermost extent of the study area, with demands projected within this boundary. The SOI delineation has undergone public review and California Environmental Quality Act (CEQA) analysis on growth inducing and other impacts.

Within this IEUA SOI boundary, the eight member agencies have boundaries established to prevent overlapping water service and demand projections. The SOIs for public water purveyors are also established by San Bernardino County LAFCO. Private water companies are governed by the State of California Public Utilities Commission, and do not have LAFCO designated SOIs, thus the use of their established member agency boundaries within IEUA is important. These boundaries are presented on Figure 2-1.




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DEMAND MODEL

**Study Area Boundaries**

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FIGURE 2-1

Within the study area and underlying each of the member agency boundaries, lie eight cities with land use planning authority. The cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, Rialto, and Upland, also have SOIs established by San Bernardino County LAFCO. These boundaries were useful in developing demand projections based on future land uses, as discussed in more detail in Section 3.

## 2.3 Overview of Projection Methodology

As presented on Figure 2-2, , the methodology used to create the Demand Model and identify demand projections relied on developing a land use database within a geographic information system (GIS), and determining Land Use Unit Demands (LUDs). LUDs measure water use on a per acre basis. Figure 2-2 presents the primary tasks for: 1) developing a land use database in orange, 2) unit demands in blue, and 3) demand projections in green.

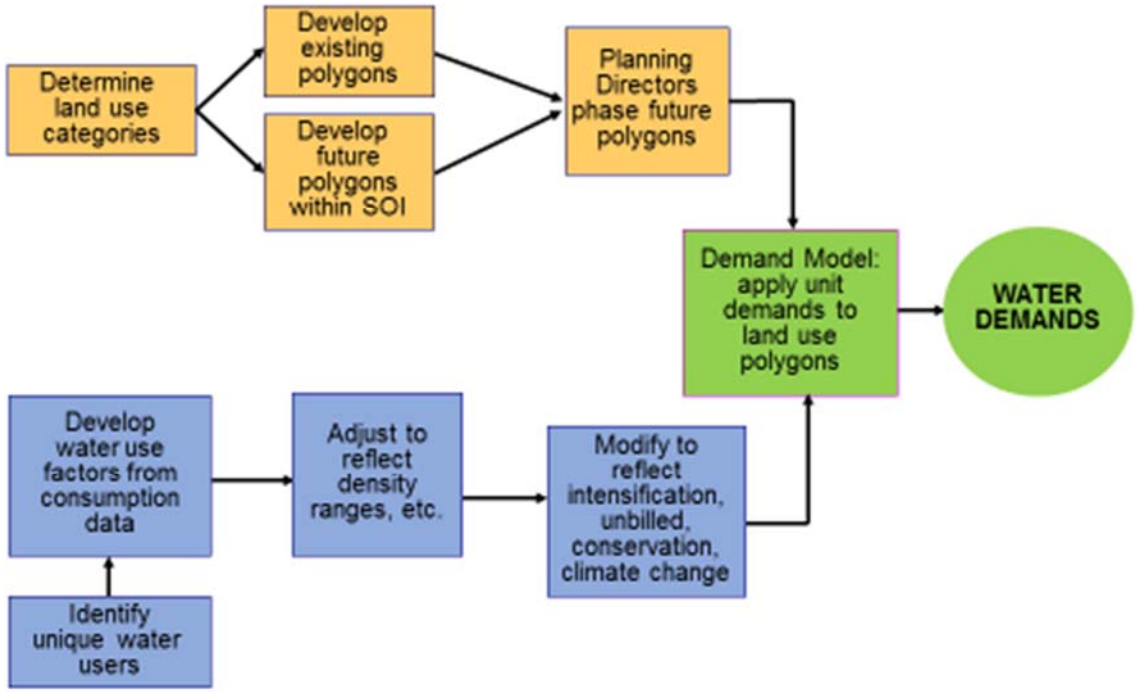



**Figure 2-2: Land Use Based Demand Model Development Process**

The demand projection process relied on the following key assumptions and data development steps.

*Land Use*

- The land use database relied on the SOIs as boundaries for IEUA, public member agencies, and cities.
- Because general plans reflect allowable development, not existing development, actual land uses were mapped by first using city parcel data that was updated as a part of the project to reflect actual land use, thus improving accuracy.
- The projections relied on using approved general plans, specifically the land use element and map for vacant lands identified for future development.
- Planning staff at each land use agency phased development by providing an estimate of potential construction dates for these future land uses.

*Land Use Unit Demands*

- Billing data and unbilled water estimates were provided by member agencies for the previous five years.
- The billing data from 2010 through 2014 were averaged to determine the existing year 2015 "normalized demands", thus smoothing out the annual and seasonal effects of weather and other variables. This approach to normalizing demands was used because of the difficulty separating out the economic complexities of the past eight years (i.e., the Great Recession) and years of drought. The normalized demand became the starting point for the demand projections.
- LUDs were generated for each member agency using existing land use acreage and member agency billing data to ensure that the LUDs reflected the unique demand characteristics of each water purveyor's service area.
- The unbilled water estimate (or unaccounted for water) reflects the percent difference between metered production and consumption; these percentages were provided by each member agency and used as an adjustment factor.
- Climate change impacts on estimated demands in 2040 were obtained from IRP assumptions and used as an adjustment factor.
- Redevelopment, increased densities, repurposing buildings, and other forms of land use intensification as land values increase can have a great effect on future water demands. This was accounted for in the adjustment factors based on an analysis of demand impacts associated with strong market conditions, which was noted in the IRP.
- Conservation savings were obtained from the IRP for plumbing code and efficiency regulation impacts.
- The Demand Model has an adjustment factor category called "Other" that is available to accommodate active conservation savings analyses, by percentage, for each land use, time frame, and member agency.

*Demand Model*

- The Demand Model relied on existing land use and LUDs normalized for 2015 existing demands.
- The Demand Model relied on future land uses and future LUDs, which were existing LUDs adjusted to reflect future changed conditions, to determine water demand projections in five year increments to 2040.
- Demands were identified and projected for each member agency separately which were combined for the IEUA service area in total.

More specific information follows regarding each of these key assumptions and data development steps.

## 2.4 Demand Model Development and Use

The project resulted in a GIS based software application, or tool, to calculate future water demands, called the Demand Model. The Demand Model linked GIS land use polygons and existing land use unit demands (input data) to calculate average annual projections 25 years into the future.

The Demand Model is a Microsoft Access database that contains GIS data collected from IEUA members and land use agencies including parcel data, member agency SOIs, and land use agency boundaries. Additionally, the database also contains layers for future land uses that were developed by the consultant team after consultation with each of the eight land use planning directors (described in Section 3.3 and 3.4). All original data in the individual parcel layer were maintained in this database. A few fields were added to each parcel layer, including the general plan land use, existing land use, year anticipated to be developed, and water purveyor serving the parcel.

The Demand Model can be used to develop demands spatially (by member agency and land use) and temporally (2015 to 2040 in five-year increments). Analysis, such as determining the savings associated with various demand management tools, can be conducted by land use and time frame for member agencies or the entire IEUA service area. The resulting study area Demand Model projections were similar to IRP projections, as described in Section 5.1. The Demand Model projection of approximately 278,000 AF at 2040 were four percent higher than the high range IRP projection.

# 3 LAND USE AND TRENDS

The process of consolidating general plan land use categories for all eight land use planning agencies into one master set of categories is described below, along with how existing and future land use GIS layers and the resulting land use inventories were developed.

## 3.1 Consolidation of Land Use Categories

All cities and counties in California have a general plan to provide and implement the vision for development of each community. All general plans contain a land use element and land use map to describe specific allowable land use and densities for each parcel. City general plans include all lands within their SOI overlapping in some areas with the San Bernardino County general plan that addresses all lands outside of city limits (unincorporated lands).

Each city uses different land use categories in their general plan; therefore, it was important to standardize these categories into a master set for the Demand Model. Appendix A presents the various general plan land use designations and the master set developed for the land use mapping and demand projections. Table 3-1 presents the resulting master set of land use categories and associated residential densities.

**Table 3-1: Land Use Categories**

| Master Land Use Categories |
|---|
| Very Low Residential (<1-2 dwelling units per acre [du/ac]) |
| Low Residential (3-7 du/ac) |
| Medium Residential (8-14 du/ac) |
| High Residential (15-24 du/ac) |
| Very High Residential (25+ du/ac) |
| Commercial |
| Industrial |
| Public/Institutional |
| Parks, Schools, Irrigation |
| Agriculture |
| Unique Water Users |
| Non-irrigated |
| Vacant |

These land use categories were grouped to reflect similar water demand patterns. For example, parks, and other large turf areas receiving irrigation water (served with potable or recycled water, versus private wells) were identified as Parks, Schools, Irrigation, and retained in the database. Lands that do not receive water service were removed or identified as non-irrigated lands. The parks, schools, and other primarily irrigation uses reflect outdoor irrigation water use that aids in analyzing outdoor water demands. This category includes homeowner association common area irrigation accounts wherever possible.

Residential densities were separated into five categories that reflect new development patterns, density groupings of most general plans, and general customer control over irrigation. For example, residential densities associated with apartment buildings and condominiums typically have no control over outdoor irrigation.

“Mixed use” designations in the general plans reflected different configurations of mixed uses such as different commercial use, or commercial and residential use within the same project boundary but not necessarily on the same parcel. A standard convention for mixed use designations is commercial use on the ground floor with residential above, with a “mixed use” land use category developed. However, since the model needs spatial land use data, and the standard convention was not used for these cities, mixed use lands were delineated to reflect the percentages identified in the general plan or specific plan of planned land uses for each individual development project.

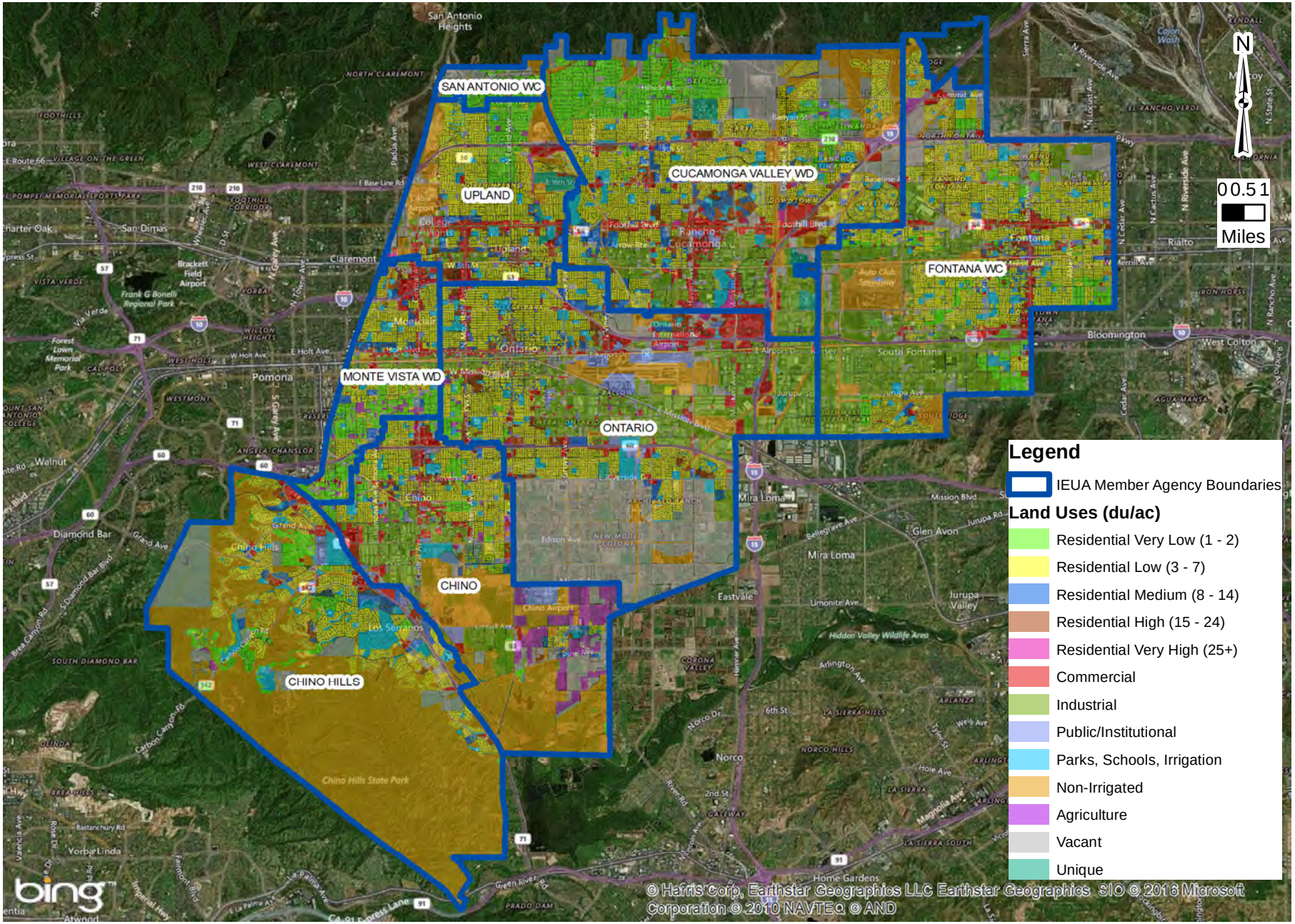
When the Demand Model is updated in the future, a new land use category should be considered to reflect higher densities of residential use. The Very High category in the model reflects densities of 25 du/ac or greater, which is appropriate now. As the region develops “up not out”, it is likely the general plans will be amended to accommodate higher density development.

## 3.2 Existing Land Use Layer Development

Spatially referenced existing land use polygons were created for the entire IEUA service area. Each polygon represents an area of predominant land use identified through parcel data provided by the cities and the county. The parcel data indicating existing land use typically have one category each for single family residential and multi-family residential use. In addition, many of the parcels are labeled “undefined”. For this study, existing land use categories were more specifically defined (e.g., five categories of residential land use and identification of all undefined parcels) using Google Earth maps and street view, windshield surveys, and meetings with community development departments. This extensive effort to improve the classification accuracy of over 70 percent of the existing land use resulted in a detailed database of existing land use that will yield increased accuracy of the LUDs.

The existing land use layer is not an exact replica of land uses but a best estimate. The process started with the use of parcel boundaries used to delineate each land use. But this often resulted in odd shaped polygons in areas such as airport tarmacs or new growth areas in southern Ontario where the ownership boundary does not match the general plan land use boundaries. Areas with parcel shapes that would have a significant impact on the accuracy of the demands, such as New Model Colony in Ontario, were modified to reflect the general plan land use map polygons.

“Unique water users” are identified as customers with consumption patterns determined by the agencies to be unusual, significantly higher (up to 1,240 percent higher) or lower (up to 340 percent lower) than the average customer of that sector. Unique users were separated from general land use categories to prevent a high or low water user from skewing the average unit demand for that particular land use for




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**Existing Land Uses**

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FIGURE 3-1

each member agency. The unique water users were maintained in the Demand Model as a separate land use.

The result is a GIS layer with existing land use that is presented on Figure 3-1 for the entire study area. Figure 3-2 presents an example of existing land use polygons. Existing land use maps for each member agency can be found in Appendix B.




**Figure 3-2: Detail of Existing Land Uses**

An important land use category in the existing land use database is “Vacant” lands. These vacant lands were defined as not having a current water demand but were designated on the general plans for future urban use having a demand for water. Vacant and agricultural lands that were not identified in the general plan for a future urban use were designated as “Non-irrigated” and include open space, agricultural lands with private water supply, or other lands with private water supplies that will remain private. Although open space lands could include uses with a water demand, each was carefully reviewed to determine if it was natural open space that was not irrigated or was irrigated by private well water. Non-irrigated lands also include significant road and highway rights-of-way and airport tarmacs; supporting airport uses with a water demand were not included in the non-irrigated tarmac polygons; these large land areas are an urban use but typically have minimal demand. The vacant lands with a future urban use were incorporated into a new GIS mapping layer for future land uses.

## 3.3 Future Land Use Layer Development

An important part of developing land use based water demand projections, is reliance on locally defined visions of how communities are to grow and change during the planning horizon. Using vacant land use parcels identified during existing GIS land use map development, the city general plan maps were applied to these vacant lands to identify future land uses. Future GIS land use maps were then generated to reflect these future developments. General plans are the most reliable indicators of future development policy because they have been subjected to extensive public review and rigorous environmental documentation prior to adoption. General plans, however, have a single hypothetical buildout date, used for analyses of environmental impacts associated with the full buildout of all lands in accordance with the

land use map. Actual development will occur at varying rates and times, and can extend beyond these general plan dates. Therefore, a more accurate method for identifying the timing of projected water demands based on the general plan was used and is described in the subsequent section.

## 3.4 Land Use Planning Agency Meetings

It is important to have city land use planners identify anticipated timing of development. They are the most knowledgeable of development activities, growth patterns, and trends within their city. The project team held meetings with planning or community development departments of each city (see inset below), with representatives of the applicable water purveyor in attendance, along with IEUA representative(s).

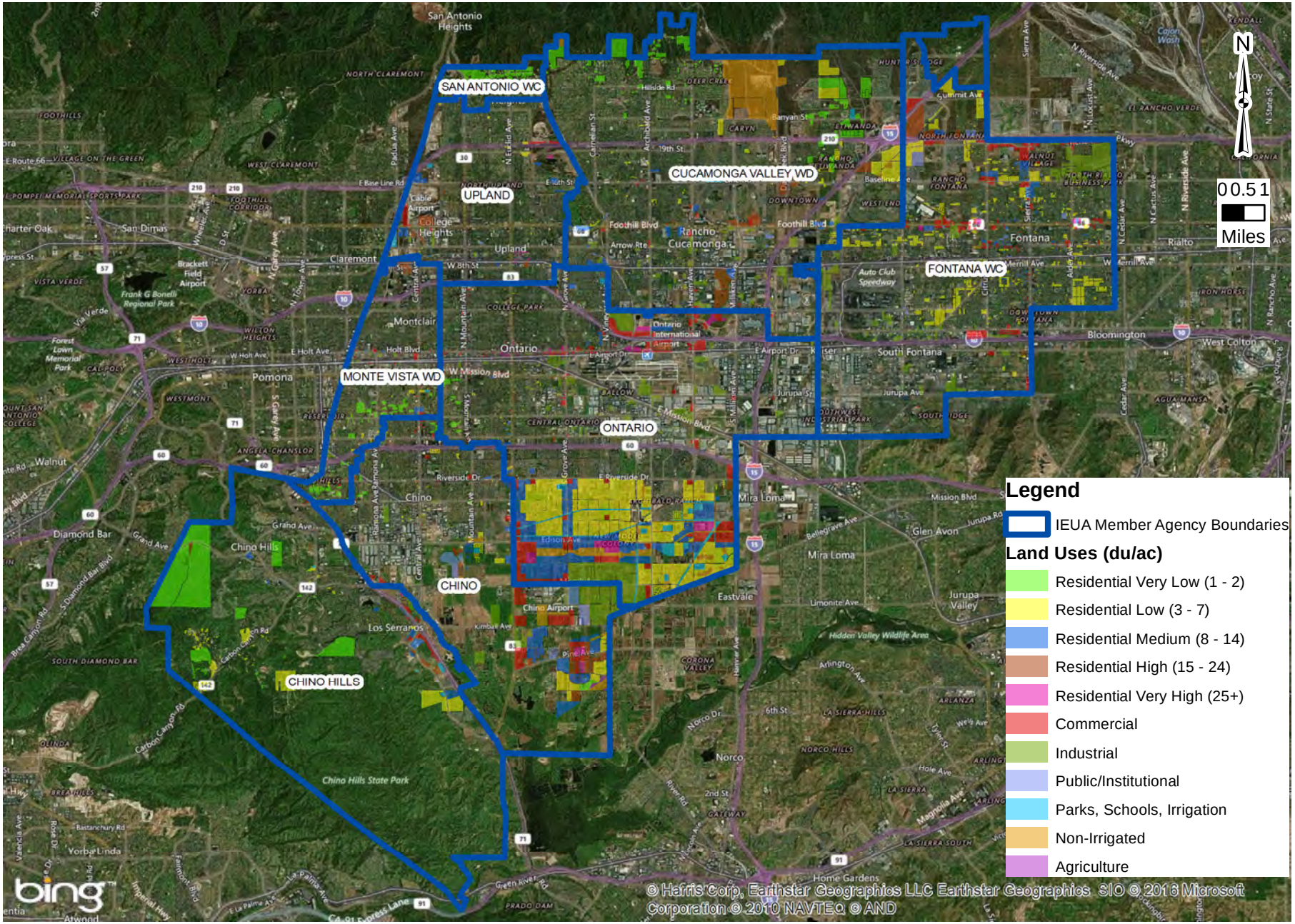
Existing land use maps were provided for each of the eight member agencies using their boundaries to capture service area land use. Future land use maps were also provided for each city within their SOIs. The meetings focused on the confirmation or identification of general plan land use for vacant land that is developable, and the planning representatives' best estimate of development time frame in five year increments through 2040. As 2015 is the year for existing demands, any development under way currently or in the recent past, and not in water billing data, was assigned a 2020 development date for water demand purposes. Also addressed at the meetings were confirmation of boundaries and a general review of existing land uses.

**Land Use Agencies**

- City of Chino
- City of Chino Hills
- City of Fontana
- City of Montclair
- City of Ontario
- City of Rancho Cucamonga
- City of Rialto (partially in Fontana Water Company boundary)

Planning staff provided information on observed land use trends and areas of redevelopment (creating denser development) and reuse (reusing existing buildings for different purposes) in their cities. Trends are discussed later in Section 4.3. Most densification changes are anticipated to not be a change in land use designation, but rather a reuse or repurposing of buildings or redevelopment of lands with higher density buildings within general plan-allowable ranges. These areas reflecting an intensification of use, will result in increased water demands but not necessarily a change in land use designation. The process to accommodate intensification of uses is discussed in Section 4.3.

The existing and future land use maps were edited in the GIS database based on these planning agency meetings. Figure 3-3 presents future land uses within the study area. Appendix B provides future land use maps for each of the member agencies.




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**Future Land Uses**

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FIGURE 3-3

## 3.5 Acreage Inventories

Based on the existing and future land use GIS mapping effort as described in previous sections, acreage inventories were generated in the Demand Model for each member agency. Table 3-2 presents the acreage of each land use within the study area to be developed over the planning horizon. The total acreage may not reflect the total IEUA service area because large areas of open space lands that will not have a water demand (e.g., most of Chino Hills State Park) were not included. Table 3-3 presents the net change in acreages for each land use.

**Table 3-2: Study Area Acreage Inventory**

| | Acreage Inventory by Year | | | | | |
|---|---|---|---|---|---|---|
| **Land Use (du/ac)** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| **Residential Very Low (<1 - 2)** | 9,089 | 9,504 | 10,155 | 10,282 | 10,115 | 11,522 |
| **Residential Low (3 - 7)** | 26,329 | 27,090 | 28,463 | 29,691 | 30,804 | 32,593 |
| **Residential Medium (8 - 14)** | 3,067 | 3,500 | 3,959 | 4,425 | 4,663 | 5,915 |
| **Residential High (15 - 24)** | 2,349 | 2,678 | 3,131 | 3,263 | 3,300 | 3,427 |
| **Residential Very High (25+)** | 231 | 256 | 283 | 408 | 466 | 646 |
| **Commercial** | 6,838 | 6,925 | 7,180 | 7,994 | 8,456 | 9,221 |
| **Industrial** | 16,974 | 18,587 | 19,856 | 20,141 | 20,306 | 20,420 |
| **Public/Institutional** | 2,979 | 2,990 | 3,066 | 3,095 | 3,289 | 3,334 |
| **Parks, Schools, Irrigation** | 5,629 | 5,687 | 5,657 | 5,890 | 5,963 | 6,154 |
| **Agriculture** | 2,026 | 1,534 | 1,175 | 630 | 376 | 68 |
| **Unique Water Users** | 863 | 863 | 852 | 852 | 852 | 852 |
| **Non-Irrigated** | 34,438 | 34,410 | 35,668 | 35,833 | 35,904 | 36,085 |
| **Vacant** | 19,724 | 16,512 | 11,090 | 8,032 | 6,042 | 298 |
| **Total** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** | **130,537** |

Acreage inventories from the Demand Model for each member agency can be found in Appendix C. As shown in Table 3-2, the largest percent increase in land use in the study area is very high density residential at 180 percent increase. The largest acreage increase by 2040 is low density residential by 6,264 acres. The majority of this new low density residential is attributed to new growth areas in Ontario's New Model Colony and Chino's The Preserve. These lands are currently agricultural lands, but as shown in Table 3-2, most agricultural lands will decline over time as they are converted to urban uses. Medium and high density residential lands are also anticipated to increase at a greater rate (percentage) than very low and low density.

Land use patterns that are unique to each member agency can be identified by studying the maps in Appendix B and the acreage inventories in Appendix C. This is where the agricultural conversions of Ontario and to a lesser extent, Chino, are apparent. And MVWD's service area does not have a lot of

vacant or agricultural land for development but is still growing as infill parcels are developed. Another interesting characteristic in the future acreage inventories in Appendix C is the decrease in acreage for the Parks, Schools, Irrigation land use designation for Rancho Cucamonga and Upland. This decrease in acreage reflects a statewide trend of golf courses replacing some or all of its lands with medium or other density residential uses.

**Table 3-3: Changes in Acreage from 2015 to 2040**

| Land Use (du/ac) | Percent Change |
|---|---|
| **Residential Very Low (1 - 2)** | 27 |
| **Residential Low (3 - 7)** | 24 |
| **Residential Medium (8 - 14)** | 93 |
| **Residential High (15 - 24)** | 46 |
| **Residential Very High (25+)** | 180 |
| **Commercial** | 35 |
| **Industrial** | 20 |
| **Public/Institutional** | 12 |
| **Parks, Schools, Irrigation** | 9 |
| **Agriculture** | -97 |

What is not apparent from the inventories are characteristics such as the extensive underutilized lands in the Fontana Water Company service area that will be consolidated and developed with higher densities. There are currently many acres of very low density (<1 to 2 du/ac) residential lands with a small house on a large unirrigated parcel, and is designated as low density residential. A development pattern has emerged where parcels have been consolidated and homes replaced with a subdivision reflecting a general plan designation of low density (up to 7.6 du/ac in the Fontana General Plan). An example is provided on Figure 3-4.

As discussed in Section 4, acreages have a LUD assigned to them that represents average conditions for that land use within that service area. The LUDs for each land use were adjusted to reflect changing conditions in the study area such as intensification of land uses. An exception to the use of LUD adjustment factors to accommodate intensification can be found with Fontana's very low density land use.



**Fontana Very Low Density Residential**

This is an example of very low density residential land use next to a subdivision of low density residential that was likely built from a consolidation of parcels.

**Figure 3-4: Fontana Very Low Density Residential**

# 4 WATER USE AND ADJUSTMENT FACTORS

Existing water demands are described in this section, along with the development of LUDs, LUD adjustment factors, and the resulting future LUDs.

## 4.1 Existing Demands

### 4.1.1 Establishing Existing Year Demands

Year 2015 was selected at the "existing year" to develop existing demands. To smooth out the effects of weather, and other annual variability, five years of billing data by billing sector were averaged. Averaging of data was used as the methodology to "normalize" demands because of the difficulty teasing out the effects of multiple dry years sandwiching a wet year versus conservation outreach to the public versus the economy partially rebounding from the Great Recession. Water billing data reflects metered consumption. Both the historical five year period of metered consumption and the normalized 2015 demand are presented on Figure 4-1. The existing year (2015) demands are 190,175 acre-feet (AF).

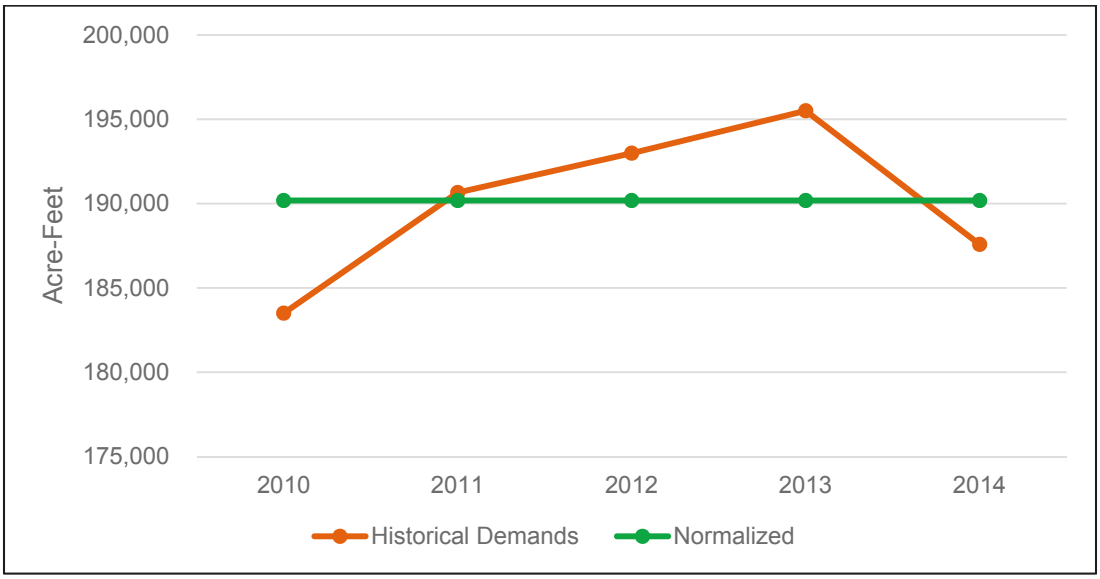



**Figure 4-1: Historical Water Demands**

## 4.2 Existing Land Use Unit Demands

Consumption patterns vary throughout IEUA's service area based on local conditions such as microclimate, demographics, economics, and land use densities. Land Use Unit Demands or LUDs were generated to represent these spatial characteristics of consumption patterns by developing existing LUDs on a per acre basis for each land use within each member agency boundary.

### 4.2.1 Disaggregation of Billing Data

In general, LUDs are calculated by dividing the estimated normalized consumption by the acres for a similar land use. This results in a unit demand of x acre-feet per acre per year (af/ac/yr) for each land use

for each member agency. For example, five years of commercial billing data in CVWD averaged 2,196 acre-feet per year (AFY). The total acreage of commercial use is 1,592 acres. Therefore, 2,196 divided by 1,592 equals an existing CVWD commercial LUD of 1.38 af/ac/yr.

Each member agency tracks and bills metered water consumption differently. The billing data range from 3 to 10 billing sectors or categories for each member agency. Since many of these do not align exactly with the 13 master land uses of the Demand Model, the billing data were disaggregated to apply to the land use categories. For example, data for a "single family residential" billing category were disaggregated into three land use categories: Very Low, Low, and Medium, by determining the prevalent average density of each of the three land use categories multiplied by the total number of existing acres of each land use (based on the Demand Model acreage inventory) to determine the approximate number of dwelling units.

An AFY)/Dwelling Unit (DU) factor was developed using the sum of the dwelling units; this unit factor was then apportioned to each of the three single family land use densities to reflect consumption patterns based on density. For example, approximately 40,600 single family residential dwelling units (i.e., very low, low, and medium densities) in CVWD's service area were calculated from identified densities. Single family residential billing data of 27,790 AFY was divided by 40,600 DUs resulting in 0.68 AFY/DU. Applying 0.68 AFY/DU to approximately 26,140 single family-low density dwelling units resulted in a distribution of Low Density Residential demands of approximately 17,900 AFY. The Very Low category has a higher consumption for the individual home (approximately 1 AF/DU) yet has a lower consumption on a per acre basis (1.85 af/ac/yr), compared with the other categories. Conversely, a Medium density residential dwelling unit has a lower consumption (0.46 AF/DU) than a Very Low and Low density dwelling unit, but has a higher consumption on a per acre basis (4.57 af/ac/yr) because there are more dwelling units per acre.

For multi-family residential billing data, since the majority of water demands are associated with indoor water consumption, the billing data were applied to the estimated total number of dwelling units (based on the prevalent average densities) and the same unit demand per dwelling unit was applied to the average prevalent density to obtain the calculated LUD.

Often the commercial, industrial, and other non-residential uses are combined in the billing data. LUDs from other communities were sometimes used to separate out the demands associated with a specific land use. For example, Fontana Water Company has a Public Authority billing category. The Public/Institutional LUDs from four other member agencies were averaged to obtain an LUD for Public/Institutional for Fontana Water Company with the balance of its Public Authority billing data assigned to Parks, Schools, and Irrigation. This resulted in LUDs for both categories that are within range of the other member agencies.

Another example is the City of Upland. Billing data from its Commercial/Industrial category was separated by applying a typical commercial LUD obtained from Irvine Ranch Water District and East Bay Municipal Utility District LUDs, which were similar, to the data with the balance assigned to Industrial. This resulted in an Industrial LUD for Upland which is higher than the other member agencies for Industrial. Since Upland does not have low water uses associated with warehousing and distribution that other member agencies have, the resulting LUDs are reasonable.

### 4.2.2 Existing LUDs

Table 4-1 presents a comparison of existing LUDs for each member agency by land use. These LUDs represent normalized consumption, but without unbilled water (production) estimates. As shown in Table 4-1, each agency has different service area characteristics represented in their unit demands. These LUDs are calculated outside of the Demand Model using current billing data. They can be easily updated in the future with new billing data and updated existing land use inventories for each agency.

**Table 4-1: Existing Land Use Unit Demands**

| Land Use | Existing Land Use Unit Demands (af/ac/yr) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Chino | Chino Hills | CVWD | FWC | MVWD | Ontario | SAWCO | Upland |
| **Residential Very Low (<1 - 2)** | 1.73 | 1.40 | 1.85 | 1.25 | 1.27 | 1.20 | 2.34 | 1.90 |
| **Residential Low (3 - 7)** | 2.60 | 2.47 | 2.88 | 2.75 | 2.11 | 2.12 | 0.00 | 2.84 |
| **Residential Medium (8 - 14)** | 4.36 | 4.10 | 4.57 | 6.70 | 4.67 | 5.27 | 4.95[1] | 4.95 |
| **Residential High (15 - 24)** | 4.78 | 4.28 | 6.07 | 11.55 | 9.86 | 7.60 | 6.36 | 8.95 |
| **Residential Very High (25+)** | 6.88 | 6.88[4] | 8.81 | 15.66 | 0.00 | 13.20 | 0.00 | 13.96 |
| **Commercial** | 1.31 | 3.34 | 1.38 | 6.54 | 2.13 | 2.82 | 2.20 | 2.13 |
| **Industrial** | 0.22[3] | 1.07 | 0.51 | 0.33 | 0.65 | 0.38 | 0.00 | 1.07 |
| **Public/Institutional** | 1.31 | 1.17 | 2.73[2] | 2.73[2] | 2.39 | 2.82 | 2.20 | 3.52 |
| **Parks, Schools, Irrigation** | 4.99 | 3.11 | 6.88 | 4.99 | 4.72 | 7.48 | 0.00 | 5.87 |
| **Agriculture** | 0.00 | 0.00 | 0.28 | 0.00 | 0.34 | 15.08 | 0.00 | 0.00 |
| **Unique Water Users #1** | 299[5] | | 3.62 | | 5.59 | 47.57 | | 1.33 |
| **Unique Water Users #2** | 186[5] | | 1.47 | | 43.49 | 18.81 | | 242[5] |
| **Unique Water Users #3** | 81[5] | | 7.43 | | | 10.07 | | 4.57 |
| **Unique Water Users #4** | | | 2.58 | | | | | 3.08 |

Note: Existing LUDs reflect normalized consumption billing data. Unbilled estimate (production) not included here.
[1] Used Upland Medium density residential LUD for SAWCO Medium density residential

[2] Average Public/Institutional LUD from four agencies applied to FWC and CVWD

[3] Highest Industrial LUD used for Chino Hills due to lack of warehousing and distribution uses

[4] Used Chino Very high density residential LUD for future Chino Hills Very high density residential

[5]Chino Unique Water Users and 1 Upland Unique are not located; 1 acre was used with full water demands.

## 4.3 Adjustment Factors

Looking back on Figure 2-2, the LUDs presented in Table 4-1 are applied in the Demand Model to the acreages of land use to determine existing and future demands. The land uses may be undeveloped or

agricultural lands presently to be converted to an urban use in the future – this is a simple calculation of changing the agricultural land use category for each polygon reflecting the City planning staff input on timing resulting in overall increased urban acreage. The next step is to adjust the resulting water demands to reflect more specific existing and future conditions. There are two types of adjustment factors applied to existing LUDs. One, an unbilled water estimate to change the demands from billed consumption to total production demands. The second type are future adjustment factors to approximate how water demands change over time due to climate change, intensification, and conservation. The land use changes over time were discussed in Section 3.3. The adjustment factors described here were applied to the Existing LUDs using the Demand Model to calculate Future LUDs. Each of these adjustment factors are described here along with their correlation to impacts on water demands.

### 4.3.1 Unbilled Water

The existing demand reflects metered consumption data, or billed water use. The Demand Model identified water needs for the quantity of water entering distribution systems, or production requirements. The difference between production and consumption demands has historically been called unaccounted for water or unmetered water. These uses reflect authorized water use that is not billed and other water losses. Authorized uses typically include fire flows, unmetered public facilities, and water main flushing. Other water system losses typically include losses from pipe breaks, storage facilities, and service connections. System losses also can include unauthorized consumption, metering inaccuracies, and other unidentified loss. For the Demand Model, the difference between production and billed consumption is called the unbilled water estimate.

Unbilled water, as provided by each member agency, ranged from two to nine percent of production. The unbilled water estimates were applied to the individual existing LUDs for each member agency. The total production demands are five percent higher than total normalized metered consumption data. It is recommended that as the member agencies conduct water loss analyses, or reduce system losses over time, that their adjustment factor be modified to reflect updated information.

### 4.3.2 Climate Change

The following impacts identified by the Department of Water Resources are associated with climate change that could also impact the study area.

- Increased surface temperature of 5.5 to 10.4 degrees fahrenheit anticipated by the end of the century
- Heat waves will increase in frequency, magnitude, and duration
- Longer, drier, and more frequent periods of droughts are anticipated with up to 2.5 times the number of critically dry years by the end of the century

The IEUA IRP analyzed long term climate change impacts on water demands by reviewing recent predictions of potential increases in temperature. Long term climate change assumptions were based on a National Oceanic and Atmospheric Administration (NOAA) Technical Report (NOAA, 2013), which stated that the anticipated increased temperatures of 3.6 degrees Fahrenheit have the potential to increase water use by as much as 4.3 percent by 2040. However, this number was reduced to 3.2 percent by 2040 for this Demand Model region and applied to four of the residential density demands and outdoor irrigation demands to reflect the trend of new development having less outdoor irrigated landscaping. Using 0

percent at 2015 and 3.2 percent at 2040, an adjustment factor for the intervening years was calculated as a linear interpolation and input to the Demand Model.

### 4.3.3 Intensification

There are many factors that influence water demands associated with land use development patterns, land uses, and activities. Our understanding of these factors is based on discussions during the eight land use planning agency meetings, research on local socioeconomic trends and conditions, analyses of land use patterns observed from the GIS database in the Demand Model, and land use planning trends observed throughout California. The study area is still rebounding from the Great Recession and market conditions for the region are noted by economists to be strong with higher employment and higher occupancy rates anticipated. As agricultural lands develop to urban uses, some communities are reaching "buildout". But the term buildout is a bit of a misnomer as lands are continually evolving over time, resulting in an "up not out" land use pattern shift. In addition, land values are increasing and are anticipated to increase over the 25 year planning horizon which contributes to higher densities and higher utilization of existing buildings or lands. Although difficult to quantify specifically, all of these conditions result in an intensification of land uses and thus higher water demands on a per acre basis. Visual examples are provided in the photos of denser commercial land use patterns (e.g., newer 2-story buildings with high occupancy, smaller floor space but more businesses, more food services, and less parking) reflecting intensification resulting in higher unit water use demands on a per acre basis.

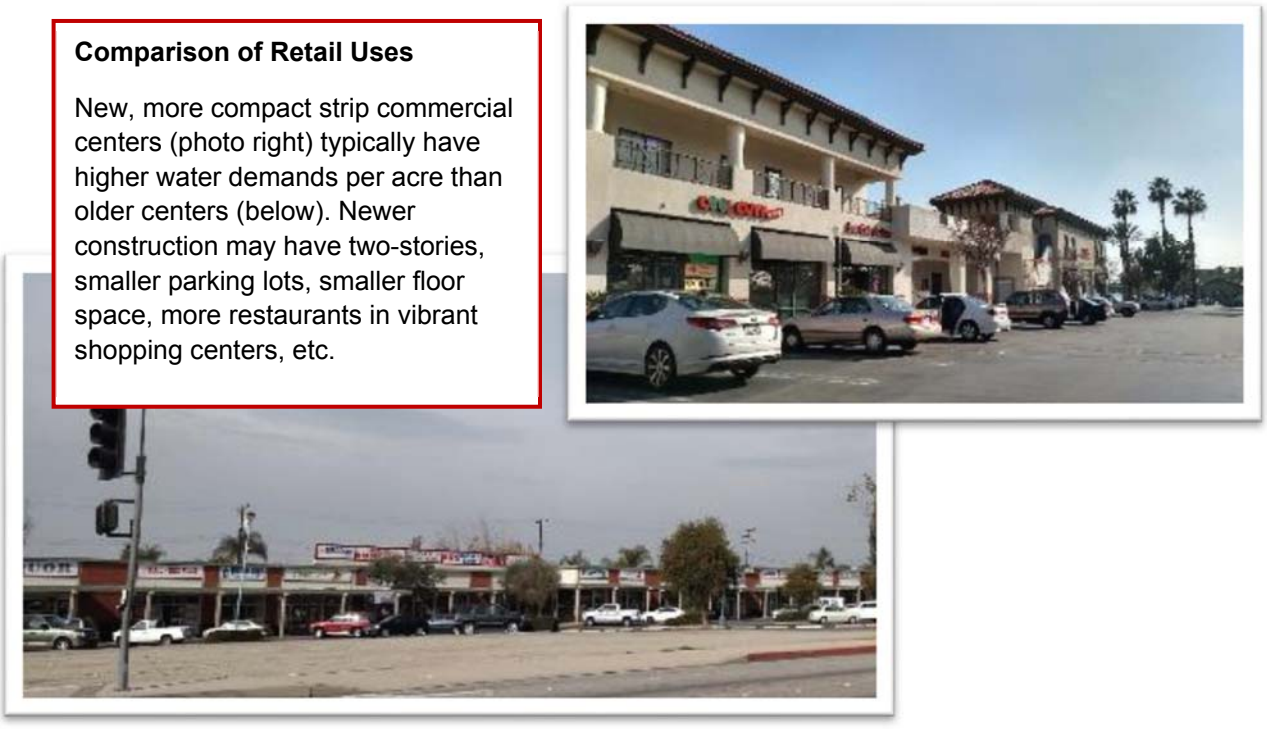



**Figure 4-2: Comparison of Retail Uses**

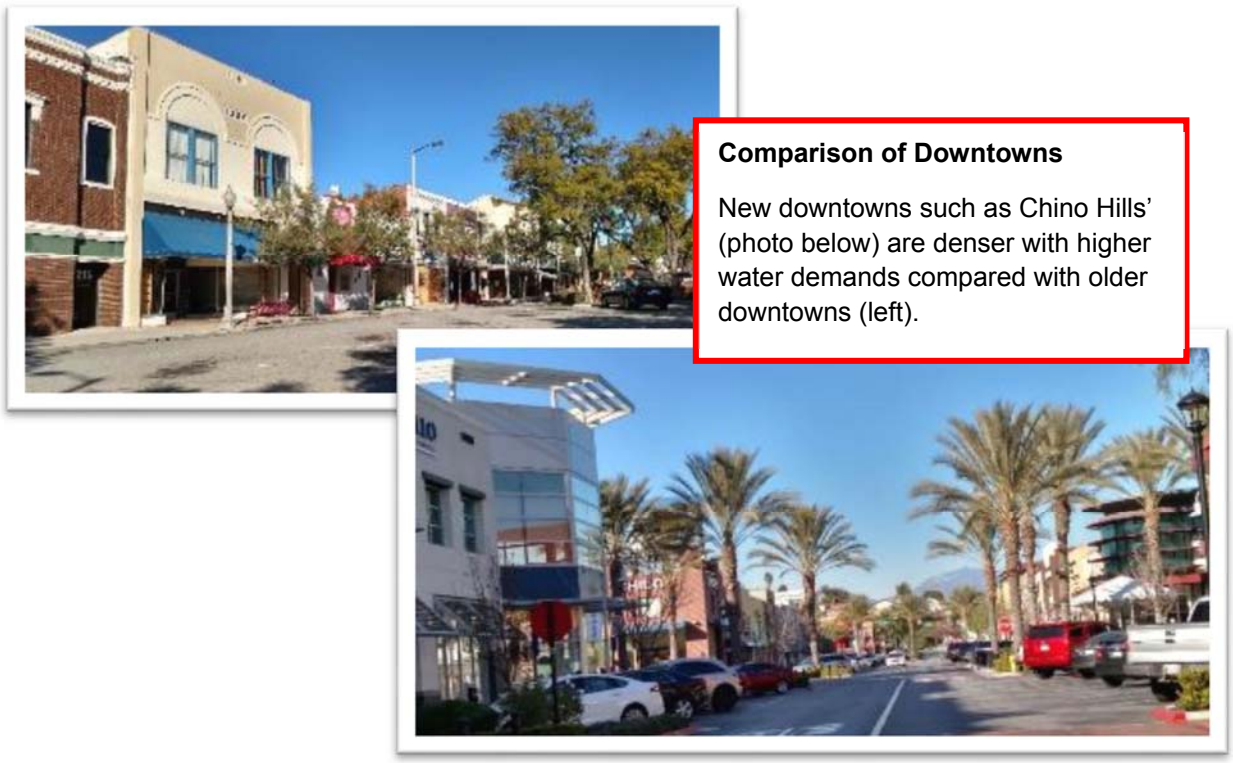



**Figure 4-3: Comparison of Downtowns**

As the member agencies observed during the past eight years, recessions result in reduced water use. Rebound from the Great Recession is still occurring in the study area with gradually increasing demands with strong market conditions anticipated through 2040. Vacant industrial lands are rapidly being developed, and although the predominant industrial use is warehousing and distribution – with low water use – most vacant industrial lands were anticipated by the land use agencies to be built out by 2025 if not sooner. When these large vacant parcels are built out, the region will likely see a consolidation of smaller parcels with currently underutilized uses, replaced with new industrial uses. For example, several city planning staff indicated that older industrial buildings that are vacant or have low occupancy or otherwise underutilized uses are being purchased with adjoining parcels with the intent to consolidate the lands and build larger industrial facilities. Although office commercial vacancy rates are currently very high, with no construction occurring in this sector, the lack of new construction will eventually result in vacancy rates decreasing with more employees per acre, until new commercial office lands are developed.

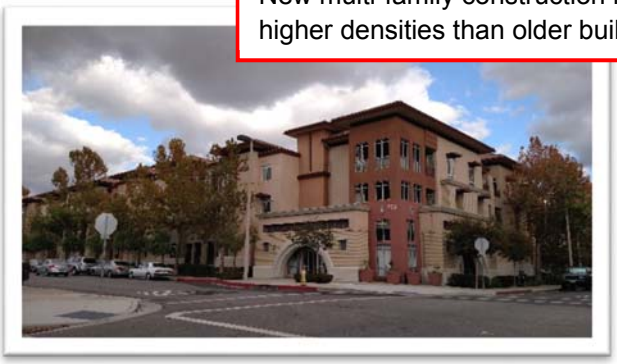
A "jobs per acre" analysis was conducted to determine the intensification of employment on non-residential lands. The total 2015 employment estimate of 350,460 for the study area (IRP data from Center for Demographic Research using Southern California Association of Governments data) was applied to the 2015 acreage inventory (for commercial, industrial, and public/ institutional land uses) resulting in 13.1 jobs per acre. The 2035 employment estimate of 488,930 was applied to the 2035 acreage, resulting in 15.3 jobs per acre, a 17 percent increase.

There are many acres of underutilized lands which will change in character as land values increase, such as the industrial example described above. Another example is new retail or office construction in shopping center parking lots. Most of the large areas of underutilized lands are in unincorporated areas under San Bernardino County development regulations, although all unincorporated lands in the study area are also within a sphere of influence of a city. Within cities, underutilized lands and buildings also exist, but aren't as prevalent. Land use planners discussed many redevelopment projects where obsolete buildings will be replaced with higher density and intensity of uses, within the same land use designation. This is likely to occur throughout the study area as land values continue to increase and population increases.

Existing residential land use, of which 35,420 acres are low and very low density residential (46 percent of 2015 lands with a water demand), will have changes in water demands associated with unpermitted conversion of garages to living spaces, increased numbers of multiple generational households under one roof, and expansion of homes to accommodate more people per household. A study in the Bay Area comparing water consumption between 1996 and 2005 for low density residential sample areas, found an increase in water demands ranging from 6 to 12 percent due increased intensification of existing land uses (EBMUD, 2009).

Repurposing buildings – for example a train station housing retail stores or restaurants – will likely occur throughout the study area as the economy improves. Another trend is that cities are allowing underutilized industrial buildings to accommodate more customer related functions, such as will-call centers or sports activities, resulting in more employees and customers per acre.

The most prominent trend discussed at the land use agency meetings and observed in the analysis of existing land uses, is the overall increased densities of residential land use occurring and planned in the study area. Increased residential densities have the greatest potential for increasing water demands on a per acre basis, although actual demands decrease on a per dwelling unit and per capita basis due to the reduction of outdoor landscaping associated with compact residential growth.



New multi-family construction has higher densities than older buildings.

Compact development is evident in the land use inventory data that shows the majority of land uses are low density residential but the greatest increase in residential land use is associated with very high density residential use. Each community is planning for higher densities and in general, developers are maximizing allowable densities as cities experience frequent general plan amendment requests. Smart growth is a concept typically associated with compact development along and near transportation corridors, and this trend is being observed in the cities' promoting a revitalization of their downtowns and near Metrolink stations.

Another form of intensification is typically found with the development of small infill parcels that are too small, less than five acres, to be identified on the GIS existing land use layer. However, for this analysis, because much of the existing land use data provided in the GIS parcel files needed clarification, it provided an opportunity to specifically identify many of these small vacant lots. They were therefore included with the land use inventory as vacant, instead of being included as another factor to consider in the development of an intensification adjustment factor.

The intensification adjustment factor was determined using economic data developed for the IRP. The impact to water demands associated with strong market conditions alone, were estimated to increase demands by seven percent. A more conservatively lower estimate of six percent by 2040, with an extrapolation from 2015 for interim demands, was applied in the Demand Model.

In the future when individual customer meters are geocoded and consumption data can be linked and saved in the Demand Model GIS, it is recommended that sample areas be analyzed to compare consumption patterns of older development to newer development of similar land use. This historical comparison data will contribute to quantifying part of the intensification adjustment factor.

### 4.3.4 Conservation

Conservation savings associated with plumbing code changes and water use efficiency programs were determined in IEUA's 2015 Wastewater Facilities Master Plan. Flow monitoring of older residential developments compared with new homes indicated a reduction of indoor flows from an average of 55 gallons per capita per day (GPCD) to 37 GPCD. The proportional share of this indoor reduction on total 2040 residential demands is approximately 2.8 percent. This 2.8 percent at 2040, with an extrapolation from 2015 for interim demands, was used as the conservation adjustment factor and applied to the member agencies' land uses in the Demand Model.

### 4.3.5 Other

The Demand Model has an additional tab in the adjustment factors to allow the user to conduct demand management or other scenarios. The conservation adjustment factor addresses the indoor plumbing code and other efficiency savings, but the "Other" adjustment factor tab could be used by IEUA or its member agencies to study savings potential associated with conservation program scenarios for different land uses.

## 4.4 Future Land Use Unit Demands

There are over 2,000 adjustment factors in the Demand Model. Tables with these adjustment factors can be found in Appendix D. The adjustment factors for each member agency, are applied in the Demand Model to the Existing LUDs to generate Future LUDs, for each land use under each planning period and each member agency. Appendix D Land Use Unit Demands, contains tables of the resulting LUDs after they were adjusted. The LUDs are applied in the Demand Model to the acreage inventories for each member agency to calculate the total production water demands.

# 5 WATER DEMAND PROJECTIONS

Based on the land use GIS layers (existing and future) and the LUDs (existing and future) developed for each member agency, future demands for each land use within each member agency were calculated. This process is summarized in this section along with a discussion of other projection methodologies. Use of the Demand Model is also summarized here with a reference to the User Guide.

## 5.1 Demand Projections through 2040

Future demands were calculated in the Demand Model by applying the Final LUDs (Appendix D) to the acreage inventories of land use for each member agency's service area. This resulted in a total IEUA demand of approximately 278,040 AF at 2040, a 38 percent increase over 2015 normalized production demands (production demands include system losses). Table 5-1 and Figure 5-1 presents the water demands for the IEUA service area for existing normalized 2015, and projected years 2020, 2025, 2030, 2035, and 2040.

**Table 5-1: Demand Projections for IEUA**

| Land Use (du/ac) | Five Year Incremental Demand Projections (AF) | | | | | |
|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Residential Very Low (<1 - 2) | 15,761 | 16,753 | 18,097 | 18,557 | 18,778 | 21,303 |
| Residential Low (3 - 7) | 73,060 | 75,949 | 80,499 | 84,647 | 88,824 | 94,202 |
| Residential Medium (8 - 14) | 16,012 | 18,376 | 20,967 | 24,117 | 25,806 | 33,264 |
| Residential High (15 - 24) | 18,611 | 21,212 | 25,739 | 27,062 | 27,752 | 28,827 |
| Residential Very High (25+) | 2,634 | 2,904 | 3,300 | 5,105 | 6,009 | 8,292 |
| Commercial | 19,607 | 19,922 | 20,885 | 24,281 | 27,068 | 29,455 |
| Industrial | 6,974 | 7,601 | 8,143 | 8,318 | 8,436 | 8,529 |
| Public/Institutional | 7,285 | 7,354 | 7,627 | 7,746 | 8,138 | 8,257 |
| Parks, Schools, Irrigation | 32,890 | 33,607 | 33,756 | 35,988 | 36,975 | 38,926 |
| Agriculture | 2,274 | 1,466 | 1,188 | 559 | 309 | 23 |
| Unique Water User #1 | 3,848 | 3,872 | 3,878 | 3,903 | 3,926 | 3,949 |
| Unique Water User #2 | 1,487 | 1,498 | 1,507 | 1,515 | 1,523 | 1,533 |
| Unique Water User #3 | 1,068 | 1,074 | 1,082 | 1,088 | 1,095 | 1,101 |
| Unique Water User #4 | 368 | 371 | 373 | 375 | 377 | 379 |
| | **201,879** | **211,959** | **227,041** | **243,261** | **255,016** | **278,040** |

On Figure 5-1, total IEUA demands are shown using the shaded area and values read from the right vertical axis. The individual member agency demands are shown using different lines and values are reads from the left vertical axis.

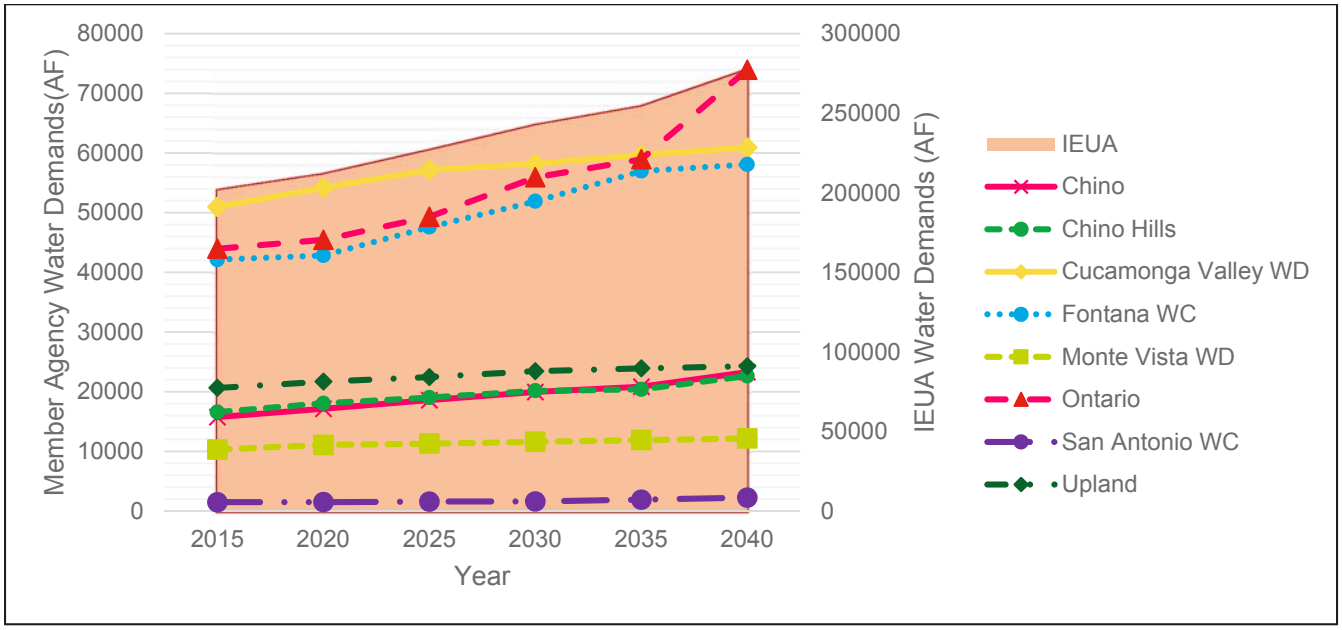



**Figure 5-1: Demand Projections by Member Agency**

As shown on Figure 5-1, total water demands increase gradually between 2015 and 2035 with a slightly steeper curve between 2035 and 2040. The steeper curve in later years is primarily attributed to the large amounts of residential land uses to be developed in Ontario's New Model Colony. Development this land is anticipated to be at the outer end of the study planning horizon. Appendix E contains tables of the resulting projection of water demands by member agency and combined into a total IEUA demand.

Because the projections do not include active conservation efforts, these projections should be considered an upper end. If the City of Ontario's New Model Colony developments are delayed, its projections will likely extend beyond 2040.

There are many methodologies used to project water demands, ranging from simple per capita projections to complex, data-intensive econometric models. The various methodologies rely on different data and assumptions in trying to project future conditions in a changing environment. The land use based demand projections are typically within approximately 10 percent above and 10 percent below actual demands when smoothed to remove annual climatic influences, assuming nothing significant occurs like a great recession. If something significant occurs, since the demands are based on general plan land uses, the later date projections typically remain while interim demands recover.

Different methods can result in slightly or significantly different projections. Per capita projections are inexpensive and simple to develop because they rely on easily available data. However, they are not rigorous, and do not reflect the complexities of water demand patterns or different community characteristics. Therefore, although the results may be consistent with land use based demands for the first few years, as the land use composition (changing percentage of each land use) and characteristics (e.g., higher densities) change over time to reflect that planned for by the community, the per capita demands do not reflect these changing conditions.

Econometric models can be rigorous if socioeconomic data are available and used, as with the IEUA IRP model. These models are typically more cost effective for large service areas, such as Metropolitan Water

District (MWD) or IEUA as a region, to capture regional demographic, economic, and other (e.g., climate change) characteristics and trends that are not site specific to smaller entities. IEUA's econometric model demand projections were similar to the land use based demand projections. Several of its analytical analyses quantifying demand characteristics, such as passive conservation, economic rebound, and climate change, were of particular value to the Demand Model, as presented in this TM.

In summary, different demand projection methodologies will result in different projections. The more rigorous methodologies typically result in projections within a range of plus 20 percent and minus 20 percent of each other. This may be attributable to the use of underlying source data. The similarity in projections of the land use based Demand Model and the IRP econometric model (within four percent) provides a very high level of confidence to use the results as a reliable predictor for future planning projects.

It is recommended that demand projections be updated every ten years or less. This will ensure that changing community characteristics are captured, and that accurate projections are continually relied on for planning purposes.

## 5.2 Use of Demand Model

The land use based Demand Model (welcome menu screenshot presented on Figure 5-2) was developed to perform the calculations described in the previous sections. The major inputs to the model included city general plans, parcel data, city boundaries, IEUA retail agency SOIs in GIS format, and LUDs calculated as described in sections 4.3 and 4.4.

The main purpose of the Demand Model was to provide detailed, rigorously developed demand projections for each member agency. The model does that, as well as test various scenarios to study the effects of conservation, for example, through the use of adjustment factors. The resulting projections described in Section 5.1 were developed using the best available data at a point in time.

As the cities and communities in IEUA's service area develop and change over time, the demand projections can be updated based on new data. For example, if new growth areas in the City of Ontario, which has large land areas converting from agricultural uses to urban over an extended period of time, change land use designations to higher densities than now planned, the acreage inventories can be modified through changes to the GIS files. The model would be re-run to determine the effect on the city's or IEUA's overall demand. Another example is with the intensification of the older commercial areas in the IEUA service area; higher densities are being proposed by developers for underutilized and infill sites. The land use categories can be easily modified in the GIS files to reflect these approved changes and the model re-run. The underlying GIS files and LUDs can also be updated if the development timelines assumed in this study change or updated LUDs are calculated by retail agencies. Appendix F contains a User Guide as a reference document to run these scenarios. The Demand Model, created in Microsoft Access, is completely open and customizable if IEUA or its member agencies choose to add more features in the future.

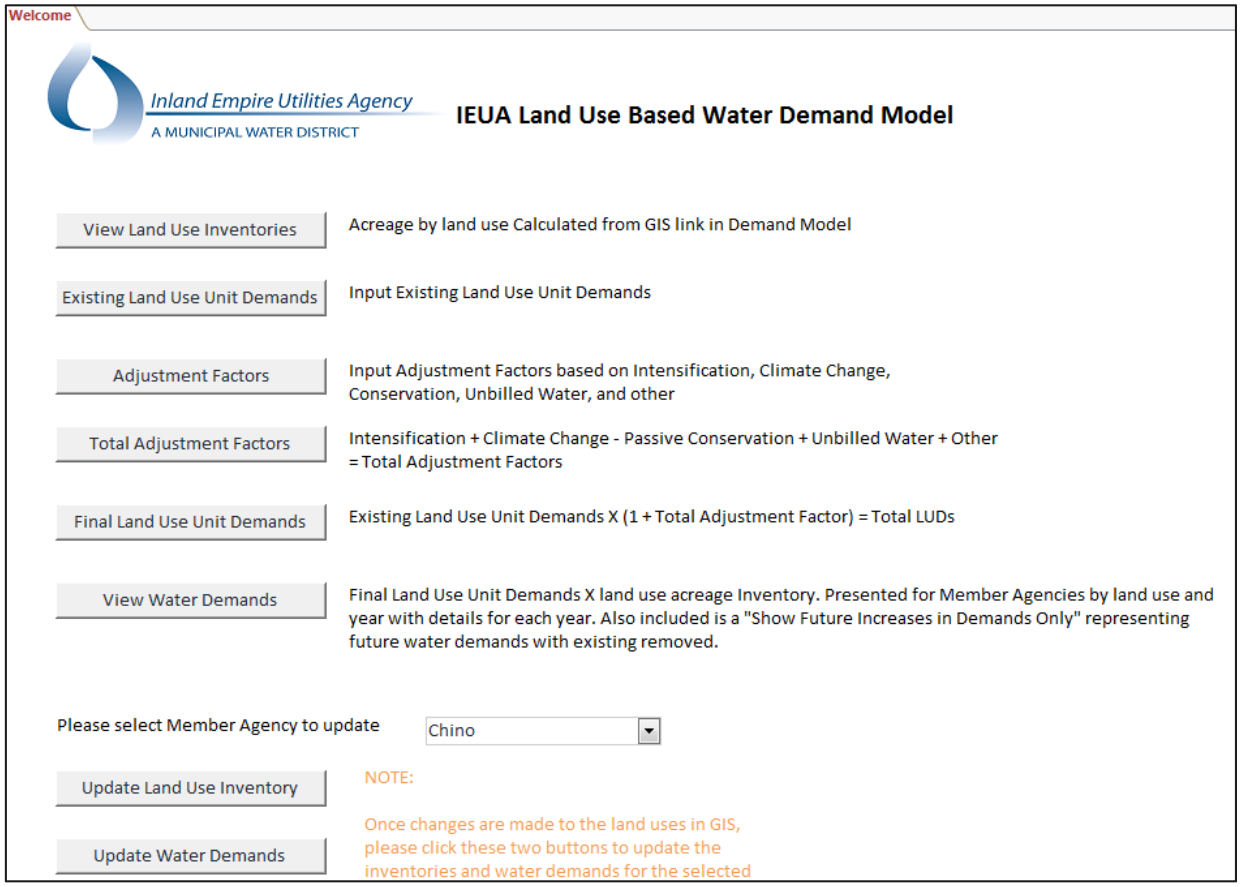



**Figure 5-2: Land Use Based Demand Model Screenshot**

# 6 REFERENCES

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# APPENDIX A

## Land Use Categories

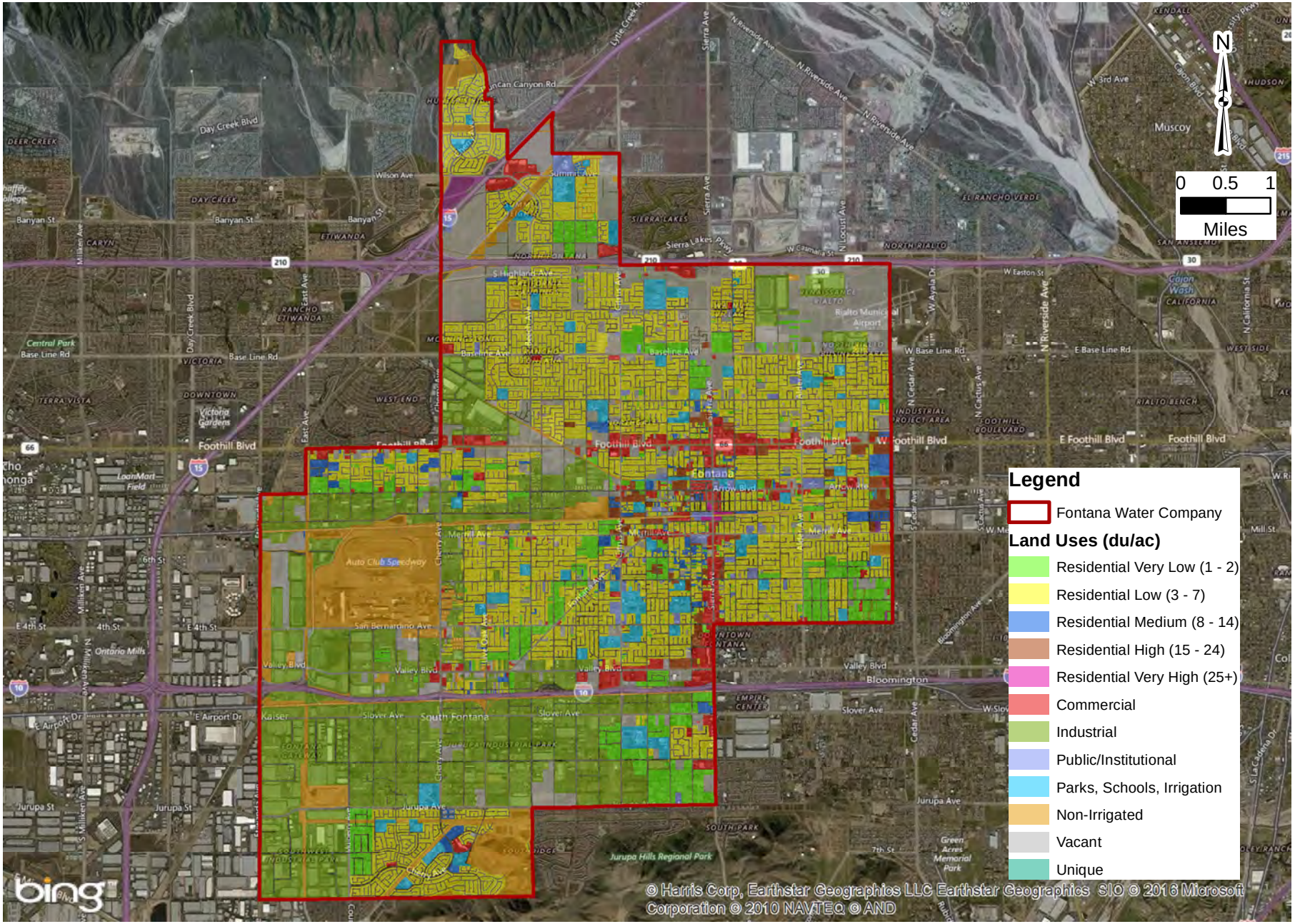
# Appendix A - Land Use Categories

| Master GP LU Categories | Density (du/ac) | City of Chino: Chino GP Land Uses | Density (du/ac) | City of Chino Hills: Chino Hills GP Land Uses | Density (du/ac) | City of Fontana: Fontana GP Land Uses | Density (du/ac) | City of Montclair: Montclair GP Land Uses | Density (du/ac) | City of Ontario: Ontario GP Land Uses | Density (du/ac) | City of Rancho Cucamonga: Rancho Cucamonga GP Land Uses | Density (du/ac) | City of Rialto: Rialto GP Land Uses | Density (du/ac) | City of Upland: Upland GP Land Uses | Density (du/ac) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Residential** | | Agriculture | | Agriculture/Ranches | 0-0.2 | | | | | | | Hillside Residential | 0.1-2 | Residential 2 | 0-2 | SFR | 0-2 |
| **Very Low** | <1.0-2.0 | RD 1 | 0-1 | Rural Residential | up to 2 | Residential Estates | 2.0 | Very Low | 0-2 | Rural | 0-2 | Very Low | 0.1-2 | | | SFR | 2-3 |
| | | RD 2 | 1-2 | | | | | | | | | | | | | | |
| **Low** | 3.0-7.0 | RD 4.5 | 3-4.5 | Low Density Res | up to 6 | Single Family Res | 2.1-5 | | | | | Low | 2-4 | Residential 6 | 2.1-6 | SFR | 3-4 |
| | | | | | | Residential Planned Community | 3-6.4 | Low | 3-7 | Low Density | 2.1-5 | Low Medium | 4-8 | | | SFR | 4-6 |
| | | RD 8 | 4.5-8 | | | Medium Density Res SFR detached | 5.1-7.6 | | | | | | | | | | |
| **Medium** | 8.0-14.0 | | | Medium Density Res | up to 12 | SFR attached or MFR | 7.7-12 | Medium | 8-14 | Low-Medium Density | 5.1-11 | Medium | 8-14 | Residential 12 | 6.1-12 | SFR | 7-10 |
| | | RD 12 | 8-12 | | | | | | | | | | | | | MFR / Condo | 7-12 |
| | | RD 14 | 12-14 | | | | | | | | | | | | | Mobile Home | 8-14 |
| **High** | 15.0-24 | | | High Density Res | up to 25 | Multi-Family Res | 12.1-24 | High | 15-30 | Medium Density | 11.1-25 | Medium High | 14-24 | Residential 21 | 12.1-21 | MFR | 12-20 |
| | | RD 20 | 14-20 | | | | | Senior Housing | | | | High | 24-30 | | | MFR Condo | 12-20 |
| | | Mixed Use 20 | 0-20; 1.25 FAR | | | | | | | | | | | | | | |
| **Very High** | 25.0+ | Mixed Use 30 | 0-30; 1.5 FAR | Very High Density Res | up to 35 | MFR Medium/High | 24.1-39 | | | High Density | 25.1-45 | | | Residential 30 | 22.1-30 | | |
| | | | | | | MFR High | 39.1-50 | | | | | | | | | | |
| **Mixed Uses were identified by actual planned uses** | | College Park Specific Plan | | Mixed Use | NA | Regional Mixed Use | 12-24 du/ac; 0.1-1.0 FAR | Planned Development (i.e., mixed uses) | | Mixed Uses: 12 identified areas | | Mixed Use: 13 identified areas | 0.25-1.0 | Downtown Mixed Use | 6.1-60 du/ac; 1.5 FAR | Specific Plans: 3 areas | |
| | | The Preserve Specific Plan | | | | | | | | | | Haven Ave Office Overlay | | Specific Plan Overlay | | | |
| **Commercial** | | Office Commercial | 1.0 FAR | Commercial | 0.3 FAR | Community Commercial | 0.1-1.0 FAR | Medical Center | | Hospitality | 1.0 FAR | Office | 0.4-1.0 | Office | 0.75 | Highway Commercial | |
| | | Neighborhood Commercial | 0.3 FAR | Business Park | 0.75:1 FAR | General Commercial | 0.1-1.0 FAR | Office Professional | | Office Commercial | 0.75 FAR | Neighborhood Commercial | 0.25-0.35 | Community Commercial | 0.35 | Central Trading | |
| | | General Commercial | 1.0 FAR | | | | | Neighborhood | | Neighborhood | | | | Business Park | 1.0 | Commercial Professional | |
| | | Regional Commercial | 0.6 FAR | | | | | Commercial | | Commercial | 0.4 FAR | Community Commercial | 0.25-0.35 | | | Office Only | |
| | | Business Park | 0.6 FAR | | | | | General Commercial | | General Commercial | 0.4 FAR | | | | | Transit Commercial | |
| | | Service Commercial | 0.6 FAR | | | | | Regional Commercial | | Business Park | 0.6 FAR | | | | | Regional Commercial | |
| | | | | | | | | Business Park | | | | | | | | Neighborhood Business - Specialty | |
| | | | | | | | | | | | | | | | | Neighborhood Conservation | |
| | | | | | | | | | | | | | | | | Mixed Use: Commercial/Industrial | |
| **Industrial** | | Light Industrial | 0.6 FAR | | | Light Industrial | 0.1-0.6 FAR | Industrial Park | | Industrial | 0.55 FAR | Industrial Park | 0.4-0.6 | Light Industrial | 1.0 | Light Industrial | |
| | | General Industrial | 0.6 FAR | | | General Industrial | 0.1-0.6 FAR | Limited Manufacturing | | Airport | | General Industrial | 0.5-0.6 | General Industrial | 1.0 | Industrial/Loft Mixed | |
| | | | | | | | | | | | | Heavy Industrial | 0.4-0.5 | | | Neighborhood Industrial | |
| | | | | | | | | | | | | | | | | Cable Airport | |
| | | | | | | | | | | | | | | | | Light Industrial/Neighborhood | |
| **Public/ Institutional** | | Public | | Institutional/Public | 0.5:1 | Public Facilities | 0.1 FAR | Public/Quasi Public Community Plan (unincorporated Narod Tract and Kadota Homes Tract) | | Public Facility | | Civic/Regional | 0.4-1.0 | Public Facility | 1.0 | | |
| | | | | Commercial Recreation | 0.10:1 | Activity Center Overlay | 7.1-24 du/ac; 0.1-1.0 FAR | | | | | | | | | Public/Gvnt: civic center, schools, public works, hospital, etc. | |
| **Parks, Schools, Irrigation** | | Public Schools | | Public Park | | Recreational Facilities | 0.1 FAR | Neighborhood Park | | Public School | | Schools | 0.1-0.2 | School Facility | | Park | |
| | | | | Private Open Space (HOAs etc) | | | | | | Open Space - park land | | Parks | | Open Space Recreation | | | |
| | | | | | | | | | | Open Space - NonRecreation | | | | | | | |
| **Non-Irrigated Open Space** | | Recreation/Open Space | | CH State Park | | Open Space | | Conservation Basins | | Open Space - Water | | Open Space | | Open Space Resources | | Open Space | |
| | | Urban Reserve | | Public Open Space | | Public Utility Corridors | | | | Rail | | Conservation | | | | Flood Control | |
| | | | | | | | | | | | | Flood Control/Utility | | | | | |
| | | | | | | | | | | Landfill | | Corridor | | | | Reservoir | |
| **Agriculture** | | Agriculture | | | | | | | | | | | | | | Edison Easement | |
| | | | | | | | | | | | | | | | | Landfill closed | |

Land Use Demand Model

# APPENDIX B

## Land Use Maps



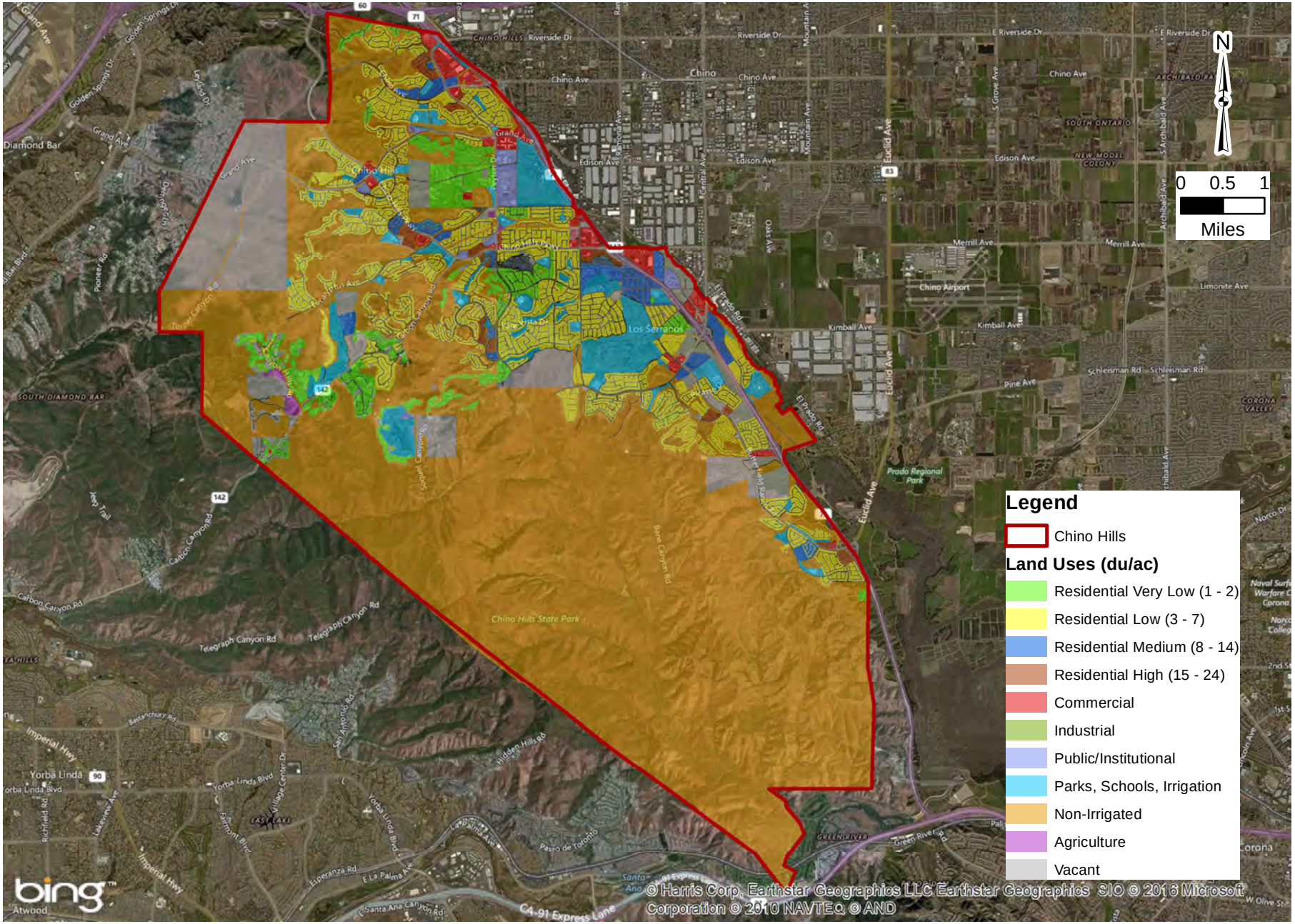

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Fontana Water Company – Existing Land Use**

ARCADIS

May 2016
FIGURE B-1



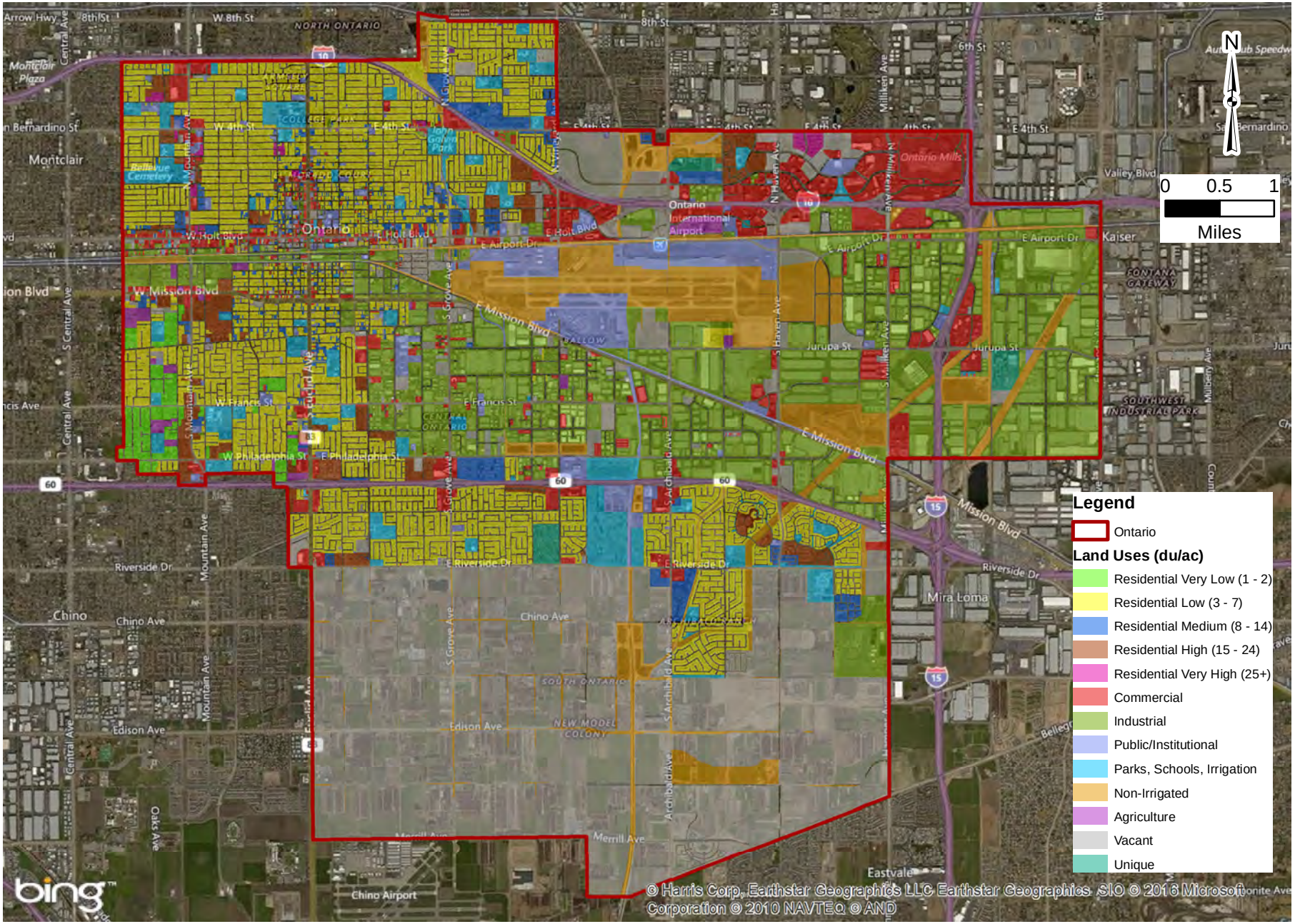

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino Hills – Existing Land Use**

ARCADIS

May 2016
FIGURE B-2



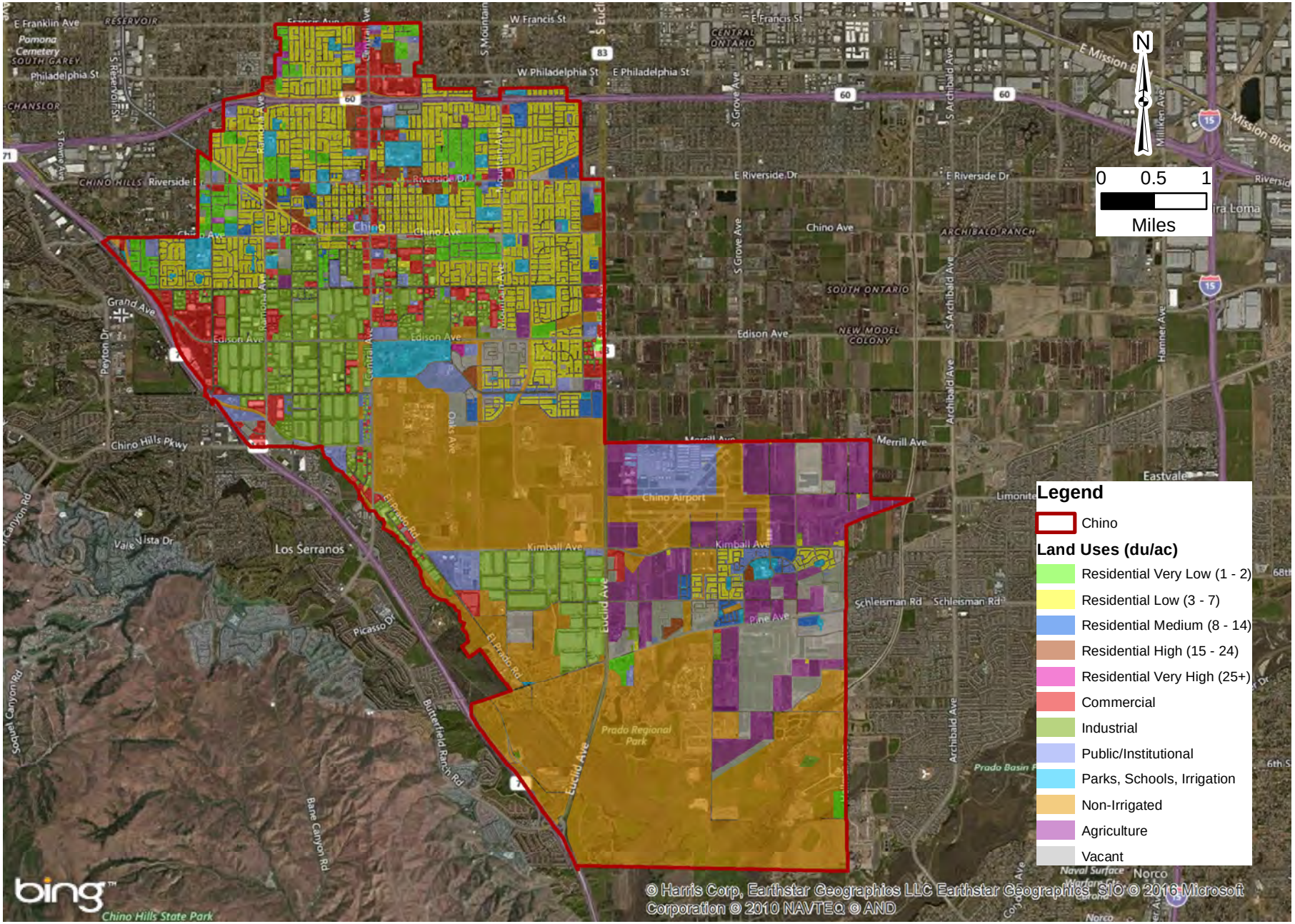

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Ontario – Existing Land Use**

ARCADIS

May 2016
FIGURE B-3



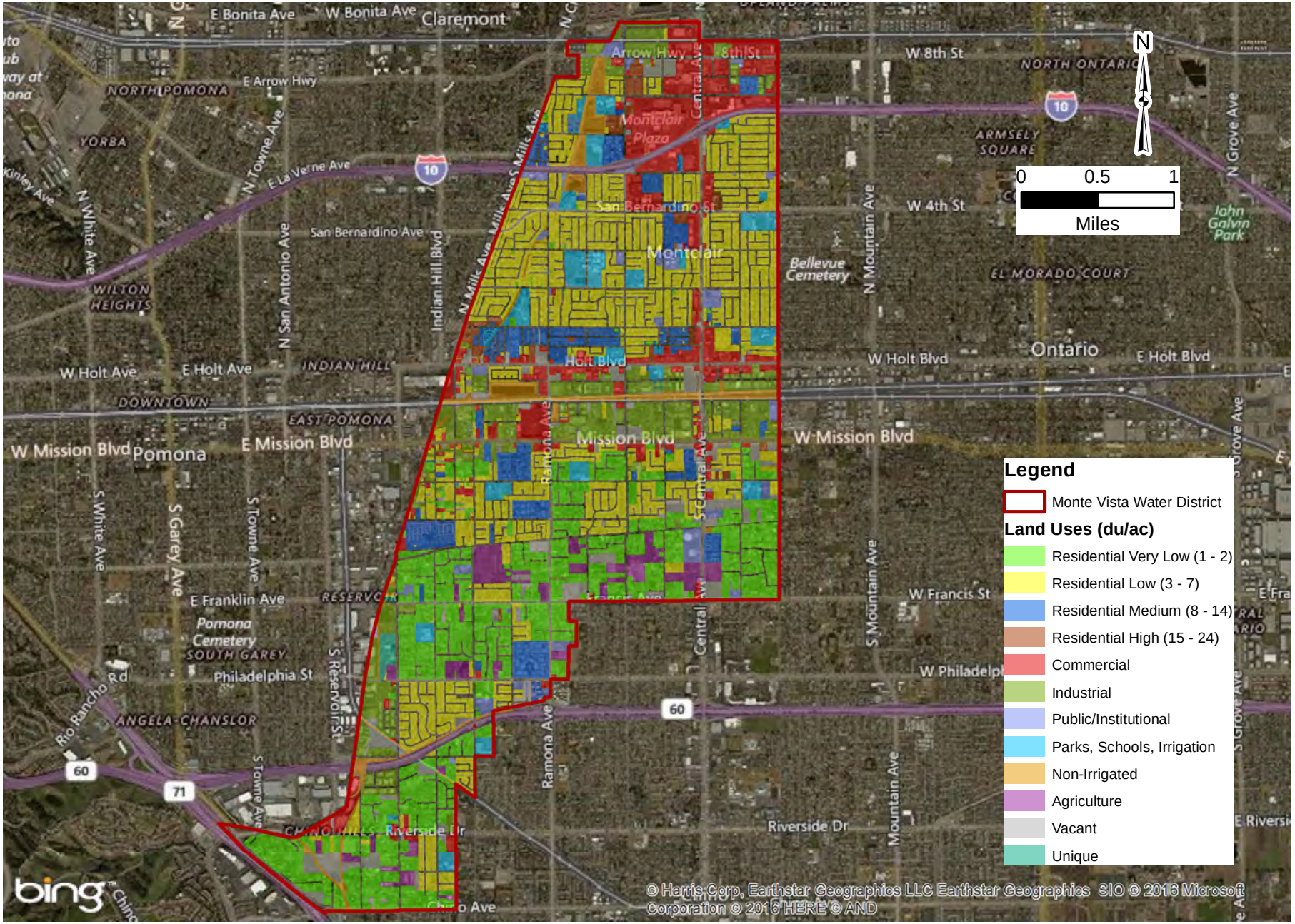

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino – Existing Land Use**

ARCADIS

May 2016
FIGURE B-4



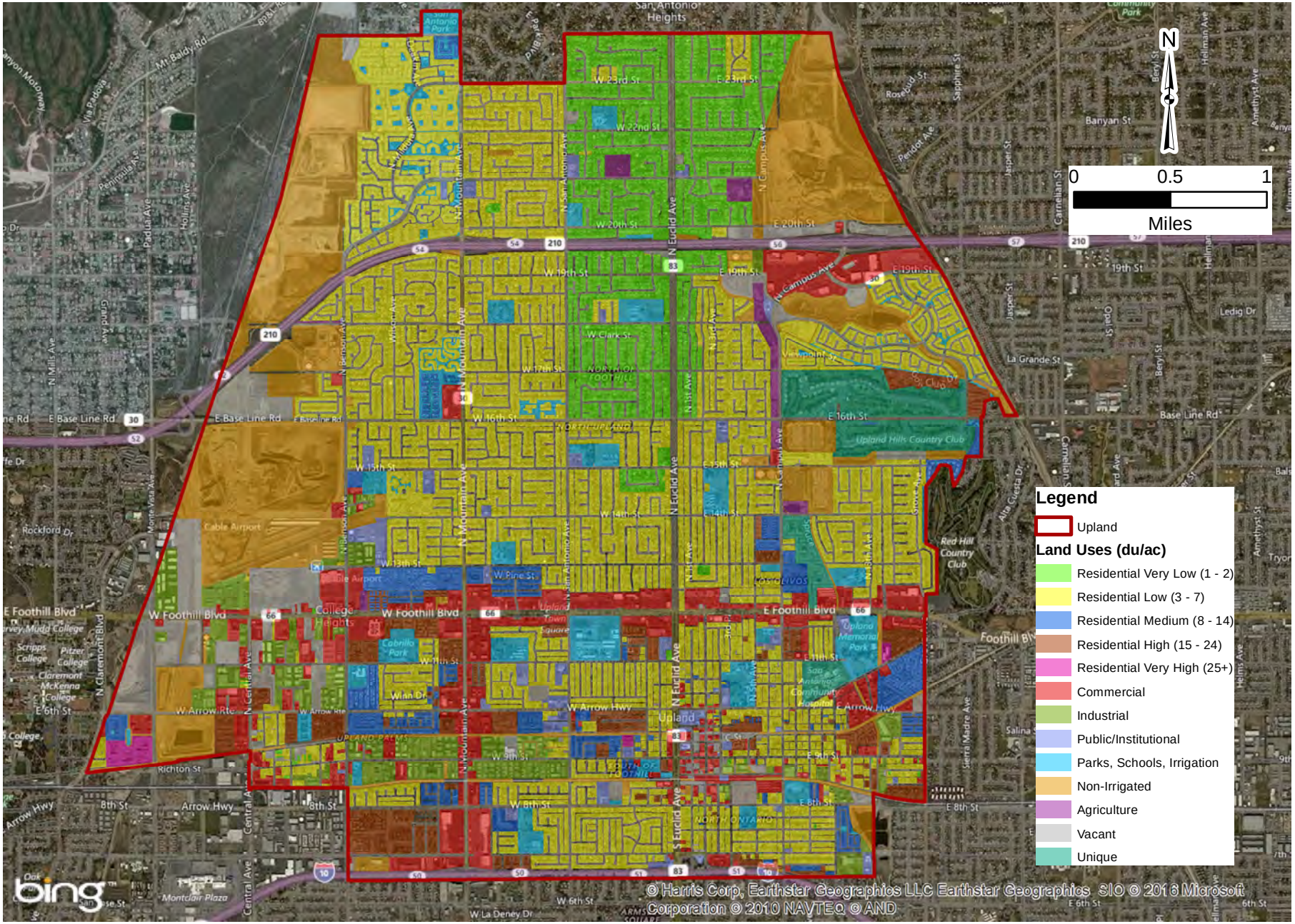

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Monte Vista Water District – Existing Land Use**

ARCADIS

May 2016
FIGURE B-5



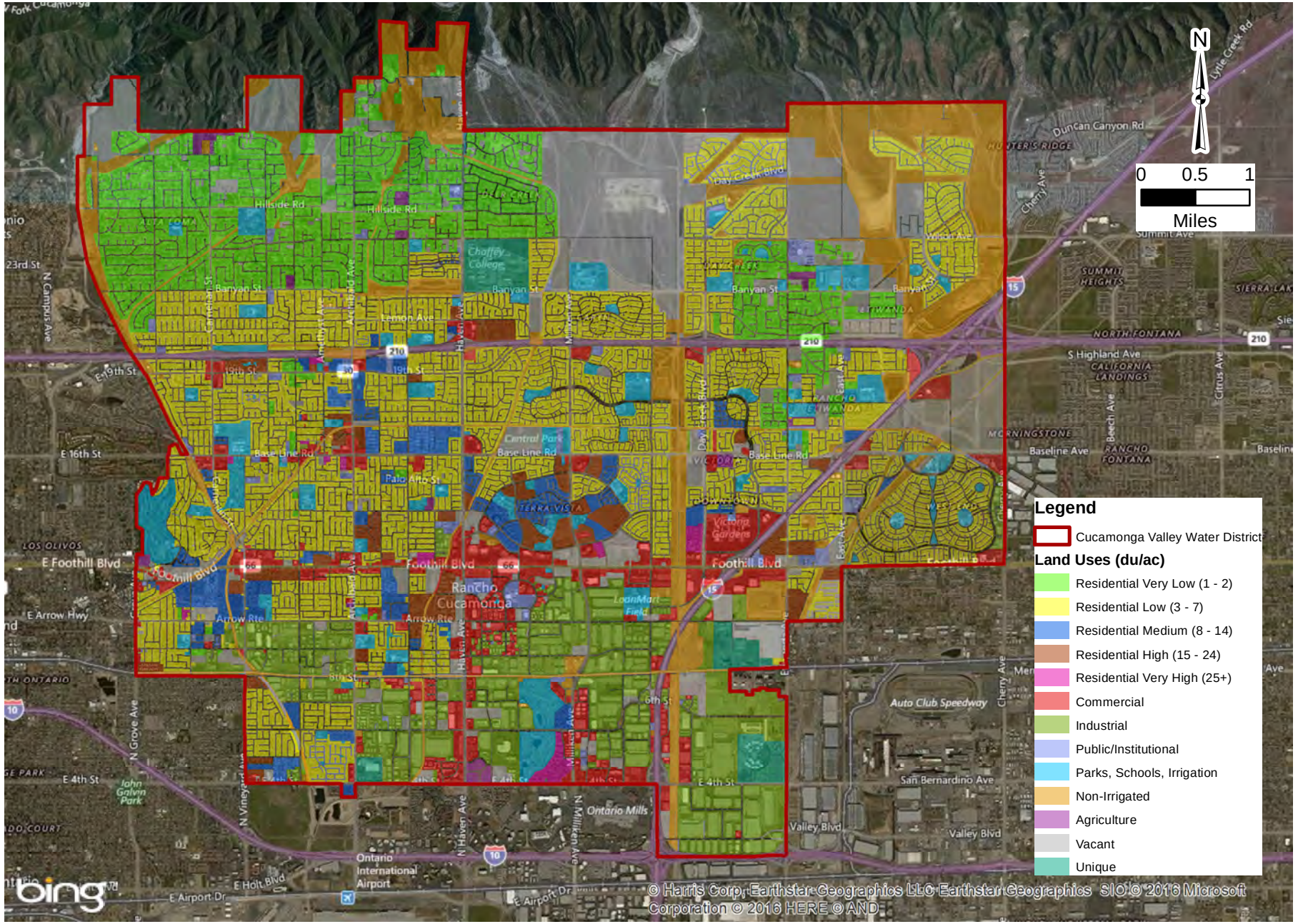

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Upland – Existing Land Use**

ARCADIS

May 2016
FIGURE B-6



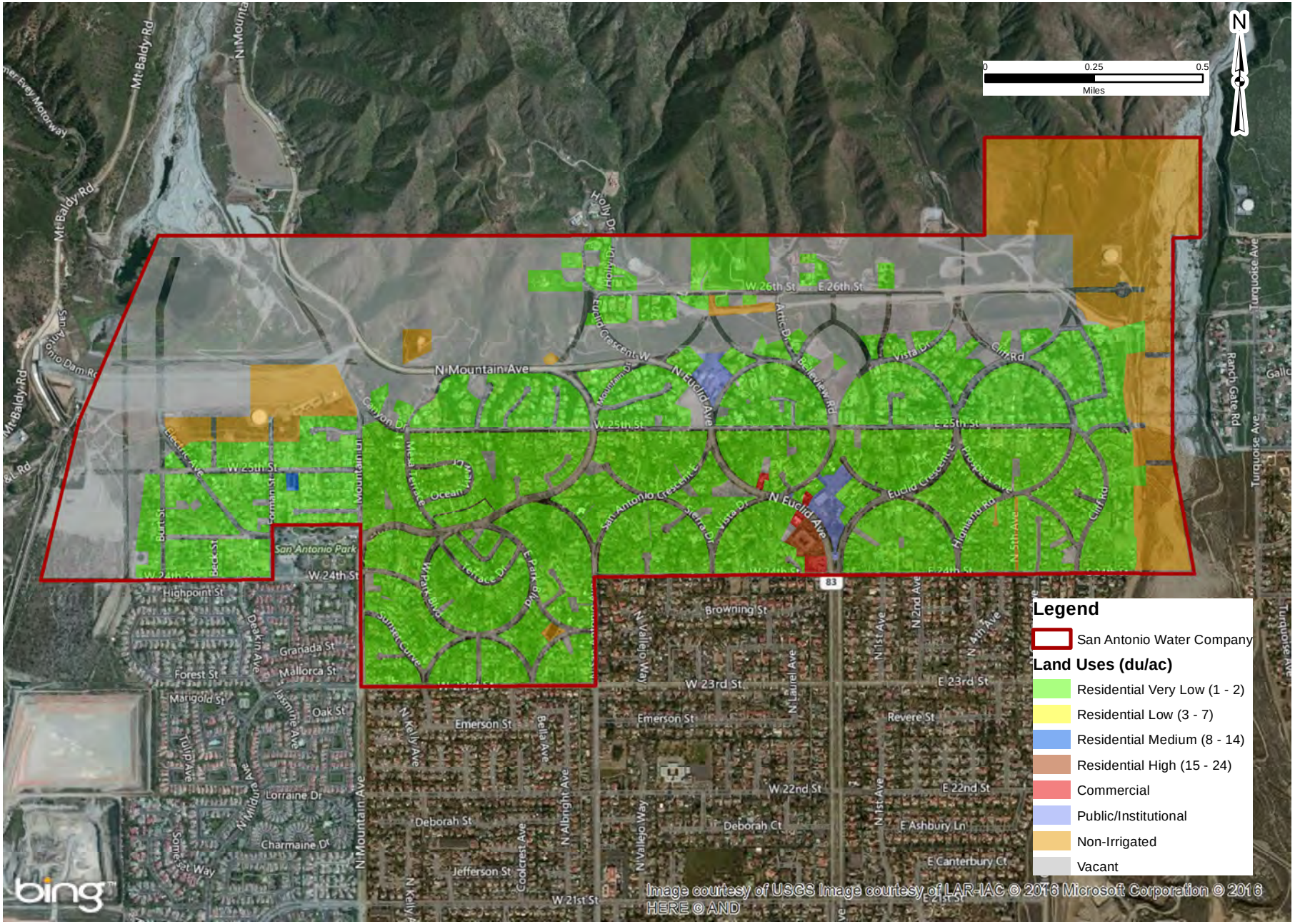

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Cucamonga Valley Water District – Existing Land Use**

ARCADIS

May 2016
FIGURE B-7



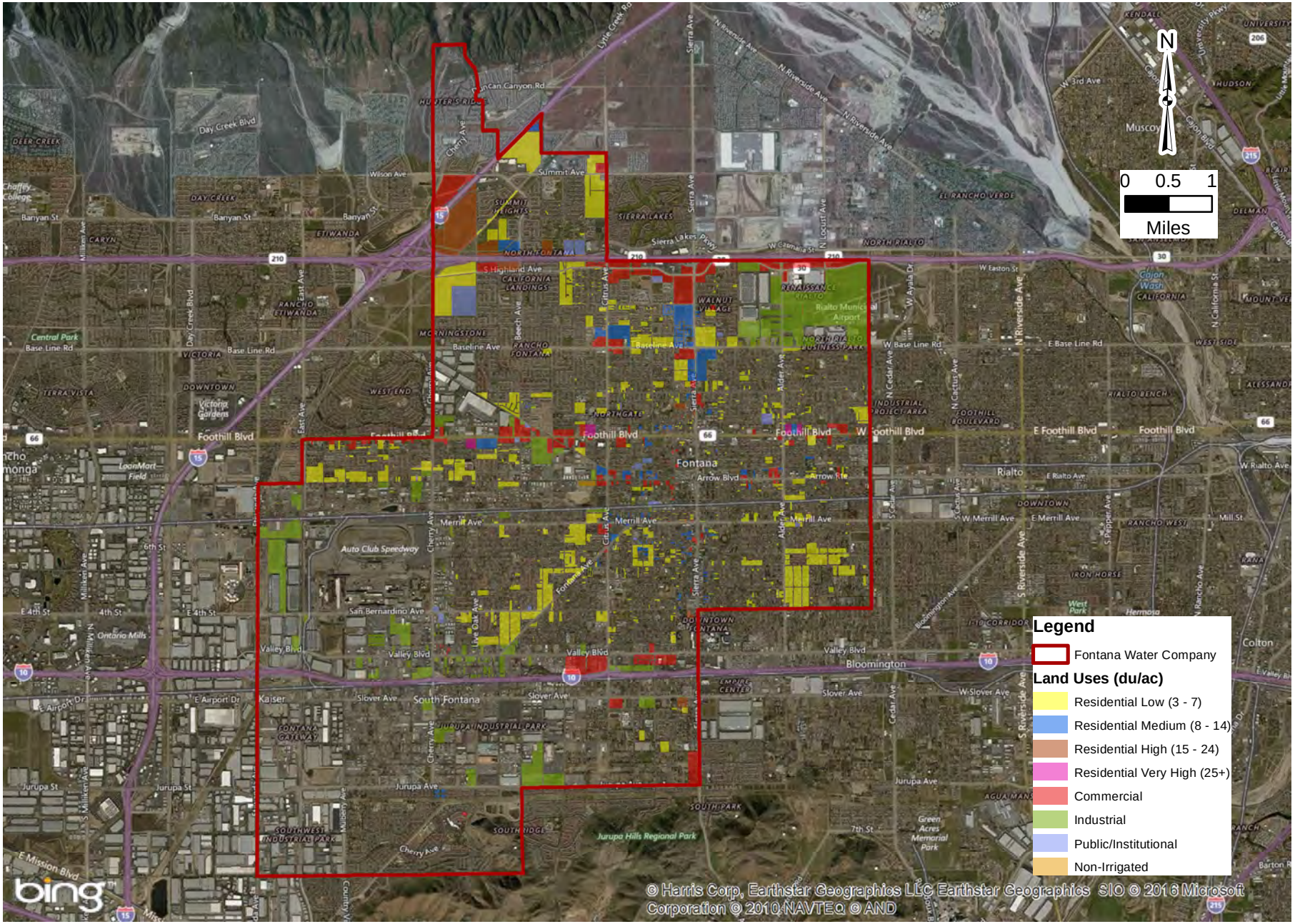

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**San Antonio Water Company – Existing Land Use**

ARCADIS

May 2016
FIGURE B-8



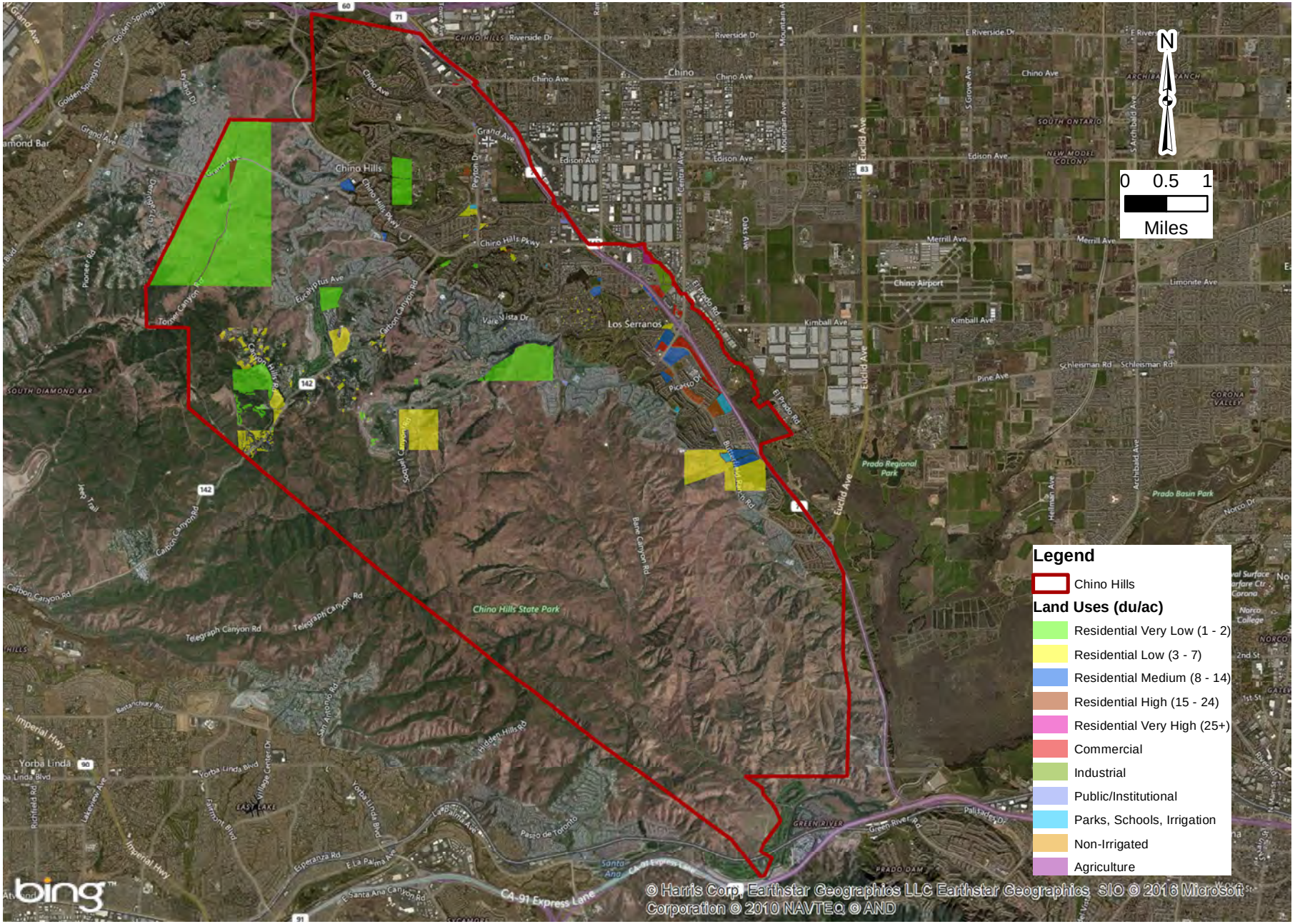

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Fontana Water Company – Future Land Use**

ARCADIS

May 2016
FIGURE B-9



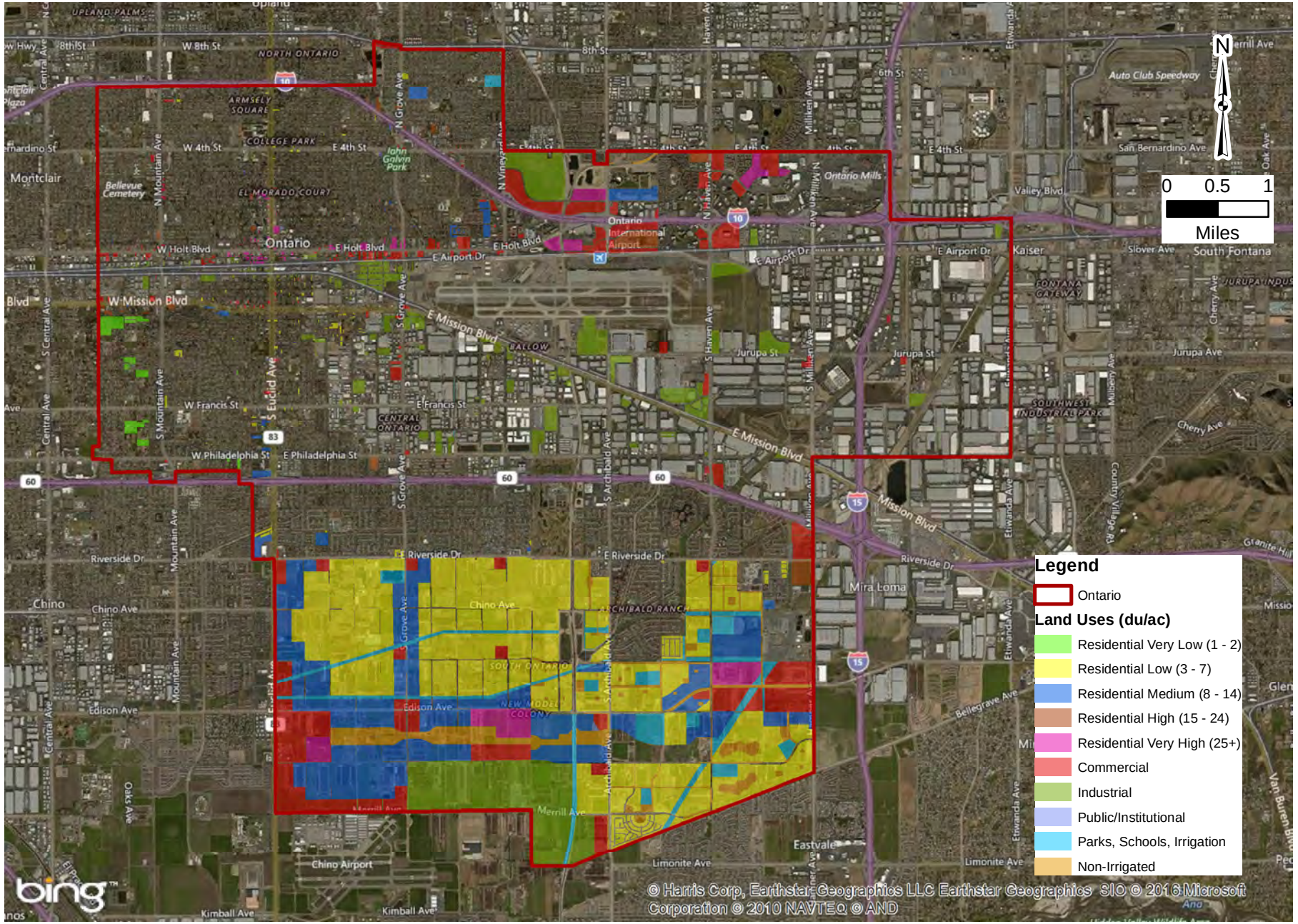

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino Hills – Future Land Use**

ARCADIS

May 2016
FIGURE B-10



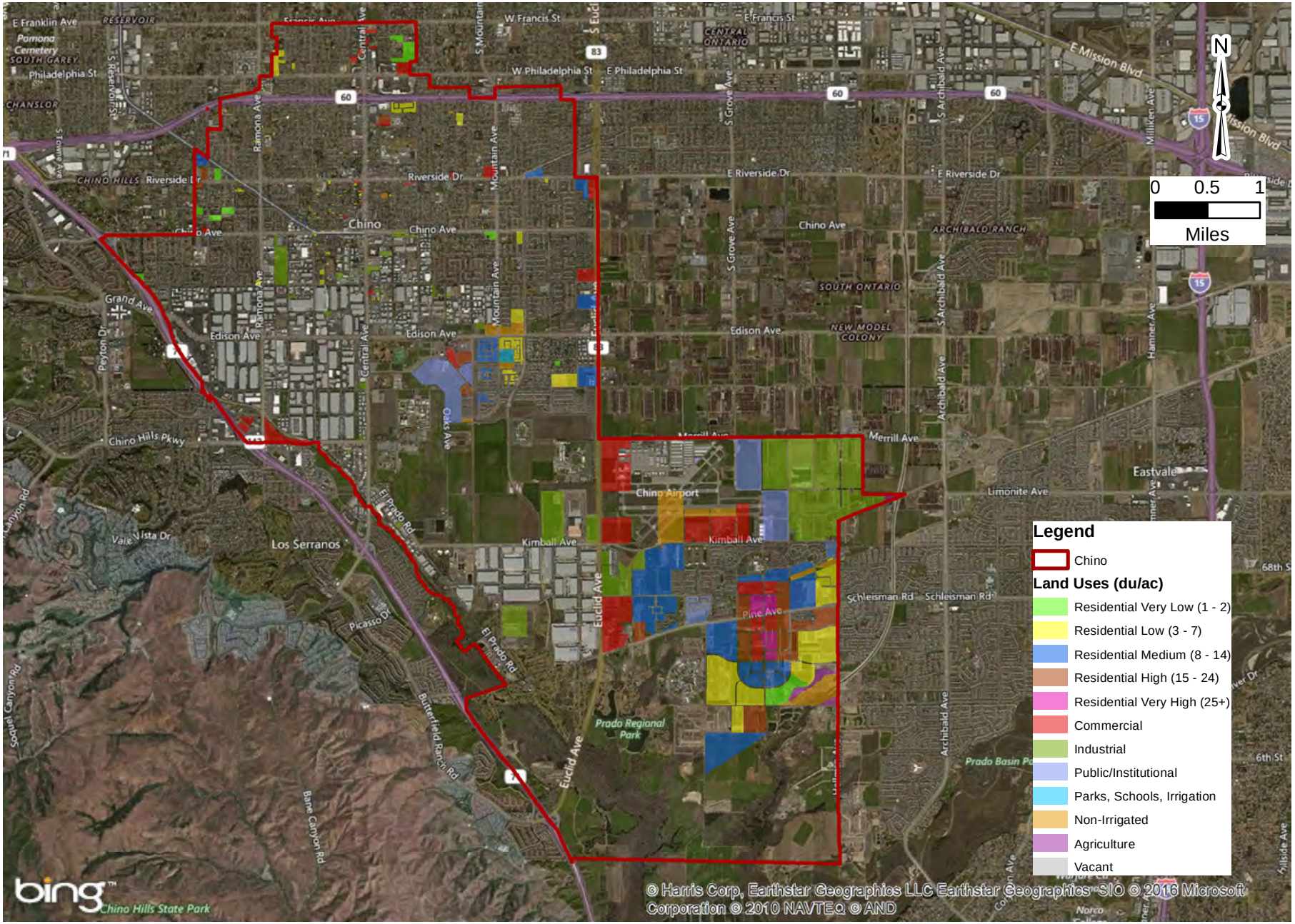

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Ontario – Future Land Use**

ARCADIS

May 2016
FIGURE B-11



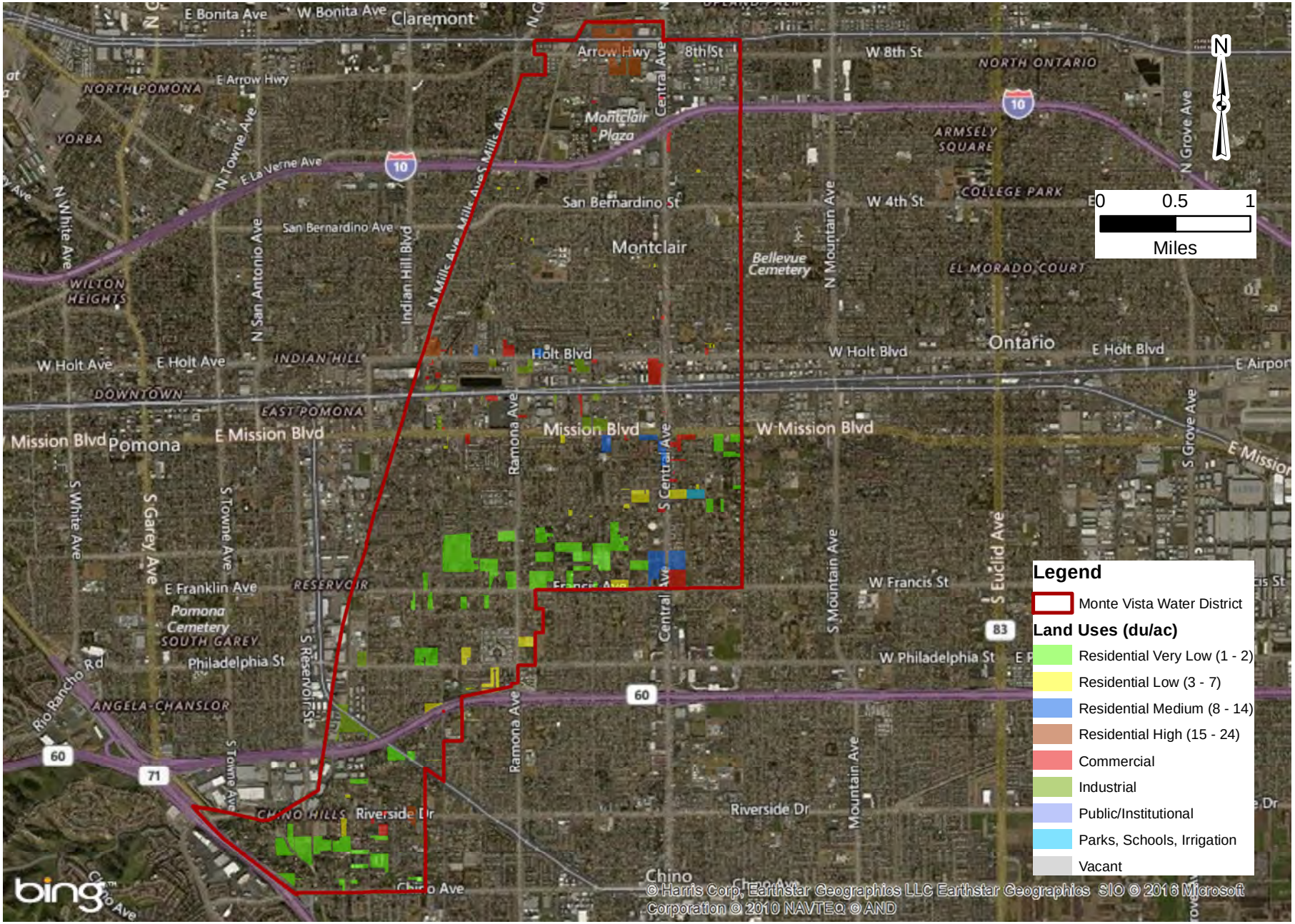

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Chino – Future Land Use**

ARCADIS

May 2016
FIGURE B-12



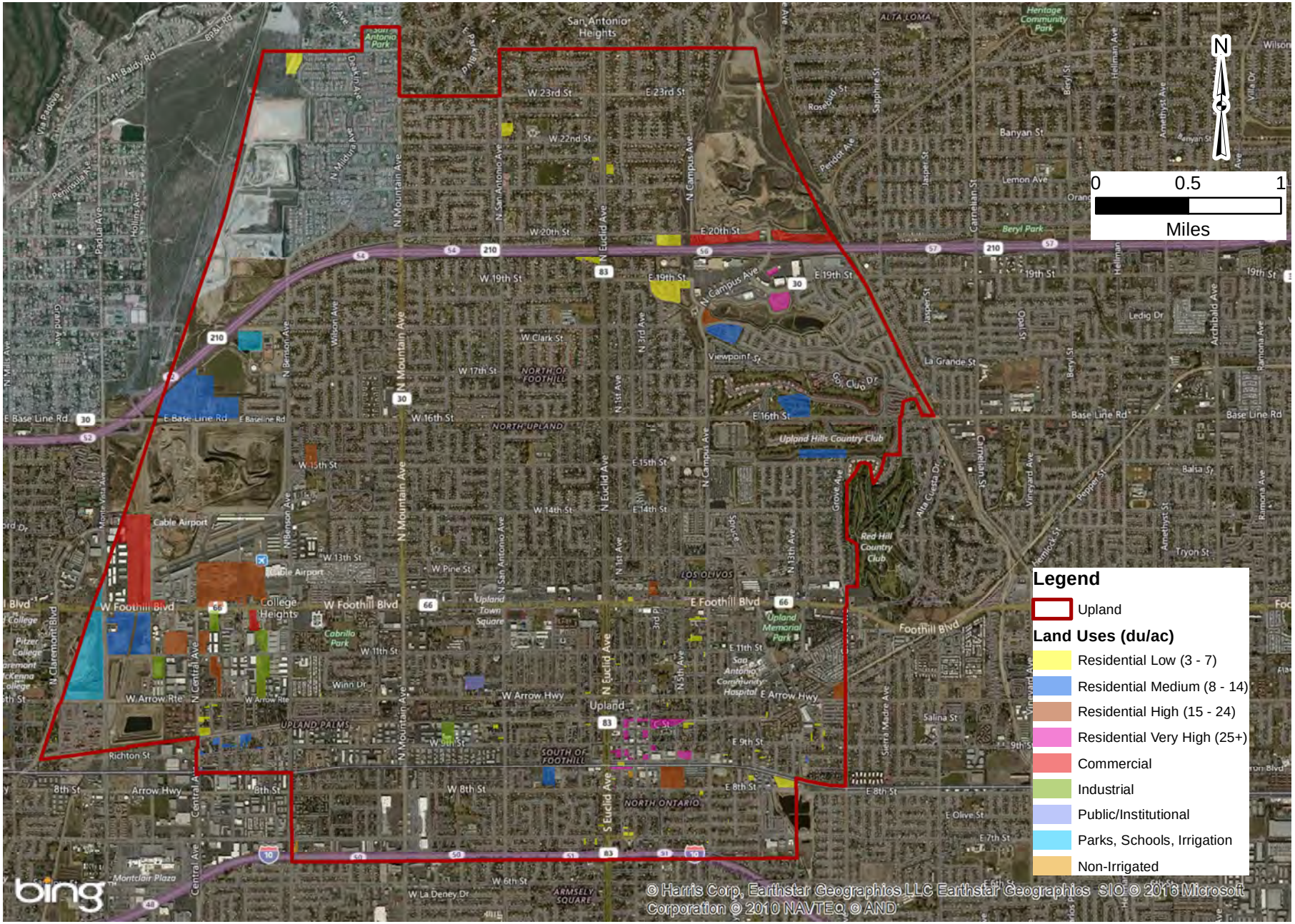

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Monte Vista Water District – Future Land Use**

ARCADIS

May 2016
FIGURE B-13



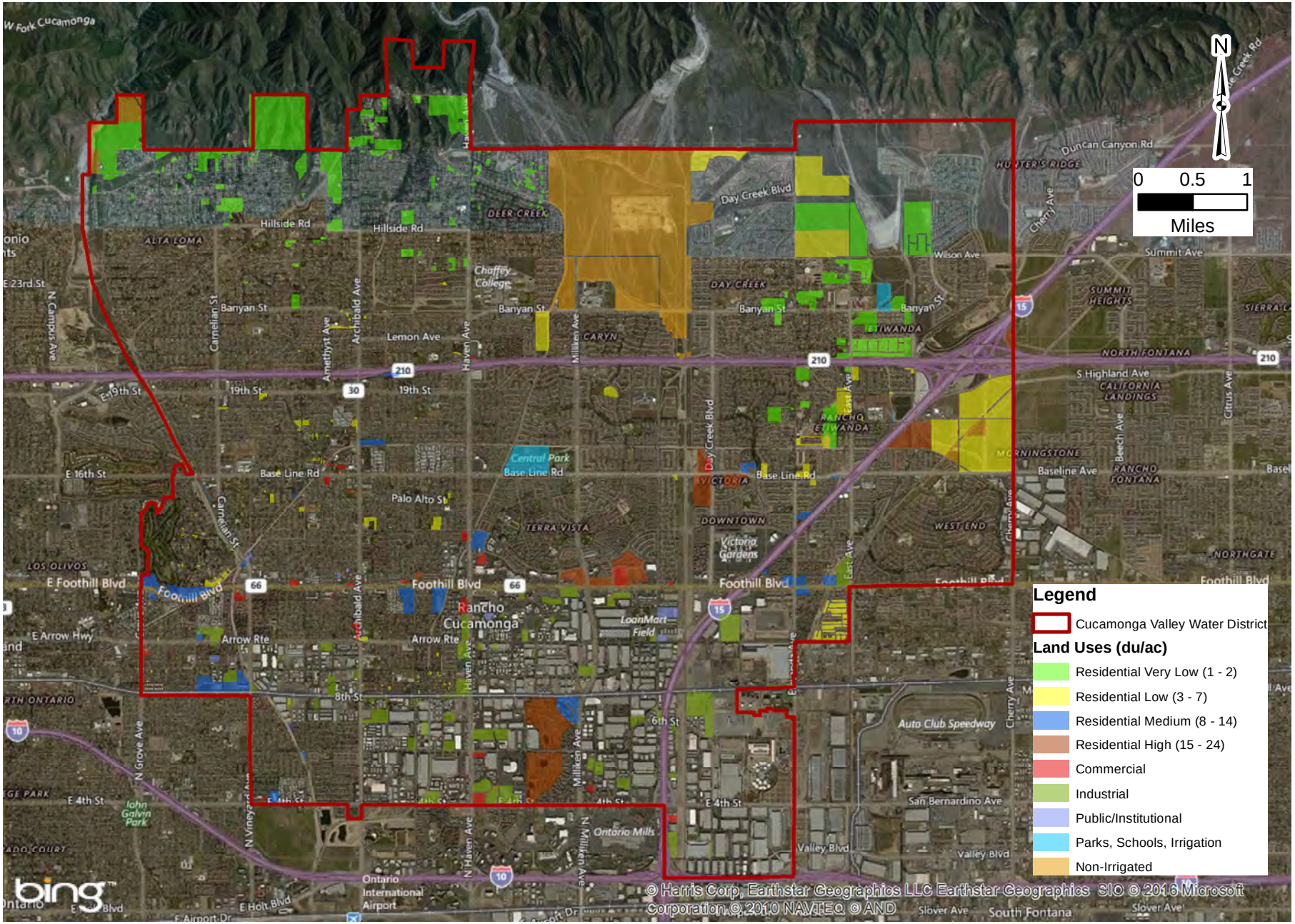

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Upland – Future Land Use**

ARCADIS

May 2016
FIGURE B-14



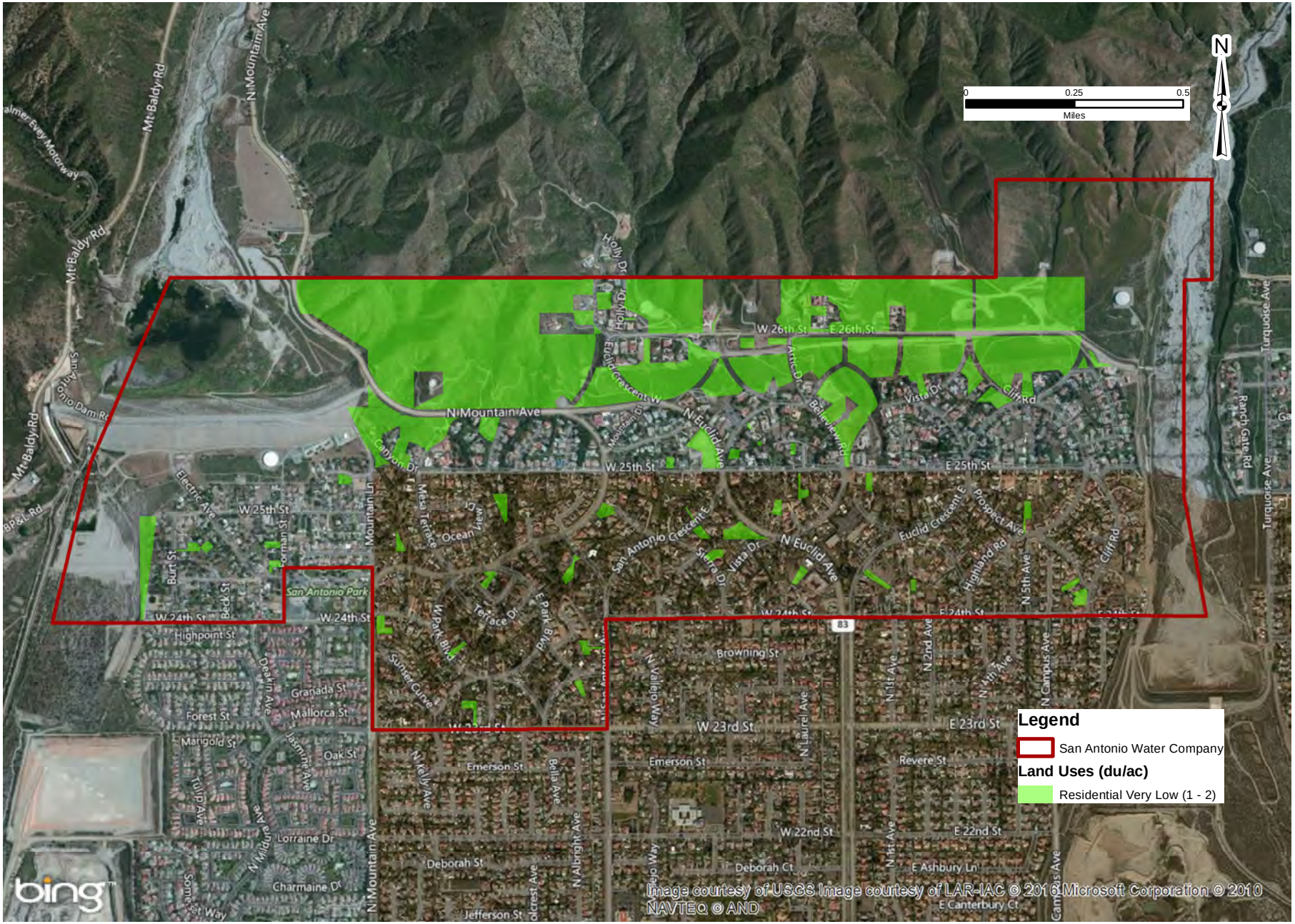

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**Cucamonga Valley Water District – Future Land Use**

ARCADIS

May 2016
FIGURE B-15




Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

INLAND EMPIRE UTILITIES AGENCY, CALIFORNIA
DEMAND MODEL

**San Antonio Water Company – Future Land Use**

ARCADIS

May 2016
FIGURE B-16

# APPENDIX C

## Acreage Inventories

# Appendix C - Member Agency Acreages

**CHINO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 533 | 526 | 526 | 530 | 569 | 605 |
| Residential Low (3 - 7) | 2234 | 2286 | 2337 | 2365 | 2471 | 2602 |
| Residential Medium (8 - 14) | 204 | 312 | 528 | 631 | 636 | 754 |
| Residential High (15 - 24) | 205 | 267 | 267 | 315 | 321 | 411 |
| Residential Very High (25+) | 18 | 18 | 18 | 18 | 18 | 67 |
| Commercial | 894 | 923 | 953 | 1183 | 1195 | 1352 |
| Industrial | 2062 | 2611 | 2728 | 2746 | 2759 | 2771 |
| Public/Institutional | 793 | 806 | 806 | 806 | 959 | 1002 |
| Parks, Schools, Irrigation | 499 | 509 | 509 | 509 | 509 | 509 |
| Agriculture | 1497 | 1069 | 821 | 448 | 255 | 4 |
| Unique Water User #1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 6124 | 6096 | 6131 | 6132 | 6136 | 6137 |
| Undefined | - | - | - | - | - | - |
| Vacant | 1156 | 796 | 595 | 538 | 390 | 5 |
| **Total** | **16,222** | **16,222** | **16,222** | **16,224** | **16,221** | **16,222** |

**CHINO HILLS Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1034 | 1057 | 1411 | 1464 | 1464 | 2740 |
| Residential Low (3 - 7) | 2761 | 2973 | 3009 | 3290 | 3290 | 3290 |
| Residential Medium (8 - 14) | 413 | 479 | 480 | 488 | 488 | 494 |
| Residential High (15 - 24) | 174 | 210 | 215 | 219 | 219 | 228 |
| Residential Very High (25+) | 0 | 15 | 15 | 15 | 15 | 15 |
| Commercial | 369 | 387 | 420 | 430 | 430 | 430 |
| Industrial | 1 | 29 | 29 | 29 | 29 | 29 |
| Public/Institutional | 170 | 161 | 161 | 170 | 170 | 170 |
| Parks, Schools, Irrigation | 1277 | 1298 | 1298 | 1303 | 1303 | 1303 |
| Agriculture | 38 | 38 | 25 | 1 | 1 | 1 |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 18311 | 18294 | 18294 | 18294 | 18294 | 18294 |
| Undefined | - | - | - | - | - | - |
| Vacant | 2454 | 2059 | 1644 | 1300 | 1300 | 8 |
| **Total** | **27,002** | **27,000** | **27,001** | **27,003** | **27,003** | **27,002** |

# Appendix C - Member Agency Acreages

**CUCAMONGA VALLEY WATER DISTRICT Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 3206 | 3596 | 3895 | 4011 | 4178 | 4204 |
| Residential Low (3 - 7) | 6224 | 6481 | 6804 | 6827 | 6872 | 6876 |
| Residential Medium (8 - 14) | 869 | 928 | 1031 | 1031 | 1075 | 1076 |
| Residential High (15 - 24) | 652 | 745 | 959 | 975 | 975 | 988 |
| Residential Very High (25+) | 113 | 113 | 113 | 113 | 113 | 113 |
| Commercial | 1592 | 1611 | 1638 | 1643 | 1650 | 1651 |
| Industrial | 2675 | 2849 | 2984 | 3010 | 3011 | 3013 |
| Public/Institutional | 471 | 489 | 476 | 477 | 478 | 479 |
| Parks, Schools, Irrigation | 1326 | 1326 | 1165 | 1165 | 1185 | 1246 |
| Agriculture | 123 | 111 | 52 | 41 | 13 | 0 |
| Unique Water User #1 | 120 | 120 | 120 | 120 | 120 | 120 |
| Unique Water User #2 | 190 | 190 | 190 | 190 | 190 | 190 |
| Unique Water User #3 | 36 | 36 | 36 | 36 | 36 | 36 |
| Unique Water User #4 | 95 | 95 | 95 | 95 | 95 | 95 |
| Non-Irrigated | 3323 | 3312 | 4460 | 4517 | 4517 | 4517 |
| Undefined | 0 | 0 | 0 | 0 | 0 | 0 |
| Vacant | 3688 | 2703 | 687 | 452 | 196 | 100 |
| **Total** | **24,703** | **24,705** | **24,705** | **24,703** | **24,704** | **24,704** |

**FONTANA WATER COMPANY Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1534 | 1534 | 1492 | 1275 | 761 | 633 |
| Residential Low (3 - 7) | 6379 | 6392 | 6700 | 7051 | 7682 | 7823 |
| Residential Medium (8 - 14) | 360 | 360 | 390 | 578 | 624 | 624 |
| Residential High (15 - 24) | 320 | 320 | 519 | 524 | 544 | 544 |
| Residential Very High (25+) | 13 | 13 | 13 | 23 | 42 | 42 |
| Commercial | 930 | 934 | 973 | 1214 | 1524 | 1564 |
| Industrial | 5734 | 6306 | 6645 | 6708 | 6767 | 6806 |
| Public/Institutional | 231 | 231 | 317 | 335 | 362 | 362 |
| Parks, Schools, Irrigation | 861 | 861 | 861 | 861 | 861 | 861 |
| Agriculture | 65 | 65 | 65 | 7 | 7 | 7 |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 2370 | 2370 | 2371 | 2379 | 2379 | 2379 |
| Undefined | | | | | | |
| Vacant | 2870 | 2280 | 1320 | 711 | 113 | 21 |
| **Total** | **21,667** | **21,666** | **21,666** | **21,666** | **21,666** | **21,666** |

# Appendix C - Member Agency Acreages

**MONTE VISTA WATER DISTRICT Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 1122 | 1122 | 1122 | 1251 | 1277 | 1345 |
| Residential Low (3 - 7) | 1388 | 1402 | 1403 | 1416 | 1428 | 1431 |
| Residential Medium (8 - 14) | 328 | 342 | 365 | 365 | 365 | 365 |
| Residential High (15 - 24) | 63 | 115 | 115 | 115 | 115 | 119 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 589 | 598 | 598 | 600 | 620 | 628 |
| Industrial | 528 | 516 | 516 | 520 | 541 | 543 |
| Public/Institutional | 127 | 128 | 128 | 129 | 137 | 137 |
| Parks, Schools, Irrigation | 223 | 223 | 223 | 223 | 228 | 228 |
| Agriculture | 167 | 167 | 146 | 46 | 27 | 0 |
| Unique Water User #1 | 16 | 16 | 16 | 16 | 16 | 16 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 195 | 195 | 195 | 195 | 195 | 195 |
| Undefined | | | | | 0 | 0 |
| Vacant | 261 | 184 | 180 | 132 | 58 | 0 |
| **Total** | **5,008** | **5,009** | **5,008** | **5,009** | **5,008** | **5,008** |

**ONTARIO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 271 | 280 | 293 | 334 | 334 | 335 |
| Residential Low (3 - 7) | 4532 | 4743 | 5397 | 5925 | 6215 | 7725 |
| Residential Medium (8 - 14) | 586 | 694 | 754 | 918 | 1060 | 2183 |
| Residential High (15 - 24) | 611 | 666 | 698 | 699 | 708 | 720 |
| Residential Very High (25+) | 62 | 66 | 93 | 200 | 239 | 364 |
| Commercial | 1777 | 1776 | 1888 | 2273 | 2337 | 2896 |
| Industrial | 5647 | 5939 | 6617 | 6774 | 6846 | 6904 |
| Public/Institutional | 1054 | 1047 | 1049 | 1050 | 1050 | 1050 |
| Parks, Schools, Irrigation | 1041 | 1068 | 1144 | 1371 | 1420 | 1550 |
| Agriculture | 139 | 86 | 70 | 33 | 18 | 1 |
| Ontario Unique Water User #1 | 54 | 54 | 54 | 54 | 54 | 54 |
| Ontario Unique Water User #2 | 35 | 35 | 35 | 35 | 35 | 35 |
| Ontario Unique Water User #3 | 55 | 55 | 55 | 55 | 55 | 55 |
| Ontario Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 2498 | 2526 | 2609 | 2708 | 2773 | 2953 |
| Undefined | - | - | - | - | - | - |
| Vacant | 8479 | 7806 | 6085 | 4413 | 3698 | 16 |
| **Total** | **26,841** | **26,841** | **26,841** | **26,842** | **26,842** | **26,841** |

# Appendix C - Member Agency Acreages

**SAN ANTONIO WATER CO Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 603 | 603 | 631 | 631 | 745 | 874 |
| Residential Low (3 - 7) | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential Medium (8 - 14) | 1 | 1 | 1 | 1 | 1 | 1 |
| Residential High (15 - 24) | 3 | 3 | 3 | 3 | 3 | 3 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 3 | 3 | 3 | 3 | 3 | 3 |
| Industrial | - | - | - | - | - | - |
| Public/Institutional | 10 | 10 | 10 | 10 | 10 | 10 |
| Parks, Schools, Irrigation | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |
| Non-Irrigated | 167 | 167 | 167 | 167 | 167 | 167 |
| Undefined | 0 | | | | | |
| Vacant | 414 | 414 | 385 | 385 | 272 | 143 |
| **Total** | **1,201** | **1,201** | **1,200** | **1,200** | **1,201** | **1,201** |

**UPLAND Acreage**

| LAND USE | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (<1 - 2) | 786 | 786 | 786 | 786 | 786 | 786 |
| Residential Low (3 - 7) | 2811 | 2813 | 2813 | 2817 | 2846 | 2846 |
| Residential Medium (8 - 14) | 306 | 384 | 410 | 414 | 414 | 418 |
| Residential High (15 - 24) | 319 | 351 | 354 | 413 | 413 | 413 |
| Residential Very High (25+) | 26 | 32 | 32 | 39 | 39 | 46 |
| Commercial | 685 | 693 | 706 | 706 | 755 | 755 |
| Industrial | 327 | 337 | 337 | 353 | 353 | 353 |
| Public/Institutional | 124 | 119 | 119 | 119 | 124 | 124 |
| Parks, Schools, Irrigation | 401 | 401 | 457 | 457 | 457 | 457 |
| Agriculture | 55 | 55 | 55 | 55 | 55 | 55 |
| Unique Water User #1 | 200 | 200 | 189 | 189 | 189 | 189 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 25 | 25 | 25 | 25 | 25 | 25 |
| Unique Water User #4 | 33 | 33 | 33 | 33 | 33 | 33 |
| Non-Irrigated | 1457 | 1457 | 1448 | 1449 | 1450 | 1450 |
| Undefined | - | - | - | - | - | - |
| Vacant | 401 | 269 | 192 | 100 | 16 | 5 |
| **Total** | **7,957** | **7,956** | **7,957** | **7,956** | **7,956** | **7,956** |

# APPENDIX D

## Land Use Unit Demands

## Appendix D - Land Use Unit Demands (af/ac/yr)

| | Chino* | Chino Hills | CVWD | FWC | MVWD | Ontario | SAWCO | Upland* |
|---|---|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1.73 | 1.40 | 1.85 | 1.25 | 1.27 | 1.20 | 2.34 | 1.90 |
| Residential Low (3 - 7) | 2.60 | 2.47 | 2.88 | 2.75 | 2.11 | 2.12 | 0.00 | 2.84 |
| Residential Medium (8 - 14) | 4.36 | 4.10 | 4.57 | 6.70 | 4.67 | 5.27 | 4.95 | 4.95 |
| Residential High (15 - 24) | 4.78 | 4.28 | 6.07 | 11.55 | 9.86 | 7.60 | 6.36 | 8.95 |
| Residential Very High (25+) | 6.88 | 6.88 | 8.81 | 15.66 | 0.00 | 13.20 | 0.00 | 13.96 |
| Commercial | 1.31 | 3.34 | 1.38 | 6.54 | 2.13 | 2.82 | 2.20 | 2.13 |
| Industrial | 0.22 | 1.07 | 0.51 | 0.33 | 0.65 | 0.38 | 0.00 | 1.07 |
| Public/Institutional | 1.31 | 1.17 | 2.73 | 2.73 | 2.39 | 2.82 | 2.20 | 3.52 |
| Parks, Schools, Irrigation | 4.99 | 3.11 | 6.88 | 4.99 | 4.72 | 7.48 | 0.00 | 5.87 |
| Agriculture | 0.00 | 0.00 | 0.28 | 0.00 | 0.34 | 15.08 | 0.00 | 0.00 |
| Unique Water Users #1 | 299.01 | | 3.62 | 0.00 | 5.59 | 47.57 | | 1.33 |
| Unique Water Users #2 | 186.62 | | 1.47 | | 43.49 | 18.81 | | 242.43 |
| Unique Water Users #3 | 81.60 | | 7.43 | | | 10.07 | | 4.57 |
| Unique Water Users #4 | | | 2.58 | | | | | 3.08 |

Notes:

Used Upland Medium for SAWCO Medium density residential (4.95 af/ac/yr)

Avg Public/Institutional from 4 agencies applied to FWC and CVWD (2.73 af/ac/yr)

Highest Industrial LUD used for Chino Hills due to lack of warehousing and distribution uses (1.07 af/ac/yr)

Used Chino VH for future Chino Hills VH density residential (6.88 af/ac/yr)

*Chino Unique users and 1 Upland Unique are not located; 1 acre was used with full water demands.

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CHINO** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.89 | 1.91 | 1.93 | 1.95 | 1.97 | 1.99 |
| Residential Low (3 - 7) | 2.83 | 2.87 | 2.90 | 2.93 | 2.96 | 3.00 |
| Residential Medium (8 - 14) | 4.75 | 4.81 | 4.86 | 4.91 | 4.97 | 5.02 |
| Residential High (15 - 24) | 5.21 | 5.27 | 5.33 | 5.39 | 5.45 | 5.51 |
| Residential Very High (25+) | 7.50 | 7.54 | 7.59 | 7.63 | 7.68 | 7.72 |
| Commercial | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Industrial | 0.24 | 0.24 | 0.24 | 0.24 | 0.25 | 0.25 |
| Public/Institutional | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.69 | 5.75 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | 325.92 | 327.83 | 329.75 | 331.66 | 333.58 | 335.49 |
| Unique Water User #2 | 203.42 | 204.61 | 205.80 | 207.00 | 208.19 | 209.39 |
| Unique Water User #3 | 88.94 | 89.47 | 89.99 | 90.51 | 91.03 | 91.56 |
| Unique Water User #4 | | | | | | |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CHINO HILLS** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.44 | 1.46 | 1.48 | 1.49 | 1.51 | 1.53 |
| Residential Low (3 - 7) | 2.54 | 2.57 | 2.61 | 2.64 | 2.67 | 2.70 |
| Residential Medium (8 - 14) | 4.22 | 4.27 | 4.32 | 4.38 | 4.43 | 4.48 |
| Residential High (15 - 24) | 4.41 | 4.46 | 4.51 | 4.57 | 4.62 | 4.67 |
| Residential Very High (25+) | 7.09 | 7.13 | 7.17 | 7.22 | 7.26 | 7.31 |
| Commercial | 3.44 | 3.46 | 3.48 | 3.50 | 3.53 | 3.55 |
| Industrial | 1.10 | 1.11 | 1.12 | 1.12 | 1.13 | 1.14 |
| Public/Institutional | 1.21 | 1.21 | 1.22 | 1.23 | 1.24 | 1.24 |
| Parks, Schools, Irrigation | 3.20 | 3.24 | 3.28 | 3.32 | 3.36 | 3.40 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | | | | | | |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **CVWD** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.96 | 1.99 | 2.01 | 2.03 | 2.06 | 2.08 |
| Residential Low (3 - 7) | 3.06 | 3.09 | 3.13 | 3.17 | 3.20 | 3.24 |
| Residential Medium (8 - 14) | 4.85 | 4.91 | 4.97 | 5.02 | 5.08 | 5.14 |
| Residential High (15 - 24) | 6.45 | 6.52 | 6.60 | 6.67 | 6.75 | 6.82 |
| Residential Very High (25+) | 9.36 | 9.41 | 9.47 | 9.53 | 9.58 | 9.64 |
| Commercial | 1.47 | 1.47 | 1.48 | 1.49 | 1.50 | 1.51 |
| Industrial | 0.54 | 0.54 | 0.55 | 0.55 | 0.55 | 0.56 |
| Public/Institutional | 2.90 | 2.92 | 2.93 | 2.95 | 2.97 | 2.99 |
| Parks, Schools, Irrigation | 7.31 | 7.39 | 7.48 | 7.56 | 7.65 | 7.73 |
| Agriculture | 0.30 | 0.30 | 0.30 | 0.31 | 0.31 | 0.31 |
| Unique Water User #1 | 3.84 | 3.87 | 3.89 | 3.91 | 3.94 | 3.96 |
| Unique Water User #2 | 1.56 | 1.57 | 1.58 | 1.59 | 1.60 | 1.61 |
| Unique Water User #3 | 7.89 | 7.94 | 7.99 | 8.03 | 8.08 | 8.13 |
| Unique Water User #4 | 2.74 | 2.76 | 2.77 | 2.79 | 2.81 | 2.82 |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Fontana WC** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.36 | 1.38 | 1.39 | 1.41 | 1.42 | 1.44 |
| Residential Low (3 - 7) | 3.00 | 3.03 | 3.06 | 3.10 | 3.13 | 3.17 |
| Residential Medium (8 - 14) | 7.30 | 7.38 | 7.47 | 7.55 | 7.63 | 7.71 |
| Residential High (15 - 24) | 12.58 | 12.73 | 12.87 | 13.01 | 13.16 | 13.30 |
| Residential Very High (25+) | 17.06 | 17.16 | 17.26 | 17.36 | 17.46 | 17.56 |
| Commercial | 7.12 | 7.17 | 7.21 | 7.25 | 7.29 | 7.33 |
| Industrial | 0.36 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 |
| Public/Institutional | 2.97 | 2.99 | 3.01 | 3.03 | 3.04 | 3.06 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.68 | 5.75 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Monte Vista WD** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.36 | 1.37 | 1.39 | 1.40 | 1.42 | 1.44 |
| Residential Low (3 - 7) | 2.25 | 2.28 | 2.31 | 2.33 | 2.36 | 2.38 |
| Residential Medium (8 - 14) | 4.99 | 5.05 | 5.10 | 5.16 | 5.22 | 5.28 |
| Residential High (15 - 24) | 10.53 | 10.65 | 10.78 | 10.90 | 11.02 | 11.14 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 2.28 | 2.29 | 2.30 | 2.32 | 2.33 | 2.34 |
| Industrial | 0.69 | 0.70 | 0.70 | 0.71 | 0.71 | 0.72 |
| Public/Institutional | 2.55 | 2.57 | 2.58 | 2.60 | 2.61 | 2.63 |
| Parks, Schools, Irrigation | 5.04 | 5.10 | 5.16 | 5.22 | 5.28 | 5.33 |
| Agriculture | 0.36 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 |
| Unique Water User #1 | 5.97 | 6.01 | 6.04 | 6.08 | 6.11 | 6.15 |
| Unique Water User #2 | 46.45 | 46.73 | 47.01 | 47.29 | 47.57 | 47.84 |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

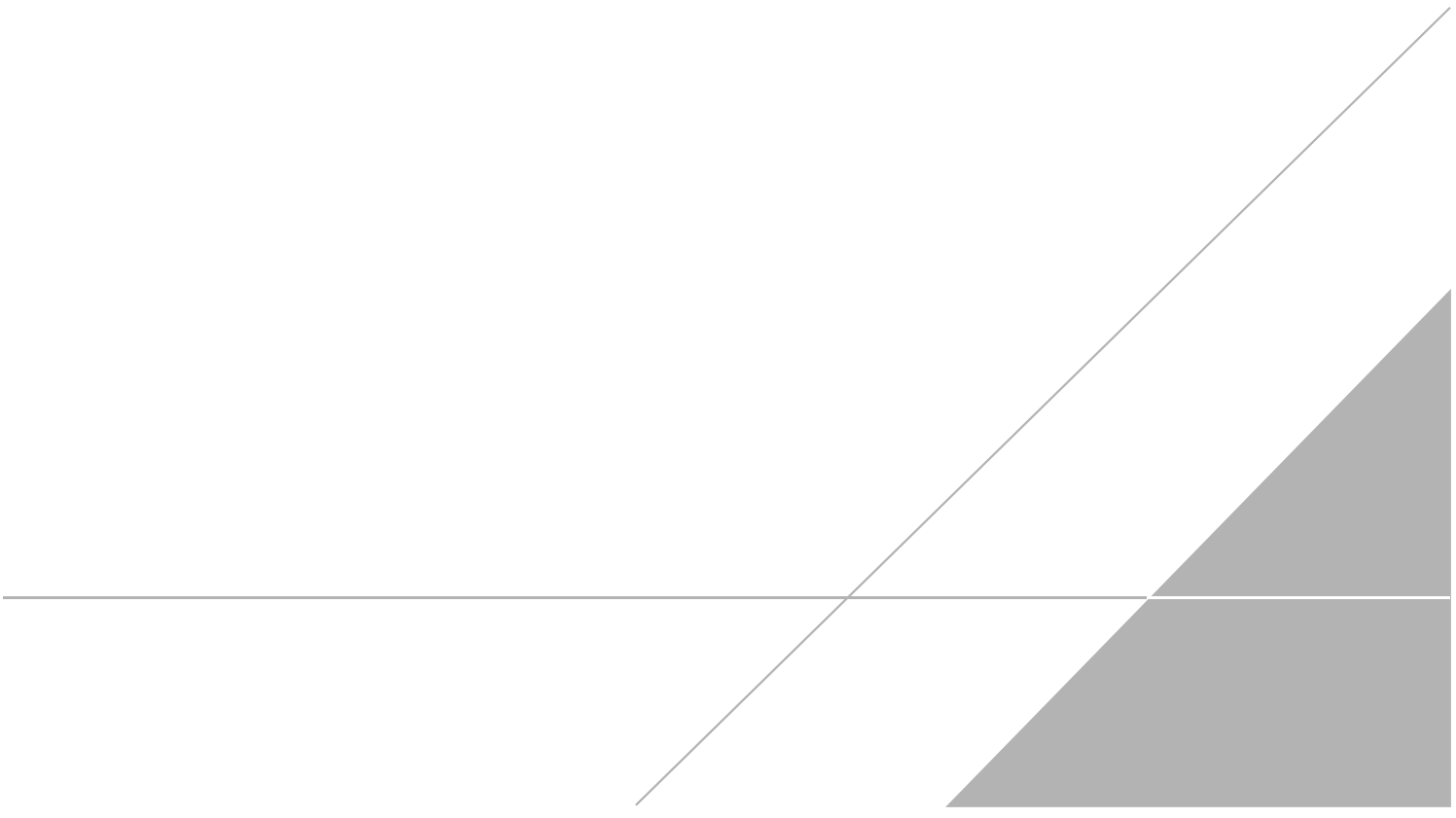
| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Ontario** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 1.25 | 1.26 | 1.28 | 1.29 | 1.31 | 1.32 |
| Residential Low (3 - 7) | 2.20 | 2.23 | 2.26 | 2.28 | 2.31 | 2.34 |
| Residential Medium (8 - 14) | 5.48 | 5.55 | 5.61 | 5.68 | 5.74 | 5.81 |
| Residential High (15 - 24) | 7.90 | 8.00 | 8.09 | 8.19 | 8.28 | 8.38 |
| Residential Very High (25+) | 13.73 | 13.81 | 13.90 | 13.98 | 14.07 | 14.15 |
| Commercial | 2.93 | 2.95 | 2.97 | 2.99 | 3.00 | 3.02 |
| Industrial | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.41 |
| Public/Institutional | 2.93 | 2.95 | 2.97 | 2.99 | 3.00 | 3.02 |
| Parks, Schools, Irrigation | 7.78 | 7.87 | 7.96 | 8.06 | 8.15 | 8.24 |
| Agriculture | 15.68 | 15.87 | 16.06 | 16.24 | 16.43 | 16.62 |
| Unique Water User #1 | 49.47 | 49.78 | 50.08 | 50.39 | 50.69 | 51.00 |
| Unique Water User #2 | 19.56 | 19.68 | 19.80 | 19.92 | 20.04 | 20.16 |
| Unique Water User #3 | 10.47 | 10.54 | 10.60 | 10.67 | 10.73 | 10.80 |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **San Antonio WC** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 2.39 | 2.42 | 2.44 | 2.47 | 2.50 | 2.53 |
| Residential Low (3 - 7) | - | - | - | - | - | - |
| Residential Medium (8 - 14) | 5.05 | 5.11 | 5.17 | 5.23 | 5.29 | 5.36 |
| Residential High (15 - 24) | 6.49 | 6.57 | 6.64 | 6.72 | 6.80 | 6.88 |
| Residential Very High (25+) | - | - | - | - | - | - |
| Commercial | 2.24 | 2.26 | 2.27 | 2.29 | 2.30 | 2.31 |
| Industrial | - | - | - | - | - | - |
| Public/Institutional | 2.24 | 2.26 | 2.27 | 2.29 | 2.30 | 2.31 |
| Parks, Schools, Irrigation | - | - | - | - | - | - |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | - | - | - | - | - | - |
| Unique Water User #2 | - | - | - | - | - | - |
| Unique Water User #3 | - | - | - | - | - | - |
| Unique Water User #4 | - | - | - | - | - | - |

| | Final LUDS (af/ac/yr) | | | | | |
|---|---|---|---|---|---|---|
| **Upland** | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | 2.01 | 2.03 | 2.06 | 2.08 | 2.10 | 2.13 |
| Residential Low (3 - 7) | 3.00 | 3.04 | 3.07 | 3.11 | 3.14 | 3.18 |
| Residential Medium (8 - 14) | 5.23 | 5.29 | 5.35 | 5.42 | 5.48 | 5.54 |
| Residential High (15 - 24) | 9.46 | 9.57 | 9.68 | 9.79 | 9.90 | 10.02 |
| Residential Very High (25+) | 14.76 | 14.85 | 14.93 | 15.02 | 15.11 | 15.20 |
| Commercial | 2.25 | 2.27 | 2.28 | 2.29 | 2.31 | 2.32 |
| Industrial | 1.13 | 1.14 | 1.14 | 1.15 | 1.16 | 1.17 |
| Public/Institutional | 3.72 | 3.74 | 3.77 | 3.79 | 3.81 | 3.83 |
| Parks, Schools, Irrigation | 6.20 | 6.28 | 6.35 | 6.42 | 6.50 | 6.57 |
| Agriculture | - | - | - | - | - | - |
| Unique Water User #1 | 1.41 | 1.41 | 1.42 | 1.43 | 1.44 | 1.45 |
| Unique Water User #2 | 256.25 | 257.80 | 259.35 | 260.90 | 262.45 | 264.01 |
| Unique Water User #3 | 4.83 | 4.86 | 4.89 | 4.92 | 4.95 | 4.98 |
| Unique Water User #4 | 3.26 | 3.28 | 3.29 | 3.31 | 3.33 | 3.35 |

# APPENDIX E

## Demand Projections



# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CHINO** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,004 | 1,003 | 1,015 | 1,034 | 1,122 | 1,205 |
| Residential Low (3 - 7) | | 6,330 | 6,553 | 6,775 | 6,930 | 7,322 | 7,793 |
| Residential Medium (8 - 14) | | 967 | 1,499 | 2,566 | 3,099 | 3,158 | 3,787 |
| Residential High (15 - 24) | | 1,070 | 1,407 | 1,423 | 1,695 | 1,747 | 2,261 |
| Residential Very High (25+) | | 138 | 139 | 139 | 140 | 141 | 518 |
| Commercial | | 1,277 | 1,325 | 1,377 | 1,719 | 1,747 | 1,988 |
| Industrial | | 495 | 630 | 662 | 670 | 677 | 684 |
| Public/Institutional | | 1,132 | 1,157 | 1,164 | 1,171 | 1,402 | 1,473 |
| Parks, Schools, Irrigation | | 2,713 | 2,800 | 2,832 | 2,863 | 2,895 | 2,926 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | 326 | 328 | 330 | 332 | 334 | 335 |
| Unique Water User #2 | | 203 | 205 | 206 | 207 | 208 | 209 |
| Unique Water User #3 | | 89 | 89 | 90 | 91 | 91 | 92 |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **15,744** | **17,135** | **18,579** | **19,951** | **20,844** | **23,271** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CHINO HILLS** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,491 | 1,543 | 2,084 | 2,187 | 2,213 | 4,189 |
| Residential Low (3 - 7) | | 7,024 | 7,655 | 7,839 | 8,672 | 8,773 | 8,874 |
| Residential Medium (8 - 14) | | 1,745 | 2,048 | 2,078 | 2,133 | 2,158 | 2,212 |
| Residential High (15 - 24) | | 767 | 938 | 971 | 1,001 | 1,013 | 1,066 |
| Residential Very High (25+) | | - | 106 | 107 | 107 | 108 | 108 |
| Commercial | | 1,269 | 1,340 | 1,463 | 1,506 | 1,515 | 1,524 |
| Industrial | | 1 | 33 | 33 | 33 | 33 | 33 |
| Public/Institutional | | 204 | 196 | 197 | 208 | 209 | 211 |
| Parks, Schools, Irrigation | | 4,091 | 4,207 | 4,257 | 4,324 | 4,375 | 4,425 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **16,592** | **18,066** | **19,029** | **20,171** | **20,397** | **22,642** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **CVWD** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 6,299 | 7,148 | 7,830 | 8,156 | 8,592 | 8,742 |
| Residential Low (3 - 7) | | 19,037 | 20,053 | 21,295 | 21,613 | 21,999 | 22,259 |
| Residential Medium (8 - 14) | | 4,217 | 4,556 | 5,122 | 5,180 | 5,463 | 5,525 |
| Residential High (15 - 24) | | 4,206 | 4,858 | 6,327 | 6,506 | 6,579 | 6,742 |
| Residential Very High (25+) | | 1,054 | 1,060 | 1,066 | 1,073 | 1,079 | 1,085 |
| Commercial | | 2,333 | 2,375 | 2,430 | 2,452 | 2,476 | 2,492 |
| Industrial | | 1,449 | 1,552 | 1,635 | 1,660 | 1,670 | 1,681 |
| Public/Institutional | | 1,366 | 1,425 | 1,397 | 1,409 | 1,418 | 1,431 |
| Parks, Schools, Irrigation | | 9,688 | 9,801 | 8,715 | 8,814 | 9,065 | 9,632 |
| Agriculture | | 36 | 33 | 16 | 13 | 4 | - |
| Unique Water User #1 | | 460 | 462 | 465 | 468 | 471 | 474 |
| Unique Water User #2 | | 296 | 298 | 300 | 301 | 303 | 305 |
| Unique Water User #3 | | 284 | 286 | 288 | 289 | 291 | 293 |
| Unique Water User #4 | | 261 | 263 | 264 | 266 | 267 | 269 |
| | **Total** | **50,986** | **54,170** | **57,150** | **58,200** | **59,677** | **60,930** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Fontana WC** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 2,088 | 2,112 | 2,077 | 1,796 | 1,084 | 911 |
| Residential Low (3 - 7) | | 19,110 | 19,366 | 20,529 | 21,846 | 24,061 | 24,771 |
| Residential Medium (8 - 14) | | 2,631 | 2,661 | 2,908 | 4,360 | 4,763 | 4,815 |
| Residential High (15 - 24) | | 4,029 | 4,075 | 6,682 | 6,820 | 7,161 | 7,239 |
| Residential Very High (25+) | | 216 | 217 | 219 | 399 | 728 | 732 |
| Commercial | | 6,628 | 6,697 | 7,016 | 8,801 | 11,117 | 11,467 |
| Industrial | | 2,061 | 2,281 | 2,417 | 2,454 | 2,490 | 2,519 |
| Public/Institutional | | 687 | 691 | 953 | 1,014 | 1,101 | 1,109 |
| Parks, Schools, Irrigation | | 4,682 | 4,735 | 4,789 | 4,842 | 4,895 | 4,949 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **42,132** | **42,835** | **47,590** | **52,332** | **57,400** | **58,512** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Monte Vista WD** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,522 | 1,540 | 1,557 | 1,756 | 1,813 | 1,930 |
| Residential Low (3 - 7) | | 3,129 | 3,197 | 3,235 | 3,301 | 3,367 | 3,413 |
| Residential Medium (8 - 14) | | 1,635 | 1,724 | 1,863 | 1,884 | 1,905 | 1,926 |
| Residential High (15 - 24) | | 666 | 1,223 | 1,237 | 1,251 | 1,272 | 1,326 |
| Residential Very High (25+) | | - | - | - | - | - | - |
| Commercial | | 1,339 | 1,368 | 1,378 | 1,389 | 1,444 | 1,472 |
| Industrial | | 367 | 360 | 363 | 367 | 385 | 388 |
| Public/Institutional | | 324 | 329 | 331 | 335 | 358 | 360 |
| Parks, Schools, Irrigation | | 1,125 | 1,138 | 1,152 | 1,165 | 1,203 | 1,216 |
| Agriculture | | 61 | 61 | 54 | 17 | 10 | - |
| Unique Water User #1 | | 93 | 94 | 94 | 95 | 95 | 96 |
| Unique Water User #2 | | 51 | 51 | 52 | 52 | 52 | 53 |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **10,312** | **11,085** | **11,316** | **11,612** | **11,904** | **12,180** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Ontario** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 338 | 353 | 374 | 432 | 437 | 442 |
| Residential Low (3 - 7) | | 9,993 | 10,581 | 12,183 | 13,531 | 14,357 | 18,047 |
| Residential Medium (8 - 14) | | 3,212 | 3,851 | 4,231 | 5,214 | 6,087 | 12,678 |
| Residential High (15 - 24) | | 4,830 | 5,327 | 5,652 | 5,719 | 5,864 | 6,031 |
| Residential Very High (25+) | | 845 | 914 | 1,298 | 2,793 | 3,357 | 5,157 |
| Commercial | | 5,213 | 5,241 | 5,606 | 6,789 | 7,021 | 8,754 |
| Industrial | | 2,232 | 2,361 | 2,647 | 2,727 | 2,772 | 2,813 |
| Public/Institutional | | 3,090 | 3,089 | 3,115 | 3,135 | 3,154 | 3,174 |
| Parks, Schools, Irrigation | | 8,101 | 8,407 | 9,111 | 11,046 | 11,575 | 12,778 |
| Agriculture | | 2,177 | 1,372 | 1,118 | 529 | 295 | 23 |
| Unique Water User #1 | | 2,688 | 2,705 | 2,721 | 2,738 | 2,755 | 2,771 |
| Unique Water User #2 | | 681 | 686 | 690 | 694 | 698 | 702 |
| Unique Water User #3 | | 573 | 577 | 581 | 584 | 588 | 591 |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **43,973** | **45,464** | **49,327** | **55,931** | **58,960** | **73,961** |

# Appendix E - Demands Projection by Member Agency

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **San Antonio WC** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,440 | 1,457 | 1,544 | 1,562 | 1,864 | 2,212 |
| Residential Low (3 - 7) | | - | - | - | - | - | - |
| Residential Medium (8 - 14) | | 4 | 4 | 4 | 4 | 4 | 4 |
| Residential High (15 - 24) | | 21 | 21 | 21 | 22 | 22 | 22 |
| Residential Very High (25+) | | - | - | - | - | - | - |
| Commercial | | 6 | 6 | 6 | 6 | 6 | 6 |
| Industrial | | - | - | - | - | - | - |
| Public/Institutional | | 22 | 22 | 22 | 23 | 23 | 23 |
| Parks, Schools, Irrigation | | - | - | - | - | - | - |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | - | - | - | - | - | - |
| Unique Water User #2 | | - | - | - | - | - | - |
| Unique Water User #3 | | - | - | - | - | - | - |
| Unique Water User #4 | | - | - | - | - | - | - |
| | **Total** | **1,493** | **1,510** | **1,597** | **1,617** | **1,919** | **2,267** |

| | | Water Demands (AF) | | | | | |
|---|---|---|---|---|---|---|---|
| **Upland** | | **2015** | **2020** | **2025** | **2030** | **2035** | **2040** |
| Residential Very Low (<1 - 2) | | 1,579 | 1,597 | 1,616 | 1,634 | 1,653 | 1,672 |
| Residential Low (3 - 7) | | 8,437 | 8,544 | 8,643 | 8,754 | 8,945 | 9,045 |
| Residential Medium (8 - 14) | | 1,601 | 2,033 | 2,195 | 2,243 | 2,268 | 2,317 |
| Residential High (15 - 24) | | 3,022 | 3,363 | 3,426 | 4,048 | 4,094 | 4,140 |
| Residential Very High (25+) | | 381 | 468 | 471 | 593 | 596 | 692 |
| Commercial | | 1,542 | 1,570 | 1,609 | 1,619 | 1,742 | 1,752 |
| Industrial | | 369 | 384 | 386 | 407 | 409 | 411 |
| Public/Institutional | | 460 | 445 | 448 | 451 | 473 | 476 |
| Parks, Schools, Irrigation | | 2,490 | 2,519 | 2,900 | 2,934 | 2,967 | 3,000 |
| Agriculture | | - | - | - | - | - | - |
| Unique Water User #1 | | 281 | 283 | 268 | 270 | 271 | 273 |
| Unique Water User #2 | | 256 | 258 | 259 | 261 | 262 | 264 |
| Unique Water User #3 | | 122 | 122 | 123 | 124 | 125 | 125 |
| Unique Water User #4 | | 107 | 108 | 109 | 109 | 110 | 110 |
| | **Total** | **20,647** | **21,694** | **22,453** | **23,447** | **23,915** | **24,277** |

# APPENDIX F

## Model User Guide

# Land Use Base Water Demand Model User Guide

This Demand Model is built in Microsoft Access which is linked with ArcGIS and provides users with an easy-to-use interface to view and update factor and demands.

## 1 WELCOME

The Welcome page (Figure 1-1 ) is the first interface the user sees when they open the model and is the primary interface for viewing, entering and updating model parameters and inputs like acreages, Land Use Demand Factors (LUD), and adjustment factors.

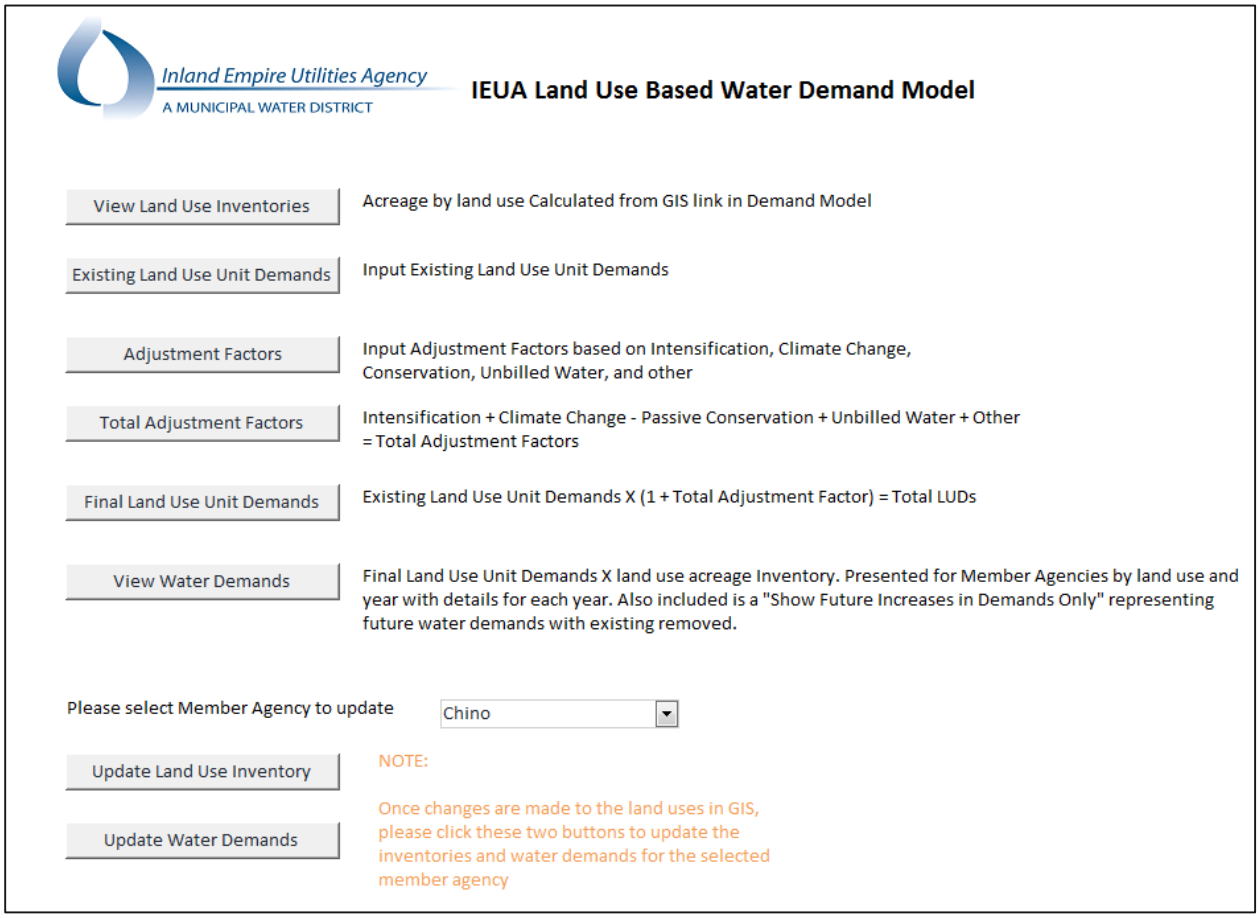



Figure 1-1 Welcome Form

Below list describes the functions for each of the buttons on the Welcome page -

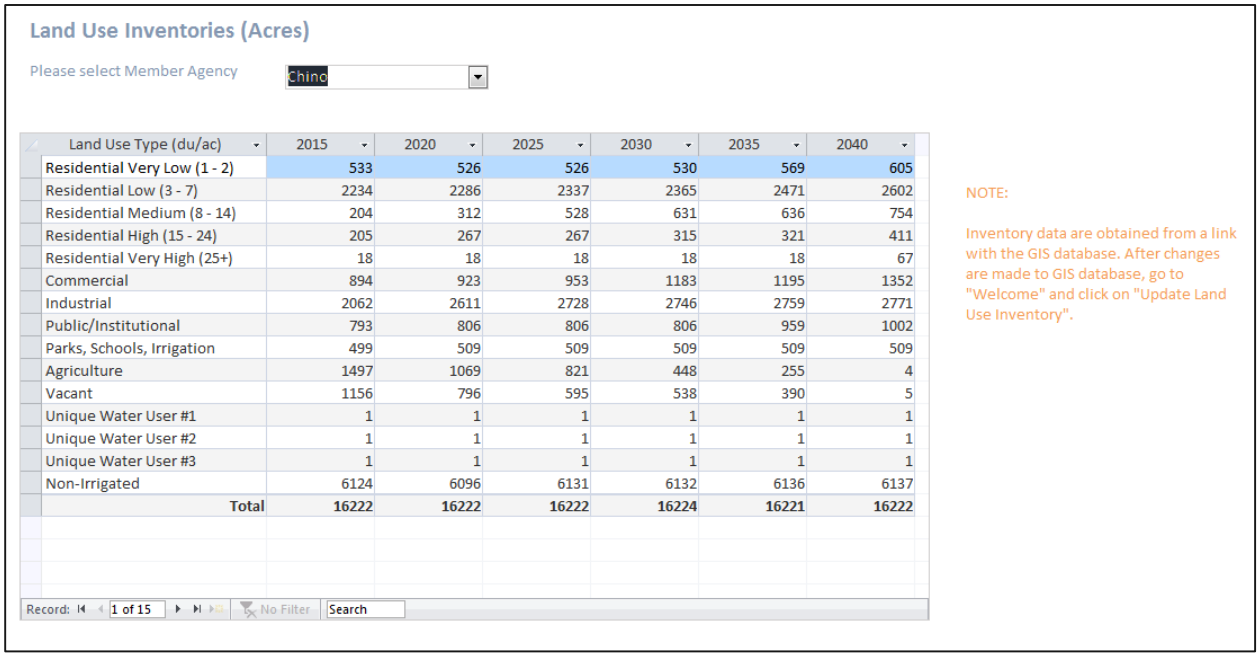
- Click “View Land Use Inventories” to view land use acreages by member agency which are calculated from GIS linked in the Demand Model. Any modification to the acreages and Landuse type must be done using GIS.
- Click “Existing Land Use Unit Demands” to view or update Existing LUD by member agency. LUDs are calculated outside the model as described in the memo. Users can manually update the LUDs when they are updated in the futures. Users can also update the Final Land Use Unit Demands from this form.

- Click “Adjustment Factors” to view or update Adjustment Factors by member agency. Users can also update the Total Adjustment Factors from this form.
- Click “Total Adjustment Factors” to view Total Adjustment Factors by member agency and update the Final Land Use Unit Demands.
- Click “Final Land Use Unit Demands” to view Final Land Use Unit Demands by member agency and update the Water Demands.

If updates are made to the GIS land use layers, users can select the appropriate member agency or all member agencies from the dropdown list and click ”Update Land Use Inventory” and “Update Water Demands” to update acreage inventories and total water demands.

# 2 VIEW LAND USE INVENTORIES

Click on View Land Use Inventories on the Welcome Page to view the acreages by land use. Select a member agency or “All Member Agencies” from the dropdown list to view their land use acreages. The acreages are calculated directly from the GIS database. This table cannot be manually updated without updating the background GIS layers.




| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 533 | 526 | 526 | 530 | 569 | 605 |
| Residential Low (3 - 7) | 2234 | 2286 | 2337 | 2365 | 2471 | 2602 |
| Residential Medium (8 - 14) | 204 | 312 | 528 | 631 | 636 | 754 |
| Residential High (15 - 24) | 205 | 267 | 267 | 315 | 321 | 411 |
| Residential Very High (25+) | 18 | 18 | 18 | 18 | 18 | 67 |
| Commercial | 894 | 923 | 953 | 1183 | 1195 | 1352 |
| Industrial | 2062 | 2611 | 2728 | 2746 | 2759 | 2771 |
| Public/Institutional | 793 | 806 | 806 | 806 | 959 | 1002 |
| Parks, Schools, Irrigation | 499 | 509 | 509 | 509 | 509 | 509 |
| Agriculture | 1497 | 1069 | 821 | 448 | 255 | 4 |
| Vacant | 1156 | 796 | 595 | 538 | 390 | 5 |
| Unique Water User #1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Unique Water User #3 | 1 | 1 | 1 | 1 | 1 | 1 |
| Non-Irrigated | 6124 | 6096 | 6131 | 6132 | 6136 | 6137 |
| Total | 16222 | 16222 | 16222 | 16224 | 16221 | 16222 |

Figure 2-1 Land Use Inventories Form

# 3 EXISTING LAND USE UNIT DEMANDS

Click on Existing Land Use Unit Demands on the Welcome Page to view and update the Existing land Use Unit Demands manually. The Dropdown menu on the Existing Land Use Unit Demand table can be used view and update LUDs. These Existing LUDs are calculated from the Existing Water Consumption based on the Land Uses (explained in the Technical Memorandum). Updates to LUDS can be made by simply entering the number in the appropriate cell in the table.

After updating the LUD values, Click “Update Final Land Use Unit Demands” to update the final unit demands of all member agencies with the adjustment factors applied.

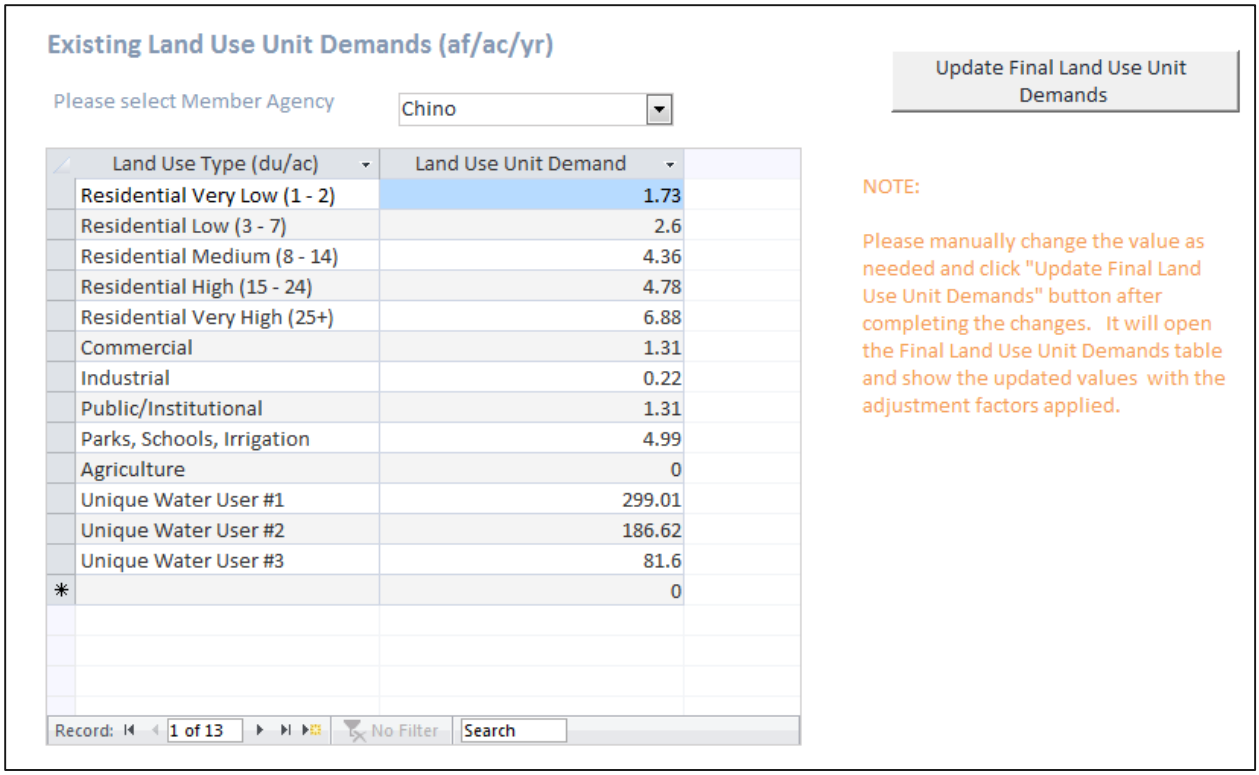



Figure 3-1 Existing land Use Unit Demands Form

# 4 ADJUSTMENT FACTORS

Click on 

on the Welcome Page to view and update the various Adjustment Factors (Figure 4-1). Select a member agency from the drop down menu on the Adjustment Factors table to view and update factor values in each factors. Definition for each Adjustment Factor and how it affects the existing LUDs is provided in the Technical Memorandum.

## 4.1 Intensification

Click on the “Intensification” tab to view the values for each land use by member agency and to update the intensification factors independently. To perform a global update for all land use types, enter a number in the "Update Intensification" box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

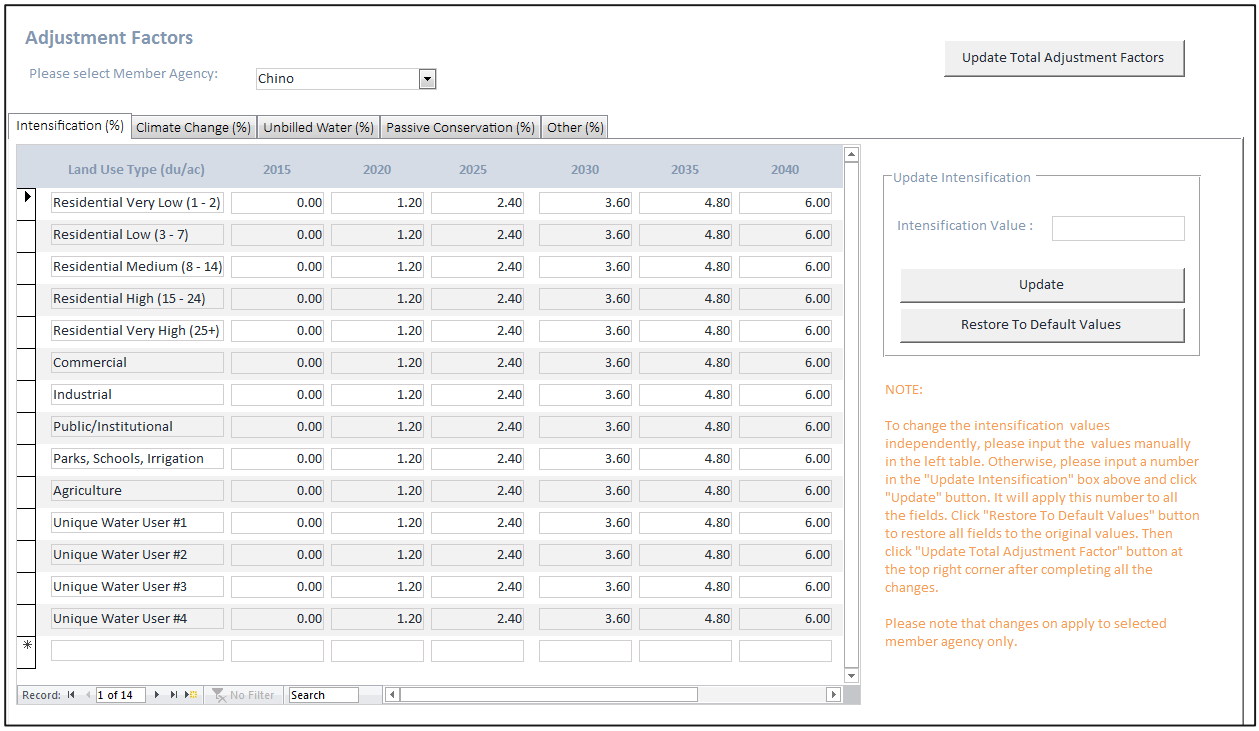



Figure 4-1 Intensification Form

## 4.2 Climate Change

Click on the “Climate Change” tab to view the values for each land use by member agency and to update the factors independently.

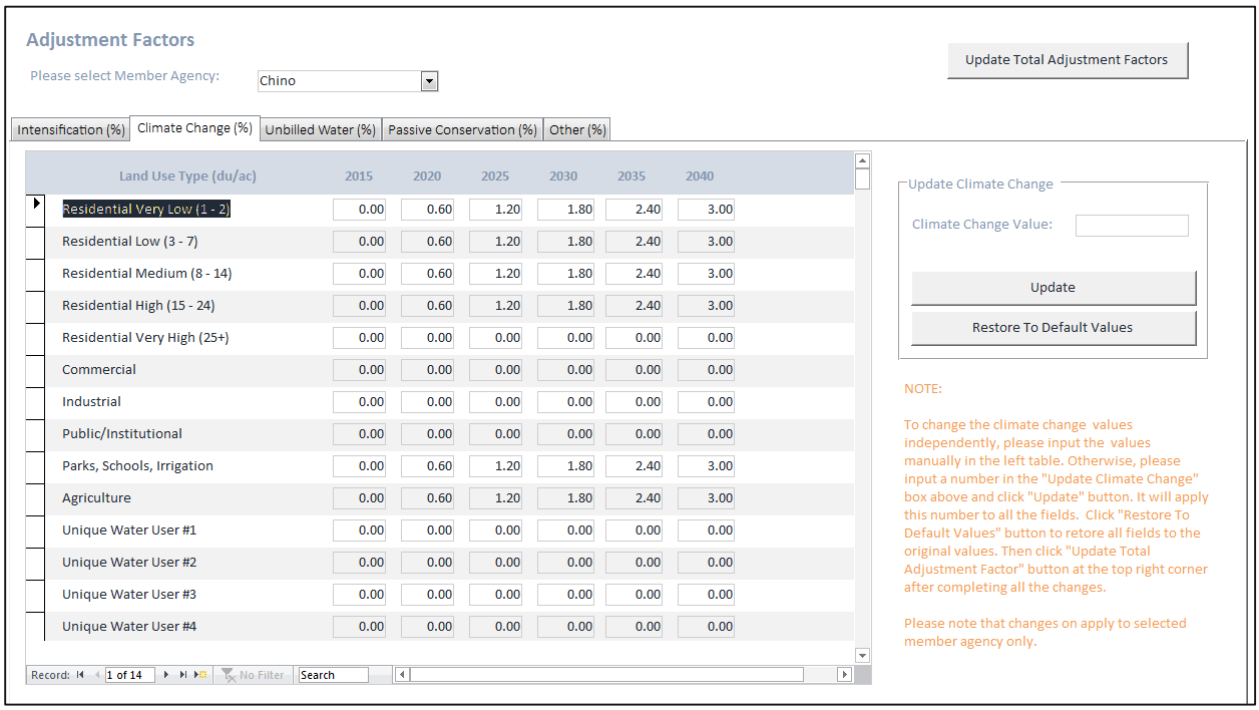



Figure 4-2 Climate Change Form

To perform a global update for all land use types, enter a number in the "Update Climate Change" box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

## 4.3 Unbilled Water

Click on the “Unbilled Water” tab to view the values by member agency and to update the factors. Unbilled Water factors is applied uniformly for all land uses. Click "Restore To Default Values" button to restore it to the original value.

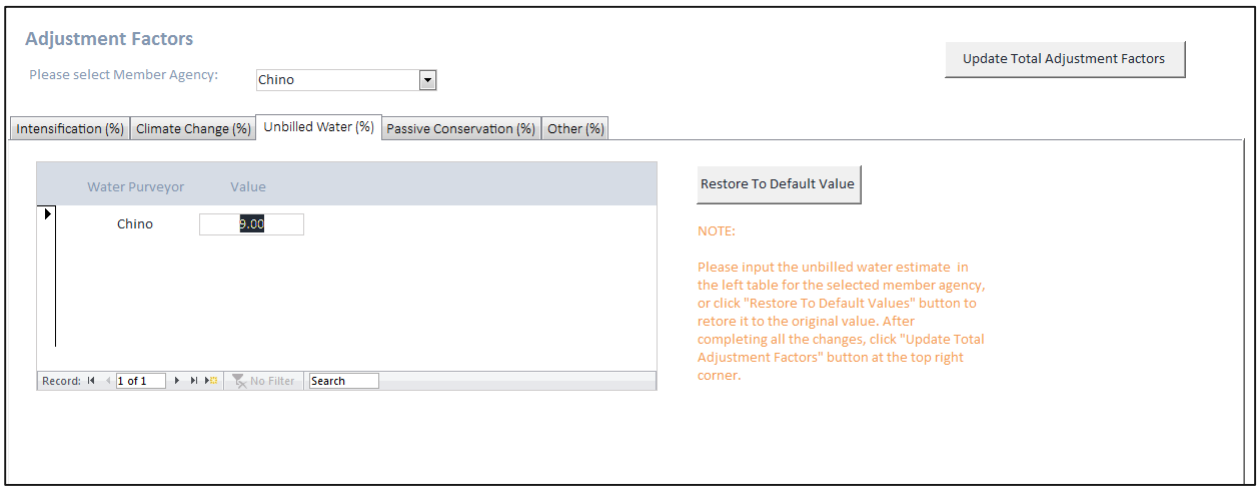



Figure 4-3 Unbilled Water Form

## 4.4 Passive Conservation

Click on the “Passive Conservation” tab to view the values for each land use by member agency and to update the factors independently. To perform a global update for all land use types, enter a number in the "Update Passive Conservation” box and click "Update" button. Click "Restore To Default Values" button to restore all fields to the original values.

Entering a positive number for passive conservation to indicate decrease in adjustment factor and demand.

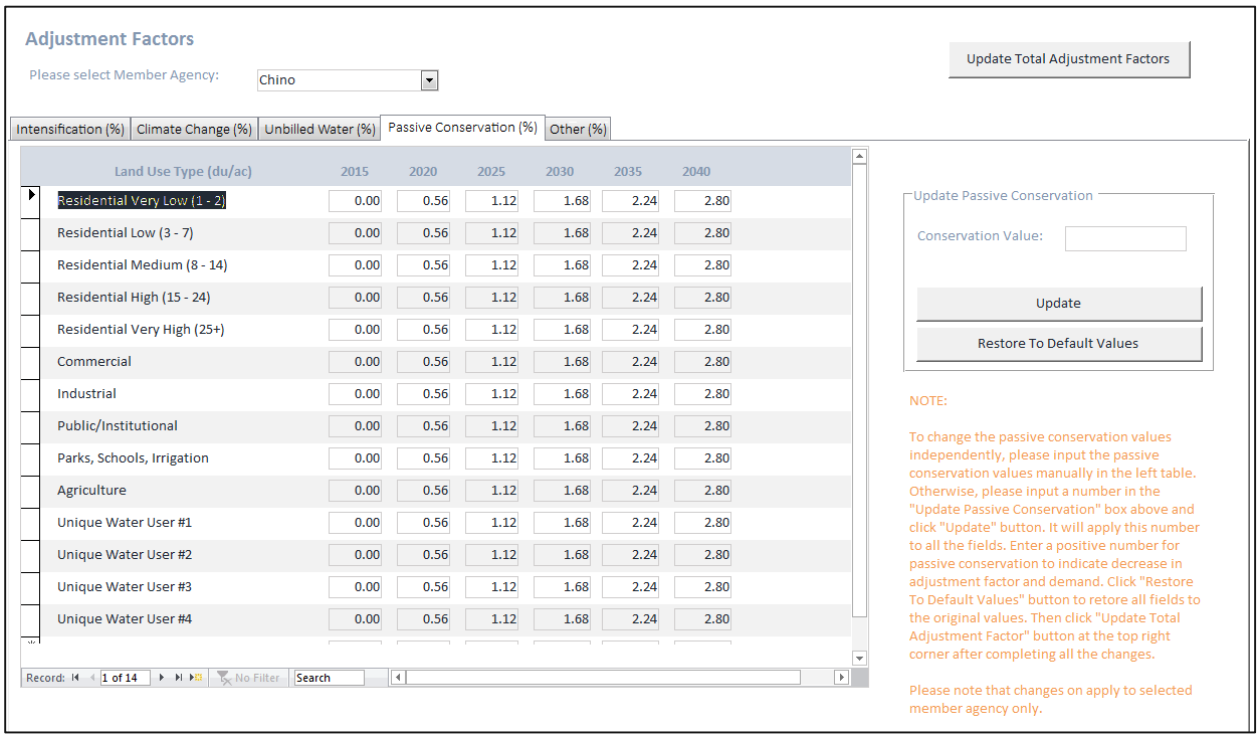



Figure 4-4 Passive Conservation Form

## 4.5 Other

The “Other” tab is an empty form that user can use to capture any additional adjustment factor not captures in the other tabs. The default value is 0 in all cells.

To perform a global update for all land use types, enter a number in the "Update Other Value” box and click "Update" button. Click "Restore To Default Values" button to restore all fields to 0.

A positive value will increase the Existing LUD and hence the total demand. And a negative number will decrease the Existing LUD.

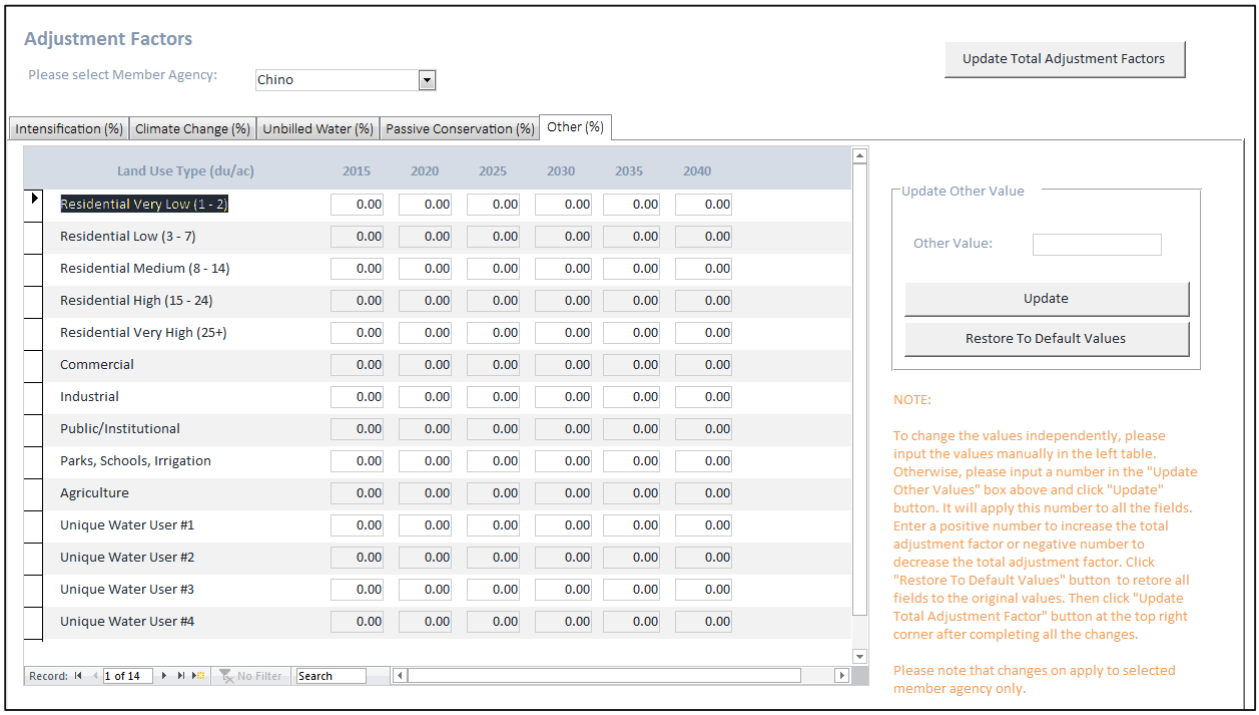



Figure 4-5 Other Form

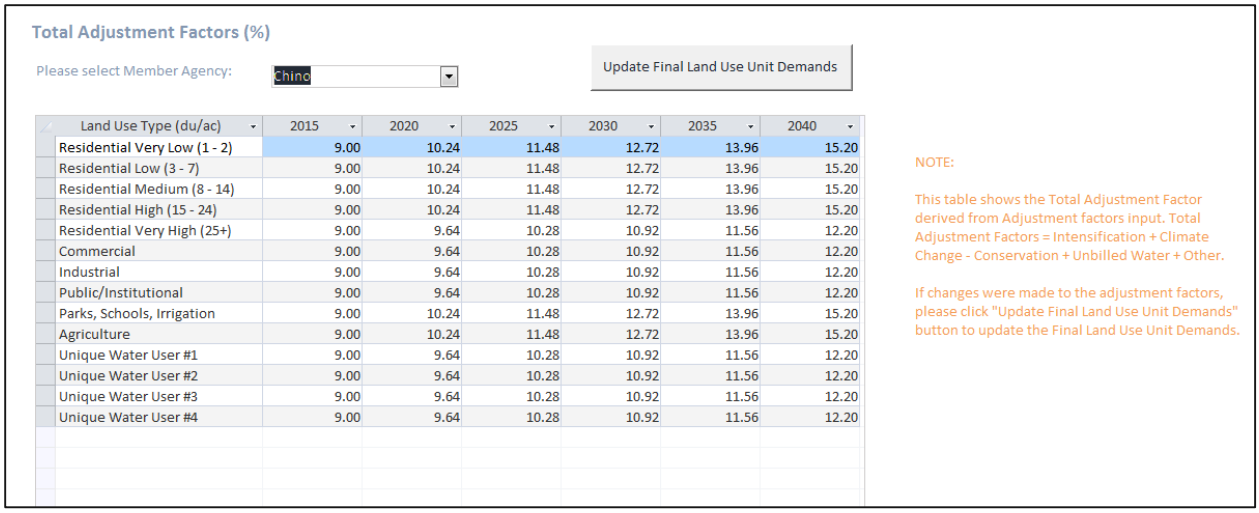
After updating or changing any adjustment factor, click "Update Total Adjustment Factor" button. It will recalculate the Total Adjacent Factors for all member agencies. Then the “Total Adjustment Factors” Form will pop up to show the new Adjustment Factors.

# 5 TOTAL ADJUSTMENT FACTORS

Click on Total Adjustment Factors on the Welcome Page to view the Total Adjustment Factors (Figure 5-1). Use the dropdown box to select the appropriate member agency. These values cannot be changed in this table. These values is calculated using the Adjustment Factors table using below equation

Total Adjustment Factors = Intensification + Climate Change - Conservation + Unbilled Water + Other.

If changes were made to the adjustment factors, please click "Update Final Land Use Unit Demands" button to update the Final Land Use Unit Demands of all member agencies. Then the “Final Land Use Unit Demands” form will pop up to show the results (Figure 6-1)



Total Adjustment Factors (%)

Please select Member Agency: Chino

Update Final Land Use Unit Demands

| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Low (3 - 7) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Medium (8 - 14) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential High (15 - 24) | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Residential Very High (25+) | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Commercial | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Industrial | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Public/Institutional | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Parks, Schools, Irrigation | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Agriculture | 9.00 | 10.24 | 11.48 | 12.72 | 13.96 | 15.20 |
| Unique Water User #1 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #2 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #3 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |
| Unique Water User #4 | 9.00 | 9.64 | 10.28 | 10.92 | 11.56 | 12.20 |

NOTE:

This table shows the Total Adjustment Factor derived from Adjustment factors input. Total Adjustment Factors = Intensification + Climate Change - Conservation + Unbilled Water + Other.

If changes were made to the adjustment factors, please click "Update Final Land Use Unit Demands" button to update the Final Land Use Unit Demands.

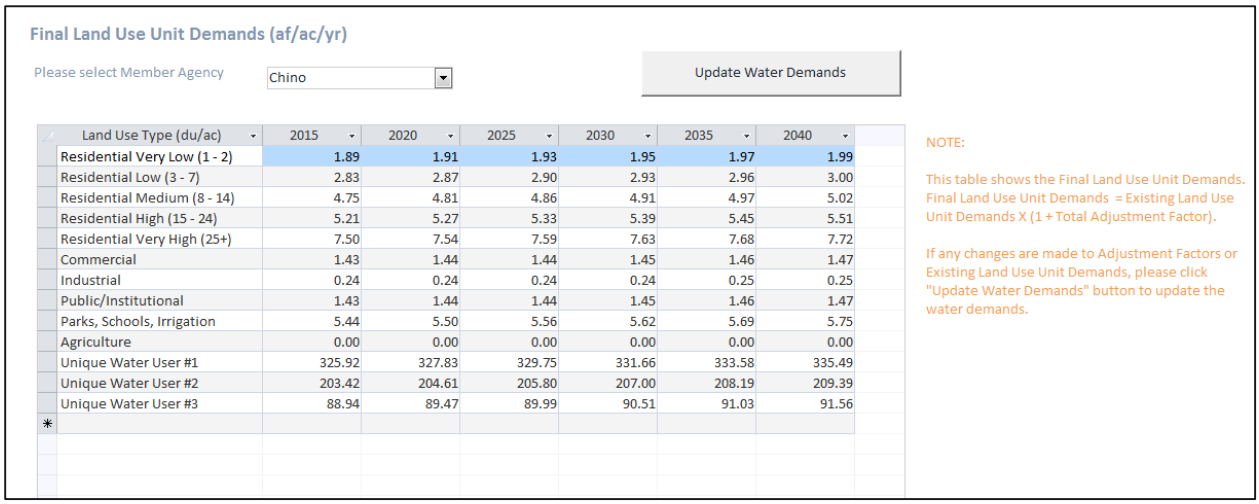
Figure 5-1 Total Adjustment Factors Form

# 6 FINAL LAND UNIT DEMANDS

Click on Final Land Use Unit Demands on the Welcome Page to view the Final LUDs (Figure 6-1) by member agency. Final LUDs is calculated using the below formula

Final Land Use Unit Demands = Existing Land Use Unit Demands X (1 + Total Adjustment Factor)

If changes were made to Adjustment Factors or Existing Land Use Unit Demands, please click "Update Water Demands" button to update the water demands of all member agencies. Then the “Water Demands” Form will pop up to show results.



Final Land Use Unit Demands (af/ac/yr)

Please select Member Agency Chino

Update Water Demands

| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1.89 | 1.91 | 1.93 | 1.95 | 1.97 | 1.99 |
| Residential Low (3 - 7) | 2.83 | 2.87 | 2.90 | 2.93 | 2.96 | 3.00 |
| Residential Medium (8 - 14) | 4.75 | 4.81 | 4.86 | 4.91 | 4.97 | 5.02 |
| Residential High (15 - 24) | 5.21 | 5.27 | 5.33 | 5.39 | 5.45 | 5.51 |
| Residential Very High (25+) | 7.50 | 7.54 | 7.59 | 7.63 | 7.68 | 7.72 |
| Commercial | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Industrial | 0.24 | 0.24 | 0.24 | 0.24 | 0.25 | 0.25 |
| Public/Institutional | 1.43 | 1.44 | 1.44 | 1.45 | 1.46 | 1.47 |
| Parks, Schools, Irrigation | 5.44 | 5.50 | 5.56 | 5.62 | 5.69 | 5.75 |
| Agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unique Water User #1 | 325.92 | 327.83 | 329.75 | 331.66 | 333.58 | 335.49 |
| Unique Water User #2 | 203.42 | 204.61 | 205.80 | 207.00 | 208.19 | 209.39 |
| Unique Water User #3 | 88.94 | 89.47 | 89.99 | 90.51 | 91.03 | 91.56 |

NOTE:

This table shows the Final Land Use Unit Demands. Final Land Use Unit Demands = Existing Land Use Unit Demands X (1 + Total Adjustment Factor).

If any changes are made to Adjustment Factors or Existing Land Use Unit Demands, please click "Update Water Demands" button to update the water demands.

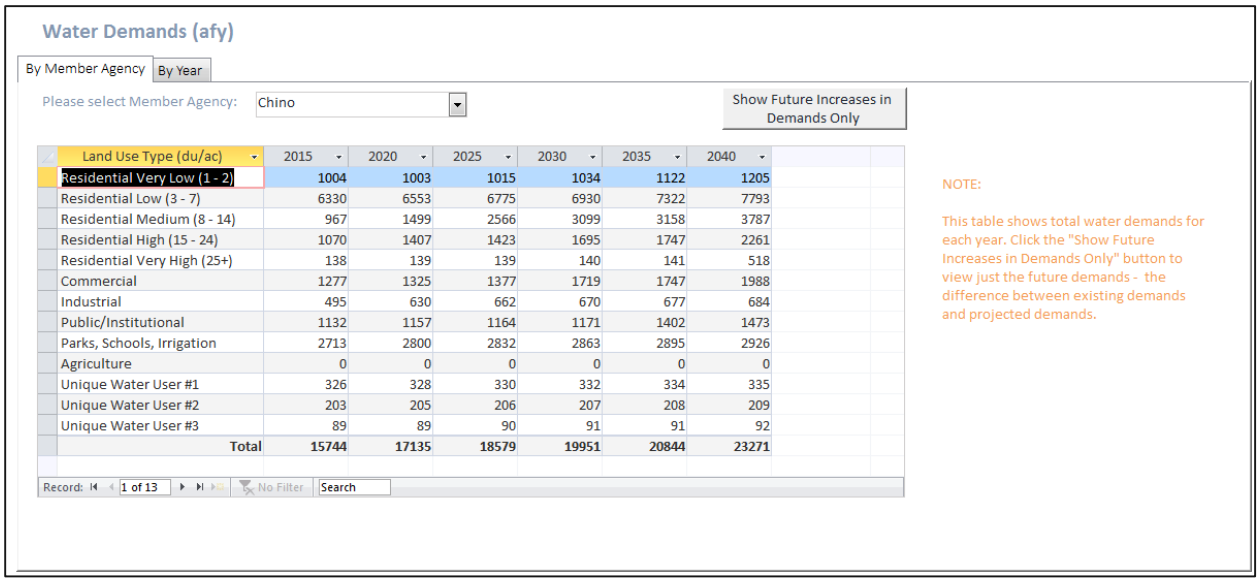
Figure 6-1 Final Land Unit Demands Form

# 7 VIEW WATER DEMANDS

Click on View Water Demands on the Welcome Page to view the Water Demands, either by Member Agency (Figure 7-1) or Year (Figure 7-3).

## 7.1 By Member Agency

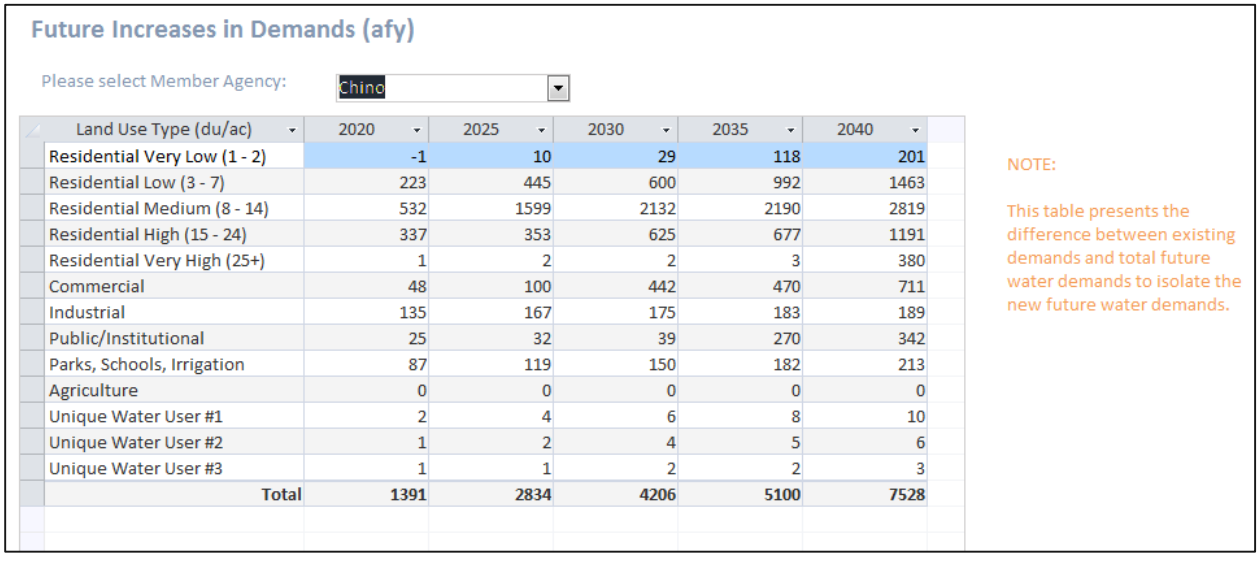
In “By Member Agency” tab, Use the dropdown menu to view the Water Demands by Member Agency.




| Land Use Type (du/ac) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1004 | 1003 | 1015 | 1034 | 1122 | 1205 |
| Residential Low (3 - 7) | 6330 | 6553 | 6775 | 6930 | 7322 | 7793 |
| Residential Medium (8 - 14) | 967 | 1499 | 2566 | 3099 | 3158 | 3787 |
| Residential High (15 - 24) | 1070 | 1407 | 1423 | 1695 | 1747 | 2261 |
| Residential Very High (25+) | 138 | 139 | 139 | 140 | 141 | 518 |
| Commercial | 1277 | 1325 | 1377 | 1719 | 1747 | 1988 |
| Industrial | 495 | 630 | 662 | 670 | 677 | 684 |
| Public/Institutional | 1132 | 1157 | 1164 | 1171 | 1402 | 1473 |
| Parks, Schools, Irrigation | 2713 | 2800 | 2832 | 2863 | 2895 | 2926 |
| Agriculture | 0 | 0 | 0 | 0 | 0 | 0 |
| Unique Water User #1 | 326 | 328 | 330 | 332 | 334 | 335 |
| Unique Water User #2 | 203 | 205 | 206 | 207 | 208 | 209 |
| Unique Water User #3 | 89 | 89 | 90 | 91 | 91 | 92 |
| Total | 15744 | 17135 | 18579 | 19951 | 20844 | 23271 |

Figure 7-1 Water Demands by Member Agency

Click the "Show Future Increases in Demands Only" button to view just the future demands - the difference between existing demands and projected demands.




| Land Use Type (du/ac) | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | -1 | 10 | 29 | 118 | 201 |
| Residential Low (3 - 7) | 223 | 445 | 600 | 992 | 1463 |
| Residential Medium (8 - 14) | 532 | 1599 | 2132 | 2190 | 2819 |
| Residential High (15 - 24) | 337 | 353 | 625 | 677 | 1191 |
| Residential Very High (25+) | 1 | 2 | 2 | 3 | 380 |
| Commercial | 48 | 100 | 442 | 470 | 711 |
| Industrial | 135 | 167 | 175 | 183 | 189 |
| Public/Institutional | 25 | 32 | 39 | 270 | 342 |
| Parks, Schools, Irrigation | 87 | 119 | 150 | 182 | 213 |
| Agriculture | 0 | 0 | 0 | 0 | 0 |
| Unique Water User #1 | 2 | 4 | 6 | 8 | 10 |
| Unique Water User #2 | 1 | 2 | 4 | 5 | 6 |
| Unique Water User #3 | 1 | 1 | 2 | 2 | 3 |
| Total | 1391 | 2834 | 4206 | 5100 | 7528 |

Figure 7-2 Future Increase in Demands by Member Agency

## 7.2 By Year

In “By Year” tab, use the dropdown menu to view the Water Demands for each year. This table also displays the total amounts in the last column and last row.

Water Demands (afy)

By Member Agency | By Year

Please select year: 2015

| Land Use Type (du/ac) | Chino | Chino Hills | Cucamonga Valley WD | Fontana WC | Monte Vista WD | Ontario | San Antonio WC | Upland | Total |
|---|---|---|---|---|---|---|---|---|---|
| Residential Very Low (1 - 2) | 1004 | 1491 | 6299 | 2088 | 1522 | 338 | 1440 | 1579 | 15761 |
| Residential Low (3 - 7) | 6330 | 7024 | 19037 | 19110 | 3129 | 9993 | 0 | 8437 | 73060 |
| Residential Medium (8 - 14) | 967 | 1745 | 4217 | 2631 | 1635 | 3212 | 4 | 1601 | 16012 |
| Residential High (15 - 24) | 1070 | 767 | 4206 | 4029 | 666 | 4830 | 21 | 3022 | 18611 |
| Residential Very High (25+) | 138 | 0 | 1054 | 216 | 0 | 845 | 0 | 381 | 2634 |
| Commercial | 1277 | 1269 | 2333 | 6628 | 1339 | 5213 | 6 | 1542 | 19607 |
| Industrial | 495 | 1 | 1449 | 2061 | 367 | 2232 | 0 | 369 | 6974 |
| Public/Institutional | 1132 | 204 | 1366 | 687 | 324 | 3090 | 22 | 460 | 7285 |
| Parks, Schools, Irrigation | 2713 | 4091 | 9688 | 4682 | 1125 | 8101 | 0 | 2490 | 32890 |
| Agriculture | 0 | 0 | 36 | 0 | 61 | 2177 | 0 | 0 | 2274 |
| Unique Water User #1 | 326 | 0 | 460 | 0 | 93 | 2688 | 0 | 281 | 3848 |
| Unique Water User #2 | 203 | 0 | 296 | 0 | 51 | 681 | 0 | 256 | 1487 |
| Unique Water User #3 | 89 | 0 | 284 | 0 | 0 | 573 | 0 | 122 | 1068 |
| Unique Water User #4 | 0 | 0 | 261 | 0 | 0 | 0 | 0 | 107 | 368 |
| * | | | | | | | | | 0 |
| Total | 15744 | 16592 | 50986 | 42132 | 10312 | 43973 | 1493 | 20647 | 201879 |

Record: | No Filter | Search

Figure 7-3 Water Demands by Year

## 7.3 Water Demands Graph

Water Demands table also displays a graph of the water demands of all member agencies throughout the years. Total IEUA demands is shown as default. Click “Not Show IEUA” to show curves of member agencies only.

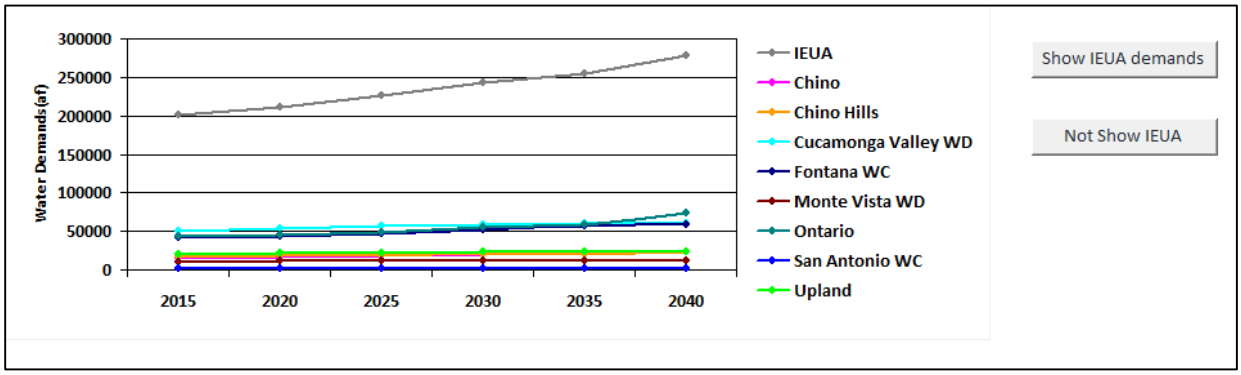



Figure 7-4 Water Demands Graph

# 8 UPDATE LAND USES IN ARCGIS

The model database contain multiple GIS feature classes with land use data which can be updated if changes to land uses occurs or year of development changes. These updates must be done within GIS.

The feature classes in the database is organized based on Cities within IEUA service area. Each city has two data tables: existing data and future data except City of Ontario and City of Upland. These two cities have existing and future data combined in one feature classes.

Since the land uses are mapped to existing parcel data, users only need to update the existing and future land use in the [CityName]_Existing or [CityName]_Existing_GeneralPlan tables. Below table shows which Feature Class is used to calculates acreages in the model. These can be updated within GIS when changes to Land Use type or development year happens.

| City Name | Feature Class Name | Used for Inventory Calculation |
|---|---|---|
| **Chino** | Chino_Existing | Y |
| | Chino_GeneralPlan | Y |
| **Chino Hills** | ChinoHills_Existing | Y |
| | ChinoHills_GeneralPlan | N |
| **Fontana** | Fontana_Existing | Y |
| | Fontana_GeneralPlan | N |
| **Montclair** | Montclair_Existing | Y |
| | Montclair_GeneralPlan | N |
| **Ontario** | Ontario_Existing_GeneralPlan | Y |
| **Rancho Cucamonga** | RanchoCucamonga_Existing | Y |
| | RanchoCucamonga_GeneralPlan | N |
| **Rialto** | Rialto_Existing | Y |
| | Rialto_GeneralPlan | N |
| **Unincorporated area between Montclair and Chino** | UINC_MontClair_Chino_Existing | Y |
| | UINC_MontClair_Chino_GP | N |
| **Upland** | Upland_Existing_GeneralPlan | Y |

In the [CityName]_Existing or [CityName]_Existing_GeneralPlan, besides the geographic information, a few new fields were added (below table).

| Field Name | Description |
|---|---|
| **Master_LU** | Existing land use (in 2015) |
| **GeneralPlan_LU** | Original planned future land use (Not used in inventory calculation) |
| **Future_LU** | Future land use |
| **Year_Developed** | The year the future land use developed |
| **WaterPurveyor** | The member agency belonged to |

To update land use in ArcGIS,

A) Be sure to close the database opened in MS Access
B) Add the needed feature classes to ArcMap and start Editor.
C) Change the land use in Master_LU for existing or change the land use in Future_LU for future and change the Year_Developed as well. Year_Developed value need to be multiples of 5 and starting from 2015 (till 2040). For example, a future land use will be developed in 2023, please input “2020” in Year_Developed field
D) Save the edits and close ArcGIS

Please note, Chino is a special case when editing future land uses. Since the parcels at southeast of Pine Ave & Chino Corona Rd changes significantly in future, the parcels in Chino_GeneralPlan are used for representing the land use in future. If future land uses in the colored area (shown in figure 8-1) needs to be changed, please update the Future_LU and Year_Developed fields in Chino_GeneralPlan feature class. For all other landuse changes, please update these two fields in Chino_Existing feature class.




Figure 8-1 Parcels representing future land uses in Chino

# 9 UPDATE WATER DEMAND MODEL

Once you have completed and saved the changes to the GIS feature classes, use the update features on Welcome page to update land use inventories and water demands.

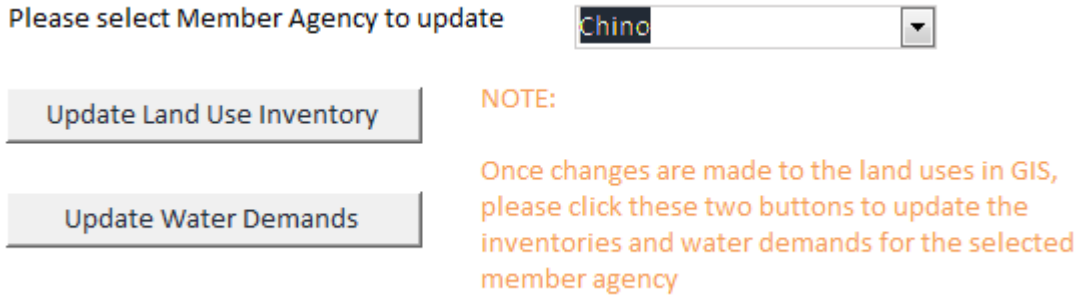



Figure 9-1 Update section in Welcome Form

## 9.1 Update Land Use Inventories

Before making the update, make sure the database is not opened in ArcGIS. Select a member agency or “All Member Agencies” in the dropdown list and click “Update Land Use Inventory” button to run the

calculation. This update procedure can take several minutes, please don't interrupt it. The "Land Use Inventories" window will pop up once the updating finished.

## 9.2 Update Water Demands

Once the inventories update is done, click "Update Water Demands" button to re-calculate the total water demands and the "Water Demands" form will pop up once the updating finished.

Arcadis U.S., Inc.

320 Commerce

Suite 200

Irvine, California  92602

Tel 714 730 9052

Fax 714 730 9345

**www.arcadis.com**

# Appendix H:
# Fiscal Year Ending 2015
# Water System Audit

*using*
*American Water Works Association (AWWA)*
*Free Water Audit Software (v5.0)*

# AWWA Free Water Audit Software:
## Reporting Worksheet

WAS v5.0

American Water Works Association.
Copyright © 2014, All Rights Reserved.

? Click to access definition
+ Click to add a comment

**Water Audit Report for:** Monte Vista Water District (3610029)
**Reporting Year:** 2015 | 7/2014 - 6/2015

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

**All volumes to be entered as: ACRE-FEET PER YEAR**

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

### WATER SUPPLIED

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 8 | 8,408.094 | acre-ft/yr | 8 | | 0.000 | acre-ft/yr |
| Water imported: | 4 | 7,635.200 | acre-ft/yr | 8 | | 0.000 | acre-ft/yr |
| Water exported: | 5 | 6,932.977 | acre-ft/yr | 8 | | 0.000 | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 9,110.317 acre-ft/yr

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Billed metered: | 6 | 8,531.701 | acre-ft/yr | | | |
| Billed unmetered: | n/a | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | 10 | 74.043 | acre-ft/yr | | | |
| Unbilled unmetered: | 8 | 7.488 | acre-ft/yr | | 7.488 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** ? 8,613.232 acre-ft/yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 497.085 acre-ft/yr

#### Apparent Losses

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 22.776 | acre-ft/yr | 0.25% | | acre-ft/yr |

**Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed**

| | | | | | |
|---|---|---|---|---|---|
| Customer metering inaccuracies: | 3 | 175.627 | acre-ft/yr | 2.00% | acre-ft/yr |
| Systematic data handling errors: | 8 | 0.250 | acre-ft/yr | 0.250 | acre-ft/yr |

**Apparent Losses:** ? 198.653 acre-ft/yr

#### Real Losses (Current Annual Real Losses or CARL)

**Real Losses = Water Losses - Apparent Losses:** ? 298.432 acre-ft/yr

**WATER LOSSES:** 497.085 acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** ? 578.617 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 198.0 | miles |
| Number of active AND inactive service connections: | 6 | 12,280 | |
| Service connection density: | | 62 | conn./mile main |

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

**Average length of customer service line has been set to zero and a data grading score of 10 has been applied**

Average operating pressure: 7 85.0 psi

### COST DATA

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | 10 | $12,957,128 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $2.13 | $/100 cubic feet (ccf) |
| Variable production cost (applied to Real Losses): | 7 | $720.00 | $/acre-ft |

☐ Use Customer Retail Unit Cost to value real losses

### WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 69 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

### PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Customer metering inaccuracies
3: Water exported

# AWWA Free Water Audit Software:
## System Attributes and Performance Indicators

WAS v5.0
American Water Works Association.
Copyright © 2014, All Rights Reserved.

Water Audit Report for: Monte Vista Water District (3610029)
Reporting Year: 2015 7/2014 - 6/2015

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 69 out of 100 ***

### System Attributes:

| | | | |
|---|---|---|---|
| | Apparent Losses: | 198.653 | acre-ft/yr |
| + | Real Losses: | 298.432 | acre-ft/yr |
| = | Water Losses: | 497.085 | acre-ft/yr |
| ? | Unavoidable Annual Real Losses (UARL): | 277.37 | acre-ft/yr |
| | Annual cost of Apparent Losses: | $184,143 | |
| | Annual cost of Real Losses: | $214,871 | Valued at Variable Production Cost |

Return to Reporting Worksheet to change this assumpiton

### Performance Indicators:

| | | | |
|---|---|---|---|
| Financial: | Non-revenue water as percent by volume of Water Supplied: | 6.4% | |
| | Non-revenue water as percent by cost of operating system: | 3.5% | Real Losses valued at Variable Production Cost |
| Operational Efficiency: | Apparent Losses per service connection per day: | 14.44 | gallons/connection/day |
| | Real Losses per service connection per day: | 21.70 | gallons/connection/day |
| | Real Losses per length of main per day*: | N/A | |
| | Real Losses per service connection per day per psi pressure: | 0.26 | gallons/connection/day/psi |
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 298.43 | acre-feet/year |
| ? | Infrastructure Leakage Index (ILI) [CARL/UARL]: | 1.08 | |

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

# Appendix I:
# Indirect Recycled Water Reuse Calculation

*provided by*
*Inland Empire Utilities Agency*
*April 18, 2016*

Total RW Deliveries

| FYE | Chino | Chino Hills | Ontario | Upland | Fontana | SBC | IEUA | CVWD | Montclair/MVWD | Recharge | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | - | - | - | - | - | - | - | - | - | - | - |
| 1996 | - | - | - | - | - | - | - | - | - | - | - |
| 1997 | - | - | - | - | - | - | - | - | - | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - |
| 2000 | - | - | - | - | - | - | - | - | - | - | - |
| 2001 | 293.4 | 568.7 | 1,001.3 | - | - | 1,427.9 | 5.1 | - | - | 500.3 | 3,796.6 |
| 2002 | 367.1 | 798.1 | 1,231.7 | - | - | 1,438.6 | 101.6 | - | - | 504.6 | 4,441.8 |
| 2003 | 952.5 | 766.7 | 1,196.7 | - | - | 1,341.6 | 50.9 | - | - | 184.5 | 4,492.9 |
| 2004 | 1,532.6 | 1,057.8 | 1,160.0 | - | - | 1,501.7 | 95.9 | - | - | 48.5 | 5,396.5 |
| 2005 | 822.0 | 815.1 | 1,169.2 | - | - | 1,459.3 | 964.4 | - | - | 158.3 | 5,388.3 |
| 2006 | 1,746.2 | 947.9 | 1,586.8 | 16.7 | - | 1,421.0 | 1,798.4 | 38.7 | - | 1,303.0 | 8,858.7 |
| 2007 | 2,296.4 | 1,630.5 | 3,672.7 | - | - | 1,404.3 | 766.4 | 253.3 | - | 2,981.0 | 13,004.5 |
| 2008 | 2,896.5 | 1,479.2 | 3,005.5 | - | - | 1,288.4 | 1,172.6 | 561.6 | - | 2,340.0 | 12,743.9 |
| 2009 | 4,620.0 | 1,281.4 | 3,955.3 | - | - | 1,250.7 | 1,548.4 | 617.2 | 99.1 | 2,684.0 | 16,055.9 |
| 2010 | 7,157.5 | 1,494.4 | 5,678.4 | - | - | 1,250.7 | 831.1 | 659.5 | 241.3 | 7,208.0 | 24,520.8 |
| 2011 | 6,472.9 | 1,631.4 | 5,743.6 | - | - | 1,250.7 | 520.2 | 733.6 | 303.6 | 8,028.0 | 24,683.9 |
| 2012 | 8,274.1 | 1,567.0 | 7,493.0 | - | - | 1,449.9 | 514.8 | 1,019.0 | 287.8 | 8,634.0 | 29,239.6 |
| 2013 | 8,957.2 | 1,889.5 | 6,894.3 | 263.6 | - | 14,027.3 | 870.8 | 1,230.7 | 326.6 | 10,479.0 | 44,939.0 |
| 2014 | 8,915.7 | 2,001.8 | 8,428.0 | 868.7 | - | 1,611.0 | 841.1 | 1,651.6 | 339.3 | 13,593.0 | 38,250.2 |
| 2015 | 8,324.0 | 1,827.1 | 8,018.2 | 636.3 | - | 1,370.6 | 695.2 | 1,400.5 | 307.7 | 10,840.0 | 33,419.5 |

SBC = San Bardino County, Retial customer for IEUA
IEUA = in plant uses and irrigation

Chino

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | 256.6 | 36.9 | 10.32% | 51.63 |
| 2002 | 324.6 | 42.5 | 10.32% | 52.07 |
| 2003 | 315.6 | 636.9 | 10.32% | 19.04 |
| 2004 | 403.1 | 1,129.5 | 10.34% | 5.02 |
| 2005 | 399.8 | 422.2 | 10.30% | 16.31 |
| 2006 | 603.4 | 1,142.9 | 10.40% | 135.51 |
| 2007 | 622.9 | 1,673.5 | 10.50% | 313.01 |
| 2008 | 961.8 | 1,934.8 | 10.50% | 245.70 |
| 2009 | 1,113.3 | 3,506.6 | 10.31% | 276.72 |
| 2010 | 1,288.1 | 5,869.4 | 10.84% | 781.35 |
| 2011 | 1,192.7 | 5,280.2 | 10.86% | 871.84 |
| 2012 | 1,214.7 | 7,059.4 | 10.67% | 921.25 |
| 2013 | 1,839.4 | 7,117.8 | 10.65% | 1,116.01 |
| 2014 | 2,242.5 | 6,673.2 | 10.74% | 1,459.89 |
| 2015 | 2,023.4 | 6,300.6 | 10.58% | 1,146.87 |

Chino Hills

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | 568.7 | - | 9.55% | 47.78 |
| 2002 | 798.1 | - | 9.55% | 48.19 |
| 2003 | 766.7 | - | 9.55% | 17.62 |
| 2004 | 1,057.8 | - | 9.52% | 4.62 |
| 2005 | 815.1 | - | 9.33% | 14.77 |
| 2006 | 934.1 | 13.8 | 9.34% | 121.70 |
| 2007 | 1,555.4 | 75.1 | 9.34% | 278.43 |
| 2008 | 1,415.2 | 64.1 | 8.99% | 210.37 |
| 2009 | 1,195.9 | 85.5 | 9.23% | 247.73 |
| 2010 | 1,430.4 | 64.0 | 9.43% | 679.71 |
| 2011 | 1,564.3 | 67.1 | 9.35% | 750.62 |
| 2012 | 1,521.9 | 45.1 | 9.19% | 793.46 |
| 2013 | 1,853.6 | 36.0 | 9.10% | 953.59 |
| 2014 | 1,960.6 | 41.2 | 9.11% | 1,238.32 |
| 2015 | 1,814.4 | 12.7 | 8.91% | 965.84 |

Ontario

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | 1,001.3 | - | 24.60% | 123.07 |
| 2002 | 1,231.7 | - | 24.60% | 124.13 |
| 2003 | 1,196.7 | - | 24.60% | 45.39 |
| 2004 | 1,160.0 | - | 24.34% | 11.81 |
| 2005 | 1,002.0 | 167.2 | 23.96% | 37.94 |
| 2006 | 1,146.9 | 439.9 | 22.83% | 297.47 |
| 2007 | 1,155.9 | 2,516.8 | 23.11% | 688.91 |
| 2008 | 996.2 | 2,009.3 | 22.86% | 534.92 |
| 2009 | 1,217.3 | 2,738.0 | 23.12% | 620.54 |
| 2010 | 1,942.4 | 3,735.9 | 22.62% | 1,630.45 |
| 2011 | 2,628.4 | 3,115.3 | 21.29% | 1,709.16 |
| 2012 | 3,486.2 | 4,006.9 | 22.12% | 1,909.84 |
| 2013 | 3,829.8 | 3,064.5 | 22.30% | 2,336.82 |
| 2014 | 4,061.9 | 4,366.1 | 22.18% | 3,014.93 |
| 2015 | 3,656.6 | 4,361.6 | 21.67% | 2,349.03 |

Upland

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | - | - | 10.65% | 53.28 |
| 2002 | - | - | 10.65% | 53.74 |
| 2003 | - | - | 10.65% | 19.65 |
| 2004 | - | - | 10.80% | 5.24 |
| 2005 | - | - | 10.49% | 16.61 |
| 2006 | 16.7 | - | 10.43% | 135.90 |
| 2007 | - | - | 10.39% | 309.73 |
| 2008 | - | - | 10.21% | 238.91 |
| 2009 | - | - | 10.27% | 275.65 |
| 2010 | - | - | 10.35% | 746.03 |
| 2011 | - | - | 10.32% | 828.49 |
| 2012 | - | - | 10.14% | 875.49 |
| 2013 | 263.6 | - | 10.10% | 1,058.38 |
| 2014 | 868.7 | - | 10.05% | 1,366.10 |
| 2015 | 636.1 | 0.2 | 9.96% | 1,079.66 |

SBC

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | | | |
| 1996 | - | | | |
| 1997 | - | | | |
| 1998 | - | | | |
| 1999 | - | | | |
| 2000 | - | | | |
| 2001 | 1,427.9 | - | | - |
| 2002 | 1,438.6 | - | - | - |
| 2003 | 1,341.6 | - | - | - |
| 2004 | 1,501.7 | - | - | - |
| 2005 | 1,459.3 | - | - | - |
| 2006 | 1,421.0 | - | - | - |
| 2007 | 1,404.3 | - | - | - |
| 2008 | 1,288.4 | - | - | - |
| 2009 | 1,250.7 | - | - | - |
| 2010 | 1,250.7 | - | - | - |
| 2011 | 1,250.7 | - | - | - |
| 2012 | 1,449.9 | - | - | - |
| 2013 | 14,027.3 | - | - | - |
| 2014 | 1,611.0 | - | - | - |
| 2015 | 1,370.6 | - | - | - |

IEUA

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | - | 5.1 | - | - |
| 2002 | 67.8 | 33.8 | - | - |
| 2003 | 39.0 | 11.9 | - | - |
| 2004 | 84.1 | 11.8 | - | - |
| 2005 | 964.4 | - | - | - |
| 2006 | 1,798.4 | - | - | - |
| 2007 | 766.4 | - | - | - |
| 2008 | 1,172.6 | - | - | - |
| 2009 | 1,548.4 | - | - | - |
| 2010 | 831.1 | - | - | - |
| 2011 | 520.2 | - | - | - |
| 2012 | 514.8 | - | - | - |
| 2013 | 870.8 | - | - | - |
| 2014 | 841.1 | - | - | - |
| 2015 | 695.2 | - | - | - |

CVWD

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | - | - | 21.91% | 109.62 |
| 2002 | - | - | 21.91% | 110.56 |
| 2003 | - | - | 21.91% | 40.42 |
| 2004 | - | - | 21.97% | 10.66 |
| 2005 | - | - | 22.74% | 36.00 |
| 2006 | 38.65 | - | 23.83% | 310.50 |
| 2007 | 253.28 | - | 23.35% | 696.06 |
| 2008 | 561.55 | - | 24.48% | 572.83 |
| 2009 | 617.21 | - | 23.58% | 632.89 |
| 2010 | 659.53 | - | 21.87% | 1,576.39 |
| 2011 | 733.55 | - | 23.89% | 1,917.89 |
| 2012 | 1018.96 | - | 24.37% | 2,104.11 |
| 2013 | 1230.72 | - | 24.23% | 2,539.06 |
| 2014 | 1651.57 | - | 24.02% | 3,265.04 |
| 2015 | 1400.5 | - | 25.18% | 2,729.51 |

Montclair/MVWD

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | - | - | 4.93% | 24.66 |
| 2002 | - | - | 4.93% | 24.88 |
| 2003 | - | - | 4.93% | 9.10 |
| 2004 | - | - | 4.78% | 2.32 |
| 2005 | 0 | - | 4.61% | 7.30 |
| 2006 | 0 | - | 4.60% | 59.94 |
| 2007 | 0 | - | 4.56% | 135.93 |
| 2008 | 0 | - | 4.45% | 104.13 |
| 2009 | 99.11 | - | 4.38% | 117.56 |
| 2010 | 241.32 | - | 4.44% | 320.04 |
| 2011 | 303.58 | - | 4.45% | 357.25 |
| 2012 | 287.79 | - | 4.33% | 373.85 |
| 2013 | 326.59 | - | 4.54% | 475.75 |
| 2014 | 339.3 | - | 4.67% | 634.79 |
| 2015 | 307.73 | - | 4.46% | 483.46 |

Fontana

| FYE | Non-Ag | Ag | %share | GWR |
|---|---|---|---|---|
| 1995 | - | - | | |
| 1996 | - | - | | |
| 1997 | - | - | | |
| 1998 | - | - | | |
| 1999 | - | - | | |
| 2000 | - | - | | |
| 2001 | - | - | 18.0% | 90.25 |
| 2002 | - | - | 18.0% | 91.03 |
| 2003 | - | - | 18.0% | 33.28 |
| 2004 | - | - | 18.2% | 8.85 |
| 2005 | - | - | 18.56% | 29.39 |
| 2006 | - | - | 18.57% | 241.97 |
| 2007 | - | - | 18.75% | 558.94 |
| 2008 | - | - | 18.51% | 433.13 |
| 2009 | - | - | 19.11% | 512.91 |
| 2010 | - | - | 20.44% | 1,473.32 |
| 2011 | - | - | 19.84% | 1,592.76 |
| 2012 | - | - | 19.18% | 1,656.00 |
| 2013 | - | - | 19.08% | 1,999.39 |
| 2014 | - | - | 19.24% | 2,615.29 |
| 2015 | - | - | 19.24% | 2,085.62 |

| Deduct Recycled Water Use for Indirect Potable Reuse | | | | |
|---|---|---|---|---|
| FYE | Total Groundwater Recharge | (1) 5-Year Average Recharge (Acre-Feet) | (2) Loss Factor for Recharge & Recovery | (1) x (2) = (3) Volume Entering Distribution System (Acre-Feet) |
| 1995 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 |
| 2001 | 500.3 | 500.3 | 90% | 450.27 |
| 2002 | 504.6 | 502.5 | 90% | 452.21 |
| 2003 | 184.5 | 396.5 | 90% | 356.82 |
| 2004 | 48.5 | 309.5 | 90% | 278.53 |
| 2005 | 158.3 | 279.3 | 90% | 251.33 |
| 2006 | 1,303.0 | 439.8 | 90% | 395.81 |
| 2007 | 2,981.0 | 935.1 | 90% | 841.56 |
| 2008 | 2,340.0 | 1,366.2 | 90% | 1,229.55 |
| 2009 | 2,684.0 | 1,893.3 | 90% | 1,703.94 |
| 2010 | 7,208.0 | 3,303.2 | 90% | 2,972.88 |
| 2011 | 8,028.0 | 4,648.2 | 90% | 4,183.38 |
| 2012 | 8,634.0 | 5,778.8 | 90% | 5,200.92 |
| 2013 | 10,479.0 | 7,406.6 | 90% | 6,665.94 |
| 2014 | 13,593.0 | 9,588.4 | 90% | 8,629.56 |
| 2015 | 10,840.0 | 10,314.8 | 90% | 9,283.32 |

| Indirect Recycled Water (AFY) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **FYE** | **Chino** | **Chino Hills** | **Ontario** | **Upland** | **Fontana** | **SBC** | **CVWD** | **Montclair /MVWD** |
| 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 21.7 | 0 | 0 | 0 | 0 | 0 | 0 | 29.3 |
| 2002 | 16.8 | 0 | 94.2 | 0.007 | 0 | 0 | 0 | 36.4 |
| 2003 | 13.0 | 0 | 75.3 | 0 | 0 | 0 | 0 | 28.9 |
| 2004 | 9.6 | 0 | 44.1 | 0 | 0 | 0 | 0 | 20.0 |
| 2005 | 8.9 | 0 | 42.0 | 0 | 0 | 0 | 0 | 15.7 |
| 2006 | 14.6 | 0 | 73.1 | 0 | 0 | 0 | 0 | 21.0 |
| 2007 | 43.5 | 7.8 | 136.7 | 0 | 0 | 0 | 0 | 57.0 |
| 2008 | 68.1 | 20.3 | 233.9 | 0 | 0 | 0 | 59.5 | 127.5 |
| 2009 | 119.4 | 28.4 | 447.5 | 0 | 0 | 0 | 37.3 | 218.6 |
| 2010 | 202.7 | 37.3 | 662.3 | 80.3 | 849.4 | 0 | 500.2 | 409.6 |
| 2011 | 268.8 | 74.1 | 725.0 | 27.1 | 966.4 | 0 | 747.8 | 443.0 |
| 2012 | 379.3 | 172.2 | 925.2 | 25.4 | 1388.0 | 0 | 721.7 | 508.8 |
| 2013 | 379.0 | 169.2 | 1122.8 | 127.3 | 1812.4 | 0 | 1011.5 | 557.3 |
| 2014 | 415.4 | 132.1 | 1341.8 | 174.3 | 949.8 | 0 | 995.8 | 773.4 |
| 2015 | 445.1 | 199.0 | 1193.8 | 234.0 | 914.2 | 0 | 992.6 | 576.0 |

| Table 1: GW Pumped from Chino Basin (AFY) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FYE | Chino | Chino Hills | Ontario | Upland | FWC | SBC | CVWD | Montclair/ MVWD | Other Pumpers? | Total Pumped from Chino Basin |
| 1995 | | | | | | | | | 152,768 | 152,768 |
| 1996 | | | | | | | | | 150,669 | 150,669 |
| 1997 | | | | | | | | 7,315 | 153,966 | 161,281 |
| 1998 | | | | | | | | 7,981 | 137,754 | 145,735 |
| 1999 | | | | | | | | 8,647 | 153,620 | 162,267 |
| 2000 | 5,115 | 1,004 | - | 3,851 | - | | - | 9,313 | 159,537 | 178,820 |
| 2001 | 7,775 | - | - | | - | | - | 10,507 | 143,193 | 161,475 |
| 2002 | 6,189 | - | 34,702 | 3 | - | | - | 13,419 | 112,218 | 166,531 |
| 2003 | 5,990 | - | 34,570 | - | - | | - | 13,285 | 110,052 | 163,897 |
| 2004 | 6,282 | - | 28,777 | - | - | | - | 13,047 | 133,621 | 181,727 |
| 2005 | 5,797 | - | 27,524 | - | - | | - | 10,299 | 120,968 | 164,588 |
| 2006 | 5,932 | - | 29,788 | - | - | | - | 8,535 | 116,987 | 161,241 |
| 2007 | 8,861 | 1,580 | 27,859 | - | - | | - | 11,620 | 121,571 | 171,491 |
| 2008 | 7,608 | 2,270 | 26,144 | - | - | | 6,654.64 | 14,252 | 80,498 | 137,427 |
| 2009 | 8,499 | 2,018 | 31,847 | - | - | | 2,656.12 | 15,555 | 60,678 | 121,253 |
| 2010 | 7,808 | 1,436 | 25,509 | 3,092 | 32,713 | | 19,263.16 | 15,774 | 8,901 | 114,496 |
| 2011 | 7,304 | 2,014 | 19,698 | 737 | 26,257 | | 20,317.71 | 12,038 | 25,301 | 113,667 |
| 2012 | 7,856 | 3,566 | 19,164 | 526 | 28,748 | | 14,948.73 | 10,538 | 22,376 | 107,722 |
| 2013 | 7,022 | 3,134 | 20,801 | 2,358 | 33,576 | | 18,739.95 | 10,325 | 27,539 | 123,495 |
| 2014 | 6,725 | 2,138 | 21,723 | 2,822 | 15,378 | | 16,121.55 | 12,522 | 62,281 | 139,711 |
| 2015 | 6497.47 | 2,904 | 17,426 | 3,416 | 13,344 | | 14,489.70 | 8,407 | 69,024 | 135,509 |

Need data for this table

| | |
|---|---|
| 17 | 152,768 |
| 16 | 150,669 |
| 15 | 161,281 |
| 14 | 145,735 |
| 13 | 162,267 |
| 12 | 178,820 |
| 11 | 161,475 |
| 10 | 166,531 |
| 9 | 163,897 |
| 8 | 181,727 |
| 7 | 164,588 |
| 6 | 161,241 |
| 5 | 171,491 |
| 4 | 137,427 |
| 3 | 121,253 |
| 2 | 114,496 |
| 1 | 113,667 |

Data from CBWM annual reports + Member agency reported data to IEUA

| Table 2: % GW Pumped from Chino Basin (AFY) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FYE | Chino | Chino Hills | Ontario | Upland | FWC | SBC | CVWD | Montclair/ MVWD | Other Pumpers? | Total Pumped from Chino Basin |
| 1995 | | | | | | | | | | |
| 1996 | | | | | | | | | | |
| 1997 | | | | | | | | | | |
| 1998 | | | | | | | | | | |
| 1999 | | | | | | | | | | |
| 2000 | 2.86% | 0.56% | 0.00% | 2.15% | 0.00% | 0.00% | 0.00% | 5.21% | 89.22% | 100.00% |
| 2001 | 4.82% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 6.51% | 88.68% | 100.00% |
| 2002 | 3.72% | 0.00% | 20.84% | 0.00% | 0.00% | 0.00% | 0.00% | 8.06% | 67.39% | 100.00% |
| 2003 | 3.65% | 0.00% | 21.09% | 0.00% | 0.00% | 0.00% | 0.00% | 8.11% | 67.15% | 100.00% |
| 2004 | 3.46% | 0.00% | 15.84% | 0.00% | 0.00% | 0.00% | 0.00% | 7.18% | 73.53% | 100.00% |
| 2005 | 3.52% | 0.00% | 16.72% | 0.00% | 0.00% | 0.00% | 0.00% | 6.26% | 73.50% | 100.00% |
| 2006 | 3.68% | 0.00% | 18.47% | 0.00% | 0.00% | 0.00% | 0.00% | 5.29% | 72.55% | 100.00% |
| 2007 | 5.17% | 0.92% | 16.25% | 0.00% | 0.00% | 0.00% | 0.00% | 6.78% | 70.89% | 100.00% |
| 2008 | 5.54% | 1.65% | 19.02% | 0.00% | 0.00% | 0.00% | 4.84% | 10.37% | 58.58% | 100.00% |
| 2009 | 7.01% | 1.66% | 26.26% | 0.00% | 0.00% | 0.00% | 2.19% | 12.83% | 50.04% | 100.00% |
| 2010 | 6.82% | 1.25% | 22.28% | 2.70% | 28.57% | 0.00% | 16.82% | 13.78% | 7.77% | 100.00% |
| 2011 | 6.43% | 1.77% | 17.33% | 0.65% | 23.10% | 0.00% | 17.87% | 10.59% | 22.26% | 100.00% |
| 2012 | 7.29% | 3.31% | 17.79% | 0.49% | 26.69% | 0.00% | 13.88% | 9.78% | 20.77% | 100.00% |
| 2013 | 5.69% | 2.54% | 16.84% | 1.91% | 27.19% | 0.00% | 15.17% | 8.36% | 22.30% | 100.00% |
| 2014 | 4.81% | 1.53% | 15.55% | 2.02% | 11.01% | 0.00% | 11.54% | 8.96% | 44.58% | 100.00% |
| 2015 | 4.79% | 2.14% | 12.86% | 2.52% | 9.85% | 0.00% | 10.69% | 6.20% | 50.94% | 100.00% |

This table will be calculated from table above.

# Appendix J:
# Chino Basin Judgment
# and
# Optimum Basin Management Program
# Implementation Plan

*The above documents*
*and all other*
*Chino Basin Watermaster*
*groundwater management agreements*
*can be found on the*
*Watermaster website under*
*"Reports – Legal":*
*www.cbwm.org/rep_legal.htm*

# Appendix K:
# Summary of Chino Groundwater Basin Management

# Summary of Chino Groundwater Basin Management

The 1978 Chino Basin Judgment requires that Watermaster develop a management plan for the Chino Basin that meets water quality and water quantity objectives for the region. Three primary agreements govern the adjudication and management of the basin: 1) the 1978 Chino Basin Judgment; 2) the 2000 Peace Agreement, incorporating the Optimum Basin Management Program Implementation Plan; and 3) the 2007 Peace II Agreement. The following discusses each of these agreements as they pertain to basin management and the District's groundwater supply.

## Chino Basin Judgment Adjudication (1978)

In 1978, the Superior Court of the State of California entered into the Chino Basin Judgment that adjudicated the water rights of the Chino Groundwater Basin and imposed a physical solution.

According to the Judgment, there are significant imported water supplies available to supplement the native safe yield of the basin. Therefore, the purpose of the physical solution was to establish a legal and practical means for making the maximum reasonable beneficial use of the waters of the basin by providing for the optimal economic, long-term, conjunctive utilization of surface waters, ground waters, and supplemental water to meet the requirements of water users having rights in or dependence on the basin. A fundamental premise of the physical solution was that all water users dependent on the basin would be allowed to pump sufficient waters to meet their requirements. To the extent that a water producer's pumping exceeds its share of the safe yield, Watermaster has the obligation to provide for replenishment of the basin for the amount of production exceeding its rights.

Watermaster, as an extension of the Court, manages the basin in accordance with the provisions of the Judgment. An Assessment Package is produced by Watermaster on an annual basis, which describes the rights and abilities to which parties are entitled according to the provisions of the Judgment.

*Water Rights*

Three operating pools were established by the Judgment for Watermaster administration: the Overlying Agricultural Pool, the Overlying Non-Agricultural Pool, and the Appropriative Pool. Rights to the safe yield of the basin were allocated to each pool.

An "overlying" right is defined as the appurtenant right of an owner of lands overlying the basin to produce water from the basin for overlying beneficial use on such lands. An "appropriative" right is defined as the annual production right of a producer from the basin other than pursuant to an overlying right.

According to the 1978 Judgment, the safe yield of the basin is 140,000 AFY. "Safe yield" is defined as the long-term average annual quantity of groundwater (excluding replenishment water or stored water but including return flow to the basin from use of replenishment or storage water) which can be produced from the basin under cultural conditions of a particular year without causing an undesirable result.

Aggregate preserved overlying rights in the safe yield for Agricultural Pool use, including the rights of the State of California, total 82,800 AFY, or 414,000 AF in any five consecutive years. Overlying rights for Non-Agricultural Pool use total 7,366 AFY. In accordance with the provisions of the Judgment, when land converts from agricultural to urban use, the purveyor that will supply water to the converted land may apply for additional groundwater production credit; this process is known as Land Use Conversion.

Appropriative rights allocated by the Judgment include rights by prescription and are entitled under the physical solution to share in the remaining safe yield, after satisfaction of overlying rights. "Operating Safe Yield" (OSY) is defined as the amount of groundwater that Watermaster shall determine can be produced from the basin by the Appropriative Pool parties free of replenishment obligation under the physical solution. Any subsequent change in the OSY would be offset by use of available Overlying Agricultural Pool rights. The District's current share of the OSY is 8.797 percent and the Company's current share is 1.234 percent.

*Reallocation of Unpumped Agricultural Water Rights*

According to the Judgment, in any five years that any portion of the share of safe yield allocated to the Overlying Agricultural Pool is not produced, that water is available for reallocation to the Appropriative Pool. Priority of that water is first to supplement water available from OSY to compensate for any reduction in the safe yield after the tenth year of operation (1988), conversion claims, and then for supplement to the OSY without regard to reductions in safe yield.

Appropriative rights and corresponding shares of OSY may be assigned or may be leased or licensed to another appropriator, as approved by Watermaster.

*Approved Overdraft*

Overdraft is defined as a condition wherein the total annual production from the Basin exceeds the safe yield. The 1978 Judgment stated that the Basin, since at least 1953, was in a condition of overdraft.

In adopting the OSY for any year, Watermaster is limited to 200,000 AF of accumulated overdraft, and in no event shall the OSY in any year be less than the Appropriative Pool's share of safe yield or exceed the Appropriative Pool's share of safe yield by more than 10,000 AF.

*Replenishment for Overproduction*

Watermaster levies an annual Replenishment Assessment in an amount sufficient to purchase replenishment water to replace production during the preceding year which exceeds the safe yield. Assessments are based on the pooling plan for each pool. The Replenishment Assessment for the Appropriative Pool is recovered by a uniform assessment against all production during the preceding year equaling 15 percent of replenishment cost of water, and a uniform assessment on each AF of production by each party in excess of its allocated share of OSY during the preceding year equaling 85 percent of costs.

Supplemental water may be used to recharge the basin either directly by spreading and percolating or injecting the water into the basin, or indirectly by delivering the water for use in lieu of production and use of safe yield or OSY. Supplemental water may be obtained from any available source including recycled water and imported water.

Much of the available natural surface water runoff in the Santa Ana River Watershed is captured and recharged to the groundwater aquifers. A system of flood control channels and percolation basins have been developed to increase the natural recharge capacity of the basin. A limited quantity of excess storm water is captured for recharge; however, the groundwater recharge program is being expanded to include greater quantities of storm water, recycled water, and lesser quantities of imported water.

*Replenishment with Recycled Water*

IEUA assumes responsibility for delivery of recycled water for basin recharge. Recycled recharge water is credited to parties to the Regional Sewer Service Contract, based on relative contributions of wastewater flow delivered to the regional reclamation plants by the respective agencies. This provides additional groundwater pumping rights calculated annually as stored water credits. In FYE 2015, the District received 468 AF of additional production capability as a result of recycled water recharge activity and its Recycled Water Purchase Agreement with the City of Montclair (Section 4.2.4). The Company does not participate in the recharge activity.

*Carryover of Production Rights*

Any Appropriative Pool party who produces less than its assigned share of OSY may carry such unexercised rights forward for use in subsequent years. The first water used in any such subsequent year is to be an exercise of that carryover right. If the aggregate carryover of any Appropriative Pool party exceeds its share of OSY, the water is placed in an excess carryover storage account. Carry-over water has no limit at this time. For the District's latest carryover activity, see Table 4-2.

*Groundwater Storage*

The Judgment states that a substantial amount of available groundwater storage capacity exists in the basin which is not utilized for storage or regulation of basin waters. The basin stores approximately 5 MAF of groundwater and has the capability of storing an additional 1 MAF. Reservoir capacity can be utilized appropriately for storage and conjunctive use of supplemental water with basin waters. Any person or public entity may make reasonable beneficial use of the available groundwater storage capacity for storage of supplemental water, with allocation preference of storage capacity to the needs and requirements of the lands overlying the basin and the owners of rights in the basin.

As of June 30, 2015, the District estimates it has a total of 26,484 AF of water in its excess carryover and local supplemental storage accounts. This quantity represents a significant reserve for use during times of drought and restrictions on other sources of supply.

**Chino Basin Optimum Basin Management Program**

In 1998, Watermaster developed an integrated set of water management goals and actions for the Basin. Known as the Optimum Basin Management Program (OBMP), this document describes nine program elements to meet the water quality and local production objectives in the basin. The OBMP encourages the increased use of local supplies to help "drought proof" the basin.

The OBMP is intended to formulate and implement a groundwater management program that will preserve and enhance the safe yield and the water quality of the basin. Watermaster's goal is to make it possible for all groundwater users to produce water from the basin for beneficial uses at an affordable cost. The OBMP is intended to allow continued reliance on groundwater for beneficial use within the basin while minimizing demand for imported water, and to encourage beneficial use of the large available storage space in the aquifer system. OBMP actions are intended to benefit both local and regional water supply programs.

The effort to complete the OBMP for the basin was divided into two phases. The first phase culminated in the September 1999 submittal of the draft Phase 1 Report to the Court with continuing jurisdiction over the basin groundwater resources. The second phase, including a programmatic Environmental Impact Report, was completed and adopted in July 2000, as the Implementation Plan which was incorporated into the Peace Agreement.

Phase 1 of the OBMP defined the state of the Chino Groundwater Basin, established the goals and objectives concerning major issues identified by stakeholders, and affirmed a management plan for the achievement of the stated goals and objectives. Phase 2 of the OBMP is the Implementation Plan for the installation and operation of OBMP facilities. The major OBMP facilities include pipelines, desalters, possibly an ion exchange facility, recharge basins, pump stations, production wells, and monitoring devices.

The four primary OBMP management goals are to enhance basin water supplies, to protect and enhance water quality, to enhance management of the basin, and to equitably finance the OBMP.

The OBMP includes nine program elements that were developed during the Phase 1 OBMP Report that collectively will meet the goals of the OBMP. The scope of implementation of some of the programs have been combined since they overlap and have synergies between them. The program elements include developing and implementing each of the following:

Element 1 – Comprehensive Monitoring Program

Element 2 – Comprehensive Recharge Program

Element 3 – Water Supply Plan for the Impaired Areas of the Basin

Element 4 – Comprehensive Groundwater Management Plan for MZ 1

Element 5 – Regional Supplemental Water Program

Element 6 – Cooperative Programs With the Regional Water Quality Control Board, Santa Ana Region, and Other Agencies to Improve Basin Management

Element 7 – Salt Management Program

Element 8 – Groundwater Storage Management Program

Element 9 – Storage and Recovery Programs

**Peace Agreements**

In July 2000, Watermaster's planning process culminated with the adoption of a "Peace Agreement" that ended over 15 years of litigation within the basin. The Peace Agreement amended the 1978 Chino Basin Judgment and has a term of 30 years. The Peace Agreement facilitates the implementation of the OBMP.

The Peace Agreement amended the Judgment in three areas:

1. Members of the Overlying Non-Agricultural Pool have the right to transfer or lease their quantified production rights within the same pool or to Watermaster in conformance with specified procedures.

2. Any Appropriative Pool party who provides water service to overlying lands may exercise overlying rights to the extent necessary to provide water service to overlying lands.

3. For the term of the Peace Agreement, in any year in which sufficient unallocated safe yield from Overlying Agricultural Pool is available for conversion claims, Watermaster can allocate each Appropriative Pool party with a conversion claim, 2.0 AF of unallocated safe yield water for each converted acre approved.

The "Peace II" Agreement, signed in 2008, provided improved flexibility in managing the basin's water supply, better utilization of the desalters, and reduced water losses to the Santa Ana River. The Peace II Agreement determined the financial and institutional arrangements needed to implement basin reoperation and hydraulic control, including the following:

Ensures the beneficial use of groundwater in the southern end of the basin by enabling the construction of desalters to produce and treat about 40,000 AFY of groundwater degraded by past agricultural practices;

Maximizes the reuse of recycled water;

Fulfills Watermaster's and IEUA's maximum benefit commitments;

Provides up to 400,000 AF of replenishment water for the desalters;

Creates 400,000 AF of new storage space available for groundwater storage programs; and,

Extends the MZ 1 recharge obligation to be a minimum of 6,500 AFY in perpetuity.

*Supplemental and In-Lieu Recharge*

Watermaster is responsible to conduct recharge and replenishment of the basin. The Peace Agreement directs that during the five years from Fiscal Year Ending (FYE) 2001, Watermaster will conduct physical recharge of supplemental water of 6,500 AFY in MZ 1. If the cumulative total of 32,500 AF of recharge has not been accomplished at the end of the five years, then recharge will continue at the same annual rate until 32,500 AF has been reached.

Recharged supplemental water increases the OSY under the Judgment. Cost and allocation of supplemental water is apportioned pro-rata among members of the Appropriative Pool according to the producer's share of the initial safe yield. Watermaster provides an annual accounting of the amount and location of recharge. Individual producers do not currently have a limit on how much they can over-produce; however, they are assessed an amount to replenish the basin for all overproduction. Producers generally develop annual demand projections that assist in making arrangements with other appropriators for prepurchase of replenishment water through transfers and other agreements. This allows Watermaster to optimize planning within the OBMP.

Any member of the Appropriative Pool who is willing to abstain for any reason from producing any portion of its share of OSY in any year may offer the unproduced water to Watermaster. Watermaster then may purchase water in place of spreading replenishment water.

*Transfers*

Transfers include the assignment, lease, or sale of a right to produce water to another producer within the basin or to another person or entity for use outside the basin whether the transfer is temporary or permanent. Transfers must have the approval of Watermaster. Lease of water rights are also permissible to allow producers to make up for the lessee's over-production. For the District's latest transfer activity, see footnote for Table 4-2.

*Early Transfer and Land Use Conversion*

"Early Transfer" means the reallocation of safe yield not produced by the Overlying Agricultural Pool to the Appropriative Pool on an annual basis rather than according to the five-year increment described in the Judgment. The Early Transfer of not less than 32,800 AFY was the expected approximate amount of water not produced by the Overlying Agricultural Pool. The Early Transfer is to be the greater of 32,800 AF or 32,800 AF plus the actual quantity of water not produced in a given year after all the land use conversions are satisfied. Early transfer water is allocated among members of the Appropriative Pool in accordance with their pro-rata share of the initial safe yield.

With the effective date of the Peace Agreement, the amount of water rights converted from agricultural land to urban use was changed from 2.6 AF per acre with allocation between initial shares of safe yield and service provider to 2.0 AF per acre, all of which is allocated upon conversion of the land to the Appropriative Pool member service provider. Upon conversion of water rights, the purveyor pledges the amount of water needed for the urban land use, and up to 2.0 AFY per acre of land will be made available.

An Overlying Agricultural Pool member has the right to a voluntary agreement with an appropriator, which has a service area contiguous to or inclusive of the agricultural land, to provide the required water to the overlying land on behalf of the pool member. The Appropriative Pool party is then entitled to a credit to off-set production to the extent it is serving the overlying land up to the amount of the historical maximum annual quantity previously used on that property. The credit is debited to the pool's collective production right.

Total required reallocations from Early Transfers and Land Use Conversions are subject to availability. For the District's latest Early Transfers and Land Use Conversions activity, see Table 4-2.

*Local Storage*

Each Appropriative Pool and Overlying Non-Agricultural Pool party has the right to store supplemental water and un-produced carry-over water in the basin. Local storage agreements are approved so long as the total quantity of supplemental water under local storage agreements does not exceed the cumulative total of 100,000 AF. Water held in storage is transferable, but storage capacity is not.

Parties may continue to produce the actual quantity of carry-over water and supplemental water held in its storage account, subject only to the loss provisions. Rate of loss from local storage is currently 2 percent. The 2015 Safe Yield Reset Agreement changes storage losses to 0.07 percent upon achievement of Hydraulic Control; such change is contingent on Court adoption of the agreement. Losses are deducted annually from each storage account.

*Storage and Recovery Program*s

Since the Chino Basin Judgment was implemented in 1978, total groundwater storage in the Basin has stabilized. Current groundwater production from the Basin is 117,000 AFY, well below the current safe yield. By limiting annual water production to a safe yield level, but still allowing agencies to over pump as needed (provided replenishment water is later purchased and restored to the basin), the local agencies have alleviated overdraft concerns. Through improved management such as hydraulic control of the groundwater basin, Watermaster oversees a basin capable of storing 500,000 AF consistent with the OBMP.

Overlying Appropriative and Non-Agricultural Pool members are entitled to the compensation paid for a Storage and Recovery Program paid in any form, including money, revenues, credits, proceeds, programs, facilities, or other contributions. Compensation may also be used to offset the cost of operations, to reduce assessments on the members, and to defray the costs of capital projects at the request of the members.

Under the Peace Agreement, Watermaster is responsible to conduct best efforts to do the following: 1) complete the short-term conjunctive use project conducted by IEUA, Three Valleys Municipal Water District and MWD; 2) develop a seasonal peaking program for in-Basin use and dry year yield to reduce the Basin's demand on MWD water; 3) develop a dry year export program; and 4) develop a seasonal peaking export program. The short-term conjunctive use project includes construction of facilities to store water and later withdraw it for conjunctive use. The program goals are to reduce summertime peaking on MWD, deliver SWP supplies to the Basin, minimize MWD surface water deliveries during future droughts/emergencies, and allow MWD to export storage water for other member agencies.

*Basin Reoperation and Hydraulic Control*

A primary element of the Peace II Agreement is Basin Reoperation. Essentially, Basin Reoperation is the controlled overdraft of the basin by 400,000 AF via forgiveness of the desalter replenishment obligation, resulting in a regional lowering of groundwater levels across the basin, which makes it possible for the desalter pumping to achieve and maintain Hydraulic Control.

The many benefits of Basin Reoperation and Hydraulic Control include improved basin yield by reduced groundwater outflow to (and increased groundwater inflow from) the Santa Ana River, a local and reliable supply of potable water from the desalters, improved salinity management via salt export from the desalters, and the "maximum benefit" groundwater quality objectives which allow for recycled water reuse, among others.

*Conjunctive Use / Dry Year Yield Program*

Conjunctive use describes the coordinated operation of surface water storage and use, groundwater storage and use, and conveyance facilities to meet water management objectives. There are three primary components to a conjunctive management program. The first is to recharge groundwater when surface water is available to increase groundwater in storage. This can be accomplished by reducing groundwater use and substituting it with surface water, allowing natural recharge to increase groundwater (often called in-lieu recharge) or by augmenting recharge with supplemental supplies. The second component is to switch to groundwater use in dry years when surface water is scarce. The third component is to have an ongoing monitoring program to evaluate and allow water managers to respond to changes in groundwater, surface water, or environmental conditions that could exceed management objectives or impact other users.

Chino Basin producers have developed regional conjunctive use programs that store supplemental water for MWD. Under these programs, surplus water during wet periods would be banked and then withdrawn at a later time (either directly or through an in-lieu program). Under the OBMP, Watermaster has identified the potential to store and recover up to 500,000 AF in the Basin.

In 2004, Watermaster, TVMWD, and IEUA executed the Dry Year Yield (DYY) Program with MWD. The eight appropriators participating with MWD in the program are the District, the cities of Chino, Chino Hills, Ontario, Upland and Pomona, CVWD, and Jurupa Community Services District. DYY developed facilities to pump 33,000 AFY during a dry year utilizing the 100,000 AF storage account. The participants are required to reduce (shift) their imported water usage by a predetermined amount during a dry year (see below table). Each participating agency has a specific shift obligation that, when added together, provide MWD with a total of 33,000 AFY of dry year supply.

In exchange for participating in the program, each agency received funding for new groundwater treatment and well facilities that would enable additional groundwater production during dry years. The District received $3.1 million to construct a groundwater production well and an aquifer storage and recovery well with wellhead treatment facilities; the latter project was a joint effort with the City of Chino. Project construction was completed in 2008, the same year the DYY Program went into effect.

**DYY Shift Obligations for Participating Agencies**

| Local Retail Agency | DYY Program Shift Obligation (AFY) |
|---|---|
| City of Chino | 1,159 |
| City of Chino Hills | 1,448 |
| CVWD | 11,353 |
| Jurupa Community Services District | 2,000 |
| Monte Vista Water District | 3,963 |
| City of Ontario | 8,076 |
| City of Pomona | 2,000 |
| City of Upland | 3,001 |
| **Total** | **33,000** |

# Appendix L:
# Monte Vista Water District
# 2011 Recycled Water Master Plan

*Available on the*
*District website –*
*follow the "Public Documents" and*
*"Planning Documents"*
*menu links:*
*www.mvwd.org*

# Appendix M:
# 2013-2014 CUWCC Best Management Practices Annual Reports and Coverage Reports

# CUWCC BMP Retail Coverage Report 2013

*Foundational Best Managemant Practices for Urban Water Efficiency*

## BMP 1.1 Operation Practices

**ON TRACK**

**163 Monte Vista Water District - Retail**

**1. Conservation Coordinator provided with necessary resources to implement BMPs?**

Name: Justin Scott-Coe

Title: Public Affairs Director

Email: jscottcoe@mvwd.org

**2. Water Waste Prevention Documents**

| WW Document Name | WWP File Name | WW Prevention URL | WW Prevention Ordinance Terms Description |
|---|---|---|---|
| Option A Describe the ordinances or terms of service adopted by your agency to meet the water waste prevention requirements of this BMP. | | http://www.mvwd.org/download.cfm?ID=117 | Ordinance 33: Establishing Water Use Efficiency Best Practices and Staged Water Supply Shortage Measures |
| Option B Describe any water waste prevention ordinances or requirements adopted by your local jurisdiction or regulatory agencies within your service area. | | | |
| Option C Describe any documentation of support for legislation or regulations that prohibit water waste. | | | |
| Option D Describe your agency efforts to cooperate with other entities in the adoption or enforcement of local requirements consistent with this BMP. | | | |
| Option E Describe your agency support positions with respect to adoption of legislation or regulations that are consistent with this BMP. | | | |
| Option F Describe your agency efforts to support local ordinances that establish permits requirements for water efficient design in new development. | | | |

**At Least As effective As** No

**Exemption** No

**Comments:**

CUWCC BMP Retail Coverage Report 2013

*Foundational Best Managemant Practices for Urban Water Efficiency*

BMP 1.1 Operation Practices **ON TRACK**

# CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.2 Water Loss Control **ON TRACK**

**163 Monte Vista Water District - Retail**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| MVWD Water System Audit - FYE2013.xls | |
| AWWA Water Audit Validity Score? | 69 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 152 | 221590 | 184376 | 0 | False | 346735.14 | |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

### 163 Monte Vista Water District - Retail

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | 329 |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | Yes |
| Feasibility Study provided to CUWCC? | Yes |

Date: 4/12/2011

Uploaded file name:

| | |
|---|---|
| Completed a written plan, policy or program to test, repair and replace meters | Yes |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.4 Retail Conservation Pricing

**On Track**

**163 Monte Vista Water District - Retail**

Implementation (Water Rate Structure)

| Customer Class | Water Rate Type | Conserving Rate? | (V) Total Revenue Comodity Charges | (M) Total Revenue Fixed Carges |
|---|---|---|---|---|
| Single-Family | Allocation Based | Yes | 4141607.86 | 1714195.86 |
| Multi-Family | Uniform | Yes | 1202835.26 | 234259.45 |
| Commercial | Uniform | Yes | 1342968.43 | 419305.66 |
| Dedicated Irrigation | Uniform | Yes | 836889.22 | 185521.43 |
| Agricultural | Uniform | Yes | 35625.17 | 7788.16 |
| Other | Uniform | Yes | 19324.27 | 234105.84 |
| Institutional | Uniform | Yes | 252660.68 | 78556.12 |
| Industrial | Uniform | Yes | 18087.9 | 9094.2 |
| | | | **7849998.79** | **2882826.72** |

**Calculate: V / (V + M)** **73 %**

Implementation Option: Use Annual Revenue As Reported

☐ Use 3 years average instead of most recent year

Canadian Water and Wastewater Association

Upload file:

Agency Provide Sewer Service: No

**At Least As effective As** No

**Exemption** No

Comments:

Option 1: $7,849,998.79 / $10,732,825.51 = 73.1%

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**163** **Monte Vista Water District - Retail** **Retail**

Does your agency perform Public Outreach programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Inland Empire Utilities Agency

| Agency Name | ID number |
|---|---|
| Inland Empire Utilities Agency | 135 |

The name of agency, contact name and email address if not CUWCC Group 1 members

Home Depot

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| General water conservation information | 8 |
| Newsletter articles on conservation | 5 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 4 |
| Website | 6 |
| Email Messages | 6 |
| **Total** | **29** |

Did at least one contact take place during each quater of the reporting year? Yes

| Number Media Contacts | Number |
|---|---|
| News releases | 10 |
| Newspaper contacts | 3 |
| **Total** | **13** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Public Relations | 27000 |
| Conservation - Public Relations | 7250 |
| **Total Amount:** | **34250** |

| Public Outreah Additional Programs |
|---|
| Water Fair |

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

Description of all other Public Outreach programs

Inland Empire Garden Friendly

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| **Exemption** | No | 0 |

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**163 Monte Vista Water District - Retail** **Retail**

Does your agency implement School Education programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Inland Empire Utilities Agency,Metropolitan Water District of SC

Chino Basin Water Conservation District (Group 3)

Materials meet state education framework requirements? Yes

See past reports

Materials distributed to K-6? Yes

See past reports

Materials distributed to 7-12 students? Yes (Info Only)

See past reports

Annual budget for school education program: 5750.00

Description of all other water supplier education programs

See past reports

Comments:

**At Least As effective As** No

**Exemption** No 0

# CUWCC BMP Retail Coverage Report 2014

*Foundational Best Managemant Practices for Urban Water Efficiency*

## BMP 1.1 Operation Practices

**ON TRACK**

**163 Monte Vista Water District - Retail**

**1. Conservation Coordinator provided with necessary resources to implement BMPs?**

Name: Justin Scott-Coe

Title: Public Affairs Director

Email: jscottcoe@mvwd.org

**2. Water Waste Prevention Documents**

| WW Document Name | WWP File Name | WW Prevention URL | WW Prevention Ordinance Terms Description |
|---|---|---|---|
| Option A Describe the ordinances or terms of service adopted by your agency to meet the water waste prevention requirements of this BMP. | | http://www.mvwd.org/download.cfm?ID=117 | Ordinance 33: Establishing Water Use Efficiency Best Practices and Staged Water Supply Shortage Measures |
| Option B Describe any water waste prevention ordinances or requirements adopted by your local jurisdiction or regulatory agencies within your service area. | | | |
| Option C Describe any documentation of support for legislation or regulations that prohibit water waste. | | | |
| Option D Describe your agency efforts to cooperate with other entities in the adoption or enforcement of local requirements consistent with this BMP. | | | |
| Option E Describe your agency support positions with respect to adoption of legislation or regulations that are consistent with this BMP. | | | |
| Option F Describe your agency efforts to support local ordinances that establish permits requirements for water efficient design in new development. | | | |

**At Least As effective As** No

**Exemption** No

**Comments:**

CUWCC BMP Retail Coverage Report 2014

*Foundational Best Managemant Practices for Urban Water Efficiency*

BMP 1.1 Operation Practices **ON TRACK**

# CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.2 Water Loss Control **ON TRACK**

**163 Monte Vista Water District - Retail**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| MVWD Water System Audit - FYE2014.xls | |
| AWWA Water Audit Validity Score? | 69 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 132 | 300118 | 284885 | 0 | False | 349960.55 | |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

### 163 Monte Vista Water District - Retail

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | 333 |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | Yes |
| Feasibility Study provided to CUWCC? | Yes |

Date: 4/12/2011

Uploaded file name:

| | |
|---|---|
| Completed a written plan, policy or program to test, repair and replace meters | Yes |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.4 Retail Conservation Pricing

**On Track**

**163 Monte Vista Water District - Retail**

Implementation (Water Rate Structure)

| Customer Class | Water Rate Type | Conserving Rate? | (V) Total Revenue Comodity Charges | (M) Total Revenue Fixed Carges |
|---|---|---|---|---|
| Single-Family | Allocation Based | Yes | 4246569.62 | 1872204.11 |
| Multi-Family | Uniform | Yes | 1221901.39 | 280117.84 |
| Commercial | Uniform | Yes | 1405986.35 | 479019.61 |
| Dedicated Irrigation | Uniform | Yes | 956591.34 | 212509.16 |
| Agricultural | Uniform | Yes | 56001.5 | 10427.16 |
| Other | Uniform | Yes | 22625.1 | 255798.35 |
| Institutional | Uniform | Yes | 266329.09 | 86315.12 |
| Industrial | Uniform | Yes | 18088.03 | 8794.76 |
| | | | **8194092.42** | **3205186.11** |

**Calculate: V / (V + M)** **72 %**

Implementation Option: Use Annual Revenue As Reported

☐ Use 3 years average instead of most recent year

Canadian Water and Wastewater Association

Upload file:

Agency Provide Sewer Service: No

**At Least As effective As** No

**Exemption** No

Comments:

Option 1: $8,194,092.42 / $11,399,278.53 = 71.9%

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**163** **Monte Vista Water District - Retail** **Retail**

Does your agency perform Public Outreach programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Inland Empire Utilities Agency

| Agency Name | ID number |
|---|---|
| Inland Empire Utilities Agency | 135 |

The name of agency, contact name and email address if not CUWCC Group 1 members

Home Depot

Did at least one contact take place during each quater of the reporting year? Yes

| Public Outreach Program List | Number |
|---|---|
| General water conservation information | 10 |
| Newsletter articles on conservation | 4 |
| Flyers and/or brochures (total copies), bill stuffers, messages printed on bill, information packets | 6 |
| Website | 6 |
| Email Messages | 6 |
| **Total** | **32** |

Did at least one contact take place during each quater of the reporting year? Yes

| Number Media Contacts | Number |
|---|---|
| News releases | 16 |
| Newspaper contacts | 3 |
| **Total** | **19** |

Did at least one website update take place during each quater of the reporting year? Yes

Public Information Program Annual Budget

| Annual Budget Category | Annual Budget Amount |
|---|---|
| Public Relations | 28000 |
| Public Relations Conservation | 7250 |
| **Total Amount:** | **35250** |

| Public Outreah Additional Programs |
|---|
| Water Fair |

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

Description of all other Public Outreach programs

Inland Empire Garden Friendly

Comments:

| | | |
|---|---|---|
| **At Least As effective As** | No | |
| **Exemption** | No | 0 |

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**163 Monte Vista Water District - Retail** **Retail**

Does your agency implement School Education programs? Yes

The list of wholesale agencies performing public outreach which can be counted to help the agency comply with the BMP

Inland Empire Utilities Agency,Metropolitan Water District of SC

Chino Basin Water Conservation District (Group 3)

Materials meet state education framework requirements? Yes

See past reports

Materials distributed to K-6? Yes

See past reports

Materials distributed to 7-12 students? Yes (Info Only)

See past reports

Annual budget for school education program: 5750.00

Description of all other water supplier education programs

See past reports

Comments:

**At Least As effective As** No

**Exemption** No 0

## CUWCC BMP Coverage Report 2014

163 Monte Vista Water District - Retail

**Baseline GPCD:** 206.6

GPCD in 2014 169.1

**GPCD Target for 2018:** 169.40

**Biennial GPCD Compliance Table**

**ON TRACK**

| | | Target | | Highest Acceptable Bound | |
|---|---|---|---|---|---|
| Year | Report | % Base | GPCD | % Base | GPCD |
| 2010 | 1 | 96.4% | **199.20** | 100% | **206.60** |
| 2012 | 2 | 92.8% | **191.70** | 96.4% | **199.20** |
| 2014 | 3 | 89.2% | **184.30** | 92.8% | **191.70** |
| 2016 | 4 | 85.6% | **176.80** | 89.2% | **184.30** |
| 2018 | 5 | 82.0% | **169.40** | 82.0% | **169.40** |

# CUWCC BMP Wholesale Coverage Report 2013

*Foundational Best Managemant Practices for Urban Water Efficiency*

## BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**7055** **Monte Vista - Wholesale**

Name: Justin Scott-Coe Email: jscottcoe@mvwd.org

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 1.1 Operation Practices | 0 | 100 | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 5/12/2010

File Name: Ordinance 33: Establishing Water Use Efficiency Best Practices and Staged Water Supply Shortage Measures

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Already a member

0.00

**At Least As effective As** No

**Exemption** No

**Comments:**

# CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.2 Water Loss Control **ON TRACK**

**163 Monte Vista Water District - Retail**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| MVWD Water System Audit - FYE2013.xls | |
| AWWA Water Audit Validity Score? | 69 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 152 | 221590 | 184376 | 0 | False | 346735.14 | |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

**7055 Monte Vista - Wholesale**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |
| Date: | |
| Uploaded file name: | |
| Completed a written plan, policy or program to test, repair and replace meters | Yes |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**7055** **Monte Vista - Wholesale** **Wholesale**

Does your agency perform Public Outreach programs? No

The list of retail agencies your agency assists with public outreach

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? No

Did at least one contact take place during each quater of the reporting year? No

Did at least one website update take place during each quater of the reporting year? No

Public Information Program Annual Budget

Description of all other Public Outreach programs

Comments:

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for Public Information services.

**At Least As effective As** Yes

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for Public Information services.

**Exemption** No 0

CUWCC BMP Coverage Report 2013

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**7055 Monte Vista - Wholesale** **Wholesale**

Does your agency implement School Education programs? No

The list of retail agencies your agency assists with public outreach

Materials meet state education framework requirements? No

Materials distributed to K-6? No

Materials distributed to 7-12 students? No (Info Only)

Annual budget for school education program:

Description of all other water supplier education programs

Comments:

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for School Education services.

**At Least As effective As** Yes

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for School Education services.

**Exemption** No 0

# CUWCC BMP Wholesale Coverage Report 2014

*Foundational Best Managemant Practices for Urban Water Efficiency*

## BMP 1.1 Wholesale Agency Assistance Programs

**ON TRACK**

**7055** **Monte Vista - Wholesale**

Name: Justin Scott-Coe Email: jscottcoe@mvwd.org

**a) Financial Investments and Building Partnerships**

| BMP Section | Monetary Amount for Financial Incentives | Monetary Amount for Equivalent Resources | |
|---|---|---|---|
| BMP 1.1 Operation Practices | 0 | 100 | |

**b) Technical Support**

**c) Retail Agency**

**d) Water Shortage Allocation**

Adoption Date: 5/12/2010

File Name: Ordinance 33: Establishing Water Use Efficiency Best Practices and Staged Water Supply Shortage Measures

**e) Non signatory Reporting of BMP implementation by non-signatory Agencies**

**f) Encourage CUWCC Membership List Efforts to Recuit Retailers**

Already a member

0.00

**At Least As effective As** No

**Exemption** No

**Comments:**

# CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.2 Water Loss Control **ON TRACK**

**163 Monte Vista Water District - Retail**

| | |
|---|---|
| Completed Standard Water Audit Using AWWA Software? | Yes |
| AWWA File provided to CUWCC? | Yes |
| MVWD Water System Audit - FYE2014.xls | |
| AWWA Water Audit Validity Score? | 69 |
| Complete Training in AWWA Audit Method | Yes |
| Complete Training in Component Analysis Process? | Yes |
| Component Analysis? | Yes |
| Repaired all leaks and breaks to the extent cost effective? | Yes |
| Locate and Repar unreported leaks to the extent cost effective? | Yes |
| Maintain a record keeping system for the repair of reported leaks, including time of report, leak location, type of leaking pipe segment or fitting, and leak running time from report to repair. | Yes |

Provided 7 Types of Water Loss Control Info

| Leaks Repairs | Value Real Losses | Value Apparent Losses | Miles Surveyed | Press Reduction | Cost Of Interventions | Water Saved (AF) |
|---|---|---|---|---|---|---|
| 132 | 300118 | 284885 | 0 | False | 349960.55 | |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 1.3 Metering With Commodity

**ON TRACK**

**7055 Monte Vista - Wholesale**

| | |
|---|---|
| Numbered Unmetered Accounts | No |
| Metered Accounts billed by volume of use | Yes |
| Number of CII Accounts with Mixed Use Meters | |
| Conducted a feasibility study to assess merits of a program to provide incentives to switch mixed-use accounts to dedicated landscape meters? | No |
| Feasibility Study provided to CUWCC? | No |
| Date: | |
| Uploaded file name: | |
| Completed a written plan, policy or program to test, repair and replace meters | Yes |

**At Least As effective As** No

**Exemption** No

Comments:

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.1 Public Outreach

**ON TRACK**

**7055** **Monte Vista - Wholesale** **Wholesale**

Does your agency perform Public Outreach programs? No

The list of retail agencies your agency assists with public outreach

The name of agency, contact name and email address if not CUWCC Group 1 members

Did at least one contact take place during each quater of the reporting year? No

Did at least one contact take place during each quater of the reporting year? No

Did at least one website update take place during each quater of the reporting year? No

Public Information Program Annual Budget

Description of all other Public Outreach programs

Comments:

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for Public Information services.

**At Least As effective As** Yes

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for Public Information services.

**Exemption** No 0

CUWCC BMP Coverage Report 2014

*Foundational Best Management Practices For Urban Water Efficiency*

## BMP 2.2 School Education Programs

**ON TRACK**

**7055 Monte Vista - Wholesale** **Wholesale**

Does your agency implement School Education programs? No

The list of retail agencies your agency assists with public outreach

Materials meet state education framework requirements? No

Materials distributed to K-6? No

Materials distributed to 7-12 students? No (Info Only)

Annual budget for school education program:

Description of all other water supplier education programs

Comments:

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for School Education services.

**At Least As effective As** Yes

Wholesalers are only to provide services as requested by their retailers; we have not received such a request for School Education services.

**Exemption** No 0

# Appendix N:
# 2011-2015 Regional Water Use Efficiency Program Water Savings

*from*
*Inland Empire Utilities Agency's*
*Annual Water Use Efficiency Programs Report*
*FY 2014-2015*

# MONTE VISTA WATER DISTRICT

## Annual Water Use Efficiency Programs Report

## FY 2014-2015

# Monte Vista Water District
# IEUA Regional Conservation Programs Annual Report

| Program | District Devices/ Rebates | Gallons Saved (year) | AF Saved (year) | AF Saved Lifetime | Funding Sources (dollars) Outside Funding | IEUA | MWD | Total | Payback Period (years) [1] |
|---|---|---|---|---|---|---|---|---|---|
| **FY 2014-2015** | | | | | | | | | |
| **SoCal Water$mart Residential Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 66 | 914,150 | 3 | 56 | $0 | $3,300 | $3,300 | $6,600 | 3.1 |
| High Efficiency Clothes Washers (HECW) | 51 | 458,737 | 1 | 21 | $0 | $3,315 | $4,335 | $7,650 | 7.2 |
| Rotating Nozzles for Pop-up Spray Heads | 15 | 19,551 | 0 | 0 | $0 | $15 | $60 | $75 | 1.7 |
| Weather based Irrigation Controllers (WBIC) | 3 | 317,753 | 1 | 10 | $0 | $210 | $240 | $450 | 0.6 |
| Turf Removal (6,908 Sq. Ft.) | 3 | 977,700.00 | 0.89 | 9 | $0 | $0 | $12,770 | $12,770 | 19.1 |
| Rain Barrels | 5 | 529,508 | 2 | 16 | $0 | $0 | $375 | $375 | 0.3 |
| **IEUA Locally Implemented Residential Programs** | | | | | | | | | |
| FreeSprinklerNozzles.com Program | 2,426 | 3,162,058 | 10 | 49 | $0 | $0 | $8,190 | $8,190 | 1.1 |
| Residential Landscape Retrofit Program (112 WBIC/1,785 Nozzles) | 72 | 14,339,600 | 44 | 403 | $64,912 | $0 | $64,912 | $129,825 | 3.9 |
| Landscape Transformation Program (19,028 Sq. Ft.) | 21 | 306,607 | 1 | 9 | $0 | $25,417 | $38,056 | $63,473 | 89.7 |
| ***Subtotal*** | **2,662** | **21,025,663** | **62** | **573** | **$64,912** | **$32,257** | **$132,238** | **$229,407** | **127** |
| **SoCal Water$mart Commercial Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 0 | 0 | 0 | 0 | $0 | $90 | $200 | $290 | 0.0 |
| Waterless Urinals | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Cooling Tower Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Weather Based Irrigation Controllers (WBIC) | 0 | 0 | 0 | 0 | $0 | $0 | $184 | $0 | 0.0 |
| Rotating Nozzles for Pop-up Spray Heads | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Large Rotary Nozzles | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Central Computerized Irrigation Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Laminar Flow Restrictor | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Air-Cooled Ice Machine | 1 | 65,180 | 0 | 1 | $0 | $930 | $1,000 | $1,930 | 12.8 |
| Turf Removal (15,020 Sq. Ft.) | 5 | 636,352 | 2 | 20 | $0 | $15,020 | $30,040 | $45,060 | 30.7 |
| **IEUA Locally Implemented Commercial Programs** | | | | | | | | | |
| FreeSprinklerNozzles.com Program | 200 | 260,720 | 1 | 4 | $0 | $0 | $650 | $650 | 1.1 |
| ***Subtotal*** | **206** | **962,252** | **3** | **25** | **$0** | **$16,040** | **$32,074** | **$47,931** | |
| **TOTAL** | **2,868** | **21,987,915** | **65** | **598** | **$64,912** | **$48,297** | **$164,312** | **$277,338** | |

[1] Payback period = $\frac{\text{Total direct program costs}}{\text{AF saved/year x MWD Tier II rate/AF}}$

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# IEUA Regional Conservation Programs Annual Report

| Program | District Devices/ Rebates | Gallons Saved (year) | AF Saved (year) | AF Saved Lifetime | Funding Sources (dollars) Outside Funding | IEUA | MWD | Total | Payback Period (years) [1] |
|---|---|---|---|---|---|---|---|---|---|
| **FY 2013-2014** | | | | | | | | | |
| **SoCal Water$mart Residential Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 39 | 540,098 | 2 | 33 | $0 | $1,950 | $1,950 | $3,900 | 3.1 |
| High Efficiency Clothes Washers (HECW) | 38 | 341,753 | 1 | 16 | $0 | $2,470 | $3,230 | $5,700 | 7.2 |
| Rotating Nozzles for Pop-up Spray Heads | 2 | 2,607 | 0 | 0 | $0 | $2 | $8 | $10 | 1.7 |
| Weather based Irrigation Controllers (WBIC) | 2 | 211,803 | 1 | 7 | $0 | $140 | $160 | $300 | 0.6 |
| Rain Barrels | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| **IEUA Locally Implemented Residential Programs** | | | | | | | | | |
| FreeSprinklerNozzles.com Program | 712 | 928,024 | 3 | 14 | $0 | $0 | $7,394 | $7,394 | 3.5 |
| Residential Landscape Retrofit Program (55 WBIC/347 Nozzles) | 32 | 6,192,100 | 19 | 188 | $15,310 | $0 | $15,310 | $30,619 | 2.1 |
| Landscape Transformation Program (6,720 Sq. Ft.) | 7 | 306,607 | 1 | 9 | $0 | $13,414 | $6,720 | $20,134 | 28.5 |
| ***Subtotal*** | **832** | **8,522,991** | **26** | **267** | **$15,310** | **$17,976** | **$34,771** | **$68,056** | **47** |
| **SoCal Water$mart Commercial Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 2 | 27,697 | 0 | 2 | $0 | $90 | $200 | $290 | 4.5 |
| Waterless Urinals | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Cooling Tower Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Weather Based Irrigation Controllers (WBIC) | 2 | 211,803 | 1 | 7 | $0 | $0 | $184 | $0 | 0.0 |
| Rotating Nozzles for Pop-up Spray Heads | 48 | 62,563 | 0 | 1 | $0 | $48 | $192 | $240 | 1.7 |
| Large Rotary Nozzles | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Central Computerized Irrigation Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Laminar Flow Restrictor | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Air-Cooled Ice Machine | 0 | 65,170 | 0 | 1 | $0 | $0 | $0 | $0 | 0.0 |
| Turf Removal | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| **IEUA Locally Implemented Commercial Programs** | | | | | | | | | |
| FreeSprinklerNozzles.com Program | 1,460 | 1,902,970 | 6 | 29 | $0 | $0 | $4,745 | $4,745 | 1.1 |
| ***Subtotal*** | **1,512** | **2,270,204** | **7** | **40** | **$0** | **$138** | **$5,321** | **$5,276** | |
| **TOTAL** | **2,344** | **10,793,195** | **33** | **307** | **$15,310** | **$18,114** | **$40,092** | **$73,332** | |

[1] Payback period = $\frac{\text{Total direct program costs}}{\text{AF saved/year x MWD Tier II rate/AF}}$

# Monte Vista Water District
# IEUA Regional Conservation Programs Annual Report

| Program | District Devices/ Rebates | Gallons Saved (year) | AF Saved (year) | AF Saved Lifetime | Funding Sources (dollars) Outside Funding | IEUA | MWD | Total | Payback Period (years) [1] |
|---|---|---|---|---|---|---|---|---|---|
| **FY 2012-2013** | | | | | | | | | |
| **SoCal Water$mart Residential Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| High Efficiency Clothes Washers (HECW) | 50 | 449,674 | 1.38 | 20.70 | $0 | $3,250 | $4,250 | $7,500 | 7.5 |
| Rotating Nozzles for Pop-up Spray Heads | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Weather based Irrigation Controllers (WBIC) | 5 | 529,508 | 1.63 | 16.25 | $0 | $350 | $400 | $750 | 0.6 |
| **IEUA Locally Implemented Residential Programs** | | | | | | | | | |
| FreeSprinklerNozzles.com Program | 1,575 | 2,052,861 | 6 | 63 | $0 | $0 | $7,394 | $7,394 | 1.6 |
| Residential Landscape Retrofit Program | 20 | 5,214,400 | 16 | 145 | $10,305 | $1,678 | $11,982 | $23,965 | 2.1 |
| Landscape Transformation Program (4,732 Sq. Ft.) | 6 | 199,477 | 1 | 6 | $1,183 | $3,629 | $4,732 | $9,544 | 21.4 |
| ***Subtotal*** | **1,656** | **8,445,920** | **26** | **251** | **$11,488** | **$8,907** | **$28,758** | **$49,153** | **33** |
| **IEUA High Efficiency Toilet (HET) Installation Prog.** | | | | | | | | | |
| IEUA Multi-Family Direct Install Prog. (HET) | 4 | 55,395 | 0.17 | 3.4 | $293 | $143 | $200 | $636 | 5.1 |
| IEUA Single-Family Direct Install Prog. (HET) | 96 | 1,329,472 | 4.08 | 81.6 | $7,041 | $3,423 | $4,800 | $15,264 | 5.1 |
| ***Subtotal*** | **100** | **1,384,867** | **4** | **85** | **$7,334** | **$3,566** | **$5,000** | **$15,900** | |
| **SoCal Water$mart Commercial Rebates** | | | | | | | | | |
| High Efficiency Toilets (HET) | 11 | 152,335 | 0.47 | 9.35 | $0 | $550 | $550 | $1,100 | 3.2 |
| Waterless Urinals | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Cooling Tower Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| High Efficiency Clothes Washers | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Weather based Irrigation Controllers (WBIC) | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Rotating Nozzles for Pop-up Spray Heads | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Large Rotary Nozzles | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Central Computerized Irrigation Controller | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| Laminar Flow Restrictor | 30 | 224,837 | 0.69 | 3 | $0 | $300 | $300 | $600 | 1.2 |
| Air-Cooled Ice Machine | 1 | 65,170 | 0.20 | 1.40 | $0 | $930 | $1,000 | $1,930 | 13.3 |
| **IEUA Locally Implemented Commercial Programs** | | | | | | | | | |
| Fontana Unified School Retrofit Program | 0 | 0 | 0 | 0 | $0 | $0 | $0 | $0 | 0.0 |
| FreeSprinklerNozzles.com Program | 282 | 367,560 | 1.13 | 5.64 | $0 | $0 | $917 | $917 | 1.1 |
| ***Subtotal*** | **324** | **809,903** | **2** | **20** | **$0** | **$1,780** | **$2,767** | **$4,548** | |
| **TOTAL** | **2,080** | **10,640,690** | **33** | **356** | **$18,822** | **$14,253** | **$36,524** | **$69,600** | |

[1] Payback period = $\frac{\text{Total direct program costs}}{\text{AF saved/year x MWD Tier II rate/AF}}$

# Monte Vista Water District
# IEUA Regional Conservation Programs Annual Report

| Program | District Devices/ Rebates | Gallons Saved (year) | AF Saved (year) | AF Saved Lifetime | Funding Sources (dollars) DWR | IEUA | MWD | Total | Payback Period (years) [1] |
|---|---|---|---|---|---|---|---|---|---|
| **FY 2011-2012** | | | | | | | | | |
| **Residential Rebate Programs** | | | | | | | | | |
| High Efficiency Clothes Washers (HECW) | 54 | 485,648 | 1.49 | 22.36 | 0 | 0 | 4,590 | 4,590 | 4.5 |
| Rotating Nozzles for Pop-up Spray Heads | 40 | 52,136 | 0.16 | 0.80 | 0 | 80 | 120 | 200 | 1.8 |
| Weather Based Irrigation Controllers (WBIC) | 1 | 105,902 | 0.33 | 3.25 | 0 | 45 | 80 | 125 | 0.6 |
| FreeSprinklerNozzles.com Program | 2,197 | 2,863,579 | 9 | 87.88 | 0 | 0 | 6,825 | 6,825 | 1.1 |
| Residential Landscape Retrofit Program | 3 | 977,700 | 3 | 25.00 | 0 | 2,167 | 1,858 | 4,025 | 2.0 |
| ***Subtotal*** | **2,295** | **4,484,965** | **14** | **139.29** | **0.00** | **2,292.00** | **13,473.37** | **15,765.37** | |
| **IEUA Multi-Family Direct Install Prog. (HET)** | | | | | | | | | |
| IEUA Multi-Family Direct Install Prog. (HET) | 9 | 124,638 | 0.38 | 7.65 | 660 | 321 | 450 | 1,431 | 7.5 |
| IEUA Single-Family Direct Install Prog. (HET) | 143 | 1,980,359 | 6.08 | 121.55 | 10,488 | 5,099 | 7,150 | 22,737 | 7.5 |
| ***Subtotal*** | **152** | **2,104,997** | **6** | **129.20** | **11,147.68** | **5,420** | **7,600** | **24,168.00** | |
| **CII Save-A-Buck Rebate Program** | | | | | | | | | |
| High Efficiency Toilets (HET) | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Waterless Urinals | 5 | 199,910 | 0.61 | 12.27 | 0 | 250 | 1,000 | 1,250 | 3.0 |
| Conductivity Controller | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| High Efficiency Clothes Washers | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Weather Based Irrigation Controllers (WBIC) | 17 | 1,800,327 | 5.53 | 55.25 | 0 | 6,120 | 10,200 | 16,320 | 4.3 |
| Rotating Nozzles for Pop-up Spray Heads | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Large Rotary Nozzles | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| FreeSprinklerNozzles.com Program | 2,889 | 3,765,534 | 11.56 | 115.56 | 0 | 0 | 37,557 | 37,557 | 4.8 |
| Central Computerized Irrigation Controller | 0 | 0 | 0 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| ***Subtotal*** | **2,911** | **5,765,771** | **18** | **183.08** | **1.00** | **6,370.00** | **48,757.00** | **55,128.00** | |
| **TOTAL** | **5,358** | **12,355,733** | **38** | **451.57** | **11,148.68** | **14,082.32** | **69,830.37** | **95,061.37** | |

[1] Payback period = $\frac{\text{Total direct program costs}}{\text{AF saved/year x MWD Tier II rate/AF}}$

# Monte Vista Water District
# IEUA Regional Conservation Programs Annual Report

| Program | District Devices/ Rebates | Gallons Saved (year) | AF Saved (year) | AF Saved Lifetime | Funding Sources (dollars) DWR | IEUA | MWD | Total | Payback Period (years) [1] |
|---|---|---|---|---|---|---|---|---|---|
| **FY 2010-2011** | | | | | | | | | |
| **Residential Rebate Programs** | | | | | | | | | |
| High Efficiency Toilets (HET) | 2 | 27,697 | 0.09 | 1.70 | 0 | 70 | 100 | 170 | 4.0 |
| High Efficiency Clothes Washers (HECW) | 94 | 845,388 | 2.59 | 38.92 | 0 | 0 | 7,990 | 7,990 | 6.2 |
| Rotating Nozzles for Pop-up Spray Heads | 150 | 195,511 | 0.60 | 3.00 | 0 | 300 | 450 | 750 | 0.0 |
| Weather Based Irrigation Controllers (WBIC) | 4 | 423,606 | 1.30 | 13.00 | 0 | 180 | 320 | 500 | 0.0 |
| Synthetic Turf (0 Sq. Ft.) | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| FreeSprinklerNozzles.com Program | 91 | 118,610 | 0 | 3.64 | 0 | 0 | 6,825 | 6,825 | 1.0 |
| Residential Landscape Retrofit Program | 10 | 2,933,100 | 9 | 85.00 | 0 | 5,662 | 5,482 | 11,144 | 2.0 |
| ***Subtotal*** | **351** | **4,543,912** | **14** | **145.26** | **0.00** | **6,212.39** | **21,166.89** | **27,379.28** | |
| **IEUA Multi-Family Direct Install Prog. (HET)** | | | | | | | | | |
| IEUA Multi-Family Direct Install Prog. (HET) | 11 | 152,335 | 0.47 | 9.35 | 807 | 392 | 550 | 1,749 | 7.5 |
| ***Subtotal*** | **11** | **152,335** | **0** | **9.35** | **806.74** | **392** | **550** | **1,749.00** | |
| **CII Save-A-Buck Rebate Program** | | | | | | | | | |
| High Efficiency Toilets (HET) | 1 | 13,849 | 0.04 | 0.85 | 0 | 135 | 165 | 300 | 0.0 |
| Waterless Urinals | 14 | 559,747 | 1.72 | 34.36 | 0 | 700 | 2,800 | 3,500 | 0.0 |
| Conductivity Controller | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Weather Based Irrigation Controllers (WBIC) | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Synthetic Turf (0 Sq. Ft.) | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Rotating Nozzles for Pop-up Spray Heads | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| Large Rotary Nozzles | 0 | 0 | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0.0 |
| ***Subtotal*** | **15** | **573,596** | **2** | **35.21** | **0.00** | **835** | **2,965** | **3,800.00** | |
| **TOTAL** | **377** | **5,269,843** | **16** | **189.81** | **806.74** | **7,439.65** | **24,681.89** | **32,928.28** | |

[1] Payback period = $\frac{\text{Total direct program costs}}{\text{AF saved/year x MWD Tier II rate/AF}}$

# Appendix O:
# Ordinance 33: Establishing Water Use Efficiency Best Practices and Staged Water Supply Shortage Measures

# ORDINANCE 33

## AN ORDINANCE OF THE BOARD OF DIRECTORS OF THE MONTE VISTA WATER DISTRICT, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, TO ESTABLISH WATER USE EFFICIENCY BEST PRACTICES AND STAGED WATER SUPPLY SHORTAGE MEASURES

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The Board of Directors of the Monte Vista Water District (District) of San Bernardino County, California, does hereby ordain the following:

**Section 1: Purpose**

Monte Vista Water District is responsible for providing reliable water supply for the beneficial use, health, safety and welfare of its customers. The District has worked diligently to educate its customers about the value of water use efficiency and available water supplies to the District. In the unlikely event of a water shortage, the District shall request that its customers make reasonable and necessary reductions in their water use, according to the provisions of this Ordinance.

**Section 2: Policy**

1. The waste or unreasonable use of water by District customers shall be prevented to the greatest extent possible, and the efficient use of water shall be encouraged.

2. The District shall meet its urban water efficiency targets as set forth in California Water Code Sections 10608-10608.60, requiring the District to achieve a 20% reduction in per capita water use or a comparable water use reduction goal by December 31, 2020.

3. The District shall declare respective water supply shortage stages only if the District determines one or more of the following situations has occurred or may occur in the foreseeable future:

   a. The District may be unable to acquire or produce adequate water supplies to meet projected customer demands; or,

   b. The cost to acquire or produce adequate water supplies to meet projected customer demands may rise above the projected revenues generated by currently adopted water rates.

   Such circumstances would most likely occur due to one or more of the following events: imported water supply cutbacks by Metropolitan Water District of Southern California, extended drought, equipment failure, act of terrorism, and/or natural disaster.

4. During a declared water supply shortage, the District shall reduce water deliveries to wholesale water customers equal to the percentage of water demand reduction requested from the District's retail customers. The wholesale customer shall be responsible for managing water demand within its service area to comply with reduced deliveries during the declared water supply shortage.

5. The District shall offer to local agencies within whose boundaries the District provides retail and wholesale water service, upon their request, reasonable levels of assistance in complying with California Government Code Sections 65591-65599 (Water Conservation in Landscaping Act), enacted by Assembly Bill No. 1881 (2006).

**Section 3: Authority and Implementation**

1. The Board of Directors has the statutory power to declare that water supply shortage conditions exist and to implement the various staged provisions of this Ordinance as required to maintain reliable and safe water service to District customers.

2. The General Manager shall request the Board of Directors to declare a water supply shortage at a regular or special meeting of the Board of Directors. The Board shall receive evidence of water supply conditions at a public hearing and shall make findings concerning the adequacy of water supplies for the District and the necessity, if any, of declaring a water supply shortage.

3. The declaration of the Board that a water supply shortage exists or is threatened to exist shall be made by Resolution and public announcement, and shall be published in a newspaper of general circulation within ten (10) calendar days of adoption. The declaration shall become effective immediately upon adoption. The Resolution shall set a time schedule for expiration after review of water supply shortage conditions as reported by the General Manager.

**Section 4: Compliance Responsibility**

The District customer whose name is on the account shall be responsible for compliance with the provisions of this Ordinance.

**Section 5: Water Use Efficiency Best Practices**

1. District customers are required to implement the following water use efficiency best practices at all times:

    a. Set automatic irrigation controllers to water outdoor landscaped areas only between the hours of 8 p.m. and 8 a.m. and for no more than fifteen (15) minutes per day per valve-controlled station. Exempt from this requirement:

        i. Watering by hand.

        ii. Drip irrigation.

        iii. Irrigation systems equipped with weather-based or soil moisture-based irrigation controllers.

    b. Adjust irrigation system so there is no run-off, over-spray or excessive irrigation causing irrigation water to flow off of the customer's property.

    c. Turn off outdoor irrigation during rain.

    d. Repair all plumbing and irrigation system leaks within seven (7) days of discovery.

e. Wash motor vehicles, trailers, boats and other types of mobile equipment with a hand-held bucket or a hand-held hose equipped with a shutoff nozzle, or use a commercial vehicle wash equipped with a water recycling system.

f. Wash paved areas for health and safety purposes only with the use of a waterbroom or water-efficient pressure washer.

g. Restaurants serve water only upon request.

h. Hotels offer guests the option to not launder linen daily.

2. The following technologies shall be equipped with water recycling, recirculation or reuse systems prior to the establishment of new water service:

   a. Cooling towers and evaporative cooling systems.

   b. Decorative water fountains.

   c. Conveyer vehicle washes and in-bay automatic vehicle washes.

3. The District shall offer local agencies and retail and wholesale customers reasonable assistance in complying with State and local water use efficiency guidelines and requirements.

**Section 6: Significant Water Supply Shortage**

If the Board of Directors finds that current or near-term water supply shortage conditions require a 10 to 25 percent demand reduction, the Board may pass a Significant Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Section 5 above:

1. Landscaping and Landscape Irrigation.

   a. All lawns, landscape or turf areas shall be irrigated only on Tuesday, Thursday and Saturday of each week. Exempt from this requirement:

      i. Commercial nurseries, golf courses and other water-dependent industries.

      ii. Watering by hand.

      iii. Drip irrigation.

      iv. Irrigation systems equipped with weather-based or soil moisture-based irrigation controllers.

   b. Water consumption through water meters designed for landscape irrigation shall not exceed 75 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

2. Potable water used on a one-time basis for construction and dust control shall be limited to that quantity identified in the plan submitted by the user which describes water use requirements. The plan shall be submitted to and approved by the General Manager. Upon availability, non-potable recycled water will be made available for these uses.

3. The use of water from fire hydrants shall be limited to fire fighting and related activities, or for municipal activities necessary to maintain the public health, safety and welfare, or for construction use and dust control as approved by the General Manager.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by 10 to 25 percent, effective upon the date of its public announcement of a Significant Water Supply Shortage. The General Manager shall consult with District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 7: Critical Water Supply Shortage**

If the Board of Directors finds that current or near-term water supply shortage conditions require a 25 to 40 percent demand reduction, the Board may pass a Critical Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Sections 5 and 6 above:

1. Landscaping and Landscape Irrigation.

    a. All lawns, landscape or turf areas shall be watered only on Tuesday and Saturday of each week.

    b. Water consumption through water meters designed for landscape irrigation shall not exceed 50 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

    c. No person or entity shall implement any landscaping requirements of any homeowners association, developer or governing agency if it will result in an increase in water consumption from the prior calendar year.

2. No washing of motor vehicles, trailers, boats and other types of mobile equipment shall be permitted, unless done on the premises of a commercial car wash.

3. No one shall empty or refill swimming pools, spas or ponds for cleaning purposes. Water levels may be maintained.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by 25 to 40 percent, effective upon the date of its public announcement of a Critical Water Supply Shortage. The General Manager shall consult with the District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 8: Emergency Water Supply Shortage**

If the Board of Directors finds that, due to emergency circumstances, current or near-term water supply shortage conditions require a 40 percent or higher demand reduction, the Board may pass an Emergency Water Supply Shortage Resolution, enacting the following water use requirements in addition to those described in Sections 5, 6 and 7 above:

1. Landscaping and Landscape Irrigation.

    a. All lawns, landscape or turf areas shall be watered only on Saturday of each week.

    b. Water consumption through water meters designed for landscape irrigation shall not exceed 33 percent of the amount of water used during the same billing period in the last calendar year during which no water shortage was declared.

    c. No installation of new landscaping shall be permitted.

2. No potable water for construction and dust control shall be permitted. Upon availability, non-potable recycled water will be made available for these uses.

3. No water shall be used to fill or maintain swimming pools, spas or ponds.

4. The District shall reduce wholesale water deliveries in the same amount applicable to its retail customers, by at least 40 percent, effective upon the date of its public announcement of an Emergency Water Supply Shortage. The General Manager shall consult with District wholesale customers prior to the announcement to coordinate and implement periods of reduction in water delivery.

**Section 9: Exceptions**

No water use requirements described in Sections 5, 6, 7 and 8 above shall apply to the following water uses:

1. The use of recycled water distributed through the District's recycled water distribution system and used for landscape irrigation, construction, dust control or other approved uses, or the use of recycled water produced for direct reuse by commercial car washes, commercial laundries and various industries utilizing industrial water reuse systems.

2. The routine and necessary use of water by a governmental entity in pursuit of its functions for protecting the public health, safety and welfare of its citizens. This exception does not apply to the use of potable water for landscape irrigation by a governmental agency.

3. The necessary use of water for the routine maintenance, testing and/or repair of water distribution facilities, residential and commercial plumbing and permanently installed landscape irrigation systems.

4. The use of "gray water". For the purposes of this Ordinance, "gray water" is defined as non-septic domestic wastewater collected from clothes washers, bathtubs, showers, and sinks. This provision shall not be construed to authorize the use of "gray water" if such use is otherwise prohibited by law.

**Section 10: Immediate Water Shortage Response**

In the event that an immediate shortage of water supply occurs due to disaster, the General Manager shall declare the extent of the water supply shortage and shall implement the appropriate water supply shortage stage as defined herein. The General Manager shall report such water supply shortage condition and level of response to the Board of Directors at a time which is reasonable and practicable.

**Section 11: Failure to Comply**

1. Any District customer violating the provisions set forth in this Ordinance shall be subject to the procedures and/or penalties described in this Section.

2. The following table outlines the procedures and penalties for violating the provisions set forth in this Ordinance, and each subsequent violation which occurs at least seven (7) days subsequent to the previous violation:

| | First Violation | Second Violation | Third Violation | Fourth Violation | Fifth Violation |
|---|---|---|---|---|---|
| **Best Practices** | Written Notice | Final Written Notice | $50 Fine | $100 Fine | $150 Fine; Flow Restrictor |
| **Significant Water Supply Shortage** | Written Notice | $50 Fine | $100 Fine | $150 Fine | $200 Fine; Flow Restrictor |
| **Critical Water Supply Shortage** | Written Notice | $100 Fine | $200 Fine | $300 Fine; Flow Restrictor | --- |
| **Emergency Water Supply Shortage** | Written Notice | $150 Fine | $300 Fine; Flow Restrictor | --- | --- |

3. Written Notice

   a. Notice of a violation of Ordinance provisions, as outlined in Subsection 2 above, shall be given in writing by regular mail or personal delivery to the customer at the address on file with the District. If notice is given by mail, the person depositing the notice by mail shall complete a Proof of Service by Mail form indicating the time, date and place the notice was deposited in the U.S. Mail.

   b. If personal delivery is used, any notice of violation of the water use requirements shall be made in the following manner:

i. By handing the notice to the customer personally. The person serving the notice shall complete a Proof of Service form indicating the time, date and place of service.

ii. If the customer is absent from or unavailable at the premises at which the violation occurred, by leaving a copy with some person of suitable age and discretion at the premises and sending a copy through the regular mail to the customer at the address at which the customer is normally billed.

iii. If a person of suitable age or discretion cannot be found, by affixing a copy in a conspicuous place at the premises at which the violation occurred and also sending a copy through the regular mail to the customer at the address at which the customer is normally billed.

c. The notice shall contain a description of the facts of the violation, a statement of the possible penalties for each violation and a statement informing the customer of his or her right to request a waiver due to hardship or special circumstances.

4. After multiple violations of Ordinance provisions, as outlined under Subsection 2 above, the District may install a flow restricting device on a customer's water meter. The District may terminate a customer's landscape meter service upon a prior determination that the customer has repeatedly violated this Ordinance. Such action will only be taken after a hearing held by the Review Board where the customer will have the opportunity to respond to the District's evidence of repeated violation.

5. Any restricted or terminated service may be restored upon request of the customer made not less than forty-eight (48) hours after the implementation of the action restricting or terminating service and only upon a showing by the customer that the customer is ready, willing and able to comply with the provision of this Ordinance. Prior to any restoration of the service, the customer shall pay all District charges for any restriction or termination of service and its restoration.

**Section 12: Review Board**

1. A District customer may request a waiver from any provisions of this Ordinance due to hardship or special circumstances. A Review Board comprised of members of the District staff shall be designated by the General Manager to review such requests. The Review Board shall respond to a waiver request within ten (10) working days of receipt of request.

2. The Review Board shall review customer written requests for a waiver from Ordinance provisions due to hardship or special circumstances, and determine whether or not the case warrants a waiver. No waiver shall be granted unless the water customer shows that he or she has achieved the maximum practical reduction in water consumption other than in the specific area(s) in which a waiver is being sought. No waiver shall be granted to any water customer who, when requested by the District, fails to provide any information necessary for resolution of the customer's request for a waiver.

3. Any customer who is granted a waiver shall provide proof of compliance with said waiver upon demand by any person authorized by the District. If the customer is found to violate any provision of the waiver, the Review Board shall revoke the waiver. The Review Board shall notify the customer in writing of the proposed revocation five (5) working days before taking such action, and the customer shall be given the opportunity to be heard by the Review Board prior to its taking such action.

4. A waiver issued under a particular water supply shortage stage shall not be valid upon passage of a higher water supply shortage stage. A new waiver must be granted by the Review Board for each enacted water supply shortage stage.

5. Appeal of Review Board decisions shall be made in writing to the Board of Directors, whose decision shall be final. The Board of Directors shall consider the appeal within thirty (30) days from the date the appeal was filed. The appealing customer shall be given the opportunity to address the Board of Directors and submit evidence orally and in writing.

**Section 13: Validity**

If any section, sub-section, clause, phrase or portion of this Ordinance is for any reason held to be invalid or unconstitutional by any court of competent jurisdiction, such decision shall not affect the validity of remaining portions of this Ordinance.

**Section 14: Consistency**

1. This Ordinance is consistent with the provision of California Water Code Sections 375-378, inclusive, and Sections 31020-31035.1, inclusive.

2. This Ordinance fulfills the District's water supply shortage planning obligation as required by California Water Code Sections 10610-10656, inclusive (Urban Water Management Planning Act). Subsequent District Urban Water Management Plan updates shall comply with this Ordinance.

**Section 15: Effective Date**

This Ordinance shall be effective immediately upon adoption and shall be published in any newspaper of general circulation and distributed within the District as required by law.

The President of the Board of Directors shall sign this Ordinance and the Secretary shall attest to the same. The Secretary shall cause this Ordinance to be published within ten (10) days after its adoption, at least once in a newspaper of general circulation which is distributed within the boundaries of the Monte Vista Water District.

**Section 16: Repeal and Rescind**

Upon adoption of this Ordinance, Ordinance 32 shall be repealed and rescinded effective on the date of adoption of this Ordinance.

ADOPTED THIS 12th day of May 2010.

Sandra S. Rose
President of the Board of Directors
MONTE VISTA WATER DISTRICT

ATTEST:

Mark N. Kinsey
Secretary to the Board of Directors
MONTE VISTA WATER DISTRICT

California Regional Water Quality Control Board
Santa Ana Region

**RESOLUTION NO. 94-1**

**Resolution Adopting the Updated Water Quality Control Plan for the Santa Ana River Basin (8)**

WHEREAS, the California Regional Water Quality Control Board, Santa Ana Region (hereinafter Regional Board), finds that:

1. The Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) was adopted by the Regional Board on April 11, 1975 and approved by the State Water Resources Control Board (State Board) on April 17, 1975.

2. An amended Basin Plan was adopted by the Regional Board on May 13, 1983 and approved by the State Board on October 20, 1983. Since that time, specific amendments to the Basin Plan have been adopted by the Regional Board and approved by the State Board. These amendments include the following: revisions of compliance dates for certain waste discharge prohibitions; revisions of the beneficial use designations, in part to conform the Basin Plan to the State Board's Sources of Drinking Water Policy; revision of the total inorganic nitrogen wasteload allocation for discharges to the Santa Ana River system; and the incorporation of minimum lot size requirements and exemption criteria for the use of septic tank-subsurface disposal systems in the Region.

3. Section 303(c) of the Federal Clean Water Act requires that water quality standards be reviewed and revised, if appropriate, on a triennial basis, and Section 13240 of the California Water Code provides that basin plans must be periodically reviewed and may be revised.

4. In 1989, the State Board initiated a statewide program for comprehensive review and update of the basin plans by all regional boards.

5. With extensive public participation and input, the Regional Board has prepared an updated Basin Plan. This Basin Plan update process satisfies federal triennial review requirements under Section 303(c) of the Clean Water Act and the periodic review requirements of the California Water Code under Section 13240.

6. The Regional Board discussed the basin plan update process at its meeting on April 23, 1993. A first draft of the revised Basin Plan was released in June, 1993 and a public workshop to review that draft was conducted on July 16, 1993. The Regional Board released a second draft of the Basin Plan and the relevant staff report in September, 1993 and conducted a public workshop on October 22, 1993. The public workshops were conducted after notice was given to all interested persons in accordance with Section 13244 of the California Water Code. The testimony introduced at those workshops was considered in the preparation of the final revised Basin Plan.

7. Significant additions to the revised Basin Plan include the addition of a new beneficial use designation of "Limited Warm Freshwater Aquatic Habitat" (LWRM) specifically for concrete-lined channels, the creation of wetlands as a waterbody type, designation of RARE beneficial use for a number of waterbodies, revised un-ionized ammonia objectives and corresponding total ammonia effluent limits, water quality objectives for the Big Bear groundwater basin, revised total dissolved solids wasteload allocation and a discussion of water quality and water resource managment projects in the region.

8. In accordance with applicable guidance and regulations, the Regional Board has developed site-specific water quality objectives (SSOs) for cadmium, copper and lead in the Middle Santa Ana River system. The Regional Board reviewed and discussed the issues related to the development and adoption of these SSOs in public meetings and workshops on August 7, 1992, March 5, 1993 and June 4, 1993. The testimony introduced at these workshops was considered in the preparation of final recommendations for SSOs.

9. In accordance with the provisions of California Water Code, Section 13280 *et seq.*, the Regional Board developed a proposed Basin Plan amendment to incorporate the SSOs.

10. At a duly noticed Public Hearing on October 22, 1993, the Regional Board adopted Resolution No. 93-64, adopting the proposed Basin Plan amendment to incorporate the SSOs for cadmium, copper and lead for the middle Santa Ana River system. A staff report regarding this matter was prepared and distributed to all interested parties 30 days prior to the hearing. However, between the time of the transmittal of the staff report and the October 22, 1993 hearing, new information was presented that led to the modification of the SSOs which had been recommended in the staff report. To avoid procedural questions, it is appropriate to rescind Resolution No. 93-64 and to reconsider adoption of the SSOs as part of the final revised Basin Plan. A report concerning the SSOs considered and adopted by the Regional Board on October 22, 1993 is included in the staff report pertaining to the adoption of the revised Basin Plan.

11. Regional Board Resolution No. 92-10, adopted February 14, 1992, found that some of the national water quality criteria, including those for cadmium, copper and lead, are inappropriate for the Middle Santa Ana River because the flows are dominated by reclaimed water, which provides and supports beneficial uses which would not otherwise exist.

12. A Use-Attainability Analysis (UAA) has been conducted for the Santa Ana River. The UAA provided data and analyses which allow the Regional Board to make the following findings regarding the Santa Ana River:
    a. The Site-Specific Water Quality Objectives (SSOs) for cadmium, copper and lead proposed by Regional Board staff will protect the beneficial uses of the Santa Ana River.
    b. The proposed SSOs have been shown to be conservative.

c. The proposed SSOs, which represent higher water quality than presently exists, will not result in degradation of water quality.
d. Existing levels of cadmium, copper and lead in the SAR do not contribute to toxicity in the Santa Ana River.
e. Dischargers to the Santa Ana River are either in compliance with their NPDES permits or are meeting approved compliance schedules.

13. Adoption and implementation of the cadmium, copper and lead SSOs is consistent with the maximum benefit to the people of California, particularly because it encourages water reclamation and will support important social and economic development in the Santa Ana Region.

14. The findings of this Resolution with respect to metals SSOs are specific to the Santa Ana River and to cadmium, copper and lead These findings are not meant to establish precedent or be applicable to other metals or other water bodies.

15. The Regional Board has prepared and distributed a written report (Staff Report) on adoption of the revised Basin Plan, including site-specific objectives for metals, in compliance with applicable state and federal environmental regulations (California Code of Regulations, Section 3775, Title 23 and 40 CFR Parts 25 and 131).

16. The process of basin planning is exempt from the requirements of the California Environmental Quality Act (Public Resources Code Section 21000 *et seq*) to prepare an Environmental Impact Report or Negative Declaration. The updated Basin Plan includes a completed Environmental Checklist, an assessment of the environmental impacts of the adoption of the updated Basin Plan and a discussion of alternatives. The updated Basin Plan, Environmental Checklist, staff report and supporting documentation are functionally equivalent to an Environmental Impact Report or Negative Declaration.

17. Review of potential environmental impacts of adoption and implementation of the reviewed Basin Plan indicated that a substantial increase in energy consumption might be required and that there may be no feasible alternatives or mitigation measures for this impact. However, the only alternatives identified which would not require increase in energy consumption would not ensure protection of the beneficial uses of the waters of the Santa Ana Region and would therefore not comply with state and federal laws. Pursuant to CEQA regulations Section 15093a, Findings of Overriding Considerations, as attached to the Checklist, are therefore appropriate. The benefits of the Basin Plan amendments outweigh the unavoidable adverse environmental effects.

18. The Regional Board has considered federal and state antidegradation policies, the state Sources of Drinking Water Policy and other relevant water quality control policies and finds the updated Basin Plan consistent with those policies.

19. On January 28, 1994, the Regional Board held a Public Hearing to consider the revised Basin Plan, including site-specific objectives for metals. Notice of the Public Hearing was given to all interested persons and published in accordance with Water Code Section 13244.

20. This Basin Plan must be submitted for review and approval by the State Board, the Office of Administrative Law (OAL) and the US Environmental Protection Agency. Once approved by the State Board, the Basin Plan is to be submitted to the Office of Administrative Law. A Notice of Decision will be filed after the State Board and the Office of Administrative Law have acted on this matter. The Basin Plan must then be submitted for review by the U.S. Environmental Protection Agency.

21. The revised Basin Plan will become effective upon approval by the State Water Resources Control Board and the Office of Administrative Law

NOW THEREFORE BE IT RESOLVED THAT:

1. The California Regional Water Quality Control Board, Santa Ana Region, adopts the updated Water Quality Control Plan for the Santa Ana River Basin (8) as set forth in the attached document.

2. The Regional Board hereby adopts the Findings of Overriding Considerations attached to the Environmental Checklist prepared for the updated Water Quality Control Plan.

3. Resolution No. 93-64 adopting site-specific objectives for metals for the middle Santa Ana River system is hereby rescinded.

4. The Regional Board will implement the Inland Surface Waters Plan and Enclosed Bays and Estuaries Plan (Plans), where applicable, as long as they remain in effect. If the Plans are invalidated, the Regional Board will continue to issue National Pollutant Discharge Elimination System permits in compliance with the Porter-Cologne Act and applicable State and federal regulations, including but not limited to, 40 CFR 122.44(d).

5. Within three years after consultation with the Department of Fish and Game on specific waterbodies that support threatened or endangered species, and where scientific evidence indicates that certain existing water quality objectives for these water bodies do not adequately protect such species, the Regional Board will determine whether these objectives are adequately protective. In cases where such existing objectives do not provide adequate protection for threatened and endangered species, the Regional Board will develop and adopt adequately protective site-specific objectives for those constituents.

6. The Executive Officer is directed to forward copies of the updated Water Quality Control Plan for the Santa Ana River Basin (8) to the State Water Resources Control Board in accordance with the requirements of Section 13245 of the California Water Code.

7. The Regional Board requests that the State Water Resources Control Board approve the Water Quality Control Plan in accordance with the requirements of Sections 13245 and 13246 of the California Water Code and forward it to the Office of Administrative Law and the US Environmental Protection Agency-Region IX for approval.

I, Gerard J. Thibeault, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Santa Ana Region, on March 11, 1994.

Gerard J. Thibeault
Executive Officer

7. The Regional Board requests that the State Water Resources Control Board approve the Water Quality Control Plan in accordance with the requirements of Sections 13245 and 13246 of the California Water Code and forward it to the Office of Administrative Law and the US Environmental Protection Agency-Region IX for approval.

I, Gerard J. Thibeault, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Santa Ana Region, on January 28, 1994.

for Gerard J. Thibeault
Executive Officer

# CHAPTER 1

# INTRODUCTION

## THE WATER QUALITY CONTROL PLAN (BASIN PLAN) FOR THE SANTA ANA RIVER BASIN

The State Water Resources Control Board (SWRCB or State Board) and the nine Regional Water Quality Control Boards (RWQCBs or Regional Boards) are responsible for the protection and, where possible, the enhancement of the quality of California's waters. The SWRCB sets statewide policy, and together with the RWQCBs, implements state and federal laws and regulations. Each of the nine Regional Boards adopts a Water Quality Control Plan, or Basin Plan, which recognizes and reflects regional differences in existing water quality, the beneficial uses of the region's ground and surface waters, and local water quality conditions and problems.

This document is the Basin Plan for the Santa Ana Region. The Santa Ana Regions includes the upper and lower Santa Ana River watersheds, the San Jacinto River watershed, and several other small drainage areas. The Santa Ana Region covers parts of southwestern San Bernardino County, western Riverside County, and northwestern Orange County.

## FUNCTION OF THE BASIN PLAN

The Basin Plan for the Santa Ana Region is more than just a collection of water quality goals and policies, descriptions of conditions, and discussions of solutions. It is also the basis for the Regional Board's regulatory programs. The Basin Plan establishes water quality standards for the ground and surface waters of the region. The term "water quality standards," as used in the federal Clean Water Act, includes both the beneficial uses of specific waterbodies and the levels of quality which must be met and maintained to protect those uses. The Basin Plan includes an implementation plan describing the actions by the Regional Board and others that are necessary to achieve and maintain the water quality standards.

The Regional Board regulates waste discharges to minimize and control their effects on the quality of the region's ground and surface water. Permits are issued under a number of programs and authorities. The terms and conditions of these discharge permits are enforced through a variety of technical, administrative, and legal means.

Water quality problems in the region are listed in the Basin Plan, along with the causes, where they are known. For waterbodies with quality below the levels necessary to allow all the beneficial uses of the water to be met, plans for improving water quality are included.

In some cases, it has been necessary for the Regional Board to completely prohibit the discharge of certain materials. Some types of discharges are prohibited in specific areas. Details on these prohibitions also appear in the Basin Plan.

## LEGAL BASIS AND AUTHORITIES

The Basin Plan reflects, incorporates, and implements applicable portions of a number of national and statewide water quality plans and policies, including the California Water Code and the Clean Water Act.

### California Water Code

California's Porter-Cologne Water Quality Control Act (Section 13000 ["Water Quality"] ***et seq***., of the California Water Code), which established both the State Water Resources Control Board and the present system of nine Regional Water Quality Control Boards, directs in Chapter 4, Article 3, "Regional Water Quality Control Plans," that each Regional Board is to formulate and adopt water quality control plans for all areas within the region and is to periodically review and revise them as necessary. Each Regional Board is to set water quality objectives that will insure the reasonable protection of beneficial uses and the prevention of nuisance, with the understanding that water quality can be changed somewhat without unreasonably affecting beneficial uses.

The California Water Code also lists the specific factors which are to be considered in establishing water quality objectives. A detailed listing appears in Chapter 4 (p. 4-1).

Implementation plans are to include, but not limited to:

(1) a description of the nature of the actions necessary to achieve the objective, including recommendations for appropriate action by any entity, public or private;

(2) a time schedule for the actions to be taken; and

(3) a description of the surveillance to be undertaken to determine compliance with the objectives.

### Clean Water Act

The objective of the federal Clean Water Act is to "***restore and maintain the chemical, physical and biological integrity of the Nation's waters,***" to make waters of the United States "fishable and swimmable." The Clean Water Act includes several sections which relate to Basin Plans and the basin planning process, including sections on Areawide Waste Treatment Management, Basin Planning, and Water Quality Standards and Implementation Plans.

The Clean Water Act requires that states adopt water quality standards, including standards for toxic substances. The states are also required to have a continuing planning process, which includes public hearings at least once every three years to review the water quality standards and revise them if necessary.

## ENVIRONMENTAL SETTING

The Santa Ana Region is the smallest of the nine regions in the state (2800 square miles) and is located in southern California, roughly between Los Angeles and San Diego. Although small, the region's four million residents (1993 estimate) make it one of the most densely populated regions. People have come to southern California over the years for a wide variety of reasons. Once here, many decide to stay. Snow skiing areas in the mountains are as little as two hours from world-famous broad, sandy ocean beaches.

The climate of the Santa Ana Regions is classified as Mediterranean: generally dry in the summer with mild, wet winters. The average annual rainfall in the region is about fifteen inches, most of it occurring between November and March. Much of the area would be near-desert were it not for the influence of modern civilization.

### Regional Boundaries and Geography

In very broad terms, the Santa Ana Region is a group of connected inland basins and open coastal basins drained by surface streams flowing generally southwestward to the Pacific Ocean (See Figure 1-1).

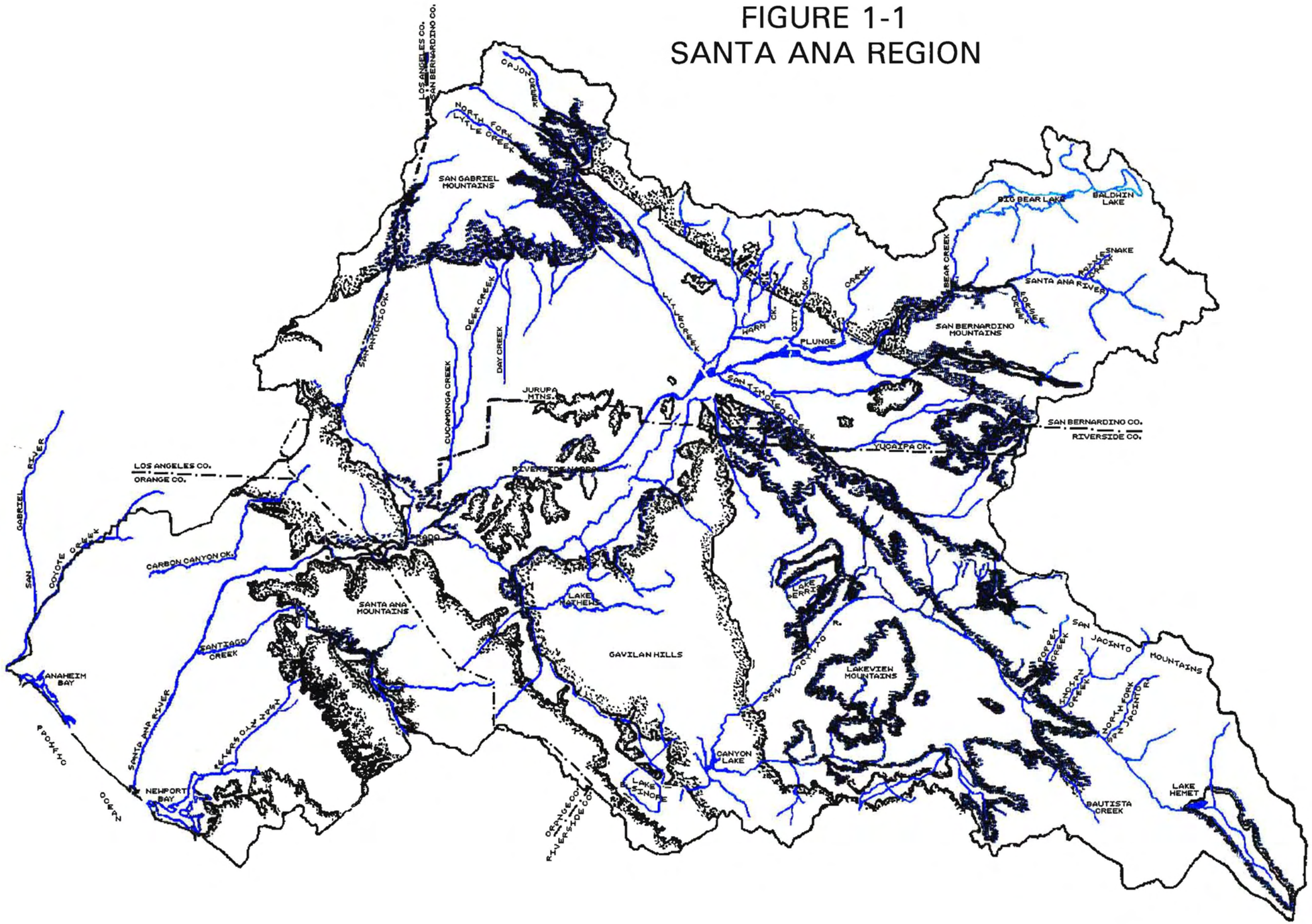
The boundaries between California's nine regions are usually hydrologic divides that separate watersheds, but the boundary between the Los Angeles and Santa Ana Regions is the Los Angeles County Line. Since that county line only approximates the hydrologic divide, part of the Pomona area drains into the Santa Ana Region, and in Orange County, part of the La Habra drains into the Los Angeles Region.

The east-west alignment of the crest of the San Gabriel and San Bernardino Mountains separates the Santa Ana River basin from the Mojave Desert, which is part of the Lahontan Basin (Region 6).

In the south, the regional boundary divides the Santa Margarita River drainage area from that of the San Jacinto River, which normally terminates in Lake Elsinore.

Near Corona, the Santa Ana River has cut through the Santa Ana Mountains and flows down onto the Orange County coastal plain. The Pacific Ocean coast of the Santa Ana Region extends from just north of Laguna Beach up to Seal Beach and the Los Angeles County line. Other features of the coast include Newport Bay, Anaheim Bay-Huntington Harbour, and the major coastal wetlands areas associated with those bays.

# FIGURE 1-1
# SANTA ANA REGION



**REGION 8 INDEX**

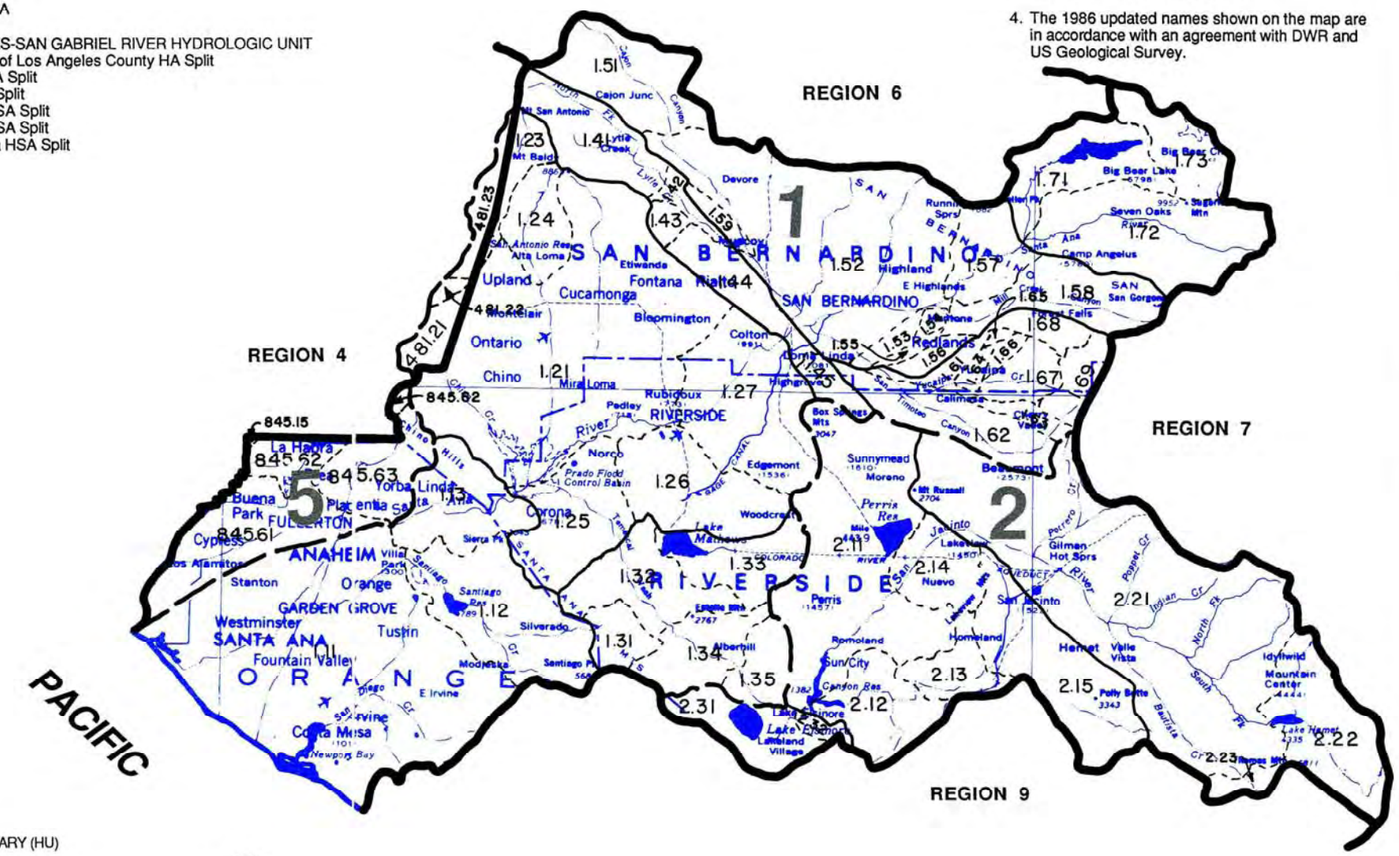
| | |
|---|---|
| 801.00 | SANTA ANA RIVER HYDROLOGIC UNIT |
| 801.10 | Lower Santa Ana River HA |
| 1.11 | East Coastal Plain HSA |
| 1.12 | Santiago HSA |
| 1.13 | Santa Ana Narrows HSA |
| 801.20 | Middle Santa Ana River HA Split |
| 801.21 | Chino HSA Split |
| 481.21 | Chino HSA Split |
| 481.22 | Harrison HSA |
| 801.23 | Claremont Heights HSA Split |
| 481.23 | Claremont Heights HSA Split |
| 801.24 | Cucamonga HSA |
| 1.25 | Temescal HSA |
| 1.26 | Arlington HSA |
| 1.27 | Riverside HSA |
| 801.30 | Lake Matthews HA |
| 1.31 | Coldwater HSA |
| 1.32 | Bedford HSA |
| 1.33 | Cajalco HSA |
| 1.34 | Lee Lake HSA |
| 1.35 | Terra Cotta HSA |
| 801.40 | Colton-Rialto HA |
| 1.41 | Upper Lytle HSA |
| 1.42 | Lower Lytle HSA |
| 1.43 | Rialto HSA |
| 1.44 | Colton HSA |
| 1.45 | Reche HSA |
| 801.50 | Upper Santa Ana River HA |
| 1.51 | Cajon HSA |
| 1.52 | Bunker Hill HSA |
| 1.53 | Redlands HSA |
| 1.54 | Mentone HSA |
| 1.55 | Reservoir HSA |
| 1.56 | Crafton HSA |
| 1.57 | Santa Ana Canyon HSA |
| 1.58 | Mill Creek HSA |
| 1.59 | Sycamore HSA |
| 801.60 | San Timoteo HA |
| 1.61 | Yucaipa HSA |
| 1.62 | Beaumont HSA |
| 1.63 | Cherry Valley HSA |
| 1.64 | Chicken Hill HSA |
| 1.65 | Gateway HSA |
| 1.66 | Oak Glen HSA |
| 1.67 | South Mesa HSA |
| 1.68 | Triple Falls Creek HSA |
| 1.69 | Nobie Creek HSA |
| 801.70 | San Bernardino Mountain HA |
| 1.71 | Bear Valley HSA |
| 1.72 | Seven Oaks HSA |
| 1.73 | Baldwin HSA |

| | |
|---|---|
| 802.00 | SAN JACINTO VALLEY HYDROLOGIC UNIT |
| 802.10 | Perris HA |
| 2.11 | Perris Valley HSA |
| 2.12 | Menifee HSA |
| 2.13 | Winchester HSA |
| 2.14 | Lakeview HSA |
| 2.15 | Hemet HSA |
| 802.20 | San Jacinto HA |
| 2.21 | Gilman Hot Springs HSA |
| 2.22 | Hemet Lake HSA |
| 2.23 | Bautista HSA |
| 802.30 | Elsinore Valley HA |
| 2.31 | Elsinore HSA |
| 2.32 | Railroad HSA |

| | |
|---|---|
| 805.00 | LOS ANGELES-SAN GABRIEL RIVER HYDROLOGIC UNIT |
| 805.10 | Coastal Plain of Los Angeles County HA Split |
| 845.15 | Central HSA Split |
| 845.60 | Anaheim HA Split |
| 845.61 | Anaheim HSA Split |
| 845.62 | La Habra HSA Split |
| 845.63 | Yorba Linda HSA Split |

NOTE:

1. The names and areas shown on this map are the same as used by the Department of Water Resources (DWR) in their Bulletin 130 Series except as explained below.
2. The numbering system used on this map is an adaptation of the numbering system used in the 130 Series.
3. The boundary between Region 8 and Region 4 follows the boundary between Los Angeles County and Orange or San Bernardino Counties, not the Hydrologic Boundary. The San Bernardino County line splits Hydrologic Unit 1 (Santa Ana River HU) so that Sub-Areas 481.21, 481.22, and 481.23 are legally in Region 4 but drain into Region 8. The Orange County line splits Hydrologic Unit 5 (Los Angeles-San Gabriel River HU) so that Sub-Areas 845.15, 845.61, 845.62 and 845.63 are legally in Region 8 but drain into Region 4. Therefore, a 5 digit number on the map indicates that a regional boundary divides a hydrologic unit, area or subarea. In these cases the second digit is the number of the region from which the hydrologic area has been separated by the regional boundary. All other digits are as described in the legend.
4. The 1986 updated names shown on the map are in accordance with an agreement with DWR and US Geological Survey.

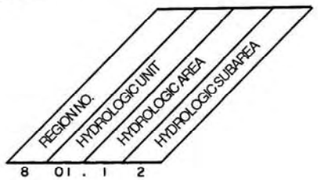



KEY TO REGION




LEGEND

- STREAM
- REGIONAL BOUNDARY
- HYDROLOGIC UNIT BOUNDARY (HU)
- HYDROLOGIC AREA BOUNDARY (HA)
- HYDROLOGIC SUBAREA BOUNDARY (SA)
- 5 HYDROLOGIC UNIT NUMBER




N

April 1973
Revised: July 1976
Revised: August 1986

State Water Resources Control Board
Surveillance and Monitoring Section
T.E. Lavenda, P.E. T E Lavenda

State of California
REGIONAL WATER QUALITY CONTROL BOARD

# Santa Ana Region (8)

## SANTA ANA HYDROLOGIC BASIN PLANNING AREA (SA)

Scale in miles
8 0 8 16 24 32
Scale 1:500,000

### Geological Faults

Southern California is a geologically active area. Major earthquake faults in the region include the San Andreas Fault and its large branch, the San Jacinto Fault; the Elsinore-Whittier Fault; and the Newport-Inglewood Fault. The San Andreas Fault divides the San Gabriel Mountains from the San Bernardino Mountains. The San Jacinto Fault, which splits off from the San Andreas Fault near San Bernardino, affects groundwater flows associated both with the Santa Ana and San Jacinto Rivers. The Elsinore-Whittier Fault passes under Prado Dam as it trends, like the others, from the northwest toward the southeast. The Newport-Inglewood Fault enters the region from the Los Angeles basin and passes offshore at Newport Beach. In addition to these major faults, there are many branching, connecting, and parallel faults in the region.

## HISTORY OF WATER DEVELOPMENT

### Early Settlement

Following the Spanish Mission and Rancho Periods, early agriculture centered around horses and cattle. In the early 1800s, the increasing population required more farms and orchards to produce more food. The weather generally supported farming year-round, but the dry summers made irrigation a necessity. Once water supplies became dependable, vast areas of citrus orchard and vineyards also followed. Today, the region still has strong ties to agriculture, including a large dairy industry, but much of what remains is under increasing development pressure. The future probably involves an even larger human population and much less commercial agriculture.

### Original Conditions

Before this area was settled, it is thought that the Santa Ana River flowed from its headwaters in the San Bernardino Mountains to the Pacific Ocean throughout most of the year. The San Jacinto River, also a substantial surface stream, typically would have ended at Lake Elsinore, which acted as an inland sink. Once out of the sycamore-filled mountain canyon, these rivers meandered along in sandy streambeds, shaded by willows, cottonwoods, and live oaks, flows decreasing where water percolated, filling the groundwater basins, increasing where local geological features forced the groundwater to the surface. High groundwater made springs, swampy areas, marshes and bogs common.

Deep alluvial valley deposits made up large groundwater basins, both in the inland valleys and on the coastal plain, basins naturally full of fresh water. Along with its nearby tributaries, the Santa Ana River fed the Bunker Hill groundwater basin, the Colton and Riverside basins, and to a lesser extent, part of the Chino Basin. Streams in the San Gabriel Mountains recharged the Chino Basin. The San Jacinto River recharged a deep (over two thousand feet) graben, the San Jacinto groundwater basin, as it left the mountains, then several other basins in succession on its way to Lake Elsinore. When especially heavy rainfalls or a series of wet winters filled Lake Elsinore, overflows went down Temescal Creek to the Santa Ana River near Corona. The Santa Ana River entered Santa Ana Canyon and passed through the coastal mountains out onto the Orange County Plain, overlying another large, deep groundwater basin largely recharged by river flows. With the diversion of most of this natural surface flow for agricultural and domestic uses, creeks and rivers dried up, carrying only storm flows and runoff. Eventually, treated wastewater replaced some of the flows in some streams.

**Irrigation**

The first irrigation diversions were made directly from the streams, often using crude brush and sand dams and hand-dug ditches to lead the water from the river to the fields. As more and more settlers arrived, the number of diversions increased. Eventually, all the surface flows were taken and groundwater recharge diminished sharply.

Ground water pumping became necessary to provide water for irrigation and for the growing settlements. Windmills were followed by motor-driven pumps, and as groundwater levels fell, deep well turbines became necessary. Artesian areas, such as those near San Bernardino and in Fountain Valley, stopped flowing naturally. The springs, swamps, and other historically wet areas began drying up.

The history of the San Jacinto River and its tributaries parallels that of the Santa Ana. The San Jacinto had historically kept all the groundwater basins in that part of the region full. Now, there is essentially no surface flow beyond the mouth of the canyon, where it exits the mountains; the riverbed is typically dry. Flood flows every five or ten years, however, produce a broad, shallow “Mystic Lake” in the riverbed near the town of Lakeview.

Further downstream, the river is dammed to form Canyon Lake, just upstream from Lake Elsinore. As noted earlier, Lake Elsinore is normally a sink, with no outflow. High annual evaporation rates have historically limited the amount of water in the lake, which has gone dry several times in this century. Only torrential rains or extended wet cycles have produced the rare overflows down Temescal Creek to the Santa Ana River. Several projects to stabilize the level of Lake Elsinore are now being completed.

When local water supplies inevitably ran short, the area’s economy, based on agriculture, was strong enough to help support the construction of large imported water projects. The Metropolitan Water District of Southern California (locally MWD-

SC or “Met”) built and still operates the Colorado River Aqueduct, which has imported millions of acre-feet of water from the Colorado River across the Mojave Desert and into the region. A second, newer system, the California Water Project, pumps comparable volumes of water out of the Sacramento-San Joaquin Delta for delivery to the Santa Ana Region and other parts of Southern California.

### Santa Ana River Stipulated Judgement

Despite the availability of imported water, legal arguments focused on locally available (generally cheaper) water supplies. Overuse of the upstream water by extensive recycling had reduced summer flows in the Santa Ana River to a trickle, and even that trickle was somewhat salty. The largest of these legal arguments pitted Orange County (the downstream users) against all of the upstream users in Riverside and San Bernardino Counties. When the case was settled through an engineered solution the four largest water districts - San Bernardino Valley Municipal Water District (MWD), Chino Basin MWD, Western MWD, and Orange County WD agreed to implement the court’s solution through a Santa Ana River Watermaster.

Minimum average annual flows and guaranteed quality (total dissolved solids, or TDS) from the San Bernardino area to and through the Riverside Narrows were required, as well as flows from the upper basin to the lower basin (Orange County), measured at Prado Dam. The water required to meet the Stipulated Judgement can be made up of wastewater, imported water, dry weather runoff or some combination of these, with TDS the measure of minimum acceptable quality.

Together, the four large water agencies affected by the judgement formed SAWPA, the Santa Ana Watershed Planning (later “Project”) Authority, a forum for discussion of water issues as well as a joint powers agency that can build projects of common interest to two or more members.

## BASIN PLANNING

### History

In the 1950s and ‘60s, the Regional Boards were not actively involved in water quality planning. Water quality problems typically resulted in controls on waste discharges, usually including effluent limits for TDS and perhaps a few other parameters. Beyond that, the only serious restrictions prohibited the creation of a pollution or nuisance. By 1970, however, the Regional Boards were actively involved in the formulation of plans to meet established water quality objectives. The federal Clean Water Act and the Porter-Cologne Act, which required basin-wide planning, plus the National Pollution Discharge Elimination System (NPDES), which empowers the states to set discharge standard, placed new tools in the hands of the Regional Boards and encouraged the development of new approaches to water quality management. With the development of the “1967 Standards,” applicable to interstate waters, came Water Quality Control

Policies for the San Gabriel Tidal Prism, for the Coastal Bays, Marinas and Sloughs, and for Pacific Ocean Coastal Waters.

In the Santa Ana Region, the 1971 Interim Water Quality Control Plan incorporated the 1967 Standards and set water quality objectives for the Santa Ana River at Prado Dam. After the State Board developed the Ocean Plan and the Thermal Plan, the revised Interim Water Quality Control Plan incorporated that information.

Also in the early 1970s, the Santa Ana Regional Water Quality Control Board (Regional Board) was investigating the salt balance situation in the upper basin. An early computer model, primitive and slow by modern standards but providing answers of a kind never available before, had been used to assess the situation. SAWPA was contracted to write the first (1975) essentially complete Basin Plan (Water Quality Control Plan) for the Regional Board, using an improved version of that model.

The 1975 Basin Plan outlined a specific water quality management scheme designed to improve groundwater quality in the upper basin. Unfortunately, the kinds of large-scale actions necessary to maintain the quality of the region's ground and surface waters – basin management facilities, changes in water supply, regional wastewater treatment – were well beyond the regulatory powers of the Regional Board.

One of the region's major problems at that time was salt balance. Salt (TDS) buildup in the water results from excessive reuse of a given volume of water. Each cycle of use, whether in the home, in industry or use by irrigated agriculture, adds salts directly or indirectly, either through partial evaporation (or evapotranspiration) or direct addition of soluble materials. Typically, each use of water adds 200-300 parts per million (ppm) or milligrams per liter (mg/L) of TDS. TDS begins to interfere with the use of water somewhere between 500 and 1000 mg/L TDS; at 2000 mg/L, water is brackish and generally unusable. In order to allow for subsequent use downstream and to keep ground and surface water bodies usable, careful management of water reuse was necessary. Unlimited recycling created water quality problems. "Pumpback" schemes were strongly discouraged.

Part of the 1975 Basin Plan's solution to the salt balance problem, which seemed most acute in the Chino groundwater basin, was to import and recharge large volumes of low-TDS State Water Project (SWP) water. A second feature of the implementation plan was a large wellfield to extract poor quality water from the lower part of the basin. The third component was a pipeline to the sea to export brines from the upper basin. As years have passed, the list of projects has changed, with desalters replacing groundwater flushing projects. Most of the brine line (the Santa Ana River Interceptor or SARI Line) has been built and one groundwater desalter (Arlington) is now in place. Plans for two more desalters (East and West Chino Basin) in this area are still in design; at least one more is proposed in the San Jacinto watershed.

The Santa Ana Regional Water Quality Control Board and SAWPA (now also including Eastern MWD as a member) have continued to work together toward a common goal

– a well-operated basin that meets reasonable standards in an economical manner and provides high-quality water supplies when and where they're needed.

## THE SANTA ANA RIVER

### Reaches

The mainstem of the Santa Ana River is divided into six reaches (Figure 1-2). Each reach is generally a hydrologic and water quality unit.

**Reach 6** includes the river upstream of Seven Oaks Dam, now under construction. Flows consist largely of snowmelt and storm runoff. Water quality tends to be very high.

**Reach 5** extends from Seven Oaks Dam to San Bernardino, to the San Jacinto Fault (Bunker Hill Dike), which marks the downstream edge of the Bunker Hill groundwater basin. Most of this reach tends to be dry, except as a result of storm flows, and the channel is largely operated as a flood control facility. The extreme lower end of this reach includes rising water and intermittently, San Timoteo Creek flows.

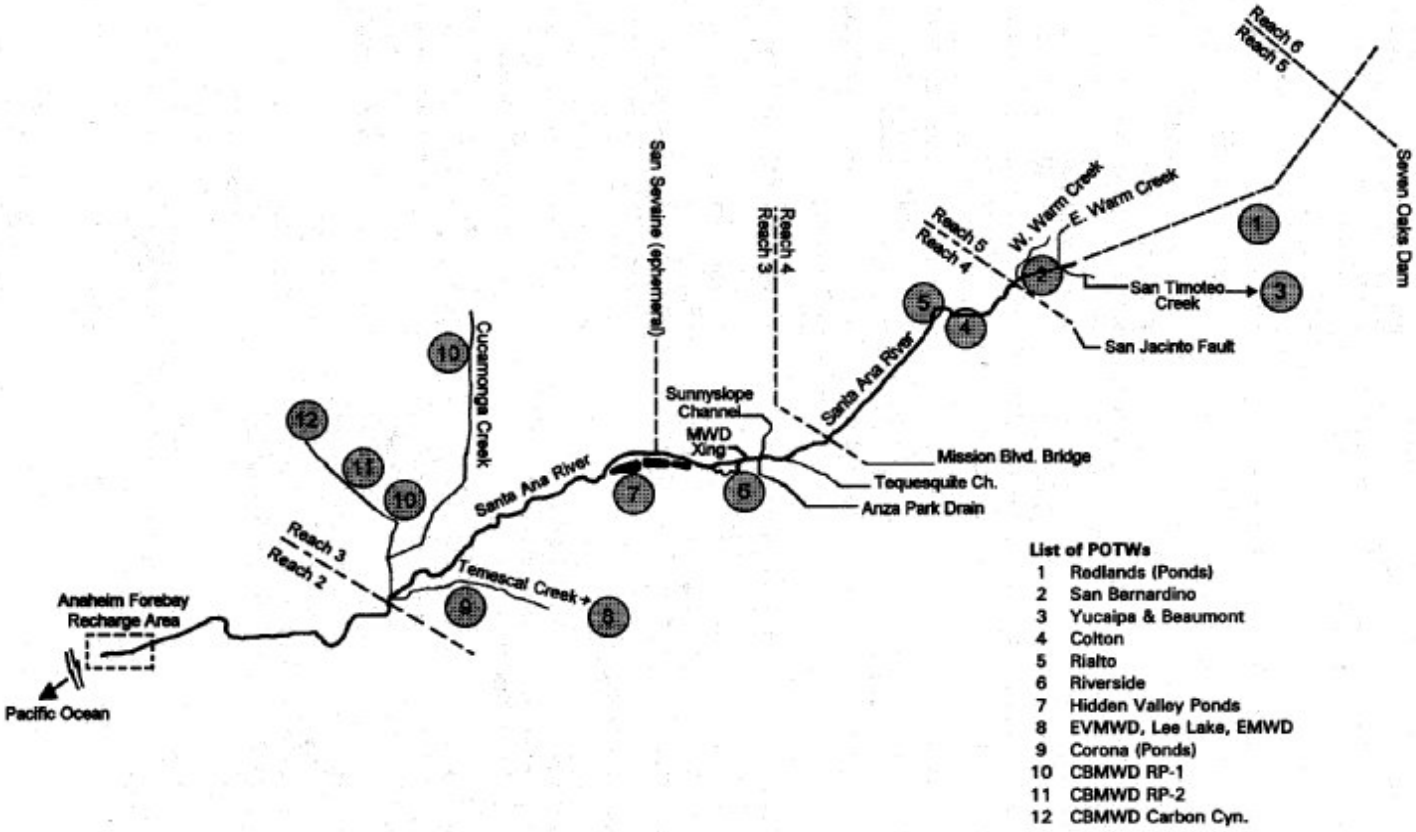
**Reach 4** includes the river from the Bunker Hill Dike down to Mission Boulevard Bridge in Riverside. That bridge marks the upstream limit of rising water induced by the flow constriction in the Riverside Narrows. Until about 1985, rising water from upstream and wastewater discharges percolated and the lower part of the reach was dry. Flows are now perennial, but may not remain so as new projects are built. Much of this reach is also operated as a flood control facility.

**Reach 3** includes the river from Mission Bridge to Prado Dam. In the Narrows, rising water feeds several small tributaries (Sunnyslope Channel, Tequesquite Arroyo, and Anza Park Drain) which are important breeding and nursery areas for the native fish. Temescal, Chino, and Mill/Cucamonga Creeks in Prado Basin are also important river tributaries.

**Reach 2** carries all the upstream flows down through Santa Ana Canyon to Orange County where as much of the water as possible is recharged into the Orange County groundwater basin. The downstream end of the forebay/recharge area and, therefore, the ordinary limit of surface flows, is at 17$^{th}$ Street in Santa Ana.

**Reach 1** is a normally dry flood control facility, presently being expanded and improved even further as a part of the US Army Corps of Engineers' Santa Ana River Project. This reach extends from 17$^{th}$ Street to the tidal prism at the ocean.

# FIGURE 1-2
# SANTA ANA RIVER AND TRIBUTARIES



## Flows and Water Quality

When the Santa Ana River Stipulated Judgement was finalized in 1969, surface diversions and groundwater pumping had eliminated most of the dry weather surface flows in the river system between the mountains and Prado Dam. As the inland cities grew, wastewater flows increased. Between 1970 and 1990, the total volume rose from less than 50,000 to over 130,000 acre-feet per year. The river is effluent-dominated, a rare circumstance outside the Southwest. Nevertheless, water quality in the river has improved steadily, due largely to the efforts of the dischargers action in response to the requirements of the Regional Board.

In the 1970s, secondary treatment with disinfection was required in order to protect the health of the people who used it for contact recreation. These treatment requirements were further upgraded to include virus control: in-line coagulation and filtration and improved disinfection (or their equivalents) were then required. In the late 1980s, control of inorganic nitrogen levels was required to protect the aquatic habitat from un-ionized ammonia toxicity and to manage nitrate levels in groundwater for subsequent municipal uses. Further controls on residual chlorine levels were also added.

By 1991, when SAWPA's Use-Attainability Analysis of the middle Santa Ana River was conducted; full compliance with all these requirements had not yet been achieved. The river was posted to warn against water contact recreation, because certain upstream dischargers had not achieved compliance with virus control requirements. Compliance is expected by the end of 1995. Other identifiable water quality problems in the river were restricted to parts of Reach 4 where ammonia and chlorine controls were not yet in place. No water quality impairment due to toxics was seen in other parts of the system. In those other areas, the kinds and numbers of aquatic organisms at any given location tend to be dictated by habitat conditions.

## Aquatic Environment in the Santa Ana River

Because flows are limited or generally absent in several parts of the Santa Ana River, there is no sustained aquatic habitat in those areas. Even where there are perennial flows, the habitat is frequently harsh – warm, shallow water, shifting sand substrate, little or no instream cover, and no riparian vegetation or tree canopy for shade.

There are no dependable flows from the mouth of the canyon, where the river leaves the mountains, for some distance downstream. In the canyon itself, the Corps of Engineers is presently building the Seven Oaks Dam, a large flood control structure. Groundwater recharge basins immediately downstream percolate flows from the river and its nearby tributaries. The river channel is operated as a typically dry flood control facility.

In the San Bernardino area, the San Jacinto Fault (Bunker Hill Dike) forces groundwater to the surface. At present (1993), perennial flows in the middle Santa Ana River begin at the confluence with East Warm Creek, a short distance upstream. The rising water area associated with the fault, now relatively small, was historically a

much larger, swampy area with many large springs. San Timoteo Creek, which the Corps of Engineers plans to line with concrete in the near future, joins the river in this area, its flows predominantly reclaimed wastewater from Yucaipa and other upstream dischargers.

East Warm Creek (near San Bernardino) carries small amounts of water from various non-point sources as well as some rising water. The San Bernardino Publicly-Owned Treatment Works (POTW) currently discharges to this creek just upstream of where it joins the river, but the city plans to move its point of discharge downstream in the near future. The river passes under several major highways and railroads in this area, and parts of the river bottom are lined with concrete. West Warm Creek, fully improved by the Corps for flood control but usually dry, also joins the river in this area.

The Santa Ana River Use-Attainability Analysis (1991) found areas of relatively high habitat value downstream of La Cadena Avenue in Colton, but these areas were largely washed out during the wet 1992-93 winter. Aquatic biota in the stream in this part of Reach 4 were limited, however, because certain POTWs had not yet installed full tertiary treatment and because physical conditions downstream – high temperatures, lack of cover or shelter – strongly discouraged upstream or downstream migration. Recent flood control maintenance practices have included removal of all vegetation and straightening of the river channel, severely reducing the value of the habitat. Surface flows presently continue on down through Reach 4, though conditions are likely to change when San Bernardino and Colton effluents are diverted to the RIX (rapid infiltration and extraction) project further downstream. The City of Rialto may also change its point of discharge to the river.

Near the Mission Boulevard Bridge and the upstream limit of Reach 3, rising water marks the Riverside Narrows area. Groundwater rises in the river channel and to either side as well. This water supports several small tributaries: Sunnyslope Channel, mostly improved for flood control; Tequesquite Arroyo Creek, which also drains Sycamore Canyon; and Anza Park Drain. In addition, the overflow from Lake Evans makes up a perennial tributary to the river in this area. These small streams form the present center of population of the Santa Ana Sucker, one of two remaining native species (in the Santa Ana River).

The City of Riverside's POTW on the south side of the river discharges in the Narrows, diverting all or part of its flows through the Hidden Valley Wildlife Area. Jurupa's Indian Hills POTW on the north side is permitted to discharge under certain conditions as well, but typically reclaims all its flow for golf course landscape irrigation.

From the Riverside Narrows area downstream to Prado Basin, the river is generally natural and unmodified. Even here, however, the water is warm because the mainstem is generally shallow and has a limited canopy. The substrate is dominated by shifting sand, limiting the bottom habitat and available opportunities for attached algae and insects, with only occasional gravel bars and riffles. The Santa Ana River Use-Attainability Analysis demonstrated that these habitat limitations dictate the kinds of numbers of aquatic organisms found here.

The Prado Flood Control Basin is a largely undisturbed, dense riparian wetland. In this area, flows in tributaries from both north and south of the river are again augmented by rising water. Temescal Creek comes in from the south, also carrying Arlington Channel flows and the occasional overflows from Lake Elsinore mentioned previously. A short distance from the river, near the edge of Prado Flood Control Basin, a section of Temescal Creek is the breeding center of the local Arroyo Chub population, the second native fish species still present in the middle river system. All the other species of fish found in the Middle Santa Ana River, including mosquitofish, bass, carp, catfish, etc., are exotics, escaped or introduced species.

All of the creeks draining Chino Basin come into the river on the north side, but the total dry-weather surface flow is negligible. Reclaimed wastewater from Chino Basin MWD's Regional Plant 1 is discharged to Cucamonga Channel, concrete-lined, offers extremely limited aquatic habitat – some attached algae, a few worms and insects, but not resident finfish. The improved channel ends near Prado Basin, and the stream changes names to Mill Creek. Chino Basin MWD's Regional Plant 2 discharges to Chino Creek near Prado Basin, some distance downstream of the discharge from the relatively new Carbon Canyon Plant. The lowest segments of Chino and Mill Creeks, down in Prado Basin, are quite different from most other streams in the watershed, with their muddy bottoms and deeper, slow-flowing water.

Most of the rising Chino Basin groundwater in the Prado area is high in TDS, nitrate, and other constituents, largely reflecting heavy present and historic agricultural water use in the area. Much of the initial water development went to citrus irrigation. That was supplanted first by large-scale vineyards and then by dairies, which are now slowly yielding to urban development.

Temescal Creek also carries reclaimed wastewater from the Lake Elsinore area, but most of that water percolates fairly quickly. Eastern MWD may discharge reclaimed wastewater to Temescal Creek in the future.

Below Prado Dam, the aquatic habitat is again different. The channel is deep in many places, with some rocky substrate and rapid sections. It supports a variety of organisms. In contrast, other stretches are improved for flood control. The river slows as it reaches Anaheim, where Orange County Water District diverts and recharges essentially all the dry weather flows. Downstream from the groundwater recharge areas near Anaheim, the Santa Ana River is normally dry.

## WATER SUPPLY AND WASTEWATER RECLAMATION

The most serious water-related problem in the Santa Ana River Basin at this time is water supply. This region now uses approximately twice as much water as is available from local sources. As a result, the quantity of water imported into this region each year now equals or exceeds the amount of ground and surface water utilized.

As noted earlier, the Colorado River Aqueduct delivers water to Lake Matthews, but the relatively high mineral content of this water limits its reuse in this area. The State Water Project likewise imports water from the Sacramento-San Joaquin Delta, water with lower levels of dissolved minerals. State Water Project water can be used and reused again.

**FLOOD CONTROL**

Most of the annual rainfall in the Santa Ana Region occurs in the winter, as noted earlier. Further, most of it can come in a day or two, resulting in major floods and widespread damage. The last of these was shortly before World War II – much of coastal Orange County was inundated, stimulating the construction of Prado Dam by the US Army Corps of Engineers (Corps). The subsequent further urbanization of Orange County has been accompanied by channelizing essentially all the surface steams in the area.

The Corps is presently increasing the capacity of the main river channel through Orange County, and has begun construction of Seven Oak Dam in the San Bernardino Mountains, upstream of the mouth of Santa Ana River Canyon. Another of the Corps' current projects involves increasing the height of the Prado dam.

Flood control channels are typically designed to move large volumes of water from one place to another rapidly, without property damage. A fully improved channel is usually concrete, severely limiting the aquatic habitat beneficial uses. Partially improved channels may only have levees on either side, but other flood control activities (such as channel straightening, vegetation clearing, and weed control using copper or other toxic materials) can reduce or eliminate the aquatic habitat. Storm flows themselves, not necessarily part of flood events, can and do eliminate streamside habitat in parts of the river through sheer scouring force every few years.

**ADOPTION OF THE BASIN PLAN – AMENDMENTS TO THE BASIN PLAN**

As noted earlier, the California Water Code established the original requirements for the Basin Plan. After the necessary workshops and public hearings, the Regional Board formally adopts the Plan and forwards it to the State Board for their review and approval.

Pursuant to the California Fish and Game Code, Section 2090, Article 4, the Regional Board is required to consult with the Department of Fish and Game with respect to addressing the potential impacts (a) Basin Plan provision(s) may have on rare, threatened or endangered species within the Region. A Basin Plan or amendment is not considered final until that consultation has occurred.

After the State Board approval, the Office of Administrative Law (OAL) must review and approve any new regulatory provisions in the plan to assure that six specific standards are met: necessity (need for the regulation), authority (legislative or legal),

clarity (easily understood), consistency (with other regulations), reference (Water Code or other citation), and non-duplication (of existing regulations).

The plan is also transmitted to EPA for review and approval of those parts of the plan that establish or modify water quality standards as defined in the Clean Water Act (CWA).

## CONTENTS OF THE BASIN PLAN

**Chapter 2** (Plans and Policies) describes some of the many statewide regulatory and guidance documents which apply to the shape and the Regional Board's activities.

**Chapter 3** (Beneficial Uses) discusses the many beneficial uses of the various waters of the Santa Ana Region. Ground and surface waterbodies are identified and tabulated, showing the beneficial uses of each.

**Chapter 4** (Water Quality Objectives) also tabulates the region's waterbodies, and lists the water quality objectives (levels of various water quality parameters which must be met) necessary to protect those beneficial uses.

**Chapter 5** (Implementation) details the Regional Board's water quality regulations and protection programs, lists the region's significant water quality problems and conditions, and describes approaches and solutions to them.

**Chapter 6** (Monitoring and Assessment) contains listings and discussions of the monitoring programs, agencies involved, sampling locations and parameters tested, as well as the programs which collect, manage and maintain the data bases. California's statewide Water Quality Assessment is also described and referenced.

**Chapter 7** (Water Resources and Water Quality Management) covers topics of regional importance not addressed in the other chapters.

### REFERENCES

California Water Code, Section 13000, "Water Quality" ***et seq.***

Clean Water Act, PL 92-500, as amended

Annual Reports of the Santa Ana River Watermaster (Orange County Water District vs. City of Chino, ***et al.***) Case No. 117628 – County of Orange

Santa Ana Watershed Project Authority, Reports of the Santa Ana River Use-Attainability Analysis, 1991-3

# CHAPTER 2

# PLANS AND POLICIES

## INTRODUCTION

In addition to the Santa Ana Region Basin Plan, a number of water quality control plans and policies adopted by the State Water Resources Control Board direct the Regional Board's actions. The State Board Plans and Policies which apply in this region are briefly described below. Copies of the plans and policies are attached in Appendix I.

These plans and policies may be reviewed periodically and may be revised. The Regional Board should be contacted to determine if a particular plan or policy is still current.

## SATE BOARD PLANS

### Thermal Plan (Resolution No. 75-89)

This plan, formally known as the "Water Quality Control Plan for Control for Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California," was developed and adopted in order to minimize the effects of wastes and wastewaters on the temperature of the receiving waters. This plan specifies water quality objectives, effluent quality limits, and discharge prohibitions related to thermal characteristics of interstate waters, enclosed bays estuaries, and waste discharges.

### Ocean Plan (Resolution No. 90-27)

The "Water Quality Control Plan for Ocean Waters of California," amended in 1990, establishes beneficial uses and water quality objectives for waters of the Pacific Ocean along the California coast outside of enclosed bays, estuaries, and coastal lagoons. The Ocean Plan prescribes effluent quality requirements and management principles for waste discharge prohibitions.

The Ocean Plan identifies specific objectives for bacteriological, physical, chemical, and biological characteristics and radioactivity. These objectives are implemented by issuance of waste discharge requirements which include effluent limitations on major wastewater constituents and receiving water limitations for toxic materials. In addition, the Ocean Plan prohibits discharges of specific hazardous substances and waste sludge, bypassing of untreated waste, and impacts to Areas of Special Biological Significance.

### Nonpoint Source Management Plan (Resolution No. 88-123)

In 1988, the State Board adopted the Nonpoint Source Management Plan which established the framework for statewide nonpoint source activities. Six statewide objectives and implementation strategies to manage nonpoint source problems are included in the plan. Chapter 5 provides more detailed information regarding the management plan.

Point sources were the principal focus of water quality control in the 1970s and 1980s. Nonpoint sources are now receiving a larger proportion of planning and regulatory attention.

## STATE BOARD POLICIES

### Policy with Respect to Maintaining High Quality Waters in California (Resolution No. 68-16)

The regulations implementing the Clean Water Act (40 CFR 131.6; 131.12(a)) require that each state develop and adopt a statewide antidegradation policy. In California, this requirement is satisfied by SWRCB Resolution No. 68-16, the "Statement of Policy with Respect to Maintaining High Quality Waters of California." The SWRCB policy requires the continued maintenance of existing high quality waters unless there is a demonstration that: (1) allowing some degradation is consistent with the maximum benefit to the people of the state; and (2) that such degradation would not unreasonably affect existing or potential beneficial use.

Actions which may adversely affect surface water quality must satisfy both Resolution No. 68-16 and the federal antidegradation policy (40 CFR 131.12). The requirements of the two policies are similar: the federal policy requires that existing instream uses and the level of water quality necessary to protect them must be maintained and protected. In addition, a reduction in water quality can be allowed only if there is a demonstration that such a reduction is necessary to accommodate important economic or social development.

### Policy for Water Quality Control (by motion July 6, 1972)

This policy declares the State Board's intent to protect water quality through the implementation of water resources management programs and serves as the general basis for the adoption of subsequent water quality control policies.

### Policy for Enclosed Bays and Estuaries (Resolution No. 74-43)

The Bays and Estuaries Policy recognizes the high environmental and ecological values of the bays and estuaries in the state. Specific direction is given regarding the San Francisco Bay-Delta system. New discharges to other bay and estuarine waters

are prohibited unless enhancement of those waters can be demonstrated. It is also the state's stated policy to phase out or in other ways eliminate existing discharges to bays and estuaries unless such enhancement can de demonstrated.

**Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling (Resolution No. 75-58)**

This policy provides consistent principles and guidance for supplementary waste discharge requirements or other water control actions for thermal powerplants using inland waters for cooling. The policy specifies that fresh inland waters should be used for cooling only when other alternatives are environmentally undesirable or economically unsound.

**Policy and Action Plan for Water Reclamation (Resolution No. 77-1)**

The Reclamation policy recognizes the present and future need for increased amounts of water in California primarily to support growth. This policy commits both the State Board and Regional Boards to support reclamation in general and reclamation projects which are consistent with sound principles and demonstrated needs.

**Policy on the Disposal of Shredder Waste (Resolution No. 87-22)**

This policy permits the disposal of shredded waste produced by the mechanical destruction of car bodies, old appliances, and similar castoffs, into certain landfills under specific conditions designated and enforced by the Regional Boards.

Supplementary to the state policy, the Santa Ana Regional Board Shredder Waste Policy (Resolution 87-108) designates specific solid waste facilities in the region which are authorized to accept shredder waste. Prior to accepting shredder waste at a facility, a Report of Waste Discharge (ROWD) is required to be submitted to the Regional Board.

**Sources of Drinking Water Policy (Resolution No. 88-63)**

The sources of Drinking Water Policy (Policy) declares that with specified expectations, all waters of the state are to be considers suitable, or potentially suitable, for municipal or domestic supply and should be so designated (**MUN**) by the Regional Boards. Those waters excepted under the Policy include the following: surface and ground waters that are contaminated, either by natural processes or by human activity, to the extent that they cannot reasonably be treated for domestic use; and surface waters in systems designated or modified to carry municipal/industrial/agricultural wastewaters or stormwater runoff. Other exceptions are specified in the Policy.

Adoption of the Policy required that Regional Boards review the beneficial uses of their ground and surface waters and determine where **MUN** designations should be added

and which water bodies should be excepted. Periodic reviews and updates of Regional Basin Plans must conform to this policy.

## STATE BOARD PLANNING ACTIVITES FOR THE BAY/DELTA

The SWRCB is engaged in a comprehensive, multiphase program to protect the waters of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. While the Santa Ana Regional Board will not be directly involved in implementing the management plans which result from this program, the SWRCBs actions are likely to affect both water quality and quantity in the Regional Board's water quality control programs.

The Bay/Delta water system is a major source of supply to the State, providing more than half of all water used in California. The Bay/Delta is also of extreme ecological significance: it is one of the largest systems for fish and waterfowl habitat and production in the United States.

Two major water distribution systems divert water from the Delta: the Central Valley Project, operated by the United States Bureau of Reclamation; and the State Water Project (SWP), operated by the California Department of Water Resources. The SWP is an important source of high quality, supplemental water supplies for the Santa Ana Region (see Chapter 5 - Salt Balance and Assimilative Capacity). Numerous other water diversion and management efforts influence the inflows into, flows through, and outflows from the Bay/Delta estuary.

In 1978, the SWRCB adopted the "Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh" (the Delta Plan) and Water Rights Decision 1485 (D-1485). The Delta Plan established water quality objectives for salinity and outflow standards and operational constraints necessary to meet the objectives and assure reasonable protection of beneficial uses. These outflow standards and operational constraints are implemented through D-1485.

The Delta Plan proceedings were limited to the current and near term conditions in the Delta. The SWRCB committed to subsequent review of the Delta Plan and is not in that process.

The current Bay/Delta review program has a number of components, including the development and adoption by the SWRCB of the "Water Quality Control Plan for Salinity – San Francisco Bay/Sacramento-San Joaquin Delta Estuary" (Salinity Plan, 19-15 WR, May 1991). This Plan is primarily concerned with salinity and temperature factors. Numerous water quality objectives were established for: salinity at municipal and industrial intakes; salinity levels to protect Delta agriculture; salinity levels to protect export agriculture; and salinity for fish and wildlife resources in the Estuary. Water quality objectives were also established to provide expansion of the period of protection for striped bass spawning, and to address temperature and dissolved oxygen levels for fisheries in the Delta.

This Salinity Plan set the stage for the ongoing Water Rights phase of the proceedings. Determining the flow requirements necessary to meet the Plan objectives and the allocation of responsibility for meeting those objectives will lead to a revised Water Rights Decision.

A draft decision (D-1630) was released in 1992 and revised in 1993. D-1630 called for substantial limits on exports of waters from the Bay/Delta system, including exports to the SWP, during spring. The quality of Bay/Delta waters is generally best during this time of high flows. Limiting exports to other times of the year is likely to mean that poorer quality water will be supplied to users outside the Bay/Delta system, including the Santa Ana Region. High quality SWP water is essential to address the severe mineralization problem in this Region (see Chapter 5).

The SWRCB has determined that it will not adopt an interim water rights decision (D-1630), in part because the above-average rainfall during 1993 eliminated the urgent need to do so to protect fish and wildlife resources. The SWRCB has resumed its proceedings to establish a long-term water right decision to replace D-1485.

# CHAPTER 3
# BENEFICIAL USES

## INTRODUCTION

Basically, a beneficial use is one of the various ways that water can be used for the benefit of people and/or wildlife. Examples include drinking, swimming, industrial and agricultural water supply, and the support of fresh and saline aquatic habitats.

Section 303 of the federal Clean Water Act (33 USC §1313) defines water quality standards as consisting of both the uses of the surface (navigable) waters involved and the water quality criteria which are applied to protect those uses. Under the Porter-Cologne Water Quality Control Act (California Water Code, Division 7, Chapter 2 §13050) these concepts are separately considered as beneficial uses and water quality objectives. Beneficial uses and water quality objectives are to be established for all waters of the state, both surface and subsurface (groundwater).

## BENEFICIAL USES

Beneficial uses were tabulated and discussed in Chapters 1 and 2 of the 1975 Basin Plan and in Chapter 2 of the 1983 Basin Plan. In 1983, twenty-one beneficial uses were defined statewide. Of those, eighteen were identified and recognized in the 1983 Plan: **MUN, AGR, IND, PROC, GWR, NAV, POW, REC1, REC 2, COMM, WARM, COLD, BIOL, WILD, RARE, SPWN, MAR,** and **SHEL.**

In 1988, the State Board adopted the Sources of Drinking Water Policy (SWRCB Resolution No. 88-63) which directed the Regional Boards to add the Municipal and Domestic Supply (**MUN**) Beneficial Use for all waterbodies not already so designated, unless they met certain exception criteria. To implement this Policy, the Regional Board revised the table of Beneficial Uses in the 1983 Basin Plan, adding the **MUN** designation for certain waterbodies and specifically excepting others (RWQCB Resolution No. 89-42). Shortly thereafter, this revised Beneficial Use table was reviewed again and changes were made, including the addition of the Water Contact Recreation (**REC 1**) use for some waterbodies, the revision of some Beneficial Use designations from intermittent (I) to existing (X), and the addition of more waterbodies (RWQCB Resolution No. 89-99).

In this Plan, further changes to the Beneficial Use table have been made. Significant waterbodies not previously identified are included and the beneficial uses are designated. Certain of these waters are excepted from the **MUN** designation. The designation **RARE** has been added where substantial evidence indicates that the waterbody supports rare, threatened or endangered species (Appendix II). Certain known wetlands in the Region are listed in a new waterbody category (see wetlands discussion below). A revised list of Beneficial Uses was developed as part of a comprehensive statewide update of all Basin Plans. Using this revised statewide list as a guide, this Basin Plan updates the list of Beneficial Uses definitions contained in the 1983 Plan.

In all, twenty-three beneficial uses are now defined statewide; of these, nineteen are recognized within the Santa Ana Region. (The four not utilized are Migration of Aquatic Organisms, Freshwater Replenishment, Inland Saline Water Habitat and Aquaculture). One beneficial use specific to the Region, Limited Warm Freshwater Habitat, has been added, bringing the total number of beneficial uses recognized in the Santa Ana Region to twenty. The region's beneficial uses are listed and described below.

<<<<<<<<<<<<>>>>>>>>>>>>

## BENEFICIAL USE DEFINITIONS

Municipal and Domestic Supply (**MUN**) waters are used for community, military, municipal or individual water supply systems. These uses may include, but are not limited to, drinking water supply.

Agricultural Supply (**AGR**) waters are used for farming, horticulture or ranching. These uses may include, but are not limited to, irrigation, stock watering, and support of vegetation for range grazing.

Industrial Service Supply (**IND**) waters are used for industrial activities that do not depend primarily on water quality. These uses may include, but are not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection and oil well repressurization.

Industrial Process Supply (**PROC**) waters are used for industrial activities that depend primarily on water quality. These uses may include, but are not limited to, process water supply and all uses of water related to product manufacture or food preparation.

Groundwater Recharge (**GWR**) waters are used for natural or artificial recharge of groundwater for purposes that may include, but are not limited to, future extraction, maintaining water quality or halting saltwater intrusion into freshwater aquifers.

Navigation (**NAV**) waters are used for shipping, travel or other transportation by private, commercial or military vessels.

Hydropower Generation (**POW**) waters are used for hydroelectric power generation.

Water Contact Recreation **(REC 1***) waters are used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing and use of natural hot springs.

* The **REC 1** and **REC 2** beneficial use of designations assigned to surface waterbodies in this Region should not be construed as encouraging recreational activities. In some cases, such as Lake Matthews and certain reaches of the Santa Ana River, access to the waterbodies is prohibited because of potentially hazardous conditions and/or because of the need to protect other uses, such as municipal supply or sensitive wildlife habitat. Where **REC 1** or **REC 2** is indicated as a beneficial use in Table 3-1, the designations are intended to indicate that the uses exist or that the water quality of the waterbody could support recreational uses.

Non-contact Water Recreation (**REC 2***) waters are used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water would be reasonably possible. These uses may include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing and aesthetic enjoyment in conjunction with the above activities.

Commercial and Sportfishing (**COMM**) waters are used for commercial or recreational collection of fish or other organisms, including those collected for bait. These uses may include, but are not limited to, uses involving organisms intended for human consumption.

Warm Freshwater Habitat (**WARM**) waters support warmwater ecosystems that may include, but are not limited to, preservation and enhancement of aquatic habitats, vegetation, fish and wildlife, including invertebrates.

Limited Warm Freshwater Habitat (**LWRM**) waters support warmwater ecosystems which are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows which result in extreme temperature, pH, and/or dissolved oxygen conditions. Naturally reproducing finfish populations are not expected to occur in **LWRM** waters.

Cold Freshwater Habitat (**COLD**) waters support coldwater ecosystems that may include, but are not limited to, preservations and enhancement of aquatic habitats, vegetation, fish and wildlife, including invertebrates.

Preservation of Biological Habitats of Special Significance (**BIOL**) waters support designated areas or habitats, including, but not limited to, established refuges, parks, sanctuaries, ecological reserves or preserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.

Wildlife Habitat (**WILD**) waters support wildlife habitats that may include, but are not limited to, the preservation and enhancement of vegetation and prey species used by waterfowl and other wildlife.

Rare, Threatened or Endangered Species (**RARE**) waters support the habitats necessary for the survival and successful maintenance of plant or animal species designated under state or federal law as rare, threatened or endangered.

* The **REC 1** and **REC 2** beneficial use of designations assigned to surface waterbodies in this Region should not be construed as encouraging recreational activities. In some cases, such as Lake Matthews and certain reaches of the Santa Ana River, access to the waterbodies is prohibited because of potentially hazardous conditions and/or because of the need to protect other uses, such as municipal supply or sensitive wildlife habitat. Where **REC 1** or **REC 2** is indicated as a beneficial use in Table 3-1, the designations are intended to indicate that the uses exist or that the water quality of the waterbody could support recreational uses.

Spawning, Reproduction and Development (**SPWN**) waters support high quality aquatic habitats necessary for reproduction and early development of fish and wildlife.

Marine Habitat (**MAR**) waters support marine ecosystems that include, but are not limited to, preservation and enhancement of marine habitats, vegetation (*e.g.,* kelp), fish and shellfish and wildlife (*e.g.,* marine mammals and shorebirds).

Shellfish Harvesting (**SHEL**) waters support habitats necessary for shellfish (*e.g.,* clams, oysters, limpets, abalone, shrimp, crab, lobster, sea urchins and mussels) collected for human consumption, commercial or sport purposes.

Estuarine Habitat (**EST**) waters support estuarine ecosystems, which may include, but are not limited to, preservation and enhancement of estuarine habitats, vegetation, fish, and shellfish, and wildlife, such as waterfowl, shorebirds, and marine mammals.

**<<<<<<<<<<<<>>>>>>>>>>>>**

More than one beneficial use may be identified for a given waterbody. The most sensitive use must be protected. The Regional Board reserves the right to resolve any conflicts among beneficial uses based on the facts in a given case.

## WETLANDS

The Clean Water Act was enacted by Congress to restore and maintain the chemical, physical and biological integrity of the nation's waters. The nation's waters include *wetlands*, as well as rivers, streams, lakes, estuaries and the territorial seas. Generally, wetlands include swamps, marshes, bogs, sloughs, mangroves, wet meadows, savannas, wet tundra, playa lakes and vernal pools. Wetlands serve a number of important functions, including absorption of floodwaters, shoreline erosion control and water quality improvement by the removal of pollutants. They also provide habitat for wetland species, and have important aesthetic, recreational, scientific and educational values. More than half of the wetlands in the United States have been destroyed. Due to this high loss, a goal of "no net loss" of wetlands has been established at both the federal and state level.

The definition of wetlands varies widely among the federal agencies, however both the United States Army Corps of Engineers and United States Environmental Protection Agency (US EPA) agree on the definition in Section 404 of the Clean Water Act, which specifies that wetlands are "those areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands are generally agreed to have three characteristics: hydrophytic vegetation; hydric soils; and wetland hydrology. Hydrophytic vegetation describes those plants adapted for growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. Hydric soils are those soils that are oxygen-depleted due to saturation for long periods during

the growing season. Wetland hydrology can be described as the presence of water at or above the soil surface for a sufficient period of the year to significantly influence the plant types and soil that occur in the area. Strict definitions of these characteristics have not been formally adopted. The Regional Board includes these characteristics and criteria as general reference and not as guidance.

As part of an overall effort to protect the Nation's wetland resources, US EPA has called for states to adopt water quality standards (beneficial uses and water quality objectives) for wetlands. Applying water quality standards to wetlands provides a regulatory basis for a variety of wetlands management programs. For example, these standards will play an important role in the State and Regional Boards' water quality certification process by providing the basis for approving, conditioning or denying federal permits and licenses as appropriate. (This certification process, conducted in accordance with Section 401 of the CWA is described in more detail in Chapter 5.)

The 1975 and 1983 Basin Plans listed a number of waterbodies which are known to be or to include wetlands (*e.g.,* San Joaquin Freshwater Marsh, Upper Newport Bay, Anaheim Bay-National Wildlife Refuge). These Plans specified both beneficial uses and water quality objectives for these waterbodies. In the earlier Plans, these waters were not specifically identified as wetlands. In this plan, a "Wetlands" waterbody category has been added to the Table of Beneficial Uses. Certain waters known to be wetlands are listed under this category and their beneficial uses are designated. (Note: estuarine wetlands continue to be shown in the "Bays, Estuaries and Tidal Prisms" category). The numeric objectives specified for these wetlands in the earlier Basin Plans are included in this Plan (Chapter 4). Additional numeric objectives will be developed and implemented as part of the ongoing Basin Planning process. Further detailed review of the water resources within the Region is also expected to result in the listing of additional wetlands.

The intent of including the wetlands category is to provide a more accurate description of the Region's waters. The listing of specific wetlands does not trigger any new or different regulatory actions by the Regional Board. Standards applied to permitting, 401 certification, and/or enforcement actions will not be affected by this listing. Again, the listing of wetlands in this Plan is a <u>partial</u> one only and should not be construed as placing any limitations on the exercise of the Regional Board's responsibilities or authorities with respect to the protection of wetlands in the region. Nor is the present listing intended to define wetlands which are subject to the United States Army of Corps of Engineers jurisdiction.

Figure 3-1 shows the general locations of the wetlands listed in this Plan. The specific boundaries of each of these wetland areas will be determined on an as-needed basis (for 401 certifications and the like), using the methods described in the 1987 Corps of Engineers Wetland Delineation Manual or other accepted techniques.

A brief description of each of the wetlands listed in this Plan is provided in Appendix III. Some of these wetlands occur naturally. Others were created, either incidentally, as the result of the construction of dams or levees, or purposefully, as mitigation for

development projects elsewhere. Examples of created wetlands include those in the Prado Basin, which resulted from the construction of Prado Dam, and the San Joaquin Freshwater Marsh, created for development mitigation purposes.

A third type of wetlands, constructed wetlands, is proposed for the Santa Ana Region. Constructed wetlands would be designed, built and managed to provide wastewater treatment to meet specific waste discharge requirements. Constructed wetlands do not include percolation ponds, equalization basins or other conventional treatment works. At this time, the proposed use of constructed wetlands in the region would be principally for nitrogen removal. The use of constructed wetlands for management of stormwater flows may also be proposed. Currently, the Orange County Water District is using approximately 600 acres of ponds in the Prado area to investigate the use of constructed wetlands for nitrogen removal. The City of Riverside proposes to construct and operate wetlands treatment ponds in the Hidden Valley area. Constructed wetlands are also being contemplated by Eastern Municipal Water District and Elsinore Valley Municipal Water District.

While the purpose of these constructed wetlands would be to provide wastewater treatment, they will inevitably have other uses and benefits, including the support of waterfowl and other wildlife and opportunities for education and recreation. The Regional Board's approach toward regulation of the use of these constructed wetlands will be to ensure that these affiliated uses are reasonably protected, while appropriate wastewater treatment uses are supported. As an example, the Board could allow the use of constructed wetlands for the treatment of various parameters such as nitrogen and phosphorus. However, the Board may disallow the use of wetlands for treatment of certain parameter such as toxics if there is evidence that these parameters would adversely and unreasonably affect the affiliated uses of the constructed wetlands. In this case, the Board would require compliance with toxics limits prior to discharge to the constructed wetlands.

In August 1993, the "California Wetlands Conservation Policy" was announced by the Governor. The Policy, included in the Appendix III, has three principal objectives:

- to ensure no overall net loss of wetlands and achieve a long-term gain in the quantity, quality and permanence of wetlands acreage and values;

- to reduce procedural complexity and confusion in the administration of wetlands conservation programs; and

- make cooperative planning efforts and landowner incentive programs the primary focus of wetland conservation and restoration.

The methods identified to achieve these objectives are numerous and include:

- a statewide wetlands inventory and identification of conservation, restoration and enhancement goals;

- development of a consistent wetlands definition, standards, and guidelines for regulatory purposes; and

- integration of wetlands policy and planning with other environmental and land use processes.

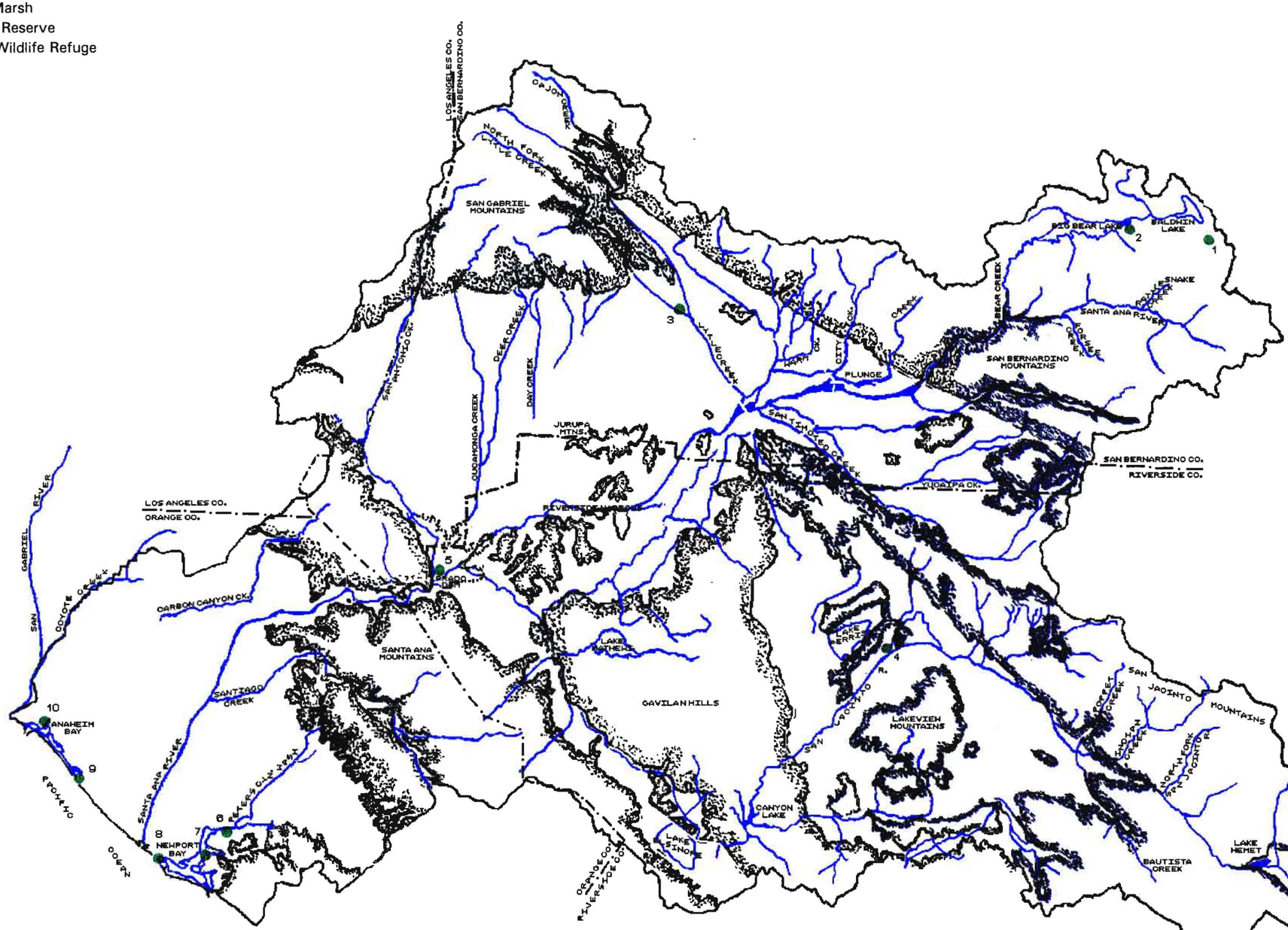
An interagency task force on wetlands is to be created to direct and coordinate administration and implementation of this policy.

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**List of Wetlands**

1 Shay Meadows
2 Stanfield Marsh
3 Glen Helen
4 San Jacinto Wildlife Area
5 Prado Flood Control Basin
6 San Joaquin Freshwater Marsh
7 Upper Newport Bay
8 Santa Ana River Salt Marsh
9 Bolsa Chica Ecological Reserve
10 Seal Beach - National Wildlife Refuge

# FIGURE 3-1
# SANTA ANA REGION
# WETLANDS



**GROUNDWATER (Amended by Resolution No. R8-2004-0001, January 22, 2004)**

Groundwater subbasin boundaries included in the 1975 and 1984 Basin Plans, and initially in this 1995 Basin Plan, were, for the most part, based on data and information collected in the 1950's and 1960's. Since these boundaries were first established in the 1975 Basin Plan, a considerable amount of new water level, water quality and geologic data has become available. As part of the 2004 update of the TDS/Nitrogen management plan in the Basin Plan (see further discussion of this work in Chapter 5 – Salt Management Plan), these new data were used to review and revise the sub-basin boundaries.

To accomplish this task, all available geologic studies of the Santa Ana Region, through 1995, were gathered and re-analyzed. A comprehensive database of water level and water quality data and well drilling logs was created and utilized to delineate revised groundwater subbasin boundaries, now designated as groundwater "Management Zones". The groundwater Management Zones are shown in Figures 3-3 through 3-7.

The specific technical basis for distinguishing each groundwater Management Zone is provided in the report entitled "TIN/TDS Study – Phase 2A Final Technical Memorandum," Wildermuth Environmental, Inc., July 2000. In general, the new groundwater Management Zone boundaries were defined on the basis of (1) separation by impervious rock formations or other groundwater barriers, such as geologic faults; (2) distinct flow systems defined by consistent hydraulic gradients that prevent widespread intermixing, even without a physical barrier; and (3) distinct differences in water quality. Groundwater flow, whether or not determined by a physical barrier, was the principal characteristic used to define the Management Zones. Water quality data were used to support understanding of the flow regime and to assure that unusually high or poor quality waters were distinguished for regulatory purposes.

In addition to these technical considerations, water and wastewater management practices and goals for the Chino Basin were considered and used to define an alternative set of Management Zone boundaries for that area. These so-called "maximum benefit" Management Zone delineations , shown in Figure 3-5a, were developed as part of recommendations by the Chino Basin Watermaster and the Inland Empire Utilities Agency (IEUA) to implement a "maximum benefit" proposal, including an Optimum Basin Management Plan (OBMP), for the area.[1] These agencies have committed to the implementation of a specific set of projects and

[1] The term "maximum benefit" is drawn from the state's antidegradation policy (SWCRB Resolution No. 68-16; see Chapter 2)), which provides that high quality water can be lowered only if beneficial uses are fully protected and water quality consistent with *maximum benefit* to the people of the state is maintained.

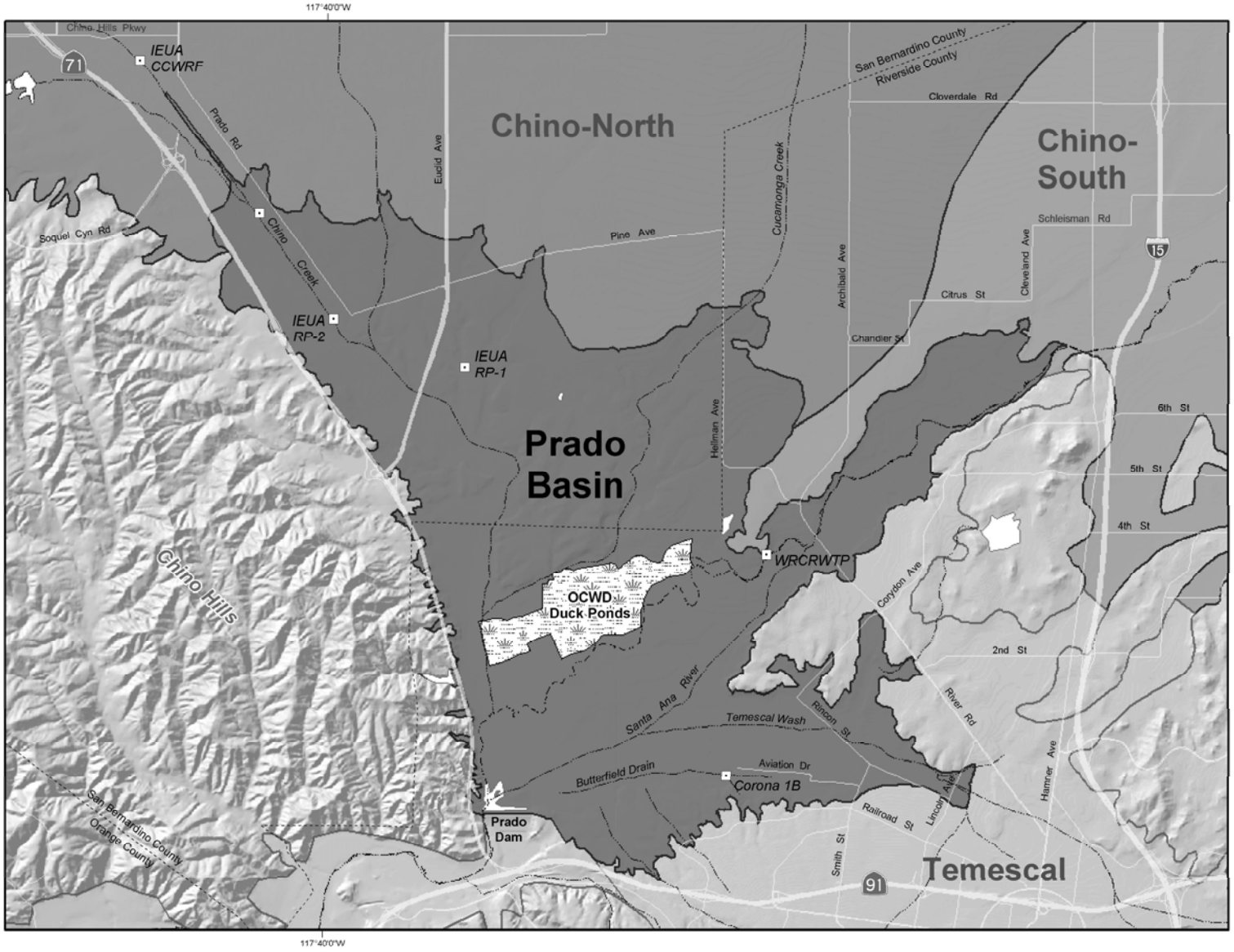
requirements in order to demonstrate that the "maximum benefit" Management Zone boundaries, and particularly the "maximum benefit" nitrate-nitrogen and TDS objectives for these Zones (see Chapter 4), assure protection of beneficial uses and are of maximum benefit to the people of the state (see Chapter 5, VII. Maximum Benefit Implementation Plans for Salt Management, A. Salt Management – Chino Basin and Cucamonga Basin). These "maximum benefit" Management Zone boundaries apply for regulatory purposes provided that the Regional Board continues to find that the Watermaster and IEUA are demonstrating "maximum benefit" by timely and appropriate implementation of these agencies' commitments. If, after consideration at a duly noticed Public Hearing, the Regional Board finds that these commitments are not being met and that "maximum benefit" is not being demonstrated, then the Management Zone boundaries for the Chino Basin shown in Figure 3-5b apply for regulatory purposes.

**PRADO BASIN SURFACE WATER MANAGEMENT ZONE (PBMZ)**

The flood plain behind Prado Dam has unique hydraulic characteristics. Chino Creek, Cucamonga Creek (which flows into Mill Creek) and Temescal Creek join the Santa Ana River behind the dam. Flood control operations at the dam, coupled with an extremely shallow groundwater table and an unusually thin aquifer, significantly affect these surface flows, as well as subsurface flows in the area. Depending on how the dam is operated, surface waters may or may not percolate behind the dam. There is little or no groundwater storage in the flood plain behind the dam. Any groundwater in storage is forced to the surface because the foot of Prado Dam extends to bedrock and subsurface flows cannot pass through the barrier created by the dam and the surrounding hills. Given these characteristics, this area is designated as a surface water management zone, rather than a groundwater management zone. The Prado Basin Management Zone is generally defined by the 566-foot elevation above mean sea level. It extends from Prado Dam up Chino Creek, Reach 1A and 1B to the concrete-lined portion near the road crossing at Old Central Avenue, up the channel of Mill Creek (Prado Area) to where Mill Creek becomes named as Cucamonga Creek and the concrete-lined portion near the crossing at Hellman Road, up what was formerly identified as Temescal Creek, Reach 1A (from the confluence with the Santa Ana River upstream of Lincoln Avenue) (this area is indistinguishable because of shifting topography and is now considered a part of the Prado Basin Management Zone), and up the Santa Ana River, Reach 3 to the 566-foot elevation (just west of Hamner Avenue). The Prado Basin Management Zone encompasses the Prado Flood Control Basin, which is a created wetlands as defined in this Plan (see the discussion of wetlands elsewhere in this Chapter). Orange County Water District's wetlands ponds are also located within the Prado Basin Management Zone.

The beneficial uses of the proposed PBMZ include all of the beneficial uses currently designated for the surface waters identified above. The PBMZ also incorporates the Prado Flood Control Basin. The beneficial uses previously identified for this Basin are designated also for the Zone (See Table 3-1, Beneficial Uses, page 3-21).

**The Prado Basin Management Zone is shown in Figure 3-2.**




***Map Explanation***

Management Zone Boundary

Rivers & Streams

Recycled Water Discharge Location




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www.wild-environment.com

Author: AEM
Date: 20031113
File: Figure_3-2.mxd

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0 2 KM

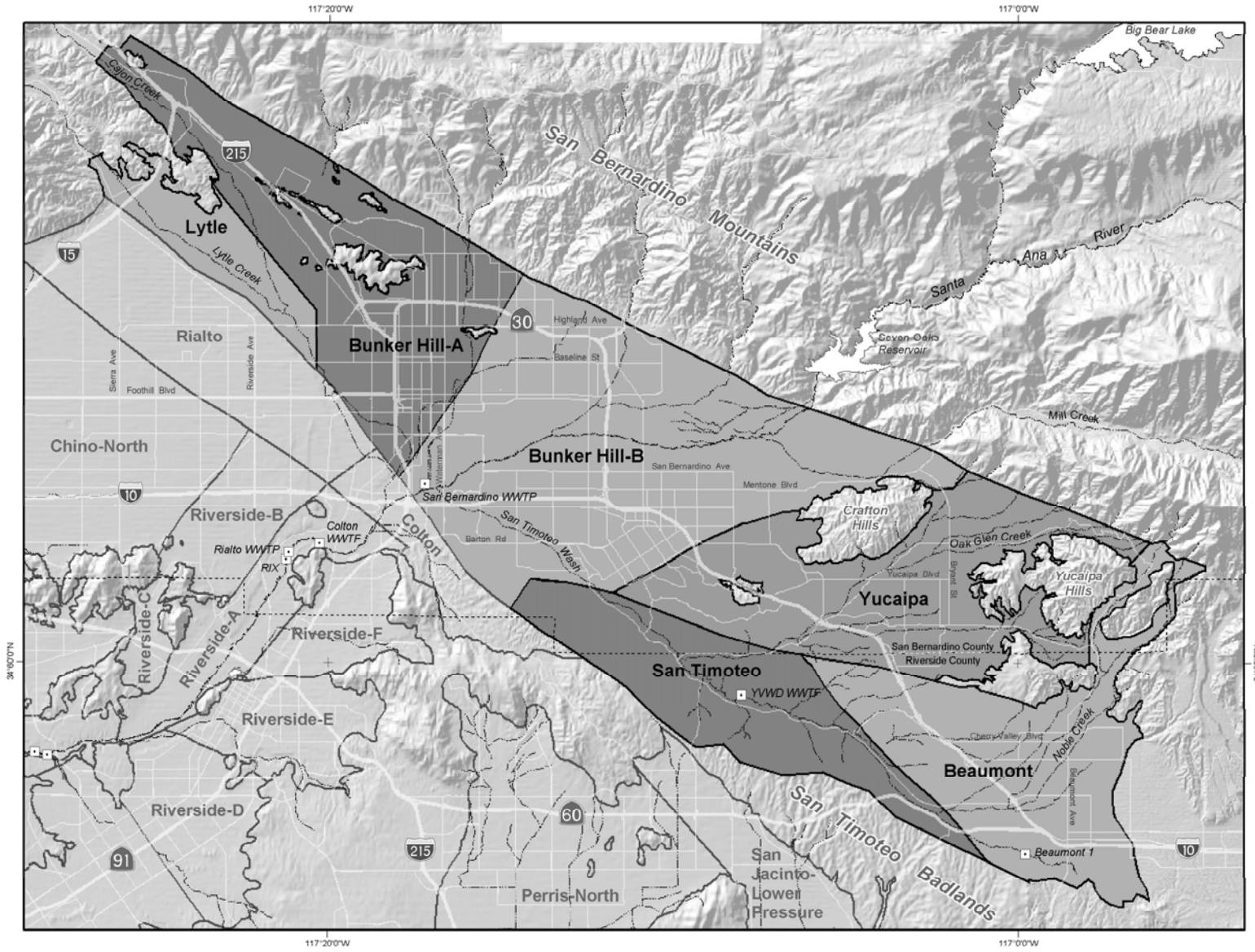
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**TIN/TDS Study Phase 2A -- Task 3**
*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*

**Prado Basin**
**Management Zone Boundaries**

**Figure 3-2**




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File: Figure_3-3.mxd

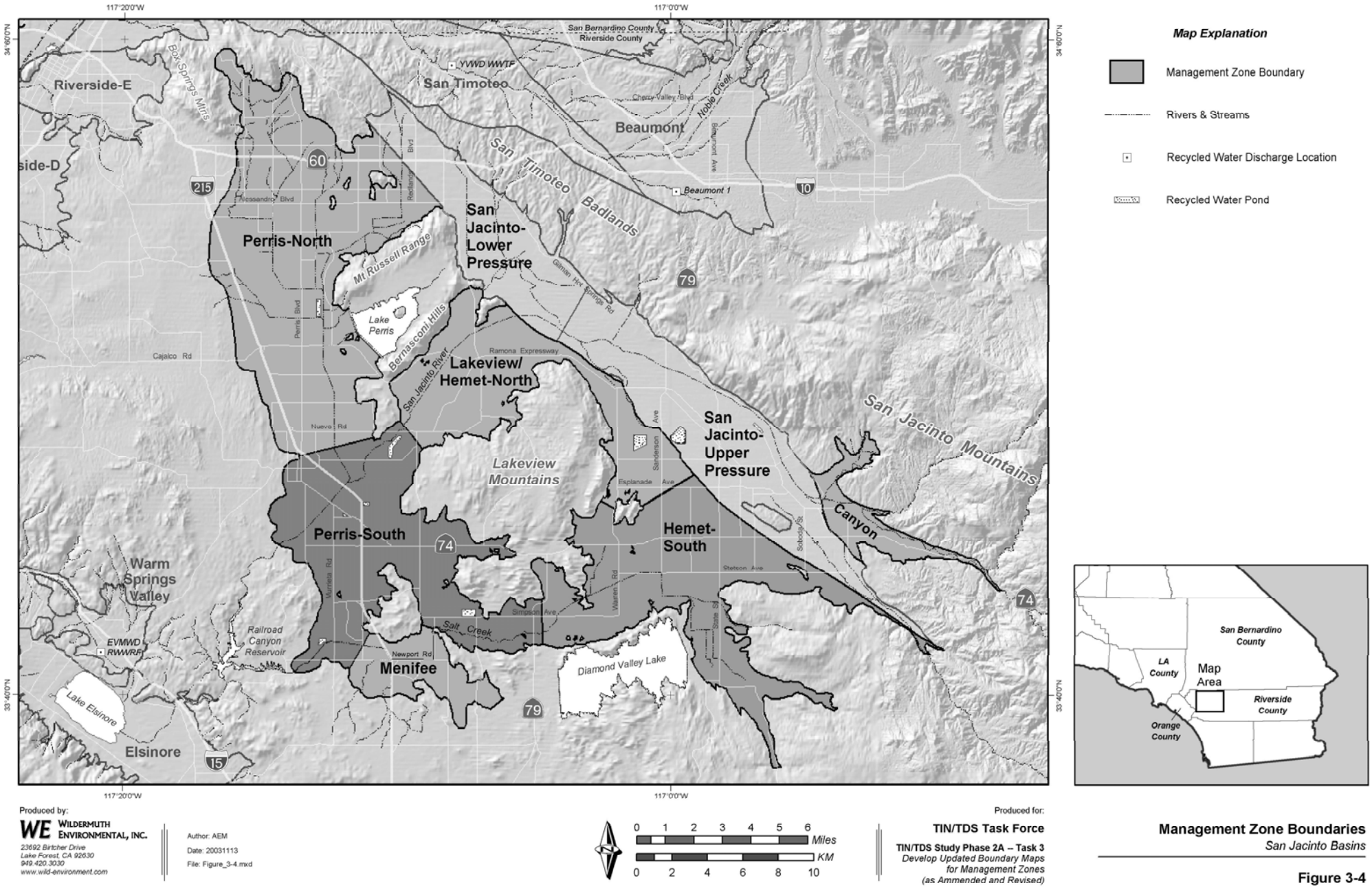
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**Management Zone Boundaries**
*San Bernardino Valley & Yucaipa/Beaumont Plains*

**Figure 3-3**




***Map Explanation***

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location
- Recycled Water Pond





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File: Figure_3-4.mxd


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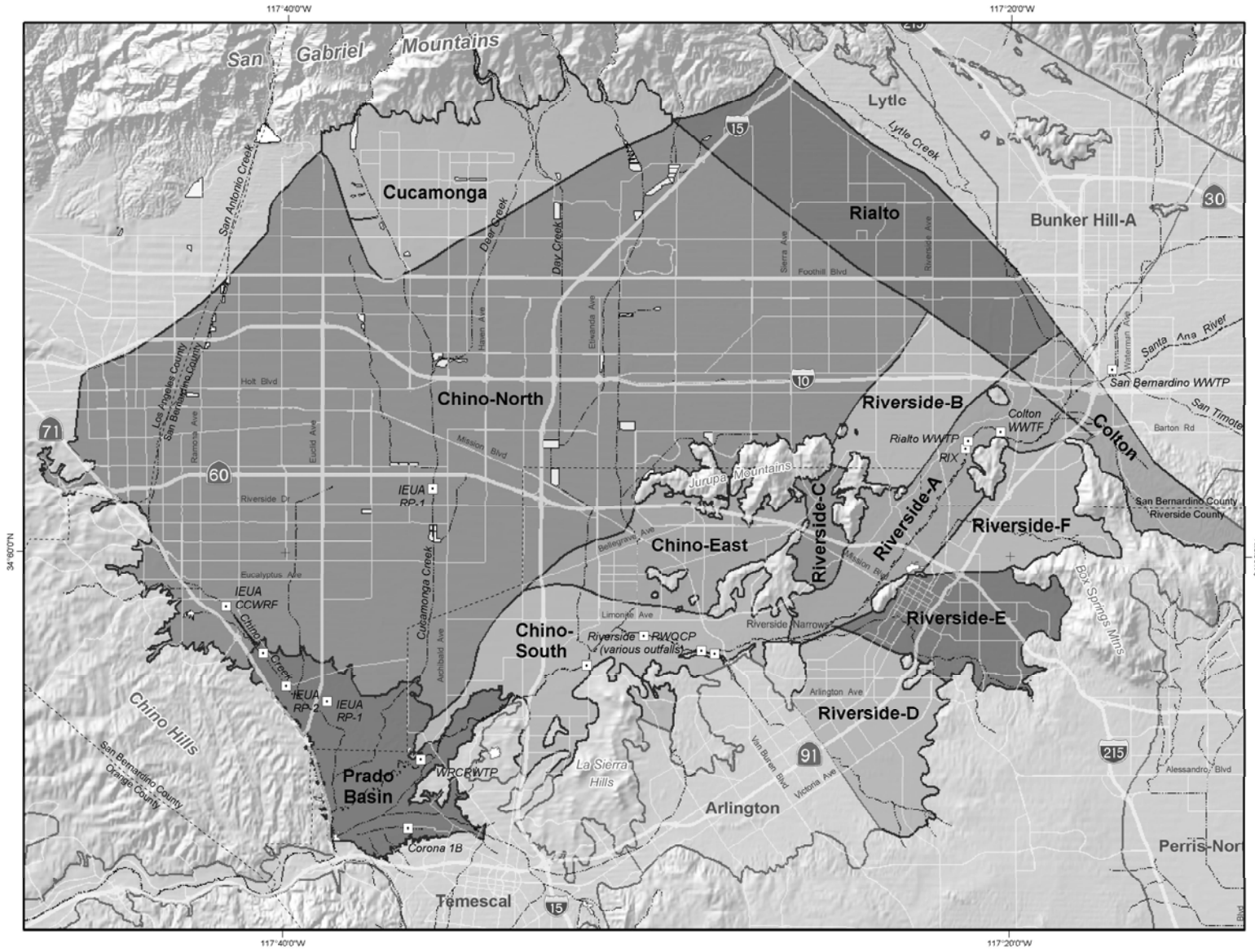
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*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*

**Management Zone Boundaries**
*San Jacinto Basins*

**Figure 3-4**




***Map Explanation***

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location




**Management Zone Boundaries**
*Chino (Maximum Benefit), Rialto-Colton, & Riverside Basins*

**Figure 3-5a**


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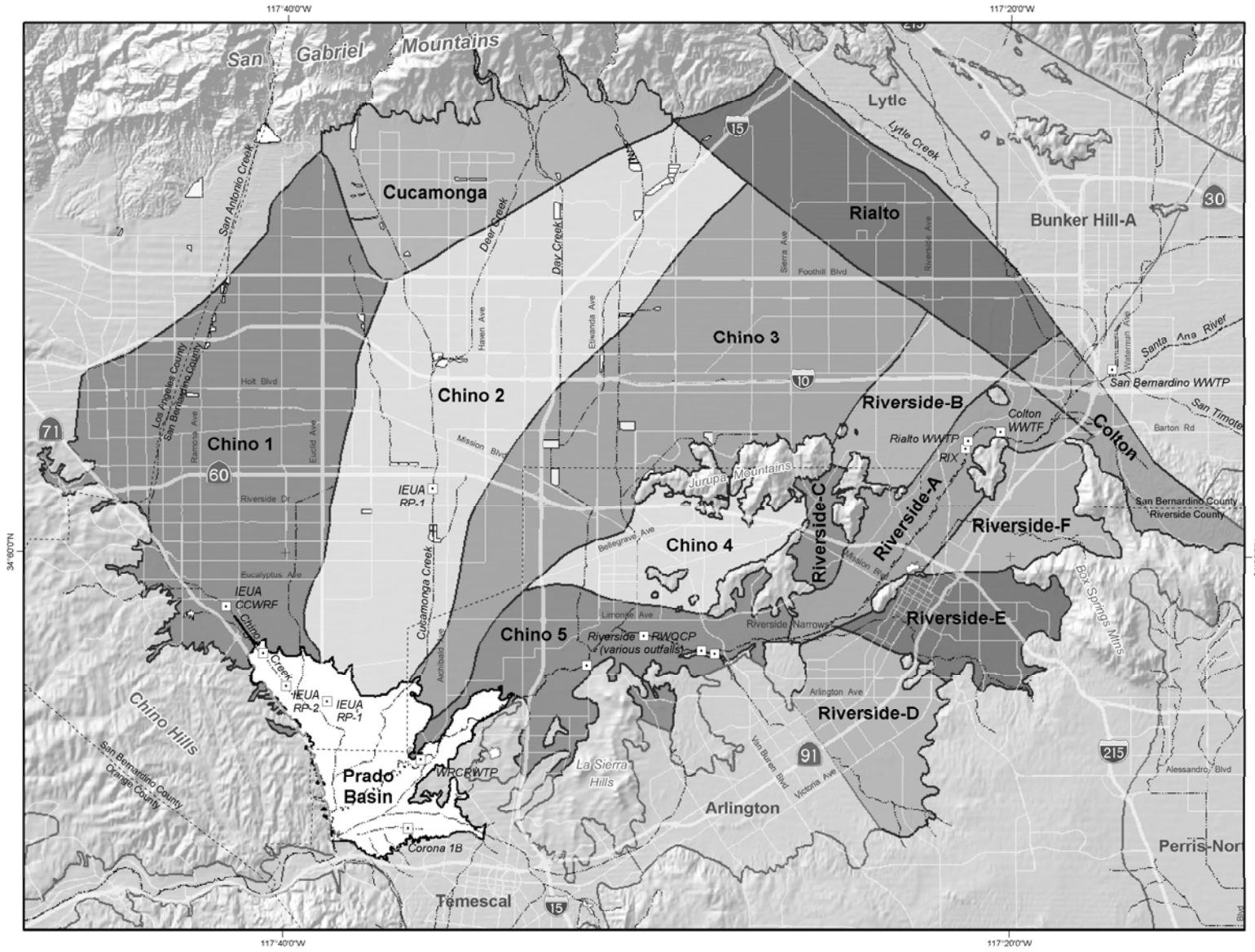

Author: AEM
Date: 20031113
File: Figure_3-5a.mxd

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0 2 4 6 8 10 KM

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*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*




***Map Explanation***

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location




**Management Zone Boundaries**
*Chino (Anti-degradation), Rialto-Colton, & Riverside Basins*

**Figure 3-5b**


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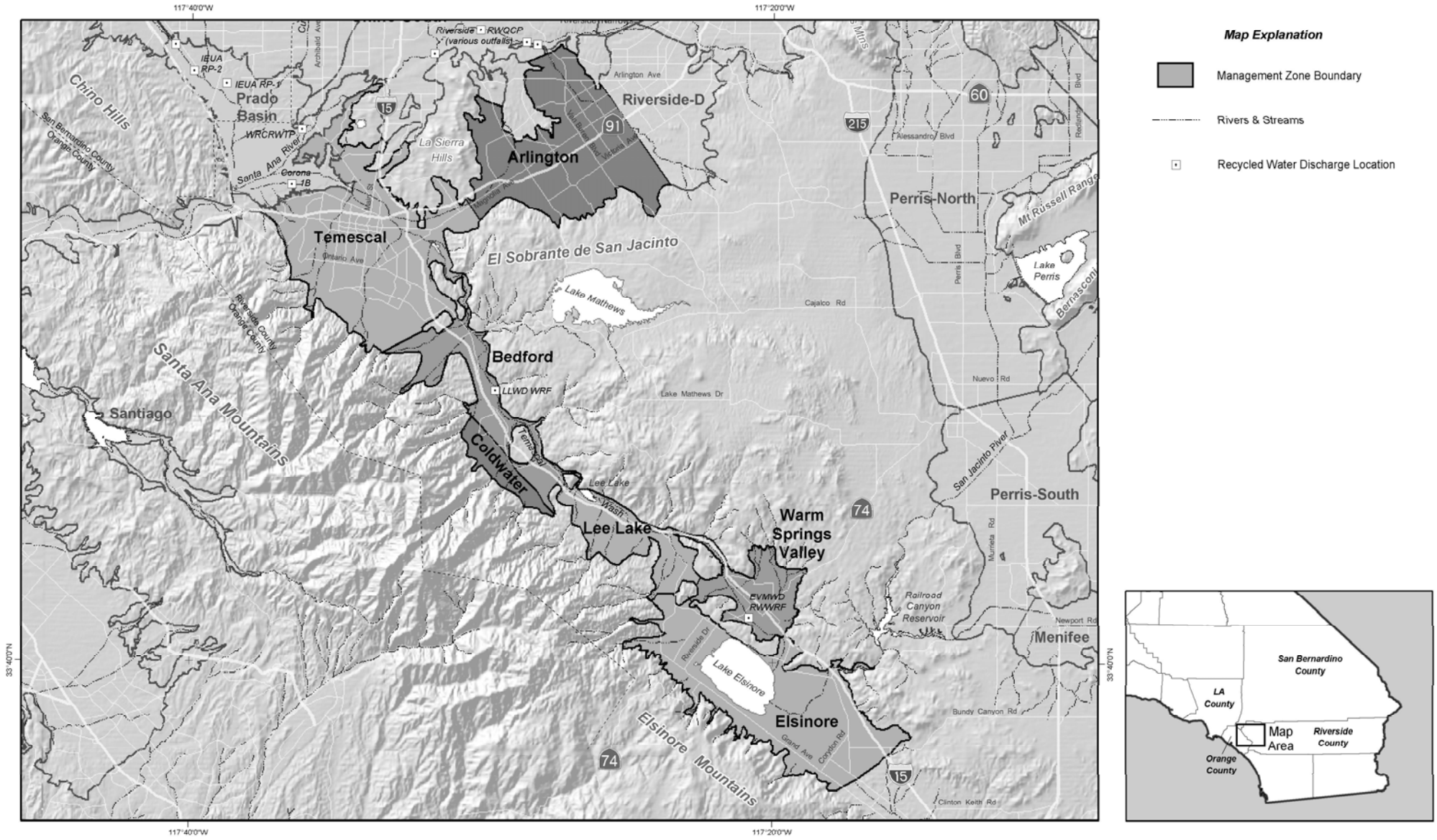
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0 2 4 6 8 10 KM

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*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*







***Map Explanation***

Management Zone Boundary

Rivers & Streams

Recycled Water Discharge Location

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File: Figure_3-6.mxd

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0 2 4 6 8 10 KM

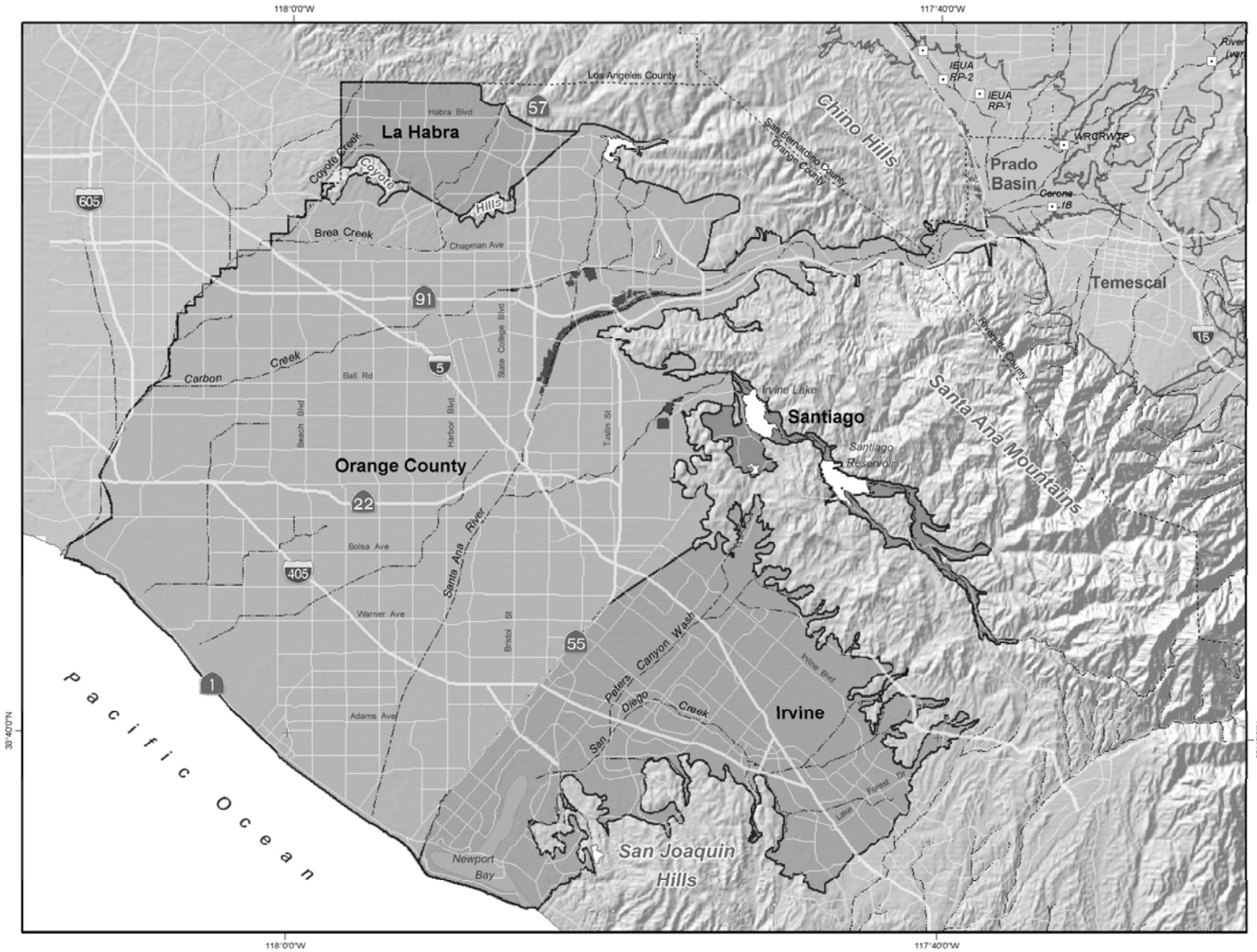
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*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*

**Management Zone Boundaries**
*Elsinore/Temescal Valleys*

**Figure 3-6**




***Map Explanation***

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location
- Orange County Water District Forebay Recharge Facilities





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Author: AEM
Date: 20031113
File: Figure_3-7.mxd

0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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**TIN/TDS Study Phase 2A -- Task 3**
*Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)*

**Management Zone Boundaries**
*Orange County Basins*

**Figure 3-7**

## BENEFICIAL USE TABLE

Table 3-1 lists the designated beneficial uses for waterbodies within the Santa Ana Region. In this table, an "X" indicates that the waterbody has an existing or potential use. Many of the existing uses are well-known; some are not. Lakes and streams may have potential beneficial uses established because plans already exist to put he water to those uses, or because conditions (*e.g.,* location, demand) make such future use likely. The establishment of a potential beneficial use serves to protect the quality of that water for such eventual use.

An "I" in Table 3-1 indicates that the waterbody has an intermittent beneficial use. This may occur because water conditions do not allow the beneficial use to exist year-round. The most common example of this is an ephemeral stream. Ephemeral streams in this region include, at one extreme, those which flow only while it is raining or for a short time afterward, and at the other extreme, established streams which flow through part of the year but also dry up for part of the year. While such ephemeral streams are flowing, beneficial uses are made of the water. Because such uses depend on the presence of water, they are intermittent. Waste discharges which could impair intermittent beneficial uses, whether they are made while those uses exist or not, are not permitted.

A "+" in the **MUN** column in Table 3-1 indicates that the waterbody has been specifically excepted from the **MUN** designation in accordance with the criteria specified in the "Sources of Drinking Water Policy."

The listing of waters within the basin attempts to include all significant surface streams and bodies of water, as well as the significant groundwater basins and subbasins which are receiving waters. Specific waters which are not listed have the same beneficial uses as the steams, lakes or reservoirs to which they are tributary or the groundwater basins or subbasin to which they are tributary or overlie.

### REFERENCES


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California Regional Water Quality Control Board, Santa Ana Region, Resolution No. 89-42, "Incorporation of 'Sources of Drinking Water' Policy into the Water Quality Control Plan (Basin Plan)," adopted March 10, 1989.

California Regional Water Quality Control Board, Santa Ana Region, Resolution No. 89-99, "Adoption of Revised Table of Beneficial Uses," adopted July 14, 1989.

California Water Code, Section 13000, "Water Quality" *et seq.*

City of Big Bear Department of Water and Power, “Final Report – Task 4, Revised Water Quality Objectives, Big Bear Ground Water Basins,” April 1993.

United States Environmental Protection Agency “National Guidance-Water Quality Standards for Wetlands,” EPA 440/s-90-011, July 1990.

Governor Pete Wilson, “California Wetlands Conservation Policy,” August, 1993.

## REGION 8 INDEX

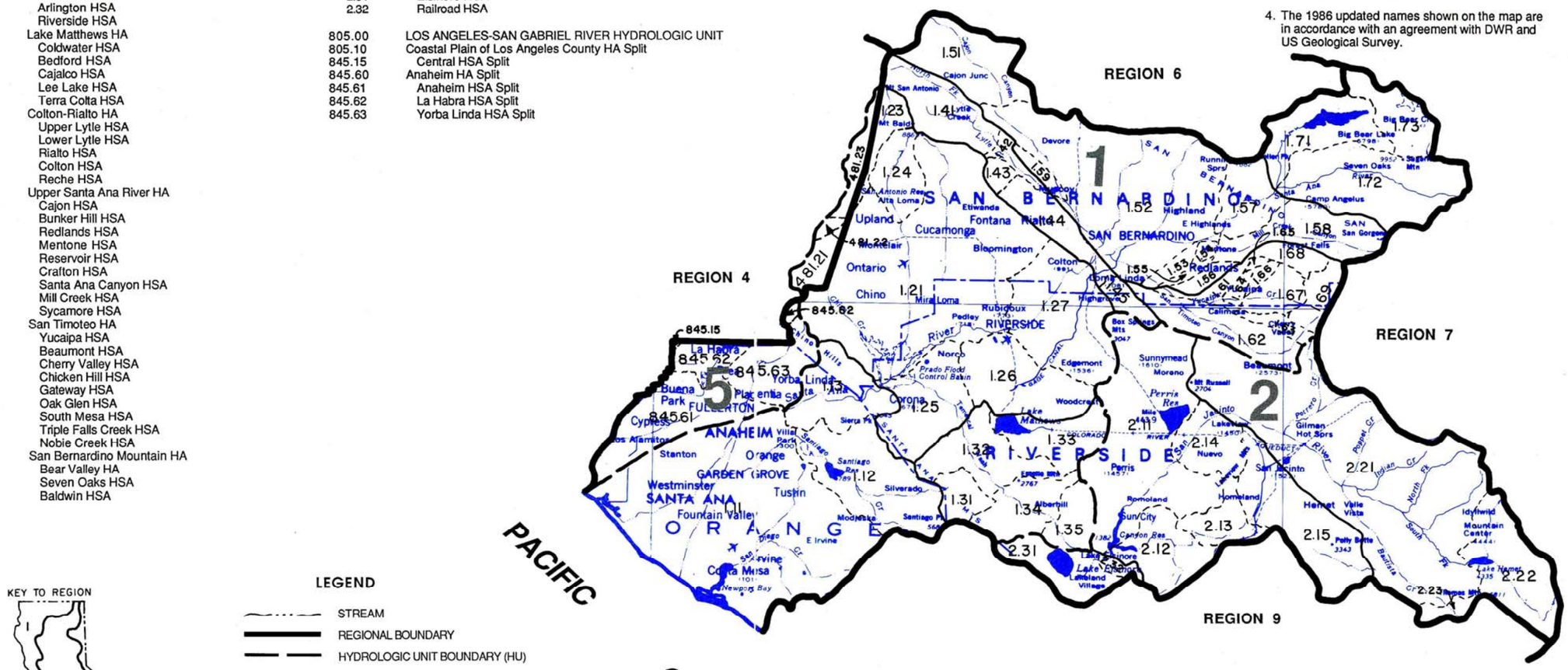
| | |
|---|---|
| 801.00 | SANTA ANA RIVER HYDROLOGIC UNIT |
| 801.10 | Lower Santa Ana River HA |
| 1.11 | East Coastal Plain HSA |
| 1.12 | Santiago HSA |
| 1.13 | Santa Ana Narrows HSA |
| 801.20 | Middle Santa Ana River HA Split |
| 801.21 | Chino HSA Split |
| 481.21 | Chino HSA Split |
| 481.22 | Harrison HSA |
| 801.23 | Claremont Heights HSA Split |
| 481.23 | Claremont Heights HSA Split |
| 801.24 | Cucamonga HSA |
| 1.25 | Temescal HSA |
| 1.26 | Arlington HSA |
| 1.27 | Riverside HSA |
| 801.30 | Lake Matthews HA |
| 1.31 | Coldwater HSA |
| 1.32 | Bedford HSA |
| 1.33 | Cajalco HSA |
| 1.34 | Lee Lake HSA |
| 1.35 | Terra Cotta HSA |
| 801.40 | Colton-Rialto HA |
| 1.41 | Upper Lytle HSA |
| 1.42 | Lower Lytle HSA |
| 1.43 | Rialto HSA |
| 1.44 | Colton HSA |
| 1.45 | Reche HSA |
| 801.50 | Upper Santa Ana River HA |
| 1.51 | Cajon HSA |
| 1.52 | Bunker Hill HSA |
| 1.53 | Redlands HSA |
| 1.54 | Mentone HSA |
| 1.55 | Reservoir HSA |
| 1.56 | Crafton HSA |
| 1.57 | Santa Ana Canyon HSA |
| 1.58 | Mill Creek HSA |
| 1.59 | Sycamore HSA |
| 801.60 | San Timoteo HA |
| 1.61 | Yucaipa HSA |
| 1.62 | Beaumont HSA |
| 1.63 | Cherry Valley HSA |
| 1.64 | Chicken Hill HSA |
| 1.65 | Gateway HSA |
| 1.66 | Oak Glen HSA |
| 1.67 | South Mesa HSA |
| 1.68 | Triple Falls Creek HSA |
| 1.69 | Nobie Creek HSA |
| 801.70 | San Bernardino Mountain HA |
| 1.71 | Bear Valley HSA |
| 1.72 | Seven Oaks HSA |
| 1.73 | Baldwin HSA |

| | |
|---|---|
| 802.00 | SAN JACINTO VALLEY HYDROLOGIC UNIT |
| 802.10 | Perris HA |
| 2.11 | Perris Valley HSA |
| 2.12 | Menifee HSA |
| 2.13 | Winchester HSA |
| 2.14 | Lakeview HSA |
| 2.15 | Hemet HSA |
| 802.20 | San Jacinto HA |
| 2.21 | Gilman Hot Springs HSA |
| 2.22 | Hemet Lake HSA |
| 2.23 | Bautista HSA |
| 802.30 | Elsinore Valley HA |
| 2.31 | Elsinore HSA |
| 2.32 | Railroad HSA |

| | |
|---|---|
| 805.00 | LOS ANGELES-SAN GABRIEL RIVER HYDROLOGIC UNIT |
| 805.10 | Coastal Plain of Los Angeles County HA Split |
| 845.15 | Central HSA Split |
| 845.60 | Anaheim HA Split |
| 845.61 | Anaheim HSA Split |
| 845.62 | La Habra HSA Split |
| 845.63 | Yorba Linda HSA Split |

NOTE:

1. The names and areas shown on this map are the same as used by the Department of Water Resources (DWR) in their Bulletin 130 Series except as explained below.
2. The numbering system used on this map is an adaptation of the numbering system used in the 130 Series.
3. The boundary between Region 8 and Region 4 follows the boundary between Los Angeles County and Orange or San Bernardino Counties, not the Hydrologic Boundary. The San Bernardino County line splits Hydrologic Unit 1 (Santa Ana River HU) so that Sub-Areas 481.21, 481.22, and 481.23 are legally in Region 4 but drain into Region 8. The Orange County line splits Hydrologic Unit 5 (Los Angeles-San Gabriel River HU) so that Sub-Areas 845.15, 845.61, 845.62 and 845.63 are legally in Region 8 but drain into Region 4. Therefore, a 5 digit number on the map indicates that a regional boundary divides a hydrologic unit, area or subarea. In these cases the second digit is the number of the region from which the hydrologic area has been separated by the regional boundary. All other digits are as described in the legend.
4. The 1986 updated names shown on the map are in accordance with an agreement with DWR and US Geological Survey.

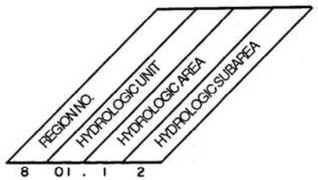



KEY TO REGION




LEGEND

- STREAM
- REGIONAL BOUNDARY
- HYDROLOGIC UNIT BOUNDARY (HU)
- HYDROLOGIC AREA BOUNDARY (HA)
- HYDROLOGIC SUBAREA BOUNDARY (SA)
- 5 HYDROLOGIC UNIT NUMBER




N

April 1973
Revised: July 1976
Revised: August 1986

State Water Resources Control Board
Surveillance and Monitoring Section
T.E. Lavenda, P.E. T E Lavenda

State of California
REGIONAL WATER QUALITY CONTROL BOARD

# Santa Ana Region (8)

## SANTA ANA HYDROLOGIC BASIN PLANNING AREA (SA)

Scale in miles
8 0 8 16 24 32
Scale 1:500,000

## Table 3-1 BENEFICIAL USES

| OCEAN WATERS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | MAR | SHEL | EST | Primary | Secondary |
| **NEARSHORE ZONE*** | | | | | | | | | | | | | | | | | | | | | | |
| San Gabriel River to Poppy Street in Corona Del Mar | + | | X | | | X | | X | X | X | | | | | X | X | X | X | X | | 801.11 | |
| Poppy Street to Southeast Regional Boundary | + | | | | | X | | X | X | X | | | | X | X | X | X | X | X | | 801.11 | |
| **OFFSHORE ZONE** | | | | | | | | | | | | | | | | | | | | | | |
| Waters Between Nearshore Zone and Limit of State Waters | + | | X | | | X | | X | X | X | | | | | X | X | X | X | | | | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

* Defined by Ocean Plan Chapter II B-1.: "Within a zone bounded by shoreline and a distance of 1000 feet from shoreline or the 30-foot depth contour, whichever is further from shoreline…"

## Table 3-1 BENEFICIAL USES - Continued

| BAYS, ESTUARIES, AND TIDAL PRISMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | MAR | SHEL | EST | Primary | Secondary |
| Anaheim Bay – Outer Bay | + | | | | | X | | X | X | | | | | X | X | X | X | X | | | 801.11 | |
| Anaheim Bay – Seal Beach National Wildlife Refuge | + | | | | | | | X[1] | X | | | | | X | X | X | X | X | | X | 801.11 | |
| Sunset Bay – Huntington Harbor | + | | | | | X | | X | X | X | | | | | X | X | X | X | | | 801.11 | |
| Bolsa Bay | + | | | | | | | X | X | X | | | | X | X | X | X | X | X | | | |
| Bolsa Chica Ecological Reserve | + | | | | | | | X | X | | | | | X | X | X | X | X | | X | 801.11 | |
| Lower Newport Bay | + | | | | | X | | X | X | X | | | | | X | X | X | X | X | | 801.11 | |
| Upper Newport Bay | + | | | | | | | X | X | X | | | | X | X | X | X | X | X | X | 801.11 | |
| Santa Ana River Salt Marsh | + | | | | | | | X | X | | | | | X | X | X | | X | | X | 801.11 | |
| Tidal Prism of Santa Ana River (to within 1000' of Victoria Street) and Newport Slough | + | | | | | | | X | X | X | | | | | X | X | | X | | | 801.11 | |
| Tidal Prism of San Gabriel River - River Mouth to Marina Drive | + | | X | | | | | X | X | X | | | | | X | X | | X | X | X | 845.61 | |
| Tidal Prisms of Flood Control Channels Discharging to Coastal or Bay Waters | + | | | | | | | X | X | X | | | | | X | | | X | | | 801.11 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

[1] No access per agency with jurisdiction (U.S. Navy)

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Santa Ana River | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – Tidal Prism to 17th Street in Santa Ana | + | | | | | | | X[2] | X | | I | | | | I | | | | 801.11 | |
| Reach 2 – 17th Street in Santa Ana to Prado Dam | + | X | | | X | | | X | X | | X | | | | X | X | | | 801.11 | 801.12 |
| Aliso Creek | X | | | | X | | | X | X | | X | | | | X | X | | | 845.63 | |
| Carbon Canyon Creek | X | | | | X | | | X | X | | X | | | | X | X | | | 845.63 | |
| Santiago Creek Drainage | | | | | | | | | | | | | | | | | | | | |
| Santiago Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – below Irvine Lake | X | | | | X | | | X[2] | X | | X | | | | X | | | | 801.12 | 801.11 |
| Reach 2 – Irvine Lake (see Lakes, pg. 3-23 | | | | | | | | | | | | | | | | | | | | |
| Reach 3 – Irvine Lake to Modjeska Canyon | I | | | | I | | | I | I | | I | | | | I | | | | 801.12 | |
| Reach 4 – Modjeska Canyon | X | | | | X | | | X | X | | X | | | | X | | | | 801.12 | |
| Silverado Creek | X | | | | X | | | X | X | | X | | | | X | | | | 801.12 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

[2] Access prohibited in all or part by Orange County Resources Development and Management Division (RDMD)

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Santiago Creek Drainage | | | | | | | | | | | | | | | | | | | | |
| Black Star | I | | | | I | | | I | I | | I | | | | I | | | | 801.12 | |
| Ladd Creek | I | | | | I | | | I | I | | I | | | | I | I | | | 801.12 | |
| San Diego Creek Drainage | | | | | | | | | | | | | | | | | | | | |
| San Diego Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – below Jeffrey Road | + | | | | | | | X[2] | X | | X | | | | X | | | | 801.11 | |
| Reach 2 – above Jeffrey Road to Headwaters | + | | | | I | | | I | I | | I | | | | I | | | | 801.11 | |
| Other Tributaries: Bonita Creek, Serrano Creek, Peters Canyon Wash, Hicks Canyon Wash, Bee Canyon Wash, Borrego Canyon Wash, Agua Chinon Wash, Laguna Canyon Wash, Rattlesnake Canyon Wash, Sand Canyon Wash*, and other Tributaries to these Creeks | + | | | | I | | | I | I | | I | | | | I | | | | 801.11 | |
| San Gabriel River Drainage | | | | | | | | | | | | | | | | | | | | |
| Coyote Creek (within Santa Ana Regional boundary | X | | | | | | | X | X | | X | | | | X | | | | | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

[2] Access prohibited in all or part by Orange County Resources Development and Management Division (RDMD)
* Sand Canyon Wash also has RARE Beneficial Use

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Santa Ana River | | | | | | | | | | | | | | | | | | | | |
| Reach 3 – Prado Dam to Mission Blvd. in Riverside | + | X | | | X | | | X | X | | X | | | | X | X | | | 801.21 | 801.21, 801.25 |
| Reach 4 – Mission Blvd. in Riverside to San Jacinto Fault in San Bernardino | + | | | | X | | | X[3] | X | | X | | | | X | | | | 801.27 | 801.44 |
| Reach 5 – San Jacinto Fault in Bernardino to Seven Oaks Dam[t] | X* | X | | | X | | | X[3] | X | | X | | | | X | X | | | 801.52 | 801.57 |
| Reach 6 – Seven Oaks Dam to Headwaters (see also Individual Tributary Streams) | X | X | | | X | | X | X | X | | | | X | | X | | X | | 801.72 | |
| San Bernardino Mountain Streams | | | | | | | | | | | | | | | | | | | | |
| Mill Creek Drainage: | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – Confluence with Santa Ana River to Bridge Crossing Route 38 at Upper Powerhouse | I | I | | | I | | | I | I | | | | I | | I | I | | | 801.58 | |
| Reach 2 – Bridge Crossing Route 38 at Upper Powerhouse Headwaters | X | X | | | X | | X | X | X | | | | X | | X | | | | 801.58 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
\+ Excepted from MUN (see text)

* **MUN** applies upstream of Orange Avenue (Redlands); downstream, water is excepted from **MUN**
[t] Reach 5 uses are intermittent upstream of Waterman Avenue
[3] Access prohibited in some portions by San Bernardino County Flood Control

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Mountain Home Creek | X | | | | X | | X | X | X | | | | X | | X | | | | 801.58 | |
| Mountain Home Creek, East Fork | X | | | | X | | X | X | X | | | | X | | X | | X | | 801.70 | |
| Monkey Face Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.70 | |
| Alger Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.70 | |
| Falls Creek | X | | | | X | | X | X | X | | | | X | | X | | X | | 801.70 | |
| Vivian Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.70 | |
| High Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.70 | |
| Other Tributaries: Lost, Oak Cove, Green, Skinner, Momyer, Glen Martin, Camp, Hatchery, Rattlesnake, Slide, Snow, Bridal Veil, and Oak Creeks and other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.71 | |
| Bear Creek Drainage: | | | | | | | | | | | | | | | | | | | | |
| Bear Creek | X | X | | | X | | X | X | X | | | | X | | X | | X | | 801.71 | |
| Siberia Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.71 | |
| Slide Creek | I | | | | I | | | I | I | | | | I | | I | | | | 801.71 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| All other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.71 | |
| Big Bear Lake (see Lakes, pg. 3-23) | | | | | | | | | | | | | | | | | | | | |
| Big Bear Lake Tributaries: | | | | | | | | | | | | | | | | | | | | |
| North Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.71 | |
| Metcalf Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.71 | |
| Grout Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.71 | |
| Rathbone (Rathbun) Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.71 | |
| Meadow Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.71 | |
| Summit Creek | I | | | | I | | | I | I | | | | I | | I | | | | 801.71 | |
| Other Tributaries to Big Bear Lake: Knickerbocker, Johnson, Minnelusa, Polique, and Red Ant Creeks and other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.71 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Baldwin Lake (see Lakes, pg. 3-23) | | | | | | | | | | | | | | | | | | | | |
| Baldwin Lake Drainage: | | | | | | | | | | | | | | | | | | | | |
| Shay Creek | X | | | | X | | | X | X | | | | X | | X | X | | | 801.73 | |
| Other Tributaries to Baldwin Lake: Sawmill, Green, and Caribou Canyons and other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.73 | |
| Other Streams Draining to Santa Ana River (Mountain Reaches‡) | | | | | | | | | | | | | | | | | | | | |
| Cajon Creek | X | | | | X | | | X | X | | | | X | | X | X | | | 801.52 | 801.51 |
| City Creek | X | X | | | X | | | X | X | | | | X | | X | X | X | | 801.57 | |
| Devil Canyon Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.57 | |
| East Twin and Strawberry Creeks | X | X | | | X | | | X | X | | | | X | | X | | X | | 801.57 | |
| Waterman Canyon Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.57 | |
| Fish Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.57 | |
| Forsee Creek | X | | | | X | | | X | X | | | | X | | X | | X | | 801.72 | |
| Plunge Creek | X | X | | | X | | | X | X | | | | X | | X | X | | | 801.72 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Barton Creek | X | X | | | X | | | X | X | | | | X | | X | | | | 801.72 | |
| Bailey Canyon Creek | I | | | | I | | | I | I | | | | I | | I | | | | 801.72 | |
| Kimbark Canyon, East Fork Kimbark Canyon, Ames Canyon and West Fork Cable Canyon Creeks | X | | | | X | | | X | X | | X | | X | | X | | | | 801.52 | |
| Valley Reaches‡ of Above Streams | I | | | | I | | | I | I | | I | | | | I | | | | 801.52 | |
| Other Tributaries (Mountain Reaches‡): Alder, Badger Canyon, Bledsoe Gulch, Borea Canyon, Breakneck, Cable Canyon, Cienega Seca, Cold, Converse, Coon, Crystal, Deer, Elder, Fredalba, Frog, Government, Hamilton, Heart Bar, Hemlock, Keller, Kilpecker, Little Mill, Little Sand Canyon, Lost, Meyer Canyon, Mile, Monroe Canyon, Oak, Rattlesnake, Round Cienega, Sand, Schneider, Staircase, Warm Springs Canyon, and Wild Horse Creeks and other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.72 | 801.71, 801.57 |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| San Gabriel Mountain Streams (Mountain Reaches‡) | | | | | | | | | | | | | | | | | | | | |
| San Antonio Creek | X | X | X | X | X | | X | X | X | | | | X | | X | | | | 801.23 | |
| Lytle Creek (South, Middle, and North Forks) and Coldwater Canyon Creek | X | X | X | X | X | | X | X | X | | | | X | | X | X | | | 801.41 | 801.42, 801.52, 801.59 |
| Day Creek | X | | | X | X | | | X | X | | | | X | | X | | | | 801.21 | |
| East Etiwanda Creek | X | | | X | X | | | X | X | | | | X | | X | X | | | 801.21 | |
| Valley Reaches ‡ of Above Streams | I | | | | I | | | I | I | | I | | | | I | | | | 801.21 | |
| Cucamonga Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – Confluence with Mill Creek to 23 rd St. in Upland | + | | | | X | | | X[3] | X | | | X | | | X | | | | 801.21 | |
| Reach 2 (Mountain Reach‡) - 23 rd St. In Upland to headwaters | X | | X | X | X | | X | X | X | | | | X | | X | | X | | 801.24 | |
| Mill Creek (Prado Area) | + | | | | | | | X | X | | X | | | | X | X | | | 801.25 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

[3] Access prohibited in some portions by San Bernardino County Flood Control

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Other Tributaries (Mountain Reaches ‡): Cajon Canyon, San Sevaine, Deer, Duncan Canyon, Henderson Canyon, Bull, Fan, Demens, Thorpe, Angalls, Telegraph Canyon, Stoddard Canyon, Icehouse Canyon, Cascade Canyon, Cedar, Falling Rock, Kerkhoff, and Cherry Creeks and other Tributaries to these Creeks | I | | | | I | | | I | I | | | | I | | I | | | | 801.21 | 801.23 |
| San Timoteo Area Streams | | | | | | | | | | | | | | | | | | | | |
| San Timoteo Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1A – Santa Ana River Confluence to Barton Road | + | I | | | | | | I[3] | I | | I | | | | I | | | | 801.52 | |
| Reach 1B – Barton Road to Gage at San Timoteo Canyon Rd | + | I | | | I | | | I[3] | I | | I | | | | I | | | | 801.52 | |
| Reach 2–Gage at San Timoteo to confluence with Yucaipa Creek | + | | | | X | | | X | X | | X | | | | X | | | | 801.61 | |
| Reach 3 – Confluence with Yucaipa Creek to confluence with little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek) | + | | | | X | | | X | X | | X | | | | X | | | | 801.61 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains
[3] Access prohibited in some portions by San Bernardino County Flood Control

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Oak Glen, Potato Canyon, and Birch Creeks | X | | | | X | | | X | X | | X | | | | X | | | | 801.67 | |
| Little San Gorgonio Creek | X | | | | X | | | X | X | | | | X | | X | | | | 801.69 | 801.62, 801.63 |
| Yucaipa Creek | I | | | | I | | | I | I | | I | | | | I | | | | 801.67 | 801.61, 801.62, 801.64 |
| Other Tributaries to these Creeks-Valley Reaches‡ | I | | | | I | | | I | I | | I | | | | I | | | | 801.62 | 801.52, 801.53 |
| Other Tributaries to these Creeks-Mountain Reaches‡ | I | | | | I | | | I | I | | | | I | | I | | | | 801.69 | 801.67 |
| Anza Park Drain | X | | | | | | | X | X | | X | | | | X | | X | | 801.27 | |
| Sunnyslope Channel | X | | | | | | | X | X | | X | | | | X | | X | | 801.27 | |
| Tequesquite Arroyo (Sycamore Creek) | + | | | | X | | | X | X | | X | | | | X | | X | | 801.27 | |
| Prado Area Streams | | | | | | | | | | | | | | | | | | | | |
| Chino Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1A – Santa Ana River confluence to downstream of confluence with Mill Creek (Prado Area) | + | | | | | | | X | X | | X | | | | X | X | | | 801.21 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Reach 1B – Confluence with Mill Creek (Prado Area) to beginning of concrete lined channel south of Los Serranos Rd.** | + | | | | | | | X | X | | X | | | | X | X | | | 801.21 | |
| Reach 2 – Beginning of concrete lined channel south of Los Serranos Rd. to confluence with San Antonio Creek | + | | | | X | | | X[3] | X | | | X | | | X | | | | 801.21 | |
| Temescal Creek | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – Lincoln Ave. to Riverside Canal | + | | | | | | | X[4] | X | | X | | | | X | | | | 801.25 | |
| Reach 2 – Riverside Canal to Lee Lake | + | I | I | | I | | | I | I | | | I | | | I | | | | 801.32 | 801.25 |
| Reach 3 – Lee Lake (see Lakes, Pg. 3-36) | | | | | | | | | | | | | | | | | | | | |
| Reach 4 – Lee Lake to Mid-Section line of Section 17 (downstream end of freeway cut) | + | I | | | I | | | I | I | | I | | | | I | X | | | 801.34 | |
| Reach 5 – Mid-section line of Section 17 (downstream end of Freeway cut) to Elsinore Groundwater Subbasin Boundary | + | X | | | X | | | X | X | | X | | | | X | X | | | 801.35 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
\+ Excepted from MUN (see text)

** The confluence of Mill Creek is in Chino Creek, Reach 1B
[3] Access prohibited in some portions by San Bernardino County Flood Control District
[4] Access prohibited in some portions by Riverside County Flood Control District

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Reach 6 – Elsinore Groundwater Subbasin Boundary to Lake Elsinore Outlet | + | | | | I | | | I | I | | I | | | | I | | | | 801.35 | |
| Coldwater Canyon Creek | X | X | | | X | | | X | X | | X | | | | X | | | | 801.32 | |
| Bedford Canyon Creek | + | | | | I | | | I | I | | I | | | | I | | | | 801.32 | |
| Dawson Canyon Creek | I | | | | I | | | I | I | | I | | | | I | | | | 801.32 | |
| Other Tributaries to these Creeks | I | | | | I | | | I | I | | I | | | | I | | | | 801.32 | |
| **SAN JACINTO RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| San Jacinto River | | | | | | | | | | | | | | | | | | | | |
| Reach 1 – Lake Elsinore to Canyon Lake | I | I | | | I | | | I | I | | I | | | | I | | | | 801.32 | 802.31 |
| Reach 2 – Canyon Lake (see Lakes Pg. 3-37) | | | | | | | | | | | | | | | | | | | | |
| Reach 3 – Canyon Lake to Nuevo Road | + | I | | | I | | | I | I | | I | | | | I | | | | 802.11 | |
| Reach 4 – Nuveo Road to North-South Mid-Section Line, T4S/R1W-S8 | + | I | | | I | | | I | I | | I | | | | I | | | | 802.14 | 802.21 |
| Reach 5 – North-South Mid-Section Line, T4S/R1 W-S8, to Confluence with Poppet Creek | + | I | | | I | | | I | I | | I | | | | I | | | | 802.21 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

[1] The confluence of Mill Creek is in Chino Creek, Reach 1B
[2] Access prohibited in some portions by San Bernardino County Flood Control District
[3] Access prohibited in some portions by Riverside County Flood Control District

## Table 3-1 BENEFICIAL USES - Continued

| INLAND SURFACE STREAMS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE* | SPWN | EST | Primary | Secondary |
| Reach 6 – Poppet Creek to Cranston Bridge | I | I | | | I | | | I | I | | I | | | | I | | | | 802.21 | |
| Reach 7 – Cranston Bridge to Lake Hemet | X | X | | | X | | | X | X | | | | X | | X | | | | 801.21 | |
| Bautista Creek – Headwaters to Debris Dam | X | X | | | X | | | X | X | | | | X | | X | | | | 802.21 | 802.23 |
| Strawberry Creek and San Jacinto River, North Fork | X | X | | | X | | | X | X | | | | X | | X | | | | 801.21 | |
| Fuller Mill Creek | X | X | | | X | | | X | X | | | | X | | X | | | | 802.22 | |
| Stone Creek | X | X | | | X | | | X | X | | | | X | | X | | | | 802.21 | |
| Salt Creek | + | | | | | | | I | I | | I | | | | I | | | | 802.12 | |
| Other Tributaries: Logan, Black Mountain, Juaro Canyon, Indian, Hurkey, Poppet, and Potrero Creeks and other Tributaries to these Creeks | I | I | | | I | | | I | I | | I | | | | I | | | | 802.21 | 802.22 |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| LAKES AND RESERVOIRS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Baldwin Lake | + | | | | | | | I | I | | I | | I | I | I | I | | | 801.73 | |
| Big Bear Lake | X | X | | | X | | | X | X | | X | | X | | X | X | | | 801.71 | |
| Erwin Lake | X | | | | | | | X | X | | | | X | X | X | X | | | 801.73 | |
| Evans, Lake | + | | | | | | | X | X | | X | | X | | X | | | | 801.27 | |
| Jenks Lake | X | X | | | X | | | X | X | | | | X | | X | | | | 801.72 | |
| Lee Lake | + | X | X | | X | | | X | X | | X | | | | X | | | | 802.34 | |
| Mathews, Lake | X | X | X | X | X | | | X[5] | X | | X | | | | X | X | | | 802.33 | |
| Mockingbird Reservoir | + | X | | | | | | X[6] | X | | X | | | | X | | | | 802.26 | |
| Norconian, Lake | + | | | | | | | X | X | | X | | | | X | | | | 802.25 | |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Anaheim Lake | + | | | | X | | | X | X | | X | | | | X | | | | 801.11 | |
| Irvine Lake (Santiago Reservoir) | X | X | | | | | | X | X | | X | | X | | X | | | | 801.12 | |
| Laguna, Lambert, Peters Canyon, Rattlesnake, Sand Canyon, and Siphon Reservoirs | + | X | | | | | | X[7] | X | | X | | | | X | | | | 801.11 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

[5] Access prohibited by the Metropolitan Water District.
[6] Access prohibited by the Gage Canal Company (owner-operator)
[7] Access prohibited by the Irvine Company and/or the Irvine Ranch Water District

## Table 3-1 BENEFICIAL USES - Continued

| LAKES AND RESERVOIRS | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE* | SPWN | EST | Primary | Secondary |
| **SAN JACINTO RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Canyon Lake (Railroad Canyon Reservoir) | X | X | | | X | | | X | X | | X | | | | X | | | | 802.11 | 802.12 |
| Elsinore, Lake | + | | | | | | | X | X | | X | | | | X | | | | 802.31 | |
| Fulmor, Lake | X | X | | | | | | X | X | | X | | X | | X | | | | 802.21 | |
| Hemet, Lake | X | X | | | X | | X | X | X | | X | | X | | X | | X | | 802.22 | |
| Perris, Lake | X | X | X | X | X | | | X | X | | X | | X | | X | | | | 802.11 | |

X Present or Potential Beneficial Use .
I Intermittent Beneficial Use
\+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| WETLANDS (INLAND) | BENEFICIAL USE | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| San Joaquin Freshwater Marsh** | + | | | | | | | X | X | | X | | | X | X | X | | | 801.11 | 801.14 |
| Shay Meadows | I | | | | | | | I | I | | | | I | | I | | | | 801.73 | |
| Stanfield Marsh** | X | | | | | | | X | X | | | | X | | X | X | | | 801.71 | |
| Prado Basin Management Zone@ | + | | | | | | | X | X | | X | | | | X | X | | | 802.21 | |
| San Jacinto Wildlife Preserve** | + | | | | | | | X | X | | X | | | X | X | X | | | 802.21 | 802.14 |
| Glen Helen | X | | | | | | | X | X | | X | | | | X | | | | 801.59 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

** This is a created wetland as defined in the wetland discussion
@ The Prado Basin Management Zone includes the Prado Flood Control Basin, a created wetland as defined in the Basin Plan (see Chapter 3, pages 3-4 through 3-7)

## Table 3-1 BENEFICIAL USES - Continued

| GROUNDWATER MANAGEMENT ZONES | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| UPPER SANTA ANA RIVER BASIN | | | | | | | | | | | | | | | | | | | | |
| Big Bear Valley | X | | | X | | | | | | | | | | | | | | | 801.71 | 801.73 |
| Beaumont | X | X | X | X | | | | | | | | | | | | | | | 801.62 | 801.63, 801.69 |
| Bunker Hill - A | X | X | X | X | | | | | | | | | | | | | | | 801.52 | 801.52 |
| Bunker Hill - B | X | X | X | X | | | | | | | | | | | | | | | 802.52 | 801.53, 801.54, 801.57, 801.58 |
| Colton | X | X | X | X | | | | | | | | | | | | | | | 801.44 | 801.45 |
| Chino North “maximum benefit”++ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | 481.21, 481.23 |
| Chino 1 – “antidegradation”++ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | 481.21 |
| Chino 2 – “antidegradation”++ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | |
| Chino 3 – “antidegradation”++ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | |
| Chino East @ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | 801.27 |
| Chino South @ | X | X | X | X | | | | | | | | | | | | | | | 801.21 | 801.25, 801.26 |
| Cucamonga | X | X | X | X | | | | | | | | | | | | | | | 801.24 | 801.21 |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

++ Chino North “maximum benefit” management zone applies unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, the Chino 1, 2, and 3 “antidegradation” management zones would apply (see also discussion in Chapter 5).

@ Chino East and South are the designations in the Chino Basin Watermaster “maximum benefit” proposal (see Chapter 5) for the management zones identified by Wildermuth Environmental, Inc. (July 2000) as Chino 4 and 5, respectively.

## Table 3-1 BENEFICIAL USES - Continued

| GROUNDWATER MANAGEMENT ZONES | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Lytle | X | X | X | X | | | | | | | | | | | | | | | 801.59 | 801.42 |
| Rialto | X | X | X | X | | | | | | | | | | | | | | | 801.44 | 801.21, 801.43 |
| San Timoteo | X | X | X | X | | | | | | | | | | | | | | | 801.62 | 801.61 |
| Yucaipa | X | X | X | X | | | | | | | | | | | | | | | 801.61 | 801.55, 801.63, 801.67 |
| **MIDDLE SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Arlington | X | X | X | X | | | | | | | | | | | | | | | 801.26 | |
| Bedford | X | X | X | X | | | | | | | | | | | | | | | 801.32 | 481.31 |
| Coldwater | X | X | X | X | | | | | | | | | | | | | | | 801.31 | |
| Elsinore | X | X | | X | | | | | | | | | | | | | | | 802.31 | |
| Lee Lake | X | X | X | X | | | | | | | | | | | | | | | 801.34 | |
| Riverside - A | X | X | X | X | | | | | | | | | | | | | | | 801.27 | 801.44 |
| Riverside – B | X | X | X | X | | | | | | | | | | | | | | | 801.27 | 801.44 |
| Riverside - C | X | X | X | X | | | | | | | | | | | | | | | 801.27 | |
| Riverside - D | X | X | X | X | | | | | | | | | | | | | | | 801.27 | 801.26 |
| Riverside - E | X | X | X | X | | | | | | | | | | | | | | | 801.27 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| GROUNDWATER MANAGEMENT ZONES | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| Riverside - F | X | X | X | X | | | | | | | | | | | | | | | 801.27 | |
| Temescal | X | X | X | X | | | | | | | | | | | | | | | 801.25 | |
| **SAN JACINTO RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| Garner Valley | X | X | | | | | | | | | | | | | | | | | 802.22 | |
| Idyllwild Area | X | | X | | | | | | | | | | | | | | | | 802.22 | 802.21 |
| Canyon | X | X | X | X | | | | | | | | | | | | | | | 802.21 | |
| Hemet - South | X | X | X | X | | | | | | | | | | | | | | | 802.15 | 802.13, 802.21 |
| Lakeview – Hemet North | X | X | X | X | | | | | | | | | | | | | | | 802.14 | 802.15 |
| Menifee | X | X | | X | | | | | | | | | | | | | | | 802.13 | |
| Perris North | X | X | X | X | | | | | | | | | | | | | | | 802.11 | |
| Perris South | X | X | | | | | | | | | | | | | | | | | 802.11 | 802.12, 802.13 |
| San Jacinto - Lower | X | X | X | | | | | | | | | | | | | | | | 802.21 | 802.11 |
| San Jacinto - Upper | X | X | X | X | | | | | | | | | | | | | | | 802.27 | 802.23 |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

## Table 3-1 BENEFICIAL USES - Continued

| GROUNDWATER MANAGEMENT ZONES | BENEFICIAL USE | | | | | | | | | | | | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MUN | AGR | IND | PROC | GWR | NAV | POW | REC1 | REC2 | COMM | WARM | LWRM | COLD | BIOL | WILD | RARE | SPWN | EST | Primary | Secondary |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | | | | | | | | | | | | |
| La Habra | X | X | | | | | | | | | | | | | | | | | 845.62 | |
| Santiago | X | X | X | | | | | | | | | | | | | | | | 801.12 | 801.11 |
| Orange | X | X | X | X | | | | | | | | | | | | | | | 801.11 | 801.13, 801.14 845.61, 845.63 |
| Irvine | X | X | X | X | | | | | | | | | | | | | | | 801.11 | |

X Present or Potential Beneficial Use
I Intermittent Beneficial Use
+ Excepted from MUN (see text)

# CHAPTER 4

# WATER QUALITY OBJECTIVES

## INTRODUCTION

The Porter-Cologne Act defines water quality objectives as "…the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area" (§13050 (h)). Further, the Act directs (§13241) that:

"Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses as the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a regional board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following:

(a) Past, present, and probable future beneficial uses of water.

(b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

(c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

(d) Economic considerations.

(e) The need for developing housing within the region.

(f) The need to develop and use recycled water."

Two important additional factors which were also considered in setting the water quality objectives in this Plan are (1) historic and present water quality, and (2) the antidegradation policies cited in Chapter 2.

The water quality objectives in this plan supersede and replace those adopted in the 1983 Basin Plan. Perhaps the most significant difference between this and the prior Plan is the inclusion of new objectives for un-ionized ammonia and site-specific objectives for the middle Santa Ana River system for copper, cadmium, and lead.

Some of these water quality objectives refer to "controllable sources" or "controllable water quality factors." Controllable sources include both point and nonpoint source discharges, such as conventional discharges from pipes, as well as discharges from land areas or other diffuse sources. Controllable water quality factors are those characteristics of the discharge and/or the receiving water which can be controlled by

treatment or management methods. Examples of other activities which may not involve waste discharges, but which also constitute controllable water quality factors, include the percolation of storm water, transport/delivery of water via natural stream channels, and stream diversions.

The water quality objectives in this Plan are specified according to waterbody type: ocean waters; enclosed bays and estuaries; inland surface waters; and groundwaters.

The narrative water quality objectives below are arranged alphabetically. They vary in applicability and scope, reflecting the variety of beneficial uses of water that have been identified (Chapter 3). Where numerical objectives are specified, they generally represent the levels that will protect beneficial uses. However, in establishing waste discharge requirements for specific discharges, the Regional Board may find that more stringent levels are necessary to protect beneficial uses. In other cases, an objective may prohibit the discharge of specific substances, may tolerate natural or "background" levels of certain substances or characteristics but no increases over those values, or may express a limit in terms of not impacting other beneficial uses. An adverse effect or impact on a beneficial use occurs where there is an actual or threatened loss or impairment of that beneficial use.

## OCEAN WATERS (Amended by Resolution No. 97-20, April 18, 1997)

Water quality objectives specified in the "Water Quality Control Plan for Ocean Waters of California" (Ocean Plan) and the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California" (Thermal Plan) are incorporated into this Basin Plan by reference. The provisions of the Ocean Plan and Thermal Plan apply to the ocean waters within this Region. **(End of Resolution No. 97-20)**

## ENCLOSED BAYS AND ESTUARIES

"Enclosed bays" means indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. "Estuaries" means waters, including coastal lagoons, located at the mouths of steams which serve as areas of mixing for fresh and ocean waters. Enclosed bays and estuaries do not include ocean waters or inland surface waters (see definition in the Inland Surface Waters section).

The objectives which are included below apply to all enclosed bays and estuaries within the region. In addition to these parameter-specific objectives, the following narrative objective shall apply:

*Enclosed bay and estuarine communities and populations, including vertebrate, invertebrate, and plant species, shall not be degraded as a result of the discharge of waste. Degradation is damage to an aquatic community or population with the result that a balanced community no longer exists. A balance community is one that is (1) diverse, (2) has the ability to sustain itself through cyclic seasonal changes, (3) includes necessary food chain species, and (4) is not dominated by pollution-tolerant*

*species, unless that domination is caused by physical habitat limitations. A balanced community also (5) may include historically introduced non-native species, but (6) does not include species present because best available technology has not been implemented, or (7) because site-specific objectives have been adopted, or (8) because of thermal discharges.*

**Algae**

Excessive growth of algae and/or other aquatic plants can degrade water quality. Algal blooms sometimes occur naturally, but they are often the result of excess nutrients (*i.e.,* nitrogen, phosphorus) from waste discharges or nonpoint sources. These blooms can lead to problems with tastes, odors, color, and increased turbidity and can depress the dissolved oxygen content of the water, leading to fish kills. Floating algal scum and algal mats are also an aesthetically unpleasant nuisance.

*Waste discharges shall not contribute to excessive algal growth in receiving waters.*

**Bacteria, Coliform**

Fecal bacteria are part of the intestinal flora of warm-blooded animals. Their presence in bay and estuarine waters is an indicator of pollution. Total coliform is measured in terms of the number of coliform organisms per unit volume. Total coliform numbers can include non-fecal bacteria, so additional testing is often done to confirm the presence and numbers of fecal coliform bacterial. Water quality objectives for numbers of total and fecal coliform vary with the uses of the water, as shown below.

*Bays and Estuaries*

**REC-1** *Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.*

**SHEL** *Fecal coliform: median concentration not more than 14 MPN (most probable number )/100 ml and not more than 10% of samples exceed 43 mpn / 100 mL*

**Chlorine, Residual**

Wastewater disinfection with chlorine usually produces a chlorine residual. Chlorine and its reaction products are toxic to aquatic life.

*To protect aquatic life, the chlorine residual in wastewater discharged to enclosed bays and estuaries shall not exceed 0.1 mg/L.*

**Color**

Color in water may arise naturally, such as from minerals, plant matter or algae, or may be caused by industrial pollutants. Color is primarily an aesthetic consideration.

*Waste discharges shall not result in coloration of the receiving waters which causes a nuisance or adversely affects beneficial uses. The natural color of fish, shellfish or other bay and estuarine water resources used for human consumption shall not be impaired.*

**Floatables**
Floatables are an aesthetic nuisance as well as a substrate for algae and insect vectors.

*Waste discharges shall not contain floating materials, including solids, liquids, foam or scum, which cause a nuisance or adversely affect beneficial uses.*

**Oil and Grease**
Oil and grease can be present in water as a result of the discharge of treated wastes and the accidental or intentional dumping of wastes into sinks and storm drains. Oils and related materials have a high surface tension and are not soluble in water, therefore forming a film on the water's surface. This film can result in nuisance conditions because of odors and visual impacts. Oil and grease can coat birds and aquatic organisms, adversely affecting respiration and/or thermoregulation.

*Waste discharges shall not result in deposition of oil, grease, wax or other materials in concentrations which result in a visible film or in coating objects in the water, or which cause a nuisance or adversely affect beneficial uses.*

**Oxygen, Dissolved**
Adequate dissolved oxygen (D.O.) is vital for aquatic life. Depression of D.O. levels can lead to fish kills and odors resulting from anaerobic decomposition. Dissolved oxygen content in water is a function of water temperature and salinity.

*The dissolved oxygen content of enclosed bays and estuaries shall not be depressed to levels that adversely affect beneficial uses as a result of controllable water quality factors.*

**pH**
pH is a measure of the hydrogen ion concentration of water. pH values generally range from 0 (most acidic) to 14 (most alkaline). Many pollutants can alter the pH, raising or lowering it excessively. These extremes in pH can have adverse effects on aquatic biota and can corrode pipes and concrete. Even small changes in pH can harm aquatic biota.

*The pH of bay or estuary waters shall not be raised above 8.6 or depressed below 7.0 as a result of controllable water quality factors; ambient pH levels shall not be changed more than 0.2 units.*

**Radioactivity**
*Radioactive materials shall not be present in the bay or estuarine waters of the region in concentrations which are deleterious to human, plant or animal life.*

**Solids, Suspended and Settleable**
Settleable solids are deleterious to benthic organisms and may cause anaerobic conditions to form. Suspended solids can clog fish gills and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development.

*Enclosed bays and estuaries shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.*

**Sulfides**
Sulfides are generated by many industries and from the anaerobic decomposition of organic matter. In water, sulfides can react to form hydrogen sulfide ($H_2S$), commonly known for its "rotten egg" odor. Sulfides in ionic form are also toxic to fish.

*The dissolved sulfide content of enclosed bays and estuaries shall not be increased as a result of controllable water quality factors.*

**Surfactants (surface-active agents)**
This group of materials includes detergents, wetting agents, and emulsifiers.

*Waste discharges shall not contain concentrations of surfactants which result in foam in the course of flow or the use of the receiving water, or which adversely affect aquatic life.*

**Taste and Odor**
Undesirable tastes and odors in water may be a nuisance and may indicate the presence of a pollutant(s).

*The enclosed bays and estuaries of the region shall not contain, as a result of controllable water quality factors, taste- or odor-producing substances at concentrations which cause a nuisance or adversely affect beneficial uses. The natural taste and odor of fish, shellfish or other enclosed bay and estuarine water resources used for human consumption shall not be impaired.*

**Temperature**
Waste discharges can cause temperature changes in the receiving waters which adversely affect the aquatic biota. Discharges most likely to cause these temperature effects are cooling tower and heat exchanger blowdown.

*All bay and estuary waters shall meet the objective specified in the Thermal Plan.*

**Toxic Substances**
*Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to level which are harmful to human health.*

*The concentrations of toxic substances in the water column, sediments or biota shall not adversely affect beneficial uses.*

**Turbidity**
Turbidity is a measure of light scattered due to particulates in water.

*Increases in turbidity which result from controllable water quality factors shall comply with the following:*

| *Natural Turbidity* | *Maximum Increase* |
|---|---|
| *0-50 NTU* | *20%* |
| *50-100 NTU* | *10 NTU* |
| *Greater than 100 NTU* | *10%* |

*All enclosed bay and estuaries of the region shall be free of changes in turbidity which adversely affect beneficial uses.*

## INLAND SURFACE WATERS

Inland surface waters include streams, rivers, lakes, and wetlands in the Region. Ocean waters and enclosed bays and estuaries are not considered inland surface waters.

The narrative objectives which are included below apply to all inland surface waters within the region, including lakes, streams, and wetlands. In addition, specific numerical objectives are listed in Table 4-1. Where more than one objective is applicable, the stricter shall apply. In addition to these objectives, the following shall apply:

*Inland surface water communities and populations, including vertebrate, invertebrate, and plant species, shall not be degraded as a result of the discharge of waste. Degradation is damage to an aquatic community or population with the result that balanced community no longer exists. A balanced community is one that is (1) diverse, (2) has the ability to sustain itself through cyclic seasonal changes, (3) includes necessary food chain species, and (4) is not dominated by pollution-tolerant species, unless that domination is caused by physical habitat limitations. A balanced community also (5) may include historically introduced non-native species, but (6) does not include species present because best available technology has not been implemented, or (7) because site-specific objectives have been adopted, or (8) because of thermal discharges.*

**Algae**

Excessive growth of algae and/or other aquatic plants can degrade water quality. Algal blooms sometimes occur naturally, but they are often the result of excess nutrients (*i.e.,* nitrogen, phosphorous) from waste discharges or nonpoint sources. These blooms can lead to problems with tastes, odors, color, and increased turbidity and can depress the dissolved oxygen content of the water, leading to fish kills. Floating algal scum and algal mats are also an aesthetically unpleasant nuisance.

*Waste discharges shall not contribute to excessive algal growth in inland surface receiving waters.*

**Ammonia, Un-ionized**

Un-ionized ammonia ($NH_3$, or UIA) is toxic to fish and other aquatic organisms. In water, UIA exists in equilibrium with ammonium ($NH_4+$) and hydroxide (OH) ions. The proportions of each change as the temperature, pH, and salinity of the water change.

The 1983 Basin Plan specified an UIA objective of 0.8 mg/L for waterbodies designated **WARM**. The SWRCB directed the Regional Board to review the 0.8 mg/L objective because of concerns that it is not stringent enough to protect aquatic wildlife. The USEPA concurred that this review was necessary.

The Regional Board contracted with California State University, Fullerton to conduct a study of un-ionized ammonia in the Santa Ana River and to develop recommendations regarding the UIA objective. This study, which was conducted in 1985-87, was complemented by additional Regional Board staff analysis. The additional staff analysis focused on adjusting EPA's national criteria for **WARM** waters (published in 1984 and amended in 1992), using the recalculation procedure. With this procedure, cold and warmwater species not found in the Santa Ana Region's **WARM** designated waters were deleted from the database used to derive the national criteria, and new criteria were calculated.

Based on these analyses, this Plan specifies UIA objectives for **WARM** and **COLD** designated waterbodies in the Region. **Note:** site-specific objectives have been developed for the Santa Ana River and certain tributaries (see next page).

**Acute (1-hour) UIA-N Objectives**

For waterbodies designed **COLD**:

Objective = 0.822 [0.52/FT/FPH/2], where

$FT = 10^{(0.03(20-T))}$ $0 \le T \le 20°C$

$FT = 1$ $20 \le T \le 30°C$

$FPH = \frac{1+10^{(7.4-pH)}}{1.25}$ $6.5 \le pH \le 8$

$FPH = 1$ $8 \le pH \le 9$

For waterbodies designated **WARM**:
Objective = 0.822[0.87/FT/FPH/2], where

$FT = 10^{(0.03(20-T))}$ $0 \le T \le 25°C$
$FT = 0.7079$ $25 \le T \le 30°C$

$FPH = \frac{1+10^{(7.4-pH)}}{1.25}$ $6.5 \le pH \le 8$
$FPH = 1$ $8 \le pH \le 9$

**Chronic (4-day) UIA-N Objectives**
For waterbodies designated **COLD**:
Objective = 0.822[0.52/FT/FPH/RATIO], where

$FT = 10^{(0.03(20-T))}$ $0 \le T \le 15°C$
$FT = 1.4125$ $15 \le T \le 30°C$

$FPH = \frac{1+10^{(7.4-pH)}}{1.25}$ $6.5 \le pH \le 8$
$FPH = 1$ $8 \le pH \le 9$

$RATIO = \frac{24[10^{(7.7-pH)}]}{1+10^{(7.4-pH)}}$ $6.5 \le pH \le 7.7$
$RATIO = 13.5$ $7.7 \le pH \le 9$

For waterbodies designed **WARM**:
Objective = 0.822[0.87/FT/FPH/RATIO], where

$FT = 10^{(0.03(20-T))}$ $0 \le T \le 20°C$
$FT = 1$ $20 \le T \le 30°C$

$FPH = \frac{1+10^{(7.4-pH)}}{1.25}$ $6.5 \le pH \le 8$
$FPH = 1$ $8 \le pH \le 9$

$RATIO = \frac{24[10^{(7.7-pH)}]}{1+10^{(7.4-pH)}}$ $6.5 \le pH \le 7.7$
$RATIO = 13.5$ $7.7 \le pH \le 9$

*Calculated numerical UIA-N objectives as well as corresponding total ammonia nitrogen concentration for various pH and temperature conditions are shown in Tables*

*4-2 and 4-3. Table 4-4 lists the above equations in a form that can be entered into a computer or calculator program.*

**Site-specific Un-ionized Ammonia Objective for the Santa Ana River System**
In addition to the un-ionized ammonia (UIA) objectives specified above, this Plan includes a chronic (4-day) site-specific UIA objective for the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. This site-specific objective is based on carefully controlled chronic toxicity tests on Santa Ana River water conducted as part of the Santa Ana River Use-Attainability Analysis Study. The Santa Ana River water was spiked with UIA concentrations ranging from 0.0 (control) to 1.0 mg/L. The No Observed Effect Level (NOEL) was found to be at a UIA concentration of 0.24 mg/L (or 0.19 mg/L as UIA-nitrogen). Using a 50% safety factor, the UIA objective developed is 0.12 mg/L (or 0.098 mg/L UIA-nitrogen).

*To prevent chronic toxicity to aquatic life in the Santa Ana River, Reaches 2, 3, and 4, Chino Creek, Mill Creek (Prado Area), Temescal Creek and San Timoteo Creek, discharges to these waterbodies shall not cause the concentration of un-ionized ammonia (as nitrogen) to exceed 0.098 mg/L ) ($NH_3$-N) as a 4-day average.*

**Bacteria, Coliform**
Fecal bacteria are part of the intestinal flora of warm-blooded animals. Their presence in surface waters is an indicator of pollution. Total coliform is measured in terms of the number of coliform organisms per unit volume. Total coliform numbers can include non-fecal bacteria, so additional testing is often done to confirm the presence and numbers of fecal coliform bacteria. Water quality objectives for numbers of total and fecal coliform vary with the uses of the water, as shown below.

*Lakes and Streams*

**MUN** *Total coliform: less than 100 organisms/100 mL*

**REC-1** *Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period*

**REC-2** *Fecal coliform: average less than 2000 organisms/100 mL and not more than 10% of samples exceed 4000 organisms/100 mL for any 30-day period*

**Boron**
Boron is not considered a problem in drinking water supplies until concentrations of 20-30 mg/L are reached. In irrigation, boron is an essential element. However, boron concentrations in excess of 0.75 mg/L may be deleterious to certain crops, particularly citrus. The maximum safe concentration of even the most tolerant plants is about 4.0mg/L of boron.

*Boron concentrations shall not exceed 0.75 mg/L in inland surface waters of the region as a result of controllable water quality factors.*

**Chemical Oxygen Demand (COD)**
COD is a measure of the total amount of oxidizable material present in a sample, including stable organic materials which are not measured by the BOD test.

*Waste discharges shall not result in increases in COD levels in inland surface waters which exceed the values shown in Table 4-1 or which adversely affect beneficial uses.*

**Chloride**
Excess chloride concentrations lead primarily to economic damage rather than public health hazards. Chlorides are considered to be among the most troublesome anions in water used for industrial or irrigation purposes since they significantly affect the corrosion rate of steel and aluminum and can be toxic to plants. A safe value for irrigation is considered to be less than 175 mg/L of chloride. Excess chlorides affect the taste of potable water, so drinking water standards are generally based on potability rather than on health. The secondary drinking water standard for chloride is 500 mg/L.

*The chloride objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors.*

**Chlorine, Residual**
Wastewater disinfection with chlorine usually produces a chlorine residual. Chlorine and its reaction products are toxic to aquatic life.

*To protect aquatic life, the chlorine residual in wastewater discharged to inland surface waters shall not exceed 0.1 mg/L.*

**Color**
Color in water may arise naturally, such as from minerals, plant matter, or algae, or may be caused by industrial pollutants. Color is primarily an aesthetic consideration, although it can discolor clothes and food. The secondary drinking water standard for color is 15 color units.

*Waste discharges shall not result in coloration of the receiving waters which causes a nuisance or adversely affect beneficial uses. The natural color of fish, shellfish or other inland surface water resources used for human consumption shall not be impaired.*

**Dissolved Solids, Total (Total Filtrable Residue)**
The department of Health Services recommends that the concentration of total dissolved solids (TDS) in drinking water be limited to 1000 mg/L (secondary drinking water standard) due to taste considerations. For most irrigation uses, water should have a TDS concentration under 700mg/L. Quality-related consumer cost analyses

have indicated that a benefit to consumers exist if water is supplied at or below 500mg/L TDS.

*The dissolved mineral content of the waters of the region, as measured by the total dissolved solids test ("Standard Methods for the Examination of Water and Wastewater, 16th Ed.," 1985: 209B (180˚C), p. 95), shall not exceed the specific objectives listed in Table 4-1 as a result of controllable water quality factors.*

**Filtrable Residue, Total**
See Dissolved Solids, Total

**Floatables**
Floatables are an aesthetic nuisance as well as a substrate for algae and insect vectors.

*Waste discharges shall not contain floating materials, including solids, liquids, foam or scum, which cause a nuisance or adversely affect beneficial uses.*

**Fluoride**
Fluoride in water supply used for industrial or irrigation purposes has certain detrimental effects. Fluoride in optimum concentrations in water supply (concentrations dependent upon the mean annual air temperature) is considered beneficial for preventing dental caries, but concentrations above approximately 1 mg/L, or its equivalent at a given temperature, are considered likely to increase the risk of occurrence of dental fluorosis.

*Fluoride concentrations shall not exceed values specified in the table below in inland surface waters designated* **MUN** *as a result of controllable water quality factors.*

| Annual Average of Maximum Daily Air Temperature (˚C) | Optimum Fluoride Concentration (mg/L) |
|---|---|
| 12.0 and below | 1.2 |
| 12.1 to 14.6 | 1.1 |
| 14.7 to 17.6 | 1.0 |
| 17.7 to 21.4 | 0.9 |
| 21.5 to 26.2 | 0.8 |
| 26.3 to 32.5 | 0.7 |

**Hardness (as $CaCO_3$)**
The major detrimental effect of hardness is economic. Any concentration (reported as mg/L $CaCO_3$) greater than 100mg/L results in the increased use of soap, scale buildup in utensils, in domestic uses, and in plumbing. Hardness in industrial cooling waters is generally objectionable above 50mg/L.

*The objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors. If no hardness objective is listed in Table 4-1, the hardness of*

*receiving waters used for municipal supply (**MUN**) shall not be increased as a result of waste discharges to levels that adversely affect beneficial uses.*

**Inorganic Nitrogen, Total**
see Nitrogen, Total Inorganic

**Metals**
Metals can be toxic to human and animal life.

In 1990, the Environmental Protection Agency (EPA) placed the Santa Ana River, reaches 2, 3, and 4, and Chino Creek on the §304(1) list of "Waters Not Meeting Applicable Water Quality Standards" based on its review of data on certain metals in POTW discharges to the River.

The Santa Ana River dischargers and the Regional Board disagreed with and objected to EPA's §304(1) designation. To demonstrate whether or not the §304(1) designation is correct and what effects, if any, heavy metal levels may have on aquatic life in the Region, the Santa Ana River Dischargers Association and the Santa Ana Watershed Project Authority agreed to conduct a Use-Attainability Analysis (UAA).

The purpose of a Use-Attainability Analysis is to evaluate the "physical, biological, chemical, and hydrological conditions of a river to determine what specific beneficial uses the waterbody can support." If local conditions preclude full attainment of an aquatic life beneficial use for reasons unrelated to water quality, federal and state authorities may allow variances from the generic water quality criteria.

The UAA began in February 1991 and concluded in March 1992. It provided detailed information on chemical, biological, and hydrologic conditions in the middle Santa Ana River aquatic system. Conclusions and recommendations were presented to the Board in June 1992. The information presented is reflected in the Santa Ana River discussion in Chapter 1 and in the new **LWRM** Beneficial Use designation (Chapter 3). Data provided by the UAA was also used to support the adoption of site-specific objectives for three metals, cadmium (Cd), copper (Cu), and lead (Pb) for the Santa Ana River (Reaches 2, 3, and 4) and the perennial portions of some tributaries (including Chino Creek, Cucamonga/Mill Creek, Temescal Creek, and creeks in the Riverside Narrows area).

In adopting these SSOs the Regional Board found (RWQCB Resolution No. 94-1) that:

a. The Site-Specific Water Quality Objectives (SSOs) will protect the beneficial uses of the Santa Ana River.

b. The SSOs are conservative.

c. The SSOs, which represent higher quality than presently exists, will not result in degradation of water quality.

d. Existing levels of cadmium, copper, and lead in the Santa Ana River do not contribute to toxicity in the Santa Ana River.

The toxicity of these metals varies with water hardness. No fixed hardness value is assumed; objectives are calculated using the hardness of the collected sample.

The following equations represent the SSOs which apply to these waterbodies. These SSOs are expressed as the dissolved form of the metals.

SSO *for cadmium*:

$$\text{Cd SSO} = 0.85[e^{(0.7852*\ln(TH)-3.490)}]$$

SSO for Copper

$$\text{Cu SSO} = 0.85[e^{(0.8545*\ln(TH)-1.465)}]$$

SSO for lead

$$\text{Pb SSO} = 0.25\ [e^{(1.237*\ln(TH)-3.958)}]$$

*where TH is the total hardness (as $CaCO_3$) in mg/L.*

The SSOs for cadmium and copper are simply the hardness-dependent formulas for calculating the objective (national criteria), corrected by the dissolved-to-total (metal) ratio. The SSO for lead is the recalculated* hardness-dependant formula, corrected by the dissolved-to-total ratio.

*****Recalculation for lead was carried out by EPA-Region IX, using the lowest genus mean acute value (GMAV) as the final acute value (FAV) and an acute-to chronic ratio (ACR) of 51.29, resulting in a final chronic value (FCV) of 2.78 and the SSO formula already shown.

The Table below shows the site-specific objectives for cadmium, copper, and lead that would apply to a water sample with 200 mg/L total hardness (as $CaCO_3$).

| Metal | Calculated WQO | Recalculated Value | EPA Correction Factor | SSO |
|---|---|---|---|---|
| Cd | 2.0 | NA | 0.85 | 1.7 |
| Cu | 21.4 | NA | 0.85 | 18.2 |
| Pb | 7.7 | 16.2 | 0.25 | 4.1 |

Toxicity testing performed as part of the Santa Ana River Use-Attainability Analysis (UAA) has demonstrated that the levels of dissolved metal shown below are safe and non-toxic in Santa Ana River water.

| | |
|---|---|
| Cadmium | 4 µg/L |
| Copper | 37 µg/L |
| Lead | 28 µg/L |

There is also evidence that levels as much as 100% higher than those shown above do not result in chronic toxicity.

**Methylene Blue-Activated Substances (MBAS)**
The MBAS test is sensitive to the presence of detergents (see surfactants). Positive results may indicate the presence of wastewater. The secondary drinking water standard for MBAS is 0.05 mg/L.

*MBAS concentrations shall not exceed 0.05mg/L I inland surface waters designated **MUN** as a result of controllable water quality factors.*

**Nitrate**
High nitrate concentrations in domestic water supplies can be toxic to human life. Infants are particularly susceptible and may develop methemoglobinemia (blue baby syndrome). The primary drinking water standard for nitrate (as $NO_3$) is 45 mg/L or 10 mg/L (as N) in inland surface waters designated MUN as a result of controllable water quality factors.

*Nitrate-nitrogen concentrations shall not exceed 45 mg/L (as $NO_3$) or 10 mg/L (as N) in inland surface waters designated **MUN** as a result of controllable water quality factors.*

**Nitrogen, Total Inorganic**
*The objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors.*

**Oil and Grease**

Oil and grease can be present in water as a result of the discharge of treated wastes and the accidental or intentional dumping of wastes into sinks and storm drains. Oils and related materials have a high surface tension and are not soluble in water, therefore forming a film on the water's surface. This film can result in nuisance conditions because of odors and visual impacts. Oil and grease can coat birds and aquatic organisms, adversely affecting respiration and/or thermoregulation.

*Waste discharges shall not result in deposition of oil, grease, wax, or other material in concentrations which result in a visible film or in coating objects in the water, or which cause a nuisance or adversely affect beneficial uses.*

**Oxygen, Dissolved**

Adequate dissolved oxygen (D.O.) is vital for aquatic life. Depression of D.O. levels can lead to fish kills and odors resulting from anaerobic decomposition. Dissolved oxygen content in water is a function of water temperature and salinity.

*The dissolved oxygen content of surface waters shall not be depressed below 5mg/L for waters designated **WARM**, or 6mg/L for waters designated **COLD**, as a result of controllable water quality factors. In addition, waste discharges shall not cause the median dissolved oxygen concentration to fall below 85% of saturation or the 95$^{th}$ percentile concentration or fall below 75% of saturation within a 30-day period.*

**pH**

pH is a measure of the hydrogen ion concentration of water. pH values generally range from 0 (most acidic) to 14 (most alkaline). Many pollutants can alter the pH, raising or lowering it excessively. These extremes in pH can have adverse effects on aquatic biota and can corrode pipes and concrete. Even small changes in pH can harm aquatic biota.

*The pH of inland surface waters shall not be raised above 8.5 or depressed below 6.5 as a result of controllable water quality factors.*

**Radioactivity**

*Radioactivity materials shall not be present in the waters of the region in concentrations which are deleterious to human, plant or animal life. Waters designated **MUN** shall meet the limits specified in the California Code of Regulations, Title 22, and listed here:*

| | | |
|---|---|---|
| *Combined Radium-226 and Radium-228* | *5* | *pCi/L* |
| *Gross Alpha particle activity* | *15* | *pCi/L* |
| *Tritium* | *20,000* | *pCi/L* |
| *Strontium-90* | *8* | *pCi/L* |
| *Gross Beta particle activity* | *50* | *pCi/L* |
| *Uranium* | *20* | *pCi/L* |

**Sodium**
The presence of sodium in drinking water may be harmful to persons suffering from cardiac, renal, and circulatory diseases. It can contribute to taste effects, with the taste threshold depending on the specific sodium salt. Excess concentrations of sodium in irrigation water reduce soil permeability to water and air. The deterioration of soil quality because of the presence of sodium in irrigation water is cumulative and is accelerated by poor drainage.

*The sodium objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors.*

**Solids, Suspended and Settleable**
Settleable solids are deleterious to benthic organisms and may cause anaerobic conditions to form. Suspended solids can clog fish gill and interfere with respiration in aquatic fauna. They also screen out light, hindering photosynthesis and normal aquatic plant growth and development.

*Inland surface waters shall not contain suspended or settleable solids in amounts which cause a nuisance or adversely affect beneficial uses as a result of controllable water quality factors.*

**Sulfate**

Excessive sulfate, particularly magnesium sulfate ($MgSO_4$) in potable waters can lead to laxative effects, but this effect is temporary. There is some taste effect from magnesium sulfate in the range of 400-600 mg/L as $MgSO_4$. The secondary drinking water standard for sulfate is 500 mg/L. Sulfate concentrations in waters native to this region are normally low, less than 40 mg/L, but imported Colorado River water contains approximately 300 mg/L of sulfate.

*The objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors.*

**Sulfides**
Sulfides are generated by many industries and from the anaerobic decomposition of organic matter. In water, sulfides can react to form hydrogen sulfide ($H_2S$), commonly known for its “rotten egg” odor. Sulfides in ionic form are also toxic to fish.

*The dissolved sulfide content of inland surface waters shall not be increased as a result of controllable water quality factors.*

**Surfactants (surface-active agents)**
This group of materials includes detergents, wetting agents, and emulsifiers. See also Methylene Blue-Activated Substances (MBAS).

*Waste discharges shall not contain concentrations of surfactants which result in foam in the course of flow or use of the receiving water, or which adversely affect aquatic life.*

**Taste and Odor**
Undesirable tastes and odors in water may be a nuisance and may indicate the presence of a pollutant(s). The secondary drinking water standard for odor (threshold) is about 3 odor units.

*The inland surface waters of the region shall not contain, as a result of controllable water quality factors, taste- or odor-producing substances at concentrations which cause a nuisance or adversely affect beneficial uses. The natural taste and odor of fish, shellfish or other regional inland surface water resources used for human consumption shall not be impaired.*

**Temperature**
Waste discharges can cause temperature changes in the receiving waters which adversely affect the aquatic biota. Discharges most likely to cause these temperature effects are cooling tower and heat exchanger blowdown.

*The natural receiving water temperature of inland surface waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses. The temperature of waters designated **COLD** shall not be increased by more than 5˚F as a result of controllable water quality factors. The temperature of waters designated **WARM** shall not be raised above 90˚F June through October or above 78˚F during the rest of the year as a result of controllable water quality factors. Lake temperatures shall not be raised more than 4˚F above established normal values as a result of controllable water quality factors.*

**Total Dissolved Solids**
See Dissolved Solids, Total

**Total Filtrable Residue**
See Dissolved Solids, Total

**Total Inorganic Nitrogen**
See Nitrogen, Total Inorganic

**Toxic Substances**
*Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health.*

*The concentrations of contaminants in waters which are existing or potential sources of drinking water shall not occur at levels that are harmful to human health.*

*The concentrations of toxic pollutants in the water column, sediments or biota shall not adversely affect beneficial uses.*

**Turbidity**
Turbidity is a measure of light scattered due to particulates in water. The secondary drinking water standard for turbidity is 5 NTU (nephelometric turbidity units).

*Increases in turbidity which result from controllable water quality factors shall comply with the following:*

| *Natural Turbidity* | *Maximum Increase* |
|---|---|
| 0-50 NTU | 20% |
| 50-100 NTU | 10 NTU |
| *Greater than* 100 NTU | 10% |

*All inland surface waters of the region shall be free of changes in turbidity which adversely affect beneficial uses.*

## GROUNDWATERS

The narrative objectives that are included below apply to all groundwaters, as noted. In addition, specific numerical objectives are listed in Table 4-1. With the exception of the "maximum benefit" objective identified in this Table (see further discussion below and in Chapter 5), where more than one objective is applicable, the stricter shall apply.

**Arsenic**
*Arsenic concentrations shall not exceed 0.05 mg/L in groundwater designated **MUN** as a result of controllable water quality factors.*

**Bacteria, Coliform**
Fecal bacteria are part of the intestinal flora of warm-blooded animals. Their presence in groundwater is an indicator of pollution. Total coliform is measured in terms of the number of coliform organisms per unit volume. Total coliform numbers can include non-fecal bacteria, so additional testing is often done to confirm the presence and numbers of fecal coliform bacteria. Water quality objectives for numbers of total fecal coliform vary with the uses of the water, as shown below.

*Total coliform numbers shall not exceed 2.2 organism/100 mL median over any seven-day period in groundwaters designated **MUN** as a result of controllable water quality factors.*

**Barium**
*Barium concentrations shall not exceed 1.0mg/L in groundwaters designated **MUN** as a result of controllable water quality factors.*

**Boron**
Boron is not considered a problem in drinking water supplies until concentrations of 20-30 mg/L are reached. In irrigation, boron is an essential element. However, boron concentrations in excess of 0.75 mg/L may be deleterious to certain crops, particularly citrus. The maximum safe concentration of even the most tolerant plants is about 4.0 mg/L of boron.

*Boron concentrations shall not exceed 0.75 mg/L in groundwaters of the region as a result of controllable water quality factors.*

**Chloride**
Excess chloride concentrations lead primarily to economic damage rather than public health hazards. Chlorides are considered to be among the most troublesome anion in water used for industrial or irrigation purposes since they significantly affect the corrosion rate of steel and aluminum and can be toxic to plants. A safe value for irrigation is considered to be less than 175 mg/L of chloride. Excess chlorides affect the taste of potable water, so drinking water standards are generally based on potability rather than on health. The secondary maximum contaminant level range - upper for chloride is 500 mg/L (CCR, Division 4, Chapter 15, Article 16, § 64449).

*Chloride concentrations shall not exceed 500 mg/L in groundwaters of the region designated MUN as a result of controllable water quality factors.*

**Color**
Color in water may arise naturally, such as from minerals, plant matter or algae, or may be caused by industrial pollutants. Color is primarily an aesthetic consideration, although it can discolor clothes and food. The secondary drinking water standard for color is 15 color units.

*Waste discharges shall not result in coloration of the receiving waters which causes a nuisance or adversely affects beneficial uses.*

**Cyanide**
*Cyanide concentrations shall not exceed 0.2mg/L in groundwaters designated **MUN** as a result of controllable water quality factors.*

**Dissolved Solids, Total (Total Filtrable Residue)**
The Department of Health Services recommends that the concentration of total dissolved solids (TDS) in drinking water be limited to 500 mg/L (secondary maximum contaminant level) (CCR, Division 4, Chapter 15, Article 16, § 64449), due to taste considerations. For most irrigation uses, water should have a TDS concentration under 700 mg/L. Quality-related consumer cost analyses have indicated that a benefit to consumers exists if water is supplied at or below 500 mg/L TDS[2].

*The dissolved mineral content of the waters of the region, as measured by the total dissolved solids test ("Standard Methods for the Examination of Water and Wastewater, 20th Ed.," 1998: 2540C (180˚C), p.2-56), shall not exceed the specific objectives listed in Table 4-1 as a result of controllable water quality factors. (See also discussion of management zone TDS and nitrate nitrogen water quality objectives).*

**Filtrable Residue, Total**
See Dissolved Solids, Total

**Fluoride**
Fluoride in water supply used for industrial or irrigation purposes has certain detrimental effects. Fluoride in optimum concentrations in water supply (concentration dependent upon the mean annual air temperature) is considered beneficial for preventing dental caries, but concentrations above approximately 1 mg/L, or its equivalent at a given temperature, are considered likely to increase the risk of occurrence of dental fluorosis.

*Fluoride concentrations shall not exceed 1.0 mg/L in groundwaters designated **MUN** as a result of controllable water quality factors.*

**Hardness (as $CaCO_3$)**
The major detrimental effect of hardness is economic. Any concentration (reported as mg/L $CaCO_3$) greater than 100mg/L results in the increased use of soap, scale buildup in utensils in domestic uses, and in plumbing. Hardness in industrial cooling waters is generally objectionable above 50 mg/L.

*The hardness of receiving waters used for municipal supply (**MUN**) shall not be increased as a result of waste discharges to levels that adversely affect beneficial uses.*

**Metals**
Metals can be toxic to human and animal life.

*Metals concentrations shall not exceed the values listed below in groundwaters designated **MUN** as a result of controllable water quality factors.*

[2] These TDS values are noted for information purposes only. For some management zones, the historic ambient quality, on which the TDS objectives are largely based (see also discussion of maximum benefit objectives for specific management zones), exceeds these recommended levels.

| *Metal* | *Concentration (mg/L)* |
|---|---|
| *Cadmium* | 0.01 |
| *Chromium* | 0.05 |
| *Cobalt* | 0.2 |
| *Copper* | 1.0 |
| *Iron* | 0.3 |
| *Lead* | 0.05 |
| *Manganese* | 0.05 |
| *Mercury* | 0.002 |
| *Selenium* | 0.01 |
| *Silver* | 0.05 |

**Methylene Blue-Activated Substances (MBAS)**
The MBAS test is sensitive to the presence of detergents (see surfactants in inland surface waters discussion). Positive results may indicate the presence of wastewater. The secondary drinking water standard for MBAS is 0.05 mg/L.

*MBAS concentrations shall not exceed 0.05 mg/L in groundwaters designated **MUN** as a result of controllable water quality factors.*

**Nitrate**
High nitrate concentrations in domestic water supplies can be toxic to human life. Infants are particularly susceptible and may develop methemoglobinemia (blue baby syndrome). The primary drinking water standard for nitrate (as $NO_3$) is 45 mg/L or 10 mg/L (as N).

*Nitrate-nitrogen concentrations listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors. (See also discussion of management zone TDS and nitrate nitrogen water quality objectives below).*

**Oil and Grease**
Oil and grease can be present in water as a result of the discharge of treated wastes and the accidental or intentional dumping of wastes into sinks and storm drains. Oils and related materials have a high surface tension and are not soluble in water, therefore forming a film on the water's surface. This film can result in nuisance conditions because of odors and visual impacts.

*Waste discharges shall not result in deposition of oil, grease, wax or other materials in concentrations which cause a nuisance or adversely affect beneficial uses.*

**pH**
pH is a measure of the hydrogen ion concentration of water. pH values generally range from 0 (most acidic) to 14 (most alkaline). Many pollutants can alter the pH,

raising or lowering it excessively. These extremes in pH can corrode pipes and concrete.

*The pH of groundwater shall not be raised above 9 or depressed below 6 as a result of controllable water quality factors.*

**Radioactivity**

*Radioactive materials shall not be present in the waters of the region in concentrations which are deleterious to human, plant or animal life. Groundwaters designated **MUN** shall meet the limits specified in the California Code of Regulations, Title 22, and listed here:*

| | | |
|---|---|---|
| *Combined Radium-226 and Radium-228* | *5* | *pCi/L* |
| *Gross Alpha particle activity* | *15* | *pCi/L* |
| *Tritium* | *20,000* | *pCi/L* |
| *Strontium-90* | *8* | *pCi/L* |
| *Gross Beta particle activity* | *50* | *pCi/L* |
| *Uranium* | *20* | *pCi/L* |

**Sodium**

The presence of sodium in drinking water may be harmful to persons suffering from cardiac, renal and circulatory diseases. It can contribute to taste effects, with the taste threshold depending on the specific sodium salt (US Geological Survey, Resources Agency of California – State Water Resources Control Board). Excess concentrations of sodium in irrigation water reduce soil permeability to water and air. The deterioration of soil quality because of the presence of sodium in irrigation water is cumulative and is accelerated by poor drainage (California State Water Resources Control Board).

*The California Department of Health Services and the U.S. Environmental Protection Agency have not provided a limit on the concentration of sodium in drinking water. Sodium concentrations shall not exceed 180 mg/L in groundwaters designated MUN as a result of controllable water quality factors.*

*Groundwaters designated AGR shall not exceed a sodium absorption ration (SAR[3]) of 9 as a result of controllable water quality factors.*

**[3] Sodium absorption ratio (SAR)=** $\frac{Na}{\left[\frac{1}{2}(Ca + Mg)\right]^{1/2}}$

where Sodium (Na), Calcium (Ca) and Magnesium (Mg) are concentrations in milliequivalents per liter

**Sulfate**

Excessive sulfate, particularly magnesium sulfate ($MgSO_4$) in potable waters can lead to laxative effects, but this effect is temporary. There is some taste effect from magnesium sulfate in the range of 400-600mg/L as MgSO4. The secondary drinking water standard for sulfate is 500mg/L (CCR, Division 4, Chapter 15, Article 16, §64449). Sulfate concentrations in waters native to this region are normally low, less than 40mg/L, but imported Colorado River water contains approximately 300mg/L of sulfate.

*Sulfate concentrations shall not exceed 500 mg/L in groundwaters of the region designated MUN as a result of controllable water quality factors.*

**Taste and Odor**

Undesirable tastes and odors in water may be a nuisance and may indicate the presence of a pollutant(s). The secondary drinking water standard for odor (threshold) is 3 odor units.

*The groundwaters of the region shall not contain, as a result of controllable water quality factors, taste- or odor-producing substances at concentrations which cause a nuisance or adversely affect beneficial uses.*

**Total Dissolved Solids**

See Dissolved Solids, Total

**Total Filtrable Residue**

See Dissolved Solids, Total

**Total Inorganic Nitrogen**

See Nitrogen, Total Inorganic

**Toxic Substances**

*All waters of the region shall be maintained free of substances in concentrations which are toxic, or that produce detrimental physiological responses in human, plant, animal or aquatic life.*

**Management Zone TDS and Nitrate-nitrogen Water Quality Objectives (Amended by Resolution No. R8-2004-0001, January 22, 2004)**

The TDS and nitrate-nitrogen objectives specified in the 1975 and 1984 Basin Plans, and initially in this 1995 Basin Plan, were based on an evaluation of groundwater samples from the five year period 1968 through 1972. This period represented ambient quality at the time of preparation of the 1975 Basin Plan. As part of the 2004 update of the TDS/Nitrogen management plan in the Basin Plan, historical ambient quality was reviewed using additional data and rigorous statistical procedures. This update also included characterization of current water quality. A

comprehensive description of the methodology employed is published in the "Final Technical Memorandum for Phase 2A of the Nitrogen-TDS Study" (Wildermuth Environmental Inc., July 2000). This effort, coupled with "maximum benefit" demonstrations by certain agencies in the watershed (see further discussion below and in Chapter 5), culminated in the adoption of the TDS and nitrate-nitrogen objectives specified in Table 4-1.

For the most part, the TDS and nitrate-nitrogen water quality objectives for each management zone are based on historical concentrations of TDS and nitrate-nitrogen from 1954 through 1973 and are referred to herein as the "antidegradation" objectives. This period brackets 1968, when the State Board adopted the state's antidegradation policy in Resolution No. 68-16, "Policy with Respect to Maintaining High Quality Waters". This Resolution establishes a benchmark for assessing and considering authorization of degradation of water quality. The 20-year period was selected in order to ensure that at least 3 data points in each management zone would be available to calculate historical ambient quality. In general, the following steps were taken to calculate the TDS and nitrate objectives:

a. Annual average TDS and nitrate-nitrogen data from 1954 – 1973 for each well in a management zone were compiled;
b. For each well, the data were statistically analyzed. The mean plus "t" (Student's t) times the standard error of the mean was calculated;
c. A rectangular grid across all management zones was overlaid. Groundwater storage within each grid was computed; and,
d. The volume-weighted TDS and nitrate-nitrogen concentration for each management zone was computed. These concentrations are the calculated historical ambient quality for each zone. [4]

These volume-weighted TDS and nitrate-nitrogen concentrations for each management zone were typically identified as the appropriate objectives. However, it is important to note that if the calculated nitrate-nitrogen concentration exceeded 10 mg/L, the nitrate-nitrogen objective was set to 10 mg/L to be consistent with the primary drinking water standard, or to current ambient quality if less than 10 mg/L.

Finally, in some cases, certain agencies proposed alternative, less stringent TDS and nitrate-nitrogen objectives for specific management zones, based on additional consideration of antidegradation requirements and the factors specified in Water Code Section 13241 (see below and Chapter 5). Table 4-1 includes both the historical ambient quality TDS and nitrate-nitrogen objectives (the "antidegradation" objectives) and the objectives based on this additional consideration (the "maximum benefit"

[4] In limited cases, data for ammonia-nitrogen and nitrite-nitrogen as well as nitrate-nitrogen were available and included in the analysis. The ammonia-nitrogen and nitrite-nitrogen values were insignificant. The objectives are thus expressed as nitrate-nitrogen, even where ammonia-nitrogen and nitrite-nitrogen data were included in the analysis.

objectives) for specific management zones. Chapter 5 specifies detailed requirements noticed Public Hearing, the Regional Board finds that “maximum benefit” is not being demonstrated, then the “antidegradation” objectives apply for regulatory purposes.

## THE SANTA ANA RIVER

Setting objectives for the flowing portions of the Santa Ana River is a significant feature of this Basin Plan. The River provides water for recreation and for aquatic and wildlife habitat. River flows are a significant source of groundwater recharges in lower basin, which provides domestic supplies for more than two million people. These flows account for about 70% of the total recharge.

The dividing line between reaches 2 and 3 of the River, and between the upper and lower Santa Ana Basins, is Prado Dam, a flood control facility built and operated by the U.S. Army Corps of Engineers. The dam includes a subsurface groundwater barrier, and as a result all ground and surface waters form the upper basin are forced to pass through the dam (or over the spillway). For this reason, it is an ideal place to measure flows and monitor water quality.

The Prado Settlement, a stipulated court judgement (Orange County Water District vs. City of Chino, *et al*), which requires that a certain minimum amount of water be released each year from the upper basin, is overseen by the Santa Ana River Watermaster. The U.S. Geologic Survey (USGS) operates a permanent continuous monitoring station immediately below Prado Dam, and the data collected there are utilized by the Watermaster. Orange County Water District (OCWD) samples the river monthly at the USGS gage and determines the water quality. Compliance with the objective for reaches 2 and 3 is monitored by the Regional Board, using the data and information available from the USGS gage and these sources, plus the data from its own specific sampling programs. (see Chapter 6).

The quality of the Santa Ana River is a function of the quantity and quality of the various components of the flows. The two major components of total flow are storm flow and base flow. Storm flow is the water which results directly from rainfall (surface runoff) in the upper basin; it also includes the stormwater runoff form the San Jacinto Basin which may reach the River via Temescal Creek. Most storms occur during the winter rainy season (December through April). Base flow is composed of wastewater discharges, rising groundwater, and nonpoint source discharges. Wastewater discharges are the treated sewage effluents discharged by municipalities to the river and its tributaries. Rising groundwater occurs at a number of locations along the River, including the San Jacinto Fault, Riverside Narrows, and in or near the Prado flood Control Basin. Nonpoint source discharges include uncontrolled runoff from agricultural and urban areas which is not related to storm flows.

Nontributary flow is a third element of total flow. It is generally imported water released in the upper basin, for recharge in the lower basin (Santa Ana Forebay).

The Santa Ana River Watermaster calculates the amount and quality of total flow for each water year (October 1 to September 30). The Watermaster's Annual Report is used to determine compliance with the stipulated judgement referred to earlier, which set quality and quantity limits on the river. The Watermaster's report presents summary data compiled from the continuous monitoring of flow in cfs (cubic feet per second) and salinity as EC (electrical conductivity) at the USGS Prado Gaging Station. The Watermaster's annual determination of total flow quality will be used to determine compliance with the total flow objective in this Plan. In years of normal rainfall, most of the total flow of the river is percolated in the Santa Ana Forebay, and directly affects the quality of the groundwater. For that reason, compliance with the total dissolved solids (TDS) water quality objective for Reach 2 will be based on the five-year moving average of the annual TDS content of total flow. Use of this moving average allows the effects of wet and dry years to be smoothed out over the five-year period.

As was noted earlier, the three components of base flow in the river are wastewater, rising water, and nonpoint source discharges. These three components are present in varying amounts throughout the year, and the contributions and quality of each can be affected by the regulatory activities of the Regional Board. The quantity of storm flow is obviously highly variable; programs to control its quality are in their nascent stages. For these reasons, water quality objectives for controllable constituents are set based on the base flow of the river, rather than on total flow.

The regulatory activities of the Regional Board include setting waste discharge requirements on point source discharges. Waste discharges requirements are developed on the basis of the limited assimilative capacity of the river (see TDS and Nitrogen Wasteload Allocation, Chapter 5). Nonpoint source discharges, generally urban runoff (nuisance water) and agricultural tailwater, will be regulated by requiring compliance with Best Management Practices (BMPs), where appropriate. The rising water component of base flow will be affected by the extraction of brackish groundwater in several subbasins (a Basin Plan implementation action), by regulation of wastewater discharges, and other activities.

In order to determine whether the water quality and quantity objectives for base flow in Reach 3 are being met, the Regional Board will collect a series of grab and composite samples when the influence of storm flows and nontributary flows is at a minimum. This typically occurs during August and September. At this time of year, there is usually no water impounded behind Prado Dam. The volumes of storm flows, rising water and nonpoint source discharges tend to be low. The major component of base flow at this time is municipal wastewater. The results of this sampling will be compared with the continuous monitoring data collected by USGS and data from other sources. These data will be used to evaluate the efficacy of the Regional Board's regulatory approach, including the TDS and nitrogen wasteload allocations (see Chapter 5). Additional sampling in Reach 3 by the Board and other agencies will help evaluate the fate and effects of the various constituents

of base flow, including the validity of the 50% nitrogen loss coefficient (discussed in Chapter 5).

Future river flows and quality (TDS and TIN) were projected by computer models. The results indicate that the objectives for TDS and total nitrogen will be met. The objectives for individual mineral constituents are expected to be met if the TDS objective is met.

### Prado Basin Surface Water Management Zone

As discussed in Chapter 3 – Beneficial Uses, the Prado Basin Management Zone (PBMZ) is generally defined as a surface water feature within the Prado Basin. It is defined by the 566-foot elevation above mean sea level along the Santa Ana River and the four tributaries to the Santa Ana River in the Prado Basin (Chino Creek, Temescal Creek, Mill Creek and Cucamonga Creek). Nitrogen, TDS and other water quality objectives that have been established for these surface waters that flow within the proposed PBMZ are shown in Table 4-1. For the purpose of regulating discharges that would affect the PBMZ and downstream waters, these surface water objectives apply. This application of the existing surface water objectives assures continued water quality and beneficial use protection for waters within and downstream of the PBMZ.

## "MAXIMUM BENEFIT" WATER QUALITY OBJECTIVES

As part of the 2004 update of the TDS/Nitrogen Management plan in the Basin Plan, several agencies proposed that alternative, less stringent TDS and/or nitrate-nitrogen water quality objectives be adopted for specific groundwater management zones and surface waters. These proposals were based on additional consideration of the factors specified in Water Code Section 13241 and the requirements of the State's antidegradation policy (State Board Resolution No. 68-16). Since the less stringent objectives would allow a lowering of water quality, the agencies were required to demonstrate that their proposed objectives would protect beneficial uses, and that water quality consistent with maximum benefit to the people of the state would be maintained (thus, the use of the term "maximum benefit" water quality objectives).

Appropriate beneficial use protection/maximum benefit demonstrations were made by the Chino Basin Watermaster/Inland Empire Utilities Agency, the Yucaipa Valley Water District and the City of Beaumont/San Timoteo Watershed Management Authority to justify alternative "maximum benefit" objectives for the Chino North, Cucamonga, Yucaipa, Beaumont and San Timoteo groundwater management zones. These "maximum benefit" proposals, which are described in detail in Chapter 5 – Implementation, entail commitments by the agencies to implement specific projects and programs. While these agencies' efforts to develop these proposals indicate their strong interest to proceed with these commitments, unforeseen circumstances may impede or preclude it. To address this possibility,

this Plan includes both the “antidegradation” and “maximum benefit” objectives for the subject waters (See Table 4-1). Chapter 5 specifies the requirements for implementation of these objectives. Provided that these agencies’ commitments are met, then the agencies have demonstrated maximum benefit, and the “maximum benefit” objectives included in Table 4-1 for these waters apply for regulatory purposes. However, if the Regional Board finds that these commitments are not being met and that “maximum benefit” is thus not demonstrated, then the “antidegradation” objectives for these waters will apply. Chapter 5 also describes the mitigation requirements that will apply should discharges based on “maximum benefit” objectives occur unsupported by the demonstration of “maximum benefit”.

**COMPLIANCE WITH OBJECTIVES (Amended by Resolution No. 00-27, May 19, 2000)**

“The Regional Board recognizes that immediate compliance with new, revised or newly interpreted water quality objectives adopted by the Regional Board or the State Water Resources Control Board, or with new, revised or newly interpreted water quality criteria promulgated by the U.S. Environmental Protection Agency, may not be feasible in all circumstances. Where the Regional Board determines that it is infeasible for a discharger to comply immediately with effluent limitations specified to implement such objectives or criteria, compliance shall be achieved in the shortest practicable period of time, not to exceed ten years after the adoption or interpretation of applicable objectives or criteria. This provision authorizes schedules of compliance for objectives and criteria that are adopted or revised or newly interpreted after the effective date of this amendment July 15, 2002.

REFERENCES

The “Federal Clean Water Act,” 33 USC 466 *et seq*.

California Water Code, Section 13000 “Water Quality,” *et seq*.

California State Water Resources Control Board, “Water Quality Criteria, Second Edition,” 1963.

US EPA, “Ambient Water Quality Criteria for Ammonia,” 1984.

US EPA Memorandum, “Revised Tables for Determining Average Freshwater Ammonia Concentrations,” 1992.

California State University, Fullerton, “Investigation of Un-ionized Ammonia in the Santa Ana River, Final Project Report,” February 1988.

California Regional Water Quality Control Board, “Public Workshop – Review of the Un-ionized Ammonia Objective – Summary of Findings & Recommendations,” Staff Report, December 1988.

Santa Ana Watershed Project Authority, “Final Report, Santa Ana River Use-Attainability Analysis,” June 1992.

California Regional Water Quality Control Board, Resolution No. 93-64, “Resolution Amending the Water Quality Control Plan to Set Site-Specific Water Quality Objectives for Cadmium, Copper, and Lead in the Middle Santa Ana River,” October 1993.

ENSR Consulting and Engineering, “Short-Term Chronic Toxicity of Un-ionized Ammonia to Fathead Minnows (*Pimephales promelas*) in a Site Water,” September 1993.

California Code of Regulations (CCR), Division 4, Chapter 15, Article 16, § 64449

Wildermuth Environmental, Inc., TIN/TDS – Phase 2A of the Santa Ana Watershed, Development of Groundwater Management Zones, Estimation of Historic and Current TDS and Nitrogen Concentrations in Groundwater, Final Technical Memorandum,” July 2000.

40 Code of Federal Regulations (CFR), Chapter 1, § 143,3

The Resources Agency of California, State Water Resources Control Board, Publication No. 3-1, “Water Quality Criteria”, pages 258-26, 1963

US Geological Survey, “Basic Ground-Water Hydrology”, Water Supply Paper 2220, pages 64-65, 1984

California State Water Resources Control Board, “Irrigation with Reclaimed Municipal Wastewater, A Guidance Manual”, Report No. 84-1, wr, July 1984.

## REGION 8 INDEX

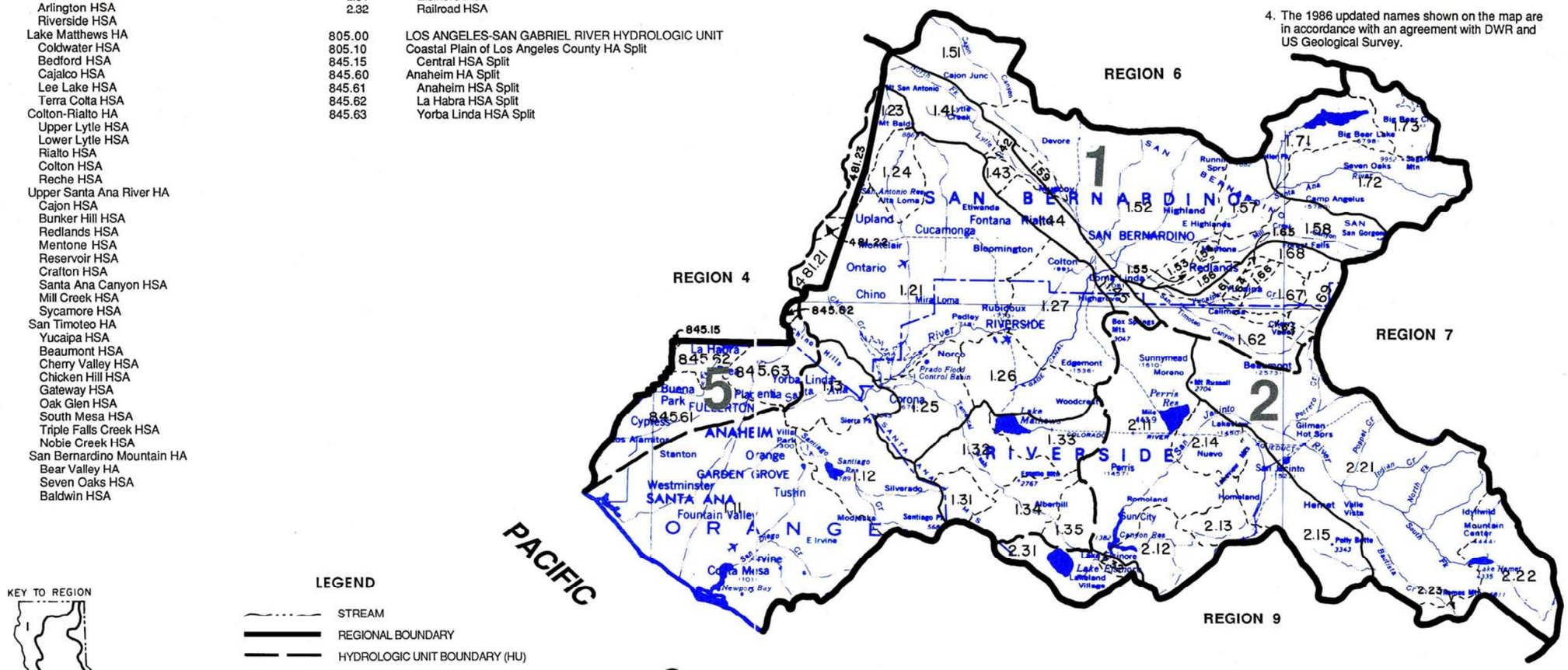
| | |
|---|---|
| 801.00 | SANTA ANA RIVER HYDROLOGIC UNIT |
| 801.10 | Lower Santa Ana River HA |
| 1.11 | East Coastal Plain HSA |
| 1.12 | Santiago HSA |
| 1.13 | Santa Ana Narrows HSA |
| 801.20 | Middle Santa Ana River HA Split |
| 801.21 | Chino HSA Split |
| 481.21 | Chino HSA Split |
| 481.22 | Harrison HSA |
| 801.23 | Claremont Heights HSA Split |
| 481.23 | Claremont Heights HSA Split |
| 801.24 | Cucamonga HSA |
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| 1.52 | Bunker Hill HSA |
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| 1.56 | Crafton HSA |
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| 1.65 | Gateway HSA |
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| 1.67 | South Mesa HSA |
| 1.68 | Triple Falls Creek HSA |
| 1.69 | Nobie Creek HSA |
| 801.70 | San Bernardino Mountain HA |
| 1.71 | Bear Valley HSA |
| 1.72 | Seven Oaks HSA |
| 1.73 | Baldwin HSA |

| | |
|---|---|
| 802.00 | SAN JACINTO VALLEY HYDROLOGIC UNIT |
| 802.10 | Perris HA |
| 2.11 | Perris Valley HSA |
| 2.12 | Menifee HSA |
| 2.13 | Winchester HSA |
| 2.14 | Lakeview HSA |
| 2.15 | Hemet HSA |
| 802.20 | San Jacinto HA |
| 2.21 | Gilman Hot Springs HSA |
| 2.22 | Hemet Lake HSA |
| 2.23 | Bautista HSA |
| 802.30 | Elsinore Valley HA |
| 2.31 | Elsinore HSA |
| 2.32 | Railroad HSA |

| | |
|---|---|
| 805.00 | LOS ANGELES-SAN GABRIEL RIVER HYDROLOGIC UNIT |
| 805.10 | Coastal Plain of Los Angeles County HA Split |
| 845.15 | Central HSA Split |
| 845.60 | Anaheim HA Split |
| 845.61 | Anaheim HSA Split |
| 845.62 | La Habra HSA Split |
| 845.63 | Yorba Linda HSA Split |

NOTE:

1. The names and areas shown on this map are the same as used by the Department of Water Resources (DWR) in their Bulletin 130 Series except as explained below.
2. The numbering system used on this map is an adaptation of the numbering system used in the 130 Series.
3. The boundary between Region 8 and Region 4 follows the boundary between Los Angeles County and Orange or San Bernardino Counties, not the Hydrologic Boundary. The San Bernardino County line splits Hydrologic Unit 1 (Santa Ana River HU) so that Sub-Areas 481.21, 481.22, and 481.23 are legally in Region 4 but drain into Region 8. The Orange County line splits Hydrologic Unit 5 (Los Angeles-San Gabriel River HU) so that Sub-Areas 845.15, 845.61, 845.62 and 845.63 are legally in Region 8 but drain into Region 4. Therefore, a 5 digit number on the map indicates that a regional boundary divides a hydrologic unit, area or subarea. In these cases the second digit is the number of the region from which the hydrologic area has been separated by the regional boundary. All other digits are as described in the legend.
4. The 1986 updated names shown on the map are in accordance with an agreement with DWR and US Geological Survey.


REGION 6
REGION 4
REGION 7
REGION 9
PACIFIC OCEAN
SAN BERNARDINO
RIVERSIDE
ORANGE
ANAHEIM
SANTA ANA
GARDEN GROVE
FULLERTON
Upland
Ontario
Chino
Fontana
Rialto
Cucamonga
Bloomington
Colton
Redlands
Yucaipa
Beaumont
Banning
Corona
Norco
Riverside
Moreno Valley
Perris
Hemet
San Jacinto
Lake Elsinore
Menifee
Murrieta
Temecula
Lake Matthews
Woodcrest
Edgemont
Sunnymead
Highland
Devore
Big Bear Lake
Seven Oaks
Camp Angelus
Mt San Antonio
Mt Baldy
Cajon Junc
Stanton
Westminster
Tustin
Irvine
Costa Mesa
Newport Bay
Laguna Beach
Dana Point
San Clemente
Lake Forest
Mission Viejo
Rancho Santa Margarita
Trabuco Canyon
Silverado
Modjeska
Yorba Linda
Placentia
Buena Park
Cypress
Los Alamitos
Villa Park
Orange
Tustin
Irvine
Foothill Ranch
Coto de Caza
Ladera Ranch
Aliso Viejo
Laguna Niguel
Laguna Hills
Lake Forest
Rancho Santa Margarita
Mission Viejo
Trabuco Canyon
Silverado
Modjeska
Santiago Res
Santiago Peak
Santiago Creek
Santa Ana River
Prado Flood Control Basin
Lake Mathews
Lake Elsinore
Lake Perris
Lake Hemet
Diamond Valley Lake
Railroad Canyon Res
Canyon Lake
Lake Elsinore
Lake Matthews
Mt Russell
Box Springs Mts
Sierra Peak
Cajon Creek
Lytle Creek
Lytle Creek Wash
Cajon Wash
Devil Canyon
Waterman Canyon
Glen Helen Pkwy
Big Bear Dam
Big Bear City
Sugarloaf Mtn
Running Spring
Arrowhead Springs
Mentone
E Highlands
San Gorgonio Falls
Crafton
Loma Linda
Redlands
Calimesa
Cherry Valley
Beaumont
Banning
Sunnymead
Moreno
Edgemont
Woodcrest
Norco
Corona
Riverside
Perris
Nuevo
Lakeview
San Jacinto
Gilman Hot Spgs
Romoland
Homeland
Sun City
Canyon Lake
Lake Elsinore
Lakeland Village
Hemet
Valle Vista
Idyllwild
Mountain Center
Lake Hemet
Pine Meadow
Box Springs Mts
Pigeon Pass
Alessandro
Arlington
Mockingbird Canyon
Temescal Canyon
Coldwater Canyon
Bedford Canyon
Cajalco Canyon
Lee Lake
Terra Cotta
Reche Canyon
Colton
Rialto
Fontana
Cucamonga
Bloomington
Ontario
Chino
Mira Loma
Rubidoux
Pedley
Jurupa Mts
Santa Ana Mts
Santa Ana Canyon
Modjeska Canyon
Trabuco Creek
Oso Creek
Aliso Creek
Arroyo Trabuco
Chiquita Canyon
Gobernadora Canyon
Bell Canyon
Tenaja Canyon
Wildomar
Murrieta
Temecula
Pechanga
Rancho California
Vail Lake
Domenigoni Valley
Diamond Valley Lake
Hemet Lake
Bautista Creek
Bautista Canyon
Poppet Flat
Indian Flat
North Fork
South Fork
Strawberry Peak
Santa Rosa Plateau
Santa Rosa Mts
Agua Tibia Mts
Palomar Mtn
Mt San Jacinto
Mt San Antonio
Mt Baldy
Cucamonga Peak
Sierra Peak
Telegraph Peak
Mt Gleason
Mt Wilson
Mt Lowe
Mt Harvard
Mt Rubidoux
Mt Russell
Mt Baldy

## Table 4-1 WATER QUALITY OBJECTIVES

| OCEAN WATERS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **NEARSHORE ZONE*** | | | | | | | | | |
| San Gabriel River to Poppy Street in Corona del Mar+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Poppy Street to Southeast Regional Boundary+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| **OFFSHORE ZONE** | | | | | | | | | |
| Waters Between Nearshore Zone And Limit of State Waters+ | --- | --- | --- | --- | --- | --- | --- | | |

* Defined by Ocean Plan Chapter II A.1.: "Within a zone bounded by shoreline and a distance of 1000 feet from shoreline or the 30-foot depth Contour, whichever is further from shoreline…"

\+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| BAYS, ESTUARIES, AND TIDAL PRISMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solid** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Anaheim Bay – Outer Bay+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Anaheim Bay – Seal Beach National Wildlife Refuge+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Sunset Bay – Huntington Harbour+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Bolsa Bay+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Bolsa Chica Ecological Reserve+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Lower Newport Bay+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Upper Newport Bay+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Santa Ana River Salt Marsh+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Tidal Prism of Santa Ana River (to within 1000' of Victoria Street) and Newport Slough+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| Tidal Prism of San Gabriel River – River Mouth to Marina Drive+ | --- | --- | --- | --- | --- | --- | --- | 845.61 | |
| Tidal Prisms of Flood Control Channels Discharging to Coastal or Bay Waters+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |

+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| **INLAND SURFACE STREAMS** | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | |
| Santa Ana River | | | | | | | | | |
| Reach 1 – Tidal Prism to 17th Street in Santa Ana+ | (Flood Flows Only) | | | | | | | 801.11 | |
| Reach 2 - 17th Street in Santa Ana to Prado Dam | 650[1] | --- | --- | --- | --- | --- | --- | 801.11 | 801.12 |
| Aliso Creek+ | --- | --- | --- | --- | --- | --- | --- | 845.63 | |
| Carbon Canyon Creek+ | --- | --- | --- | --- | --- | --- | --- | 845.63 | |
| Santiago Creek Drainage | | | | | | | | | |
| Santiago Creek | | | | | | | | | |
| Reach 1 – below Irvine Lake | 600 | --- | --- | --- | --- | --- | --- | 801.12 | 801.11 |
| Reach 2 - Irvine Lake (see Lakes, Pg. 4-46) | | --- | --- | --- | --- | --- | --- | | |
| Reach 3 – Irvine Lake to Modjeska Canyon | 350 | 260 | 20 | 12 | 2 | 80 | --- | 801.12 | |
| Reach 4 – in Modjeska Canyon | 350 | 260 | 20 | 12 | 2 | 80 | --- | 801.12 | |
| Silverado Creek | 650 | 450 | 30 | 20 | 1 | 275 | --- | 801.12 | |
| Black Star Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.12 | |
| Ladd Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.12 | |

[1] Five-year moving average

\+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| **INLAND SURFACE STREAMS** | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| San Diego Creek Drainage | | | | | | | | | |
| San Diego Creek | | | | | | | | | |
| Reach 1 – below Jeffrey Road | 1500 | --- | --- | --- | 13 | --- | 90 | 801.11 | |
| Reach 2 – above Jeffrey Road to Headwaters | 720 | --- | --- | --- | 5 | --- | --- | 801.11 | |
| Other Tributaries: Bonita Creek, Serrano Creek, Peters Canyon Wash, Hicks Canyon Wash, Bee Canyon Wash, Borrego Canyon Wash, Agua Chinon Wash, Laguna Canyon Wash, Rattlesnake Canyon Wash, Sand Canyon Wash and other Tributaries to these Creeks+ | --- | --- | --- | --- | --- | --- | --- | 801.11 | |
| San Gabriel River Drainage | | | | | | | | | |
| Coyote Creek (within Santa Ana Regional Boundary)+ | --- | --- | --- | --- | --- | --- | --- | | |

+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| **INLAND SURFACE STREAMS** | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | | |
| Santa Ana River | | | | | | | | | |
| Reach 3 – Prado Dam to Mission Blvd. in Riverside – Base Flow[2] | 700 | 350 | 110 | 140 | 10[3] | 150 | 30 | 801.21 | 801.27, 801.25 |
| Reach 4 – Mission Blvd. in Riverside to San Jacinto Fault in San Bernardino | 550 | --- | --- | --- | 10 | --- | 30 | 801.27 | 801.44 |
| Reach 5 – San Jacinto Fault in San Bernardino to Seven Oaks Dam | 300 | 190 | 30 | 20 | 5 | 60 | 25 | 801.52 | 801.57 |
| Reach 6 – Seven Oaks Dam to Headwaters (see also Individual Tributary Streams) | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.72 | |
| San Bernardino Mountain Streams | | | | | | | | | |
| Mill Creek Drainage: | | | | | | | | | |
| Mill Creek | | | | | | | | | |
| Reach 1 – Confluence with Santa Ana River to Bridge Crossing Route 38 at Upper Powerhouse | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.58 | |
| Reach 2 – Bridge Crossing Route 38 at Upper Powerhouse to Headwaters | 110 | 100 | 25 | 5 | 1 | 15 | 5 | 801.58 | |

[2] Additional Objectives: Boron: 0.75 mg/l

[3] Total nitrogen, filtered sample

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Mountain Home Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.58 | |
| Mountain Home Creek, East Fork | 200 | --- | --- | --- | --- | --- | --- | 801.70 | |
| Monkey Face Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.70 | |
| Alger Creek | 200 | --- | --- | --- | --- | --- | --- | 801.70 | |
| Falls Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.70 | |
| Vivian Creek | 200 | --- | --- | --- | --- | --- | --- | 801.70 | |
| High Creek | 200 | --- | --- | --- | --- | --- | --- | 801.70 | |
| Other Tributaries: Lost, Oak Cove, Green, Skinner, Momyer, Glen Martin, Camp, Hatchery, Rattlesnake, Slide, Snow, Bridal Veil, and Oak Creeks, and other Tributaries to these Creeks | 200 | --- | --- | --- | --- | --- | --- | 801.70 | |
| Bear Creek Drainage: | | | | | | | | | |
| Bear Creek | 175 | 115 | 10 | 10 | 1 | 4 | 5 | 801.71 | |
| Siberia Creek | 200 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Slide Creek | 175 | --- | --- | --- | --- | --- | --- | 801.71 | |
| All other Tributaries to these Creeks+ | --- | --- | --- | --- | --- | --- | --- | 801.71 | |
| Big Bear Lake (see Lakes, pg. 4-46) | | | | | | | | | |

\+ Numeric objectives have not been established; narrative objectives apply. .

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Big Bear Lake Tributaries: | | | | | | | | | |
| North Creek | 175 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Metcalf Creek | 175 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Grout Creek | 150 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Rathbone (Rathbun) Creek | 300 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Meadow Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.71 | |
| Summit Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.71 | |
| Other Tributaries to Big Bear Lake: Knickerbocker, Johnson, Minnelusa, Polique, and Red Ant Creeks, and other Tributaries to these Creeks | 175 | --- | --- | --- | --- | --- | --- | 801.71 | |
| Baldwin Lake (see Lakes, pg. 4-46) | | | | | | | | | |
| Baldwin Lake Drainage: | | | | | | | | | |
| Shay Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.73 | |
| Other Tributaries to Baldwin Lake: Sawmill, Green, and Caribou Canyons and other Tributaries to these Creeks+ | --- | --- | --- | --- | --- | --- | --- | 801.73 | |

\+ Numeric objectives have not been established; narrative objectives apply. .

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Other Streams Draining to Santa Ana River (Mountain Reaches[1]) | | | | | | | | | |
| Cajon Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.51 | |
| City Creek | 200 | 115 | 30 | 10 | 1 | 20 | 5 | 801.57 | |
| Devil Canyon Creek | 275 | 125 | 35 | 20 | 1 | 25 | 5 | 801.57 | |
| East Twin and Strawberry Creeks | 475 | --- | --- | --- | --- | --- | --- | 801.57 | |
| Waterman Canyon Creek | 250 | --- | --- | --- | --- | --- | --- | 801.57 | |
| Fish Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.57 | |
| Forsee Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.72 | |
| Plunge Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.72 | |
| Barton Creek | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.72 | |
| Bailey Canyon Creek | 200 | --- | --- | --- | --- | --- | --- | 801.72 | |
| Kimbark Canyon, East Fork Kimbark Canyon, Ames Canyon And West Fork Cable Canyon Creeks | 325 | --- | --- | --- | --- | --- | --- | 801.52 | |
| Valley Reaches[‡] of Above Streams | (Water Quality Objectives Correspond to Underlying GW Basin Objectives) | | | | | | | 801.52 | |

[‡] The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Other Tributaries (Mountain Reaches[1]): Alder, Badger Canyon, Bledsoe Gulch, Borea Canyon, Breakneck, Cable Canyon, Cienega Seca, Cold, Converse, Coon, Crystal, Deer, Elder, Fredalba, Frog, Government, Hamilton, Heart Bar, Hemlock, Keller, Kilpecker, Little Mill, Little Sand Canyon, Lost, Meyer Canyon, Mile, Monroe Canyon, Oak, Rattlesnake, Round Cienega, Sand, Schneider, Staircase, Warm Springs Canyon And Wild Horse Creeks, and other tributaries to those Creeks | 200 | 100 | 30 | 10 | 1 | 20 | 5 | 801.72 | 801.71, 801.57 |
| San Gabriel Mountain Streams (Mountain Reaches[‡]) | | | | | | | | | |
| San Antonio Creek | 225 | 150 | 20 | 6 | 4 | 25 | 5 | 801.23 | |
| Lytle Creek (South, Middle, and North Forks) and Coldwater Canyon Creek | 200 | 100 | 15 | 4 | 4 | 25 | 5 | 801.41 | 801.42, 801.52, 801.59 |
| Day Creek | 200 | 100 | 15 | 4 | 4 | 25 | 5 | 801.21 | |
| East Etiwanda Creek | 200 | 100 | 15 | 4 | 4 | 25 | 5 | 801.21 | |
| Valley Reaches[‡] of Above Streams | (Water Quality Objectives Correspond to Underlying GW Basin Objectives) | | | | | | | 801.21 | |

‡ The division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Cucamonga Creek | | | | | | | | | |
| Reach 1 – Confluence with Mill Creek to 23rd St. in Upland+ | --- | --- | --- | --- | --- | --- | --- | 801.21 | |
| Reach 2 ( Mountain Reach‡) – 23rd St. in Upland to headwaters | 200 | 100 | 15 | 4 | 4 | 25 | 5 | 801.24 | |
| Mill Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.25 | |
| Other Tributaries (Mountain Reaches+): Cajon Canyon, San Sevaine, Deer, Duncan Canyon, Henderson Canyon, Bull, Fan, Demens, Thorpe, Angalls, Telegraph Canyon, Stoddard Canyon, Icehouse Canyon, Cascade Canyon, Cedar, Failing Rock, Kerkhoff and Cherry Creeks, and other Tributaries to these Creeks | 200 | --- | --- | --- | --- | --- | --- | 801.21 | 801.23 |
| San Timoteo Area Streams | | | | | | | | | |
| San Timoteo Creek ** | | | | | | | | | |
| Reach 1A – Santa Ana River Confluence to Barton Road | --- | --- | --- | --- | --- | --- | --- | 801.52 | 801.53 |
| Reach 1B – Barton Road to Gage at San Timoteo Canyon Rd. u/s of Yucaipa Valley WD discharge | --- | --- | --- | --- | --- | --- | --- | 801.52 | 801.53 |
| Reach 2 – Gage at San Timoteo Canyon Road to Confluence with Yucaipa Creek | --- | --- | --- | --- | --- | --- | --- | 801.52 | 801.62 |

\+ Numeric objectives have not been established; narrative objectives apply

‡ The Division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

** Surface water objectives not established; underlying Management Zone objectives apply. Biological quality protected by narrative objectives

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Reach 2 – Gage at San Timoteo Canyon Road to Confluence with Yucaipa Creek | --- | --- | --- | --- | --- | --- | --- | 801.52 | 801.62 |
| Reach 3** – Confluence with Yucaipa Creek to confluence with Little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek) | --- | --- | --- | --- | --- | --- | --- | 801.62 | |
| Oak Glen, Potato Canyon and Birch Creeks | 230 | 125 | 50 | 40 | 3 | 45 | 5 | 801.67 | |
| Little San Gorgonio Creek | 230 | 125 | 50 | 40 | 3 | 45 | 5 | 801.69 | 801.62, 801.63 |
| Yucaipa Creek | 290 | 175 | 60 | 60 | 6 | 45 | 15 | 801.67 | 801.61, 801.62 801.64 |
| Other Tributaries to these Creeks – Valley Reaches +‡ | --- | --- | --- | --- | --- | --- | --- | 801.62 | 801.52, 801.53 |
| Other Tributaries to these Creeks – Mountain Reaches‡ | 290 | --- | --- | --- | --- | --- | --- | 801.69 | 801.67 |
| Anza Park Drain+ | --- | --- | --- | --- | --- | --- | --- | 801.27 | |
| Sunnyslope Channel+ | --- | --- | --- | --- | --- | --- | --- | 801.27 | |
| Tequesquite Arroyo (Sycamore Creek)+ | --- | --- | --- | --- | --- | --- | --- | 801.27 | |

\+ Numeric objectives have not been established; narrative objectives apply

** Surface water objectives not established; underlying Management Zone objectives apply. Biological quality protected by narrative objectives

‡ The Division between Mountain and Valley reaches occurs at the base of the foothills of the San Bernardino or San Gabriel Mountains

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Prado Area Streams | | | | | | | | | |
| Chino Creek | | | | | | | | | |
| Reach 1A – Santa Ana River confluence to downstream of confluence with Mill Creek (Prado Area) – Base Flow* | 700 | 350 | 110 | 140 | 10** | 150 | 30 | 801.21 | |
| Reach 1B – Confluence of Mill Creek (Prado Area) to beginning of concrete-lined channel south of Los Serranos Road | 550 | 240 | 75 | 75 | 8 | 60 | 15 | 801.21 | |
| Reach 2 – Beginning of concrete lined channel south of Los Serranos Road to confluence with San Antonio Creek | --- | --- | --- | --- | --- | --- | --- | 801.21 | |
| Temescal Creek | | | | | | | | | |
| Reach 1 – Lincoln Avenue to Riverside Canal+ | --- | --- | --- | --- | --- | --- | --- | 801.25 | |
| Reach 2 – Riverside Canal to Lee Lake+ | --- | --- | --- | --- | --- | --- | --- | 801.32 | 801.25 |
| Reach 3 – Lee Lake, (see Lakes, Pg. 4-46) | | | | | | | | | |

* Additional objective: Boron 0.75 mg/l

** Total nitrogen, filtered sample

\+ Numeric objectives have not been established; narrative objectives apply

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Reach 4 – Lee Lake to Mid-section line of Section 17 (downstream end of freeway cut)+ | --- | --- | --- | --- | --- | --- | --- | 801.34 | |
| Reach 5 – Mid-section line of Section 17 (downstream end of freeway cut) to Elsinore Groundwater Subbasin Boundary+ | --- | --- | --- | --- | --- | --- | --- | 801.35 | |
| Reach 6 – Elsinore Groundwater Subbasin Boundary to Lake Elsinore Outlet+ | --- | --- | --- | --- | --- | --- | --- | 801.35 | |
| Coldwater Canyon Creek | 250 | --- | --- | --- | --- | --- | --- | 801.32 | |
| Bedford Canyon Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.32 | |
| Dawson Canyon Creek+ | --- | --- | --- | --- | --- | --- | --- | 801.32 | |
| Other Tributaries to these Creeks | 250 | --- | --- | --- | --- | --- | --- | 801.32 | |

\+ Numeric objectives have not been established; narrative objectives apply

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| INLAND SURFACE STREAMS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **San Jacinto River Basin** | | | | | | | | | |
| San Jacinto River | | | | | | | | | |
| Reach 1 – Lake Elsinore to Canyon Lake | 450 | 260 | 50 | 65 | 3 | 60 | 15 | 802.32 | 802.31 |
| Reach 2 – Canyon Lake (see Lakes, Pg. 4-47) | | | | | | | | | |
| Reach 3 – Canyon Lake to Nuevo Road | 820 | 400 | --- | 250 | 6 | --- | 15 | 802.11 | |
| Reach 4 – Nuevo Road to North-South Mid-Section Line, T4S/R1W-38* | 500 | 220 | 75 | 125 | 5 | 65 | --- | 802.14 | 802.21 |
| Reach 5 – North-South Mid-Section Line, T4S/R1 W-SB, to Confluence With Poppet Creek | 300 | 140 | 30 | 25 | 3 | 40 | 12 | 802.21 | |
| Reach 6 – Poppet Creek to Cranston Bridge | 250 | 130 | 25 | 20 | 1 | 30 | 12 | 802.21 | |
| Reach 7 – Cranston Bridge to Lake Hemet | 150 | 100 | 10 | 15 | 1 | 20 | 5 | 802.21 | |
| Bautista Creek – Headwaters to Debris Dam | 250 | 130 | 25 | 20 | 1 | 30 | 5 | 802.21 | 802.23 |
| Strawberry Creek and San Jacinto River, North Fork | 150 | 100 | 10 | 15 | 1 | 20 | 5 | 802.21 | |

* Note the quality objective for Reach 4 is not intended to preclude transport of water supplies or delivery to Canyon Lake

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| **INLAND SURFACE STREAMS** | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| Fuller Mill Creek | 150 | 100 | 10 | 15 | 1 | 20 | 5 | 802.22 | |
| Stone Creek | 150 | 100 | 10 | 15 | 1 | 20 | 5 | 802.21 | |
| Salt Creek+ | --- | --- | --- | --- | --- | --- | --- | 802.12 | |
| Other Tributaries: Logan, Black Mountain, Juaro Canyon, Indian, Hurkey, Poppet and Protrero Creeks, and other Tributaries to these Creeks | 150 | 70 | 10 | 12 | 1 | 15 | 5 | 802.12 | 802.22 |

+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| LAKES AND RESERVOIRS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | | |
| Baldwin Lake*+ | --- | --- | --- | --- | --- | --- | --- | 801.73 | |
| Big Bear Lake** | 175 | 125 | 20 | 10 | 0.15 | 10 | --- | 801.71 | |
| Erwin Lake+ | --- | --- | --- | --- | --- | --- | --- | 801.73 | |
| Evans Lake | 490 | --- | --- | --- | --- | --- | --- | 801.27 | |
| Jenks Lake | 200 | 100 | 30 | 10 | 1 | 20 | --- | 801.72 | |
| Lee Lake+ | --- | --- | --- | --- | --- | --- | --- | 801.34 | |
| Mathews, Lake | 700 | 325 | 100 | 90 | --- | 290 | --- | 801.33 | |
| Mockingbird Reservoir | 650 | --- | --- | --- | --- | --- | --- | 801.26 | |
| Norconian, Lake | 1050 | --- | --- | --- | --- | --- | --- | 801.25 | |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | | |
| Anaheim Lake | 600 | --- | --- | --- | --- | --- | --- | 801.11 | |
| Irvine Lake (Santiago Reservoir) | 730 | 360 | 110 | 130 | 6 | 310 | --- | 801.12 | |
| Laguna, Lambert, Peters Canyon, Rattlesnake, Sand Canyon, and Siphon Reservoirs | 720 | --- | --- | --- | --- | --- | --- | 801.11 | |

* Fills occasionally with storm flows; may evaporate completely

** Additional Objective: 0.15 mg/l Phosphorus

\+ Numeric objectives have not been established; narrative objectives apply.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| LAKES AND RESERVOIRS | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| **SAN JACINTO RIVER BASIN** | | | | | | | | | |
| Canyon Lake (Railroad Canyon Reservoir)*** | 700 | 325 | 100 | 90 | 8 | 290 | --- | 802.11 | 802.12 |
| Elsinore, Lake**** | 2000 | --- | --- | --- | 1.5 | --- | --- | 802.31 | |
| Fulmor, Lake | 150 | 70 | 10 | 12 | 1 | 15 | --- | 802.21 | |
| Hemet, Lake | 135 | --- | 25 | 20 | 1 | 10 | --- | 802.22 | |
| Perris, Lake | 220 | 110 | 50 | 55 | 1 | 45 | --- | 802.11 | |

*** Note: The quality objectives for Canyon Lake is not intended to preclude transport of water supplies or delivery to the Lake.
**** Lake volume and quality highly variable

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| **WETLANDS (INLAND)** | WATER QUALITY OBJECTIVES (mg/l) | | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Total Inorganic Nitrogen** | **Sulfate** | **Chemical Oxygen Demand** | Primary | Secondary |
| San Jacinto Freshwater Marsh** | 2000 | --- | --- | --- | 13 | --- | 90 | 801.11 | |
| Shay Meadows+ | --- | --- | --- | --- | | --- | --- | 801.73 | |
| Stanfield Marsh+** | --- | --- | --- | --- | --- | --- | --- | 801.71 | |
| Prado Basin Management Zone @ | --- | --- | --- | --- | --- | --- | --- | 801.21 | |
| San Jacinto Wildlife Preserve+** | --- | --- | --- | --- | --- | --- | --- | 802.11 | 802.14 |
| Glen Helen+ | --- | --- | --- | --- | --- | --- | --- | 801.59 | |

** This is a created wetlands as defined in the wetlands discussion (see Chapter 3)

+ Numeric objectives have not been established; narrative objectives apply

@ includes the Prado Flood Control Basin, a created wetland as defined in the wetlands discussion (see Chapter 3). Chino Creek, Reach 1A, Chino Creek, 1B, Mill Creek (Prado Area) and Santa Ana River, Reach 3 TDS and TIN numeric objectives apply (see discussion).

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| GROUNDWATER MANAGEMENT ZONES | WATER QUALITY OBJECTIVES (mg/l) | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Nitrate as Nitrogen** | **Sulfate** | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | |
| Big Bear Valley | 220 | 225 | 20 | 10 | 5.0 | 20 | 801.73 | |
| Beaumont “maximum benefit”++ | 330 | --- | --- | --- | 5.0 | --- | 801.62 | 801.63, 801.69 |
| Beaumont “antidegradation”++ | 230 | --- | --- | --- | 1.5 | --- | 801.62 | 801.63, 801.69 |
| Bunker Hill - A | 310 | --- | --- | --- | 2.7 | --- | 801.51 | 801.52 |
| Bunker Hill - B | 330 | --- | --- | --- | 7.3 | --- | 801.52 | 801.53, 801.54, 801.57 801.58 |
| Colton | 410 | --- | --- | --- | 2.7 | --- | 801.44 | 801.45 |
| Chino – North “maximum benefit”++ | 420 | --- | --- | --- | 5.0 | --- | 801.21 | 481.21, 481.23, 481.22 801.21, 801.23, 801.24 |
| Chino 1 – “antidegradation”++ | 280 | --- | --- | --- | 5.0 | --- | 802.21 | 481.21 |
| Chino 2 – “antidegradation”++ | 250 | --- | --- | --- | 2.9 | --- | 801.21 | |
| Chino 3 – “antidegradation”++ | 260 | --- | --- | --- | 3.5 | --- | 801.21 | |
| Chino – East @ | 730 | --- | --- | --- | 10.0 | --- | 801.21 | 801.27 |
| Chino – South @ | 680 | --- | --- | --- | 4.2 | --- | 801.21 | 801.26 |
| Cucamonga “maximum benefit”++ | 380 | --- | --- | --- | 5.0 | --- | 801.24 | 801.21 |

++ “Maximum benefit” objectives apply unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, “antidegradation” objectives apply (for Chino North, antidegradation objectives for Chino 1, 2, 3 would apply if maximum benefit is not demonstrated). (see discussion in Chapter 5).

@ Chino East and South are the designations in the Chino Basin Watermaster “maximum benefit” proposal (see Chapter 5) for the management Zones identified by Wildermuth Environmental, Inc., (July 2000) as Chino 4 and Chino 5, respectively.

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| GROUNDWATER MANAGEMENT ZONES | WATER QUALITY OBJECTIVES (mg/l) | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Nitrate as Nitrogen** | **Sulfate** | Primary | Secondary |
| **UPPER SANTA ANA RIVER BASIN** | | | | | | | | |
| Cucamonga "antidegradation"++ | 210 | --- | --- | --- | 2.4 | --- | 801.24 | 801.21 |
| Lytle | 260 | --- | --- | --- | 1.5 | --- | 801.41 | 801.42 |
| Rialto | 230 | --- | --- | --- | 2.0 | --- | 801.41 | 801.42 |
| San Timoteo "maximum benefit"++ | 400 | --- | --- | --- | 5.0 | --- | 801.62 | |
| San Timoteo "antidegradation"++ | 300 | --- | --- | | 2.7 | --- | 801.62 | |
| Yucaipa "maximum benefit"++ | 370 | --- | --- | --- | 5.0 | --- | 801.61 | 801.55, 801.54, 801.56, 801.63, 801.65, 801.66 801.67 |
| Yucaipa "antidegradation"++ | 320 | --- | --- | --- | 4.2 | --- | 801.61 | 801.55, 801.54, 801.56, 801.63, 801.65, 801.66 801.67 |
| **MIDDLE SANTA ANA RIVER BASIN** | | | | | | | | |
| Arlington | 980 | --- | --- | --- | 10 | --- | 801.26 | |
| Bedford** | --- | --- | --- | --- | --- | --- | 801.32 | |
| Coldwater | 380 | --- | --- | --- | 1.5 | --- | 801.31 | |
| Elsinore | 480 | --- | --- | --- | 1.0 | --- | 802.31 | |
| Lee Lake** | --- | --- | --- | --- | --- | --- | 801.34 | |

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++ "Maximum benefit" objectives apply unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, "antidegradation" objectives apply (for Chino North, antidegradation objectives for Chino 1, 2, 3 would apply if maximum benefit is not demonstrated). (see discussion in Chapter 5).

** Numeric objectives not established; narrative objectives apply

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| GROUNDWATER MANAGEMENT ZONES | WATER QUALITY OBJECTIVES (mg/l) | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Nitrate as Nitrogen** | **Sulfate** | Primary | Secondary |
| Riverside - A | 560 | --- | --- | --- | 6.2 | --- | 801.27 | |
| Riverside - B | 290 | --- | --- | --- | 7.6 | --- | 801.27 | |
| Riverside - C | 680 | --- | --- | --- | 8.3 | --- | 801.27 | |
| Riverside - D | 810 | --- | --- | --- | 10.0 | --- | 801.27 | |
| Riverside - E | 720 | --- | --- | --- | 10.0 | --- | 801.27 | |
| Riverside - F | 660 | --- | --- | --- | 9.5 | --- | 801.27 | |
| Temescal | 770 | --- | --- | --- | 10.0 | --- | 801.25 | |
| **SAN JACINTO RIVER BASIN** | | | | | | | | |
| Gardner Valley | 300 | 100 | 65 | 30 | 2.0 | 40 | 802.22 | |
| Idyllwild Area** | --- | --- | --- | --- | --- | --- | 802.22 | 802.21 |
| Canyon | 230 | --- | --- | --- | 2.5 | --- | 802.21 | |
| Hemet - South | 730 | --- | --- | --- | 4.1 | --- | 802.15 | 802.21 |
| Lakeview – Hemet North | 520 | --- | --- | --- | 1.8 | --- | 802.14 | 802.15 |

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** Numeric objectives not established; narrative objectives apply

## Table 4-1 WATER QUALITY OBJECTIVES - Continued

| GROUNDWATER MANAGEMENT ZONES | WATER QUALITY OBJECTIVES (mg/l) | | | | | | Hydrologic Unit | |
|---|---|---|---|---|---|---|---|---|
| | **Total Dissolved Solids** | **Hardness** | **Sodium** | **Chloride** | **Nitrate as Nitrogen** | **Sulfate** | Primary | Secondary |
| Menifee | 1020 | --- | --- | --- | 2.8 | --- | 802.13 | |
| Perris North | 570 | --- | --- | --- | 5.2 | --- | 802.11 | |
| Perris South | 1260 | --- | --- | --- | 2.5 | --- | 802.11 | 802.12, 802.13 |
| San Jacinto - Lower | 520 | --- | --- | --- | 1.0 | --- | 802.21 | |
| San Jacinto - Upper | 320 | --- | --- | --- | 1.4 | --- | 802.21 | 802.23 |
| **LOWER SANTA ANA RIVER BASIN** | | | | | | | | |
| La Habra** | --- | --- | --- | --- | --- | --- | 845.62 | |
| Santiago** | --- | --- | --- | --- | --- | --- | 801.12 | |
| Orange | 580 | --- | --- | --- | 3.4 | --- | 801.11 | 801.13, 845.61, 801.14 |
| Irvine | 910 | --- | --- | --- | 5.9 | --- | 801.11 | |

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** Numeric objectives not established; narrative objectives apply

## Table 4-2

## 4-Day Average Concentration for Ammonia
## Salmonids or Other Sensitive Coldwater Species Present
## (COLD)

| Un-ionized Ammonia (mg/liter N) | | Temperature, C | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| pH | 6.50 | 0.0004 | 0.0005 | 0.0007 | 0.0010 | 0.0010 | 0.0010 | 0.0010 |
| | 6.75 | 0.0006 | 0.0009 | 0.0013 | 0.0018 | 0.0018 | 0.0018 | 0.0018 |
| | 7.00 | 0.0011 | 0.0016 | 0.0022 | 0.0031 | 0.0031 | 0.0031 | 0.0031 |
| | 7.25 | 0.0020 | 0.0028 | 0.0040 | 0.0056 | 0.0056 | 0.0056 | 0.0056 |
| | 7.50 | 0.0035 | 0.0050 | 0.0070 | 0.0099 | 0.0099 | 0.0099 | 0.0099 |
| | 7.75 | 0.0069 | 0.0097 | 0.0137 | 0.0194 | 0.0194 | 0.0194 | 0.0194 |
| | 8.00 | 0.0080 | 0.0112 | 0.0159 | 0.0224 | 0.0224 | 0.0224 | 0.0224 |
| | 8.25 | 0.0080 | 0.0112 | 0.0159 | 0.0224 | 0.0224 | 0.0224 | 0.0224 |
| | 8.50 | 0.0080 | 0.0112 | 0.0159 | 0.0224 | 0.0224 | 0.0224 | 0.0224 |
| | 8.75 | 0.0080 | 0.0112 | 0.0159 | 0.0224 | 0.0224 | 0.0224 | 0.0224 |
| | 9.00 | 0.0080 | 0.0112 | 0.0159 | 0.0224 | 0.0224 | 0.0224 | 0.0224 |

| Total Ammonia (mg/liter N) | | Temperature, C | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| pH | 6.50 | 1.36 | 1.27 | 1.20 | 1.15 | 0.796 | 0.556 | 0.393 |
| | 6.75 | 1.36 | 1.27 | 1.20 | 1.15 | 0.796 | 0.556 | 0.393 |
| | 7.00 | 1.36 | 1.27 | 1.20 | 1.16 | 0.798 | 0.558 | 0.395 |
| | 7.25 | 1.36 | 1.27 | 1.20 | 1.16 | 0.800 | 0.560 | 0.397 |
| | 7.50 | 1.36 | 1.27 | 1.21 | 1.16 | 0.804 | 0.565 | 0.402 |
| | 7.75 | 1.49 | 1.40 | 1.33 | 1.28 | 0.890 | 0.627 | 0.448 |
| | 8.00 | 0.974 | 0.913 | 0.871 | 0.844 | 0.589 | 0.418 | 0.302 |
| | 8.25 | 0.551 | 0.519 | 0.497 | 0.484 | 0.341 | 0.245 | 0.179 |
| | 8.50 | 0.313 | 0.297 | 0.286 | 0.282 | 0.202 | 0.147 | 0.111 |
| | 8.75 | 0.180 | 0.172 | 0.168 | 0.169 | 0.123 | 0.093 | 0.072 |
| | 9.00 | 0.105 | 0.101 | 0.101 | 0.105 | 0.079 | 0.062 | 0.050 |

## Table 4-3

## 4-Day Average Concentration for Ammonia
## Salmonids or Other Sensitive Coldwater Species Absent [1]
## (WARM)

| Un-ionized Ammonia (mg/liter N) | | Temperature, C | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| pH | 6.50 | 0.0006 | 0.0008 | 0.0012 | 0.0017 | 0.0024 | 0.0024 | 0.0024 |
| | 6.75 | 0.0010 | 0.0015 | 0.0021 | 0.0030 | 0.0042 | 0.0042 | 0.0042 |
| | 7.00 | 0.0019 | 0.0026 | 0.0037 | 0.0053 | 0.0074 | 0.0074 | 0.0074 |
| | 7.25 | 0.0033 | 0.0047 | 0.0066 | 0.0094 | 0.0132 | 0.0132 | 0.0132 |
| | 7.50 | 0.0059 | 0.0083 | 0.0118 | 0.0166 | 0.0235 | 0.0235 | 0.0235 |
| | 7.75 | 0.0115 | 0.0162 | 0.0229 | 0.0324 | 0.0458 | 0.0458 | 0.0458 |
| | 8.00 | 0.0133 | 0.0188 | 0.0265 | 0.0375 | 0.0530 | 0.0530 | 0.0530 |
| | 8.25 | 0.0133 | 0.0188 | 0.0265 | 0.0375 | 0.0530 | 0.0530 | 0.0530 |
| | 8.50 | 0.0133 | 0.0188 | 0.0265 | 0.0375 | 0.0530 | 0.0530 | 0.0530 |
| | 8.75 | 0.0133 | 0.0188 | 0.0265 | 0.0375 | 0.0530 | 0.0530 | 0.0530 |
| | 9.00 | 0.0133 | 0.0188 | 0.0265 | 0.0375 | 0.0530 | 0.0530 | 0.0530 |

| Total Ammonia (mg/liter N) | | Temperature, C | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 5 | 10 | 15 | 20 | 25 | 30 |
| pH | 6.50 | 2.27 | 2.12 | 2.01 | 1.93 | 1.88 | 1.31 | 0.928 |
| | 6.75 | 2.27 | 2.12 | 2.01 | 1.93 | 1.88 | 1.31 | 0.930 |
| | 7.00 | 2.27 | 2.12 | 2.01 | 1.93 | 1.89 | 1.32 | 0.933 |
| | 7.25 | 2.27 | 2.12 | 2.01 | 1.94 | 1.89 | 1.32 | 0.939 |
| | 7.50 | 2.27 | 2.13 | 2.02 | 1.95 | 1.90 | 1.33 | 0.949 |
| | 7.75 | 2.49 | 2.34 | 2.22 | 2.14 | 2.10 | 1.48 | 1.06 |
| | 8.00 | 1.63 | 1.53 | 1.46 | 1.41 | 1.39 | 0.987 | 0.173 |
| | 8.25 | 0.922 | 0.868 | 0.831 | 0.811 | 0.806 | 0.578 | 0.424 |
| | 8.50 | 0.524 | 0.496 | 0.479 | 0.472 | 0.476 | 0.348 | 0.262 |
| | 8.75 | 0.301 | 0.287 | 0.281 | 0.282 | 0.291 | 0.219 | 0.170 |
| | 9.00 | 0.175 | 0.170 | 0.170 | 0.175 | 0.187 | 0.146 | 0.119 |

[1] The values may be conservative, however. If a more refined criterion is desired, EPA recommends a site-specific Criteria modification.

## Table 4-4

## Equations Used to Calculate UIA-N and Total Ammonia -N Water Quality Objectives for COLD and WARM Waterbodies

| **COLD**-Chronic UIA-N | 0≤T≤15 | 15≤T≤30 |
|---|---|---|
| 6.5≤pH≤7.7 | $\frac{0.0223}{10^{(8.3-.03T-pH)}}$ | $\frac{0.0158}{10^{(7.7-pH)}}$ |
| 7.7≤pH≤8 | $\frac{0.0396}{10^{(0.6-0.03T)}+10^{(8.0-0.03T-pH)}}$ | $\frac{0.0280}{1+10^{(7.4-pH)}}$ |
| 8≤pH≤9 | $\frac{0.0317}{10^{(0.6-0.03T)}}$ | 0.0224 |

| **WARM-**Chronic UIA-N | 0≤T≤15 | 15≤T≤30 |
|---|---|---|
| 6.5≤pH≤7.7 | $\frac{0.0372}{10^{(8.3-.03T-pH)}}$ | $\frac{0.0372}{10^{(7.7-pH)}}$ |
| 7.7≤pH≤8 | $\frac{0.0662}{10^{(0.6-0.03T)}+10^{(8.0-0.03T-pH)}}$ | $\frac{0.0662}{1+10^{(7.4-pH)}}$ |
| 8≤pH≤9 | $\frac{0.0530}{10^{(0.6-0.03T)}}$ | 0.0530 |

Total Ammonia-N Objectives

$$NH_3\text{-}N = UIA\text{-}N \cdot [1+10^{(0.09018+\frac{2729.92}{T+273.15}-pH)}]$$

Note: For all equations, T is the temperature in °C

# CHAPTER 5

# IMPLEMENTATION

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## INTRODUCTION

This chapter describes the implementation plan, the actions that are necessary to achieve the water quality objectives specified in Chapter 4 and thereby protect the beneficial uses of the region's surface and groundwaters (Chapter 3). These actions will require the coordinated efforts of the Regional Board and numerous water supply and wastewater management agencies, as well as city and county governments and other planning entities within the Region.

The Implementation chapter of the 1983 Basin Plan focused largely on the mineral imbalance problem in the region and the management of total dissolved solids (TDS) through waste discharges requirements, wastewater reclamation requirements, improvements in water supply quality, recharge projects, and other measures. Since the adoption of the 1983 Basin Plan, the Regional Board's knowledge of the water quality problems in the Santa Ana Region has increased considerably, and the number and variety of water quality programs undertaken to address those problems have increased accordingly. Several new programs are being implemented statewide by each regional board, including broad new responsibilities related to landfill operations and closure, oversight of leaking underground storage tank cleanup activities, and control of nonpoint sources such as urban runoff and stormwater from industrial facilities and construction sites. These new programs are part of the Board's implementation plan and are described in this chapter.

## IMPLEMENTATION THROUGH WASTE DISCHARGE REQUIREMENTS

The Regional Board's principal means of achieving the water quality objectives and protecting the beneficial uses specified in this plan is the development, adoption, issuance and enforcement of waste discharge requirements. By regulating the quality of wastewaters discharged, and in other ways controlling the discharge of wastes which may impact surface and groundwater quality, the Regional Board works to protect the Region's water resources.

The Regional Board's regulatory tools include National Pollutant Discharge Elimination System permits, Waste Discharge Requirements, Water Reclamation Requirements, Water Quality Certification and Waste Discharge Prohibition.

**National Pollutant Discharge Elimination System (NPDES)**

National Pollutant Discharge Elimination System (NPDES) permits are required for discharges of pollutants to "navigable waters" of the United States, which includes any discharge to surface waters – lakes, rivers, streams, bays, the ocean, dry streambeds, wetlands and storm sewers that are tributary to any surface water body. NPDES permits are issued under the federal Clean Water Act, Title IV "Permits and Licenses," Section 402 (33 USC 466 *et seq*.). The Regional Board issues these permits in lieu of direct issuance by the US EPA, subject to review and approval by the US EPA Regional Administrator (EPA Region IX). The terms of these NPDES permits implement pertinent provisions of the federal Clean Water Act and the Act's implementing regulations including pretreatment, sludge management, effluent limitations for specific industries and antidegradation. In general, the discharge of pollutants is to be eliminated or reduced as much as practicable so as to achieve the Clean Water Act's goal of "fishable and swimmable" navigable (surface) waters. Technically, all NPDES permits issued by the Regional Board are also Waste Discharge Requirements issued under the authority of the California Water Code.

In addition to regulating discharges of wastewater to surface waters, NPDES permits also require municipal sewage treatment facilities to implement and monitor industrial pretreatment programs if their design capacity is greater than five million gallons per day (MGD). Smaller municipal treatment systems may also be required to conduct pretreatment programs if there are significant industrial contributions to their systems. The pretreatment programs must comply with the federal regulations specified in 40 CFR 403.

At this time, there are approximately 2,000 NPDES permits in effect in the Santa Ana Region. As shown in Table 5-1, these NPDES permits regulate discharge from publicly owned treatment works (POTWs, or sewage treatment plants), industrial discharges, stormwater runoff, dewatering operations, and groundwater cleanup discharges. NPDES permits are issued for five years or less and are therefore to be updated regularly. The rapid and dramatic population and urban growth in the Santa Ana Region has caused a significant increase in NPDES permit applications for new waste discharges. Because of staff resource limitations, the Board generally focuses its permitting efforts on the issuance of permits for these new discharges. NPDES permit updates are done to the extent feasible, particularly for the more significant discharges. In some cases, if the discharge does not change substantially over the permitting period, administrative extensions of the existing permits are issued by the Regional Board's Executive Officer.

To expedite the permit issuance process, the Regional Board has adopted several general NPDES permits, each of which regulates numerous discharges of similar types of wastes. These general permits address discharges from groundwater cleanup projects (Order No. 91-63) and dewatering activities (Order No. 93-49). Proponents of groundwater cleanup or dewatering projects are required to file individual permit applications, which are reviewed

by Regional Board staff to determine whether the requirements of the general permits apply and are sufficient to assure water quality protection. If so, the applicants are authorized by the Regional Board's Executive Officer to discharge in conformance with the general permit. A general permit for boatyard operations is being drafted. Additional general permits will be developed and adopted as appropriate to streamline the permitting process.

Similarly, the State Board has issued general permits for stormwater runoff from industrial facilities and construction sites statewide (see discussion on stormwater runoff). Stormwater discharges from industrial and construction activities in the Santa Ana Region can be covered under these general permits, which are administered jointly by the State Board and Regional Boards.

**(Amended by Resolution No. 00-27, May 19, 2000)**
Where the Regional Board determines that it is infeasible to achieve immediate compliance with an effluent limitation specified to implement a new, revised or newly interpreted water quality objective, whether numeric or narrative, adopted by the Regional Board or State Water Resources Control Board, or with a new, revised or newly interpreted water quality criterion promulgated by the U.S. Environmental Protection Agency, the Regional Board may establish a schedule of compliance in a discharger's waste discharge requirements (NPDES permit). The schedule of compliance shall include a time schedule for completing specific actions that demonstrate reasonable progress toward attainment of the effluent limitation and, thereby, the objective or criterion. The schedule shall contain a final compliance date, based on the shortest practicable time (determined by the Regional Board at a public hearing) required to achieve compliance. In no event shall an NPDES permit include a schedule of compliance that allows more than ten years from the date of adoption or interpretation of the applicable objective or criterion. Schedules of compliance are authorized by this provision only for those effluent limitations that implement objectives and criteria adopted, revised or newly interpreted after the effective date of this provision, July 15, 2002.

To document the need for and justify the duration of any such compliance schedule, a discharger must submit the following information, at a minimum: (1) the results of a diligent effort to quantify pollutant levels in the discharge and the sources of the pollutant(s) in the waste stream; (2) documentation of source control efforts currently underway or completed, including compliance with any Pollution Prevention programs that have been established; (3) a proposed schedule for additional source control measures or waste treatment; (4) the discharge quality that can reasonably be achieved until final compliance is attained; and (5) a demonstration that the proposed schedule is as short as possible, taking into account economic, technical and other relevant factors. The need for additional information and analyses will be determined by the Regional Board on a case-by-case basis. **(End of Resolution No. 00-27)**

Table 5-1

Representative NPDES Permitted Facilities in the Santa Ana Region
(as of November 3, 1993)[1]

| Facility Type | Number Requested |
|---|---|
| Boatyards | 10 |
| Dewatering Operations | 31 |
| Groundwater Cleanup Projects | 150 |
| Stormwater Discharges<br>39 individually regulated by RWQCB;<br>1800 regulated by SWRCB's general permits | 1839 |
| Publicly Owned Treatment Works | |
| **TOTAL** | **2054** |

[1] The list of facilities is regulated under NPDES permits is updated periodically and is available at the Regional Board office.

Table 5-2

Representative WDR Permitted Facilities in the Santa Ana Region
(as of November 3, 1993) [2]

| Facility Type | Number Regulated |
|---|---|
| Brine Evaporation | 24 |
| Composing | 19 |
| Groundwater Cleanup | 32 |
| Dairies | 468 |
| Landfills | 43 |
| Mobile Home Parks (community septic systems) | 22 |
| Publicly Owned Treatment Works | 37 |
| **TOTAL** | **645** |

[2] The list of facilities regulated under WDR permits is updated periodically and is available at the Regional Board office.

Where the terms of these general permits are not sufficient to protect water quality, the Board issues individual permits for these discharges.

## Waste Discharge Requirements

Waste Discharge Requirements (WDRs) are issued by the Regional Board under the provisions of the California Water Code, Division 7 "Water Quality," Article 4 "Waste Discharge Requirements." These requirements regulate the discharge of wastes which are not made to surface waters but which may impact the region's water quality by affecting underlying groundwater basins. Such WDRs are issued for POTWs' wastewater reclamation operations, discharges of wastes from industries, subsurface waste discharges such as septic systems, sanitary landfills, dairies and a variety of other activities which can affect water quality. There are approximately 550 WDRs in place, as indicated in Table 5-2.

Table 5-2 shows that most WDRs have been issued to dairies. To streamline the permit process, the Regional Board has developed a general permit for dairies and other animal confinement facilities (Order No. 94-7). To implement the federal stormwater requirements, this permit will be issued as an NPDES permit.

## Waivers

The California Water Code allows Regional Boards to waive waste discharge requirements (WDRs) for a specific discharge or types of discharges where it is not against the public interest (Section 13269). These waivers are conditional and may be terminated at any time.

On May 11, 1984, the Regional Board adopted Resolution No. 84-48, which waives WDRs for certain types of discharges. Resolution No. 84-48 was amended by Resolution No. 91-75 in 1991. Resolution No. 84-48 and Resolution No 91-75 are incorporated into the Basin Plan by reference and are included in Appendix IV. Only discharges which comply with the conditions contained in Resolution No. 84-48 as amended by Resolution No. 91-75, qualify for this waiver. Even though a discharge may qualify for a waiver, dischargers are still required to file Reports of Waste Discharge (ROWD), together with the appropriate filing fees. Regional Board staff determines if the effort expended in reviewing the ROWD justifies retaining any portion of the fee. If not, the fee is fully refunded.

## Water Reclamation Requirements

Reclaimed water is water that, as a result of treatment, is suitable for a direct beneficial use or a controlled use that would otherwise not occur and is therefore considered a valuable resource. The State Board adopted the Reclamation Policy to encourage development of water reclamation facilities to increase the availability of reclaimed water to help meet the growing water requirements of the State (Chapter 2). The State Board is authorized to provide loans for the development of water reclamation facilities, or for studies and investigations in connection with water reclamation.

Section 13521 of the California Water Code requires the State Department of Health Services to establish statewide reclamation criteria for each type of use of reclaimed water, where such use involves the protection of public health. These regulations, contained in Title 22 of the California Code of Regulations, are the basic regulations governing the use of reclaimed water in California. The existing Title 22 regulations were adopted in 1978; proposed new regulations are currently under review.

The Regional Board implements the provisions of Title 22 by issuing Water Reclamation Requirements (WRRs) to the producer, the user of reclaimed water, or both. WRRs are issued for a variety of uses, including, but not limited to, landscape irrigation, fodder crop irrigation, duck ponds, freeway landscape irrigation, groundwater recharge, injection for seawater intrusion barrier, use in toilet flushing, and other non-domestic uses in high rises or nonresidential buildings.

The Santa Ana Regional Board currently has 76 WRRs issued to producers and/or users of reclaimed water. Some of the producers have received or applied for Master Reclamation Requirements (MRR) which would allow the producer to distribute their reclaimed water to various users without additional user reclamation requirements for the Regional Board. With the water shortage in southern California, there is an increase in the demand for reclaimed water. With sophisticated treatment technologies, reclaimed water could be used for almost anything, except domestic supply.

The detailed requirements, conditions, prohibitions, and other specifications included within NPDES, WDR, and WRR permits are developed on the basis of existing state and federal law, Sate Board Water Quality Control Plans and Policies (*e.g.*, the Ocean Plan), and the contents of this Basin Plan. The foremost consideration is the protection of water quality. The quality of the discharge specified through the limitations in the permit is calculated to allow the water quality objectives of the receiving water to be met or maintained, and in some cases, the water quality is improved.

When the limits included in the NPDES, WDR or WRR permits cannot be met because treatment facilities are inadequate or the water supply is inferior, these permits may include a time schedule for compliance and interim discharger a period of time to make the necessary changes and/or improvements.

## Waste Discharge Prohibitions

The Regional Board also implements this Basin Plan through the adoption of waste discharge prohibitions as necessary. Section 13243 of the California Water Code states that a Regional Board may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted. The Regional Board implements this section of the Water Code by adopting waste discharge requirements issued to individual discharges and in the Basin Plan itself.

A. General Prohibitions

1. Unless regulated by appropriate waste discharge requirements, the discharge to surface or groundwaters of waste which contains the following substances is prohibited.

    - Toxic substances or materials;
    - Pesticides;
    - PCB's (polychlorinated biphenyls);
    - Mercury or mercury compounds;
    - Radioactive substances or material in excess of levels allowed by the California Code of Regulations.

   This list is not necessarily all-inclusive. The Regional Board may modify or update this list as appropriate.

B. Prohibitions Applying to Inland Surface Waters

1. The discharge of untreated sewage to any surface water stream, natural or man-made, or to any drainage system intended to convey stormwater runoff to surface water streams is prohibited.

2. The discharge of treated sewage to streams, lakes or reservoirs, or to tributaries thereto, which are designated **MUN** and which are used as a domestic water supply is prohibited unless approved by the California Department of Health Services. The discharge of treated sewage to waterbodies which are excepted from **MUN** (see Table 3-1) but which are tributary to waters designated **MUN** and are used as a domestic water supply is prohibited unless the discharge of treated sewage to the drinking water supply is precluded or approved by the California Department of Health Services.

C. Prohibitions Applying to Oceans, Bays, and Estuary Waters

   The prohibitions included in the California Ocean Plan, Thermal Plan, and the Policy for Enclosed Bays and Estuaries are hereby incorporated into this plan by reference.

D. Prohibitions Applying to Groundwaters

1. The discharge of the following materials to the ground, other than into impervious facilities, is prohibited:

    a. Acids or caustics, whether neutralized or not, and

    b. Excessively saline wastes (electrical conductivity greater than 2000 µmhos/cm)

2., Prohibitions Applying to Subsurface Leaching Percolation Systems

In 1973, the Regional Board adopted prohibitions on the use of subsurface disposal systems in the following areas:

a. Grand Terrace (CSA 70, Improvement Zone H);

b. Yucaipa-Calimesa (Yucaipa Valley County Water District);

c. Lytle Creek above 2600 foot elevation;

d. Mill Creek above 2600 foot elevation; and

e. Bear Valley (includes Baldwin Lake Drainage Area);

In 1982, the Regional Board adopted prohibition on the use of subsurface disposal systems for the Homeland-Green Acres area and Romoland areas (exact boundaries for these prohibition areas are shown on maps on file at the Regional Board office).

The Board adopted specified dates for final compliance with these prohibitions. In some cases, these dated have been revised via Basin Plan amendments. The compliance dates are as follows:

a. Grand Terrace: February 1, 1988

b. Yucaipa-Calimesa – February 1, 1988

c. Lytle Creek – July 1, 1978

d. Mill Creek - July 1, 1978

e. Bear Valley – July 1, 1980

f. Homeland-Green Acres – July 1, 1990

g. Romoland – July 1, 1990

Exemptions from these prohibitions may be granted if certain criteria are satisfied (exemption criteria are described in Appendix V).

Quail Valley On-site Septic Tank-Subsurface Disposal System Prohibition
(Amended by Resolution No. R8-2006-0024, October 3, 2006)

On October 3, 2006, the Board adopted a Basin Plan amendment prohibiting the use of septic tank-subsurface disposal systems in the Quail Valley area of Riverside County in accordance with the following:

Effective Date: August 20, 2007

(1) The discharge of waste from new on-site septic tank-subsurface disposal systems in the Quail Valley area of Riverside County is prohibited, if a sewer system is available to serve the lot. Except as provided in (2) below, the discharge of waste from existing on-site septic tank-subsurface disposal systems in the Quail Valley area of Riverside County is prohibited, if a sewer system is available to serve the lot.

(2) All existing septic tank-subsurface disposal systems shall connect to the sewer designed to serve the lot within one year of sewer installation. New septic tank-subsurface disposal systems shall not be permitted in Quail Valley if a sewer system is available to serve the lot.

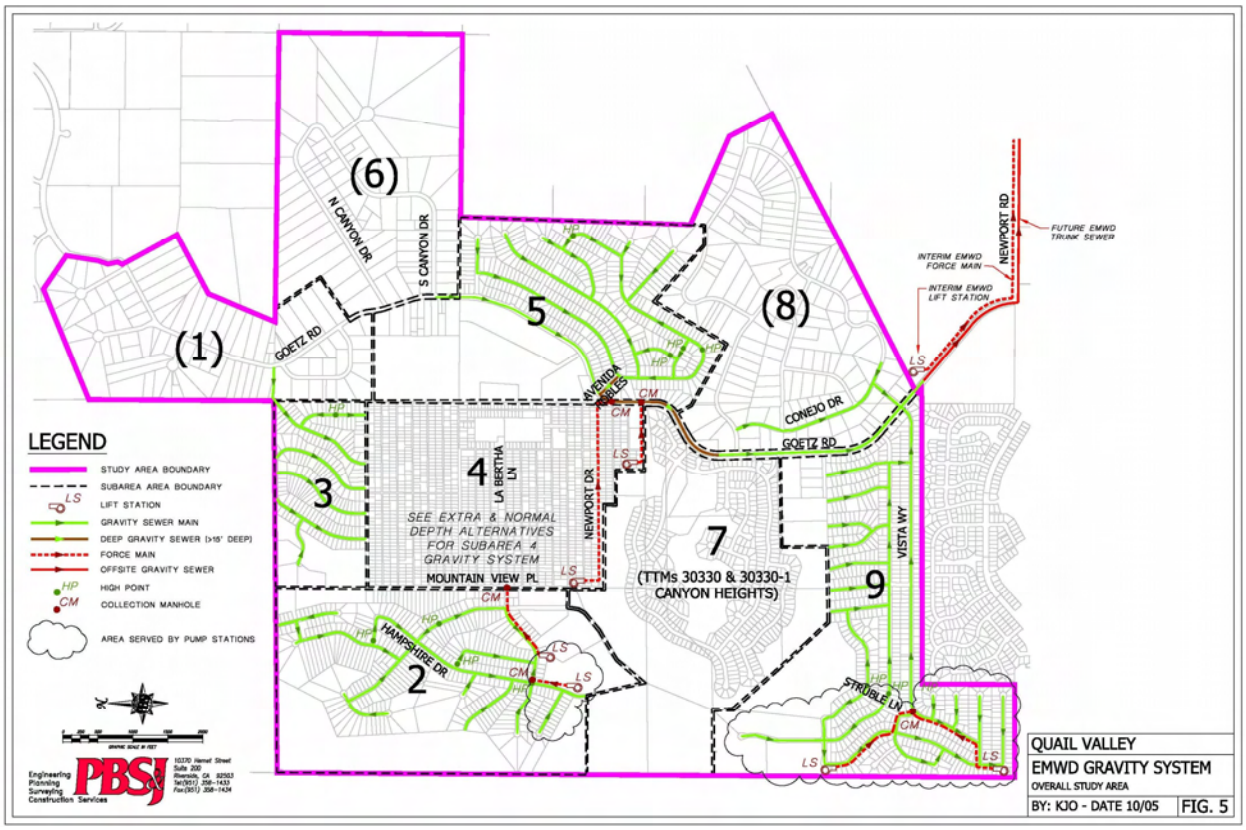
(3) This prohibition applies to all areas within Quail Valley as depicted on a detailed map maintained in the Regional Board office (Quail Valley Septic Tank Prohibition Boundary Map). A copy of the boundary map is attached as Attachment "A".

(4) Upon the effective date of this prohibition, new septic systems in Quail Valley (see Attachment "A") shall not be permitted, except as follows:

(a) For areas in Quail Valley other than areas 4 and 9, new systems may be permitted, provided the Regional Board finds that the sewering agency proposes, and is on schedule, to provide sewer service for areas 4 and 9 within five years of the effective date of this amendment, and if the lot proposed for a septic system meets all Board and Riverside County requirements.

(b) If the Board finds that the sewering agency cannot meet the schedule identified in 1(4)(a), above, but that design of the project proceeds nonetheless, then, upon completion of the sewer system design, new systems may be permitted in areas other than 4 and 9, if all Board and Riverside County requirements are met.

## ATTACHMENT "A": MAP OF QUAIL VALLEY PROHIBITION AREA
## FIGURE 5-1a



**Water Quality Certification (Section 401)**

In addition to the issuance of NPDES permits or waste discharge requirements, the Regional Board acts to protect the quality of surface waters through water quality certification as specified in Section 401 of the Clean Water Act (33 USC 466 *et seq.*). Section 401 requires that any person applying for a federal permit or license for an activity which may result in a discharge of pollutants into waters of the nation must obtain a state water quality certification verifying that the activity complies with the state's water quality standards.

No license or permit can be granted until certification required by Section 401 has been obtained or waived. Further, no license or permit can be granted if certification has been denied by the state. Similarly, coastal states must concur that the activity meets the requirements of the Coastal Zone Management Program of the state or waive their right to concur by not taking action by a specified time.

The following permits or licenses require 401 Certification:

- NPDES permits issued by US EPA under Section 402 of the CWA (33 USC 466 *et seq.*);
- CWA Section 404 (33 USC 466 *et seq.*) permits issued by the U.S. Army Corps of Engineers;
- Permits issued under Sections 9 and 10 of the Rivers and Harbors Act (33 USC 466 *et seq.*) (for activities which may affect navigation);
- Licenses for hydroelectric power plants issued by the Federal Energy Regulatory Commission under the Federal Power Act; and
- Licenses issued by the Nuclear Regulatory Commission.

To date, the Regional Board's water quality certification activities have focused on applications for permits for the discharge of dredged or fill material to surface waters. These permits are issued by the U.S. Army Corps of Engineers (Section 404 permits) subject to any conditions imposed by the Regional Board.

The Section 404 program is administered at the federal level by the U.S. Army Corps of Engineers and the US EPA. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service have important advisory roles. The U.S. Army Corps of Engineers has the primary responsibility for the permit program and is authorized, after notice and opportunity for a public hearing, to issue permits of the discharge of dredged or fill material. US EPA developed the regulations under which permits may be granted. States may assume the responsibility for implementation of the 404 permit program, however, California has not done so.

The Regional Board evaluates the projects for which 404 permits are requested and determines whether to deny water quality certification, issue a certification with conditions, or waive the certification. A certification is usually denied if the activity violates any water

quality standard; if the activity may violate standards, a conditional certification is given; when the activity does not violate any standard, a 401 waiver may be given.

Presently, the executive Director of the State Board issues all water quality certifications in accordance with recommendations from the Regional Board.

## MONITORING AND ENFORCEMENT

Waste discharge requirements issued by the Regional Board include requirements for monitoring of discharges. In some cases, the receiving waters must be monitored by the dischargers. The results of the "self monitoring" programs are reported to the Board and are used to determine compliance with the waste discharge requirements (see Chapter 6).

The California Water Code provides the Regional Board with a number of enforcement remedies for violations of requirements. Enforcement actions include Time Schedules, Cease and Desist Orders, Cleanup and Abatement Orders, and the issuance of Administrative Civil Liability Complaints.

### Time Schedules

When a discharge is taking place or threatening to occur that will cause a violation of a Regional Board requirement, a discharger may be required to submit a detailed compliance plan and schedule (California Water Code Section 13300). These schedules may also be required when the waste collection treatment or disposal facility of a discharger are approaching capacity. Time Schedules are adopted by the Regional Board after a public hearing or by the Executive Officer pursuant to his or her authority.

### Cease and Desist Order

If discharge prohibitions or requirements of the State Board or Regional Board are violated or threatened to be violated, the Regional Board may adopt a Cease and Desist order (California Water Code Section 13301) requiring the discharger to comply in accordance with a time schedule, or if the violation is threatened, to take appropriate remedial or preventive action. Cease and Desist orders may restrict or prohibit the volume, type or concentration of waste added to community sewer systems, if existing or threatened violations of waste discharge requirements occur. Cease and Desist Orders may specify interim time schedules as well as limitations that must be complied with until full compliance is achieved. Cease and Desist orders are adopted by the Regional Board after a public hearing.

### Cleanup and Abatement Order

The Board may order *any* person who has discharged, is discharging or is threatening to discharge wastes that will result in a violation of waste discharge requirements or other order or prohibition of the State Board or Regional Board, to cleanup and abate the effects

of the discharge or to take appropriate remedial action (California Water Code 13304). The Regional Board has delegated issuance of these orders to its Executive Officer; Cleanup and Abatement orders do not require Board action, but are often brought before the Regional Board for consideration.

### Administrative Civil Liability

The Regional Board may also issue Administrative Civil Liability complaints (ACLs) to those who intentionally or negligently violate enforcement orders of the Board, or who intentionally or negligently discharge wastes in violation of any order, prohibition or requirement of the Board where the discharge causes conditions of pollution or nuisance (California Water Code Sections 13350). ACLs may also be issued in cases where a person fails to submit reports requested by the Board (California Water Code Sections 13261 and13268) or when a person discharges waste without first having filed the appropriate Report of Waste Discharge (ROWD) (California Water Code Section113265). ACLs may be issued pursuant to California Water Code Section 13385 for violations of any Regional Board prohibition or requirement implementing specified sections of the Clean Water Act, or any requirement in an approved pretreatment program, without showing intent or negligence. Issuance of ACLs is delegated to the Board's Executive Officer, but, all administrative civil liability settlements must be affirmed by the Board. Amounts of administrative civil liability that the Board can impose range up to $10,000 per day of violation. The Water Code also provides that a superior court may impose civil liability assessments in substantially higher amounts. The Regional Board may conduct a hearing if a discharger contests the imposition of the Administrative Civil Liability.

The Water Code provides that a Regional Board may request the State Attorney General to petition a superior court to enforce orders and complaints issued by the Board. The Regional Board may also request that the Attorney General seek injunctive relief in specific situations, such as violations of Cease and Desist orders or discharges which cause or threaten to cause a nuisance or pollution that could result in a public health emergency (California Water Code Sections 13331 and 13340).

## TOTAL DISSOLVED SOLIDS AND NITROGEN MANAGEMENT (Amended by Resolution No. R8-2004-0001, December 22, 2004)

### 1. Background

The 1975 and 1983 Basin Plans for the Santa Ana River Basin reported that the most serious problem in the basin was the build up of dissolve minerals, or salts, in the ground and surface waters. Sampling and computer modeling of groundwaters showed that the levels of dissolved minerals, generally expressed as total dissolved solids (TDS) or total filterable residue (TFR), were exceeding water quality objectives or would do so in the future unless appropriate controls were implemented. Nitrogen levels in the Santa Ana River, largely in the form of nitrate, were likewise projected to exceed objectives. As was discussed in Chapter 4, high levels of TDS and nitrate adversely affect the beneficial uses

of ground and surface waters. The mineralization of the Region's waters, and its impact on beneficial uses, remains a significant problem.

Each use of water adds an increment of dissolved minerals. Significant increments of salts are added by municipal and industrial use, and the reuse and recycling of the wastewater generated as it moves from the hydrologically higher areas of the Region to the ocean. Wastewater and recycled water percolated into groundwater management zones is typically pumped and reused a number of times before reaching the ocean, resulting in increased salt concentrations. The concentration of dissolved minerals can also be increased by evaporation or evapotranspiration. One of the principal causes of the mineralization problem in the Region is historic irrigated agriculture, particularly citrus, which in the past required large applications of water to land, causing large losses by evaporation and evapotranspiration. TDS and nitrate concentrations are increased both by this reduction in the total volume of return water and by the direct application of these salts in fertilizers. Dairy operations, which began in the Region in the 1950's and continue today, also contribute large amounts of salts to the basin.

The implementation chapters of the 1975 and 1983 Basin Plans focused on recommended plans to address the mineralization problem. The 1975 Plan initiated a total watershed approach to salt source control. Both Plans called for controls on salt loadings from all water uses including residential, commercial, industrial and agricultural (including dairies). The plans included: measures to improve water supply quality, including the import of high quality water from the State Water Project; waste discharge regulatory strategies (e.g., wasteload allocations, allowable mineral increments for uses of water); and recharge projects and other remedial programs to correct problems in specific areas. These Plans also carefully limited reclamation activities and the recycling of wastewaters into the local groundwater basins.

These salt management plans were developed using a complex set of groundwater computer models and programs, known collectively as the Basin Planning Procedure (BPP).

The modeling work focused on the upper Santa Ana Basin and, to a lesser extent, on the San Jacinto Basin, where the BPP was less developed and refined. The constituent modeled in those Plans was TDS.

For the salt management plan specified initially in the 1995 Basin Plan, when the Plan was adopted and approved in 1994 and 1995, modeling was conducted with the BPP for both the upper Santa Ana and San Jacinto Basins. However, most of the attention was again directed to the upper Santa Ana Basin, for which significant improvements to the BPP were made under a joint effort by the Santa Ana Watershed Project Authority, the Santa Ana River Dischargers Association, the Metropolitan Water District of Southern California, and the Regional Board. The most significant change to the BPP was the addition of a nitrogen modeling component so that projections of the nitrogen (nitrate) quality of groundwaters could be made, in addition to TDS. This enabled the development of a management plan for nitrogen, as well as TDS.

The BPP has not been used to model groundwater quality conditions in the lower Santa Ana Basin. For that Basin, the Regional Board's TDS and nitrogen management plans have relied, in large part, on the control of the quality of the Santa Ana River flows, which are a major source of recharge in the Basin. As discussed in Chapter 4, most of the baseflow (80-90%) is composed of treated sewage effluent; it also includes nonpoint source inputs and rising groundwater. Baseflow generally provides 70% or more of the water recharged in the Orange County Management Zone. In rare wet years, baseflow accounts for a smaller, but still significant, percentage (40%) of the recharge on an annual basis. Therefore, to protect Orange County groundwater, it is essential to control the quality of baseflow. To do so, baseflow TDS and nitrogen objectives are specified in this Plan for Reach 3 of the River. Wasteload allocations have been established and periodically revised to meet those and other Santa Ana River objectives.

For the 1983 Basin Plan, QUAL-II, a surface water model developed initially by the US EPA, was calibrated for the Santa Ana River and used to make detailed projections of River quality (TDS and nitrogen) and flow. The model was used to develop wasteload allocations for TDS and nitrogen discharges to the River that were approved as part of that Plan. (Wasteload allocations are discussed in detail in Section III of this Chapter). An updated version of the model, QUAL-2e, was used to revise these wasteload allocations, which were included as part of the initial salt management plan in the 1995 Basin Plan. The models were used to integrate the quantity and quality of inputs to the River from various sources, including the headwaters, municipal wastewater treatment plant discharges, and rising groundwater, based on the water supply and wastewater management plans used in the BPP. Data on rising groundwater quality and quantity were provided to the QUAL-II/2e models by the BPP. As with the BPP, the QUAL-II/2e model projections were used to identify water quality problems and to assess the effectiveness of changes in TDS and nitrogen management strategies.

## II. Update of the Total Dissolved Solids/Nitrogen Management Plan

The studies conducted to update the TDS/Nitrogen Management Plans in the 1983 and 1995 Basin Plans were not designed to validate or revise the TDS or nitrate-nitrogen objectives for groundwater. Rather, the focus of the studies was to determine how best to meet those established objectives. During public hearings to consider adoption of the 1995 Basin Plan, a number of water supply and wastewater agencies in the region commented that the TDS and nitrate-nitrogen objectives for groundwater should be reviewed, considering the estimated cost of complying with them (several billion dollars). In response, the Regional Board identified the review of these objectives as a high Basin Plan triennial review priority, and stakeholders throughout the Region agreed to provide sufficient resources to perform the necessary studies. In December 1995, these agencies, under the auspices of the Santa Ana Watershed Project Authority (SAWPA), formed the Nitrogen/Total Dissolved Solids (TDS) Task Force (Task Force) to undertake a watershed-wide study (Nitrogen/TDS Study) to review the groundwater objectives and the TDS/Nitrogen Management Plan in the Basin Plan as a whole. SAWPA managed the study, and Risk Sciences and Wildermuth Environmental, Inc., served as project consultants. Major tasks included review of the groundwater

subbasin boundaries, development of recommendations for revised boundaries, development of appropriate TDS and nitrate-nitrogen objectives for the subbasins (management zones), and update of the TDS and TIN wasteload allocations to ensure compliance with both the established objectives for the Santa Ana River and tributaries and the recommended groundwater objectives. A complete list of all tasks completed in Phases 1A & 1B and 2A & 2B is included in the Appendix. The Task Force effort resulted in substantive proposed changes to the Basin Plan, including new groundwater management zones (Chapter 3) and new nitrate-nitrogen and TDS objectives for the management zones (Chapter 4). These changes necessitated the update and revision of the TDS/Nitrogen Management Plan, which is described below.

The Task Force studies, including the technical methods employed, are documented in a series of reports (Ref. 1-5). The Task Force studies differed from prior efforts to review the TDS and nitrogen management plans in that the BPP was not utilized. A revised model approach, not involving use of the QUAL-2e model, was used to update the wasteload allocations for the Santa Ana River. The Task Force concluded that the BPP no longer remained a viable tool for water quality planning purposes, and also concluded that the development of a new model was beyond the scope and financial capabilities of the Task Force. The efficacy of modeling to formulate and update salt management plans in this Region has been well demonstrated; in the future, priority should be given to the development of a new model that would assist with future Basin Plan reviews.

## III. TDS/Nitrogen Management Plan

TDS and nitrogen management in this Region involves both regulatory actions by the Regional Board and actions by other agencies to control and remediate salt problems. Regulatory actions include the adoption of appropriate TDS and nitrogen limitations in requirements issued for waste disposal and municipal wastewater recycling, and the adoption of waste discharge prohibitions. These regulatory steps are described earlier in this Chapter. Actions by other agencies include projects to improve water supply quality and the construction of groundwater desalters and brine lines to remove highly saline wastes from the watershed. The following sections discuss these programs in greater detail.

### A. Water Supply Quality

Water supply quality has a direct affect on the quality of discharges from municipal wastewater treatment plants, discrete industrial discharges, returns to groundwater from homes using septic tank systems, returns from irrigation of landscaping in sewered and unsewered areas, and returns to groundwater from commercial irrigated agriculture. Water supply quality is an important determinant of the extent to which wastewater can be reused and recycled without resulting in adverse impacts on affected receiving waters. This is particularly true for TDS, since it is a conservative constituent, less likely than nitrogen to undergo transformation and loss as wastewater is discharged or recycled, and typically more difficult than nitrogen to treat and remove.

Water supplies cannot be directly regulated by the Regional Board; however, limitations in waste discharge requirements, including NPDES permits, may necessitate efforts to improve source water quality. These efforts may include drilling new wells, implementing alternative blending strategies, importing higher quality water when it is available, and constructing desalters to create or augment water supplies.

Imported water supplies are an important part of salt management strategies in the region from both a quantity and quality standpoint. Imported water is needed by many agencies to supplement local sources and satisfy ever-increasing demands. The import of high quality State Water Project water, with a long-term TDS average less than 300 mg/L, is particularly essential. The use of State Water Project water allows maximum reuse of water supplies without aggravating the mineralization problem. It is also used for recharge and replenishment to improve the quality of local water supply sources, which might otherwise be unusable. Thus, the use of high quality State Water Project water in the Region has water supply benefits that extend far beyond the actual quantity imported.

In some cases, the TDS quality of water supplies in a wastewater treatment service area may make it infeasible for the discharger to comply with TDS limits specified in waste discharge requirements. In other cases, the discharger may add chemicals that enable compliance with certain discharge limitations, but also result in TDS concentrations in excess of waste discharge requirements. The Board recognizes these problems and incorporates provisions in waste discharge requirements to address them. These and other aspects of the Board's regulatory program are described next.

## B. TDS and Nitrogen Regulation

As required by the Water Code (Section 13263), the Regional Board must assure that its regulatory actions implement the Basin Plan. Waste discharge requirements must specify limitations that, when met, will assure that water quality objectives will be achieved. Where the quality of the water receiving the discharge is better than the established objectives, the Board must assure that the discharge is consistent with the state's antidegradation policy (SWRCB Resolution No. 68-16). The Regional Board must also separately consider beneficial uses, and where necessary to protect those uses, specify limitations more stringent than those required to meet established water quality objectives. Of course, these obligations apply not only to TDS and nitrogen but also to other constituents that may adversely affect water quality and/or beneficial uses.

As indicated previously, the Regional Board's regulatory program includes the adoption of waste discharge prohibitions. The Board has established prohibitions on discharges of excessively saline wastes and, in certain areas, on discharges from subsurface disposal systems (see "Waste Discharge Prohibitions," above). The Board has also adopted other requirements pertaining to the use of subsurface disposal system use, both to assure public health protection and to address TDS and nitrogen-related concerns. These include the Regional Board's "Guidelines for Sewage Disposal from Land Developments" [Ref. 6], which are hereby incorporated by reference, and the

minimum lot size requirements for septic system use (see Nonpoint Source section of this Chapter).

However, the principal TDS and nitrogen regulatory tool employed by the Regional Board is the issuance of appropriate discharge requirements, in conformance with the legal requirements identified above. Several important aspects of this permitting program warrant additional discussion:

1. Salt assimilative capacity
2. Mineral increments
3. Nitrogen loss coefficients
4. TDS and nitrogen wasteload allocations
5. Wastewater reclamation
6. Special considerations – subsurface disposal systems

1. Salt Assimilative Capacity

Some waters in the Region have assimilative capacity for additions of TDS and/or nitrogen; that is, wastewaters with higher TDS/nitrogen concentrations than the receiving waters are diluted sufficiently by natural processes, including rainfall or recharge, such that the TDS and nitrogen objectives of the receiving waters are met. The amount of assimilative capacity, if any, varies depending on the individual characteristics of the waterbody in question.

The adoption of new groundwater management zone boundaries (Chapter 3) and new TDS and nitrate-nitrogen objectives for these management zones (Chapter 4), pursuant to the work of the Nitrogen/TDS Task Force, necessitated the re-evaluation of the assimilative capacity findings initially incorporated in the 1995 Basin Plan. To conduct this assessment, the Nitrogen-TDS study consultant calculated current ambient TDS and nitrate-nitrogen water quality using the same methods and protocols as were used in the calculation of historical ambient quality (see Chapter 4). The analysis focused on representing current water quality as a 20-year average for the period from 1978 through 1997. [Ref. 1]. For each management zone, current TDS and nitrate-nitrogen water quality were compared to water quality objectives (historical water quality)[1]. Assimilative capacity was also assessed relative to the "maximum benefit" objectives established for certain management zones. If the current quality of a management zone is the same as or poorer than the specified water quality objectives, then that management zone does not have assimilative capacity. If the current quality is better than the specified water quality objectives, then that management zone has assimilative capacity. The difference between the objectives and current quality is the amount of assimilative capacity available.

[1] As noted in Chapter 4, ammonia-nitrogen and nitrite-nitrogen data were also included in the analysis, where available. This occurred for a very limited number of cases and ammonia-nitrogen and nitrite-nitrogen concentrations were insignificant.

Tables 5-3 and 5-4 show the water quality objectives and the current ambient quality for TDS and nitrate-nitrogen, respectively, for each management zone. These tables also list the TDS and nitrate-nitrogen assimilative capacity of the management zones, if any. Of the thirty-seven (37) management zones, twenty-seven (27) lack assimilative capacity for TDS, and thirty (30) lack assimilative capacity for nitrate-nitrogen (this assumes the "maximum benefit" objectives are in effect). There are five (5) management zones for which there were insufficient data to calculate TDS and/or nitrate-nitrogen water quality objectives and, therefore, assimilative capacity. For regulatory purposes, these 5 management zones are assumed to have no assimilative capacity. Dischargers to these management zones may demonstrate that assimilative capacity for TDS and/or nitrate-nitrogen is available. If the Regional Board approves this demonstration, then the discharger would be regulated accordingly.

As indicated in Table 5-3, it will be assumed for most regulatory purposes that there is no assimilative capacity for TDS in the Orange County groundwater management zone. The 20 mg/L of management zone-wide TDS assimilative capacity calculated for this zone will be allocated to discharges resulting from groundwater remediation and other legacy contaminant removal projects implemented within the Orange County Management Zone.

Tables 5-3 and 5-4 show the assimilative capacity available in management zones for which "maximum benefit" objectives have been specified. As described in Chapter 4 and later in this Chapter, the application of these objectives is contingent on the implementation of certain projects and programs by specific dischargers as part of their maximum benefit demonstrations. Assimilative capacity created by these projects/programs will be allocated to the party(-ies) responsible for implementing them.

Chapter 3 delineates the Prado Basin Management Zone, and Chapter 4 identifies the applicable TDS and nitrogen objectives for this Zone (the objectives for the surface waters that flow in this Zone). No assimilative capacity exists in this zone.

These assimilative capacity findings are significant from a regulatory perspective. If there is assimilative capacity in the receiving waters for TDS, nitrogen or other constituents, a waste discharge may be of poorer quality than the objectives for those constituents for the receiving waters, as long as the discharge does not cause violation of the objectives and provided that antidegradation requirements are met. However, if there is no assimilative capacity in the receiving waters, such as the management zones identified in Tables 5-3 and 5-4, the numerical limits in the discharge requirements cannot exceed the receiving water objectives or the degradation process would be accelerated.[2] This rule was expressed clearly by the State Water Resources

[2] A discharger may conduct analyses to demonstrate that discharges at levels higher than the objectives would not cause or contribute to the violation of the established objectives. See, for example, the discussion of wasteload allocations for discharges to the Santa Ana River and its tributaries (Section III. B. 4.) If the Regional Board approves this demonstration, then the discharger would be regulated accordingly.

Control Board in a decision regarding the appropriate TDS discharge limitations for the Rancho Caballero Mobilehome park located in the Santa Ana Region (Order No. 73-4, the so called “Rancho Caballero decision”) [Ref. 7]. However, this rule is not meant to restrict overlying agricultural irrigation, or similar activities, such as landscape irrigation. Even in management zones without assimilative capacity, groundwater may be pumped, used for agricultural purposes in the area and returned to the management zone from which it originated.

In regulating waste discharges to waters with assimilative capacity, the Regional Board will proceed as follows. (see also Section III.B.6., Special Considerations – Subsurface Disposal Systems).

If a discharger proposes to discharge wastes that are at or below (i.e., better than) the current ambient TDS and/or nitrogen water quality, then the discharge will not be expected to result in the lowering of water quality, and no antidegradation analysis will be required. TDS and nitrogen objectives are expected to be met. Such discharges clearly implement the Basin Plan and the Board can permit them to proceed. Of course, other pertinent requirements, such as those of the California Environmental Quality Act (CEQA) must also be satisfied. For groundwater management zones, current ambient quality is as defined in Table 5-3 and Table 5-4, or as these Tables may be revised (through the Basin Plan amendment process) pursuant to the detailed monitoring program to be conducted by dischargers in the watershed (see Section V., Salt Management Plan – Monitoring Program Requirements).

If a discharger proposes to discharge wastes that exceed the current ambient TDS and/or nitrogen quality, then the Board will require the discharger to conduct an appropriate antidegradation analysis. The purpose of this analysis will be to demonstrate whether and to what extent the proposed discharge would result in a lowering of ambient water quality in affected receiving waters. That is, to what extent, if any, would the discharge use available assimilative capacity. If the discharger demonstrates that no lowering of water quality would occur, then antidegradation requirements are met, water quality objectives will be achieved, and the Regional Board can permit such discharges to proceed. If the analysis indicates that a lowering of current ambient water quality would occur, other than on a minor or temporally or spatially limited basis, then the discharger must demonstrate that: (1) beneficial uses would continue to be protected and the established water quality objectives would be met; and (2) that the resultant water quality would be consistent with maximum benefit to the people of California; and, (3) that best practicable treatment or control has been implemented. Best practical treatment or control means levels that can be achieved using best efforts and reasonable control methods. For affected receiving waters, the discharger must estimate the amount of assimilative capacity that would be used by the discharger. The Regional Board would employ its discretion in determining the amount of assimilative capacity that would be allocated to the discharger. Rather than allocating assimilative capacity, the Regional Board may require the discharger to mitigate or offset discharges that would result in the lowering of water quality.

Again, discharges to waters without assimilative capacity for TDS and/or nitrogen must be held to the objectives of the affected receiving waters (with the caveat identified in footnote 3 previous page). In some cases, compliance with management zone TDS objectives for discharges to waters without assimilative capacity may be difficult to achieve. Poor quality water supplies or the need to add certain salts during the treatment process to achieve compliance with other discharge limitations (e.g., addition of ferric chloride) could render compliance with strict TDS limits very difficult. The Regional Board addresses such situations by providing dischargers with the opportunity to participate in TDS offset programs, such as the use of desalters, in lieu of compliance with numerical TDS limits. These offset provisions are incorporated into waste discharge requirements. Provided that the discharger takes all reasonable steps to improve the quality of the waters influent to the treatment facility (such as through source control or improved water supplies), and provided that chemical additions are minimized, the discharger can proceed with an acceptable program to offset the effects of TDS discharges in excess of the permit limits.

Similarly, compliance with the nitrate-nitrogen objectives for groundwaters specified in this Plan would be difficult in many cases. Offset provision may apply to nitrogen discharges as well.

An alternative that dischargers might pursue in these circumstances is revision of the TDS or nitrogen objectives, through the Basin Plan amendment process. Consideration of less stringent objectives would necessitate comprehensive antidegradation review, including the demonstrations that beneficial uses would be protected and that water quality consistent with maximum benefit to the people of the State would be maintained. As discussed in Chapter 4 and later in this Chapter, a number of dischargers have pursued this “maximum benefit objective” approach, leading to the inclusion of “maximum benefit” objectives and implementation strategies in this Basin Plan. Discharges to areas where the “maximum benefit” objectives apply will be regulated in conformance with these implementation strategies. Any assimilative capacity created by the maximum benefit programs will be allocated to the parties responsible for implementing them.

Table 5-3
Total Dissolved Solids (TDS) Assimilative Capacity Findings

| Management Zone | Water Quality Objective (mg/L) | Current Ambient (mg/L) | Assimilative Capacity (mg/L) |
|---|---|---|---|
| **UPPER SANTA ANA RIVER BASIN** | | | |
| Beaumont – "max benefit" [3] | 330 | 290 | 40 |
| **Beaumont – "antideg"** | 230 | 290 | None |
| Bunker Hill A | 310 | 350 | None |
| Bunker Hill B | 330 | 260 | 70 |
| Colton | 410 | 430 | None |
| Chino North – "max benefit" | 420 | 300 | 120 |
| Chino 1 – "antideg" | 280 | 310 | None |
| Chino 2 – "antideg" | 250 | 300 | None |
| Chino 3 – "antideg" | 260 | 280 | None |
| Chino South | 680 | 720 | None |
| Chino East | 730 | 760 | None |
| Cucamonga – "max benefit" [3] | 380 | 260 | 120 |
| Cucamonga – "anti-deg" | 210 | 260 | None |
| Lytle | 260 | 240 | 20 |
| Rialto | 230 | 230 | None |
| San Timoteo – "max benefit" [3] | 400 | 300 | 100 |
| San Timoteo – "anti-deg" | 300 | 300 | None |
| Yucaipa – "max benefit" [3] | 370 | 330 | 40 |
| Yucaipa – "antideg" | 320 | 330 | None |
| ***MIDDLE SANTA ANA RIVER BASIN*** | | | |
| Arlington | 980 | --[1] | None |
| Bedford | --[1] | --[1] | None |
| Coldwater | 380 | 380 | None |
| Elsinore | 480 | 480 | None |
| Lee Lake | --[1] | --[1] | None |
| Riverside A | 560 | 440 | 120 |
| Riverside B | 290 | 320 | None |
| Riverside C | 680 | 760 | None |
| Riverside D | 810 | --[1] | None |
| Riverside E | 720 | 720 | None |
| Riverside F | 660 | 580 | 80 |
| Temescal | 770 | 780 | None |
| Warm Springs | --[1] | --[1] | None |
| **SAN JACINTO RIVER BASINS** | | | |
| Canyon | 230 | 220 | 10 |
| Hemet South | 730 | 1030 | None |
| Lakeview – Hemet North | 520 | 830 | None |
| Menifee | 1020 | 3360 | None |
| Perris North | 570 | 750 | None |
| Perris South | 1260 | 3190 | None |
| San Jacinto Lower | 520 | 730 | None |
| San Jacinto Upper | 320 | 370 | None |
| ***LOWER SANTA ANA RIVER BASINS*** | | | |
| Irvine | 910 | 910 | None |
| La Habra | --[1] | --[1] | None |
| Orange County[2] | 580 | 560 | None[2] |
| Santiago | --[1] | --[1] | None |

[1] Not enough data to estimate TDS concentrations; management zone is presumed to have no assimilative capacity. If assimilative capacity is demonstrated by an existing or proposed discharger, that discharge would be regulated accordingly.

[2] For the purposes of regulating discharges other than those associated with projects implemented within the Orange County Management Zone to facilitate remediation projects and/or to address legacy contamination, no assimilative capacity is assumed to exist

.[3] Assimilative capacity created by "maximum benefit" objectives is allocated solely to agency(ies) responsible for "maximum benefit" implementation (see Section VI.).

Table 5-4
Nitrate Nitrogen ($NO_3$-N) Assimilative Capacity Findings

| Management Zone | Water Quality Objective (mg/L) | Current Ambient (mg/L) | Assimilative Capacity (mg/L) |
|---|---|---|---|
| ***UPPER SANTA ANA RIVER BASINS*** | | | |
| Beaumont – "max benefit" [3] | 5.0 | 2.6 | 2.4 |
| **Beaumont – "antideg"** | 1.5 | 2.6 | None |
| Bunker Hill A | 2.7 | 4.5 | None |
| Bunker Hill B | 7.3 | 5.5 | 1.8 |
| Colton | 2.7 | 2.9 | None |
| Chino North – "max benefit" [3] | 5.0 | 7.4 | None |
| Chino 1 – "antideg" | 5.0 | 8.4 | None |
| Chino 2 – "antideg" | 2.9 | 7.2 | None |
| Chino 3 – "antideg" | 3.5 | 6.3 | None |
| Chino South | 4.2 | 8.8 | None |
| Chino East | 10 | 29.1 | None |
| Cucamonga – "max benefit" [3] | 5.0 | 4.4 | 0.6 |
| Cucamonga – "anti-deg" | 2.4 | 4.4 | None |
| Lytle | 1.5 | 2.8 | None |
| Rialto | 2.0 | 2.7 | None |
| San Timoteo – "max benefit" [3] | 5.0 | 2.9 | 2.1 |
| San Timoteo – "anti-deg" | 2.7 | 2.9 | None |
| Yucaipa – "max benefit" [3] | 5.0 | 5.2 | None |
| Yucaipa – "antideg" | 4.2 | 5.2 | None |
| ***MIDDLE SANTA ANA RIVER BASINS*** | | | |
| Arlington | 10.0 | --[1] | None |
| Bedford | --[1] | --[1] | None |
| Coldwater | 1.5 | 2.6 | None |
| Elsinore | 1.0 | 2.6 | None |
| Lee Lake | --[1] | --[1] | None |
| Riverside A | 6.2 | 4.4 | 1.8 |
| Riverside B | 7.6 | 8.0 | None |
| Riverside C | 8.3 | 15.5 | None |
| Riverside D | 10.0 | --[1] | None |
| Riverside E | 10.0 | 14.8 | None |
| Riverside F | 9.5 | 9.5 | None |
| Temescal | 10.0 | 13.2 | None |
| Warm Springs | --[1] | --[1] | None |
| ***SAN JACINTO RIVER BASINS*** | | | |
| Canyon | 2.5 | 1.6 | 0.9 |
| Hemet South | 4.1 | 5.2 | None |
| Lakeview – Hemet North | 1.8 | 2.7 | None |
| Menifee | 2.8 | 5.4 | None |
| Perris North | 5.2 | 4.7 | 0.5 |
| Perris South | 2.5 | 4.9 | None |
| San Jacinto Lower | 1.0 | 1.9 | None |
| San Jacinto Upper | 1.4 | 1.9 | None |
| ***LOWER SANTA ANA RIVER BASINS*** | | | |
| Irvine | 5.9 | 7.4 | None |
| La Habra | --[1] | --[1] | None |
| Orange County | 3.4 | 3.4 | None |
| Santiago | --[1] | --[1] | None |

[1] Not enough data to estimate nitrate nitrogen concentrations
[2] Assimilative capacity created by "maximum benefit" objectives is allocated solely to agency(ies) responsible for "maximum benefit" implementation (see Section VI.).

2. Mineral Increments

The fundamental philosophy of TDS management plans in Santa Ana Region Basin Plans to date has been to allow a reasonable use of the water, to treat the wastewater generated appropriately, and to allow it to flow downstream (or to lower groundwater basins) for reuse. "Reasonable use" is defined in terms of appropriate mineral increments that can be applied to water supply quality in setting discharge limitations.

The Department of Water Resources has recommended values for the maximum use incremental additions of specific ions that should be allowed through use, based on detailed study of water supplies and wastewater quality in the Region [Ref. 8]. Their recommendations are as follows:

| | |
|---|---|
| Sodium | 70 mg/L |
| Sulfate | 40 mg/L |
| Chloride | 65 mg/L |
| TDS | 250 mg/L |
| Total Hardness | 30 mg/L |

These mineral increments were incorporated into the 1983 Basin Plan. They will be incorporated into waste discharge requirements when appropriate and necessary.

3. Nitrogen Loss Coefficients

The Regional Board's regulatory program has long recognized that some nitrogen transformation and loss can occur when wastewater is discharged to surface waters or reused for landscape irrigation. For example, the Total Inorganic Nitrogen (TIN) wasteload allocation adopted for the Santa Ana River in 1991 included unidentified nitrogen losses in the surface flows in Reach 3 of the River. Waste discharge requirements have allowed for nitrogen losses due to plant uptake when recycled water is used for irrigation.

In contrast, nitrogen has been considered a conservative constituent in the subsurface, not subject to significant transformation or loss, and no such losses have been identified or assumed for regulatory purposes.

One of the tasks included in the Nitrogen/TDS Task Force studies leading to the 2004 update of the N/TDS Management Plan was the consideration of subsurface transformation and loss. One objective of this task was to determine whether dischargers might be required to incur costs for additional treatment to meet the new groundwater management zone nitrate-nitrogen objectives (Chapter 4), or whether natural, subsurface nitrogen losses could achieve any requisite reductions. The second objective was to develop a nitrogen loss coefficient that could be used with certainty to develop appropriate limits for nitrogen discharges throughout the Region.

To meet these objectives, the Nitrogen/TDS study consultant, Wildermuth

Environmental, Inc. (WEI), evaluated specific recharge operations (e.g., the Orange County Water District recharge ponds overlying the Orange County Forebay), wastewater treatment wetlands (e.g., the Hidden Valley Wildlife Area, operated by the City of Riverside) and Santa Ana River recharge losses (for the Santa Ana River, water quality in reaches where recharge is occurring ("losing" reaches) was compared with local well data). In each case, WEI evaluated long-term (1954 to 1997) nitrogen surface water quality data and compared those values to long-term nitrogen data for adjacent wells.

Based on this evaluation, a range of nitrogen loss coefficients was identified. [Ref. 1] In light of this variability, the N/TDS Task Force recommended that a conservative approach to be taken in establishing a loss coefficient. The Task Force recommended that a region-wide default nitrogen loss of 25% be applied to all discharges that affect groundwater in the Region. The Task Force also recommended that confirmatory, follow-up monitoring be required when a discharger requested and was granted the application of a nitrogen loss coefficient greater than 25%, based on site-specific data submitted by that discharger.

The City of Riverside also presented data to the Task Force regarding nitrogen transformation and losses associated with wetlands. These data support a nitrogen loss coefficient of 50%, rather than 25%, for the lower portions of Reach 3 of the Santa Ana River that overlie the Chino South groundwater management zone. [Ref. 9]. In fact, the data indicate that nitrogen losses from wetlands in this part of Reach 3 can be greater than 90%. However, given the limited database, the Task Force again recommended a conservative approach, i.e., 50% in this area, with confirmatory monitoring.

The 25% and, where appropriate, 50% nitrogen loss coefficients will be used in developing nitrogen discharge limits. These coefficients will be applied to discharges that affect groundwater management zones with and without assimilative capacity.

For discharges to groundwater management zones with assimilative capacity, the TIN discharge limitation would be calculated as follows:

$$\text{TIN Discharge Limit (mg/)} = \frac{\text{management zone nitrate-nitrogen current ambient water quality}}{(1 - \text{nitrogen loss coefficient})}$$

The Regional Board will employ its discretion in specifying a higher TIN limit that would allocate some of the available assimilative capacity.

For discharges to groundwater management zones without assimilative capacity, the TIN discharge limitation would be calculated as follows:

$$\text{TIN Discharge Limit (mg/)} = \text{management zone nitrate-nitrogen water ambient water quality} \div (1 - \text{nitrogen loss coefficient})$$

These coefficients do not apply to discharges specifically addressed by the TIN wasteload allocation, described in the next section, since surface and subsurface nitrogen losses were accounted for in developing this allocation.

4. TDS and Nitrogen Wasteload Allocations for the Santa Ana River

Wasteload allocations for regulating discharges of TDS and total inorganic nitrogen (TIN) to the Santa Ana River, and thence to groundwater management zones recharged by the River, are an important component of salt management for the Santa Ana Basin. As described earlier, the Santa Ana River is a significant source of recharge to groundwater management zones underlying the River and, downstream, to the Orange County groundwater basin. The quality of the River thus has a significant effect on the quality of the Region's groundwater, which is used by more than 5 million people. Control of River quality is appropriately one of the Regional Board's highest priorities.

Sampling and modeling analyses conducted in the 1980's and early 1990's indicated that the TDS and total nitrogen water quality objectives for the Santa Ana River were being violated or were in danger of being violated. Under the Clean Water Act (Section 303(d)(1)(c); 33 USC 466 *et seq.*), violations of water quality objectives for surface waters must be addressed by the calculation of the maximum wasteloads that can be discharged to achieve and maintain compliance. Accordingly, TDS and nitrogen wasteload allocations were developed and included in the 1983 Basin Plan. The nitrogen wasteload allocation was updated in 1991; an updated TDS wasteload allocated was included in the 1995 Basin Plan when it was adopted and approved in 1994/1995.

The wasteload allocations distribute a share of the total TDS and TIN wasteloads to each of the discharges to the River or its tributaries. The allocations are implemented principally through TDS and nitrogen limits in waste discharge requirements issued to municipal wastewater treatment facilities (Publicly Owned Treatment Works or POTWs) that discharge to the River, either directly or indirectly[3]. Nonpoint source inputs of TDS and nitrogen to the River are also considered in the development of these wasteload allocations. Controls on these inputs are more difficult to identify and achieve and may be addressed through the areawide stormwater permits issued to the counties by the Regional Board or through other programs. For example, the Orange County Water District has constructed and operates more than 400 acres of wetlands ponds in the

[3] With some exceptions that may result from groundwater pumping practices, the ground and surface waters in the upper Santa Ana Basin (upstream of Prado Dam) eventually enter the Santa Ana River and flow through Prado Dam. Discharges to these waters will therefore eventually affect the quality of the River and must be regulated so as to protect both the immediate receiving waters and other affected waters, including the River.

Prado Basin Management Zone to remove nitrogen in flows diverted from, and then returned to, the Santa Ana River.

Because of the implementation of these wasteload allocations, the Orange County Water District wetlands and other measures, the TDS and TIN water quality objectives for the Santa Ana River at Prado Dam are no longer being violated, as shown by annual sampling of the River at the Dam by Regional Board staff [Ref. 10A]. However, as part of the Nitrogen/TDS Task Force studies to update the TDS/nitrogen management plan for the Santa Ana Basin, a review of the TDS and TIN wasteload allocations initially contained in this Basin Plan was conducted. In part, this review was necessary in light of the new groundwater management zones and TDS and nitrate-nitrogen objectives for those zones recommended by the N/TDS Task Force (and now incorporated in Chapters 3 and 4). The wasteload allocations were evaluated and revised to ensure that the POTW discharges would assure compliance with established surface water objectives and would not cause or contribute to violation of the groundwater management zone objectives. The Task Force members also recognized that this evaluation was necessary to determine the economic implications of assuring conformance with the new management zone objectives. Economics is one of the factors that must be considered when establishing new objectives (Water Code Section 13241).

WEI performed the wasteload allocation analysis for both TDS and TIN [Ref. 3, 5], In contrast to previous wasteload allocation work, the QUAL-2e model was not used for this analysis. Further, the Basin Planning Procedure (BPP) was not used to provide relevant groundwater data. Instead, WEI developed a projection tool using a surface water flow/quality model and a continuous-flow stirred-tank reactor (CFSTR) model for TDS and TIN. The surface water Waste Load Allocation Model (WLAM) is organized into two major components – RUNOFF (RU) and ROUTER (RO). RU computes runoff from the land surface and RO routes the runoff estimated with RU through the drainage system in the upper Santa Ana watershed. Both the RU and RO models contain hydrologic, hydraulic and water quality components.

To ensure that all hydrologic regimes were taken into account, hydrologic and land use data from 1950 through 1999 were used in the analysis. The analysis took into account the TDS and nitrogen quality of wastewater discharges, precipitation and overland runoff, instream flows and groundwater. Off-stream and in-stream percolation rates, rising groundwater quantity and quality, and the 25% and 50% nitrogen loss coefficients described in the preceding section were also factored into the analysis. The purpose of the modeling exercise was to estimate discharge, TDS and TIN concentrations in the Santa Ana River and tributaries and in stream bed recharge. These data were then compared to relevant surface and groundwater quality objectives to determine whether changes in TDS and TIN regulation were necessary.

Discharges from POTWs to the Santa Ana River or its tributaries were the focus of the analysis. POTW discharges to percolation ponds were not considered. The wasteload allocation analysis assumed, correctly, that these direct groundwater discharges will be

regulated pursuant to the management zone objectives, findings of assimilative capacity and nitrogen loss coefficients identified in Chapter 4 and earlier in this Chapter.

The surface waters evaluated included the Santa Ana River, Reaches 3 and 4, ChinoCreek, Cucamonga/Mill Creek and San Timoteo Creek. Management zones that are directly under the influence of these surface waters and that receive wastewater discharges were evaluated. These included the San Timoteo, Riverside A, Chino South, and Orange County Management Zones[4]. In addition, wastewater discharges to the Prado Basin Management Zone were also evaluated.

WEI performed three model evaluations in order to assess wasteload allocation scenarios through the year 2010. These included a "baseline plan" and two alternative plans ("2010-A" and "2010-B"). The baseline plan generally assumed the TDS and TIN limits and design flows for POTWs specified in waste discharge requirements as of 2001. These limits implemented the wasteload allocations specified in the 1995 Basin Plan when it was approved in 1995. A TDS limit of 550 mg/L was assumed for the Rapid Infiltration and Extraction Facility (RIX) and the analysis assumed a 540 mg/L TDS for the City of Beaumont. The baseline plan also assumed reclamation activities at the level specified in the 1995 Basin Plan, when it was approved. The purpose of the baseline plan assessment was to provide an accurate basis of comparison for the results of evaluation of the two alternative plans. For alternative 2010-A, it was generally assumed that year 2001 discharge effluent limits for TDS and TIN applied to POTW discharges, but projected year 2010 surface water discharge amounts were applied. TDS limits of 550 mg/L and 540 mg/L were again assumed for RIX and the City of Beaumont discharges. The same limited reclamation and reuse included in the baseline plan was assumed (see Table 5-7 in Section III.B.5.). For alternative 2010-B, POTW discharges were also generally limited to the 2001 TDS and TIN effluent limits (RIX was again held to 550 mg/L and Beaumont to 540 mg/L). However, in this case, large increases in wastewater recycling and reuse were assumed (Table 5-7), resulting in the reduced surface water discharges projected for 2010.

Analysis of the model results demonstrated that the TDS and nitrogen objectives of affected surface waters would be met and that water quality consistent with the groundwater management zone objectives would be achieved under both alternatives. It is likely that water supply and wastewater agencies will implement reclamation projects with volumes that are in the range of the two alternatives. The wasteload allocations would be protective throughout the range of surface water discharges identified. The year 2010 flow values are not intended as limits on POTW flows; rather, these flows were derived from population assumptions and agency estimates and are

[4] The City of Beaumont discharges to Coopers Creek in a subunit of the Beaumont Management Zone. However, for analytical and regulatory purposes, it is considered a discharge to the San Timoteo Management Zone since it enters that Management Zone essentially immediately. Recharge of wastewater discharges by YVWD and Beaumont in downgradient management zones that may be affected by surface water discharges (e.g., Bunker Hill B, Colton), is not expected to be significant. Therefore, these management zones were not evaluated as part of the wasteload allocation analysis.

used in the models for quality projections. Surface water discharges significantly different than those projected will necessitate additional model analyses to confirm the propriety of the allocations.

The wasteload allocations for TDS and TIN are specified in Table 5-5. Allocations based on the 2010-A and 2010-B alternatives are shown for both TDS and TIN to reflect the expected differences in surface water discharge flows that would result from variations in the amount of wastewater recycling actually accomplished in the Region. As shown in this Table, irrespective of these differences, the TDS and TIN allocations remain the same.

It is essential to point out that the wasteload allocations in Table 5-5 will be not be used to specify TDS and TIN effluent limitations for wastewater recycling (reuse for irrigation) and recharge by the listed POTWs, but will be applied only to the surface water discharges by these POTWs to the Santa Ana River and its tributaries. TDS and TIN limitations for wastewater recycling and recharge by these POTWs will be based on the water quality objectives for affected groundwater management zones or, where appropriate, surface waters. These limitations are likely to be different than the wasteload allocations specified in Table 5-5.

For most dischargers, the allocations specified in Table 5-5 are the same as those specified in the prior 1995 Basin Plan TDS and TIN wasteload allocations. However, for certain dischargers, two sets of TDS and TIN wasteload allocations are shown in Table 5-5. One set is based on the assumption that the “maximum benefit” objectives defined in Chapter 4 for the applicable groundwater management zones are in effect. The other set of wasteload allocations applies if maximum benefit is not demonstrated and the antidegradation objectives for these management zones are therefore in effect. Maximum benefit implementation is described in Section VI. of this Chapter.

In addition, in contrast to the prior wasteload allocations, a single wasteload allocation for TDS and TIN that would be applied on a flow-weighted average basis to all of the treatment plants operated by the Inland Empire Utilities Agency as a whole is specified. These allocations are based on the water quality objectives for Chino Creek, Reach 1B (550 mg/L TDS and 8 mg/L TIN), to which the IEUA discharges occur, directly or indirectly. As described in Section VI, IEUA proposes to implement a “maximum benefit” program to support the implementation of the “maximum benefit” TDS and nitrate-nitrogen objectives for the Chino North and Cucamonga Management Zones. Separate “maximum benefit” and “antidegradation” wasteload allocations are not necessary for IEUA, as they are for YVWD and Beaumont. This is because the IEUA wasteload allocations are based solely on the Chino Creek objectives and are not contingent on “maximum benefit” objectives or implementation. The IEUA surface water discharges do not affect the groundwater management zones for which “maximum benefit” objectives are to be implemented.

Finally, the TDS wasteload allocation for the RIX facility is less stringent (550 mg/L) than the prior wasteload allocation. The new allocation will assure beneficial use protection and

will not result in a significant lowering of water quality. As such, it is consistent with antidegradation requirements. Given this, the less stringent effluent limitation can be specified pursuant to the exception to the prohibition against backsliding established in the Clean Water Act, Section 303(d)(4)(a).

In most cases, the surface water discharges identified in Table 5-5 will affect or have the potential to affect groundwater management zones without assimilative capacity for TDS and/or nitrogen. As discussed earlier in this section, the lack of assimilative capacity normally dictates the application of the water quality objectives of the affected receiving waters as the appropriate waste discharge limitations. However, as shown in Table 5-5, the TIN and, in some cases, TDS wasteload allocations for these discharges exceed the objectives for these management zones. This is because the wasteload allocation analysis conducted by WEI demonstrated that POTW discharges at these higher-than-objective levels will not result in violations of the TDS and nitrate-nitrogen objectives of the affected management zones, or surface waters. Accordingly, these wasteload allocations will be used for surface water discharge regulatory purposes, rather than the underlying groundwater management zone objectives. If the extensive monitoring program to be conducted by the dischargers (see Salt Management Plan – Monitoring Program Requirements, below) indicates that this strategy is not effective, then this regulatory approach will be revisited and revised accordingly.

Table 5-5

Alternative Wasteload Allocations through 2010
based on "Maximum Benefit" or "Antidegradation" Water Quality[1]

| Publicly Owned Treatment Works (POTW) | Alternative 2010A – Reclamation in 1995 Basin Plan | | | Alternative 2010B – Reclamation Plans Advocated by POTWs/others | | |
|---|---|---|---|---|---|---|
| | Surface Water Discharge (MGD) | TDS (mg/L) | TIN (mg/L) | Surface Water Discharge (MGD) | TDS (mg/L) | TIN (mg/L) |
| Beaumont – "max benefit" [2] | 2.3 | 490 | 6.0 | 1.0 | 490 | 6.0 |
| Beaumont – "antideg" [2, 3] | 2.3 | 320[3] | 4.1[3] | 1.0 | 320[3] | 4.1[3] |
| YVWD – Wochholz – "max benefit" | 5.7 | 540 | 6.0 | 0.0 | 540 | 6.0 |
| YVWD – Wochholz – "antideg" [3] | 5.7 | 320[3] | 4.1[3] | 0.0 | 320[3] | 4.1[3] |
| Rialto | 12.0 | 490 | 10.0 | 10.0 | 490 | 10.0 |
| RIX | 49.4 | 550 | 10.0 | 28.2 | 550 | 10.0 |
| Riverside Regional WQCP | 35.0 | 650 | 13.0 | 26.1 | 650 | 13.0 |
| Western Riverside Co. WWTP | 4.4 | 625 | 10.0 | 3.3 | 625 | 10.0 |
| EMWD[4] | 43 | 650 | 10.0 | 6.0 | 650 | 10.0 |
| EVMWD – Lake Elsinore Regional | 7.2 | 700 | 13.0 | 2.0 | 700 | 13.0 |
| Lee Lake WRF | 1.6 | 650 | 13.0 | 1.6 | 650 | 13.0 |
| Corona WWTP # 1 | 3.6 | 700 | 10.0 | 2.0 | 700 | 10.0 |
| Corona WWTP # 2 | 0.2 | 700 | 10.0 | 0.5 | 700 | 10.0 |
| Corona WWTP # 3 | 2.0 | 700 | 10.0 | 0.5 | 700 | 10.0 |
| IEUA Facilities [5] | 80.0 | 550 | 8.0 | 37.4 | 550 | 8.0 |

1. "Antidegradation" wasteload allocation is the default allocation if the Regional Board determines that "maximum benefit" commitments are not being met.
2. Beaumont discharges to Coopers Creek, a tributary of San Timoteo Creek, Reach 4, it is a *de facto* discharge to San Timoteo Creek/San Timoteo Management Zone.
3. "Antidegradation" wasteload allocations for City of Beaumont and YVWD based on additional model analysis performed by WEI (WEI, October 2002).
4. EMWD discharges are expected to occur only during periods of wet weather.
5. IEUA facilities include the RP#1, Carbon Canyon WRP, RP#4 and RP#5; These facilities are to be regulated as a bubble (see text).

Ammonia

Total inorganic nitrogen is used for regulatory purposes in wasteload allocations and surface water discharge limits. It is the sum of nitrate, nitrite and ammonia. Ammonia dissociates under certain conditions to the toxic un-ionized form. Thus, nitrogen discharges to the Santa Ana River and other surface waters pose a threat to aquatic life and instream beneficial uses, as well as to the beneficial uses of affected groundwater.

Un-ionized ammonia objectives are specified in Chapter 4 of this Basin Plan for warmwater aquatic habitats, such as the Santa Ana River system. Table 5-6 specifies the ammonia limits necessary to achieve these objectives. These limits were derived using QUAL2E, the Colorado Ammonia Model, water quality data on the River and effluent quality.

The un-ionized ammonia objectives have not been approved by the United States Environmental Protection Agency (USEPA), which recommends that the objectives be reviewed and revised based on the Agency's revised national ammonia criteria. A review of the un-ionized ammonia objectives is included in the Regional Board's 2002 Triennial Review Priority List. Any revised objectives and revised ammonia effluent limits needed to achieve the revised objectives will be incorporated in future amendments to this Plan once the requisite review is completed.

Table 5-6
Effluent Limits for Total Ammonia Nitrogen[1]

| Discharge Location | Effluent Limit - Total Ammonia Nitrogen[2] (mg/L) | |
|---|---|---|
| | Year 1995 | Year 2000 |
| San Timoteo Wash | 5.0 | 4.5 |
| Santa Ana River - Reach 4 | 5.0 | 4.5 |
| Santa Ana River - Reach 3 | 5.0 | 5.0 |
| Chino Creek | 5.0 | 4.5 |
| Mill Creek (Prado Area) | 5.0 | 4.5 |
| Temescal Creek | 5.0 | 4.5 |
| Other **WARM** designated waterbodies | Determined on a case-by-case basis | |

[1] Total Ammonia Nitrogen Wasteload Allocation is specified in order to meet the site-specific Santa Ana River un-ionized ammonia objective (See Chapter 4).

[2] Total Ammonia Nitrogen = Un-ionized Ammonia Nitrogen ($NH_3$-N) Ammonium Nitrogen ($NH_4^+$-N).

## 5. Wastewater Reclamation

Reclamation of wastewater for reuse (recycled water) is an important feature of wastewater and water management for the Santa Ana Region. The California Legislature has declared the primary interest of the people of California in the development of facilities to recycle wastewater to supplement existing water supplies and to meet future water demands (Water Code Section 13510-13512). State policy (State Board Resolution No. 77-1) affirms this commitment to encourage recycled water use. However, because reclamation projects tend to add to the salt balance problem in the Region, they must be carefully planned and implemented. The significant benefits that result from such projects, include:

- The total water supply can be effectively increased, reducing the need for imports;
- Wastewater treatment costs can be reduced in some cases. Meeting the level of treatment required for discharge to surface waters may be more expensive than treating the effluent for use in irrigation;
- Stream flows can be established or enhanced, providing aquatic riparian habitat and allowing recreation and other beneficial uses of the stream;
- Downstream delivery commitments can often be met by discharges of appropriately treated wastewater.

Concerns related to wastewater reclamation projects include:

### 1. Mineral Quality Effects

The mineral quality of the receiving water (surface or groundwater) can be adversely affected. Each cycle of water use increases the salinity of the water. The amount of the increase depends on the type of use; normal domestic use generally adds 200-300mg/L of TDS to the initial concentration. Agricultural use generally doubles the salinity, while industrial uses most often degrade water quality to a level where it may be unsuitable for discharge. Therefore, it is important that the type of reclaimed wastewater use and the likely effects on water quality be evaluated carefully prior to initiating such reuse. Certain waters in the upper Santa Ana Basin do not have assimilative capacity to accept the additional salinity that would be expected to result from reclamation.

### 2. Public Health Effects

Municipal wastewaters contain significant concentrations of bacteria, viruses, and organics. These wastewaters must be treated extensively to remove pathogens before they can be reclaimed. Stable organics in reclaimed water are also cause for considerable concern. Chlorination of treated wastewater effluents can

produce chlorinated hydrocarbons, some of which are carcinogenic. For this reason, the California State Department of Health Services is concerned with proposals that would return a high proportion of treated wastewater effluent into domestic water supply aquifers. Adequate treatment and dilution of the wastewater is essential. The Department is developing guidelines for the purposed use of reclaimed wastewater for groundwater recharge.

Because of the high percentage of wastewater in river baseflow, the Santa Ana River Water Quality and Health (SARWQH) Study was initiated by OCWD in 1994 to evaluate the use of the Santa Ana River to recharge the Orange County groundwater basin. The goal of the SARWQH Study was to characterize the quality of the Santa Ana River water and the quality of the groundwater basin it recharges. The study included an examination of hydrogeology, microbiology, water chemistry, toxicology and public health. The results of the study indicate that current recharge practices using Santa Ana River water are protective of public health.

3. Land Use Considerations

One of the major problems facing the future of wastewater reclamation is a decrease in the total amount of agricultural land in the basin. As the population of the basin increases, commercial and residential developments eliminate agricultural land and the need for irrigation waters. Some reclaimed wastewater may be used for irrigating landscaping in the new developments, but the volume utilized will almost certainly be reduced.

4. The Prado Settlement

On October 18, 1963, the Orange County Water District filed a class action lawsuit against the water users in the upper Santa Ana Basin, seeking an adjudication of water rights against substantially all the water users in the area tributary to Prado Dam in the Santa Ana River watershed. As a result of the 1969 settlement of this case, the wastewater dischargers in the upper basin are required to provide 42,000 acre-feet at Prado Dam. This can consist of treated wastewater effluent or imported water as well as certain natural flows (*e.g.,* rising water); stormflows are not included. The amount of flow delivered is subject to adjustment based upon the TDS content of the water. Reclamation uses within the upper basin are thus limited to a degree by the need to ensure compliance with this settlement.

Wastewater is presently being reclaimed in the Santa Ana Watershed in a number of different ways:

1. Irrigation of Agricultural Land and Landscaping

Most of the direct reclamation of wastewater in the Region occurs as part of commercial agricultural and landscape irrigation, although this will change as recharge projects using recycled water are implemented (see below). This use is conducted under water reclamation requirements issued by the Regional Board, typically as part of Waste Discharge Requirements and NPDES permits. In the San Jacinto Watershed, most of the wastewater is reclaimed for agricultural uses.

2. Discharge to the Santa Ana River

Although it is not widely considered as such, discharges of treated wastewater to Reaches 3, 4 and 5 of the Santa Ana River constitute the largest single reclamation activity in the Region. These discharges make up as much as 95 percent of the river's dry weather flow and enhance the in-stream beneficial uses of the river throughout its 26-mile length (San Bernardino to Prado Dam). Essentially all of this water is recharged into the groundwater basin in Orange County

3. Groundwater Recharge by Percolation

This type of reclamation is common throughout the Region. Most wastewater treatment plants that do not discharge directly to the River discharge their effluent to percolation ponds. All of the treated wastewater in the upper Santa Ana Basin that is not directly reclaimed for commercial agricultural and landscape irrigation purposes, or discharged directly to the Santa Ana River, is returned to local or downstream groundwater management zones by percolation. In Orange County, reclaimed water is used for greenbelt and landscape irrigation, and injected into coastal aquifers to control sea water intrusion.

Significant additional reclamation activities are planned in the Region, as reflected in Table 5-7. The Chino Basin Watermaster, Inland Empire Utilities Agency, Yucaipa Valley Water District, the City of Beaumont and the San Timoteo Watershed Management Authority propose to implement extensive groundwater recharge projects using recycled water. To accommodate these projects and other water and wastewater management strategies, these agencies have made the requisite demonstrations necessary to support the "maximum benefit" TDS and nitrate-nitrogen water quality objectives specified in this Plan for certain groundwater management zones (see Chapter 4). The recharge projects will provide reliable sources of additional water supply needed to support expected development within the agencies' areas of jurisdiction. These agencies' "maximum benefit" programs are described in detail in Section VI. of this Chapter.

In Orange County, significant reclamation activities include the implementation of the Groundwater Replenishment System, a joint effort of the Orange County Water District and Orange County Sanitation District. Treated wastewater provided by the Sanitation District will receive extensive advanced treatment, including microfiltration, reverse osmosis, and disinfection using ultraviolet light and hydrogen peroxide. In the first phase of the project, approximately 70,000 acre-feet per year of highly treated recycled water will be produced and distributed to groundwater recharge facilities and to injection wells used to maintain a seawater intrusion barrier. The System will enhance both the quality and quantity of groundwater resources, the major source of water supply in the area. It will reduce the need for imported water and prevent, or at least delay, the need for an additional ocean outfall for disposal of the wastewater treated by the Sanitation District. Implementation of the GWR System will be phased**.** Operation of Phase 1 will begin in 2007. Future phases to expand the capacity of the GWR System are possible.

4. Dual Water Supply Systems

Given increasing demands for water supply but diminishing resources, there is great interest in using reclaimed water in office buildings and the like for flushing toilets and urinals. Clearly, the addition of this water supply source must be carefully planned and overseen to prevent public health problems. No dual systems have been implemented as yet in the upper basin; in Orange County, the Irvine Ranch Water District has implemented dual systems (a reclaimed water system in addition to a potable supply) in a number of office buildings in its service area, with the approval of the Department of Health Services and the Regional Board.

The Salt Management Plan draws a balance between the benefits and problems of reclamation by including carefully planned reclamation activities in the watershed. The Recommended Plan provides for reclamation within the upper basin, as shown in Table 5-7. All recycled water recharge projects will be regulated pursuant to the process identified in the discussion regarding assimilative capacity, and in accordance with the “maximum benefit” implementation strategies identified later in this Chapter (see section VI., Maximum Benefit Implementation Plans for Salt Management).

Recycled water used for landscape irrigation deserves special regulatory consideration. As discussed in the section on nitrogen loss coefficients, the Regional Board does not regulate nitrogen in recycled water used for landscape irrigation, recognizing the nitrogen losses that will occur as the result of plant uptake. The Nitrogen /TDS Task Force sponsored update of the TDS/Nitrogen Management Plan demonstrated that it is appropriate also to apply a 25 percent nitrogen loss coefficient to recycled water discharges applied to land to account for subsurface transformation and loss. Nitrogen losses due to plant uptake and subsurface transformation justify the Board’s regulatory approach. With respect to TDS, the

water quality effects of recycled water used for landscape irrigation will be evaluated on a case-by-case basis and regulated accordingly.

6. Special Considerations – Subsurface Disposal Systems

In addition to establishing prohibitions and minimum lot size requirements for the use of subsurface disposal systems for sanitary wastes, the Regional Board issues waste discharge requirements where necessary to assure the protection of water quality and public health. In most cases, these requirements have been issued for commercial and industrial facilities, including mobile home parks, RV parks and truck washing operations, where the volume of waste is high and/or there is the potential for the discharge of wastes other than domestic sewage. Waste discharge requirements for individual residential systems and low volume (less than 500 gallons per day) domestic waste discharges from industrial and commercial facilities have been largely waived, pursuant to the waiver provisions of the Water Code (see discussion of waivers in the "Implementation through Waste Discharge Requirements" section, above). These waivers are conditional and may be revoked by the Regional Board at any time.

The Board has included TDS limitations in these waste discharge requirements in order to assure that the discharges are consistent with the TDS objectives of the affected receiving waters. These limits are expressed as both a maximum value that is based on the TDS objective of the receiving water, and a value that allows a reasonable use increment of 250 mg/L TDS above water supply quality. The more restrictive of the two TDS limits controls the allowed quality of the discharges.

TDS and nitrogen contributions from domestic waste discharges to existing commercial, industrial and residential subsurface disposal systems are reflected in the determinations of current ambient ground water quality and assimilative capacity (see preceding section – B.1.) on salt assimilative capacity). These determinations were made as part of the N/TDS Task Force sponsored update of the TDS/nitrogen management plan in this Basin Plan. These contributions are expected to decline over time as these discharges are eliminated through the expansion of regional sewer systems.

Compliance with TDS limits by these facilities is particularly problematic, since these facilities typically have little or no control over the TDS quality of water supplied to them, unlike POTWs. Further, sewering of the discharges is often not an option, at least at the present time, although this is changing as rapid new development in many parts of the region continues to drive the expansion of sewer facilities. As systems expand, many of these discharges will be eliminated as they are connected to the sewers. Finally, the offset provisions that are applied to POTWs are unnecessary for existing residential commercial and industrial domestic waste discharges, given that they are addressed as part of the Regional Board's minimum

lot size program for subsurface disposal systems and through the updated TDS and nitrogen management plan in this Basin Plan as part of the overlying land-use considerations and ambient water quality determinations.

Taking these factors into consideration, the waste discharge requirements that have been issued and will be updated periodically for domestic waste discharges from these existing residential, commercial and industrial facilities will include TDS requirements that specify a maximum mineral increment of 250 mg/L TDS to the water supply quality. This will assure reasonable use and prevent the disposal of highly saline wastes. Existing facilities are defined as those for which waste discharge requirements have been issued, or that have been built as of December 23, 2004.

Table 5-7
Wastewater Reclamation

| Subbasin (Management Zone) Receiving Reclaimed Water | Source | Amount AF/Y 2010-A[1] | Amount AF/Y 2010-B[2] |
|---|---|---|---|
| Beaumont MZ | Beaumont, City of | 250 | 1,500 |
| Yucaipa MZ | Yucaipa Valley Water District | -- | 6,400 |
| Bunker Hill B MZ | San Bernardino, City of and Colton, City of | 117 | 26,200 |
| Colton MZ | Rialto, City of | 200 | |
| Chino North MZ | IEUA RP-1 | 1,200 | 48,000 |
| Chino North MZ | IEUA RP-2A | 2,470 | |
| Chino North MZ | IEUA RP-4 | 3,300 | |
| Chino North MZ | California Institute for Men | 650 | 650 |
| Chino North MZ | Upland Golf Course | 31 | 31 |
| Temescal MZ | Corona, City of | 1,000 | 3,100 |
| | **TOTAL** | **9,218** | **86,000** |

[1] wastewater reclamation assumed in 2010-A is the same as that assumed in the 1995 Basin Plan when approved in 1994/1995 (also known as Table 5-7)

[2] wastewater reclamation assumed in 2010-B as identified by POTWs (see Ref. 3, 5).

## V. Other Projects and Programs

In addition to the regulatory efforts of the Regional Board described in the preceding section, water and wastewater purveyors and other parties in the watershed have implemented, and propose to implement, facilities and programs designed to address salt problems in the groundwater of the Region. These include the construction of brine lines and groundwater desalters, implementation of programs to enhance the recharge of high quality stormwater and imported water, where available, and re-injection of recycled water to maintain salt water intrusion barriers in coastal areas. These projects and programs are motivated by the need to protect and augment water supplies, as well as to facilitate compliance with waste discharge requirements.

### A. Brine Lines

There are two brine line systems in the Region, the Santa Ana Regional Interceptor (SARI) and the older Chino Basin Non-Reclaimable Line (NRL). These lines are used to transport brine wastes out of the basin for treatment and disposal to the ocean. They are a significant part of industrial waste management and essential for operation of desalters in the upper watersheds. The SARI Line was constructed and is owned by SAWPA. It is approximately 93 miles of 16 inch to 84 inch pipeline connected to the Orange County Sanitation District treatment facilities. SAWPA owns capacity rights in SARI downstream of Prado Dam. The line extends from the Orange County Line near Prado Dam northeast to the San Bernardino area. Recently, the SARI Line has been extended to serve the San Jacinto Watershed. SARI Reach 5 extends up the Temescal Canyon from the City of Corona to the Eastern Municipal Water District (EMWD) brine line terminus in the Lake Elsinore area. EMWD's Menifee Desalter and other high salinity discharges from EMWD and Western Municipal Water District now have access to the brine line.

The Chino Basin Non-Reclaimable Line (NRL) is connected to the Los Angeles County Sanitation District sewer system in the Pomona area. The NRL, which is owned and operated by Inland Empire Utilities Agency, exports non-reclaimable industrial wastes and brine from the Chino Basin. It extends eastward from the Los Angeles County Line to the City of Fontana. It was originally built to serve industries including the Kaiser Steel Company and Southern California Edison Power Plants.

### B. Groundwater Desalters

The studies leading to the development of the TDS/Nitrogen management plan included in this Basin Plan when it was approved in 1995 demonstrated that it was not realistic to achieve compliance with all the nitrogen and TDS objectives for the groundwater subbasins then identified within the Region. Long-term historic land use practices, particularly agriculture, have left an enormous legacy of salts that are now

in the unsaturated soils overlying the groundwater subbasins (now, newly defined groundwater management zones). A significant amount of these salts will, over time, degrade groundwater quality. The programs of groundwater extraction, treatment, an replenlishment needed to completely address these historic salt loads were shown to far exceed the resources available to implement them.

While the boundaries of the groundwater management zones have been revised and new TDS and nitrate-nitrogen water quality objectives established, the salt legacy problem remains. The construction and operation of groundwater desalters to extract and treat poor quality groundwater continues to be an essential component of salt management in the Region. Such projects will be increasingly important to protect local water supplies and to provide supplemental, reliable sources of potable supplies.

A number of groundwater desalters have already been constructed, and more are planned. These facilities are described below.

1. Upper Santa Ana Basin

In the Upper Santa Ana Basin, the Santa Ana Watershed Project Authority constructed and operates the Arlington desalter. This desalter, with a capacity of about 7 MGD, treats water extracted from the Arlington Management Zone, which was heavily impacted by historic agricultural activities.

In the Chino Basin, the Chino Desalter Authority operates the Chino 1 desalter, which is planned for expansion from 8 MGD to 13 MGD capacity. Additional desalters and desalter capacity will be constructed as part of a “maximum benefit” proposal by the Chino Basin Watermaster and the Inland Empire Utilities Agency (see Section VI., Maximum Benefit Implementation Plans for Salt Management).

The City of Corona began operation of the Temescal desalter in late 2001. The desalter has a capacity of 10 MGD. The City is currently expanding the desalter by 5 MGD. It is expected to be operational in the early 2004. The product water is used to supplement current municipal supplies. The improved TDS quality of these supplies is an important part of the City’s efforts to assure compliance with waste discharge requirements.

In the San Timoteo Watershed areas, desalters will be implemented as necessary for the Yucaipa and Beaumont areas, as discussed in detail in Section VI., Maximum Benefit San Timoteo Watershed Salt Management Plan.

2. San Jacinto Watershed

EMWD operates the Menifee desalter, which has a capacity of about 3 MGD. Product water is added to the EMWD municipal supply system, and the waste brine is discharged to a non-reclaimable waste disposal system that is ultimately connected to the SAWPA SARI system. The desalter extracts groundwater from the Perris South and Menifee Management Zones, both of which are adversely affected by historic salt loads contributed largely by agricultural activities.

EMWD plans to construct a desalter with capacity of about 4.5 MGD to treat poor quality water extracted from the Perris South and Lakeview/Hemet North Management Zones. The purpose of this facility is to stop subsurface migration of poor quality groundwater from the Perris South Management Zone into the Lakeview/Hemet North Management Zone.

3. Orange County

The Tustin Nitrate Removal project, which began operation in 1996, added approximately 3,000 acre-feet of water annually to Tustin's domestic water supply. Treatment systems employing reverse osmosis and ion exchange are operating at two wells that had been shut down because of excessive nitrate concentrations. The Orange County Water District and Irvine Ranch Water District (IRWD) are moving forward with the Irvine Desalter, a dual-purpose regional groundwater remediation and water supply project located in the City of Irvine and its sphere of influence. The project consists of an extensive seven-well groundwater extraction and collection system, a treatment system, a five-mile brine disposal pipeline, a finished water delivery system, and ancillary facilities. While providing approximately 6,700 acre-feet per year to IRWD for potable supply, the desalter will extract and treat brackish groundwater and capture an overlapping regional plume of TCE-contaminated groundwater demonstrated to have originated from the U.S. Marine Corps Air Station-El Toro.

C. Recharge of Stormwater and/or Imported Water

The Orange County Water District, San Bernardino Valley Water Conservation District and other agencies in the Region operate extensive facilities designed to enhance the capture and recharge of high quality stormwater. More such facilities are planned as part of "maximum benefit" proposals by the Chino Basin Watermaster/Inland Empire Utilities Agency, Yucaipa Valley Water District, San Timoteo Watershed Management Authority and the City of Beaumont (Section VI., Maximum Benefit Implementation Plans for Salt Management). These proposals also include efforts to import and recharge high quality State Water Project water, when it is available. These activities increase both the quantity and quality of available groundwater resources.

D. Sea Water Intrusion Barriers

The Orange County Water District operates advanced facilities designed to provide significantly enhanced tertiary treatment of secondary treated municipal wastewater from the Orange County Sanitation District's (Sanitation District) Fountain Valley Reclamation Plant No. 1. The recycled water is injected into a series of wells located along Ellis Avenue in the City of Fountain Valley to maintain the Talbert Gap Seawater Intrusion Barrier. The treatment facility, currently known as Water Factory 21, will be supplanted by the Groundwater Replenishment System (GWRS) being constructed jointly by Orange County Water District and the Sanitation District (see preceding section on wastewater reclamation).

## V. Salt Management Plan -- Monitoring Program Requirements

California Water Code Section 13242 specifies that Basin Plan implementation plans must contain a description of the monitoring and surveillance programs to be undertaken to determine compliance with water quality objectives. The adoption of new groundwater TDS and nitrate-nitrogen water quality objectives (Chapter 4) in response to the studies sponsored by the N/TDS Task Force triggered the need to develop and implement a new, watershed-wide nitrogen/TDS monitoring program. The Task Force provided additional impetus for this comprehensive monitoring program. The Task Force recommended that future review and update of the salt management plan, including findings of assimilative capacity, appropriate changes to the wasteload allocations, etc., should be based on real-time data obtained through a rigorous monitoring program, rather than on model projections. As discussed earlier (see Section II., Update of the Total Dissolved Solids/Nitrogen Management Plan), the Task Force concluded that the development of new, workable modeling tools to assist in this review was beyond the scope and financial capability of the Task Force.

The monitoring program must consist of both surface water and groundwater components. Some of these are already being implemented, including the annual sampling of the Santa Ana River, Reach 3 at Prado Dam by Regional Board staff (see Chapter 4 and below). Certain agencies have committed to conduct monitoring of specific water bodies as part of their "maximum benefit" proposals (see Section VI., Maximum Benefit Implementation Plans for Salt Management, below). The N/TDS Task Force members, and other parties as appropriate, will be required to propose a comprehensive monitoring program that would integrate these existing commitments with other monitoring recommendations. These parties will be required to implement this program upon approval by the Regional Board.

A. Surface Water Monitoring Program Requirements for TDS and Nitrogen

Implementation of a surface water monitoring program is needed to determine compliance with the nitrogen and TDS objectives of the Santa Ana River, and

thereby, the effectiveness of the wasteload allocations. It is also needed to provide data required to evaluate the effects of surface water discharges on affected groundwater management zones. In particular, data are needed to confirm the validity of the 50% nitrogen loss coefficient that will be applied in regulating discharges to that part of Reach 3 of the River that overlies the Chino South groundwater management zone (see Section III.B.3., Nitrogen loss coefficients).

As discussed in Chapter 4, the Basin Plan specifies baseflow TDS and total nitrogen objectives for Reach 3 of the River. For Reach 2, a TDS objective based on a five-year moving average of the annual TDS concentration is specified. Use of this moving average allows the effects of wet and dry years to be integrated over the five-year period and reflects the actual long-term quality of water recharged by Orange County Water District downstream of Prado Dam.

The Basin Plan specifies a monitoring program to determine compliance with the Reach 3 baseflow objectives at Prado Dam (see Chapter 4). As noted above, Regional Board staff conducts this program on an annual basis. Measurement of baseflow quality, rather than the quality of flows in Reach 2, has long been used to indicate the effects of recharge of Santa Ana River flows on Orange County groundwater. The efficacy of this approach was evaluated as part of the 2004 update of the TDS/nitrogen management plan in the Basin Plan. Insufficient data were available to draw a direct correlation between the long-term TDS and nitrogen quality of River flows at Prado Dam and that of affected Orange County groundwater. However, the conclusion drawn was that reliance on the Reach 3 baseflow objectives to protect Orange County groundwater, and the existing monitoring program designed to measure compliance, is adequate.

In addition to this baseflow sampling program and the surface water monitoring commitments associated with certain agencies' "maximum benefit" programs, the comprehensive monitoring program to be proposed and implemented by the Task Force members, and other agencies as appropriate, must include an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4 and 5 of the Santa Ana River. Compliance with the Reach 2 TDS objective can be determined by evaluation of data collected by the Santa Ana River Watermaster, Orange County Water District, the United States Geological Survey, and others.

Surface water monitoring program requirements for TDS and nitrogen are as follows:

1. No later than March 23, 2005, Orange County Water District, Inland Empire Utilities Agency, Chino Basin Watermaster, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal Water District, City of Colton, City of San Bernardino Municipal Water Department, Jurupa Community Services District, Western Riverside County Regional Wastewater Authority, Lee Lake Water District, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto shall submit to the Regional Board for approval, a proposed surface water TDS and nitrogen

monitoring program that will provide an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4 and 5 of the Santa Ana River.

In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group monitoring plan shall also be submitted no later than March 23, 2005.

2. By April 15th of each year, the Orange County Water District, Inland Empire Utilities Agency, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal Water District, Lee Lake Water District, City of Colton, City of San Bernardino Municipal Water Department, Jurupa Community Services District, Western Riverside County Wastewater Agency, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto, shall submit an annual report of Santa Ana River, Reach 2 , 4 and 5 water quality. Data evaluated shall include that collected by the Santa Ana River Watermaster, Orange County Water District, and the US Geologic Survey, at a minimum.

   In lieu of this coordinated annual report, one or more of the parties identified in the preceding paragraph may submit an individual or group annual report. Any such individual or group report shall also be submitted by April 15th of each year.

Additional surface water monitoring programs may be specified by the Regional Board depending upon watershed conditions, waste discharge specifications and/or any special studies related to TDS and nitrogen.

B. Groundwater Monitoring Program for TDS and Nitrogen

Implementation of a watershed-wide TDS/nitrogen groundwater monitoring program is necessary to assess current water quality, to determine whether TDS and nitrate-nitrogen water quality objectives for management zones are being met or exceeded, and to update assimilative capacity findings. Groundwater monitoring is also needed to fill data gaps for those management zones with insufficient data to calculate TDS and nitrate-nitrogen historical quality and current quality. Finally, groundwater monitoring is needed to assess the effects of POTW discharges to surface waters on affected groundwater. In particular, monitoring is needed to confirm the 50% nitrogen loss coefficient for discharges to that part of the Santa Ana River, Reach 3 that affect the Chino South Management Zone.

Groundwater monitoring requirements for TDS and nitrogen are as follows:

1. No later than June 23, 2005, Orange County Water District, Irvine Ranch Water District, Inland Empire Utilities Agency, Chino Basin Watermaster, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal Water District, City of Colton, City of San Bernardino Municipal Water Department, City of

Redlands, Jurupa Community Services District, Western Riverside County Regional Wastewater Authority , Lee Lake Water District, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto shall submit to the Regional Board for approval, a proposed watershed-wide TDS and nitrogen monitoring program that will provide data necessary to review and update the TDS/nitrogen management plan. Data to be collected and analyzed shall address, at a minimum: (1) determination of current ambient quality in groundwater management zones; (2) determination of compliance with TDS and nitrate-nitrogen objectives for the management zones; (3) evaluation of assimilative capacity findings for groundwater management zones; and (4) assessment of the effects of recharge of surface water POTW discharges on the quality of affected groundwater management zones. The determination of current ambient quality shall be accomplished using methodology consistent with that employed by the Nitrogen/TDS Task Force (20-year running averages) to develop the TDS and nitrogen water quality objectives included in this Basin Plan. [Ref. 1] The determination of current ambient groundwater quality throughout the watershed must be reported by July 1, 2005, and, at a minimum, every three years thereafter.

In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group monitoring plan shall also be due no later than June 23, 2005.

Details to be included in the proposed monitoring program shall include, but not be limited to, the following:

- Monitoring program goals
- responsible agencies
- groundwater water sampling locations
- surface water sampling locations (if appropriate)
- water quality parameters
- sampling frequency
- quality assurance/quality control
- database management
- data analysis and reporting

*Within 30 days of Regional Board approval of the proposed monitoring plan, the monitoring plan must be implemented.*

2. No later than June 23, 2005, the City of Colton, City of San Bernardino Municipal Water Department, City of Riverside, Jurupa Community Services District and the City of Rialto, shall submit to the Regional Board for approval, a monitoring program that will be utilized to confirm the 50% Santa Ana River, Reach 3 nitrogen loss coefficient.

In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group monitoring plan shall also be due no later than June 23, 2005.

*Within 30 days of Regional Board approval of the monitoring plan, the monitoring program must be implemented.*

Additional groundwater monitoring programs may be specified by the Regional Board depending upon watershed conditions, waste discharge specifications and/or any special studies related to TDS and nitrogen.

## VI. Maximum Benefit Implementation Plans for Salt Management

As discussed in Chapter 4, with some limited exceptions, TDS and nitrate-nitrogen objectives for groundwater management zones in the Santa Ana Region were established to ensure that historical quality is maintained, pursuant to the State's antidegradation policy (State Board Resolution No. 68-16). However, alternative, less stringent "maximum benefit" objectives are also specified in Chapter 4 for certain groundwater management zones. These "maximum benefit" objectives, which would allow the lowering of water quality, were established based on demonstrations by the agencies recommending them that antidegradation requirements were satisfied. First, these agencies demonstrated that beneficial uses would continue to be protected. Second, these agencies showed that water quality consistent with maximum benefit to the people of the state would be maintained. Other factors, such as economics, the need to use recycled water, and the need to develop housing in the area were also taken into account in establishing the objectives (see Chapter 4).

The demonstrations of "maximum benefit" by these agencies are contingent on the implementation of specific projects and programs by the agencies. As discussed in Chapter 4, if these projects and programs are not implemented to the Regional Board's satisfaction, then the alternative "antidegradation" objectives apply to these waters for regulatory purposes.

This section identifies the specific commitments by the Chino Basin Watermaster and Inland Empire Utilities Agency, the Yucaipa Valley Water District, the City of Beaumont and the San Timoteo Water Management Authority to implement projects and programs to support the "maximum benefit" objectives established for groundwater management zones affected by their wastewater and water management practices.

A. Salt Management – Chino Basin and Cucamonga Basin

As shown in Chapter 4, both "antidegradation" and "maximum benefit" objectives for TDS and nitrate-nitrogen are specified in this Plan for certain parts of the Chino Basin and the Cucamonga groundwater Management Zone. The application of the "maximum benefit" objectives relies on the implementation by the Chino Basin Watermaster and the Inland Empire Utilities Agency of a specific program of projects

and requirements [Ref. 10B], which are an integral part of the Chino Basin Optimum Basin Management Program (OBMP) [Ref. 10C]. The OBMP was developed by the Watermaster under the supervision of the San Bernardino County Superior Court. The OBMP is a comprehensive, long-range water management plan for the Chino Basin as a whole, including the Chino North (or Chino 1, 2, and 3) and Cucamonga Management Zones. The OBMP includes the use of recycled water for basin recharge, initially in the Chino North Management Zone. Recycled water recharge in the Cucamonga Management Zone may be pursued in the future. The OBMP also includes the capture of increased quantities of high quality storm water runoff, recharge of imported water when its TDS concentrations are low, improvement of water supply by desalting poor quality groundwater, and enhanced wastewater pollutant source control programs. The OBMP maps a strategy that will provide for enhanced yield for the Chino Basin and seeks to provide reliable water supplies for development expected to occur within the Basin. The OBMP also includes the implementation of management activities that would result in the hydraulic isolation of Chino Basin groundwater from the Orange County Management Zone, thus insuring the protection of downstream beneficial uses and water quality.

Table 5-8a identifies the projects and requirements that must be implemented to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. An implementation schedule is also specified. The Regional Board will revise IEUA's waste discharge requirements, issue appropriate permits to the Chino Basin Watermaster, and utilize the authority provided by Section 13267 of the Water Code as necessary to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" TDS and nitrate-nitrogen objectives apply to the Chino North and Cucamonga Management Zones as long as the schedule is being met. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-8a, then maximum benefit is not demonstrated, and the "antidegradation" TDS and nitrate-nitrogen objectives for the Chino 1, 2, and 3 and Cucamonga Management Zones apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen discharges to these management zones that took place in excess of limits based on the "antidegradation" objectives.

## *Table 5-8a*

Chino Basin Maximum Benefit Commitments

| **Description of Commitment** | **Compliance Date – as soon as possible, but no later than** |
|---|---|
| 1. Surface Water Monitoring Program | |
| a. Submit Draft Monitoring Program to Regional Board | a. January 23, 2005 |
| b. Implement Monitoring Program | b. Within 30 days from date of Regional Board approval of monitoring plan |
| c. Quarterly data report submittal | c. April 15, July 15, October 15, January 15 |
| d. Annual data report submittal | d. February 15th |
| 2. Groundwater Monitoring Program | |
| a. Submit Draft Monitoring Program to Regional Board | a. January 23, 2005 |
| b. Implement Monitoring Program | b. Within 30 days from date of Regional Board approval of monitoring plan |
| c. Annual data report submittal | c. February 15th |
| 3. Chino Desalters | |
| a. Chino 1 desalter expansion to 10 MGD | a. Prior to recharge of recycled water |
| b. Chino 2 desalter at 10 MGD design | b. Recharge of recycled water allowed once award of contract and notice to proceed issued for construction of desalter treatment plant |
| 4. Future desalters plan and schedule submittal | October 1, 2005 Implement plan and schedule upon Regional Board approval |
| 5. Recharge facilities (17) built and in operation | June 30, 2005 |
| 6. IEUA wastewater quality improvement plan and schedule submittal | 60 days after agency-wide 12 month running average effluent TDS quality equals or exceeds 545 mg/L for 3 consecutive months or agency-wide 12 month running average TIN equals or exceeds 8 mg/L in any month.<br>Implement plan and schedule upon approval by Regional Board. |

Table 5-8a

Chino Basin Maximum Benefit Commitments (cont.)

| **Description of Commitment** | **Compliance Date – as soon as possible, but no later than** |
|---|---|
| 7. Recycled water will be blended with other recharge sources so that the 5-year running average TDS and nitrate-nitrogen concentrations of water recharged are equal to or less than the "maximum benefit" water quality objectives for the affected Management Zone (Chino North or Cucamonga). | Compliance must be achieved by end of 5th year after initiation of recycled water recharge operations. |
| a. Submit a report that documents the location, amount of recharge, and TDS and nitrogen quality of stormwater recharge before the OBMP recharge improvements were constructed and what is projected to occur after the recharge improvements are completed | a. Prior to initiation of recycled water recharge |
| b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of CBW/IEUA enhanced recharge facilities. | b. Annually, by February 15th, after initiation of construction of basins/other facilities to support enhanced stormwater recharge. |
| 8. Hydraulic Control Failure | |
| a. Plan and schedule to correct loss of hydraulic control | a. 60 days from Regional Board finding that hydraulic control is not being maintained |
| b. Achievement and maintenance of hydraulic control | b. In accordance with plan and schedule approved by Regional Board. The schedule shall assure that hydraulic control is achieved as soon as possible but no later than 180 days after loss of hydraulic control is identified. |
| c. Mitigation plan for temporary failure to achieve/maintain hydraulic control | c. By January 23, 2005. Implement plan upon Regional Board determination that hydraulic control is not being maintained. |
| 9. Ambient groundwater quality determination | July 1, 2005 and every 3 years thereafter |

Description of Chino Basin Watermaster and Inland Empire Utilities Agency Commitments

1. Surface Water Monitoring Program (Table 5-8a #1)

The Chino Basin Watermaster (Watermaster), in conjunction with staff of the Orange County Water District and Regional Board, has developed a proposed surface water monitoring program. By January 23, 2005 and prior to the discharge of recycled water to the Chino Basin, Watermaster shall submit the recommended surface water monitoring program to the Regional Board for approval. The monitoring program must be implemented within 30 days of Regional Board approval, and six months of data must be generated prior to the discharge of recycled water to the Chino Basin.

At a minimum, the surface water monitoring program shall include the collection of bi-weekly measurements of general minerals and nitrogen components at the locations listed in Table 5-8b. Data reports shall be submitted to the Regional Board Executive Officer by April 15, July 15, October 15, and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted by February 15$^{th}$ of each year.

2. Groundwater Monitoring Program (Table 5-8a, #2)

The purpose of the Groundwater Monitoring Program is to (1) identify potential impacts from implementation of the Chino Basin "maximum benefit" water quality objectives on water levels and water quality within the Chino Basin and in downgradient basins and (2) determine whether hydraulic control (see # 8, below) is being achieved and maintained. By January 23, 2005 and prior to the discharge of recycled water to the Chino Basin, Watermaster shall submit to the Regional Board for approval a proposed groundwater monitoring program to determine hydraulic control and ambient water quality in the Chino North and Cucamonga Management Zones. Within 30 days of Regional Board approval of the monitoring plan, the groundwater monitoring program must be implemented.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15$^{th}$ of each year.

3. Chino 1 and Chino 2 Desalters (Table 5-8a, # 3)

Prior to the recharge of recycled water in the Chino Basin, the Chino 1 desalter must be expanded and in operation at a capacity of 10 million gallons per day (MGD). Also, contracts for the construction of the Chino 2 desalter treatment plant must be awarded and a notice to proceed with the construction must be given prior to recharge of recycled water.

4. Future Desalter Development (Table 5-8a, # 4)

No later than October 1, 2005, the schedule for implementation of the next 20 MGD of desalter capacity, pursuant to the Peace Agreement that implements the Chino Basin OBMP, and as required by the San Bernardino Superior Court, must be submitted to the Regional Board by the Chino Basin Watermaster. IEUA and/or the Chino Basin Watermaster and/or other responsible parties deemed acceptable by the Executive Officer, will initiate building of the next desalter when the 12-month running average effluent concentration (measured as an average for all IEUA wastewater treatment facilities) reaches 545 mg/L TDS for three consecutive months.

Table 5-8b

Surface Water Monitoring Sites for Monitoring of Surface Water and Groundwater Quality
Near the River to Determine the Presence and Source of Rising Groundwater

| Site Name | Discharge | Owner | Type | Discharge Monitoring | | Water Quality Monitoring | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Frequency | Period | Frequency | Period | Analyses |
| 11066460 | Santa Ana Riv. | USGS | Total Discharge | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| 11072100 | Temescal Cr. | USGS | Total Discharge | Bi-weekly | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| 11073495 | Cucamonga Cr. | USGS | Total Discharge | Bi-weekly | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| 11073440 | Chino Cr. | USGS | Total Discharge | Bi-weekly | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| 11074000 | Santa Ana Riv. | USGS | Total Discharge | Bi-weekly | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RWQCP Direct | Recycled Water | Riverside | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RWQCP Hidden Valley | Recycled Water | Riverside | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| Corona RW | Recycled Water | Corona | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RP1 Cucamonga | Recycled Water | IEUA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RP1 Prado | Recycled Water | IEUA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RP2 | Recycled Water | IEUA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| Carbon Canyon | Recycled Water | IEUA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| RP5 | Recycled Water | IEUA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| WRCRWTP | Recycled Water | WR-JPA | Recycled Water | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-MWDXING | Santa Ana Riv. | OCWD | Total Discharge | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-HOLELK-01 | Hole Lake | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-VANBUREN | Santa Ana Riv. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-ETIWANDA-01 | Santa Ana Riv. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-HAMNER-01 | Santa Ana Riv. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-RIV.RD | Santa Ana Riv. | OCWD | Total Discharge | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-DIV-PRADOWTLNDS | Santa Ana Riv. | OCWD | Total Discharge | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| SAR-BELOWDAM-01 | Santa Ana Riv. | OCWD | Total Discharge | Daily | Jan - Dec | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| CK-CHINO | Chino Cr. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| CK-MILL | Cucamonga Cr. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |
| CK-TEMESCAL | Temescal Cr. | OCWD | Total Discharge | Bi-weekly | May-Sep | Bi-weekly | Jan - Dec | Gen. Min. & Physical |

(Source: Ref. 10B)

5. Recharge Facilities (Table 5-8a, # 5)

By June 30, 2005, or no later than one year from the start of discharge of recycled water, the 17 recharge facilities identified in the August 2001 Watermaster Recharge Master Plan and as updated by the Watermaster and IEUA, must be completed and operated to maximize the capture of storm water in the Chino Basin. The Watermaster has also committed to optimize the recharge of imported water in the Chino Basin based on the goal of maximizing recharge of State Project water when the TDS of that water is lowest.

The Watermaster proposal recognizes the importance and necessity of recharge of both storm water and imported water to meet the water supply demands on the Chino Basin. Recharge of high quality supplies to the Chino Basin is necessary to offset the quality effects of recycled water and to achieve an ambient water quality equal to or better than the "maximum benefit" TDS and nitrate-nitrogen water quality objectives.

6. IEUA Wastewater Effluent Quality (Table 5-8a, # 6)

Within 60 days after the IEUA 12-month running average effluent concentration (measured as an average for all IEUA wastewater treatment facilities) for TDS exceeds 545 mg/L for 3 consecutive months, or the 12-month running average total inorganic nitrogen (TIN) concentration (measured as an average for all IEUA wastewater treatment facilities) exceeds 8 mg/L in any month, the IEUA shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the12-month running average agency wastewater effluent quality does not exceed 550 mg/L and 8 mg/L for TDS and TIN, respectively. The Plan and schedule are to be implemented upon Regional Board approval.

7. Recycled Water Use (Table 5-8a, # 7)

The use and recharge of recycled water within the Chino Basin is a critical component of the Watermaster OBMP and is necessary to maximize the use of the water resources of the Chino Basin. The demonstration of maximum benefit, and the continued application of the "maximum benefit" TDS and nitrate-nitrogen water quality objectives, depends on the recharge to the Chino North Management Zone of 5-year annual average (running average) TDS and nitrogen concentrations of no more than 420 mg/L and 5 mg/L, respectively. If and when recycled water recharge in the Cucamonga Management Zone is pursued, the application of the "maximum benefit" objectives will depend on the recharge to that zone of 5-year running average TDS and nitrogen concentrations no greater than 380 mg/L and 5 mg/L, respectively. IEUA has committed to meeting these levels and recognizes that the maximum benefit objectives depend on achieving these 5-year running average concentrations.

Accordingly, the use of recycled water for groundwater recharge shall be limited to the amount that can be blended on a volume-weighted basis with other sources of

recharge to the management zone to achieve a 5-year running average concentration equal to or less than the "maximum benefit" TDS and nitrogen water quality objectives of the affected Management Zone (Chino North or Cucamonga). The 25% nitrogen loss coefficient will be applied to calculate recycled water nitrogen quality when determining the amount of recharge of other water sources that must be achieved to meet the 5-year running averages.

8. Hydraulic Control (Table 5-8a, # 8)

"Hydraulic Control" is defined as eliminating groundwater discharge from the Chino Basin to the Santa Ana River, or controlling the discharge to *de minimis* levels. The surface water and groundwater monitoring programs described above are intended to demonstrate whether hydraulic control is achieved and maintained. In the event that the Regional Board finds that hydraulic control is not being accomplished, the Watermaster shall submit to the Regional Board within 60 days of that finding a plan and time schedule to correct (within 180 days from the Regional Board approval of the plan and schedule) the failure to achieve and maintain hydraulic control.

By January 23, 2005, the Watermaster and IEUA shall prepare a proposed plan and schedule to mitigate temporary losses of hydraulic control. These agencies must implement this plan upon a determination by the Regional Board that hydraulic control is not being achieved or maintained.

9. Ambient Groundwater Quality Determination (Table 5-8a, # 9)

By July 1, 2005, and every three years thereafter, Watermaster shall submit a determination of ambient TDS and nitrate-nitrogen quality in the Chino North and Cucamonga Management Zones. This determination shall be accomplished using methodology consistent with the determinations (20-year running averages) used by the TDS/Nitrogen Task Force to develop the "antidegradation" TDS and nitrate-nitrogen water quality objectives for groundwaters subbasins within the Region. [Ref. 1].

<u>Implementation by Regional Board</u>

1. Revision of the Inland Empire Utilities Agency NPDES Permits

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permits for IEUA wastewater discharges to reflect the commitments described above, as appropriate. This includes the following. TDS and TIN (includes nitrate-nitrogen) limits of 550 mg/L and 8 mg/L, respectively, will be specified as an agency-wide, volume weighted-average. The limits will be expressed as 12-month running averages. These limits implement the wasteload allocations for IEUA surface water discharges (see Table 5-5), and are not

contingent on the "maximum benefit" objectives or demonstration[5]. IEUA will be required to implement measures to improve effluent quality when the 12 month running average effluent concentration (measured as an average for all IEUA treatment facilities) exceeds 545 mg/L for 3 consecutive months, or when the 12-month running average total inorganic nitrogen concentration (also measured as an average for all IEUA treatment facilities) exceeds 8 mg/L in any month. The permits will require that recycled water used for recharge shall be limited to the amount that can be blended in the management zone with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Chino North or Cucamonga). Recycled water recharge is not currently contemplated in other parts of the Chino Basin. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified for recycled water recharge in the Chino 1, 2 and 3 and Cucamonga Management Zones. These limits will apply should the Regional Board find that maximum benefit is not demonstrated. If recharge projects are implemented elsewhere in the Chino Basin, TDS and TIN limits will be based on the TDS and nitrate-nitrogen objectives of the affected management zones.

The effluent limits for IEUA, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the basin, are a cornerstone of the maximum benefit demonstration. The cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality in the Chino Basin. The TDS in IEUA's effluent is expected to reach 550 mg/L before the groundwater in the Chino North Management Zone or the Cucamonga Management Zone reaches the "maximum benefit" objectives of 420 mg/L and 380 mg/L, respectively. The IEUA/Chino Basin Watermaster maximum benefit proposal commits to the initiation of construction of another Chino Basin desalter when the TDS in IEUA's effluent reaches 545 mg/L for three consecutive months. This desalter may be constructed by IEUA and/or Chino Basin Watermaster and/or other responsible parties deemed acceptable by the Executive Officer. Further, IEUA will immediately implement a salt management program to reduce the salts, including nitrogen, entering IEUA's wastewater treatment plants. This salt management program will include: 1) connection of new industries that have wastewater discharges with TDS greater than 550 mg/L to the brine line; 2) regulation of the use of new and existing water softeners to the extent allowed by law, with incentives provided for the removal of on-site regenerative water softeners and the use of exchange canisters or other off-site regenerative systems; 3) connection of existing domestic system industries with high TDS waste discharges to the brine lines; 4) percolation of State Water Project water into the Chino Basin when that water is low in TDS; and 5) development of a plan for sewering areas presently served by septic

[5] Surface water discharges by IEUA do not affect the groundwater management zones for which "maximum benefit" objectives are specified. Thus, the wasteload allocations do not vary depending on whether or not the "maximum benefit" objectives apply.

tanks to reduce the nitrogen loading into the Chino and Cucamonga Management Zones. IEUA's permits will reflect these commitments.

Implementing these measures will assure that the groundwater quality remains at or below the Chino North Management Zone objective of 420 mg/L and the Cucamonga Management Zone objective of 380 mg/L. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that IEUA's wastewater treatment facilities are able to meet the effluent TDS limits. Chino Basin groundwater is a significant component of the water supplied in IEUA's service area and its quality thus has an important effect on effluent quality. Poor ambient water quality will preclude IEUA from meeting effluent limits, without desalting. IEUA can revise treatment plant operations to assure that the TIN limit is achieved. These TDS and TIN limitations assure beneficial use protection for Chino Basin and downstream Orange County groundwater, as well as surface waters (including Chino Creek and the Santa Ana River) affected by IEUA discharges.

IEUA's revised permits will also reflect the surface and groundwater monitoring program requirements described above.

2. Issuance of permits to Chino Basin Watermaster

The Regional Board will issue appropriate permits to the Watermaster, individually or jointly with IEUA, for the recharge of recycled water in the Basin. These permits will implement the commitments described above for recharge of other water sources to offset the quality of the recycled water. The parties will be required to document the amount, quality and location of recharge of these other sources, and to demonstrate that stormwater recharge used for blending purposes occurred as the result of the parties' efforts to enhance such recharge. Other "maximum benefit" commitments will be reflected in these permits, or in other orders of the Regional Board, as appropriate.

3. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the Watermaster and IEUA to demonstrate maximum benefit and to justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-8a are met. If, as a result of this review and after consideration at a duly noticed Public Hearing, the Regional Board finds that the Watermaster and IEUA commitments are not met, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives") is not of maximum benefit to the people of the state. By default, the scientifically derived, "antidegradation objectives" for the Chino 1, 2 and 3 and Cucamonga Management Zones would become effective (280 mg/L,

250 mg/L, 260 mg/L and 210 mg/L TDS respectively; 5.0 mg/L, 2.9 mg/L, 3.5 mg/L and 2.4 mg/L for nitrate-nitrogen – see Chapter 4).

The Watermaster and IEUA have made clear commitments to the implementation of projects and management strategies to achieve the "maximum benefit" objectives. A finding of "maximum benefit to the people of the state" is also a very strong commitment of support by the Regional Board for the goals, vision and future plans of the Watermaster and IEUA. Watermaster and IEUA have indicated that the supervision of the Watermaster program by the San Bernardino County Superior Court will ensure that the Watermaster and IEUA commitments are met. However, people change, commitments may be changed, and public agency decisions may certainly change. If the commitments are not met and "maximum benefit" is not demonstrated, then the Regional Board will require that Watermaster and IEUA mitigate the effects of discharges of recycled and imported water that took place under the maximum benefit objectives. Under this circumstance, mitigation will be required such that, after mitigation, the salt and nitrogen loads to the basin from imported water, newly captured stormwater inputs under the Watermaster enhanced stormwater interception program, and recycled water are made to be equivalent to the salt loads that would have been allowed to the Chino Basin under the antidegradation objectives. Discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load. (Desalting will be an effective mitigation strategy, but desalting removes water, as well as salt, and the resulting salt concentrations in the groundwater will not completely mitigate the effects of the maximum benefit discharges, if mitigation is considered simply on a salt load, rather than concentration, basis.) This remediation will be required of the agencies that were responsible for the discharge of recycled and imported water (waste discharge permit holders) under the maximum benefit objectives. The remediation must be completed within a 10-year period following the finding by the Regional Board that the antidegradation objectives apply. The Regional Board will also require mitigation of any adverse effects on water quality downstream of the Chino Basin that result from failure to implement the "maximum benefit" commitments.

## B. Salt Management - San Timoteo Watershed

### 1. San Timoteo and Yucaipa Management Zone - Yucaipa Valley Water District

Two sets of objectives have been adopted for the San Timoteo and Yucaipa Management Zones; the "maximum benefit" objectives and objectives based on historic ambient quality ("antidegradation" objectives) (see Chapter 4). The application of the "maximum benefit" objectives relies on the implementation by the Yucaipa Valley Water District (YVWD) (and in the case of the San Timoteo Management Zone, by the City of Beaumont/STWMA (see discussion below)) of a specific program of projects and requirements [Ref. 10D]. This program is a part of a watershed-scale water resources management plan designed by YVWD and other members of the San Timoteo Watershed Management Authority (STWMA) (the City of Beaumont, the Beaumont-Cherry Valley Water District and the South Mesa Water Company) to assure reliable supplies to meet present and anticipated demands. The projected water demands for the Yucaipa area for the year 2030 require approximately an additional 10,000 AF/Y of supplemental water, including State Water Project water, water imported from local sources, recharged storm water and recycled water. YVWD is in the process of implementing the water resources management plan, which includes enhanced recharge of stormwater and recycled water, optimizing direct use of recycled and imported water, and conjunctive use.

In addition to its water supply responsibilities, YVWD provides sewage collection and treatment services within its service area. YVWD operates a wastewater treatment facility that currently discharges tertiary treated wastewater to San Timoteo Creek, Reach 3. This unlined reach of the Creek overlies and recharges the San Timoteo groundwater management zone.

Table 5-9a identifies the projects and requirements that must be implemented by YVWD to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. An implementation schedule is also specified. The Regional Board will revise YVWD's waste discharge requirements to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" water quality TDS and nitrate-nitrogen objectives apply to the Yucaipa and San Timoteo Management Zones, as long as the schedule is being met[6]. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-9a (and in the case of the San Timoteo Management Zone, the commitments and schedule shown in Table 5-10a (see next section)), then maximum benefit is not demonstrated and the "antidegradation" TDS and nitrate-nitrogen objectives apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen

[6] Application of "maximum benefit" objectives for the San Timoteo Management Zone is also contingent on the timely implementation of the commitments by the City of Beaumont and the San Timoteo Watershed Management Authority which are discussed in the next section.

discharges affecting these management zones that took place in excess of limits based on the “antidegradation” objectives. As for Chino Basin Watermaster and Inland Empire Utilities Agency, discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water, at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load.

Table 5-9a

Yucaipa Valley Water District Maximum Benefit Commitments

| **Description of Commitment** | **Compliance Date – as soon as possible, but no later than** |
|---|---|
| 1. Surface Water Monitoring Program | |
| a. Submit Draft Monitoring Program to Regional Board | a. January 23, 2005 |
| b. Implement Monitoring Program | b. Within 30 days from Regional Board approval of monitoring plan |
| c. Quarterly data report submittal | c. April 15, July 15, October 15, January 15 |
| d. Annual data report submittal | d. February 15th |
| 2. Groundwater Monitoring Program | |
| a. Submit Draft Monitoring Program to Regional Board | a. January 23, 2005 |
| b. Implement Monitoring Program | b. Within 30 days from Regional Board approval of monitoring plan |
| c. Annual data report submittal | c. February 15th |
| 3. Desalter(s) and Brine Disposal Facilities | |
| a. Submit plan and schedule for construction of desalter(s) and brine disposal facilities. Facilities are to operational as soon as possible but no later than 7 years from date of Regional Board approval of plan/schedule. | a. Within 6 months of either of the following:<br>i. When YVWD's effluent 5-year running average TDS exceeds 530 mg/L; and/or<br>ii.. When volume weighted average concentration in the Yucaipa MZ of TDS exceeds 360 mg/L |
| b. Implement the plan and schedule | b. Within 30 days from Regional Board approval of monitoring plan |
| 4. Non-potable water supply<br><br>Implement non-potable water supply system to serve water for irrigation purposes. The non-potable supply shall comply with a 10-year running average TDS concentration of 370 mg/L or less | December 23, 2014 |

| Description of Commitment | Compliance Date – as soon as possible, but no later than |
|---|---|
| 5. Recycled water recharge<br><br>The recharge of recycled water in the Yucaipa or San Timoteo Management Zones shall be limited to the amount that can be blended with other recharge sources to achieve a 5-year running average equal to or less than the "maximum benefit" objectives for TDS and nitrate-nitrogen for the relevant Management Zone(s).<br><br>a. Submit baseline report of amount, locations, and TDS and nitrogen quality of stormwater/imported water recharge.<br><br>b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of YVWD enhanced recharge facilities/programs | Compliance must be achieved by end of 5th year after initiation of recycled water use/recharge operations.<br><br>a. Prior to initiation of construction of basins/other facilities to support enhanced stormwater/imported water recharge.<br><br>b. Annually, by January 15th, after initiation construction of facilities/implementation of programs to support enhanced recharge. |
| 6. Ambient groundwater quality determination | July 1, 2005 and every 3 years thereafter |
| 7. Replace denitrification facilities (necessary to comply with TIN wasteload allocation specified in Table 5-5) | New facilities shall be operational no later than December 23, 2007 |
| 8. YVWD recycled water quality improvement plan and schedule<br><br>a. Submit plan and schedule<br><br>b. Implement plan and schedule | a. 60 days after the TDS 12-month running average effluent quality equals or exceeds 530 mg/L for 3 consecutive months and/or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place)<br><br>b. Upon approval by Regional Board |

| Description of Commitment | Compliance Date – as soon as possible, but no later than |
|---|---|
| 9. Remove/reduce the discharge of YVWD effluent from the unlined portion of San Timoteo Creek<br><br>a. Submit proposed plan/schedule<br><br>b. Implement plan/schedule | <br><br>a. June 23, 2005<br><br>b. Upon Regional Board approval |
| 10. Construct the Western Regional Interceptor for Dunlap Acres<br>a. Submit proposed construction plan and schedule. The schedule shall assure the completion of construction as soon as possible but no later than January 1, 2010.<br><br>b. Implement plan and schedule | <br><br>a. June 23, 2005<br><br>b. Upon Regional Board approval |

A. Description of Yucaipa Valley Water District Commitments

1. Surface Water Monitoring Program (Table 5-9a, # 1)

The YVWD shall develop and submit for Regional Board approval a surface water monitoring program for San Timoteo Creek and the Santa Ana River Reaches 4 and 5. The monitoring program must be implemented within 30 days of Regional Board approval of the monitoring plan, and six months of data must be generated prior to the implementation of any changes made to the effluent discharge points and before any recycled water is used in the Yucaipa or San Timoteo Management Zones.

At a minimum, the surface water monitoring program shall include the collection of monthly measurements of TDS and nitrogen components in San Timoteo Creek and Santa Ana River, Reaches 4 and 5 (see Table 5-9b). Data reports shall be submitted to the Regional Board's Executive Officer by April 15, July 15, October 15 and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted by February 15$^{th}$ of each year.

2. Groundwater Monitoring Program (Table 5-9a, #2)

The purpose of the Groundwater Monitoring Program is to identify the effects of the implementation of the San Timoteo and Yucaipa Management Zones maximum benefit water quality objectives on water levels and water quality within the San Timoteo and Yucaipa Management Zones. Prior to discharge of recycled water to the San Timoteo and/or Yucaipa Management Zones, YVWD shall submit to the Regional Board for approval a groundwater monitoring program to determine ambient water quality in the San Timoteo and Yucaipa Management Zones . The groundwater monitoring program must be implemented within 30 days of approval by the Regional Board.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15$^{th}$ of each year.

3. Desalters and Brine Disposal (Table 5-9a, #3)

YVWD anticipates that demineralization of groundwater or recycled water will be necessary in the future. YVWD is committed to construct and operate desalting and brine disposal facilities when:

1) The 5-year running average TDS concentration in recycled water produced at the YVWD wastewater treatment plant exceeds 530 mg/L; or

2) The volume-weighted TDS concentration in the Yucaipa Management Zone reaches or exceeds 360 mg/L

The construction of these facilities will be in accordance with a plan and schedule submitted by YVWD and approved by the Regional Board. The schedule shall assure that these facilities are in place within 7 years of Regional Board approval. These facilities shall be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

4. Non-potable water supply distribution system (Table 5-9a, # 4)

A key element of the YVWD's water resources management plan is the construction of a non-potable supply system to serve a mix of recycled water and un-treated imported water for irrigation uses. The intent of blending these sources is to minimize the impact of recycled water use on the Yucaipa and San Timoteo Management Zones.

Parts of this system are under design and construction. A higher proportion of State Project water will be used in wet, surplus years, while larger amounts of recycled

water will be used in dry, deficit years. YVWD will produce a non-potable supply with a running ten-year average TDS concentration less than the “maximum benefit” objective for the Yucaipa Management Zone (370 mg/L).

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Table 5 – 9b

Surface Water Monitoring Sites for Monitoring Water Quality and Quantity
Yucaipa Valley Water District

| Site Name | Discharge | Owner | Type | Discharge Frequency | Monitoring Period | Water Quality Monitoring Frequency | Period | Analyses |
|---|---|---|---|---|---|---|---|---|
| 11057500, Gage | San Timoteo Creek | USGS | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| At Barton Rd. | San Timoteo Creek | YVWD | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| At San Timoteo Canyon Rd. | San Timoteo Creek | YVWD | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Above confluence Yucaipa Creek | San Timoteo Creek | YVWD | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Above YVWD Discharge | San Timoteo Creek | YVWD | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| 11059300 Gage | Santa Ana River | USGS | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| At Waterman Ave | Santa Ana River | YVWD | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Recharged to Yucaipa MZ | State Water Project | YVWD | Total Discharge | Monthly | Jan-Dec | Monthly | Jan-Dec | TDS, Nitrate-N |
| Recharged to Yucaipa MZ | Storm water | YVWD | Total Discharge | Monthly | Jan-Dec | Monthly | Jan-Dec | TDS, Nitrate-N |

## 5. Recycled Water Use (Table 5-9a, # 5)

The use and recharge of recycled water within the Yucaipa Management Zone is a critical component of the YVWD water management plan and is necessary to maximize the use of the water resources of the Yucaipa area. The demonstration of "maximum benefit" and the continued application of the "maximum benefit" objectives depends on the combined recharge (recycled water, imported water, storm water) to the Yucaipa Management Zone of a 5-year annual average (running average) TDS concentration of 370 mg/L and nitrate-nitrogen concentration of 5 mg/L. If recycled water recharge in the proposed San Timoteo Management Zone is pursued, then the application of the "maximum benefit" objectives will depend on the combined recharge to that Zone of 5-year annual average (running average) concentrations of 400 mg/L or less TDS, and 5 mg/L or less nitrate-nitrogen.

To meet this requirement, YVWD will establish a fund to purchase imported water from local sources and/or the State Water Project and will recharge water with a TDS concentration less than 300 mg/L (recent long term historical average of water delivered from the State Project). YVWD will also pursue implementation, with the City of Yucaipa and the San Bernardino County Flood Control District, of the *Yucaipa Water Capture and Resource Management Complex* by December 31, 2010.

Accordingly, the use of recycled water for groundwater recharge in the Yucaipa or San Timoteo Management Zone shall be limited to the amount that can be blended in the management zone on a volume-weighted basis with other sources of recharge to achieve 5-year running average concentrations less than or equal to the "maximum benefit" objectives for the affected groundwater management zone. The 25% nitrogen loss coefficient will be applied in determining the amount of recharge of other water sources that must be achieved to meet the 5-year running average nitrogen concentrations.

6. Ambient Groundwater Quality Determination (Table 5-9a, # 6)

By July 1, 2005, and every three years thereafter, YVWD shall submit a determination of ambient TDS and nitrate-nitrogen quality in the San Timoteo and Yucaipa Management Zones. This determination shall be accomplished using methodology consistent with the calculation (20-year running averages) used by the Nitrogen/TDS Task Force to develop the TDS and nitrate-nitrogen "antidegradation" water quality objectives for groundwater management zones within the region. [Ref. 1].

7. Replacement of Denitrification Facilities (Table 5-9a, #7)

YVWD shall replace existing denitrification facilities to provide effluent total inorganic nitrogen quality (6 mg/L) needed to assure compliance with the "maximum benefit" nitrate-nitrogen objective of the San Timoteo and Yucaipa Management Zones (see Wasteload Allocation section of this Chapter). A maximum three year schedule for completion of these facilities will be required. This schedule will be specified in a revised NPDES permit for YVWD's discharges to San Timoteo Creek.

8. YVWD Recycled Water Management (Table 5-9a, #8)

YVWD expects to limit the TDS concentration in its effluent to less than or equal to 540 mg/L by using a low TDS source water supply for potable uses, selective desalting of either source water and/or recycled waters, and minimizing the TDS waste increment. YVWD is currently constructing a 12-MGD treatment plant to treat and serve State Project Water. The plant will also be able to treat low TDS Mill Creek and Santa Ana River water. When necessary, YVWD will construct desalters to reduce either the TDS concentration in water supplied to customers or the TDS concentration in the effluent. YVWD will also use best efforts to enact ordinances and other requirements to minimize the TDS use increment.

Within 60 days after the YVWD 12-month running average concentration for TDS equals or exceeds 530 mg/L for 3 consecutive months, or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place), YVWD shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the average agency wastewater effluent quality does not exceed 540 mg/L and 6 mg/L for TDS and TIN, respectively. The plan and schedule are to be implemented upon approval by the Regional Board.

9. Relocation of San Timoteo Creek Discharge (Table 5-9a, #9)

YVWD has established the goal of eliminating its discharge to the unlined reach of San Timoteo Creek by 2008. First priority will be given to the direct reuse and limited recharge of this recycled water in the YVWD service area (principally the area overlying the Yucaipa Management Zone). The District may construct a pipeline to convey the recycled water to the San Jacinto watershed for reuse. The District is also planning the construction of a pipeline to convey recycled water downstream to the lined reach of the Creek (Reach 1A) to minimize recycled water effects on the San Timoteo Management Zone. In the long-term, discharges to this area of the Creek are likely to be infrequent and limited to the wintertime, when the recycled water cannot be used in the YVWD (or potentially, the San Jacinto) service areas. However, YVWD is obligated to maintain flows in the Creek to support existing riparian habitat (State Board Order No. WW-26) and may need to continue recycled water discharges at some level. Groundwater and imported State Project water may also be used as alternative water sources.

Whole or partial removal of the discharge from the unlined reach of San Timoteo Creek would improve the quality of groundwater in the San Timoteo Management Zone and supplement recycled water supplies available for reuse elsewhere in the service area.

By June 23, 2005, YVWD shall submit a proposed plan and schedule to remove/reduce the discharge of recycled water to the unlined reach of San Timoteo Creek. The plan and schedule shall be implemented upon Regional Board approval.

10. Construction of Western Regional Interceptor (Table 5-9a, # 10)

YVWD will construct the Western Regional Interceptor to provide wastewater collection and treatment services to Dunlap Acres in order to mitigate what has been identified as a poor quality groundwater area due to prior agricultural use and existing septic systems. The Dunlap Acres area was inadvertently omitted from the Yucaipa-Calimesa septic tank subsurface disposal system prohibition established by the Regional Board in 1973. The interceptor includes the construction of a major wastewater interceptor pipeline, a force main and pump station. YVWD committed to complete construction of these facilities prior to 2010. Regional Board action may be necessary to require connection of properties to the wastewater collection system, when it is completed.

By June 23, 2005, YVWD shall submit a plan and schedule for construction of the

Interceptor. The Interceptor is to be complete no later than January 1, 2010. YVWD shall implement the plan and schedule upon Regional Board approval.

B. Implementation by Regional Board

1. Revision to Yucaipa Valley Water District NPDES Permit

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permit for YVWD wastewater discharges to reflect the commitments described above, as appropriate. This includes the following.

The discharge limits for TDS and TIN will be specified as an annual volume-weighted average not to exceed 540 mg/L TDS and 6 mg/L TIN. These limits are based on the "maximum benefit" wasteload allocations shown in Table 5-5. A schedule not to exceed December 23, 2007 for compliance with this TIN limit shall be included in the permit. This schedule will enable YVWD to replace its existing denitrification facilities. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified and will apply should the Regional Board find that maximum benefit is not demonstrated. These alternative limits are also specified in Table 5-5. Compliance schedules for these alternative limits will be specified in YVWD's waste discharge requirements, as necessary.

YVWD will be required to implement measures to improve effluent quality when the 12-month running average effluent TDS quality equals or exceeds 530 mg/L for 3 consecutive months, and/or when the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place).

YVWD's waste discharge requirements will require that recycled water used for recharge shall be limited to the amount that can be blended with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Yucaipa or San Timoteo). Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified for recycled water recharge in these management zones.

The effluent limits for YVWD, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the Yucaipa and/or San Timoteo Management Zones, are a cornerstone of the maximum benefit demonstration. The cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality. YVWD will be required to initiate the building of a desalter and brine disposal line when the 5-year running average TDS in YVWD's effluent reaches 530 mg/L, or when the volume weighted-average TDS concentration in the Yucaipa Management Zone reaches 360 mg/L. YVWD will immediately implement a salt management program to reduce the salts entering the District's wastewater treatment plant. This salt management program will include: 1) provision of incentives for the removal of on-site regenerative water softeners and the

use of off-site regenerative systems; and 2) percolation of State Water Project water into the Yucaipa Management Zone when State Water Project water has low TDS. Implementing these measures will assure that the groundwater quality remains at or below the Yucaipa Management Zone objective of 360 mg/L TDS. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that YVWD's wastewater treatment facility is able to meet the effluent TDS limits. Yucaipa Management Zone groundwater is a significant component of the water supplied in YVWD's service area, and its quality thus has an important effect on effluent quality. Poor ambient quality will preclude YVWD from meeting effluent limits without desalting.

YVWD will be required to submit proposed plans and schedules for the removal/reduction of its wastewater discharges from the unlined reach of San Timoteo Creek and for the construction of the Western Regional Interceptor. YVWD's revised permit will also reflect the surface and groundwater monitoring program requirements described above. This includes the determination of ambient quality in the San Timoteo and Yucaipa Management Zones.

2. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the YVWD to demonstrate maximum benefit and justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-9a are met. As indicated above, if, as a result of this review, the Regional Board finds that the YVWD commitments are not met and after consideration at a duly noticed Public Hearing, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives) is not of maximum benefit to the people of the state. By default, the scientifically derived "antidegradation" objectives for the San Timoteo (300 mg/L for TDS, 2.7 mg/L for nitrate-nitrogen) and Yucaipa (320 mg/L for TDS and 4.2 mg/L for nitrate-nitrogen Management Zones would become effective (see Chapter 4).

Furthermore, in the event that the projects and actions specified in Table 5-9a are not implemented, the Regional Board will require that the YVWD mitigate the adverse water quality effects, both on the immediate and downstream waters, that resulted from the recycled water discharges based on the "maximum benefit" objectives.

## 2. San Timoteo and Beaumont Management Zones – City of Beaumont and San Timoteo Watershed Management Authority (STWMA)

As shown in Chapter 4, two sets of TDS and nitrate-nitrogen objectives have been adopted for both the San Timoteo and Beaumont Management Zones: the "maximum benefit" objectives and objectives based on historic ambient quality (the "antidegradation" objectives). The application of the "maximum benefit" objectives for these Management Zones is contingent on the implementation of commitments by the City of Beaumont/STWMA (and, in the case of the San Timoteo Management Zone, by the Yucaipa Valley Water District (YVWD; see preceding discussion)) to implement a specific water and wastewater resources management program [Ref. 10E]. This program is part of a coordinated effort by the member agencies of STWMA to develop and implement projects that will assure reliable water supplies to meet rapidly increasing demands in this area. The San Timoteo Watershed Management Program (STWMP) developed by STWMA entails enhanced recharge of native and recycled water, maximizing the direct use of recycled water, optimizing the direct use of imported water, recharge and conjunctive use.

Wastewater collection and treatment services in the STWMA service area are provided by the City of Beaumont, as well as YVWD. Beaumont discharges tertiary treated wastewater to Coopers Creek, a tributary of San Timoteo Creek, Reach 3. This unlined reach of the Creek overlies and recharges the San Timoteo groundwater management zone.

Table 5-10a identifies the projects and requirements that must be implemented by Beaumont/STWMA to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. STWMA, acting for all its member agencies, has committed to conduct the regional planning and monitoring activities necessary to implement these "maximum benefit" commitments, and the San Timoteo Watershed Management Program as a whole. Table 5-10a also specifies an implementation schedule. The Regional Board will revise the City of Beaumont's waste discharge requirements and take other actions as necessary to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" water quality TDS and nitrate-nitrogen objectives apply to the Beaumont and San Timoteo Management Zones, as long as the schedule is being met[7]. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-10a (and in the case of the San Timoteo Management Zone, the commitments and schedule shown in Table 5-9a (see preceding section)), then maximum benefit is not demonstrated, and the "antidegradation" TDS and nitrate-nitrogen objectives apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen discharges

[7] Application of "maximum benefit" objectives for the San Timoteo Management Zone is also contingent on the timely implementation of the commitments by the Yucaipa Valley Water District which are discussed in the preceding section.

affecting these management zones that took place in excess of limits based on the "antidegradation" objectives.

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Table 5-10a

City of Beaumont and San Timoteo Watershed Management Authority
Maximum Benefit Commitments

| **Description of Commitment** | **Compliance Date – as soon as possible, but no later than** |
|---|---|
| 1. Surface Water Monitoring Program<br><br>a. Submit Draft Monitoring Program to Regional Board<br><br>b. Implement Monitoring Program<br><br>c. Quarterly data report submittal<br><br>d. Annual data report submittal | <br><br>a. January 23, 2005<br><br><br>b. Within 30 days from Regional Board approval of monitoring plan<br><br><br>c. April 15, July 15, October 15, January 15<br><br>d. February 15th |
| 2. Groundwater Monitoring Program<br><br>a. Submit Draft Monitoring Program to Regional Board<br><br>b. Implement Monitoring Program<br><br>c. Annual data report submittal | <br><br>a. January 23, 2005<br><br>b. Within 30 days from Regional Board approval of monitoring plan<br><br>c. February 15th |
| 3. Desalter(s) and Brine Disposal Facilities<br><br>Submit plan and schedule for construction of desalter(s) and brine disposal facilities. Facilities are to be operational as soon as possible but no later than 7 years from date of Regional Board approval of plan/schedule.<br><br>b. Implement the plan and schedule | <br><br>a. Within 6 months of either of the following:<br><br>i. When Beaumont's effluent 5-year running average TDS exceeds 480 mg/L; and/or<br>ii. When volume weighted average concentration in the Yucaipa MZ of TDS exceeds 320 mg/L<br><br>b. Within 30 days from Regional Board approval of monitoring plan |
| 4. Non-potable water supply<br><br>Implement non-potable water supply system to serve water for irrigation purposes. The non-potable supply shall comply with a 10-year running average TDS concentration of 330 mg/L or less | <br><br>December 23, 2014 |

| **Description of Commitment** | **Compliance Date – as soon as possible, but no later than** |
|---|---|
| 5. Recycled water recharge<br><br>The recharge of recycled water in the Beaumont or San Timoteo Management Zones shall be limited to the amount that can be blended with other recharge sources to achieve a 5-year running average equal to or less than the "maximum benefit" objectives for TDS and nitrate-nitrogen for the relevant Management Zone(s).<br><br>a. Submit baseline report of amount, locations, and TDS and nitrogen quality of stormwater/imported water recharge.<br><br>b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of City of Beaumont/STWMA enhanced recharge facilities/programs | Compliance must be achieved by end of 5th year after initiation of recycled water use/recharge operations.<br><br>a. Prior to initiation of construction of basins/other facilities to support enhanced storm/water imported water recharge .<br><br>b. Annually, by January 15th, after initiation construction of facilities/implementation of programs to support enhanced recharge. |
| 6. Ambient groundwater quality determination | July 1, 2005 and every 3 years thereafter |
| 7. Replace denitrification facilities (if necessary to comply with TIN wasteload allocation specified in Table 5-5) | Compliance with 6 mg/L TIN limitation to be achieved by December 23, 2007 |
| 8. City of Beaumont recycled water quality Improvement plan and schedule<br>a. Submit plan and schedule<br><br>b. Implement plan and schedule | a. 60 days after the TDS 12-month running average effluent quality equals or exceeds 480 mg/L for 3 consecutive months and/or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once facility/operational changes needed to achieve 6 mg/L TIN are in place)<br>b. Upon approval by Regional Board |
| 9. Remove/reduce the discharge of Beaumont Effluent From the unlined portion of San Timoteo Creek<br><br>a. Submit proposed plan/schedule<br><br>b. Implement plan/schedule | a. June 23, 2005<br><br>b. Upon Regional Board approval |

A. Description of City of Beaumont, San Timoteo Watershed Authority Commitments

1. Surface Water Monitoring Program (Table 5-10a, #1)

The City of Beaumont and the STWMA shall develop and submit for Regional Board approval a surface water monitoring program for San Timoteo, Little San Gorgonio and Noble Creeks at the locations listed in Table 5-10b. The monitoring program must be implemented within 30 days of Regional Board approval of the monitoring plan, and six months of data must be generated prior to the implementation of any changes to the effluent discharge points and before any recycled water is used in the Beaumont or San Timoteo Management Zones.

At a minimum, the surface water monitoring program shall include the collection of monthly measurements of TDS and nitrogen components at locations in San Timoteo, Little San Gorgonio and Noble Creeks (see Table 5-10b). Data reports shall be submitted to the Regional Board's Executive Officer by April 15, July 15, October 15 and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted February 15th of each year.

2. Groundwater Monitoring Program (Table 5-10a. #2)

The purpose of the groundwater monitoring program is to identify the effects of the implementation of the Beaumont and San Timoteo Management Zone maximum benefit TDS and nitrate-nitrogen water quality objectives on water levels and water quality within the Beaumont and San Timoteo Management Zones. Prior to discharge of recycled water to the Beaumont and/or San Timoteo Management Zone, the City of Beaumont and the STWMA shall submit to Regional Board for approval a groundwater monitoring program to determine ambient water quality in the Beaumont and San Timoteo Management Zones. The groundwater monitoring program must be implemented within 30 days of approval by the Regional Board.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15th of each year.

3. Desalters and Brine Disposal (Table 5-10a. #3)

The City of Beaumont and the STWMA shall construct and operate desalting facilities and brine disposal facilities when:

a. The 5-year running average TDS concentration in recycled water produced at the City of Beaumont wastewater treatment plant exceeds 480 mg/L, or

b. The volume-weighted TDS concentration in the Beaumont Management Zone equals or exceeds 320 mg/L.

The construction of these facilities will be in accordance with a plan and schedule submitted by Beaumont/STWMA and approved by the Regional Board. The schedule shall assure that these facilities are in place within 7 years of Regional Board approval. These facilities shall be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

Table 5 – 10b

Surface Water Monitoring Sites for Monitoring Water Quality and Quantity
City of Beaumont & San Timoteo Watershed Management Authority

| Site Name | Discharge | Owner | Type | Discharge Frequency | Monitoring Period | Water Quality Monitoring Frequency | Period | Analyses |
|---|---|---|---|---|---|---|---|---|
| Above confluence With Coopers Cr. | San Timoteo Creek | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Near Hinda Sec.35 T2S,R2W | San Timoteo Creek | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Above confluence With San Timoteo Creek | Coopers Creek | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| At Freeway 10 | Little San Gorgonio Cr. | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| At Freeway 10 | Noble Creek | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Bi-weekly | Jan-Dec | TDS, TIN, Physical |
| Recharged to Beaumont MZ | State Water Project | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Monthly | Jan-Dec | TDS, Nitrate-N |
| Recharged to Beaumont MZ | Storm water | Beaumont & STWMA | Total Discharge | Bi-weekly | Jan-Dec | Monthly | Jan-Dec | TDS, Nitrate-N |

4. Non-potable water supply distribution system (Table 5-10a, #4)

Like YVWD, the City of Beaumont is constructing a non-potable water system that will convey untreated State Project water and recycled water for irrigation within its service area. The intent of blending these sources is to minimize the impact of recycled water use on groundwater quality in the proposed Beaumont and San Timoteo Management Zones. A higher proportion of State Project water will be used in wet, surplus years, while larger amounts of recycled water will be used in dry, deficit years.

5. Recycled Water Use (Table 5-10a, #5)

The use of recycled water within the Beaumont Management Zone is a critical component of the City of Beaumont and STWMA water management plan and is necessary to maximize the use of the water resources of the Beaumont area.

The demonstration of "maximum benefit" and the continued application of the "maximum benefit" objectives depends on the combined recharge (recycled water, imported water, storm water) to the Beaumont Management Zone of a 5-year annual average (running average) TDS concentration of 330 mg/L and a nitrate-nitrogen concentration of 5 mg/L. If recycled water recharge in the San Timoteo Management Zone is pursued, then the application of the "maximum benefit" objectives will depend on the combined recharge to that Zone of 5-year annual average (running average) concentrations of 400 mg/L or less TDS, and 5 mg/L or less nitrate-nitrogen.

To comply with this requirement, the STWMA member agencies are developing plans to recharge and store State Project water in the proposed Beaumont Management Zone. The Beaumont-Cherry Valley Water District (BCVWD) is developing a new 80-acre groundwater recharge project that will increase storm water recharge in the Beaumont Basin by 4,100 acre-ft/yr. This facility will also be used to recharge State Water project water. The City of Beaumont is also developing storm water recharge in facilities in newly developing areas, which is expected to result in the recharge of an additional 2,400 acre-ft/yr of stormwater runoff.

Accordingly, the use of recycled water for use or recharge in the Beaumont or San Timoteo Management Zone shall be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve 5-year running average concentrations less than or equal to the "maximum benefit" objectives for the affected groundwater management zone. The 25% nitrogen loss coefficient will be applied in determining the amount of recharge of other water sources that must be achieved to meet the 5-year running average nitrogen concentrations.

6. Ambient Groundwater Quality Determination (Table 5-10a, # 6)

By July 1, 2005, and every three years thereafter, the City of Beaumont and STWMA shall submit a determination of ambient TDS and nitrate-nitrogen quality in the Beaumont and San Timoteo Management Zones. This determination shall be accomplished using methodology consistent with the calculation (20-year running averages) used by the Nitrogen /TDS Task Force to develop the TDS and nitrate-nitrogen "antidegradation" water quality objectives for groundwater management zones within the region [Ref. 1].

7. Replacement/modification of denitrification facilities (Table 5-10a, #7)

The City of Beaumont has committed to produce recycled water with a 12-month average TIN concentration of 6 mg/L or less by 2008. This may be accomplished via operational changes, or may require the installation/modification of facilities. This TIN effluent quality is specified in the TIN wasteload allocation (see Table 5-5) and is necessary to assure compliance with the proposed "maximum benefit" nitrate-nitrogen objective for the Beaumont and San Timoteo Management Zones (5 mg/L). An appropriate schedule, not to exceed December 23, 2007 for compliance with this effluent limit will be specified in a revised NPDES permit for the City.

8. City of Beaumont Wastewater Management (Table 5-10a, #8)

Beaumont expects to limit the TDS concentration in its effluent to less than or equal to 490 mg/L by using a low TDS source water supply for potable uses, selective desalting of either source water and/or recycled waters, and minimizing the TDS waste increment.

Within 60 days after the Beaumont 12-month running average concentration for TDS equals or exceeds 480 mg/L for 3 consecutive months, or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once facility/operational changes needed to achieve 6 mg/L TIN are in place), the City of Beaumont shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the average agency wastewater effluent quality does not exceed 490 mg/L and 6 mg/L for TDS and TIN, respectively. The plan and schedule are to be implemented upon approval by the Regional Board.

9. Relocation of San Timoteo Creek Discharge (Table 5-10a, #9)

Like YVWD, Beaumont has established the goal of eliminating its discharge to the unlined reach of San Timoteo Creek by 2008 to minimize the impacts of these discharges on the San Timoteo Management Zone. The STWMP anticipates that Beaumont's recycled water will be almost completely reused within the Beaumont area for landscape irrigation, habitat enhancement, and potentially for groundwater recharge. Like YVWD, Beaumont and STWMA are also considering the export of a portion of Beaumont's surplus recycled water to the San Jacinto basin, where the

TDS objectives are higher than those for the Beaumont Management Zone and recycled water demands are greater than supplies. Some limited recycled water discharge to Coopers Creek and thence /San Timoteo Creek may need to be continued to support existing riparian habitat.

Whole or partial removal of the discharge from the unlined reach of San Timoteo Creek would improve the quality of groundwater in the San Timoteo Management Zone and supplement recycled water supplies available for reuse elsewhere in the service area.

By June 23, 2005, Beaumont/STWMA shall submit a proposed plan and schedule to remove/reduce the discharge of recycled water to the unlined reach of San Timoteo Creek. The plan and schedule shall be implemented upon Regional Board approval.

B. Implementation by Regional Board

1. Revision of City of Beaumont NPDES Permit

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permit for the City of Beaumont wastewater discharge to reflect the commitments described above, as appropriate. This includes the following.

The discharge limits for TDS and TIN will be specified as an annual volume-weighted average not to exceed 490 mg/L TDS and 6 mg/L TIN. These limits are based on the wasteload allocation shown in Table 5-5. A schedule not to exceed December 23, 2007 for compliance with this TIN limit shall be included in the permit. This schedule will enable Beaumont to make the necessary facility/operational changes. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified and will apply should the Regional Board find that maximum benefit is not demonstrated. These alternative limits are also specified in Table 5-5. Compliance schedules for these alternative limits will be specified in Beaumont's waste discharge requirements, as necessary.

Beaumont will be required to implement measures to improve effluent quality when the 12-month running average effluent TDS quality equals or exceeds 480 mg/L for 3 consecutive months, and/or when the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once the facility/operational changes necessary to assure compliance with the 6 mg/L limit are in place).

Beaumont's waste discharge requirements will require that recycled water used for recharge shall be limited to the amount that can be blended with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Beaumont or San Timoteo).

The effluent limits for the City of Beaumont, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the management zones, are

a key part of the maximum benefit demonstration. The cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality. The City of Beaumont has committed to initiate the building of a groundwater desalter and brine disposal line when the TDS in the City's effluent reaches 480 mg/L. Further, the City will immediately implement a salt management program to reduce the salts entering the City's wastewater treatment plant. This salt management program will include: 1) provision of incentives for the removal of on-site regenerative water softeners and the use of off-site regenerative systems; and 2) percolation of State Water Project water into the Beaumont Management Zone when State Water Project water has low TDS. Implementing these measures will assure that the groundwater quality remains at or below the Beaumont management zone objective of 330 mg/L TDS. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that the City's wastewater treatment facility is able to meet the effluent TDS limits. Beaumont Management Zone groundwater is a component of the water supplied to the City and its quality thus has an important effect on the effluent quality. Poor ambient quality will preclude the City from meeting effluent limits without desalting.

Beaumont will be required to submit a proposed plan and schedule for the removal/reduction of its wastewater discharges from the unlined reach of San Timoteo Creek. Beaumont's revised permit will also reflect the surface and groundwater monitoring program requirements described above. This includes the determination of ambient quality in the San Timoteo and Beaumont Management Zones.

2. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the City of Beaumont and STWMA to demonstrate maximum benefit and justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-10a are met. As indicated above, if, as a result of this review, the Regional Board finds that the City of Beaumont and STWMA commitments are not met and after consideration at a duly noticed Public Hearing, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives) is not of maximum benefit to the people of the state. By default, the scientifically derived "antidegradation" objectives for the Beaumont and San Timoteo Management Zones would become effective (230 mg/L TDS and 1.5 mg/L nitrate-nitrogen for the Beaumont Management Zone; 300 mg/L TDS and 2.7 mg/L nitrate-nitrogen for the San Timoteo Management Zone (see Chapter 4).

Furthermore, in the event that the projects and actions specified in Table 5-10a are not implemented, the Regional Board will require that the City of Beaumont and STWMA mitigate the adverse water quality effects, both on the immediate and

downstream waters, that resulted from the recycled water discharges based on the "maximum benefit' objectives. As for CBW/IEUA and YVWD, discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water, at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load.

**(End of Salt Management Plan Section) (End of Resolution R8-2004-0001)**

## NONPOINT SOURCE PROGRAM

Considerable improvements in water quality have been achieved in the nation through the control of point source discharges such as those from sewage treatment plants or industrial facilities. It is now recognized that in many areas, nonpoint source inputs, such as urban nuisance flows and stormwater runoff, are the principal sources of contaminant inputs to surface and groundwaters.

In contrast to point sources, which discharge wastewater of predictable quantity and quality at a discrete point (usually at the end of a pipe), nonpoint source inputs are diffuse in origin and variable in quality. Management of nonpoint source inputs is in many ways more difficult to achieve, since it requires an array of control techniques customized to local watershed conditions.

### Nonpoint Source Management Plan

Section 319 of the 1987 amendments to the Clean Water Act (33 USC 466 *et seq.*), established the framework for nonpoint source activities. Section 319 requires each state to prepare a Nonpoint Source Management Plan and to conduct an assessment of the impact nonpoint sources have on the state's waterbodies. In response to these requirements, the State Board adopted the Nonpoint Source Management Plan (NPSMP) in 1988 and the Water Quality Assessment in 1990 (see Chapter 6 for a discussion of the Water Quality Assessment). The NPSMP establishes a statewide policy for managing nonpoint source inputs to California's waters and is part of this Basin Plan.

The State Board defined six objectives of the Nonpoint Source Management Plan, four of which apply to activities in the Santa Ana Region:

1. Initiate and institutionalize activities for control of nonpoint source pollution (drainage from urban activities, agriculture, silviculture, abandoned mines construction, grazing, hydrologic modification, and individual disposal systems). These activities include outreach, education, public participation, technical assistance, financial assistance, interagency coordination, and demonstration projects.

A major part of the Regional Board staff's nonpoint source activities is participation in outreach activities. Board staff attend committee meetings to exchange information and to coordinate planning efforts among the various agencies in the region. Staff also coordinates with other public agencies and citizens' groups engaged in protecting water quality form nonpoint source impacts, generally by participating in technical advisory committees. Regional outreach activities are also beginning to include identification of best management practices such as education, information dissemination, and structural and nonstructural water quality controls.

2. Fund contracts for nonpoint source projects selected for nonpoint source grant funding in State Fiscal Year 1992-93. Regional water Board staff will also participate in these projects and provide technical assistance.

   Regional Board staff has managed or acted in an advisory capacity for a number of nonpoint source grant funded contracts. These projects have included Newport Bay studies to develop a hydrodynamic model of the Bay as well as a study to monitor sources of toxics into the Bay.

3. Initiate nonpoint source watershed pilot programs on nine watersheds in the state.

   San Diego Creek was designated as the region's pilot watershed project. The Creek's water quality has been impaired by excessive sedimentation, nitrates, pesticides, and metals originating from point and nonpoint sources (see the following discussion on the Newport Bay Watershed). In addition, the Upper Newport Bay Dredging Project was identified as the Region's focused nonpoint source watershed project. The U.S. Army Corps of Engineers, under Congressional authorization, is investigating dredging Upper Newport Bay to deepen the channel. The Army Corps of Engineers' activities could modify the Upper Bay's water quality and currents. Regional Board staff are aiding the Army Corps of Engineers in their development of preliminary ideas so as to prevent potential water quality degradation.

4. Implement the requirements of the 1990 Reauthorization of the Coastal Zone Management Act (CZMA) which requires the State Water Board and the California Coastal Commission to develop and implement an enforceable nonpoint source program in the coastal zone.

   The reauthorization of the CZMA, together with specific guidance from the US EPA and the National Oceanic & Atmospheric Administration (NOAA), requires coastal states to develop coastal nonpoint pollution control programs. These programs are to implement management measures for the control of land uses which contribute nonpoint source pollution to coastal waters. Management measures, which include specific measures for mitigating water quality impacts, are specified for the following land uses: agriculture; gazing; confined animal facilities; forestry; urban development; roads; marinas and recreational boating; hydromodification; and mines. The state's coastal program is to be considered for approval by the US EPA and NOAA in July 1995.

Revision of the NPSMP has been initiated. The revised NPSMP will go beyond the requirements of the Coastal Zone Management Act by specifying management measures that are applicable throughout the state. There will also be more of an emphasis placed on watershed based nonpoint source controls in the revised NPSMP. To develop these management measures, the State Board is forming Task Force Committees composed of experts in the various nonpoint source categories. The management measures developed by the Task Force Committee will be reviewed by an oversight committee made up of State and Regional Board staff prior to inclusion in the revised NPSMP. The anticipated date of completion of the revised NPSMP is in 1995.

Some major nonpoint source problems which have been addressed in the Santa Ana Region include:

- Urban runoff: addressed through the stormwater permitting program;
- Animal confinement facilities: addressed through the Dairy Regulatory Strategy;
- On-site disposal system: addressed through prohibitions and the Minimum Lot-Size Criteria; and
- Erosion/sedimentation in the Newport Bay watershed: addressed through the implementation of the Areawide 208 Plan.

**Stormwater Program**

The 1987 Clean Water Act amendments required the U.S. Environmental Protection Agency (US EPA) to establish regulations to control stormwater discharges associated with industrial activity, and discharges from large and medium municipal separate storm sewer systems. Large municipal separate storm sewer systems serve a population of 250,000 or more and medium municipal separate storm sewer systems serve a population of more than 100,000 but less than 250,000. On November 16, 1990, EPA published the final regulations that established the National Pollutant Discharge Elimination System (NPDES) permit requirements for discharges of stormwater from large and medium municipal separate storm sewer systems and stormwater discharges associated with industrial activities, including construction activities.

The stormwater NPDES permitting program is administered by the State Board and the Regional Boards.

A. Municipal Stormwater Discharge Permits

Prior to the promulgation of EPA's final regulations, the Santa Ana Regional Water Quality Control Board adopted areawide urban NPDES stormwater permits for each of the three counties in the Region. As shown in Table 5-9, as part of the areawide urban permits, the counties are named as the principal permittee and the incorporated cities are named as co-permittees. These permits require the development and

implementation of programs to identify and eliminate illegal/illicit discharges to municipal stormwater conveyance systems, the development and implementation of best management practices (BMPs) to reduce pollutants in stormwater and urban runoff, and the development and implementation of monitoring programs.

Table 5-9
Municipal
Stormwater Permits
Santa Ana Region

| Municipality | Order Number | Date Issued |
|---|---|---|
| Orange County Environmental Management Agency, the County of Orange, and 23 incorporated cities | 90-071<br>NPDES - CA8000180 | 7/12/90 |
| Riverside County Flood Control and Water Conservation District, the County of Riverside, and 13 incorporated cities | 90-104<br>NPDES - CA8000192 | 7/13/90 |
| San Bernardino County Transportation and Flood Control Department, the County of San Bernardino, and 16 incorporated cities | 90-136<br>NPDES - CA8000200 | 10/19/90 |

B. Industrial and Construction Stormwater Discharge Permits

The federal regulations identify eleven industrial categories which are subject to stormwater discharge permitting:

1. Facilities subject to stormwater effluent guidelines (40 CFR Subchapter N);
2. Manufacturing facilities;
3. Mining and Oil and Gas facilities;
4. Hazardous waste treatment, storage or disposal facilities;
5. Landfills, land application sites, and open dumps that receive industrial waste;
6. Recycling facilities such as metal scrap yards, battery reclaimers, salvage yards, and automobile yards;
7. Steam electric generating facilities;
8. Transportation facilities;
9. Sewage treatment plants;
10. Construction activities; and
11. Certain facilities if materials are exposed to stormwater.

As shown these categories include construction activities (#10), which are covered by a separate permit in the State of California (see below).

To satisfy the federal requirements, the State Board issued two general permits: the General Industrial Activities Stormwater Permit (State Board Order No. 91-13-DWQ as amended by State Board Order No. 92-12-DWQ); and the General Construction Activity Stormwater Permit (State Board Order No. 92-08-DWQ). Industrial facilities and proponents of construction projects must file a Notice of Intent (NOI) with the State Board to be covered under the applicable general permit.

The General Industrial Activities Stormwater Permit requires dischargers to comply with federal regulations to reduce or eliminate industrial stormwater pollution, to develop and implement a stormwater pollution prevention plan, and to perform monitoring of stormwater discharges. This permit covers stormwater discharges from all the listed categories of industrial activity, except construction activities.

The General Construction Activity Stormwater Permit addresses stormwater discharges associated with a construction activity where grading, clearing, and excavation results in a land disturbance of five acres of more. A stormwater discharge from a construction resulting in a land disturbance of less than five acres also requires a permit if the construction is a part of a larger common plan of development or sale.

The use of general permits to regulate these various types of stormwater discharges streamlines the permitting process, which greatly benefits the Regional Board. It is also the least costly way for a discharger to obtain a permit and comply with federal and state regulations.

For industrial and construction activities in the Region, it is the Regional Board's responsibility to enforce the General Industrial Activities and General Construction Activity stormwater permits. In addition to these general permits, the Regional Board has issued and will continue to issue individual permits for stormwater dischargers if warranted by the character of the discharges and/or sensitivity of the receiving waters.

**Animal Confinement Facilities (Dairies)**

As described earlier in this chapter, one of the most significant water quality problems confronting the region is increasing concentrations of TDS and nitrates in the groundwater. This problem is particularly acute in those groundwater subbasins without assimilative capacity, including the Chino II and III Groundwater Subbasins (Subbasins changed by December 22, 2004 amendment).

In 1989-90, the Regional Board conducted a special investigation of the salt balance problem in the Chino Basin, described in "Dairies and Their Relationship to Water Quality Problems in the Chino Basin" or Dairy Report [Ref. 10]. The findings of this study showed that while irrigated agriculture and municipal wastewater disposal are contributors to the degradation, wastes form dairies and other animal confinement facilities play an overwhelmingly significant role.

Dairy operations began in the Chino Basin about 40 years ago and continue intensively today. In fact, the Chino Basin contains the highest concentration of dairy animals found anywhere in the world. Within an area of about 15,000 acres, there are approximately 300 dairies, housing about 300,000 animals. These animals produce approximately 0.5 million tons (dry weight) per year of manure. Significant quantities of water are used to wash the cows prior to milking. Both this wastewater and the manure contain significant quantities of salts (TDS and nitrogen). The Regional Board's studies showed that close to 30,000 tons of salts reach Chino Basin groundwater every year as a result of the disposal of these dairy wastes.

Dairy operations and waste disposal practices can also affect the quality of surface waters. Discharges of washwater and/or runoff of stormwater which has come into contact with manure contribute salts and other pollutants to receiving streams, which ultimately flow into the Santa Ana River. While the Regional Board prohibits these discharges (with the exception of stormwater under certain conditions), these discharges do occur as a result of inadequate construction and maintenance of containment facilities. Drainage from upstream urban areas exacerbates this problem.

The quality of the Santa Ana River is affected indirectly as well: significant quantities of the poor quality groundwater in the Chino Basin rise to the surface and enter the River just upstream of Prado Dam. The TDS and nitrogen problems in the Santa Ana River, which are addressed by the implementation of wasteload allocations, have been described previously. The failure to address and correct the water quality problems in the Chino Basin could compromise the effectiveness of the water quality improvements implemented by the sewage treatment plants in response to those allocations.

The Regional Board initiated a regulatory program to address the water quality impacts of the salt loads from dairy operations in 1972. Waste discharge requirements are issued to all dairies and other significant animal confinement facilities. (See the Dairy Report for a detailed description of the Regional Board's waste discharge requirements). However, the Regional Board's studies demonstrated that changes in this regulatory program were necessary.

The Regional Board developed a revised regulatory strategy, working closely with dairy industry representatives. As described in the Dairy Report, it consists of a comprehensive, three part program. Part I is designed to address the present and future impacts from ongoing dairy activities. Part II addresses the impacts from past dairy activities, and Part III addresses the need for improved drainage facilities upstream of and within the dairy area. Although termed a "dairy" regulatory strategy, the strategy is intended to apply to <u>all</u> animal confinement facilities within the Chino Basin. The term "dairy" is used here for simplicity.

Part I. Dairy Waste Discharge Requirements: Impacts of Ongoing Operations

The first part of the strategy addresses dairy waste discharge requirements and the impacts of ongoing operations. Four specific changes to the dairy regulatory program are included: an improved manure tracking system; inclusion of groundwater monitoring requirements for dairy operators; submittal of engineered waste

management plans; and revision of waste discharge requirements to prohibit dairy waste disposal unless suitable offset programs are implemented.

1. Implementation of Manure Tracking and Reporting System

The Regional Board determined that the manure tracking system in use was not adequate to determine the full effects of dairy waste management practices on groundwater quality nor was it adequate to determine compliance with waste discharge requirements related to manure disposal.

In response, a new manure tracking manifest form was developed and is now being used. Dairy operators are required to complete the form and submit it annually in a report to the Regional Board.

2. Implementations of Groundwater Monitoring Requirements

Comprehensive groundwater quality data is necessary for planning mitigation activities in the Chino Basin. Groundwater monitoring requirements will be included in the waste discharge requirements for all dairy operators in the Chino Basin. The WDRs will provide the operators with the option of participating in an established, comprehensive groundwater monitoring program in lieu of their individual monitoring efforts. Such a monitoring program is now being conducted by the Chino Basin Watermaster.

3. Preparation of an Engineered Waste Management Plan as part of the Report of Waste Discharge

Historically, the Regional Board has required that dairy operators provide a general description of their proposed containment controls as part of the Report of Waste Discharge (ROWD). Experience has shown, however, that this is not adequate and that illegal discharges of manured water occur due to improper design, construction, and maintenance of containment controls.

To address this problem, the Regional Board now requires that a waste management plan be prepared by a registered engineer, member of the Soil Conservation Service or others who are suitably qualified. This plan must address containment of all washwater and stormwater runoff, as well as protection of the facility from inundation, as required by the waste discharge requirements. For any given property, the engineering plan must address necessary containment controls for the property as a whole, even in situations where some portion of that property is leased, subleased or operated by another party (for example, cultivation of agricultural crops by a farmer on a portion of dairy property).

Engineered waste management plans are required to be submitted as part of the ROWD for new or substantially modified dairy operations. These plans are also

required when the containment controls at facilities are known or suspected to be inadequate.

4. Revision of the Manure and Washwater Disposal Requirements

As noted earlier, the Chino II and III Groundwater Subbasins lack assimilative capacity for additional salt inputs. In basins without assimilative capacity, mineral increments are not permitted when regulating waste discharges (see preceding section on salt balance and assimilative capacity, State Board Order No. 73-4, the Rancho Caballero decision [Ref. 7]). To meet the Chino Basin groundwater objectives, the discharge of manure and dairy washwater and their application as fertilizer and irrigation water cannot be legally permitted.

The implications of prohibiting manure and washwater disposal are significant. Recognizing this, the strategy allows for the implementation of programs to offset the salt loads contributed by ongoing manure/washwater disposal. An offset program would work as follows: for every ton of salt that will reach groundwater as a result of continued disposal/application of manure or washwater within the Chino Basin, the dairy operator must remove an equivalent amount of salt from the Basin through participation in a desalter or other appropriate means. The offsets required of the dairy industry would depend on the industry's success in identifying acceptable methods of manure and wastewater disposal; the more manure and washwater that is removed form the basin, the less need there is for offset.

The strategy calls for the waste discharge requirements for dairy operators in the Chino Basin to "prohibit the disposal of manure and washwater, and their application as fertilizer or irrigation water in the Chino Basin unless the dairy operator participates in an offset program. The offset program must ensure that water quality impacts of continued manure and/or washwater disposal/application practices are mitigated."

Implementation of this element of the dairy regulatory strategy has been withheld since acceptable mitigation projects are now being developed. As described in the preceding section the selected TDS and nitrogen management plan (Alternative 5C) includes two desalters in the Chino Basin, which are being built by the Santa Ana Watershed Project Authority and other participating agencies. These desalters, though not designed or implemented specifically to address ongoing dairy salt loading, will provide sufficient groundwater treatment and salt loads identified in Alternative 5C. This includes the salt loads from present and future dairy operations and other agriculture, unsewered areas, and other sources.

Part II. Impacts of Past Dairy Operations

This part of the dairy regulatory strategy addresses the mitigation of water quality impacts caused by past discharges of dairy waste in the Chino Basin.

While the two desalters mentioned above should be adequate to offset present and future salt wasteloads, they will not provide sufficient groundwater treatment to address the historic contributions of salts from long-term dairy or other agricultural activities, municipal wastewater disposal, etc. These historic salt inputs must be addressed to protect the beneficial uses of the Basin's groundwaters and to prevent long-term adverse impacts to the Santa Ana River.

Additional desalters or other treatment facilities and strategies will be necessary. The implementation of these measures may have significant costs. To be equitable, each of the sources of TDS and nitrogen input to the Basin, including dairies, other types of agriculture, and municipalities, should assume its fair share of the Chino Basin cleanup costs. The dairy regulatory strategy incorporates the concept of shared responsibility and directs the use of this concept to develop an equitable approach to water quality correction in the Chino Basin.

A comprehensive study of water resources management in the Chino Basin is now being conducted. The study, the Chino Basin Water Resources Management Study, is funded by a task force which includes representatives of the Chino Basin Watermaster (composed of water users in the Chino Basin including the agricultural industry), Chino Basin Municipal Water District, Western Municipal Water District, the Santa Ana Watershed Project Authority, Metropolitan Water District, and the Regional Board. The goal of this study is to identify a water resources management plan which will provide for water quality protection, water demands are met, and the quality of the Santa Ana River is not adversely affected by outflow from the Basin.

Part III. Surface Water Quality Impacts: Control of Drainage in the Chino Agricultural Preserve

The third part of the dairy strategy addresses surface water drainage problems in the Chino Agricultural Preserve, where most of the dairies are located. These problems are caused both by inadequate and poorly maintained drainage facilities within the Preserve, and by inadequate controls on drainage from upstream urban areas.

Runoff from the rapidly developing areas upstream of the dairy area creates additional difficulties for many dairy operators in complying with the manured water containment requirements specified in their waste discharge requirements. A number of studies have been conducted to determine the best method of preventing urban stormwater runoff impacts in the dairy area. The most recent study, "Chino Agricultural Preserve Drainage and Land Use Study"[Ref. 11], was conducted with federal 205(j) planning funds and was completed in 1987. The recommended

solution to these urban drainage problems was the construction of a trapezoidal earth swale at the northern boundary of the dairy area (roughly, at Riverside Avenue, between Campus Avenue and the Cucamonga Creek flood control channel, just west of Archibald Avenue). This swale would intercept flows from upstream urban areas (cities of Ontario and Chino) and convey these flows to the Lower Cucamonga Spreading Grounds, adjacent to the Cucamonga Creek Channel.

To alleviate drainage problems in the dairy area and reduce surface water quality problems which result from dairy waste inputs, the following measures need to be implemented:

1. Riverside Avenue interceptor swale – San Bernardino County and/or the cities of Ontario and Chino should pursue the funding and implementation of the interceptor swale project at Riverside Avenue.
2. Other drainage controls – Both San Bernardino and Riverside counties and the cities tributary to the dairy area should identify and implement a coordinated program of drainage controls necessary to supplement the interceptor swale and prevent drainage problems within the dairy area.

These recommendations are directed to the counties and cities, rather than to the dairy industry. The counties are required to implement such best management practices (BMPs) as part of their NPDES stormwater permits.

**Dairy Operations Outside the Chino Basin**

Since the greatest concentration of dairies occurs in the Chino Basin, the dairy strategy has appropriately focused on mitigating the problems in this area. However, in recent years, many new dairies have been established elsewhere in the Region, specifically in the San Jacinto Basin, and this trend appears to be continuing. To prevent the recurrence of the groundwater quality problem now confronting the Region in the Chino Basin, an appropriate dairy waste management strategy for the San Jacinto Basin must be developed and implemented. The pattern of dairy land use, the quality of underlying groundwater, and the availability of assimilative capacity in the San Jacinto Groundwater Subbasins should be considered in more detail before recommending a complete dairy strategy. However, it is anticipated that the wastewater management plan, the manure tracking system, and the groundwater monitoring elements of the strategy recommended for the Chino Basin will also apply in the San Jacinto Basin.

**Minimum Lot Size Requirements and Exemption Criteria for New Developments Using On-Site Septic Tank-Subsurface Leaching/Percolation Systems**

The Santa Ana Region is characterized by dramatic population growth. Most of this population is concentrated in urban areas, where high density development on small lots is typical. Sanitary sewers are not available in many areas where rapid growth is occurring, so many of these high density developments use on-site septic tank-subsurface disposal systems for sewage disposal.

In 1989, the Regional Board investigated the relationship between these high density developments and the nitrate problems found in the groundwater of the Region [Ref. 12]. The findings showed that the use of high density subsurface disposal systems would cause or add to nitrate quality problems. To control these impacts, the Board found that it was necessary to limit the density of new subsurface systems.

On October 13, 1989, the Regional Board adopted Resolution No. 89-157, amending the Water Quality Control Plan to add a one-half acre minimum lot size requirement for new developments using on-site septic tank-subsurface leaching/percolation systems region-wide. Certain exemptions from the minimum lot size requirement were specified in Resolution No. 89-157. On December 7, 1990, the Regional Board adopted Resolution No. 90-158, which revised the exemption criteria. However, on June 7, 1991, the Regional Board adopted Resolution No. 91-51, rescinding Resolution No. 90-158 and revising the exemption criteria in Resolution No. 89-157. On July 16, 1993, the Regional Board adopted Resolution No. 93-40, revising the requirements and exemption criteria in Resolution No. 89-157, as amended by Resolution No. 91-51. Resolution No. 89-157, as amended by Resolution No. 93-40, stipulates the following:

1. A minimum lot size of one-half acre (average gross) per dwelling unit is required for new developments in the Region using on-site septic tank-subsurface leaching/percolation systems.

   A. The term “one-half acre” specified as the minimum lot size requirement means an average gross area of land of one-half acre per dwelling unit. Easements (including streets, curbs, commons, and greenbelts), or those portions thereof which are part of the property proposed for development shall be included in the calculation of the average gross area of land.

   B. A “new” development is defined as a proposed tract, parcel, industrial or commercial development for which:

      1. One or more of the following has not been granted on or prior to September 7, 1989:

         a. Conditional approval or approval of a tentative parcel or tract map by the local agency such as the county/city Planning Commission, City Council or the Board of Supervisors.

         b. A conditional use permit.

         c. Conditional approval or approval by the San Bernardino County Department of Environmental Health Services, Riverside County Department of Health Care Agency or other local agency; or

2. One or more of the conditional approvals or approvals listed under B.1., above, were granted on or prior to September 7, 1989 but had expired prior to September 7, 1989.

C. The minimum lot size requirement does not apply to existing developments where septic tank-subsurface disposal systems have been installed on or prior to September 7, 1989. Replacement of the existing septic tank-subsurface disposal systems shall be exempt from the minimum lot size requirements under the following conditions:

1. For Residential, Commercial and Industrial Developments

   Replacement of the existing septic tank-subsurface disposal systems is necessary to bring the system up to code as required by the local health care agencies and/or the building and safety departments.

2. For Single-Family Residential Only

   Replacement of the existing septic tank-subsurface disposal systems is proposed to allow additional flows resulting from additions to the existing dwelling unit. (This does not include any free-standing additional structures.)

   (Note: Board staff does not consider the number of bedrooms and/or bathrooms for existing or proposed single-family dwelling units in determining compliance with the exemption criteria.)

   a. An existing development on land zoned single-family residential will be considered as a new development if the addition of any free-standing structures which result in additional wastewater flows to the septic system is proposed. Commercial and/or industrial developments will be considered as new development if any additions to the existing structures are proposed which will result in additional wastewater flows to the septic system.

   b. For single-family residential developments, if the existing septic system could accommodate additional wastewater flows, then additional installations (rooms/bathroom) to these developments shall be exempt from the minimum lot size requirements.

D. Those tracts, parcels, industrial or commercial developments which have received one or more of the approvals listed in B.1., above, on or prior to September 7, 1989 are exempt from minimum lot size requirements for use of septic tank-subsurface disposal systems. However, those tracts, parcels, industrial or commercial developments which had received one or more of the approvals listed in B.1., above, but for which the approval had expired prior to

September 7, 1989 are considered as new development and are subject to the minimum lot size requirements.

E. Industrial/commercial developments are developments other than single-family residential developments. For new industrial commercial developments utilizing septic tank-subsurface disposal systems, the wastewater flow for each one-half acre gross area of land may not exceed that from a three-bedroom, two bathroom single-family dwelling unit. For determining compliance with this criterion, a flow rate of 300 gallons per day shall be considered as the flow equivalent to that from a 3-bedroom, 2-bathroom single-family dwelling. For industrial/commercial developments with lots smaller than one-half acre, this flow rate requirement shall be prorated. (For example, an industrial/commercial development on a one-quarter (1/4) acre parcel will be in compliance with this requirement if the wastewater flow does not exceed 150 gallons per day.)

F. This minimum lot size requirement does not affect the lot size criterion for continuing exemptions in prohibition areas (1 acre minimum).

G. This minimum lot size requirement does not preclude the prescription of more stringent lot size requirements in specific areas if it is determined necessary to protect water quality.

H. No exemptions shall be granted for new developments on lots less than one-half acre which are 200 feel or less from a sewer which could serve that tract/parcel, barring legal impediments to such use. All other developments shall be considered on sliding scale, *e.g.,* for each additional unit (any development which is more than a single-family dwelling), this requirement should be increased by 100 feet per dwelling unit. For example, a 10-lot subdivision shall be required to connect to a sewer if the sewer is within 1,100 feet (200 + 9 x 100 feet = 1,100 feet) of the proposed development barring legal impediments to connection to the sewer. For this subsection, a commercial/industrial development which produces a wastewater flow of up to 300 gallons per day would be considered equivalent to a single-family dwelling unit.

I. New lots of less than one-half acre may be formed by combining two or more lots which have received one of the approvals specified in Section B.1., above on or prior to September 7, 1989. Individually, these existing lots would be eligible for an exemption from the minimum lot size requirement. Developments on the combined lots may also be granted an exemption provided that the total number of units proposed for the new parcel is equal to or less than the total number of units proposed for the existing parcel. For the purposes of this subsection, a combined lot of less than one-half acre formed from two or more existing lots shall not be considered a new development.

J. Exemptions from the minimum lot size requirements for the use of septic tank-subsurface disposal systems on lots smaller than one-half acre may be granted if the following conditions are met:

   1. The project proponent implements an acceptable offset program. Under an offset program, the project proponent can proceed with development using septic systems on lots smaller than one-half acre if the proponent connects an equivalent number of septic systems to the sewer. The unsewered developments must be those which would not otherwise be required to connect to the sewer.

   2. If the septic systems (developments) proposed are not identical to the ones connected to the sewer (the offset), an engineering report shall be submitted certifying that the nitrogen loading rate from the proposed development(s) is(are) equivalent to or less than the nitrogen loading rate from the septic systems in the offset program.

   3. The proposed use of septic tank-subsurface disposal systems complies with the Regional Board's "Guidelines for Sewage Disposal from Land Developments,"

K. The project proponent may propose an alternative treatment system for sewage disposal as the basis for an exemption from the minimum lot size requirement. Each request for use of an alternative treatment system shall be reviewed on a case-by-case basis and submitted to the Regional Board for consideration.

**Newport Bay Watershed**

Water quality problems in Newport Bay were described in detail in reports prepared in response to Senate Concurrent Resolutions 38 and 88 [Ref. 16, 17]. These problems are essentially nonpoint source problems and fall into four major categories: 1) TMDL for sediment; 2) bacterial contamination; 3) eutrophication and 4) toxic substances contamination. Each of these problems have been or is being addressed by either local or state agencies. A brief description follows:

### 1.a Phase 1 of the TMDL for Sediment (Amended by Resolution 98-101)

The Total Maximum Daily Load for sediment in the Newport Bay/San Diego Creek Watershed includes the following quantifiable targets and Load Allocations that shall be implemented by the Cities (Irvine, Tustin, Lake Forest, Costa Mesa, Santa Ana and Newport Beach) and County responsible for the sediment discharged into stormwater and flood control conveyances under their control which discharge into San Diego Creek and/or Newport Bay.

1. Sediment control measures shall be implemented and maintained to ensure that sediment discharges into Newport Bay will not significantly change the existing acreages of aquatic, wildlife, and rare and endangered species habitat, and to maintain the navigational and non-contact recreational beneficial uses of the bay. The existing aquatic and wildlife habitat of the Upper Bay, which is comprised of approximately 210 acres of marine aquatic habitat, 214 acres of mudflat habitat, 277 acres of salt marsh, and 31 acres of riparian habitat within, and adjacent to**,** the 700 acre Upper Newport Bay Ecological Reserve and the existing navigational and recreational uses of Newport Bay, will be used by the Regional Board as a performance standard of the effectiveness of the sediment TMDL. If these acreages are changed by more than 1% as the result of sediment deposition, if the in-bay sediment basins or the in-channel sediment basins are not maintained, or if there are impacts to navigational and recreational uses, this will indicate that the local sediment control measures are not adequate to protect the beneficial uses provided by these areas, and the Board will reevaluate the sediment TMDL for Newport Bay and San Diego Creek. Since the intent of the sediment TMDL is to protect these beneficial uses, this quantifiable target will be used as the primary measurement of the success of the TMDL. In order to maintain the marine aquatic habitat of the Unit 1 and 2 Sediment Basins in Upper Newport Bay, a minimum depth of 7 feet below mean sea level shall be maintained**.** The Cities and County, acting through cooperative agreements under the Newport Bay Watershed Executive Committee, shall conduct bathymetric and vegetation surveys of Newport Bay no less than once every three years or as agreed upon by the Executive Officer. This information will be used to evaluate compliance with the acreage and depth targets. If these acreages are changed by more than 1% as the result of sediment deposition, if the minimum depth is not maintained**,** and if the 50% target sediment reduction described below is not achieved, the Regional Board may consider appropriate enforcement action.

2. It is recognized that the Department of Fish and Game, which is responsible for the management of the Reserve, may wish to modify the habitat composition and acreages of the Reserve to address wildlife needs. The habitat acreages identified above will be revised accordingly through the Basin Plan Amendment process.

3. The second quantifiable target is to reduce the annual average sediment load in the watershed from a total of approximately 250,000 tons per year to 125,000 tons per year, thereby reducing the sediment load to Newport Bay to approximately 62,500 tons per year and limiting sediment deposition in the drainages to approximately 62,500 tons per year. Sediment control measures shall be implemented and maintained to result in a 50% reduction in the current load of sediment in the Newport Bay/San Diego Creek Watershed within 10 years. The Regional Board will determine compliance with this target by calculating the annual average amount of suspended solids measured in San Diego Creek at Jamboree Boulevard and Campus Drive over a ten year period, and by evaluating the scour studies of the creek channels and topographic surveys of all the sediment control basins in the watershed to estimate the amount of deposition. Given that annual sediment deposition can vary widely based on weather and other conditions, it is appropriate to evaluate compliance with

the sediment reduction target as a 10 year running annual average of the suspended solids load measured in San Diego Creek at Jamboree Boulevard and Campus Drive. The Regional Board will compare this information to the bathymetric and scour studies information to determine if the monitoring data accurately reflects sediment deposition in the bay and creek channels and to determine compliance with this target.

4. Sediment control measures shall be implemented and maintained to comply with the following Load Allocations (implemented as 10-year running annual averages) for discharges of sediment to Newport Bay: 1) no more than 28,000 tons per year of sediment shall be discharged to Newport Bay from open space areas within the watershed, 2) no more than 19,000 tons per year shall be from agricultural land, 3) no more than 13,000 tons per year from construction sites, 4) no more than 2,500 tons per year discharged from urban areas. The Cities and County, acting through cooperative agreements under the Newport Bay Watershed Executive Committee, shall be required to provide a proposal for evaluating compliance with these individual land use type load allocations that is subject to the approval of the Executive Officer. This proposal shall be implemented upon approval of the Executive Officer.

5. Sediment control measures shall be implemented and maintained to comply with the following Load Allocations (implemented as 10-year running annual averages) in addition to the load allocations specified above for Newport Bay for discharges of sediment to tributaries of Newport Bay: 1) no more than 28,000 tons per year of sediment shall be discharged to San Diego Creek and its tributaries from open space areas within the watershed, 2) no more than 19,000 tons per year shall be discharged to San Diego Creek and its tributaries from agricultural land, 3) no more than 13,000 tons per year discharged to San Diego Creek and its tributaries from construction sites, 4) no more than 2,500 tons per year discharged to San Diego Creek and its tributaries from urban areas. The Cities and County, acting through cooperative agreements under the Newport Bay Watershed Executive Committee, shall be required to provide a proposal for evaluating compliance with these individual land use type load allocations that is subject to the approval of the Executive Officer. This proposal shall be implemented upon approval of the Executive Officer.

6. Sediment control measures shall be implemented such that Upper Newport Bay, including In-Bay Sediment Basins 1 and 2, need not be dredged more frequently than about once every 10 years, and the long term goal of Phase 1 of the TMDL for sediment is to reduce the frequency of dredging to once every 20 to 30 years. It is recognized that extreme rainfall conditions may necessitate more frequent dredging of the in-bay basins. The Regional Board will adopt waste discharge requirements for such dredging projects as the means of recommending Clean Water Act Section 401 Water Quality Certification for the dredging, and to ensure proper disposal of the dredged sediment.

7. Waste Discharge Requirements will be waived for maintenance dredging of flood control channels and drainages throughout the watershed in order to maintain flood control capacity, under the following conditions; 1) any vegetation removal or earthwork conducted between March 1 and September 1 shall be supervised by a

qualified biologist, approved by the Department of Fish and Game, to ensure compliance with the Endangered Species Act and Migratory Bird Treaty Act (this monitor shall have the authority to the stop or divert work to avoid impacts as necessary); and 2) the information in a complete application (report of waste discharge) demonstrates that the waiver criteria specified herein and in Regional Board Resolution No. 96-9, Waiver of Waste Discharge Requirements for Certain Types of Discharges, are met.

8. All in-channel and foothill sediment control basins throughout the drainages in the watershed shall be maintained to have at least 50% of design capacity available prior to November 15 of each year. Waste Discharge Requirements will be waived for sediment control basin maintenance activities under the following conditions: 1) any vegetation removal or earthwork conducted between March 1 and September 1 shall be supervised by a qualified biologist, approved by the Department of Fish and Game, to ensure compliance with the Endangered Species Act and Migratory Bird Treaty Act (this monitor shall have the authority to the stop or divert work to avoid impacts as necessary); 2) the use of herbicides for the control of vegetation within channels shall be avoided to the greatest extent practicable; and 3) the information in a complete application (report of waste discharge) demonstrates that the waiver criteria specified herein and in Regional Board Resolution No. 96-9, Waiver of Waste Discharge Requirements for Certain Types of Discharges, are met.

9. Waste Discharge Requirements will be waived for drainage channelization and stabilization projects on drainages within the watershed between the foothill sediment basins and Upper Newport Bay, under the following conditions: 1) while modifying the channels, no native riparian wetland vegetation shall be removed from within the basins or adjacent to the basins during the period between April 1 and September 1 of each year, in order to protect the federally listed least Bell's vireo, unless one to one mitigation is provided for the loss of the riparian and aquatic habitat; 2) any vegetation removal or earthwork conducted between March 1 and September 1 shall be supervised by a qualified biologist, approved by the Department of Fish and Game, to ensure compliance with the Endangered Species Act and Migratory Bird Treaty Acts (this monitor shall have the authority to stop or divert work to avoid impacts as necessary); and 3) the information in a complete application (report of waste discharge) demonstrates that the waiver criteria specified herein and in Regional Board Resolution No. 96-9, Waiver of Waste Discharge Requirements for Certain Types of Discharges, are met. The Regional Board will continue to work with the U.S. Army Corps of Engineers and other appropriate agencies towards the adoption of a Special Area Management Plan (or comparable plan) and General Permit for channel stabilization and flood control projects in accordance with Section 404 and 401 of the Clean Water Act. If a plan for completing the Special Area Management Plan by June 1, 1999 is not submitted to the Executive Officer by January 1, 1999, then the Executive Officer is directed to require, as an additional condition for obtaining a waiver, the completion of a comprehensive delineation of all the wetlands in the watershed and an evaluation of the cumulative impacts of projects to control sediment and the build-out of the watershed on the beneficial uses of these waters

of the State. This evaluation of the cumulative impacts must be completed, according to a plan acceptable to the Executive Officer, by June 1, 1999. Staff intends to use the delineation to propose a general permit to the Regional Board that will cover the kind of activities described in the amendment. Until the SAMP, or, alternatively, the comprehensive delineation described above, is completed, staff will continue to process individual permit applications for each project.

10. The Cities and County, acting through cooperative agreements under the Newport Bay Watershed Executive Committee, shall evaluate: 1) the amount of sediment being discharged from areas that contribute sediment to the total load discharged to Newport Bay; and 2) the effectiveness of the local sediment control plan (the 208 Plan). Where areas that contribute sediment are not under the jurisdiction of entities that are currently part of the Newport Bay Watershed Executive Committee, the Cities and County shall recommend to the Regional Board, if necessary, a new formula for allocating sediment loads and sharing of the costs of implementing the sediment control measures that will provide a 50% reduction in the current load of sediment. This evaluation shall, at a minimum, address the sediment loads from the Santa Ana-Delhi Channel, Bonita Creek, the federal lands within the watershed, and the City of Lake Forest.

These conditions shall not supersede more restrictive conditions of other agencies, such as the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, the State Department of Fish and Game, or other local agencies.

### 1.b Phase 2 of the TMDL for Sediment: Monitoring and Reassessment

The Newport Bay Watershed Executive Committee has developed an agreement whereby the County of Orange conducts the monitoring of sediment discharge within the watershed, with the costs shared by all parties, except the Department of Fish and Game. There has been no site specific monitoring of the various sources of sediment, so it is impossible to determine the effectiveness of specific BMPs. It is also too soon to reach any conclusions about the overall effectiveness of the local sediment control measures.

Since 1983, the County has monitored flow and total suspended solids at three locations and conducts periodic scour studies to evaluate sediment transport and deposition in the drainages within the watershed. In addition, the County has conducted two topographic surveys of the Upper Bay to determine sediment accumulation in the Upper Bay. The County intends to continue this monitoring program on behalf of the Newport Bay Watershed Executive Committee.

In addition, the Newport Bay Watershed Executive Committee shall:

1. Propose monitoring stations and schedules to be established to monitor the discharge of sediment from the Santa Ana-Delhi Channel and Bonita Canyon Creek into the Upper Bay and to evaluate the effectiveness of the BMPs being implemented in the watershed. This monitoring plan shall also propose monitoring to evaluate compliance with the Load Allocations for various land use types. This

monitoring plan will not become effective until approved by the Regional Board at a duly noticed public hearing as specified in Chapter 1.5, Division 3, Title 23 of the California Code of Regulations (Section 647 et seq.).

2. Propose monitoring stations and schedules to conduct the scour studies for the drainages in the watershed to be conducted annually. These surveys shall determine the amount of sediment accumulated in San Diego Creek and its tributaries, the in-channel sediment basins, the foothill sediment basins, and any other sediment basins in the watershed. The survey report shall be used to demonstrate whether the sediment basins have at least 50% capacity prior to November 15 of each year. This monitoring plan will not become effective until approved by the Regional Board at a duly noticed public hearing as specified in Chapter 1.5, Division 3, Title 23 of the California Code of Regulations (Section 647 et seq.).

3. Conduct topographic and vegetation surveys of Upper Newport Bay at least every three years, or as agreed upon by the Executive Officer, and after any year in which the monitoring for total suspended solids at Campus Drive shows that more than 250,000 tons of sediment were discharged to the Bay. In any year in which these surveys are required, the surveys shall be conducted by July 1. The results of these surveys shall be submitted as part of an annual report by December 31 of each year. The topographic and vegetation surveys shall be conducted to determine the amount of sediment deposition in the two In-Bay basins and the other marine aquatic habitat areas and to determine changes in the areal extent of the existing aquatic, wildlife and endangered species habitat areas.

4. Submit an annual report by December 31 of each year providing the monitoring data and information collected by the Newport Bay Watershed Executive Committee, including the flow and suspended solids monitoring data, the scour studies, the bathymetric and vegetation surveys, (and any additional information collected by the Committee). The monitoring shall be completed prior to July 1 of each year and this information shall be used to determine the maintenance requirements of all sediment basins in the watershed. Additionally, the Newport Bay Watershed Executive Committee shall submit a report by November 15 of each year certifying whether the sediment basins in the watershed have at least 50% capacity. The Regional Board will use the information collected by this monitoring program to evaluate the effectiveness of the sediment TMDL and will reevaluate the sediment TMDL as part of the Regional Board's Basin Planning process.

5. The monitoring data and information collected by the Newport Bay Watershed Executive Committee, including the flow and suspended solids monitoring data, the scour studies, the bathymetric surveys and the vegetation surveys, (and any additional information collected by the Newport Bay Watershed Executive Committee) shall be submitted in an annual report by December 31 of each year. The monitoring shall be completed prior to July 1 of each year and this

information shall be used to determine the maintenance requirements of all sediment basins in the watershed. Additionally, the Newport Bay Watershed Executive Committee shall submit a report by November 15 of each year certifying whether the sediment basins in the watershed have at least 50% capacity. The Regional Board will use the information collected by this monitoring program to evaluate the effectiveness of the sediment TMDL and will reevaluate the sediment TMDL as part of the Board's Basin Planning process. (End of Amendment Resolution No. 98-101)

2. Bacterial Contamination

Bacterial contamination of the waters of Newport Bay can directly affect two designated beneficial uses: water-contact recreation (**REC-1**) and shellfish harvesting (**SHEL**). The Orange County Health Care Agency (OCHCA) conducts routine bacteriological monitoring and more detailed sanitary surveys as necessary, and is responsible for closure of areas to recreational and shellfish harvesting uses if warranted by the results.

Because of consistently high levels of total coliform bacteria, the upper portion of Upper Newport Bay (Upper Bay) has been closed to these uses since 1974. In 1978, the shellfish harvesting prohibition area was expanded to include all of the Upper Bay, and the OCHCA generally advises against the consumption of shellfish harvested anywhere in the Bay. Bacterial objectives established to protect shellfish harvesting activities are rarely met in the Bay. (Fecal coliform objectives for the protection of shellfish harvesting and water-contact recreation are shown in Chapter 4, “Enclosed Bays and Estuaries”. The OCHCA has relied on total coliform standards specified in the California Health and Safety Code. Fecal coliform are a subset of total coliform.). Certain areas in the lower parts of the Upper Bay and in Lower Newport Bay (Lower Bay) are also closed to water-contact recreation on a temporary basis, generally in response to storms. In these areas, there is generally good compliance with water-contact recreation bacterial objectives in the summer.

Data collected by the OCHCA demonstrate that tributary inflows, composed of urban and agricultural runoff, including stormwater, are the principal sources of coliform input to the Bay. As expected, there are more violations of bacterial standards in the Bay during wet weather, when tributary flows are higher, than in dry weather. There are few data on the exact sources of the coliform in this runoff. Coliform has diverse origins, including: manure fertilizers which may be applied to agricultural crops and to commercial and residential landscaping; the fecal wastes of humans, household pets and wildlife; and other sources. Special investigations by OCHCA have demonstrated that food wastes are a significant source of coliform. Many restaurants wash down equipment and floor mats into storm drains tributary to the Bay and may improperly dispose of food waste such that it eventually washes into the Bay. Such discharges likely contribute to the chronic bacterial quality problems in certain parts of the Bay.

Another source of bacterial input to the Bay is the discharge of vessel sanitary wastes. Newport Bay has been designated a no-discharge harbor for vessel sanitary wastes since 1976. Despite this prohibition, discharges of these wastes have continued to

occur. Since these wastes are of human origin, they pose a potentially significant public health threat.

The Regional Board, the City of Newport Beach (City), the County of Orange, the City of Newport Beach Harbor Quality Committee, and other parties have taken or stimulated actions to enforce the vessel waste discharge prohibition. The principal focus of these efforts has been to make compliance with the prohibition convenient and therefore more likely. Vessel waste pumpouts have been installed at key locations around the Bay and are inspected routinely by the OCHCA. A City ordinance addresses people-intensive boating activities to ensure proper disposal of sanitary wastes. The ordinance requires that sailing clubs, harbor tour, and boat charter operations install pumpouts for their vessels. Another City ordinance addresses vessel waste disposal by persons living on their boats. Efforts have also been made to ensure that there are adequate public rest rooms onshore. The City also sponsors an extensive public education campaign designed to advise both residents and visitors of the discharge prohibition, the significance of violations, and of the location of pumpouts and rest room facilities. The effectiveness of these extensive vessel waste control efforts is not known.

As noted, the fecal waste of wildlife, including waterfowl that inhabit the Bay and its environs, is a source of coliform input. The fecal coliform from these natural sources may contribute to the violations of water quality objectives and the loss of beneficial uses, but it is currently unknown to what extent these natural sources contribute to, or cause, the violations of bacterial quality objectives in Newport Bay.

Reports prepared by Regional Board staff describe the bacterial quality problems in the Bay in greater detail and discuss the technical basis for the fecal coliform TMDL that follows (21, 22). Implementation of this TMDL is expected to address these bacterial quality problems and to assure attainment of water quality standards, that is, compliance with water quality objectives and protection of beneficial uses.

## 3.a. Fecal Coliform TMDL (Amended by Resolution No. 99-10)

A prioritized, phased approach to the control of bacterial quality in the Bay is specified in this TMDL. This approach is appropriate, given the complexity of the problem, the paucity of relevant data on bacterial sources and fate, the expected difficulties in identifying and implementing appropriate control measures, and uncertainty regarding the nature and attainability of the SHEL use in the Bay. The phased approach is intended to allow for additional monitoring and assessment to address areas of uncertainty and for future revision and refinement of the TMDL as warranted by these studies.

Table 5-9f summarizes the TMDL, Waste Load Allocations (WLAs) for point sources of fecal coliform inputs and Load Allocations (LAs) for nonpoint source inputs. As shown, the TMDL, WLAs and LAs are established to assure compliance with water contact recreation standards no later than December 30, 2014 and with shellfish standards no later than December 30, 2019. WLAs are specified for vessel waste and urban runoff, including stormwater, the quality of which is regulated under a County-wide NPDES

permit issued by the Regional Board. This runoff is thus regulated as a point source, even though it is diffuse in origin. LAs are specified for fecal coliform inputs from agricultural runoff, including stormwater, and natural sources. The TMDL is to be adjusted, as appropriate, based upon completion of the studies contained in Table 5-9g. Upon completion of these studies, an updated TMDL report will be prepared summarizing the results of the studies and making recommendations regarding implementation of the TMDL. The results of the studies may lead to recommendations for changes to the TMDL specified in Table 5-9f to assure compliance with existing Basin Plan standards (objectives and beneficial uses). The study results may also lead to recommendations for changes to the Basin Plan objectives and/or beneficial uses. If such standards changes are approved through the Basin Plan amendment process, then appropriate changes to the TMDL would be required to assure attainment of the revised standards. Revision of the TMDL, if appropriate, would also be considered through the Basin Plan amendment process.

Upon completion and consideration of the studies and any appropriate Basin Plan amendments, a plan for compliance with the TMDL specified in Table 5-9f, or with an approved amended TMDL, will be established. It is expected that this plan will specify a phased compliance approach, based on consideration of such factors as geographic location, the priority assigned by the Regional Board to specific locations for control actions (see Section 3.a.ii, “Beneficial Use Assessment”), season, etc. Interim WLAs, LAs and compliance dates that lead to ultimate compliance with the TMDL will be established.

The TMDL and its allocations contain a significant margin of safety. The margin of safety can be either incorporated implicitly through analytical approaches and assumptions used to develop the TMDL or added explicitly as a separate component of the TMDL. A substantial margin of safety is implicitly incorporated in the TMDL in the fact that the TMDL does not apply criteria for dilution, natural die-off, and tidal flushing. The TMDL, WLAs, and LAs are established at concentrations equivalent to the water quality objectives.

**Table 5-9f: Total Maximum Daily Load, Waste Load Allocations, and Load Allocations for Fecal Coliform in Newport Bay**

| Total Maximum Daily Load for Fecal Coliform In Newport Bay | Waste Load Allocations for Fecal Coliform in Urban Runoff, including stormwater, Discharges to Newport Bay | Load Allocations for Fecal Coliform in Agricultural Runoff, including stormwater, Discharges to Newport Bay | Load Allocations for Fecal Coliform from Natural Sources in all Discharges to Newport Bay | Waste Load Allocations for Vessel Waste |
|---|---|---|---|---|
| **As soon as possible but no later than (14 years after State TMDL Approval)*** | | | **In Effect** | **In Effect** |
| 5-Sample/30-days Geometric Mean less than 200 organisms/100 mL, and not more than 10% of the samples exceed 400 organisms/ 100 mL for any 30-day period. | 5-Sample/30-days Geometric Mean less than 200 organisms/100 mL, and not more than 10% of the samples exceed 400 organisms/ 100 mL for any 30-day period. | 5-Sample/30-days Geometric Mean less than 200 organisms/ 100 mL, and not more than 10% of the samples exceed 400 organisms/ 100 mL for any 30-day period. | 5-Sample/30-days Geometric Mean less than 200 organisms/100 mL, and not more than 10% of the samples exceed 400 organisms/ 100 mL for any 30-day period. | 0 MPN/100 mL<br><br>No discharge. |
| **As soon as possible but no later than (20 years after State TMDL Approval)*** | | | | **In Effect** |
| Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. | Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. | Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. | Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. | 0 MPN/100 mL<br>No discharge. |

**Table 5-9g: Fecal Coliform Implementation Plan/Schedule Report Due Dates**

| Task | Description | Compliance Date-As soon As Possible but No Later Than |
|---|---|---|
| Task 1 | Routine Monitoring Program (Section 3.a.ii.a)<br>a) Submit Proposed Routine Monitoring Plan(s)[1]<br>b) Implement Routine Monitoring Plan(s)<br><br>c) Submit Monthly and Annual Reports (Reporting Period: April 1-March 31) | <br>a) (Within 30 days)[2]<br>b) Upon Regional Board Approval of Plan(s)<br>c) Monthly within 30 days, Annual Report by September 1 |
| Task 2 | Water Quality Model for Bacterial Indicators (Section 3.a.ii.b)<br>a) Submit Proposed Model Development Plan<br>b) Submit Calibrated Model and Model Documentation | <br>a) (Within 30 days) [2]<br>b) 13 months after Regional Board approval of plan(s) |
| Task 3 | Beneficial Use Assessment Plan (Section 3.a.ii.c)<br>Submit Proposed Assessment Plan for:<br>a) REC-1<br>b) SHEL | <br><br>a) (Within 30 days) [2]<br>b) (Within 13 months) [2] |
| Task 4 | Beneficial Use Assessment Report (3.a.ii.c)<br>Submit Beneficial Use Assessment Report for:<br>a) REC-1<br><br>b) SHEL | <br><br>a) 13 months after Regional Board approval of plan(s)<br>b) 13 months after Regional Board approval of plan(s) |
| Task 5 | Source Identification and Characterization Plan(s) (Section 3.a.ii.d)<br>Submit Proposed Source Identification Plans for:<br>a) The Dunes Resort<br>b) Urban Runoff (including stormwater)<br>c) Agriculture (including stormwater)<br>d) Natural Sources | <br><br>a) (Within 60 days) [2]<br>b) (Within 60 days) [2]<br>c) (Within 3 months) [2]<br>d) (Within 3 months) [2] |

**Table 5-9g: Fecal Coliform Implementation Plan/Schedule Report Due Dates**

| Task | Description | Compliance Date-As Soon As Possible but No Later Than |
|---|---|---|
| Task 6 | Source Identification and Characterization Reports (Section 3.a.ii.d)<br>Submit Source Identification and Characterization Reports for:<br>a) The Dunes Resort<br>b) Urban Runoff (including stormwater)<br>c) Agriculture (including stormwater)<br>d) Natural Sources | <br><br>a) 7 months after Regional Board approval of plan(s)<br>b) 13 months after Regional Board approval of plan(s)<br>c) 16 months after Regional Board approval of plan(s)<br>d) 16 months after Regional Board approval of plan(s) |
| Task 7 | Evaluation of Vessel Waste Program (Section 3.a.ii.e)<br>a) Submit Proposed Plan for Evaluating the Current Vessel Waste Program<br>b) Submit Report on the Evaluation of the Vessel Waste Program | <br>a) (Within 3 months) [2]<br>b) 12 months after Regional Board approval of plan |
| Task 8 | TMDL, WLA, and LA Evaluation and Source Monitoring Program (Section 3.a.ii.f)<br>a) Submit Proposed Evaluation and Source Monitoring Program Plan(s)<br>b) Implement Evaluation and Source Monitoring Plan(s)<br>c) Submit Monthly and Annual Reports (Reporting Period: April 1-March 31) | <br>a) 3 months after completion of Tasks 2, 4a, and 6<br>b) Upon Regional Board approval of plan(s)<br>c) Monthly within 30 days, Annual Report by September 1 |
| Task 9 | Updated TMDL Report<br>Submit updated TMDL report for:<br>a) REC-1<br>b) SHEL | <br><br>a) 6 months after completion of Tasks 2, 4a, 6, and 7<br>b) 6 months after completion of Tasks 2, 4b, 6, and 7 |

**Table 5-9g: Fecal Coliform Implementation Plan/Schedule Report Due Dates**

| Task | Description | Compliance Date-As Soon As Possible but No Later Than |
|---|---|---|
| Task 10 | Adjust TMDL, if necessary; adopt interim WLAs, LAs, and Compliance Dates (Section 3.a.ii.h)<br>a) REC-1<br><br>b) SHEL | <br><br>a) 12 months after completion of Updated TMDL Report for REC-1 (Task 9.a)<br>b) 12 months after completion of Updated TMDL Report for SHEL (Task 9.b) |
| [1]Note: Provided that the monitoring program plan(s) fulfills the minimum requirements specified in this TMDL, approval of the TMDL shall constitute Regional Board approval of the monitoring program plan(s). | | |
| [2]Note: Within specified time periods of State TMDL approval (i.e., approval by the Regional Board, the State Water Resources Control Board, and the Office of Administrative Law). Upon State TMDL approval, this parenthetical "formula" will be replaced by the date certain, based upon the date of approval. | | |

### 3.a.i. TMDL Implementation

As soon as possible but no later than the dates specified in Table 5-9g, the County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach and agricultural operators in the Newport Bay watershed shall submit the plans and schedules shown in Table 5-9g and described in Section 3.a.ii. Subsequent phases of TMDL implementation shall take into account the results of the monitoring and assessment efforts required by the initial study phase of the TMDL implementation plan and other relevant studies.

The following sections describe the requirements for the submittal of plans by dischargers in the Newport Bay watershed to complete specific monitoring, investigations and analyses. In each and every case, the plans submitted by the named dischargers will be considered for approval by the Regional Board at a duly noticed public hearing as specified in Chapter 1.5, Division 3, Title 23 of the California Code of Regulations (Section 647 et seq.). The plans are to be implemented upon Regional Board approval and completed as specified in Table 5-9g.

### 3.a.ii. Monitoring and Assessment

Routine monitoring and special investigations and analyses are an important part of this phased TMDL. Routine monitoring is necessary to assess compliance with the bacterial quality objectives in the Bay and with the WLAs and LAs specified in the TMDL. Special investigations and analyses are needed to identify and characterize sources of fecal coliform input and to determine their fate in the Bay so that appropriate control measures can be developed and implemented. The effectiveness of current and future bacterial control measures needs to be evaluated. The results of these studies may warrant future changes to this TMDL.

#### 3.a.ii.a. Routine Monitoring

By January 30, 2000, the County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach, and the agricultural operators in the Newport Bay watershed shall propose a plan for routine monitoring to determine compliance with the bacterial quality objectives in the Bay.

At a minimum, the proposed plan shall include the collection of five (5) samples/30-days at the stations specified in Table 5-9h and shown in Figure 5-1 and analysis of the samples for total and fecal coliform and enterococci. Reports of the collected data shall be submitted monthly. An annual report summarizing the data collected for the year and evaluating compliance with the water quality objectives shall be submitted by September 1 of each year.

In lieu of this coordinated, regional monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group plan to conduct routine monitoring in areas solely within their jurisdiction to determine compliance with the bacterial objectives in the Bay (if appropriate). Any such individual or group plans shall also be submitted by January 30, 2000. Reports of the data collected pursuant to approved individual/group plan(s) shall be submitted monthly and an annual report summarizing the data and evaluating compliance with water quality objectives shall be submitted by September 1 of each year.

The monitoring plan(s) shall be implemented upon Regional Board approval.

**Table 5-9h**

**Newport Bay Sampling Stations for Routine Compliance Monitoring with Bacterial Quality Objectives (see Figure 1 for Station Locations)**

| | | |
|---|---|---|
| Ski Zone | 33rd Street | Park Avenue |
| Vaughns Launch | Rhine Channel | Via Genoa |
| Northstar Beach | De Anza | Alvarado/Bay Is. |
| Abalone Avenue | Promontory Pt. | 10th Street |
| Dunes East | Bayshore Beach | 15th Street |
| Dunes Middle | Onyx Avenue | 19th Street |
| Dunes West | Garnet Avenue | Lido Island Yacht Club |
| Dunes North | Ruby Avenue | Harbor Patrol |
| 43rd Street | Sapphire Avenue | N Street Beach |
| 38th Street | Newport Blvd. Bridge | Rocky Point |
| San Diego Creek @ Campus Dr. | Santa Ana Delhi Channel | Big Canyon Wash |
| Backbay Dr. Drain | | |

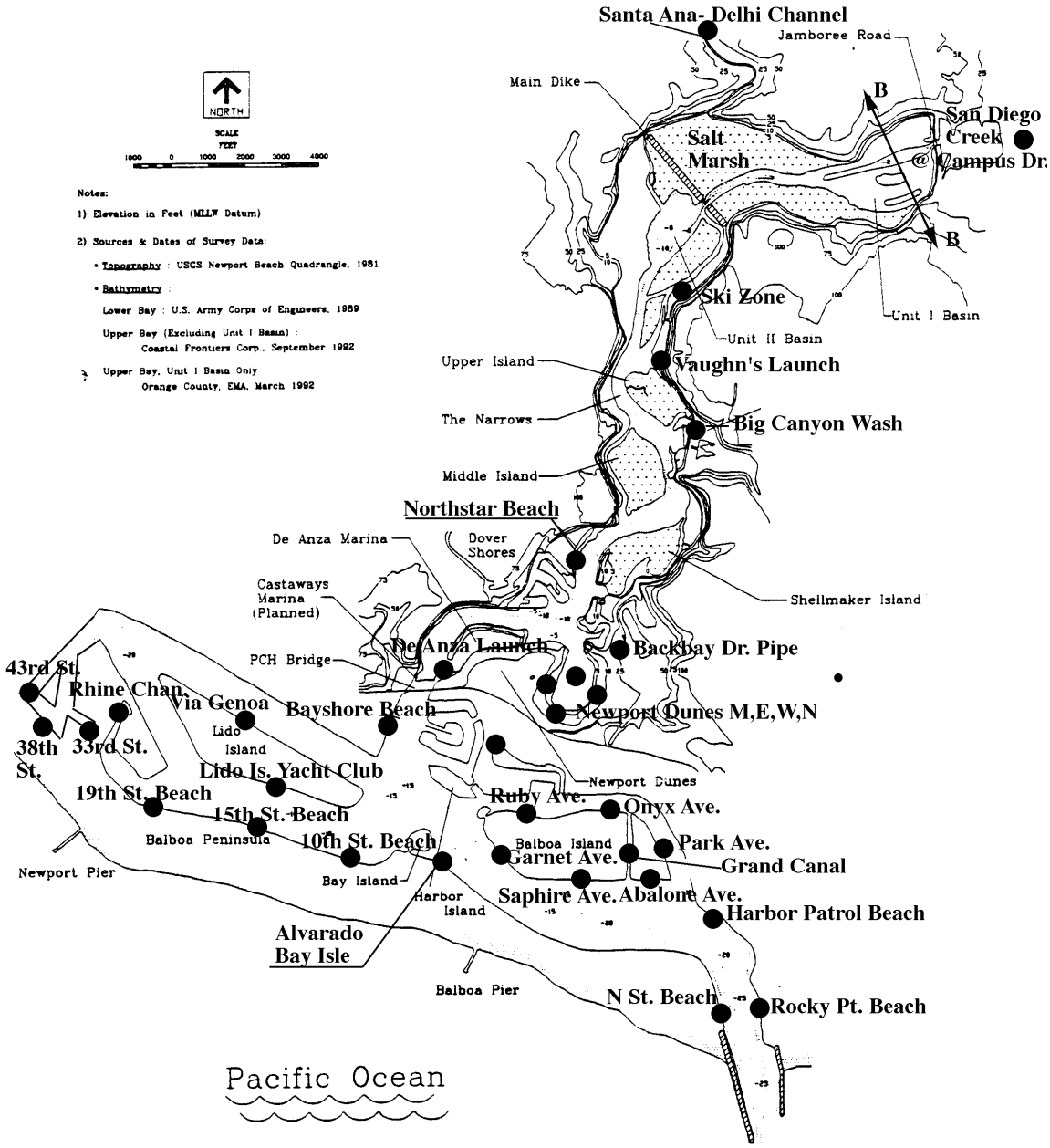



Figure 5-1: Newport Bay Bacterial Quality Monitoring Stations

3.a.ii.b. Fate of Bacterial Inputs

By January 30, 2000, the County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, and Newport Beach and the agricultural operators in the Newport Bay watershed shall submit a plan for the development and submittal of a water quality model to be completed by 13 months after Regional Board approval of the plan. The model shall be capable of analysis of fecal coliform inputs to Newport Bay, the fate of those inputs, and the effect of those inputs on compliance with bacterial quality objectives in the Bay.

3.a.ii.c. Beneficial Use Assessment

By January 30, 2000, the County of Orange , the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach shall submit a plan to complete, by 13 months after Regional Board approval of the plan, a beneficial use assessment to identify and quantify water contact recreation activities in Newport Bay. By 13 months after Regional Board approval of the beneficial use assessment plan, these parties shall submit a report of the results of the water contact recreation beneficial use assessment.

By March 1, 2001, the County of Orange , the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach shall submit a plan to complete, by 13 months after Regional Board approval of the plan, a beneficial use assessment to identify and quantify shellfish harvesting activities in Newport Bay. By 13 months after Regional Board approval of the beneficial use assessment plan, these parties shall submit a report of the results of the shellfish harvesting beneficial use assessment.

The beneficial use assessment reports shall contain recommendations for prioritizing areas within Newport Bay for purposes of evaluation and implementation of cost-effective and reasonable control actions as part of the TMDL process. The Regional Board will consider these recommendations and make its determinations regarding high priority water contact recreation and shellfish harvesting areas at a duly noticed public hearing. These determinations will be considered in establishing interim WLAs and LAs and compliance dates (Task 10, Table 5-9g).

3.a.ii.d. Source Identification and Characterization

By March 1, 2000 the County of Orange and the City of Newport Beach shall submit a proposed plan for a program, to be completed within 7 months after Regional Board approval of the plan to identify and characterize fecal coliform inputs to The Dunes Resort. In lieu of this coordinated plan, each of these parties may submit an individual plan to identify and characterize fecal coliform inputs to The Dunes Resort. Any such individual plan shall also be submitted by March 1, 2000 and completed within 7 months after Regional Board approval of the plan(s).

By (60 days after State TMDL approval),* the County of Orange and the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, and Newport Beach shall submit a proposed plan for a program, to be completed within 13 months after Regional Board approval of the plan to identify and characterize fecal coliform inputs to Newport Bay from urban runoff, including stormwater. In lieu of this coordinated, regional plan, one or more of these parties may submit an individual or group plan to identify and characterize fecal coliform inputs to the Bay from urban runoff from areas within its jurisdiction. Any such individual or group plan shall also be submitted by (60 days after State TMDL approval)* and completed within 13 months after Regional Board approval of the plan(s).

By April 1, 2000, the agricultural operators in the Newport Bay watershed shall submit a proposed plan for a program, to be completed within 16 months after Regional Board approval of the plan, to identify and characterize fecal coliform inputs to Newport Bay from agricultural runoff, including stormwater. In lieu of this coordinated plan, one or more of the agricultural operators may submit an individual or group plan to identify and characterize fecal coliform inputs to the Bay from agricultural runoff from areas within their jurisdiction. Any such individual or group plan shall also be submitted by April 1, 2000, and completed within 16 months after Regional Board approval of the plan(s).

By April 1, 2000, the County of Orange and the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest, and Newport Beach shall submit a proposed plan for a program, to be completed within 16 months after Regional Board approval of the plan, to identify and characterize fecal coliform inputs to Newport Bay from natural sources. In lieu of this coordinated, regional plan, one or more of these parties may submit an individual or group plan to identify and characterize fecal coliform inputs to the Bay from natural sources from areas within its jurisdiction. Any such individual or group plan shall also be submitted by April 1, 2000 and completed within 16 months after Regional Board approval of the plan(s).

3.a.ii.e. Evaluation of Vessel Waste Control Program

By April 1, 2000 the County of Orange and the City of Newport Beach shall submit a plan to complete, by one year after Regional Board approval of the plan, an assessment of the effectiveness of the vessel waste control program implemented by those

agencies in Newport Bay. The plan shall be implemented upon approval by the Regional Board. A report of the study results shall be submitted, together with recommendations for changes to the vessel waste program necessary to ensure compliance with this TMDL.

The Regional Board will consider appropriate changes to the vessel waste control program. These changes shall be implemented in accordance with a schedule to be established by the Regional Board.

3.a.ii.f. TMDL, WLA and LA Evaluation and Source Monitoring Program

By (3 months after completion of Tasks 2, 4a, and 6 as shown in Table 5-9g)* the County of Orange, the Cities of Tustin, Irvine, Costa Mesa Santa Ana, Orange, Lake Forest and Newport Beach, and the agricultural operators in the Newport Bay watershed shall propose a plan for evaluation and source monitoring to determine compliance with the WLAs and LAs specified in Table 5-9f. In lieu of this coordinated, regional plan, one or more of these parties may submit an individual or group plan to conduct TMDL, WLA, LA and Source Evaluation monitoring from areas solely within their jurisdiction. Any such individual or group plan shall also be submitted by (3 months after completion of Tasks 2, 4a, and 6 as shown in Table 5-9g).* Reports of the data collected pursuant to approved individual/group plan(s) shall be submitted monthly and an annual report summarizing the data and evaluating compliance with WLAs and LAs shall be submitted by September 1 of each year. The annual report shall also include an evaluation of the effectiveness of control measures implemented to control sources of fecal coliform, and recommendations for any changes to the control measures needed to ensure compliance with the TMDL, WLAs, and LAs.
The evaluation and source monitoring plan(s) shall be implemented upon Regional Board approval.

3.a.ii.g. Updated TMDL Report

The County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Orange, Lake Forest and Newport Beach, and the agricultural operators in the Newport Bay watershed shall submit Updated TMDL Reports as specified in Table 5-9g. These updated TMDL reports shall, at a minimum, integrate and evaluate the results of the studies required in Table 5-9g (Task 1 – 7). The reports shall include recommendations for revisions to the TMDL, if appropriate and for interim WLAs, LAs and compliance schedules

3.a.ii.h. Adjust TMDL; Adopt Interim WLA, LAs and Compliance Dates

Based on the results of the studies required by Table 5-9g and recommendations made in the Updated TMDL Reports, changes to the TMDL for fecal coliform may be warranted. Such changes would be considered through the Basin Plan Amendment process. Upon completion and consideration of the studies and any appropriate Basin Plan amendments, interim WLAs and LAs that lead to ultimate compliance with the TMDL specified in Table 5-9f, or with an approved amended TMDL, will be established with interim compliance dates. Schedules will also be established for submittal of implementation plans for control measures to achieve compliance with these WLAs, LAs, and compliance dates. These implementation plans will be considered by the Regional Board at a duly noticed public hearing.

The Regional Board is committed to the review of this TMDL every three years or more frequently if warranted by these or other studies. The County of Orange, the Cities of Tustin, Irvine, Costa Mesa, Santa Ana, Lake Forest, and Newport Beach, The Irvine Company and the Irvine Ranch Water District have undertaken to prepare a health risk assessment for Newport Bay for water contact recreation and shellfish harvesting beneficial uses. This study will evaluate whether exceedances of fecal coliform objectives correlates with actual impairment of beneficial uses and may recommend revisions to the Basin Plan objectives and/or beneficial use designations. Because this study is in progress, it is not required by this TMDL implementation plan, but will be considered in conjunction with the studies required by the implementation plan.
**(End of Resolution No. 99-10)**

## 4. Eutrophication (Amended by Resolution No. 98-9)

Nutrient loading to the Bay, particularly from the San Diego Creek watershed, contributes to seasonal algal blooms which can create a recreational and aesthetic nuisance. These algal blooms may also adversely affect wildlife.

The nutrient TMDL for the Newport Bay/San Diego Creek Watershed distributes the portions of the waterbody's assimilative capacity to various pollution sources so that the waterbody achieves its water quality standards. The Regional Board supports the trading of pollutant allocations among sources where appropriate. Trading can take place between point/point, point/nonpoint, and nonpoint/nonpoint pollutant sources. Optimizing alternative point and nonpoint control strategies through allocation tradeoffs may be a cost effective way to achieve pollution reduction benefits.

While there are a number of sources of nutrient input, tailwaters from the irrigation of agricultural crops and from several commercial nurseries in the watershed have been the predominant source. The Regional Board issued Waste Discharge Requirements to the three nurseries, requiring substantial reductions in their nutrient loads. Significant improvements have been achieved by these nurseries, largely due to the implementation of drip irrigation systems (which greatly reduce the amount of tailwater) and/or recycle systems. Installation of drip irrigation systems for other agricultural crops

has also significantly reduced the volume of nutrient-laden tailwaters. These improvements, coupled with the increased tidal flushing caused by the in-bay basins, appears to have resulted in a substantial downward trend in nitrate concentrations in the Bay. However, algal blooms are still occurring in Newport Bay and San Diego Creek. As a result, Newport Bay and San Diego Creek are listed as water quality impaired due to nutrients pursuant to Section 303(d) of the Clean Water Act. A nutrient TMDL to address this problem for Newport Bay and San Diego Creek is described in the following sections.

The hydrodynamic, sediment transport, and water quality models of Newport Bay being jointly developed by the U.S. Army Corps of Engineers and the Regional Board will be used in the future to further refine the algae and nutrient relationships in the Bay. These refinements will be considered in future reviews and revisions of the nutrient TMDL.

## 2.a. Quantifiable Nutrient Targets

The annual loading of total nitrogen and phosphorus to Newport Bay shall be reduced by 50% by 2012. The seasonal and annual loading targets are listed in Table 5-9a.

Table 5-9a Summary of Loading Targets and Compliance Time Schedules.

| **TMDL** | **December 31, 2002[5]** | **December 31, 2007[5]** | **December 31, 2012[5]** |
|---|---|---|---|
| Newport Bay Watershed<br>Total Nitrogen - Summer Load[1] | 200,097 lbs. | 153,861 lbs. | |
| Newport Bay Watershed<br>Total Nitrogen - Winter Load[2] | | | 144,364 lbs. |
| Newport Bay Watershed<br>Total Phosphorus - Annual Load[3] | 86,912 lbs. | 62,080 lbs. | |
| San Diego Creek, Reach 2<br>Total Nitrogen - Daily Load[4] | | | 14 lbs. |

1 Total nitrogen summer loading limit applies between April 1 and September 30.

2 Total nitrogen winter loading limit applies between October 1 and March 31 when the mean daily flow rate at San Diego Creek at Campus Drive is below 50 cubic feet per second (cfs), and when the mean daily flow rate in San Diego Creek at Campus Drive is above 50 cubic feet per second (cfs), but not as the result of precipitation.

3 Total phosphorus annual loading is the sum of summer and winter loading during all daily flow rates.

4 Total nitrogen daily loading limit applies when the mean daily flow rate at San Diego Creek at Culver Drive is below 25 cubic feet per second (cfs), and when the mean daily flow rate in San Diego Creek at Culver Drive is above 25 cubic feet per second (cfs), but not as the result of precipitation.

5 Compliance to be achieved no later than this date. The Regional Board may require earlier compliance with these targets when it is feasible and reasonable.

The margin of safety of the nutrient TMDL is implicit through the use of conservative assumptions. These conservative assumptions include controlling all forms of nitrogen and phosphorus and controlling seasonal and annual loading.

Load Allocations

The 5, 10, and 15 year seasonal load allocations of total nitrogen for the Newport Bay Watershed are presented in Table 5-9b. The 5 and 10-year annual total phosphorus load allocations for the Newport Bay Watershed are presented in Table 5-9c. The 15 year daily total nitrogen load allocations for San Diego Creek, Reach 2 are presented in Table 5-9d. The nutrient load reduction targets will be incorporated into waste discharge requirements as effluent limits, load allocations, and waste load allocations as necessary to ensure that:

a. the total inorganic nitrogen and narrative water quality objectives for Newport Bay and San Diego Creek are achieved

b. Clean Water Act requirements for the implementation of a TMDL are satisfied

**Table 5-9b Seasonal Load Allocations of Total Nitrogen for the Newport Bay Watershed.**

| Nutrient TMDL | 1990-1997 Loading | 2002 Allocation[8] | 2002 Summer Allocation (April-Sept)[8] | 2007 Allocation[8] | 2007 Summer Allocation (April-Sept)[8] | 2012 Allocation[8] | 2012 Winter Allocation (Oct-Mar)[7, 8, 11] |
|---|---|---|---|---|---|---|---|
| Newport Bay Watershed | lbs/year TN[2] | lbs/day TN[10] | lbs/season TN | lbs/day TN[10] | lbs/season TN | lbs/day TN[10] | lbs/season TN |
| | | | | | | | |
| Wasteload Allocation | | | | | | | |
| Hines Nurseries | 96,360 TIN[1] | 224 | 40,992 | 211 | 38,613 | 211 | 14,227 |
| Bordiers Nursery | 30,660 TIN | 71 | 12,993 | 67 | 12,261 | 67 | 4,518 |
| El Modeno Gardens | 18,250 TIN | 43 | 7,869 | 40 | 7,320 | 40 | 2,697 |
| Unpermitted nurseries | -----[3] | 30 | 5,490 | 24 | 4,392 | 24 | 1,618 |
| Nursery subtotal | | | 67,344 | | 62,586 | | 23,060 |
| | | | | | | | |
| IRWD WWSP (permanent discharge)[9] | 0 | 62 | | 62 | | 62 | 4,181 |
| Silverado Constructors ETC[4] | 0 | 141 | 25,671 | 141 | 25,671 | 141 | 9,459 |
| Urban runoff | 277,131[6] | | 20,785 | | 16,628 | | 55,442 |
| Wasteload Allocation | | | 113,800 | | 104,885 | | 92,142 |
| | | | | | | | |
| Load Allocation | | | | | | | |
| Agricultural discharges | 328,040[6] | | 22,963 | | 11,481 | | 38,283 |
| Undefined sources (Open space, atmospheric deposition, rising groundwater, groundwater cleanup/dewatering, in-bay nitrogen) | -----[3] | | 63,334 | | 37,495 | | 13,939 |
| Load Allocation | | | 86,297 | | 48,976 | | 52,222 |
| | | | | | | | |
| Total | 1,087,000[5] | | 200,097 | | 153,861 | | 144,364 |
| | | | 5 year target | | 10 year target | | 15 year target |

1 TIN = (NO3+NH3).
2 TN = (TIN + Organic N).
3 Unknown.
4 Wasteload allocation of a 50% reduction in nitrogen concentration upon commencement of discharge
5 1990-1997 annual average (summer loading and winter loading).
6 Estimated annual average (summer and winter loading).
7 Total nitrogen winter loading limit applies between October 1 and March 31 when the mean daily flow rate at San Diego Creek at Campus Drive is below 50 cubic feet per second (cfs), and when the mean daily flow rate in San Diego Creek at Campus Drive is above 50 cubic feet per second (cfs), but not as the result of precipitation.
8 Compliance to be achieved no later than this date. The Regional Board may require earlier compliance with these targets when it is feasible and reasonable.
9 Daily load limit applies upon commencement of discharge.
10 Lbs/day TN (monthly average).
11 Assumes 67 non-storm days.

Table 5-9c Annual Total Phosphorous Load Allocations For The Newport Bay Watershed.

| | **2002 Allocation lbs/year TP[1]** | **2007 Allocation lbs/year TP[1]** |
|---|---|---|
| TMDL | 86,912 | 62,080 |
| | | |
| Urban areas | 4,102 | 2,960 |
| Construction sites | 17,974 | 12,810 |
| Waste Load Allocation | 22,076 | 15,770 |
| | | |
| Agricultural areas | 26,196 | 18,720 |
| Open space | 38,640 | 27,590 |
| Load Allocation | 64,836 | 46,310 |

[1] Compliance to be achieved no later than this date. The Regional Board may require earlier compliance with these targets when it is feasible and reasonable.

Table 5-9d Annual Total Nitrogen Load Allocations For San Diego Creek, Reach 2 During Non-Storm Conditions.[1]

| | 2012 Allocation lbs/day TN[2] |
|---|---|
| TMDL | 14 lbs/day (TN) |
| Waste Load Allocation (Urban runoff) | 5.5 lbs/day (TN) |
| Load Allocation (Nurseries, agriculture, undefined sources) | 8.5 lbs/day (TN) |

[1] Total nitrogen loading limit applies when the mean daily flow rate at San Diego Creek at Culver Drive is below 25 cubic feet per second (cfs), and when the mean daily flow rate in San Diego Creek at Culver Drive is above 25 cubic feet per second (cfs), but not as the result of precipitation.

[2] Compliance to be achieved no later than this date. The Regional Board may require earlier compliance with these targets when it is feasible and reasonable.

2.b. Phase I of the Nutrient TMDL

1. Review and Revision of Water Quality Objectives

By December 31, 2000, the Regional Board shall review, and revise as necessary, the numeric water quality objectives for total inorganic nitrogen for San Diego Creek, Reaches 1 and 2. The Regional Board shall also examine the appropriateness of establishing numeric water quality objectives for phosphorus for San Diego Creek, Reaches 1 and 2.

2. Establish New Waste Discharge Requirements

By December 31, 1999, the Regional Board shall issue new Waste Discharge Requirements (WDRs) to nursery operations of 5 acres or greater which currently are not regulated by WDRs (as of the effective date of this amendment) but discharge nutrients in excess of 1 mg/L TIN to storm channels which are tributary to Newport Bay. The new WDRs shall incorporate the appropriate wasteload, load, and margin of safety allocations identified in the nutrient load targets for the Newport Bay Watershed. Appropriate monitoring programs to evaluate compliance with load targets and allocations shall be required and incorporated into the WDRs

3. Revision of Existing Waste Discharge Requirements

a. By December 31, 1998, the Regional Board shall revise existing WDRs for nursery operations which currently (as of the effective date of this amendment) discharge nutrients in excess of 1 mg/L TIN to drainages which are tributary to Newport Bay. The revised WDRs shall incorporate the appropriate wasteload, load, and margin of safety allocations identified in the nutrient load reduction targets for the Newport Bay Watershed. Appropriate monitoring programs to evaluate compliance with load targets and allocations shall be required and incorporated into the WDRs.

b. By December 31, 1998, the Regional Board shall revise existing NPDES permits for discharges which currently (as of the effective date of this amendment) discharge nutrients in excess of 1 mg/L TIN to drainages which are tributary to Newport Bay. The revised NPDES permits shall incorporate the appropriate wasteload, load, and margin of safety allocations identified in the nutrient load reduction targets for the Newport Bay Watershed. Appropriate monitoring programs to evaluate compliance with load targets and allocations shall be required and incorporated into the NPDES permits.

c. By March 31, 1999, the Regional Board shall revise the Monitoring and Reporting Programs of existing NPDES permits and WDRs for groundwater dewatering and cleanup operations which discharge to drainages which are tributary to Newport Bay to include requirements for phosphorus and total nitrogen sampling and analysis. This monitoring will generate the data necessary to develop appropriate wasteload allocations for these discharges.

4. Agricultural Activities

A watershed-wide nutrient management program for agricultural activities shall be developed by the Orange County Farm Bureau, University of California Cooperative Extension, and the affected growers, in conjunction with Regional Board staff. The proposed management program shall be submitted by July 1, 1999. The nutrient management program will not become effective until approved by the Regional Water Quality Control Board at a duly noticed public meeting as specified in Chapter 1.5, Division 3, Title 23 of the California Code of Regulations (Section 647 et seq.).

5. Urban Stormwater

Co-permittees of the Orange County Areawide Urban Stormwater Permit (Order No. 96-31) shall be required to submit for approval by the Regional Board's Executive Officer an analysis of appropriate Best Management Practices which will be additionally implemented through the Drainage Area Management Plan (DAMP) to achieve the short term (5-year) interim targets and final nutrient load reduction targets for the Newport Bay Watershed. The co-permittees shall also be required to provide a proposal for 1) evaluating the effectiveness of control actions implemented and 2) evaluating compliance with the nutrient load allocation. The proposal and analysis shall be submitted by July 1, 1999, and shall be implemented upon approval of the Executive Officer as specified by Section IV.1.a.ii.A of Order No. 96-31.

6. Phosphorus

The primary reduction of phosphorus loading is expected to be achieved by the implementation of the total maximum daily load for sediment in the Newport Bay/San Diego Creek watershed. The sediment TMDL is incorporated into the nutrient TMDL for the Newport Bay/San Diego Creek watershed by reference (Note - the sediment TMDL will be appropriately referenced once it is approved by OAL). Limits on phosphorus discharges shall be incorporated into the new and revised Waste Discharge Requirements previously listed, as necessary.

## 2.c. Phase II of the Nutrient TMDL

### 1. Monitoring

The Regional Board will establish and oversee a regional monitoring program (RMP) for the Newport Bay watershed. The new and revised WDRs, NPDES permits, DAMP, and agricultural nutrient management plans shall have include requirements to conduct self-monitoring, or in lieu of self-monitoring, to participate in the RMP. Participation in the RMP could result in the reduction of self-monitoring requirements. The RMP will not become effective until approved by the Regional Water Quality Control Board at a duly noticed public meeting as specified in Chapter 1.5, Division 3, Title 23 of the California Code of Regulations (Section 647 et seq.).

The RMP shall be designed by the Regional Board to assess the attainment of the goals of the nutrient TMDL. The objectives of the monitoring program shall be the quantification of the three endpoints of the nutrient TMDL: (1) the seasonal nutrient loading from the watershed; (2) the nutrient concentration in San Diego Creek, Reaches 1 and 2; and (3) the extent, magnitude, and duration of algal blooms in San Diego Creek and Newport Bay. The monitoring plan shall be implemented by March 1999.

The Regional Board will initiate investigations into the currently unknown sources of nutrients in the Newport Bay Watershed. The Regional Board, in cooperation with other agencies and entities, will investigate the occurrence of rising shallow groundwater in the Newport Bay Watershed. The study will focus on the contributions of rising groundwater to the loading of nutrients to drainage channels which are tributary to Newport Bay. Additionally, the study of the nutrient and algae processes of Newport Bay and San Diego Creek will be encouraged and supported by the Regional Board. Regional Board support could include financial resources, personnel, agency coordination, and scientific review.

### 2. Actions and Schedule to Achieve Water Quality Objectives

The actions and schedule to achieve water quality objectives is outlined in Table 5-9e. Meeting load reduction targets is highly dependent upon the effectiveness of individual actions; therefore, the Regional Board will review the TMDL, WDRs and compliance schedule at least once every 3 years. Any or all of these may be revised in order to meet water quality standards.

**Table 5-9e Schedule of Actions to Achieve Water Quality Objectives.**

| Program Actions | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Review and revision of water quality objectives | | | X | | | | | | | | | | | | | |
| New nursery permits | | X | | | | | | | | | | | | | | |
| Revise existing permits | X | | | | | | | | | | | | | | | |
| Nurseries | X | | | | | | | | | | | | | | | |
| NPDES permit | X | | | | | | | | | | | | | | | |
| Groundwater cleanup/dewatering | | X | | | | | | | | | | | | | | |
| Agricultural nutrient management plans | | X | | | | | | | | | | | | | | |
| Urban runoff BMP plan | | X | | | | | | | | | | | | | | |
| Sediment TMDL implementation | X | | | | | | | | | | | | | | | |
| Monitoring | | X | | | | | | | | | | | | | | |
| Newport Bay Watershed total nitrogen - summer TMDL targets | | | | | X | | | | | X | | | | | | |
| Newport Bay Watershed total nitrogen - winter TMDL target | | | | | | | | | | | | | | | X | |
| Newport Bay Watershed total phosphorus - annual TMDL targets | | | | | X | | | | | X | | | | | | |
| San Diego Creek, Reach 2 total nitrogen - daily target | | | | | | | | | | | | | | | X | |
| Evaluation of TMDL | | | X | | | X | | | X | | X | | | X | | X |

2.d. Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing

The estimates of capital and operational costs to achieve the nutrient targets of the nutrient TMDL for the San Diego Creek/Newport Bay watershed range from $0.69 million/year to $4.73 million/year.

Potential funding sources include:

1. Private financing by individual sources.

2. Bonded indebtedness or loans from governmental institutions.

3. Surcharge on water deliveries to lands contributing to the drainage problem.

4. Ad Valorem tax on lands contributing to the drainage problem.

5. State or federal grants or low-interest loan programs.

6. Single-purpose appropriations from federal or State legislative bodies (including land retirement programs).

## 4. Toxic Substance Contamination (Amended by Resolution No. R8-2003-0039)

San Diego Creek and Newport Bay are not attaining water quality standards with respect to certain classes of toxic pollutants. On June 14, 2002, USEPA established Total Maximum Daily Loads (TMDLs) for selenium, heavy metals (cadmium, copper, lead, and zinc), organochlorine pesticides (chlordane, dieldrin, DDT, and toxaphene), PCBs, and organophosphate pesticides (diazinon and chlorpyrifos). In addition, USEPA established a separate TMDL for the Rhine Channel in Lower Newport Bay. Table 5-9i shows these TMDLs, the constituents addressed, and the waterbodies affected.

USEPA's TMDLs do not specify implementation plans, which are the responsibility of the Regional Board. The Regional Board has adopted or will adopt Basin Plan amendments to incorporate the USEPA TMDLs, revised if and as appropriate, into the Basin Plan. These amendments will include implementation plans. The anticipated schedule for these Basin Plan amendments is also shown in Table 5-9i.

**Table 5-9i. USEPA TMDLs Established June 14, 2002**

| TMDL | Basin Plan Schedule | Location | Constituents |
|---|---|---|---|
| Organophosphate Pesticides | 2003 | SDC | Diazinon, chlorpyrifos |
| | | UNB | Chlorpyrifos |
| Selenium | 2007 | SDC, UNB LNB | Selenium |
| Metals | 2007 | SDC | Cd, Cu, Pb, Zn |
| | | UNB | Cd, Cu, Pb, Zn |
| | | LNB | Cu, Pb, Zn |
| Organochlorine Compounds | 2007 | SDC | Chlordane, dieldrin, DDT, PCBs, toxaphene |
| | | UNB | Chlordane, DDT, PCBs |
| | | LNB | Chlordane, dieldrin, DDT, PCBs |
| Rhine Channel | 2007 | Rhine Channel | Se, Cr, Hg, Cu, Pb, Zn<br>Chlordane, dieldrin, DDT, PCBs |

*SDC= San Diego Creek; UNB=Upper Newport Bay; LNB=Lower Newport Bay*

## 4.a Diazinon and Chlorpyrifos TMDL

Aquatic toxicity in San Diego Creek and Upper Newport Bay causes adverse impacts to the established beneficial uses of those waterbodies.

A report prepared by Regional Board staff describes the aquatic life toxicity problems in San Diego Creek and Upper Newport Bay in greater detail and discusses the technical basis for the TMDL that follows[1]. This TMDL is the same as that promulgated by the USEPA on June 14, 2002, but an implementation plan is also specified (see Section 4.a.i.). The USEPA TMDL was, in fact, based on a draft TMDL prepared by Regional Board staff. The TMDL addresses toxicity due to diazinon and chlorpyrifos in San Diego Creek and chlorpyrifos in Upper Newport Bay. Implementation of this TMDL is expected to address, to a significant extent, the occurrence of aquatic life toxicity in these waterbodies. Reduction in aquatic life toxicity will help assure attainment of water quality standards; that is, compliance with water quality objectives and protection of beneficial uses.

Table 5-9j shows the TMDL and the allocations for diazinon and chlorpyrifos in San Diego Creek.

[1] Diazinon and Chlorpyrifos TMDL, Upper Newport Bay and San Diego Creek, April 4, 2003

Table 5-9j. Diazinon and Chlorpyrifos Allocations for San Diego Creek

| Category | Diazinon (ng/L) | | Chlorpyrifos (ng/L) | |
|---|---|---|---|---|
| | Acute | Chronic | Acute | Chronic |
| Wasteload Allocation | 72 | 45 | 18 | 12.6 |
| Load allocation | 72 | 45 | 18 | 12.6 |
| MOS | 8 | 5 | 2 | 1.4 |
| **TMDL** | **80** | **50** | **20** | **14** |

*MOS = Margin of Safety; Chronic means 4-consecutive day average*

Table 5-9k shows the TMDL and the allocations for chlorpyrifos in Upper Newport Bay.

Table 5-9k. Chlorpyrifos Allocations for Upper Newport Bay

| Category | Acute (ng/L) | Chronic (ng/L) |
|---|---|---|
| Wasteload allocation | 18 | 8.1 |
| Load allocation | 18 | 8.1 |
| MOS | 2 | 0.9 |
| **TMDL** | **20** | **9** |

*MOS = Margin of Safety; Chronic means 4-consecutive day average*

The TMDL and its allocations contain an explicit 10% margin of safety. In addition, a substantial margin of safety is implicitly incorporated in the TMDL through use of conservative assumptions.

### 4.a.i TMDL Implementation

Table 5-9l outlines the tasks and schedules to implement the TMDL.

Table 5-9l. TMDL Task Schedule

| Task No. | Task | Schedule | Description |
|---|---|---|---|
| 1 | USEPA Re-Registration Agreements | 12/2001 to 12/2006 | Phase-out of uses specified in the re-registration agreements. Should end over 90% of usage. [2] |
| 2 | Revise Discharge Permits | 2005 | WDR and NPDES permits will be revised to include the TMDL allocations, as appropriate. |
| 3 | Pesticide Runoff Management Plan | 2004 | A pesticide runoff management plan will be developed |
| 4 | Monitoring | 2003 | Modify existing regional monitoring program to include analysis for organophosphate pesticides and toxicity |
| | Special Studies | | |
| 5a | Atmospheric deposition | 2003 | Quantify atmospheric deposition of chlorpyrifos loading to Upper Newport Bay |
| 5b | Mixing volumes in Upper Newport Bay | 2003 | Model mixing and stratification of chlorpyrifos in Upper Newport Bay during storm events |

**Task 1: USEPA Re-Registration Agreements**

The re-registration agreements negotiated by USEPA with the manufacturers of diazinon and chlorpyrifos are the most significant factor affecting the implementation plan. Usage of both diazinon and chlorpyrifos in the Newport Bay Watershed is expected to be reduced by over 90 percent.

**Task 2: Revise Discharge Permits**

The TMDL allocates wasteloads to all dischargers in the watershed. Since the TMDL is concentration-based, these wasteloads are concentration limits. The concentration limits will be incorporated into existing and future discharge permits in the watershed. Compliance schedules would be included in permits only if they are demonstrated to be necessary. Compliance would be required as soon as possible, but no later than December 1, 2007.

**Task 3: Pesticide Runoff Management Plan**

A pesticide runoff management plan will be developed for the watershed as a cooperative project between the Regional Board and stakeholders.

**Task 4: Monitoring**

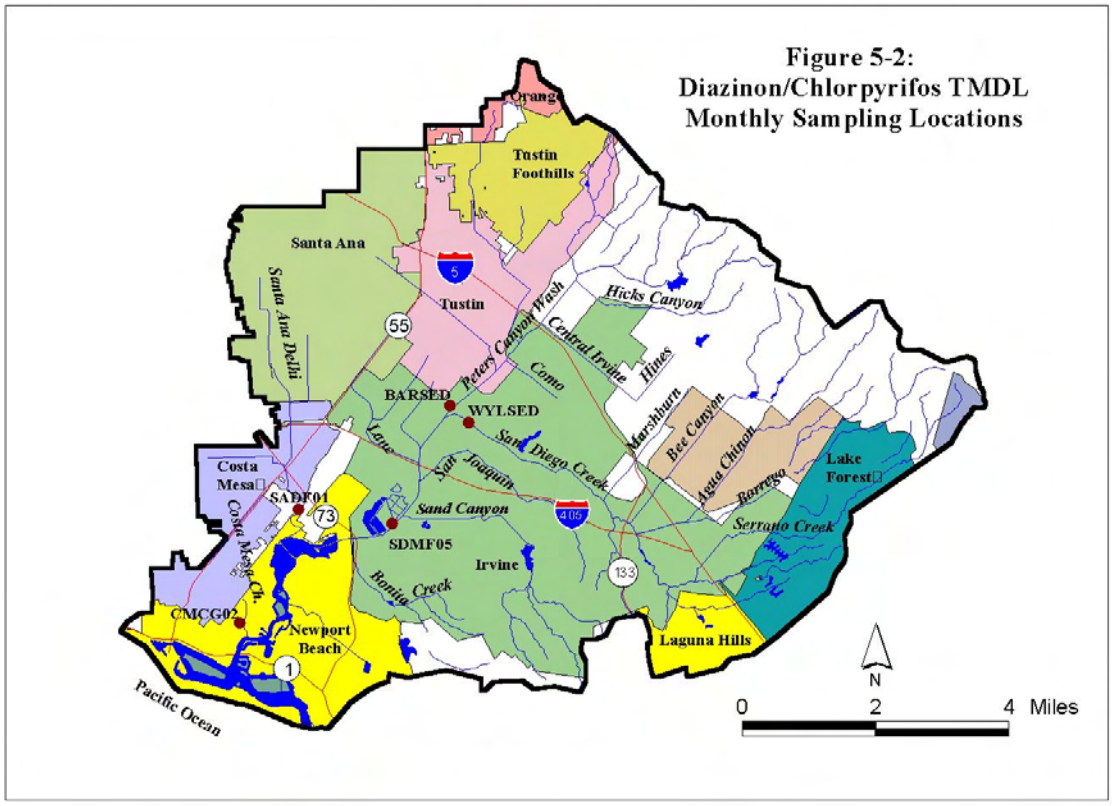
Routine monitoring is necessary to assess compliance with the allocations specified in the TMDL. The County of Orange, the Cities of Tustin, Irvine, Costa

[2] This task is not within the purview of the Regional Board, but is nevertheless of critical significance for implementation of the TMDL.

Mesa, Santa Ana, Orange, Lake Forest and Newport Beach, and the agricultural operators in the Newport Bay watershed will be required to propose a plan by January 30, 2004 for routine monitoring to determine compliance with the TMDL allocations for diazinon and chlorpyrifos. At a minimum, the proposed plan must include the collection of monthly samples at the stations specified in Table 5-9m and shown in Figure 5-2 and analysis of the samples for diazinon and chlorpyrifos. Monthly toxicity tests should also be conducted at several locations in the watershed. Data summaries will be required monthly. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL will be required to be submitted by November 30 of each year.

Table 5-9m. Minimum Required Monthly Sampling Stations

| Station Code | Location |
|---|---|
| BARSED | Peters Canyon Wash |
| WYLSED | San Diego Creek at Harvard Dr. |
| SDMF05 | San Diego Creek at Campus Dr. |
| SADF01, or<br>CMCG02 | Santa Ana Delhi Channel, or<br>Costa Mesa Channel |



In lieu of this coordinated, regional monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group plan to conduct routine monitoring in areas solely within their jurisdiction to determine compliance with the TMDL. Any such individual or group plans must also be submitted by January 30, 2004. Reports of the data collected pursuant to approved individual/group plan(s) will be required to be submitted monthly, and an annual report summarizing the data and evaluating compliance with the TMDL will be required to be submitted by November 30 of each year.

It is likely that implementation of these requirements will be through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and implemented upon the Regional Board's approval.

**Task 5: Special Studies**

With the anticipated assistance of stakeholders in the watershed, the Regional Board will conduct investigations to (1) quantify the significance of atmospheric deposition of chlorpyrifos to Upper Newport Bay, and (2) determine the adequacy of the freshwater allocations for chlorpyrifos in the tributaries to Upper Newport Bay in achieving the lower saltwater allocations. The existing hydrodynamic model for Newport Bay is being used to perform simulations that predict contaminant concentrations in the Bay based on various flow and management scenarios. The model results will be used to verify whether the TMDL allocations for chlorpyrifos in the watershed will be sufficient to achieve the TMDL allocations in Upper Newport Bay. One of the questions to be addressed is the magnitude of toxic exposure that could result from development of a freshwater lens associated with the discharge of stormwater to Upper Newport Bay.

**4.a.ii Adjust TMDL**

Based on the results of the special studies and recommendations made in the Pesticide Runoff Monitoring reports, changes to the TMDL may be warranted. Such changes would be considered through the Basin Plan Amendment process.

The Regional Board is committed to the review of this TMDL every three years, or more frequently if warranted by these or other studies.**(End of Resolution No. RB-2003-0039)**

**Anaheim Bay/Huntington Harbour**

As in Newport Bay, bacteria and toxics threaten the water quality and beneficial uses of Anaheim Bay/Huntington Harbour. As shown in Table 5-10, the presence of toxic metals and pesticides/herbicides has resulted in the designation of Anaheim Bay and Huntington Harbour as a Toxic Hot Spot for some constituents and a Potential Toxic Hot Spot for other constituents. Two major storm drains, the Bolsa Chica Channel and the East Garden Grove Wintersburg Channel, as well as their tributaries, drain in to the Anaheim Bay/Huntington Harbour complex. Inputs of stormwater and urban nuisance flows via

these channels appear to be significant sources of pollutants. The Count of Orange's general stormwater permit requires the implementation of best management practices (BMPs) and other measures in the watershed to control these inputs to the maximum extent practicable.

During 1992-93, the Regional Board contracted with UC Irvine and UC Davis to evaluate the occurrence and impacts of these toxics in Huntington Harbour [Ref. 21, 22]. Results of the study indicated that concentrations of trace metals have decreased over a 13 year period and 1992/93 measurements met established water quality criteria. However, an unidentified nonpolar organic compound was found to be acutely toxic to test species.

Anaheim Bay (inland of Pacific Coast Highway bridge) and Huntington Harbour are designated as no discharge areas for vessel sanitary wastes. Pumpout facilities are in place throughout the Harbour to facilitate compliance. Additional discussion of the activities of the Huntington Harbour Waterways Committee is provided in Chapter 7.

**Big Bear Lake (Amended by Resolution No. R8-2006-0023)**

Big Bear Lake, located in the San Bernardino Mountains, was created by the construction of the Bear Valley Dam in 1884. The Lake has a surface area of approximately 3,000 acres, a storage capacity of 73,320 acre-ft and an average depth of 24 feet. The lake reaches its deepest point of 72 feet at the dam. The Big Bear Lake drainage basin encompasses 37 square miles and includes more than 10 streams. Local stream runoff and precipitation on the Lake are the sole source of water supply to the Lake. The spillway altitude is 6,743.2 feet. The major inflows to the lake are creeks, including Rathbone (Rathbun) Creek, Summit Creek, and Grout Creek. Outflow from the Lake is to Bear Creek, which is tributary to the Santa Ana River at about the 4,000-foot elevation level. Twelve percent of Big Bear Lake's drainage basin consists of the Lake itself. The US Forest Service is the largest landowner in the Big Bear area. Two ski resorts, Bear Mountain and Snow Summit, lease land from the Forest Service.

The beneficial uses of Big Bear Lake include cold freshwater habitat (COLD), warm freshwater habitat (WARM), water contact recreation (REC1), non-contact water recreation (REC2), municipal and domestic supply (MUN), agriculture supply (AGR), groundwater recharge (GWR), wildlife habitat (WILD) and rare, threatened or endangered species (RARE).

Big Bear Lake is moderately eutrophic. During the summer months, deeper water may exhibit severe oxygen deficits. Nutrient enrichment has resulted in the growth of aquatic plants, which has impaired the fishing, boating, and swimming uses of the lake. To control this vegetation, mechanical harvesters are used to remove aquatic plants, including the roots.

Toxics may be entering the Big Bear Lake watershed and accumulating in aquatic organisms and bottom sediments at concentrations that are of concern, not only for the

protection of aquatic organisms, but for the protection of human health as well. Past Toxic Substances Monitoring Program data have indicated the presence of copper, lindane, mercury, zinc, and PCBs in fish tissue.

During 1992-93, the Regional Board conducted a Phase I Clean Lakes study (Section 314 of the Clean Water Act) to evaluate the current water quality condition of the lake and its major tributaries [Ref. 20]. The focus of the study was to identify the tributaries responsible for inputs of toxics and nutrients. As a result of data collected in the Clean Lakes Study, Big Bear Lake and specific tributaries were placed on the 1994 Clean Water Act Section 303(d) List of Water Quality Limited Segments for the reasons indicated in Table 5-9a-b.

Table 5-9a-b

Big Bear Lake Watershed Waterbodies on the
1994 303(d) List of Impaired Waters

| WATERBODY | STRESSOR |
|---|---|
| Big Bear Lake | nutrients |
| | noxious aquatic plants |
| | sedimentation/siltation |
| | metals |
| | copper |
| | mercury |
| Rathbone (Rathbun) Creek | nutrients |
| | sedimentation/siltation |
| Grout Creek | metals |
| | nutrients |
| Summit Creek | nutrients |
| Knickerbocker Creek | metals |
| | pathogens |

In 2000, the Regional Board convened a TMDL workgroup to assist in the development of Total Maximum Daily Loads for the Big Bear Lake watershed. The Big Bear Municipal Water District, a key contributor to the workgroup, created the Big Bear Lake TMDL Task Force, including representatives of the District, Regional Board staff, the San Bernardino County Flood Control District, the City of Big Bear Lake, the Big Bear Area Regional Wastewater Authority, the State of California, Department of Transportation (Caltrans), the US Forest Service and the Big Bear Mountain Resorts. Initial TMDL development efforts were focused on nutrients, leading to Regional Board adoption of a nutrient TMDL for dry

hydrological conditions for Big Bear Lake in 2006. Nutrient TMDLs for wet and/or average hydrological conditions will be incorporated in the Basin Plan when these TMDLs are developed in the future. As shown in Table 5-9a-f, the development of these TMDLs is a requirement of the adopted TMDL implementation plan for the nutrient TMDL for dry hydrological conditions.

## 1. Big Bear Lake Nutrient Total Maximum Daily Loads (TMDLs)

Past studies, starting in 1968/1969, have shown that Big Bear Lake is moderately eutrophic and that the limiting nutrient is generally phosphorus. In Big Bear Lake, nutrients (nitrogen and phosphorus) are available in the water column and sediment and are taken up by aquatic macrophytes and algae. Nutrients are also bound in living and dead organic material, primarily macrophytes and algae. Decomposition of this organic material, as well as macrophyte and algal respiration, consumes dissolved oxygen, resulting in the depletion of dissolved oxygen from the water column. Oxygen depletion in the hypolimnion results in anoxic conditions, leading to periodic fish kills in Big Bear Lake. Oxygen depletion also results in the release of nutrients from the sediment into the water column, promoting more algae and aquatic macrophyte production. Nutrients released by plant decomposition are cycled back into a bioavailable form.

Although aquatic macrophytes provide protection from shoreline erosion, habitat for fish and other aquatic biota and waterfowl habitat, excessive growth of noxious and nuisance species, particularly Eurasian watermilfoil (*Myriophyllum spicatum*) impairs recreational uses of the Lake and reduces plant and animal species and habitat diversity.

As stated above, development of nutrient TMDLs to address these problems was initiated in 2000. In this process, it was recognized that insufficient data for wet or average hydrological conditions were available to allow calibration of the lake water quality model used to calculate the TMDL. Accordingly, a TMDL was developed to address dry hydrologic conditions only (see Section 1.B., below). This TMDL was adopted by the Regional Board in 2006 and became effective on August 21, 2007. The implementation plan included with this TMDL specifies a requirement for the development of nutrient TMDLs for wet and/or average hydrological conditions.

A key step in the development of the nutrient TMDL was the identification of the numeric targets to be achieved. The numeric targets, identified in Section 1.A., below, do not vary based upon hydrological condition. Like the approved TMDL for dry hydrological conditions, the TMDLs for wet and/or average hydrological conditions that will be developed are expected to assure also that these numeric targets are achieved. Indeed, since the TMDL for dry hydrological conditions was developed to meet the targets under the critical, worst-case conditions, consistent compliance with these targets is expected to be achieved even in the absence of TMDLs for wet/average hydrological conditions, given the greater lake volume and dilution anticipated under

wetter conditions. It is recognized that future modifications to the targets may be found necessary.

### 1. A. Numeric Targets

As shown in Table 5-9a-c, both "causal and response" numeric targets are specified for Big Bear Lake. The causal target is for phosphorus. Phosphorus is the primary limiting nutrient in Big Bear Lake[1] Response targets include macrophyte coverage, percentage of nuisance aquatic vascular plant species and chlorophyll *a* concentration. These response targets are more direct indicators of impairment and are specified to assess and track water quality improvements in Big Bear Lake

A weight of evidence approach will be used to assess compliance with the TMDL, which means that data pertaining to all the numeric targets will be evaluated and non-compliance with one target will not automatically imply non-compliance with the TMDL.

[1]There is evidence that nitrogen is a limiting nutrient under certain conditions. However, given data and analytical limitations, no nitrogen targets are specified. Nitrogen monitoring is required as part of this TMDL. The data will be used to specify nitrogen targets in the future, as warranted.

Table 5-9a-c
Big Bear Lake Nutrient TMDL Numeric Targets[a]

| Indicator | Target Value |
|---|---|
| Total P concentration | Annual average[b] no greater than 35 µg/L;<br>to be attained no later than 2015 (dry hydrological conditions), 2020 (all other times)[c] |
| Macrophyte Coverage | 30-40% on a total lake area basis;<br>to be attained by 2015 (dry hydrological conditions), 2020 (all other times) [c, d] |
| Percentage of Nuisance Aquatic Vascular Plant Species | 95% eradication on a total area basis of Eurasian Watermilfoil and any other invasive aquatic plant species; to be attained no later than 2015 (dry hydrological conditions), 2020 (all other times) [c, d] |
| Chlorophyll *a* concentration | Growing season[e] average no greater than 14 µg/L;<br>to be attained no later than 2015 (dry hydrological conditions), 2020 (all other times)[c] |

[a] Compliance with the targets to be achieved as soon as possible, but no later than the date specified

[b] Annual average determined by the following methodology: the nutrient data from both the photic composite and discrete bottom samples are averaged by station number and month; a calendar year average is obtained for each sampling location by averaging the average of each month; and finally, the separate annual averages for each location are averaged to determine the lake-wide average. The open-water sampling locations used to determine the annual average are MWDL1, MWDL2, MWDL6, and MWDL9 (see 1.B.4. Implementation, Task 4.2, Table 5-9a-i).

[c] Compliance date for wet and/or average hydrological conditions may change in response to approved TMDLs for wet/average hydrological conditions.

[d] Calculated as a 5-yr running average based on measurements taken at peak macrophyte growth as determined in the Aquatic Plant Management Plan (see 1.B.4. Implementation, Task 6C)

[e] Growing season is the period from May 1 through October 31 of each year. The open-water sampling locations used to determine the growing season average are MWDL1, MWDL2, MWDL6 and MWDL9 (see 1.B.4. Implementation, Task 4.2, Table 5-9a-i). The chlorophyll *a* data from the photic samples are averaged by station number and month; a growing season average is obtained for each sampling location by averaging the average of each month; and finally, the separate growing season averages for each location are averaged to determine the lake-wide average.

## 1.B. Big Bear Lake Nutrient Total Maximum Daily Load (TMDL) for Dry Hydrological Conditions

The TMDL technical report [Ref. #25] describes in detail the technical basis for the TMDL for Dry Hydrological Conditions that follow.

### 1. B. 1. Nutrient TMDL, WLAs and LAs and Compliance Dates – Dry Hydrological Conditions

A TMDL, and the WLAs and LAs necessary to achieve it, are established for total phosphorus for dry hydrological conditions only. As stated above, phosphorus and nitrogen are the nutrients that cause beneficial use impairment in Big Bear Lake. Dry hydrological conditions are defined by the conditions observed from 1999-2003; that is, average tributary inflow to Big Bear Lake ranging from 0 to 3,049 AF, average lake levels ranging from 6671 to 6735 feet and annual precipitation ranging from 0 to 23 inches. TMDLs, WLAs and LAs for wet and/or average hydrological conditions will be established as part of the TMDL Phase 2 activities once additional data have been collected (see 1.B.4. TMDL Implementation, Task 9).

The phosphorus TMDL for Big Bear Lake for dry hydrological conditions is shown in Table 5-9a-d. Wasteload allocations for point source discharges and load allocations for nonpoint source discharges are shown in Table 5-9a-e.

Table 5-9a-d

Big Bear Lake Nutrient TMDL for Dry Hydrological Conditions

| | **Total Phosphorus (lbs/yr)** [b] |
|---|---|
| TMDL[a] | 26,012 |

[a] Compliance to be achieved as soon as possible, but no later than December 31, 2015.
[b] Specified as an annual average for dry hydrological conditions only.

Table 5-9a-e

Big Bear Lake
Phosphorus Wasteload and Load Allocations for Dry Hydrological Conditions

| Big Bear Lake Nutrient TMDL for Dry Hydrological Conditions | Total Phosphorus Load Allocation (lbs/yr)[a, b] |
|---|---|
| **TMDL** | 26,012 |
| | |
| **WLA** | 475 |
| Urban | 475 |
| | |
| **LA** | 25,537 |
| Internal Sediment | 8,555 |
| Internal macrophyte | 15,700 |
| Atmospheric Deposition | 1,074 |
| Forest | 175 |
| Resort | 33 |

[a] Allocation compliance to be achieved as soon as possible, but no later than December 31, 2015.
[b] Specified as an annual average for dry hydrological conditions only.

## 1.B.2. Margin of Safety

The Big Bear Lake Nutrient TMDL for Dry Hydrological Conditions includes an implicit margin of safety (MOS) as follows:

1. The derivation of numeric targets based on the 25$^{th}$ percentile of nutrient data;
2. The use of conservative assumptions in modeling the response of Big Bear Lake to nutrient loads.

## 1. B.3. Seasonal Variations/Critical Conditions

The critical condition for attainment of aquatic life and recreational uses in Big Bear Lake occurs during the summer and during dry years, when nutrient releases from the sediment are greatest and water column concentrations increase. Macrophyte biomass peaks in the summer/early fall. Recreational uses of the lake are also highest during the summer. This nutrient TMDL for Big Bear Lake is focused on the critical dry hydrological conditions and, in particular, on the control of the internal sediment loads that dominate during these periods. This is the first phase of TMDLs needed to address eutrophication in Big Bear Lake. The next phase will include collection of data needed to refine the in-lake and watershed models (see

1.B.4. TMDL Implementation, Task 6A) and to develop TMDLs that address other hydrological conditions (see 1.B.4. TMDL Implementation, Task 9). TMDLs for wet and average hydrological conditions will be developed to address external loading that contributes to the nutrient reservoir in the lake and thus eutrophic conditions, particularly during the critical dry periods. However, it is important to note again that since the TMDL for dry hydrological conditions was developed to meet the numeric targets under the critical, worst-case conditions, consistent compliance with these targets is expected to be achieved even in the absence of TMDLs for wet/average hydrological conditions, given the greater lake volume and dilution anticipated under wetter conditions.

The TMDL recognizes that different nutrient inflow and cycling processes dominate the lake during different seasons. These processes were simulated in the in-lake model using data collected during all seasons over a multi-year period**.** Thus, the model results reflect all seasonal variations. The phosphorus numeric target is expressed as an annual average, while the chlorophyll *a* numeric target is expressed as a growing season average. The intent is to set targets that will, when achieved, result in improvement of the trophic status of Big Bear Lake year-round.

Compliance with numeric targets will ensure water quality improvements that prevent excessive algae blooms and fish kills, particularly during the critical summer period when these problems are most likely to occur.

## 1.B.4. TMDL Implementation

Table 5-9a-f outlines the tasks and schedules to implement the TMDL for Dry Hydrological Conditions. Each of these tasks is described below.

Table 5-9a-f

Big Bear Lake Nutrient TMDL Implementation
Plan/Schedule Report Due Dates

| Task | Description | Compliance Date-As soon As Possible but No Later Than |
|---|---|---|
| **TMDL Phase** 1 | | |
| Task 1 | Establish New Waste Discharge Requirements for Nutrient Sources | February 29, 2008 |
| Task 2 | Establish New Waste Discharge Requirements for Lake Restoration Activities | February 28, 2009 |
| Task 3 | Revise Existing Waste Discharge Requirements | February 29, 2008 |
| Task 4 | Nutrient Water Quality Monitoring Program<br>4.1 Watershed-wide Nutrient Monitoring Plan(s)<br>4.2 Big Bear Lake Nutrient Monitoring Plan(s) | Plan/schedule due November 30, 2007. Annual reports due February 15 |
| Task 5 | *Atmospheric Deposition Determination* | Plan/schedule due August 31, 2008 |
| Task 6 | *Big Bear Lake – Lake Management Plan, including:*<br>*6A. Big Bear Lake and Watershed Model Updates*<br>6B. Big Bear Lake In-Lake Sediment Nutrient Reduction Plan<br>6C. Big Bear Lake Aquatic Plant Management Plan | Plan/schedule due August 31, 2008. Annual reports due February 15 |
| TMDL Phase 2 | | |
| ***Task 7*** | Review/Revision of Big Bear Lake Water Quality Standards<br>7.1 Review/Revise Nutrient Water Quality Objectives<br>7.2 Development of biocriteria<br>7.3 Development of natural background definition | December 31, 2015 |
| Task 8 | Review Big Bear Lake Tributary Data | December 31, 2008 |
| Task 9 | Develop TMDLs, WLAs and LAs for wet and/or average hydrological conditions | December 31, 2012 |
| Task 10 | Review of TMDL/WLAs/Las | Once every 3 years |

**Task 1: Establish New Waste Discharge Requirements for Nutrient Sources**

On or before February 29, 2008, the Regional Board shall issue the following new waste discharge requirements

1.1 Waste Discharge Requirements (WDRs) or Conditional Waiver of WDRs to the US Forest Service to incorporate the nutrient load allocations, compliance schedule and monitoring and reporting requirements for Forested Areas.

Other nutrient discharges will be addressed and permitted as appropriate.

**Task 2: Establish New Waste Discharge Requirements for Lake Restoration Activities**

On or before February 28, 2009, the Regional Board shall issue the following new waste discharge requirements

NPDES Permit to the US Forest Service, the State of California, Department of Transportation (Caltrans), the County of San Bernardino, San Bernardino County Flood Control District, the City of Big Bear Lake, and Big Bear Mountain Resorts for Lake restoration activities, including, but not limited to alum treatment and/or herbicide treatment. Requirements specified in these Waste Discharge Requirements, shall be developed using the Aquatic Plant Management Plan and Schedule submitted pursuant to Task 6C.

**Task 3: Review and/or Revise Existing Waste Discharge Requirements**

Waste Discharge Requirements (WDRs) have been issued by the Regional Board regulating discharge of various types of wastes in the Big Bear Lake watershed. On or before February 29, 2008, these WDRs shall be reviewed and revised as necessary to incorporate the nutrient wasteload allocations, compliance schedule and TMDL monitoring and reporting requirements.

3.1 Waste Discharge Requirements for the San Bernardino County Flood Control and Transportation District, the County of San Bernardino and the Incorporated Cities of San Bernardino County within the Santa Ana Region, Areawide Urban Runoff, NPDES No. CAS 618036 (Regional Board Order No. R8-2002-0012). The current Order has provisions to address TMDL issues. In light of these provisions, revision of the Order may not be necessary to address TMDL requirements.

3.2 State of California, Department of Transportation (Caltrans) Stormwater Permit

Provision E.1 of Order No. 99-06-DWQ requires Caltrans to maintain and implement a Storm Water Management Plan (SWMP). Annual updates of the SWMP needed to maintain an effective program are required to be submitted to the State Water

Resources Control Board.

Provision E.2 of Order No. 99-06-DWQ requires Caltrans to submit a Regional Workplan by April 1 of each year for the Executive Officer's approval. As part of the annual update of the SWMP and Regional Workplan, Caltrans shall submit plans and schedules for conducting the monitoring and reporting requirements specified in Task 4 and the special studies required in Task 6.

## Task 4: Monitoring

### 4.1 Watershed-wide Nutrient Water Quality Monitoring Program

No later than November 30, 2007, the US Forest Service, the State of California, Department of Transportation (Caltrans), the County of San Bernardino, San Bernardino County Flood Control District, the City of Big Bear Lake and Big Bear Mountain Resorts shall, as a group, submit to the Regional Board for approval a proposed watershed-wide nutrient monitoring program that will provide data necessary to review and update the Big Bear Lake Nutrient TMDL, to determine specific sources of nutrients and to develop TMDLs for other hydrological conditions. Data to be collected and analyzed shall address, at a minimum, determination of compliance with the phosphorus dry condition TMDL, including the WLAs and LAs, and with the existing total inorganic nitrogen (TIN) objective.

At a minimum, the proposed plan shall include the collection of samples at the stations specified in Table 5-9a-g and shown in Figure 5-7, at the frequency specified in Table 5-9a-h. Modifications to the required sampling stations, sampling frequencies and constituents to be monitored (see below) will be considered upon request by the stakeholders, accompanied by a report that describes the rationale for the proposed changes and identifies recommended alternatives. In addition to water quality samples, every two weeks on a year-round basis, visual monitoring (including documenting flow type and stage) determinations shall be made at all stations shown in Table 5-9a-g. Flow measurements will be required each time water quality samples are obtained.

At a minimum, samples shall be analyzed for the following constituents:

- Total nitrogen
- Nitrate + nitrite nitrogen
- Total phosphorus
- Total dissolved phosphorus
- Suspended sediment concentration
- Chlorophyll *a*
- Dissolved oxygen
- Alkalinity
- Bedload concentration
- Total nitrogen in sediment
- Ammonia nitrogen
- Total dissolved nitrogen
- Ortho-phosphate (SRP)
- Temperature
- Turbidity
- pH
- Conductivity
- Hardness
- Grain size
- Total phosphorus in sediment

Note: Chlorophyll *a* to be collected and analyzed only from May 1- October 31 of each year at the frequencies described in Table 5-9a-h; chlorophyll *a* sampling not required at Bear Creek outlet.

In addition, the proposed plan shall include a proposed plan and schedule for development of a Big Bear Lake Sedimentation Processes Plan for the determination of nutrient loads associated with sediment. At a minimum, the proposed plan shall include the placement of sediment traps at the mouths of Rathbun, Knickerbocker, Grout and Boulder Creeks to determine the rate of influx of sediment and particulate nutrients to Big Bear Lake, as specified in Table 5-9a-g and shown in Figure 5-7, at the specified frequency indicated in Table 5-9a-h. Modifications to the required sampling stations, sampling frequencies and constituents to be monitored will be considered upon request by the stakeholders, accompanied by a report that describes the rationale for the proposed changes and identifies recommended alternatives. The proposed monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL/WLAs/LAs shall be submitted by February 15 of each year.

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. Any such individual or group monitoring plan is due no later than November 30, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report of data collected pursuant to approved individual/group plan(s) shall be submitted by February 15 of each year. The report shall summarize the data and evaluate compliance with the TMDL/WLAs/LAs.

Table 5-9a-g
Big Bear Lake Watershed
Minimum Required Sampling Station Locations

| Station Number | Station Description |
|---|---|
| MWDC2 | Bear Creek Outlet |
| MWDC3 | Grout Creek at Hwy 38 |
| MWDC4 | Rathbun Creek at Sandalwood Ave. |
| MWDC5 | Summit Creek at Swan Dr. |
| MWDC6 | Rathbun Creek below the Zoo |
| MWDC8 | Knickerbocker Creek at Hwy 18 |
| MWDC13 | Boulder Creek at Hwy 18 |

Note: Bear Creek outlet to be sampled monthly from March – November. At a minimum, samples shall be analyzed at the frequencies specified in Table 5-9a-h:

Table 5-9a-h
Big Bear Lake Watershed
Sampling Frequency

| Flow type | Months monitoring is required | Frequency |
|---|---|---|
| Baseflow | January 1 – December 31 | Once/month when baseflow is present; |
| Snowmelt | January 1 – May 31[1] | Varied -See note 2 below |
| Storm events | January 1 – December 31 | 3 storms per year[3] |

[1] Sampling to begin after the first substantial snowfall resulting in an accumulation of 1.0 inch or more of snow

[2] Samples to be collected daily for the first three days of the snowmelt period. If ambient air temperatures remain above freezing after three days have passed, snowmelt sampling will then be performed once a week for the following three weeks or until the snowmelt period ceases. Snowmelt cessation will be determined by one of the following: a) ambient air temperatures drop below freezing during most of the day; or b) a storm/rain precipitation event occurs after the snowmelt event was initiated. Beginning March 15th of each year, snowmelt flows will most likely be continuous since ambient air temperatures will usually remain above freezing. From March 15th through May 31 of each year, snowmelt sampling events will be conducted daily for the first two days of a snowmelt event and then once a week thereafter until the spring runoff period has ended or the tributary station location shows no signs of daily flows for one week. Flow status will be evaluated in the afternoon, when ambient air temperatures are highest and flow potential is greatest.

[3] Two storm events to be sampled during October – March; 1 storm event to be sampled during April – September. For each storm event, eight samples across the hydrograph are to be collected.

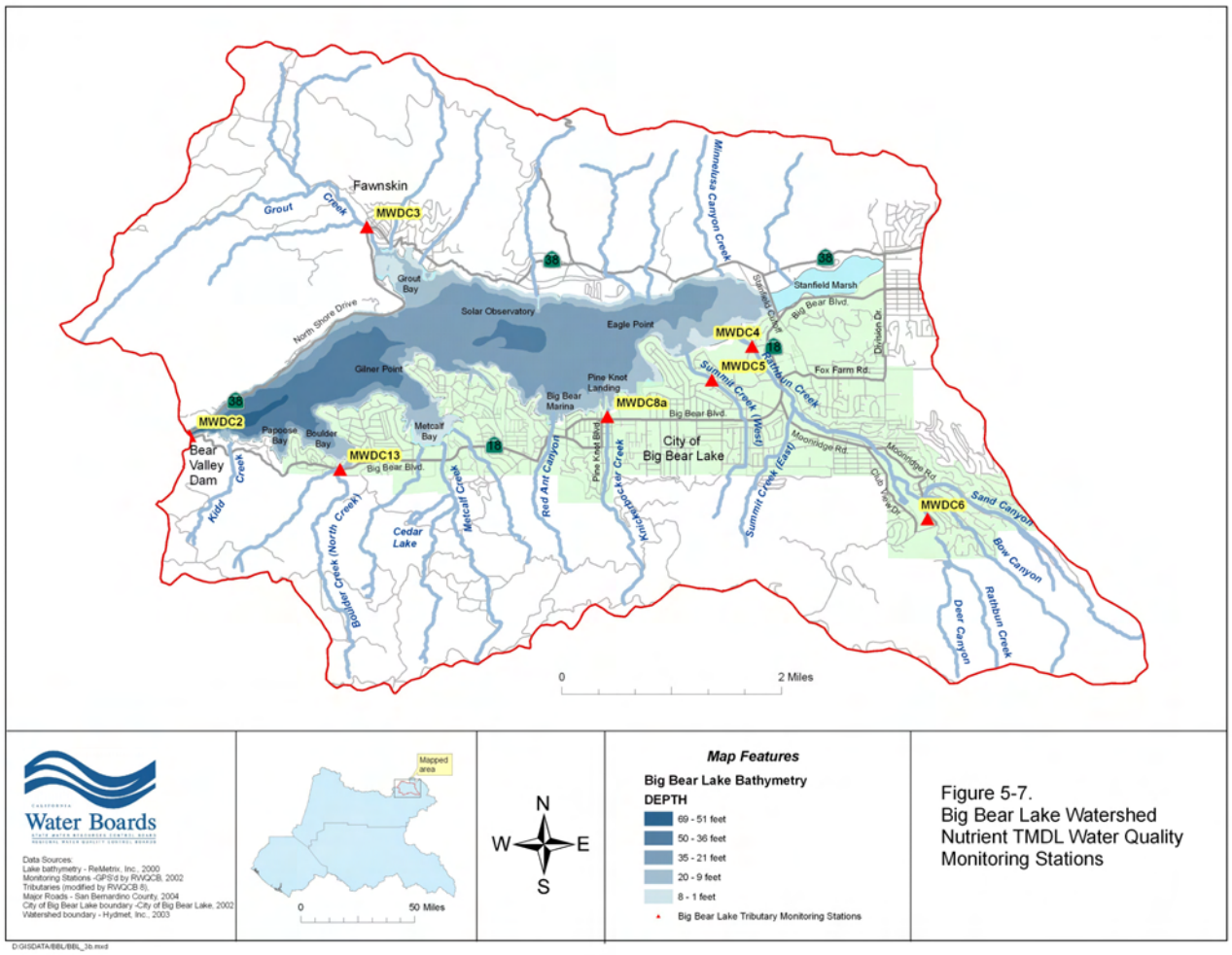



Figure 5-7 – Big Bear Lake Watershed Nutrient TMDL Water Quality Stations

## 4.2 Big Bear Lake: In-Lake Nutrient Monitoring Program

No later than November 30, 2007, the US Forest Service, the State of California, Department of Transportation (Caltrans), the County of San Bernardino, San Bernardino County Flood Control District, the City of Big Bear Lake, and Big Bear Mountain Resorts shall, as a group, submit to the Regional Board for approval a proposed Big Bear Lake nutrient monitoring program that will provide data necessary to review and update the Big Bear Lake Nutrient TMDL, and to develop TMDLs for other hydrological conditions. Data to be collected and analyzed shall address, at a minimum: (1) determination of compliance with phosphorus and chlorophyll *a* numeric targets; (2) determination of compliance with the existing total inorganic nitrogen (TIN) objective; and (3) refinement of the in-lake model for the purposes of TMDL review and development.

At a minimum, the proposed plan shall include the collection of samples at the stations specified in Table 5-9a-i and shown in Figure 5-8, at the specified frequency indicated in Table 5-9a-i. Modifications to the required sampling stations, sampling frequencies and constituents to be monitored (see below) will be considered upon request by the stakeholders, accompanied by a report that describes the rationale for the proposed changes and identifies recommended alternatives. With the exception of hardness, alkalinity, total organic carbon (TOC), dissolved organic carbon (DOC), and chlorophyll *a,* each sample to be analyzed shall be collected as a photic zone composite (from the surface to 2 times the secchi depth) and as a bottom discrete (0.5 meters off the surface bottom) sample. Hardness, alkalinity, TOC, DOC, and chlorophyll *a* shall be collected as photic zone composites. Dissolved oxygen, water temperature, turbidity, specific conductance, and pH shall be measured at 1-meter intervals from the surface to 0.5 meters from the bottom using a multi-parameter water quality meter. Water clarity shall be measured with a secchi disk.

At a minimum, in-lake samples must be analyzed for the following constituents:

- Specific conductance
- Water temperature
- Chlorophyll *a*
- Total nitrogen
- Nitrate +nitrite nitrogen
- Total phosphorus
- Total hardness
- Total dissolved phosphorus
- Dissolved organic carbon(DOC)
- Total dissolved nitrogen
- Dissolved oxygen
- Water clarity (secchi depth)
- Ammonia nitrogen
- Alkalinity
- Turbidity
- Ortho-phosphate (SRP)
- Total suspended solids (TSS)
- pH
- Total dissolved solids (TDS)
- Total organic carbon (TOC)

The monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL/WLAs/LAs and numeric targets shall be submitted by February 15 of each year.

Table 5-9a-i

Big Bear Lake Minimum Required Sampling Station Locations

| Station Number | Station Description |
|---|---|
| MWDL1 | Big Bear Lake – Dam |
| MWDL2 | Big Bear Lake – Gilner Point |
| MWDL6 | Big Bear Lake – Mid Lake Middle |
| MWDL9 | Big Bear Lake – Stanfield Middle |

Frequency of sampling at all stations: for all constituents except TOC and DOC, monthly from March – November; bi-weekly (i.e., every other week) from June 1 through October 31. TOC and DOC to be monitored four times per year (quarterly) from January through December.

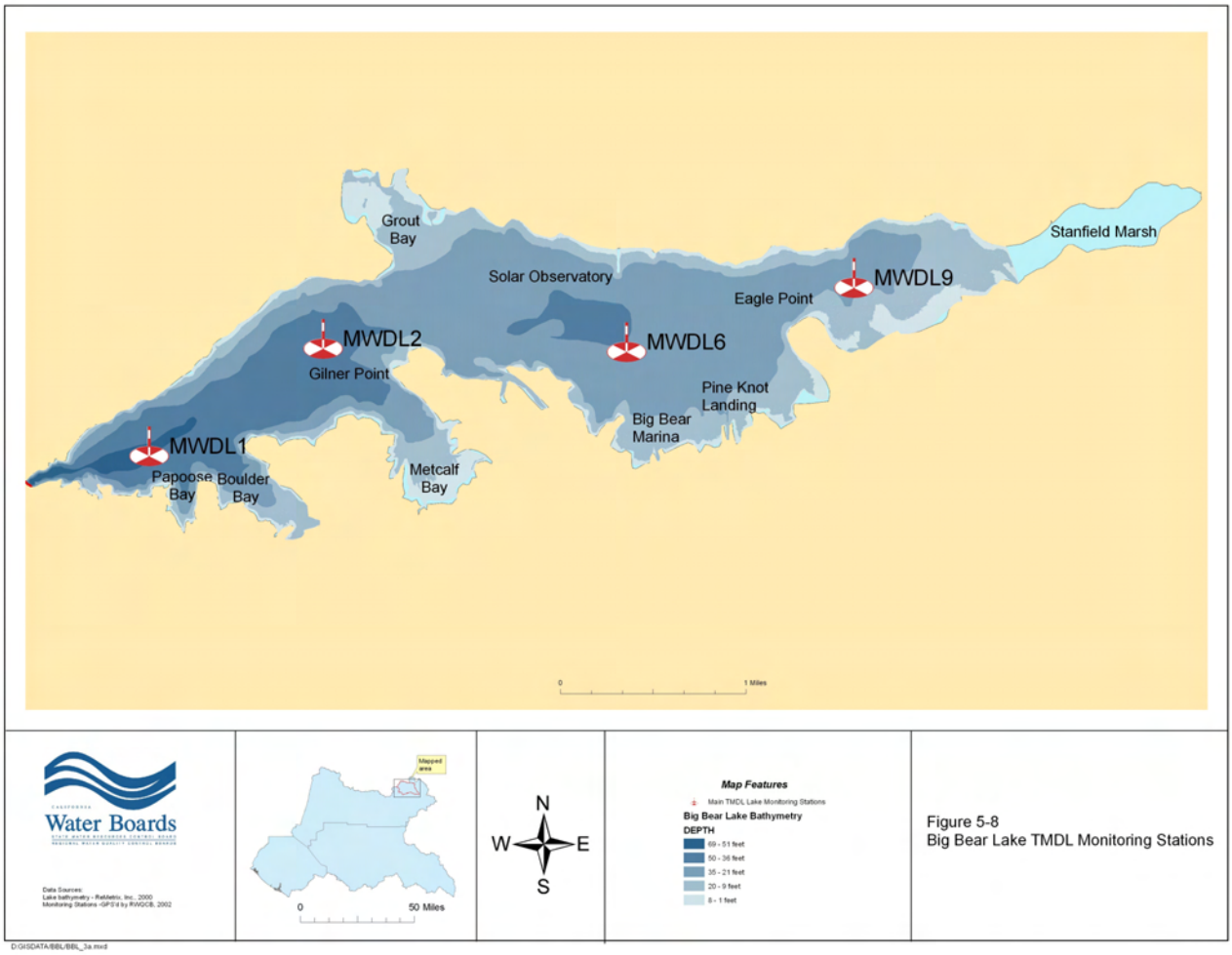



**Figure 5-8 Big Bear Lake TMDL Monitoring Stations**

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. Any such individual or group monitoring plan is due no later than November 30, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report of data collected pursuant to approved individual/group plan(s), shall be submitted by February 15 of each year. The report shall summarize the data and evaluate compliance with the TMDL/WLAs/LAs and numeric targets.

### Task 5: Atmospheric Deposition Determination

No later than August 31, 2008, the Regional Board, in coordination with local stakeholders, the South Coast Air Quality Management District and the California Air

Resources Board, shall develop a plan and schedule for quantifying atmospheric deposition of nutrients in the Big Bear Lake watershed.

**Task 6: Big Bear Lake-Lake Management Plan**

No later than August 31, 2008, the US Forest Service, the State of California, Department of Transportation (Caltrans), the County of San Bernardino, San Bernardino County Flood Control District, the City of Big Bear Lake, and Big Bear Mountain Resorts, shall, as a group, submit to the Regional Board for approval a proposed Lake Management Plan for Big Bear Lake. The purpose of the plan is to identify a coordinated and comprehensive strategy for management of the lake and surrounding watershed to address restoration and protection of the lake's beneficial uses.The plan shall include the following:

A) A proposed plan and schedule for updating the existing Big Bear Lake watershed nutrient model and the Big Bear Lake in-lake nutrient model. The plan and schedule must take into consideration additional data and information that are or will be generated from the required TMDL monitoring programs (Tasks 4.1 and 4.2, above).

B) A proposed plan and schedule for in-lake sediment nutrient reduction for Big Bear Lake. The proposed plan shall include an evaluation of the applicability of various in-lake treatment technologies to support development of a long-term strategy for control of nutrients from the sediment. The submittal shall also contain a proposed sediment nutrient monitoring program to evaluate the effectiveness of any strategies implemented.

C) The proposed plan shall include an evaluation of the applicability of various in-lake treatment technologies to control noxious and nuisance aquatic plants. The plan shall also include a description of the monitoring conducted and proposed to track aquatic plant diversity, coverage, and biomass. Data to be collected and analyzed shall address, at a minimum, determination of compliance with the numeric targets for macrophyte coverage and percentage of nuisance aquatic vascular plant species (see 1.A., above).

In addition, at a minimum, the proposed plan shall also address the following:

- The plan shall be based on identified and acceptable goals for lake capacity, biological resources and recreational opportunities. Acceptable goals shall be identified in coordination with the Regional Board and other responsible agencies, including the California Department of Fish and Game and the U.S. Fish and Wildlife Service.
- The plan shall include a proposed plan and schedule for the development of biocriteria for Big Bear Lake. (This is intended to complement Regional Board efforts to develop biocriteria and to signal the parties' commitment to participate substantively.)
- The plan must identify a scientifically defensible methodology for measuring changes in the capacity of the lake.

- The proposed plan shall identify recommended short and long-term strategies for control and management of sediment and dissolved and particulate nutrient inputs to the lake.
- The plan shall also integrate the beneficial use survey information required to be developed pursuant to the Regional Board's March 3, 2005, Clean Water Act Section 401 Water Quality Standards Certification for Big Bear Lake Nutrient/Sediment Remediation Project, City of Big Bear Lake, County of San Bernardino, California. The purpose of the beneficial use survey is to correlate beneficial uses of the lake with lake bottom contours. The survey is required to be conducted throughout the lake. The survey will determine the location and the quality of beneficial uses of the lake and the contours of the lake bottom where these uses occur. The survey is expected to be used in regulating future lake dredge projects to maximize the restoration and protection of the lake's beneficial uses.

The Big Bear Lake – Lake Management Plan shall be implemented upon Regional Board approval at a duly noticed public meeting. Once approved, the plan shall be reviewed and revised as necessary at least once every three years. The review and revision shall take into account assessments of the efficacy of control/management strategies implemented and relevant requirements of new or revised TMDLs for Big Bear Lake and its watershed. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL/WLAs/LAs and numeric targets shall be submitted by February 15 of each year.

In lieu of this coordinated plan, one or more of the parties identified above may submit a proposed individual or group Big Bear Lake – Lake Management Plan and schedule for approval by the Regional Board. Any such individual or group plan must conform to the requirements specified above and is due no later than August 31, 2008. An individual or group plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL/WLAs/LAs and numeric targets shall be submitted by February 15 of each year.

**Task 7: Review and Revision of Big Bear Lake Water Quality Standards**

By December 31, 2015, the Regional Board shall:

7.1 Review/revise as necessary the total inorganic nitrogen and total phosphorus numeric water quality objectives for Big Bear Lake. The Regional Board shall also consider the development of narrative or numeric objectives for other indicators of impairment (e.g., chlorophyll *a*, macrophyte coverage and species composition), in lieu of or in addition to review/revision of the numeric objectives for phosphorus and nitrogen.

7.2 Develop biocriteria for Big Bear Lake.

7.3 Develop a definition for natural background sources of nutrients (and other constituents) to Big Bear Lake and its tributaries.

Given budgetary constraints, completion of these tasks are likely to require substantive contributions from interested parties.

**Task 8: Review of Big Bear Lake Tributary Data**

No later than December 2008, the Regional Board shall review data collected on Rathbun Creek, Summit Creek and Grout Creek to determine whether beneficial uses of these tributaries are impaired by nutrients. If the Creeks are found to be impaired by nutrients, the Regional Board shall develop a TMDL development project plan and schedule. If these tributaries are found not to be impaired by nutrients, Regional Board shall schedule the delisting of the tributaries from the 303(d) list of impaired waters at the earliest opportunity.

**Task 9: Development of TMDLs for Wet and/or Average Hydrological Conditions**

No later than December 31, 2012, the Regional Board shall utilize additional water quality data and information collected pursuant to monitoring program requirements (Tasks 4 and 5) and model updates (Task 6A) to develop proposed nutrient TMDLs for Big Bear Lake for wet and/or average hydrological conditions. Completion of this task is contingent on the collection of requisite data for wet and/or average hydrological conditions.

**Task 10: Review/Revision of the Big Bear Lake Nutrient TMDL for Dry Hydrological Conditions (TMDL "Re-opener")**

The basis for the TMDL for Dry Hydrological Condtions, the implementation plan and schedule will be re-evaluated at least once every three years[2] to determine the need for modifying the allocations, numeric targets and TMDL. Regional Board staff will continue to review all data and information generated pursuant to the TMDL requirements on an ongoing basis. Based on results generated through the monitoring programs, special studies and/or modeling analyses, changes to the TMDL may be warranted. Such changes will be considered through the Basin Plan Amendment process.

The Regional Board is committed to the review of this TMDL every three years, or more frequently if warranted by these or other studies.

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[2] The three-year schedule is tied to the 3 year triennial review schedule.

## Lake Elsinore/San Jacinto River Watershed (Amended by Resolution No. R8-2006-0023)

The Lake Elsinore/San Jacinto River Watershed is located in Riverside County and includes the following major waterbodies: Lake Hemet, San Jacinto River, Salt Creek, Canyon Lake and Lake Elsinore. The total drainage area of the San Jacinto River watershed is approximately 782 square miles. Over 90 percent of the watershed (735 square miles) drains into Canyon Lake. Lake Elsinore is the terminus of the San Jacinto River watershed. The local tributary area to Lake Elsinore, consisting of drainage from the Santa Ana Mountains and the City of Lake Elsinore, is 47 square miles.

Land use in the watershed includes open/forested, agricultural (including concentrated animal feeding operations such as dairies and chicken ranches, and irrigated cropland), and urban uses, including residential, industrial and commercial. Vacant/open space is being converted to residential uses as the population in the area expands. The municipalities in the watershed include the cities of San Jacinto, Hemet, Perris, Canyon Lake, Lake Elsinore and portions of Moreno Valley and Beaumont.

### 1. Lake Elsinore and Canyon Lake Nutrient Total Maximum Daily Load (TMDL)

Lake Elsinore and Canyon Lake are not attaining water quality standards due to excessive nutrients (nitrogen and phosphorus). Reports prepared by Regional Board staff describe the impact nutrient discharges have on the beneficial uses of Lake Elsinore and Canyon Lake [Ref. #26,27] Lake Elsinore was formed in a geologically active graben area and has been in existence for thousands of years. Due to the mediterranean climate and watershed hydrology, fluctuations in the level of Lake Elsinore have been extreme, with alternate periods of a dry lake bed and extreme flooding. These drought/flood cycles have a great impact on lake water quality. Fish kills and excessive algae blooms have been reported in Lake Elsinore since the early 20th century. As a result, in 1994, the Regional Board placed Lake Elsinore on the 303(d) list of impaired waters due to excessive levels of nutrients and organic enrichment/low dissolved oxygen.

Canyon Lake, located approximately 5 miles upstream of Lake Elsinore, was formed by the construction of Railroad Canyon Dam in 1928. Approximately 735 square miles of the 782 square mile San Jacinto River watershed drain to Canyon Lake. During most years, runoff from the watershed terminates at Canyon Lake without reaching Lake Elsinore, resulting in the buildup of nutrients in Canyon Lake. While Canyon Lake does not have as severe an eutrophication problem as Lake Elsinore, there have been periods of algal blooms and anecdotal reports of occasional fish kills. Accordingly, in

1998, the Regional Board added Canyon Lake to the 303(d) list of impaired waters due to excessive levels of nutrients.
A TMDL technical report prepared by Regional Board staff describes the nutrient related problems in Canyon Lake and Lake Elsinore in greater detail and discusses the technical basis for the TMDLs that follow [Ref. # 28].

## A. Lake Elsinore and Canyon Lake Nutrient TMDL Numeric Targets

Numeric targets for Lake Elsinore and Canyon Lake are based on reference conditions when beneficial uses in the lakes were not significantly impacted by nutrients. Table 5-9n shows both "causal" and "response" interim and final numeric targets for both lakes. Causal targets are those for phosphorus and nitrogen. Phosphorus and nitrogen are the primary limiting nutrients in Lake Elsinore and Canyon Lake, respectively. However, under certain conditions, nitrogen may be limiting in Lake Elsinore and phosphorus may be limiting in Canyon Lake. Targets for both nutrients are therefore necessary . Reduction in nitrogen inputs will be necessary over the long-term and only final targets are specified. Response targets include chlorophyll *a* and dissolved oxygen. These targets are specified to assess water quality improvements in the lakes. Finally, ammonia targets are specified to prevent un-ionized ammonia toxicity to aquatic life.

Table 5-9n

Lake Elsinore and Canyon Lake Nutrient TMDL Numeric Targets*

| Indicator | Lake Elsinore | Canyon Lake |
|---|---|---|
| Total P concentration (Final) | Annual average no greater than 0.1 mg/L; to be attained no later than 2020 | Annual average no greater than 0.1 mg/L; to be attained no later than 2020 |
| Total N concentration (Final) | Annual average no greater than 0.75 mg/L; to be attained no later than 2020 | Annual average no greater than 0.75 mg/L; to be attained no later than 2020 |
| Ammonia nitrogen concentration (Final) [Ref. #4] | Calculated concentrations to be attained no later than 2020<br><br>Acute: 1-hour average concentration of total ammonia nitrogen (mg/L) not to exceed, more than once every three years on the average, the CMC (acute criteria), where<br>$CMC = 0.411/(1+10^{7.204-pH}) + 58.4/(1+10^{pH-7.204})$<br><br>Chronic: thirty-day average concentration of total ammonia nitrogen (mg/L) not to exceed, more than once every three years on the average, the CCC (chronic criteria)<br>$CCC = (0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) * \min(2.85, 1.45*10^{0.028(25-T)})$ | Calculated concentrations to be attained no later than 2020<br><br>Acute: 1-hour average concentration of total ammonia nitrogen (mg/L) not to exceed, more than once every three years on the average, the CMC (acute criteria), where<br>$CMC = 0.411/(1+10^{7.204-pH}) + 58.4/(1+10^{pH-7.204})$<br><br>Chronic: thirty-day average concentration of total ammonia nitrogen (mg/L) not to exceed, more than once every three years on the average, the CCC (chronic criteria)<br>$CCC = (0.0577/(1+10^{7.688-pH}) + 2.487/(1+10^{pH-7.688})) * \min(2.85, 1.45*10^{0.028(25-T)})$ |
| Chlorophyll *a* concentration (Interim) | Summer average no greater than 40 ug/L; to be attained no later than 2015 | Annual average no greater than 40 ug/L; to be attained no later than 2015 |
| Chlorophyll *a* concentration (Final) | Summer average no greater than 25 ug/L; to be attained no later than 2020 | Annual average no greater than 25 ug/L; to be attained no later than 2020 |
| Dissolved oxygen concentration (Interim) | Depth average no less than 5 mg/L; to be attained no later than 2015 | Minimum of 5 mg/L above thermocline; to be attained no later than 2015 |
| Dissolved oxygen concentration (Final) | No less than 5 mg/L 1 meter above lake bottom; to be attained no later than 2020 | Daily average in hypolimnion no less than 5 mg/L; to be attained no later than 2020. |

* compliance with targets to be achieved as soon as possible, but no later than the date specified

## B. Lake Elsinore and Canyon Lake Nutrient TMDLs, Wasteload Allocations, Load Allocations and Compliance Dates

As discussed in the technical TMDL report, nutrient loading to Canyon Lake and Lake Elsinore varies depending on the hydrologic conditions that occur in the San Jacinto watershed. As part of the TMDL analysis and development, three hydrologic scenarios

and the relative frequency of each of these conditions (based upon an 87 year record of flow data at the USGS Gauging station downstream of Canyon Lake), were identified as shown in Table 5-9o. The resulting TMDLs, wasteload allocations and load allocations are based on 10-year running flow weighted average nutrient loads, taking into account the frequency of the three hydrologic conditions and the nutrient loads associated with each of them. Phosphorus and nitrogen TMDLs for Canyon Lake and Lake Elsinore are shown in Table 5-9p. The TMDLs, expressed as 10–year running averages, will implement the numeric targets and thereby attain water quality standards,. Phosphorus and nitrogen wasteload allocations for point source discharges and load allocations for nonpoint source discharges, also expressed as 10-year running averages, are shown in Tables 5-9q and 5-9r. No TMDLs, wasteload allocations or load allocations are specified for chlorophyll a, dissolved oxygen or ammonia. Chlorophyll a and dissolved oxygen targets are intended to serve as measures of the effectiveness of phosphorus and nitrogen reductions implemented to meet TMDL requirements. Until ammonia transformations, and nitrogen dynamics in general, are better understood, no ammonia TMDLs, wasteload allocations or load allocations are specified.

Table 5-9o
San Jacinto River Hydrologic Conditions with Relative Flow Frequency at the USGS Gauging Station Downstream of Canyon Lake (Station No. 1170500)

| Hydrologic Condition | Representative Water Year | Years of Hydrologic Condition | Relative Frequency (%) | Description |
|---|---|---|---|---|
| Wet | 1998 | 14 | 16 | Both Canyon Lake and Mystic Lake overflow; flow at the USGS gauging station 11070500 17,000 AF or greater |
| Moderate | 1994 | 36 | 41 | No Mystic Lake overflow; Canyon Lake overflowed; flow at the USGS gauging station 11070500 less than 17,000 AF and greater than 2,485 AF |
| Dry | 2000 | 37 | 43 | No overflows from Mystic Lake or Canyon Lake; flow at the USGS gauging station 11070500 371 AF or less |

Table 5-9p
Nutrient TMDLs and Compliance Dates for Lake Elsinore and Canyon Lake

| TMDL | Final Total Phosphorus TMDL (kg/yr)[a, b] | Final Total Nitrogen TMDL (kg/yr) [a, b] |
|---|---|---|
| Canyon Lake | 8,691 | 37,735 |
| Lake Elsinore | 28,584 | 239,025 |

[a] Final compliance to be achieved as soon as possible, but no later than December 31, 2020.
[b] TMDL specified as 10-year running average.

Table 5-9q

Canyon Lake
Nitrogen and Phosphorus Wasteload and Load Allocations[a]

| Canyon Lake Nutrient TMDL | Final Total Phosphorus Load Allocation (kg/yr)[b, c] | Final Total Nitrogen Load Allocation (kg/yr) [b, c] |
|---|---|---|
| **TMDL** | **8,691** | **37,735** |
| **WLA** | 486 | 6,248 |
| Supplemental water | 48 | 366 |
| Urban | 306 | 3,974 |
| CAFO | 132 | 1,908 |
| **LA** | **8,205** | **31,487** |
| Internal Sediment | 4,625 | 13,549 |
| Atmospheric Deposition | 221 | 1,918 |
| Agriculture | 1,183 | 7,583 |
| Open/Forest | 2,037 | 3,587 |
| Septic systems | 139 | 4,850 |

[a] The TMDL allocations for Canyon Lake apply to those land uses located upstream of Canyon Lake.
[b] Final allocation compliance to be achieved as soon as possible, but no later than December 31, 2020.
[c] TMDL and allocations specified as 10-year running average.

Table 5-9r

Lake Elsinore
Nitrogen and Phosphorus Wasteload and Load Allocations[a]

| Lake Elsinore Nutrient TMDL | Final Total Phosphorus Load Allocation (kg/yr)[b, c] | Final Total Nitrogen Load Allocation (kg/yr)[c, d] |
|---|---|---|
| **TMDL** | **28,584** | **239,025** |
| WLA | 3,845 | 7,791 |
| Supplemental water [d] | 3,721 | 7,442 |
| Urban | 124 | 349 |
| CAFO | 0 | 0 |
| **LA** | **21,969** | **210,461** |
| Internal Sediment | 21,554 | 197,370 |
| Atmospheric Deposition | 108 | 11,702 |
| Agriculture | 60 | 213 |
| Open/Forest | 178 | 567 |
| Septic systems | 69 | 608 |
| CL Watershed [e] | 2,770 | 20,774 |

[a] The Lake Elsinore TMDL allocations for urban, agriculture open/forest, septic systems and CAFOs only apply to those land uses located downstream of Canyon Lake.
[b] Final allocation compliance to be achieved as soon as possible, but no later than December 31, 2020.
[c] TMDL and allocations specified as 10-year running average.
[d] WLA for supplemental water should met as soon as possible as a 5 year running average.
[e] Allocation for Canyon Lake overflows

The TMDL distributes the portions of the waterbody's assimilative capacity to various pollution sources so that the waterbody achieves its water quality standards. The Regional Board supports the trading of pollutant allocations among sources, where appropriate. Trading can take place between point/point, point/nonpoint, and nonpoint/nonpoint pollutant sources. Optimizing alternative point and nonpoint control strategies through allocation tradeoffs may be a cost-effective way to achieve pollution reduction benefits. (See Section E. TMDL Implementation, Task 11, below).

## C. Margin of Safety

The Canyon Lake and Lake Elsinore Nutrient TMDLs include an implicit margin of safety (MOS) as follows:

- the derivation of numeric targets based on the 25$^{th}$ percentile of data for Lake Elsinore; Canyon Lake numeric targets to be consistent with the Lake Elsinore targets;
- the use of multiple numeric targets to measure attainment of beneficial uses and thereby assure TMDL efficacy;
- the use of conservative literature values in the absence of site-specific data for source loading rates in the watershed nutrient model;
- the use of conservative assumptions in modeling the response of Lake Elsinore and Canyon Lake to nutrient loads; and
- requiring load reductions to be accomplished during hydrological conditions when model results indicate, in some instances, that theoretical loads could be higher.

## D. Seasonal Variations/Critical Conditions

The Canyon Lake and Lake Elsinore Nutrient TMDLs account for seasonal and annual variations in external and internal nutrient loading and associated impacts on beneficial uses by the use of a 10-year running average allocation approach. This 10-year running average approach addresses variation in hydrologic conditions (wet, moderate and dry) that can dramatically affect both nutrient loading and lake response.

Compliance with numeric targets will ensure water quality improvements that prevent excessive algae blooms and fish kills, particularly during the critical summer period when these problems are most likely to occur.

## E. TMDL Implementation

Typically, under dry and moderate conditions, the internal nutrient loading drives the nutrient dynamics in both Canyon Lake and Lake Elsinore. However, it is the extreme (albeit infrequent) loading that occurs during wet conditions that provides the nutrients to the lakes that remain in the lakes as internal nutrient sources in subsequent years. Given the complexity of the San Jacinto River watershed hydrology, control of nutrients input to the lakes is needed for all hydrologic conditions. Collection of additional monitoring data is critical to developing long-term solutions for nutrient control. With that in mind, the submittal of plans and schedules to implement the TMDLs should take into consideration the need to develop and implement effective short-term solutions, as well as allow for the development of long-term solutions once additional data have been generated.

Implementation of tasks and schedules as specified in Table 5-9s is expected to achieve compliance with water quality standards. Each of these tasks is described below.

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## Table 5-9s

## Lake Elsinore and Canyon Lake Nutrient TMDL Implementation Plan/Schedule Report Due Dates

| Task | Description | Compliance Date-As soon As Possible but No Later Than |
|---|---|---|
| ***TMDL Phase 1*** | | |
| Task 1 | Establish New Waste Discharge Requirements | March 31, 2006 |
| Task 2 | Revise Existing Waste Discharge Permits | March 31, 2006 |
| Task 3 | Identify Agricultural Operators | October 31, 2005 |
| Task 4 | Nutrient Water Quality Monitoring Program<br>4.1 Watershed-wide Nutrient Monitoring Plan(s)<br>4.2 Lake Elsinore Nutrient Monitoring Plan(s)<br>4.3 Canyon Lake Nutrient Monitoring Plan(s) | • Initial plan/schedule due December 31, 2005<br>• Annual reports due August 15<br>• Revised plan/schedule due December 31, 2006 |
| Task 5 | Agricultural Discharges – Nutrient Management Plan | Plan/schedule due September 30, 2007 |
| Task 6 | On-site Disposal Systems (Septic Systems) Management Plan | Dependent on State Board approval of relevant regulations (see text). |
| Task 7 | Urban Discharges<br>7.1 Revision of Drainage Area Management Plan (DAMP)<br>7.2 Revision of the Water Quality Management Plan (WQMP)<br>7.3 Update of the Caltrans Stormwater Management Plan and Regional Plan<br>7.4 Update of US Air Force, March Air Reserve Base SWPPP | Plan/schedule due:<br>7.1 August 1, 2006<br>7.2 August 1, 2006<br>7.3 April 1, 2006<br>7.4 Dependent on Task 3 results. See text. |
| Task 8 | Forest Area – Review/Revision of Forest Service Management Plans | Plan/schedule due September 30, 2007 |
| Task 9 | Lake Elsinore In-Lake Sediment Nutrient Reduction Plan | Plan/schedule due March 31, 2007 |
| Task 10 | Canyon Lake In-Lake Sediment Treatment Evaluation | Plan/schedule due March 31, 2007 |
| Task 11 | Watershed and Canyon Lake and Lake Elsinore In-Lake Model Updates | Plan/schedule due March 31, 2007 |
| Task 12 | Pollutant Trading Plan | Plan/schedule due September 30, 2007 |
| Task 13 | Review and Revise Nutrient Water Quality Objectives | December 31, 2009 |
| Task 14 | Review of TMDL/WLA/LA | Once every 3 years to coincide with the Regional Board's triennial review |

**Task 1: Establish New Waste Discharge Requirements**

On or before March 31, 2006, the Regional Board shall issue new waste discharge requirements (NPDES permit) to Elsinore Valley Municipal Water District for supplemental water discharges to Canyon Lake that incorporate the appropriate interim and final wasteload allocations, compliance schedule and monitoring program requirements.

Other proposed nutrient discharges will be addressed and permitted as appropriate.

**Task 2: Review and/or Revise Existing Waste Discharge Requirements**

There are five Waste Discharge Requirements (WDRs) issued by the Regional Board regulating discharge of various types of wastes in the San Jacinto watershed. On or before March 31, 2006, each of these WDRs shall be reviewed and revised as necessary to implement the Lake Elsinore and Canyon Lake Nutrient TMDLs, including the appropriate nitrogen and phosphorus interim and final wasteload allocations, compliance schedules and/or monitoring program requirements.

2.1 Waste Discharge Requirements for the Riverside County Flood Control and Water Conservation District, the County of Riverside and the Incorporated Cities of Riverside County within the Santa Ana Region, Areawide Urban Runoff, NPDES No. CAS 618033 (Regional Board Order No. R8-2002-0011). The current Order has provisions to address TMDL issues (see Task 7.1, below). In light of these provisions, revision of the Order may not be necessary to address TMDL requirements.

2.2 Watershed-Wide Waste Discharge Requirements for Discharges of Storm Water Runoff Associated with New Developments in the San Jacinto Watershed, Order No. 01-34, NPDES No. CAG 618005. It is expected that this Order will be rescinded once the Regional Board/Executive Officer approves a Water Quality Management WQMP) under Order No. R8-2002-0011 (see 2.1, above and Task 7.2, below)

2.3 General Waste Discharge Requirements for Concentrated Animal Feeding Operations (Dairies and Related Facilities) within the Santa Ana Region, NPDES No. CAG018001 (Regional Board Order No. 99-11).

2.4 Waste Discharge and Producer/User Reclamation Requirements for the Elsinore Valley Municipal Water District, Regional Water Reclamation Facility Riverside County, Order No. 00-1, NPDES No. CA8000027. Revised permit specifications will take into consideration the Lake Elsinore Recycled Water Pilot Project findings.

2.5 Waste Discharge Requirements for Eastern Municipal Water District, Regional Water Reclamation System, Riverside County, Order No. 99-5, NPDES No. CA8000188[1]. Revised permit specifications will take into consideration the Lake Elsinore Recycled Water Pilot Project findings.

2.6 Waste Discharge Requirements for US Air Force, March Air Reserve Base, Storm Water Runoff, Riverside County, Order No. R8-2004-0033, NPDES CA 00111007

**Task 3: Identify Agricultural Operators**

On or before October 31, 2005, the Regional Board shall develop a list of all known agricultural operators in the San Jacinto watershed that will be responsible for implementing requirements of this TMDL. The Regional Board will send a notice to these operators informing them of their TMDL responsibility and alerting them to potential regulatory consequences of failure to comply.

**Task 4: Monitoring**

No later than December 31, 2005, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval monitoring program as required by Tasks 4.1, 4.2 and 4.3.

If modifications to the monitoring program are warranted, no later than December 31, 2006, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a revised proposed Watershed nutrient monitoring program (Task 4.1), Lake Elsinore monitoring program (Task 4.2) and Canyon Lake nutrient monitoring program (Task 4.3).

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval for the monitoring program specified in tasks 4.1, 4.2 and 4.3. Any such individual or

[1] Contingent on Eastern Municipal Water District discharge of recycled water to Lake Elsinore.

group monitoring plan is due no later than December 31, 2005. If needed, any individual or group revised monitoring plan is due no later than December 31, 2006.

## 4.1 Watershed-wide Nutrient Water Quality Monitoring Program

The US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a proposed watershed-wide nutrient monitoring program that will provide data necessary to review and update the Lake Elsinore and Canyon Lake Nutrient TMDL. Data to be collected and analyzed shall address, at a minimum: (1) determination of compliance with interim and/or final nitrogen and phosphorus allocations; and (2) determination of compliance with the nitrogen and phosphorus TMDL, including the WLAs and LAs.

At a minimum, the stations specified in Table 5-9t and shown in Figure 5-3, at the frequency specified in Table 5-9t, shall be considered for inclusion in the proposed monitoring plan. If one or more of these monitoring stations are not included, rationale shall be provided and proposed alternative monitoring locations shall be identified in the proposed monitoring plan. In addition to water quality samples, at a minimum, daily discharge (stream flow) determinations shall be made at all stations shown in Table 5-9t.

At a minimum, samples shall be analyzed for the following constituents:

- organic nitrogen
- nitrite nitrogen
- total phosphorus
- total hardness
- total suspended solids (TSS)
- biological oxygen demand (BOD)
- ammonia nitrogen
- nitrate nitrogen
- ortho-phosphate (SRP)
- total dissolved solids (TDS)
- turbidity
- chemical oxygen demand (COD)
- pH
- water temperature

The proposed monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the WLAs/LAs shall be submitted by August 15 of each year.

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. This individual monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report of data collected pursuant to approved individual/group plan(s) shall be submitted by August 15 of each year. The report shall summarize the data and evaluate compliance with the WLAs/LAs.

It may be that implementation of these monitoring requirements will be required through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and implemented upon the Regional Board's approval.

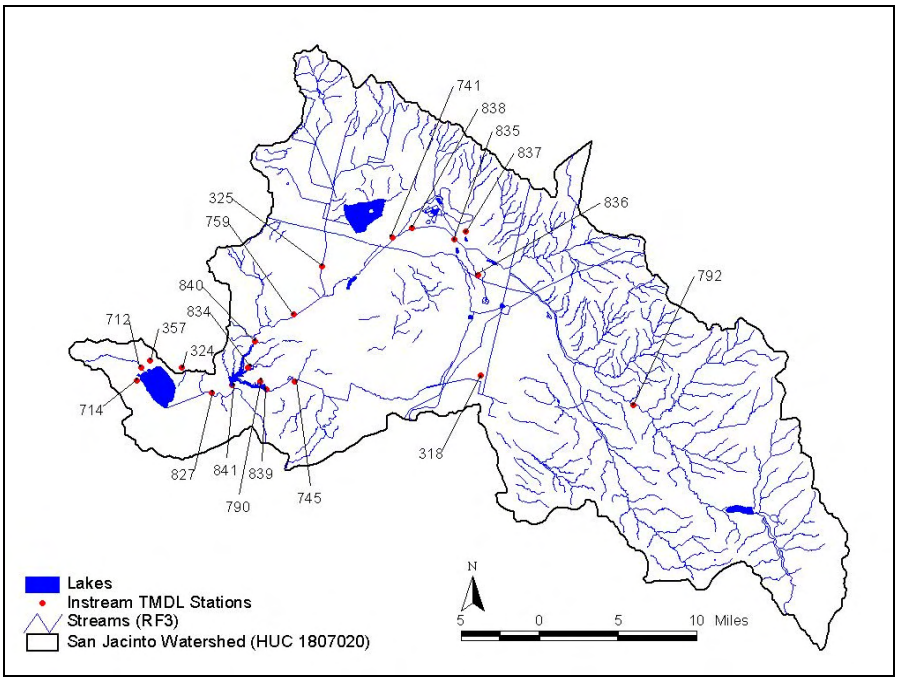



Figure 5-3 – San Jacinto River Watershed Nutrient TMDL Water Quality Stations Locations

Table 5-9t
Lake Elsinore and Canyon Lake Watershed
Minimum Required Sampling Station Locations

| Station Number | Station Description |
|---|---|
| 792 | San Jacinto River @ Cranston Guard Station |
| 318 | Hemet Channel at Sanderson Ave. |
| 745 | Salt Creek @ Murrieta Road |
| 759 | San Jacinto River @ Goetz Rd |
| 325 | Perris Valley Storm Drain @ Nuevo Rd. |
| 741 | San Jacinto River @ Ramona Expressway |
| 827 | San Jacinto River upstream of Lake Elsinore |
| 790 | Fair Weather Dr. Storm Drain in Canyon Lake |
| 357 | 4 Corners Storm Drain in Elsinore |
| 714 | Ortega Flood Channel in Elsinore |
| 324 | Lake Elsinore Outlet Channel |
| 712 | Leach Canyon Channel in Elsinore |
| 834 | Sierra Park Drain in Canyon Lake |
| 835 | Bridge Street and San Jacinto River |
| 836 | North Side of Ramona Expressway near Warren Road |
| 837 | Mystic Lake inflows |
| 838 | Mystic Lake outflows |
| 841 | Canyon Lake spillway |

Frequency of sampling at all stations: dry season – none; wet season; minimum of 3 storms/year whenever possible and 8 samples across each storm hydrograph

## 4.2 Lake Elsinore: In-Lake Nutrient Monitoring Program

The US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a proposed Lake Elsinore nutrient monitoring program that will provide data necessary to review and update the Lake Elsinore Nutrient TMDL. Data to be collected and analyzed shall address, at a minimum: determination of compliance with interim and final nitrogen, phosphorus, chlorophyll *a*, and dissolved oxygen numeric targets. In addition, the monitoring program shall evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Lake Elsinore.

At a minimum, the proposed plan shall include the collection of samples at the stations specified in Table 5-9u and shown in Figure 5-4, at the specified frequency indicated in Table 5-9u. With the exception of dissolved oxygen and water temperature, all samples to be analyzed shall be depth integrated.

The monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL shall be submitted by August 15 of each year.

Table 5-9u

Lake Elsinore Minimum Required Sampling Station Locations

| Station Number | Station Description |
|---|---|
| LE 14 | Lake Elsinore – inlet |
| LE 15 | Lake Elsinore – four corners |
| LE 16 | Lake Elsinore – mid-lake |

Frequency of sampling at all stations: monthly October through May; bi-weekly June through September.

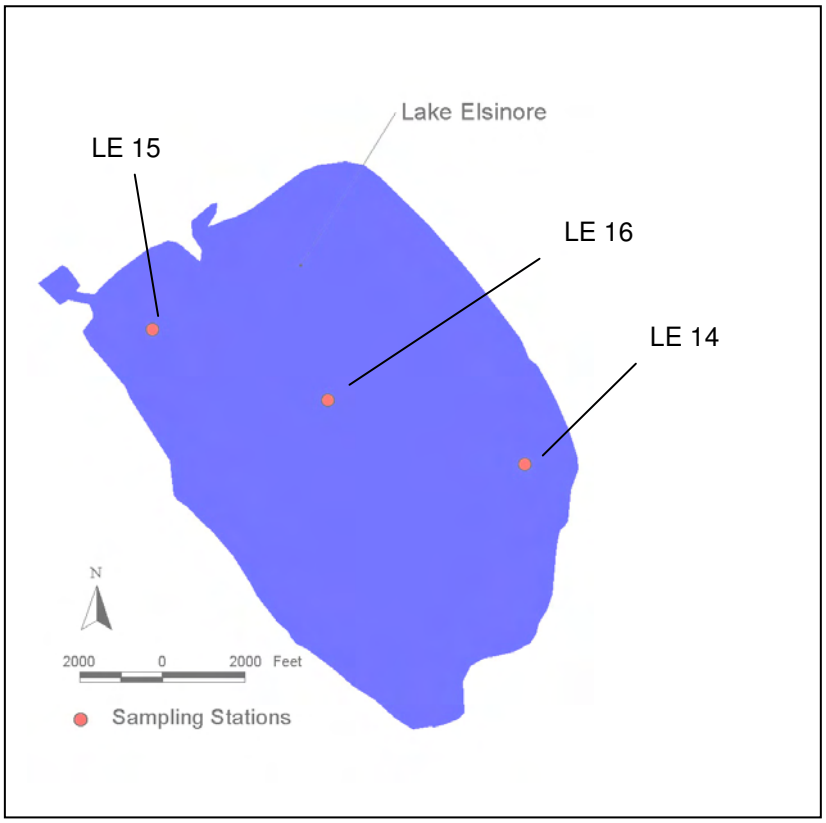



Figure 5-4 Lake Elsinore TMDL monitoring Stations

At a minimum, in-lake samples must be analyzed for the following constituents:

- specific conductance
- water temperature
- pH
- chlorophyll *a*
- organic nitrogen
- nitrite nitrogen
- organic phosphorus
- total hardness
- total dissolved solids (TDS)
- chemical oxygen demand (COD)
- dissolved oxygen
- water clarity (secchi depth)
- ammonia nitrogen
- nitrate nitrogen
- turbidity
- ortho-phosphate (SRP)
- total suspended solids (TSS)
- biological oxygen demand (BOD)

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. This individual monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report of data collected pursuant to approved individual/group plan(s), shall be submitted by August 15 of each year. The report shall summarize the data and evaluate compliance with the numeric targets.

It may be that implementation of these requirements will be required through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and implemented upon the Regional Board's approval.

### 4.3 Canyon Lake Nutrient Monitoring Program

The US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a proposed Canyon Lake nutrient monitoring program that will provide data necessary to review and update the Canyon Lake Nutrient TMDL. Data to be collected and analyzed shall address, at a minimum: determination of compliance with interim and final nitrogen, phosphorus, chlorophyll *a*, and dissolved oxygen numeric targets. In addition, the monitoring program shall evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Canyon Lake.

At a minimum, the proposed plan shall include the collection of samples at the stations specified in Table 5-9v and shown in Figure 5-5, at the specified frequency indicated in Table 5-9v. Discrete samples in Canyon Lake are to be collected in the epilimnion, hypolimnion and thermocline when and where appropriate.

The monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report summarizing the data collected for the year and evaluating compliance with the TMDL shall be submitted by August 15 of each year.

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Table 5-9v

Canyon Lake Minimum Required Sampling Station Locations

| Station Number | Station Description |
|---|---|
| CL 07 | Canyon Lake – At the Dam |
| CL 08 | Canyon Lake – North Channel |
| CL 09 | Canyon Lake – Canyon Bay |
| CL 10 | Canyon Lake – East Bay |

Frequency of sampling at all stations: monthly October through May; bi-weekly June through September.

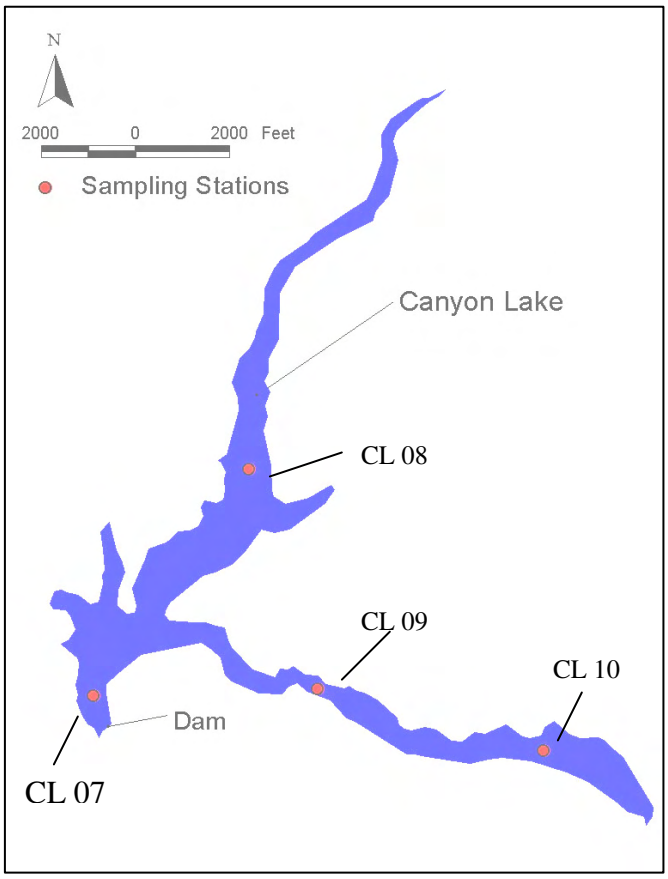



**Figure 5-5 – Canyon Lake Nutrient TMDL Monitoring Station Locations**

At a minimum, in-lake samples must be analyzed for the following constituents:

- specific conductance
- water temperature
- pH
- chlorophyll *a*
- organic nitrogen
- nitrite nitrogen
- organic phosphorus
- total hardness
- total dissolved solids (TDS)
- chemical oxygen demand (COD)
- dissolved oxygen
- water clarity (secchi depth)
- ammonia nitrogen
- nitrate nitrogen
- turbidity
- ortho-phosphate (SRP)
- total suspended solids (TSS)
- biological oxygen demand (BOD)

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. This individual plan shall be implemented upon Regional Board approval at a duly noticed public meeting. An annual report of data collected pursuant to approved individual/group plan(s) shall be submitted by August 15 of each year. The report shall summarize the data and evaluate compliance with the numeric targets.

It may be that implementation of these requirements will be required through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and implemented upon the Regional Board's approval.

### Task 5: Agricultural Activities

No later than September 30, 2007, the agricultural operators within the Lake Elsinore and Canyon Lake watershed (see Task 2), in cooperation with the Riverside County Farm Bureau, the UC Cooperative Extension, Western Riverside County Ag Coalition shall, as a group, submit a proposed Nutrient Management Plan (NMP). The Nutrient Management Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

In lieu of a coordinated plan, one or more of the parties identified above may submit a proposed individual or group Nutrient Management Plan to conduct the above studies for areas within their jurisdiction. Any such individual or group plan shall also be submitted for Regional Board approval no later than September 30, 2007. This Nutrient Management Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

At a minimum, the NMP shall include, plans and schedules for the following. In order to facilitate any needed update of the numeric targets and/or the TMDLs and/or agricultural LA, the proposed schedule shall take into consideration the Regional Board's triennial review schedule.

- implementation of nutrient controls, BMPs and reduction strategies designed to meet load allocations;
- evaluation of effectiveness of BMPs;
- development and implementation of compliance monitoring; and
- development and implementation of focused studies that will provide the following data and information
  - inventory of crops grown in the watershed;
  - amount of manure and/or fertilizer applied to each crop with corresponding nitrogen and phosphorus amounts; and
  - amount of nutrients discharged from croplands.

The Regional Board expects that the NMP will be submitted and implemented pursuant to these TMDL requirements. Where and when necessary to implement these requirements, the Regional Board will issue appropriate waste discharge requirements.

Compliance with the agricultural load allocation may be achieved through a Regional Board approved pollutant trading program.

## Task 6: On-site Disposal Systems (Septic System) Management Plan

No later than 6 months after the effective date of an agreement between the County of Riverside and the Regional Board to implement regulations adopted pursuant to Water Code Sections 13290-13291.7, or if no such agreement is required or completed, within 12 months of the effective date of these regulations, the County of Riverside and the Cities of Perris, Moreno Valley and Murrieta shall, as a group, submit a Septic System Management Plan to identify and address nutrient discharges from septic systems within the San Jacinto watershed. The Septic System Management Plan shall implement regulations adopted by the State Water Resources Control Board pursuant to California Water Code Section 13290 – 13291.7.

At a minimum, the Septic System Management Plan shall include plans and schedules for the development and implementation of the following. In order to facilitate any needed update of the numeric targets and/or the TMDLs and septic system LA, the proposed schedule shall take into consideration the Regional Board's triennial review schedule.

- public education program;
- tracking system, including maintenance thereof;

- maintenance standards;
- enforcement provisions;
- monitoring program; and
- sanitary survey.

In lieu of a coordinated plan, one or more of the agencies with septic system oversight responsibilities may submit an individual or group Management Plan to develop the above Plan for areas within their jurisdiction. Any such individual or group plan shall also be submitted no later than March 31, 2006. This Septic System Management Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

Compliance with the septic systems load allocation may be achieved through a Regional Board approved pollutant trading program.

**Task 7: Urban Discharges**

Urban discharges, including stormwater runoff, are those discharges from the cities and unincorporated communities in the San Jacinto River watershed. These discharges are regulated under the Riverside County MS4 NPDES permit, the San Jacinto Watershed Construction Activities Storm Water permit, the State Board's General Permit for Storm Water Runoff from Construction Activities, and the State Board's General Permit for Storm Water Runoff from Industrial Activities. Nuisance and stormwater runoff from state highways and right of ways is regulated under the State of California, Department of Transportation (Caltrans) statewide general NPDES permit. Finally, nuisance and stormwater runoff from the March Air Reserve Base is also regulated through an NPDES permit.

7.1 Revision to the Drainage Area Management Plan (DAMP)

Provision XIII.B. of Order No. R8-2002-0011 (see 2.1, above) requires the permittees to revise their Drainage Area Management Plan (DAMP) to include TMDL requirements. By August 1, 2006, the permittees shall review and revise the DAMP and or WQMP (see 7.2 below) as necessary to address the requirements of these nutrient TMDLs. Further review and revision of the DAMP needed to address these TMDLs shall be completed in accordance with the requirements of Order No. R8-2002-0011 or amendments/updates thereto that are adopted by the Regional Board at a public hearing. The DAMP revisions shall include schedules for meeting the interim and final nutrient wasteload allocations. In order to facilitate any needed update of the numeric targets and/or the TMDLs and urban discharge WLA, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. The revised DAMP/WQMP shall also include a proposal for 1) evaluating the effectiveness of BMPs and other control actions implemented and 2) evaluating compliance with the nutrient waste load allocation for urban runoff. The proposal must be implemented upon approval by the Regional Board after public notice and public hearing, or upon approval by the Executive Officer if no significant comments are received during the public notice period.

7.2 Revision of the Water Quality Management Plan (WQMP)

Provision VIII.B. of Order No. R8-2002-0011 (see 2.1, above) requires the permittees to develop and submit a WQMP by June 2004 for approval. On September 17, 2004, the Board approved a WQMP developed by the permittees. The approved WQMP includes source control BMPs, design BMPs and treatment control BMPs. Further revisions to the WQMP and/or the DAMP may be necessary to meet the WLA for urban runoff. By August 1, 2006, the permittees shall submit a revised WQMP and/or revised DAMP (see 7.1 above) that addresses the nutrient input from new developments and significant redevelopments to assure compliance with the nutrient wasteload allocations for urban runoff. The WQMP shall also address requirements currently in Order No. 01-34 (see 2.2, above). Once the WQMP is approved, Order No. 01-34 may be rescinded. Further review and revision of the WQMP necessary to assure that TMDL requirements are addressed shall be completed in accordance with the requirements of Order No. R8-2002-0011 or amendments/updates thereto that are adopted by the Regional Board at a public hearing.

7.3 Revision of the State of California, Department of Transportation (Caltrans) Stormwater Permit

Provision E.1 of Order No. 99-06-DWQ requires Caltrans to maintain and implement a Storm Water Management Plan (SWMP). Annual updates of the SWMP needed to maintain an effective program are required to be submitted to the State Water Resources Control Board.

Provision E.2 of Order No. 99-06-DWQ requires Caltrans to submit a Regional Workplan by April 1 of each year for the Executive Officer's approval. By April 1, 2006, Caltrans shall submit a Regional Workplan that includes plans and schedules for meeting the interim and final nutrient wasteload allocations, and provides a proposal for 1) evaluating the effectiveness of BMPs and other control actions implemented and 2) evaluating compliance with the nutrient waste load allocations for urban runoff , which includes runoff from Caltrans facilities. In order to facilitate any needed update of the numeric targets and/or the TMDLs and urban discharge WLA, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. The proposal shall be implemented upon the Executive Officer's approval. Annual updates to the Regional Workplan shall include, as necessary, revised plans and schedules for meeting the interim and final nutrient wasteload allocations and revised proposals for evaluating the efficacy of control actions and compliance with the nutrient wasteload allocations.

7.4 Revision to the United States Air Force, March Air Reserve Base, Stormwater Permit

Order No. R8-2004-0033 specifies monitoring and reporting requirements for stormwater runoff from the US Air Force, March Air Reserve facility. Provision C.17

indicates that the order could be reopened to incorporate TMDL requirements. Provisions C.18.a and C.18.b require that March Air Reserve Base submit a report and revise the Stormwater Pollution Prevention Plan (SWPPP) to address any pollutants that may be causing or contributing to exceedances of water quality standards. Results from the TMDL nutrient monitoring program conducted pursuant to Task 3, shall serve as the basis for revision of the SWPPP and/or reopening the order.

Development of the Municipal permittee's WQMP and revisions to their DAMP, development of the Caltrans SWMP and Regional Workplan, and Revision to the March Air Reserve Base SWPPP, shall address the urban component of the nutrient TMDL.

Compliance with the urban wasteload allocation may be achieved through a Regional Board approved pollutant trading program.

### Task 8: Forest Area –Identification of Forest Lands Management Practices

No later than September 30, 2007, the US Forest Service shall submit for approval a plan with a schedule for identification, development and implementation of Management Practices to reduce nutrient discharges emanating from the Cleveland National Forest and the San Bernardino National Forest . The Plan shall identify watershed-specific appropriate Best Management Practices (BMPs) that will be implemented to achieve the interim and final load allocations for forest/. The proposal shall include specific recommendations and a schedule for 1) evaluating the effectiveness of control actions implemented to reduce nutrient discharges from forest and 2) evaluating compliance with the nutrient load allocation from forest/open space. The revised watershed-specific Management Practices shall be implemented upon Regional Board approval at a duly noticed public meeting.

Compliance with the open space/forest load allocation may be achieved through a Regional Board approved pollutant trading program.

### Task 9: Lake Elsinore Sediment Nutrient Reduction Plan

No later than March 31, 2007, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, the State of California, Department of Transportation (Caltrans), the State of California, Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a proposed plan and schedule for in-lake sediment nutrient reduction for Lake Elsinore. The proposed plan shall include an evaluation of the applicability of various in-lake treatment technologies to prevent the

release of nutrients from lake sediments to support development of a long-term strategy for control of nutrients from the sediment. The submittal shall also contain a proposed sediment nutrient monitoring program to evaluate the effectiveness of any strategies that are implemented. The Lake Elsinore In-lake Sediment Nutrient Reduction Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

In lieu of this coordinated plan, one or more of the parties identified above may submit a proposed individual or group In-lake Sediment Nutrient Reduction Plan for approval by the Regional Board. Any such individual or group Plan is due no later than March 31, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting.

Compliance with the Lake Elsinore Sediment Nutrient Reduction Plan requirement may be achieved through a Regional Board approved pollutant trading program.

**Task 10: Canyon Lake Sediment Nutrient Treatment Evaluation Plan**

No later than March 31, 2007, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Murrieta, Riverside and Beaumont, Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators within the San Jacinto watershed shall, as a group, submit to the Regional Board for approval a proposed plan and schedule for evaluating in-lake sediment nutrient treatment strategies for Canyon Lake. The proposed plan shall include an evaluation of the applicability of various in-lake treatment technologies to prevent the release of nutrients from lake sediments in order to develop a long-term strategy for control of nutrients from the sediment. The submittal shall also contain a proposed sediment nutrient monitoring program to evaluate the effectiveness of any strategies that are implemented. The Canyon Lake In-lake Sediment Nutrient Treatment Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

In lieu of this coordinated plan, one or more of the parties identified above may submit a proposed individual or group In-lake Sediment Nutrient Treatment Evaluation Plan for approval by the Regional Board. Any such individual or group Plan is due no later than March 31, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting.

**Task 11: Update of Watershed and In-Lake Nutrient Models**

No later than March 31, 2007, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities

of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators shall, as a group, submit to the Regional Board for approval a proposed plan and schedule for updating the existing Lake Elsinore/San Jacinto River Nutrient Watershed Model and the Canyon Lake and Lake Elsinore in-lake models. The plan and schedule must take into consideration additional data and information that are generated from the respective TMDL monitoring programs. In order to facilitate any needed update of the numeric targets and/or the TMDLs/WLAs/LAs, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. The plan for updating the Watershed and In-lake Models shall be implemented upon Regional Board approval at a duly noticed public meeting.

In lieu of this coordinated plan, one or more of the parties identified above may submit a proposed individual or group plan for update of the Lake Elsinore/San Jacinto River Nutrient Watershed Model and the Canyon Lake and Lake Elsinore in-lake models. The plan and schedule must take into consideration additional data and information that are generated from the respective TMDL monitoring programs. In order to facilitate any needed update of the numeric targets and/or the TMDLs/WLAs/LAs, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. Any such individual or group Plan is due no later than March 31, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting.

**Task 12: Pollutant Trading Plan**

No later than September 30, 2007, the US Forest Service, the US Air Force (March Air Reserve Base), March Joint Powers Authority, California Department of Transportation (Caltrans), California Department of Fish and Game, the County of Riverside, the cities of Lake Elsinore, Canyon Lake, Hemet, San Jacinto, Perris, Moreno Valley, Riverside and Beaumont, Eastern Municipal Water District[1], Elsinore Valley Municipal Water District, concentrated animal feeding operators and other agricultural operators shall, as a group, submit to the Regional Board for approval a proposed Pollutant Trading Plan. At a minimum, this plan shall contain a plan, schedule and funding strategy for project implementation, an approach for tracking pollutant credits and a schedule for reporting status of implementation of the Pollutant Trading Plan to the Regional Board, The Pollutant Trading Plan shall be implemented upon Regional Board approval at a duly noticed public meeting.

In lieu of this coordinated plan, one or more of the parties identified above may submit a proposed individual or group Pollutant Trading Plan. Any such individual or group Plan is due no later than September 30, 2007 and shall be implemented upon Regional Board approval at a duly noticed public meeting.

**Task 13: Review and Revision of Water Quality Objectives**

By December 31, 2009, the Regional Board shall review and revise as necessary the total inorganic nitrogen numeric water quality objectives for Lake Elsinore and Canyon Lake. In addition, the Regional Board shall evaluate the appropriateness of establishing total phosphorus and un-ionized ammonia numeric water quality objectives for both Lake Elsinore and Canyon Lake. Given budgetary constraints, completion of this task is likely to require substantive contributions from interested parties.

**Task 14: Review/Revision of the Lake Elsinore/Canyon Lake Nutrient TMDL**

The basis for the TMDLs and implementation schedule will be re-evaluated at least once every three years[2] to determine the need for modifying the load allocations, numeric targets and TMDLs. Regional Board staff will continue to review all data and information generated pursuant to the TMDL requirements on an ongoing basis. Based on results generated through the monitoring programs, special studies, modeling analysis, and/or special studies by one or more responsible parties, changes to the TMDL, including revisions to the numeric targets, may be warranted. Such changes would be considered through the Basin Plan Amendment process.

The Regional Board is committed to the review of this TMDL every three years, or more frequently if warranted by these or other studies

**(End of Resolution No. R8-2004-0037)**

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[2] The three-year schedule will coincide with the Regional Board's triennial review schedule.

## Middle Santa Ana River Watershed (Amended by Resolution No. R8-2005-0001)

The Middle Santa Ana River Watershed covers approximately 488 square miles and lies largely in the southwestern corner of San Bernardino County, and the northwestern corner of Riverside County. A small part of Los Angeles County (Pomona/Claremont area) is also included. This watershed is comprised of three sub–watersheds. The first sub-watershed is the Chino Basin Watershed, which includes portions of San Bernardino County, Los Angeles County, and Riverside County. Surface drainage in this area is directed to Chino Creek and Cucamonga/Mill Creek and is generally southward, from the San Gabriel Mountains toward the Santa Ana River and the Prado Flood Control Basin. The second sub–watershed, the Riverside Watershed, is located in Riverside County. Surface drainage in this area is generally westward from the City of Riverside to the Santa Ana River, Reach 3. The third sub–watershed, the Temescal Canyon Watershed, is also located in Riverside County. Surface drainage in this area is generally northward to Temescal Creek.

Land uses in the Middle Santa Ana River watershed include urban, agriculture, and open space. Although originally developed as an agricultural area, the watershed is being steadily urbanized. Incorporated cities in the Middle Santa Ana River watershed include Pomona, Chino Hills, Upland, Montclair, Claremont, Ontario, Rancho Cucamonga, Rialto, Chino, Fontana, Norco, Corona, and Riverside. In addition, there are several pockets of urbanized unincorporated areas. The current population of the watershed, based upon 2000 census data, is approximately 1.4 million people. The principal remaining agricultural area in the watershed is the area formerly known as the Chino Dairy Preserve. This area is located in the south–central part of the Chino Basin watershed and contains approximately 300,000 cows, which generate the waste equivalent of more than two million people. Recently, the cities of Ontario and Chino annexed the San Bernardino County portions of this area. The remaining portion of the former preserve, which is in Riverside County, remains unincorporated. Open space areas include National Forest lands and State Parks lands.

## Middle Santa Ana River Watershed Bacterial Indicator Total Maximum Daily Loads(TMDLs)

Middle Santa Ana River Watershed waterbodies listed on the Clean Water Act Section 303(d) list of impaired waters due to violations of REC1 fecal coliform bacteria objectives are shown in Table 5-9w.

Table 5-9w – Middle Santa Ana River Watershed Waterbodies on the 303(d) List Due to Bacterial Contamination

| Waterbody, Reach |
|---|
| Santa Ana River, Reach 3 |
| Chino Creek, Reach 1 |
| Chino Creek, Reach 2 |
| Mill Creek (Prado Area) |
| Cucamonga Creek, Reach 1 |
| Prado Park Lake |

During storm events, these waterbodies receive and transport runoff from urban, agricultural, and open space areas. During dry weather, these waterbodies receive and transport nuisance runoff, primarily from urban areas. Based on monitoring results, and observed waterbody conditions (fish kills and waste-laden stormflows), the Regional Board placed these waterbodies on the 303(d) list of impaired waters due to levels of bacterial indicators that exceeded established objectives for REC1 uses. The listings took place from 1988 to 1998.
A TMDL technical report prepared by Regional Board staff describes the bacterial indicator related problems in the Middle Santa Ana River Watershed waterbodies in greater detail and discusses the technical basis for the TMDLs that follow [Ref. # 30].

## A. Middle Santa Ana River Watershed Bacterial Indicator TMDL Numeric Targets

Bacterial indicator numeric targets for the Middle Santa Ana River Watershed waterbodies shown in Table 5-9x are based, in part, on the fecal coliform water quality objective specified in Chapter 4 for the protection of body-contact recreation (REC1) in inland surface waters.

Recognizing that, in the future, *Escherichia coli* (*E. coli*) may be incorporated into the Basin Plan as new bacterial water quality objectives for REC1, alternative numeric targets for *E. coli* are also specified[1]. These targets are based on *E. coli* criteria recommended by the U.S. Environmental Protection Agency [Ref #31]. The *E. coli* levels were chosen to roughly correspond to the health risk level associated with the fecal coliform objectives.

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[1] USEPA is requiring the states to evaluate and incorporate more appropriate bacterial indicators, including *E. coli*, as water quality standards based on its Ambient Water Quality Criteria for Bacteria – 1986. The Regional Board is participating in the efforts of the Storm Water Quality Standards Task Force (SWQSTF), which is evaluating USEPA's bacterial indicator recommendations and REC1 beneficial use designations for waterbodies within the Santa Ana Region, including the Middle Santa Ana River watershed waterbodies. This numeric target and resulting TMDLs, WLAs and LAs will be adjusted accordingly when and if recommendations from the SWQSTF are incorporated into the Basin Plan.

The numeric targets for both bacterial indicators incorporate an explicit 10% margin of safety to address uncertainties recognized in the development of the TMDLs.

These numeric targets are specified as follows:

> **Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples per 30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30–day period**.
>
> ***E. coli*: log mean less than 126 organisms/100 mL based on five or more samples per 30–day period, and not more than 10% of the samples exceed 235 organisms/100mL for any 30 day period.**

The fecal coliform numeric targets (and other fecal coliform related provisions of these TMDLs) will become ineffective upon the replacement of the fecal coliform REC1 objectives in the Basin Plan with REC1 objectives based on *E. coli* Incorporation of new *E. coli* objectives will be considered through the Basin Planning process.

## B. Middle Santa Ana River Watershed Bacterial Indicator TMDLs, Wasteload Allocations, Load Allocations and Compliance Dates

As discussed in the technical TMDL Report, the bacterial indicator TMDLs are expressed in terms of density since it is the number of organisms in a given volume of water (i.e., their density), and not their mass that is significant with respect to public health and the protection of beneficial uses. Similarly, the wasteload allocations for point source discharges (WLAs) and load allocations for nonpoint source discharges (LAs) are also based on density. The density–based WLAs and LAs do not add up to equal the TMDLs, since this is not scientifically valid. To achieve the density–based TMDLs, each WLA and LA must meet the density–based TMDL. As indicated in Table 5-9x, the TMDLs, WLAs and LAs also include a 10% margin of safety (see C., below) applied to the existing Basin Plan fecal coliform objective for REC1 for inland surface waters and to the alternative indicator *E. coli* criteria recommended by the U.S. Environmental Protection Agency. Again, the *E. coli* was chosen to correspond with the health risk level associated with the fecal coliform objectives.

WLAs are specified for urban discharges and discharges from Confined Animal Feeding Operations, including stormwater. LAs are specified for runoff from other types of agriculture and from natural sources (open space/undeveloped forest land). TMDLs, WLAs and LAs are specified for both dry weather discharges and wet weather discharges, with separate compliance schedules. An extended schedule for compliance with the wet weather TMDLs is specified in light of the expected increased difficulty in achieving compliance under these conditions.

**Table 5-9x – Total Maximum Daily Loads, Waste Load Allocations, and Load Allocations for Bacterial Indicators in Middle Santa Ana River Waterbodies[a,b,c]**

| Indicator | Total Maximum Daily Loads for Bacterial Indicators | Waste Load Allocation for Bacterial Indicators in Urban Runoff including stormwater discharges | Waste Load Allocation for Bacterial Indicators in Confined Animal Feeding Operations discharges | Load Allocation for Bacterial Indicators in Agricultural runoff discharges | Load Allocation for Bacterial Indicators from Natural Sources |
|---|---|---|---|---|---|
| **Dry Summer Conditions: April 1 through October 31, as soon as possible, but no later than December 31, 2015** | | | | | |
| **Fecal coliform** | 5–sample/30–day Logarithmic Mean less than 180 organisms/100mL, and not more than 10% of the samples exceed 360 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100mL, and not more than 10% of the samples exceed 360 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100mL, and not more than 10% of the samples exceed 360 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100mL, and not more than 10% of the samples exceed 360 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100mL, and not more than 10% of the samples exceed 360 organisms/100mL for any 30–day period. |
| **E. coli** | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. |
| **Wet Winter Conditions: November 1 through March 31, as soon as possible, but no later than December 31, 2025** | | | | | |
| **Fecal coliform** | 5–sample/30–day Logarithmic Mean less than 180 organisms/100ml, and not more than 10% of the samples exceed 360 organisms/100ml for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100ml, and not more than 10% of the samples exceed 360 organisms/100ml for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100ml, and not more than 10% of the samples exceed 360 organisms/100ml for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100ml, and not more than 10% of the samples exceed 360 organisms/100ml for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 180 organisms/100ml, and not more than 10% of the samples exceed 360 organisms/100ml for any 30–day period. |
| **E. coli** | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. | 5–sample/30–day Logarithmic Mean less than 113 organisms/ 100mL, and not more than 10% of the samples exceed 212 organisms/100mL for any 30–day period. |

[a] To be achieved as soon as possible, but no later than dates specified.
[b] TMDLs, WLAs and LAs, include a 10% Margin of Safety
[c] The fecal coliform TMDLs, WLAs, and LAs become ineffective upon the replacement of the REC1 fecal coliform objectives in the Basin Plan by approved REC1 objectives based on E. coli.

## C. Margin of Safety

A 10% margin of safety is explicitly incorporated into the Bacterial Indicator TMDLs for the Middle Santa Ana River Watershed to account for unknowns, such as bacterial regrowth, bacteria dilution and organism die–off. As additional data on bacterial dynamics in the Middle Santa Ana River watershed are developed, the margin of safety can be adjusted accordingly.

## D. Seasonal Variations/Critical Conditions

The Basin Plan REC1 fecal coliform objectives apply year-round; no distinctions based on climate or other conditions that may affect actual REC1 use are specified[2]. As shown in Table 5-9x, different compliance dates are specified for dry season discharges and wet season discharges. This ensures that dry season recreational beneficial uses are addressed on a priority basis. Additional time is allowed to address complexities associated with the control of wet weather discharges.

## E. TMDL Implementation

Implementation is expected to result in compliance with the water quality objectives/numeric targets for fecal coliform and with the numeric targets for *E. coli*. The intent is to ensure protection of the REC1 beneficial uses of Middle Santa Ana River Watershed waterbodies. Collection of additional monitoring data is critical to developing long-term solutions for bacterial indicator control, as well as to consider whether changes to the TMDL are appropriate. With that in mind, the requirements for submittal of plans and schedules to implement the TMDLs take into consideration the need to develop and implement effective short-term solutions, as well as allow for the development of long-term solutions once additional data have been generated.

Implementation of tasks and schedules as specified in Table 5-9y is expected to achieve compliance with the TMDLs and, thereby, water quality standards. Each of these tasks is described below.

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[2] The SWQSTF may recommend changes to the REC1 objectives to reflect conditions, such as high flows, that affect REC1 use. Any such changes will be considered through the Basin Planning process

**Table 5-9y – Middle Santa Ana River Watershed Bacterial Indicator TMDL Implementation Plan/Schedule Due Dates**

| Task | Description | Compliance Date-As soon As Possible but No Later Than |
|---|---|---|
| ***TMDL Phase 1*** | | |
| Task 1 | Revise Existing Waste Discharge Requirements | February 28, 2008 |
| Task 2 | Identify Agricultural Operators | June 30, 2007 |
| Task 3 | Develop Watershed-Wide Bacterial Indicator Water Quality Monitoring Program<br><br>Implement Watershed-Wide Bacterial Indicator Water Quality Monitoring Program | November 30, 2007<br><br>Upon Regional Board approval<br><br>Seasonal reports due May 31 and December 31 of each year<br><br>Triennial reports due every 3 years beginning with first report due February 15, 2010. |
| Task 4 | Urban Discharges<br><br>4.1 Develop and Implement Bacterial Indicator Urban Source Evaluation Plan<br><br>4.2 San Bernardino County MS4: Revise Municipal Storm Water Management Program (MSWMP)<br><br>4.3 Riverside County MS4: Revise Drainage Area Management Plan (DAMP)<br><br>4.4 San Bernardino County MS4: Revise Water Quality Management Plan (WQMP)<br><br>4.5 Riverside County MS4: Revise Water Quality Management Plan (WQMP) | Plan/schedule due<br><br>4.1 November 30, 2007<br><br>4.2 Dependent on Task 4.1 results (see text)<br><br>4.3 Dependent on Task 4.1 results (see text)<br><br>4.4 Dependent on Task 4.1 results (see text)<br><br>4.5 Dependent on Task 4.1 results (see text) |
| Task 5 | Agricultural Discharges<br><br>5.1 Develop and Implement Bacterial Indicator Agricultural Source Evaluation Plan<br><br>5.2 Develop and Implement Bacterial Indicator Agricultural Source Management Plan | Plan/schedule due<br><br>5.1 November 30, 2007<br><br>5.2 Dependent on Task 5.1 results (see text) |
| Task 6 | Review of TMDLs/WLAs/LAs | Once every 3 years to coincide with the Regional Board's triennial review, or more frequently as warranted |

## Task 1: Review and/or Revise Existing Waste Discharge Requirements

There are three Waste Discharge Requirements (WDRs) issued by the Regional Board regulating discharge of various types of wastes in the watershed. On or before **February 28, 2008**, each of these WDRs shall be reviewed and revised as necessary to implement the TMDLs, including the appropriate wasteload allocations, compliance schedules and/or monitoring program requirements.

1.1 Waste Discharge Requirements for the San Bernardino County Flood Control and Transportation District, the County of San Bernardino and the Incorporated Cities of San Bernardino County within the Santa Ana Region, Areawide Urban Runoff, NPDES No. CAS 618036 (Regional Board Order No. R8-2002-0012). The current Order has provisions to address TMDL issues (see Task 4, below). In light of these provisions, revision of the Order may not be necessary to address TMDL requirements.

1.2 Waste Discharge Requirements for the Riverside County Flood Control and Water Conservation District, the County of Riverside and the Incorporated Cities of Riverside County within the Santa Ana Region, Areawide Urban Runoff, NPDES No. CAS 618033 (Regional Board Order No. R8-2002-0011). The current Order has provisions to address TMDL issues (see Task 4, below). In light of these provisions, revision of the Order may not be necessary to address TMDL requirements.

1.3 General Waste Discharge Requirements for Concentrated Animal Feeding Operations (Dairies and Related Facilities) within the Santa Ana Region, NPDES No. CAG018001 (Regional Board Order No. 99-11). Updated waste discharge requirements for Concentrated Animal Feeding Operations are expected to be considered by the Regional Board in 2005. These requirements will include appropriate TMDL requirements.

Other waste discharge requirements may be reviewed and/or revised to address bacterial indicator discharges as appropriate.

## Task 2: Identify Agricultural Operators

On or before **June 30, 2007**, the Regional Board shall develop a list of all known agricultural owners/operators in the Middle Santa Ana River watershed that will be responsible for implementing requirements of these TMDLs. The Regional Board will send a notice to these operators informing them of their TMDL responsibility and alerting them to the potential regulatory consequences of failure to comply.

To implement the agricultural load allocations for non-Concentrated Animal Feeding Operations, monitoring program requirements specified in Task 3 and the agricultural source evaluation studies (Task 5), the Regional Board may issue waste discharge requirements or a waiver of such waste discharge requirements that is conditioned on satisfactory compliance with these TMDL elements.

**Task 3: Watershed-Wide Bacterial Indicator Water Quality Monitoring Program**

No later than **November 30, 2007**, the US Forest Service, the County of San Bernardino, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, and Corona, Pomona and Claremont and agricultural operators in the watershed, shall as a group, submit to the Regional Board for approval a proposed watershed-wide monitoring program that will provide data necessary to review and update the TMDLs. Data to be collected and analyzed shall address, at a minimum, determination of compliance with the TMDLs, WLAs and LAs.

At a minimum, the stations specified in Tables 5-9z and 5-9aa and shown in Figure 5-6, at the frequency specified in Tables 5-9z and 5-9aa, shall be considered for inclusion in the proposed monitoring plan. If one or more of these monitoring stations are not included, the rationale shall be provided and proposed alternative monitoring locations shall be identified in the proposed monitoring plan. The proposed monitoring plan shall also include a plan to compile streamflow measurements at existing USGS stream gauging stations.

At a minimum, samples shall be analyzed for the following constituents:

- Fecal Coliform
- Escherichia Coli (E. coli)
- Total Suspended Solids
- pH
- Temperature
- Electrical Conductivity
- Dissolved Oxygen
- Turbidity

The proposed monitoring plan shall be implemented upon Regional Board approval at a duly noticed public meeting. Seasonal reports summarizing and including copies of the data collected during the dry season and wet season monitoring periods shall be submitted by May 31 and December 31 of each year. In order to facilitate review and update of the numeric targets and/or the TMDLs, WLAs, LAs, a triennial report summarizing the data collected for the preceding 3 year period and evaluating compliance with the WLAs/LAs shall be submitted every three years, beginning with the first report due February 15, 2010.

In lieu of this coordinated monitoring plan, one or more of the parties identified above may submit a proposed individual or group monitoring plan for Regional Board approval. Any such individual or group monitoring plan is due no later than **November 30, 2007** and shall be implemented upon Regional Board approval at a duly noticed public

meeting. Seasonal reports summarizing and including copies of the data collected during the dry season and wet season monitoring periods shall be submitted by May 31 and December 31 of each year. In order to facilitate review and update of the numeric targets and/or the TMDLs, WLAs, LAs, a triennial report summarizing the data collected for the preceding 3 year period and evaluating compliance with the WLAs/LAs shall be submitted every three years, beginning with the first report due **February 15, 2010**.

It may be that implementation of these monitoring requirements will be required through the issuance of Water Code Section 13267 letters to the affected parties. The monitoring plan(s) will be considered by the Regional Board and shall be implemented upon the Regional Board's approval.

Table 5-9z – Watershed Minimum Required Weekly Sampling Station Locations

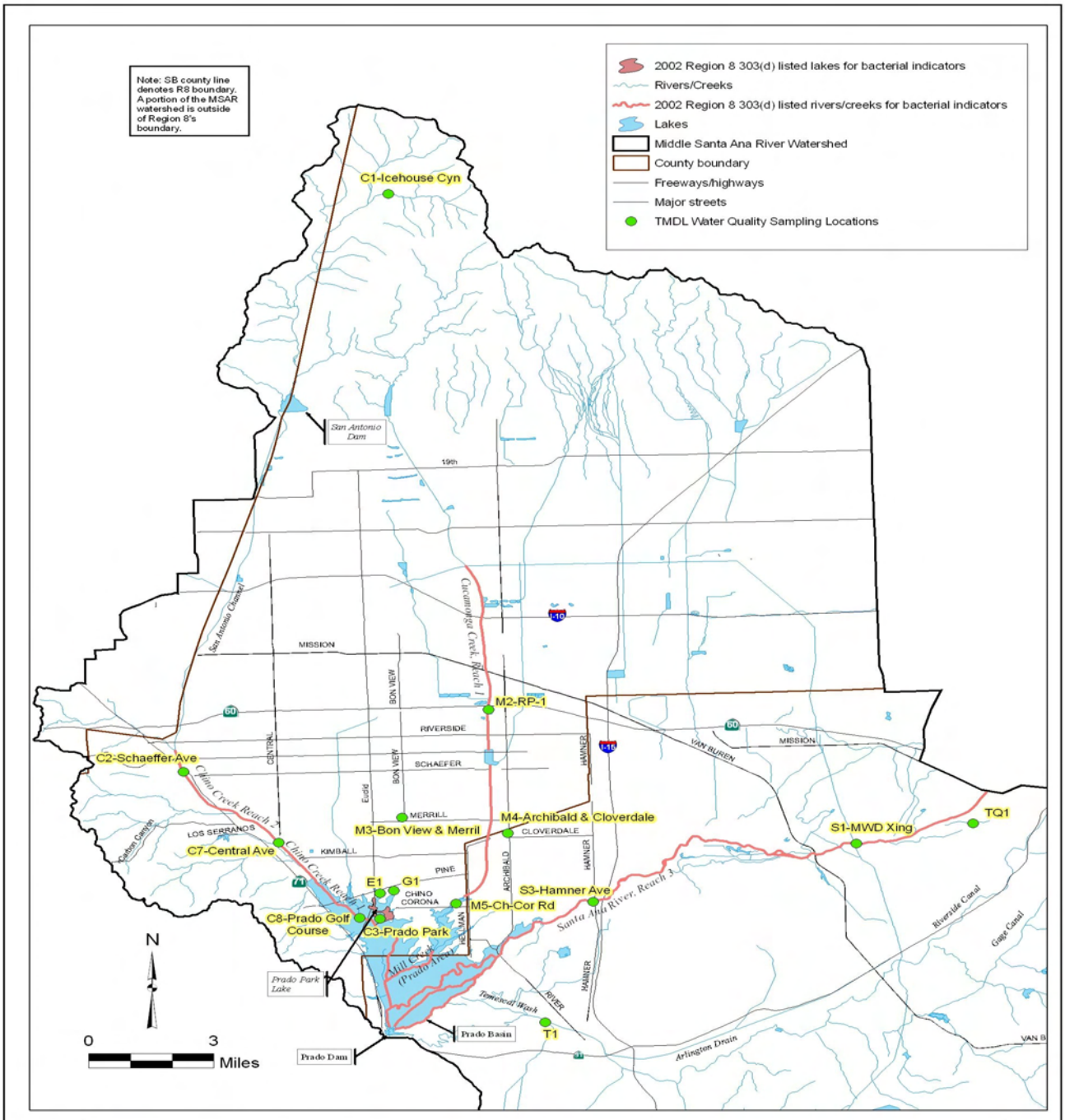
| **Station Number** | **Station Description** |
|---|---|
| C1 | Icehouse Canyon Creek |
| C2 | Chino Creek at Schaeffer Avenue |
| C3 | Prado Park Lake at lake outlet |
| C7 | Chino Creek at Central Avenue |
| C8 | Chino Creek at Prado Golf Course |
| M2 | Cucamonga Creek at Regional Plant No. 1 |
| M5 | Mill Creek at Chino–Corona Road |
| S1 | Santa Ana River at MWD Crossing |
| S3 | Santa Ana River at Hamner Avenue |
| T1 | Temescal Wash at Lincoln Avenue |
| TQ1 | Tequesquite Arroyo at Palm Avenue |

Frequency of sampling:
dry season: weekly
wet season: two 30-day sampling periods during which a minimum of 5 samples are to be collected (at least one sample weekly) and if possible, a minimum of 5 of those samples must be from storm events.

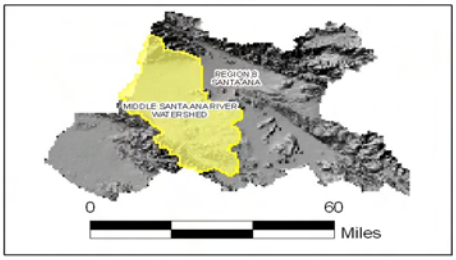
**Table 5-9a-a --Additional Watershed Storm Event Sampling Locations**

| Station Number | Station Description |
|---|---|
| M3 | Bon View Avenue @ Merrill Avenue |
| M4 | Archibald Avenue @ Cloverdale Avenue |
| G1 | Grove Channel @ Pine Avenue |
| E1 | Euclid Avenue Channel @ Pine Avenue |

Frequency of sampling: wet weather – one sample/storm event for 5 storm events/year; dry weather – none.




# FIGURE 5-6: TMDL WATER QUALITY SAMPLING LOCATIONS




CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Map created January 2005
Map created by: HB

Data Sources:
Middle Santa Ana River Watershed:
based on Calwater v. 2.2.1 boundaries -
CA Spatial Information Library (2004),
Santa Ana River reach designations,
and GDT streets (SWRCB, 2002)
County: CA Spatial Information Library (2004)
Rivers/creeks, and lakes:
CA Spatial Information Library (1998)
2002 303(d) listed water bodies:
SWRCB (2003)

File name: wbr_tmdl_2.mxd

## Task 4: Urban Discharges

Phase I urban discharges, including stormwater runoff, include those from the cities and unincorporated communities in the Middle Santa Ana River Watershed. These discharges are regulated under the MS4 NPDES permits identified in Tasks 1.1 and 1.2 (Review and Revise Existing Waste Discharge Requirements), above. The requirements of these NPDES permits differ somewhat and therefore the TMDL implementation requirements that pertain to the permittees under each permit also vary slightly, as shown below[3].

### 4.1 Develop and Implement Bacterial Indicator Urban Source Evaluation Plans

On or before **November 30, 2007**, the County of San Bernardino, the County of Riverside, the cities of Ontario, Chino, Chino Hills, Montclair, Rancho Cucamonga, Upland, Rialto, Fontana, Norco, Riverside, and Corona, Pomona and Claremont shall develop a Bacterial Indicator Urban Source Evaluation Plan(s) (USEP). This plan shall include steps needed to identify specific activities, operations, and processes in urban areas that contribute bacterial indicators to Middle Santa Ana River Watershed waterbodies. The plan shall also include a proposed schedule for completion of each of the steps identified. The proposed schedules can include contingency provisions that reflect uncertainty concerning the schedule for completion of the SWQSTF work and/or other investigations that may affect the steps that are proposed. The USEP shall be implemented upon Regional Board approval at a duly noticed public meeting.

### 4.2 Revise the San Bernardino County Municipal Storm Water Management Program (MSWMP)

Provision XVI.3. of Order No. R8-2002-0012 (see 1.1, above) requires the permittees to revise their Municipal Storm Water Management Program (MSWMP) to include TMDL requirements. Revisions to the MSWMP may be necessary based on the results of Task 4.1, Basin Plan amendments to address recommendations of the SWQSTF, or other investigations. Because of uncertainties regarding the timing of completion of these studies, it is not feasible to identify an explicit date whereby the revision of the MSWMP is to be accomplished. Instead, the Executive Officer shall notify the permittees of the need to revise the MSWMP. Within 90 days of notification by the Executive Officer, the permittees shall submit for Regional Board approval, a plan and schedule to review and revise the MSWMP as necessary to incorporate measures to address the results of

[3] The San Bernardino MS4 permit requires the development and implementation of a Municipal Stormwater Management Program (MSWMP) to address stormwater discharges from existing urban activities. For the Riverside County MS4 permit, the Drainage Area Management Plan (DAMP) addresses stormwater discharges from existing urban activities.

the USEP and/or other studies. Further review and revision of the MSWMP needed to address these TMDLs shall be completed in accordance with the requirements of Order No. R8-2002-0012 or amendments thereto that are adopted by the Regional Board at a public hearing. The MSWMP revisions shall include schedules for meeting the bacterial indicator wasteload allocations based on the schedule established in these TMDLs. In order to facilitate any needed update of the numeric targets and/or the TMDLs and urban discharge WLAs, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. The permittees shall also provide a proposal and schedule for 1) evaluating the effectiveness of BMPs and other control actions implemented and 2) evaluating compliance with the bacterial indicator waste load allocations for urban runoff. The plan and schedule to review the MSWMP must be implemented upon approval by the Regional Board after public notice and public hearing, or upon approval by the Executive Officer if no significant comments are received during the public notice period.

**4.3 Revise the Riverside County Drainage Area Management Plan (DAMP)**

Provision XIII.B. of Order No. R8-2002-0011 (see 1.2, above) requires the permittees to revise their Drainage Area Management Plan (DAMP) to include TMDL requirements. Revisions to the DAMP may be necessary based on the results of Task 4.1, Basin Plan amendments to address recommendations of the SWQSTF, or other investigations. Because of uncertainties regarding the timing of completion of these studies, it is not feasible to identify an explicit date whereby the revision of the DAMP is to be accomplished. Instead, the Executive Officer shall notify the permittees of the need to revise the DAMP. Within 90 days of notification by the Executive Officer, the permittees shall submit for Regional Board approval, a plan and schedule to review and revise the DAMP as necessary to incorporate measures to address the results of the USEP and/or other studies. Further review and revision of the DAMP needed to address these TMDLs shall be completed in accordance with the requirements of Order No. R8-2002-0011 or amendments/updates thereto that are adopted by the Regional Board at a public hearing. The DAMP revisions shall include schedules for meeting the bacterial indicator wasteload allocations based on the schedule established in these TMDLs. In order to facilitate review and update of the numeric targets and/or the TMDLs and urban discharge WLAs, the proposed schedule shall take into consideration the Regional Board's triennial review schedule. The revised DAMP shall also include a proposal and schedule for 1) evaluating the effectiveness of BMPs and other control actions implemented and 2) evaluating compliance with the bacterial indicator waste load allocations for urban runoff. The plan and schedule to review and revise the DAMP must be implemented upon approval by the Regional Board after public

notice and public hearing, or upon approval by the Executive Officer if no significant comments are received during the public notice period.

### 4.4 Revise the San Bernardino County Water Quality Management Plan (WQMP)

Provision XII.B. 1. of Order No. R8-2002-0012 requires the permittees to develop and submit a WQMP for new developments and significant redevelopments by January 2004 for the Executive Officer's approval. Revisions to the WQMP may be necessary based on the results of Task 4.1, Basin Plan amendments to address recommendations of the SWQSTF, or other investigations. Because of uncertainties regarding the timing of completion of these studies, it is not feasible to identify an explicit date whereby the revision of the WQMP is to be accomplished. Instead, the Executive Officer shall notify the permittees of the need to revise the WQMP. Within 90 days of notification by the Executive Officer, the permittees shall submit for Regional Board approval a plan and schedule to review and revise the WQMP that addresses the bacterial indicator input from new developments and significant redevelopments to assure compliance with the bacterial indicator wasteload allocations for urban runoff. Further review and revision of the WQMP necessary to address TMDL requirements, shall be completed in accordance with the requirements of Order No. R8-2002-0012 or amendments/updates thereto that are adopted by the Regional Board at a public hearing.

### 4.5 Revise the Riverside County Water Quality Management Plan (WQMP)

Provision VIII.B. of Order No. R8-2002-0011 (see 1.2, above) requires the permittees to develop and submit a WQMP for new developments and significant redevelopments by June 2004 for approval. On September 17, 2004, the Board approved a WQMP developed by the permittees. The approved WQMP includes source control BMPs, design BMPs and treatment control BMPs. Further revisions to the WQMP may be necessary to meet the WLA for urban runoff. Such revisions may be necessary based on the results of Task 4.1, Basin Plan amendments to address recommendations of the SWQSTF, or other investigations. Because of uncertainties regarding the timing of completion of these studies, it is not feasible to identify an explicit date whereby the revision of the WQMP is to be accomplished. Instead, the Executive Officer shall notify the permittees of the need to revise the WQMP. Within 90 days of notification by the Executive Officer, the permittees shall submit for Regional Board approval a plan and schedule for review and revision of the WQMP that addresses the bacterial indicator input from new developments and significant redevelopments to assure compliance with the bacterial indicator wasteload allocations for urban runoff. Further review and revision of the WQMP necessary to address TMDL requirements, shall be completed in accordance with the requirements of

Order No. R8-2002-0011 or amendments/updates thereto that are adopted by the Regional Board at a public hearing.

If the results of studies conducted pursuant to Tasks 3 and 4.1 above demonstrate that either the Phase II non-traditional small MS4 discharges covered under the statewide Waste Discharge Requirements for Stormwater Discharges from Small Municipal Separate Storm Systems (Order No. 2003-0005-DWQ) or industrial discharges from facilities covered by the statewide Industrial Stormwater General Permit (Order 97-03-DWQ) or any Regional Board individual industrial permit, are responsible, to a significant degree, for exceedances of the urban WLAs, the Regional Board will take the appropriate regulatory steps to address these discharges.

**Task 5: Agricultural Discharges**

Agricultural discharges include stormwater runoff, wastewater release and tailwater runoff from agricultural land uses. Tailwater runoff is irrigation water that runs off of agricultural land. Agricultural land uses include concentrated animal feeding operations and irrigated and dry-land farming in the Middle Santa Ana River Watershed. Concentrated animal feeding operations are regulated under WDRs (see Task 1.3,above); irrigated agriculture and dry-land farming are not currently regulated.

**5.1 Develop and Implement Bacterial Indicator Agricultural Source Evaluation Plans**

On or before **November 30, 2007**, concentrated animal feeding facility operators and agricultural operators in the Middle Santa Ana River Watershed shall develop and implement Bacterial Source Agricultural Source Evaluation Plans (AGSEP). These plans shall include steps needed to identify specific activities, operations, and processes in agricultural areas that contribute bacterial indicators to Middle Santa Ana River Watershed waterbodies. The plan shall also include a proposed schedule for completion of each of the steps identified. The proposed schedules can include contingency provisions that reflect uncertainty concerning the schedule for completion of the SWQSTF work and/or other investigations that may affect the steps that are proposed. The AGSEP shall be implemented upon Regional Board approval at a duly noticed public meeting.

The Regional Board expects that the AGSEP will be submitted and implemented pursuant to these TMDL requirements. Where and when necessary to implement these requirements, the Regional Board will utilize appropriate waste discharge requirements including those for concentrated animal feeding operations (see 1.3, above), or other Water Code authorities.

In lieu of a coordinated source evaluation plan, one or more of the parties identified above may submit a proposed individual or group AGSEP to conduct the above studies for areas within their jurisdiction. Any such individual or group plan shall also be submitted for Regional Board approval no later than. **November 30, 2007**. This AGSEP shall be implemented upon Regional Board approval at a duly noticed public meeting.

**5.2 Develop and Implement a Bacterial Indicator Agricultural Source Management Plan**

Based on the results of Task 5.1 or other studies conducted in the watershed, concentrated animal feeding operators and agricultural operators within the Middle Santa Ana River Watershed shall, as a group, submit a proposed Bacterial Indicator Agricultural Source Management Plan (BASMP). Because of uncertainties regarding the timing of completion of these studies and in recognition that readily identifiable steps may be taken to reduce bacterial discharges from agricultural lands, it is not feasible to identify an explicit date whereby the development and implementation of the BASMP is to be accomplished. Instead, the Executive Officer shall notify agricultural operators of the need to submit the proposed BASMP in whole or to submit plans and schedule to address a subset of tasks identified in the AGSEP. Within 90 days of notification by the Executive Officer, the proposed BASMP, or a subset thereof, shall be submitted. The BASMP, or subset thereof, shall be implemented upon Regional Board approval at a duly noticed public meeting. At a minimum, the BASMP shall include, plans and schedules for the following:

A. implementation of bacterial indicator controls, BMPs and reduction strategies designed to meet load allocations;
B. evaluation of effectiveness of BMPs; and
C. development and implementation of compliance monitoring program(s).

The Regional Board expects that the BASMP will be submitted and implemented pursuant to these TMDL requirements. Where and when necessary to implement these requirements, the Regional Board will utilize appropriate waste discharge requirements or other Water Code authorities.

In lieu of a coordinated plan, one or more of the parties identified above may submit a proposed individual or group BASMP to develop and implement the above plan for areas within their jurisdiction. Any such individual or group plan shall also be submitted for Regional Board approval. Because of uncertainties regarding the timing of completion of these studies and in recognition that readily identifiable steps may be taken to reduce bacterial discharges from agricultural lands, it is not feasible to identify an explicit date whereby the development and implementation of the BASMP is to be accomplished. Instead, the Executive Officer shall notify agricultural operators of the need to submit the proposed BASMP in whole or to submit plans and schedule to address a subset of tasks

identified in the AGSEP. Within 90 days of notification by the Executive Officer, the proposed BASMP, or a subset therefore, shall be submitted. This BASMP, or a subset thereof, shall be implemented upon Regional Board approval at a duly noticed public meeting.

**Task 6: Review/Revision of the Bacterial Indicator TMDL (TMDL "Re-opener")**

The basis for the TMDLs and implementation schedule will be re-evaluated at least once every three years[4] to determine the need for modifying the load and wasteload allocations, numeric targets and TMDLs. Regional Board staff will continue to review all data and information generated pursuant to the TMDL requirements on an ongoing basis. Based on results generated through the monitoring programs, special studies, modeling analysis, efforts of the Storm Water Quality Standards Task Force[5] and/or special studies by one or more responsible parties, changes to the TMDLs, including revisions to the numeric targets, WLAs and LAs, may be warranted. Such changes would be considered through the Basin Plan Amendment process.

The Regional Board is committed to the review of this TMDL every three years, or more frequently if warranted by the results of monitoring and/or other relevant studies

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[4] The three-year schedule will coincide with the Regional Board's triennial review schedule.

[5] Stakeholders formed the Storm Water Quality Standards Task Force (Task Force) in 2002 to support review and update of the bacterial quality objectives for REC1 waters and to review the REC1 designations themselves to assure their accuracy. Participants include representatives from the Santa Ana Watershed Project Authority, (SAWPA) flood control agencies from the 3 counties within the Santa Ana Region, POTW dischargers and stormwater staff from various municipalities in the watershed. Environmental groups, Regional Board staff and USEPA staff are also participants. SAWPA staff serve as facilitators for the Task Force.

## BAY PROTECTION AND TOXIC CLEANUP PROGRAM

Legislation enacted in 1989 added Chapter 5.6, Bay Protection and Toxic Cleanup, to Division 7 of the California Water Code (Sections 13390-13396). These new sections require the State Board and Regional Boards to establish programs for the maximum protection of beneficial uses of bays and estuaries, focusing on water quality problems due to toxic substances. In part, the State Board was directed to formulate and adopt a water quality control plan for Enclosed Bays and Estuaries and a workplan for the development of sediment quality objectives. When setting waste discharge requirements, the Regional Boards must implement the water quality control plan and any sediment quality objectives which may be adopted by the State Board.

The Bay Protection and Toxic Cleanup Program (BPTCP) must also include plans to identify and remediate "toxic hot spots." These are areas in the enclosed bays, estuaries or adjacent waters where the contamination affects the interests of the state and "…where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries or human health, or (2) may adversely affect the beneficial uses of bay, estuary or ocean waters as defined in water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives." Criteria for the assessment and priority ranking of toxic hot spots are to be developed by the State Board in coordination with the California Department of Fish and Game and the California Office of Environmental Health Hazard Assessment (OEHHA). The ranking criteria will be used by the Regional Board to prioritize toxic hot spots based on the severity of the problem.

The BPTCP consists of both short- and long-term activities. The short-term activities include:

- Develop and maintain a program to identify toxic hot spots, plan for their cleanup or mitigation, and amend Water Quality Control Plans and policies to abate toxic hot spots;
- Develop and implement regional monitoring and assessment programs;
- Develop numeric sediment quality objectives;
- Develop and implement Toxic Hot Spot Cleanup Plans;
- Revise waste discharge requirements, if necessary, to conform to the Basin Plan; and
- Develop a comprehensive database containing information pertinent to describing and managing toxic hot spots.

Long-term activities of the BPTCP include:

- (Continue to) develop numeric sediment quality objectives;
- Develop and implement strategies to prevent the formation of new Toxic Hot Spots and to reduce the severity of effects from existing Toxic Hot Spots;
- Periodic review and update of a Water Quality Control Plan for enclosed bays and estuaries; and
- Maintain the comprehensive database.

The BPTCP is a comprehensive effort to regulate toxic pollutants in enclosed bays and estuaries and is not intended to be a monitoring program resembling the State Mussel Watch Program or the Toxic Substances Monitoring Program (see Chapter 6 for descriptions of these programs). The BPTCP program does, however, use the data from the State Mussel Watch Program and the Toxic Substances Monitoring Program to identify Toxic Hot Spots.

The Santa Ana Region, State Mussel Watch data and data provided by the Orange County Environmental Management Agency have been used to identify toxic hot spots in Newport Bay and Anaheim Bay/Huntington Harbour. Tables 5-10 and 5-11 lists the known toxic hot spots and potential toxic hot spots, respectively. The Regional Board, in coordination with the State Board and the California Department of Fish and Game are currently in the process of confirming these toxic hot spots and potential toxic hot spots using a battery of toxicity tests on both the water column and sediment. Once confirmed, the list of toxic hot spots and potential toxic hot spots will be ranked according to the ranking criteria. The priority ranking will be included in the regional Toxic Hot Spot Cleanup Plan(s) which will include identification of likely contaminant sources and appropriate remedial actions.

## GROUNDWATER CONTAMINATION FROM VOLATILE ORGANIC COMPOUNDS

In 1984, the legislation passed Assembly Bill 1803 which instructed the California Department of Health Services, Office of Drinking Water, to develop and implement a program to require the sampling of public drinking water supply wells for volatile organic compounds. The Department was instructed to provide the results to the appropriate Regional Board. The initial data indicated extensive organic contamination of groundwater supplies throughout the state. As a result, in 1985, the State Board and the Regional Water Quality Control Boards initiated the Well Investigation Program. The intent of the Well Investigation Program was to identify the parties responsible for the organic contamination of municipal drinking water supply wells so that those parties could be made accountable for cleanup.

In order to identify the responsible parties, the Regional Board followed an intensive investigation program for each contaminated public drinking water supply well on a priority basis. This program included:

- Field reconnaissance for potential sources
- Record searches
- Hydrogeological assessments
- Questionnaires, meetings, and inspections
- Requests for preliminary soil investigations and follow-up soil and groundwater investigations of potential sources
- Requests for cleanup
- Enforcement actions, where appropriate

In the late1980's the Well Investigation Program was expanded to include private drinking water supply wells and agricultural and industrial supply wells that were located in areas where organic contamination posed a threat to public drinking water supply wells. In the late 1980's the Well Investigation Program represented the largest single funded program in the Region. However, due to severe budget cuts statewide, the Well Investigation Program was scaled down and eventually discontinued in 1992. Investigation and cleanup of sites identified by the Well Investigation Program are currently being overseen by the Regional Board's Spills, Leaks, Investigations, and Cleanup (SLIC) program.

Currently (1993), there are more than 300 water supply wells identified in the Region which contain organic compound contaminants. The loss of many drinking water supply wells and the threat of loss of additional existing drinking water supply wells due to organic compound contamination is a serious problem in several areas of the Region, most notably the Bunker Hill, Chino, and Santa Ana Forebay Groundwater Basins.

Perchloroethylene (PCE) and trichloroethylene (TCE) are the major contaminants in the Bunker Hill I Subbasin, which underlies northern San Bernardino. The City of San Bernardino lost 25% of its water supply in the early 1980s when 14 wells operated by the City were found to contain concentrations of perchloroethylene above the state and federal drinking water Maximum Contaminant Level (MCL). The Newmark Wellfield was placed on the federal Superfund list in 1988, and EPA assumed lead responsibility for investigating the extent of the contamination and identifying long-term cleanup measures. The Regional Board has identified no specific source of the contamination; potential sources include dry cleaners, airports, and a World War II munitions facility. Interim groundwater extraction and treatment at existing municipal supply wells using air stripping and granulated activated carbon (GAC) facilities funded by the California Department of Toxic Substances Control. These facilities have the capacity to treat 37.6 million gallons per day (MGD). The treated water is used as a potable water supply to replace the water lost as a result of the solvent contamination.

Table 5-10

Known Toxic Hot Spots
Santa Ana Region

| Waterbody Name | Pollutants Involved |
|---|---|
| Lower Newport Bay | Cd, Pb, As, Se, Zn, Cu |
| Upper Newport Bay Ecological Reserve | Pb, Cu, Cd |
| Anaheim Bay | Cd, Cu, Pb, Cr |
| Huntington Harbour | Cd, Pb, Se, Cr, Cu |
| Bolsa Bay | Cr, Cu, Pb |

Table 5-11

Potential Toxic Hot Spots
Santa Ana Region

| Waterbody Name | Pollutants Involved |
|---|---|
| Lower Newport Bay | Chlorpyrifos, Dacthal, PCB, Chlorbenside, DDT, Lindane, Ronnel, Hexachlorbenzene, Chlordane, Endosulfan, Toxaphene, Aldrin, Heptachlorepoxide, Heptachlor |
| Upper Newport Bay Ecological Reserve | Dacthal,DDT,PCB,Endosulfan,Chlordane, Chlorpyrifos, Diazinon, Lindane, Heptachlorepoxide, Hexchlorbenzene |
| Anaheim Bay | Aldrin, Chlordane, Lindane, Chlorbenside, PCB, DDT, Chlorpyrifos, Endosulfan, Heptachlorepoxide, Hexachlorbenzene |
| Huntington Harbour | Aldrin, Chlorbenzide, DDT, Lindane, Endosulfan, Chlordane, Chlorpyrifos, Dieldrin, Endrin, Toxaphene, Heptachlorepoxide |

The Bunker Hill II Subbasin underlying Redlands has been contaminated with TCE and dibromochloropropane (DBCP). It is estimated that the TCE plume covers an area of approximately twenty square miles. Twenty-six water supply wells are impacted by TCE or DBCP, including five municipal water supply wells where the concentration of TCE or DBCP exceeds the MCL. No responsible parties have been identified yet, however, potential sources for the TCE plume include an airport, commercial and industrial facilities, and a former rocket motor testing facility. DBCP, a soil fumigant, was used extensively by the citrus industry prior to the 1960's and the DBCP contamination in the Bunker Hill II Subbasin is believed to be the result of this past legal agricultural use. A 3.0 MGD GAC facility at the Rees Well, which began operation in 1989, treats the contaminated water and provides potable water for the City of Redlands. In addition, an 8.6 MGD wellhead treatment facility at the Texas Street Well Field began operation in 1993. The facility, which was funded by the State Board and the State Department of Toxics, removes TCE and DBCP and also provides potable water back to the City of Redlands.

Forty-four water supply wells in the Chino Basin, primarily the Chino II Subbasin, contain TCE and PCE. To date, only one facility, the former GE Flatiron Plant in Ontario, has been confirmed as a source of organic compound contamination that has impacted a water supply well. In 1993, prior to exploring final cleanup options, GE will be implementing plume containment and interim cleanup activities on the almost two mile long, one-half mile wide TCE plume. Other potential sources in the Chino Basin include the California Institute for Men, the Chino Airport, and the Ontario Airport. Potential responsible parties are in the process of conducting investigative studies.

Organic contamination from TCE, PCE, dichloroethylene (DCE), and dichloroethane (DCA) has been found in water supply wells in Orange County in the Santa Ana Forebay and Irvine Forebay Groundwater Basins. A wellhead treatment unit (air stripping) was installed at the City of Orange Well No. 13 and began operation in 1993. The Regional Board staff oversees investigations at numerous sites in the Forebay area where past discharges of industrial solvents have occurred. Twenty-one of these sites have been identified to date as sources of volatile organic compounds in groundwater. Site investigations are being conducted to identify the extent of contamination and to clean up the effects of the discharges.

The Regional Board has been successful in identifying many sites throughout the region where volatile organic compounds have impacted groundwater. However, with the exception of the former GE Flatiron facility in the Chino Basin, there has been no other direct cause-and-effect relationship drawn between a contaminated drinking water supply well and a specific source. In most cases, records of compounds used at facilities have not been maintained and information regarding past disposal practices is not available, making it difficult to pinpoint specific

sources. In addition, considering that most sources of the volatile organic compounds found in water supply wells are probably industrial discharges that may have occurred as long as 30 years ago, and considering the complex factors affecting the fate of volatile organic compounds in soil and groundwater and the changes in groundwater flow patterns from pumping, etc., it is difficult to backtrack contamination from water supply wells to specific sites which may be sources of local groundwater contamination.

## DEPARTMENT OF DEFENSE FACILITIES

There are six major Departments of Defense (DoD) facilities in the Santa Ana Region, two of which are currently scheduled for closure. Table 5-12 identifies these facilities and the water quality problems of each.

Significant groundwater contamination has been detected at a number of these facilities. Contamination is severe enough at three of these facilities to have them placed on EPA's National Priorities List (NPL) for remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly referred to as Superfund).

For these three National Priorities List facilities (Norton and March Air Force Bases and Marine Corps Air Station – El Toro), the EPA is the lead environmental regulatory agency for oversight of investigation and cleanup. CERCLA requires EPA to consider applicable or relevant and appropriate state laws and regulations when establishing cleanup. CERCLA requires EPA to consider applicable or relevant and appropriate state laws and regulations when establishing cleanup standards for remedial activities. To ensure that the state's concerns are properly addressed, two Cal/EPA agencies, the Regional Board and the Department of Toxic Substances Control (DTSC) also perform a significant oversight role in the investigations and cleanup of these facilities.

The US EPA, DoD, and the state agencies have signed Federal Facility Agreements (FFA) for each of the National Priorities List facilities. The intent of the FFA is to ensure that: (1) environmental impacts are investigated; (2) remedial actions are defined; (3) procedural framework or schedules are established; (4) cooperation among agencies is facilitated; (5) adequate assessment it performed; and (6) compromise is reached.

The US EPA is not involved in the investigation and cleanup of DoD facilities that are not on the National Priorities List (Marine Corps Air Station-Tustin, Naval Weapons Station-Seal Beach, and Armed Forces Reserve Center-Los Alamitos). However, many of these facilities have significant contamination. In these cases, the two state agencies enter info Federal Facility Site Remediation Agreements

Table 5-12

Summary of Water Quality Problems from
Department of Defense (DoD) Facilities

Santa Ana Region

| DoD Facility | Receiving Water Affected | Water Quality Problem Identified to Date |
|---|---|---|
| Norton Air Force Base [1] | Bunker Hill I Subbasin | trichloroethylene (TCE) plume landfills; Superfund listing |
| March Air Force Base | Perris North Subbasin | trichloroethylene (TCE) plume; fuel plume; landfills; Superfund listing |
| Marine Corps Air Station - El Toro | Irvine Forebay Subbasin | trichloroethylene (TCE) plume; fuel plume; benzene plume; landfills; proposed Superfund Listing |
| Marine Corps Air Station - Tustin [1] | Irvine Pressure Subbasin | volatile organic compound (VOC) plume; fuel plume |
| Naval Weapons Station - Seal Beach | Santa Ana Pressure Subbasin | fuel plume; landfills |
| Armed Forces Reserve Center - Los Alamitos | Santa Ana Pressure Subbasin | fuel plume; landfills |

[1] Facilities which are scheduled to be closed. These bases are given high cleanup priority.

(FFSRAs) with DoD. FFSRAs are very similar to the above-mentioned Federal Facility Agreements, with the exception that US EPA is not a party. The Regional Board and Department of Toxic Substances Control have already entered into an agreement with DoD for the Naval Weapons station – Seal Beach and are near the end of negotiations on Federal Facility Site Remediation Agreements for Marine Corps Air Station – Tustin.

The Department of Toxic Substances Control has been identified as the "lead" state agency and the Regional Board as "support" agency for all of the above facilities. A Memorandum of Understanding has been signed by the State Board and Department of Toxic Substances Control which describes the roles of each agency. The Regional Board's oversight role is with regard to the investigation and cleanup of water resources that have been impacted or are threatened by waste discharges from the facilities. The Regional Board's responsibility also extends to source areas (landfills, contaminated soil, etc.) that currently, or may in the future, pose a threat to water quality. DTSC's role is to address all other environmental aspects including health risk assessment, air emissions, community relations, etc.

The State Board and DTSC have entered into a two-year cooperative agreement with the Department of Defense for cleanup and oversight reimbursement. All work performed by the State agencies with regard tot he investigation and cleanup of environmental problems at these facilities is fully reimbursed by DoD.

## LEAKING UNDERGROUND STORAGE TANKS

The Underground Storage Tank Program was enacted in 1983 and took effect January 1,1984. The authority for the program is found in the Health and Safety Code, Division 20, Chapter 6.7, and the regulations for the program are found in the California Code of Regulations, Title 23, Division 3, Chapter 16. In 1988, the State Board and the Department of Health Services (now Department of Toxic Substances Control) issued the Leaking Underground Fuel Tank (LUFT) field manual which prescribes specific methods for evaluating the effects of underground storage tank leaks.

There are approximately 2,000 known cases of leaking underground storage tanks (USTs) in the Region. Approximately 35% of the cases involve instances where only soil contamination is present, 35% are cases which have been closed. The majority of the releases from these underground storage tanks are gasoline and the constituent of most concern is benzene, a known carcinogen. A smaller percentage of the underground storage tank releases involve chlorinated industrial solvents, which are suspected carcinogens. As anticipated, the majority of the sites where these releases have occurred are automotive service stations, with tanks from industrial facilities contributing a smaller, but significant, minority. To date, these groundwater impacts have not grown to the point where drinking water supply wells have been affected. The Regional Board maintains and regularly updates the

Leaking Underground Storage Tank Information Systems (LUSTIS) database, which identifies all known underground storage tank release sites in the Region.

Implementation of the underground storage tank program includes direct Regional Board oversight of leaking underground storage tank cleanups. It also involves coordination of oversight activities with local agencies under contract with the State Board through the Local Oversight Program. Local agencies have the authority, pursuant to Section 25297.1 of the Health and Safety Code, to act on behalf of the Regional Board in requiring investigations and cleanup of underground storage tanks cases. The local agencies also implement the permitting, construction, inspections, and monitoring portion of the Underground Tank Regulations. The Orange County Health Care Agency, the County of Riverside Department of Environmental Health, and the County of San Bernardino Department of Environmental Health Services handle approximately 80% of the active cases in the Region, with several cities managing their own programs. The local agencies' caseload consists of soil cases, while the Regional Board maintains responsibility for the highly complex cases where groundwater has been affected.

As specified in State Board Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges," the investigation and cleanup of releases from underground storage tanks involves several steps including: (1) preliminary site assessment and workplan submittal; (2) pollution characterization; (3) remediation; and (4) post-remedial action monitoring. Soil contamination cleanup levels are determined on a case-by-case basis and are established to prevent continued leaching from the affected soils at levels which may cause the underlying groundwater to exceed applicable water quality objectives. Cleanup goals for groundwater contamination cases are generally established at drinking water standards (Maximum Contaminant Levels or Action Levels).

In most areas of the Santa Ana Region, the uppermost portions of the aquifers are considered to be in hydrologic contact with deeper portions which are currently utilized for drinking water supplies. In the pressure zone of Orange County, the uppermost sediments are fine-grained materials which are unable to sustain sufficient pumping rates. However, due to the large volume of water held within these sediments, the close vertical proximity of these areas to underlying pumping locations, and the existence of pathways for movement into the deeper aquifers, the shallow waters in this area are considered as contributing to the sources of drinking water in Orange County. Leaking underground storage tank cleanups must be conducted accordingly.

## Underground Storage Tank Cleanup Fund

The State Board, Division of Clean Water Programs, administers the Underground Storage Tank Cleanup Fund. The Cleanup Fund can be used as a mechanism to satisfy federal financial responsibility requirements and pay for corrective action and

third party liability costs resulting from a leaking petroleum UST. The Fund can also pay for direct cleanup (by local agency or Regional Board) of UST sites requiring emergency and prompt action on abandoned or recalcitrant sites. This fund, collected by the Board of Equalization, is supported by a 0.6 cents per gallon fee for gasoline. The Fund has been established to provide reimbursement to tank owners or operators for the costs of cleanup of the effects of unauthorized releases of petroleum. Up to one million dollars ($1,000,000) can be provided per site, with the first ten thousand dollars ($10,000) being provided by the claimant. With certain qualifications, expenditures made to remediate an unauthorized petroleum release since January 1, 1988 can be reimbursed and letters of credit can be issued for the funding of ongoing remediation activities.

The Regional Boards provide technical support to both the applicants who file claims against the UST Cleanup Fund and the State Board staff who verify the corrective action work covered by the claim. For claims that involve future work, the Regional Boards will oversee site investigation and cleanup on cases for which they are the lead agency.

## ABOVEGROUND STORAGE TANKS

The state's Aboveground Petroleum Storage Act was enacted in 1989 and amended in 1991. The Act became effective on January 1, 1990 (Health and Safety Code, Chapter 6.67).

The purpose of the regulation is to protect the public and the environment from the serious threat of millions of gallons of petroleum-derived chemicals stored in thousands of aboveground storage tanks. The Regional Board inspects aboveground petroleum storage tanks, which were used to store crude oil and its fractions after January 1991, to assure compliance with a federally required site-specific Spill Prevention, Control, and Countermeasure Plan. In the event that a release occurs which threatens surface or groundwater, the Act allows the state to recover reasonable costs incurred in the oversight and regulation of cleanup.

Storage statements are required from facilities with aboveground storage tanks, describing the nature and size of their tanks. Filing fees are required which are intended to fund inspections, training, and research. Approximately 280 aboveground storage tanks are under regulation in the Santa Ana Region as of May 1, 1993. Their number is continually expanding as aboveground storage tanks are increasingly used to replace underground storage tanks. A list of aboveground storage tanks is available from the Regional Board.

## DISPOSAL OF HAZARDOUS AND NONHAZARDOUS WASTE TO LAND

Hazardous and nonhazardous waste disposal can, if not properly managed and regulated, diminish the beneficial uses of the waters of the Region. These are typically losses to groundwater beneficial uses, but in some cases, surface waters

can also be affected by disposal operations or contaminated soil in the vadose zone.

The Regional Board regulates landfills receiving municipal solid wastes and surface impoundments receiving hazardous or designated liquid wastes. Although these sites are closely regulated and monitored, some water quality problems have been detected and are being addressed. There are no hazardous solid waste disposal facilities currently operating in the Region.

The laws and regulations governing the disposal of both hazardous and nonhazardous solid wastes have been revised and strengthened in the last few years. The US EPA, DTSC, the State Board, and Regional Water Quality Control Boards are implementing the federal RCRA regulations. Described below is Regional Board implementation of RCRA and the following state programs: Title 23, Division 3, Chapter 15; Toxic Pits Cleanup Act; and Solid Waste Assessment Tests.

**Resource Conservation and Recovery Act**

The state implements the Resource Conservation and Recovery Act (RCRA) in California through the Department of Toxic Substances Control (DTSC) and the Regional Boards. Chapter 15 monitoring requirements have been implemented through the adoption of waste discharge requirements for both hazardous and nonhazardous waste disposal sites covered by RCRA. The discharge requirements for both hazardous waste sites are part of a state RCRA permit issued by the DTSC. The Regional Board and the Integrated Waste Management Board issues state permits for nonhazardous waste disposal sites.

The Resource Conservation and Recovery Act of 1976 provided for the development of federal and state programs for the regulation of land disposal of waste materials and the recovery of materials and energy resources from the waste stream. The Act regulates not only the generation, transportation, treatment, storage, and disposal of hazardous wastes, but also nonhazardous solid waste disposal facilities. In addition, the 1976 Act called for phasing out the use of open dumps for disposal of solid wastes in favor of sanitary landfills.

The most recent and significant amendments to RCRA (1984) impose a variety of new, more stringent requirements both on hazardous and nonhazardous waste generators, transporters, and the owners/operators of treatment, storage, and disposal facilities within the existing regulated community. Significant provisions include bans on land disposal of certain wastes, restrictions and placement of liquids in landfills, and establishment of minimum technological requirements for landfills and surface impoundments.

Subtitle C of RCRA contains requirements related to the identification and listing of hazardous wastes and standards applicable to generators, transporters, owners, and owner/operators of treatment, storage, and disposal facilities. Primary

responsibility for the implementation of Subtitle C rests with the DTSC, with Regional Board participation as necessary.

Subtitle D of RCRA establishes a framework for federal, state, and local government cooperation in controlling the management of nonhazardous solid waste. The federal role in this arrangement is to establish the overall regulatory direction by providing minimum nationwide standards for protecting human health and the environment and to provide technical assistance to states for planning and developing their own environmentally sound waste management practices. The actual planning and direct implementation of solid waste programs under subtitle D. however, remain largely state and local functions, and the act authorizes states to devise programs to deal with state-specific conditions and needs. US EPA approved the state's proposed solid waste management program, and delegated authority to the state to implement the program in October 1993. In September 1993, the Santa Ana Region adopted a blanket Waste Discharge Requirement (WDR) amendment for all affected landfills in the Region which implements both Subtitle D and Chapter 15.

Subtitle D includes the Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257). The criteria establish minimum national performance standards necessary to ensure that "no reasonable probability of adverse effects on health or the environment" will result from solid waste disposal facilities or practices.

Part 258 of subtitle D establishes minimum national criteria for municipal solid waste landfills including those used for sludge disposal and disposal of nonhazardous waste combustion and ash. Part 258 also sets forth minimum federal criteria for municipal solid waste landfills, including location restrictions, facility design and operating criteria, groundwater monitoring requirements, financial assurance requirements, and closure and post-closure care requirements. The rule establishes differing requirements for existing and new units, (*e.g.,* existing units are not required to remove wastes in order to install liners).

Subtitle D provides that states with approved water management programs that wish to run the program will have flexibility in implementing these criteria. A municipal solid waste landfill unit that does not meet the Part 258 Criteria will be considered to be engaged in the practice of "open dumping" in violation of Section 4005 of RCRA. Municipal solid waste landfill units that receive sewage sludge and fail to satisfy those criteria will be deemed to be in violation of Sections 309 and 405(e) of the Clean Water Act.

**Title 23, Division 3, Chapter 15**

The most important regulation used by the Regional Board in regulating hazardous and nonhazardous waste disposal is California Code of Regulations (CCR) Title 23,

Division 3, Chapter 15 (formerly Subchapter 15). These regulations include very specific siting, construction, monitoring, and closure requirements for all existing and new waste disposal facilities. Chapter 15 also contains a provision requiring landfill operators to provide assurances of financial responsibility for initiating and completing closure, and for corrective action to address all known or reasonably foreseeable releases from their waste management units. Detailed technical criteria are provided for establishing water quality protection standards, monitoring programs, and corrective action programs for releases from waste management units. Chapter 15 defines waste types to include hazardous wastes (Class I), designated wastes (Class II), and nonhazardous solid wastes (Class III). Hazardous wastes are defined by DTSC in Title 22 of the California Code of Regulations.

Designated wastes are defined as:

1. Those non hazardous wastes consisting of or containing contaminants which under ambient landfill conditions could be released at concentrations that could cause water quality degradation, or

2. Those wastes which are hazardous according to Title 22, but are not considered hazardous by the federal RCRA definition and have been granted a variance from hazardous waste management requirements by DTSC.

Nonhazardous solid wastes are those normally associated with domestic and commercial activities. The California Integrated Waste Management Board (CIWMB) is the lead agency responsible for non-water quality-related issues relating to nonhazardous waste management in California (Division 7 of Title 14 of the CCR). CIWMB has the overall responsibility for landfill operations and ensuring that nonhazardous wastes are collected and disposed of in a manner which protects public health and safety as well as the environment. Inert wastes can be regulated by the Regional Board if necessary to protect water quality.

The Regional Board has regulated nonhazardous municipal solid waste facilities (Class III) since the mid-1970s. Many of the smaller, older facilities have closed, and waste is now typically disposed of at larger regional nonhazardous solid waste facilities. The Regional Board is responsible for the review and revision of waste discharge requirements for both active and inactive permitted sites to assure consistency with the current regulations. These responsibilities include the upgrading of groundwater monitoring systems to identify violations of water quality protection standards, and the establishment of corrective action programs where standards are violated.

A significant task faced by the Regional Board in implementing Chapter 15 at nonhazardous solid waste facilities is defining what constitutes designated wastes. Many wastes which are not hazardous still contain constituents of water quality concern that can become mobile in a nonhazardous solid waste facility, and can

produce leachates that could pose a threat to beneficial uses of the water of the state. The criteria for determining whether a nonhazardous waste is a designated waste are based on water quality objectives for waters located in the vicinity of the sites, the containment features of the solid waste facility, and the solubility/mobility of the waste constituents. To assist in the identification of designated waste criteria, the Regional Board will rely on a methodology acceptable to the Executive Officer and other relevant technical data.

**Landfill Expansion**

A steady increase in the rate of solid waste generation in the region is causing landfills to reach capacity sooner than expected. This situation has man it necessary not only to plan for the closure of some existing landfills, but also to anticipate the need for expansions of existing facilities and the construction of new ones. To minimize the problems associated with the rapid filling and subsequent closure of solid waste disposal facilities, the Regional Board supports efforts to reduce the volume of wastes disposed of at landfills. To reduce the potential for household hazardous wastes entering municipal landfills, the Regional Board also supports public education and household hazardous waste disposal and recycling programs.

The Regional Board conducts many other activities related to the disposal of wastes. Examples of these activities are review and approval of site design plans and construction oversight for new or expanding facilities, implementation of strict drainage and erosion control measures at landfills, soil and groundwater cleanup activities at contaminated disposal sites, and closure/post-closure plan review, approval, and closure construction oversight.

**Toxics Pits Cleanup Act**

The Toxics Pits Cleanup Act of 1984 (TPCA) required that all impoundments containing liquid hazardous wastes or free liquids containing hazardous waste must be either reconstructed with a liner/leachate collection system or be dried out by July 1, 1988. These facilities must also be closed by removing all contaminants or by capping to contain any residual soil contamination. In 1985, there were 11 sites in the Santa Ana Region with ponds subject to TPCA. As of 1993, 2 facilities are continuing to operate following upgrades to meet TPCA requirements, eight facilities have closed, and discharges at the remaining facility have ceased. Lead responsibility for closure of the remaining site has been assumed by the DTSC, with participation continued by the Regional Board.

**Solid Waste Assessment Tests**

Section 13273 was added to the Water Code in 1985, requiring all operations of both active and inactive nonhazardous landfills to complete a Solid Waste

Assessment Test (SWAT). The purpose of the SWAT is to determine whether hazardous or toxic substances above regulatory thresholds, or any other constituents which may threaten water quality, are migrating from the facility. Funding for the SWAT program is provided by the California Integrated Waste Management Board.

There were 159 sites identified in the region subject to this program. Pursuant to a list adopted by the State Board, 150 sites statewide were to be evaluated each year through the year 2001 (approximately 10 sites per year in the Santa Ana Region). These sites were according to their perceived threat to water quality. Active sites, those overlying high quality aquifers, and those already known to have adversely impacted groundwater were replaced in the highest ranks (Rank 1 through 4).

Program funding was eliminated in 1991, but was restored in 1992 for a period of three years to allow for review of reports for sites in Ranks 1 through 5 only. These reviews must be completed by 1995. Although landfill site evaluations, which seek to identify adverse impacts to both surface and groundwater quality, can be required pursuant to Chapter 15 whenever necessary, it appears that the SWAT program will be fully funded after 1995. A revised SWAT ranking list will be created prior to implementation of the program for Rank 6 and beyond.

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# CHAPTER 6

# MONITORING AND ASSESSMENT

## INTRODUCTION

The effectiveness of a water quality control program cannot be judged without information supplied by a comprehensive monitoring and assessment program. The State Board, the Regional Boards, and other federal, state, and local agencies monitor water quality throughout the state. Coordination among the agencies is essential to identify data gaps and supplement monitoring efforts as necessary. The results of these programs show where water quality problems exist now and where problems can be expected based on quality trends over time. Monitoring activities in the Santa Ana Region were described as part of Chapter 5 (Plan Assessment) in the 1983 Basin Plan. In this Plan, the discussion has been expanded and updated. New programs have been added and obsolete programs have been deleted. Additionally, this chapter provides a brief description of the databases being used to store and analyze the data collected. This chapter also describes the periodic water quality assessments which are conducted on a statewide basis, using the monitoring data collected.

## STATE MONITORING PROGRAMS

The State Board is the lead agency for statewide monitoring activities. The State Board coordinates extensively with the California Departments of Fish and Game, Water Resources, Health Services, and various federal agencies in its monitoring activities. The objectives of the State's surveillance and monitoring program are as follows:

- To measure the achievement of water quality goals and objectives specified in the Basin Plan;
- To measure the specific effects of water quality changes on established beneficial uses;
- To measure background conditions of water quality;
- To determine long-term trends in water quality;
- To locate and identify sources of water pollution that pose an acute, accumulative, and/or chronic threat to the environment;
- To provide information needed to compare receiving water quality to mass emissions of pollutants from waste discharge;

- To provide data for determining compliance with permit conditions and to support enforcement actions, if necessary;

- To measure wasteloads discharged to receiving waters and to identify their effects, and in water quality limited segments, to prepare wasteload allocations necessary to achieve water quality control;

- To provide data needed to carry on the continuing planning process;

- To measure the effects of water rights decisions on water quality and to guide the State Board in its responsibility to regulate unappropriated water for the control of quality;

- To provide a clearinghouse for the collection and dissemination of water quality data gathered by other agencies and private parties cooperating in the program; and

- To prepare reports on water quality conditions as required by federal and state regulations and other users requesting water quality data.

The monitoring program provides for collection and analysis of samples and the reporting of water quality data. It includes laboratory support and quality assurance, storage of data for rapid and systematic retrieval and preparation of reports and data summaries. Most important is the interpretation and evaluation of data leading to recommendations for action.

The State monitoring program focuses on fresh and marine surface waters. The goal of the State monitoring program is to provide an overall, continuing assessment of water quality in the state. Historically, conventional parameter such as minerals, nutrients, and dissolved oxygen were considered to be the most important parameters. More recently, toxic substances have received increasing attention in federal and state water pollution control activities. The State and Regional Boards are intensifying their efforts to investigate the presence of toxic substances in surface waters and the effects of these substances on aquatic biota.

The State program consists of a toxicity monitoring program, the Inland Surface Waters Toxicity Testing Program, and two toxic substances monitoring programs – the Toxic Substances Monitoring Program and State Mussel Watch.

**Inland Surface Waters Toxicity Testing Program**

The goal of this program, which was initiated in 1990, is to evaluate the extent, magnitude, nature and sources of toxicity in the waters of the State. Emphasis is on those waters where toxicity is associated with unregulated discharges such as runoff from agriculture, mining or urban areas. As part of this program, a toxicity

testing facility at the University of California, Davis was established to conduct State and Regional Board studies. The Regional Board performs the sampling of the waterbodies in the region and supplies the testing facility with the samples.

The toxicity test measures the combined effects of toxics in the water and is not used to separate and identify a specific toxic substance. Toxicity is determined by using water column examples from a waterbody under lab conditions. Appropriate test organisms are observed for their response by using growth, reproduction or mortality as indicators. Two types of toxicity tests are used, acute and chronic, which involve measuring responses in different life stages of the test organisms.

In the Santa Ana Region, Big Bear Lake and its tributaries, the Anaheim and Newport Bay Watersheds, Lake Elsinore, and some creeks have been sampled for toxicity as part of this program.

**Toxic Substances Monitoring Program**

The Toxic Substances Monitoring Program (TSMP) was initiated in 1976 by the State Board. The TSMP was organized to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in fresh and estuarine waters of the state. The TSMP primarily targets waterbodies with known or suspected impaired water quality and is not intended to give an overall water quality assessment. Data obtained from the TSMP is used to focus the Regional Board's attention on those waterbodies impacted by toxic pollutants. Special TSMP or other studies are then conducted to investigate the source(s) of the pollutants. The State Board has contracted with the Department of Fish and Game to perform the monitoring and chemical analyses associated with this program.

The presence of toxic substances often cannot be determined by water column sampling due to the low concentrations of toxicants in the water. Also, a number of toxic substances are not water soluble, but can be found associated with sediment or organic matter. The process of bioaccumulation acts to concentrate toxicants through the aquatic food web, sometimes many hundreds of times the levels actually in water. Therefore, in the TSMP the flesh of fish and other aquatic organisms (mainly crayfish) is analyzed to indicate whether any toxic substance is present. Fish livers are analyzed for metals, including arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc; fish muscle tissue (filet) is analyzed for mercury and selenium. In addition, fish filet and crayfish tail are analyzed for 45 synthetic organic compounds, which include pesticides and PCBs (Table 6-1). When very small-sized fish are available, only whole-body analyses are conducted.

The objectives of the Toxic Substances Monitoring Program are as follows:

- To develop statewide baseline data and to demonstrate trends in the occurrence of toxic elements and organic substances in the aquatic biota;
- To assess impacts of accumulated toxicants upon the usability of State waters by man;
- To assess impacts of accumulated toxicants upon the aquatic biota; and
- Where problem concentrations of toxicants are detected, to attempt to identify sources of toxicants and to relate concentrations found in the biota to concentrations found in the water.

Based upon the priorities identified by the Regional Board and the TSMP, the number and location of the sampling stations and the constituents investigated vary each year. When the program began, streams and lakes were ranked according to various criteria established to indicate their importance to the state in terms of water quality. The priority I, or highest priority, waterbodies were included in the first phase of monitoring. The Santa Ana River was included in this list and the station at Prado Dam has been sampled annually since the program began. The monitoring was expanded to include four other stations on the Santa Ana River and two of its tributaries, Chino and Cucamonga Creeks. A number of sites in the Newport Bay Watershed have also been sampled, largely in response to findings by the State Mussel Watch Program (see below) of high levels of organics and metals in the Bay itself. The results of this TSMP sampling led to an intensive study of toxics in San Diego Creek in 1985. Several stations were added to the program to monitor Anaheim Bay and its tributaries because of similar concerns. A number of the lakes in the region, including several park lakes, have also been sampled in this program. Table 6-2 lists the TSMP sampling sites in the Santa Ana Region (1978-1991).

Reports which describe the statewide TSMP sampling program sites, the constituents investigated, and the results have been published annually since 1977. A ten-year data summary was published in 1987.

**State Mussel Watch Program**

The State Mussel Watch (SMW) program is the state's long term marine water quality monitoring program, initiated in 1977. The SMW program provides the state with data showing trends in coastal and estuarine water quality. The Regional Board uses the data from SMW to establish the presence or absence of toxic substances and to monitor the variation in the concentrations detected at the various locations. Using this information, the Regional Board then attempts to locate the sources of the contamination. As with the Toxic Substances Monitoring Program, the State Board contracts with the Department of Fish and Game to perform the sampling and analysis.

- The primary goal of the SMW program are as follows:
- To provide long-term monitoring of certain toxic substances levels in coastal marine waters;

- To provide an important element in comprehensive water quality monitoring strategy; and
- To identify on a year-to-year basis specific areas where concentrations of toxic materials are higher than normal.

Mussels were chosen for the State Mussel Watch program because: (1) they are common along the California coast; (2) they are immobile in nature, permitting a localized measurement of water quality; (3) they have the ability to concentrate pollutants above ambient seawater levels; and (4) they provide a time-averaged sample. Where freshwater tributaries are suspected sources of toxics, freshwater clams are used. The trace metals analyzed in mussel and clam tissues are similar to those investigated by the Toxic Substances Monitoring Program and include aluminum, cadmium, chromium, copper, lead, manganese, mercury, nickel, silver, and zinc. Synthetic organic compounds analyzed are listed in Table 6-1.

As with the Toxic Substances Monitoring Program, the number and location of SMW sites investigated varies each year, according to program needs and resource constraints. Several key areas in the Santa Ana Region are frequently sampled in this program (See Table 6-3). Anaheim Bay/Huntington Harbour area sampling locations include the Anaheim Navy Harbor, Anaheim Navy Marsh, Anaheim Bay at Edinger Street, and Anaheim Bay at Warner Avenue. In the Newport area, the most frequently sampled stations include Newport Bay Island, Newport Bay at Hwy 1 Bridge, Newport Bay at Crows Nest, Rhine Channel, and Newport Bay/Upper Rhine Channel. As with the TSMP, statewide SMW reports are published annually and a ten-year data summary for 1977-1987 is available.

## REGIONAL MONITORING PROGRAMS

The regional monitoring programs are grouped with local agencies' programs because they are, for the most part, cooperative efforts. The sampling frequency, sampling stations, constituents, and other details vary from year to year, depending on needs and budgets of the Regional Board and local agencies.

The regional monitoring effort consists of the following:

1. Surface Water Monitoring
2. Groundwater Monitoring
3. Compliance Monitoring
4. Complaint Investigation
5. Intensive Surveys
6. Aerial Surveillance
7. Stormwater Monitoring

## Surface Water Monitoring

With the exception of the annual sampling of the Santa Ana River at Prado Dam, the Regional Board's surface water monitoring program is not strictly formalized. The sampling frequency, locations, constituents, and other details vary from year to year depending on identified problems and needs, and on staff and funding availability. A number of other agencies conduct surface water monitoring programs in the region, including water purveyors, wastewater dischargers, and flood control agencies. The Regional Board makes every effort to coordinate its monitoring activities with these other agencies to maximize the collection and exchange of data, as well as the use of resources.

This Basin Plan specifies water quality objectives applicable to Reach 3 of the Santa Ana River for TDS, nitrogen, and other constituents which are set on the baseflow of the River (see Chapter 4). To determine compliance with these objectives, the Basin Plan requires that sampling of the River be conducted annually at Prado Dam. As directed by the Basin Plan, Board staff conducts the sampling during August, when the quantity and quality of baseflow is most consistent. Staff then reports the results to the Board. The results of this program are used to assess the effectiveness of the Board's regulatory programs and to determine whether changes, such as revisions to the TDS and nitrogen wasteload allocations, are necessary.

## Groundwater Monitoring

The regional groundwater monitoring program depends upon the cooperation of local agencies to ensure that data are collected. The Region's municipal water supply districts sample their potable water wells to assure that the public health regulations are met. The sample results are also submitted to the Regional Board.

This Region relies greatly on groundwater computer models for basin planning studies. The groundwater quality data is collected by numerous agencies. The Regional Board contributes to the collection effort. All data will be collected in a computer database compiled by the Santa Ana Watershed Project Authority.

## Compliance Monitoring

Under this program, data is collected and used to determine compliance with discharge requirements and receiving water standards, and to support enforcement actions and waste discharge prohibitions. The data are collected from self-monitoring reports generated by waste dischargers and from compliance monitoring reports prepared by Regional Board staff.

Self-monitoring reports submitted to the Regional Board are reviewed, and if violations are noted, appropriate action is taken, ranging from administrative

enforcement to judicial abatement, depending on the circumstances. Self-monitoring report data have also been used to develop pollutant loads and to measure general water quality conditions in the receiving water.

**Table 6-1**

Synthetic Organic Compounds Analyzed
in the State Mussel Watch
and Toxic Substances Monitoring Programs

| | | |
|---|---|---|
| Aldrin | p,p'-DDMU | delta-Lindane |
| Chlorbenside | o,p'-DDT | Total Lindane [2] |
| alpha-Chlordane | p,p'-DDT | Methoxychlor |
| gamma-Chlordane | Total DDT | Methyl Parathion |
| cis-Chlordane | Diazinon | Oxadiazon [2] |
| trans-Clordane | Dieldrin | PCB 1248 |
| Oxychlordane | Endrin | PCB 1254 |
| Total Chlordane | Endosulfan [1] | PCB 1260 |
| cis-Nonachlor | Endosulfan [2] | Total PCB |
| trans-Nonachlor | Endosulfan Sulfate | Pentachlorophenol [1] |
| Chlorpyrifos | Total Endosulfan | Phenol [1] |
| Dacthal | Ethyl Parathion | Ronnel [1] |
| Dicofol [2] | Heptachlor | Tetrachlorophenol [1] |
| p,p'-DDE | Heptachlor Epoxide | Tetradifon [1] |
| o,p'-DDE | Hexachlorobenzene | Toxaphene |
| o,p'-DDD | alpha-Lindane | Tributylin [1] |
| p,p'-DDD | beta-Lindane | |
| p,p'-DDMS | gamma-Lindane | |

1 These constituents are analyzed only in the State Mussel Watch Program

2 These constituents are analyzed only in the Toxic Substances Monitoring Program

**Table 6-2**

Toxic Substances Monitoring Program Stations
(Santa Ana Region)

| Stations | Station Nos. | Map No. [1] | Year Sampled | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 |
| **Anaheim Bay Watershed** | | | | | | | | | | | | | | | | |
| Bolsa Chica Channel/Westminster Ave. | 801.11.08 | 1 | | | | | | | | | X | X | X | | | |
| E.G.G. Wintersburg Chnl/Beach Blvd. | 801.11.90 | 2 | | | | | | | | | | X | | | | |
| E.G.G. Wintersburg Chnl/Gothard St. | 801.11.02 | 3 | | | | | | | | | X | | X | | | |
| Huntington Harbour/Anaheim Bay | 801.11.00 | 4 | | | | | | | | | | | | | X | |
| Ocean View Chnl/Beach Blvd. | 801.11.03 | 5 | | | | | | | | | X | X | | | | |
| Ocean View Chnl/Brookhurst St. | 801.11.91 | 6 | | | | | | | | | | X | | | | |
| Ocean View Chnl/Newhope St. | 801.11.92 | 7 | | | | | | | | | | X | | | | |
| Westminster Chnl/Graham St. | 801.11.01 | 8 | | | | | | | | | X | X | | | | |
| **Newport Bay Watershed** | | | | | | | | | | | | | | | | |
| Newport Bay | 801.11.97 | 9 | | | | | | | | | | | | | X | |
| Peters Canyon Channel | 801.11.96 | 10 | | | | | | | | | | | | X | X | X |
| San Diego Ck/Barranca Pkwy | 801.11.09 | 11 | | | | | | | | | | X | | | X | X |
| San Diego Ck/Laguna Rd. | 801.11.13 | 12 | | | | | | | | | | X | | | | |
| San Diego Ck/Michelson Dr. | 801.11.07 | 13 | | | | | | X | X | X | X | X | X | X | X | X |
| San Diego Ck/Upper Newport Bay | 801.11.04 | 14 | | | | | | | X | X | X | | | | | |
| **Other** | | | | | | | | | | | | | | | | |
| Anza Channel | 801.26.03 | 15 | | | | | | | | | | | | X | X | |

1 See Figure 6-1 for station locations.

**Table 6-2**

Toxic Substances Monitoring Program
Stations
(Santa Ana Region)
(Continued)

| | | | Year Sampled | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stations | Station Nos. | Map No. [1] | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 |
| Big Bear Lake | 801.71.10 | 16 | | | | | | | | | | | X | X | | |
| Big Bear Lake/Boulder Bay | 801.71.08 | 17 | | | | | | | X | | | | | | | |
| Canyon Lake | 802.12.01 | 18 | | | | | | | | | | | | X | | |
| Carbon Canyon Park Lake | 801.13.90 | 19 | | | | | | | | | | X | | | | |
| Chino Creek/d/s Euclid Ave. | 801.21.02 | 20 | | | | | | | X | X | X | | X | | | |
| Chino Creek/u/s Pine Ave. | 801.21.03 | 21 | | | | | | | | | X | | | | | |
| Craig Park Lake | 845.61.91 | 22 | | | | | | | | | | X | | | | |
| Cucamonga-Mill Ck/McCarty Rd. | 801.21.04 | 23 | | | | | | | | | | | | X | | |
| Delhi Channel | 801.11.05 | 24 | | | | | | | | X | | | | | | |
| Irvine Park Lake | 801.12.01 | 25 | | | | | | | | | | X | | | | |
| Lake Elsinore | 802.31.00 | 26 | | | | | | X | X | | | | | | | |
| Lake Evans | 801.26.01 | 27 | | | | | | | | | X | | | | | |
| Lake Mathews | 801.33.00 | 28 | | | | | | | | | X | | | | | |
| Los Coyotes Park Lake | 845.61.90 | 29 | | | | | | | | | | X | | | | |
| Mason Park Lane | 801.11.93 | 30 | | | | | | | | | | X | | | | |
| Mile Square Park Lake #1 | 801.11.94 | 31 | | | | | | | | | | X | | | | |
| Mile Square Park Lake #2 | 801.11.95 | 32 | | | | | | | | | | X | | | | |
| Prado Lake | 801.21.90 | 33 | | | | | | | | | | | | X | | |

1 See Figure 6-1 for station locations.

**Table 6-2**

Toxic Substances Monitoring Program Stations
(Santa Ana Region) (Continued)

| | | | Year Sampled | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stations | Station Nos. | Map No.[1] | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 |
| Santa Ana River/Featherly Park | 801.13.03 | 34 | | | | | | | | X | | | | | | |
| Santa Ana River/Hammer Ave. | 801.21.05 | 35 | | | | | | | | | | | X | | | |
| Santa Ana River/Imperial Hwy | 801.13.00 | 36 | | | | | | | | X | | | | | | |
| Santa Ana River/Prado Dam | 801.25.00 | 37 | X | X | X | X | X | X | X | X | X | | X | X | X | X |
| Santa Ana River/USGS Gage | 801.21.09 | 38 | | | | | | | | X | | | X | | | |
| Yorba Park Lake | 801.13.91 | 39 | | | | | | | | | | X | | | | |

1 See Figure 6-1 for station locations.

**Table 6-3**

State Mussel Watch Stations
(Santa Ana Region)

| Stations | Station Nos.[1] | Year Sampled | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
| **Anaheim Bay Watershed** | | | | | | | | | | | | | | | | | |
| Anaheim Navy Harbor | 707 | | | | | | | X | | X | X | X | | X | X | X | |
| Anaheim Navy Marsh | 708 | | | | | | | X | | | X | X | | X | X | X | |
| Anaheim Navy Marsh 2 | 708.5 | | | | | | | | | | | | | | X | X | |
| Anaheim Bay Entrance | 709 | | | | | | X | | | | | | | | | | |
| Anaheim Fuel Docks N | 710 | | | | X | X | | | | | | | | | | | |
| Anaheim Fuel Docks S | 710.2 | | | | | | | | | X | X | | | X | | | |
| Launch Ramp Docks | 711 | | | | | | X | | | | | | | | | | |
| Peters Landing | 712 | | | | | | X | | | | | | | | | | |
| Anaheim Edinger St. | 713 | | | | | | | X | | X | X | | | | X | X | |
| Anaheim Bay - Warner Ave. | 715 | | | | | | | X | | X | X | | | X | X | X | |
| Anaheim Harbor Ln. | 717 | | | | | | | | | | X | | | | X | X | |
| G.G. Wintersburg Channel | 727 | | | | | | | | | | | | | | | X | |
| **Newport Bay Watershed** | | | | | | | | | | | | | | | | | |
| Newport Pier | 720 | | | | | | | | | | X | | | | | | |
| Newport Entrance Channel | 721 | | | | | | X | X | | X | X | | | X | | | |
| Newport Bay Police Docks | 722 | | | | X | | X | | | | X | | | | | | |
| Newport Bay El Pasco Dr. | 722.4 | | | | | | | | | | X | | | | | | |

1 See Figure 6-2, 6-3, and 6-4 for station locations.

**Table 6-3**

State Mussel Watch Stations
(Santa Ana Region) (Continued)

| | | Year Sampled | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stations | Station Nos. [1] | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
| Newport Bay Island | 723 | | | | | | X | | X | X | X | | | X | X | X | |
| Newport Bay Turning Basin | 723.4 | | | | | | | | | | X | | | X | X | X | |
| Newport Hwy 1 Bridge | 724 | | | | | | X | X | | X | X | | | X | | X | |
| Newport Bay Dunes Duck | 724.4 | | | | | | | | | | X | | | | | | |
| Newport Crows Nest | 725 | | | | | | X | X | | X | X | X | X | X | X | X | |
| Newport Upper Rhine | 726 | | | | | | X | X | | X | X | X | X | X | | | |
| Newport Bay Rhine Channel | 726.2 | | | | | | | | | | X | | | | X | | |
| Newport Bay Rhine Channel End | 726.4 | | | | | | | | | | X | | | | | X | |
| Newport Pier | 731 | | | | X | | | | | | | | | | | | |
| Newport W. Jetty | 732 | | | X | X | | | | | | | | | | | | |
| Newport W. Jetty End | 733 | | | | X | | | | | | | | | | | | |
| Newport E. Jetty | 734 | | | | X | | | | | | | | | | | | |
| San Diego Ck./MacArthur | 728.4 | | | | | | | | | X | X | | | | X | X | |
| San Diego Ck./Michelson | 728.7 | | | | | | | | | | | | | | | X | |
| Peters Cyn/Barranca | 728.9 | | | | | | | | | | | | | | | X | |
| **Other** | | | | | | | | | | | | | | | | | |
| Corona Del Mar | 735 | X | X | X | | X | | | | | | | | | | X | |
| Santa Ana River/Prado Dam | 719.1 | | | | | | | | | | | | | | | | X |
| Temescal Ck/Nickels Road | 719.8 | | | | | | | | | | | | | | | | X |

1 See Figure 6-2, 6-3, and 6-4 for station locations.

Figure 6-1
Toxic Substances Monitoring Program
Santa Ana Region Stations

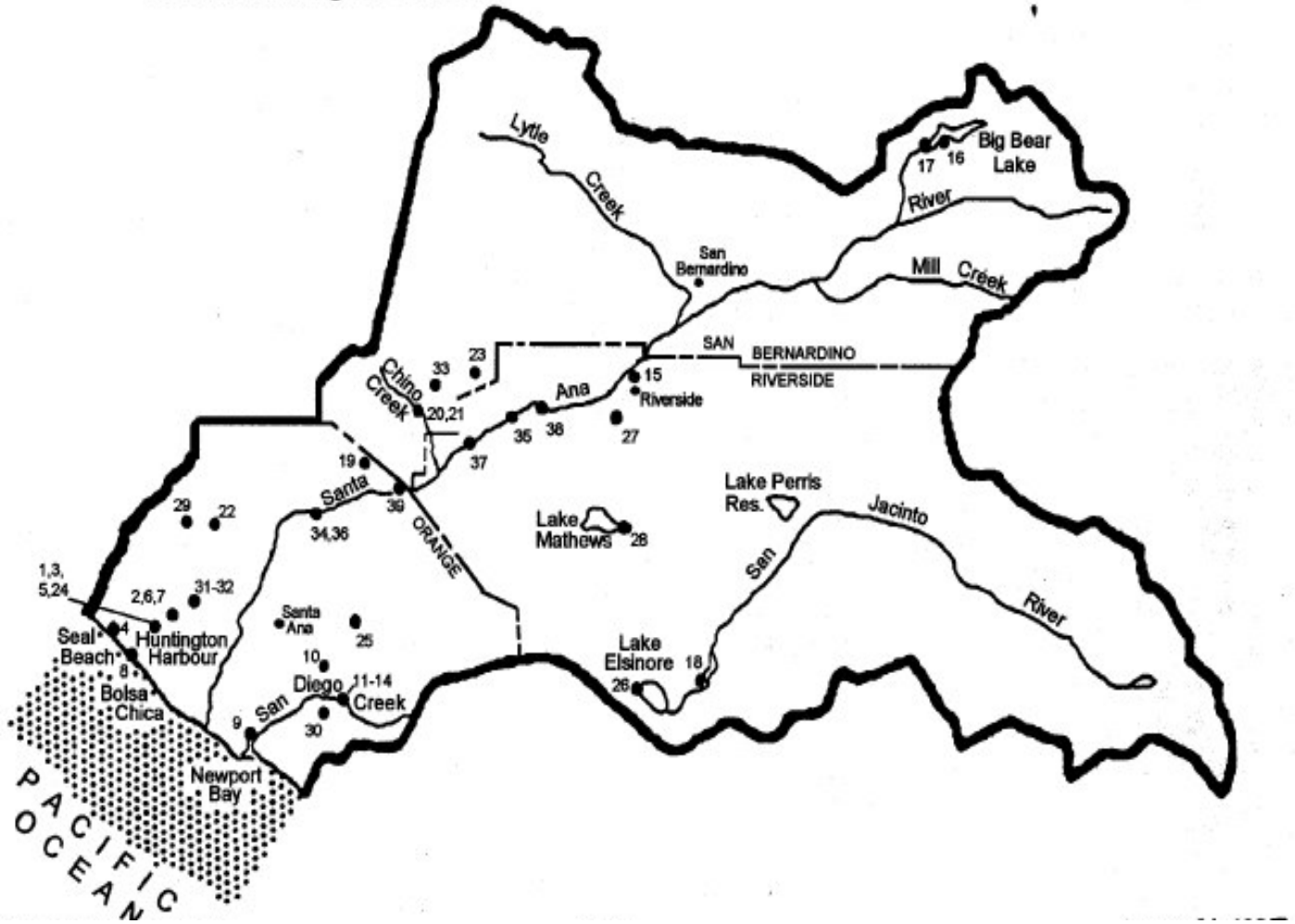


Figure 6-2
State Mussel Watch Stations
Anaheim Bay/Huntington Harbour Watershed

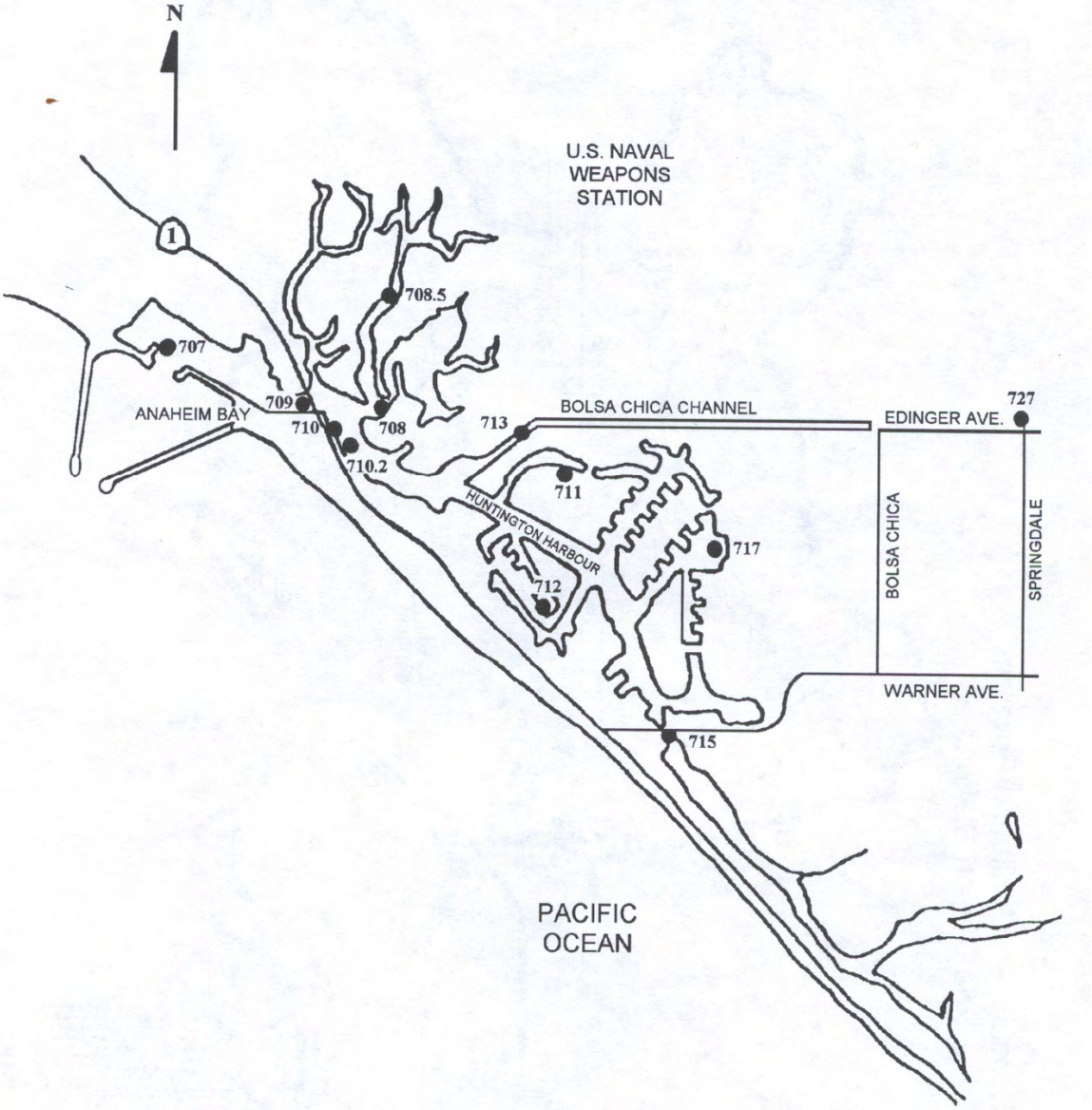


Figure 6-3
State Mussel Watch Stations
Newport Bay Watershed

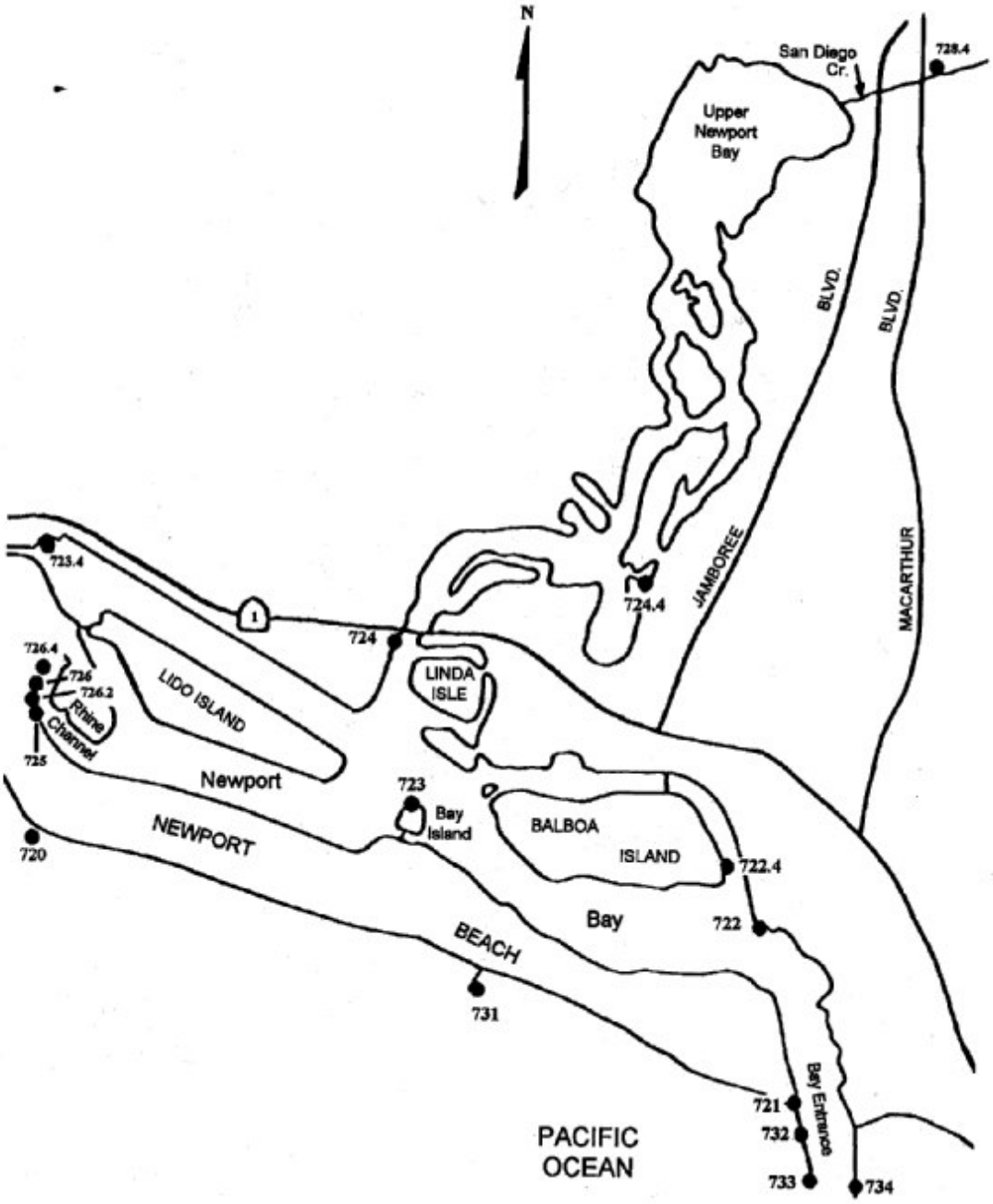
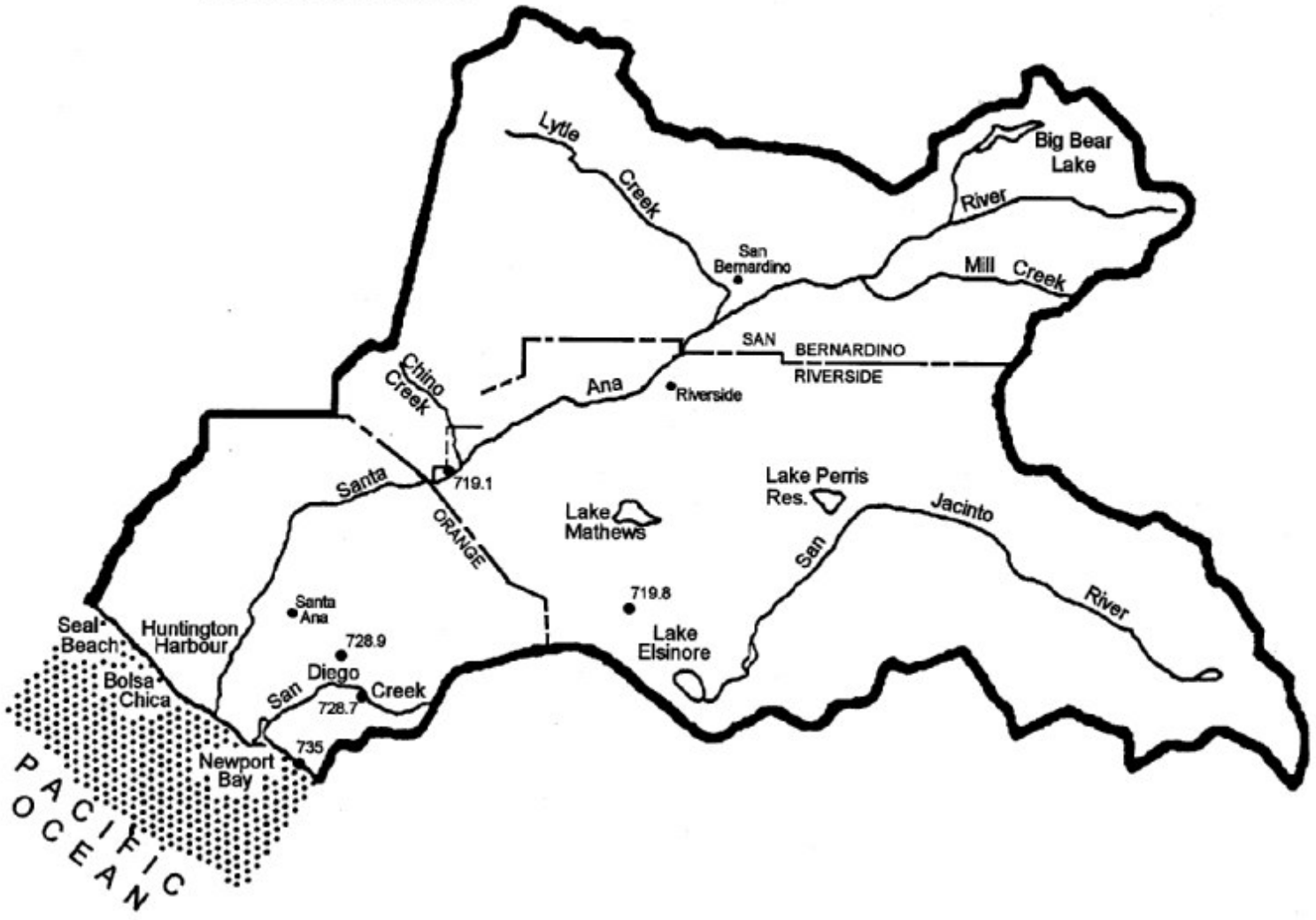


Figure 6-4
State Mussel Watch
Additional Stations



**Compliance Monitoring** (Continued form page 6-6)

The lowest concentration by which permit compliance is reliably measured is called the Practical Quantification Level (PQL). The PQL is used and taken into account when establishing waste discharge limits. PQLs will be developed using all available information, and will be established based upon information obtained from regional laboratories.

The Regional Board requires the initiation of a Toxicity Reduction Evaluation (TRE) if a discharge consistently exceeds its chronic toxicity effluent limit. The Regional Board, to date, has interpreted the "consistency exceeds" trigger as the failures of three successive monthly toxicity tests, each conducted on separate samples. Initiation of the TRE has also been conditioned on a determination that a sufficient level of toxicity exists to permit effective application of the analytical techniques required by a TRE. The Regional Board also encourages the development of scientifically sound toxicity test quality control and standardized interpretation criteria to improve the accuracy and reliability of chronic toxicity demonstrations.

Compliance monitoring also involves staff inspections of regulated and unregulated sites and includes observations made by staff members and/or results of analyses performed on samples collected by staff members.

**Complaint Investigation**

This program involves the investigation of complaints from citizens and public governmental agencies regarding the discharge of wastes or creation of nuisance conditions. It is a Regional Board responsibility which includes field studies, preparation of reports and letters, and other necessary follow-up actions to document observed conditions and to initiate appropriate corrective actions.

**Intensive Surveys**

Intensive monitoring surveys provide detailed water quality data to locate and evaluate violations of receiving water standards and to make wasteload allocations. They usually involved localized, intermittent sampling at higher than normal frequency. These surveys are performed in water quality-limited segments or hydrologic units which require additional sampling data to supplement the routine monitoring program results. The surveys are specially designed to evaluate water quality problems.

Beneficial use surveys are executed to aid in the review of the Basin Plan's water quality standards. This periodic review, entitled a "triennial review," is required in the

Clean Water Act. Intensive surveys have been performed on the middle Santa Ana River, Lake Elsinore, Lytle Creek, Mill Creek, San Diego Creek, Newport Bay, Huntington Harbour, and Strawberry Creek.

The Clean Lakes Program is specified in Section 314 of the Clean Water Act, and requires that all publicly owned freshwater lakes be identified and classified according to their trophic conditions. If a lake's condition is not known, a Clean Lakes Program survey may be performed to assess its water quality condition. If the trophic quality of the lake is determined not to protect its beneficial uses, the pollution sources and potential restorative measures are to be identified. The above actions may be conducted under a Clean Lake grant received from the federal government. Clean lake grant-funded studies of Lake Elsinore and Big Bear Lake are currently in progress.

**Aerial Surveillance**

Aerial surveillance is used primarily to gather photographic records of discharges and water quality conditions in the Region. Aerial surveillance is particularly effective because of the overall view of a facility that is obtained and because many facilities can be observed in a short period of time.

**Municipal Stormwater Monitoring**

The stormwater permitting program has been established to protect the water quality of the waterbodies which receive stormwater runoff. See Chapter 5 for a complete description of this program. Sampling of first-flush phenomena has indicated that stormwater discharges contain significant amounts of pollutants. Therefore, the Region's municipal stormwater permits require the permittees to develop comprehensive management and monitoring programs. Because each permit generally covers a large number of waterbodies, the required monitoring program is in two phases.

Phase I requires the discharger to sample those receiving waters where the beneficial uses are threatened or impaired due to runoff of stormwater and urban nuisance water. Under Phase II the dischargers will be required to develop stormwater management and monitoring programs for the remaining waterbodies included under the permit.

Stormwater discharges from urbanized areas consist mainly of surface runoff emanating from residential, commercial, and industrial areas. In addition, there are stormwater discharges from agricultural and other land uses. The constituents of concern in these discharges include: total and fecal coliform, enterococcus, total suspended solids, biochemical oxygen demand, chemical oxygen demand, total organic carbon, oil and grease, heavy metals, nutrients, base/neutral and acid extractibles, pesticides, herbicides, petroleum hydrocarbon products, and/or those causing extremely high or low pH.

The objectives of the stormwater monitoring programs are to: 1) define the type, magnitude, and sources of pollutants in the stormwater discharges within the permittee's jurisdiction so that appropriate pollution prevention and correction measures can be identified; 2) evaluate the effectiveness of pollution prevention and correction measures; and 3) evaluate compliance with water quality objectives established for the stormwater system or its components.

## QUALITY ASSURANCE / QUALITY CONTROL

The purpose of the Quality Assurance Program is to ensure that data generated from environmental measurement studies are technically sound and legally defensible. A State Quality Assurance (QA) Program Plan was prepared under authority of the State Board in April 1990 describing how the State and Regional Boards will implement and manage the QA program. This Plan was approved by the State Board and the US EPA, Region IX, to meet requirements for federal funding.

The federal regulation requiring the State to develop and implement a QA Program is written in EPA Order 5360.1, April 3, 1993. The mandate is identified in 40 CFR 30.503 (July 1, 1987) requiring State agencies involved in environmentally-related measurement projects to develop and implement a Quality Assurance Program for programs partially or fully supported by Federal funds.

This mandate further requires that a QA Program Plan be developed that describes how a State agency will implement and manage a QA Program. It also requires that a QA Project Plan be prepared and approved prior to the start of any field or laboratory activities. A State's QA Program Plan must be approved by the federal award official before federal funds can be released. QA Project Plans are approved by a state's designated QA Officer and are available for federal review.

The State Board has appointed a QA Program Manager to direct and coordinate the overall program. Each State Board division and Regional Board has appointed a QA Officer to administer their respective QA responsibilities. The State and Regional Boards jointly administer the program but the State Board has lead responsibility for managing the overall program and reporting to EPA.

The Regional Board's QA Officer interacts with project managers on the required preparation of QA Project Plans for studies involving field and laboratory activities. The Project Plans should outline project objectives, data quality objectives in which management decisions will be based, and field and laboratory procedures that will be used to achieve the objectives. Once completed, the Plan must be reviewed and approved by an agency QA Officer or, when problems arise, by the State Board QA Program Manager before any field work can begin. Guidelines on Plan preparation have been distributed to the State and Regional Board QA Officers.

## ASSESSMENT PROGRAMS

There are several statewide water quality assessments which are performed periodically. The assessments are used to evaluate the effectiveness of the Regional Boards' water quality programs to determine if making any changes are needed.

### Water Quality Assessment

The Water Quality Assessment (WQA) is a catalog of the State's waterbodies and their water quality condition. The WQA identifies the water quality condition as good, intermediate, impaired or unknown. The data used to categorize waterbodies in the WQA are obtained from the various monitoring programs identified previously. All Regional Boards adopted their regional WQA at public meetings and submitted them to the State Board for inclusion in the State WQA. In addition, for impaired and high priority waters, factsheets were prepared to provide additional detail. The State Board intends the WQA to be updated on a regular basis, generally every two years.

The WQA serves many different purposes. The WQA, a public document, reports the condition of the State's waterbodies in a summary format. The lists of impaired waterbodies, included in the WQA, satisfy several Clean Water Act listing requirements. These federal lists are identified by the applicable Clean Water Act (CWA) section or Code of Federal Regulation (CFR) number. These include:

- CWA 303(d) – Water Quality Limited Segments where water quality objectives will not be met even with the Best Available Treatment/Best Control Technology (BAT/BCT)

- CFR 131.11 – Segments which may be affected by or warrant concern due to toxics

- CWA 314 – Lake Priorities

- CWA 319 – Nonpoint Source Impacted Waters

- CWA 304(l) ("Long List") – Waters designated as impaired because narrative or numeric objectives are violated or beneficial uses are impaired similar to CWA Section 303(d).

- CWA 304(s) ("Short List") – Waters not meeting water quality objectives because of toxics from point source discharges

- CWA 304(m) ("Mini List") – Waters not meeting water quality objectives because of toxics from either point or nonpoint sources.

WQA Water Quality Condition Classification

For each region, the individual waterbodies are listed. They are identified by water resource type, ***i.e.***, bays and harbors, wetlands, coastal waters, estuaries, lakes and reservoirs, groundwater, rivers and streams, and saline lakes. An entire waterbody may be classified with one water quality condition or divided by segments into more than one.

Good: waters that support and enhance the designated beneficial uses. Waterbodies classified as good may be designated a high priority if a threat to water quality is present.

Intermediate: waters that support designated beneficial uses while there is occasional degradation of water quality. Waterbodies suspected of impairment but for which there is inadequate data to conclude impairment are also given this classification.

Impaired: waters not reasonably expected to attain or maintain applicable water quality standards. Standards include both numeric and narrative water quality objectives and the beneficial uses the objectives are intended to protect.

Unknown: waters with unknown water quality where limited or no direct observations are available.

The WQA also provides the foundation for the State Board's Clean Water Strategy process. The current regional WQA and the associated factsheets are included as Appendix VII.

**Clean Water Strategy**

The Clean Water Strategy (CWS) is a process that the State Board implemented to assure that staff and fiscal resources are directed at the highest priority water quality issues throughout California. The primary objective of the CWS is to more effectively define and respond to priorities as revealed by the best available water quality information. A CWS goal is to link State and Regional Board programs together in directing actions on individual waterbodies.

The CWS relies on the Water Quality Assessment condition ratings to provide the technical information necessary to identify waterbodies needing protection or prevention actions, additional assessment or cleanup activities. In addition to the Water Quality Assessment, the regions determined the relative resource value of their waterbodies to recognize the relative importance of individual waters when compared to each other. The regions developed priority waterbody lists which are based upon the severity of their water quality problems or needs and relative resource values, from which the State Board assembled a statewide priority list based upon the same criteria.

There are six phases involved in implementing the Clean Water Strategy. As of this date, phases 1 and 2 have been completed. The State Board has begun a pilot study to determine the feasibility of phases 3 through 6.

Phase 1: Obtain the best information
2: Compare and prioritize waterbody concerns
3: Prioritize actions to address concerns
4: Allocate new resources
5: Implement strategy goals
6: Review results

### 305(b) Report

The 305(b) Report, also known as the National Water Quality Inventory Report, is a summary of all states' water quality reports compiled by the Environmental protection Agency. The report is prepared biennially from information that states are required to submit pursuant to Section 305(b)(1) of the Clean Water Act.

The State Board prepares the State report using information taken from the WQA. The State 305(b) Report includes: (a) a description of the water quality of major navigable waters in the State during the preceding years; (b) and analysis of the extent to which significant navigable waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water; (c) an analysis of the extent to which elimination of the discharge of pollutants is being employed or will be needed; and (d) estimates of the environmental impact, the economic and social costs necessary to achieve the "no discharge" objective of the Clean Water Act, the economic and social benefits of such achievement, and the dates of such achievement. The report also recommends programs which must be implemented to achieve the CWA goals.

## DATA MANAGEMENT

### Regional Modeling Efforts

SAGIS/ADSS: The Santa Ana Watershed Project Authority Planning Department has devised a modeling program and system called the Advanced Decision Support System (ADSS) to aid in the development of long-range plans to meet water quality and quantity objectives (ARC/INFO is the trademark of the Environmental Systems Research Institute's copyrighted program. Although this product is mentioned in the Basin Plan, the Santa Ana Regional Board is not endorsing any commercial products). The ADSS creates a central data storage facility standardizing data collection, storage, and retrieval. The core of the ADSS is the Santa Ana

Geographic Information Systems (SAGIS). SAGIS is an ARC/INFO[1]-based water resource analysis and graphic tool written in ARC Marco Language. SAGIS includes a library of various geographic overlays to create custom base maps for water resource data. The system also allows the user to view data stored in tabular form and plot the results versus time. SAGIS will produce a variety of water quality and quantity analysis maps and plots. SAGIS includes a comprehensive landuse database of the Santa Ana River Basin to project future water needs.

**Regional Databases**

STORET: STORET, which stands for STOrage and RETrieval, is a national database system that contains environmental monitoring data relating to the water quality within this Regional Board's boundaries and throughout the United States. These data are the result of field and laboratory analyses performed on samples gathered from streams, lakes, estuaries, groundwater, and other waterbodies. The STORET system resides on an IBM 3090 mainframe computer maintained by the US EPA at the National Computer Center in North Carolina.

The original database has evolved into a more comprehensive system capable of performing a broad range of analyses, as well as serving as the depository for data. In California, stations are sampled, in part, by the following agencies: California Department of Water Resources, U.S. Geographical Survey, California Department of Health Services, and the Regional Boards. The Regional Boards, as well as the State Board, EPA, and other regulatory agencies utilize the STORET database to examine the causes and effects of water pollution, to measure compliance with water quality objectives and maintenance of beneficial uses, and to determine water quality trends.

SABRINA: Another part of the ADSS is the Santa Ana Relational Database Management System, or SABRINA. Developed by SAWPA, SABRINA is a menu-driven application written in a database language and stores the data used by SAGIS.

[1] ARC/INFO is the trademark of the Environmental Systems Research Institute's copyrighted program. Although this product is mentioned in the Basin Plan, the Santa Ana Regional Board is not endorsing any commercial products.

## REFERENCES

California Regional Water Quality Control Board – Santa Ana Region, “Newport Bay Clean Water Strategy – A Report and Recommendations for Future Actions,” September, 1989.

California State Water Resources Control Board, “California State Mussel Watch, Ten Year Data Summary 1977-1987, WQMR No. 87-3,” May, 1988.

California Regional Water Quality Control Board, Santa Ana Region, Staff Report, “State Mussel Watch Results, 1987-1988 and 1988-1989, Item 21,” February 9, 1990.

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California Regional Water Quality Control Board, Santa Ana Region, “Newport Bay Clean Water Strategy, A Report and Recommendations for Future Action,” September, 1989.

United Sates Environmental Protection Agency, “STORET Documentation for Menu-Driven User Interface,” February, 1992.

# CHAPTER 7

# WATER RESOURCES AND WATER QUALITY MANAGEMENT

## INTRODUCTION

Numerous water resource management studies and projects, focused on water quality and/or water supply, are in progress in the Region under the auspices of a variety of parties. Some of these activities bear directly on the implementation of this Plan and were briefly described earlier (Chapter 5). Others may lead to future Basin Plan amendments to incorporate appropriate changes, such as revised regulatory strategies for POTWs or other dischargers. Excellent examples of these programs are the extensive, multi-agency effort in the Chino Basin to evaluate water resource management alternatives and the implementation of groundwater desalters by the Santa Ana Watershed Project Authority (SAWPA) to address the severe TDS and nitrate quality problems in that Basin. Such investigations, and the implementation of appropriate physical solutions, are an essential and integral part of the effort to restore and maintain water quality in the Region.

Funding for these investigations and projects comes from a variety of sources. Local and regional agencies contribute substantial funds and staff resources. State and federal funds, in the form of loans or grants administered principally by the State Water Resources Control Board or the US EPA, are an important source of support. Volunteer efforts by citizens' groups and private landowners also contribute significantly.

The purpose of this chapter, which is new to the Basin Plan, is strictly informational – the intent is to provide an overview of some of these studies, the agencies conducting them and funding mechanisms. This discussion is necessarily brief and incomplete but should convey a sense of the scope and significance of the participation of others in water resources management in the Region.

## SANTA ANA WATERSHED PROJECT AUTHORITY

The activities of the Santa Ana Watershed Project Authority (SAWPA) have been and remain exceptionally important to the management and protection of water resources in the Region. For this reason, SAWPA warrants special discussion.

As noted in Chapter 1, SAWPA is a joint powers agency which conducts water-related investigations and planning studies, and builds physical facilities where needed for water supply, wastewater treatment or water quality remediation. SAWPA is comprised of the five major water supply and/or wastewater management agencies in the Region: Chino Basin Municipal Water District (CBMWD); Eastern Municipal Water District (EMWD); Orange County Water

District (OCWD); San Bernardino Valley Municipal Water District (SBVMWD); and Western Municipal Water District (WMWD).

Since the early 1970's, SAWPA has played a key role in the development and update of the Basin Plan for the Santa Ana Region. SAWPA continues to sponsor, participate in, and/or oversee numerous water quality planning studies. Ongoing studies include the Chino Basin Water Resources Management Study, the Colton-Riverside Conjunctive Use Project, an investigation of water quality in Lake Elsinore, and studies of nitrogen and organic carbon in the Prado Basin. These studies are briefly described later in this chapter.

SAWPA also plays a crucial role in the implementation of the Basin Plan through the construction of physical facilities. SAWPA built and now operates the Arlington Desalter and is in the process of implementing two such facilities in the Chino Basin. As described in Chapter 5, these desalters are key parts of this Plan's strategy to address salt problems in the upper Santa Ana Basin. Additional desalters for the Riverside/Colton and Temescal areas are being considered.

SAWPA is responsible for the construction of the West Riverside County Regional Wastewater Treatment Facility and, with the cities of San Bernardino and Colton, for the Rapid Infiltration and Extraction treatment facility, which will provide wastewater treatment equivalent to tertiary for those cities. SAWPA built and is now planning expansion of the Santa Ana Regional Interceptor, or SARI line, which transports highly saline wastes out of the Basin (see also Chapter 5). SAWPA constructed and operates treatment facilities for contaminated groundwater at the Stringfellow site. SAWPA has also played a key role in the implementation of the Lake Elsinore Stabilization Project.

As noted in Chapter 6, SAWPA has undertaken to act as a clearinghouse for region-wide data on water quality, landuse, population, etc., by implementing database and geographical information systems including SABRINA, SAGIS (Santa Ana Geographic Information System) and the Advanced Decision Support System.

## NATIONAL WATER RESEARCH INSTITUTE

The National Water Research Institute (NWRI) was founded through funding provided by the Joan Irvine Smith and Athalie R. Clarke Foundation, the County Sanitation Districts of Orange County, the Irvine Ranch Water District, the Municipal Water District of Orange County, Orange County Water District, and the San Juan Basin Authority. The Institute was created to identify and support independent research projects throughout the United States which will lead to improved water quality and water supplies.

The Institute's research priorities include water quality improvement and recycling, watershed management, health risk assessment, membrane research,

and the development of public policy. The Institute uses a number of strategies to fulfill these objectives, including:

- working with local, state, and national water resource organizations to identify research needs;
- encountering broad-based participation in joint venture partnership which support water research;
- providing opportunities for members of the national water research community to meet and exchange ideas;
- developing technical and institutional strategies which ensure that research results are implemented in a timely, cost-effective manner;
- educating the general public about the need for water conservation and research; and
- serving as a catalyst to encourage development of centers of excellence in water research.

The Institute is independently governed by a Board of Directors consisting of one member from each of the contributing agencies. The NWRI and its partners establish joint ventures to sponsor research projects. NWRI has funded numerous projects which benefit the region including research on water quality and wildlife enhancement in the Prado Wetlands, television documentaries focusing on water resources issues on the lower Santa Ana River, investigation of several wastewater treatment technologies, and the treatment of contaminants in groundwater.

## INLAND SURFACE WATERS

### Big Bear Watershed

Big Bear Lake is located in the San Bernardino Mountains in central San Bernardino County. The close proximity of the Lake and mountains to the urban communities within Los Angeles, San Diego, Riverside, and San Bernardino Counties has made it a heavily utilized recreational attraction. During winter, the mountains surrounding Big Bear Lake are visited by hundreds of thousands of skiers and sightseers, while the summer months bring thousands of tourists to enjoy the pleasures of the Lake and the beautiful forested landscape. The Lake is also an important wildlife resource, providing habitat for a wide variety of plants and animals, including rare and endangered species.

A cooperative effort to ensure proper management and protection of this resource is in progress. A number of agencies, private organizations, and

individuals have joined in the development of the Big Bear Valley Coordinated Resource Management Plan (CRMP). A geographic information system will be developed to integrate information on plant and animal habitats, tributaries, and other relevant data. The intent is to use this system as a guide in making land use decisions.

The participants include:

- East Valley Resource Conservation District
- City of Big Bear Lake
- Big Bear Municipal Water District
- County of San Bernardino Planning Department
- Santa Ana Regional Water Quality Control Board
- California Department of Forestry
- California Department of Fish and Game
- California Department of Health Services
- Natural Heritage Foundation
- Big Bear Area Regional Wastewater Agency
- Big Bear City Community Services District
- Bear Mountain Ski Area
- Snow Summit Ski Area
- U.S. Fish and Wildlife Services
- U.S. Army Corps of Engineers
- U.S. Soil Conservation Service
- USDA Forest Service

**Lake Elsinore**

Lake Elsinore is a heavily used recreational waterbody located in the San Jacinto Watershed in southwest Riverside County. As noted in Chapter 1, the lake periodically goes dry, resulting in fish kills and adverse impacts on recreational opportunities. Projects to stabilize the level of the Lake are now being completed or considered. Among these is consideration of the use of reclaimed water to maintain water levels.

SAWPA is overseeing a study of the Lake, funded by a Clean Water Act Section 314 Clean Lakes Program grant. The objectives of the study, which is to be completed by December 1993, are to:

- determine Lake Elsinore's current water quality and its effect on its beneficial uses;

- analyze the potential effects of reclaimed water upon the Lake; and

- prepare a water quality management plan.

The study is a one-year program consisting of water quality sampling and analysis. The Lake's water quality will be compared to the water quality of reclaimed water distributed by Eastern Municipal Water District. A water quality management plan will be prepared and should specify: (1) ways to maximize the Lake's water quality; (2) the feasibility of the proposed improvements; (3) a technical plan; and (4) a schedule with implementation milestones.

**Santa Ana River Mainstream Project**

Because of rapid growth and development in Orange, Riverside, and San Bernardino Counties, the current flood control system is inadequate to manage the runoff in these areas. The three counties are working collaboratively with the U.S. Army Corps of Engineers (Corps) to design and construct the Santa Ana River Mainstream project (Mainstream Project). The Mainstream Project will provide increased flood protection to communities within those counties, and will include specific environmental restoration projects.

The Mainstream Project will cover 75 miles from the Santa Ana River headwaters to its mouth. The project will provide the upper and lower Santa Ana River Basin various levels of flood protection ranging from a 100-year to 190-year flood flows.

The Corps will construct structural improvements including Seven Oaks Dam, Mill Creek Levee, San Timoteo Creek, Prado Dam, Oak Street Drain in Corona, 23 miles of the lower Santa Ana River, and Santiago Creek. Prado Dam and the spillway will be raised an additional thirty feet in height. Ninety-two acres of currently degraded marshland located within the Santa Ana River Salt Marsh will be restored increasing the marsh's value as a wetland habitat. In addition, a large portion of Santa Ana Canyon will be purchased and a resource, habitat, and floodplain management plan will be developed to ensure that that part of the Canyon will not undergo any landuse changes.

**Santa Ana River Total Inorganic Nitrogen/Total Organic Carbon**

Modeling work done for the update of the total dissolved solids and nitrogen management plans for the upper Santa Ana Basin (see Chapter 5) demonstrated the presence of a "nitrogen sink" in the Prado Basin. This sink effectively removes a major portion of the nitrate present in the Santa Ana River. In order to optimize this phenomenon, Orange County Water District and SAWPA have undertaken a study to evaluate the natural biochemical processes impacting total inorganic nitrogen (TIN) and total organic carbon (TOC) concentrations in the water as it flows through constructed wetlands. Based on the study's findings and conclusions, ways to enhance the natural processes to maximize total inorganic nitrogen removal will be recommended.

## Multipurpose Corridor

Eastern Municipal Water District is leading the conceptual development of a natural multipurpose corridor to be located within the San Jacinto River and Salt Creek riparian corridors. The multipurpose corridor would connect adjacent communities, as well as agricultural regions, wildlife habitats, and rural areas. A planning task force has endorsed the idea of establishing such a passageway. The task force is hoping the corridor will lead to other benefits such as the development of:

- A water resource management plan, including groundwater basin recharge and emergency storage, general water quality improvement, storm flow storage, and erosion and flood control;

- coordinated landuse planning, including parks, water conservation measures, recreational areas, buffer zones, shared utility easements, and cost-effective resource management; and

- enhancement of the local environment for both wildlife and people.

## Water Harvesting Demonstration Project

The development of demonstration water harvesting facilities within the San Jacinto watershed has been proposed by Eastern Municipal Water District (EMWD). The objective would be to capture surface water flows, consisting of rainfall runoff and stormwater discharges, which would normally flow unimpeded in the river. EMWD is considering this project because rapid urban development has decreased the amount of surface area available for percolation of rainfall and other runoff into the aquifers.

The District is interested in implementing the water capture plan to supplement their reclaimed water supplies. EMWD could use the harvested runoff directly for irrigation or site percolation ponds in locations where the groundwater basin would be recharged for domestic beneficial uses. Initiation of the program will entail a review of the physical and chemical properties of the runoff, hydrology, operational and maintenance controls of the reuse facilities, economics, compliance with the Basin Plan's water quality objectives, and permitting issues.

Several project locations were identified during a feasibility study and include existing storm drains, conveyance pipelines, and recharge facilities. Facilities currently under consideration are the Buena Vista and San Jacinto Retention Basins and the San Jacinto Reservoir. Conceptual projects include the Salt Creek and San Jacinto Northwest Improvement Plan, and the Lake Hemet Municipal Water District Cooperative Program.

### Multipurpose Wetlands

EMWD and the U.S. Bureau of Reclamation are cooperating in a Multipurpose Wetlands Research and Demonstration Study. The objective is to evaluate the effectiveness and feasibility of integrating constructed wetlands with conventional wastewater treatment facilities.

The agencies have constructed a wetlands research facility located on four acres of Hemet/San Jacinto Regional Water Reclamation Facility. It is being used to determine future design and operating criteria for demonstration wetlands at the Reclamation Facility and to refine the design and operating criteria for future EMWD wetlands projects.

EMWD is interested in the use of desalters to reclaim brackish groundwater for water supply or groundwater recharge purposes. A pilot study at the Wetlands Research Facility is being conducted to evaluate the feasibility of using the reject stream from the desalters in vegetated saline marshes. If they prove feasible, these marshes would provide wildlife habitat as well as additional use of brackish water.

A 20-to-30-acre demonstration project at the Reclamation Facility is expected to begin in the fall of 1993. It will include an integrated system of 5 separate wetlands treatment units, a combined open water and marsh habitat area, and a combined final polishing wetland. One of the objectives of this project is to evaluate the ability of a constructed wetland system to provide treatment of secondary wastewater which is equivalent to that of conventional tertiary treatment facilities, and to remove nitrogen and low levels of metals and organic compounds.

A 20-acre demonstration project at the San Jacinto Wildlife Area is also planned. The intent is to provide additional treatment of wastewater, while maximizing brooding habitat for a variety of birds.

## GROUNDWATERS

### Chino Basin Water Resources Management Study

The purpose of this study is to develop a comprehensive plan for water resources management in the Chino Basin. The objectives are to coordinate the management of imported and local water supplies, including wastewater, and to develop plans and projects which will maximize the use of these resources, assure reliable, good quality supplies, and protect or improve local water quality.

This study is being conducted by a consortium of agencies, including the Chino Basin Municipal Water District, SAWPA, the Metropolitan Water District of Southern California (MWD), the Chino Basin Watermaster (which represents municipal and agricultural water users in the Basin), and the Regional Board.

A significant feature of this study is the development of a new integrated ground and surface water model for the Chino Basin. The model is calibrated for both TDS and nitrogen. This model is much more detailed and refined than the Basin Planning Procedure (BPP) (see Chapter 5) and will supplant the use of the BPP in this area. The new model will be used to evaluate the water quality (and quantity) effects of alternative water resource management plans. These analyses will then be used to select a recommended plan.

The Chino Basin water resources management plan is expected to include the following: management of rising groundwater contributions to the Santa Ana River; use and protection of groundwater supplies; the expansion of wastewater reclamation; optimization of capture of local runoff for recharge purposes; and reduction of water demand through water conservation.

MWD has proposed a groundwater storage program in the Chino Basin, whereby State Water Project water would be recharged in the Basin for use during emergency, drought, and other conditions when the Project water is not available. As proposed, the recharge would occur directly, via spreading or injection of State Project Water, and indirectly, through exchange of Chino Basin groundwater for surface water delivered to local water supply agencies. The Chino Basin study will evaluate opportunities to increase seasonal storage and optimize local and imported water use.

In part because of the involvement and varied interests of so many parties, the development and implementation of the water resources management plan is likely to be very complex. The Regional Board's requirements must also be satisfied. Further, Chino Basin is adjudicated and the requirements of the adjudication must be met or modified, if all the parties agree to the management plan.

The results and recommendations of this study may lead to changes in the Basin Plan. Such changes would be accomplished through appropriate Basin Plan amendments.

**Colton-Riverside Basins Water Resources Management Plan**

Under the auspices of SAWPA, a project task force has been formed to develop a water resources conjunctive use plan for the Colton and Riverside groundwater subbasins. The task force members are:

- Western Municipal Water District
- San Bernardino Valley Municipal Water District
- Orange County Water District
- Eastern Municipal Water District
- Elsinore Valley Municipal Water District

- San Bernardino Valley Water Conservation District
- Yucaipa Valley Water District
- Jurupa Community Services District
- City of Riverside
- City of San Bernardino
- City of Colton
- City of Rialto
- SAWPA

Many other parties have interest in the development and implementation of the management plan, including the Regional Board, which is participating in the study in an advisory role.

The purpose of the plan is to integrate the management of imported water, wastewater, and stormwater in the two subbasins. The overall objective is to maximize the use of local water resources with equitable sharing of the costs among all parties, including water purveyors, regional water management agencies, and wastewater dischargers. The term “conjunctive use” refers to this coordinated management of water supply sources that the yield from these sources is greater than the sum of the yields resulting from independent management of the sources.

Some of the goals identified are to: restore the quality of the Colton and Riverside subbasins; ensure a reliable potable water supply; reduce dependence on imported water; maximize both the use of local groundwater and reuse of wastewater; minimize the cost of wastewater treatment; and redistribute base flow in the Santa Ana River to allow more capture of the flows by Orange County Water District.

Four projects, designated A, B, C, and D, have been identifies to accomplish these goals. Project A involves the improvement of wastewater quality discharged to the Santa Ana River through improvements at the Colton, Rialto, and San Bernardino wastewater treatment plants, and the construction of a pipeline to relocate the wastewater discharge points downstream of the Colton subbasin. Project B involves the production of high-TDS groundwater from the Riverside subbasin with the goal of creating capacity for recharge with higher quality water (such as stormwater, State Project water, and Bunker Hill subbasin groundwater) and seasonal storage of wastewater. Project C would improve groundwater quality in the Colton subbasin by pumping and export of groundwater and recharge with higher quality local runoff, State Project water, Bunker Hill groundwater, and San Bernardino wastewater. Recharge would be accomplished via run-of-river “T” levees. Project D is a Riverside subbasin restoration and water supply project. Groundwater would be extracted and high quality stormwaters, imported water, Bunker Hill groundwater, and reclaimed wastewater would be percolated in a system of “T” levees in the Santa Ana River. The mix of waters recharged would be controlled to produce a water

supply quality that is consistent with both drinking water standards and wastewater discharge limitations.

These projects will be considered and implemented in phases. Wastewater treatment plant improvements (Project A) are already in progress. As in the Chino Basin (see preceding discussion), the involvement and interests of the many parties is likely to make implementation complex. Water resources in this area are also adjudicated and, again, the requirements of the adjudication must be satisfied. The Regional Board's concerns and requirements must also be addressed.

The result of the Conjunctive Use study may lead to changes in this Basin Plan. For example, a revised regulatory strategy for wastewater discharges by San Bernardino, Colton, and Rialto may be found appropriate. Implementation of the identified projects may supplant the need for the Riverside-Colton desalter, which is included in the Recommended Plan (Alternative 5C). If appropriate, amendments to the Basin Plan can be made to incorporate such changes.

**Bunker Hill Basin Replenishment**

The Bunker Hill Basin is artificially recharged by several agencies. Surface stream diversions are made for groundwater replenishment by the Lytle Creek Water Association on Lytle Creek and by the San Bernardino Valley Water Conservation District on Santa Ana River and Mill Creek. The San Bernardino County Flood Control District has facilities on Devil Creek, Twin Creek, Waterman Creek, and Sand Creek which may be used for groundwater recharge. The surface diversion of the waters of Lytle Creek have occurred as early as 1872. Lytle Creek water rights, which include diversions for groundwater recharge, are now administered by the Lytle Creek Water Association for six parties, according to a 1924 judgement. The San Bernardino Valley Water Conservation District began recharging the Bunker Hill Basin with Santa Ana River water (through its predecessor) in 1911 while groundwater recharge on Mill Creek began in the 1890s and was taken over by the Conservation District in 1934. In excess of 1,000,000 acre feet of Santa Ana River and Mill Creek waters have been recharged to replenish the Bunker Hill Basin. In addition, the San Bernardino Valley Municipal Water District has imported State Project water for replenishment into the Bunker Hill Basin. Since 1972, in excess of 150,000 acre feet of imported State Project Water has been recharged in the Bunker Hill Basin. The replenishment activities of the above four agencies play an extremely important role in managing the Bunker Hill Basin to supply the current and future needs of the Basin.

**Hemet and San Jacinto Groundwater Basin Management Program**

The Hemet/San Jacinto Groundwater Association and Eastern Municipal Water District are in the process of developing a Groundwater Management Plan for the Hemet and San Jacinto basins. The Objective of the Management Plan is to

optimize use and management of the groundwater resources in the Hemet and San Jacinto groundwater subbasins through the cooperative efforts of an association of the major basin pumpers. Eastern Municipal Water District is cooperating with the Metropolitan water District of Southern California (MWD), the U.S. Geological Survey, UC Riverside and UC Los Angeles to collect water quality and quantity data, landuse information, and data on basin hydrogeology, and to develop appropriate planning tools. A Management Plan will be developed and will include plans or programs designed to maximize the groundwater resources and ensure future water supplies.

To protect the other subbasins in the San Jacinto watershed, including Perris, Menifee, Lakeview, Winchester, and San Jacinto Lower Pressure, Eastern Municipal Water District has initiated an Assembly Bill (AB) 3030 Groundwater Management Plan. AB 3030 was adopted by the California Legislature in 1992. AB 3030 amends Section 10750 ***et seq.*** of the Water Code to allow a local agency whose service area includes a groundwater basin that is not already subject to groundwater management pursuant to law or court order to adopt and implement a groundwater management plan. The program could include plans to mitigate overdraft conditions, control brackish water, and monitor and replenish groundwater.

**Hemet Groundwater Investigations**

Eastern Municipal Water District and the U.S. Geological Survey (USGS) are currently involved in a four-year investigation of the dynamics of nitrate and TDS movement in the unsaturated zone of the Hemet groundwater subbasin. The Study objectives are to define the thickness and extent of water-bearing materials and to determine the direction of groundwater flow, the chemical quality of groundwater, the flux of nitrate in the unsaturated zone, and the degree of mixing and vertical distribution of nitrate in the saturated zone. The USGS has completed a draft study and is scheduled to provide a final report by the end of 1993.

Eastern Municipal Water District and MWD are also contracting with UC Los Angeles to develop and Optimal Data Collection Design Strategy as a basin management planning tool for the Hemet Basin. Eastern Municipal Water District and MWD contracted with UC Riverside to perform geophysical investigations in order to delineate the bedrock of the Hemet Basin and to obtain information on the available water supply of the Basin.

**San Jacinto River Groundwater Recharge Program**

A groundwater recharge/storage program within the San Jacinto Basin has been developed by EMWD. A demonstration project was begun in October 1990 with cooperation from MWD and the Universities of California, Riverside, and Los Angeles. The objectives of the demonstration project were to evaluate the

infiltration rate, establish the impacts on basin hydrology and groundwater quality, and approximate the distribution of the recharged water.

The demonstration project used ponds located within the San Jacinto riverbed to recharge the aquifer with State Project Water for a three-year period. Interaction between the local groundwater and State Project Water was assessed by monitoring water quality conditions and levels from October 1990 through January 1991. It was concluded that the average percolation rate in these basins is 6.30 feet/day. The study has determined that imported water can be successfully stored seasonally.

**Green Acres Project**

Orange County Water District has obtained funding for the Green Acres project from the State Board. The Green Acres project uses reclaimed wastewater to extend local water supplies. Secondary effluent supplied by the County Sanitation Districts of Orange County is treated at the Green Acres facility site in Fountain Valley. The product water is provided to parks, greenbelts, nurseries, schoolyards, golf courses, and industrial sites within a five-mile radius of the plant. Phase I of the project provides 7.5 million gallons of water each day for those uses. The facility design allows for a second-phase expansion to 15 million gallons per day.

The Green Acres distribution system calls for over 25 miles of pipe ranging in diameter from 6 to 36 inches. The first reach of the pipeline will extend into the City of Fountain Valley. The distribution system will supply areas in Santa Ana, Costa Mesa, and eventually Huntington Beach and Newport Beach.

**Southern California Comprehensive Reclamation and Reuse Study**

In October 1991, SAWPA and several other local agencies became participants in the Southern California Comprehensive Reclamation and Reuse (“SOCAL”) Study. The project is a 6-year, $6 million effort which will be cost-shared 50 percent by the U.S. Bureau of Reclamation and 50 percent by local agencies. The region’s participants include SAWPA, Chino Basin Municipal Water District, Eastern Municipal Water District, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District. The San Diego County Water Authority is a participant as well. The purpose of the study is to develop a long-range strategy for more effective integration of fresh and reclaimed water management programs, and to determine the feasibility of various water reclamation projects within Southern California.

The overall study, initiated on March 10, 1992, consists of two main phases with the first phase consisting of two parts. The first part, Phase 1a, will be the compilation and generation of baseline information. The intended objective of Phase 1a is to more clearly identify the potential for increasing the use of

reclaimed water throughout Southern California. When all data on reclaimed water supply and potential use is collected, possible reclamation project alternatives will be identified, including the possibility of transferring reclaimed water across jurisdictional lines.

Phase 1a will also include the development of screening criteria and tools of analysis necessary to identify and evaluate potential reclaimed water projects. Significant public involvement efforts will begin in Phase 1a and continue through the remainder of the study.

Phase 1a will conclude with the production of a report. The report will include: 1) a description and evaluation of those project alternatives that are considered likely to be feasible given the current and expected economic, environmental, and institutional conditions during the 20-year and 50-year planning horizons; 2) and economic distribution model to be used to further analyze the feasibility of those projects; and 3) a detailed scope of work for Phase 1b.

## COASTAL WATERS

### Southern California Coastal Water Research Project

As discussed in Chapter Six (Monitoring and Assessment), the Regional Board requires that waste dischargers conduct monitoring programs to evaluate the effects of their discharges on the receiving waters. In the Santa Ana Region, the most extensive self-monitoring program (approximately 2 million dollars per year) is carried out by the County Sanitation Districts of Orange County (CSDOC), which discharges about 240 MGD of wastewater to the Pacific Ocean via a 5-mile outfall.

Other ocean dischargers, such as the Southern California Edison's Huntington Beach Generating Station, conduct receiving water monitoring programs, though these are considerably less extensive than that prescribed for CSDOC.

It has been recognized for some time, however, that these individual discharger efforts, despite their intensity and sophistication, are not in themselves sufficient to obtain an accurate and complete picture of the impacts of ocean discharges. A broader, regional perspective is necessary to evaluate the cumulative effects and interactions of all inputs to the coastal waters from both point and nonpoint sources.

Towards that end, the Southern California Coastal Water Research Project (SCCWRP) was established in 1969 by a consortium of waste dischargers. SCCWRP conducts a wide variety of chemical, physical, and biological investigations of the open coastal waters from San Diego to Ventura, and area commonly called the Southern California Bight. SCCWRP's mission is to understand the effects of urban wastes on the marine environment. Annual reports describe the specific research projects conducted to characterize the

sources, fates, and effects of anthropogenic pollution on marine water quality, biota, and sediments.

The organization of the SCCWRP administration was recently revised. The SCCWRP Commission, which provides direction on regional monitoring needs and priorities, now includes staff representatives from the Los Angeles, Santa Ana, and San Diego Regional Boards, the State Board and US EPA, as well as the Sanitation Districts of Orange and Los Angeles Counties and the cities of Los Angeles and San Diego.

**Huntington Beach**

The City of Huntington Beach coordinates the Huntington Beach Waterways and Beaches Committee, a public outreach task force engaged in tracking agency activities in the Huntington Beach area. The public at large is invited to the meetings in which staff from the City Council, Orange County (Environmental Management Agency, Health Care Agency, and Flood Control District), the U.S. Naval Weapons Station at Seal Beach, and Regional Board staff participate. Reports are given to update the activities and studies in which the above agencies are involved. One of the Committee's major concerns is water quality. The Committee is actively involved in public education and efforts to ensure compliance with holding tank requirements.

**Newport Bay Watershed**

Water quality problems in Newport Bay and its watershed and the activities in progress to address them are described briefly in Chapter 5 and, in more detail, in reports prepared in response to Senate Concurrent Resolutions (SCR) 38 and 88. Both SCR reports identify a plan for future action by the agencies and parties with responsibilities and interests related to water quality in the watershed. A major them of these reports is the need for continued interagency coordination to implement these action plans.

Towards this end, the Newport Bay Coordinating Council was formed. It includes representatives from the Regional Board, the Environmental Management and Health Care Agencies of Orange County, Senator Marian Bergeson's office, City of Newport Beach, Newport Harbor Quality Committee, California Department of Fish and Game, U.S. Army Corps of Engineers (Corps), Irvine Company, and various Newport Bay community action groups. The Council provides a forum for the exchange of information on and coordination of activities related to the Bay, from grass roots debris cleanups to the possible Corps dredging in the Upper Bay. The Council also sponsors public education and outreach programs.

Many of the representatives on the Coordinating Council are also members of the City of Newport Beach Harbor Quality Committee. The City of Newport Beach Parks and Recreation and Marine Departments are participants as well. This committee has been involved in many projects to educate the public on ways Newport Harbor water quality can be better protected. It has sponsored excellent outreach projects, such as the Baywatchers Program, and has distributed informational brochures identifying simple pollution prevention practices. The Committee assisted in the development of a pamphlet showing the locations of vessel pumpout stations in the Bay and was instrumental in the adoption of a city ordinance regarding vessel waste management for charter and tour boats. The Committee's action also led to a ban on the use of endosulfan in the Newport Bay watershed.

## FUNDING PROGRAMS

### Grant Programs

Clean Water Act §205(j) Water Quality Planning Grant Program

Section 205(j) of the federal Clean Water Act (CWA) allows each state to reserve up to one percent of its annual Clean Water Construction Grant allotment for water quality management and planning. In addition, Congress has provided funding under Section 604(b), State Revolving Fund Set Aside. Any interstate, regional or local public agency may apply directly to the State Water Resources Control Board for funding. As funds are available, State agencies and publicly-funded educational institutions may also apply.

Generally, the State Board requests a workplan on the project be submitted one year prior to the project's actual start date, due to the period of delay between submittal of the proposal and receipt of federal funding. The State Board notifies interested parties through a Request for Workplans notice. Currently, the workplans are evaluated and ranked according to specific criteria. The criteria include:

- Resource value of the waterbody
- Condition rating of the waterbody
- Whether/how water quality is addressed
- Feasibility of the workplan proposal
- Benefits expected from the work
- Cost of the work

- Applicant's Institutional/financial commitment to implement work products

- Applicant's capability to carry out workplan

The resource value and condition ratings have been calculated and usually are identified in the Water Quality Assessment factsheets. In all cases, there is a minimum 25 percent local funds match requirement for all 205(j)(2) funded projects. The match is calculated on the basis of the total project cost.

Clean Water Act §319 Nonpoint Source (NPS) Grant Program

The Clean Water Act (CWA) Section 319(h) provides grant funds for projects directed at the management of nonpoint source pollution. In California, the State Board determines which project receives Section 319 funds, with input from the Regional Boards. The amount of funds available is dependent upon Congressional Appropriations and therefore varies each year.

The State Board has placed highest priority on projects which implement specified nonpoint source management practices under Section 319 requirements. The State Board must also commit to address nonpoint source waters listed pursuant to CWA section 303(d) (water quality limited segments), and to the protection of high quality waters.

For fiscal Year (FY) 1994, the nonpoint source funds are to be used for the implementation of watershed management plans or strategies that will lead to coordinated water management, or for the demonstration of specific practices considered part of a watershed management effort.

Activities which reduce, eliminate, and/or prevent NPS pollution are eligible projects. The agencies eligible to receive Section 319 funds are those with the demonstrated authority to require implementation of the project (***e.g.***, Resource Conservation Districts). Examples of specific activities eligible for Section 319 funds include the demonstration of best management practices (BMPs) for agricultural drainage, acid mine drainage, acid mine drainage, channel erosion, hydrologic modification, groundwater protection, pollution prevention, and septic systems.

Generally, the State Board requests that a workplan on the project be submitted one year prior to the projects actual start date, due to the period of delay between submittal of the proposal and receipt of federal funding. The State Board notifies interested parties of the availability of finds through a Request for Workplans notice. The workplans are then evaluated and ranked according to specific criteria. The applicant is required to match the grant funds with a 40 percent nonfederal match. The State Board's NPS Program staff should be contacted to get other specific guidance on this grant.

Clean Water Act §314 Clean Lakes Grant Program

The Clean Lakes Program grant is similar to the CWA 205(j) program, but is specified under CWA section 314. Under the Clean Lakes Program, the US EPA, through the State Board, provides assistance in two phases. Phase I awards up to $100,000 per project for diagnostic feasibility studies and requires a 30 percent non-federal match. These studies must be completed in three years. The Phase II awards have no funding cap, but they require a 50 percent non-federal match. These funds are available to support implementation of pollution control and/or in-lake restoration methods and procedures, including final engineering design. These projects must be completed in four years.

Funding is also available for Lake Water Quality Assessment projects, which are projects intended to achieve any needed lake monitoring and assessment which would not otherwise be done. These grants require a fifty percent non-federal match.

All State and local agencies can participate in the 314 Program. Only projects dealing with publicly-owned lakes are eligible for funding. The lake must also be prioritized for remediation by the State, which is demonstrated by placement on the 314 list of impacted water bodies in the Water Quality Assessment.

Currently, procedures require State Board staff to evaluate the proposed projects and draft a project priority list to be brought before the State Board. The State Board adopts and submits the list to the US EPA, which determines the final priority projects for funding.

Small Communities Grant Program

The 1987 amendments to the CWA terminated the federal Clean Water Grant Program but provided for the use of federal funds to capitalize State Revolving Fund (SRF) loan programs (see SRF discussion below). California voters recognized that many small communities would not be able to afford the higher costs of the SRF Program and passed the Clean Water and Water Reclamation Bond Law of 1988. The Clean Water Bond Law contains 25 million dollars in State grant assistance for small communities. The program defines a small community as less than 3,500 people. No grant under this program can exceed 2 million dollars. The Law also states that the State Board may make grants on a sliding scale based on a community's ability to pay.

The Small Communities Grant (SCG) Program provides only the funds to make a wastewater treatment project affordable. It is assumed that a community can afford to spend a certain percentage of its Median Household Income (MHI) calculated, the higher the percentage the community can afford to spend for wastewater facilities. If a community's treatment costs exceeds what the program assumes is affordable, the SCG Program will provide up to 2 million dollars to reduce the costs to make the project more affordable.

A community can receive a SCG for up to 97.5 percent of the allowable project costs and is also eligible to apply to any other State or federal agency to fund the local share of the project costs. A low interest loan from the SRF Program may be obtained, for example, if the project is on the SRF Loan Priority List. If funding is not available for the local share from any source at a reasonable cost, the community may apply for a low interest loan from the Water Quality Control Fund. The combined assistance can not exceed 100 percent of the total project costs.

There are many requirements to receive a SCG. Briefly, the project must be submitted to the Regional Board for placement on a Regional Board SCG Priority List. The project is classified according to the need for a sewage treatment facility. The Regional Board SCG lists are compiled for State Board adoption and further prioritized according to several criteria. There are other restrictions and specific provisions a grantee must satisfy, as specified in guidelines provided by the State Board.

The State Board may use a portion of the SCG to fund pollution study grants. The SCG Program will fund up to 97.5 percent of the eligible costs for an approved pollution study. The objective of the study must be to document the existence of an actual or potential public health or water quality problem.

## Loan Programs

State Revolving Fund (SRF) Loan Program

The SRF Loan Program provides funding for construction of publicly-owned treatment works (POTWs), for nonpoint source correction programs and projects, and for the development and implementation of estuary conservation and management programs. Water reclamation projects are also eligible for SRF funding. The loan interest rate is set at one-half the rate of the most recent sale of a State general obligation bond.

Proposed projects must be submitted to the Regional Board for placement on a Regional Board SRF Priority List. Projects are classified and ranked according to several criteria, including documented health problems, conformance with applicable Water Quality Control Plans, and/or compliance with waste discharge requirements. The Executive Officer can directly submit the list to the State Board. The State Board adopts the Statewide Priority List, after which the funds are available on a first-come, first-served basis.

There are other restrictions and specific provisions which the SRF prioritized projects must satisfy; the State Board's Clean Water Program staff should be contacted for a copy of the guidelines.

Agricultural Drainage Water Management Loan Program (ADLP)

The State Agricultural Drainage Water Management Loan Program is funded with a $75 million bond fund. The program funds are available for feasibility studies and the design and construction of agricultural drainage water management projects. The interest rate is set at one-halt the rate of the most recent sale of a general obligation bond. The loan term is not to exceed 20 years. The loan limitations are $20 million for any one project and $100,000 dollars for each feasibility study.

Only local agencies can apply for this loan. The project must remove, reduce, or mitigate pollution from agricultural drainage. The specific types of projects funded include agricultural drainage projects such as evaporation ponds and deep injection wells, selenium removal project, cleanup of groundwater contaminated form agricultural practices, and agroforestry projects. In this region, projects which have acquired ADLP funds include SAWPA's Arlington Desalter and the Chino Basin West Desalter.

The loan application is obtained from the State Board's Division of Water Quality. The completed loan application is submitted with the project planning documents. Upon completion of the loan contract, the applicant submits the final plans and specifications for the project.

Water Reclamation Loan Program

This program makes available low-interest loans for the design and construction of water reclamation projects. The objective of this program is to meet a portion of the future water needs for California through the use of reclaimed water. Projects funded must be cost-effective compared to the development of new sources of water or alternative new freshwater supplies.

As of July 1, 1989, $33 million were available for use only by local public agencies. The funds are augmented annually by loan repayments. The loan interest rate is set at one-half the rate of the most recent sale of the State general obligation bond. The loan term may not exceed 20 years, with up to $5 million available for any one project. Eligible projects include the wastewater treatment facilities necessary to produce water for beneficial reuse, as well as reclaimed water storage and distribution systems. Only that capacity of wastewater which can be used within five years of the completion of construction is eligible.

A loan application package may be obtained from the State Board's Office of Water Recycling. The completed application is submitted with the project planning documents. Projects with complete application packages are funded on a first-come, first-served basis.

Water Quality Control Fund (WQCF) Loan Program

The WQCF Loan Program is a special set-aside intended only for the construction of wastewater treatment facilities or for wastewater reclamation loan feasibility studies. Approximately 6 million dollars are available with the interest

rate set at one-half the average rate paid by the State on general obligation bonds sold in the preceding year.

This program's eligibility requirements state that the applicant must hold a local election with a simple majority approving the application for the loan. In addition, the applicant must demonstrate that: 1) revenue or general obligation bonds cannot be sold; 2) financial hardship exists; and 3) local funding is not available.

The State Board's Division of Clean Water Programs is the contact for a loan application. The application is submitted with the documents which demonstrate financial hardship, lack of the local share, and the election results.

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# WATER QUALITY CONTROL PLAN

## SANTA ANA RIVER BASIN (8)

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Adopted February 4, 2014

# One Water One Watershed 2.0 Plan

## Santa Ana River Watershed



## Moving into Implementation

SAWPA

**FINAL**

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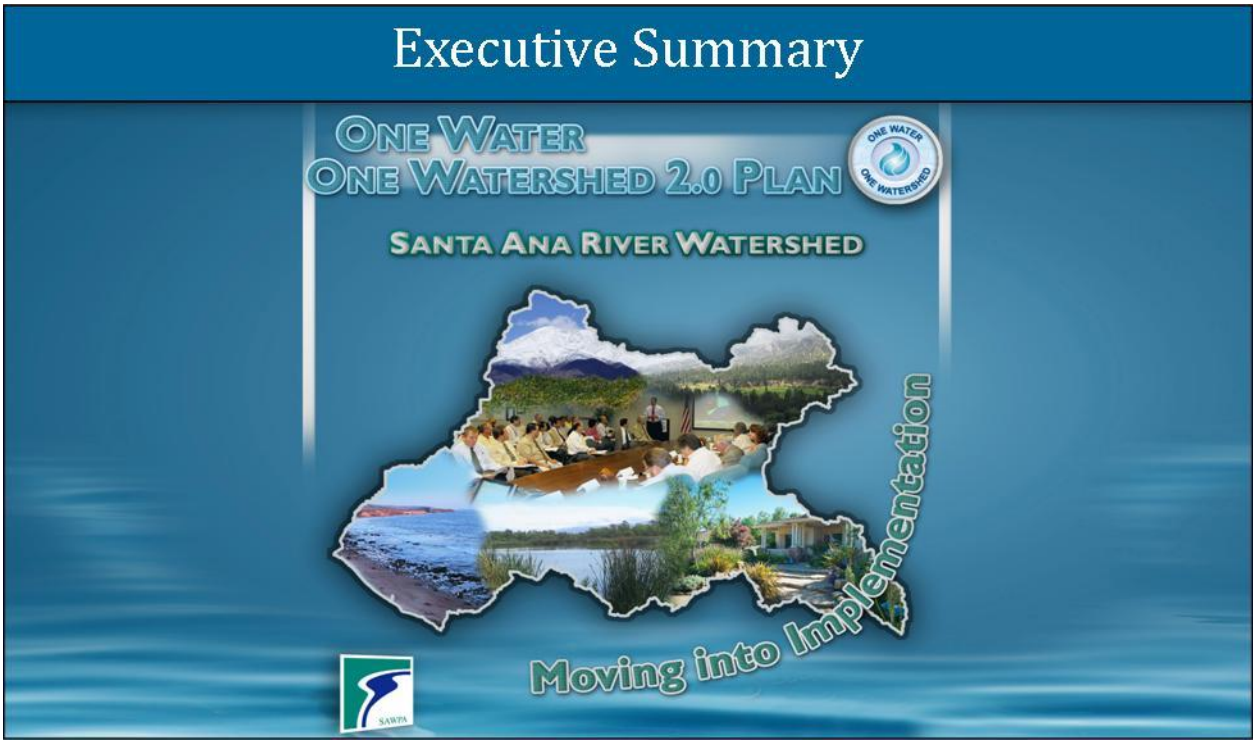
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# Executive Summary




The Santa Ana River Watershed faces enormous challenges as it strives to adapt to changing conditions, many of which are at an unprecedented scale in its modern history. The watershed's population, already one of the most densely populated in the State, continues to grow and urbanize, increasing demands on water supply, water quality, and flood management. Even with its plentiful groundwater resources, several basins now are experiencing declining groundwater levels and overdraft conditions. With the uncertainties of climate change and its impacts, environmental concerns are taking even greater precedence than they ever have in the past, affecting how we manage water for the future.

Most agree that the water management approaches of the past several decades are no longer sustainable in today's environment and economic climate. And most agree that a more integrated and collaborative approach to water resource management will show tremendous promise to water resources everywhere. But in the Santa Ana River Watershed, this approach is not new; it has been our practice and legacy since the first integrated plan was approved by the Santa Ana Watershed Project Authority (SAWPA) Commission in 1998.

In a nutshell, the goal of yesteryear was affordable water for a growing economy. But over time, the goal has changed to become a more complicated balancing act of environmental sustainability, quality of life and, economic growth in a changing environment dominated by water and financial scarcity. The strategy to achieve this goal is integrated water management. This means the various silos of water supply, flood management, water quality, ecosystem restoration, and recreation are brought together as one. Another way to think about it is that while the drop of water may at different times be characterized by different elements, it is still the same drop of water.

The benefits of this approach are better coordination across functions that are often managed separately and across a broader geographic scale larger than the boundaries of individual agencies. Through integration at the watershed scale, economic and environmental performance is more effectively balanced. This water resource planning approach based on a watershed basis has even been recognized by independent review, objective and nonpartisan research organizations such as the Public Policy Institute of California, which cited SAWPA as an excellent example of integrated water management in the State.

> SAWPA 's approach – coordination, cooperation, and integration of water agencies to pool resources and manage water at the basin scale-is one of California's best models for integrated water management.
>
> *Public Policy Institute of California 2011 "Managing California's Water – From Conflict to Reconciliation"*

The Santa Ana River Watershed continues to progress with many "bright spots" and pilot projects accomplished to date. The use of sophisticated "big data" analytics continues to set us apart, resulting in a more robust watershed and a very competitive position to compete for State and Federal funds.

The "One Water One Watershed" (OWOW) 2.0 Plan is the Santa Ana River Watershed's integrated regional water management (IRWM) plan. This plan reflects a collaborative planning process that addresses all aspects of water resources in a region or watershed, in our case. It includes planning of future water demands and supplies over a 20-year time horizon within the watershed as a hydrologic and interconnected system. The plan represents collaboration across jurisdictions, and political boundaries involving multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. The plan reflects a new suite of innovative approaches that instead of relying solely on continued imported water deliveries to meet growing water demands in the region, is leading with a water demand reduction strategy. These approaches include the following:

- Multi-beneficial projects and programs that are linked together for improved synergy
- Proactive innovative, and sustainable solutions
- Integrated regional solutions supporting local reliability and local prioritization
- Watershed based project and programs that effectively leverage limited resources, promote trust and produce a greater bang for the buck
- Integrates water supply, water quality, recycled water, stormwater management, water use efficiency, land use, energy, climate change, habitat, and disadvantaged communities and tribes
- Coordinates resources so that water is used multiple times
    - Manages stormwater for drinking water
    - Treats wastewater for irrigation and groundwater replenishment
    - Builds or modifies parks to support water efficiency, ecosystem habitat, and stormwater capture
    - Improves water quality pollution prevention
    - Addresses energy and water nexus

The OWOW 2.0 Plan was funded by the SAWPA member agencies with grant funding assistance from the California Department of Water Resources (DWR) through the Proposition 84 IRWM Planning Grant program, and a funding partnership from the U.S. Bureau of Reclamation (Reclamation) through their Basin Studies program. Work with Reclamation, the State, local and non-profit organizations provided the OWOW 2.0 Plan with the necessary resources to expand outreach and support that ultimately will create more cost effective integrated water resource management solutions.

In the final analysis, the prescription for success is clear; we need to "double down" on integrated water management, strengthen the alignment among all government agencies, and invest in innovation and infrastructure. For the Santa Ana River Watershed, the road map for this success is our IRWM plan known as the OWOW Plan.

The emphasis of this new OWOW 2.0 Plan is that all people are encouraged to adopt a water ethic that focuses on understanding where their water comes from, how much they use of it, what they put into water, and where it goes after they finish using it. To meet growing water demands in the region, a new suite of approaches to planning are needed now that lead with a water demand reduction strategy.

## Analysis and Support Tools

To support implementation of the OWOW 2.0 Plan, SAWPA in conjunction with its funding partners, conducted research and analyses on climate change impacts to the watershed, and developed a variety of new computer support tools to support our modern water management goals. Under this Plan, new resource tools and analyses were developed to help water resource managers adapt to changing climate conditions, support project proponents in better integrated solutions, assist analysis of watershed performance over time, and provide the public better access to water quality for beneficial use.

Through the work of Reclamation, an interactive climate change modeling tool was developed to provide water planners with information on potential impacts of climate change within the Santa Ana River Watershed. This tool provides a simplified modeling framework for evaluating climate change impacts, as well as mitigation/adaptation alternatives. The climate change tool enables the user to explore, identify, and download custom climate change data for various scenarios modeled for the Santa Ana River Watershed**.** Some of the results of the climate change analysis for the watershed that address common public concerns are as follows:

*Will surface water supply decrease?*

- Annual surface water is likely to decrease over future periods.
- Precipitation is projected to show long-term slightly decreasing trends.
- Temperature is projected to increase, which will likely cause increased water demand and reservoir evaporation.
- Snow melt water runoff is projected to decrease.



*Will I still be able to go skiing at Big Bear Mountain Resorts?*

- The projected warmer temperatures would result in a delayed onset and shortened ski season. Both

Big Bear Mountain Resorts lie below 3,000 meters and are projected to experience declining snowpack that could exceed 70% by 2070.

*How many more days over 95°F are expected in Anaheim, Riverside, and Big Bear City?*

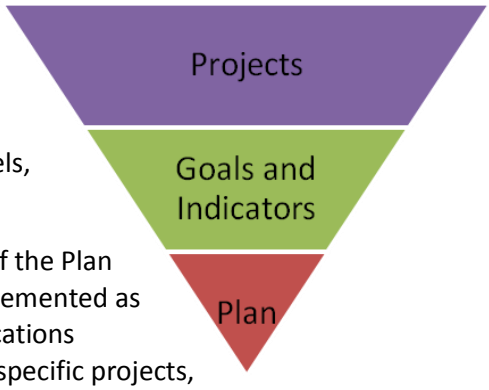
- By 2070, it is projected that the number of days above 95°F will quadruple in Anaheim (4 to 16 days) and nearly double in River*side* (43 to 82 days). The number of days above 95°F at Big Bear City is projected to increase from zero days historically to four days in 2070.

Another powerful tool that Reclamation developed under the OWOW 2.0 Plan is an interactive green house gas (GHG) modeling tool to provide water planners and the public about the impacts of GHG within the Santa Ana River Watershed. This tool enables the user to explore, identify and download custom GHG data for a suite of water technologies modeled for the Santa Ana River Watershed. It also will exhibit energy consumption in the delivery and treatment process with relation to water. In accordance with AB – 32, which requires regions to reduce their overall GHG emissions, the tool also evaluates both water supply and demand in the Santa Ana River Watershed. This tool will prove to be very useful within the watershed because it allows users to calculate different scenarios, which can be used to compare each outcome and result. Further, the tool can be adapted to individual projects and is anticipated for use in future GHG emissions calculations by project proponents.

### *Santa Ana River Watershed Water Quality Tools*

SAWPA, partnering with the Santa Ana Regional Water Quality Control Board and local stakeholders, has developed a suite of tools to provide water planners and the public access to water quality information relating to designated beneficial uses, water quality objectives, and water quality data for water bodies and waterways within the Santa Ana River Watershed.

### *Watershed Assessment Tool, Plan Performance and Monitoring*




In order to track progress, SAWPA has developed a system to monitor the implementation of the OWOW Plan and projects implemented under OWOW. The monitoring takes place at two levels, the plan level and project level, to:

- Ensure progress is being made toward meeting objectives of the Plan
- Ensure specific projects identified in the Plan are being implemented as planned in terms of schedule, budget, and technical specifications
- Identify potential necessary modifications to the Plan or to specific projects, to more efficiently and effectively accomplish the goals and objectives of the Plan
- Provide transparency and accountability regarding the disbursement and use of funds for project implementation

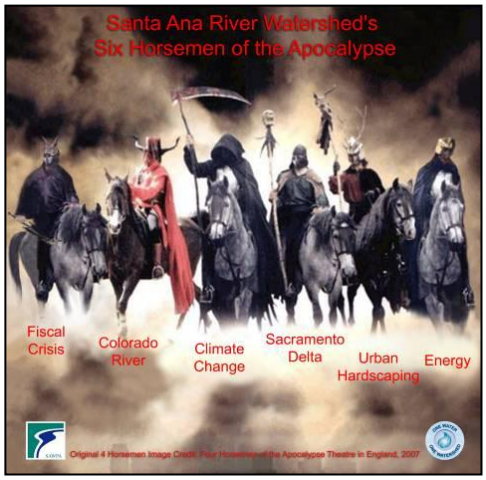
To tie the plan and project monitoring together, SAWPA recognized the need for an interface process of measuring progress on meeting the goals and objectives, as well as the health of the Santa Ana River Watershed. SAWPA engaged the services of the Council for Watershed Health, a nonprofit organization, and Dr. Fraser Shilling of the University of California, Davis to develop a watershed assessment framework for the Santa Ana River Watershed. The Council and Dr. Shilling worked with the OWOW Pillars, workgroups of experts and stakeholders organized generally based on water resource management strategies, to update the watershed management goals, establish planning targets, and

utilize data indicators from existing datasets to track progress. With the input of SAWPA staff, a new tracking computer tool was created, incorporating this work that will allow managers to evaluate and assess progress, and assure actionable results for implementation.

## Vision, Mission and Challenges

Under OWOW 1.0, the vision for the watershed was developed and continues under the OWOW 2.0 Plan as follows:

1. A watershed that is sustainable, drought-proofed and salt-balanced by 2035, and in which water resources are protected and water is used efficiently
2. A watershed that supports economic and environmental viability
3. A watershed that is adaptable to climate change
4. A watershed in which environmental justice deficiencies are corrected
5. A watershed in which the natural hydrology is protected, restored, and enhanced
6. A water ethic is created at the institutional and personal level




The mission of the OWOW Plan is to create opportunities for smarter collaboration to find sustainable watershed-wide solutions among diverse stakeholders from throughout the watershed. Clinging to the path of yesteryear will place us at greater risk of producing results with limited impact and unintended consequences. Our 21st Century plan creates a blueprint for more effective water resource management by using data and tools to keep us better informed and allowing us to be more productive in using less energy and producing less GHG emissions.

To achieve this vision and mission, stakeholders must address four major threats, which we have dubbed the Four Horsemen of the Apocalypse: 1) Climate Change resulting in reduced water supplies combined with increased water needs in the region; 2) Colorado River Drought Conditions resulting in pressures on imported supply due to upper basin entitlements and continued long-term drought; 3) San Joaquin-Bay Delta Vulnerability resulting in loss of supply due to catastrophic levee failure or changing management practices of the Delta; and 4) Population Growth and Development resulting in interruptions in hydrology and groundwater recharge while increasing water needs.

To implement OWOW 2.0 and adjust to current affairs, SAWPA and stakeholders needed to adapt to address the new challenges, the Energy and Fiscal Crises. The Four Horsemen of the Apocalypse herd has grown to six. The Fiscal Crisis reflects the impacts of the Great Recession commonly marked by a global economic decline that began in December 2007, and took a particularly sharp downward turn in September 2008. Some say the epicenter was the Inland Empire. By late 2013, the recession remains a part of our lives resulting in far fewer State and Federal funds, and State bond funding being deferred each year as the realization that they would not likely be supported by the California electorate.

Recent energy developments such as the closure of the San Onofre Nuclear Generating Station, have forced us to recognize the water-energy nexus and the need to address our energy needs and escalating costs for delivering energy. Energy costs can be reduced by water agencies through energy efficiency measures, while teaching the public that water conservation equates to energy conservation and thus money saved.

## Goals, Objectives, Targets and Indicators

As previously stated, in order to achieve the watershed's vision, the Pillars worked with the Council of Watershed Health on updating the goals and objectives for the OWOW 2.0 Plan as part of the new watershed assessment framework.

The Pillars and the Council selected five areas: water supply, hydrology, open spaces, beneficial uses, and effective and efficient management. Using these newly defined goals and objectives, an assessment process was established that will assure actionable results for implementation.

Thereafter, the new goals and objectives were shared with the Steering Committee for their acceptance. Planning targets within the watershed along with data indicators were developed to track progress and allow measurement of the extent to which the plan objectives are being met. To achieve the updated goals and objectives, resource and broad management strategies were investigated through work of the Pillars. Quantifiable planning targets were developed in conjunction with the 20-year planning horizon of Year 2035.

| Goals | Objectives |
|---|---|
| Maintain reliable and resilient water supplies and reduce dependency on imported water | •Decrease water demand<br>•Increase water-use efficiency<br>•Increase use of rainfall and snowpack as a resource<br>•Increase use of recycled water<br>•Sustainably develop local water resources<br>•Maintain sufficient storage to overcome multi-year (3 year) drought over a ten year hydrologic cycle<br>•Reduce green-house-gas emissions and energy consumption from water resource management |
| Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities | •Preserve and restore hydrologic function of forested and other lands<br>•Preserve and restore hydrogeomorphic function of streams and water bodies<br>•Safely co-manage flood protection and water conservation<br>•Include ecosystem function in new development planning and construction |
| Preserve and enhance the ecosystem services provided by open space and habitat within the watershed | •Increase the capacity of open space to provide recreational opportunities without degrading its quality or increasing its consumption of water & energy<br>•Protect existing and restore native habitats<br>•Protect and maintain healthy forests<br>•Manage aquatic and riparian invasive species<br>•Protect estuarine and marine near-shore habitats<br>•Reduce ornamental irrigated landscapes<br>•Improve management support for landscaping that utilizes native and drought tolerant vegetation<br>•Protect and Restore wildlife corridors<br>•Protect endangered and threatened species and species of special concern through improved habitat |
| Protect beneficial uses to ensure high quality water for human and natural communities | •Attain water quality standards in fresh and marine environments to meet designated beneficial uses<br>•Protect and improve source water quality<br>•Achieve and maintain salt balance in the watershed |
| Accomplish effective, equitable and collaborative integrated watershed management | •Improve regional integration and coordination<br>•Ensure high quality water for all users<br>•Balance quality of life and social, environmental and economic impacts when implementing projects<br>•Maintain quality of life<br>•Provide economically effective solutions<br>•Engage with disadvantaged communities to eliminate environmental injustices<br>•Engage with Native American tribes to ensure equity<br>•Reduce conflict between water resources and protection of endangered species |

The targets and indicators are listed in Chapter 4.3, Planning Targets.

| Goals | Performance Targets for 2035 |
|---|---|
| Maintain reliable and resilient water supplies and reduce dependency on imported water | •Conserve an additional 256,500 AFY of water through water use efficiency and conservation measures<br>•Create 58,000 AFY using a combination of additional wells, treatment, conjunctive use storage and desalination of brackish groundwater<br>•Increase production of recycled water by 157,000 AFY<br>•Increase both centralized and distributed stormwater capture and recharge by 132,000 AFY<br>•Develop 54,000 AFY of ocean water desalination |
| Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities | •Reduce flood risk in 700 acres using integrated flood management approaches.<br>•Remove 500,000 cubic yards of sediment from debris basins and reservoirs |
| Preserve and enhance the ecosystem services provided by open space and habitat within the watershed | •Preserve or restore 3,500 acres of terrestrial aquatic habitat<br>•Construct 39.5 miles of additional Santa Ana River Trail and Parkway |
| Protect beneficial uses to ensure high quality water for human and natural communities | • Reduce non-point source pollution by treating an additional 35 MGD of surface and stormwater flow, emphasizing higher priority TMDL areas<br>• Remove an additional 25,000 tons of salt per year from the watershed |
| Accomplish effective, equitable and collaborative integrated watershed management | •Engage with 50% (approximately 35) Disadvantaged Communities within the watershed<br>•Engage with 100% of the Non-Federally Recognized Tribes in the watershed |

## OWOW Planning Process

SAWPA officially launched its OWOW 2.0 planning effort on April 20, 2011, with the signing ceremony of the agreement with Reclamation. The work commenced in earnest with the first meeting with the Pillar Co-chairs. Regular workshops throughout the watershed were held with more than 100 agencies and non-profit organizations spanning Riverside, San Bernardino, and Orange counties. From the very beginning, the process has been open to and has received the participation of representatives from all

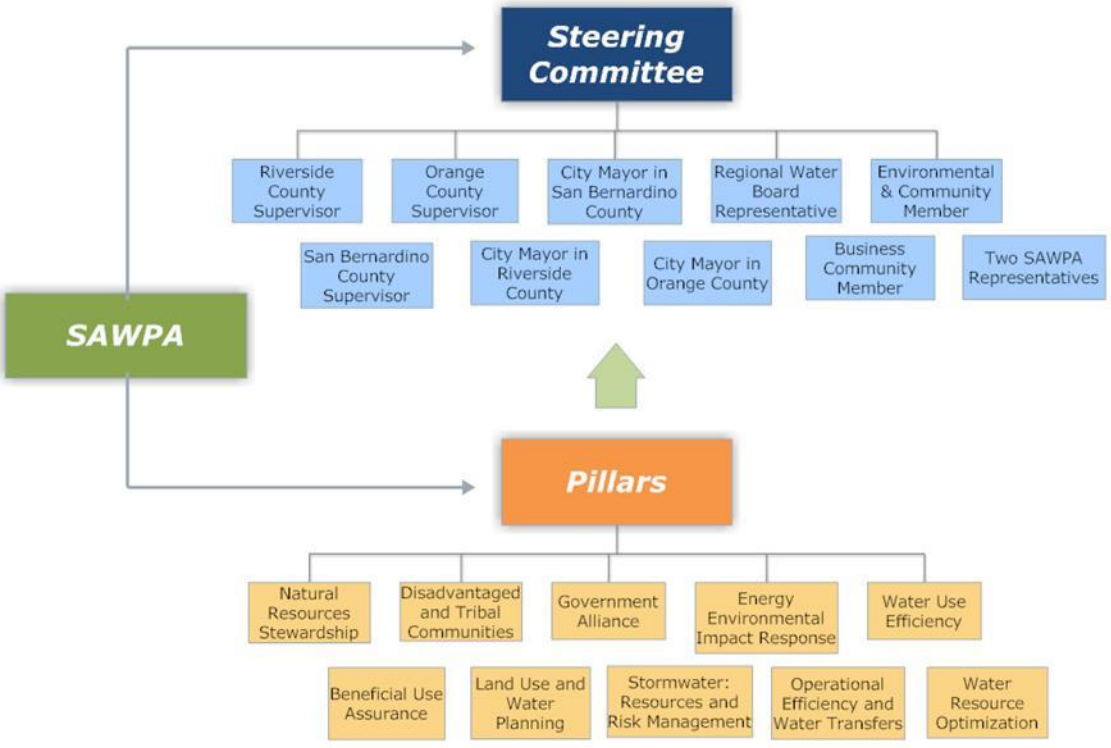
geographic regions and political jurisdictions within the watershed, and from diverse representatives of different sectors of the community (governments, water agencies, the development and environmental community, and the public).

As with the OWOW 1.0 Plan development, the OWOW 2.0 Plan utilized a "bottom up" approach for governance and involvement. Every effort was made to encourage the development of a shared vision and the involvement and participation of all watershed stakeholders in key discussions of major water resource issues, concerns, problems, goals, and objectives, with a particular focus on supporting multi-beneficial system-wide implementation. By expanding the involvement and collaboration to the *on-the-ground* level, greater buy-in and support were realized for this planning development process.

## OWOW 2.0 Governance

As with OWOW 1.0, the OWOW 2.0 Plan is led by an 11-member Steering Committee composed of elected officials from counties and cities in the watershed, representatives from the environmental, regulatory, and business communities, and representatives from SAWPA.

The Steering Committee's role is to serve as the developer of integrated regional water management goals and objectives for the watershed, and to act as the oversight body that performs strategic decision making, crafts and adopts programmatic suites of project recommendations, and provides program advocacy necessary to optimize water resource protection for all.

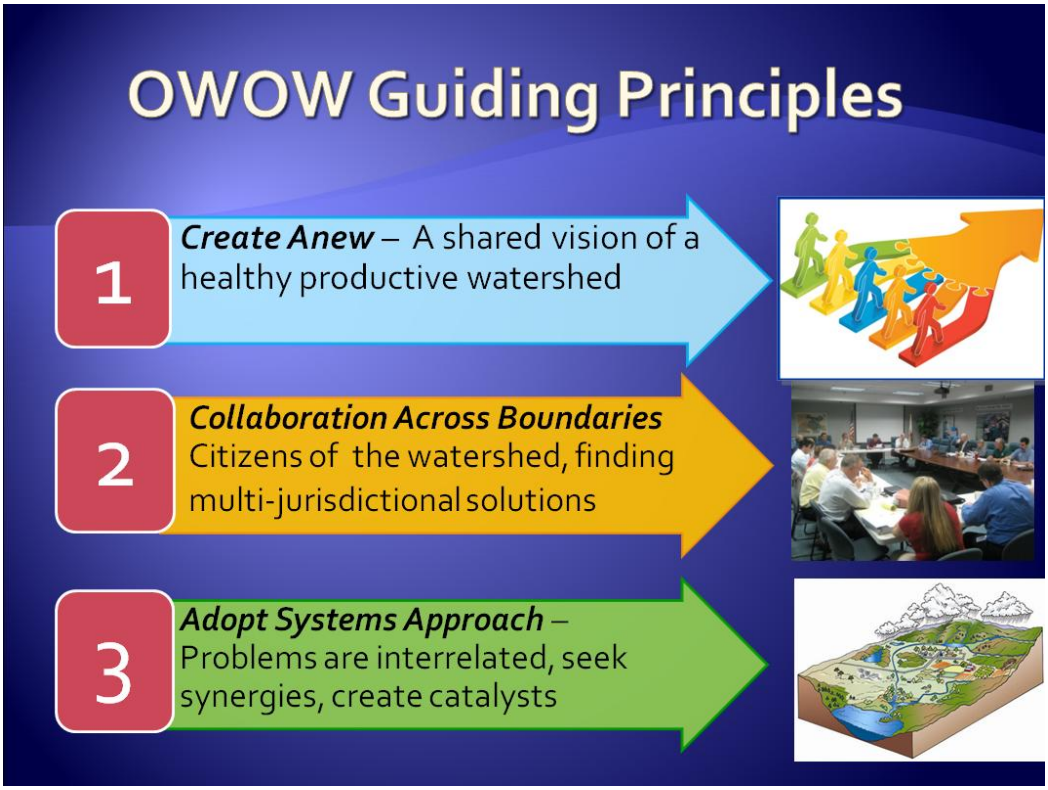



The Steering Committee is supported by technical experts assembled into ten groupings (known as Pillars), generally aligned along major water resource management strategies, but renamed under the OWOW 2.0 Plan to reflect greater integration and synergy.

While SAWPA facilitates the planning process and provides technical input and support through its staff and consultants, the development of the goals and strategies of the Plan, as well as the decision making process, are under the purview of the Steering Committee and the SAWPA Commission, with support of the Pillars and with consideration to comments from the public.

## Pillar Work and Key Findings

Under OWOW 2.0, more emphasis is being placed on the watershed scale, and multi-benefit and multi-purpose solutions. Multi-beneficial projects and greater diversification of water management approaches are achieved through greater collaboration and cooperation, building trust among stakeholders, viewing the watershed as a hydrologic whole, working in concert with nature, and seeing each problem as interrelated that provides opportunities for synergy and efficiencies. These OWOW guiding principles were shared with the Pillars and the watershed stakeholders on multiple occasions.




In preparation for the next phase of OWOW 2.0 planning, SAWPA directed that the OWOW 2.0 Plan was not intended to be merely an update of previous planning data from the OWOW 1.0 Plan, but rather would focus on identifying integrated and watershed-wide implementation actions. To achieve this, SAWPA conducted innovative brainstorming processes with the Pillars utilizing the experience and skills of local experts to inspire and promote integrated system-wide implementation actions that address water resource challenges in the Santa Ana River Watershed.

Starting in September of 2011, three well known water resource experts dubbed the "Master Craftsmen", were tasked to develop a list of conceptual project concepts and to describe the spatial, temporal, regulatory, economic, political, and physical barriers that impair the ability to implement

watershed-based implementation actions that support the vision articulated in the OWOW Plan. From these Master Craftsmen meetings, a white paper was developed that identifies 13 key examples of watershed-based water resource management concepts that, when implemented, would provide tangible and measurable benefits by removing impairments. These watershed-based concepts are ideas, vetted by the Pillars, and provide significant additional benefits such as habitat restoration and increased habitat connectivity. Two types of concepts were included: (1) those that require implementation of capital projects, and (2) those that are programmatic and focus on establishment of regional management practices or policies that increase sustainability of existing resources.

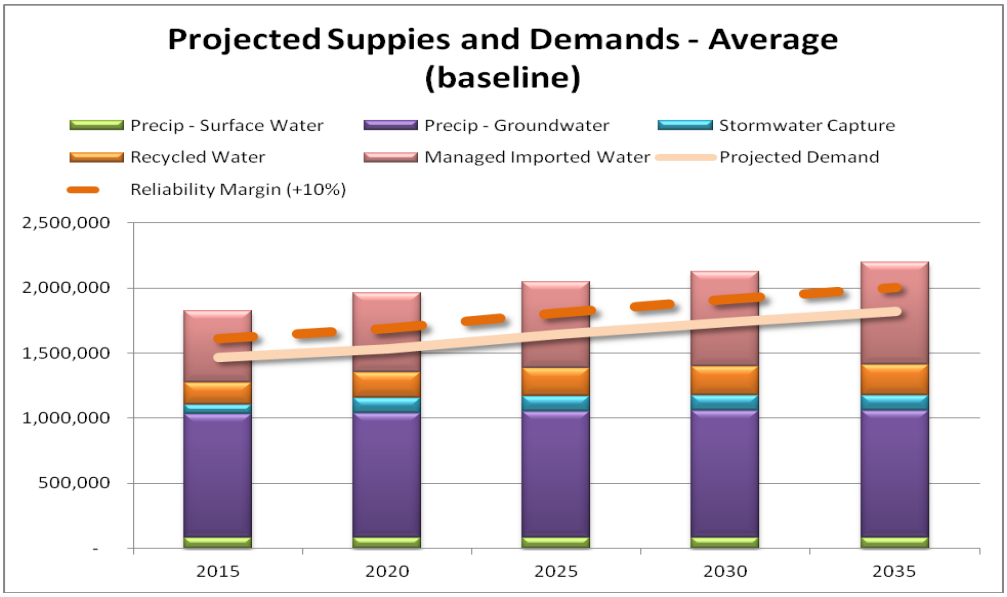
These ideas and concepts were approved by the Steering Committee and the SAWPA Commission. Thereafter, the Pillars commenced their respective meetings over the following 18 months of the OWOW 2.0 planning. They investigated new regional implementation actions within their Pillars that could lead to multiple, integrated benefits that, in turn, could be linked and integrated with other Pillar implementation actions. In addition to conceptual implementation actions, the Pillars developed key findings that will support implementation described as follows:

### *Water Use Efficiency Pillar – Key Findings*

- Water use efficiency practices remain the number one water resource management priority for the watershed.
- Agencies and their partnerships with each other and private industry will continue to collaborate and develop new programs promoting water use efficiency.
- The ultimate goal will be to get water customers to automatically base decisions on what is the most water efficient way to plan, implement, and maintain devices and landscapes. This will require customer education and continued incentives to promote water use efficiency.
- Landscape demonstrates the greatest potential for water savings. Therefore, the Water Use Efficiency Pillar will move forward with collaborative projects that primarily emphasize outdoor efficient use of water.

### *Water Resource Optimization Pillar - Key Findings*

Based on the work of the Water Resource Optimization Pillar, the projected supplies and demands for the average year are as follows:




A key finding from this Pillar's analysis is that with implementation of the 20% water demand reductions by 2020, as well as a reliability margin of 10%, water supplies will be adequate to meet demands through the 20-year planning horizon or Year 2035. This evaluation also was conducted for the single year, the historical year that received the lowest amount of imported water, and the multi-year drought, three- year period that received the lowest amount of imported water. Their findings show that the watershed in the aggregate will be able to meet its demands in a single year drought with a reliability margin of 11% in 2035, and for a multi-year drought of 13% in 2035. The watershed is able to make it through these drought years by relying on the native water, precipitation as surface water and precipitation as groundwater, and imported water storage programs that store water when it is available during wet periods for use during drought periods, and on recycled water that is not impacted by weather.

The Water Resource Optimization Pillar concludes that there is more to be done to ensure water supply reliability for the future. This is particularly true in the face of climate change that may impact local precipitation patterns, the need for intra-basin transfers to maintain groundwater levels, the State-defined mandate for regions to become less dependent on Delta imported water, and a significant funding requirement of water use efficiency and infrastructure to meet future demands.

### *Beneficial Use Assurance Pillar - Key Findings*

- Surface water quality monitoring is not coordinated within the watershed leading to duplicative sampling in some areas and inadequate sampling in others. Work on a plan to improve coordination and development of a regional approach to monitoring that will generate better information and be less expensive.
- New statewide regulations setting biological objectives and nutrient objectives for surface water are being developed and will be a compliance challenge for wastewater agencies. Participate in rule making process to support development of policies and regulations that are effective and efficient.

- A small number of small water systems in operation within the watershed that do not have resources for monitoring and proper operations and maintenance, may result in drinking water provided to customers that is in violation of drinking water standards. Work with California Department of Public Health and county health departments to identify small system water providers, if any, which need assistance with providing safe drinking water. Develop a plan to address any small system water providers that need assistance.
- Sediment deposition in some areas creates water quality impairments, reduces aquatic habitat, and reduces water conservation storage. Reduced sediment flow downstream of dams causes armoring of river/creek beds resulting in reduction in percolation capacity, aquatic habitat, and beach replenishment. Support USACE/OCWD Prado Basin Sediment Management Demonstration Project and Newport Bay Stakeholders to reduce sediment load into Upper Newport Bay.

*Land Use and Water Planning Pillar – Key Findings*

- Water supply agencies should be consulted early in the land use decision-making process regarding technology, demographics and growth projections.
- City and county officials, the watershed stakeholders**,** Local Agency Formation Commissions, special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at a watershed level.
- Plans, programs, projects and policies affecting land use and water should be monitored and evaluated to determine if the expected results are achieved and to improve future practices.
- Limited, accessible, and low-cost, outdoor recreational opportunities should be promoted throughout the watershed.

*Stormwater: Resource and Risk Management Pillar – Key Findings*

- Comprehensive and integrated stormwater management projects driven by a multi-stakeholder project paradigm can more effectively and efficiently address watershed needs. Such projects can assist stakeholders to achieve compliance with the Municipal Stormwater National Pollutant Discharge Elimination System Permits (MS4 Permits), while increasing capture of stormwater and other flows and groundwater recharge using favorable cost benefit approaches.
- Reducing the risk of loss of life and property damage due to flooding remains a high priority within the Santa Ana River Watershed. The completion of the Santa Ana River Mainstem Project will reduce the risk of a catastrophic flood event in the Santa Ana River Watershed. However, there remains significant flood risk related to tributary watercourses within the watershed, compounded by potential impacts of wildfires and earthquakes.

*Natural Resources Stewardship Pillar – Key Findings*

- A plan for sustainable management of conservation areas with targeted restoration efforts is essential for preventing further deterioration of habitat. Consideration for characteristics of each of the main habitat types: Chaparral/forest, Alluvial fan; Riparian, Wetland, and Coastal and their specific ecosystems, require habitat-specific management plans and restoration criteria.
- Creating sustainable wildlife corridors requires land use planning coordinated across jurisdictional boundaries. Cooperation also must take place among all of the current regional conservation plans, mitigation providers, resource conservation districts, and non-profit conservation organizations.

- Consensus among all agencies and organizations with ownership/stewardship over areas of the Santa Ana River Mainstem and tributaries should be sought that provides for long-term protection of areas where habitat restoration efforts are occurring or need to occur. This kind of cooperative agreement will be critical to the ability of governmental and non-profit organizations to secure mitigation funding to do the necessary habitat restoration work needed in the watershed.
- Grant and bond funding in the watershed have funded the removal of thousands of acres of invasive plants, initial and ongoing restoration of habitat areas, biological monitoring of sensitive species, and conservation of habitat areas. All of these sources and more should continue to support restoration and ongoing maintenance.
- Much of the remaining invasive plant biomass and areas that could benefit from re-establishment activities (removal of invasive species followed by long-term, active planting and biological monitoring) in the watershed is on land owned by Federal, State, and local governments for purposes other than water-oriented habitat conservation. These are prime lands for future habitat restoration projects with multi-use and benefit.

### *Operational Efficiency and Water Transfers Pillar – Key Findings*

- Expand compliance with the SBx7-7 and implement projects that reduce per capita water usage by more than 20 percent by the year 2020.
- Create/ expand supply and system reliability during drought, emergency, and peak demand situations.
- Create/expand coordination with other agencies in the area and develop regional water management strategies that would increase conservation and local water supplies.
- Create/expand local recycled water reuse program(s) in the area with an OWOW 2.0 goal of 157,000 acre feet per year.
- Develop/Implement projects that protect groundwater resources, the environment and consider storage and transfers. These projects are important to assure that water is readily availability in the right place when we need it. This can be overcome with storage and transfers.

### *Disadvantaged and Tribal Communities Pillar – Key Findings*

- Engaging Disadvantage Communities (DACs) and Tribes in water and related resources planning through effective outreach is good for both the community and the water sector itself. There are distinct differences due to cultural and historic context. Both need their voices heard during proposed project development.
- Today, DACs and some Tribes face critical and serious water and related resources challenges, such as failing septic systems, isolation, language barriers, flood risk, and lack of funding and or resources. It is imperative that the water sector and its key stakeholders recognize proposed DAC and Tribe water project needs, and engage these communities early in the process. The OWOW 2.0 process recognizes the various funding needs for DACs and Tribes, and the Federal and State funding programs available to them.
- From engaging and speaking with DAC residents and attending Tribal Council meetings, it is evident that there is a need for continuous networking resulting in consensus based development and implementation of project solutions.

*Government Alliance Pillar – Key Findings*

- Ensure that Federal and State agencies effectively partner in the management of water and other resources within the watershed, and consider other Pillars' perspectives in their support of OWOW goals and objectives.
- Periodically publish updates of the Resource Guide and post them on SAWPA's website.
- Use the Resource Guide's agency contacts, and assure that steps are taken to keep all information current.
- Continue coordination with various governmental agencies, as appropriate, for all proposed projects, initiatives, and integrated water and related resources activities to help identify necessary environmental compliance requirements and or potential areas of conflict.

*Energy and Environmental Impact Response Pillar – Key Findings*

- Annual surface water is likely to decrease over future periods with precipitation showing somewhat long-term decreasing trends. Temperature will increase, which is likely to cause increased water demand and reservoir evaporation. Projected decreases in precipitation and increases in temperature will decrease natural recharge throughout the basin.
- Management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports within the watershed may be required to maintain current groundwater levels.
- Warmer temperatures likely will cause Jeffrey Pines to move to higher elevations and may decrease their total habitat. Forest health also may be influenced by changes in the magnitude and frequency of wildfires or infestations. Alpine ecosystems are vulnerable to climate change because they have little ability to expand to higher elevations.
- Increasing temperatures will result in a greater number of days above 95°F in the future. The number of days above 95°F gets progressively larger for all cities advancing into the future.
- Simulations indicate a significant increase in flow for 200-year storm events in the future. The likelihood of experiencing what was historically a 200-year event will nearly double (i.e. the 200-year historical event is likely to be closer to a 100-year event in the future). Findings indicate an increased risk of severe floods in the future, although there is large variability between climate simulations.
- Sea level rise is likely to inundate beaches and coastal wetlands and may increase coastal erosion. The effects on local beaches depend upon changes in coastal ocean currents and storm intensity, which are highly uncertain at this time. Sea level rise will increase the area at risk of inundation due to a 100-year flood event.
- Existing barriers are sufficient to deter seawater intrusion at Talbert and Alamitos gaps under a 3-foot rise in sea levels. However, operation of barriers under sea level rise may be constrained by shallow groundwater concerns.

To further enhance the integration and linkages among the recommended conceptual implementation actions suggested by the Pillars, Pillar Integration Workshops were conducted by SAWPA throughout the OWOW 2.0 Plan development period. The integration workshops included discussion of system-wide regional or watershed scale implementation actions, addressing different components of the hydrologic cycle, evaluating linkages among proposed projects/programs, and developing and identifying synergy among projects and programs to create anew.

## OWOW 2.0 Plan – Future Implementation

During the last two years, Pillars have been working together to write the next integrated water plan, OWOW 2.0. The Broad Planning/Management Guidance Strategies were distilled from that work and will serve to guide future planning and management in the watershed. The strategies reflect a change in thinking about water resource management. Historically, water activities were organized into different silos, and managers worked to achieve separate and individual goals that were thought to be unrelated. The water supplier's goal was to deliver water for a growing population and economy. The flood control manager's goal was to channelize stormwater to get it out of the community before it could harm people and property. The wastewater manager's goal was to highly treat wastewater before it is discharged into the river or ocean to be carried away. Managing the watershed and water resources as done in the past realized narrow singular goals, but did so with tremendous unintended consequences. The list of endangered species only grew longer, as did the list of impaired water bodies. Societal values have changed, water and funds are scarcer, and together we have realized that the old way is no longer viable.

These Broad Planning/Management Guidance Strategies are not projects or programs themselves. These strategies represent a shift from remediation to protection. It is the opportunity to be proactive rather than reactive. This can facilitate the vision we want, a sustainable and productive watershed, rather than only focusing on solving the problems that past practices have created.



These watershed planning and management strategies are separate and distinct from priorities assigned to evaluate projects for funding that are often dependent on the grant sponsoring agency criteria. These Planning/Management Strategies are meant to guide planning efforts and are *in no particular ranked or priority order* as shown below.

- **Demand Reduction and Water Use Efficiency**

Water use efficiency practices remain a key resource management priority for the watershed and a cost effective tool for reducing the gap between available supplies and projected demand. This is reflected through a reduced per capita water use as well as potentially reduced commercial and industrial water use. Although significant progress is anticipated with mandated reductions through 20% by 2020 legislation, more can be done. Many water use efficiency actions have been implemented locally, but these can be scaled watershed-wide. These include water rates structures that encourage conservation, also known as budget-based water rates, garden friendly landscaping and landscape ordinance application, smart controllers and irrigation nozzles, and turf buy-back programs, to name a few. The last acre foot of water is often the most expensive, reducing that cost goes far to keep water rates stable.

Monitoring data shows wasteful irrigation runs off yards, down streets and culverts collecting pet waste and pollution until it hits the receiving water with a toxic slug causing beach closures and fish kills. At great expense, cities have been tasked to clean up this dry weather urban runoff pollution. This cost can be avoided with successful water use efficiency.

It is understood too that there is a direct link of water use efficiency with energy efficiency and GHG emission reduction.

- **Watershed Hydrology and Ecosystem Protection and Restoration**

Implementing cost effective programs will protect and restore our watershed's ecosystem and hydrologic system so that it will sustainably produce the array of services including water resources. Recognizing that the Santa Ana River Watershed has multiple interrelated parts, a holistic approach to solving issues of supply, quality, flood, and ecosystem management is necessary. This approach recognizes that in order to achieve a healthy productive watershed, improvements starting at the top of the watershed with a healthy and managed forest effectively support downstream stormwater attenuation and runoff capture and water quality improvement. The emphasis is on source control rather than end-of-pipe treatment as a best management practice. Implementation actions under this priority include forest management, pollution prevention, low impact development, stormwater capture and flood management, and MS4 stormwater implementation.

- **Operational Efficiency and Transfers**

Cooperative agreements arising from water transfers, exchanges, and banking can resulted in better use of water resources. With the rich groundwater storage opportunities available in the watershed, expanding the groundwater storage with a variety of available water sources can be more much more cost effective than new surface storage. Such agreements will result in our ability to stretch available supplies and replace the storage lost by a shrinking snowpack. Projects under this category occur by collaboration and cooperation among the multitude of agencies and entities in the watershed, and agencies that import water into the watershed, expanding on the many past successful water agreements within the watershed. New banking agreements can represent both habitat mitigation

banking as well as groundwater banking. These agreements only can occur by entities working together and opening doors to improved efficiency and increased water supply reliance.

- **Innovative Supply Alternatives**

This strategy recognizes the need for more progress in a portfolio approach with expansion of innovative and effective 21st Century technology for water production, recycling, pumping, and desalinization. Traditionally these projects serve as an important component to achieving water supply reliability. Moving forward, a broader range of tools is available to us to serve both economic and environmental objectives. Projects under this category provide multiple benefits and thus can be mutually reinforcing. Brackish desalination and salinity management are necessary to sustain local supplies. Salinity management is essential for groundwater basin health in the watershed.

- **Remediation and Clean up**

Another strategy is implementing Total Maximum Daily Loads (TMDLs) and pollution remediation. Projects under this category must reflect projects that have region wide benefit, are integrated and have multiple benefits without a focus only on local or single purpose needs. Under this strategy, the focus is on preventing pollution and dealing with the pollution that has already occurred. This reflects a desire to duplicate the successes already established in the watershed to prevent and remediate pollution.

The Broad Planning/Management Guidance Strategies were presented and discussed with the Pillars and other stakeholders for possible prioritization of the five strategies. The feedback received is that all five strategies are a priority to the watershed. But as stakeholders of the watershed, entities are encouraged to consider the long term watershed planning approach as they consider competing alternatives to meet needs and give more merit or attention to strategies such as water use efficiency that has been traditionally found to be more cost effective in reducing water demands and generating water supply. Further, projects should consider system wide benefits before other alternatives. This applies particularly to pollution prevention at the source rather than having to address a chain of unintended and possibly negative consequences downstream for future generations.

Shown below is a list of Pillar Recommended Implementation Actions that were prepared based on the Pillar's work and other stakeholder input. These regional implementation actions are not listed in priority, nor are they in any particular order. They represent the integrated work of the Pillars that resulted from their collaboration internally and with other Pillars and are the solutions to the challenges that they identified in each of their Pillar chapters. This list does not represent a list of projects that been rated and ranked projects under the more formal Project Review Process defined under the OWOW 2.0 Plan. However, they are recommended implementation actions that reflect an emphasis on integration and system-wide solutions to the watershed challenges and include the 13 watershed-wide framework concepts previously discuss.

Each of the Pillar-recommended watershed-wide implementation actions eventually could become projects once they are more fully investigated and analyzed. Multi-agency project proponents for these implementation actions have not have been identified yet. It is anticipated that these recommended actions may best help fulfill the vision of the OWOW 2.0 Plan.

## Pillar Recommended Implementation Actions
### (In no particular order)

| Title | Description |
|---|---|
| Water Rate Structures that Encourage Conservation | Create incentive programs for retail water agencies in the watershed to reduce water demand and help meet SBX7-7 required demand reductions. |
| Water Use Efficiency Incentive Program | Create an incentive program for expanded water use efficiency programs including cash for grass, landscape retrofit support, and California-friendly plant discounts. Utilize IEUA Residential Landscape Transformation Program and MWDOC Comprehensive Landscape Water Use Efficiency Programs as template. |
| Watershed Exchange Program | - Upper watershed foregoes development of more water recycling and provides future treated wastewater to the lower watershed via the Santa Ana River<br>- Lower watershed provides "replacement" water to upper/middle watershed |
| Wet Year Imported Water Storage Program | - Upper watershed and MWDSC would implement this strategy<br>- Goal: change MWDSC place of storage from Central Valley to Santa Ana River watershed<br>- Develop MWDSC pricing structure to encourage more storage in watershed<br>- Water stored in wet years for a reduced price. Water pumped in dry years for remaining Tier 1 price |
| Enhanced Santa Ana River stormwater capture below Seven Oaks Dam | Additional stormwater detained by Seven Oaks Dam could enable the diversion of up to 500 cfs and up to 80,000 acre-feet per year. This may require execution of new water rights agreement among SAR Watermaster parties. |
| Off River Storage and Supply Credits | Additional stormwater capture along the SAR tributaries could enhance capture/ recharge. Specific locations in the watershed would need to be defined. New recharge projects could allow for purchase of "MS4 Credits" by cities and counties as part of new development as a regional MS4 compliant recharge project. |
| Re-Operate Flood Control Facilities | Working with flood control agencies re-operate flood control facilities with the goal of increasing stormwater capture increasing flood get away capacity and revising decades old storage curves. Without any impending storms, the flood control agencies may be able to release stormwater at a slower rate. This relatively minor operational change would make stormwater flows easier to capture and put to use. It also would result in impounding the water longer, which would increase artificial recharge during the "holding period". This strategy has already been successfully implemented in some portions of the watershed. |
| Increase Surface Water Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. This project would supplement but not replace existing or proposed groundwater storage. |
| Increase Groundwater Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. |

| Title | Description |
|---|---|
| Inland Empire Garden Friendly Demonstration and LID Project | Using the Inland Empire Garden Friendly Program as a template, a demonstration project is proposed to quantify the benefits of installing Inland Empire garden friendly products and further demonstrate Low Impact Development features in a DAC neighborhood. The project would be modeled in part after the successful City of Santa Monica Garden-Friendly Project, as well as the Elmer Ave. Neighborhood Retrofit project in the LA Basin. |
| DAC Water Supply or Water Quality Improvement Projects | Provide funding support to assure drinking water standards are met such as in the County Water Company of Riverside near Wildomar. Construct new sewer system for the areas that have failing septic systems/undersized treatment facilities like Beaumont Cherry Valley. |
| Wetlands Expansion Watershed wide | Create new wetlands along the tributaries of Santa Ana River to provide for natural water quality improvement, ecosystem restoration and recreational opportunities. Water supply for such wetlands would be dry weather urban runoff and available recycled water and would be patterned after the Mill Creek Wetlands in Chino Basin. |
| Watershed wide Multi-Use Corridor Program | Create multi-use corridors along SAR and its tributaries and Upper Newport Bay tributaries in all three counties in watershed to provide for sustainable wildlife corridors, stormwater attenuation and capture, flood control, sediment reduction and erosion restoration, enhanced NPS pollution treatment, removal of non-native species, and creation of recreational trails,. In Riverside County, along Temescal Wash, in San Bernardino in San Timoteo Wash, in Orange County along Borrego Canyon Wash between Irvine Blvd and Town Center Drive. |
| Multi-Species Habitat Plan for Gap areas of Watershed | Create multi-species habitat plan for San Bernardino County and portions of Orange County. Though work is underway on the Upper Santa Ana Wash Land Management and Habitat Conservation Plan, there is no MSHCP covering the growing areas of southwestern San Bernardino County. Western Orange County is also not covered by an MSHCP. |
| Water conservation recharge optimization program | Establish a water conservation-recharge optimization plan for existing and potential future flood control facilities, using the example work of the Chino Basin Recharge Master Plan and implementation projects as a template. |
| Watershed wide geodatabase access | Connect existing county or program-specific geodatabases to create a comprehensive watershed geodatabase that provides access to appropriate stakeholders, and set up a data quality control and maintenance program. The main component County MS4 geodatabases are well under way. |
| Forest Restoration Projects | Expand forest restoration through fuels reduction, meadow and chaparral restoration projects to strategic areas above major stormwater recharge basins for flood control, water supply and water quality benefits. |
| Residential Self-Regenerating Water Softener Removal Rebate Program | Removal of self regenerating water softeners has been proven as an effective strategy to reduce TDS levels at WWTP and assure future salt discharge requirements. The project provides watershed-wide rebates and would be a joint program among water agencies in the watershed. |
| Salt removal projects to achieve Salt Balance | Expand groundwater desalination to key groundwater basins where TDS and Nitrate concentrations are approaching discharge limits. Locations may include Elsinore Basin, Perris Basins in EMWD and Riverside Basins. |

| Title | Description |
|---|---|
| Enhanced stormwater capture from the tributaries of the Santa Ana River | Develop additional stormwater capture projects along the SAR tributaries that support key groundwater management zones identified by SB, RV, and OC Geodatabases. Early estimates indicated a capture potential of 12,000 AFY. |
| Conjunctive Use Storage and Water Transfer Project using Wet Year and Dry Year Allocation | This project concept proposes a purchase by downstream entities of up to 45,000 AF of imported water to be recharged by the upstream agencies during wet years. Water would be purchased at a reduced imported water rate from MWD reflecting the savings of not storing the SWP water at one of MWD's own storage programs such as the Semi-Tropic Water Storage District and/or Kern County Water Bank. In dry years, downstream agencies could request upstream agencies to increase their groundwater production for three years by up to 15,000 AF per year in-lieu of direct deliveries from MWD, while MWD increases deliveries in the downstream area by an equal amount. |
| Salt Assimilative Capacity Building and Recycled Water Transfer Project | EMWD has the capability to discharge 15,000 AFY of recycled water into Temescal Creek. The recycled water discharge will be dependent on surplus recycled water available and not used within EMWD particularly during wet seasons. With the approval of the SAR Watermaster, this flow can be contractually added to the Santa Ana River base flow allocation at Prado. The water quality of EMWD's discharged recycled water may require some salinity mitigation by downstream parties to meet the RWQCB Basin Plan Objective in Orange County. The GWRS will be used to provide the required mitigation for the discharged water, and EMWD will pay downstream parties for the cost of that mitigation. |
| Riverside Basin Aquifer Storage and Recovery Project | Riverside Public utilities, in partnership with Valley District and others are developing a design for a rubber dam that would cross the Santa Ana River and be used to divert flows, while mitigating environment impacts. The project is currently anticipated to capture and recharge 15,000 AFY. |
| Watershed Invasive Plant Removal Project | The Santa Ana Watershed Association, the Front Country District Ranger on the San Bernardino National Forest and Southern California Edison had proposed a major an invasive plant eradication project for the Mill Creek Watershed. This project proposes to expand the San Bernardino Mountains Front Range Invasive Plant Removal Project to an invasive plant removal and restoration project in the Santa Ana River Watershed that has many partners and stakeholders extending from the coast to the headwaters. |
| Regional BMPs to manage municipal stormwater discharges | Develop regional BMPs including infiltration, harvest & reuse, and biotreatment as proposed under current MS4 Permits. Initial phase would be located in MSAR Pathogen TMDL area and expand into other areas of the watershed under future phases to address pathogen treatment. |
| Watershed-wide coordinated surface water monitoring program | Surface water quality monitoring is not coordinated within the watershed leading to duplicative sampling in some areas and inadequate sampling in others. In some cases this may lead to 303(d) listings that do not reflect real impairments. A new program to coordinate surface water quality monitoring to enhance efficiency and reduce costs is proposed. Sources of monitoring data would come from MSAR Watershed TMDL, SWQSTF, MS4 Stormwater Permits, and SCCWRP Bioassessment Program. |
| Watershed Urban Runoff Management | Establishing a Watershed Based Urban Runoff Management Fund to support the implementation of stormwater management programs. Components of this program |

| Title | Description |
|---|---|
| Fund | could include the regulatory basis for a watershed based program, the legal basis and authority for the fund, the agreements, and programmatic elements. |
| Santa Ana River Sediment Transport | Building upon an OCWD demonstration project, implementation of a full scale project that allows for the appropriate transfer of sediment to maximize recharge operations, restore habitat, and reduce operation costs. |
| Transportation Corridor Stormwater Capture and Treatment | New uses of the current transportation right of ways can be expanded to for capturing rain runoff and replenishing groundwater basins. |
| Modified Watershed Brine Management System | Optimizing the water used to transport brine so that less water is lost to the ocean through increased concentrating of brine or delivery to the Salton Sea for beneficial use. |
| Water Industry Energy Use Reduction Incentive Program | Supporting regional purchase and installation programs of water resource related greener energy projects that reduce capital costs and green house gas emissions. |
| Watershed Land Use Planning Tool Kit | Developing a tool kit that translates water principles to support watershed planning decisions and implements a jurisdictional outreach effort for relevant regional, county and city planning agencies that encourages adoption of the guidance ideology into General Plans and zoning codes at the local level. |

## OWOW Projects and Benefits

It is the intent of the OWOW planning process to transcend specific funding cycles. Projects are included in the OWOW 2.0 Plan based on the latest rating and ranking criteria and their merit to address the watershed's strategic needs, regardless of available funding opportunities at any given time. (See list in **Appendix K**)

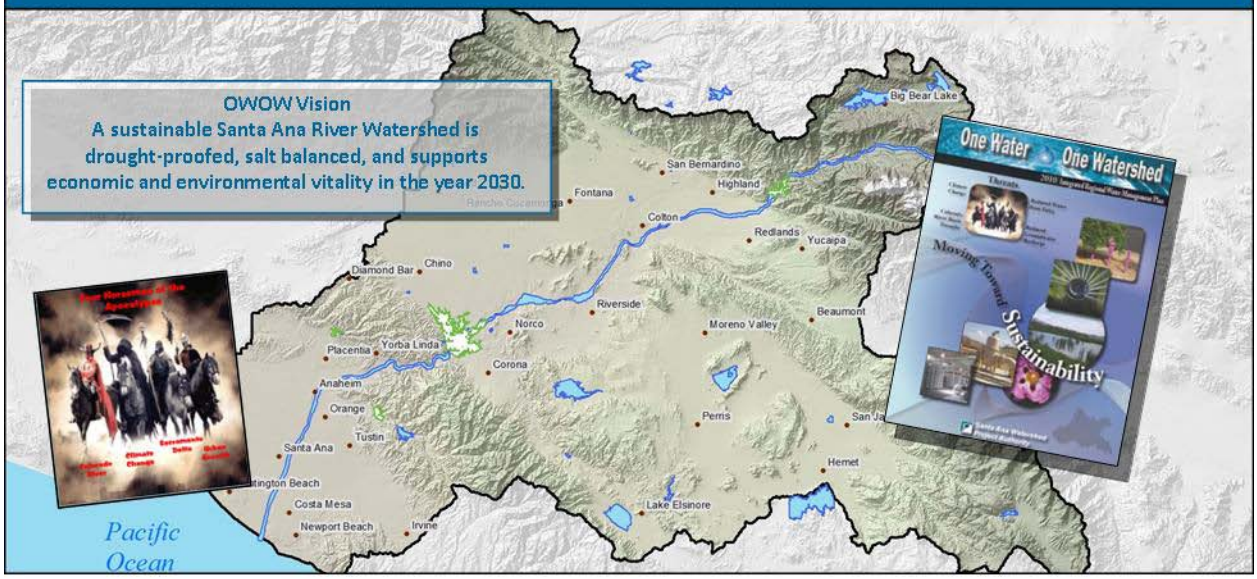
Shown below is a list of the Round 1 Proposition 84 projects and the benefits that ultimately will be realized once all these projects are fully constructed. Round 2 projects submitted by SAWPA are under consideration by DWR for future grant funding with awards anticipated in early 2014.

**OWOW Proposition 84, Round 1 Projects**

| Project | Project Sponsor | Total Local Cost | Grant Amount | Other State Funds Being Used | Total Cost |
|---|---|---|---|---|---|
| Groundwater Replenishment System - Flow Equalization | OCWD | $14,399,680 | $1,000,000 | $0 | $15,399,680 |
| Sludge Dewatering, Odor Control, and Primary Sludge Thickening | OCSD | $137,115,600 | $1,000,000 | $0 | $138,115,600 |
| Vireo Monitoring | SAWA | $269,207 | $600,000 | $0 | $869,207 |
| Mill Creek Wetlands | City of Ontario | $14,355,000 | $1,000,000 | $5,000,000 | $20,355,000 |
| Cactus Basin | SBCFCD | $8,250,752 | $1,000,000 | $0 | $9,250,752 |
| Inland Empire Brine Line Rehabilitation and Enhancement | SAWPA | $698,153 | $1,000,000 | $5,234,576 | $6,932,729 |
| Arlington Desalter Interconnection Project | City of Corona | $948,049 | $400,000 | $0 | $1,348,049 |
| Perris II Desalination Facility | EMWD | $1,335,752 | $1,000,000 | $0 | $2,335,752 |
| Perchlorate Wellhead Treatment System Pipelines | WVWD | $419,000 | $1,000,000 | $0 | $1,419,000 |
| Chino Creek Wellfield | WMWD | $5,331,118 | $1,000,000 | $0 | $6,331,118 |
| Impaired Groundwater Recovery | IRWD | $36,321,970 | $1,000,000 | $0 | $37,321,970 |
| Alamitos Barrier Improvement Project | OCWD | $10,571,600 | $1,000,000 | $0 | $11,571,600 |
| Arlington Basin Water Quality Improvement Project | WMWD | $3,443,636 | $1,000,000 | $0 | $4,443,636 |
| Grant Total | | $233,459,517 | $12,000,000 | $10,234,576 | $256,354,097 |

- Reduces water demand by 11,200 AF/YR
- Captures 16,300 AFY of stormwater for recharge
- Produces 28,600 AFY of desalted groundwater while removing 21,600 tons of salt
- Creates 90,400 AFY of new water recycling
- Creates 16,400 AF of new storage
- Improves water quality to 7,800 AFY
- Creates or restores 400 acres of habitat
- Leverages $11.7 million in grants funds with $240 million on local funds
- Creates about 3900 construction related jobs for region

# 1.1 Overview




Santa Ana River Watershed

The One Water One Watershed (OWOW) Program provides a comprehensive view of the watershed and water issues encompassing all sub-regions, political jurisdictions, water agencies, and non-governmental stakeholders (private sector, environmental groups, and the public at large) in the watershed. It is one in which all types of water (imported, local surface and groundwater, stormwater, and wastewater effluent) are viewed as components of a single water resource, inextricably linked to land use, habitat, and that endeavors to limit impacts to natural hydrology.

The OWOW planning process is supported by a diverse group of stakeholders led by a Steering Committee composed of public officials from counties and cities in the watershed, representatives from the environmental, regulatory, and business communities, and representatives from the Santa Ana Watershed Authority (SAWPA). The Steering Committee is supported by technical experts and stakeholders grouped into ten disciplines (known as Pillars), ranging from water supply reliability and quality, to climate change, to environmental justice.

SAWPA acts as the Regional Water Management Group for the process. While SAWPA facilitates the planning process, provides technical input and support through its staff and consultants, the development of the goals and strategies of the Plan, as well as the decision making process, are prepared by the Steering Committee with support of the Pillars, and with consideration to comments from the public at large.

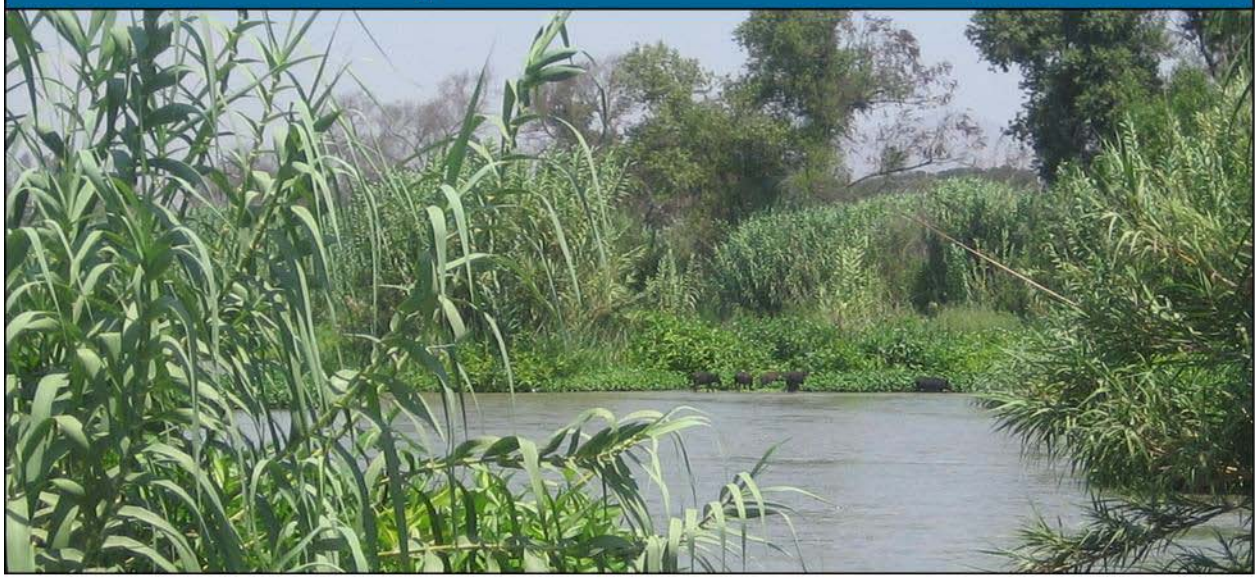
The collaborative, transparent, and watershed-wide view embraced by the OWOW planning process from the onset, builds upon previous planning efforts in the watershed, and seeks to change the way that water and other environmental resources are managed, moving from reliance on large centralized infrastructure projects to a systems approach that complements existing centralized infrastructure with decentralized facilities (e.g., groundwater desalination), technology, natural infrastructure and human capital.

In 2011, SAWPA received funding to update the 2010 OWOW Plan to address the new IRWM Program Guidelines, and implement this process of moving from a water supplier to a water resource manager mentality. The resulting 2013 OWOW 2.0 Plan advances a paradigm change from water supply to an integrated water resource management mentality; moving from a mission of providing abundant high-quality water at the lowest cost possible, to one in which water resources are managed in a sustainable manner and with regard for the needs of the environment and those downstream. Rather than investing more or working harder on the ways of the 20th century, OWOW 2.0 seeks a new approach that is lighter on the land, and protects habitat and a sustainable future for a robust economy and healthy environment. This Plan, in keeping with requirements of the Department of Water Resource's Proposition 84 IRWM Planning Grant award, and the November 2012 IRWM Proposition 84 and 1E Program Guidelines, documents the current IRWM program and processes that have evolved through the OWOW planning process, and is organized according to **Table 1.1-1**.

**Table 1.1-1 Current IRWM Program and Process Evolved through the OWOW Planning Process**

| DWR IRWM Plan Standard | 2013 OWOW 2.0 Plan Chapter |
|---|---|
| Governance | Chapter 2: Governance, Outreach, and Integration |
| Region Description | Chapter 3: Watershed Setting |
| Objectives | Chapter 4: Regional Goals and Objectives |
| Resource Management Strategies | Chapter 5: Water Management Strategies and Integration |
| Integration | Chapter 2: Governance, Outreach, and Integration<br>Chapter 5: Water Management Strategies and Integration |
| Project Review Process | Chapter 6: Project/Program Review, Evaluation and Prioritization |
| Impact and Benefit | Chapter 7: Impacts and Benefits of Sustainable Integrated Solutions |
| Plan Performance and Monitoring | Chapter 9: Data Management and Plan Performance/Monitoring |
| Data Management | Chapter 9: Data Management and Plan Performance/Monitoring |
| Finance | Chapter 8: Finance |
| Technical Analysis | Chapter 9: Data Management and Plan Performance/Monitoring |
| Relation to Local Water Planning | Chapter 5: Water Management Strategies and Integration |
| Relation to Local Land Use Planning | Chapter 5: Water Management Strategies and Integration |
| Stakeholder Involvement | Chapter 2: Governance, Outreach, and Integration |
| Coordination | Chapter 2: Governance, Outreach, and Integration |
| Climate Change | Chapter 5: Water Management Strategies and Integration |

# 1.2 OWOW Plan 1.0
# Moving Towards Sustainability



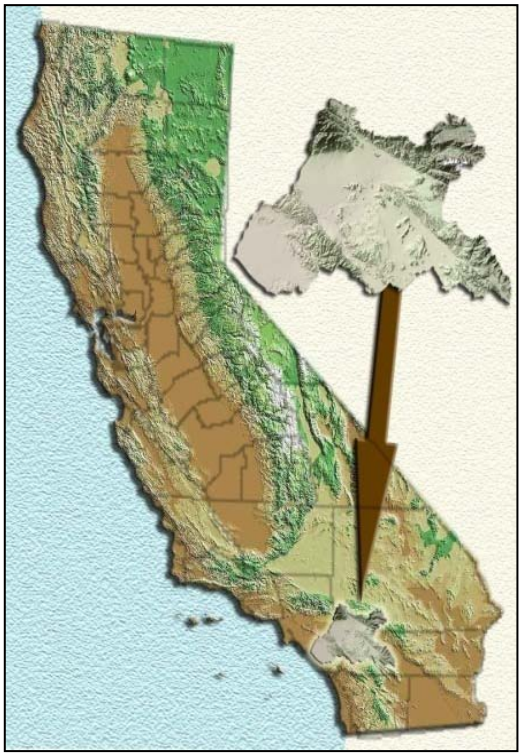
Wild pigs drinking from the Santa Ana River

## The Planning Process

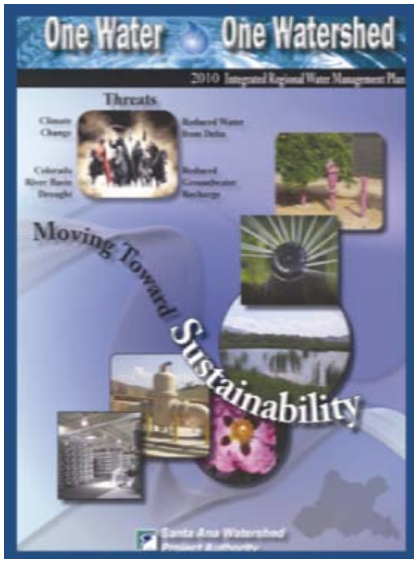
The development of this One Water One Watershed (OWOW) 2.0 Plan is built upon the planning process of the past to address the challenges of the future. The first phase of OWOW, known as *OWOW 1.0*, produced a broad-based, stakeholder-driven assessment of the watershed. Rather than engage a consultant to prepare a plan, SAWPA developed and convened a process whereby all segments of the water community worked in various workgroups called "Pillars" to produce an Integrated Regional Water Management Plan (IRWMP) for the watershed. Over 300 stakeholders described current conditions within the watershed and developed specific strategies and targets to make the watershed sustainable in 2030.

All aspects of water were considered, from flood risk management to water supply reliability, to habitat and open space. To manage such a complex process, SAWPA engaged the broader community and created a Steering Committee consisting of county supervisors, mayors, and business leaders, as well as water agency officials. At the conclusion of OWOW 1.0, the Steering Committee recommended funding several new integrated projects under Proposition 84 Integrated Regional Water Management (IRWM) funding that provide regional benefit. A wide variety of projects was selected from across the watershed and from varied disciplines, including local water supply development, and stormwater and habitat management. All projects considered provided multiple benefits to a broad area, leveraging scarce resources for many purposes.

With the development of integrated watershed planning, multi-benefit and multi-purpose projects have moved to the forefront and have become one of the primary goals of the OWOW implementation. Past efforts, with a few notable exceptions, primarily focus on single purpose projects. The additional effort required to develop multi-objective solutions has made true multi-benefit projects relatively uncommon. In California, much of which has been prompted by SAWPA's historical integrated watershed programs, there has been an effort to incentivize collaborative planning through IRWM planning and associated funding sources.



Some of the earliest multi-benefit water projects were done through a partnership between those interested in flood and groundwater management. Spreading grounds along the front slopes of local mountains have attenuated flood flows and recharged groundwater basins for nearly 100 years. Orange County Water District partnered early with Orange County Flood Control District (OCFCD) to provide recharge basins within flood control basins. More recently, Inland Empire Utilities Agency has worked with San Bernardino County Flood Control District to modify the operation of the flood control system to maximize recharge opportunities. Irvine Ranch Water District has partnered with the OCFCD to store recycled water in some flood basins. All of these projects primarily were facilitated by operational changes rather than the construction of new infrastructure, although in some cases the flood control system was upgraded. Operational changes could occur only when both parties understood the needs and assets of the other.




Although OWOW planning identifies numerous projects that implement the OWOW vision, the need exists to continually develop high level watershed management concepts, that when implemented, create the opportunity to make significant strides in efforts to make this watershed fully sustainable from a water resource perspective within a 30-year planning horizon. Inherent in this effort is the need to understand where we are today, and identify where we collectively want to be as a watershed in the future. SAWPA began efforts in 2011 to update and refine our IRWMP as the OWOW 2.0 Plan, and take the vision to the next level, encouraging stakeholders to focus on the key water resource management needs in the watershed, and to identify high-level watershed concepts for further development. With this vision in mind, regional stakeholders have been able to work collaboratively, thus improving the process associated with resource planning.

## OWOW 1.0 Challenges

Significant water crises have arisen over the past decade, prompting SAWPA and regional stakeholders to collaboratively find solutions. A vision for the watershed was established as a sustainable watershed that is drought-proofed, salt-balanced, and that supports economic and environmental viability. To achieve this vision, stakeholders under the OWOW 1.0 Plan agreed to address four major threats that SAWPA has labeled as the *Four Horsemen of the Apocalypse*. They are:

Climate Change resulting in reduced water supplies combined with increased water needs in the region.

Colorado River Drought Conditions resulting in threats to imported supply due to upper basin entitlements and continued long-term drought.

San Joaquin Delta Vulnerability resulting in reductions or loss of supply due to catastrophic levee failure or changing management practices of the Delta.

Population Growth and Development resulting in interruptions in hydrology and groundwater recharge while increasing water needs.

Further description as to why these crises must be addressed herein follows.

### Climate Change



One horseman impacting not just our region or State, but the entire world, is climate change. Climate change is occurring and must be addressed immediately to offset the impacts to water resources and the environment. The International Panel on Climate Change has stated that the world's climate is warming by an average of 1.3 degrees Fahrenheit in the past century. Unless current trends are reversed, global warming is projected to keep increasing and raise temperatures by as much as 11.5 degrees by the end of the century. The California Department of Water Resources' report entitled, *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water*, details how climate change already is affecting the State's water supplies, and sets forth a number of recommendations to help avoid or reduce climate change impacts to water resources. The report indicated that global warming will present significant challenges to future water supply, water quality, ecosystem protection, and flood management.




Assessments on water supply and other impacts from climate change indicate likely reductions in snow pack, earlier and larger peak stream flows, potential reduction in runoff, greater evaporative losses, declining ecosystem health, sea level rise, and more extreme weather events, including flood and droughts. Other management activities affected by climate change include the need to consider energy use and greenhouse emissions of water resource projects, as well as the regional vulnerability of water systems.

## Colorado River Drought Conditions

In addition to the statewide drought, another horseman of the Apocalypse that has impacted the Santa Ana River Region is the growing threat of possible future imported water flow decreases to Southern California from the Colorado River. For most of the first decade of the 21st century, the Colorado River Basin experienced some of the driest consecutive years in the history of the basin. If similar drought conditions were to continue, reservoirs along the river, such as Lake Powell and Lake Mead, will continue to drop, and thereby reduce storage releases and energy production.

As reported by N. Christensen in his 2004 Climate Change report, *The Effects of Climate Change on Hydrology and Water Resources of the Colorado River Basin*, projections show that by 2050 the Colorado River flow would decline by 18% with the average Colorado River Basin water storage declining by 32%. Experts conducting studies of tree ring data in the Colorado River Basin have determined that severe and prolonged droughts, lasting up to 60 years or more, have occurred in the past and likely will occur again. As population continues to grow throughout the dry desert southwest, the water levels at Lake Powell and Lake Mead likely will continue to drop, with some projections indicating that the lakes may become dry by 2025.



Metropolitan Water District of Southern California, which serves as the importing water agency for most of Southern California, relies heavily on the flows from the Colorado River Aqueduct to assure that water demands are met. Because the drought conditions, as well as climate change, impact the entire Colorado River Basin, river flows are anticipated to decrease. Although under the Colorado River Compact Agreement, Southern California has senior water rights, and under the Quantification Settlement Agreement, is limited to 4.4 MAF. Greater stress will be upon all the Colorado River Compact Agreement parties to reopen the settlement agreement, as drought conditions exacerbate the ability of all parties to take from the river to meet their continued water demands.

## San Joaquin Delta Vulnerability

The San Joaquin Delta is home to over 750 plant and animal species. Out of 29 identified indigenous fish species, 12 of them are threatened either with extinction or already have become extinct. Endangered species include the spring-run and winter-run Chinook salmon and the Delta smelt. Other fish species are threatened as well, including longfin smelt, threadfin shad, and striped bass. Water diversions, urban development, loss of habitat, impaired water quality due to pesticides, and increased competition from invasive species, are all factors thought to be influencing the decline. Many scientists have warned that an ecological crash of the food web and the Delta food web is possible.

The crisis of the Delta centers not just on water pumping issues, but also on the condition of the Delta's levees, many of which were not properly designed. Concerns have arisen that if several key levees should fail, due to increasing sea levels or earthquake conditions, water deliveries could be interrupted again. Looking long-term, rising sea levels caused by climate change also could push additional salt into the Delta, potentially affecting the quality or availability of drinking and irrigation water. Further, climate change also likely will reduce snow pack affecting the volume of water available for export. As a result, public agencies are working together to find a solution to the co-equal Delta goals of reliable water supply deliveries from the Delta and ecosystem restoration, at the same time becoming less dependent on Delta water to meet local water demands for the future.

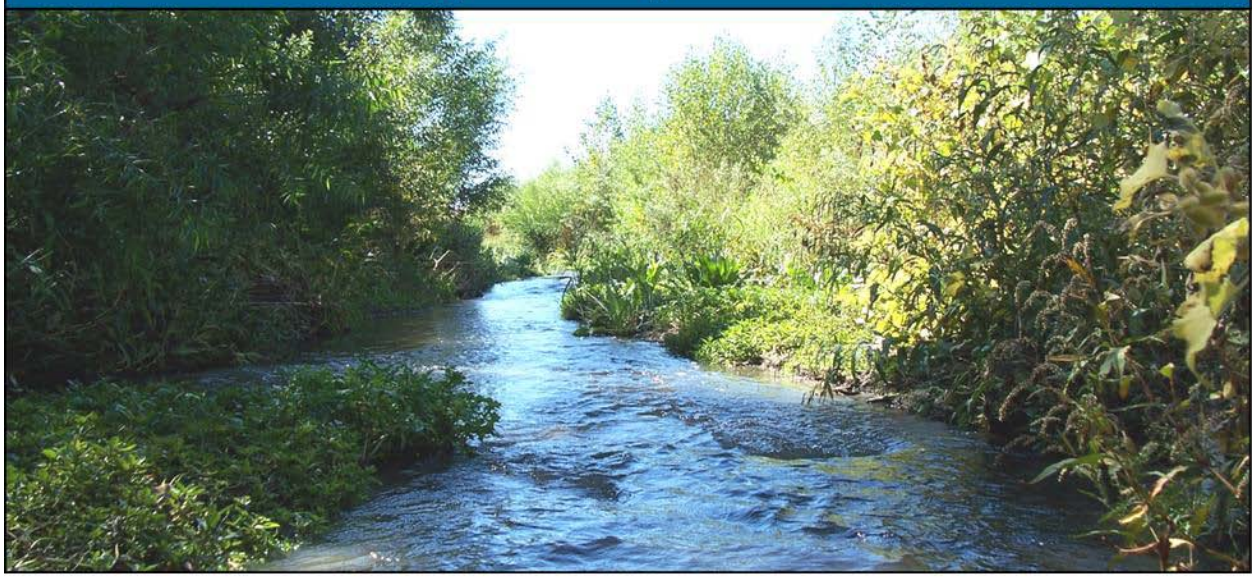
## Population Growth and Development

Most of the precipitation and snowmelt runoff occurs in the northern part of California, but the majority of the population lives in the drier central and southern portions of the State. This imbalance is not expected to change. According to population estimates issued by California's Department of Finance, Southern California counties will add more than five million people between now and 2050, an increase of 25% over the 2010 census numbers. Los Angeles is expected to remain the most populated county in California, followed by Riverside County, San Diego County, San Bernardino County, and Orange County, all of which portions of the most heavily populated areas fall within the watershed. With the projected increases in population growth, efforts to assure adequate water supply for the region will become more difficult. The crisis to water resources is not the growth of development *per se*, but how the water is used in new development that assures sustainability.



Huge areas of land gradually are being paved over in the watershed, which historically captured and recharged natural runoff into the groundwater and provides important replenishment water for pumping. Instead, the runoff from development is directed to storm sewers and channels that discharge to downstream rivers and streams and eventually are lost to the ocean. This tremendous amount of water that is no longer percolating into the ground is picked up along parking lots and streets and further contaminated by oil, grease, trash, bacteria, and fertilizer additives applied to adjacent landscaping. These byproducts represent a major water quality threat to downstream water bodies, many of which have been listed by water quality regulators as impaired, requiring total maximum daily loads. Taken cumulatively, the water lost from the resulting development when sustainable land use and water use practices are not in place, if continued unchecked, will become a major water crisis for the region, and is one of the four horsemen of the Apocalypse impacting water resources. The need for a water ethic for the preciousness of water, increased water capture and percolation, and improved land use practices will be required to handle this looming problem.

# 1.3 OWOW Plan 2.0
# Moving into Implementation



Santa Ana River

## Moving into Implementation

Building upon its statewide leadership role in integrated water resources planning since 1998, SAWPA and its stakeholders have worked hard to ensure that the integrated water resources planning for the Santa Ana River Watershed program not only meets the California Department of Water Resources (DWR) Integrated Regional Water Management (IRWM) Guidelines, but also actually raises the bar of what an Integrated Regional Water Management Plan (IRWMP) can achieve. By the OWOW 1.0 Plan and our previously approved and successful salt/nutrient management plan, SAWPA also has expanded its collaboration and stakeholder involvement to a broader and more effective level. The integrated regional water resource management approaches conducted in the past have set the framework to address needs for years to come.

However, as the next OWOW update was contemplated, rather than working harder on the old model, SAWPA resolved to create a new model so that stakeholders were not creating the same problems that we still are working to resolve. Instead, a new level in IRWMP planning was envisioned, whichbrings the process to an even higher and more effective model using a *system-wide approach* that creates a new template for collaboration and water management. Past IRWM plans have focused on the water supply professional, often with a focus on water supply reliability and assuring that additional imported water could be brought to regions to address ever growing demands. However, in light of the ongoing water scarcity challenges facing the State and our watershed, SAWPA recognized the need to establish a new planning approach that creates the catalyst for change that could potentially apply to all regions across the State.

This approach is different in that all sectors of our community (water suppliers, water consumers, stormwater managers, parks and recreation providers, environmental stewards, developers, etc.) would be encouraged to adopt a water ethic that focuses on living within our means and living in the

environment that nature has given us. It also is recognizing that excessive irrigation water use and waste creates downstream pollution. Often the problem in achieving solutions is not data gathering, but rather the sharing of existing water information so that water consumers can become the true stewards of water. That information is made available to all levels of the public to better understand where their water comes from, how it is used, what impacts we have on it, and where it goes after it is used. New or expanded existing Web-based tools would be developed to answer this need.

### Creating Anew

SAWPA, under OWOW 2.0 planning, sought to expand collaboration across multiple jurisdictional and institutional boundaries so that natural hydrology is restored, aquifers are protected, ecosystems are enhanced and improved, landscapes are developed appropriate to the arid environment in which we reside, and where people are not using water for waste transport downstream. The work addresses and recognizes the upstream and downstream dynamic. Through these efforts, we sought to resolve conflicts that will arise when more and more stormwater and recycled water is captured and stored upstream as a result of low-impact development and recharge and reuse activities, resulting in less water flowing downstream for their capture and reuse. Water quality challenges would be addressed resulting from nonpoint source pollution carried by stormwater, which is often captured and then recharged into our groundwater basins and aquifers for later use as a drinking water supply. Furthermore, this plan would create effective outreach and liaisons with disadvantaged communities, environmental justice communities, Native American Tribes, and land use planning sectors that would be key to implementing this new paradigm in integrated water resource planning.

## Highlights of New Model in IRWM Planning

As a first step, SAWPA developed a work plan that proposed to raise the bar so that all IRWM Plan Standards are met, all DWR IRWM program preferences are addressed, and the vision for the region is achieved. To accomplish this end and still achieve the OWOW Plan goals and objectives, a new integrated water management plan for the Santa Ana Region was proposed to focus on the following areas.



### Water Demand Reduction Strategies

Developing education and outreach actions that encourage implementation of tier-based allocated water conservation rates for not just some, but all retail water agencies in the watershed. This encourages programs such as “Cash for Grass” and indoor water efficient appliance rebates, outdoor irrigation efficiency measures, and implementation of new programs where landscaping and irrigation experts are hired to educate homeowners, homeowner associations and businesses in better methods. It also provides incentives to retrofit high water use lawns and greenways into California Friendly and Water Smart landscaping. This education process would be supported by the development of new or expanded Web-based interactive tools that reach down not only to the water professional, but also to the public, increasing awareness of the full water cycle and water quality impacts to quality of life issues. These tools also would allow the public to continue to enjoy a high quality of life with less per capita water use.

## Water Quality Improvement and Awareness

Creating processes to assure that water sources used to replenish local supplies are safe and clean for public and environmental uses. With increased capture and collection of rainwater with subsequent recharge to local groundwater, assurance must be achieved that nonpoint source pollutants are addressed. Web-based tools would be developed or expanded upon so that the public has full access and an awareness of local water quality conditions of their lakes, streams, and beaches that they may be used for recreation throughout the region.




## Targeted and Expanded Community Outreach

Conducting outreach actions that reach deeply into disadvantaged communities, environmental justice communities, and Native American Tribal communities to support their needs for clean, safe, and reliable water supplies; using trusted facilitators with native language skills that connect with communities rather than relying on surveys or mailers that often are poorly translated and fail to address the water related needs of these communities.

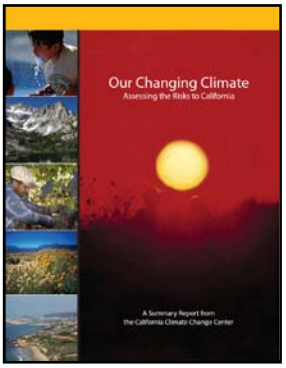
## Restore Natural Systems and Hydrology

Establishing systems where hydrology is restored to its natural paths while preserving environmental habitat, parks and recreation opportunities. Exploring opportunities where mutual benefit projects can be identified that capture, store, and infiltrate rainwater with the assurances that the water is clean and safe for people and wildlife. Continuing the planning and removal of non-native, water-thirsty plants will restore the region's habitat and save water as well.



## Expand Collaboration

Build upon past successful collaboration models to create bridges to key U.S. and State landholders in the region such as the U.S.D.A. Forest Service, U.S. Bureau of Land Management, March Air Reserve Base, California State Parks, and Natural Resources Conservation Service. As a large percentage of the region and the headwaters are on Federal lands, collaboration with Federal entities is critical to the health of the watershed. Furthermore, with a recent MOU with the Bureau of Reclamation, Federal funding support became available to assist the planning process. Working with these Federal partners, our shared goals could be addressed to attend to water supply and water quality compliance issues, while protecting and enhancing the land.




## Climate Change and Energy Impacts

Evaluate complete system impacts of climate change drilling down to the water infrastructure operation and building level to determine greenhouse gas emissions, the sea level rise impacts to Orange County coastal areas, new policies that can assist water managers in providing the flexibility to adapt management actions to respond to changing hydrologic conditions, as well as the chain effects that climate change impacts have on other systems. For example, with less water conveyed to wastewater treatment plants based on water efficiency implementation, the impacts that need to be considered are more highly concentrated wastewater being conveyed to wastewater treatment plants that may result in possible increased treatment processing needs and energy usage. These energy impacts also may translate into other cost impacts associated with water recycling delivery and water quality compliance and protection.

## System-Wide Approaches and Leadership

Seeking to encourage water demand reduction for a region covering 2,650 square miles, six million people and over 65 water agencies is a daunting task. SAWPA and its member agencies and other water agencies in the watershed, are steadily making progress in encouraging water to be used wisely, especially outdoors. However, more must be done to achieve our vision of a high-functioning sustainable watershed. Consequently, new methods to spur change and to be the catalyst for new actions are needed on a watershed-wide, system-wide basis. New models must be developed that inspire behavior change to accomplish plan goals, create synergies, and develop inter-jurisdictional solutions. Using new system approaches developed under this plan for the Santa Ana River Region, a new template then can be shared with other Regional Water Management Groups and be incorporated into their IRWM plans. This would provide the leadership for their respective regions, similar to how LEED certification through the U.S. Green Building Council has caught on nationwide becoming synonymous with “green” building. The IRWM plans can and should become the guidepost for the water ethic and meeting “sustainability” goals for regions across the State.

To implement the work plan and adjust to current affairs, SAWPA and stakeholders needed to adapt to even greater challenges recognizing not only the Four Horsemen of the Apocalypse, but that the herd was growing. At the end of the first decade of the new century, Fiscal Crisis and Energy were identified as two additional Horsemen of the Apocalypse.

# Fiscal Crisis

Budget limitations are changing how we fulfill our goals. Because of the fiscal crisis faced by the Nation, the State, and the Watershed, funding for large scale projects is much less certain. Federal earmarks largely have vanished and future State Bond funding is shaky. Due to these financial limitations, we increasingly have called upon citizens and stakeholder to help craft responsible, sustainable solutions. Many challenges facing the water community today cannot be solved by technology, infrastructure, or engineering alone. Solutions popular in the 20th Century are too expensive today and have too large of a

carbon footprint. We hope to solve our problems and meet our needs through collaboration and cooperative agreements in addition to engineering regional projects.

For the 21st Century, the solutions to water resources lie in developing multi-beneficial and collaborative regional solutions. Such projects allow minimal resources to be leveraged providing more "bang for the buck" and multi-needs are addressed through integration. Moreover, we need to look to our rates to support our investments, and this means we need to include our consumers as key stakeholders. We need to engender a water ethic and by this awareness of the water cycle, residents of the watershed will be more mindful of what they spend on water and seek ways to save water and save money.

## Energy



Solar Panels at Western Municipal Water District

Nearly all water resources infrastructure requires energy, from wastewater treatment plants to groundwater wells; we need energy not only to maintain, but also to harvest this valuable resource. Approximately 19% of all energy in California is used to transport, treat, and heat water. It is clear that water infrastructure is highly energy intensive. However, this also is true the other way. Water is a valuable aspect of the energy production process from cooling towers to mining for oil and minerals. In fact, air-cooled energy production actually is less efficient than water-cooled energy production. We cannot have one without the other. We must realize this vital connection and work toward creating sustainable solutions. Many water agencies in the Santa Ana River Watershed have begun to turn to "greener" sustainable energy sources, such as solar arrays and turbines, alongside existing water infrastructure. Several agencies are researching new, innovative sources of alternative energy from mini-turbines in water conveyance pipelines to capturing energy produced during the wastewater treatment process. Moving the water industry in the watershed toward renewable sources of energy will ease the burden of water resource infrastructure.

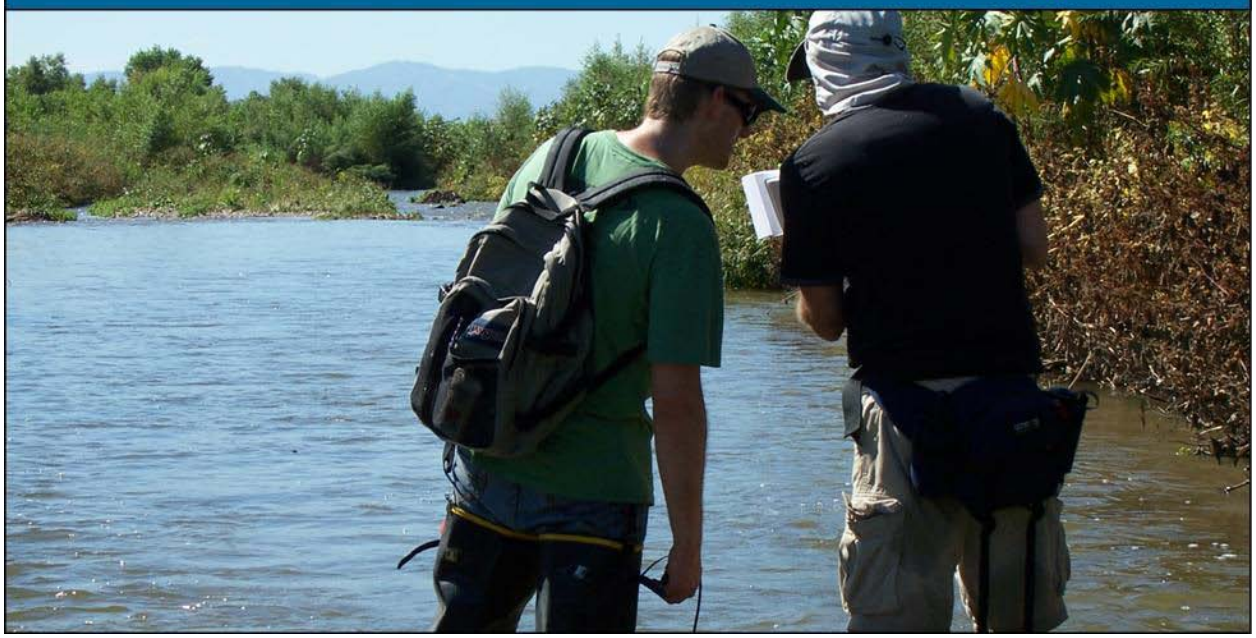
Early adopters in the watershed include the Inland Empire Utilities Agency (IEUA), which is pursuing a progressive energy management strategy to be self-sufficient or "Gridless" by the year 2020. In 2008, IEUA installed 3.5 megawatts of solar power and a 2.8 MW fuel cell system. In 2012, IEUA installed 1 megawatt of wind energy at their northern water recycling plant. Western Municipal Water District (WMWD), which manages the Western Riverside County Regional Wastewater Authority, has installed more than 5,000 solar panels at their wastewater treatment plant that will provide up to 1 megawatt of energy during peak energy use hours. Eastern Municipal Water District has completed a 500 kilowatt solar photovoltaic renewable energy facility at its Administrative Campus, and has installed digester gas driven fuel cells at two of their water reclamation fuel cells providing energy during peak hours virtually free of charge, with no toxic emissions, and cutting greenhouse gases by more than 10,600 tons annually. San Bernardino Municipal Water District has installed a co-generation facility that uses the methane gas produced during the treatment processes to fuel two 750-watt generators that supply electricity to the San Bernardino Water Reclamation Plant. Solar arrays also have been installed at the

City of Redlands Wastewater Treatment Plant, Irvine Ranch Water District, Cucamonga Valley Water District, and Elsinore Valley Municipal Water District, which are all located in the watershed.

Due to this link between water and energy, to conserve water is to conserve energy. Unfortunately, we generally need a lot of hydro-electrical power and as river flows and dam levels shrink, so does our ability to generate electricity. Thus the path to sustainability not only relies on renewable and innovative energy sources, but also on reducing the amount of water that needs to be treated and pumped throughout the watershed.

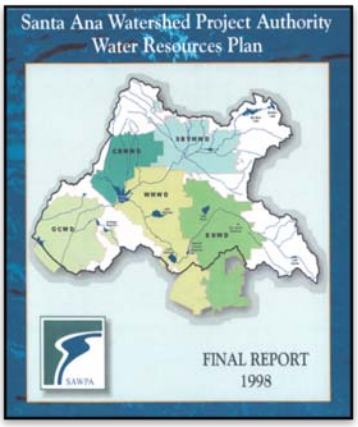
With the addition of these two new Horsemen of the Apocalypse and a new workplan in place, OWOW 2.0 kicked off its IRWM planning with the execution of the DWR IRWM Planning Grant in September 2011 and started with the review and collection of past and current local and sub-regional water planning documents.

# 1.4 Relation to Local Water Planning



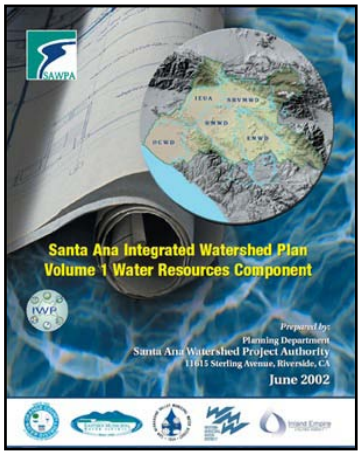
## History of Santa Ana River Watershed Planning

Since its formation, SAWPA and it member agencies have been on the forefront of water resource planning for the region. Initially formed as a regional planning agency in 1967, SAWPA undertook the first water quality management program study for the watershed. These early planning roots provided the important water quality data and analysis for the development of the first Regional Board Basin Plan. SAWPA since has worked closely with the Regional Board in all Water Quality Basin Plan Updates and watershed planning efforts.

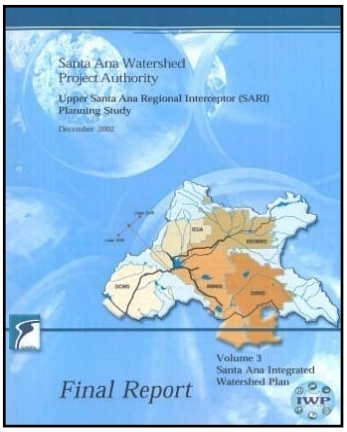



The 1998 SAWPA Water Resources Plan was one of the first watershed-wide water resource plans undertaken by SAWPA to optimize all available water resources in the watershed in an integrated fashion. This plan was initiated after Metropolitan Water District of Southern California (MWDSC) had kicked off their first Integrated Resource Plan in 1995. Because only three of the five SAWPA member agencies were MWDSC member agencies, the SAWPA Commission directed staff to prepare a similar water resource plan for the watershed that would examine all available water resource development opportunities and assets within the watershed. With one of the SAWPA member agencies, San Bernardino Valley Municipal Water District, also serving as an additional importing water agency and State Water Project Contractor within the watershed besides MWDSC, new water resource development projects were identified. This 1998 Plan was prepared entirely by SAWPA's planning staff.

In 2002, SAWPA updated and expanded the water resources planning in its Santa Ana Integrated Watershed Plan (IWP), a three-volume planning document that examines water resource management strategies to address regional needs in an integrated fashion. Water resource management strategies identified in this report included water storage, water quality protection and improvement, water recycling, storm and flood water management, and environment and habitat protection.

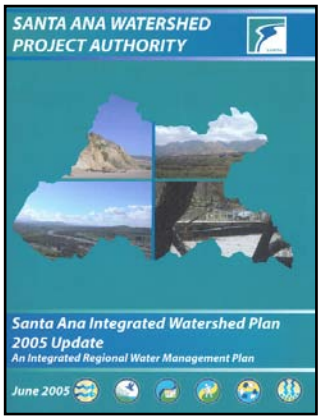



The first volume of the IWP is the Water Resources Component, a planning document that built upon member agency long-term water resource plans and management programs, thus providing a vehicle to ensure effective and concerted planning efforts on a regional basis. This volume also describes the necessary water resources projects to achieve zero reliance on imported water supply, and the amount of salt removal facilities necessary to achieve a salt balance in the watershed.
The second volume of the IWP is the Environmental and Wetlands Component. It describes the watershed-wide wetlands program and watershed plan that integrates wetlands, trails, habitat, open space, education, and invasive species removal.



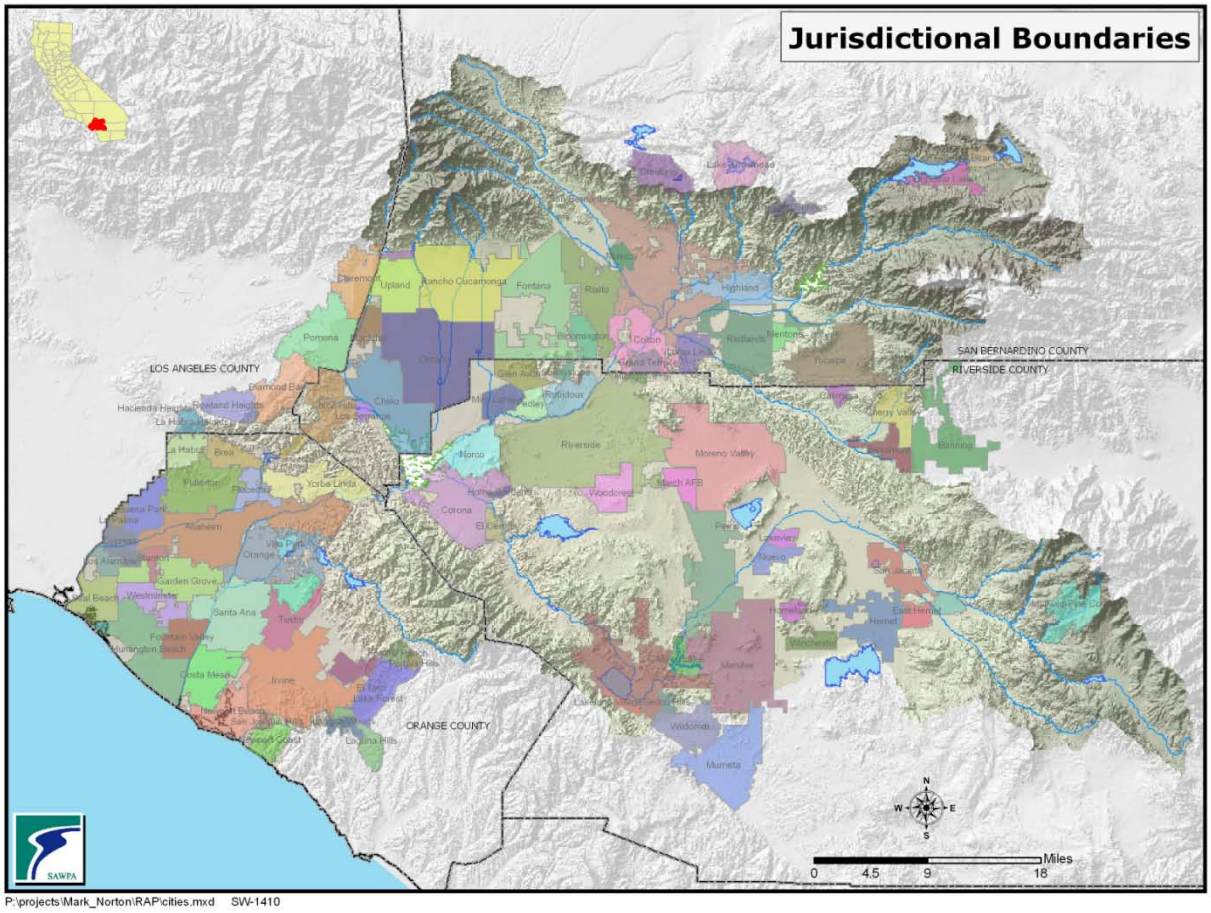

The third volume of the IWP is the Upper Santa Ana Regional Interceptor (SARI) Planning Component, which provides a foundational evaluation of the upper SARI, the watershed brine disposal pipeline, and a future long-term beneficial use of the SARI as the critical facility required to meet the SAWPA goal of transporting highly saline, non-domestic discharges out of the upper watershed to protect its groundwater resources.

The first two volumes of the 2002 Integrated Regional Water Management Plan (IRWMP) were written and prepared by SAWPA planning staff, with the third volume prepared by SAWPA's consultant, CDM Smith. The 2002 three-volume report describes integrated water projects and provides justification for the first IRWMP in the State, described under the State Proposition 13 Water Bond. The success of this effort provided funding totaling $235 million for the watershed.




In 2005, SAWPA prepared the Santa Ana IWP 2005 Update, an IRWMP. This report, also prepared by SAWPA planning staff, updated much of the work from the 2002 report incorporating the Urban Water Management Plans (UWMPs) performed by SAWPA member agencies and sub-agencies, and provided an updated listing of priority projects to achieve the goals of the watershed stakeholders. Recognizing the significant size of the watershed in geography and population, and the sheer complexity of coordination and integration of projects, the 2005 report sought to briefly describe and highlight the many detailed resource planning processes and documents that led to a list of proposed prioritized regional projects, as opposed to serving as a detailed technical or scientific water resource evaluation in itself. Because of these efforts, the plan was ranked among

the top ten IRWMPs by California Department of Water Resources (DWR) staff, and provided the justification for $25 million from Proposition 50 IRWM implementation grant program.




## Planning from OWOW 1.0 to OWOW 2.0

### Integrated Regional and Sub-Regional Water Management Plans

Efforts to obtain improved water quality, sustainability, and other goals represented in the OWOW 2.0 Plan are practiced by water districts and agencies throughout the Santa Ana River Watershed. The IRWMP illustrates the collaboration of different projects, plans, policies, and task forces between SAWPA and other water agencies that strive to reach these goals. For example, in correlation with the Water Use Efficiency Pillar found in the OWOW 2.0 Plan, most water district/agencies administer programs that help reduce water demand through rebate programs on water efficient appliances, and educate the public through water-wise educational programs were described. Under the Water Resource Optimization pillar, several water resource management strategies are encouraged, including the implementation of water recycling programs. The OWOW 2.0 Plan stresses the importance of recycled water to the watershed as a whole, and suggests innovative approaches of recycled water use in a more cost effective systems approach. Through such project and program implementation, the region can support less dependence on imported water, particularly from the California State Water Project (SWP), constituting about 15%- 20% of the region's imported water. Also, SAWPA and its member agencies take initiative in employing water quality improvement and natural resource stewardship by teaming up with multiple task forces established within the region and sub-regions. OWOW 2.0 has worked with many sub-regional areas to provide assistance and improve overall

sustainability, such as the case of Lake Elsinore water quality improvements sitting at the downstream end of the San Jacinto River sub-watershed. The Plan proponents also have encouraged the continued support for Best Management Practices (BMPs). BMPs have proven to be very useful when applied to water related projects and construction. These BMPs have been executed by various districts in the effort to achieve higher water quality, reduce water demand, and achieve resource stewardship.

The overall success of the OWOW Plan is dependent upon the valuable input and local water planning documents from resource agencies across the watershed, including sub-regional IRWMs, Groundwater Management Plan's, Urban Management Water Plan's, County Flood Controls and Water Conservation Districts, and regional government agencies throughout the watershed. The OWOW 2.0 Plan does not replace or supersede local planning; rather the OWOW 2.0 Plan as a regional plan appropriately incorporates local planning elements. Most of the following sub-regional IRWPs were all developed and executed prior to the OWOW 1.0 Plan, but still serve as important resources to the current OWOW plan.

### *San Bernardino Valley Municipal Water District Sub-Regional IRWM*

San Bernardino Valley Municipal Water District (SBVMWD), as a sub- regional water agency, agreed to lead a planning effort and received a grant from the DWR to prepare their sub-regional IRWMP using Proposition 50 grant funding. The main benefit of this plan was the development of the process for managing the San Bernardino Basin Area, and also to obtain more detailed evaluation of water resource needs in the area. The plan was finalized in November 2007. Similar to the OWOW 2.0 Plan, this particular plan was carefully developed through the participation of water managers and stakeholders within the sub-region. This is a very important factor, integrating water plans either regionally or sub-regionally to help create a more sustainable watershed. The update for this sub-regional plan by SBVMWD is scheduled for the first part of 2014. For more information regarding the SBVMWD sub-regional IRWM visit www.sbvmwd.com.

### *Western Municipal Water District Sub-Regional IRWM*

The preparation of the IRWMP for Western Municipal Water District (WMWD) fulfills a need to address long range water supply planning in order to meet the future demands in a rapidly growing area, but also to meet the water supply reliability needs now and in the future. This plan was funded by Proposition 50 and was completed in November 2006. The essence of this IRWMP is the identification and evaluation of water management strategies that could increase local water supply, thereby improving water supply reliability. Additional benefits of the IRWMP are to address local and regional water quality issues; this process was started with discussions of WMWD's member agencies and stakeholders. No plans are anticipated at this stage to update this sub-regional plan by WMWD. For more information regarding the WMWD sub-regional IRWM visit www.wmwd.com.

### *San Jacinto River Watershed Sub-Regional IRWM*

The San Jacinto River IRWMP integrates input from a wide variety of organizations and individuals with a stake in water resource management issues. Development of this report was led by the San Jacinto River Watershed Council (SJRWC) with financial and in-kind support from a number of member and partnering agencies such as SAWPA, as well as local, State, and Federal government agencies, water suppliers, environmental groups, trade organizations, businesses, and individuals. Through a collaborative process, the San Jacinto River Watershed stakeholders were able to identify resource management strategies and associated sub-objectives that improved their sub-region. If improvements are made on a sub-regional level, it only makes the process of implementing the OWOW 2.0 Plan more efficient. No plans

are anticipated at this stage to update this sub-regional plan by SJRWC. For more information regarding the San Jacinto Watershed sub-regional IRWM visit www.sawpa.org/collaboration/projects/san-jacinto-river-watershedcouncil.

### *Central Orange County Sub-Regional IRWM*

The Central Orange County IRWMP addresses critical water resource management needs for the Newport Bay Watershed and the Newport Coast Watershed. This plan was completed on September 2012. Within this developed area are fragile coastal ecosystems with designated critical coastal areas and areas of special biological significance. The Central Orange County sub-regional IRWMP incorporates the tenets of integrated regional water management planning to address challenging issues related to flood risk management, water quality, water supply, habitat, balanced environmental sustainability, and collaboration. It was developed with stakeholder input from a diverse set of views to develop a common vision of the most urgent resource needs within the watersheds. The purpose of the Central Orange County Plan is to provide a bridge between existing and developing watershed planning efforts, allowing collaboration that is more effective and more opportunities to leverage agency resources across jurisdictions. For more information regarding the Central Orange County sub-regional IRWMP, visit ocwatersheds.com.

### *Santa Ana Regional Board Basin Plan*

The State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards (Regional Boards) are responsible for the protection and, where possible, the enhancement of the quality of California's waters. The State Board sets statewide policy, and together with the Regional Board, implements State and Federal laws and regulations. Each of the nine Regional Boards adopts a Water Quality Control Plan, or Basin Plan, which recognizes and reflects regional differences in existing water quality, the beneficial uses of the region's ground and surface waters, and local water quality conditions and problems. The Santa Ana River Region includes the upper and lower Santa Ana River Watershed, the San Jacinto River Watershed, and several other small drainage areas. The Santa Ana River Region covers parts of southwestern San Bernardino County, western Riverside County, and northwestern Orange County. The Basin Plan for the Santa Ana River Region is more than just a collection of water quality goals and policies, descriptions of conditions, and discussions of solutions. It also is the basis for the Regional Board's regulatory programs. The Basin Plan establishes water quality standards for the ground and surface waters of the region. The term "water quality standards," as used in the Federal Clean Water Act, includes both the beneficial uses of specific water bodies and the levels of quality that must be met and maintained to protect those uses. The Basin Plan includes an implementation plan describing the actions by the Regional Board and others that are necessary to achieve and maintain the water quality standards. For more information regarding the Santa Ana River Regional Board Basin Plan visit www.swrcb.ca.gov.

## Urban Water Management Plans

The UWMP developed by retail agencies in the watershed have served as a valuable resource to the OWOW planning effort particularly to the Water Resource Optimization Pillar in evaluation of water demands and supplies. The UWMPs are prepared by California's urban water suppliers to support their long-term resource planning and ensure adequate water supplies are available to meet existing and future water demands. Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves more than 3,000 or more connections, is required to assess the reliability of its water

sources over a 20-year planning horizon, considering normal, dry, and multiple dry years. This assessment is to be included in its UWMP, which is to be prepared every five years and submitted to the DWR. SAWPA has gathered all the UWMPs for this region for analysis.

One big difference observed in the 2010 UWMPs used for the OWOW 2.0 plan over previous OWOW planning, was the inclusion of SBX7-7 water conservation requirements. Reporting on agency plans to reduce overall agency water use by 20 percent per capita by the year 2020 was supported by legislation passed in November 2009 as a new requirement. Water demand is very important to urban areas, so it is vital that these areas practice water use efficiency to the fullest extent. In addition, local agencies are encouraged to ensure the reliability of local supplies in any natural event. These practices encompass a broad range from Water Use Efficiency Programs to groundwater desalination plants. The value of these local Water Use Efficiency Programs is the need to transfer BMPs for water use efficiency successfully practiced by one agency over other agencies, so that efficiency in programmatic development and implementation result. OWOW 2.0 has recognized the importance of water use efficiency by acknowledging this as its own Pillar, the Water Use Efficiency Pillar, serving as a roundtable forum to share techniques and procedures to reduce water demand and increase supply. The work from this Pillar is integrated with other pillars, particularly as implementation actions are suggested resulting from the Water Resource Optimization Pillar and the Operational Efficiency and Water Transfer Pillar. Implementation actions can be as simple as checking for leaks throughout a supply line on a regular basis, or implementing more efficient water conveyance strategies through the system. These are only some of the programs and practices encouraged by OWOW.

## County Flood Control and Water Conservation Plans

The watershed is home to three different county flood control districts; Riverside County Flood Control and Water Conservation District, San Bernardino County Flood Control District, and Orange County Flood Control District. The OWOW 2.0 Plan has integrated the planning efforts of these different flood control and water conservation districts, as well as offered support in consideration of system-wide projects. Such efforts are discussed in more detail in the Stormwater Resource and Risk Management Pillar of the OWOW 2.0 Plan.

Flood control and water conservation districts and OWOW 2.0 both support implementing a strategy of fully utilizing natural channels and other environmental features within the flood control system, while evaluating opportunities for stormwater recharge as a future drinking water source. Flood control channels and adjoining detention basins can play an important role also in serving as groundwater recharge facilities in the watershed. In turn, fewer negative impacts would be anticipated to the environment, thus protecting surrounding natural habitats. Through the integration of the flood control plans with other local water resource plans, new multi-benefit approaches will continue to be investigated. It is through the implementation of these synergistic solutions that help improve water quality and capture more water for recharge, while meeting the standards in their respective counties. Overall, county flood control and water conservation agencies have a tremendous influence on the sustainability of the watershed by their practices. It is through stakeholder collaboration with these agencies that key system-wide solutions will arise for the future. For more information visit the county flood control websites and **Chapter 5.8 Stormwater: Resource and Risk Management.**

## Basin and Ground Water Plans

There are dozens of groundwater basins in the watershed that each require careful planning and monitoring. These groundwater basins play a pivotal role in the sustainability of the Santa Ana River Watershed, and are discussed in more detail under **Chapters 5.4 Water Resource Optimization** and **Chapters 5.10 Operational Efficiency and Water Transfers**.

The West San Jacinto Groundwater Basin Management Plan was adopted in 1995. Annual reports on the status of groundwater and water resources efforts in the area have been published since 1996. The 2007 Annual Report compiled, reviewed, evaluated, and analyzed 2007 groundwater quality and water level monitoring program data, summarized groundwater-related changes, and reported results of an extraction monitoring program and status of previous recommendations.

To the east, the Hemet/San Jacinto Water Management Plan was completed in November 2007 by Eastern Municipal Water District, Lake Hemet Municipal Water District, and the Cities of Hemet and San Jacinto to guide and support responsible water management. The plan's objectives include reducing the historical impact of overdraft caused by past groundwater production, increasing recharge of the groundwater basin, providing for the water rights of the Soboba Tribe, ensuring water supply reliability, providing for planned urban growth, and protecting and enhancing water quality. Options to increase water supply and reliability include developing underutilized sources, particularly recycled water and imported water. To accomplish the plan's objectives, the Hemet/San Jacinto Integrated Recharge and Recovery Program are being implemented. This program includes the construction of numerous water supply and conjunctive use projects such as direct and in-lieu recharge, increased use of recycled water, increased conservation, and improved monitoring.

The Chino Basin Watermaster (CBWM) is the manager of Chino groundwater basin. The CBWM prepared the Optimum Basin Management Plan, which describes the state of the basin in terms of historical groundwater levels, storage, production, water quality, and safe yield. Current and projected water demands and water supply plans are described. The goal of the plan is to develop a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the basin in a cost-effective manner. The plan includes a monitoring program for groundwater levels, as well as programs for monitoring well construction, abandonment, and destruction.

The City of Corona prepared a Groundwater Management Plan (GWMP) for the Temescal, Bedford, and Coldwater sub-basins. The conditions of each groundwater basin were described including groundwater levels, production, and quality. Current and projected water demands and supplies were evaluated. Basin management objectives were determined and management strategies were set. The objectives include:

- Managing the groundwater basin in a sustainable manner
- Preventing substantial water level declines in the Channel Aquifer
- Protecting groundwater quality in the unconfined aquifer
- Maintaining required outflow at Prado Dam
- Monitoring groundwater levels, quality, and storage

The Orange County Water District prepared the GWMP 2009 Update for the Orange County Groundwater Basin to identify key issues related to groundwater management. The three major objectives are to protect and enhance groundwater quality, protect and increase the basin's sustainable yield, and increase the efficiency of operations. Recommendations in the report to proactively manage the basin include:

- Monitoring water quality and groundwater levels
- Managing groundwater recharge
- Managing groundwater quality by controlling seawater intrusion, evaluating emerging constituents, and preventing future contamination
- Implementing projects to clean up existing contamination problems
- Preparing an integrated demand and supply program

These plans are important to the entire area because they help promote water storage, water supply and reliability, and improved water quality. This coincides with the OWOW 2.0 Plan that encourages all districts/agencies to create a sustainable watershed through better development of basin and groundwater plans, and is a brief summary of some types of methods, goals, and objectives being implemented in the watershed. More information may be found in **Chapter 5.5 Beneficial Use Assurance**.

## Low Impact Development Planning

Low Impact Development (LID) proves to be a very useful tool both regionally and inter-regionally. LID offers many different multi-beneficial gains once properly developed and utilized. OWOW recognizes the importance of LID and encourages it through the Land Use and Water Planning Pillar. Some of the benefits that projects like these could contribute are increased water supply and improved water quality, while practicing resource stewardship. By using water in an effective manner, the Santa Ana River Watershed comes one more step closer to becoming more sustainable. More information may be found in **Chapter 5.7 Land Use and Water Planning**.

## Stormwater Management and Watershed Action Plans

Stormwater management is a crucial part to the development of a more sustainable watershed. Planning for high quality stormwater management allows the Santa Ana River Watershed to improve overall flood control. The plans to implement these strategies mostly are found through local flood control and water conservation districts plans, and watershed action plans required in the MS4 permits for each of the counties in the watershed. The watershed action plans further support the need for collaboration between flood control and water conservation agencies with water agencies in the watershed particularly as regional low impact development practices are considered. OWOW 2.0 has implemented strategies that aid the idea of creating more efficient stormwater management through the increase of stormwater utilization. By doing so, the Santa Ana River Watershed grows in becoming more self-efficient. More information may be found in **Chapters 5.4 Water Resource Optimization**, **Chapter 5.5 Beneficial Use Assurance** and **Chapter 5.8 Stormwater: Resource and Risk Management**.

## Salt and Salinity Management Plans

Another influence OWOW has on regional and sub-regional areas is salt and salinity management. It is important that the salt within the watershed be regulated accordingly in order to improve water quality. This is described more in detail in **Chapter 5.5 Beneficial Use Assurance**. Essentially, salt always has been an issue since the utilization of the Santa Ana River and imported water. Salt always will remain,

which is why the OWOW 2.0 Plan has encouraged the improved management of salt, which has been able to improve the quality of water throughout the Santa Ana River Watershed. SAWPA has been a leader in the State in preparing salt and nutrient management plans with ongoing triennial reporting of groundwater management zone salt and nitrogen monitoring, as well as annual reporting of salt and nutrients in the Santa Ana River. More information may be found in **Chapter 5.5 Beneficial Use Assurance**.

## Emergency Response/Disaster Plans

OWOW supports the integration into the current OWOW 2.0 Plan of emergency and disaster planning in relation to water resources. All major water agencies have an Emergency Response Plan or a Disaster Plan that were used as a resource in evaluating a multi-hazard preparation response. The purpose of these plans is to be prepared for any type of possible event, natural or unnatural. These events typically include storms, earthquakes, drought, or terrorist attacks. Being prepared for any of these disasters allows each sub-region to be self sufficient for a period of time. More information may be found in **Chapter 5.8 Stormwater: Resource and Risk Management**.

## Forestry Service/Fish and Game Planning

Located within the Santa Ana River Watershed are three national forests: the Angeles National Forest, which covers over 650,000 acres and is located northwest of the Watershed; Cleveland National Forest, which covers 460,000 acres and is located in the southern area of the watershed; and San Bernardino National Forest, which covers over 670,000 acres and is located in the northern and eastern areas of the watershed. National forests provide habitat and a safe haven for threatened and endangered plants and animals, as well as provide people with opportunities for recreation in a natural environment. OWOW 2.0 safeguards natural habitats through its Natural Resources Stewardship Pillar. These influences help protect the natural environment and water supplies.

The watershed receives the majority of its local water from rain and snow fall in and around the San Bernardino, San Gorgonio, and the San Jacinto Mountain's forest areas. Precipitation in these areas provides surface water and groundwater basin recharge throughout the region. SAWPA's involvement and implementation of the OWOW 2.0 plan have been able to properly assist in forest planning efforts related to water recharge. These efforts help reduce the risk of any resulting physical, chemical, and biological impacts due to wildfires, which preserves the water that is captured within the forest. In correlation with the Natural Resources Stewardship Pillar, OWOW 2.0 was able to support the California Department of Fish and Wildlife (CDFW), to help protect natural habitats of certain species along the Santa Ana River. OWOW 2.0 also supports TMDL Nutrient Monitoring and Fishery Enhancements, which have given indigenous species vital habitat to call home in the Santa Ana River Watershed.

Through collaborative interests, developers of the OWOW 2.0 Plan, the USDA, the Forest Service San Bernardino National Forest, and Cleveland National Forest were able to create the Forest First Initiative. The purpose of this initiative is to encourage further cooperation among the Forest Service and downstream groundwater management agencies, recharging agencies, flood control and water conservation districts and resources agencies to proactively improve the resilience of the watersheds in the Santa Ana River Watershed that are critical in delivering quality water supplies. This initiative, through involvement of the OWOW 2.0 Plan, was able to offer multi-beneficial results both regionally and inter-regionally by providing high quality water to its constituents. More information may be found

in **Chapters 2.3 Collaboration, Coordination and Integration** and **Chapter 5.9 Natural Resources Stewardship**.

**Table 1.4 – 1 Plans Supporting OWOW 2.0**

| Plans Supporting OWOW 2.0 | |
|---|---|
| Santa Ana River Waste-load Allocation Model Report - May 2009 | West San Jacinto Groundwater Basin Management Plan 2011 |
| Eastern Municipal Water District Urban Water Management Plan 2010 | Hemet/San Jacinto Water Management Plan 2011 |
| Inland Empire Utilities Agency Urban Water Management Plan 2010 | RWQCB Water Quality Control Plan for the Santa Ana River Basin 2011 |
| Municipal Water District of Orange County Urban Water Management Plan 2010 | North Orange County Watershed Management Area Integrated Regional and Coastal Watershed Management Plan 2011 |
| San Bernardino Valley Municipal Water District Urban Water Management Plan 2010 | County of Orange Health Care Agency-Environmental Health Annual Ocean and Bay Water quality Report 2011 |
| Western Municipal Water District Urban Water Management Plan 2010 | Eastern Municipal Water District Sewer System Management Plan (SSMP) 2011 |
| San Jacinto River Integrated Regional Water Management Plan 2010 | 2011-2012 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District |
| San Bernardino Valley Municipal Water District Habitat Conservation Plan 2010 | 2011-2012 Report on Groundwater Recharge in the Orange County Groundwater Basin |
| Addendum to the 2008 Santa Ana River Waste-load Allocation Model Report Scenario 7 - July 2010 | 2012 Sampling Report for Emerging Constituents in the Santa Ana Region |
| Model Water Quality Management Plan Orange County Watershed 2011 | Irvine Ranch Water District Energy and Green House Gas Master Plan 2012 |
| Orange County Natural Communities Conservation Plan 2011 | Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin Bunker Hill – A, Bunker, Hill – B, Lytle, Rialto, and Colton Management Zones – July 18, 2013 |
| Total Dissolved Solids and Nitrate-Nitrogen Projections for the Beaumont Management Zone prepared by Wildermuth Environmental Inc. - April 29, 2011 | Riverside County Watershed Action Plan: Santa Ana Region 2013 |
| Bay Delta Conservation Plan 2011 | 2012 Annual Report of Santa Ana River Water Quality July 2013 |
| Re-computation of Ambient Water Quality in the Santa Ana Watershed for the Period of 1990 to 2009 - Aug. 2011 | NMFS' Southern California Steelhead Recovery Plan (2012) and recovery plans for endangered and threatened species found within the Santa Ana River watershed. |

# 2.1 Governance Structure



OWOW Steering Committee

## OWOW Governance

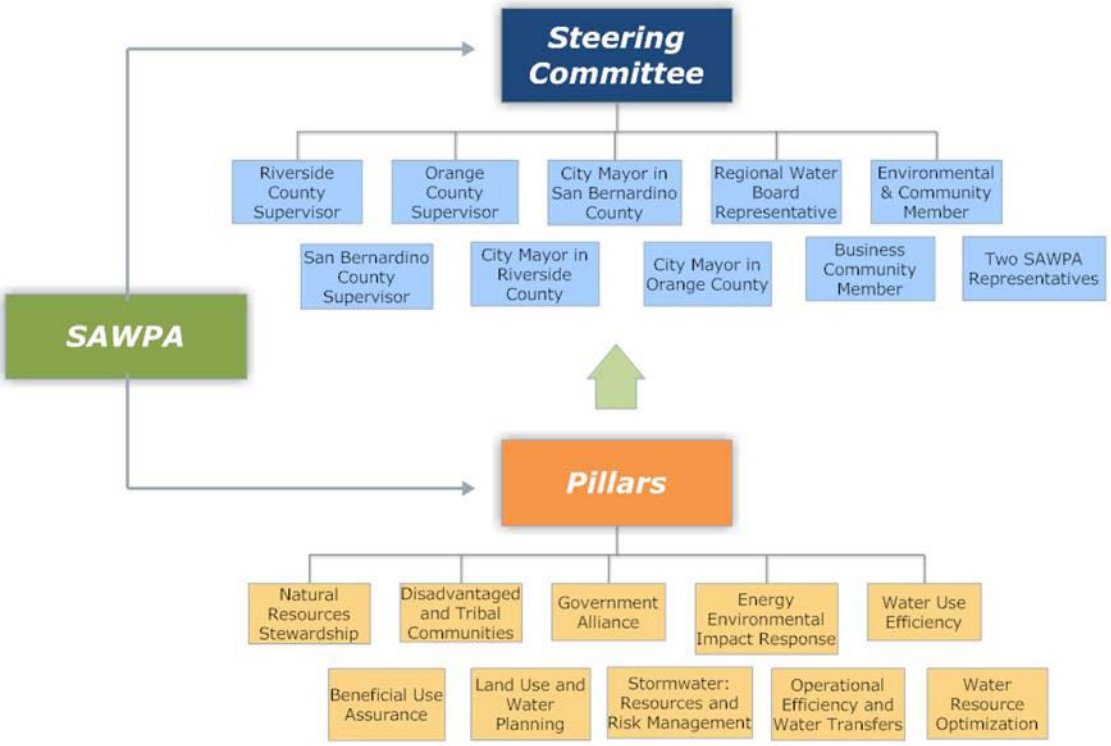
In developing the One Water One Watershed (OWOW) Integrated Regional Water Management (IRWM) plan for the Santa Ana River Watershed, a decided "bottom up" approach was envisioned for governance, as opposed to a "top down" approach. The core of this approach was that unlike previous Santa Ana Watershed Project Authority (SAWPA) IRWM plans or other IRWM planning approaches across the State, every effort was made to allow the key discussions of major water resource issues, concerns, problems, goals and objectives, and potential solutions to originate and be fully vetted at the stakeholder level – the stakeholders being the local agencies, organizations, and other interested parties within the Santa Ana River Watershed. By expanding the involvement and collaboration of stakeholders at the "on-the-ground" level, it was possible to incorporate the deeper understanding of local issues afforded by stakeholders, and generate greater buy-in and support.

Consequently, if one were to ask where the governance for the Santa Ana River Watershed OWOW process originates, we believe it is at the grass-roots level, the foundation of a decentralized and collaborative "big tent" approach. OWOW governance takes place at several levels:

- Involvement from the watershed community at large through the creation of ten working groups (referred to as **Pillars** referencing the foundation of the governance structure) representing different water issues, and in charge of identifying issues, proposing potential solutions, and writing the OWOW Plan
- The Steering Committee, composed of elected officials and representatives from the three counties, municipalities, water districts, the private sector, and the environmental and regulatory communities, were tasked with the development of the goals and objectives of the plan, strategic

decision-making, project prioritization, and issuing recommendations

- The Santa Ana Watershed Project Authority Commission (Commission), a Joint Powers Authority, provides final direction, review, and approval
- SAWPA administration and staff are in charge of facilitating this bottom-up approach to watershed planning




## Pillars

In order to manage the technical and planning work, the stakeholders are organized into separate workgroups, or Pillars, centered on specific water resource management areas, issues, or concepts. They are identified, named, and may be dissolved by, the Steering Committee. Some of the areas where the Pillars support and assist SAWPA staff are in offering creative ideas, conducting brainstorming, vetting ideas, assisting with regional coordination, assisting with outreach efforts, gathering or reviewing data or information, or developing or reviewing analysis.

Under the OWOW 1.0 Plan, ten Pillars originally were established and organized along resource management areas, largely aligned with the Resource Management Strategies identified in the DWR Proposition 84 Guidelines.

| | | | |
|---|---|---|---|
| 1. | Water Supply Reliability | 2. | Flood Risk Management |
| 3. | Water Quality Improvement | 4. | Environment and Habitat Enhancement |
| 5. | Water Recycling | 6. | Parks, Recreation, and Open Space |
| 7. | Water Use Efficiency | 8. | Climate Change |

| | |
|---|---|
| 9. Water and Land Use | 10. Environmental Justice |

The Pillars consist of approximately 10 to 60 volunteers depending on the topic and interest level. The volunteers include participants from local agencies, special districts, non-profit organizations, university officials, Native American Tribes, and private citizens. Each Pillar group is led by a volunteer chair and co-chair, if assigned, with expertise in the water issue assigned to each particular group. The Pillar Chairs are responsible for organizing, leading, and facilitating the workgroup process. The Pillar Chairs were selected based on ad-hoc recommendations to SAWPA by stakeholders, and SAWPA contacted each to determine interest in serving in these positions. The final list of Chair appointments was approved by the Steering Committee and ratified by the SAWPA Commission. No limits are placed on the duration of the position; however, a Pillar Chair may hold only one Chair position at a time.



OWOW Pillar Kickoff meeting

In addition to identifying issues and potential strategies for their particular area of interest, the Pillars were asked to view the watershed problems from a multidisciplinary perspective that extended beyond their topic, and to consider other Pillars' perspectives. For example, the Water Supply Pillar had to keep into consideration environmental and habitat restoration issues when developing their strategies. Through this process, synergies were developed and multi-benefit programs were identified. For example, through this approach, it was possible to incorporate the understanding that many downstream water resource and water quality problems could be more effectively and efficiently addressed upstream at the source, thus requiring collaboration with other entities. Over time, this collaboration among the pillar groups provided a more unified vision resulting in new integrated and multi-beneficial solutions to water resource challenges, which increased collaboration among jurisdictions and geographies. To further encourage collaboration between Pillars, the responsibilities of each were designed to overlap. This overlap enhances the benefits of a unified vision for the watershed.

Pillar work product development is a consensus process. If there are disagreements on specific recommendations, the Steering Committee provides guidance. Pillars are added or subtracted by the Steering Committee as needed to address planning needs. Pillar Co-Chairs, with assistance from SAWPA staff, are responsible for maintaining notification lists of interested stakeholders and notifying them of meetings. SAWPA staff provides lists of interested stakeholders to Pillar Co-Chairs and assists with meeting postings and notifications. Pillar Committee meetings are open to all interested parties.

Another role of the Pillar Co-Chairs is to provide support and input to SAWPA staff as they make recommendations to the Steering Committee about the OWOW goals and objectives. As technical experts in various water resource fields, the Pillar Co-Chairs provide important feedback to the Steering Committee. The Pillar Co-Chairs periodically meet and act, in collaboration with SAWPA staff, as a technical management committee for reviewing and making recommendations to the Steering Committee and to the Commission relative to implementation of the Plan and development of specific proposals for funding. The Pillar Co-Chairs also support SAWPA staff as a technical management committee to provide oversight for OWOW projects.

One of the main functions of the pillar groups is to prepare the water resource management strategy chapters of the OWOW Plan. Under the OWOW 1.0 Plan, each pillar group prepared a chapter of the Plan, documenting current conditions and issues, and describing current and future watershed management strategies. Under OWOW 2.0, the Pillars updated the chapters to reflect recent changes and focused efforts on proposing new regional and integrated projects and programs to address the goals and objectives of the Plan.

It is important to point out that the planning approach taken for the development of this Plan transcends previous integrated regional water resource planning efforts by de-emphasizing planning solely as a prerequisite for an impending grant funding opportunity, or for the development of a list of specific projects. Rather, the emphasis was placed on building a collaborative approach amongst stakeholders to help meet long-term (2030 time horizon) goals and objectives in an integrated and multi-beneficial manner.

### *OWOW 2.0 Plan Pillar Updates*

In July 2011, as part of the OWOW 2.0 Plan development, SAWPA and the OWOW Steering Committee reviewed the OWOW Plan and made several beneficial revisions to the OWOW 2.0 Pillar structure to promote collaboration between groups for a more well-rounded vision. A listing of the new Pillars with their alignment with the DWR Proposition 84 IRWM Guidelines is as follows:

| Pillars | Corresponding DWR Prop 84 Guidelines Resource Management Strategies |
|---|---|
| Water Resource Optimization | Reduce Water Demand<br>Improve Operational Efficiency and Transfers<br>Increase Water Supply<br>Improve Water Quality |
| Beneficial Use Assurance | Improve Water Quality |
| Water Use Efficiency | Reduce Water Demand |
| Land Use and Water Planning | Increase Water Supply<br>Improve Water Quality<br>Practice Resource Stewardship |
| Stormwater Resource and Risk Management | Improve Flood Management |
| Natural Resources Stewardship | Practice Resource Stewardship |
| Operational Efficiency and Water Transfer | Improve the Efficiency of Water Transfers and Infrastructure in the Watershed |
| Disadvantaged and Tribal Communities | Included in Guidelines as part of Impact and Benefit Standard |
| Government Alliance | Create Partnerships between DWR and Member Agencies |
| Energy and Environmental Impact Response | Included in Guidelines as a Separate Standard |

The Water Recycling Pillar was combined with the Water Resource Optimization Pillar. The Water Quality Improvement Pillar was renamed the Beneficial Use Assurance Pillar to better suit its change in responsibilities. The Climate Change Pillar was changed to the Energy and Environmental Impact Response Pillar to reflect the inclusion of the water-energy nexus. The Environment and Habitat Pillar was renamed the Natural Resources Stewardship Pillar to better fit its responsibilities. The Water and Land Use Pillar was changed to the Low Impact Development Planning Pillar; however, by consensus, the Pillar indicated a preference to be renamed the Water and Land Use Planning Pillar, as the Pillar stakeholders felt that Low Impact Development Planning was not comprehensive enough for their subject matter. The Environmental Justice Pillar was changed to the Disadvantaged and Tribal Communities Pillar to better fit its responsibilities. The Flood Risk Management Pillar was revised to the Stormwater Resource and Risk Management Pillar. The Parks, Recreation and Open Space Pillar was removed and folded under Natural Resources Stewardship Pillar, and both a Government Alliance Pillar and Operational Efficiency and Water Transfer Pillar have been added. These changes better reflect the Pillar goals and objectives of the OWOW 2.0 Plan and are reflected in the table above. In addition to the ten new pillar categories, each Pillar now shares leadership among the co-chairs.

Similar to the original Pillar Chair selection, Co-chairs were selected based on ad-hoc recommendations to SAWPA by stakeholders. SAWPA contacted each to determine interest in serving in these positions. The final list of co-chairs was approved by the OWOW Steering Committee and the SAWPA Commission.

Voluntary participation in any Pillar was encouraged through OWOW workshops, email blasts, and the OWOW annual conference.

In late summer of 2011, the new Pillars started meeting monthly to begin the process of updating their chapters, and they evaluated how their area of resource focus could fulfill the OWOW vision, goals and objectives. A SAWPA staff liaison shared with each of the Pillars that the OWOW 2.0 Plan would not merely be an update of information gathered under the OWOW 1.0 Plan. Rather, emphasis was placed on the need for each Pillar to examine what multi-beneficial, multi-jurisdictional implementation projects and programs could be developed and described to address the regional needs. The Pillars also were encouraged to work with other pillar groups as the need arose to assure integration and to avoid duplication of work.

The time commitment by the Pillar Co-chairs and other volunteers varies based on the intensity of the activity, the phase of work, and the personal initiative of the participant. On average, the time commitment is on the order of 10-15 hours per month.

After the completion of the OWOW 2.0 Plan, the pillar groups and other interested stakeholders likely will continue meeting to advance the system-wide projects and programs and to explore new opportunities for collaboration, particularly as funding opportunities arise.

## Steering Committee

The next level of governance up from the foundation of the Pillars is the OWOW Steering Committee. The Steering Committee's role is to serve as the developer of integrated regional water management goals and objectives for the watershed, and to act as the oversight body that performs strategic decision making, crafts and adopts programmatic suites of project recommendations, and provides program advocacy necessary to optimize water resource protection for all. These are described in more detail below.

The OWOW Steering Committee consists of eleven (11) members from the three (3) counties (Orange, Riverside, and San Bernardino) that are within the Santa Ana River Watershed regional planning area. The following describes the composition of the Steering Committee:

- One Supervisor from Orange County
- One Supervisor from Riverside County
- One Supervisor from San Bernardino County
- One Mayor or City Council Member from a City within the Region of Orange County
- One Mayor or City Council Member from a City within the Region of Riverside County
- One Mayor or City Council Member from a City within the Region of San Bernardino County
- Two SAWPA Commission representatives selected by the SAWPA Commission
- One member of the business community
- One member of the environmental community
- One member of the Regional Water Quality Control Board

In September 2012, the transition of Steering Committee members was clarified with adoption of an amended governance document defining the position terms and transition process. The selection and transition process is as follows:

The Steering Committee members serve a four-year term with staggered end dates, and may be appointed for multiple terms. A seated member who loses the status upon which membership on the Steering Committee is based (e.g. leaving an elected office), will continue as a member of the Steering Committee through the balance of that Steering Committee term, or until the entity that selected him/her selects a new representative. Steering Committee members are selected as follows:

- SAWPA Commission representatives shall be selected by the SAWPA Commission
- County Supervisors shall be selected by their respective Boards
- City representatives shall be selected by a majority vote of the Council of Governments in the respective county:
    - Western Riverside County Council of Governments [WRCOG] – Riverside County
    - San Bernardino Association of Governments [SANBAG] – San Bernardino County
    - Orange County Council of Governments [OCCOG] – Orange County
- Business and environmental community representatives shall be selected by a majority vote of the eight governmental representatives on the Steering Committee, based on an application process conducted during a public meeting
- The Regional Water Quality Control Board representative is selected by the Santa Ana Regional Water Quality Control Board

The time commitment associated with the Steering Committee participation is somewhat dependent upon the development activity of the OWOW planning process, and whether or not a funding opportunity occurs. Generally, the Steering Committee meets quarterly during the OWOW planning process. However, when funding opportunities arise, the OWOW Steering Committee input is more time-intensive with more frequent meetings, usually bi-monthly. The Committee plays a key role in providing direction and input to SAWPA staff in the process of updating the project selection criteria development, rating and ranking, and approval of projects for funding based on the project solicitation package defined by the grant administrator. Overall, from the "Call for Projects" to the approval of project selection for funding rounds under Proposition 84, the process usually takes about ten (10) months. To assure continuity and support for the OWOW Steering Committee, SAWPA provides full administrative support, with participation of the SAWPA General Manager at its meetings.

### *Functions of the OWOW Steering Committee*

The Steering Committee is responsible for the development of the Plan. This includes receiving input from staff of their respective agencies, as well as SAWPA staff, providing direction for the development and long-term maintenance of the Plan, and development of a project prioritization process. The Steering Committee may make recommendations to the SAWPA Commission on proposed amendments to this governance document. Any such proposed amendments do not take effect unless approved by the SAWPA Commission.

In implementing the Steering Committee's Goals and Objectives, the Steering Committee will:

1. Acknowledge that water resources of the Santa Ana River Watershed Region should be put to maximum beneficial use and that water waste must be prevented.
2. Acknowledge water as a public resource and respect existing agreements governing the water resources of the Santa Ana River Watershed Region.
3. Seek regional solutions for regional problems.
4. Encourage collaboration across boundaries and between multiple parties in project development.
5. Consider sub-regional plans and planning efforts.

During the OWOW process the Steering Committee will complete the following functions:

1. Provide incentives for the development of multi-benefit integrated projects through the allocation of State Bond funds.
2. Oversee the development of an integrated watershed management plan.
3. Identify institutional barriers and opportunities for more efficient management that further advance the integration of water management activities.
4. Advocate for policy changes the increase interagency effectiveness and efficiency in integrated water management.

As funding opportunities arise to implement the OWOW plan, the Steering Committee provides the SAWPA Commission an updated Santa Ana River Watershed Region IRWM plan and programmatic portfolio of projects specific to the funding opportunity. The Steering Committee is responsible for the development and implementation of the project selection criteria.

Besides involvement through the OWOW outreach and Pillars, the public also can voice their opinion during the public and noticed meetings held by the Steering Committee. The Steering Committee meetings are held at least annually with the provision that special meetings may be called as needed. All Steering Committee meetings are conducted in accordance with the Ralph M. Brown Act. Meeting minutes are prepared and kept by SAWPA staff and posted on the SAWPA website.

## SAWPA Administration

The other arm to the governance of the OWOW process includes the management function conducted by SAWPA. As a regional water agency for the Santa Ana River Watershed, SAWPA has a long history of supporting regional collaborative efforts of this kind. As with previous IRWMP efforts for the Santa Ana River Watershed, SAWPA serves as support in providing administrative and facilitative assistance to the pillar groups and the Steering Committee for the overall OWOW Plan development.

### *SAWPA and its Member Agencies*

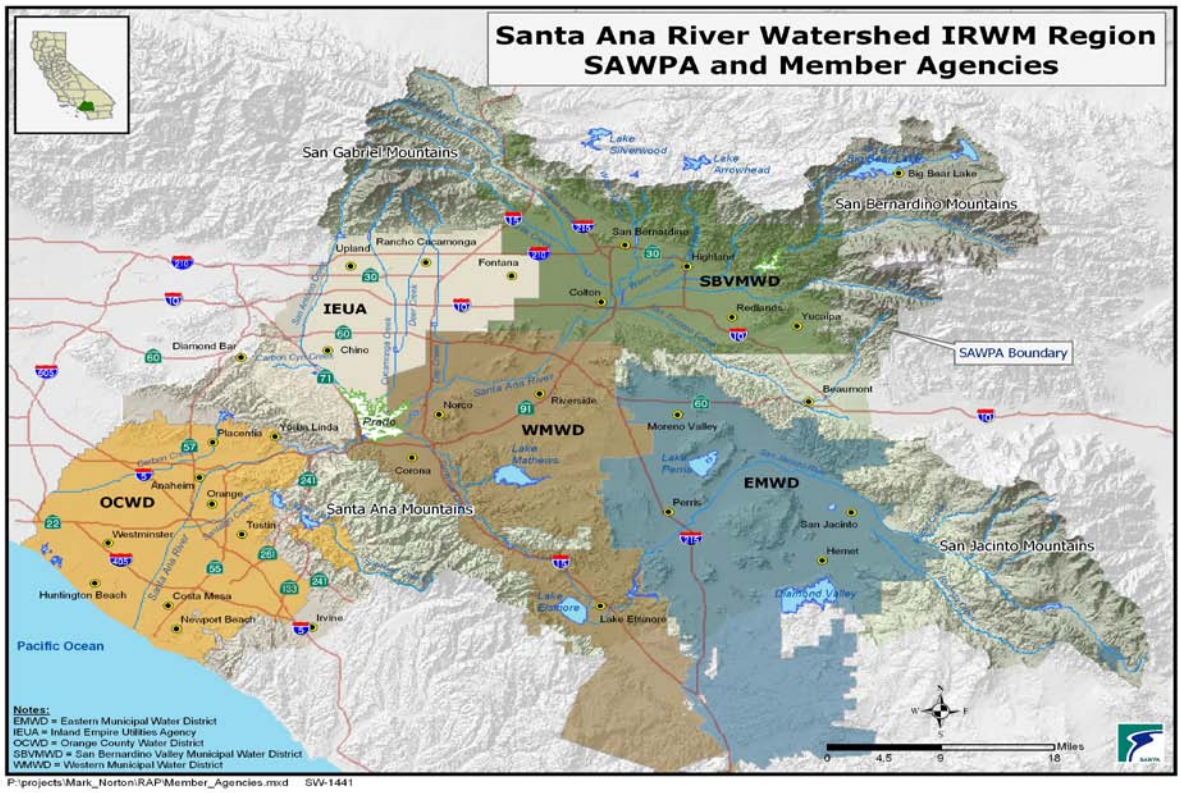
SAWPA is the designated Regional Water Management Group (RWMG) for the Santa Ana River Watershed, and the one DWR-recognized IRWM region within the watershed. SAWPA is a Joint Powers Authority focusing on a broad range of water resource issues including water supply reliability, water quality improvement, recycled water, wastewater treatment, groundwater management, brine disposal, and integrated regional planning. Its stated mission is to develop and maintain regional plans, programs, and projects that will protect the Santa Ana River basin water resources to maximize

beneficial uses within the watershed in an economically and environmentally responsible manner. As a joint powers authority consisting of more than three local agencies, with more than two (2) of which has statutory authority over water supply or water management, the RWMG meets the requirements of CWC 10540, 10541 and 10539.

SAWPA consists of twenty three (23) staff members and serves at the direction of the SAWPA Commission that is composed of its five (5) member agencies, all of which have statutory authority over water supply and water management in their service areas. These five (5) agencies represent the majority of the water management authorities and stakeholders within the region boundary.

SAWPA carries out functions useful to its five (5) member agencies: Eastern Municipal Water District (EMWD), Inland Empire Utilities Agency (IEUA), Orange County Water District (OCWD), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD). The jurisdiction of SAWPA and its member agencies spans approximately 2,800 square miles of the Santa Ana Watershed encompassing much of Orange County, a sliver of Los Angeles County, and the major population centers of western Riverside and southwestern San Bernardino Counties. Each of these agencies plans and executes long-term projects and management programs of their own; however, it primarily is the agencies working through SAWPA that provide the vehicle for effective and concerted planning efforts on a regional basis.

**Figure 2.1-1 Santa Ana River Watershed IRWM Region SAWPA and Member Agencies**



## Eastern Municipal Water District

Eastern Municipal Water District is a retail water agency servicing an area of approximately 555 square miles in western Riverside County. EMWD serves a population of approximately 675,000 in six (6) incorporated cities and unincorporated portions of western Riverside County. In addition, to its role as a retail agency, it also provides wholesale water to the sub-agencies; Lake Hemet Municipal Water District, City of Hemet, City of San Jacinto, City of Perris, Nuevo Water Company, Elsinore Valley Municipal Water District (EVMWD), and Rancho California Water District.

As a member agency of the Metropolitan Water District of Southern California (MWD), EMWD gained a supply of imported water from the Colorado River Aqueduct (CRA) and ultimately, water from northern California through the State Water Project (SWP), which transports water from northern California via the California Aqueduct. EMWD's initial mission was to deliver imported water to supplement local groundwater supplies. Over time, EMWD's role changed as additional agency responsibilities were added, including groundwater production and resource management, wastewater collection and treatment, and finally regional water recycling.

## Inland Empire Utilities Agency

Inland Empire Utilities Agency's service area covers about 242 square miles in the southwestern corner of San Bernardino County, and serves a population of approximately 800,000. IEUA provides regional wastewater service and imported water deliveries to eight (8) contracting agencies. These include; the City of Chino, City of Chino Hills, Cucamonga Valley Water District (CVWD), City of Fontana, City of Montclair, City of Ontario, City of Upland, and Monte Vista Water District.

As a member agency of MWD, IEUA provides supplemental water, as well as regional wastewater treatment for both domestic and industrial clients, and energy recovery/production facilities. In addition, the Agency has become a recycled water purveyor, biosolids/fertilizer treatment provider, and continues to focus on water supply salt management to protect the region's vital groundwater supplies.

## Orange County Water District

Orange County Water District's service area covers more than 350 square miles and the Orange County Groundwater Basin. The basin provides a water supply to more than 20 cities and water agencies, serving over 2.3 million people. OCWD owns 1,600 acres in and near the Santa Ana River (SAR) in Anaheim and Orange, which it uses to capture flows and recharge the groundwater basin. OCWD also owns 2,400 acres above Prado Dam, which uses it for water conservation and water quality improvement.

OCWD's mission is to manage and protect the Orange County Groundwater Basin in northern and central Orange County. The groundwater basin supplies approximately two-thirds of the water used by over two million residents in this District's service area. The balance is imported from the Colorado River and from northern California through the Sacramento/San Joaquin Delta SWP by MWD.

### San Bernardino Valley Municipal Water District

San Bernardino Valley Municipal Water District's service area covers about 325 square miles, primarily in southwestern San Bernardino County with a very small portion of its service area in Riverside County. The area within SBVMWD includes a population of around 600,000. SBVMWD spans the eastern two-thirds of the San Bernardino Valley, the Crafton Hills, a portion of the Yucaipa Valley, and includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Bloomington, Highland, Grand Terrace, and Yucaipa. SBVMWD's mission is to import water into its service area through participation in the California SWP. SBVMWD also is charged with managing groundwater and surface water within its boundaries through various court judgments.

### Western Municipal Water District

Western Municipal Water District's service area covers a 527 square mile area of western Riverside County, with a population of about 825,000 people. WMWD serves more than 24,000 retail and eight wholesale customers with water from the Colorado River and the SWP. As a member agency of MWD, WMWD provides supplemental water to the cities of Corona, Norco, and Riverside, and the water agencies of Box Springs, Lee Lake, Elsinore Valley, and Rancho California, as well as serving customers in the unincorporated areas of El Sobrante, Eagle Valley, Temescal Creek, Woodcrest, Lake Mathews, and March Air Reserve Base. WMWD also operates and maintains domestic and industrial wastewater collection and conveyance systems for retail and contract services customers in Lake Hills, March Air Reserve Base, Home Gardens, Corona, and Norco.

About one-fifth of the water that WMWD purchases from the MWD comes from the CRA, and about four-fifths from the SWP, which transports water from Northern California via the California Aqueduct. WMWD currently imports a small quantity of water from the San Bernardino basin and intends to increase these imports with the implementation of the Riverside-Corona Feeder project. WMWD also has several wells for pumping in its Murrieta Division.

#### *Role of SAWPA and member agencies in RWMG process*

As a regional water agency for the Santa Ana River Watershed, SAWPA has had a long history of supporting and developing integrated regional water management plans. Over its four decades of existence, SAWPA has assisted with the preparation of the Santa Ana Regional Water Quality Control Board Basin Plan, as well as multiple watershed management plans. Over the last 15 years, integrated watershed plans became an emphasis in regional water planning, and frameworks for such plans were shared by federal agencies. SAWPA, as a watershed entity, took the lead in preparing these plans for the Santa Ana River Watershed. Under its 2002 Santa Ana Integrated Watershed Plan, SAWPA staff wrote and prepared much of the three-volume document and administered consultant services in some support roles. SAWPA staff and its consultants conducted extensive outreach with stakeholders throughout the watershed. Collaborative outreach meetings were held in multiple locations throughout the watershed to assure that input was obtained and included in the Plan. This role was repeated with the June 2005 Update; the report was prepared almost entirely by SAWPA staff with extensive outreach similar to the 2002 effort.

In the current update to the IRWM Plan, the OWOW Plan, SAWPA staff serves in providing administrative and facilitative assistance to water resource management working groups (OWOW Pillars) and the OWOW Steering Committee for the overall OWOW Plan development. This role includes hiring and managing consultant services to support the planning and project selection criteria development process. In addition, SAWPA provides decision support tools to assist the Steering Committee and Pillars in decision-making processes, provides planning documents to allow Pillars to build upon previous existing plans, and performs significant public outreach and education about the integrated planning approach for the Santa Ana River Watershed.

### *SAWPA RWMG Administrative and Oversight Role*

The SAWPA Commission and SAWPA staff is the regional water management group (RWMG) and is responsible for all administrative oversight for the Plan, and for coordinating all on-going administrative responsibilities associated with its implementation. This includes arranging for meetings of the OWOW Steering Committee, preparing agendas, taking and distributing minutes of the meetings, preparing staff reports when directed by the SAWPA General Manager, and other related duties. The Commission reviews the Plan for compliance with applicable laws and guidelines. In the event that no issues or inconsistencies are detected with the Plan or project selection process, the Commission approves the Plan and the project prioritization as submitted by the Steering Committee. Should the Commission determine that the Plan or a specific selected portfolio of projects fails to meet applicable laws and guidelines, it will refer the Plan back to the Steering Committee for further revision and subsequent re-submittal to the Commission for reconsideration and ratification.

Additionally, SAWPA provides decision support tools to assist the Steering Committee and Pillars in decision-making processes, provides planning documents to allow Pillars to build upon previous existing plans, and performs significant public outreach and education about the integrated planning approach for the Santa Ana River Watershed.

Another role that SAWPA plays as the administrator of OWOW and the Regional Water Management Group for the Santa Ana River Watershed is to work closely with several sub-regional IRWM planning efforts in the watershed that took place prior to, or concurrent with, the OWOW planning process. Of particular interest was the need to assure that proper coordination and incorporation of the excellent work conducted by the sub-regional IRWM planning groups was included in the OWOW plan. SAWPA staff conducted outreach to all stakeholders of the sub-regional IRWM planning efforts, and invited their stakeholders to participate in the pillar processes. In some cases, SAWPA staff even participated in the sub-regional IRWM planning process. Where sub-regional IRWM plans previously were completed, these plans were shared with the Pillars to serve as background material to their Pillar planning efforts. In all cases, SAWPA took a lead role in coordinating the sub-regional IRWM lead agencies to assure that their planning work would be folded into the OWOW watershed-wide process as seamlessly as possible. It is understood that the Steering Committee will be responsible for the development and implementation of the project selection criteria.

As previously indicated under the Steering Committee role, as funding opportunities arise to implement the OWOW Plan, the Steering Committee will provide to the SAWPA Commission an updated Plan and programmatic portfolio of projects specific to the funding opportunity. The Commission will review the plan and programmatic project portfolio to ensure that these fulfill the intent and requirements of the specific funding mechanism, any legislation authorizing the funding, all legal requirements as defined by the funding administrative agency and equitable application of the benefits of the project portfolio across the entire region. Review of these items and the project selection process is conducted by the Commission in a public meeting open to all interested stakeholders. If the Commission is unable to ratify a specific portfolio of projects, the Commission will send it back to the Steering Committee.

SAWPA serves as the State liaison for the Santa Ana region, on behalf of the OWOW stakeholders, responsible for all final report submittals, plan adoption processes, grant application submittals, and administrative oversight for the Santa Ana OWOW IRMW Plan funding. As lead, SAWPA also works closely to coordinate with neighboring IRWM regions to coordinate water resource planning efforts. In many instances, joint interregional projects have evolved resulting in relationship building and development of common interests. These cooperative activities with neighboring and overlapping IRWM regions undertaken under OWOW 2.0 planning are explained in detail under **Chapter 2.3 Collaboration, Coordination and Integration**.

Another role that SAWPA administration played particularly under the OWOW 2.0 Plan was to establish individual SAWPA staff liaisons for each of the Pillar workgroups. Although conducted largely informally, SAWPA staff was available to aid the volunteer Pillars in ensuring that new DWR IRWM plan standards were conveyed, and overall direction of the planning process was provided. In some cases, where pillar groups struggled with participation, SAWPA staff also aided a few of the Pillars with support material, consultant support for in-depth analysis, development of tables and graphs, meeting notes preparation and meeting scheduling services. This was largely the exception to the general rule, however, with most Pillars effectively running their own meetings, preparing meeting notes and preparing their own OWOW chapter write-ups.

To support an emphasis on implementation and integration, SAWPA arranged multiple meetings with all ten (10) Pillar Chairs and Co-chairs in the development of a watershed framework document to develop templates for integration and multi-beneficial projects and programs. SAWPA hired three (3) leading watershed thinkers to work with the Pillar Chair in crafting a guidance document that each Pillar then could use to assist them in crafting their own new implementation projects and programs for the future. Cross pollination of new projects and programs among the Pillars was encouraged by SAWPA to promote integration and innovation in the development of new implementation solutions for the region.

## Governance Structure Evaluation

As part of the OWOW 2.0 Plan, an evaluation was conducted of the OWOW governance structure to ensure that the existing structure does in fact reflect a balance of interested persons or entities representing different sectors and interests, and provides them the opportunity to participate,

regardless of their ability to contribute financially to the IRWM Plan. Consideration was given to other possible governance models that address inefficiencies in the interplay between different authorities and roles of Federal, State, local and tribal governments in management water resources as described in a September 2010 publication prepared by the Johnson Foundation Freshwater Summit entitled *Charting New Waters: A Call to Action to Address U.S. Freshwater Challenges.* Periodic self examination and assessment of appropriate water resource governance was considered important to ensure that such governance reflects a jurisdictional framework that integrated water quality and quantity management across geographic scales of governance, and to make recommendations about how to streamline intergovernmental interactions if such improvements are necessary. Further, opportunities should be explored to expand the application of successful cross-jurisdictional governance models that can be adapted to different authorities, create opportunities for local level leadership and innovation, and establish inter-jurisdictional dispute resolution mechanisms.

As an initial step, the DWR Plan guidelines were reviewed to determine requirements for IRWM governance. Requirements for governance are defined as follows:

Regional decision making process - In describing decision making, define how information is collected and processed within the governance structure, and how a decision is vetted with stakeholders in the RWMG.

Equal distribution of power and voice among stakeholders – Define what structures or procedures are in place that ensure there is an equal playing field for all stakeholders involved in the RWMG.

Equal opportunity and representation of stakeholders in multiple roles (leadership, advisory) regardless of economic and power status within the RWMG – Define roles in the governance structure and explain how someone occupies that role. Explain how the governance structure invites participation in the workings of the RWMG.

Terms of service for positions within the structure – Define the kind of time commitment that the positions require and their turn over.

The next step of the examination was to conduct a survey of other similar scale RWMGs in California to evaluate their governance structures and to consider strengths and weaknesses. **Table 2.1-1** shows a comparison of five other RWMGs.

**Table 2.1-1 Comparison of Five other RWMGs**

| Similar IRWM Region | Lead Agency | RWMG Agreement | Governance Structure | Governance Committees | Governance Roles | Governance Members |
|---|---|---|---|---|---|---|
| North Coast | County of Humboldt | MOU. Evaluating formation of North Coast Region Joint Powers Authority, or similar legal entity | Seven counties and six North Coast Tribes comprise the leadership of the North Coast IRWMP. | The NCIRWMP consists of a collaborative partnership between the NCIRWMP Policy Review Panel (PRP), the Technical Peer Review Committee (TPRC), project staff, consultants, and the stakeholders within the North Coast Region. | NCIRWMP Policy Review is supported in their evaluation of projects and plan development by the Technical Peer Review Committee (TPRC). The TPRC is comprised of technical & agency staff appointed from each County Board of Supervisors and Tribal representatives. | With the exception of Modoc County, with one representative, the PRP consists of two representatives appointed by each County's Board of Supervisors and three Tribal Representatives appointed by North Coast Tribes. |
| Bay Area | Bay Area Water Agencies Coalition | Letters of Mutual Understanding (LOMUs) | Organized into four Functional Areas (FA):<br>(1) Water Supply & Water Quality (BAWAC)<br>(2) Wastewater & Recycled Water (BACWA),<br>(3) Flood Protection & Stormwater Management (BAFPAA), and<br>(4) Watershed Management & Habitat Protection and Restoration (BAWN).<br>The Coordinating Committee (CC) is composed of a Chair and Vice Chair. There are 12 voting reps made up of three reps from each FA, each of which has statutory authority over water resources. | Representatives from agencies that represented the four Functional Areas (FAs) formed and provided oversight for the IRWMP process, called the San Francisco Bay Area IRWMP Coordinating Committee. An additional organization structure was formed based on demographic and geographic divisions for the Bay Area. East, West, South, North. | The CC is responsible, directly or through participating agencies, for decision-making and actions including, but not limited to, establishing IRWMP goals and objectives, prioritizing projects, identifying financing for CC and IRWMP activities, implementing Plan activities, making future revisions to the IRWMP, hiring and managing consultants, coordinating, authorizing and/or approving grant proposals and managing funding agreements. | The CC is composed of representatives from Bay Area water supply agencies, wastewater agencies, flood control agencies, ecosystem management and restoration agencies, regulatory agencies, nongovernmental organizations (NGOs), and members of the public. |
| Ventura County | Watersheds Coalition of Ventura County, Ventura County Executive Office and Resource Management Agency Planning Division(staff lead) | MOU | Watershed Coalition of Ventura County (WCVC) working with two new watershed committees/councils. | Calleguas Creek Watershed Management Plan Steering Committee, Santa Clara River Watershed Committee, Ventura River Watershed Council. In addition to the watershed committees, a subcommittee was formed under WCVC to review water management strategies and evaluate the effectiveness of certain types of projects and programs in addressing these strategies. | The WCVC, and its three watershed committees, are engaged in a variety of local planning efforts designed to address the objectives developed by the watershed committees. | The Group includes 41 local governmental agencies (Cities, water agencies, County agencies, local, State and Federal agricultural service agencies), non- governmental organizations (environmental organizations, homeowners groups and public interest groups), and consultants. The majority of the Group, 17 members, represented water and sanitation districts with direct retail supply and/or treatment responsibilities. |

**Table 2.1-1 Comparison of Five other RWMGs (Continued)**

| Similar IRWM Region | Lead Agency | RWMG Agreement | Governance Structure | Governance Committees | Governance Roles | Governance Members |
|---|---|---|---|---|---|---|
| LA County | Los Angeles County Flood Control District, RWMG Chair | MOU of Leadership Committee | Leadership Committee and five Subregional Steering Committees | Leadership Committee has 16 voting members including LC Chair; Chairs and Vice-Chairs of the five Subregional Steering Committees; and five stakeholder agencies representing the following Water Management Areas: Groundwater, Surface Water, Sanitation, Open Space, and Stormwater. | Each of the ten Subregional SC representatives to the LC is elected by the SCs as Chairs and Vice-Chairs of their SCs. The alternate representatives to the LC for each of the five Subregions also serve as Alternates to the Chairs and Vice-Chairs on the SCs. Both the Subregional Chair and Vice-Chair representatives are elected by a majority vote of each Subregional SC according to the rules defined by each SC. The five Water Management Area LC members are elected from nominations provided by SCs. | The Leadership Committee also includes 5 ex-officio (non-voting members), including: California State, Coastal Conservancy, United States Bureau of Reclamation (USBR), United States Department of Agriculture (USDA) Forest Service: Angeles National Forest, United States Department of the Interior, National Park Service, United States Army Corps of Engineers (USACE): Los Angeles District |
| San Diego | San Diego County Water Authority, City of San Diego, County of San Diego | MOU among three entities | Regional Policy Committee provides policy-level input to the IRWM Plan and includes subject matter experts representing environmental groups, academic entities, local business, agricultural groups, water suppliers, wastewater agencies, water quality interests, and regulatory agencies. | Water Authority Member Agency Technical Advisory Committee, Project Clean Water, Project Clean Water Watershed Protection Technical Advisory Committee, Stormwater Copermittee Management Committee | The RAC served as the primary organization that provided direction to the RWMG for plan preparation | The RAC includes representatives of public agencies that serve disadvantaged communities. Additionally, disadvantaged community interests are addressed by several non-government organizations within the RAC. |
| Santa Ana | SAWPA | JPA among five member water resource agencies | Steering Committee and SAWPA Commission | Pillar groups with chair and co chairs based on 10 water resource management strategies | Steering Committee provides policy direction on IRWM Planning. SAWPA reviews and ratifies Steering Committee actions. | Steering Committee is composed of 11 members with 3 county Supervisor and 3 city Mayors from three counties, two water agency reps, development rep, environmental rep, and Regional Board rep |

Recognizing that SAWPA originally was formed as a joint powers authority in 1968 with five (5) member water agencies, apparent from the start of the OWOW 1.0 planning process was the need to expand the governance structure to form a Steering Committee composed of a broader spectrum of watershed stakeholders. The OWOW Steering Committee was developed and organized by SAWPA to reflect not strictly a water agency emphasis, but a cross section of many types of stakeholders such as DACs and Tribes as well as water resource sectors such as stormwater and flood control, thus providing equal opportunity and representation throughout the watershed. Through the Steering Committee, better decision making and distribution of power and voice is provided to the stakeholders of the watershed in the planning process as opposed to only involving the five (5) original water resource agencies of SAWPA. This process of adding a diverse stakeholder governance committee layer follows the path taken by most other IRWMs.

In evaluating other RWMG government structures to SAWPA's OWOW governance, one of the most striking differences was how SAWPA utilized the Pillars approach to reflect one of the most comprehensive involvement and grass roots processes in the integrated regional water management planning across the State and is quite unique. Using the Pillars centered on water resource strategies and asking their voluntary involvement even to the scale of composing and authoring sections or chapters of the OWOW 1.0 Plan, as well as the OWOW 2.0 Plan, has helped to ensure strong buy-in and support by all those who have participated. This approach is highly unusual as compared to other IRWM where a single consultant usually is hired to oversee the IRWM plan development and work with stakeholder groups for input, but with the consultant ultimately responsible for writing the plan. Further, it appears that approximately half of all the recognized 48 IRWM regions across the State utilize the same consultant for their IRWM plan development. This uniform and more cookbook approach for plan preparation, though effective in assuring consistency with meeting IRWM guidelines and requirements, may fail to meet the buy-in and support of stakeholders or achieve the synergistic development of integrated regional solutions as observed in the Santa Ana River Watershed, and perhaps a few other IRWM regions.

Another observation in review of governance structure models in comparison to the current OWOW governance is the emphasis on a fair, neutral, and transparent approach in the selection of projects for funding that meet the goals and objectives of the OWOW Plan. A separate body of outside reviewers is asked to review a rated and ranked list of recommended projects to ensure that the projects reflect the selection criteria approved by the Steering Committee and the SAWPA Commission, and are validated for veracity. Rather than parceling out funding based upon the five JPA SAWPA member agency jurisdictions or subwatershed or subregions as observed in many other RWMGs, the best projects are selected that meet the OWOW project selection criteria and OWOW goals. By this process, SAWPA plays a more neutral role as facilitator rather than as judge or sole governance of funding distribution.

A common concern observed in many IRWMs is the challenge of assuring the involvement of the often under-represented Native American Tribes and DACs in the RWMG governance. To improve governance representation to be more effective under OWOW 2.0 planning, SAWPA revised the OWOW Pillars to include Native American Tribes with the DACs as a distinct Pillar on par with other water resource Pillars. Representation of Native Americans' interests also has occurred at the Steering Committee level with

the 2012 transition of the San Bernardino County Supervisor on the Steering Committee. The new Supervisor selected by the San Bernardino County Board of Supervisors to serve on the OWOW Steering Committee is also a Native American tribal member from a tribe located within the watershed. Sworn in as a member, James Ramos is the first Native American to be elected to the San Bernardino County Board of Supervisors and the OWOW Steering Committee. Mr. Ramos also serves on the California State Native American Heritage Commission.

Also a concern to be addressed was assuring involvement of Federal and State governments in management of water resources under OWOW planning as evidenced in the previously mentioned publication *Charting New Waters: A Call to Action to Address U.S. Freshwater Challenge.* To remedy this challenge, a separate and new Pillar was established called the Government Alliance Pillar. Chaired by a representative from the U.S. Bureau of Reclamation (Reclamation) and co-chaired by a representative from the regional office of the U.S. Army Corps of Engineers, the Government Alliance Pillar included representatives from multiple Federal, State and local agencies and tribes including Reclamation; Army Corps of Engineers; U.S. Fish and Wildlife; Army Corps of Engineers; U.S. Bureau of Indian Affairs; U.S. Geological Survey; U.S. National Park Service, U.S. National Marine Fisheries; U.S. Forest Service; U.S. EPA; California Fish and Wildlife (formerly California Fish and Game); Santa Ana Regional Board; Calif. Dept of Public Health; CAL-Fire; Calif. Dept of Water Resources; Soboba Native American Tribe; San Manuel Native American Tribe, and the emergency support services of all three counties within the watershed. The Government Resource Guide developed by the Government Alliance Pillar will assist coordination among the Federal, State, and local agencies in the implementation of future projects, and will serve as a valuable resource to all stakeholders for years to come.

Finally, in review of the governance structure, it should be mentioned that of the support to the OWOW planning process from the roughly ten (10) multi-agency task forces that SAWPA currently administers as a regional and watershed facilitator. These task forces range from a focus on surface and groundwater water quality issues, to threatened species preservation and restoration, to establishing park and recreation trail opportunities that are integrated with water resources. Taken together, these task forces constitute over one hundred different agencies and organizations in the watershed. The work coming out of these task forces that often involve retail and wholesale water agencies, groundwater management agencies, wastewater agencies, NGOs, businesses, universities and other organizations have been integrated into the OWOW planning processes expanding the support and involvement of stakeholders throughout the Santa Ana Region.

## Planning Updates and Adoption

The OWOW Plan will be a “living document” and will be updated every three to five years in a coordinated manner with local, regional and statewide plans. Plan updates will be adopted formally by the Steering Committee and ratified by the SAWPA Commission. There may be occasions where informal changes that reflect minor process, organizational, or water management changes are conducted by SAWPA staff. The Pillars will continue to be an instrumental part of the update process by providing technical expertise and ensuring that the points of view of different disciplines and interest groups are taken into consideration.

Plan updates will incorporate, for example, changes to city General Plans, land use elements, Stormwater Management Plans, Water and Wastewater Master Plans, Urban Water Management Plans, County land use planning documents, and the Southern California Association of Governments (SCAG) land use data.

In addition, new water management strategies will be incorporated into future versions of the Plan as additional knowledge is gained on the state of the watershed, new technologies and best practices, and changes in policy and public mindsets. Furthermore, the Plan will be updated as necessary to comply with the requirements of future grant funding opportunities.

One example where subsequent formal action was taken by the Steering Committee after adoption of the plan occurred was the addition of several stormwater projects under Proposition 1E Stormwater program. Since many grant programs include language that projects must be cited in the IRWMP, SAWPA has been approached to add these from time to time. SAWPA typically will update its project priority list as part of the funding round opportunities, and then fold these into the next OWOW plan to be adopted. If SAWPA is solicited to add a significant number of projects after the formal "Call for Projects" deadline has passed or after formal adoption of the OWOW Plan, then amendments to the adopted plan may be necessary, with formal approval by the Steering Committee at publicly noticed Steering Committee meetings. If approved, such amendments then are forwarded to the SAWPA Commission for ratification. Re-adoption of the OWOW Plan by the Commission with formal public hearings for these amendments is not considered necessary, as these are considered fairly insignificant changes to the Plan and affect only the Project List in the last adopted OWOW Plan.

To ensure awareness of ongoing planning and projects, stakeholders have been invited to submit projects to SAWPA, both implementable and conceptual, if they so choose using our on-line project information form. The online project information form requires data about the project similar to what is requested under the previous OWOW "Call for Projects" for funding rounds. As an informal practice, project proponents that complete the on-line project information and submit their project information on-line can be considered as a part of the list of projects under the OWOW Plan for their outside grant submittal needs. However, in order to be considered for future IRWM funding through OWOW, rating and ranking by OWOW Governance must occur. Further, each SAWPA OWOW "Call for Projects" solicitation typically conducted under an IRWM funding round starts anew, inviting collaborative parties to submit both conceptual and proposed projects and programs for consideration and evaluation, and must abide by the deadlines and criteria for project evaluation defined under the OWOW program. If a project proponent does not have access to the on-line project information tool, special arrangements will be made to accommodate project data submittal needs.

The OWOW Plan will be provided to cities, counties, water suppliers, nonprofit organizations, and other regional and State agencies for use in their water resource planning efforts. It is anticipated that the findings will support planning efforts and updates to General Plans, Strategic Plans, and other plans and programs. The document also will be helpful input to the Metropolitan Water District of Southern California Integrated Resources Plan, and the State of California DWR Water Plan.

### *IRWM Plan Adoption*

The SAWPA Commission and all its member agencies adopted the SAWPA IRWMP known as the "One Water One Watershed (OWOW)" Plan 1.0 in November of 2010. Since the time of its adoption, the Plan was amended formally in March 2011 to include additional Proposition 1E eligible stormwater projects to the Plan's project list.

In September 2011, an update to the OWOW 1.0 Plan was initiated and is known as the OWOW 2.0 Plan. Prior to commencing work on the update, SAWPA published a formal notice of intention to prepare a plan in September 20, 2011. The emphasis of the OWOW 2.0 Plan is not only to update the planning data, but to emphasize and describe regional implementation projects and programs that meet the OWOW 2.0 goals and objectives. The OWOW 2.0 Plan is anticipated to be adopted by the OWOW Steering Committee and SAWPA Commission in early 2014, with formal notice of intention to adopt the Plan to be published prior to adoption in accordance with Section 6066 of the Government Code.

# 2.2 Stakeholder Involvement and Outreach



Santa Ana River Watershed Conference 2013

## Stakeholder Involvement and Outreach

Engaging stakeholder involvement in a large, diverse watershed is challenging. It is unlikely that any one individual "knows" all of the stakeholders, and as such, the development of mailing lists and notification of workgroup meetings can be daunting. The One Water One Watershed (OWOW) process was designed to be different from other planning processes. One critical difference is that OWOW was designed to be a "bottom-up", rather than a "top-down" process. By encouraging participation from different groups of people and those holding varying viewpoints from throughout the Watershed, the capacity to reach larger numbers of stakeholders also grew.

Similar to our OWOW 1.0 Plan, many of the same procedures, processes, structures and tools were used for stakeholder outreach. However, in some cases where these tools were not deemed effective in reaching adequate numbers of an interest group, they were not used under OWOW 2.0 planning. Thus an evolving process of determining the most effective means of reaching out to involve stakeholders and groups occurred. For example, three (3) forms of outreach used under OWOW 1.0 planning were discontinued under OWOW 2.0 planning. These included the Podcasts, Beam Blasts, and virtual web-based meetings based on relatively light use. New social media outreach tools were established in place of those tools.

For a full timeline of major OWOW 2.0 milestones, including stakeholder outreach events like the OWOW 2.0 Conferences, see **Appendix M**.

## Pillars

The OWOW Pillars represent one of the most effective means to insure public involvement in the planning process. Invites to participate in the Pillar meetings are made through the planning process and are voluntary in nature. Members of the public may choose to participate in one or many Pillars based on their level of interest. Each Pillar is led by a subject area expert, and that person receives a list of volunteers, but as a Pillar leader he/she can also invite potential participants to attend and support the planning efforts. For example, a water supply expert likely knows other water supply experts within and outside the region. These individuals were invited to the process and were an important addition to the vast mailing list maintained by SAWPA. Each Pillar Co-chair is responsible for maintaining a list of contacts interested in their particular Pillars, and SAWPA provides names of additional contacts. The knowledge and contacts of the Pillars provide an important link to watershed stakeholders.

Most of the Pillars were based on water resource strategies similar to the water resource strategies defined in the California Water Plan Update. However, in some cases, special Pillars were established to expand outreach and involvement, such as the Disadvantaged and Tribal Communities Pillar and the Government Alliance Pillar. The Disadvantaged and Tribal Communities Pillar is addressed under **Chapter 5.11 Disadvantaged and Tribal Community**. The work of the Government Alliance Pillar is addressed under **Chapter 5.12 Government Alliance**.

## Outreach Audience

The list of stakeholders involved in our most recent integrated regional water management planning is one of the most extensive ever taken by any regional water management group. The master contacts database includes a rather diverse base of over **4,000 stakeholders**. The focus of the database is to include those entities having an interest in water and representatives from cities located within the watershed. It includes representatives from **120 agencies** associated with water, including flood control, water conservation districts, and water supply agencies. It also includes representatives from the **63 incorporated cities** within the watershed, including mayors, key department heads, city council members, and planning commissioners. The database also includes an up-to-date list of members of the California legislature.

Also included are representatives from County, State, and Federal government; Indian Tribes, the real estate community, members of the environment and environmental justice, agricultural and development communities, consultants, trade associations, academia, non-profit organizations, and others simply interested in water.

The working relationship in the development of the IRWM plan was very positive overall, collaborative, and in many cases, long term. Through SAWPA's history of administering collaborative working groups and task forces, strong working relationships were built with the many entities listed below. The collaborative efforts through workgroup or task forces, also known as SAWPA's Roundtable or Task Forces, are described in detail under **Chapter 2.3 Collaboration, Coordination and Integration**.

With so many organizations and agencies, overlap to some extent exists and some facilities and infrastructure may be shared. However, based on the long history of cooperation and past integrated water resource planning, conflicts and competing policies have been minimal among the members that affect integrated water planning and management.

| 1 | **Wholesale and retail water purveyors; including a local agency, mutual water company, or a water corporation as defined by Section 241 of the Public Utilities Code:** | |
|---|---|---|
| | Banning Heights Mutual Water Company | Municipal Water District of Orange County |
| | Bear Valley Mutual Water Company | Muscoy Mutual Water Company |
| | Beaumont Cherry Valley Water District | Nuevo Water Company |
| | Big Bear Municipal Water District | Orange County Water District |
| | Box Springs Mutual Water Company | Orange Park Acres Mutual Water District |
| | Cucamonga Valley Water District | Pine Cove Water District |
| | Eagle Valley Mutual Water Company | Rancho California Water District |
| | East Orange County Water District | Rancho Santa Margarita Water District |
| | East Valley Water District | Riverside Highlands Water Company |
| | Eastern Municipal Water District | Running Springs Water District |
| | El Toro Water District | San Antonio Water Company |
| | Elsinore Valley Municipal Water District | San Bernardino Valley Municipal Water District |
| | Fern Valley Water District | San Gorgonio Pass Water Agency |
| | Fontana Water Company | Santa Ana River Water Company |
| | Gage Canal Company | Santiago County Water District |
| | Home Gardens County Water District | Serrano Water District |
| | Idyllwild Water District | Southern California Water Company |
| | Inland Empire Utilities Agency | Terrace Water Company |
| | Irvine Ranch Water District | Trabuco Canyon Water District |
| | Lake Hemet Municipal Water District | West Valley Water District |
| | Lee Lake Water District | Western Heights Mutual Water Company |
| | Marygold Mutual Water Company | Western Municipal Water District |
| | Meeks & Daly Water Company | Yorba Linda Water District |
| | Mesa Consolidated Water District | Yucaipa Valley Water District |
| | Monte Vista Water District | |

SAWPA has worked directly with these agencies and companies through our collaborative workgroups and task forces. All were contacted and invited to participate in the OWOW process.



| 2 | **Wastewater Agencies:** |
|---|---|
| | Big Bear Regional Wastewater Authority |
| | Orange County Sanitation District |
| | Western Riverside County Regional Wastewater Authority |

Where wastewater divisions and departments are operated by a city or by joint water and wastewater entities, these agencies are shown under the city or water agency categories. SAWPA has worked extensively with each of the wastewater agencies through the Santa Ana River Dischargers Associations and on several task force efforts, such as the Santa Ana River Use Attainability Analysis, the TIN TDS Task Force, and the Basin Monitoring Program Task Force. The wastewater agencies were particularly active in the water quality pillar and the water recycling pillar efforts of OWOW.

| 3 | **Flood Management Agencies:** |
|---|---|
| | Riverside County Flood Control & Water Conservation District |
| | San Bernardino County Public Works |
| | Orange County Flood Control Division |

SAWPA has a strong and positive working relationship with all three (3) flood control agencies through their involvement in the Flood Risk Management Pillar, the Stormwater Quality Standards Task Force, the various TMDL task forces administered by SAWPA, the brine line improvement coordination, and through low impact development projects and other forums.



Release at Prado Dam

| 4 | Municipal and County Governments and Special Districts: | |
|---|---|---|
| | City of Anaheim | City of Orange |
| | City of Banning | City of Perris |
| | City of Beaumont | City of Placentia |
| | City of Big Bear Lake | City of Pomona |
| | City of Brea | City of Rancho Cucamonga |
| | City of Buena Park | City of Redlands |
| | City of Calimesa | City of Rialto |
| | City of Canyon Lake | City of Riverside |
| | City of Cerritos | City of Running Springs |
| | City of Chino | City of San Bernardino |
| | City of Chino Hills | City of San Jacinto |
| | City of Claremont | City of Santa Ana |
| | City of Colton | City of Seal Beach |
| | City of Corona | City of Stanton |
| | City of Costa Mesa | City of Temecula |
| | City of Cypress | City of Tustin |
| | City of Diamond Bar | City of Upland |
| | City of Eastvale | City of Villa Park |
| | City of Fontana | City of Wildomar |
| | City of Fountain Valley | City of Westminster |
| | City of Fullerton | City of Yorba Linda |
| | City of Garden Grove | City of Yucaipa |
| | City of Grand Terrace | Riverside County |
| | City of Hemet | County of San Bernardino |
| | City of Highland | Orange County Board of Supervisors |
| | City of Huntington Beach | Orange County Public Facilities & Resources Department |
| | City of Irvine | Orange County Resources & Development Management Department |
| | City of Jurupa Valley | Riverside County Department of Waste Management |
| | City of La Habra | Riverside County Park & Open Space District |
| | City of Lake Elsinore | San Bernardino County Board of Supervisors |
| | City of Lake Forest | Big Bear Lake Department of Water & Power |
| | City of Lakewood | Big Bear City Community Services District |
| | City of Loma Linda | Edgewater Community Services District |
| | City of Los Alamitos | Jurupa Community Services District |
| | City of Menifee | Rubidoux Community Services District |
| | City of Montclair | Riverside County Economic Development Agency |
| | City of Moreno Valley | Chino Basin Water Conservation District |
| | City of Murrieta | San Bernardino Valley Water Conservation District |
| | City of Newport Beach | San Timoteo Watershed Management Authority |
| | City of Norco | Chino Desalter Authority |
| | City of Ontario | Lake Elsinore and San Jacinto Watersheds Authority |

SAWPA has conducted extensive outreach to these entities including presentations to City Councils, Boards of Supervisors, and involved cities and counties in the OWOW governance, and worked with many under various workgroups and task forces and in some cases, even served on the these organizations' boards.

| 5 | **Electrical Corporation, as defined in Section 218 of the Public Utilities Code:** |
|---|---|
| | Southern California Public Power Authority |
| | So Cal Edison |
| | Power Sol Energy |
| | Colmac Energy Inc. |

SAWPA has been a strong supporter of the American Society of Civil Engineers Inland Empire Infrastructure Report Card, serving as Chair of the Report Card prepared in 2005. In 2008, an update to the Report Card was prepared, which included the involvement of the electrical corporations listed above. Briefings about the OWOW planning process were shared with the Report Card committee and the results were incorporated into the OWOW Plan. For the OWOW 2.0 Plan, a new pillar was formed to specifically address the water-energy nexus. See **Chapter 5.13 Energy and Environmental Impact Response** for more details.

| 6 | **Native American Tribes that have Lands within the Region:** |
|---|---|
| | Morongo Band of Mission Indians |
| | San Manuel Band of Mission Indians |
| | Santa Rosa Band of Mission Indians |
| | Soboba Band of Luiseño Indians |
| | Temecula Band of Luiseno Mission Indians |

Since OWOW 1.0, significant progress has been made with outreach and involvement of the native American tribes with the establishment of the Disadvantaged and Tribal Pillars, and participation of a tribal member on the OWOW Steering Committee.

| 7 | **Self-supplied Water users, including Agricultural, Industrial, Residential and Park Districts, School Districts, Colleges and Universities, and Others:** |
|---|---|
| | March Air Reserve Base |

SAWPA has worked with the March Air Reserve Base through the Lake Elsinore/Canyon Lake Nutrient TMDL Task Force, which receives briefings on the OWOW process.

| | |
|---|---|
| 8 | **Environmental Stewardship Organizations Including Watershed Groups, Fishing Groups, Land Conservancies, and Environmental Groups** |
| | Audubon Society |
| | Endangered Habitats League |
| | Sierra Club, San Gorgonio Chapter |
| | Newport Bay Naturalists & Friends |
| | Santa Ana River Watershed Alliance |
| | Santa Ana Watershed Association |
| | Coastal Coalition |
| | Southern California Wetlands Restoration Project |
| | Friends of the Northern San Jacinto Valley |
| | Friends of the Santa Ana River |
| | San Jacinto River Watershed Council |
| | Inland Empire WaterKeeper |
| | Orange County CoastKeeper |
| | Western Riverside Regional Conservation Authority |
| | Redlands Conservancy |
| | California Coastal Conservancy |
| | Riverside Land Conservancy |
| | San Gabriel & Lower Los Angeles Rivers & Mountains Conservancy |
| | The Nature Conservancy |
| | The Wildlands Conservancy |
| | San Jacinto Basin Resource Conservation District |
| | Inland Empire Resource Conservation District |
| | Riverside Corona Resource Conservation District |

Recognizing the importance of the relationship of water and the environment, SAWPA has worked actively to involve the environmental community under the Natural Resources Stewardship Pillars, and in the many collaborative workgroups and task forces. Examples include the Santa Ana Fish Conservation group, the Emerging Constituents Workgroup, the Arundo Removal Programs, and Mitigation Banks. In some cases, SAWPA serves on the boards of these organizations.

| | |
|---|---|
| 9 | **Community Organizations, Including Land Owner Organizations, Taxpayer Groups, and Recreational Interests:** |
| | Trails 4 All |
| | Jurupa Area Recreation & Park District |
| | Santa Ana River Trail & Parkway Partnership |
| | Orange County Conservation Corps |
| | March Joint Powers Authority |
| | Canyon Lake Property Owners Association |

| | |
|---|---|
| 10 | **Industry Organizations Representing Agriculture, Developers, and other Industries Appropriate to the Region:** |
| | American Society of Civil Engineers |
| | Building Industry Association of Riverside County |
| | Building Industry Association: Baldy View Chapter |

| |
|---|
| Inland Action Group |
| Valley Group |
| Green Valley Initiative |
| Raincross Group |
| Riverside County Farm Bureau |
| San Bernardino County Farm Bureau |
| Milk Producers Council |
| Western Riverside County Agricultural Coalition |

SAWPA has worked actively to involve several recreational communities in the OWOW planning process and in the many collaborative workgroups and task forces. Examples include the Santa Ana Fish Conservation group, the Emerging Constituents Workgroup, the Santa Ana River Trails group, the Arundo Removal Programs, and Mitigation Banks. In some cases, SAWPA serves on the boards of these organizations.

The feedback and involvement of the building and agricultural industry are important components to the development of the OWOW Plan. Representatives from these organizations have actively participated in various OWOW conferences and outreach meetings. A representative from the Farm Bureau served as Co-chair on the Natural Resources Stewardship Pillar. A strong relationship has developed with the Western Riverside County Agricultural Coalition and various farm bureaus, through SAWPA facilitation of TMDL task forces and other collaborative efforts.

| 11 | **State, Federal, and Regional Agencies or Universities that have Specific Responsibilities or Knowledge within the Region:** | |
|---|---|---|
| | Association of California Water Agencies | California Department of Water Resources |
| | South Coast Air Quality Management District | Caltrans |
| | Southern California Association of Governments | Santa Ana Regional Water Quality Control Board |
| | Western Governors Association | U.S. National Park Service |
| | University of California Riverside | USDA Forest Service, PSW |
| | University of California Irvine | U.S. Bureau of Reclamation |
| | California Baptist University | U.S. Army Corps of Engineers |
| | Cal State University, Fullerton | U.S. National Marine Fisheries Service |
| | California Department of Fish and Game | |

The four universities have worked as consultants and participants in many multi-agency efforts with SAWPA, including the ASCE Report Card, demographic studies for watershed as part of the SAWPA IRWM, joint research projects, the Emerging Constituents Program Task Force, and many other forums. The working relationship with State agencies is very strong particularly with the Santa Ana Regional Water Quality Control Board through their participation in just about every workgroup and task force effort, as well as OWOW planning. The importance of working closely with State and Federal agencies was deemed so vital that a Pillar known as the Government Alliance was formed under OWOW 2.0. Details of their involvement are described under **Chapter 5.12 Government Alliance**.

| 12 | DAC Members and Representatives, Including Environmental Justice Organizations, Neighborhood Councils, and Social Justice Organizations: |
|---|---|
| | Latino Health Network |
| | Rialto Singe Center |
| | Latino Health Access |
| | Riverside County Housing Authority |
| | California Latino Water Coalition |

Of the many agencies and stakeholders involved in the process, particular emphasis was placed on conducting outreach to Disadvantaged Communities and Environment Justice interests. As part of the planning process, it became apparent that in order to fulfill the goal of direct involvement in the environmental justice community, it would be necessary to go directly to communities within disadvantaged census tracts and engage residents directly. It appeared implausible that adequate, unbiased information could be collected from meetings structured like those in the usual water resources planning process. It also became apparent that outreach would need to be conducted in a bilingual setting, as many residents were Spanish speaking and uncomfortable providing information in English.

In order to get the widest possible assessment of the concerns of the residents in minority and/or low income communities in the three counties, the Disadvantaged and Tribal Communities Pillar conducted significant outreach. Details of these efforts are described under **Chapter 5.11 Disadvantaged and Tribal Communities**.

| 13 | Other Interested Groups Appropriate to the Region: | |
|---|---|---|
| | Chino Basin Watermaster | SE Corporation |
| | Basin Technical Group of San Bernardino Valley | Stantec |
| | Inland Empire Utilities Agency Chino Creek Planning Group | The Irvine Company |
| | Newport Bay Watershed Executive Committee | Southern California Water Committee |
| | San Antonio Canyon Stakeholders Committee | Inland Empire Economic Partnership |
| | Santa Ana River Dischargers Association | Canyon Lake Chamber of Commerce |
| | California Foundation on Environment and the Economy | Chino Valley Chamber of Commerce |
| | National Water Research Institute | Corona Chamber of Commerce |
| | Urban Water Institute | Greater Riverside Chamber of Commerce |
| | Water Education Foundation | Lake Elsinore Chamber of Commerce |
| | Brown and Caldwell | Ontario Chamber of Commerce |
| | CDM | San Bernardino Area Chamber of Commerce |
| | David Taussig & Associates | Temecula Valley Chamber of Commerce |
| | Ferguson Group | Cities of Murrieta and Temecula Business Group |
| | Iger & Associates | Western Riverside Council of Governments |
| | Kennedy Jenks | Western Riverside Council of Governments |
| | RBF | |

## SAWPA Email Blasts

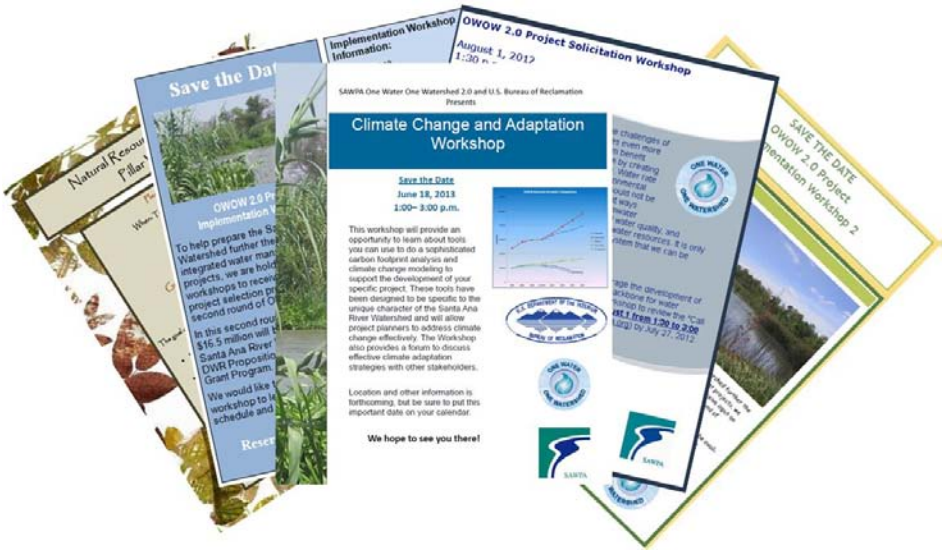
SAWPA primarily provided communication to stakeholders based on an extensive electronic mailing list maintained on by SAWPA. The list is updated regularly, and anyone requesting information is added to the list using software known as "Constant Contact". Email contact allows regular communication with a broad group of stakeholders throughout the watershed. The mailing list also includes stakeholders outside the watershed who are interested in the watershed issues.

The master contacts database includes a rather diverse base of approximately 4,000 stakeholders. The focus of the database is those having an interest in water and representatives from cities located within the watershed. It includes representatives from 121 agencies associated with water; from flood control, water conservation districts, and water supply agencies. It also includes contacts from the 66 incorporated cities within the watershed, including mayors, key department heads, City Council Members, and Planning Commissioners. The database also includes an up-to-date list of members of the California legislature.

Also included are representatives from County, State, and Federal governments, Indian Tribes, the real estate community, members of the environmental, agricultural and development communities, consultants, trade associations, academia, media, nonprofit organizations, and others simply interested in water.

## Public Meetings, Conferences and Presentations

The core of any public outreach program is the direct contact with interested stakeholder groups. As part of the OWOW process, SAWPA staff has made over 50 presentations to specific stakeholder groups to both inform and to invite participation. Since September 2011, SAWPA has hosted multiple workshops, forums, and presentations in San Bernardino County, Orange County, and Riverside County—to discuss the benefits of collaboration and multi-benefit watershed projects. Emphasis was placed on the next generation of OWOW planning with the kick off of OWOW 2.0 as not simply an update, but the "Implementation" phase of the OWOW plan. The OWOW 1.0 Plan adopted by the SAWPA Commission in November of 2011 was posted on the SAWPA website for reference as stakeholders kicked off the planning work on the OWOW 2.0 Plan.



Since September 2011, SAWPA has hosted its third and fourth annual OWOW watershed conferences on April 25, 2012, at the National Orange Show Events Center in San Bernardino, CA, and on April 11, 2013, at the Westin South Coast Plaza Hotel, Costa Mesa, CA. These events were well attended, each with over 400 attendees. The conferences serve as a very effective opportunity to invite the public to become involved in OWOW, to discuss the OWOW plan development to date, and the new DWR IRWM Plan standards and IRWM Proposal Solicitation Packages under Proposition 84. The conferences also serve to reinforce the OWOW plan goals to encourage a watershed focus, and encourage collaboration in developing multi-benefit projects. Participants identified greater operational efficiencies and reduced environmental impacts as benefits of these kinds of projects.




SAWPA staff also has provided briefings and presentations to a number of specific groups. The presentations included a review of the OWOW program and an invitation to participate in the process. Representative presentations to specific groups are summarized below.

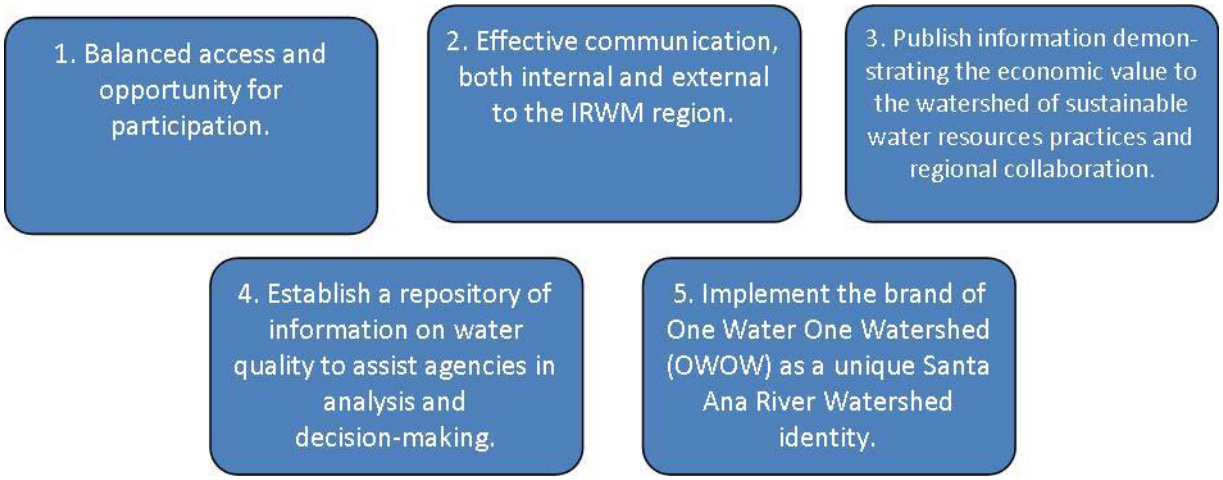
- Cities
- Agricultural Groups
- Business/Economic Development Groups
- Watershed Councils and Groups
- Presentations to Organizations

## Expanded Stakeholder Outreach – Social Media

Under OWOW 2.0, stakeholder outreach expanded in the watershed to more interaction with universities/colleges, the business community, and the public, with the development of new tools and outreach materials. One of the growing sets of tools is the use of social media. Social networking and the tools used to reach out increase the avenue for communicating OWOW goals and encourage involvement and collaboration to broad and diverse audiences. Consequently, SAWPA has folded in social media as a component of its overall public outreach for its strategic plan, as well as support of OWOW outreach.

In the design of an OWOW social media program, SAWPA has built upon the public outreach vehicles used in the past under OWOW 1.0 Plan, such as SAWPA e-newsletter and e-blasts to create additional traffic to the SAWPA website. Further, based on the linkages that exist between social media tools such as websites, Facebook, Twitter, YouTube, and blogs, viewership has increased resulting in more stakeholder interest and participation in the development of the Plan, and consideration of increased integration of future projects and programs that will meet the goals of the Plan.

In the development of social media tools, one of our first steps was to define the goals, strategy, and audience for these tools. In recognition of the multiple roles of SAWPA, new social media tools sought to support mutual goals of the organization, as well as to support the outreach and collaboration necessary for OWOW 2.0 planning. The establishment of strategic goals for public outreach area was a necessary first step. They are listed as follows:




The goals listed above are supported through traditional SAWPA communication efforts and through social media. Particular outreach activities are well suited to social media tools. For example, providing clear, understandable and valuable information to the public is effectively accomplished through social media.

### *What is our Message?*

SAWPA provides leadership and information to all stakeholders in reaching the goal of a sustainable Santa Ana River Watershed. The following key message points describe SAWPA's role in accomplishing this OWOW vision and serves as a guide that is consistently weaved into our outreach.

1. SAWPA is a collaborator/facilitator emphasizing a watershed focus and as such, can provide tools and models useful for addressing watershed issues.
2. Water Ethic is crucial for implementing an integrated watershed vision - every stakeholder should know:
   a. Where does your water come from?
   b. How much of it do you use?
   c. What do you put into the water before it leaves?

d. Where does it go after you use it?

3. SAWPA is a "go to" place, providing valuable information to our stakeholders useful for the implementation of creative solutions to watershed issues.
4. SAWPA is a State model for leadership in watershed planning and can provide a forum and tools for development of integrated solutions.
5. SAWPA is a leader in developing new ways to see and to respond to problems, and we share this information and insight with our stakeholders.
6. Multi-function, multi-beneficial projects are the most cost effective ways of working, and SAWPA provides facilitation/information to support these projects.
7. SAWPA's collaborative models are "WIN-WIN" and adaptable to multiple problems.
8. The world is changing and SAWPA can help manage the change in the way we do business, especially as we face;
   a. Climate change
   b. Increased stress on resources
   c. Reduced financial resources for single purpose projects
9. SAWPA emphasizes the use of local resources as it provides more reliability and sustainability.
10. Sustainability makes good economic and resource sense, and SAWPA serves as a resource to model sustainability.
11. SAWPA continues to develop and share new models for working in response to changing conditions.

### *Who is our Target Audience(s)?*

One of the most important aspects of developing a social media outreach plan is to identify SAWPA's audience. With over six million residents in the Santa Ana River Watershed and in the IRWM region, our audience is diverse in age and communication style. Social media outreach can reach an audience that is diverse in both of these categories. As much as information is distributed to stakeholders via email, it is important to note that email is not the preferred mode of communication of younger stakeholders. Through social media, SAWPA has the ability to immediately connect to a much broader geographic audience by providing valuable information, creating and expanding the value of a water ethic for the 21st Century, and encouraging resource stewardship.

SAWPA's audiences include:

- **All residents of the Santa Ana River Watershed:** For example, the young mom/family concerned about the quality of their drinking water, or the retired resident on a fixed income, or the political advocate. An effort using social media would be particularly effective in these circumstances. SAWPA currently is partnering with its member agencies to provide all watershed residents with unbiased, fact-based information regarding "Emerging Constituents".

- **Decision leaders and elected officials: SAWPA is a leader in providing information and cooperative models for decision leaders** from water and general government, senior management and technical staffs from agencies engaged in water and resource management, the regulatory community, and NGOs. For example, the OWOW Planning effort provides information to all those interested in the management of water and in some cases, provides general stakeholder information to those interested in water. In other cases, the OWOW planning process provides

focused technical information to water resource practitioners. In each case, the appropriateness of communication outreach needs to be considered. In the case of more technical or detailed information, email or other means of communication may be more effective.

- **Stakeholders Engaged in the SAWPA Roundtable Process**: SAWPA convenes a number of roundtable efforts focused on discrete problems or issues within the watershed. The content is often technical in nature and is best communicated through other means such as email, but the actions of these groups often have results of interest to broader audiences. In these cases, social media may be used to provide updates to the broader audience (e.g., emerging constituents' task force group).

SAWPA typically has engaged in a "business to business" (B2B) outreach model; however, by establishing a strong social media presence, SAWPA reaches out to a wider variety of audiences than we traditionally have reached.

Through social media presence, SAWPA provides a virtual venue to invite collaboration and encourage interaction from others, to inspire and educate watershed residents, and provide Web-based information. Under OWOW 2.0 and the use of social media, SAWPA has driven even more visitor traffic to its website, promoting itself as the State's role model for integrated regional watershed management planning, sharing its expertise and knowledge with others, and becoming known as a trendsetter for innovation and collaboration, as well as establishing a brand of a sustainable Santa Ana River Watershed.

SAWPA's website is considered as "home base":




1. By using appropriate social media tools such as Linked In, Facebook, YouTube and Twitter, SAWPA drives more visitor traffic to its website.
2. Through Linked In, Twitter, YouTube and Facebook, SAWPA expands its outreach efforts for events and services provided by SAWPA. For example, Twitter is used to provide real time messaging of conferences and events watershed-wide.
3. Social media provides powerful tools to network and engage in the political process. Many of SAWPA's stakeholders are key decision leaders in water resource management, and SAWPA's integrated approach helps engender a unified voice for political action in a regional manner.
4. With such a large geographic area in the Santa Ana River Watershed, 2,650 square miles and stretching across three counties – Orange, Riverside, and San Bernardino, social media allows SAWPA to provide outreach to a diverse population in an economical and resource-saving manner.
5. SAWPA's website provides links inviting visitors to join us on Facebook, Twitter, YouTube, and LinkedIn.

*Twitter:* https://twitter.com/sawpa_owow

SAWPA currently uses Twitter as a social media tool for providing updates and timely information of interest to watershed stakeholders. Frequency of stakeholder contact occurs at least weekly.




*YouTube:* http://www.youtube.com/user/SAWPATUBE

In efforts to increase SAWPA's social media presence, videos are uploaded to YouTube. Videos are used to promote OWOW events.

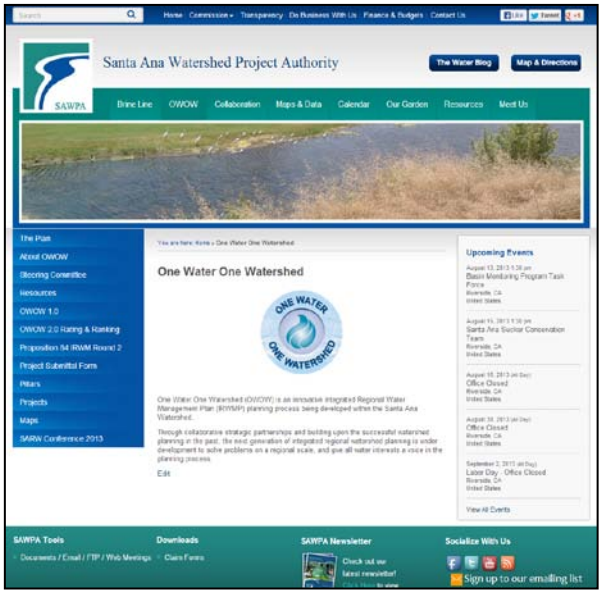



*Constant Contact*

SAWPA, as the regional IRWM group for the OWOW 2.0 Update, held numerous workshops and speaking engagements about OWOW, sent out numerous email blasts announcing OWOW related events and actions, and distributed OWOW newsletters by email blasts. The email blasts are sent by an email marketing company called Constant Contact that reaches over 3,000 stakeholders throughout the watershed.

*Website Update*

To support the OWOW planning process, SAWPA has made improvements to its website, including the dedication of resources to an OWOW webpage. The OWOW webpage created in 2010 provides watershed stakeholders and the public with various information and updates relating to SAWPA's integrated regional watershed management program.




*Upcoming Events* http://www.sawpa.org/events/

The SAWPA website events calendar's versatile options allow viewers to choose the type of events they want to see. By selecting the OWOW option, viewers are shown an up-to-date calendar of upcoming OWOW events such as workshops, pillar meetings, and releases from DWR. When opening an event, the viewer has access to agendas and any other documents pertaining to that event.

*Web Links*

The webpage provides viewers access to a number of links to the OWOW plan, as well as program background information, tools, forms, and data.

| **About OWOW** http://www.sawpa.org/owow/about-owow/ | **OWOW Plan (IRWMP)** http://www.sawpa.org/owow/the-plan/ | **How do I get involved?** http://www.sawpa.org/owow/how-do-i-get-involved/ | **Governance** http://www.sawpa.org/owow/steering-committee/ |
|---|---|---|---|
| Viewers are provided with the history of OWOW. From the "Four Horsemen of the Apocalypse" concept to the importance of collaboration in future projects, the "About OWOW" page allows the viewer to understand the many purposes of OWOW. | Viewers have access to the current OWOW plan. Each chapter is linked separately in order to facilitate the downloading process of the plan. | This page engages the viewer's involvement in SAWPA's various ways of staying connected to the OWOW process. This is done by encouraging viewers to sign up to SAWPA's emailing list, joining an OWOW pillar workgroup, and allowing viewers to obtain past workshop's agendas, meeting notes, and presentations. | This page gives the viewer an opportunity to get to know the OWOW Steering Committee by providing a brief background on the elected officials. Viewers also can download the Steering Committee agenda packets.<br><br>Current OWOW Pillars are also listed by Pillar names with their respective SAWPA staff contacts. |
| **Project Database** http://www.sawpa.org/owow/project-submittal-form/ | **OWOW Tools** http://www.sawpa.org/owow/owow_tools/ | **Resources** http://www.sawpa.org/owow/resources/ | |
| SAWPA allows agencies to submit their projects for consideration to be included in the OWOW Plan. A list of submitted projects also is available. | This page allows viewers to obtain access to computer support tools that support our modern water management goals. Viewer will find the Greenhouse Gas Emissions Calculator, Climate Change Analysis, and, soon to come, Watershed Report Card. | Viewers are provided with materials that will allow them to be better informed about OWOW. | |

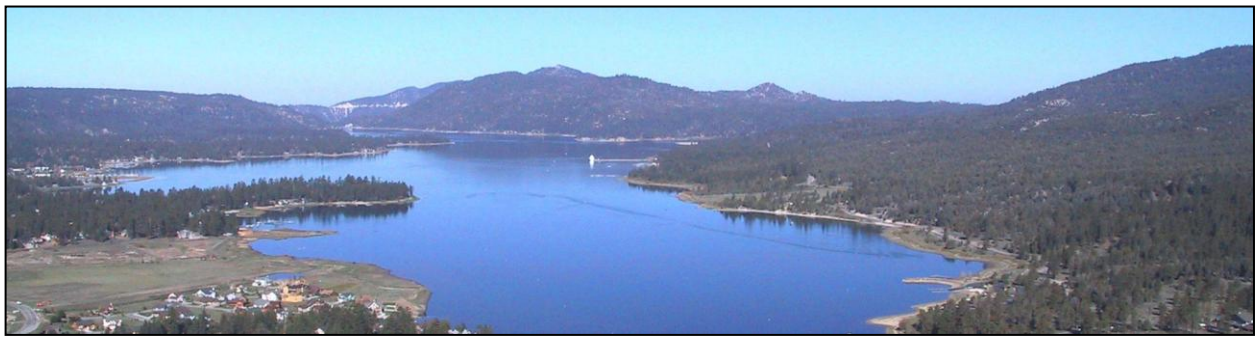
# 2.3 Collaboration, Coordination and Integration



OWOW Call For Projects Workshop

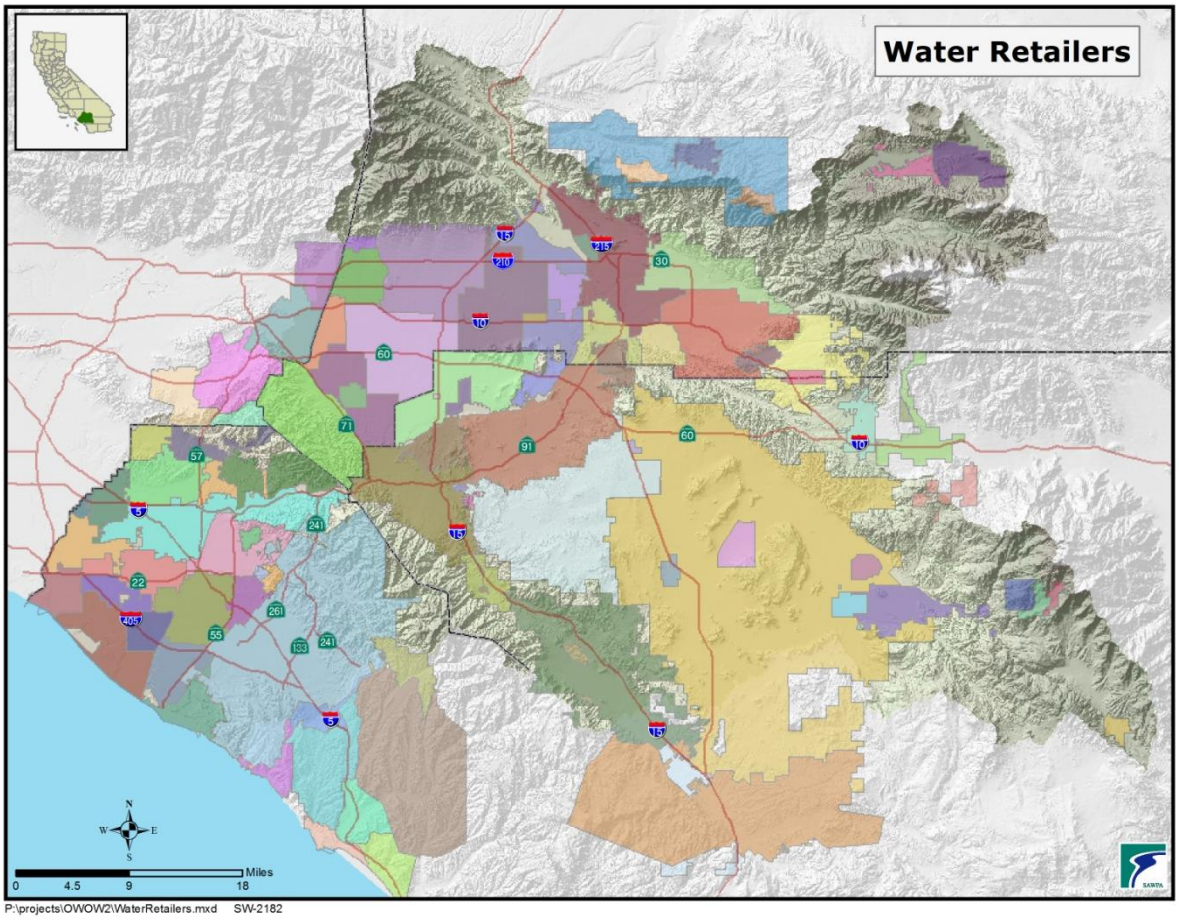
As is likely to occur within any watershed, sometimes conflicting goals or priorities of various watershed agencies can hinder progress towards collaboration and coordination. Within the Santa Ana River Watershed there are over 100 large and small water districts (**Figure 2.3-1** on page 2), local, regional, State and Federal agencies, and public/private stakeholder groups. The Santa Ana Watershed Project Authority (SAWPA) recognizes that all of these stakeholders have their own valid interests in ensuring that there is sufficient clean, reliable water in the watershed, and SAWPA takes the initiative to keep all of these groups working together to solve the watershed's issues under One Water One Watershed (OWOW) 2.0 planning and various other "Roundtable" forums.

SAWPA strives for a collaborative approach to bring together the planning community, including both public and private sector planners, to advance the benefits of planning on a watershed scale and integrating watershed thinking into the everyday planning process. Working with varied interests and agendas, this watershed planning process has opened the doors to great partnerships, funding



opportunities, connectivity, and increased awareness of planning projects and opportunities both in the city next door, and in the community on the other side of the watershed.

**Figure 2.3-1 Santa Ana River Watershed Water Agencies Service Areas**




As many cities and counties are in the process of updating their General Plans, funding opportunities and greater collaboration between water agencies, non-governmental organizations, and local land use authorities are facilitating beneficial projects such as conservation, open space, restoration, enhancement, connectivity, and multi-benefit approaches. In this way, planners are finding themselves in a new place, one of noting the quality of these projects and how to get them through the regulatory planning process with more agreement and greater speed. State law is helpful in this process because Conservation, Safety, Open Space, and Land Use Elements are required elements of every General Plan in the State of California. These elements provide essential components of good watershed plans. In addition, newly proposed Fire Hazard Planning, as well as the more traditional floodplain management guidelines for preparation of General Plans include helpful explanations and instructions for planners trying to make sense of how watershed planning can be and should be integrated into General Plan Updates.

In developing regional plans and prioritizing multi-benefit projects, it is important to not only coordinate efforts with other planning agencies within the region, but it is equally important to coordinate across regional boundaries. During the preparation of the OWOW 2.0 Plan, SAWPA staff exchanged information and discussed priorities with planners from regions adjoining the Watershed. For example, SAWPA staff coordinated closely with planners and project proponents in south Orange County, the Los Angeles and San Gabriel River Valleys, Upper Santa Margarita, Mojave and Coachella Valley regions.

## Collaborative Efforts within the Santa Ana River Watershed



SAWPA, as the leading regional water resource agency for the Santa Ana River Watershed and region, plays a major role in administering, participating, coordinating, and facilitating efforts to address regional water management issues. In fact, since its formation, this has been one of the major purposes of SAWPA in supporting the resolution of water issues and conflicts, and is one of the primary reasons why it was formed in the first place. From the early 1930s to the late 1960s, litigation occurred between upstream and downstream water agencies in the watershed over water rights issues affecting the Santa Ana River, and an adjudicated settlement occurred. As part of the recommendations for the adjudicated settlement, the need for a way to resolve regional differences and conflicts in a cooperative approach was suggested and realized by the creation of SAWPA. The cooperative approach exists today by the regular meetings among the SAWPA member districts but also among the many multi-agency and multi-organizations that SAWPA supports through what is described as the "SAWPA Roundtable".

The results of the Nitrogen and TDS Task Force, the Emerging Constituents Program Task Force and many others serves as an outstanding template for collaboration and was sighted by resolution of the Regional Water Quality Control Board and the State Water Resource Control Board Strategic Plan as an outstanding example of collaborative efforts to resolve water quality issues.

Utilizing the capable skills of SAWPA staff, multi-agency agreements are developed, consultant contracts are managed, and discussion meetings are administered. The end products of these efforts are successful programs and projects that represent the best in collaboration and facilitation support services. In addition, by the positive and cooperative relationship that SAWPA has with the Santa Ana

Regional Water Quality Control Board, SAWPA has served as an effective liaison between the regulators and regulated community in producing effective partnerships and working relationships.

The following task forces and workgroups are examples of watershed partnerships that SAWPA has administered and formed often with the Santa Ana Regional Board and represent positive steps toward integrated and collaborative solutions.



## Overview of Governing Laws, Judgments and Agreements

This section lists  mostof the governing laws, judgments, and agreements in place that have had significant influence on water management and addressed conflicts in the watershed.

- Settlement Agreement between City of San Bernardino and City of Riverside and Riverside Water Company, 1922
- Colorado River Compact, 1922
- Seven-Party Agreement, 1931
- Rialto Basin Judgment, 1961
- Chino Basin-City of Pomona Agreement, 1968
- Orange County/Chino Judgment, 1969
- Western/San Bernardino Judgment, 1969
- Western, Chino Basin, County of Riverside, Riverside County Flood Control and Water Conservation District Agreement, 1969
- Chino Basin-Western Agreement, 1970
- Endangered Species Act, 1973
- Santa Ana River-Mill Creek Cooperative Water Project Agreement, 1976
- Big Bear Municipal Water District/North Fork Water Co. Judgment, 1977
- Chino Basin Judgment, 1978
- San Bernardino-City of San Bernardino, City of Riverside Agreement, 1981
- San Bernardino-Western Agreement, 1981
- San Bernardino-Western, Orange County, Riverside, and San Bernardino City Agreement, 1985
- Monterey Agreement, 1994
- Big Bear Municipal and Valley District Agreement, 1996
- Chino Basin Peace Agreement, 2000
- Integrated Regional Water Management Planning Act, 2002
- Groundwater Management Planning Act, 2002
- Seven Oaks Accord, 2004
- Beaumont Basin Judgment, 2004
- Settlement Agreement with San Bernardino Valley Water Conservation District, 2005
- Memorandum of Understanding with the City of Riverside, 2005
- Chino Basin Peace II Agreement, 2008
- Soboba Water Rights Settlement Act, 2008
- Institutional Controls and Settlement Agreement (ICSA), 2004
- Agreement Relating to the Diversion of Water from the SAR System among WMWD, Valley District, and City of Riverside, 2004
- Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the SAR Basin, 2007
- Southern California Steelhead Recovery Plan, 2012

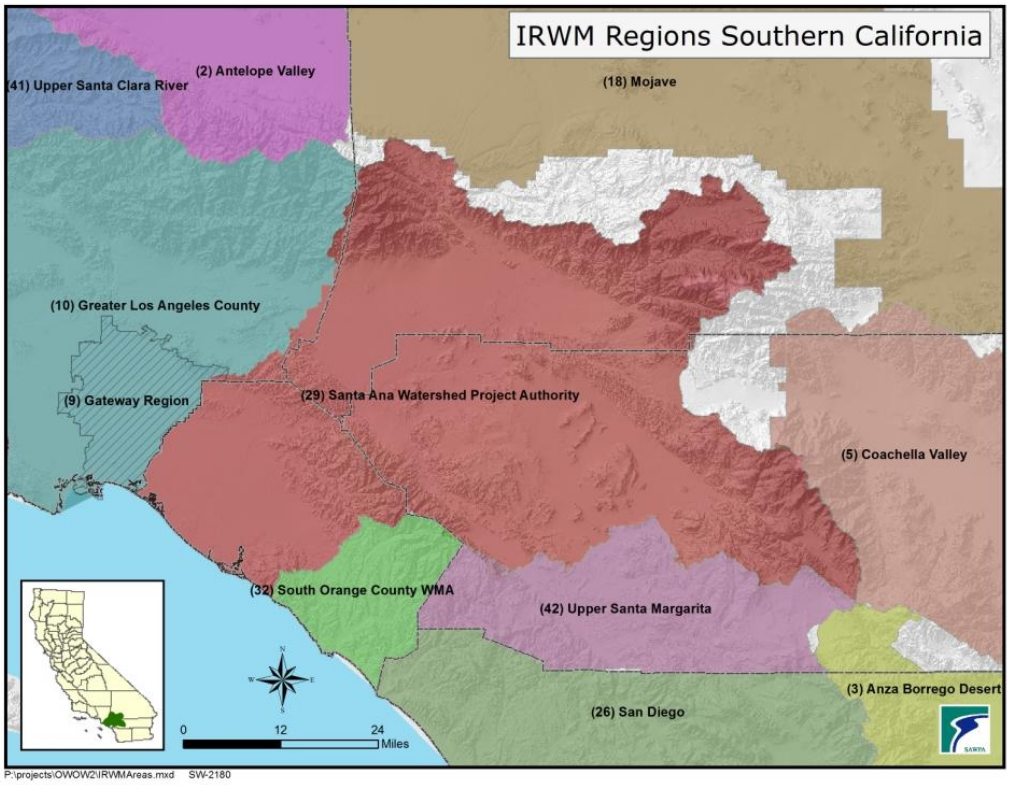


## Collaborative Efforts with Adjacent or Overlapping Areas to Watershed

The Santa Ana IRWM region is surrounded by six other IRWM regions, as shown in the map below, including: South Orange County Watershed Management Area, Upper Santa Margarita, Greater Los Angeles County, Gateway Region, Coachella Valley and Mojave.

SAWPA proactively seeks meeting with neighboring regions to share and stay abreast of critical issues, ongoing efforts, and opportunities for collaboration in the region. Under OWOW 2.0, SAWPA worked closely with the Upper Santa Margarita RWMG serving on their review panel for selecting a consultant to support their IRWM plan development. Through SAWPA staff's involvement on the Water Advisory Committee of Orange County, the Southern California Water Committee, Southern California Water Dialogue, and various other water resource forums, communication and collaboration about water resource planning has been conducted with all six other IRWM regions. When SAWPA conducted multiple climate change workshops working closely with the U.S. Bureau of Reclamation, invites were sent out to all neighboring IRWM regions as well as State and Federal agencies all impacted by the climate change and are currently conducting analysis on their own respective impacts. Feedback received from these surrounding and involved regions was that these workshops were extremely beneficial particularly as each continued development on their respective climate change adaptation plans under the IRWM planning.

Another forum in which SAWPA plays a significant role in promoting cooperation and coordination with other neighboring regions as well as IRWM regions across the State is through the Roundtable of Regions organization. This coalition of IRWMs allows all the regions to voice and discuss common issues and concerns and have worked closely with the CA Dept of Water Resources on many occasions.



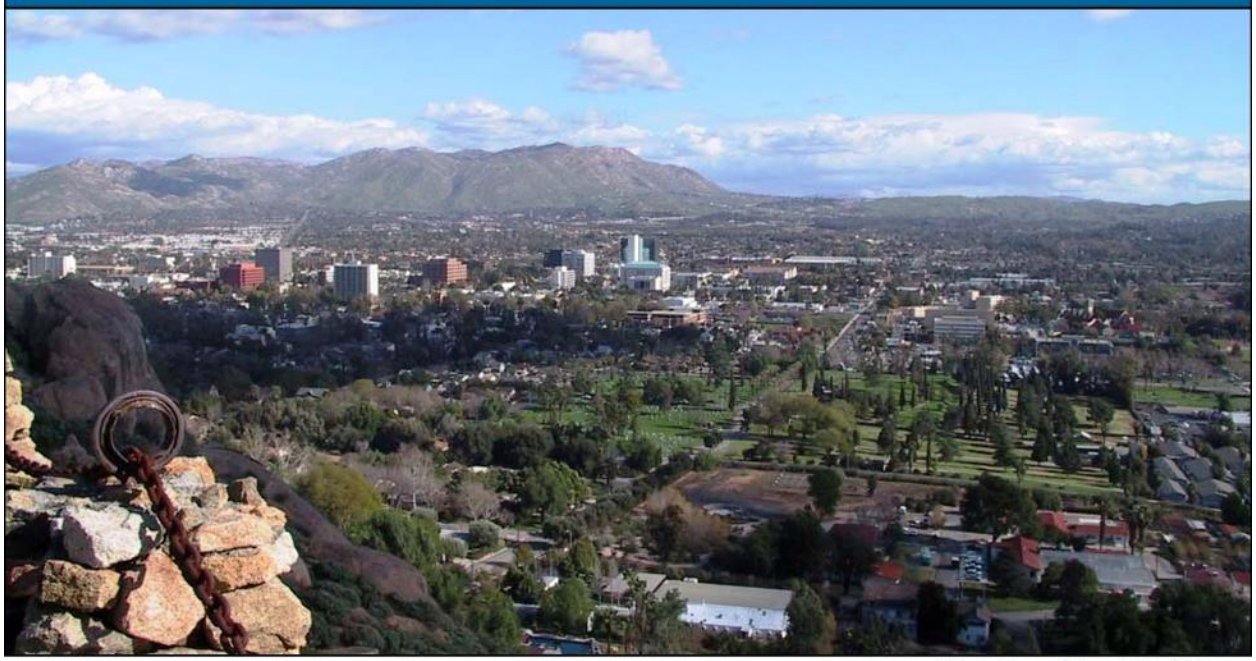
The Roundtable of Regions has conducted informational surveys, conducted collaborative workshops and conferences and provided important input to DWR on grant applications and other legislative issues affecting IRWMs. At the IRWM conferences, SAWPA has been very involved in the sponsoring, planning and speaking of the Roundtable of Regions events.

At the State level, SAWPA has also taken a prominent leadership role in assisting the visioning and strategic planning of IRWM for the State through its participation on a select focus group called the IRWM Strategic Plan Focus Group. Selected by his peers along with four other IRWM region staff, Mark Norton, Water Resources and Planning Manager for SAWPA, represents the 48 IRWM regions' voice at the meetings of the focus group. The focus group is designed to review and comment on DWR's planning approach for stakeholder outreach and engagement, validate DWR's efforts to collect, document and assimilate stakeholder input and provide preliminary review and feedback on strategic plan documents to ensure input is appropriately portrayed and addressed. The focus group is expected to serve in this role in 2013-2014.

Finally, the collaboration among neighboring regions has also on occasion led to interregional projects as in the case of the "Brine line to the Salton Sea". This conceptual project was conceived as an opportunity to transfer brine flow that is ordinarily sent to the ocean for disposal as a resource to the inland water body, the Salton Sea located in the Coachella Valley and outside the Santa Ana River Watershed. This brine flow could be delivered to the Salton Sea to help stabilize water levels at the sea and provide water for playa dust abatement. With brine flow concentrations coming out of the Santa Ana River Watershed at 5000-6000 mg/L TDS, these concentrations are far lower than the ambient salt levels of the Salton Sea at 55,000 mg/L and could actually be viewed as a benefit. In discussions of this conceptual project, several meetings were held by SAWPA with the US Bureau of Reclamation, Colorado River Regional Water Quality Control Board, the Salton Sea Authority and representatives from the Coachella Valley IRWM region who are also working to update their IRWM plan. The brine line to the Salton Sea project would involve the construction of a brine disposal pipeline heading east out of the Santa Ana River Watershed and would traverse portions of the Coachella Valley IRWM region to the Salton Sea. In addition to Salton Sea water level stabilization, potential benefit of a new brine disposal pipeline to help dispose of brine from future groundwater desalination from Coachella Valley groundwater basins was also discussed. An appraisal level analysis is described and included under **Chapter 5.5.1 Brine Line to the Salton Sea**.

Though the project at this stage still needs much further study and evaluation, the project serves as an effective demonstration of an inter-regional cooperative project among two neighboring IRWM regions initiated by SAWPA that could enhance efficiencies and help solve salt issues facing both regions.

# 3.0 Watershed Setting



View from Mount Rubidoux
City of Riverside

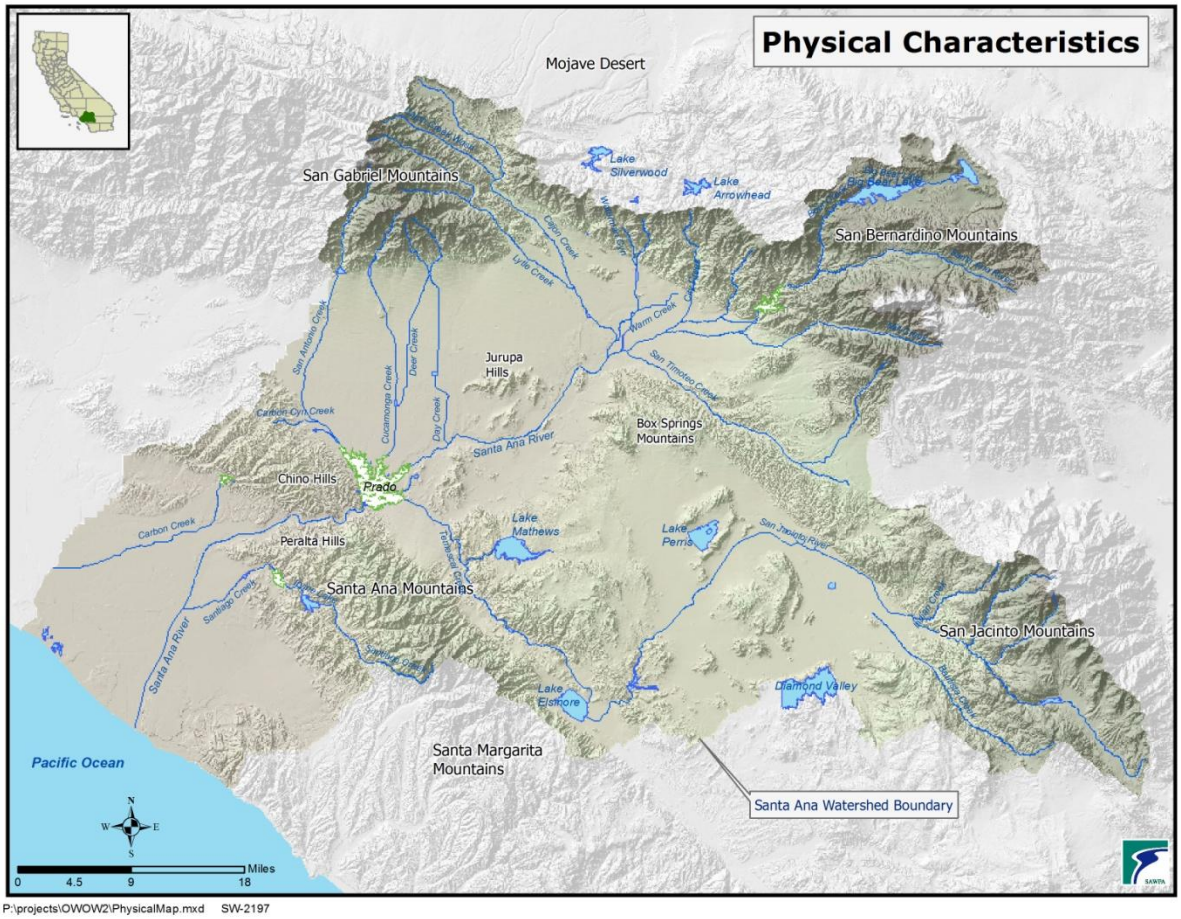
## Physical Setting

Dunne and Leopold (1978) define a watershed as an area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel.

The Santa Ana River (SAR) Watershed, depicted in **Figure 3-1**, drains a 2,650 square-mile area. The watershed is home to over 6 million people and includes the major population centers of parts of Orange, Riverside, and San Bernardino Counties, as well as a sliver of Los Angeles County.

The Santa Ana River flows over 100 miles and drains the largest coastal stream system in Southern California. It discharges into the Pacific Ocean at the City of Huntington Beach. The total length of the SAR and its major tributaries is about 700 miles.

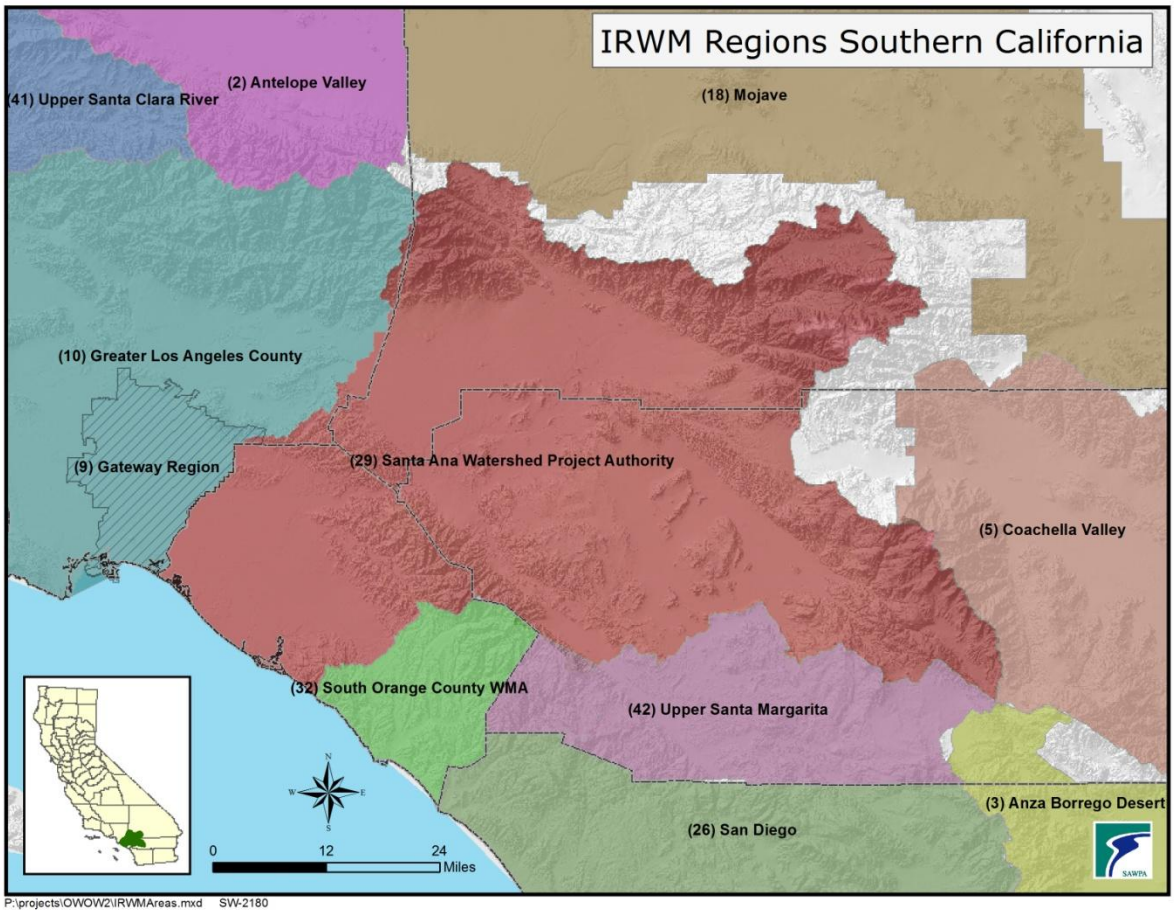
**Figure 3-1 Santa Ana Integrated Regional Water Management Region**




The watershed boundaries nearly match the boundaries of the Santa Ana Regional Water Quality Control Board, an organization with whom the Santa Ana Watershed Project Authority (SAWPA) has worked closely with for many years. In addition, its boundaries match the Integrated Regional Water Management (IRWM) region and the recognized Santa Ana Funding Area, as defined by the Proposition 84 IRWM program. Although there are many sub-watershed planning efforts, One Water One Watershed 2.0 (OWOW) attempts to bring all these efforts, as well as all different jurisdictions in the watershed, into a single watershed-wide vision. Over the years, SAWPA has participated in the development of sub-regional IRWM plans, with the understanding that such plans would be complementary to OWOW.

In addition, SAWPA proactively seeks meeting with neighboring regions, shown in **Figure 3-2** to share and stay abreast of critical issues, ongoing efforts, and opportunities for collaboration in the region.

**Figure 3-2 Santa Ana IRWM Neighboring Regions**

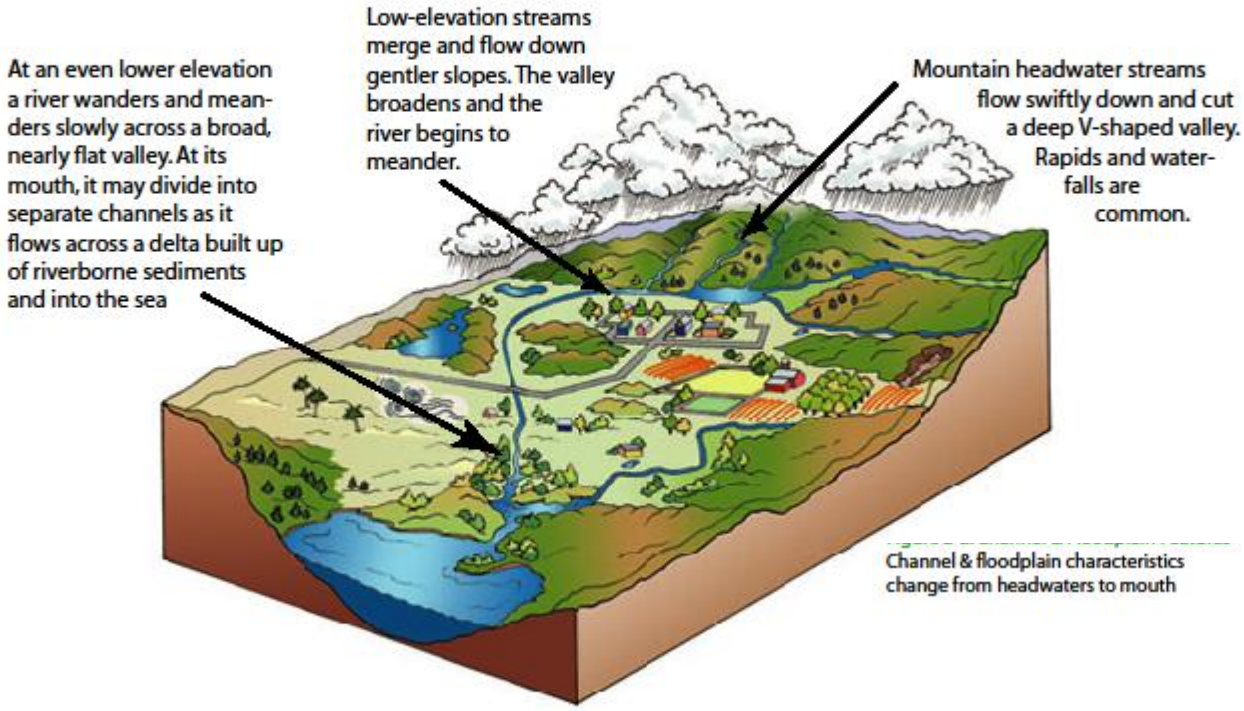



A more detailed write up on regional collaboration is included in **Chapter 2 Governance, Outreach and Integration.**

## Hydrology, and Geomorphologic Features of the Watershed

Much of the movement of materials, energy, and organisms associated with the channel environment and adjoining upland environment depend on the movement of water within the Watershed. To the extent that this movement is altered, so does the potential exist for the system to become "dysfunctional" for species that depend on it. That is, alteration of water movement via damming or channelization can reduce ecosystem functionality. Refer to **Figure 3-3** for an illustration of water and sediment transport throughout a watershed.

**Figure 3-3 Water and Sediment Transport through the Watershed**




Today, only 20% of the SAR is a concrete channel, the majority being near the mouth of the river. Discharge from publicly owned treatment works (POTWs) have changed natural surface flows and provides base flow in many parts of the Santa Ana River's drainage network. This treated wastewater has altered the natural system by providing year-round river flow. As populations have increased, urban runoff and wastewater flows have increased. Between 1970 and 2000, the total average volume rose from less than 50,000 to over 146,000 acre-feet per year (AFY), as measured at the Prado Dam. Base flow is expected to rise to 370,000 AFY by 2025, a projected increase of 153 percent since 1990.

The geologic and hydrologic features of the watershed or geomorphology – the study of the classification, description, nature, origin, and development of present landforms and their relationships to underlying structures – and of the history of geologic changes as recorded by these surface features includes the following features. The upper watershed or headwaters, including the highest point in the drainage system, is delineated by the east-west ridgeline of the San Gabriel and San Bernardino Mountains. Over this ridgeline lies the Mojave Desert, which is part of the Lahontan Basin. This upper "erosion" zone of the watershed has the highest gradient, highest erosion level of new sediment to the system, and fastest stormwater runoff. As flows consist mainly of snowmelt and storm runoff from the undeveloped land in the San Bernardino National Forest, water quality tends to be high, with low concentrations of total dissolved solids (TDS), nitrates, and other pollutants. In this zone, the SAR channel is confined in its lateral movement, contained by the slope of the high, mountainous terrain. Within the upper watershed, the SAR and its tributaries travel around large boulders and over sand and gravel bars punctuated by pools and riffles reaching depths of about six feet.

In addition to the SAR, several other important watersheds make up the Santa Ana River basin. The Newport Bay sub-watershed encompasses an area of approximately 154 square miles. The sub-watershed is bounded to the north by the Santiago Hills (Loma Ridge) and to the south by the San Joaquin Hills. The Tustin Plain, a broad alluvial valley, occupies the major portion of this watershed. The Newport Bay sub-watershed is within the United States Geological Survey (USGS) hydrologic unit no. 18070204. The Newport Bay sub-watershed is composed of the San Diego Creek sub-watershed, with an area of 119 square miles, which is the largest system draining into Upper Newport Bay. The Santa Ana-Delhi Channel drains 17 square miles and Big Canyon Wash drains 2 square miles. The remaining 16 square miles are divided among several small sub-watersheds that discharge into lower Newport Bay.

Two other important watersheds in the Santa Ana region include the Anaheim-Bay Huntington Harbor (AB-HH) and Lower San Gabriel River/Coyote Creek. The AB-HH watershed encompasses an area of 81 square miles. The main surface water systems that provide drainage in this watershed are the Bolsa Chica Channel that provides drainage to the Anaheim Bay-Huntington Harbor Complex; and the East Garden Grove-Wintersburg Channel that carries flow to Bolsa Bay and ultimately to Huntington Harbor. The Coyote Creek Watershed encompasses an area of 85 square miles within the Santa Ana region. This watershed is located in the northernmost portion of the County of Orange. This watershed straddles the Los Angeles and Orange County border in its upper reaches and then continues through Orange County until it discharges into the San Gabriel River in Long Beach.

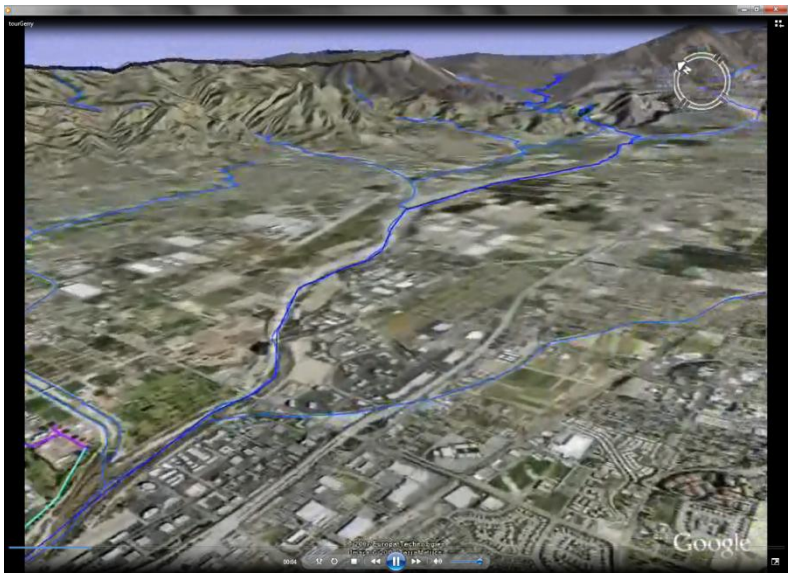
Sedimentary and crystalline materials from the upper watershed move down slope through a process fed by storm pulses; therefore, sediment does not move at a continuous speed. River flow from Seven Oaks Dam to the City of San Bernardino consists mainly of storm flows, flows from the Lower San Timoteo Creek, and groundwater that is rising due to local geological features. From the City of San Bernardino to the City of Riverside, the river flows perennially and much of the reach is operated as a flood control facility. The principal tributary streams in the upper Watershed originate in the San Bernardino and San Gabriel Mountains. These tributaries include San Timoteo, Reche, Mill, Plunge, City, East Twin, Waterman Canyon, Devil Canyon, Cajon Creeks, and University Wash from the San Bernardino Mountains; and Lone Pine, Lytle, Day, Cucamonga, Chino, and San Antonio Creeks from the San Gabriel Mountains.

From the City of Riverside to the recharge basins below Imperial Highway, river flow in Orange County consists of highly treated POTW effluent, urban runoff, irrigation runoff water, imported water applied for groundwater recharge, and groundwater forced to the surface by underground barriers (SAWPA, March 2004). Near Corona, the SAR cuts through the Santa Ana Mountains and the Peralta-Chino Hills, which together form the northern end of the Peninsular Ranges in Southern California. The SAR then flows down onto the Orange County coastal plain where the channel lessens in gradient, the valley floor is reached, and the soft features of the channel where sediment has deposited are more prevalent. Floodplains are strewn with boulders and characterized by sand and gravel washes. Within this valley floor, the transport and depositional processes are less confined by higher terrain as water, dissolved material and sediment move toward the sea. Over time, aquatic and terrestrial wildlife have adapted to this dynamic process and channel form. However, rapid urbanization has artificially increased the rate of

sedimentation and loss of habitat in this part of the watershed, negatively affecting water quality and wildlife habitat.

A visual "fly-through" of the Santa Ana Watershed is available here:
http://www.youtube.com/watch?v=HXDQCXKP6lM

**Figure 3-4 Watershed Flythrough**



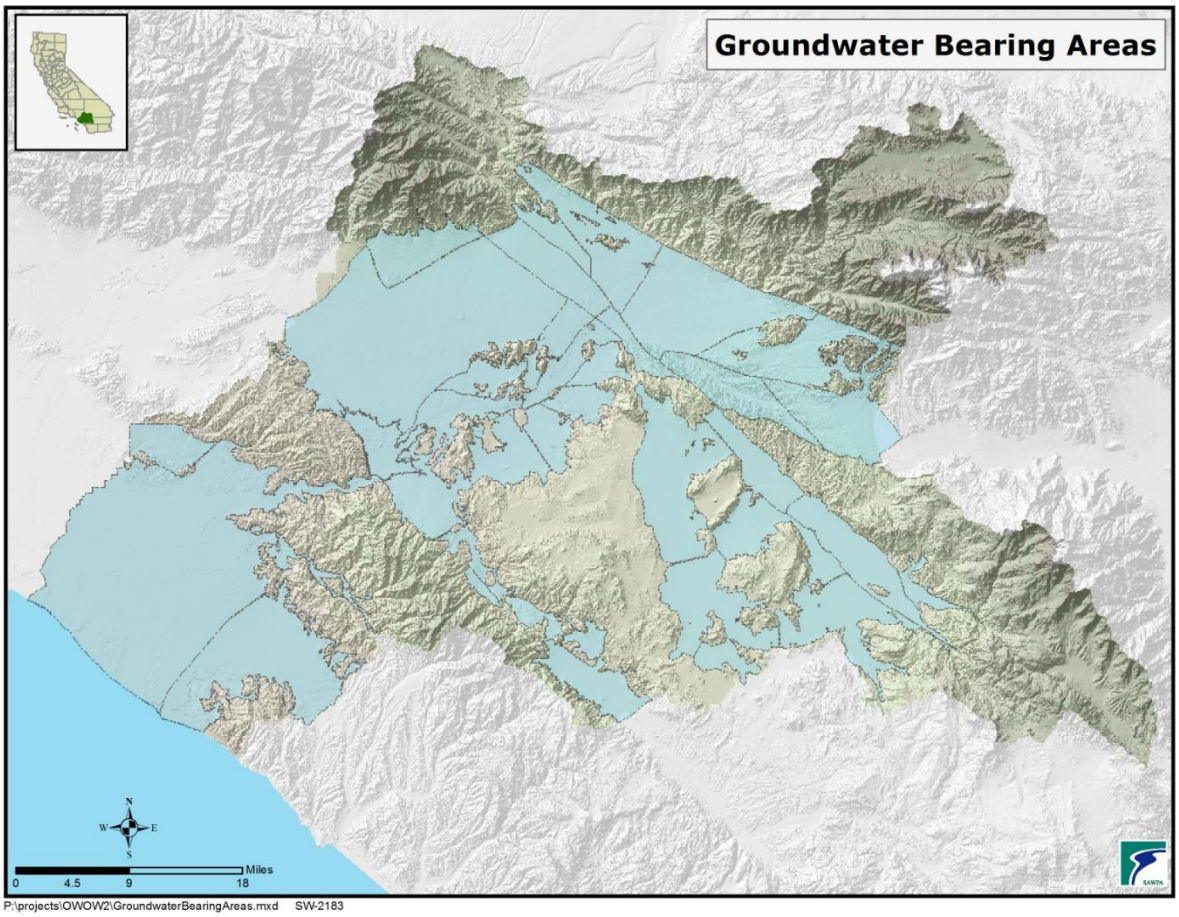

In the southern portion of the watershed, the regional boundary divides the Santa Margarita River drainage area, which is not part of the watershed, from that of the San Jacinto River. The San Jacinto River, which is part of the Watershed, starts in the San Jacinto Mountains, runs westerly through Canyon Lake and normally ends in Lake Elsinore. In wet years, the San Jacinto River will overflow the lake and connect with the SAR through the Temescal Wash. Flood flows from the San Jacinto River produce a broad, shallow wetlands area called Mystic Lake.

The Orange County coastal plain is composed of alluvium derived from the mountains. Upstream from the Santa Ana Canyon lay Prado Dam and Prado Wetlands; SAR flows are passed through the Prado Wetlands to improve water quality and remove nitrates before being used for Orange County Groundwater Basin recharge. Santiago Creek, the only major tributary to the lower SAR, joins the SAR in the City of Santa Ana. The lower limit of both the groundwater recharge area and the SAR's ordinary flows is 17$^{th}$ Street in the City of Santa Ana. Prior to channelization of the lower part of the SAR, the channel used to meander slowly across broad flood plains. Currently, the SAR is a concrete channel from 17$^{th}$ Street in the City of Santa Ana to Adams Avenue in Huntington Beach. The riverbed is ordinarily dry from 17$^{th}$ Street in the City of Santa Ana to the Victoria Street Bridge. The Greenville-Banning Channel, which carries stormwater discharge and urban runoff, is channelized to the Victoria Street Bridge where it joins the SAR. Discharge from the Greenville-Banning Channel combines with tidal flow from the Pacific Ocean and the SAR is wet from the Victoria Street Bridge to the mouth of the SAR.

## Groundwater

Groundwater in the watershed is highly controlled by the geology of the area, in both the configuration of bedrock and by the extensive faulting. Most groundwater basins are unconfined, much like a bowl full of sand that has water poured in halfway, see **Figure 3-5**. However, the variable depth to bedrock, and the presence of faults cause pressure zones where water flows towards (or to) the ground surface. In general, groundwater flows the same direction as surface waters from the mountains in the east/north to the Pacific Ocean in the west. There are about 40 groundwater basins in the watershed (depending on how they are defined and boundaries are drawn); many are inter-related. Some of the largest groundwater basins include the Chino Basin (Chino/Ontario/Fontana area), the Orange County Basin, the Bunker Hill Basin (San Bernardino), the San Timoteo Basin (Yucaipa/Banning/Beaumont area), and the San Jacinto/Hemet Basins.

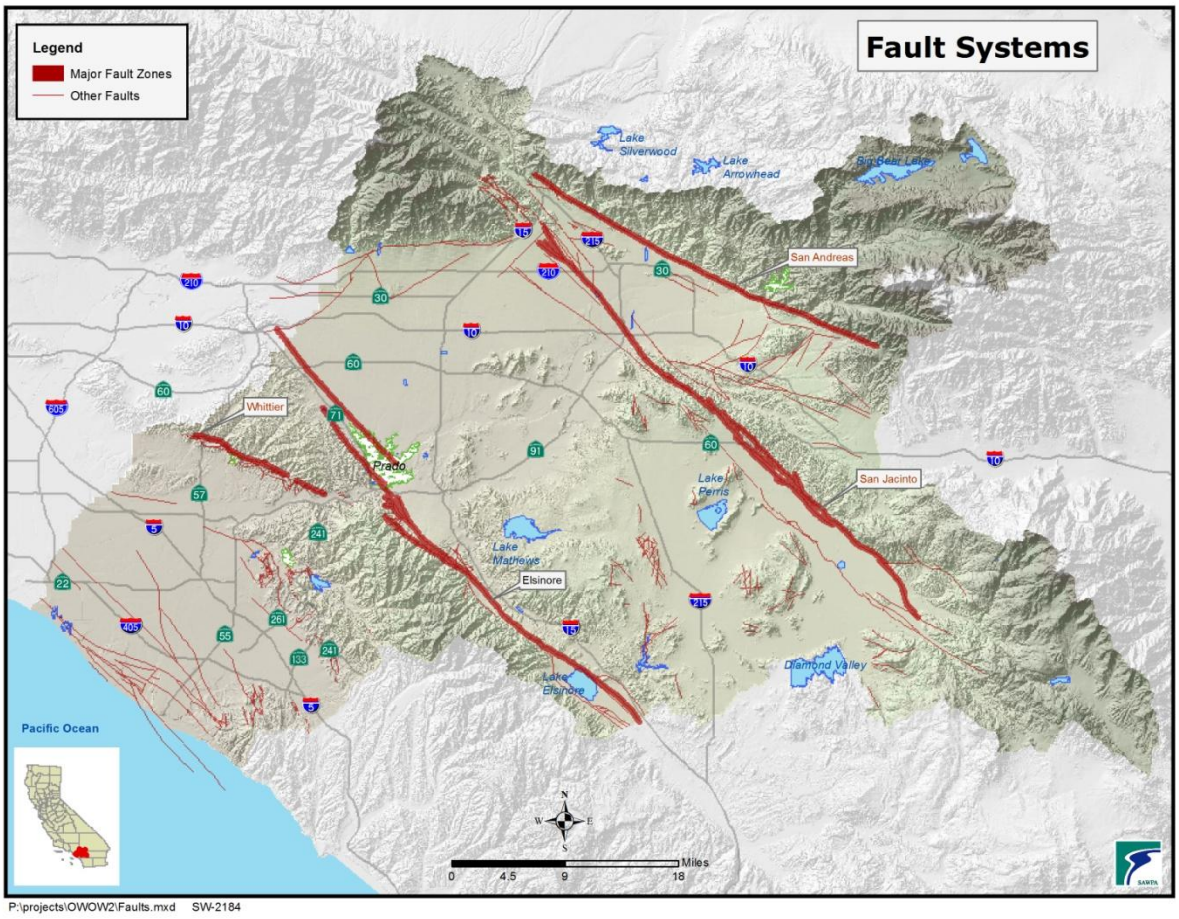
**Figure 3-5 Groundwater Basins**




Four primary faults transverse the watershed, with other minor faults either branching off of, or running parallel to, the major faults **(Figure 3-6)**. Within the upper watershed, the San Andreas Fault divides the San Bernardino Mountains from the San Gabriel Mountains and branches off into the San Jacinto Fault near San Bernardino. Known as Southern California's most active fault, the San Jacinto Fault affects groundwater in the San Jacinto River and the SAR, forcing groundwater to the surface at the Bunker Hill

Dike. Toward the central watershed, the Elsinore-Whittier Fault passes under the Prado Dam from the northwest to the southeast. Toward the coast, the Newport-Inglewood Fault enters the region from the Los Angeles area and passes offshore near Newport Beach.

**Figure 3-6 Fault Systems**

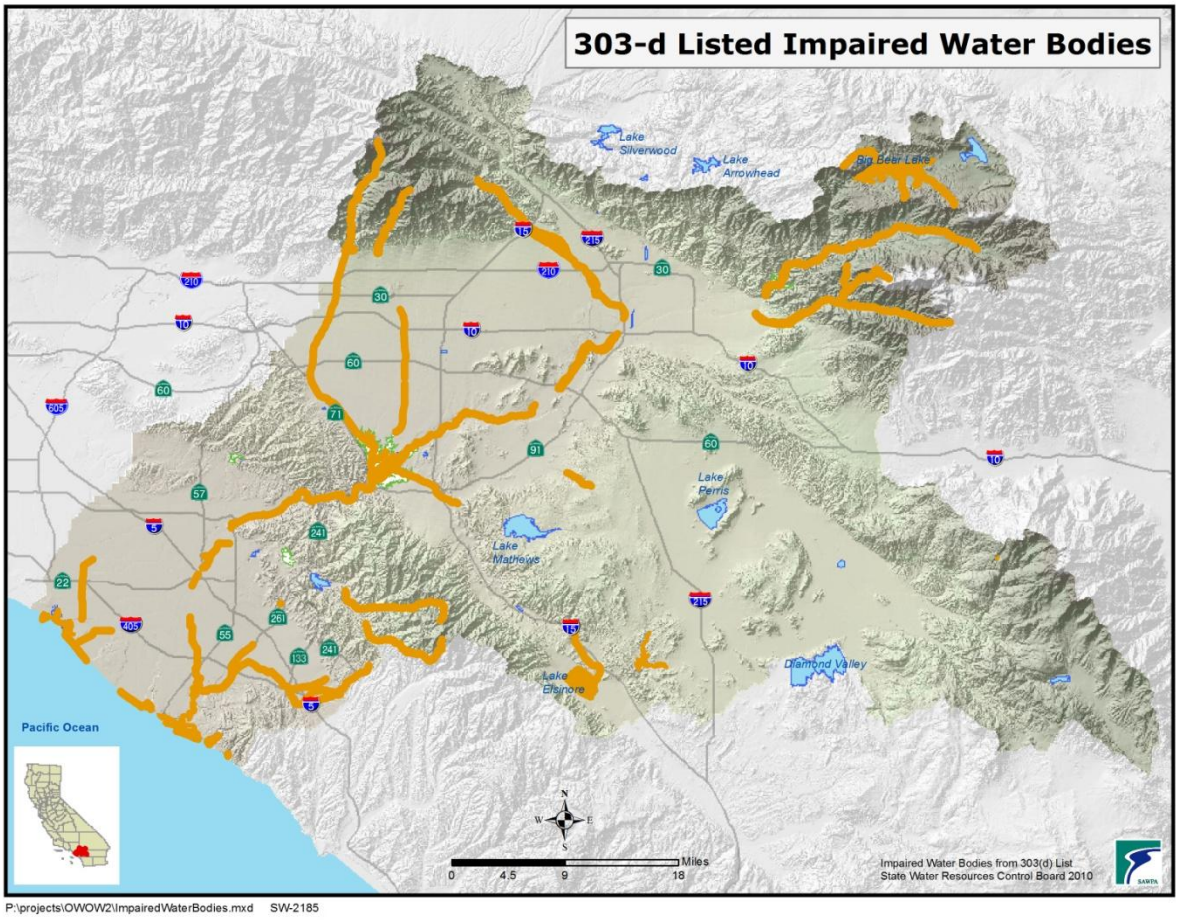



## Water Quality

Fortunately, water quality in the SAR has improved in recent years due to technological developments and water quality planning. Most of the native fishes of the Watershed are adapted to clear, unpolluted water that can support food resources and provide the various habitat conditions necessary to complete their respective life cycles. While fish kills, due to the spill of toxic substances into streams, are dramatic examples of the effects of pollution, these instances are acute, or short-term, rather than chronic. More insidious, however, are the chronic effects on aquatic resources of non-lethal forms of pollution that decrease growth, inhibit reproduction, or impair movement. Chronic elevated water temperatures or high sediment loads are an example of this type of pollution, even though toxic chemicals are not involved. Other examples include elevated but non-toxic levels of ammonia, increases in salinity, and low levels of dissolved oxygen (DO). Because most of the remaining native freshwater fishes live, at some time, in treated wastewater, the issue of chronic, low-level pollution is of great concern, although

the quality of wastewater has increased markedly in past years. Impaired water bodies can be seen in **Figure 3-7**.

**Figure 3-7 Impaired Waterbodies**

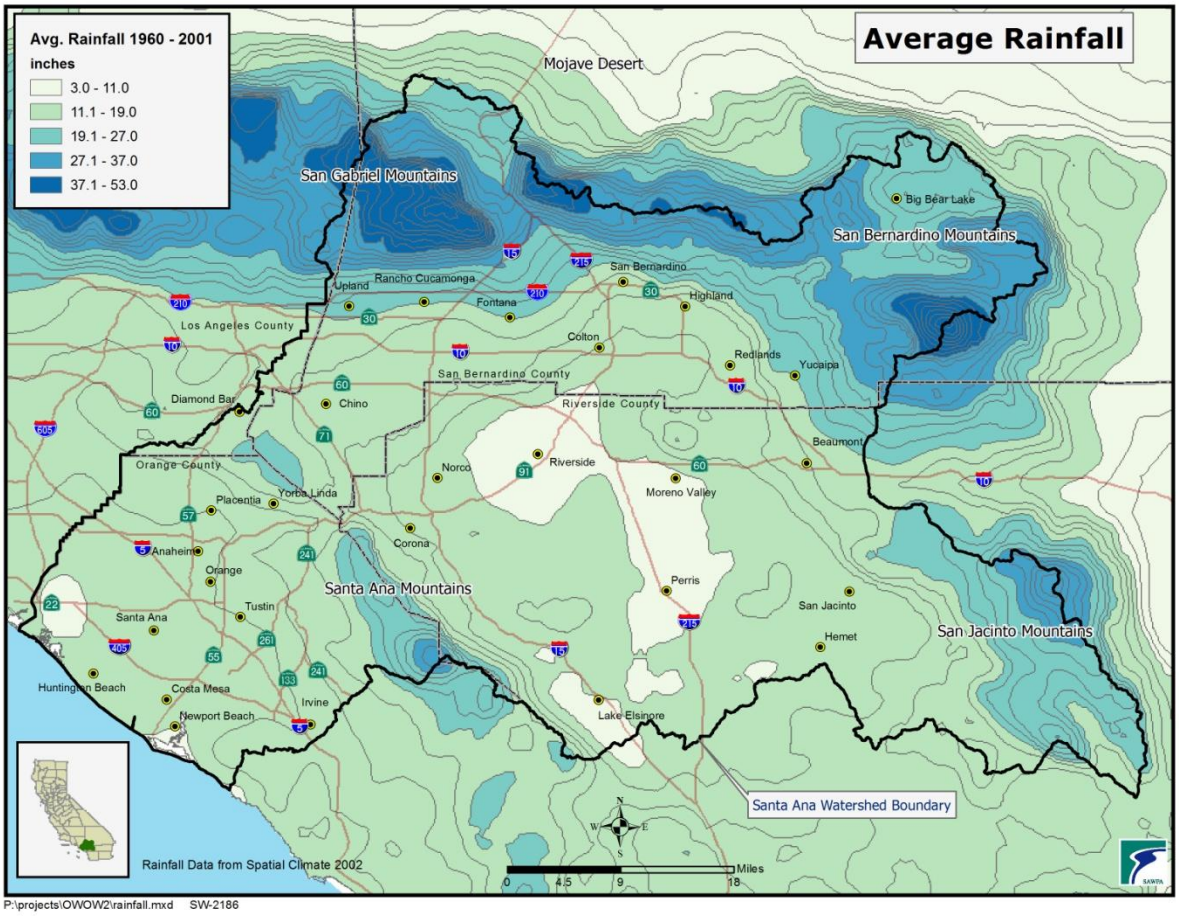



A more detailed write up on water quality issues in the Santa Ana Watershed is included in **Chapter 5.5 Beneficial Use Assurance**.

## Climate

The climate of the Watershed is considered Mediterranean with hot, dry summers, and cooler, wetter winters. Average annual precipitation ranges from 12 inches per year in the coastal plain to 18 inches per year in the inland alluvial valleys, reaching 40 inches or more per year in the San Bernardino Mountains (**Figure 3-8**). Most of the precipitation occurs between November and March in the form of rain with variable amounts of snow in the higher mountains of the Watershed. The climatological cycle of the region results in high surface water flows in the spring and early summer period, followed by typically low flows during the dry season. Winter and spring floods generated by precipitation in the high mountains are not uncommon. Similarly, during the dry season, severe thunderstorms in the high mountains periodically have generated torrential floods in local streams.

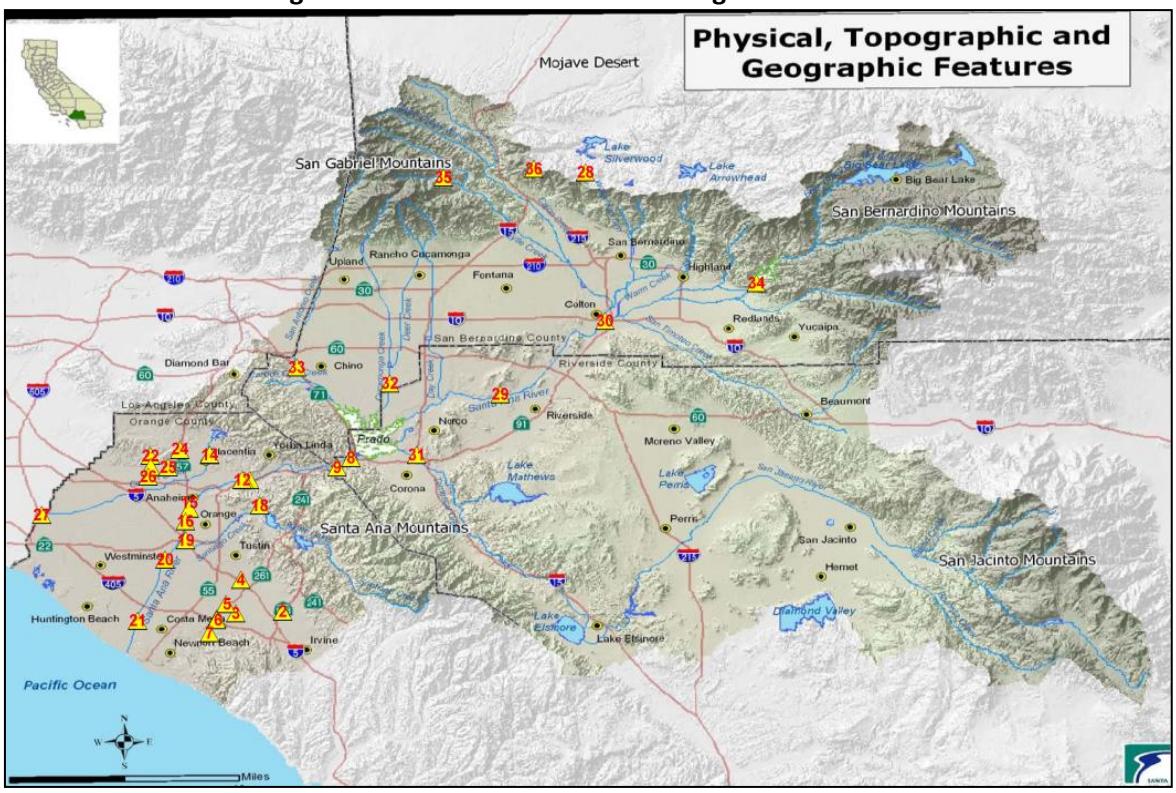
**Figure 3-8 Average Rainfall**




## Climate Impacts

Climate change-related impacts already have taken place in California, and are having an effect within the watershed. According to the Department of Water Resources (DWR), historic hydrologic patterns can no longer be relied upon to forecast the water future. As such, the reliability of the system of imported water that provides significant supply to the region has been lessened. Precipitation and associated runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions. The average early snowpack in the Sierra Nevada has decreased by about ten percent during the last century, representing a loss of 1.5 million AF of snowpack storage. During the same period, the sea level rose seven inches along California's coast. The state's temperature also has risen 1 degree Fahrenheit. Most of the increased temperature readings are at night and during the winter season, with higher elevations showing the greatest increase. Rainfall has become increasingly variable, with Southern California experiencing both its driest and wettest years on record within the past decade.

**Figure 3-9 Climate Model Monitoring Locations**




A more detailed write up on the impacts of Climate Change in the Santa Ana Watershed is included in **Chapter 5.13 Energy and Environmental Impact Response**.

# Habitat and Native Species

## Habitat

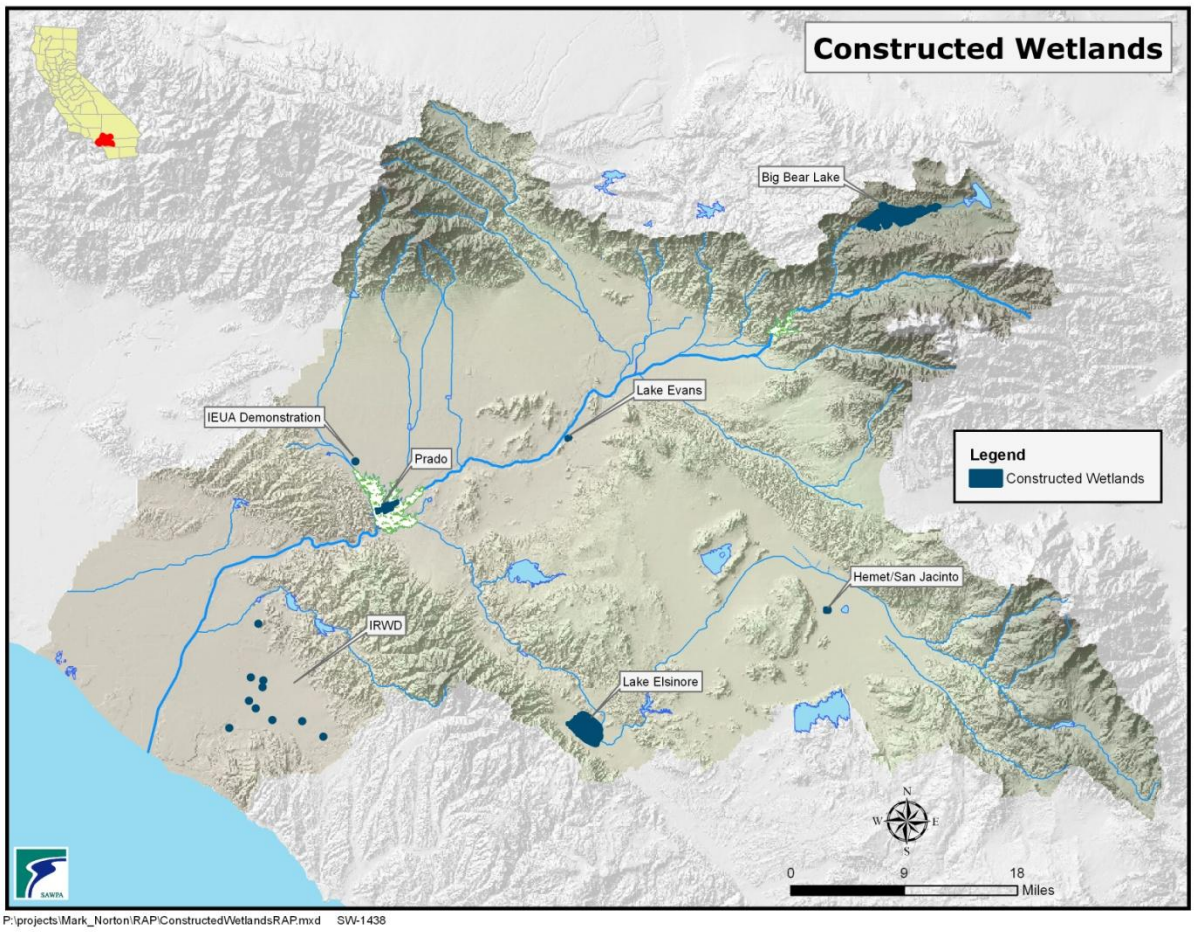
OWOW attempts to catalog the locations of many water-oriented habitats within the watershed. While there are several types of habitat within the watershed boundary that are not directly water-oriented (e.g., chaparral, pine forest, oak woodland, grassland), the primary focus is on water-oriented habitat types (e.g., alluvial fans, riparian woodland, emergent wetlands, vernal pools, lakes, streams, estuaries, tidelands, open ocean). These water-oriented habitats tend to show up on maps as the "corridors" that connect the larger, non-water-oriented habitats. Water-oriented habitats locations that are candidates for protection or enhancement are of particular interest.

## Wetlands

Constructed wetlands have a wide range of benefits, including surface water protection . Constructed wetlands designed to treat secondary effluent will directly affect the reclaimed water supply. If water produced from the wetlands is of suitable quality to be recharged into groundwater aquifers, diminishing groundwater resources can be supplemented, or in some areas, reclaimed water can be recharged as part of a groundwater remediation program. Located along the Pacific Flyway, the critical migratory corridor connecting Alaska and Canada to Latin America, Southern California wetlands provide

vital habitat for migratory waterfowl. Opportunities for wildlife enhancement were considered in the construction/preservation of many of the following wetlands with environmental features that increase habitat diversity and wildlife productivity.

**Figure 3-10 Constructed Wetlands**




## Impacts to the Natural System

As noted by Moyle (2002), most of California's inland waterways today bear little resemblance to the streams and lakes encountered by the first European explorers and settlers. In the watershed, this observation is certainly true as flood control and channelization activities have left portions of streams channelized and concrete-lined where once riparian forests grew along a meandering stream. Fortunately, today only 20% of the SAR is concrete-lined. Dam construction and flood control activities were not the only factors influencing the watershed in ways that adversely impact habitat critical for aquatic resources. The following factors have also played a role:

- Stream channel alteration
- Draining of streams and lakes, especially adjacent wetlands

- Livestock grazing and the impact on aquatic and riparian vegetation, sedimentation, and water pollution
- Historical logging practices
- Bark Beetle infestation
- Mining, particularly in-stream aggregate mining
- Watershed changes resulting in cumulative affects to aquatic resources

A more detailed write up on issues relating to natural systems in the Santa Ana Watershed are included in **Chapter 5.9 Natural Resources Stewardship**.

## Forest

As home to the headwaters of the Santa Ana River, the San Bernardino and Cleveland national forests encompass approximately 29% of the Santa Ana watershed's land mass. These forest areas also receive 90% of annual precipitation. Runoff on that land directly affects the amount and quality of water received downstream**.** If there are too many trees, the water supply is reduced by their thirst and the amount of fire fuel is increased resulting in more intense fires which are more difficult to control and have a greater potential for incurring loss of property or life. Meadows, which act as nature's sponge retaining water for groundwater recharge, can dry up due to natural and manmade channelization prohibiting the potential benefit of this resource. Restoration of impaired meadows could restore their beneficial function. The benefit of chaparral has mixed perception, having good benefits for erosion control and water dispersion contrasted by negativity when viewed as excessive fire fuel, therefore a clear method of management has been elusive.

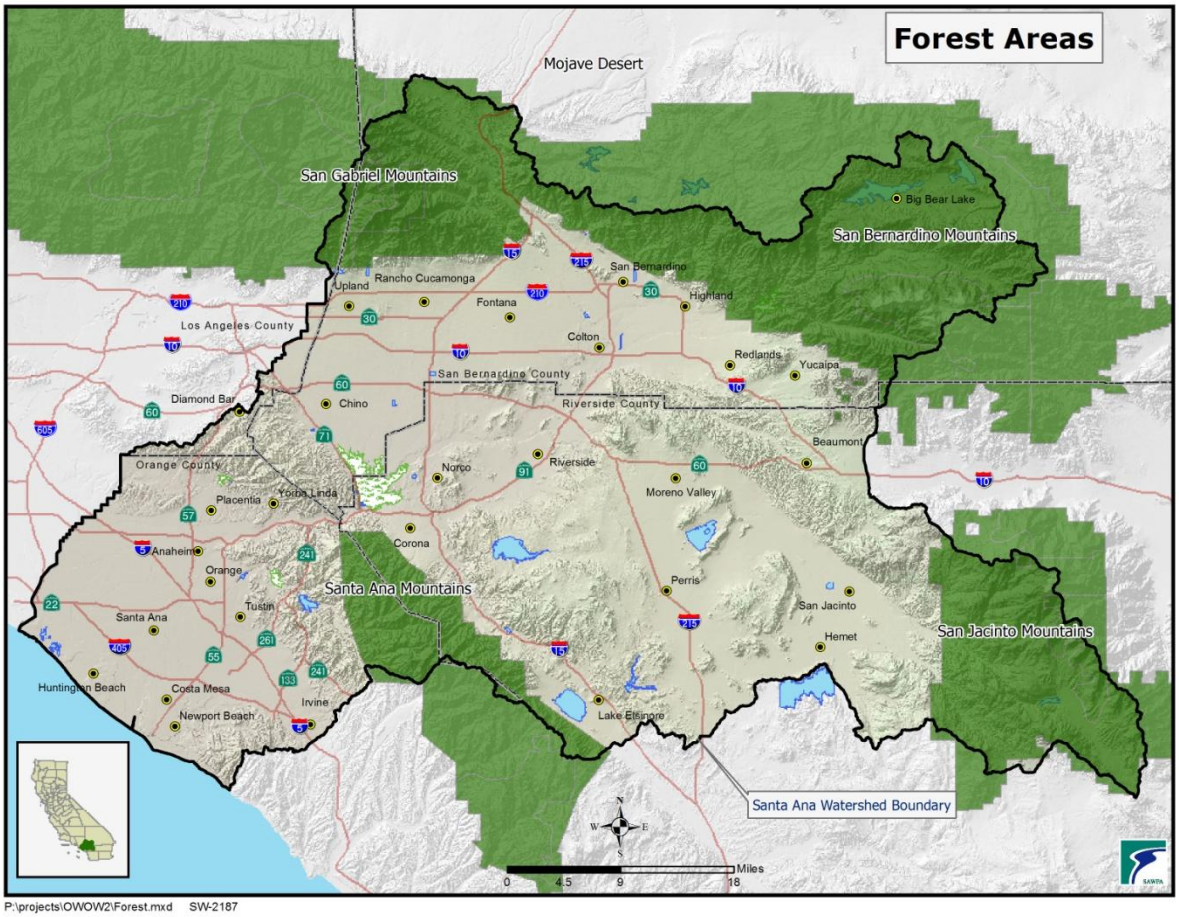
There are two forests under the management of the U.S. Forest Service within the Santa Ana River Watershed; San Bernardino National Forest and Cleveland National Forest. The combined area of these forests is approximately 1.1 million acres. The U.S. Forest Service is challenged with managing this vast area while striving to address the multiple goals of conserving habitat for sensitive and endangered species, hazardous fuels reduction and the restoration of meadows. However, their resources have been limited to proactive measures aimed at protecting urbanized areas in and adjacent to national forest land leaving a substantial quantity of land vulnerable to overgrowth and increased fire risks and intensity.

Fire is an ongoing risk faced by the U.S. Forest Service due to man's encroachment into forested areas as evidenced by the nearly 2,300 special use permits issued each year by the U.S. Forest Service. The variables in weather such as drought seasons and wind also contribute to fire risk. The combinations of variables that contribute to fire risk make predictions and planning for fire events problematic. Hard lessons were learned after the forests experienced devastating fires in the early 2000's and the aftermath of those fires directly impacted the quality of water downstream of the burn areas and it took between three and five years to recover.

A partnership is being pursed among downstream groundwater management agencies, flood control and water conservation districts, water supply agencies, resource agencies and the U.S. Forest Service to

find amicable projects that can be executed in specific areas within the forest that will have a direct effect in preserving the quality and quantity of water resources from the source or headwaters, contributing to the overall health of the watershed. Evidence of a quantitative cost/benefit analysis is being sought to validate investment in projects that when implemented will help the U.S. Forest Service to keep the forest healthy which will in turn promote a gain in both the quantity and quality of available water resources.

**Figure 3-11 Forested Areas in the Santa Ana River Watershed**




A more detailed discussion relating to the partnership between water agencies and the U.S. Forest Service are included in **Chapter 5.12 Government Alliance**.

## Native Riparian Species

### Fish

The SAR historically provided habitat for eight species of native fish (species have multiple forms). Only four native non-game freshwater fishes are currently found in non-estuarine waters: arroyo chub, Santa Ana Speckled Dace, Santa Ana Sucker, and Threespine Stickleback. All of these remaining fishes have limited distributions and face possible extirpation. As previously mentioned, the Santa Ana Sucker is

listed by the Federal government as a "threatened" species pursuant to the Endangered Species Act. Currently, the Western Brook Lamprey, Steelhead, and Unarmored Threespine Stickleback are known to be extirpated from the watershed. The Pacific Lamprey has been observed once in the past 47 years and it likely is extirpated as well. Introduced forms of the rainbow trout have been extensively stocked in the watershed for sport fishing for over 100 years, and it is unknown if any genetically pure rainbow trout stocks endemic to the watershed remain. The partially Armored Threespine Stickleback was widely planted in the watershed for mosquito control in the early 1900s and is now found out of its natural historical range, e.g., Big Bear Lake. In contrast, at least 33 fishes have been introduced into the watershed and are currently present. New species can be expected to be found at any time due to inter-basin water transfers, ship ballast water hitchhikers, bait bucket introductions, and hobbyists disposing of unwanted fishes. Many of the introduced fishes are widespread, while a few are restricted to specific locations or habitats. Of the current inventory of introduced fishes, most were introduced by government agencies to serve as a food resource, for insect control, for sport fishing, or to serve as forage for sport fishes. A smaller number of fish have become established after arriving inadvertently via inter-basin water transfers or in ships' ballast water. For a detailed discussion of the introduction of fishes to California, the reader is directed to Dill and Cordone (1997). Additional information about introductions of fishes to Southern California is presented by Swift *et al*. (1993). Supplemental records can be found in Moyle (2002).




**The Santa Ana sucker is a federally listed fish native to the Santa Ana River**

## Amphibians

During the last 50 years, population growth and urban development in Southern California has displaced many amphibian species, and encroached upon much of former amphibian habitat. Several species are thought to be extinct, and many others have fragmented populations, which are at risk of extirpation. Amphibians especially are sensitive to environmental changes that alter the hydrology, ecology, and geology of a region because they have evolved, highly specialized adaptations that have allowed them to exist in these relatively arid regions. Introduced species also have been a major contributor to the decline in amphibian populations in Southern California. These non-native species increase competition for food sources, as well as prey upon many of the native amphibians.

## Reptiles

The California Department of Fish and Wildlife (CDFW) considers the Southwestern Pond Turtle (*Clemmys marmorata*) a species of "special concern". Recent reports on *C. marmorata* in Southern California indicates that a few viable populations remain in the regions (see also Brattstrom 1988).

Approximately six to eight viable populations of the turtle remain south of the Santa Clara River system in California. Droughts have exacerbated the negative effects of habitat alteration accumulated over many years over much of this region from changes in land and water use, and abusive grazing practices. In particular, most western pond turtle populations examined in this region appear to show an age structure increasingly biased towards adults, indicating little or no recruitment is taking place. Recent surveys indicate that the southwestern pond turtle also is seriously threatened throughout most of its range outside of California.

## Birds

Riparian ecosystems harbor the highest number of bird species in the arid and semi-arid parts of the southwestern United States. Riparian habitat provides productive breeding grounds and offers vital over-wintering and migration stop-over areas for migrating birds. Loss and degradation of riparian habitat have negatively impacted bird populations throughout the watershed. Other factors affecting bird populations are brood parasitism by the brown-headed cowbird, and disruption of natural hydrological regimes from dams and levees.



**Least Bell's Vireo, a federally listed bird species**

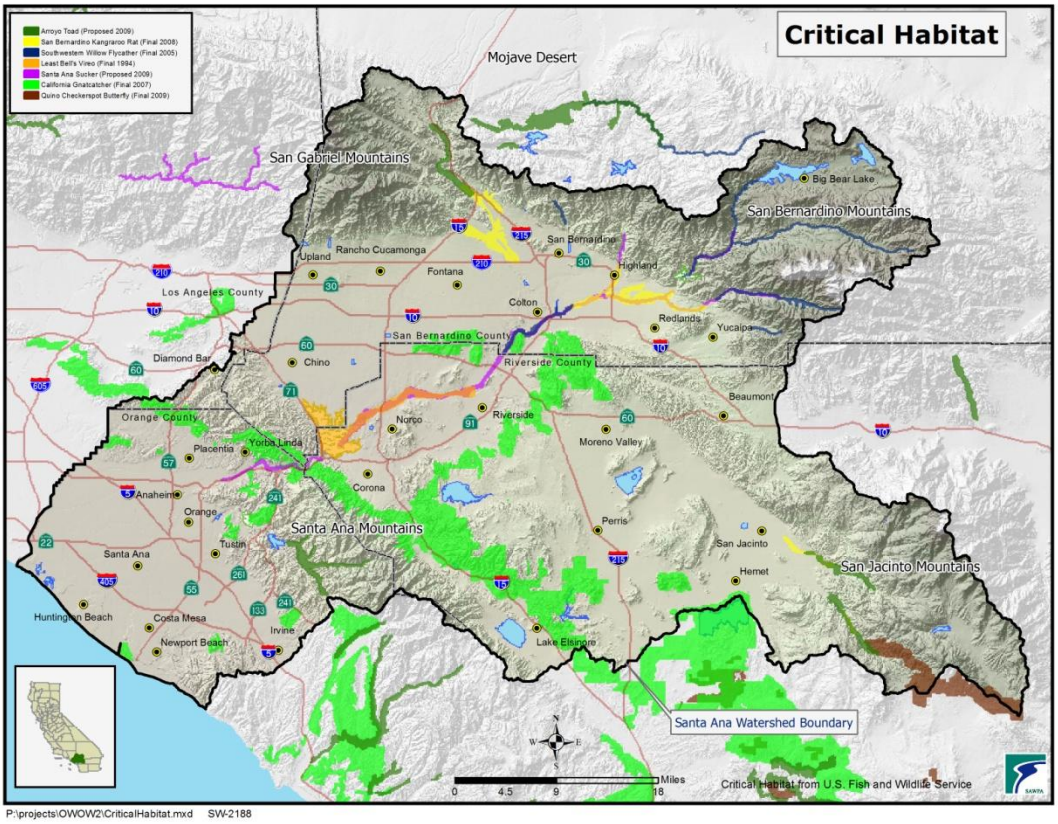
The Federally endangered Least Bell's Vireo has experienced recent population growth within the watershed due to aggressive management activities within Prado Basin and on adjacent lands. Within the basin, the population rose from 19 nesting pairs in 1986 to 123 nesting pairs in 1993. By the end of 1996, the count stood at 195 nesting pairs. This stunning recovery is due to the provision of a high quality habitat for the bird species, in part, due to invasive species removal, a project in place to control populations of the predatory cowbird, and efforts on the part of the U.S. Fish and Wildlife Service (USFWS) , Orange County Water District (OCWD), a number of Resource Conservation Districts (RCDs), and others.

The Federally endangered southwestern willow flycatcher also is affected by cowbird brood parasitism. The implementation of cowbird management programs in addition to preservation and restoration of riparian deciduous shrub habitat is needed to reduce current populations. The bald eagle, listed by the USFWS as endangered in 1978 has experienced population growth over the past two decades. The bald eagle could be considered a USFWS success story: reclassified as "threatened" in 1995 and first proposed for delisting in 2000. Delisting of a species is the USFWS's ultimate goal and only happens when specific recovery goals have been met for a species. Unfortunately, delisting is an infrequent occurrence. In the case of the bald eagle, delisting has been delayed while the USFWS determines how the species would be managed once it is no longer classified as threatened.

## Special Status Species

Second only to Hawaii, the State of California is home to the highest number of endangered species in the United States. As defined within the Federal Endangered Species Act of 1973, an endangered species is any animal or plant listed by regulation as being in danger of extinction throughout all or a significant portion of its geographical range. A threatened species is any animal or plant that is likely to become endangered within the foreseeable future throughout all or a significant portion of its geographical range. Federal law prohibits the "take" of any individuals or habitat of federally listed species without a special permit. In addition to federal laws, the State of California has its own California Endangered Species Act, with a separate listing of species and separate laws governing take of listed species. Enforcement of the Federal Endangered Species Act is administered by the USFWS and the National Marine Fisheries Service, while the CDFW enforces the California Endangered Species Act.

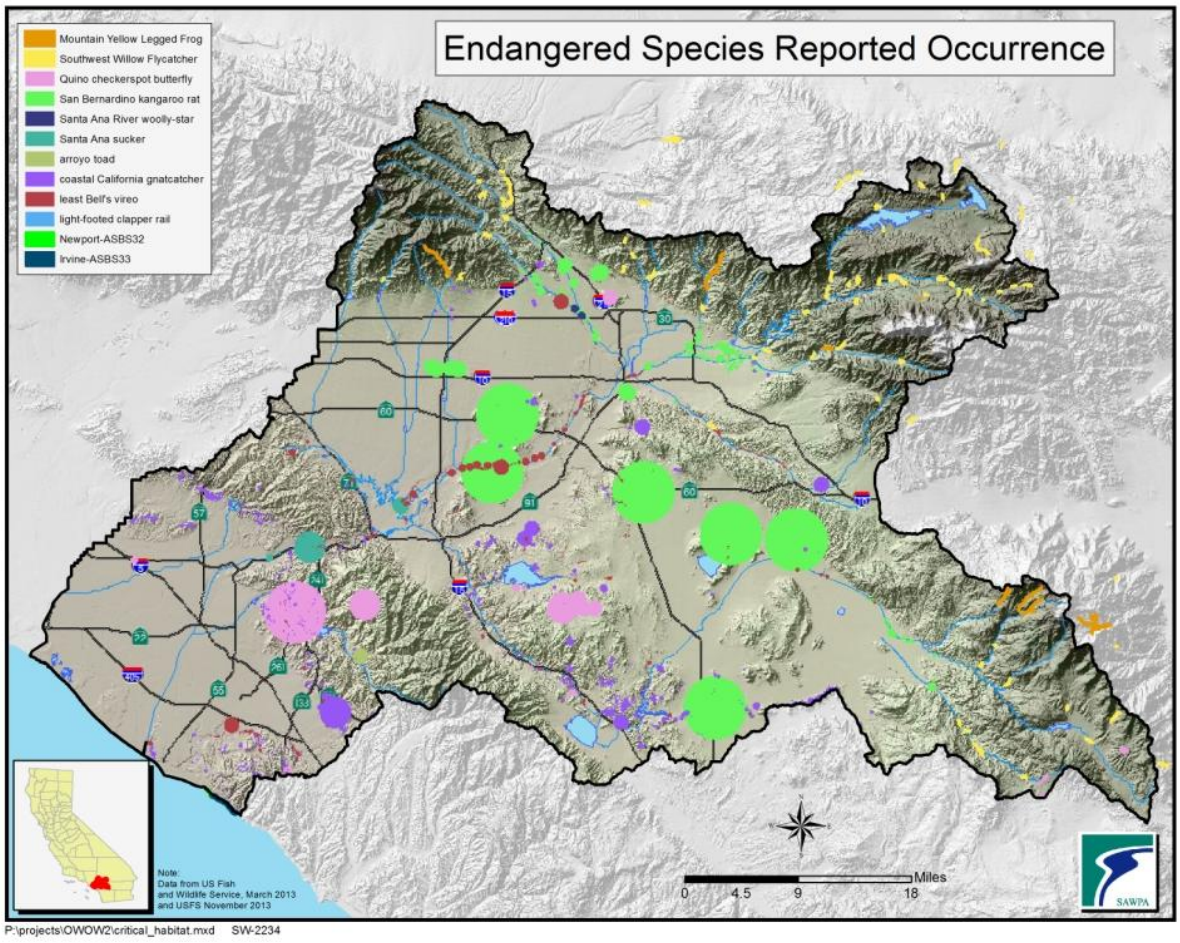
**Figure 3-12 Critical Habitat within the Watershed**




The varied geography and natural features of the Watershed provide habitat for a number of Federally and/or state-listed species. As OWOW 2.0 focuses on the resources in and around the SAR, listed species of concern herein are those that occupy aquatic, wetland, riparian, or riparian adjacent areas. Of these, two are plants – the Santa Ana River Woolly Star (*Eriastrum densifolium*) and the slender-horned spine flower (*Dodecahema leptoceras*); one fish – the Santa Ana River Sucker (*Catostomus santaanae*); one amphibian – the Arroyo Toad (*Bufo californicus*); three birds – the Least Bell's Vireo (*Vireo bellii pusillus*), the Southwestern Willow Flycatcher (*Empidonax traillii*), and the Bald Eagle (*Haliaeetus leucocephalus*);

two mammals – the San Bernardino Kangaroo Rat (*Dipodomys merriami parvus*) and Stephen's Kangaroo Rat (*Dipodomys panamintinus*); and one insect – the Delhi Sands Flower-loving Fly (*Rhaphiomidas terminatus abdominalis*). Any project or policy recommended by the Santa Ana IWP will need to assess potential impacts to listed species, and incorporate measures to avoid impacts to these species.

**Figure 3-13 Endangered Species Reported Occurrence**




## Factors Affecting Native Species

### Introduced Species

The 33 species of introduced fishes greatly outnumber the four remaining native fish species. The number of species, *per se*, is not the problem but, rather, the impact that introduced fishes and other aquatic organisms, have on the native fishes of the watershed. Introduced fishes have dramatically changed the composition of the watershed's fish community and now act as a deterrent to the restoration and enhancement of the native fishes that remain. The manner in which introduced fishes can affect the aquatic resources of the watershed are:

- Competition between native and introduced fishes for food and space
- Predation by introduced species on native fishes
- Habitat interference by introduced fishes that change habitat characteristics
- Introduction of diseases that may infect native fish or other aquatic animals
- Hybridization between closely related species

## Exploitation

Over-exploitation of rainbow trout/steelhead, primarily by angling, was a major factor in driving the native populations to low levels, and perhaps to extinction. Over-fishing, in turn, led to the stocking of hatchery fish and the introduction of various exotic species as angling alternatives to the native trout. The intensity of over-exploitation is illustrated by a report in the July 17, 1892 edition of the *Citrograph*, a Redlands newspaper, which reported that three boys fishing in Bear Creek, a tributary to the SAR in San Bernardino County, had caught 592 trout in three hours. Similar reports are common in the historical press.

It was not until 1872 that the California Legislature banned the use of nets, weirs, baskets, traps, explosives, and poisons as acceptable means of harvesting trout. Unfortunately, there was no one to enforce this statute, nor was there any limit on the number of fish that could be harvested by legal means. The over-exploitation of trout became such a problem in the watershed that in 1894, San Bernardino County, on its own authority, finally took action and limited the number of trout a person could catch to 50 per day. The State of California did not take similar action until 1905, when the harvest was limited to 50 trout per day and 25 total pounds. By then, the native stocks already had become depleted in the watershed.

Each of the aforementioned factors has acted in concert over a long period of time to reduce the native fish community of the Watershed to that which remains today. OWOW 2.0 recognizes that history cannot be undone and the aquatic community cannot be restored to its pre-settlement condition; however, a conservation strategy can be implemented that will ensure the long-term viability of the watershed's aquatic communities.

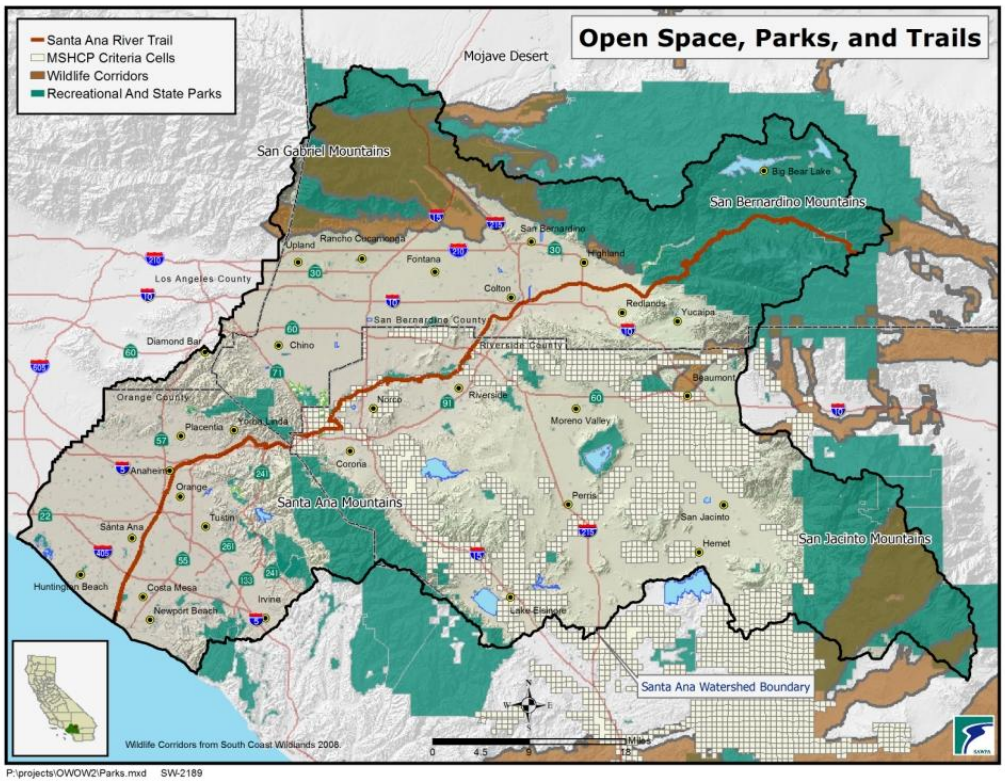
## Open Space and Recreation

The Santa Ana River Watershed is a stunning location with a wide variety of scenery and natural resources. It is a unique location, situated between the desert, mountains, and the sea. The watershed combines a complex arrangement of terrain, climates, and habitats that extend from the San Bernardino Mountains down to the Pacific Ocean.

Taking advantage of the watershed's beautiful landscape, the Santa Ana River Trail, highlighted in **Figure 3-14** links open space areas throughout the Watershed. Building the SART has been a highly successful collaborative effort and should be used as a model for other recreation projects in the future. The

SART's achievements only could have been accomplished through a variety of partnerships, combining the expertise and resources of multiple counties, cities and other groups.

**Figure 3-14 Recreational Opportunities within the Santa Ana River Watershed**



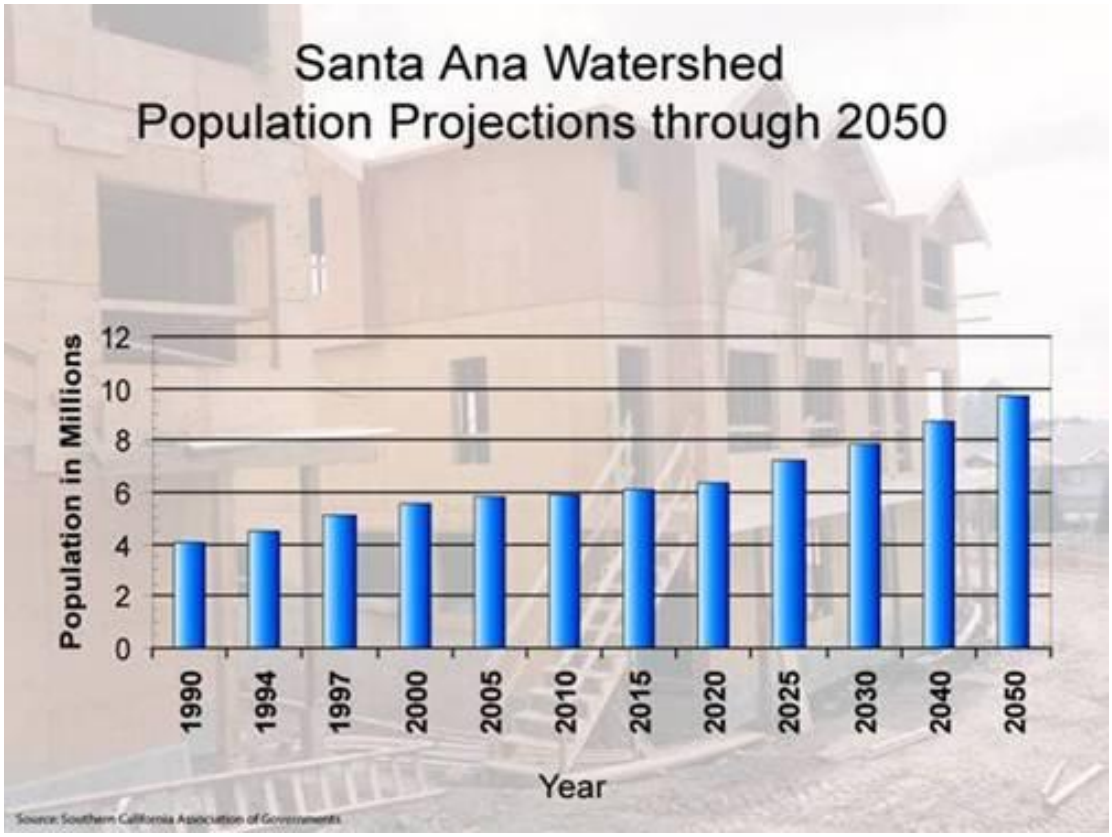

A more detailed write up on issues relating to recreational opportunities in the Santa Ana Watershed are included in **Chapter 5.9 Natural Resources Stewardship**.

# Watershed Demographics

## Population and Population Projections

The Santa Ana River Watershed has experienced significant population growth in recent years and is expected to continue growing at a considerable pace over the next 40 years. According to the U.S. Census Bureau, the watershed had a population of 5.9 million in 2010 and is expected to reach 9.9 million by 2050, or an average annual growth rate of 1.3 percent (**Figure 3-15**). The recent recession most likely will slow this growth rate substantially. Although recent Southern California Association of Governments (SCAG) reports show that the Santa Ana Watershed will continue to grow and reach long–term population estimates, the timeline is uncertain. Until the issues of higher unemployment and high-foreclosure rates within the region are resolved, population growth rates will be slowed.

**Figure 3-15 Population Projections**




Demographic estimates for the watershed indicate that much of future population growth will take place in Riverside and San Bernardino counties, as Orange County is fairly built out. According to the U.S. Census Bureau, Riverside County grew by 37.5% between 2000 and 2010 (or an annual average of 3.6%), compared to 9.1% for the state of California as a whole (an average of less than 1% per year). Population growth will continue at an average of 1.9% per year through 2035, according to Riverside County Center for Demographic Research.

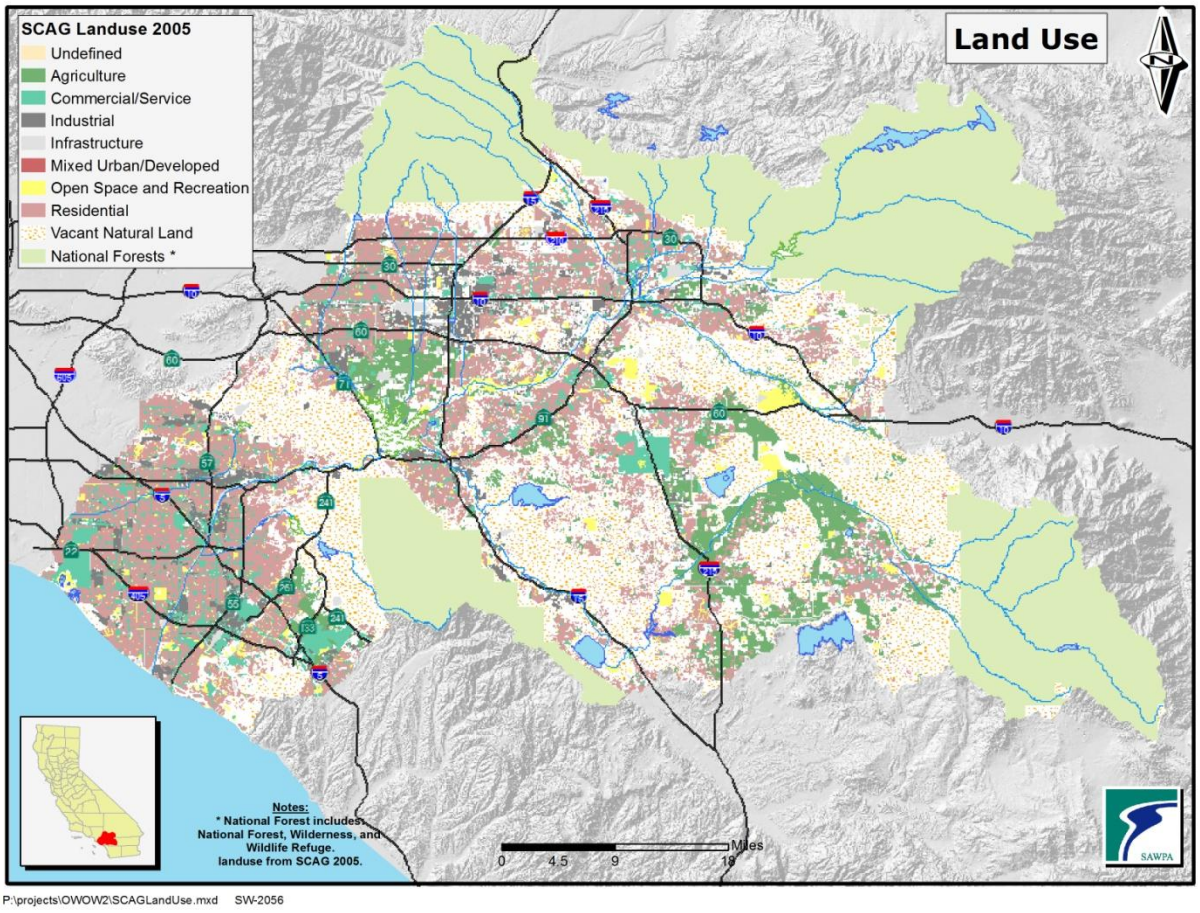
Similarly, San Bernardino County grew by 18.0% in the same period (or 1.8% per year), or almost twice the state rate. In contrast, Orange County grew by 6.3% in the same period, below the State average. Population growth will exacerbate some of the issues previously described for the watershed if no action is taken. In particular, population growth could result in more habitat fragmentation, increased impervious surfaces, modification of natural hydrology, increased water demand, and increased waste generation. The types of multi-benefit and multi-jurisdictional or watershed-wide projects promoted by the OWOW plans could help reverse this trend.

## Land Use

The watershed is substantially urbanized; about 32 percent of the land use is residential, commercial, or industrial. Agricultural land, once accounting for virtually all of the use of the watershed during the days of the ranchos, now accounts for a mere ten percent. Instead of a scattered population of indigenous

peoples, the watershed now supports over 5 million people. **Figure 3-16** presents a breakdown of the major land use categories of the watershed obtained from the SCAG 2005 land use dataset.

**Figure 3-16 Land Use**

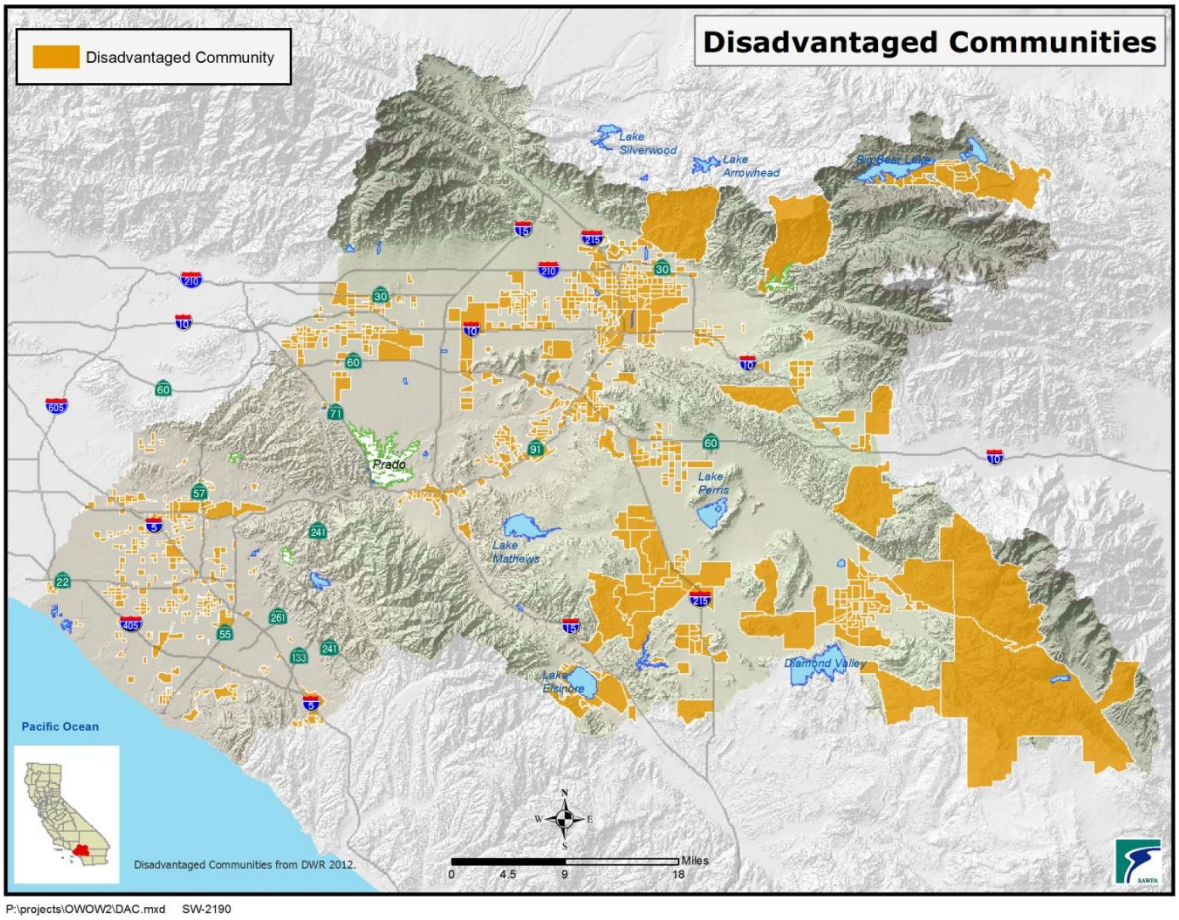



A more detailed write up on issues relating to land use planning in the Santa Ana Watershed are included in **Chapter 5.7 Land Use and Water Planning**.

## Disadvantaged Communities

The SAR Watershed contains one of the fastest growing regions in California and also some of the State's poorest residents. In 2000, the per capita income of portions of the Inland Empire was about 25% below the state average (Schreiber, 2003). **Figure 3-17** depicts watershed income in the SAR Watershed by census tract, based on 2007 incomes as collected by the Claritas division of Nielson Company in 2008. This disparity in income is exacerbated by the recent economic downturn which has had a detrimental effect on the region in general and specifically impacted laborers in disadvantaged communities with limited job skills.

**Figure 3-17 Disadvantaged Communities in the Santa Ana River Watershed**




A more detailed write up on issues relating to disadvantaged and tribal communities in the Santa Ana Watershed are included in **Chapter 5.9 Natural Resources Stewardship**.

## Water Infrastructure Systems

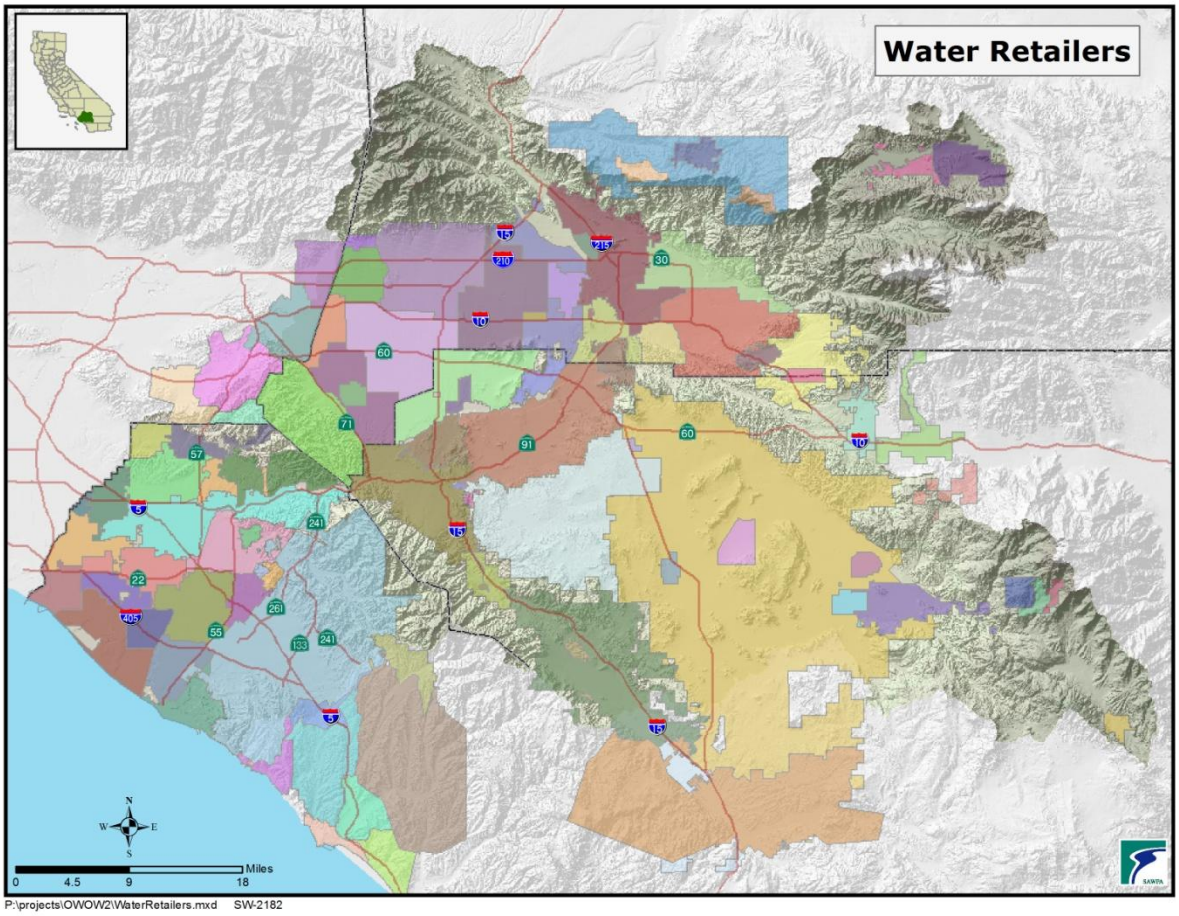
In order to suggest ways to improve water reliability for the future, the existing water infrastructure system must be considered as the foundation to build upon. Particularly in this watershed, when we describe water infrastructure, we are describing not just the large-scale systems, services, and facilities that are necessary to support the collection, storage, treatment and delivery of water to customers in the region, but also many other systems, service and facilities, such as trails, parks, and land use that may use or have a nexus with water. In addition, since water demands and supplies are interrelated to a variety of other natural and man-made support systems, several different maps are included in this chapter to fully convey the opportunities to coordinate among infrastructure systems, as well as land use for the development of multi-beneficial integrated projects.

The importance of an effective water-related infrastructure system cannot be understated. Evaluations of the infrastructure in the watershed were conducted by the American Society of Civil Engineers in 2010 as conveyed in two separate infrastructure report cards, one for the San Bernardino and Riverside

Counties and one for the Orange County. These infrastructure report cards evaluated the condition, capacity, operations and security as criteria for assigning grades to the systems. In the San Bernardino and Riverside counties, the most populated and developed areas of the counties lie within the western portions (Inland Empire) and within the SAR Region.

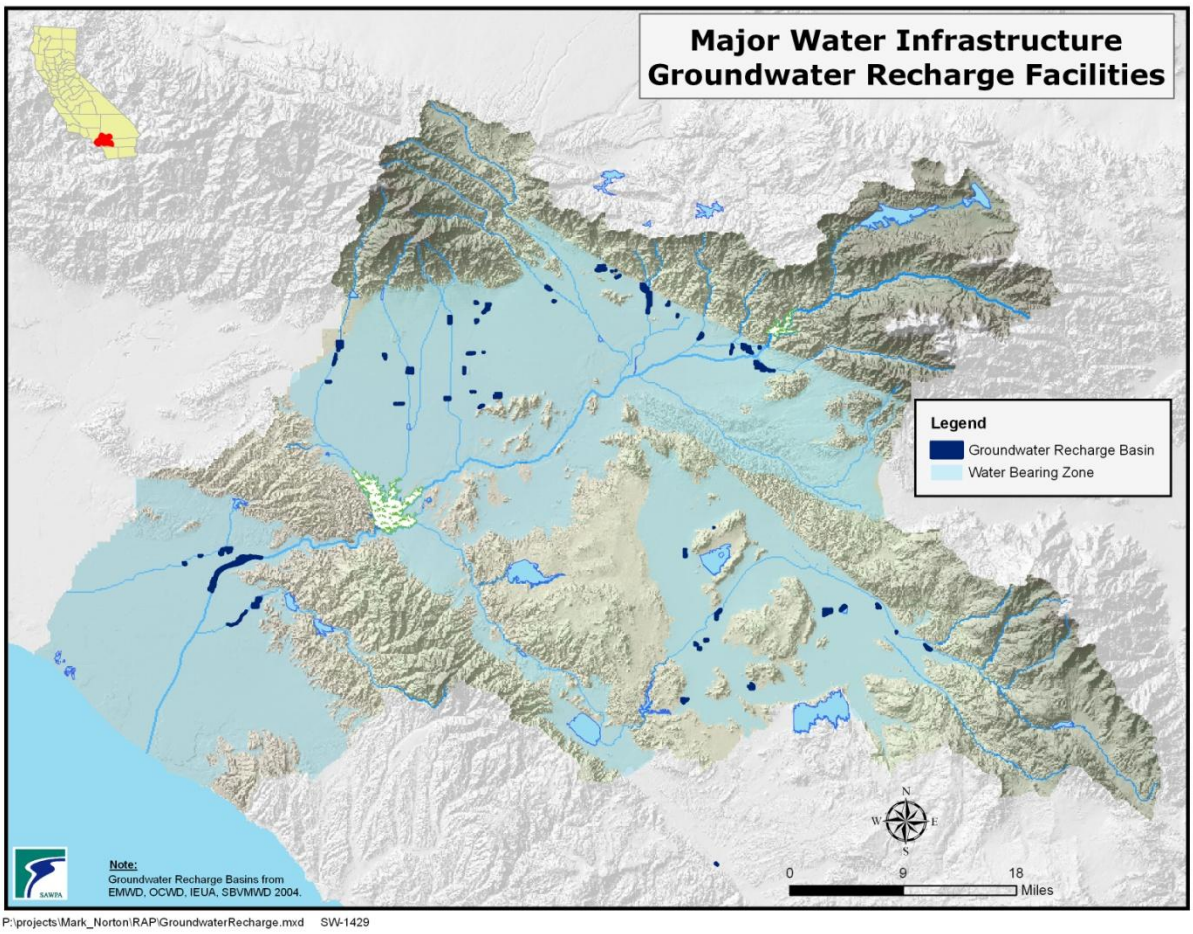
In review of the water-related infrastructure grades for the Inland Empire, room for improvement clearly exists, particularly as this area struggles to maintain and provide water-related infrastructure for two counties, as reflected in **Figure 3-18**, which shows the various water retail service areas within the SAR region.

**Figure 3-18 Water Retail Service Areas in the Santa Ana River Watershed**




In Orange County, the strains of an increasingly built-out area with a population base of 2,846,289 (2000 census), the second most populous county in the State of California, have resulted in both surface quality and groundwater recharge concerns to meet the needs in this area. New infrastructure is required to clean up urban runoff, increase groundwater recharge, treat increasing wastewater flows for recycled use, and expand capture of upper watershed flows to recharge the groundwater supply. **Figure 3-19** displays groundwater recharge facilities within the Santa Ana River Watershed.

**Figure 3-19 Groundwater Recharge Facilities in the Santa Ana River Watershed (overlying GW basins)**

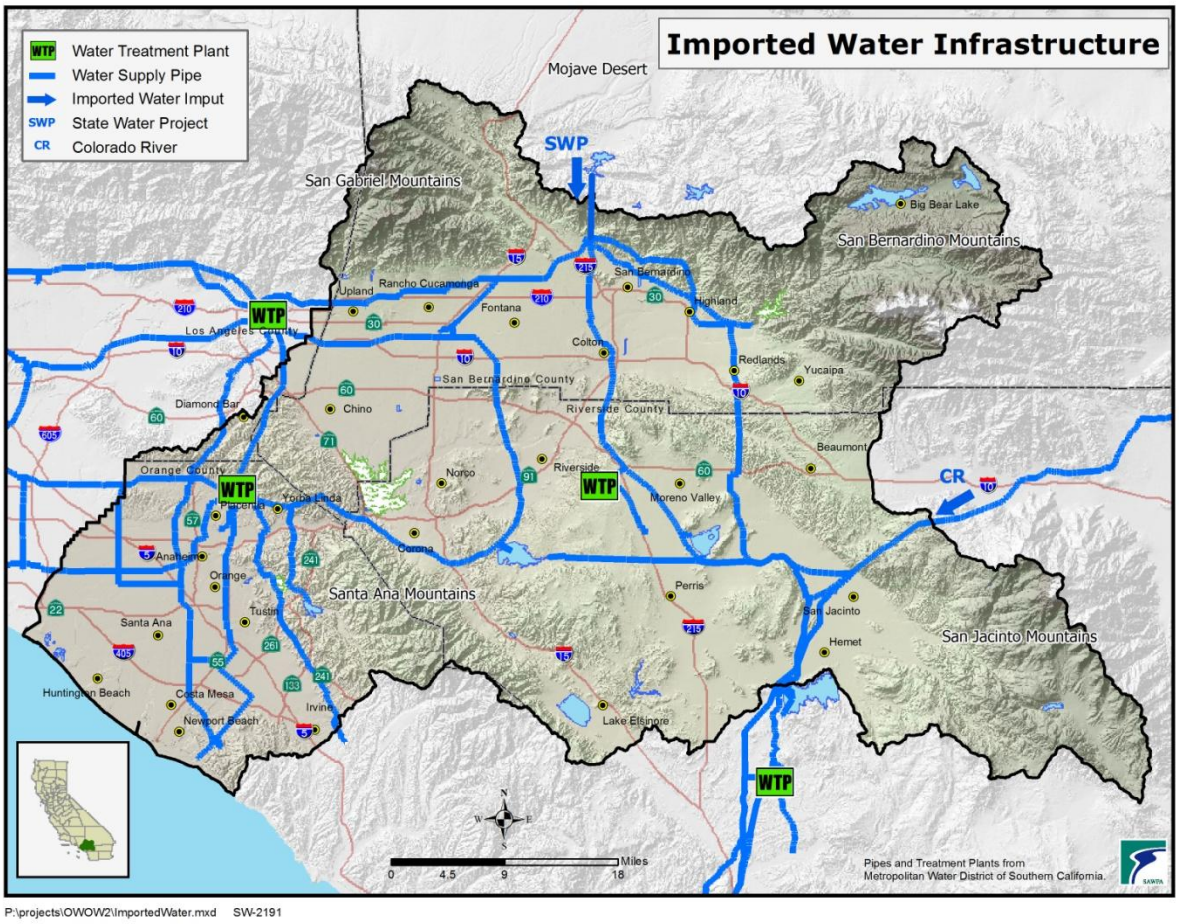



To best understand the water-related infrastructure in the Watershed, some sense of the water development history of the region is appropriate. Prior to the Mission and Rancho periods of the 1800s, the primary land use in the Watershed consisted of grazing cattle and horses. With the advent of Mormon settlements, agricultural lands began to be developed, utilizing the readily available surface springs as a dependable source of irrigation water. As more and more settlers arrived and communities sprang up demanding more water supplies, issue of water rights arose along with competition for the best diversion points. Gradually, a system of water rights was established and shares in a water supply became marketable commodities. As agricultural activity continued to increase in the inland areas of the Watershed, more and more infrastructure was needed to provide the necessary water. First windmills, then motors, and finally, deep well turbines were installed. Gradually over time with increasing urbanization, the dominant land use of the region, agriculture, was subsumed by residential, commercial and industrial areas to serve a burgeoning population drawn to the semi-arid warm climate of this region (see Year 1933-2000 Land Use Transition Maps).

In the late 1920s, to assure adequate water supplies for the population growth of Southern California and following the lead of the City of Los Angeles in its construction of the LA Aqueduct in the early 1910s, efforts commenced to raise money to import water from other places. Metropolitan Water

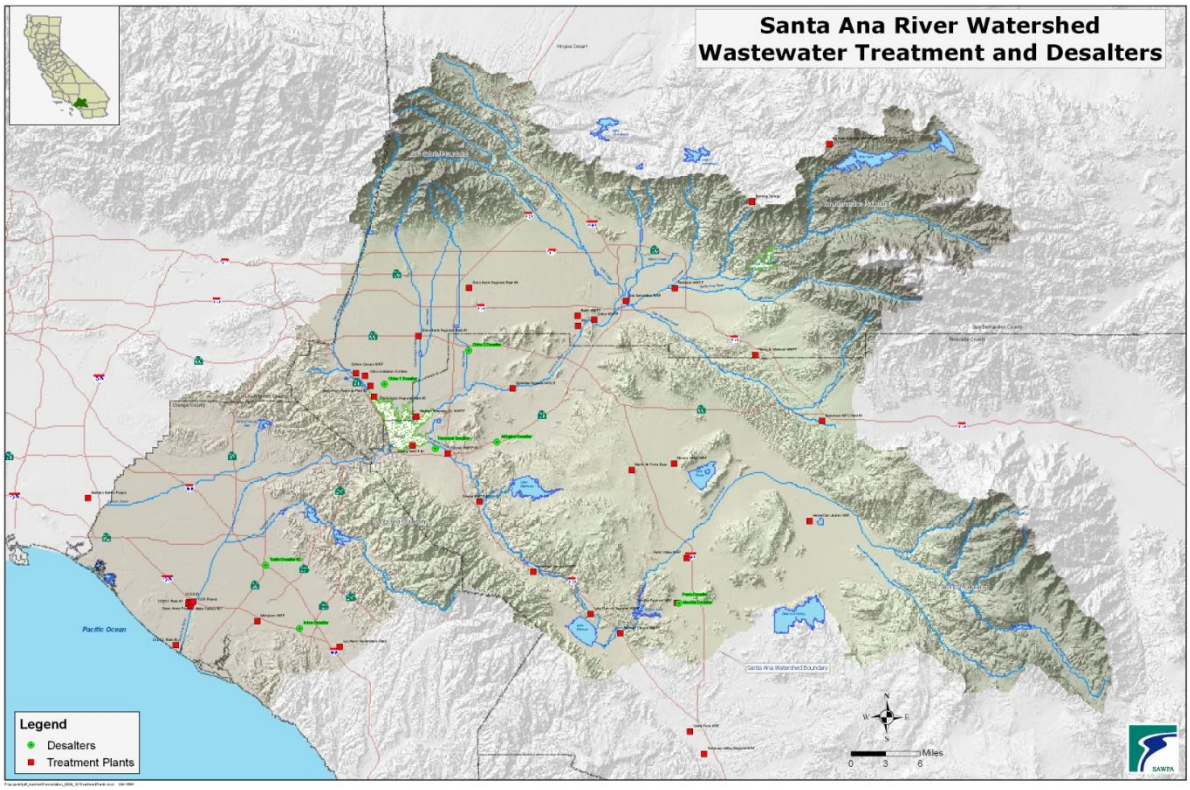
District (MWD) built and still operates the Colorado River Aqueduct, which each year imports millions of AF of water westward across the Mojave Desert and into the SAR Region. After SWP facilities were extended into the region in the early 1970s, State Water Contractors received deliveries from northern California's Bay Delta region to constructed pipelines to deliver imported water to serve the rapidly growing water demands of the region. Connections were established for the SAR Region by four State Water Contractors: MWD, Valley District, San Gorgonio Pass Water Agency (SGPWA), and the San Gabriel Valley Municipal Water District as shown in **Figure 3-20**.

**Figure 3-20 Imported Water Infrastructure in the Santa Ana River Watershed**



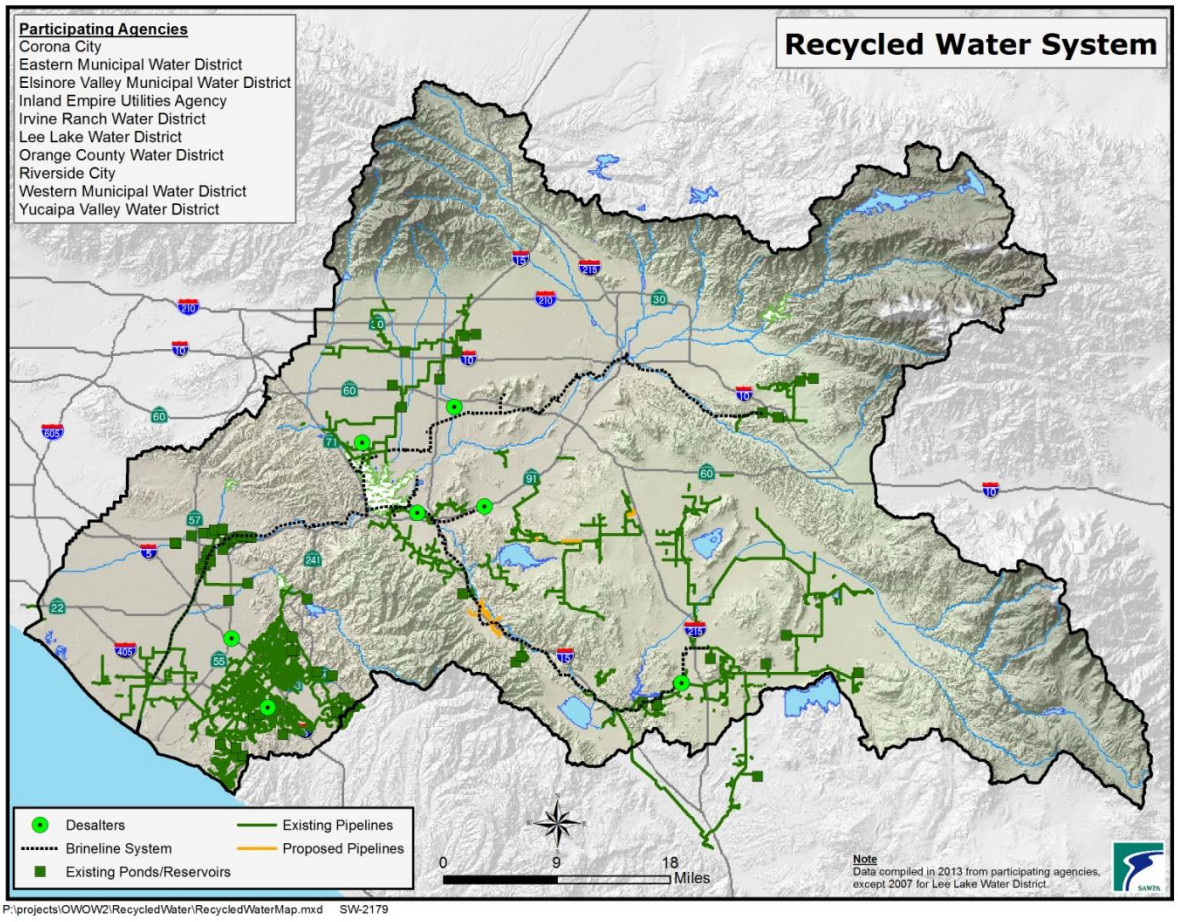

After use of available local and imported water by urban populations, wastewater treatment infrastructure collects and treats the effluent at locations, shown in **Figure 3-21**, but with the majority located near the SAR due to their proximity to a discharge location.

**Figure 3-21 Wastewater Treatment Facilities in the Santa Ana River Watershed**




Gradually over time, the once perennial flows of the SAR, which often dwindled to a near trickle during the summer months in the late 1800s, were replaced with predominantly steady and reliable, tertiary-treated discharge flows that could be captured downstream for reuse and recharge by downstream entities. Major infrastructure developed to support water reuse is shown in **Figure 3-22**.

**Figure 3-22 Major Recycled Water Infrastructure in the Santa Ana River Watershed**



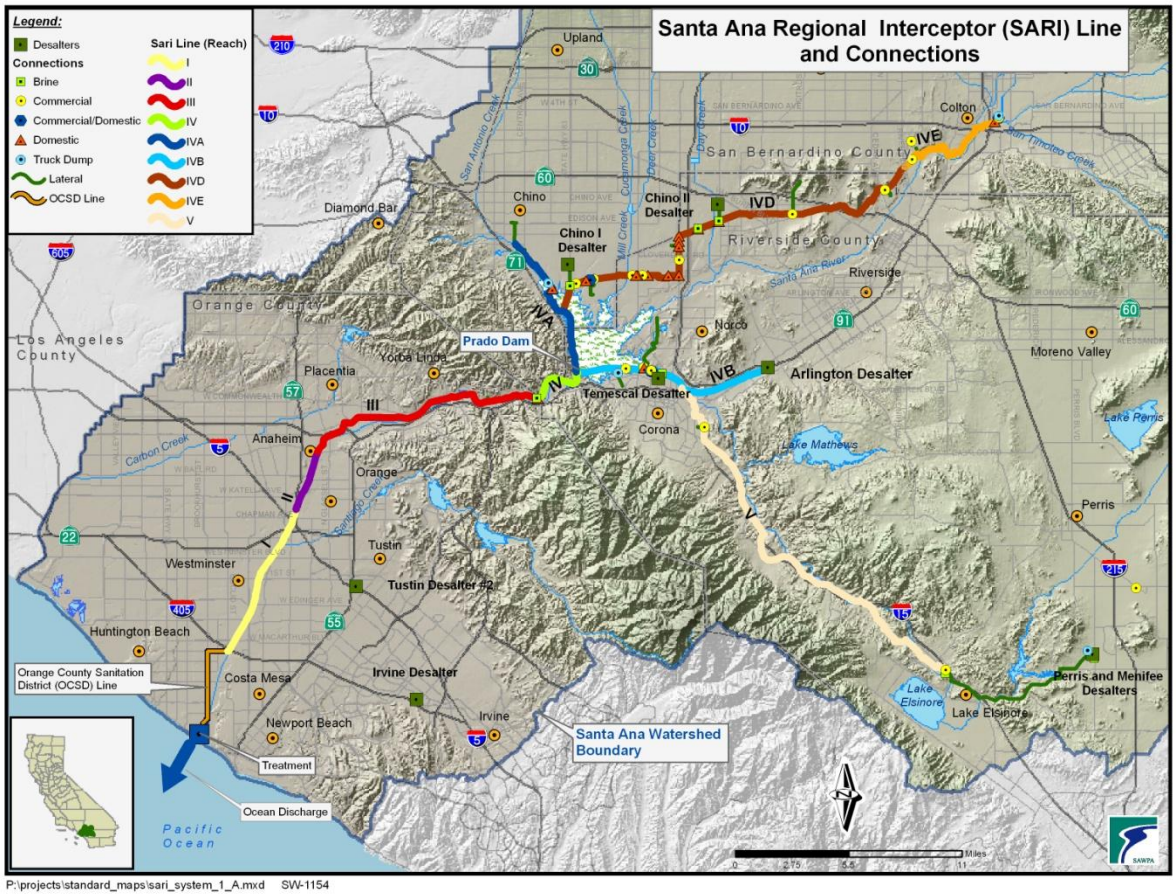

A more detailed write up on issues relating to water supply and demand relating to water resources in the Santa Ana Watershed are included in **Chapter 5.4 Water Resource Optimization**.

## Salt Management

One of the most predominant concerns arising from the heavy use of the watershed for past agricultural practices, and now from the imported water and use of water, is the buildup of salts. Almost a century of agricultural and industrial use has resulted in salts and other constituents of concern infiltrating many aquifers and streams within the watershed. As the watershed continues to grow, cities encroach ever closer in proximity to dairies and other agricultural operations. To counter this added stress to the stream and groundwater supplies, producers have developed advanced methods of reducing potential conflicts. Technologically advanced wastewater control infrastructure has been rigorously employed, and negative impacts from agricultural runoff continue to be minimized. Nevertheless, the existing salts and contaminants present in the watershed from past practices still need to be removed, as improving water quality is inextricably linked to improving water supplies and implementing a comprehensive groundwater storage program.

As part of the solution to the TDS issues within the Watershed, SAWPA constructed approximately 93 miles of the 16- inch to 84-inch Inland Empire Brine Line to convey non reclaimable high saline brine out of the Watershed, as shown in **Figure 3-23**. These brine flows are collected throughout the upper Watershed and sent to Orange County Sanitation District (OCSD) wastewater treatment facilities before final discharge to the ocean. SAWPA owns capacity rights in Brine Line downstream of Prado Dam, and owns the brine line pipeline upstream of Prado Dam. With projected future growth, both developmentally and economically, the watershed's reliance on this 100-mile long pipeline will continue to be a critical factor in the overall plan to minimize future drought impacts, achieve the desired salt balance, and improve the quality of the water resources in the upper SAR Basin. Therefore, maintaining the integrity of the brine line and optimizing its future use are of utmost importance.

**Figure 3-23 Inland Empire Brine Line and Connections**



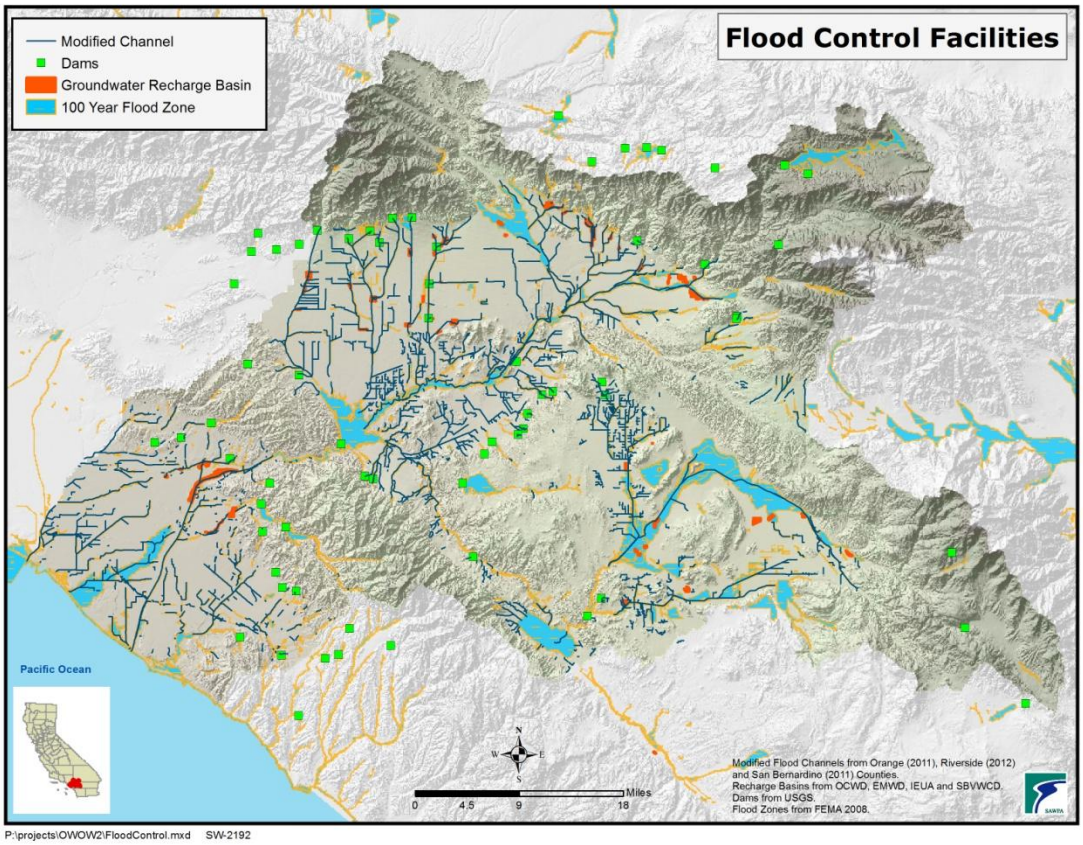

## Flood Control

Flood control in the Santa Ana River has been the focus of U.S. Army Corps of Engineers projects starting with the authorization of Prado Dam in 1936. The dam was completed in 1941. Levees were constructed in Riverside in 1955.

Prado Dam was built primarily for downstream flood protection, and 92 percent of the watershed lies above it. More recently, the dam also has become a vital component of the water supply management program in the region, and has allowed the creation of ecologically important habitat areas behind the dam. Prado Dam was originally designed to provide protection against flooding in a 200-year event but as the watershed urbanized, the protection had decreased to a 70-year event with the downstream channel only having capacity for a 50-year event. To address these deficiencies the Army Corps of Engineers (Corps) initiated study of the Santa Ana River Main Stem Project (SARP) in 1964. Construction of the SARP was initiated in 1989.

The SARP is located along a 75-mile reach of the Santa Ana River in Orange, Riverside and San Bernardino Counties. The project's objective is to provide the developed and developing areas in the watershed with approximately 100-year flood protection through the end of the project life.

**Figure 3-24 Built Flood Control Systems and 100-Year Flood Zones in the Santa Ana River Watershed**




A more detailed write up on issues relating to stormwater and flood risks in the Santa Ana River Watershed are included in **Chapter 5.8 Stormwater: Resource and Risk Management.**

## Conservation and Reducing Dependence on Delta Supply Regionally

With pressures on available local groundwater and imported water supplies in the watershed increasing due to continuing drought conditions, increasing population, climate change impacts and mandated cutbacks in imported water, particularly from the Bay Delta, collaborative and integrated water resource planning is critical for a sustainable future. A study by the Pacific Institute, "Waste Not, Want Not: The Potential for Urban Water Conservation in California," concludes that Water Use Efficiency (WUE) is the most cost-effective way to maximize diminishing water supplies, which makes it one of the most important components for diversifying the region's water portfolio in the coming years.

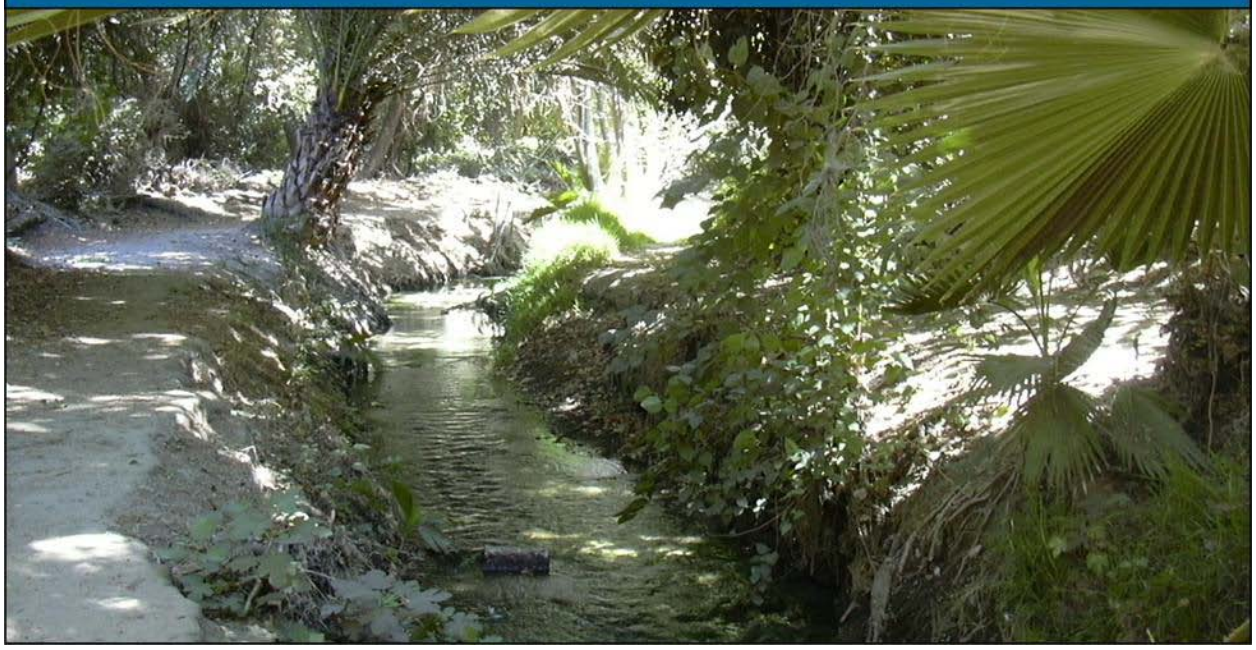
Over the past decade, significant WUE measures have been implemented by Southern California water agencies. These programs include the large-scale replacement of old inefficient water fixtures and the upgrade of building and plumbing codes in the state requiring low-flow toilets and showerheads in all new development. It is anticipated that these types of regulatory mandates will continue to be enhanced as emerging technologies become available. Through these programs, the amount of water imported into much of Southern California has remained fairly constant, sufficiently meeting demands despite significant development and population increases. However, with the water supply outlook continuing to worsen, WUE will be a critical resource management strategy that this region will need to embrace.

With implementation of expanded water use efficiency practices as well as other integrated local water resource development, the OWOW 2.0 Plan will help reduce dependence on Delta supply regionally. A more detailed write up on issues relating to water conservation and water use efficiency practice that are proposed for the Santa Ana River Watershed are included in **Chapter 5.6 Water Use Efficiency**

## Future

As we in the watershed move forward with an eye on sustainability, future water infrastructure improvements will be key to achieving a sustainable balance. Keeping these systems, on which we depend so completely, in a good state of repair, is not a luxury, but prudent self-interest. Without a continued and reliable flow of infrastructure services, the viability of the region, as defined by our quality of life and economic well being, is put at risk. It is up to us now to assure that adequate infrastructure is in place to meet the needs of the region for tomorrow.

# 4.1 Vision



In order to guide the development of the One Water One Watershed (OWOW) 1.0 Plan, the Santa Ana Watershed Project Authority (SAWPA), working with the Steering Committee and Pillars, established a vision along with goals and objectives for the watershed that would allow a holistic approach to resource management. Since the adoption of the OWOW 1.0 Plan and the kick off of the OWOW 2.0 Plan, a process began to reevaluate the goals and objectives again in order to fine tune them based on additional information and to ensure that OWOW goals and objectives could be monitored for progress in watershed improvement. Much of this reevaluation was prompted by the development of a new tool discussed later in **Chapter 9 Data Management and Plan Performance/ Monitoring**, known as the Santa Ana River Watershed Assessment.

## Vision

Prior to embarking on any major regional planning effort involving multiple stakeholders, the stakeholder values and principles needed to be established to serve as a foundation to the work ahead. With a firm foundation in place, a vision of the future could be defined with steps to accomplish that vision defined in a plan mission, goals and objectives. For the initial OWOW Plan, this work was conducted in late 2007 as the first step in the development of the OWOW 1.0 Plan. To define these parameters, SAWPA, with the consulting support of Bob Ohland of Stantec, led a two-day eco-charette workshop with the OWOW Steering Committee and the Pillar Leader group to create a holistic approach to resource management. This event provided an interactive and thought-provoking forum to discuss ideas and priorities in the pursuit of sustainable water resources and to discuss and take a first step toward developing goals and objectives for the watershed. In depth discussions were held regarding the values and principles that

would be used as guiding principles for the Pillars to follow in the development the OWOW IRWMP. Further, the eco-charette format served to provide a consensus of the OWOW leadership values and principles, challenges, and strategies via group input and voting mechanisms to refine and enhance the overall vision of the group.

The results of that initial foundational workshop continue today and remain largely unchanged as the foundation to our current watershed planning under the OWOW 2.0 Plan. It is recognized that as new watershed challenges arise, fiscal and energy crises, dubbed the 5th and 6th Horsemen of the Apocalypse under **Chapter 1.0 One Water One Watershed Program**, SAWPA governance must adapt and reevaluate the specific goals and objectives of the watershed plan to fine tune and focus regional efforts to affect positive change. Further, with improved tools and tracking systems to monitor progress in attaining watershed goals, we now have the capability to establish indicators of change so that the performance can be assessed. With development of the indicators, the language of the goals and objectives for the OWOW 2.0 Plan were redefined and clarified.

## OWOW Vision and Mission

The vision of the OWOW Plan is:

1. A watershed that is sustainable, drought-proofed and salt-balanced by 2035, and in which water resources are protected and water is used efficiently
2. A watershed that supports economic and environmental viability
3. A watershed that is adaptable to climate change
4. A watershed in which environmental justice deficiencies are corrected
5. A watershed in which interruptions to natural hydrology are minimized
6. A water ethic is created at the institutional and personal level

Listed below is a summary of the issues that rose to the top as priorities at the eco-charette.

### Values

- Sustainability
- Comprehensive Water Strategy
- Smart Growth/Urban Centers Communities
- Maintain Quality of Life

With an established values, vision and mission, the OWOW Steering Committee conveyed a sense of urgency that moderately aggressive to aggressive planning was needed. Furthermore, they were effective in conveying direction to produce a plan that is more aggressive in taking steps to plan for major changes in how developing, protecting, and conserving water is approached. At the end of the eco-charette, the general direction was as follows:

- There was a shared understanding that all water within the Santa Ana River Watershed is a precious resource. Climate change, continuing Colorado River drought, questions about the San Joaquin Bay Delta's vulnerability and its ability to reliably deliver water to southern California, and interruptions

to the hydrologic cycle as the result of our very own successful growth and development will stress our ability to provide sufficient water to supply to our Watershed for economic and environmental sustainability.

- There was an expressed commitment to invest time and resources for high quality planning, both long-range and short-range, to ensure the best possible outcome and to achieve the stated mission of making the Santa Ana River Watershed drought-proofed, salt-balanced, and to continue its economic and environmental vitality.
- As major paradigm changes are being considered, the quality of life of the residents must be protected, and the economic impact of a recommended change must be understood before implementation.
- The group indicated through voting that in order to meet these challenges, the leadership in the watershed would need to consider significant review of current practices and expectations. The best solutions would likely engender new ways of thinking about water use and its value.
- There was acknowledgment that while many advances would need to be made in conservation and water use efficiency, the planning process should consider if agricultural water conservation measures could free up water for urban use, or if water could be purchased from agriculture for urban use.
- There was a commitment to employ emerging technologies to further urban water efficiencies and to develop new water supplies.

The next step was the establishment of a set of principles to guide the watershed planning. These principles serve as the guiding rules or qualities that most people can support and reflect the essential elements for planning of water resources in the Santa Ana River Watershed.

## Principles for Watershed Planning

- The planning process must be watershed-wide and bottom-up in order to allow for a holistic and systematic approach to watershed management.
- It is necessary to involve stakeholders representing counties, cities, and water districts, as well as the private sector and the regulatory, environmental, and environmental justice communities. The active participation of this diverse group of stakeholders integrates the different interests in the watershed beyond political boundaries.
- The OWOW Plan and the projects included therein must pursue multiple objectives beyond the "traditional" objective of providing reliable water, and include ensuring reliable water supply, ensuring high quality water for all users, preserving and enhancing the environment, promoting sustainable water solutions, managing rainfall as a resource, preserving open-space and recreational opportunities, maintaining quality of life (including addressing the needs of disadvantaged communities), providing economically effective solutions, and improving regional integration and coordination.
- The OWOW Plan must continue the paradigm change already in play from water supply to an integral water management mentality: moving from a mission of providing abundant high-quality water at the lowest cost possible, to one in which water resources are managed in a sustainable manner and with regard for the needs of the environment.

- Watershed-wide planning must transcend specific funding opportunities (e.g. State grants).
- The implementation of the Plan must result in agreements among the Watershed stakeholders on how to manage and operate the watershed.
- The Plan must improve life conditions throughout the watershed, ensuring that an improvement in the welfare of one area is not at the expense of others.

Generally, the consensus is that the OWOW effort needs to be bold and innovative to meet the watershed's vision.



# 4.2 Goals and Objectives




## Goals and Objectives

As a result of the two-day eco-charette for One Water One Watershed (OWOW) 1.0 back in 2007, the Steering Committee, as well as the Pillar leaders, met on several occasions to develop goals and objectives based on the eco-charette exercises. There also was interest in matching the quality of water delivered to the water quality needed for a specific purpose. For example, highly treated drinking water is not needed for agriculture or landscaping use. The Steering Committee members and Pillar Co-Chairs discussed the impacts of land use decisions on water quality and the quantity of water available. There was a desire for better communication and coordination between the water industry and those charged with land use planning. Furthermore, Steering Committee members and Pillar Co-chairs also discussed how much public open space is dedicated to grass and how much of residential personal outdoor space can be maintained in grass verses other plantings that would be less water dependent. They acknowledged the need for grass play areas while seeing opportunities for water savings by replacing grass with drought tolerant plantings in other areas. The Steering Committee and Pillar Co-chairs suggested that the price paid for water by the consumer versus the actual cost of water, including environmental, wheeling, and infrastructure replacement costs, be reconciled.

With this guidance in mind, a draft set of Goals and Objectives was established after extensive stakeholder outreach and review. The final 2007 product of their efforts is shown below in **Table 4.2-1**, which summarizes the goals and objectives developed in consensus by the group.

**Table 4.2-1 OWOW 1.0 Goals and Objectives**

| Goals | Objectives |
|---|---|
| Provide reliable water supply | Reduce dependency on imported water<br>Meet current and future water demands during all hydrologic conditions<br>Meet water demands during emergency or catastrophic conditions<br>Maximize water use efficiency<br>Increase use of recycled water |
| Preserve and enhance the environment | Protect and enhance the ecological function of open-space<br>Protect and enhance water-related habits<br>Reduce or eliminate invasive riparian and aquatic species<br>Protect sensitive marine and estuarine environments<br>Consider ecological functionality in new development |
| Promote sustainable water solutions | Promote strategies that link land and water use<br>Reduce greenhouse gas emissions<br>Reduce energy consumption and promote urban greening projects<br>Develop partnerships for planning and implementation of economically, environmentally, and socially sustainable watershed projects |
| Ensure high quality water for all users | Attain water quality standards in fresh and marine environments<br>Match water quality with intended uses<br>Protect and improve source water<br>Manage salinity |
| Provide economically effective solutions | Leverage existing financial and infrastructure assets<br>Minimize capital, O&M, and life-cycle cost<br>Promote aggressive pursuit of grants and loans<br>Pursue innovative, non-traditional revenue-generating concepts<br>Protect and value green infrastructure |
| Improve regional integration and coordination | Engage stakeholders in planning and implementation of watershed projects<br>Increase communication and coordination<br>Search for projects that meet multiple goals across geographic and water resource services |
| Manage rainfall as a resource | Provide appropriate flood control capacity and other benefits to the community<br>Maximize beneficial use of rain water |
| Preserve open-space and recreational opportunities | Increase opportunities for recreation and open-space<br>Provide useable open-space for all residents of the watershed |
| Maintain quality of life | Balance quality of life, and social, environmental, and economic impacts when implementing projects<br>Consider the needs of disadvantaged communities |

These goals and objectives were created with the Department of Water Resources (DWR) Program Preferences and the California Water Plan in mind. These goals and objectives are at the core of the OWOW 1.0 Plan and the Pillar groups. Additionally, **Table 4.2-2** shows how the OWOW Plan complies with the CWC§10540(C) Objectives. These goals were not prioritized based on the need for OWOW governance to have the flexibility to weight the objectives in accordance with funding opportunities or current water resource challenges that may change over time.

**Table 4.2-2 OWOW Plan Goals and CWC§10540(C) Objectives**

| CWC§10540(C) Objectives | Corresponding OWOW Plan Goals |
|---|---|
| Protection and improvement of water supply reliability, including identification of feasible agricultural and urban water use efficiency strategies | Provide reliable water supply<br>Promote sustainable water solutions<br>Provide economically effective solutions<br>Improve regional integration and coordination<br>Manage rainfall as a resource |
| Identification and consideration of the drinking water quality of communities within the area of the Plan | Ensure high quality water for all users |
| Protection and improvement of water quality within the area of the Plan consistent with relevant basin plan | Ensure high quality water for all users |
| Identification of any significant threats to groundwater resources from over-drafting | Provide reliable water supply<br>Promote sustainable water solutions<br>Manage rainfall as a resource |
| Protection, restoration, and improvement of stewardship of aquatic, riparian, and watershed resources within the region | Preserve and enhance the environment<br>Promote sustainable water solutions<br>Improve regional integration and coordination<br>Preserve open-space and recreational opportunities |
| Protection of groundwater resources from contamination | Ensure high quality water for all users<br>Promote sustainable water solutions |
| Identification and consideration of water-related needs of disadvantaged communities in the area within boundaries of the Plan | Provide reliable water supply<br>Provide economically effective solutions<br>Improve regional integration and coordination<br>Maintain quality of life |

## OWOW 2.0 Goals and Objectives Update

While all of the goals and objectives under OWOW 1.0 pave the way to a sustainable watershed, SAWPA recognized the need for a common method of measuring progress on meeting the goals and objectives, as well as the health of the Santa Ana River Watershed. As a first step, SAWPA engaged the services of the Council for Watershed Health, formerly known as the Los Angeles and San Gabriel Watersheds Council, a 501(c) 3 nonprofit organization that helped develop a methodology for the California Watershed Assessment Framework (WAF), a derivative of a U.S. Environmental Protection Agency (EPA) Science Advisory Board framework (EPA 2002). The techniques and technology of the Framework developed by the Council are well accepted by DWR and also play a role in the development of the California Water Plan 2013 Update. The value of the assessment is particularly important to the OWOW 2.0 process, as the current guidelines from DWR require inclusion of performance monitoring in all Integrated Regional Water Management (IRWM) planning efforts.

The use of the framework initially was applied by the Council for Watershed Health in 2010 to a watershed located in Los Angeles County called the Aroyo Seco watershed, and provided a template for an assessment process. Under OWOW 2.0, the development and analysis of a framework for indicator assessment was kicked off as a collaborative process among SAWPA, the Pillars, the Council for Watershed Health, and Dr. Fraser Shilling of UC Davis.

One of the key strengths of the Framework is that it uses existing watershed management goals as the focus of the assessment. This allows a variety of managers to participate in creation of the assessment, and assures actionable results for implementation. The watershed management goals drive the selection of indicators and metrics that often can be drawn from existing datasets or data collection efforts.

The process included presentations of the Framework and its application in working sessions orchestrated by SAWPA for stakeholders. This learning process included both small-group meetings with SAWPA staff, as well as larger-scale stakeholder sessions with the Pillars.

Under the facilitation and guidance of the Council for Watershed Health, goals and objectives from the original OWOW Plan were compared to the OWOW 2.0 Framework to identify and fill gaps. The Pillars selected five areas for which to update goal definition for OWOW 2.0: water supply, hydrology, open spaces, beneficial uses, and effective & efficient management. The goals and objectives for each of these five areas are detailed in this section.

## Water Supply

**Goal**: Maintain reliable and resilient water supplies and reduce dependency on imported water

**Objectives**:

- Decrease water demand
- Increase water-use efficiency
- Increase use of rainfall and snowpack as a resource
- Increase use of recycled water
- Sustainably develop local water resources
- Maintain sufficient storage to overcome multi-year (3 year) drought over a ten year hydrologic cycle
- Reduce green-house-gas emissions and energy consumption from water resource management

The Santa Ana River Watershed, among all the services it provides, is the source of a great deal of the water used by human communities, and virtually all of the non-human communities. In fact, approximately 70% of the supply is of local origin coming from local groundwater, local precipitation and surface flows, and recycled water. The supply of water to communities is foremost in the management effort of the watershed, and this goal seeks to understand the effectiveness and efficiency of the water supply system.

## Hydrology

**Goal**: Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities.

**Objectives**:

- Preserve and restore hydrologic function of forested and other lands
- Preserve and restore hydrogeomorphic function of streams and water bodies
- Safely co-manage flood protection and water conservation
- Include ecosystem function in new development planning and construction

The physical processes of the watershed exist on the land and in the water. This goal highlights how managers of water and land (and the relationship between the two) are striving to protect and restore natural processes that benefit other goals within the watershed, like supply or habitat augmentation.



## Open Spaces

**Goal**: Preserve and enhance the ecosystem services provided by open space and habitat within the watershed.

**Objectives**:

- Increase the capacity of open space to provide recreational opportunities without degrading its quality or increasing its consumption of water and energy
- Protect existing and restore native habitats
- Protect and maintain healthy forests
- Manage aquatic and riparian invasive species
- Protect estuarine and marine near-shore habitats
- Reduce ornamental irrigated landscapes
- Improve management support for landscaping that utilizes native and drought tolerant vegetation
- Protect and Restore wildlife corridors
- Protect endangered and threatened species and species of special concern through improved habitat




Like the Hydrology goal, the desire to protect open spaces reveals efforts to maintain land in a natural condition. Here, however, the focus is more on the habitat and recreational value of the open space. Changing the ethic for managing developed open space, even at the household scale, also is included here, found in the objectives to diminish irrigation and water-intensive ornamental landscapes.

## Beneficial Uses

**Goal**: Protect beneficial uses to ensure high quality water for human and natural communities

**Objectives**:

- Attain water quality standards in fresh and marine environments to meet designated beneficial uses
- Protect and improve source water quality
- Achieve and maintain salt balance in the watershed

Strong Federal and State regulatory authority drives water quality management. This goal acknowledges the need for water quality on the surface and in the ground to be improved through management changes.

## Effective & Efficient Management

**Goal:** Accomplish effective, equitable and collaborative integrated watershed management

**Objectives**:

- Improve regional integration and coordination
- Ensure high quality water for all users
- Balance quality of life and social, environmental, and economic impacts when implementing projects
- Maintain quality of life
- Provide economically effective solutions
- Engage with disadvantaged communities to eliminate environmental injustices
- Engage with Native American tribes to ensure equity
- Reduce conflict between water resources and protection of endangered species

This goal is at the heart of the OWOW process, saying that only through inclusive collaborative processes can the necessary unity of purpose be achieved. Managing the Santa Ana watershed requires actors at multiple scales and with vastly different authorities and responsibilities. Through an adaptive management process OWOW seeks to achieve the correct organization of decision-makers for the decisions that must be made.

The watershed assessment and the indicators for the updated goals and objectives under OWOW 2.0 are explained in detail under **Chapter 9.0 Data Management and Plan Performance Monitoring**. The assessment is an effective tool that can be repeated in a time interval to include a set of metrics that express trends. The assessment conducted in this exercise is a snapshot of the current day in the Santa Ana River Watershed, and many of the goals are specifically designed to encourage progress. In five years, perhaps sooner, this assessment can be repeated to uncover laudable progress and spots where efforts should be redoubled.

# 4.3 Planning Targets



## Planning Targets

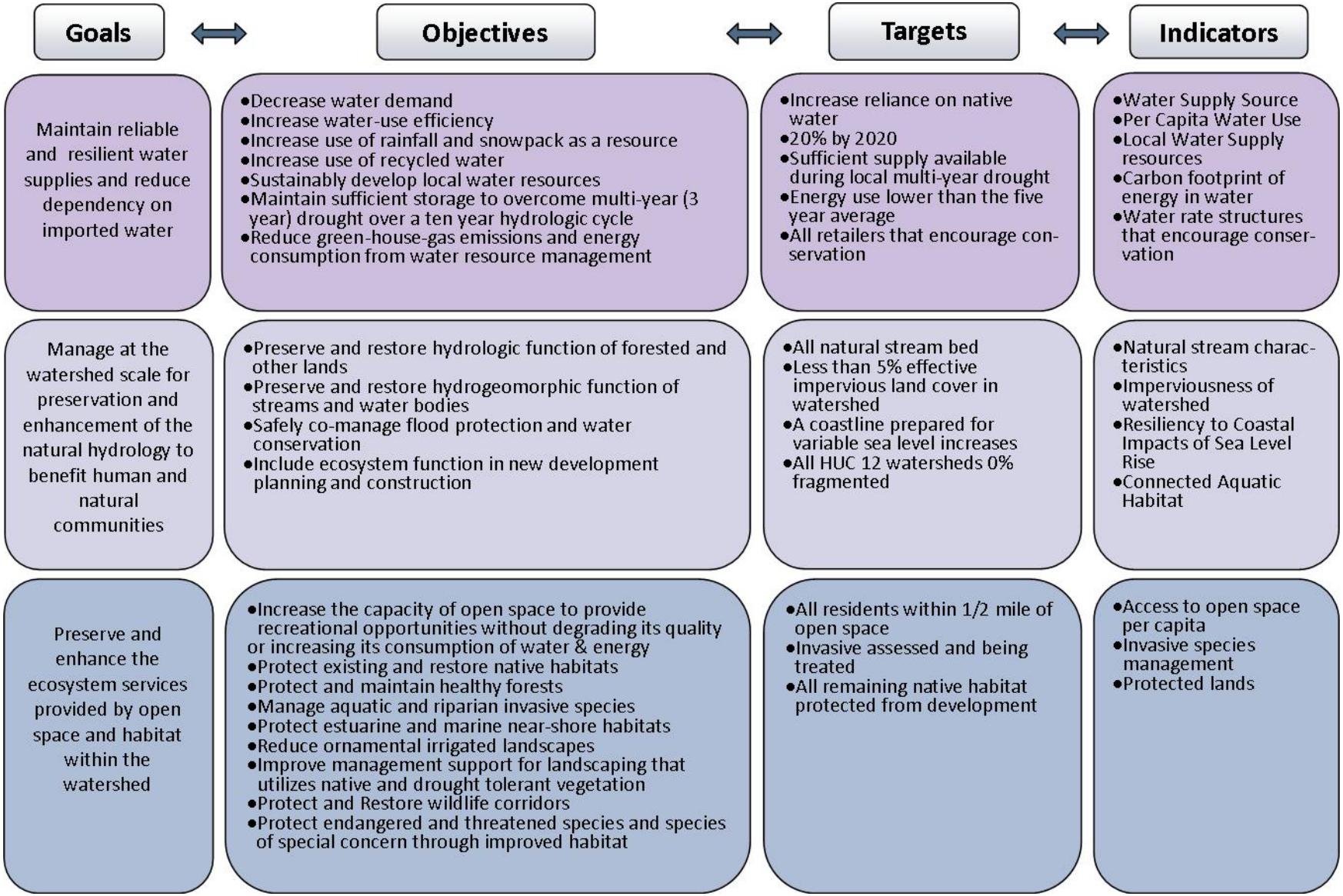
Based on the new watershed assessment previously discussed, the Santa Ana Watershed Project Authority (SAWPA) now has improved planning targets, described as “wanted conditions” or “metrics” and indicators, that will allow stakeholders to track progress in achieving the planning targets associated with each goal. The metrics and indicators are discussed in more detail under **Appendix A**. **Figure 4.3-1** reflects an overview of the One Water One Watershed (OWOW) Plan Guiding Principles, Goals, Objectives, Targets, and Indicators. The lists below reflect that the OWOW governance chose not to prioritize the OWOW goals, objectives, or targets with the understanding that each objective is equally important relative to the others, given that the OWOW Plan is intended to be a truly integrated plan. The OWOW governance may choose, however, to prioritize these objectives relative to grant requirements to enhance project prioritization and selection. In those cases, the type of funding program will dictate which target should be emphasized.

In addition to the watershed assessment tool, planning targets were developed for many of the quantifiable objectives based on the work of the Pillars to provide additional metrics to gage the watershed’s progress toward meeting the goals over a 25-year time period (2010 through 2035). The objective relating to the greenhouse gas emission reduction uses a longer 40-year time horizon to reflect the current science of climate change time scales and impact estimates that use the year 2050. The targets, summarized in **Table 4.3-1**, will help the Santa Ana River Watershed to define projects that will help it to address its water-related issues.

One planning target of particular interest for tracking progress in water demand reduction within the watershed is the level of water use efficiency. Water use efficiency measures will help reduce water demand and free up water supplies for other uses. Retail water suppliers within the watershed, as with the rest of the State, are required to report and meet water conservation targets in compliance with regulations set forth in the Water Conservation Act of 2009, also known as 20x2020 or SBX7-7. 20x2020 seeks a reduction in State-wide daily per person potable water use of 20 percent by the year 2020, and uses Urban Water Management Plans (UWMPs) as the compliance reporting vehicle. The first UWMPs completed with 20x2020 requirements were due to DWR in 2011. Each retail water supplier was required to include a calculation of the demand reduction target to meet 20x2020 as part of its 2010 UWMP.

The target reflects what can be achieved if the watershed's municipal water providers are able to meet the targets identified for 20x2020. The OWOW watershed target of 256,500 AFY by 2035 was developed based on a compilation of UWMPs through 2020, Water Resource Optimization Pillar demand projections data, and assumptions of continued 20% reduction per decade from (2020-2035). Through 2020, significant progress is anticipated in the watershed with a total 34,100 AFY increase in water savings by 2015, and 91,000 AFY by 2020 compared to Year 2010 levels as reported by the retail water agencies in their UWMPs.

**Figure 4.3-1 OWOW Plan Guiding Principles, Goals, Objectives and Targets**



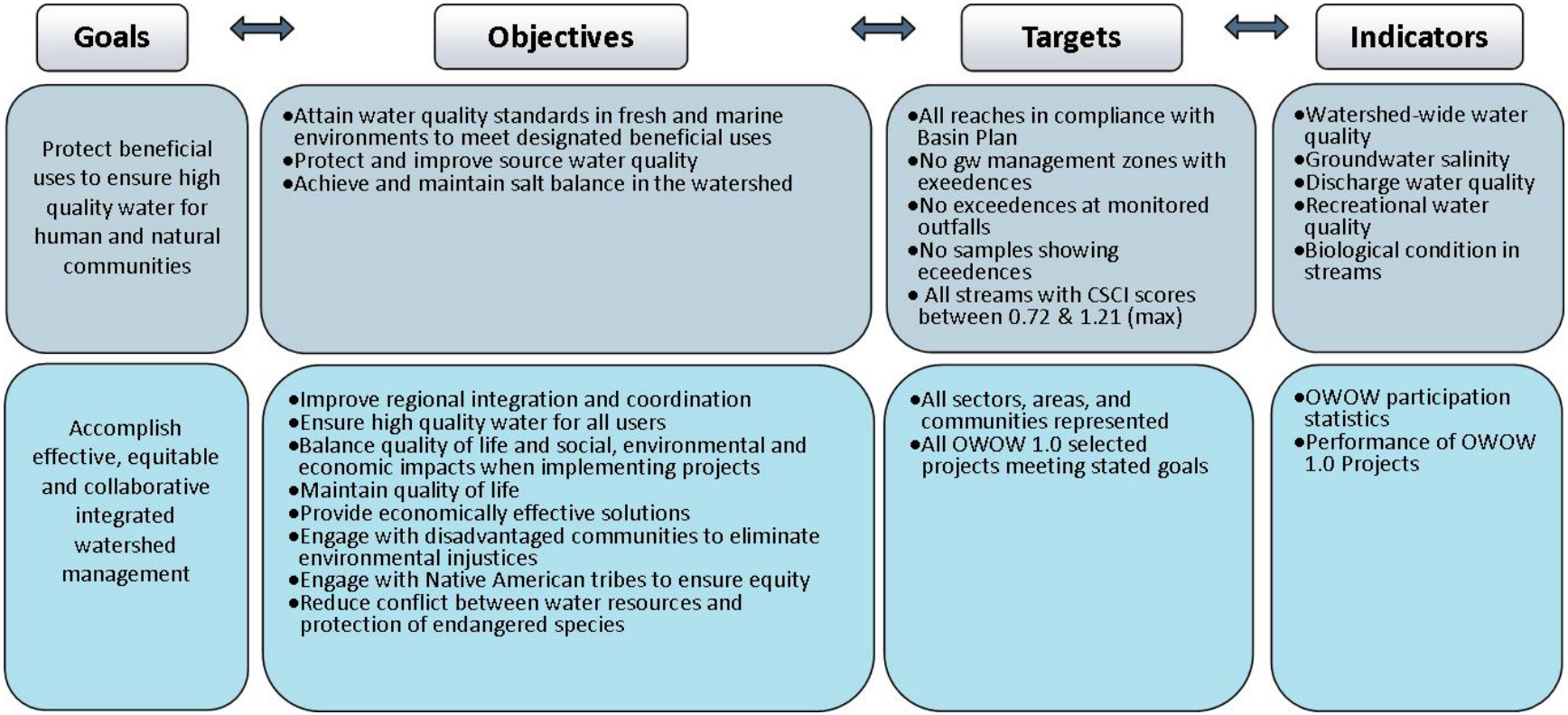
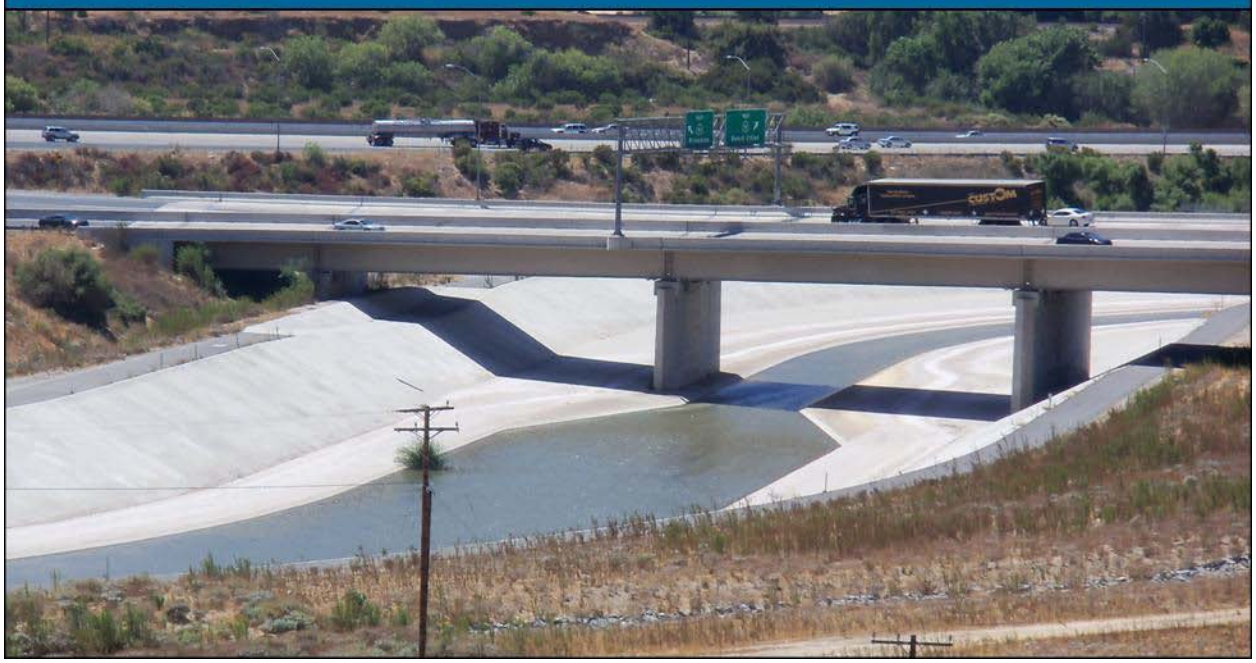

Goals
Objectives
Targets
Indicators
Protect beneficial uses to ensure high quality water for human and natural communities
•Attain water quality standards in fresh and marine environments to meet designated beneficial uses
•Protect and improve source water quality
•Achieve and maintain salt balance in the watershed
•All reaches in compliance with Basin Plan
•No gw management zones with exeedences
•No exceedences at monitored outfalls
•No samples showing eceedences
• All streams with CSCI scores between 0.72 & 1.21 (max)
•Watershed-wide water quality
•Groundwater salinity
•Discharge water quality
•Recreational water quality
•Biological condition in streams
Accomplish effective, equitable and collaborative integrated watershed management
•Improve regional integration and coordination
•Ensure high quality water for all users
•Balance quality of life and social, environmental and economic impacts when implementing projects
•Maintain quality of life
•Provide economically effective solutions
•Engage with disadvantaged communities to eliminate environmental injustices
•Engage with Native American tribes to ensure equity
•Reduce conflict between water resources and protection of endangered species
•All sectors, areas, and communities represented
•All OWOW 1.0 selected projects meeting stated goals
•OWOW participation statistics
•Performance of OWOW 1.0 Projects

**Table 4.3-1 Performance Targets for 2035**

| Goals | Performance Targets for 2035 |
|---|---|
| Maintain reliable and resilient water supplies and reduce dependency on imported water | •Conserve an additional 256,500 AFY of water through water use efficiency and conservation measures<br>•Create 58,000 AFY using a combination of additional wells, treatment, conjunctive use storage and desalination of brackish groundwater<br>•Increase production of recycled water by 157,000 AFY<br>•Increase both centralized and distributed stormwater capture and recharge by 132,000 AFY<br>•Develop 54,000 AFY of ocean water desalination |
| Manage at the watershed scale for preservation and enhancement of the natural hydrology to benefit human and natural communities | •Reduce flood risk in 700 acres using integrated flood management approaches<br>•Remove 500,000 cubic yards of sediment from debris basins and reservoirs |
| Preserve and enhance the ecosystem services provided by open space and habitat within the watershed | •Preserve or restore 3,500 acres of terrestrial aquatic habitat<br>•Construct 39.5 miles of additional Santa Ana River Trail and Parkway |
| Protect beneficial uses to ensure high quality water for human and natural communities | • Reduce non-point source pollution by treating an additional 35 MGD of surface and stormwater flow, emphasizing higher priority TMDL areas<br>• Remove an additional 25,000 tons of salt per year from the watershed |
| Accomplish effective, equitable and collaborative integrated watershed management | •Engage with 50% (approximately 35) Disadvantaged Communities within the watershed<br>•Engage with 100% of the Non-Federally Recognized Tribes in the watershed |

# 5.1 Introduction



In the early stages of the One Water One Watershed 2.0 (OWOW) planning process, various resource management strategies were evaluated. In 2000, as reflected in the Santa Ana Watershed Project Authority's (SAWPA) early integrated water resource plans, six resource management strategies were developed that covered a broad spectrum of water resource planning. At the time, the integration of these six strategies 1) Groundwater Cleanup and Purification, 2) Water Storage, 3) Flood Protection, 4) Wetlands, Habitat, and the Environment, 5) Water Recycling and 6) Recreation and Conservation was considered innovative in proposing a new way to support the needs of water resources in a region. Past water resource management practices focused primarily on water supply functions without considering the more expansive and integrated benefits of integrating other resource management strategies.

To further emphasize the importance of integrated regional water management planning, the State incorporated the integrated resource management approach into its California Water Plan Update 2005 and again in its 2009 Update. This latest plan emphasizes the value of an integrated regional water management approach using multiple resource management strategies as defined in California Water Plan.

In 2006, in light of new threats to water resources in the Santa Ana River Watershed and to the State overall such as climate change, fiscal crises and the energy crises, SAWPA reviewed its past resource management strategies to update. New resource management strategies defined in the California Water Plan, previous Department of Water Resources (DWR) guidelines for Integrated Regional Water Management Plan (IRWMP) development, and local water resource needs were considered. For the

OWOW 1.0 Plan, the following resource management strategies were defined and aligned along ten major areas of focus, or Pillars:

| Pillar | Corresponding Proposition 84 Guidelines Resource Management Strategies |
|---|---|
| Land Use and Water | Increase water supply |
| Water Supply Reliability | Reduce water demand |
| Water Recycling | Increase water supply |
| Water Use Efficiency | Reduce water demand |
| Water Quality | Improve water quality |
| Environmental and Habitat Restoration | Practice resource stewardship |
| Stormwater Risk Assessment | Improve flood management |
| Environmental Justice | Included in Guidelines as part of Impact and Beneficial |
| Parks and Open Space | Not explicitly mentioned in Guidelines |
| Climate Change | Included in Guidelines as separate standard |

In 2011 with the commencement of OWOW 2.0 Plan and the focus on implementation, the water resource management strategies and OWOW Pillars were again reevaluated. To assure that these OWOW Plan resource management strategies are comprehensive and fully reflect the resource management strategies as defined in the California Water Plan Update 2009, the following new OWOW 2.0 Plan resource management strategies or Pillars were established, many of which continued from the previous Pillars, but with new "implementation oriented" titles.

| Pillar | Corresponding DWR Prop 84 Guidelines Resource Management Strategies |
|---|---|
| Water Resource Optimization | Reduce water demand<br>Improve operational efficiency and transfers<br>Increase water supply<br>Improve water quality |
| Beneficial Use Assurance | Improve water quality |
| Water Use Efficiency | Reduce water demand |
| Land Use and Water Planning | Increase water supply<br>Improve water quality<br>Practice resource stewardship |
| Stormwater Resource and Risk Management | Improve flood management |
| Natural Resources Stewardship | Practice resource stewardship |
| Operational Efficiency and Water Transfer | Improve the efficiency of water transfers and infrastructure in the watershed |

| | |
|---|---|
| Disadvantaged and Tribal Communities | Included in Guidelines as part of Impact and Benefit Standard |
| Government Alliance | Create partnerships between DWR and member agencies |
| Energy and Environmental Impact Response | Included in Guidelines as separate standard |

In order to manage the initial planning work, the stakeholders were organized into ten workgroups, or Pillars, centered on a specific water resource management issue. Discussion of the formation of the Pillars and their work approach is previously described in **Chapter 2.1 Governance Structure**.

## Pillar Chapter Development

The following chapters of this report have been written and prepared by the respective OWOW water management strategy committees (Pillars), and represent the culmination of work by the Pillar Chair and the Pillar members (local stakeholders). Unlike a single agency or consultant-prepared report, SAWPA did not significantly modify the following Pillar chapters, other than minor editing, in order to ensure that the work developed through the grassroots stakeholder-driven OWOW process was genuinely conveyed intact, and best reflects the interests, issues, and potential solutions of interested stakeholders in the Watershed.

Each Pillar was led by a recognized expert in their subject area, and was selected by the SAWPA Commission. A list of Pillar Leaders is shown as follows:

| Pillar | Pillar Co-Chairs |
|---|---|
| Water Resource Optimization | Robert Tincher<br>Mark Tettemer |
| Beneficial Use Assurance | Greg Woodside<br>Mark Adelson |
| Water Use Efficiency | Pam Pavela<br>Gail Covey |
| Land Use and Water Planning | Susan Lien-Longville<br>Jerry Blum |
| Stormwater: Resource and Risk Management | Maryanne Skorpanich<br>Stuart McKibben |
| Natural Resources Stewardship | Lee Reeder<br>Nancy Gardner |
| Operational Efficiency and Water Transfer | Behrooz Mortazavi<br>Craig Miller |
| Disadvantaged and Tribal Communities | Maria Elena Kennedy |

| | |
|---|---|
| | Leslie Cleveland |
| Government Alliance | Eileen Takata<br>Jack Simes |
| Energy and Environmental Impact Response | Roy Herndon<br>Craig Perkin |

Local stakeholders participated in a number of Pillar or subject area meetings held in person throughout the watershed. The number of meetings scheduled for each particular group was determined by the individual Pillar leaders with support and guidelines provided by SAWPA staff. Additional stakeholders with an interest in particular subject areas were referred to Pillar leaders for inclusion into the process.

Each of the following sections to this chapter reflects the direction given to each Pillar by SAWPA to update their Pillar write-ups from OWOW 1.0, and then consider and identify regional implementation projects and programs. These conceptual implementation projects and programs were developed using the updated goals and objectives, review of Proposition 84 IRWM Plan standards, past suggested strategies by their Pillars, or by integration of their Pillars with other Pillars. The results of the collaboration are described in Chapters 5.4 – 5.13. **Chapter 5.14 Integration and Implementation** reflects even further integration of the Pillars output through integration workshops with the Pillars to improve implementation synergy and linkages.

# 5.2 California Water Plan Resource Management Strategies



With the development of integrated watershed planning, multi-benefit, multi-purpose projects have moved to the forefront and have become one of the primary goals of the One Water One Watershed (OWOW) progression. The idea of meeting a number of community necessities with a single project is not new; however, specialization within agencies that deal with water has often moved these project types to the backburner. Efforts in the past primarily focused on single purpose projects; the additional effort required to develop multi-objective solutions have made true multi-benefit projects relatively uncommon. The best way to create multi-beneficial projects and to encourage diversification of water management approaches to mitigate uncertain future circumstances is the application of Resource Management Strategies (RMS).

RMS are set standards that encourage the diversification of water management approach as a way to mitigate for uncertain future circumstances. Integrated regional strategies were encouraged for the management of water resources and to provide funding, through competitive grants, for projects that protect communities from drought, protect and improve water quality, and improve local water security by reducing dependence on imported water. These standards are met through the application of the OWOW 2.0 Plan with the creation and implementation of the Pillars. Listed below are the RMSs defined by the California Water Plan Update 2009.

**Table 5.2-1 CA Water Plan Update 2009 Resource Management Strategies**

| CA Water Plan Update 2009 Resource Management Strategies | |
|---|---|
| • Agricultural Water Use Efficiency<br>• Urban Water Use Efficiency<br>• Crop Idling for Water Transfers<br>• Irrigated Land Retirement<br>• Conveyance – Delta<br>• Conveyance – Regional/Local<br>• System Reoperation<br>• Water Transfers<br>• Flood Risk Management<br>• Agricultural Lands Stewardship<br>• Economic Incentives (Loans, Grants and Water Pricing)<br>• Ecosystem Restoration<br>• Forest Management<br>• Recharge Area Protection<br>• Watershed Management | • Conjunctive Management & Groundwater Storage<br>• Desalination<br>• Precipitation Enhancement<br>• Recycled Municipal Water<br>• Surface Storage – CALFED<br>• Surface Storage – Regional/Local<br>• Drinking Water Treatment and Distribution<br>• Groundwater Remediation/Aquifer Remediation<br>• Land Use Planning and Management<br>• Matching Quality to Use<br>• Pollution Prevention<br>• Salt and Salinity Management<br>• Urban Runoff Management<br>• Water-Dependent Recreation |

## Consideration when Implementing RMS

For the development of the OWOW 2.0 Plan, multiple RMS were considered relative to the new IRWM Plan 2013 objectives and the RMS listed in the California Water Plan Update 2009 (DWR, 2009). The purpose of reviewing these management strategies was to identify which ones will help achieve the OWOW 2.0 Plan objectives through project or program implementation within the Santa Ana River Watershed. When choosing specific RMS that are met by the OWOW 2.0 Plan, it is important to remain cognitive of contributing factors that may be problematic. As defined by the California Water Plan 2013 updates, climate change tends to be a reoccurring problematic factor. Climate change is expected to impact water use, as rising temperatures will result in higher evapotranspiration and higher water use requirements. The effects of climate change must be evaluated when implementing specific RMSs (Listed on **Table 5.2-1**); with particular note of the following:

- Concerns over groundwater impacts, overdraft, and loss of recharge
- Increase in the vulnerability of trees and vegetation and burn area susceptibility
- Unpredictability of changing climate

All of these issues were taken into consideration when developing the OWOW 2.0 and yet the Integrated Regional Water Management (IRWM) is still capable of implementing RMS defined by the guidelines.

## Implementation of RMS

Implementation of RMS is an important objective met and influenced by the OWOW Plan. Within the OWOW 2.0 Plan, these RMS, as defined by the guidelines of Proposition 84 and 1E, meet the standard of a project, program, or policy that help local and government agencies involved in water management. The OWOW 2.0 Plan was developed for the implementation of multi-beneficial projects, programs, and policies throughout the watershed.

This implementation of the CWP 2009 Update RMS has encouraged water agencies within the watershed to adopt new strategies for a sustainable watershed. To assure that these RMS for the OWOW Plan are comprehensive and fully reflect as many of the resource management strategies as possible, as defined in the California Water Plan Update 2009 and guidelines, the OWOW Plan Pillars are largely aligned with the resource management strategies identified in the Proposition 84 Guidelines.

The following California Water Plan Update 2009 Resource Management Strategies are met in the OWOW Plan and can be seen in **Table 5.2-2**.

**Table 5.2-2 RMS and Pillar Group Relationship**

| Pillar | Resource Management Strategy | Management Goal |
|---|---|---|
| Natural Stewardship | Agricultural Lands Stewardship<br>Ecosystem Restoration<br>Recharge Area Protection<br>Water-Dependent Recreation<br>Forest Management | Practice Resource Stewardship |
| Water Use Efficiency | Agricultural Water Use Efficiency<br>Urban Water Use Efficiency | Reduce Water Demand |
| Water Resource Optimization | Conjunctive Management and Groundwater Storage<br>Recycled Municipal Water<br>Conveyance – Regional/Local<br>System Reoperation<br>Water Transfers | Increase Water Supply |
| Beneficial Use Assurance | Desalination<br>Groundwater Remediation/Aquifer Remediation<br>Matching Water Quality to Use<br>Pollution Prevention<br>Salt and Salinity Management<br>Urban Runoff Management | Increase Water Supply<br>Improve Water Quality |
| Stormwater: Resource and Risk Management | Flood Risk Management<br>Recharge Area Protection | Improve Flood Management<br>Practice Resource |

| | | |
|---|---|---|
| | | Stewardship |
| Government Partnership | Economic Incentives | Fund Procurement |
| Energy and Environmental Impact | Ecosystem Restoration<br>Pollution Prevention | Reduce Pollutants |
| Land Use and Water Planning | Agricultural Water Use Efficiency<br>Pollution Prevention<br>Recharge Area Protection<br>Land Use Planning and Management | Increase Water Supply<br>Improve Water Quality<br>Practice Resource Stewardship |

The following RMSs were not applicable to the Santa Ana River Watershed or were not considered as effective practices within our watershed:

| CA Water Plan Update 2009 Resource Management Strategies | |
|---|---|
| • Crop Idling for Water Transfers<br>• Irrigated Land Retirement<br>• Conveyance – Delta | • Precipitation Enhancement<br>• Surface Storage – CALFED<br>• Surface Storage – Regional/Local<br>• Drinking Water Treatment and Distribution |

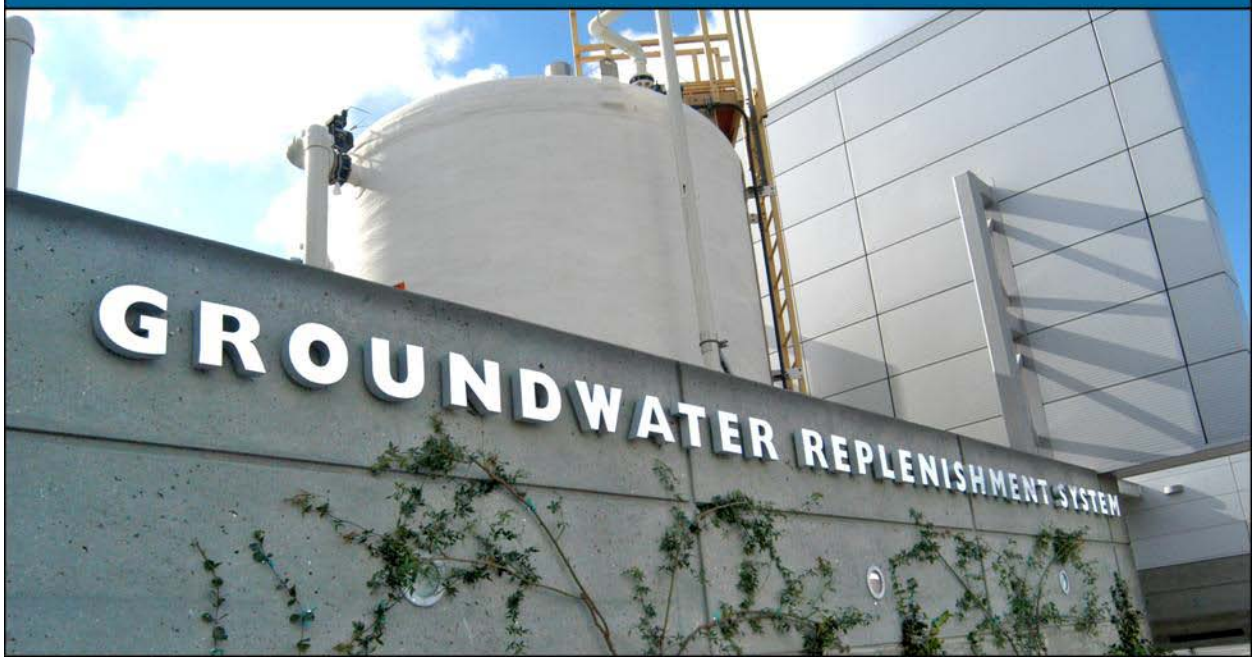
## Integration of RMS

As shown in the table above, it is apparent that the relationship between the Pillars described in OWOW 2.0 and the RMS in the guidelines, correlate with each other to accomplish set OWOW 2.0 objectives. These objectives benefit both local and government agencies located within the watershed. Integration is a key aspect of this relationship; obtaining strategies and putting them together produce multi-beneficial results throughout the watershed.

It is the intent of OWOW 2.0 to facilitate the formation of multi-agency partnerships of local and governmental agencies; this is described in more detail within **Chapter 5.12 Government Alliance**.

The development of multi-benefit projects, through the implementation of resource management strategies, will remain challenging and require sustained effort by agencies that manage water. There are approximately 100 agencies that manage water in some way, and OWOW 2.0 endeavors to bring them all together to create and achieve regional and inter-regional goals. Agencies and non-profits organizations in the watershed through the OWOW will need to eventually prioritize collaborative projects and provide the staff resources to ensure that such projects are implemented in order to achieve the implementation of resource management strategies.

# 5.3 Preliminary Integration and Systems Approach




As indicated in Department of Water Resources (DWR) Integrated Regional Water Management Plan (IRWMP) Guidelines, one of the primary purposes of the inclusion of an integration standard is to ensure that the region intentionally creates a system where integration can occur. Integration is at the heart of Santa Ana Watershed Project Authority's (SAWPA) IRWM as reflected in the genesis of its regional plan name, One Water One Watershed Plan (OWOW Plan) where stakeholders across the watershed work collaboratively to develop an integrated water resource plan, where all types of water (local surface and groundwater, imported water, stormwater, and treated wastewater effluent) are viewed in a comprehensive, integrated manner as a "single" water resource.

The achievements of a "grass roots" but integrated regional planning approach as defined under the previous OWOW 1.0 Plan were a testament to innovation. In fact, on May 2, 2011, Harvard University's Kennedy School of Government selected the program as one of the 25 most innovative programs in the country representing the best in creative problem solving of local, state, and federal municipalities around the Country.

Building upon the framework of integration from the OWOW 1.0 plan, SAWPA under OWOW 2.0 planning sought to raise the bar further with an emphasis on integration and implementation at a regional and holistic scale. To promote this concept of watershed based and integrated approach under OWOW, SAWPA conducted innovative brainstorming processes utilizing the experience and skills of local experts to inspire and promote integrated system-wide projects and programs that address water resource challenges in the Santa Ana River Watershed. The first brainstorming process conducted under OWOW 1.0 planning involved gathering a group of 11 watershed experts that SAWPA termed the "Dream Team." The second brainstorming group convened under OWOW 2.0 planning was termed the

"Master Craftsmen." These two groups consisted of some of the best and brightest experts in the water resources field, who were familiar with the Santa Ana River watershed and willing to set aside their local agency thinking to brainstorm ideas and describe new regional projects and programs.

Some of the regional projects and programs proposed by the Dream Team and Master Craftsmen are not entirely new, but may not have been ready to be implemented in the past due to historical regulatory, institutional, or financial barriers. As with any project or program, timing plays a key role toward implementation. After these ideas and concepts were shared by the experts and recorded, they were shared with the Pillar co-chairs, the Steering Committee, and the SAWPA Commission to serve as sounding boards and contributors to these early visioning and brainstorming meetings. The purpose of these early screening processes was to provide templates and examples of integrated regional solutions for the Pillars to consider as they developed more specific regional implementation projects and programs affecting their respective water resource, or a combination of other water resources in the watershed.

## Dream Team

In early 2010, SAWPA recognized the need to encourage a stronger systems approach and motivate development of new multi-jurisdiction, multi-benefit solutions that weren't as readily apparent in the previous Proposition 84 Round 1 OWOW Call for Projects. Thus, SAWPA assembled a "Dream Team" of high level water resource visionaries to brainstorm new cross-jurisdictional proposals to achieve a shared vision of a multi-benefit, integrated, multipurpose, highly-functioning Santa Ana River Watershed. The Dream Team included the following individuals:

- Joe Grindstaff, Past Executive Director, Delta Stewardship Council and CA Bay Delta Authority
- Wyatt Troxel, Past IEUA Director and SAWPA Director
- Mark Wildermuth, President Wildermuth Environmental, Inc.
- Gerard Thibeault, Past Exec. Officer, Santa Ana RWQCB
- Tim Moore, Risk Sciences
- Jerry King, Vice President , Michael Brandman Associates
- Larry McKenney, Past Vice President, RBF
- Don Schroeder, Vice President, CDM Smith
- Steve PonTell, Past Board member, Santa Ana RWQCB
- Pete Dangermond, Dangermond Group President
- Jeff Mosher, Exec. Director National Water Research Institute; Dream Team Chair



The Dream Team was convened in a one-day workshop with the direction to think big and broadly. Water resources maps were made available to the Team to reference as they considered conceptual projects. The first half of the workshop focused on background issues and discussion of watershed sustainability goals from the OWOW 1.0 plan, and then

subgroups were formed generally based on multiple water resource strategies. The latter part of the day reconvened the subgroups for reporting to the combined larger group.

The following is a listing of the early results.

**Stormwater is a local supply**
- Water District and Flood District projects key
- Rubber dams, retrofit of basins, alluvial fan park projects
- Local control needed for system of dams

**Recycled water is underutilized**
- Develop storage in-ground
- Serve water down-gradient

**Existing storage under-used**
- Lake Perris
- Connection system between reservoirs and recycled plants needed (includes Met to OC connection)
- Ground water basins have capacity

**Local water is dependent on Federal Lands**
- Comprehensive overhaul of management needed
- Forest First program

**Regional entity needed for support**
- Expand SAWPA Commission to include County Supervisors
- Develop "marketplace" to link groundwater recharge with MS-4 compliance

**IE Brine Line (SARI) is source of new water**
- Can provide 32,000 AF to OC basins by gravity
- Recycling and groundwater desalting will depend on IE Brine Line for foreseeable future

**State Water Project is important, but somewhat unreliable**
- Dependent on decisions in Delta
- Link SWP entitlements to conservation compliance multipliers
- Infiltrate water when available, including from alternate sources

**Connect the "waste water" system to the supply system**
- GWRS prime example
- Additional groundwater injection, desalting of waste water, development of storage capacity for recycled water needed
- Desalting can support basin clean up and regional salt management across the watershed
- IE Brine Line (SARI) critical infrastructure link

**Better connect flood control system to groundwater system**
- Alluvial fan recharge to improve groundwater quality
- Re-purpose retention and detention basins
- Recharge within system requires revised management strategies
- MS-4 Permit compliance may encourage increased stormwater capture

Overall, the Dream Team encouraged researching processes, such as sponsorship of key agencies in the watershed that may spur large scale actions, leverage available resources and reflect major institutional and/or behavioral changes.

The second exercise implemented by SAWPA under OWOW 2.0 planning to inspire and motivate system-wide solutions, was the creation of a three-person group of well-respected experts in water policy and project implementation. These experts were affectionately labeled the "Master Craftsmen", continuing the theme of constructing better 21st century solutions. Brief biographies of each of the Master Craftsmen are listed as follows:



**Jerry A. King**

*Former Vice President, Michael Brandman Associates (MBA)*

Jerry King brings over 25 years of professional experience in water resources planning, management, and regulation with an emphasis on water quality, wetlands treatments and urban runoff management. Mr. King has drafted guidelines for Storm Water Pollution Prevention Plans and developed a number of basin master plans. Mr. King's expertise includes governmental relations, planning coordination, land use analysis, land development processing, project management, and public utility policy development. He also is well versed in agricultural regulations and permitting, wetlands creation and restoration, development of storm water regulations, and regulatory policy oversight and permitting.



**Richard Meyerhoff**

*Associate at CDM Smith- Greater Denver*

Richard Meyerhoff has more than 19 years of experience involving developing, evaluating and implementing programs for the protection of surface water resources. Mr. Meyerhoff assisted numerous clients with federal and state Clean Water Act -related activities, including development and/or implementation of water quality studies, TMDL implementation plans, and the technical basis of water quality standards regulations, bio-assessments, and water quality permitting.



**Wyatt Troxel**

*Former Vice Chair, Santa Ana Watershed Project Authority*

Wyatt Troxel was a former vice chair of the Santa Ana Watershed Project Authority and is former president of the board of directors of the Inland Empire Utilities Agency, representing the City of Rancho Cucamonga since 1992. Mr. Troxel has more than 36 years of experience in municipal water and wastewater activities in both the public and private sectors, and is an independent consultant in the field of wastewater treatment. Mr. Troxel has the highest certifications in wastewater treatment plant operations in both California and Hawaii, and holds a lifetime teaching credential from the California Board of Education.

The Master Craftsmen acted as facilitators and worked closely with the OWOW Pillar co-chairs to describe the spatial, temporal, regulatory, economic, political, and physical barriers that impair the ability to implement watershed-based concepts supporting a regional approach to water resource management that support the vision articulated in the OWOW Plan. These impairments are well known and acknowledged by water resource practitioners. The OWOW process provides a mechanism to overcome these barriers when stakeholders in a watershed-based project can clearly identify the tangible benefits that will be received through participation in such a project. Pillar leader engagement was critical to the success of any project. Thereafter, efforts began to take this vision to the next level by initiating a series of meetings that provided opportunity for the Pillar Leaders to focus in on the key water resource management needs in the watershed, and to identify high-level watershed concepts for further development. This effort started with identification of six watershed-based or system-wide strategies as follows:

- Increase Water Use Efficiency
- Regional Water Quality Enhancement
- Water Banking and Intra-Regional Transfer
- Salt Export & Groundwater Management
- Stormwater Capture and Off-River Storage
- Disadvantaged Community Infrastructure Enhancement
- Water Recycling
- Land Use Practice

From these Master Craftsmen meetings, a white paper was developed that identifies key examples of watershed-based water resource management concepts that, when implemented throughout the watershed as a single project or series of interconnected projects, can provide tangible and measurable benefits by removing impairments. These watershed-based concepts are ideas vetted by the Pillar groups that target a particular water resource management need, and in addressing that need, provide significant additional benefits, e.g. habitat restoration and increased habitat connectivity, and improvements to the environment. Two types of concepts were included: (1) those that require implementation of capital projects, and (2) those that are programmatic and focus on establishment of regional management practices or policies that increase sustainability of existing resources.



The product of the Master Craftsmen's work is reflected in the document "OWOW Santa Ana River Watershed Planning Framework" as shown in **Appendix B**. This document includes 13 concepts that target a particular water resource management need, and at the same time provides significant corollary benefits, e.g., water supply, water quality, stormwater attenuation, habitat restoration, increased habitat connectivity, increased open/green space, and provides an improved quality of life for citizens in the watershed. A brief description of each of the 13 watershed-wide concepts is shown on the following pages.




**Water Budget Based Rate -** Incentive to our water retailers to implement sustainable water rate systems resulting in a stable revenue stream to the water agency, a significant water demand reduction by all water users, and reduced runoff pollution in TMDLs.




**Efficient Water Use Guidebook -** Developing an outreach tool or guidebook that is a well-designed, appealing, and easy to understand that provides information on how to use landscape water more efficiently and landscape appropriately for the Santa Ana River Watershed with simple easy –to-use tools, and establishes a water ethic that becomes the new norm for the next generation.




**Forest First Program Incentives -** Working with the U.S. Forest Service to support programs and projects that provide downstream water supply and water quality benefits including: Hazardous Fuels Reduction; 2) Meadow Restoration; 3) Chaparral Restoration on the front country above recharge areas; 4) Run-off reduction on roads that cross forest lands; and 5) Removal of invasive vegetative species.




**Watershed Land Use Planning Tool Kit -** Developing a tool kit that translates water principles to support watershed planning decisions and implements a jurisdictional outreach effort for relevant regional, county , and city planning agencies that encourages adoption of the guidance ideology into General Plans and zoning codes at the local level.




**Multi-Use Flood Control Corridor -** Expanding the use of existing flood control retention or detention facilities along, streams and tributaries of the Santa Ana River for water supply augmentation through stormwater capture and recharge while maintaining greenways, habitat, and recreational use.




**Water Banking and Transfer -** Constructing facilities and developing agreements to allow water to be stored in one part of the watershed in groundwater basins for later use and purchase by water agencies in other locations.




**Off-River Storage and Supply Credits -** Under a capture and replenishment program, a city or county could provide a "water credit" as part of new development that allows reconstituted or restored wetlands off river, providing opportunities to capture storm runoff and valued natural habitat.




**Watershed Urban Runoff Management Fund -** Establishing a watershed-based Urban Runoff Fund to support implementation of stormwater management programs. Components of this program could include the regulatory basis for a watershed-based program, the legal basis and authority for the fund, the agreements, and programmatic elements.




**Transportation Corridor Stormwater Capture and Treatment -** New uses of wide transportation right-of-way areas can be expanded for capturing rain runoff and replenishing groundwater basins.




**Santa Ana River Sediment Transport -** Implementing measures to assure that sediment is appropriately transferred along the entire Santa Ana River system to maximize recharge operations, restore habitat, and reduce operation costs.




**Modified Watershed Brine Management System -** Optimizing the water used to transport brine so that less water is lost to the ocean through increased concentrating of brine or delivery to the Salton Sea for beneficial use.




**Water Industry Energy Use Reduction Incentive Program -** Supporting regional purchase and installation programs of water resource related greener energy projects that reduce capital costs and reduce greenhouse gas emissions.




**Watershed Habitat Conservation Gap Planning -** Developing regional habitat conservation planning that covers areas that are not currently covered by existing conservation programs, and that allows implementation of land use decisions consistent with a plan without project-by-project review and permitting by the resource agencies, that also results in greater economic development certainty and provides for and maintains biological diversity by creating a network of interconnected Conservation Areas.

With the OWOW Santa Ana River Watershed Planning Framework document release in April 2012, the Pillars commenced their respective meetings over the following 18 months of the OWOW 2.0 planning. They investigated new regional implementation projects/programs that could lead to multiple, integrated benefits that in turn support other projects/programs concepts.

The following chapters represent the work of each stakeholder pillar as written by the Pillars, centered on a water resource strategy or need. The implementation projects and programs of each Pillar typically are shown at the end of each chapter. In many situations, the Pillars held joint meetings with other Pillars to improve synergy and integration, and to reflect a better final regional implementation project or program. **Chapter 5.14 Integration and Implementation** covers integration and implementation support to the Pillars under multiple workshops.

# 5.4 Water Resource Optimization



Arlington Desalter (WMWD)
Riverside, CA

## Recommendations

Based on the data from 2010 Urban Water Management Plans (UWMPs), the Santa Ana River Watershed is able to meet its demands in the average, single-year drought and multi-year drought scenarios while maintaining a reliability margin of 10%, or greater, to help offset future unknowns. The UWMPs assume that:

1. Future local precipitation patterns will be the same as past precipitation patterns (possible effects of climate change addressed later in the Chapter)
2. The predicted reliability of the State Water Project as taken from the Department of Water Resources (DWR) *The State Water Project Delivery Reliability Report 2009* (August 2010) is accurate
3. Imported water projections include possible effects of climate change
4. Imported water will be managed to store wet year supply for use during dry years
5. Future demands will match the estimated demand
6. The watershed will invest over $4 billion in water conservation and infrastructure projects
7. Significant investments will be made to improve the reliability of imported water supplies as detailed in Metropolitan Water District of Southern California's (MWDSC) 2010 Regional UWMP

Given the uncertainty in these assumptions, it is recommended that the Santa Ana River Watershed focus on the implementation of water management concepts marked with a ☑ over the next five years to achieve water supply reliability over the broadest area of the watershed at the most reasonable cost. Each of these concepts is described in more detail in the **Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability** section of the Chapter.

# Summary of Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability

(☑ indicates a concept recommended for focus during the next planning cycle)

| | Strategy<br>Concept (in no particular order) | Status | Estimated Benefit |
|---|---|---|---|
| **REDUCE DEMAND** | | | |
| ☑ | Water rate structures that encourage conservation | Widely implemented | Help meet SBX7-7 required demand reductions |
| ☑ | Public education to encourage water conservation | Widely implemented | Help meet SBX7-7 required demand reductions |
| | Outdoor conservation | Widely implemented | Help meet SBX7-7 required demand reductions |
| | Reduce evapotranspiration | Conceptual | More investigation required |
| **OPTIMIZE IMPORTED WATER** | | | |
| | Wet year storage program | In process | Increases storage in watershed |
| ☑ | Bay Delta Conservation Plan[1] | In process | $730{,}000 \times 0.18 = 131{,}400$ Acre Feet per Year (AFY) and improved water quality |
| | Imported water banking | Widely implemented | Water in dry years |
| | Prevent invasive species from clogging infrastructure | In process | Consistent deliveries |
| **STORMWATER CAPTURE** | | | |
| ☑ | Enhanced Santa Ana River stormwater | In process | 12,000 AFY |
| ☑ | Enhanced stormwater capture from tributaries of Santa Ana River | In process | 28,000 AFY |
| ☑ | Riverside North Aquifer Storage and Recovery Project | In process | 12,800 AFY |
| ☑ | Enhanced Santa Ana River stormwater capture at Prado Dam | Conceptual | 10,000 AFY |
| ☑ | MS4 Credits | Conceptual | Increased stormwater capture |
| ☑ | Re-operate flood control facilities | In process | More investigation required |
| ☑ | Size flood control facilities for stormwater capture | Conceptual | Increased stormwater capture |
| ☑ | Forest First: Forest management for increased downstream stormwater capture | In process | Increased stormwater capture |

[1] Assume average maximum entitlement for the State Water Project (SWP) increases from 60% to 78%.

| | | | |
|---|---|---|---|
| | Development Standards that enhance stormwater capture | Conceptual | Increased stormwater capture |
| **RECYCLE WATER** | | | |
| ☑ | Recycled water exchange | Conceptual | Capital and energy savings ($100s millions), improved water quality |
| ☑ | Recycled water for potable use | Conceptual | More investigation required |
| | Recycle wastewater flowing to the ocean | In process | 157,000 AFY |
| | Import recycled water from outside the watershed | Conceptual | More investigation |
| | Ocean Desalination[2] | | 54,000 AFY |
| | Recycled water use to offset potable demand | In process | This is widely implemented by several agencies and part of the projected water supply portfolio |
| **INCREASE STORAGE** | | | |
| ☑ | Surface Water Storage | In process | Helps offset drought and climate change |
| ☑ | Groundwater storage | In process | Helps offset drought and climate change |
| **IMPLEMENT EMERGENCY MEASURES** | | | |
| | Emergency Measures | In process | Preparation for catastrophic event |
| | **Total** | | **405,200 AFY** |

The climate and geography of the State of California present a unique challenge to the management and delivery of water. While most of the precipitation falls on the northern portion of the State, most of California's population resides in the semi-arid, southern portion of the State. Water is diverted, stored, and then transferred from the water-rich north when needed to the more arid central and southern sections of the state through the California State Water Project (SWP), the Central Valley Project (CVP), and the Los Angeles Aqueduct.

In addition to the projects that transport water from the north to the south, the southern coastal area relies on water imported through MWDSC's Colorado River Aqueduct (CRA). The U.S. Bureau of Reclamation and seven basin states manage the Colorado River (CR) system under the authority of the Secretary of the Interior and for the benefit of seven "basin states". California's share of the CR Supply is 4.4 million acre-feet (maf).

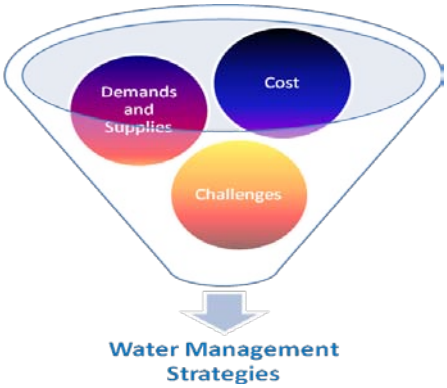
During most years the supply available to the region has been adequate for its needs. The region has gotten through the drier years by using water that was stored during wetter years.

[2]Poseidon Huntington Beach Ocean Water Desalination, 50 million gallons per day.

Even though the State's water supply is more than adequate for its population and economic needs, the laws of the State and Federal governments have allocated the majority of that supply for environmental purposes and made building new surface storage increasingly difficult and expensive. This has forced Californians to seek more creative and sustainable and often more expensive solutions to water resource management wherever possible.

The Santa Ana River Watershed lies in semi-arid Southern California. Like many other areas, the watershed is carefully evaluating water supplies and demands and seeking creative, cost-effective strategies to provide a reliable water supply into the future. Water supply reliability in Southern California will be challenged by multi-year droughts, droughts on the CR, limited local water resources, the vulnerability of the Sacramento-San Joaquin River Bay-Delta, and the threat of climate change. In addition, vulnerabilities in regional and statewide infrastructure could increase due to major seismic events. Designing a diverse and flexible water resource management system that can meet these challenges will help to ensure water reliability and a sustainable and vibrant economy for the Watershed.

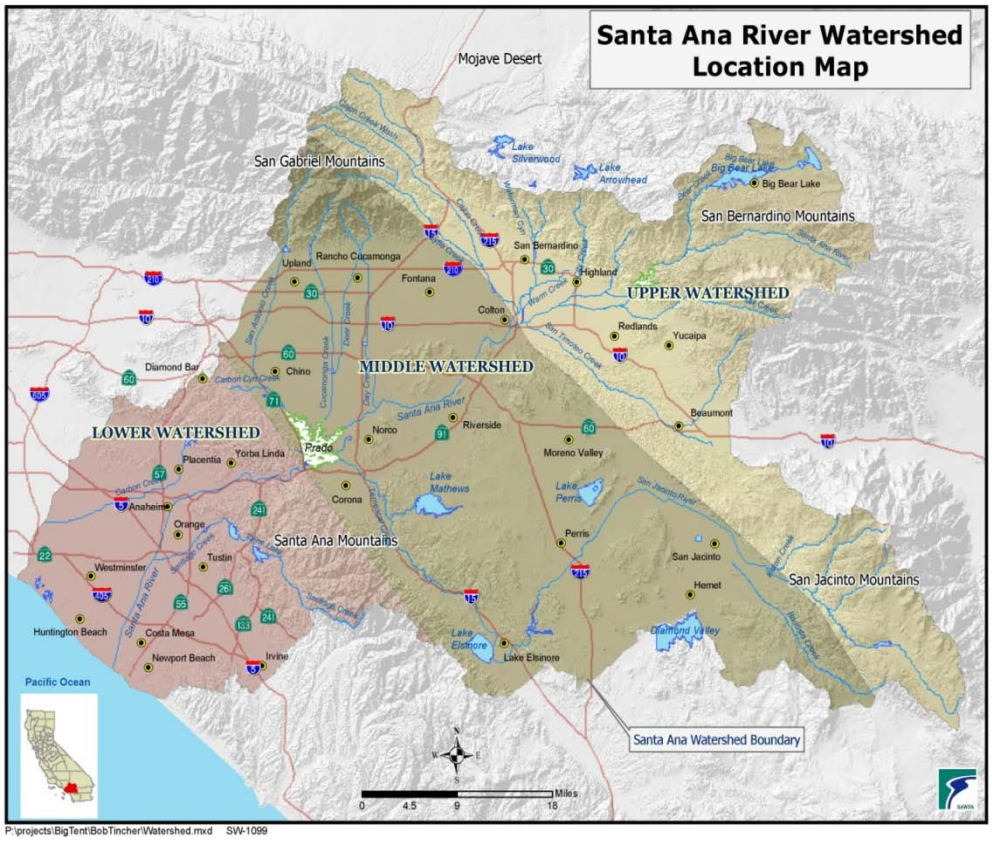
The One Water One Watershed (OWOW) collaborative process has facilitated the discussion of water management and sustainability throughout the Watershed. The key objective for water supply reliability is a cost-effective and diverse water supply and water storage portfolio that makes better use of existing facilities and supplies; improves overall water use efficiency; achieves a practical level of inter-connections and redundancy; and optimizes water storage for use during drought periods. This section of the plan focuses on how to maintain a robust and reliable water supply within the watershed.




## Current Conditions

There are five principal wholesale agencies that form the Santa Ana Watershed Project Authority (SAWPA) and manage most of the water supplies within the watershed, both local and imported. In addition to these regional water agencies, the watershed also contains portions of four counties represented, as well as retail and wholesale water agencies. For purposes of this report, the analysis has been organized by three general areas: upper watershed, middle watershed, and lower watershed. These areas are subsets of the Santa Ana River Watershed (**Figure 5.4-1**). The regional water agencies within each general area are described below.

**Figure 5.4-1 Watershed Areas**




## Upper Watershed

*San Bernardino Valley Municipal Water District (Valley District)* is a State Water Contractor and provides imported water from the SWP to local retail agencies in its 325 square mile service area to supplement and enhance groundwater resources. Valley District's service area generally includes the cities and communities of San Bernardino, Colton, Loma Linda, Redlands, Rialto, Bloomington, Highland, Grand Terrace, and Yucaipa. Valley District is a member agency of SAWPA.

*San Gorgonio Pass Water Agency (SGPWA)* is a State Water Contractor, and provides imported water from the SWP to local retail agencies in its 225 square mile service area to supplement and enhance groundwater resources. SGPWA's Service area includes Calimesa, Beaumont, Banning, Cherry Valley, Cabazon, and Morongo Indian Reservation. The SGPWA service area straddles the Watershed, with its western two-thirds in the watershed and eastern one-third in the Whitewater River watershed.

## Middle Watershed

*Eastern Municipal Water District (EMWD)* is a member agency of MWDSC and provides both water and sewer service throughout its 555 square mile service area. Major communities include Moreno Valley, Hemet, San Jacinto, Perris, Sun City, Menifee, Winchester, and parts of Temecula, and Murrieta. In addition to retail customers, EMWD wholesales water through seven local water agencies. EMWD is a member agency of SAWPA.

*Western Municipal Water District (WMWD)* is a member agency of MWDSC and provides water service throughout its 510 square mile service area in western Riverside County. Within its boundaries lie the communities of Jurupa, Rubidoux, Riverside, Norco, Corona, Elsinore Valley, and parts of Temecula. WMWD serves imported water directly to customers who are located in the unincorporated and non-water bearing areas around Lake Mathews and portions of the City of Riverside. Ten wholesale customers are served by WMWD with both CR and SWP water. WMWD is a member agency of SAWPA.

*Inland Empire Utilities Agency (IEUA)* is a member agency of MWDSC and provides water and sewer services to a 242 square mile area in the western portion of San Bernardino County. Within its boundaries lie the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, and Upland. IEUA is a member agency of SAWPA. Also, the majority of the IEUA service area overlies the Chino Basin Watermaster boundary.

*Chino Basin Watermaster (Watermaster)* is a consensus-based organization facilitating the development and utilization of the Chino Groundwater Basin. The Watermaster consists of various entities pumping water from the Basin including cities, water districts, water companies, agricultural, commercial, and other private concerns. The Watermaster's mission is "to manage the Chino Groundwater Basin in the most beneficial manner and to equitably administer and enforce the provisions of the Chino Basin Watermaster Judgment", Case No. RCV 51010 (formerly Case No. SCV 164327).

### Lower Watershed

*Orange County Water District (OCWD)* manages groundwater within its 355 square mile service area. Within its boundaries lie the Cities of Anaheim, Buena Park, Costa Mesa, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, Irvine, La Palma, Los Alamitos, Newport Beach, Orange, Placentia, Santa Ana, Seal Beach, Stanton, Tustin, Villa Park, Westminster, and Yorba Linda. OCWD recharges the groundwater basin with surface water flows from the Santa Ana River and Santiago Creek, recycled water from the OCWD Groundwater Replenishment System (GWRS), and imported water which is purchased from the Municipal Water District of Orange County. OCWD is a member agency of SAWPA.

*Municipal Water District of Orange County (MWDOC)* is a member agency of MWDSC and sells imported water to 29 retail water agencies and cities in north and south Orange County. MWDOC also sells water to OCWD. MWDOC also straddles the Watershed, with its northernmost portion being in the Watershed and its southern portion being outside of the watershed.

Within each of these regional agencies, there are a number of retail water agencies. For purposes of brevity, these local agencies have not been individually listed in this report. However, these agencies did provide invaluable input into the OWOW process.

## Water Sources

The Watershed gets about 50% of its water from local precipitation in the form of surface water and stored as groundwater. The Watershed imports about 30% of its water from the SWP and Colorado

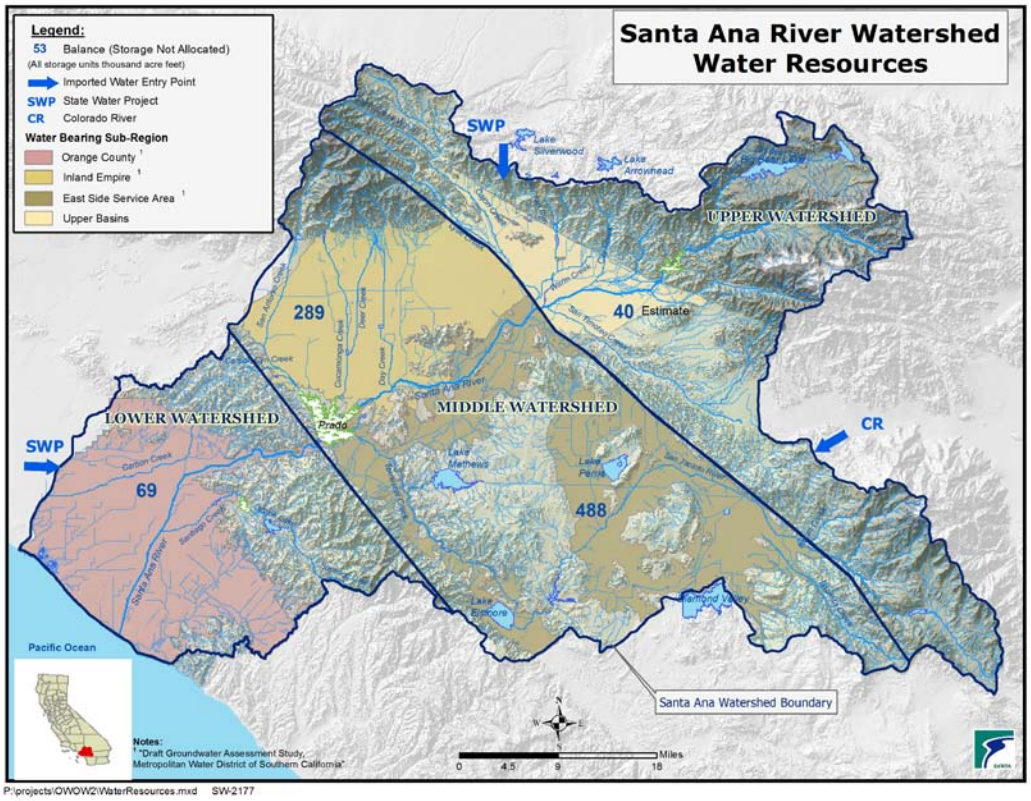
River. The remaining 20% of the Watershed's water supply is recycled water. Each of these sources are explored below.

### *Precipitation Stored as Groundwater*

The underground pore space between soil granules provides a location to store water, referred to as groundwater, which can be later extracted using wells. To avoid double-counting water supplies, OWOW 2.0 limits the term groundwater to precipitation stored as groundwater. Imported water stored in the ground is classified as "imported water". The watershed's underground storage space functions essentially like a series of underground reservoirs. These underground reservoirs, or basins, range from a few hundred to over one thousand feet in thickness. Basins upstream from Prado Dam underlie about 1,200 square miles of the watershed, while basins downstream from Prado Dam underlie about 400 square miles of the watershed. Yields of nearly all of the basins within the watershed have been estimated using past hydrology and, for planning purposes, agencies have assumed that this past hydrology will continue to repeat itself and does not include any possible effects from climate change. Possible water resource effects from climate change are addressed later in this chapter and the possible overall effects of climate change are addressed in **Chapter 5.13 Energy and Environmental Impact Response**. Recognizing that hydrological patterns are expected to be altered due to climate change with subsequent impacts to demand and supplies, climate change impacts are discussed and addressed later in this chapter. Basin's safe yield is the amount of water that can be annually pumped from a basin on a permanent basis without emptying the basin.

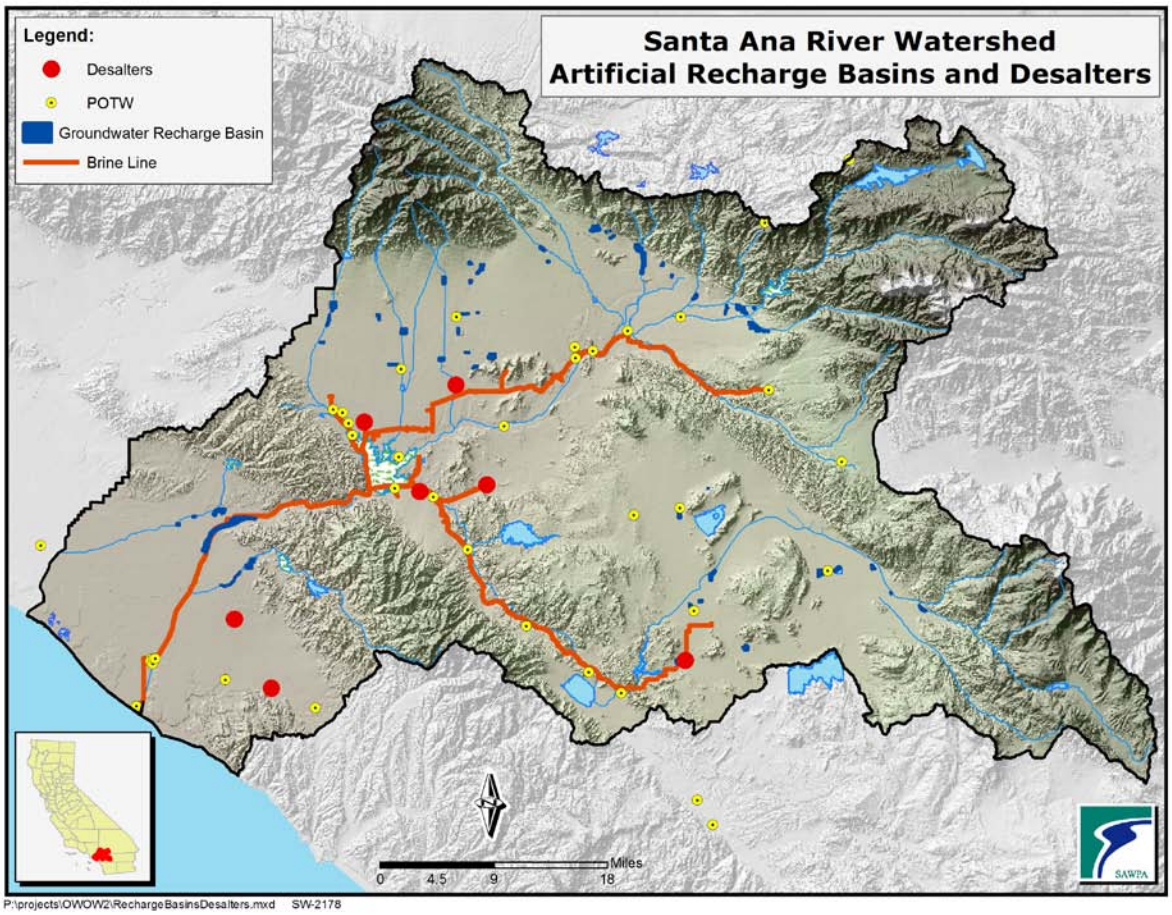
In general, the watershed relies on precipitation stored as groundwater to provide about 50% of the water supply. **Figure 5.4-2** generally shows the larger groundwater basins within the watershed along with any available storage capacity (individual basins and sub-basins have been omitted for clarity). These basins provide storage space for local and imported water supplies that can be used during droughts or other shortages. The amount of storage space in the lower watershed is based on the storage volume that could be available in approximately eight out of ten years.

**Figure 5.4-2 Groundwater Resources within the Watershed (Thousand acre-feet)**




Artificial replenishment involves storing additional water in the basin(s), over and above precipitation stored as groundwater. The most common type of artificial replenishment is “spreading” water into open “pits”, or basins, and allowing it to soak into the ground down to the “water table”. Another commonly used method is called “in-lieu” replenishment. This method involves replacing groundwater with another source of water. This corresponding reduction in groundwater pumping results in less water being removed from the basin which effectively acts to replenish the groundwater supply. Finally, the most costly method of artificial replenishment is to inject the water into the basin using an injection well(s). Of the various methods available, artificial recharge the most common throughout the Watershed. **Figure 5.4-3** shows the locations of spreading basins in the watershed.

**Figure 5.4-3 Artificial Recharge Basins and Desalters**




One challenge to groundwater supplies in the watershed is poor water quality, typically due to total dissolved solids (TDS or salinity) and nitrates. These salts accumulate mostly through use and evaporation, but also are introduced to the water supply by way of agricultural fertilizers and septic tanks. Further, there are numerous forms of contamination found in the watershed, such as; TCE, PCE (commonly used solvents) and Perchlorate (fertilizer, fireworks and explosives). All these forms of contamination must be removed using various treatment methods before it can be introduced into the water supply system.

### *Precipitation as Surface Water*

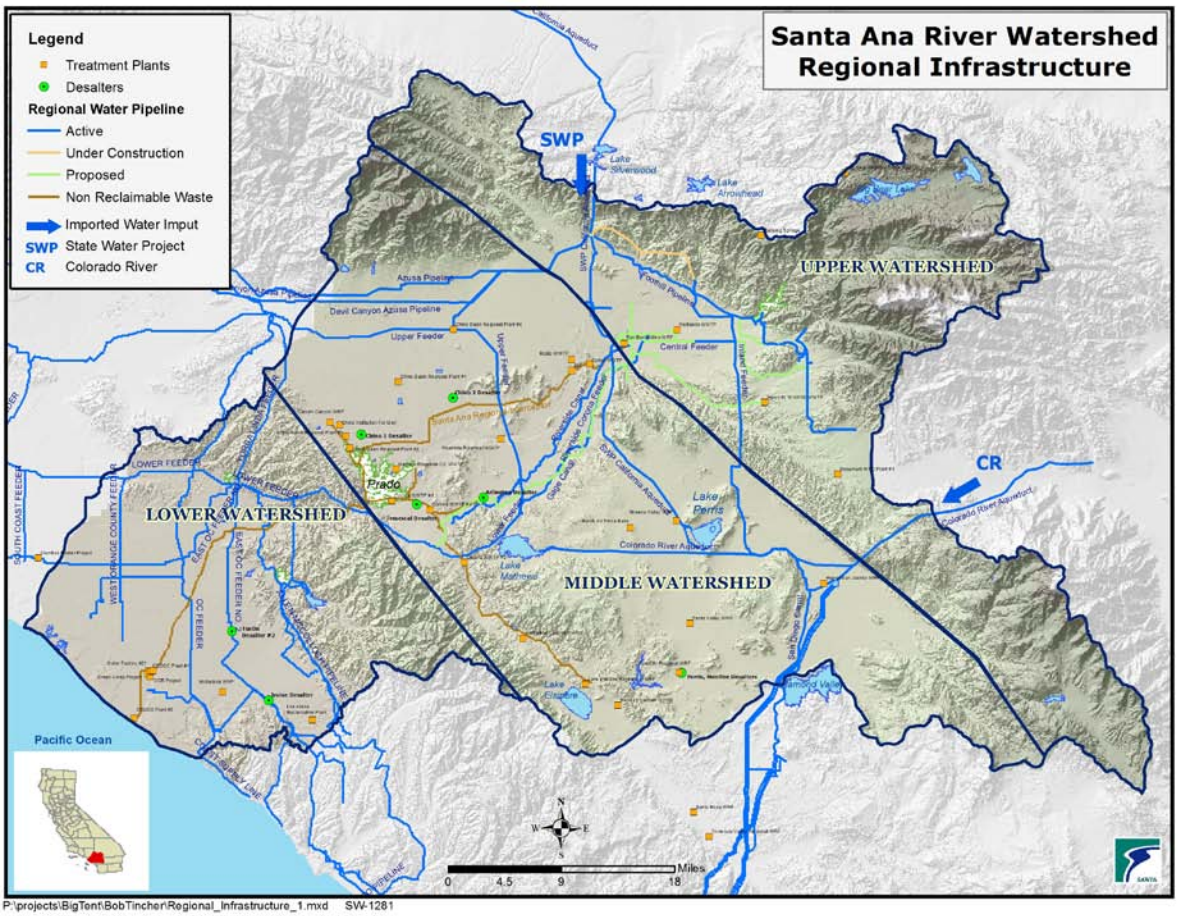
In 2005, the amount of precipitation that flowed from rivers and streams that was diverted and used accounted for approximately 5% of the total water supply. Local surface water is largely seasonal, meaning that most of the water comes in the "wet" or rainy season, and is dramatically reduced in the "dry" season to snowmelt, natural springs, and treated wastewater flows. Facilities, such as dams and flood control detention basins divert and slow storm runoff providing additional opportunity for groundwater replenishment. In the upper watershed, only a portion of storm runoff is being diverted and used as surface water. In other portions of the watershed, the exact opposite is true. Much of the

runoff from the upper and middle watershed is captured by the U.S. Army Corps of Engineers' Prado Dam and later is used by the Lower Watershed. A similar opportunity is available in the upper watershed at the U.S. Army Corps of Engineers Seven Oaks Dam and other dams in the watershed.

### *Imported Water*

The watershed relies upon imported water for about 1/3 of its water supply. Water is imported into the area by MWDSC (SWP and CR), SGPWA (SWP) and Valley District (SWP). Current and predicted reliability of the SWP was taken from DWR's *The State Water Project Delivery Reliability Report 2009* (August 2010). **Figure 5.4-4** shows the regional infrastructure and the entry points for the SWP and the CR.

**Figure 5.4-4 Regional Infrastructure within the Watershed**



As shown on **Figure 5.4-4**, there are significant regional pipelines (48 inch diameter and larger) and surface storage reservoirs in the watershed. These pipelines provide opportunities for water transfers, especially in an emergency situation. **Table 5.4-1** provides a list of surface water reservoirs in the watershed and their capacities.

**Table 5.4-1 Surface Water Reservoir Capacities**

| Reservoir | Capacity (acre-feet) |
|---|---|
| Lake Arrowhead | 48,000 |
| Big Bear Lake | 73,000 |
| Diamond Valley Reservoir | 800,000 |
| Lake Elsinore | 45,000 |
| Canyon Lake | 12,000 |
| Lake Mathews | 178,500 |
| Lake Perris | 120,000 |
| Prado Dam | Flood control and conservation |
| Seven Oaks Dam | Flood control (conservation pending) |
| Lake Silverwood | 74,970 |
| Irvine Lake | 25,000 |

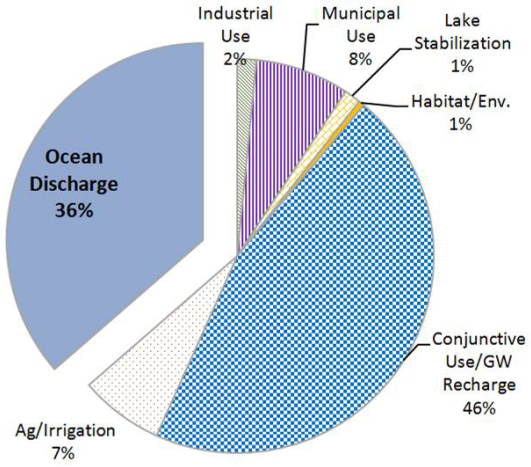
## Recycled Water

Water recycling, also known as water reclamation or water reuse, is a reliable, economically feasible, and environmentally sensitive means to preserve the State's potable water resources, assist with drought mitigation, and reduce the demand on potable water supplies.

Statewide, over 669,000 (AF) of wastewater is recycled each year according to the State Water Resources Control Board (SWRCB). Currently, recycled water is used to irrigate agricultural crops, urban landscapes, golf courses, and freeway medians; replenish groundwater basins; flush toilets and urinals; and act as a barrier to sea water intrusion into freshwater groundwater basins. It is also increasingly used by industry in cooling processes, in new home and other construction, and for other purposes. In the future, the level of recycling will increase to help meet the needs of the State's burgeoning population.

## Current Conditions in the Watershed

**Figure 5.4-5 Current Rate of Recycled Water Use within the Watershed**



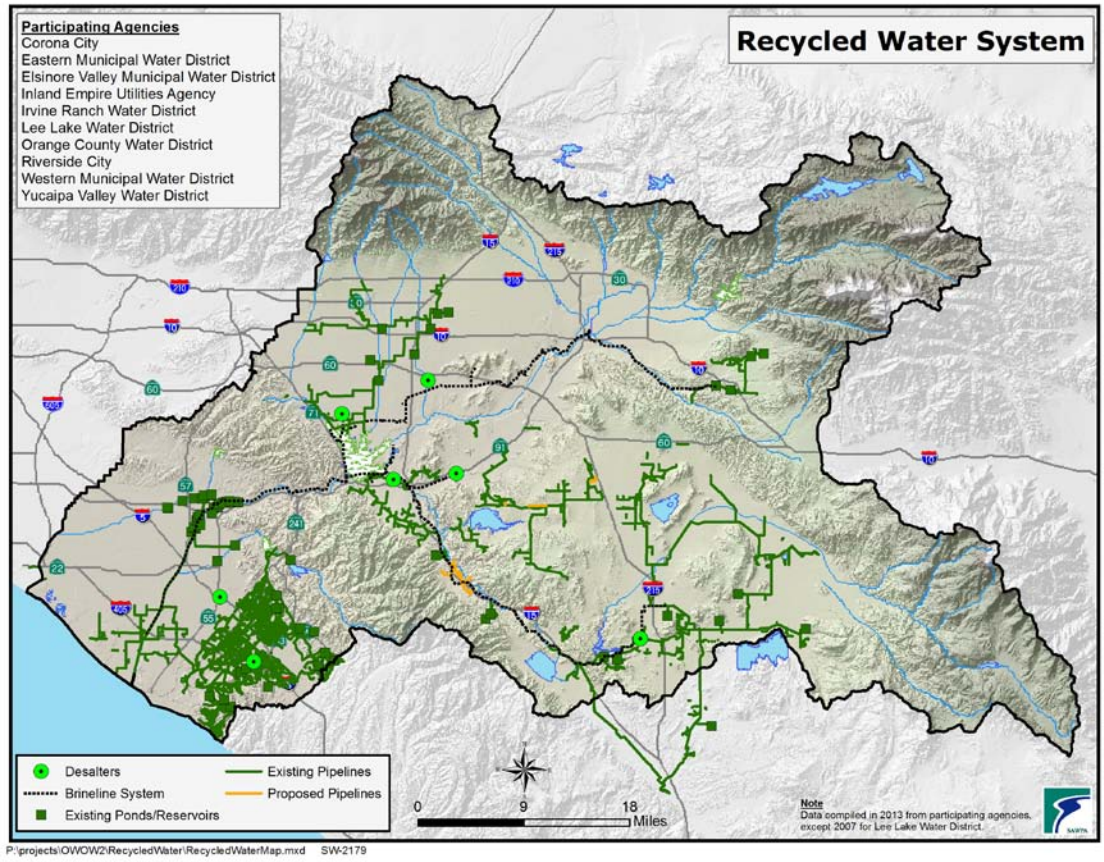

Recycled water has been used in the watershed for many years to supplement local and imported potable supplies. Water reclamation involves treating wastewater to State standards so that the water is safe for State-approved applications. Currently, over 285,000 AFY of recycled water is being used to meet groundwater recharge (72%), municipal (12%), agricultural irrigation (11%), lake stabilization (2%) , industrial (2%), and habitat and environmental (1%) water needs within the Santa Ana River Watershed (see **Figure 5.4-5**). The 285,000 AFY includes approximately 100,000 AFY of tertiary treated wastewater that flows down the Santa Ana River from San Bernardino and Riverside Counties that is recharged by OCWD in surface recharge basins in Anaheim and Orange. OCWD generally captures all of the river flows, except during periods of high storm flow. As seen in in **Figure 5.4-5** only 36% of recycled water in the watershed, or 157,000 AF is currenlty being discharged to the ocean.

The 100,000 AFY is considerably more than the 42,000 AF at Prado Dam required by the 1969 Orange County Judgment. As demands continue to increase and other supplies become less reliable, the upper and middle watershed have plans to increase recycling. Over time, any reduction in treated wastewater flow in the river would have to be replaced by OCWD recycling more of the wastewater that flows into the ocean, importing more water, desalting the ocean, or some other new source of supply. Tables 5a.8 through 5a.11 of **Appendix C** show the proposed increase in recycled water use in the upper watershed from 2015 through 2035.

Overall recycled water currently represents the third largest water supply source to the watershed, accounting for approximately 20% of total water demands. **Appendix C** includes information about existing and proposed treatment facilities, plant flow and recycled water use.

**Figure 5.4-6** shows the recycled water systems in the watershed. Included in the display are existing and proposed recycled water pipelines, existing and proposed wastewater treatment plants, existing and proposed storage tanks, existing storage ponds, and the Inland Empire Brine Line. Agencies that provided map information include Big Bear Area Regional Wastewater Agency, City of Corona, City of Riverside, EMWD, EVMWD, IEUA, Irvine Ranch Water District, Lee Lake Water District (LLWD), Orange County Sanitation District (OCSD), OCWD, WMWD, and Yucaipa Valley Water District (YVWD).

**Figure 5.4-6 Recycled Water Systems**

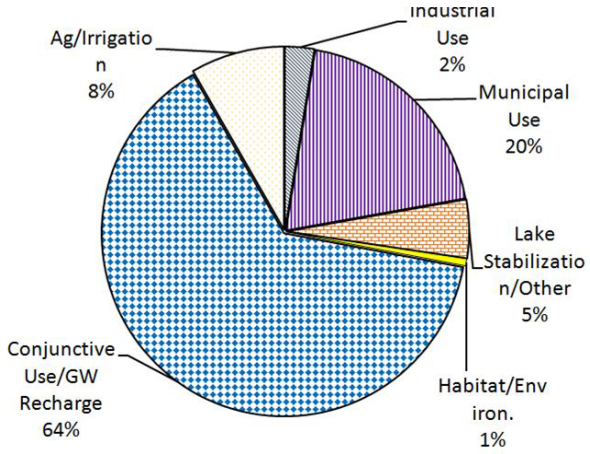



## Proposed Recycled Use

As urban and suburban growth and development in the watershed continue, an increasing amount of recycled water will be available while the traditional demand by agricultural customers will decrease. This creates a challenge to establish a growing recycled water market for groundwater recharge, commercial, industrial, and institutional customers as well as developing innovative and creative markets elsewhere.

Current projections for 2035 indicate 432,000 AFY of water treatment plant flows will be recycled in the watershed, and 205,000 AFY discharged into the ocean. **Figure 5.4-7** depicts the estimated distribution of the recycled water in 2035.

**Figure 5.4-6 Projected 2035 Rate of Recycle Water Use within the Watershed**



## Current Management Strategies

Current management strategies include the planned and conceptual recycled water projects as described below.

**EMWD** has completed a Recycled Water Strategic Plan to identify the preferred strategy to be pursued in developing its recycled water system through the year 2030. The principal goal of the Strategic Plan was to develop a preferred long term strategy for highest beneficial reuse of recycled water. EMWD's Recycled Water Strategic Plan recommended the Indirect Potable Reuse (IPR) Project, using advanced treated water for recharge of basins in the Hemet/San Jacinto Water Management Plan area. Currently, EMWD is working on a phase I planning study. This next step in the planning process consists of determining blending water strategy, brine disposal alternatives, salt balance considerations, regulatory requirements, facilities needs assessment & constraints analysis and program cost analysis. This phase will produce 5,000 AFY, and is scheduled to be completed in 2020.

**City of Riverside -** The SWRCB approved the City of Riverside's wastewater change petition on May 20, 2008. The primary condition of the Order requires that the City of Riverside discharge not less than 25,000 AFY of treated wastewater from its Regional Water Quality Control Plant to the Santa Ana River. The Order also modified the purpose of recycle water use to include municipal, industrial, and agricultural purposes and expanded the place of use to included areas within the City's limits, the City's water service area boundary, and within the boundary of the Jurupa Area Plan to reflect diversion of treated wastewater to recycled water use sites. To be able to meet these future projected needs without increasing the City of Riverside's reliance upon imported State Water purchases, it will be critical for the City of Riverside to significantly expand its use of the recycled water recently made available.

In addition to the description of the City of Riverside's recycled water efforts, the City of Riverside Public Utilities also received a master reclamation permit from the Regional Water Quality Control Board.

**IEUA** recently developed a Three Year Business Plan to rapidly expand the recycled water distribution system and increase recycled water use by 35,000 AFY. The capital program emphasizes increased system storage as well as distribution system piping and piping to reach high capacity recharge sites. The business strategy, while regional in nature, is founded on the principle of partnerships with IEUA member agencies, both from a water marketing standpoint and a capital facilities standpoint. The partnerships are having the effect of "supercharging" the capital program through conversion of member agency owned local potable water facilities to regional recycled water facilities.

**LLWD** has completed a recycled water master plan that will allow for the connection of the local parks and schools in the near future. They also have partnered with the City of Corona in its Ground Water Management Plan for the basins underlying LLWD's boundaries. LLWD currently is investigating potential groundwater recharge options.

**OCWD and OCSD** jointly developed the GWRS. In 2011, the GWRS produced 72,000 AF of recycled water. OCWD is constructing the Initial Expansion of the GWRS. This project will increase the amount of water produced by 31,000 AFY. When construction is completed in 2014, the total amount of water produced by the GWRS will be 103,000 AFY. OCWD is also evaluating an additional expansion of the

GWRS. Implementation of additional expansion of the GWRS would further reduce the amount of effluent discharged into the ocean. Because they reduce the amount of water discharged into the ocean, expansions of the GWRS are a new regional water source that would increase the net overall supply of water to the watershed.

**City of Riverside** in May 2013, the Regional Water Quality Control Board adopted Order No. R8-2013-0028 granting the City of Riverside Public Utilities a waste discharge requirements and master reclamation permit for distributing recycled water.

**Valley District** does not own or operate a wastewater treatment plant within its service area. However, recycled water is part of the region's water budget as they move toward the future. The City of San Bernardino Municipal Water Department is planning a "clean water factory" that may produce up to 14,000 AFY in the future.

**WMWD** expanded its recycled water portfolio with the expansion of the Western Water Recycling Facility (WWRF) in 2011. The plant is capable of producing up to three Million Gallons per Day (MGD) of tertiary-treated recycled water. Plans call for eventually expanding to five MGD.

WMWD possesses an extensive non-potable distribution system that includes both storage and pumping capabilities. This system functions as the backbone distribution system to expand use of recycled water (for irrigation) within its service area. One major commercial area (Meridian Business Center) and one large residential community already are dual-piped for recycled water use and a new Riverside Unified School District (RUSD) high school has been retrofitted to allow recycled water use. Two new large residential projects (including a golf course development) will be conditioned to install dual plumbing. WMWD also will work with RUSD to dual plumb new campuses, including a new middle school west of the Orangecrest area.

The City of Riverside is still working with WMWD to conduct joint planning for recycled water use. At this time, the City does not plan to deliver recycled water to Riverside's greenbelt. The system also will distribute non-potable groundwater through the legacy canal system thereby maximizing use of local water resources.

WMWD is working with the Riverside County Ben Clark Training Center to site a large recycled water storage impoundment on their facility located just south of Van Buren Boulevard and west of I-215. This proposed 600 AF impoundment would serve the County as a dive/water training facility while providing wet weather storage for recycled water produced by the WWRF, a truly unique and innovative use of recycled water.

Finally, WMWD is in the early stages of evaluating the use of recycled water to recharge local groundwater basins as a new source of supply. As total summer irrigation demands likely will exceed recycled water supply, recharge will probably be limited to winter months. Close coordination with the Regional Board and California Department of Public Health (CDPH) will be required.

**YVWD** adopted a Strategic Plan in August 2008, which outlines the methods used to maximize the use of recycled water to meet future water demands. This policy requires new homes to install dual water meters to provide potable water and non-potable water to each property. The use of recycled water

delivered to residential and commercial properties for irrigation is expected to reduce future potable water demands by 50%-60% per equivalent dwelling unit. This policy will require YVWD to implement a salinity control program which will provide extremely high quality recycled water to new neighborhoods providing a sustainable water supply for the future.

Other reclamation projects in the watershed include innovative uses such as toilet and urinal flushing in high-rise buildings and schools as well as residential landscaping irrigation, as evidenced by recycled water programs in IRWD.

## Barriers and Constraints

Challenges related to recycling projects include: regulatory requirements, brine line constraints, storage/seasonal constraints, financial constraints, water quality management, and public perception. They are discussed below.

### *Regulatory Requirements*

An important component of maximizing local supplies is the ability to safely and efficiently regulate and permit recycled water use. California's laws governing the permitting of recycled water were established more than 20 years ago, and are in need of updating to communicate that recycled water is a valued commodity, not a waste. Additionally, the current permitting framework establishes multiple recycled water permitting paths and overlapping jurisdictions overseeing the process which has resulted in confusing, costly delays and often inconsistent requirements.

To address some of these concerns, the Recycled Water Act of 2013 is currently making its way through the legislative process with the support of many water agencies and water reuse proponents. This bill will address barrier to recycled water use. It will align recycled water spill reporting and incidental runoff in codes, and authorize SWRCB permitting of advanced treated water. Clear, comprehensive legislation is required to maximize the use of recycled water in the future and to further reduce reliance on imported water.

In November 2011, the CDPH released draft regulations regarding recycling water for public comment. These draft regulations pertain to groundwater replenishment with recycled water. CDPH reviewed the public comments and released another draft in March of 2013. The final proposed version will proceed through the formal regulation adoption process and will be subject to public review and comment as part of that process.

### *Storage/Seasonal Constraints*

The recycled water supply is not dependent on weather patterns; supply is fairly constant throughout the year. For these reasons, recycled water is viewed as one of the most reliable sources of water in the Watershed. However, because recycled water is used primarily for irrigation purposes and associated seasonal demands, recycled water demands can be variable and are often affected by weather and the season. In some areas, demands increase in dry years. However, wet years generally pose a greater operational challenge as customer demand decreases and storage facilities fill. Storage during periods of low demand is necessary to meet high demand during other times of the year. The amount of available recycled water storage varies greatly between agencies. Some have little or no storage and others have

thousands of AF of storage. Each agency's existing and proposed recycled water storage facility capacities, excluding groundwater basins, are shown in **Appendix C**.

### *Financial Constraints*

The cost of infrastructure to produce, store, and distribute recycled water is expensive. Given that demands for recycled water are more scattered throughout communities, recycled water distribution pipelines are built only where demands justify the expense and where customers agree to use recycled water. This is especially true where sites need to be retrofitted to use recycled water as opposed to newly constructed sites where rules may dictate its use. Other issues include the cost of recycled water use to the customers as well as administration of the recycled water system by both the distributor and user. Because of the cost, there are sites where there may be willing customers but no infrastructure to serve them. Grant funds and other forms of financial aid can help make some projects viable, but other projects still may not be financially viable.

Other issues include the cost of recycled water use to the customers as well as administration of the recycled water system by both the distributor and user. Many agencies are unable to charge the true cost to produce this high quality water due to the stigma attached.

Costs associated with recycled water use could include retrofitting of existing systems, required inspections and cross-connection shutdown testing, employee training, and use site maintenance. Administrative requirements include extensive permitting, recordkeeping, and reporting requirements.

Each use area also must have a Site Supervisor knowledgeable of the use area system and recycled water use restrictions. The Site Supervisor must be available at all times to correct any condition that does not conform to use area requirements specified by regulations and the recycled water distributor.

### *Water Quality Management*

Higher TDS source water, such as the Colorado River (up to 650 mg/l average) adds cost because TDS removal, or demineralization, requires energy intensive reverse osmosis. Residential use of water typically adds 200 to 300 mg/L of TDS to the wastewater stream, and self-regenerating water softeners can add another 60 to 100 mg/L. If an area receives CR water with a TDS of 650 mg/L, and residents add 300 mg/L through normal use, the recycling facility will produce water with a TDS concentration of 950 mg/L. This would not meet basin plan objectives anywhere in the watershed. It is also problematic for industrial customers and virtually unusable for many agricultural customers which limit the marketability. Nutrients such as nitrate present similar issues as TDS.

### *Public Perception*

Public perception of recycled water is changing! One successful example of this is OCWD's GWRS project that undergoes an advanced treatment process including two membrane filtration systems – microfiltration and reverse osmosis, and treatment by ultraviolet light and hydrogen peroxide. Once purified, the water is sent to recharge basins where it seeps into the ground, like rain, and blends with groundwater. The GWRS provides a new drought-proof water source for northern and central Orange County, reducing reliance on imported water. Additionally, the GWRS will save additional funds in the future by improving the quality of the water in the Orange County groundwater basin. This successful

effort utilized widespread public outreach activities involving the scientific, political, and other communities to assist in informing the public and addressing potential public perception issues.

## Evaluate Water Supply Reliability

Water supply reliability for the Watershed was evaluated using the scenarios given in the Urban Water Management Planning Act (**Table 5.4-2**) and using some additional scenarios developed by the Water Resource Optimization Pillar (**Table 5.4-3**).

**Table 5.4-2 Water Supply Reliability Scenarios Provided in the Act**

| Scenario | Description |
|---|---|
| Average conditions* | What are the water supply reliability vulnerabilities given average supplies to the region? |
| Single year drought*[1] | What are the water supply reliability vulnerabilities given a single year of drought? |
| Multi-year drought*[1] | What are the water supply reliability vulnerabilities given a multi-year drought? |
| 50% reduction in imported water supplies*[1] | What are the water supply reliability vulnerabilities if the Watershed loses 50% of imported water supplies? |
| Natural Disaster | What are the water supply reliability vulnerabilities if a catastrophic interruption occurs due to an earthquake or other disaster? |

**Table 5.4-3 Additional Water Supply Reliability Scenarios Evaluated as part of the OWOW Process**

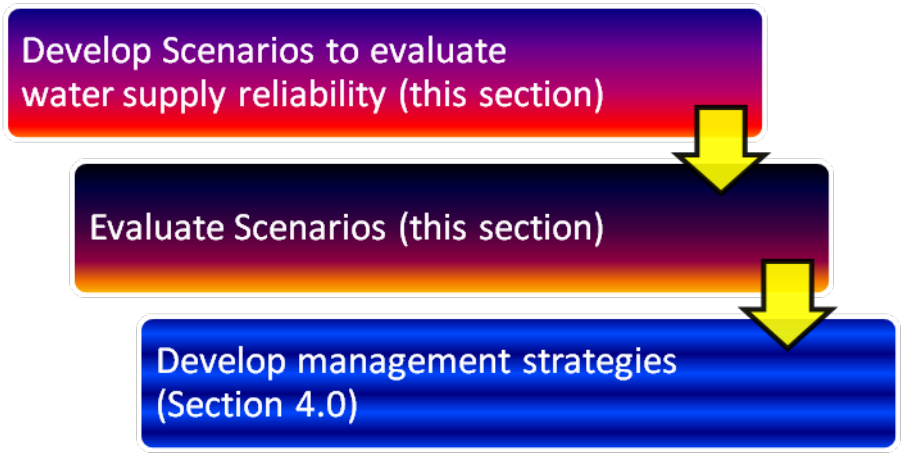
| Scenario | Description |
|---|---|
| Climate Change | What are the water supply reliability vulnerabilities given the assumed effects of climate change as presented in the Draft 2007 State Water |
| Zebra and/or Quagga Mussels | What are the water supply reliability vulnerabilities of the Zebra Mussel and/or the Quagga Mussel were to infiltrate the SWP? |
| Sediment Transport | How does sediment transport at Seven Oaks Dam and/or Prado Dam affect water supply reliability? |
| Wildfire | How does the threat of wildfire affect water supply reliability? |
| Channel Armoring | How does channel armoring in the Santa Ana River affect water supply reliability? |
| Water quality degradation | How does water quality degradation affect water supply reliability? |
| Terrorism | How does terrorism affect water supply reliability? |

*Scenario presented in the Catastrophic Interruption, Urban Water Management Planning Act.

Collectively, **Tables 5.4-2** and **5.4-3** provide a complete list of the evaluated scenarios.

All of the scenarios pose a threat to water supply reliability. The evaluation consisted of analyzing anticipated water supplies for each of these scenarios to determine if they are adequate to meet the anticipated demands. If anticipated demands are less than anticipated supplies, the system is deemed reliable. If anticipated demands are greater than anticipated supplies, water management strategies will need to be developed to offset these deficits. **Figure 5.4-8** provides an overview of the evaluation process.

**Figure 5.4-7. Overview of the Water Supply Reliability Evaluation Process**




The scenarios analyzed in this document represent a "snapshot" in time. As new challenges and constraints to water supply reliability are identified, they will require evaluation.

## Evaluation of Water Supply Reliability Scenarios

Every urban water supplier that either provides over 3,000 acre-feet of water annually or serves more than 3,000 or more connections is required to assess the reliability of its water sources over a 20-year planning horizon considering normal, dry, multiple dry years and other scenarios. The scenarios evaluated in OWOW are summarized in **Table 5.4-4**. The assessment of water sources is reported in an UWMP, which is to be prepared every 5 years and submitted to DWR. DWR reviews the UWMPs to ensure they have completed the requirements from the Urban Water Management Planning Act (Division 6 Part 2.6 of the Water Code §10610 - 10656). Current and predicted reliability of the State Water Project used in the UWMPs was taken from the Department of Water Resources *The State Water Project Delivery Reliability Report 2009* (August 2010).

In November 2009,SB X7-7 (Steinberg) was passed requiring urban water suppliers to reduce per capita use 10% by 2015 and 20% by 2020. This required reduction in per capita consumption is reflected in the 2010 UWMPs which were used to evaluate water supply reliability for the watershed. This legislation results in a significant reduction in demand since OWOW 1.0 which eliminated the deficit between supplies and demands shown in OWOW 1.0. In each of the UWMP scenarios, the watershed is able to meet its projected demands plus the 10% Reliability Margin with the projected supplies. However, it is

important to recognize that both the reduced demand and anticipated supplies are dependent upon a significant public investment. In the Proposition 84 process, the total estimated cost for projects that reduce demand and improve supply is over $4 billion and that does not include ongoing operations and maintenance costs.

To eliminate the potential for "double-counting", OWOW supplies are characterized by their source. For example, imported water recharged into a groundwater basin would be labeled "imported water" rather than "groundwater".

**Table 5.4-4 Summary of Water Supply Reliability Scenarios**

| Short-term Impacts | Long-term Impacts |
|---|---|
| **Catastrophic Interruption** | Average Hydrologic Conditions |
| Earthquake[1] | |
| Power outage[1] | Single-year Drought Hydrologic Conditions |
| Mussels[1] | |
| Wildfire[1] | Multi-year Drought Hydrologic Conditions |
| Water quality degradation | |
| Terrorism[1] | Climate Change[1] |
| | Sediment Transport[1] |

1 Actual effects uncertain.

## Reliability Margin

There are many hydrologic uncertainties including future weather patterns, the effects of climate change and possible legal restrictions that could be placed on water supplies such as past restrictions placed on the SWP. To help prepare for these and any other uncertainties, it is recommended that supplies exceed demands thereby providing a buffer, or "reliability margin". For the OWOW process, this reliability margin was established at 10% to be consistent with other water budgets in the watershed.

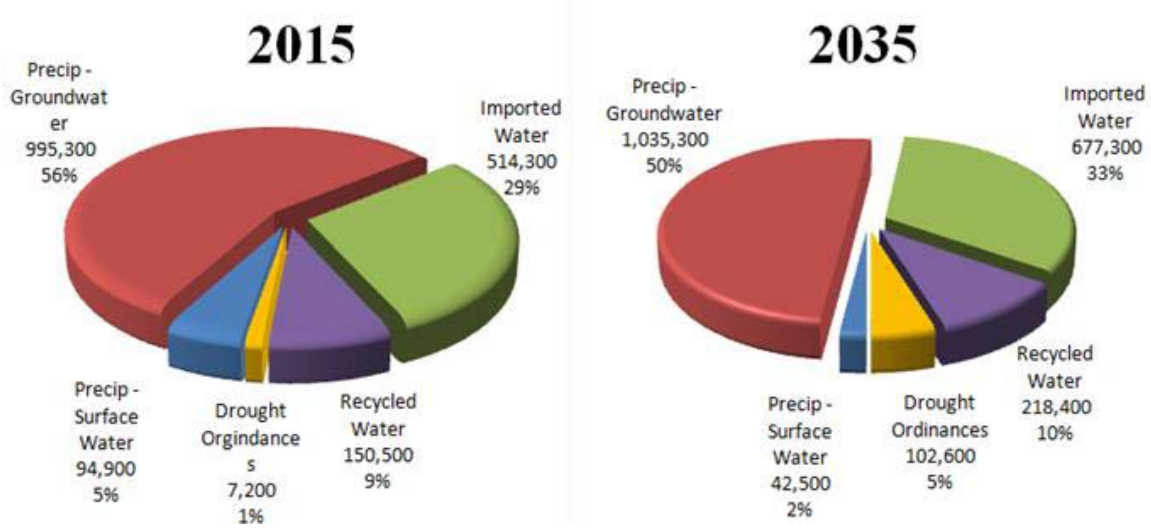
## Average Year (Baseline)

Evaluating average water supplies provides a "baseline" for comparison purposes. **Figure 5.4-9** summarizes the data for 2010 and 2035, which is based upon the UWMPs but also includes the following proposed stormwater capture projects that were not included in the UWMPs:

**Table 5.4-5 Stormwater Capture Projects Not Included in UWMPs but Included in OWOW Water Budget**

| Project | Amount (AF/Y) | | |
|---|---|---|---|
| | IEUA | SBVMWD | WMWD/RPU |
| Chino Basin Recharge Master Plan | 5,000 | | |
| Stormwater capture along the tributaries of the Santa Ana River (Active Recharge Project) | | 20,000 | 8,000 |
| Riverside North [Basin] Aquifer Storage and Recovery Project | 5,000 | 5,000 | 5,000 |
| **Total** | 10,000 | 25,000 | 13,000 |

**Figure 5.4-8 Summary of Water Supply Estimated from UWMP Data for 2015 and 2035**




Local precipitation presently meets about 60% of the demand and, due to increasing demand over time, is projected to meet about 50% of the demand in 2035. Other sources of supply and/or conservation measures are needed to meet the remaining 40% and 50% of demands, respectively. Although "drought ordinances" result in a reduction in demand, they have been presented as a supply to add emphasis and ensure they are not overlooked.

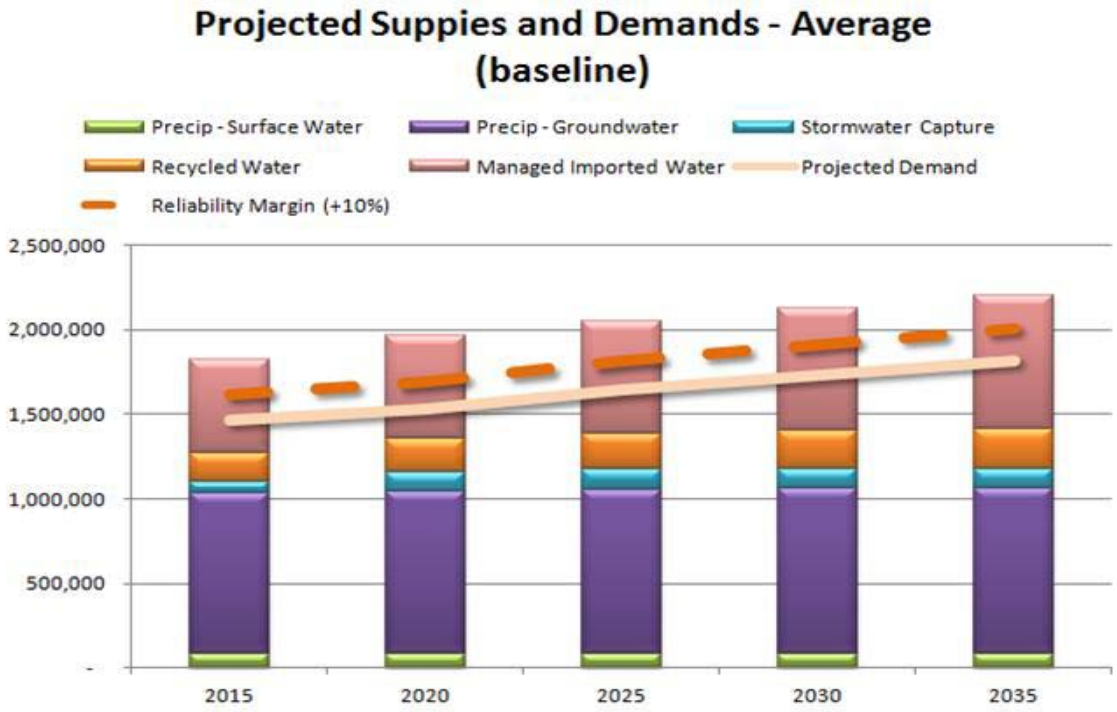
Given average hydrologic conditions, **Figure 5.4-10** shows that the watershed will be able to meet its needs through 2035 with a reliability margin of 15% in 2035. However, although the watershed, as a whole, will be able to meet demands, the SGPWA is projecting a 16,500 AF deficit. So, the watershed will need to work together to help overcome this deficit. The overall projections based on the UWMP data are positive and are generally based on the following assumptions:

1. Future local precipitation patterns will be the same as past precipitation patterns (possible effects of climate change addressed later in the chapter)

2. The predicted reliability of the State Water Project as taken from the Department of Water Resources *The State Water Project Delivery Reliability Report 2009* (August 2010) is accurate
3. Imported water projections include possible effects of climate change
4. Imported water will be managed to store wet year supply for use during dry years
5. Future demands will match the estimated demand
6. The watershed will invest over $4 billion in water conservation and infrastructure projects
7. Significant investments will be made to improve the reliability of imported water supplies as detailed in MWDSC's 2010 Regional UWMP

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

**Figure 5.4-9 Comparison of Total Supply (by source) versus the Projected Demand**

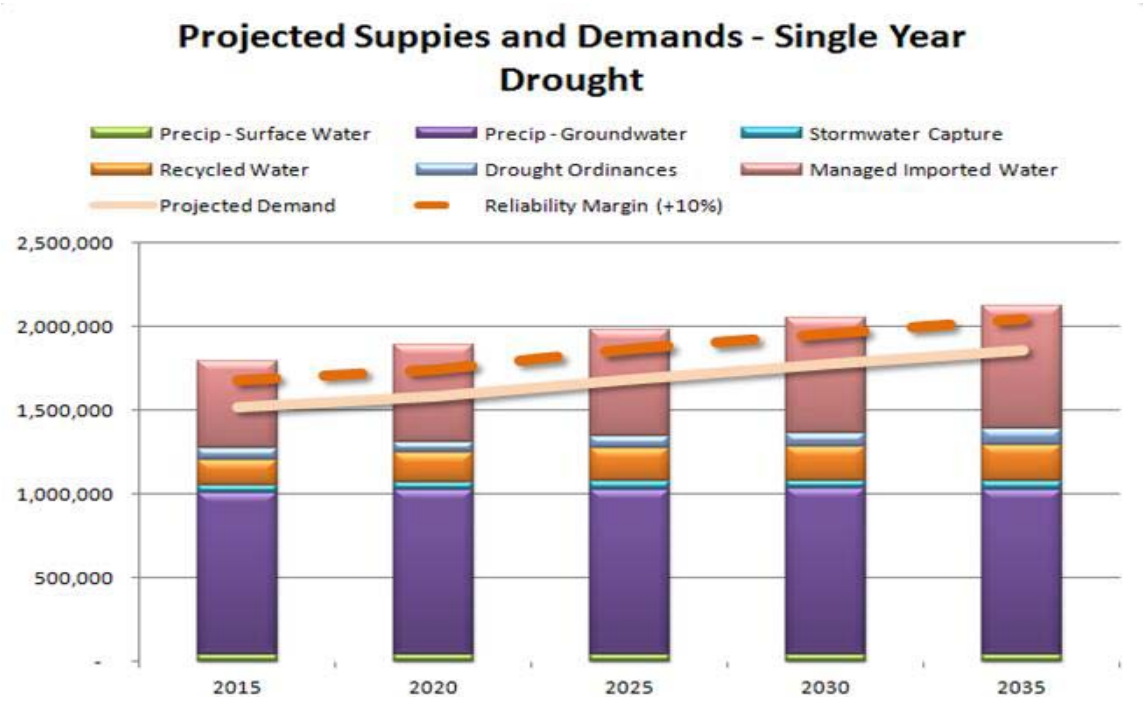



## Single-Year Drought

**Figure 5.4-11** summarizes the UWMP data for a single year drought. Nearly all of the water agencies defined the single-year drought as the year that they historically received the lowest amount of imported water. The watershed will be able to meet its demands in a single year drought with a reliability margin of 11% in 2035. The watershed is able to make it through a single year drought by relying on the various imported water storage programs that store water when it is available during wet periods for use during drought periods and on recycled water which is not impacted by weather. Although the watershed, as a whole, has enough supply to meet demand during a single year drought, the SGPWA projects a shortage of 27,000 AF in a single year of drought. Much of this deficit would be met by taking groundwater out of storage in the SGPWA service area. The overall projections based on the UWMP data are positive and are generally based on the same seven assumptions listed above.

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

**Figure 5.4-10 Anticipated Supply (by source) versus Projected Demand for a Single Year of Drought**




## Multi-Year Drought

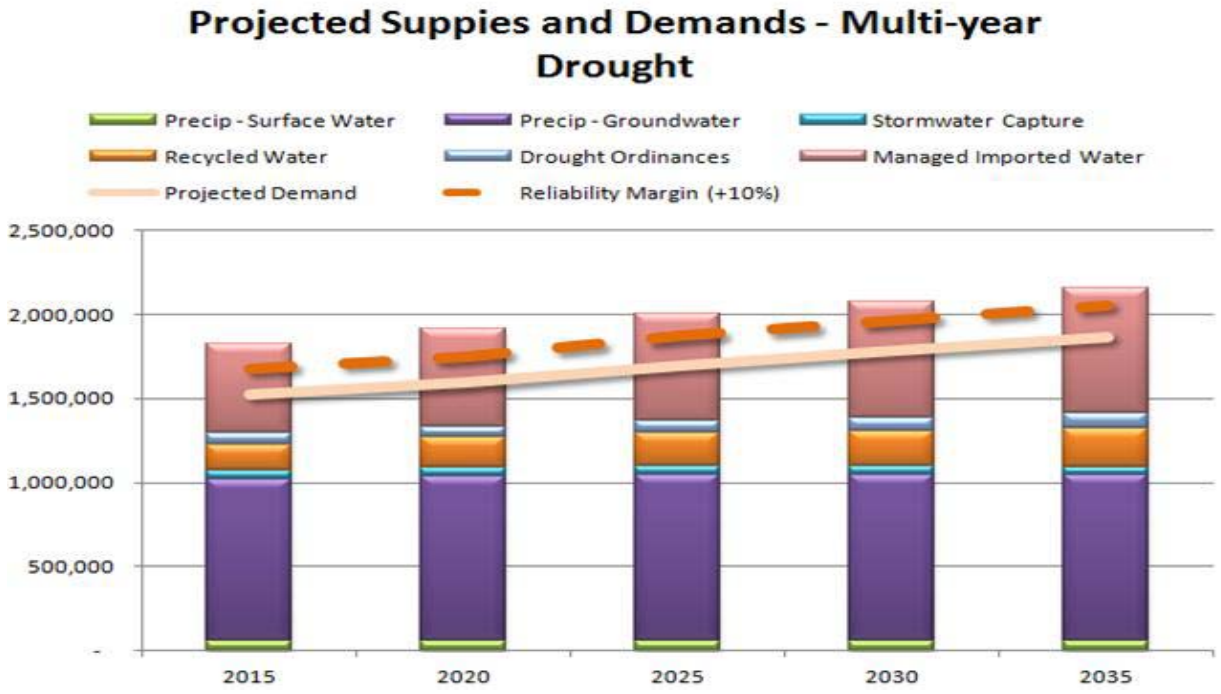
This scenario evaluates the water supply reliability for the Watershed assuming a multi-year (3 year) drought. Nearly all of the water agencies chose a3 year period that had the lowest, historic delivery of imported water.

**Figure 5.4-12** summarizes the UWMP data for a multi-year drought and shows that the watershed will be able to meet demands with a reliability margin of 13% in 2035, higher than a single year drought. Although a 3 year drought lasts longer, the average entitlement available during multi-year drought is slightly higher than the entitlement available during a single year drought. The watershed is able to meet its needs during a multi-year drought due mostly to the storage programs implemented by MWDSC, Valley District, SGPWA, and others. However, despite the overall ability to meet demand, SGPWA is expecting a deficit of about 23,000 AF during a multi-year drought. Much of this would be met by withdrawing groundwater from storage in the SGPWA service area.[3]The overall projections based on the UWMP data are positive and are generally based on the seven assumptions listed above.

[3]Upper Santa Ana River Watershed Integrated Regional Water Management Plan, Table 3-12, November 2007, pg. 3-20.

Given these unknowns, the watershed should continue to strive toward efficiency and toward projects that provide redundancy in case hydrologic projections are incorrect.

**Figure 5.4-11 Projected Supply (by source) versus Projected Demand during a Multi-Year Drought**




## Evaluate a Short-term 50% Reduction in Imported Water Supplies

One of the scenarios water agencies must evaluate as part of their UWMP is a 50% reduction in supplies. To maintain consistency with this requirement, it was decided to evaluate a 50% reduction in imported water supplies for the watershed. However, both a single year drought and multi-year drought result in greater reductions in imported water supplies than 50%. Since both the single-year drought and multi-year drought scenarios reduce imported water supplies more than 50%, this scenario is less conservative and, therefore, did not warrant detailed evaluation.

## Evaluate a Catastrophic Interruption in Water Supplies

The water system that serves both local and imported water to the watershed is made up of a variety of facilities including pipes, canals, and levees that are all susceptible to damage or failure from a catastrophic event. The catastrophic events that were evaluated as part of the OWOW process are earthquake, Delta levee failure, power failure, wildfire, and terrorism. While catastrophic events may not be avoided entirely, measures can be developed and set in place to minimize the interruption to water service following a catastrophic event. These measures include: assessing the vulnerability of systems, quantifying available resources, determining optimal use of resources, increasing the flexibility of distribution systems, increasing regional coordination and establishing repair priorities.

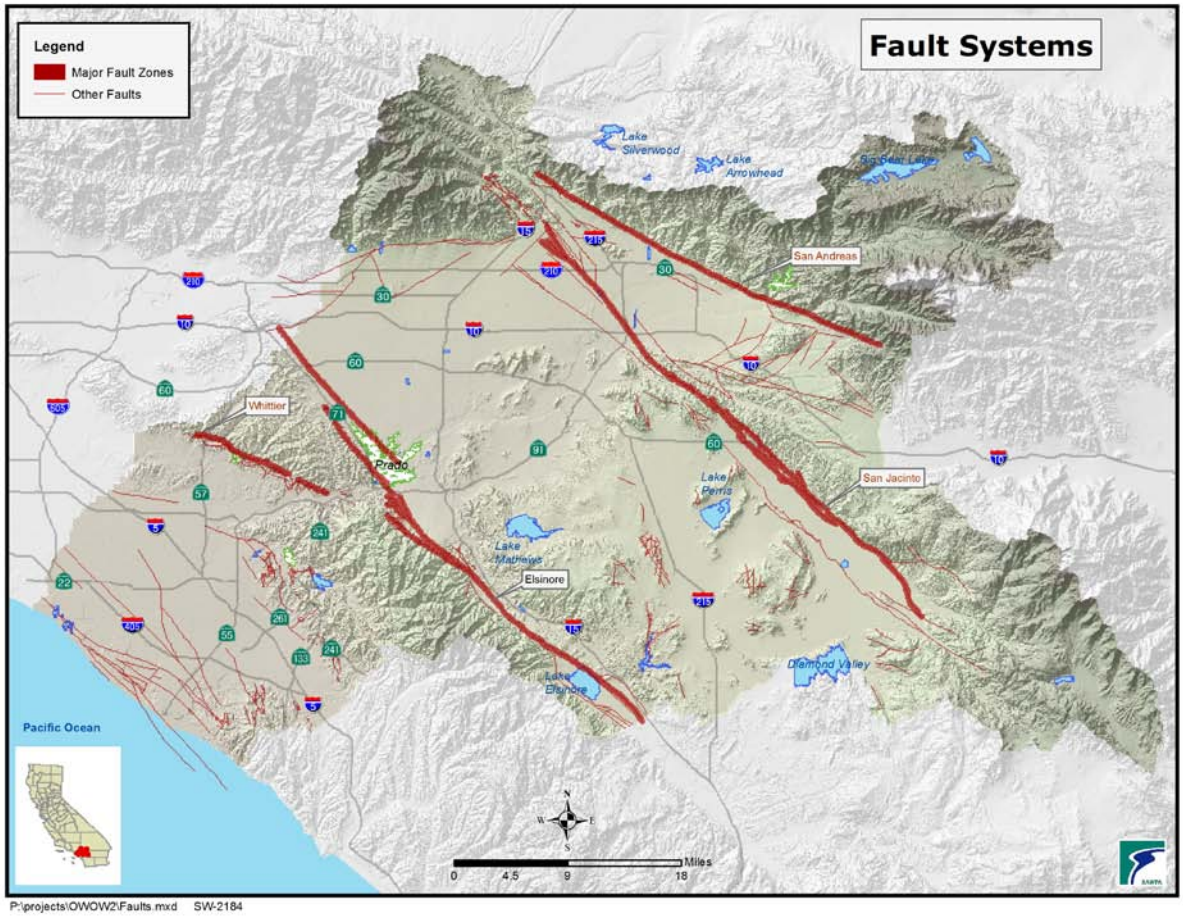
### *Evaluate the Effect of an Earthquake on Water Supplies*

The watershed is located within a seismically active region of Southern California. As shown on **Figure 5.4-13**, six active major earthquake faults and a number of smaller faults extend through the Watershed. As shown on **Table 5.4-6**, a seismic event along one of the major active faults within the Watershed could result in an earthquake in the range of magnitude 6.0 to 8.0 on the Richter Scale.

**Table 5.4-6 Estimated Maximum Richter Magnitude for Various Faults in the Watershed**

| Fault | Maximum Magnitude |
|---|---|
| San Andreas | 8.0 |
| San Jacinto | 7.5 |
| Elsinore | 6.8 |
| Chino | 6.5 |
| Whittier | 6.8 |
| Peralta Hills | 6.6 |
| Puente Hills | 7.5 |
| Newport/Inglewood | 6.9 |

**Figure 5.4-12 Major Earthquake Faults in the Watershed**




Depending on the intensity of the earthquake and location of the epicenter, catastrophic damage and interruptions of water service could occur throughout the watershed. Regional water conveyance systems, including the CRA; the Upper, Lower and Coastal Feeder Systems; as well as the East Branch of the California Aqueduct (also known as Foothill Pipeline) could sustain significant damage from a major earthquake that would interrupt the delivery of imported water supplies to the watershed. It also would make it difficult to transport water regionally within the watershed. Additionally, damage could occur to local water transmission systems operated by retail water agencies within the watershed, such as the Gage Transmission Main, Waterman Transmission Main, and the Riverside Canal. In addition to the potential damage to transmission facilities, damage also could occur to groundwater pumping facilities, water storage facilities, and water treatment plants as a result of seismic shaking impacts and/or from liquefaction impacts in areas that have high groundwater tables.

Based upon past seismic events, it is assumed that the impacts of a seismic event will be short-term. Due to the uncertainty tied to seismic events (magnitude, epicenter, etc.), it is not possible to determine the exact impact of a seismic event on water supply. However, the watershed can implement strategies that will better prepare the watershed for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

*Evaluate a Delta Levee Failure on Water Supplies*

The Sacramento-San Joaquin Delta is a region where two of California's largest rivers, the Sacramento River and the San Joaquin River meet. It is the hub of the State's water supply system. About two-thirds of all California residents and millions of acres of irrigated farmland rely on the Delta for water from the SWP and the Federal Central Valley Project. The structural integrity of the delta levee system is vital to maintain water supplies to southern California. However, the Delta levee system is aging and a considerable amount of the land along the Delta levee system has subsided below sea level. The earthen levees are subject to risk from earthquakes, flooding and salt water intrusion. Catastrophic damage sustained by the levees would result in interruptions to SWP supplies to the Watershed due mostly to saltwater intrusion. The New Orleans levee failures resulting from Hurricane Katrina on August 29, 2005 particularly prompted awareness of the severe consequences and export outages that would occur with catastrophic multi-island levee failures resulting from a severe earthquake in the Sacramento-San Joaquin Delta region.

A severe earthquake in the Delta region of a frequency similar to a Hurricane Katrina would result in multiple levee breaches and slumping causing multi-island failures. There would be extensive levee slumping and overtopping resulting from liquefaction of levee foundations, severely hampering levee restoration efforts. This failure scenario would allow excessive salinity to enter the central and south Delta increasing salinity at the export pumps significantly beyond levels for municipal and agricultural uses. The difficulty in restoring water quality at the pumps is driven by the inability to displace saline water out of that region.

For example, a June 2005 report by Jack Benjamin and Associates in association with Resource Management Associates and Economic Insights (Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento – San Joaquin Delta June 2005) indicates a 6.5 earthquake in the western Delta would generate a 21-island failure and a 28-month duration water supply disruption in the Delta to restore levees in their current state. There is a 66% probability that a 6.5 magnitude earthquake will occur in the Delta region by 2032 or within the next 20 years (United States Geological Survey Delta Seismic Risk Report 2005). Further, one or more dry years immediately before or within the disruption period would substantially increase economic impacts and may lengthen the disruption period due to less availability of fresh waters within the Delta.

Determining the length of time water supplies will be shut down by severe earthquakes is influenced by a combination of complicated hydrodynamic, emergency response, water operations, and water treatment and geotechnical factors. In 2005, DWR released a study that estimated Delta levee failure resulting from a 6.5 magnitude earthquake would eliminate deliveries on the SWP for 28 months[4]. Assuming a 28 month repair period, the effects of this catastrophic interruption would be very similar to a multi-year drought. Thus, the strategies that are implemented to offset the effects of a multi-year

[4] Jack R. Benjamin & Associates, Inc. in association withResource Management Associates and Economic Insights, Preliminary Seismic Risk Analysis Associated with Levee Failures in the Sacramento – San Joaquin Delta, June 2005, Page 18.

drought also would be helpful to offset this event. Should the levee failure(s) occur after a drought period when stored water supplies are severely depleted, other emergency strategies would need to be implemented, such as extreme conservation and mandatory rationing.

In 2011, an independent analysis of impacts to levees along the Middle River emergency freshwater pathway have been performed by URS under contract to MWDSC considering all seismic hazards relevant to the central Delta pathway region (Estimated Levee Displacement Pathway Alignment, Sacramento - San Joaquin Delta, California July 2011). The analyses indicates that levee slumping in excess of ten feet can occur from an earthquake with a frequency of a hurricane Katrina resulting from liquefaction of loose sand levee foundations, placing the levees below high tide elevation and severely hampering restoration efforts. More recent RMA analyses supporting the preparation of the 2012 DWR Delta Flood Emergency Preparedness, Response and Recovery plan studies suggest that, depending on hydrologic conditions, several years would be required for a catastrophic multi-island levee failure to restore salinity concentrations necessary for municipal water quality needs at the export pumps. RMA analyses contained in the February 2007 Moffat & Nichol report (Delta Emergency Preparedness, A Feasibility Plan for Protecting the State's Water Supplies during a Catastrophic Collapse of Multiple Delta Islands) indicate that reservoir releases alone could not restore water quality at the export pumps adequate for municipal use.

The MWDSC Board has sought a comprehensive emergency preparedness and response strategy to safeguard water exports from the Delta. On April 10, 2007 the Board approved a strategy to respond to a plausible multiple-island failure scenario by restoring an emergency freshwater pathway through the Delta generally along Middle River to water export facilities in the south Delta in approximately 6-months. This strategy has been accepted by DWR in their preparation of a Delta Flood Emergency Preparedness and Response Plan (EPRRP) due for publishing in 2012 in coordination with the U.S. Army Corps of Engineers. This Plan covers a wide range of emergency response strategies ranging from isolated levee failures, up to and including catastrophic multiple-island failures causing severe water export disruptions. MWDSC has also promoted levee improvements on pathway levees to reduce levee slumping and breaches, as well as advance placement of redundant materials stockpiles such as rock and sheet pile for the reliable closure of breaches to ensure freshwater pathway restoration. Both pathway levee improvements and preparedness stockpiles have been initiated and will continue to completion in the next several years.

### *Evaluate a Power Failure on Water Supplies*

Power failure can occur as isolated incidents or as part of larger event such as a regional power grid failure caused by a catastrophic event. During a large-scale power failure, water conveyance systems, water treatments plants, and ground water pumping wells could cease to operate.

Most power officials believe that under a scenario when only a portion of the regional power grid fails, the loss of power should not extend beyond 24 hours. However, under a scenario where all three grids of the North American Grid fail, the loss of power could extend for days. Depending on how much of the grid is lost and the length of time it takes to repair, the loss of power could have a profound impact on water delivery.

Power failure likely would have a short-term impact on water supply reliability. Due to the uncertainty of this scenario, it is not possible to determine the exact impact. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

### *Evaluate Wildfire on Water Supplies*

Wildfire can damage water delivery facilities or the power infrastructure used by water facilities. In addition, the loss of vegetation resulting from a wildfire can change runoff patterns, increase sediment, and reduce water storage. There also are potential water quality concerns associated with ash falling into surface reservoirs, which could overwhelm filtration plants as turbidities increase by orders of magnitude.

The effects of wildfire likely will have a short-term impact on water supply. Possible effects are loss of vegetation, change in runoff patterns, increased sedimentation, reduced natural water storage, and ash falling into surface reservoirs. Due to the uncertainty of this scenario, it is not possible to determine the exact impacts. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in the *Management Strategies to Improve Water Supply Reliability* section.

### *Evaluate the Effects of Terrorism on Water Supplies*

There is always a possibility that water infrastructure could be targeted by terrorists. Water agencies have responded to this potential threat by reducing public access to water infrastructure or even the information about infrastructure. They have also responded by increasing security measures at their facilities.

The effects of a terrorist attack likely will cause short-term reduction in water supply reliability. Due to the uncertainty of this scenario, it is not possible to determine the exact impacts. However, the same strategies that will help to prepare for an earthquake will help prepare for such an event. These strategies are provided in Management *Strategies to Improve Water Supply Reliability.*

### *Evaluate Delta Flow Restrictions on Water Supplies*

On December 14, 2007, U.S. District Judge Oliver Wanger issued an Interim Remedial Order to protect the threatened Delta smelt, which restricted water exports from the Delta to agricultural and urban customers of the SWP and CVP. In December 2008, the U.S. Fish and Wildlife Service issued a biological opinion covering Project effects on Delta smelt. In June 2009, the National Marine Fisheries Service issued a biological opinion covering Project effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. The biological opinions replaced opinions issued earlier by the federal agencies.

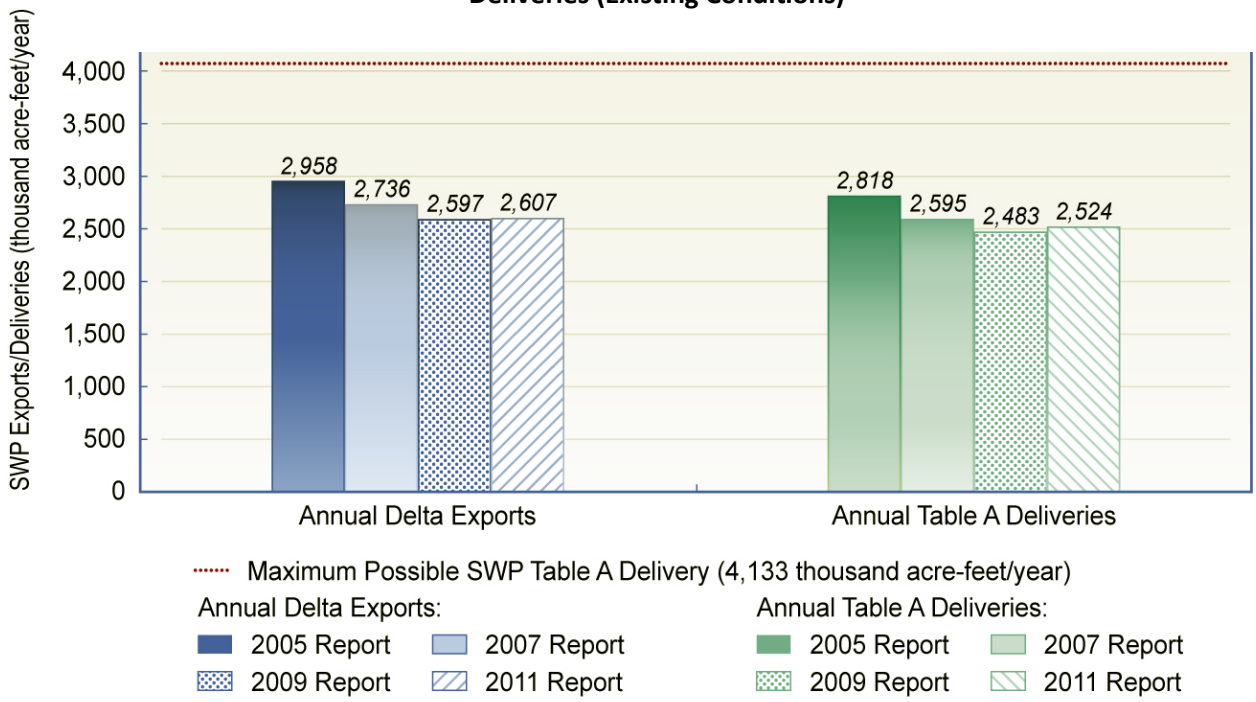
The 2008 and 2009 biological opinions were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third

consecutive dry year. Both opinions have been subject to considerable litigation. Recent Court decisions and settlements have changed specific operational rules in 2011-12, and both opinions have been remanded to the agencies for further review and analysis.

The impacts of the above decisions were analyzed by DWR in The State Water Project Delivery Reliability Report 2009 which was used in the 2010 UWMPs.

DWR has also released a draft update titled "The State Water Project DRAFT Delivery Reliability Report 2011". As shown in the **Figure 5.4-14**, estimated average annual Delta exports and SWP Table A water deliveries have generally decreased since 2005 but are slightly up as compared with 2009. Under existing conditions, average annual Delta exports have decreased since 2005 from 2,960 thousand acre-feet per year (taf/year) to 2,610 taf/year in 2011, a decrease of 350 taf or 12%. Similarly, average annual Table A deliveries have decreased since 2005 from 2,820 taf/year to 2,520 taf/year in 2011, a decrease of 300 taf or 10%.

**Figure 5.4-13 Trends in Estimated Average Annual Delta Exports and SWP Table A Water Deliveries (Existing Conditions)**




A number of water agencies, federal and state resources agencies and non-governmental organizations are currently engaged in the development of a Bay Delta Conservation Plan (BDCP). An explanation of the BDCP is provided later in this chapter.

### *Evaluate Climate Change on Water Supplies*

Temperature data suggest that California's climate is getting warmer. This phenomenon is being referred to as "climate change". Climate change could have an impact on water supply reliability. In a recent report, the U.S. Bureau of Reclamation provides potential impacts including reduction in snow pack, changes in the timing and amount of runoff, changes in the frequency and magnitude of extreme storm events, increased watershed vegetation demands due to higher evapotranspiration rates, changes in future agriculture and urban water demands, changes in sea level rise, and increased potential for salt water intrusion to the Sacramento-San Joaquin Delta and groundwater basins near the coast.

From a water management perspective, the strategies that increase reliability without climate change will also increase reliability with climate change. As a result, there are no specific strategies targeting climate change. To plan for this and other unknowns, the Watershed has implemented a "reliability margin" of 10%. More discussion about climate change impacts are included in the Energy and Environmental Impact Response pillar chapter later in this OWOW 2.0 report.

### *Evaluate the Impact of Quagga and/or Zebra Mussels on Water Supplies*

Quagga mussels (*Dreissenabugensis*) were discovered in Lake Mead in January 2007 and rapidly spread throughout the lower Colorado River and Metropolitan's CRA system. Quagga mussels are indigenous to the Ukraine and are a related species to the better-known zebra mussels (*Dreissenapolymorpha*). Similar to the zebra mussel, which was most likely introduced to the Great Lakes in the late 1980s via ship ballast water, Quagga mussels were introduced to Lake Mead most probably through the translocation of boats. Although the introduction of these two species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments. Two areas of relevance for aquatic environments used as sources of drinking water are the potential for clogging of intakes and raw water conveyance systems via attachment of high numbers of mussels to surfaces and a long-term potential for rendering lakes more susceptible to deleterious algae blooms. Control of mussel infestations can cost water conveyance systems millions of dollars annually in facility improvements and/or maintenance. Quagga mussels have infested water conveyance systems linked to the lower Colorado River. There is concern that Quagga mussels could become more widespread and infest the State Water Project System and other watersheds by boats and watercraft vehicles. Preventive measures implemented include boat inspections prior to entering un-infested water bodies and decontamination (clean, drain and dry) of vessels departed infested water bodies.

### *Evaluate the Effects of Santa Ana River Channel Armoring and Sediment Transport*

The Santa Ana River is a productive recharge "facility" that helps replenish the Watershed's groundwater basins. The transport and deposition of sediment along the Santa Ana River is critical to maintaining existing groundwater recharge capacity. A sandy river bottom allows surface water to percolate easily into the groundwater basin and maximizes recharge rates. If this process is interrupted, the amount of recharge can be reduced.

The transport and disposition of sand within the Santa Ana River is interrupted when it is trapped by both the Seven Oaks Dam and Prado Dam. Seven Oaks Dam traps sediment at the base of the San Bernardino Mountains while Prado Dam traps sediment just upstream of Orange County. This entrapment of the sand causes negative impacts on the recharge capacity of the riverbed.

In addition, as the sand washes away and no longer is being replaced by sand from upstream, the river bottom gradually transitions from a "soft" bottom to a coarser bottom that includes heavier material such as gravel and cobbles. The gravel and cobbles eventually interlock with fine sediments and form an "armored" layer. This process is referred to as "channel armoring," which can reduce the recharge rate of the river. A Groundwater Recharge Study prepared by OCWD estimates that the armoring of the Santa Ana River has resulted in a loss of percolation of about 1% per year. With a long-term degradation of recharge rates, longer stretches of the river would be needed to recharge the same amount of water that is recharged today or some other kind of mitigation would be required.

Additionally, sediment loading behind the two dams can reduce surface water storage volumes. The continued build up of sediment behind the dams will reduce the overall storage capacity of the dams, which will, in turn, reduce the amount of storm flow that can be temporarily stored and released for groundwater recharge.

Channel armoring could reduce recharge rates along the Santa Ana River. Sediment transport could reduce storage volumes behind Prado Dam and Seven Oaks Dam thereby reducing the amount of stormwater that can be captured and used.

### *Evaluate the Effects of Water Quality Degradation on Water Supplies*

Water supply reliability in the Watershed can be improved by reinstating local water resources that have been avoided due to poor water quality. For example, some groundwater basins in the Watershed have been impacted by high concentrations of salts. In the past, rather than pump and treat this poorer quality water, many groundwater producers chose to replace it with another source(s) of water that did not require treatment. This same approach also has been used in groundwater basins that were polluted by volatile, organic compounds and other contaminants. If, instead, these local resources were to be treated and used, they effectively would become "new" sources of water within the watershed which would act to increase water supply reliability. Water supply reliability can be increased if water resources that were avoided in the past due to poorer water quality are, instead, treated and utilized.

### *Summary of Evaluation Results*

The water supply reliability scenarios that were evaluated as part of this analysis can be divided into two general categories, short-term impacts and long-term impacts. **Table 5.4-4** summarizes the two general categories. Those in the short-term category are difficult to quantify. Those in the long-term category are more easily quantified with the exception of climate change, sediment transport and channel armoring which are still under investigation. However, all of the recommended water management strategies to help the watershed overcome the long-term impacts will also help the watershed endure the short-term impacts.

Based on the data from 2010 UWMPs, the watershed is able to meet its demands in the average, single-year drought and multi-year drought scenarios while maintaining a reliability margin of 10%, or greater, to help offset future unknowns. These results assume that:

8. Planned infrastructure will be constructed
9. Demand projections are correct
10. It will rain locally the same in the future as it did in the past
11. The watershed will continue to manage imported supplies by storing water in wet years for later use during droughts

Given the uncertainty in these assumptions, it is recommended that the watershed continue to invest in planned infrastructure projects and that it implement a broad range of management strategies to diversify supplies thereby enhancing water supply reliability.

## Water Management Strategies and Watershed-wide Project/Program Concepts to Improve Water Supply Reliability

To increase reliability, the following water management strategies are recommended:

**Reduce Demand**
**Stormwater Capture**
**Optimize Imported Water**
**Recycle Water**
**Increase storage**
**Implement emergency measures**

Each of these strategies enhances reliability to offset unknowns.

Water agencies throughout the watershed are implementing one, or more, of these strategies for their individual service areas. The goal of OWOW 2.0 was to develop watershed-wide project/program concepts, based on these strategies, which would increase water supply reliability throughout the watershed while reducing costs. The following sections discuss a number of watershed-wide project/program concepts organized by water management strategy. Some of the concepts build on OWOW 1.0 and some are new for OWOW 2.0. The concepts marked with a ☑ are recommended for focus over the next five years.

### Reduce Demand

One of the ways the watershed can increase water supply reliability is to reduce demand, wherever possible, by using water more efficiently. The following concepts are recommended for the watershed:

☑*Water Rate structures that encourage conservation*

*Estimated benefit: Help achieve a 20% demand reduction by 2020.*

Water rates that increase as consumption increases have been shown to reduce consumption. While many of the retail water agencies have this type of rate structure in place, there are still agencies in the watershed that do not have this type of rate structure.

☑*Public education to encourage water conservation*

*Estimated benefit: Help achieve a 20% demand reduction by 2020.*

Educating the public on the State and watershed's water supply system is a crucial component to implementing permanent change in water use habits. If the public understands the water supply situation, they will understand the need to raise rates, change water use habits permanently and continue investing in the Watershed's water supplies.

*Outdoor conservation*

*Estimated benefit: Help achieve a 20% demand reduction by 2020.*

The upper and middle watershed uses 60 – 70% of its water outdoors. A significant number of outdoor water use efficiency programs are already in place. The watershed has made considerable progress in this area through the Inland Empire Garden Friendly, and other, programs. More details about this and other suggested water conservations measures are discussed in the Water Use Efficiency Pillar chapter later in the OWOW 2.0 Plan.

*Reduce evapotranspiration*

*Estimated benefit: More investigation required*

One of the only measurable "losses" in the Watershed is evapotranspiration. Evapotranspiration is the combined water loss associated with evaporation and transpiration. Evaporation is the movement of water to the air from the land surface and water bodies. Transpiration is the movement of water into plants and the subsequent loss of water as vapor through its leaves. The losses associated with evaporation might be reduced by developing and implementing specific programs to increase the amount of shaded area such as planting trees or constructing shade structures. However, more analysis is required to estimate savings and determine whether the increased water use by any new shade trees would offset any potential decrease in evaporation associated with their shade. This strategy would be most appropriate in the areas of the watershed with the highest evaporation rates, namely the upper and middle Watershed.

## Optimize Imported Water

The Watershed is dependent upon imported water to meet approximately one-third of its needs into the future. However, the reliability of this source of water has proven to be less certain, at times, due to unforeseen circumstances such as the "Delta Smelt Decision" in 2007. This historic decision resulted in one of the single largest court-ordered SWP delivery reductions in state history to protect the endangered Sacramento/San Joaquin Delta smelt (fish). As a result of this and other problems in the

Delta, the SWP operates below its delivery capacity. However, the Watershed may be able to implement strategies that could help offset the various uncertainties, and possibly even increase the amount of imported water available to the watershed.

☑*Wet Year Imported Water Storage Program*

*Estimated benefit: Improved reliability and reduced cost by storing water locally.*

This concept was introduced in OWOW 1.0 as "Base Load Off of Imported Water" and involves storing imported water (primarily SWP water) in wet years for later use in dry years. This not only improves water supply reliability but could also reduce costs by dramatically reducing the amount of imported water that is purchased during dry years when the "market rate" is the highest. The watershed has made strong progress on this strategy. The largest State Water Contractor for the watershed, MWDSC, has had a wet year storage program for many years that stores water in surface reservoirs and groundwater basins including the Central Valley during wet years for later use in dry years. San Bernardino Valley Municipal Water District, the State Water Contractor serving the upper watershed, has stored over 100,000 acre-feet of imported water in the San Bernardino Basin Area since 2008.

The Pillar explored the possibility of improving this concept by changing the MWDSC storage location from the Central Valley to the watershed. The most likely and effective way to change the storage location would be for the MWDSC member agencies (4 of the 5 SAWPA agencies) in the watershed to purchase more imported water during wet years when they typically purchase less, if any, imported water due to its higher cost. The Pillar worked on a possible MWDSC payment structure that would lower member agencies costs during wet years but result in full compensation to MWDSC in the dry year when the water is used. MWDSC currently offers a similar groundwater storage program titled "Conjunctive Use Program (CUP)".

The proposed payment structure was compared to the existing CUP program. The evaluation assumed a 120,000 AF storage program (imported water and storage capacity of approximately 60,000 AFY and 40,000 AFY of groundwater pumping capacity) and was based on a 10 year cycle consisting of 2 wet years, 3 dry years and 5 normal years. **Table 5.4-7** below compares the MWDSC CUP program to the proposed Program (key differences are bolded).

**Table 5.4-7 Term Comparison between MWD's CUP Program and Proposed Program**

| Component | MWD CUP | Proposed Program |
|---|---|---|
| "Put" Capacity | 60,000 AFY | 60,000 AFY |
| "Take" Capacity | 40,000 AFY | 40,000 AFY |
| Program Storage Capacity | 120,000 AF | 120,000 AF |
| Storage/Extraction Capital Cost | None | Paid by member agency |

| | | |
|---|---|---|
| Annual Administration Costs | None | None |
| Program Term | 25 years | 25 years |
| Storage Losses | Varies by basin | Varies by basin |
| Total Payment at Time of "Put" | None | • MWDSC Variable Supply Cost<br>• MWDSC Variable Treatment Cost<br>• Watershed Incentive |
| Total Payment at Time of "Take" | • MWDSC Tier 1 (at time of extraction) | • MWDSC Tier 1 (at delivery) less "Put" Payment |

A preliminary economic analysis suggested that the revenue from the proposed program was comparable to the existing MWD CUP program. However, the proposed program would result in water being stored in the watershed which could increase participation and thereby increase the amount of water in storage within the watershed.

☑*Bay Delta Conservation Plan*

*Estimated benefit: Would restore the reliability of the SWP to 78% from 60% which equates to about 131,400 acre-feet per year for the watershed.*

The proposed BDCP offers a solution that would restore reliability to the SWP. Nearly all of the reduction of imported water deliveries through the SWP is due to environmental and other problems in the Delta. The proposed solution which will achieve the "coequal goals" of improving the health of the ecological system as a whole while also protecting SWP deliveries (SWP deliveries are less than 20% of the total flow through the Delta) is to transport SWP deliveries "around" or "under" the Delta in some sort of "Delta conveyance facility." Not only would this "Delta conveyance facility" increase the reliability of deliveries, but it would also improve SWP water quality in the form of lower Total Dissolved Solids (TDS). The decrease in TDS will reduce water recycling costs. The BDCP which is being prepared by a group of local water agencies, environmental and conservation organizations, state and federal agencies, and other interest groups includes such a facility. When complete, the BDCP will provide the basis for the issuance of endangered species permits for the operation of the state and federal water projects. Implementation of the plan will occur over a 50 year time frame.

*Imported Water Banking*

*Estimated benefit: Dry year supply.*

Although the watershed has significant groundwater storage, it is not easily accessible to the entire watershed. In some cases, it may be more efficient to participate in a groundwater storage opportunity

outside the watershed. These storage opportunities are often referred to as “water banks” and are located throughout the State.

The wholesale water agency that covers 80% of the watershed, MWDSC, already has significant water banking throughout the state. Since OWOW 1.0, the upper watershed has participated in a water bank in the central valley and in Big Bear Lake to help keep surface water treatment plants operational during drought periods. The watershed has made significant progress in this area.

*Prevent Invasive Species from Clogging Infrastructure*

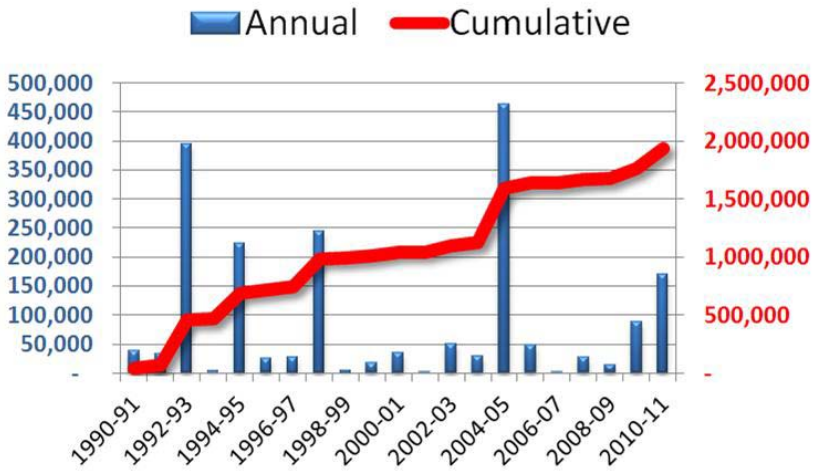
*Estimated benefit: Consistent deliveries.*

Quagga Mussels and the closely related Zebra Mussels are small shellfish, usually less than half inch in size. Once only found in the Great Lakes, the Quagga Mussel has now been discovered in Lake Mead, the CRA, and a local reservoir in San Diego County. They will live and reproduce in pipes causing them to clog. Once they are established, they are very difficult to eradicate. Quagga Mussels can be controlled by super chlorination and drying out, sometimes requiring the temporary drawing down of water supplies. The additional maintenance costs associated with controlling these mussels could cost tens of millions of dollars a year. There is concern that Quagga Mussels could become more widespread and migrate into the watershed through untreated water pipelines or larvae carried on boats and other watercraft. The watershed should participate in any programs, such as the one initiated by MWDSC, which target the prevention of these species from entering water infrastructure.

## Stormwater Capture

Capturing stormwater runoff within the Watershed is challenging due to the “flashy” hydrology. The watershed tends to be either extremely wet or extremely dry. **Figure 5.4-15** shows how much stormwater has gone to the Pacific Ocean since 1990. As the figure shows, most of the un-captured flow came during “flood” years when it was nearly impossible to capture. However, even if these flood years are removed, there is still an opportunity to capture more stormwater throughout the watershed.

**Figure 5.4-15 Stormwater Flow Lost to the Ocean since 1990**




Because stormwater originates in the mountains, it can be diverted at high elevation enabling it to be delivered by gravity thereby saving energy costs. Diverting it higher in the watershed also provides the opportunity to use the water more than once before it reaches the ocean. In addition to the low energy cost, this water is also high quality, which helps the Watershed achieve both surface water and groundwater quality objectives established by State and Federal agencies. The watershed is currently working on the following projects that will use more local stormwater. More details on many of these projects, though briefly described below, are covered in greater detail **Chapter 5.8 Stormwater: Resource and Risk Management** later in the OWOW 2.0 Plan report.

☑*Enhanced Santa Ana River stormwater capture below Seven Oaks Dam*

*Estimated benefit: 12,000 acre-feet per year.*

The upper watershed has obtained a water right for the additional stormwater detained by Seven Oaks Dam and is presently designing facilities that will enable the diversion of up to 500 cfs and up to 80,000 acre-feet per year.

☑*Enhanced stormwater capture from the tributaries of the Santa Ana River*

*Estimated benefit: 28,000 acre-feet per year.*

The upper watershed has completed the conceptual design of improvements and operational changes that result in additional stormwater capture from the tributaries of the Santa Ana River.

☑*Riverside Basin Aquifer Storage and Recovery Project*

*Estimated benefit: 28,000 acre-feet per year.*

Riverside Public utilities, in partnership with Valley District and others are developing a design for a rubber dam that would cross the Santa Ana River and be used to divert flows into off-stream recharge basins.

☑*Enhanced Santa Ana River stormwater capture at Prado Dam*

*Estimated benefit: 10,000 acre-feet per year.*

The lower watershed is evaluating the feasibility of increasing the Prado flood season water storage elevation from 498 MSL to 505. After the Santa Ana River Mainstem flood control project is completed in approximately 2022, it may be possible to store water to higher elevations in Prado Dam for water conservation. A preliminary economic analysis of storing water to elevation 510 feet and 514 feet is summarized in **Table 5.4-8** below.

**Table 5.4-8 Preliminary Economic Analysis - Enhanced Stormwater Capture at Prado Dam**

| Category | Storage to 510 feet | Storage to 514 feet |
|---|---|---|
| Estimated capital cost[1] | $54M | $125M |
| Estimated annual operations and maintenance cost | $300,000 | $400,000 |
| Estimated water yield (acre-feet per year)[2] | 5,000 | 10,000 |
| Estimated cost per acre-feet[3] | $600 | $700 |

[1] Includes environmental mitigation

[2] Estimated water yield in comparison to year-round 505 ft storage

[3] Based on capital cost repayment over 30 years at 5% interest

☑*MS4 Credits*

*Estimated benefit: Increased reliability by utilizing more local stormwater.*

The Municipal Separate Storm Sewer Systems (MS4) permit process is intended, among other things, to increase the amount of stormwater captured and recharged in the watershed. These permits require the owner to construct their project in such a way to recharge stormwater on their site. However, in some cases, it may be more ideal from a water management perspective to recharge the stormwater somewhere upstream. One way to introduce flexibility into this process would be to allow owners to purchase "MS4 Credits" that could be applied to recharge projects in other locations. There may also be an opportunity to allow these credits to be used throughout the watershed. For example, a project in Orange County could purchase credits that could be used for a project in the upper watershed.

☑*Re-operate flood control facilities*

*Estimated benefit: More investigation required.*

Working with flood control agencies to re-operate flood control facilities with the goal of increasing stormwater capture increasing flood get away capacity and revising decades old storage curves. For example, when weather forecasts do not show any impending storms, the flood control agencies may be able to release stormwater at a slower rate. This relatively minor operational change would make stormwater flows easier to capture and put to use. It also would result in impounding the water longer, which would increase artificial recharge during the "holding period". This strategy has already been successfully implemented in some portions of the watershed.

☑*Size flood control facilities for stormwater capture*

*Estimated benefit: Increased reliability by utilizing more local stormwater.*

Another way to increase stormwater capture would be to work with flood control agencies to increase the size of existing, or new, detention basins. Larger detention basins would slow the flow and increase the recharge area, which would increase the amount of stormwater that is artificially recharged. In addition to this increased recharge, the larger basins also would provide greater flood protection. A related strategy would be to construct additional surface water reservoirs within the watershed. Unlike detention basins, which need to be drained every year before the flood season, surface water reservoirs provide the added flexibility of allowing the water to be stored until it is needed. In addition, surface water reservoirs also provide a storage location(s) for other sources of water such as imported water. Although effective, both of these strategies would be viable only in areas of the watershed that have vacant land.

☑*Forest First: Forest management for increased downstream stormwater capture*

*Estimated benefit: Increased reliability by utilizing more local stormwater.*

Another way to increase stormwater capture would be to work under the Forest First MOU with SAWPA to support collaborative projects among the U.S. Forest Service and downstream flood control and groundwater management agencies to support forest management including a) fuels reduction, b) chaparral restoration, c) meadows restoration, and 4) forest maintenance road runoff control. With collaboration between upstream and downstream parties, water flows from the forest may be spread more evenly over the hydrograph cycle allowing for slower and more even flows from the forest lands to the plains resulting in increased recharge. This will also result in less sediment transport particularly after forest burn events and water quality improvement downstream.

☑*Development Standards that enhance stormwater capture*

*Estimated benefit: Increased reliability by utilizing more local stormwater.*

Another strategy to increase stormwater capture would be to implement new development standards that promote the construction of infrastructure that increases the infiltration of stormwater such as porous concrete, infiltration galleries, and perforated pipelines. These facilities could be implemented in public areas such as parking lots, schoolyards, parks and greenbelts, as well as private areas, by establishing a requirement in local development codes.

## Recycle Water

Treating and reusing wastewater, referred to as "recycled water", provides the most reliable sources of water in the watershed. Wherever recycled water can be put to use, it effectively replaces a like amount of potable water. Over the years, the watershed has seen significant accomplishments in the development of recycled water. In fact, at present, nearly all of the recycled water from the upper and middle watershed is being discharged into the Santa Ana River and is being reused at various locations downstream. In the future, the upper and middle watershed plan to develop enhanced recycling programs that could change the place of use for much of this resource. Should enhanced recycling occur in the upper and middle watershed, it would reduce the amount of recycled water flowing to the lower watershed. This could be offset in the lower watershed by increasing water recycling, increasing conservation measures, desalting the ocean and/or purchasing more imported water. There may also be an opportunity for the upper, middle and lower watersheds to leave their treated wastewater in the river in exchange for the lower watershed providing a "replacement" source, of like quantity and reliability, to the upper and middle watershed. This concept was first introduced in OWOW 1.0 and has been further developed in OWOW 2.0 as "Recycled Water Exchange".

☑*Recycled Water Exchange*

*Estimated benefit: Although many details would need to be worked out, this type of concept could potentially save the watershed nearly $1/2 billion in capital costs and, perhaps even more, in energy costs not to mention the potential to reduce the amount of salt imported into the watershed.*

This concept was first introduced in OWOW 1.0 and could save the watershed nearly $1 billion in facilities and, perhaps even more, in energy costs. The upper watershed currently delivers nearly all of its treated wastewater effluent to the lower watershed via the Santa Ana River. The Lower Watershed uses the effluent to recharge its groundwater basin and reduce the need for imported water.

This concept would exchange treated wastewater from the upper watershed for a like amount of imported water delivered to the upper watershed. The following summarizes this concept:

- *Treated wastewater flows remain in the river for lower watershed*– The Upper Watershed would continue to deliver treated wastewater to the Lower Watershed via the Santa Ana River instead of developing recycled water programs (the concept seems most feasible in areas without mature recycled water programs).
- *Lower watershed provides imported water Upper Watershed* – The Lower Watershed would essentially change the place of delivery for some of the imported water they are already planning to

import to the Upper Watershed which would replace the treated wastewater flowing from the Upper Watershed.

- *Comparable reliability* – Recycled water is 100% reliable and imported water is about 60% reliable. This concept would mitigate the reduced in reliability to the upper watershed by storing imported water in the upper watershed, or some other water bank, during wet years for later use in dry years.

A preliminary evaluation of this concept identified the following benefits as compared to current plans:

- *Less salt* – under this Program, the lower watershed would provide imported water to the upper watershed. The only source of imported water available to the upper watershed is SWP which is higher quality than Colorado River and many of the existing groundwater basins in the Watershed. To the extent that SWP water delivered to the upper watershed replaces CR water delivered to the lower watershed and/or is stored in a basin of lower water quality, there could be a water quality improvement in the watershed.
- *1/3 Return on investment*– under this program, the lower watershed essentially changes the place of delivery for imported water from the lower watershed to the upper watershed. Since approximately 1/3 of every acre-foot delivered to the upper watershed ends up as treated wastewater and back in the river, the lower watershed essentially receives 1 - 1/3 acre-feet for every acre-foot delivered, a 33% return on investment!
- *Lower cost – less energy* – The energy required to produce recycled water and to pump it up to higher elevation where it can be used throughout a water system is substantial. This concept would eliminate these energy costs. Since the imported water delivered to the upper watershed from the lower watershed would have been imported anyway, there is no increase in energy associated with this component of the concept.
- *Dry Year Reliability* – Recycled water is 100% reliable which benefits the lower watershed. Although imported water is only about 60% reliable, it can be stored in wet years so that it is available in dry years to improve the reliability. Thus, both the Upper and the lower watershed end up with a reliable supply.

☑*Recycled Water for Potable Use*

*Estimated benefit: Improved reliability by increasing the amount of times water can be used*

Legislation will be required to allow recycled water to be used for potable use. The watershed should work together to promote such legislation.

☑*Recycle sewage effluent from Orange County Sanitation District Plants No. 1 and No. 2 that is currently flowing to the ocean*

*Estimated benefit: 157,000 acre-feet per year*

As presented in the Recycled Water section of this chapter, OCSD expects to "dispose" of effluent into the ocean each year from its Plant No. 1. This effluent could be treated and used for a variety of

purposes including the offset of any reduction in recycled water flows to the lower watershed due to recycling in the upper and middle watersheds.

As presented in the Recycled Water section of this chapter, by 2030 the Orange County Sanitation District expects to "dispose" of effluent into the ocean each year from its Plant No. 2. However, based on current Department of Public Health (DPH) requirements, this water cannot be recycled because it includes the effluent from the Inland Empire Brine Line which contains discharges from the String fellow Hazardous Waste Site, and other sources that would require further characterization by DPH. The Watershed should consider working with DPH on a strategy that would allow this effluent to be recycled.

*Importation of recycled water from outside the Watershed*

There may be opportunities to import recycled water from outside the Watershed. Any recycled water imported into the watershed would be viewed as a new supply.

*Recycled water use to offset potable demand*

This is widely implemented by several agencies and part of the projected water supply portfolio

## Desalt the Pacific Ocean

*Estimated benefit: 54,000 acre-feet per year*

The lower watershed borders the Pacific Ocean and while ocean desalination generally is considered technically and institutionally feasible, it is also expensive both in capital and operational costs and is subject to significant regulatory scrutiny depending upon the environmental impact of the specific project. It also requires significant base loaded energy that is costly. Over the last five years, a number of water agencies have been investing significant effort and funds in ocean desalination program development work. There are currently two sites along coastal Orange County that have completed extensive exploratory work and permit approvals to construct desalination facilities but to date neither completely permitted or successful in securing contracts for the supply.

The cost of this water is significantly more expensive than any other current source of supply. For this reason, the watershed should focus on the other strategies.

## Increase Storage

In general, the hydrology for the watershed can be characterized by a short series of wet years followed by a longer series of dry years. When the wet years come, they tend to be really wet, or "flood" type years. Thus, a fundamental water management challenge for the watershed is to capture the water during wet years, when it is plentiful, and store it for later use during dry years. The water may be stored in surface water reservoirs or the groundwater basins within the watershed.

☑*Surface Water Storage*

*Estimated benefit: Helps offset the effects of drought, climate change and emergencies*

As shown in **Table 5.4-1**, the watershed is fortunate to have a number of surface water reservoirs. However, additional surface storage space would allow the capture of additional stormwater and "unused" imported water. Not only do surface water reservoirs provide a location to store water when it is available, but they also enhance reliability during a disaster. Therefore, the Watershed should work toward increasing surface water storage both inside and outside the region. Due to the fast development within the watershed, the number of potential reservoir sites inside the watershed continues to diminish every year. Potential surface storage opportunities outside of the watershed would include any additional reservoirs constructed as part of the SWP and/or the CRA.

☑*Groundwater Storage*

*Estimated benefit: Helps offset the effects of drought and climate change*

In addition to additional surface water storage, the watershed also should pursue the utilization of any unused groundwater storage in the watershed. Like a surface water reservoir, these underground reservoirs provide a place to store wet year supplies for later use during extended drought periods.

Some groundwater basins in the middle and lower watershed have been abandoned or have not been fully utilized due to high salt content, contamination, color, odor or some other concern. Projects to pump and treat water in these basins, or portions thereof, provide restoration of groundwater storage that may not have been historically available for municipal use. In addition to recovering the storage space, it could also result in new yield.

## Emergency Measures Strategies

*Estimated benefit: Improved recovery time following a disaster*

Despite careful planning, there will still be catastrophic events and unforeseen circumstances. Although the timing and extent of such events or circumstances are unknown, the following strategies will help the watershed prepare for the unknown.

### *Local Emergency Plans*

Each of the water agencies within the Watershed must have an emergency plan that complies with both the Standardized Emergency Management System (SEMS) and the National Incident Management System (NIMS).

### *Mutual Aid and Coordination*

All of the water agencies should have mutual aid agreements in place. One mutual aid option used by many of the water agencies is to join the California Water/Wastewater Agency Response Network (Cal

WARN), www.calwarn.org. CalWARN provides a "standard" mutual aid agreement, and also maintains a database of personnel and equipment that could be made available during an emergency. It is recommended that each of the water agencies in the Watershed join CalWARN and "upload" their personnel and equipment data. In addition to participating in mutual aid agreements, the water agencies also may want to consider additional coordination with one another through a regional group. Two such groups already have been formed in the Watershed: Water Emergency Response Organization of Orange County (WEROC), and the Emergency Response Network of the Inland Empire (ERNIE). Water agencies should consider partnering with one of these groups or, perhaps, forming an additional group, if necessary.

### *System Interconnections*

Wherever possible, water agencies should pursue interconnections to increase redundancy and provide aid during an emergency situation.

### *Extraordinary Conservation*

"Extraordinary" conservation would be required following an extreme catastrophic event such as an earthquake. In these situations, the only way demands can be met is by asking the public to implement extraordinary conservation measures such as halting all outside irrigation, limiting the frequency of bathing, etc. In the upper Watershed, outside uses account for nearly 70% of water use. Thus, this type of extreme conservation could reduce demands in the upper watershed by the same amount.

### *Optimize Outside Funding Opportunities*

The watershed is encouraged to work together to maximize outside funding opportunities that provide the greatest overall benefit to the watershed.

**References**

EMWD 20010 Urban Water Management Plan
IEUA 2010 Urban Water Management Plan
MWDOC 2010 Urban Water Management Plan
2010 San Bernardino Valley Regional Urban Water Management Plan
WMWD 2010 Urban Water Management Plan
SAWPA – Maps from Various Documents
SAWPA 2002 IRP, One Water One Watershed

**Contributors**

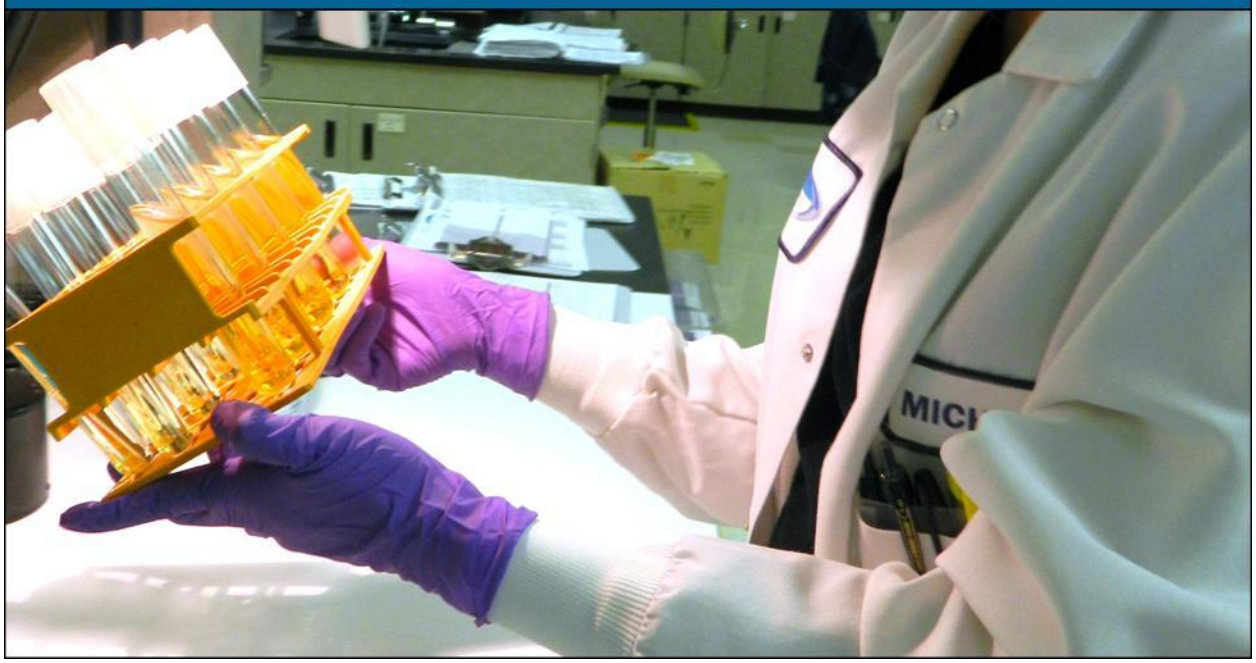
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# 5.5 Beneficial Use Assurance



This chapter presents a general overview of water quality issues in the Santa Ana River Watershed (SARW) and programs to improve water quality. The change in name from "Water Quality Improvement" from the One Water One Watershed (OWOW) 1.0 Plan to "Beneficial Use Protection" reflects a focus on striving to meet water quality objectives for all waterbodies in the SARW. Collaboration of stakeholders with the Santa Ana Regional Water Quality Control Board (Regional Board) is essential to achieve this goal. To expand outreach with Regional Board staff, the Chief of Regional Planning Programs served as the Co-Chair of the Beneficial Use Protection Pillar Group.

The three focus areas of this chapter, surface water, groundwater, and ocean water quality, are described from the top of the watershed downstream to the ocean. This discussion includes the significant impact of imported water supplies and stormwater runoff on water quality.

Surface water discharges to the ocean impact ocean water quality. Ocean water, defined as the zone from the beach to three miles offshore, and bays and estuaries near the coast, are included in this report, reflecting the comprehensive, integrated approach utilized in the development of the new Integrated Regional Water Management Plan (IRWMP).

This chapter also includes coastal watersheds such as Anaheim Bay-Huntington Harbor, Newport Bay, and Newport Coastal streams, as well as, Coyote Creek and Carbon Creek in the San Gabriel River Watershed in the northern part of the watershed. Although outside the Santa Ana River Watershed boundaries, these areas are within the jurisdiction of the Regional Board Region 8.

## Brief History of Santa Ana River Watershed

The Santa Ana River (SAR), its tributary streams, and the groundwater basins provided adequate water for early inhabitants of the watershed. By the late nineteenth century, the region had developed a successful agricultural economy. By the early twentieth century, expanding farms and orchards along with increased population began to outgrow available water supplies. The Colorado River Aqueduct (CRA) was the first facility to bring imported water into the region, followed by the State Water Project (SWP).

By the time of passage of the California Porter-Cologne Water Quality Act in 1969, population growth, agriculture, and industry already had created a legacy of water quality problems. Agricultural irrigation, fertilizer use, and dairy operations added nutrients and salts to groundwater supplies. Use of pesticides contributed to the contamination of soils and groundwater. In some areas, chemicals used in military facilities and industrial processes were improperly disposed of, resulting in the migration of hazardous substances into groundwater. Impacts from urbanization of the watershed included stormwater runoff from urban areas, non-storm nuisance flows from landscape irrigation, increased salt concentrations, and elevated levels of nutrients.

Local agencies, non-governmental organizations, and other stakeholders, working in conjunction with regulatory agencies, have made progress in restoring the quality of water in the watershed. Challenges still remain.

## Regulatory Framework

### Drinking Water Regulations

The California Safe Drinking Water Act (Health and Safety Code, Section 116270 et seq.) directs the California Department of Public Health (CDPH) Division of Drinking Water and Environmental Management to set standards for drinking water quality. Drinking water regulations are addressed in Title 17 and Title 22 of the California Code of Regulations. These include establishing the Maximum Contaminant Limits (MCLs) and treatment requirements for potable water and recycled water.

### Water Quality Control Plan, Santa Ana River Basin

The State Water Resources Control Board (State Board) and the Regional Board are responsible for implementing California's Porter-Cologne Water Quality Control Act and the Federal Clean Water Act. These State and Federal laws, and associated regulations and policies, provide the overall framework for managing water quality. Extensive voluntary efforts of stakeholders play an important role in protecting and improving water quality in the watershed.

The Water Quality Control Plan, Santa Ana River Basin (Basin Plan) guides the Regional Board's water quality control programs, water quality management decisions, and enforcement efforts. The Basin Plan establishes water quality standards, which include beneficial uses, water quality objectives (WQOs), and implementation plans to achieve the standards.

Beneficial uses as listed in the Basin Plan for waterbodies within the SARW include:

- Municipal and domestic supply
- Agricultural supply
- Industrial service supply
- Industrial process supply
- Groundwater recharge; navigation
- Hydropower generation
- Water contact recreation
- Non-contract water recreation
- Commercial and sport fishing
- Warm freshwater habitat
- Cold freshwater habitat
- Preservation of biological habitats of special significance
- Wildlife habitat
- Rare, threatened, or endangered species
- Spawning, reproduction and development
- Marine habitat
- Shellfish harvesting.

WQOs are set to establish reasonable protection of the beneficial uses. WQOs and beneficial uses are specified according to water body type: ocean waters, enclosed bays and estuaries, inland surface waters, and groundwater.

Since its last major revision in 1995, the Basin Plan has been amended eleven times. Amendments added Total Maximum Daily Loads (TMDLs) in 1998, 1999, and 2003through 2006; made provisions for and included time schedules in waste discharge requirements (2000); revised bacterial objectives in ocean waters (1997); and incorporated a revised Nitrogen/Total Dissolved Solids (N/TDS) management plan (2004). To implement the N/TDS plan, stakeholders and the Regional Board formed the Basin Monitoring Program Task Force (BMPTF). The Task Force is developing and implementing a monitoring program for nitrate and TDS in both groundwater and surface water in the watershed.

Basin Plan amendments are adopted through a public basin planning process. The process requires approval by the Regional Board, State Board, California Office of Administrative Law, and United States Environmental Protection Agency (EPA). The Regional Board establishes priorities for Basin Plan revisions approximately every three years; the latest of these triennial reviews was conducted in 2006. Clearly, the schedule for triennial reviews has slipped reflecting a lack of resources and staff at the Regional Board to be able to conduct these reviews as planned. Updating the 2006 triennial review would be the first step in an effort to determine water quality project preferences in the watershed and to integrate with other regional needs to define integrated management strategies that meet water quality and water supply goals.

The primary methods of enforcing water quality regulations are through the issuance of the (Federal) National Pollutant Discharge Elimination System (NPDES) Permits and State Waste Discharge Requirements.In California, both permit programs are administered by the State Board and the Regional Boards. These permits regulate discharges to surface waterbodies of both wastewater and urban runoff from municipal and industrial systems, and stormwater runoff from municipal separate storm sewer systems, industrial sources, and construction sites. Permit requirements are based on technology-based limits for wastewater and maximum extent practicable standard for stormwater intended to meet water quality standards.

Several monitoring programs in the watershed involve the collection of data on the water quality of surface waterbodies and groundwater basins. The BMPTF is responsible for collecting and analyzing data in order to calculate the ambient TDS and nitrate concentrations in the region's groundwater basins. The Regional Board requires a re-calculation of ambient concentration every three years. The Imported Water Recharge Workgroup is tasked with the responsibility of documenting the TDS and nitrate load to groundwater basins from the use of imported water for groundwater recharge. The Emerging Constituents Workgroup conducts a program to sample and analyze surface waterbodies in the watershed to test for a selected group of emerging constituents. The Middle SAR TMDL Task Force developed and is implementing a Comprehensive Bacteria Reduction Plan for Riverside and San Bernardino Counties, which includes sampling selected surface water sites to be analyzed for fecal bacteria indicators. The Stormwater Quality Standards Task Force conducted a comprehensive evaluation of surface waterbodies to assess conditions for and existing use of sites for water-contact recreation.

### *Total Maximum Daily Loads*

The Federal Clean Water Act Section 303(d) requires states to identify as impaired those waters that do not, or are not, expected to meet water quality standards. Impaired waterbodies are placed on the Clean Water Act Section 303(d) List of Water Quality Limited Segments, which initiates a process to develop TMDLs. A TMDL is considered to be adopted when approved by the Regional Board, the State Board, the California Office of Administrative Law, and the EPA.

A TMDL defines how much of a pollutant a water body can tolerate and still meet water quality standards. Each TMDL must account for all sources of the pollutant, including:

- discharges from wastewater treatment facilities
- non-point source pollutants in runoff from residential areas
- forested lands
- agriculture
- streets or highways, etc.
- soils/sediments polluted with legacy contaminants such as DDT and PCBs
- on-site disposal systems (septic systems); and deposits from the air

Projected growth that could increase pollutant levels may be considered. TMDLs allocate allowable pollutant loads for each source and identify management measures that, when implemented, will assure that water quality standards are attained.

### *California Toxics Rule*

The California Toxic Rule was promulgated by the EPA to set numeric water quality criteria for priority toxic pollutants and other provisions for water quality standards to be applied to California waters. The criteria apply to all inland surface waters and enclosed bays and estuaries regulated by the Clean Water Act.

### *California Ocean Plan*

The California Ocean Plan is the state water quality control plan for ocean waters prepared by the State Board as required by the Clean Water Act. The plan is implemented by State Board and the coastal Regional Boards. It lists beneficial uses for marine waters, including protection of Areas of Special

Biological Significance (ASBS), rare and endangered species, marine habitat, fish migration, recreation, fishing, aesthetic enjoyment, and others. Narrative and numerical WQOs are set to protect designated beneficial uses. The objectives are implemented through a program that sets waste discharge limitations, monitoring, and enforcement. Through a triennial review process, the plan sets priorities for actions over the next three-year period.

### *Ocean Water-Contact Standards- AB 411*

In 1996, AB 411 (Wayne) required the establishment of bacteriological ocean water quality standards to protect public health (CCR Sections 7956-7962). Contaminated runoff and untreated sewage spills are two of the most common factors that negatively impact ocean water quality. The AB 411 standards require that waters adjacent to ocean and bay public beaches be monitored for total coliforms, fecal coliforms, and enterococci bacteria. When any waters adjacent to a public beach fail to meet any of the standards, warnings are issued to the public. In the event that sewage is known or suspected, access to the affected waters is restricted.

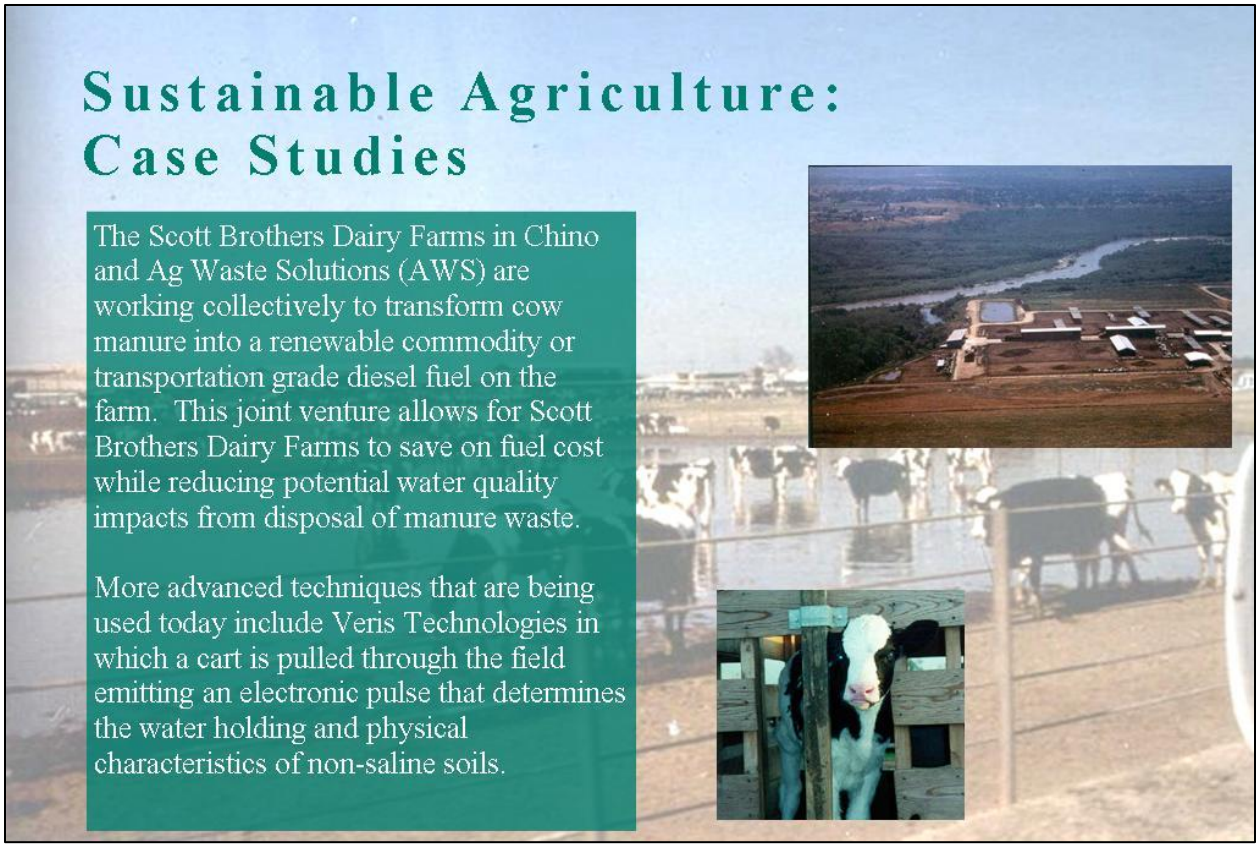
### *Agriculture and Dairies: Water Quality Protection*

Regulatory agencies in the watershed have taken a number of regulatory actions to address water quality impacts related to agricultural and dairy practices in the region, including impacts to both surface water and groundwater due to runoff from manure in dairy farm corrals, spreading of manure for fertilizer in agricultural fields, and use of pesticides.

In 2007 the Regional Board issued R8-2007-0001 *(NPDES No. CAG018001): General Waste Discharge Requirements for Concentrated Animal Feeding Operations (Dairies and Related Facilities) within the Santa Ana Region (Santa Ana RWQCB, 2007)* prohibiting all dairies in the watershed from discharging process wastewater or stormwater runoff up to a 25-year, 24-hour rainfall event and requiring each facility to develop a Engineered Waste Management Plan. This permit was amended with adoption of R8-2013-0001, which directed dairies in the San Jacinto Watershed to collaborate with Eastern Municipal Water District's Salinity Management Program.

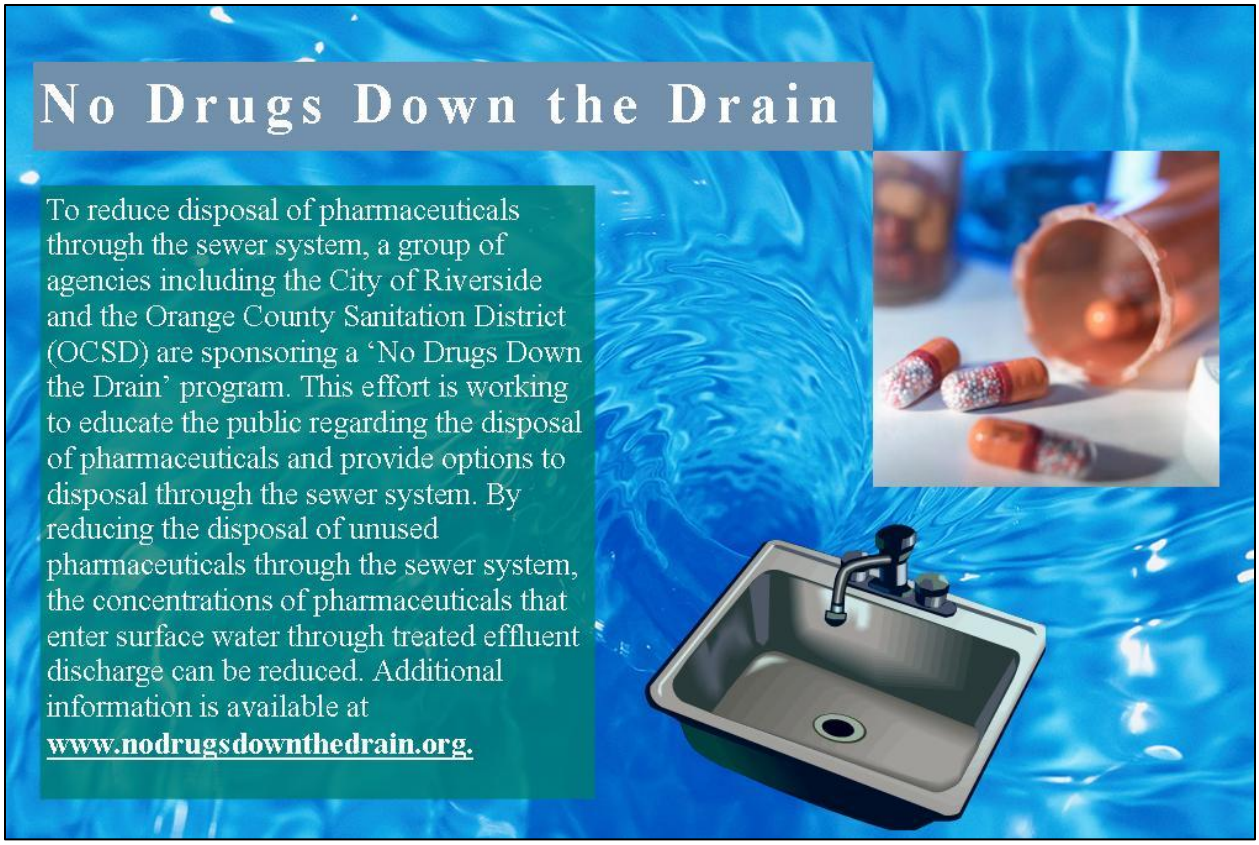
The Riverside County Ordinance 427.2, passed by the Riverside Board of Supervisors, regulates safe transportation and application of manure in certain county districts by requiring operators and/or landowners to report manure application. The purpose of the ordinance is to minimize impacts to neighboring properties, local waterways, underground water supplies, and soil resources.

The San Jacinto Basin Resource Conservation District and the Western Riverside County Agriculture Coalition developed a multi-phase process for establishing and running a Manure Manifest System (MMS) as part of the Integrated Regional Dairy Management Plan (IRDMP). The IRDMP addresses dairy issues of concern on a regional basis. The MMS addresses nutrient and salt loadings by specifying that manure be applied to land at rates consistent with cropping practices and groundwater conditions. The MMS will prohibit over-application at sites where potential impacts to groundwater basins are a concern. Excerpts of the MMS have been adopted by the RWQCB in the new manifest forms under the new 2013 permit.




### *Constituents of Emerging Concern*

The potential impact of trace levels of constituents of emerging concern in water supplies has become an increasing concern for water and wastewater agencies, regulators, and the public.

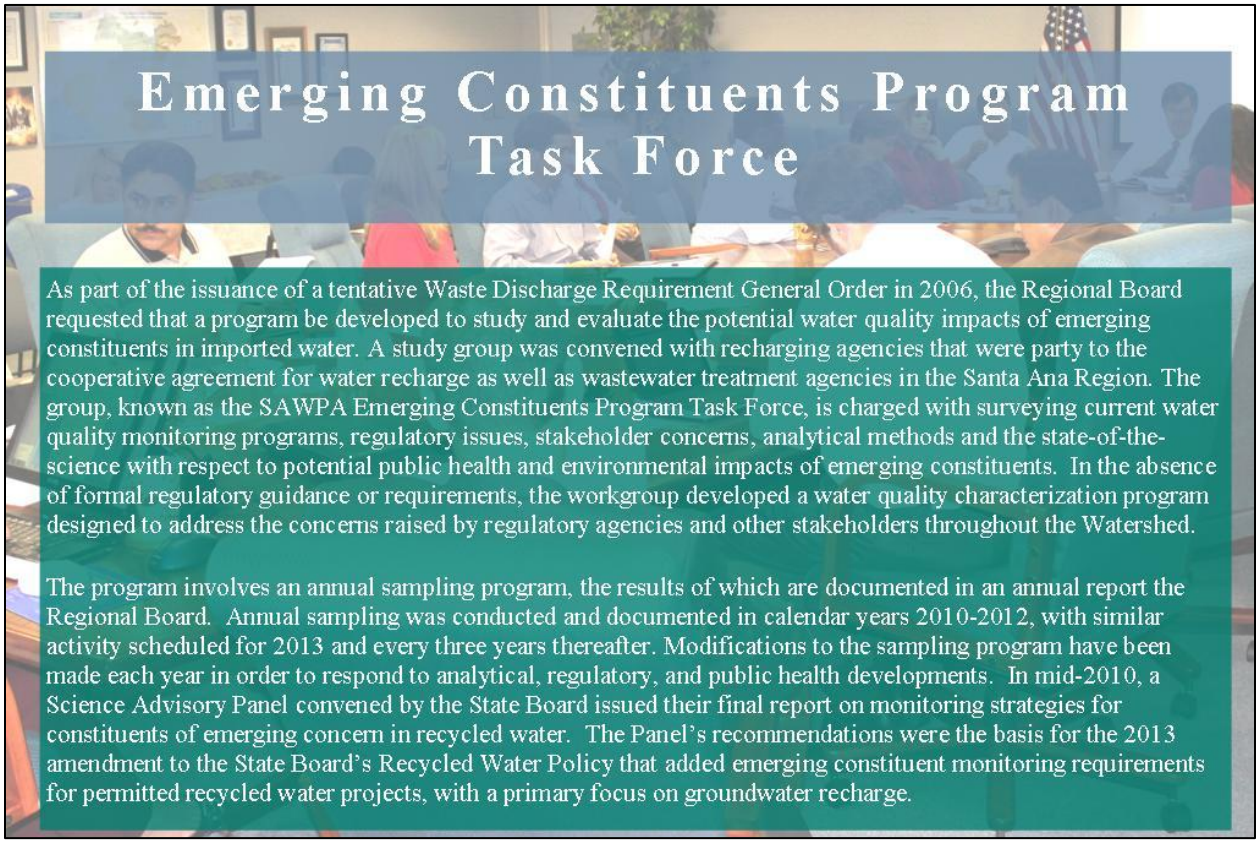



These constituents, also referred to as 'emerging constituents', include a wide range of chemical constituents, including pharmaceuticals, personal care products, pesticides, and other synthetic organic compounds. Potential constituents may include thousands of chemicals in consumer and health-related products such as drugs, food supplements, fragrances, sun-screen agents, deodorants, and insect repellants. Typically, these constituents of emerging concern are found at very low concentrations (*i.e.*, parts per trillion) in waterbodies. Some of these chemicals enter surface water through the discharge of treated effluent when the public disposes of unused pharmaceuticals through the sewer system or the pharmaceuticals that are consumed are not entirely broken down in the human body.

Constituents of emerging concern currently are not regulated by Federal or State agencies and very few have regulatory levels or California Notification Levels. In general, when detected, the chemicals occur at low concentrations in surface water. Although ecological impacts to fish and other wildlife have been shown for some of these trace contaminants in waterbodies, less is known about potential human health effects. However, some of these constituents are known or suspected to have endocrine disrupting effects, if present at a sufficiently high concentration. In addition, concerns are being raised about the potential reproductive and developmental effects of these compounds. There is a significant amount of research being done in the area of ecological and human health effects and new information continues to be developed on the significance of this issue.

A major driver in characterizing these constituents in water supplies is the use of newly developed analytical methods. As laboratory methods improve, new tests can detect substances at lower and lower concentrations. As many of these methods are not standard, they are considered research methods with

development still ongoing. As part of the methods development process, issues such as method detection limits and intra- and inter-laboratory comparisons are being evaluated.




Additional research is needed on the public health significance of low level concentrations of these constituents, especially when they occur as mixtures. Knowledge of the potential human health effects at low concentrations is limited for compounds other than pharmaceuticals, and data gaps exist in trying to establish levels of human health risk or regulatory limits. However, public concern is a significant issue and will need to be addressed before complete scientific-based health information is available.

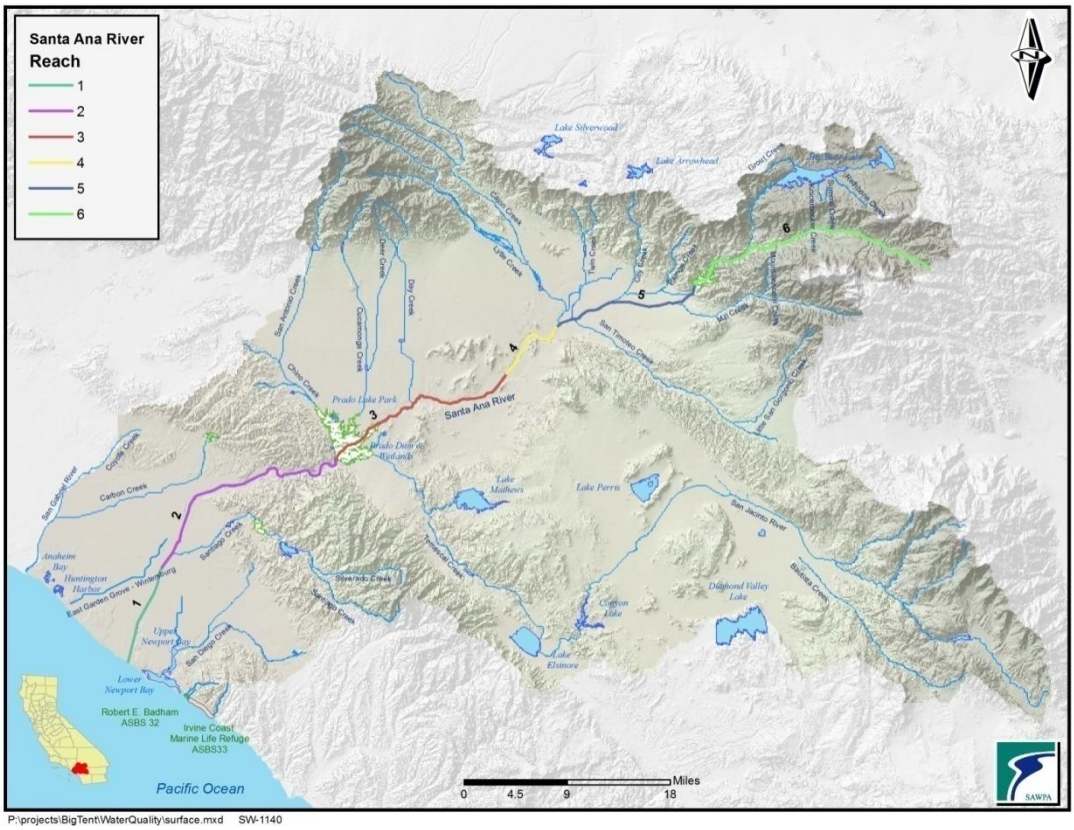
## Surface Water

Surface water in this chapter includes rivers, streams, creeks, lakes, and bays and estuaries. These waters provide many benefits to the watershed, including water supply, habitat, and recreation.

### *Current Conditions*

Water in less developed and non-agricultural areas of the watershed is typically the highest quality water in the watershed. Agricultural, industrial, commercial, and residential developments over the last, approximately, 150 years have degraded surface water quality. Pollutants include nutrients, sediment, pesticides and microbial contaminants, such as bacteria. Concentrations of soluble mineral substances commonly referred to as 'salinity' or 'TDS', also impact surface water quality. In developed areas and agricultural areas, stormwater carries pollutants from roads, parking lots, and other sources, degrading the quality of water as it flows downstream. The following sections describe surface water conditions in each reach of the Santa Ana River Watershed as defined by the Basin Plan and shown in **Figure 5.5-1**.

**Figure 5.5-1 Santa Ana River Watershed, Surface Waters**




Waterbodies that do not meet water quality standards are identified as impaired and are placed on the 303(d) List of Water Quality Limited Segments. A water body remains on the list until a TMDL is adopted and the water quality standards are attained or there are sufficient data to demonstrate that water quality standards have been met and delisting should take place.

**Figure 5.5-2** shows the locations of impaired waterbodies where the Regional Board has yet to begin the process of developing TMDLs. Surface waterbodies where TMDL projects are in the process of development, as shown on the Regional Board's TMDL project list, are shown in **Figure 5.5-3**.

**Figure 5.5-2 Santa Ana River Watershed, Impaired Waterbodies**

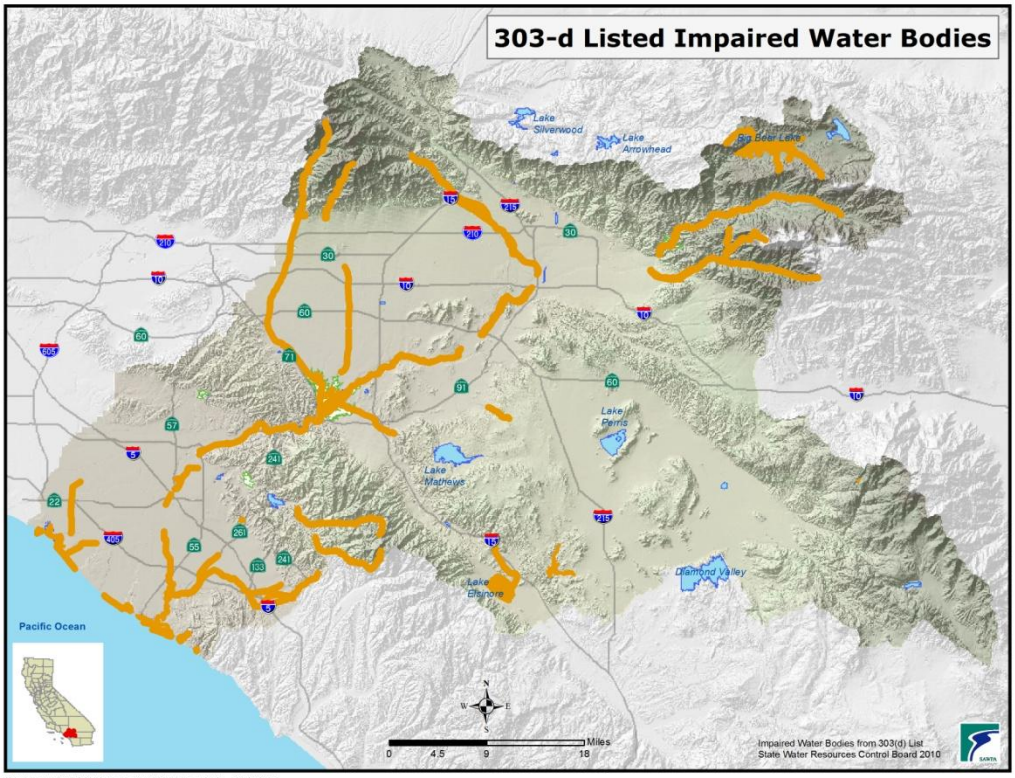
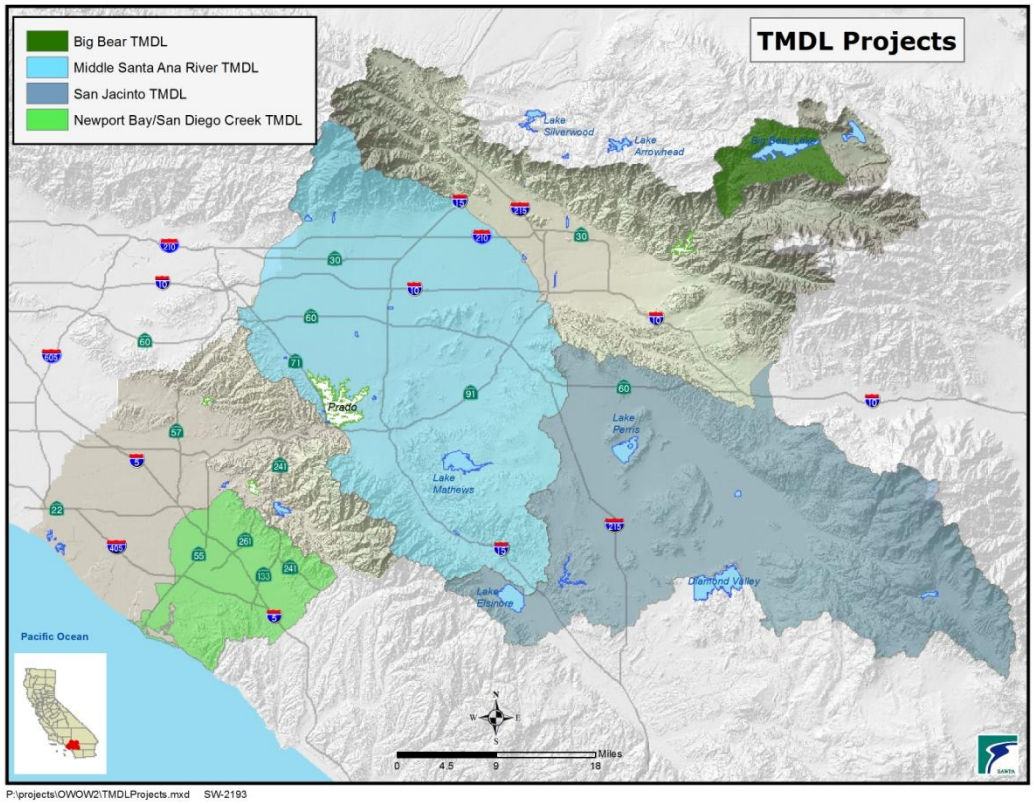



**Figure 5.5-3 Santa Ana River Watershed, TMDL Projects**



*SAR Reach 6*

Past and present land use practices have negatively impacted water quality in Big Bear Lake and the SAR, Reach 6. Impairments and current TMDL projects are shown in **Table5.5-1** and **Table5.5-2.**

**Table 5.5-1 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Big Bear Lake Watershed**

| Water Body | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Big Bear Lake | Mercury | Resource extraction | 2007 |
| | PCBs | Unknown | 2019 |
| | Noxious Aquatic Plants | Construction/Land Development and Unknown Nonpoint Source | 2007 |
| | Nutrients | Construction/Land Development and Snow Skiing Activities | 2007 |

**Table 5.5-2 TMDL Projects – Big Bear Lake Watershed**

| Water Body | Pollutant (s) | TMDL Project | Status |
|---|---|---|---|
| Big Bear Lake | Noxious aquatic plants<br>Nutrients | Nutrient TMDL for Dry Hydrological Conditions for Big Bear Lake | Implementation Phase |

Shay Creek, Shay Meadows, and Baldwin Lake are relatively undeveloped areas that contain natural resources highly valued by stakeholders. Shay Creek and Baldwin Lake have threatened and endangered plant species, as well as the endangered, unarmored three-spine stickleback fish and a unique wetlands system. The U.S. Fish and Wildlife Service, U.S. Forest Service, and the California Department of Fish and Wildlife are interested in restoring the quality of these waters.

Grout, Knickerbocker, Summit, and Rathbone (Rathbun) Creeks, tributaries to Big Bear Lake, are listed as impaired, as shown in **Table 5.5-3**.

**Table 5.5-3 TMDL Projects in the Big Bear Lake Watershed**

| Impaired Water Body | Pollutant (s) | TMDL Project | Status |
|---|---|---|---|
| Grout Creek | Nutrients | Nutrient TMDLs for Big Bear Lake Tributaries | Under development |
| Knickerbocker Creek | Pathogens | Knickerbocker Creek Bacterial Indicators | USEPA Action |
| Rathbone Creek | Nutrients | Nutrient TMDLs for Big Bear Lake Tributaries | Under development |
| | Sedimentation/ siltation | Sediment TMDLs for Big Bear Lake and Rathbone Creek | Other Action |
| | Cadmium | Cadmium TMDLs for Rathbone Creek | TMDL Required |
| | Copper | Copper TMDLs for Rathbone Creek | TMDL Required |
| Summit Creek | Nutrients | Nutrient TMDLs for Big Bear Lake Tributaries | TMDL Required |

Mountain Home Creek and mountain reaches of Mill Creek and Lytle Creek are impacted by high seasonal recreational use and/or flow through remote residential communities. Impairments are shown in **Table 5.5-4.** Although the potential sources on the official 2010 303(d) list for pathogens is "unknown nonpoint source", sources are likely from sewage spills, recreational activities, and residential development.

**Table 5.5-4 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs**

| Water Body | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Lytle Creek, Mountain Home Creek, Mountain Home Creek-East Fork, Mill Creek-Reaches 1 and 2 | Pathogens | Unknown nonpoint source | 2019 |
| Santa Ana River Reach 6 | Cadmium. Copper, Lead | Source Unknown | 2021 |
| San Antonio Creek | pH | Source Unknown | 2021 |

The water quality of Reach 6 (the SAR upstream of the Seven Oaks Dam) and Reach 5 (the Seven Oaks Dam to the San Jacinto Fault) and their tributaries is generally very good, with low to very low levels of TDS, indicator bacteria, or other pollutants. Impounding water behind the Seven Oaks Dam reduces water quality because of sediment entrapment and algae growth. This may render some of the impounded water unsuitable for use unless additional treatment is provided. The U.S. Army Corps of Engineers is studying this problem.

Many of the mountain reaches of these streams support self-sustaining populations of trout and other indigenous aquatic species. Several rare, threatened, and endangered species inhabit these areas including the unarmored three spine stickleback, the San Bernardino kangaroo rat, the yellow-legged mountain frog, the speckled dace, the Santa Ana woolly star, the least Bell's vireo, and the Southwest Willow Flycatcher.

### *Santa Ana River Reach 5*

Reach 5 and its primary tributaries are believed to meet the Basin Plan's water quality standards. However, this may be due to the lack of recent or rigorous water quality assessments rather than a true indication of water quality. Segments of many of these streams support or have the potential to support a wide range of beneficial uses.

### *Santa Ana River Reach 4*

Reach 4 includes the river from the San Jacinto Fault down to Mission Boulevard Bridge in Riverside. In this reach, all the WQOs are being met except for fecal coliform. **Table 5.5-5** summarizes the 303(d) listing for pathogens for Reach 4.

**Table 5.5-5 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs**

| Water Body | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Santa Ana River-Reach 4 | Pathogens | Nonpoint source | 2019 |

### *Santa Ana River Reach 3 and Chino Basin Surface Waterbodies*

Reach 3 includes the portion of the river from Mission Boulevard Bridge to Prado Dam. Rising groundwater feeds small creeks tributary to Reach 3 that are important breeding and nursery areas for native fish. Excessive nutrient loading in Reach 3 was addressed by amendments to the Basin Plan as recommended by the N/TDS Task Force. Watershed partners are working closely with regulators to improve the quality of impaired waterbodies and to develop TMDLs as shown in **Tables 5.5-6** and **5.5-7**.

**Table 5.5-6 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Santa Ana River, Reach 3**

| Water Body | Pollutant/ Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Chino Creek-Reach 1 and Mill Creek (Prado Area) | Nutrients | Agriculture, dairies | 2019 |
| Mill Creek (Prado Area) | TSS | Dairies | 2019 |
| Prado Park Lake | Nutrients | Nonpoint source | 2019 |
| SAR Reach 3 | Lead | Source Unknown | 2021 |
| | Copper | Source Unknown | 2021 |
| Chino Creek Reach 2 | pH | Source Unknown | 2021 |
| Cucamonga Creek – Valley Reach | Cadmium | Source Unknown | 2021 |
| | Copper | Source Unknown | 2021 |
| | Lead | Source Unknown | 2021 |
| | Zinc | Source Unknown | 2021 |
| Cucamonga Creek – Mountain Reach | pH | Source Unknown | 2021 |
| Chino Creek Reach 1B | COD | Source Unknown | 2021 |
| | Nutrients | Agriculture | 2019 |
| Temescal Creek Reach 1 | pH | Source Unknown | 2021 |
| Temescal Creek, Reach 6 | Indicator Bacteria | Source Unknown | 2021 |

**Table 5.5-7 TMDL Projects-Santa Ana River Watershed, Reach 3**

| Impaired Water Body | Pollutant(s) | TMDL Project | Status |
|---|---|---|---|
| Chino Creek-Reach 1, Mill Creek (Prado Area); SAR-Reach 3, Prado Park Lake | Pathogens | Bacterial Indicator TMDLs for the Middle SARWWaterbodies | Implementation Phase |
| Chino Creek-Reach 2;Cucamonga Creek-Valley Reach | High coliform count | | |
| SAR – Reach 3 | Nitrate | SAR, Reach 3 Nitrate TMDL | Implementation Phase |

*Prado Wetlands*

The Orange County Water District (OCWD) operates the Prado Wetlands in Riverside County to remove nitrogen from SAR water. During non-storm conditions, the river flow upstream of the Prado Wetlands consists predominately of tertiary-treated effluent discharged from wastewater treatment plants. Before reaching the Prado Dam, river water is diverted through 465 acres of constructed wetlands with more than 50 engineered ponds. Following wetland treatment, the water is then discharged into Chino Creek, and then back to the SAR. The wetlands serve as a natural, cost-effective treatment to reduce nitrate levels before the water flows to Orange County, where it is used for groundwater recharge. The Prado Basin is home to several rare and endangered bird and waterfowl species. More than 124 acres are set aside as protective habitat for the endangered least Bell's vireo and Southwestern Willow Flycatcher.

**Middle Santa Ana River TMDL Task Force**

In 2007, in support of local stakeholders, SAWPA formed a multi-agency task force to address the pathogen TMDLs in the Santa Ana River Reach 3 and its tributaries. This area was named the Middle SAR by the Regional Board. This task force includes county agencies, cities, dairies, and agricultural operators. The MSAR Bacteria TMDL requires implementation of a watershed-wide compliance monitoring program for bacterial indicators. The first water quality assessment was submitted to the Regional Board for sampling conducted from 2007-08. The Counties of Riverside and San Bernardino have completed and are implementing Comprehensive Bacteria Reduction Plans. The agricultural community is developing an Agricultural Source Management plan.

*Temescal Creek*

Temescal Creek, also called Temescal Wash, stretches approximately 25 miles from Lake Elsinore to Prado Basin. However, water overflows from the lake to the creek only during very wet periods. For

most of the year, portions of the creek are dry, and flow in Temescal Creek originates downstream of Lake Elsinore. Water quality in the creek is impacted by non-point source pollution. Recycled water produced at Eastern Municipal Water District's (EMWD) Regional Water Reclamation Facilities, Elsinore Valley Municipal Water District's Regional Water Reclamation Facility, City of Corona's Wastewater Treatment Plant IB, and Lee Lake Water District's Wastewater Treatment Plant is discharged to Temescal Creek.

### *Lake Mathews*

Lake Mathews, located in Riverside County, is the terminal reservoir for the Colorado River Aqueduct. Metropolitan Water District of Southern California (MWDSC) owns and operates the 182,000 acre-foot reservoir to supply Colorado River water to its member agencies. The Lake Mathews Watershed is drained primarily by Cajalco Creek which has intermittent flows during storm events or in the presence of urban or agricultural runoff.

The Lake Mathews Drainage Water Quality Management Plan (DWQMP) was completed in the early 1990's through a partnership between Metropolitan, County of Riverside, and Riverside County Flood Control and Water Conservation District (RCFCandWCD) to protect water quality in Lake Mathews from runoff pollution. Under the DWQMP, runoff would be managed and mitigated by the implementation of BMPs throughout the watershed, including several regional stormwater treatment facilities. As recommended in the DWQMP, the Cajalco Creek Dam and Detention Basin and multiple sediment basins have been constructed to detain runoff flows and allow sediment to settle. In 2012, Metropolitan, County of Riverside, and RCFCandWCD completed the Lake Mathews Watershed Study and developed a watershed model for Lake Mathews to assess the effects of future development on runoff pollution. The study evaluated and prioritized stormwater management options that would be pursued, as watershed development conditions warrant, to ensure long-term protection of Lake Mathews.

### *San Jacinto Watershed*

The San Jacinto River (SJR) originates in the San Jacinto Mountains and flows through the San Jacinto Valley. The valley, although undergoing considerable development, still contains citrus orchards, dairy farms, and other agricultural operations.

The SJR passes through Railroad Canyon to Canyon Lake before draining into Lake Elsinore. Lake Elsinore is a natural endpoint for its tributaries, and has no natural outlet. Historically, the lake was known to dry completely; imported and recycled water are now used to maintain the water level. To provide a water outlet during heavy rains, Lake Elsinore was modified to allow overflow into Temescal Creek, which drains into the SAR. Nutrients from sources such as septic systems, farming, reclaimed water, and poor land use practices can cause significant algae growth in the lake, thereby impairing recreational use and degrading aesthetic values. Moreover, excessive algae growth in the lake depletes dissolved oxygen resulting in occasional fish kills.

**Lake Elsinore and Canyon Lake Nutrient TMDL Task Force**.

In 2006, Lake Elsinore and San Jacinto Watersheds Authority (LESJWA) administered the formation of a multi-agency task force to address nutrient TMDLs for Lake Elsinore and Canyon Lake. Over 20 agencies joined the task force to work with the Regional Board to implement studies, monitoring and water quality improvements necessary to achieve TMDL targets for 2015 and 2020 at both lakes. Many water quality improvements at Lake Elsinore implemented by LESJWA from 2005-2012 that produced significant improvements and progress toward TMDL compliance. With TMDL interim targets approaching, greater focus has been place on water quality improvements at Canyon Lake, upstream of Lake Elsinore.

To assist the Task Force, the Regional Board agreed to defer lake monitoring at Canyon Lake and Lake Elsinore from 2013-2015 to allow funding resources to directed for implementation measures at Canyon Lake. Canyon Lake improvements include chemical addition, alum application, a common nutrient flocculating agent used in water treatment and possible an oxygenation injection system dependent on the results of alum application. The improvements at both lakes will also be supplemented by ongoing BMP measures implemented in the upper watershed by the municipal stormwater permittees and agricultural operators. This Task Force established one of the first TMDL agreements signed by Federal, State, and local parties in the State. The cooperative effort has enabled agencies to combine efforts, economically address water quality challenges, and pursue additional grant funding for this process.

*Lake Elsinore*

Lake Elsinore is on the 303(d) list as impaired for Polychlorinated Biphenyls (PCBs) and unknown toxicity. Nutrient TMDLs for Lake Elsinore and Canyon Lake have been developed as shown in **Table5.5-8** and **Table5.5-9**. A Nutrient Source Assessment, a Nutrient Management Plan, and a Bacteria Source Assessment have been completed on Canyon Lake. The bacterial indicator TMDL for Canyon Lake may be revised by the Regional Board if the Stormwater Quality Standards Task Force's recommended change of the REC-1 Pathogen Standards from fecal coliform to E. coli is adopted into the Basin Plan. Should this change occur, Canyon Lake is likely to be in compliance with REC-1 standards and taken off the 303(d) list.

**Table 5.5-8 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – San Jacinto Watershed**

| Water Body | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Lake Fulmor | Pathogens | Unknown nonpoint source | 2019 |
| Lake Elsinore | PCBs | Source unknown | 2019 |
| | Unknown toxicity | Unknown nonpoint source | 2007 |

**Table 5.5-9 TMDL Projects – San Jacinto Watershed**

| Impaired Water Body | Pollutant(s) | TMDL Project | Status |
|---|---|---|---|
| Canyon Lake (Railroad Canyon Reservoir) | Nutrients | Nutrient TMDLs for Lake Elsinore and | Implementation Phase |
| | Pathogens | Bacterial Indicator TMDLs for Canyon Lake | Other Action |
| Lake Elsinore | Nutrients | Nutrient TMDLs for Lake Elsinore and Canyon Lake | Implementation Phase |
| | Organic Enrichment/ Low Dissolved Oxygen | | |

Conditional Waiver of Waste Discharge Requirements in the San Jacinto River Watershed

In the San Jacinto River Watershed, waste discharges from a variety of sources (urban, agriculture, transportation, and other) are contributing to pollution in Canyon Lake and Lake Elsinore. In response, the Regional Board adopted nutrient TMDLs for the two lakes. The TMDLs include a variety of tasks that need to be completed by watershed stakeholders to achieve the objectives of restoring water quality in the watershed.

Whereas dairy operators are already contributing to the TMDL program, many other agriculture operators are not. To include all operators of irrigated and other agricultural or livestock operations the Regional Board is developing the Conditional Waiver (of waste discharge requirements) for Agricultural Discharges (CWAD, or "quad") program. This program will allow for the waiving of waste discharge requirements provided that certain conditions, established by the regional board, are met. The CWAD program will also satisfy the State's policy for "Implementation and Enforcement of the Non-Point Source Pollution Control Program."

With stakeholder involvement, Regional Board staff is developing conditions that will be incorporated in a draft conditional waiver that will be considered by the Regional Board. Once the conditional waiver of caste discharge requirements is adopted affected agricultural operators will be required to enroll in the CWAD program or to obtain individual waste discharge requirements.

*Lake Perris*

Lake Perris, located in western Riverside County, is owned and operated by the California Department of Water Resources (DWR) and is the 2,000-acre terminal reservoir of the East Branch of the California Aqueduct (State Water Project). The lake is a source of water for the MWDSC Water quality concerns,

including pathogens, taste and odors, algal toxins, and anoxia within the lake's bottom layer, have limited its use for water supplies.

Recreational activities at the lake include body-contact recreation such as, swimming and water skiing and non-body contact activities such as, boating, fishing, camping, and hiking. Over a million people visit each year, with an estimated 50 percent of the peak season visitors involved in body-contact recreation. Beach closures occur in spite of implementation of several BMPs aimed at reducing coliform levels.

The State Board provided funding to MWDSC to study microbial contamination at the lake. The studies concluded that body-contact recreation was a key source of fecal contamination and recommended voluntary alternatives to swimming in the lake, such as swim lagoons, water play areas and other water features. Modeling and risk analysis suggest that such alternatives would reduce the consumer health risk by one-half (to approximately a 5 percent probability of exceeding the EPA maximum risk level). A CALFED Science Panel in March 2005 concurred with the main findings of the report.

## Santa Ana River Reaches 2 and 1 and Santiago Creek Watershed

Reach 2 extends from Prado Dam to 17th Street in the City of Santa Ana. In this reach, the OCWD recharges as much of the river water as possible into the Orange County groundwater basin. Reach 1 extends from 17th Street in the City of Santa Ana to the ocean. In Reach 1, the Talbert and Huntington Beach Channels drain urban and stormwater runoff from the western side of the watershed carrying flow to the Talbert Marsh along the coast. The Greenville-Banning Channel drains the southeast side of the watershed and carries flows to the SAR. This area also includes Huntington Beach State Park.

SAR, Reach 2 is listed as impaired for indicator bacteria. The river's main tributary in Orange County, Santiago Creek, has several impairments as does its tributary, Silverado Creek. Water quality impairments in this area are shown in **Table 5.5-10**.

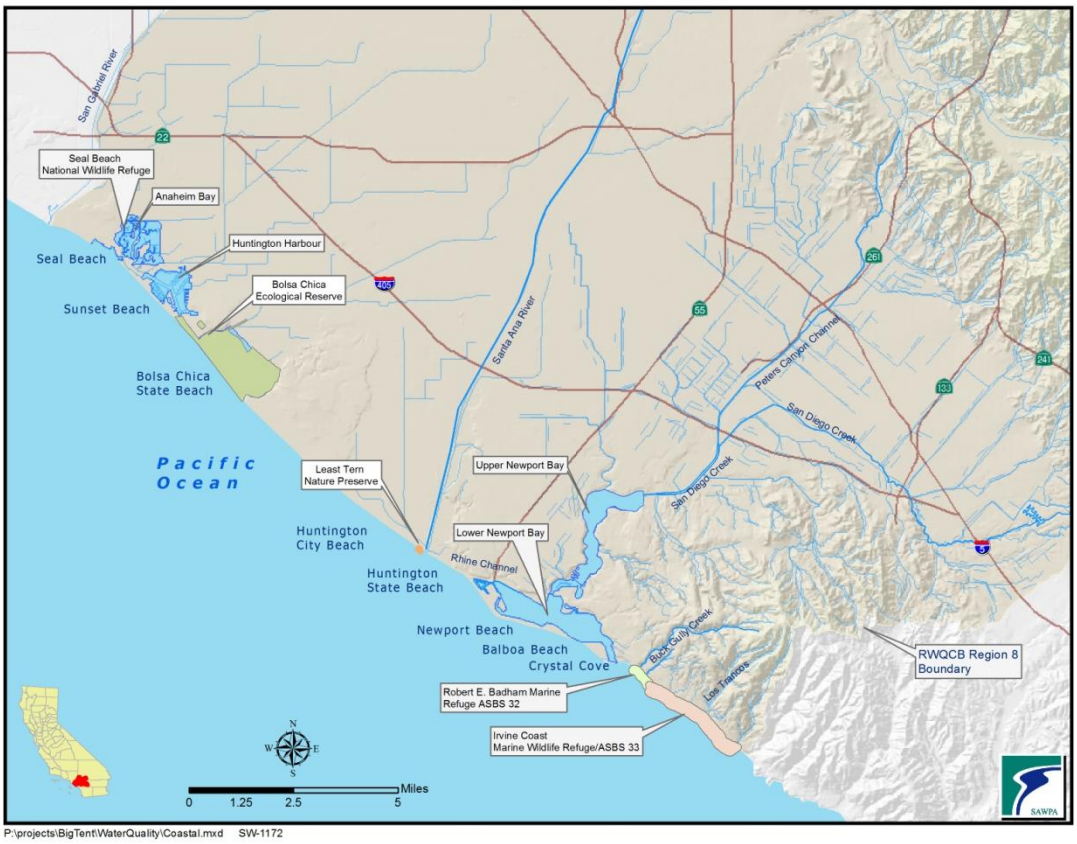
**Table 5.5-10 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Santa Ana River Watershed, Reaches 1 and 2**

| Water Body | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| SAR, Reach 2 | Indicator bacteria | | 2021 |
| Santiago Creek Reach 4 | Salinity, TDS, chlorides | Source unknown | 2019 |
| Silverado Creek | Pathogens, Salinity/TDS/ Chlorides | Unknown nonpoint source | 2019 |
| Huntington Beach State Park | PCBs | Source unknown | 2019 |
| Morning Canyon Creek | Indicator Bacteria | Source Unknown | 2021 |
| Serrano Creek | Ammonia (Unionized)/Indicator Bacteria/pH | Source Unknown | 2021 |

## West Orange County and Coastal Watersheds

This section discusses the water quality challenges facing coastal bays and harbors and coastal area tributary streams, as shown in **Figure 5.5-4**.

**Figure 5.5-4 Coastal Area**




### *San Gabriel River Watershed- Coyote Creek*

The San Gabriel River Hydrologic Unit lies within Los Angeles and Orange Counties. Approximately 86 square miles are within Orange County. The area is drained by a number of tributaries to the San Gabriel River, including Coyote Creek and Carbon Creek that originate in the foothills of northern Orange County. This area is highly urbanized and dry weather urban runoff and wet weather stormwater runoff discharge pollutants into the river. Seal Beach is located just south of the mouth of the San Gabriel River and is impacted by local drainage as well as the water quality of the river. TMDLs for Coyote Creek are listed in **Table 5.5-11**.

**Table 5.5-11 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – San Gabriel Watershed**

| Water Body | Pollutant/Stressor | Potential sources | Proposed TMDL Completion |
|---|---|---|---|
| Coyote Creek | Lead | Major Municipal Point Source-wet weather discharge | TMDL Approval in 2007 |
| | Toxicity | Point source | 2008 |
| | Diazinon, pH | Point, nonpoint source | 2019 |
| | Indicator Bacteria | Source Unknown | 2009 |
| | Copper, Dissolved | Source Unknown | TMDL Approved in 2007 |
| | Ammonia | Point Source | 2019 |
| Seal Beach | Enterococcus, PCBs | Source unknown | 2019 |
| Coyote Creek | Lead | Major Municipal Point Source-wet weather discharge | San Gabriel River Metals (39) |
| | Copper, Dissolved | Source Unknown | San Gabriel River Metals (39) |

Note: Dissolved Copper and Lead is being addressed by a EPA approved TMDL (San Gabriel River Metals (39)) and is being considered for removal under sections 2.2 and 4.1 of the Listing Policy.

### *Anaheim Bay and Huntington Harbour Watershed*

The Anaheim Bay and Huntington Harbour Watershed covers approximately 80 square miles in northwestern Orange County. One of its three tributaries, the Los Alamitos Channel, drains into the San Gabriel River. The Bolsa Chica Channel empties into the Anaheim Bay and Huntington Harbor complex. The East Garden Grove-Wintersburg Channel drains through Bolsa Bay into Huntington Harbor.
The Anaheim Bay and Huntington Harbor complex is located at the northwestern edge of Orange County. Cattle ranching, agriculture, and commercial port facilities preceded rapid urbanization in the 1940s. Discharges containing metals and pesticides from a variety of sources including boating-related activities; stormwater, urban, and agriculture runoff; and past historical inputs have negatively impacted water quality. Impairments in Anaheim Bay and Huntington Harbor are shown in **Table 5.5-12**.

**Table 5.5-12 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Anaheim Bay and Huntington Harbor Watershed**

| Name | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Anaheim Bay | Dieldrin (tissue), nickel, PCBs, sediment toxicity | Source unknown | 2019 |
| Huntington Harbor | Chlordane, copper, lead, nickel, PCBs, sediment toxicity | Source unknown | 2019 |
| | Pathogens | Urban runoff, storm sewers | 2019 |
| Bolsa Chica State Beach | Copper, nickel | Source unknown | 2019 |
| East Garden Grove Wintersburg Channel | Ammonia (Unionized) | Source Unknown | 2021 |
| Bolsa Chica Channel | Ammonia (Unionized) | Other Urban Runoff/Surface Runoff/Storm Sewers/Unknown Nonpoint | 2021 |
| | Indicator Bacteria | Source Unknown | 2021 |
| | pH | Source Unknown | 2021 |

## Newport Bay Watershed

The Newport Bay Watershed covers approximately 152 square miles in central Orange County, draining into upper Newport Bay. San Diego Creek drains 80 percent of the watershed, with Santa Ana Delhi Channel draining 15 percent.

### *San Diego Creek*

San Diego Creek Reach 1 and Reach 2 impairments and TMDL projects are listed in **Tables 5.5-13** and **5.5-14**. The TMDLs include all San Diego Creek tributaries.

**Table 5.5-13 TMDL Projects - Newport Bay/San Diego Creek Watershed**

| Impaired Water Body | Pollutant | TMDL Project | Status |
|---|---|---|---|
| San Diego Creek-Reach 1 | Nutrients | Nutrient TMDL for the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| | Pesticides | San Diego Creek-Newport Bay Organochlorine Compounds TMDLs | Technical TMDLs |
| | | Diazinon and Chlorpyrifos TMDL for San Diego Creek and upper Newport Bay | Implementation Phase |
| | Siltation | Sediment TMDL for the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| San Diego Creek-Reach 2 | Nutrients | Nutrient TMDL for the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| | Siltation | TMDL for Sediment in the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| | Unknown toxicity | Addressed by metals and organochlorine TMDLs | Implementation Phase (Being addressed by EPA Approved TMDL) |

**Table 5.5-14 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Newport Bay/San Diego Creek Watershed**

| Name | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| San Diego Creek- Reach 1 | Selenium | Source unknown | 2007 |
| | Fecal coliform | Urban runoff, storm sewers, other urban runoff | 2019 |
| | Toxaphene | Source unknown | 2019 |
| San Diego Creek- Reach 2 | | | |
| | Indicator Bacteria | Source Unknown | 2021 |
| Peters Canyon- Channel | DDT, Toxaphene, | Source unknown | 2019 |
| | pH | Unknown Point Source, Urban Runoff/Storm Sewers | 2021 |
| | Indicator Bacteria | Source Unknown | 2021 |
| Borrego Creek | Ammonia (Unionized) | Other Urban Runoff/Unknown Nonpoint Source/Surface Runoff/Storm Sewers | 2021 |
| | Indicator Bacteria | Source Unknown | 2021 |

## Newport Bay

San Diego Creek flows into Upper Newport Bay. The bay is a unique area containing a fragile coastal ecosystem that is designated as a State Ecological Reserve. Newport Bay is divided into two distinct areas. The 750-acre **U**pper Bay begins at the Pacific Coast Highway Bridge and extends five miles inland. The Lower Bay encompasses the area below the bridge and includes the Rhine Channel; it is separated from the ocean by Balboa Peninsula.

### *Upper Newport Bay (CCA No. 69)*

Upper Newport Bay, a Critical Coastal Area (CCA) with a significant ecosystem, is the receiving waters for impaired flows emanating from the San Diego Creek Watershed. It supports seven diverse estuarine habitats with several hundred species of marine and terrestrial flora and fauna including six federal and state listed, threatened, and endangered species (five bird species, one plant species). The Bay's fish diversity is rated as the highest of the seven major coastal embayments between San Diego and Point Conception; it provides critical habitat for commercially and ecologically important species, such as California halibut, sand bass, gobies, topsmelt, and anchovy. Impairments and TMDL projects for upper Newport Bay are listed in **Table 5.5-15** and **Table 5.5-16**.

**Table 5.5-15 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs – Newport Bay/San Diego Creek Watershed**

| Name | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Newport Bay, Lower | Copper | Source unknown | 2007 |
| | Chlordane, DDT, PCBs, sediment toxicity | Source unknown | 2019 |
| Newport Bay, Upper (Ecological Reserve) | Copper | Source unknown | 2007 |
| | Chlordane, DDT, metals, PCBs, sediment toxicity | Source unknown | 2019 |
| Rhine Channel | Copper, lead, mercury, PCBs, sediment toxicity, | Source unknown | 2019 |
| Balboa Beach | DDT, dieldrin, PCBs | Source unknown | 2019 |
| Santa Ana Dehli Channel | Indicator Bacteria | Source Unknown | 2021 |
| Newport Slough | Enterococcus/Fecal Coliform/Total Coliform | Source Unknown | 2021 |

**Table 5.5-16 TMDL Projects - Newport Bay Watershed**

| Name | Pollutant/ Stressor | Potential Sources | Status |
|---|---|---|---|
| Newport Bay, Lower | Nutrients | Nutrient TMDL for the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| | Pathogens | TMDL for Fecal Coliform Bacteria in Newport Bay | Implementation Phase |
| | Pesticides/Priority Organics | San Diego Creek-Newport Bay Organochlorine Compounds TMDLs | Technical TMDLs |
| | | Organochlorine Compounds and Metals TMDL, Lower Newport Bay: Rhine Channel | |
| | Siltation | TMDL for Sediment in the Newport Bay-San Diego Creek Watershed | Implementation Phase |
| Newport Bay, Upper (Ecological Reserve) | Metals | San Diego Creek and Newport Bay Metals TMDLs | Technical TMDLs |
| | | Newport Bay-San Diego Creek Selenium TMDL | |
| | Nutrients | Nutrient TMDL for the Newport Bay/San Diego Creek Watershed | Implementation Phase |
| | Pathogens | TMDL for Fecal Coliform Bacteria in Newport Bay | Implementation Phase |
| | Pesticides | Diazinon and Chlorpyrifos TMDL for San Diego Creek and upper Newport Bay | Implementation Phase |
| | | San Diego Creek-Newport Bay Organochlorine Compounds TMDLs | Technical TMDLs |
| | Siltation | TMDL for Sediment in the Newport Bay-San Diego Creek Watershed | Implementation Phase |

### *Lower Newport Bay and Rhine Channel*

The Lower Newport Bay with two main channels is a small boat harbor berthing 9,000 boats. The Rhine Channel is located at the western end of lower Newport Bay. It has been designated by the Regional Board as one of Orange County's hot spots for toxic sediments. Years of operating canneries, metal plating companies, and shipyards deposited PCBs, mercury, and other pollutants in the channel. Several studies have documented contamination in the channel. Impairments and TMDL projects in the Lower Bay and Balboa Beach are listed in **Table 5.5-17** and **Table 5.5-18.**

### *Newport Bay Watershed Toxics TMDLs*

In addition to State Board TMDLs, the EPA has also promulgated Toxics TMDLs in the Newport Bay Watershed. EPA established technical TMDLs (without implementation plans) for toxic pollutants in San Diego Creek and Newport Bay on June 14, 2002. Regional Board staff is developing the State required Basin Plan amendments, including implementation plans. These TMDLs are listed in **Table 5.5-17**.

**Table 5.5-17 Newport Bay Watershed Toxics TMDLs**

| Water Body | Element/Metal | Organic Compound |
|---|---|---|
| San Diego Creek | Cd, Cu, Pb, Se, Zn | Chlorpyrifos, Diazinon, Chlordane, Dieldrin, DDT, PCBs, Toxaphene |
| Upper Newport Bay | Cd, Cu, Pb, Se, Zn | Chlorpyrifos, Chlordane, DDT, PCBs |
| Lower Newport Bay | Cu, Pb, Se, Zn | Chlordane, Dieldrin, DDT, PCBs |
| Rhine Channel | Cu, Pb, Se, Zn, Cr, Hg | Chlordane, Dieldrin, DDT, PCBs |

### *Newport Coastal Streams Watershed*

The Newport Coastal Streams Watershed encompasses approximately eight square miles south of the Newport Bay Watershed. Several coastal canyons drain this area directly into the ocean, into two ASBS. Both Buck Gully and Los Trancos Creeks are listed as impaired for fecal coliform and total coliform, as shown in **Table 5.5-18**. The City of Newport Beach conducted a study of the water quality of eight coastal canyon creeks (Newport Coast Flow and Water Quality Assessment Final Report, January 2007) to determine if conditions protect beneficial uses and to investigate sources of water quality impairments.

**Table 5.5-18 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs**

| Name | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Buck Gully Creek and Los Trancos (Crystal Cove Creek) | Fecal coliform, total coliform (downstream of Pacific Coast Highway) | Source unknown | 2019 |

**Nitrogen and Selenium Management Plan**

Nitrogen is an essential nutrient that causes algal blooms when present in excessive quantities. Selenium is a naturally occurring trace element that is found in ancient marine sediments in the foothills of Newport Bay Watershed. When selenium is released to surface waterbodies, such as via passive groundwater seepage and groundwater cleanup/dewatering operations, it accumulates in the food chain to levels that can be harmful to fish and birds.

In renewing the region-wide permit for discharges that pose an insignificant (de minimus) threat in 2004, the Regional Board issued a separate permit for the Newport Bay Watershed for short term groundwater-related discharges. The concern was that high levels of nitrogen and selenium in groundwater discharges would violate established TMDLs. The Regional Board recognized that numerical effluent limits for selenium would be difficult, if not impossible, to meet as there is no technically feasible and economically practical treatment technology available for selenium. As an alternative, the permit allowed for the formation of a working group to develop a comprehensive understanding of and a management plan for controlling levels of selenium and nitrogen in groundwater discharges. In 2005, the participating watershed stakeholders formed the Nitrogen and Selenium Management Program (NSMP) and agreed to fund and implement the NSMP Workplan, which was scheduled to be completed in 2009.

The NSMP Work Plan tasks include monitoring, testing and evaluation of best management practice (BMP), development of an offset and trading program, total maximum daily loads (TMDL) and site-specific water quality objective, among others. Since 2005, the NSMP Working Group has made significant progress and completed essentially all Work Plan tasks. However, achieving the numerical selenium limitations before the 2009 deadline was infeasible. On December 10, 2009, the Regional Board adopted the Time Schedule Order (TSO) No. R8-2009-0069 that extended the compliance deadline to December 9, 2014. Currently, watershed stakeholders are implementing the tasks outlined in the TSO.

## Current Management Strategies for Surface Water

As described in the previous sections, regulatory efforts aimed at maintaining and improving surface water quality and cleaning up poor quality water are based on implementing the Basin Plan. Non-regulatory approaches are also being implemented to protect and improve water quality.
Attaining water quality standards is a framework identified in the Federal Clean Water Act and its associated regulations, and includes four components:

- Protecting beneficial uses
- Attaining water quality objectives to protect beneficial uses
- Implementing the State and Federal anti-degradation policies
- Executing the Implementation Plan

The approaches available to manage surface water quality include managing urban runoff through municipal National Pollutant Discharge Elimination System (NPDES) permits, developing Drainage Area Management Plans (DAMP) and water quality management plans for new development and redevelopment, and encouraging low impact development. Protection of surface waters also can be achieved through construction of wetlands, implementing BMPs, using brine lines, and building and operating appropriate wastewater treatment facilities. These tactics are listed in **Table 5.5-19**.

**Table 5.5-19 Surface Water Quality Goals, Strategies, and Tactics**

| Goal | Strategies | Tactics |
|---|---|---|
| • Water Quality Standards attained (includes California Toxics Rule) | • Protect good surface water quality<br>• Clean up poor quality surface water<br>• Re-evaluate water quality standards where appropriate | • Monitoring water quality<br>• Protecting source water<br>• Wastewater treatment by Publicly Owned Treatment Works (POTWs): source control, tertiary treatment, and nutrient removal<br>• Urban runoff management<br>• NPDES permits for other dischargers such as dewatering operations<br>• TMDLs<br>• Brine lines<br>• BMPs that include constructed wetlands<br>• Research<br>• Public outreach |

## Future Water Quality Issues

In addition to addressing present water quality problems in the Santa Ana River Watershed, regulators and stakeholders will likely face new challenges. Below is a list of new challenges followed by a brief discussion of several of these issues.

- Establishing new pathogen indicators
- Reevaluating water quality standards to assure that limited resources are allocated appropriately
- Amending the Basin Plan, including additions to the 303(d) list
- Revising the Lake Elsinore/Canyon Lake TMDL
- Setting new residual chlorine objectives
- Establishing nutrient objectives
- Setting new statewide sediment toxicity standards
- Managing sediment loading
- Encouraging appropriate low-impact development
- Evaluating the effects of water use efficiency on wastewater treatment plants and recycled water

- Remediating pollution from septic systems

### *Recreational Water Quality Standards Basin Plan Amendment*

As a follow up to the 2002 triennial review of the Basin Plan, the Stormwater Quality Standards Task Force was convened with representatives from major water, wastewater, and stormwater management agencies, environmental groups, the Regional Board and the EPA. Funding for the effort was provided by the stormwater programs of Orange, Riverside, and San Bernardino Counties, and by SAWPA and Orange County Sanitation District. The Task Force's approach was to work within the existing law, to understand the science underlying the standards, and to agree upon an approach to standards that is appropriate, enforceable, achievable, and that focuses effort on reducing the actual risk of illness.

The Task Force met regularly from 2003 to 2011 to evaluate key issues related to beneficial use designations and appropriate water quality objectives for water contact recreation, including definitions of body contact recreation and non-contact recreation, science underlying the use of bacteria as pathogen indicators, statistical risk bases for setting indicator objectives, channel characteristics associated with recreational uses, and the actual recreational uses that are occurring in the watershed. This deliberation was the most thorough consideration of recreational use standards ever undertaken in California. As part of the Task Force's evaluation to measure the frequency and nature of activity associated with specific waterbodies, digital cameras were installed to record images of the waterbodies at 15-minute intervals. The resulting 275,000 images provided an unprecedented record of the incidence of water contact recreation in a number of representative waterbodies. This information, together with water quality data and a GIS-based assessment of channel characteristics, supported the submission of use attainability analyses justifying the re-designation of beneficial uses in four channels.

The Task Force's recommendations included changing the appropriate indicator to *E.coli* with new geometric mean objectives for that indicator, an agreement on how to address single sample data, and the protection of water designated for non-contact recreation, and a consensus on defining and implementing a strategy for a high-flow suspension of recreational uses during dangerous flood conditions. In addition, the amendments expressly acknowledge the continuing requirement to protect beneficial uses not only at a particular location, but downstream from that location. The amendments address only fresh water and therefore do not affect the standards that apply at ocean beaches.

The amendments will allow local agencies responsible for protecting public health to focus their attention on those areas where recreation actually occurs, thus being more efficient with public resources and likely reducing public health risks. It will be feasible for municipalities to use treatment technologies where needed to protect swimmers without remaining technically out of compliance with basin plan standards.

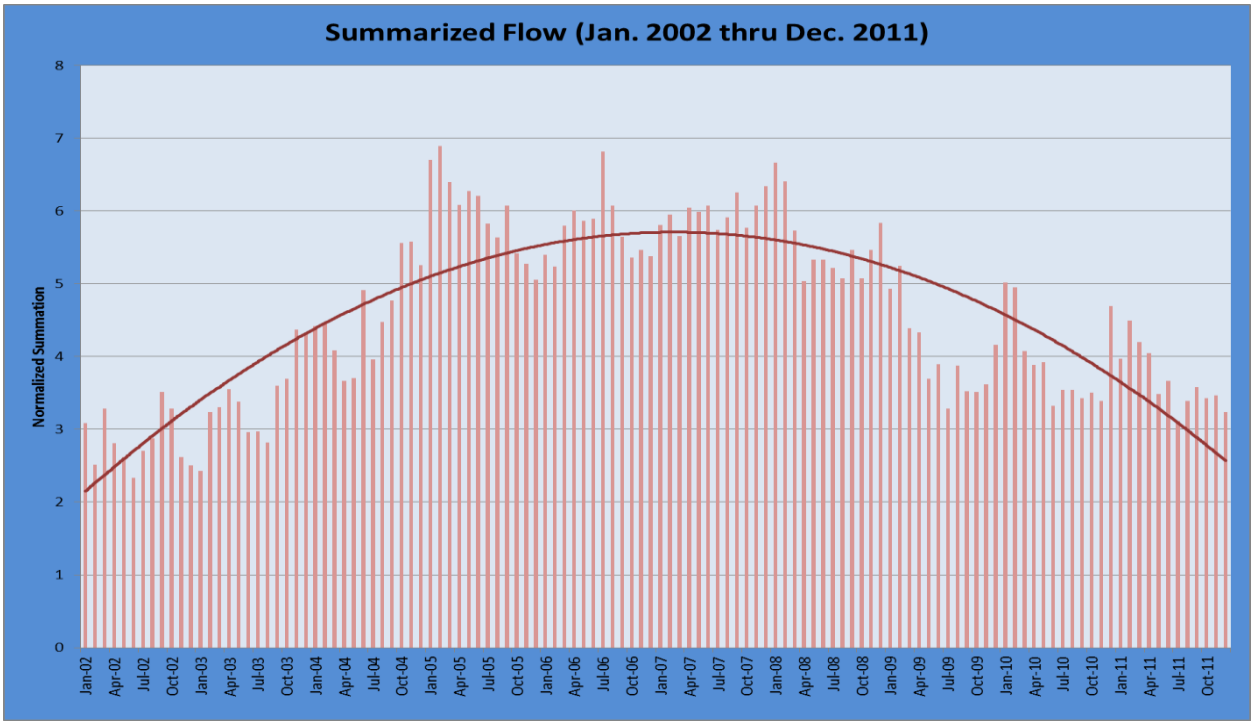
During the long process, the Task Force was adamant about seeking consensus so as to avoid any opposition for its ultimate recommendations and actively sought the involvement of staff from the State Board and the EPA. By the end of 2012, the basin plan amendments recommended by the Task Force were approved by the Regional Board. The Task Force continues to work with the State Board and the EPA to incorporate language changes requested by the EPA.

*Changes in Wastewater Characteristics*

The water reclamation facilities located in the Santa Ana River Watershed are experiencing changes in the influent flows to their facilities due to the depressed economy and heightened focus on water use efficiencies. Because of these changes, the Santa Ana River Dischargers Association (SARDA) compiled their respective wastewater quality data to determine if there have been any changes in the wastewater quality influents. The preliminary evaluations of the wastewater quality have indicated an increase of total suspended solids (TSS) and biological oxygen demand (BOD) in the influent quality. Though not yet conclusive, the data presented below indicates that flows are decreasing and wastewater quality is changing.

Influent flow data from the water reclamation facilities indicate flow rates increased until approximately 2007, then declined. **Figure 5.5-5** shows a normalized summation of the total flow from 16 facilities located in the watershed. The figure is a normalized set of values for each month data point with each facility having the same weighted value no matter the volume of flow. As shown, the summarized influent flow displays a bell-shaped curve with the peak around January 2007.

**Figure 5.5-5 Normalized Summation of Total Flow from Sixteen Facilities Located in the Watershed**



A hypothesis was considered that water use efficiency efforts would cause an increase in influent TSS and BOD. Ten years of data from eight water reclamation plants was compiled and graphed for trending purposes. **Figure 5.5-6** and **Figure 5.5-7** represent the influent water quality results for TSS and BOD, respectively. Both figures indicate an increasing trend in concentration of TSS and BOD for the Santa Ana River Watershed water reclamation facilities since 2002. The influent BOD concentrations displayed more consistent increases than TSS, and thus appear amenable to linear interpretation. In comparison to the influent flow data in **Figure 5.5-5** for the same facilities, both the influent TSS and BOD appear to be uninfluenced by the influent flow. That is, the influent flow data presented a "bell" shaped curve, while the TSS and BOD displayed a more increasing linear line over the same time period. The hypothesis that water use efficiency strategies may increase influent TSS and BOD is a plausible conclusion.

**Figure 5.5-6 Influent Water Quality Results for TSS**

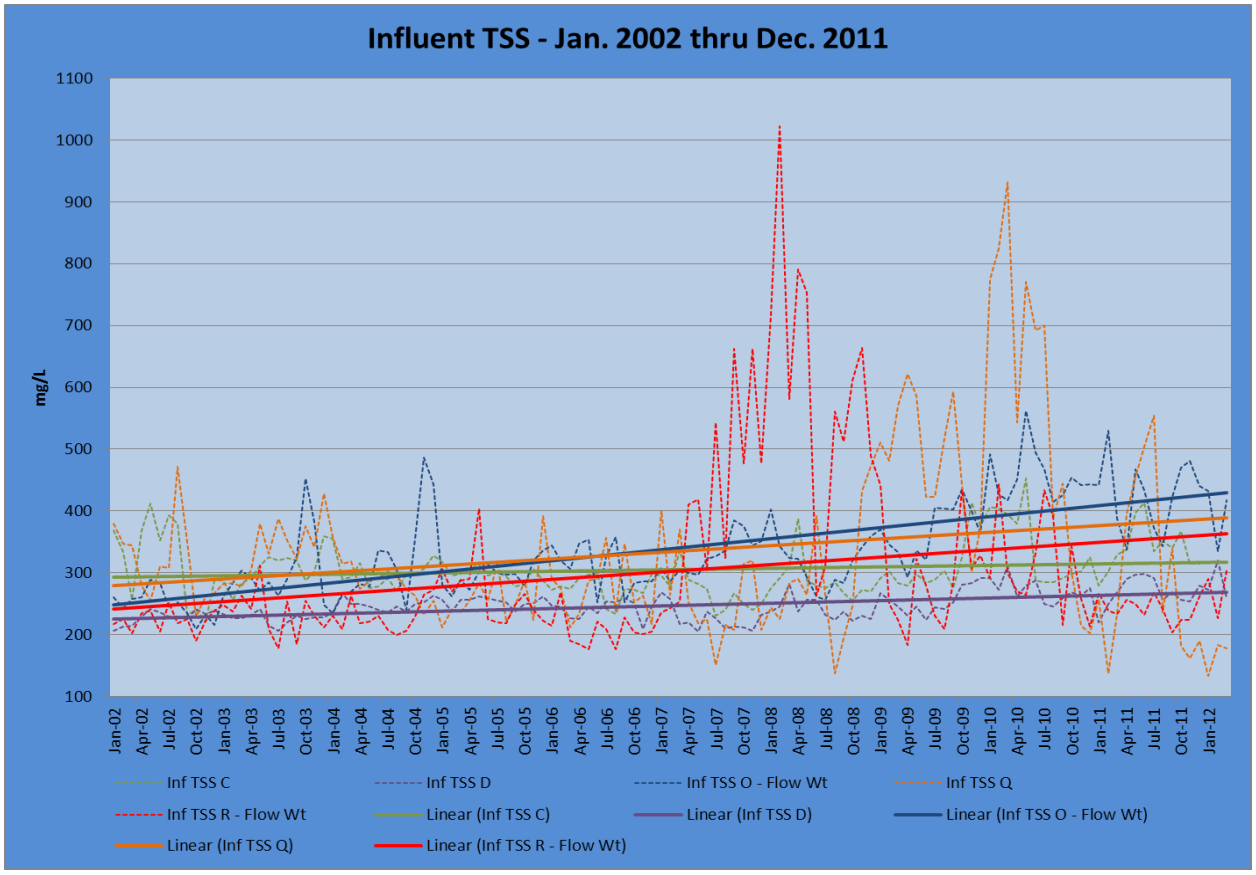
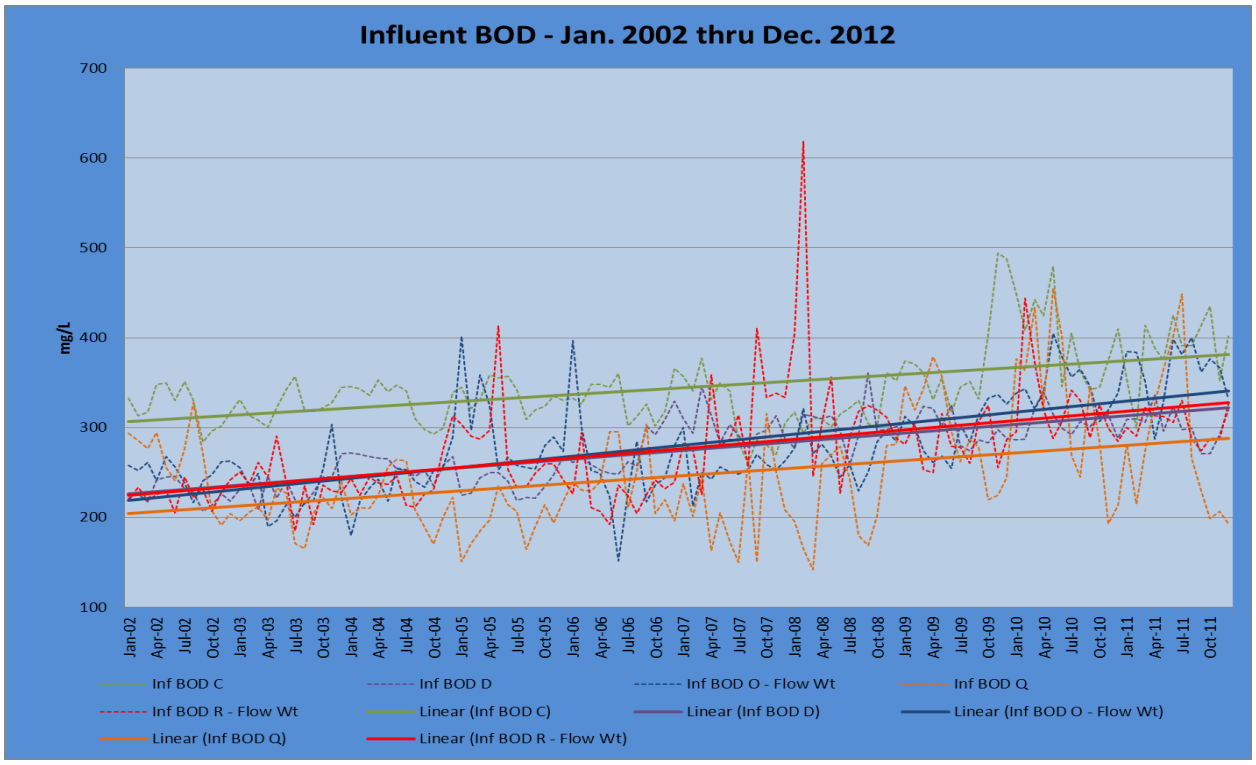


**Figure 5.5-7 Influent Water Quality Results for BOD**




Based on these preliminary results showing a consistent trend in wastewater quality for the SARDA facilities, further evaluations may need to be done. BOD and TSS are only two of the key constituents to measure the strength of the influent. There are other constituents that may also be upward trending such as total dissolved solids (TDS) and nutrients. TDS is a concern because the wastewater plants do not effectively reduce TDS, and these changes may affect compliance with the discharge permits. Further evaluation will help agencies to better understand any potential impact to their facilities and these findings can be incorporated into water reclamation facility design and management.

## Proposed New Water Quality Criteria for Nutrients and Biological Objectives

There are two efforts led by the State Board to develop new water quality criteria for nutrients and biological objectives. The intent of the water quality criteria is to protect aquatic systems. Presently, the State Board uses either narrative or numeric standards that have been identified in the Regional Board's Basin Plan for these aquatic systems. These standards then become NPDES permit limitations. The regulators recognize the complexity of aquatic systems and are attempting to include other indicators of adverse impacts rather than exclusively using chemical, physical, and toxicological thresholds. To add to this complexity it is understood that aquatic systems do not behave similarly. Therefore, site specific indicators may be required. The outcome of the State Board's effort will translate into revised NPDES permit limits and therefore these regulations need to be followed closely to ensure that the proposed criteria will be practicable. Brief descriptions of the two efforts underway are described in the following page.

### *Nutrient Criteria*

EPA has committed to the development of nutrient criteria and knowing the complexity of the aquatic systems and that they vary significantly across the country, EPA has delegated this effort to the States. California has been evaluating nutrient criteria models for several years. The State Board determined that the nutrient criteria framework needs to contain, in addition, to nutrient concentrations, targeting information on secondary biological indicators such as benthic algal biomass, planktonic chlorophyll, dissolved oxygen, dissolved organic carbon, macrophyte cover, and clarity. These secondary indicators provide a more direct risk-based linkage to beneficial uses than the nutrient concentrations alone.

The State Board has evaluated a model called the California Numeric Nutrient Endpoint (NNE) approach. This approach classifies the waterbodies based on three beneficial use risk categories, where Category I is not expected to exhibit impairment, Category II is in an intermediate range, where additional information and analysis may be needed to determine if a use is supported, threatened, or impaired, and Category III has a probable risk of impairment due to the presence of nutrients. Based on the site specific characteristics and secondary indicators, the NNE model will calculate a nutrient water quality objective for the water body. The State Board has pilot tested this approach and has learned that the development of nutrient criteria suggests that no one approach will be suitable for all diverse waterbodies within California. However, the State Board further recognizes that the NNE and its risk based approach will provide solutions to many of the issues that need to be addressed in setting numeric nutrient endpoints in California.

### *Biological Objectives*

The State Board is proposing a statewide biological objectives policy for perennial wadeable streams. The policy will address the need for statewide consistent, enforceable, and scientifically rigorous tools for evaluating aquatic life use attainment in these waterbodies. Most of the State Board's waterbodies have one or more aquatic beneficial uses assigned to them, therefore this policy will affect the streams with beneficial use designations of warm water habitat, cold water habitat, marine or estuarine habitat, migration, spawning, wetland habitat, wildlife habitat, and preservation of rare, threatened, or endangered species. Currently, the biological indicators in most of the Regional Board Basin Plans are narrative and are therefore not enforceable.

The State Board is writing a policy and developing the tools to assess aquatic life uses in the perennial wadeable streams. In addition, the State Board will supply consistent, statewide guidance for establishing biological targets for restorations, permits, and other regulatory actions. The State Board believes that this policy will maximize the efficiency of the extensive pool of bio-assessment data now available in California by producing objectives that are applicable to the greatest number of waterbodies possible in the State. And it reduces the expenditures of time and resources that are necessary to evaluate aquatic life uses on a case by case basis.

### *Regional Solutions for MS4 Stormwater Management*

Regulators and watershed stakeholders agree that stormwater is a valuable resource for the region and that increased capture of stormwater will be an increasingly important component of the region's local water supply. Currently, MS4 permit compliance[1] is focused on integrating BMPs such as vegetated swales, meandering linear parks, and rain gardens into local permits. Two alternative compliance provisions, regional infiltration facilities and in-lieu fee programs, can complement BMPs and offer greater opportunities to transform stormwater into long-term, sustainable groundwater supplies. Interestingly, some of the obstacles to developing regional infiltration projects and in-lieu programs lie within the MS4 permits. For example, one of the requirements is that a regional facility, which may be on a separate construction timeline, must be fully operational once the development is completed. Another challenge is that some projects require costly evaluations to determine that a site is not suitable for infiltration so that alternative approaches can be incorporated into the project. And, although in-lieu payments are included as an option, a preliminary program has yet to be developed.

However, the greatest benefits will be realized when regulations and programs strike a balance between requiring on-site BMPs and utilizing alternative compliance approaches, which improve surface water quality, maximize beneficial use of stormwater for water supply, and protect groundwater quality;progress is being made in these areas. Riverside and San Bernardino Counties have completed the first phase of their Watershed Action Plans. These are interactive online programs that will provide tools to locate an individual parcel, outline potential site constraints that may limit use of certain BMPs, and identify potential future sites for regional infiltration facilities. A similar program has been developed by the County of Orange, the *Coyote Creek Watershed Infiltration and Hydromodification Management Plan*, and is the first in a series of sub-watershed plans that has been finalized.

## Existing Management Plans

A variety of water quality management plans have been prepared within the watershed. This section discusses existing plans.

### *Upper Santa Ana River Watershed Sub-Regional IRWMP (November 2007)*

The upper Santa Ana River Water Resources Association members, lead by the San Bernardino Valley Municipal Water District (Valley District), prepared the upper Santa Ana River Watershed IRWMP to address water management issues in the upper Santa Ana River Watershed. This plan aims to evaluate water management opportunities, improve water supply reliability, reduce dependence on and optimize the use of imported water, and assist local agencies to optimize management and protection of water resources in the region. This plan's objectives include improving surface and groundwater management, water supply reliability, the quality of surface water and groundwater resources, and ecosystem and environmental restoration. This plan was funded in part by the State of California Proposition 50 IRWMP Planning Grant and by local funding sources.

[1] MS4 permits: Municipal Separate Storm and Sewer System permits issued by Regional Water Quality Control Boards to municipalities. The permits regulate the discharge of stormwater into county and municipal storm drains and other surface waters.

*Western Municipal Water District Sub-Regional IRWMP (October 2006)*

Western Municipal Water District prepared their IRWMP to evaluate water management alternatives, address long range water supply planning to meet future demands, and increase system reliability as the amount of available supply of imported water becomes less certain. This plan was funded in part by the State of California Proposition 50 IRWMP Planning Grant and by local funding sources.

This IRWMP identifies and evaluates management strategies that aim to increase local water supplies and to address local and regional water quality concerns. The report focuses predominately on projects that result in an increase in available local water supplies. Projects were ranked with an emphasis on those with regional benefits and based on total percent of demand met. A plan for water conservation also was included.

*San Jacinto River Sub-Regional IRWMP (December 2007)*

Water resources in the SJR Watershed are particularly important due to high demand from urban, agricultural, and recreational users. The nutrient TMDL for Canyon Lake and Lake Elsinore, as well as NPDES stormwater permits are regulatory drivers for improved management of water resources. The IRWMP area consists of the SJR Hydrologic Unit. Most of the watershed falls within Riverside County; with only a small portion extending into Orange County. The SJR, Salt Creek, Perris Valley Storm Drain, Mystic Lake, Perris Reservoir, Canyon Lake, and Lake Elsinore are the dominant hydrologic features in the watershed. Through a collaborative process, the SJR IRWMP was developed and led by the San Jacinto River Watershed Council (SJRWC) with financial assistance from the State of California Proposition 50 Grant and in-kind support and input from a number of member and partnering agencies.

*Chino Creek Integrated Plan (2006)*

The Chino Creek Integrated Plan was prepared by a broad stakeholder group and administered by the Inland Empire Utilities Agency (IEUA). This plan focuses attention on the lower Chino Creek area as a step in the process of preserving and restoring the Prado Basin. IEUA, with a grant from State Board, technical support from OCWD, and funding from the City of Chino, worked with stakeholders over the course of four years to prepare the plan.

Integrated Plan goals were identified as implementable, multi-barrier strategies aimed at reducing pollutants and providing multi-purpose opportunities such as constructing treatment wetlands and natural flood control technologies. Recommended projects identified in the Integrated Plan aim to create recreational linkages, provide public education, develop sustainable development projects for the built environment, preserve habitat, and environmental restoration.

*North Orange County Watershed Management Area Sub-Regional IRWMP*

With a wide range of stakeholders, the County of Orange has completed the North Orange County Watershed Management Area (WMA) IRWMP. This IRWMP will be used to guide watershed management programs and support the region in pursuing funding opportunities. The plan's objectives will include:

- Protecting and enhancing water quality in the region, including current and planned TMDLs
- Enhancing local water supplies
- Promoting flood management

- Enhancing wetlands
- Addressing runoff and its related impacts from existing and future and uses
- Enhancing public education programs
- Reducing invasive species and enhance habitat
- Promoting environmental justice

### *Coyote Creek Watershed Management Plan (January 2007)*

The Coyote Creek Watershed Management Plan provides a blueprint for improving the health of the watershed through multi-objective projects, policies, and site design guidelines. Rather than focusing on the ecological problems that have resulted from piecemeal management of land and water resources, it serves as a user guide on how to improve the management of the watershed for maximum social, economic, and environmental benefit.

### *Central Orange County Sub-Regional IRWMP (COC IRWMP)*

The County of Orange led the first IRWM effort for the Central Orange County Watershed Management Area (WMA), which culminated in the production of the Phase I Central Orange County IRWM Plan (IRWMP). The Phase I IRWMP was undertaken to provide a bridge between existing and developing watershed planning efforts, allowing for more effective collaboration and greater opportunity to leverage agency resources across jurisdictions. It had a strong emphasis on the sensitive coastal resources, ASBS and Critical Coastal Areas (CCAs) that are located within the Central Orange County WMA. The Phase I IRWMP was also developed to meet Proposition 50 priorities. The Phase I IRWMP was integral to subsequent watershed planning efforts led by the City of Newport Beach.

In January 2006, the City of Newport Beach was awarded a planning grant by the State Board through Proposition 40 for preparation of an Integrated Coastal Watershed Management Plan (ICWMP) to address area of biological significance (ASBS) and CCA issues along Newport Coast. Much of the material in the Phase I Central Orange County IRWMP was used during the preparation of the ICWMP. In May 2006, the City of Newport Beach was awarded a second planning grant by the DWR through Proposition 50 for the preparation of an IRWMP for the Newport Bay Watershed including data collection, analysis, and formulation of policy and guidelines. Though building on some new elements, this Phase II effort incorporated the Phase I Central Orange County IRWMP.

The County of Orange completed Phase III of the Central Orange County IRWMP. Phase III is a compilation and revision of the first two IRWMPs; the information contained in the Phase I and Phase II was used to form the basis of the Phase III plan. The purpose of the Central Orange County IRWM Plan is to provide a local plan that bridges the gap between existing and developing watershed planning efforts, allowing for more effective collaboration and greater opportunity to leverage agency resources across jurisdictions.

Extensive water resource program development and implementation has occurred in this region over the past three decades, with agency partnerships, agreements, and the formation of a formal stakeholder involvement structure. The water quality issues are daunting; within this region there are eight waterbody segments listed on the State Board 2010 Section 303(d) list and there are five TMDLs for nutrients, fecal coliform, sediment, toxics, and organophosphate pesticides, with more TMDLs

pending. Water quality has been the overarching issue that has brought the water resource and land use agencies, environmental groups, and other stakeholders within the region together in the spirit of collaboration. Public agencies and private interests have entered into numerous cooperative agreements to leverage financial resources for the development of programs that implement studies, best management practices (BMPs), and other control measures consistent with regulatory requirements and regional goals for watershed conditions. These water quality-related projects and programs have not been undertaken with a narrow focus or single purpose; the stakeholders within this region, both public and private, understand the nexus between growth, land use decisions, water resource management, and watershed impacts.

This region has experienced significant population growth over the past 20 years, with development of former agricultural lands and expansion in the established urban areas. In addition to addressing water quality issues, the water and wastewater agencies have established partnerships to develop local resources, including groundwater and recycled water, to ensure a reliable source of water supply and to minimize the need for imported water. Public agencies and private entities have implemented a broad range of multi-purpose projects and programs to protect and enhance watershed conditions. The IRWMPbuilds on this history of successful collaboration and furthers the interests of the stakeholders through this integrated planning approach.

## Groundwater

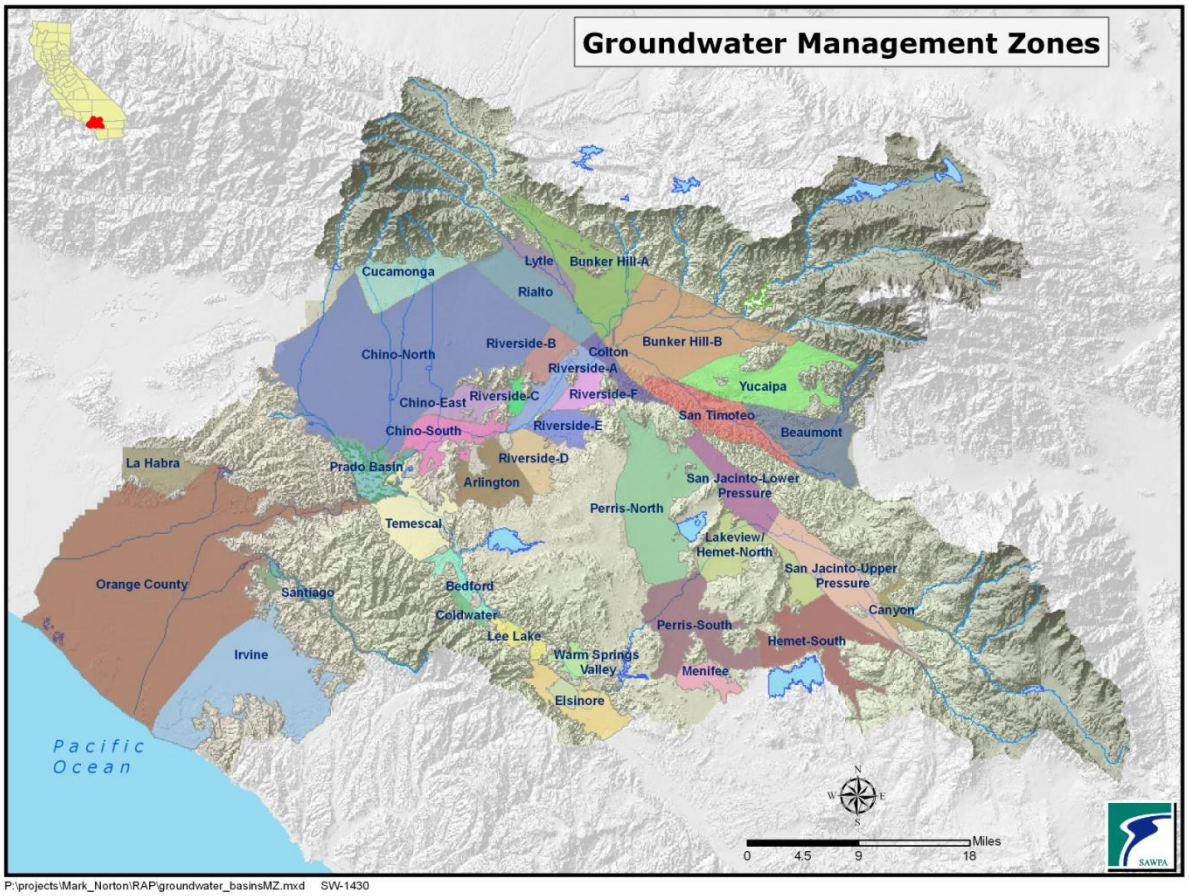
Groundwater is a major source of water supply in the watershed. Protection of this source is critical to maintain the viability of local water supplies. The Basin Plan identifies 39 groundwater management zones in the Santa Ana River Watershed as shown in **Figure 5.5-8**.
Basin Plan amendments that were approved by the Regional Board in 2004, provide a comprehensive, watershed approach to controlling nitrogen and TDS in the watershed, while also encouraging water recycling and reuse.

This section describes the TDS and nitrate-nitrogen WQOs and current ambient water quality. Ambient water quality, as defined here, is based on the 20-year period ending in 2009. Where the ambient water quality is better than the WQO, this increment is referred to as the assimilative capacity.

All but five groundwater management zones in the watershed have TDS and nitrate WQOs identified in the Basin Plan. The five that were not identified had insufficient data to establish TDS and nitrate WQOs. In this discussion, the groundwater management zones are grouped as follows:

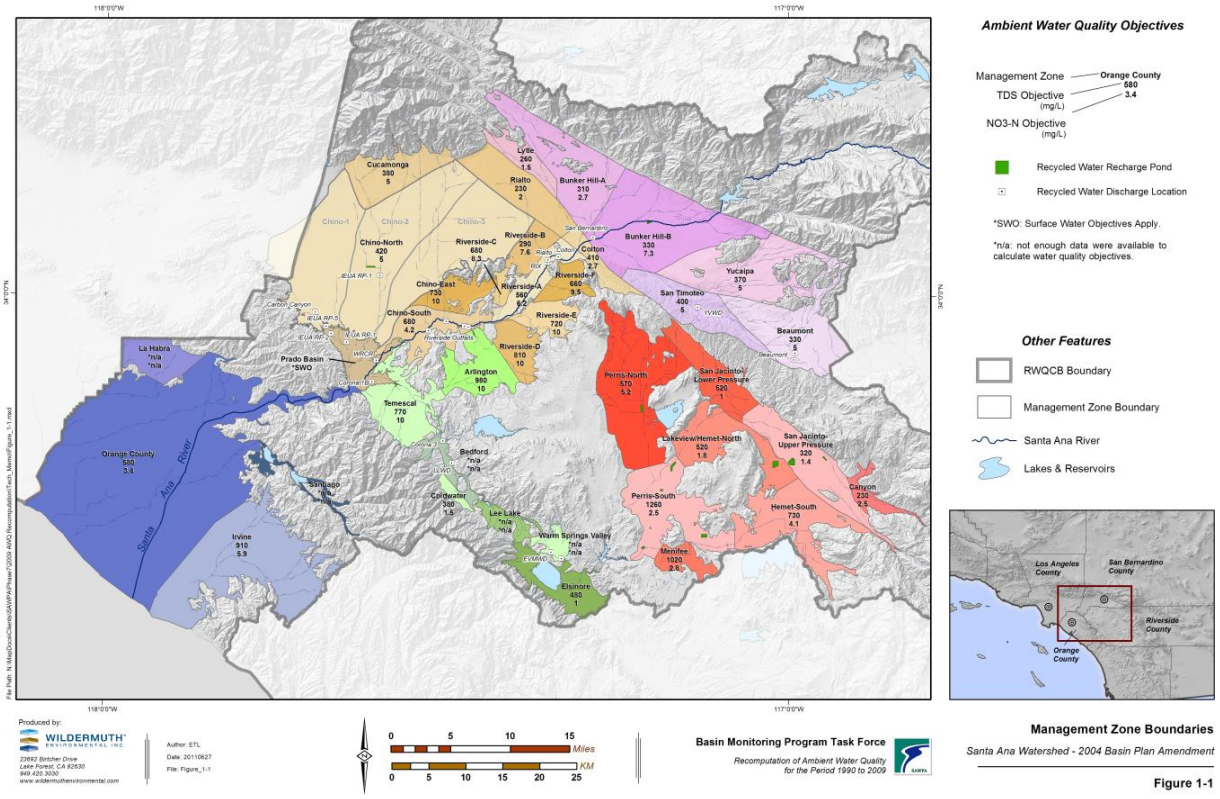
- Upper Santa Ana River Basin
- Chino Basin
- Middle Santa Ana River Basin
- San Jacinto River Basin
- Lower Santa Ana River Basin
- San Jacinto River Basin
- Lower Santa Ana River Basin

**Figure 5.5-8 Santa Ana River Watershed: Groundwater Management Zones**




The Basin Plan requires that concentrations of TDS and nitrate in each groundwater management zone be estimated every three years. These ambient conditions are compared to the WQOs to determine the amount of assimilative capacity in each zone. In areas where there is no assimilative capacity, the Regional Board will not permit waste discharges that degrade water quality. **Figure 5.5-9** shows the ambient WQOs for TDS and nitrates in groundwater management zones. Ambient water quality for the years 1990-2009 for nitrates is shown in **Figure 5.5-10** and for TDS in **Figure 5.5-11**.

**Figure 5.5-9 Ambient Water Quality Objectives**




## *Current Conditions*

High salt and nitrate concentrations are two long-standing groundwater quality issues in the SARW. Sources of elevated levels include mineral content in the sediments, recharge and drainage patterns, source water quality, irrigation, wastewater discharges, and historic land use. Managing levels of TDS in groundwater basins is a significant challenge as the recycling of waste water increases in the watershed. Each cycle of residential water use typically adds approximately 200 mg/L of salt to the water. Industrial and commercial operations may contribute higher levels. Construction and use of salinity management facilities, such as brine lines and desalters, are being used to prevent salt-build up and to remediate high TDS groundwater basins.

**Figure 5.5-10 Ambient Water Quality Objectives 1990-2009 - Nitrates**

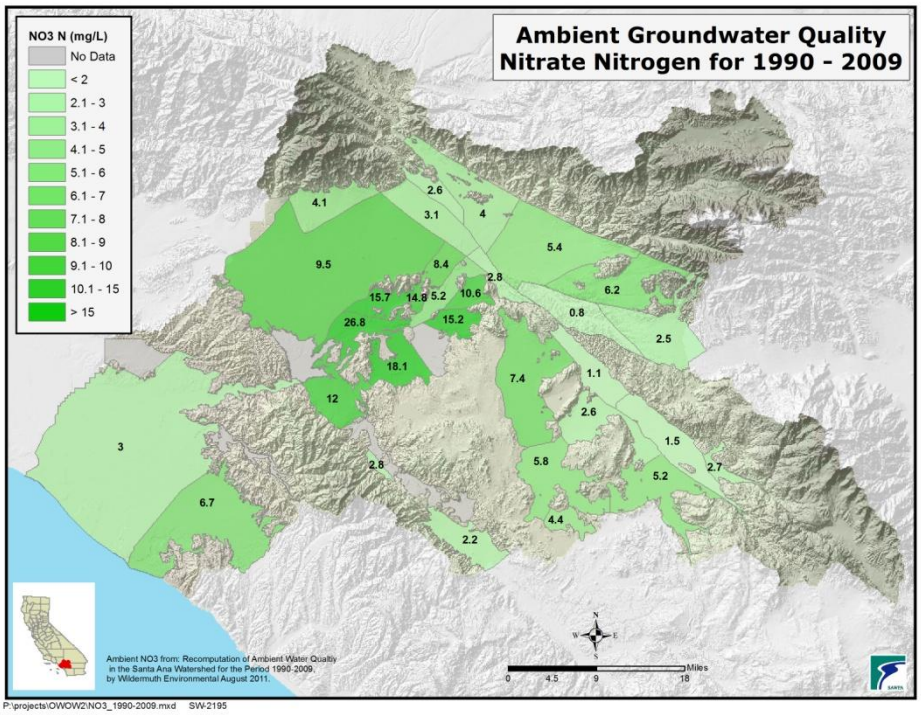
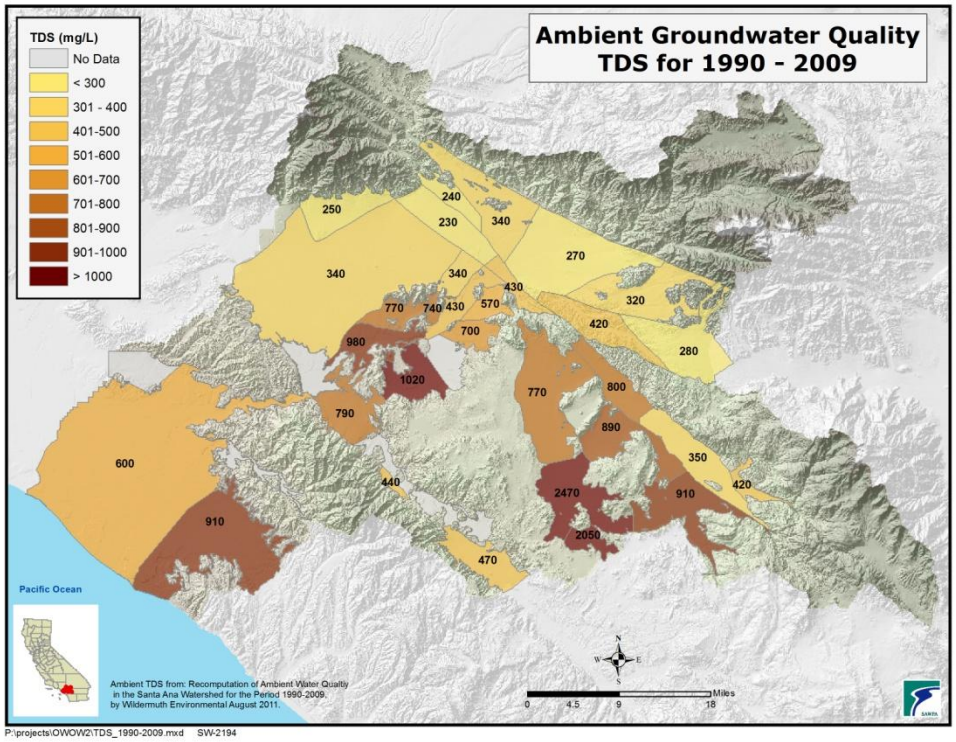
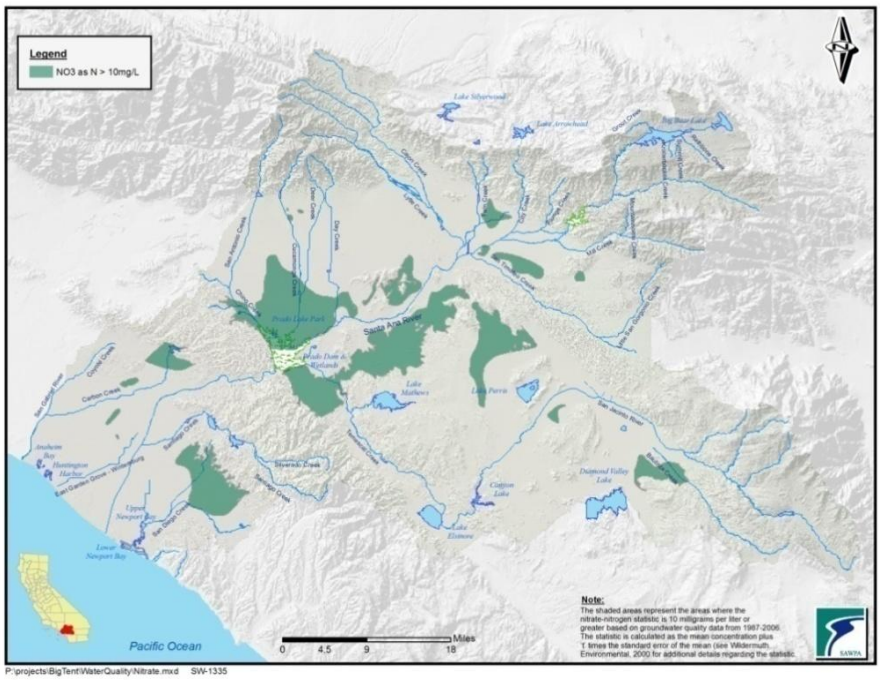



**Figure 5.5-11 Ambient Water Quality Objectives 1990-2009 – TDS**



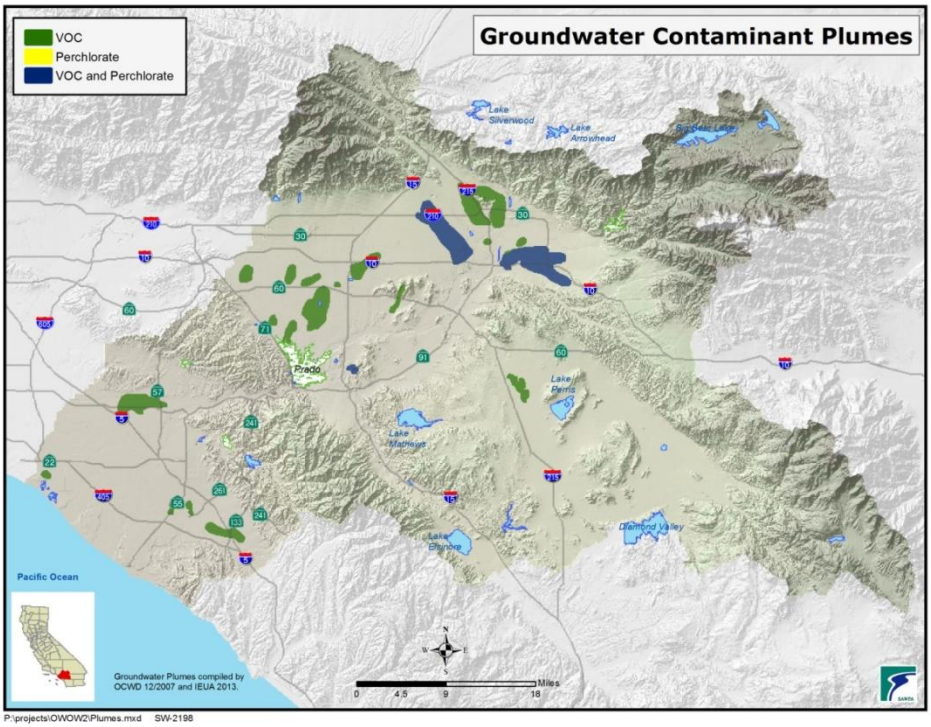
Elevated levels of nitrates in groundwater originate primarily from use of fertilizers, confined animal feedlots, and waste water treatment facilities. Areas with elevated nitrates (nitrate-nitrogen greater than the Maximum Contaminant Levels (MCL) of 10 mg/L, using the ambient water quality statistics) in groundwater are shown in **Figure 5.5-12**.

**Figure 5.5-12 Groundwater with Elevated Nitrate Levels**




Approximately 25 years ago, volatile organic compounds (VOCs) were discovered in groundwater in some areas. More recently, contamination due to perchlorate has become a major concern in some portions of the watershed. Areas with groundwater contamination above the primary MCLs for VOCs and perchlorate are shown in **Figure 5.5-13**.

**Figure 5.5-13 Groundwater Contamination Plumes**




## Upper Santa Ana River Basin

The upper Santa Ana River Basin is divided into seven management zones. TDS and nitrate WQOs and current ambient water quality levels are summarized in **Table 5.5-20**.

In the Bunker Hill management zones, the largest area of groundwater contamination is the Newmark Superfund Site. Treatment plants are operating to remove VOC contamination. A total of 13 extraction wells produce on average approximately 26,000 AFY, which is treated at the four treatment plants.

In the Bunker Hill B management zone, a six-mile long plume of VOC and ammonium perchlorate contamination, known as the Crafton-Redlands Plume, was first detected in the early 1980's. Approximately 46 drinking water wells have been affected. A number of well head treatment units and treatment plants to remove these contaminants are being operated by the Cities of Redlands, Loma Linda and Riverside.

Cherry Valley is an unincorporated area located northeast of the City of Beaumont, in the Beaumont management zone. The community is not served by a sanitary sewer system. The only source of drinking water for the community is the groundwater. A study commissioned by the San Timoteo Watershed Management Authority indicated an ongoing degradation of the quality of the groundwater due to nitrate. The source of the nitrate was attributed to the onsite waste treatment systems, *i.e.*, septic systems.

**Table 5.5-20 Water Quality Objectives for Upper Santa Ana River Basins**

| Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Big Bear Valley | 300 | NA | 5.0 | NA |
| Beaumont | 330 | 280 | 5.0 | 2.5 |
| Bunker Hill A | 310 | 340 | 2.7 | 4.0 |
| Bunker Hill B | 330 | 270 | 7.3 | 5.4 |
| Lytle | 260 | 240 | 1.5 | 2.6 |
| San Timoteo | 400 | *420* | 5.0 | 0.8 |
| Yucaipa | 370 | 320 | 5.0 | 6.2 |

Source: Wildermuth Environmental (2011)

Note: Current ambient water quality computations for the San Timoteo management zone were not made during this study. These values were published in *Preliminary Assessment of Assimilative Capacity*

The County of Riverside has adopted three ordinances to ban new septic systems unless the systems are designed to remove 50 percent of the nitrogen in the discharged wastewater. Beaumont Cherry Valley Water District is in the process of providing sewer service to a major portion of the area and has applied for State Revolving Fund loans for the project.

## Chino Basin, Cucamonga, and Rialto Management Zones

The Chino Basin is divided into three management zones. This section covers these three zones, and the adjacent Cucamonga, Colton, and Rialto management zones. The Basin Plan established "maximum benefit" and "anti-degradation" TDS and TIN water quality for the Chino and Cucamonga management zones as summarized in **Table 5.5-21**.

**Table 5.5-21 Water Quality Objectives for Chino Basin and Rialto**

| Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Chino North | 420 | 340 | 5.0 | 9.5 |
| Chino East | 730 | 770 | 10.0 | 15.7 |
| Chino South | 680 | 980 | 4.2 | 26.8 |
| Colton | 410 | 430 | 2.7 | 2.8 |
| Cucamonga | 380 | 250 | 5.0 | 4.1 |
| Rialto | 230 | 230 | 2.0 | 3.1 |

Source: Wildermuth Environmental (2011)

The Chino Basin is experiencing rapid commercial and residential development. The groundwater quality in the basin is generally good, with better groundwater quality found in the northern portion where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of the Basin. Between 2001 and 2006, about 80 percent of the private wells south of Highway 60 had nitrate concentrations greater than the MCL. Pollution from point sources and emerging contaminants are concerns for the overall groundwater quality in Chino Basin. Constituents that have the potential to impact groundwater quality include VOCs, arsenic, nitrates, and perchlorate.

Groundwater in several areas is impacted by elevated levels of perchlorate. Sources of perchlorate include the Stringfellow Acid Pits, Chilean nitrate fertilizer that was imported in the early 1900s for the citrus industry, and other manmade sources such as ammunition manufacturing.

**Newmark Cleanup Restores Groundwater Supplies**

In 1980, the California Department of Health Services discovered the chlorinated solvents tetrachloroethylene (PCE) and trichloroethylene (TCE) in several municipal water supply wells in the northern San Bernardino/Muscoy region. Investigations into the extent of contamination led the EPA to place the area on the National Priorities List in 1989. This Superfund site was determined to contain two plumes originating from the same source near the site of a closed World War II Army site: an approximately eight-mile Newmark plume and an approximately six-mile Muscoy plume.

Contamination impacted 25 percent of the municipal water supplies for the City of San Bernardino. In addition, 75 percent of the water supplies for the City of Riverside downgradient of the contamination plume were threatened as were water supplies for the Cities of Colton, Loma Linda, Fontana, and Rialto.

The San Bernardino Municipal Water Department, in cooperation with the EPA, constructed 13 extraction wells to contain the plume and treat the contaminated groundwater. As a result, 12 of the 20 contaminated wells were brought back into operation; clean up operations continue.

Pictured below is a façade house built around one of the extraction wells.



EPA Well 111 with façade house.

In the Rialto management zone, at least 20 wells providing 40,135 gallons per minute (gpm) of domestic water supply capacity to the Cities of Rialto and Colton, West Valley Water District and Fontana Water Company have been contaminated by perchlorate. Well head treatment is operating on 11 of these wells.

Arsenic at levels above the MCL appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not a groundwater issue for Chino Basin, may become so depending on the promulgation of future standards.

**Maximum Benefit Demonstrations in Santa Ana River Watershed**

A successful template for groundwater quality management is the maximum benefit demonstration utilized in the Chino, Beaumont/Yucaipa, and San Jacinto basins. Stakeholders collaborated with the Regional Board to demonstrate that groundwater quality can be protected not solely based on historical quality (the "antidegradation" objectives). Instead, the Regional Board agreed to "maximum benefit" objectives to protect groundwater quality for the "maximum benefit to the people of the State".

In the Chino, Beaumont/Yucaipa, and San Jacinto basins, local stakeholders proposed programs to implement local cooperative projects, such as groundwater desalination plants, expanded stormwater capture and recharge basins, and comprehensive groundwater management plans in order to protect groundwater basin quality and meet existing and downstream beneficial uses. Through an aggressive series of monitoring requirements, the State will be able to assure that water quality is protected. The antidegradation objectives are defined as the default condition if the commitments made to protect water quality are not attained. The success of this multi-agency approach to maximize the use of water resources while protecting water quality as defined by the State Board serves as a progressive water management and water quality protection example for other regions in the state, according to the State Board.

## Middle Santa Ana River Basin

The management zones for the Middle Santa Ana River Basin are listed in **Table 5.5-22** and **Table 5.5-23**. Agriculture and dairy activities are suspected to be partially responsible for elevated salt and nitrate concentrations in the groundwater. As the population within the Riverside Basins continues to grow, homes, commercial centers, new industry, and warehouses are replacing agriculture and open space.

Several areas in the Riverside basin are impacted by the presence of nitrate, dibromochloropropane (DBCP), and perchlorate. As such, the City of Riverside has increased monitoring schedules at select production well sites and has implemented blending plans and provided treatment for DBCP removal at its Palmyrita GAC plant.

**Table 5.5-22 Water Quality Objectives for Riverside Basin**

| Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Riverside-A | 560 | 430 | 6.2 | 5.2 |
| Riverside-B | 290 | 340 | 7.6 | 8.4 |
| Riverside-C | 680 | 740 | 8.3 | 14.8 |
| Riverside-D | 810 | NA | 10.0 | NA |
| Riverside-E | 720 | 700 | 10.0 | 15.2 |
| Riverside-F | 660 | 570 | 9.5 | 10.6 |

Source: Wildermuth Environmental (2011)

**Table 5.5-23 Water Quality Objectives for Arlington, Elsinore, Corona Area Groundwater Management Zones**

| Groundwater Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Arlington | 980 | 1020 | 10 | 18.1 |
| Bedford | NA | NA | NA | NA |
| Coldwater | 380 | 440 | 1.5 | 2.8 |
| Elsinore | 480 | 470 | 1.0 | 2.2 |
| Lee Lake | NA | NA | NA | NA |
| Temescal | 770 | 790 | 10.0 | 12.0 |

Source: Wildermuth Environmental (2011)

## San Jacinto River Basin

Agricultural activities in the San Jacinto River Basin are suspected to be partially responsible for elevated salt and nitrate concentrations in the groundwater. Septic tank discharges are creating significant water quality problems that have triggered local agency and the Regional Board's regulatory response in the unincorporated areas of Quail Valley (north of Canyon Lake) and Enchanted Heights (west Perris). The basin is dotted with several other areas believed to be at risk of water quality degradation from septic systems. A septic system management plan has been developed by RCFCWCD.

A Groundwater Salinity Management Program, developed by EMWD, addresses several water quality issues in this area. The Perris South Sub-basin contains a surplus of marginal to unusable quality groundwater that flows into the adjacent high quality Lakeview Sub-basin, rendering several wells unusable and threatening the remaining production of the basin. Due to the unavailability of imported water, blending to improve water quality is not an option. Therefore, three desalination facilities, two

constructed and one being designed, will recover high TDS water in the Menifee and Perris South Groundwater Management Zones for potable use. In addition to providing clean drinking water, the desalters will play a role in reducing the migration of brackish groundwater into areas of good quality groundwater. WQOs are shown in **Table 5.5-24**.

**Table 5.5-24 Water Quality Objectives for San Jacinto River Basins**

| Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Canyon | 230 | 420 | 2.5 | 2.7 |
| Hemet – South | 730 | 910 | 4.1 | 5.2 |
| Lakeview/Hemet-North | 520 | 890 | 1.8 | 2.6 |
| Menifee | 1020 | 2050 | 2.8 | 4.4 |
| Perris – South | 1260 | 2470 | 5.2 | 5.8 |
| Perris – North | 570 | 770 | 2.5 | 7.4 |
| San Jacinto – Lower | 520 | 800 | 1.0 | 1.1 |
| San Jacinto – Upper | 320<br>500* | 350 | 1.4<br>7.0* | 1.5 |

*Maximum Benefit Objectives
Source: Wildermuth Environmental (2008)

## Lower Santa Ana River Basin

The Lower Santa Ana River Basin contains four groundwater management zones: Orange County, Irvine, La Habra, and Santiago. The La Habra and Santiago Management Zones have minimal pumping and TDS and nitrate WQOs have not been established due to the scarcity of data. This section focuses on the Orange County and Irvine Management Zones, which are important sources of water in Orange County.

### *Orange County Groundwater Basin*

The Orange County Groundwater Basin is the source of approximately 70 percent of the water supply for 2.4 million people. Of this total production, about 90 percent meets drinking water standards without treatment. The remaining 10 percent requires treatment for VOCs, salts, or other constituents. WQOs for nitrates and TIN/TDS are listed in **Table 5.5-25**.

A shallow VOC plume exists in the Anaheim/Fullerton area where VOC concentrations exceed MCLs over approximately six square miles. To address this plume, the North Basin Groundwater Protection Project is being constructed to extract and treat VOC contaminated groundwater and recharge treated water back into the groundwater basin. Other VOC plumes exist in Orange, Santa Ana, the Seal Beach Naval Weapons Station, and the now closed Tustin Marine Corps Air Station. Various other sites have generally shallow VOC contamination or other contaminants. The Tustin desalters, using reverse osmosis and ion

exchange, treat high TDS, nitrate, and perchlorate levels in a section of Tustin. Areas in Garden Grove have groundwater with high nitrate concentrations that are likely the result of historic agricultural practices.

**Table 5.5-25 Water Quality Objectives for Lower Santa Ana River Basin Management Zones**

| Management Zone | TDS | | Nitrate-nitrogen | |
|---|---|---|---|---|
| | Water Quality Objective (mg/L) | Ambient Quality (mg/L) | Water Quality Objective (mg/L) | Ambient Quality (mg/L) |
| Orange County | 580 | 600 | 3.4 | 3.0 |
| Irvine | 910 | 910 | 5.9 | 6.7 |
| La Habra | NA | NA | NA | NA |
| Santiago | NA | NA | NA | NA |

Source: Wildermuth Environmental (2008)

### *Irvine Management Zone*

The Irvine Management Zone is a sub-basin of the Orange County Groundwater Basin. Water naturally flows between the boundaries, but the operation of the Irvine Desalter limits movement of water between the two management zones.

Groundwater contaminated with VOCs exceeding MCLs from the now closed El Toro Marine Corps Air Station, also contains high TDS and nitrate concentrations. The Irvine Desalter, using reverse osmosis, air stripping, and carbon absorption, was built to treat the contaminated water. Water treated for VOC contamination is distributed after treatment through the Irvine Ranch Water District non-potable system (irrigation and other non-potable uses); water treated for high TDS and nitrate is distributed through the potable system.

## Current Management Strategies for Groundwater

Three goals are defined for groundwater quality. These goals are:

- Attaining water quality standards
- Meeting drinking water standards
- Achieving salt and nutrient balances

Attaining water standards is a framework identified in the Federal Clean Water Act and its associated regulations, and includes four components:

- Protecting beneficial uses
- Attaining water quality objectives to protect beneficial uses
- Implementing the State and Federal anti-degradation policies
- Executing the Implementation Plan

**Table 5.5-26 Groundwater Quality Goals, Strategies, and Tactics**

| Goals | Strategies | Tactics |
|---|---|---|
| • Water Quality Standards attained<br>• Drinking water standards (DWS) met<br>• Salt and nutrient balance achieved | • Protect good quality groundwater<br>• Clean up poor quality groundwater<br>• Re-evaluate water quality standards where appropriate | • Monitoring, assessment and reporting<br>• Source water protection programs<br>• Pollutant source identification and control<br>• Groundwater treatment<br>Pump and treat for local plumes<br>Wellhead treatment (e.g., for arsenic and perchlorate)<br>Desalters<br>• Brine lines<br>• Recharge of recycled, stormwater and imported water<br>• Research<br>• Public outreach |

Meeting drinking water standards will require the attainment of both maximum contaminant levels for primary drinking water contaminants and secondary drinking water standards. Goals for improving groundwater quality and protecting groundwater supplies also include achieving a salt and nutrient balance. Strategies and tactics to achieve these goals are listed in **Table 5.5-26**. A summary of two of these issues is as follows:

*Matching Water Quality with Water Use*

The possibility of replacing potable water supplies used for landscape irrigation with pumped groundwater containing some contamination should be considered in discussions on improving local water supply reliability. Groundwater may have slightly elevated salinity or nutrient levels or, at the other extreme, may be contaminated with high levels of VOCs, pesticides, and/or perchlorate. In cases of groundwater with low levels of contaminants, use of this water for irrigation could have several benefits beyond reduced use of potable water supplies.

Supplies unsuitable for drinking water that are used for irrigation and carefully managed to allow for infiltration may naturally be purified of some contamination, such as low levels of VOCs and nitrates. Some contaminates also would be absorbed by vegetation. Over time as the water percolates back into aquifers, contamination levels may be reduced naturally.

One example of an approach utilizing groundwater contaminated by nitrates is a cooperative project by the City of Corona and the community of Home Gardens. Home Gardens ceased pumping of nitrate contaminated groundwater because of lack of treatment options. Construction of a pipeline will allow

for groundwater, pumped by Home Gardens, to be conveyed to Corona's Temescal Desalter for treatment and blending. The resulting potable supply will be shared by the two agencies.

A potential new water supply may be to utilize shallow groundwater in Orange County for irrigation. In areas where slightly elevated nitrate levels or low concentrations of VOCs in the shallow aquifer preclude utilizing that supply, development of a clean-up strategy could consider irrigation use as a means to reduce contaminant concentrations and prevent spread of contamination into deeper drinking water aquifers.

Certainly, these projects must be carefully considered for unintended, negative impacts. One such consideration must be the likely increase in TDS of percolated water that would result from using pumped groundwater for irrigation.

### *Hindrances to Groundwater Cleanup Projects*

When it occurs, groundwater contamination is ideally cleaned up by the entity that caused it. In cases where this does not occur, regulatory agencies may be required to force the responsible party to remedy the contamination.

In some situations, the regulatory agencies may not have the resources to investigate contaminated areas and oversee and enforce investigation and cleanup actions, particularly for contamination that has migrated beyond the property where the contamination originally occurred. In these situations, the local water district may desire to implement a cleanup or remediation project to protect local water supplies. The water district may do this at the district's expense and seek cost recovery from the entities that caused the contamination.

Local agencies seeking to cleanup groundwater contamination encounter many hurdles. For example, a groundwater cleanup project proposed by a water district has experienced opposition by potentially responsible parties through legal challenges to California Environmental Quality Act (CEQA) documentation. Additionally, existing laws may not provide adequate legal authority for recovery of the cleanup costs from the entities that caused the contamination.

The issue considered here is the extent to which CEQA challenges can be used to discourage, hinder, and slow down a groundwater cleanup project. Arguably, the groundwater cleanup project is beneficial to the environment, since it benefits water quality and protects drinking water supplies. If the project is not implemented, contamination will continue to spread in the aquifer and the environment would continue to be degraded by continued migration of contamination.

An agency in the watershed received CEQA legal challenge by entities believed to have caused the contamination the project was intended to address. In brief, the project consists of extraction wells, pipelines, a treatment plant, and injection wells to recharge the treated water. The challenge was unsuccessful in court. However, the agency had to expend substantial public funds to defend itself in court. Additionally, the legal challenge can delay project implementation.

Legal challenges have also been a reason for the delay in the implementation of projects. For example, an event occurred in which an agency within the SARW had received a CEQA legal challenge by entities who believed to have caused the contamination of a project that they originally intended to address.

If progress on implementing cleanup projects is hindered, this allows contamination to spread further, threatening even more drinking water supplies. Even if the project is ultimately constructed after legal challenges are addressed, the delays are harmful to the environment.

Consideration should be given to streamlining CEQA to facilitate groundwater cleanup projects implemented by public agencies with powers to manage groundwater. For example, a Statutory Exemption for groundwater cleanup projects, or a streamlined approach to comply with CEQA could be proposed. There is an existing Categorical Exemption that may apply to certain relatively small projects. This Categorical Exemption should be evaluated and the type and size of projects covered under the exemption should be expanded, if appropriate.

## Existing Groundwater Management Plans

### *2005 Regional Groundwater Management Plan*

A Regional Groundwater Management Plan was prepared by SAWPA in 2005. SAWPA is not directly responsible for managing groundwater basins in the watershed. However, the agency coordinates numerous groundwater management planning efforts within the watershed. This plan describes the water and groundwater management plans in the Santa Ana River Watershed.

### *Upper Santa Ana Basin Plans*

In 2005, the Upper Santa Ana Water Resources Association developed an Integrated Regional Groundwater Management Plan (IRGM Plan) to address major water management issues for the communities of the Upper Santa Ana River Watershed. Valley District led the planning effort. The plan developed a process for managing the San Bernardino Basin Area and identified proposed regional projects. The two management objectives were to improve water reliability during drought periods and reduce liquefaction, and to protect water quality and maximize conjunctive use opportunities. Computer models were used to evaluate the various water management strategies.

### *San Jacinto Basin Plans*

The West San Jacinto Groundwater Basin Management Plan was adopted in 1995. Annual reports on the status of groundwater and water resources efforts in the area have been published since 1996. The 2007 Annual Report compiled, reviewed, evaluated, and analyzed 2007 groundwater quality and water level monitoring program data; summarized groundwater-related changes; and reported results of an extraction monitoring program and on the status of previous recommendations.

To the east, the Hemet/San Jacinto Water Management Plan was completed in November 2007 by EMWD, Lake Hemet Municipal Water District, and the Cities of Hemet and San Jacinto to guide and support responsible water management. The plan's objectives include, reducing the historical impact of overdraft caused by past groundwater production, increasing recharge of the groundwater basin, providing for the water rights of the Soboba Tribe, ensuring water supply reliability, providing for planned urban growth, and protecting and enhancing water quality. Options to increase water supply and reliability include developing underutilized sources particularly recycled water and imported water. To accomplish the plan's objectives, the Hemet/San Jacinto Integrated Recharge and Recovery Program is being implemented. This program includes the construction of numerous water supply and

conjunctive use projects such as direct and in-lieu recharge, increased use of recycled water, increased conservation, and improved monitoring.

*Elsinore Valley Municipal Water District, Elsinore Basin Groundwater Management Plan (March 2005)*

The objective of this Groundwater Management Plan (GWMP) is to provide an evaluation of the groundwater basin and develop a reliable groundwater supply to meet drought and dry season demands through the year 2020. This plan addresses the hydrogeologic understanding of the basin, the evaluation of baseline conditions, identification of management issues and strategies, and the definition and evaluation of four alternatives. This document concludes with an implementation plan of the recommended plan. This GWMP was adopted by the Elsinore Valley Municipal Water District Board of Directors on March 24, 2005 under the authority of the Groundwater Management Planning Act (California Water Code Part 2.75, §10753) as amended.

*Chino Basin Watermaster, Optimum Basin Management Plan, State of the Basin Report 2006 (June 2007)*

The Chino Basin Watermaster (CBWM) is the manager of Chino Groundwater Basin. CBWM prepared the Optimum Basin Management Plan which describes the state of the basin in terms of historical groundwater levels, storage, production, water quality, and safe yield. Current and projected water demands and water supply plans are described. The goal of the plan is to develop a groundwater management program that enhances the safe yield and the water quality of the basin, enabling all groundwater users to produce water from the basin in a cost-effective manner. The plan includes a monitoring program for groundwater levels, as well as programs for monitoring well construction, abandonment, and destruction.

*City of Corona, Department of Water and Power, Groundwater Management Plan (June 2008)*

The City of Corona prepared a Groundwater Management Plan for the Temescal, Bedford, and Coldwater sub-basins. The conditions of each groundwater basin were described including groundwater levels, production, and quality. Current and projected water demands and supplies were evaluated. Basin management objectives were determined and management strategies were set. Objectives include to:

- Manage the groundwater basin in a sustainable manner
- Prevent substantial water level declines in the Channel Aquifer
- Protect groundwater quality in the unconfined aquifer
- Maintain required outflow at Prado Dam
- Monitor groundwater levels, quality, and storage

*OCWD Groundwater Management Plan (2009 Update)*

The OCWD prepared the Groundwater Management Plan 2009 Update for the Orange County Groundwater Basin to identify key issues related to groundwater management. The three major objectives are to protect and enhance groundwater quality, to protect and increase the Basin's sustainable yield, and to increase the efficiency of operations. Recommendations in the report to proactively manage the Basin include:

- Monitoring water quality and groundwater levels
- Managing groundwater recharge
- Managing groundwater quality by controlling seawater intrusion, evaluating emerging constituents, and preventing future contamination
- Implementing projects to clean up existing contamination problems
- Preparing an integrated demand and supply program

*WMWD Arlington Basin Groundwater Management Plan (September 2012)*

The goal of this Groundwater Management Plan (GWMP) is to provide a planning framework to operate and manage the groundwater basin in a sustainable manner to ensure a long-term reliable supply for beneficial uses among all stakeholders in the basin.

The purpose of this GWMP, including development of the plan and the plan document itself, is to inform the public of the importance of groundwater to the Arlington Basin and the challenges and opportunities it presents; develop consensus among stakeholders on issues and solutions related to groundwater; build relationships among stakeholders within the Arlington Basin and with local, State, and Federal agencies; and define actions for developing project and management programs to ensure the long-term sustainability of groundwater resources in the Arlington Basin. This GWMP provides action items that, when implemented, are designed to optimize groundwater levels, enhance water quality, and minimize land subsidence.

*RPU Riverside Basin Groundwater Management Plan (October 2012)*

The goal of the Riverside Basin Groundwater Management Plan (GWMP) is to provide a planning framework to operate and manage the groundwater basin in a sustainable manner to ensure a long term reliable supply for beneficial uses among all stakeholders in the basin.

The purpose of this Riverside Basin GWMP, including the development of the plan and the plan document itself, is to inform the public of the importance of groundwater to the Riverside Basin and the challenges and opportunities it presents; develop consensus among stakeholders on issues and solutions related to groundwater; build relationships among stakeholders within the basin and between local, State, and Federal agencies; and define actions for developing project and management programs to ensure the long term sustainability of groundwater resources in the Riverside Basin. This GWMP provides action items that, when implemented, are intended to optimize groundwater levels, enhance water quality, and minimize land subsidence.

## Imported Water Quality

Water agencies in the Santa Ana River Watershed receive imported water from the CRA and the SWP. The majority of this imported supply used by local agencies is received from the Metropolitan. The San Bernardino Valley Municipal Water District and the San Gorgonio Pass Water Agency also provide imported water from the SWP to local agencies within their service areas. The quality of imported water that is used for recharging groundwater directly affects groundwater quality. Since imported water is a significant source of potable water in the region, it affects the quality of discharges from wastewater treatment plants for certain constituents, such as salinity.

CRA and SWP source water is of high quality. This section provides a summary of key water quality constituents within the imported water systems. Source water protection activities aimed at maintaining a safe and reliable imported water supply are described.

## Colorado River

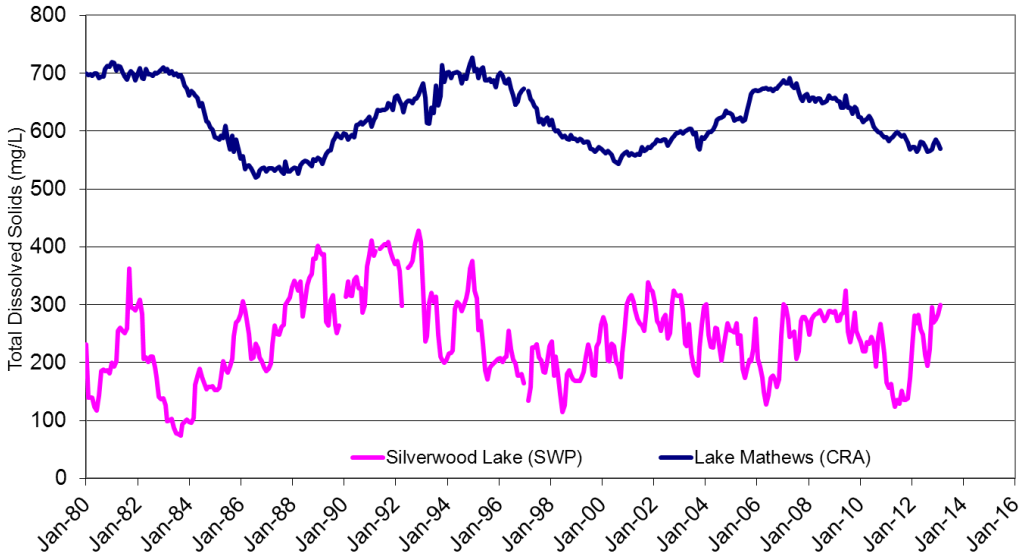
The Colorado River travels approximately 1,400 miles from the Rocky Mountains to its outlet into the Gulf of California in Mexico. The Colorado River Watershed encompasses 242,000 square miles, including portions of seven states–Wyoming, Utah, Colorado, Nevada, New Mexico, Arizona, and California–and portions of Mexico. Several dams and reservoirs along the Colorado River control river flows and Lake Havasu, formed by Parker Dam, serves as the Forebay for Metropolitan's CRA. The CRA, which has a flow capacity of 1,800 cubic feet per second (cfs), spans 242 miles between Whitsett Intake on Lake Havasu and Lake Mathews in Riverside County. The CRA system consists of pumping plants, reservoirs, conveyance infrastructure (i.e., canals, conduits, siphons and tunnels), and an extensive power transmission system. This section describes water quality in the CRA system.

### *Salinity*

Colorado River salinity averages 630 mg/L, with cycles up and down over multiple years based on hydrologic conditions. Salinity changes are gradual over time due to large storage reservoirs along the river such as Lake Mead and Lake Powell. **Figure 5.5-14** shows historical TDS levels at Lake Mathews, the terminal reservoir on the CRA system.

Salinity in the basin is due to both natural sources and anthropogenic activities. Metropolitan's goal is to achieve an annual average salinity concentration of 500 mg/L for treated waters in order to reduce financial impacts to water consumers, impediments to recycling projects, and salt buildup in groundwater basins. This goal has been met primarily by blending Colorado River water with SWP supplies. It is anticipated that there may be periods when this goal cannot be achieved.

**Figure 5.5-14 Imported Water TDS Levels**




### *Nutrients*

Phosphorus is the limiting nutrient for algal growth in the CRA system. Currently there is no regulatory limit for total phosphorus in drinking water. Despite relatively low concentrations (near 0.010 mg/L), any increase can cause algal growth; excessive growth can result in unpleasant taste and odor, filter clogging, organic carbon, and toxins.

Increasing wastewater discharges from the Las Vegas area to Lake Mead may increase nutrient loads in the lower Colorado River system. Metropolitan and other stakeholders work closely with Las Vegas area wastewater agencies who have taken steps to optimize treatment and reduce phosphorus loading.

A large number of septic systems are located near Lake Havasu, the intake for the CRA, and nearby communities have recorded some groundwater well sites with nitrate values well above the MCL. As a result of elevated nitrate levels in groundwater, many communities are converting to centralized wastewater treatment systems. Nitrate levels in recent years at the intake of the CRA have averaged <0.5 mg/L as nitrogen, well below the nitrate MCL of 10 mg/L measured as nitrogen.

### *Perchlorate*

Perchlorate has been detected at low levels in Metropolitan's CRA water supply. In 1997, perchlorate contamination in the Colorado River was traced to Las Vegas Wash, originating from two chemical manufacturing sites in Henderson, Nevada. Under the oversight of the Nevada Division of Environmental Protection, remediation systems were put in place in the late 1990's and since then perchlorate levels in the river have declined. Since 2006, monitoring has typically indicated non-detectable levels (less than 2 µg/L) entering Metropolitan's conveyance system.

### *Uranium*

Uranium is a naturally occurring radioactive element found at low levels in rock, soil, and water. A 16 million-ton pile of uranium tailings from a former uranium mill site near Moab, Utah, lies approximately

750 feet from the Colorado River, approximately 650 miles upstream of the CRA intake at Lake Havasu. Although uranium levels at the intake are much lower than the MCL of 20 pCi/L, averaging 3.2-3.4 pCi/L, there continues to be a looming threat of the tailings being washed directly into the Colorado River during a significant flood or earthquake. This threatens downstream consumers and harms the public's confidence in the safety of this critical water supply. In 2009, the United States Department of Energy began removing the tailings via rail to an engineered disposal cell located 30 miles northwest of the mill tailings pile site. As of April 2013, approximately 5.9 million tons of uranium mill tailings have been removed.

### *Chromium VI*

There is a contaminated groundwater plume located adjacent to the Colorado River near Needles, CA. This plume contains hexavalent chromium (chromium VI), a form of chromium used as an anti-corrosive agent. The chromium VI groundwater plume exists from past waste disposal practices at the Topock Pacific Gas and Electric gas-compressor station. The California Department of Toxic Substances Control is the lead regulatory agency responsible for the investigation and cleanup activities for the site. The project is currently in the design phase and construction is anticipated for completion in 2016. Chromium VI levels in the river downstream of the site have been mostly non-detect (<0.03 µg/L) with an occasional low background level (0.03-0.04 µg/L).

## State Water Project

SWP water originates at Lake Oroville, located on the Feather River, and flows into the Sacramento-San Joaquin Delta from where it is transported through the California Aqueduct to water users in Central and Southern California. The two major sources of freshwater inflow to the Delta are the Sacramento and San Joaquin Rivers which during wet years can exceed flows of 100,000 cfs and 50,000 cfs, respectively. The SWP vastly encompasses the 27,000-square-mile Sacramento River and the 13,000-square-mile San Joaquin River watersheds. Overall, the SWP, which terminates at Lake Perris in Riverside County, consists of a series of pump stations, reservoirs, aqueducts, tunnels, and power plants operated by the DWR. This section describes water quality in the SWP system.

### *Organic Carbon and Bromide*

Total organic carbon (TOC) can originate from decayed plant material and organics from wastewater and urban and agricultural runoff. Seawater intrusion is the primary source of bromide in the Delta and SWP. TOC and bromide in SWP water react with disinfectants during the water treatment process. Some disinfection byproducts are considered carcinogenic and may cause adverse reproductive or developmental effects in animals at very high doses. During the period of record through 2010, TOC levels ranged from <0.1 to 8.4 mg/L and bromide levels ranged from 0.03 to 0.64 mg/L at the intake to the California Aqueduct. Ozone treatment has been added to three of Metropolitan's water treatment plants to reduce the formation of chlorine disinfection byproducts. Metropolitan's other two plants are expected to have ozone treatment online in 2014 and 2016, respectively.

### *Salinity*

Salt in the Sacramento and San Joaquin Rivers originates from natural sources, agricultural discharges, urban runoff and seawater intrusion. Although TDS concentrations in the East Branch of the California Aqueduct averages 250 mg/L, concentrations can vary significantly in response to hydrologic conditions in the Delta watersheds. SWP supplies, significantly lower in TDS concentrations than the Colorado River, are blended with CRA water to reduce the salinity of delivered water. Historical TDS levels at Silverwood Lake, a reservoir along the East Branch of the SWP system, are shown in **Figure 5.5-14**.

### *Nutrients*

Wastewater discharges and agricultural drainage in the Delta are two primary sources of nutrient loading to the SWP. During the reporting period through 2010, nitrate levels along the California Aqueduct ranged from 0.2 to 7.1 mg/L as nitrate and total phosphorus levels ranged from 0.06 to 0.21 mg/L. Although nitrate levels are well below the MCL of 45 mg/L measured as nitrate, they are higher than those found in the Colorado River. Total phosphorus levels in the SWP are also higher than in the Colorado River.

### *Arsenic*

Arsenic is a naturally occurring element found in rocks, soil, water, and air, and is used in certain agricultural applications, wood preservatives, paints, dyes, and soaps. Of all the regulated inorganic chemicals, arsenic is the most problematic in SWP supplies. Groundwater in the Central Valley which can contain higher arsenic concentrations enters the California Aqueduct through water exchange and banking programs. These programs are managed to protect downstream water quality while also meeting supply targets. Routine monitoring between 1997 and 2010 at key SWP locations recorded maximum concentrations of 6 µg/L. Although levels are still below the MCL of 10 µg/L, increasing coagulant dosages during drinking water treatment may be needed to maintain safe levels for delivered water.

## Salinity and Nutrient Management

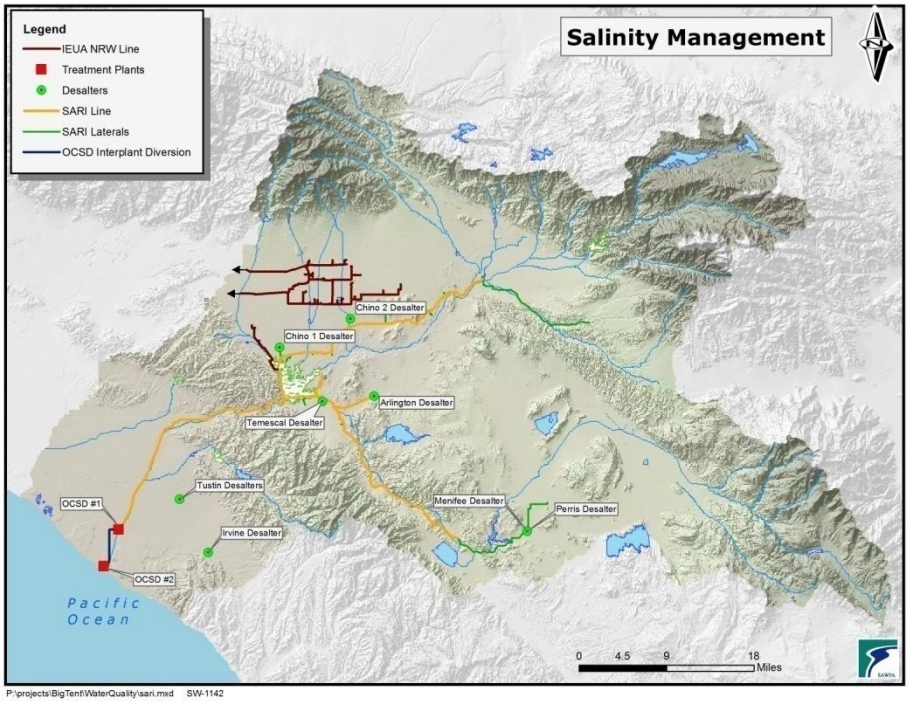
As stated earlier in this report, two of the most serious water quality problems in the Santa Ana River Watershed are the buildup of TDS in surface and groundwater and nitrogen levels. Consideration of potential changes to climate, as discussed in **Appendix F2**, includes prediction of an increase in drought conditions in the watershed. One of the most important impacts this may have to the watershed would be an increase in salinity of water resources. This section discusses on-going efforts aimed at achieving and maintaining a salt balance in the watershed, and efforts to manage nitrogen.

### *Salinity Management Facilities*

The Inland Empire Brine Line (Brine Line), formally known as the Santa Ana Regional Interceptor, was built by SAWPA over a period of 25 years (1975-2000) to collect and transport industrial brine that could not be treated at local (inland) wastewater treatment facilities. The section of the 93-mile-long Brine Line that runs above the Riverside-Orange County line (Reaches IV and V) is owned and operated by SAWPA. Reach IV serves the Cities of Riverside, Chino, and San Bernardino; Reach V lies along the Temescal Wash and terminates near the City of Lake Elsinore. In Orange County, the Brine Line (Reaches I, II, and III) is owned by OCSD.

The Brine Line is used to dispose of brine from groundwater desalters, industrial wastewater high in TDS concentrations, water with high nutrient levels, and other domestic and industrial wastewater. The wastewater is treated at OCSD's treatment plant in Huntington Beach prior to discharge to the ocean. Additional brine lines have been constructed by IEUA and the IRWD. Salinity management facilities in the watershed are shown in **Figure 5.5-15**. These facilities are vital to on-going protection of water quality in the watershed.

**Figure 5.5-15 Santa Ana Region Salinity Management Facilities**




In January 2010, SAWPA completed the Phase 1 Salinity Management Plan Technical Memorandum (CDM 2010), which identifies a significant long-term salt imbalance in the watershed (see **Table 5.5-27**). Despite progress made over the years, through the implementation and operation of the Brine Line, groundwater desalters, and other projects and activities with salt reduction have been a primary goal. Much of the discussion in this section is taken from the Phase 1 Salinity Management Plan Technical Memorandum.

Salinity problems are anticipated to exacerbate if no action is taken, as the import of surface water continues, particularly from the Colorado River Aqueduct, which historically has a TDS concentration of 650 mg/L or more; water reuse increases, effectively increasing the salinity of the recycled water supply if demineralization is not provided; and as industrial and commercial growth continues.

In fact, the Salinity Management Plan projects that the seven groundwater management zones in the watershed modeled will exceed Basin Plan TDS standards in the future, as groundwater extraction and saltier water import continues. Five of the seven management zones have some assimilative capacity that will allow them to meet TDS standards for some years (Beaumont, Bunker Hill-B, Chino-North,

Elsinore, and Yucaipa); while the remaining two already are in excess of TDS standards and thus have no assimilative capacity available (Bunker Hill-A and Temescal).

Future salt removal needs in the Watershed will be driven by four main regulatory limits:

- TDS objectives in the Basin Plan
- EPA secondary MCL for TDS in the potable water supply
- TDS discharge limits in the NPDES permits of POTWs
- TDS concentrations in recycled water that exceed the Basin Plan water quality objectives, thus preventing its use for irrigation or recharge in zones with no assimilative capacity

**TDS Objectives in Basin Plan**: As previously mentioned, two of seven management zones in the watershed have no assimilative capacity, and are already in excess of Basin Plan TDS criteria. For the remaining five, it is anticipated that desalination or other mitigation will be required if and when TDS concentration is within 10 mg/L of the standard. It is anticipated that this condition would occur by 2028 for Beaumont, 2016 for Yucaipa, and 2023 for Chino-North.

**EPA Secondary MCL**: The 500 mg/L secondary MCL may be exceeded in the future if mitigation measures are not taken. Potential measures include desalting, blending, importing lower-salinity water, and capturing and recharging more stormwater upstream of supply wells. According to the Salinity Management Plan, at least eight of 59 management zones in the watershed are anticipated to exceed potable water TDS standards and will require action in the future.

**TDS Discharge from POTWs:** Similar to potable water, the Salinity Management Plan estimates likely exceedances of TDS effluent discharge limits by wastewater treatment plants in the Watershed. Plants exceeding NPDES limits, with TDS effluent concentrations in the 490 to 700 mg/L range, will require actions such as desalinating all or a portion of the effluent. According to these estimates, eight out of 12, POTWs in the region will require action at some point over the next 30 years.

**TDS concentrations in recycled water**: TDS concentration in recycled water is a function of the salinity in the original potable water supply (*i.e.*, imported water and/or groundwater), which drives the salinity of effluent and in any salt reduction actions being taken. As described above, salinity issues are anticipated for groundwater basins, potable water supplies, and eventually wastewater effluent. Desalination of all or a portion of effluent may be required in the future in some areas to allow water recycling.

The Salinity Management Plan describes a number of projects planned or ongoing in the watershed that will address salinity issues. These projects include:

- Yucaipa Valley Water District wastewater desalting and reuse
- City of Riverside water supply and wastewater desalination projects
- Western Municipal Water District and City of Corona water supply projects

- Eastern Municipal Water District groundwater desalter expansion and wastewater desalting and reuse

Even with the implementation of these projects, a gap for salt removal remains. The Salinity Management Plan identifies potential long-term options to address the need for additional salt removal, including:

- Best Management Practices (BMPs)
- Desalters for water supply
- Desalters for wastewater
- Zero liquid discharge/evaporative ponds
- Sanitation Districts of Los Angeles (LACSD) Non-reclaimable wastewater system

**Best management practices**: BMP's include source control measures aimed at reducing salt mass balances that would otherwise be discharged to ground or surface waters, or introduced into the wastewater stream. Examples of BMPs include: eliminating salt-based domestic water softening devices, promoting the use of low-salt detergents, addressing salt runoff, and implementing pre-treatment programs.

**Desalters for water supply**: As previously mentioned, there are some agencies whose blended water supply could slightly exceed the 500 mg/L secondary MCL. Agencies potentially could add additional source water desalination because it is cost effective, or because there are limited alternative supplies.

**Desalters for wastewater**: Similar to potable water, some agencies potentially will exceed TDS effluent discharge limits. Agencies could reduce TDS in their effluent by implementing additional source control programs; reducing TDS of source water, as mentioned above; or adding desalination to all or a portion of their effluent stream. Providing advanced treatment to secondary effluent would also increase the possibility of reusing the effluent, including indirect potable water reuse via groundwater recharge or surface storage augmentation.

**Zero liquid discharge**: Some agencies in the watershed are exploring brine concentration projects to reduce the quantity of flows to the Brine Line, while exporting the same amount of salt but at a higher concentration.

**LACSD non-reclaimable wastewater system**: IEUA owns 60 miles of pipelines used to convey high TDS water to an interceptor owned by LACSD for treatment at Carson Treatment Plant and ocean discharge. Capacity is available (approximately six MGD) for additional brine disposal through this system.

The Salinity Management Plan projects a need for future brine exports in the amount of 35.5 MGD, which is approximately 23 percent greater than the nominal capacity of the SARI. This is equivalent to nearly 271,000 tons of salt per year. This amount does not include 2.27 MGD of domestic wastewater discharges that could potentially be eliminated from the SARI.

**Table 5.5-27 Summary Potential Future Brine Export Needs**

| Project | Salt load (tons/yr) Current/ near term | Future | Total | Brine flow (mgd) Current/ near term | 2010-2015 increase | 2015-2025 increase | Beyond 2025 increase | Total |
|---|---|---|---|---|---|---|---|---|
| Water supply | 131,392 | 38,144 | 169,536 | 10.08 | 0.32 | 5.00 | -- | 15.40 |
| Wastewater and recycled water | 8,760 | 69,170 | 77,930 | 1.20 | 0.80 | 11.55 | 0.00 | 13.55 |
| Unspecified desalting [(1)] | -- | 24,006 | 24,006 | -- | -- | -- | 3.74 | 3.74 |
| Other | | | | | | | | |
| Domestic wastewater | -- | Remove | 0 | 2.27 | 0.00 | Remove (-2.27) | 0.00 | 0.00 |
| Direct industrial connection and waste haulers | -- | -- | 0 | 0.69 | 0.50 | 1.00 | 0.60 | 2.79 |
| **Total** | **140,152** | **131,320** | **271,472** | **14.24** | **1.62** | **15.28** | **4.34** | **35.48** |

The Phase 2 SARI Planning Technical Memorandum (CDM, May 10, 2010), complements the Salinity Management Plan, as well as identified strategies and their associated cost to address the anticipated deficit in the capacity of the Brine Line. Six potential reconfigurations of the Brine Line system were considered:

1. *Baseline*: Continue use of current configuration in which the Brine Line flows to OCSD POTWs prior to ocean discharge.

2a. *Centralized in-line brine minimization*: All water flows are diverted from the Brine Line to a centralized facility with biological treatment and desalination. Concentrate will flow back to the Brine Line, and in turn to OCSD and the ocean.

2b. *Decentralized brine minimization*: Groundwater desalters implement further concentrate management via secondary RO process, thus reducing flows to the Brine Line.

3a. *Direct ocean discharge with brine minimization*: Groundwater desalters implement further concentrate management via secondary RO process, and discharge directly to a new parallel

pipeline to the ocean. Pretreatment will be required for some discharges to keep BOD concentrations below 30 mg/L.

3b. *Direct ocean discharge without brine minimization*: Groundwater desalters discharge brine without further concentration directly to a new parallel pipeline to the ocean. Pretreatment will be required for some discharges to keep BOD concentrations below 30 mg/L.

4. *Salton Sea discharge*: A new 125-mile pipeline from south of Prado Dam to the Salton Sea is built to transport all Brine Line flows, with no treatment at OCSD.

SAWPA prepared the Brine Line Market Analysis (EEC August, 2009) to gain an understanding of how the use of the Brine Line by industry and other brine dischargers could be increased to increase revenue and reduce cost to all users. Several factors impacting the use of the Brine Line were identified, along with potential solutions. SAWPA believes that a stronger marketing effort is needed to convey to potential users the value they will receive from discharging brine to the Brine Line when compared to other alternatives, SAWPA estimates that waste disposal to the Brine Line costs approximately $0.05 per gallon, compared to a cost of $0.25 per gallon of discharging to other alternatives in the Los Angeles basin.

## Colorado River Basin Salinity Control Forum

The Colorado River Basin Salinity Control Forum, established by the Colorado River Basin states in 1973, has developed projects to meet agreed-upon numeric criteria along the lower Colorado River. The Salinity Control Program projects include improving agricultural irrigation practices in the upper Colorado River Basin and reducing salinity from natural sources. The Federal government and Colorado River Basin states, contribute approximately $50 million annually for this effort.

**Basin Monitoring Program Task Force**

On January 22, 2004, the Regional Board approved the Basin Plan Amendment for Nitrogen and TDS. Approximately 20 specific agencies throughout the watershed were charged with the responsibility to conduct several monitoring and analyses programs for nitrogen and TDS. These requirements included the preparation of an annual water quality report for the SAR and a triennial report to determine the ambient water quality (Nitrogen and TDS) in each groundwater management zone. To cost-effectively prepare these reports, a task force, which included the Regional Board, was convened in 2004 with SAWPA as the administrator to conduct the data gathering, consultant support and river analyses programs.

In 2009, the State Board adopted a “Policy for Water Quality Control for Recycled Water” that required the development of salt and nutrient management plans for all groundwater basins in the State. The basin monitoring program approved by the Santa Board in 2004 satisfies the requirements in the State Recycled Water Policy and as such as been determined to be in conformance with that policy.

## Southern California Salinity Coalition

The Southern California Salinity Coalition (SCSC; www.socalsalinity.org) was formed in 2002 to address the critical need to control salinity in water supplies and to protect the water resources in California from increasing salinity. SCSC's purpose is to coordinate salinity management strategies and programs, including research projects, with water and wastewater agencies throughout Southern California. Members of the coalition include major water and sewer districts in San Bernardino, Riverside, Orange, Los Angeles, and San Diego Counties; the National Water Research Institute; and SAWPA. SCSC's objectives are to:

- Establish proactive programs to address the critical need to remove salts from water supplies
- Preserve, sustain, and enhance the quality of source water supplies
- Support economic development
- Help drought-proof the community
- Reach out to the general public on salinity problems

## Future Issues

Due to increased water usage, irrigation and agricultural use, and other activities, the control of salinity will continue to be a challenge for the region. Inland desalination studies of brackish water must be funded as well as construction of facilities for concentrate disposal and management to help address salinity issues. The use of high quality imported water and region-wide planning to promote BMPs for reducing runoff impacts will continue to be essential. Managing salinity inputs to wastewater collections from water softeners also is an important factor in protecting water quality and maintaining the ability to use recycled water.

Control of salinity will continue to be a challenge. Desalinization studies must be funded and additional facilities for brine disposal are needed. From a salinity standpoint, it is preferable for the watershed to use SWP supplies compared to CRA supplies. Shortages of SWP supplies, due to regulatory issues in the Sacramento-San Joaquin Delta or other factors, can significantly impact the TDS concentrations in surface water and groundwater in the watershed. When SWP supplies are decreased, the percentage of the imported supply that comes from the CRA is increased, resulting in increased salinity in the imported supply. As water is used, discharged, and used again downstream, this increase in salinity affects downstream users in addition to the area that first used the water.

### *Nutrient Management*

Elevated nitrogen and phosphorus concentrations come from municipal and industrial wastewater, septic tanks, animal wastes, and agricultural and lawn fertilizers. Nitrogen-containing and phosphorus-containing compounds act as nutrients in streams and rivers. Nitrate in freshwater can cause oxygen depletion. Desalination facilities or desalters, in operation in Chino, San Jacinto, and Orange County basins reduce nutrient concentrations in groundwater. Brine lines also are being used to export high nutrient water to the OCSD for treatment and disposal to the ocean.

## Imported Water Recharge Cooperative Agreement

The Santa Ana Region was the first in the State to develop a comprehensive management plan for nitrogen and total dissolved solids (collectively referred to as "salinity"). The Regional Board adopted the *Total Dissolved Solids/Nitrogen Management Plan* as an amendment to the Santa Ana Region Basin Plan in 2004. The plan was developed in collaboration with stakeholders to address salt management in the watershed.

Concentrations of salinity in some surface water supplies and some groundwater basins are elevated due in part to past agricultural and dairy operations. Besides the historical legacy of salinity contamination, there is an additional salt load to the water basins associated with importing water into the region and recycling and reusing local and imported water supplies. Some of the groundwater basins in the Santa Ana River Watershed have a higher water quality than imported water. As a result, one of the concerns, which emerged from the Regional Board, was that by replenishing groundwater with imported supplies basin quality would deteriorate, violating state anti-degradation policies.

The 2004 Basin Plan amendment provided a framework for regulating recycled water discharges to surface water or groundwater in order to meet groundwater salinity objectives and beneficial uses. However; the Basin Plan did not directly address the potential salinity impacts of using imported water for groundwater recharge. The Regional Board and the State Legislature recognized that conjunctive use of imported water was necessary to facilitate the long-term sustainability of water supplies. Therefore, to avoid the necessity of regulating imported water salinity as a waste, the Regional Board worked with water supply agencies to develop a cooperative means of achieving compliance with salinity objectives without issuing waste discharge requirements.

In January of 2008, the Regional Board and water supply entities in the Santa Ana Region signed a "Cooperative Agreement to Protect Water Quality and Encourage the Conjunctive Uses of Imported Water in the Santa Ana River Basin." It states that:

> *"The Parties that intentionally recharge imported water within the Santa Ana Region (the "Recharging Parties") agree voluntarily to collect, compile and analyze the N/TDS water quality data necessary to determine whether the intentional recharge of imported water in the Region may have a significant adverse impact on compliance with the Salinity Objectives with the Region."*

The Cooperative Agreement was signed by the Regional Board and eight agencies in the watershed that import water to the region, import or export water between basins in the region, recharge groundwater basins with imported water, or treat or recharge wastewater in the region that includes imported water. The Cooperative Agreement directs the eight water agencies to prepare a summary of the amount of imported water recharged in each groundwater management zone, analyze the impact of such recharge on salinity levels in those zones, and compare projected water quality to historical ambient water quality. Specifically the agencies agreed to:

- Prepare a report every three years documenting the amount and quality of imported water recharged in each groundwater management zone during the previous three-year period

- Prepare a report every six years that projects ambient water quality in each groundwater management zone for the subsequent 20 years based on modeling that accounts for salt inputs from surface waters and reflects the effects of all existing and reasonably foreseeable recharge projects

**TDS and Nitrate Management in the Chino Basin**

For many years, the Chino Basin was home to one of the highest concentrations of dairies in the world. Waste discharges from years of dairy operations, as well as discharges from other commercial operations, left the southern portion of Chino Basin with a serious salt-imbalance. While the water quality in the northern portion of the basin remained high, increasing TDS and nitrate levels degraded groundwater in the south, threatening the quality of Chino Basin's groundwater supplies and SAR water that was flowing into Orange County's groundwater recharge basins.

The Regional Board addressed the impacts of salt loads from dairy operations by adopting waste discharges requirements, which included the requirements for dairies to adopt engineered waste management programs and manure control programs. The Chino Basin Desalter Authority, composed of IEUA and other local agencies, operates two desalters to pump out and remove contaminants in the groundwater. OCWD operates wetlands in the Prado Basin to naturally filter out nitrates. In addition, economic changes have led to a decline in number of dairies located in the Chino Basin.

These efforts have begun to reduce levels of TDS and nitrate in the basin. Plans are underway by IEUA and the CBWM as part of their maximum benefit agreement with the Regional Board for construction of an additional desalter and to expand other programs to improve groundwater quality in this area.

Each of the agencies importing water for groundwater recharge has completed these requirements. The first round of monitoring and modeling indicates that water quality impacts are minimal. The second round of the six-year reports is now in progress and will be completed by year 2015. Staffs from the agencies continue to meet regularly to discuss modeling approaches and coordinate the modeling efforts.

## Ocean Water

This section focuses on issues related to ocean water quality. The primary emphasis with ocean water is maintaining water quality in order to protect marine resources and public health. Furthermore, the quality of ocean water may become a concern for drinking water, if seawater desalination facilities are built to create new water supplies.

## Current Condition

Ocean water quality is evaluated using a number of different parameters and constituents related to beneficial uses. In the Basin Plan, one of the key beneficial uses is full body contact recreation, known as REC-1.

The California Health and Safety Code requires ocean waters adjacent to public beaches be tested for indicator bacteria to ensure public safety. This program, created by AB 411, establishes uniform and consistent water quality monitoring, response, and public notification requirements for the entire California coastline. The water quality standards established by AB 411 have been incorporated into the State Board's Ocean Plan and by reference into the Basin Plan. In addition to recreation, the ocean waters also support important habitat areas, including two ASBS and their related onshore Critical Coastal Areas (CCAs).

*Compliance with California Health and Safety Code Standards*

The County of Orange Health Care Agency implements AB 411 for Orange County's beaches, harbors, and bays shown in **Figure 5.5-4**.

Regulatory compliance is determined from the percentage the time standards were met. Beach Mile Days (BMDs) are calculated from the number of days and the linear area of ocean or bay front that is in violation of the AB 411 standards. BMD represents the loss of beneficial use of ocean recreational waters. **Table 5.5-28** lists total number of BMDs posted for beaches due to violation of AB411 standards. Orange County beaches on the CWA 303 (d) list are shown in **Table 5.5-29**.

**Table 5.5-28 Total Number of Beach Mile Days Posted for Open Coastal Ocean Water Areas Due to Violation of AB 411**

| Year | Seal/Surfside/Sunset | Bolsa Chica | Huntington City | Huntington State | Newport Beach | Crystal Cove |
|---|---|---|---|---|---|---|
| 2000 | 3.7 | 5.4 | 10.1 | 67.6 | 2.2 | 1.3 |
| 2001 | 0.4 | 0.1 | 1.4 | 14.8 | 0.7 | 0.3 |
| 2002 | 1.2 | 0.9 | 1.2 | 23.8 | 1.2 | 0.1 |
| 2003 | 0.3 | 0.8 | 0.8 | 41.9 | 1.4 | 0.2 |
| 2004 | 2.4 | 0.1 | 0.5 | 10.6 | 1.2 | 0.1 |
| 2005 | 0.1 | 0.4 | 0.4 | 12.1 | 6.0 | 0.0 |
| 2006 | 0.6 | 0.7 | 0.9 | 21.9 | 1.9 | 0.4 |
| 2007 | 0.5 | 0.6 | 1.4 | 61.0 | 0.6 | 0.1 |
| 2008 | 1.3 | 0.2 | 0.7 | 26.2 | 0.6 | 0.4 |
| 2009 | 0.5 | 0.1 | 0.5 | 11.0 | 0.6 | 0.0 |
| 2010 | 0.3 | 0.1 | 0.2 | 8.1 | 0.7 | 0.2 |
| 2011 | 0.3 | 0.1 | 2.4 | 2.2 | 0.0 | 0.1 |

**Table 5.5-29 2010 CWA 303(d) List of Water Quality Limited Segments Requiring TMDLs**

| Name | Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|---|
| Balboa Beach | DDT, Dieldrin, PCBs | Source unknown | 2019 |
| Bolsa Chica State Beach | Copper, nickel | Source unknown | 2019 |
| Huntington Beach State Park | PCBs | Source unknown | 2019 |
| Seal Beach | Enterococcus, PCBs | Source unknown | 2019 |

### *Newport Beach Marine Life Refuge (CCA No. 70/ASBS No. 32)*

The Newport Beach Marine Life Refuge is bounded to the west by a line heading oceanward 1,000 feet along Poppy Avenue in Corona Del Mar, and to the east by a line heading oceanward 1,000 feet along the westerly limits of Crystal Cove State Park. It extends from the mean high tide line to 1,000 feet offshore or 100 feet of ocean depth, whichever is nearer. This ASBS is designated to protect dolphin breeding areas and other marine species. Water quality is impacted by the following:

- Stormwater and dry weather runoff from Buck Gully, its major tributary and from over two dozen direct discharge pipes from residential neighborhoods along the coastal edge of the ASBS
- Sediment transported from Buck Gully and coastal bluffs
- Beachgoer scavenging and trampling, despite educational efforts to discourage taking of tide pool species

### *Irvine Coast Marine Life Refuge (CCA No. 71/ASBS No. 33)*

The Irvine Coast Marine Life Refuge is bounded by the Newport Beach Marine Life Refuge to the west and to the east by a line heading oceanward 1,000 feet along the Irvine Cove cliffs at the edge of Laguna Beach. It extends from the mean high tide line to 1,000 feet offshore or 100 feet of ocean depth, whichever is nearer. Like its immediate neighbor, this ASBS is designated to protect dolphin breeding areas and other waterborne species. It is impacted by the following:

- Stormwater and dry weather runoff from the Pelican Hill/Point area and from Los Trancos Canyon and Muddy Creek
- Stormwater and dry weather runoff from direct discharge facilities draining through Crystal Cove State Park, Pacific Coast Highway, and Pelican Point
- Beachgoer scavenging despite educational efforts to discourage taking of tide pool species

**Southern California Coastal Water Research Project (SCCWRP)**

SCCWRP was formed in 1969 as a JPA to conduct research about the effects of wastewater and other discharges to the Southern California coastal marine environment. Its mission is to contribute to the scientific understanding of linkages among human activities, natural events, and the health of the Southern California coastal environment; communicate this understanding to decision makers and other stakeholders; and recommend strategies for protecting the coastal environment for this and future generations.

SCCWRP's 14 member agencies include representatives of city, county, State, and Federal government agencies responsible for monitoring and protecting the marine environment. SCCWRP brings together a multidisciplinary team of scientists to address complex environmental problems; recommend protection strategies; and foster communication and cooperation between scientists, the regulated community, and regulators.

SCCWRP is a recognized leader in environmental research. Accomplishments include developing new environmental monitoring methods, and defining the mechanisms by which biota are potentially affected by anthropogenic stressors. SCCWRP has participated in some of the most significant scientific discoveries, methodology developments, and environmental policy decisions of the past 40 years.

In the 2013-2014 Research Plan, SCCWRP scientists address topics such as, ocean acidification and hypoxia, beach bacteria, nutrients and eutrophication, freshwater and marine bioassessment, emerging contaminants, molecular method development, and regional monitoring, as well as environmental data acquisition, sharing, processing, and visualization technology.

Additional information may be found at www.sccwrp.org.

## Current Management Strategies for Ocean Water

The major goal for ocean water quality improvement is to achieve water quality standards, which includes meeting beneficial uses and WQOs, preventing anti-degradation and meeting California's Ocean Plan and AB 411 standards. Goals, management strategies, and tactics are summarized in **Table 5.5-30**.

**Table 5.5-30 Ocean Water Quality (including Bays, Estuaries, and Tidal Prisms) Goals, Strategies, and Tactics**

| Goals | Strategies | Tactics |
|---|---|---|
| Water Quality Standards attained (includes Ocean Plan and AB 411 standards) | • Protect good quality ocean water<br>• Clean up poor quality ocean water | • Monitoring<br>• Source water protection<br>• POTWs implement source control and treatment<br>• Urban runoff managed through NPDES/DAMP<br>• NPDES permits for other dischargers<br>• Implement State Non-Point Source (NPS) Plan<br>• TMDLs<br>• Constructed wetlands<br>• Localized urban runoff treatment systems<br>• Surface water diversions to POTWs or other treatment systems<br>• Research<br>• Public outreach |

The Newport Coast Watershed Management Program works on water quality issues from Buck Gully in Corona del Mar to El Morro Canyon. These concerns include canyon stability, impacts to sensitive marine life areas, water quality impacts due to dry-weather nuisance flows, and invasive plants. This watershed program, organized by the City of Newport Beach, coordinates efforts between city staff, community members, property owners, jurisdictional agencies, Orange County Coastkeeper and other interested parties.

**Orange County Coastkeeper**

The Orange County Coastkeeper, founded in 1999, is a non-profit organization dedicated to the protection and preservation of the marine habitats and watersheds in Orange County. This is accomplished through programs of education, restoration, enforcement and advocacy. Members work with businesses, developers, cities, elected officials and regulatory agencies to develop solutions to the problems of polluted urban runoff. The long-term goal is to protect and preserve all of Orange County's waterbodies and restore them to healthy, fully functioning systems that will protect recreational uses and aquatic life.

### *Seawater Desalination*

In previous integrated water resource planning, potable water arising from seawater desalination had not appeared to be a viable or economic water supply alternative for the foreseeable future for Southern California. However, on November 29, 2012, this scenario changed. With the approval by the

San Diego County Water Authority (Authority), a 30 year water purchase agreement, with Poseidon Resources, for the purchase of up to 56,000 acre-feet of desalinated seawater per year from a new Carlsbad Desalination Project, which is projected to begin soon. The seawater desalination facility takes advantage of an existing seawater intake operated by the Encina Power Station in Carlsbad. This unique operations and management agreement will result in a purchase price by the Authority of desalted seawater at $1,897-$2,097 per acre-foot in 2012 dollars. The Authority estimates that water produced by the project will account for about one-third of all locally generated water in San Diego County by the Year 2020.

Though the Carlsbad seawater desalination project is outside the Santa Ana River Watershed, planning efforts are underway for a similar type of project to be located at the Huntington Beach. In February 2012 the Santa Ana Regional Board approved a permit for a large-scale desalination plant at Huntington Beach that would turn ocean water into drinking water. Similar to the Carlsbad plant, Poseidon Resources, a private investment firm that specializes in seawater desalination, will develop and manage the proposed Huntington Beach seawater facility on a 12-acre site next to a coastal power plant. According to the company, it would be the largest such facility in the western hemisphere and supply 50 million gallons of drinking water a day, which is enough to supply 300,000 people.

While local water agencies, lawmakers and the business community generally support building the plant, water quality concerns remain. The ocean water intake system would discharge extra salty water, known as “brine”, and would release water tainted with iron and cleaning fluids that could impact or kill fish, plankton larvae and other sea creatures.

A State policy adopted in 2010 will phase out the use of seawater to cool coastal power plants, a process that may harm fish, larvae, eggs, seals, sea lions, turtles and other creatures, when they get trapped against screens or sucked into the plant and are exposed to heated water.

The new policy by the State Board would end seawater cooling by ocean beach power plants similar to the Huntington Beach plant as early as 2020. The Huntington Beach project, which has been in the works for more than 12 years, still needs approval from the State Coastal Commission to move forward. State water regulators are collecting scientific and technical data in order to draft new policies on seawater intake that will be specific to desalination plants that could be adopted in the next year. Environmental groups said they would appeal the decision to the State Board. The earliest the Huntington Beach plant could start operating is 2016.

## CHALLENGE: Identification and Solutions

**Table 5.5-31** identifies current challenges for water quality management. The challenges were identified by members of the Beneficial Use Assurance Pillar. Because of the broad scope of issues, the diversity of challenges is significant. A range of potential solutions for each challenge are identified and categorized by the type of water body affected and the nature of the challenge (institutional/political, financial, regulatory, or insufficient data). Each item listed in the table is discussed in more detail on the following page.

**Table 5.5-31 Water Management Challenges**

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Regional Board's resources insufficient for Basin Planning; priorities in most recent triennial review conducted in 2006 have yet to be completed | • Secure additional resources for Basin Planning | • No new funding for Basin Planning<br>• 2006 Triennial Review issues still incomplete<br>• Revisions needed for Lake Elsinore/Canyon Lake TMDL not being addressed | • Work with Regional Board staff to develop potential options to address funding challenges<br>• Evaluate potential for watershed stakeholder resources to be utilized to supplement work of Regional Board staff<br>• Identify top Basin Plan priorities in need of review<br>• Develop funding mechanism for Regional Board to develop revisions to the Lake Elsinore/Canyon Lake TMDL |
| Lack of prioritization in addressing water quality problems and limited resources make it difficult to solve the most pressing water quality issues in the watershed | • Create process to determine water quality problems presenting greatest human health and environmental risk<br>• Allocate funding and staff resources to identified priorities | • Stormwater Quality Standards Task Force (SWQSTF) developed proposed Basin Plan amendments addressing water quality impacts related to recreational water use and providing method for prioritizing regulatory efforts. Basin Plan was approved by the Regional Board and State Boardas of Jan. 21, 2014. | • Support adoption of SWQSTF proposed Basin Plan amendments<br>• Encourage development of additional programs that prioritize water quality improvements.<br>• Identify top Basin Plan priorities in need of review |
| Solving water quality challenges by developing multi-agency, multi-benefit projects has advantages, but this is difficult to achieve as agencies have traditionally worked independently at the local level | • Increase regional dialogue<br>• Foster pooling of resources and cost sharing<br>• ID areas where regional efforts likely to have greatest impact and chance of success; target those areas for | • State grant programs have facilitated development of multi-agency, multi-benefit projects and have provided funding for such projects | • Continue working toward development of regional solutions for water quality problems |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| | regional projects | | |
| Regulatory barriers make it difficult to develop regional BMPs to manage municipal stormwater discharges | • Work to overcome regulatory barriers | • Stakeholders continue to discuss methods/options to addressing regulatory barriers | • Regulators and stakeholders should address regulatory barriers in next phase of MS4 permits scheduled for adoption in 2014<br>• Permits should allow for regional BMPs as co-equal to infiltration, harvest and reuse, and bio-treatment BMPs<br>• Assign watershed stakeholder task force to develop these options |
| Fecal bacterial contamination in stormwater remains a problem | • Conduct research<br>• Assess health impacts from human vs. nonhuman sources and relationship between fecal indicators and health risks<br>• Develop sanitary survey criteria to assess urban and non-urban environments | • Middle Santa Ana River (MSAR) TMDL Task Force completed development and implementation of Comprehensive Bacteria Reduction Plans for Counties of Riverside and San Bernardino | • Continue work of the MSAR TMDL Task Force |
| Floatable debris in stormwater hard to control | • Financial incentives to develop outreach and source control programs<br>• Develop and implement trash and litter control municipal ordinances<br>• Coordinate with the State Board's Marine Debris Steering Committee | • Control of floatable debris continues to be a problem in the watershed | • Continue efforts to address floatable debris and trash in stormwater<br>• Apportion funding from future stormwater funding and grant programs |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Problems with septic system impacts to groundwater difficult and expensive to solve | • ID lead agency for expanding sewers to areas outside local agency jurisdictions<br>• Extend sewers to areas without them<br>• Amend laws to simplify annexations of areas without sewer providers<br>• Provide source protection to reduce emerging contaminants<br>• Increase minimum lot size for septic systems | • EMWD extended sewer system to community of Enchanted Heights; service extension to Quail Valley in progress.<br>• Diamond Park Mutual Water Company customers in Santa Ana connected to municipal supply<br>• Review of water quality data from small system water providers in Orange County completed<br>• Municipal stormwater permits required permittees to develop septic system inventories by 2012 | • As first step to working on remediating water quality problems from septic systems, produce an inventory map locating areas within the watershed that remain on septic systems<br>• Work to develop plan to extend sewer systems to these areas |
| WUE and conservation increases pollutant concentrations in influent water to wastewater treatment plants challenging discharge permit compliance (i.e. TDS limits) | • Promote use of containers for food waste, pharmaceuticals, and household chemicals disposal<br>• Promote use of detergents and products with low salt levels<br>• Include higher loading levels in new treatment plant design and during CEQA and permit processes for new reclamation projects | | • New section added to OWOW 2.0 discussing challenge of influent water quality<br>• Promote source control efforts throughout watershed |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Salt balance not achieved in watershed | • Regional efforts for reducing salt impacts in runoff<br>• Establish mitigation plans for recycled water projects<br>• Ensure long-term viability of existing brine lines<br>• Expand existing brine lines<br>• Financial incentives for desalination studies and facilities<br>• Encourage regulators to recognize exporting certain brines and constituents as regulatory relief/offsets for wastewater permitting requirements<br>• Support elimination of water softeners<br>• Address long-term need for increased brine disposal capacity | • IEUA's water softener program has removed over 600 salt-based softeners in the Chino Basin since 2008<br>• Water softener ordinances preventing the future installation of salt-based softeners have been passed in the cities of Montclair, Upland, and Fontana<br>• Throughout the Inland Empire, public agencies have joined the "No Drugs Down the Drain" program, installing drop off boxes in public locations and participating in the National Drug Take-Back Day<br>• Mitigation plans are required by Regional Board for recycled water projects where appropriate<br>• Mitigation plans approved for recycled water use by IEUA and EMWD<br>• SAWPA working on plans to ensure viability of and expansion of the Inland Empire Brine Line | • Work toward adoption of the Delta Plan in order to promote reliability of low-TDS imported water supplies for use in the watershed<br>• Consider brine concentration alternatives to reduce discharges to brine line and/or zero discharge projects<br>• Increase outreach, promotion, and awareness of National Drug Take-Back Day and "No Drugs Down the Drain" programs by posting prominently on websites, etc<br>• Implement salt and nutrient management plans consistent with the statewide Recycled Water Policy<br>• Identify regional strategies to support salinity control for imported water sources |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Public agencies must comply with new regulations without ability to increase revenues | • Federal and State funds for infrastructure banks<br>• Amend Proposition 218<br>• Prepare strategies to address legal decisions adverse to public agencies setting/increasing fees for improvements<br>• Increase effectiveness of new regulations by encouraging ID of goals and implementation plans for those regulations<br>• Build public support for funds to address challenging water supply needs | • Public agencies continue to struggle to keep up with rising costs | • Work toward implementation of recommendations from OWOW 1.0 |
| Emerging constituents detected at low levels without understanding of human health and toxicological effects<br><br>Standard lab methods not available for emerging contaminants | • Outreach to agencies and Regional Board on status of studies and research<br>• Evaluate joint opportunities to conduct studies<br>• Encourage development of human health and ecological risk levels for specific compounds<br>• Develop list of appropriate surrogates and indicators of water quality for monitoring constituents<br>• Develop monitoring plan for waterbodies and facilities and test for appropriate set of constituents<br>• Support creation of Blue Ribbon Commission to recommend monitoring of emerging contaminants in recycled water<br>• Collaborate on public information outreach<br>• Create collaborative efforts to develop new analytical methods<br>• Regulators and dischargers coordinate with California Department of Publlic Health (CDPH) to ensure analytical methods developed and approved<br>• Promote collection facilities and programs for unused pharmaceuticals and distribute smaller amounts to patients when possible | • State Blue Ribbon Commission completed report on monitoring of emerging constituents<br>• Emerging Constituents (EC) Program Task Force completed four years of annual EC sampling in watershed<br>• EC Task Force created a Water Quality Program Public Relations Work Group to collaborate on outreach<br>• Standard methodology is under development | • Continue to support work of the Emerging Constituents Work Group<br>• Work with CA Office of Environmental Health Hazard Assessment and CA Department of Public Health on development of Public Health Goals and water quality standards |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Land for new water treatment facilities in urban areas difficult to obtain | • Financial incentives for property owners to make land available for cleanup facilities | • Land availability continues to be a challenge | • Continue working to implement recommendations from OWOW 1.0 |
| Finding parties responsible for groundwater contamination is difficult<br><br>Typical response to well contamination is to shut down well, but pump and treat may be most effective means to cleanup | • Work with State and Federal agencies to obtain grants, including U.S. Dept. of Agriculture for perchlorate cleanup<br>• Set up an orphan share fund<br>• Develop incentives for groundwater producers to treat for wells producing contaminated water<br>• Change existing local rules and regulations that act as barriers to cleaning up water contamination | • Groundwater contamination clean-up efforts continue to be slowed<br>• In some cases potentially responsible parties are using CEQA or other means to delay clean-up | • Support efforts of water districts and other agencies to investigate parties responsible for groundwater contamination and collect funds from those parties to clean up contamination<br>• Evaluate methods to streamline groundwater cleanup projects<br>• Explore arrangements where multiple public agencies with grant funding form an MOU with non-public potential responsible parties to share cost and provide regional water supply solutions |
| Local agencies limited in amount of fines and penalties able to assess and have limited regulatory jurisdiction over some agencies (i.e. school districts) | • Consolidate enforcement authority to the regulating agency<br>• Expand local agencies' enforcement authority<br>• Develop panel to discuss current regulatory environment, interagency impacts, and impacts to business and residents, such as groundwater discharge permitting requirements | • Limitations on local agencies remain a problem | • Continue to work on providing local agencies authority to properly enforce regulations protecting water quality<br>• Utilize part of future stormwater funding to pay for cost of enforcement |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Solving 1 problem may cause new one, i.e. infiltrating runoff improves surface water but may cause ground-water problem | • Increase communication, planning and cooperation among stakeholders<br>• Collect data on infiltration BMPs at selected sites to evaluate potential impacts to groundwater quality | • RCFCWCD LID Testing and Demonstration Facility will collect water quality data on LID BMP performance<br>• County of Orange is implementing Glassell Yard Campus Stormwater LID Retrofit Project<br>• Business Industries of America completed study evaluating cost effectiveness of variety of LID BMPs | • Continue evaluation of LID BMPs to document long-term performance and water quality benefits.<br>• Promote and increase the profile of BMP examples within communities (e.g. RCFCWCD campus) |
| Changing public behavior is difficult | • Develop, pilot, and evaluate effectiveness of strategies to change public behavior<br>• Foster watershed sustainability by encouraging behavior aimed at reducing runoff and preventing pollution<br>• Increase public perception of value of water. | • No Drugs Down the Drain website – http://www.nodrugsdownthedrain.org | • Continue efforts to educate public on water quality issues in the watershed<br>• Expand efforts to change public behavior |
| Planning for complex growth impacts difficult in rapidly urbanizing areas<br><br>Potential water quality impacts hard to ID | • Educate local officials so water quality concerns become core issues<br>• Conduct studies to identify water quality challenges in rapidly developing areas | • Approaches used in Stormwater MS4 permits continue to be evaluated<br>• Managing growth impacts continues to be difficult | • Implement recommendations from OWOW 1.0<br>• Work with Regional Board in development of next Stormwater MS4 permit |

| OWOW 1.0 Challenge | OWOW 1.0 Recommendations | Status of Addressing Challenge | OWOW 2.0 Suggested Implementation Activities |
|---|---|---|---|
| Urbanization and concrete-channelization have seriously reduced groundwater recharge leading to water quality impairments and reduced water supplies | • Promote LID principles<br>• Recognize in regulatory and funding frameworks that using design and retrofit technology to minimize runoff and increase infiltration is beneficial for water quality and TMDL goals | • Chino Basin stakeholders preparing the Recharge Master Plan Update for the basin to monitor MS4 compliance and quantify benefits to basin | • Continue to work toward recognition in regulatory and funding frameworks that using design and retrofit technology to minimize runoff and increase infiltration is beneficial for water quality and TMDL goals |

**Table 5.5-32 OWOW 2.0 Recommendations**

| Challenges | Recommendations |
|---|---|
| Fracking for oil or gas development, if conducted within the watershed, could cause groundwater contamination | • Support development of statewide regulations that protect water quality |
| New statewide regulations setting biological objectives for surface water are being developed and will be compliance challenge for wastewater agencies | • Participate in rule making process to support development of policies and regulations that are effective and efficient and do not place an undue burden on dischargers |
| New statewide regulations setting nutrient objectives for surface water are being developed that will be compliance challenge for wastewater agencies | • Participate in rule making process to support development of policies and regulations that are effective and efficient and do not place an undue burden on dischargers |
| Surface water quality monitoring is not coordinated within the watershed leading to duplicative sampling in some areas and inadequate sampling in others. In some cases this may lead to 303(d) listings that do not reflect real impairments | • Assess surface water quality monitoring in watershed. Work on plan to improve coordination and development of regional approach to monitoring<br>• Use monitoring developed by MSAR Watershed Pathogen TMDL Task Force, SWQSTF, SCCWRP's Regional Bio-assessment program, and SWAMP as models |
| A small number of small water systems may be in operation within the watershed that do not have resources for monitoring and proper operations and maintenance, which may result in drinking water provided to customers that are in violation of drinking water standards. (25 people or more, or 15 or more connections is a public water system in CA; State Small Water Systems are at least 5 connections, but less than 15 and are regulated by county health departments) | • Work with CDPH and county health departments to identify small system water providers, if any, which need assistance with providing safe drinking water<br>• Develop plan to address any small system water providers that need assistance |
| Sediment deposition in some areas creates water quality impairments, reduces aquatic habitat, and reduces water conservation storage. Reduced sediment flow downstream of dams causes armoring of river/creek beds resulting in reduction in percolation capacity, aquatic habitat, and beach replenishment | • Support USACE/OCWD Prado Basin Sediment Management Demonstration Project<br>• Support efforts of Newport Bay Stakeholders to reduce sediment load into Upper Newport Bay |

## Description of Data Collection Process

Greg Woodside of the OCWD and Mark Adelson of the Regional Board co- chaired the Beneficial Use Assurance Pillar Committee and coordinated the preparation of this report. Committee members, listed below, provided direction and assisted in collecting the information contained in this report and reviewed and commented on draft versions. The committee met in person and also held conference calls on a number of occasions.

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# 5.5.1 Brine Line to the Salton Sea



## Introduction

In support of the One Water One Watershed (OWOW) 2.0 Plan, the Bureau of Reclamation (Reclamation) conducted an appraisal-level analysis of the connection of the Inland Empire Brine Line (Brine Line), formerly known as the Santa Ana Regional Interceptor (SARI), to the Salton Sea. It is one of several salt management alternatives involving brine delivery that the Santa Ana Watershed Project Authority (SAWPA) examined within the basin. One alternative option explores direct brine discharge to the Sea. Reclamation's appraisal analysis of the Brine Line are found in a four-volume set of technical memoranda that address the SARI history; engineering, brine and flow data; various options and strategies; projected cost information; and recommendations. Those points are captured in Reclamation's *Inland Empire Interceptor Appraisal: Technical Manuals 1-4* and the associated *Executive Summary*, attached as OWOW 2.0 **Appendix D1-D5**.

The Brine Line was constructed to help manage the basin's water quality by exporting highly saline waters from the Inland Empire to a wastewater plant in Orange County for ocean discharge. Like nearly all watersheds in arid climates, salt management is essential for water resource managers to ensure populations and ecosystems continue to thrive.

SAWPA's Brine Line, an important tool in managing inland groundwater basins, has allowed businesses with industrial processes that produce brine to move into and expand in the Inland Empire. Orange County also benefits from the Brine Line through the removal of salinity from the Santa Ana River, providing a reliable level of protection for its water quality and reducing the area's dependence upon imported water.

A study entitled Santa Ana Watershed Salinity Management Program (Salinity Management Program) was completed in 2010, by a team of consultants led by Camp, Dresser & McKee Smith (CDM Smith), which addressed the Brine Line capacity limitations. The Salinity Management Program identified and evaluated several alternatives for managing flows in the Brine Line system.

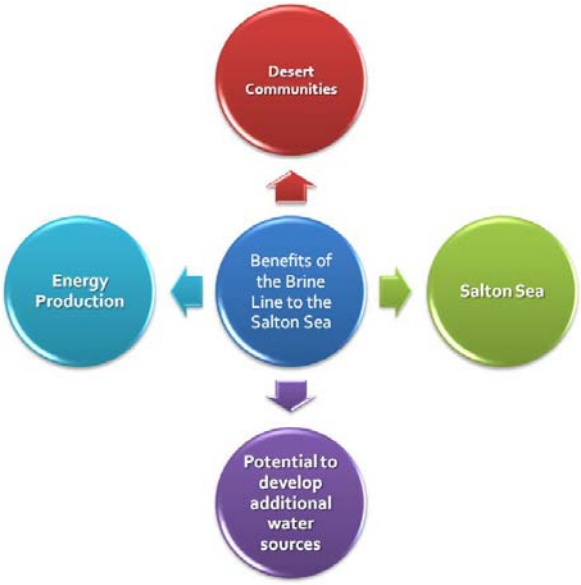
Some alternatives have been considered for improved salt management involving the Brine Line within the Santa Ana River Watershed (SARW). The first was a Brine Line flow reduction through a centralized treatment facility. Here the brine would undergo biological treatment, followed by chemical softening, then high recovery reverse osmosis treatment and disinfection concludes the process. The treated water is then available for use while the reject water continues downstream for further treatment and discharge to the ocean. A variation of this option would be to further treat and concentrate brine at individual desalters or facilities, but the benefits of scale for a single facility would be lost. Another salt management alternative includes providing incentives to commercial users to encourage use of the existing Brine Line. Brine disposal can be maximized and the cost can be minimized by directly discharging brine to the ocean. Currently, brine in the Brine Line is several times less salty than ocean water and with sufficient pretreatment at the source stream the brine could be discharged directly to the ocean without any negative impact to the environment, avoiding downstream treatment costs. Pretreatment is only required of system users with high BOD/TSS waste, but the cost of pretreatment may provide an incentive for the highest valued use of the Brine Line, salt disposal. In addition, the permit requirements for direct ocean discharge are onerous and time-consuming, so making use of the existing brine line is advantageous to these industries.

The final salt management alternative assumes all the flows in the Brine Line would be collected just below Prado Dam, the lowest elevation in the upper watershed, and that a separate pipeline would be constructed to transport that flow directly to the Salton Sea. The Salton Sea, California's largest inland lake, is a shallow, highly saline basin with no outfall to external water bodies. It is 14,000 parts per million saltier than ocean water.

After delivery of the Santa Ana Watershed Salinity Management Program report by CDM Smith, SAWPA staff prepared a report entitled *Inland Empire Brine Line Disposal Option Concept Investigation* (SAWPA Investigation) in which four alternative conceptual designs for the Brine Line to the Salton Sea alternative were developed and evaluated. Such a pipeline could accommodate additional saline flows which would be treated to some extent prior to discharge into the Salton Sea. A list of potential benefits including bringing in 30-40 thousand acre -feet of water every year to the Salton Sea were indentified that would significantly assist in the following:

- Dilute salt concentrations
- Help stabilize lake levels
- Enhance water reliability
- Protect fish and wildlife that are dependent on the Salton Sea ecosystem

- Restore the long-term stable aquatic and shoreline habitat for fish and wildlife that depend on the Sea
- Mitigate air quality impacts from exposed playas
- Maintain the Salton Sea as a vital link along the Pacific Flyway
- Minimize noxious odors and other water and air quality problems
- Enhance economic development opportunities that will provide sustainable financial improvements
- Improve the economic quality of life for communities around the Salton Sea
- Improve aquifer water quality
- Increase water production




Reclamation's engineering analysis and recommendations are attached as a separate report, which is an **Appendix D5** in OWOW 2.0. Based on that analysis, SAWPA remains hopeful that as new partnerships are developed with potential brine customers throughout the Basin and other parts of the state, the viability of this salt management alternative will become a truly system-wide solution. An economic analysis was recommended to help examine the potential for this proposed undertaking.

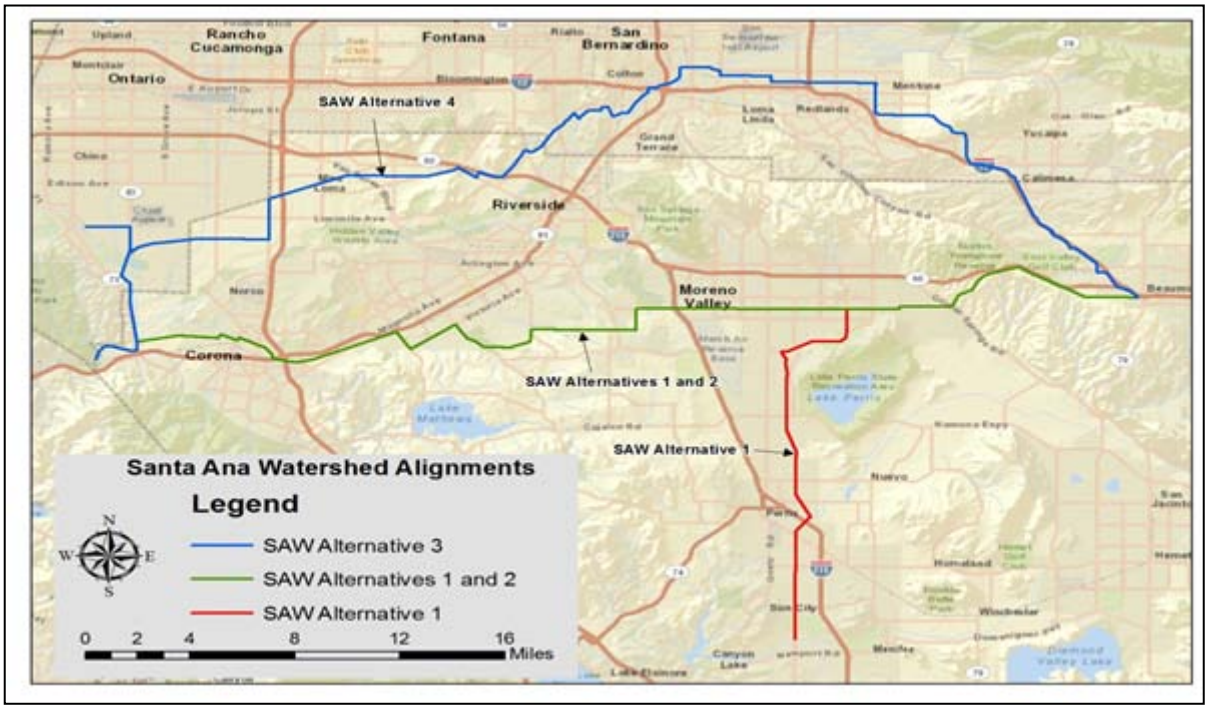
## Appraisal Analysis Objectives

As mentioned above, the Brine Line to the Salton Sea alternative was the subject of the Appraisal Analysis and is identified as the Inland Empire Interceptor (IEI).

The purpose of this Appraisal Analysis is to help determine whether more detailed investigations of the proposed IEI are justified. Under Reclamation criteria set forth in *Reclamation Manual, Directives and Standards, FAC 09-01: Cost Estimating* (Reclamation Manual), appraisal analyses "are intended to be used as an aid in selecting the most economical plan by comparing alternative features". Several alternative conceptual designs for the proposed IEI will be developed and evaluated in this Appraisal Analysis for the purpose of comparison.

Three of the four alternative conceptual designs for the portion of the proposed IEI in the Santa Ana Watershed addressed in the SAWPA Investigation described above were considered in this Appraisal Analysis.

**Figure 5.5.1-1 Santa Ana Watershed Alignments for the Proposed IEI**




Additionally, two alternative alignments were developed and evaluated in this Appraisal Analysis for the portion in the San Gorgonio Pass and Coachella Valley. The route of the proposed IEI through the San Gorgonio Pass and Coachella Valley areas in eastern Riverside County represents an opportunity for SAWPA to expand the Brine Line service area.

**Figure 5.5.1-2 Coachella Valley Alignments for the Proposed IEI**

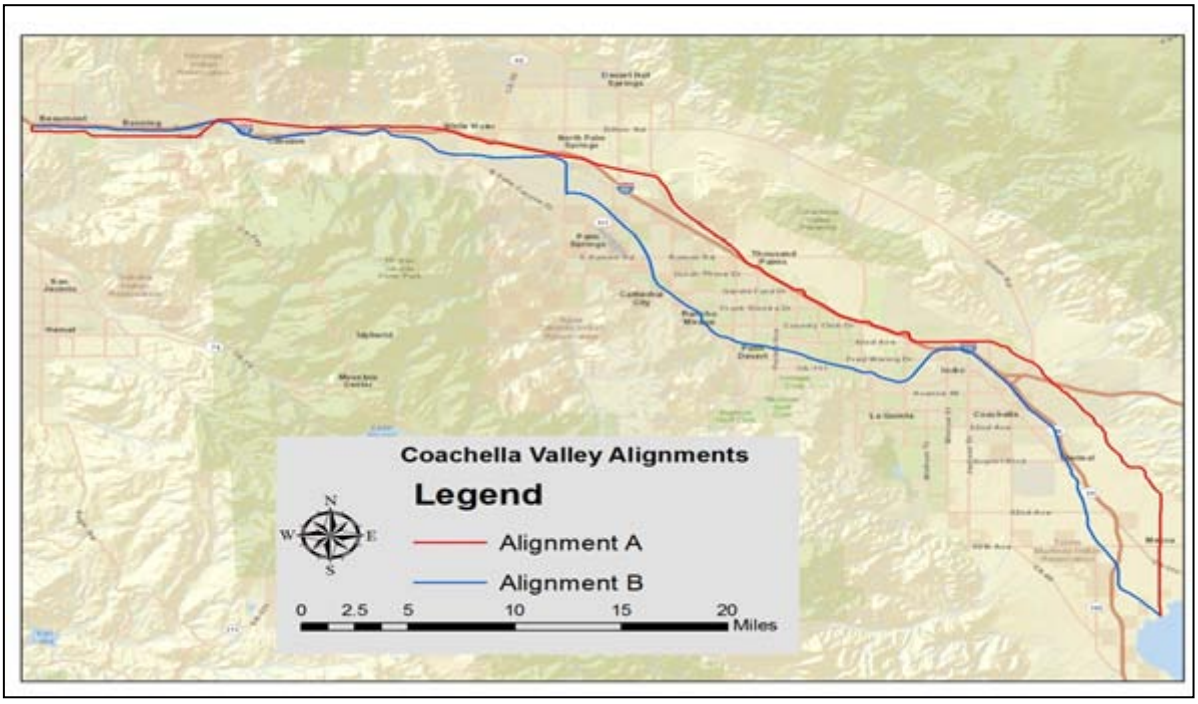
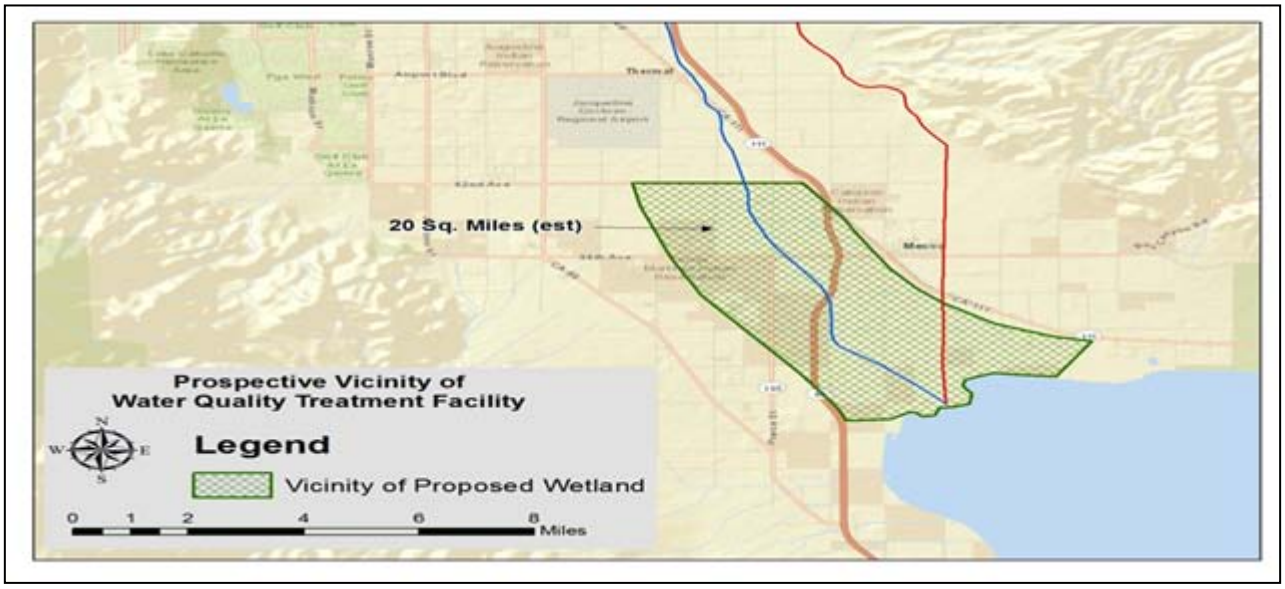



**Figure 5.5.1-3 Water Quality Treatment Facility Location for Proposed IEI**



## Feasibility Analysis and Benefit-Cost Analysis

As discussed above, the purpose of an Appraisal Analysis is to help determine whether more detailed investigations of a proposed project are justified, the criteria for which are set forth in the Reclamation Manual. The *Reclamation Manual* also describes criteria for "a project Feasibility Study and Feasibility-level cost estimate, which are intended to support funding authorization for new construction" and "cannot be conducted without authorization and appropriation of funds by the Congress".

Also, as a Federal agency, Reclamation must perform benefit-cost analyses (BCA) for proposed water resources projects at the appropriate stage of project planning. The main set of guidelines for a BCA is the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, U. S. Water Resources Council, 1983 (P&Gs). For Reclamation projects, BCAs are typically performed at the Feasibility level of study.

The purpose of a BCA is to compare the benefits of a proposed project to its costs. The total costs of the project are subtracted from the total benefits to measure net benefits. If the net benefits are positive (benefits exceed costs), then the project could be considered economically justified. Conversely, if net benefits are negative (costs exceed benefits), then the project would not be economically justified. When multiple alternatives are being considered for a project, the alternative with the greatest positive net benefit would be preferred from an economic perspective.

A BCA is comprised of four "accounts" identified as the National Economic Development (NED) account, the Regional Economic Development (RED) account, the Environmental Quality (EQ) account, and the Social Effects (OSE) account. The NED and RED accounts are used to evaluate the economic effects of proposed alternative plans.

A RED analysis focuses on economic impacts to the region in which the project is located. The RED analysis recognizes the NED benefits accruing to the local region plus the transfers of income into the region.

A NED analysis focuses on economic impacts to the entire Nation. The *P&Gs* require Reclamation to analyze the NED effects so as not to favor one area of the country over another. Economic justification is determined solely by the benefit-cost analysis and must be demonstrated on the basis of NED benefits exceeding NED costs.

## Conclusions and Recommendations

The results of the present worth analyses of the estimated costs for the proposed IEI are presented in Technical Memorandum No.4 (TM4). A simple comparison of those results with the present worth analyses for the other Options presented in the Salinity Management Program indicates that the costs of the proposed IEI are greater than the costs of other Options. However, certain aspects of the proposed IEI distinguish this Option 4 from the other options considered in the Salinity Management Program, and further investigation and analysis of the proposed IEI warrants consideration.

Significant opportunities are available for refinement of the conceptual designs for the proposed IEI presented in this Appraisal Analysis. Further investigation and analysis of these opportunities could help refine the estimated costs, reduce the multiplier applied to estimated costs for contingencies, and evaluate the benefits associated with the project. These refinements could lead to a more favorable present worth comparison of the proposed IEI with the other Options.

Opportunities to refine the scope, conceptual designs, estimated costs, and benefits associated with the proposed IEI are identified and discussed in TM4. In general, these Opportunities represent the Conclusions of this Appraisal Analysis. Suggested Optimization Strategies for the proposed IEI are also identified and discussed in TM4. These suggested Optimization Strategies describe recommended next steps (or Recommendations) for further investigation and analysis of the proposed IEI.

As discussed above, a Feasibility level of study "cannot be conducted without authorization and appropriation of funds by the Congress" and represents a substantial commitment to a project. These recommendations are suggested as interim stages of investigation and analysis of the proposed IEI. A Feasibility study and benefit-cost analysis of the proposed IEI would be warranted only if these additional investigations and analyses produce favorable results.

## Conclusions

The Conclusions from this Appraisal Analysis are summarized as follows:

C1. Economic Development: The economic development potential associated with the proposed IEI is significant and unique to this option. If implemented, the proposed IEI would make brine management infrastructure available to prospective employers located in the San Gorgonio Pass and Coachella Valley areas.

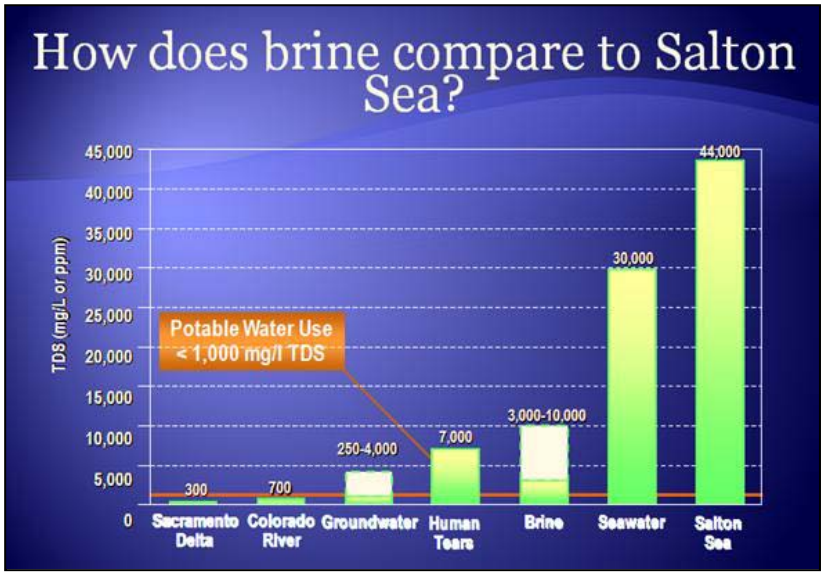
C2. Net Impact: The proposed IEI would impact the Salton Sea in various ways, some of which may be considered beneficial and others negative. Further investigation and analysis of these aspects would help determine design criteria for associated components of the proposed IEI.

C3. Salton Sea Restoration: Delays to implementation of a restoration plan for the Salton Sea have contributed to uncertainties regarding salinity and water quality aspects of the proposed IEI. Improved understanding of progress toward restoration of the Sea would help determine appropriate project design criteria for the affected components of the proposed IEI.

C4. Basin Plan: Uncertainties regarding Salton Sea salinity and water quality regulatory requirements contribute to uncertainties regarding planning and design of associated components of the proposed IEI and the associated costs.

C5. Stakeholder Partnering: The standards established in the Basin Plan for salinity and water quality in the Salton Sea are a deterrent to potential new sources of water supply to the Sea.

Community and stakeholder support would enhance the likelihood of adoption of changes to those standards.




C6. Salton Sea Salinity: The salts in the IEI flows would add to the existing rate of accumulation of salts in the Sea. Whether those salts would cause total dissolved solids (TDS) concentrations in the Sea to increase will depend on such factors as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan.

C7. Salton Sea Water Quality: Similar to salinity, whether the total suspended solids (TSS) and biochemical oxygen demand (BOD) in the IEI flows would cause an adverse impact on the water quality in the Salton Sea will depend on such factors as the magnitude of the Salton Sea water budget imbalance over time and progress toward implementation of a Salton Sea restoration plan. The estimated cost of the proposed Water Quality Treatment Facility (TF) represents a substantial portion of the total estimated costs for the project, which calls for careful scrutiny of the design criteria for this facility.

C8. Brine Pretreatment and Treatment Strategies: The proposed TF could function in place of the Brine Pretreatment and Treatment Strategies presented in the Salinity Management Program, or it could function as part of a hybrid design in combination with a Strategy from the Salinity Management Program.

C9. Management of Surplus Energy: The large estimated costs of the proposed IEI Turbine Generator Stations and associated electric transmission facilities indicate that the time period necessary to recover that investment in would be long. The estimated cost of the proposed IEI could likely be significantly reduced by using an alternative approach to remove surplus energy from flows in the system.

C10. Other Opportunities: Examples of other opportunities to refine, reduce and/or eliminate estimated costs identified in this Appraisal Analysis include but are not limited to the following:

- Synthetic Membrane Liner - The synthetic membrane liner under the TF is the largest single component of the estimated cost of that facility; use of an alternative approach to soil permeability could likely significantly reduce that cost.
- Tunneling – Tunneling in lieu of direct bury of the proposed pipeline through the Badlands west of the City of Beaumont along the Gas Main Alignment may reduce impacts associated with construction of the project.
- Phasing - Phasing of certain project components could allow some project costs to be deferred.

## Recommendations

The results of this Appraisal Analysis and the Conclusions listed above suggest appropriate recommended next steps for further investigation and analysis of the proposed IEI to refine the scope, conceptual designs, estimated costs and anticipated benefits of the proposed IEI. These recommendations are summarized as follows:

R1. Economic Impact Analysis: In response to Conclusion C1 (Economic Development), perform an economic impact analysis for the proposed IEI to quantify the economic development and other benefits of the proposed IEI.

R2. Salton Sea Water Budget: In response to Conclusions C2, C3, C6 and C7, develop water budgets for the Salton Sea and for the planned Salton Sea restoration, or update available existing water budgets.

R3. Salton Sea Salinity and Water Quality Models: In response to Conclusions C2, C3, C6 and C7, develop models for salinity and water quality in the Salton Sea and for the planned Salton Sea restoration, or update available existing models.

R4. IEI Influence on Salton Sea Salinity: In response to Conclusions C2, C3 and C6, use the water budgets and the salinity models for the Salton Sea to evaluate the impact of proposed IEI flows on TDS concentrations in the Salton Sea, to evaluate the influence of those impacts on the IEI design, and to refine estimated costs for the proposed IEI.

R5. IEI Influence on Salton Sea Water Quality: In response to Conclusions C2, C3 and C7, use the water budgets and the water quality models for the Salton Sea to evaluate the impact of the proposed IEI flows on TSS and BOD concentrations in the Salton Sea, to evaluate the influence of those impacts on the IEI design, and to refine estimated costs for associated components of the proposed IEI.

R6. Salton Sea Restoration Influence on IEI Design: In response to Conclusion C2, C3, C6 and C7, use the water budgets and the salinity and water quality models for the Salton Sea restoration to evaluate the impact of the proposed IEI flows on the planned restoration, to evaluate the influence of the planned restoration on the IEI design, and to refine estimated costs for the proposed IEI.

R7. Basin Plan Amendment Process: In response to Conclusion C4 (Basin Plan), evaluate the process and technical requirements for a Basin Plan Amendment to modify Salton Sea salinity and water quality regulatory requirements for the proposed IEI.

R8. Identify, Investigate & Initiate Partnerships: In response to Conclusion C5 (Stakeholder Partnering), seek opportunities to partner with other Salton Sea stakeholders in support of regulatory changes to encourage new sources of water supply to the Salton Sea in support of restoration efforts. This effort may include:

- Establish a dialogue with other organizations serving the San Gorgonio Pass, Coachella Valley areas, and/or other areas adjacent to the Salton Sea,
- Investigate community support for changes to the regulatory approach to Salton Sea salinity and water quality standards to encourage new sources of water supply for the Salton Sea, and
- Develop specific proposals for suggested regulatory changes and identify benefits. Communicate the suggested regulatory changes and associated benefits to the community.

R9. Hybrid Strategies for Brine Treatment: In response to Conclusion C8 (Brine Pretreatment and Treatment Strategies), identify and evaluate alternative strategies for treatment of the IEI flows, which may include hybrid designs incorporating Salinity Management Program brine pretreatment strategies in combination with alternative configurations of the wastewater treatment ponds and/or constructed wetlands that comprise the TF considered in this Appraisal Analysis.

R10. Alternative Designs for Surplus Energy: In response to Conclusion C9 (Management of Surplus Energy), develop and evaluate alternative strategies for management of surplus energy in IEI flows such as low-head in-line turbine generators and pressure reducing valves.

R11. Alternative Liner Materials: In response to Conclusion C10 (Other Opportunities), investigate alternatives to the proposed synthetic membrane liner under the TF, including site-specific soil investigations to determine actual soil permeability to facilitate investigation of alternatives such as soil treatment using clay and suitability of a "leaky wetland".

R12. Tunneling: In response to Conclusion C10 (Other Opportunities), investigate the constructability of and the impacts associated with direct-bury of the proposed pipeline through the Badlands west of the City of Beaumont along the Gas Main Alignment and the feasibility of tunneling in lieu of direct bury in that area.

R13. Phasing of Improvements: In response to Conclusion C10 (Other Opportunities), investigate opportunities for phasing of selected project components (e.g. use of dual pipelines in Coachella Valley) to defer costs until warranted by system flows, including a Present Worth analysis of the phased project costs.

## Summary

The Conclusions (Opportunities) and the associated Recommendations (Optimization Strategies) identified above are summarized in **Table 5.5.1-1**. Priority rankings are assigned the table to those recommendations, which are loosely based on the potential influence on the estimated project costs and/or the value of anticipated benefits.

**Table 5.5.1-1 Summary of Conclusions and Recommendations**

| CONCLUSIONS (OPPORTUNITIES) | | RECOMMENDATIONS (OPTIMIZATION STRATEGIES) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R1 - Economic Impact Analysis | R2 - Salton Sea Water Budget | R3 - Salton Sea Salinity & Water Quality Model | R4 - IEI Influence on Salton Sea Salinity | R5 - IEI Influence on Salton Sea Water Quality | R6 - Influence of Salton Sea on IEI Design | R7 - Basin Plan Amendment Process | R8 - Identify, Investigate, & Initiate Partnerships | R9 - Hybrid Strategies for Brine Treatment | R10 - Alternative Designs for Surplus Energy | R11 - Alternative Liner Materials | R12 - Tunneling in Lieu of Direct Bury | R13 - Phasing of Improvements |
| | PRIORITY | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 7 | 7 |
| C1 - Economic Development | 1 | x | | | | | | | | | | | | |
| C2 - Net Impact | 2 | | x | x | x | x | x | | | | | | | |
| C3 - Salton Sea Restoration | 2 | | x | x | x | x | x | | | | | | | |
| C4 - Basin Plan | 3 | | | | | | | x | | | | | | |
| C5 - Stakeholder Partnering | 4 | | | | | | | | x | | | | | |
| C6 - Salton Sea Salinity | 2 | | x | x | x | | x | | | | | | | |
| C7 - Salton Sea Water Quality | 2 | | x | x | | x | x | | | | | | | |
| C8 - Brine Pretreatment and Treatment | 5 | | | | | | | | | x | | | | |
| C9 - Management of Surplus Energy | 6 | | | | | | | | | | x | | | |
| C10 - Other Opportunities | 7 | | | | | | | | | | | x | x | x |

# 5.6 Water Use Efficiency



SAWPA's Demonstration Garden
Riverside, CA

## Background

Of the many broad watershed management strategies proposed under One Water One Watershed (OWOW) 2.0, the highest priority strategy to meet future water demands, as well as the most cost efficient, is water use efficiency. The OWOW Pillars and OWOW Governance support the importance of this strategy and need for changing current irrigation behavior and move forward with implementation of water use efficiency measures necessary to meet future water resource needs. The Water Use Efficiency (WUE) Pillar has worked closely with the other OWOW Pillars to recognize WUE is an absolutely necessary and key integration component of the overall watershed portfolio of existing, and planned water supply strategies to ensure a sustainable watershed for future generations.

The WUE element of the Integrated Regional Water Management Plan (IRWMP) is the product of a growing regional effort to diversify our portfolio of water supplies, drought-proof the watershed, and ensure a reliable water supply into 2030. The terminology "water use efficiency" implies and supports efficient use of all water resources at all times. To begin identifying how to support existing water conservation strategies, enhance existing programs and measures, develop new WUE efforts, and be a model for others in this arena, a comprehensive long-term WUE plan needs to be envisioned and developed.

Assessing the current and existing WUE conditions and resources will identify opportunities for agencies in the Santa Ana River Watershed and partnering agencies outside the purview of the watershed to work together to maximize expertise, share resources, apply for various WUE program funding sources, collaborate on regional public awareness initiatives, and expand implementation of WUE programs.

The reader will notice that the term “water use efficiency” has been used in place of “water conservation” in this chapter. In the past, “water conservation” was used in many state and local water planning documents to mean the effective and appropriate use of water by consumers. However, it is the consensus of the WUE pillar that this effective and appropriate use of water is more accurately described by the term “water use efficiency.” Furthermore, the phrase “water conservation” usually is associated with water-saving programs that are implemented when water supplies are compromised due to drought or a water shortage brought on by an emergency situation, thereby implying a water “diet.” By using the phrase “water use efficiency” in future program implementation activities, and in educational and outreach efforts, the WUE team intends to convey and emphasize year-round, long-term improvements in how we use water while maintaining quality of life standards.



## Current Conditions

### Description of Resource Management

With pressures on available local groundwater, and imported water supplies in the watershed increasing due to continuing drought conditions, increasing population, climate change impacts, and mandated cutbacks in imported water, collaborative, and integrated water resource planning, is critical for a sustainable future. A study by the Pacific Institute, “Waste Not, Want Not: The Potential for Urban Water Conservation in California,” concludes that WUE is the most cost-effective way to maximize diminishing water supplies, which makes it one of the most important components for diversifying the region’s water portfolio in the coming years.

Over the past decade, significant WUE measures have been implemented by Southern California water agencies. These programs include the large-scale replacement of old inefficient water fixtures and the upgrade of building and plumbing codes in the State requiring low-flow toilets and showerheads in all new development. It is anticipated that these types of regulatory mandates will continue to be enhanced as emerging technologies become available. Through these programs, the amount of water imported into much of Southern California has remained fairly constant, sufficiently meeting demands despite significant development and population increases. However, with the water supply outlook continuing to worsen, WUE will be a critical resource management strategy that this region will need to embrace.

WUE measures can be categorized as “active” programs, such as rebates, or “passive” programs, such as the incorporation of WUE into standardized plumbing codes. Currently, the majority of WUE water savings is achieved through passive measures. Active WUE measures, however, will provide for a more

holistic approach to watershed planning, and help usher a social transformation in water consumption attitudes and standards among the public and water industry. Through a combination of active and passive measures, it is estimated that over 20% of forecasted water demand in the Santa Ana River Watershed can be met through the implementation of aggressive WUE programs.

This subsection describes the current urban water resources available to the Santa Ana River Watershed. It also describes resource management programs currently implemented or participated in by the Santa Ana Watershed Project Authority (SAWPA) member agencies, and other partners within the watershed. These programs include: the OWOW initiative, programs offered by the California Department of Water Resources (DWR) Office of Water Use Efficiency and Transfers, the California Urban Water Conservation Council's (CUWCC) Memorandum of Understanding Regarding Urban Water Conservation; Metropolitan Water District of Southern California (MWDSC) Conservation Measure Funding, the United States Bureau of Reclamation (USBR) programs, other current resource management programs; and trends in WUE legislation.

### *DWR Office of Water Use Efficiency and Transfers*

The DWR Office of Water Use Efficiency and Transfers offers several WUE programs that are utilized by water agencies in the Santa Ana River Watershed. These programs include funding from the WUE Grant Program that was established by Propositions 50 and 84; The Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002; providing and updating the State Model Local Water Efficient Landscape Ordinance; and consulting with the State Energy Commission to develop performance standards and labeling requirements for water-efficient landscape irrigation equipment.



*Courtesy of MWDSC*

The Office of Water Use Efficiency and Transfers also offers an urban planning assistance program to assist urban water suppliers in meeting the requirements of the Urban Water Management Planning (UWMP) Act by preparing comprehensive and useful water management plans, implementing water conservation programs, and understanding the requirements of the Act. DWR is required to evaluate all applications for WUE grant and loan financing on the applicant agency's compliance with, and implementation of, its UWMP.

### *California Urban Water Conservation Council*

The CUWCC is a partnership of water suppliers, environmental groups, and others interested in conserving California's greatest natural resource – Water. The CUWCC was created in 1991 to increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private entities. A significant number of agencies within the Santa Ana River Watershed are signatories to their "Memorandum of Understanding Regarding Urban Water Conservation in California" (MOU), which is the foundation of the CUWCC. The MOU created a negotiated framework between water agencies and environmental groups to facilitate expedited implementation of reasonable water conservation measures. The agencies that are signatories to the

MOU have agreed to implement comprehensive urban water conservation best management practices (BMPs) intended to reduce long-term urban water demands, and to consider water conservation on an equal basis with other water resource management options.

The BMPs established in the MOU are listed in **Table 5.6-1** below. Many of these BMPs are significant to the future success of WUE programs and planning efforts in the state of California. However, with close to 400 MOU signatories, differences exist between how each agency implements and tracks the BMPs. For instance, public outreach methods and marketing strategies vary among agencies in the SARW due to differences in each agency's size and resources.

Some of the agencies within the SARW who are signatories to the CUWCC's MOU are pursuing regional and collaborative WUE planning efforts and funding programs, yet because these agencies are geographically located outside of MWDSC's service territory, they are finding it difficult to implement the CUWCC's BMP programs in the same robust fashion as their MWDSC counterparts.

**Table 5.6-1 CUWCC's BMPs**

| | | |
|---|---|---|
| Foundational BMP's | | |
| 1 | Utility Operations Programs | |
| 1.1 | Operations Practices | |
| 1.2 | Water Loss Control | |
| 1.3 | Metering with Commodity Rates | |
| 1.4 | Retail Conservation Pricing | |
| 2 | Education Programs | |
| 2.1 | Public Information Programs | |
| 2.2 | School Education Programs | |
| Programmatic BMP's | | |
| 3 | Residential | |
| 4 | Commercial, Industrial, Institutional | |
| 5 | Landscape | |

In addition to the BMP list, the CUWCC has developed two options: a Flex Track Options and a gallon per capita day Compliance Option. These options can be implemented by participating agencies to help them meet their savings goals for a particular BMP measure. Agencies choosing either of these options are responsible for achieving water savings greater than or equal to that which they would have achieved using only the BMP list items. Through this type of innovative approach, smaller agencies, as well as those that are implementing extraordinary conservation measures will be able to better demonstrate their efforts to achieve water savings.

### *MWDSC WUE Measure Funding*

Through a water conservation commitment to its member agencies, MWDSC provides incentive funding for a wide variety of WUE programs, devices, and measures throughout its service area. These programs are offered to residential, commercial and industrial, agricultural, and public sector entities.

In 2008, MWDSC issued a call for extraordinary conservation measures and outlined some of the tools that they would develop to help their member agencies achieve its call for increased water savings. MWDSC launched a region-wide residential rebate program to help make it simpler for the over 18 million people in their service territory to take advantage of rebates through a one-stop shop concept. The program, known as SoCal Water$mart, is proving to be very effective, and has increased the convenience factor for the average Southern California consumer.

To help defray the criticism of those that would point the finger at public agencies as some of the largest water wasters, MWDSC created the Accelerated Public Sector Program to provide funding opportunities to public agencies to help them implement WUE programs and practices. The program has proved to be a tremendous success, especially with cities and school districts across the southland.

MWDSC hosts a monthly WUE meeting for conservation coordinators to share information and learn about important changes in the field. Certain entities (including Pillar participants, San Bernardino Valley Municipal Water District (Valley District) and the City of Yucaipa), are within the SARW but lie outside of MWDSC's boundaries, and are therefore not eligible to participate in MWDSC's programs. It is crucial that watershed planners find ways to encourage the development of similar WUE programs and funding opportunities for these communities, especially since many of these areas fall within the auspices of the Disadvantaged and Tribal Communities Pillar and are home to disadvantaged stakeholders.

### *Resource Management Programs*

A variety of WUE management programs, pilot programs, and outreach efforts have been implemented by SAWPA member agencies, MWDSC, cities and counties, and other entities from within the watershed. These programs include:

- California Friendly Homes
- Targeted Water Conservation Programs
- Water-wise Ordinances and Design Guidelines for New and Existing Developments
- Green Building and LEED Standards
- Development Mitigation Credits for New WUE Programs
- Weather-Based Irrigation Controller (WBIC) Programs and rebates
- Agricultural and High Water Use Residential and Commercial Audits and Evaluations
- Landscape Irrigation Budgets
- Rotating Sprinkler Nozzles for Sprinkler Heads Rebates
- High-Efficiency Nozzles for Large Landscape Heads
- Turf Reduction Rebate Programs (Cash for Grass)

- Synthetic Turf Rebate Programs
- Residential and Professional Landscape Classes (California Friendly)
- Landscape Audit Programs
- Regional Landscape Alliances
- Variable Flow Pumping Systems for Homeowners Association (HOAs), Municipalities, etc.
- Custom-Sized, Pressure-Specific Pump and WBIC Packages
- US Environmental Protection Agency (EPA) WaterSense Certification Programs
- High-Efficiency Toilet (HET) Rebates, Direct-install and Distribution Programs
- Multi-Family High-Efficiency Toilet – Direct Install
- High-Efficiency Clothes Washer (HECW) Rebates and Added Incentives
- Industrial Water Use Reduction Audits and Incentive Programs
- Swimming Pool Cover and Rain Barrel Rebates
- Public Sector Incentive Programs
- CII Water Use Surveys & Rebate Program
- Hotel and Tourism Industry Programs
- HOA Outreach and Training Programs (Changes to CCRs)
- Industrial Process Performance Improvements Programs
- Allocated Budgeted (Tiered)Water Rates
- University Sponsored Water Institutes
- Fundraising Projects with Water-wise Plant Palettes
- Community Outreach Programs and Water Festivals
- Public Awareness and Communications Campaigns
- School Education Programs
- Water Conservation Demonstration Gardens
- Water-wise Landscape Contests, Gardening Guides and CDs

Various water agencies and other water related organizations in the watershed will implement WUE programs on a regional basis deemed to have a high probability of success and are cost-effective but will not duplicate MWDSC's conservation efforts. SAWPA, on behalf of the OWOW stakeholders and participants, will apply for grant funding to complement and expand on existing efforts.

### *WUE Policy and Legislation*

The California Legislature has been active in creating and passing legislation regarding WUE. Legislation passed by the California Legislature, such as AB566, AB 662, AB 715, AB 1420, AB 1560, and AB 1881, are guiding and shaping the way for WUE. AB 566 requires, rather than permits, the model landscape ordinance (per the Water Conservation Act) to include climate information for irrigation scheduling based on the California Irrigation Management Information System (CIMIS) system. AB 662 requires the minimum standards for operating efficiency of water-using devices/appliances be based on those efficiencies that will reduce the energy and water consumption rates, and that do not result in any added total costs over the designed life of the appliances concerned. AB 715 requires that all toilets sold or installed in California use no more than an average of 1.6 gallons per flush, and that all urinals sold or installed in California use no more than an average of one gallon per flush. It also requires that, on and after January 1, 2014, all toilets and all urinals, other than blow-out urinals, sold or installed in California are high-efficiency toilets (1.28 gallons per flush or less) and urinals. AB 1420 requires eligibility for any

grant or loan to an urban water supplier awarded or administered by DWR, State Water Resources Control Board (State Board) or the Bay-Delta Authority to be conditioned on the implementation of the water demand management measures described in the UWMP. DWR is required to convene an independent panel to provide recommendations to the legislature relating to adoption, implementation, and reporting of demand management measures. The DWR also must identify demand management measures that achieve a standard of excellence. AB 1560 requires the Energy Commission to prescribe, by regulation, water conservation design standards for new residential and new nonresidential buildings. Additionally, the DWR prepared a Water Efficient Landscape Model Ordinance as part of the implementation of AB 1881.

On November 6, 2009, the State Legislature approved Senate Bill X7-7 – Statewide Water Conservation as part of the State Comprehensive Water Package. This legislation establishes one of the most progressive mandates to establish statewide water use efficiency standards in the State's history. The bill includes the following:

SB X7-7 creates a framework for future planning and actions by urban and agricultural water suppliers to reduce California's water use. This bill requires the development of agricultural water management plans and requires urban water agencies to reduce statewide per capita water consumption 20 percent by 2020. Specifically, this bill:

- Establishes multiple pathways for urban water suppliers to achieve the statewide goal of a 20 percent reduction in urban water use
- Specifically, urban water suppliers may:
    - Set a conservation target of 80 percent of their baseline daily per capita water use
    - Utilize performance standards for water uses that are specific to indoor, landscape, and commercial, industrial and institutional uses
    - Meet the per capita water use goal for their specific hydrologic region as identified by DWR and other state agencies in the 20 percent by 2020 Water Conservation Plan
    - Reduce from a 10-year or 15-year baseline daily per capita water use, a specific amount for different water sectors: indoor residential, unmetered uses, commercial, and landscape
- Requires urban water suppliers to set an interim urban water use target and meet that target by December 31, 2015 and meet the overall target by December 31, 2020
- Requires DWR to cooperatively work with the CUWCC to establish a task force that shall identify BMPs to assist the commercial, industrial, and institutional sector in meeting the water conservation goal
- Requires agricultural water suppliers to measure water deliveries and adopt a pricing structure for water customers based at least in part on quantity delivered, and, where technically and economically feasible, implement additional measures to improve efficiency
- Requires agricultural water suppliers to submit Agricultural Water Management Plans beginning December 31, 2012, and include in those plans information relating to the water efficiency measures they have undertaken and are planning to undertake

- Makes ineligible for State grant funding any urban or agricultural water supplier who is not incompliance with the requirements of this bill relating to water conservation and efficient water management
- Requires DWR to report to the Legislature in 2013, 2016 and 2021, on agricultural efficient water management practices being undertaken and reported in agricultural water management plans
- Requires the DWR, the State Board, and other state agencies to develop a standardized water information reporting system to streamline water reporting required under the law

## Regional WUE Strengths, Weaknesses, Opportunities and Threats

As part of the process of evaluating the region's overall WUE performance and future WUE planning efforts, a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was conducted to determine best strategies and the most effective course of action. The identified Strengths, Weaknesses, Opportunities and Threats, which are further categorized as physical, institutional, and customer-related are summarized in the SWOT analysis described below.

### *Strengths*

The regional WUE strengths lie primarily in the activities and experience of the regional water agencies and their sub-agencies. SAWPA consists of five major water and wastewater agencies: Valley District, Inland Empire Utilities Agency, Western Municipal Water District, Eastern Municipal Water District, and Orange County Water District. Many of these agencies also serve as the primary wholesale water agency for sub-agencies within their service area.

Through SAWPA, multi-agency forums or roundtables are held among member agencies to provide interagency communication, communication with the public, and communication with regulating bodies. It is also through these forums that agencies can share their technical and practical expertise in WUE program implementation. By meeting together to discuss issues and concerns, a unified message and response is continually refined and implemented by agencies for important issues such as the water crisis and future policy initiatives. Additionally, other organizations including non-profit entities, coalitions, and environmental interest groups, as well as larger institutions such as MWDSC and USBR, have been instrumental in helping to create and maintain the region's vision for a sustainable watershed.

### *Weaknesses*

The regional WUE weaknesses lie generally in the differences in implementation of WUE programs, available agency resources for those programs, and in customer awareness and attitudes toward WUE.

With so many water agencies participating in regional processes, there are sometimes conflicting goals or priorities that can hinder progress. There also seems to be a gap in the distribution and implementation of conservation programs in various portions of the region. One reason is the ineligibility for conservation funding of those agencies that do not fall within the MWDSC boundaries. Public outreach and marketing methods vary due to the differences in the size and resources of agencies, budgets, and number of agency staff dedicated to WUE programs. This variance translates into

customers within the same region not being similarly informed, and thereby not attuned to local water usage issues and regional water conservation measures.

Additionally, the Santa Ana River Watershed is limited in the number of landscaping professionals, contractors, and other trade staff members who are knowledgeable about WUE, water-efficient techniques, and technologies; and who can serve as resources for water customers looking to implement WUE measures. It will be important to forge partnerships with industry groups and large retailers to help bring about a transformation in the marketplace by making it easier for consumers to purchase new water efficient irrigation devices.

### *Opportunities*

One of the key opportunities that can be implemented is the use and reiteration of the term "water use efficiency" instead of "water conservation" in any education or outreach to the stakeholders and the community. As explained previously, the word "conservation" usually conjures negative image of a water "diet", which is generally associated with times when water supplies are compromised due to drought. By using the phrase "water use efficiency," agencies convey the importance of efficient use of water resources at all times and encourage water-wise behaviors as an integral part of customers' lifestyles.

The weaknesses noted earlier are also opportunities to build new strengths. By using the OWOW WUE Pillar forum, agencies can collaborate on projects that will provide regional benefits by maximizing shared resources and developing new relationships and programs.

Other opportunities available to the regional WUE effort are mainly customer-oriented: changing expectations and behaviors; inspiring and motivating WUE; and providing information, training, and support programs regarding WUE and technologies. The opportunity for increased solution-oriented collaboration among water agencies and professionals is also a key opportunity.

There are many opportunities for WUE measures in the region. With the continuation of regional marketing measures, WUE issues can reach a broader audience throughout the region. SAWPA and local agencies will have an enhanced role to advance WUE by embracing emerging technologies, and creating grant-funded technical assistance for the region. Other WUE opportunities include new programs such as EPA's WaterSense, training classes for landscapers and the public, and the possibility of developing a contractor certification program. Better coordination with water agencies and cities will help promote new WUE ordinances based on AB 1881, the California Model.

Local Water Efficient Landscape Ordinance, such as the Riverside County Water Efficient Landscape Requirements Ordinance, County Ordinance 859; new water-efficient development; and the use of allocated tiered water rates. There also is an opportunity for SAWPA and local agencies to partner with the area's energy utilities on marketing and incentive programs for California's commercial, industrial, and institutional (CII) water users that target water use and water-related energy use. All of these opportunities will be designed to motivate customers to increase their WUE.

As implementation measures are enacted to comply with AB 32, California Global Water Solutions Act of 2006, to control greenhouse emissions, the advantages in reduced energy use of WUE applications become readily apparent. As indicated in **Figure 5.6-1**, on the following page, WUE is ranked as the most

energy efficient of water supply source per kWh/AF in Southern California based on research conducted by Dr. Robert Wilkinson, Director Water Policy Program, University of California, Santa Barbara.

**Figure 5.6-1 Energy Intensity of Selected Water Supply Sources in Southern California**

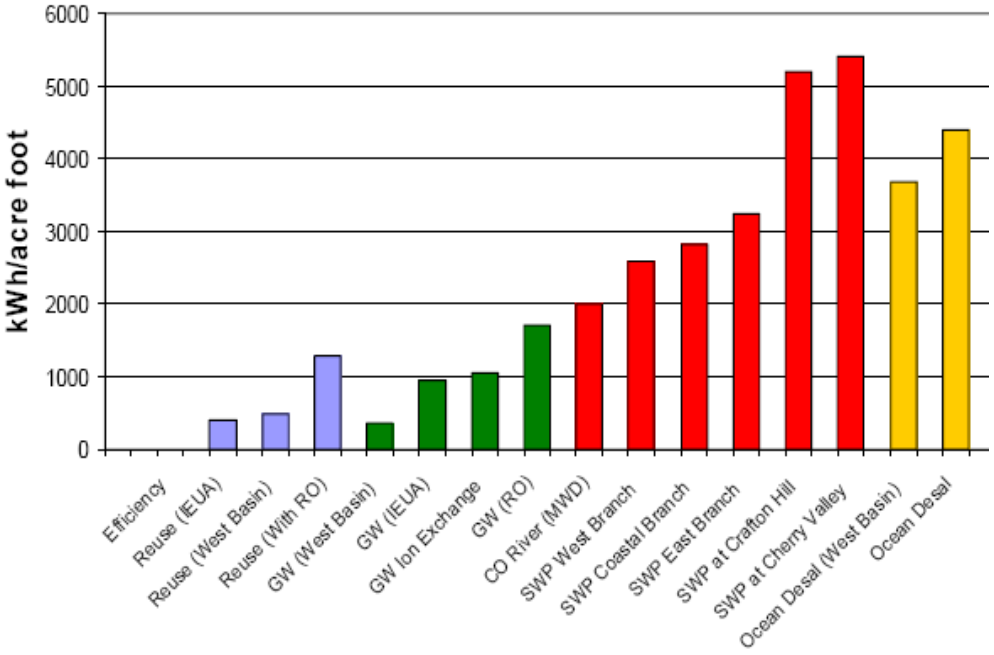
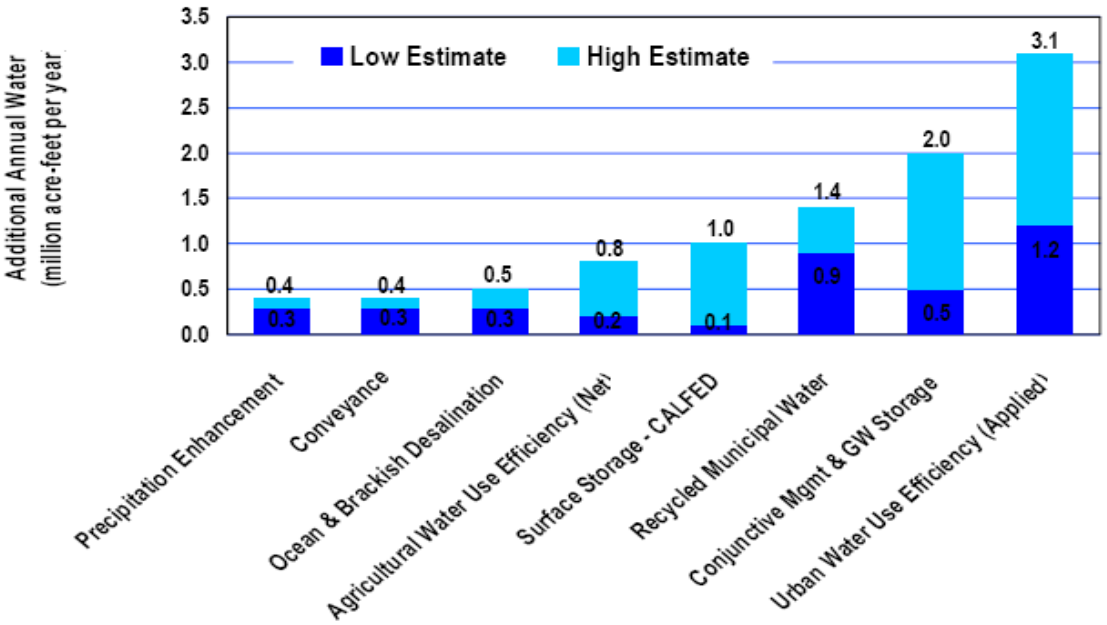



**Figure 5.6-2 California Water Supply**



Further, under **Figure 5.6-2**, of the many California water supply options available, urban WUE offers the largest supply available under low and high estimates statewide.

*Threats*

Funding, population growth, water infrastructure maintenance, and legislation are several main issues that could inhibit the regional WUE programs. The region is in need of programs to promote efficient use of its water supply, while facing a possible cutback on grant funding. Other issues include political pressures, the need for agencies to remain cost-effective and recent legislation requiring compliance with UWMPs.

Several of these threats are embodied in AB 1420, a bill signed by Governor Schwarzenegger in October 2007 regarding water demand management measures and water management grant or loan funds. This legislation states that eligibility for any grant or loan to an urban water supplier awarded or administered by DWR, the State Board, or the Bay-Delta Authority is to be conditioned on the implementation of the water demand management measures (DMMs) described in the supplier's UWMP. If the supplier is not in compliance with any of the DMMs in its UWMP, it will not be eligible for state funding grants or loans.

Agencies will have to work together to examine these potential threats and create a plan for moving forward if faced with any of these challenges.

## Identification & Implementation of Strategies to Improve Resources

With their key goal to reduce demand for imported supplies received from the State Water Project and Colorado River, SAWPA, its member agencies, and other retail agencies in the watershed are developing water-efficient strategies to become more self-reliant and sustainable. To identify opportunities for using water more efficiently, existing conditions and regional resources were identified and analyzed by the Pillar members.

### Water Use Efficiency Measures

The WUE Pillar meetings gathered information and ideas on potential new conservation opportunities, programs, and emerging technologies that could be implemented in the SARW. The WUE team developed two primary points of agreement: 1) the main focus of WUE's current and future efforts should shift from indoor residential water use to landscape and CII water use, and 2) regionally standardized WUE programs should be implemented throughout the watershed.

To develop a plan and outline strategies to accomplish these items, the WUE Pillar members held quarterly meetings to exchange information and ideas, partner and support each other's efforts, and coordinate with SAWPA staff. Through these meetings, a comprehensive list was created to summarize existing and potential new opportunities for WUE efforts. The WUE list was created by the Pillar. It lists several conservation measures by the following categories: Regional Programs and Incentives,

Landscape, CII, Financial and Policy Initiatives (also refer to *Current Conditions* section), and Partnerships and Outreach. Pillar members were invited to check off the WUE measures they currently were implementing, and measures they wanted to pursue. Using this information, the Pillar was able to review everyone's efforts and validate their agreed vision to focus on landscape and CII water use, and regionally standardized WUE programs.

The following is the list of the WUE Pillar's list of programs determined to be the most effective in the categories listed above:

*Regional Programs and Incentives*

- ***Promulgate HETs and High Efficiency Clothes Washer (HECWs)***
  Toilets and clothes washers typically account for 27% and 22%, respectively of residential indoor use, representing the most significant remaining savings potential for indoor use. (Note: Aggressive showerhead replacement programs in the early 1990's, in addition to plumbing code changes, have resulted in high saturation levels for low-flow showerheads). By replacing a toilet that uses 3.0 gallons or more per flush with one that uses 1.28 gallons per flush or less, a resident may receive $100, depending on the toilet selected and the incentive offered by the local water provider.

  Incentives also exist for residents who want to buy a new HECW that uses less water and energy than conventional washers. These incentives encourage residents to invest in and install WUE devices that will be used frequently in their households.

  Building upon the success of indoor WUE programs provides the groundwork to now shift the focus to outdoor and landscape water conservation measures. Out of all of the topics in the WUE matrix, the landscape category had the most conservation measures identified by the Pillar. The irrigation system improvements (audits and equipment) and the CII large-scale and key account audits and Implementation measures were the ones that were ranked the highest in the landscape category, which reinforces the Pillar's focus on landscape and CII water use.

- ***Utilize MWD's Regional Support for WUE Rebate Incentive Programs***
  MWDSC has implemented a program that allows water agencies to customize their rebates by adding additional incentives. The program also allows agencies to target markets, analyze data, and implement new approaches. MWDSC rolled out SoCal Water$mart, a regional residential rebate program where any resident within MWDSC's general service area will be eligible to apply for rebates on water efficient purchases for the home directly from MWDSC, thereby eliminating the ineligibility of customers who live in non-participating MWDSC areas. The landscape water use efficiency statewide market survey conducted by the Water Resources Institute at California State University, San Bernardino, shows that rebates would provide motivation for a significant percentage of decision-makers for residential and managed properties to invest in landscape water efficiency technologies.

*Landscape*

- ***Irrigation System Improvements (Audits and Equipment)***

Irrigation of residential and certain types of commercial landscapes currently is one of the largest uses of water. Landscape water use can be reduced by up to 30% by simply repairing broken or damaged irrigation components, adjusting pressure, retrofitting with more efficient components, and scheduling irrigation properly. A simple system improvement is retrofitting spray head sprinkler nozzles with rotating sprinkler nozzles. The rotating sprinkler nozzles apply water at one-third the rate of spray heads, thereby allowing the sprinklers to run for longer periods of time before runoff occurs.

A significant system improvement that can be accomplished in combination with other irrigation improvements to reduce landscape water use by 20% or more is the installation of a "smart" irrigation controller. It estimates or measures depletion of available plant and soil moisture, and replenishes water as needed while minimizing excess water use. It adjusts water application throughout the irrigation season without human intervention. There are two types of smart controllers: 1) sensor-based controllers, which use historical weather data, plus temperature and precipitation monitoring, or information provided by an on-site weather station; and 2) signal-based controllers that use localized weather data provided by the California Irrigation Management Information System or an equivalent. The benefits of encouraging and promoting the use of smart controllers include reduction of outdoor water use, healthy and attractive landscaping, reduction of runoff and non-point source pollution, and improved water quality.

*Commercial, Industrial, Institutional*

- ***CII Large Scale and Key Account Audits and Implementation***
  Large-scale CII customers use water in unique ways that must be examined for opportunities to save water on an industry-wide or individual basis. To assist with this, MWDSC has the Water Savings Performance Program that provides audits and retrofits to large industrial water users. Financial assistance is provided for documented water savings derived from projects implemented under the program that meet the qualifying criteria.

  Equipment for the proposed improvements may be purchased or leased. Typical process improvements that qualify include installation of equipment to capture, treat, and reuse water that otherwise would be discharged to the sewer, and replacement of existing equipment with more efficient process improvements resulting in reduced water demand.

  On a smaller scale, many local water agencies have obtained grant funding to implement local programs to assist commercial users in retrofitting to more efficient devices.

- ***SoCal WaterSmart Program***
  MWDSC's SoCal WaterSmart Rebate Program, in which three of the four eligible SAWPA member agencies participate, is tailored specifically for the CII and residential sectors. Rebates are available for numerous water efficient devices and technologies to help lower water and sewer bills, reduce energy costs, and address environmental impacts. The program also allows regional marketing to key strategic partners, including device vendors. The lifetime water savings for devices and

technologies installed to date in Southern California through the SoCal WaterSmart program is anticipated to be over 20 billion gallons.

The growing population in this semi-arid region puts an ever-increasing strain on the limited water supply. The dramatic anticipated water savings resulting from the SoCal WaterSmart program show that one of the best ways to meet this demand is for Metropolitan and its member agencies to help customers become more aware of water-saving technologies, and to provide the necessary financial incentives to encourage their implementation.

## Other Inferences from the WUE Matrix

The other categories of financial and policy initiatives, and partnerships and outreach, are important in strategizing, designing, and implementing WUE efforts. Each is a category that directly affects and influences the direction and development of future WUE programs.

### *Financial and Policy Initiatives*

Water budgets and allocated tiered water rates offers individualized allocated water budgets for each water customer. This creates a structure that encourages people to stay within their water budget, and may be used at the discretion of local retail water agencies to penalize those who are careless or excessive with their water use. The money generated from overuse penalties is used as a funding source to implement new local WUE programs. AB 2882 supports this strategy by allowing wholesale and retail water suppliers to adopt allocation-based conservation water pricing.

### *Partnerships and Outreach*

Partnering and outreach is an integral part in building consensus, sharing resources, and unifying the message for WUE efforts. There were numerous responses from WUE Pillar members on the ideas for how to partner with Resource Conservation Districts and Pollution Prevention/Water Quality efforts.

- ***Partner with Resource Conservation Districts***
  Conservation districts emerged during the 1930s as a way to prevent the soil erosion problems of the Dust Bowl from recurring. Formed as independent local liaisons between the Federal government and landowners, conservation districts have worked closely with the USDA Natural Resources Conservation Service (formerly the Soil Conservation Service).

  In California, conservation districts are called Resource Conservation Districts (RCD), and are independent "special districts" organized under the state Public Resources Code, Division 9. Each RCD has a volunteer Board of Directors made up of five to nine district landowners who are elected locally or appointed. Currently, 103 RCDs in California work to address a wide variety of conservation issues including forest fuel management, water and air quality, wildlife habitat restoration, soil erosion control, and conservation education.

  Because RCDs are grassroots, nongovernmental organizations, they have no regulatory power and must meet their goals for the natural resources in their community through voluntary approaches, i.e., neighbors asking neighbors to cooperate. Opportunities exist for agencies in the watershed to

work with local RCDs on cooperative efforts to improve the natural environment, in this case, through WUE.

- ***Partner with Pollution Prevention/Water Quality Efforts and Vector Control***
  A major source of water pollution is "non-point source" pollution, or pollution that comes from an indirect source. Storm runoff and excess irrigation are primary sources of non-point source water pollution. Irrigation runoff can contain fertilizers and pesticides that can harm habitat, flora, and fauna. Contamination of streams and rivers, as well as groundwater can result from storm and irrigation runoff if they carry pollution loads that are high. Reduction of non-point source water pollution is especially critical in areas that drain directly into the watershed. Reducing the use of irrigation and scheduling irrigation correctly to avoid runoff can accomplish this. Similarly, the majority of mosquito and vector activity is in and around storm drains, so reducing runoff will help alleviate this problem and reduce the threat of vector-based diseases such as West Nile Virus. There also are opportunities to share public outreach messaging among the various regulating agencies.

- ***Partnership and Collaboration***
  Many agencies on their own have contributed to the current WUE programs and these efforts do not go unnoted. The existing programs are the foundation for our next steps, which include maintaining as well as expanding existing partnerships and collaborations with water wholesalers, sub-wholesalers, retailers, and municipalities.

  Another potential opportunity is to create new and innovative partnerships with customers that are large water users, such as schools, parks, businesses, irrigation companies, HOAs/property managers, gardeners, landscape architects, and contractors. Some of these partnerships could correspond with other CII programs.

  Collaborations with energy utilities could lead to improved outreach, cost-savings and opportunities for increased (combined) financial incentives that will further motivate participation. Energy utilities already are partnering with key water agencies, including MWDSC, on the pilot water-energy programs outlined in the California Public Utilities Commission’s ruling regarding water-related energy use.

  Other possible partnerships and collaboration efforts include co-marketing between water agencies and product vendors. Examples include the WUE device certification with the EPA’s “WaterSense” certification and labeling program, or WUE device training sessions sponsored by water agencies and led by a representative from the device’s manufacturer.

  The WUE Pillar also can support partnerships and collaboration among water agencies by serving as a forum to share ideas on what works or does not work for an agency. Collaboration between SAWPA member agencies in and outside of the MWDSC service area on WUE programs will allow those agencies and their customers outside of the MWDSC Metropolitan area to participate.

- ***Public Outreach: Emphasis on Outdoor Landscaping and Irrigation Efficiency***

With up to 70% percent of household water consumption going toward outdoor use, there is a growing need to provide water efficient programs targeting outdoor landscaping. There are various ways to increase water efficiency of outdoor landscaping. The outdoor efficiency program topics identified by the WUE team include:

*Marketing programs:*

- Changing landscape design elements: increase pervious hard surfaces, pavers and bioswales
- Creating sample landscape plan templates
- Using captured rainwater, recycled wastewater, gray water, or treated water for non-potable uses including irrigation
- Positioning water-efficient gardens as in style and "hip"
- Utilizing marketing suggestions from the Water Resource Institute (WRI) Landscape Water Use Efficiency statewide market survey: positives of water smart landscapes, the cost of doing nothing, children's involvement, and responsibility for the environment
- Targeting marketing efforts to various demographic communities

*Technology/training programs:*

- Advancing emerging technologies such as, smart irrigation controllers, high-efficiency nozzles, and new irrigation device technology
- Creating a comprehensive package for consumers to promote use of smart irrigation controllers (e.g. rebates, stores, installers, training, and check-ups)
- Advocating use of climate-appropriate plants and functional warm season turf throughout the region
- Developing a "one-stop shop" that offers accessible and comprehensive water-efficient landscape planning programs

- ***Public Outreach: Community-Based Social Marketing***

  Community-based social marketing is a behavior-change tool that can supplement traditional information-intensive marketing campaigns. Previously utilized as a strategy in health care initiatives such as smoking cessation, it now is being utilized for other causes, including natural resource management, to achieve the adoption of environmentally sustainable behaviors by the members of our communities.

  Community-based social marketing involves four steps: 1) identifying the barriers and benefits to a sustainable behavior through a combination of literature reviews, focus groups, and survey research; 2) developing a strategy to promote the sustainable behavior that utilizes "tools" that have been shown to be effective in removing barriers and changing behavior; 3) piloting the strategy; and 4) evaluating the strategy once it has been implemented across a community. These steps result in a community outreach campaign that will successfully foster the desired sustainable behavior, which in the WUE Pillar's case, is water-efficient behavior.

  There are several typical reasons why people do not engage in a particular sustainable behavior. One reason is that people are unaware of the activity and/or its benefits. Another reason is that the

activity may be perceived as having significant difficulties and barriers associated with adopting it. For example, people may believe that switching their traditional garden to a California-friendly landscape is a daunting task that requires expertise and money. A third reason why people do not engage in a sustainable activity is that they feel that there are no significant barriers that discourage their current behavior. For example, irrigation schedules are left the same throughout the entire year because it is easier to leave it alone rather than have to adjust it due to weather conditions or the time of year.

To better influence what people do, community-based social marketing helps public outreach campaigns to identify perceived barriers and benefits to an action, and promote specific changes to overcome those obstacles. People naturally tend to gravitate to actions that have the most benefit and that have the fewest barriers to overcome. Additionally, perceived barriers and benefits vary from individuals and groups. What may work for one neighborhood may not work for another, or what may work for residents may not work for businesses. Behaviors also compete with each other; as one adopts a new behavior, the previous behavior is being rejected. For example, the behavior of capturing cold water in a bucket before the shower water gets warm replaces the behavior of letting the unused water run down the drain.

Because of this diversity of motivations, the perceived barriers and benefits to the desired sustainable behavior have to be understood so that the available behavior change tools can be prioritized by the benefits they offer and barriers they remove. From this analysis, effective community-based social marketing strategies can be developed. For future community-based social marketing efforts by the WUE Pillar, the WRI Landscape Water Use Efficiency Statewide Market Survey will be a good starting point as it identifies several residential and managed properties incentives and barriers to increased landscape WUE.

Once a sustainable behavior-specific marketing strategy has been developed, the piloting and post-pilot evaluation of the behavior change strategy ensure that a project is effective at achieving the desired result before it is implemented on a large scale. By careful research and planning, pilot testing, and pilot results evaluation, community-based social marketing strategies that promote sustainable behaviors, can successfully become and remain a part of people's lifestyles.

## Other WUE Strategies Discussed in WUE Meetings

The following is a brief summary of additional measures prioritized by the WUE Pillar that were not included in the Table of WUE Measures, but highly discussed in WUE meetings.

- ***UWMP***

  In the area of WUE planning, water agencies in California must perform certain minimum planning processes required by the California Water Code. The most informative of these planning tools is the UWMP. Agencies that either have more than 3,000 service connections or deliver more than 3,000 acre-feet annually must complete a UWMP, at least every five years. The UWMP incorporates requirements for describing how the agency will implement WUE demand management measures, which are equivalent to the CUWCC BMPs. In the Santa Ana River Watershed, there are many

overlapping water agency jurisdictions and their respective UWMPs, creating a large amount of information about WUE. BMP implementation information is also available, much of it from the CUWCC.

- ***20 x 2020***
  The Water Conservation Bill of 2009 (SB X7-7) provides the regulatory framework to support the statewide reduction in urban per capita water use described in the *20 by 2020 Water Conservation Plan*. Consistent with the Bill, each urban water supplier must determine and report its existing baseline water consumption and establish future water use targets in gallons per capita per day. The first report began with the 2010 UWMP.

  An urban water supplier must set a 2020 water use target and an interim target for 2015. There are four methods or options for compliance: 1.) establish a conservation target of 80% of their baseline daily per capita water use; 2.) utilize performance standards for water uses that are specific to indoor, landscape, commercial, industrial and institutional uses; 3.) meet the per capita water use goal for the appropriate hydrologic region; 4.) reduce from a 10 year or 15-year baseline daily per capita water use, a specific amount for different water sectors. Option 4 is subject to revision by the DWR prior to 2015.

- ***Evaporation and Transpiration Correlation***
  Significant water loss can be attributed to evaporation and transpiration. Evaporation accounts for surface water that enters the air as vapor due to the heat of the sun. Transpiration accounts for the use of water by plants. By promoting climate-appropriate plant species instead of turf grass, transpiration is reduced. By planting more trees, the amount of shade area is increased, which reduces evaporation and the heat island effect.

  There will be opportunities for water agencies within a watershed to partner with other public and private entities that share the same goal of increasing the amount of climate-appropriate plants in the watershed. The goal of reducing evaporation and transpiration should be incorporated into the plant palette idea, where landscape contractors can recommend a palette of plants that are climate-appropriate to a resident, business, or industry. Additional evaporation reductions can be accomplished by providing incentives or voucher programs for swimming pool and spa covers, and banning outdoor misting systems.

## Collaboration and Integration with other OWOW Pillars

The nine other OWOW Pillars are developing programs, resources, and strategies for addressing challenges in their areas of expertise, similar to the WUE Pillar. By integrating strategies from multiple OWOW Pillars into planned water resource management programs, and by increasing program planning and implementation coordination among Pillars, efficiencies and benefits are generated that yield program results greater than those achieved through the efforts of a single agency or Pillar. Additionally, collaboration that produces consensus among the OWOW Pillars creates a stronger, more unified voice to communicate regional water management goals, strategies, and messages to stakeholders. Described

below are the three reasons that collaboration and planning integration with other OWOW Pillars is crucial to the fulfillment of the WUE vision.

## Leveraging Expertise

The WUE Pillar aims to maximize the benefits of the work of the other Pillars and water agencies by incorporating their expertise in future WUE programs. Among others, the Water Resource Optimization, Stormwater: Resource and Risk Management, Energy and Environmental Impact Response, and Land Use and Water Planning Pillars share common ground with the WUE Pillar. For example, WUE is a response to the region's dependence on imported water supplies, which is a water supply reliability and climate change concern, and WUE targets behaviors that create dry weather run-off that carries non-point source pollution. Collaboration and information sharing between these Pillars and the WUE Pillar will create consistency among programs and services, establishing a norm that is recognized within and beyond the region.

The more connections that can be made between Pillars in the design of a project, the more the project can be deemed valuable and successfully prioritized for funding and implementation due to its ability to provide multiple benefits. On another level, publicity and marketing strategies can be maximized through the dissemination and repetition of the message across different Pillars and diverse audiences.

Additionally, as WUE is a watershed-wide goal shared by many Pillar areas, the potential exists for the WUE Pillar to become a clearinghouse for WUE programs and resources, which could be made available through a Website for easy access. The WUE Pillar also could take on the role of a regional coordination planning body for WUE experts, including irrigation repair services, landscape design firms, and landscape contractors. Putting the public in touch with these experts through the clearinghouse would demonstrate a grassroots and social marketing approach to the implementation of WUE measures.

## Leveraging Resources

Water resources are vital to the Santa Ana River Watershed, and resources including time and funding are vital to the successful implementation of WUE projects and programs. As the Santa Ana River Watershed's water resources cannot meet unlimited demands, and the WUE Pillar members' time and funding do not allow an unlimited number of WUE programs to be implemented, leveraging available resources to achieve the most benefit is critical.

In terms of water resources, the water agencies in the Santa Ana River Watershed currently rely on varying degrees of imported water supply to meet customer needs. Through the identification of existing local resources such as groundwater and recycled water, water agencies will be able to better leverage water supply resources. One of those available local water supply resources is water saved through WUE measures.

Especially now, as the State Water Plan and the SB X7-7- Statewide Water Conservation is in full swing along with current legislative initiatives of AB 1420 (access to water conservation funding), AB 1881 (water efficient landscapes and land use planning), focus on water efficiency, increased engagement by, and resources from, the WUE Pillar will be necessary to meet these new requirements.

One way to leverage time and funding resources is to group together WUE projects and programs by similar geographic areas. By collaborating on work activities, timelines, and stakeholder outreach, the sponsors of these projects and programs can reduce project costs, lessen community impact by decreasing completion time for capital projects, and achieve greater success in community outreach and stakeholder behavior change for education and marketing programs.

Having multiple Pillars come together to combine various water management strategies within a single project or program, is another way to leverage time and funding resources. For example, the Water Resource Optimization, Stormwater: Resource and Risk Management, Energy and Environmental Impact Response, Disadvantaged and Tribal Communities, and Land Use and Water Planning Pillars could integrate WUE into all resource-based planning efforts (*i.e.*, treating WUE as a supply source and as a means to offset climate change impacts, while mitigating land use impacts). WUE provides opportunities to increase demand for recycled water use. Landscape water conservation programs have a secondary benefit of reducing runoff and non-point source water pollution, as well as reducing the proliferation of vector-based diseases.

As available staff and funding resources are not uniform among member agencies, leveraging resources and programs across geographical areas and Pillars can address equity and fair distribution of resources while maximizing results. WUE programs and WUE ads can be spread across geographic areas and Pillars to leverage resources and maximize benefits. Using region-wide communications outlets obtains the greatest benefit for the funding resources available by allowing the ads' messages to reach the widest audience possible, and can result in earned media, better ad rates, and extra airtime.

Employing WUE staff expertise and funding resources on a regional basis using the IRWMP process ensures that smaller agencies and agencies outside of the MWDSC service area have access to the available resources. Pursuing regional implementation of programs will help to both leverage and balance resources, as agencies already implementing WUE will impart their expertise in the design and implementation of new regional WUE programs. These programs will then be available to the customers of smaller agencies, and regional programs will be able to employ new implementation formats and access new funding. The region's water agencies will benefit from more consistent messaging and improved reliability of regional WUE programs.

Leveraging the available resources to implement WUE programs that benefit those with sufficient means and those in need of resources is a proactive approach that will maximize the WUE benefits throughout the region.

### Leveraging Funds

Integration of water management strategies across geographies, within the project implementation process, and through partnerships between agencies can result in significant financial efficiencies. Collaborative projects that are widely supported can be more far-reaching and implemented more quickly, effectively, and efficiently than could be accomplished by one agency focused on a single water management strategy.

Spreading WUE funding throughout a watershed results in cost benefits through the integration of multiple strategies or messages and through regional marketing efficiencies. For example, Valley District and the Yucaipa Valley Water District (YVWD) are within the SARW, but are not MWDSC member agencies, making them ineligible for MWDSC efficiency funding. However, collaborative projects with regional benefits facilitated by the OWOW effort, such as a regional conservation incentive funding program that would overlap with efforts by MWDSC Metropolitan member agencies, SAWPA agencies, and Pillars, would be a way to enable Valley District, YVWD, and other agencies outside of MWDSC's boundaries to receive funding and to maximize WUE benefits and results.

Funds also can be leveraged to achieve goals through regional partnerships and projects that use matching funds, such as MWDSC's conservation credits program. Created in 1988 and regularly updated, this conservation credits program provides funds to MWDSC's Metropolitan's member agencies to advance their individual demand management strategies. Additionally, Federal government funds could be used to leverage State and local funding.

Focusing in particular on the Water Resource Optimization, Energy and Environmental Impact Response, and Disadvantaged and Tribal Communities Pillars, Santa Ana River Watershed water agencies should incorporate WUE funding into their planning portfolios to ensure a constant funding stream for WUE programs and efficiency measure implementation.

## Description of Data Collection and Compilation Process

### Stakeholder Identification

The WUE Pillar is comprised of over 40 stakeholders from all three counties (Orange, Riverside, and San Bernardino), consisting of WUE experts, consultants, business leaders, and other industry leaders. Members were solicited during several outreach events held by SAWPA in the early stages of the planning process. A fish bowl type public involvement approach (participants placed their business card in a "fish bowl" for each Pillar group of interest to them) was used to gather interest and collect contact information from potential participants. SAWPA also sent numerous email outreach blasts that invited and encouraged involvement and participation. Some members volunteered and others were assigned by their respective agencies.

### Strategies Deployed to Involve and Motivate Stakeholders

Strategies used to involve and motivate the WUE members were establishing meeting dates early, creating an advisory committee within the larger pillar group, structuring meetings to constructively

gather input, committing attendance for half-day brainstorming sessions, providing refreshments and lunch at workshops, making chapter drafts available electronically for review and comment, and continually reaching out to potential new participants.

## Event Coordination

A chapter outline was developed by compiling input from a total of three large-scale meetings, PowerPoint presentations, and other resources, and organizing them into the categories developed by SAWPA. An interactive workshop was developed as a way to review the outline and gather more information. Participants were assigned to a group that worked on a particular section of this chapter. Within these groups, participants discussed and refined the key message of the section. Each group answered the question: "What should be the key message of this section of the WUE Chapter?" Participants were asked to develop key messages that relate to the mission statement of WUE discussed in the last meeting, and to determine if keywords, such as "future vision" and "proactive" needed to be part of the mission statement.

Another assignment for each group was to review a section of the WUE chapter. Participants read through their chapter section outline and discussed what information was missing or needed to be further developed. Each group thought about:

- What information is missing that is needed to support the section's key message?
- Can this section be organized or structured differently?
- Are there examples that can be placed in this section?
- Is there a program or resource that needs to be described in more detail in this section?
- What resources can be researched and cited?
- What supporting graphics/photos can communicate ideas in this chapter section?
- Are there statistics that need to be included in this chapter section? If so, where can this information be extrapolated?



Each group then presented their ideas of their key message and chapter section to the rest of the team. Afterwards, each participant was able to comment and add information to other sections of the chapter. Additionally, two matrices were provided to the stakeholders: Table of WUE Measures, and Table of BMPs. These matrices will serve as comprehensive databases to summarize efforts in the SAWPA OWOW region. Participants were asked to fill out these matrices marking the existing and future efforts of their organization in terms of WUE and the CUWCC's BMPs. With over 100 agencies listed in the matrix,

these working databases identify and track areas of overlap, areas of collaboration, areas in need of development or improvement, and levels of prioritization.

## Data Collection Methodology

Some of the SAWPA member agencies serve disadvantaged communities that have not yet had the opportunity to access grant funding to implement WUE programs. Other agencies have been promoting WUE for years, or have not begun at all. Thus, within the Santa Ana River Watershed, there are varying levels of familiarity with, and implementation of, WUE programs. It is this "uneven playing field" that the WUE Pillar has attempted to address by devising mechanisms to allow the Santa Ana River Watershed as a whole to achieve water demand reduction. Key questions regarding implementation of WUE programs in the Santa Ana River Watershed include:

- Should an approach to WUE be broad and non-specific so that agencies within the region have local flexibility, or should there be a list of specific measures and projects that have high potential for multiple regional benefits that are to be implemented by all agencies?
- If a conservation measure or project is locally cost-effective, should it be implemented regardless of the availability of grant funding?

Because each agency has its own set of ongoing circumstances, customers, and funding, agencies have differing preferences about the answers to these questions.

As a way to envision the greater picture of how to design a plan of action, the WUE Pillar members have expressed a desire to hold quarterly meetings to exchange information and ideas, partner by supporting each other's efforts, and coordinate with SAWPA staff. By coming together regularly, members can prioritize next steps, coordinate grant funding opportunities, and continually evaluate each WUE strategy to confirm its cost-effectiveness and benefits to the region.

Under the OWOW Plan, comprehensive databases were compiled to summarize two large efforts in the SAWPA OWOW region: 1) List of WUE measures: existing and potential new opportunities for WUE efforts, and 2) Table of BMPs: implementation coverage of the CUWCC BMP. With over 100 agencies listed, these working databases identify and track:

- Areas of overlap
- Areas of collaboration
- Areas in need of development or improvement
- Levels of prioritization

The WUE "opportunities" matrix was developed under this Plan that identifies existing and potential new programs as a result of a Pillar brainstorming effort. The programs are categorized as Regional Programs and Incentives, Landscape, CII, Financial and Policy Initiatives, and Partnerships and Outreach. Each SAWPA member agency has indicated which programs are of most interest to their service area.

This Plan demonstrated that water efficiency measures could have significant beneficial impacts on future water supplies in the region and how they are managed. As the major regional wholesalers, MWDSC and Valley District have compiled water demand and supply data. MWDSC also has provided water conservation savings data. The data is based on the 2005 UWMPs and the OWOW 1.0 plan, as well as MWDSC's internal planning processes with data gathered from its member agencies. These datasets were discussed and analyzed in the WUE Pillar to determine the potential level of savings that will be targeted in the IRWMP.

One challenge is obtaining conservation savings data from those retail water suppliers within the Santa Ana River Watershed that are not MWDSC member agencies or sub-agencies, or that have not signed the urban CUWCC MOU. Most of them will likely have supply and demand data, but they may not necessarily have conservation savings data. Agencies that have this full set of information should be contacted to make sure the data is integrated into the data set.

## The Future of Water Use Efficiency

Agencies and their partnerships with each other and private industry will continue to collaborate and develop new programs promoting water use efficiency. The ultimate goal will be to get water customers to automatically base decisions on what is the most water efficient way to plan, implement, and maintain devices and landscapes. This will require customer education and continued incentives to promote water use efficiency. The sector that demonstrates the greatest potential for water savings is the landscape. Therefore, the WUE Pillar will move forward with collaborative projects that primarily emphasize outdoor efficient use of water.

### Customer Handbook for Using Water Efficiently Outdoors

When it comes to using water outdoors, particularly when using water to irrigate, most water customers do not know how to be efficient. The WUE pillar plans to create and promote an engaging customer handbook to promote the use of, and assist customers with, using landscape water efficiently. The handbook will be specific to the SARW, authored by University of California Cooperative Extension researchers and others, and will be available to anyone in the watershed. The handbook will inform the public about the importance of knowing some basic soil science, as well as landscape and irrigation design, implementation, and maintenance to prevent inefficient water use. Up to 30% of a landscape's water use can be eliminated by simply repairing and adjusting irrigation, and using an appropriate plant palette. However, most people do not know how to fix irrigation problems, properly schedule their irrigation, or select appropriate plants. This guide will entice people to educate themselves on specific methods and materials that will assist them in becoming water-efficient in their landscape.

### Inland Empire Garden Friendly

Most of the Santa Ana River Watershed lies within what is locally known as the Inland Empire. This area consists of the greater basin that lies within western San Bernardino and Riverside counties. Public agencies, California State University, San Bernardino, and Rancho Santa Ana Botanic Garden formed the Inland Empire Garden Friendly Program to expose the public to a recognizable branding that identifies with using water efficiently in the landscape. Agencies have partnered with The Home Depot and local nurseries to successfully promote climate-appropriate plants. The program has a website that contains information on local workshops, plant sales, botanical gardens, a plant list, and other related resources (http://www.iegardenfriendly.com/). Increased promotion, events, and a greatly expanded plant database are planned for the future.




## Agricultural Water Use

Within the watershed, there are over 157 million acres in production consisting of nursery stock, fruit and nut crops, field crops, and vegetable crops with a value of over $388 million dollars. Almost all of these crops would not be possible without irrigation.

Resource conservation districts and water districts are expanding their role in conducting irrigation audits. MWDSC recently opened its water saving performance program to include agricultural customers. This program provides financial incentives, up to 50% of eligible project costs, for customized water efficiency improvements. The WUE Pillar will be working on irrigation management strategies, and making new technologies available to farmers.

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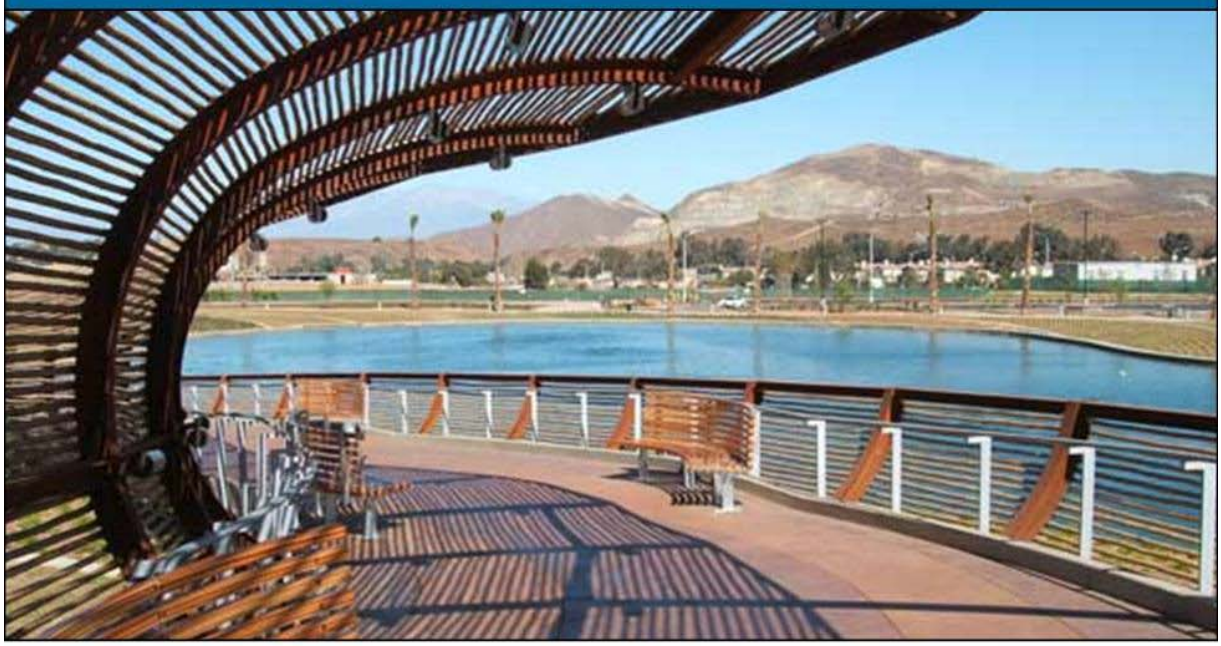
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| Lee Reeder | Inland Empire Waterkeeper |
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| Carlos Rodriguez | Building Industry Association, (BIA) Baldy View Chapter |
| Paul Rugge | Western Municipal Water District |
| Jack Safely | Western Municipal Water District |
| Elizabeth Sanchez | Riverside Public Utilities |
| Fiona Sanchez | Irvine Ranch Water District |
| David Schroeder | Chino Basin Water Conservation District |
| Jeff Simonetti | Building Industry Association, (BIA) Baldy View Chapter |
| SarinaSriboonlue | Malcolm Pirnie, Inc. |
| Matthew Stone | Municipal Water District of Orange County |
| Helen Stratton | Eastern Municipal Water District |
| Gordon Treweek | Chino Basin Water Master |
| Roger Turner | Roger Turner & Associates, Inc. |
| Dean Unger | Santa Ana Watershed Project Authority |
| Julie Vandermost | Native Grow Nursery |
| Eudell Vis | California State Polytechnic Univ., Pomona |
| Rob Whipple | Elsinore Valley Municipal Water District |
| Deb Whitney | United States Bureau of Reclamation |
| John Wiedmann | Metropolitan Water District of Southern California |
| Shelby Wimberly | Riverside Public Utilities |

# 5.7 Land Use and Water Planning



The Shops at Dos Lagos
Corona, CA

## Introduction

The Land Use and Water Planning Pillar for One Water One Watershed 2.0 (OWOW) was re-formed in early 2012 and was co-chaired by Jerry Blum, City of Ontario Planning Director and Susan Lien-Longville, Santa Ana Regional Water Quality Control Board (RWQCB) Board Member (formerly Water Resources Institute: CSU, San Bernardino). The Pillar conducted ten meetings at the Santa Ana Watershed Project Authority (SAWPA) between July 2012 and August 2013, which were regularly attended by staff from water and utility agencies, Caltrans, the development community, resource conservation groups, and interested consultants.

Land use decisions are arguably the primary underlying cause of, and potential solution for, the existing water supply, water quality, and natural resource challenges in the Santa Ana River (SAR) Watershed. Similarly, relative energy use and greenhouse gas emission levels result from the level of efficiency produced by land use patterns. Land use designations and development through time have resulted in areas of economic vitality and comfortable living, while leaving other areas in blighted conditions, with inequitable exposure to environmental hazards and poorly maintained infrastructure. To improve conditions and create a sustainable watershed, land use decisions must provide net watershed benefits. We must avoid land use decisions that allow net degradation of watershed conditions.

The Land Use and Water Planning Pillar reviewed the guidance of the Department of Water Resources (DWR) Integrated Regional Water Management (IRWM) Guidelines, Relation to Land Use Planning Standard to assist the development of this chapter and actions to support their efforts. This section encouraged an exchange of knowledge and expertise between land use and water resource managers;

examining how Regional Watershed Management Groups (RWMG) and land use planning agencies currently communicate; and identifying how to improve planning efforts between the RWMGs and land use planning agencies.

This Chapter: 1) describes the history of development and watershed planning efforts in the Santa Ana River Watershed; 2) identifies key watershed sustainability needs; 3) evaluates how watershed priorities can be addressed by improved collaboration between water and land use agencies; and 4) recommends the strategies and implementation actions expected to be effective to ensure watershed sustainability priorities are a primary consideration in the land use decision process. Finally, this OWOW 2.0 Plan (Plan) updates and revises the OWOW 1.0 Plan.

Chapter 1.2 of the OWOW 1.0 Plan, Moving Towards Sustainability, summarized the history of land use patterns and practices in the Santa Ana River Watershed and some of the impacts of land use decisions on water resources and lessons learned. An objective analysis of the strengths, threats and weaknesses of land use patterns and practices is followed by strategies that address land use and water management producing mutually beneficial and cost effective results. The chapter closes with suggestions of collaborative partnerships between regional water management agencies and local governments, and private sector developers and environmental organizations to address the sustainability of prior and future land use decisions. The authors of this chapter are confident that solutions to the challenges we face in the watershed are limited only by our determination to solve complex land use and watershed sustainability problems by working together.

The way in which we manage water resources is inextricably linked to our land use patterns. Our current land use planning and practices have damaged and threaten to further damage our water-supply reliability, and are costly in many other ways, including loss of historic watershed functionality, habitat deterioration and high energy consumption for transport. This problem can be stopped and even reversed if local governments and their planning and water agencies, real estate developers, and the environmental community work together to fully incorporate water in the development process. No one agency can be successful working alone.

Working together, the watershed can increase the understanding that unavoidable impacts do result from previous long-standing standard building practices. Embracing a sustainable development ethic steers the Watershed in a direction to meet human needs, while preserving the environment so that these needs can be met now, as well as in the indefinite future. Furthermore, ignoring the opportunities to curb the impacts of land use will result in only greater impacts tomorrow.

## Implementation Principles[1]

1. Water supply agencies should be consulted early in the land use decision-making process regarding technology, demographics and growth projections
2. City and county officials, the watershed stakeholders, Local Agency Formation Commission (LAFCO), special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at a watershed level
3. The best, multi-benefit and integrated strategies and projects should be identified and implemented before less integrated proposals, unless urgency demands otherwise
4. From start to finish, projects and programs should involve the public, build relationships, and increase the sharing of and access to information. The participatory process should focus on ensuring that all residents have access to clean, reliable and affordable water for drinking and recreation
5. Plans, programs, projects and policies should be monitored and evaluated to determine if the expected results are achieved and to improve future practices
6. Limited, accessible, low-cost, outdoor recreational opportunities

## Current Priorities and Approaches for Watershed Sustainability—OWOW 2.0

### Main objectives for the Land Use and Water Planning Pillar:

- Identify implementation actions to conduct collaboration between water and land use communities
- Prepare (as appropriate): updates to conditions of land use and resource management; implementation measures to support water savings through land use practices including low impact development; implementation of Ahwahnee Water Principles for Resource Efficient Land Use, new green building programs and onsite and offsite conservation land use practices
- Determine new opportunities to improve collaboration between water managers and land use decision makers and interaction with the land use community
- Determine what forums, policies and projects could be instituted to improve water management efforts with the land use community
- Describe how improved interaction between water managers and land use planners could advance the Plan implementation and the planning process

Despite over a decade of Integrated Regional Watershed Management planning within the SAR Watershed and numerous similar plans designed to address watershed challenges from the watershed perspective, the core challenges of population growth and expanding urbanization remain. Innovative ideas and projects have been implemented and water quality and water supplies are better managed as a result. However, key challenges remain—the integration of watershed stakeholders and an

[1] Local Government Commission, 2005. Ahwahnee Water Principles. http://www.lgc.org/ahwahnee/h2o_principles.html

overwhelming need to develop unbiased cooperative watershed implementation processes. Competing individual agency priorities can limit the level of cooperation and the resulting assemblage of feasible projects. Watershed sustainability priorities should be given greater weighting in the project conceptualization and implementation process.

### Relationship to other OWOW Pillars

#### *Land Use Links All Pillars*

Water use is dictated by land use. Likewise, water supply is a function of location, and groundwater recharge is impacted by land uses—agriculture uses water and adds nutrients, urbanization demands water for residents and businesses, and historically reduces groundwater recharge by the use of impervious cover. Wastewater treatment is designed to accommodate the needs of the watershed, which are largely a function of population and resulting development. Water quality is also directly impacted by land uses. Natural hazard risks are exacerbated by development in fault zones, flood plains, and fire-prone areas—these scenarios are made better or worse by land use decisions. Natural resources and habitat are exploited, managed, or preserved based on the allowed development, which is controlled by land use decisions. Energy use is a function of land use characteristics and the infrastructure required to support the developed areas—suburban sprawl leads to more land used for roadways and imported water requires transport systems. These choices lead to relative levels of energy use, limit energy efficiency for the watershed, and determine greenhouse gas emissions from the watershed that drive climate change. Finally, government oversight tries to reduce undue environmental degradation and minimize health risks, but works within a context of existing land uses and ongoing land use demands. Economically disadvantaged communities are a consequence of ongoing land use decisions and policies.

## Current Land Development Planning, Design, and Approval Processes

### Historical and Current Conditions of Land Use

Historical documents describe years of sustainable land use practices in the SAR Watershed by native tribes, followed by the California missions that established the first significant rangelands and the first agricultural production in the region. A steady wave of migration from other regions of the country and abroad continued, and accelerated during the construction of the railroads in the years between 1861 and 1900, following the path of available water supplies needed to operate the steam engines. From the top to the bottom of the watershed, the history of small towns that became respectably sized cities is linked to the arrival of thousands of permanent railroad jobs. Readily available water supplies then fueled the development of a vibrant agricultural community, including a large citrus industry, dependent on irrigation.

Growth throughout the watershed stagnated during the Great Depression, but World War II caused military installations and industrial war suppliers to move further inland, along with a major wave of migration. Residential and commercial development were greatly expanded in the watershed by the soldiers returning from the Pacific Theater of World War II-they relocated throughout the nation including Southern California where they had trained or been stationed at military bases.

Demographic patterns clearly reflect an internal migration pattern from west to east in the Watershed that began when coastal property become too expensive for many prospective buyers, driving population further inland in search of affordable homes and land. The construction of the freeway system was enthusiastically welcomed in Riverside and San Bernardino Counties where the new link to robust job markets on the coast and in Los Angeles triggered the growth of suburbs that primarily served as bedroom communities for commuters.

Land use patterns show the expansion from locations with direct access to surface water to places that could be served by gravity-fed irrigation ditches and canals. Land use intensified in areas where drilling a private well was affordable until the critical mass of urban and agriculture water users prompted the establishment of private water companies, irrigation districts, and municipal water districts that could tap the groundwater and build systems to deliver the water directly to customers.

Concerns over reliable water supplies to sustain future land uses led to decades of water rights disputes in the courts between downstream and upstream water agencies in the watershed. By the time the State and Federal environmental protection regulations were established in the 1970's, consumptive land use patterns in the Watershed had dramatically decreased the quality and quantity of open space, and surface waters and groundwater had been severely impaired by practices of the time.

## Management of Land Resource

The sole authority of cities and counties to regulate land use in their own jurisdiction is deeply anchored in California history and cherished by local communities. Local governments have focused on sustaining a robust economy through land use decisions that contribute to construction of infrastructure, and generating local government revenues that cover the costs of city and county services that protect the lives and property of their constituents.

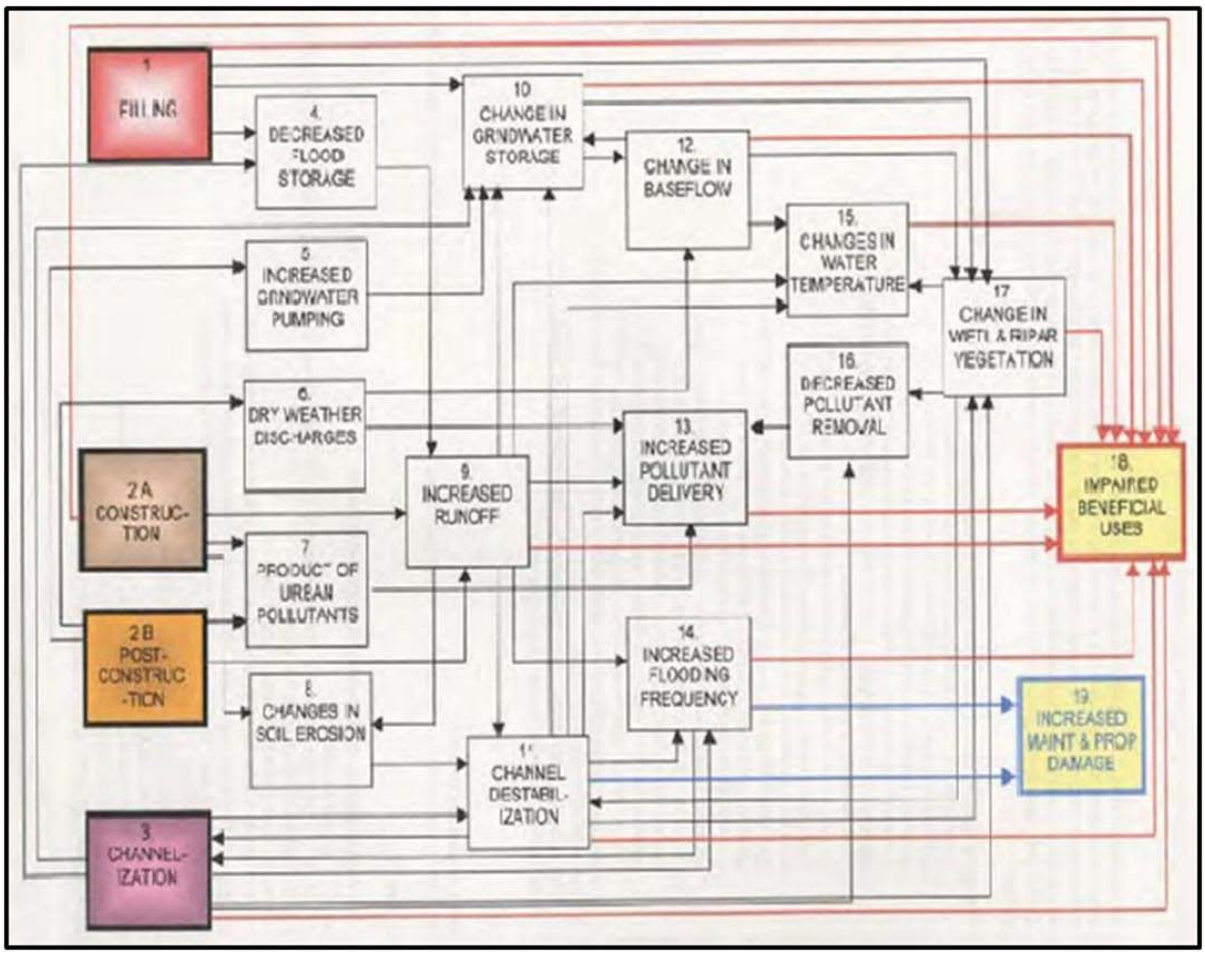
## Regional Strengths, Threats, and Weaknesses of Land Use

The increase in hard surfacing and flood control over decades of land use practices in the watershed has changed stormwater runoff patterns resulting in a threat to the sustainability of regional groundwater basins losing historical recharge capacity. For example, the Chino Basin Watermaster estimates that over 40,000 acre-feet/year (AFY) of groundwater recharge have been lost on average since land use practices began increasing impervious surfaces.

Various studies have demonstrated a strong correlation between the impervious cover in a watershed and reductions in water supply sustainability. When impervious cover exceeds 10% of total watershed area, there is typically a decrease in groundwater recharge and an increase in 1-2 year frequency flood events, decreased baseflow, and increased pollutant discharges into surface waters.

**Figure 5.7-1,** developed by the State Water Resources Control Board (SWRCB), illustrates the potential effects of development on the beneficial uses of water from a science-based perspective. All of these effects are present in varying degrees throughout the developed watershed.

**Figure 5.7-1 Potential Effects of Development of Beneficial Uses**
**(Source: State Water Resources Control Board)**




Drawing on the most recent land use maps available from the Southern California Association of Governments (SCAG), **Figure 5.7-2** reflects the collective outcome of land use planning and decisions in the Watershed that, over time, has shrunk the footprint of agriculture, open space and recreation, while the areas consumed by new residential, commercial, and industrial developments have expanded. **Figure 5.7-3** projects specific areas of population increase from 2008 to 2035 and pinpoints locations where future land use decisions will need to address a robust economy with new jobs and housing for residents, as well as a sustainable water supply over a long-term planning horizon.

**Figure 5.7-2 Land Uses in the Santa Ana River**

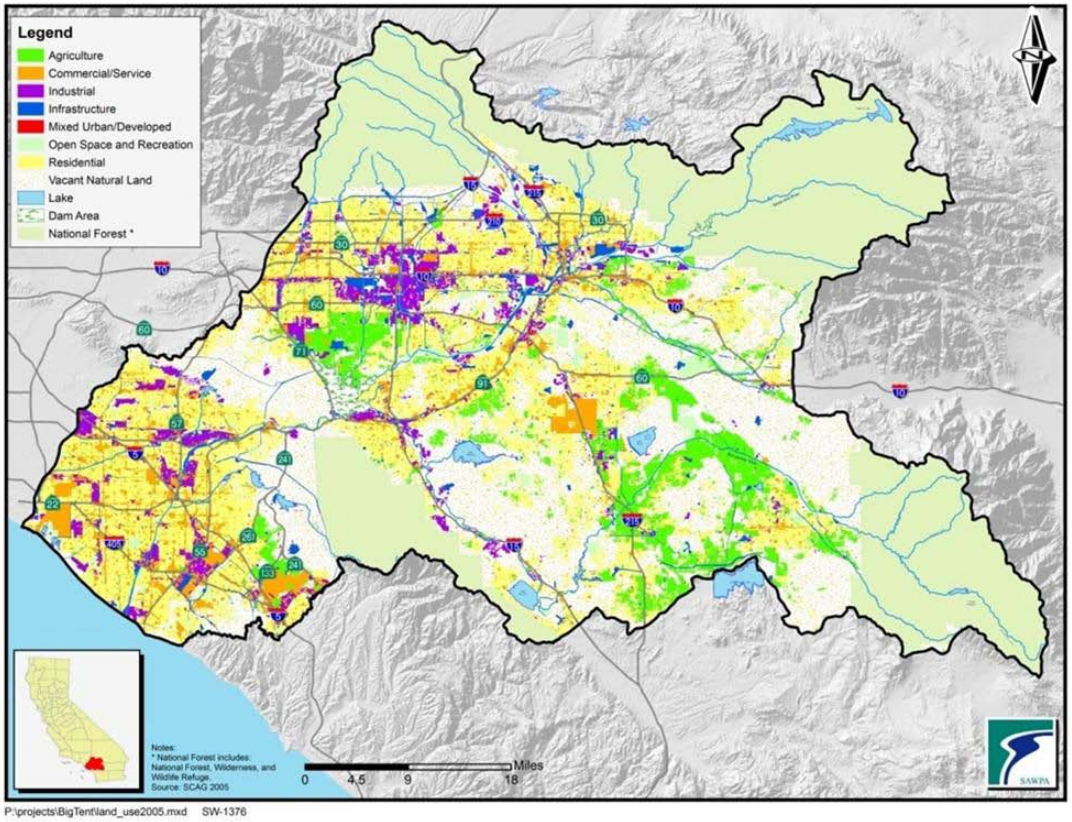
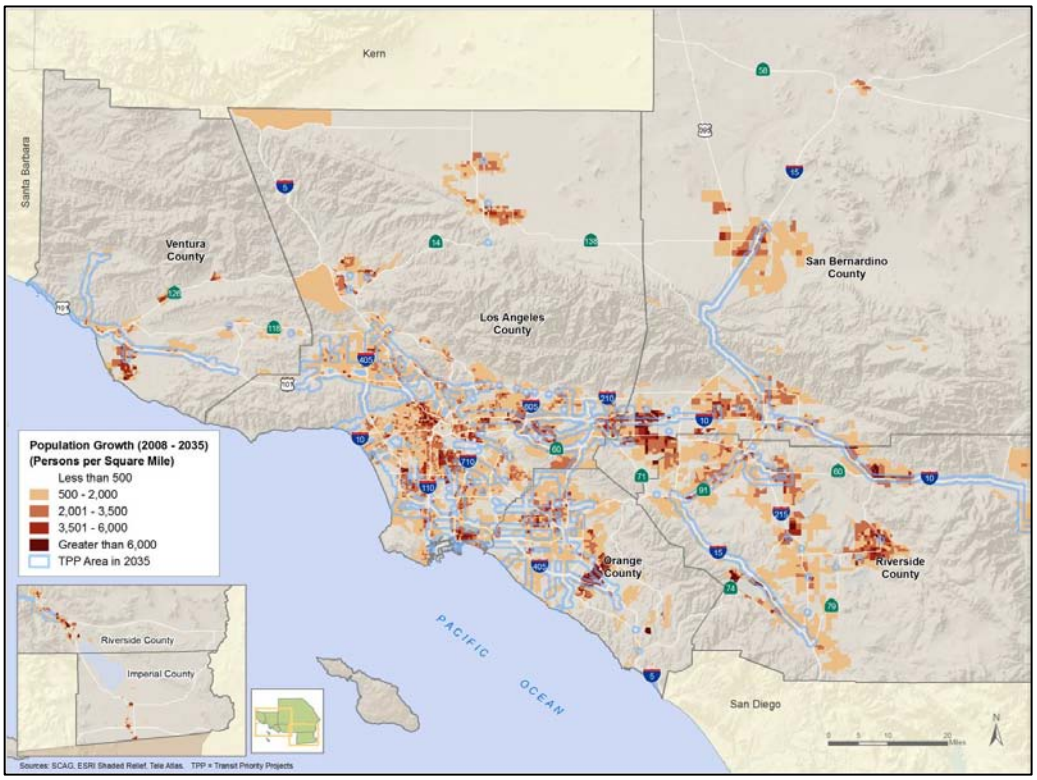



**Figure 5.7-3 Projected Population Growth 2008-2035 (SCAG RTP 2012)**



## Regional Planning and Implementation of Land Use Strategies

### *Compass Blueprint*

The Compass Blueprint was developed by SCAG in companionship with the 2003 Regional Transportation Plan (RTP) and it continued as a companion to the 2008 RTP. The 2008 RTP recognized "The centrifugal force of growth that continues to push the development footprint of the urbanized area outward. At the same time, pushing back on dispersed development are natural barriers, financial constraints to pay for outward expansion, and public resistance to unsustainable 'leap frog' growth into green fields and sensitive habitat areas. Nearly all natural locations for urban development have been consumed, leaving us with hard choices about how we are to grow and change to meet the demands of the future."

The Compass Blueprint recommended implementation of integrated land use and transportation planning in the local communities of the Southern California region to accommodate the growth forecasted over the next 25 years in an environmentally sustainable manner.

Working with stakeholders in each county, the regional planning agencies that serve as Council of Governments for Orange, Riverside, and San Bernardino Counties developed the Compass Blueprint. The Compass Blueprint 2% strategy envisions the direction of future development in strategic opportunity areas (SACs) that do not exceed 2% of the region's land resources. The Compass effort also educated stakeholders regarding alternative development that is more compact and more sustainable. A series of maps identified SACs in each county (**Figure 5.7-4A** to **Figure 5.7-4C**). The Opportunity Areas are shown as colored areas within a blue perimeter line. Substantial future development is anticipated to happen around transit hubs, railway stations, major bus stations, and along transit corridors. The maps point to modest changes in current land use and transportation trends on only 2% of the land area of the region. Efforts already are underway to reduce the quantity of low-density development in a number of the Opportunity Areas.

**Figure 5.7-4a SCAG Compass Blueprint Strategic Opportunity Areas – SANBAG**

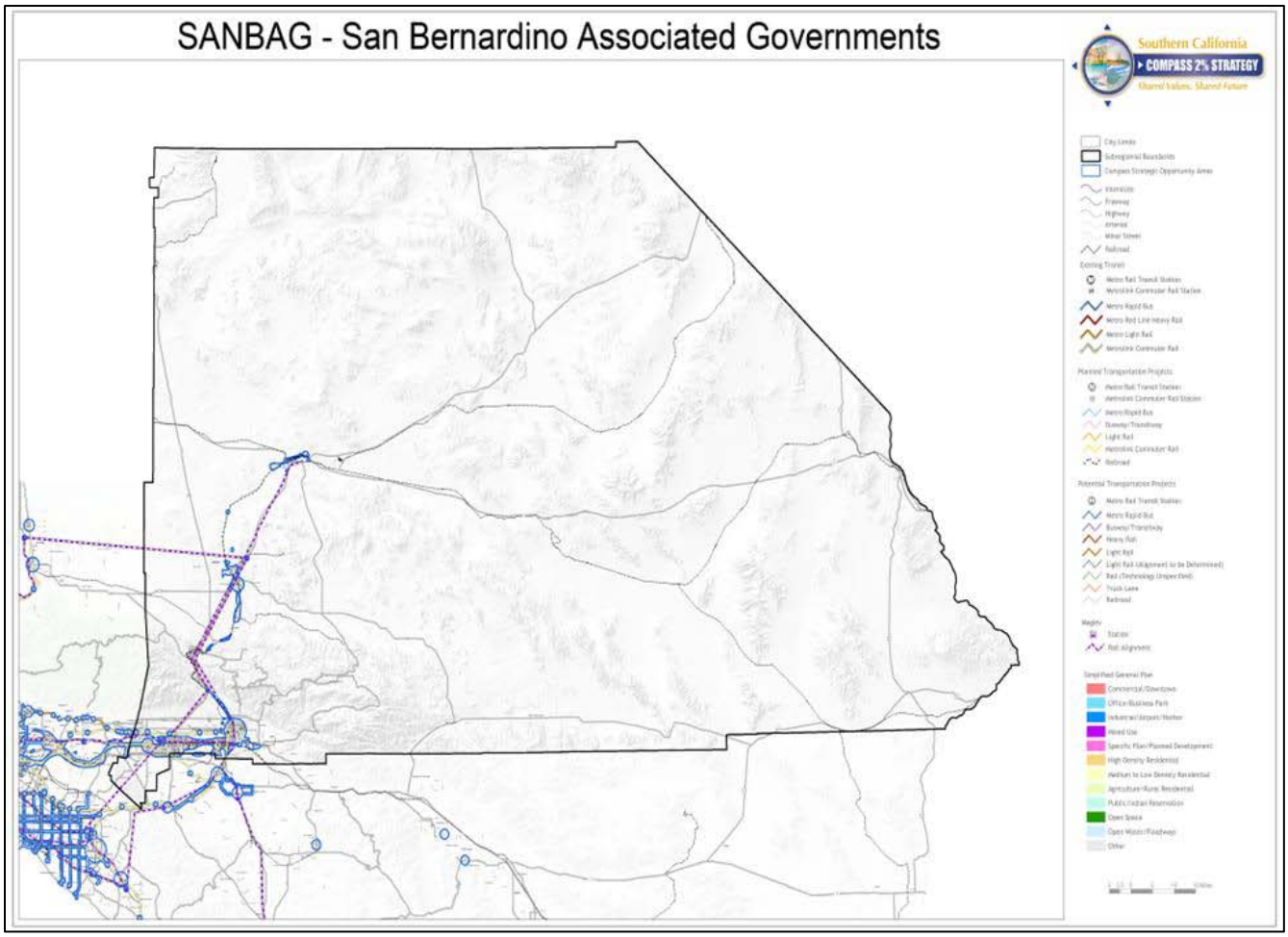


**Figure 5.7-4b SCAG Compass Blueprint Strategic Opportunity Areas - OCCOG**

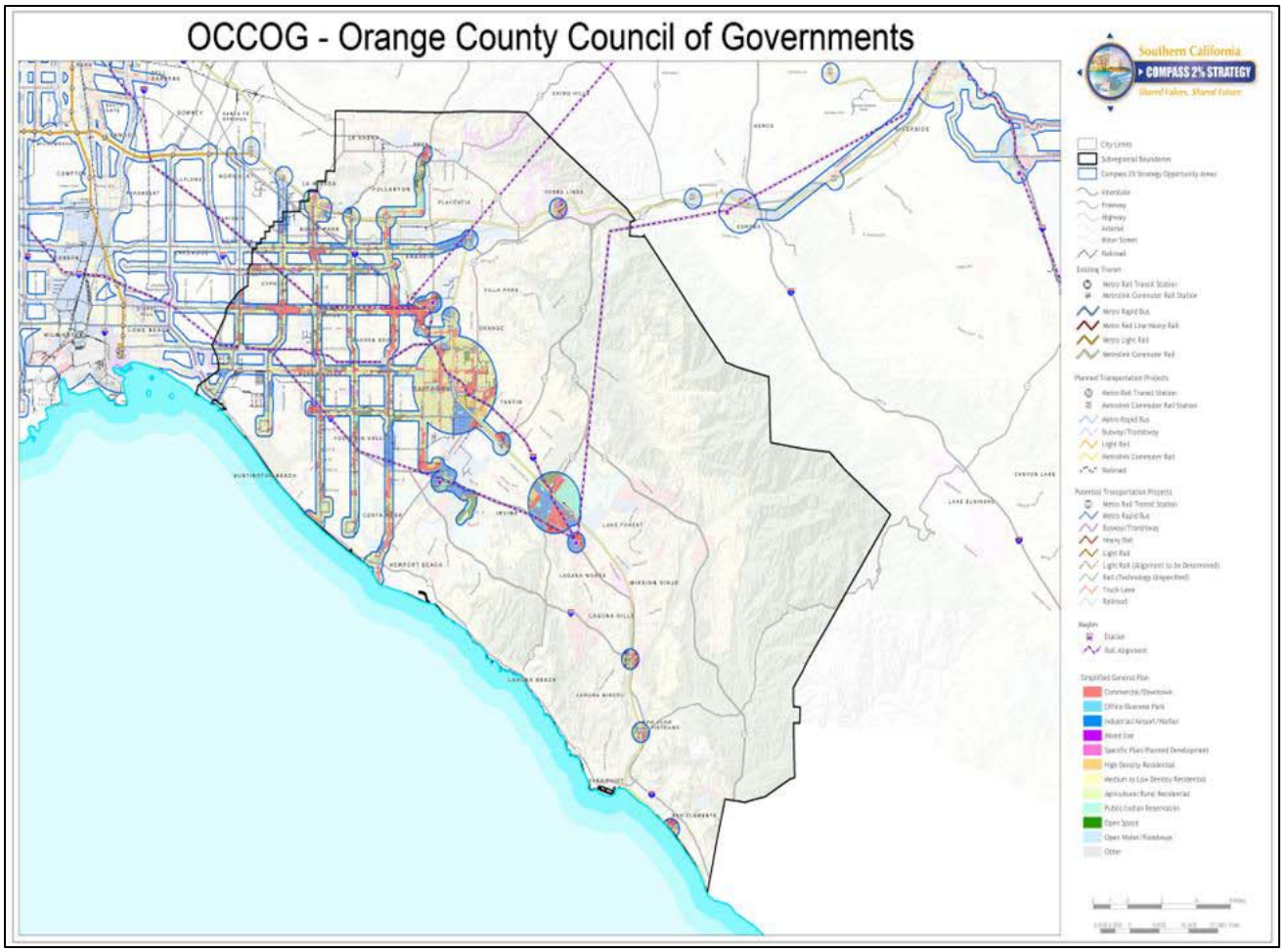
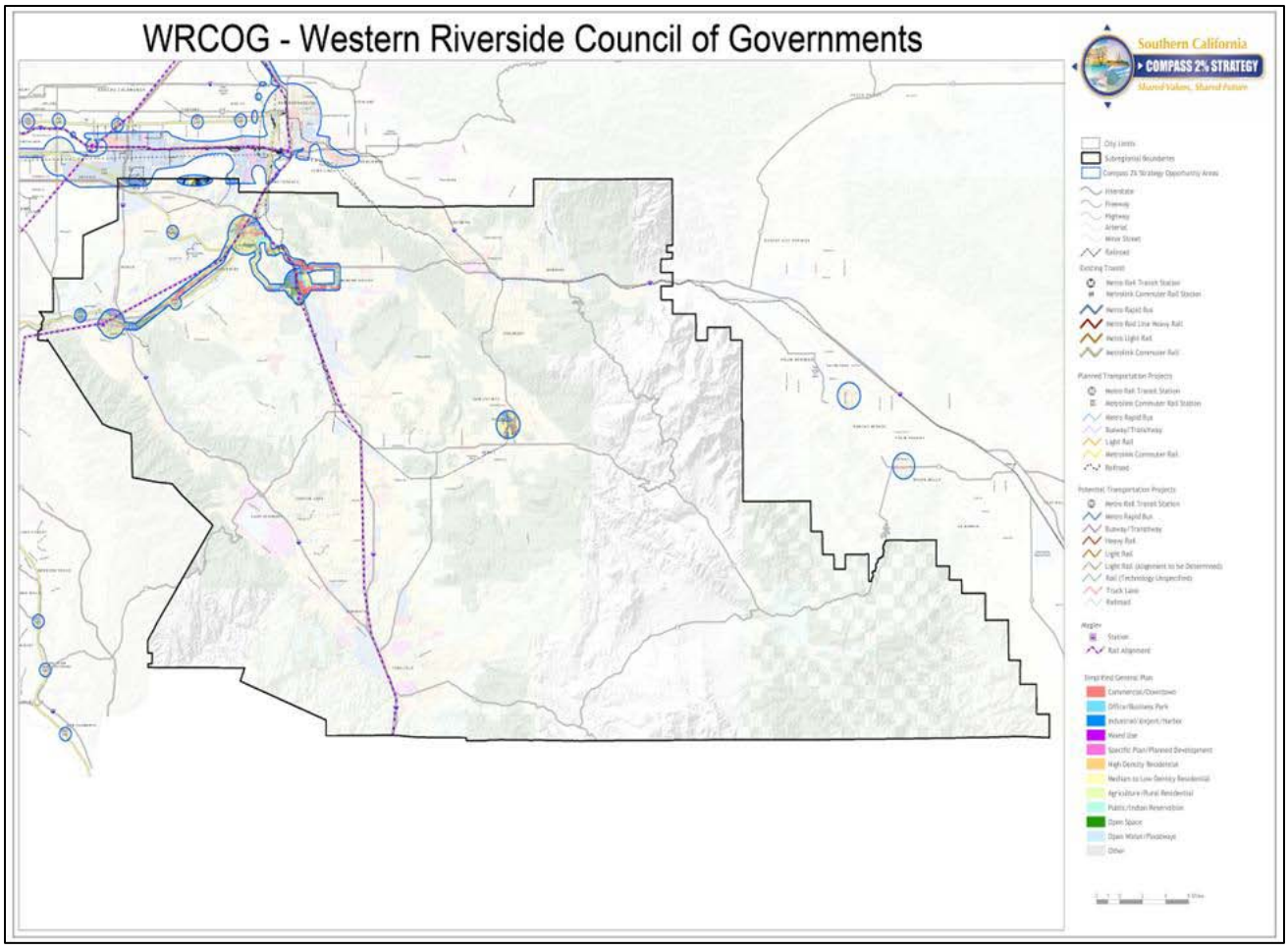


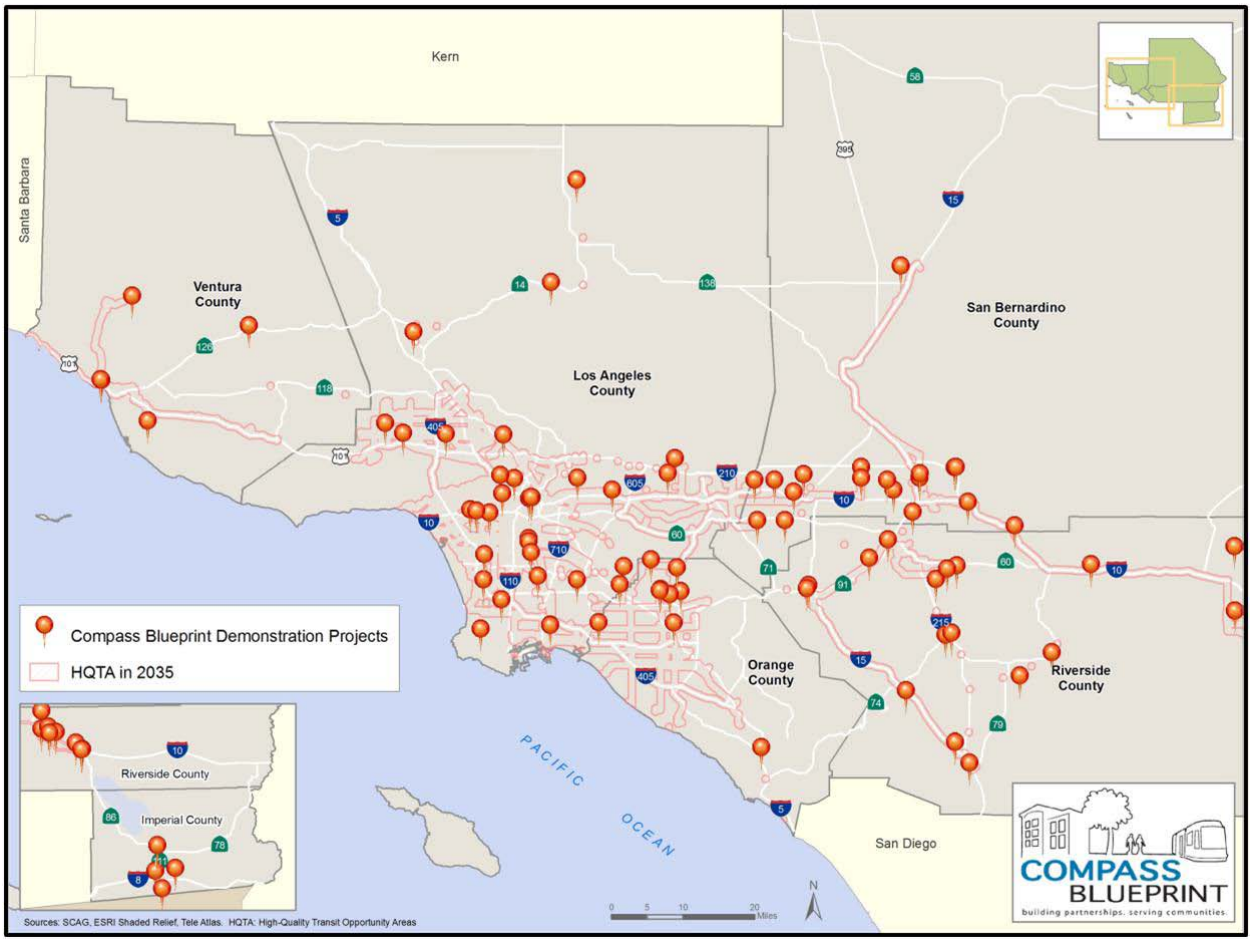
**Figure 5.7-4c SCAG Compass Blueprint Strategic Opportunity Areas – WRCOG**




Higher density development that is compact, mixed use, walkable, and transit-oriented not only preserves open lands that absorb water to the maximum extent possible, but minimizes automobile generated urban runoff pollutants that degrade both surface and ground water quality.

The Compass Blueprint used four (4) guiding principles: "Mobility, Livability, Prosperity and Sustainability." Since 2004, Compass Blueprint has supported integrated land use and transportation planning through incentive funding of over $10.5 million for 132 demonstration projects in the SCAG Region. These are voluntary SCAG/local government partnerships that use innovative approaches to work with local plans and implement regional priorities. Projects include transit-oriented development plans, downtown revitalization efforts, low-income community visioning, and other projects that support local and regional goals. **Figure 5.7-5** shows all completed Compass Blueprint Demonstration Projects, including thirty projects located within the SAR Watershed. (See 2012 SCAG RTP, Appendix: SCS Background Documentation for project list. Also see interactive project map at: http://maps.scag.ca.gov/cbp/

**Figure 5.7-5 SCAG Compass Blueprint Demonstration Projects and HQTA Projected for 2035**




Future Demonstration Projects throughout the region will encourage implementation of sustainability principles by focusing on regionally-significant local plans that directly implement the Sustainable Communities Strategy (SCS) and its goal of translating policy to on-the-ground land use changes and multi-modal transportation improvements. Concurrently, Compass Blueprint will further incentivize local implementation of the SCS through the Compass Blueprint Awards Program, and through the "Toolbox Tuesdays" program offering free, monthly, professional training events for local planners.

### *Local Sustainability Planning Tool*

The SCAG 2012 RTP was developed with support from the Local Sustainability Planning Tool (LSPT), a GIS tool that allows users to evaluate various development scenarios and potential impacts **(Figure 5.7-6A and 6B).** The LSPT is a sketch planning tool that can be used by local jurisdictions and members of the public to analyze the impact of different land use scenarios on vehicle ownership, vehicle miles traveled, mode-use, and their associated effects on GHG emissions. (See http://rtpscs.scag.ca.gov/Pages/Local-Sustainability-Planning-Tool.aspx for more information or to access the LSPT.)

**Figure 5.7-6a SCAG RTP Workshop Scenario Elements**

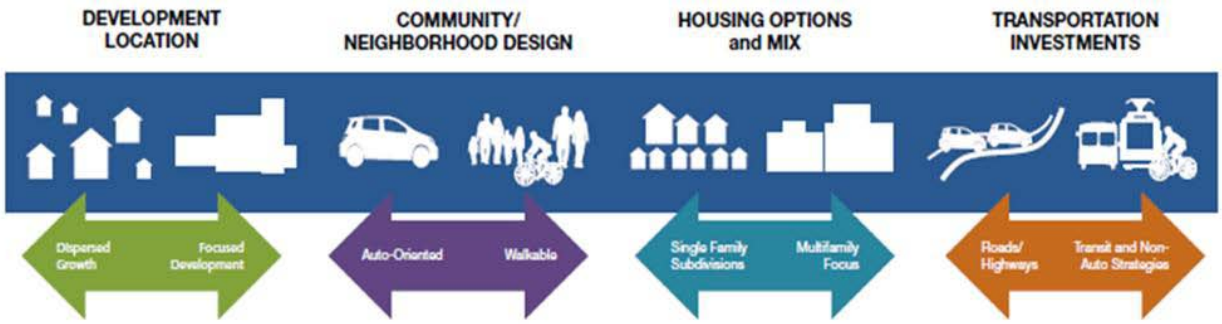
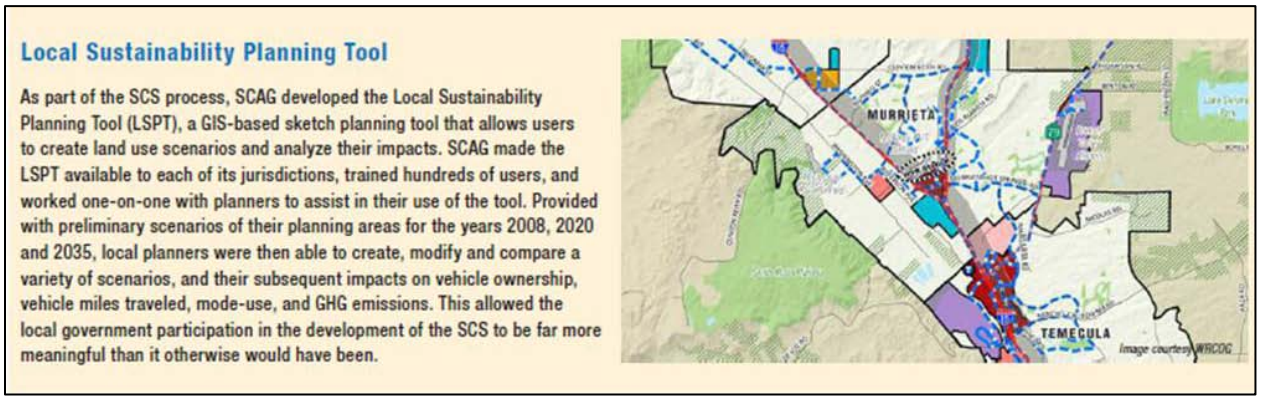



**Figure 5.7-6b SCAG Local Sustainability Planning Tool ( SCAG 21012 RTP)**




The implementation of land planning relies on three primary tools authorized in California Government Code (CA Code): the General Plan (Section 65300 et seq.) and Specific Plans; the zoning ordinance (Section 65850 et seq.); and the Subdivision Map Act (Section 66410 et seq.)[2].

### *General Plans*

General Plans include development goals and policies and lay the foundation for land use decisions made by planning commissions, city councils, or board of supervisors. General Plans must contain text sections and maps or diagrams illustrating the general distribution of land uses, circulation systems,

[2] Fulton, William, 1999. Guide to California Planning, Second Edition. Point Arena, California, Solano Press Books.

open space, environmental hazard areas, and other policy statements that can be illustrated. General Plans must contain seven mandatory elements: circulation, conservation, housing, land use, noise, open-space, and safety. Cities and counties could adopt an optional water element in their general plans, but few have done so. Instead, water has typically been addressed in the mandatory conservation element or in optional natural resources or public facilities elements. Commonly, water is addressed only in terms of water supply and/or water conservation.[3] CA Code (65302.2) requires General Plans adopted or revised after January 1, 1996, to consider any applicable Urban Water Management Plans.

General Plans can be amended four times per year, and multiple individual changes can comprise each amendment. Although not required, guidance is available for preparing a Water Element[4]. Few jurisdictions in California have prepared Water Elements for their general plan (see Merced County for one example).[5] Also, "The Department of Water Resources or the Central Valley Flood Protection Board, as appropriate, and the Department of Fish and Game may develop site design and planning policies to assist local agencies which request help in implementing the general plan guidelines for meeting flood control objectives and other land management needs." (CA Code 65303.4)

Discussions with the Land Use and Water Planning Pillar noted that there are contrary attitudes about the effectiveness of General Plans among the watershed stakeholders. Local governments, who approve the plans, tend to view them favorably as dynamic tools for planning land use because city councils or board of supervisors have the capacity to approve General Plan Amendments as deemed appropriate. On the other hand, local residents and environmental organizations voice frustration with General Plans that in practice are not routinely "implemented over time for the physical development of the communities", but rather serve as convenient placeholder planning documents for processing routine General Plan Amendments that expand land use.

### *Specific Plans*[6]

Specific plans are flexible and scalable by design and can be used in different ways to implement LID and watershed protection priorities. If adopted by resolution, a specific plan is a policy document. If adopted by ordinance, a specific plan can be a regulatory document. An overlay specific plan could be adopted either by resolution or ordinance to address only the watershed protection issues. Alternatively, a specific plan could be adopted to address the comprehensive development or redevelopment of a defined area and include watershed protection requirements among the standards

[3] Low Impact Development Manual for Southern California, 2010. Low Impact Development Center; https://www.casqa.org/LinkClick.aspx?fileticket=zA3DaxiwHtE%3d&tabid=242

[4] State of California General Plan Guidelines 2003. http://opr.ca.gov/docs/General_Plan_Guidelines_2003.pdf

[5] Merced County Water Element draft: June 2011: http://www.co.merced.ca.us/pdfs/planning/generalplan/2030sections/mcgpu_2030gp_part_ii_12_water_pcrd_2011_06_14.pdf

[6] Appendix B: California Planning and Regulatory Framework for LID. Low Impact Development Manual for Southern California, 2010. Low Impact Development Center; https://www.casqa.org/LinkClick.aspx?fileticket=zA3DaxiwHtE%3d&tabid=242

and implementation measures applicable to the area. The Land Use and Water Planning Pillar stakeholders support the expanded use of Specific Plans as Watershed Planning Tools.

### *Zoning Ordinances*

CA Code Section 65850 authorizes zoning as a regulatory mechanism to implement general plans. Zoning is adopted by ordinances and must be consistent with general plans. Zoning requires compliance on a lot-by-lot basis with specific enforceable standards. Zoning ordinances specify categories of land use and associated standards such as minimum lot size, maximum building heights, and minimum building setbacks. Zoning ordinances can include overlay zones that provide additional standards for specified areas such as historic districts, wetlands, and other areas deemed to require extra protection. [2] AB 1881 required California cities to adopt landscaping ordinances to improve water conservation through drought-tolerant landscaping and effective irrigation control systems.

### *Subdivision Map Act*

Any subdivision of land for sale or financing requires local government approval through adopted subdivision regulations required by state law. Subdivision approvals can be granted by local Planning Commissions or may also require approval by local government councils or boards. Such approvals offer an opportunity for local government to require conditions of approval for land development, including water supply, water quality, habitat conservation, or other watershed-based requirements.

### *CEQA*

The California Environmental Quality Act (CEQA), is not a planning law as such, but has significantly influenced land use since it was passed in 1970. "By law CEQA has four functions:

1. To inform decision-makers about significant environmental impacts;
2. To identify ways environmental damage can be avoided;
3. To prevent avoidable environmental damage;
4. To disclose to the public why a project is approved even if it leads to environmental damage."[7]

The ideal timeframe for CEQA implementation is as early in the planning process as possible to "enable environmental considerations to influence project program and design and yet late enough to provide meaningful information for environmental assessment" [CA Code §15004(b)]. Since the earliest planning stage is the development of the applicable General Plan, Water and Land Use considerations should be incorporated into general plans in California. Any subsequent municipal planning must be consistent with a municipality's general plan. Therefore, incorporation of water and land use issues into general plans would provide support at the foundational level of development planning, and would serve to link LID with CEQA Guidelines.[2] The requirements of the National Environmental Policy Act (NEPA) were patterned after CEQA, and only apply to projects with federal involvement. Therefore, compliance with CEQA is typically sufficient in substance to comply with NEPA, although NEPA compliance may require a longer timeline.

[7] Fulton, William, 1999. Guide to California Planning, Second Edition. Point Arena, California, Solano Press Books. Chapter 9.

### CEQA Incentive[8]

SB 375 provides incentives in the form of CEQA streamlining to encourage community design that supports reduction in per capita GHG emissions. Generally, two types of projects are eligible for streamlined CEQA review once a compliant RTP/SCS has been adopted: (1) residential/mixed use projects (consistent with the SCS) or (2) a Transit Priority Project (TPP). See Appendix: SCS Background Documentation for more information on CEQA streamlining incentives through SB 375.

#### *Development codes*

Development codes typically combine zoning ordinances, subdivision regulations, design review guidelines, and related planning requirements.[1] Recently developed CalGreen building codes are now required.

As of January 1, 2011, "California requires new buildings to reduce water consumption, employ building commissioning to increase building system efficiencies, divert construction waste from landfills, and install low pollutant emitting finish materials. CALGreen's mandatory measures establish a minimum for green construction practices, and incorporate environmentally responsible buildings into California cities without significantly driving up construction costs in a slow economy.

CALGreen has approximately 52 nonresidential mandatory measures and an additional 130 provisions that have been placed in the appendix for optional use. Some key mandatory measures for commercial occupancies include specified parking for clean air vehicles, a 20% reduction of potable water use within buildings, a 50% construction waste diversion from landfills, use of building finish materials that emit low levels of volatile organic compounds, and commissioning for new, nonresidential buildings over 10,000 square feet."[9]

## OWOW and Land Use Planning Interaction

There are a variety of innovative collaborations that already exist between water supply agencies and other public agencies that are producing mutually-beneficial and cost-effective results, as demonstrated in the Plan. However, opportunities remain for water agencies to develop more effective partnerships with local governments, developers and environmental organizations that will leverage funds, resources and expertise.

As previously described, the OWOW Plan was developed in an open, multi-jurisdictional and multidisciplinary process in which the interests of all stakeholders in the watershed were considered. The Steering Committee and the Pillars included representatives not only from water agencies, but from cities and counties, the development community, and a host of non-governmental organizations. The resulting Plan: (1) links the need for sufficient and clean water with land use, environmental protection, and the need for economic development; (2) and increases understanding of the link between water resources and land use for both land use planning and water agencies. More comprehensive

[8] SCAG 2012. Regional Transportation Plan 2012-2035: Sustainable Communities Strategy. http://www.scagrtp.net/

[9] The 2010 California Green Building Standards Code. http://www.bsc.ca.gov/Home/CALGreen.aspx

understanding creates a perspective of land use planning that includes new development, open space for parks, recreation and environmental services, such as habitat and water filtration and natural treatment. Furthermore, the OWOW process strengthens interactions between water agencies and land use planning entities into the future.

Incorporating water use considerations into land use planning will be required to meet the requirements on Senate Bill (SB) 7, which requires urban water agencies to reduce per capita consumption 20% by 2020. Considering that outdoor use (i.e. landscaping) accounts for at least half of typical water use, land use decisions will have tremendous impact on future water conservation efforts.

The following sections describe ongoing efforts in the region to simultaneously address land use and water planning:

### *Working with Residential, Commercial and Industrial Developers*

Water supply agencies, including the Metropolitan Water District of Southern California (MWDSC), have been investing in landscape water use efficiency projects with homebuilders for several years.

As of January 2010, Assembly Bill (AB) 1881 required local governments to adopt the State's Model Water Efficient Landscape Ordinance or equivalent ordinance, and required public and private development projects to submit water efficient landscape plans for areas equal or greater than 2,500 square feet. AB1881 institutionalizes the incorporation of water efficient landscaping into new development at the State level. Stakeholders in the Chino Basin developed an AB1881-equivalent landscape ordinance prior to the 2010 deadline as a locally-tailored alternative.

In addition to the accomplishments to be provided by AB1881, residential, commercial, and industrial developers have been working to support critical aspects of integrated regional water management, such as:

- Supporting LID site designs that reverse the conventional concept of stormwater runoff as a waste needed to be conveyed offsite as rapidly as possible, to recognizing stormwater as an essential resource to be captured for groundwater recharge or other use. Implementation of LID techniques also reduces pollutants in stormwater, including metals, nutrients, pesticides, total dissolved solids, petroleum hydrocarbons, and bacterial contaminants.
- Reducing the proportion of impervious surfaces in new developments by installing green roofs or rainfall-capturing roofs, and pervious pavement for parking lots, sidewalks, plazas and other similar uses.

### *Working with Local Governments*

Water supply agencies, such as MWDSC, continue to expand investment of resources in water-efficient, highly visible public landscaping projects in cooperation with local governments in the watershed. Unfortunately, investments to date have yet to create the critical mass of water-use efficient landscapes necessary to prompt the public toward a dramatic paradigm shift. Considerable additional investment is

necessary to reduce unreasonable water waste and meet SB 7 requirement of 20% reduction in per capita water use by 2020.

Obsolete land use practices present in visible public places that employ wasteful water use practices should be prioritized for investment to be retrofitted and transformed into examples of water use efficiency and livability.

The outcome of investing resources in this manner offers the benefits of:

- Increasing the conservation of potable water supplies that are currently dedicated to irrigating public landscapes that lack water use efficiencies
- Reducing the portfolio of negative images of public agencies wasting water
- Educating the public using visible public places with signage that explains the smart controllers and irrigation systems that are supporting attractive water-use-efficient landscape designs that the public would find desirable in their own homes and businesses
- Replacing impervious surfaces in public projects where flashy urban runoff is a chronic problem with attractive permeable paving illustrated with signage for the public
- Natural resources, such as wetlands, floodplains, recharge zones, riparian area preservation and restoration, open space, and native habitats, should be identified, preserved and restored as valued assets for flood protection, water quality improvement, groundwater recharge, habitat, and overall long-term water resource sustainability
- Reducing development in high risk areas prone to wildfires and post-fire debris flows that reduce the efficiency of water supply programs when foreseeable disasters do occur
- Sewering disadvantaged communities with failing septic systems that are proximate to available sewer lines where residents lack financial resources and political will

### *Working with Environmental Organizations*

Agencies and stakeholders in the Watershed have partnered with the environmental community in restoring over 3,000 acres of riparian habitat**.** These projects have increased surface water flow, replacing water hungry invasive species with native plants, and increased habitat suitability for endangered riparian species. However, water supply agencies have insufficiently invested resources working with environmental organizations in low-income communities that disproportionately lack sufficient land surfaces for the capture of stormwater from urban runoff that also can serve as open space for recreation.

The outcome of investing resources in this manner reduces stormwater pollutant loads, and serves the needs of Disadvantaged Communities.

## Regional and Watershed Examples

### University of California, Irvine Cooperative Extension LID Test Site[10]

The University of California, Irvine Cooperative Extension (UCCE) Low Impact Development (LID) Test Facility (UCCE Facility), located in Irvine, California, consists of three model residential landscapes each with a mock residence, and a fourth, undisturbed landscape **(Figure 5.7-7).** The residential landscapes were constructed with various levels of LID BMP implementation. The volume and pollutant concentration of discharges, and the percentage of runoff from various BMPs and LID systems have been monitored, and the soil type reviewed.

**Figure 5.7-7 UCCE LID Site**




The mock residences are used for equipment storage and occasionally as meeting rooms or classrooms during demonstrations of the facility. Pesticides and fertilizers were applied according to package directions, and irrigation was applied as needed to maintain the residential landscapes. The plots are each 90 feet by 45 feet, totaling 4,050 square feet. The mock residences have footprints of 576 square feet. The LID features at the four sites are described below.

[10] San Bernardino County Flood Control District Lid Guidance Manual and Training Program Monitoring Technical Memorandum Revised July 2011. Prepared by Mactec Engineering, Inc.

- Landscape A: Typical Landscape – The typical landscape was designed to represent a single-family residence in a modern development with no LID techniques implemented. This landscape was developed with a concrete driveway, landscaped grass and flowers, concrete walkways, standard roof drains, and landscape drains running to the street. Landscape A is approximately 37 percent impervious.
- Landscape B: Retrofit Landscape – The retrofit landscape consists of LID techniques that a homeowner could install on an existing residential development such as Landscape A. The driveway and walkway were constructed with pervious stone pavers, and a positive sub-drain/infiltration system was installed under the driveway. A dry-well infiltration pit, rain gutter cisterns, and minor landscaping modifications including native plant materials are additional features of the retrofit landscape. Landscape B is approximately 14-percent impervious and 23-percent semi-pervious (stone pavers).
- Landscape C: Full Implementation or Sustainable Landscape – The full implementation landscape consists of LID features such as interlocking pavers for the driveway and walkways, landscape infiltration trenches, and landscaping with low water use and native plants. Roof drains are directly connected to dry wells. This landscape was designed with the goal of minimizing runoff from irrigation and storms. Landscape C is approximately 14-percent impervious and 23-percent semipervious (stone pavers).
- Landscape D: Undisturbed Landscape – The graded lot consists of an empty, undeveloped landscape adjacent to the three residential landscape sites. This area is surrounded by a berm and is absent a driveway, walkways, a housing structure, landscape vegetation, and any LID features of the residential sites. This site was established in March 2009 and is used to represent the characteristics of pre-development land.

Drainage for the four landscapes has been designed to direct all runoff into concrete collection boxes located at the west corner of each lot. Each of the collection boxes has a sump pump connected to a flow meter. A data logger inside each mock residence records the volume of all discharges. Grab samples have been collected from the three residential landscapes and analyzed for pesticides during both dry weather and wet weather events between early 2007, late 2008, and in early 2010 for a separate perimeter study.

## Multi-Objective Stormwater Management Projects in the Chino Creek Watershed[11]

### *Chino Creek Wetlands and Educational Park*

This project, conceptually modeled after the Sepulveda Basin in Los Angeles, where a public park is a part of the flood control system, had two main objectives. The first objective was to detain, infiltrate and treat stormwater from the upper, off-site watershed and tributary areas; and the second was to be a demonstration site for different types of constructed wetlands so that developers in the area would understand the most cost-effective wetland type for their projects. Developers were very interested to learn whether there was a wetland type that had a small footprint, reasonable capital and O&M cost,

[11] SCWC, 2012. Stormwater Capture: Opportunities to Increase Water Supplies in Southern California. http://socalwater.org/images/SCWC_Stormwater_White_Paper__Case_Studies.Smaller.pdf

and was reliable over time so that regulations were met consistently. Different types of wetlands operating in parallel provided comparable treatment data.

The 22-acre wetlands and educational park serves as a demonstration area and has incorporated educational features for improving water supply, stormwater treatment and water efficiency. Educational tours are provided through a partnership between IEUA and the Santa Ana Watershed Association (SAWA) (see: http://www.ieua.org/education/docs/ChinoCreekParkBrochure.pdf) **(Figure 5.7-8).**

**Figure 5.7-8 Chino Creek Wetlands**




The park was designed to capture and infiltrate flows generated from up to a 25-year frequency design storm as well as to attenuate flows from the 100-year storm event (395 cubic feet per second (cfs)) from the upper tributary area of 700 acres.

Stormwater flow from the upper tributary area enters the Park from two reinforced concrete boxes on the north and northwest of the site. Currently, a 3 ft. x 10 ft. box culvert transports this flow under Kimball Avenue in the north location into an unlined channel and then a detention pond before entering the park for treatment.

The detention basin was designed to divide the flow into three types of wetlands:

- Subsurface flow
- Surface emergent marsh/pond habitat
- Cottonwood/Native Willow riparian channel

The park design also included small surface bioswales, in order to provide further water quality improvement and create habitat for native flora and fauna.

Both the subsurface flow and surface type of wetlands were expected to provide water quality improvement and to retain storm flows on-site. The subsurface wetlands were designed based on a pilot project that was completed at a local dairy previous to the design of the park. The Cottonwood/Native Willow riparian channel was designed to mimic natural wetlands typically found in Southern California and in this region.

The wetland basins were all designed so that grab sampling could occur and to provide electrical outlets for automatic sampling if desired. Key operations and maintenance personnel were involved in the design to promote ease of maintenance. While the site looks very organic, the entire site allows easy re-routing of flow from one basin and/or wetland to another, to facilitate maintenance.

The upland park areas have trails, habitat and open space, and were designed for detention and sheet flow of stormwater. Open areas were planted with native vegetation and mulched with compost. After traversing through the wetlands and the habitat, flow is discharged under El Prado Road and discharges as surface flow in an existing flow pattern to Chino Creek.

### *Inland Empire Utilities Agency (IEUA) Headquarters*

The IEUA Headquarters (HQ), a Leadership Energy & Environmental Design (LEED) Platinum facility, was designed to meet all LEED requirements for both site and water, including stormwater, and became a demonstration of on-site BMPs. This site is aesthetically pleasing, with outdoor opportunities for staff, including picnicking. It has provided extensive opportunities for education and public outreach, including numerous tours and demonstration visits.

The four main goals of the HQ site were determined by IEUA and by LEED Platinum certification criteria, and included:

- Maximize open space, native plants, and habitat
- Reduce stormwater
- Treat stormwater
- Use of recycled water

Maximizing open space involved conserving existing natural areas, restoring damaged areas (dairy farm activities), providing habitat and promoting biodiversity within the vicinity. The Agency reduced the

development of its footprint (site area, building footprint, future building expansion, parking lot, water feature and pavement) to exceed the local zoning open space requirement for the site by 25%. Reducing stormwater flow involved eliminating runoff and contamination and increasing on-site infiltration by limiting the disruption of natural water flows. The site was graded in such a way as to create an on-site retention basin with a capacity of 75.9 acre-feet. This was in addition to the infiltration capacity of the site itself and the parking lot. Reuse of stormwater was not done at the site, as it was seen as not cost-effective and potentially maintenance intensive.

The treatment of stormwater was accomplished by focusing on both suspended solids and phosphorus by limiting disruption of natural water flows by eliminating stormwater runoff, increasing on-site infiltration and using vegetation and the natural biota in soil to treat stormwater contaminants.

Infiltration and retention basins were used to estimate the removal of pollutants (Total Suspended Solids [TSS] and Total Phosphorus [TP]) from on-site storm runoff produced from an 85th percentile 24-hour storm event ("first flush" storm runoff). Bio-filters and bio-swales are included as pre-treatment for the infiltration/retention basins. The large wet pond is also used as a BMP facility. The majority of the parking areas have permeable surfaces which provide additional stormwater treatment, thus improving water quality.

Recycled water from the adjacent Regional Wastewater Treatment Plant No. 5 (RP-5) was considered to be a critical component for reducing water consumption and demonstrating water conservation practices. Recycled water is an important product of the Agency. Demonstrating the use of this water on grass lawns and native and California adaptive plants is still seen today as important in overcoming barriers to its use.

### *Cucamonga Creek Watershed Regional Water Quality Project*[12]

This is a unique multi-jurisdictional project to create and restore the region's native ecosystems while enhancing recreational and educational uses as part of a regional watershed management plan. Spearheaded by the City of Ontario and supported by the City of Chino, the County of San Bernardino, the Inland Empire Utilities Agencies (IEUA), the Orange County Water District (OCWD), and the United States Army Corps of Engineers (USACE), the project transforms a fallow and underutilized area within the Prado Basin to provide regional environmental and recreational benefits. The project's unique regional approach is also supported by the State Water Resources Control Board through grant funding and is an integral part of the Santa Ana Watershed Project Authority's (SAWPA) Integrated Regional Water Management Plan, "One Water, One Watershed" (OWOW).

Prado Dam was originally constructed as a flood protection project and was completed in 1941 (see Chapter 5.8, Pages 10-11 for more complete description). Although there are many benefits associated with having the dam in place and valuable habitat being developed behind the dam, it is a physical

[12] Text from City of Ontario 2013.

barrier in the Santa Ana River Channel. As such, the dam creates habitat blockage for a variety of species that rely, now or historically, on the Santa Ana River as a migratory corridor[13].

Water Quality Benefits

The Prado Basin contains some of the best and largest riparian habitat in all of Southern California. Included are threatened and endangered species such as the least Bell's vireo, arroyo chub, and Santa Ana sucker. In addition, groundwater pumped from the basin is the primary source of drinking water consumed and used in Orange County. The Santa Ana Regional Water Quality Control Board (RWQCB) has designated Cucamonga Creek/Mill Creek as impaired pursuant to Section 303(d) of the Clean Water Act. The project provides a regional approach to enhancing water quality in Prado Basin, protecting the viability of native habitat while improving groundwater quality for downstream water users.

The Cucamonga Creek Watershed encompasses approximately 77 square miles, comprised of portions of the cities of Ontario, Chino, Rancho Cucamonga, and Upland. Pollutants such as pathogens, nutrients, salinity/total dissolved solids/chlorides, and suspended solids are known to occur in these water bodies. Active and former agricultural uses and urban runoff from developed areas represent the primary contributors to the pollutants found in the watershed.

The project, proposed for completion in 2014, diverts flows from Cucamonga Creek into a series of natural water quality treatment ponds that include areas of open water and wetland vegetation. The system is designed to first remove trash and debris as water flows through a de-silting basin, then remove pollutants through natural settlement, ultraviolet light treatment, and biological activity as it travels through native wetland vegetation. The system is designed to be entirely gravity fed, requiring no manmade energy sources, thus promoting progressive water quality alternatives that advance the use of renewable, sustainable, and environmentally sensitive designs, materials and practices **(Figure 5.7-9).**

[13] Source: Comments from Anthony Spina, National Marine Fisheries Service, West Coast Region.

**Figure 5.7-9 Cucamonga Creek Wetlands**




The project is a regional natural treatment facility designed to hold and treat 160 acre-feet of water. This volume translates into treatment of 10 – 18% of all wet-weather runoff in the Cucamonga Channel watershed. In contrast, a single-function water quality project of the same size in an upstream tributary could effectively capture approximately 6% of the total wet-weather runoff from the watershed. Thus, the project is an effective means of leveraging water quality benefits for the region.

Recreational Benefits

The project's recreational plan provides for additional passive recreation opportunities in the Prado Basin by incorporating approximately 3.5 miles of hiking and equestrian trails, forming a looped trail system around vegetated and open water ponds **(Figure 5.7-10).** The proposed trail system includes benches in locations that offer vistas of the wetland ponds and the surrounding environment, providing wildlife viewing opportunities with interpretative signage. Planting will be coordinated around the benches to provide shade and increase the aesthetic character of the views. The surrounding native plantings and open water wetlands will attract numerous wildlife species, offering excellent wildlife viewing opportunities.

**Figure 5.7-10 Cucamonga Creek Time Series**




Interpretive signage is proposed at the trailheads as well as throughout the trail system to provide park users with a better understanding of the history of the area; local wildlife that might be viewed; information on native vegetation, including plant communities and individual species; and an explanation on water quality and natural treatment systems.

Consistent with the needs identified by the USACE Prado Basin Master Plan and the San Bernardino County Parks Department, the trail system will provide future trail connections for the inter-county trail system as well as the Coast to Crest Trail System intended to connect the Santa Ana River Trail from its outfall in Orange County to the mountains in San Bernardino. The new trail system will also connect to the City of Chino Urban Buffer linear park/open space (The Preserve Specific Plan, City of Chino – March 2003, Amended – January 2008).

Native Habitat Creation and Restoration Benefits

The Prado Basin currently protects 4,400 acres of native habitat. The Prado Basin also contains some of the best and largest riparian habitat in all of Southern California with more than 300 species of plants, 13 species of reptiles, 47 species of breeding birds, 11 raptor species, and 23 mammal species. Included

are threatened and endangered species such as the least Bell's vireo, arroyo chub, and Santa Ana sucker.

The Project will create 32 acres of native habitat through the use of native planting in the wetland ponds and slopes in addition to replacing non-native vegetation, agricultural lands, and disturbed areas with high quality native vegetation. The Native Habitat Plan creates several habitat types that will benefit local wildlife, including endangered species, by utilizing species that promote nesting, breeding and foraging. The Native Habitat Plan also supports the Recreation Plan by providing shade, wildlife viewing opportunities, and aesthetics.

## Low Impact Development Guidance and Training for Southern California

This project, funded under Proposition 40 and cooperatively conducted with local governments and regulatory agencies from six counties (Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura; and RWQCBs from Los Angeles, Santa Ana, and San Diego regions), began in 2006. It was led by the San Bernardino County Flood Control District with guidance from the Southern California Stormwater Monitoring Coalition (SMC), and a stakeholder-comprised Technical Advisory Committee (TAC). The project developed the Low Impact Development Manual for Southern California, which facilitates the implementation of LID techniques for projects in Southern California. It also provides guidance for municipalities, land developers, consultants and other design professionals who prepare stormwater engineering plans and specifications in Regional Water Quality Control Board Districts 4, 8 and 9 of Southern California.

The LID GTPSC also conducted several training workshops in 2007 and 2008, and transferred the final LID Manual to the California Stormwater Quality Association (CASQA) for statewide access via the World Wide Web and to steward updates and revisions to the manual over time. CASQA now hosts an LID web portal and will be developing this portal under a 2012 Proposition 84 Stormwater Grant.

Finally, the project included a monitoring element designed to evaluate the effectiveness of LID BMPs in reducing stormwater impacts. Monitoring has been underway at selected sites, although precipitation has generally been less than average, so few events have been captured. The monitoring program is currently under review by the SMC, and is expected to be refined and continued. The objective is to adaptively update the LID Manual based on actual performance of LID in the field.

## Riverside County Flood Control & Water Conservation District LID Retrofit Project

The RCFCWCD retrofitted their 15-acre headquarters near downtown Riverside with LID BMPs from their LID BMP Design Manual to showcase, learn, and gather local, real-world data of constructible LID BMPs. The Project was supported through a partnership with SAWPA and funded in part by Proposition 13 Water Bond funding administered by the SWRCB. The Project entailed construction and installation of selected LID BMPs, including porous pavers, porous concrete pavement, porous asphalt pavement, biofiltration basins, and a vegetated infiltration swale. The Project also replaced turfed landscaped areas with drought tolerant and California-friendly landscaping **(Figure 5.7-11).** The total construction cost of the Project was $ 2,557,634.36.

**Figure 5.7-11 Riverside County FC and WCD LID Testing and Demonstration Facility**




A dedicated website was developed during the project to educate the public about LID practices. The website also served as an avenue to show construction progression of the different LID BMPs. Since construction completion in 2012, the facility has welcomed and educated visitors through signs, markers, and a walking guide. The facility has also garnered several awards, including the ASCE's (Region 9, Los Angeles Section) 2012 Civil Engineering Project Improvement Award, ASCE Region 9 2012 Outstanding Stormwater Management Project, and the Southern California APWA 2012 Project of the Year in Stormwater Quality.

The project also constructed and installed a monitoring center which will allow future water quality monitoring of LID BMP influent and effluent that aims to enumerate LID BMP performance in the semi-arid Southern California climate.

## San Bernardino County Vision Water Element[14, 15]

This project is an effort to "improve countywide efforts to plan and manage water resources in San Bernardino County." The Vision: "Develop a Countywide strategy that encourages collaboration among business, residents, and water agencies that will:

- Address multiple watersheds and water agencies
- Build institutional and organizational capacity for future countywide networking efforts
- Create mutually beneficial investment opportunities to ensure adequate water supplies and quality for the future"

"Leaders from public and private water agencies, regulators, planners, education and business formed the Countywide Vision Water Element group in January 2012 and have been meeting regularly to discuss the challenges faced by the county community as it strives to meet the water needs of an ever -growing region."

"The Water Element Group recognized the need for a high-level, comprehensive look at countywide water management. With participation from water agencies throughout the County, the Water Element Group prepared an inventory of current and planned water needs and available water resources. The inventory found that more than ***enough water will exist to meet the needs of San Bernardino County residents and businesses through 2035 only if water users step-up conservation efforts and the public and local government leaders are willing to invest in projects that will store and protect additional water supplies***."

"The County Vision Water Element group will use the information contained in the inventory to promote partnerships among water agencies and other stakeholders within the county, improve water management and efficiency, protect and conserve water resources, and identify the most important next steps the group should take to further these goals."

## City of Ontario New Model Colony General Plan[16]

Since 1998, the City of Ontario has been developing a bold vision for its future growth, including the adoption of its general plan and adding 3,303 acres of former agricultural land into its sphere of influence. The City's recent plans call for 13,000 new housing units across a broad range of housing types and a mix of business spaces oriented towards three mixed-use centers that are served by pedestrian-friendly roadways and a large central park. Emphasizing connections to corridors and transit, the City is creating a major regional center for Southern California.

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[14] San Bernardino County Countywide Water Inventory Executive Summary September 5, 2012 http://www.sbcounty.gov/Uploads/CAO/Vision/Water_Inventory_Executive_Summary_9_6_2012_v01.pdf

[15] http://www.sbcounty.gov/Uploads/CAO/Vision/FINAL-Water-Conference-Presentation.pdf

[16] SCAG 2012. Regional Transportation Plan 2012-2035: Sustainable Communities Strategy, Page 149. http://www.scagrtp.net/

## Existing Forums to Address Watershed Planning

SCAG is the Regional Transportation Planning Authority. As such, SCAG has been evaluating regional growth problems and developing guidance and approaches to implement community sustainability principles in collaboration with local governments and County Transportation Commissions (CTCs). Water quality and water supply are key sustainability considerations and are given high priority in the SCAG efforts. The Water Chapter of SCAG's 2008 Regional Comprehensive Plan (RCP)[17] (Pages 48-63) evaluates water priorities and climate change, and provides comprehensive recommendations for addressing these issues in the immediate future as related to regional growth needs.

The SCAG recommendations are entirely consistent with the OWOW Mission to develop a sustainable and adaptable watershed. For example the 2008 RCP provides the following Water Goals:

- "Develop sufficient water supplies through environmentally sustainable imports, local conservation and conjunctive use, reclamation and reuse to meet the water demands created by continuing regional growth
- Achieve water quality improvements through implementation of land use and transportation policies and programs that promote water stewardship and eliminate water impairments and waste in the region
- Foster comprehensive and collaborative watershed planning within the region that produces waterwise programs and projects with multiple benefits and ecosystem protections, integrating local government planning efforts with those of special districts, environmental advocate and other watershed stakeholders"

### *Transportation Planning[18]*

Since 2000, SCAG has worked with Southern California stakeholders to create a dynamic regional growth vision. "Charged by federal law with preparing a Regional Transportation Plan every four years, SCAG has traditionally focused most on the mobility aspects of the region's growth. Under state law, SCAG is also charged with working with its member local governments on planning for an adequate regional housing supply."

The 2012 RTP land use mitigation program includes the following types of measures:

- Encourage cities and counties to update their general plans and provide the most recent plans to SCAG
- Work with member cities to ensure that transportation projects are consistent with the RTP and general plans
- Work with cities and counties to ensure general plans reflect RTP policies

### *Water Resources in the RTP*

[17] SCAG 2008. Regional Comprehensive Plan. http://www.scag.ca.gov/rcp/pdf/finalrcp/f2008RCP_Water.pdf

[18] SCAG 2012. Regional Transportation Plan 2012-2035: Sustainable Communities Strategy. http://www.scagrtp.net/

Cumulative impacts to water resources from the growth projected in the 2012 RTP include potential water quality impairment from increased impervious surfaces; increased development in alluvial fan floodplains; and increased water demand and associated impacts. Increased greenhouse gas emissions from the transportation system impact the security and reliability of the imported water supply.
The water resources mitigation program from the 2012 RTP includes the following types of measures:

- Utilizing advanced water capture and filtration techniques, showing a preference for naturalized systems and designs, to control stormwater at the source
- Avoiding any new construction of impervious surfaces in non-urbanized areas, such as wetlands, habitat areas, parks, and near river systems
- Avoiding any new construction that provides access to flood-prone areas, such as in alluvial fans and slide zones
- Protection and preservation of existing natural flood control systems, such as wetlands and riparian buffers, and expansion of such systems in areas where they do not currently exist
- Constructing projects according to Best Management Practices for water quality protection and water conservation, including low-impact development and green building standards
- Coordinating project development and construction efforts across jurisdictional, agency, and departmental boundaries, to increase project benefits

### *Orange County Sustainable Communities Strategy (SCS)*[19]

The Orange County Council of Governments (OCCOG) developed their own SCS and entered into a *Memorandum of Understanding with SCAG specifying submission* schedules and standards for each component of the subregional SCS. While OCCOG conducted their own research and outreach to develop their SCS, they worked closely with SCAG through workshop preparation **(Figure 5.7-6a),** data and information sharing, and regular meetings. SCAG's Local Sustainability Planning Tool was also made available along with trainings and one-on-one working sessions to assist in the review and revision of the preliminary scenarios.

### *Riverside County and City Arroyo-Watershed Project*

The Riverside Arroyo/Watershed Policy Study, completed in November 2006, was a joint effort between the City of Riverside and the County of Riverside to establish a broad plan for the protection of the arroyos and other watercourses that traverse the boundary between the City and County. The study also made recommendations intended to facilitate the protection of water quality, and the augmentation of water supply for the City-County area. The study applies to a large portion of the Santa Ana Watershed area, offers a comprehensive program of water protective policies and land use/riparian and water interface design concepts, and involves two closely coordinated neighboring jurisdictions, and thus can provide a model for other jurisdictions within the OWOW Plan area, both in terms of policies and design concepts, as well as inter-jurisdictional cooperation in implementing them. The study was prepared by the County-City Arroyo/Watershed Committee (CCAC), an interdisciplinary group whose members were appointed by the Riverside City Council and the Riverside County Board of Supervisors.

[19] Orange County Sustainable Communities Strategy, June 2011. http://www.occog.com/pdf/OCSCS20110614.PDF

Many organizations contributed to the work of the CCAC, especially SAWPA, the California Department of Fish and Game, the Riverside-Corona Resource Conservation District, the Riverside County Flood Control and Water Conservation District, SAWA, Riverside Land Conservancy, UCR (logistical research), and Mt. San Jacinto College.

The recommendations of the CCAC in the Riverside Arroyo/Watershed Policy Study were intended to result in implementing amendments to both the City's and County's General Plans, their zoning ordinances, grading ordinances, and other ordinances and policies under the charge of the those jurisdictions' Planning, Transportation, Flood Control, Health, Agricultural Commissioner, and Parks offices/departments. Study recommendations have been incorporated into the City's General Plan and ordinances, and are in the process of being similarly adopted by the County as part of a major, comprehensive General Plan update.

The Study's policies address a wide variety of land use and watershed issues, including (but not limited to): building/graded area setbacks from arroyos; illegal grading policies; a GIS tool for mapping watercourse features requiring protection; golf course setbacks from arroyos; a model policy associating slope, setbacks from arroyos, and lot size; requirements for septic tanks; policies for bridging, rather than grading road (with culverts) arroyo crossings; water quality protection policies that emphasize multiple, compatible uses, using storm water management and runoff as design elements; requirements for domestic and farm animals and livestock grazing in and near arroyos; restrictions on nurseries in and near arroyos; and restrictions on the location of utility facilities in and near arroyos. The CCAC GIS Watercourse Layer Map of arroyos and watercourses in the project area was accompanied by 19 specific recommendations for proactive and sensitive development that occurs near watercourses and arroyos[20].

The Study identifies several "next" steps to carry forth the benefits of its approach, including:

- Ensure the incorporation of the study's concepts on a long-term basis into local general plans and zoning ordinances
- Thorough, adequate assessments of at-risk land use conversions in and near arroyos;
- The establishment of various levels of governance and coordination on a watershed-wide basis; and public education about the study and the public's role in assisting in its implementation
- Conduct an objective evaluation of the effectiveness of existing protection measures and their implementation

[20] Riverside Arroyo Watershed Policy Study: Recommendations, 2006. Prepared by the County/City Arroyo-Watershed Committee. http://www.rctlma.org/planning/content/geninfo/ccacpolicystudy.pdf

Benefits to implementing the recommended actions included:

1. ***Create dynamic scenarios*** for protecting watercourses and other watershed values described in General Plan vision statements by applying policy recommendations in combination with the new GIS Watercourse Protection Map
2. ***Reduce the occurrence of code violations*** due to consistent and clear rules across boundaries for developers, land owners, staff, and land use decision-makers
3. ***Lessen potential for citizen complaints, litigation, and development delays*** over code violations due to consistent and clear rules across boundaries and an approach that is integrative in nature
4. ***Enhance public safety*** through incorporation of BMPs that reduce downstream flooding, landslides and erosion, and water quality impacts from new and existing development
5. ***Lower flood management and water quality management costs*** through controlling runoff and water quality at the source while providing multiple benefits that include habitat protection, recreation enhancement, aesthetic improvements, and high quality development
6. ***Improve neighborhood and community quality of life*** through increased opportunities for recreation, significant protection and enhancement of the aesthetic quality of Riverside, and high quality development
7. ***Enhance funding opportunities*** for acquiring State and Federal funds, including the recently passed Proposition 84 water bond funds, to make flood management and water quality protection improvements that are consistent with the CCAC policy recommendations and design guidelines

### *Newport Bay Conservancy*

The Newport Bay Conservancy is developing a Concept Book for the Newport Bay Watershed that is intended to inform land use planning in the region and inform how it could be used to support water resource restoration goals. The project will first identify the ecological and water resource infrastructure goals that enable cross-agency buy in. It will then look for land use design opportunities throughout the watershed for implementing those goals in their entirety. The idea is to paint a picture for what complete resource integration and restoration would look like in the urban landscape and demonstrate how it could be integrated into other urban planning objectives such as transportation planning, community beautification and economic development. In this way, water resource restoration can become a part of the bigger picture of creating and enhancing community identity while also achieving technical environmental goals.

### *OWOW Influence on Planning Commissions*

The OWOW Plan can influence local Planning Commissions indirectly, through project consideration and selection for funding and outreach from OWOW Pillar participants. Projects identified and recommended by the Plan could be communicated to local Planning agencies for consideration through brochures or other outreach. The SAWPA Commission and OWOW Steering Committee include local decision makers and elevate the level of awareness of watershed priorities.

### *General Plan Water Element*

Current CA Code does not require General Plans to include a "water element." A water element has been strongly recommended as a fundamental approach to incorporate water issues into the planning process. Therefore, the 2003 General Plan Guidelines from the California Office of Planning Research the included guidelines for an optional water element (Page 128) and a flood management element (Page 116) (OPR General Plan Guideline are currently in the process of being updated. See: http://opr.ca.gov/docs/GPG_2013_One_Pager.pdf).

### *Model Ordinance Governing Planning for Watershed Sustainability*

Local government ordinances and implementing codes are more directly implemented than higher-level planning documents. Many local governments have adopted ordinances to address specific environmental concerns, including water supply and conservation, water quality, and sustainable development practices. MS4 Permits in the watershed require all Permittees to "maintain adequate legal authority to control the discharge of pollutants to their MS4s through ordinance… and enforce these authorities." MS4 Permittees in the watershed have complied by adopting ordinances based on regionally developed model stormwater ordinances. All watershed cities were required by AB1881 to adopt a landscape ordinance by January 2010—most cities complied through the use of the DWR model ordinance or regional model ordinances.

### *Los Angeles County Ordinance Example*[21]

"The County of Los Angeles added a chapter to the Title 12 Environmental Protection of the Los Angeles County Code. This chapter is entitled Low Impact Development Standards; its stated purpose is to require the use of LID principles in development projects. The chapter states, *"LID builds on conventional design strategies by utilizing every softscape and hardscape surface in the development to perform a beneficial hydrologic function by retaining, detaining, storing, changing the timing of, or filtering stormwater and urban runoff."* The ordinance requires comprehensive LID plans that demonstrate compliance with an LID Standards Manual to be submitted for review and approval by the Department of Public Works. It also specifies that urban and stormwater runoff quantity and quality control standards will be established in the LID Standards Manual that is to be updated and maintained by the Department of Public Works. For subdivisions, the LID plans must be approved prior to tentative map approval. For all other development, an LID plan must be approved prior to issuance of a grading permit or, where a grading permit is not required, prior to issuance of a building permit.

The Subdivision and Planning Zoning Titles of the Los Angeles County Code were amended to add reference to the Low Impact Development Title. In addition, the County adopted ordinances for green building and drought-tolerant landscaping. All three ordinances apply to all administrative and all discretionary projects."

[21] Low Impact Development Manual for Southern California, 2010. Low Impact Development Center, Appendix B, Page 203.; https://www.casqa.org/LinkClick.aspx?fileticket=zA3DaxiwHtE%3d&tabid=242

Therefore, the Land Use and Water Pillar recommends the development of a model ordinance that would facilitate the consistent implementation of Watershed Sustainability Planning Procedures. Such a model ordinance could be readily adapted from existing ordinance examples, such as the "Model Ordinance Governing Planning and Development on Alluvial Fans" that was recommended by stakeholders appointed to DWR's Alluvial Fan Task Force (AFTF). (See: http://aftf.csusb.edu/documents/DRAFT_MODEL_ORDINANCE.pdf).

The AFTF Model Ordinance was designed to provide a platform for pre-project level discussion and evaluation of sustainability issues related to individual development projects being proposed in alluvial fan areas. The sole purpose of the Model Ordinance was to facilitate better informed land use decisions. The Model Ordinance procedures are intended provide project proponents with as much information about sustainability issues before any project planning expenditures take place.

It is important that OWOW 2.0 stakeholders also note that AFTF Model Ordinance (MO), crafted by attorneys and vetted by legal stakeholders, **was designed specifically not expand or conflict with any existing land use regulatory processes in any way**. To that end, the MO merely sets forth procedures to be followed, and substantive factors to be considered, for these particular types local land use decisions. The ultimate goal is for local communities to utilize the best available scientific information to ensure that land use planning and development adequately consider watershed sustainability issues.

### *OWOW Governance and OWOW Project Selection*

The OWOW 2.0 Plan will guide the selection of projects to be awarded California Proposition 84 funds and other future water resource implementation funding in the SAR Watershed. However, to maximize project benefits and ultimately optimize watershed sustainability, project concepts and designs need to be influenced before project selection process begins. Projects created to serve single or very limited entity interests may not have considered the cumulative watershed impact and demand close scrutiny. Comprehensive watershed planning should include project conceptualization that maximizes benefits from the holistic watershed perspective.

To further more holistic project concepts, the plan binds watershed stakeholders through trust and relationship building. The plan will be most effective if successfully communicated to the local and regional agency decision-makers.

### *Relevant policies*

- General Plans have conservation elements that can serve watershed sustainability requirements
- Local Ordinances—such as AB 1881 Landscape Ordinance
- Master Drainage Plans
- MS4 Permit Requirements for development, redevelopment, and roads
- MS4 Permits require Permittees to review the watershed protection principles and policies, specifically addressing urban and stormwater runoff, in its planning procedures, including CEQA preparation, review and approval processes; General Plan and related documents

including, but not limited to its Development Standards, Zoning Codes, Conditions of Approval, Development Project Guidance; and WQMP development and approval processes[22]

## Drivers for Land Use and Water Planning Collaboration

### *Implementation of land development provisions of MS4 Permits*

The U.S. Environmental Protection Agency (EPA) requires Municipal Separate Storm Sewer Systems (MS4) permits to address new development and significant redevelopment projects through implementation of post-construction controls to reduce pollutants in stormwater discharges, and ensure long-term operation and maintenance of these controls.[23]

Hydrologic modifications from urbanization increase the quantity of stormwater discharges, and cause excessive erosion and stream channel degradation. Frequently the volume, duration, and velocity of stormwater discharges cause degradation to aquatic systems. Protecting and restoring the physical, chemical and biological integrity of receiving waters must be a central issue in stormwater permits. The National Research Council[24] recommends that the NPDES stormwater program examine the impacts of stormwater flow, treat flow as a surrogate for other pollutants, and includes recommended control requirements in stormwater permits. The report recommends that the volume retention practices of infiltration, evapotranspiration and rainwater harvesting be used as primary stormwater management mechanisms. For this reason, EPA recommends use of a permit condition that is based on maintaining or restoring predevelopment hydrology although other forms of this permit condition maybe appropriate as well.

### *MS4 Tasks (WQMPs, LID, General Plan, Codes, CEQA, hydromodification, habitat)*

As part of the development program, the MS4 Permits include several requirements aimed at linking water quality and watershed protection with land use planning processes. These requirements include the "consideration of watershed protection principles in…CEQA and planning processes" (San Bernardino County MS4 Permit, Section XI.B.3.b.4; Page 77). These principles include specific consideration of the impacts of stormwater runoff, discharge of pollutants, and physical impacts which could affect downstream receiving waters and beneficial uses. The permittees must also coordinate with the Santa Ana RWQCB when projects require a Clean Water Act Section 401 Water Quality Certification. The MS4 Permit also specifies development of "common principles and policies necessary for watershed protection," which must include seven specific considerations (SB County MS4; Section XI.C.3.a – g; Page 78). These required considerations are very similar to the Ahwahnee Water Principles. The three

[22] CRWQCB, Santa Ana Region, January 29, 2010. Waste Discharge Requirements for the County of San Bernardino and the Incorporated Cities of San Bernardino County, Order No. R8-2010-0036, NPDES No. Cas618036, Areawide Urban Storm Water Runoff.

[23] USEPA, 2010. MS4 Permit Improvement Guide. **EPA 833-R-10-001**

[24] *Urban Stormwater Management in the United States*, National Academies Press, 2008 www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf

county MS4 Programs are each developing watershed geodatabases intended to integrate watershed data and facilitate better planning. These are being developed within Watershed Action Plans (WAPs) (San Bernardino and Riverside County MS4s) and Watershed Infiltration and Hydromodification Master Plans (WIHMPs) (in Orange County). These are described in more detail in the **Chapter 5.8 Stormwater: Resource and Risk Management** "MS4 Permits as a driver for Plan implementation," and table 5.8-1.

Water Quality Management Plans (WQMPs) contain the requirements for implementation of post-construction BMPs for development projects subject to approval by the Permittees. The most recent WQMPs require the implementation of LID principles at all sites, with infiltration BMPs preferred wherever feasible. WQMPs are required for most projects that disturb 5,000 square feet or more, all auto repair facility projects, and projects 2,500 square feet or more that discharging environmentally sensitive areas (SB County MS4 Permit, Section XI.D.4; Page 79).

The WQMPs include specific requirements for projects that have a downstream Hydrologic Condition of Concern (HCOC). HCOCs are locations where water quality or habitat will be adversely affected by increased flow volumes, velocities, or by changes in the timing or duration of stormwater runoff. Protection of areas with HCOCs is a developing science and the MS4 Permits encourage watershed and stream-specific evaluations and require monitoring to ensure appropriate protection is devised and implemented.

The MS4 Permits require the development and/or revision of Local Implementation Plans (LIPs) for each Permittee. The LIPs describe each individual Permittee's detailed processes and identifies departments responsible for implementing all MS4 Permit requirements as specified in the Drainage Area Management Plans (DAMPs) and Municipal Storm Water Management Plans (MSWMPs). LIPs are an enforceable extension of the MS4 Permit. Individual LIPs are reviewable by the Regional Board and lack of implementation of LID provisions constitutes non-compliance with the MS4 Permit.

The MS4 Permits also require the implementation of LID or "greenstreet" techniques for applicable road construction projects. These requirements have been incorporated into the WQMPs and Technical Guidance Documents (TGDs).

### *Alternative compliance approaches*

Alternative approaches for compliance with the MS4 Permit development requirements are described in **Chapter 5.8 Stormwater: Resource and Risk Management** in this plan. However, additional description and project applications are included below from the land use perspective.

### *Alternative land development compliance under MS4 Permits*

Urban Runoff Fund, Water Quality Credit System, Regional Treatment BMPs

(These are described in more detail in the **Chapter 5.8 Stormwater: Resource and Risk Management** "MS4 Permits as a driver for Plan implementation," pages 26-27 and Table 5.8-1**)** Alternative stormwater compliance elements for development projects in the Santa Ana Region MS4 Permits.)

The MS4 Permits allow the development and significant redevelopment requirements of the WQMPs to be met through the use of: regional treatment BMPs, and urban runoff fund, or a water quality credit system. Regional treatment BMPs include sediment basins, infiltration basins or water quality wetlands that would receive storm runoff from upstream project sites. Potentially, regional facilities could be funded in part by contributing development projects, and be maintained by a public agency. Properly implemented regional BMPs could protect water quality and provide groundwater recharge, while providing a cost-effective means for MS4 WQMP compliance.

An urban runoff fund (URF) would be established to develop water quality projects using contributions from development projects where LID and infiltration are not feasible, or where greater benefits could be derived from off-site project implementation. Challenges to use of the URF include administration of the fund, assessing the value of projects and appropriate fund contributions, and scheduling constraints written into the MS4 Permits.

A water quality credit system would be established to allow projects to trade water quality or LID/infiltration credits. Projects unable to provide adequate runoff BMPs onsite could purchase credits for BMPs implemented elsewhere. Sites that are able to provide water quality or infiltration BMPs that exceed the required design standards would be allowed to sell credits for the net additional treatment capacity.

Design and approval of development project occurs within a complicated process involving regulations, permits, water supply determinations, and guidance. Regulatory agencies technically do not have land use authority, but influence land use through permit requirements. **Figure 5.7-12** shows schematically the linkages between regulations, permits, local government authority, water agency responsibilities, and where watershed protection priorities are incorporated. State and federal authorities are imposed by state and federal agencies on projects through permits. MS4 Permits specifically require incorporation of watershed protection "principles and policies" into local government General Plans, CEQA documents and the overall development process. Stream channel dredge and fill (USACE Section 404 Permits) RWQCB and SWRCB 401 Water Quality Certifications, and stream alteration permits (CDFW Section 1600 Permits) are typically issued directly to individual projects. Local jurisdictions must verify and facilitate these permits before approving project plans. Water suppliers are responsible to provide water supply assurance before projects can be approved by the local government **(See Figure 5.7-13**). Finally, OWOW Plan priorities inform the permitting process and are indirectly incorporated into local development approval processes and into individual projects.

**Figure 5.7-12 Local Land Use Authority, Regulatory Authority and Permitting Requirements**

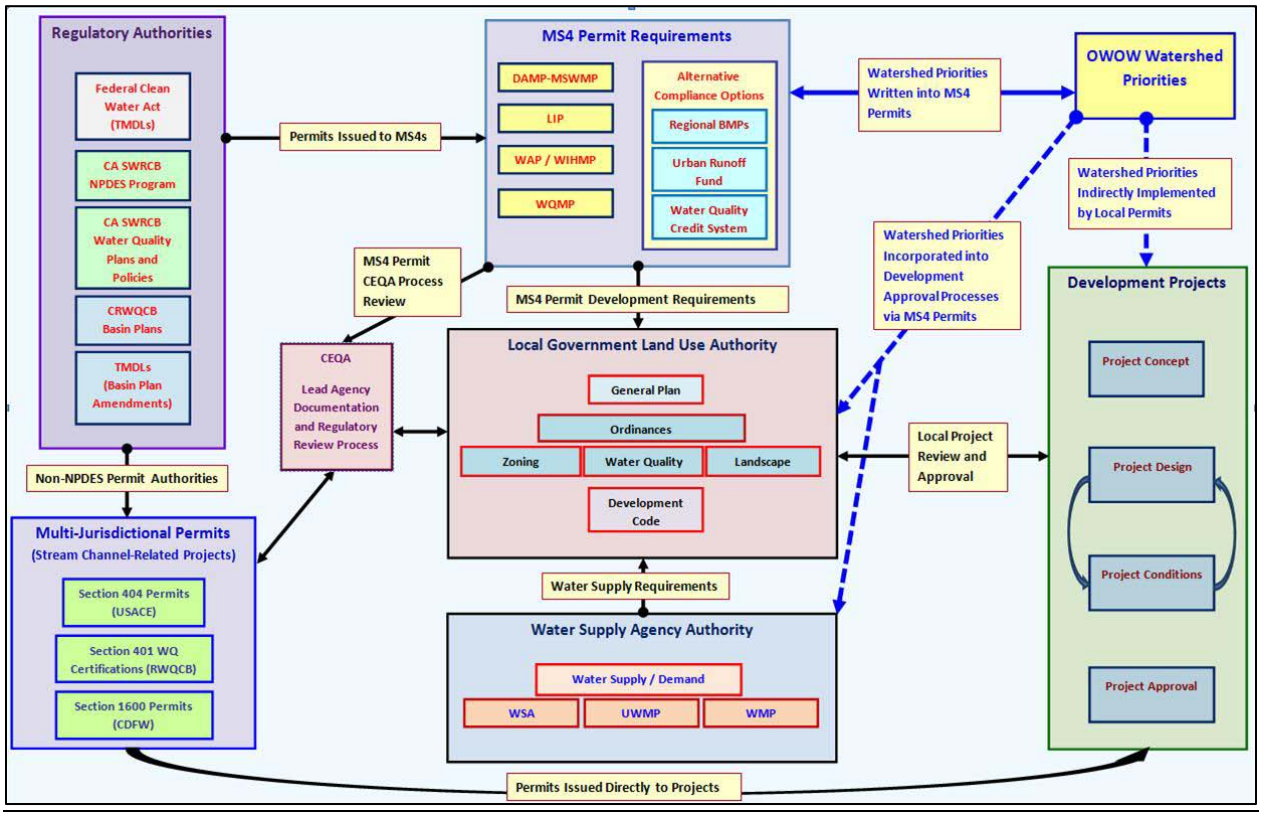
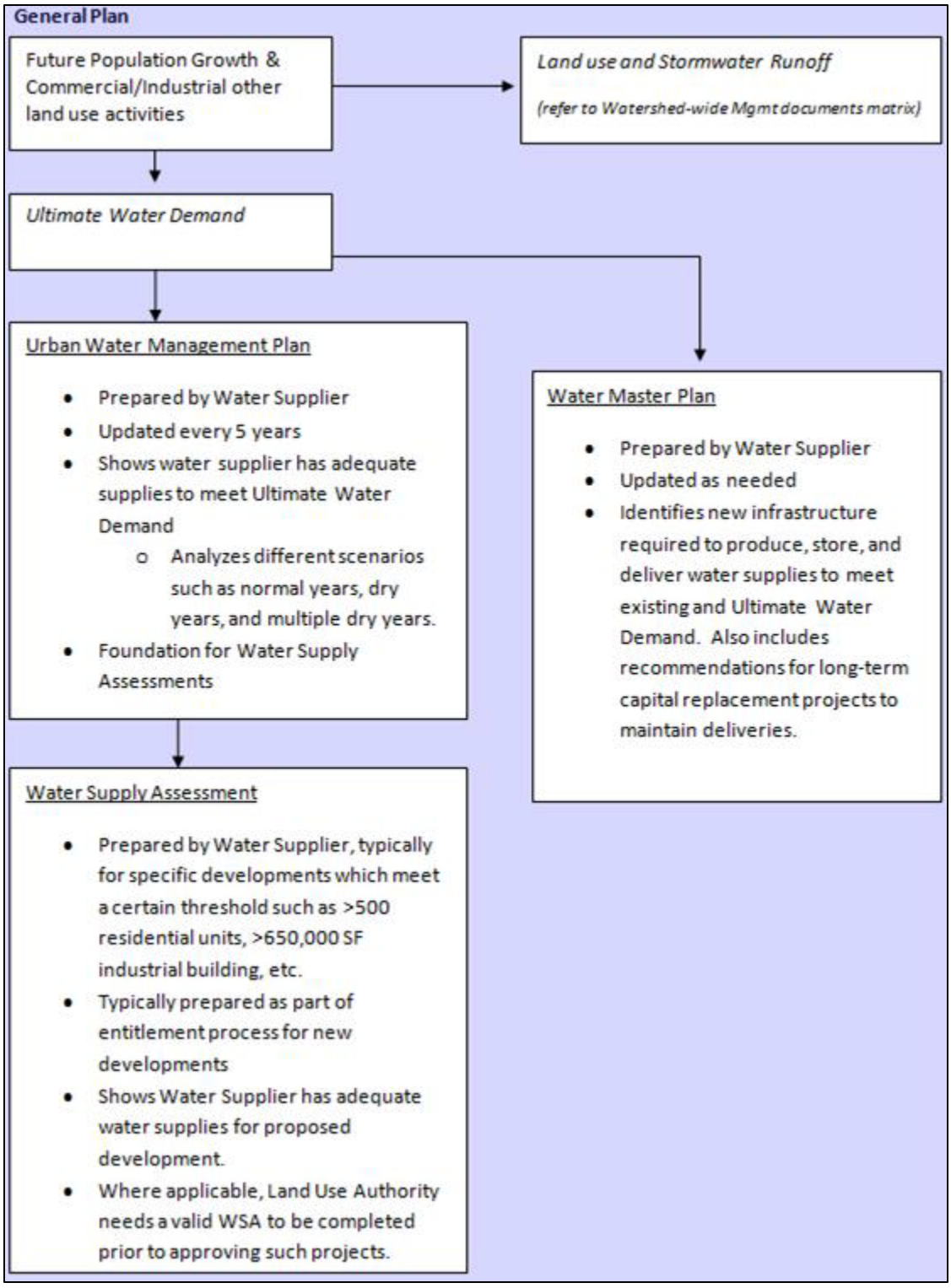


**Figure 5.7-13 General Plan-Water Supply Requirements**



### *Incentives for OWOW stakeholders to partner on MS4 Development projects*

Ground water yield increase from LID implementation

A primary goal of LID implementation is to maintain or restore natural hydrologic conditions at project sites. A key aspect of hydrology is enhancing infiltration to compensate for installation of impervious surfaces. LID implementation can incrementally increase the recharge of groundwater basins, whether at individual, distributed sites in the watershed, or at larger scale catchment or regional infiltration sites. This increases the local groundwater supply and improves watershed sustainability.

### *Quantification (estimates) of groundwater recharge from site-based or regional LID—value of water supply*

As stated by the Southern California Water Committee (SCWC): "Not all development will occur in areas where on-site capture and infiltration results in augmentation of groundwater basins used as drinking water supplies…"[25] Although LID techniques will increase groundwater recharge, it is difficult to determine the actual quantity of new available supply due to variable soil and subsurface characteristics. Larger scale infiltration facilities are more quantifiable and more likely to be maintained and monitored. Valuation of increased recharge and new supply is needed to understand cost benefit factors and to incentivize such projects to encourage broader project support. The Chino Basin Water Master has evaluated the volume of recharged and potentially accessible water from LID implementation in the Chino Basin. The challenge is to demonstrate cost-benefits for the stakeholders under various implementation scenarios, especially distributed, individual site based infiltration BMPs v. larger scale catchment or subwatershed regional infiltration basins. Larger scale basins would most likely be maintained by water agencies and their effectiveness would be monitored and maximized, whereas individual privately maintained BMPs will have less scrutiny and less effective maintenance on average. Water agencies will need demonstrated long-term supply increases to justify cost sharing on such projects, while MS4 partners need to show pollutant reduction and mitigation of hydromodification.

### *Development community perspective and partnering*

The development community in the SAR Watershed has demonstrated a willingness to adapt projects to meet watershed needs and to lead innovative projects (See examples in the **Chapter 5.8 Stormwater: Resource and Risk Management,** "Stormwater as an Essential Resource for the SAR Watershed" and "Regional and Watershed Examples" described earlier in this chapter) Building Industry Association and the Construction Industry Coalition on Water Quality have partnered in research and implementation projects to advance understanding of costs and benefits of LID and sustainable community designs. Developers will design and build the projects that serve watershed priorities as a result of ongoing collaboration.

## Legislated Water Supply or Conservation Goals

### *Water Supply Legislation*

In 1983, the State legislature enacted the Urban Water Management Planning Act which requires urban water suppliers that provide water to 3,000 or more customers, or that provides over 3,000 acre-feet of

[25] SCWC, 2012. Stormwater Capture: Opportunities to Increase Water Supplies in Southern California.

water annually, to prepare an Urban Water Management Plan (UWMP) and update it every 5 years. The UWMP describes the supplier's efforts to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its customers during normal, single dry, and multiple dry years. UWMPs and General Plans are linked and interdependent as the assumptions for land use, population growth, etc., must be consistent. UWMPs are a critical source document for cities and counties as they update General Plans. Similarly, General Plans are a source document as water suppliers update their UWMPs. Continuing land use changes and population growth have resulted in additional water demand on water systems. In 2002, the State legislature enacted Senate Bills 610 and 221 as companion measures, to further promote more collaborative planning between local water suppliers and land use authorities and to ensure the increased demands are adequately addressed, and a firm source of water supply is available prior to approval of certain developments. *Water Supply Assessments* pursuant to SB 610 and *Written Verifications of Water Supply* pursuant to SB 221 are prepared by the water supplier for applicable projects and typically rely on UWMPs as a foundational document.

SB 610 (Water Supply Assessment) requires an urban water supplier to include a description of all water supply projects and programs that may be undertaken to meet total projected water use over the next 20 years. SB 221 (Written Verification of Water Supply) prohibits approval of a tentative map, or a parcel map for which a tentative map was not required, or a development agreement for a subdivision of property of more than 500 dwelling units, including the design of the subdivision or the type of improvement, unless the legislative body of a city or county provides written verification from the applicable water supplier that sufficient water supplies are, or will be available prior to completion of the project.

In 2009, the State legislature enacted Senate Bill 7x-7 (20x2020 Plan) to set forth a statewide road map to maximize urban water use efficiency and conservation and establish a requirement to reduce per capita water consumption by 20% by 2020. To ensure progress in meeting the goal, water suppliers were mandated to develop water use targets and document such compliance in their UWMPs.

Water supply, needed for population growth, is a significant limiting factor for development projects. UWMPs and Water Supply Assessments link water resource constraints with local project planning, design and approval process. Water supply is a critical sustainability factor and should be recognized as a high priority feasibility factor in project concept development. Projects that enhance water supply, such as LID capture and use BMPs and infiltration BMPs on various scales (that recharge supply aquifers) should merit stronger acceptance with the regulatory programs.

### *Sustainable Communities Legislation*[26]

The purpose of SB 375 (Sustainable Communities and Climate Protection Act of 2008) is to implement the state's greenhouse gas emissions (GHG) reduction goals in the sector of cars and light trucks. This mandate requires the California Air Resources Board to determine per-capita GHG emission reduction

[26] SCAG 2012. Regional Transportation Plan 2012-2035: Sustainable Communities Strategy. http://www.scagrtp.net/

targets for each Metropolitan Planning Organization (MPO) in the state for years 2020 and 2035. SCAG and California's 17 other MPOs must address GHG reduction in a "Sustainable Communities Strategy" that is part of the respective MPO's Regional Transportation Plan. In accordance with Govt. Code section 65080(b)(2)(B)(vii), the 2012 Regional Transportation Plan (RTP) and incorporated SCS are expected to achieve GHG emission reductions of 8 percent per capita in 2020 and 16 percent per capita in 2035.

Transportation strategies contained in the RTP—managing transportation demand and making key transportation system improvements – are major components of the SCS. However, the SCS also focuses on the general land use growth pattern for the region, because geographical relationships between land uses—including density and intensity—help determine the need for travel in the first place. Therefore, SCAG's SCS includes not only projections about the transportation network but also about land use. Under SB 375, a SCS must, in summary:

- Identify existing and future land use patterns
- Consider statutory housing goals and objectives
- Identify areas to accommodate long-term housing need
- Identify areas to accommodate 8-year housing need
- Consider resource areas and farmland
- Identify transportation needs and the planned transportation network
- Set forth a future land use pattern to meet GHG emission reduction targets
- Comply with federal law for developing an RTP

The SCS does not create a mandate for land use policies at the local level. In fact, SB 375 specifically states that the SCS cannot dictate local General Plan policies (see, Government Code Section 65080(b) (2) (J)). However, the SCS is intended to provide a regional policy foundation for local governments to build upon and includes quantitative growth projections from each city and county in the region. In addition, some projects consistent with the SCS are eligible for streamlined environmental review.

One aspect of SB 375 unique to the SCAG region is that subregions within SCAG have the option of creating their own subregional SCS. Of SCAG's 15 subregions, two accepted this option: the Gateway Cities Council of Governments (Gateway COG) and the Orange County Council of Governments (OCCOG). These subregional SCS documents are incorporated into the regional SCS.

## Optimize Watershed Supply and Quality

The Ahwahnee Water Principles for Resource Efficient Land Use describe values that a community should consider to maximize the sustainability of a watershed or region. These are grouped into nine basic principles that link community development with sustainable approaches for land use, water supply, water quality protection, flooding, and natural resource conservation.

The plan describes opportunities and constraints in the SAR Watershed that must be managed to ensure increased sustainability while accommodating population growth. The goal is to achieve optimal resource use and to adapt to changing conditions over time.

### *Constraints that limit Land Use & Water Planning Collaboration*

Collaboration pros and cons:

Pros:

- Collaboration can pool or leverage resources of multiple agencies
- Provides a more multi-disciplinary, multi-agency perspective, and increased experience and expertise
- Avoids unnecessary duplication of efforts
- Helps ensure all related priorities and projects are considered
- Collaborative projects can be more competitive for grant funding

Cons:

- Differing multi-jurisdictional priorities may be difficult to address adequately
- Collaborative projects may be slower to develop and implement
- Multi-jurisdictional permitting requires more effort

Process and regulatory constraints

- Existing plans and codes may preclude LID designs (e.g. curb requirements)
- Right-of-way, safety and design requirements may limit adaptability of road retrofit or improvement projects
- Regional BMPs are generally favored by stakeholders, including regulators. However, regulations and permits contain potentially conflicting limitations such as the transport of waste in waters of the US and habitat protection requirements that limit BMP maintenance opportunities
- MS4 Permit WQMPs require BMP selection and implementation based on a strict hierarchy that limits the possible configurations that can be approved

Relevant constraints identified by other Pillars

- Watershed locations with non-infiltrating soils and geology
- Areas with groundwater contaminant plumes
- Concern regarding infiltration of stormwater from industrial land uses, or from BMPs that are poorly designed, installed, and/or maintained
- Project site may not be the most effective location to recharge a water-supply aquifer
- Watershed priorities are not part of the WQMP site feasibility analysis

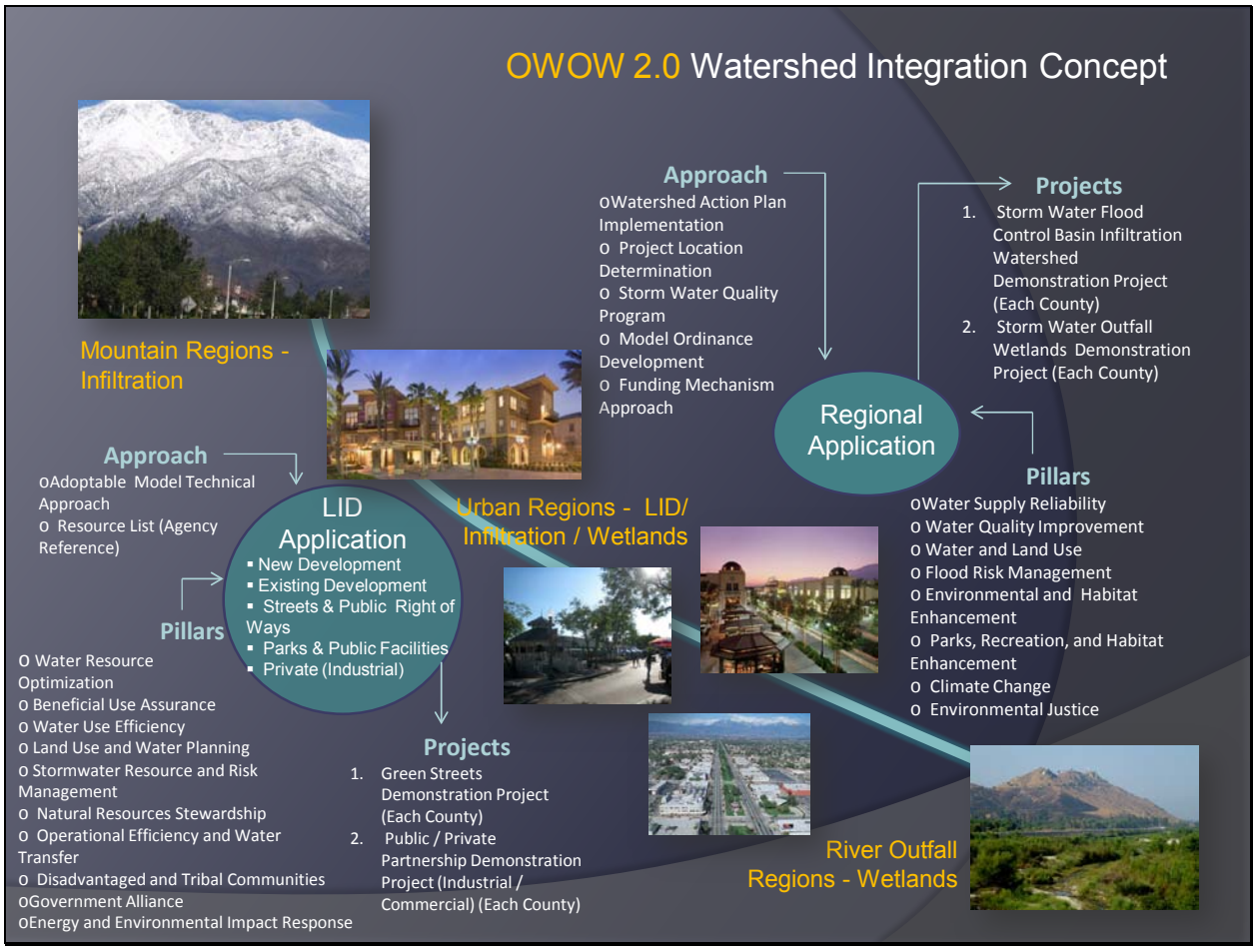
Funding options to support collaboration

- OWOW supports collaborative projects
- An URF or Water Quality Credit System could become a funding source based on cooperation
- Seek state/federal funding to develop regional funding mechanisms for collaborative projects
- Partner with SCAG or Councils of Government for incentive funding for demonstration projects
- USDA Grants to partner with agricultural stakeholders

## Strategies for Improved Interaction Between Water Managers and Land Use Planners

The OWOW Plan and process has significantly expanded the breadth and level of stakeholder involvement in understanding watershed problems and in developing strategies to address these problems and improve the watershed over previous IRWMP efforts. However, to effectively integrate watershed sustainability into the land use planning and development concept, design, and approval process, additional stakeholders and higher management and executive level staff within stakeholder organizations must become fully participating members of the OWOW effort. Watershed sustainability priorities must be integrated into decisions driven by the priorities of economic development. An alternative is to have OWOW integrated into economic development processes. A diagram of the OWOW land use and water planning process is shown in **Figure 5.7-14** below.

**Figure 5.7-14 OWOW 2.0 Watershed Integration Concept**



## OWOW Outreach Committee

The OWOW Pillars held several Pillar Integration meetings during the development of the Plan. These meetings provided a unique forum to develop and evaluate potential watershed priorities and projects to address watershed sustainability. We recommend a continued series of periodic meetings to further the ideas and continue to develop new ideas. Outreach efforts should also be periodically held to update other stakeholder forums, such as Regional Board meetings, Boards of Supervisors, and other watershed groups.

## OWOW /FCD Partnership Development or Enhancement

Stakeholders in the Chino Basin have successfully completed several multi-stakeholder projects that address stormwater, water supply and habitat. One of the most significant is the Chino Basin Facility Improvement Project. This project is a partnership between the Chino Basin Watermaster, the Inland Empire Utilities Agency, The San Bernardino County Flood Control District and the Chino Basin Water Conservation District. This project has retrofitted approximately two-dozen offline flood control basins with remotely operable control valves to allow capture and recharge of stormwater and dry weather flows. The project is supported by a four-party Agreement and received funding support from Proposition 13 Water Bond through SAWPA. Although this project has increased the capture and recharge of stormwater in the basin, it has not been coordinated with the MS4 Program and does not provide any MS4 compliance benefits.

## Revisions to the Land Planning Process to Address Constraints

Basic land planning tools can be revised or amended to incorporate watershed sustainability priorities. General Plans can incorporate a specific water element, or can include watershed requirements in the conservation element. Specific Plans can also be used to implement watershed and/or sustainability considerations. Different local governments will have specific preferences and concerns regarding general plan revisions.

Model sustainability ordinances (LID implementation, alluvial fans, water conservation, or sustainable communities) can be used to implement watershed priorities. Model ordinances have been developed for such purposes, such as the Model Ordinance Governing Planning and Development on Alluvial Fans[27], and the LID, Green Streets, and Drought-Tolerant Landscaping Ordinance adopted by the County of Los Angeles.

## Early Consideration of Project Concepts and Designs

Planning processes should encourage the earliest possible consideration or watershed priorities. Project concepts should serve watershed needs and be designed and implemented to optimize watershed sustainability. Once a project has been conceived, it is subject only to process-based modifications. Fundamental choices regarding allowable projects should be informed by the plan.

[27] Alluvial Fan Task Force: Findings and Recommendations Report, July 2010. Appendix D: Model Ordinance Governing Planning and Development on Alluvial Fans.
http://aftf.csusb.edu/documents/FINDINGS_Final_Oct2010_10-29-10_web.pdf

## General Plan, Specific Plan, and Ordinance Changes

General Plans and Specific Plans could be revised to require projects to demonstrate early consideration of Plan priorities and recommendations. Ordinances can specify the process to implement early project planning practices.

## Training Needs—Various Target Audiences

Implementation of the cooperative and multi-benefit project concepts will be supported by education. Training and outreach have been a part of the OWOW process, and should be enhanced for OWOW 2.0. It is especially important to provide education for the high-level decision makers, including elected officials, the RWQCB, and other local and regional stakeholders. Outreach can build trust and acceptance of new approaches.

## Consider How Water Agency "Will Serve" Letters May Be Used to Support Land Use Planning

Current requirements for water supply assessments limit their applicability to relatively large-scale projects. Requiring water supply assurances for all projects could help ensure implementation of water conservation measures (landscaping, water recycling, stormwater capture and use) for a wider range of projects. A watershed scale supply assessment could provide an incentive for water agencies to collaborate—and develop guidelines for water supply requirements.

## Incorporate Recommendations of Alluvial Fan Task Force in Land Use Planning[28]

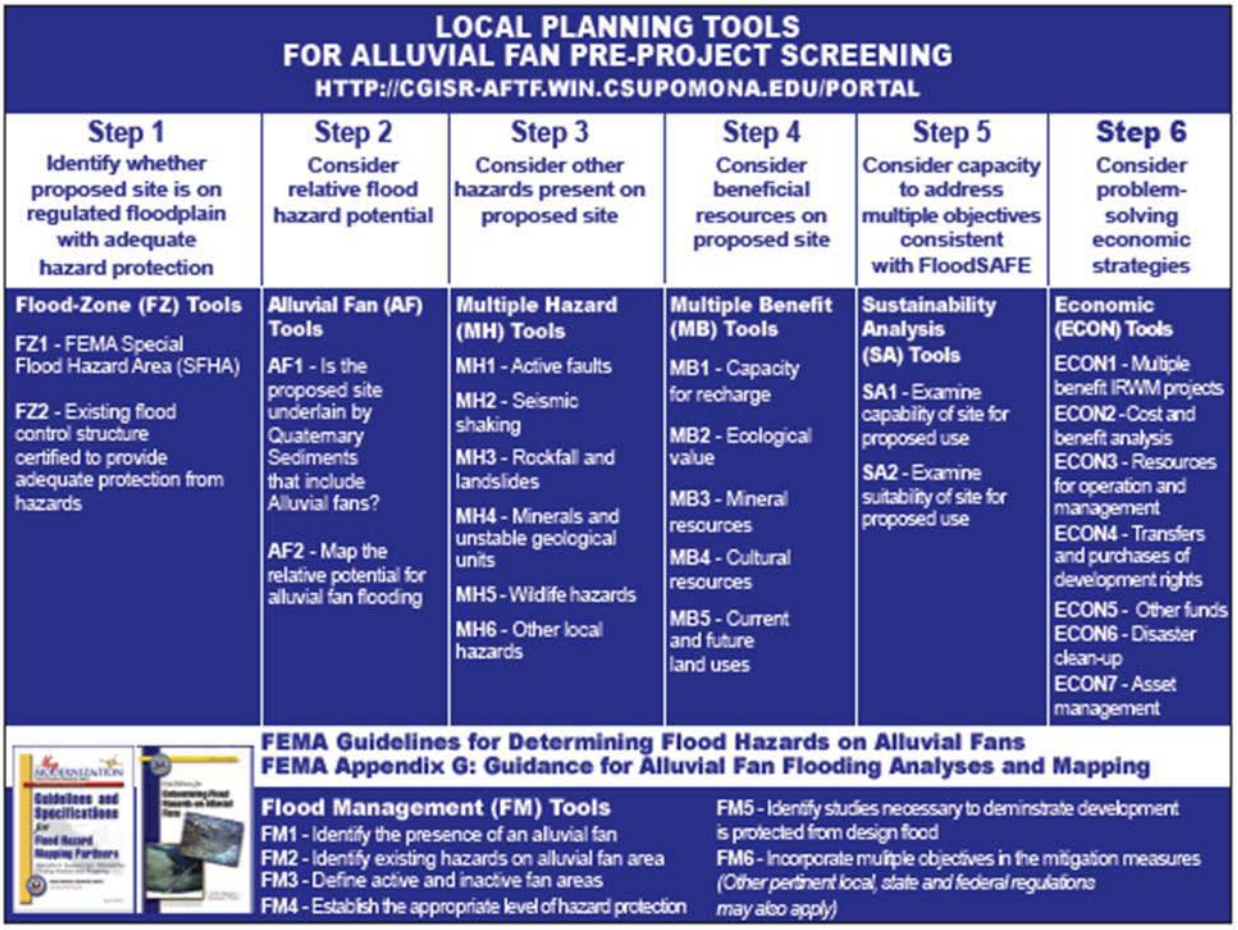
Alluvial fans are gently sloping fan-shaped landforms commonly seen at the base of semi-arid mountain ranges in the SAR Watershed and serve as natural buffers between fire-prone mountain ranges and flooding. Paths of flooding and debris flows on alluvial fans may be uncertain, making development challenging.

The Integrated Approach (IA) for development on alluvial fans consists of a suite of local planning tools for preproject screening designed to assist local communities that need to plan for and evaluate future development proposals on alluvial fans **(Figure 5.7-15)**[29].

[28] Alluvial Fan Task Force Fact Sheet 2010.
http://aftf.csusb.edu/documents/AFTF_FACTS_Final_Oct2010_web[1].pdf

[29] AFTF, 2010. Integrated Approach for Sustainable Development On Alluvial Fans.
http://aftf.csusb.edu/documents/IA_Final_Oct2010_web.pdf

**Figure 5.7-15 Local Planning Tools and FEMA**




The tools provide a method for planners to evaluate hazards, resources, and site-specific issues in alluvial fan areas that are proposed for development. This evaluation helps determine, in the pre-project phase, whether new development can be designed to promote flood management sustainability, by avoiding the most hazardous areas and conserving the most valuable resources. Flood management tools are included that are consistent with FEMA guidelines to analyze alluvial fan flood hazards and to formulate flood hazard protection.

As directed by Assembly Bill 2141, the findings and recommendations of the Task Force will be submitted to DWR and the State legislature for possible future action.

# Implementation Recommendations to Support Water and Land Use Planning Collaboration

## Watershed Integration: Watershed Identity Development and Implementation Project

This comprehensive project includes an assemblage of component projects designed to overcome existing limitations on watershed-based planning and project development to accelerate progress toward a sustainable watershed. SAWPA OWOW would lead and steer this project assemblage, including:

### *Local land use authority process enhancement*

This element will provide education, guidance, and ready-to-use tools for local jurisdictions to align all aspects of their land planning and approval processes to reinvent communities over time, based on watershed sustainability priorities. This effort can benefit from coordination with the ongoing San Bernardino County Vision Water Element, and should incorporate innovative methods and findings. The approach should start with efforts to engage the Councils of Government in the watershed, and work to influence and integrate the elected officials, Boards, and other high-level decision makers. This project would provide workshops, training materials, case examples, and focused outreach and training. Products of this project would include:

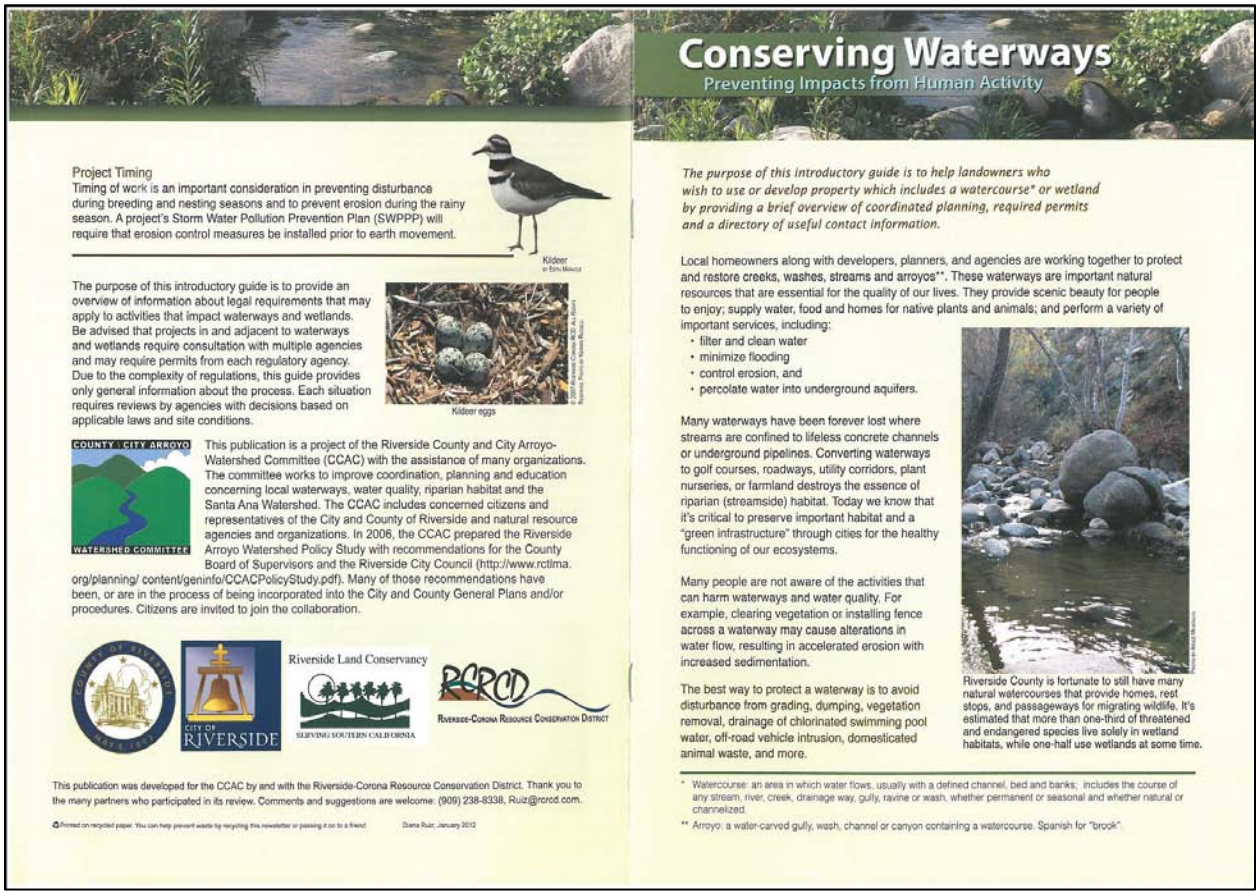
- Watershed-wide land use planning guidelines manual(s)
- Model ordinance governing planning for watershed sustainability
- Model general plan water element for the SAR Watershed
- Watershed coordination forums and training workshops
- Planning Commission education and outreach

Three pilot programs can implement these enhancements:

<u>The Riverside City/County Arroyo-Watershed Program</u>

This program provides the initial concepts and tools, and has experience working through local jurisdictions and building cooperation. The Riverside City-County Arroyo/Watershed Policy study and subsequent coordination efforts developed a methodology to achieve local government implementation of General Plan, ordinance, and policy amendments that address watershed protection priorities. This methodology can be implemented throughout the SAR Watershed to align local government plans and procedures with OWOW Plan priorities. The original project focused on preserving stream and arroyo areas and habitat, and needs to more fully incorporate water supply and overall sustainability principles. These can be readily incorporated into the method.

**Figure 5.7-16 Riverside City/County Arroyo-Watershed Program**



Conserving Waterways

Preventing Impacts from Human Activity

Project Timing

Timing of work is an important consideration in preventing disturbance during breeding and nesting seasons and to prevent erosion during the rainy season. A project's Storm Water Pollution Prevention Plan (SWPPP) will require that erosion control measures be installed prior to earth movement.

Killdeer

The purpose of this introductory guide is to provide an overview of information about legal requirements that may apply to activities that impact waterways and wetlands. Be advised that projects in and adjacent to waterways and wetlands require consultation with multiple agencies and may require permits from each regulatory agency. Due to the complexity of regulations, this guide provides only general information about the process. Each situation requires reviews by agencies with decisions based on applicable laws and site conditions.

Killdeer eggs

COUNTY CITY ARROYO WATERSHED COMMITTEE

This publication is a project of the Riverside County and City Arroyo-Watershed Committee (CCAC) with the assistance of many organizations. The committee works to improve coordination, planning and education concerning local waterways, water quality, riparian habitat and the Santa Ana Watershed. The CCAC includes concerned citizens and representatives of the City and County of Riverside and natural resource agencies and organizations. In 2006, the CCAC prepared the Riverside Arroyo Watershed Policy Study with recommendations for the County Board of Supervisors and the Riverside City Council (http://www.rctlma.org/planning/ content/geninfo/CCACPolicyStudy.pdf). Many of those recommendations have been, or are in the process of being incorporated into the City and County General Plans and/or procedures. Citizens are invited to join the collaboration.

CITY OF RIVERSIDE

Riverside Land Conservancy

SERVING SOUTHERN CALIFORNIA

RCRCD

RIVERSIDE-CORONA RESOURCE CONSERVATION DISTRICT

This publication was developed for the CCAC by and with the Riverside-Corona Resource Conservation District. Thank you to the many partners who participated in its review. Comments and suggestions are welcome: (909) 238-8338, Ruiz@rcrcd.com.

Printed on recycled paper. You can help prevent waste by recycling this newsletter or passing it on to a friend. Diana Ruiz, January 2012

*The purpose of this introductory guide is to help landowners who wish to use or develop property which includes a watercourse* or wetland by providing a brief overview of coordinated planning, required permits and a directory of useful contact information.*

Local homeowners along with developers, planners, and agencies are working together to protect and restore creeks, washes, streams and arroyos**. These waterways are important natural resources that are essential for the quality of our lives. They provide scenic beauty for people to enjoy; supply water, food and homes for native plants and animals; and perform a variety of important services, including:

- filter and clean water
- minimize flooding
- control erosion, and
- percolate water into underground aquifers.

Many waterways have been forever lost where streams are confined to lifeless concrete channels or underground pipelines. Converting waterways to golf courses, roadways, utility corridors, plant nurseries, or farmland destroys the essence of riparian (streamside) habitat. Today we know that it's critical to preserve important habitat and a "green infrastructure" through cities for the healthy functioning of our ecosystems.

Many people are not aware of the activities that can harm waterways and water quality. For example, clearing vegetation or installing fence across a waterway may cause alterations in water flow, resulting in accelerated erosion with increased sedimentation.

The best way to protect a waterway is to avoid disturbance from grading, dumping, vegetation removal, drainage of chlorinated swimming pool water, off-road vehicle intrusion, domesticated animal waste, and more.

Riverside County is fortunate to still have many natural watercourses that provide homes, rest stops, and passageways for migrating wildlife. It's estimated that more than one-third of threatened and endangered species live solely in wetland habitats, while one-half use wetlands at some time.

* Watercourse: an area in which water flows, usually with a defined channel, bed and banks; includes the course of any stream, river, creek, drainage way, gully, ravine or wash, whether permanent or seasonal and whether natural or channelized.

** Arroyo: a water-carved gully, wash, channel or canyon containing a watercourse. Spanish for "brook".

<u>The Newport Bay Conservancy Concept Book</u>

The Newport Bay Conservancy Concept Book for the Newport Bay Watershed is intended to inform land use planning in the region and inform how it could be used to support water resource restoration goals. This project can pilot the local government enhancement approach within the Newport Bay Watershed and influence adjacent jurisdictions.

<u>City of Ontario – New Model Colony</u>

The City of Ontario has implemented innovative land use planning approaches and can provide a pilot project area for local government enhancement in urbanized San Bernardino County. The City's recent plans call for 13,000 new housing units across a broad range of housing types and a mix of business spaces oriented towards three mixed-use centers that are served by pedestrian-friendly roadways and a large central park. Emphasizing connections to corridors and transit, the City is creating a major regional center for Southern California.

*Coordinate and integrate with other regional planning efforts to build-in key watershed sustainability priorities into plans that apply to the SAR Watershed.*

This element would engage the regional transportation planning agencies (SCAG, SANBAG, WRCOG, RCTC, and OCCOG) and other planning agencies as partners in OWOW. This would coordinate closely with (1) above.

Regional transportation planning efforts have successfully reached local, regional, and state decision-makers, and enlisted significant stakeholder participation and support. The OWOW Plan should integrate, or be integrated into the transportation planning world. Transportation planning should incorporate the OWOW watershed sustainability priorities as co-equal with the other RTP elements. Although sustainability is a key consideration, mandated by legislation, water quality and water supply are inadequately weighted in the RTPs. Reinvent these elements into a comprehensive sustainability effort, including all stakeholders and decision-makers and a plan for the watershed. Partner with the SCWC, ASCE, Urban Land Institute, and other groups for technical support.

SCAG has funded transportation demonstration projects in the Region and at least 30 projects in the SAR Watershed. Conduct an evaluation of these projects and their linkages to water and sustainability.

Coordinate and host a symposium to describe the ecology, hydrology, and natural history of the SAR Watershed. This is needed to inform stakeholders regarding how the watershed is naturally integrated, and how urbanization has disrupted the integration and how to reintegrate to maximize functions and sustainability.

*Watershed-wide geodatabase alignment and connection, access portal, and planning and evaluation tool development.*

County-based geodatabases have been recently prepared by San Bernardino and Riverside County Watershed Action Plans, and Orange County hydromodification mapping and Watershed Master Plans. This includes evaluation of existing watershed planning tools and a search for other existing applicable tools.

- Develop GIS layer of “community improvement areas” based on local government economic development needs—street rebuilding, drainage improvements, utility rehabilitation in conjunction with streets
- Workshop with planners
    - Layer of transportation opportunity areas
    - overlay with WQ project sites
    - Economic development areas
    - Failed street areas
    - DAC layer
- Identify project types—example
- DAC Greenstreets
- FCD Recharge Basins

- Transportation Agency Data (Rail/Caltrans)
    - Locate joint project areas (Trans/Water)
    - Locate joint Ag/water project areas
- Integrate Land Use Decision Support Tools Developed Elsewhere
- Coordinate geodatabase development with the development of applicable tools that include areas outside the SAR Watershed to enhance functionality. Several relevant tools and mapping efforts are of particular interest.
    - EcoAtlas
    - The San Francisco Estuary Institute developed a statewide geodatabase designed to track riparian and wetland resources under the State Wetland and Riparian Monitoring Program. The EcoAtlas includes interactive base layers, including streams, wetlands, riparian areas, and special habitats, and provides maps and other spatial information. This tool was developed by the Wetland and Riparian Monitoring Workgroup and provides detailed statewide information on wetland and riparian restoration projects. This is an active online tool and is viewable at http://www.ecoatlas.org/. The project team continues to maintain and improve the EcoAtlas.
    - DWR Integrated Water and Land Smart Planning Tool
    - DWR, in partnership with Sonoma State University Center for Sustainable Communities, is developing a decision support tool that integrates land use with water supply, water quality, energy and water/energy use and impacts including GHGs, and project cost factors. The tool was "designed for local decision makers who are considering land use and project design decisions, based on economic development needs and consistency with general and specific plans."[30] This tool can be customized with local condition inputs and will soon be tested by local governments in California. The tool will quantify costs associated with different development and design scenarios, and is intended to:
        - "Create an open, locally-modifiable and user-friendly tool to help guide land use and land cover decisions
        - Quantify relationships between land use alternatives and key water supply benefits, including water supply reliability, flood management, water quality, habitat value, Climate Action Mitigation
        - Quantify the monetary costs of implementing LID and traditional development strategies, including long term costs
        - Compare and contrast different development styles exemplified in four case study sites."
- USBR online climate change model for the SAR Watershed.
- Water/Energy use and impact data and resources (see **Chapter 5.13 Energy and Environmental Impact Response**, "Water-Energy Projects" and the Energy Network)

[30] Draft Report, April 2013: Integrating Land and Water Management: A Suburban Case Study and User-Friendly, Locally Adaptable Tool. California Department of Water Resources and Sonoma State University. (http://www.waterplan.water.ca.gov/docs/meeting_materials/caucus/2013.05.09/DRAFT_DWR-Report_4_30_13.pdf)

*Regulatory assessment and integration to support watershed sustainability project concepts and implementation.*

Regulatory Boards and staff support the OWOW Plan. However, varying interpretations of regulations and permit requirements may impede the development of concepts and projects that provide overall cumulative and long-term watershed sustainability improvements. This project element would engage the regulators (RWQCB and SWRCB, DWR, CDFW, USACE, etc.) and proactive stakeholders (including NGOs) to develop approaches to implement projects and ensure compliance with relevant regulations and permits.

*Demonstration project site identification, project design, coordinated planning, construction and maintenance.*

These are multi-benefit, multi-jurisdictional projects that address watershed sustainability priorities. Projects should Identify project partners and costs/benefits, and develop incentives to encourage continued implementation. The project should consider developing model implementation tools such as a model MOU or Agreement for multi-agency projects or watershed-wide projects.

Two proposed project categories:

<u>Green street/parking lot projects</u>

Retrofits or new projects that create new functions of stormwater treatment and capture, groundwater recharge if feasible, flood risk reduction, enhanced aesthetics and/or walkable/recreation spaces, and incrementally improve water quality and maximize water use efficiency. Projects can integrate with other projects or include elements such as public parks.

This project would coordinate the three SAR Watershed county Public Works Departments, interested cities, water agencies, and other stakeholders to identify locations and designs for multi-use green street or parking lot related projects that address stormwater runoff and improve existing developed areas. The project would also develop funding strategies for maintenance and additional projects, will include water quality credit and regulatory compliance evaluation, and recommend provisions for permit compliance credit. Completed projects will serve as models to increase understanding and acceptance of similar projects in the watershed.

Specific considerations should include:

- Commercial and “clean” industrial areas for parking lot retrofit
- Street use safety and design constraints
- Existing design manuals (e.g. San Mateo Street Design Manual)
- Needs to link economic development, Planning, and Public Works departments of local government
    - Locate and prioritize streets already in need of upgrade or replacement
        - Such as ”failed” streets in City of LA

- coordinate with utility infrastructure replacement—in street corridors
- sell as a community redevelopment project

Example Projects:

- Monte Vista Avenue Grade Separation
  **(**http://www.cityofmontclair.org/depts/pw/engineering/projects/upcoming_projects.asp

A railroad grade separation project in the City of Montclair on Monte Vista Avenue at the Union Pacific Railroad tracks is planned over the next few years. Rail traffic has been increasing on this stretch of busy rail line known as the Alameda Corridor East. The traffic is expected to increase significantly as trade traffic continues to grow at the ports of Los Angeles and Long Beach. Montclair has begun acquiring a right-of-way for the project. Funding for this project is coming from a variety of sources. The 30 million dollar project is expected to begin construction in 2014.

- City of Riverside “parklets" policy projects and small street retrofits by private entities
- Elmer Ave Neighborhood Retrofit – Council for Watershed Health

http://www.watershedhealth.org/programsandprojects/was.aspx?search=elmer

**Figure 5.7 -17 Elmer Avenue Neighborhood Retrofit**



Regional treatment for surface and stormwater runoff

Sites to be selected, optimally one per county, that can accept and treat/infiltrate stormwater, nuisance runoff, and other surface flows. Projects will be multi-benefit and multi-agency collaborations. These sites can be identified based on previous evaluations of opportunities within the county flood control systems and the geodatabases, combined with evaluation and recommendations from other watershed stakeholders, especially the water and regulatory agencies. Water supply, habitat conservation, creation or mitigation, and long-term maintenance must be addressed. These sites would develop mechanisms to account for water quality benefits and provide MS4 Permit compliance capacity. This project element would collaborate with the regulatory assessment effort (No. 4, above) to develop a model regional treatment/retention BMP implementation guidance document.

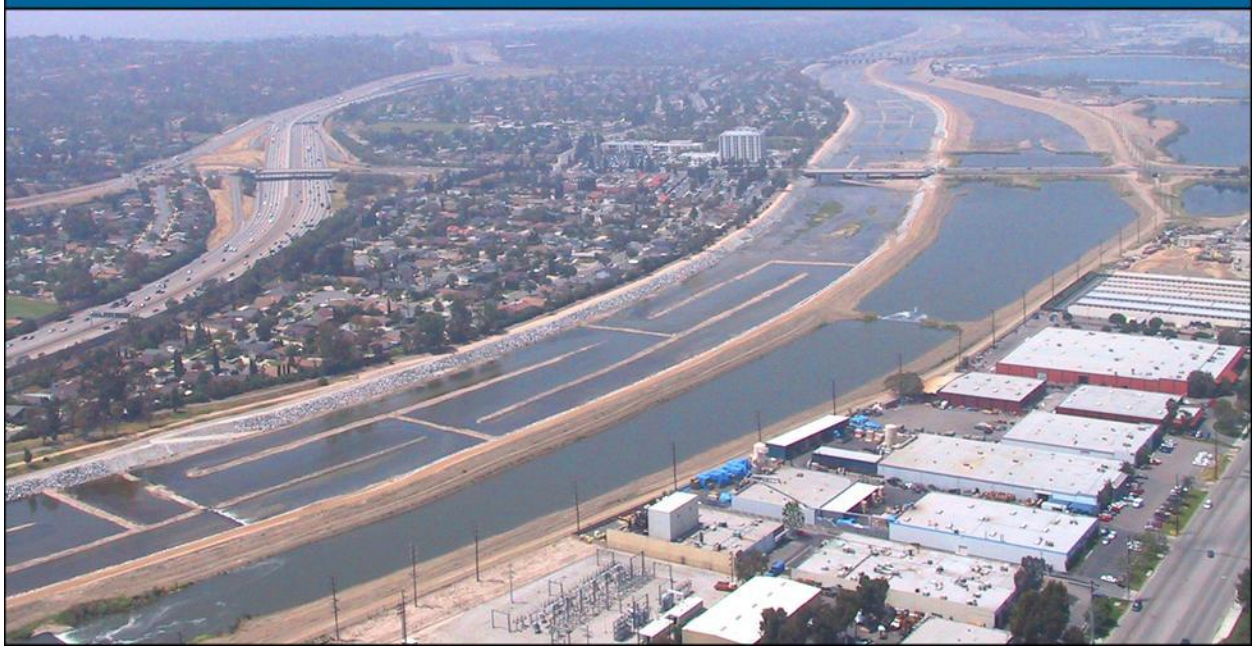
Potential project locations:

- The City and County of Riverside are partnering to develop increased groundwater recharge in the Kansas, Marlborough, and Columbia basins
- Geodatabases provide initial list of project sites, collaborate with Water Agencies to prioritize sites
- Evaluate existing multi-use projects to determine their effectiveness in achieving stated benefits (e.g. Big League Dreams—Cucamonga-Mill Creek Wetlands)

## List of Contributors

| | |
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# 5.8 Stormwater: Resource and Risk Management



## Chapter Findings and Recommendations Summary

The purpose of this Chapter is to 1) describe the mission, facilities, and operations of Flood Control Management agencies in the Santa Ana River Watershed; 2) identify past, current, and emerging key watershed priorities; 3) evaluate how key priorities have been, and potentially can be, addressed by Flood Control Districts/Divisions (FCDs) using a range of strategies; and 4) recommend the strategies and projects most likely to be effective to ensure watershed sustainability over a range of timescales. Finally, this OWOW 2.0 Plan (Plan) updates and revises the 2010 Plan.

### Priority Issues

- Water supply is challenged by increased demand due to population growth in the watershed; reductions in imported water supplies; reduced groundwater recharge from expansion of urbanization and impervious surfaces placed over viable recharge areas; loss of riparian habitat; losses to the ocean due to concrete channelization and lost recharge in the channels themselves, seawater intrusion due to decreased groundwater recharge in coastal areas, and uncertain, but expected, long-term reductions in average annual precipitation due to climate change.
- High priority water quality problems include maintaining the salt balance in the watershed (see **Chapter 5.5 Beneficial Use Assurance**), reducing anthropogenic pollutants in surface water runoff to optimize beneficial uses, preventing pollutants from contaminating groundwater; and cleanup and management of existing contaminated groundwater sites (**Chapter 5.5 Beneficial Use Assurance**).

- Watershed management efforts of past decades were driven largely by individual entity priorities or programs. However, more comprehensive and integrated projects driven by a multi-stakeholder project paradigm can more effectively and more efficiently address watershed needs. Such projects can assist stakeholders to achieve compliance with the increasingly complex Municipal Stormwater NPDES Permits (MS4 Permits), while providing increased stormwater capture and groundwater recharge using favorable cost benefit approaches. Cooperative projects also unite various watershed jurisdictions and information, and more readily adapt to future conditions—and adaptability will be essential to effectively manage uncertain future conditions such as climate change.
- Reducing the risk of loss of life and property damage due to flooding remains a high priority within the Santa Ana River Watershed. The completion of the Santa Ana River Mainstem Project will reduce the risk of a catastrophic flood event in the Santa Ana River Watershed. However, there remains significant flood risk related to tributary watercourses within the watershed, compounded by potential impacts of wildfires and earthquakes.

## Policy and Procedure Recommendations

1. Describe a process to link public and private project development processes among stakeholders that promotes consideration of watershed priorities and stakeholder priorities very early in the planning process;
2. Preserve floodplain functions through stricter management of development in floodplains—limit project construction in areas subject to flooding, preserve and restore riparian habitat functions, and enhance groundwater recharge;
3. Where appropriate, FCDs, and all watershed stakeholders, should develop procedures and guidelines to ensure consideration of IRWM goals and watershed protection principles and priorities, consistent with the MS4 Permits, when planning and designing CIP or other projects, and during development or revisions of Master Drainage Plans (MDPs) and planning of projects that implement the MDPs;
4. Create a lead watershed-wide Plan coordinating advisory and facilitation group that brings stakeholders together for decision making, partnership formation, and resource allocation to achieve Plan goals;
5. Create a source of funds targeted at multi-agency Plan projects.

## Implementation Recommendations

1. Develop a water conservation-recharge optimization plan for existing and potential future flood control facilities, using the example work of the Chino Basin Recharge Master Plan and implementation projects as a template.
2. Connect existing county or program-specific geodatabases to create a comprehensive watershed geodatabase that provides access to appropriate stakeholders, and set up a data quality control and maintenance program. The main component County MS4 geodatabases are well under way as described under “Map-Based Watershed Plans” in Section 6.

3. Develop adaptable mechanisms to implement regional BMPs and alternative compliance options (see **Table 5.8-1**) under the MS4 Permits where appropriate (see example concept project in **Appendix F2**).
4. Describe role of a lead watershed-wide Plan coordinating advisory group with facilitation to ensure coordination of project partners.
5. Preserving and restoring riparian habitat areas in conjunction with the comprehensive and integrated project recommendations within the 2.0 Plan.

**Table 5.8-1 Alternative Stormwater Compliance Elements for Development Projects in the Santa Ana Region MS4 Permits**

| Alternative Compliance Options (MS4 Permits: San Bernardino Co.--Section XI.G; Riverside Co.—Section XII.G; Orange Co.—Section XII.E) | |
|---|---|
| **1** | If a preferred BMP is not technically feasible, other BMPs should be implemented to mitigate the project impacts, or if the cost of BMP implementation greatly outweighs the pollution control benefits, the Permittees may grant a waiver of the BMPs. All waivers, along with waiver justification documentation, must be submitted to the Executive Officer at least 30 days prior to Permittee approval of the WQMP. Only those projects that have completed a feasibility analysis as specified in the WQMP Guidance and Template (see Section XI.E.7) and approved by the Executive Officer shall be considered for alternatives and in-lieu programs. If a waiver is granted, the Permittees shall ensure that project proponents participate in one of the in-lieu programs discussed in this section. |
| **2** | The permittees may collectively or individually propose to establish an urban runoff fund to be used for urban water quality improvement projects within the same watershed that is funded by contributions from developers granted waivers.<br><br>The contributions should be at least equivalent to the cost savings for waived projects and the urban runoff fund shall be expended for water quality improvement or other related projects approved by the Executive Officer within two years of receipt of the funds. If a waiver is granted and an urban runoff fund is established, the annual report for the year should include the following information with respect to the urban runoff fund:<br>• Total amount deposited into the funds and the party responsible for managing the urban runoff fund;<br>• Projects funded or proposed to be funded with monies from the urban runoff fund;<br>• Party or parties responsible for design, construction, operation and maintenance of urban runoff funded projects; and<br>• Current status and a schedule for project completion. |

| | |
|---|---|
| **3** | The obligation to install structural treatment control BMPs at a new development is met if, for a common plan of development, BMPs are constructed with the requisite capacity to serve the entire common project, even if certain phases of the common project may not have BMP capacity located on that phase in accordance with the requirements specified above.<br><br>This goal may be achieved through watershed-based structural treatment controls, in combination with site-specific BMPs. All treatment control BMPs should be located as close as possible to the pollutant sources, should not be located within waters of the US, and pollutant removal should be accomplished prior to discharge to waters of the US. Regional treatment control BMPs shall be operational prior to occupation of any of the priority project sites tributary to the regional treatment BMP. |
| **4** | The permittees may establish a water quality credit system for alternatives to infiltration, harvesting and reuse, evapotranspiration, and other LID BMPs and hydromodification requirements specified above.<br><br>Any credit system that the permittees establish should be submitted to the Executive Officer for review and approval. The following types of projects may be considered for the credit system:<br>• Redevelopment projects that reduce the overall impervious footprint<br>• Brownfield redevelopment<br>• High density developments (>7 units per acre)<br>• Mixed use and transit-oriented development (within ½ mile of transit)<br>• Dedication of undeveloped portions of the project to parks, preservation areas and other pervious uses<br>• Regional treatment systems with a capacity to treat flows from all upstream developments<br>• **Contribution to an urban runoff fund (see 2, above)**<br>• Offsite mitigation or dedications within the same watershed<br>• City Center area<br>• Historic Districts and Historic Preservation areas<br>• Live-work developments<br>• In-fill projects<br><br>**Riverside County Only**<br>• Projects that enhance the transport of coarse sediment to the coast for beach replenishment. |
| **5*** | The water quality credit system should not result in a net impact on water quality. |
| **6*** | A summary of waivers of LID (along with a short description of the Section XII.G.2 through XII.G4 In-Lieu program selected), Hydromodification and Treatment Control BMPs along with any water quality credit granted, in-lieu projects, or urban runoff fund contribution required by each Co-Permittee shall be included in the Annual Report. |
| *Not specified in the Orange County MS4 Permit. | |

## Evolution of OWOW Plan Flood Risk Management Pillar from 1.0 to 2.0

The Plan has evolved in the past few years as water supply and water quality problems, and flood, fire, and earthquake risks have been further evaluated and better understood. The linkage to FCD agency activities, as described in the Plan, version 1.0 and 2.0, are summarized below.

### OWOW 1.0

1. Evaluate how to achieve the goal to "manage rainfall as a resource," thereby maximizing beneficial use of rainwater and providing adequate flood control capacity and other community benefits; and,
2. Develop potential improved metrics for the expression of risk that are more understandable and more universal, to facilitate the establishment of better flood protection standards.
3. The 1.0 Plan objectives are reflected in its "vision of flood risk management in 2030":
4. Each person in the watershed feels secure that there is a less than one in one hundred chance in any given year that their home will be flooded.
5. There is no loss of life and no uninsured property damage in the watershed due to flooding.
6. Stormwater is managed with the understanding that it is both a potential risk and a valuable resource.
7. The 1.0 Plan, Chapter 5.6, describes the watershed's physical geography, basic hydrology, land uses, and the history of the region's floods and flood response. Regional flood response culminated in the ongoing Santa Ana River Project, and management strategies focused on hardening and straightening stream channels to maximize drainage efficiency, and buffering peak flows by providing large flood storage facilities.

### Chapter Findings

1. Very early land use decisions have preceded implementation of flood management strategies, severely limiting feasible flood control alternatives. Significant urban encroachment has occurred in most regional floodplain areas, where regional storage and hardened, straightened, and levied channels may be the only feasible and effective flood protection approaches.
2. If flood management strategies were developed during the original (earliest) planning for development of the region, and implemented in a proactive, rather than reactive, manner, flood risk management could be balanced with other watershed priorities, and overall benefits could be optimized.
3. To address the current regional priorities, given the existing systems, the Flood Risk Management Pillar and the Water and Land Use Pillar will need to collaborate to develop more effective new approaches going forward.

### Challenges for the Future

1. Watershed Coordination: To improve upon the results of traditional approaches to flood risk management, more collaborative and comprehensive planning and implementation needs to be coordinated at the watershed scale.
2. Water Conservation: Develop additional ways to modify our infrastructure, or build new infrastructure components with more effective designs, to maximize the capture of local water while maintaining the required level of flood protection. Water conservation is part of the missions of the watershed FCDs (see Section 5.b, below). Probably the greatest opportunities for increased

capture and recharge of stormwater are in the Inland Empire (generally San Bernardino and Riverside Counties and the incorporated cities in the SAR Watershed), where geology and open space allow enhanced recharge to reduce downstream flood magnitudes.

3. Stormwater Quality Management and Flood Risk Management: MS4 Permits adopted in 2009 and 2010 for the watershed include explicit requirements to limit changes in runoff volume and velocity of runoff from new development and significant redevelopment projects using "low impact development" (LID) design concepts. These include minimizing impervious surface area, including pervious areas to interrupt flows across impervious areas, and maximizing stormwater infiltration. However, LID concepts and other methods used to avoid changes to the hydrograph will not address flood management issues. The LID requirements apply predominantly to new development projects so will not provide short-term solutions for existing developed areas, and a large proportion of the suitable watershed areas are already mostly built-out.
4. Ecological Impacts: Construction of flood control conveyance facilities and dams for flood detention have a direct effect on riparian and wetland habitats. New projects of this type have become increasingly unacceptable to the public and environmental groups, and when approved, incur major costs for environmental mitigation. This Plan should develop a regional consensus on how to balance habitat protection and restoration priorities with flood protection and regulatory requirements.
5. Money and Advocacy: Flood control projects and water supply projects are expensive. Public investment for such projects has typically been spread over a large population, and required as a condition of project approvals, leading to the expectation that infrastructure improvements depended on growth to be affordable. The Watershed needs to find alternatives to relying on future development to fund infrastructure.

Flood control infrastructure project construction often depends on State and Federal subsidies. This approach necessitates a sustained commitment to advocacy in Sacramento and Washington, DC, that is expensive and has not always been well coordinated. A comprehensive, watershed-wide plan for flood management, integrated with other water resources programs, would be the foundation for focused advocacy efforts of all stakeholders and the entire delegation of legislators in the Watershed.

1. Decision Making: Historical land development and land planning decisions have occurred before flood protection planning and implementation. Therefore, land development has pre-empted flood control and constrained the available flood management approaches, thus limiting the ability of FCDs to fully achieve their flood control missions and address the economic and environmental impacts of those actions.
2. Quantification of Risk (to prioritize): Flood risk needs to be clearly communicated to elected officials, and to compare that risk to other priority community needs, including water resources. It is important for the public to understand what 100-year flood protection means. Currently, the average citizen is concerned mainly whether flood insurance premiums are required, and whether the local FCD is doing its job.

### Conclusions (OWOW 1.0)

1. Environmental Review requirements have increased the complexity of FCD infrastructure management.
2. FCD Management priorities should be integrated into the earliest stages of land use planning and decision/approval processes.

### OWOW 2.0

1. Build on the work of OWOW 1.0 to identify implementation actions to address strategies for flood risk and stormwater management.
2. Define any new opportunities to address flood protection and integrate storm water management and water conservation with reduction of risk to property from flood events.
3. Explore feasibility of automated rainwater harvesting systems and networks that could provide water conservation and flood control, as well as water quality benefits.
4. Examine the framework and potential development of regional mitigation banks.
5. Evaluate "alternative compliance," options provided by MS4 Permits include regional BMPs, retention credits, in lieu BMP implementation, and an urban runoff fund.
6. Identify approaches and processes to partner with FCDs on projects.

These objectives and recommendations for the 2.0 Plan are discussed further in the following sections.

## Relation to other OWOW Pillars

FCD Jurisdictions cross virtually all other jurisdictional areas in the watershed, and almost all surface water infrastructures are managed by the FCDs, some in partnership with the U.S. Army Corps of Engineers (USACE), the U.S. Bureau of Reclamation USBR, the California Department of Water Resources (DWR), water districts, cities, or other agencies. Projects requiring surface water conveyance or storage will typically require permits from the FCDs and other agencies. Therefore, FCDs are mandatory project stakeholders and partners in the vast majority of existing and potential projects to enhance stormwater capture and groundwater recharge. FCD legislative authorities included water conservation, but the highest mission priority is flood protection. Any cooperative project with a FCD as a partner must ensure that project design and operation does not compromise flood protection priorities.

In California, most MS4 Permits designate FCDs as Principal Permittees. In the Santa Ana River (SAR) Watershed, the Principal Permittees are the San Bernardino County Flood Control District (SBCFCD), the Riverside County Flood Control & Water Conservation District (RCFCWCD), and the County of Orange. SBCFCD, RCFCWCD, and OCFCD (OC/OCFCD)[1] are collectively referred to herein as the FCDs. Principal Permittees lead the development of required implementation documents and programs and coordinate

[1]The Orange County Flood Control District, administered by the Orange County OC Public Works (OC Public Works), is governed by the Orange County Board of Supervisors. OCFCD is a political entity that has no employees, but owns land, and assesses an annual benefit on all taxable real property in Orange County. Because OCFCD has no specific employees, the District and its property are administered, maintained, and operated by OC Public Works staff, who are in turn employed by the County of Orange. (http://ocflood.com/about/history)

implementation of the MS4 Permits among all of their co-permittees (cities and counties). Therefore, the Principal Permittees and FCDs are a primary source of information and guidance for the co-permittees and other stakeholders in the watershed. These MS4 Permit requirements include:

1. WQMPs—Water Quality Management Plans are enforceable guidance that specifies the requirements for stormwater quality and hydromodification mitigation project designs and BMPs.
2. Watershed Plans—Detailed plans to address watershed management within specific subwatersheds with the SAR Watershed and within specified jurisdictional or hydrologically defined areas. These include plans to address specific water quality problems (such as TMDLs), and/or hydromodification management, specific habitats, or other subwatershed-specific concerns.
3. Tools: MS4 programs are required to develop a variety of tools to address urban runoff impacts, including public outreach materials and programs, technical guidance for development project design and conditioning, mapping and GIS, hydrology manuals, water quality and biological monitoring programs, and various special studies to address specific concerns.

Therefore, the Principal Permittees and FCDs (and their co-permittees) are the direct link to compliance with the MS4 Permits. These permits require consideration of water quality, changes in runoff hydrology, integration of runoff water quality issues into land use planning and development project approval, preservation and improvement of habitat, and compliance with all related state and federal regulations (USACE 404 Dredge and Fill permits; CDFW stream alteration agreements; USFW species and habitat concerns; RWQCB Section 401 Water Quality Certifications, and others) as well as local ordinances and codes. The broad scope of the MS4 Permits and the watershed-wide jurisdiction of the Principal Permittees link the FCDs to all the other OWOW Pillars.

# Background

## Santa Ana Watershed Physical Characteristics[2]

The Santa Ana River watershed covers about 2,650 square miles. Maximum elevations in the Watershed exceed 11,000 feet, and more than one-third of the watershed area lies within three steep mountain ranges. Most of the rest occurs in lower-sloped valleys formed by a series of broad alluvial fans that extend from the base of the mountain front. The SBCFCD has jurisdiction over the largest and most upgradient areas in the watershed, RCFCWCD manages the intermediate and lower eastern section, and OC/OCFCD manages the lower, more coastal portion.

The watershed comprises three main sub-watersheds: 1) The Santa Ana River above Prado Dam (upper SAR Watershed) which drains of about 62% of the watershed, 2) the San Jacinto River which drains about 30% of the watershed into Lake Elsinore--flows from the San Jacinto River only reach Prado Dam when Lake Elsinore spills over into Temescal Wash (last spillover occurred in 1980), and 3) the S A R Watershed below Prado Dam which drains about 8% of the watershed and includes the Santa Ana Mountains, Chino Hills and the broad coastal plain.

[2] This section follows very closely with only some ammendation (and where elsewhere referenced) the hydrology section of the *Review Report on the Santa Ana River Main Stem---including Santiago Creek and Oak Street Drain for flood control and allied purposes*, US Army Corps of Engineers, Los Angeles District, December 1975

Physiographic differences between the three areas result in significant differences in the design and operation of FCD facilities. The upper SAR Watershed includes three significant tributaries, Mill Creek, Bear Creek, and Lytle Creek. The Upper SAR Watershed has areas of extreme slopes and elevations, the average gradient of the Mountain reaches of the upper SAR average 240 ft. /mile, and 30 ft. /mile near Prado Dam. The gradients of the main tributaries average 700 ft. /mile in the mountains and 30 ft. /mi in the valley reaches[3]. Storm and runoff events in the upper SAR Watershed can be extremely dynamic and subject to high levels of sediment and debris delivery in very short timelines. One large rainfall season, or event (or fire) can cause impacts to the FCD system that takes all available resources to recover from—thus delaying work on other planned projects for up to several years.

The San Jacinto River flows from headwaters in the San Jacinto Mountains. Mountains and foothills account for 471 square miles while 288 square miles are considered valley floor (SWRB, 1955). Elevations range from less than 1,250 feet above sea level at Lake Elsinore to approximately 1,400 to 1,700 feet on the valley floor to 10,834 feet at Mt. San Jacinto in the San Jacinto Mountains[4]. More than 90 percent of the San Jacinto River Watershed drains to Lake Elsinore (McKibbin, Stuart 2013). Runoff from as far as Moreno Valley, San Jacinto, Hemet, and Perris contribute to surface flows that reach Lake Elsinore during rainfall events. During normal to dry periods, when the San Jacinto River and the surrounding tributaries are essentially dry, little or no flow enters Lake Elsinore.[3]

Approximately 60% of the drainage area for the SAR Watershed below Prado Dam lies within the Santa Ana Mountains and the Chino Hills. Most of the remaining area lies within the broad coastal plain that extends southwestward to the Pacific Ocean. Numerous tributaries contribute to the Santa Ana River within this reach. The principal tributary is Santiago Creek with a drainage area of approximately 102 square miles. Lesser tributaries include Wardlow Canyon, Aliso Canyon, Gypsum Canyon, Blue Mud Canyon, Walnut Canyon, and Carbon Canyon Creek. The average gradient of these tributaries is about 300 feet/mile, while the average slope of the Santa Ana River from Prado Dam to the ocean is about 15 feet/mile[2].

The climate is generally mild, but both temperature and precipitation vary considerably with distance from the ocean, elevation, and topography. Most precipitation occurs as rain from December through March, although some falls as snow at higher elevations. The average annual rainfall varies from ten inches per year south of Riverside, to about 45 inches per year in the higher mountains.

Winter storms usually move in from the Pacific Ocean bringing widespread rain, and snow at the higher elevations. Such storms often last several days. More localized episodic storms associated with frontal systems can occur at any time of the year, and can produce high-intensity precipitation over a comparatively small area for up to six hours.

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[3] USACE, 1988. Design Memorandum No. 1 **PHASE II GDM ON THE SANTA ANA RIVER MAINSTEM including Santiago Creek**

[4] Tetra Tech, WRIME, Inc., for the San Jacinto Watershed Council, 2007. **San Jacinto River Integrated Regional Watershed Management Plan**

Stream flow is perennial in the canyons of the Santa Ana River and in the headwaters of most of its tributaries, but is generally ephemeral in most valley segments. Stream flow increases rapidly in response to precipitation. High-intensity precipitation, especially following wildfire, may result in intense sediment-laden floods, with some debris load in the form of shrubs and trees.

There are several large lakes and reservoirs within the watershed that help regulate flood flows; the largest being Prado Dam, Seven Oaks Dam, Lake Elsinore, Big Bear Lake, Lake Hemet Reservoir, and Santiago Reservoir.

### Historical Flooding

The SAR Watershed has experienced flooding on numerous occasions in the American era, including floods in 1825, 1862, 1884, 1914, 1916, 1927, 1938, 1965, 1969, 1980, 1983, 1995, 2005 and 2010. The critical event in flood management in the SAR Watershed was the 1938 flood. In that event, Orange County experienced California's worst flooding of the 20th century. The City of Anaheim experienced 15 feet of water in some places, and 182,000 total acres were inundated. Dozens of deaths occurred. In Riverside and San Bernardino Counties, the 1938 flood made it painfully clear that the County governments did not have an adequate program of flood protection. The Orange County FCD was formed in 1927, San Bernardino County created its flood control district in 1939, and Riverside County followed the same course in 1944.

### Missions

The FCDs' highest priority is to ensure flood protection of life and property and comes directly from legislative authority (CWC Section 8100). However, FCDs also have parallel missions to provide water conservation, and recreational and irrigation use of impounded waters within their jurisdictions, while preserving flood protection effectiveness (see Section 5.a, below).[5]

## Flood Control Improvements

### Santa Ana River

The Santa Ana River has been the focus of USACE of Engineers projects starting with the authorization of Prado Dam in 1936. The dam was completed in 1941. Levees were constructed in Riverside in 1955. Prado Dam was built primarily for downstream flood protection, and 92 percent of the watershed lies above it. More recently, the dam also has become a vital component of the water supply management program in the region, and has allowed the creation of ecologically important habitat areas behind it.

Prado Dam originally was designed to provide protection against flooding in a 200-year event, but as the watershed urbanized, the protection had decreased to a 70-year event with the downstream channel having capacity for only a 50-year event. To address these deficiencies the USACE initiated study of the Santa Ana River Main Stem Project (SARP) in 1964. Construction of the SARP was initiated in 1989. The SARP is located along a 75-mile reach of the Santa Ana River in Orange, Riverside and San Bernardino Counties. The project's objective is to provide the developed and developing areas in the

[5] Public Law 534, 78th Congress, 1944, and specific projects referenced therein and as updated since.

watershed with approximately 100-year flood protection through the end of the project life. The plan for flood control improvements included three principal features:

1. Lower river channel modification for flood control along the 30.5 miles of the Santa Ana River from Prado Dam to the Pacific Ocean. Construction of a retarding basin and channel improvements on Santiago Creek are also planned. (Ongoing, estimated completion date: 2016)[6]
2. Enlargement of Prado Dam to increase reservoir storage capacity from 217,000 acre-feet to 362,000 acre-feet. (Ongoing, projected completion date 2024.)
3. Construction of Seven Oaks Dam (about 35 miles upstream of the existing Prado Dam) with gross reservoir storage of 145,600 acre-feet. (Completed in 1999.)
4. The drainage area behind Seven Oaks Dam comprises 177 square miles, excluding 32 square miles that drains internally to Baldwin Lake. The principal tributary is Bear Creek, which drains 55 square miles, and has an average gradient of 460 feet/ mile. The only existing structure that would affect flood flows in this sub-watershed is Big Bear Lake, which is a water conservation reservoir. It collects water from a 38-square-mile drainage area, and has a surcharge storage capacity of about 8600 AF between the top of the conservation pool and the top of the dam.

## San Jacinto River

The San Jacinto River Watershed Council (SJRWC) developed an Integrated Regional Water Management Plan (IRWMP) for that 770-square-mile sub-watershed (now incorporated into the Plan). The San Jacinto IRWMP, addressed water supply, water quality, drought-proofing, and critical habitat protection. The plan also addresses flood risk concerns, and recognizing that the issue is risk management and not purely a matter of engineering, the SJRWC approach frames the issue as "providing]flood protection to existing disadvantaged communities." The plan acknowledges a number of flood risk management strategies as alternatives to channelization.

In 1960 the USACE constructed the San Jacinto River Levee to protect the city of San Jacinto. The levee was rehabilitated by the USACE in 1980 after the levee was breached by a 30-year return frequency flood event. Another major USACE project was the Lake Elsinore Management Project constructed in 1995; the project allows for better management of the lake water levels and provides a safe outlet for the lake when it spills.

## Improvements to Tributaries

Other flood control improvements exist along some of the smaller tributaries: San Antonio, Chino, Cucamonga, Deer, Lytle, San Sevaine, Day, San Timoteo, City, and Cajon Creeks, above Prado Dam; Carbon Canyon Dam and Villa Park Dam in Orange County; and Perris Valley Storm Drain and Salt Creek above Lake Elsinore. These improvements include channelization, debris basins, storm drains, levees, stone and wire-mesh fencing, stone walls or rip-rap along the banks of stream channels, concrete side slope protection, and drop structures.

[6] Orange County Public Works, Flood Control Division: http://ocflood.com/sarp/lower

Other improvements not aimed mainly at flood control include spreading grounds, recharge basins, and water conservation reservoirs. There are more than 100 water conservation and recreational reservoirs in the watershed, with storage volumes ranging from 5 AF to 182,000 AF in Lake Mathews. These improvements affect the regimen of lesser flood flows, but do not appreciably affect major flood flows. Below Prado Dam in Orange County, local and tributary projects include: improvements to Fullerton Creek Channel, Greenville-Banning Channel, Bolsa Chica Channel, East Garden Grove-Wintersburg Channel, Huntington Beach Channel, Talbert Channel, Peters Canyon Channel, Aliso Creek Channel, Serrano Creek Channel, San Juan Creek Channel, Westminster Channel, and Atwood Channel.

## Flood Risk

Risk is the product of the likelihood of the flood control facility failing, the amount of damage that might occur for given depths of flooding and the likelihood of a flood discharge. For example, a levee made from sand is much more likely to fail than one made of concrete and the risk for residents behind it is higher. Or if an area is flooded to a depth of 1-foot but all the buildings in the area are elevated 2-feet above the ground the risk from flooding is dramatically reduced.

Flood discharges can be estimated. One way to estimate flood discharges is the Probable Maximum Flood (PMF) which is the most severe combination of critical meteorological and hydrological conditions that are reasonably *possible* in the region. Application of PMF is mostly confined to determination of spillway requirements of high dams in order to give virtually complete security against potential floods catastrophes.

The USACE has chosen to design many flood control structures in the region to the Standard Project Flood (SPF), which represents the discharge that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably *characteristic* of the geographical region involved, including extremely rare combinations. SPF is selected where some small degree of risk can be accepted but an unusually high degree of protection is justified by hazards to life and high property values within the area to be protected. It is estimated that the SPF discharges are generally equal to 40-60 percent of the MPF discharges for the same basin. For example the Prado Dam and Seven Oaks Dam storage areas and the Santa Ana levees were designed for the SP F.

Today, the discharge most commonly used by local jurisdictions for planning and design is the 100-year flood, a hypothetical event that is defined as having a 1 in 100 (1%) chance of occurring in any given year. This standard came about through the National Flood Insurance Act of 1968 which created the National Flood Insurance Program (NFIP). At the outset of the program, a national standard was needed to enable all properties to be treated similarly. The 100-year or base flood was selected as a trade-off between two possible extremes. At one end of the spectrum, the program could have sought to protect everyone from almost all floods, no matter how large or rare, which would have placed economic improvement restrictions on very large areas. At the other end, the program could have provided

protection only for the smaller floods, which would have left many buildings exposed to damage. The 100-year standard was the balance point between the pros and cons of both extremes.[7]

In order to take advantage of the federal government's offer of affordable flood insurance, communities that participate in the NFIP must manage their floodplains by applying land use regulation and construction standards in an effort to reduce future flood losses. Local communities adopted the 100-year standard to be consistent with the NFIP, although some critical flood facilities are designed to higher standards. For example, the California State Legislature adopted SB5 in 2005 which established that levees and floodwalls in the Sacramento-San Joaquin Valley provide protection against a flood that has a 1-in-200 chance of occurring any given year.

The California Department of Water Resources and the USACE have developed a program called "California's Flood Future."[8] They found that millions of Californians live in areas exposed to flood risk, and believe there is an unacceptable level of flood threat to public safety and the economy. They evaluated risk in 100-yr and 500-yr flood zones as defined by FEMA and statewide county sources. They found an expectedly larger population would be affected by a 500-yr flood with concomitant economic losses. They also found that the South Coast Region has the greatest population exposed to floods, with the majority in the Orange and Los Angeles Counties: 250,000 in the 100-yr floodplain, and over 3 million in the 500-yr flood plain. The results of this work will influence flood risk management approaches in the future, and explicitly suggests use of integrated water management and IRWMs to address this challenge.

The NFIP has mapped 100-year floodplains for the major tributaries throughout the watershed. The Table below shows the scope of the existing flood hazard within the Santa Ana River Watershed.

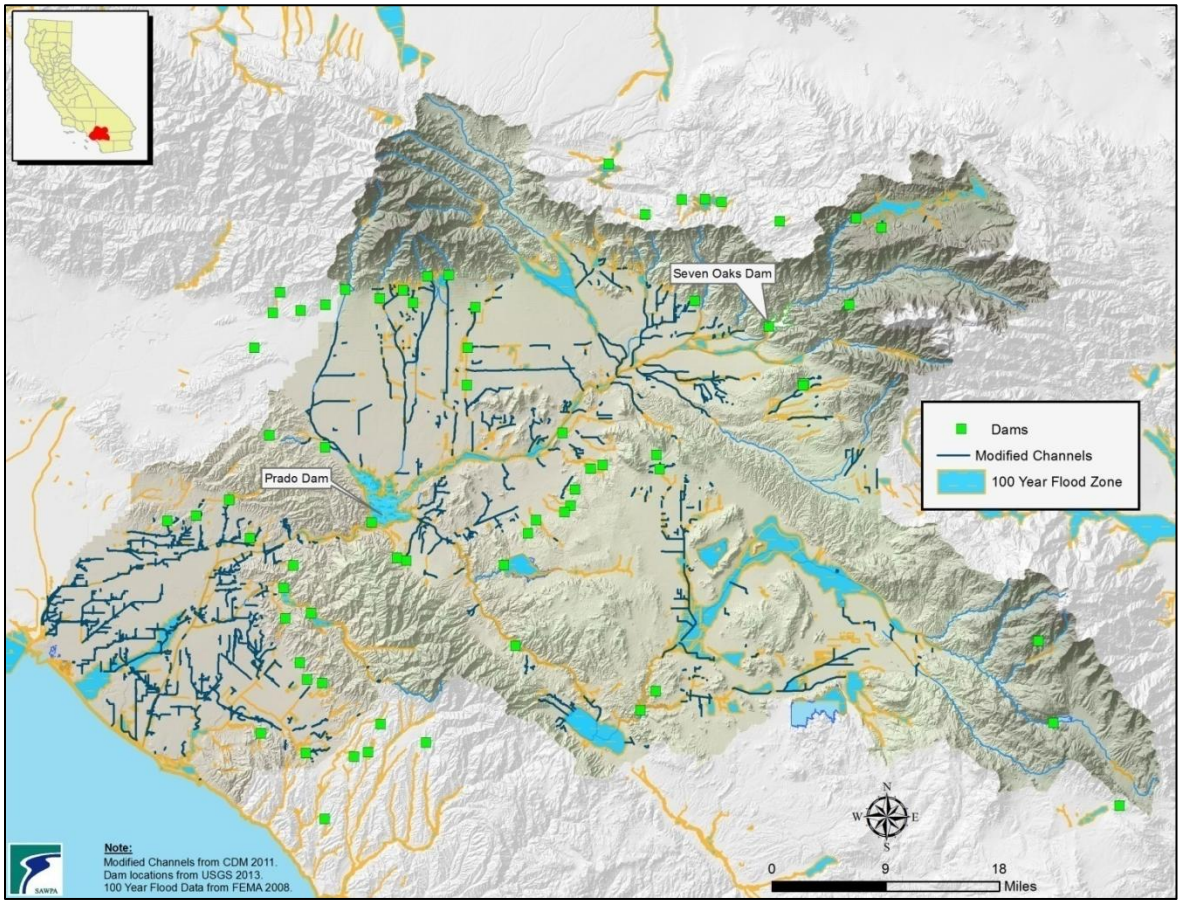
**Table 5.8-2 Square Mileage of 100-Year Floodplain**

| County | 100-year floodplain (sq. mi) | Number of structures | Value of structures |
|---|---|---|---|
| Orange | 46 | | |
| Riverside | 90 | 7200 | $2.4 Billion |
| San Bernardino | 191 | | |

[7] See: NFIP Website at: http://www.floodsmart.gov/floodsmart/; and High Risk definition at: http://www.floodsmart.gov/toolkits/flood/downloads/FloodInsuranceFloodMaps-11%2019%2010.pdf

[8] http://www.water.ca.gov/sfmp/flood-future-report.cfm, and http://www.water.ca.gov/sfmp/resources/PRD_AttachF_Exposure_4-3-13.pdf

**Figure 5.8-1 Flood Channels and 100-Year Flood Zones in the Santa Ana River**




## Sediment management (sediment as a resource)[9]

1. There are many benefits associated with managing sediment within the Watershed. With Seven Oaks and Prado Dams, sediment transfer could provide a longer usable life of the dams for flood control purposes. The costs of raising the elevation of a dam in the future have large economic and social implications. Some of the impacts include the cost of construction, purchase of property that will lie within the new flood zone and the relocation of infrastructure. Sediment-filled reservoirs behind dams have been addressed elsewhere by plans to remove the dams (e.g. Matilija Dam in Ventura County: http://www.matilijadam.org/).
2. Removing sediment from behind our dams would also preserve and create valuable storage volume for water conservation efforts. Water conservation is limited based on storing water at elevations that minimally impact flood control efforts and natural resources. As sediment accumulates behind a dam it reduces the available volume for water conservation. Active management of sediment at the Prado Dam is being investigated by the USACE's Prado Basin, California Feasibility Study and the

[9] Sediment management section adapted from the OWOW Santa Ana River Watershed Planning Framework white paper, Sediment Transfer Section, p. 10-11, April 17, 2012.

Proposition 84-funded Prado Basin Sediment Management Demonstration Project (Project ID #2098, Table SW-2a and b).

3. Sediment released below a dam is carried further downstream and provides replenishment sediment that could replace eroded areas that have compromised critical infrastructure. Two examples in the SAR Watershed include the CA 91 Freeway and the current location of the Inland Empire Brine Line. This replenishment sediment would also preserve stream embankments and critical flood control levees. As the river incises due to reduced sediment loads, it erodes the embankments and adversely impacts wildlife habitat for protected riparian species. This adverse impact is termed "hydromodification" in the MS4 Permits.
4. Sediment is needed in the Santa Ana River for groundwater recharge operations between Imperial Highway and the CA 57 Freeway. Coarsening, and subsequent armoring, occurs when the natural sands in the river are washed downstream and not replaced by new sediment deposition. Over time the accumulation of these fine sediments create an impermeable layer in the river bottom thereby reducing percolation rates.
5. The Santa Ana River is also a major source of sediment for beach sand. While anthropogenic beach replenishment is a regular activity, the full effects of sediment impoundment by Prado Dam have yet to be felt by Orange County coastal communities. Consequences of reduced sediment at the coast will affect private and public properties, infrastructure, and adverse environmental impacts.
6. Effective sediment management requires a watershed-wide approach. Sediment originates from erosion in the local mountains and foothills and is transported through and stored within the jurisdictions of numerous agencies on its way to the ocean.

## Floating Debris

Floating debris and trash can cause clogging and slow drainage of flood facilities and water quality BMPs. If such facilities are not adequately maintained, these materials can become a source for mosquitos, and other disease vectors and nuisance pests. Accumulated trash and debris are also remobilized to downstream areas with successive storm events, and blown by strong winds.

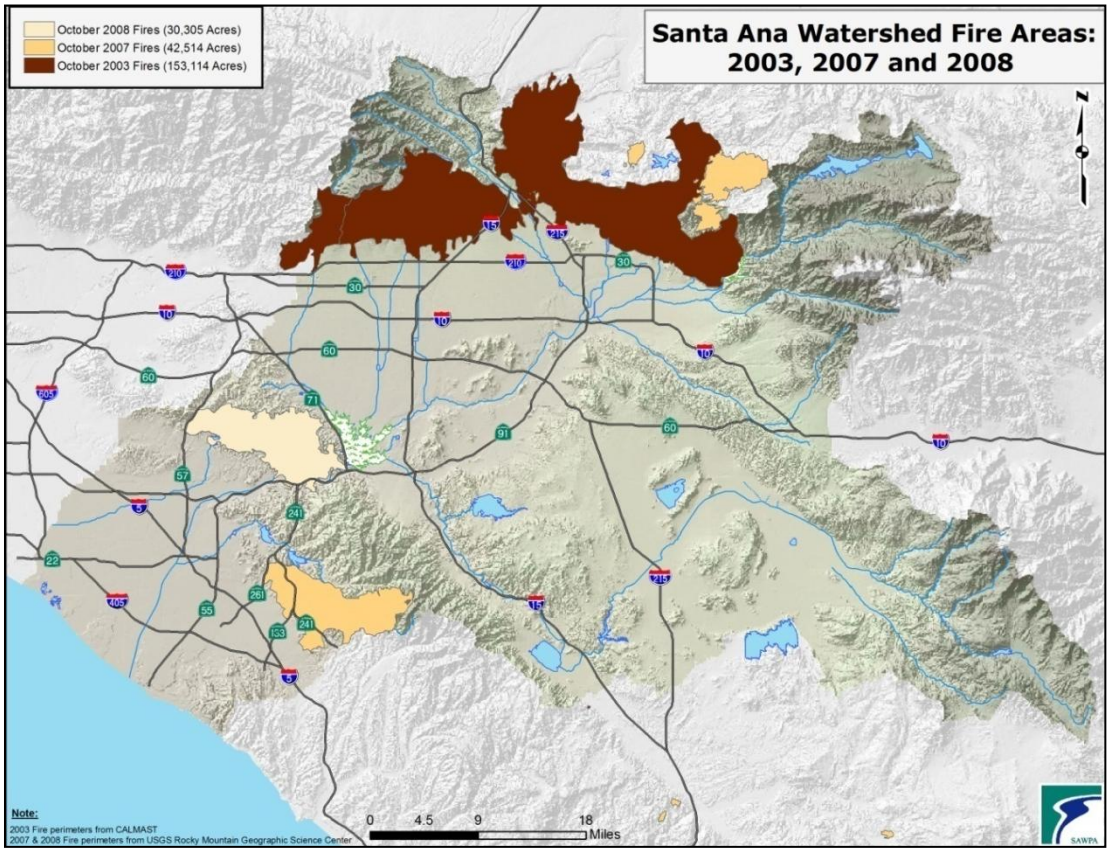
## Fire

Episodic wildfires are natural occurring events in southern California landscapes. However, fire suppression practices in the past decades have altered the character of natural landscapes and plant communities, and urban expansion and encroachment into natural areas has resulted in an increased frequency of wildfires (**Figure 5.8-2**).[10] Increases in runoff, erosion, and sediment loading during storm events have been well documented. Flood facilities can be overwhelmed and uncontrolled debris flows and floods can occur. Long-term slope stability is compromised by intense wildfire events, and post-fire runoff contains increased levels of pollutants that can cause severe impacts to receiving waters. These impacts are not fully understood, but may be best managed by prevention. Anthropogenically-intensified wildfires also cause longer-lasting landscape impacts, and habitat recovery may be delayed.

[10] Stein and Brown, 2009. Effects of post-fire runoff on surface water quality: Development of a southern California regional monitoring program with management questions and implementation recommendations. Southern California Coastal Water Research Project, Technical Report 598.

The "Forest-First" programs under development between SAWPA and the USFS should provide proactive management actions to reduce wildfire impacts over time.[11]

**Figure 5.8-2 Major Wildfire Areas in the Santa Ana River Watershed in 2003, 2007, and 2008**




## Earthquake

The Santa Ana River Watershed very seismically active, being affected by three major fault systems, the San Andreas, San Jacinto, and Elsinore faults (**Figure 5.8-3**). Although FCD facilities and dams have been engineered and constructed to meet all applicable seismic hazard requirements (e.g. Seven Oaks dam is designed to withstand an 8.0 magnitude earthquake), actual infrastructure damage from earthquakes remains uncertain.

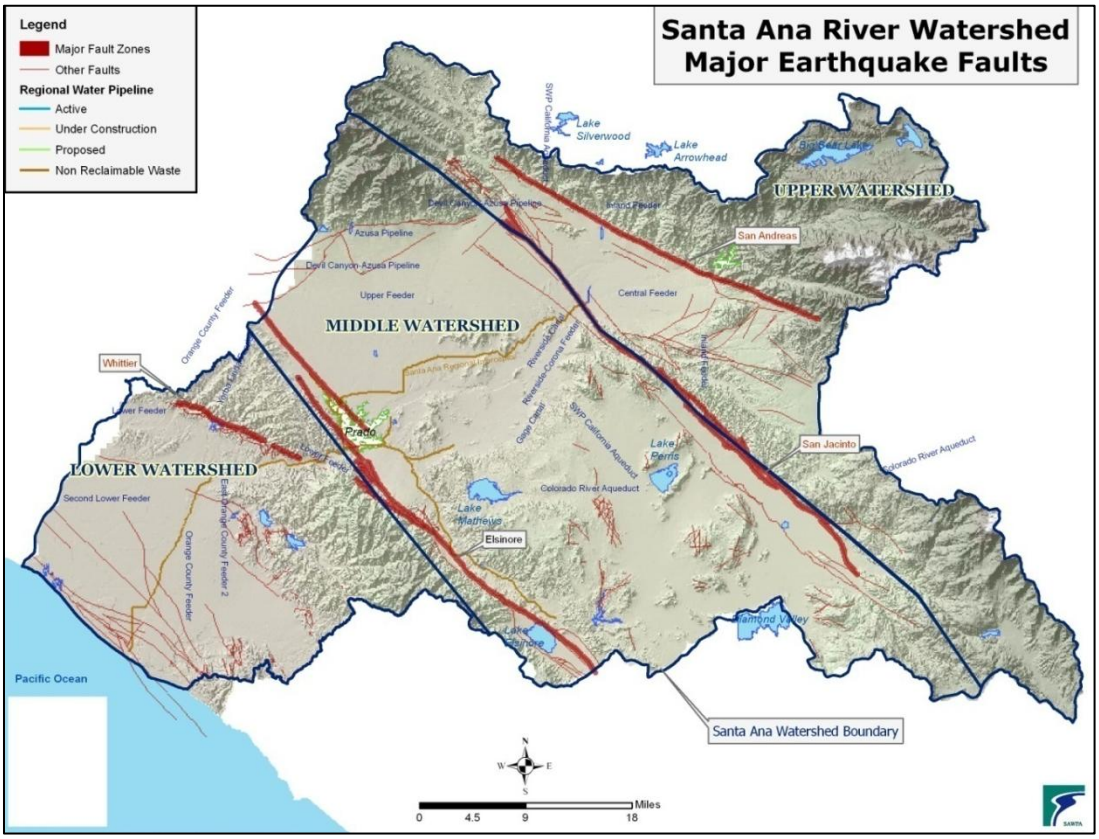
The USGS has developed a theoretical, yet plausible, San Andreas Fault earthquake scenario called The Great California Shakeout[12]. The Great California Shakeout scenario depicts the impacts from a 7.8 magnitude earthquake on the San Andreas Fault in Southern California. On average, such an earthquake occurs south of the San Gabriel Mountains every 150 years; the most recent was 300 years ago. A 7.8 magnitude earthquake is expected to affect 7.5 million people. An estimated 200,000 people commute over the San Andreas Fault for work and would potentially be separated from their homes. Ground

[11] OWOW Santa Ana River Watershed Planning Framework white paper, Forest First Program Projects Section, p. 11-13, April 17, 2012.
[12] USGS, Great Shake Out, updated 2013. http://earthquake.usgs.gov/regional/nca/simulations/shakeout/

shaking would last as long as 2 minutes and some areas will experience ground level displacement of up to 10 feet. Thousands of aftershocks would be expected in the following months. There would be an estimated 1,800 deaths and 53,000 injuries in the first minutes of the event. As many as 1,500 buildings would collapse and 300,000 structures would be severely damaged causing $213 billion in damages. 255,000 people would be homeless. In the minutes following the earthquake Southern California would expect up to 1,600 fires due to severely reduced fire-fighting capability from damaged infrastructure, and a lack of running water and/or electricity for weeks or months.

The SAR Watershed would be significantly affected, especially by interruptions in the supply of imported water. Such an earthquake event could cause extensive levee failure along the State Water Project, resulting in significant imported water loss and flooding of surrounding areas.

**Figure 5.8-3 Major Geologic Fault Zones in the Santa Ana River Watershed**




## Climate Change

The OWOW Plan includes evaluation of climate change impacts and recommendations to the watershed through mitigation and adaptation to a changing climate. Details of the watershed's evaluation can be found in the Bureau of Reclamation's Technical Memorandum: 86-68210-2013-02: Climate Change Analysis for the Santa Ana River Watershed, dated August 2013. It is located at **[Appendix F2]** in the OWOW 2.0 Plan. Some of the highlights of the watershed's climate change analysis reveal that in the next 50-years and beyond, average annual temperatures will increase, total annual precipitation will

probably decrease, and winter snowpack will melt sooner, causing more runoff in the winter rather than in the spring.

In the Santa Ana River Watershed, nearly 95% of the average annual rainfall occurs in about a 4.5 day period. Collecting a substantial portion of large runoff volumes in the short timeframes characteristic of intense, short duration events in such a short timeframe in detention or recharge basins is difficult. Given the same average annual rainfall, runoff from more frequent and less intense storms could be captured more effectively by typical basins. However, changing weather conditions resulting from climate change are expected to increase the intensity of storms in the SAR Watershed while decreasing their frequency, which would decrease the expected volume captured by existing approaches.
FCDs are not expected to make significant changes to facilities in the near future, but should evaluate their systems to address variable runoff scenarios in partnership with other stakeholders. It may be possible to modify the runoff capture facilities to optimize groundwater recharge for shorter duration, larger magnitude, and higher intensity storm events. Collaborative projects with water supply and groundwater management agencies as partners would provide a multi-perspective approach, and higher likelihood for success for climate change adaptation projects, than FCDs conducting such projects in isolation. Successful flood control and stormwater capture/groundwater recharge projects will likely require adaptive management approaches for long-term optimization.

## Intersection of IRWM (OWOW) and Flood Control District Missions

California's Flood Future (2013)[13] identified the following problems currently facing FCDs:

- Land use decisions may not adequately prioritize public safety;
- Differing methodologies and inadequate data make risk assessment complex and costly;
- Flood management projects are not prioritized from a system wide perspective;
- Emergency preparedness may not receive necessary funding;
- Delayed permit approvals and complex permit requirements are obstacles to flood risk reduction; and,
- Lack of reliable, sustained funding puts Californians at significant risk.
- This section links these and other problems, from the perspective of FCDs, with the purpose of the Plan and efforts to improve compatibility and how to partner with FCDs.

### FCD Missions

The missions of FCDs hold flood protection as their highest priority. FCDs are natural partners for many projects due to their broad jurisdictional areas, and parallel missions of water conservation and water quality improvement. However, FCD funding is generated from property assessments which may limit the applicability of FCD funds to the areas from which fees are derived (FCD Zone areas). Mission statements for the SAR Watershed FCDs:

[13] California's Flood Future Highlights: Recommendations for managing the State's Flood Risk. Public Review Draft March 2013, California Department of Water Resources and the USACE.

### *RFCWCD*

"The objects and purposes of this act are to provide for the control of the flood and storm waters of the district and the flood and storm waters of streams that have their source outside of the district, but which streams and the waters thereof flow into the district, and to conserve the waters for beneficial and useful purposes by retarding, spreading, storing, retaining and causing to percolate into the soil within the district, these waters, or to save or conserve in any manner all or any of these waters and protect from these flood or storm waters, the watercourses, watersheds, public highways, life and property in the district, and to prevent waste of water or diminution of the water supply in, or unlawful exportation of water from the district, and to obtain, retain and reclaim drainage, storm, flood and other waters for beneficial use in the district.[14]

### *SBCFCD*

"To provide for the control of flood and storm waters of the District in order to protect watercourses, watersheds, public highways, life and property; to conserve such waters for beneficial purposes by spreading, storing and causing to percolate in the soil."[15]

### *OCFCD*

The purposes of this act are to provide for the control of the flood and storm waters of the district, and the flood and storm waters of streams that have their source outside of the district, but which flow into the district, and to conserve those waters for beneficial and useful purposes by spreading, storing, retaining, and causing them to percolate into the soil within the district, or outside the district, or to save or conserve in any manner all or any of those waters and protect from damage from those flood or storm waters, the harbors, waterways, public highways, and property in the district."[16]

## Right of Way

FCDs are also constrained by right-of-way and easements. Master Plans of Drainage (MPDs) typically develop a conceptual conveyance system for a plan area, with the intention to preserve adequate right-of-way for FCD facilities to be built when needed. However, many MPDs were developed without due consideration for enhanced stormwater capture, or for soft-bottom or more ecological alternatives to standard hardened and concrete facilities. Therefore, existing right-of-way for FCD facilities may be inadequate to accommodate multi-use facility designs.

## Environmental permitting requirements

Construction of most FCD facilities requires environmental permitting, including CEQA documents and permits from the USACE (404 Dredge and Fill Permits), RWQCBs (401 Water Quality Certifications), and CDFW (1601 Streambed Alteration Agreements). Increasing concern over the environmental impacts of the construction of hardened and concrete-lined facilities has resulted in increased environmental mitigation requirements for such facilities. Permitting for more ecologically benign designs and multi-

[14] Riverside County Flood Control Act, 1944.
[15] SBCFCD Flood Control Act of 1938.
[16] Orange County Flood Control Act, Chapter 723 of the State of California Statutes of 1927

benefit facilities can be less costly and more streamlined. This provides an incentive for FCDs to incorporate such project concepts and designs into their CIP plans, and enhances their benefits as partners in cooperative projects.

## Challenges for collaboration

The FCDs have been implementing CIP projects and maintaining these facilities in the watershed for approximately 80 years, acting with legislative authority to protect life, property, and navigation. This includes debris basins in the steep foothills, engineered conveyance and storage facilities in the inland valleys, and dams and channel protection measures to allow flood runoff to flow to the ocean with a minimum of uncontrolled floodwaters. On a parallel track, the FCDs have implemented water conservation elements within their facilities, particularly as an aid to flood protection, and to remove sediment and improve water quality as it moves downstream in the watershed. These facilities were built and maintained to protect large pre-existing urban areas, and to serve constantly growing urban and suburban areas in the watershed. These works were completed with local, state and federal funding, and were constructed in part by the USACE.

Each FCD (SBCFCD, RCFCWCD, and OC/OCFCD) has differing challenges based on their physiography (as described in Section 4), on their proportion of existing urbanized area and remaining developable areas, and on economic factors. Orange County has the lowest gradient topography and conveyance system overall, has the greatest population and economic resources, yet probably has the biggest challenge to find new space for recharge basins or to enlarge FCD facilities to meet greater flood flows. Riverside County has high gradient and lower gradient areas, a smaller population and less economic resources than OC/OCFCD, and has added constraints associated with a large existing Multi-Species Habitat Conservation Plan. San Bernardino County has the highest gradient areas and the Seven Oaks Dam, has significant sediment and debris removal needs, and has several large groundwater basins and potential for increased storage, somewhat more developable area, yet fewer economic resources than the other counties. Each county has existing sites of groundwater contamination, but only Orange County has the issue of seawater intrusion.

With the adoption of the environmental regulations in the late 1960s and early 1970s (Porter-Cologne Water Quality Act; reauthorized and amended Federal CWA; CEQA; NEPA; and the ESA), regulatory permitting has impacted the planning, design operations, and maintenance activities of the FCDs. In more recent decades, the environmental impacts of FCD facilities and activities have been observed and criticized by environmental protection advocacy groups. FCD facility planning, design, and permitting, and maintenance has become more complex and costly as a result of this layer of regulation and scrutiny, while the flood protection and water conservation directives have continued as highest priorities.

There appears to be great benefit for significantly increasing the degree of project planning, design, implementation, and maintenance conducted collaboratively among the FCDs; with watershed partners including water suppliers, groundwater management agencies, Watermasters, sewering agencies, local land development authorities, and the USACE and the USFS. Each of these entities brings experience,

design ideas, and potentially funding and maintenance resources to the project. A collaborative project development team also fulfills the objectives of IRWMP implementation and is more competitive in the quest for grant funding. This was recognized by the Board of Supervisors of the RCFCWCD when they approved Resolution Number F2004-18 in June 2004. This resolution directs RCFCWCD and Western Municipal Water District (WMWD) to jointly plan and develop water conservation projects in western Riverside County, including a conjunctive use program for Colton and Riverside groundwater basins; the Riverside-Corona Feeder Project; and joint participation in new conservation at Seven Oaks Dam. RCFC also investigated with WMWD whether an existing detention basin in the City of Riverside would function for water conservation. However, high groundwater in the area precluded an increase in infiltration at the site.

In San Bernardino County, the SBCFCD and the San Bernardino Valley Municipal Water District first entered into a cooperative agreement to recharge groundwater using SBCFCD basins in 1972. Several projects have been developed since this first agreement. Most recently, the SBCFCD and the SBVMWD have approved a MOU for the purpose of evaluating SBCFCD facilities for dual purposing to provide increased groundwater recharge while maintaining flood protection as the highest priority. Current work is focused on the Cactus FC/Recharge Basins in Rialto. Here, the SBCFCD, in cooperation with SBVMWD, obtained $1 million from a Proposition 84 Grant to enhance Cactus Basins 3/3A for flood control and groundwater recharge purposes.

However, collaborative projects using FCD facilities must acknowledge the overarching priority for flood protection. Projects must be designed to allow FCD facilities to function unimpeded and dynamically during and in preparation for potential flood conditions. In addition, FCD facilities may have other constraints regarding design and maintenance that support their flood protection function, and these must be accommodated by the design and operation of the project. FCDs are willing partners to accomplish watershed-based objectives, but must fulfill their legislative mandate when conditions demand it.

Compliance with the MS4 Permits may provide significantly increased incentives for FCDs to collaborate on watershed projects that address MS4 Permit requirements (see discussions in Sections 3 and 6).

## Stormwater as an Essential Resource for the SAR Watershed

This section builds on the work of OWOW 1.0 to provide examples of three projects successfully implemented in the SAR Watershed to achieve IRWM goals. Each project includes multiple component projects, and are either ongoing or are planning future implementation actions. This is, or course, not an exhaustive project list. These particular projects are presented as examples of how several of the "challenges for the future" (as listed in Section 2, above) can and have already been met in parts of the SAR Watershed—some were achieved decades earlier. The approaches, tools, and partnerships developed during these projects will help guide and improve future implementation projects for flood risk and stormwater management.

### Successful Implementation Projects

#### *The Santa Ana River Mainstem Project (SARP)*[17]

This ongoing project is designed to provide flood protection to the growing urban communities in Orange, Riverside and San Bernardino Counties. The proposed improvements to the system cover 75 miles, from the headwaters of Santa Ana River east of the city of San Bernardino to the mouth of the river at the Pacific Ocean between the cities of Newport Beach and Huntington Beach. This project is perhaps the most significant successful project in the SAR Watershed. Although it began with a flood protection priority as a driver that leveraged state and federal funding, it has incorporated a wide range of water quality and water conservation components over several decades—and is managed by a multi-agency entity. It is a model for adaptive infrastructure management with changing priorities.

All three counties, collectively, work closely with the USACE to design and construct the project elements. The project approach has been significantly improved through use of facilities on the SAR to increase groundwater recharge, especially in the lower SAR. The project pioneered the reoperation of Prado Dam and the use of Seven Oaks Dam to allow more use of storage capacity for water conservation, without unacceptably diminishing flood protection.
Project success factors:

1. Overriding flood threat mitigation priority initiated the project.
2. Legislative mandates drove project implementation and funding.
3. Strong and long-term ongoing cooperation among federal, state, and local project partners with a multi-party Agreement.
4. Demonstrable short and long-term benefits.

#### *Chino Basin Facility Improvement Project*

In the Chino Basin, over 25 flood control retention basins were retrofitted to allow infiltration of stormwater, and to infiltrate imported water and recycled water when seasonal storm control functions were not needed. Funding for these improvements was provided by SAWPA under the Year 2000 Proposition 13 Water Bond, Southern California Integrated Watershed Program.

[17] Santa Ana River Project Website: http://cms.ocgov.com/gov/pw/flood/sarp/default.asp

Enhanced imported and stormwater infiltration in the Chino Basin has been studied and implemented since the adjudicated basin yield was defined by the Court in 1978 (Case No. 164237). The adjudication found that the "safe yield" of 145,000 AFY (acre-feet/year) had been routinely exceeded in previous years. Corrective action was identified as augmenting the recharge of imported and natural flows by the use of offline recharge basins.[18] Following the adjudication, the Chino Basin Watermaster began replenishing groundwater with imported water. This plan recognized that impervious surfaces of flood control facilities and urbanization reduced groundwater recharge and that offline recharge basins should compensate by additional recharge to the extent feasible. It also recognized the advantage of infiltration of natural runoff due to the higher relative concentration of total dissolved solids present in imported water. So, the CBWM and the SBCFCD began a water conservation and stormwater capture project in the early 1980's that continues to the current day. Improvements include monitoring wells and SCADA (computer controlled operating system) for the basins.

The project determined that flood control facilities can be successfully augmented for stormwater recharge, that stormwater infiltration/ recharge and flood protection objectives are often compatible, and that communication among project partners was critically important.[19]
Project success factors:

1. Hydrologic studies were ongoing to develop groundwater and surface water data acceptable by all parties—estimated conservable runoff were almost 11,000 AFY (acre-feet/year) for Day Creek, and 31,000 AFY for San Sevaine; The most efficient recharge areas were identified based on soils and geology; The Inland Empire Utilities Agency reported that these improvements have captured approximately 100,000 AFY each year of operation;
2. Flood protection must be the highest priority and has been incorporated into the operating plans for the system by all parties;
3. Facility operation and maintenance responsibilities were to be shared among the parties;
4. Stakeholder trust, backed up by formal Four-Party Agreement for the project (Agreement for Operation and Maintenance of Facilities to Implement the Chino Basin Recharge Master Plan). See related update report on these efforts.[20]
5. SAWPA/State grant funding assistance (Proposition 13) for construction.

### *The Hemet-San Jacinto Integrated Recharge and Recovery Program.*[21]

The Hemet-San Jacinto Basins are located within the San Jacinto River Watershed in Western Riverside County, and consist of the Hemet South, Hemet North, Canyon, and San Jacinto Upper Pressure sub basins or management zones. These sub basins underlie Eastern Municipal Water District's (Eastern

[18] Bill Mann and Associates, 1983. Day, Etiwanda, and San Sevaine Creeks Drainage Plan, Water Conservation Report
[19] Campbell, 2011. Planning and Operations Experiences with the Chino Basin Groundwater Recharge Program. Managed Aquifer Recharge Symposium January 25-26, 2011 Irvine, California. www.nwri-usa.org/rechargesymposium2011.htm
[20] Wildermuth Environmental, 2008.Chino Basin Optimum Basin Management Program, 2008 State of the Basin Report.
[21] Eastern Municipal Water District 2000.State of the Hemet/San Jacinto basins. http://www.emwd.org/modules/showdocument.aspx?documentid=93

MWD) service area and are utilized for groundwater supply for the cities of San Jacinto and Hemet, as well as unincorporated areas of Riverside County.

This project involves 100 acres of ponds, eight recovery wells, and a 60-inch diameter pipeline from Eastern MWD's EM-14 connection to the ponds. The objectives of the project include: providing Tribal Settlement Water (long-term average of 7,500 AFY), elimination of groundwater overdraft (10,000 AFY) and additional long-term supply (15,000 AFY). The project includes 20 acres of wet pond recharge area in the San Jacinto River channel, and has captured and recharged over 10,000 acre-feet since June 2012. A Stipulated Judgment (including the Soboba Tribe, EMWD, MWD, and LHMWD) has been filed as a collaborative solution to promote the efficient and coordinated management of surface water and groundwater, to avoid problems from overdraft, to assist in protecting the rights of the Tribe, to sustain and enhance water resources, and to resolve competing claims to surface water and groundwater[22]. Project success factors:

1. Currently, Eastern MWD has a Planning Department that pursues efforts to work with other agencies and private groundwater producers to establish cooperative groundwater management programs including groundwater storage and conjunctive use programs[23].
2. The project was guided by a unique committee that included construction oversight staff, attorneys, and managers (the CAM committee). Although impetus to initiate the project came from a water rights decision, the project has been a successful multi-agency recharge project.
3. The project team recommends that future projects should conduct thorough early planning, identify and secure funding from multiple sources, and involve regulatory permitting agencies early in the project development process. The San Jacinto Upper Pressure Groundwater Basin has a large remaining capacity for storage.[20]

### *Riverside City/FCD/WVMWD basin retrofit projects*

These are in various stages of implementation—planning, design, and contract procurement.

### *Key Project Success Factors*

1. Partnering with FCDs requires adoption of flood protection as the highest priority.
2. Thorough early planning and feasibility studies will streamline project design and implementation.
3. Long-term strong project leadership and management.
4. Strong and long-term ongoing trust and cooperation among all project partners, supported by a multi-party Agreement.
5. Adequate funding sources to plan, design, construct, and maintain the project must be identified, and be available.
6. Collaborative projects benefit from multiple stakeholder expertise and resources, and improve the cost-benefit balance.

[22] EVWD 2013. Hemet/San Jacinto Groundwater Basin Management: The Stipulated Judgment—PowerPoint Presentation. **http://www.emwd.org/modules/showdocument.aspx?documentid=5593**
[23] Daverin, John. Personal communication May 30, 2013.

7. Regulatory, judicial, or legislative mandates can rapidly initiate project development and implementation.
8. Participation in the OWOW Plan.

### *Stormwater Recharge Projects awarded under OWOW 1.0 and 2.0*

**Tables 5.8-3a and 3b** list the projects recently funded and currently under varying phases of implementation, which were awarded funding under Phases 1.0 and 2.0 of Proposition 84 per the Plan. The FCDs expect to have further discussions with all stakeholders to Identify potential site-specific opportunities for flood damage reduction and stormwater capture projects in partnership with stakeholders, using the map-based Watershed Geodatabase tools .

**Table 5.8-3a Implementation Projects Funded by Proposition 84 Round 1**

| Agency | Project | Benefits |
|---|---|---|
| City of Ontario | Cucamonga Creek Watershed Regional Water Quality Project (Mill Creek Wetlands) | • New storage of 160 AF<br>• 14 acres of preservation restored |
| Western Municipal Water District | Arlington Basin Water Quality Improvement Project | • Stormwater capture storage increase of 1,300 AFY<br>• 16 acres of preservation restored |

**Table 5.8-3b Implementation Projects Funded by Proposition 84 Round 2**

| Agency | Project | Benefits |
|---|---|---|
| San Bernardino Valley Municipal Water District | Enhanced Stormwater Capture and Recharge along the Santa Ana River | • Stormwater capture storage increase of 14,600 AFY |
| Inland Empire Utilities Agency | San Sevaine Ground Water Recharge Basin | • Stormwater capture storage increase of 2,000 AFY<br>• 26 acres of preservation restored |
| City of Fontana | Vulcan Pit Flood Control and Aquifer Recharge Project | • Stormwater capture storage increase of 2,000 AFY<br>• 60 acres of preservation restored |
| City of Yucaipa | Wilson III Basins Project and Wilson Basins/Spreading Grounds | • Stormwater capture storage increase of 1,300 AFY<br>• |
| San Bernardino Valley Water Conservation District | Plunge Creek Water Recharge and Habitat Improvement | • Stormwater capture storage increase of 1,250 AFY<br>• 50 acres of preservation restored |
| Orange County Water District | Prado Basin Sediment Management Demonstration Project | • Stormwater capture storage increase of 450 AFY |

### *Planned Project Site*[24]

The City of Santa Ana in association with the Cities of Newport Beach and Costa Mesa, is developing conceptual engineering for a proposed urban discharge diversion facility. The proposed facility will be located in the downstream portions of the Santa Ana Delhi Channel near the intersection of Mesa Drive and Irvine Avenue. The proposed project is intended to capture and divert urban discharge low-flow into the sanitary sewer system to address urban surface water quality in accordance with the Orange County MS4 Permit and the Total Maximum Daily Load (TMDL) for selenium discharge to the Upper Newport Bay. The Selenium TMDL includes waste load allocations for MS4 Dischargers in the Upper Newport Bay watershed, including discharges from the Santa Ana Delhi Channel watershed and facilities owned and operated by the Cities of Santa Ana, Costa Mesa and Newport Beach and the Orange County Flood Control District. The primary impetus of developing the proposed Urban Discharge Diversion System is to address the current Selenium TMDL, but also to address potential future TMDL's including bacteria, trash, toxics, metals and nutrients. The proposed diversion system has the ability to essentially eliminate discharges to the Upper Newport Bay and, therefore, eliminate the threat of pollutants entering the Backbay.

Three design concepts have been developed for discharging the treated flows. One concept would allow the treated water to be harvested for irrigation by the Newport Beach Golf Course.

## MS4 Permits as a driver for Plan implementation

Renewed MS4 Permits for Orange, Riverside, and San Bernardino Counties in the Santa Ana River Watershed were adopted in 2009 and 2010. These permits contain broad and specific requirements to implement programs and conduct projects that are consistent with the objectives of the Plan and this Chapter. The requirements for New Development and Significant Redevelopment emphasize the implementation of LID principles. The default requirement is for development projects to be designed and built so that stormwater is infiltrated to the extent feasible. Infiltration of stormwater from these projects should benefit groundwater recharge in areas suitable for recharge. However, the water quality volume to be captured is the runoff from the 24-hour 85$^{th}$ percentile storm event (generally varying from 0.5 – 1.25 inches per 24 hours). This capture volume is small compared to flood protection design storms (10-yr, 50-yr, or 100-yr frequency event) so flood protection infrastructure will likely still be required for the foreseeable future, in spite of LID implementation.

The MS4 Permits also require projects to implement BMPs to maintain the predevelopment hydrograph for the 2-yr 24-hour storm event. Similarly, the control of runoff from this small storm event size will not provide the required flood protection.

However, the MS4 Permits provide several requirements to incentivize the development of watershed-based compliance alternatives to meet MS4 Permit requirements for sites where LID implementation is not feasible. **Table 5.8-4** excerpts the specific requirements from the MS4 Permits. Despite the

[24] Excerpted and paraphrased from Santa Ana Delhi Channel Diversion Project: Preliminary Design Report. September 2012 Revision.

potential benefits, the MS4 Permit alternative compliance options have been proposed and evaluated to some degree, but have yet to be widely implemented in the SAR Watershed. Note that the successful projects summarized earlier were initiated without specific intent to comply with MS4 Permits, and some component projects predate the MS4 Permits.

Another study that has been proposed by the Inland Empire Utilities Agency[25] will evaluate the feasibility to increase stormwater capture and improve water quality by diverting and recharging up to 100% of the urban dry weather flow, and first-flush wet weather flow from a 303-d listed waterbody segment with a TMDL for pathogens. The project will investigate the feasibility of retrofitting existing recharge basins as part of the regional strategy to augment groundwater resources, and comply with urban stream TMDLs and MS4 permits.

Examples of recent projects that were developed with MS4 Permit compliance in mind include: the New Model Colonies offline treatment wetlands in the Chino Basin (see **Chapter 5.7 Land Use and Water Planning** ). These wetlands are being construction downstream and are separate from the development project site. However, it has not been designed or approved as an acceptable alternative BMP for any other development projects to exploit; and the County of Orange is conducting a feasibility study for the creation of a retention credit system using an existing site where a basin has been filled in. This project was submitted for funding under Proposition 84, but was not funded (see project description in **Appendix K**).

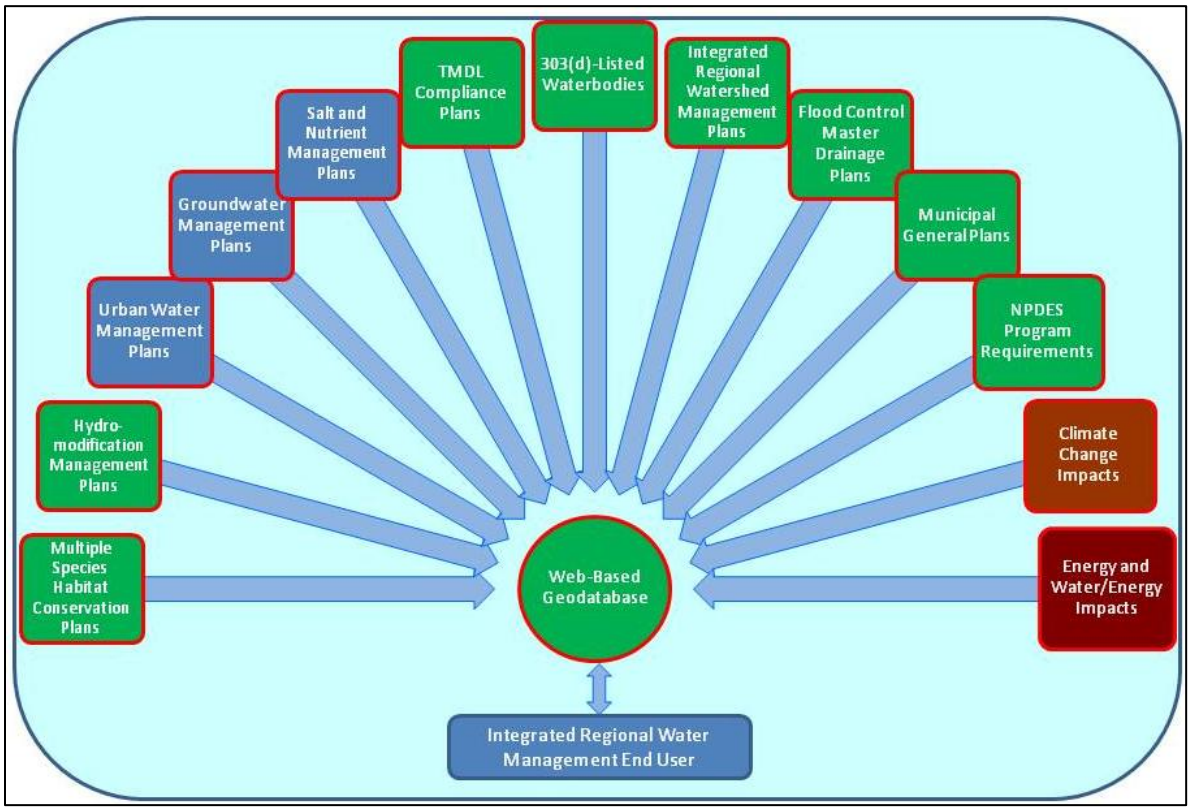
## Alternative watershed-or sub-watershed based compliance options include:

- Establishment of an urban runoff fund—development projects could contribute funding that would be pooled with funds from other projects and used to fund water quality projects elsewhere in the watershed.
- Off-site or Regional BMPs—BMPs may be implemented downstream from the project site, or are watershed-based structural BMPs.
- Establish a water quality credit system—certain project types can comply with water quality BMPs requirements through credits produced by alternative environmentally beneficial actions (brownfields, in-fill projects, redevelopment and transit –oriented projects, credit for urban runoff fund contribution, etc.).

[25] Urban Runoff Capture Retrofits at Recharge Sites--Feasibility and Case Study. Inland Empire Utilities Agency, January 2012 Proposition 84 Concept Proposal, PIN 24000.

## Map Based Watershed Plans (GIS-based or geodatabase development)

**Figure 5.8-4 Web-Enabled Watershed Geodatabase Components (adapted from RCFC&WCD slide)**




### *Planning Tools*

The geodatabases described below were designed as a resource for long-term land planning as well as for project siting and design evaluations. The planning aspects are described in the **Chapter 5.7 Land use and Water Planning**. Development of planning tools is recommended to include significant outreach to and participation from Planning Departments and Commissions.

### *Development tools*

San Bernardino County (Watershed Action Plan)

MS4 Permittees (cities and counties) must develop an integrated watershed approach to integrate planning and approvals for water quality and water quantity control measures. The requirements include revising the General Plan and CEQA documents to incorporate the water quality and watershed management principles. The Watershed Action Plan (WAP) is required to "improve integration of water quality, stream protection, storm water management, water conservation and re-use, and flood protection, with land use planning and development processes."

Phase 2 of the WAP requires the development and implementation of a Hydromodification Monitoring Plan, and a Hydromodification Management Plan. It also requires the development of "recommendations for streamlining regulatory approval of Regional Treatment Control BMPs."
In support of the San Bernardino MS4 Permit Watershed Geodatabase and the Watershed Action Plan, SAWPA participated in monthly meetings led by the San Bernardino MS4 Permit staff and other interested agencies from Jan. 2010 through Jan. 2011. Outreach meetings in conformance with watershed linkages to the OWOW process and SAWPA task forces were conducted on Dec. 15, 2010. San Bernardino Flood Control District hired RBF to develop the Watershed Geodatabase and provided demonstrations of the tool periodically throughout its development with input provided by stakeholders. The tool was submitted to the Regional Board as part of the Phase I deliverables under the MS4 Permit in Jan. 2011.

Status: WAP Phase 1 has been submitted and approved, Phase 2 tasks are ongoing.

Riverside County (Watershed Action Plan)
The Permittees must develop a Watershed Action Plan that describes and implements the Permittees' stated approach to coordinated watershed management. The WAP should address watershed scale water quality impacts of urbanization in the Permit Area associated with Urban TMDL WLAs, stream system vulnerability to Hydromodification from Urban Runoff, cumulative impacts of development on vulnerable streams, preservation of Beneficial Uses of streams in the Permit Area, and protection of water resources, including groundwater recharge areas.

Within two years from Permit adoption, the Permittees shall identify existing unarmored or soft-armored stream channels in the Permit Area that are vulnerable to Hydromodification.
Within three years the Permittees must submit the WAP that includes proposed regional approaches to meet urban TMDL WLAs, recommendations for retrofit studies of public facilities to address TMDLs, hydromodification, and LID implementation. They must also describe regional collaborative efforts (e.g. Task Forces) that benefit water quality and how the Permittees should link these to their Urban Runoff Programs.

Further requirements include developing a hydromodification management plan and a schedule to develop a watershed geodatabase available via the World Wide Web, and to provide training regarding implementation of the WAP and associated tools to all appropriate personnel.

In support of the Riverside MS4 Permit Watershed Geodatabase development, SAWPA held a joint meeting of the Stormwater: Resource and Risk Management Pillar and the Land Use and Water Planning Pillar on October 5, 2012. The Riverside County Flood Control and Water Conservation District provided an overview of the Watershed Geodatabase tool purpose and future use. Data for the tool was requested from the audience. SAWPA received a formal request for specific data from the RCFCWD in Sept. 2012 and available data was provided to them in Oct. 2012.

Status: Draft WAP was submitted for review January 29, 2013; the RWQCB provided comments on March 26, 2013; the revised draft WAP is due for submittal by June 24, 2013. RCFCWCD made a formal request for GIS and other data to water districts in their county area in January 2013.

Orange County (Watershed Master Plan)

The Permittees are allowed a compliance approach for mitigating impacts from hydromodification using mapping, modeling and reconnaissance methods. These tools are to be integrated into Watershed Master Plans (WMPs) that are an alternative means to comply with site-by-site implementation of hydromodification BMPs. WMPs are limited in scope by the MS4 Permit to apply only for alternative hydromodification compliance. The WMPs are similar in approach to the WAPs, but less comprehensive.

In the Orange County MS4 permit, though not specifically required, a geodatabase tool has been developed to support the MS4 compliance described as the Watershed Characteristic/ Mapping Tools under the Watershed Infiltration and Hydromodification Management Plan (WIHMP). This work was prepared by PACE Advanced Water Engineering Inc. under contract with the Orange County Watershed and Coastal Resources Division.

Status: The County of Orange is currently developing WIHMPs for the regional drainage areas in the SAR Watershed. The WIHMPs incorporate more comprehensive watershed data.

Since the three county MS4 permits were not approved at the same time, the schedule to implement the tools is staggered with the first efforts in the development of a support tool having occurred in Orange County with approval of their permit on May 22, 2009 and the San Bernardino permit and the Riverside County permit approval in Jan. 29, 2010.

## Policy and Procedure Opportunities and Recommendations

- Develop procedures and guidelines to ensure consideration of IRWM goals at project concept, planning, and design stages
- Collaborate with Land Use and Water Planning Pillar on development of geodatabase and other planning tools.
- Create a lead watershed advisory and facilitation group as forum for stakeholder planning and project development
- Preserve floodplain functions through stricter management of development in floodplains. Consider development of Model General Plan Language to implement this priority.
- Where appropriate, FCDs, and all watershed stakeholders, should develop procedures and guidelines to ensure consideration of IRWM goals and watershed protection principles and priorities, consistent with the MS4 Permits, when planning and designing CIP or other projects, and during development or revisions of Master Drainage Plans (MDPs) and planning of projects that implement the MDPs.
- Create a watershed-wide IRWM coordinating advisory group that continues the work of the OWOW Stormwater: Resource and Risk Management Pillar that brings FCDs, groundwater managers, and

other stakeholders together for decision making, partnership formation, and resource allocation to achieve IRWM goals.

- Water Agencies and Flood Control Districts should partner together via site specific agreements and general memorandums of understanding to develop multi-use facilities and optimize existing facilities for flood control, water conservation and water quality purposes. These agencies should work together to develop funding mechanisms to compensate the constituencies of the FCDs for the use of the facilities in re-charge activities, and preserve existing water rights.
- Evaluate impacts of 500 year flood management standard.

## Implementation Recommendations

### Develop Watershed Geodatabase Tools

Align and connect the San Bernardino, Riverside, and Orange County Watershed Geodatabase tools to create a system-wide or true watershed-wide tool supporting the entire Santa Ana River Watershed, coinciding with the Santa Ana Regional Board jurisdiction. This would enhance development and implementation of system-wide and watershed-wide solutions under the next round of MS4 Permits, due for renewal in 2014 and 2015. Connecting these geodatabase tools would greatly aid the development of an optimization and prioritization plan for the capture and recharge of stormwater, imported water, and low flow urban runoff to enhance water availability and reliability for the future of the watershed. Some additional data layers will be needed, particularly consideration of the impacts of climate change and energy, and energy/water use in watershed evaluations and planning. See integration of multiple watershed inputs in [**Figure 5.8-4.**]Coordinate and host geodatabase for the SAR Watershed (from WAPs and HCOC Maps): compile, coordinate, and provide hosting/access to GIS/geodatabase resources for the entire SAR Watershed. The comprehensive tool would achieve the following:

- Accessible by all stakeholders, with data quality assurance and maintenance program
- Maps developed to support development project conditions and acceptable BMPs
- Infiltration emphasized in MS4s
- Connecting 3 county geodatabase layers will support watershed project concepts, and identify likely project partners
- Includes FCD facility analyses for retrofit opportunities
- Have been and will be reviewed by regulatory agencies
- Set up a data quality control and long-term maintenance program
- Provide user-friendly access to these tools from a single portal
- Geodatabase tools provide preliminary project sites and priorities
- Site lists have been developed by FCDs
- Must prioritize flood protection
- Ideally, must address MS4 Permit compliance
- Ensure full participation of FCDs in early planning and project siting and design
- Costs/benefits need to be spread over FCD constituency
- Identify top three sites for demonstration project

*Develop tools for analysis and pre-populated standard form templates related to development projects:*

Map layers will include the following (and many others as are relevant):

- Recharge areas
- Preservation areas
- Multi-jurisdictional contacts for project sites
- Water supply areas by agency; imported water dependent sites, imported water infrastructure
- Water sources—groundwater wells, recycling plants, desalters
- Links to on-line climate change models
- Links to energy use and water/energy use data
- Include Regional Transportation Plan data and project concepts and potential partnering on transportation/water resource projects
- Include Utility data and evaluate coordination and cooperation with Utility Company sites and right-of-way

Coordinate/collaborate with EcoAtlas and/or other relevant map or model efforts, such as the DWR Integrated Water and Land Smart Planning Tool [See **Chapter 5.7 Land Use and Water Planning**]

Implementation-Specific Tools

- WQMP Templates
- Regional BMP sites
- Feasibility determinations—e.g. does the site provide more benefit as a regional BMP?
- Pollutants of concern

Identify top three sites for multi-benefit regional BMP demonstration projects, initiate partner relationships, and develop background needed to prepare funding applications:

Riverside County potential project example sites:

- Kansas Basin
- Marlborough Basin
- Columbia Basin
- Arlington Basin Projects (depending on status)

## Develop ground water recharge optimization and prioritization

Develop optimization and prioritization plan for existing and potential future flood control facilities for the capture and recharge of stormwater, imported water, and low flows in the SAR Watershed. Use Geodatabases and facility evaluation lists and prioritize top three basins for each County for feasibility study and further work as warranted. Identify pilot/demonstration projects for FCD Basin retrofits in partnership with Water Agencies and other stakeholders.

*Considerations to Include:*

- Groundwater basin recharge area optimization and prioritization: FCDs collaborate with groundwater management agencies to develop GIS/geodatabase of groundwater basin recharge potential; develop and execute an optimization methodology and prioritize watershed areas for stormwater capture recharge project planning.
- Consider where and how to maximize water supply and minimize waste.
- Existing FCD basin and facility retrofit evaluation and implementation studies (MS4 Permit requirement): Determine stormwater capture and groundwater recharge potential, concomitant with continued flood protection requirements, for FCD facilities throughout the SAR Watershed. Develop list of priorities for implementation, and consult with potential project partners.
- Use existing county or program-specific geodatabases, and/or the recommended comprehensive watershed geodatabase (Recommendation (a), above) that provides access to appropriate stakeholders.
- Develop guidance for development of WQMPs for Flood Control CIPs that recognizes the flexibility in the MS4 Permits and goals of the Plan.

## Develop Watershed-Based Tools for Alternative MS4 Stormwater Compliance the Serves Regional Priorities

This project involves creating a Task Force that includes the county FCDs, the water agencies, regulators, environmental NGOs, and interested stakeholders in parallel with demonstration projects and upcoming MS4 Permit renewals. Watershed-based and optimized BMPs also will provide compliance with MS4 Permit compliance where applicable. Alternative compliance approaches (see **Table 5.8-4**) will include:

- Identification of regional water quality and/or infiltration sites for watershed-based compliance
  - Pilot sites for off-site or Regional BMPs—BMPs will typically be implemented downstream from the project site. Identify 3 pilot sites for watershed-wide applicability
- Water quality and/or water quantity credit system, and/or an Urban Runoff Fund
  - Build on Orange County's retention credit pilot project [see **Appendix E**]
  - Development projects contribute funds used for water quality/recharge/habitat projects elsewhere in the watershed.
  - Current MS4 permits list project types which can comply via credits produced by alternative environmentally beneficial actions.
- Assessment of regulatory constraints and flexibility regarding alternative compliance approaches.

**Table 5.8-4 Watershed Action Plan, Watershed Master Plan, and Hydromodification Requirements in the Santa Ana River Watershed MS4 Permits.**

## Watershed Action Plan and Watershed Master Plan Requirements

(Excerpted from the San Bernardino County MS4 Permit Section XI.B; similar requirements excerpted from the Riverside County MS4 Section XII.B. The WAPs in the Orange County MS4 Section XVIII are focused on TMDL implementation; relevant OC MS4 requirements for Watershed Master Plans excerpted from Hydromodification Requirements Section XII.D.5)

## San Bernardino County MS4 Section XI.B

B. **Watershed Action Plan**

1. The Permittees shall develop an integrated watershed management approach to improve integration of planning and approval processes with water quality and quantity control measures. Management of the water quality and hydrologic impacts of urbanization will be more effective whether managed on a per site, sub-regional or regional basis, if coordinated within the Watershed Action Plan. Pending completion of a Watershed Action Plan, management of the impacts of urbanization shall be accomplished using existing programs.
2. Within twelve months of adoption of this Order, each Permittee shall review the watershed protection principles and policies, specifically addressing urban and stormwater runoff, in its planning procedures, including CEQA preparation, review and approval processes; General Plan and related documents including, but not limited to its Development Standards, Zoning Codes, Conditions of Approval, Development Project Guidance; and WQMP development and approval processes.
3. The Principal Permittee, in collaboration with the Co-Permittees, shall develop a Watershed Action Plan (WAP) that describes and implements the Permittees' approach to coordinated watershed management. The WAP shall improve coordination of existing programs and identify new and/or enhanced program elements as applicable. The objective of the WAP is to improve integration of water quality, stream protection, storm water management, water conservation and re-use, and flood protection, with land use planning and development processes. The WAP shall be developed in two phases:

a. Phase 1: within 12 months of adoption of this Order, the Principal Permittee, in coordination with the Co-Permittees shall:

i. Identify program-specific objectives for the WAP; the objectives will include consideration of:

1. The watershed protection principles specified in Section XI.C.3.a - g, below;

2. The Permittee's planning and procedure review required in XI.B.2, above;

3. Potential impediments to implementing watershed protection principles during the planning and development processes, including but not limited to LID principles and management of the impacts of hydromodification;

4. Impaired waters [CWA § 303(d) listed] with and without approved TMDLs, pollutants causing impairment, monitoring programs for these pollutants, control measures, including any BMPs that the Permittees are currently implementing, and any BMPs the Permittees are proposing to implement. In addition, if a TMDL has been developed and an implementation plan is yet to be developed, the WAP shall specify that the responsible Permittees should develop constituent-specific source control measures, conduct additional monitoring and/or cooperate with the development of an implementation plan, where feasible, and consistent with the MEP standard.

ii. Develop a structure for the WAP that emphasizes coordination of watershed priorities with the

Permittees' LIPs via the areawide model LIP;

iii. Identify linkages between the WAP and the SWQSTF, MSWMP, WQMP, the implementation of LID, and the TMDL Implementation Plans;

iv. Identify other relevant existing watershed efforts (Chino Basin Master Plan, SAWPA's IRWMP, etc., and their role in the WAP;

v. Ensure that the HCOC Map/Watershed Geodatabase is available to watershed stakeholders via the World Wide Web, and has incorporated the following information:

1. Delineation of existing unarmored or soft-armored drainages in the permitted area that are vulnerable to geomorphological changes due to hydromodification and those channels and streams that are engineered, hardened, and maintained.

2. GIS layers for known sensitive species, protected habitat areas, drainage boundaries, and potential storm water recharge areas and/or reservoirs;

3. 303(d)-listed waterbodies and associated pollutants;

4. Available and relevant regulatory and technical documents accessible via hyperlinks;

b. Phase 2: within 12 months of the approval by the Executive Officer of the Report from Phase 1, above, the Principal Permittee, in coordination with the CoPermittees, shall:

i. Contingent upon consensus with Regional Board staff and other resource agencies as described in XI.B.3.a.vii, above, specify procedures and a schedule to integrate the use of the Watershed Geodatabase into the implementation of the MSWMP, WQMP, and TMDLs;

ii. Develop and implement a Hydromodification Monitoring Plan (HMP) to evaluate hydromodification impacts for the drainage channels deemed most susceptible to degradation. The HMP will Identify sites to be monitored, include an assessment methodology, and required follow-up actions based on monitoring results. Where applicable, monitoring sites may be used to evaluate the effectiveness of BMPs in preventing or reducing impacts from hydromodification.

iii. Develop and implement a Hydromodification Management Plan prioritized based on drainage feature/susceptibilitylrisk assessments and opportunities for restoration.

iv. Conduct training workshops in the use of the Watershed Geodatabase. Each Permittee must ensure that their planning and engineering staffs attend a workshop.

v. Conduct demonstration workshops for the Watershed Geodatabase to be attended by appropriate upper-level managers and directors from each Permittee.

vi. Develop recommendations for streamlining regulatory agency approval of regional treatment control BMPs. The recommendations should include information needed to be submitted to the Regional Board for approval of regional treatment control BMPs. At a minimum, this information should include: BMP location; type and effectiveness in removing pollutants of concern; projects tributary to the regional treatment system; engineering design details; funding sources for construction, operation and maintenance; and parties responsible for monitoring effectiveness, operation and maintenance. The Permittees are encouraged to collaborate and work with other counties to facilitate and coordinate these recommendations.

vii. Implement applicable retrofit or regional treatment recommendations from the evaluation conducted in Section B.3.a.ix, above.

viii. Submit the Phase 2 components in a report to the Executive Officer. The submitted report shall be deemed acceptable to the Regional Board if the Executive Officer raises no written objections within 30 days of submittal.

XI.B.3.a.

ix: Conduct a system-wide evaluation to identify opportunities to retrofit existing storm water conveyance systems, parks, and other recreational areas with water quality protection measures, and

develop recommendations for specific retrofit studies that incorporates opportunities for addressing applicable TMDL implementation plans, hydromodification management, and/or LID implementation within the permitted area. (Orange County Section XIV.10)

x. Conduct a system wide evaluation to identify opportunities for joint or coordinated development planning to address stream segments vulnerable to hydromodification and coordinated re-development planning to identify restoration opportunities for hardened and engineered streams and channels. The WAP shall identify contributing jurisdictions and the stream segments that will benefit from this coordination.

XI.B.3.a.xi: Invite participation and comments from resource conservation districts, water and utility agencies, state and federal agencies, non-governmental agencies and other interested parties in the development and use of the Watershed Geodatabase;

## Riverside County MS4 Section XII.B.

**B. WATERSHED ACTION PLAN**

1. An integrated watershed management approach may facilitate integration of planning and project approval processes with water quality and quantity control measures. Management of the impacts of Permit Area urbanization on water quality and stream stability is more effectively done on a per-site, neighborhood and municipal basis based on an overall watershed plan. Pending completion of the Watershed Action Plan consistent with this section, management of the impacts of urbanization shall be accomplished using existing programs. The Permittees shall develop a Watershed Action Plan to address the entire Permit Area. The Permittees may choose to develop sub-watershed action plans based on the overall Watershed Action Plan in the future based on new 303(d) impairments, TMDL requirements, or other factors.

2. The Permittees shall develop and submit to the Executive Officer for approval a Watershed Action Plan that describes and implements the Permittees' approach to coordinated watershed management. The objective of the Watershed Action Plan is to address watershed scale water quality impacts of urbanization in the Permit Area associated with Urban TMDL WLAs, stream system vulnerability to Hydromodification from Urban Runoff, cumulative impacts of development on vulnerable streams, preservation of Beneficial Uses of streams in the Permit Area, and protection of water resources, including groundwater recharge areas.

3. Within three years of Permit adoption, the Co-Permittees shall develop the Watershed Action Plan and implementation tools to address impacts of urbanization in a holistic manner. At a minimum, the Watershed Action Plan shall include the following:

a. Describe proposed Regional BMP approaches that will be used to address Urban TMDL WLAs.

b. Develop recommendations for specific retrofit studies of MS4, parks and recreational areas that incorporate opportunities for addressing TMDL Implementation Plans, Hydromodification from Urban Runoff and LID implementation.

c. Description of regional efforts that benefit water quality (e.g. Western Riverside County Multiple Species Habitat Conservation Plan, TMDL Task Forces, Water Conservation Task Forces, Integrated Regional Watershed Management Plans) and their role in the Watershed Action Plan. The Permittees shall describe how these efforts link to their Urban Runoff Programs and identify any further coordination that should be promoted to address Urban WLA or Hydromodification from Urban Runoff to the MEP.

4. Within two years of adoption of this Order, the Permittees shall delineate existing unarmored or soft-armored stream channels in the Permit Area that are vulnerable to Hydromodification from New Development and Significant Redevelopment projects.

5. Within two years of completion of the delineation in Section XII,B.4 above, develop a

Hydromodification management plan (HMP) describing how the delineation will be used on a per project, sub-watershed, and watershed basis to manage Hydromodification caused by urban runoff. The HMP shall prioritize actions based on drainage feature/susceptibility/risk assessments and opportunities for restoration.

a. The HMP shall identify potential causes of identified stream degradation including a consideration of sediment yield and balance on a watershed or subwatershed basis.

b. Develop and implement a HMP to evaluate Hydromodification impacts for the drainage channels deemed most susceptible to degradation. The HMP will identify sites to be monitored, include an assessment methodology, and required follow-up actions based on monitoring results. Where applicable, monitoring sites may be used to evaluate the effectiveness of BMPs in preventing or reducing impacts from Hydromodification.

6. Identify Impaired Waters [CWA § 303(d) listed] with identified Urban Runoff Pollutant sources causing impairment, existing monitoring programs addressing those Pollutants, any BMPs that the Permittees are currently implementing, and any BMPs the Permittees are proposing to implement consistent with the other requirements of this Order. Upon completion of XII.B.4, develop a schedule to implement an integrated, world-wide-web available, regional geodatabase of the impaired waters [CWA § 303(d) listed], MS4 facilities, critical habitat preserves defined in the Multiple Species Habitat Conservation Plan and stream channels in the Permit Area that are vulnerable to Hydromodification from Urban Runoff.

7. Develop a schedule to maintain the geodatabase required in Section XII.B.4 and other available and relevant regulatory and technical documents associated with the Watershed Action Plan.

8. Within three years of adoption of this Order, the Watershed Action Plan shall be submitted to the Executive Officer for approval and incorporation into the DAMP. Within six months of approval, each Permittee shall implement applicable provisions of the approved revised DAMP and incorporate applicable provisions of the revised DAMP into the LIPs for watershed wide coordination of the Watershed Action Plan.

9. The Permittees shall also incorporate Watershed Action Plan training, as appropriate, including training for upper-level managers and directors into the training programs described in Section XV. The Co-Permittees shall also provide outreach and education to the development community regarding the availability and function of appropriate web-enabled components of the Watershed Action Plan.

10. Invite participation and comments from resource conservation districts, water and utility agencies, state and federal agencies, non-governmental agencies and other interested parties in the development and use of the Watershed Geodatabase;

## Orange County MS4 Section XII.D.

Section XII.D.5 provides a compliance approach for mitigating impacts from hydromodification using mapping and reconnaissance methods.

5. The permittees shall address the hydrologic conditions of concern on a watershed basis by preparing a Watershed Master Plan as described below:

The Watershed Master Plans shall integrate water quality, hydromodification, water supply, and habitat for the following watersheds: Coyote Creek-San Gabriel River; Anaheim Bay-Huntington Harbour; Santa Ana River; and Newport Bay-Newport Coast. Components of the Plan shall include: (1) maps to identify areas susceptible to hydromodification including downstream erosion, impacts on physical structure, impacts on riparian and aquatic habitats and areas where storm water and urban runoff infiltration is possible and appropriate; and, (2) a hydromodification model to make available as a tool to enable proponents of land development projects to readily select storm water preventive and mitigative site BMP measures.

The maps and a model Plan for one watershed shall be prepared by May 22, 2011. The model Plan should specify hydromodification management standards for each sub-watershed and provide assessment tools. In the preparation of the model Plan, the permittees are encouraged to use currently available information from other sources such as: (1) Orange County Flood Control Master Plan; (2) Irvine Ranch Water District's Natural Treatment System Master Plan; (3) Orange County Watershed Plans; (4) Nutrient and Selenium Management Program; (5) TMDL and 303(d) Listing information from the U.S. EPA and/or the Regional Board, and (6) and water districts.
The model Watershed Master Plan shall be submitted to the Executive Officer for approval. Watershed Master Plans shall be completed for all watersheds 24 months after approval of the model Watershed Master Plan.
The Watershed Master Plans shall be designed to meet applicable water quality standards and the Federal Clean Water Act.

### Possible Approaches and Products of the Task Force:

- Develop approaches for streamlined regulatory approval of off-site, regional BMPs, or other alternative compliance options.
    - Develop a draft Regional Board Resolution regarding alternative compliance options
- Develop a model administration program for a water quality/quantity credit system
- Clarify MS4 permit language, applicable to permit renewals coming up
- Identify lead agency (involve Southern California Monitoring Coalition)
- Develop model for mechanism to initiate and manage a Regional Urban Runoff Management Fund in a pilot area of the watershed.

## Development Process and Watershed Planning Coordination Group

To support important coordination and collaboration among the development and planners, it is recommended that the OWOW Steering Committee, supported by SAWPA staff, serve as the lead organization to ensure coordination of project partners (e.g. Chino Basin Groundwater Recharge Coordinating Committee) tasked with coordinating and persuading through coordinated meetings to cooperatively discuss mission and goals of the agencies, resources available among agencies, understand economic and technical constraints, and discuss opportunities for cooperative efforts to promote watershed sustainability priorities. The OWOW Steering Committee is uniquely situated to perform this function with representation on the Committee by cities, counties, environment, Regional Board and sustainable land development interests.

- Needs to transcend Proposition 84 or other funding decisions
- Should include the Regional Board
- Evaluates project ideas using the geodatabase
- Recommends necessary elements of training programs

### Specific Agency/Committee Tasks:

- Develop a process to link project development processes for various watershed stakeholders with each other, and align project plans and designs with watershed sustainability priorities
- Develop an approach to coordinate agencies' processes for project planning and design
    - Increased flood control system and management capacity and reliability
    - Projects and efforts that attenuate peak storm flows resulting from urbanization
    - Projects and efforts that increase recharge of stormwater
    - Projects that allow the region to meet nonpoint pollution control goals
    - Projects and efforts for groundwater clean-up by infiltrating high quality water into the groundwater basins
    - Improved habitat and facility maintainability.
- Proposed Participants:
    - US Army Corps of Engineers
    - Santa Ana Regional Water Quality Control Board
    - San Bernardino County Public Facilities and Flood Control District
    - Riverside County Flood Control and Water Conservation District
    - Orange County Flood Control District, OC Public Works
    - Eastern Municipal Water District
    - Inland Empire Utilities Agency
    - Orange County Water District
    - San Bernardino Valley Municipal Water District
    - Western Municipal Water District
    - Chino Basin Watermaster
    - San Bernardino Valley Water Conservation District
    - Santa Ana Watershed Project Authority
    - Cucamonga Valley Water District
    - Other parties of interest and affected agencies
- Outline project development and implementation processes of watershed stakeholders
- Identify decision/influence points in each process
    - Determine approach to incorporate watershed optimization priorities into project concepts and designs
    - Develop mechanisms or procedures to ensure watershed priorities are adequately incorporated or considered
- Identify and coordinate with regulatory project permitting processes
    a. Watershed optimization priorities inform permit processes and qualifiers
    b. Evaluate the role of CEQA

## Conduct further study of the 500-year flood impacts

Develop recommendations regarding appropriate changes to local policies based on the 500-year storm frequency standard for flood protection.

## List of Contributors

Contributors to the OWOW 2.0 Stormwater: Resource and Risk Management Pillar Chapter include:

| | |
|---|---|
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# 5.9 Natural Resources Stewardship



## Introduction

The Santa Ana River Watershed historically contained an abundance of natural resources, including water captured from snowmelt in the local mountains, diverse wildlife populations, abundant aquatic life in streams and coastal waters, geological resources for building materials, and a wide range of plant communities from coastal sage, to wetlands, to evergreen forests. These assets were first utilized by Native Americans and then by European settlers, who began to change the land use in the watershed with irrigation and farming.

Over the past 200 years, human population has increased greatly in the Santa Ana River Watershed. Since the 1930s, controlling floods and providing a reliable water supply have taken precedence over other critical watershed issues. These priorities have changed the natural hydrology of the Santa Ana Watershed, diminishing the once abundant natural water resources in the region. This strain on water resources and associated urbanization has left only remnants of isolated habitat in highly populated areas. Other factors including invasive plant species, frequent local fires and rogue recreational uses also have contributed to a reduction or complete loss of available habitat in some areas.

The natural resources and habitat in the Santa Ana River Watershed are now a fraction of their historical values. Therefore, efforts must be made to sustain and conserve the remaining resources for the benefit of future generations of life in the ecosystems of the watershed, and even expand them where possible. The purpose of this chapter is to detail the current status of these natural resources, including their benefits as both habitat and recreational assets, and to identify opportunities to promote and

implement sustainability followed by recommendations for solutions that maintain ecological balance and economic health.

## Resources of the Santa Ana River

### *Surface Water*

Water is the key life-sustaining resource within the Santa Ana River Watershed. The river begins high in the San Bernardino Mountains, where it flows westward for approximately 18 miles and then picks up additional flows from Bear Creek, a major tributary. The river then runs southward and meets up with Seven Oaks Dam, which provides capacity for flood control and also serves as a reservoir, with a total capacity of 145,600 acre-feet. The released flows from the Seven Oaks Dam continue westward with additional flows into the river contributed by Mill Creek, City Creek, San Timoteo Creek, Warm Creek, Twin Creek, Cajon Creek, and Lytle Creek before reaching the reservoir at Prado Dam. The Prado Basin also is fed by Chino Creek and another stream named Mill Creek, and occasionally by Temescal Creek in wetter years.

Water released from Prado Dam continues westward into Orange County, where the river then is diverted into spreading grounds for groundwater recharge in the north Orange County aquifer. Any remaining flows are confined to concrete channels between earthen levees, and additional flows are received from Santiago Creek, located near the city of Anaheim. The flows continue in a concrete flood control channel until crossing Interstate 5 near the city of Santa Ana, where the river again flows through a soft-bottom channel before reaching its mouth between Huntington Beach and Newport Beach.

Much of the river's historical flows have been diverted for local use along its path. The majority of water that currently flows in the Santa Ana River during the non-rainy season now comes from effluent from wastewater treatment plants.

The Santa Ana River Watershed has one natural and several manmade lakes that retain water for use as drinking water, irrigation, recreation, and habitat for aquatic species. Big Bear Lake is manmade and resulted from the construction of a dam along Bear Creek to hold back the runoff and snowmelt for the purpose of providing a reliable source of irrigation water for citrus growers near Redlands. Recreational boating and fishing are also beneficial uses of Big Bear Lake. Lake Perris, located in the eastern side of the Santa Ana River Watershed, is also manmade. Completed in 1973, Lake Perris is the terminus of the State Water Project and is used as a recreational amenity for the region. Lake Mathews, also manmade, is located in the foothills of the Santa Ana Mountains and functions strictly as a drinking water reservoir. It is the terminus of the Colorado River Aqueduct.

Lake Elsinore is a natural lake that offers recreational boating and fishing. In recent years, the lake has been replenished with recycled water. Mystic Lake, in the San Jacinto Basin, is an ephemeral lake that appears in wetter years, receiving waters from overflows from the San Jacinto River.

### *Minerals*

The geological composition in the Santa Ana Watershed has developed over a long period of time by the forces of natural seismic events and climate changes that affected the course and volume of the Santa Ana River. As flows from tributaries carried and deposited sediment along its varied alignments, areas referred to as alluvial fans were created. Most of the watershed from the base of the San Bernardino Mountains and north of the Santa Ana River are comprised of marine and non-marine sedimentary rocks. On the south, in the area of the Cleveland National Forest, shale, sandstone, limestone and slate dominate the geology. The San Bernardino Mountains' geology consists largely of a composite of Precambrian igneous and metamorphic rocks and Mesozoic granite.

The greatest mineral economic resource in the region is in aggregate, which can be in the form of natural sand and gravel, or produced by crushing rock. It is valued for its many uses in construction such as in Portland cement concrete, asphaltic concrete, road base, railroad ballast, and rip-rap. The California Geological Survey estimates that current permitted mining for this resource in the Santa Ana River Watershed region will meet only 25 percent of the estimated local demand. Importing this resource from other than local sources will result in higher project costs for all types of construction and have negative environmental impacts. Mining, however, also has been associated with negative environmental impacts including noise, dust, and habitat destruction. Mitigation of these impacts results in a lengthy process of five to ten years to acquire permits, which has greatly reduced the amount of aggregate mined in the region despite its abundance.

### *Vegetation in Habitat Areas*

Habitat classifications can be very complex, and while complex information is available for interested parties, this document will refer to several generalized groups, including alluvial fan, riparian, wetland, coastal, chaparral, and forested habitats.

Alluvial fans are located where stream flows that originate in mountainous areas flatten and spread out. Fan-shaped deposits of sand and gravel sediment, brought down from higher elevations, are left in the wake of storm and flood events, building up over time. They also can be found in desert areas that are prone to flash floods. Alluvial fan areas create a unique habitat in the Santa Ana River Watershed, but most significantly, they are home to both endangered and threatened plants and animals. They also are in areas where historical groundwater recharge has occurred, increasing the importance for conservation of alluvial fan areas.

Riparian habitats are those areas that transition between land and rivers or streams, and sometimes are referred to as buffer zones. These riparian zones provide valuable wildlife habitat and serve as wildlife corridors, allowing for increased biodiversity by enabling wildlife, including aquatic life, to move freely along river systems. Keeping this connectivity intact is vital in avoiding development of isolated communities.

According to the Clean Water Act, wetlands are defined as: "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal

circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands serve as vital habitats for a wide range of birds and aquatic creatures. Coastal habitats consist of a combination of beaches and intertidal wetlands, which meet the definition of wetlands above.

Chaparral is comprised of hard-leafed evergreen shrubs that grow two to four meters tall with deep roots. An understory layer rarely exists. Chaparral habitat occurs in different types of terrain including plains, rocky hills, and mountain slopes. Forested habitats exist mainly in the higher elevations of the watershed.

## *Wildlife*

*Birds*

Riparian ecosystems harbor the highest number of bird species in the watershed. Riparian habitat provides productive breeding grounds and offers vital over-wintering and migration stop-over areas for migrating birds. Loss and degradation of riparian habitat have negatively impacted bird populations throughout the watershed. Other factors affecting bird populations are brood parasitism by the brown-headed cowbird, and disruption of natural hydrological regimes from dams and levees.

The federally endangered least Bell's vireo has experienced recent population growth within the watershed due to aggressive management activities that started within Prado Basin and spread to other riparian areas throughout the watershed. In 1986 there were only 16 pairs of vireos reported breeding in the Prado Basin. With the management and restoration provided by the Santa Ana Watershed Association (SAWA) and its constituent agencies, there were more than 1,200 vireo territories throughout the Santa Ana River Watershed in 2012.

This stunning recovery is due to the provision of a high quality habitat for the bird species, in part, due to invasive species removal, a project in place to control populations of the predatory cowbird, and other efforts on the part of the U.S. Fish and Wildlife Service (USFWS), Orange County Water District (OCWD), several resource conservation districts (RCDs), and SAWA. The Coastal California Gnatcatcher (*Polioptila californica*) is a focal species under California's Natural Communities Conservation Planning (NCCP) program and is listed as a Species of Special Concern in California. The USFWS listed it as threatened in 1993. Critical Habitat for the species was designated in 2000, but court-ordered review of the economic effects of this designation is under way. *(Mock 2004)*

Both the least Bell's vireo and the federally endangered southwestern willow flycatcher are affected by cowbird brood parasitism. The implementation of cowbird management programs, in addition to preservation and restoration of riparian deciduous shrub habitat are needed to reduce current populations. The bald eagle, listed by the USFWS as endangered in 1978, has experienced population growth over the past two decades. The bald eagle could be considered a USFWS success story: reclassified as "threatened" in 1995 and first proposed for delisting in 2000. Delisting of a species is the USFWS's ultimate goal and only happens when specific recovery goals have been met for a species. Unfortunately, delisting is an infrequent occurrence. In the case of the bald eagle, delisting has been

delayed while the USFWS determines how the species would be managed once it is no longer classified as threatened.

### *Aquatic Life*

*Fishes*

The Santa Ana River and its tributaries historically provided habitat for eight species of native fish (species have multiple forms). Only four native non-game freshwater fishes currently are found in non-estuarine waters: arroyo chub, Santa Ana speckled dace, Santa Ana sucker, and threespine stickleback. All of these remaining fishes have limited distributions and face possible extirpation.

As previously mentioned, the Santa Ana sucker is listed by the federal government as a "threatened" species pursuant to the Endangered Species Act. Currently, the western brook lamprey is known to be extirpated from the watershed. The Pacific lamprey has been observed once in the past 47 years and it likely is extirpated as well. Introduced forms of the rainbow trout have been extensively stocked in the watershed for sport fishing for over 100 years, and it is unknown if any genetically pure rainbow trout stocks endemic to the watershed remain. The partially armored threespine stickleback was widely planted in the watershed for mosquito control in the early 1900s and now is found out of its natural historical range, e.g., Big Bear Lake. There are three current known occurrences of threespine stickleback: in Shay Pond, Juniper Springs Pond, and Sugarloaf Meadow Pond. During high water conditions, Shay Creek and Baldwin Lake also are occupied. Historically, they extended up Caribou Creek (Van Dusen Canyon), but water diversions and re-routing of drainages currently have made that unlikely. Juniper Springs drains to Arrastre Creek, which drains to the Mojave Desert. Shay Pond and Shay Creek drain to Baldwin Lake. Baldwin is considered a mountain playa lake and historically didn't have an outlet. The connection to Big Bear Lake is an artificial man-made connection for flood control purposes, so now Baldwin Lake will drain to Big Bear Lake in an extreme flood event.

In contrast, at least 33 fishes have been introduced into the watershed and currently are present. New species can be expected to be found at any time due to inter-basin water transfers, ship ballast water hitchhikers, bait bucket introductions, and hobbyists disposing of unwanted fishes. Many of the introduced fishes are widespread, while a few are restricted to specific locations or habitats. Of the current inventory of introduced fishes, most were introduced by government agencies to serve as a food resource, for insect control, for sport fishing, or to serve as forage for sport fishes. A smaller number of fish have become established after arriving inadvertently via inter-basin water transfers or in ships' ballast water. For a detailed discussion of the introduction of fishes to California, the reader is directed to Dill and Cordone (1997). Additional information about introductions of fishes to Southern California is presented by Swift *et al*. (1993). Supplemental records can be found in Moyle (2002).

*Oncorhynchus mykiss* is one of six Pacific salmon in the genus *Oncorhynchus* that are native to the North American coast. O*. mykiss*, along with other species of Pacific salmon exhibit an anadromous life history, which means that juveniles of the species undergo a change that allows them to migrate from freshwater to mature in salt water before returning to their natal rivers or streams (*i.e.,* streams where they were spawned) to reproduce.

Historically, these fish were the only abundant salmonid species that occurred naturally within the coast ranges of Southern California. Steelhead entered the rivers and streams draining the Coast Ranges from Point Sal to the U.S. Mexican Border during the winter and spring, when storms produced sufficient runoff to breach the sandbars at the rivers' mouths, and provided fish passage to upstream spawning and rearing habitats. These fish and their progeny were sought out by recreational anglers during the winter, spring and summer fishing seasons.

Steelhead are a highly migratory species. Adult steelhead spawn in coastal watersheds; their progeny rear in freshwater or estuarine habitats prior to migrating to the sea. Within this basic life history pattern, the species exhibits a greater variation in the time and location spent at each life history stage than other Pacific salmon within the genus *Oncorhynchus.*

The life cycle of steelhead generally involves rearing in freshwater for one to three years before migrating to the ocean, and spending from one to four years maturing in the marine environment before returning to spawn in freshwater. Adult steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more times. It is rare for steelhead to spawn more than twice before dying, and most that do so are females.

This species may also display a non-anadromous life history pattern (*i.e.*, a "freshwater-resident" strategy); non-anadromous individuals that complete their entire life history cycle (incubating, hatching, rearing, maturing, reproducing, and dying) in freshwater commonly are referred to as rainbow trout. However, this terminology does not capture the complexity of the life history cycles exhibited by native *O. mykiss*. "Rainbow trout", which have completed their life history cycle entirely in freshwater, sometimes produce progeny that become anadromous and emigrate to the ocean and return as adults to spawn in freshwater. Conversely, it has also been shown that steelhead may produce progeny that complete their entire life cycle in freshwater.

There is a third type of life history strategy displayed by *O. mykiss* fish that is referred to as "lagoonanadromous", which may spend a majority of the freshwater phase of their life moving back and forth between the estuary or lagoon at a river's mouth and upstream freshwater habitats before emigrating to the ocean. Steelhead populations in Southern California have not been investigated to determine whether or to what extent they may exhibit this life history strategy; however, steelhead smolts have been documented rearing in Southern California estuaries.

Within each of the three basic life history strategies (fluvial-anadromous, freshwater-resident, and lagoon-anadromous), there is additional variation, including examples of finer-scale habitat switching, such as multiple movements between lagoon and freshwater habitats in the course of a single summer in response to fluctuating habitat conditions; and also so-called "adfluvial" populations that inhabit freshwater reservoirs but spawn in tributary creeks.

Closely related to these various life history strategies is the use by steelhead of a wide variety of habitats over their lifespan, including river mainstems, small montane tributaries, estuaries, and the ocean. Steelhead move between these habitats because each habitat supports only certain aspects of what the fish require to complete their life cycle. Different populations frequently differ in the details of the times

and habitats that they utilize while pursuing the general pattern of the anadromous life cycle. These differences can reflect the evolutionary response of populations to environmental opportunities, subject to a variety of biological constraints that are also a product of evolution.

See the National Marine Fisheries Services Southern California Steelhead Recovery Plan (2012) for more details, and supporting references, particularly Chapter 1 “Introduction”, and Chapter 2 “Steelhead Biology and Ecology”.

For the other native fish species, see C. C. Swift, T. R. Haglund, M. Ruiz, and R. N. Fisher “The Status and Distribution of Freshwater Fishes of Southern California” (1993).

The decline of indigenous steelhead/rainbow trout (*Oncorhynchus mykiss*) populations in the Santa Ana River watershed is the result of a multitude of anthropogenic activities that have degraded riverine and estuarine habitats, and fragmented riverine habitats through the construction of instream barriers such as dams, diversions, road-crossing, and flood control structures. The threats analysis conducted by NMFS as part of the recovery planning for the Southern California steelhead populations, identified “Dams and Surface Water Diversions”, “Flood Control”, “Groundwater Extraction”, “Levees and Channelization”, and “Urban Development” as the highest threats to the native trout/steelhead populations in the Santa Ana River Watershed.

Over-exploitation of rainbow trout/steelhead by recreational angling was not identified as a principal factor for the decline of this species in the Santa Ana River, or in Southern California generally. Stocking of *O. mykiss* to supplement an existing native freshwater recreational fishery was initiated and subsequently increased over the years in response to a variety of factors, including human population growth, increased accessibility to angling areas, expansion of leisure time, and to support expanding outdoor recreational activities as an important component in a developing tourist industry. The reported catches of large number of trout by anglers in local media (*e.g.,* the July 17, 1982 report in the *Citrograph*, a Redlands newspaper, of three individuals taking 592 trout in three hours from Bear Creek, a tributary to the Santa Ana River in San Bernardino County) provide an indication of the natural productivity of the native fishery of the watershed.

The California Legislature began regulating recreational angling (along with other forms of angling) in 1861, when the Southern California human population was a small fraction of its current levels. The increasing restrictions on recreational angling were prompted by the increasing human pressures on the indigenous fishery resources, but were not intended to address the underlying cause of the decline of the populations, nor to safeguard native fish populations or maintain natural ecosystem functions. While both the anadromous form and the freshwater resident forms of *O. mykiss* now have been reduced to critically low levels, residualized populations persist in the headwater tributaries above and below impassible barriers, and the lower reaches remain accessible to the anadromous form when hydrologic conditions permit upstream migration from the ocean.

In February 2012, the City of Riverside, showing community support for steelhead restoration, adopted Resolution 22351, “A Resolution of the City Council …Supporting Restoration Efforts for the Southern California Steelhead in the Santa Ana River.” This resolution supports recommendations for restoring

the Santa Ana River steelhead population through mitigation actions identified in the U.S. National Marine Fisheries Service Southern California Steelhead Recover Plan.

See the National Marine Fisheries Services Southern California Steelhead Recovery Plan (2012) for more details, and supporting references, particularly Chapter 2 “Steelhead Biology and Ecology”, and Chapter 12 “Mojave Rim Biogeographic Population Group”.

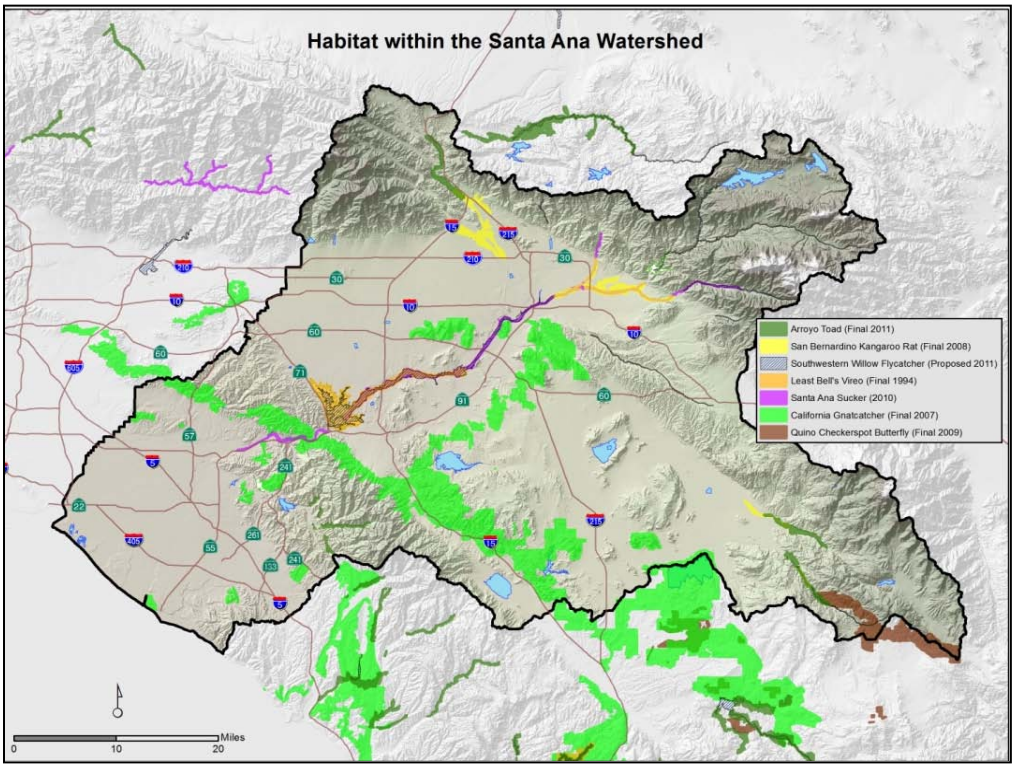
### *Amphibians*

During the past 50 years, population growth and urban development in Southern California have displaced many amphibian species, and encroached upon much of the former amphibian habitat. These include the federally listed endangered arroyo toad (*Bufo californicus*) and mountain yellow-legged frog, (Rana muscosa), and the federally-listed threatened California red-legged frog (Rana aurora draytonii). Several species are thought to be extinct, and many others have fragmented populations that are at risk of extirpation. Amphibians are especially sensitive to environmental changes that alter the hydrology, ecology, and geology of a region because they have evolved, highly specialized adaptations that have allowed them to exist in these relatively arid regions. Introduced species also have been a major contributor to the decline in amphibian populations in Southern California. These non-native species increase competition for food sources, as well as prey upon many of the native amphibians.

### *Reptiles*

The California Department of Fish and Wildlife (CDFW) considers the Southwestern pond turtle (*Clemmys marmorata*) a species of “special concern”. Recent reports on *C. marmorata* in Southern California indicate that a few viable populations remain in the regions (see also Brattstrom 1988). Approximately six to eight viable populations of the turtle remain south of the Santa Clara River system in California. Droughts have exacerbated the negative effects of habitat alteration accumulated over many years in much of this region from changes in land and water use, and abusive grazing practices. In particular, most western pond turtle populations examined in this region appear to show an age structure increasingly biased toward adults, indicating little or no recruitment is taking place. Recent surveys indicate that the southwestern pond turtle also is seriously threatened throughout most of its range outside of California.

**Figure 5.9-1 Map of Critical Habitat within the Santa Ana River Watershed**




## Current Status of Resources

### *Water Quality and Quantity*

Water quality in the mountain portion of the watershed is good overall, with low concentrations of total dissolved solids, nitrates, and other pollutants. Although elevated levels of total coliform and silt have been identified with storm flows, water quality exceeds the State standards set for the identified beneficial uses of the water. The water quality generally decreases, and turbidity increases with distance from the mountains. Multiple water reuse becomes a more dominant factor. The river courses through a large dairy preserve. Treated municipal wastewater is discharged into the river at many points between Riverside and the Prado Basin.

Fortunately, water quality in the SAR has improved in recent years due to technological developments and water quality planning. Most of the native fishes of the watershed are adapted to clear, unpolluted water that can support food resources and provide the various habitat conditions necessary to complete their respective life cycles. While fish kills that are due to the spill of toxic substances into streams are dramatic examples of the effects of pollution, these instances are acute, or short-term, rather than chronic. More insidious, however, are the chronic effects on aquatic resources of non-lethal forms of pollution that decrease growth, inhibit reproduction, or impair movement. Chronic elevated water temperatures or high sediment loads are examples of this type of pollution, even though toxic chemicals are not involved. Other examples include elevated but non-toxic levels of ammonia, increases in salinity, and low levels of dissolved oxygen (DO). Because most of the remaining native freshwater fishes live, at

some time, in treated wastewater, the issue of chronic, low-level pollution is of great concern, although the quality of wastewater has increased markedly in past years.
The base flow of the Santa Ana River continues to increase because of continuing urbanization. A minimum base flow of 42,000 acre-feet per year was adjudicated in 1969 as a result of litigation between OCWD and Chino. This flow rate is measured at Prado Dam and was based upon historical averages. However, rapid urbanization has resulted in increasing discharges of high-quality tertiary treated water from the many treatment plants located along the river. In 1999, the base flow had increased to 140,000 acre-feet and was once projected to rise to 230,000 acre-feet by 2020. However, increasing conservation measures and re-use, along with development standards that require water to be retained on site, put the future base flow of the river in question. Decreases in flow would result in diminishing supplies of water to maintain habitat restoration, especially along the river mainstem and its tributaries.

The flow through the alluvial scrub is seasonal. Between the cities of San Bernardino and Riverside, the river picks up enough urban discharge to support perennial flow and productive riparian habitat dominated by willows. The quality of the fish habitat also increases greatly and there are recent records for the occurrence of native fishes including the federally listed, threatened Santa Ana River sucker (*Catostomus santaanae*). The other native species recorded from several, scattered localities are the arroyo chub (*Gila orcutti*) and more rarely, the speckled dace (*Rhinichthys osculus*). Fish habitat will be particularly affected if flows are reduced because of less runoff and less water being discharged from treatment facilities.

### *Spotty Conservation Areas*

Without a comprehensive, regional plan for water-oriented habitat conservation, independent efforts by various planners, regulators, and landowners can lead to fragmented habitat areas and fragmented management of those areas. In addition, a parcel-by-parcel, or piecemeal planning approach can lead to inconsistent, inequitable regulation of land development and unnecessary costs and delays. Broader planning and management approaches would benefit both the environment and development.

In general, the larger a habitat area, the healthier it is, with ample breeding, feeding and shelter opportunities for its inhabitants. Fragmented, small habitat areas can pose a threat to species diversity and the overall health of ecosystems.

Habitat fragmentation frequently is caused when native vegetation is cleared for activities such as agriculture or urbanization. Habitats, which were once continuous, become divided into separate fragments or islands. When habitat is fragmented, plants and animals lose their protective buffers around the fringes and access to each other, food, and water. Eventually the fragments become unable to support their natural diversity and species disappear.

The Army Corps of Engineers promotes a watershed approach to placement of compensatory mitigation in implementing its 2008 Mitigation Rule. The following is its definition of that approach: “Watershed Approach means an analytical process for making compensatory mitigation decisions that support the sustainability or improvement of aquatic resources in a watershed. It involves consideration of

watershed needs, and how locations and types of compensatory mitigation projects address those needs. A landscape perspective is used to identify the types and location of compensatory mitigation projects that will benefit the watershed and offset losses of aquatic resource conditions, past and projected aquatic resource impacts in the watershed, and terrestrial connections between aquatic resources when determining compensatory mitigation requirements for Corps permits."

However, compensatory mitigation and its restrictions can result in fragmented management, especially when mitigation providers are required by regulatory agencies to assign long-term real estate instruments, conservation easements, or other restrictive covenants to land before funding for compensatory mitigation can be directed to the mitigation provider. In many areas of the Santa Ana Watershed where habitat has been significantly degraded, especially along the mainstem where most of the invasive plants thrive, providing long-term protection through such instruments is not feasible. Much of this land is owned by cities, counties, flood control districts, water districts, park districts and by the Army Corps itself. These entities historically have not been willing to grant easements or other restrictive covenants to third parties, such as non-profit environmental organizations and resource conservation districts.

Fragmented management refers to piecemeal approaches to conservation and restoration of water-oriented habitat. When management is approached in a collective, comprehensive manner, overall costs can be reduced, funding can be pooled, and wasteful or harmful practices can be minimized or eliminated. When management is fragmented, there is a potential for duplication of effort, conflicting practices, and excessive costs.

### *Special Status Species*

Second only to Hawaii, the State of California is home to the highest number of endangered species in the United States. As defined within the Federal Endangered Species Act of 1973, an endangered species is any animal or plant listed by regulation as being in danger of extinction throughout all or a significant portion of its geographical range. A threatened species is any animal or plant that is likely to become endangered within the foreseeable future throughout all or a significant portion of its geographical range. Federal law prohibits the "take" of any individuals or habitat of federally-listed species without a special permit.

In addition to Federal laws, the State of California has its own California Endangered Species Act, with a separate listing of species and separate laws governing take of listed species. Enforcement of the Federal Endangered Species Act is administered by the USFWS and the National Marine Fisheries Service, while the CDFW enforces the California Endangered Species Act. Refer to **Figure 5.9-1** above for a map of critical habitat within the watershed.

The varied geography and natural features of the watershed provide habitat for a number of Federal and/or State-listed species. As the Santa Ana Integrated Regional Watershed Plan focuses on the resources in and around the Santa Ana River, listed species of concern herein are those that occupy aquatic, wetland, riparian, or riparian-adjacent areas. Of these, two are plants – the Santa Ana River woolly star (*Eriastrum densifolium*) and the slender-horned spine flower (*Dodecahema leptoceras*); one

fish – the Santa Ana River sucker (*Catostomus santaanae*); three amphibians – the arroyo toad (*Bufo californicus*), Mountain Yellow-legged frog, (Rana muscosa), and the California red-legged frog (Rana aurora draytonii); three birds – the least Bell's vireo (*Vireo bellii pusillus*), the southwestern willow flycatcher (*Empidonax traillii*), and the bald eagle (*Haliaeetus leucocephalus*); two mammals – the San Bernardino kangaroo rat (*Dipodomys merriami parvus*) and Stephen's kangaroo rat (*Dipodomys panamintinus*); one insect – the Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*) and one invertebrate - Riverside Fairy shrimp, (Streptocephalus woottoni). Reaches 4 and 5 of the Santa Ana River are federally-designated critical habitat for the Santa Ana sucker. Reach 5 also is federally-designated critical habitat for the San Bernardino kangaroo rat. Any project or policy recommended by the Santa Ana Integrated Watershed Plan will need to assess potential impacts to listed species, and incorporate measures to avoid impacts to these species.

### *Coastal Conditions*

Essential Fish Habitat areas exist in the coastal waters off Orange County. The Magnusen Stevens Act defines Essential Fish Habitat as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." To clarify this definition, "waters" is defined as aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish. Substrate means "sediment, hard bottom, structures underlying the waters, and associated biological communities"; necessary means "the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem"; and spawning, breeding, feeding, or growth to maturity covers the full life cycle of a species.

An additional coastal resource is in the form of sea-grasses, including eelgrass. They have great economic benefits by providing habitat, nursery grounds, and refuge that is essential for the continued replenishment of fish, a vital economic resource in the form of food. The economic value of sea-grass also is seen in its ability to filter nutrients such as phosphates and nitrates that come from fertilizers used in gardens and lawns. According to a recent study, a value in the form of global nutrient cycling by the world's sea-grasses is an estimated $1.9 trillion per year. (Waycott 2009) Documented decline in the amount of sea-grass areas globally has made their preservation a priority. Sea-grasses are now federally-protected under the Clean Water Act.

Marine habitat, in the form of eelgrass habitat, also is affected by human activity because of its location in the shallow sub-tidal zones of coastal areas. Coastal development, boating, aquaculture and fishing, and urban runoff are all contributing factors that have the potential for causing damage due to pollution. The health of this habitat is important as nursery grounds and refuge from predation for many species of fish and invertebrates including juvenile halibut, lobster, sharks, scallops, and oysters. It also provides protective shade to prevent overheating, and there are many species that actually lay eggs on the blades for protection until they hatch. Eelgrass is also a food source to both aquatic and waterfowl species.

## Agriculture and Dairies: Water Quality Protection

Regulatory agencies in the watershed have taken a number of regulatory actions to address water quality impacts related to agricultural and dairy practices in the region, including impacts to both surface

water and groundwater due to runoff from manure in dairy farm corrals, spreading of manure for fertilizer in agricultural fields, and use of pesticides.
In 2007, the Santa Ana Regional Water Quality Control Board (RWQCB) issued R8-2007-0001 (NPDES No. CAG018001): General Waste Discharge Requirements for Concentrated Animal Feeding Operations (Dairies and Related Facilities) within the Santa Ana Region (Santa Ana RWQCB, 2007), prohibiting all dairies in the watershed from discharging process wastewater or stormwater runoff up to a 25-year, 24-hour rainfall event, and requiring each facility to develop an Engineered Waste Management Plan. This permit was amended with adoption of R8-2013-0001, which directed dairies in the San Jacinto Watershed to collaborate with Eastern Municipal Water District's Salinity Management Program.

The Riverside County Ordinance 427.2 passed by the Riverside Board of Supervisors in 2001, regulates safe transportation and application of manure in certain county districts by requiring operators and/or landowners to report manure application. The purpose of the ordinance is to minimize impacts to neighboring properties, local waterways, underground water supplies, and soil resources.

The San Jacinto Basin Resource Conservation District (SJBRCD) and the Western Riverside County Agriculture Coalition (WRCAC) developed a multi-phased process for establishing and running a Manure Manifest System (MMS). The MMS addresses nutrient and salt loadings by specifying that manure be applied to land at rates consistent with cropping practices and groundwater conditions. This will prohibit over-application at sites where potential impacts to groundwater basins are a concern.

### *Santa Ana Watershed Agricultural Report*

The objective of this report is to provide an overview of agriculture in the Santa Ana Watershed. This report includes information on types of commodities produced in the watershed, value of these commodities, information on whether agriculture is shrinking, percentage of irrigated land and percentage of region covered by Confined Animal Feeding Operations (CAFO). The focus of this report is especially on regions in San Bernardino, Riverside, and Orange County, which is a part of the Santa Ana Watershed. One of the other objectives of this report also is to shed some light on the impacts of agricultural pattern or CAFO in the Santa Ana Watershed on the overall water quality of the region.

### *San Bernardino County*

Livestock and poultry contribute to the highest value in the San Bernardino County region; this is followed by nursery and miscellaneous crops. Next, vegetables, fruit and nuts constitute the third and fourth most valuable crops within the region. Livestock and poultry cover the most amounts of acres compared to the any other type of crop that is produced in the region. Nursery and miscellaneous crops utilize the least amount of land compared to all other crop types, although it is of the second highest value in the region. All of the agriculture in the Santa Ana Watershed is irrigated and CAFO operations in the watershed include numerous dairies and chicken farms.

### *Riverside County*

In Riverside County, nursery is the highest value crop followed by vegetable crop; the third most valuable crop is fruit and nuts. According to the Riverside County Agricultural Commissioner, everything in the Riverside area of the Santa Ana Watershed is irrigated with the exception of "Range" and "Grain" acreage. Although there are dairies in Riverside and San Jacinto districts, the Riverside County

Agricultural Commissioner could not provide any statistics on the CAFO as they do not regulate CAFO in the region.

### *Orange County*

In Orange County the highest value crops are nursery and miscellaneous, followed by fruit and nut crops, and then by vegetable crops. As suggested by the County Agricultural Commissioner, agriculture is shrinking and operators are moving to high value crops in this region. The field crops in this region are grown without irrigation without any CAFO.

## The Value of Understanding

The urban watersheds of the California coast provide a unique opportunity to explore the value of historical ecology research for developing contemporary wetland and riparian restoration plans. Studies have demonstrated that restoration and mitigation planning would be greatly improved if done within the context of ecosystem function (Kentula 1997, 2007; Kershner 1997; National Research Council [NRC] 2001; White and Fennessy 2005). Unfortunately, in the urban environments of California, much of the current understanding of wetland and riparian ecology is derived from systems highly modified by human activities. Thus, identifying appropriate functional reference conditions or distinguishing natural processes from anthropogenic effects can be difficult. Recent historical ecology studies in California have provided new and surprising evidence of wetland resources previously not recognized, particularly in Southern California where evidence suggests wetland ecosystems were larger and more diverse than previously thought (Stein et al. 2010; Grossinger et al. 2011; San Dieguito River Park 2010). This suggests that historical ecology not only provides important information about functional reference conditions but also sheds light on previous misconceptions about the historical environment.

The value of historical ecology has been questioned in the urban coastal regions of Southern California where natural hydrologic processes are unlikely to be fully recoverable. Arguably, historical ecology may provide confusion in the face of a systematic incapability to return wetland ecosystems to their pre-development condition, often due to the permanent loss of natural hydrodynamic processes that were present prior to human contact. Understanding the historical template is as important as understanding the contemporary condition. Knowledge of historical ecosystem components is key to creating management and restoration plans that make sense relative to the contemporary landscape. The historical perspective provides an understanding of the relationship between physical settings that support natural wetland functions, the driving forces behind ecosystem degradation, and perhaps most important, the value of wetland ecosystems that remain intact (Stein et al. 2010). Considerable evidence supporting the importance of historical ecology in contemporary wetland management, even in highly urbanized areas, now exists (Kentula 1997; White & Fennessy 2005; Stein et al. 2010). In addition, new technical tools provide shared access to data collected for historical ecology projects, creating an opportunity for cross-disciplinary collaboration and ongoing discovery of historical reference conditions beyond traditional reports.

## Current Threats to Resources

Primary threats to aquatic resources within the Santa Ana River Watershed include past and ongoing loss and degradation of native habitat—approximately 90 percent of the wetland habitat in the Santa Ana River Watershed has been lost. Non-native invasive plants have taken over approximately half of the remaining wetlands, resulting in greatly increased threat of fire, greatly reduced wildlife values, and increased flooding issues, particularly from the arundo breaking off and forming huge debris dams. Non-native vertebrate and invertebrate species are wreaking havoc as competitors and predators of native species. There has been a historical lack of coordinated natural resources management to counteract some of the effects of human-induced impacts on the wetlands, along with a lack of public awareness and stewardship of wetland resource. The future availability of water is also a significant issue in habitat restoration and ongoing maintenance.

### *Unnatural Hydrology*

The Santa Ana River and its tributaries have been largely channelized and dammed to provide flood protection for the growing human population. There are many lakes, reservoirs, and dams on the tributaries including Santiago Dam, Villa Park Reservoir, Brea Dam, Fullerton Dam, Prado Dam, Carbon Canyon Dam, San Antonio Dam, Lake Hemet, Railroad Canyon Lake, Lake Elsinore, Lake Mathews, Big Bear Lake, and Baldwin Lake. Seven Oaks Dam is situated on the mainstem near its emergence from the San Bernardino Mountains, and captures about 7.2 percent of the total watershed. Prado Dam is located near the middle of the mainstem, capturing 52 percent of the watershed.

As noted by Moyle (2002), most of California's inland waterways today bear little resemblance to the streams and lakes encountered by the first European explorers and settlers. In the watershed, this observation is certainly true as flood control and channelization activities have left portions of streams channelized and concrete-lined where once riparian forests grew along a meandering stream. Fortunately, today only 20 percent of the Santa Ana River is concrete-lined. Dam construction and flood control activities were not the only factors influencing the watershed in ways that adversely impact habitat critical for aquatic resources. The following factors also have played a role:

- Stream channel alteration
- Draining of streams and lakes, especially adjacent wetlands
- Livestock grazing and the impact on aquatic and riparian vegetation, sedimentation, and water pollution
- Historical logging practices
- Invasive plant infestations
- Invasive and feral animal populations
- Bark Beetle infestation
- Mining, particularly in-stream aggregate mining
- Watershed changes resulting in cumulative effects to aquatic resources

### *Invasive Species*

Human development and activities in the watershed have greatly reduced the floodplain and associated habitats, and deleteriously affected the river's natural function and processes. One of the most

challenging agents of deleterious change has been a multitude of non-native, invasive species, primarily, but not exclusively, plants. One major problematic species, *Arundo donax,* at one point was reported to have taken over approximately 10,000 acres of river bottom, replacing native wetland habitats. The Santa Ana River has been transformed by giant reed. Other weedy species are major local issues including perennial pepperweed (*Lepidium latifolium*), tamarisk (*Tamarix* spp.), castor bean (*Ricinus molle*), and tree of heaven (*Ailanthus* altissima), among others, but Arundo is pervasive. Giant reed provides no redeeming wildlife value— it carries fire, causes obstruction to flood flows and results in damages to bridges and other structures, and results in expensive beach clean-ups. Compared to native habitat, Arundo consumes nearly three times the water, and it provides poor stream shading, impacting water quality. Arundo consumes an estimated 56,200 acre-feet of water annually from the Santa Ana River alone—enough for more than 100,000 households.

Achieving total eradication of Arundo in some parts of the Santa Ana River Watershed will take decades. Arundo control started in the upper watershed and continues downstream because Arundo invades by pieces that wash down and sprout in moist soil. Arundo seeds are sterile in our area, so the spread of Arundo has been entirely by vegetative means in the watershed.

Arundo on the Santa Ana River mainstem has been nearly completely eradicated in an area that stretches upstream from the Mission Bridge in Riverside, through San Bernardino and Redlands, and through the major tributaries of Mill Creek and San Timoteo Canyon. The San Bernardino National Forest also has projects focused on Arundo removal. Arundo has been nearly eliminated also in the Riverside County areas of Mystic Lake, the San Jacinto River, and Mockingbird Canyon/Woodcrest. In Orange County, it has been nearly eradicated in Carbon Canyon, Modjeska Canyon, Santiago Creek and Blackstar Canyon areas. All of these areas are being kept under control. This leaves the mainstem areas from Mission Bridge downstream, and then through the Prado Basin and the lower reaches in the Santa Ana Canyon. There are still thousands of acres of Arundo in these areas. Mitigation providers need to be given access to these lands and develop long-term agreements with the public and private landowners to complete the task of eradicating Arundo from the Santa Ana Watershed.

Certain species of non-native vertebrates like the brown-headed cowbird are extremely harmful to native species and are managed in association with endangered species monitoring to ensure no harmful effects to listed species. More than 100,000 cowbirds have been removed from the Santa Ana River Watershed since 1986.

In coastal regions, an invasive algae nicknamed “killer algae” or the alien seaweed *Caulerpa taxifolia* was found, according to NOAA, in Southern California’s coastal waters located in Huntington Harbour in Orange County. It is actually the result of a clone developed for aquarium foliage that “escaped” into the coastal waters. It originally was discovered in the Mediterranean where it has had devastating consequences. In areas where the species has become well established, it has caused ecological devastation by overgrowing and eliminating native seaweeds, sea grasses, reefs, and other communities, and economic devastation by harming tourism, pleasure boating, and recreational diving, and had a costly impact on commercial fishing. The dense carpet that this species can form on the bottom could inhibit the establishment of juveniles of many reef species, and its establishment offshore

could seriously impact commercial fisheries and navigation through quarantine restrictions to prevent the spread of this species. This alga poses a substantial threat to marine ecosystems in Southern California, particularly to the extensive eelgrass meadows and other benthic environments that make coastal waters such a rich and productive environment for fish and birds. The eelgrass beds and other coastal resources that could be directly impacted by an invasion of *Caulerpa* are part of a food web that is critical to the survival of numerous native marine species including the commercially and recreationally important spiny lobster, California halibut, and sand basses. Eradication methods have been undertaken in Huntington Harbour, however, constant monitoring is necessary to insure that this threat is eliminated. (NOAA)

### *Invasive Fishes*

Introduced fishes have a great impact on the aquatic resources of the watershed. The 33 species of introduced fishes greatly outnumber the four remaining native fish species. The number of species, *per se*, is not the problem but, rather, the impact that introduced fishes and other aquatic organisms, have on the native fishes of the Watershed. Introduced fishes have dramatically changed the composition of the watershed's fish community and now act as a deterrent to the restoration and enhancement of the native fishes that remain. Some of the aquatic species that continue to be destructive include: carp, bass, African clawed frogs, and red-eared sliders.

The manner in which introduced fishes can affect the aquatic resources of the Watershed include:

- Competition between native and introduced fishes for food and space
- Predation by introduced species on native fishes
- Habitat interference by introduced fishes that change habitat characteristics
- Introduction of diseases that may infect native fish or other aquatic animals
- Hybridization between closely related species

Each of the aforementioned factors has acted in concert over a long period of time to reduce the native fish community of the watershed to that which remains today. The Santa Ana Integrated Regional Watershed Management Plan recognizes that history cannot be undone and the aquatic community cannot be restored to its pre-settlement condition; however, a conservation strategy can be implemented that will ensure the long-term viability of the watershed's aquatic communities

### *Other invasive species*

Destruction to habitat also can be caused by animals such as feral dogs, cats, and pigs. With no natural predators, the numbers of these animals have greatly increased in recent years. The feral pigs are the most destructive. They root, trample and eat their way through sensitive plant and animal species' habitats. On National Forest managed lands, they have harmed the riparian habitat and oak grasslands by wallowing and turning over the soil in search of grubs, tubers and bulbs. The eggs of ground-nesting birds also are on their menu as they compete for vegetative food sources with other native animals. Their consumption of seeds such as acorns affects the ability for a habitat to regenerate naturally, potentially leaving areas they frequent in a desolate state.

### *Diminished Habitat Areas and Wildlife Linkages*

Development, especially during the past 50 years, has destroyed hundreds of thousands of acres of habitat. The result is now that much of the remaining habitat is fragmented, and connections among some remaining habitat areas have been irretrievably lost. The challenge to watershed stakeholders is to find innovative ways of preserving those connections that remain and creating new ones.

Transportation infrastructure—including roads, bridges and rail lines—presents significant obstacles to wildlife movement, especially for large mammals that are accustomed to roaming extensive territories. Commercial and residential developments, unlike roads, create many other issues along with being a barrier. These issues include introduction of non-native plants and non-native, predatory animals into the surrounding habitat areas.

Wildlife movement and habitat connectivity should be important considerations in any residential or commercial development. Community planners should make it a priority.

Current major efforts to preserve habitat connections in the Santa Ana River Watershed focus on the high country ringing the watershed and facilitating movement in and out of the watershed from outside areas, including the San Gabriel River Watershed, the Santa Barbara Mountains, San Diego County and the eastern and northern desert areas of San Diego, and Riverside and San Bernardino Counties. One example is an effort to preserve the linkage between the Palomar Mountains and the inland ranges of San Diego County through the southern Riverside County area to the Santa Ana Mountains.

While efforts to keep our watershed linked with surrounding natural areas are vital to species diversity and abundance, it is also important that intra-watershed linkages be preserved and created. Within the watershed, many conservation efforts are conducted with a focus on preserving habitat areas with linkages for wildlife (see Current Conservation Measures below).

Several efforts in the Santa Ana River Watershed are focused on road and freeway barriers. Many critical former wildlife movement corridors have been significantly disrupted by major freeways.

Riparian areas of the Santa Ana River and subwatersheds and drainages provide opportunities to preserve linkages for wildlife movement, especially for larger wildlife. Studies have shown that large mammals prefer to move through areas that are less confined and contain quality habitat on both sides of the obstruction and in the crossing area itself over areas that lack one or more of these characteristics.

Alluvial fan areas—such as those found along the lower elevations of the front ranges of the San Gabriel, Santa Ana, San Bernardino and San Jacinto Mountains—should be considered valuable not only for their aquifer-recharge abilities, but also for use as wildlife linkages. According to the California Alluvial Fan Task Force's *Planning Manual for Development on Alluvial Fans*, "Alluvial fan areas can provide connectivity between lowland and highland areas and provide critical habitat for sensitive plant and animal species downstream and downwind of the fans themselves." For this reason, preservation of sensitive alluvial fan areas should be considered in all development plans.

Population increases in the Santa Ana Watershed have resulted in the need for additional commercial and residential development, making the remaining open space areas attractive for these purposes.

Developmental goals often conflict with conservation efforts to preserve habitat and the region would benefit from collaborative land use planning to ensure that continuous wildlife corridors are preserved to promote biological diversity and prevent isolated conservation areas that diminish species viability.

### *Climate Change and Natural Factors*

The habitat within the Santa Ana Watershed is affected by natural occurring droughts, seasonal floods and fires resulting from both natural occurring lightning and human activities. Climate change is an additional uncertain variable that can influence the intensity of these natural events and the resulting damage to habitat.

### *Unsanctioned Recreational Uses*

It is recognized that the Santa Ana River, in areas where stream flow is substantial, is a destination for recreation and relief from the heat of hot summer days. There are, however, no designated areas for such uses along the mainstem (except in the San Bernardino National Forest) and efforts to restrict access have had limited success. Sensitive habitat is vulnerable to damage in the form of pollution as there are no trash receptacles or restroom facilities, as well as foot traffic. In some cases, people have constructed dams out of plastic bags in order to make a larger pool of water for swimming. This type of activity can damage the native aquatic habitat and natural hydrology of the stream flow.

Sensitive habitat also is at risk from all terrain vehicle recreation. Continued use can result in the development of ruts in which rainfall can find its way into, exacerbating the problem by increasing erosion and runoff debris, as well as forming new channels that change the natural hydrology of the area.

Other restricted activities specifically along the Santa Ana River Trail are as follows:

- Discharge of firearms and hunting is prohibited along the Trail
- Motor vehicles are prohibited
- Possession of alcoholic beverages is prohibited
- No overnight camping is allowed along the Trail, although it may be allowed in some adjoining park areas
- Fireworks, grills and campfires are prohibited
- Geocaches are allowed where they do not affect natural, cultural and historical resources, visitor safety, or other park users.

Implemented policies such as these are submitted and then reviewed by the Policy Advisory Group (PAG) and Technical Advisory Committee (TAC) for the Trail. Comprised of eight elected representatives from county and city government, these groups are responsible for policy creation and modification.

## Recreational Opportunities of Natural Resources

Most park and open space areas are local amenities, so the implementation of projects to develop them becomes a local decision intended to serve a focused, local population often residing within a few miles of a given developed park or open space area.

On the other hand, regional parks and open space areas tend to be larger, and provide more diverse amenities than those found in locally operated park facilities, and are managed to attract visitors from a wider area. Visitors come from within the Santa Ana River Watershed or from adjoining areas. The diversity of available facilities may enhance the region's attractiveness to visitors, and thereby provide economic growth through increased tourism. Most notably, parkland containing exceptional natural resources may attract eco-tourists looking for an opportunity to experience outdoor activities unavailable in their own areas. The wide variety of topography and natural resources within the watershed provide excellent opportunities for the development of this type of tourism.

Regional park facilities also may serve an important role in the continued economic development of the region. Businesses interested in attracting highly-skilled workers often use the proximity to well-developed recreational resources in attracting and retaining talent. Among the amenities often considered by skilled professionals are culture and the arts, nightlife, and the availability of outdoor recreation opportunities. From the ocean to the mountains, the watershed provides numerous opportunities for such a population.

Running through the watershed is the Santa Ana River Trail and Parkway (SART), a regional recreational amenity linking open space areas throughout the watershed. Models, such as the SART, could be developed in other parts of the watershed, such as in San Timoteo Canyon, along Lytle Creek, and within the San Jacinto Watershed. Completion of these linear park amenities and their connection with the existing trail backbone could create a world-class recreation system available to millions of residents and visitors.

Funding for recreational projects vary on location and type of project. Typically, projects are funded by various grants from agencies within the benefiting area. Other sources of funding include the California Department of Parks and Recreation, and additional grants available through the federal government.

### *Anaheim Park Projects*

OCWD and the City of Anaheim have forged a creative partnership to address the lack of open space and resources. On November 15, 2011, Anaheim opened a 14-acre nature park and a 1-½ mile bike path on public lands owned by OCWD near the City's urban core.

In the early 2000s, it was apparent that the City of Anaheim needed to find open space to provide an opportunity for nature and exercise. However, due to the built-out environment, lack of land, and high land prices, the City had few opportunities for large-scale nature parks. So The City forged a relationship with the largest landowner in Anaheim, the OCWD. The OCWD's Burris Basin is a 116-acre ground water replenishment facility on the west bank of the Santa Ana River. It is located only one-half mile north of the Platinum Triangle, Honda Center, Angel Stadium, and the Anaheim Regional Intermodal Transportation Center (ARTIC) that currently is under construction.

In 2005, the OCWD granted a 25-year lease to the City of Anaheim to open 14 acres of land for a public trail and nature park for an annual payment of $1. The agreement required the City to pay for the

construction, maintenance, and security of the public park area. The City immediately began an intense public input process and funding campaign. The City of Anaheim received $6.3 million in grants from the Rivers and Mountains Conservancy, California River Parkway Grant, and the Recreational Trails Program.

Anaheim Coves at Burris Basin offers a resting spot for Santa Ana River Trail users and nearby neighborhoods. There are two parking lots and restrooms, along with ample seating and opportunities for bird watching. Integrated public art interprets the natural environment with bird images embedded in the concrete seating, and metal pelican shapes in the gates that welcome patrons. This is a place for people (including the elderly and young children) to exercise, socialize, commute, and enjoy nature at the same time. There also has been a drastic reduction in calls for service and crime within the area.

The signage interprets OCWD's mission of groundwater recharge and the importance of water conservation; it also presents local history and the native flora and fauna. All landscaping is comprised of plants and trees indigenous to the Santa Ana River Watershed.

On April 30, 2013, a Memorandum of Understanding was ratified between OCWD and the City for the extension of the bike path almost one mile north and an eleven-acre nature park on the OCWD 5 Coves facility. Anaheim Coves at Burris Basin represents a great example of how cities and local water agencies can partner to further meet the needs of the community.

### *Parks, Recreation and Open Space*

The former Parks, Recreation and Open Space Pillar (now integrated in to the Natural Resources Stewardship Pillar) brought together park, recreation, and open space advocates from the three counties, including cities, other governmental agencies, and citizens who are interested in public access relative to water resources in the watershed. This group focused attention on the larger "picture" of opportunities. However, they consider the SART as a model for the development of additional regional amenities where close cooperation across many areas and jurisdictions is necessary.

The general findings included a survey of current Regional Park and open space offerings and conditions. While there have been many accomplishments, especially with regard to river access, more planning, management and coordination are needed. Urban development patterns, high land prices, and low availability of land for recreation make expansion of opportunities difficult. Also, new parks or trails may impact habitat with limited land remaining for public access and recreation.

Possible future threats include availability of funding for new trails and parks within the watershed, a shortage of ongoing maintenance funds, and the ability to maintain a high level of security and care for the parks and trails.

Strategies for addressing existing threats include: 1) seeking more stable funding through assessments; 2) increasing public awareness of park, recreation and open space issues; 3) developing a plan to leverage existing resources and expertise; 4) forging and maintaining partnerships; 5) improving resource mapping; 6) curtailing vandalism by increased patrol presence; and 7) ensuring regional park master plans include proper trail and open space protections. One of the most important regional

strategies is to fund and complete the SART. It also is imperative to help local agencies find support for their recreation needs radiating from the SART backbone. The model developed on the mainstem of the Santa Ana River (SAR) to develop the SART can be adapted to tributaries such as San Timoteo Creek and the San Jacinto River.

Current recreation opportunities in the watershed include bicycling, hiking, walking, skiing, snowboarding, rock climbing, geocaching, bird watching, swimming, horseback riding, and organized team and individual sports. The availability and level of participation in such activities is dictated by terrain, the location within the watershed, and degree of urbanization. For example, approximately 18 percent of the Watershed is within the San Bernardino National Forest. Recreational opportunities in this area are much different than in highly urbanized areas such as the cities of San Bernardino and Huntington Beach. In the upper watershed, hiking, rock climbing, and mountain biking are very popular on national forest lands. In the lower, more urbanized areas in the watershed, jogging and cycling are more common, as well as organized sports such as soccer and baseball. Sports fields are located adjacent to the river along its length.

The centerpiece of recreation in the watershed is the SART, a 100-mile trail currently under development, extending from the crest of the San Bernardino Mountains to the coast of the Pacific Ocean. The trail runs through three counties, 15 cities, and multiple jurisdictions. The trail is approximately 65-percent complete with plans to complete the remaining portions over the next five years (**Table 5.9-1**).

**Table 5.9-1 Status of Santa Ana River Trail and Parkway**

| County | Completed (miles) | In Construction (miles*) | Planned (miles*) |
|---|---|---|---|
| San Bernardino | 7 | 0 | 14.0 |
| Riverside | 12 | 0 | 21.0 |
| Orange | 24 | 0 | 4.5 |
| **Total Miles** | **43** | **0** | **39.5** |
| *Mileages are approximate and do not include earthen trail in San Bernardino National Forest. | | | |

The SART, shown in **Figure 5.9-2**, is a common thread through each county, and **Figure 5.9-3** lists the recreational opportunities available in the Watershed. **Table 5.9-2** describes each county's unique set of recreational resources.

**Figure 5.9-2 Santa Ana River Trail Parkway**

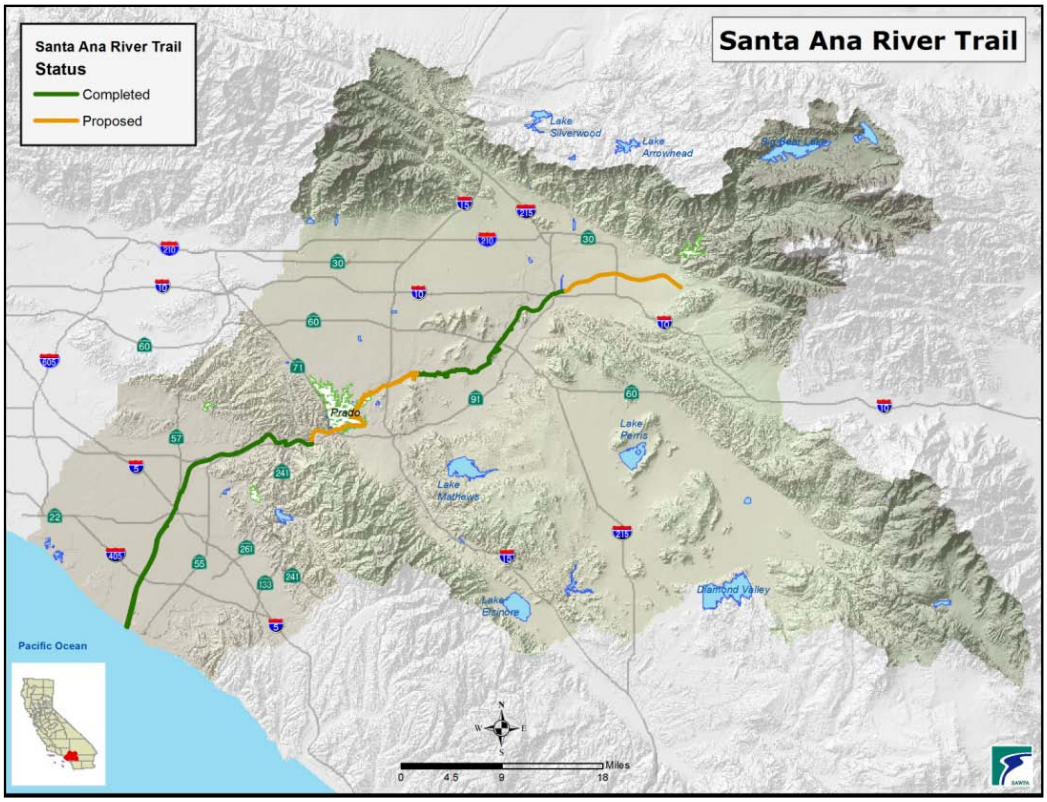


**Figure 5.9-3 Recreational Opportunities within the Watershed**

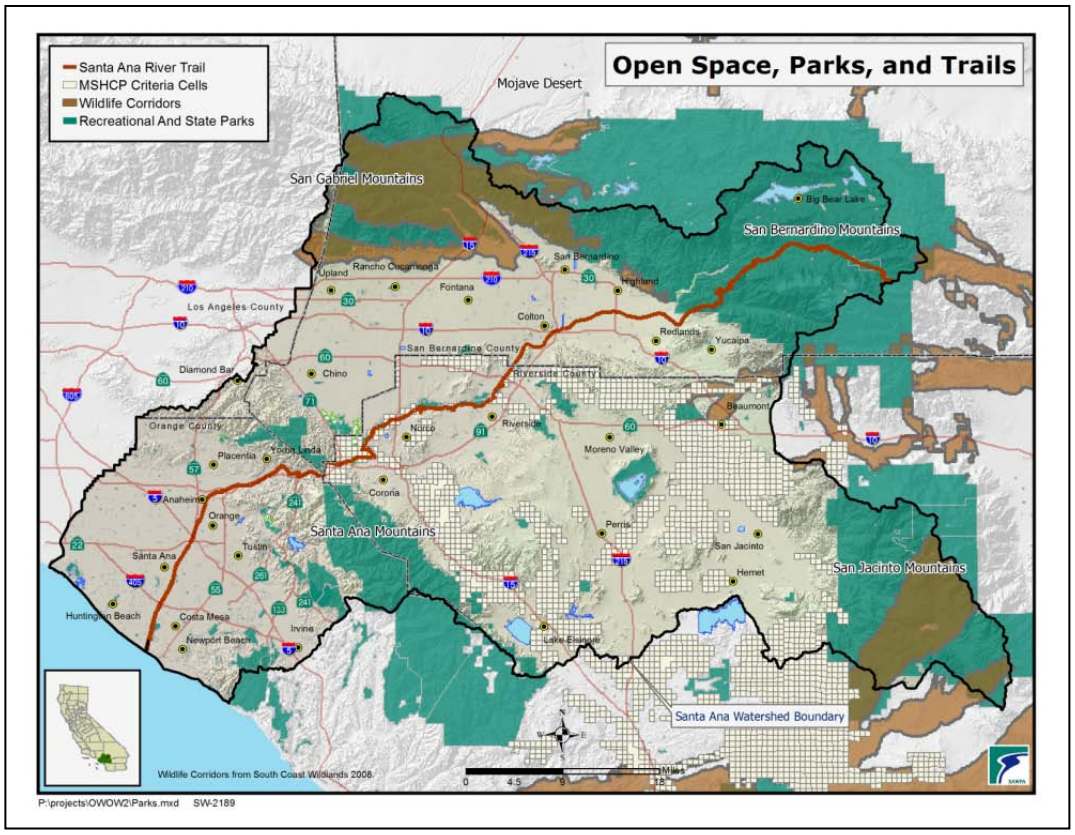


**Table 5.9-2 Regional Recreational Resources by County**

| County | Name and Location of Recreational Resource | Description of Resource and Available Activities |
|---|---|---|
| **San Bernardino County** | San Bernardino National Forest | Approximately 672,000 acres<br>352 miles of trails<br>Camping, fishing, hiking, equestrian, skiing, outdoor education, biking, target shooting and motorized sports |
| | Chino Hills State Park<br>Chino Hills | 6,000 acre park<br>Mostly open space<br>Hiking, bird watching, mountain biking |
| | Wildwood Canyon State Park<br>Yucaipa | Under development<br>1,200 acres currently; plans to expand to 5,000 acres and to develop trails and campgrounds |
| | County Parks: Glen Helen, Prado Basin, Cucamonga Guasti, and Yucaipa | Approximately 4,500 acres total<br>Camping, fishing, swimming and general day use |
| | City Parks: Cities of Chino, Chino Hills, Redlands, San Bernardino, Colton, Highland and Loma Linda | Various locations, facilities and acreages with mostly urban uses |
| | Rails to Trails<br>Upland and Fontana | |
| | Wildlands Conservancy Los Rios Rancho, Oak Glen | 6,000 acres of open space with hiking and outdoor educational facilities |
| **Riverside County** | County Parks: Hidden Valley Wildlife Area, Martha McLean-Anza Narrows, Rancho Jurupa, and Louis Rubidoux Nature Center | Hiking, bird watching, equestrian, camping, and outdoor education |
| | City Parks: City of Riverside, Norco River Trails, Mt. Rubidoux Park, Fairmount Park, and Butterfield | Various locations, facilities and acreages with mostly urban uses |

**Table 5.9-2 Regional Recreational Resources by County (continued…)**

| County | Name and Location of Recreational Resource | Description of Resource and Available Activities |
|---|---|---|
| **Orange County** | County Parks: 3 regional parks along SART | |
| | City Parks: 9 City parks along SART | |
| | Burris Basin currently under development | |
| | Existing equestrian facilities: Rancho Del Rio and Singletree Farms | |
| | SART bikeway: 27 miles complete<br>Riding and hiking trail: 23 miles complete | |
| | Talbert Marsh | Multi-purpose trail on 25 acres.<br>Bird watching |
| | Upper Newport Bay State Ecological Reserve/Interpretive Center | Bird watching, outdoor education, biking, and walking |
| | Irvine Ranch Wildlands and Parks | Hiking, equestrian, outdoor education, and mountain biking |
| | Bolsa Chica Ecological Reserve<br>Bolsa Chica State Beach | 300 acres<br>Outdoor education, hiking, biking, bird watching, and camping |

## Regional Strengths, Threats and Weaknesses in Recreation

### *Physical*

One of the great strengths of the region is that each county is geographically distinct, providing a variety of recreational opportunities. However, this diversity in topography also creates some threats and challenges. The biggest threat to recreation in the region is arguably patterns of urban development. The upper portion of the watershed, in San Bernardino County, is mountainous and relatively less populated than other areas in the watershed. The lower valleys are more urban with a discernible pattern of higher density near the coast. However, recently, relatively lower land values inland have resulted in increasing urbanization in these areas. Open space is being converted at a rapid pace, reducing opportunities to establish large parks and natural recreational amenities. The result most likely will be the development of more urban parks, which will support more urban recreational activities.

The upper portion of the watershed, being mountainous, results in a diversity of activities associated with forested environments. These include skiing, camping, hiking, rock climbing, and fishing. The middle portion of the watershed is relatively flat, valley terrain and is more densely urbanized. Activities in these areas include walking, jogging, bike riding, and horseback riding. Also, activities associated with more urban environments such as organized team sports played on developed fields, are more common in these areas.

The proximity of the ocean in the lower parts of the watershed is a draw for outdoor recreation in Orange County. The beach provides recreational opportunities found nowhere else in the watershed.

This is a strength, in that unique activities are available, but also a weakness in that the area is heavily used and requires additional maintenance and management. Facilities require greater upkeep and the potential for conflicts among users is higher here than elsewhere.

The presence of the Prado Dam in the center of the watershed also creates some unique challenges and opportunities. The area behind the dam is a largely undisturbed wetland, habitat to a number of threatened and endangered bird species. Bird watching is popular in this area, but access is challenging. Additionally, the river below the dam has water year round, providing recreational opportunities such as boating and fishing. The river upstream of the dam is more intermittent and does not offer these same opportunities in the same way.

The presence of the SART and various State and regional parks adjacent to the river along its course provide a ready-made infrastructure on which to build future trail linkages. There are few recreational trails adjacent to water in Riverside and San Bernardino counties, but opportunities exist to develop recreational amenities at flood control facilities.

### *Institutional*

All counties and cities in the watershed have some type of park and recreation management agency in place. These agencies provide an existing framework from which to plan and implement future projects. Several working groups currently exist to address specific issues that also provide forums from which to collaborate. Additionally, many agencies have developed management plans for various parks and resources under their purview. For example, most cities have master plans that reference recreation along the river. A major institutional strength is that most of the agencies currently cooperate and maintain good working relationships with one another as they endeavor to build trails. Most cities in the watershed have completed or are in the process of completing some type of vision document for the Santa Ana River Trail within their jurisdictions. Sponsored mainly by the Wildlands Conservancy, these "blue ribbon" committees have assembled stakeholders in each city to craft a vision for recreation adjacent to the river. Each city will have a document that can be used to guide future recreational development.

Private institutions, such as the Wildlands Conservancy, located in San Bernardino County, provide key private support and involvement. The Wildlands Conservancy has provided critical and substantial funding and works effectively with government agencies to further outdoor recreational and educational programs. Other groups, such as the Crafton Hills, Yucaipa Valley, San Bernardino Mountains, and Riverside land conservancies are working with their own contacts and partners to acquire lands, build connecting trails, and encourage elected officials to make recreation and open space a priority. The SART Partnership, a relatively new collaboration between public and private entities in the watershed also has been effective in bringing about funding and planning in the watershed. In 2006, the three counties, SAWPA, and the Wildlands Conservancy signed a Memorandum of Understanding to form the SART Collaborative Partnership. This group brings political will to bear, and directs the agencies under its umbrella to coordinate, seek funding, and leverage resources to finish building the SART. This group has developed the first regionally adopted plan for completing the unfinished segments of the trail.

Many of the group's participants felt that lack of funding to implement management plans was a widespread problem. Much of the funding focused on non-native species removal, such as Arundo donax (giant cane). The group also expressed that funding was available for new park development, but not for maintenance and operations. Many expressed the need for acquiring lands to expand or build new facilities.

## Current Conservation Measures

There are several active, proposed and inactive conservation plans in the Santa Ana River Watershed. The following is a list of some of the current plans. There are large gaps between these plans in the watershed, including in Western Orange County and in San Bernardino County.

### Upper Santa Ana River Wash Land Management and Habitat Conservation Plan

The project is located in the eastern valley portion of San Bernardino County, mostly within the cities of Highland and Redlands, but also partially within county jurisdiction. The plan area is bounded by Greenspot Road to the north and east, Alabama street to the west, and the SAR Wash to the south. The purpose of the proposed project is to allow the continued use of land and mineral resources while maintaining the biological and hydrological resources of the planning area in an environmentally sensitive manner. The Wash Plan is intended to coordinate and manage the present and future activities in the wash that are part of multiple jurisdictions, each with different needs. The goal of the project is to balance the ground-disturbing activities of aggregate mining, recreational activities, water conservation, and other public services with quality, natural habitat for endangered, threatened and sensitive species (San Bernardino Valley, 2007).

### Western Riverside County Multiple Species Habitat Conservation Plan

The Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) is a comprehensive, multi-jurisdictional Habitat Conservation Plan (HCP) focusing on the conservation of species and their associated habitats in Western Riverside County. The MSHCP is one of several large, multi-jurisdictional habitat-planning efforts in Southern California with the overall goal of maintaining biological and ecological diversity within a rapidly urbanizing region. Large-scale HCP planning efforts have been completed in San Diego and Orange Counties, and a similar effort is under way in the Coachella Valley. The MSHCP will allow Riverside County and its cities to better control local land use decisions and maintain a strong economic climate in the region, while addressing the requirements of the State and Federal Endangered Species Acts.

Riverside County's population in 2000 was approximately 1.5 million people. Its population is expected to double by 2020, to reach approximately 3.5 million by 2030, and be approximately 4.5 million by 2040, according to forecasts by SCAG. This is nearly a 400% increase over the next 40 years. Most of Southern California's growth over the next 40 years is expected to occur in the Inland Empire (San Bernardino and Riverside Counties) (SCAG 2001).

Accommodating an increase in population of this magnitude will involve urbanizing thousands of acres of undeveloped land and result in significant conflicts with regulations protecting species and their habitats. Conflicts and delays will escalate costs for all development projects, uncoordinated mitigation efforts will fragment habitats, the region will miss opportunities to improve the quality of life, and economic development opportunities for the current and future residents of Riverside County also will not be realized.

The MSHCP plan area encompasses approximately 1.26 million acres (1,966 square miles). It includes all unincorporated Riverside County land west of the crest of the San Jacinto Mountains to the Orange County line, as well as the jurisdictional areas of the cities of Temecula, Murrieta, Lake Elsinore, Canyon Lake, Norco, Corona, Riverside, Moreno Valley, Banning, Beaumont, Calimesa, Perris, Hemet, and San Jacinto. This HCP is one of the largest plans ever attempted. It covers multiple species and multiple habitats within a diverse landscape, from urban centers to undeveloped foothills and montane forests, all under multiple jurisdictions. It extends across many bioregions as well, including the Santa Ana Mountains, Riverside Lowlands, San Jacinto Foothills, San Jacinto Mountains, Agua Tibia Mountains, Desert Transition, and San Bernardino Mountains. It will provide a coordinated MSHCP Conservation Area and implementation program to preserve biological diversity and maintain the region's quality of life.

**Existing Reserves within the Western Riverside County MSHCP**

- Box Springs Reserve
- Bureau of Land Management Lands
- Cleveland National Forest
- Emerson Oaks Reserve
- Harford Springs Reserve
- Kabian Park
- Lake Mathews-Estelle Mountain Reserve
- Lake Perris Recreation Area
- Lake Skinner Recreation Area
- March Air Reserve Base Reserve Lands
- Metropolitan Water District Lands
- Mount San Jacinto Wilderness State Park
- Norton Younglove Reserve
- Orange County Water District Lands
- Prado Basin
- Riverside County Flood Control and Water
- Conservation District Lands
- San Bernardino National Forest
- San Diego Gas and Electric Lands
- San Jacinto Wildlife Refuge
- San Timoteo Creek State Park
- Santa Margarita Ecological Reserve
- Santa Rosa Plateau Nature Reserve
- Southern California Edison Lands
- Southwestern Riverside County Multi Species Reserve
- Sycamore Canyon Wilderness Park
- UC James San Jacinto Mountain Reserve

## Orange County Natural Communities Conservation Plan

The purpose of this project is to create a sub-regional multi-habitat-based HCP that balances resource protection with reasonable economic growth. This effort provided an opportunity to preserve coastal sage scrub and oak woodland habitats that have nearly disappeared from Southern California. The remote canyons of the 13,000-acre northern boundary, east of the City of Orange, are notable for "The

Sinks" area of Limestone Canyon, a huge, steep-walled sandstone ravine that resembles a mini-Grand Canyon. The land harbors some of Orange County's richest oak and sycamore woodlands, as well as

streams and springs laced with blackberries and monkey flowers and shared by animals of all sizes – from mountain lions to rare lizards. The ranch's 12,000-acre Weir, Gypsum and Fremont Canyons, adjacent to the Cleveland National Forest, are home to many native animals and plants. These include the rare Tecate cypress, found only in three other areas of California. The 14,000-acre southern boundary, with its hills, meadows, wooded canyons and sweeping views of the Pacific, connects Crystal Cove State Park and the Laguna Coast Wilderness Park. The Irvine Ranch Wildlands and Parks are home to bobcats, red-tailed hawks, coyotes, mule deer, meadowlarks, and an abundance of other wildlife (Nature Conservancy, 2008).

The Irvine Ranch Conservancy was established in 2005. It is a non-profit, non-advocacy organization, created to help care for the 50,000 acres of permanently protected wildlands and parks on the historic Irvine Ranch. The organization works with its partners to enhance the public's appreciation, understanding and connection to the land, while helping other landowners and managers with all aspects of stewardship. The Irvine Ranch Conservancy contributes its resources, expertise and energy to achieve the best possible balance of preservation and public participation. Nearly 50,000 acres of wildlands and parks have been designated as permanent open space on The Irvine Ranch. However, protecting the land is only the first step. Mediterranean ecosystems like these need extremely attentive stewardship. The rare plants, animals, and habitats found here are adapted to specialized conditions and need our long-term management to survive. The mission of the Irvine Ranch Conservancy is to make sure that these lands are cared for and enjoyed to the highest possible standards.

The wildlands of the North Ranch are connected to the Cleveland National Forest and are one of the few places where natural habitat ranges relatively unbroken from lowland scrub, grassland and oak woodlands up to higher altitude montane chaparral and conifers. The Venturan and Diegan associations of coastal sage scrub and native grasslands of Southern California are all critically endangered, and the Irvine Ranch Wildlands and Parks and adjacent wildlands offer one of the last, best places to protect these ecosystems and many of the species associated with them.

This area also is sufficiently large and continuous to support native ecosystems that still benefit from the presence of large predators such as mountain lion, coyote, golden eagle and bobcat. Their ecological role as top carnivores helps maintain a healthy and resilient ecosystem. The wildlands are some of the last and most extensive lower elevation habitat for these important predators. For all of these reasons, The Irvine Ranch Wildlands and Parks have been identified by The Nature Conservancy as one of the top 50 priority conservation landscapes in California.

Not only are these natural areas a globally important conservation priority, they are remarkably close to one of the world's largest urban regions. This offers an unparalleled opportunity for people to experience and enjoy these extraordinary native ecosystems in their own backyard, while enhancing understanding and support for their protection and stewardship (Irvine Ranch Conservancy, 2008).

*Existing Conservation Plans Western Riverside County MSHCP*

| Plan | Agency | Acres | Status |
|---|---|---|---|
| WRC MSHCP | WRC RCA | | Underway |
| Cleveland NF | USFS | | Completed |
| San Bernardino NF | USFS | | Completed |
| Prado Basin | OCWD | | Completed |
| Bureau of Land Management Lands | BLM | | Fluctuates |
| Lake Perris SRA | CA State Parks | | Completed |
| San Jacinto WR | CA State Parks | | Underway |
| San Timoteo Creek SP | CA State Parks | | Underway |
| Mt San Jacinto Wilderness SP | CA State Parks | 10,000 | Completed |
| Santa Margarita Ecological Reserve | | | Completed |
| Santa Rosa Plateau Nature Reserve | | 8,300 | Completed |
| Motte Rimrock Reserve | UC NRS | | Completed |
| Box Springs Reserve | UC NRS | 1,155 | Completed |
| Emerson Oaks Reserve | UC NRS | | Completed |
| James San Jacinto Mountain Reserve | UC NRS | 160 | Completed |
| Kabian Park | RC Parks | 640 | Completed |
| Norton Younglove/De Anza Reserve | | | Completed |
| Harford Springs Reserve | RC | | Completed |
| Lake Skinner Recreation Area | RC Parks | | Completed |
| Lake Mathews-Estelle Mountain Reserve | MWD | | Completed |
| SW Riverside County Multi Species Reserve | RCHCA | | Completed |
| Metropolitan Water District Lands | MWD | | Completed |
| March ARB Reserve Lands | USAF | | Completed |
| Southern California Edison Lands | SCE | | Completed |
| San Diego Gas and Electric Lands | SDGE | | Completed |
| | **Total Acres:** | 500,000 | |

*San Bernardino County MSHCP*

| PLAN | AGENCY | ACRES | STATUS |
|---|---|---|---|
| San Bernardino National Forest | USFS | | |
| San Bernardino County MSHCP | SB County | | Hiatus |
| Upper Santa Ana River Land Management & Habitat Conservation Plan | SBVWCD | | Draft |

### *Orange County MSHCP*

| PLAN | AGENCY | ACRES | STATUS |
|---|---|---|---|
| Cleveland National Forest | USFS | | Completed |
| Irvine Ranch Wildlands | Nature Conservancy | 50,000 | Under way |
| Irvine Open Space Preserve - South | City of Irvine | 4,000 | Under way |
| | **Total Acres:** | 54,000 | |

### *Innovative Conservation Arrangements*

Restoring the river requires many partners, agencies and landowners. Some of the key agencies include the following. The Corps has provided major funding through mitigation requirements and permits the wetland activities under Section 404 of the Clean Water Act. EPA receives, administers, and has distributed funds earmarked for this program through the efforts of Congressman Calvert and others. The CDFW permits the wetland activities under Section 1601 of the Fish and Game Code, has directed mitigation funds to SAWA, and contributes expertise to deal with some of the resource issues. The USFWS oversees and must approve activities that could affect wetland resources and endangered species. The RWQCB approves activities that could affect water quality and provides oversight of the recognized beneficial uses of the wetland resources. OCWD, which is responsible for managing water resources and providing water to more than two million Orange County residents, has provided major funding, provides personnel to manage wetlands and endangered species, and manages 2,400 acres near the middle of the river in the Prado Basin, attempting to maximize wildlife resources. The county flood control agencies maintain sections of the river for flood conveyance, cooperate toward achieving mutual goals, and issue entry permits.

Other programs include the Federal Safe Harbor Policy, which protects the ability of landowners to use their land responsibly in exchange for the setting aside of large land parcels for conservation of specific threatened or endangered species.

## Opportunities for Improvement

As the watershed has been developed over the past two centuries, many water-oriented habitats have been altered by man. Where water-oriented habitats have been reduced, the flora and fauna have adapted, moved or disappeared. Through the OWOW process, stakeholders will investigate how to successfully manage water-oriented habitats while ensuring adequate public water supply, protecting water quality, and providing housing and commerce for a growing population.

The following is a list of issues/challenges, followed by a brief discussion of potential approaches that take advantage of opportunities for improvement.

### *Create managed system and restoration targets*

A plan for sustainable management of conservation areas with targeted restoration efforts is essential for preventing further deterioration of habitat. Consideration for characteristics of each of the main

habitat types:  alluvial fan; riparian, wetland and coastal and their specific ecosystems, will require habitat specific management plans and restoration criteria.

Potential Approaches:

- Develop a map of the watershed reflecting all the water-oriented habitat areas as described in this chapter
- Develop a landownership database along riparian corridors
- Work with landowners to manage habitat more effectively and provide "assistance agreements"
- Develop an urban habitat management model that softens/blurs the transition from urban development to surrounding habitat areas, and allows urban gardens and green space to be used safely/responsibly by wildlife based in the habitat areas
- Partner with transportation agencies to minimize fragmentation and incorporate wildlife crossings
- Incorporate vector control efforts into habitat management efforts to avoid conflicting activities
- Consolidate the various "vision plans" by various agencies regarding water-oriented habitat conservation

The region's favorable climate and historically high employment rate make the region prime for development and urban growth, and it is expected to remain so in the future. This produces a great deal of pressure on water-oriented habitat. To address these pressures, this Plan recommends that the development community consider water-oriented habitats early in the development planning process.
Potential Approaches:

- Analyze the economic value of environmental and habitat enhancement to new and existing communities
- Identify early what general and specific areas should be preserved at full build-out of the Watershed rather than identifying them after landowners have prepared development plans (the latter approach can result in inequitable, piecemeal conservation efforts)
- Incorporate water-oriented habitat conservation into land use planning in a manner that provides a return on investment while protecting the environment
- Modify the State tax structure to encourage conservation
- Facilitate cooperation among regulators and private landowners to prioritize lands that could be purchased and set aside as public lands
- Identify funding sources for such purchases or facilitate development agreements that transfer such lands to public agencies for future management
- Consider the natural configuration of water-oriented habitat that does not recognize political jurisdictional boundaries. A regional coordination effort is needed to provide consistent planning and regulation across multiple jurisdictions

### *Create Sustainable wildlife corridors and expansion of restored areas*

Creating sustainable wildlife corridors will require land use planning coordinated across jurisdictional boundaries.  Cooperation also must take place among all of the current regional conservation plans, mitigation providers, resource conservation districts, and non-profit conservation organizations.

Potential Approaches:

- Facilitate legislation to simplify landowner habitat conservation programs
- Develop an inventory of existing mitigation lands
- Develop a Watershed-wide, water-oriented habitat conservation program
- Create mitigation banks to "pool" smaller mitigation requirements to enable the creation of larger, more beneficial habitat mitigation projects
- Work with private landowners to manage habitat more effectively, provide "assistance agreements" that help those landowners manage their lands partnership, and management education
- Build on successes of the Western Riverside County MSHCP and other similar efforts to expand conservation opportunities

### *Provide sustainable funding sources for ongoing maintenance of conservation areas*

Over the past few decades, development interests, regulators and environmental groups have worked together to encourage habitat conservation and enhancement while allowing for reasonable land development. Such efforts include Natural Community Conservation Plans and HCPs. These programs have provided large conservation areas to accommodate large developments, but have taken years and large financial commitments to develop and implement. Despite significant bond funding in recent years, there still is a shortage of funding available in both the private and public sectors to purchase, operate, and maintain valuable habitat areas.

Challenges to the effort to restore areas of the mainstem include an in-lieu fee program and other mitigation program regulations that insist on long-term protections such as conservation easements, fee-title ownership, and real estate instruments over all areas where removal and restoration occur. This is not feasible in many places along the Santa Ana River because these lands are controlled by flood control agencies, parks districts, cities, counties, and the Army Corps itself. However, other long-term agreements need to be made among these agencies and organizations whose missions include invasive removal and native habitat restoration. Public and private landowners with ownership and jurisdiction over these areas need to work with mitigation providers, such as non-profit organizations, conservation authorities and resource conservation districts to develop long-term protection agreements that will satisfy the requirements of the Army Corps of Engineers, the California Department of Fish and Wildlife, the US Fish and Wildlife Service, and the Regional Water Quality Control Board.

The Integrated Regional Watershed Management Plan should include consensus among all agencies and organizations with ownership/stewardship over areas of the Santa Ana River mainstem and tributaries that provide for long-term protection of areas where habitat restoration efforts are occurring or need to occur. This kind of cooperative agreement will be critical to the ability of governmental and non-profit organizations to secure mitigation funding to do the necessary habitat restoration work needed in the watershed. Without such agreements, the fragmentation of restored habitat in the watershed will continue to be a problem.

Potential Approaches:

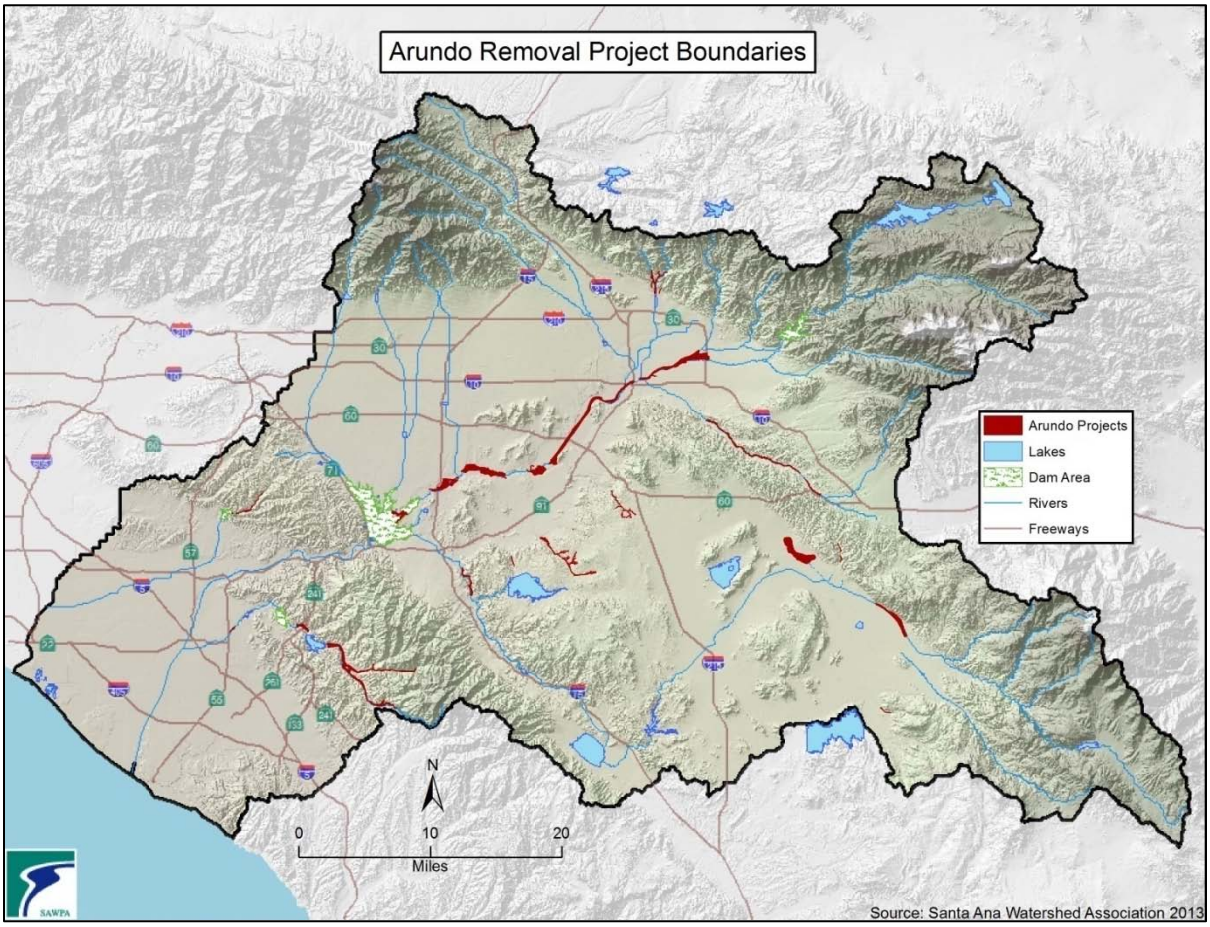
- Research and develop innovative funding arrangements to buy high priority, water-oriented conservation lands, construct needed improvements for appropriate public access, and fund on-going operation and maintenance of those lands
- Create cooperative agreements among public landowners and organizations that conduct long-term maintenance of habitat areas that provide reasonable protections in perpetuity for ongoing restoration

### *Invasive species eradication and maintenance funding*

Restoring the river requires many partners, agencies and landowners. Some of the key agencies include the following. The Army Corps of engineers has provided major funding through mitigation requirements and permits the wetland activities under Section 404 of the Clean Water Act. EPA receives, administers, and has distributed funds earmarked for habitat program. The CDFW permits the wetland activities under Section 1601 of the Fish and Game Code, and has directed mitigation funds to mitigation providers, and contributes expertise to deal with some of the resource issues. The USFWS oversees and must approve activities that could affect wetland resources and endangered species. The RWQCB approves activities that could affect water quality and provides oversight of the recognized beneficial uses of the wetland resources. The county flood control agencies maintain sections of the river for flood conveyance, cooperate toward achieving mutual goals, and issue entry permits. OCWD, which is responsible for managing water resources and providing water to more than two million Orange County residents, has provided major funding for habitat restoration throughout the watershed, provides personnel to manage wetlands and endangered species, and manages 2,400 acres near the middle of the river in the Prado Basin, attempting to maximize wildlife resources.

The historical and current sources of habitat restoration funding include developer fees directed by the Army Corps to in-lieu fee mitigation providers. Outside of in-lieu fee mitigation, the CDFW and the RWQCB order mitigation measures that result in developer fees that that are directed to non-profit and governmental mitigation providers and conservation organizations. Grant and bond funding in the watershed also have funded the removal of thousands of acres of invasive plants, initial and ongoing restoration of habitat areas, biological monitoring of sensitive species, and conservation of habitat areas. The image below, **Figure 5.9-4,** illustrates the multiple areas affected by the Arundo Donax.

**Figure 5.9-4 Arundo Donax Removal Areas**




All of these sources and more should continue to support restoration and ongoing maintenance. Access to such funding should be expanded to benefit the watershed. New, innovative partnerships should be developed to direct funding to habitat issues.

Potential Approaches:

- Create and update watershed-wide, public contact list of mitigation and conservation organization organizations, their capabilities and areas of expertise
- Create a regional grant opportunities network and clearinghouse to direct more funding to the watershed for restoration and public education
- Develop a wider range of in-lieu funding programs, habitat banks for water-oriented habitats throughout the watershed
- Create and encourage innovative public/private/non-profit partnerships and collaboration to improve opportunities for bringing grant funding to the watershed.

### *Habitat Restoration Projects*

Much of the remaining invasive plant biomass and areas that could benefit from Re-establishment activities (removal of invasive species followed by long-term, active planting and biological monitoring) in the watershed is on land owned by Federal, State, and local governments for purposes other than water-oriented habitat conservation. In many cases, these lands currently are left unmanaged or are managed in a manner that discourages the development of habitat. There are many unused portions of public lands that could be set aside for habitat enhancement without impacting the landowner's primary purpose. An example may be flood control channels and basins that could provide habitat while still providing critical flood protection.

Potential Approaches:

- Develop a public land database as a first step toward a more comprehensive, coordinated management plan
- Develop a regional plan for public land use
- Develop regional "safe harbor" type agreements that allow for long-term management of public lands for multiple uses including habitat conservation
- Coordinate wildlife management with local parks departments
- Provide expert assistance to public agency landowners to help them better understand how they can manage their lands for multiple purposes, especially short- or long-term habitat enhancement
- Partner with public utilities in utility corridors

### *Pollutant Trading Programs*

Constructed wetlands can be used to remove pollutants from surface runoff using natural processes. Formal pollutant trading programs provide the mechanism to pool funding from multiple, smaller sources to construct wetlands that would create habitat and increase the pollutant removal benefit.
Potential Approach:

- Develop formal pollutant trading programs that facilitate pooling of funds to construct wetlands

### *Create community involvement in habitat conservation and restoration*

As development moves into the arroyos and hillsides of the watershed, more people are living closer to valuable habitat. Unfortunately, not enough emphasis has been placed on developing a land ethic across the watershed, even among those residents who live directly adjacent to some of the watershed's richest habitats. There is a great deal of potential to improve the connection between people and local habitats. For instance, along the northeastern slope of the Santa Ana Mountains, stewardship groups could be formed among residents to care for the habitat and wildlife in the local canyons and forest water courses.

Some of the watershed's high quality, water-oriented habitats are near disadvantaged communities, where little attention has been paid to stewardship of the local resources. Developing local "ownership" of these habitats could benefit both the habitat and the community.
Potential Approaches:

- Develop a social marketing campaign, including opinion surveys to determine how to best enhance the people/habitat connection
- Develop community "ownership" of local water courses and wetlands by forming wetland societies or stewardship/"friend" groups
- Create educational centers near water-oriented habitat areas
- Provide educational tours of both local and regional water-oriented habitat areas
- Sponsor conferences that include outdoor seminars
- Produce/distribute wildlife habitat maps and make them available on-location and on the Internet
- Increase citizen science opportunities/involvement
- Increase access to high-quality habitat
- Provide field trips to elementary and high school students to increase watershed awareness

### *Sediment restored downstream of dams*

Sediment buildup behind Prado Dam is a problem for this Army Corps flood control and water retention facility because its capacity to store water is being continuously degraded by upstream sediment that has nowhere to go once it reaches the dam.

Water that is discharged from Prado Dam picks up existing sand and sediment below the dam and transports the material to the coast. Because Prado Dam is cutting off the replacement source of sediment, the River below Prado Dam is "sand starved." The lack of replenishment sand to the lower Santa Ana River will have significant negative impacts to groundwater recharge efforts in Orange County. Because sands are unable to get past Prado Dam, areas of the River below Prado Dam have started to armor. Riverbed armoring occurs when replenish sediments are restricted allowing the particle size distribution to change and the remaining sediment to become more densely packed, resulting in reduced permeability. This process severely impedes the recharge capacity of the river. The decreased flow of sediments downstream of Prado Dam also has affected natural habitats and decreased replenishment of beach sands. Multiple studies and field surveys have been performed to quantify the degradation of the Santa Ana River Channel below Prado Dam.

OCWD has proposed its "Prado Basin Sediment Management Demonstration Project." The purpose of this project is to demonstrate the feasibility of taking on a long-term sediment management plan for the basin. The Corps is also currently engaged in development in a feasibility study for ecosystem restoration throughout the Prado Basin.

### *Creating MSHCPs and RCDs in areas that are currently not covered*

There are several areas of the watershed where special conservation districts and formal habitat conservation plans do not exist that could benefit from their establishment.

A regional multi-species habitat conservation plan is needed for the more populated areas of San Bernardino County. There have been several efforts in specific places, but there is no MSHCP covering the quickly growing southwestern San Bernardino County region. Western Orange County also has not been covered by an MSHCP.

In addition to the positive effects of habitat conservation plans, resource conservation districts (RCDs) provide valuable services that preserve and restore habitat, and help landowners protect and enhance habitat on their properties. There currently is no Resource Conservation District in Orange County. Other resource conservation districts (including Inland Empire RCD, in conjunction with SAWA) in the watershed have conducted habitat restoration work in Orange County, but this requires special permission from the Local Agency Formation Commission (LAFCO) to allow them to work outside of their district boundaries. Orange County has a unique mix of habitat that includes forest, chaparral, riparian, coastal sage scrub, marsh and open ocean, and could benefit greatly from the formation of an RCD to serve the area.

## Project Proposals

Two of the most immediate needs in the Santa Ana River watershed in natural resources preservation and protection are Arundo removal and wildlife connections. **Table 5.9-3** shows two concepts from the Natural Resources Stewardship Pillar Implementation Concept Projects table.

**Table 5.9-3 Natural Resources Stewardship Pillar Implementation Concept Project**

| Project Title | | Project Concept |
|---|---|---|
| NR2 | Establish sustainable wildlife corridors and expansion of restored areas | Creating sustainable wildlife corridors will require land use planning coordinated across jurisdictional boundaries. Cooperation also must take place among all of the current regional conservation plans, mitigation providers, resource conservation districts and non-profit conservation organizations. |
| NR4 | Project that provides invasive species eradication and maintenance funding | All of these sources and more should continue to support restoration and ongoing maintenance. Access to such funding should be expanded to benefit the watershed. New, innovative partnerships should be developed to direct funding to habitat issues. |

These two projects would occur along the mainstem of the Santa Ana River, but would have far-reaching positive effects for habitat restoration, recreation, wildlife movement, disadvantaged communities and water retention.

### *NR2—Project to Create Sustainable Wildlife Linkages and Expand Restored Areas*

There are several areas in the Santa Ana River Watershed that have been identified by regulatory agencies and conservation groups as vital linkages that need to be preserved for movement of wildlife and species diversity. Most of these areas preserve a link among natural habitats from the San Diego County Mountains and deserts, through southwestern Riverside County, through the Santa Ana Mountains and Cleveland National Forest, and then n across the Santa Ana Canyon through to Chino Hills State Park and the Prado Basin, and the rest of the Santa Ana River upstream. Of course the linkages work in the other direction as well.

Significant chokepoints in these wildlife movement linkages are created in the watershed by roadways, especially Interstate 15 in the Temecula area, the 241 Toll Road in Orange County, and the 91 Freeway in the Santa Ana Canyon adjacent to the river.

The biggest challenge to such a project is providing a large enough crossing with the right characteristics to encourage crossings by everything from the smallest insects to the largest mammals. In a study published in *Biological Conservation* titled, "Use of highway undercrossings by wildlife in Southern California," the authors wrote the following regarding wildlife crossings: "Our results show that while many native animals used passages beneath highways, the presence of suitable habitat on either side of the passage was a particularly important factor for predicting use." The study also found that size of the passage was important especially with large carnivores and deer. The study authors recommended the following: "To increase the likelihood of utilization and to help prevent animals from crossing road surfaces, we suggest that simple improvements, such as habitat restoration near crossing points and animal-proof fencing that serves to funnel wildlife to passages, can facilitate animal movement between fragmented habitats that are bisected by roads." (Ng, et al 2003)

The 91 Freeway in the Santa Ana Canyon provides a significant barrier to wildlife movement, especially large mammals, including carnivores such as bobcats, coyotes and mountain lions. At B Canyon in Riverside County adjacent to the upstream edge of the Green Valley Golf Club, the freeway creates a barrier between two of the Riverside County MSCHP's major habitat areas—Existing Core A (Prado Basin/Santa Ana River) and Existing Core B (Cleveland National Forest). In the Plan, this is known as Constrained Linkage 1. The Plan recommends creating an adequate wildlife underpass or overpass at this location. Plans have been submitted by the Riverside County Transportation Commission to enlarge a culvert under the freeway to improve movement of wildlife. However, further measures are needed to improve this linkage for the future.

In the Santa Ana Canyon outside of the MSHCP area, the 91 Freeway also constrains the linkage between the Cleveland National Forest and Chino Hills State Park, most notably at Coal Canyon. The corridor under the freeway was never vegetated and mountain lions are no longer using it, although historical use of this linkage is well documented. Currently, there is a considerable amount of construction taking place in this area, which also is hampering animal movement

Suggested solutions include re-vegetating the Coal Canyon ramp undercrossing and improving oak-riparian structure coming down the drainage that leads to the large culvert there to enhance the likelihood that certain wildlife, including mountain lions, would even approach the crossing. Other solutions include keeping the culvert clear of heavy sediment but with a sandy or dirt floor, cutting light and noise impacts at the crossing with sound walls or other measures, moving Caltrans and other equipment and construction-related activities to other locations, and improving some of the fencing around this area.

We recommend a project that would begin with a study of the current mitigation and construction measures taking place in these areas, determine what is lacking in planning and funding, and then

develop a plan to create crossings that meet criteria for successful crossing sites. Implementation would include crossing construction, funnel fencing construction, initial and ongoing habitat restoration, mitigation of lighting and noise effects, and landscaping and monitoring. Partners could include the Western Riverside Regional Conservation Authority, the Army Corps of Engineers, Caltrans, Riverside County Transportation Commission, Santa Ana Watershed Association, Riverside-Corona Resource Conservation District, and the counties of Orange and Riverside.

### *NR4—Project to Eradicate Invasive Species and Provide Native Habitat*

As noted earlier, Arundo has been nearly completely eradicated in the upper Santa Ana River watershed upstream from Riverside, and the San Bernardino National Forest also has projects focused on Arundo removal. There are also several ongoing invasive-removal and maintenance operations in Norco, Eastvale, and in the Prado Basin. These downstream projects are in constant danger of re-infestation because of scattered, large Arundo infestations on the Riverside area of the mainstem in the area between the Mission Bridge and the Goose Creek Golf Course.

Within this stretch of the mainstem, there are significant "gaps" where Arundo is present and presents a threat of re-infesting downstream areas that have been cleared by the Army Corps, SAWA, the resource conservation districts and OCWD. However, the area also contains several large eradication and restoration projects managed by the Santa Ana Watershed Association and Riverside County Parks and Open Space District totaling nearly 1,500 acres. In the middle of this stretch of the river is Hidden Valley Wildlife Area, where SAWA has been eradicating approximately 775 acres of invasive plants over an approximately 1,000-acre project area since 2008 with Proposition 50 funding. In 2013, active planting and restoration has occurred on some of the more bare areas of the project. In 2014, the Proposition 50 grant will expire and other funding will be needed to keep this area under control and in active restoration. Riverside County Parks also is working to remove Arundo on its own property.

Funding for removal and restoration of these "Arundo gaps" in the Riverside area of the Santa Ana River mainstem will result in a more systematic removal of Arundo from the watershed, and remediate some of the problems mentioned earlier in this chapter of spotty conservation areas and fragmented management of natural resources. Removing these large areas of Arundo also returns a significant amount of water to the river every year because of the plant's rapid growth and heavy water use compared to native vegetation. The removal of Arundo and restoration of native habitat also provide benefits to sensitive species including the least Bell's vireo, the southwestern willow flycatcher, and the Santa Ana sucker.

Potential partners in this project could include Riverside County Flood Control and Water Conservation District, Riverside County Parks and Open Space District, California Department of Fish and Wildlife, the Inland Empire Resource Conservation District, Riverside-Corona Resource Conservation District, the City of Riverside, and the City of Jurupa Valley.

## Summary

One of the greatest questions for the future of habitat restoration in the Santa Ana River Watershed is future hydrology. As conservation and reclamation efforts grow within water and sanitation districts

and the Regional Water Quality Control Board seeks to eliminate urban runoff, areas that currently experience year-round flows may become dry. This will have an adverse effect on native vegetation and native fishes, birds and other wildlife. In addition, the effects of climate change on watershed hydrology are uncertain. In the face of these challenges, maintaining current flows or restoring natural stream flows may be problematic and expensive.

There are many opportunities for improving habitat in the Santa Ana Watershed, and there are numerous benefits for wildlife and people. However, the current fragmented management of habitat is one of the greatest barriers to success. Restoring and maintaining valuable habitat throughout the watershed will require a "big tent" approach that involves all of the stakeholders in the watershed. One Water, One Watershed is an example of the kind of effort that is needed to bring all of the elements and organizations together.

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# 5.10 Operational Efficiency and Water Transfer



## Introduction

The water management in California has always been a critical element for the State's economic growth over the last two decades. California Department of Water Resources (DWR) has worked extensively on the concept of Integrated Regional Water Management (IRWM) planning to encourage the development of comprehensive water resources management plans throughout the state. Using water efficiently, improving water quality and reliability, and integrating environmental stewardship are not new concepts to the regional water agencies within the Santa Ana River (SAR) Watershed and the Santa Ana Watershed Project Authority (SAWPA). Within the SAR Watershed there are over 100 large and small water districts: local, regional, state and federal agencies, and public/private stakeholders. These agencies have developed strategies such as water use efficiency, water recycling, groundwater storage and conjunctive use, urban runoff management, and water budget based rate billing structures to enhance their comprehensive water resources management plans. Through One Water One Watershed (OWOW) planning process, the Operational Efficiency and Water Transfers Pillar worked together to discuss the integrated regional projects that could be implemented for the future.

The purpose of this report is to explore the strategies that have already been defined within the SAR watershed, and ascertain potential region-wide operational efficiency and water transfer concepts that can be developed by cooperative strategic planning effort among different agencies. Such concepts can benefit from integration of different resources, facilities, and capabilities that currently exist to achieve a higher operational efficiency within the SAR Watershed. The goal of the report is to provide operational efficiency and water transfer concepts that can be developed utilizing elements within

different water resources plans prepared by various agencies and others in support of the OWOW program. To achieve this goal, the report provides an overview of water resources conditions at the State and regional level and offers assessment matrixes based on different strategic documents prepared by stakeholders within different geographical regions of the SAR Watershed. In addition, the report provides preliminary water transfer concepts, and potential implementation procedures that can be used to enhance the water resources reliability and operational efficiency within the SAR Watershed.

The report provides a common foundation that frames the potential imbalances that may be faced in the future and potential concepts that may be considered to resolve those imbalances.

## Water Resources Management Activities at the State Level

This section reviews major planning activities and goals that are being implemented and/or considered at the state level. These goals play an important role in the objectives set by the regional and local water resources leaders in the SAR Watershed area.

### California Water Plan

The California Water Plan (CWP) has always been a valuable source of information for water planners since 1957. In the early years, these plans were primarily produced by DWR. However, for the 2009 CWP Update the DWR formed an interagency steering committee representing over 20 agencies and a 45-member advisory committee to better integrate regional water management activities into the State water and flood management planning.

By law, the CWP documents are required to be published every five years. The purpose of the CWP is to provide regional, local, tribal, state, and federal governments and organizations a strategic planning forum to collaboratively identify short-term and long-term actions that would help sustain California's water resources, and to prepare response plans for catastrophic events that would threaten the livelihood of the people of California.

These reports have evolved from statistical summaries of water supply and demand to expert analyses of complex hydrology, water use, conservation, and emerging trends issues in water resource management, flood safety and climate change adaptation. The CWP provides strategic recommendations to guide future state investments and the direction of resource management policies.

The 2009 Water Plan Update implementation plan identifies 13 objectives that could provide more sustainable water and flood systems given the changing climate and other uncertainties and risks throughout the state. Some of these objectives such as setting co-equal goals for the ecosystem and reliable water supply by managing a sustainable California Delta are site specific, but many of the objectives mentioned requiring regional implementation for their success. The following implementation objectives mentioned by the CWP are also considered by several regional agencies within the SAR watershed as part of their strategy for a more adaptive and resilient water resources management system.

- Integrated Regional Water Management – improve and expand IRWM to create and build on partnerships that are essential for sustainable watershed management, and would increase regional self-sufficiency
- Use Water More Efficiently – use greater water conservation, recycling, and reuse to help meet future water demands and adapt to climate change
- Expand Conjunctive Management of Multiple Supplies –use existing and new surface and import water with groundwater storage to prepare for droughts, and climate change
- Protect Surface Water and Groundwater Quality – protect and restore water quality for public health and beneficial use of state's water supplies
- Reduce Energy Consumption of Water Systems and Uses – reduce the energy consumption of water and wastewater systems by implementing water related strategies

The 2009 CP Update was published in March 2009 right before passage of a historic water legislation package by the California State Legislature in November of 2009. The SAWPA member agencies strategies focusing on the above mentioned objectives are reviewed in Section 4 of this report.

## Climate Change

In December 2009, the U.S. Environmental Protection Agency (EPA) issued findings that greenhouse gas (GHG) emissions is a threat to public health. As a result, responding to climate change remains a priority in both Houses and Senate; and increases the likelihood of federal regulatory action. Legislative and regulatory actions will exacerbate the existing water management challenges confronting regional agencies in the watershed. Possible consequences of climate change include:

- More frequent drought periods
- Changes in runoff patterns from the Sierra Nevada
- Increased flooding intensity, as well as impacts to the operations of the State's surface water storage facilities

Higher temperatures in the Sierras will result in earlier and more rapid runoff of snowmelt and less storage ability. The DWR is projecting that the California snowpack will decline by 25 to 40 percent by 2050 and significantly reduce the amount of water that is stored for use during the summer and fall. Decreased energy production through hydropower is also a concern. In addition, population growth will result in an increased demand for water in California. Inadequate storage and increased growth will significantly impact water supply reliability within the State, and the Santa Ana River Watershed.

Regional temperature increases and precipitation variability would likely reduce flows in local streams which would reduce groundwater recharge and impact sources of water supply; increase storm intensity and flooding; increase erosion and related water quality problems; and impact on wildlife habitat. Furthermore, the implications of global sea level rise would increase sea-water intrusion into groundwater supplies and infrastructure damage in the coastal communities. In general, the watershed

should plan for reduced water supply availability, higher costs for water, and lower environmental quality.

While climate change projections at regional scale are undergoing constant refinement, the science, the causes, and extent of climate change will continue to be debated, water agencies within the watershed must position themselves to protect and promote their constituents' interests. SAWPA highlighted the water supply reliability challenges by state droughts, droughts on the Colorado River, and the threat of climate change in its OWOW planning process and helped the regional agencies to work together to address these challenges.

## Bay-Delta Conservation Plan

The Bay-Delta Conservation Plan (BDCP) is being prepared through a collaboration of state, federal, and local water agencies, environmental organizations, and other interested parties. These organizations have formed the BDCP Steering Committee. The BDCP will identify a set of water flow reliability and habitat restoration actions that could contribute to the recovery of endangered and sensitive species and their habitats. The goal of the BDCP is to provide for the Sacramento-San Joaquin River Bay-Delta (Delta) species/habitat protection and to improve reliability of water supplies.

As the BDCP evaluates habitat, physical and operational alternatives necessary to restore the Delta ecosystem while providing water supply reliability, state and federal agencies are developing a joint Environmental Impact Report/Statement (EIR/EIS) under the Delta Habitat Conservation and Conveyance Program (DHCCP). The EIR/EIS will determine the potential environmental impacts of the proposed BDCP.

Lead agencies for the EIR/EIS are the California Department of Water Resources, the Bureau of Reclamation, the U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration's National Marine Fisheries Service, in cooperation with the California Department of Fish and Game, the EPA and the U.S. Army Corps of Engineers (ACoE).

The BDCP is being developed in compliance with the Federal Endangered Species Act (ESA) and the California Natural Communities Conservation Planning Act (NCCPA). When completed, the BDCP would provide the basis for the issuance of endangered species permits for the operation of the state and federal water projects. The BDCP would be implemented over the next 50 years.

The OWOW planning effort highlighted the vulnerability of the Delta and helped the regional agencies to address some of the challenges related to this threat.

## Urban Water Management Planning

The State of California requires urban water suppliers that either provide over 3,000 acre-feet of water annually or have more than 3,000 connections to prepare Urban Water Management Plans (UWMP) in support of their long-term resource planning. The UWMP identifies different water supply sources that are available to meet existing and future water demands over a 20-year planning horizon considering

normal, dry, and multiple dry years. The UWMPs are prepared every 5 years and submitted to DWR to make sure the plans meet the requirements identified in the Urban Water Management Planning Act (Division 6 Part 2.6 of the Water Code §10610 - 10656). The Act requires the urban water supply agencies to describe their Demand Management Measures (DMM) in their UWMPs. These DMMs are the same as the California Urban Water Conservation Council (CUWCC) Best Management Practices (described in Section 2.5).

The requirement that all urban retail water suppliers quantify per capita baseline water use, set water use targets, and then show actual reductions in 2015 and 2020 has caused suppliers throughout the watershed to pay particularly close attention to the effectiveness of their water conservation programs.

The water suppliers within the Santa Ana River Watershed prepare UWMPs in support of long-term resource planning in their respective geographic area. Also, as part of the OWOW process, SAWPA took the initiative to highlight the challenges of population growth in the watershed and how this growth can be sustained based on the UWMPs prepared by the water suppliers in the region.

## Water Use Efficiency

The CCUWCC was created to increase efficient water use throughout the state by forming partnerships among urban water agencies, public interest organizations, and private industry. Some 400 water agencies and environmental groups have signed a Memorandum of Understanding (MOU) voluntarily pledging to implement a series of Best Management Practices (BMP) within a reasonable time frame. Water agencies that became signatories to the CUWCC MOU pledge to implement the BMPs to specified levels and to report progress on their BMP implementation biannually to the CUWCC.

In order to be eligible for grant or loan funding from the State of California, an urban water supplier, whether a signatory to the CUWCC MOU or not, must demonstrate that it's efforts in implementing each DMM or BMP will be implemented at the coverage level determined by the CUWCC MOU.

Only the BMPs that are cost-effective for the water supplier need to be implemented; and successful implementation of all BMPs and credit for actively participating in the CUWCC process need not be a "complete" implementation of all BMPs.

The CUWCC maintains a self-reporting database on the status of BMP implementation by MOU participants. This information includes results of each BMP, the money invested in each BMP, and the estimated water savings for each of those measures by each participant.

The Water Conservation Act of 2009 (Senate Bill Number 7 of the 7th Extraordinary session - SBX 7-7) was enacted by the California legislature in November 2009. This Act sets an overall goal of reducing per capita urban water use statewide by 20 percent by December 31, 2020 and requires the urban water suppliers to report the 20 percent by 2020 water use reduction goals in their UWMPs. The UWMP documents were one of the most pertinent documents reviewed and used to develop the matrix in Section 5.

The SBX 7-7 legislation also directed DWR to address the following urban water use efficiency issues:

- Convene a task force to investigate alternative best management practices for the commercial, industrial and institutional sectors
- Establish a standardized water use reporting form
- Promote regional water resource management through increased incentives and decreased barriers
- Develop statewide targets for regional water management practices like recycled water, brackish groundwater, desalination and urban stormwater infiltration and direct use

Increasing the supply of water has the same effect on water availability as decreasing the demand for water (through increased efficiency). However, engineered methods for increasing supply, such as building new dams for surface storage, or increasing water exports from the Delta, are becoming less certain as California moves into the future. Many water suppliers are turning to other strategies, such as improving efficiency, to meet increasing demand. As the costs for engineered water supply options go up, even the most expensive conservation strategies are becoming economically viable.

The 2020 state population is expected to be in the range of 44 million people and a decrease in per capita water use of 20 percent will equate to an annual demand reduction of 2 million acre-feet of water.

Many of the water suppliers within the Santa Ana River Watershed are signatories to the CUWCC MOU and evaluate their BMPs when developing their water resources strategies. Need for a collaborative approach amongst the watershed stakeholders to help meet long term goals of water use efficiency is part of the OWOW process.

## Regional Water Resources Management Activities

This section reviews major operational efficiencies and water transfer activities in support of the state goals that are being implemented and/or considered at the regional level by Metropolitan Water District of Southern California (MWD), and SAWPA. These integrated activities play an important role in the objectives set by SAWPA member agencies in their respective region, and local water resources leaders in their respective regions/areas.

### MWD Integrated Resources Plan

The MWD Integrated Resources Plan (IRP) is the long-term water resources strategy for MWD's six-county service area. The MWD IRP is the blueprint that guides MWD's efforts to increase water supplies and lower demands through 2035. MWD's first IRP was developed in 1996 and updated in 2004.

The MWD's 2009 IRP was prepared as part of MWD's normal five-year planning cycle. The major update on this IRP is addressing changing water supply conditions and the unprecedented series of challenges and uncertainties facing the Southern California region. These uncertainties include Delta and Colorado River water supply restrictions, climate change, continued population growth, emerging water quality

issues and rising energy costs. These challenges require new approaches by MWD, its member agencies, and other regional stakeholders.

MWD member agencies, including the regional stakeholders in the SAR Watershed actively participated in the preparation of the 2009 IRP through Regional Workshops, Technical Oversight Committee and Technical Workgroups. The MWD IRP provided recommendations with respect to six resource areas: groundwater, recycled water, conservation, stormwater/urban runoff, graywater and seawater desalination.

## MWD Water Supply Allocation Plan

In 2007, MWD was concerned about many water supply challenges in its service area as a result of:

- Critically dry conditions in the State Water Project (SWP) systems
- A ruling in the Federal Courts in August 2007 provided protective measures for the Delta Smelt in the Sacramento-San Joaquin River Delta

These challenges brought uncertainty about future pumping operations from the SWP and raised the possibility that MWD would not have access to the supplies necessary to meet total demands in Southern California, and would have to allocate shortages in supplies to its member agencies. It is important to note that MWD's SWP supply contract with DWR prohibits importing SWP water into MWD's service area without MWD's consent; therefore, transfers of SWP water originating outside of MWD's service area are subject to approval and agreement with MWD.

In preparing for any potential shortages, MWD developed a Water Supply Allocation Plan (WSAP). The WSAP calculates each of the MWD's member agency supply allocations and identifies the key implementation elements needed for administering an allocation should a shortage occur. The WSAP is used by the MWD's member agencies for the urban water shortage contingency analysis that is required under Water Code Section 10632 and is incorporated into MWD's Regional Urban Water Management Plan (RUWMP).

In February of 2009 Governor Schwarzenegger proclaimed a statewide water shortage emergency when California was in its third consecutive year of drought. At the time, the SWP Table A allocation was at 20 percent and the MWD Board saw it appropriate to implement the WSAP and allocated water to its member agencies effective July 1, 2009. Because of the supply impacts from the recent drought conditions and Bay-Delta operational constraints, deliveries of the discounted water at the replenishment rate were suspended in 2007. MWD is currently working with its member agencies on potential long-term revisions of the Replenishment Water Program. The biggest issue causing MWD's rate increases is the loss of sales. Water sales are at record low as a result of many factors, including unemployment, foreclosures, extraordinary conservation, and the response to water rate increases. MWD water sales are at 1.73 MAF, compared to the usual sale of 2.3 MAF. Since 2007, MWD Tier 1 and Tier 2 rates have increased 69 percent and 86 percent, respectively. The Tier 2 water rate in 2013 is $997/AF.

The proclamation of the water shortage emergency by the Governor, the WSAP, discontinuation of the replenishment water program, and increased MWD water rates, were catalysts for the regional agencies within the SAR Watershed to take a closer look at their water supply reliability.

## Planning Work Group Effort within the Santa Ana Watershed

Since the early 1970's, SAWPA has played a key role in the development and update of the Basin Plan for the SAR Watershed. Several task forces have been formed to address complex technical and regulatory issues and resolve inter-Agency conflicts. These task forces generally include staff of the Santa Ana Regional Water Quality Control Board (RWQCB) as active members or advisors and other stakeholders.

SAWPA's Nitrogen/Total Dissolved Solids Task Force, which met between 1996 and 2003,included some 22 water supply and wastewater management agencies and RWQCB. SAWPA has led different Task Force activities and has completed multi-million dollar studies to review groundwater quality, groundwater sub-basin boundaries, waste load allocations, and other related studies within the SAR Watershed. Different Task Force efforts usually include development of more scientifically defensible data and acceptable projects for a sustainable Watershed.

SAWPA's Basin Monitoring Program Task Force (BMPTF) is another effort tasked with executing some of the monitoring and reporting commitments within the Watershed, such as a triennial compilation of ambient groundwater quality data and an annual report of Santa Ana River water quality. The BMPTF also updates the Santa Ana River Wasteload Allocation model used to evaluate different discharge scenarios and the impacts of the Santa Ana River flows on the Orange County groundwater.

Another SAWPA work group is the Emerging Constituents (EC) Task Force. In 2007, a workgroup of water agencies and Publicly Owned Treatment Works (POTWs) was formed to develop a characterization program for emerging constituents. In the early years of its formation, the work group evaluated water quality monitoring programs, regulatory issues, stakeholder concerns, analytical methods, and potential public health and environmental impacts. Later, the workgroup developed an EC Investigative Work Plan based on ongoing characterization studies and other related evaluations. This Work Plan was submitted to and approved by the RWQCB in December 2009 (Resolution No. R8-2009-0071). Thereafter, the workgroup was formalized as a task force of multiple agencies under a task force agreement and renamed the EC Program Task Force.

The Work Plan originally had identified nine ECs, increasing to 13 ECs in 2012 to be sampled, and required each participating POTW agency to sample and pay for its own analyses of these constituents. In 2013, the list was reduced to just the ECs mandated by the SWRCB Water Recycled Water Policy and transitioned to a triennial sampling program.

## Integrated Watershed Programming in the Santa Ana Watershed

Since its formation in 1968, SAWPA has been a leader in water resource planning for the SAR Watershed. SAWPA coordinated development of the first Santa Ana Integrated Watershed Program (IWP) document in 2002. This planning document identified seven major elements for a sustainable Watershed:

- Drought-proofing of the watershed by storing up to 1.3 million acre-feet (MAF) of new water
- Mitigating water quality impacts from the past activities
- Use water recycling as a major supply to reduce the area's overall need for imported water
- Develop flood protection along the main stem of the Santa Ana River
- Enhance wetlands and habitat to restore the Pacific Flyway
- Bring additional recreational opportunities and increase public awareness of the environmental needs
- Protect the long-term beneficial uses of the groundwater basins by using the Inland Empire Brine Line (IEBL) to carry saline wastes to the ocean

SAWPA has pursued the above elements based on the needs of its member agencies and other stakeholders within the watershed. The success of the SAWPA's planning efforts have provided the watershed with $389 million of different grant funding, including $250 million of Proposition 13, $25 million of Proposition 50, and $114 million of Proposition 84 grant funding. In 2005, SAWPA updated the IWP to include a summary of the many planning processes underway and priority projects of the stakeholders within the watershed. In early 2009, SAWPA completed a new integrated water management plan for the region known as OWOW. The vision of the OWOW Plan is a sustainable drought proofed and salt-balanced watershed with economic and environmental viability.

As part of OWOW process, SAWPA placed emphasis on building a collaborative approach amongst stakeholders to help meet long-term goals and objectives of the watershed in an integrated and multi-beneficial manner. Hence, the OWOW process includes a ten-member Steering Committee representing different interests throughout the Watershed. The Committee includes two representatives from the SAWPA Commission; three County Supervisors (one from each county); three mayors (one from each county); a business representative from the development community, and a representative from the environmental community. The Steering Committee developed the following working goals and objectives:

- Provide Reliable Water Supply
- Preserve and Enhance the Environment
- Promote Sustainable Water Solutions
- Ensure High Quality Water
- Provide Economically Effective Solutions
- Improve Regional Integration and Coordination
- Use Rainfall as a Resource
- Provide Recreational Opportunities

- Maintain Quality of Life

During the OWOW process, it was recognized that additional projects implemented as a result of different grant funding has closed the gap between supply and demand and increasing emphasis should be placed on water use efficiency and development of local supplies.

With as much as 60 percent of household water consumption going toward outdoor usage, there is a growing need to provide effective programs targeting outdoor landscaping.

While water recycling is an important local supply for the watershed's sustainable future, challenges related to recycled water projects are varied and range from regulatory issues, ability to handle storage/seasonal variability, water quality impacts, salinity management to public acceptance, perception, and other policy issues.

The OWOW planning process has created greater partnerships, funding opportunities, connectivity, and increased awareness of planning projects in all the communities within the watershed. A collaborative process that results in multifunction, multi-benefit projects will ultimately reduce the cost to the taxpayer and increase the efficiency of local agencies. The idea of meeting a number of community needs with a single project is not new; however, specialization within regional agencies has often moved these project types to the backburner. Hence, efforts primarily have focused on a single purpose projects, and efforts required to develop multi-objective solutions have made true multi-benefit projects relatively uncommon.

SAWPA recognizes that the OWOW process is not complete. All solid plans require constant refinement, and the OWOW Plan is no different.

## Water Resources Management Activities within the Santa Ana Watershed Regions

This section reviews major planning activities being implemented and/or considered within the SAR Watershed. These planning activities were evaluated as part of the OWOW process and did set the basis for the integrated resources planning objectives set by the OWOW Steering Committee. The water resources management activities are evaluated within five geographic areas of the SAR Watershed, starting from Big Bear Lake to the Pacific Ocean. The watershed is divided into five geographical areas. These management activities, concepts, and concerns are based on a summary of existing conditions as observed by the SAWPA member agencies.

### Management Activities in the Upper Santa Ana River Portion of the Watershed

The main regional agency in this area is San Bernardino Valley Municipal Water District (SBVMWD) covers about 353 square miles of southwestern San Bernardino County. The projected demand in the Upper SAR region is expected to increase by about 50 percent from 349,200 AF in 2005 to 519,700 AF in 2030 (2007 Upper Santa Ana River Watershed Integrated Regional Management Plan).

SBVMWD is the fifth largest of the 29 water contractors in the state with an annual maximum Table A entitlement of 102,600 AFY. SBVMWD imports SWP water into its service area and manages groundwater storage within the San Bernardino Valley area. Based on the Department of Water Resources State Water Project Delivery Reliability Report, the long-term average supply for SBVMWD by 2030 is estimated to be 60 percent of their Table A allocation unless the pumping restrictions in the Delta are lifted. To optimize its imported water supply, SBVMWD is attempting to increase the amount of water it imports during wet years for direct delivery and artificial recharge. This stored wet year water can then be pumped during the dry years.

SBVMWD is developing a storage program to help meet direct delivery demands during SWP shortages. The current storage program includes the DWR Carryover Storage Program, the Yuba Accord, the DWR Dry Year Water Transfer Program, storage in the Kern-Delta water bank, and storage in Big Bear Lake.

Development and reuse of recycled water is at its infancy in this region and is projected to increase steadily over the next two decades (2010 Regional UWMP - SBVMWD).

The Cities of San Bernardino and Colton joined together and developed the 41 MGD Rapid Infiltration/Extraction (RIX) process to treat un-chlorinated secondary effluent prior to ultraviolet (UV) light disinfection for tertiary treatment and discharge to SAR. Currently, RIX discharges all of its product water (approximately 33 MGD) to the SAR. RIX is obligated to provide 16,000 AFY for downstream purposes to meet the 15,250 AFY SAR "base flow" obligations. However, there is local interest to use RIX discharge for direct groundwater recharge and non-potable demands.

Yucaipa Valley Water District (YVWD) has an 8 MGD recycled water plant which has microfiltration filters and ultraviolet (UV) light for disinfection. YWVD Regional Water Recycling Facility discharges about 1,000 AFY of recycled water into the San Timoteo Creek. YVWD is considering construction of reverse osmosis membrane treatment at its Yucaipa Valley Regional Water Filtration Facility for the treatment of imported water supplies in compliance with the basin plan objectives set by the RWQCB. In order to dispose of the brine flow, YVWD constructed a 15-mile brineline to connect to the existing IEBL pipeline in San Bernardino. YVWD has adopted planning guidelines requiring the use of recycled water for front and rear yard irrigation of new development in its service area, and has developed a dual distribution system of potable and recycled water to convey recycled water (2010 Regional UWMP - SBVMWD).

The City of Redlands supplies recycled water to Southern California Edison’s Mountain View Power Plant for its cooling water. City of Redlands expects to produce 8,015 AFY of recycled water by 2030 and is evaluating the potential of providing recycled water to the City of Loma Linda (2010 Regional UWMP - SBVMWD). Recycled water facilities are not currently available in the City of Colton's service area; construction of such facilities is cost prohibitive and the City has no plans to reuse recycled water in the area at this time (2010 Regional UWMP - SBVMWD). The City of Rialto is updating its Recycled Water Master Plan and is investigating the expansion of its existing tertiary treatment plant and reclaimed water system as a way to supplement the City's water supply. Beaumont-Cherry Valley Water District is upgrading its Waste Water Treatment Plant from 2 MGD to 4 MGD. The District is currently discharging

this water to Cooper Creek, but is planning to use a portion of its recycled water in the future. Fontana Water Company and City of Fontana are planning the construction of a facility that will produce 5,000 AFY of recycled water for distribution; while Big Bear Valley Recycled Water Master Plan emphasizes on groundwater recharge (2007 Upper Santa Ana River Watershed Integrated Regional Management Plan).

Approximately 60 percent of this region's supply is from groundwater, 70 percent of which is from the San Bernardino Basin Area (SBBA). The SBBA was adjudicated by the 1969 Judgment. This Judgment established a natural safe yield of 232,100 AFY; SBVMWD agencies are allowed 167,238 AFY and Riverside County agencies receive 64,862 AFY of the safe yield (2010 Regional UWMP - SBVMWD).

SBVMWD and WMWD share a long history of working together on water supply issues; both agencies are members of the Watermaster Committee for the OC Judgment and they are the two-member Watermaster Committee for the 1969 Judgment.

Liquefaction in the Pressure Zone remains a major threat. The City of San Bernardino has a very high water table and experiences high pressure; at times wells have become artesian and damaged property in the area. An agreement among groundwater producers in the Pressure Zone to maximize production from this area during high groundwater level conditions is desirable. Additional facilities may be required to produce and convey large quantities of groundwater from the Pressure Zone for use outside of this area (2007 Upper Santa Ana River Watershed Integrated Regional Management Plan).

SBVMWD and San Bernardino Valley Water Conservation District (SBVWCD) are primarily the agencies in charge of groundwater recharge. Conjunctive use projects may be feasible with construction of additional recharge basins, wells, pipeline facilities; so long as the projects comply with terms and conditions of the 1969 Judgments, and various decrees and agreements (2010 Regional UWMP - SBVMWD).

Bunker Hill groundwater basin is estimated to have 6 million AF of storage capacity; with a recharge efficiency rate of 95 percent (2007 Upper Santa Ana River Watershed Integrated Regional Management Plan).

In 2010, SBVMWD and Western Municipal Water District (WMWD) received two permits from the State Water Resources Control Board (SWRCB) to divert Santa Ana River water downstream from Seven Oaks Dam. The yield from these two permits is estimated to be up to 200,000 AF in wet years, with an average annual yield of 10,800-27,000 AF. Additional infrastructure for capturing and utilizing this local stormwater is required. SBVMWD has completed CEQA and 60 percent design for the first phase of these facilities.

The City of Redlands has surface water rights to approximately 15,000 AFY from the Mill Creek and SAR. The current use of this water by the City is limited to its treatment capacity. Fontana Water Company as an agent for Fontana Union Water Company diverts water from Lytle Creek. During normal years, West Valley Water District (WVWD) uses up to 5,500 AFY from Lytle Creek surface flows and projects using a minimum of 2,130 AFY during extended drought periods. East Valley Water District (EVWD) has water

rights for 4,500 AFY of SAR water, with the ability to expand to 7,300 AFY through the conversion of remaining agricultural properties and water shares of stock through the North Fork Mutual Water Company (2010 Regional UWMP - SBVMWD).

Nine agencies in the area have an "exchange agreement" that allows them to exchange SWP, SAR, and Mill Creek water through simultaneous and deferred exchanges for the benefit of each party (2010 Regional UWMP - SBVMWD).

The San Gorgonio Pass Water Agency (SGPWA) may have a shortage of about 17,500 AFY by 2030. During multi-year drought periods, this shortage could increase to 26,700 AFY. This shortfall can be overcome by reducing demands and/or purchasing additional water supplies (2007 Upper Santa Ana River Watershed Integrated Regional Management Plan).

The agencies in the San Bernardino County have difficulty achieving adequate local funding. A major constraint in implementing many of the projects in this region is lack of financial capacity and funding availability. Many of the local communities are economically disadvantaged and may not be able to finance costly projects.

The water agencies in this region are concerned about expansion of the critical habitat area for the Santa Ana Sucker fish, which could impact water allocation, water use, and recharge efforts along the SAR. In October 2012, several water agencies in this region lost a court battle when the federal district judge allowed for the expansion of the critical habitat of the Santa Ana Sucker in upstream areas of the SAR. The agencies are appealing this court decision.

## Management Activities Between Colton and Prado Dam

The main stem of the SAR extends between the cities of Colton and Corona. Temescal Creek also flows into the Prado dam in Corona. The main regional water agency in this area is Western Municipal Water District (WMWD) serves the western portion of Riverside County (**Figure 5.10-1**) including nine water purveyors in its jurisdiction 1) Box Springs Mutual Water Company, 2) City of Corona, 3) City of Norco, 4) City of Riverside, 5) Eagle Valley Mutual Water Company, 6) Elsinore Valley Municipal Water District, 7) Lee Lake Water District, 8) Rancho California Water District, and 9) Jurupa Community Services District.

WMWD receives treated imported water through MWD's Mills and Skinner Water Filtration Plants (WFPs); the untreated imported water is delivered through MWD's Lower Feeder. Demand for imported water within the WMWD area is expected to increase from 104,000 AFY in 2010 to 208,000 AFY by the year 2040 (2008 Updated IRWM Plan - WMWD).

Imported water from MWD accounts for 33 percent of total water demands in the WMWD area and is expected to comprise 35 percent of total water demand by 2030 (2008 Updated IRWM Plan - WMWD). WMWD recognizes the importance of a collaborative relationship with MWD and expects to receive 100 percent of its imported water needs from MWD. Even though WMWD is counting on the imported water from MWD, there are concerns over salinity, bromide, and organic carbon concentration levels of the imported water (2008 Updated IRWM Plan - WMWD).

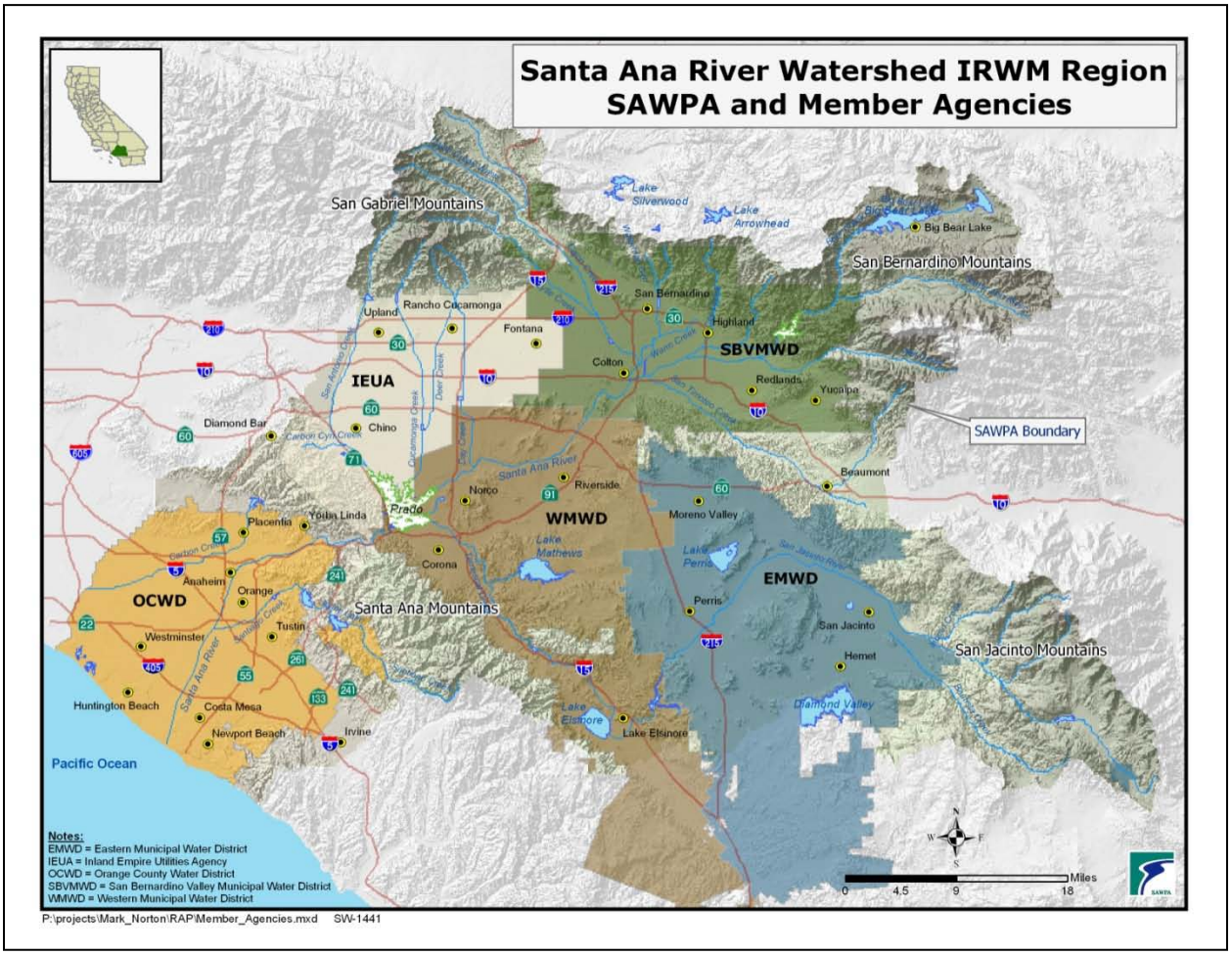
WMWD's Ordinance 377 requires customers to use recycled water where this resource is available and can be properly used (2010 UWMP Update - WMWD). Recycled water use in 2005 accounted for 9,100 AFY (3 percent of total water demands in 2005) within the WMWD area. The use of recycled water is expected to increase to 59,600 AFY by 2030, which represents about 12 percent of the total demands in 2030 (2008 Updated IRWM Plan - WMWD). WMWD is interested in expanding the current recycled water treatment capacities and reuse this resource for recharge into the groundwater basins (2010 UWMP Update - WMWD).

Groundwater continues to be the primary water supply source available to WMWD and agencies within its jurisdiction. The largest city in this region is the City of Riverside, which receives less than 5 percent of its supply from WMWD (2010 UWMP Update - WMWD), and its remaining supply from Bunker Hill, Riverside North, and Riverside South groundwater basins (2010 UWMP - City of Riverside). Groundwater is expected to meet 252,000 AFY of demands by 2025 which is approximately 54 percent of the 2025 total water supply (2008 Updated IRWM Plan - WMWD). WMWD is interested in expanding its groundwater production capacity in the vicinity of the March Air Reserve Base (2010 UWMP Update - WMWD). WMWD is a member of the Chino Desalter Authority, and this membership gives WMWD access to treated Chino Basin groundwater (2010 UWMP Update - WMWD). Future expansion and use of the groundwater resources may require additional treatment and/or desalination which are subject to availability of brine disposal facilities (2008 Updated IRWM Plan - WMWD).

In 2010, WMWD and SBVMWD received two permits from SWRCB to withdraw water from the SAR. These permits are issued based on the surface water that can be made available from the Seven Oaks Dam facilities (2010 UWMP Update - WMWD). WMWD is interested in storing excess stormwater runoff, SAR water, and SWP water in the San Bernardino Groundwater basin (2010 UWMP Update - WMWD).

WMWD has been proactive in developing its regional water shortage contingency plan and has a Water Conservation and Supply Shortage Program. WMWD has implemented a tiered-rate billing system and Staff is focused on reducing land use irrigation water consumption through the District's Water Use Efficiency Master Plan (2010 UWMP Update - WMWD).

**Figure 5.10-1 Different Geographical Regions within the Santa Ana River Watershed**




## Management Activities within the San Jacinto Watershed

San Jacinto Watershed extends from San Jacinto Mountains to Canyon Lake. The water from San Jacinto River flows into Canyon Lake and to Temescal Creek. The main regional agency serving the San Jacinto Watershed is Eastern Municipal Water District (EMWD). This region includes four water purveyors 1) Lake Hemet Municipal Water District, 2) City of Hemet, 3) City of San Jacinto, and 4) City of Perris. Population in the EMWD service area is expected to grow by 75 percent in the next 25 years (2011 IRP - EMWD).

EMWD receives treated imported water through MWD's Mills and Skinner WFPs; the untreated imported water is delivered though several MWD connections with EMWD. EMWD receives approximately 80 percent of its potable water supply from MWD (2011 IRP - EMWD). EMWD is concerned about its imported water supply because MWD's reliability buffer for retailers is predicated on finding a solution to the Delta issues within the next ten to fifteen years. Other imported water concerns include persistence of drought in the Colorado River system, and water quality issues such as salinity, uranium, perchlorate, chromium VI, nutrients, N-Nitrosodimethylamine, and pharmaceuticals in the water supply from the Colorado River Aqueduct. MWD is making significant investments to its

infrastructure to improve supply and system reliability, and EMWD is concerned about the cost increases to the MWD member agencies as a result of these improvements (2011 IRP - EMWD).

MWD is facing regional treatment capacity shortages in the future. In 2007, MWD in cooperation with EMWD and WMWD completed an Integrated Area Study (IAS) and identified the need for a new filtration plant in the area. In addition, Mills WFP conveyance capacity for delivery of treated water to EMWD is limited, which requires significant transmission infrastructure upgrades (2011 IRP - EMWD).

To address some of the imported water concerns, EMWD has expanded local treatment of untreated MWD water, and with the cooperation of three of its purveyors has developed a groundwater replenishment program to reduce reliance on treated MWD water in its area (2011 IRP - EMWD)/ (2010 UWMP - EMWD).

EMWD is responsible for all wastewater collection and treatment in its service area and treated 46,500 AF of water in 2010. All of the wastewater collected in the EMWD service area is treated to tertiary standards, and EMWD has an extensive recycled water system for the use of its recycled water. EMWD's recycled water system includes four Regional Water Reclamation Facilities (RWRF), several recycled water unlined surface storage ponds, above ground storage tanks, and a distribution system that connects all of its RWRF's. EMWD has a mandatory recycled water use ordinance, which requires new and existing customers to use recycled water for appropriate permitted uses when available (2010 UWMP - EMWD).

EMWD reuses all of its produced recycled water during peak demand months (June-September). The demand during these months is higher than the recycled water that is produced, and supply is supplemented by recycled water that is stored during cooler, wetter parts of the year (October –May). During these months surplus recycled water is stored in unlined surface storage ponds, resulting in extensive groundwater recharge. Any surplus water that cannot be stored due to storage limitations is disposed through a regional outfall pipeline to Temescal Creek and Santa Ana River (2010 UWMP - EMWD).

EMWD intends to capture and reuse all of its future growth generated recycled water by constructing an Advanced Water Treatment Facility (AWTF) and recharging the product water into the San Jacinto groundwater basin (2011 IRP - EMWD). Such a project requires significant capital investment, a significant outreach program to overcome regulatory and local acceptance hurdles, and additional capacity in the brine disposal facilities.

EMWD produces potable groundwater from two management plan areas in the San Jacinto Watershed, the West San Jacinto Groundwater Basin Management (WSJGM) area, and the Hemet/San Jacinto Water Management (HSJWM) area. The groundwater produced from the WSJGM area is brackish and requires treatment. EMWD operates two desalination plants in the WSJGM area to convert brackish groundwater into potable water (2010 UWMP - EMWD).

The groundwater from the HSJWM area is of potable quality, but the basins are overdrafted. The overdrafted conditions caused a prolonged litigation against EMWD and MWD, by the Soboba Band of Luiseño Indians, and a settlement that was signed in 2006. Under this settlement, the local purveyors in the HSJWM area are required to develop a management plan for the HSJWM area; and for thirty years MWD is obligated to deliver 7,500 AFY for groundwater replenishment. The HSJWM Plan activities will be coordinated by a Watermaster who is responsible to overcome the chronic groundwater overdrafts in the HSJWM area (2010 UWMP - EMWD). The Watermaster in collaboration with EMWD will be responsible for operating the HSJWM groundwater basins within their safe yield limits; recharge groundwater basins with imported water; and use EMWD's San Jacinto River flow diversion rights of 5,760 AFY for recharge of the HSJWM groundwater basins.

As part of compliance with SBX7-7 legislation, EMWD implemented a budget based tiered rate program for its retail residential and landscape customers. Each customer account has a monthly budget based on the number of persons in the household and the irrigation landscape area. The conservation programs being implemented by EMWD are expected to conserve 19,200 AFY of water by 2035 (2010 UWMP - EMWD).

High reliance on imported water and its associated challenges have caused EMWD to pay particular attention to improving water supply reliability within its service area. EMWD is continuously looking at programs such as conservation, desalination, budget based tiered rate billing structure, recycled water use, urban stormwater runoff harvesting, groundwater recharge, and water transfers to improve its water supply reliability.

## Management Activities within the Chino Basin Area

This region extends from San Gabriel Mountains to Prado Dam. The two main regional agencies serving this area are Chino Basin Watermaster (CBWM) and Inland Empire Utility Agency (IEUA).

### *Activities Within The Chino Basin Watermaster Area*

The Optimum Basin Management Plan (OBMP) for the Chino Basin is a major strategic planning in the CBWM area which was prepared by the IEUA and CBWM to address groundwater quality problems and identify groundwater management opportunities. The OBMP objective is to develop cost-effective, reliable, potable water supplies, enhance and protect the yield and quality of the Chino groundwater basins; while minimizing demand for imported water and encouraging the use of the large available storage space in the aquifer system. The OBMP provides the framework for cooperative groundwater management program development among agencies in the Chino groundwater basins. To facilitate implementation of the OBMP, an agreement (the "Peace Agreement") was signed by Watermaster, Inland Empire Utility Agency (IEUA), Western Municipal Water District (WMWD), and various other stakeholders in June of 2000. The OBMP does address the urban water management planning needs within the Chino groundwater basins through water quality treatment, groundwater recharge, groundwater desalination, and water recycling programs. In 2007, the original Peace Agreement was updated (Peace II Agreement) to redefine the future programs and actions required to implement the OBMP. In 2010, IEUA completed a Peace II subsequent Environmental Impact Report (SEIR) for the OBMP update.

The Peace II Agreement includes groundwater desalination which creates "Hydraulic Control" in the Chino groundwater basin. The Hydraulic Control ensures that the water management activities in the Chino groundwater basins will not impair the beneficial uses of the Santa Ana River downstream of Prado Dam.

### *Activities Within the Inland Empire Utility Agency Area*

IEUA was originally formed in 1950 as the Chino Basin Municipal Water District and officially changed its name to IEUA on July 1, 1998, to reflect the change in the District's mission. IEUA provides imported water, wastewater management, and energy recovery/production services to a 242 square mile area in the southwest corner of San Bernardino County (see **Figure 5.10-1**). IEUA provides water and wastewater services to ten contracting agencies in its jurisdiction 1) City of Chino, 2) City of Chino Hills, 3) Cucamonga Valley Water District (CVWD), 4) City of Fontana, 5) San Antonio Water Company, 6) City of Ontario, 7) City of Upland, 8) Monte Vista Water District, 9) Fontana Water Company, and 10) City of Montclair. The IEUA service area population is expected to grow from 830,000 to 1,200,000 by 2035.

MWD has invested $2.7 million in a 100,000 AF Chino Basin groundwater conjunctive use program. MWD and IEUA are working together to expand this program by a minimum of 50,000 AF. This strategy will provide dry year water supplies for the Chino Basin and the SAR watershed (2010 UWMP - IEUA). In December 2012, the MWD Board eliminated their groundwater replenishment program.

Although IEUA has worked to reduce its reliance on imported water, due to increased demand, in six of the past ten years IEUA was required to purchase imported water at a higher cost (MWD's Tier 2 rate) (2010 UWMP - IEUA).

Since 2007, MWD Tier 1 and Tier 2 rates have increased 69 percent and 86 percent, respectively. Increasing rates in conjunction with the elimination of the replenishment program has caused IEUA and its member agencies to re-evaluate how the Chino Basin is operating. As a result, it is no longer economical for the groundwater users to overproduce the basin during dry years, and it is less expensive to purchase MWD's imported water at the Tier 1 rate as a direct import (2012-13 Operating and Capital Budget - IEUA).

Currently, IEUA produces about 60,000 AFY of recycled water from four recycled water plants IEUA reuses about 54 percent of its recycled water and discharges the remaining 36 percent of its recycled water into the SAR.

The Inland Empire Regional Composting Facility is a joint venture between IEUA and Los Angeles County Sanitation District. This facility uses biosolids from IEUA's anaerobic digesters (2010 UWMP - IEUA). IEUA's ultimate recycled water plan is for delivery of 93,000 AFY of recycled water from all four of its plants. As of 2012, the recycled water distribution pipeline network has been constructed at a cost of $250 million, and is expected to deliver 62,000 AFY for direct use and replenishment by 2035 (2010 UWMP - IEUA). Currently IEUA recharges 10,000 AFY into the Chino Basin; with plans to double the recycled water recharge within the next ten years.

Available recycled water supplies are projected to reach 83,000 AFY by 2035. The SAR judgment requires IEUA to discharge 17,000 AFY into the SAR. This leaves approximately 66,000 AFY of recycled water available for beneficial use within the IEUA service area by 2035 (2010 UWMP - IEUA).

The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. In 2010, Chino Basin groundwater provided the IEUA service area with 105,000 AFY of supply (60-70 percent of its water supply). Development and maintenance of the Chino Basin are critical for the supply reliability in the region. Chino Basin groundwater production is expected to reach 170,000 AFY by 2035(2010 UWMP - IEUA).

The 1978 Chino Basin Judgment adjudicated water rights in the Chino Basin and formed the Chino Basin Watermaster (CBWM). The Judgment set the safe-yield at 145,000 AFY, but an additional 40,000 AFY of desalted groundwater can be produced via three desalters under the CBWM's OBMP. These desalters use a combination of reverse osmosis and ion exchange technology to treat the pumped groundwater. Salt balance is a major issue for the Chino Basin and the SAR Watershed as a whole. Depletion of groundwater reserves, undesired water quality, contravention of existing water rights, excessive increases in production costs, streamflow depletion, and subsidence are other factors that affect the Chino Basin water supplies. In 2005, CBWM, IEUA, OCWD, and the RWQCB developed a hydraulic control monitoring program to characterize the relationship of the SAR and the Chino Basin. Information from this program is used to adaptively manage the Chino Basin's storage and recovery activities (2010 UWMP - IEUA). The Chino Basin is a valuable resource for water transfers in the SAR Basin because of its ability to store vast quantities of water, and has storage capability of up to 6 million AF (2010 UWMP - IEUA).

In 2002, CBWM, Chino Basin Water Conservation District (CBWCD), San Bernardino County Flood Control District (SBCFCD), and IEUA formed a joint committee to implement the Chino Basin Facilities Improvement Project (CBFIP). Improvements to the Chino Basin groundwater recharge will substantially increase the replenishment of the groundwater basin through a combination of storm water, recycled water, and imported water. This project is designed to maximize the use of uninterruptible supplies when available (2010 UWMP - IEUA). IEUA is the lead agency for implementation of the CBFIP which has constructed and improved 19 recharge sites with a total potential recharge capacity of 110,000 AFY(2012-13 Operating and Capital Budget - IEUA).

Changes in the environmental regulations, the GHG emission legislation, and other legislations can significantly impact energy programs and costs. As a result, IEUA has adopted a "Gridless by 2020" campaign, in which IEUA will meet 100 percent of its2020 energy needs with renewable energy sources (2012-13 Operating and Capital Budget - IEUA).

Population increase, combined with uncertain effects from climate change, have prompted IEUA management to alert its Board of Directors to the significant water management challenges that the area will be facing in the future (2010 UWMP - IEUA).

## Management Activities within the Orange County Area

The SAR below Prado dam flows through Orange County and discharges into the Pacific Ocean. The main regional groundwater agency serving this area of the SAR Watershed is Orange County Water District (OCWD). The OCWD was formed in 1933 to manage and protect the Orange County groundwater basin (**Figure 5.10-1**). OCWD encompasses 350 square miles in the lower SAR Watershed serving more than 2.4 million people and providing water supply to thirteen cities and six water districts.

Total water demand within OCWD's boundary is about 480,000 AFY (2009 Update GWM Plan - OCWD). Total demand includes the use of groundwater, surface water from Santiago Creek and Irvine Lake, recycled water, and imported water (2009 Long-Term Facilities Plan - OCWD). The groundwater basin managed by OCWD provides up to 75 percent of the water needed within OCWD's boundary. Municipal Water District of Orange County (MWDOC) has estimated total water demands within OCWD's boundary in 2035 to be 558,000 AFY (2010 UWMP - MWDOC).

MWDOC and the cities of Anaheim, Fullerton, and Santa Ana are members of MWD and can import water directly from MWD. Since 2004, OCWD, MWDOC, and participating producers in the region have participated in MWD's Conjunctive Use Program. The existing MWD storage program provides for MWD to store up to 66,000 AF of water in the basin in exchange of MWD's contribution to improvements in basin management facilities (2010 UWMP - MWDOC).

Water managers in Orange County are very concerned about the increasing cost of the imported water due to endangered/threatened species in the Delta, drought along the Colorado River, and reduced water sales by MWD.

The Orange County Sanitation District (OCSD) is the regional wastewater management agency for 21 cities, three special districts, and a portion of the unincorporated county areas. The OCSD treats 210 MGD of wastewater at its two treatment facilities in Huntington Beach and Fountain Valley. OCWD receives secondary treated wastewater from OCSD and treats it to a pristine level at the Groundwater Replenishment System (GWRS) before recharging it into the groundwater basin. GWRS can currently produce up to 72,000 AFY (2009 Update GWM Plan - OCWD). The system can be expanded to a total of 120,000 AFY in two phases (2009 Long-Term Facilities Plan - OCWD).

Since 1965, Los Angeles County Flood Control District (LACFCD) and OCWD have been jointly operating injection wells in the Alamitos and Talbert Barriers to control the seawater intrusion into the Orange and Los Angeles Counties. Controlling seawater intrusion into the groundwater basin is critical to protecting the water quality of groundwater in the region. GWRS provides water for the Talbert Barrier injection wells in addition to recharge water for the Anaheim surface water recharge facilities. Approximately 34,000 AFY (30 MGD) of injection is used at the Talbert Barrier to substantially raise water levels, an amount sufficient to fully prevent seawater intrusion. Talbert Barrier may require up to 45 MGD of injection to meet the projected 2020 conditions (2009 Update GWM Plan - OCWD).

OCWD owns and operates a network of recharge facilities that cover over 1,500 acres in addition to the 2,150 acres that it owns above Prado Dam (used for conservation and water quality improvement).

OCWD has two diversion permits from the SWRCB for diversion and use of up to 362,000 of SAR water, and collection and storage of 33,560 AFY from Santiago Creek. OCWD utilizes the permitted diversions from the SAR and Santiago Creek to maximize recharge of the groundwater basin. SWRCB has also agreed to hold an additional 143,000 AFY in abeyance for OCWD for possible future projects. This provides an opportunity for OCWD to pursue long-term projects and complete environmental analysis and planning of those projects by 2023.In its Long-Term Facilities Plan (2009 Long-Term Facilities Plan - OCWD) OCWD identified potential projects for recharge enhancement, including sediment removal from SAR; new injection wells to recharge GWRS water in the basin; subsurface recharge galleries to recharge more GWRS water; and cooperation with the County of Orange to recharge at Fletcher Basin-area.

The groundwater basin's primary source of water is the OCWD recharge activities in and adjacent to the SAR and Santiago Creek. The SAR bed percolation rate has been declining by approximately one percent per year for the last 20 years due to the coarsening of the riverbed. In addition, invasive and pervasive plant species, such as Arundo Donax, prohibit maximize flow in the SAR and Prado dam areas. OCWD is able to recharge essentially all non-storm flow in the SAR that enters the OC through Prado Dam; however, stormflows exceed the diversion capacity during years of heavy precipitation. During wet years, there is a significant loss of water to the ocean. Maximum percolation at the recharge facilities is estimated at 500 cubic-feet per second (cfs), while the rate of stormflow can reach 3,000 cfs. In 1997-98 alone, approximately 270,000 AF of SAR stormflow were lost to the ocean (2009 Update GWM Plan - OCWD).

OCWD has legal rights to a minimum of 42,000 AFY of SAR baseflow (defined as “perennial flows from the upper watershed” in SAR which is predominantly treated wastewater). Over the last 10 years, the SAR provided approximately 200,000 AFY of water to Orange County (150,000 AFY of baseflow and 50,000 AFY of stormflow) to recharge the groundwater basin (2009 Long-Term Facilities Plan - OCWD).

OCWD has developed an extensive groundwater modeling, monitoring, and tracking system; and has comprehensive sub-surface geology, and water quality data for the region. OCWD estimates the entire groundwater storage capacity in the region to be 66,000,000 AF. In 2009, OCWD estimated the inflows to the groundwater to be approximately 341,000 AF (with 235,000 AF at the Forebay recharge facility, 35,000 AF at Talbert Gap, 2,500 AF at Alamitos Gap, and 69,000 AF of other recharge). This inflow is balanced with groundwater production of 335,000 AF and subsurface outflow of 8,000 AF (2009 Update GWM Plan - OCWD).

The GWRS provides a dependable supply of water and is expected to remove approximately 47,000 tons of salt per year. In addition, Tustin and Irvine desalters remove and treat impaired groundwater in the region (2009 Update GWM Plan - OCWD). MWDOC has identified several projects in the area that would double impaired groundwater production. However, these projects will require additional replenishment water for their implementation (2010 UWMP - MWDOC).

To control nitrate levels, OCWD operates 350 acres of wetlands in the Prado Basin to naturally remove nitrates before they enter recharge facilities. In addition, OCWD is interested in developing more wetlands above the Prado Dam at Chino Creek (Prado Basin area), River Road (to treat SAR baseflow

that is not diverted to the existing Prado wetlands), Temescal Creek, and Mill Creek (proposed by the City of Ontario) (2009 Long-Term Facilities Plan - OCWD).

Development and implementation of water use efficiency programs to assure 20 x 2020 compliance and establishing water use efficiency is considered as a main source for water resources mix in Orange County by the MWDOC Strategic plan. One of the key strategies identified by MWDOC is increasing Orange County's water supply from non-local sources. MWDOC plans to assist member agencies with water transfers and exchanges and would like to be proactive in identifying and screening innovative, non-local water supply. Irvine Ranch Water District (IRWD) worked with MWD and MWDOC to develop the IRWD Strand Ranch Integrated Banking Project that allows for recharge, storage and recovery of 50,000 AF of SWP water in Kern County. Another MWDOC objective is to build coalitions in support of developing ocean desalination as a component of the water resources strategy for Orange County.

Concerns within this region includes:

- Decreases in baseflows reaching Prado Dam caused by several factors including increased recycling in the upper SAR basin
- Protecting groundwater quality from industrial contamination and other potential sources of contamination
- Declining flows in the SAR and tributaries to the SAR impacting natural resources in the watershed
- Changes in the amount of inflow to OCSD that could affect supplies for the GWRS
- Continuation of drought conditions impacting the MWD supply reliability
- Availability of imported water to replenish the groundwater basin
- Maintaining the quality of water in the SAR that is the source water for recharging the Orange County groundwater basin

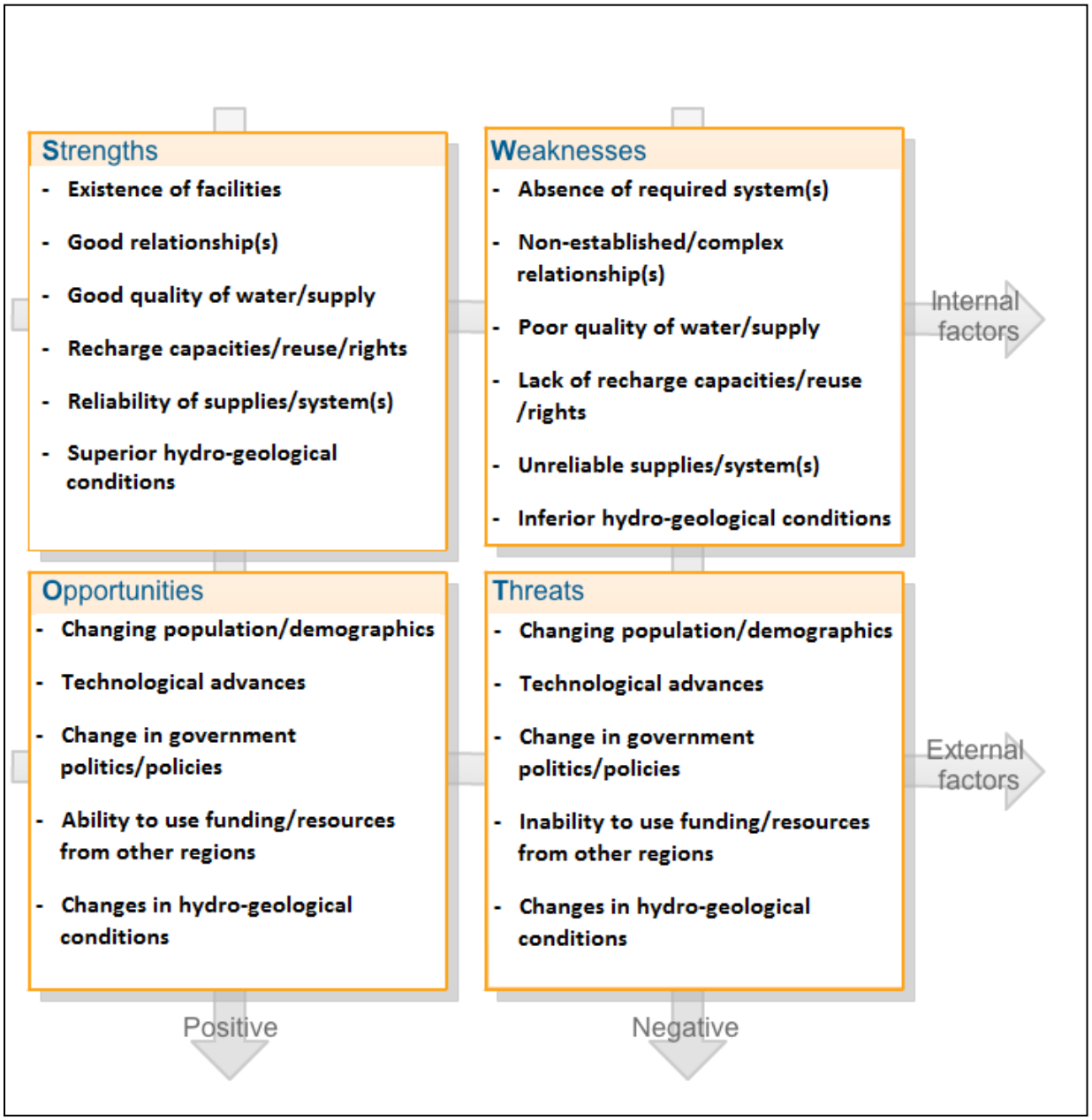
Water agencies within the Orange County recognize the importance of a collaborative relationship with the agencies in the upper SAR watershed and have historically entered into agreements with these agencies for excess water that the agencies pump into the SAR and reaches Prado dam (2009 Update GWM Plan - OCWD).

## Watershed Integration Nexus Analysis

By definition, Strengths (S) and Weaknesses (W) in a geographic area are considered to be internal factors over which water supply agencies have some measure of control. Also, by definition, Opportunities (O) and Threats (T) are considered to be external factors over which the agencies in a geographic region have essentially no control. SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats, and SWOT Analysis is the most renowned tool for analysis of the overall strategic position of a business and its environment. The key purpose of a SWOT analysis is to identify the strategies that will create a specific business model that will best align resources and capabilities to the requirements of the environment in which the business operates. Basic guidelines were set to categorize Strengths, Weaknesses, Opportunities, and Threats for each geographical area. These

guidelines (shown in **Figure 5.10-2**) provide a standardized approach in preparation of SWOT analysis for the entire watershed. A SWOT analysis, also called situational analysis, is usually used to evaluate the internal strengths and weaknesses of an organization and the external opportunities and threats to that organization.

**Figure 5.10-2 SWOT Analysis Guidelines**




However, in this report, a SWOT analysis is conducted to explore the strategies that have already been defined by SAR watershed stakeholders, in particular SAWPA member agencies, and identify the strengths and opportunities that can be developed by a cooperative planning effort amongst SAWPA member agencies. Such cooperative concepts can benefit from the integration of different resources,

facilities, and capabilities that currently exist within the watershed. The SWOT analysis used for this WIN study began with an examination of strengths and concerns identified in different geographical areas by SAR watershed agencies in their strategic documents, and the opportunities and threats are based on information gathered from the regional planning documents. The goal of the report is to provide a Watershed Integration Nexus (WIN) concept by utilizing SWOT analysis elements within different geographical regions of the SAR watershed in support of the OWOW program.

Using the SWOT analysis presented in this report, water managers can help the SAR watershed increase its internal strengths and reduce its internal weaknesses while augmenting external opportunities and reducing external threats.

The accuracy of a SWOT analysis is dependent upon the amount and source of data that are available. Any analysis with a lack of data may suffer from a biased viewpoint, and an incorrect hypothesis may be formulated that would corrupt the sole purpose of the analysis. In order to validate the accuracy of data and information related to a particular geographical area, several meetings with the SAWPA member agencies' strategic planners were conducted. **Table 5.10-1** through **Table 5.10-5** summarizes the SWOT analysis results for different geographical areas. These summary tables were prepared based on information provided in Section 4 of the report, which were validated by SAWPA member agencies' strategic planners.

The SWOT analysis is instrumental in strategy formulation and is a strong tool, but it involves a great subjective element. The analysis provided in this report is intended as a guideline and not as a prescription. Regional water managers in different geographical regions can use the SWOT analysis summaries in **Table 5.10-1** through **Table 5.10-5** capitalize on their regional strengths, and collaborate with agencies in other geographical regions to overcome weakness and external threats to their specific region.

**Table 5.10-1 SWOT Analysis Summary for the Upper Santa Ana River Portion of the Watershed**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| SBVMWD permits to divert Santa Ana River Water | Lack of a mature recycled water reuse program in the region | Construct additional recharge facilities to capture recently permitted diversions | Liquefaction threat if groundwater levels rise within 50 feet of land surface |
| Most of the watershed's runoff flows through this region | Conjunctive use opportunities limited to around 40,000 acre-feet due to potential for high groundwater in San Bernardino | Increase stormwater capture through "Active Recharge" and "Rubber Dam" projects | Many of the local communities are economically disadvantaged and unattractive to potential companies for economic growth |
| Stored water in Kern-Delta and Big Bear Lake to supplement direct delivery needs in dry years | Good quality groundwater preservation requires expensive AWTF of recycled water for groundwater recharge | Optimize the effectiveness of existing recharge operations and build additional recharge facilities so that SBVMWD can import SWP in wet years | Expansion of the critical habitat area for the Santa Ana Sucker, and its interference with regional water management efforts |
| The region has an estimated groundwater capacity of 5 million acre-feet | Projected supply shortage in the SGPWA area | Regional access to the Inland Empire Brine Line (IEBL) | Environmental needs in the Delta impacting imported supplies to the SAR watershed |
| SBVMWD is the fifth largest of the 29 water contractors in the state | | Dewatering plan should high groundwater return | Meeting demands during droughts |
| Maximizing imported water during wet years through Cooperative Recharge Program | | Improve the local economy by attracting pharmaceutical and other businesses that need a brine line | |
| Collaborative water management through the Basin Technical Advisory Committee (BTAC) | | | |
| Having the Rapid Infiltration/Extraction (RIX) project permits/process. | | | |

**Table 5.10-2 SWOT Analysis Summary for Area Between City of Colton and Prado Dam**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| WMWD collaborative relationship with MWD and its involvement in the IRP Process | Expansion and use of the groundwater requires additional treatment and/or desalination | Planning for expansion of recycled water use in the area | Significant future demand increase in the region due to rapid population growth and urban development |
| Participation in different Task Force activities to resolve regulatory issues with RWQCB | | Ability to store excess stormwater runoff, SAR water, and SWP water, in the San Bernardino Groundwater basin | Climate change altering hydrologic conditions impacting imported supplies to the SAR watershed |
| Ability to address concerns within the SAR Watershed through collaborative approach amongst stakeholders (Members of SAWPA) | | WMWD has a temporary permit from SWRCB to receive surface water from Seven Oaks Dam | Concerns over salinity, bromide, and organic carbon concentration levels of the imported water |
| Ability to receive treated imported water from two WFP (MWD's Mills and Skinner WFP) | | Access to the IEBL for brine disposal | Restrictions on SWP and Colorado River operation |
| Reliance on imported water limited to 33 percent of total water demand in the WMWD area | | | Extensive MWD imported water rate increases in recent years |
| WMWD is a member of the Chino Desalter Authority with access to treated Chino Basin groundwater | | | |
| Long history of working relationship between WMWD and SBVMWD on water supply issues | | | |
| WMWD has implemented a tiered-rate water rate structure to improve water use efficiency in the area | | | |

**Table 5.10-3 SWOT Analysis Summary for the San Jacinto River Sub-watershed Area**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Collaborative relationship with MWD and its involvement in the IRP Process | Reliance on imported water exceeds 80 percent of total potable water demand in the EMWD area | Development of a stipulated judgment to address the over drafted groundwater issues | Climate change altering hydrologic conditions impacting imported supplies to the SAR watershed |
| Participation in different Task Force activities to resolve regulatory issues with RWQCB | Reuse all of future generated recycled water requires construction of AWTF | Existence of a comprehensive conservation program in the area | Significant future demand increase in the region due to rapid population growth and urban development |
| Ability to address concerns within the SAR Watershed through collaborative approach amongst stakeholders | Need for significant transmission infrastructure upgrades, and future regional treatment capacity shortages at the Mills WFP | Regional access to the Inland Empire Brine Line (IEBL) | Restrictions on SWP (finding a solution to the Delta issues within the next ten to fifteen years) and persistence of drought in the Colorado River system |
| Ability to receive treated imported water from two WFP (MWD's Mills and Skinner WFP) | Over drafted groundwater basins in the area | | Extensive MWD imported water rate increases in recent years |
| Existence of a groundwater replenishment program to reduce reliance on treated MWD water | | | |
| Having a budget based tiered rate program | | | |
| Existence of an extensive recycled water system in the area | | | |
| Existence of desalination plants to treat and use the brackish groundwater in the area | | | |
| Expanded local treatment of untreated MWD water | | | |
| Availability of tertiary treated recycled water in the area | | | |

**Table 5.10-4 SWOT Analysis Summary for the Chino Basin Area**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Collaborative relationship with MWD and its involvement in the IRP Process | Operational, capacity and permitting limitations to the recycled water recharge program | The SAR judgment requiring discharge of 17,000 AFY into the SAR (another 66,000 AFY of recycled water is available by 2035) | Climate change altering hydrologic conditions impacting imported supplies to the SAR watershed |
| Participation in different Task Force activities to resolve regulatory issues with RWQCB | Groundwater contamination | Regional access to the Inland Empire Brine Line (IEBL) | Extensive MWD imported water rate increases in recent years |
| Ability to address concerns within the SAR Watershed through collaborative approach amongst stakeholders | Procedural and legal constraints due to the Adjudication | Having CBWM and a framework (OBMP) for cooperative groundwater management development | Significant future demand increase in the region due to rapid population growth and urban development |
| Implementing the OBMP to ensure the water management activities will not impair the beneficial uses downstream of Prado Dam | | IEUA's "Gridless by 2020" campaign to meet 100 percent of its2020 energy needs with renewable energy sources | No longer economical for the groundwater users to overproduce the Chino Basin during dry years after the elimination of MWD's replenishment rates |
| Ability to use recycled water for irrigation, agriculture, commercial/industrial and groundwater recharge instead of imported water | | Further expansion of conjunctive use type programs, to further manage imported and groundwater resources during wet and dry periods | Increase in groundwater production costs, streamflow depletion, groundwater contamination, and subsidence effect on the Chino Basin |
| Extensive investment in a major conjunctive use program | | | Restrictions on SWP and droughts in the Colorado River system |
| Chino Basin having up to 6 million AF of storage capability | | | Changes in the environmental regulations, the GHG Emission legislation, and other legislations |

**Table 5.10-5 SWOT Analysis Summary for the Orange County Area**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| Having good collaborative relationships with agencies in the upper SAR region | Need to control seawater intrusion into the groundwater basin, and using GWRS water for the Talbert Barrier | Groundwater production in 2035 will only be 7.5 percent more than the current production | Future demand increase in the region due to population growth and urban development |
| Ability to address concerns within the SAR Watershed through collaborative approach amongst stakeholders | Diversion capacity along the SAR is less than wet year stormflows (flow rates up to 3,000 cfs) | GWRS can be expanded to a total of 120,000 AFY | Restrictions on SWP and drought in the Colorado River system |
| Participation in different Task Force activities to resolve regulatory issues with RWQCB | Lack of sufficient replenishment water | OCWD has two diversion permits from the SWRCB (up to 362,000 of SAR water, and 33,560 AFY from Santiago Creek) | Climate change altering hydrologic conditions impacting imported supplies to the SAR watershed |
| OCWD has legal rights to 42,000 AFY of perennial flows from the upper watershed (this is predominantly treated wastewater) | | Extensive increase of recycled water reuse in the region from current 85,000 AFY to 135,000AFY by 2035 | Increased use of recycled water in the upper SAR basin (decreases base flows reaching Prado Dam) |
| GWRS provides a dependable supply of water and treats up to 72,000 AFY for recharge into the groundwater basin | | SWRCB has agreed to hold 143,000 AFY in abeyance for OCWD for possible future projects | Decline in baseflow due to upper basin recycling projects and other factors |
| 450 acres of wetlands naturally remove nitrates before SAR flows enter OC | | Developing additional recharge capability (recharge basins; new injection wells; and recharge galleries) | SAR bed percolation declining one percent per year for the last 20 years |
| OCWD owns and operates a network of recharge facilities that cover over 1,500 acre | | Ability to develop ocean desalination as a component of the water resources strategy in the region | Arundo Donax prohibits maximum flows in the SAR to reach OC |

**(Continuation of Table 5.10-5 SWOT Analysis Summary for the Orange County Area)**

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| GWRS removes up to 47,000 tons of salt per year | | Potential for USACE/OCWD agreement to increase water conservation behind Prado Dam | Increased water demands within the region due to population growth |
| Cooperative relationship with other agencies in the region | | Ability to recharge all non-storm SAR flows (max. percolation capacity is at 500 cfs) | USACE Prado stormwater releases at rates exceeding the region recharge capacity |
| Ability to use groundwater for more than 2/3 of the water needs in the area | | | The increasing cost of the imported water |
| IRWD Strand Ranch Integrated Banking Project allows for recharge, storage and recovery of 50,000 AF of SWP water in Kern County | | | Sediment accumulation behind Prado Dam reducing storage capacity |
| SAR provides approximately160,000 AFY (to groundwater basin in the region(110,000 AFY of baseflow and 50,000 AFY of stormflow) | | | Legal constraints affecting groundwater contamination remediation |
| OCWD has extensive knowledge of the groundwater basins in the region (groundwater modeling, monitoring, and tracking system; comprehensive sub-surface geology, and water quality data) | | | |
| The groundwater storage capacity in the region is estimated to be 66,000,000 AF | | | |

## Conclusions and Recommendations

The stakeholders within the Santa Ana River Watershed were asked how they would distribute future strategic planning funds in their geographical area using a standardized questionnaire. **Table 5.10-6** shows the different funding categories that were listed on the questionnaire, and **Figure 5.10-3** shows the responses received for four out of the five agencies participating in the process. The numbers shown on **Figure 5.10-3** correspond to categories list on **Table 5.10-6**.

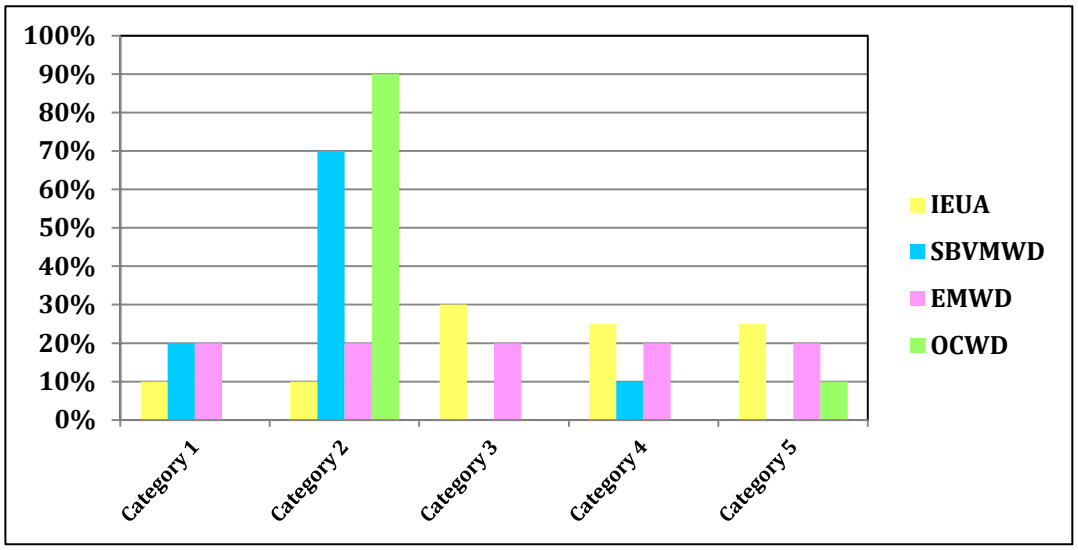
**Table 5.10-6 Questionnaire Identifying Different Strategic Planning Funding Categories**

| Strategic Funding Categories | Category Nos. Used on Figure 5.10-3 |
|---|---|
| Expand compliance with the SBx7-7 and implement projects that reduce per capita water usage by more than 20 percent by the year 2020. | **1** |
| Create/ Expand supply and system reliability during drought, emergency, and peak demand situations. | **2** |
| Create/Expand coordination with other agencies in the area and develop regional water management strategies that would increase conservation and local water supplies. | **3** |
| Create/Expand local recycled water reuse program(s) in the area. | **4** |
| Develop/Implement projects that protect groundwater resources and the environment. | **5** |

It is interesting to note that the agencies at the most upstream and most downstream geographical areas of the watershed are more focused on creating and expanding supply and system reliability during drought, emergency, and peak demand situations (Category 2), whereas the interest of the agencies in the middle of the watershed is more distributed amongst the other categories listed on **Table 5.10-6**. The conceptual recommendations offered in this report are based on information presented.

The sections below provide brief discussion for these recommendations.

**Figure 5.10-3 Future Strategic Planning Funding Priorities within Different Santa Ana River Watershed Geographic Area**




## Recommended Water Transfer Concepts

Based on the feedback received from strategic planners in different geographical regions, it is concluded that Watershed Integration Nexus (WIN) can be developed for two different water transfer concepts to improve operational efficiency in the watershed:

- Imported Water Transfer
- Recycled Water Transfer

### *Imported Water Transfer Concept*

This concept allows an agency to take MWD imported water during wet years and store it in the groundwater basins within (or outside) its own geographic area. This concept requires an agency with groundwater storage rights (Storing Agency) to work with another agency looking at improving its water supply reliability (Consuming Agency) and coordinate their supply and demand activities within their respective geographical areas.

During the years that MWD stores water in its storage accounts such as the Semitropic Water Storage District and Kern County Water Bank, the Storing Agency receives imported water from MWD in-lieu of groundwater production; and the Consuming Agency pays MWD for the water delivered to the Storing Agency at the time of delivery.

During the years that MWD Board implements the Water Supply Allocation Plan (see section 3.2 for more detail on MWD's WSAP) and MWD withdraws water from its storage accounts, the Consuming Agency will receive additional imported water from MWD above its WSAP allotment while the Storing Agency receives a reduced WSAP allotment and increases its groundwater production to offset the reduced WSAP allotment. In addition, during the Dry Year period the Consuming Agency pays the Storing Agency a storage fee for the additional water it receives above its WSAP allotment from MWD.

At the present time, MWD staff is working with its member agencies to develop a Local Storage Program that is complementary with other storage programs and provide:

- Regional water management benefits
- Equity for MWD member agencies
- Financial integrity (program should not reduce the full service purchases in the year when the water is stored)
- Operational flexibility for MWD

Therefore, it is important for MWD to participate in further development of the imported water transfer concept in the SAR watershed, and MWD's willingness to allow for allotment exchange between the Storing and Consuming Agencies at a revenue neutral price to MWD.

This section quantifies a proposed imported water transfer project based on the imported water transfer concept.

### *Recycled Water Transfer Concept*

This concept allows a geographical region to receive revenue for discharge of recycled water into SAR in-lieu of developing costly AWTF for treatment and use of recycled water in the same geographical region that the recycled water is generated. This concept requires the agency that discharges recycled water into the SAR (Discharging Agency) to coordinate with an agency with existing water purification facilities downstream of the discharge point (Consuming Agency). A good Consuming Agency candidate would be OCWD with its existing GWRS.

In this concept, the Discharging Agency will handle any salinity management regulatory requirements through mitigation at the Consuming Agency's geographical area. This would require the Discharging Agency to pay the Consuming Agency for the cost of any salinity mitigation at the point of treatment. In return, the Consuming Agency will pay for the water provided by the Discharging Agency. The revenues received by the Discharging Agency can be used to purchase imported water from MWD during Wet Years for recharge in the Discharging Agency's groundwater basins. This concept will improve operational efficiency and water supply reliability at both Discharging and Consuming Agencies' geographical areas. It is important for the SAR Watermaster to be involved in the development of this concept.

The section below quantifies a proposed recycled water transfer project based on the above described concept.

## Recommended Water Transfer Projects

Defining the institutional, technical, legal, and financial aspects of the concepts outlined the sections below can be very complex and would require close coordination between different stakeholders involved in a particular project benefiting from a particular concept.

The implementation of such projects requires economic studies to define benefits for specific agencies that can participate in each concept, and cooperation between agencies in different geographical areas to jointly prepare project specific implementation plans.

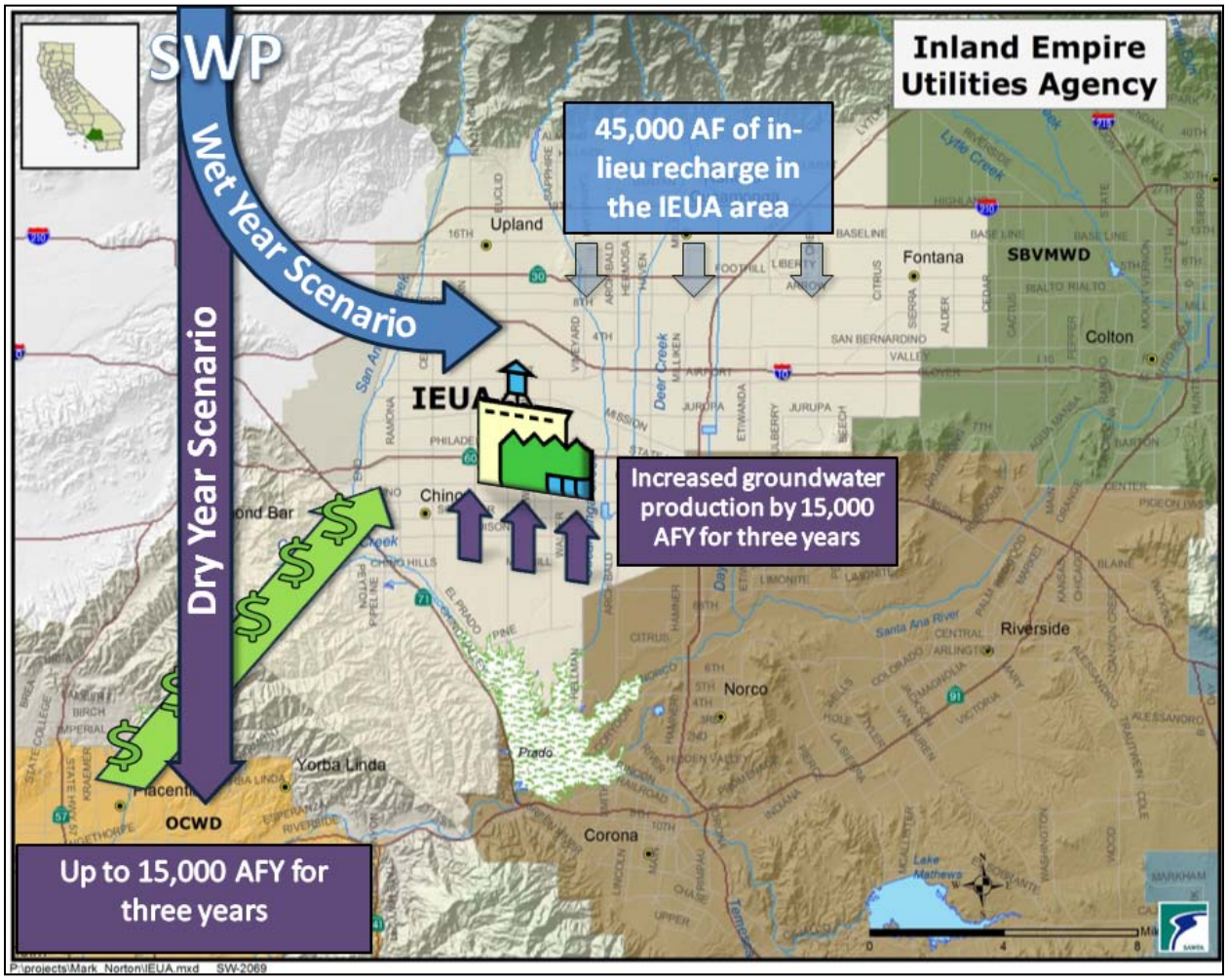
The sections below provide basic quantification for two potential projects that can be implemented based on the concepts outlined in this section.

### *Recommended Imported Water Transfer Project*

Using Chino Basin storage capabilities as a resource to improve water supply reliability in Orange County is the basis for this recommended project. Inland Empire Utility Agency (IEUA) staff has indicated ability to use 45,000 AF of the Chino Basin storage during wet years, and groundwater production capacity of agencies within the Chino Basin to extract up to 15,000 AFY of additional groundwater during dry years. In addition, Orange County Water District (OCWD) is willing to discuss this potential project in more detail with IEUA.

This project concept would require OCWD member agencies to provide some (or all) funding for the purchase of up to 45,000 AF of imported water by the IEUA member agencies during wet years. It is important for MWD to provide the imported water at a rate that recognizes the benefits of MWD not storing the SWP water at one of MWD's own storage programs such as the Semitropic Water Storage District and/or Kern County Water Bank. During dry years, OCWD member agencies can request IEUA member agencies to increase their groundwater production for three years by up to 15,000 AF per year in-lieu of direct deliveries from MWD, while MWD increases deliveries in the Orange County area by an equal amount. Under this scenario, the net MWD deliveries during dry years (years that Water Supply Allocation Plan is implemented) will remain unchanged, without the need for MWD to produce water from its own storage accounts. At the same time, having the imported water stored in the SAR watershed will increase local supply reliability, and provide some financial incentive to both IEUA and OCWD member agencies. **Figure 5.10-4** shows the schematics for this project. Institutional, technical, legal, and financial details for this project need to be developed by interested agencies within the Chino Basin and Orange County areas.

**Figure 5.10-4 Recommended Imported Water Transfer Project**




### *Recommended Recycled Water Transfer Project*

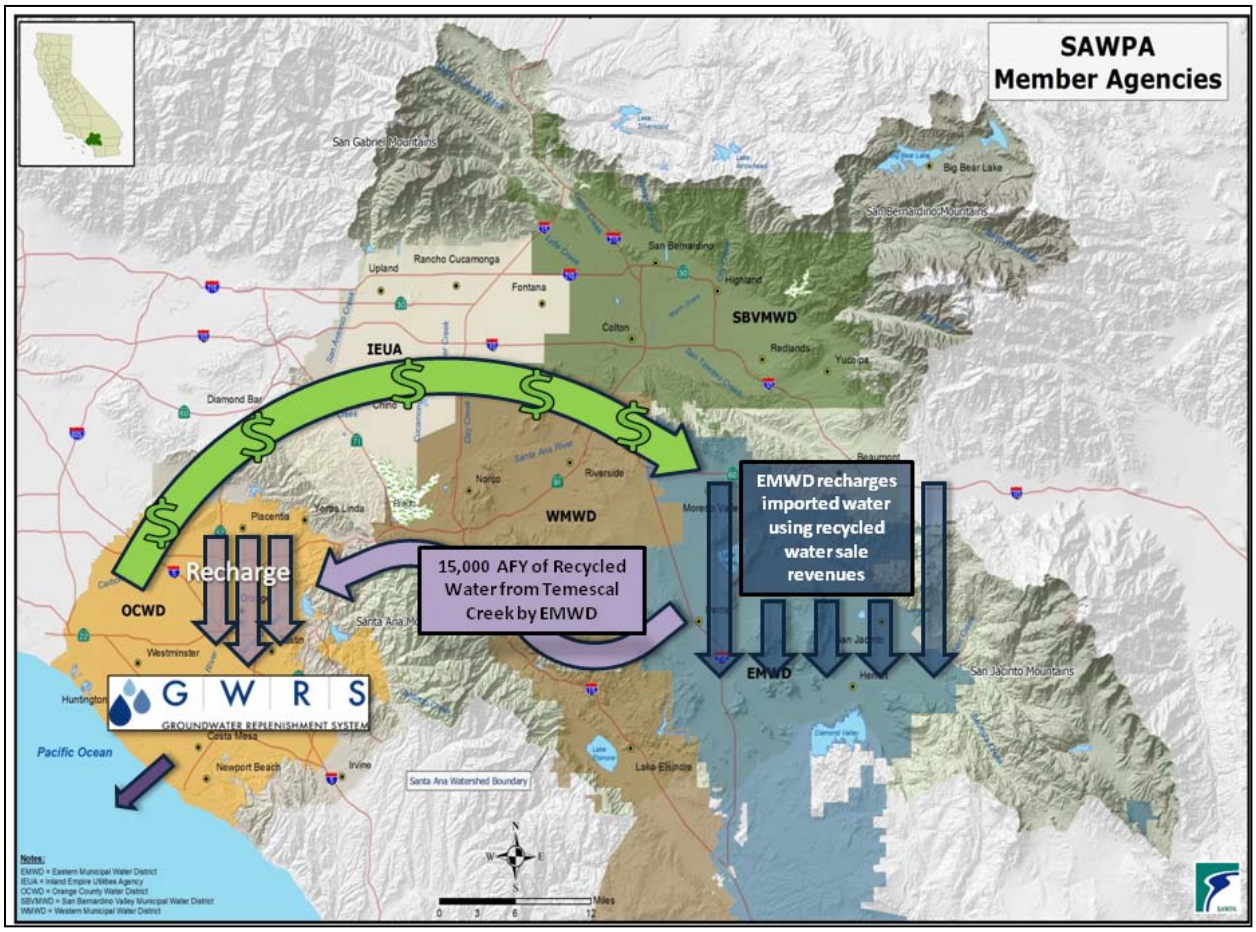
EMWD has the capability to discharge 15,000 AFY of recycled water into Temescal Creek. The discharge will be mostly in the winter months of the year for the benefit of OCWD member agencies. With the approval of the SAR Watermaster, this flow can be contractually added to OCWD's SAR base flow allocation at Prado.

The water quality of EMWD's discharged recycled water may require some salinity mitigation by OCWD to meet the RWQCB Basin Plan Objective in basins downstream of Temescal Creek and Orange County. The details of the required mitigation shall be defined and negotiated with the RWQCB. There is a potential to use GWRS for the required mitigation. EMWD will be responsible to pay for the cost of that mitigation.

As part of this project, OCWD will credit EMWD for the purified water that is recharged into the Orange County groundwater basin, and compensate EMWD when that water is produced by OCWD member

agencies. To increase water supply reliability in the SAR Watershed, it is important for EMWD to use the revenues from this water transfer project for imported water banking during wet years in the San Jacinto Watershed groundwater basins. **Figure 5.10-5** shows the schematics for this project. Institutional, technical, legal, and financial details for this project need to be developed by EMWD and OCWD.

**Figure 5.10-5 Recommended Recycled Water Transfer Project**




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## Acknowledgments

Special thanks to Charlie Bachmann, Joe Grindstaff, John Kennedy, Andrew Kenzler, Craig Miller, Brian Powell, P. Ravishanker, Jack Safely, Ryan Shaw, Bob Tincher, Marsha Westropp, and Greg Woodside who provided information and feedback on the strategic planning activities within their geographic region. We also thank Mark Norton and Jeff Beehler for reviewing a draft version of this report, Lindsey Stuvick for researching and reviewing planning documents published by different stakeholders within the Santa Ana River Watershed, and Irma Verino for editorial support.

# 5.11 Disadvantaged and Tribal Communities



Soboba Band of Luiseño Indians
Indian Water Rights Signing Ceremony

## Introduction

This Chapter provides a brief description of Disadvantaged Communities (DACs) and Native American Indian Tribes (Tribes) located in or near the Santa Ana River Watershed (SARW). A summary of water and related resource opportunities and challenges facing these entities can be found in the Bureau of Reclamation (Reclamation) report *Overview of Disadvantaged Communities & Native American Indian Tribes in the Santa Ana River Watershed*, located at **Appendix G**. This Chapter of the OWOW 2.0 Plan updates the OWOW 1.0 report's **Chapter 5.10: Environmental Justice**.

Environmental Justice, as defined by the U.S. Environmental Protection Agency (EPA), is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." With coordinated efforts by local, state and federal governments, such justice can be achieved in communities throughout the SARW, ensuring that all residents can enjoy the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.

Information for Reclamation's report was gathered from several sources including personal interviews, web research, documentation review, and publically available information. This report addresses DACs and Tribes separately, as they each have very different and distinctive demographics and economic bases. The report is not meant to be an exhaustive analysis of their unique factors, but rather an introduction and, in some cases, an overview of these populations and their unique water resources requirements.

There are legitimate water quality issues that impact low income and Tribal communities throughout the SARW, but some perceptions of unsafe water where water supplies are clearly safe for public consumption identify another problem. The solution to these issues is to ensure that all communities have the information, financial and technical resources, and administrative and regulatory policies they need to make informed decisions that can result in benefits to all members of communities within the Watershed.

One of the key provisions found through the research that could assist DACs is the 1996 Safe Drinking Water Act (SDWA) Amendments and the 2006 Safe Drinking Water State Revolving Fund (DWSRF) program. Through the DWSRF, states can provide below-market interest rate loans to publicly and privately owned community water systems and nonprofit non-community water systems for necessary infrastructure improvements. States may also establish separate eligibility criteria and special funding options for economically disadvantaged communities through this program.

Section 1452 of the SDWA defines a disadvantaged community as "the service area of a public water system that meets affordability criteria established after public review and comment by the State in which the public water system is located." Under this section, states may provide additional subsidies (including forgiveness of principal) to communities that meet the established criteria, or that are expected to meet these criteria as a result of a proposed project.

Though no special provision was found related to Tribes, the EPA supports "Tribal Assumption of Federal Environmental Laws" under federal statutes, stating, among other things, that "[t]he Agency will recognize tribal governments as the primary parties for setting standards, making environmental policy decisions, and managing programs for reservations, consistent with Agency standards and regulations." Three Federal environmental statutes - the SDWA, the Clean Water Act, and the Clean Air Act - explicitly authorize EPA to "treat tribes in the same manner as states" for purposes of implementing various EPA environmental programs that may be of benefit to these communities.

## Background

This Chapter and the Reclamation report address DACs and Tribes separately. The water and related resources opportunities and challenges for these entities vary widely based on their locations and community compositions. This diversity is captured in compilation tables are found in Table 1 (for DACs), and Table 3 (for Tribes) in Reclamation's report.

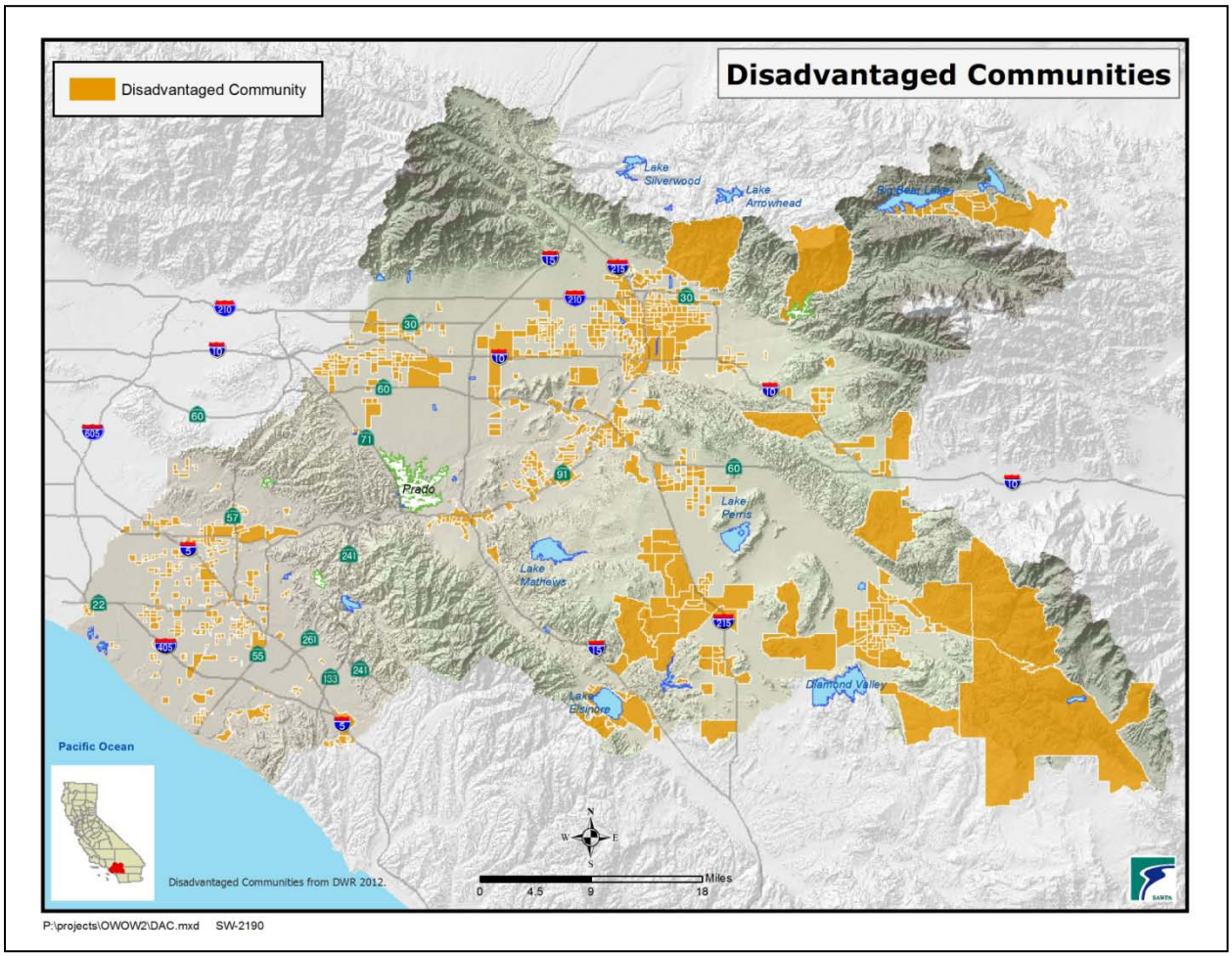
The conclusion in the report summarizes the information to offer SAWPA water resources planners a means to examine future opportunities, and topics for consideration as the OWOW plan is updated. It also provides recommendations to engage DACs and Tribes in future Proposition 84 grant programs and others grant programs as they arise. Though SARW was considered on the fastest growing regions in California prior to the 2008 recession, it still has some of the poorest residents in the state.

## Disadvantaged Communities

The California Department of Water Resources defines a DAC as "a community with a median household income less than 80% of the state-wide average. A Medium Household Income (MHI) of $48,706 is the DAC threshold (80% of the statewide MHI). " **Figure 5.11-1** notes the general area of the DACs located in SARW (provided by Proposition 84 and 1E Integrated Regional Water Management Guidelines, dated August 2010).

During the OWOW 1.0 planning process, DAC outreach was conducted in strategic areas throughout the watershed, including the following communities: Lake Elsinore and Pedley in Riverside County, Rialto and Colton in San Bernardino County, and Santa Ana in Orange County. OWOW 2.0 DAC outreach expanded on that initial effort and also classified DACs into regions. Each region has distinct characteristics and roughly follows the Santa Ana River as it flows from its headwaters in the San Bernardino Mountains to the outfall/estuary at Huntington Beach, a journey of 96 miles. These regions are not "officially" recognized, but they serve as a tool in guiding future DAC/Tribal outreach in the watershed.

**Figure 5.11-1 Disadvantaged Communities in SARW**



## Methodology for Assessing the DACs

The SARW covers approximately 2,650 square miles and is home to 5.4 million residents. Approximately 69 percent of the cities/communities within the watershed are considered disadvantaged or contain disadvantaged communities. In terms of population, approximately 26 percent (1.4 million residents) of the total watershed population is considered disadvantaged.

As previously noted above, the watershed was separated into regions for investigation. To assist in identifying DACs in each region, meetings were held with the California Department of Public Health and the Santa Ana Regional Water Quality Control Board. Once a DAC was identified, meetings were held with local public agencies to gain detailed knowledge about the unique characteristics of each region. Meetings were also held with the residents of these communities to help gain an understanding of their water quality and supply concerns. **Figure 5.11-2** lists known Disadvantaged Communities or Partially Disadvantaged Communities in the SARW.

**Figure 5.11-2 Disadvantaged or Partially Disadvantaged Communities in SARW**

| | | | |
|---|---|---|---|
| Anaheim | Garden Grove | Long Beach | Riverside |
| Banning | Glen Avon | Los Alamitos | Romoland |
| Beaumont | Grand Terrace | March AFB | Rubidoux |
| Big Bear City | Hemet | Mira Loma | San Jacinto |
| Big Bear Lake | Highgrove | Montclair | Santa Ana |
| Bloomington | Highland | Moreno Valley | Seal Beach |
| Buena Park | Home Gardens | Muscoy | Sedco Hills |
| Calimesa | Homeland | Newport Beach | Stanton |
| Cherry Valley | Huntington Beach | Norco | Sun City |
| Chino | Idyllwild-Pine Cove | Nuevo | Sunnyslope |
| Claremont | Irvine | Ontario | Upland |
| Colton | La Habra | Orange | Valle Vista |
| Corona | La Mirada | Placentia | Westminster |
| Costa Mesa | La Palma | Pomona | Wildomar |
| East Hemet | Laguna Hills | Quail Valley | Winchester |
| El Toro | Lake Elsinore | Rancho Cucamonga | Woodcrest |
| Fontana | Lakeland Village | Redlands | Yucaipa |
| Fullerton | Loma Linda | Rialto | |

## DAC Challenges and Opportunities

The SARW is rich in diversity and, as like many arid regions in the West, faces numerous water and related resources challenges. There are distinct regional differences throughout the watershed with much variability due to economic factors. Numerous economic resources are concentrated along the Orange County coast, and many natural resources are concentrated in the San Bernardino Mountains and its headwaters. The Santa Ana River is the watershed's unifying element.

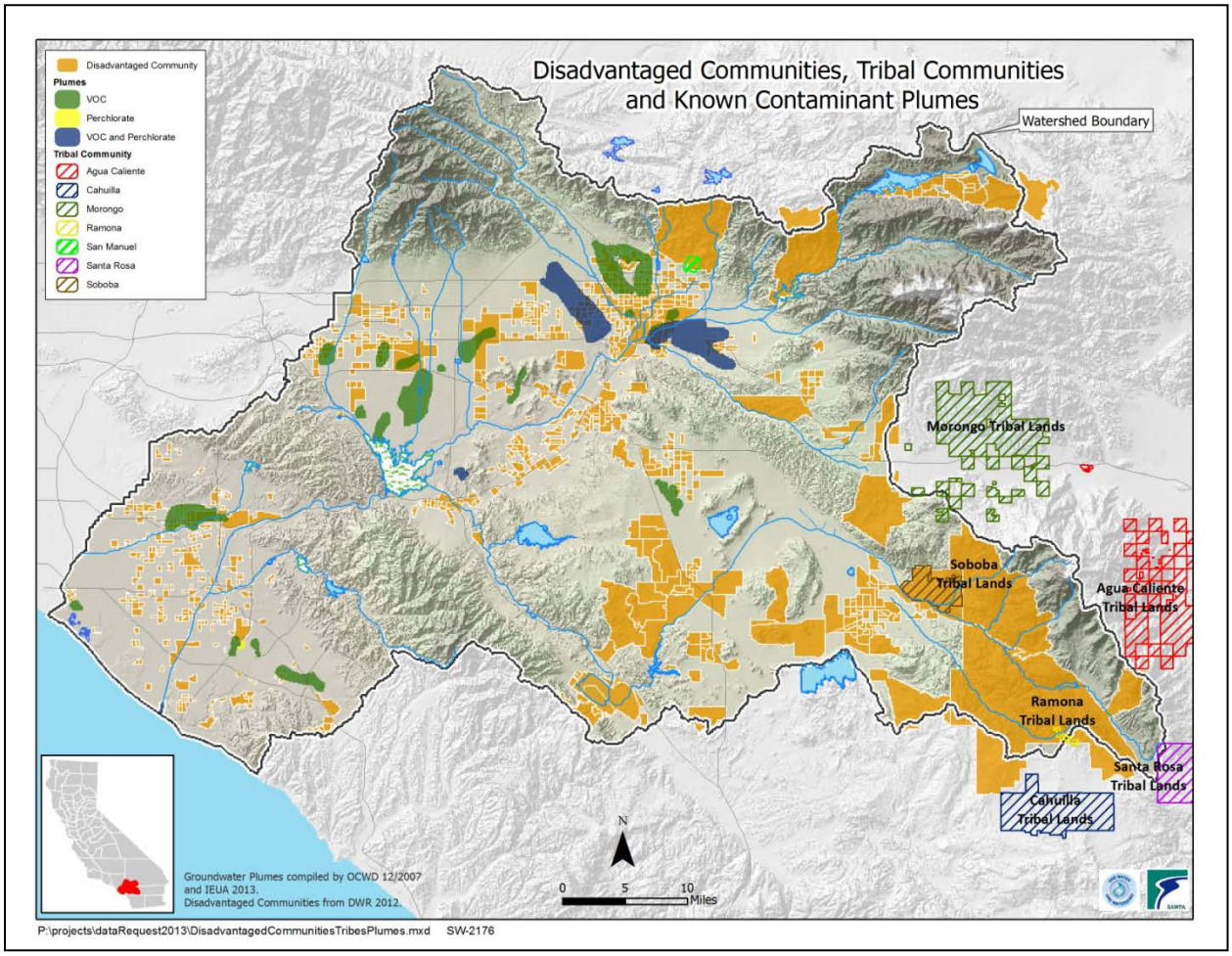
Through the OWOW planning process, significant outreach has been conducted to communicate with DACs within its service area; however, more needs to be done. These small and/or disadvantaged communities are often located in sparsely populated, rural areas and cannot provide the economies of scale necessary to build and maintain adequate water and wastewater systems. Also, many of these communities lack the resources and in-house expertise necessary to apply for grants and loans to help make wastewater projects more feasible, and often do not have the technical expertise to determine the best project alternative to appropriately plan and manage long-term operations and maintenance needs. Thus, as SAWPA moves forward with its Integrated Regional Watershed Management Planning, best practices to help with DAC assessments and stakeholder engagement will be critical.

DACs also face many of the same challenges as their neighboring communities, including:

- Limited funding/funding sources
- High infrastructure costs
- Poor water quality
- Limited water supplies
- Failing septic systems/undersized treatment facilities
- Increasing demands on existing water resources
- Flooding or drought
- Inadequate community support
- Limited project communication

Groundwater is highly used throughout the state of California and in SARW. DACs in particular tap this vital resource as their primary drinking water source. **Figure 5.11-3** depicts the various groundwater contaminant plumes (volatile organic compounds (VOC), perchlorate, and VOC and perchlorate) in or near these disadvantaged or Tribal communities within the SARW.

**Figure 5.11-3 DACs, Tribal Communities and Known Groundwater Contaminant Plumes**




## Future DAC Support and Implementation

The 'Quail Valley Subarea 9, Phase 1 Sewer System Project' and 'Home Gardens Well Rehabilitation, Corona - Multi-jurisdictional Transmission Line Project' were approved for Round 2 Proposition 84 funding and will have significant value-added benefits not only for the DAC areas involved, but for the surrounding communities and water agencies that work with these entities. The early engagement process with DACs can't be overstated.

These proposed projects were scored, ranked and proposed for funding under OWOW Proposition 84 Round 2 Implementation. OWOW 2.0 calls for all of SARW to see the links between stormwater management and local water supply, land use and water quality, and accommodation of a growing population with finite water resources. It is only through a view of the watershed as an integrated system that SAWPA and its member agencies can successfully develop operational efficiencies system-wide. These DAC projects as well as future ones will help achieve that objective.

## Best Practices for DAC Engagement and Participation

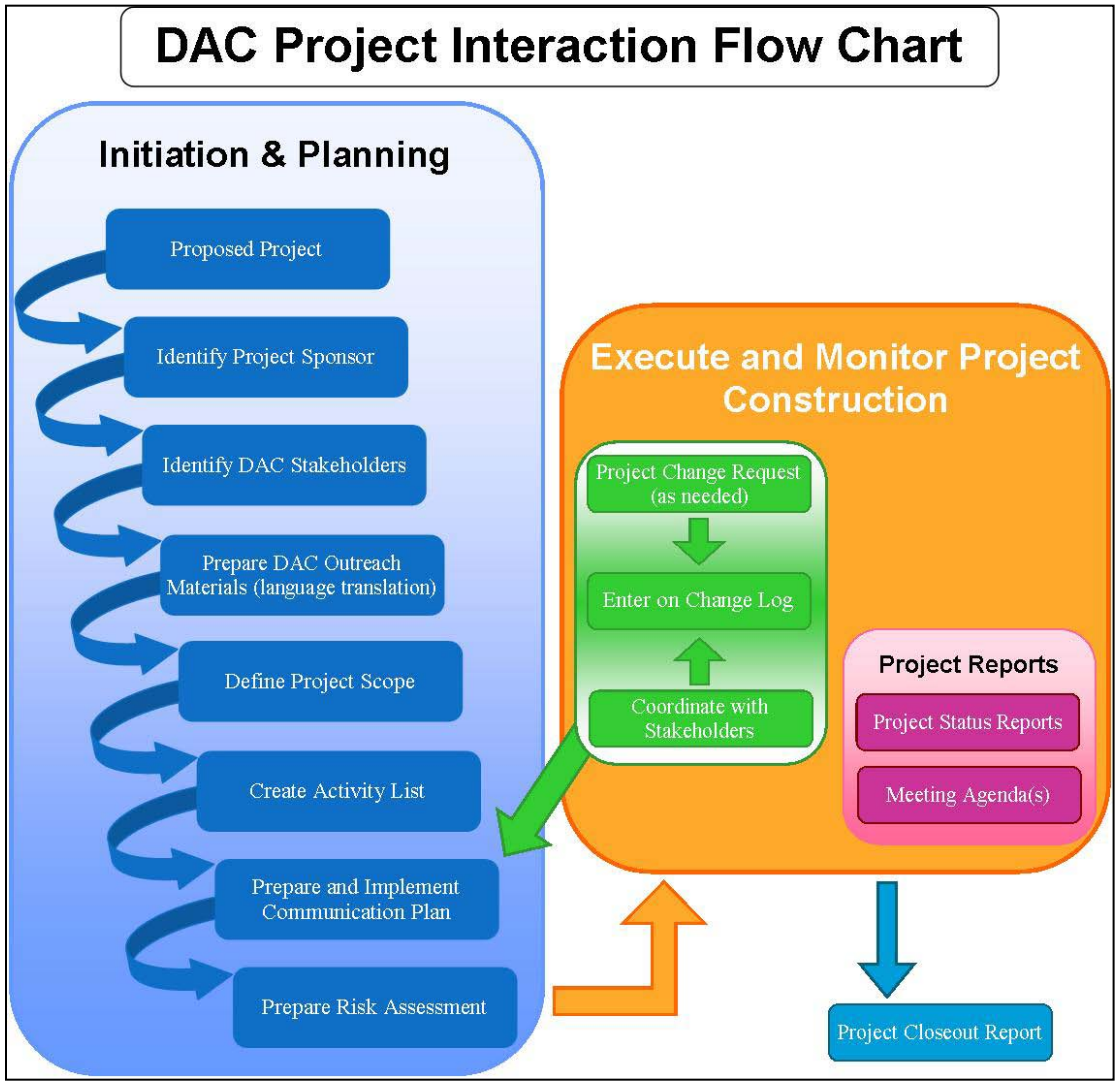
At times, community outreach is seen as a cursory notification for an upcoming event. For many water agencies, it may be conducted by sending a billing notice with an insert, or using an email blast or a website posting. However, these outreach methods should be modified to effectively work with DACs. It may be possible that English is not a DAC population's first language, and substantial cultural differences may also affect message reception. To effectively communicate the impact of a potential project, water and other public service agencies should create diverse lines of communication with their stakeholders and customers.

A participatory planning process - one in which all the stakeholders are involved - is often the most effective and inclusive way to work with DAC residents. This process provides community ownership and support; information about community history, politics, and past mistakes; and respect and a voice for everyone. It also takes time, care, mutual respect, and commitment. To conduct such a process well, stakeholders must be identified, and communication techniques must be used that are specifically designed to reach them. Also, the process must be maintained over time, so momentum will not be lost. By implementing a planning process that meets all these requirements, it is likely that SAWPA can conduct successful community interactions that truly work and meet DACs' unique needs.

Through direct assistance to DAC drinking water and wastewater treatment facility managers, many systems can begin to achieve compliance with health and safety regulations. Or the solution may lie in consolidating with adjacent systems so as to gain an economy of scale that assures fiscal sustainability. Either way, the goal of a safe, reliable, and sustainable water system is essential to securing protection to the public health, economy, and environment of California's rural and economically disadvantaged communities.

**Figure 5.11-4** lists some of the activities that should be considered and/or implemented when conducting outreach with DACs.

**Figure 5.11-4 SARW Disadvantaged Communities Engagement Flow Chart**



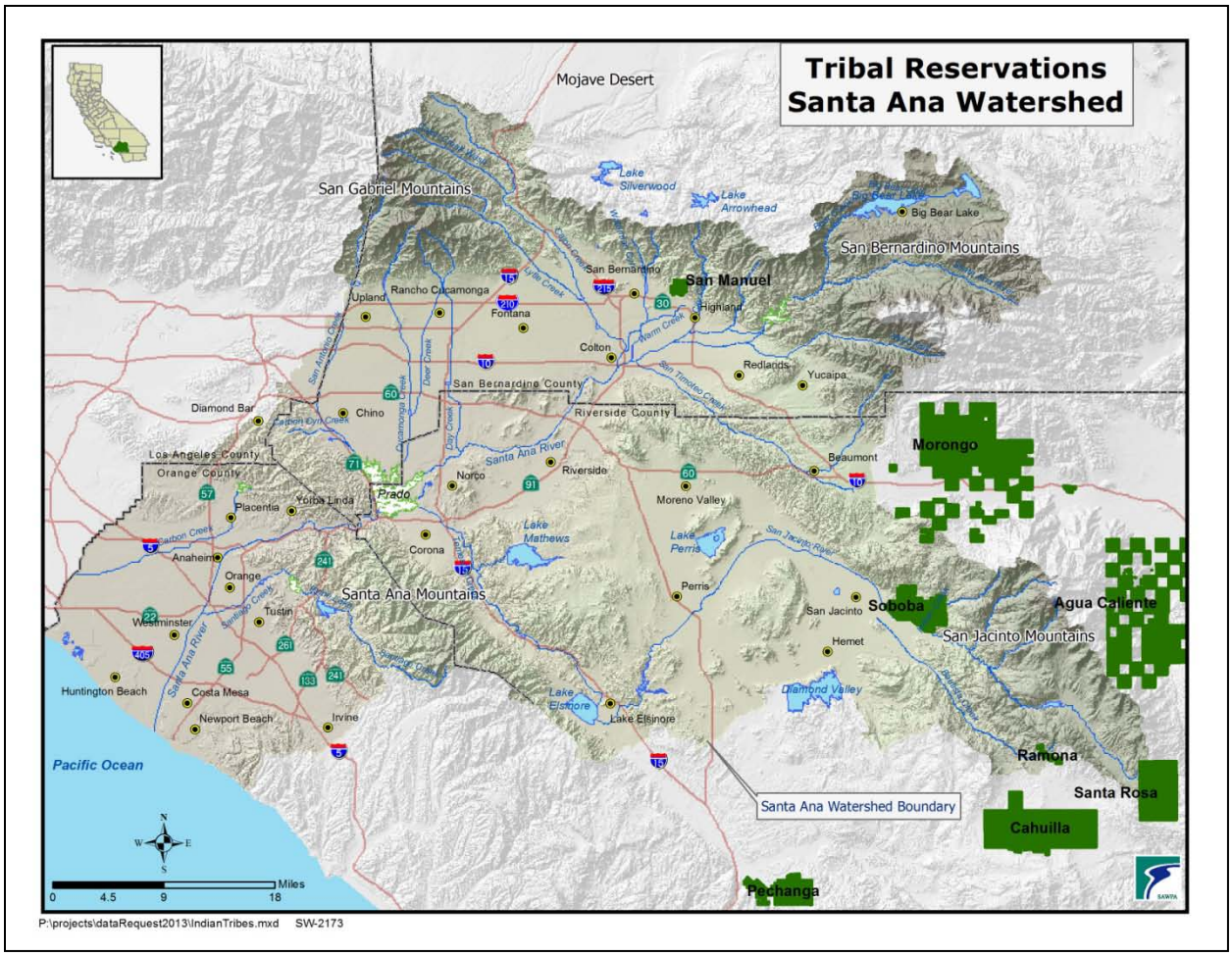

## Native American Indian Tribes

### Definitions

**Federally Recognized Tribe:** As identified in CFR Section 900.6 an Indian Tribe "means any Indian tribe, band, nation or other organized group or community, including pueblos, Rancherias, colonies and any Alaska Native Village, or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act, which recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians."

**Non-Federally Recognized Tribe:** According to the U.S. Department of the Interior, a non-recognized tribe has no relationship with the United States. Congress, not the Department of the Interior, has the final word as to whether a tribe should be federally recognized and whether a non-recognized tribe may nevertheless receive certain federal benefits. All of this information is represented in **Figure 5.11-5.**

**Figure 5.11-5 SARW Native American Tribal Communities**




## Methodology for Assessing the Tribes

The OWOW 2.0 update process ensures Tribes have a voice and provides a means for these cultures to be equal and active participants with other stakeholders, encouraging early participation in the actions taken within the watershed that could impact them. The region's Tribes believe that the past is the foundation of their future. To ensure the culture and traditions of these Tribes are embraced in the process, it is important to provide a means to educate the stakeholders early on, as well. As part of the outreach process, the four Santa Ana Watershed Tribes were contacted, although not all provided input to this document. Outreach was extended to neighboring Tribes, as well.

## Santa Ana River Watershed Tribes

The Soboba Band of Luiseno Indians, the San Manuel Band of Serrano Mission Indians, the Morongo Band of Mission Indians, and the Santa Rosa Band of Cahuilla Indians reside within the SARW boundary. Just outside the communities of the Agua Caliente Band of Cahuilla Indians, the Cahuilla Band of Mission Indians, the Ramona Band of Cahuilla Mission Indians, and the Pechanga Band of Luiseno Indians. For purposes of this Chapter and the Reclamation report, contact was made with all these Tribes.

## Tribal Challenges and Opportunities

Water resources in the Santa Ana River Watershed consist of local surface water and groundwater, imported surface water, and reclaimed water. In many cases, the water challenges Tribes encounter are no different than local, state, or federal challenges. A decision to use water for a particular purpose can have far-reaching impacts which can affect not only state and local communities, but the Tribal communities as well. Early in the planning process, it is particularly important to include Tribes to ensure their possibly unique requirements may be recognized.

Listed below are potential water management issues on tribal lands:

- Groundwater overdraft
- Insufficient groundwater supply
- Growing water demands
- Habitat conservation planning requirements
- County groundwater ordinances (if applicable)
- Impact of neighboring communities
- Inadequate water recycling facilities
- Adverse impact of groundwater depletion on water quality
- Increased runoff from newly developed impervious surfaces
- High cost of imported water
- Chlorine sediments
- Inadequate flood protection infrastructure
- Tribal lands in flood inundation areas
- California Environmental Quality Act compliance

## Future Tribal Support and Implementation

Similar to approaches with DACs, the importance of an early engagement and effective outreach with Tribes cannot be overstated. Though only four Tribes are within the SARW, they have important roles in their neighboring communities as well as the region's economy. Additionally, more work and coordination is needed to isolate water and related resources issues in these communities, and make SAWPA and its member agencies aware of requirements for unique Tribal activities. Consultation protocols with Tribes should be used by senior Santa Ana Watershed Project Authority and District staff. Improving coordination with regulating agencies like the Santa Ana Regional Water Quality Control Board and EPA will also help characterize issues and solutions.

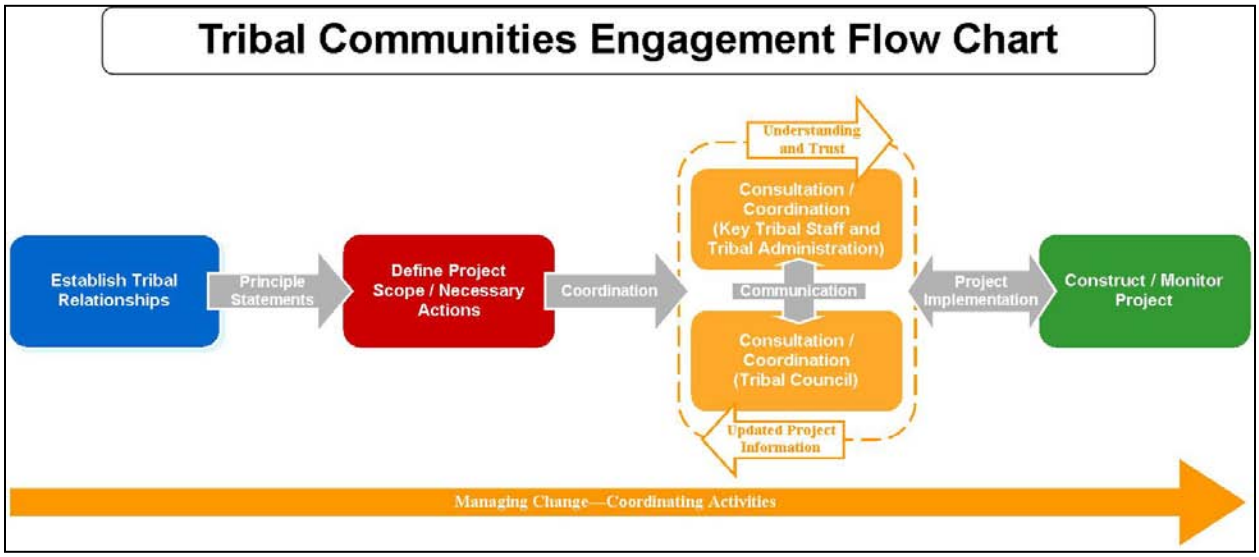
### *Soboba Band of Luiseño Indians Wastewater Treatment Project*

One success story is already in the making. The Soboba Band of Luiseño Indians joined forces with Eastern Municipal Water District, Lake Hemet Municipal Water District, and the federal Bureau of Indian Affairs to propose a Wastewater Treatment Plan project for Round 2 Proposition 84 funding. After review by the Project Selection Committee, it was ranked and prioritized and recommended for funding. This $15 million wastewater treatment plant on the Soboba Indian Reservation will improve the health and welfare of Soboba tribal members, and extend local water supplies by reclaiming previously unused low-quality water. Also, under an historic agreement among the Tribe and two local water agencies – Eastern and Lake Hemet Municipal Water Districts – the partners will cooperatively restore and protect the health of the San Jacinto River groundwater basin, part of the SARW that provides valuable water resources to the region. The Soboba wastewater treatment plant will address much needed water and sewer improvements on the reservation, positively impacting tribal members for generations to come, and will improve the quality of life for non-Tribal citizens residing near the reservation.

## Best Practices for Tribal Engagement and Participation

A variety of goals and actions for tribal involvement are in the Reclamation report, but **Figure 5.11-6** offers a step-by-step process to successfully engage Tribes in decision-making related to water resources programs.

**Figure 5.11-6 Tribal Engagement Process**




# Conclusion

Engaging DACs and Tribes in water and related resources planning through effective outreach is good for both the community and the water sector itself. There are distinct differences due to cultural and

historic context; however, the two groups have more in common. Both need their voices heard during proposed project development.

Today, DACs and Tribes face critical and serious water and related resources challenges, such as failing septic systems, isolation, language barriers, flood risk, and lack of funding and or resources to name a few. It is imperative that the water sector and its key stakeholders recognize proposed DAC and Tribe water project needs, and engage these communities early in the process. The OWOW 2.0 process recognizes the various funding needs for DACs and Tribes, and the Federal and State funding programs available to them.

Water sector outreach and engagement should include speaking with DAC residents, listening to their issues, attending Tribal Council meetings, participating on DAC and or Tribal-related committees, and conducting continuous networking. These actions could lead to consensus-based development and implementation project solutions for these groups, and the sooner that approach is under taken by the water sector, the better for everyone within the SARW.

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# 5.12 Government Alliance



## Introduction

The One Water One Watershed (OWOW) Government Alliance Pillar (Pillar) was established under the Santa Ana Watershed Project Authority's (SAWPA) update of their Integrated Regional Water Management (IRWM) Plan, also known as the OWOW 2.0 Plan.

From May 2011 through June 2013, the Pillar met 14 times. Collectively, it had 29 active participants from 10 Federal agencies, two Tribal Nations, eight State agencies, and four local government agencies which are listed below.

**Federal Agencies**
- Department of the Defense
  - Army Corps of Engineers
- Department of the Interior
  - Bureau of Indian Affairs
  - Bureau of Reclamation
  - U.S. Fish and Wildlife Service
  - U.S. Geological Survey
  - National Park Service
- Department of Commerce
  - National Marine Fisheries Service
- U.S. Department of Agriculture
  - Natural Resources and Conservation Service
  - Rural Development
  - U.S. Forest Service

**Tribal Nations**
- San Manuel Band of Mission Indians Tribe
- Soboba Band of Luiseño Indians Tribe

**State Agencies**
- Natural Resources Agency
- Department of Water Resources
- State Parks
- Department of Public Health
- Department of Fish and Wildlife
- Department of Transportation
- Department of Forestry and Fire Protection
- Santa Ana Regional Water Quality Control Board

**Local Government Agencies**
- Santa Ana Watershed Project Authority
- Riverside County Emergency Services
- Riverside County Flood Control and Water Conservation District
- Santa Ana Regional Water Quality Control Board

It's noteworthy to also point out that the U.S. Federal Emergency Management Agency and the U.S. Environmental Protection Agency both requested ongoing information updates on the Pillar's activities; meeting notes and notices were provided to those designated agency representatives.

In the beginning of the OWOW 2.0 water resource planning process, the Pillar met for a brainstorming session. SAWPA staff provided planning guidance, while group discussions focused on regional and integrated projects and programs concepts that could benefit the watershed as a whole. The Pillar also forged potential long-term alliances, and addressed each agency's involvement in existing or planned programs throughout the watershed. Proposed projects and programs that resulted from past proposals submitted by watershed stakeholders were also addressed.

Two key goals of this Pillar are: 1) leverage watershed information and potential resources from governmental agencies and seek out synergistic opportunities; and 2) consider large-scale ideas for implementation.

As part of the Government Partnerships Pillar planning process, a *Resource Guide* (**Appendix H**) was developed that lists contact information for governmental agencies within and outside the watershed that support the OWOW efforts. It provides a compilation of all the governmental organization contacts with ties to the Watershed including Federal, Tribal, and State agencies, and the local water agencies from the three counties within the Watershed's boundary. The Guide also contains key resources from documents like the *California Climate Adaptation Strategy* and the *California Water Plan Update*; tools for users like the *Water Energy Relationship Report and Water Equivalents Table*; key websites; applicable Federal and State laws for the water sector; and an A-to-Z list of key terms, acronyms and concepts. The *Resource Guide* contains valuable information that the Pillar members hope that SAWPA and its member agencies and stakeholders will find useful in promoting collaboration with agencies on future regional integrated projects and programs.

Luna Leopold, an early pioneer of water science, proclaimed: "The health of our waters is the principal measure how we live on the land." The Pillar hopes that the *Resource Guide's* useful information is measured by its frequent use and will ensure that periodic updates are conducted to help maintain its value.

## A Pillar's Path to Success

Every plan and the supporting processes to help enhance or refine a strategy must connect with its key components. But identifying these components can be challenging. This Pillar's path to develop a "planned" approach for OWOW 2.0 process success began with a simple seven step outline (**Table 5.12-1**) to document all the steps necessary for an "integrated planning" blueprint.

**Table 5.12-1 Seven Step Outline for Integrated Planning**

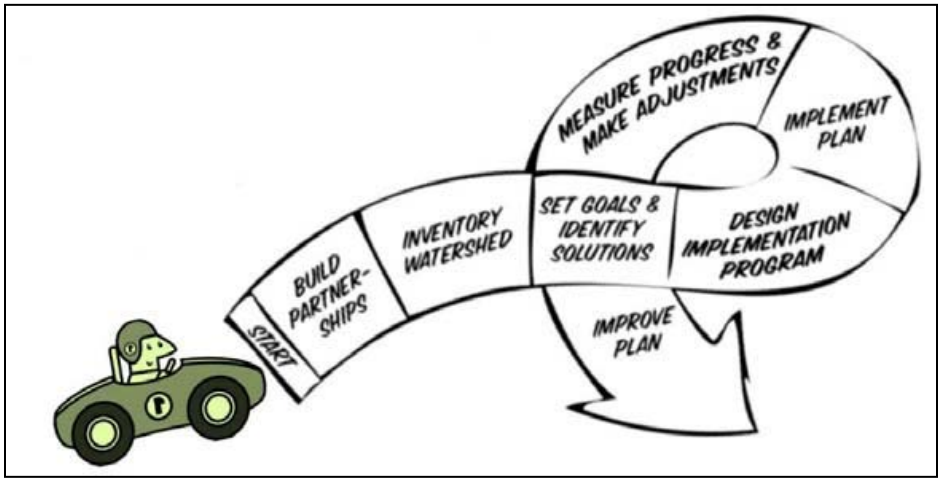
| | |
|---|---|
| 1 | Build Partnerships |
| 2 | Characterize the Watershed |
| 3 | Set Goals and Identify Solutions |
| 4 | Design an Implementation Program |
| 5 | Develop Watershed Plan Outline |
| 6 | Implement the Watershed Plan |
| 7 | Measure Progress and Make Adjustments |

Through Pillar meetings, relationships were built and partnerships were formed as the participants shared critical information and developed collaborative ideas. Over time, a new outline was created which reflected the increasing sophistication of the process.

## The Road Less Traveled

A roadmap metaphor (**Figure 5.12-1**) helped the Pillar further address the planning process and approach, and reflected both short and long-term Pillar goals to complement OWOW 2.0 goals. It also helped the Pillar reach consensus about the priorities of Pillar members, and recognized that a mechanism was needed to help forecast proposed projects for development. The roadmap, as a framework, helped the Pillar plan and coordinate information on the development of a proposed project or activity.

**Figure 5.12-1 Pillar Roadmap**




## OWOW 1.0 Phase…and Beyond

The Government Partnerships Pillar was established in 2011 as part of SAWPA's initial OWOW planning effort. It was formed based on a desire to forge improved working relationships among the various

governmental agencies in the watershed, and support interaction among watershed stakeholders and governmental agencies as new integrated projects and programs were advanced.

The two Pillar co-leads were selected from the U.S. Army Corps of Engineers and the Bureau of Reclamation. Several additional Federal, Tribal, State, and Local governmental agency representatives helped forge several key alliances to foster collaboration within the watershed. The multi-agency engagement in this Pillar's activities helped pave the way to enhance communications among the agencies and close any coordination gaps that may have existed.

Today, the OWOW 2.0 vision is for a sustainable watershed that is drought-proof, salt-balanced, and supports economic and environmental viability. SAWPA and its member agencies and stakeholders will be able to achieve that mission with continued coordination and communication with the various Federal, Tribal, State, and local government agencies that support and/or regulate planning and proposed project development in the watershed. Long-term collaboration among the many participating agencies, new synergies, and multi-beneficial projects must be developed to help maintain the Watershed's sustainability, now and into the future.

## Key Pillar Success Stories

### Fourteen meetings over two years

*Nine 'Themed' Presentations:*

- EPA's Web-based Watershed Planning Tools
- Community Collaborative Rain, Hail, & Snow Network
- Riverside County's Water & Dam Emergency Response and Army Corps of Engineers Dam Emergency Management Program Overview
- Caltrans Planning
- Regional Advanced Mitigation Planning
- Riparian Habitat Joint Venture
- Forest First
- EPA Climate Change Indicators

*Seven 'Big Ideas' Brainstormed:*

- Group Purchasing: leveraging member agencies' buying power for supplies and services
- Energy Savings: engaging member agencies in collaborative partnerships to reduce carbon footprints and save energy
- Site/Facility Security: sharing security expertise among the member agencies to protect personnel, equipment and facilities
- Climate Change/Adaptation: exploring improved joint agency planning through adaptive development and implementation strategies

- Water Conservation: collaborating and partnering among member agencies and other entities to save water through outreach and education
- Sustainability: promoting the goals of OWOW through member agencies promoting wise use of water and energy
- Right-of-Way Dual-Use: working with Caltrans and local governments to use land right-of-ways to collect and store more water in the watershed

*Four Video Reviews:*

- **Watershed** - http://www.youtube.com/watch?v=3mcHrzOImoY – a James Redford production that explores creating a water ethic in the West
- **Last Call at the Oasis** - http://www.youtube.com/watch?v=fLE3i92LkQk – a Jessica Yu production that addresses our world's growing water crisis
- **Climate change video series** - http://www.water.ca.gov/climatechange/video.cfm – a California Department of Water Resources series that addresses planning and adapting to effects of climate change
- **The Next Frontier: Engineering the Golden Age of Green** - http://www.thenextfrontiermovie.com/ – an award-winning documentary that addresses the use of fossil fuels and their impacts on our growing greenhouse gas emissions and possible mitigation strategies

## Next Steps for the Pillar

The Government Alliance Pillar will continue to ensure that Federal and State agencies effectively partner in the management of water and other resources within the watershed, and consider other Pillar's perspectives in their support of OWOW 2.0 goals and objectives. The Pillar will:

- Periodically publish updates of the *Resource Guide* and post them on SAWPA's website
- Conduct an email blast to continue contact with Pillar members
- Encourage active networking with SAWPA's planning team
- Ensure reminders are sent out well in advance of proposed future meetings

The Pillar should continue to meet at a minimum annually and preferably bi-annually. There are many dynamic regulatory and governmental activities in the watershed, so the need to continue and maintain vital program and activity communication is critical. To maintain these lines of communication, the Pillar will:

- Periodically develop agendas and host Pillar meetings to keep lines of communication open and relationships strong
- Leverage the *Resource Guide's* agency contacts, and assure that steps are taken to keep all information current

- Continue coordination with various governmental agencies, as appropriate, for all proposed projects, initiatives, and integrated water and related resources activities to help identify necessary environmental compliance requirements and or potential areas of conflict

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Mark Norton, Santa Ana Watershed Project Authority Project Manager
Jeff Beehler, (formerly Santa Ana Watershed Project Authority)
Other Government Contacts are included in Resource Guide shown in the **Appendix H**.

# 5.13 Energy and Environmental Impact Response



Inland Empire Utilities Agency

In 2005, the California Energy Commission investigated statewide energy use and found that water-related energy uses account for about 19 percent of all electricity and 30 percent of non-powerplant natural gas used within California. Since that finding, some progress has been made in identifying strategies for achieving benefits found at the nexus of water, energy and climate. In 2006, the California Public Utilities Commission (CPUC) conducted a number of workshops to explore whether – and how – the water-energy nexus should be included in the state's regulated energy programs. Concurrently, the California Department of Water Resources (DWR) began investigating how the linkages among water, energy and climate should be included in the state's water planning processes. Since that time, DWR has required consideration of the water-energy nexus in competition for Integrated Regional Water Management (IRWM) planning grants, and has also included elements of the state's water-energy-climate nexus in the California Water Plan.

In examining the water-energy nexus in greater detail, an important white paper was published in September 2012 by GEI Consultants entitled "California's Water Energy Nexus: Pathways to Implementation." The white paper was funded by the Water-Energy Team of the Governor's Climate Action Team (WET-CAT) for the purpose of facilitating the on-going dialogue among policymakers and regulators as to the types of actions that can be taken by California's water sector to help achieve the state's aggressive resource efficiency, economic and environmental goals.

GEI summarized key findings and recommendations that suggest that water and wastewater agencies have unique characteristics that could be leveraged through appropriate partnerships to provide significant benefits to the state's electric system. As a result of the sizeable energy impact by water and wastewater agencies, the GEI report indicates that Santa Ana Watershed Project Authority (SAWPA), as a water resources management agency, is uniquely positioned to collaborate with and help California attain its energy efficiency, renewable energy and greenhouse gas reduction goals. Many areas of the state, water and wastewater agencies may have the capacity through their lands, facilities and professional staff to generate significant new amounts of renewable energy through solar, biogas, wind and other sources. Other agencies have the flexibility to consider feasible changes for when and how they use energy that are consistent with maintaining reliable water deliveries and public safety.

The two overarching conclusions from GEI's white paper are:

- *The choices that the water and wastewater agency sector make to invest in energy efficiency and renewable energy generation, matter to California*
- *It is rare to have so much opportunity for making such a positive and powerful impact – improvements in energy efficiency, renewable energy generation and reduction in greenhouse gases – concentrated into one sector. It is an opportunity that cannot be ignored*

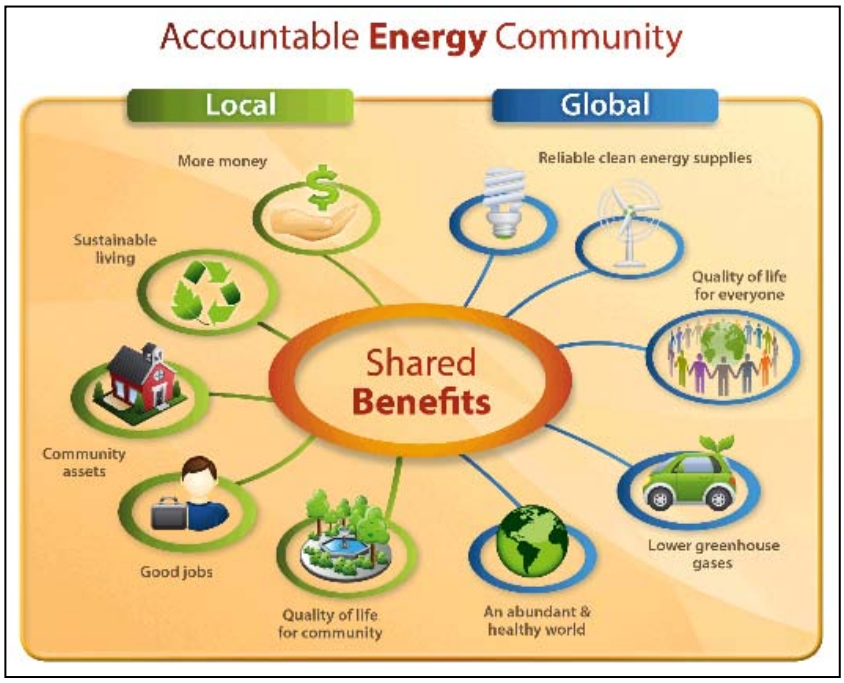
Under OWOW 1.0, a chapter was prepared by the Climate Change Pillar describing the impacts of climate change on the water resources-related projects. That chapter described the climate change impacts and various broad-based implementation strategies that the watershed should take to mitigate and adapt to these impacts. Under the OWOW 2.0 Plan, SAWPA reformed the Pillar as the "Energy and Environmental Impact Response" Pillar recognizing that each IRWM region needs to not only address climate change, but must also recognize and mobilize implementation actions to reduce energy demand and improve energy efficiencies in the water and wastewater industries in their areas. Craig Perkins, executive director of The Energy Coalition, a non-profit organization based in Irvine, California was named Co-chair of the new Energy and Environmental Response Pillar. Roy Herndon from Orange County Water District (OCWD) was named co-chair. The Pillar's work focused on: 1) energy outreach to the water and wastewater industries, and 2) development of new and updated climate change models and forecasting tools as supported by the U.S. Department of the Interior's Bureau of Reclamation (Reclamation).

# Water-Energy Projects

## The Energy Coalition

The Energy Coalition is a non-profit organization formed to develop and implement energy blueprints – the plans and strategies that integrate these energy efficiency practices to help schools, businesses, and governments. The Energy Coalition created The Energy Network, a program funded by the CPUC to provide a suite of services that increase participation in energy efficiency projects. The Energy Network's services are available to public agencies in the Southern California Edison and Southern California Gas service territories. A team of professionals is working through The Energy Network to develop a regional model for local government collaboration statewide to support accountable energy communities.

**Figure 5.13-1 Shared Benefits of an Accountable Energy Community**
(source: The Energy Coalition)




One specific area of focus for The Network is engaging water and wastewater agencies in energy efficiency projects through the development of aggressive energy management programs. While including the retrofit of aging infrastructure equipment, an ideal efficiency project will complete a system-wide optimization designed to reduce energy inputs throughout facility operations (see **Table 5.13-1**). With funding through the CPUC, the services offered to water districts and other public agencies are free of charge, and utilize an expedited project delivery model, cutting the time to construct in half for many projects and significantly reducing the completion costs. Technical, engineering, and project management services are also available to public agencies enrolled in The Energy Network program.

**Table 5.13-1 Energy Efficiency Measures for Water Management Facilities**

| Wastewater Facility Sample Measures | |
|---|---|
| Design and Control of Aeration Systems | Peak flow storage and/or intermittent aeration |
| | Dual impeller aerator (mechanical mixing) |
| | Integrated airflow control |
| | Automated SRT/DO Control (Solids Retention Time and Dissolved Oxygen) |
| | Respirometry for aeration control |
| | Off-gas monitoring and control |
| | Online monitoring and control of nitrification using nicotinamide adenine dinucleotide (NADH) |
| | Proprietary control systems |
| Blower and Diffuser Technology for Aeration Systems | High-speed gearless (turbo) blowers |
| | Single-stage centrifugal blowers with inlet guide vanes and variable diffuser vanes |
| | Ultra-fine bubble diffusers |
| | New diffuser cleaning technology |
| Innovative and Emerging Energy Conservation Measures for Selected Treatment Processes | Low-pressure high-output lamps for UV disinfection |
| | Automated channel routing for UV disinfection |
| | Membrane air scour alternatives |
| | Hyperbolic mixers |
| | Pulsed large bubble mixing |
| Energy Conservation Measures for Solids Processing | Vertical linear motion mixer |
| | Upgrade of multiple hearth furnaces to incorporate waste heat recovery/combustion air pre-heating |
| | Solar drying |
| **Water Distribution System Sample Measures** | |
| Supply and Conveyance | Install high efficiency pumps |
| | Shift distribution pumping to off-peak hours and utilize reservoirs when possible |
| | Shift water pumping from the summer months to other months |
| Water Treatment | Install high efficiency pumps |
| | Develop lower energy intensity water treatment methods |
| | Shift water treatment to off-peak and partial peak times |
| Distribution | Install high efficiency pumps |
| | Shift water pumping to off-peak and partial peak times |
| End-Use | Increase energy efficiency of water heating and pumping devices |
| | Reduce the use of once-through cooling, thereby slowing reliance on treated water supplies |
| | Save energy by conserving water |

By providing unbiased expertise and premium engineering services, The Energy Network addresses the common barriers that prevent many local governments and public agencies with limited resources from adopting energy saving measures. These new services will complement and support services provided by existing programs offered by the electric and gas utilities.

Under the first phase of a program specifically designed to work with water and wastewater agencies, The Energy Network is providing free technical, project management, financing and rebate information to cities, municipalities, and water agencies looking to pursue energy efficiency projects to improve facilities' performance and streamline capital improvement processes. The Network's technical staff, in

close collaboration with SAWPA, is conducting a number of outreach meetings to explain the program and engage water and wastewater agencies throughout the Santa Ana River Watershed (SARW).

The Energy Network will provide energy resources, expertise and technical assistance to multiple water and wastewater agencies to develop strategic energy management plans for municipal energy efficiency projects. The Network also offers assistance with securing an energy project master lease option to help agencies pay for projects that are beyond their current budget capacities. This private sector financing will enable participating agencies to pay for retrofits without up-front funding. The Energy Network will serve as a model for energy efficiency retrofit implementation and financing statewide. The following resources to the water and wastewater agencies in the SARW are being made available:

- Technical and project management support
- Competitive private sector funding
- Construction management support, including procurement and contractor coordination
- Aggregated procurement of equipment and construction services
- A data management platform that supports energy management and permitting
- Evaluation and assessment of energy efficiency opportunities to reduce operating costs

Multiple meetings among water and wastewater agencies throughout the SARW SARW were held with The Energy Network Project Manager James Ferro, with support of SAWPA staff, to explain these services and to explore opportunities to reduce energy consumption by water agencies within the watershed.

## Water-Energy Innovation Projects

A majority of public utility departments in the SARW encourage the implementation of projects that capture renewable sources of energy. These renewable energy projects are often recommended to businesses and homeowners through the use of financial incentives. However, water and wastewater agencies, both public and private, share the same benefits of renewable energy. Due to energy-intensive water infrastructure, such as pump stations and treatment facilities, water agencies implementing renewable energy collection systems benefit from considerable cost savings. These collection systems also assist in stabilizing the California Energy Grid by “giving back” to the grid.

Of those water agencies implementing a form of renewable energy, the most common water-energy innovation projects currently envisioned and being implemented are forms of solar and wind energy collection systems. These projects often range from modifications of wastewater treatment plant processes to installing windmills to utilizing solar panels that also provide shaded parking spaces. A few agencies are also exploring innovative, less conventional sources of renewable energy such as using food-waste to create energy to power their wastewater treatment plants, or mini-turbines installed in their water pipelines to create electricity. These renewable water-energy innovation projects not only

cut energy costs for municipal agencies, but are better for the environment. An overview of water-energy projects within the SARW are described in detail below.

### *Inland Empire Utilities Agency 'Go Gridless by 2020'*

The Inland Empire Utilities Agency (IEUA) is committed to building a better environment through better business practices. In addition to its LEED Platinum-level design administrative headquarters, IEUA is pursuing a progressive energy management strategy to be self-sufficient or 'gridless' by the year 2020. In 2008, IEUA installed 3.5 megawatts of solar power at its water recycling facilities and at the Inland Empire Regional Composting Facility. The solar energy saves IEUA hundreds of thousands of dollars a year on energy costs. In 2010 IEUA signed a 20-year Power Purchase Agreement with Anaergia Services to install, operate and maintain a 2.8-megawatt (MW) fuel cell system at the IEUA RP-1 Water Recycling Facility. Under the agreement, Anaergia is responsible for funding, design, construction, operation and maintenance of the system. IEUA will purchase power generated from the fuel cell plant at the agreed-upon price over the next 20 years, and use the heat generated from the process to heat the anaerobic digesters. The fuel cell plant will be fueled primarily with renewable biogas, making it the largest unit of its kind in the world. In 2012, IEUA installed 1 MW of wind energy at its northern water recycling plant. The treatment plant is located where a persistent wind source is available to drive a wind turbine, generating enough electricity to power the plant and provide an annual savings of more than $100,000 in electricity costs. Together, the existing and planned projects will generate 10+ megawatts of renewable energy for the agency.

### *Western Municipal Water District - Solar Power System*

The Western Riverside County Regional Wastewater Authority (WRCRWA), which is managed by Western Municipal Water District (WMWD), has more than 5,000 solar panels covering nine acres at the WRCRWA's wastewater treatment plant. This system can provide up to 1 MW of energy during peak energy use hours. WRCRWA is committed to utilizing renewable energy sources to help lower the amount of greenhouse gases released into the atmosphere.



The solar panels track the sun, increasing sunlight capture by up to 30 percent more than conventional fixed-tilt systems. At its peak, the solar panels provide 25 percent of the power needed to operate the wastewater treatment plant.

This will help reduce WRCRWA's energy costs as the price of electricity increases in the years to come. It also increases the reliability of the plant and protects the region against power outages by reducing the burden on the California electrical grid during peak demand.

### *The Metropolitan Water District of Southern California – Skinner Solar Array*

As part of an ongoing district-wide sustainability initiative, The Metropolitan Water District of Southern California activated a 10-acre solar power facility at its Robert A. Skinner Water Treatment Plant in Riverside County. The one-megawatt solar installation generates about 2.4 million kilowatt-hours (kWh) of clean, renewable energy a year.



### *Eastern Municipal Water District Solar Photovoltaic Renewable Energy Project*

A 500-kilowatt (kW) solar photovoltaic renewable energy facility was constructed at Eastern Municipal Water District's (EMWD) Administrative Campus to provide approximately 1 to 1.2 MWs for its Administrative Campus in the City of Perris. The site, adjacent to the I-215 freeway, provides high visibility for the project to the public. The panels are ground-mounted, with underground electrical transmission conduits, instrumentation conduits, and other related appurtenances.

### *EMWD Digester Gas Driven Fuel Cells*

These fuel cells allow EMWD to run some of its Moreno Valley and Perris Valley Regional Water Reclamation facilities during peak hours virtually free of charge, with no toxic emissions, cutting greenhouse gases by more than 10,600 tons annually—the equivalent of taking approximately 1,000 cars off the road for one year. The fuel cells use an electrochemical process that generates significantly less pollution than combustion technologies by converting the chemical energy in fuel (hydrogen) into electricity through a non-combustion process that is virtually emissions free. The conversion produces heat that can be used for cogeneration (cogen) or other processes and operates on a variety of fuels – including digester gas. The cogen process in a wastewater treatment plant is the simultaneous generation of electricity and recovery of usable heat from engines, fuel cells, microturbines, or other generation technologies. Recovered heat is often used to heat anaerobic digesters, which enhance the production of digester gas. This may then be used as a renewable fuel source within an EMWD wastewater treatment plant to power equipment or to generate electricity.



### *Elsinore Valley Municipal Water District Solar Project*



With increasing energy costs and California's requirement to become more reliant on renewable energy sources, Elsinore Valley Municipal Water District's (EVMWD) solar power project supplies enough energy – more than 1 million kWh of electricity a year – to run the District's Administration building, saving money, resources, and reducing carbon emissions. This project is part of the District's long-term plan to reduce overhead costs and, in turn, reduce costs for EVMWD customers.

### *Riverside Public Utilities Spherical and Steam-Powered Turbines*

Riverside Public Utilities (RPU) was selected by the California-Nevada Section of the American Water Works Association to receive its 2011 Outstanding Energy Management Award, for its in-system study of a water pipe that generates electricity. The award recognizes top water utilities whose energy management in operation of potable water supplies provides cost savings attributed to innovative, significant, and transferable techniques.

Developed through a partnership with Lucid Energy Technologies of Portland, Oregon, and Northwest Pipe Company of Vancouver, Washington, a portion of a gravity-fed water pipe is fitted with a vertical axis spherical turbine, which spins as water passes it, generating electricity. The world's first prototype unit was installed inside a 48-inch water pipe in Riverside in February 2010. Riverside was chosen as the pilot project city for this new technology based on RPU's progressive quest to find new renewable energy resources and the City's ongoing commitments to create a more sustainable and environmentally stable community.

The first generation system of the in-line power pipe produced a maximum of 7 kW of electricity at full flow on a continuous basis. Through monitoring, redesign, and installing prototypes, Northwest Pipe Co. and Lucid Energy have been able to increase that output to 20 kW with the third generation turbine that is currently in place. The third generation unit alone has already produced more than 23 megawatt-hours of energy.

RPU's newly acquired Clearwater Cogeneration Power Plant (Clearwater) was purchased from the City of Corona in 2010. Clearwater produces approximately 22 MWs from a natural gas-fired single combustion turbine generator, which is similar to those that RPU operates at its facilities. Additionally, Clearwater cogenerates an additional 8 MW of power by utilizing the heat produced by the gas-fired generator in boilers, which in turn create the steam that is needed to power a steam turbine generator on site. In addition to producing environmentally friendly power, Clearwater helps reduce energy procurement

costs for RPU, which helps the agency provide high quality, reliable power to its customers at the lowest rates possible.

The City Council authorized RPU to move forward with an agreement with Shoshone Renaissance LLC that provides 64 MW of renewable geothermal power resources for the city, increasing its renewable resources portfolio to 33 percent in 2011. Geothermal power plants utilize super-heated fluid from the Earth to create pressurized steam, which is used to turn the blades of a turbine that creates electricity. Compared to solar or wind generation sources (which don't produce energy at night or when there is no wind), geothermal plants provide reliable sources of energy for utilities to use for baseload needs. At full capacity, the 64 MW received through the new facility will provide 20 percent of Riverside's baseload.

### *San Bernardino Municipal Water District Methane Gas Generators*

The San Bernardino Municipal Water Reclamation Plant (WRP) reuses resources generated during the wastewater treatment processes. Since 2000, methane gas has been used as a renewable energy source to power two pump stations operated by San Bernardino Municipal Water District. In 2010, a co-generation facility was installed at the WRP which uses the methane gas produced during the treatment processes as a source of energy. This highly valuable energy source is used to fuel two 750-watt generators, which supply electricity to the WRP, minimizing the amount of electricity required to be purchased for WRP operations.

### *Irvine Ranch Water District Food Waste to Energy / Solar Project*

The Irvine Ranch Water District (IRWD) is evaluating several potential projects for renewable energy sources to be implemented as early as 2014. The IRWD Food Waste Energy Project evaluates the collection and use of pre-processed and liquefied food waste to increase digester gas production to be used to generate electricity. Equipment would include a food waste receiving station and microturbine generators. The IRWD Solar Program evaluates the potential for future solar projects, and various purchase structures including: IRWD-owned and -operated, a power purchase agreement, and a land lease to a solar developer at Jackson Ranch.

### *Cucamonga Valley Water District Solar Project*

The Cucamonga Valley Water District (CVWD) joined with SolarWorld California to construct a new ground-mounted solar energy system and Environmental Learning Center in 2006. Designed to augment the energy needs of CVWD particularly during peak summer demand periods, the system also serves as an on-site example of clean energy production for the students who visit the Environmental Learning Center. It is innovatively designed to teach children from grades K-12 about their role in preserving the environment.

The solar system was designed in response to CVWD’s visionary approach to satisfy long-term energy needs, provide a hedge against rising electricity rates, and proactively preserve and protect the environment. Consisting of 1,416 modules, the 274 kW system annually generates 380,000 kWh. The system also eliminates the production of 240 metric tons of carbon dioxide per year, or the pollution an average car emits over 10,132 days. SolarWorld's proprietary panelization process, consisting of a factory-assembled design, allows for more efficient installation and virtually eliminates packaging.

CVWD has indicated that the project will ultimately reduce the required power load by 27 percent. As part of the Self-Gen Program, Southern California Edison defrayed a significant portion of the installation cost with a $720,000 rebate to CVWD.

### *City of Redlands Wastewater Treatment Plant Photovoltaic Array*

In 2011, the City of Redlands implemented a project to install a photovoltaic array on property located at the city's wastewater treatment plant (WWTP). The WWTP is a city-owned facility that operates 24 hours per day, 365 days per the year. It is a high-energy user, and can use as much as 239,000 kWh during a 32-day billing cycle. An Energy Efficiency and Conservation Block Grant project will contribute to other efforts designed to make this high-energy-use facility into a greener, leaner operation. Under this renewable energy project, the city would develop a scope of work and construction documents for competitive bid. The scope of work includes installation of a photovoltaic array on a piece of property referred to as the brine pond, which has a surface area of roughly 42,124 square feet on which to perform the installation. Project components of this installation are: 627 solar panels at 175 watts each; a 100-kW power inverter with AC/DC current disconnects; and other integration parts such as combiner boxes and MC connectors. The solar panel installation will yield an estimated system size of 113 kilowatts with an estimated output of 14,416 kWh per month. The city estimates the cost of the project to be $678,400 for the equipment and installation. This project will contribute to an overall improvement in energy efficiency of the WWTP.

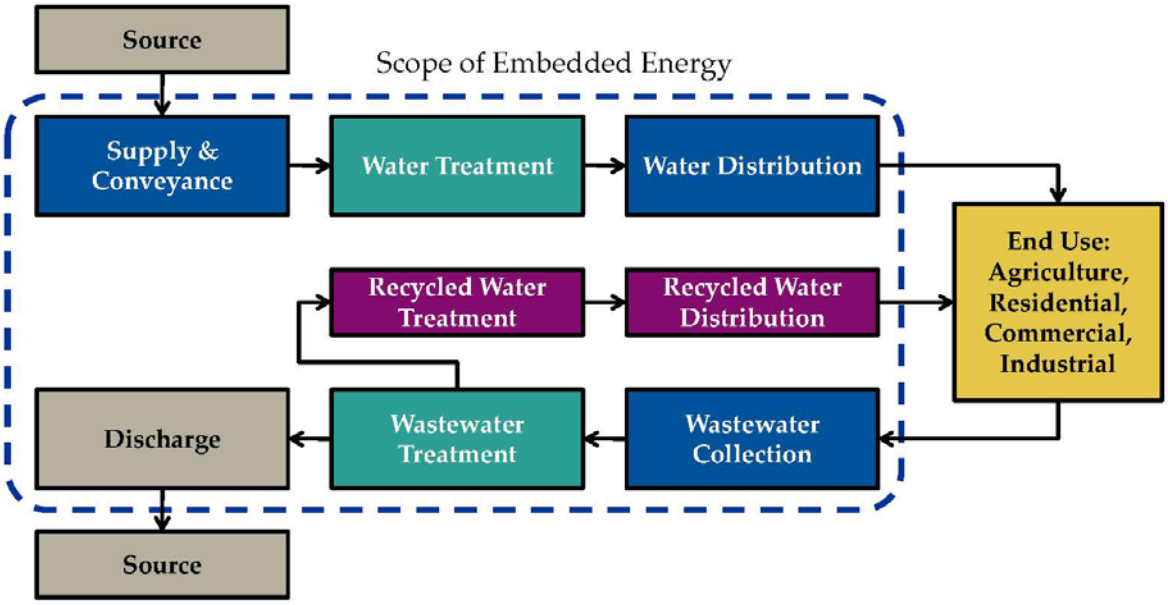
## Future Opportunities

The Energy Network is also leading a water/energy nexus pilot project designed to facilitate the implementation of water efficiency projects that capture embedded energy savings. Many discussions on how to quantify embedded energy in water savings have occurred at the statewide level, yet little has been done to move forward on identifying the lost opportunities of doing nothing. The pilot project has brought together a team of experts from academia, the private sector, and the government throughout California to apply a scientifically robust energy intensity factor to a portfolio of water supplies at the watershed level. Using historical data collected from SAWPA member agencies, this metric will be applied to completed water efficiency measures and rebates issued within the watershed from SAWPA member agencies from 2010-2012. This data will be compiled and presented in the form of a report to the CPUC and other interested state agencies to support the inclusion of embedded energy rebates for water efficiency projects in the next program cycle.

The second phase of this project will integrate high energy intensity water efficiency measures into The Energy Network's offerings for public agencies to implement as part of their energy efficiency strategies through the Network's comprehensive project delivery method. The third and final phase of the pilot will result in the publication of a 'how-to guide' for public agencies looking to broaden their energy and water efficiency programs, including the identification of high energy intensity water efficiency projects that can result in significant energy savings for the state.

The Energy Coalition, in coordination with SAWPA, is also developing a white paper describing the increased opportunities that are available by capturing the embedded energy in the water use cycle.

**Figure 5.13-2 Scope of Embedded Energy** (Source: Navigant Consulting, Inc.)




In June 2013, the importance of this program came to light as news was announced that one of the major power generating facilities serving Southern California, the San Onofre Nuclear Generating Site (SONGS), would be decommissioned due to safety concerns. In late June 2013, SAWPA conducted an outreach and education program for retail water agency public information officers in SARW. With the assistance of the Governor's Office of Research, public message points and outreach graphics on the water-energy nexus were prepared, which focused on the message of "saving energy could be accomplished by saving water." The outcome of the meetings was the understanding that, while most Californians know about the importance of conserving water, many require a greater awareness of the importance of saving energy, and few know about the direct connection between saving both.

Saving water could help water and wastewater providers save energy which, in turn, saves consumers money. As a result, message points and graphics for outreach material were shared among the water retail agencies in SARW to mobilize for important summer requirements associated with the SONGS shutdown. This timely messaging by the water retail agencies in the watershed reflects an excellent example of collaboration and integration of water-energy nexus outreach messaging.

Also, in the past decade renewable energy projects have become increasingly efficient and popular sources of energy. Many wastewater treatment plants in the SARW are using fuel cells as a way to store energy and recycle the heat produced. Solar panels are being considered to provide energy to reduce operations costs have now become the norm. Windmills have not become as popular as solar or fuel cell technology, but have been implemented at a limited scale. This is primarily due to the limited reliable wind patterns in developed areas and possible concern with aesthetics. With several agencies researching and developing innovative sources of renewable energy, such as the mini-turbines placed in water pipelines and collecting energy produced during the wastewater treatment process, as well as

local energy rebates being offered by federal and state government, the probability of increased levels of reliable and renewable sources of energy is very likely. In the near future, one can expect to see more water agencies moving to be "gridless" through renewable energy projects.

# Climate Change Assessment

## Introduction

In 2009, the newly published OWOW Plan addressed the impacts of climate change on the SARW on a very broad scale based on the available science at the time. Climate change science has and continues to evolve; however, incontrovertible evidence suggests that changing weather patterns can have a profound impact on California and within the SARW. To help assess possible long-term effects, SAWPA and the Reclamation entered into a partnership in the Spring of 2011 under the SECURE Water Act (Title IX, Subtitle F of Public Law 111-11) through the U.S. Department of the Interior's WaterSMART (Sustain and Manage America's Resources for Tomorrow) program and used Reclamation's West-wide Climate Risk Assessment to help conduct a thorough climate change analysis for SARW.

In updating OWOW 1.0, SAWPA identified several tasks related to climate change that could benefit from Reclamation technical assistance. Results from Reclamation's climate change analysis addressed SARW's water supply and demand projections and can help identify necessary adaptation strategies in light of projected effects from climate change. Key findings in Reclamation's *Technical Memorandum (TM) No. 86-68210-2013-02: Climate Change Analysis for the Santa Ana River Watershed* (**Appendix F2**) were used to update OWOW 1.0's Chapter 5.9: Climate Change, and to evaluate new research information on climate change implications for SARW. That information was also used to help assess increased energy demand to comply with the state's mandated Assembly Bill (AB) 32, Global Warming Solutions Act, and to help ensure SARW's future water supply and demand needs are met.

SAWPA, its five member agencies, and key water sector stakeholders know that warmer temperatures, altered patterns of precipitation and runoff, and rising sea levels are, in all likelihood, going to continue to increase and may potentially compromise local and imported water supplies and SARW's environmental resources, and challenge sustainability of SARW communities. SARW's water sector awareness to these unfolding events and development of associated adaptation strategies will help water agencies assess impacts on local water supply, infrastructure, and imported water sources, including the State Water Project (SWP).

Responding to climate change within the SARW presents significant challenges. Climate change impacts and vulnerabilities will vary in each SARW sub-region, and the resources available to each water agency to effectively respond to climate change will also vary.

Regional solutions and integrated projects, such as those proposed through the OWOW 1.0 and 2.0 Call for Projects, are vital to SARW's future and key to addressing and developing necessary adaptation strategies to help combat effects of climate change.

The basis for this Chapter update is **Appendix F2**, as noted above, and the key findings extracted to help frame this update. Reclamation's TM explains the methods used to analyze potential implications of

changing climate, and how those implications might affect issues of importance to SAWPA and the SARW.

Chapter 1 of **Appendix F2** provides an introduction to the project and the study area, along with a summary of relevant previous studies. The development of climate projections and hydrology models can be found in Chapter 2. Chapter 3 provides projections for SARW's water supply and demand for water years 1951- 2009. These projections are summarized and highlighted below. An impact analysis was also conducted that focused on key areas of importance in SARW, and these results can be found in Chapter 4 of **Appendix F2**. Also, a tool to help SAWPA evaluate its water demand management is presented in Chapter 5, along with a case study of potential adaptation strategies. Finally in Chapter 6, uncertainties are addressed relative to SARW's climate change analysis. A SARW vulnerability assessment is included.

In light of climate change, prolonged drought conditions, potential economic growth, and population projections, a strong concern exists to ensure an adequate water supply will be available to meet SARW's future water demands. The goals from this analysis include: incorporating existing regional and local planning studies within the watershed; sustaining the innovative "bottom up" approach to regional water resources management planning; ensuring an integrated, collaborative approach; using science and technology to assess climate change and greenhouse emissions effects; facilitating watershed adaptation planning; and expanding outreach to all major water uses and stakeholders.

## Projections for the Watershed

Global climate models (GCMs) used in this **Appendix F2** were downscaled to 12-kilometer grids to make them relevant for regional analysis. The downscaled GCM projections are produced by internationally recognized climate modeling centers around the world and make use of greenhouse gas (GHG) emissions scenarios, which include assumptions of projected population growth and economic activity.

Future water supply was analyzed for the SARW using the downscaled GCMs and a hydrologic model to project streamflow using 112 different projections of future climate. Projected climate variables, including daily precipitation, minimum temperature, maximum temperature, and wind speed were included, as well as historical model simulations over the period 1950-1999. Final products include data sets at key locations for precipitation, temperature, evapotranspiration, April 1 Snow Water Equivalent (SWE), and streamflow.

These data sets were used to answer the following frequently asked questions regarding impacts of climate change on the watershed:

### *Will surface water supply decrease?*

- Annual surface water is likely to decrease over future periods.
- Precipitation shows somewhat long-term decreasing trends.
- Temperature will increase, which is likely to cause increased water demand and reservoir evaporation.
- April 1$^{st}$ SWE will decrease.

*Will groundwater availability be reduced?*

- Groundwater currently provides approximately 54 percent of total water supply in an average year, and groundwater use is projected to increase over the next 20 years.
- Projected decreases in precipitation and increases in temperature will decrease natural recharge throughout the basin.
- Management actions such as reducing municipal and industrial water demands or increasing trans-basin water imports and recharge will be required to maintain current groundwater levels.
- A basin-scale groundwater screening tool was developed to facilitate analysis of basin-scale effects of conservation, increasing imported supply, changing agricultural land use, and other factors on basin-scale groundwater conditions.

*Is Lake Elsinore in danger of drying up?*

- Lake Elsinore has less than a 10 percent chance of drying up by 2099.
- In the 2000-2049 period, Lake Elsinore has a greater than 75 percent chance of meeting the minimum elevation goal of 1,240 feet (ft).
- In the future period 2050-2099, Lake Elsinore has less than a 50 percent chance of meeting the minimum elevation goal of 1,240 ft.
- There is less than a 25 percent chance that Lake Elsinore will drop below low lake levels (1,234 ft) in either period.
- The EVMWD project does aid in stabilizing lake levels; however, for the period 2050-2099, additional measures will likely be required to help meet the minimum elevation goal of 1,240 ft.

*Will the region continue to support an alpine climate and how will the Jeffrey Pine ecosystem be impacted?*

- Warmer temperatures will likely cause Jeffrey pines to move to higher elevations and may decrease their total habitat.
- Forest health may also be influenced by changes in the magnitude and frequency of wildfires or infestations.
- Alpine ecosystems are vulnerable to climate change because they have little ability to expand to higher elevations.
- Across the State, it is projected that alpine forests will decrease in area by 50 to 70 percent by 2100.

*Will skiing at Big Bear Mountain Resorts be sustained?*

- Simulations indicate significant decreases in April 1$^{st}$ snowpack that amplify throughout the 21$^{st}$ century.
- Warmer temperatures will also result in a delayed onset and shortened ski season.

- Lower elevations are most vulnerable to increasing temperatures.
- Both Big Bear Mountain Resorts lie below 3,000 meters and are projected to experience declining snowpack that could exceed 70 percent by 2070.

*How many additional days over 95°F are expected in Anaheim, Riverside and Big Bear City?*

- All the climate projections demonstrate clear increasing temperature trends.
- Increasing temperatures will result in a greater number of days above 95°F in the future.
- The number of days above 95°F gets progressively larger for all cities advancing into the future.
- By 2070 it is projected that the number of days above 95°F will quadruple in Anaheim (4 to 16 days) and nearly double in Riverside (43 to 82 days). The number of days above 95°F at Big Bear City is projected to increase from 0 days historically to 4 days in 2070.

*Will floods become more severe and threaten flood infrastructure?*

- Simulations indicate a significant increase in flow for 200-year storm events in the future.
- The likelihood of experiencing what was historically a 200-year event will nearly double (i.e. the 200-year historical event is likely to be closer to a 100-year event in the future).
- Findings indicate an increased risk of severe floods in the future, though there is large variability between climate simulations.

*How will climate change and sea level rise affect coastal communities and beaches?*

- Climate change will contribute to global sea level rise (SLR) through melting of glaciers and ice caps and thermal expansion of ocean waters, both of which increase the volume of ocean water.
- Regional SLR may be higher or lower than global SLR due to effects of regional ocean and atmospheric circulation.
- Average sea levels along the Southern California coast are projected to rise by 5 to 24 inches by 2050 and 16 to 66 inches by 2100.
- SLR is likely to inundate beaches and coastal wetlands and may increase coastal erosion. Effects on local beaches depend on changes in coastal ocean currents and storm intensity, which are highly uncertain at this time.
- SLR will increase the area at risk of inundation due to a 100-year flood event.
- Existing barriers are sufficient to deter seawater intrusion at Talbert and Alamitos gaps under a 3-foot rise in sea levels. However, operation of barriers under SLR may be constrained by shallow groundwater concerns.

All these Frequently Asked Questions and their answers were documented in a series of fact sheets that supplement this analysis; they are presented as **Appendix F1** to this chapter.

## Climate Change Analysis Methodology

Reclamation conducted an extensive literature review relevant to SARW, and also consulted with IEUA about their 2006 work with the RAND Corporation and the National Science Foundation that was used to prepare the Climate Change chapter for the SARW's 2010 OWOW 1.0 Plan. The RAND report evaluated case studies addressing water management decision-making under conditions of abrupt climate change.

Under the OWOW 1.0 Plan's Climate Change chapter, the IEUA's 2005 Urban Water Management Plan (UWMP) was used to create a baseline case for water management. That plan emphasized development of local supplies and a reduced dependence on imported water supplies.

Under base-year conditions, approximately 70 percent of the water supplies come from local sources (e.g., groundwater, recycled water, and desalted groundwater supplies). These ratios of potential water supply sources are relatively common throughout SARW, but in some regions are less so, and some are more dependent on imported water. The UWMP projected that IEUA would be able meet nearly 80 percent of its service area water demand by 2025.

The RAND study showed that IEUA's 2005 UWMP performed well under many potential climate change scenarios. Still, after four years of research, SARW faces significant risk to its water supply sources if nothing more is done now or in the future, especially to develop additional local supplies.

The core vulnerability identified from the UWMP model run was the region's continued reliance on imported water supply; climate change scenarios show that imported supply is likely to be severely impacted by declines in statewide precipitation. The most cost-effective scenarios were those which included significant improvements in local water use efficiency along with the development of additional conjunctive use and recycled water programs.

For the OWOW 2.0 Plan Climate Change evaluation, **Appendix F2**, Reclamation reviewed a large body of research that has been conducted over the past ten or more years on climate change and how the western United States might be affected. Most of this research has focused on large-scale implications (for example, over the western United States), while providing limited regional scale information. The following section summarizes research that is relevant to the SARW, and shows that although these results are applicable, additional research was required – through this Basin Study – to evaluate smaller scale, site specific, climate change impacts.

Reclamation also used a combined physical and statistical modeling approach for the climate change research. Specific details on these approaches can be found in the report.

Observed trends in hydroclimatology over the western United States will likely have significant impacts on water resources planning and management. There have been preliminary efforts by agencies managing California's water resources to incorporate climate change research into their planning and management tools, including preliminary modeling studies of potential impacts of climate change to operations of the SWP and Central Valley Project, Delta water quality and water levels, flood forecasting and evapotranspiration rates.

Weather projections for SARW, reflective of climate changes predicted by the scientific community's global climate models, were developed. That data was used with a water management model to evaluate how various water management scenarios for the region would perform under different scenarios of climate and other management options.

The probable scenarios affecting water supplies in SARW included increased temperature but variable precipitation levels. It also was recognized and confirmed by Reclamation's analysis that the statewide climate trends would likely result in reduced snowpack and runoff amounts, which would, in turn, reduce the amount of water that is likely to be available for water imports to the region.

## Water Supply and Demand Summary

**Table 5.13-2** shows a summary of the projected effects of climate change on a variety of hydroclimate metrics for three future periods (above the most downstream location, Santa Ana River at Adams St. Bridge). **Table 5.13-3** shows a summary of projected water demands out to 2050.

**Table 5.13-2 Summary of Effects of Climate Change on Supply**

| Hydroclimate Metric (change from 1990's) | 2020's | 2050's | 2070's |
|---|---|---|---|
| Precipitation (%) | 0.67 | -5.41 | - 8.09 |
| Mean Temperature (%) | 1.22 | 3.11 | 4.1 |
| April 1st SWE (%) | -39.93 | -80.4 | -93.07 |
| Annual Runoff (%) | 2.6 | - 10.08 | -14.61 |
| December-March Runoff (%) | 9.82 | - 3.01 | -6.38 |
| April-July Runoff (%) | -6.35 | - 25.24 | -31.39 |

**Table 5.13-3 Summary of Water Demand for the Santa Ana River Watershed**

| | 1990 | 2000 | 2010 | Present | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|
| **Demand (MAFY)** | **.0924** | **1.121** | **1.298** | **1.339** | **1.503** | **1.723** | **1.958** | **2.178** |

Imported water for the SARW will also likely be affected by the changing climate. The 2011 SWP Reliability report projects a temperature increase of 1.3° to 4.0° F by mid-century and 2.7° to 8.1° F by the end of the 21st century. It predicts that increased temperatures will lead to less snowfall at lower elevations and decreased snowpack. By mid-century it predicts that Sierra Nevada snowpack will reduce

by 25 to 40 percent of its historical average. Decreased snowpack is projected to be greater in the northern Sierra Nevada, closer to the origin of SWP water, than in the southern Sierra Nevada. Furthermore, an increase in "rain on snow" events may lead to earlier runoff.

Given these changes, a water shortage worse than the 1977 drought could occur one out of every six to eight years by the middle of the 21st century and one out of every two to four years by the end of 21st century. Also, warmer temperatures might lead to increased demand. This factor, combined with declining flows, will likely lead to decreased carryover storage from year to year. Alternative water supply options, such as recycled water, rainwater harvesting, and desalination may need to be relied upon in order to meet the continually growing demand.

## Sea Level Rise Impacts

Climate change will contribute to global SLR through melting of glaciers and ice caps and thermal expansion of ocean waters, both of which increase the volume of water in the oceans. Regional SLR may be higher or lower than global SLR due to effects of regional ocean and atmospheric circulation.

California's 2,000 miles of coastline has experienced just under eight inches of sea level rise over the past decade, a number that is likely to increase drastically as the climate continues to change. Critical infrastructure, such as roads, hospitals, schools, emergency facilities, wastewater treatment plants, power plants, and more will also be at increased risk of inundation, as would vast areas of wetlands and other natural ecosystems.

Flooding and erosion already pose a threat to communities along the California coast and there is compelling evidence that these risks will increase in the future. In areas where the coast erodes easily, SLR will likely accelerate shoreline recession due to erosion. Erosion of some barrier dunes may expose previously protected areas to flooding.

OCWD conducted a study to evaluate the potential effects of projected sea level rise on coastal Orange County groundwater conditions. Two locations were selected near the Talbert and Alamitos seawater intrusion injection barriers for analysis. The model for the analysis used data from well logs, aquifer pump tests, groundwater elevation measurements, hand-drawn contour maps, geologic cross sections, water budget spreadsheets, and other data stored in OCWD's Water Resources Management System database.

The results showed that increasing temperatures will melt ice sheets and glaciers and cause thermal expansion of ocean water, both of which will increase the volume of water in the oceans and thus contribute to global mean SLR. Regional SLR may be higher or lower than global mean SLR due to regional changes in atmospheric and ocean circulation patterns. Regional mean sea level along the Southern California coast is projected to rise by 1.5 to 12 inches by 2030, 5 to 24 inches by 2050, and 16 to 66 inches by 2100.

Inundation due to SLR is likely to reduce the area of beaches and wetlands along the Southern California coast. In addition, SLR is likely to increase erosion of sea cliffs, bluffs, sand bars, dunes, and beaches

along the California coast. However, the overall effects of climate change on local beaches will depend on changes in coastal ocean currents and storm intensities, which are less certain at this time.

SLR is likely to increase the coastal area vulnerable to flooding during storm events. Also, detailed analysis carried out by OCWD found that the Talbert Barrier would be effective at preventing seawater intrusions through the Talbert Gap under a 3-foot sea level rise. In the case of the Alamitos Barrier, seawater intrusion through the Alamitos Gap would likely be prevented once current plans to construct additional injection wells are implemented. At both barriers, however, shallow groundwater concerns could limit injection rates and thus reduce the effectiveness of the barriers in preventing seawater intrusion under rising sea levels.

## Addressing Climate Change

Addressing climate change in OWOW 2.0 provides SAWPA staff, the OWOW Steering Committee, OWOW Pillars, and SARW's water sector stakeholders with specific information necessary to plan, assess, and rank proposed IRWM projects. These proposed projects must address reductions to greenhouse gas (GHG) emissions within their water management activities. Projects are given a performance measure to help determine how effectively criteria are addressed, which helps with the ranking process.

Proposed projects that could be funded under the DWR IRWM Proposition 84 grant program and other funding programs can help adapt or mitigate effects from climate change, as they are required to track the effectiveness and performance of GHG emissions during and after implementation and construction.

SAWPA is a member in good standing with the California Climate Action Registry, and encourages SAWPA's member agencies and water sector partners to also do the same. SAWPA also continuously tracks legislative developments at the Federal and State level that deal with climate change, especially as it relates to IRWM planning.

SAWPA and key watershed stakeholders continuously analyze current, past, and or proposed legislation and policies relative to the water sector, and the context of Executive Orders (EO), such as EO S-3-05, the California Global Warming Solutions Act of 2006 (AB 32); Senate Bill 97, the California Environmental Quality Act (CEQA) and GHG Emissions; and EO S-13-18, Climate Adaptation Strategy. The following list of publications, updates, and presentations, relative to California and climate change, have been reviewed and are continuously being monitored.

- Update to the Climate Change Scoping Plan, California Air Resources Board (2013)
- California Climate Adaptation Strategy, California Natural Resources Agency (2013 Update)
- Preparing for New Risks: Addressing Climate Change in California's Urban Water Management Plans, University of California - Berkeley and DWR (June 2013)
- Sea-Level Rise for Coasts of California, Oregon, and Washington: Past, Present, and Future, The National Academies Press (June 2012)
- Atmospheric Rivers, Floods, and Climate Change, DWR (January 2012)

- Climate Change and Integrated Regional Water Management in California, University of California - Berkeley and DWR (June 2012)
- Climate Change, Extreme Weather, and Southern California Floods, DWR (January 2012)
- Draft Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan, DWR (March 2012)
- Proposition 84 and 1E Guidelines Update, DWR (November 2012)
- California Adaptation Planning Guide, California Emergency Management Agency and Natural Resources Agency (July 2012)
- Climate Change Handbook for Regional Water Planning, DWR (November 2011)
- Water & Climate Change Adaptation Symposium: From the Sierra to the Ocean, DWR (October 2011)
- Annual Climate Change Reports, DWR (2008, 2009, 2010, & 2011).

The following table shows additional portions of the OWOW 2.0 planning efforts that address climate change.

**Table 5.13-4 Climate Change Information Included in OWOW Plan**

| OWOW Plan Section | Climate Change Information Included |
|---|---|
| SARW Description | Describes likely climate change impacts in SARW, determined by a vulnerability assessment. |
| OWOW Objectives | Adaptation to climate change:<br>• Addresses adapting to changes in the amount, intensity, timing, quality and variability of precipitation, runoff, and recharge.<br>• Considers SLR effects on water supply and other water resource conditions (e.g., recreation, habitat) and identify suitable adaptation measures. Consider the Ocean Protection Council's SLR Policy.<br><br>Reducing emissions (mitigation of GHG):<br>• Reduces carbon consumption, embedded energy in water, and GHG emissions.<br>• Strategies adopted by California Air Resources Board in its AB32 Scoping Plan, including innovative applications.<br>• Options for carbon sequestration where options are integrally (directly or indirectly) tied to OWOW objectives. |
| Resource Management Strategies | Identifies and implements adaptation strategies that address SARW specific or local climate change contributions or impacts. |

| | |
|---|---|
| Project Review Process | Includes these factors:<br>• Contributes to adapting to climate change; and<br>• Contribution to reducing GHGs, compared to the alternative. |
| Local Water Planning to OWOW | Considers and incorporates water management issues and climate change adaptation and mitigation strategies from local plans into OWOW. |
| Relation to Local Land Use Planning | Demonstrates information sharing and collaboration, with regional land use planning in order to manage multiple water demands through the state (as described in CWP Update 2009), adapts water management systems to climate change, and potentially offsets climate change impacts to water supply. |
| Plan Performance and Monitoring | Contains policies and procedures that promote adaptive management. |
| Coordination | Considers the following:<br>• Stay involved in the Natural Resources Agency's California Adaptation Strategy process, and<br>• Join The California Registry (www.theclimateregistry.org) |

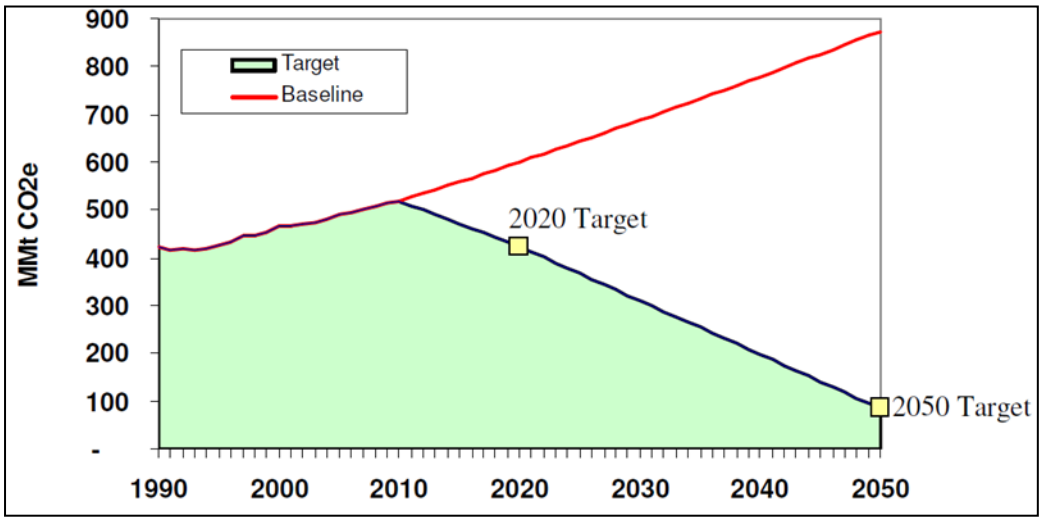
Source: DWR's 2012 Prop 84 and Prop 1E IRWM Guidelines, Table 7

## Greenhouse Gas Reduction

Climate change threatens California's natural environment, economic prosperity, public health, and quality of life. Recognizing the need for action, California has put in place ambitious emission reduction goals in the form of AB 32. By requiring in law a reduction in GHG emissions, California has set the stage to transition to a sustainable, clean energy future, and has put climate change mitigation on the national agenda, spurring action by many other states. AB 32 directly links anthropogenic GHG emissions and climate change, provides a timeline for statewide GHG emissions reduction, requires quantitative accounting of GHG emissions, and enforces disclosure of GHG emissions from every major sector in the state.

AB 32 requires that every major sector in California reduce its GHG emissions to the 1990 levels by 2020, and to 80 percent below the 1990 levels by 2050, shown in **Figure 5.13-3**. These targets were developed from the levels of reduction climate scientists agree is required to stabilize our climate. The red line represents the projected GHG emissions out to 2050, if no action is taken. In order to reach the GHG emissions target set by AB 32 for 2020, a reduction of approximately 30 percent is required from the 'no action' scenario.

**Figure 5.13-3 AB 32 GHG Emission Reduction Targets**




Each water agency must address its carbon footprint to help the region meet the compliance requirements spelled out in AB 32. GHG emissions related to water consumption in the region must be continually measured and reported. A GHG Emissions Calculator developed by Reclamation will help the water sector meet these mandated requirements that drive compliance with projected GHG targets out to 2050. The Calculator allows users within the SARW to easily and quickly evaluate how their water management decisions affect their water demand, energy use, and GHG emissions. A TM on the GHG Emissions Calculator is included as an **Appendix J** to this report.

The TM explains the methods used to develop the calculator and provides instructions on how to use it by introducing examples. The examples focus on the SARW and demonstrate how to develop a GHG emissions baseline, evaluate what actions are required to meet specific GHG emission reduction goals, and illustrate how the GHG Emissions Calculator can be used to analyze projects.

The GHG analysis was designed to take advantage of best available datasets and modeling tools and to follow methodologies documented in peer-reviewed literature. However, there are a number of analytical uncertainties that are not reflected in Reclamation's study results, including uncertainties associated with analytical areas that can be grouped under two categories—climate projection information, and assessing hydrologic impacts that inform many of the Basin Study FAQs.

OWOW 2.0 has taken steps in planning for climate change by examining current climate change projections to determine potential impacts, assessing water resource vulnerabilities, and developing a series of strategies that can be used in projects to adapt to climate change and mitigate GHGs.

The table below lists suggested implementation actions for SARW stakeholders to apply that can help reduce energy consumption and ensure AB 32 Global Warming Solutions Act compliance.

**Table 5.13-5 Implementation Actions to Reduce Energy Consumption**

| Action | Ways and Means |
|---|---|
| Inventory the Water Sector | Calculate the watershed's carbon footprint |
| Promote Energy Conservation | Use appliances and vehicles that are efficient; weatherization; implement temperature controls (on A/C and heating units); turn off lights; install CFP bulbs; install LCD computer screens; and use natural light. |
| Promote Water Conservation | Reduce urban and ag water demands; build resilient communities; and integrate water resources management practices; and promote project collaboration and partnerships. |
| Promote Alternative Energy Use | Install solar, wind, geothermal, tidal, and biomass fuel capacity; and implement any hydropower capabilities. |
| Implement Offsets | Purchase carbon offsets; plant trees; promote innovative approaches and solutions that foster community vitality, environmental quality, and economic prosperity. |
| Review or Implement Effective Policies | Conduct a gap analysis on the watershed's policies on dealing with GHG emissions; create an energy solutions campaign - save energy, reduce carbon footprint; review applicable laws and ordinances; and promote and implement energy efficiencies and sound conservation practices. |

Source: Climate Adaptation Knowledge Exchange, see: www.cakex.org

## Vulnerabilities

To help determine potential watershed vulnerabilities, the Energy and Environmental Impact Response Pillar assessed the Reclamation Climate Change Analysis and all applicable climate change technical data compiled about the SARW and its projected outlook through the year 2099. Reclamation used existing or new climate change models and other resources to help look beyond what was described in OWOW

1.0 and evaluate the amount, intensity, quality, variability of runoff, recharge, and imported water deliveries to the watershed that will potentially result from climate change.

Climate change is projected to affect many aspects of water resources management in the SARW. A critical first step to help prevent and/or mitigate those impacts is identifying key water sector vulnerabilities. Below is a summary of key vulnerabilities relative to the SARW:

**Water Supply**

- Insufficient local water supply
- Increased dependence on imported supply
- Inability to meet water demand during droughts
- Shortage in long-term operational water storage capacity

**Water Quality**

- Poor water quality
- Increased water treatment needs

**Flooding**

- Increased flash flooding and inland flooding damage
- Increased coastal flooding and inundation of coastal community storm drains
- Damage to coastal community sewer systems from sea level rise

**Ecosystem and Habitat**

- Damage to coastal ecosystems and habitats
- Adverse impacts to threatened and sensitive species from reduced terrestrial flows and SLR

Direct coordination with OCWD on SLR modeling in Orange County was also conducted to help assess potential impacts to their seawater intrusion barrier infrastructure and groundwater basins. Another part of critical criteria in addressing SARW's vulnerabilities is dealing with GHG emissions from operations of construction equipment, passenger vehicle trips during construction and operation, transportation of construction materials and equipment, transportation of material inputs and output for operations and maintenance activities, generation of electricity used for project operations, and waste generation and disposal of materials during construction and operations.

## Climate Change Adaptation Strategies

### *OWOW Implementation Activities*

Identifying SARW's vulnerabilities helps establish a foundation for SAWPA staff, its member agencies and key stakeholders to implement actions and employ resource management strategies necessary to address, adapt to, and mitigate the projected effects of climate change. OWOW's Resource Management Strategies, as identified in the OWOW 1.0 Plan and the follow-up implementation activities under the OWOW 2.0 Plan, are detailed in the two tables below.

**Table 5.13-6 OWOW 1.0 Resource Management Strategies**

| OWOW 1.0 Strategy | Description |
|---|---|
| Understand that the past is not the future | Planning within the SARW must include consideration of the potential impacts of climate change, such as reduced precipitation, more intense storm patterns, increased flooding, reduced snow pack decreasing the reliability of imported water, great evaporation of surface water, sea level rise and associated impacts of coastal groundwater basins, and increased stress on natural habitats. |
| Develop watershed-wide programs | Time, money and water can be saved though coordinated program implementation with the SARW. |
| Incorporate climate considerations into land use planning | The development of SmartGrowth Communities, the implementation of Low Impact Development, and improved water efficiency standards will play a significant role in helping the watershed adapt to climate change impacts. |
| Factor in flood and fire management in planning decisions | The steep mountains and alluvial flood plans of the watershed, combined with its historical proclivity towards intense storm events, makes the region more vulnerable to climate change induced flooding and fires, as the intensity of flood and fire events may increase further. |
| Protect and restore aquatic ecosystems | The watershed has a rich array of biological resources that are critical to the quality of life in the region, Healthy ecosystems are more resistant to climate impacts, and enhancement of these systems provide other benefits including water quality, recreation, and flood protection. |
| Make water use efficiency and local water supply development a top priority | Increase investment in water use efficiency, recycled water, stormwater capture, and groundwater storage are vital to the long-term reliability of water supplies for the Watershed. |
| Promote investment in renewable energy, building efficiency, and vehicle efficiency | Transportation, power generation, and heating are primary sources of controllable carbon emissions, and constitute early implementation opportunities for the reduction of greenhouse gases. Wind and solar energy implementation could become significant sources of renewable energy. |

| | |
|---|---|
| Recognize the energy intensity of water supplies | Development of local supplies is acknowledged by the California Air Resources Board as a core adaptation strategy, as well as a way to reduce greenhouse gas emissions under California's AB 32 Scoping Plan. |

The following climate adaptation strategies were developed through a consultative process among Reclamation, SAWPA staff, and three members of the Energy and Environmental Impact Response Pillar. By identifying SARW's vulnerabilities (listed as a 'checklist' in **Appendix F3**), SAWPA staff, its member agencies, and key water sector stakeholders developed the adaptation strategies listed below that will be addressed in OWOW 2.0 Plan activities.

**Table 5.13-7 OWOW 2.0 Implementation Activities**

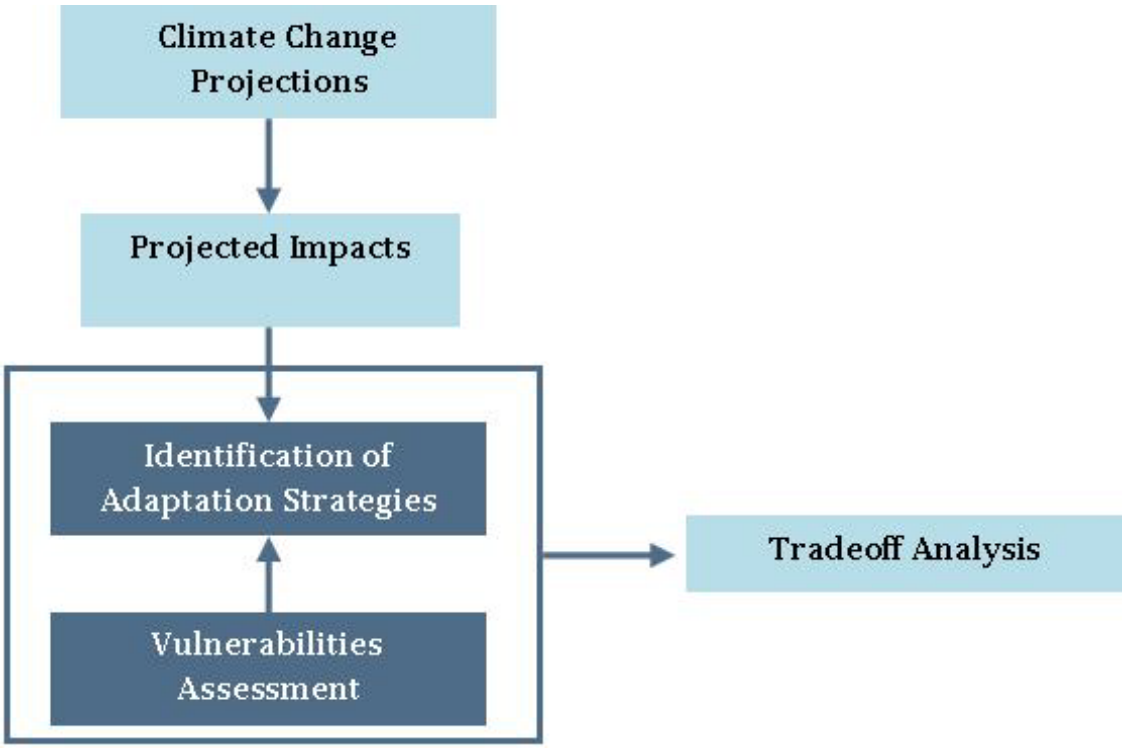
| OWOW 2.0 Implementation Activities | Description |
|---|---|
| Reduce demand | Promote the State's 20 x 2020 Water Conservation Plan in the watershed. |
| Improve operational efficiency | Promote systems reoperations, water transfers, improved local and regional water conveyance projects, reduction in energy consumption, and water transfers. |
| Increase water supply | Promote conjunctive management and groundwater storage; consider brackish and ocean desalination opportunities and more recycled water use, and local and regional surface storage opportunities. Identify watershed supply sources and increase storage capacity, and improve surface water operating efficiencies. |
| Land fallowing | Implement land-use policies that address and reduce agriculture and urban water use; improve flood and fire risk management; identify ecosystems vulnerabilities, and ways/means to improve water quality. Reduce agriculture and landscape water demand, promote xeriscape, and improve water supply reliability. |
| Reduce coastal infrastructure threats | Plan for SLR; optimize coastal infrastructure operations; maintain and improve infrastructure; and reduce flooding impacts on habitat and water quality. |
| Resource stewardship | Improve management of watershed lands, wildlife, and water resources |

| | |
|---|---|
| | through conservation, preservation, and ecosystem restoration. |
| Improve water quality | Improve drinking water treatment, distribution, and groundwater use. Improve stormwater capture practices; address urban landscape improvements and urban runoff management; improve salinity management practices; implement groundwater remediation and pollution prevention practices. |
| AB 32 compliance | Develop methodology for quantifying energy intensity of SARW water supplies and uses. Perform carbon footprint assessment and use the GHG Calculator Tool to identify additional opportunities for reducing carbon emissions. |
| Public education | Increase public outreach and education through the OWOW process |

### *Tradeoff Analysis*

Based on the OWOW 2.0 Plan Energy and Environmental Impact Response Pillar's review and analysis of Reclamation's Climate Change Analysis TM, the SARW is potentially highly sensitive to climate change, with a particular vulnerability to changes in precipitation, temperature, evapotranspiration, snow water equivalent, and streamflow. A Tradeoff Analysis (seen below) was employed to assess the various climate change adaptation strategies noted in the OWOW 2.0 Plan update.

**Figure 5.13-4 Tradeoff Analysis Methodology**



Adaptation strategies (listed in **Table 5.13-8**) were cross-referenced with the vulnerability issues, discussed above, to determine the number and type of climate change vulnerabilities that can be addressed. This interaction is shown in the table below.

**Table 5.13-8 Adaptation Strategies to Address Climate Change Vulnerabilities**

| | | Vulnerability | | | |
|---|---|---|---|---|---|
| | | **Water Supply** | **Water Quality** | **Flood** | **Ecosystem** |
| **Adaptation Strategies** | Reduce Demand | ✓ | ✓ | - | ✓ |
| | Improve Operational Efficiency | ✓ | ✓ | ✓ | ✓ |
| | Increase Water Supply | ✓ | ✓ | - | ✓ |
| | Land Fallowing | ✓ | ✓ | - | ✓ |
| | Reduce Coastal Infrastructure Threat | - | ✓ | ✓ | ✓ |
| | Resource Stewardship | ✓ | ✓ | ✓ | ✓ |
| | Improve Water Quality | ✓ | ✓ | - | ✓ |
| | AB32 Compliance | ✓ | ✓ | ✓ | ✓ |
| | Public Education | ✓ | ✓ | ✓ | ✓ |

In this table, the adaptation strategy addresses vulnerability by marking with a checkmark '✓ '. Analysis of this table demonstrates that four adaptation strategies – improve operational efficiency, resource stewardship, AB32 compliance, and public education – would address the four key vulnerabilities in the watershed.

These four adaptation strategies collectively form what is referred to as the 'no regrets strategy,' a strategy which argues that energy-saving measures should be undertaken immediately to help reduce climate change impacts. Such a strategy is one that would provide benefits in the present while also reducing vulnerability to future climate change impacts. If immediately implemented, such a strategy may provide some benefit even under the uncertainty of climate change projections. Specific actions under the 'no regrets strategy' are listed below.

**Table 5.13-9 Proposed Actions Under a 'No Regrets Strategy'**

| | Proposed Action | | | |
|---|---|---|---|---|
| | Improve Operational Efficiency | Resource Stewardship | AB32 Compliance | Public Education |
| Urban Water Use Efficiency | ✓ | ✓ | ✓ | ✓ |
| Improved Conveyance System | ✓ | ✓ | ✓ | ✓ |
| GW Management | ✓ | ✓ | ✓ | ✓ |
| Pollution Prevention | ✓ | ✓ | ✓ | ✓ |
| Stormwater BMP | ✓ | ✓ | ✓ | ✓ |
| Forestry Management | ✓ | ✓ | ✓ | ✓ |

Description of individual proposed actions under the 'no regrets strategy' is given below.

### *Urban Water Use Efficiency*

Conservation of existing water supplies is of utmost importance to a growing population in the SARW. A representative analysis from Orange County shows that per capita water use will need to be reduced from the current value of about 175 gallons per day (gpd) to about 98 gpd by 2030.

### *Improved Conveyance Systems*

By increasing the efficiency of local and regional conveyance systems, water can be moved at a decreased cost. This is particularly important in the context of being compliant with the AB32 legislation, and is related to urban water use efficiency. With reduced per capita water use, GHG emissions can be

reduced from the current level of about 120,000 GHG emissions to about 75,000 GHG emissions by 2030.

### *Groundwater Management*

By taking into account the balance between groundwater and surface water, managers can improve long-term viability of each resource. Reclamation's Groundwater Screening Tool evaluates impacts to groundwater from a changing climate, and evaluates effective conjunctive surface water groundwater management. The groundwater screening tool was applied to four groundwater basins (Orange County, Upper Santa Ana Valley, San Jacinto, and Elsinore) within the watershed. As an example, potential actions to avoid projected water level declines in Orange County are listed below. Each alternative listed will protect against groundwater declines through 2060.

- Reduce municipal and industrial demand with a gradual reduction of approximately 15 percent by 2020 (i.e., reduce per capita use from ~175 gpd in 2010 to ~150 gpd by 2020 to ~98 gpd by 2030).
- Increase local water supplies by ~75,000 acre-feet (af) per year through recycled water treatment capacity and development of seawater desalination capacity, and increase stormwater capture efficiency.
- Increase imports from the Colorado River Aqueduct and SWP gradually from ~30,000 af per year to ~105,000 af per year (this may not be feasible due to cost, greenhouse gas emissions, or availability).
- Reduce summertime groundwater pumping.

### *Pollution Prevention*

Preventing and remediating polluted water resources improves quality for users and improves long-term viability of local resources. This includes improved salt management in brackish desalinization and water reuse systems in the SARW. Specific alternatives analyzed include:

- Modify the existing Brine Line system.
- Salton Sea considerations including, restoration plans, salt load and increased water supply to the sea.
- Brine pre-treatment strategies.
- Alternative pipeline alignments including easement, right of way, and designs.
- Remediate polluted groundwater to reduce treatment of larger quantities of migrating water (future avoided costs).

### *Stormwater Best Management Practices*

Implementing stormwater best management practices (BMP) reduces storm runoff and pollution, improves groundwater recharge, improves air quality, reduces heat island effect, and decreases sun exposure to asphalt. BMPs will continue to be required in the SARW. SAWPA member agencies, flood control districts, and the Regional Water Quality Control Board will continue to enforce BMPs.

### *Forestry Management*

Create plans to restore, sustain and enhance forest health and watershed functions within forests. As part of forest management, SAWPA has initiated a Forest First initiative in collaboration with the U.S. Forest Service. As home to the headwaters of the Santa Ana River, the National Forests encompass approximately 30 percent of the SARW's land mass. These forest areas also receive 90 percent of the SARW annual precipitation. Forest management practices have direct effects on both water quality and quantity, particularly relative to forest fires and the consequential effects of soil erosion and water storage.

The collaborative efforts in the Forest First initiative include four main watershed restoration strategies that would provide significant benefits to downstream water supply and quality. The first of these strategies includes forest fuels management, which would focus on reducing understory growth that can contribute to the intensity of fires, making them more devastating and difficult to fight. The second strategy involves restoration of chaparral plant communities in areas that have not recovered due to repeated fires, and where native vegetation has been replaced by grasses that increase runoff, instead of the chaparral capturing and dispersing rainfall, and allowing moisture to percolate and recharge groundwater basins. The third strategy is meadow restoration that would involve returning water that had been converted to conveyance back to a meadow sheet flow so that the meadow can function in a natural groundwater recharge capacity. The last strategy involves retrofitting roads in order to reduce water conveyance, reduce fire risk, and increase the number of fire breaks. Further details on this initiative are available at: http://www.sawpa.org/collaboration/projects/forest-first/.

This analysis of the 'no regrets strategy' allows SAWPA, its member agencies, and key stakeholders an opportunity to assess proposed Proposition 84 projects and specific adaptation strategies, and the associated costs and benefits in terms of productivity, mitigation potential, resilience, and sustainability. The most promising projects and strategies can then become part of SAWPA's toolbox of climate change adaptation strategies. SAWPA's 'no regret strategies' will, however, tend to encourage incremental adaptation responses as opposed to more expansive adaptation responses.

### *Additional Strategies*

Beyond 'no regrets strategies', a group of actions, under what could be referred to as 'low regrets strategies,' can be formulated. 'Low regrets strategies' are designed to facilitate adaptation with respect to climate change predictions. These strategies are marginally more costly than 'no regrets strategies' and have a stronger reliance upon climate change predictions, especially for more severe scenario predictions. As such, they provide a scientifically conservative approach to public health and safety in terms of water supply.

'Low regret strategies' are important to consider in terms of a planning horizon. For example, such strategies for SAWPA might include changing the design of infrastructure that is intended to last many years to a design that, despite an incremental cost increase, will serve its intended purpose even under an increased risk climate change model.

**Table 5.13-10 Summary of Actions Under 'Low Regrets' Strategies**

| Low Regrets Strategy | Description |
|---|---|
| Emissions targets | Conduct a survey of emissions generated from all water-related operations and plan for a specific reduction in carbon emissions. |
| Expanded flood control infrastructure | Climate change projections call for an increase in the intensity of storms, and existing infrastructure may not be effective. |
| Solar projects for water conveyance systems | Using solar power as part of a renewable energy portfolio helps water districts control variable costs, as well as decrease carbon emissions. |
| Consider high SLR<br><br>Model predictions and build new infrastructure accordingly | When in the planning process for building new water-related infrastructure, deliberately plan for SLR and design the project accordingly. |
| Expansion of wetlands | By expanding natural wetlands project areas, SLR will not inundate existing wetlands. In addition, wetlands provide carbon reduction benefits, water filtration benefits, heat island reduction and habitat benefits. |

## System Reliability and Risk Assessment

The impetus for integrated water and related resources management is the recognition that the following factors threaten the future of water resources in the SARW:

- Drought conditions in the Colorado River Watershed, a primary source of imported water to the SARW
- Unpredictability of future water imports from the San Joaquin-Bay Delta and Colorado River Watershed due to uncertainties in water availability, and changing water management requirements

- Continued population growth and development, which puts further stress on the natural hydrology of the watershed and increases the need for additional assured water supplies
- Uncertainties of climate change and its associated hydrologic variability

OWOW 2.0 is this watershed's preliminary answer to these threats. The OWOW 2.0 Plan envisions a region where its stakeholders take an active role in creating a watershed that:

- Is sustainable, drought-proofed, and salt balanced by 2035
- Protects its water resources and uses water efficiently
- Supports economic and environmental viability
- Mitigates and adapts to a changing climate
- Corrects environmental justice deficiencies
- Minimizes interruptions to natural hydrology
- Creates a water ethic at both institutional and personal levels

## Next Steps

Several tools are available for SAWPA, its member agencies, and key water sector stakeholders to help address the effects of climate change and plan ways to adapt to or mitigate those potential impacts. Adaptation is the key component in the toolbox to help water resources planners and water sector decision-makers thoroughly understand and evaluate potential vulnerabilities from climate change impacts.

Research on climate change impacts is still evolving and as new findings are developed, they are shared throughout the SARW and California. SAWPA will continue to explore innovative quantitative tools to help assess vulnerabilities and conduct decision support analysis to help progress toward addressing climate change impacts in SARW. Actions that have been productive, and will continue to be in working toward this goal include:

- Aggregation of climate change knowledge from State and Federal research
- Further assess No and Low Regret strategies
- Develop a centralized and clearinghouse of information and lessons-learned for member agencies
- Offer web-based and workshop-delivered information on climate change impacts for the SARW
- Create adaptation strategies and share that information with the water sector

- Conduct webinars to further collaboration among water agencies
- Develop regional case studies to discuss implementation actions
- Bring additional agencies and officials into the discussion
- Encourage innovative projects and search for flexibility
- Seek to use evaluation studies/economic analysis as part of the message
- Examine co-benefits to gain more support
- Ensure disadvantaged and tribal communities have roles in the planning
- Continue to involve key watershed stakeholders
- Explore supportive resources/connections: Water Research Foundation, Water Environment Federation, Climate Ready Estuaries
- Collaborate whenever possible

## Implications of Climate Change

The SARW and its water sector leaders are preparing to meet the uncertainty associated with climate change, tackling its challenges head-on with various adaptation strategies and decision support tools from the latest climate science available. The region continues to see population and business growth and development. With unreliable imported water supply sources from the SWP and Colorado River, which could help sustain this growth and development, addressing the region's water supply and demand management balance within finite water resources, will be equally challenging.

Additionally, the region's increased construction and development patterns invite more hardscape surfaces, reduce natural water infiltration into groundwater basins, and impede groundwater recharge opportunities. The call for urban communities to employ more "green" development standards should be increased region-wide for all new and existing homes. These communities and the water sector should also embrace the Ahwahnee Water Principles (Principles) developed by California's Local Government Commission. The Principles provide the communities of California a broader, more coordinated and more flexible water management system that tackles water quality, supply and flood risks together. In support of the Principles, several proposed Proposition 84 projects will help address potential water shortfalls once they are complete. They are: WMWD's Customer Handbook for Using Water Efficiently in the Landscape, and its commercial, industrial, and institutional performance-based Water Use Efficiency Program; and the Inland Empire Utility Agency's (IEUA) Regional Residential Landscape Retrofit Program.

Coupled with all this uncertainty is a growing concern of the basin's water quality and the cost of water from various (imported and local) supply sources. SAWPA, its member agencies, and watershed stakeholders, continue to explore alternative means to augment and convey imported water supplies, especially if they were to be interrupted on a large-scale from a major earthquake. Some additional options being addressed include developing more brackish desalination, increasing water recycling with advanced water treatment technologies, and cleaning up contaminated water plumes with advanced water treatment in SARW's groundwater basins. None of these options are inexpensive, but investing in today's technology may prove to be less costly in comparison to the future price of water. Investing in local resources now buys down risk to future key water vulnerabilities. Some projects that are proposed for funding under OWOW and DWR's Proposition 84 Round 2 IRWM Implementation grant program include EMWD's Perris Desalination Program - Brackish Water Wells 94, 95, & 96; the City of Irvine's Peters Canyon Channel Water Capture and Reuse Pipeline; WMWD's Arlington Basin Water Quality Improvement Program; and Lake Elsinore and San Jacinto Watersheds Authority's Canyon Lake Hybrid Treatment Process.

Projected increases in the region's temperature over time will increase water demand (and increase evapotranspiration) in urban communities and the environment. The heat island effect will also become more prominent, especially during summer months, as will the impacts to the region's wildlife habitat and air quality. Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and GHG emissions, heat-related illness and mortality.

Less snowpack, which feeds SARW's creeks, streams, and rivers, is projected in the future. Less runoff from snowmelt will negatively impact local water supply. Potential increases in storm intensity or extreme weather events will also increase the likelihood of impact and effects from flooding. Some of the proposed projects supported by OWOW will help abate that impact through more stormwater capture that would otherwise be lost to the sea. Stormwater runoff helps groundwater replenishment, and smarter management practices of that precious resource will help further basin-wide recharge efforts. Proposed projects supported by OWOW and DWR's Proposition 84 IRWM Implementation program include the City of Yucaipa's Wilson III Basin Project and Wilson Basins/Spreading Grounds; the City of Fontana's Vulcan Pit Flood Control and Aquifer Recharge Project; the City of Ontario's Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project; San Bernardino Valley Municipal Water District's Enhanced Stormwater Capture and Recharge along the Santa Ana River project; and the IEUA's San Sevaine Groundwater Recharge Basin.

SLR will impact Orange County coastal communities and some of their essential infrastructure and coastal habitat. SLR leads to flooding of low-lying areas, loss of coastal wetlands, erosion of coastal beaches, saltwater contamination of groundwater aquifers and impacts on roads, sewage treatment plants and other coastal infrastructure. It also increases sea water intrusion opportunities to coastal groundwater basins and impairs the available fresh water supplies, which, if affected, would require the use of advanced water treatment systems. That would raise the cost of water produced and delivered to the end-user. Orange County Water District's Alamitos Barrier Improvement Project recommended by OWOW for funding under DWR's Proposition 84 Round 2 IRWM Implementation grant program would help curtail potential seawater intrusion of their freshwater aquifer.

All these implications of climate change have a direct result on SARW's socio-economics. Future predictions of development affect estimates of future climate change impacts. In some instances, different estimates of development trends can lead to a reversal from a predicted positive to a predicted negative impact, or vice versa. Climate change in the region will create inequalities between the counties that make up SARW, its communities, and within the watershed as a whole. The future level of adaptive capacity of SARW's residents, businesses, and the natural systems to climate change will affect how our society will be impacted by climate change.

## Future Considerations

The SARW and our world, as we know it, will change over time, requiring that the strategies implemented to avoid, adapt, or mitigate the most severe impacts of climate change must be flexible enough to change too. The imminence and severity of the problems posed by the accelerating changes in the global climate are becoming increasingly evident: global surface temperatures are rising, heat waves and droughts are becoming more severe, storm events are becoming more frequent and more intense, land and sea ice cover is shrinking, sea level is rising, and the pH of the ocean is changing with the potential to disrupt healthy and functional ocean ecosystems. Our environment and the communities dependent on it are facing a global crisis with real, local impacts.

What is needed in these ever-changing times are ways to help identify research needs that can support scientifically-based regulations to minimize effects of climate change on our forests, aquatic resources, and fish and wildlife populations. Much of the most innovative work on climate change is occurring at the State and local levels, but this work must be coordinated with efforts around the globe to ensure reliability and consistency of approaches. Wherever you look in the SARW, it is not difficult to find at a city council, county board, or planning and zoning meeting where a concerned citizen is raising an energy policy or climate change concern and demanding action from their leaders.

SARW's water sector leaders are also engaged in those discussions and, with respect to climate change and implementing an adaptation strategy, they are committed to helping reduce agency carbon footprint by reaching the mandated AB 32 compliance by 2020. SAWPA, its member agencies, and key watershed stakeholders, recognize that the reality of climate change is that human activity is contributing significantly to altering or damaging our environment, and that it has the potential to create significant social and economic impacts. Hence, climate change management strategies can help reduce the significance of the projected impacts.

The impacts of climate change span many issues, including: combined sewer overflows, inundation of treatment water and wastewater facilities, and shifts in the timing of the rainfall that recharges groundwater basins and provides much needed surface water supply to sustain the region's drinking water supply and prevents saltwater intrusion in coastal aquifers. The new climate reality in SARW must incorporate land-use decisions across the watershed into regional water management strategies. This will be challenging because land-use decisions are often made at the local level, and the role for State or Federal agency engagement is not very clear.

Preserving the function of valuable ecosystem services is critical in the battle to combat the impacts of climate change in the region. One of the best things that can be done to prevent flooding is to preserve wetlands. Regulators and planners need to consider adaptation strategies when making decisions about preserving or filling local wetlands. Another land-use concern is building structures in the water or up to the water's edge. Based on past data and the intensity of storms, such structures are vulnerable to damage and are unlikely to be rebuilt quickly given today's economic situation. This type of thinking brings the conversation about building resilience to a watershed level.

Some of the greatest impacts related to local effects of climate change are highly variable and uncertain. SLR is the only factor in the climate equation that has durability and simplicity, and the observation that more frequent extreme events likely will occur at the local level is among the few that can be made with confidence. The need for resilience—that is, flexibility in thinking about a potential change and the ability to learn and adjust with the realities of that change—is very clear.

In developing management strategies that address climate change, SAWPA can serve as a catalyst throughout the watershed to help address human activity and instigate the necessary behavior changes to bring about meaningful desired effects. A plan of action detailing how SARW stakeholders can make a difference must be developed and periodically updated. External factors, such as weather changes, will prompt the need for watershed stakeholders to consider changes in technology, human behavior, and water sector investments to help address the uncertainty associated with climate change.

To that end, the SARW's climate change analysis helps identify necessary adaptation strategies. These strategies focus on flood risk, stormwater management, and water use efficiency optimization. In this arid region of the state, every drop of water counts, and SAWPA and its member agencies and stakeholders need to nurture the resilience of the watershed.

Regional water resources planners must continue to address the watershed's flood protection and stormwater capture opportunities, and must also promote more project integration with regional benefits. By implementing adaptation strategies that help optimize our finite water resources, realize greater water and energy conservation practices, and identify rain harvesting opportunities while implementing flood control measures, managers of SARW water resources can help reduce risk to property and lives.

To manage unavoidable impacts from a changing climate, water managers should consider changes to their infrastructure and storage reservoir operations, funding tools and incentives, and flood control approaches. Traditional approaches of the past are not adequate because they underestimate the severity and speed of climate change and overestimate the ability of natural systems to respond. Moreover, the impacts of climate change will have greater variability across our region than has been seen before. The water and energy resource management strategies described throughout this chapter should be implemented on a regional scale to harness process efficiencies and conservation savings.

OWOW 2.0 addresses this by developing an IRWM plan that is flexible, forward looking, and integrates environmental and societal constraints, considerations, and opportunities across stakeholder groups.

The science is available to water managers and decision makers and is relevant to the choices that policymakers must make. Decision-making inherently relies on forecasting, and accepts a certain amount of risk that the decision being made is less than optimal. Economists explain that risk equals probability multiplied by impact. However, risk is difficult to conceptualize when the probabilities and impacts are uncertain or unknown. Serious thought also is needed to consider the advantages of different decision-making models.

SARW's stakeholders need to create a climate risk management team that will ensure integration of proposed Proposition 84 projects and build a bridge to include climate change adaptation strategies within member agency water management practices. Those practices should include risk and disaster management response, and any current and future land-use planning exercises and decisions that can promote sustainable watershed development and reduce vulnerabilities associated with climate risk. The team's central focus should be on maximizing the positive and minimizing the negative outcomes in SARW's communities with respect to climate change and agricultural and water and related resources interests.

## List of Contributors

Contributors to the Chapter include:

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# 5.14 Integration and Implementation



## Integration and Implementation

Concurrent with the preparation and development of integrated regional implementation actions conducted by the Pillars, SAWPA conducted several integration workshops throughout the OWOW 2.0 plan development to encourage collaboration and integration between the Pillars. These workshops served to promote further integration held among the Pillars with discussions of the linkages and integration. A shared vision for the watershed was discussed as described below:

1. A Watershed that is sustainable, drought-proofed and salt-balanced by 2030, and in which water resources are protected and water is used efficiently.
2. A Watershed that supports economic and environmental viability.
3. A Watershed that is adaptable to climate change.
4. A Watershed in which environmental justice deficiencies are corrected.
5. A Watershed in which interruptions to natural hydrology are minimized.
6. A water ethic is created at the institutional and personal level.

The integration of projects considered partnerships among different organizations, employing multiple water resource management strategies, supporting multiple beneficial uses, considering system-wide regional or watershed wide scales, and addressing different components of the hydrologic cycle.

The workshop meetings sought to promote integration, to investigate linkages and consider additional synergistic solutions. The workshops were facilitated by SAWPA and were held with the Pillar Co-chairs and several additional Pillar members. The goals of the workshop were shared with the group as follows:

- Inform – Increase awareness of proposed pillar implementation
- Evaluate – Linkages among proposed projects/programs
- Develop – Identify synergy and refine existing projects/programs to create anew

In discussion of integration, the benefits of an integrated system approach were reviewed with all participants. One of the advantages of the OWOW 2.0 planning process is the ability to address similar project objectives by local interests with a larger scale, integrated regional project. Resources devoted to implementing multiple smaller projects such as staffing, funding, and equipment may benefit from economies of scale when project proponents can work together on a regional project. All IRWM plans must contain provisions for reviewing project objectives and considering new, expanded, or even different solutions that meet multiple local needs.

SAWPA has stressed this strategy of a system's approach to all stakeholders in outreach material, workshops and conferences associated with OWOW 2.0. Examples are shown below in **Figure 5.14-1**.

**Figure 5.14-1 Strategy of a Systems Approach Examples**

## Traditional Silo Approach

- Single purpose, single problem project
- Little collaboration
- Unintended downstream environmental consequences
- Sectoral isolation of water resources
- Lack of coordination of resources:
  - ◊ Stormwater shunted out of the watershed
  - ◊ Wastewater treated to increasingly high standards is dumped
  - ◊ Clean water imported from faraway



## 21st Century Approach

**Integrated Regional Water Management (IRWM)**

- Multi-beneficial projects and programs linked together for improved synergy
- Provides "Biggest Bang for the Buck"
- Proactive innovative, and sustainable solutions
- Watershed systems based approach
- Promotes collaboration cross-sectoral integration among diverse water related agencies
- Focuses on integrated regional solutions supporting local reliability and local prioritization
- Integrates water supply, water quality, recycled water, stormwater management, water use efficiency, land use, energy, climate change, habitat, and disadvantage communities and tribes
- Coordinates resources so that water is used multiple times
  - ◊ Manages stormwater for drinking water
  - ◊ Treats wastewater for irrigation and groundwater replenishment
  - ◊ Builds or modify parks to support water efficiency, ecosystem habitat, and stormwater capture
  - ◊ Improves water quality pollution prevention
  - ◊ Addresses energy and water nexus



## Pillar Recommended Implementation Actions

The OWOW 2.0 Plan reflects the interconnected needs of the Region, examines linkages and develops synergy and does not limit solutions to just the needs of specific entities in the watershed. Opportunities for examining true integration were regular topics of discussion at OWOW pillar integration meetings. As the draft OWOW 2.0 plan was nearing completion, an increased focus was placed on sharing the pillar recommended implementation actions by each pillar and integration of these actions. This process of supporting implementation will continue even after the adoption of the OWOW 2.0 Plan as a new "Call for Projects" approach is contemplated in mid- 2014 in anticipation of Round 3 Prop 84 IRWM Implementation funding.

Shown below is the list of benefit elements that support a multi-benefit approach. The benefit acronym is listed alongside each of the recommended pillar implementation actions described further below.

1. WUE - Water supply reliability, water conservation, and water use efficiency
2. SCT - Stormwater capture, storage, clean-up, treatment, and management
3. RWE- Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands
4. NPS -Non-point source pollution reduction, management, and monitoring
5. GWR -Groundwater recharge and management projects
6. CRR- Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users
7. WQB-Water banking, exchange, reclamation, and improvement of water quality
8. FMP -Planning and implementation of multipurpose flood management programs
9. WPM-Watershed protection and management
10. DWT -Drinking water treatment and distribution
11. EFR- Ecosystem and fisheries restoration and protection
12. DAC – Disadvantaged community critical water supply and/or water quality improvements
13. CC – Climate change adaptation and mitigation

Details of each implementation actions are described in each pillar chapter and in **Table 5.14-1** through **Table 5.14-10**.

**Table 5.14-1 Water Resource Optimization Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Water Rates that Encourage Conservation | Create incentive programs for retail water agencies in the watershed to reduce water demand and help meet SBX7-7 required demand reductions. | WUE |
| Water Conservation Public Education | Promote more public education of water use efficiency practices both indoor and outdoor. | WUE |
| Outdoor Conservation | Promote increased California friendly outdoor landscaping through incentives to reduce irrigation, currently at 60%-80%. | WUE |
| Reduce Evapotranspiration | Evapotranspiration might be reduced by developing and implementing programs to increase the amount of shaded area such as planting trees or constructing shade structures watershed-wide or strategic locations in the watershed. | WUE |
| Watershed Exchange Program | Upper Watershed foregoes development of more water recycling and provides future treated wastewater to the Lower Watershed via SAR. Lower watershed provides "replacement" water to upper/middle watershed | GWR, WUE, WQB |
| Wet Year Imported Water Storage Program | Upper watershed and MWDSC would implement this strategy.<br>Goal: Change MWDSC place of storage from Central Valley to Santa Ana River Watershed<br>Develop: MWDSC pricing structure to encourage more storage in watershed.<br>Concept: Water stored in wet years for a reduced price. Water pumped in dry years for remaining Tier 1 price. | GWR, WUE, WQB |
| Enhanced Water Conservation at Prado Dam | - Corps & OCWD currently studying 505 ft year-round<br>- Enhanced Project<br>- Cannot start until Mainstem project complete<br>- Would increase water storage elevation to:<br>510 ft or 514 ft<br>- Benefit: ~10,000 AF | SCT, WUE |
| Enhanced Santa Ana River Stormwater Capture below Seven Oaks Dam | Additional stormwater detained by Seven Oaks Dam could enable the diversion of up to 500 cfs and up to 80,000 acre-feet per year. This may require execution of new water rights agreement among SAR Watermaster parties. | SCT, FMP, GWR |
| Enhanced Stormwater Capture from the Tributaries of the Santa Ana River | Additional stormwater capture along the SAR tributaries could enhance capture of 28,000 AFY Specific locations in the watershed would need to be defined. | SCT, GWR |

**Table 5.14-1 Water Resource Optimization Pillar Implementation Actions (Continued)**

| Title | Summary Description | Benefits |
|---|---|---|
| Riverside Basin Aquifer Storage and Recovery Project | Riverside Public Utilities, is in partnership with Valley District and others are developing a design for a rubber dam that would cross the Santa Ana River and be used to divert flows, 12,800 AFY into off-stream recharge basins. | SCT, GWR |
| MS4 Credits | Under MS4, increase the amount of stormwater captured and recharged in the watershed by allowing owners to purchase "MS4 Credits" that could be applied to recharge projects in the watershed. | SCT, NPS |
| Re-Operate Flood Control Facilities | Working with flood control agencies re-operate flood control facilities with the goal of increasing stormwater capture increasing flood get away capacity and revising decades old storage curves. Without any impending storms, the flood control agencies may be able to release stormwater at a slower rate. This relatively minor operational change would make stormwater flows easier to capture and put to use. It also would result in impounding the water longer, which would increase artificial recharge during the "holding period". This strategy has already been successfully implemented in some portions of the watershed | SCT, FMP |
| Size Flood Control Facilities for Stormwater Capture | Increase the size of existing, or new, detention basins. Larger detention basins would slow the flow and increase the recharge area, which would increase the amount of stormwater that is artificially recharged. In addition to this increased recharge, the larger basins also would provide greater flood protection. | SCT, FMP |

**Table 5.14-1 Water Resource Optimization Pillar Implementation Actions (Continued)**

| Title | Summary Description | Benefits |
|---|---|---|
| Increase Surface Water Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. This project would supplement but not replace existing or proposed groundwater storage. | WUE, WQB |
| Increase Groundwater Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. | WUE, WQB |

**Table 5.14-2 Beneficial Use Assurance Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Develop Regional BMPs to Manage Municipal Stormwater Discharges | Develop regional BMPs, infiltration and harvest & reuse projects to support efficiency and effective stormwater quality improvement. | SCT, NPS |
| Salt Removal Projects to Achieve Salt Balance | • Expand groundwater desalination to key groundwater basins where TDS and Nitrate concentrations are approaching discharge limits. Locations may include Elsinore Basin, Perris Basins in EMWD and Riverside Basins.<br>• Support adoption of the Bay Delta Conservation Plan in order to promote reliability of low-TDS imported water supplies for use in the watershed. | CRR, WUE |
| Coordinate Surface Water Quality Monitoring Program | Assess surface water quality monitoring in watershed for overlap. Align proposed SAR Watershed stormwater regional monitoring program, MS4 stormwater monitoring, TMDL monitoring, and POTW monitoring for cost efficiencies and reduction of redundancies. | WQB |
| Support Small Water Systems that do not have Resources for Monitoring and Proper Operations and Maintenance | Work with CDPH and county health departments to identify small system water providers which need assistance with providing safe drinking water. Preliminary investigations indicate needs and support for both San Bernardino and Riverside Counties. | DAC, DWT |

**Table 5.14-3 Water Use Efficiency Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Educational and Marketing Programs for Water Use Efficiency | • Video modules of simplified demonstrations and instructions<br>• Contractor education programs<br>• Alliances with private industry (Professional orgs, manufacturers, distributors)<br>• Expanded marketing of Customer Handbook<br>• Regional information and marketing such as Inland Empire Garden Friendly and similar<br>• A truly simple irrigation scheduling tool | WUE, CC |
| Technology and Training Programs for Water Use Efficiency | • Advancing emerging technologies such as smart irrigation controllers, high-efficiency nozzles, and new irrigation device technology<br>• Creating a comprehensive package for consumers to promote use of smart irrigation controllers (e.g. rebates, stores, installers, training, and check-ups)<br>• Advocating use of climate-appropriate plants and functional warm season turf throughout the region<br>• Developing a "one-stop shop" that offers accessible and comprehensive water-efficient landscape planning programs | WUE, CC |
| Incentive Programs for Water Use Efficiency | Implement programs that allow water agencies to customize their rebates by adding additional incentives like MWDSC's programs. Support programs that allow agencies to target markets, analyze data, and implement new approaches. Rebates have been proven to motivate residential and managed properties decision makers to invest in landscape water efficiency technologies. | WUE, CC |
| Market Transformation for Water Use Efficiency | • Changing landscape design elements: increase pervious hard surfaces, pavers, and bioswales<br>• Creating sample landscape plan templates<br>• Using captured rainwater, recycled wastewater, graywater, or treated water for non-potable uses including irrigation<br>• Positioning water-efficient gardens as in style and "hip"<br>• Utilizing marketing suggestions from the WRI Landscape Water Use Efficiency statewide market survey: positives of water smart landscapes, the cost of doing nothing, children's involvement, and responsibility for the environment | WUE, CC |

**Table 5.14-4 Land Use and Water Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Programs to Integrate Water Resource Management into Land Use Planning | • Improve Interaction Between Water Resource Managers and Land Use Planners<br>  o Effectively incorporate proposed water supply protection and use factors into land use planning<br>• OWOW /FCD partnership development or enhancement (links to Stormwater Pillar)<br>• Land planning process enhancements<br>  o Early consideration of project concepts and designs<br>• Focused training for Land Use Planners and Land Development Engineering Community<br>• Incorporate recommendations of Alluvial Fan Task Force in land use planning | WPM, NPS |
| Programs that Support Watershed Integration, Identity Development and Implementation | • Local land use authority process enhancement<br>• Coordinate regional transportation planning to build-in key watershed sustainability priorities into plans that apply to the SAR Watershed.<br>• Watershed-wide geodatabase integration, access portal, and planning and evaluation tool development.<br>• Regulatory assessment and integration to support watershed sustainability project concepts and implementation.<br>• Demonstration project site identification, project design, coordinated planning, construction, and maintenance.<br>• Develop alternative compliance programs for MS4 Permit land development requirements | WPM, NPS |
| Program to Enhance Local Land Use Authority Process | • In each SAR Watershed County<br>  o The Riverside City/County Arroyo-Watershed Program<br>  o The Newport Bay Conservancy Pilot Project<br>  o City of Ontario--New Model Colonies<br>• Products of this project would include:<br>  o Watershed-Wide Land Use/ Water Resource Planning Guidelines Manual(s)<br>  o Model General Plan Water Element for the SAR Watershed<br>  o Watershed Coordination Forums and Training Workshops<br>  o Planning Commission Education and Outreach | WPM, NPS |
| Connect Watershed-wide Geodatabase Integration, Access Portal, and Planning and Evaluation Tools | • Develop “Community Improvement Area” layer<br>• Groundwater recharge areas (optimization with FCDs and Water Agencies)<br>• Overlay with Water Quality/Resource/Habitat characteristics<br>• Transportation Planning collaboration potential | WPM, NPS |

**Table 5.14-4 Land Use and Water Pillar Implementation Actions (Continued)**

| Title | Summary Description | Benefits |
|---|---|---|
| Demonstration Projects Including Site Identification, Design, Coordinated Planning, Construction, and Maintenance | • One in each county<br>• Green street/parking lot projects<br>  o Possible: Monte Vista Ave in the City of Montclair<br>• Regional treatment/recharge for surface and stormwater runoff (follow example of Chino Basin)—Possible locations include Gibson, Victoria, and Metrolink Basins projects with City and County of Riverside and Western MWD<br>  o Joint projects with SBCFCD and SBVMWD<br>  o Additional SBFCD/IEUA projects in Chino Basin | WPM, NPS, CC |

**Table 5.14-5 Stormwater: Resource and Risk Management Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Stormwater Policy/Procedure Recommendations | • Develop procedures and guidelines to ensure consideration of IRWM goals at project concept, planning, and design stages using OWOW Stormwater Resource and Risk Management Pillar to implement<br>• Provide stricter land management in floodplains<br>  o Evaluate impacts of 500 year flood management standard | WPM, NPS, |
| Align County Geodatabases Into a Comprehensive Watershed Geodatabase | • Accessible by all stakeholders, with data quality assurance and maintenance program<br>• Maps developed to support development project conditions and acceptable BMPs<br>  o Infiltration emphasized in MS4s<br>• Maps include all watershed data parameters<br>• Aligning or connecting the three county geodatabase layers will support watershed project concepts, and identify likely project partners even across county lines<br>  o Includes FCD facility analyses for retrofit opportunities<br>  o Have been and will be reviewed by regulatory agencies<br>  o Provide access and develop user tools<br>  o Planning Tools<br>  o Outreach to Planning Departments<br>• Implementation Tools<br>  o WQMP Templates<br>  o Regional BMP sites<br>  o Feasibility issues<br>  o Prioritize top three basins for potential recharge retrofit demonstration projects for each county in partnership with stakeholders | SCT, GWR |

**Table 5.14-5 Stormwater Resource and Risk Management Pillar Implementation Actions (Continued)**

| Title | Summary Description | Benefits |
|---|---|---|
| Develop a Groundwater Recharge Optimization Plan for Existing and Potential Future Flood Control Facilities | • Chino Basin Watermaster Optimization Plan as a guide<br>• Geodatabase tools provide preliminary project sites and priorities<br>  o Site lists have been developed by FCDs<br>• Supports multi-benefits approach of recharge and flood protection while addressing MS4 Permit requirements<br>• Costs/benefits need to be spread over FCD constituency<br>• Identify top three sites for demonstration projects | GWR, FMP |
| Develop Watershed-Based Tools for MS4 Stormwater Compliance | • Task Force approach with regulators in parallel with demonstration projects and MS4 Permit renewals<br>• Regional water quality and/or infiltration sites<br>  o Off-site or Regional BMPs—BMPs will typically be implemented downstream from the project site<br>• Water quality and/or water quantity credit system<br>• Build on Orange County's retention credit pilot project<br>  o Development projects contribute funds used for water quality/recharge/ habitat projects elsewhere in the watershed.<br>  o Current MS4 permits list project types which can comply via credits produced by alternative environmentally beneficial actions.<br>• Identify pilot sites for watershed-based compliance | SCT, GWR, WPM |

**Table 5.14-6 Natural Resources Stewardship Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Create Managed System and Restoration Targets | A plan for sustainable management of conservation areas with targeted restoration efforts is essential for preventing further deterioration of habitat. Consideration for characteristics of each of the main habitat types: Alluvial fan; Riparian, Wetland and Coastal and their specific ecosystems, will require habitat specific management plans and restoration criteria. | EFR, RWE |
| Establish Sustainable Wildlife Corridors and Expansion of Restored Areas | Using Riverside County Multi-Species Habitat Plan as a template, create sustainable wildlife corridors conduct across jurisdictional boundaries in San Bernardino and Orange County for watershed connectivity Coordinate among all of the current regional conservation plans, mitigation providers, resource conservation districts and non-profit conservation organizations. | EFR, RWE |
| Provide Sustainable Funding Sources for Ongoing Maintenance of Conservation Areas | Create a permanent funding program to assure funding for long-term protection of areas where habitat restoration efforts are occurring or need to occur. This kind of cooperative agreement will be critical to the ability of governmental and non-profit organizations to secure mitigation funding to do the necessary habitat restoration work needed in the watershed. | EFR |
| Project that Provides Invasive Vegetative Species Eradication and Maintenance Funding | Establish watershed wide non-native vegetation removal program to support habitat restoration and water savings. Removal program would address arundo removal of areas not currently addressed in the watershed as well as tamarisk removal. | EFR, WUE, CC, FMP |
| Pollutant Trading Programs | Constructed wetlands can be used to remove pollutants from surface runoff using natural processes. Formal pollutant trading programs provide the mechanism to pool funding from multiple, smaller sources to construct wetlands that would create habitat and increase the pollutant removal benefit. | WPM, EFR |
| Create Programs for Community Involvement in Habitat Conservation and Restoration | Some of the watershed's high quality, water-oriented habitats are near disadvantaged communities, where little attention has been paid to stewardship of the local resources. Developing local "stewardship" of these habitats could benefit both the habitat and the community. | EFR, RWE |

**Table 5.14-7 Operational Efficiency and Water Transfers Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Water Transfer Project between IEUA and OCWD: Wet Year and Dry Year Allocation | This project concept proposes a purchase by OCWD of up to 45,000 AF of imported water to be recharged by the IEUA member agencies during wet years. Water would be purchased at a reduced imported water rate from MWD reflecting the savings of not storing the SWP water at one of MWD's own storage programs such as the Semitropic Water Storage District and/or Kern County Water Bank. During dry years, OCWD member agencies could request IEUA member agencies to increase their groundwater production for three years by up to 15,000 AF per year in-lieu of direct deliveries from MWD, while MWD increases deliveries in the Orange County area by an equal amount. Under this scenario, the net MWD deliveries during dry years (years that Water Supply Allocation Plan is implemented) will remain unchanged, without the need for MWD to produce water from its own storage accounts. At the same time, having the imported water stored in the SAR watershed will increase local supply reliability, and provide some financial incentive to both IEUA and OCWD member agencies. | WQB, WUE, GWR, CC |
| Water Recycling Project between EMWD and OCWD | EMWD has the capability to discharge 15,000 AFY of recycled water into Temescal Creek. The discharge will be provided in wet years when local use cannot occur for the benefit of OCWD member agencies. With the approval of the SAR Watermaster, this flow can be contractually added to OCWD's SAR base flow allocation at Prado. The water quality of EMWD's discharged recycled water may require some salinity mitigation by OCWD to meet the RWQCB Basin Plan Objective in Orange County. The GWRS will be used to provide the required mitigation for the discharged water, and EMWD will pay OCWD for the cost of that mitigation. As part of this project, OCWD will credit EMWD for the purified water that is recharged into the Orange County groundwater basin, and compensate EMWD when that water is produced by OCWD member agencies. To increase water supply reliability in the SAR Watershed, EMWD could use the revenues from this water transfer project for imported water banking during wet years in the San Jacinto Watershed groundwater basins. | WQB, WUE, GWR, CRR, CC |

**Table 5.14-8 Disadvantaged and Tribal Communities Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| DAC Water Supply or Water Quality Improvement Projects | • Address poor water quality for the Edgemont Water District and County Water of Riverside District.<br>• Construct new sewer systems to address failing septic systems/undersized treatment facilities in Beaumont Cherry Valley. | DAC, DWT |
| Tribal Water Management Projects | • Provide funding support to water recycling facilities; that share mutual benefit to tribes and surrounding regions. Based on cooperative efforts among tribes and adjoining water agencies. | DWT |

**Table 5.14-9 Government Alliance Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| Government Alliance Coordination: | • Provide resource guide to all government entities and publish updates of the Resource Guide and post them on SAWPA's website. | WPM |

**Table 5.14-10 Energy and Environmental Impact Response Pillar Implementation Actions**

| Title | Summary Description | Benefits |
|---|---|---|
| GHG Inventory of the Water Sector | Calculate the Watershed's Carbon Footprint | CC |
| Promote Water Use Efficiency | Reduce Urban and Ag water demands; Build Resilient Communities; and Integrate water resources management practices; and Promote project collaboration and partnerships. | WUE, CC |
| Promote Alternative Energy Use to Reduce Embedded Water Use | Install Solar; Wind, Geothermal, Tidal, and Biomass Fuel capacity; and Implement any hydropower capabilities. | WUE, CC |
| Implement GHG Emission Offsets | Purchase Carbon Offsets; Plant Trees; Promote innovative approaches and solutions that foster community vitality, environmental quality, and economic prosperity. | WUE, CC, EFR |
| Review or Implement Effective Energy Efficiency Policies | Conduct a gap analysis on the watershed's policies on dealing with Greenhouse Gas Emissions; Create an energy solutions campaign - save energy, reduce your carbon footprint; Review applicable laws and ordinances; and Promote and implement energy efficiencies and sound conservation practices. | CC, WPM |
| Inventory the Water Sector | Calculate the Watershed's Carbon Footprint | WPM |
| Promote Electricity Conservation to Address Embedded Water Use | Region-wide Use Appliances and Vehicles that are efficient; Weatherization; Implement Temperature Controls (on A/C and Heating units; Install CFP Bulbs; Install LCD computer screens; and Use natural light. | CC, WPM |

## Regional Implementation Action Linkages

Upon review of the recommended pillar implementation actions, the participants in the workshops were asked to discuss linkages, overlaps and similarities among the actions.

The following questions were proposed:

1. Are any actions that are similar to one another overlap?
2. Is the action better if we combine overlapping aspects?
3. Are any actions dependent on another action, recommended here or separately, to be implemented?
4. Can we link or integrate any of the actions proposed?
5. Any new synergistic ideas for regional implementation actions?
6. Any areas of the watershed that need more attention where a regional implementation action would be desirable?

These questions were posed particularly mindful of DWR IRWM Implementation requirements to develop work plans that identify linkages between and among actions that are critical to the success of the regional effort. From the discussions, a list of Pillar recommended implementation actions that best represent watershed-wide and system-wide solutions was defined. These are discussed in the next section. However, the Pillar Integration Workshop also covered a number of suggestions that would assist and support implementation as well as shown below.

- Support PUC rebates to implement for sustainability and water conservation in outreach to customers (PUC rebates for water conservation).
- Geodatabase concept affects a number of the Pillars so that it could be part of the Basin Plan.
- Add layers to the Geodatabase that shows the following:
    - Utility company information
    - Climate change scenarios
    - Layers of natural resources areas
    - Layers of Potential restoration areas
    - Layer of highly economical land to stay away from and BMP opportunities
    - Status of ongoing planning activities by agencies
- Promote Geographical integration
    - Scale up ideas for watershed wide basis
    - Example: Water softener ordinance IEUA
    - Program could scale up to stormwater capture
    - Increase rate of return in recycled water if this program would be watershed wide
- Tool that allows everyone to see what agencies are working on beneficial use and water quality
    - If a project will transfer water or use less water, using the new GHG emission calculation tools to save water and reduce GHG
        - San Bernardino County has a GHG emission calculation tool for developers, for water and energy reduction
    - Sea Level Rise can effect water quality – coordination between agencies must be done
- LID should be looking at a regional perspective (streets and landscape areas)
- The impacts of recharge to groundwater basins with contaminant plumes must be considered. IEUA did ordinance on controlling water softeners and everyone in the watershed can benefit from it

- Creating sustainable jobs should not be excluded from the discussion – (Habitat for Birds and Bees).
- WMWD has surf and turf program though it's very labor intensive and they help subsidize retrofit to residential properties, up to 6,000 sq ft
- Sea level rise is an issue that will affect other types of land use and costs
- Pillar meetings should keep going on a monthly basis
- The key to unwind the 303 (d) impaired water body listing dilemmas is to address problems at a sub-watershed scale
- A regional monitoring plan could save time and money
- Climate change is relevant to beneficial use (habitat and water quality)
- How do we go back and recapture conservation and industrial commercial? Innovative Mitigation!
- Work with regulatory agencies from the beginning of a project
    - Need to incorporate a forward vision
    - Begin a plan by integrating all water resource issues first
    - Bring in all agencies and other regional project proponents for innovative mitigation
- Legislation
    - Consider needs for changing legislation
    - Stormwater should not considered wastewater
        - Change "Water used" to "Water consumed"
        - Upstream water user and downstream water user – how do we give them credit for keeping water in the river?
        - Assimilative capacity with salt – How to get credit?

## OWOW 2.0 Plan – Future Implementation

In preparing the OWOW 2.0 Plan, a series of Broad Planning/Management Guidance Strategies were distilled from that work and will serve to guide future planning and management in the watershed. The Strategies reflect a change in thinking about water resource management. Historically, water activities were organized into different silos and managers worked to achieve separate and individual goals that were thought to be unrelated. The water supplier's goal was to divert water for a growing population and economy without regard its impact on the environment. The flood control manager's goal was to channelize stormwater to get it out of the community before it could harm people and property or sink into the ground. The waste water manager's goal was to highly treat and dump waste into the river or ocean to be carried away. The environmentalists were isolated and recreation was left to its own devises. Managing the watershed and water resources as done in the past realized narrow singular goals but did so with tremendous unintended consequences. The list of endangered species only grew longer, as did the list of impaired water bodies. Societal values have changed, water and funds are scarcer, and together we have realized that the old way is no longer viable. SAWPA adopted its first Integrated Water Plan in 1998 and has been committed to this kind of watershed or system thinking ever since. **Figure 5.14-2** shows this relationship.

**Figure 5.14-2 Depiction of Planning/Management Strategies**



These Broad Planning/Management Guidance Strategies are not projects or programs themselves and are separate and distinct from priorities assigned to evaluate projects for funding that are often dependent on the grant sponsoring agency criteria. These Planning/Management Strategies are meant to guide planning efforts and are listed *in no particular ranked order or priority as shown below*.

### *Demand Reduction and Water Use Efficiency*

Water use efficiency practices remain a key resource management priority for the watershed and a cost effective tool for reducing the gap between available supplies and projected demand. This is reflected through a reduced per capita water use as well as potentially reduced commercial and industrial water use. Though significant progress is anticipated with mandated reductions through 20% by 2020 legislation, more can be done. Many water use efficiency actions have been implemented locally but these can be scaled watershed-wide. These include water conservation rates that encourage budged based rates, Garden Friendly landscaping and landscape ordinance application, smart controllers and irrigation nozzles, and turf buy-back programs, to name a few. The last acre foot of water is often the most expensive, reducing that cost goes far to keep water rates stable.

Monitoring data shows wasteful irrigation runs off yards down streets and culverts collecting pet waste and pollution until it hits the receiving water with a toxic slug causing beach closures and fish kills. At great expense cities have been tasked to clean up this dry weather urban runoff pollution. This cost can be avoided with successful water use efficiency.

It is understood too that there is a direct link of water use efficiency with energy efficiency and GHG emission reduction.

*Watershed Hydrology and Ecosystem Protection and Restoration*

Implement cost-effective programs that will protect and restore our watershed's ecosystem and hydrologic system so that it will sustainably produce the array of services including water resources. Recognizing that the SAR Watershed has multiple interrelated parts, a holistic approach to solving issues of supply, quality, flood and ecosystem management is necessary. This approach recognizes that in order to achieve a healthy productive watershed, improvements starting at the top of the watershed with a healthy and managed forest effectively support downstream stormwater attenuation and runoff capture and water quality improvement. The emphasis is on source control rather than end-of-pipe treatment as a best management practice. Implementation actions under this priority include forest management, pollution prevention, low impact development, stormwater capture and flood management, and MS4 stormwater implementation.

*Operational Efficiency and Transfers*

Cooperative agreements that result in water transfers, exchanges, and banking have resulted in better use of water resources. With the rich groundwater storage opportunities available in the SAR Watershed, expanding the groundwater storage with a variety of available water sources can be more much more cost effective than new surface storage. Such agreements will result in our ability to stretch available supplies and replace the storage lost by a shrinking snowpack. Projects under this category occur by collaboration and cooperation among the multitude of agencies and entities in the watershed, and agencies that import water into the watershed. New banking agreements can represent both habitat mitigation banking as well as groundwater banking. These agreements can only occur by entities working together and opening doors to improved efficiency and increased water supply reliance.

*Innovative Supply Alternatives*

This strategy recognizes the need for more progress in a portfolio approach with expansion of innovative and effective 21st Century technology for water production, recycling, pumping, and desalinization. Traditionally, these projects serve as an important component to achieving water supply reliability. Moving forward, a broader range of tools are now available to us to serve both economic and environmental objectives. Projects under this category provide multiple benefits and thus can be mutually reinforcing. Brackish desalination and salinity management are necessary to sustain local supplies. Salinity management is essential for groundwater basin health in the watershed.

*Remediation and Clean up.*

Another strategy is implementing TMDLs and pollution remediation. Projects under this category must reflect projects that have region wide benefit, are integrated and have multiple benefits without a focus only on local or single purpose needs. Under this strategy, the focus is on preventing pollution and also dealing with the pollution that has already occurred. This reflects a desire to duplicate the success already established in the watershed to prevent pollution and then to remediate pollution. If we continue operating in ways that cause pollution, degrading the watershed, the list of TMDLs will continue to grow.

The Broad Planning/Management Guidance Strategies were presented and discussed with the Pillars and other stakeholders to possibly prioritize the five (5) strategies. The feedback received is that all five (5) strategies are a priority to the watershed. Depending on locality and progress made by entities within the watershed. However, each local entity should evaluate the water resources strategies that make the most sense at the higher watershed level over multiple decades as opposed to immediate or

parochial needs. It is true that factors such as of cost effectiveness, water supplies generated versus demand, environmental benefit, feasibility, and practicality must be considered. But as stakeholder of the watershed, entities are encouraged to consider the long term watershed planning approach as they consider competing alternatives to meet needs and give more merit or attention to strategies such as water use efficiency that has been traditionally found to be more cost effective in reducing water demands and generating water supply with additional benefits of dry weather urban runoff pollution reduction before other alternatives. Further projects should consider system wide benefits before other alternatives that can have multiple benefits downstream. This applies particularly to pollution prevention at the source rather than having to address a chain of unintended and possibly negative consequences downstream for future generations.

Shown below is a list of Pillar Recommended Implementation Actions that were prepared based on the Pillar work, Master Craftsmen work, and other stakeholder input. These regional implementation actions are not listed in priority or are in any particular order. They represent the integrated work of the Pillars that resulted from their collaboration internally and with other Pillars and are the solutions to the challenges that they identified in each of their Pillar chapters. This list does not represent a list of projects that been rated and ranked projects under the more formal Project Review Process defined under the OWOW 2.0 Plan. However, they are recommended implementation actions that reflect an emphasis on integration and system-wide solutions to the watershed challenges and include the 13 watershed-wide framework concepts previously discuss.

Each of the Pillars recommended watershed-wide implementation actions that could eventually become projects once they are more fully investigated and analyzed. Multi-agency project proponents for these implementation actions have not been identified yet. It is anticipated that these recommended actions may best help fulfill the vision of OWOW 2.0 Plan.

**Appendix K** shows projects submitted to SAWPA under the Round 2 "Call for Projects" conducted in 2012, and are rated and ranked based on the project criteria defined for OWOW Round 2. The process undertaken for project review for the OWOW Round 2 projects is discussed in **Chapter 6 Project/Program Review, Evaluation and Prioritization**.

Each of the pillars recommended implementation actions shown below, and must be further investigated and analyzed to fulfill future grant funding requirements. Further, multi-agency project proponents for these actions may not have been identified yet. It is anticipated that this list of Pillar recommended actions, shown in **Table 5.14-11**, will serve as planning guidance for possible watershed-wide implementation projects to be encouraged for funding under Proposition 84 Round 3, and can best help fulfill the vision of OWOW 2.0 Plan.

**Table 5.14-11 Pillar Recommended Implementation Actions**
**(In no particular order)**

| Title | Summary Description |
|---|---|
| Water Budget Based Tiered Water Rates | Create incentive programs for retail water agencies in the watershed to adopt water budget-based tiered water rates. |
| Water Use Efficiency Incentive Program | Create an incentive program for expanded water use efficiency programs including cash for grass, landscape retrofit support, and California-friendly plant discounts. Utilize IEUA Residential Landscape Transformation Program and MWDOC Comprehensive Landscape Water Use Efficiency Programs as template. |
| Watershed Exchange Program | • Upper Watershed foregoes development of more water recycling and provides future treated wastewater to their Lower Watershed via SAR<br>• Lower watershed provides "replacement" water to upper/middle watershed |
| Wet Year Imported Water Storage Program | • Upper watershed and MWDSC would implement this strategy<br>• Goal: change MWDSC place of storage from Central Valley to Santa Ana River Watershed<br>• Develop MWDSC pricing structure to encourage more storage in the watershed<br>• Water stored in wet years for a reduced price. Water pumped in dry years for remaining Tier 1 price |
| Enhanced Water Conservation at Prado Dam | • Corps & OCWD currently studying 505 ft year-round<br>• Enhanced Project<br>o Cannot start until Mainstem project complete<br>o Would increase water storage elevation to:<br>510 ft or 514 ft<br>Benefit: ~10,000 AF |
| Enhanced Santa Ana River Stormwater Capture Below Seven Oaks Dam | Additional stormwater detained by Seven Oaks Dam could enable the diversion of up to 500 cfs and up to 80,000 acre-feet per year. This may require execution of new water rights agreement among SAR Watermaster parties. |
| Off River Storage and Supply Credits | Additional stormwater capture along the SAR tributaries could enhance capture/ recharge. Specific locations in the watershed would need to be defined. New recharge projects could allow for purchase of "MS4 Credits" by cities and counties as part of new development as a regional MS4 compliant recharge project. |

| Title | Summary Description |
|---|---|
| Re-Operate Flood Control Facilities | Working with flood control agencies re-operate flood control facilities with the goal of increasing stormwater capture increasing flood get away capacity and revising decades old storage curves. Without any impending storms, the flood control agencies may be able to release stormwater at a slower rate. This relatively minor operational change would make stormwater flows easier to capture and put to use. It also would result in impounding the water longer, which would increase artificial recharge during the "holding period". This strategy has already been successfully implemented in some portions of the watershed. |
| Increase Surface Water Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. This project would supplement but not replace existing or proposed groundwater storage. |
| Increase Groundwater Storage | Helps offset drought and climate change while also increasing watershed sustainability and less dependence on imported water. |
| Inland Empire Garden Friendly Demonstration and LID Project | Using the Inland Empire Garden Friendly Program as a template, a demonstration project is proposed to quantify the benefits of installing Inland Empire garden friendly products and further demonstrate Low Impact Development features in a DAC neighborhood. The project would be modeled in part after the successful City of Santa Monica Garden-Friendly Project, as well as the Elmer Avenue Neighborhood Retrofit project in the LA Basin. |
| DAC Water Supply or Water Quality Improvement Projects | Provide funding support to assure drinking water standards are met such as in the County Water Company of Riverside near Wildomar. Construct new sewer system for the areas that have failing septic systems/undersized treatment facilities like Beaumont Cherry Valley. |
| Wetlands Expansion Watershed wide | Create new wetlands along the tributaries of Santa Ana River to provide for natural water quality improvement, ecosystem restoration and recreational opportunities. Water supply for such wetlands would be dry weather urban runoff and available recycled water and would be patterned after the Mill Creek Wetlands in Chino Basin. |
| **Title** | **Summary Description** |
| Watershed-wide Multi-Use Corridor Program | Create multi-use corridors along SAR and its tributaries and Upper Newport Bay tributaries in all three counties in the watershed to provide for sustainable wildlife corridors, stormwater attenuation and capture, flood control, sediment reduction and erosion restoration, enhanced NPS pollution treatment, removal of non-native species, and creation of recreational trails,. In Riverside County, along Temescal Wash, San Bernardino, San Timoteo Wash, Orange County along Borrego Canyon Wash between Irvine Blvd., and Town Center Drive. |

| | |
|---|---|
| Multi-Species Habitat Plan for Gap Areas of Watershed | Create multi-species habitat plan for San Bernardino County and portions of Orange County. Though work is underway on the Upper Santa Ana Wash Land Management and Habitat Conservation Plan, there is no MSHCP covering the growing areas of southwestern San Bernardino County. Western Orange County is also not covered by an MSHCP. |
| Water Conservation Recharge Optimization Program | Establish a water conservation-recharge optimization plan for existing and potential future flood control facilities, using the example work of the Chino Basin Recharge Master Plan and implementation projects as a template. |
| Watershed-wide Geodatabase Access | Connect existing county or program-specific geodatabases to create a comprehensive watershed geodatabase that provides access to appropriate stakeholders, and set up a data quality control and maintenance program. The main component County MS4 geodatabases are well under way. |
| Forest Restoration Projects | Expand forest restoration through fuels reduction, meadow and chaparral restoration projects to strategic areas above major stormwater recharge basins for flood control, water supply and water quality benefits. |
| Residential Self-Regenerating Water Softener Removal Rebate Program | Removal of self regenerating water softeners has been proven as an effective strategy to reduce TDS levels at WWTP and assure future salt discharge requirements. The project provides watershed-wide rebates and would be a joint program among water agencies in the watershed. |
| Salt Removal Projects to Achieve Salt Balance | Expand groundwater desalination to key groundwater basins where TDS and Nitrate concentrations are approaching discharge limits. Locations may include Elsinore Basin, Perris Basins in EMWD and Riverside Basins. |
| Enhanced Stormwater Capture from the Tributaries of the Santa Ana River | Develop additional stormwater capture projects along the SAR tributaries that support key groundwater management zones identified by San Bernardino, Riverside, and Orange County Geodatabases. Early estimates indicated a capture potential of 12,000 AFY. |
| **Title** | **Summary Description** |
| Conjunctive Use Storage and Water Transfer Project using Wet Year and Dry Year Allocation | This project concept proposes a purchase by OCWD of up to 45,000 AF of imported water to be recharged by the IEUA member agencies during wet years. Water would be purchased at a reduced imported water rate from MWD reflecting the savings of not storing the SWP water at one of MWD's own storage programs such as the Semi-Tropic Water Storage District and/or Kern County Water Bank. In dry years, OCWD member agencies could request IEUA member agencies to increase their groundwater production for three years by up to 15,000 AF per year in-lieu of direct deliveries from MWD, while MWD increases deliveries in the Orange County area by an equal amount. Under this scenario, the net MWD deliveries during dry years (years that Water Supply Allocation Plan is |

| | |
|---|---|
| | implemented) will remain unchanged, without the need for MWD to produce water from its storage accounts. At the same time, having the imported water stored in the SAR watershed will increase local supply reliability, and provide some financial incentive to both IEUA and OCWD member agencies. |
| Salt Assimilative Capacity Building and Recycled Water Transfer Project | EMWD has the capability to discharge 15,000 AFY of recycled water into Temescal Creek. The recycled water discharge will be dependent on surplus recycled water available and not used within EMWD particularly during wet seasons. With the approval of the SAR Watermaster, this flow can be contractually added to OCWD's SAR base flow allocation at Prado. The water quality of EMWD's discharged recycled water may require some salinity mitigation by OCWD to meet the RWQCB Basin Plan Objective in Orange County. The GWRS will be used to provide the required mitigation for the discharged water, and EMWD will pay OCWD for the cost of that mitigation. As part of this project, OCWD will credit EMWD for the purified water that is recharged into the Orange County groundwater basin, and compensate EMWD when that water is produced by OCWD member agencies. To increase water supply reliability in the SAR Watershed, EMWD could use the revenues from this water transfer project for imported water banking during wet years in the San Jacinto Watershed groundwater basins. |
| Riverside Basin Aquifer Storage and Recovery Project | Riverside Public Utilities, in partnership with Valley District and others, are developing a design for a rubber dam that would cross the Santa Ana River and be used to divert flows while mitigating environment impacts. Creates, 28,000 AFY into off-stream recharge basins. |
| Watershed Invasive Plant Removal Project | The Santa Ana Watershed Association, the Front Country District Ranger on the San Bernardino National Forest and Southern California Edison had proposed a major an invasive plant eradication project for the Mill Creek Watershed. This project area covers the front (southern slopes) of the San Bernardino Mountains from Highway 18 through Waterman Canyon on the west to Highway 38 from the Mill Creek Ranger Station to Angelus Oaks, an area of approximately 172,773 acres. The proposed future 3-year work area in this proposal covers the Mill Creek Watershed from the Forest boundary to the headwaters. This project proposes to expand the San Bernardino Mountains Front Range Invasive Plant Removal Project to an invasive plant removal and restoration project in the Santa Ana River Watershed that has many partners and stakeholders extending from the coast to the headwaters. |
| **Title** | **Summary Description** |
| Regional BMPs to Manage Municipal Stormwater Discharges | Develop regional BMPs including infiltration, harvest & reuse, and biotreatment as proposed under current MS4 Permits. Initial phase would be located in MSAR Pathogen TMDL area and expand into other areas of the watershed under future phases to address pathogen treatment. |
| Watershed-wide coordinated surface water monitoring program | Surface water quality monitoring is not coordinated within the watershed leading to duplicative sampling in some areas and inadequate sampling in others. In some cases this may lead to 303(d) listings that do not reflect real impairments. A new program to coordinate surface water quality monitoring to enhance efficiency and reduce costs is proposed. Sources of monitoring |

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|---|---|
| | data would come from MSAR Watershed TMDL, SWQSTF, MS4 Stormwater Permits, and SCCWRP Bio-assessment Program. |
| Watershed Urban Runoff Management Fund | Establishing a Watershed Based Urban Runoff Management Fund to support the implementation of stormwater management programs. Components of this program could include the regulatory basis for a watershed based program, the legal basis and authority for the fund, the agreements, and programmatic elements. |
| Santa Ana River Sediment Transport | Building upon an OCWD demonstration project, implementation of a full scale project that allows for the appropriate transfer of sediment to maximize recharge operations, restore habitat, and reduce operation costs. |
| Transportation Corridor Stormwater Capture and Treatment | New uses of the current transportation right-of-ways can be expanded for capturing rain runoff and replenishing groundwater basins. |
| Modified Watershed Brine Management System | Optimizing the water used to transport brine so that less water is lost to the ocean through increased concentrating of brine or delivery to the Salton Sea for beneficial use. |
| Water Industry Energy Use Reduction Incentive Program | Supporting regional purchase and installation programs of water resource related greener energy projects that reduce capital costs and green house gas emissions. |
| Watershed Land Use Planning Tool Kit | Developing a tool kit that translates water principles to support watershed planning decisions and implements a jurisdictional outreach effort for relevant regional, county and city planning agencies that encourages adoption of the guidance ideology into General Plans and zoning codes at the local level. |

## From Concept to Reality – Next Steps for OWOW Implementation

Implementation of the Watershed-based Implementation Concepts just described requires a collaborative multi-jurisdictional effort to be successful. Two types of efforts are envisioned: (1) implementation of Water Resources Infrastructural Conceptual Projects; and (2) Watershed Sustainability Guidance and Programs. Implementation of infrastructural conceptual projects have both institutional (regulatory, jurisdictional, economic) and technical (planning, design and construction) elements. The biggest challenge to successful implementation is not the technical issues; it is the institutional issues that will be associated with any project. We have the technical skills to build the infrastructure; however, developing the institutional support across the watershed, which is required to actually build the infrastructure, requires substantial work. Developments of Watershed-based Guidance and Programs have similar challenges. From a technical standpoint, we have numerous experts throughout the watershed that have the skills and knowledge to develop the projects and programs. On the ground, implementation of the guidance will require a significant focus on the institutional issues.

With these distinctions (technical vs. institutional) in mind, the following recommendations are made to move forward particularly as the future grant funding opportunities arise:

- Identify a champion(s) for each conceptual implementation action or project, one who has the time and resources to commit to the effort.

- Form teams that are responsible for the various project elements, but led by the project champion(s). Recommended teams and examples of their potential responsibilities could include:

    - Financial – This team develops either the means to finance a project (including state/federal grant development) or develops economically sound programs to support watershed management activities, e.g., establishment and operation of an Urban Mitigation Fund to support regional stormwater treatment.
    - Regulatory – This team's job is to eliminate or minimize regulatory barriers or steer projects in a manner to work around such barriers. They would identify regulatory issues associated with implementation of an infrastructure project or implementation of elements of a guidance document. This team would work directly with the regulatory agencies to resolve conflicts and overcome barriers; they would also lead the effort to develop regulatory documents, e.g., prepare permit applications or complete CEQA requirements for the implementation of an infrastructure project.
    - Legal – Experts can provide critical information regarding legal issues such as making sure existing legally binding agreements, e.g., water rights, are not impacted by a project. If they are impacted, they would develop options and provide means for working around such barriers.
    - Marketing – Outreach is a key to success of any watershed project. The marketing team would be responsible for developing stakeholder support, preparing outreach materials, and coordinating outreach activities, including arranging for experts from the other teams to attend outreach events to share their knowledge.
    - Technical – The technical team includes the skill sets needed to design the project or develop the technical aspects of a guidance document. For infrastructure projects, the team would begin with a 10% planning level design, which then would be used by the other teams to initiate their efforts. Once agreement is reached on the planning level concept, the various financial, regulatory, legal and marketing needs can be defined,

and the other teams can go to work while the technical team moves forward with design. Similarly, for guidance development, the technical team would first develop the technical framework, methods, or ideas that will comprise the guidance. With that understanding developed, the other teams would go to work to lay the groundwork, where needed, to increase the likelihood of implementation across the watershed.

- Empower the teams to work autonomously with oversight by the champion. The project champion(s) would ensure the work of the various teams is shared as needed.

- Decision makers need to be at the table leading the teams. The staff of the decision makers can certainly do the heavy lifting, but decision makers are needed to drive the process forward, especially when the inevitable speed bumps arise. A commitment to work to the 30% design level will develop project and program concepts that can engage and encourage the input from other potential partners and encourage project development beyond the single purpose project.

- Investing in 30% level design (preliminary design) is helpful to the permitting process as the 10-15% design concepts sometimes leave many unanswered questions for regulators resulting in lower commitment to the project initially due to uncertainty.

Preliminary design and feasibility analysis of the projects will improve eligibility for future IRWM grant funding rounds. As project development occurs and regional multi-benefits are more clearly defined, it is likely such projects will be highly rated under future funding rounds through Prop 84 IRWM grant program. With the lion's share of Prop 84 **Chapter 2 Governance, Outreach, and Integration** called out for the Santa Ana River Watershed occurring under the next and final round of Prop 84 amounting to $73.5 million; greater funding support will be available to support regional implementation projects and projects that benefit larger geographic areas of the watershed. Disadvantaged communities and Native American Tribes will be provided special consideration and attention particularly to find adjoining agencies, cities, counties or NGOs that may serve as the sponsoring entity for new water supply or water quality improvement projects.




Eligibility Gates

## Project Prioritization

The Santa Ana Watershed Project Authority (SAWPA), as the regional watershed planning group for the Santa Ana River Watershed, has been facilitating efforts to implement a watershed planning framework to guide water resource managers for the immediate future through the year 2035. To date, this has resulted in the development of the *One Water One Watershed 2.0 Plan* (OWOW Plan). The goal of this process is to develop the tools and strategies necessary to define an integrated water resource plan where all types of water (local surface and groundwater, imported water, stormwater and treated wastewater effluent) are viewed in a comprehensive, integrated manner as a single water resource with water use efficiency as the number one goal.

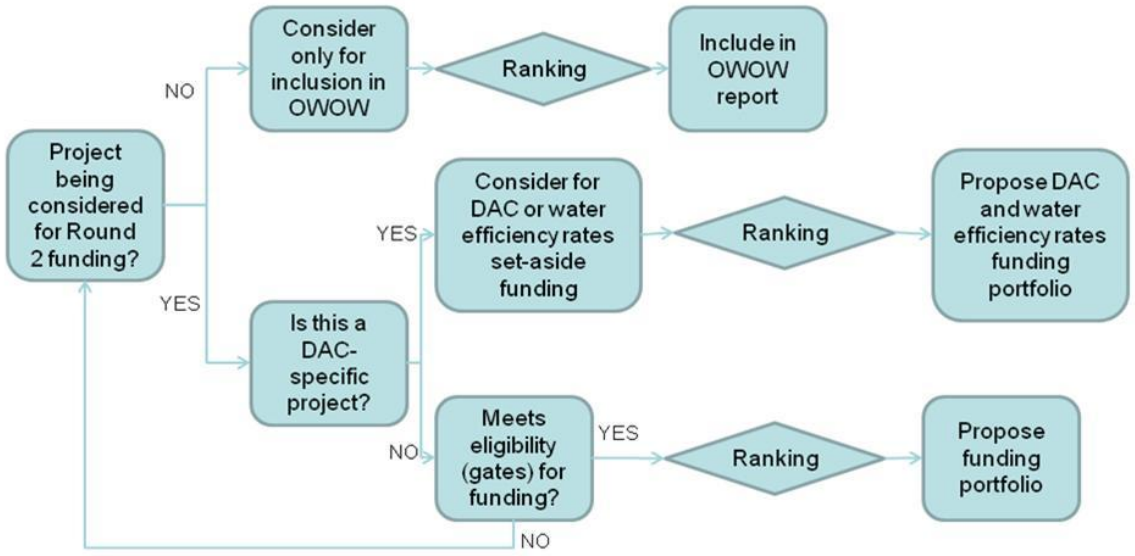
To assure that the OWOW plan included a list of prioritized implementation projects sufficiently developed and demonstrating appropriate needs that can be funded through the Integrated Regional Water Management (IRWM) Grant programs or other funding opportunities. Under OWOW 1.0, SAWPA issued its first Call for Projects to be included in the OWOW Plan from any public agency or non-profit organization in the Santa Ana River Watershed. The period for the preparation of project application was from May 17 to June 30, 2010. During this initial Call for Projects, project applications were evaluated in a two-step process to: 1) determine their eligibility to be included in the OWOW Plan, and, 2) prioritize projects for potential Proposition 84 funding based on their merits to address the watershed goals and objectives. The selection process was developed with goal of transparency, objectivity and deliberation. With the first round of project funding made available from the Department of Water Resource's (DWR) Proposition 84 Integrated Regional Water Management (IRWM) grant program,

agencies in the watershed were asked to collaborate ensuring that their constituencies received multiple benefits that were regional in nature

Under Round 1 of Proposition 84 IRWM program, SAWPA awarded $12 million to 13 integrated projects in the Santa Ana River Watershed in 2011 using a project evaluation and rating and ranking process that incentivized integration and collaboration for watershed management,

In the second round of Proposition 84 project funding conducted in 2012, SAWPA sought to further expand the power of multi-agency cooperation as a means for more holistic, integrated program/project implementation. The primary difference and focus for this second funding round was to encourage projects that reflect a watershed approach that that could create opportunities for local agencies to help shape the implementation of actions that restore hydraulic functionality, solve problems, and provide long-term sustainability. To achieve this end, a new project solicitation was conducted by SAWPA in the summer of 2012. In this project/program solicitation, there were 136 projects submitted for rating and ranking. The adopted rating and ranking process used in OWOW 2.0 is depicted in **Figure 6-1**. Of these projects, 52 requested funding in this round. Others provided project information for planning/ partnership development purposes and to be eligible for other funding sources, such as Proposition 1E.

**Figure 6-1 Adopted Rating and Ranking Process**




## Project Prioritization Criteria

Candidate projects included in the OWOW Plan were evaluated and prioritized based on the degree to which they comply with Evaluation Criteria developed by SAWPA staff. These were based on the goals and objectives, strategies and targets established by the Steering Committee and the Pillars. The achievement of goals and objectives by a project is directly related to the projects ability to obtain Proposition 84, Chapter 2 funding. Chapter 6 Project/Program Review, Evaluation and Prioritization describes the process followed to develop and weight the criteria.

Evaluation criteria were the basis for ranking projects in a reproducible way, using numerical scores for quantitative and qualitative criteria, and applying a consistent scoring and ranking process, described below. A performance measure was created for each criterion to numerically establish the degree to which a project meets each criterion. In some cases, more than one performance measure was used for a given criterion.

The evaluation criteria and performance measures for project prioritization had the following attributes:

**Non-redundant:** each criterion needs to measure something not measured by others to avoid a bias decision.

**Specific:** each criterion is described in detail, clearly specifying what is being measured and the rationale for it.

**Relevant:** criteria and, particularly, performance measures need to help discriminate between "better" and "worse" projects in terms of matching with goals and objectives. If a performance measure value does not vary between projects (if the score for all projects is the same for a given performance measure) the performance measure is unnecessary or inadequate.

Evaluation criteria and their respective performance measures employed in OWOW 2.0 are presented below in **Table 6-1 Ranking Criteria and Performance Measures**.

**Table 6-1 Ranking Criteria and Performance Measures**

| Project Evaluation Criteria | Criteria Weights | Performance Measures | Performance Measure Weights | Performance Measure Units |
|---|---|---|---|---|
| 1. Improve Water Reliability | 20% | Water Use Efficiency | 20% | AFY |
| | | Stormwater Capture/Storage | 20% | AFY |
| | | Recycling/Reuse | 20% | AFY |
| | | Groundwater Desalination | 20% | AFY |
| | | Other | 20% | AFY |
| 2. Improve Water Quality and Salt Balance in the Watershed | 20% | Non-Point Source Reduction | 33% | MGD |
| | | Reduction of TMDLs and Other | 33% | kg/year |
| | | Salt Removal | 33% | tons/year |
| 3. Manage Flood Waters Through Preservation and | 20% | Acres of habitat created | 60% | acres |
| | | Natural hydrology restoration and connectivity | 20% | -na- |

| Project Evaluation Criteria | Criteria Weights | Performance Measures | Performance Measure Weights | Performance Measure Units |
|---|---|---|---|---|
| Restoration of Natural Hydrology | | LID or resource efficient land use practices | 20% | -na- |
| 4. Reduce Greenhouse Gas Emissions from Water Management Activities | 20% | GHG Reduction (CO2 equivalent) | 100% | metric tons |
| 5. Cost Effectiveness | 20% | Cost per AFY | 20% | -na- |
| | | Cost per Acre of Habitat | 20% | -na- |
| | | Cost per Tons of Salt Removed | 20% | -na- |
| | | Cost per MGD of Water Treated | 20% | -na- |
| | | Cost per kg of TMDL or Other Pollutants Removed | 20% | -na- |

## Call for Projects

After the criteria was established by the OWOW governance, SAWPA conducted a Call For Projects to all stakeholders in the watershed and solicited candidate projects from agencies and non-profit organizations in the watershed for inclusion in the OWOW 2.0 plan. The on-line form required specific information that assured that all the Project Review Process requirements could be met (**Appendix L**). These included the following:

- Description of how project contributes to OWOW Goals and Objectives
- Description of how project relates to Resource Management Strategies
- Description of how project is technical feasible
- Description of specific benefits to Disadvantaged Community issues
- Description of Environmental Justice considerations
- Description of project cost and financing
- Description of economic feasibility and economic analysis
- Description of project status
- Description of project merit, benefits and application to OWOW plan
- Description of climate change impacts in region
- Description of how project will reduce greenhouse gas emission compared to project alternatives

Multiple outreach flyers, email notices and workshops were implemented by SAWPA prior to and during the Call for Project Application period of two months. Procedures for submitting projects online and in hard copy for those who were unable to submit online were also made available to stakeholders.

## Project Eligibility Requirements

The first step of the prioritization process was to determine those projects specifically eligible for funding from full OWOW Project List that included conceptual projects and projects seeking grant funding. For the OWOW Round 2 Call for Projects, the Steering Committee established a number of eligibility gates as minimum requirements to compete for available Proposition 84 Implementation grant funding. The eligibility gates were not limited just to the Proposition 84 statutory requirements but also include eligibility gates that would emphasize the need for integration, collaboration and meeting the OWOW Plan Goals and Objectives. These included Proposition 84 Statutory Requirements, Multi-jurisdictional Collaboration, Cost-Match Commitment and Completion Commitment.

### Proposition 84 Statutory Requirements – Project Eligibility for Proposition 84 Funding:

Through this eligibility gate project proponents are required to address Proposition 84 eligibility requirements in relation to the DWR Prop 84 IRWM Proposal Solicitation Package (PSP) requirements including funding match, urban water suppliers, groundwater projects, agricultural water suppliers, and surface water diverters.

### Multi-jurisdictional Collaboration – Number of Partners, Partners Role and Level of Participation:

This eligibility gate requires that project proponents have local partners and to identify each partner identify the role(s) of the partnership (e.g., planning coordination, funding partner, etc). A mere letter of support was considered insufficient to reflect multi-jurisdictional collaboration.

### Cost-Match Commitment – Minimum Percent of Project Cost Funded Locally:

This eligibility gate requires that project proponents provide a minimum 25% match.

### Completion Commitment - Secured Funding:

This eligibility gate requires that project proponents provide documentation of the availability of local funds to complete the project.

## Initial Review

After the deadline for the Call for Projects was reached, all projects were evaluated by SAWPA staff to determine their eligibility to be part of the OWOW Plan. Since the projects received were in different stages of development, projects beyond the conceptual level, largely with feasibility studies in place, were parsed out to be considered for possible Proposition 84 IRWM Implementation funding. It is important to reiterate that initial ranking was based on self-reported project data.

The first review step occurred internally by SAWPA staff to assure quality control and catch any data input errors. With so many project information forms representing over a hundred projects from across the watershed, QA/QC was important to confirm any data outliers and verify with the project proponents whether the data was accurate. The process was conducted to ensure a sense of fairness and completeness before commencing the prioritization process. If errors based on SAWPA's review

were encountered largely based on unrealistic data entry errors, the project proponent was contacted and encouraged to correct the error by re-submittal of the corrected project information form.

Thereafter, review by SAWPA included more in depth evaluation and confirmation of the costs, benefits and overall economic feasibility analysis. Quantification and accuracy of claimed benefits were also double checked.

## Project Scoring

The next step of the prioritization process was to score each project. Scoring is the process by which the information provided by the project sponsors is converted to a numerical value for each sub-criterion using the performance measures presented in **Table 6-1** above. In many instances, the information provided in the nomination forms need to be processed or combined to establish the numerical value of each performance measure. Relevant methodological notes on the scoring of each performance measures are presented above. The Project Form is located in **Appendix L**.

Each project submitted to SAWPA for inclusion in the OWOW 2.0 ranking process was scored and evaluated using the five criteria established by the OWOW Steering Committee. Each criteria was equally weighted at 20%. Each project was scored based on the effective benefit that would be realized at the conclusion of the project as described within the scope in the application. For each criterion, a scale was developed such that it would be used as the basis for analysis utilizing a commercially available software package developed by Infoharvest, Inc., called Criterium DecisionPlus (CDP).

### Criterion 1 – Improve Water Reliability and Reduce Reliance on Imported Water

Scores were developed for Criterion 1 by using the acre-foot per year (AFY) yields provided by applicants for the water use efficiency, stormwater capture and storage, recycled reuse, groundwater desalination, and other categories. The score for this criterion was developed using the following steps:

- The total AFY were summed up for each project for all the categories
- A scale was developed to account for the full range of benefits
- The projects were scored based on this scale
- The values were entered into CDP

### Criterion 2 – Improve Water Quality and Salt Balance

Scores were developed for Criterion 2 for each of three categories: Non-Point Source Reduction (mgd), Reduction of Total Maximum Daily Loads (TMDL) Listed Pollutants and other Pollutants (KG/year), and Salt Removal (tons/year). To develop the scores, the following steps were taken:

- Data for each category was normalized on a scale of 1 to 5, 1 being the worst and 5 the best
    - To develop the normalization, the data for each category with a value greater than 0 was divided into quartiles to facilitate developing ranges. Scores were assigned using the scale.

- Normalized data was then summed together for the three categories for each project to value the multi-benefit of multiple categories.
- Summed data was adjusted to display a 1 to 5 scoring.
- The values were entered into CDP.

### Criterion 3 – Manage Flood Waters through Preservation and Restoration of Natural Hydrology

Criterion 3 was evaluated using three performance measures: Acres of Habitat Created (3a), Natural Hydrology Restoration and Connectivity (3b), and Low Impact Development or Resources Efficient Land Use Practices (3c). The performance measures were weighted with the following percentages 60%, 20%, and 20%, respectively. Performance measure 3a was weighted higher as it provides the greatest benefit to the criteria.

#### *Performance Measure 3a*

Scores were developed for performance measure 3a using the following steps:
Develop a scale that would best convey the benefit for each project.

- Each project was scored
- Scores were entered into CDP

#### *Performance Measures 3b and 3c*

Performance measures 3b and 3c consist of 2 components: a yes/no answer to whether the project provides the applicable benefit and a description of the benefit. Values for each component were developed based on the following factors:

- Project had no applicable benefit
- Project had benefits but had little or no quantification of such benefits
- Project had quantified and clear benefits
- Values were then entered into CDP

### Criterion 4 – Reduce Greenhouse Gas Emissions from Water Management Activities

Scores were developed for Criteria 4 using the following steps:

- Data was normalized on a scale of 1 to 5, 1 being the worst and 5 the best (any project that provided more than 10,000 metric tons of $CO_2e$ reduction were scored a 5)
- The values were entered into CDP

### Criterion 5 – Cost Effectiveness

Criteria 5 is composed of five components evaluating the cost-effectiveness on a per unit basis per year for each benefit identified by the applicant: Cost per AFY of Water (5a), Cost per Acre of Habitat (5b), Cost per Tons of Salt Removed (5c), Cost per MGD of Water Treated (5d), Cost per KG of TMDL listed or Other Pollutants Removed (5e). Values for each component were calculated using the following steps:

- Data was normalized on a scale of 1 to 5, 1 being the worst and 5 the best
- The normalized values for each project and for all components were summed together and averaged to arrive at the cost effectiveness value
- The values were entered into CDP

## OWOW Project Ranking

The project scores for each performance measure were used for the ranking of the projects using a multi-criteria ranking method. The method is known as Multi-Attribute Rating Technique (MART). The method consists of applying the weights for each criterion to the criteria scores, and adding the weighted criteria scores to obtain an overall weighted and final score to use in ranking. For the ranking process, the commercial software used was CDP. CDP uses MART for ranking projects or planning alternatives.

One of the steps in the MART consists of normalizing the scores. The *normalization* of a score is necessary to eliminate the units of the scores and to be able to add, average, or compare scores from different performance measures. *Normalization* basically means converting any dimensional or dimensionless quantity to a common scale.

*Normalization* of scores was done at two levels in this prioritization process. The first level of normalization was done within the scoring (i.e., before the application of CDP) where a criterion required addition or averaging of performance measures. In OWOW 2.0 the following performance measures were normalized to a scale of 1-5:

For the criterion “Improve Water Quality and Salt Balance in the Watershed” the performance measures:

- Non-Point Source Reduction [MGD]
- Reduction of TMDLs and Other [KG/year]
- Salt Removal [tons/year]

Once these three performance measures were normalized, they were combined in a composite score of 1-5 to be used for prioritization. For the criterion “Reduce Greenhouse Gas Emissions from Water Management Activities” the Data normalized to 1-5 scale for CO2equivalent.

- Data > 10,000 co2e metric tons capped at 5
- Data with value less 10,000 co2e divided into quartiles to develop ranges for scale

For the criterion “Cost effectiveness” the performance measures:

- Cost per AFY of Water [$/AFY]

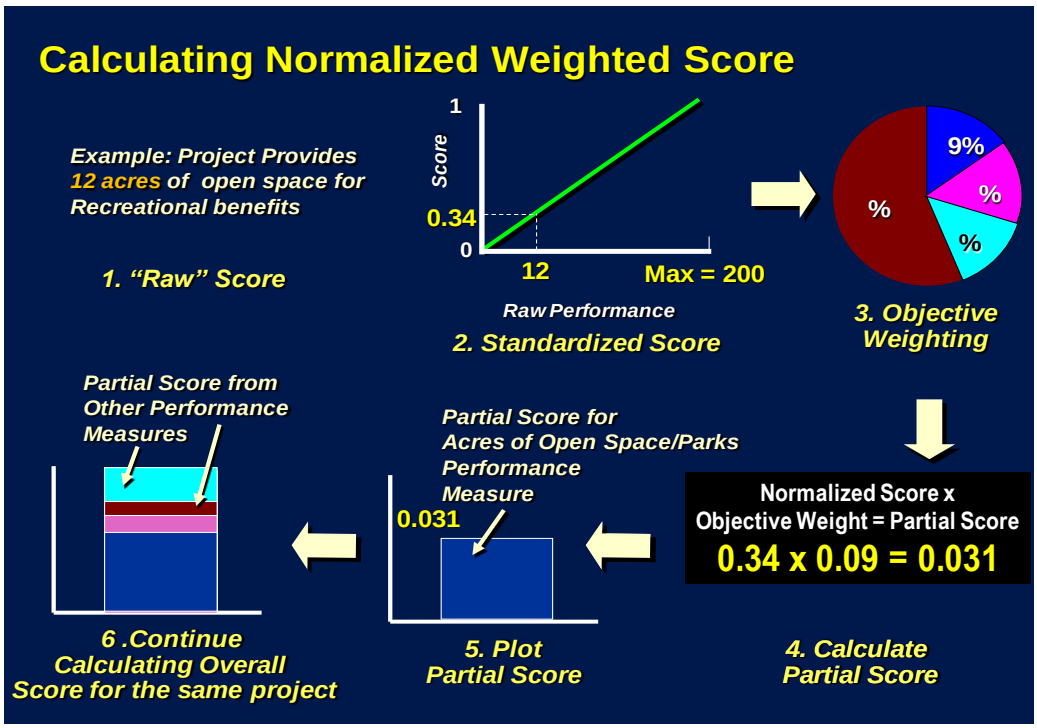
- Cost per Acre of Habitat [$/acre]
- Cost per Tons of Salt Removed [$/(tons/year)]
- Cost per MGD of Water Treated [$/MGD]
- Cost per Kg of TMDL listed or Other Pollutants Removed [$/(KG/year)]

The normalized scores in the scale of 1 to 5 then were combined in an average as a composite score of cost effectiveness to be used in prioritization.

The second case in which *normalization* was conducted was within the ranking process, for all of the scores. This step always is performed in MART and it's a step performed within CDP. CDP normalizes all scores using a scale of 0 to 1.

In addition to the normalization score in CDP, there are five other basic steps in MART (**Figure 6-2**). The first step is the scoring of the project against each sub-criteria as described in the earlier sections. In the example described in **Figure 6-2**, the project has a score of 12 acres (raw performance measure) for recreational benefits. As different criteria have different units of measurement (for example salt removal is measured in tons/year, water treatment benefits are measured in MGD, etc.) normalization is used, as mentioned above. In the example depicted in **Figure 6-2**, the recreational benefits score is converted with a scale between 0 and 1, using a linear scale. The raw performance of 12 acres translates into a normalized score of 0.34 (where the score of 0 indicates the worst performance, i.e. no acres for open space, and the score of 1.0 indicates the best performance, i.e. largest recreational and open space area provided by any project).

**Figure 6-2 Multi-Attribute Rating Technique to Rank Any Type of Alternatives or Projects**

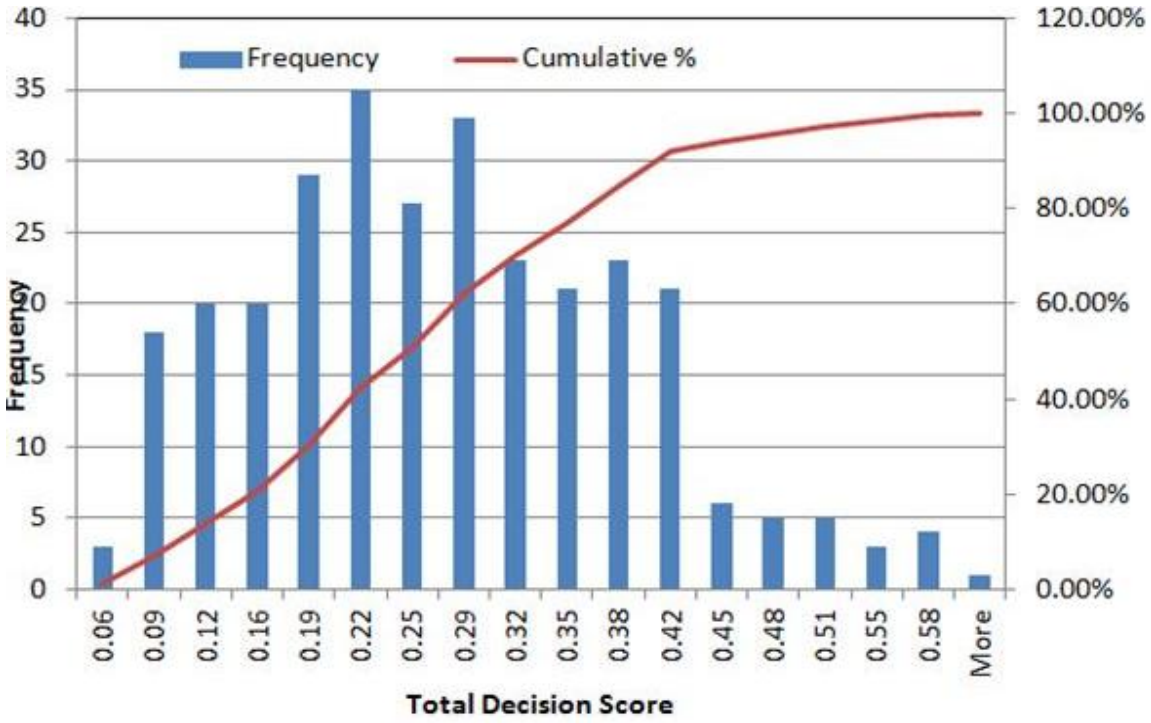


Step 3 on **Figure 6-2** shows the weighting of the criteria. In OWOW 2.0 all criteria were weighted equally. In Step 4 in **Figure 6-2**, the normalized score is multiplied by the weight of the criterion. In the example in **Figure 6-2**, the open space criterion received a weight of 9 percent (out of a possible 100 percent). The normalized score (0.34) is multiplied by its weight of 9 percent in order to get a partial score of 0.031 for the project.

The partial score of 0.031 then is plotted on a graph for that project [Step 5 in **Figure 6-2**]. This procedure is repeated for all of the other criteria (or performance measures) for the same project until a total decision score for the alternative is calculated [Step 6 in **Figure 6-2**]. Finally, after all projects receive a total score, they can be compared to the rest of the projects and ranked according to the overall CDP score, also called *decision score*.

**Figure 6-3** shows the example of a linear scale for normalization of scores in Step 2. In the process of normalizing scores for the OWOW projects, however, some of the normalization scales were defined as non-linear scales. This was necessary to avoid an effect called "shadowing" by which a few projects with significantly higher raw scores can generate low scores for the rest of the projects when a linear scale is used. For example, in a situation in which 95 percent of projects have benefits under 100 acres, but one or two percent of projects have benefits over 5,000 acres, a linear scale could result in the lowest score for the 95 percent of projects under 100 acres. The shadowing of those high performing projects could render the performance measure irrelevant since the normalized score would not serve as a discriminator for 95 percent of projects.

**Figure 6-3 Distribution of Total Decision Scores for all OWOW**




In the OWOW ranking process, the scales for "Improve Water Reliability and Reduce Reliance on Imported Water", "Improve Water Quality and Salt Balance", "Manage Flood Waters through Preservation and Restoration of Natural Hydrology" and "Cost Effectiveness" scales for these benefits each required non-linear normalization scales.

## Project Prioritizations Results

All 136 projects included in the OWOW 2.0 plan were ranked using MART. The complete ranked list of projects is presented in **Appendix K**.

**Figure 6-4** presents the spread of decision scores (ranking scores) in a horizontal bar chart. The figure shows an inflection point around 90 percent of projects. This means that about ten percent of the projects (between 25 and 20 projects) distinguish from the rest obtaining scores that would indicate that they provide more benefits and/or perform significantly better than the rest of the projects for most of the criteria.

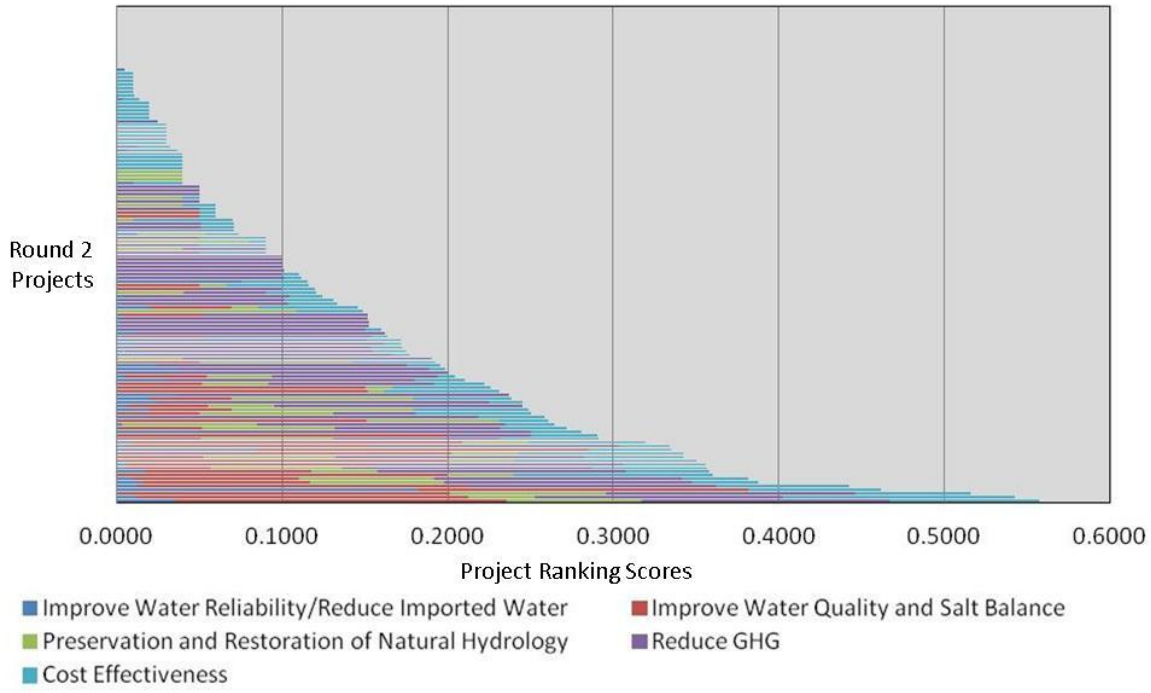
In order to test the robustness of the ranking method used (including the qualitative scales and the non-linear normalization scales), a series of sensitivity analyses were run on the model.

Additionally the sensitivity of the ranking to the weights of the sub criteria also was tested. Results of the sensitivity analysis showed that the ranking is not sensitive to the qualitative scales (such as the

greenhouse gas scale of 1 to 5). The model is not sensitive to the actual shape of the non-linear scales used for normalization of some criteria, as long as the scale remains non linear (to avoid the "shadowing" effect). Similarly, the ranking generally is not sensitive to reasonable changes in the weights of the criteria (changes of ten percentage points). The ranking, however, does show a sensitivity to the actual raw scores (numbers reported in the project nomination forms) mainly for water supply and water quality benefits. For a ranking of projects to determine the actual Proposition 84 funding, the information provided in the nomination form would have to be vetted to avoid biases in decision scores due to inaccurate information.

The final prioritized OWOW project implementation list is presented in **Appendix K**. Projects are ranked from highest CDP decision score to lowest CDP decision score. Scores range from about 0.06 for the lowest ranked projects to above 0.60 for the highest ranked projects (shown in **Figure 6-4**). The "perfect" theoretical score is 1.0. The results of the ranking with the highest ranked project around 0.61 are not unexpected given the great number and diversity of sub-criteria. Generally, in any multi-criteria ranking process, the greater the number of criteria the lower the decision scores tend to be, as it becomes increasingly less likely that the best project will score well for all criteria.

**Figure 6-4 Distribution and Magnitude of Total Decisions Scores for all OWOW 2.0 Projects**




Based on project numeric score from established criteria approved by the OWOW Steering Committee, projects were assigned to one of three tiers to reflect natural breaks in the results on the project rankings. Identification of these breaks and placement in a specific tier was based on an analysis of

score distributions by an independent consultant for all ranked projects. The tiers represent how well a specific project meets the OWOW benefit criteria.

## Project Review Committee

The next step in this process was to assure the veracity of information submitted by project proponents. To evaluate projects, SAWPA formed a three person Project Review Committee (PRC) to provide an independent and expert review of the top ranked submissions including disadvantaged community assistance and water use efficiency rate funding. The three committee members were selected for their knowledge of water, both technically and at a policy level, their understanding and leadership in developing integrated approaches to problem solving and their knowledge of the Santa Ana River Watershed. The PRC included Joe Grindstaff, former Executive Officer of the Delta Stewardship Council and former SAWPA General Manager; Pete Silva, former State Water Resources Control Board member and former US EPA's Assistant Administrator for the Office of Water; and Gerry Thibeault, former Executive Officer of the California Regional Water Quality Control Board, Santa Ana Region. Over the last week of November of 2012, the PRC interviewed project proponents from the top 32 projects.

Prior to the interview process, the PRC were asked to focus on finding projects that were not only technologically feasible, but projects that were integrated and provided regional benefit. In the review process, the PRC first vetted the claims made by the project proponents on their on-line application. Secondly, they focused on the projects in the context of the goals and objectives of OWOW. Projects that provided single benefits, were not regional in scope and impact or were not representative of significant collaboration were not considered for funding. The PRC sought to identify and move projects forward that exemplified the integrated planning concept and provided the most benefit to the OWOW planning region.

A portfolio of 22 projects and programs was recommended by the PRC, two of which were subsequently accelerated into Round 1, due to the availability of additional Round 1 funding. These projects combined provide water use efficiency, enhanced groundwater recharge, integrated flood control/ habitat benefits, non-point source pollution reduction, salt removal from local aquifers, and assistance to disadvantaged communities. Funding from Round 2 is expected to provide about $17 million to support the 22 projects. In addition to the grant funding, local funding in the amount of $193 million has also been committed by project proponents to implement the projects.

The recommended projects were approved by OWOW Steering Committee and SAWPA Commission in December 2012. Thereafter, the approved Round 2 project proponents from the Santa Ana Region were asked to prepare the DWR application with compilation of the project solicitation package by SAWPA staff and submittal to the State by March 29, 2013. DWR announced their recommended projects under Round 2 released on Sept. 25, 2013. The implementation of Round 2 IRWM Implementation projects will serve to augment the important initial implementation of OWOW projects from Round 1 in moving the watershed closer to meeting the OWOW vision of a Watershed that is sustainable, drought proofed and salt balanced by 2030, and in which water resources are protected and water is used efficiently.

**OWOW Prop 84 Round 2 Recommended Project list is as follows:**

| Project Name | Lead Agency | Recommended Grant |
|---|---|---|
| Wineville Recycled Water | Inland Empire Utilities Agency (IEUA) | $1,000,000 |
| San Sevaine Recharge | IEUA | $750,000 |
| Vulcan Pit Flood Control | City of Fontana | $1,000,000 |
| Wilson Basins Project | City of Yucaipa | $750,000 |
| Francis St/Ely Basin Project | City of Ontario | $750,000 |
| Plunge Creek Recharge | San Bernardino Valley Municipal Water District (SBVMWD) | $500,000 |
| Enhanced SAR Recharge | SBVWCD | $1,000,000 |
| 14th St. Recharge | City of Upland | $500,000 |
| Arlington-Central Ave. Phase I | City of Riverside | $1,000,000 |
| Perris Desalter Wells | Eastern Municipal Water District (EMWD) | $1,000,000 |
| Alamitos Barrier Project | Orange County Water District (OCWD) | $500,000^ |
| Peters Canyon Capture | City of Irvine | $1,000,000 |
| Corona/Home Gardens Well | City of Corona Department of Water and Power | $1,300,000 |
| Prado Basin Sediment Demo | OCWD | $750,000 |
| Wastewater Project | Soboba Tribe | $150,000 |
| Canyon Lake Hybrid Project | Lake Elsinore and San Jacinto Watersheds Authority | $500,000 |
| Arlington Basin WQ Project | Western Municipal Water District (WMWD) | $500,000^ |
| Forest First Project | US Forest Service | $1,000,000 |
| Com/Ind/Inst. Water Efficiency | Municipal Water District of Orange County | $500,000 |
| Regional Landscape Retrofit | IEUA | $500,000 |
| Customer WUE Handbook | WMWD | $120,000 |
| Quail Valley Sewer System | EMWD | $1,930,000 |

SAWPA staff worked closely with each project proponent to ensure that their Proposition 84 IRWM Implementation Grant applications were completed appropriately. Upon announcement and approval of the recommended Round 2 project list by SAWPA Governance, weekly workshops were held with the 20 project proponents to support application preparation and submittal to SAWPA to compilation.

As part of this process, each project proponent had to adopt the OWOW 1.0 plan. Additionally, due to new State legislation, a description of how the projects would reduce dependence on the Delta Supply was included as part of the overall application submitted by SAWPA to DWR.

## Future Review Processes

It is anticipated that the project review and prioritization process will be reviewed and refined to support greater integration and collaboration, to comply with any new DWR IRWM Guidelines and PSP requirements, and improve the streamlining and efficiency of project submittal. Further, based on public workshop feedback the process will be refined to better serve the stakeholders and support the overall goals and objectives of the OWOW plan.

# 7.0 Impacts and Benefits Of Sustainable Integrated Solutions



With the development of integrated watershed planning, multi-benefit and multi-purpose projects have moved to the forefront and have become one of the primary goals of the One Water One Watershed (OWOW) process. The idea of meeting a number of community needs with a multi-benefit project is not new; however, specialization within agencies that deal with water has often moved these project types to the backburner. Past efforts primarily have focused on single purpose projects, and the additional effort required to develop multi-objective solutions has made true multi-benefit projects relatively uncommon. In California, there has been an effort to incentivize collaborative planning through Integrated Regional Watershed Management (IRWM) Planning and associated funding sources.

This reliance on single-purpose projects is not unique to water. An interesting analogy can be drawn with the field of public health. Infectious diseases that plague much of the world can be treated by eliminating the infectious agent or interrupting the transmission of the pathogen. Public health programs traditionally focus on both approaches and use a team of physicians, sanitary engineers, and others professionals to address problems, often with great results. The development of more specialization in public health practice, in many cases, has been correlated with the resurgence of some diseases, such as malaria. Recently, scientists have become concerned that the "Balkanization of Science" has resulted in specialists with narrow training focusing only on a single aspect of a broader problem. Effective solutions often are missed by this approach (Moore, 2008). Similar statements could be made about water management. If water is considered in the broadest sense as a resource that benefits a wide group of interests, including those represented by the ten Pillar groups of the OWOW process, the projects that address as many of those interests as possible should be encouraged.

Some of the earliest multi-benefit water projects were done through a partnership between those interested in flood and groundwater management. Spreading grounds along the front slopes of local mountains have attenuated flood flows and recharged groundwater basins for nearly 100 years. OCWD partnered early with Orange County Flood Control District to provide recharge basins within flood control basins. More recently, Inland Empire Utilities Agency (IEUA) has worked with San Bernardino County Flood Control to modify the operation of the flood control system to maximize recharge opportunities. IRWD has partnered with the Orange County Flood Control District to store recycled water in some flood control basins. All of these projects primarily were facilitated by operational changes rather than the construction of new infrastructure, although in some cases the flood system was upgraded. Operational changes could occur only when both parties understood the needs and assets of the other.

The development of multi-benefit projects will remain challenging and require sustained effort by agencies that manage water. In the watershed alone, there are approximately 100 agencies that manage water in some way. This situation is not unique to this watershed. The Federal government has 12 agencies and eight separate committees all doing water-related work (Udall and Averyt, 2009). Agencies need to prioritize collaborative projects and provide the staff resources to ensure that such projects are developed.

The purpose of integrated watershed planning is to consider other disciplines or functional areas when planning and implementing projects. Benefits of this approach far exceed the immediate benefit of reducing controversy surrounding a particular project. The Pillars developed a list of potential benefits in a workshop to identify incentives associated with the development of multi-benefit programs and projects. They are listed below:

**Solving Problems using a multi-benefit approach prevents the creation of other problems.** Often when a single-function project is developed, it has an impact on other water-related areas, often unanticipated. The truth of this statement is often born out in a CEQA or NEPA analysis, where numerous problem areas can be identified.

**Mult-benefit problem solving results in no missed opportunities.** In a multi-benefit type of approach, a careful exploration of all aspects of a particular project often results in the identification of incremental project changes that can result in large benefits in other areas.

**Cost and resource savings for the public can be achieved.** When a multi-benefit project is developed, the cost of providing each benefit is often less than providing similar benefits to the public using two or more separate projects. As land and other public resources become scarce, these types of projects are more likely to be undertaken and provide more public benefit.

**Developing projects that provide multiple benefits develops trust.** As groups develop multi-benefit projects, trust is developed among different constituencies, each interested in a different aspect of water. These groups are more likely to work toward similar solutions in the future if they have successfully developed multi-benefit projects.

**Multi-benefit projects are focused on building successful projects, not dispute resolutions.** Groups focused on problem solving rather than dispute resolution or litigation save public resources and implement solutions to regional problems faster than they would had they disputed each other's single-function project.

**Development of multi-purpose projects can develop better communication.** Through the development of a project, groups that span geography or area of interest develop better communication and trust.

**Multi-purpose projects often have diverse sources of funding.** As multi-benefit projects are developed, multiple State and Federal funding sources become available providing cost share opportunities, and increasing the probability that a specific project would move forward.

**Development of multi-function projects allows sharing of human resources.** Each agency or constituency interested in developing a project has access to individuals with unique abilities and perspectives. Teams formed from diverse groups often develop unique solutions to problems.

Pillar Co-chairs met several times to develop matrices that demonstrated the potential benefits of multi-benefit projects undertaken between Pillar groups. In other words, how would a multi-benefit project conducted by one Pillar group benefit another group? The purpose of this exercise was to encourage the Pillars to begin to focus on how implementing projects to benefit their constituency can be designed to benefit others.

Drafts of these matrices were taken to three public workshops held in Orange, Riverside, and San Bernardino Counties. At these sessions, stakeholders were invited to comment on the work of the Pillars, as well as suggest their own benefits. Again, the primary purpose of these workshops was to encourage discussion around the concept of designing projects for more than one purpose. As the Pillar leaders completed their final drafts, they developed a list of project types that would benefit more than one Pillar and were worthy of further consideration and implementation.

Under OWOW 2.0 Plan, as some Pillars were folded into others and new ones arose as compared to the OWOW 1.0 Plan, new tables were developed that catalog the potential impacts and benefits at the region level and inter-region levels. A project that fulfills a particular watershed need can be designed to provide other benefits to several other Pillars and to surrounding regions. Maximizing these benefits provides for better projects and better use of public money.

## Implementation Benefits of Prop 84 Round 1 and Round 2

Since the development of the OWOW Plan, there have been many multi-beneficial projects proposed and funded for the improvement of communities and water agencies alike. These projects have been financed by Proposition 84 Chapter 2 Round 1, and Proposition 84 Round 2, implementation of these developments has provided both regional and inter-regional benefits. Shown below in **Table 7-1** is a list of all the projects and their associated benefits. These projects were able to target key improvement areas within the watershed such as:

- Water Use Efficiency
- Stormwater Capture Storage
- Groundwater Desalination
- Recycling Reuse
- New Storage
- Non-point Source Reduction
- Salt Removal
- Preservation Restoration
- Reduction of TMDL's and other Pollutants

Also part of Round 2, another sequence of proposed and funded projects proved to be multi-beneficial to the watershed. Listed below on **Table 7-2** is a record of all the funded projects and their respective benefits. These follow the same key target improvement areas as shown above. Development and implementation of projects such as these contribute to the overall goal in creating a sustainable watershed.

**Table 7-1 Implementation Projects Funded by Proposition 84 Chapter 2 Round 1**

| Project | Benefits |
|---|---|
| Santa Ana Watershed Vireo Monitoring and Breeding Bird Surveys | • Restored 300 acres of endangered bird species habitat |
| Arlington Desalter Connection Project No. 27 – 1208 & Western Municipal Water District Promenade Connection | • Water use efficiency increase of 11,200 AFY |
| Groundwater Replenishment System – Flow Equalizer | • Recycling reuse increase of 12,000 AFY<br>• |
| Perris II Desalination Facility | • Groundwater desalination of 6,050 AFY<br>• Non-point source reduction of 7 MGD<br>• 21,000 tons of salt removed<br>• Two acres of preservation restored |
| Cactus Basins No. 3 and No. 3A | • Stormwater capture storage increase of 15,000 AFY<br>• 700 acres of preservation restored |
| Sludge Dewatering, Odor Control, and Preliminary Sludge Thickness at Plant No. 1, Project No. P1 – 101 | • Recycling reuse increase of 78,400 AFY |
| Perchlorate Wellhead Treatment System Pipelines | • 101 tons of salt removed |
| Chino Creek Well-field, Wells 1,2, and 3 | • Groundwater desalination of 2,900 AFY<br>• One ton of salt removed |
| Cucamonga Creek Watershed Regional Water Quality Project (Mill Creek Wetlands) | • New storage of 160 AF<br>• 14 acres of preservation restored |
| Repairs to the Unlined RCP Reach IVA and Reach IV-B Santa Ana Regional Interceptor (SARI) | • Supports continued brine disposal |
| Well 21 and 22 Project | • Groundwater desalination of 6,300 AFY |
| Alamitos Barrier Improvement Project | • 520 tons of salt removed |
| Arlington Basin Water Quality Improvement Project | • Stormwater capture storage increase of 1,300 AFY<br>• 16 acres of preservation restored |

**Table 7-2 Implementation Projects funded by Proposition 84 Chapter 2 Round 2**

| Project | Benefits |
|---|---|
| Wineville Regional Recycled Water Pipeline and Groundwater Recharge Systems Upgrades | • Stormwater capture storage increase of 4,600 AFY<br>• 46 acres of preservation restored |

| | |
|---|---|
| Forest First – Increase Stormwater Capture and Decrease Sediment Loading through Forest Ecological Restoration | • 1,750 acres of preservation restored |
| Perris Desalination Program – Brackish Water Wells 94, 95 and 96 | • Groundwater desalination of 2,900 AFY<br>• 4,060 tons of salt removed |
| San Sevaine Ground Water Recharge Basin | • Stormwater capture storage increase of 2,000 AFY<br>• 26 acres of preservation restored |
| Vulcan Pit Flood Control and Aquifer Recharge Project | • Stormwater capture storage increase of 2,000 AFY<br>• 60 acres of preservation restored |
| Wilson III Basins Project and Wilson Basins/Spreading Grounds | • Stormwater capture storage increase of 1,300 AFY<br>• |
| Peters Canyon Channel Water Capture and Reuse Pipeline | • Reduction of TMDL and other pollutants |
| Corona/Home Gardens Well Rehabilitation and Multi-Jurisdictional Water Transmission Line Project | • Restoration of water service |
| Commercial/Industrial/Institutional Performance-Based Water Use Efficiency Program | • Water use efficiency increase of 400 AFY |
| Quail Valley Subarea 9 Phase 1 Sewer System Project | • Septic tank to sewer conversion |
| Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project | • Stormwater capture storage increase of 622 AFY |
| Customer Handbook to Using Water Efficiently in the Landscape | • Water use efficiency increase of 7,240 AFY |
| Plunge Creek Water Recharge and Habitat Improvement | • Stormwater capture storage increase of 1,250 AFY<br>• 50 acres of preservation restored |
| Prado Basin Sediment Management Demonstration Project | • Stormwater capture storage increase of 450 AFY |
| Enhanced Stormwater Capture and Recharge along the Santa Ana River | • Stormwater capture storage increase of 14,600 AFY |
| 14th Street Groundwater Recharge and Storm Water Quality Treatment Integration Facility | • Stormwater capture storage increase of 400 AFY |
| Soboba Band of Luiseño Indians Wastewater Project | • Feasibility Study |
| Canyon Lake Hybrid Treatment Process | • 525 acres of preservation restored<br>• 50% reduction in total Phosphorus concentration |
| Recycled Water Project Phase I (Arlington-Central Avenue Pipeline) | • Recycling reuse increase of 6,000 AFY |
| Regional Residential Landscape Retrofit Program | • Water use efficiency increase of 1,000 AFY |

**Table 7-3 Impacts and Benefits of Water Resource Optimization**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Water Resource Optimization** | • Increased expenses<br>• Surface water loss<br>• Ocean habitat loss<br>• New discharge issues associated with brine line disposal | • Quantifies environmental and habitat needs<br>• Allows cost sharing partnerships to enhance and improve the capability of flood control infrastructure to capture and infiltrate storm flows<br>• Allows sustainable growth<br>• Provide high quality supply to clean up contaminated ground water basins<br>• Promotes appropriate use of recycled water<br>• Promotes change in water usage strategies<br>• Encourages transition of landscaping to native plant types<br>• Reduced water demands<br>• Increases water supply<br>• Improve water quality<br>• Lowers the concentrations of imported salt in local surface and groundwater supplies<br>• Surface storage provides opportunities for local recreation<br>• Expands and enhances opportunities for recreational boating and sport fishing<br>• Water utility easements provide trail opportunities<br>• Enhances property value | • New outflow locations<br>• New discharge locations<br>• Additional storage/ infrastructure construction will increase Green House Gas (GHG) emissions | • Incentive for high quality industrial and commercial development<br>• Supports smart growth, enhancing quality of life<br>• Reduces the total carbon footprint associated with importing water<br>• Provides mechanism to lower the concentration of industrial pollutants<br>• Support less reliance on imported water supplies<br>• Additional storage/ Infrastructure which help prepare for inter-regional drought, natural disaster, or terriost attack |

**Table 7-4 Impacts and Benefits of Beneficial Use Assurance**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | **Potential Impacts** | **Potential Benefits** | **Potential Impacts** | **Potential Benefits** |
| **Beneficial Use Assurance** | • Increase of Green House Gas (GHG) emissions<br>• Increased energy use for water quality treatment<br>• Increased machinery maintenance | • Reduced the input of nutrients which promote eutrophication<br>• Promote greater biodiversity<br>• Use of natural treatment systems provides incentive for restoration and construction of habitats<br>• Supports and protects areas of biological significance including habitats for threatened and endangered species<br>• Provides high quality drinking water for disadvantaged communities<br>• Reduces the perceived need for bottled water<br>• Expands and enhances recreational opportunities<br>• Strategies that promote infiltration, such as LID (Low Impact Development) help reduce peak flows and flooding<br>• Extends the life of existing infrastructure<br>• Reduces risk to public health<br>• Attracts high quality industrial developments<br>• Expands opportunities for water recycling<br>• Improves the efficiency of membranes and filters<br>• Expands the range of available technologies<br>• Extends the life of fixtures and appliances<br>• Reduces the perceived need for water softeners. | • Possible damage to habitats<br>• Increased energy consumption in association with pumping<br>• Intrusion opportunity for invasive species | • Offsets climate changes stress on water supply by improving water quality overall<br>• Improve the overall perception of the surrounding regions<br>• Enhances value of property which encourages larger population growth<br>• Incentive for high quality industrial and commercial development<br>• Supports less reliance on imported water supplies<br>• Preparedness to aid surrounding regions from inter-regional drought, natural disaster, or terriost attacks via the conservation of water supplies<br>• Promotes new and innovative water treatment methods |

**Table 7-5 Impacts and Benefits of Water Use Efficiency**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | **Potential Impacts** | **Potential Benefits** | **Potential Impacts** | **Potential Benefits** |
| **Water Use Efficiency** | • Increased short term construction and site-specific impacts<br>• Reduced flow downstream<br>• Negative habitat impacts<br>• Negative water quality impacts | • Reduce carbon footprint associated with transporting and processing water<br>• Reduce carbon footprint associated with water use and consumption<br>• Encourage planting of native plant species<br>• Reduced standing plant biomass associated with fire threat in the riverbed<br>• Promotes water efficient programs through water budget based rate funds<br>• Encourage maintenance of open spaces and corridors for trails<br>• Reduce salt importation<br>• Encourage water recycling and opportunities for alternate technologies (i.e., gray water systems, cisterns for roof runoff)<br>• Reduced stress on existing infrastructure<br>• Provides opportunity for conservation of local surface and ground water flows | • Long term financial impact on local water retailers<br>• As water use efficiency programs become more effective, the funds supporting them decline<br>• Increased concentration of runoff due to decreased frequency of runoff<br>• As water becomes more efficient it may cause a possible reduction of jobs | • Reduce the volume of poor quality runoff from reaching natural systems<br>• Provide increased funding for reduced water demand government programs<br>• Provide support to CA constitutional obligations and 20% by Year 2020 compliance<br>• Provide inter-regional education opportunities through signage and multi-benefit/multi-purpose demonstration projects<br>• Supports less reliance on imported water supplies.<br>• Promote water wise methods<br>• Less water requires less overall energy used for transportation (i.e., pumping) |

**Table 7-6 Impacts and Benefits of Land Use and Water Planning**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Land Use and Water Planning** | • Increased short term construction and site-specific impacts<br>• Possible long term construction projects to meet Low Impact Development standards<br>• Possible long term construction through urban areas, which may be detrimental to surrounding businesses | • Increased water supply<br>• Improved water quality<br>• Practice resource stewardship<br>• Smart growth through higher density development reduces the carbon footprint associated with transporting and processing water<br>• Helps improve watershed functionality<br>• Preserve and integrate habitat into a built environment<br>• Enhanced habitat connectivity and quality of life<br>• Redevelopment and retrofitting provide opportunities for habitat restoration<br>• Sewer systems protect groundwater quality, reducing the risk of contamination associated with septic system failure<br>• Promotes natural groundwater recharge to reduce storm flow<br>• Improved quality of stormwater runoff<br>• Avoid flood control infrastructure costs<br>• Provides opportunities for public-private partnerships<br>• Reduced cost of regulatory compliance<br>• Integration of recycled water into new development promotes sustainable growth<br>• Higher density development reduces the cost of recycled water infrastructure<br>• Sustainable development provides market for recycled water<br>• Provides prescriptive measures for the efficient use of water and recycled water for irrigation and other non-potables uses<br>• More open space promotes gw recharge<br>• Promotes the efficient use of water<br>• Provide market for green products and water saving devices | • Increased short term construction and site-specific impacts<br>• Projects prove to be very expensive and continued maintenance could create government budget cuts elsewhere | • Supports less reliance on imported water supplies.<br>• Creates opportunity for multi-agency projects that are adopted by other regions<br>• Reduced nuisance flow from urban development into surface waters<br>• Provides better local job to housing ratio reducing the carbon footprint associated with commuting<br>• Encourages inter-regional innovative, low-impact designs and practices<br>• Creates future ideas that prove to be more innovative energy-efficient designs |

**Table 7-7 Impacts and Benefits of Stormwater: Resource and Risk Management**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Stormwater: Resource and Risk Management** | • Increased short term construction and site-specific impacts<br>• Possible damage to habitat areas used as flood zones<br>• Loss of riparian and/or wetland acreage | • Improved flood management<br>• Non-structural flood control channels help preserve natural habitats<br>• Serves as a multi-purpose source for funding habitat related projects<br>• Prevent channel erosion<br>• Easements provide fire breaks and emergency access<br>• Protect lives and properties<br>• Reduced flood insurance costs<br>• Provide improved water quality for recreational use<br>• Integrated flood strategies enhance the value of developed properties<br>• Reduced risk to infrastructure from debris dams associated with entering flood control systems<br>• Integrated flood strategies improve the quality of surface, ocean, and groundwater<br>• Support regulatory compliance and reduce compliance cost<br>• Provides additional conveyance opportunities<br>• Provides facilities to recharge recycled water<br>• High quality stormwater dilutes the salt of recycled water and imported water recharge<br>• Increased opportunities for groundwater recharge<br>• Provides temporary storage for other uses<br>• Increased available local water supply<br>• Expanded local recharge reduces the need for irrigation | • Could result in a missed allocation of funding due to infrequent flows within the regions | • Large recharge basins help reduce the heat island effect, reducing all surrounding temperatures<br>• Increased groundwater recharge that reduces the need for more energy intensive imported water<br>• Connects neighboring biological communities<br>• Better understanding of risk improves overall safety for state agencies and surrounding regions<br>• Promotes multi-agency projects which provide opportunities to expand high quality development<br>• Increased emergency flows that create inter-regional disaster planning |

**Table 7-8 Impacts and Benefits of Natural Resource Stewardship**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | **Potential Impacts** | **Potential Benefits** | **Potential Impacts** | **Potential Benefits** |
| **Natural Resources Stewardship** | • Increased short term construction and site-specific impacts<br>• Loss of any potential urban future development<br>• Possible long term construction near urban areas, which may be detrimental to surrounding businesses | • Protects natural habitats<br>• Resource stewardship<br>• Environmental services are an important link to public health – clean air, natural treatment of water<br>• Improved stormwater quality<br>• Provides additional flood control system capacity<br>• Promotes groundwater recharge<br>• Protects property from local flood impacts<br>• Redevelopment strategy for blighted areas<br>• Promotes consistency with general strategic plans<br>• Provides large permeable area for storm water infiltration<br>• Wetlands provide enhance water quality<br>• Provides erosion control and reduce accompanying sediment load<br>• Treatment wetlands reduce recycling costs | • Loss of land use and associated inter-regional revenue | • Provides a market for recycled water, decreasing reliance on imported water supplies<br>• Provides environmental education outreach programs with inter-regional agencies<br>• Improved overall aesthetics of surrounding regions<br>• Promotes inter-regional economic growth through tourism |

**Table 7-9 Impacts and Benefits of Operational Efficiency and Water Transfers**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Operational Efficiency and Water Transfer** | • Increased short term construction and site-specific impacts | • Improved efficiency of water transfers<br>• Improved infrastructure<br>• Reduced green house gas<br>• Maximizes water transportation strategies<br>• Cuts down on inefficient water transfer strategies<br>• Increased longevity of tools, machinery, and transportation vehicles<br>• Less maintenance on transportation vehicles and pipelines<br>• Decreased water waste<br>• Reduced energy use<br>• Creates more localized water availability<br>• Cuts down overall maintenance costs<br>• Decreased operational spending (i.e., fuel)<br>• Decreased energy consumption | • Long term financial impact of inter-regional water retailers and wholesalers<br>• Retrofitting programs requires copious funding from various government entities | • Supports less reliance on imported water supplies.<br>• Minimizes emission of Green House Gases (GHG)<br>• Reduces overall energy costs associated with pumping/wheeling<br>• Aids emergency flow strategies that support inter-regional disaster planning |

**Table 7-10 Impacts and Benefits of Disadvantaged and Tribal Communities**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | **Potential Impacts** | **Potential Benefits** | **Potential Impacts** | **Potential Benefits** |
| **Disadvantaged and Tribal Communities** | • Increases energy consumption associated with pumping/wheeling<br>• Increased short term construction and site-specific impacts | • Assurance of reliable drinking water<br>• Contains projects that address safe drinking water and wastewater treatment needs of DACs (Disadvantaged Communities)<br>• Helps meet State policies intended to provide access to safe, clean, and affordable water<br>• Collaboration and access to fund water programs<br>• Projects to better sustain Tribal water and natural resources.<br>• Improved esthetics of lakes and streams<br>• Enhanced value of property<br>• Promotes tourism | • Increase of inter-regional water usage<br>• Increase of green house gases (GHG) emissions | • Creates opportunity for high quality future development<br>• Proposals that include the development of Tribal consultation<br>• Develop multi-benefit projects with consideration of affected disadvantaged communities and vulnerable populations<br>• Helps address critical water supply or water quality needs of California Native American Tribes<br>• Increased cost associated with additional supplies/water quality |

**Table 7-11 Impacts and Benefits of Government Partnership**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Government Partnership** | • Possible long term operating cost<br>• Delayed implement ation of projects between regional agencies | • Creates partnership with DWR (Department of Water Resources)<br>• Creates partnership with local agencies<br>• Provides opportunity to create multi-agency committees<br>• Possibility to generate more funds<br>• Ease of access to data through government agencies<br>• Increased effective communication throughout the watershed<br>• Long-term implementation of IRWM plan through new relationships<br>• Collaboration implementing plan objectives<br>• Interim changes and formal changes to plans<br>• Updating or amending IRWMP's easily<br>• Stakeholder involvement<br>• Improved resource integration | • State/Federal agency interest inconsistency<br>• Extended delays for agreement on projects<br>• Possible funding allocation disputes | • Facilitates development of inter-regional water management<br>• Sustains development of inter-regional water management<br>• Coordination with agencies surrounding the region<br>• Reduces time between data exchange within inter-regional agencies<br>• Ability to collaborate inter-regional goals<br>• Development of new multi-purpose rebate programs<br>• Increase of multi-purpose projects<br>• Coordination of IRWM with State and Federal agencies |

**Table 7-12 Impacts and Benefits of Energy and Environmental Impact Response**

| Pillar | Within IRWM Region | | Inter-Regional | |
|---|---|---|---|---|
| | Potential Impacts | Potential Benefits | Potential Impacts | Potential Benefits |
| **Energy and Environmental Impact Response** | • Increased short term construction and site-specific impacts<br>• Potential long term operating cost | • Decreases carbon footprint<br>• Benefits to public health<br>• Increases funding opportunities for community enhancement<br>• Reduction of greenhouse gas emissions<br>• Reduction of the heat island effect<br>• Trail usage encourages non-gasoline modes of transportation<br>• Promotes efficient energy use<br>• Provides cheaper, natural treatment for surface water and groundwater recharge<br>• Provides more green rebate program opportunities<br>• Improvements to infrastructure are more energy efficient<br>• Promotes a sense of well being for the community<br>• Improved surrounding habitats<br>• Lower use of limited resources | • Increased long term construction may have an economic impact on surrounding areas<br>• Expensive future repair and/or retrofitting costs | • Increase of government green programs<br>• Reduced inter expense of resources<br>• Reduced unnecessary waste<br>• Reduction of Green House Gases (GHG) emissions<br>• Protects interconnecting natural forests<br>• Maximized energy efficiency<br>• May spur more projects/ideas of reducing carbon footprint |

## Conclusion

Implementation of these projects found in the OWOW 2.0 Plan proves to be critical in creating a sustainable watershed. We must understand that the development of ideas and methods not only have a direct impact within the region, but also inter-regionally. The information above is a list of potential impacts and benefits relatable to the Pillars found in the OWOW 2.0 Plan. These benefits and impacts are separated into two different categories that give a brief analysis of the strategic implementation. It is important that these potential impacts are realized so that if they do occur, the watershed is prepared. Also it is important to see the potential benefits these outcomes could have on the region and inter-regions. The development and implementation of multi-benefit projects will remain challenging and require sustained effort by agencies that manage water.

# 8.0 Finance



The Santa Ana Watershed Project Authority ("SAWPA") has engaged David Taussig and Associates, Inc. ("DTA") to investigate financing alternatives for public facilities and regional planning to be included as part of SAWPA's Integrated Regional Water Management Plan ("IRWMP"), also known as One Water One Watershed ("OWOW") 2.0.

Even with uncertainty in the economy, agencies are unable to wait around for funding. Financing and design efficiencies can and will be improved with regional/inter-agency coordination and transparency.

The primary objective of this chapter is to present feasible and realistic funding alternatives for regional water projects and integrated water infrastructure planning, with an emphasis on new and innovative approaches. A secondary objective of this chapter is to ensure that public financing policies are appropriately addressed, and that the integrated planning required to construct regional water and water quality improvements is adequately funded.

Specific financing objectives are:

- Public facilities and programs developed through the OWOW 2.0 process will be adequately financed and constructed in a timely manner, and the planning and coordination for these types of integrated projects also will be adequately funded.
- The OWOW 2.0 program, through SAWPA or through the actions of its Steering Committee, is able to maximize the availability of public debt financing (and the use of Federal and State grants and loans) for regional infrastructure or programmatic needs, while minimizing the financial burden on the individual agencies and/or property owners.

- Public financing for regional programs or infrastructure is equitable, financially feasible, efficiently utilized and consistent with each agency's goals and, when necessary, meets all relevant nexus and benefit criteria.
- Public financing mechanisms avoid creating a financial and administrative burden to the public agency, and develop cost savings through increased efficiency in the public arena.
- The certainty and sustainability of identified options for funding regional water projects and integrated planning will be discussed.

SAWPA, as the leading watershed wide water resource agency for the Santa Ana River Watershed (the "Watershed") and region, plays a major role in administering, participating, coordinating, and facilitating efforts to address regional water management issues. To date, these efforts have been funded primarily by the SAWPA member agencies. SAWPA's governance structure is a Joint Powers Authority ("JPA") involving five member agencies: Eastern Municipal Water District ("EMWD"), Inland Empire Utilities Agency ("IEUA"), Orange County Water District ("OCWD"), San Bernardino Valley Municipal Water District ("SBVMWD") and Western Municipal Water District ("WMWD"). It is particularly noteworthy that SAWPA's activities benefit multiple stakeholders throughout the Santa Ana River Watershed, many of whom are not SAWPA member agencies and do not share in supporting SAWPA's annual IRWM expenses budget, which are estimated at between $250,000 and $800,000 – depending on whether an IRWMP update is necessary during the year. These stakeholders include over 97 water related agencies, 3 counties, 59 cities and various State water, environmental and regulatory agencies, federal agencies, other special districts and groups.

California voters approved Propositions 84, 1E, and 1C in 2006. Under Proposition 84, $114 million has been allocated to the watershed subject to an adoption of an Integrated Regional Water Management Plan. Using a decentralized, comprehensive stakeholder involvement process, as well as involving experts from all fields and areas within the watershed, an extraordinarily collaborative and visionary plan was developed. The Santa Ana Watershed Integrated Regional Water Management Plan, called the OWOW Plan, was adopted in November 2010 with a goal of addressing the major water challenges over the next two decades. Highly respected industry-wide as the leading IRWM region in California, SAWPA is expected to receive funding in each round of the Proposition 84 IRWM program. Through the OWOW effort, SAWPA secured $12.0 million in funding for Round I implementation with a DWR-SAWPA contract executed in June 2012. Round II funding for 20 projects in the Santa Ana IRWM Region is projected to be $16 million with contracts among DWR/SAWPA and project proponents expected in the fall of 2013. According to a recent statement by the DWR, Round III IRWM implementation grant applications will not be available until early 2015.

## Funding Options for Integrated Regional Planning Efforts

SAWPA and its regional planning efforts are critical for the future of the watershed. Yet SAWPA's bottom-up, broad-based approach requires that SAWPA expend valuable resources for coordination, support, and facilitation. To date, SAWPA's efforts have been largely funded by the SAWPA member agencies and grant funded administration funds. With California's uncertain future economic climate, grant funding through water bonds is no longer a secure funding source. In addition, SAWPA's member agencies tightened their financial belts during the Great Recession which threatens SAWPA's largest funding source. Finally, many parties benefit from SAWPA's leadership and value creation, but do not contribute to SAWPA's OWOW Plan development and Plan update expenses.

It is imperative that SAWPA review its funding options and develop plans today to ensure a long-term stable funding source for the future. In June 2012, SAWPA completed a detailed evaluation of its funding challenges and summarized its findings in a document titled, "2012 OWOW Funding Options" ("Study"). DTA found the Study to be comprehensive, creative, and reasonable in its recommendations and conclusions.

SAWPA is not the only agency struggling to find a way to fund the coordination and facilitation of regional planning efforts. As part of this Report, we have investigated funding sources used by other IRWM regions. While the California Department of Water Resources ("DWR") and others encourage an integrated approach to infrastructure planning, until a long term stable funding source is identified, it will be difficult to fully achieve the desired benefits.

### SAWPA Study of Funding Alternatives

The Study identifies seven funding mechanisms that may be used to fund all or a portion of SAWPA's ongoing operating expenses. Each of these mechanisms is discussed briefly below. While individually, these mechanisms may not be an ideal source of stable, long term funding, taken in combination, one or more of these mechanisms could provide a revenue stream to offset or reduce the current contributions from SAWPA members.

- Grant Funding
- Voluntary Contributions
- Project Application Fee
- Fee on Projects Funded
- Public Private Funding Partnerships
- Form an IRWP Planning Committee
- Continue Status Quo

#### *Grant Funding*

SAWPA has been successful in receiving planning grants in the past and will continue to pursue all grant funds that are available in the future. However, planning grant funds may not always be available and should be thought of as supplemental funding, rather than a permanent source of funding.

Grant funding typically is tied to State bond funds, which are uncertain at best. While there is an

expectation that a water bond will appear on the November 2014 ballot, past attempts to put the measure on the ballot did not succeed; and even if on the ballot, approval by the voters is not guaranteed.

### *Voluntary Contributions*

Voluntary contributions of money and staff time are appreciated by SAWPA. However, SAWPA member agencies have contributed a disproportionately large share of SAWPA's funding requirements. In addition, by their nature, this type of funding is voluntary, and therefore is not a reliable source of long term funding. Voluntary contributions are a significant component of the funding for this conference.

A segregated fund administered within the SAWPA Planning Department, known as the One Water One Watershed Fund ("OWOW Fund"), was created to provide a means for other agencies or groups to participate financially in the development of the OWOW process and to help offset costs borne by SAWPA and its member agencies. The OWOW Fund collects and manages funds provided to SAWPA for development and implementation of the OWOW program.

The following is SAWPA's official policy for the administration of the OWOW Fund:

"Upon receipt of funds from agencies or other groups provided for the purpose of supporting the One Water One Watershed Program, SAWPA shall deposit such funds into a segregated account (Fund No. 392 - OWOW). This account will accrue interest. The segregated account will be included in the SAWPA budget during the annual budget cycle. SAWPA administrative and project costs will be deducted from the account.

All project-related expenditures from this account shall be reviewed by the SAWPA Commission to ensure consistency with the purpose of the One Water One Watershed Program and regional integrated watershed planning. Activities undertaken under this fund include:

- Collection, collation and analysis of data for One Water One Watershed plans
- Development of written materials, including maps and diagrams, to support the One Water One Watershed Program
- Development and implementation of stakeholder outreach and education activities in support of One Water One Watershed planning
- Provision of technical assistance and facilitation in the development of specific sub-regional plans in support of broader One Water One Watershed objectives

Participation and funding of activities undertaken as part of this fund does not imply an endorsement of specific projects developed under the One Water One Watershed Program."

### *Application Fee for Project Grant Submittals*

A new funding option would be for SAWPA to charge an application fee for each project an agency submits for funding. For the first round of Proposition 84 funding, 297 project applications were submitted to SAWPA for inclusion in the OWOW plan and for consideration of possible funding. By charging a modest application fee of $500 or $1,000 per project, SAWPA could have generated $148,500 to $297,000. However, it is unknown if the number of projects submitted would have been reduced as a result of such a fee.

In addition, charging a fee for each project generates a one-time funding source that is linked to future grant funding, rather than an ongoing permanent source.

### *Fee for Project Successful In Obtaining Grant*

A slightly different funding option would be to charge an administrative fee on each project selected to receive grant funding. By charging the successful project applicants, those who benefit most from the IRWMP process would help pay a portion of SAWPA's ongoing costs.

For Round I of Proposition 84, 13 projects in the watershed received $12.7 million in grant funding. If SAWPA charged a 10% fee for each project, this would have generated $1.3 million for planning and facilitation.

As mentioned above, charging a fee for successful projects generates a one-time funding source that is linked to future grant funding, rather than an ongoing permanent source. SAWPA's legal counsel is reviewing the legality of charging such a fee.

### *Public Private Partnerships*

Many businesses and business coalitions benefit from the work done by SAWPA to develop and implement OWOW and OWOW 2.0. A new funding option would be for SAWPA to identify these businesses and try to form beneficial relationships such that the businesses would be willing to contribute funds in support of the OWOW effort. Like voluntary contributions, this type of funding is optional, and therefore is not a stable source of long term funding.

### *IRWMP Planning Committee Memberships*

Development of an IRWMP Planning Committee could create a permanent source of funding for SAWPA's ongoing efforts. If such a task force included all stakeholders within the watershed and required a minimal annual contribution from each, this would result in a permanent funding source for the OWOW program at a minimal cost to each stakeholder (currently estimated at less than $5,000 per agency annually).

To get agencies to agree to be part of the task force and make contributions annually, there needs to be a compelling and beneficial reason for them to join. Task force membership would need to offer agencies more benefit than just receiving grant funding. Demonstrating the direct benefit of regional planning to each agency and organization sufficiently to assure regular and ongoing budgeted funding in the task force would be the most difficult hurdle to implementation. SAWPA has used the task force model to successfully fund projects in the past.

### *Status Quo*

Another option to secure funding for SAWPA's ongoing planning and collaboration efforts is to continue the current model of relying upon contributions from the SAWPA member agencies.

In many ways, funding from the five SAWPA member agencies reflects a broad based multi-agency approach for funding regional integrated planning. With most of the SAWPA member agencies serving as a wholesale water agency or water supplier role for a large area in the watershed, their sub-agencies provide funding to the SAWPA member agencies through water connection fees and rates. Funding received by water fees and rates by each of the SAWPA member agencies from sub-agencies and the general public is funneled in part to support SAWPA in its ongoing regional planning efforts.

## SAWPA Funding Versus Other Funding Approaches

### *Survey of Leading IRWM Regions*

As a part of this Report, DTA has investigated the funding approached used by other IWRM regions. In the course of DTA's research, DTA interviewed DWR staff regarding the myriad of methodologies that IRWM regions are using to fund their respective ongoing operational expenses. DWR staff provided DTA with a list of several the most highly respected and innovative IRWM regions and suggested that DTA contact them and catalogue their approaches to funding. The following are DTA's observations after conducting interviews with staff at the following agencies.

The survey participants (in no particular order) were:

- Sacramento River Sub Region Funding Area – IRWM Region No. 1, American River Basin; Regional Water Authority staff
- North Coast Sub Region Funding Area – IRWM Region No. 21, North Coast; Humboldt County Planning Department
- San Diego Sub Region Funding Area – IRWM Region No. 26, San Diego; San Diego County Water Authority
- Tulare/Kern Sub Region Funding Area – IRWM Region No. 38, Upper Kings Basin Integrated Regional Water Management Authority; Kings River Conservation District

DTA's interviews with the IRWMs revealed that all of the funding methodologies in use by the survey participants were either already implemented by SAWPA or are under consideration in SAWPA's "2012 OWOW Funding Options" Study. The most notable area of possible improvement for SAWPA is that other IRWMs have been able to develop higher percentages and a broader array of stakeholders contributing funds to support their respective operations.

The Kings Basin IRWM Authority in the Tulare/Kern Funding is funded primarily through a broad coalition of regional agricultural, municipal and community interests with a membership of 50+/- members each paying $7,000 in annual fees plus a one-time $30,000 fee to fund the original IRWMP. Further, grant applicants must be "sponsored" by a member in good standing to qualify for grant consideration.

The San Diego IRWM is funded through fiscal year 2016 with a MOU documenting combined support from San Diego County, the City of San Diego and the San Diego Water Authority to fund IRWM operations up to a total of $1,470,000; San Diego's funding sources are more vertically diverse and are a closer reflection the type of organizations (i.e. governmental, public utility, private water purveyors) submitting projects for grant funding. The San Diego IRWM region is studying the use of an application fee for grant submittals to fund its operations.

Similar to SAWPA, the American Basin IRWM governance structure is a Joint Powers Agreement ("JPA"). The American Basin IRWM is funded by a consortium of similar type organizations, water purveyors plus wastewater organizations; there are a total of 25 water and wastewater agencies operating within the IRWM boundaries. 18 of the 25 share the IRWM's ongoing administration expenses. In this case the funding source is horizontal; however, the cost sharing has greater breadth.

### *Voluntary Subscriber Fees*

In addition to reviewing the Study and surveying other IRWM regions, SAWPA recommended that DTA investigate voluntary subscriber fees, similar to those proposed by the Murrieta Fire Department.

### Murrieta Fire Department Case Study

With funding decreasing over the past few years the Murrieta Fire Department ("MFD") searched for ways to maintain its current level of service without raising taxes. To help offset the costs of providing Emergency Medical Service ("EMS"), the MFD has proposed a program that would help compensate for the cost of emergency calls. The Murrieta EMS Subscription Program would be an annual, voluntary membership fee designed to shield Murrieta residents and businesses from out-of-pocket expenses related to EMS.

MFD's proposed cost recovery program will charge $350 per response, per person for each medical aid response that is performed. As an alternative to paying this charge, the MDF EMS Subscription Program ("Subscription Program") allows residents and business owners the option of paying a small annual fee rather than being charged the response fee. For single-family homes, the cost is $48 per year. For businesses the cost of this membership depends on the size of the business measured by the number of employees. The Subscription Program membership covers all response fees for services rendered.

Similar to MFD's model, SAWPA could use a combination of committee membership with grant application fees where committee members pay lower grant application fees than non-members.

## Conclusions

In one form or another, all of the funding mechanisms described above are available to SAWPA. Further study and vetting by SAWPA leadership and legal counsel are required for implementation. With California's uncertain future economic climate, grant funding through water bonds is unreliable at best. At the same time, due to the Great Recession, SAWPA member agencies have had to tighten their financial belts fueling funding uncertainty. In addition, concerns about equity require that SAWPA investigate methods to spread its costs over a broader group of stakeholders.

## Facility Funding Options

The One Water One Watershed Plan 2.0 contains a wide variety of public improvements to be constructed by multiple public agencies, including water supply and water quality projects, as well as projects that address the habitat restoration, flood control, recreational, and open space needs of the watershed. This section summarizes financing methods which may provide funding beyond Proposition 84 Chapter 2 grant funding.

### State and Federal Funding

In the past, SAWPA, its member agencies, and other local agencies in the watershed have been successful in obtaining State and Federal funding to build projects. However, the primary emphasis of this Report is on local funding sources.

While State and Federal grants and loans can be useful in funding one-time projects or coping with shortfalls, the consistent availability of such funding cannot be ensured and is often beyond the control of local public agencies. In addition, such grant programs typically require local matching funds, while loan programs require a local revenue source for repayment. DTA strongly recommends that public agencies continue to search and apply for available grants and loans; to the extent that projects are able to receive such funding, the need to undertake the local mechanisms cited below is diminished. However, local sources of revenue are recommended because they are under the control of each agency and are more predictable for long-term planning purposes.

#### *State Funding*

##### 2014 Bond Measure

A California Water Bond is currently slated for the November 4, 2014 ballot, as a legislatively-referred bond act. The measure is known by its supporters as the Safe, Clean, and Reliable Drinking Water Supply Act and in its current configuration would authorize the State to borrow $11.1 billion to overhaul the state's water system.

A water bond measure was originally certified to be on the State's 2010 ballot. It was removed and placed on the 2012 ballot. The California State Legislature, on July 5, 2012 approved a bill to take the measure off the 2012 ballot and put it on the 2014 ballot, purportedly to increase the likelihood of the approval of the Jerry Brown Tax Hike Initiative in 2012. Although there will be plenty of hot-button issues on the 2014 ballot in California, some observers predict that "the biggest fight, the sharpest split, may come over water. Specific spending proposals currently under consideration include:

- $455 million for drought relief projects, disadvantaged communities, small community wastewater treatment improvements and safe drinking water revolving fund
- $1.4 billion for "integrated regional water management projects"
- $2.25 billion for projects that "support delta sustainability options"
- $3 billion for water storage projects
- $1.7 billion for ecosystem and watershed protection and restoration projects in 21 watersheds
- $1 billion for groundwater protection and cleanup
- $1.25 billion for "water recycling and advanced treatment technology projects"

## Prior Bond Measures

Recent successful State Bond measures that funded water quality and water supply improvements include Proposition 13, Proposition 50 and Proposition 84.

### Proposition 13

In March 2000, California voters approved Proposition 13 (2000 Water Bond), which authorized the State of California to sell $1.97 billion in general obligation bonds to support safe drinking, water quality, flood protection and water reliability projects throughout the state. SAWPA successfully implemented Proposition 13 funding to construct $1 billion in infrastructure projects.

### Proposition 50

Passed by voters in 2002, Proposition 50 authorized $3,440,000,000 general obligation bonds to fund a variety of water projects, including:

- Specified CALFED Bay-Delta Program projects including urban and agricultural water use efficiency projects;
- Grants and loans to reduce Colorado River water use;
- Purchasing, protecting and restoring coastal wetlands near urban areas;
- Competitive grants for water management and quality improvement projects; Development of river parkways;
- Improved security for state, local and regional water systems; and
- Grants for desalination and drinking water disinfection.

### Proposition 84

Passed by voters in 2006, The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84) authorized $5.388 billion in general obligation bonds to fund safe drinking water, water quality and supply, flood control, waterway and natural resource protection, water pollution and contamination control, State and local park improvements, public access to natural resources, and water conservation efforts.

## State Revolving Funds

The State of California has established two State Revolving Funds ("SRF") which allow local agencies to have access to low interest loans to finance projects. The Clean Water SRF is a loan program that provides low-cost financing to eligible entities within State and tribal lands for water quality projects including: all types of nonpoint source, watershed protection or restoration, estuary management projects, and more traditional municipal wastewater treatment projects. The Drinking Water SRF is a loan program that provides low-cost financing to eligible entities within the State and tribal lands for public and private water systems infrastructure projects needed to achieve or to maintain compliance with safe drinking water requirements and to protect public health. Small water systems and disadvantaged communities are given higher funding priority. Both SRFs are managed by the State and funded by the federal Environmental Protection Agency.

***Other State Funding***
Shown below is a list of other State funding programs:

• California Department of Fish and Game Pacific Coast Salmon Restoration Fund (Fisheries Restoration Grant Program)
• California Coastal Conservancy Proposition 84 Funds
• California Coastal Conservancy Southern California Wetlands Recovery Project
Community Wetland Restoration Grants
• California Wildlife Conservation Board
• California State and Regional Water Quality Control Board Clean Water Grant Program
• California Integrated Watershed Management Grant Program Proposition 50 Funds
• California Department of Parks and Recreation Habitat Conservation Fund
• CalTrans Environmental Enhancement and Mitigation Program
• U.C. California/NOAA California Sea Grant College Program

## *Federal Funding*

### 2013 Water Resources Development Act

On March 20, 2013 the Senate Environment and Public Works (EPW) Committee unanimously approved S.601, the Water Resources Development Act of 2013. The bill provides critical flood protection for communities across the country, maintains the flow of commerce, and will create up to 500,000 new jobs. The bill seeks to further leverage government funds for water infrastructure projects through an innovative financing pilot project program—referred to as the Water Infrastructure Finance and Innovation Act (WIFIA)—which can help our nation meet its infrastructure improvement needs. The WIFIA, based on a popular program in the transportation sector, takes the dollars appropriated to it, leverages them in the market and takes that total available assistance and loans it from the federal government directly to a project.

Title X of WRDA has $250 million authorized for the WIFIA program ($50 million per year for five years 2014-2018) with eligibility for both water resources projects (flood control, levees, dams, etc.) and water/wastewater infrastructure. Projects that are eligible for SRF funding are eligible for funding from this WIFIA, as are energy efficiency upgrades, desalination, and acquisition of real property. Projects carried out by a non-public entity are eligible, provided that they have a public sponsor. There is a $20 million minimum for eligibility, and repayment of the loan must be from a dedicated revenue source.

### Other Federal Options

Shown below is a list of other federal funding programs and options:

NOAA/NMFS Restoration Center Community-Based Restoration Program
• NOAA/NMFS Restoration Center Open Rivers Initiative
• NOAA/NMFS Proactive Species of Concern Grant Program
• NOAA National Sea Grant College Program
• NOAA Coastal and Estuarine Land Conservation Program
• NOAA/ACOE/USFWS/EPA/NRCS Estuary Habitat Restoration Program
• EPA Wetlands Protection Grants and Near Coastal Waters Programs

• US. Department of Transportation Highway Bridge Rehabilitation and Replacement Program
• U.S. Fish and Wildlife Service National Coastal Wetlands Conservation Grant Program
• U.S. Fish and Wildlife Service Coastal Program
• U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program
• U.S. Fish and Wildlife Service North American Wetland Conservation Act
• National Resource Conservation Service
• Federal Highway Administration – Road Aquatic Species Passage Funding

In 2012, the Congressional Research Service prepared a report entitled "Legislative Options for Financing Water Infrastructure" that describes several water infrastructure financing alternatives under consideration at the Federal level. The following six key actions are under consideration, some of which may benefit SAWPA and other local agencies.

- Increase funding for State Revolving Fund Programs
- Create a Federal infrastructure trust fund
- Create a Water Infrastructure Finance Innovation Act (WIFIA)
- Create a National Infrastructure Bank
- Modify Private Activity Bond Restrictions
- Reinstate Build America Bonds

### Increase Funding for State Revolving Fund Programs

Typical State Revolving Fund ("SRF") programs are funded by an initial (and periodic) capital injection(s) by the Federal government and managed by individual states. Annual capital appropriations by the Federal government fund the SRFs. The SRF essentially functions as a bank, lending at low interest rates for specific water projects. Loan repayments are then recycled back to individual SRF programs. SRF programs are governed by eligible project rules in addition to funding management constraints. States only make loans, purchase local debt, or issue financial guarantees and are not allowed to deplete the capital of the fund. Thus, the fund operates as a "revolving" source of financing.

According to the Congressional Research Service, Congress is considering expanding the funding for SRF programs.

### Federal Infrastructure Trust Fund

Federal trust funds currently exist to provide financing for airport and highway infrastructure but do not exist for water infrastructure. In contrast to an SRF, a Federal trust fund is supported by a fixed annual revenue stream (for example Federal fuel taxes). The revenues are then collected by the Federal Government and are dedicated or "earmarked" for expenditure on specific purposes.

Public focus on the Federal deficit decreases the likelihood that a water trust fund could be established. However, some members of Congress propose to increase infrastructure spending with a water trust fund.

### Water Infrastructure Finance Innovation Act ("WIFIA")

In 1998, Congress created the Transportation Infrastructure Finance Innovation Act ("TIFIA"). TIFIA provides Federal credit assistance of up to one-third of project costs, with a minimum project cost-eligibility requirement of $50 million. Eligible projects must have a dedicated revenue stream (typically tolls). TIFIA is supported by $122 million in Federal money annually, administered by the Department of Transportation.

A WIFIA program would be similar to the TIFIA and potentially administered by the Environmental Protection Agency. The Water Resources and Environment Subcommittee has circulated a draft WIFIA bill (H.R. 3145) and held two hearings on the topic in 2012. One of the main benefits of the proposed program would be to provide low-cost capital to infrastructure projects. Under the TIFIA program, loan repayment does not begin until 5 years after "substantial completion" of the project, with payments ending after 35 years. This structure allows projects to be built and benefits to be realized before loan repayment starts, a significant benefit to water management projects. However, a drawback is that the program requires a revenue stream. For water infrastructure projects, this would limit eligible projects to those that collect user fees based on water use.

WIFIA is a part of the Water Resources Development Act . In a rare display of bipartisanship on major legislation, the U.S. Senate passed Sen. Barbara Boxer's water resources bill on Wednesday, May 15, 2013. The $12.5 billion bill, which includes a long-sought authorization for levee improvements in Sacramento, drew overwhelming support from both Democrats and Republicans. The Water Resources Development Act would authorize a variety of U.S. Army Corps of Engineers projects across the country, including flood control efforts, port improvements, wetlands restoration and coastal storm protection. The bill includes language that would expedite the environmental review process that many critics say leads to unnecessary delays and added costs in such projects. The bill next moves to the House of Representatives for their consideration.

### National Infrastructure Bank

In general, an infrastructure bank is an entity that manages capital and provides loans for infrastructure development. Both current Federal and State administrations ran on a political platform that includes increased infrastructure funding, and an infrastructure bank has been considered by Congress on several occasions. An infrastructure bank could provide funding for a range of infrastructure projects, with water projects as just a single component.

### Modify Private Activity Bond Restrictions

Private Activity Bonds are tax-exempt bonds that are available for privately owned water facilities that are either operated by a government unit or charge water rates that are approved by a political subdivision of a community. Most private activity bonds, including those for water furnishing and water treatment facilities are subject to a state volume limit. Congress is considering changing requirements to allow more access to tax-exempt bonds for water infrastructure.

### Reinstate Build America Bonds

As part of the American Recovery and Reinvestment Act, Congress created Build America Bonds to encourage job creation through infrastructure projects. These bonds could be issued for any

governmental purpose for which tax-exempt governmental bonds (excluding private activity bonds) can be issued, including capital expenditures and working capital. The authority to issue Build America Bonds expired in December 2010. Congress is considering reinstating Build America Bonds to target water infrastructure projects.

### *Private National, Regional and Local Funding*

In addition to Federal and State funding sources, there are also numerous private national, regional and local funding sources for southern California habitat restoration projects, such as National Fish and Wildlife Foundation.

## Proposition 218

One of the key funding considerations of this Report is Proposition 218 which was approved by the voters in California in 1996. This constitutional amendment, which is also called the "Right to Vote on Taxes Act," is arguably the most significant impediment to arise against adequate local infrastructure funding since the adoption of Proposition 13 in 1978. Proposition 218 was a successful effort by the State's voters to ensure that local governments could not levy any taxes, assessments or user fees on property owners without the express consent of the voters in the community where such charges would be levied. Specifically, all general taxes need to be approved by at least one-half of the electorate, all special taxes need to be approved by at least two-thirds of the electorate, and all special assessments and property-related fees must be approved by at least one-half of the impacted property owners submitting mailed ballots prior to the public hearing at which such special assessments or fees are to be approved by a local legislative body (or, at the option of the legislative body, by at least two-thirds of the registered voters). Any fee that is property-related, or that arises as a consequence of property ownership, falls under the scrutiny of Proposition 218. Furthermore, the initiative power of the electorate was confirmed by Proposition 218 to ensure that local taxes, assessments, and fees can be reduced at any time by the electorate, with the only exception being when such revenues are required to satisfy an existing contractual obligation (e.g., the payment of debt service on outstanding bond issuances). The only exceptions to these voter requirements are fees for sewer, water, and refuse collection. However, based on the California Supreme Court's decision in *Bighorn-Desert View Water Agency v. Verjil* these types of fees are subject to Proposition 218 noticing and hearing requirements.

Although the distinction between fees, taxes and assessments may sometimes seem blurred and overlapping, the following discussion provides the general definition of the various local governments "charges" . A fee is a charge imposed to recover the costs of a government service or to mitigate the impacts of the fee payer's activity on the community. User fees recover the costs of service and include, for example, utility rates (enterprise fees) and facility usage (park fees). Regulatory fees are related not only to mitigation (development impact fees, capacity fees), but also to the recovery of costs to regulate fee payer activities (plan check fees, building permit fees).

A tax is a charge imposed by government to pay for general governmental purposes ("general tax") or specific governmental purposes ("special tax"). Assessments are charges related to special benefits that a property or business derives from the improvements or services paid for by these charges.

The significance of Proposition 218 to the funding of the local infrastructure cannot be overstated. Most sources of local funding, with the exception of sewer, water, and refuse collection fees, are now effectively off-limits without an election. The ability for general funds to pay for public infrastructure is also limited due to competition for such funds from other uses, and the requirement that any additional bond funds must be approved by two-thirds of the electorate. Unless the electorate or the property owners in an area vote in favor of a general tax, special tax, assessment or fee, none of these funding sources can be implemented.

### *Salinas Decision*

The far-reaching impacts of Proposition 218 are probably most clearly evidenced by the case of the *Howard Jarvis Taxpayers Association v. City of Salinas.* In that case, the City of Salinas went to great efforts to design a stormwater management utility fee that it thought was not property related, in order to avoid the necessity of holding an election. The proposed fee was not put to a vote of the property owners or the registered voters, but instead was enacted by the City Council through the adoption of two ordinances. The first ordinance imposed a Stormwater Management Utility Fee within the City, while the second established fee levels. Fee levels were assigned to assessor's parcels according to the land use types located on each parcel, with the fees themselves based on the relative amounts of impervious area typically associated with each land use type. To avoid being considered a property-related fee, the City exempted undeveloped parcels and those developed parcels that were not expected to access the City's storm management system. The Howard Jarvis Taxpayers Association challenged the fee, and the trial court ruled in favor of the City because it concluded that (a) the fee was not property-related, and (b) the fee was exempt from the voter requirement as a result of the sewer and water fee exemptions under Proposition 218.

The Howard Jarvis Taxpayers Association appealed to the Sixth Appellate District of the State Court of Appeals, which overturned the trial court's finding by a 3-0 vote. The basis for the Appeal Court's decision was an emphasis on Proposition 218's fundamental premise that "the provisions of this act shall be liberally construed to effectuate its purposes of limiting local government revenue and enhancing taxpayer consent." As a result, the Appeals Court determined that a fee based on land use was not a charge directly based on use (such as the metered use of water for a water fee), and that it was in fact a fee based on ownership of property because a property owner could not escape the fee by declining to accept the service. The Appeals Court went on to declare that stormwater management activities are separate from sewer and water services, and therefore would not be eligible for the voter exemption permitted under Proposition 218 for sewer and water fees. The State Supreme Court denied the City's petition to review the Appeals Court's decision.

### *Santa Clara County Decision*

On July 14, 2008, the State Supreme Court, in the case of *Silicon Valley Taxpayers Association v. Santa Clara County Open Space Authority*, decided two key points relating to Proposition 218. First, the State Supreme Court held that legal challenges to special assessments are subject to independent judicial review, reversing a number of pre-Proposition 218 cases which gave more deference to the public agency that established the assessment district. Second the State Supreme Court held that the assessments in the Santa Clara case did not meet the substantive requirements of Proposition 218 because the Santa Clara County Open Space Authority did not demonstrate the special benefit to the assessed property and the amounts assessed were not proportional to the benefit received by each parcel.

In 2001, the Santa Clara County Open Space Authority conducted proceedings to establish a countywide assessment district to acquire, improve and maintain regional open space. As a part of the proceedings, an Engineer's Report was prepared and a ballot protest procedure was conducted. The Engineer's Report claimed that all property within the district received special benefit from the proposed land acquisitions and set the assessment at $20 per single family parcel (and provided a formula to determine the rates for other types of property). However, the land proposed to be acquired was not identified. Following a mailed ballot procedure, the assessment passed by more than 50% of the ballots returned (weighted by level of assessment). The assessments were later challenged on the basis that the Santa Clara County Open Space Authority failed to satisfy the special benefit and proportionality requirements of Proposition 218.

Although this case involves an open space assessment and many of the court's comments are related to assessments rather than fees, this case needs to be carefully reviewed and considered for its implications for any proposed assessment or property related fee. In its decision, the State Supreme Court stated that Proposition 218 requires courts to make an independent review of local agency decisions regarding assessments and property-related fees and charges. In addition, while property-related fees do not have the same special benefit restrictions (see Section III.C.3 for further discussion) that apply to assessments, Proposition 218 states that a fee or charge imposed upon any parcel or person as an incident of property ownership shall not exceed the proportional cost of the service attributable to that parcel. The State Supreme Court found that the Santa Clara County Open Space Authority failed to meet the proportionality tests because the Engineer's Report did not (1) identify the improvements to be funded, (2) estimate the cost of such improvements, and (3) connect the proportionate costs of the benefits received from the public improvements to the assessed parcels.

Subsequent to the Santa Clara County decision, there have been additional court cases that continue to scrutinize assessments as they pertain to the requirements of Proposition 218.

### *Summary of Proposition 218 Nexus Requirements*

Under Proposition 218 a fee or a charge shall not be imposed unless it meets all of the following requirements:

- Revenues derived from the fee or charge shall not exceed the funds required to provide the property related service;
- Revenues derived from the fee or charge shall not be used for any purpose other than that for which the fee or charge was imposed;
- The amount of fee or charge imposed upon any parcel or person as an incident of property ownership shall not exceed the proportional cost of the service attributable to that parcel;
- No fee or charge may be imposed for a service unless that service is actually used by, or immediately available to, the owner of the property in question. Fees or charges based on potential or future use of a service are not permitted; and
- No fee or charge may be imposed for general governmental services including, but not limited to police, fire, ambulance or library services where the service is available to the public at large in substantially the same manner as it is to property owners.

## Local Revenue Sources

This section contains brief summaries of a number of mechanisms that may provide funding for local agencies. The findings in these sections are based on a review of relevant literature and DTA infrastructure public financing experience.

This section is focused on possible local revenue sources. Federal and State funding are discussed in earlier sections and can be very useful in funding one-time projects or coping with shortfalls, but consistent availability of such funding cannot be assured and is often beyond the control of local public agencies. In addition, Federal and State programs often involve loans that require some type of collateral and a local stream of revenue to repay them. Local agencies should search and apply for any available grants and loans; to the extent that projects are able to receive such funding, the need to undertake the local mechanisms cited below is diminished. This section summarizes financing mechanisms that may be utilized by local agencies in place of general fund revenues. **Table 8-1** and **Table 8-2** located at the end of this Chaptersummarize financing alternatives that should be considered, as well as brief descriptions their advantages and disadvantages.

### *Longevity and Certainty of Funding*

In an effort to clarify the California Department of Water Resources requirement for an explanation of the certainty and longevity of known or potential funding for an IRWM plan and projects that implement the plan, DTA contacted Ms. Tracie Billington, the Branch Chief for DWR's IRWM Grants and Funding. Ms. Billington explained DWR's perspective in great detail. While a matrix showing the specific funding sources and their certainty and longevity is appropriate for individual projects when such information is available, a more qualitative approach is acceptable when identifying potential funding mechanisms.

As explained by Ms. Billington, an analysis of the "Certainty" and "Longevity" of known or potential funding sources is most appropriately addressed when looking at specific infrastructure projects. For

example, the IRWM projects that were submitted to SAWPA as part of the OWOW 2.0 process have been ranked, and in general the higher ranking projects having a greater "Certainty" or probability of being financed than the lower ranked submittals.

In addition, those financing mechanisms which have been approved and are included in current Federal, State, or local budgets have a greater level of certainty than those which require future voter or legislative approvals.

The "Longevity" of a funding source is customarily stated in the law creating or approving the mechanism. For example, many bonds are issued for 30 year terms, while certain tax measures may sunset after 5 or 10 years. In addition, pay as you go programs may not generate sufficient revenues up front, and may require interim revenue sources to build facilities in a timely manner. Therefore, it is important to match the time constraints of various funding programs to specific projects to ensure project completion.

In addition to funding for new infrastructure projects, local agencies are also concerned funding the ongoing operations and maintenance of such facilities. Therefore as a part of the discussion of local funding options in the sections below, we have indicated where such funds can also be used to pay for ongoing operations and maintenance.

The local financing methodologies described below have been grouped into (1) traditional, customarily used approaches, and (2) new, creative and innovative financing structures.

### *Traditional Public Finance Measures*

#### Sales Tax Measure

A sales tax is a funding option that places a consumption tax on certain goods and services. Most sales taxes are collected by the seller, who pays the tax to the public entity that is charging the tax. Under state law, a local agency may only increase the sales tax within its jurisdiction in increments of 0.125%. According to Section 7251.1 of California Transactions and Use Tax Law, the combined rate of all sales taxes imposed shall not exceed 200 basis points above the base tax rate for the State (as of January 1, 2013, the rate shall not exceed 9.5% based on a base rate of 7.5%).

Sales tax revenues may be used to fund any facilities or services specified in the ballot materials. Therefore, this type of funding could be used to fund a broad array of capital, O&M and planning costs. The legislative body of a local government or district must place the sales tax increase on a special, primary, or general election ballot. As a special purpose tax, it would require a 2/3 majority vote.

Statewide, only 35 out of 68 special purpose tax measures (those requiring a 2/3 vote) were approved by the relevant electorate in the November 2012 election. School parcel taxes had the highest passing rate of 64%, County special taxes had a passing rate of 58%, and Special Districts had a passing rate of 44%. City special taxes had a passing rate of only 33%. To be successful, a local would need to undertake an effective public outreach effort to demonstrate to voters the benefits to that will be achieved through this additional tax.

As a result of California Proposition 30, the State's base sales tax rate was increased by 0.25% (from 7.25% to 7.5%) on January 1, 2013. The 0.25% tax rate increase will expire on December 31, 2016. Local agencies will find it extremely difficult to pass an additional sales tax increase to fund regional water projects until after the State 0.25% tax increase expires.

### *Stormwater Utility Fee*

A municipal stormwater utility fee ("Stormwater Utility Fee") can be adopted under Health and Safety Code Section 5471 ("Section 5471"). Section 5471 allows certain public agencies to collect fees or charges from property owners (including standby charges from owners of undeveloped properties) to pay for capital improvements, operations, and maintenance for their storm drainage, water and sewerage systems. The public agencies authorized to levy these charges include counties, cities, sanitary districts, sewer maintenance districts, and other districts authorized to acquire, construct, maintain and operate sanitary sewers and sewerage systems.

Revenues derived from the fees levied under Section 5471 can be used for the acquisition, construction, reconstruction, maintenance, and operation of storm drainage, water and sewerage systems, as well as the repayment of principal and interest on bonds issued for the construction or reconstruction of these storm drainage, water and sewerage systems.

As a parcel-related fee, a Stormwater Utility Fee must be calculated according to Proposition 218 guidelines for fees set forth in Section III.C.3.

### *Los Angeles County Case Study*

The County of Los Angeles has been considering how best to implement a dedicated funding mechanism for surface water quality since at least 2005. Waterways throughout the county have been found to be polluted above acceptable levels under the federal Clean Water Act and other state and federal laws. The Los Angeles County Flood Control District has recently proposed to adopt a Clean Water, Clean Beaches Measure, which would establish an annual fee to pay for clean water programs. The proposed clean water fee would be imposed on property within the Los Angeles County Flood Control District, which includes most of Los Angeles County (with the exception of portions of the Antelope Valley), for the purpose of improving water quality and reducing pollution from stormwater and urban runoff.

The proposed clean water fee would provide dedicated funding for local and regional projects and programs to help keep pollution out of stormwater and runoff, clean up pollution that flows into waterways, and use stormwater and runoff to recharge groundwater supplies. The proposed fee for each parcel is based on impervious area, which is determined based on land use, zoning, and lot size.

On January 15, 2013, the Board of Supervisors opened a public hearing to listen to public testimony regarding the proposed measure. Due to significant community and agency concerns at the hearing, the Board of Supervisors kept the protest period open for an additional 60 days. On March 12, 2013 the Board again listened to public testimony. At the conclusion of public testimony the Board of Supervisors voted to not proceed with the Clean Water, Clean Beaches Measure at this time and then directed Public Works to continue working towards consensus with stakeholders on key elements of the proposed measure and to report back on progress in 90 days. If consensus is reached among the

stakeholders, the Board of Supervisors may consider placing the proposed fee on the general ballot in June or November of 2014.

### *Water, Sewer, Trash Fees*

While Proposition 218 does not require voter approval for sewer, water and refuse collection user fees, it does require a clear nexus between costs and benefits, as well as a clear separation between existing development and future development. Therefore, to implement fees of this nature, a nexus must be demonstrated between the public facilities and services being funded and the demand of a household or business for water, sewer and refuse collection services. Since most local utilities already charge these types of fees to pay for their costs of service, rates would need to be increased to cover the cost of additional public facilities.

The exemptions for water, sewer and refuse collection user fees from the restrictions of Proposition 218 apply only to the voter approval requirements. As parcel-related fees, these user fees must still be calculated according to Proposition 218 guidelines for fees (discussed in Section C above). Written notice must still be provided to property owners of record. Also, the proposed fees are subject to a public hearing prior to receiving legislative approval. The submittal of written protests prior to the public hearing by a majority of the property owners impacted by a user fee is sufficient to prevent the imposition of that fee. However, it is DTA's experience that on a large-scale financing program (e.g., an entire city or water district); the protest provision has little impact because it is so difficult to contact at least 50% of a large area's property owners and persuade them to mail in their protest ballots. The only exception to this rule is when a few landowners own 50% of the acreage.

### *Public Enterprise Revenue Bonds*

Public enterprise revenue bonds are debt instruments payable from a special fund - a limited source pledge which secures debt service payments of the bonds. As such, these bonds usually finance facilities related to revenue generating enterprise and are payable from the revenues of that enterprise. There are a number of State statutes authorizing the issuance of revenue bonds. The most commonly used statute is the Revenue Bond Law of 1941.

The Revenue Bond Law of 1941 allows cities, counties, and certain special districts to issue revenue bonds to finance, among other things, water and sewer collection, supply, and treatment facilities. The law requires a majority vote to authorize the size and purpose of the bond issue. Because these bonds are secured by a pledge of revenues and not an agency's general fund, they typically carry a higher interest rate than general obligation bonds, but a lower rate than the land-secured bonds (CFD or AD). In addition, there is usually a requirement that revenues generated from an enterprise exceed debt service on bonds by twenty-five percent (25%). This "coverage" protects the bond holders from minor delinquencies and defaults that may occur.

### *Development Impact Fee*

Development Impact Fees ("DIFs") are monetary exactions (other than taxes or special assessments) that are charged by local agencies in conjunction with approval of a development project and are usually collected at the time building permits or occupancy permits are issued. DIFs are levied for the purpose

of defraying all or a portion of the costs of any public facility, improvement or amenity that benefits the development required to pay the fee. However, DIFs cannot be used to pay for public services. Most cities and counties currently impose DIFs for a broad range of public facilities.

AB 1600, which promulgated Section 66000 and other sections of the Government Code, was enacted by the State of California in 1987 to regulate the imposition of DIFs within the State. AB 1600 requires that all public agencies satisfy a number of requirements when establishing, increasing or imposing a fee as a condition of approval for a development project. These requirements include identifying the facilities to which the collected fee would be applied and determining that there is a reasonable relationship between the facilities to be financed, the benefit received by the development paying the fees, and the amount of the fees being imposed. Water and sewer agencies can impose connection fees or capacity charges, which are similar to DIFs, as specified in Government Code section 66013.

While DIFs and connection fees cannot typically be leveraged (i.e., provide security for bonds or other debt instruments), they can be used in conjunction with debt financing to help retire bonds secured by other means (e.g., a CFD or AD). Development fees can also be used to generate reimbursement revenues to property owners or public agencies that have previously paid more than their fair share of public improvement costs. To the extent that regional water improvements are required of future development, DIFs could be utilized to cover these costs for such development. However, DIFs cannot finance any improvements required by existing development, nor can they fund O&M costs for either new or existing development.

### *General Obligation Bonds*

The issuance of general obligation ("G.O.") bonds by a public agency issuer represents a pledge on the issuer's part to levy a uniform ad valorem property tax on all taxable properties within the issuer's jurisdiction in order to annually repay principal and interest due. The bonds are a "general obligation" of the issuer; that is, bondholders have recourse to the "full faith and credit" of the issuer (i.e., unlimited property taxation) to ensure that annual debt service requirements are met. G.O. Bonds may be used to acquire, construct, and improve real property. However, they may not be used to purchase furniture or equipment, or to pay for operations or maintenance.

Prior to 1978, G.O. bonds were, by far, the most popular vehicle for debt financing of infrastructure and public facilities in California. The approval of State Proposition 13 in 1978 quickly brought that era to a close. It was not until 1986, with the passage of State Proposition 46, that resurgence in G.O. bond authorization was seen. This latter proposition reinstated the ability of local public agencies to incur new bonded indebtedness and secure it through the imposition of an ad valorem property tax. Consistent with Proposition 13, however, it was required that two-thirds of the registered voters in the affected territory approve any such measure. In some cases, particularly with certain types of water districts, Improvement Districts may be established which limit the tax levying capability of the issuer and the election regarding the bond issuances to only those properties located within the Improvement District.

Because G.O. Bonds are one of the most secure debt financing instruments available to local public agencies, they generally carry lower interest rates than the other local financing mechanisms being

reviewed in this Report. In addition, the dispersion of debt service costs throughout a jurisdiction helps minimize the taxes to each property owner, as opposed to levying a tax on a special district consisting of a much smaller area. However, the requirement of a two-thirds approval by voters throughout the issuer's jurisdiction makes it difficult to obtain authorization to sell G.O. bonds.

### *Special Assessment District*

There are a number of types of Assessment Districts ("ADs") that can be utilized to fund water supply improvements and maintenance services. Public works improvements are eligible for AD financing to the extent that properties within the AD receive a special, measurable, local and direct benefit from such improvements. Traditionally, improvements to be financed using an AD under the Municipal Improvement Act of 1913 and the Improvement Bond Act of 1915 include, but are not limited to, streets and roads, water, sewer, flood control facilities, utility lines and landscaping. Other types of public improvements which have a "regional" significance (e.g., major roads, bridges, flood control facilities, etc.) are only partially eligible, based on the proportion of benefit from the improvements that can be assigned to parcels within the AD. Traditionally, items of general benefit to a community, such as schools, fire stations and parks, have not been eligible for Assessment District financing. An AD can also provide funding to operate and maintain improvements financed by the AD itself.

The Benefit Assessment Act of 1982 provides more flexibility in providing public services, as road, drainage, flood control and street lighting maintenance services can be funded under this Act, whether not the improvements themselves are funded through the AD. ADs are subject to specific benefit requirements as a result of both their enabling legislation and Proposition 218. As discussed above, under their enabling legislation, public works improvements and services are eligible for AD financing to the extent that properties within the AD receive a special, measurable, local, and direct benefit from such improvements and services. Proposition 218 further emphasized this benefit requirement by requiring that:

*"An agency which proposes to levy an assessment shall identify all parcels which will have a special benefit conferred upon them and upon which an assessment will be imposed. The proportionate special benefit derived by each identified parcel shall be determined in relationship to the entirety of the capital cost of a public improvement or for the cost of the property related service being provided. No assessment shall be imposed on any parcel which exceeds the reasonable cost of the proportional special benefit conferred on that parcel. Only special benefits are assessable, and an agency must separate the general benefits from the special benefits conferred on a parcel. Parcels within a district that are owned or used by any agency, the State of California or the United States shall not be exempt from assessment unless the agency can demonstrate by clear and convincing evidence that such publicly owned parcels in fact receive no special benefit."*

Proposition 218 defines "special benefit" as the following:

*"Special benefit means a particular and distinct benefit over and above general benefits conferred on real property located in the district or to the public at large. General enhancement of property value does not constitute special benefit."*

It also places the burden of proof on the public agency in any legal action challenging the validity of an assessment:

*"In any legal action contesting the validity of any assessment, the burden shall be on the agency to demonstrate that the property or properties in question receive a special benefit over and above the benefits conferred on the public at large and that the amount of any contested assessment is proportional to, and no greater than, the benefits conferred on the property or properties in question."*

Recent court cases discussed in Section C reinforce the special benefit requirements of Proposition 218, making an AD less attractive for funding regional water supply and water quality improvements than many other funding mechanisms.

### *Mello-Roos Community Facilities District*

A Community Facilities District ("CFD") is a funding option that can be used to pay for public infrastructure and services for future development. While a two-thirds vote of the "qualified electors" is required to establish a CFD, the boundaries of a potential CFD could be set so that fewer than twelve registered voters initially reside within the CFD. In this case, the "qualified electors" would be the property owners (not the registered voters), and if a property owner were conditioned to form or annex to a CFD in order to develop his or her property, he would need to agree to include his property in the CFD. While this type of financing would not generate funds to pay for public infrastructure and services for existing development, it could cover a substantial portion of the cost of such facilities and services related to future development and redevelopment.

The Mello-Roos Community Facilities Act ("Act") was enacted by the California State Legislature in 1982 (Section 53311 et. seq. of the Government Code) to provide an alternate means of financing public infrastructure and services subsequent to the passage of Proposition 13 in 1978. The Act complies with Proposition 13, which permits cities, counties and special districts to create defined areas within their jurisdiction and, by a two-thirds vote within the defined area, impose special taxes to pay for the public improvements and services needed to serve that area. The Act defines the area subject to a special tax as a CFD. If fewer than twelve registered voters reside within a proposed CFD, the property owners within the CFD are defined as the qualified electors. Therefore, if new development and significant redevelopment are required to join a CFD in order to gain entitlements, pull building permits or record a final map or parcel map, the cooperation of a property owner who wishes to develop a parcel can be assured. The Act provides a simple and inexpensive annexation process whereby vacant parcels can annex to a CFD on a parcel-by-parcel basis, as they become developed.

A CFD may provide for the purchase, construction, expansion or rehabilitation of any real or other tangible property (including land) with an estimated useful life of at least five years. It may also finance the costs of planning, design, engineering and consultants involved in the construction of improvements or formation of the CFD. The facilities or real property financed by the CFD do not have to be physically located within the CFD. Any facilities that will be publicly owned, and will have a useful life of five years or more, would qualify for this financing.

Furthermore, a CFD may also pay for certain types of public services, including police, fire, and ambulance services, landscape and park maintenance, street and road maintenance, flood and storm protection services, library and recreational services, and school facilities maintenance. However, a CFD may only finance these services to the extent that they are in addition to those provided within the area of the CFD before the CFD was created, and may not supplant services already available within that area.

Formation of a CFD authorizes the public agency establishing the CFD to levy a special tax on all taxable property within the CFD, as defined in the formation documents. Property owned or irrevocably offered to a public agency may be exempted from the special tax. Mello-Roos special taxes are collected at the same time and in the same manner as regular ad valorem property taxes, unless otherwise specified by the agency. Special tax revenues may be used to pay the debt service on bonds that have been sold to fund the construction or acquisition of public capital facilities, or to pay directly for facilities or public services.

### *Certificates of Participation or Lease Revenue Bonds*

Two long-term funding alternatives that could potentially be used to fund regional water supply and water quality improvements are Certificates of Participation ("COPs") and Lease-Revenue Bonds ("LRBs"). These funding mechanisms provide long-term financing for public improvements via a lease or installment sales structure, as opposed to requiring debt service payments. By establishing a lease obligation, COPs and LRBs avoid being designated as debt, and therefore avoid the election requirement (and the two-thirds vote requirement) mandated by Proposition 13 for all bond sales. As no voter election is required to sell these instruments, a county board of supervisors or a city council could approve a bond sale with a simple majority vote of the legislative body.

In brief, the principal parties to a COPs or LRB financing include a public agency, a non-profit corporation and a trustee. The non-profit corporation may be formed specifically to construct and own the necessary improvements, the funds for which are generated from the proceeds of the COPs or LRB sale. The non-profit corporation may also be an existing agency, such as a joint powers authority or an economic development corporation. However, the actual responsibilities for managing the construction are generally delegated to the public agency. The non-profit corporation then leases or sells the land and facilities back to the public agency in return for lease or installment sales payments.

The investors who purchase the COPs or LRBs receive a specified portion of the public agency's payments to cover the principal and interest due on their COPs. The certificates or bonds are secured by the public agency's pledge to make payments to cover its lease or installment sales payments, although there is no requirement that the public agency commit its general fund to making these payments. The trustee is responsible for accepting these payments and then disbursing them to the certificate or bond holders.

There are two major problems associated with COPs or LRBs. First, these instruments can only be used to fund public improvements, not O&M costs. Second, and more significantly, a source of revenues is required to repay the COPs or LRBs, so these mechanisms could not be utilized without monies being

generated by some other source. COPs are generally secured by the covenant of the public agency to make annual appropriations in an amount sufficient to service the certificates. The appropriations may come from the public agency general fund or from a designated special fund, such as the enterprise fund user fees or a CFD. Due to Gann Amendment limitations on general fund spending, the use of general fund monies to make payments on COPs or LRBs would be detrimental to other recipients of general fund monies. However, to the extent that one or a combination of the available funding mechanisms provide a reliable and secure ongoing revenue stream, a public agency can issue COPs or LRBs that are non-recourse to its general fund.

Sewer and water improvements, parking facilities and other revenue-generating public uses can be financed with revenue bonds. Debt service on these bonds may be paid through monthly utility bills, parking fees, and other revenues, etc. Bonds are not sold until sufficient revenues are available to provide a level of bond debt service coverage which is acceptable to the municipal bond market. As water rates are already used to fund the ongoing cost of providing water, financing new water facilities through the use of public enterprise revenue bonds will often require an increase in water rates.

**Table 8-1 Traditional Finance Measures**

| Financing Mechanism | Advantages | Disadvantages |
|---|---|---|
| Sales Tax Measure | • Can provide a fairly consistent source of funding<br>• Can fund any facilities or services specified in ballot materials | • Requires a 2/3 vote; Can be regressive in nature when calculated as a function of income<br>• Currently preempted by State 0.25% sales tax increase |
| Stormwater Utility Fee | • Can apply to every parcel in the area adopting the fee<br>• Can pay O&M or capital costs<br>• Can be implemented on municipality, watershed, or WMA basis | • Will require property owner or registered voter election |
| Water User Fee | • No election requirement under Proposition 218; but ballot protest process is recommended<br>• No legal constraints on raising funds other than nexus<br>• Can pay O&M or capital costs | |
| Sewer User Fee | • No election requirement under Proposition 218; but ballot protest process is recommended<br>• No legal constraints on raising funds other than nexus<br>• Can pay O&M or capital costs | |

**(Continuation of Table 8-1 Traditional Finance Measures Table)**

| Financing Mechanism | Advantages | Disadvantages |
|---|---|---|
| Refuse Collection Fee | • No election requirement under Proposition 218; but ballot protest process is recommended<br>• No legal constraints on raising funds other than nexus<br>• Can pay O&M or capital costs | • Public agencies can only control rates charged to users through negotiation with private entities |
| Public Enterprise Revenue Bonds | • Customarily finance water and sewer systems.<br>• Lower interest rate than land-secured bonds | • Requires stable revenue stream which exceeds debt service by 25% |
| Development Impact Fees | • No voter approval required<br>• Can be used to reimburse public agencies and developers for over sizing capital improvements | • Can only pay for capital improvements needed for new development |
| General Obligation Bonds | • Carry lower interest rates than the other local financing alternatives<br>• Greater dispersion of debt service costs throughout a jurisdiction helps minimize the taxes to each property owner, as opposed to levying a tax on a special district consisting of a much smaller area | |
| Special Assessment Districts | • Spreads costs equitably<br>• Can finance certain facility and O&M costs | • Public agencies can only control rates charged to users through negotiation with private entities |
| Mello Roos Community Facilities District | • Can pay O&M or capital costs<br>• Can pay capital costs anywhere within the jurisdiction forming the CFD | • Requires 2/3 vote of qualified electors so would probably only apply to new development and redevelopment<br>• Can only be used to fund increased services (not existing services) that benefit the parcels within the CFD |
| Certificates of Participation and Lease Revenue Bonds | • Can be adopted by legislative body, as no voter approval required<br>• Can be used to pay for capital improvements | • Need to find source of reliable revenues to pay interest and principal. Interest rates charged tend to be higher if repayment revenues aren't predictable<br>• Statutory and constitutional limitations on the size of municipal debt may apply |

## *Creative Funding Mechanisms*

### Local Infrastructure Bank

In general, an infrastructure bank is an entity that manages capital and provides loans for infrastructure development. Similar to a State or Federal infrastructure bank, a local infrastructure bank run by SAWPA could potentially provide funding for a range of water supply and water quality projects. In theory, SAWPA member agencies and other stakeholders could invest funds in a pool managed by SAWPA. SAWPA could then loan these funds back to certain local agencies to fund regional infrastructure. Further investigation of this option is needed.

### Water/Energy Nexus

Since the California Energy Commission ("CEC") issued its landmark finding in 2005 – that water-related energy uses account for about 19% of all electricity and 30% of non-power plant natural gas used within the state – California's water and energy sectors have been collaborating on strategies for achieving the incremental resource, economic and environmental benefits that can be found at the intersection of water, energy and climate. In 2006, a multi-agency Water-Energy Team was established to assist the Governor's Climate Action Team in identifying and promulgating statewide strategies for reducing water- sector greenhouse gases ("GHGs"). About the same time, the CEC commenced development of its first water-energy research program. The California Public Utilities Commission ("CPUC") conducted workshops to explore whether and how the water-energy nexus should be included in the state's regulated energy programs. Concurrently, the DWR commenced investigations as to how the linkages among water, energy and climate should be included in the state's water planning processes. In addition, the Federal Environmental Protection Agency has a Sustainable Infrastructure program which is intended to help water and wastewater utilities to conserve water, be more energy efficient, and adapt to the impacts of climate change.

The water sector has unique capabilities for substantially changing the amount, time and place of its consumption of electricity. Since energy is the single largest ongoing expense for water system operations and maintenance; if energy usage is made more efficient, water agencies will see significant savings. These savings will free up money that can be used for water supply and water quality improvements.

### Public Private Partnerships

A Public Private Partnership ("PPP") customarily involves a contract between a public sector organization and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project. In some types of PPP, the cost of using the service is borne exclusively by the users of the service and not by the taxpayer. In other types (notably the private finance initiative), capital investment is made by the private sector on the basis of a contract with government to provide agreed services and the cost of providing the service is borne wholly or in part by the government. Government contributions to a PPP may also be in kind (notably the transfer of existing assets). In projects that are aimed at creating public improvements like in the infrastructure sector, the government may provide a capital subsidy in the form of a one-time grant, so as to make it more attractive to the private investors. In some other cases, the government may support the project by providing revenue subsidies, including tax breaks or by removing guaranteed

annual revenues for a fixed time period.

Typically, a public sector consortium forms a special company called a "special purpose vehicle" (“SPV”) to develop, build, maintain and operate the asset for the contracted period. In cases where the government has invested in the project, it is typically (but not always) allotted an equity share in the SPV. It is the SPV that signs the contract with the government and with subcontractors to build the facility and then maintain it. In the infrastructure sector, complex arrangements and contracts that guarantee and secure the cash flows make PPP projects prime candidates for project financing. Two examples of PPPs are discussed on the next page.

### *West Coast Infrastructure Exchange*

Funded by two Rockefeller Foundation grants totaling $750,000, the West Coast Infrastructure Exchange (“Exchange”) is a start-up non-profit entity that was established to tap into the expertise of development and finance leaders to save money, find innovative financing methods and achieve cost savings via collaboration in order to make projects more feasible. Participating jurisdictions include the states of California, Oregon and Washington, as well as, British Columbia. The goal of the exchange is to explore ideas together, to share best practices and technical expertise, to help identify infrastructure projects that might help benefit from some private involvement, and to work together to find out what projects might be bundled to make them more appealing to the private sector. Target infrastructure investment opportunities include, but are not limited to energy transmission and efficiency, water storage capacity, municipal water systems and wastewater management.

During the start-up phase, through 2013, the Exchange will operate with an interim management team representing each partner office, coordinated by the Oregon State Treasury. Committees will begin to establish a framework for evaluating projects. The Exchange will seek a director with experience in public infrastructure management. After those steps have been completed, the Exchange will begin serving as an information source and develop a process for connecting projects to financing, potentially including private capital.

By establishing a center of expertise to provide technical assistance, setting standards and providing investment information, and simultaneously advancing new mechanisms for project finance the Exchange has the potential to attract large private institutional investors.

The following table (**Table 8-2**) compares traditional project operations to the Exchange’s performance-based methodology.

**Table 8-2 Comparison between Traditional Projects**

## Assessing the WCX

The West Coast Infrastructure Exchange is employing a performance-based infrastrucure, which approaches project management differently than traditional models, the ways in which are detailed in the chart below (click to enlarge).

**Types of Projects**

| Traditional | Performance-Based Infrastructure |
|---|---|
| Limited analysis of alternatives, focus on capacity additions | Thorough analysis of alternatives, consider demand and supply side solutions equally, benefit-cost analysis drives decision-making |
| Project planning doesn't consider impact of climate change | Project planning accounts for predicted changes in sea level, precipitation and extreme weather events |
| Each jurisdiction finances and delivers projects on their own | Jurisdictions plan together and pool resources to lower project costs and deliver better regional outcomes |
| Projects funded through general taxes, gas taxes, and federal grants | Projects funded with user fees such as variable tolls for highways and bridges |
| Design-Bid-Build: One group designs the project and an entirely separate group with the low bid builds the project | Design-Build-Operate-Maintain: Public owner contracts with one entity for best value on delivered infrastructure services over life of project<br><br>Design-Build-Finance-Maintain: Public owner contracts with one entity which delivers financing and project with best value for public owner |
| Tax-exempt debt offers lowest cost of capital for public projects | Taxable debt in context of public-private partnership delivers more value to public |

*Chart courtesy of westcoastx.com*

### *Pace Program*

Property Assessed Clean Energy ("PACE") programs enable property owners to finance private "green" improvements including water conservation improvements, as well as, solar panels, heating and air conditioning systems, pool filtration equipment, windows and doors, water conservation improvements, fuel cells and other types of energy saving improvements. The funding for the improvements is repaid through an annual assessment on the property tax bill. DTA currently serves as the Assessment Engineer for Western Riverside Council of Government's ("WRCOG") HERO Program for Western Riverside County as well as WRCOG's statewide California HERO Program. The HERO Program is WRCOG's version of a PACE Program, which offers qualified property the opportunity to finance energy

efficiency and water conservation improvements for their properties.

Since the HERO Program was launched in early 2012, 7,897 applications have been received, with 5,157 approved for energy improvements totaling $146.15 million. Approximately $36.1 million in bonds have been closed to date to fund eligible improvements.

To the extent that local property owners reduce their water and/or energy usage through a PACE program, the demand for new water and other infrastructure may be reduced.

### *Government Legislation*

Government Code Section 5956 et seq. allows local governmental agencies (including cities, counties and special districts) to use design-build to construct "fee producing infrastructure facilities." The legislation expressly allows facilities that provide water supply, treatment and distribution. This authority is limited to privatization transactions where the private entity will operate and maintain facility.

## Crowd Sourcing

Crowd funding, also referred to as crowd financing or crowd sourced capital, is the practice of developing an online group-based investment campaign to generate financing for a specific project. This practice leverages dedicated internet fundraising websites to spur community support and financing for an assortment of ventures, including architectural, through numerous small dollar investors. The campaign owner is provided the opportunity to petition a wide variety of potential investors as opposed to solely relying on angel investors or venture capitalists. The investing public is protected from outsized loses through the nature of the small dollar contributions with the risk spread across a larger population.

Crowdfunding refers to any kind of capital formation where both funding needs and funding purposes are communicated broadly via an open call in a forum where the call can be evaluated by a large group of individuals, the crowd. The outreach is referred to as a crowdfunding campaign and the person or company in charge of the campaign is referred to as the campaign owner.

### *Donation-Based Crowdfunding*

The type of crowd funding that comes closest to our traditional understanding of online fundraising is donation-based crowdfunding. With this model, tangible returns are not the reason for individual contributions, and thus the success of the campaign is solely determined by the crowd's identification with or emotional attachment to the campaign's cause. A common example is a community project that would otherwise require municipal or other government funding. In a report released in May 2012, Massolution's Crowdfunding Industry Report estimated the aggregate crowdfunding volume throughout 2011 was close to $1.5 billion, of which almost half was raised via donation-based crowdfunding as described above. The main benefit of donation-based crowdfunding is that the campaign owner does not need to compensate the crowd once the funding is secured. The challenge, however, is that the crowd needs to identify or have an emotional connection with the campaign cause itself. Donation-based crowdfunding is ideal for projects that do not have something tangible to offer in return for the funds raised. In order to activate the accessible crowd it is important to communicate why no other

means of funding is available. On top of that, the project itself needs to appeal either via identification or emotion in order to get individuals to contribute but also to get them to spread the word of the project on to likeminded crowdfunders. In a crowdfunding ecosystem it is crucial to make the purpose of the call for capital as clear as possible as raising funds for vague purposes can make it difficult for the individual crowdfunders to truly identify themselves with the campaign. Donation-based crowdfunding is therefore the model that will require the most carefully thoughtful communications strategy, and the most persistent communications effort.

While donations are granted due to either identification or an emotional attachment to the project's cause and/or urgency, rewards have to be interesting themselves, meaning the campaign has to offer a set of rewards that are economically sound or in some way relevant to the campaign.

Recreational walking/biking trails along river trails (which actually are stormwater flood control channels) are potential candidates for crowdsourcing. Similar to the signs along freeways acknowledging contributions for maintenance, SAWPA may use a similar signage program to reward donors with advertising. This concept appears to work best in funding operations and maintenance.

The concept may also be applied to infrastructure funding. The most familiar application is school and universities establishing building fund campaigns for a new sports facility. Religious organizations often have campaigns to raise funding to build new churches. However, public appetite for funding water infrastructure through crowdsourcing may be limited.

### Energy Service Company ("ESCO") And Energy Saving Performance Contract ("ESPC")

An Energy Service Company ("ESCO") is a business that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs for facilities over a seven to twenty year time period. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project. Typically, they offer the following services:

- develop, design, and arrange financing for energy efficiency projects
- install and maintain the energy efficient equipment involved
- measure, monitor, and verify the project's energy savings
- assume the risk that the project will save the amount of energy guaranteed

These services are bundled into the project's cost and are repaid through the dollar savings generated.

What sets ESCOs apart from other firms that offer energy efficiency, like consulting firms and equipment contractors, is the concept of performance-based contracting. When an ESCO undertakes a project, the company's compensation, and often the project's financing, is directly linked to the amount of energy that is actually saved.

Typically, the comprehensive energy efficiency retrofits inherent in ESCO projects require a large initial capital investment and offer a relatively long payback period. The customer's debt payments are tied to

the energy savings offered under the project so that the customer pays for the capital improvement with the money that comes out of the difference between pre-installation and post-installation energy use and other costs. For this reason, ESCOs have led the effort to verify, rather than estimate energy savings. One of the most accurate means of measurement is the relatively new practice of metering, which is direct tracking of energy savings according to sanctioned engineering protocols.

Most performance-based energy efficiency projects include the maintenance of all or some portion of the new high-energy equipment over the life of the contract. The cost of this ongoing maintenance is folded into the overall cost of the project. Therefore, during the life of the contract, the customer receives the benefit of reduced maintenance costs, in addition to reduced energy costs. As an additional service in most contracts, the ESCO provides any specialized training needed so that the customer's maintenance staff can take over at the end of the contract period.

Energy Savings Performance Contracts ("ESPCs"), also known as Energy Performance Contracts ("EPCs"), are an alternative financing mechanism authorized by the United States Congress designed to accelerate investment in cost effective energy conservation measures in existing Federal buildings.

ESPCs allow Federal agencies to accomplish energy savings projects without up-front capital costs and without special Congressional appropriations. The Energy Policy Act of 1992 (EPACT 1992) authorized Federal agencies to use private sector financing to implement energy conservation methods and energy efficiency technologies. An ESPC is a partnership between a Federal agency and an ESCO. The ESCO conducts a comprehensive energy audit for the Federal facility and identifies improvements to save energy. In consultation with the Federal agency, the ESCO designs and constructs a project that meets the agency's needs and arranges the necessary financing. The ESCO guarantees that the improvements will generate energy cost savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency.

The savings must be guaranteed and the Federal agencies may enter into a multiyear contract for a period not to exceed 25 years. ESPCs are regulations created by the Federal Energy Management Program ("FEMP") of the United States Department of Energy ("DOE") as required by the Energy Policy Act of 1992. The final DOE ruling came into effect on May 10, 1995. The use of ESPCs by Federal agencies was reauthorized in the Energy Policy Act of 2005 ("EPACT 2005") through the end of Fiscal Year (FY) 2016 and permanently reauthorized in The Energy Independence and Security Act of 2007 ("EISA").

### Regional General Obligation Bond

With a traditional General Obligation bond, as discussed in Section III.D.1.(f), bonds are issued by a public agency, based on a pledge of the ad valorem property taxes for all (or a portion) of the properties within the issuer's jurisdiction. Recently, Joseph Zoba, General Manger at Yucaipa Valley Water District, has proposed the use of regional general obligation bonds to raise funds regionally to be used for regional projects. This would avoid the time consuming and expensive Federal and State processes to compete for funds. A regional general obligation bond program would be administered locally for

greater local control, and would require regional partners to work together closely in developing regional solutions.

It is unclear whether a regional general obligation bond could be implemented without modifications to the existing enabling legislation. In addition, there would be many challenges for such a program including defining boundaries and achieving the 2/3 vote necessary to establish such a program.

## Conclusions

As stated in the Introduction, SAWPA engaged David Taussig and Associates, Inc. ("DTA") to investigate financing alternatives for public facilities and regional planning. In addition to its many years of successes regarding all facets of financing public infrastructure, DTA has furthered its expertise by recently working with other significant public agencies, including the California Department of Water Resources, to research current state-of-the-art financing methodologies.

The following are DTA's general observations, recommendations and conclusions regarding this review of financing methodologies for SAWPA (specific recommendations are described in detail in the body of the report):

- Throughout the prosecution of this assignment, DTA conducted many interviews with recognized leading public finance experts and reviewed the body of current, available industry documents and communications. Consistent throughout DTA's research, SAWPA is universally regarded as one of, if not the most highly regarded IRWMs in California. SAWPA has outstanding leadership, is staffed by practitioners who are recognized industry-wide for their expertise in their assigned specialties, and most noteworthy, SAWPA has a dynamic organizational structure that is focused on continual improvement, flexibility and creativity in seeking solutions to both SAWPA's and the water industry's challenges.
- This document presents feasible and realistic funding alternatives for regional water projects and integrated water infrastructure planning highlighting innovative new approaches, the effect of current public financing policies and summarizing industry "best practices" to fund the integrated planning required to construct regional water and water quality improvements.
- There exists a structural incongruity between current legislation, watersheds and the systemic structure in which watersheds are managed. Watersheds are rarely, if ever, regulated, served or are the responsibility of a single governmental entity. Literally dependent entirely on the lay of the land, the topography of a broad region determines a watershed's boundaries. In most, if not all cases, watersheds span multiple counties. Current legislation does not provide a means of assigning the functional and financial responsibility for managing this valuable natural resource as a complete integrated system. This piecemeal management system engenders philosophical conflicts, inconsistent management protocols and is inherently inefficient.
- Even though a few progressive and thoughtful ad hoc cooperative alliances exist between some counties, regional governmental entities with responsibility, authority and funding to manage significant watersheds do not currently exist. With the current funding alternatives and their respective requirements (voter approval thresholds, etc.) regional funding is not feasible. Without

funding, responsible administration with backbone is impossible.

## Limitations of Report

The conclusions and recommendations in this report rely on the information provided to DTA at the time of the writing of the Report by the following parties was true, correct, and complete:

1. The Santa Ana Watershed Project Authority
2. The California State Department of Water Resources

# 9.0 Data Management and Plan Performance/Monitoring




Managing water resources data at a watershed-wide level in a centralized and consistent manner, and providing access to this information to key stakeholders and the public at large is critical to the successful implementation of the Santa Ana Watershed Project Authority (SAWPA) One Water One Watershed (OWOW) 2.0 Plan. This chapter reports on the various methods and tools developed by SAWPA and others to monitor performance, manage data and provide new tools to support the implementation of the OWOW Plan. This includes a watershed assessment of how effectively progress is being made in achieving the OWOW 2.0 goals, objectives, and planning targets.

The results of the watershed assessment tool and reporting provides users with the status and trends in water resources, as well as the economic, ecologic and social systems that make up the watershed. This scientific, data-driven watershed assessment benefits local, regional, state and federal agencies and organizations by conveying a systematic, scientific evaluation of conditions developed for and presented to a wide-ranging audience. Integrated assessment and reporting of environmental and community conditions promote cooperative management and decision-making by increasing the public's awareness of regional conditions.

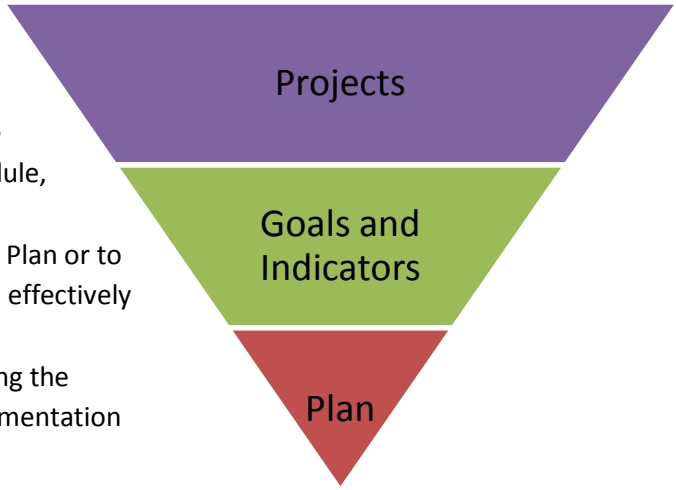
In addition, this report describes the mechanism for future plan evaluation and implementation and is designed to meet the Integrated Regional Water Management (IRWM) requirements for Plan Performance and Monitoring while also providing OWOW 2.0 with a mechanism for celebrating successes, drawing resources to challenges, and improving the health of the Santa Ana River Watershed (SARW). Properly managed data helps SAWPA, other agencies and stakeholders in the watershed

identify water quantity and quality issues, assess and develop potential solutions, quantify the anticipated impacts of these solutions, and measure the extent to which anticipated impacts materialize. In addition, having a single depository of data with a consistent format allows the sharing of information among stakeholders, and the integration of watershed data with other databases at the State level.

## OWOW Plan Performance and Monitoring

Through OWOW 2.0, SAWPA has developed a process to evaluate and implement the OWOW 2.0 Plan. The intent of which is to:

- Ensure progress is being made toward meeting the objectives of the Plan
- Ensure specific projects identified in the Plan are being implemented as planned in terms of schedule, budget, and technical specifications
- Identify potential necessary modifications to the Plan or to specific projects, in order to more efficiently and effectively accomplish the goals and objectives of the Plan
- Provide transparency and accountability regarding the disbursement and use of funds for project implementation




This process includes performance measures (indicators) and monitoring to document progress toward meeting the OWOW 2.0 Plan goals. Monitoring will take place at two levels, the plan and individual implementation project. Linking the two are a set goals, each made up of a number of specific indicators.

It is anticipated that plan performance will be evaluated every three to five years. This is based upon a number of limiting factors including:

- The scale and complexity of the Santa Ana River Watershed
- Availability of data updates
- Window of time required to complete projects

Results of this, as well as future evaluations will be published by SAWPA in the OWOW Webpage, and will include the use of visual tools (i.e. dashboards) to show progress to date in achieving the plan goals.

## Project Monitoring

The evaluation (rating and ranking) of projects, detailed in **Chapter 6 Project/Program Review, Evaluation and Prioritization**, is conducted through a multi-step process under the direction of the OWOW governance structure. Through this process projects of high value in achieving OWOW goals are identified to move forward for implementation and monitoring. The frequency of which this process for updating project ratings and rankings is conducted is based upon the availability of funding for projects. Projects implemented through OWOW are monitored through a Data Management System (DMS) maintained by SAWPA. This DMS is designed to ensure "lessons learned" from project-specific monitoring efforts will be used to improve SAWPA's ability to implement future projects in the OWOW Plan. SAWPA has established a "datamart" with the State to link directly to the California Environmental Data Exchange Network (CEDEN) database to down load data available for the SARW on a regular basis, and intends to expand this capability of other State databases as the opportunity becomes available. Additional tools to support the SAWPA DMS are described in detail in the Data Management section of this chapter.

SAWPA provides oversight on projects that are implemented through the Department of Water Resources (DWR) funding programs and require that project performance monitoring be developed and results reported as part of project implementation. The project's proponents are responsible for data that is collected and provided to SAWPA and DWR as part of the regular reporting process. The project monitoring plans developed by the project proponents must include information on the following information.

- Parameter or constituent being monitored
- Measures to remedy or react to problems encountered during monitoring
- Location of monitoring
- Monitoring frequency
- Monitoring protocols and methodologies and responsible parties
- Data management process for tracking what is monitored
- Procedures to ensure monitoring schedule and processes can be maintained

## Data Management Approach

The Santa Ana River Watershed (SARW) includes over a hundred municipalities and public agencies, and each municipality and agency is responsible for monitoring a wide range of parameters for many varied programs. SAWPA has directed each of these agencies to submit data to state agencies where appropriate and project performance data to SAWPA. The SARW Region has, therefore, determined that the focus should be on collecting the data already being provided by project proponents funded through the IRWM Program (and therefore already meeting DWR data requirements) and use of that data for the purposes of determining Plan Performance as described previously. Projects funded through the IRWM implementation funding programs are required to provide data from approved project performance monitoring programs in formats already consistent with the list of state agency databases

called out in DWR guidance. Therefore, the Region can ensure that the data provided can be effectively shared and used by the State and the Region's stakeholders.

SAWPA recognizes that a great deal of valuable data is collected from studies and projects not funded through the IRWM Program but which could benefit the Region and the State if made accessible. Therefore, SAWPA is working to expand the capabilities of a number of in-house tools to assist Regional stakeholders and agencies who wish to provide datasets to the Region through the IRWM Program, these datasets will be uploaded to the SAWPA database, but SAWPA would not be responsible for determining if these datasets meet DWR requirements nor for including the data into the Plan Performance assessment process. The region may, in the future, pursue additional funding to further enhance and grow the Region's DMS to fully include datasets from projects and programs not funded through the IRWM program.

Stakeholders contribute data through the projects funded by the IRWMP and are directed to input data into the appropriate state database. Additionally, stakeholders also contribute data through task force efforts such as the Lake Elsinore and Canyon Lake Nutrient Total Maximum Daily Load (TMDL) Task Force and the Middle Santa Ana River Pathogen TMDL Task Force.

Data that were not required to be submitted to state database but are deemed important are placed in SAWPA database and are made accessible through web tools, maps and tables. This database is reviewed by SAWPA staff and routinely backed up. Data quality is corrected through the use of spatial queries and then displayed through maps and tables. Anomalies are easily spotted and corrected by data submitters and SAWPA staff. Outside consultants, often added for their expertise on a particular project, add another set of eyes to the data.

The data that are submitted to the State through databases such as CEDEN as well as the SAWPA database, are available through web tools and data requests. These web tools combine tabular data with spatial data and allow the user to view the information on a map of the watershed. Many of the tools provide a quick method of analysis by providing a map with features that may be colored by a value or a chart on top of the map showing a value over time. Data that has been uploaded to the State per contract is available through a number of tools that use a weekly connection to CEDEN database which provides a very up-to-date view of the data. Data compatibility with State databases is exceptionally high due the feedback loop caused by using web based tools displayed near real time submitted data.

## OWOW Plan Monitoring

There are a number of ongoing monitoring programs that are collecting data in the Region to support the OWOW Program. Current pertinent monitoring activities in the Region are described briefly below.

### *Lake Elsinore and Canyon lake Nutrient TMDL*

The Lake Elsinore and Canyon Lake Nutrient TMDL Task Force is comprised of local stakeholders seeking to address the nutrient TMDLs defined by the Regional Board for two impaired water bodies in the San Jacinto River Watershed – Canyon Lake and Lake Elsinore. This Task Force was organized and formed by

SAWPA and LESJWA to address water quality targets in a cost effective manner among over 20 agencies and coalitions, including Federal, State, and local agencies. The Task Force meets monthly and includes representatives from local cities, Riverside County, agriculture and dairy, environmental groups, as well as the regulatory community. At the request of the Regional Board, SAWPA served as a neutral facilitator for the early TMDL development process for Lake Elsinore and Canyon Lake.

### *Middle Santa Ana River Pathogen TMDL*

The Middle SAR Pathogen TMDL Task Force is a collaborative effort of public and private sector agencies and interests focused on the development of pathogen TMDLs for SAR Reach 3, its tributaries, and other water bodies in the Chino Basin area. Formed in 2007, the Task Force has been working on several pathogen-related activities and studies for the Chino Basin. The objectives of this Task Force are to implement a number of tasks identified by the Regional Water Quality Control Board (RWQCB) in their 2005 Amendment to the Basin Plan. These include the implementation of a watershed-wide monitoring program to assess compliance with REC-1 beneficial use water quality objectives for fecal coliform, evaluate numeric targets established for *E. coli*, and identify and implement measures to control sources of impairment. The Task Force works with the Regional Board in the formulation of pathogen TMDL allocation and implementation strategies. SAWPA serves as the neutral facilitator and administrator of the Task Force.

### *Urban Water Management Plans*

The Urban Water Management Planning Act (UWMP Act) requires that planning projections be evaluated over at least a 20 year period. Most of the agencies within the watershed projected their demands for a 25 year period ending in 2030. This report provides the actual water demands for 2005 along with the water demand projections through 2030. Water demands within the watershed are met through a combination of both local and imported water supplies. Local resources include precipitation in the form of snow pack, surface flow and groundwater. Imported resources for the Watershed are primarily from the Colorado River Aqueduct (CRA) and the State Water Project (SWP). UWMP's evaluate scenarios that help prepare for water supply reliability the Watershed assuming a multi-year drought.

## Technical Analysis

In addition, there a vast amount of data utilized in the creation of the OWOW 2.0 Plan, which are not directly reported to the State. This data and technical information is used to develop the water management needs in the OWOW 2.0 Plan. The data collected is considered adequate for the needs of developing the OWOW plan in representing current conditions, the scope of historical highs and lows and future forecasts and projections. **Table 9.1** identifies the studies, models and other data sets used to create tables, charts and graphics throughout the OWOW Plan.

**Table 9-1 Source Material Used for OWOW 2.0 Technical Analyses**

| Data or Study | Analysis Method | Results | Use in IRWM Plan | Source |
|---|---|---|---|---|
| Tribal Communities | Spatial Analysis | Percent of Tribal Communities in the Watershed | Map of Tribal Communities | Southern California Association of Governments (SCAG) |
| Disadvantaged Communities | Spatial Analysis | Percent of Disadvantaged Communities in the Watershed | Map of Disadvantaged Communities | SCAG |
| Groundwater Management Zones | Groundwater Supply/Quality/Storage | GW Management Zone, Water Quality and available storage mapping | Map of GW management zones | RWQCB, Santa Ana Basin Plan |
| Watershed Land Use | Spatial Analysis/Land Use Trends | Spatial representation of available regions for groundwater recharge | Map of land use in the SARW | SCAG |
| Critical Habitat | Habitat/Spatial Analysis | Spatial representation of critical habitat | Map of critical habitat in the SARW | Various Agencies |
| Population | Population Projections | Projected Populations for the watershed until 2035 | Map of population density in the SARW | SCAG |
| Flood Control Facilities | Spatial/Stormwater Capture Analysis | Stormwater Capture mapping | Map of flood control infrastructure in the SARW | Various Agencies |
| Groundwater Recharge Facilities | Recharge Opportunities/Spatial Analysis | GW recharge mapping | Map of GW recharge facilities and opportunities in the SARW | Various Agencies |
| Constructed Wetlands | Habitat/Stormwater Recharge Analysis | Habitat Area/Stormwater | Map of Constructed | Various Agencies |

| Data or Study | Analysis Method | Results | Use in IRWM Plan | Source |
|---|---|---|---|---|
| | | Recharge Opportunities | Wetlands in the SARW | |
| Recycled Water Facilities | Spatial/Water Quality/Water Supply Analysis | Locations and dischargers along the SAR | Map of recycled water facilities in the SARW | Various Agencies |
| Agency Service Area | Spatial Analysis/Population Projections | Mapping of Agency Service Areas and Boundaries | Map of Agency Service Areas in the SARW and surrounding areas | UWMP/Retail Agencies |
| Watershed Delineations | Spatial Analysis | Sub-Watershed delineations within the SAR | Used in evaluation of more focused planning | Various Agencies |
| Desalination Plants | Spatial Analysis/Desalination Capacities/Quality | Mapping of Desalination Plants | Map of Desalination Plants in the SARW | Various Agencies |
| Regional Infrastructure | Spatial Analysis/Water Supply Analysis | Mapping of Regional Water Infrastructure and Supply Opportunities | Map of Regional Infrastructure and the outlets in the SARW | Member Agencies |
| Surface Water | Water Quality/Spatial Analysis | Mapping of Surface Water | Mapping of surface water sources in the SARW | RWQCB, Santa Ana Basin Plan |
| Imported Water Infrastructure | Spatial Analysis/Economic Impacts | Mapping of Metropolitan Water District (MWDSC) Imported Water Infrastructure | Mapping of MWDSC Imported Water Infrastructure in the SARW | MWDSC Regional Plans |
| Fault Lines | Spatial Analysis/Infrastructure Risk Analysis | Mapping of fault lines with water infrastructure | Mapping of fault lines and water infrastructure | US Geological Survey (USGS) |
| Delta Smelt Impacts | Water Supply Projections | Projections of water supply affected by the | Water import projections for Chapter 5.4 | MWDSC |

| Data or Study | Analysis Method | Results | Use in IRWM Plan | Source |
|---|---|---|---|---|
| | | Delta Smelt impacts | | |
| Impaired Water Bodies (303-D List) | Water Quality Analysis | Mapping of impaired water bodies in the SARW | Mapping the impaired water bodies in the SARW | 303-D List |
| TMDL Projects | Water Quality Analysis | Mapping of TMDL projects in the SARW | Map of TMDL Projects in the SARW | Various Agencies |
| Invasive Species | Habitat/Spatial Analysis | Mapping of areas affected by Invasive Species | Map and analysis of the effects of invasive species | Santa Ana Watershed Association (SAWA) |
| Water Quality Objectives | Water Quality Analysis | Mapping of water quality objectives in the SARW | Map and analysis of water quality objectives. | RWQCB, Santa Ana Basin Plan |
| Seawater Intrusion Zones | Water Quality/Spatial/Water Supply /Projections | Mapping of basins in danger of Saltwater Intrusion and the effects on supply | Map and analysis of potential seawater intrusion zones | Orange County Water District (OCWD) |
| Dam Locations | Spatial Analysis | Mapping of dams and weirs | Maps and sediment loading potential regarding dams | Various Agencies |
| Santa Ana River Trail | Habitat/Recreational Spatial Analysis | Mapping of recreation opportunities along the SAR | Map of the Santa Ana River Trail | Various Agencies |
| Temperature | Climate Analysis | Mapping of temperature zones throughout the SARW | Map and analysis of temperature data throughout the SARW | U.S. Bureau of Reclamation (Reclamation) |
| Groundwater Plume Maps | Spatial Analysis/Water Quality Analysis | Mapping of contaminated GW due contamination plumes | Map and analysis of contaminated groundwater basins/plumes | Various Agencies |

## Plan Performance and Project Support Tools

SAWPA has developed a number of tools to facilitate the evaluation, dissemination and integration of data to track plan performance as well as new tools to support project proponents in collaboration and evaluating multiple resources necessary to develop new regional projects. The emphasis of tool development is to support the achievement of the OWOW plan objectives at both the plan and project implementation levels. Most of these tools were developed in-house by SAWPA staff. However, several tools also reflect the collaborative work of SAWPA and others. The watershed assessment tool was developed by SAWPA working closely with the Council for Watershed Health and Dr. Fraser Shilling, UC Davis. New project support tools to support climate change adaptation and mitigation were developed by the Reclamation, based on a funding partnership with SAWPA for the OWOW 2.0 Plan. The Reclamation tools were designed such that project proponents as well as the general public could evaluate the projected climate change impacts in the Santa Ana River Watershed as well as adaptation and mitigation measures to deal these changing conditions. It is anticipated that these tools can be effectively adapted to other IRWM regions and users across the State.

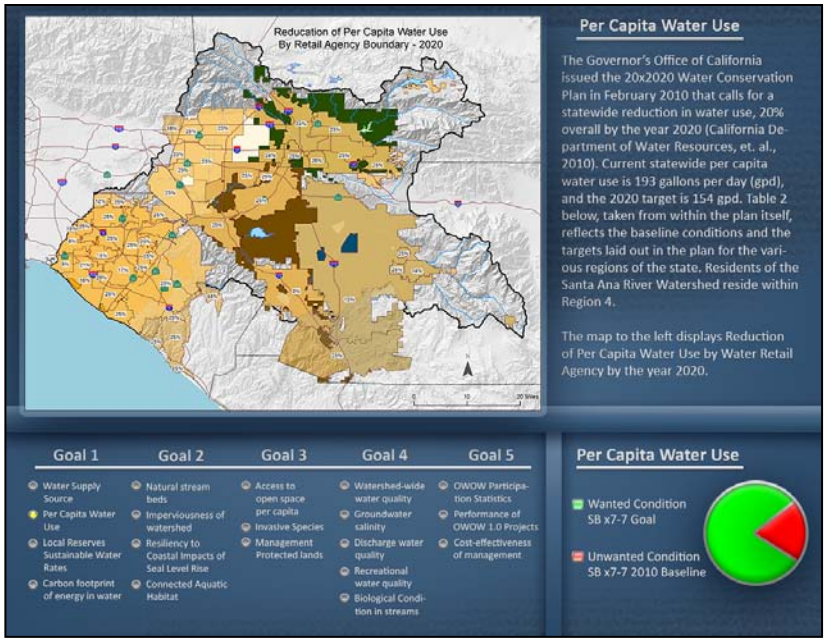
Many of the tools were designed to provide the user access to forms or data through graphical user interface (GUI) supported by Graphical information System (GIS) map layers and rely on the use of electronic reporting linked to a sequel database. It is intended that these tools will be further enhanced and expanded in the context of the OWOW Plan, as more and better data becomes available. With this information, SAWPA will be able to track the watershed's progress in meeting OWOW 2.0 goals, as well as, be responsive to opportunities to expand regional planning.

## Watershed Assessment Framework and Tool

With the implementation of integrated projects and programs seeking to achieve a sustainable watershed, SAWPA early in the OWOW 2.0 planning scoping recognized the need for a common method of measuring progress on meeting the goals and objectives as well as the health of the Santa Ana River Watershed. SAWPA engaged the services of the Council for Watershed Health, a nonprofit organization, and Dr. Fraser Shilling of UC Davis to develop a watershed assessment framework for the Santa Ana River Watershed. Based on their experience with developing methodology for a Watershed Assessment Framework (WAF) using the Arroyo Seco watershed in the Los Angeles County and their work on developing a similar project for the State on the California Water Plan 2013 Update, the Council and Dr. Shilling were able to work with the Pillar workgroups to update the watershed management goals, establish planning targets or wanted conditions for the watershed and utilize data indicators or metrics from existing datasets or data collection efforts to track progress. With the input of SAWPA staff, a new tracking computer tool was created incorporating this work that will allow managers to evaluate and assess progress and assure actionable results for implementation.

SAWPA, working with their stakeholders, developed an interface to display the goals, indicators and results for SAWPA's OWOW 2.0 watershed assessment tool.

**Figure 9-1 Watershed Assessment Tool**




This interface provides the user a menu of watershed management goals and related indicators established for SAWPA's OWOW 2.0 watershed assessment. The user can select from this menu indicators that were used in the watershed assessment. When an indicator is selected, the screen updates to provide an in depth evaluation of the indicator, data employed and watershed score.

The tool includes the following features:

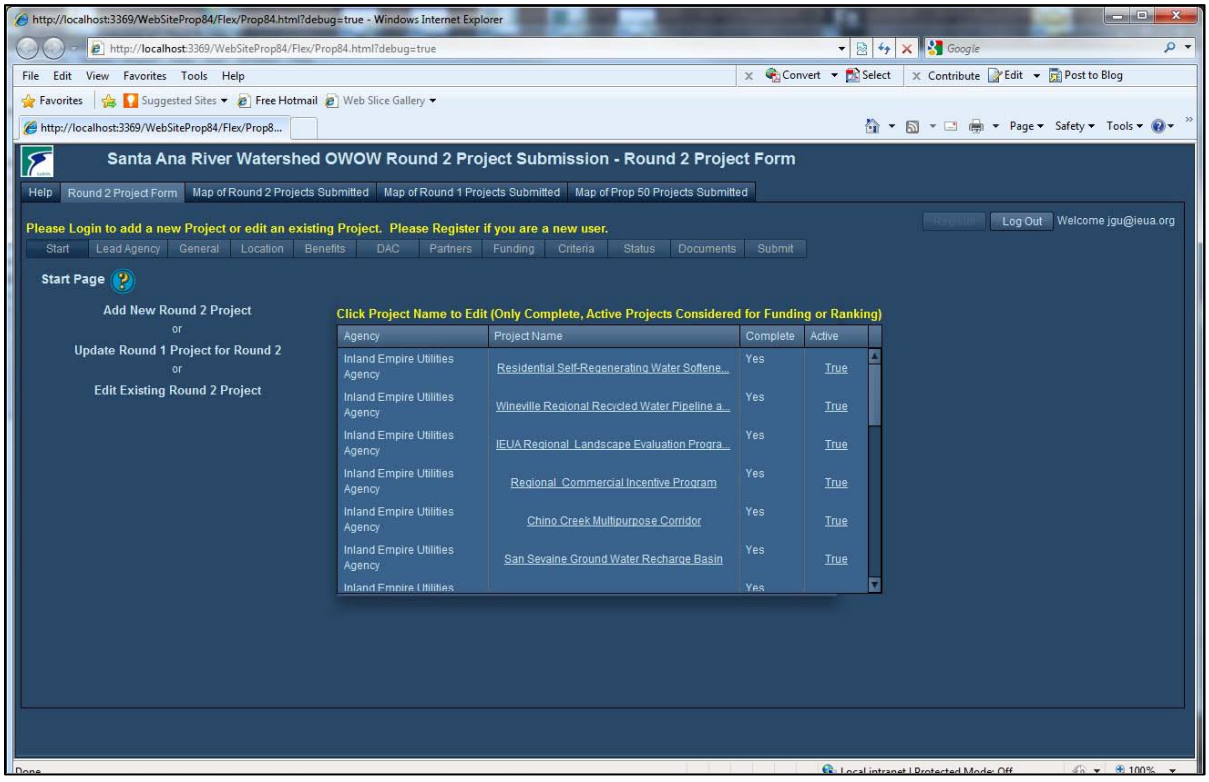
- Indicator narrative describing: What is it, Why it is important, Target or desired condition, Stress condition, Basis of calculation and use, What did we find out/How are we doing, How sure are we about our findings, Technical Information and Analysts
- Thematic map displaying the available spatial data
- Watershed assessment score

Using this assessment tool, SAWPA now has an effective, efficient and responsive ongoing monitoring program for the watershed. A report synopsis of the indicators selected for each goal, and what the analysis told us about the watershed is included in the **Appendix A**.

## OWOW 2.0 Project Application Form

OWOW 2.0 Project Application Form was developed by SAWPA staff to provide stakeholders an on-line form for the submittal of project proposals for Proposition 84 Round 2 funding.

**Figure 9-2 Project Application Form**




The OWOW 2.0 Project Application Form includes key information required to address the goals of SAWPA's OWOW 2.0 IRWM Program, as well as DWR's Proposition 84 Round 2 grant program. Access to the form requires the user to register and the account is password protected.
Key information included in the form includes:

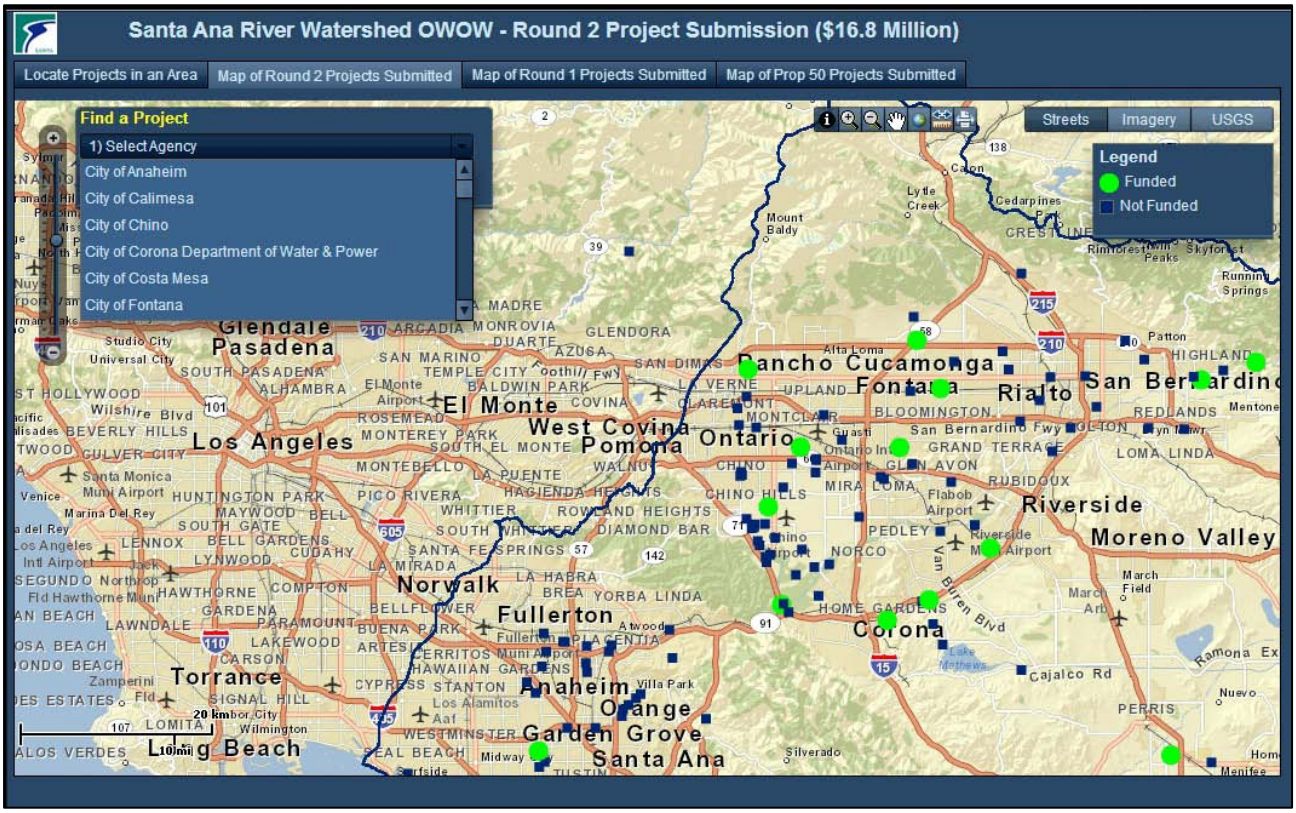
- Lead Agency Contact Information
- Project Location
- Project Benefits
- Disadvantaged Community and Tribal Support
- Project Funding
- Project Partners
- Project Status
- Attachments

Additionally, this on-line form provides the user the ability to import information from earlier proposal submissions.

## OWOW 2.0 Submitted Project Map

OWOW 2.0 Submitted Project Map was developed by SAWPA staff to provide stakeholders a tool to identify and review other project proposals submitted for Proposition 84 Round 2 funding. In addition, the tool serves as a tool to assist project proponents with a tool identify potential project partners.

**Figure 9-3 Submitted Project Map**

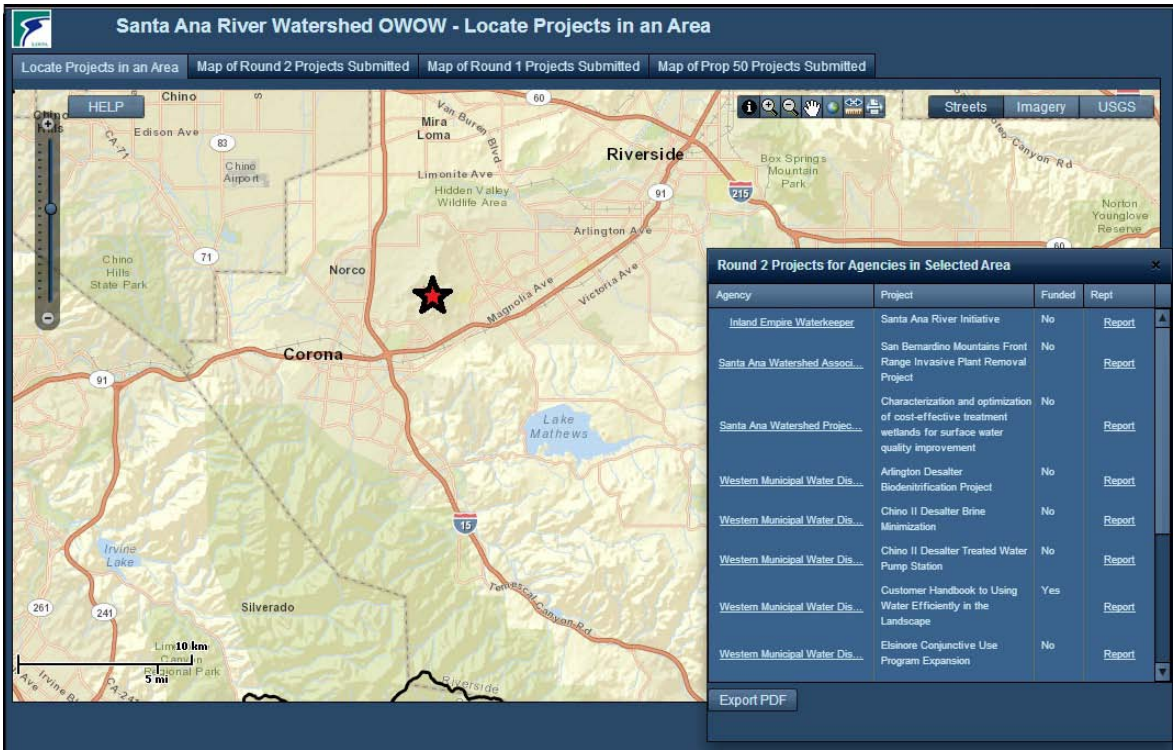



The Project Map identifies the location of each project submitted for Proposition 84 Round 2 funding. The user simply clicks on a project marker and a pop-up window is activated displaying a PDF copy of the completed OWOW 2.0 Project Application Form. Additionally, by hovering over a project marker, the user will be able to view the name of the project applicant.

## OWOW 2.0 Project Partner Locator

OWOW 2.0 Project Partner Locator was developed by SAWPA staff to provide stakeholders a tool to identify potential project partners for the development of regional integrated watershed projects.

**Figure 9-4 Project Partner Locator**




The user simply clicks on the map and a pop-up window is activated displaying agencies whose service area overlaps the proposed project area.

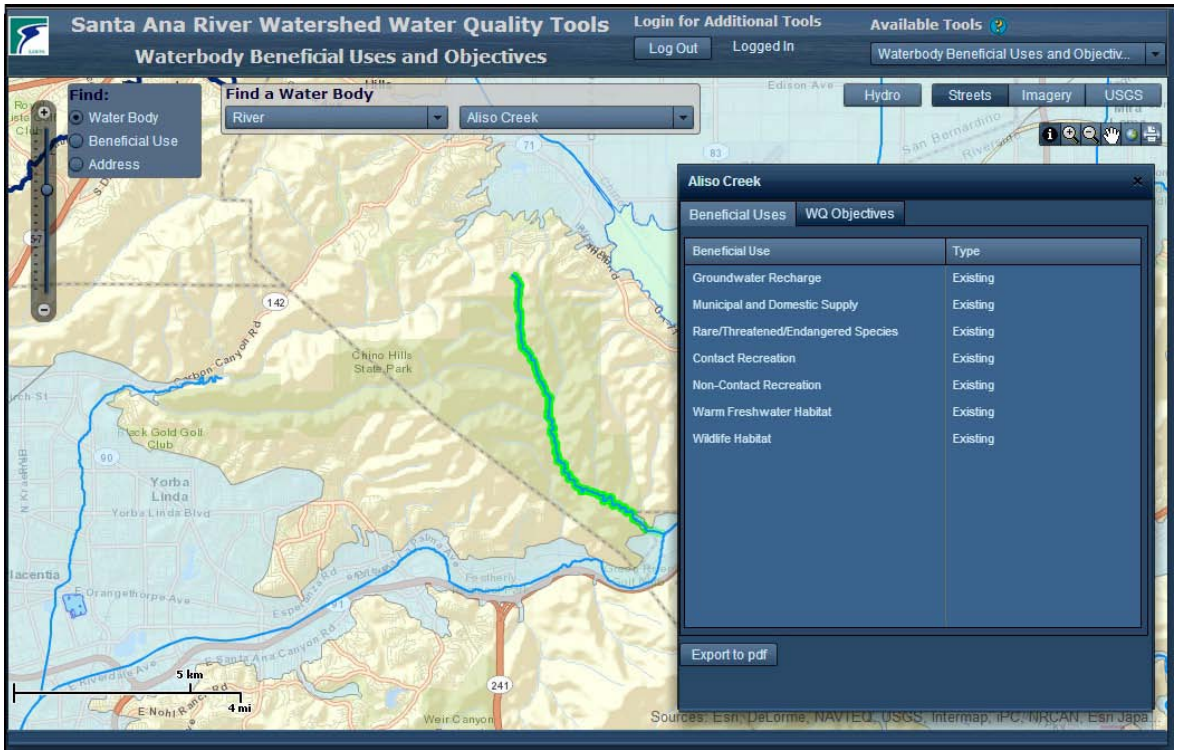
## Santa Ana River Watershed Water Quality Tools

SAWPA partnering with the Santa Ana RWQCB and local stakeholders have developed a suite of tools to provide water planners and the public access to Basin Plan information relating to designated beneficial uses, water quality objectives and water quality data for waterbodies within the Santa Ana Watershed.

## Waterbody Beneficial Uses and Water Quality Objectives

SAWPA partnering with the Santa Ana RWQCB has developed an interactive web application to explore hydrologic features and regulatory criteria established for waterbodies within the Santa Ana Watershed Basin Plan.

**Figure 9-5 Waterbody Beneficial Uses and Objectives**




This tool provides the user the ability to search a map of the Santa Ana River Watershed to identify a particular hydrologic feature, waterbody beneficial use or street address through a series of searchable menus or by simply clicking on a particular map feature.

Searching by waterbody type activates a set of pull-down menus. The first pull-down menu lists waterbody types including: bays, lakes, rivers, wetlands and groundwater management zones. The second includes a list of each named waterbody of that type identified in the Santa Ana River Watershed Basin Plan. When the user selects a waterbody, a pop-up window is activated displaying applicable beneficial uses and water quality objectives.

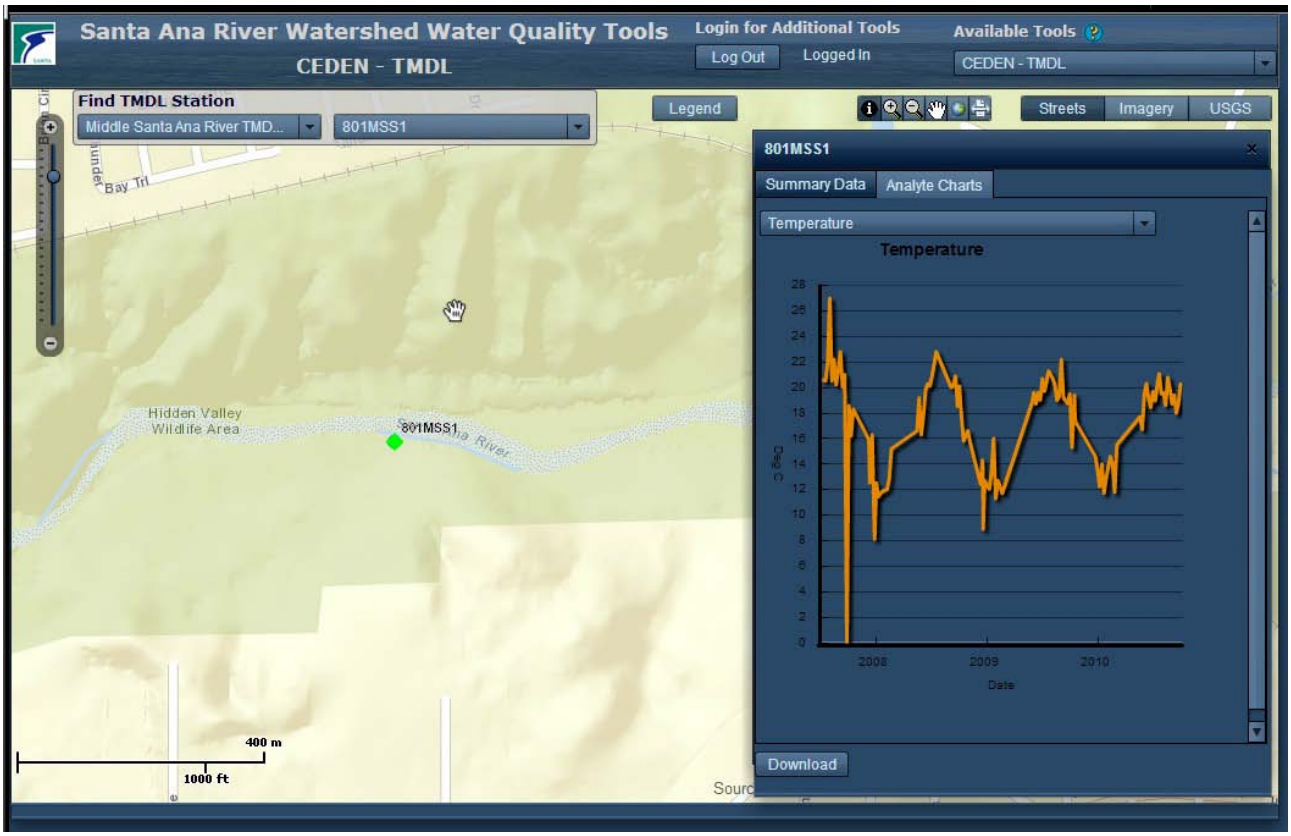
Searching by beneficial use activates a of pull-down menu of beneficial uses types identified in the Santa Ana River Watershed Basin Plan. When the user selects a beneficial use, each waterbody with that particular beneficial use is activated throughout the watershed. Selecting a waterbody activates a pop-up window displaying applicable beneficial uses and water quality objectives.

Additional features of this application include the ability to turn on/off waterbody features, export waterbody data to a PDF file, capture information from the screen and print to a PDF file, and multiple map backgrounds including: street map, satellite imagery and USGS quad.

## Water Quality Monitoring Data Tool

SAWPA partnering with the Santa Ana Regional Water Quality Control Board has developed an interactive web application to examine surface water quality data for TMDL monitoring locations within the Santa Ana Watershed Basin Plan.

**Figure 9-6 Watershed  Water Quality Tools**




This tool provides the user the ability to search monitoring locations by regulatory program through a series of searchable menus or by simply clicking on a particular monitoring location within the Santa Ana River Watershed.  Current data available includes watershed-wide monitoring data collected through the Lake Elsinore and Canyon Lake nutrient and the Middle Santa Ana River pathogen TMDL programs. Data available in this application is updated on a weekly basis and served through a datamart connection established with CEDEN, managed by the California State Water Resources Control Board (SWRCB).

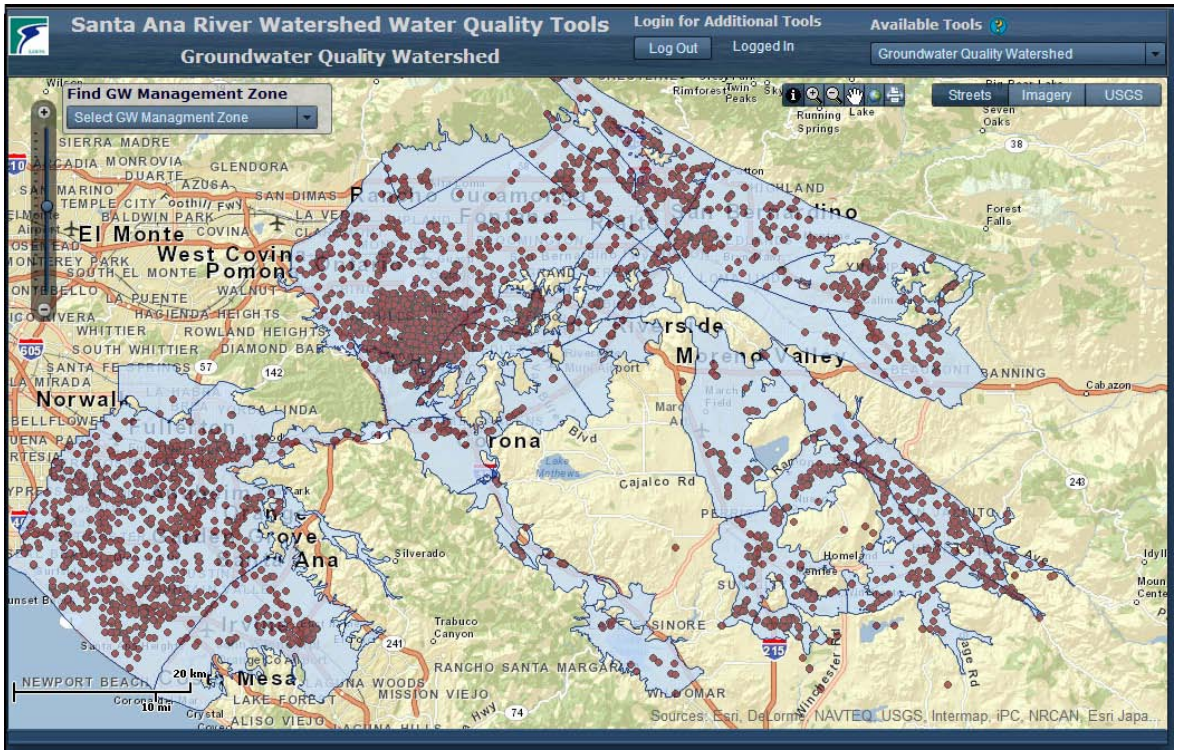
Searching by project activates a of pull-down menu listing regularly monitored stations. Selecting a particular monitoring station zooms the map to the selected location and activates a pop-up window with a series of tabs.  The first tab includes a summary of available data collected at that monitoring location including: list of analytes, average result, unit of measure, number of samples and date range. A second tab includes a chart tool, which provides the user the ability to select an analyte from a pull-down menu to view available time series data graphically.

Additional features of this application include the ability to turn export waterbody data to a PDF file, capture information from the screen and print to a PDF file, and multiple map backgrounds including: street map, satellite imagery and USGS quad.

## Ambient Groundwater Quality Tool

SAWPA partnering with the Santa Ana RWQCB has developed an interactive web application to examine summary groundwater quality data by groundwater management zones within the Santa Ana Watershed Basin Plan.

**Figure 9-7 Groundwater Quality**




This tool provides the user the ability to view groundwater quality data summarized by groundwater management zone as reported in the Recomputation of Ambient Water Quality in the Santa Ana River Watershed for TDS and NO3-N for the past 20 year well data collection period. The user can examine summary groundwater management zone data through a searchable menu or by simply clicking on a particular Santa Ana River Watershed groundwater management zone. Selecting a particular groundwater management zone "zooms" the map to the selected location and activates a pop-up window with a series of tabs.

The first tab includes a summary of available data collected at that monitoring location including: list of analytes, average result, unit of measure, number of samples and date range. A second tab includes a graph of available TDS time series data plotted against its water quality objective. A third tab includes a

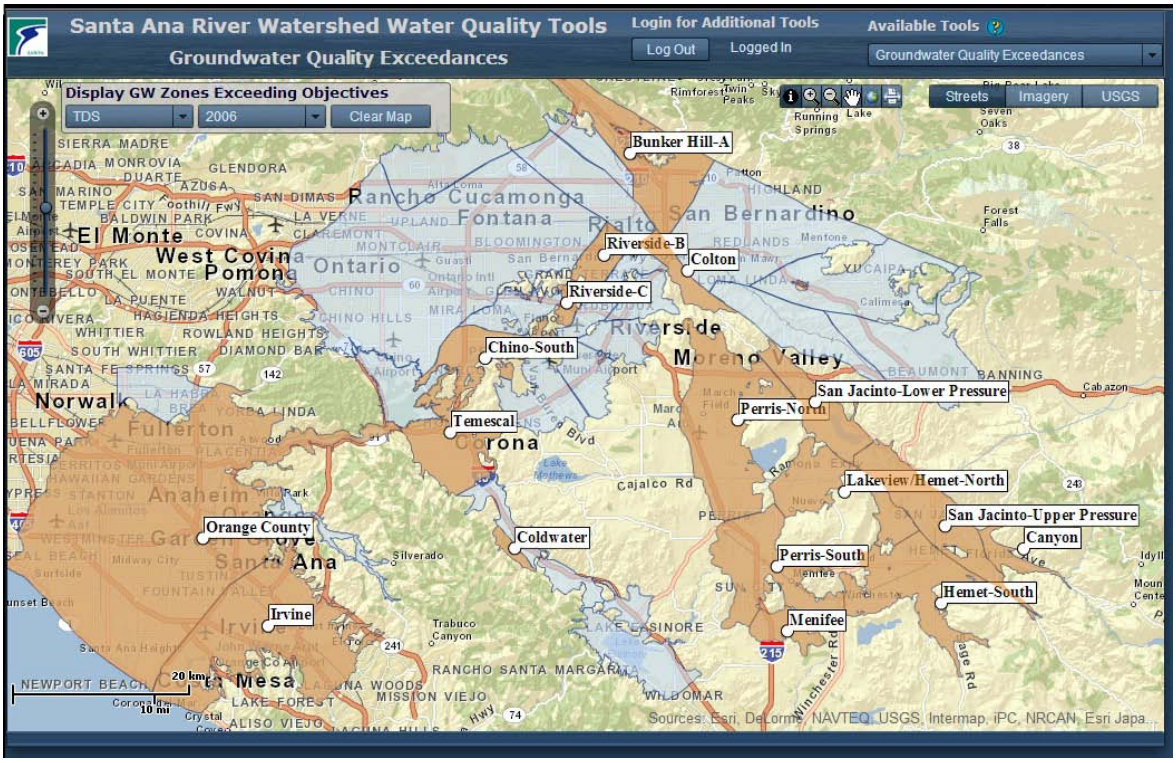
graph of available NO3-N time series data plotted against its water quality objective. A fourth tab includes a chart tool, which provides the user the ability to select an analyte from a pull-down menu to view available time series data graphically.

Additional features of this application include the ability to turn export waterbody data to a PDF file, capture information from the screen and print to a PDF file, and multiple map backgrounds including: street map, satellite imagery and USGS quad.

## Groundwater Basins Water Quality Modeling Tool

SAWPA partnering with the SWRCB has developed an interactive web application to examine exceedences to groundwater quality objectives for TDS and NO3-N by groundwater management zone within the Santa Ana Watershed Basin Plan.

**Figure 9-8 Groundwater Quality Exceedances**



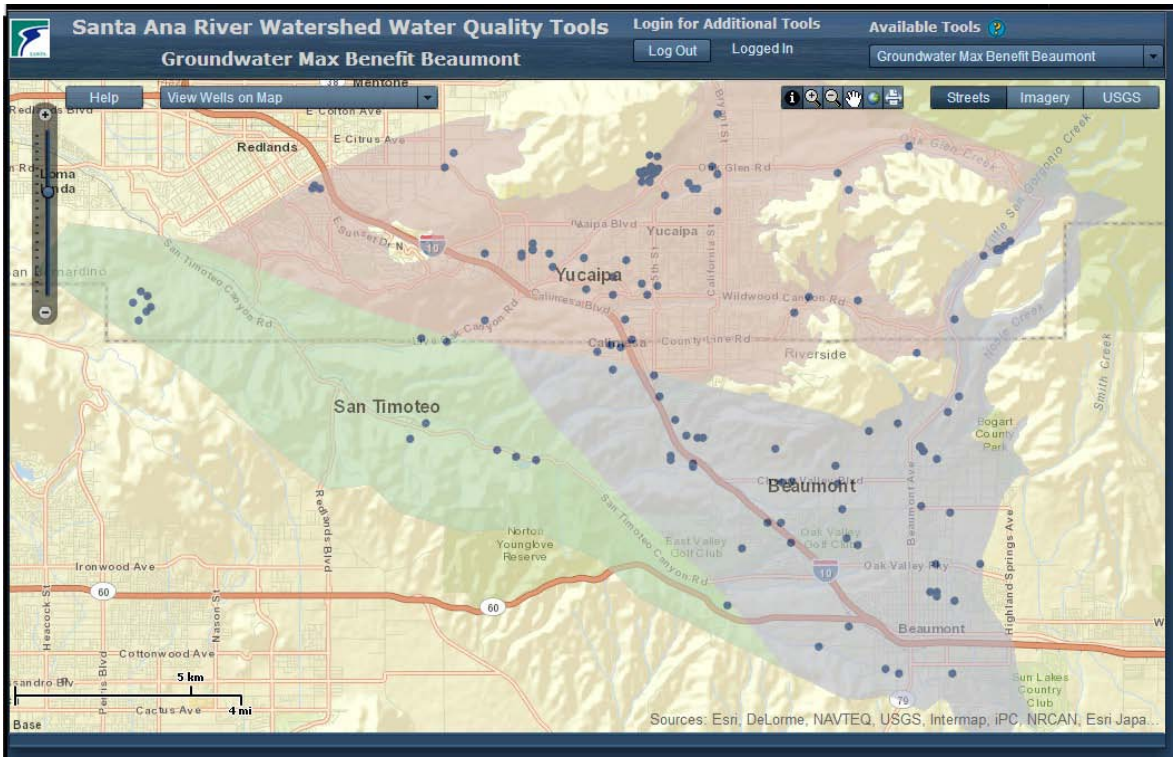

This tool provides the user the ability to view exceedences to groundwater quality objectives for TDS and NO3-N as reported by the Triennial Recomputation of Ambient Water Quality in the Santa Ana Watershed Reports. The user can identify groundwater management zones exceeding groundwater quality objectives for TDS and NO3-N through a series of pull-down menus by selecting between TDS and NO3-N and then selecting a year. After the selections are made, the map refreshes highlighting and naming the groundwater management zones with exceeding the selected groundwater quality objective for the selected year.

Additional features of this application include the ability to turn export waterbody data to a PDF file, capture information from the screen and print to a PDF file, and multiple map backgrounds including: street map, satellite imagery and USGS quad.

## Groundwater Basins Maximum Benefit Water Quality Modeling Tool (DRAFT)

SAWPA partnering with the Santa Ana RWQCB is working to develop an interactive web application to examine exceedences to the max benefit groundwater quality objectives for TDS and NO3-N in the Beaumont groundwater management zone within the Santa Ana River Watershed.

**Figure 9-9 Groundwater Maximum Benefit**




This tool provides the user the ability to examine water quality relating to max benefit groundwater quality objectives for TDS and NO3-N for the Beaumont groundwater management zone as reported in the 2011, Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1990 to 2009. A pull-down menu provides the user the following options to evaluate well data in the Beaumont groundwater management zone.

**NO3-N Exceeding BU Objective** – highlights wells exceeding the max benefit groundwater quality objective NO3-N in the Beaumont groundwater management zone

**NO3-N Concentration Range** – view provides a color ramp of NO3-N water quality for all wells

**TDS Exceeding BU Objective** – highlights wells exceeding the max benefit groundwater quality objective TDS in the Beaumont groundwater management zone

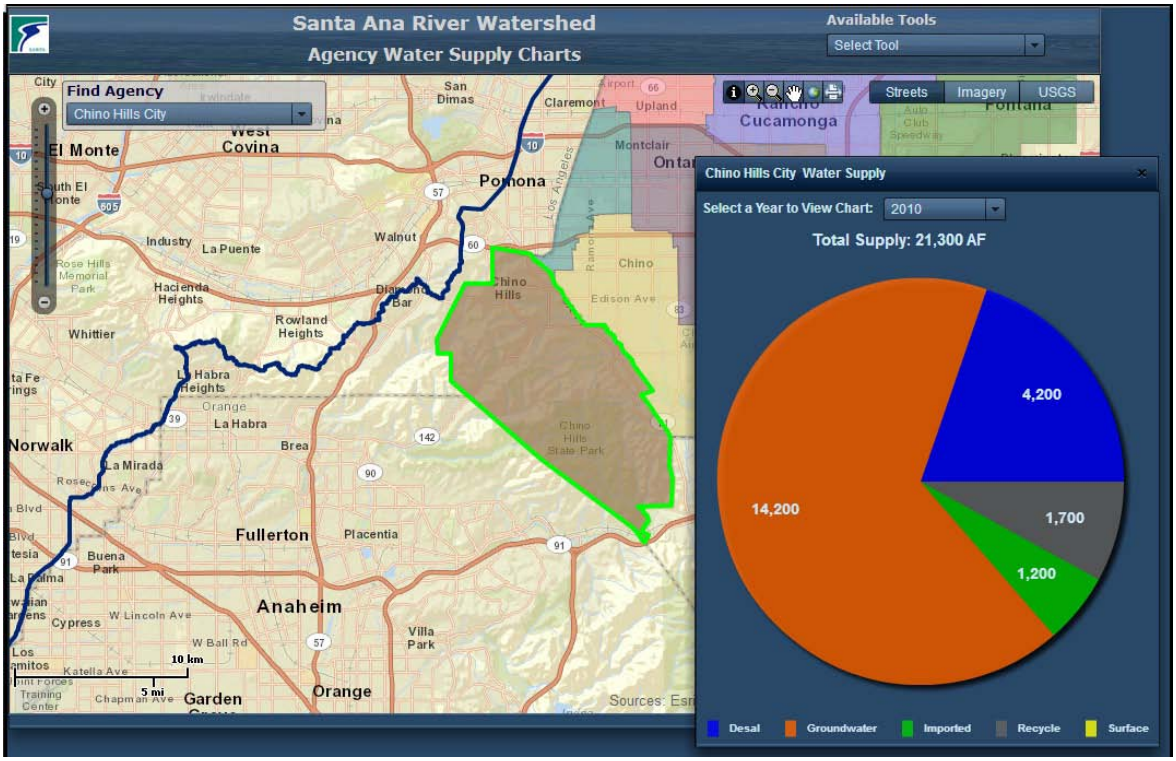
From any of these views, the user can select a highlighted well. This zooms the map to the selected location and activates a pop-up window displaying a summary of TDS and NO3-N water quality data.

Additional features of this application include the ability to turn export waterbody data to a PDF file, capture information from the screen and print to a PDF file, and multiple map backgrounds including: street map, satellite imagery and USGS quad.

## Pilot - Water Resource Management Tool

SAWPA partnering with DWR and Esri is working to develop an interactive web application to review and analyze water resources data for water purveyors operating in the Santa Ana River Watershed.

**Figure 9-10 Agency Water Supply Charts**

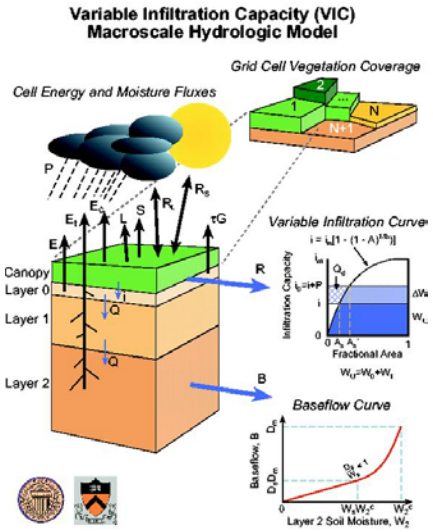



This tool will provide water planners a tool to assess data related to various sources of water supply, and water use, as well as, a number of other related water resource information for the Santa Ana River Watershed. This includes the ability to display, explore and analyze water resources data at a number of levels (agency, basin, watershed) and management scenarios projected over a 20-year planning horizon. The tool is anticipated to be on-line in 2014.

The completed tool will consider the following components:

- Water Retailers and Wholesalers

- Imported Water
- Groundwater withdrawals and recharge
- Water recycling
- Wastewater flows
- Conservation
- Surface withdrawals
- Water Use
- Planned Water Resource projects

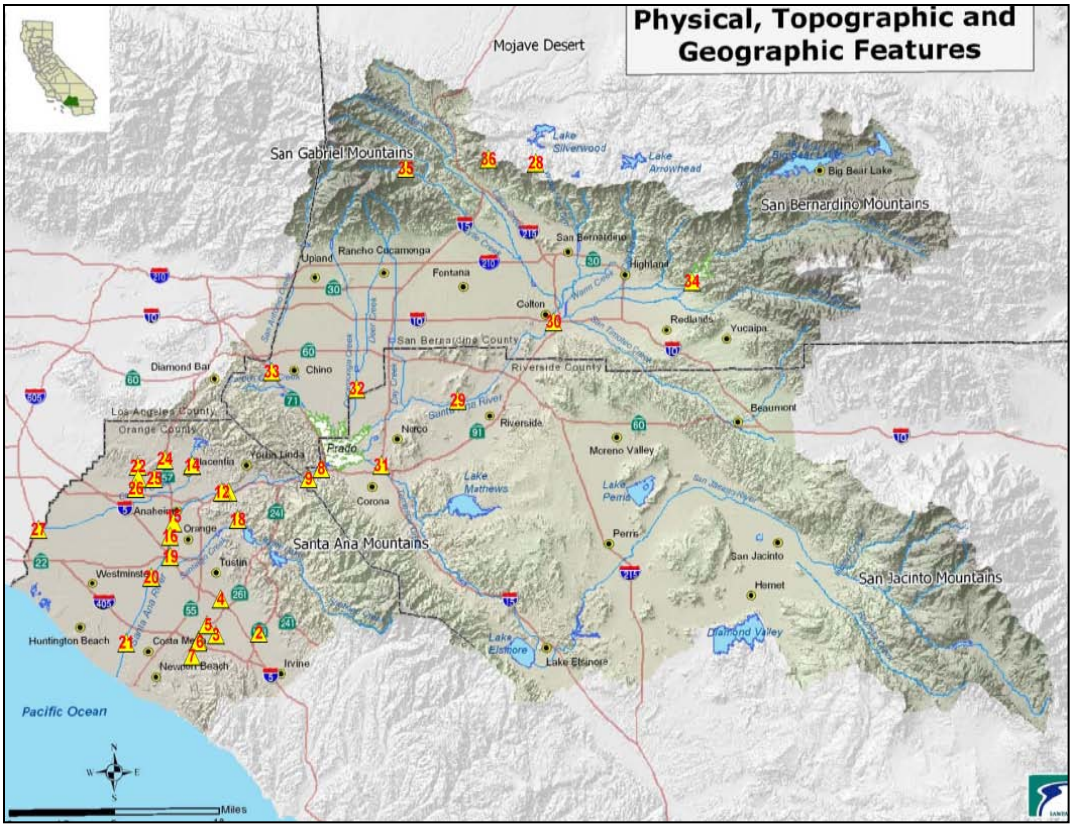



## Climate Change Model

A partnership between SAWPA and Reclamation has produced an interactive climate change modeling tool to provide water planners with information on potential impacts of climate change within the Santa Ana River Watershed. The main objective of this particular tool is to develop a simplified modeling framework for evaluating climate change impacts on surface flows, temperature, snow melt, storm flow and groundwater levels and to apply this framework to evaluate potential impacts of climate change as well as mitigation/adaptation alternatives. The Climate Change tool enables the user to explore, identify and download custom climate change data for various scenarios modeled for the Santa Ana River Watershed. Recognizing the importance of potential impacts of climate change in the future, the tool will allow planners to foresee possible issues avoiding misallocation of resources and funds.

While this tool proves to be very useful to agencies within the Santa Ana River Watershed there are still some steps that Reclamation and SAWPA are taking in order to make it even more effective. This includes data refinement, model refinement, cross validation, and sea level rise information. All of these steps target any future issue or potential impact that climate change might have within the Santa Ana River Watershed.

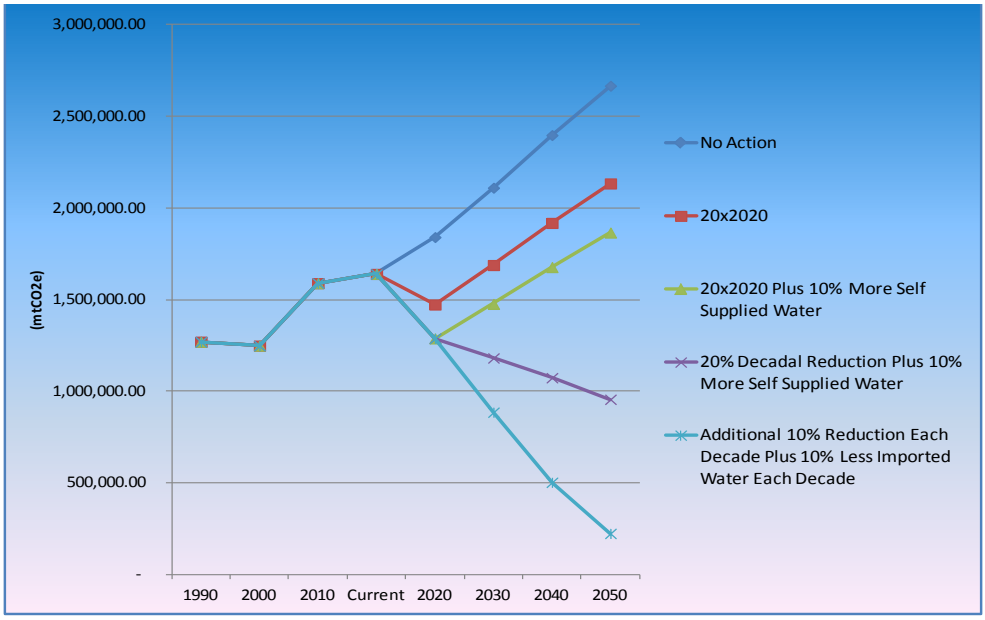
**Figure 9-11 Physical, Topographic and Geographic Features within the SARW**




## Green House Gas Modeling Tool

Reclamation, working with SAWPA, developed an interactive green house gas emissions modeling tool to provide water planners and the public information about the impacts of green house gases on water resources within the Santa Ana Watershed. This tool enables the user to explore, identify and download custom green house gas data for a suite of water technologies modeled for the Santa Ana River Watershed. It will also exhibit energy consumption in the delivery and treatment process with relation to water. In accordance with AB – 32 (Assembly Bill) which requires regions within California to reduce their overall GHG emission, the tool also evaluates both the supply and demand of water in the Santa Ana River Watershed. This tool will prove to be very useful within the watershed because it allows agencies and SAWPA alike to use the calculator for different types of scenarios which can be used to compare each outcome and result. Further, the tool can be adapted to individual projects and is anticipated for use in future GHG emissions calculations by project proponents

**Figure 9-12 GHG Emissions Scenario Comparison**




### Groundwater Basins Water Quality Modeling Tool

In partnership with SAWPA and Reclamation, an interactive groundwater modeling tool was developed to allow planner and other entities to identify potential impacts of climate change on groundwater resources within the Santa Ana River Watershed. The tool will enable the user to explore, identify and download groundwater data for various climate change scenarios modeled for the Santa Ana River Watershed. This data includes but is not limited to groundwater elevation, basin-average precipitation and potential ET, stream flows, M&I demand, agricultural demand, and augmented supplies. Utilization of this tool provides many different types benefits, the user is able to apply information the project might need in order to account for any future climate change scenarios. This is an important part of the project process, since an agency/public is able to identify problematic situations now they will be able to avoid or deal with them in the future. This tool at this time reflects four general groundwater management regions as defined by DWR for the watershed and is currently still under development.

## OWOW Watershed Outreach Tools

SAWPA's technical approach for public outreach required a broad application of current technologies due to the difference in skill sets of the watershed audience. The demographics of this audience ranged from users who relied on the telephone (land line) for information to mobile users comfortable with Twitter. The middle ground in regards to user's technology comfort zone was the web itself. SAWPA's approach relied on three distinct technologies, the Web, Email, and Telephony, to best meet the user's abilities to receive information.

The Web provided SAWPA with several avenues of outreach. The first avenue being SAWPA's own website and SAWPA's ability to quickly modify and create pages dedicated to the OWOW process. Even the home page provided immediate announcements and directions for further information. The second avenue was a Water Blog linked to the SAWPA home page that provided additional information on a wide range of water topics, often supporting current issues or related projects. The third avenue was allowing users access through the web to project forms, project reports, and interactive GIS Tools. This

provided users with additional information on all projects and water issues thru these reports and the use of the GIS Tools. The fourth avenue was providing profile sites for users to locate SAWPA and the OWOW planning process on Facebook and LinkedIn.

Telephony provided watershed users with the ability to dial in and provide input to many of the OWOW meetings that occurred at SAWPA. The use of a free audio bridge along with web enabled presentation tool allowed users to call in anywhere in the watershed and participate in the planning process. On the mobile side, the use of Twitter provided users with quick announcements and links to recently published documents, invitations to events, and current projects in the watershed.

These methods of outreach provided the multifaceted audience with up-to-date information while using technology they were comfortable with. Technology use and its methods are constantly being reviewed during the OWOW process and will be updated to further increase the watershed audience.

SAWPA's social media tool kit could include:

- Home base (Water Blog)
- Social conversation site (Twitter)
- Social profile site (Facebook) (B2C)
- Business profile (LinkedIn) (B2B)
- Search Tools (i.e., Google Blogs search or Technorati)

As efforts in a particular area grow, additional tools may need to be added (i.e., listening, social bookmarking, and photo sharing tools).

## Other Social Outreach Tools

### Watershed-Wide Master Calendar

The Watershed-wide master calendar was launched on January 15, 2012. Information about the watershed-wide calendar was sent out to the entire OWOW Constant Contacts data base announcing the new watershed-wide calendar and inviting outside agencies to post their agency's events onto this interactive master regional calendar. Participants may obtain passwords to input their events by contacting the IT Department.

As further refinements are made, the calendar will contain links to the respective agencies' websites (i.e., download registration information etc.) thus creating a helpful resource tool to all stakeholders. It is intended that the calendar will be a "go-to" place to check out watershed-wide events. Event postings will be promoted through in Linked In, Twitter, and Facebook posts every time an announcement or significant event is added.

In the early stages of development and implementation, most likely SAWPA staff will need to add and monitor the events on this calendar until outside interest and momentum are deemed acceptable and the calendar becomes self-sufficient. If this step is overlooked, the calendar's possible fate could be jeopardized immediately after launching. It is important to designate a staff member to monitor and remove outdated events that outside event planners do not remove. This staff member should monitor on a weekly basis posted events and remove any outdated events.

This tool will be in addition to the normal SAWPA in-house events/meetings calendar already posted on the SAWPA website.

## Mass Emails

Mass emails are authorized by the General Manager prior to release. Every time a mass email is sent, Constant Contact provides an opportunity to send out that same message as a social media message concurrently to Linked In, Twitter and Facebook by utilizing Constant Contact's "Simple Task" option. This additional option should be incorporated as "normal" procedure when sending out future mass emails. By sending social media messages when sending out mass emails, SAWPA's social media presence could be further enhanced.

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FOR THE COUNTY OF SAN BERNARDINO

CHINO BASIN MUNICIPAL WATER DISTRICT,

Plaintiff,

v.

CITY OF CHINO, et al.

Defendants

No. RCV 51010[1]

# RESTATED JUDGMENT

[1] Original Judgment signed January 27, 1978, Case # 164327 by Judge Howard B. Weiner. File transferred August 1989, by order of the Court and assigned new case number RCV 51010.

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SUPERIOR COURT OF THE STATE OF CALIFORNIA
FOR THE COUNTY OF SAN BERNARDINO

| | |
|---|---|
| CHINO BASIN MUNICIPAL WATER DISTRICT,<br><br>Plaintiff,<br><br>v.<br><br>CITY OF CHINO, et al.<br><br>Defendants | No. RCV 51010[2]<br><br><br><br><br><br>JUDGMENT |

## I. INTRODUCTION

1. Pleadings, Parties and Jurisdiction. The complaint herein was filed on January 2, 1975, seeking an adjudication of water rights, injunctive relief and the imposition of a physical solution. A first amended complaint was filed on July 16, 1976. The defaults of certain defendants have been entered, and certain other defendants dismissed. Other than defendants who have been dismissed or whose defaults have been entered, all defendants have appeared herein. By answers and order of this Court,

[2] Original Judgment signed January 27, 1978, Case # 164327 by Judge Howard B. Weiner. File transferred August 1989, by order of the Court and assigned new case number RCV 51010.

the issues have been made those of a full inter se adjudication between the parties. This Court has jurisdiction of the subject matter of this action and of the parties herein.

2. Stipulation For Judgment. Stipulation for entry of judgment has been filed by and on behalf of a majority of the parties, representing a majority of the quantitative rights herein adjudicated.

3. Trial; Findings and Conclusions. Trial was commenced on December 16, 1977, as to the non-stipulating parties, and findings of fact and conclusions of law have been entered disposing of the issues in the case.

4. Definitions. As used in this Judgment, the following terms shall have the meanings herein set forth:

(a) Active Parties. All parties other than those who have filed with Watermaster a written waiver of service of notices, pursuant to Paragraph 58.

(b) Annual or Year –- A fiscal year, July 1 through June 30, following, unless the context shall clearly indicate a contrary meaning.

(c) Appropriative Right –- The annual production right of a producer from the Chino Basin other than pursuant to an overlying right.

(d) Basin Water –- Ground water within Chino Basin which is part of the Safe Yield, Operating Safe Yield, or replenishment water in the Basin as a result of operations under the Physical Solution decreed herein. Said term does not include Stored Water.

(e) CBMWD –- Plaintiff Chino Basin Municipal Water District.

(f) Chino Basin or Basin –- The ground water basin underlying the area shown as such on Exhibit “B” and within the boundaries described in Exhibit “K”.

(g) Chino Basin Watershed –- The surface drainage area tributary to and overlying Chino Basin.

(h) Ground Water –- Water beneath the surface of the ground and within the zone of saturation, i.e., below the existing water table.

(i) Ground Water Basin –- An area underlain by one or more permeable formations capable of furnishing substantial water storage.

(j) Minimal Producer –- Any producer whose production does not exceed **ten** acre-feet per year. [3]

(k) MWD –- The Metropolitan Water District of Southern California.

(l) Operating Safe Yield –- The annual amount of ground water which Watermaster shall determine, pursuant to criteria specified in Exhibit "I", can be produced from Chino Basin by the Appropriative Pool parties free of replenishment obligation under the Physical Solution herein.

(m) Overdraft –- A condition wherein the total annual production from the Basin exceeds the Safe Yield thereof.

(n) Overlying Right –- The appurtenant right of an owner of lands overlying Chino Basin to produce water from the Basin for overlying beneficial use on such lands.

(o) Person. -- Any individual, partnership, association, corporation, governmental entity or agency, or other organization.

(p) PVMWD –- Defendant Pomona Valley Municipal Water District.

(q) Produce or Produced –- To pump or extract ground water from Chino Basin.

(r) Producer –- Any person who produces water from Chino Basin.

(s) Production –- Annual quantity, stated in acre feet, of water produced.

(t) Public Hearing –- A hearing after notice to all parties and to any other person legally entitled to notice.

(u) Reclaimed Water – Water which, as a result of processing of waste water, is suitable for a controlled use.

(v) Replenishment Water –- Supplemental water used to recharge the Basin pursuant to the Physical Solution, either directly by percolating the water into the Basin or

[3] Order dated September 27, 2001.

indirectly by delivering the water for use in lieu of production and use of safe yield or Operating Safe Yield.

(w) Responsible Party –- The owner, co-owner, lessee or other person designated by multiple parties interested in a well as the person responsible for purposes of filing reports hereunder.

(x) Safe Yield –- The long-term average annual quantity of ground water (excluding replenishment or stored water but including return flow to the Basin from use of replenishment or stored water) which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result.

(y) SBVMWD –- San Bernardino Valley Municipal Water District.

(z) State Water –- Supplemental Water imported through the State Water Resources Development System, pursuant to Chapter 8, Division 6, Part 6 of the Water Code.

(aa) Stored Water –- Supplemental water held in storage, as a result of direct spreading, in lieu delivery, or otherwise, for subsequent withdrawal and use pursuant to agreement with Watermaster.

(bb) Supplemental Water –- Includes both water imported to Chino Basin from outside Chino Basin Watershed, and reclaimed water.

(cc) WMWD –-Defendant Western Municipal Water District of Riverside County.

5. List of Exhibits. The following exhibits are attached to this Judgment and made a part hereof:

"A" -- "Location Map of Chino Basin" showing boundaries of Chino Basin Municipal Water District, and other geographic and political features of Chino Basin.

"B" -- "Hydrologic Map of Chino Basin" showing hydrologic features of Chino Basin.

"C" – Table Showing Parties in Overlying (Agricultural) Pool.

"D" – Table Showing Parties in Overlying (Non-agricultural Pool and Their Rights.

"E" – Table Showing Appropriators and Their Rights.

"F" -- Overlying (Agricultural) Pool Pooling Plan.

"G" -- Overlying (Non-agricultural) Pool Pooling Plan.

"H" -- Appropriative Pool Pooling Plan.

"I" -- Engineering Appendix.

"J" -- Map of In Lieu Area No. 1.

"K" -- Legal Description of Chino Basin.

## II. DECLARATION OF RIGHTS

### A. HYDROLOGY

6. Safe Yield. The Safe Yield of Chino Basin is 140,000 acre feet per year.

7. Overdraft and Prescriptive Circumstances. In each year for a period in excess of five years prior to filing of the First Amended Complaint herein, the Safe Yield of the Basin has been exceeded by the annual production therefrom, and Chino Basin is and has been for more than five years in a continuous state of over draft. The production constituting said overdraft has been open, notorious, continuous, adverse, hostile and under claim of right. The circumstances of said overdraft have given notice to all parties of the adverse nature of such aggregate over-production.

### B. WATER RIGHTS IN SAFE YIELD

8. Overlying Rights. The parties listed in Exhibits "C" and "D", are the owners or in possession of lands which overlie Chino Basin. As such, said parties have exercised overlying water rights in Chino Basin. All overlying rights owned or exercised by parties listed in Exhibits "C" and "D", have, in the aggregate, been limited by prescription except to the extent such rights have been preserved by self-help by said parties. Aggregate preserved overlying rights in the Safe Yield for agricultural pool use, including the rights of the State of California, total 82,800 acre feet per year. Overlying rights for non-agricultural pool use total 7,366 acre feet per year and are individually decreed for each affected

party in Exhibit "D". No portion of the Safe Yield of Chino Basin exists to satisfy unexercised overlying rights, and such rights have all been lost by prescription. However, uses may be made of Basin Water on overlying lands which have no preserved overlying rights pursuant to the Physical Solution herein. All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom ***for the term of the Peace Agreement except that the members of the Overlying (Non-Agricultural) Pool shall have the right to Transfer or lease their quantified Production rights (i) within the Overlying (Non-Agricultural) Pool; (ii) to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000; or (iii) in accordance with the Overlying (Non-Agricultural) Pool Pooling Plan set forth in Exhibit "G."***[4]

9. Appropriative Rights. The parties listed in Exhibit "E" are the owners of appropriative rights, including rights by prescription, in the unadjusted amounts therein set forth, and by reason thereof are entitled under the Physical Solution to share in the remaining Safe Yield, after satisfaction of overlying rights and rights of the State of California, and in the Operating Safe Yield in Chino Basin, in the annual shares set forth in Exhibit "E".

(a) Loss of Priorities. By reason of the long continued overdraft in Chino Basin, and in light of the complexity of determining appropriative priorities and the need for conserving and making maximum beneficial use of the water resources of the State, each and all of the parties listed in Exhibit "E" are estopped and barred from asserting special priorities or preferences, inter se. All of said appropriative rights are accordingly deemed and considered of equal priority.

(b) Nature and Quantity. All rights listed in Exhibit "E" are appropriative and prescriptive in nature. By reason of the status of the parties, and the provisions of Section 1007 of the Civil Code, said rights are immune from reduction or limitation by prescription.

[4] Order dated September 28, 2000 and Order dated April 19, 2001 further modified by Order dated December 21, 2007.

10. Rights of the State of California. The State of California, by and through its Department of Corrections, Youth Authority and Department of Fish and Game, is a significant producer of ground water from and the State is the largest owner of land overlying Chino Basin. The precise nature and scope of the claims and rights of the State need not be, and are not, defined herein. The State, through said departments, has accepted the Physical Solution herein decreed, in the interests of implementing the mandate of Section 2 of Article X of the California Constitution. For all purposes of this Judgment, all future production by the State or its departments or agencies for overlying use on State-owned lands shall be considered as agricultural pool use.

C. RIGHTS TO AVAILABLE GROUND WATER STORAGE CAPACITY

11. Available Ground Water Storage Capacity. There exists in Chino Basin a substantial amount of available ground water storage capacity which is not utilized for storage or regulation of Basin Waters. Said reservoir capacity can appropriately be utilized for storage and conjunctive use of supplemental water with Basin Waters. It is essential that said reservoir capacity utilization for storage and conjunctive use of supplemental water be undertaken only under Watermaster control and regulation, in order to protect the integrity of both such Stored Water and Basin Water in storage and the Safe Yield of Chino Basin.

12. Utilization of Available Ground Water Capacity. Any person or public entity, whether a party to this action or not, may make reasonable beneficial use of the available ground water storage capacity of Chino Basin for storage of supplemental water; provided that no such use shall be made except pursuant to written agreement with Watermaster, as authorized by Paragraph 28. In the allocation of such storage capacity, the needs and requirements of lands overlying Chino Basin and the owners of rights in the Safe Yield or Operating Safe Yield of the Basin shall have priority and preference over storage for export.

## III. INJUNCTION

13. Injunction Against Unauthorized Production of Basin Water. Each party in each of the respective pools is enjoined, as follows:

(a) Overlying Agricultural Pool. Each party in the Overlying (Agricultural) Pool, its officers, agents, employees, successors and assigns, is and they each are ENJOINED AND RESTRAINED from producing ground water from Chino Basin in any year hereafter in excess of such party's correlative share of the aggregate of 82,800 acre feet allocated to said Pool, except pursuant to the Physical Solution or a storage water agreement.

(b) Overlying Non-Agricultural Pool. Each party in the Overlying Non-Agricultural Pool, its officers, agents, employees, successors and assigns, is and they each are ENJOINED AND RESTRAINED from producing ground water of Chino Basin in any year hereafter in excess of such party's decreed rights in the Safe Yield, except pursuant to the provisions of the Physical Solution or a storage water agreement.

(c) Appropriative Pool. Each party in the Appropriative Pool, its officers, agents, employees, successors and assigns, is and they are each ENJOINED AND RESTRAINED from producing ground water of Chino Basin in any year hereafter in excess of such party's decreed share of Operating Safe Yield, except pursuant to the provisions of the Physical Solution or a storage water agreement.

14. Injunction Against Unauthorized Storage or Withdrawal of Stored Water. Each party, its officers, agents, employees, successors and assigns is and they each are ENJOINED AND RESTRAINED from storing supplemental water in Chino Basin for withdrawal, or causing withdrawal of, water stored by that party, except pursuant to the terms of a written agreement with Watermaster and in accordance with Watermaster regulations. Any supplemental water stored or recharged in the Basin, except pursuant to such a Watermaster agreement, shall be deemed abandoned and not classified as Stored Water. This paragraph has no application, as such, to supplemental water spread or provided in lieu by Watermaster pursuant to the Physical Solution.

## IV. CONTINUING JURISDICTION

15. Continuing Jurisdiction. Full jurisdiction, power and authority are retained and reserved to the Court as to all matters contained in this judgment, except:

(a) The redetermination of Safe Yield, as set forth in Paragraph 6, during the first ten (10) years of operation of the Physical Solution;

(b) The allocation of Safe Yield as between the several pools as set forth in Paragraph 44 of the Physical Solution;

(c) The determination of specific quantitative rights and shares in the declared Safe Yield or Operating Safe Yield herein declared in Exhibits "D" and "E"; and

(d) The amendment or modification of Paragraphs 7 (a) and (b) of Exhibit "H", during the first ten (10) years of operation of the Physical Solution, and thereafter only upon affirmative recommendation of at least 67% of the voting power (determined pursuant to the formula described in Paragraph 3 of Exhibit "H"), but not less than one-third of the members of the Appropriative Pool Committee representatives of parties who produce water within IEUA or WMWD; after said tenth year the formula set forth in said Paragraph 7 (a) and 7 (b) of Exhibit "H" for payment of the costs of replenishment water may be changed to 100% gross or net, or any percentage split thereof, but only in response to recommendation to the Court by affirmative vote of at least 67% of said voting power of the Appropriative Pool representatives of parties who produce ground water within IEUA or WMWD, but not less than one-third of their number. In such event, the Court shall act in conformance with such recommendation unless there are compelling reasons to the contrary; and provided, further, that the fact that the allocation of Safe Yield or Operating Safe Yield shares may be rendered moot by a recommended change in the formula for replenishment assessments shall not be deemed to be such a "compelling reason."

Said continuing jurisdiction is provided for the purpose of enabling the Court, upon application of any party, the Watermaster, the Advisory Committee or any Pool Committee, by motion and, upon at least 30 days' notice thereof, and after hearing thereon, to make such further or supplemental orders or directions as may be necessary or appropriate for interpretation, enforcement or carrying out of this Judgment, and to modify, amend or amplify any of the provisions of this Judgment.

## V. WATERMASTER

### A. APPOINTMENT

16. Watermaster Appointment. CBMWD, acting by and through a majority of its board of directors, is hereby appointed Watermaster, to administer and enforce the provisions of this Judgment and any subsequent instructions or orders of the Court hereunder. The term of appointment of Watermaster shall be for five (5) years. The Court will by subsequent orders provide for successive terms or for a successor Watermaster. Watermaster may be changed at any time by subsequent order of the Court, on its own motion, or on the motion of any party after notice and hearing. Unless there are compelling reasons to the contrary, the Court shall act in conformance with a motion requesting the Watermaster be changed if such motion is supported by a majority of the voting power of the Advisory Committee.

### B. POWERS AND DUTIES

17. Powers and Duties. Subject to the continuing supervision and control of the Court, Watermaster shall have and may exercise the express powers, and shall perform the duties, as provided in this Judgment or hereafter ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction.

18. Rules and Regulations.[5]

**(a) Upon recommendation by the Advisory Committee, Watermaster shall make and adopt, after public hearing, appropriate rules and regulations for conduct of Watermaster affairs, including, meeting schedules and procedures, and compensation of members of Watermaster. Thereafter, Watermaster may amend the rules from time to time upon recommendation, or with approval of the Advisory Committee after hearing noticed to active parties, except that compensation of Watermaster members shall be subject to Court Approval. A copy of the rules and regulations, and of amendments, shall be mailed to each active party.**

**(b) Under the rules, Watermaster members shall be paid up to $125 for each day's attendance at meetings at the direction of the board, not to exceed eight meetings in each month. Compensation shall not be paid for junkets or attendance at conferences, seminars, or retreats at locations other than Watermaster headquarters. Members shall not be compensated for more than one meeting each day.**

**(c) Under the rules, Watermaster members may be reimbursed for reasonable and necessary travel, meals, lodging and registration expenses incurred on Watermaster business. Mileage shall not be paid for travel to or from Watermaster meetings unless the individual must travel more than 50 miles per month. The Watermaster's budget shall include an appropriation for expense reimbursement. The Watermaster shall file a report on the expense reimbursement with the court as part of the Annual Report. The Report shall disclose total expense reimbursements and single expenditures for items of $125.00 or more.**

19. Acquisition of Facilities. Watermaster may purchase, lease, acquire and hold all necessary facilities and equipment; provided, that it is not the intent of the Court that Watermaster acquire any interest in real property or substantial capital assets.

[5] Order dated March 31, 1999.

20. Employment of Experts and Agents. Watermaster may employ or retain such administrative, engineering, geologic, accounting, legal or other specialized personnel and consultants as may be deemed appropriate in the carrying out of its powers and shall require appropriate bonds from all officers and employees handling Watermaster funds. Watermaster shall maintain records for purposes of allocation of costs of such services as well as of all other expenses of Watermaster administration as between the several pools established by the Physical Solution.

21. Measuring Devices. Watermaster shall cause parties, pursuant to uniform rules, to install and maintain in good operating condition, at the cost of each party, such necessary measuring devices or meters as Watermaster may deem appropriate. Such measuring devices shall be inspected and tested as deemed necessary by Watermaster, and the cost thereof shall constitute an expense of Watermaster.

22. Assessments. Watermaster is empowered to levy and collect all assessments provided for in the pooling plans and Physical Solution.

23. Investment of Funds. Watermaster may hold and invest any and all Watermaster funds in investments authorized from time to time for public agencies of the State of California.

24. Borrowing. Watermaster may borrow from time to time amounts not exceeding the annual anticipated receipts of Watermaster during such year.

25. Contracts. Watermaster may enter into contracts for the performance of any powers herein granted; provided, however, that Watermaster may not contract with or purchase materials, supplies or services from IEUA, except upon the prior recommendation and approval of the Advisory Committee and pursuant to written order of the Court.

26. Cooperation With Other Agencies. Subject to prior recommendation or approval of the Advisory Committee, Watermaster may act jointly or cooperate with agencies of the United States and the State of California or any political subdivisions, municipalities or districts or any person to the end that the purpose of the Physical Solution may be fully and economically carried out.

27. Studies. Watermaster may, with concurrence of the Advisory Committee or affected Pool Committee and in accordance with Paragraph 54 (b), undertake relevant studies of hydrologic conditions, both quantitative and qualitative, and operating aspects of implementation of the management program for Chino Basin.

28. Ground Water Storage Agreements. Watermaster shall adopt, with the approval of the Advisory Committee, uniformly applicable rules and a standard form of agreement for storage of supplemental water, pursuant to criteria therefore set forth in Exhibit "I". Upon appropriate application by any person, Watermaster shall enter into such a storage agreement; provided that all such storage agreements shall first be approved by written order of the Court, and shall by their terms preclude operations which will have a substantial adverse impact on other producers.

29. Accounting for Stored Water. Watermaster shall calculate additions, extractions and losses and maintain an annual account of all Stored Water in Chino Basin, and any losses of water supplies or Safe Yield of Chino Basin resulting from such Stored Water.

30. Annual Administrative Budget. Watermaster shall submit to Advisory Committee an administrative budget and recommendation for each fiscal year on or before March 1. The Advisory Committee shall review and submit said budget and their recommendations to Watermaster on or before April 1, following. Watermaster shall hold a public hearing on said budget at its April quarterly meeting and adopt the annual administrative budget which shall include the administrative items for each pool committee. The administrative budget shall set forth budgeted items in sufficient detail as necessary to make a proper allocation of the expense among the several pools, together with Watermaster's proposed allocation. The budget shall contain such additional comparative information or explanation as the Advisory Committee may recommend from time to time. Expenditures within budgeted items may thereafter be made by Watermaster in the exercise of powers herein granted, as a matter of course. Any budget transfer in excess of 20% of a budget category during any budget year or modification of such administrative budget during any year shall be first submitted to the Advisory Committee for review and recommendation.

31. Review Procedures. All actions, decisions or rules of Watermaster shall be subject to review by the Court on its own motion or on timely motion by any party, the Watermaster (in the case of a mandated action), the Advisory Committee, or any Pool Committee, as follows:

(a) Effective Date of Watermaster Action. Any action, decision or rule of Watermaster shall be deemed to have occurred or been enacted on the date on which written notice thereof is mailed. Mailing of copies of approved Watermaster minutes to the active parties shall constitute such notice to all parties.

(b) Noticed Motion. Any party, the Watermaster (as to any mandated action), the Advisory Committee, or any Pool Committee may, by a regularly noticed motion, apply to the Court for review of any Watermaster's action, decision or rule. Notice of such motion shall be served personally or mailed to Watermaster and to all active parties. Unless otherwise ordered by the Court, such motion shall not operate to stay the effect of such Watermaster action, decision or rule.

(c) Time for Motion. Notice of motion to review any Watermaster action, decision or rule shall be served and filed within ninety (90) days after such Watermaster action, decision or rule, except for budget actions, in which event said notice period shall be sixty (60) days.

(d) De Novo Nature of Proceedings. Upon the filing of any such motion, the Court shall require the moving party to notify the active parties, the Watermaster, the Advisory Committee, and each Pool Committee, of a date for taking evidence and argument, and on the date so designated shall review de novo the question at issue. Watermaster's findings or decision, if any, may be received in evidence at said hearing, but shall not constitute presumptive or prima facie proof of any fact in issue.

(e) Decision. The decision of the Court in such proceeding shall be an appealable supplemental order in this case. When the same is final, it shall be binding upon the Watermaster and all parties.

C. ADVISORY AND POOL COMMITTEES

32. Authorization. Watermaster is authorized and directed to cause committees of producer representatives to be organized to act as Pool Committees for each of the several pools created under the Physical solution. Said Pool Committees shall, in turn, jointly form an Advisory Committee to assist Watermaster in performance of its functions under this judgment. Pool Committees shall be composed as specified in the respective pooling plans, and the Advisory Committee shall be composed of ten (10) voting representatives from each pool, as designated by the respective Pool Committee[6] ***in accordance with each pool's pooling plan.*** WMWD***, Three Valleys Municipal Water District (Successor to PVMWD)*** and SBVMWD shall each be entitled to one non-voting representative on said Advisory Committee.

33. Term and Vacancies. Members of any Pool Committee, shall serve for the term, and vacancies shall be filled, as specified in the respective pooling plan. Members of the Advisory Committee shall serve at the will of their respective Pool Committee.

34. Voting Power. The voting power on each Pool Committee shall be allocated as provided in the respective pooling plan. The voting power on the Advisory Committee shall be one hundred (100) votes allocated among the three pools in proportion to the total assessments paid to Watermaster during the preceding year; provided, that the minimum voting power of each pool shall be

| | | |
|---|---|---|
| (a) | Overlying Agricultural Pool | 20, |
| (b) | Overlying Non-Agricultural Pool | 5, and |
| (c) | Appropriative Pool | 20. |

[6] Order dated September 18, 1996.

In the event any pool is reduced to its said minimum vote, the remaining votes shall be allocated between the remaining pools on said basis of assessments paid to Watermaster by each such remaining pool during the preceding year. The method of exercise of each pool's voting power on the Advisory Committee shall be as determined by the respective pool committees.

35. Quorum. A majority of the voting power of the Advisory Committee or any Pool Committee shall constitute a quorum for the transaction of affairs of such Advisory or Pool Committee; provided, that at least one representative of each Pool Committee shall be required to constitute a quorum of the Advisory Committee. No Pool Committee representative may purposely absent himself or herself, without good cause, from an Advisory Committee meeting to deprive it of a quorum. Action by affirmative vote of a majority of the entire voting power of any Pool Committee or the Advisory Committee shall constitute action by such committee. Any action or recommendation of a Pool Committee or the Advisory Committee shall be transmitted to Watermaster in writing, together with a report of any dissenting vote or opinion.

36. Compensation. Pool or Advisory Committee members may receive compensation, to be established by the respective pooling plan, but not to exceed twenty-five dollars ($25.00) for each meeting of such Pool or Advisory Committee attended, and provided that no member of a Pool or Advisory Committee shall receive compensation of more than three hundred ($300.00) dollars for service on any such committee during any one year. All such compensation shall be a part of Watermaster administrative expense. No member of any Pool or Advisory Committee shall be employed by Watermaster or compensated by Watermaster for professional or other services rendered to such Pool or Advisory Committee or to Watermaster, other than the fee for attendance at meetings herein provided, plus reimbursement of reasonable expenses related to activities within the Basin.

37. Organization.

(a) Organizational Meeting. At its first meeting in each year, each Pool Committee and the Advisory Committee shall elect a chairperson and a vice chairperson from its

membership. It shall also select a secretary, a treasurer and such assistant secretaries and treasurers as may be appropriate, any of whom may, but need not, be members of such Pool or Advisory Committee.

(b) Regular Meetings. All Pool Committees and the Advisory Committee shall hold regular meetings at a place and time to be specified in the rules to be adopted by each Pool and Advisory Committee. Notice of regular meetings of any Pool or Advisory Committee, and of any change in time or place thereof, shall be mailed to all active parties in said pool or pools.

(c) Special Meetings. Special meetings of any Pool or Advisory Committee may be called at any time by the Chairperson or by any three (3) members of such Pool or Advisory Committee by delivering notice personally or by mail to each member of such Pool or Advisory Committee and to each active party at least 24 hours before the time of each such meeting in the case of personal delivery, and 96 hours in the case of mail. The calling notice shall specify the time and place of the special meeting and the business to be transacted. No other business shall be considered at such meeting.

(d) Minutes. Minutes of all Pool Committee, Advisory Committee and Watermaster meetings shall be kept at Watermaster's offices. Copies thereof shall be mailed or otherwise furnished to all active parties in the pool or pools concerned. Said copies of minutes shall constitute notice of any Pool or Advisory Committee action therein reported, and shall be available for inspection by any party.

(e) Adjournments. Any meeting of any Pool or Advisory Committee may be adjourned to a time and place specified in the order of adjournment. Less than a quorum may so adjourn from time to time. A copy of the order or notice of adjournment shall be conspicuously posted forthwith on or near the door of the place where the meeting was held.

38. Powers and Functions. The powers and functions of the respective Pool Committees and the Advisory Committee shall be as follows:

(a) Pool Committees. Each Pool Committee shall have the power and responsibility for developing policy recommendations for administration of its particular pool, as created under the Physical Solution. All actions and recommendations of any Pool Committee which require Watermaster implementation shall first be noticed to the other two pools. If no objection is received in writing within thirty (30) days, such action or recommendation shall be transmitted directly to Watermaster for action. If any such objection is received, such action or recommendation shall be reported to the Advisory Committee before being transmitted to Watermaster.

(b) Advisory Committee. The Advisory Committee shall have the duty to study, and the power to recommend, review and act upon all discretionary determinations made or to be made hereunder by Watermaster.

[1] Committee Initiative. When any recommendation or advice of the Advisory Committee is received by Watermaster, action consistent therewith may be taken by Watermaster; provided, that any recommendation approved by 80 votes or more in the Advisory Committee shall constitute a mandate for action by Watermaster consistent therewith. If Watermaster is unwilling or unable to act pursuant to recommendation or advice from the Advisory Committee (other than such mandatory recommendations), Watermaster shall hold a public hearing, which shall be followed by written findings and decision. Thereafter, Watermaster may act in accordance with said decision, whether consistent with or contrary to said Advisory Committee recommendation. Such action shall be subject to review by the Court, as in the case of all other Watermaster determinations.

[2] Committee Review. In the event Watermaster proposes to take discretionary action, other than approval or disapproval of a Pool Committee action or recommendation properly transmitted, or execute any agreement not theretofore within the scope of an Advisory Committee recommendation, notice of such intended action

shall be served on the Advisory Committee and its members at least thirty (30) days before the Watermaster meeting at which such action is finally authorized.

(c) Review of Watermaster Actions. Watermaster (as to mandated action), the Advisory Committee or any Pool Committee shall be entitled to employ counsel and expert assistance in the event Watermaster or such Pool or Advisory Committee seeks Court review of any Watermaster action or failure to act. The cost of such counsel and expert assistance shall be Watermaster expense to be allocated to the affected pool or pools.

## VI. PHYSICAL SOLUTION

### A. GENERAL

39. Purpose and Objective. Pursuant to the mandate of Section 2 of Article X of the California Constitution, the Court hereby adopts and orders the parties to comply with a Physical Solution. The purpose of these provisions is to establish a legal and practical means for making the maximum reasonable beneficial use of the waters of Chino Basin by providing the optimum economic, long-term, conjunctive utilization of surface waters, ground waters and supplemental water, to meet the requirements of water users having rights in or dependent upon Chino Basin.

40. Need for Flexibility. It is essential that this Physical solution provide maximum flexibility and adaptability in order that Watermaster and the Court may be free to use existing and future technological, social, institutional and economic options, in order to maximize beneficial use of the waters of Chino Basin. To that end, the Court's retained jurisdiction will be utilized, where appropriate, to supplement the discretion herein granted to the Watermaster.

41. Watermaster Control. Watermaster, with the advice of the Advisory and Pool Committees, is granted discretionary powers in order to develop an optimum basin management program for Chino Basin, including both water quantity and quality considerations. Withdrawals and supplemental water replenishment of Basin Water, and the full utilization of the water resources of Chino Basin, must

be subject to procedures established by and administered through Watermaster with the advice and assistance of the Advisory and Pool Committees composed of the affected producers. Both the quantity and quality of said water resources may thereby be preserved and the beneficial utilization of the Basin maximized.

42. General Pattern of Operations. It is contemplated that the rights herein decreed will be divided into three (3) operating pools for purposes of Watermaster administration. A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To the extent that pumping exceeds the share of the Safe Yield assigned to the Overlying Pools, or the Operating Safe Yield in the case of the Appropriative Pool, each pool will provide funds to enable Watermaster to replace such overproduction. The method of assessment in each pool shall be as set forth in the applicable pooling plan.

B. POOLING

43. Multiple Pools Established. There are hereby established three (3) pools for Watermaster administration of, and for the allocation of responsibility for, and payment of, costs of replenishment water and other aspects of this Physical Solution.

(a) Overlying (Agricultural) Pool. The first pool shall consist of the State of California and all overlying producers who produce water for other than industrial or commercial purposes. The initial members of the pool are listed in Exhibit "C".

(b) Overlying (Non-agricultural) Pool The second pool shall consist of overlying producers who produce water for industrial or commercial purposes. The initial members of this pool are listed in Exhibit "D".

(c) Appropriative Pool. A third and separate pool shall consist of owners of appropriative rights. The initial members of the pool are listed in Exhibit "E".

Any party who changes the character of his use may, by subsequent order of the Court, be reassigned to the proper pool; but the allocation of Safe Yield under Paragraph 44 hereof shall not be changed. Any non-party producer or any person who may hereafter commence production of water from Chino Basin, and who may become a party to this physical solution by intervention, shall be assigned to the proper pool by the order of the Court authorizing such intervention.

44. Determination and Allocation of Rights to Safe Yield of Chino Basin. The declared Safe Yield of Chino Basin is hereby allocated as follows:

| Pool | Allocation |
|---|---|
| Overlying (Agricultural) Pool | 414,000 acre-feet in any five (5) consecutive years. |
| Overlying (Non-agricultural) Pool | 7,366 acre-feet per year. |
| Appropriative Pool | 49,834 acre-feet per year. |

The foregoing acre foot allocations to the overlying pools are fixed. Any subsequent change in the Safe Yield shall be debited or credited to the Appropriative Pool. Basin Water available to the Appropriative Pool without replenishment obligation may vary from year to year as the Operating Safe Yield is determined by Watermaster pursuant to the criteria set forth in Exhibit "I".

45. Annual Replenishment. Watermaster shall levy and collect assessments in each year, pursuant to the respective pooling plans, in amounts sufficient to purchase replenishment water to replace production by any pool during the preceding year which exceeds that pool's allocated share of Safe Yield in the case of the overlying pools, or Operating Safe Yield in the case of the Appropriative Pool. It is anticipated that supplemental water for replenishment of Chino Basin may be available at different rates to the various pools to meet their replenishment obligations. If such is the case, each pool will be assessed only that amount necessary for the cost of replenishment water to that pool, at the rate available to the pool, to meet its replenishment obligation.

46. Initial Pooling Plans. The initial pooling plans, which are hereby adopted, are set forth in Exhibits "F", "G" and "H", respectively. Unless and until modified by amendment of the judgment pursuant to the Court's continuing jurisdiction, each such plan shall control operation of the subject pool.

C. REPORTS AND ACCOUNTING

47. Production Reports. Each party or responsible party shall file periodically with Watermaster, pursuant to Watermaster rules, a report on a form to be prescribed by Watermaster showing the total production of such party during the preceding reportage period, and such additional information as Watermaster may require, including any information specified by the affected Pool Committee.

48. Watermaster Report and Accounting. **Watermaster's Annual Report shall be filed by *January 31* of each year. The Report shall apply to the preceding fiscal years' operation. The Report shall contain details as to operation of the Pools. A certified audit of assessments and expenditures pursuant to this Physical Solution, and a review of Watermaster activity.** [7]

D. REPLENISHMENT

49. Sources of Supplemental Water. Supplemental water may be obtained by Watermaster from any available source. Watermaster shall seek to obtain the best available quality of supplemental water at the most reasonable cost for recharge in the Basin. To the extent that costs of replenishment water may vary between pools, each pool shall be liable only for the costs attributable to its required replenishment. Available sources may include, but are not limited to:

(a) Reclaimed Water. There exist a series of agreements generally denominated the Regional Waste Water Agreements between IEUA and owners of the major municipal sewer

[7] Order dated March 31, 1999.

systems within the basin. Under those agreements, which are recognized hereby but shall be unaffected and unimpaired by this judgment, substantial quantities of reclaimed water may be made available for replenishment purposes. There are additional sources of reclaimed water which are, or may become, available to Watermaster for said purposes. Maximum beneficial use of reclaimed water shall be given high priority by Watermaster.

(b) State Water. State water constitutes a major available supply of supplemental water. In the case of State Water, Watermaster purchases shall comply with the water service provisions of the State's water service contracts. More specifically, Watermaster shall purchase State Water from MWD for replenishment of excess production within IEUA, WMWD and TVMWD, and from SBVMWD to replenish excess production within SBVMWD's boundaries in Chino Basin, except to the extent that MWD and SBVMWD give their consent as required by such State water service contracts.

(c) Local Import. There exist facilities and methods for importation of surface and ground water supplies from adjacent basins and watersheds.

(d) Colorado River Supplies. MWD has water supplies available from its Colorado River Aqueduct.

50. Methods of Replenishment. Watermaster may accomplish replenishment of overproduction from the Basin by any reasonable method, including:

(a) Spreading and percolation or Injection of water in existing or new facilities, subject to the provisions of Paragraphs 19, 25 and 26 hereof.

(b) In Lieu Procedures. Watermaster may make, or cause to be made, deliveries of water for direct surface use, in lieu of ground water production.

E. REVENUES

51. Production Assessment. Production assessments, on whatever basis, may be levied by Watermaster pursuant to the pooling plan adopted for the applicable pool.

52. Minimal Producers. Minimal Producers shall be exempted from payment of production assessments, upon filing of production reports as provided in Paragraph 47 of this Judgment, and payment of an annual five dollar ($5.00) administrative fee as specified by Watermaster rules.

53. Assessment Proceeds –- Purposes. Watermaster shall have the power to levy assessments against the parties (other than minimal pumpers) based upon production during the preceding period of assessable production, whether quarterly, semi-annually or annually, as may be determined most practical by Watermaster or the affected Pool Committee.

54. Administrative Expenses. The expenses of administration of this Physical Solution shall be categorized as either (a) general Watermaster administrative expense, or (b) special project expense.

(a) General Watermaster Administrative Expense shall include office rental, general personnel expense, supplies and office equipment, and related incidental expense and general overhead.

(b) Special Project Expense shall consist of special engineering, economic or other studies, litigation expense, meter testing or other major operating expenses. Each such project shall be assigned a Task Order number and shall be separately budgeted and accounted for. General Watermaster administrative expense shall be allocated and assessed against the respective pools based upon allocations made by the Watermaster, who shall make such allocations based upon generally accepted cost accounting methods. Special Project Expense shall be allocated to a specific pool, or any portion thereof, only upon the basis of prior express assent and finding of benefit by the Pool Committee, or pursuant to written order of the Court.

55. Assessments -- Procedure. Assessments herein provided for shall be levied and collected as follows:

(a) Notice of Assessment. Watermaster shall give written notice of all applicable assessments to each party on or before ninety (90) days after the end of the production period to which such assessment is applicable.

(b) Payment. Each assessment shall be payable on or before thirty (30) days after notice, and shall be the obligation of the party or successor owning the water production facility at the time written notice of assessment is given, unless prior arrangement for payment by others has been made in writing and filed with Watermaster.

(c) Delinquency. Any delinquent assessment shall bear interest at 10% per annum (or such greater rate as shall equal the average current cost of borrowed funds to the Watermaster) from the due date thereof. Such delinquent assessment and interest may be collected in a show-cause proceeding herein instituted by the Watermaster, in which case the Court may allow Watermaster its reasonable costs of collection, including attorney's fees.

56. Accumulation of Replenishment Water Assessment Proceeds. In order to minimize fluctuation in assessment and to give Watermaster flexibility in purchase and spreading of replenishment water, Watermaster may make reasonable accumulations of replenishment water assessment proceeds. Interest earned on such retained funds shall be added to the account of the pool from which the funds were collected and shall be applied only to the purchase of replenishment water.

57. Effective Date. The effective date for accounting and operation under this Physical Solution shall be July 1, 1977, and the first production assessments hereunder shall be due after July 1, 1978. Watermaster shall, however, require installation of meters or measuring devices and establish operating procedures immediately, and the cost of such Watermaster activity (not including the cost of such meters and measuring devices) may be recovered in the first administrative assessment in 1978.

## VII. MISCELLANEOUS PROVISIONS

58. Designation of Address for Notice and Service. Each party shall designate the name and address to be used for purposes of all subsequent notices and service herein, either by its endorsement on the Stipulation for Judgment or by a separate designation to be filed within thirty (30) days after Judgment has been served. Said designation may be changed from time to time by filing a written notice of such change with the Watermaster. Any party desiring to be relieved of receiving notices of Watermaster or committee activity may file a waiver of notice on a form to be provided by Watermaster. Thereafter such party shall be removed from the Active Party list. Watermaster shall maintain at all times a current list of all active parties and their addresses for purposes of service. Watermaster shall also maintain a full current list of names and addresses of all parties or their successors, as filed herein. Copies of such lists shall be available, without cost, to any party, the Advisory Committee or any Pool Committee upon written request therefor.

59. Service of Documents. Delivery to or service upon any party or active party by the Watermaster, by any other party, or by the Court, of any item required to be served upon or delivered to such party or active party under or pursuant to the Judgment shall be made personally or by deposit in the United States mail, first class, postage prepaid, addressed to the designee and at the address in the latest designation filed by such party or active party.

60. Intervention After Judgment. Any non-party assignee of the adjudicated appropriative rights of any appropriator, or any other person newly proposing to produce water from Chino Basin, may become a party to this Judgment upon filing a petition in intervention. Said intervention must be confirmed by order of this Court. Such intervenor shall thereafter be a party bound by this judgment and entitled to the rights and privileges accorded under the Physical Solution herein, through the pool to which the Court shall assign such intervenor.

61. Loss of Rights. Loss, whether by abandonment, forfeiture or otherwise, of any right herein adjudicated shall be accomplished only (1) by a written election by the owner of the right filed with Watermaster, or (2) by order of the Court upon noticed motion and after hearing.

62. Scope of Judgment. Nothing in this Judgment shall be deemed to preclude or limit any party in the assertion against a neighboring party of any cause of action now existing or hereafter arising based upon injury, damage or depletion of water supply available to such party, proximately caused by nearby pumping which constitutes an unreasonable interference with such complaining party's ability to extract ground water.

63. Judgment Binding on Successors. This Judgment and all provisions thereof are applicable to and binding upon not only the parties to this action, but also upon their respective heirs, executors, administrators, successors, assigns, lessees and licensees and upon the agents, employees and attorneys in fact of all such persons.

64. Costs. No party shall recover any costs in this proceeding from any other party.

Dated: January 1, 1978

Howard B. Weiner

Howard B. Weiner

N

0 1 2 3 4 Kilometers

0 1 2 3 Miles

San Gabriel Mountains

HIGHLAND AVE

BASE LINE ST

FOOTHILL BLVD

RIVERSIDE AVE

MERRILL AVE

15

215

10

HOLT BLVD

Ontario Int'l Airport

MISSION BLVD

RESERVOIR ST

CENTRAL AVE

EUCLID AVE

PHILADELPHIA ST

60

RIVERSIDE DR

ARCHIBALD AVE

EDISON AVE

71

Chino

Puente Hills

Chino Hills

San Bernardino County

Orange County

Los Angeles County

San Bernardino County

Riverside County

Jurupa Hills

PEDLEY RD

JURUPA RD

LIMONITE AVE

Santa Ana River

La Sierra Hills

91

**Exhibit A**

**Location Map of Chino Basin**

Adjudicated Boundary of the Chino Basin

Map prepared by:

WE WILDERMUTH ENVIRONMENTAL, INC.

N

0 1 2 3 4 Kilometers

0 1 2 3 Miles

San Gabriel Mountains

San Antonio Dam

Claremont Basin

Cucamonga Basin

Pomona Basin

Spadra Basin

Chino Basin

Riverside Basins

Rialto-Colton Basin

Indian Hill Fault

San Jose Fault

Red Hill Fault

Barrier J

Rialto-Colton Fault

San Jacinto Fault

Chino Fault

Central Avenue Fault

Lytle Creek

Cajon Creek

San Antonio Creek

Deer Creek

Day Creek

East San Sevaine Creek

Etiwanda Creek

Cucamonga Creek

Chino Creek

Santa Ana River

FOOTHILL BLVD

MISSION BLVD

EDISON AVE

LIMONITE AVE

JURUPA RD

RESERVOIR ST

CENTRAL AVE

EUCLID AVE

ARCHIBALD AVE

Ontario Int'l Airport

Chino

Puente Hills

Chino Hills

La Sierra Hills

Prado Flood Control Basin

Prado Dam

Temescal Basin

10

15

60

71

91

215

## Exhibit B

## Hydrologic Map of Chino Basin

Fault

(Solid where known; dashed where approximate; dotted where concealed; queried where unknown; big dots where barrier to groundwater flow)

Groundwater Divide

Map prepared by:

WE WILDERMUTH ENVIRONMENTAL, INC.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

STATE OF CALIFORNIA

COUNTY OF SAN BERNARDINO

Abacherli, Dairy, Inc.

Abacherli, Frank

Abacherli, Shirley

Abbona, Anna

Abbona, James

Abbona, Jim

Abbona, Mary

Agliani, Amelia H.

Agman, Inc.

Aguerre, Louis B.

Ahmanson Trust Co.

Akiyama, Shizuye

Akiyama, Tomoo

Akkerman, Dave

Albers, J.N.

Albers, Nellie

Alewyn, Jake J.

Alewyn, Normalee

Alger, Mary D.

Alger, Raymond

Allen, Ben F.

Allen, Jane F.

Alta-Dena Dairy

Anderson Farms

Anguiano, Sarah L.S.

Anker, Gus

Barnhill, Paul

Aphessetche, Xavier

Arena Mutual Water Assn.

Armstrong Nurseries, Inc.

Arretche, Frank

Arretche, Jean Pierre

Arvidson, Clarence F.

Arvidson, Florence

Ashley, George W.

Ashley, Pearl E.

Atlas Farms

Atlas Ornamental Iron Works, Inc.

Aukeman, Carol

Aukeman, Lewis

Ayers, Kenneth C., aka

Kelley Ayers

Bachoc, Raymond

Baldwin, Edgar A.

Baldwin, Lester

Banbury, Carolyn

Bangma Dairy

Bangma, Arthur

Bangma, Ida

Bangma, Martin

Bangma, Sam

Barba, Anthony B.

Barba, Frank

Barcellos, Joseph

Barnhill, Maurine W.

Boersma, Angie

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Bartel, Dale
Bartel, Ursula
Bartel, Willard
Barthelemy, Henry
Barthelemy, Roland
Bassler, Donald V., M.D.
Bates, Lowell R.
Bates, Mildred L.
Beahm, James W.
Beahm, Joan M.
Bekendam, Hank
Bekendam, Pete
Bello, Eugene
Bello, Olga
Beltman, Evelyn
Beltman, Tony
Bergquist Properties, Inc.
Bevacqua, Joel A.
Bevacqua, Marie B.
Bidart, Bernard
Bidart, Michael J.
Binnell, Wesley
Black, Patricia E.
Black, Victor
Bodger, John & Sons Co.
Boer, Adrian
Boersma and Wind Dairy
Borges, Bernadette
Boersma, Berdina
Boersma, Frank
Boersma, Harry
Boersma, Paul
Boersma, Sam
Boersma, William L.
Bohlander & Holmes, Inc.
Bokma, Peter
Bollema, Jacob
Boonstoo, Edward
Bootsma, Jim
Borba, Dolene
Borba, Dolores
Borba, Emily
Borba, George
Borba, John
Borba, John & Sons
Borba, John Jr.
Borba, Joseph A.
Borba, Karen E.
Borba, Karen M.
Borba, Pete, Estate of
Borba, Ricci
Borba, Steve
Borba, Tom
Bordisso, Alleck
Borges, Angelica M.
Bothof, Roger W.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Borges, John O.
Borges, Linda L.
Borges, Manual Jr.
Borges, Tony
Bos, Aleid
Bos, Gerrit
Bos, John
Bos, John
Bos, Margaret
Bos, Mary
Bos, Mary Beth
Bos, Tony
Bosch, Henrietta
Bosch, Peter T.
Boschma, Betty
Boschma, Frank
Boschma, Greta
Boschma, Henry
Bosma, Dick
Bosma, Florence G.
Bosma, Gerrit
Bosma, Jacob J.
Bosma, Jeanette Thea
Bosman, Frank
Bosman, Nellie
Bosnyak, Goldie M.
Bosnyak, Martin

Bouma, Cornie
Bouma, Emma
Bouma, Henry P.
Bouma, Martin
Bouma, Peter G. & Sons Dairy
Bouma, Ted
Bouman, Helen
Bouman, Sam
Bower, Mabel E.
Boys Republic
Breedyk, Arie
Breedyk, Jessie
Briano Brothers
Briano, Albert
Briano, Albert Trustee for
Briano, Albert Frank
Briano, Lena
Brink, Russell N.
Brinkerhoff, Margaret
Brinkerhoff, Robert L.
Britschgi, Florence
Britschgi, Magdalena Garetto
Britschgi, Walter P.
Brommer, Marvin
Brookside Enterprizes, dba
Brookside Vineyard Co.
Brothers Three Dairy

Brown, Eugene

Chino Corona Investment

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Brun, Martha M.

Brun, Peter Robert

Buma, Duke

Buma, Martha

Bunse, Nancy

Bunse, Ronnie L.

Caballero, Bonnie L.

Caballero, Richard F.

Cable Airport Inc.

Cadlini, Donald

Cadlini, Jesse R.

Cadlini, Marie Edna

Cambio, Anna

Cambio, Charles, Estate of

Cambio, William V.

Cardoza, Florence

Cardoza, Olivi

Cardoza, Tony

Carnesi, Tom

Carver, Robt M., Trustee

Cauffman, John R.

Chacon Bros.

Chancon, Elvera P.

Chacon, Joe M.

Chacon, Robert M.

Chacon, Virginia L.

Chez, Joseph C.

Chino Water Co.

Christensen, Leslie

Christensen, Richard G.

Christian, Ada R.

Christian, Harold F.

Christy, Ella J.

Christy, Ronald S.

Cihigoyenetche, Jean

Cihigoyenetche, Leona

Cihigoyenetche, Martin

Clarke, Arthur B.

Clarke, Nancy L.

Clarke, Phyllis J.

Coelho, Isabel

Coelho, Joe A. Jr.

Collins, Howard E.

Collins, Judith F.

Collinsworth, Ester L.

Collinsworth, John E.

Collinsworth, Shelby

Cone Estate (05-2-00648/649)

Consolidated Freightways Corp.
of Delaware

Corona Farms Co.

Corra, Rose

Costa, Dimas S.

Costa, Laura

Costa, Myrtle

De Boer, L.H.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

| | |
|---|---|
| Costamagna, Antonio | De Boer, Sidney |
| Costamagna, Joseph | De Bos, Andrew |
| Cousyn, Claus B. | De Graaf, Anna Mae |
| Cramer, Carole F. | De Graaf, Gerrit |
| Cramer, William R. | De Groot, Dick |
| Crossroads Auto Dismantlers, Inc. | De Groot, Dorothy |
| Crouse, Beatrice I. | De Groot, Ernest |
| Crouse, Roger | De Groot, Henrietta |
| Crowley, Juanita C. | De Groot, Jake |
| Crowley, Ralph | De Groot, Pete Jr. |
| Cucamonga Vintners | De Haan, Bernadena |
| D'Astici, Teresa | De Haan, Henry |
| Da Costa, Cecilia B. | De Hoog, Adriana |
| Da Costa, Joaquim F. | De Hoog, Joe |
| Daloisio, Norman | De Hoog, Martin |
| De Berard Bros. | De Hoog, Martin L. |
| De Berard, Arthur, Trustee | De Hoog, Mitch |
| De Berard, Charles | De Hoog, Tryntje |
| De Berard, Chas., Trustee | De Jager, Cobi |
| De Berard, Helan J. | De Jager, Edward D. |
| De Berard, Robert | De Jong Brothers Dairy |
| De Berard, Robert Trustee | De Jong, Cornelis |
| De Bie, Adrian | De Jong, Cornelius |
| De Bie, Henry | De Jong, Grace |
| De Bie, Margaret M. | De Jong, Jake |
| De Bie, Marvin | De Jong, Lena |
| De Boer, Fred | De Leeuw, Alice |
| De Leeuw, Sam | Dirkse, Catherine |

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

De Soete, Agnes
De Soete, Andre
De Vries, Abraham
De Vries, Case
De Vries, Dick
De Vries, Evelyn
De Vries, Henry, Estate of
De Vries, Hermina
De Vries, Jack H.
De Vries, Jane
De Vries, Janice
De Vries, John
De Vries, John J.
De Vries, Neil
De Vries, Ruth
De Vries, Theresa
De Wit, Gladys
De Wit, Peter S.
De Wyn, Evert
De Zoete, Hattie V.
Do Zoete, Leo A.
Decker, Hallie
Decker, Henry A.
Demmer, Ernest
Di Carlo, Marie
Di Carlo, Victor
Di Tommaso, Frank
Dirkse, Charles C.
Dixon, Charles E.
Dixon, Geraldine A.
Doesberg, Hendrica
Doesburg, Theodorus, P.
Dolan, Marion
Dolan, Michael H.
Dominguez, Helen
Dominguez, Manual
Donkers, Henry A.
Donkers, Nellie G.
Dotta Bros.
Douma Brothers Dairy
Douma, Betty A.
Douma, Fred A.
Douma, Hendrika
Douma, Herman G.
Douma, Narleen J.
Douma, Phillip M.
Dow Chemical Co.
Dragt, Rheta
Dragt, William
Driftwood Dairy Farm
Droogh, Case
Duhalde, Marian
Duhalde, Lauren
Duits, Henrietta
Duits, John
Excelsior Farms
F.D.I.C.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Dunlap, Edna Kraemer, Estate of
Durrington, Glen
Durrington, William F.
Dusi, John Sr.
Dykstra, Dick
Dykstra, John
Dykstra, John & Sons
Dykstra, Wilma
Dyt, Cor
Dyt, Johanna
E and S Grape Growers
Eaton, Thomas, Estate of
Echeverria, Juan
Echeverria, Carlos
Echeverria, Pablo
Eilers, E. Myrle
Eilers, Henry W.
El Prado Golf Course
Ellsworth, Rex C.
Engelsma, Jake
Engelsma, Susan
Escojeda, Henry
Etiwanda Grape Products Co.
Euclid Ave. Investment One
Euclid Ave. Investment Four
Euclid Ave. Three Investment
Fagundes, Frank M.
Fagundes, Mary
Fernandes, Joseph Jr.
Fernandes, Velma C.
Ferraro, Ann
Ferreira, Frank J.
Ferreira, Joe C. Jr.
Ferreira, Narcie
Fillippi, J. Vintage Co.
Filippi, Joseph
Filippi, Joseph A.
Filippi, Mary E.
Fitzgerald, John R.
Flameling Dairy Inc.
Flamingo Dairy
Foss, Douglas E.
Foss, Gerald R.
Foss, Russel
Fred & John Troost No. 1 Inc.
Fred & Maynard Troost No. 2 Inc.
Freitas, Beatriz
Freitas, Tony T.
Gakle, Louis L.
Galleano Winery, Inc.
Galleano, Bernard D.
Galleano, D.
Galleano, Mary M.
Garcia, Pete
Hansen, Raymond F.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Gardner, Leland V.
Gardner, Lola M.
Garrett, Leonard E.
Garrett, Patricia T.
Gastelluberry, Catherine
Gastelluberry, Jean
Gilstrap, Glen E.
Gilstrap, Marjorie J.
Godinho, John
Godinho, June
Gonsalves, Evelyn
Gonsalves, John
Gorzeman, Geraldine
Gorzeman, Henry A.
Gorzeman, Joe
Govea, Julia
Goyenetche, Albert
Grace, Caroline E.
Grace, David J.
Gravatt, Glenn W.
Gravatt, Sally Mae
Greydanus Dairy, Inc.
Greydanus, Rena
Griffin Development Co.
Haagsma, Dave
Haagsma, John
Hansen, Mary D.
Hanson, Ardeth W.
Harada, James T.
Harada, Violet A.
Haringa, Earl and Sons
Haringa, Herman
Haringa, Rudy
Haringa, William
Harper, Cecilia de Mille
Harrington, Winona
Harrison, Jacqueline A.
Hatanaka, Kenichi
Heida, Annie
Heida, Don
Heida, Jim
Heida, Sam
Helms, Addison D.
Helms, Irma A.
Hermans, Alma I.
Hermans, Harry
Hettinga, Arthur
Hettinga, Ida
Hettinga, Judy
Hettinga, Mary
Hettinga, Wilbur
Heublein, Inc., Grocery Products Group
Hibma, Catherine M.
Hibma, Sidney
Hohberg, Harold C.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Hicks, Kenneth I.
Hicks, Minnie M.
Higgins Brick Co.
Highstreet, Alfred V.
Highstreet, Evada V.
Hilarides, Bertha as Trustee
Hilarides, Frank
Hilarides, John as Trustee
Hindelang, Tillie
Hindelang, William
Hobbs, Bonnie C.
Hobbs, Charles W.
Hobbs, Hazel I.
Hobbs, Orlo M.
Hoekstra, Edward
Hoekstra, George
Hoekstra, Grace
Hoekstra, Louie
Hofer, Paul B.
Hofer, Phillip F.
Hofstra, Marie
Hogeboom, Jo Ann M.
Hogeboom, Maurice D.
Hogg, David V.
Hogg, Gene P.
Hogg, Warren G.
Hohberg, Edith J.
Hohberg, Harold W.
Holder, Arthur B.
Holder, Dorothy F.
Holmes, A. Lee
Holmes, Frances P.
Hoogeboom, Gertrude
Hoogeboom, Pete
Hoogendam, John
Hoogendam, Tena
Houssels, J. K. Thoroughbred Farm
Hunt Industries
Idsinga, Ann
Idsinga, William W.
Imbach Ranch, Inc.
Imbach, Kenneth E.
Imbach, Leonard K.
Imbach, Oscar K.
Imbach, Ruth M.
Indaburu, Jean
Indaburu, Marceline
Iseli, Kurt H.
Ito, Kow
J & B Dairy Inc.
Jaques, Johnny C. Jr.
Jaques, Mary
Jaques, Mary Lou
Jay Em Bee Farms
Knevelbaard, John

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

| | |
|---|---|
| Johnson Bro's Egg Ranches, Inc. | Knudsen, Ejnar |
| Johnston, Ellwood W. | Knudsen, Karen M. |
| Johnston, George F. Co. | Knudsen, Kenneth |
| Johnston, Judith H. | Knudson, Robert |
| Jones, Leonard P. | Knudson, Darlene |
| Jongsma & Sons Dairy | Koel, Helen S. |
| Jongsma, Diana A. | Koetsier, Gerard |
| Jongsma, Dorothy | Koetsier, Gerrit J. |
| Jongsma, George | Koetsier, Jake |
| Jongsma, Harold | Koning, Fred W. |
| Jongsma, Henry | Koning, Gloria |
| Jongsma, John | Koning, J. W. Estate |
| Jongsma, Nadine | Koning, James A. |
| Jongsma, Tillie | Koning, Jane |
| Jordan, Marjorie G. | Koning, Jane C. |
| Jordan, Troy O. | Koning, Jennie |
| Jorritsma, Dorothy | Koning, John |
| Juliano, Albert | Koning, Victor A. |
| Kamper, Cornelis | Kooi Holstein Corporation |
| Kamstra, Wilbert | Koolhaas, Kenneth E. |
| Kaplan, Lawrence J. | Koolhaas, Simon |
| Kasbergen, Martha | Koolhaas, Sophie Grace |
| Kasbergen, Neil | Koopal, Grace |
| Kazian, Angelen Estate of | Koopal, Silas |
| Kingsway, Const. Corp. | Koopman, Eka |
| Klapps Market | Koopman, Gene T. |
| Kline, James K. | Koopman, Henry G. |
| Koopman, Ted | Leck, Arthur A. |

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Koopman, Tena

Koot, Nick

Koster, Aart

Koster, Frances

Koster, Henry B.

Koster, Nellie

Kroes, Jake R.

Kroeze, Bros

Kroeze, Calvin E.

Kroeze, John

Kroeze, Wesley

Kruckenberg, Naomi

Kruckenberg, Perry

L. D. S. Welfare Ranch

Labrucherie, Mary Jane

Labrucherie, Raymond F.

Lako, Samuel

Landman Corp.

Lanting, Broer

Lanting, Myer

Lass, Jack

Lass, Sandra L.

Lawrence, Cecelia, Estate of

Lawrence, Joe H., Estate of

Leal, Bradley W.

Leal, John C.

Leal, John Craig

Leck, Evelyn M.

Lee, Harold E.

Lee, Helen J.

Lee, Henrietta C.

Lee, R. T. Construction Co.

Lekkerkerk, Adriana

Lekkerkerk, L. M.

Lekkerkerker, Nellie

Lekkerkerker, Walt

Lewis Homes of California

Livingston, Dorothy M.

Livingston, Rex E.

Lokey, Rosemary Kraemer

Lopes, Candida A.

Lopes, Antonio S.

Lopez, Joe D.

Lourenco, Carlos, Jr.

Lourenco, Carmelina P.

Lourenco, Jack C.

Lourenco, Manual H.

Lourenco, Mary

Lourenco, Mary

Luiten, Jack

Luiz, John M.

Luna, Christine I.

Luna, Ruben T.

Lusk, John D. and Sons A California Corporation

Lyon, Gregory E.

Mickel, Louise

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Lyon, Paula E.

M & W Co. #2

Madole, Betty M.

Madole, Larry B.

Marquez, Arthur

Marquine, Jean

Martin, Lelon O.

Martin, Leon O.

Martin, Maria D.

Martin, Tony J.

Martins, Frank

Mathias, Antonio

Mc Cune, Robert M.

Mc Masters, Gertrude

Mc Neill, J. A.

Mc Neill, May F.

Mees, Leon

Mello and Silva Dairy

Mello and Sousa Dairy

Mello, Emilia

Mello, Enos C.

Mello, Mercedes

Mendiondo, Catherine

Mendiondo, Dominique

Meth. Hosp. – Sacramento

Metzger, R. S.

Metzger, Winifred

Miersma, Dorothy

Meirsma, Harry C.

Minaberry, Arnaud

Minaberry, Marie

Mistretta, Frank J.

Mocho and Plaa Inc.

Mocho, Jean

Mocho, Noeline

Modica, Josephine

Montes, Elizabeth

Montes, Joe

Moons, Beatrice

Moons, Jack

Moramarco, John A. Enterprise

Moreno, Louis W.

Moss, John R.

Motion Pictures Associates, Inc.

Moynier, Joe

Murphy, Frances V.

Murphy, Myrl L.

Murphy, Naomi

Nanne, Martin Estate of

Nederend, Betty

Nederend, Hans

Norfolk, James

Norfolk, Martha

Notrica, Louis

Nyberg, Lillian N.

Ormonde, Viva

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Nyenhuis, Annie

Nyenhuis, Jim

Occidental Land Research

Okumura, Marion

Okumura, Yuiche

Oldengarm, Effie

Oldengarm, Egbert

Oldengarm, Henry

Oliviera, Manuel L.

Oliviera, Mary M.

Olson, Albert

Oltmans Construction Co.

Omlin, Anton

Omlin, Elsie L.

Ontario Christian School Assn.

Oord, John

Oostdam, Jacoba

Oostdam, Pete

Oosten, Agnes

Oosten, Anthonia

Oosten, Caroline

Oosten, John

Oosten, Marinus

Oosten, Ralph

Orange County Water District

Ormonde, Manuel

Ormonde, Pete, Jr.

Ortega, Adeline B.

Ortega, Bernard Dino

Osterkamp, Joseph S.

Osterkamp, Margaret A.

P I E Water Co.

Palmer, Eva E.

Palmer, Walter E.

Parente, Luis S.

Parente, Mary Borba

Parks, Jack B.

Parks, Laura M.

Patterson, Lawrence E. Estate of

Payne, Clyde H.

Payne, Margo

Pearson, Athelia K.

Pearson, William C.

Pearson, William G.

Pene, Robert

Perian, Miller

Perian, Ona E.

Petrissans, Deanna

Petrissans, George

Petrissans, Jean P.

Petrissans, Marie T.

Pickering, Dora M.

(Mrs. A. L. Pickering)

Pierce, John

Pierce, Sadie

Righetti, A. T.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Pietszak, Sally

Pine, Joe

Pine, Virginia

Pires, Frank

Pires, Marie

Plaa, Jeanne

Plaa, Michel

Plantenga, Agnes

Plantenga, George

Poe, Arlo D.

Pomona Cemetery Assn.

Porte, Cecelia, Estate of

Porte, Garritt, Estate of

Portsmouth, Vera McCarty

Ramella, Mary M.

Ramirez, Concha

Rearick, Hildegard H.

Rearick, Richard R.

Reinalda, Clarence

Reitsma, Greta

Reitsma, Louis

Rice, Bernice

Rice, Charlie E.

Richards, Karin

(Mrs. Ronnie Richards)

Richards, Ronald L.

Ridder, Jennie Wassenaar

Riley, George A.

Riley, Helen C.

Robbins, Jack K.

Rocha, John M.

Rocha, Jose C.

Rodrigues, John

Rodrigues, Manuel

Rodrigues, Manuel, Jr.

Rogrigues, Mary L.

Rodriquez, Daniel

Rogers, Jack D.

Rohrer, John A.

Rohrer, Theresa D.

Rohrs, Elizabeth H.

Rossetti, M. S.

Roukema, Angeline

Roukema, Ed.

Roukema, Nancy

Roukema, Siebren

Ruderian, Max J.

Russell, Fred J.

Rusticus, Ann

Rusticus, Charles

Rynsburger, Arie

Rynsburger, Berdena, Trust

Rynsburger, Joan Adele

Rynsburger, Thomas

S. P. Annex, Inc.

Scott, Frances M.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Salisbury, Elinor J.
Sanchez, Edmundo
Sanchez, Margarita O.
Santana, Joe Sr.
Santana, Palmira
Satragni, John B. Jr.
Scaramella, George P.
Schaafsma Bros.
Schaafsma, Jennie
Schaafsma, Peter
Schaafsma, Tom
Schaap, Andy
Schaap, Ids
Schaap, Maria
Schacht, Sharon C.
Schakel, Audrey
Schakel, Fred
Schmid, Olga
Schmidt, Madeleine
Schoneveld, Evert
Schoneveld, Henrietta
Schoneveld, John
Schoneveld, John Allen
Schug, Donald E.
Schug, Shirley A.
Schuh, Bernatta M.
Schuh, Harold H.
Scott, Linda F.
Scott, Stanley A.
Scritsmier, Lester J.
Serl, Charles A.
Serl, Rosalie P.
Shady Grove Dairy, Inc.
Shamel, Burt A.
Shelby, Harold E.
Shelby, John A.
Shelby, Velma M.
Shelton, Alice A.
Sherwood, Robert W.
Sherwood, Sheila J.
Shue, Eva
Shue, Gilbert
Sieperda, Anne
Sieperda, James
Sigrist, Hans
Sigrist, Rita
Silveira, Arline L.
Silveira, Frank
Silveira, Jack
Silveira, Jack P. Jr.
Simas, Dolores
Simas, Joe
Singleton, Dean
Singleton, Elsie R.
Sinnott, Jim
Staal, John

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Sinnott, Mildred B.
Slegers, Dorothy
Slegers, Hubert J.
Slegers, Jake
Slegers, Jim
Slegers, Lenwood M.
Slegers, Martha
Slegers, Tesse J.
Smith, Edward S.
Smith, Helen D.
Smith, James E.
Smith, Keith J.
Smith, Lester W.
Smith, Lois Maxine
Smith, Marjorie W.
Soares, Eva
Sogioka, Mitsuyoshi
Sogioka, Yoshimato
Sousa, Sam
Southern Pacific Land Co.
Southfield, Eddie
Souza, Frank M.
Souza, Mary T.
Spickerman, Alberta
Spickerman, Florence
Spickerman, Rudolph
Spyksma, John
Stahl, Zippora P.
Stampfl, Berta
Stampfl, William
Stanley, Robert E.
Stark, Everett
Stellingwerf, Andrew
Stellingwerf, Henry
Stellingwerf, Jenette
Stellingwerf, Shana
Stellingwerf, Stan
Stelzer, Mike C.
Sterk, Henry
Stiefel, Winifred
Stiefel, Jack D.
Stigall, Richard L.
Stigall, Vita
Stockman's Inn
Stouder, Charlotte A.
Stouder, William C.
Struikmans, Barbara
Struikmans, Gertie
Struikmans, Henry Jr.
Struikmans, Henry Sr.
Struikmans, Nellie
Swager, Edward
Swager, Gerben
Swager, Johanna
Swager, Marion
Terpstra, Theodore G.

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Swierstra, Donald
Swierstra, Fanny
Sybrandy, Ida
Sybrandy, Simon
Sytsma, Albert
Sytsma, Edith
Sytsma, Jennie
Sytsma, Louie
Te Velde, Agnes
Te Velde, Bay
Te Velde, Bernard A.
Te Velde, Bonnie
Te Velde, Bonnie G.
Te Velde, George
Te Velde, George, Jr.
Te Velde, Harm
Te Velde, Harriet
Te Velde, Henry J.
Te Velde, Jay
Te Velde, Johanna
Te Velde, John H.
Te Velde, Ralph A.
Te Velde, Zwaantina, Trustee
Ter Maaten, Case
Ter Maaten, Cleone
Ter Maaten, Steve
Terpstra, Carol
Teune, Tony
Teunissen, Bernard
Teunissen, Jane
Thomas, Ethel M.
Thommen, Alice
Thommen, Fritz
Tillema, Allie
Tillema, Harold
Tillema, Klaas D.
Timmons, William R.
Tollerup, Barbara
Tollerup, Harold
Trapani, Louis A.
Trimlett, Arlene R.
Trimlett, George E.
Tristant, Pierre
Tuinhout, Ale
Tuinhout, Harry
Tuinhout, Hilda
Tuls, Elizabeth
Tuls, Jack S.
Tuls, Jake
Union Oil Company of California
United Dairyman's Co-op.
Urquhart, James G.
Usle, Cathryn
Usle, Faustino

V & Y Properties
Van Hofwegen, Clara

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Vaile, Beryl M.
Valley Hay Co.
Van Beek Dairy Inc.
Van Canneyt Dairy
Van Canneyt, Maurice
Van Canneyt, Wilmer
Van Dam, Bas
Van Dam, Isabelle
Van Dam, Nellie
Van Den Berg, Gertrude
Van Den Berg, Joyce
Van Den Berg, Marinus
Van Den Berg, Marvin
Van Der Linden, Ardith
Van Der Linden, John
Van Der Linden, Stanley
Van Der Veen, Kenneth
Van Diest, Anna T.
Van Diest, Cornelius
Van Diest, Ernest
Van Diest, Rena
Van Dyk, Bart
Van Dyk, Jeanette
Van Foeken, Martha
Van Foeken, William
Van Hofwegen, Steve
Van Hofwegen, Adrian A.
Van Hofwegen, Jessie
Van Klaveren, A.
Van Klaveren, Arie
Van Klaveren, Wilhelmina
Van Klaveren, William
Van Leeuwen, Arie C.
Van Leeuwen, Arie C.
Van Leeuwen, Arlan
Van Leeuwen, Clara G.
Van Leeuwen, Cornelia L.
Van Leeuwen, Harriet
Van Leeuwen, Jack
Van Leeuwen, John
Van Leeuwen, Letie
Van Leeuwen, Margie
Van Leeuwen, Paul
Van Leeuwen, William A.
Van Ravenswaay, Donald
Van Ryn Dairy
Van Ryn, Dick
Van Surksum, Anthonetta
Van Surksum, John
Van Veen, John
Van Vliet, Effie
Van Vliet, Hendrika
Van Vliet, Hugo
Van Vliet, Klaas

Vande Witte, George
Vander Laan, Katie

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Vanden Berge, Gertie

Vanden Berge, Gertie

Vanden Berge, Jack

Vanden Berge, Jake

Vanden Brink, Stanley

Vander Dussen, Agnes

Vander Dussen, Cor

Vander Dussen, Cornelius

Vander Dussen, Edward

Vander Dussen, Geraldine Marie

Vander Dussen, James

Vander Dussen, John

Vander Dussen, Nelvina

Vander Dussen, Rene

Vander Dussen, Sybrand Jr.

Vander Dussen, Sybrand Sr.

Vander Dussen Trustees

Vander Eyk, Case Jr.

Vander Eyk, Case Sr.

Vander Feer, Peter

Vander Feer, Rieka

Vander Laan, Ann

Vander Laan, Ben

Vander Laan, Bill

Vander Laan, Corrie

Vander Laan, Henry

Vander Laan, James

Vander Laan, Martin Jr.

Vander Laan, Tillie

Vander Leest, Anna

Vander Leest, Ann

Vander Meer, Alice

Vander Meer, Dick

Vander Poel, Hank

Vander Poel, Pete

Vander Pol, Irene

Vander Pol, Margie

Vander Pol, Marines

Vander Pol, William P.

Vander Schaaf, Earl

Vander Schaaf, Elizabeth

Vander Schaaf, Henrietta

Vander Schaaf, John

Vander Schaaf, Ted

Vander Stelt, Catherine

Vander Stelt, Clarence

Vander Tuig, Arlene

Vander Tuig, Sylvester

Vander Veen, Joe A.

Vandervlag, Robert

Vander Zwan, Peter

Vanderford, Betty W.

Vanderford, Claud R.

Vanderham, Adrian

Vanderham, Cornelius

Vestal, J. Howard

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Vanderham, Cornelius P.
Vanderham, Cory
Vanderham, E. Jane
Vanderham, Marian
Vanderham, Martin
Vanderham, Pete C.
Vanderham, Wilma
Vasquez, Eleanor
Veenendaal, Evert
Veenendaal, John H.
Veiga, Dominick, Sr.
Verbree, Jack
Verbree, Tillie
Verger, Bert
Verger, Betty
Verhoeven, Leona
Verhoeven, Martin
Verhoeven, Wesley
Vermeer, Dick
Vermeer, Jantina
Vernola Ranch
Vernola, Anthonietta
Vernola, Anthony
Vernola, Frank
Vernola, Mary Ann
Vernola, Pat F.
Vestal, Frances Lorraine
Visser, Gerrit
Visser, Grace
Visser, Henry
Visser, Jess
Visser, Louie
Visser, Neil
Visser, Sam
Visser, Stanley
Visser, Tony D.
Visser, Walter G.
Von Der Ahe, Fredric T.
Von Euw, George
Von Euw, Majorie
Von Lusk, a limited partnership
Voortman, Anna Marie
Voortman, Edward
Voortman, Edwin J.
Voortman, Gertrude Dena
Wagner, Richard H.
Walker, Carole R.
Walker, Donald E.
Walker, Wallace W.
Wardle, Donald M.
Warner, Dillon B.
Warner, Minnie
Wassenaar, Peter W.
Waters, Michael

Weeda, Adriana
Wiersma, Jake

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Weeda, Daniel
Weeks, O. L.
Weeks, Verona E.
Weidman, Maurice
Weidman, Virginia
Weiland, Adaline I.
Weiland, Peter J.
Wesselink, Jules
West, Katharine R.
West, Russel
West, Sharon Ann
Western Horse Property
Westra, Alice
Westra, Henry
Westra, Hilda
Westra, Jake J.
Weststeyn, Freida
Weststeyn, Pete
Whitehurst, Louis G.
Whitehurst, Pearl L.
Whitmore, David L.
Whitmore, Mary A.
Whitney, Adolph M.
Wiersema, Harm
Wiersema, Harry
Wiersma, Ellen H.
Wiersma, Gladys J.
Wiersma, Otto
Wiersma, Pete
Winchell, Verne H., Trustee
Wind, Frank
Wind, Fred
Wind, Hilda
Wind, Johanna
Woo, Frank
Woo, Sem Gee
Wybenga, Clarence
Wybenga, Gus
Wybenga, Gus K.
Wybenga, Sylvia
Wynja, Andy
Wynja, Iona F.
Yellis, Mildred
Yellis, Thomas E.
Ykema-Harmsen Dairy
Ykema, Floris
Ykema, Harriet
Yokley, Betty Jo
Yokley, Darrell A.
Zak, Zan
Zivelonghi, George
Zivelonghi, Margaret
Zwaagstra, Jake
Zwaagstra, Jessie M.
Zwart, Case

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

NON-PRODUCER WATER DISTRICTS

Chino Basin Municipal Water District

Chino Basin Water Conservation District

Pomona Valley Municipal Water District

Western Municipal Water District of Riverside County

DEFAULTING OVERLYING AGRICULTURAL PRODUCERS

| | |
|---|---|
| Cheryl L. Bain | Roy W. Lantis |
| Warren Bain | Sharon I. Lantis |
| John M. Barcelona | Frank Lorenz |
| Letty Bassler | Dagney H. MacDonald |
| John Brazil | Frank E. Martin |
| John S. Briano | Ruth C. Martin |
| Lupe Briano | Connie S. Mello |
| Paul A. Briano | Naldiro J. Mello |
| Tillie Briano | Felice Miller |
| Arnie B. Carlson | Ted Miller |
| John Henry Fikse | Masao Nerio |
| Phyllis S. Fikse | Tom K. Nerio |
| Lewellyn Flory | Toyo Nerio |
| Mary I. Flory | Yuriko Nerio |
| L. H. Glazer | Harold L. Rees |
| Dorothy Goodman | Alden G. Rose |
| Sidney D. Goodman | Claude Rouleau, Jr. |
| Frank Grossi | Patricia M. Rouleau |
| Harada Brothers | Schultz Enterprises |
| Ellen Hettinga | Albert Shaw |

**EXHIBIT "C"**

**STIPULATING OVERLYING AGRICULTURAL PRODUCERS**

Hein Hettinga

Dick Hofstra, Jr.

Benjamin M. Hughey

Frieda L. Hughey

Guillaume Indart

Ellwood B. Johnston, Trustee

Perry Kruckenberg, Jr.

Martin Verburg

Donna Vincent

Larry Vincent

Cliff Wolfe & Associates

Ada M. Woll

Zarubica Co.

Lila Shaw

Cathy M. Stewart

Marvin C. Stewart

Betty Ann Stone

John B. Stone

Vantoll Cattle Co., Inc.

Catherine Verburg

**EXHIBIT "D"**

**OVERLYING NON-AGRICULTURAL RIGHTS**

| Party | Total Overlying Non-Agricultural Rights (Acre-Feet) | Share of Safe Yield (Acre-Feet) |
|---|---|---|
| Ameron Steel Producers, Inc. | 125 | 97.858 |
| County of San Bernardino (Airport) | 171 | 133.870 |
| Conrock Company | 406 | 317.844 |
| Kaiser Steel Corporation | 3,743 | 2,930.274 |
| Red Star Fertilizer | 20 | 15.657 |
| Southern California Edison Co. | 1,255 | 982.499 |
| Space Center, Mira Loma | 133 | 104.121 |
| Southern Service Co. dba Blue Seal Linen | 24 | 18.789 |
| Sunkist Growers, Inc. | 2,393 | 1,873.402 |
| Carlsberg Mobile Home Properties, Ltd '73 | 593 | 464.240 |
| Union Carbide Corporation | 546 | 427.446 |
| Quaker Chemical Co. | 0 | 0.000 |
| Totals | 9,409 | 7,366.000 |

**EXHIBIT "E"**

**APPROPRIATIVE RIGHTS**

| Party | Appropriative Right (Acre Feet) | Share of Initial Operating Safe Yield (Acre-Feet) | Share of Operating Safe Yield (Percent) |
|---|---|---|---|
| City of Chino | 5,271.7 | 3,670.067 | 6.693 |
| City of Norco | 289.5 | 201.545 | 0.368 |
| City of Ontario | 16,337.4 | 11,373.816 | 20.742 |
| City of Pomona | 16,110.5 | 11,215.852 | 20.454 |
| City of Upland | 4,097.2 | 2,852.401 | 5.202 |
| Cucamonga County Water District | 4,431.0 | 3,084.786 | 5.626 |
| Jurupa Community Services District | 1,104.1 | 768.655 | 1.402 |
| Monte Vista County Water District | 5,958.7 | 4,148.344 | 7.565 |
| West San Bernardino County Water District | 925.5 | 644.317 | 1.175 |
| Etiwanda Water Company | 768.0 | 534.668 | 0.975 |
| Feldspar Gardens Mutual Water Company | 68.3 | 47.549 | 0.087 |
| Fontana Union Water Company | 9,188.3 | 6,396.736 | 11.666 |
| Marygold Mutual Water Company | 941.3 | 655.317 | 1.195 |
| Mira Loma Water Company | 1,116.0 | 776.940 | 1.417 |
| Monte Vista Irrigation Company | 972.1 | 676.759 | 1.234 |
| Mutual Water Company of Glen Avon Heights | 672.2 | 467.974 | 0.853 |
| Park Water Company | 236.1 | 164.369 | 0.300 |
| Pomona Valley Water Company | 3,106.3 | 2,162.553 | 3.944 |
| San Antonio Water Company | 2,164.5 | 1,506.888 | 2.748 |
| Santa Ana River Water Company | 1,869.3 | 1,301.374 | 2.373 |
| Southern California Water Company | 1,774.5 | 1,235.376 | 2.253 |
| West End Consolidated Water Company | 1,361.3 | 947.714 | 1.728 |
| TOTAL | 78,763.8 | 55,834.000 | 100.000 |

**EXHIBIT "F"**

**OVERLYING (AGRICULTURAL) POOL**

POOLING PLAN

1. Membership in Pool. The State of California and all producers listed in Exhibit "C" shall be the initial members of this pool, which shall include all producers of water for overlying uses other than industrial or commercial purposes.

2. Pool Meetings. The members of the pool shall meet annually, in person or by proxy, at a place and time to be designated by Watermaster for purposes of electing members of the Pool Committee and conducting any other business of the pool. Special meetings of the membership of the pool may be called and held as provided in the rules of the pool.

3. Voting. All voting at meetings of pool members shall be on the basis of one vote for each 100 acre feet or any portion thereof of production from Chino Basin during the preceding year, as shown by the records of Watermaster.

4. Pool Committee. The Pool Committee for this pool shall consist of not less than nine (9) representatives selected at large by members of the pool. The exact number of members of the Pool Committee in any year shall be as determined by majority vote of the voting power of members of the pool in attendance at the annual pool meeting. Each member of the Pool Committee shall have one vote and shall serve for a two-year term. The members first elected shall classify themselves by lot so that approximately one-half serve an initial one-year term. Vacancies during any term shall be filled by a majority of the remaining members of the Pool Committee.

5. Advisory Committee Representatives. The number of representatives of the Pool Committee on the Advisory Committee shall be as provided in the rules of the pool from time to time but not exceeding ten (10). The voting power of the pool on the Advisory Committee shall be apportioned and exercised as determined from time to time by the Pool Committee.

6. Replenishment Obligation. The pool shall provide funds for replenishment of any production by persons other than members of the Overlying Non-Agricultural Pool or Appropriator Pool,

in excess of the pool's share of Safe Yield. During the first five (5) years of operations of the Physical Solution, reasonable efforts shall be made by the Pool Committee to equalize annual assessments.

7. Assessments. All assessments in this pool (whether for replenishment water cost or for pool administration or the allocated share of Watermaster administration) shall be in an amount uniformly applicable to all production in the pool during the preceding year or calendar quarter. Provided, however, that the Agricultural Pool Committee, may recommend to the Court modification of the method of assessing pool members, inter se, if the same is necessary to attain legitimate basin management objectives, including water conservation and avoidance of undesirable socio-economic consequences. Any such modification shall be initiated and ratified by one of the following methods:

(a) Excess Production. - In the event total pool production exceeds 100,000 acre feet in any year, the Pool Committee shall call and hold a meeting, after notice to all pool members, to consider remedial modification of the assessment formula.

(b) Producer Petition. - At any time after the fifth full year of operation under the Physical Solution, a petition by ten percent (10%) of the voting power or membership of the Pool shall compel the holding of a noticed meeting to consider revision of said formula of assessment for replenishment water.

In either event, a majority action of the voting power in attendance at such pool members' meeting shall be binding on the Pool Committee.

8. Rules. - The Pool Committee shall adopt rules for conducting meetings and affairs of the committee and for administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

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**EXHIBIT "G"**

**OVERLYING (NON-AGRICULTURAL) POOL**

POOLING PLAN

1. Membership in Pool. The initial members of the pool, together with the decreed share of the Safe Yield of each, are listed in Exhibit "D". Said pool includes producers of water for overlying industrial or commercial non-agricultural purposes, or such producers within the Pool who may hereafter take water pursuant to Paragraph 8 hereof.

2. Pool Committee. The Pool Committee for this pool shall consist of one representative designated by each member of the pool. Voting on the committee shall be on the basis of one vote for each member, unless a volume vote is demanded, in which case votes shall be allocated as follows:

The volume voting power on the Pool Committee shall be 1,484 votes. Of these, 742 votes shall be allocated on the basis of one vote for each ten (10) acre feet or fraction thereof of decreed shares in Safe Yield. (See Exhibit "D"). The remaining 742 votes shall be allocated proportionally on the basis of assessments paid to Watermaster during the preceding year.[8]

**Affirmative action of the Committee shall require a majority of the voting power of the members in attendance, provided that it includes concurrence by at least one-third of its total members.[9]**

3. Advisory Committee Representatives. At least three (3) members of the Pool Committee shall be designated by said committee to serve on the Advisory Committee. The exact number of such representatives at any time shall be as determined by the Pool Committee. The voting power of the pool shall be exercised in the Advisory Committee as a unit, based upon the vote of a majority of said representatives.

[8] Or production assessments paid under Water Code Section 72140 et seq., as to years prior to the second year of operation under the Physical Solution hereunder.
[9] Order dated October 8, 2010.

4. Replenishment Obligation. The pool shall provide funds for replenishment of any production in excess of the pool's share of Safe Yield in the preceding year.

5. Assessments.[10]

**(a) Replenishment Assessments. Each member of this pool shall pay an assessment equal to the cost of replenishment water times the number of acre feet of production by such producer during the preceding year in excess of (a) his decreed share of the Safe Yield, plus (b) any carry-over credit under Paragraph 7 hereof.**

**(b) Administrative Assessments. In addition, the cost of the allocated share of Watermaster administration expense shall be recovered on an equal assessment against each acre foot of production in the pool during such preceding fiscal year or calendar quarter; and in the case of Pool members who take substitute ground water as set forth in Paragraph 8 hereof, such producer shall be liable for its share of administration assessment, as if the water so taken were produced, up to the limit of its decreed share of Safe Yield.**

**(c) Special Project OBMP Assessment. Each year, every member of this Pool will dedicate ten (10) percent of their annual share of Operating Safe Yield to Watermaster or in lieu thereof Watermaster will levy a Special Project OBMP Assessment in an amount equal to ten percent of the Pool member's respective share of Safe Yield times the then-prevailing MWD Replenishment Rate.**

6. Assignment. Rights herein decreed are appurtenant to ***that*** land and are only assignable with the land for overlying use thereon; provided, however, **(a)** that any appropriator who may, directly or indirectly, undertake to provide water service to such overlying lands may, by an appropriate agency agreement on a form approved by Watermaster, exercise said overlying right to the extent, but only to the extent necessary to provide water service to said overlying lands***,*** and ***(b) the members of the pool shall have the right to Transfer or lease their quantified production rights within the pool or to***

[10] Order dated December 21, 2007.

***Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000 for the term of the Peace Agreement.*** [11]

7. Carry-over. Any member of the pool who produces less than its assigned water share of Safe Yield may carry such unexercised right forward for exercise in subsequent years. The first water produced during any such subsequent year shall be deemed to be an exercise of such carry-over right. In the event the aggregate carry-over by any pool member exceeds its share of Safe Yield, such member shall, as a condition of preserving such surplus carryover, execute a storage agreement with Watermaster.

8. Substitute Supplies. To the extent that any Pool member, at the request of Watermaster and with the consent of the Advisory Committee, takes substitute surface water in lieu of producing ground water otherwise subject to production as an allocated share of Safe Yield, said party shall nonetheless remain a member of this Pool.

**9. Physical Solution Transfers. All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom except that for the term of the Peace Agreement the members of the Overlying (Non-Agricultural) Pool shall have the discretionary right to Transfer or lease their quantified Production rights and carry-over water held in storage accounts in quantities that each member may from time to time individually determine as Transfers in furtherance of the Physical Solution: (i) within the Overlying (Non-Agricultural) Pool; (ii) to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000; (iii) in conformance with the procedures described in Paragraph I of the Purchase and Sale Agreement for the Purchase of Water by Watermaster from Overlying (Non-Agricultural Pool dated June 30, 2007; or (iv) to Watermaster and thence to members of the Appropriative Pool in accordance with the following guidelines and those procedures Watermaster may further provide in Watermaster's Rules and Regulations:**

[11] Order dated September 28, 2000 and Order dated April 19, 2001.

**(a) By December 31 of each year, the members of the Overlying (Non-Agricultural) Pool shall notify Watermaster of the amount of water each member shall make available in their individual discretion for purchase by the Appropriators. By January 31 of each year, Watermaster shall provide a Notice of Availability of each Appropriator's pro-rata share of such water;**

**(b) Except as they may be limited by paragraph 9(e) below, each member of the Appropriative Pool will have, in their discretion, a right to purchase its pro-rata share of the supply made available from the Overlying (Non-Agricultural) Pool at the price established in 9(d) below. Each Appropriative Pool member's pro-rata share of the available supply will be based on each Producer's combined total share of Operating Safe Yield and the previous year's actual Production by each party;**

**(c) If any member of the Appropriative Pool fails to irrevocably commit to their allocated share by March 1 of each year, its share of the Overlying (Non-Agricultural) Pool water will be made available to all other members of the Appropriative Pool according to the same proportions as described in 9(b) above and at the price established in Paragraph 9(d) below. Each member of the Appropriative Pool shall complete its payment for its share of water made available by June 30 of each year.**

**(d) Commensurate with the cumulative commitments by members of the Appropriative Pool pursuant to (b) and (c) above, Watermaster will purchase the surplus water made available by the Overlying (Non-Agricultural) Pool water on behalf of the members of the Appropriative Pool on an annual basis at 92% of the then-prevailing "MWD Replenishment Rate" and each member of the Appropriative Pool shall complete its payment for its determined share of water made available by June 30 of each year.**

**(e) Any surplus water cumulatively made available by all members of the Overlying (Non-Agricultural) Pool that is not purchased by Watermaster after completion of the process set forth herein will be pro-rated among the members of the Pool in proportion to the total quantity offered for transfer in accordance with this provision and may be retained by the**

**Overlying (Non-Agricultural) Pool member without prejudice to the rights of the members of the Pool to make further beneficial us or transfer of the available surplus.**

**(f) Each Appropriator shall only be eligible to purchase their pro-rata share under this procedure if the party is: (i) current on all their assessments; and (ii) in compliance with the OBMP.**

**(g) The right of any member of the Overlying (Non-Agricultural) Pool to transfer water in accordance with this Paragraph 9(a)-(c) in any year is dependent upon Watermaster making a finding that the member of the Overlying (Non-Agricultural) Pool is using recycled water where it is both physically available and appropriate for the designated end use in lieu of pumping groundwater.**

**(h) Nothing herein shall be construed to affect or limit the rights of any Party to offer or accept an assignment as authorized by the Judgment Exhibit "G" paragraph 6 above, or to affect the rights of any Party under a valid assignment.**

~~9~~**10**. Rules. The Pool Committee shall adopt rules for administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

**EXHIBIT "H"**

**APPROPRIATIVE POOL**

POOLING PLAN

1. Qualification for Pool. Any city, district or other public entity and public utility -- either regulated under Public Utilities Commission jurisdiction, or exempt therefrom as a non-profit mutual water company (other than those assigned to the Overlying (Agricultural) Pool) -- shall be a member of this pool. All initial members of the pool are listed in Exhibit "E", together with their respective appropriative rights and acre foot allocation and percentage shares of the initial and subsequent Operating Safe Yield.

2. Pool Committee. The Pool Committee shall consist of one (1) representative appointed by each member of the Pool.

3. Voting. The total voting power on the Pool Committee shall be 1,000 votes. Of these, 500 votes shall be allocated in proportion to decreed percentage shares in Operating Safe Yield. The remaining 500 votes shall be allocated proportionally on the basis of assessments paid to Watermaster during the preceding year. Routine business of the Pool Committee may be conducted on the basis of one vote per member, but upon demand of any member a weighted vote shall be taken. Affirmative action of the Committee shall require a majority of the voting power of members in attendance, provided that it includes concurrence by at least one-third of its total members.

4. Advisory Committee Representatives. **Members of the Pool Committee shall be designated to represent this pool on the Advisory Committee *on the following basis*: Each major appropriator, i.e., the owner of an adjudicated appropriative right in excess of 3,000 acre feet, *or each appropriator that produces in excess of 3,000 acre feet based upon the prior year's production,* shall be entitled to one representative. *Two additional representatives* of the Appropriative Pool on the Advisory Committee shall be elected at large by the remaining members of the pool. The voting power of the Appropriative Pool on the Advisory Committee shall be apportioned between the major appropriator representatives in proportion to their respective voting power in the Pool Committee. The two representatives of the remaining appropriators shall exercise equally the voting power proportional to the Pool Committee voting power of said**

**remaining appropriators; provided, however, that if any representative fails to attend an Advisory Committee meeting, the voting power of that representative shall be allocated among the representatives of the Appropriative Pool in attendance in the same proportion as their respective voting powers.** [12]

5. Replenishment Obligation. The pool shall provide funds for purchase of replenishment water to replace any production by the pool in excess of Operating Safe Yield during the preceding year.

6. Administrative Assessment. Costs of administration of this pool and its share of general Watermaster expense shall be recovered by a uniform assessment applicable to all production during the preceding year.

7. Replenishment Assessment. The cost of replenishment water required to replace production from Chino Basin in excess of Operating Safe Yield in the preceding year shall be allocated and recovered as follows:

(a) For production, other than for increased export, within CBMWD or WMWD:

(1) Gross Assessment. 15% of such replenishment water costs shall be recovered by a uniform assessment against all production of each appropriator producing in said area during the preceding year.

(2) Net Assessment. The remaining 85% of said costs shall be recovered by a uniform assessment on each acre foot of production from said area by each such appropriator in excess of his allocated share of Operating Safe Yield during said preceding year.

(b) For production which is exported for use outside Chino Basin in excess of maximum export in any year through 1976, such increased export production shall be assessed against the exporting appropriator in an amount sufficient to purchase replenishment water from CBMWD or WMWD in the amount of such excess.

[12] Order dated September 18, 1996.

(c) For production within SBVMWD or PVMWD:

By an assessment on all production in excess of an appropriator's share of Operating Safe Yield in an amount sufficient to purchase replenishment water through SBVMWD or MWD in the amount of such excess.

8. Socio-Economic Impact Review. The parties have conducted certain preliminary socio-economic impact studies. Further and more detailed socio-economic impact studies of the assessment formula and its possible modification shall be undertaken for the Appropriator Pool by Watermaster no later than ten (10) years from the effective date of this Physical Solution, or whenever total production by this pool has increased by 30% or more over the decreed appropriative rights, whichever is first.

9. Facilities Equity Assessment. Watermaster may, upon recommendation of the Pool Committee, institute proceedings for levy and collection of a Facilities Equity Assessment for the purposes and in accordance with the procedures which follow:

(a) Implementing Circumstances. - There exist several sources of supplemental water available to Chino Basin, each of which has a differential cost and quantity available. The optimum management of the entire Chino Basin water resource favors the maximum use of the lowest cost supplemental water to balance the supplies of the Basin, in accordance with the Physical Solution. The varying sources of supplemental water include importations from MWD and SBVMWD, importation of surface and ground water supplies from other basins in the immediate vicinity of Chino Basin, and utilization of reclaimed water. In order to fully utilize any of such alternate sources of supply, it will be essential for particular appropriators having access to one or more of such supplies to have invested, or in the future to invest, directly or indirectly, substantial funds in facilities to obtain and deliver such water to an appropriate point of use. To the extent that the use of less expensive alternative sources of supplemental water can be maximized by the inducement of a Facilities Equity Assessment, as herein provided, it is to the long-term benefit of the entire basin that such assessment be authorized and levied by Watermaster.

(b) Study and Report. - At the request of the Pool Committee, Watermaster shall undertake a survey study of the utilization of alternate supplemental supplies by

members of the Appropriative Pool which would not otherwise be utilized and shall prepare a report setting forth the amount of such alternative supplies being currently utilized, the amount of such supplies which could be generated by activity within the pool, and the level of cost required to increase such uses and to optimize the total supplies available to the basin. Said report shall contain an analysis and recommendation for the levy of a necessary Facilities Equity Assessment to accomplish said purpose.

(c) Hearing. - If the said report by Watermaster contains a recommendation for imposition of a Facilities Equity Assessment, and the Pool Committee so requests, Watermaster shall notice and hold a hearing not less than 60 days after distribution of a copy of said report to each member of the pool, together with a notice of the hearing date. At such hearing, evidence shall be taken with regard to the necessity and propriety of the levy of a Facilities Equity Assessment and full findings and decision shall be issued by Watermaster.

(d) Operation of Assessment. - If Watermaster determines that it is appropriate that a Facilities Equity Assessment be levied in a particular year, the amount of additional supplemental supplies which should be generated by such assessment shall be estimated. The cost of obtaining such supplies, taking into consideration the investment in necessary facilities shall then be determined and spread equitably among the producers within the pool in a manner so that those producers not providing such additional lower cost supplemental water, and to whom a financial benefit will result, may bear a proportionate share of said costs, not exceeding said benefit; provided that any producer furnishing such supplemental water shall not thereby have its average cost of water in such year reduced below such producer's average cost of pumping from the Basin. In so doing, Watermaster shall establish a percentage of the total production by each party which may be produced without imposition of a Facilities Equity Assessment. Any member of the pool producing more water than said percentage shall pay such Facilities Equity Assessment on any such excess production. Watermaster is authorized to transmit and pay the proceeds of such Facilities Equity Assessment to those producers who take less than their share of Basin water by reason of furnishing a higher percentage of their requirements through use of supplemental water.

10. Unallocated Safe Yield Water. To the extent that, in any five years, any portion of the share of Safe Yield allocated to the Overlying (Agricultural) Pool is not produced, such water shall be available for reallocation to members of the Appropriative Pool, as follows:

(a) Priorities. - Such allocation shall be made in the following sequence:

(1) to supplement, in the particular year, water available from Operating Safe Yield to compensate for any reduction in the Safe Yield by reason of recalculation thereof after the tenth year of operation hereunder.

(2) pursuant to conversion claims as defined in Subparagraph (b) hereof.

(3) as a supplement to Operating Safe Yield, without regard to reductions in Safe Yield.

(b) Conversion Claims.[13] The following procedures may be utilized by any appropriator:

***1) Record of Unconverted Agricultural Acreage. Watermaster shall maintain on an ongoing basis a record with appropriate related maps of all agricultural acreage within the Chino Basin subject to being converted to appropriative water use pursuant to the provisions of this subparagraph. An initial identification of such acreage as of June 30, 1995 is attached hereto as Appendix 1.***

**(2) Record of *Water Service Conversion*. Any appropriator who undertakes to permanently provide water service to lands *subject to conversion* may report such intent to change water service to Watermaster. Watermaster *should* thereupon verify such change in water service and shall maintain a record and account for each appropriator of the total acreage involved. *Should, at any time, converted acreage return to water service from the Overlying (Agricultural) Pool, Watermaster shall return such acreage to unconverted status***

[13] Order dated November 17, 1995.

***and correspondingly reduce or eliminate any allocation accorded to the appropriator involved.***

**(*3*) Allocation *of Safe Yield Rights***

**(i) *For the term of the Peace Agreement in* any year in which *sufficient* unallocated Safe Yield from the Overlying (Agricultural) Pool is available for such conversion claims, Watermaster shall allocat*e to* each appropriator with a conversion claim *2.0* acre feet of unallocated Safe Yield water for each converted *acre for which conversion has been approved and recorded by the Watermaster.* [14]**

***(ii) In any year in which the unallocated Safe Yield water from the Overlying (Agricultural) Pool is not sufficient to satisfy all outstanding conversion claims pursuant to subparagraph (i) herein above, Watermaster shall establish allocation percentages for each appropriator with conversion claims. The percentages shall be based upon the ratio of the total of such converted acreage approved and recorded for each appropriators's account in comparison to the total of converted acreage approved and recorded for all appropriators. Watermaster shall apply such allocation percentage for each appropriator to the total unallocated Safe Yield water available for conversion claims to derive the amount allocable to each appropriator.***

**(*4*) Notice *and Allocation*. Notice of *the* special allocation of Safe Yield water pursuant to conversion claims shall be given to each appropriator and shall be treated for purposes of this Physical Solution as an addition to such appropriator's share of the Operating Safe Yield for the particular year only.**

[14] Order dated September 28, 2000 and Order dated April 19, 2001.

***(5) Administrative Costs. Any costs of Watermaster attributable to the administration of such special allocations and conversion claims shall be assessed against the appropriators participating in such reporting, apportioned in accordance with the total amount of converted acreage held by each appropriator participating in the conversion program.***

11. In Lieu Procedures. There are, or may develop, certain areas within Chino Basin where good management practices dictate that recharge of the basin be accomplished, to the extent practical, by taking surface supplies of supplemental water in lieu of ground water otherwise subject to production as an allocated share of Operating Safe Yield.

(a) Method of Operation. - An appropriator producing water within such designated in lieu area who is willing to abstain for any reason from producing any portion of such producer's share of Operating Safe Yield in any year may offer such unpumped water to Watermaster. In such event, Watermaster shall purchase said water in place,in lieu of spreading replenishment water, which is otherwise required to make up for over production. The purchase price for in lieu water shall be the lesser of:

(1) Watermaster's current cost of replenishment water, whether or not replenishment water is currently then obtainable, plus the cost of spreading; or

(2) The cost of supplemental surface supplies to the appropriator, less

a. said appropriator's average cost of ground water production, and

b. the applicable production assessment were the water produced.

Where supplemental surface supplies consist of MWD or SBVMWD supplies, the cost of treated, filtered State water from such source shall be deemed the cost of supplemental surface supplies to the appropriator for purposes of such calculation.

In any given year in which payments may be made pursuant to a Facilities Equity Assessment, as to any given quantity of water the party will be entitled to payment under this section or pursuant to the Facilities Equity Assessment, as the party elects, but not under both.

(b) Designation of In Lieu Areas. - The first in lieu area is designated as the "In Lieu Area No. 1" and consists of an area wherein nitrate levels in the ground water generally exceed 45 mg/l, and is shown on Exhibit "J" hereto. Other in lieu areas may be designated by subsequent order of Watermaster upon recommendation or approval by Advisory Committee. Said in lieu areas may be enlarged, reduced or eliminated by subsequent orders; provided, however, that designation of In Lieu Areas shall be for a minimum fixed term sufficient to justify necessary capital investment. In Lieu Area No. 1 may be enlarged, reduced or eliminated in the same manner, except that any reduction of its original size or elimination thereof shall require the prior order of Court.

12. Carry-over. Any appropriator who produces less than his assigned share of Operating Safe Yield may carry such unexercised right forward for exercise in subsequent years. The first water produced during any such subsequent year shall be deemed to be an exercise of such carry-over right. In the event the aggregate carry-over by any appropriator exceeds its share of Operating Safe Yield, such appropriator shall, as a condition of preserving such surplus carry-over, execute a storage agreement with Watermaster. Such appropriator shall have the option to pay the gross assessment applicable to such carry-over in the year in which it accrued.

13. Assignment, Transfer and Lease. Appropriative rights, and corresponding shares of Operating Safe Yield, may be assigned or may be leased or licensed to another appropriator for exercise in a given year. Any transfer, lease or license shall be ineffective until written notice thereof is furnished to and approved as to form by Watermaster, in compliance with applicable Watermaster rules. Watermaster shall not approve transfer, lease or license of a right for exercise in an area or under conditions where such production would be contrary to sound basin management or detrimental to the rights or operations of other producers.

14. Rules. The Pool Committee shall adopt rules for administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

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**EXHIBIT "I"**

**ENGINEERING APPENDIX**

1. Basin Management Parameters. In the process of implementing the physical solution for Chino Basin, Watermaster shall consider the following parameters:

(a) Pumping Patterns. - Chino Basin is a common supply for all persons and agencies utilizing its waters. It is an objective in management of the Basin's waters that no producer be deprived of access to said waters by reason of unreasonable pumping patterns, nor by regional or localized recharge of replenishment water, insofar as such result may be practically avoided.

(b) Water Quality. - Maintenance and improvement of water quality is a prime consideration and function of management decisions by Watermaster.

(c) Economic Considerations. - Financial feasibility, economic impact and the cost and optimum utilization of the Basin's resources and the physical facilities of the parties are objectives and concerns equal in importance to water quantity and quality parameters.

**2. Hydraulic Control and Re-Operation. In accordance with the purpose and objective of the Physical Solution to "establish a legal and practical means for making the maximum reasonable beneficial use of the waters of the Chino Basin" (paragraph 39) including but not limited to the use and recapture of reclaimed water (paragraph 49(a) ) and the identified Basin Management Parameters set forth above, Watermaster will manage the Basin to secure and maintain Hydraulic Control through controlled overdraft.**

**(a) Hydraulic Control. "Hydraulic Control" means the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. The Chino North Management Zone is more fully described and set forth in Attachment I-1 to this Engineering Appendix. By obtaining Hydraulic Control, Watermaster will ensure that the water management activities in the Chino North Management Zone do not cause**

**materially adverse impacts to the beneficial uses of the Santa Ana River downstream of Prado Dam.**

**(b) Re-Operation. "Re-Operation" means the controlled overdraft of the Basin by the managed withdrawal of groundwater for the Desalters and the potential increase in the cumulative un-replenished Production from 200,000 acre-feet authorized by paragraph 3 below, to 600,000 acre feet for the express purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution.**

**[1] The increase in the controlled overdraft herein is separate from and in addition to the 200,000 acre-feet of accumulated overdraft authorized in paragraph 3(a) and 3(b) below over the period of 1978 through 2017.**

**[2] "Desalters" means the Chino I Desalter, the Chino I Expansion, the Chino II Desalter and Future Desalters, consisting of all the capital facilities and processes that remove salt from Basin water, including extraction wells and transmission facilities for delivery of groundwater to the Desalter. Desalter treatment and delivery facilities for the desalted water include pumping and storage facilities and treatment and disposal capacity in the Santa Ana Regional Interceptor.**

**[3] The groundwater Produced through controlled overdraft pursuant to Re-Operation does not constitute New Yield or Operating Safe Yield and it is made available under the Physical Solution for the express purpose of satisfying some or all of the groundwater Production by the Desalters until December 31, 2030. ("Period of Re-Operation").**

**[4] The operation of the Desalters, the Production of groundwater for the Desalters and the use of water produced by the Desalters pursuant to Re-Operation are**

**subject to the limitations that may be set forth in Watermaster Rules and Regulations for the Desalters.**

**(5) Watermaster will update its Recharge Master Plan and obtain Court approval of its update, to address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and operated at a new equilibrium at the conclusion of the period of Re-Operation. The Recharge Master Plan shall contain recharge projections and summaries of the projected water supply availability as well as the physical means to accomplish recharge projections. The Recharge Master Plan may be amended from time to time with Court approval.**

**(6) Re-Operation and Watermaster's apportionment of controlled overdraft in accordance with the Physical Solution will not be suspended in the event that Hydraulic Control is secured in any year before the full 400,000 acre-feet has been Produced without Replenishment, so long as: (i) Watermaster has prepared, adopted and the Court has approved a contingency plan that establishes conditions and protective measures that will avoid unreasonable and unmitigated material physical harm to a party or to the Basin and that equitably distributes the cost of any mitigation attributable to the identified contingencies; and (ii) Watermaster is in substantial compliance with a Court approved Recharge Master Plan.[15]**

**3**. Operating Safe Yield. Operating Safe Yield in any year shall consist of the Appropriative Pool's share of Safe Yield of the Basin, plus any controlled overdraft of the Basin which Watermaster may authorize. In adopting the Operating Safe Yield for any year, Watermaster shall be limited as follows:

(a) Accumulated Overdraft. - During the operation of this Judgment and Physical Solution, the overdraft accumulated from and after the effective date of the Physical Solution and

[15] Order dated December 21, 2007.

resulting from an excess of Operating Safe Yield over Safe Yield shall not exceed 200,000 acre feet.

(b) Quantitative Limits. - In no event shall Operating Safe Yield in any year be less than the Appropriative Pool's share of Safe Yield, nor shall it exceed such share of Safe Yield by more than 10,000 acre feet. The initial Operating Safe Yield is hereby set at 54,834 acre feet per year. Operating Safe Yield shall not be changed upon less than five (5) years' notice by Watermaster. Nothing contained in this paragraph shall be deemed to authorize, directly or indirectly, any modification of the allocation of shares in Safe Yield to the overlying pools, as set forth in Paragraph 44 of the Judgment.

**4**. Ground Water Storage Agreements. Any agreements authorized by Watermaster for storage of supplemental water in the available ground water storage capacity of Chino Basin shall include, but not be limited to:

(a) The quantities and term of the storage right.

(b) A statement of the priority or relation of said right, as against overlying or Safe Yield uses, and other storage rights.

(c) The procedure for establishing delivery rates, schedules and procedures which may include:

[1] spreading or injection, or

[2] in lieu deliveries of supplemental water for direct use.

(d) The procedures for calculation of losses and annual accounting for water in storage by Watermaster.

(e) The procedures for establishment and administration of withdrawal schedules, locations and methods.

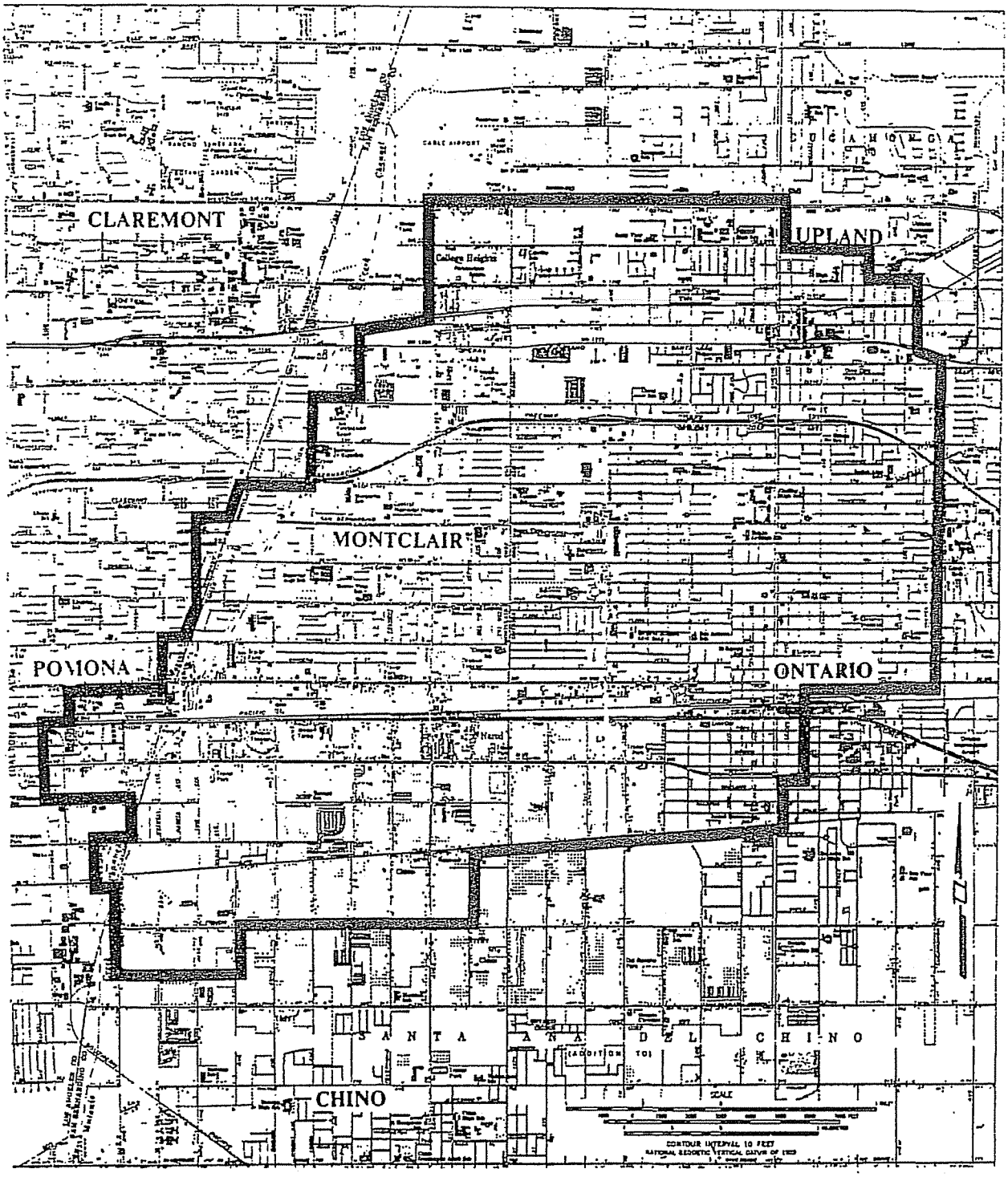
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# CHINO BASIN

## IN LIEU AREA NO. 1

## EXHIBIT "J"

**EXHIBIT "K"**
**LEGAL DESCRIPTION**

**OF CHINO BASIN**

Preamble

All of the townships and ranges referred to in the following legal description are the San Bernardino Base and Meridian. Certain designated sections are implied as the System of Government Surveys may be extended where not established. Said sections are identified as follows:

Section 20, T1N, R8W is extended across Rancho Cucamonga;

Section 36, T1N, R8W is extended across the City of Upland;

Sections 2,3, and 4, T1S, R7W are extended across Rancho Cucamonga;

Section 10, T1S, R8W is extended across the City of Claremont;

Sections 19, 20, 21, 30, 31 and 32, T1S, R8W are extended across the City of Pomona;

Sections 4, 5, and 28, T2S, R8W are extended across Rancho Santa Ana Del Chino;

Sections 15 and 16, T3S, R7W are extended across Rancho La Sierra; and

Sections 17 and 20, T3S, R7W are extended across Rancho El Rincon.

Description

Chino Basin is included within portions of the Counties of San Bernardino, Riverside and Los Angeles, State of California, bounded by a continuous line described as follows:

EXHIBIT “K”

BEGINNING at the Southwest corner of Lot 241 as shown on Map of Ontario Colony Lands, recorded in Map Book 11, page 6, Office of the County Recorder of San Bernardino County, said corner being the Point of Beginning;

1. Thence Southeasterly to the Southeast corner of Lot 419 of said Ontario Colony Lands;

2. Thence Southeasterly to a point 1300 feet North of the South line and 1300 feet East of the West line of Section 4, T1S, R7W;

3. Thence Easterly to a point on the East line of Section 4, 1800 feet North of the Southeast corner of said Section 4;

4. Thence Easterly to the Southeast corner of the Southwest quarter of the Northeast quarter of Section 3, T1S, R7W;

5. Thence Northeasterly to a point on the North line of Section 2, T1S, R7W, 1400 feet East of the West line of said Section 2;

6. Thence Northeasterly to the Southwest corner of Section 18, T1N, R6W;

7. Thence Northerly to the Northwest corner of said Section 18;

8. Thence Easterly to the Northeast corner of said Section 18;

9. Thence Northerly to the Northwest corner of the Southwest Quarter of Section 8, T1N, R6W;

10. Thence Easterly to the Northeast corner of said Southwest quarter of said Section 8;

11. Thence Southerly to the Southeast corner of said Southwest Quarter of said Section 8;

12. Thence Easterly to the Northeast corner of Section 17, T1N, R6W;

13. Thence Easterly to the Northeast corner of Section 16, T1N, R6W;

14. Thence Southeasterly to the Northwest corner of the Southeast quarter of Section 15, T1N, R6W;

15. Thence Easterly to the Northeast corner of said Southeast quarter of said Section 15;

16. Thence Southeasterly to the Northwest corner of the Northeast quarter of Section 23, T1N, R6W;

17. Thence Southeasterly to the Northwest corner of Section 25, T1N, R6W;

18. Thence Southeasterly to the Northwest corner of the Northeast quarter of Section 31, T1N, R5W;

19. Thence Southeasterly to the Northeast corner of the Northwest quarter of Section 5, T1S, R5W;

20. Thence Southeasterly to the Southeast corner of Section 4, T1S, R5W;

21. Thence Southeasterly to the Southeast corner of the Southwest quarter of Section 11, T1S, R5W;

22. Thence Southwesterly to the Southwest corner of Section 14, T1S, R5W;

23. Thence Southwest to the Southwest corner of Section 22, T1S, R5W;

24. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 6, T2S, R5W;

25. Thence Southeasterly to the Northeast corner of Section 18, T2S, R5W;

26. Thence Southwesterly to the Southwest corner of the Southeast quarter of Section 13, T2S, R6W;

27. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 26, T2S, R6W;

28. Thence Westerly to the Southwest corner of the Northwest quarter of said Section 26;

29. Thence Northerly to the Northwest corner of said Section 26;

30. Thence Westerly to the Southwest corner of Section 21, T2S, R6W;

31. Thence Southerly to the Southeast corner of Section 29, T2S, R6W;

32. Thence Westerly to the Southeast corner of Section 30, T2S, R6W;

33. Thence Southwesterly to the Southwest corner of Section 36, T2S, R7W;

34. Thence Southwesterly to the Southeast corner of Section 3, T3S, R7W;

35. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 10, T3S, R7W;

36. Thence Southerly to the Northeast corner of the Northwest quarter of Section 15, T3S, R7W;

37. Thence Southwesterly to the Southeast corner of the Northeast quarter of Section 16, T3S, R7W;

38. Thence Southwesterly to the Southwest corner of said Section 16;

39. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 20, T3S, R7W;

40. Thence Westerly to the Southwest corner of the Northwest quarter of said Section 20;

41. Thence Northerly to the Northwest corner of Section 17, T3S, R7W;

42. Thence Westerly to the Southwest corner of Section 7, T3S, R7W;

43. Thence Northerly to the Southwest corner of Section 6, T3S, R7W;

44. Thence Westerly to the Southwest corner of Section 1, T3S, R8W;

45. Thence Northerly to the Southeast corner of Section 35, T2S, R8W;

46. Thence Northwesterly to the Northwest corner of said Section 35;

47. Thence Northerly to the Southeast corner of Lot 33, as shown on Map of Tract 3193, recorded in Map Book 43, pages 46 and 47, Office of the County Recorder of San Bernardino County;

48. Thence Westerly to the Northwest corner of the Southwest quarter of Section 28, T2S, R8W;

49. Thence Northerly to the Southwest corner of Section 4, T2S, R8W;

50. Thence Westerly to the Southwest corner of Section 5, T2S, R8W;

51. Thence Northerly to the Southwest corner of Section 32, T1S, R8W;

52. Thence Westerly to the Southwest corner of Section 31, T1S, R8W;

53. Thence Northerly to the Southwest corner of Section 30, T1S, R8W;

54. Thence Northeasterly to the Southwest corner of Section 20, T1S, R8W;

55. Thence Northerly to the Northwest corner of the Southwest quarter of the Southwest quarter of said Section 20;

56. Thence Northwesterly to the Northeast corner of the Southeast quarter of the Southeast quarter of the Northwest quarter of Section 19, T1S, R8W;

57. Thence Easterly to the Northwest corner of Section 21, T1S, R8W;

58. Thence Northeasterly to the Southeast corner of the Southwest quarter of the Southwest quarter of Section 10, T1S, R8W;

59. Thence Northeasterly to the Southwest corner of Section 2, T1S, R8W;

60. Thence Northeasterly to the Southeast corner of the Northwest quarter of the Northwest quarter of Section 1, T1S, R8W;

61. Thence Northerly to the Northeast corner of the Northwest quarter of the Northeast quarter of Section 36, T1N, R8W;

62. Thence Northerly to the Southeast corner of Section 24, T1N, R8W;

63. Thence Northeasterly to the Southeast corner of the Northwest quarter of the Northwest quarter of Section 20, T1N, R7W; and

64. Thence Southerly to the Point of Beginning.

Sections Included

Said perimeter description includes all or portions of the following Townships, Ranges and Sections of San Bernardino Base and Meridian:

T1N, R5W - Sections: 30, 31 and 32

T1N, R6W - Sections: 8, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36

T1N, R7W - Sections: 19, 20, 24, 25, 26, 29, 30, 31, 32, 35 and 36

T1N, R8W - Sections: 25 and 36

T1S, R5W - Sections: 4, 5, 6, 7, 8, 9, 10, 11, 14, 15,16, 17, 18, 19, 20, 21, 22, 28, 29,30, 31 and 32

T1S, R6W - Sections: 1 through 36, inclusive

T1S, R7W - Sections: 1 through 36, inclusive

T1S, R8W - Sections: 1, 2, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36

T2S, R5W - Sections: 6, 7 and 18

T2S, R6W - Sections: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 29, 30 and 31

T2S, R7W - Sections: 1 through 36, inclusive

T2S, R8W - Sections: 1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 35 and 36

T3S, R7W - Sections: 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17 and 20

T3S, R8W - Sections: 1.